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Assessment of the impact of OH's temporal resolution on the global atmosphere

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Abstract

The current project aims to assess the impact of coarsening both temporal and spatial resolution on the accuracy of OH values in a certain data set. It also aims at the creation of correction factors that are meant to be used together with the widely used OH "climatological data" to improve accuracy.

OH concentration accuracy is crucial for other atmospheric chemical components concentration calculations and for the overall description and prediction of atmospheric chemicals. OH is widely known as the "detergent" of the lower atmosphere, emphasising its utmost importance. Since 1990, on the atmospheric chemistry modeling community one set of OH concentrations known as "climatological" data has been widely used, but now, more accurate models that calculate OH concentrations are available. Therefore, this project basis itself on one of those more accurate calculations, the hourly OH mixing ratio values obtained with the TM5-MP model.

Assessment on the loss of accuracy because of the "monthly mean" temporal coarsening method is done and its impact is analyzed through lifetime calculations. Midway of the project a new temporal coarsening methodology is implemented through temporal grouping. This opened the possibility of obtaining a group of OH mixing ratio data sets for every temporal group with a range of different temporal and spatial resolution values so that they could be used for a larger range of other modeling projects instead of developing correction factors.

Here the most significant results of the above mentioned work together with an explanation on the methodology and a brief introduction to the topic, and it links to the repository where the data sets, the code used to obtain the data sets and the tables where the accuracy of such data sets is presented.

Contents

1 Introduction

1.1 Statement of the problem

The hydroxyl radical, OH, is the most important radical in the troposphere. OH plays a crucial role in the chemistry of the lower atmosphere controlling it's oxidative capacity. Reactions with OH provide the dominant path for removal of a variety of halocarbons, hydrocarbons, volatile organic compounds (VOCs), carbon monoxide (CO), and for the conversion of NO_2 to nitric acid (HNO_3).

The global abundance of OH determines the atmospheric residence time for many anthropogenic and natural compounds, including greenhouse gases. OH affects air quality, the ozone layer and climate by its removal of atmospheric gases. Since a lot of these gases have a great impact on climate, OH concentrations and distribution around the globe become fundamentally important.

The chemistry of OH is tightly coupled in mutually compensating reactions throughout the globe, making the quest for accurate OH concentration values a key feature of tropospheric chemistry.

The primary source of hydroxyl is the photolysis of ozone by solar ultraviolet radiation through the following reaction with water vapor:

$$O_3 + hv(\lambda < 330\,nm) \longrightarrow O(^1D) + O_2 \tag{1.1}$$

$$O(^1D) + H_2O \longrightarrow 2\,OH \tag{1.2}$$

Therefore OH is very sensitive to solar radiation, temperature, O_3 and H_2O concentrations. Since OH's mainly reacts with CO and methane (CH_4) it is also pretty dependent of these chemical species' concentrations. It is also substantially recycled, adding to the dependence of the hydroxyl's concentration on chemical groups such as NO_x (NO + NO_2). OH radical is a highly reactive compound, having one of the shortest lifetimes observed in the troposphere (1-2s). All of these characteristics lead to a very large spatial and temporal variability, which makes it practically impossible to determine OH concentration from direct observations (Joeckel et al., 2003).

The main experimental method to assess global OH was pioneered by Singh and Lovelock (1977), who measured the concentrations of methyl chloroform, CH_3CCl_3, which was released at known rates into the atmosphere and which was removed mainly by its reaction with OH. From there, several efforts have been made following this method, for example in: Krol et al. (1998), Prinn et al. (2001), Krol and Lelieveld (2003), Spivakovsky et al. (1990) and Spivakovsky et al. (2000). A similar method can be observed at Krol et al. (2008), but instead of using CH_3CCl_3 values, CO was used in order to obtain OH concentrations.

Spivakovsky et al. (1990) compares the results of a chemical and transport model with the OH concentrations derived from measurements of methyl chloroform. It concludes that OH concentrations calculated from the model are overestimated and they therefore provide OH global fields with the necessary corrections in order to describe more accurately troposphere's chemical reactions.

A revision of these fields was done on Spivakovsky et al. (2000) where the tropospheric OH is computed by observing the measured distributions of O_3, H_2O, NO_t (NO_2+NO+$2N_2O_5$+NO_3+HNO_2+HNO_4), CO and hydrocarbons. They also took a closer look on temperature dependencies and cloud optical depth effects, the methyl chloroform budget change and the rate constant with OH was also taken into account. An ocean sink for CH_3CCl_3 was also included as well as reactions with nonmethane hydrocarbons. This provided an updated climatological distribution of tropospheric OH.

These OH fields have been widely used in the modeling community, specifically in inverse modeling regarding CH_4 as seen in Bergamaschi et al. (2009), Pandey et al. (2017), Mikaloff Fletcher et al. (2004), Monteil et al. (2013) and Meirink et al. (2008) which use Spivakovsky's fields. On Houweling et al. (1998), an atmospheric model that used as a chemical scheme, the Carbon Bond Mechanism CB04, recalculated these OH fields accounting for the impact of nonmethane hydrocarbon compounds, NMHC, is added. These are also commonly used as observed on Bergamaschi et al. (2005), Villani et al. (2010) and Houweling et al. (2014).

A usage of these fields with respect to other non methane chemical species are also widely found. Some of the examples involve Suntharalingam et al. (2005), where the GEOS-CHEM model is used to perform an inversion and determine CO_2 global distribution. A data assimilation analysis is done on Hooghiemstra et al. (2011) in order to optimize CO emissions using Spivakovsky's fields as well as on Jiang et al. (2017). On Vira et al. (2017) a data assimilation analysis is done using Spivakovsky's OH fields in order to optimize SO_2 emissions during a volcanic eruption.

In spite of its wide usage, a new revision of the climatological distribution of OH with an updated version of Singh and Lovelock (1977) methodology is not available. The most probable reason being that methyl chloroform is banned for its ozone depleting properties, and therefore it is not useful anymore as a chemical tracer. The compounds that have replaced CFCs (chlorofluoro carbons), the HCFCs (hydrogen chlorofluoro carbons) and the HFCs (hydrofluoro carbons) are good candidates for tracers, but the accuracy of the emissions inventories are questionable, besides, the technical necessities in order to measure these chemical's concentrations with good precision amount to a high economic cost (Joeckel et al., 2003).

In order to have a good atmospheric tracer, the concentration measurements have to be very precise. For CO this precision is at about 1%, which is considered good but the molecule is in general not well suited for large scale experiments (Joeckel et al., 2003). Most likely this is because OH is not the only sink of CO and its rates of dry deposition and the variability of these makes them more prone to errors in the calculation of OH based on CO concentrations.

Spivakovsky et al. (2000) OH fields were created on a large spatial resolution, using gridboxes with measurements of 10°longitude and 8°latitude (around 1000x800km). The concentrations are distributed in seven pressure levels. The temporal resolution of the fields is monthly, meaning that for each latitudinal band (each 8°) we have a monthly averaged value of OH concentration for each pressure level. This is done for every month in the year. The coarse spatial and temporal resolution of these fields may have something to do with the fact that methyl chloroform cannot provide regional changes in OH concentrations (Joeckel et al., 2003).

Night and polar night values are always considered 0.0 molec/cm^3 in these fields, even though nighttime formation of OH radicals haven been documented through the NO_3 radical acting upon VOCs (Platt et al., 1990), and through the ozonolysis of VOCs (Paulson and Orlando, 1996). This will all add up to uncertainties when calculating concentrations of chemical species that depend upon OH concentrations for their oxidation in the atmosphere.

Adding to the uncertainties, the neglect of transport of longer-lived products of isoprene (C_5H_8) and non methane hydrocarbons oxidation on Spivakovsky et al. (2000) study causes a difference on OH global mean of 10-15% compared to the predicted one by a full atmospheric chemistry model. Errors of 15-25% in the global mean concentration of OH may signify major misconceptions about the chemistry or the abundance of precursors of OH in the troposphere. At the same time, testing global models for OH has been associated with uncertainties of a similar or larger magnitude intrinsic to deriving an estimate indirectly from budgets of species for which reaction with OH provides the dominant sink and the sources are believed to be known (like CH_3CCl_3) (Spivakovsky et al., 2000).

For Houweling et al. (1998) recalculation of the fields, it has to be pointed out that the chemical scheme is not mass conserving and it is optimized for conditions in which NO_x dominates OH's recycling probability, not accounting that in low-NO_x other mechanisms can be important (e.g. through VOCs chemistry) (Lelieveld et al., 2016).

From all the above, another method for estimating OH concentrations outside of the use of natural or anthropogenic traces needs to be considered, one of such methods may rely on atmospheric models. Models that provide such distributions are chemical and transport models, CTMs. These models enhance our ability to understand the chemical state of the atmosphere and allow detailed analysis of issues such as pollution transport or climate change, and have been under constant development for decades (in some cases), modifying their chemical and transport schemes in order describe and predict more accurately concentrations and changes of chemical species in the atmosphere.

1.2 Objectives of the present work

The objective of this work is to obtain a set of correction factors that can be used together with the monthly mean values of OH concentration to obtain a pseudo-temporal variation throughout the year using minimal information and data by using the chemical and transport model, TM5-MP. The purpose of the correction factors is to have better accuracy when describing chemical species in the atmosphere since OH is involved in a lot of vital chemical reactions that take place in the troposphere.

The correction factors are fabricated using a more refined spatial resolution. The spatial resolution used is 1°latitude per 1°longitude and 25 pressure levels in contrast with the 8°latitude per 10°longitude and 7 levels on Spivakovsky et al. (2000) fields. The correction factors are provided per latitudinal band. They also add information on OH concentrations during nighttime and polar night.

The project involves a sensitivity analysis regarding OH concentrations obtained from the TM5-MP. On a model to model comparison, an assessment is made into how much information is lost when using a coarser temporal resolution. Specifically, the study is based on the differences of OH concentrations from monthly averaged, and hourly values. Hourly values are regarded for this study as the most accurate, based on the realistic approximation that it has been proved to have regarding the oxidative capacity at a global scale at y comparing it with the one derived using an optimized hydroxyl radical field (Huijnen, Williams, et al., 2010).

During the assessment, temporal ranges are determined for which a correction factor will be assigned. The process takes into account how much does the variability of OH concentration affects some key atmospheric species' lifetimes, such as isoprene and methane.

As documented above, in several instances, the modeling community uses the OH fields that are based on monthly averaged concentrations instead of OH hourly values. A reason for this may be because of the large amount of data this implies. Hourly outputs can exponentially grow the size of the output files, even more so when performing analysis for several years. The advantage of using a correction factor that will take into account OH's considerable variability in a given month is clear when contrasted with the computational cost and post-processing time that hourly outputs demand.

The chemistry and transport model, TM5-MP was chosen based on its three dimensional global coverage and due to the wide range of validation and improvement that the TM5 family of models have gone through because of their participation in model intercomparison projects such as ACCENT (Atmospheric Composition Change, the European Network of Excellence) (Dentener et al., 2006), the GEMS (Global and regional Earth-system (atmosphere) Monitoring using Satellite and in-situ data) project (Ordónez et al., 2010, Huijnen et al., 2010), the Transcom Continuous model intercomparison project (Law et al., 2008), and the study conducted by the Task Force on Hemispheric Transport of Air Pollution (Fiore et al., 2009).

The evaluation of the photochemical scheme used on the TM5-MP done in Huijnen, Williams, et al. (2010) concludes that the oxidizing capacity of the atmosphere, (and therefore OH concentrations values) is well represented at a global scale. The determination came by comparing calculated lifetimes of methyl chloroform with that obtained by Spivakovsky et al. (2000) and methane lifetime with that estimated by Stevenson et al. (2006). Furthermore, it is also concluded that seasonality of CO, NO_2 and O_3 cycles are well represented but there is under and over estimations in some regions, this is appointed to biases and errors on emissions inventories.

In top of this already good representation of the atmosphere's oxidation capacity, an modification was implemented on TM5's chemical scheme where the isoprene oxidation mechanism provides a better representation of the oxidation products and their role on the recycling of OH radicals (Williams et al., 2013).

A better description of both the chemistry and transport model, TM5-MP and the OH radical will be presented in the following chapters.

2 Scientific Background

2.1 The hydroxyl radical

The oxidation of most trace gases in the atmosphere start with their reaction with OH. Few of the many gases emitted into the atmosphere can be significantly removed by dry and wet deposition or by reaction with molecular oxygen, the later occurring seldomly. Therefore, even though, the atmosphere contains close to 21% of molecular oxygen it is the ultra minor constituent OH which acts as the "detergent" of the atmosphere, starting almost all atmospheric oxidation processes that lead to the removal of most natural and anthropogenic gases from the atmosphere (Crutzen and Zimmermann, 1991). There are some trace gases in the atmosphere that do not react with OH, those usually get breakdown by short wave solar radiation in the stratosphere, some of such species are N_2O and chlorofluorocarbons.

Since the oxidation efficiency of the troposphere is largely determined by the hydroxyl radical it can also be argued that it directly affects climate because several of the gases that it interacts with affect climate directly (e.g CO_2 and its link with global warming). It is therefore of the utmost necessity to acquire knowledge about OH concentrations and their possible trends on the globe.

From OH's main source which depends on the photodissociation of ozone as observed on equation1.1 the general pattern of the OH distribution can be inferred. Since the stratospheric ozone layer is thinner in the tropics (Lelieveld et al., 2016), UV light gets lets attenuated more than in other latitudes. Taking into account that the water vapor concentrations in the tropics are relatively high (compared to other latitudes), the expected OH distribution would be to observe higher concentration on the tropics than in higher latitudes (Lelieveld et al., 2016).

The high reactivity of OH, and its short lifetime of about 1-2 seconds suggests that together with OH's sunlight dependency, concentrations will vary greatly between day and night, having the maximum during daytime. Taking into account these spatial and temporal characteristics of OH behaviour, a quick assessment can be made as to whether model calculated OH concentrations follow the expected pattern.

Some of OH's multiple oxidation reactions in the atmosphere include the oxidation of CH_4, VOCs and CO. Of these, OH represents carbon monoxide's major sink in the troposphere. This reaction is as follows, where M usually represents N_2 or O_2 :

$$CO + OH \longrightarrow CO_2 + H \tag{2.1}$$

$$H + O_2 \xrightarrow{M} HO_2 \tag{2.2}$$

Where, after the initial OH reaction, a peroxyl radical, HO_2, is formed, which can then combine in order to form peroxides, ROOH. When peroxides are formed, the reaction chains can either propagate or terminate when the chemical species are deposited, but propagation implies secondary OH formation. This is an OH recycling mechanism that is controlled by sunlight since the photolysis of peroxides is what leads to OH, as can be observed on the following reaction:

$$RO_2 + HO_2 \longrightarrow ROOH + O_2 \tag{2.3}$$

$$\longrightarrow RO + O_2 + OH \tag{2.4}$$

OH can also be recycled when pollution emissions contain large amounts of nitrogen oxides (NO, NO_2). Then the following reaction between NO and the peroxyl radical occur:

$$NO + HO_2 \longrightarrow NO_2 + OH \tag{2.5}$$

This reaction also leads to ozone production through photodissociation of NO_2 by ultraviolet and visible light that subsequently increases even further the OH levels for polluted areas during daytime. This reaction is referred to by Lelieveld et al. (2016), as one of the pathways of secondary OH formation. Even though pollution changes the OH production and loss rates, the global balance between production and loss of OH has not changed as much because of a relatively constant OH recycling probability of about 50% (Lelieveld et al., 2016).

Conversions between HO_2 and OH play a key role in OH recycling and, therefore, on

OH amounts. OH concentration is mostly locally controlled by chemistry. Transport processes influence HO_x ($HO_x = HO + HO_2$) only through longer-lived precursors and reservoir species such as ozone, and oxygenated volatile organic compounds, OVOCs. These species get transported mainly in the free troposphere; therefore, on a global scale, HO_x tropospheric production is dominated by the free troposphere.

Seasonal differences in tropospheric HO_x at mid and high latitudes can be about an order of magnitude between summer and winter. The effects of seasonality are even greater when contrasting just main OH formation since it is proportional to solar radiation intensity. During winter, when OH formation is low, and OH primary formation is low, it is partly compensated by secondary OH formation. Secondary OH formation happens mostly through the NO_x mechanism previously described. This mechanism, which is less sunlight dependent, reduces the latitudinal and seasonal OH contrasts. Secondary OH formation happens mostly through the NO_x mechanism and OVOCs and the O_x mechanism also contribute.

At nighttime, most oxidation reactions start with the nitrate radical, NO_3. Several sources (Platt et al., 1990, Mihelcic et al., 2000, Carslaw et al., 1997, Bey et al., 2001) have pointed out that the initial attack of NO_3 on a volatile organic compound, VOC, is a potential source of peroxy radicals (RO_2 and HO_2) and therefore, OH radicals during night. On **Fig.2.1**, a schematic diagram of the nighttime NO_3-RO_x ($RO_x = RO_2 + HO_2 + OH$) chemistry is shown. Another source of RO_x radicals is via the ozonolysis of VOCs (Paulson and Orlando, 1996). The contributions of these production pathways for OH varies from site to site and depends heavily of atmospheric concentrations, but they both play a significant role on nighttime OH production as observed during the BERLIOZ measuring campaign (Geyer et al., 2003, Mihelcic et al., 2000) and on the marine boundary layer campaign detailed on Carslaw et al. (1997).

This nonphotochemical formation of OH is thought to initiate the nighttime removal of a large number of VOCs, thus increasing the atmospheric oxidation capacity. Furthermore peroxy radicals are not only involved in the generation of OH but are also chain carriers for the oxidation of hydrocarbons and are intermediates compounds in tropospheric ozone generation, which in turn is responsible of the nitrate radical

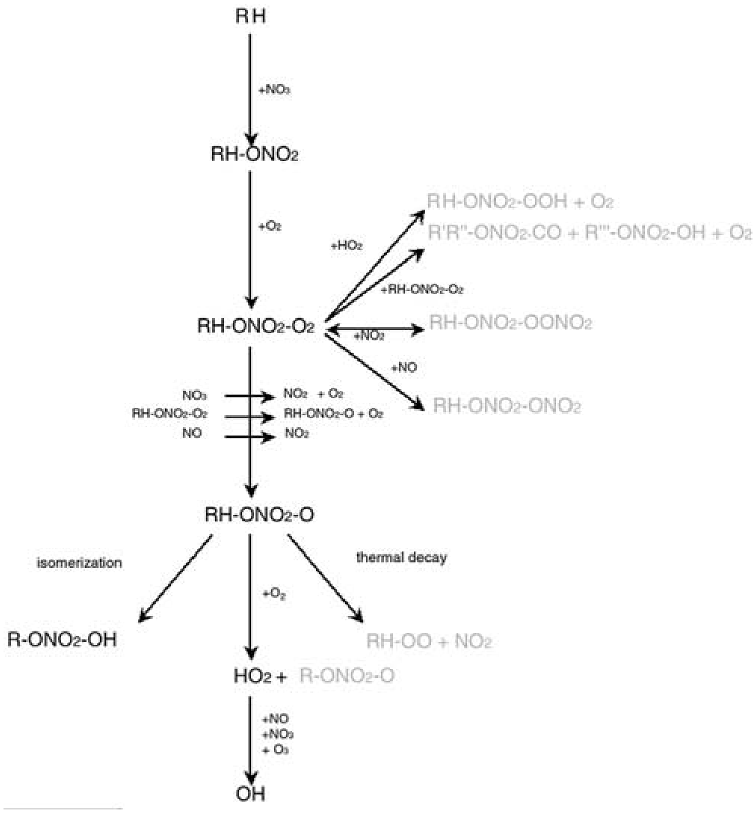

Figure 2.1: Simplified scheme of the degradation of a VOC following the attack of a nitrate radical leading to OH radicals at night (Geyer et al., 2003)

production via its reaction with NO_2 (Geyer et al., 2003).

Generally, annual global OH concentrations are not sensitive to perturbations that may arise from variations in emissions of natural and anthropogenic origin. Even when the variation of local OH concentrations are sensitive due to variations of NO_x, VOCs, CO, CH_4, and O_3 (among other compounds), the obtained correction factors that take into consideration diurnal, seasonal and latitudinal changes, will stay valid for an extended period of time, unless a big, dramatic change on the atmosphere's chemistry scheme happens. Such change would imply a complete re-construction of the actual atmosphere's chemical scheme, a possible scenario would be a significant and constant increase of global NO_x emissions that would also cause an increase on OH concentration levels.

Taking into account that OH concentrations have remained fairly constant, even though the chemical composition of the atmosphere has undergone significant changes on the last decade, it is most likely that any big variations found on OH concentration calculations will come from the CTM model's chemical schemes rather than from different emissions scenarios of sources and sinks (Lelieveld et al., 2016).

2.2 OH in modeling

Assessment of the hydroxyl radical concentration and distribution has been proven difficult due to its fluctuating nature and its dependency on trace gases that are unpredictable themselves or that are discontinuously emitted, such as NO_x that is produced by lightning, soil exhalations or by fossil fuel and biomass combustion (Joeckel et al., 2003).

Therefore, past derivations of "global average OH" based on the methyl chloroform tracer method have produced uncertain results. The concept of "global average OH" is not a suitable concept to define the oxidizing power of the atmosphere (Joeckel et al., 2003).

Measuring campaigns often focus on the boundary layer, but the global distribution and variability of OH and HO_x is dominated by the free troposphere. Since large scale processes and OH recycling are more efficient on the free troposphere, whereas boundary layer chemistry is more sensitive to local impacts (Lelieveld et al., 2016) the findings at boundary layer level measuring campaigns can not be extrapolated to show any global OH distribution. Due to the extreme variability of OH in time and space, one has to rely on atmospheric models rather on observations to provide the global distribution of OH (Spivakovsky et al., 1990).

Chemistry and transport models, come with their own uncertainty. For example, the chemistry scheme used in the TM5-MP CTM used for this study is based on the carbon bond mechanism (Williams et al., 2013). This scheme has a limitation regarding the accuracy of its concentration calculations, because second and higher generation reaction products are lumped or ignored for computational efficiency, and they could importantly contribute to OH recycling and ozone chemistry (Taraborrelli et al., 2012, Lelieveld et al., 2016). Here we apply a carbon bond mechanism that already includes C_5H_8 and a more comprehensive VOC chemistry, even so, a certain level of uncertainty is to be expected.

3 Methods

3.1 The TM5-MP chemistry and transport model

TM5-MP is a three-dimensional (3-D) global atmospheric chemistry and transport model that assesses the impacts and consequences of emissions on the atmosphere (Huijnen, Williams, et al., 2010). It is written in Fortran 90 programming language.

The model is built on a Eulerian frame view which follows the evolution of the concentration of a chemical species in a given volume. In order to evaluate the global atmosphere and to completely resolve the transport of a chemical species, 3-D grid boxes along the whole domain are required.

The TM family models are used for tropospheric and stratospheric chemistry analyses, aerosol modeling, and inversion studies. The tropospheric chemistry version has been widely validated via several model inter-comparison projects, as documented on **Section 1.2** of the present work.

All applications of the TM family share the model discretization method, via which linearization of complex, non-linear, equations encountered when resolving transport and/or chemistry in the atmosphere is done. They also share the operator splitting, which refers to the internal calculation sequence of the model, the need for meteorological fields as an input, and the subsequent treatment of them and the mass conserving equation that has to be fulfilled for all internal calculations.

The model has the following global gridding configurations: 6°x4°, 3°x2°, or 1°x1°. A 1°x1° roughly translates into 100km by 100km square box in mid-latitudes and near the equator. On higher latitudes, the grid boxes sizes are modified to represent the global sphere better.

The vertical height of the boxes is determined from the meteorological data vertical layers, which are pressure dependent. The coordinate system by which the vertical height is determined is called sigma coordinates, which is understood to be a normalized pressure coordinate system. Four sets of vertical layers (25, 31, 34, or 60) can be chosen using the sigma coordinate method, depending on the requirements of the study.

The chemical and transport model, TM5-MP, takes meteorological fields of the atmosphere as an input. Usually, these data come from the operational forecast data, which corresponds to a horizontal grid resolution of 0.56° or from the ERA-Interim reanalysis which corresponds to a horizontal grid resolution of 0.7° (Dee et al., 2011). Both of the data sets are provided by the European Center for Medium Range Weather Forecasts, ECMWF. The data are pre-processed onto a global 1°x1° from where mass fluxes are computed.

Meteorological data are stored on a three hourly frequency where the time-averaged or hourly interpolated data are used. Horizontal and vertical transport of chemical species is then calculated using these data. TM5-MP breaks complex mathematical equations in order to linearize them. It does so by breaking down the model operations according to time step value, Δt. This value is usually user-defined. For a standard spatial resolution of 3°x2°, the recommended time step is one hour.

The internal processes are divided using the operator splitting scheme. The operations are divided as follows: advection in the horizontal directions (X, Y), advection in the vertical direction (Z), vertical mixing (V), chemistry calculations (C), and sources/sinks contributions (S). For each time step, Δt, the operation sequence is:

$$(XYZVSC)(CSVZYX) \tag{3.1}$$

Each individual operation is then resolved using a time step of Δt/2. The timesteps within each sub-process can be adapted independently, if required, to improve stability and accuracy (Huijnen, Williams, et al., 2010). For example, for chemistry steps, the application of photolysis schemes or dry deposition may need smaller time steps than the one assigned.

Chemical equations are solved via the modified carbon bond mechanism mCB05 scheme (Williams et al., 2013). The mechanism is a set of generalized reactions and rate constants for use in modeling atmospheric chemistry and photochemistry. The scheme is based on grouping chemical species together based on the concept of similarly bonded carbon atoms reacting independently of the molecules in which they occur. In this manner, the issue of having a stiff set of equations is resolved. Recently, another chemical scheme has been added to the model besides the carbon bond mechanism, the Moguntia scheme (Myriokefalitakis et al., 2020). For the purposes of this work, the carbon bond mechanism mCB05 is going to be used.

The carbon bond mechanism, mcb05, scheme takes into account 54 chemical species from the available chemical species in the atmosphere, which are involved in 109 chemical reactions. A comprehensive list of all reaction rates and the associated reaction data on the chemical scheme can be found on **Appendix Table A0.1**. These chemical reactions constitute a set of differential equations that are resolved via numerical integration. This numerical integration is done by a chemical solver. This integration must be carried out repeatedly at all spatial grid points for all time step intervals chosen.

In TM5-MP's case, the default chemical solver is the Euler Backward Iterative (EBI) solver (Hertel et al., 1993). EBI is an implicit scheme resolved by an iterative method, where an initial value is used to calculate the next time, using a defined step size. EBI has a good performance (Hertel et al., 1993) when applied in large scale atmospheric models, which involve operation splitting. Otherwise, Rosenbrock methods are also available in the model (Sandu et al., 1997). These methods use more intermediate stages in their solving mechanism, than EBI, in order to achieve a higher order of consistency. The number of iterations applied for each chemical species in order to achieve convergence varies depending on the atmospheric lifetime of each particular species. This number grows wherever perturbations are the greatest, for example, on the atmospheric boundary layer where emissions and depositions take place. Therefore many perturbations on the chemical species are encountered.

For dry deposition processes, a flux of trace gases is often parameterized in models as the concentration of the trace gas at a specific height multiplied by a deposition velocity, which depends on atmospheric parameters. These atmospheric parameters are usually the aerodynamic resistance, the function of the physical state of the atmosphere and surface resistance, and the function of vegetation, soil, water, snow, and ice uptake;

in other words, functions of the chemical, physical and biological properties of the surface (Ganzeveld and Lelieveld, 1995). Deposition velocities show both a seasonal and diurnal cycle due to varying surface characteristics.

Sources of chemical species are evaluated via emissions inventories. These are annual inventories, or else external information that need to be provided to the model. Anthropogenic, biogenic, biomass burning, soil, marine, dust, among others, emissions inventories are needed. Most of the emissions data are provided on a spatial resolution of 0.5° x 0.5° with a monthly time resolution.

3.1.1 Model run

The TM5-MP needs to be set up from part of the user before running it and obtaining results. Some variables have to be chosen as the years span for the “model run” or the type of chemical scheme and solver that wants to be used. The following steps were followed in order to obtain the needed data to perform the desired analysis:

- Set up parameters have to be decided with the aid of the previously acquired knowledge. A model set up of a year with a spatial resolution of 6°x4° is chosen for the first run. This is a coarse resolution but it is also the resolution that will produce the least amount of data, and is enough to observe a general behavior pattern. The standard 1 hour time step is used and an hourly output of chemical species concentrations is asked; the received output files have concentration values for all chemical species per hour per day. The chosen mCB05 chemical scheme is picked and EBI is the chosen chemical solver.

- The model is run using the high performance computing (HPC) capabilities available with LAMOS group at the IUP department in Bremen University.

- Output of the model is verified and an overall quality check is performed in order to asses that the model run was successful.

- A second run of the model is performed with the model set up of a year with a spatial resolution of 1°x1° which is the finest global resolution available. With these data the final results are going to be obtained. The reason behind this is to obtain the most precise calculations possible.

3.2 Post processing data & data validation

The analysis and post processing of data is performed using Python programming language in a Jupyter platform in the HPC cluster of the LAMOS group.

The following are the series of steps that were followed in order to post process the data:

- First, it was necessary to get an overall idea of how the data is organized and how it can be accessed. The xarray library in Python was very helpful and was used to access the data throughout this whole project.
- Then, a visual confirmation of OH concentration values was done. The expected concentration values for surface level in a given latitude are contrasted with the obtained values. The expected latitudinal and diurnal variation is also visually validated. All these expected values are taken from literature, one example is found on Lelieveld et al. (2016).
- Monthly grouping was then performed by connecting daily output files with the OH hourly data.
- Monthly means were calculated and the first evaluation of this data compared to Spivakovsky et al. (2000) climatological data was done through lifetime calculations. The lifetime of isoprene and methane were calculated both using monthly means and Spivakovsky et al. (2000) climatological data.
- Local time data sets were created for the monthly OH surface level concentration values from where the latitudinal and diurnal variations can be better quantified, for full year values, the seasonal variation can also be observed. This was done through the resampling method.
- Solar zenith angle was calculated through the calculation performed of the elevation angle using the Pysolar library. The exact function used is called "get_altitude". The calculation was done for each day of the year, for each

latitude and longitude found on the previously grouped OH data.

- Solar zenith angle data set was resampled into local time as well and then was used to determine weather the OH value encountered at the same time, latitude and longitude belonged to daytime or nighttime values.
- A monthly mean value was obtained for these resampled and daytime / nighttime separated arrays, providing, for each hour, a monthly mean of daytime/nightime OH mixing ratio values.
- A mean differential percentage was obtained from the daily, hourly, local time concentration values and the monthly mean value. This was performed as a year long statistical analysis that assessed the magnitude of the variation when using monthly mean values in contrast to hourly values.
- An assessment was made to how big of an impact these variations have. This was done through lifetime calculations. The lifetime of isoprene and methane were calculated both using monthly means and they were also contrasted with the lifetime calculations obtained when using Spivakovsky et al. (2000) climatological data.
- The determination was made that another type of mean on the temporal resolution should be tried aiming to improving the accuracy of the OH mixing ratio data set.
- Grouping of a range of hours per latitudinal band that corresponded to sunrise, sunset, daytime and nighttime were performed and monthly data sets were created. Their corresponding variation from the hourly output was calculated.
- In order to reduce the spatial resolution of the new data set, boxes of 8°x10° were created. This spatial resolution was chosen based on Spivakovsky et al. (2000) OH fields so that a straight forward comparison could be done. For each new 8°x10° box, one OH mixing ratio value was calculated as well as their corresponding variation form the hourly, 1°x1° output.
- Seasonal arrays both 1°x1° with hour grouping depicted above and with the 8°x10°

resolution were created with their corresponding variation.

- The differential percentage between Spivakovsky et al. (2000) climatological data and the hourly 1°x1° data is also calculated for comparison.
- The correction factors data set takes the form of a group of OH mixing ratio data set that vary in their spatial and temporal resolutions and therefore on their accuracy.

The resampling of data was done both on 6°x4° and 1°x1° model results but the last grouping of temporal and spatial resolutions was just done using the 1°x1°, aiming for better accuracy.

3.2.1 Solar zenith angle

The zenith is an imaginary point directly above a point in the earth. Above meaning a straight vertical vector pointing in the opposite direction of gravity at that location. The zenith angle is the angular measurement from straight up i.e. zenith from the surface normal (considering the surface on a x-y plane) to a point in the sky. Zenith angle can be used along with azimuth angle (see **Fig.3.1**) to indicate the position of a star or other celestial body. On the figure it can also be observed that the zenith angle is the complementary angle of the elevation angle.

The solar zenith angle is then the angle between the zenith and the center of the sun's disc. It is used to indicate the position of the sun with respect to the a certain location on earth implying a certain amount of radiation that location receives at an specific time, for a solar zenith angle of $\theta_s = 0°$, the irradiance impinging on the x-y plane is maximum and for a solar zenith angle of $\theta_s = 90°$, the irridiance impinging on the x-y plane is zero (Jacobson, 2005).

Taking into account that the main way of production of the OH radical is via the sun's received UV light that acts upon ozone photolyzing it, it is of crucial importance with respect to OH concentrations at that location. Therefore, a crucial part of the analysis is to separate OH values between "daytime" values which correspond to solar zenith angle values between 0° and 90° where sunrise/sunset happens and "nighttime"

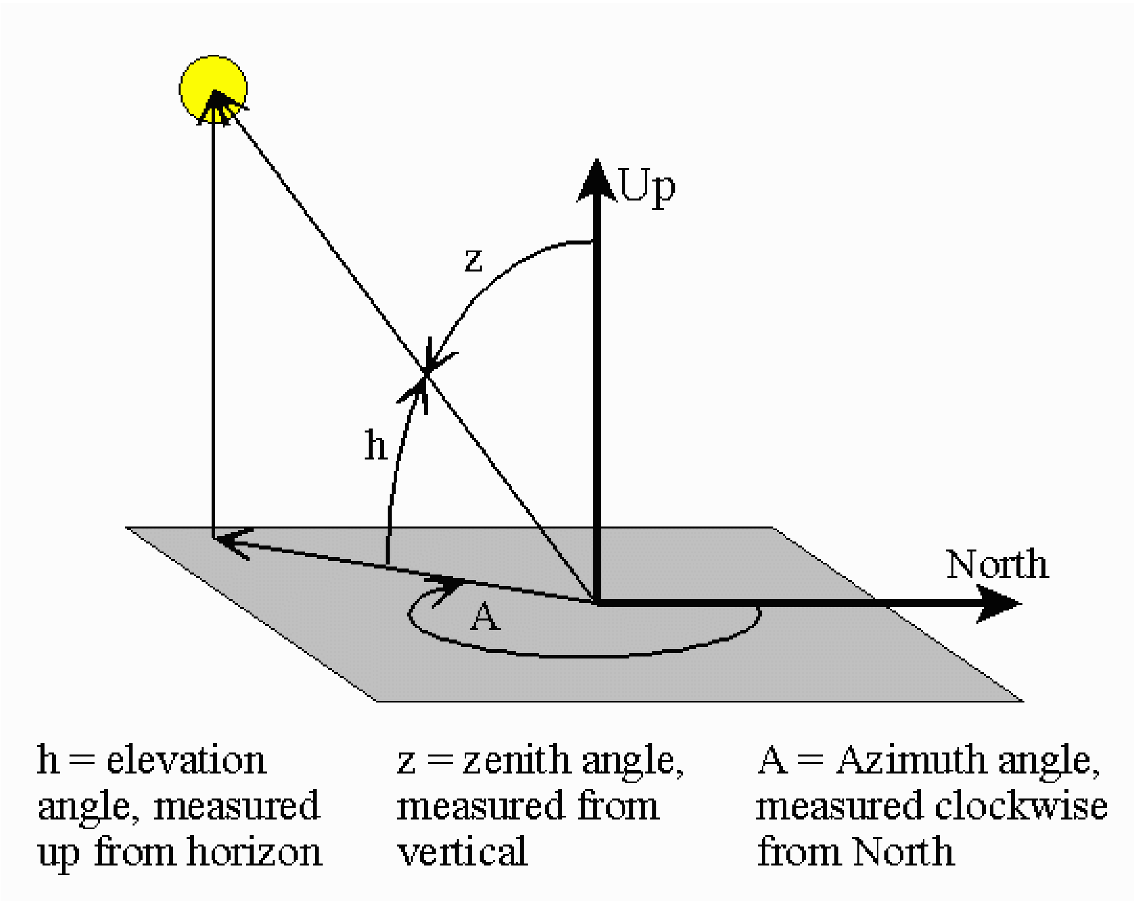

Figure 3.1: Zenith, azimuth and elevation angles relationship (*NOAA Global Monitoring Laboratory*)

values that correspond to solar zenith angle values bigger than 90°. The 90° value got revisited due to more accurate approximation found on Jacobson et al. (2011) and on *Nautical Almanac Office Sunrise/Sunset Algorithm Example* that cite the solar zenith angle value at sunrise and sunset at 90.833° or 90°50'. The last value chosen for the separation of daytime and nighttime values was set at 91.5° after a brief analysis of standard deviation by the calculation method on the Pysolar library and the Solar Position Calculation (NOAA, *NOAA Solar Position Calculator*) reported values.

The formula to calculate the solar zenith angle goes as follows:

$$\cos(z) = \sin(h) = \sin(\phi) \times \sin(\delta) + \cos(\phi) \times \cos(\delta) \times \cos(hour) \tag{3.2}$$

Where:

z = solar zenith angle

h = solar elevation angle

$hour$ = hour angle in the local solar time

δ = current declination of the sun

ϕ = local latitude

The declination angle is the angle between the equator and the north or south latitude of the subsolar point, which is the point at which the Sun is directly overhead. The local hour angle is the angle, measured westward, between the longitude of the subsolar point and the longitude of the location of interest (Jacobson, 2005).

The equation is obtained from the **Fig.3.2** by applying a law of cosines to the triangle APB.

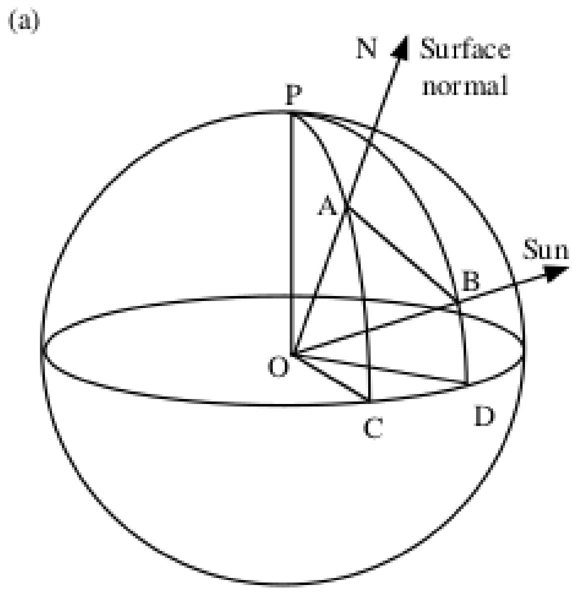

Figure 3.2: Geometry for the zenith angle calculations on a sphere. The ray OAN is the surface normal above the point of interest. Point B is the subsolar point. Angle AOB is the solar zenith angle (z). Angle BOD is the solar declination angle (δ) and the angles COD = CPD = APB are hour angles ($hour$) (Jacobson, 2005)

3.2.2 Lifetime calculation

Atmospheric lifetime refers to the time average of the life histories of a certain molecule, another name for it can be the average residence time of a molecule in the atmosphere (Seinfeld and Pandis, 2016). Then, this concept tells us on average how long a theoretical (representative) molecule of a certain substance will stay in the atmosphere before it is removed. Mostly, molecules in the atmosphere are either deposited, via precipitation or by falling into Earth's surface (i.e. wet and dry deposition) or removed by chemical reactions. The probability of a substance to be removed by any of these mechanisms depends on a number of factors like the size of the particle, its chemical composition, where in the atmosphere it is located and the meteorological phenomena surrounding it.

The fundamental physical principle governing the behavior of a chemical in the atmosphere is the conservation of mass, where a balance has to be hold from the smallest of volume of air all the way up to the entire atmosphere, then, the following formula applies:

$$\frac{dQ}{dt} = (F_{in} - F_{out}) + (P - R) \tag{3.3}$$

Where, Q is the total mass of the substance in the volume of air, F_{in} and F_{out} are the mass flow rates of the substance in and out of the air volume. P is the rate of introduction of the species from sources and R is the rate of removal of the species.

On steady state conditions the amount of mass inside the volume is not changing with time, meaning that dQ/dt = 0, and if the volume is referred to the total atmosphere then there is no fluxes of mass coming in or out. This implies that the sources must be equal to the rate of removal $P = R$, then, the average residence of lifetime, τ, would be:

$$\tau = \frac{Q}{R} = \frac{Q}{P} \tag{3.4}$$

In many atmospheric species there are several removal processes, and in order to estimate the overall lifetime of a species, special focus is given to the accurate prediction of the fastest removal rate. A very fast removal path for atmospheric substances in the troposphere is their reaction with OH. This removal path follows the chemical reaction:

$$\mathrm{OH} + \mathrm{A} \xrightarrow{\mathrm{k}} \text{products} \tag{3.5}$$

Where the k parameter is the rate constant for the reaction, then, the rate of the reaction is $k[OH][A]$ (brackets denote the concentration of the species). If the rate of removal of the A species is given by $R = k[OH][A]$, then the compound's mean lifetime is:

$$\tau = \frac{[A]}{k[OH][A]} = \frac{1}{k[OH]} \tag{3.6}$$

Where $[OH]$ is an averaged tropospheric concentration of OH radicals.

For some tropospheric chemical species their main removal pathway is their chemical reaction with OH, several of these chemical species also play a crucial for climate and therefore their lifetime predictions are crucial role for climate prognosis and evaluation. In this study specifically CH_4 and C_5H_8 lifetimes calculations were performed using OH concentration values that corresponded to different temporal and spatial resolutions, those results were used in order to assess the impact that coarser temporal and spatial resolutions of OH concentrations have on crucial chemical species' lifetimes calculations.

4 Results

4.1 First stage analysis results

On **Fig.4.1** an example of the first step of the analysis is shown. The two maps represent the results of the TM5MP model run for a specific date, this being January 15th 2009 at 12:00 hr Greenwich time and show the difference between a 1°x1° spatial resolution and a 6°x4° one. These results were scrutinized and compared with OH maps in literature in order to assess their validity. More precisely, monthly mean maps like the ones observed on **Fig.4.2** were compared with monthly mean OH maps found on Lelieveld et al. (2016).

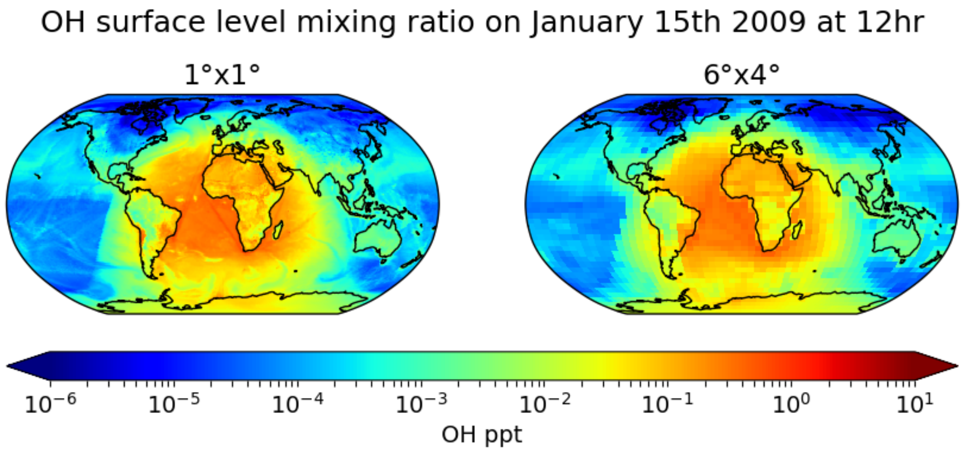

Figure 4.1: OH mixing ratio on surface level for January 15th 2009. 1°x1° spatial resolution on the left and 6°x4° spatial resolution on the right.

A first attempt at assessing the impact of the coarser spatial resolution can be achieved here by calculating lifetimes for both isoprene and methane using monthly mean OH's concentration that come from the 1°x1° and the 6°x4° model results. The lifetime calculations can be observed on **Fig.4.3** and on **Fig.4.4**. There is a clear global pattern that arises from both calculations although it is more clearly defined on the 1°x1° resolution.

The next approach is to compare these results with lifetime calculations made based on the climatological data. The comparisons of the climatological data with the 6°x4°

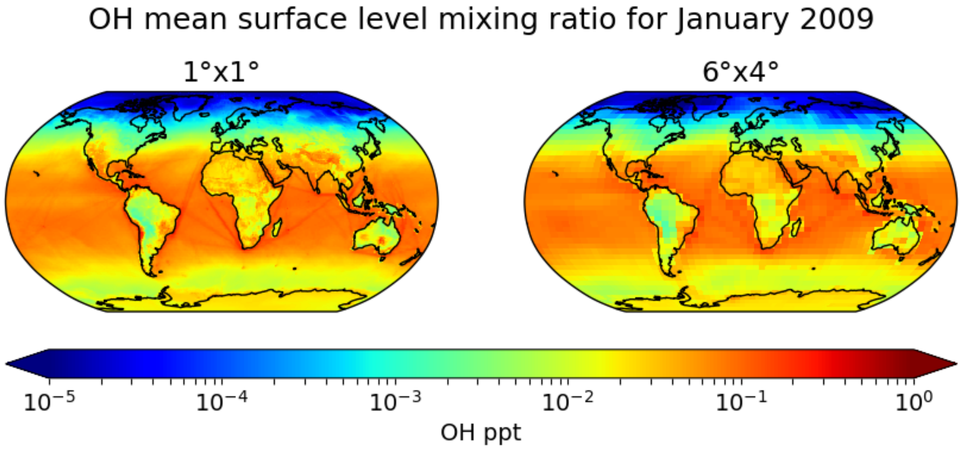

Figure 4.2: OH mean mixing ratio on surface level for January 2009. 1°x1° spatial resolution on the left and 6°x4° spatial resolution on the right.

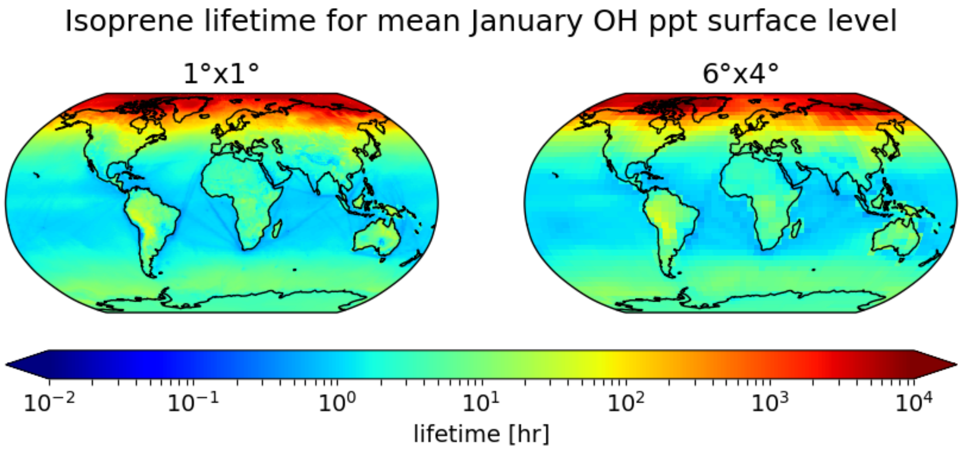

Figure 4.3: Isoprene lifetime calculation based on OH surface level mean concentration for January 2009. 1°x1° spatial resolution on the left and 6°x4° spatial resolution on the right.

model results can be observed on **Fig.4.5** and on **Fig.4.6** and the comparisons of the climatological data with the 1°x1° model results can be observed on **Fig.4.7** and on **Fig.4.8**. A disclaimer has to be done here, the climatological data used in order to create this map and all the following is not the original climatological 8°x10° data but it is an interpolated (to 1°x1° resolution) data base that is commonly used for TM5 model runs. Therefore, the results do not show a clear latitudinal band dependency that an 8°x10° spatial resolution would show.

The differences on these maps, more specifically on the 1°x1° figures are due to the different methods into which OH concentration is calculated but also on temporal

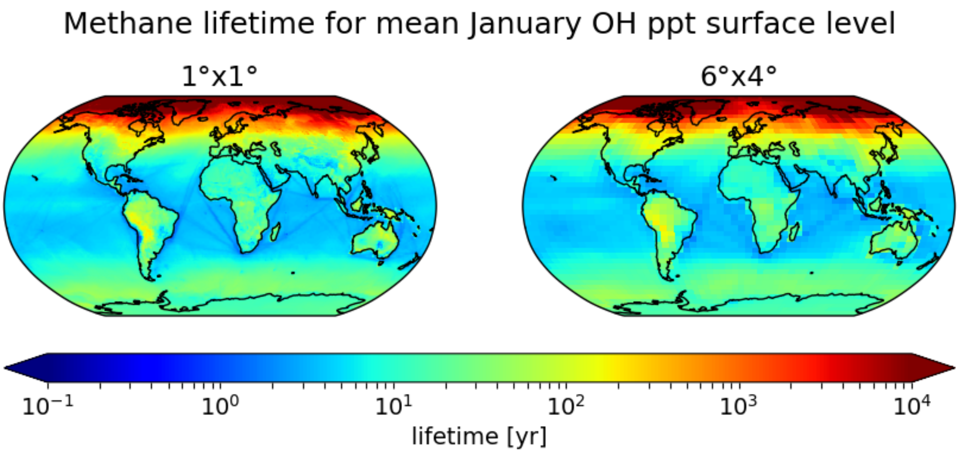

Figure 4.4: Methane lifetime calculation based on OH surface level mean concentration for January 2009. 1°x1° spatial resolution on the left and 6°x4° spatial resolution on the right.

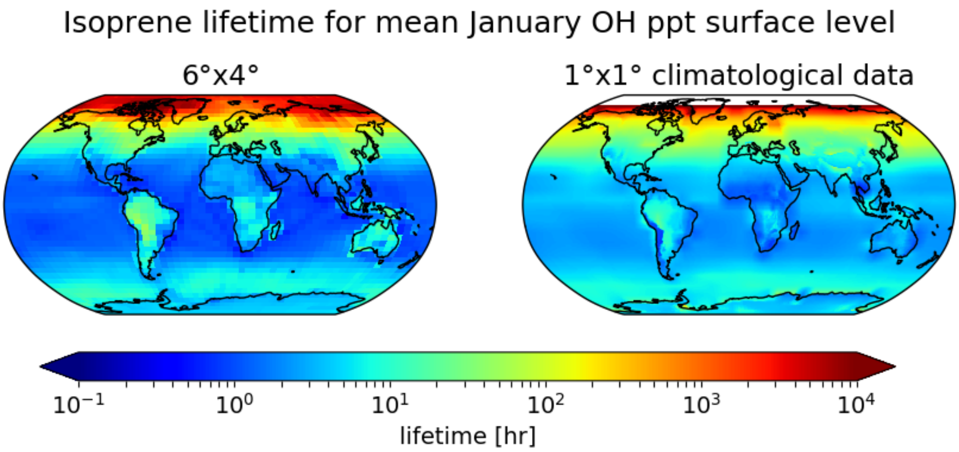

Figure 4.5: Isoprene lifetime calculation based on OH surface level mean concentration for January 2009 6°x4° spatial resolution on the left and on 1°x1° surface level climatological data on the right.

resolution. Whilst the model run is based on a mean of daily, hourly output, the climatological data is calculated via methyl chloroform concentrations, which had an average lifetime of around 3years, therefore, providing a coarser temporal resolution on OH concentrations, which effect is shown on the maps.

Assessing whether one approximation is better than the other one, a comparison with literature values for both isoprene and methane lifetimes was done. On average, the isoprene's lifetime is ≈1.7 hours (Seinfeld and Pandis, 2016), with the model run 1°x1° data an annual average of ≈2.7 hours for a temperature of 273K was obtained which is

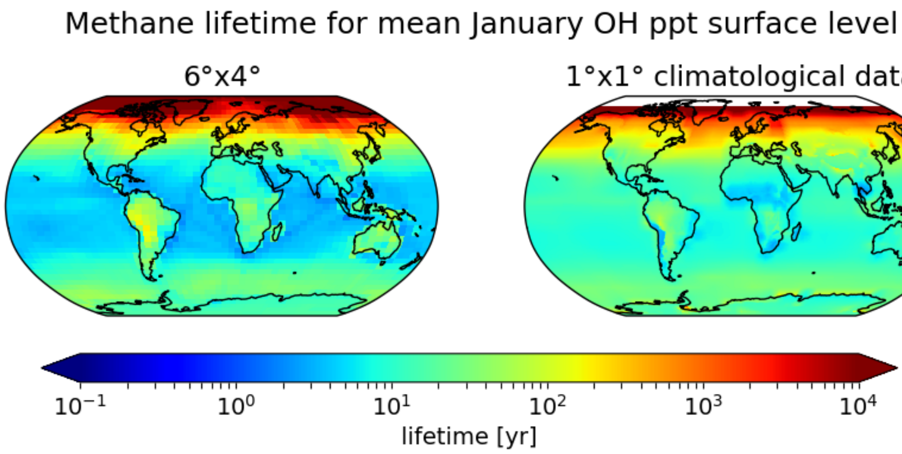

Figure 4.6: Methane lifetime calculation based on OH surface level mean concentration for January 2009 6°x4° spatial resolution on the left and on 1°x1° surface level climatological data on the right.

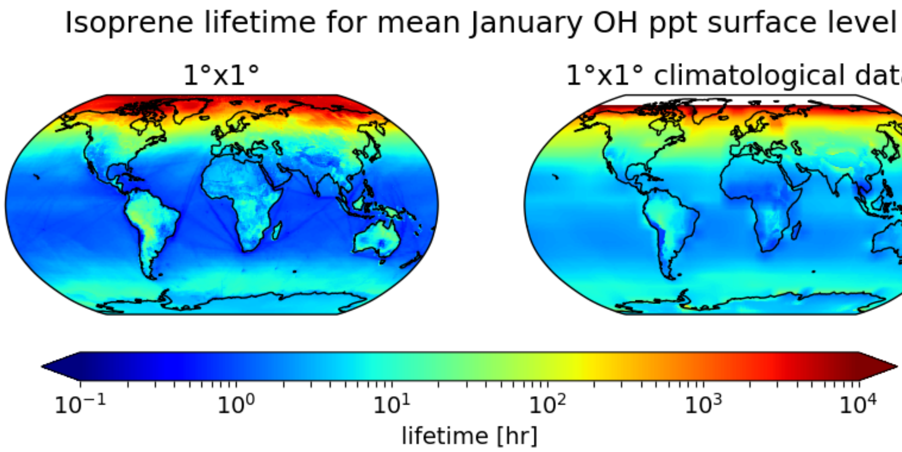

Figure 4.7: Isoprene lifetime calculation based on OH surface level mean concentration for January 2009 1°x1° spatial resolution on the left and on 1°x1° surface level climatological data on the right.

slightly higher than the value found on literature. Climatological data also over predicts the lifetime of isoprene, getting an annual average of 4 hours for the same temperature. For methane, the reported lifetime value is ≈ 8.9 years (Huijnen, Williams, et al., 2010). The model run 1°x1° data produced an annual average of ≈9.6 years for a temperature of 273K while the climatological data produced an annual average of ≈14 years for the same temperature.

These values were calculated using monthly CH_4 and C_5H_8 concentrations as calculated by the model and then averaged for the year. An example of isoprene lifetime results

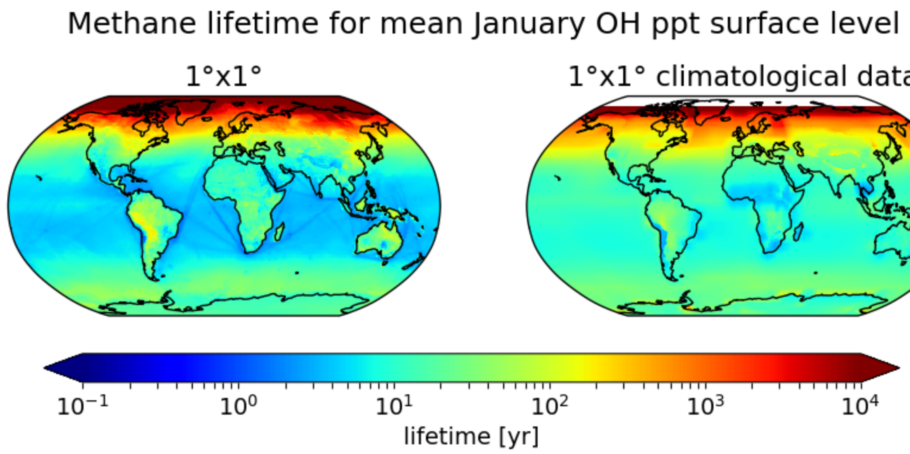

Figure 4.8: Methane lifetime calculation based on OH surface level mean concentration for January 2009 1°x1° spatial resolution on the left and on 1°x1° surface level climatological data on the right.

varying with temperature for the month of January can be observed on **Table A0.2** and on **Table A0.3** on the Appendix. Due to isoprene's relatively short lifetime, it is fair to assess that its lifetime due to the reaction with OH will be daytime dependent. This explains why the climatological data, which does not consider nighttime OH production, and the 1°x1° model run data produce similar results, while the calculations for the methane lifetimes show a sharper difference.

4.2 Second stage analysis results

To continue the analysis, a closer look on the impact of nighttime OH was done. For this reason, model obtained data was resampled into local time, solar zenith angle calculations were made and resampled into local time as well, so that they could be used to separate daytime and nighttime OH results. On **Fig.4.9** an example of the resampling of the data is shown. After applying the resampled solar zenith angle calculation to the previously local time resampled data, the separation between daytime and nighttime is achieved. An example of this is shown on **Fig.4.10** and **Fig.4.11**, where daytime and nighttime for 12:00hr and 0:00hr local time is shown for both 1°x1° and 6°x4° spatial resolution. For the purposes of this study, the 1°x1°, hourly produced data is consider as the most accurate one. The next step of the analysis consists on measuring the effects that coarsening the temporal and spatial resolution have. As a

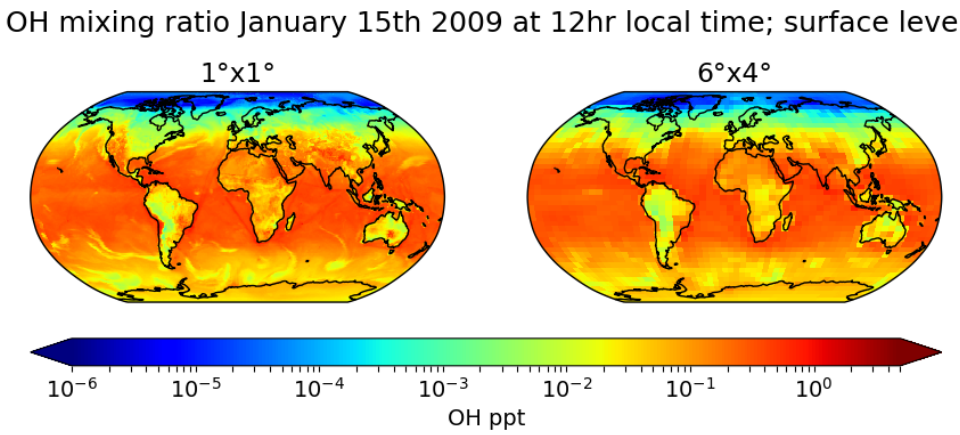

Figure 4.9: OH mixing ratio on surface level for January 15th 2009 at 12:00 local time. 1°x1° spatial resolution on the left and 6°x4° spatial resolution on the right.

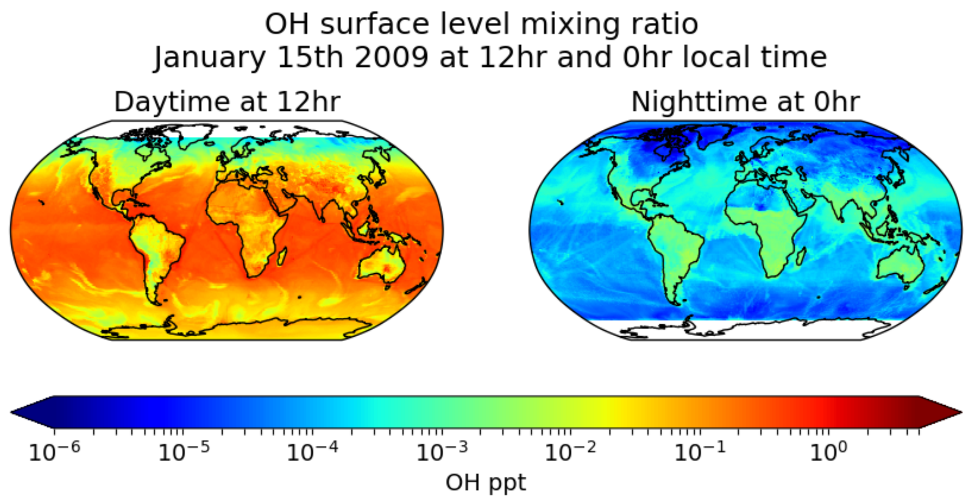

Figure 4.10: OH mixing ratio on surface level for January 15th 2009 based on 1°x1° spatial resolution. Daytime at 12:00hr local time on the left and nighttime at 0:00hr local time on the right.

first approach the daytime and nighttime calculated sets were averaged on a monthly basis for each local time. Then, the relative difference was calculated. By comparing the mean obtained from the 1°x1° values and the hourly values a good understanding of the impact that coarsening temporal resolution is provided and by comparing the mean obtained from the 6°x4° values the combined impact of coarsening both temporal and spatial resolution is observed.

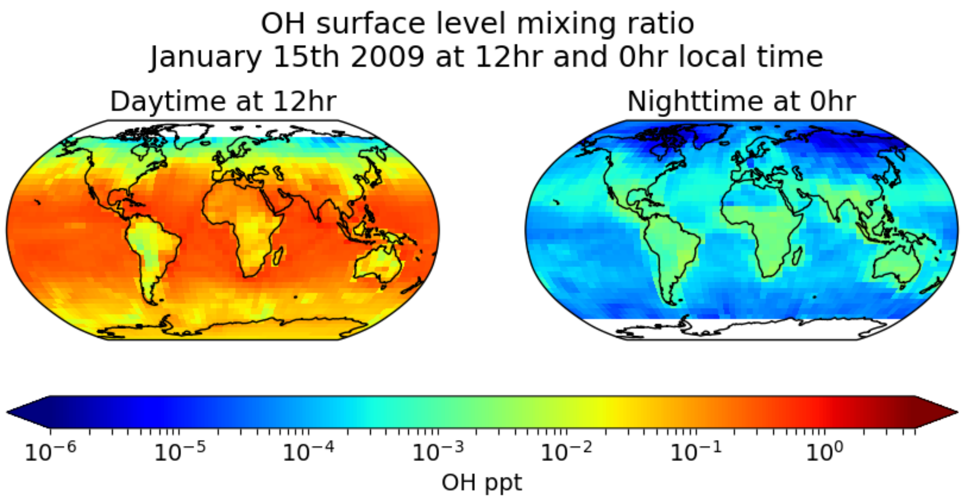

Figure 4.11: OH mixing ratio on surface level for January 15th 2009 based on 6°x4° spatial resolution. Daytime at 12:00hr local time on the left and nighttime at 0:00hr local time on the right.

In order to "measure the effect" a relative comparison is done following this formula:

$$Difference = \frac{abs(mean - hourly)}{\frac{mean+hourly}{2}} * 100 \tag{4.1}$$

The results of the monthly mean done on each set of local time for daytime for June, July and August 2009 are displayed on **Fig.4.12**, where a global mean mixing ratio was obtained for each hour of the daytime monthly means. The results are separated between Northern and Southern Hemisphere so that the effect of seasonality on OH concentrations can be observed. In these particular graphs, summer for the Northern Hemisphere is depicted and it can be appreciated that July represents the hottest month with the longest days which translates into higher OH concentration. Exactly the opposite happens on the Southern Hemisphere where July represents the coldest with the shortest days on average of the year therefore obtaining the lowest OH concentrations of the three winter months. The relative percentage difference of calculating monthly means can be observed on the **Tables A0.4 - A0.7** on the Appendix. These results show that for the month of July, the monthly mean compared to the hourly output when using 1°x1° data has a mean variation of ≈27% for the daytime values while the mean variation when using the 6°x4° to obtain the monthly mean is of ≈45%. For nighttime values, variation increases due to the small values

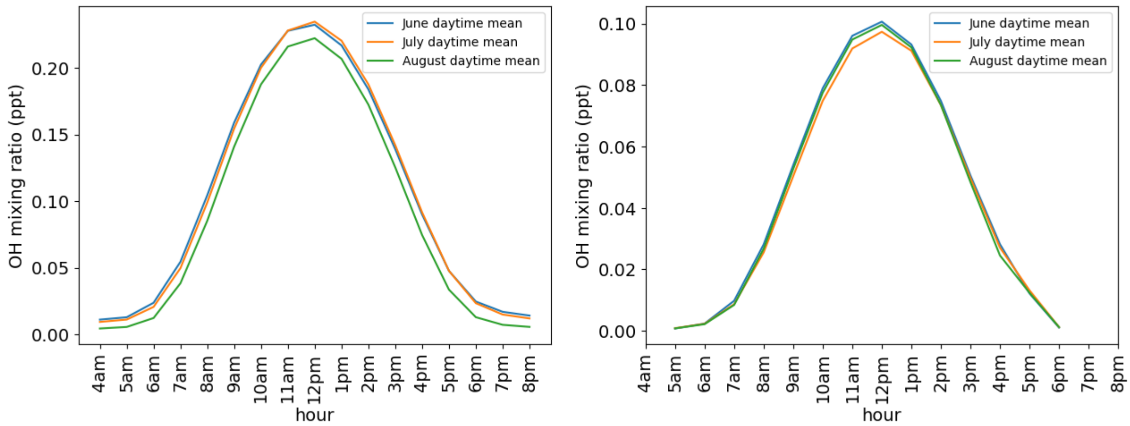

Figure 4.12: Mean OH mixing ratio for each hour of daytime for June, July and August 2009 obtained from the 1°x1° data. On the left Northern Hemisphere results are shown and on the right Southern Hemisphere results are displayed.

that are observed during nighttime due to OH's nature, then, since, naturally OH nighttime values are low, a variation of a small number gets translated into a big percentage difference, where the percentage difference of the monthly mean created from the 1°x1° data is ≈30% and the one obtained from the monthly mean 6°x4° data is ≈57%.

These results make sense and show the impact of using a coarser spatial resolution has on the accuracy of OH concentration, where the difference percentage is sometimes higher than 50%. Nonetheless, this doesn't analyze the impact that such high difference percentage may have when using an OH mean concentration in order to calculate other atmospheric parameters, like, for example, chemical compounds lifetimes. This assessment is now presented on **Table 4.1** and on **Table 4.4** where mean OH values for daytime, localtime 12:00hr and for nighttime, localtime: 0:00hr respectively for the month of July were used together with their variations. These values were used in order to calculate methane's lifetime and show the impact that the variation of the mixing ratio values have on it. On **Table 4.3** the same approach is used for isoprene's lifetime calculations using the OH mixing ratio value for daytime, localtime 12:00hr and its corresponding variation.

	OH (ppt)	**Temperature** (K)	**Methane** (molec/cm^3)	**Rate of reaction** (cm^{3}molec^{-1}s^{-1})	**Methane lifetime** (yr)
mr-%	0.129	273.0	4.821×10^{13}	6.146×10^5	2.5
mr	0.173	273.0	4.821×10^{13}	8.256×10^5	1.9
mr+%	0.217	273.0	4.821×10^{13}	1.036×10^6	1.5

Table 4.1: Calculation of methane lifetime based on July mean OH mixing ratio for 12:00hr localtime, daytime values obtained from a 1°x1° spatial resolution data set. The first row represents the lifetime calculation using the mean mixing ratio minus the difference percentage (25.55%), the second row represents the lifetime calculation with the mean mixing ratio and the last row represents the lifetime calculation using the mean mixing ratio plus the difference percentage (25.55%).

	OH (ppt)	**Temperature** (K)	**Methane** (molec/cm^3)	**Rate of reaction** (cm^{3}molec^{-1}s^{-1})	**Methane lifetime** (yr)
mr-%	0.0005	273.0	4.821×10^{13}	2620.286	583.4
mr	0.0007	273.0	4.821×10^{13}	3477.948	439.5
mr+%	0.0009	273.0	4.821×10^{13}	4335.611	352.6

Table 4.2: Calculation of methane lifetime based on July mean OH mixing ratio for 0:00hr localtime, nighttime values obtained from a 1°x1° spatial resolution data set. The first row represents the lifetime calculation using the mean mixing ratio minus the difference percentage (22.4%), the second row represents the lifetime calculation with the mean mixing ratio and the last row represents the lifetime calculation using the mean mixing ratio plus the difference percentage (22.4%).

The results presented on these tables will further be discussed on the Discussion section of this work, but for now, the clear impact that these variations have on these chemical compounds lifetimes provides enough evidence to continue the analysis using the 1°x1° model data as base for the further attempt to create an OH data set that has a coarser temporal and spatial resolution (making the data set more storage efficient) but keeping a certain level of accuracy.

On a closer look to the 1°x1° tables, it is clear that the biggest difference percentage values are encountered for, daytime during typical nighttime hours (i.e. 22:00hr -

	OH (ppt)	**Temperature** (K)	**Isoprene** (molec/cm^3)	**Rate of reaction** (cm^{3}molec^{-1}s^{-1})	**Isoprene lifetime** (hr)
mr-%	0.129	273.0	8.306×10^9	3.284×10^6	0.702
mr	0.173	273.0	8.306×10^9	4.412×10^6	0.522
mr+%	0.217	273.0	8.306×10^9	5.539×10^6	0.416

Table 4.3: Calculation of isoprene lifetime based on July mean OH mixing ratio for 12:00hr localtime, daytime values obtained from a 1°x1° spatial resolution data set. The first row represents the lifetime calculation using the mean mixing ratio minus the difference percentage (25.55%), the second row represents the lifetime calculation with the mean mixing ratio and the last row represents the lifetime calculation using the mean mixing ratio plus the difference percentage (25.55%).

3:00hr) and during nighttime on the typical daytime hours (i.e. 8:00hr - 15:00hr), which hints that the polar latitudes OH mixing ratio variations are the ones responsible for the big difference percentage. Furthermore, the results point to a higher variation when the transition between daytime and nighttime occurs. On **Fig.4.13** and **Fig.4.14** sunrise differences and mean daytime values are depicted and on **Fig.4.15** and **Fig.4.16** sunset percentage differences and mean nighttime values are shown. It is clear from these images that the poles definitely represent latitudes where the difference percentage is the highest and that the latitudes where, at certain hour, a shift between daytime and nighttime also represent the ones with the highest mixing ratio variation.

These results show the impact of the coarser temporal resolution when using a "monthly mean" technique, but it also shows that there could be another way to coarser the temporal resolution using a different monthly mean technique which is divided by groups of local times that correspond to sunrise, sunset, daytime and nighttime for a certain latitude. This project then moves forward taking this other approach in order to reduce temporal resolution, as the monthly mean technique does while aiming to create a more accurate data set.

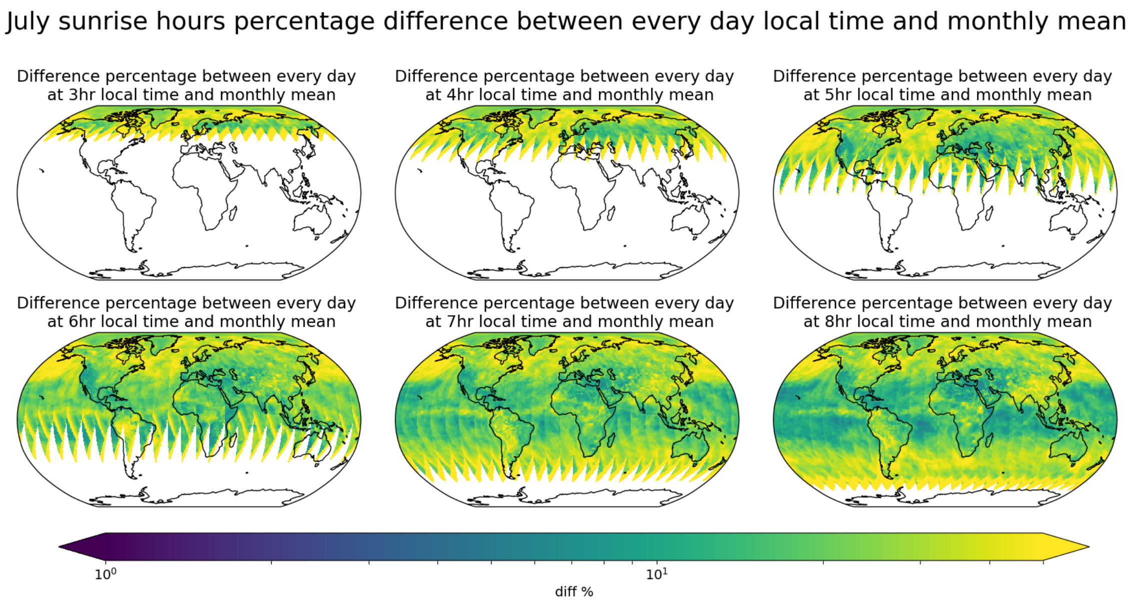

Figure 4.13: Percentage difference for daytime OH mixing ratio values vs July 2009 mean OH mixing ratio for local times in sunrise hours, 3:00hr - 8:00hr. Based on 1°x1° data.

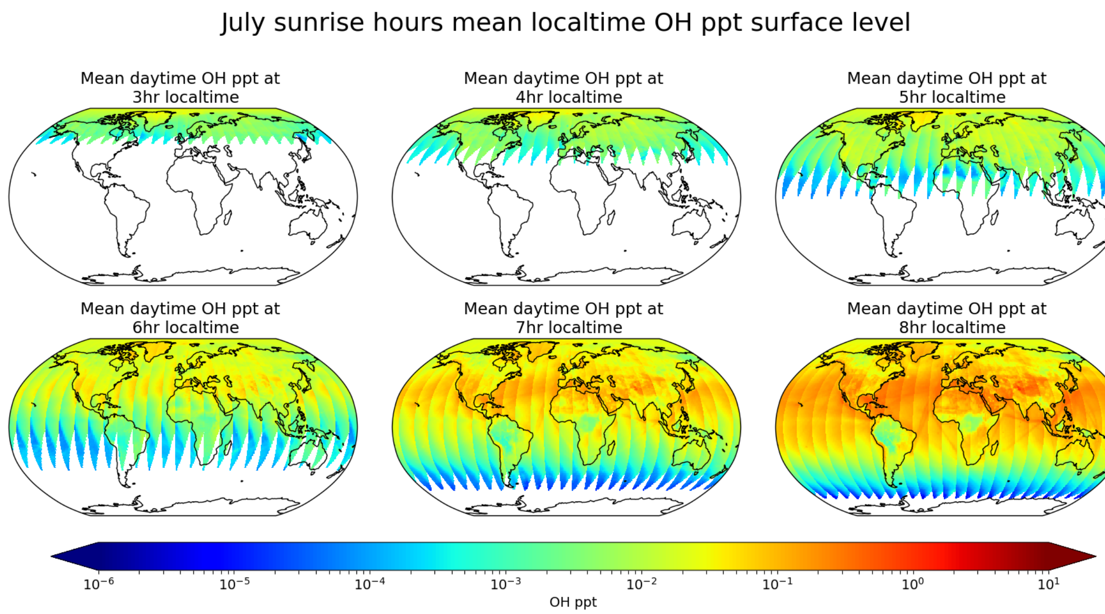

Figure 4.14: Mean July OH mixing ratio values for daytime values in local times that represent sunrise, 3:00hr - 8:00hr. Based on 1°x1° data.

4.3 Third stage analysis results

On this section, the following approach to coarser the temporal resolution of the 1°x1° hourly output obtained from the TM5MP was used:

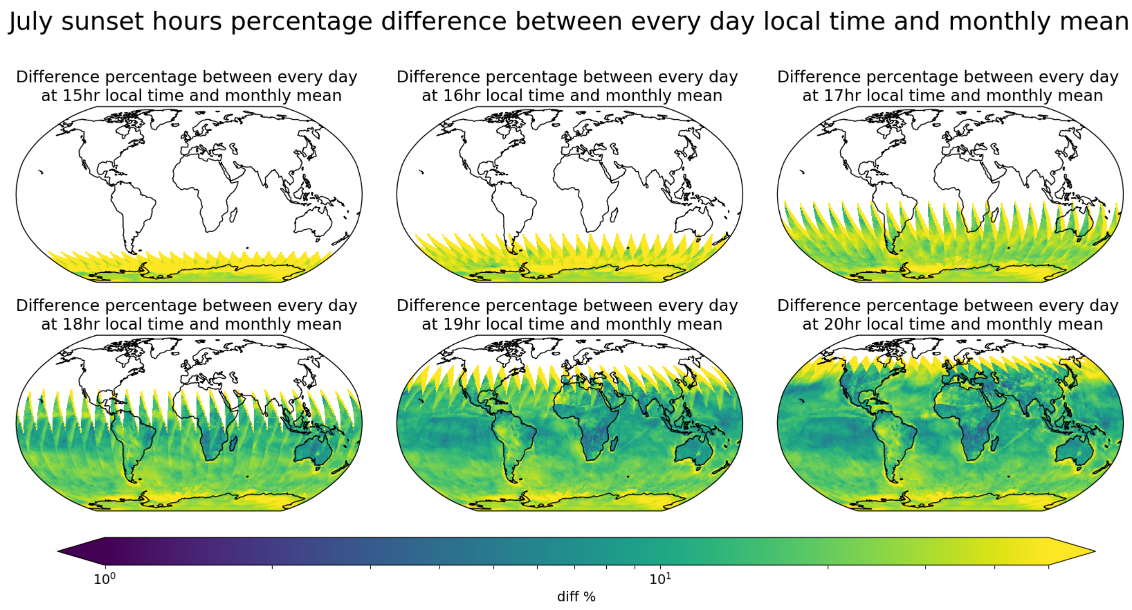

Figure 4.15: Percentage difference for nighttime OH mixing ratio values vs July 2009 mean OH mixing ratio for local times in sunset hours, 15:00hr - 20:00hr. Based on 1°x1° data.

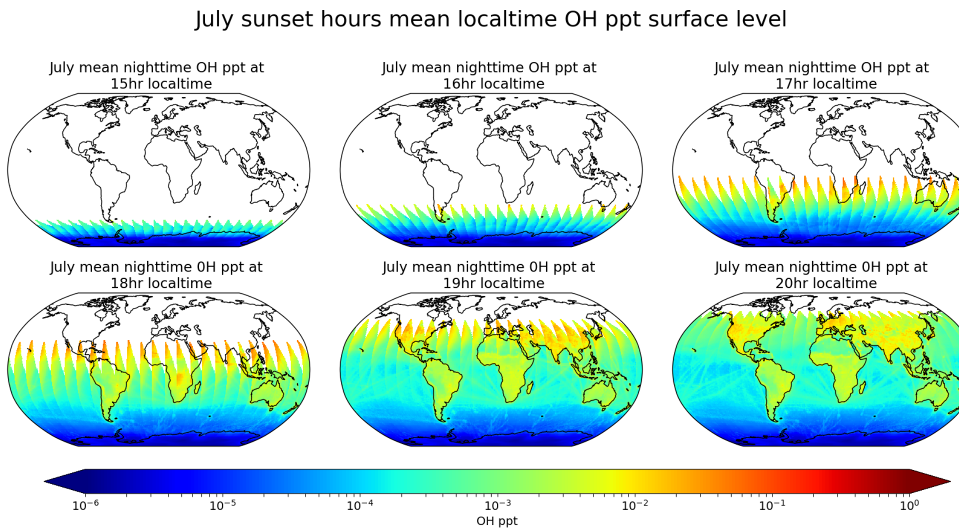

Figure 4.16: Mean July OH mixing ratio values for nighttime values in local times that represent sunset, 15:00hr - 20:00hr. Based on 1°x1° data.

- For each month in the year 2009 and December 2008 an average was made for each hour of the day using the resampled local time daytime and nighttime values.
- Following a latitudinal band approach, where the globe is separated into bands of 8°, following the original data set made on Spivakovsky et al. (2000), and two 6° bands on the poles with the aim to improve the accuracy of the mean values

in the poles, a selection was made based on the mean of the hourly values for hours that represent sunrise and sunset for each latitudinal band.

- Monthly data sets were assembled for sunrise and sunset by taking the OH mixing ratio values for the specific latitudinal sunrise and sunset hours as the monthly data sets for daytime and nighttime were done by taking the hours between sunrise and sunset for daytime and the hours between sunset and sunrise for nighttime per latitudinal band.

- From the monthly data sets, a seasonal data set was created by averaging the OH mixing ratio values per temporal grouping. Also 8°x10° monthly and seasonal data sets were created from these monthly data sets by averaging OH mixing ratio values for this spatial resolution

- To finalize, the differential percentage of each of the monthly, seasonal, 8°x10° monthly and 8°x10° seasonal data sets with the daily hourly 1°x1° OH mixing ratio values were calculated.

On the following figures, the results for the months March, April and May 2009 are shown. Firstly, on **Fig.4.17** and **Fig.4.18** the results of the monthly mean for sunrise values and their corresponding variation are presented, continuing with **Fig.4.19** and **Fig.4.20** where the results for the seasonal mean and their corresponding variation for sunrise values are depicted. On **Fig.4.21**, **Fig.4.22**, **Fig.4.23** and **Fig.4.24** the same range of hours are depicted but the 8°x10° data sets were used.

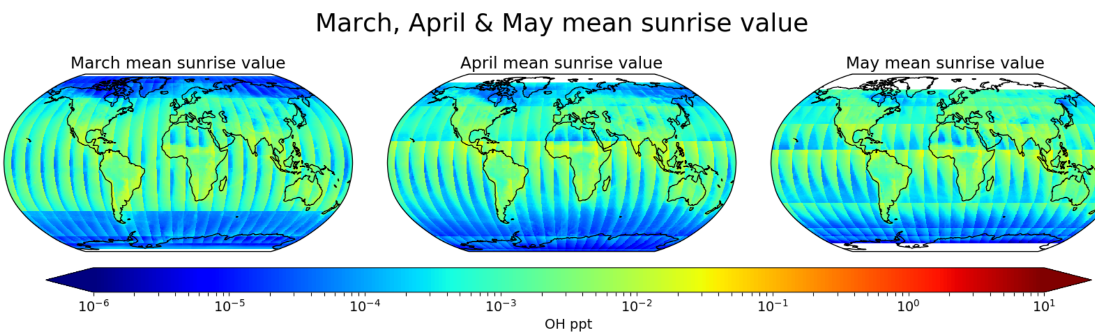

Figure 4.17: March, April and May 2009 monthly mean OH mixing ratio values for sunrise hour per latitudinal band.

Next up, the figures for daytime values are presented, where on **Fig.4.25** and **Fig.4.26**

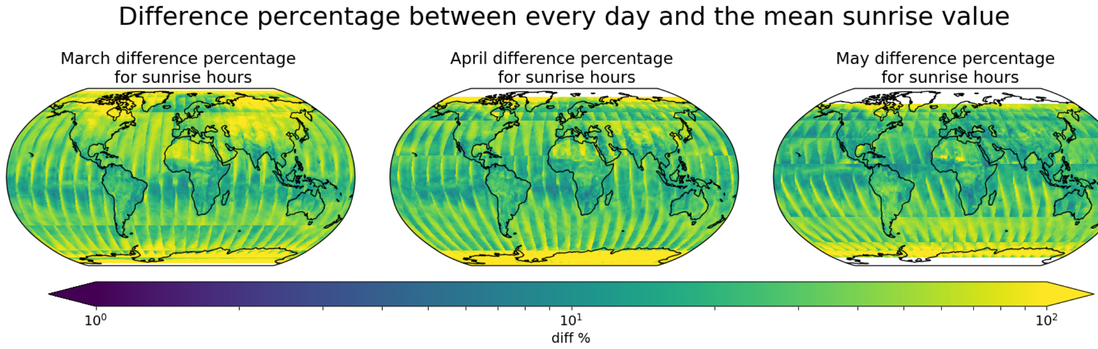

Figure 4.18: Mean March, April and May 2009 differential percentage between monthly mean OH mixing ratio values for sunrise hour per latitudinal band and daily 1°x1° values.

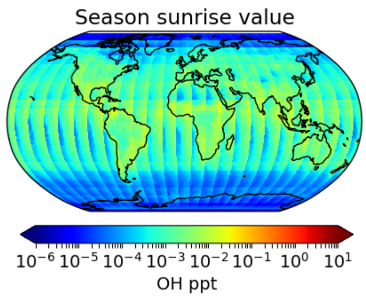

Figure 4.19: Season (March, April and May 2009) mean OH mixing ratio values for sunrise hour per latitudinal band.

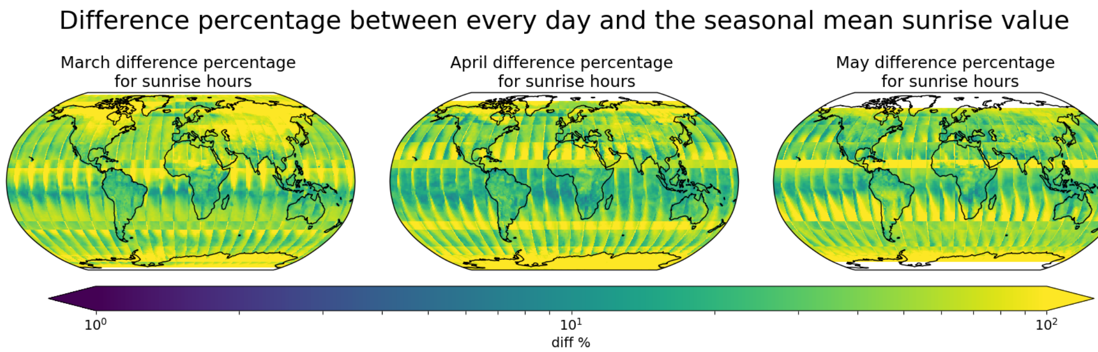

Figure 4.20: Season (March, April and May 2009) differential percentage between season mean OH mixing ratio values for sunrise hour per latitudinal band and daily 1°x1° values.

the results of the monthly mean and their corresponding variation are presented, continuing with **Fig.4.27** and **Fig.4.28** where the results for the seasonal mean and their corresponding variation are depicted. On **Fig.4.29**, **Fig.4.30**, **Fig.4.31** and **Fig.4.32** the same range of hours are depicted but the 8°x10° data sets were used.

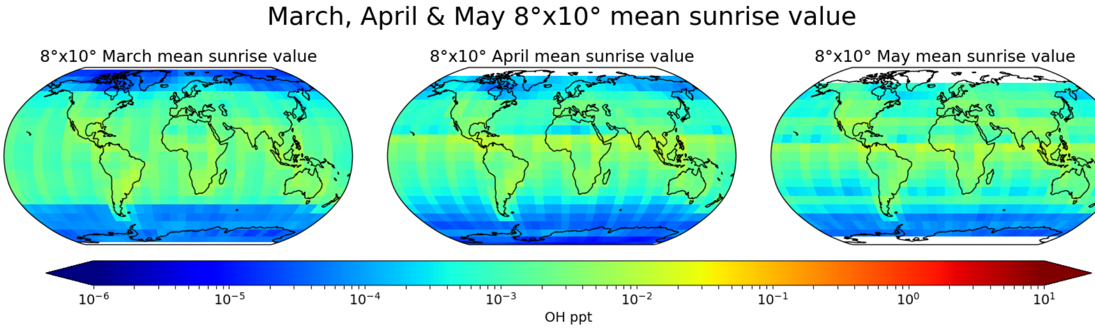

Figure 4.21: 8°x10° March, April and May 2009 monthly mean OH mixing ratio values for sunrise hour per latitudinal band.

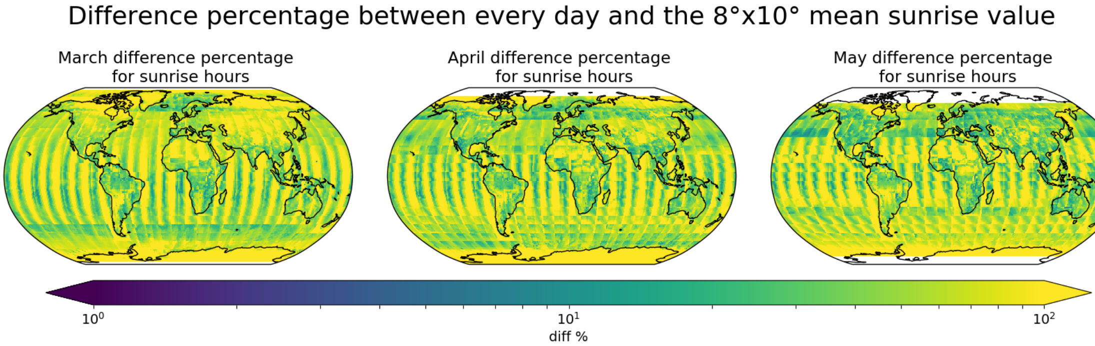

Figure 4.22: 8°x10° March, April and May 2009 differential percentage between monthly mean OH mixing ratio values for sunrise hour per latitudinal band and daily 1°x1° values.

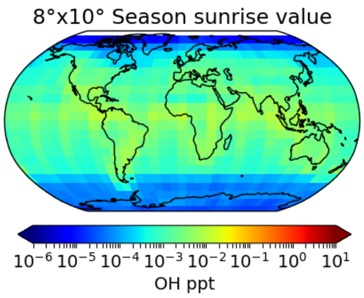

Figure 4.23: 8°x10° season (March, April and May 2009) mean OH mixing ratio values for sunrise hour per latitudinal band.

The following figures are representative of the sunset values, where on **Fig.4.33** and **Fig.4.34** the results of the monthly mean and their corresponding variation are presented, continuing with **Fig.4.35** and **Fig.4.36** where the results for the seasonal mean and their corresponding variation are depicted. On **Fig.4.37**, **Fig.4.38**, **Fig.4.39** and **Fig.4.40** the 8°x10° data sets were used for the same range of hours.

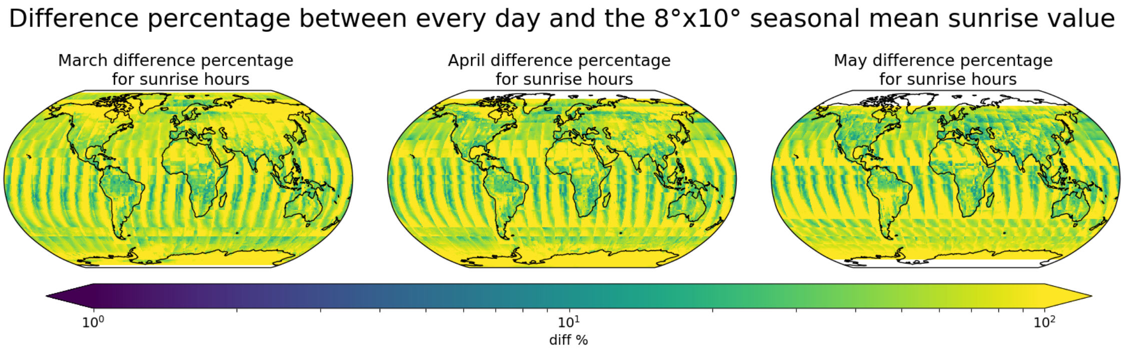

Figure 4.24: 8°x10° season (March, April and May 2009) differential percentage between season mean OH mixing ratio values for sunrise hour per latitudinal band and daily 1°x1° values.

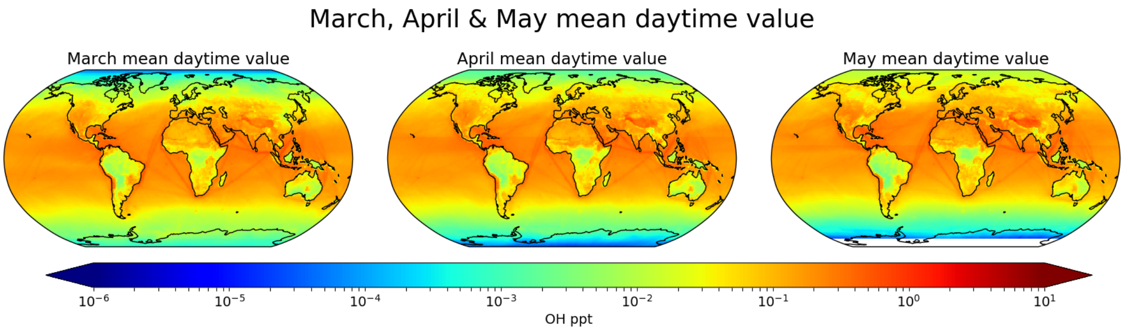

Figure 4.25: March, April and May 2009 monthly mean OH mixing ratio values for daytime hours per latitudinal band.

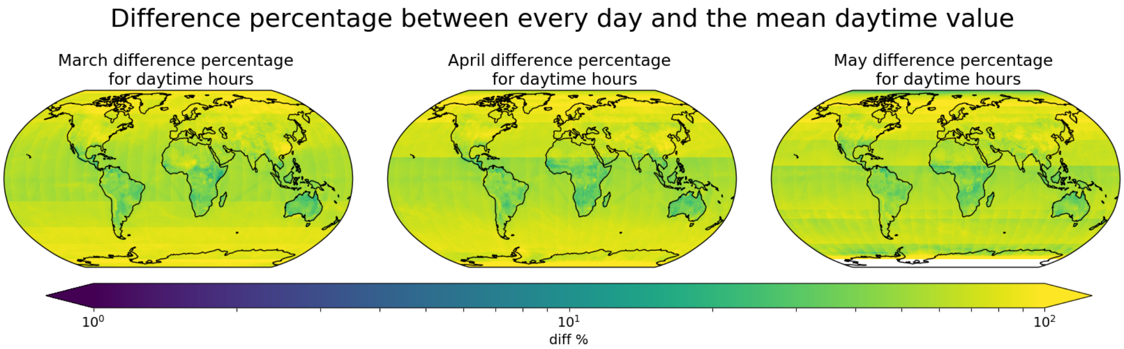

Figure 4.26: March, April and May 2009 differential percentage between monthly mean OH mixing ratio values for daytime hours per latitudinal band and daily 1°x1° values.

The final set of figures are the ones representing nighttime values, where on **Fig.4.41** and **Fig.4.42** the results of the monthly mean and their corresponding variation are presented, continuing with **Fig.4.43** and **Fig.4.44** where the results for the seasonal mean and their corresponding variation are depicted. On **Fig.4.45**, **Fig.4.46**, **Fig.4.47**

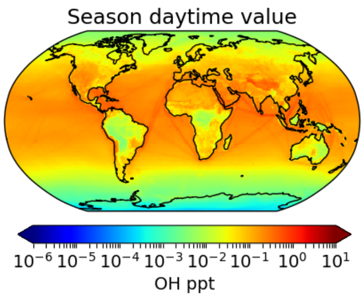

Figure 4.27: Season (March, April and May 2009) mean OH mixing ratio values for daytime hours per latitudinal band.

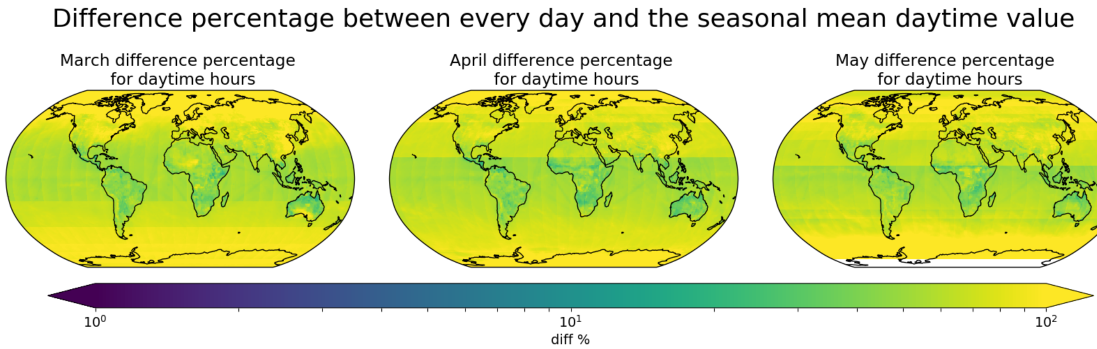

Figure 4.28: Season (March, April and May 2009) differential percentage between season mean OH mixing ratio values for daytime hours per latitudinal band and daily 1°x1° values.

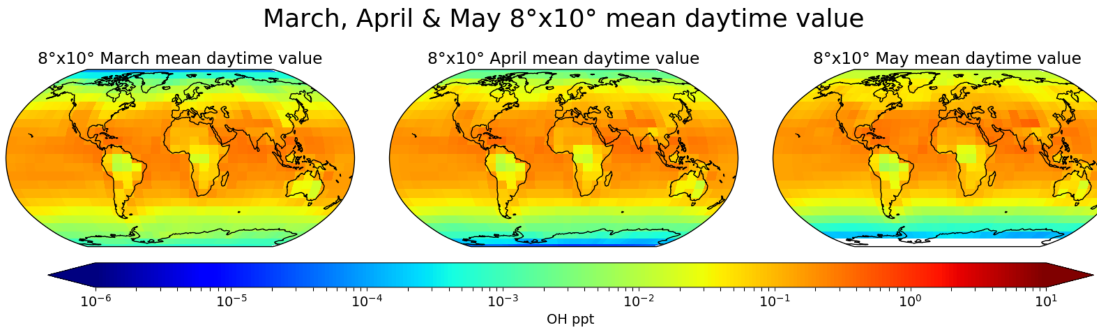

Figure 4.29: 8°x10° March, April and May 2009 monthly mean OH mixing ratio values for daytime hours per latitudinal band.

and **Fig.4.48** the 8°x10° data sets were used for the same range of hours.

Tables with average values per latitudinal band for daytime hours for every month in the year are found on the **Appendix** following this order:

- From **Table A0.8 to Table A0.19** - Monthly 1°x1° mean OH mixing ratio values per latitudinal band together with the differential percentage and absolute

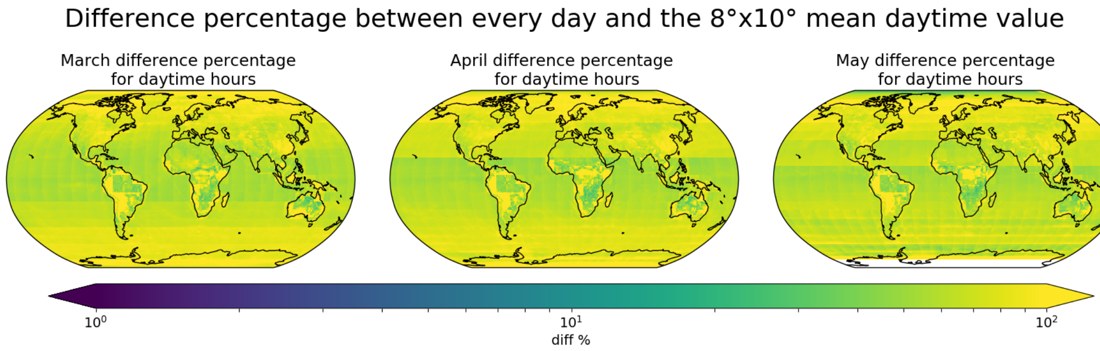

Figure 4.30: 8°x10° March, April and May 2009 differential percentage between monthly mean OH mixing ratio values for daytime hours per latitudinal band and daily 1°x1° values.

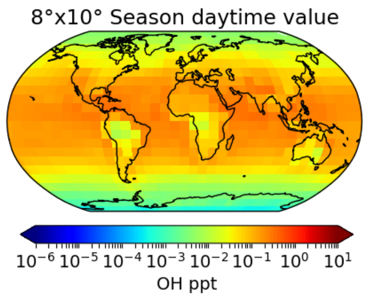

Figure 4.31: 8°x10° season (March, April and May 2009) mean OH mixing ratio values for daytime hours per latitudinal band.

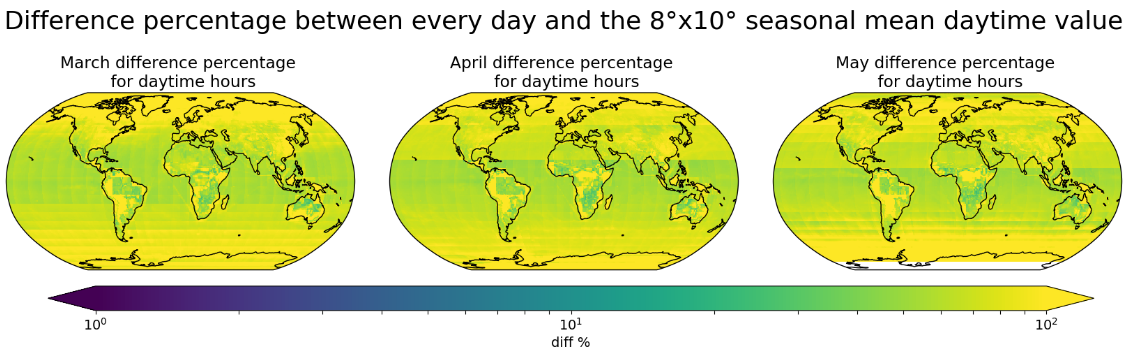

Figure 4.32: 8°x10° season (March, April and May 2009) differential percentage between season mean OH mixing ratio values for daytime hours per latitudinal band and daily 1°x1° values.

difference in ppt with the daily 1°x1° values and the differential percentage and absolute difference with the monthly climatological data.

- From **Table A0.20 to Table A0.31** - Season 1°x1° mean OH mixing ratio values per latitudinal band together with the differential percentage and absolute

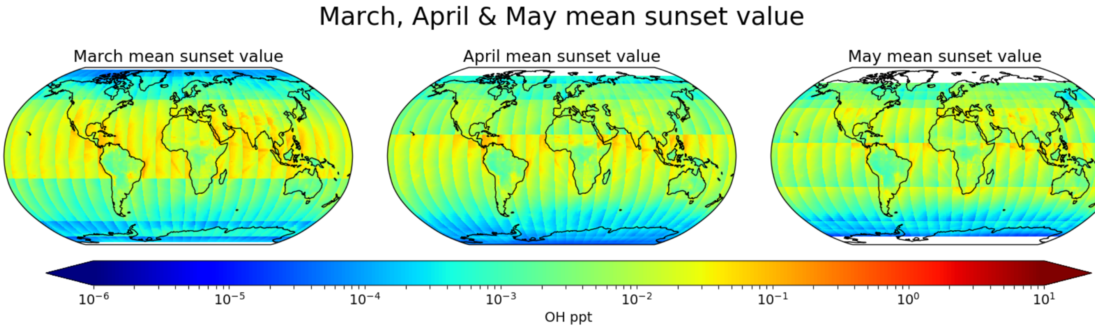

Figure 4.33: March, April and May 2009 monthly mean OH mixing ratio values for sunset hour per latitudinal band.

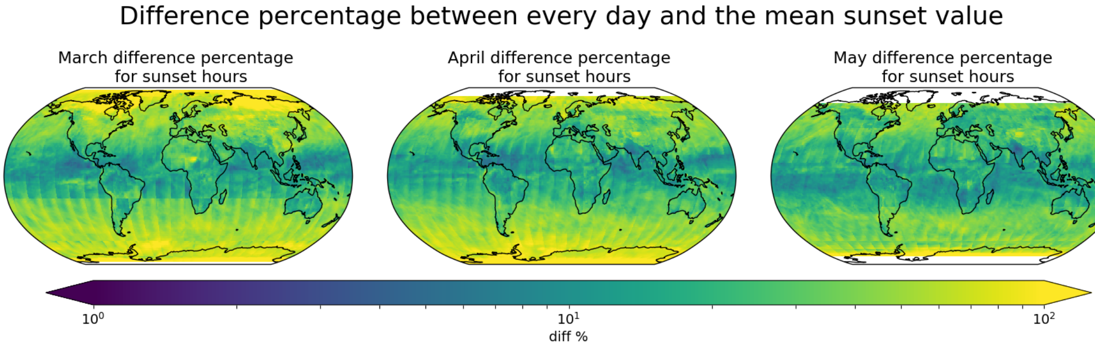

Figure 4.34: March, April and May 2009 differential percentage between monthly mean OH mixing ratio values for sunset hour per latitudinal band and daily 1°x1° values.

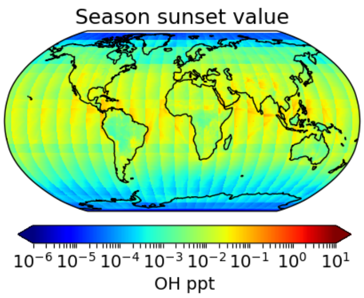

Figure 4.35: Season (March, April and May 2009) mean OH mixing ratio values for sunset hour per latitudinal band.

difference in ppt with the daily 1°x1° values and the differential percentage and absolute difference with the monthly climatological data.

- From **Table A0.32 to Table A0.43** - Monthly 8°x10° mean OH mixing ratio values per latitudinal band together with the differential percentage and absolute difference in ppt with the daily 1°x1° values and the differential percentage and

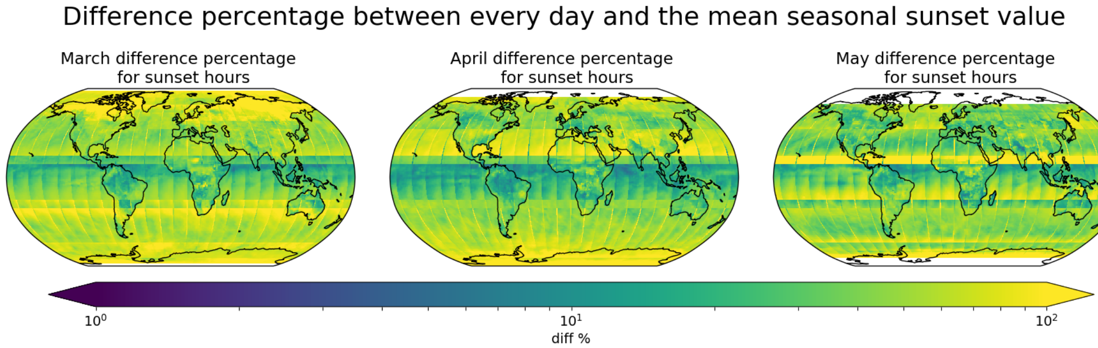

Figure 4.36: Season (March, April and May 2009) differential percentage between season mean OH mixing ratio values for sunset hour per latitudinal band and daily 1°x1° values.

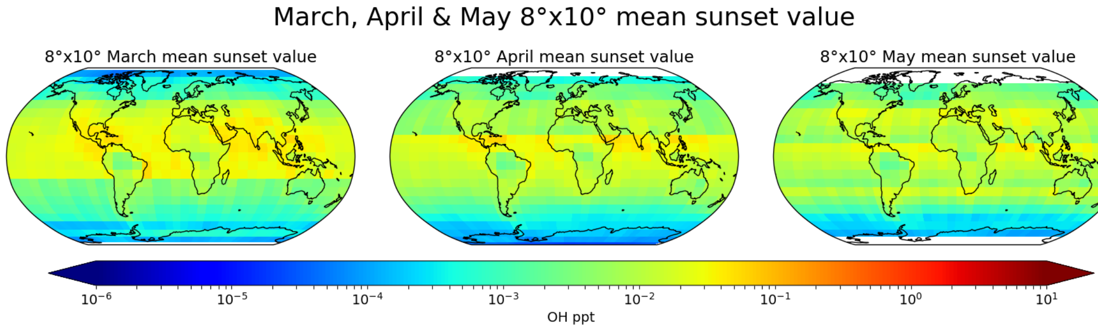

Figure 4.37: 8°x10° March, April and May 2009 monthly mean OH mixing ratio values for sunset hour per latitudinal band.

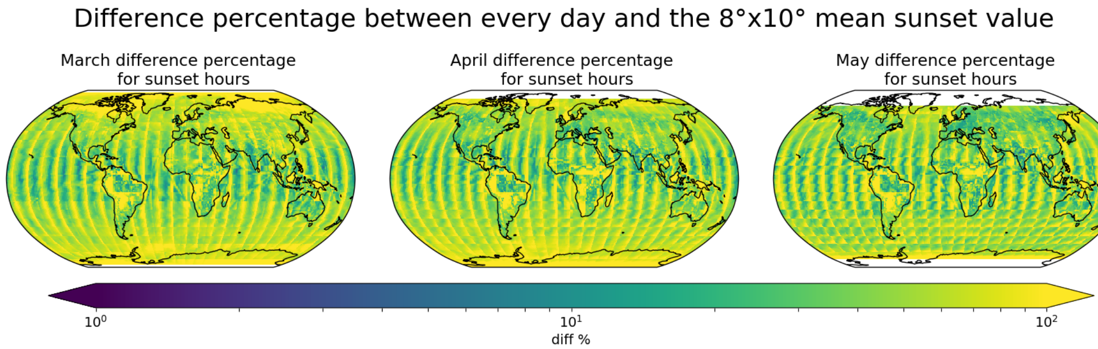

Figure 4.38: 8°x10° March, April and May 2009 differential percentage between monthly mean OH mixing ratio values for sunset hour per latitudinal band and daily 1°x1° values.

absolute difference with the monthly climatological data.

- From **Table A0.44 to Table A0.55** - Season 8°x10° mean OH mixing ratio values per latitudinal band together with the differential percentage and absolute difference in ppt with the daily 1°x1° values and the differential percentage and

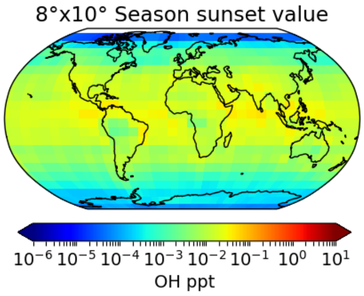

Figure 4.39: 8°x10° season (March, April and May 2009) mean OH mixing ratio values for sunset hour per latitudinal band.

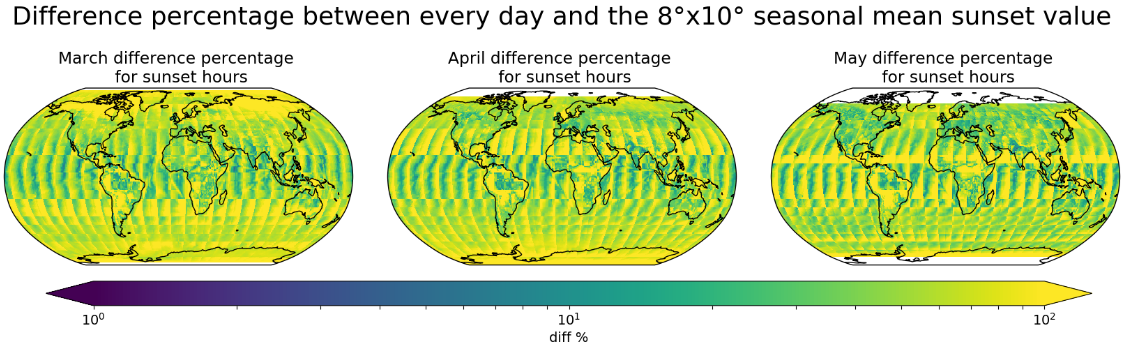

Figure 4.40: 8°x10° season (March, April and May 2009) differential percentage between season mean OH mixing ratio values for sunset hour per latitudinal band and daily 1°x1° values.

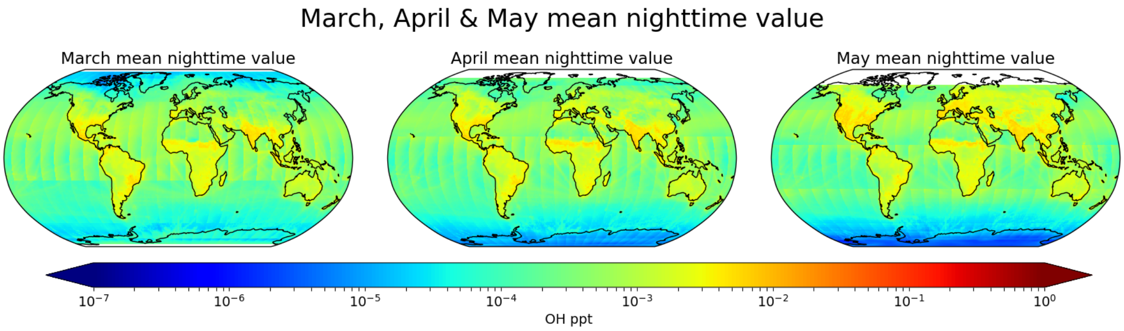

Figure 4.41: March, April and May 2009 monthly mean OH mixing ratio values for nighttime hours per latitudinal band.

absolute difference with the monthly climatological data.

On **Table 4.4** annual average values are presented regarding the differential percentage that each method of coarsening spatial and temporal resolution have with respect to the daily 1°x1° values

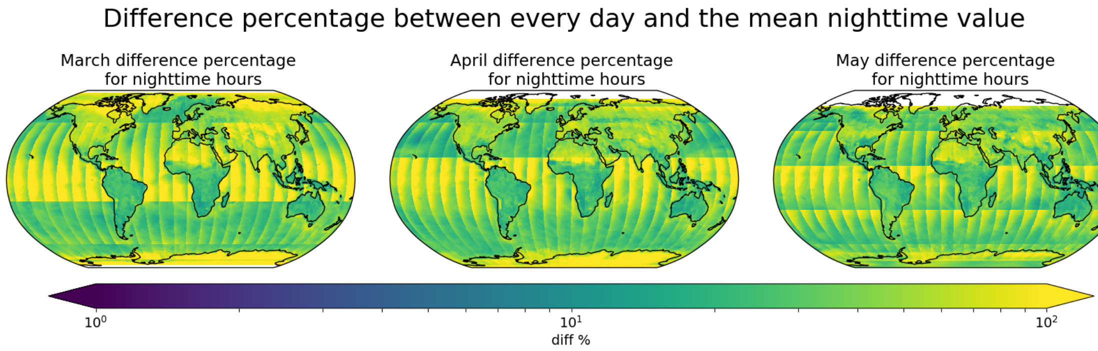

Figure 4.42: Mean March, April and May 2009 differential percentage between monthly mean OH mixing ratio values for nighttime hours per latitudinal band and daily 1°x1° values.

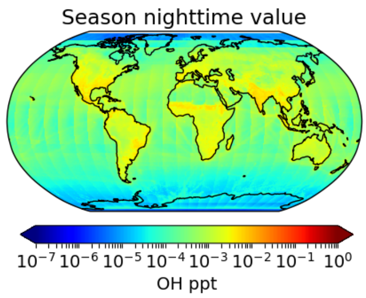

Figure 4.43: Season (March, April and May 2009) mean OH mixing ratio values for nighttime hours per latitudinal band.

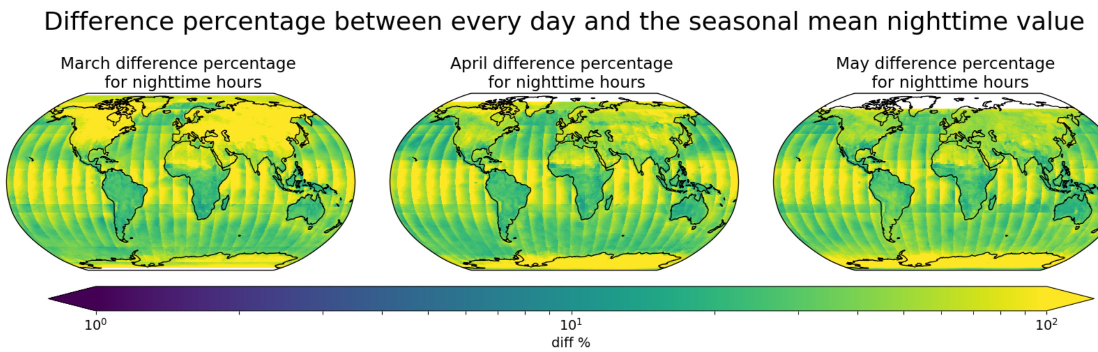

Figure 4.44: Season (March, April and May 2009) differential percentage between season mean OH mixing ratio values for nighttime hours per latitudinal band and daily 1°x1° values.

Regarding the size of these data sets, the full data sets of daily, hourly OH mixing ratio values for a month weight about ≈9 GB while the month and season 1°x1° data sets per temporal group weight ≈518 kB, while the 8°x10° monthly and seasonal data sets take the size down even more to a ≈17 kB. For annual data sets, the data storage of 108GB for the full daily 1°x1° data sets can be converted into 204kB when using

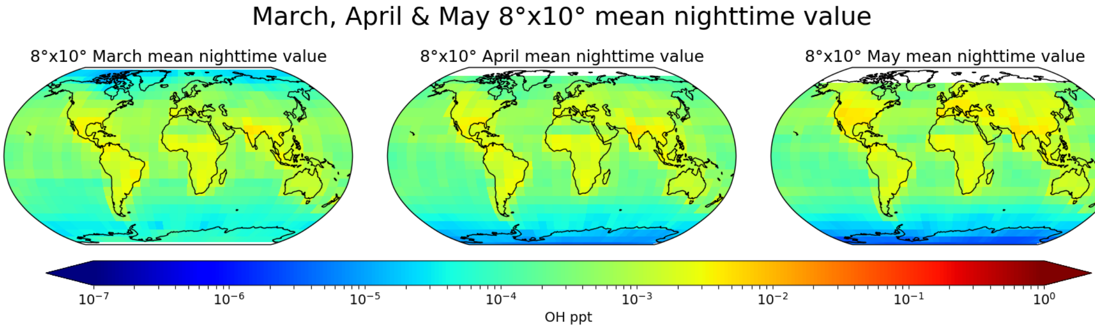

Figure 4.45: 8°x10° March, April and May 2009 monthly mean OH mixing ratio values for nighttime hours per latitudinal band.

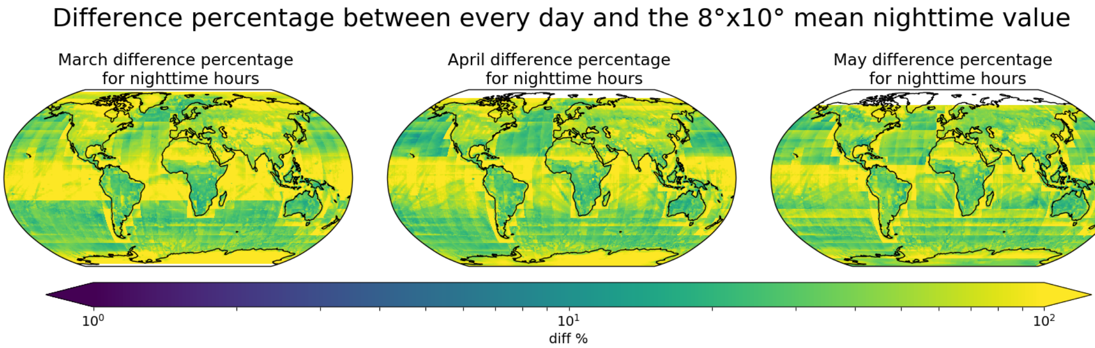

Figure 4.46: 8°x10° March, April and May 2009 differential percentage between monthly mean OH mixing ratio values for nighttime hours per latitudinal band and daily 1°x1° values.

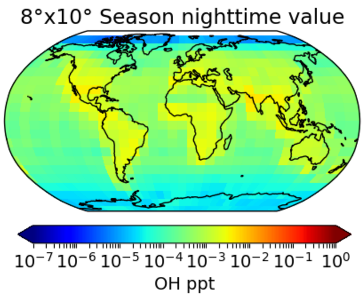

Figure 4.47: 8°x10° season (March, April and May 2009) mean OH mixing ratio values for nighttime hours per latitudinal band.

seasonal 8°x10° data sets.

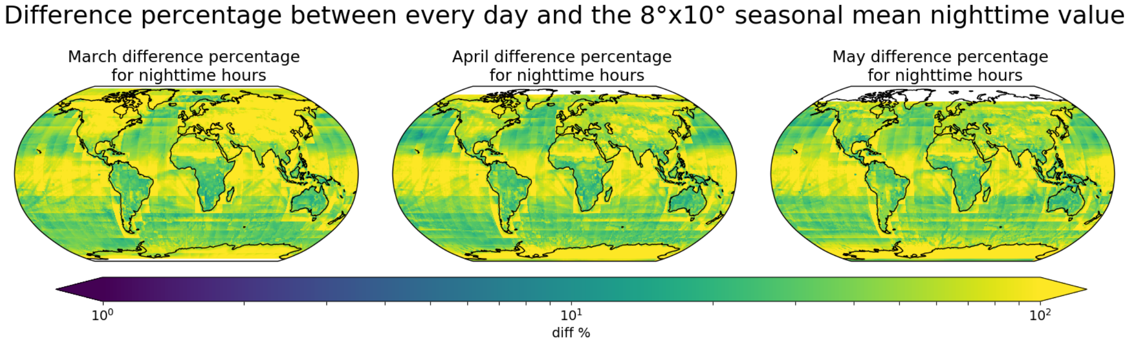

Figure 4.48: 8°x10° season (March, April and May 2009) differential percentage between season mean OH mixing ratio values for nighttime hours per latitudinal band and daily 1°x1° values.

	Differential percentage between daily 1°x1° OH mixing ratio values with:				
	Monthly mean (%)	**Season mean** (%)	**8°x10° Monthly mean** (%)	**8°x10° Season mean** (%)	**Monthly climatological** (%)
Sunrise	38	67	71	89	170
Daytime	67	80	74	87	101
Sunset	36	60	60	76	124
Nighttime	48	57	60	68	184

Table 4.4: Annual average of the differential percentage between daily 1°x1° OH mixing ratio values with respect to the monthly and seasonal mean both for the 1°x1° and the 8°x10° data sets. The annual averages where done for the 4 different temporal groups, sunrise, daytime, sunset and nighttime. The last column is dedicated to the differential percentage of the 1°x1° daily values with the monthly climatological data set

5 Discussion

5.1 Lifetime calculations

Methane lifetime calculations portrayed on **Table 4.1 and Table 4.2** show two critical things:

- Relatively small variations on mixing ratio values can have big consequences on lifetime calculations, e.g. 143years of difference for a 22.4% variation.
- A similar variation on mixing ratio, ≈24%, have very different impact on lifetimes depending on the initial mixing ratio value, e.g. starting from 0.17329 ppt, 25.55% has an impact on lifetime of ≈0.5 years but starting from 0.00073 ppt, 22.4% has an impact on lifetime of ≈110 years.
- The above mentioned variations do not represent an accurate approximation of CH_4 lifetime, but show how a seemingly low variation can have very different effects on final calculations, and therefore, they should always be used with scientific context.
- An accurate lifetime calculation of an atmospheric chemical compound which lifetime is longer than a day and whose main removal path is via a chemical reaction with OH requires both daytime and nighttime OH concentrations.

Nevertheless, it is important to note that none of these values come close to the literature reported values for methane's average lifetime. As it is noted on the first subsection of the Results chapter in this project, the average lifetime of methane obtained when using a monthly mean OH mixing ratio value did provide a close value to the literature reported values, so this implies that the combination of both daytime and nighttime values is the best way to get similar results for average lifetimes.

Isoprene's lifetime calculation (**Table 4.3**) with just daytime mixing ratio values prove to be not so far off from the literature values but this is because isoprene's reaction with OH is very much daytime dependent (Hansen et al., 2017). The variation induced by ≈24% is barely noticeable, with an average of ≈0.1 hour, which makes an overall statement on how big the impact of any variation is to lifetime calculations impossible, since the effects are not linear or follow any pattern.

These tables, though, provide an idea as to what the lifetime value would be if the earth had that mixing ratio value constantly. These provide prognostic tools that can be used to simulate climates that do not yet exist. All the above does draw a conclusion, the assessment as to whether the impact on lifetime calculation is big or small and the level of the accuracy for OH mixing ratio values has to be decided in scope of the analysis the OH mixing ratio values are going to be used for, there can not be a universal assessment.

5.2 Temporal grouping data sets

On a closer look to Figures from **Fig.4.17 to Fig.4.40**, the biggest differential percentages values come from the latitudinal bands that have the smaller OH mixing ratios. This is because when the mixing ratio value is already small, a variation that would not have such a big impact on a bigger mixing ratio value has a big impact on an small mixing ratio value. This is particularly clear on the figures that correspond to sunrise temporal grouping, where the small mixing ratio values can be attributed to the nighttime OH values, which, are factually smaller than the day time OH values, so, on the corresponding differential percentage figures those are the areas that have the biggest percentages on average.

Looking at the annual average for the temporal grouping approach (**Table 4.4**) and comparing these differential percentages with the ones observed on the second stage analysis where the differential percentage (see **Appendix Tables A0.4 - A0.7**) was calculated for monthly mean values and the daily values a superficial conclusion can be made that the variation appears to be bigger on the temporal grouping, but it has to be taken into account that the monthly mean differential percentages were only calculated with respect to the already separated daytime and nighttime arrays, in contrast with the temporal grouping variation that takes into account the original daily, 1°x1° OH mixing ratio that came from the model results. Therefore these variations can not be compared to one another.

As well as it is tempting to conclude that the variation from the original daily, 1°x1° values from the temporal grouping and even from the coarser spatial resolution data sets is less than the mean provided by the climatological data, this assessment can not be final due to the following concerns:

- The climatological data is supposed to be a monthly mean of OH concentration values in 8°x10° spatial resolution, although it doesn't take into account nighttime OH concentrations which it has been proven it can have a significant effect when calculating lifetime values.
- The climatological data is supposed to be used for several years and the comparison made for this project takes into account one year only.
- The climatological data used for this comparison is already interpolated to fit some requirements for the TM5 model.
- The OH mixing ratios values used as the "true" values do not come from observations rather from the TM5-MP model, which has been thoroughly correlated with observations and improved to better predict chemical concentrations but every model has their uncertainties.

Therefore, no conclusion can be made as to whether these data sets are more accurate than the climatological data but these results together with the lifetime calculations done on the first subsection of the Results chapter (see **Appendix Tables A0.2 and A0.3**), show that they may be.

These data sets also open the possibility of accurately studying certain temporal groups, possibility that the climatological data did not provide, as it can be seen by the differential percentage increase when compared with the sunrise, sunset temporal groups. On **Table 4.4**, it is also worth noticing that the nighttime differential percentage with the climatological data is almost 200%, which is the highest possible value, suggesting that nighttime OH is never accurately portrayed when using the climatological data.

It is also interesting to note the different effect that coarsening the temporal and spatial resolution have on the average variation of these data sets. It appears that the coarsening of temporal and spatial resolution affects differently depending on the temporal group, but also that the increase in variation between the monthly and seasonal data sets in the 1°x1° data sets are the same as the increase in variation from the monthly 1°x1° to the monthly 8°x10°, both of these changes have an average increase of 19%. The same occurs with the increase of variation between the monthly and seasonal 8°x10° data sets and the increase of variation between the monthly 1°x1° and the monthly 8°x10°, both sharing an average increase of 14%. This suggests that the same temporal coarsening method affects data sets differently depending on their spatial resolution.

Taking a closer look the tables per latitudinal band and the differential percentage with respect to the seasonal mean, the biggest values are always encountered on the last and first latitudinal bands, where for each month the biggest variation values are either at the beginning or at the end of the globe, therefore, the differential percentage gets smaller when averaged annually for these latitudinal bands, but whether these are acceptable variations that assessment depends on the project that they are going to be used for.

5.3 Improvements & further research

The selection of the differential percentage for assessing the difference between the mean OH values and the daily values is a challenging one, since percentage differences bigger than 100% are not easily understood and there are better statistical tools to express what the differential percentage was trying to convey. However, the differential percentage tool does analyzes correctly what it was supposed to analyze and it provides values of interest to the scientist that may want to use the produced data sets.

The further analyses are the comparison of the monthly daytime and nighttime means with the two methods experimented on these project, one being the temporal grouping of just daytime and nighttime and the other one being the temporal groups of sunrise, daytime, sunset and nighttime. The differential percentage of the first temporal grouping method should be done with the daily OH mixing ratio values as obtained from the TM5-MP model run so that these percentages can be compared with the second method of temporal grouping.

In order to achieve a general conclusion as to whether these data sets are more accurate than the climatological data, more years have to be added to the analysis and the other pressure levels OH mixing ratio values have to be added, since, right now, only surface pressure OH mixing ratio values were used for this evaluation. Also a study on the impact of using the more accurate data sets and the climatological data should be made, this could be done through lifetime calculations, but then OH data sets that can be directly compared to the climatological data should be used.

Overall, the methods used on this project in order to assess coarser temporal and spatial resolution on OH data sets were the correct ones, with a room for improvement with regards to the statistical tools. Regarding the correction factors that were part of the objective of this project, that became complicated since the original climatological data could not be accessed and also because another method of temporal resolution was crafted throughout the project so the idea of correction factors became more like different sets of OH mixing ratio values with several temporal and spatial resolutions, that when used together they could resemble the original monthly mean 8°x10°. In this respect, I do consider the objective met but it also opened the possibility of further analyses.

6 Summary & Conclusions

This thesis project had a twofold objective, on one side it aimed to assess the impact that coarsening temporal and spatial resolution have on the accuracy level of OH mixing ratio data sets and on the other it aimed to obtain a set of correction factors to be used together with the climatological monthly mean in order to improve this accuracy.

The first objective was successfully obtained in the way that the impact of coarsening temporal and spatial resolution was analyzed with respect to lifetime calculations and it was also analyze through the creation of OH data sets based on OH mixing ratio daily 1°x1° values that went through to different coarsening temporal and spatial resolution by subjecting them to a statistical analysis that shows their deviation from the source, "true", values. However, here is where the stastistical tools can be improved and further research is suggested that would bring a clearer understanding between two temporal coarsening methods.

The second objective was also successfully obtained but the end result did not have the shape that was conceived at the beginning of the project. The original idea was to create the set of correction factors to be used together with the climatological data but since the not interpolated climatological could not be accessed and because the temporal grouping method designed in order to obtain OH data sets is not compatible to the temporal grouping used on the climatological data. It was concluded that these data sets could be more useful divided as they are since they open the possibility of accurately describe a range of hours that would not be possible if the temporal average that the climatological data used. Therefore, the correction factors aimed at the beginning of the project turned into a group of OH mixing ratio data sets with different temporal and spatial resolutions and therefore different accuracy.

Both the accuracy studies and the data sets are provided in a repository accessible through the author of this project. The level of accuracy that is deemed good has to be defined in the scope of the study that will use these data sets. That is another reason why all the data sets are provided and not a single one, since the assessment of which combination of temporal and spatial resolution provides a "good" accuracy level can not be determined in a vacuum, since it was showed on this project that the impact of the variation on accuracy is nonlinear.

To finalize, more years have to be compared to the data sets created for this project to test the volatility of the accuracy levels and to test how much more accurate they are than the climatological data or to conclude if this is even the case. Further pressure levels have to be added to the data sets. Some of these remaining issues were beyond the scope of this project and some other were not completed because of a series of unforeseeable events that constrained the time available for the project.

A transcript of the code used for the resampling and regrouping together with the OH fields and the full set of differential percentage tables are provided on the following repository: https://seafile.zfn.uni-bremen.de/library/58cb5edf-49d7-4cec-a0bb-18b780ebe81f/OH/.

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Appendix

Table A0.1: Gas-phase chemical mechanism applied in the tropospheric chemistry version of TM5. Obtained from Table A1 on Williams, Van Velthoven, and Brenninkmeijer 2013

Reactants	**Products**	**Rate expression**
$NO + O_3$	NO_2	3.0E-12*exp(-1500/T)
$NO + HO_2$	$NO_2 + OH$	3.5E-12*exp(250/T)
$NO + CH_3O_2$	$HCHO + HO_2 + NO_2$	2.8E-12*exp(300/T)
$NO_2 + OH$ (+ M)	HNO_3	K_0 = 1.8E-30*$(300/T)^3$
		K_∞ = 2.8E-11
$OH + HNO_3$	NO_3	K_0 = 2.41E-14*exp(460/T)
		K_2 = 2.29E-17*(2199/T)
		K_3 = 6.51E-14*(1335/T)
$NO_2 + O_3$	NO_3	1.2E-13*exp(-2540/T)
$NO + NO_3$	$NO_2 + NO_2$	1.5E-11*exp(170/T)
$NO_2 + NO_3$	N_2O_5	K_0 = 2.0E-30*exp$(300/T)^{4.4}$
		K_∞ = 1.4E-12*$(300/T)^{0.7}$
HNO_4(+M)	$NO_2 + HO_2$	2.7E-27*exp(10900/T)
$OH + HNO_4$	NO_2	1.3E-12*exp(380/T)
$NO_3 + HO_2$	HNO_3	4.0E-12
$O(^1D)$)(+M)		3.3E-11*exp(55/T)*[O_2]+
		2.5E-11*exp(110/T)*[N_2]
$O(^1D) + H_{20}$	$OH + OH$	1.63E-10*exp(60/T)
$O_3 + HO_2$	OH	1.0E-14*exp(-490/T)
$CO + OH$	HO_2	K_0 = 5.9E-33*$(300/T)^{1.4}$
		K_∞ = 1.1E-12*$(300/T)^{-1.3}$
		K_0 = 1.5E-13*$(300/T)^{-0.6}$
		K_∞ = 2.9E9*$(300/T)^{-6.1}$
$O_3 + OH$	HO_2	1.7E-12*exp(-940/T)

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Table A0.1 – *Continued from previous page*

Reactants	**Products**	**Rate expression**
$OH + H_2O_2$	HO_2	1.8E-12
$OH + HCHO$	$CO + HO_2$	5.5E-12*exp(125/T)
$OH + CH_4$	CH_3O_2	2.45E-12*exp(-1755/T)
$OH + CH_3OOH$	$0.7CH_3O_2 + 0.3HCHO + 0.3OH$	3.8E-12*exp(200/T)
$OH + CH_3OH$	$HCHO + HO_2$	2.85E-12*exp(-345/T)
OH + HCOOH	HO_2	4.0E-13
OH + ROOH	$0.77XO_2 + 0.04ALD2 + 0.19$ $CH_3COCHO + 0.230H +$ $RXPAR + CH_3OOH$	2.0E-11
$CH_3O_2 + HO_2$	CH_3OOH	4.1E-13*exp(750/T)
$CH_3O_2 + CH_3O_2$	$0.66HCHO + 0.32HO_2 +$ $0.34CH_3OH$	9.5E-14*exp(390/T)
$NO_3 + CH_3O_2$	$NO_2 + HO_2 + HCHO$	1.2E-12
$OH + HO_2$		4.8E-11*exp(250/T)
$HO_2 + HO_2$	H_2O_2	3.5E-13*exp(430/T)
		1.77E-33*exp(1000/T)
		1.4E-21*exp(2200/T)
$OH + H_2$	HO_2	2.8E-12*exp(-1800/T)
$NO_3 + HCHO$	$HNO_3 + CO + HO_2$	5.8E-16
ALD2 + OH	C_2O_3	Average of:
		4.4E-12*exp(365/T)
		5.1E-12*exp(405/T)
$ALD2 + NO_3$	$HNO_3 + C_2O_3$	Average of:
		1.4E-12*exp(-1860/T)
		6.4E-15
$NO + O_3$	NO_2	3.0E-12*exp(-1500/T)
$NO + C_2O_3$	$NO_2 + CH_3O_2$	8.1E-12*exp(270/T)
$NO_2 + C_2O_3$	PAN	K_0 = 2.7E-28*$(300/T)^{7.1}$

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Table A0.1 – *Continued from previous page*

Reactants	Products	Rate expression
		K_∞ = 1.2E-11*(300/T)$^{-0.9}$
PAN	NO_2 + C_2O_3	K_0 = 4.9E-3*(-12100/T)
		K_∞ = 5.4E16*(-13830/T)
NO_3 + C_2O_3	NO_2 + CH_3O_2	4.0E-12
C_2O_3 + C_2O_3	CH_3O_2 + CH_3O_2	2.9E-12*(500/T)
C_2O_3 + HO_2	0.4CH_3COOH + 0.4O_3	4.3E-13*(1040/T)
OH + PAR	0.87XO_2 + 0.11HO_2 + 0.11ALD2 + 0.76ROR + 0.11RXPAR + 0.13XO_2N	8.1E-13
ROR	1.1ALD2 + 0.96XO_2 + 0.04XO_2N + 0.02ROR + 2.1RXPAR + 0.94HO_2	1.0E15*exp(-8000/T)
ROR	HO_2	1600.0
OH + C_2H_4(+M)	HO_2 + 1.56HCHO + 0.22ALD2 + XO_2	K_0 = 1.0E-28*(300/T)$^{4.5}$ K_∞ = 8.8E-16*(-300/T)$^{0.85}$
O_3 + C_2H_4	HCHO + 0.22HO_2 + 0.12OH + 0.24CO + 0.52HCOOH	1.2E-14*exp(-2630/T)
OH + OLE	0.8HCHO + 0.95ALD2 + 0.8XO_2 + 1.57HO_2 + 0.7RXPAR + 0.62CO	5.2E-14*exp(-610/T)
O_3 + OLE	0.5ALD2 + 0.76HO_2 + 0.1OH + 0.95CO + 0.74HCHO + 0.22XO_2 + RXPAR	8.5E-16*exp(1520/T)
NO_3 + OLE	0.91HO_2 + NO_2 + HCHO + 0.91ALD2 + 0.09XO_2N + RXPAR + 0.56HO_2 + 0.56CO	4.6E-14*exp(400/T)
OH + C_2H_6	0.991ALD2 + 0.991XO_2 + 0.009XO_2N + HO_2	6.9E-12*exp(-1000/T)
OH + C_2H_5OH	ALD2 + HO_2 + 0.1XO_2 + 0.1HCHO	3.0E-12*exp(20/T)

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Table A0.1 – *Continued from previous page*

Reactants	Products	Rate expression
OH + CH_3COOH	CH_3O_2	4.2E-14*exp(-855/T)
OH + C_3H_8	XO_2	7.6E-12*exp(-585/T)
OH + C_3H_6	XO_2	K_0 = 8.0E-27*$(300/T)^{3.5}$ K_∞ = 3.0E-11
O_3 + C_3H_6	0.54HCHO + 0.19HO_2 + 0.33OH + 0.56CO + 0.5ALD2 + 0.31CH_3O_2 + 0.25HCOOH	5.5E-15*exp(-1880/T)
NO_3 + C_3H_6	ORGNTR	4.6E-13*exp(-1155/T)
OH + ORGNTR	HNO_3 + 0.51XO_2 + 0.3ALD2 + 0.9HO_2 + 0.74C_2O_3 + 0.74CH_3O_2 + 1.98RXPAR	5.9E-13*exp(-360/T)
OH + TERPENE	1.22HO_2 + 1.25XO_2 + 0.25XO_2N + 1.22HCHO + 5.0PAR + 0.47ALD2 + 0.47CO	1.2E-11*exp(440/T)
O_3 + TERPENE	0.57OH + 0.28XO_2 + 0.76XO_2 + 0.18XO_2N + 0.18XO_2N + 1.8HCHO + 0.211CO + 6.0PAR + 0.21ALD2 + 0.39C_2O_3 + 0.39CH_3O_2	6.3E-16*exp(-580/T)
NO_3 + TERPENE	0.47NO_2 + 0.75HO_2 + 1.03XO_2 + 0.25XO_2N + 0.47ALD2 + 0.53ORGNTR + 0.47CO + 6.0PAR	1.2E-12*exp(490/T)
OH + ISOPRENE	0.912ISPD + 0.5HO_2 + 0.629HCHO + 0.991XO_2 + 0.088XO_2N	2.7E-11*exp(390/T)
O_3 + ISOPRENE	0.65ISPD + 0.6HCHO + 0.2XO_2 + 0.066HO_2 + 0.266OH + 0.2C_2O_3 + 0.15ALD2 + 0.35PAR + 0.66CO	1.04E-14*exp(-1995/T)
NO_3 + ISOPRENE	0.2ISPD + XO_2 + 0.8HO_2 + 0.8ORGNTR + 0.8ALD2 + 2.4PAR +	3.15E-12*exp(-450/T)

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Table A0.1 – *Continued from previous page*

Reactants	Products	Rate expression
	$0.2NO_2$	
OH + ISPD	$0.167HCHO + 0.503HO_2 + 0.168CH_3COCHO + 0.334CO + 0.273ALD2 + 0.498C_2O_3 + 0.713XO_2 + 1.565PAR$	Average of: 1.86E-11*exp(175/T) 2.6E-12*exp(610/T)
O_3 + ISPD	$0.15HCHO + 0.114C_2O_3 + 0.85CH_3COCHO + 0.154HO_2 + 0.268OH + 0.064XO_2 + 0.225CO + 0.02ALD2 + 0.36PAR$	Average of: 8.5E-16*exp(-1520/T) 1.4E-15*exp(-2100/T)
NO_3 + ISPD	$0.85ORGNTR + 0.357ALD2 + 0.282HCHO + 0.643CO + 0.075C_2O_3 + 0.15HNO_3 + 0.075XO_2 + 0.925HO_2 + 1.282PAR$	Average of: 6.0E-16 3.4E-15
$OH + CH_3COCH_3$	ACO_2	Sum of: 8.8E-12*exp(-1320/T) 1.7E-14*exp(423/T)
$ACO_2 + HO_2$	ROOH	1.0E-11
$ACO_2 + CH_3O_2$	$0.5CH_3OH + 0.5HO_2 + 0.7ALD2 + 0.2C_2O_3 + 0.5CH_3COCHO$	3.8E-12
ACO_2 + NO	$NO_2 + C_2O_3 + HCHO + HO_2$	8.0E-12
$HO_2 + XO_2$	ROOH	7.5E-13*exp(700/T)
$NO + XO_2$	NO_2	2.6E-12*exp(365/T)
$NO_3 + XO_2$	NO_2	2.5E-12
$NO + XO_2N$	ORGNTR	2.6E-12*exp(365/T)
$HO_2 + XO_2N$	ROOH	8.0E-12*exp(-2060/T)
$XO_2 + XO_2$		1.6E-12*exp(-2200/T)
$XO_2 + XO_2N$		6.8E-14

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Table A0.1 – *Continued from previous page*

Reactants	**Products**	**Rate expression**
$XO_2N + XO_2N$		6.8E-14
PAR + RXPAR		8.0E-11
DMS + OH	SO_2	1.1E-11*exp(-240/T)
DMS + OH	$0.75SO_2$ + MSA	1.0E-39*exp(5820/T)
		5.0E-30*exp(6280/T)
DMS + NO_3	SO_2	1.9E-13*exp(520/T)
OH + SO_2	SO_4^{-2}	K_0 = 3.3E-31*$(300/T)^{4.3}$
		K_∞ = 1.6E-12*(300/T)
OH + NH_3	NH_2	1.7E-12*exp(-710/T)
NO + NH_2		4.0E-12*exp(450/T)
$NO_2 + NH_2$		2.1E-12*exp(650/T)
$HO_2 + NH_2$		3.4E-11
$O_2 + NH_2$		6.0E-21
$O_3 + NH_2$		4.3E-12*exp(-930/T)

Table A0.2: Calculation of isprone's lifetime based on January mean OH concentration obtained from a 1°x1° model run

Temperature (K)	**Isoprene** (molec/cm^3)	**OH** (molec/cm^3)	**Rate of reaction** (cm^{3}molec^{-1}s^{-1})	**Isoprene lifetime** (hr)
273.0	7.846718e+09	894380.227	800352.123	2.723
278.0	7.705590e+09	878294.252	751252.482	2.849
283.0	7.569449e+09	862776.685	706295.234	2.976
288.0	7.438035e+09	847797.923	665044.545	3.106
293.0	7.311106e+09	833330.382	627118.840	3.238
298.0	7.188437e+09	819348.329	592183.069	3.371
303.0	7.069815e+09	805827.729	559942.206	3.507
308.0	6.955046e+09	792746.110	530135.767	3.644
313.0	6.843943e+09	780082.434	502533.169	3.783

Table A0.3: Calculation of isprone's lifetime based on January mean OH concentration obtained from 1°x1° climatological data

Temperature (K)	**Isoprene** (molec/cm^3)	**OH** (molec/cm^3)	**Rate of reaction** (cm^{3}molec^{-1}s^{-1})	**Isoprene lifetime** (hr)
273.0	7.846718e+09	538355.985	481757.470	4.524
278.0	7.705590e+09	538355.985	460484.934	4.648
283.0	7.569449e+09	538355.985	440714.582	4.770
288.0	7.438035e+09	538355.985	422306.662	4.892
293.0	7.311106e+09	538355.985	405137.252	5.012
298.0	7.188437e+09	538355.985	389096.174	5.131
303.0	7.069815e+09	538355.985	374085.214	5.249
308.0	6.955046e+09	538355.985	360016.605	5.366
313.0	6.843943e+09	538355.985	346811.731	5.481

Table A0.4: July's OH mean mixing ratio per local time in daytime and its percentage difference with the hourly output. Mean calculated from the 1°x1° data set.

Local time	**Percentage difference** (%)	**Mean OH** (ppt)
2009-07 00:00:00	47.66	0.00872
2009-07 01:00:00	47.31	0.00854
2009-07 02:00:00	46.67	0.00846
2009-07 03:00:00	45.30	0.00858
2009-07 04:00:00	41.64	0.00922
2009-07 05:00:00	35.82	0.01098
2009-07 06:00:00	30.79	0.01750
2009-07 07:00:00	31.59	0.03518
2009-07 08:00:00	30.41	0.06887
2009-07 09:00:00	28.95	0.10936
2009-07 10:00:00	27.26	0.14460
2009-07 11:00:00	26.16	0.16717
2009-07 12:00:00	25.55	0.17329
2009-07 13:00:00	25.82	0.16296
2009-07 14:00:00	26.42	0.13789
2009-07 15:00:00	27.43	0.10358
2009-07 16:00:00	29.16	0.06755
2009-07 17:00:00	28.33	0.03950
2009-07 18:00:00	28.04	0.02317
2009-07 19:00:00	36.69	0.01476
2009-07 20:00:00	40.51	0.01185
2009-07 21:00:00	42.89	0.01050
2009-07 22:00:00	44.49	0.00966
2009-07 23:00:00	46.27	0.00910

Table A0.5: July's OH mean mixing ratio per local time in daytime and its percentage difference with the hourly output. Mean calculated from the 6°x4° data set.

Local time	**Percentage difference** (%)	**Mean OH** (ppt)
2009-07 00:00:00	80.77	0.00654
2009-07 01:00:00	85.47	0.00679
2009-07 02:00:00	83.10	0.00704
2009-07 03:00:00	84.36	0.00787
2009-07 04:00:00	85.11	0.00933
2009-07 05:00:00	84.99	0.01250
2009-07 06:00:00	83.53	0.02197
2009-07 07:00:00	69.82	0.04163
2009-07 08:00:00	59.04	0.07578
2009-07 09:00:00	52.86	0.11609
2009-07 10:00:00	49.20	0.14918
2009-07 11:00:00	47.65	0.16874
2009-07 12:00:00	46.67	0.17036
2009-07 13:00:00	47.88	0.15852
2009-07 14:00:00	49.56	0.13256
2009-07 15:00:00	53.24	0.09604
2009-07 16:00:00	59.61	0.05927
2009-07 17:00:00	67.98	0.03132
2009-07 18:00:00	76.46	0.01731
2009-07 19:00:00	76.81	0.01178
2009-07 20:00:00	74.03	0.00919
2009-07 21:00:00	72.85	0.00785
2009-07 22:00:00	70.89	0.00708
2009-07 23:00:00	80.04	0.00689

Table A0.6: July's OH mean mixing ratio per local time in nighttime and its percentage difference with the hourly output. Mean calculated from the 1°x1° data set.

Local time	**Percentage difference** (%)	**Mean OH** (ppt)
2009-07 00:00:00	24.66	0.00073
2009-07 01:00:00	25.45	0.00066
2009-07 02:00:00	26.26	0.00063
2009-07 03:00:00	27.62	0.00065
2009-07 04:00:00	29.74	0.00066
2009-07 05:00:00	29.69	0.00058
2009-07 06:00:00	31.01	0.00034
2009-07 07:00:00	41.18	0.00009
2009-07 08:00:00	49.49	0.00002
2009-07 09:00:00	53.35	0.00002
2009-07 10:00:00	56.20	0.00002
2009-07 11:00:00	60.25	0.00002
2009-07 12:00:00	62.76	0.00003
2009-07 13:00:00	61.65	0.00004
2009-07 14:00:00	60.05	0.00006
2009-07 15:00:00	57.04	0.00009
2009-07 16:00:00	50.92	0.00031
2009-07 17:00:00	38.78	0.00148
2009-07 18:00:00	25.56	0.00179
2009-07 19:00:00	25.56	0.00161
2009-07 20:00:00	24.64	0.00131
2009-07 21:00:00	24.27	0.00115
2009-07 22:00:00	24.12	0.00100
2009-07 23:00:00	24.35	0.00085

Table A0.7: July's OH mean mixing ratio per local time in nighttime and its percentage difference with the hourly output. Mean calculated from the 6°x4° data set.

Local time	**Percentage difference** (%)	**Mean OH** (ppt)
2009-07 00:00:00	52.75	0.00084
2009-07 01:00:00	53.61	0.00075
2009-07 02:00:00	55.35	0.00072
2009-07 03:00:00	58.79	0.00075
2009-07 04:00:00	66.35	0.00088
2009-07 05:00:00	77.65	0.00117
2009-07 06:00:00	89.30	0.00127
2009-07 07:00:00	99.29	0.00076
2009-07 08:00:00	108.17	0.00010
2009-07 09:00:00	111.44	0.00005
2009-07 10:00:00	112.52	0.00004
2009-07 11:00:00	115.03	0.00004
2009-07 12:00:00	116.50	0.00004
2009-07 13:00:00	112.30	0.00004
2009-07 14:00:00	105.16	0.00003
2009-07 15:00:00	100.49	0.00004
2009-07 16:00:00	93.68	0.00007
2009-07 17:00:00	83.32	0.00035
2009-07 18:00:00	73.60	0.00071
2009-07 19:00:00	62.44	0.00114
2009-07 20:00:00	56.05	0.00135
2009-07 21:00:00	54.30	0.00127
2009-07 22:00:00	53.51	0.00112
2009-07 23:00:00	53.41	0.00097

Table A0.8: December 2008 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	17.40	0.0034499	0.0197432	24.83	0.0048126
-83.5	-76.5	48.53	0.0100222	0.0215863	58.83	0.0112941
-75.5	-68.5	85.01	0.0204840	0.0272840	89.20	0.0214110
-67.5	-60.5	95.62	0.0198481	0.0247384	101.62	0.0203425
-59.5	-52.5	84.78	0.0179295	0.0245521	90.38	0.0180426
-51.5	-44.5	75.34	0.0314173	0.0487312	91.51	0.0358709
-43.5	-36.5	77.19	0.0540190	0.0814018	99.50	0.0630699
-35.5	-28.5	58.02	0.0707622	0.1348166	102.95	0.1072977
-27.5	-20.5	58.28	0.0800359	0.1499757	102.56	0.1209217
-19.5	-12.5	64.18	0.0895326	0.1576586	107.56	0.1295044
-11.5	-4.5	48.25	0.0765529	0.1748709	112.94	0.1455021
-3.5	3.5	52.01	0.0745937	0.1601743	112.55	0.1347285
4.5	11.5	56.32	0.0831275	0.1646322	112.05	0.1376753
12.5	19.5	60.52	0.0838855	0.1597788	115.24	0.1338155
20.5	27.5	62.12	0.0692712	0.1317794	126.70	0.1137026
28.5	35.5	56.24	0.0483594	0.0981178	135.16	0.0871256
36.5	43.5	64.03	0.0227128	0.0395204	128.77	0.0351136
44.5	51.5	68.57	0.0082939	0.0133924	120.66	0.0116641
52.5	59.5	49.26	0.0018079	0.0038382	106.66	0.0030592
60.5	67.5	39.76	0.0003523	0.0010498	115.48	0.0008642
68.5	75.5	nan	nan	nan	nan	nan
76.5	83.5	nan	nan	nan	nan	nan
84.5	89.5	nan	nan	nan	nan	nan

Table A0.9: January 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	29.60	0.0049151	0.0171155	35.44	0.0060317
-83.5	-76.5	55.11	0.0095052	0.0183214	64.34	0.0105734
-75.5	-68.5	91.88	0.0164682	0.0206687	95.54	0.0174919
-67.5	-60.5	100.64	0.0134875	0.0159145	104.59	0.0138277
-59.5	-52.5	88.13	0.0162510	0.0215377	94.32	0.0162440
-51.5	-44.5	78.22	0.0285981	0.0428012	93.05	0.0318198
-43.5	-36.5	70.10	0.0515391	0.0843462	95.26	0.0640178
-35.5	-28.5	60.37	0.0709641	0.1312111	100.87	0.1025267
-27.5	-20.5	60.93	0.0799746	0.1442903	103.69	0.1162419
-19.5	-12.5	65.92	0.0878365	0.1509279	109.21	0.1249980
-11.5	-4.5	59.15	0.0812460	0.1541735	109.40	0.1292241
-3.5	3.5	53.67	0.0749623	0.1553450	116.27	0.1328556
4.5	11.5	56.86	0.0852219	0.1682487	117.12	0.1430383
12.5	19.5	61.69	0.0826200	0.1559103	115.85	0.1304508
20.5	27.5	55.31	0.0639923	0.1315690	121.14	0.1109904
28.5	35.5	63.40	0.0503818	0.0909206	127.54	0.0800039
36.5	43.5	64.27	0.0244342	0.0424850	128.81	0.0377195
44.5	51.5	69.76	0.0094087	0.0148406	119.48	0.0128872
52.5	59.5	60.31	0.0024397	0.0041430	98.43	0.0032701
60.5	67.5	47.13	0.0005459	0.0011611	91.06	0.0008570
68.5	75.5	58.84	0.0001150	0.0002304	104.69	0.0001875
76.5	83.5	nan	nan	nan	nan	nan
84.5	89.5	nan	nan	nan	nan	nan

Table A0.10: February 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	38.97	0.0016815	0.0044749	62.19	0.0034615
-83.5	-76.5	74.44	0.0042461	0.0060505	81.15	0.0048760
-75.5	-68.5	108.27	0.0088898	0.0095301	112.10	0.0099736
-67.5	-60.5	89.55	0.0093652	0.0122408	96.40	0.0095298
-59.5	-52.5	83.12	0.0141592	0.0198613	93.53	0.0146894
-51.5	-44.5	77.20	0.0281389	0.0425185	95.36	0.0320736
-43.5	-36.5	68.42	0.0504592	0.0849699	99.63	0.0650864
-35.5	-28.5	65.05	0.0709688	0.1228100	105.24	0.0986684
-27.5	-20.5	53.09	0.0754154	0.1519598	102.61	0.1220378
-19.5	-12.5	56.83	0.0843902	0.1636575	107.34	0.1347816
-11.5	-4.5	60.66	0.0842215	0.1563590	110.91	0.1323637
-3.5	3.5	53.18	0.0815696	0.1702693	119.80	0.1479868
4.5	11.5	54.97	0.0965920	0.1979484	119.37	0.1696452
12.5	19.5	59.18	0.0960888	0.1903347	115.51	0.1575291
20.5	27.5	63.84	0.0831275	0.1518748	120.51	0.1280300
28.5	35.5	71.54	0.0640549	0.1065086	126.98	0.0928625
36.5	43.5	64.81	0.0349364	0.0603292	122.69	0.0521023
44.5	51.5	68.64	0.0159252	0.0256010	114.59	0.0216959
52.5	59.5	70.81	0.0053738	0.0083413	97.96	0.0066092
60.5	67.5	74.83	0.0020688	0.0030499	90.59	0.0023500
68.5	75.5	67.92	0.0004285	0.0006616	77.13	0.0004738
76.5	83.5	89.56	0.0000708	0.0000915	94.10	0.0000725
84.5	89.5	nan	nan	nan	nan	nan

Table A0.11: March 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	82.85	0.0005391	0.0006964	86.65	0.0005970
-83.5	-76.5	97.38	0.0012354	0.0013805	98.38	0.0012111
-75.5	-68.5	83.33	0.0036078	0.0048154	93.25	0.0040374
-67.5	-60.5	85.90	0.0054051	0.0071751	95.04	0.0055102
-59.5	-52.5	81.32	0.0100971	0.0142677	94.73	0.0107039
-51.5	-44.5	81.56	0.0220905	0.0317021	99.46	0.0245262
-43.5	-36.5	67.52	0.0417374	0.0707003	95.87	0.0534046
-35.5	-28.5	62.24	0.0632109	0.1131482	101.13	0.0887717
-27.5	-20.5	59.18	0.0750920	0.1386519	99.91	0.1101604
-19.5	-12.5	50.29	0.0784554	0.1706631	111.61	0.1409024
-11.5	-4.5	52.15	0.0778985	0.1666188	116.14	0.1424044
-3.5	3.5	51.54	0.0831172	0.1784045	121.48	0.1560152
4.5	11.5	51.42	0.1008281	0.2177151	120.02	0.1881137
12.5	19.5	54.66	0.1045598	0.2210748	112.59	0.1806659
20.5	27.5	57.58	0.0926192	0.1859844	114.26	0.1521437
28.5	35.5	63.46	0.0821005	0.1511524	120.26	0.1279004
36.5	43.5	69.77	0.0589436	0.0969222	120.02	0.0827211
44.5	51.5	71.63	0.0344422	0.0536851	115.39	0.0451632
52.5	59.5	76.70	0.0161228	0.0227398	99.97	0.0182646
60.5	67.5	87.67	0.0080011	0.0103050	99.81	0.0083648
68.5	75.5	89.34	0.0027540	0.0033764	93.16	0.0027903
76.5	83.5	89.92	0.0005051	0.0005964	88.73	0.0004701
84.5	89.5	109.14	0.0000963	0.0001028	110.04	0.0001255

Table A0.12: April 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	134.05	0.0000344	0.0000273	142.63	0.0000317
-83.5	-76.5	96.85	0.0001463	0.0001851	99.41	0.0001418
-75.5	-68.5	75.52	0.0006815	0.0009182	77.58	0.0006799
-67.5	-60.5	82.57	0.0018273	0.0024597	90.75	0.0018512
-59.5	-52.5	79.17	0.0046496	0.0066716	91.92	0.0049452
-51.5	-44.5	76.60	0.0134587	0.0201227	96.07	0.0153864
-43.5	-36.5	70.27	0.0309129	0.0505740	99.23	0.0387868
-35.5	-28.5	62.35	0.0499676	0.0900180	101.83	0.0705684
-27.5	-20.5	55.80	0.0627201	0.1221621	101.98	0.0968610
-19.5	-12.5	53.04	0.0731015	0.1497239	109.35	0.1230087
-11.5	-4.5	52.87	0.0737108	0.1543234	112.83	0.1306961
-3.5	3.5	51.31	0.0784479	0.1692401	116.10	0.1449701
4.5	11.5	48.83	0.0983286	0.2203379	114.82	0.1848375
12.5	19.5	47.62	0.1045583	0.2443963	106.99	0.1940921
20.5	27.5	68.75	0.1120136	0.1904403	107.00	0.1533046
28.5	35.5	70.84	0.1070227	0.1776013	112.56	0.1470438
36.5	43.5	75.80	0.0846870	0.1298570	112.41	0.1075659
44.5	51.5	72.34	0.0550971	0.0867002	108.22	0.0695741
52.5	59.5	82.16	0.0332700	0.0461216	102.77	0.0367838
60.5	67.5	85.65	0.0239392	0.0319159	100.95	0.0253066
68.5	75.5	94.14	0.0106002	0.0124645	98.57	0.0103369
76.5	83.5	91.59	0.0026800	0.0030950	91.03	0.0024594
84.5	89.5	69.06	0.0010483	0.0016411	69.00	0.0010259

Table A0.13: May 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	nan	nan	nan	nan	nan
-75.5	-68.5	87.51	0.0001161	0.0001800	90.11	0.0001215
-67.5	-60.5	55.64	0.0003925	0.0007239	68.77	0.0004520
-59.5	-52.5	72.12	0.0017505	0.0027189	85.87	0.0019839
-51.5	-44.5	66.34	0.0067151	0.0112664	96.60	0.0086837
-43.5	-36.5	59.98	0.0192909	0.0357740	102.76	0.0280006
-35.5	-28.5	64.55	0.0378911	0.0678342	110.84	0.0549154
-27.5	-20.5	62.51	0.0534587	0.0963045	102.42	0.0762725
-19.5	-12.5	56.62	0.0668277	0.1302872	107.79	0.1057447
-11.5	-4.5	53.75	0.0714226	0.1462025	110.51	0.1219995
-3.5	3.5	50.94	0.0729291	0.1579744	111.49	0.1325854
4.5	11.5	48.02	0.0916557	0.2078213	113.57	0.1740954
12.5	19.5	65.93	0.1225519	0.2158917	109.54	0.1769032
20.5	27.5	63.49	0.1207984	0.2207684	108.87	0.1794186
28.5	35.5	62.55	0.1227414	0.2253247	111.99	0.1860725
36.5	43.5	75.65	0.1082300	0.1681176	114.01	0.1389559
44.5	51.5	76.62	0.0690852	0.1031239	102.62	0.0816579
52.5	59.5	83.68	0.0449856	0.0610670	97.92	0.0478307
60.5	67.5	85.38	0.0390873	0.0524687	95.85	0.0404335
68.5	75.5	98.28	0.0248425	0.0284445	101.58	0.0241177
76.5	83.5	67.12	0.0105297	0.0163817	75.88	0.0111815
84.5	89.5	37.71	0.0044896	0.0121245	52.07	0.0057703

Table A0.14: June 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	nan	nan	nan	nan	nan
-75.5	-68.5	nan	nan	nan	nan	nan
-67.5	-60.5	37.54	0.0001179	0.0003356	62.38	0.0001595
-59.5	-52.5	52.28	0.0007693	0.0015455	70.18	0.0010155
-51.5	-44.5	49.77	0.0038878	0.0082507	103.00	0.0064300
-43.5	-36.5	63.63	0.0137366	0.0243532	104.11	0.0192877
-35.5	-28.5	54.37	0.0286743	0.0592635	110.51	0.0474200
-27.5	-20.5	44.83	0.0402344	0.0989021	109.50	0.0775446
-19.5	-12.5	59.44	0.0634949	0.1209892	109.54	0.0977052
-11.5	-4.5	55.35	0.0722043	0.1452367	110.22	0.1191838
-3.5	3.5	51.56	0.0709825	0.1524520	107.35	0.1245107
4.5	11.5	48.27	0.0849156	0.1925703	113.44	0.1612645
12.5	19.5	64.95	0.1199775	0.2131044	110.11	0.1751638
20.5	27.5	60.22	0.1233845	0.2365401	111.20	0.1936197
28.5	35.5	57.36	0.1266293	0.2471272	107.87	0.1998652
36.5	43.5	74.21	0.1180630	0.1826159	104.65	0.1476330
44.5	51.5	69.35	0.0761474	0.1218156	97.33	0.0954673
52.5	59.5	73.82	0.0469402	0.0688944	89.49	0.0522936
60.5	67.5	82.08	0.0364758	0.0485561	90.84	0.0385901
68.5	75.5	86.87	0.0309255	0.0401481	90.51	0.0312000
76.5	83.5	53.26	0.0162131	0.0323515	63.18	0.0185438
84.5	89.5	24.24	0.0067448	0.0283383	36.61	0.0096233

Table A0.15: July 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	nan	nan	nan	nan	nan
-75.5	-68.5	74.04	0.0000559	0.0001050	91.85	0.0000751
-67.5	-60.5	44.59	0.0002462	0.0005479	71.34	0.0003343
-59.5	-52.5	54.74	0.0010599	0.0021010	79.68	0.0014460
-51.5	-44.5	68.60	0.0044652	0.0073206	95.27	0.0055811
-43.5	-36.5	62.43	0.0139589	0.0252420	102.39	0.0197410
-35.5	-28.5	53.30	0.0283575	0.0597949	108.71	0.0474580
-27.5	-20.5	52.80	0.0423709	0.0887216	97.77	0.0670016
-19.5	-12.5	59.14	0.0640142	0.1225578	105.14	0.0960977
-11.5	-4.5	55.60	0.0760538	0.1531024	107.77	0.1223463
-3.5	3.5	52.14	0.0750549	0.1597290	105.20	0.1283367
4.5	11.5	50.16	0.0853557	0.1869241	110.15	0.1550905
12.5	19.5	66.95	0.1205510	0.2091193	112.38	0.1733860
20.5	27.5	62.79	0.1305431	0.2433686	115.74	0.2038460
28.5	35.5	56.93	0.1345612	0.2667894	111.37	0.2183864
36.5	43.5	63.32	0.1161494	0.2044499	100.20	0.1635210
44.5	51.5	68.19	0.0719851	0.1143777	95.35	0.0906723
52.5	59.5	74.71	0.0451975	0.0643334	91.26	0.0503214
60.5	67.5	82.42	0.0326103	0.0423103	99.90	0.0374222
68.5	75.5	93.04	0.0286945	0.0347366	98.27	0.0291256
76.5	83.5	61.94	0.0174302	0.0305576	71.85	0.0198377
84.5	89.5	29.47	0.0072812	0.0252072	42.15	0.0099372

Table A0.16: August 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	113.59	0.0000472	0.0000533	118.06	0.0000529
-75.5	-68.5	81.59	0.0003666	0.0004861	85.97	0.0003923
-67.5	-60.5	78.92	0.0018065	0.0024442	83.87	0.0018019
-59.5	-52.5	65.67	0.0031688	0.0053196	83.63	0.0037377
-51.5	-44.5	79.72	0.0085450	0.0123070	96.96	0.0094786
-43.5	-36.5	75.24	0.0212884	0.0327650	100.07	0.0256231
-35.5	-28.5	68.36	0.0399116	0.0670101	102.26	0.0527324
-27.5	-20.5	60.29	0.0545865	0.1022308	97.59	0.0778788
-19.5	-12.5	56.03	0.0715289	0.1430070	101.90	0.1105981
-11.5	-4.5	54.18	0.0795152	0.1639485	106.70	0.1312602
-3.5	3.5	51.31	0.0785198	0.1685307	106.45	0.1363082
4.5	11.5	51.09	0.0883754	0.1911768	109.52	0.1584429
12.5	19.5	58.19	0.1205129	0.2376985	112.13	0.1959027
20.5	27.5	67.11	0.1377983	0.2418327	118.03	0.2042289
28.5	35.5	61.91	0.1365495	0.2497159	112.78	0.2075867
36.5	43.5	60.96	0.1103541	0.2010925	103.92	0.1628068
44.5	51.5	66.88	0.0641097	0.1030206	93.27	0.0811609
52.5	59.5	68.38	0.0331871	0.0497788	85.85	0.0380382
60.5	67.5	72.77	0.0224591	0.0319391	88.22	0.0258989
68.5	75.5	105.20	0.0166680	0.0175126	111.42	0.0170050
76.5	83.5	81.40	0.0106298	0.0145232	88.41	0.0111256
84.5	89.5	41.03	0.0047377	0.0120208	55.15	0.0061039

Table A0.17: September 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	117.95	0.0003576	0.0003568	121.16	0.0003695
-83.5	-76.5	96.10	0.0008641	0.0009919	99.99	0.0008153
-75.5	-68.5	87.54	0.0035098	0.0043755	91.45	0.0034360
-67.5	-60.5	84.27	0.0068666	0.0092047	96.68	0.0071633
-59.5	-52.5	78.17	0.0080445	0.0117190	88.72	0.0084411
-51.5	-44.5	77.98	0.0160523	0.0239298	95.99	0.0180658
-43.5	-36.5	76.39	0.0310025	0.0476422	99.75	0.0365202
-35.5	-28.5	59.63	0.0487905	0.0917416	97.16	0.0697899
-27.5	-20.5	53.03	0.0605497	0.1258926	95.25	0.0947978
-19.5	-12.5	51.39	0.0763513	0.1626971	102.17	0.1270540
-11.5	-4.5	51.58	0.0831454	0.1766745	108.72	0.1440930
-3.5	3.5	51.39	0.0819931	0.1754162	108.07	0.1434410
4.5	11.5	52.06	0.0879644	0.1866972	109.79	0.1550168
12.5	19.5	51.08	0.1068124	0.2351949	115.18	0.1949357
20.5	27.5	50.69	0.1126188	0.2526814	120.49	0.2116202
28.5	35.5	51.06	0.1063707	0.2336502	117.57	0.1951852
36.5	43.5	74.33	0.0938790	0.1445252	107.15	0.1187528
44.5	51.5	73.57	0.0571500	0.0869779	101.01	0.0694075
52.5	59.5	71.45	0.0287064	0.0433814	94.14	0.0333833
60.5	67.5	69.13	0.0168370	0.0259937	86.70	0.0192081
68.5	75.5	82.56	0.0083973	0.0109700	88.30	0.0083392
76.5	83.5	97.49	0.0030674	0.0034061	98.36	0.0028153
84.5	89.5	76.26	0.0015895	0.0022683	87.38	0.0016534

Table A0.18: October 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	67.15	0.0025423	0.0040896	74.28	0.0026896
-83.5	-76.5	83.51	0.0041571	0.0053582	88.87	0.0040827
-75.5	-68.5	93.00	0.0094214	0.0114464	99.80	0.0097458
-67.5	-60.5	84.37	0.0152255	0.0210165	99.10	0.0166881
-59.5	-52.5	85.76	0.0135726	0.0184314	93.04	0.0137964
-51.5	-44.5	81.48	0.0221300	0.0318499	95.44	0.0237605
-43.5	-36.5	71.82	0.0394338	0.0633282	92.97	0.0468341
-35.5	-28.5	61.00	0.0568135	0.1051241	99.49	0.0810160
-27.5	-20.5	57.96	0.0698993	0.1327011	105.65	0.1077041
-19.5	-12.5	59.32	0.0851522	0.1597308	108.48	0.1309779
-11.5	-4.5	61.93	0.0895989	0.1637357	114.47	0.1390260
-3.5	3.5	50.49	0.0794811	0.1745854	109.30	0.1441725
4.5	11.5	53.10	0.0915462	0.1907075	112.46	0.1605577
12.5	19.5	54.25	0.1062310	0.2214237	115.89	0.1847492
20.5	27.5	56.72	0.1023698	0.2056433	117.09	0.1716848
28.5	35.5	62.61	0.0960491	0.1751333	118.82	0.1490530
36.5	43.5	70.58	0.0690036	0.1110951	118.21	0.0950324
44.5	51.5	71.72	0.0357490	0.0544876	110.73	0.0454905
52.5	59.5	70.50	0.0147266	0.0224830	106.09	0.0183177
60.5	67.5	66.69	0.0070743	0.0115121	105.59	0.0093055
68.5	75.5	74.87	0.0021690	0.0031449	89.07	0.0023835
76.5	83.5	92.82	0.0004491	0.0005865	116.35	0.0005011
84.5	89.5	72.51	0.0000647	0.0000777	200.00	0.0000777

Table A0.19: November 2009 monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	21.54	0.0025412	0.0117280	35.39	0.0037799
-83.5	-76.5	57.14	0.0078282	0.0143260	68.03	0.0085287
-75.5	-68.5	92.94	0.0160792	0.0196104	96.97	0.0163978
-67.5	-60.5	88.09	0.0189527	0.0254924	97.10	0.0197237
-59.5	-52.5	88.16	0.0172785	0.0229567	93.87	0.0173282
-51.5	-44.5	78.60	0.0279944	0.0416148	92.53	0.0305263
-43.5	-36.5	73.47	0.0486688	0.0769055	96.53	0.0581373
-35.5	-28.5	62.58	0.0665905	0.1201798	96.36	0.0921728
-27.5	-20.5	61.35	0.0769949	0.1388844	100.47	0.1104482
-19.5	-12.5	56.40	0.0832283	0.1637698	107.15	0.1321692
-11.5	-4.5	60.64	0.0861840	0.1605598	112.35	0.1345526
-3.5	3.5	51.55	0.0796432	0.1706344	112.41	0.1432109
4.5	11.5	55.34	0.0892883	0.1776001	113.67	0.1511657
12.5	19.5	58.24	0.0957985	0.1879151	113.53	0.1568039
20.5	27.5	56.24	0.0813402	0.1686717	124.95	0.1435779
28.5	35.5	64.82	0.0692324	0.1253210	129.83	0.1101350
36.5	43.5	72.54	0.0393165	0.0614014	126.14	0.0541350
44.5	51.5	63.20	0.0148124	0.0254578	125.36	0.0219263
52.5	59.5	60.91	0.0052590	0.0094148	120.77	0.0080559
60.5	67.5	53.46	0.0014990	0.0030409	103.79	0.0024635
68.5	75.5	73.80	0.0002974	0.0005279	103.73	0.0004306
76.5	83.5	nan	nan	nan	nan	nan
84.5	89.5	nan	nan	nan	nan	nan

Table A0.20: Season (dec/jan/feb) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and December 2008 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	34.39	0.0061700	0.0137779	24.83	0.0048126
-83.5	-76.5	50.42	0.0102751	0.0153194	58.83	0.0112941
-75.5	-68.5	86.91	0.0198955	0.0191609	89.20	0.0214110
-67.5	-60.5	98.43	0.0194059	0.0176312	101.62	0.0203425
-59.5	-52.5	85.72	0.0177808	0.0219837	90.38	0.0180426
-51.5	-44.5	76.11	0.0314154	0.0446836	91.51	0.0358709
-43.5	-36.5	77.21	0.0544012	0.0835726	99.50	0.0630699
-35.5	-28.5	60.05	0.0717727	0.1296125	102.95	0.1072977
-27.5	-20.5	60.85	0.0810539	0.1487419	102.56	0.1209217
-19.5	-12.5	66.19	0.0905630	0.1574147	107.56	0.1295044
-11.5	-4.5	50.49	0.0783952	0.1618011	112.94	0.1455021
-3.5	3.5	52.54	0.0752616	0.1619295	112.55	0.1347285
4.5	11.5	56.32	0.0842130	0.1769431	112.05	0.1376753
12.5	19.5	61.31	0.0852102	0.1686746	115.24	0.1338155
20.5	27.5	62.60	0.0704407	0.1384077	126.70	0.1137026
28.5	35.5	56.98	0.0491206	0.0985157	135.16	0.0871256
36.5	43.5	67.82	0.0251730	0.0474449	128.77	0.0351136
44.5	51.5	73.89	0.0099715	0.0179447	120.66	0.0116641
52.5	59.5	62.14	0.0025138	0.0054409	106.66	0.0030592
60.5	67.5	71.21	0.0008204	0.0017536	115.48	0.0008642
68.5	75.5	200	0.0002974	0.0002974	nan	nan
76.5	83.5	200	0.0000305	0.0000305	nan	nan
84.5	89.5	nan	nan	nan	nan	nan

Table A0.21: Season (dec/jan/feb) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and January 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	33.39	0.0054739	0.0137779	35.44	0.0060317
-83.5	-76.5	54.72	0.0093244	0.0153194	64.34	0.0105734
-75.5	-68.5	92.23	0.0163412	0.0191609	95.54	0.0174919
-67.5	-60.5	101.16	0.0141399	0.0176312	104.59	0.0138277
-59.5	-52.5	88.37	0.0164279	0.0219837	94.32	0.0162440
-51.5	-44.5	78.80	0.0292568	0.0446836	93.05	0.0318198
-43.5	-36.5	70.86	0.0519110	0.0835726	95.26	0.0640178
-35.5	-28.5	61.63	0.0716709	0.1296125	100.87	0.1025267
-27.5	-20.5	62.09	0.0807585	0.1487419	103.69	0.1162419
-19.5	-12.5	67.49	0.0889016	0.1574147	109.21	0.1249980
-11.5	-4.5	59.26	0.0815760	0.1618011	109.40	0.1292241
-3.5	3.5	53.63	0.0752718	0.1619295	116.27	0.1328556
4.5	11.5	56.78	0.0856187	0.1769431	117.12	0.1430383
12.5	19.5	61.57	0.0835408	0.1686746	115.85	0.1304508
20.5	27.5	55.80	0.0650412	0.1384077	121.14	0.1109904
28.5	35.5	64.38	0.0518638	0.0985157	127.54	0.0800039
36.5	43.5	65.89	0.0255920	0.0474449	128.81	0.0377195
44.5	51.5	72.74	0.0103171	0.0179447	119.48	0.0128872
52.5	59.5	68.13	0.0029264	0.0054409	98.43	0.0032701
60.5	67.5	64.20	0.0008488	0.0017536	91.06	0.0008570
68.5	75.5	74.78	0.0001476	0.0002974	104.69	0.0001875
76.5	83.5	200	0.0000305	0.0000305	nan	nan
84.5	89.5	nan	nan	nan	nan	nan

Table A0.22: Season (dec/jan/feb) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and February 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	105.95	0.0093051	0.0137779	62.19	0.0034615
-83.5	-76.5	107.62	0.0101655	0.0153194	81.15	0.0048760
-75.5	-68.5	114.49	0.0133800	0.0191609	112.10	0.0099736
-67.5	-60.5	92.85	0.0113863	0.0176312	96.40	0.0095298
-59.5	-52.5	83.19	0.0145892	0.0219837	93.53	0.0146894
-51.5	-44.5	77.26	0.0285471	0.0446836	95.36	0.0320736
-43.5	-36.5	69.07	0.0507219	0.0835726	99.63	0.0650864
-35.5	-28.5	66.03	0.0717685	0.1296125	105.24	0.0986684
-27.5	-20.5	55.76	0.0764068	0.1487419	102.61	0.1220378
-19.5	-12.5	58.41	0.0854987	0.1574147	107.34	0.1347816
-11.5	-4.5	60.96	0.0847416	0.1618011	110.91	0.1323637
-3.5	3.5	55.48	0.0832594	0.1619295	119.80	0.1479868
4.5	11.5	57.90	0.0996686	0.1769431	119.37	0.1696452
12.5	19.5	61.68	0.0987430	0.1686746	115.51	0.1575291
20.5	27.5	65.36	0.0839511	0.1384077	120.51	0.1280300
28.5	35.5	72.27	0.0641139	0.0985157	126.98	0.0928625
36.5	43.5	66.13	0.0349199	0.0474449	122.69	0.0521023
44.5	51.5	70.89	0.0158927	0.0179447	114.59	0.0216959
52.5	59.5	73.95	0.0053481	0.0054409	97.96	0.0066092
60.5	67.5	77.77	0.0020405	0.0017536	90.59	0.0023500
68.5	75.5	78.52	0.0004437	0.0002974	77.13	0.0004738
76.5	83.5	90.09	0.0000723	0.0000305	94.10	0.0000725
84.5	89.5	nan	nan	nan	nan	nan

Table A0.23: Season (march/april/may) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and March 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	91.02	0.0005340	0.0002412	86.65	0.0005970
-83.5	-76.5	103.78	0.0011467	0.0005219	98.38	0.0012111
-75.5	-68.5	96.28	0.0037171	0.0019712	93.25	0.0040374
-67.5	-60.5	95.38	0.0054513	0.0034529	95.04	0.0055102
-59.5	-52.5	90.25	0.0102832	0.0078861	94.73	0.0107039
-51.5	-44.5	87.48	0.0222183	0.0210304	99.46	0.0245262
-43.5	-36.5	72.77	0.0431779	0.0523494	95.87	0.0534046
-35.5	-28.5	67.89	0.0657001	0.0903335	101.13	0.0887717
-27.5	-20.5	62.47	0.0771894	0.1190395	99.91	0.1101604
-19.5	-12.5	53.24	0.0814113	0.1502247	111.61	0.1409024
-11.5	-4.5	54.08	0.0796065	0.1557149	116.14	0.1424044
-3.5	3.5	52.85	0.0844302	0.1685396	121.48	0.1560152
4.5	11.5	53.09	0.1021855	0.2152915	120.02	0.1881137
12.5	19.5	55.25	0.1058711	0.2271209	112.59	0.1806659
20.5	27.5	57.90	0.0941986	0.1990644	114.26	0.1521437
28.5	35.5	65.40	0.0896542	0.1846928	120.26	0.1279004
36.5	43.5	75.95	0.0703721	0.1316323	120.02	0.0827211
44.5	51.5	81.58	0.0457988	0.0811697	115.39	0.0451632
52.5	59.5	95.54	0.0270116	0.0433095	99.97	0.0182646
60.5	67.5	122.36	0.0223985	0.0315632	99.81	0.0083648
68.5	75.5	141.39	0.0116377	0.0147618	93.16	0.0027903
76.5	83.5	171.71	0.0060975	0.0066910	88.73	0.0004701
84.5	89.5	191.51	0.0045200	0.0046228	110.04	0.0001255

Table A0.24: Season (march/april/may) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and April 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	174.01	0.0002169	0.0002412	142.63	0.0000317
-83.5	-76.5	124.53	0.0003723	0.0005219	99.41	0.0001418
-75.5	-68.5	104.57	0.0013314	0.0019712	77.58	0.0006799
-67.5	-60.5	88.23	0.0021979	0.0034529	90.75	0.0018512
-59.5	-52.5	80.15	0.0049502	0.0078861	91.92	0.0049452
-51.5	-44.5	76.76	0.0136600	0.0210304	96.07	0.0153864
-43.5	-36.5	70.37	0.0312571	0.0523494	99.23	0.0387868
-35.5	-28.5	63.05	0.0504349	0.0903335	101.83	0.0705684
-27.5	-20.5	57.20	0.0632418	0.1190395	101.98	0.0968610
-19.5	-12.5	53.71	0.0735605	0.1502247	109.35	0.1230087
-11.5	-4.5	53.72	0.0742208	0.1557149	112.83	0.1306961
-3.5	3.5	51.76	0.0787405	0.1685396	116.10	0.1449701
4.5	11.5	50.19	0.0992473	0.2152915	114.82	0.1848375
12.5	19.5	49.22	0.1070676	0.2271209	106.99	0.1940921
20.5	27.5	69.00	0.1130436	0.1990644	107.00	0.1533046
28.5	35.5	70.69	0.1076806	0.1846928	112.56	0.1470438
36.5	43.5	75.87	0.0851618	0.1316323	112.41	0.1075659
44.5	51.5	73.06	0.0552105	0.0811697	108.22	0.0695741
52.5	59.5	83.08	0.0333263	0.0433095	102.77	0.0367838
60.5	67.5	86.22	0.0241247	0.0315632	100.95	0.0253066
68.5	75.5	96.70	0.0114485	0.0147618	98.57	0.0103369
76.5	83.5	111.30	0.0047158	0.0066910	91.03	0.0024594
84.5	89.5	107.22	0.0030359	0.0046228	69.00	0.0010259

Table A0.25: Season (march/april/may) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and May 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	200	0.0002412	0.0002412	nan	nan
-83.5	-76.5	200	0.0005219	0.0005219	nan	nan
-75.5	-68.5	169.70	0.0017912	0.0019712	90.11	0.0001215
-67.5	-60.5	136.33	0.0027300	0.0034529	68.77	0.0004520
-59.5	-52.5	113.53	0.0052746	0.0078861	85.87	0.0019839
-51.5	-44.5	85.68	0.0116762	0.0210304	96.60	0.0086837
-43.5	-36.5	70.41	0.0260056	0.0523494	102.76	0.0280006
-35.5	-28.5	66.90	0.0434114	0.0903335	110.84	0.0549154
-27.5	-20.5	63.00	0.0567108	0.1190395	102.42	0.0762725
-19.5	-12.5	56.96	0.0684598	0.1502247	107.79	0.1057447
-11.5	-4.5	54.33	0.0719381	0.1557149	110.51	0.1219995
-3.5	3.5	51.19	0.0731574	0.1685396	111.49	0.1325854
4.5	11.5	49.95	0.0933106	0.2152915	113.57	0.1740954
12.5	19.5	65.89	0.1233868	0.2271209	109.54	0.1769032
20.5	27.5	65.81	0.1231936	0.1990644	108.87	0.1794186
28.5	35.5	66.28	0.1274192	0.1846928	111.99	0.1860725
36.5	43.5	79.59	0.1096742	0.1316323	114.01	0.1389559
44.5	51.5	79.12	0.0688731	0.0811697	102.62	0.0816579
52.5	59.5	86.80	0.0441638	0.0433095	97.92	0.0478307
60.5	67.5	91.84	0.0389070	0.0315632	95.85	0.0404335
68.5	75.5	102.90	0.0235348	0.0147618	101.58	0.0241177
76.5	83.5	78.65	0.0113190	0.0066910	75.88	0.0111815
84.5	89.5	79.57	0.0076078	0.0046228	52.07	0.0057703

Table A0.26: Season (june/july/august) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and June 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	200	0.0000178	0.0000178	nan	nan
-75.5	-68.5	200	0.0001970	0.0001970	nan	nan
-67.5	-60.5	110.97	0.0007753	0.0011092	62.38	0.0001595
-59.5	-52.5	83.96	0.0016061	0.0029887	70.18	0.0010155
-51.5	-44.5	52.43	0.0041897	0.0092928	103.00	0.0064300
-43.5	-36.5	64.71	0.0144353	0.0274534	104.11	0.0192877
-35.5	-28.5	54.61	0.0291206	0.0620228	110.51	0.0474200
-27.5	-20.5	45.74	0.0407956	0.0966182	109.50	0.0775446
-19.5	-12.5	60.48	0.0646441	0.1288513	109.54	0.0977052
-11.5	-4.5	56.56	0.0730787	0.1540959	110.22	0.1191838
-3.5	3.5	52.10	0.0714123	0.1602372	107.35	0.1245107
4.5	11.5	49.61	0.0855249	0.1902237	113.44	0.1612645
12.5	19.5	65.01	0.1206209	0.2199741	110.11	0.1751638
20.5	27.5	60.33	0.1239594	0.2405805	111.20	0.1936197
28.5	35.5	57.75	0.1282717	0.2545442	107.87	0.1998652
36.5	43.5	74.50	0.1209490	0.1960528	104.65	0.1476330
44.5	51.5	70.97	0.0773403	0.1130713	97.33	0.0954673
52.5	59.5	75.78	0.0473585	0.0610022	89.49	0.0522936
60.5	67.5	84.41	0.0364664	0.0409352	90.84	0.0385901
68.5	75.5	88.22	0.0302843	0.0307991	90.51	0.0312000
76.5	83.5	54.69	0.0164416	0.0258108	63.18	0.0185438
84.5	89.5	31.06	0.0083526	0.0218554	36.61	0.0096233

Table A0.27: Season (june/july/august) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and July 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	200	0.0000178	0.0000178	nan	nan
-75.5	-68.5	109.18	0.0001128	0.0001970	91.85	0.0000751
-67.5	-60.5	81.10	0.0006171	0.0011092	71.34	0.0003343
-59.5	-52.5	65.93	0.0014081	0.0029887	79.68	0.0014460
-51.5	-44.5	70.92	0.0049901	0.0092928	95.27	0.0055811
-43.5	-36.5	62.92	0.0143566	0.0274534	102.39	0.0197410
-35.5	-28.5	53.63	0.0287408	0.0620228	108.71	0.0474580
-27.5	-20.5	54.22	0.0432902	0.0966182	97.77	0.0670016
-19.5	-12.5	59.42	0.0644077	0.1288513	105.14	0.0960977
-11.5	-4.5	55.88	0.0762546	0.1540959	107.77	0.1223463
-3.5	3.5	52.48	0.0753657	0.1602372	105.20	0.1283367
4.5	11.5	50.38	0.0855794	0.1902237	110.15	0.1550905
12.5	19.5	66.85	0.1215100	0.2199741	112.38	0.1733860
20.5	27.5	63.26	0.1314046	0.2405805	115.74	0.2038460
28.5	35.5	57.97	0.1362136	0.2545442	111.37	0.2183864
36.5	43.5	64.21	0.1169364	0.1960528	100.20	0.1635210
44.5	51.5	69.72	0.0728929	0.1130713	95.35	0.0906723
52.5	59.5	76.33	0.0454484	0.0610022	91.26	0.0503214
60.5	67.5	87.72	0.0335013	0.0409352	99.90	0.0374222
68.5	75.5	93.79	0.0282715	0.0307991	98.27	0.0291256
76.5	83.5	61.85	0.0172168	0.0258108	71.85	0.0198377
84.5	89.5	30.02	0.0074041	0.0218554	42.15	0.0099372

Table A0.28: Season (june/july/august) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and August 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	110.86	0.0000461	0.0000178	118.06	0.0000529
-75.5	-68.5	92.40	0.0003604	0.0001970	85.97	0.0003923
-67.5	-60.5	81.01	0.0017468	0.0011092	83.87	0.0018019
-59.5	-52.5	74.15	0.0033513	0.0029887	83.63	0.0037377
-51.5	-44.5	82.93	0.0084548	0.0092928	96.96	0.0094786
-43.5	-36.5	77.08	0.0211778	0.0274534	100.07	0.0256231
-35.5	-28.5	69.30	0.0399675	0.0620228	102.26	0.0527324
-27.5	-20.5	61.59	0.0551233	0.0966182	97.59	0.0778788
-19.5	-12.5	59.15	0.0736261	0.1288513	101.90	0.1105981
-11.5	-4.5	55.60	0.0806768	0.1540959	106.70	0.1312602
-3.5	3.5	52.29	0.0794319	0.1602372	106.45	0.1363082
4.5	11.5	51.70	0.0889913	0.1902237	109.52	0.1584429
12.5	19.5	59.65	0.1225205	0.2199741	112.13	0.1959027
20.5	27.5	67.34	0.1380745	0.2405805	118.03	0.2042289
28.5	35.5	62.32	0.1375524	0.2545442	112.78	0.2075867
36.5	43.5	62.47	0.1118122	0.1960528	103.92	0.1628068
44.5	51.5	70.96	0.0676699	0.1130713	93.27	0.0811609
52.5	59.5	76.18	0.0375968	0.0610022	85.85	0.0380382
60.5	67.5	82.16	0.0265160	0.0409352	88.22	0.0258989
68.5	75.5	115.65	0.0233095	0.0307991	111.42	0.0170050
76.5	83.5	96.80	0.0160580	0.0258108	88.41	0.0111256
84.5	89.5	69.13	0.0104663	0.0218554	55.15	0.0061039

Table A0.29: Season (sept/oct/nov) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and September 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	177.58	0.0050347	0.0053915	121.16	0.0003695
-83.5	-76.5	157.72	0.0059104	0.0068920	99.99	0.0008153
-75.5	-68.5	116.46	0.0081345	0.0118107	91.45	0.0034360
-67.5	-60.5	99.58	0.0118336	0.0185712	96.68	0.0071633
-59.5	-52.5	83.65	0.0101773	0.0177023	88.72	0.0084411
-51.5	-44.5	80.21	0.0183982	0.0324649	95.99	0.0180658
-43.5	-36.5	77.71	0.0348619	0.0626253	99.75	0.0365202
-35.5	-28.5	60.86	0.0515641	0.1056819	97.16	0.0697899
-27.5	-20.5	54.73	0.0618286	0.1324927	95.25	0.0947978
-19.5	-12.5	52.79	0.0775790	0.1620659	102.17	0.1270540
-11.5	-4.5	53.11	0.0844723	0.1669900	108.72	0.1440930
-3.5	3.5	52.47	0.0828834	0.1735453	108.07	0.1434410
4.5	11.5	54.81	0.0898865	0.1850016	109.79	0.1550168
12.5	19.5	53.06	0.1099051	0.2148446	115.18	0.1949357
20.5	27.5	54.60	0.1199316	0.2089988	120.49	0.2116202
28.5	35.5	57.59	0.1173796	0.1780348	117.57	0.1951852
36.5	43.5	78.93	0.0955645	0.1056739	107.15	0.1187528
44.5	51.5	79.38	0.0585237	0.0556411	101.01	0.0694075
52.5	59.5	76.17	0.0290101	0.0250931	94.14	0.0333833
60.5	67.5	73.98	0.0171204	0.0135156	86.70	0.0192081
68.5	75.5	87.92	0.0081955	0.0048809	88.30	0.0083392
76.5	83.5	100.32	0.0028020	0.0013309	98.36	0.0028153
84.5	89.5	93.06	0.0017148	0.0007820	87.38	0.0016534

Table A0.30: Season (sept/oct/nov) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and October 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	71.86	0.0029408	0.0053915	74.28	0.0026896
-83.5	-76.5	89.34	0.0047968	0.0068920	88.87	0.0040827
-75.5	-68.5	93.72	0.0096295	0.0118107	99.80	0.0097458
-67.5	-60.5	85.72	0.0152943	0.0185712	99.10	0.0166881
-59.5	-52.5	86.45	0.0136657	0.0177023	93.04	0.0137964
-51.5	-44.5	81.53	0.0222629	0.0324649	95.44	0.0237605
-43.5	-36.5	72.17	0.0395947	0.0626253	92.97	0.0468341
-35.5	-28.5	62.51	0.0576671	0.1056819	99.49	0.0810160
-27.5	-20.5	60.94	0.0710837	0.1324927	105.65	0.1077041
-19.5	-12.5	60.57	0.0860506	0.1620659	108.48	0.1309779
-11.5	-4.5	62.45	0.0899984	0.1669900	114.47	0.1390260
-3.5	3.5	51.01	0.0799595	0.1735453	109.30	0.1441725
4.5	11.5	54.37	0.0925546	0.1850016	112.46	0.1605577
12.5	19.5	54.93	0.1071200	0.2148446	115.89	0.1847492
20.5	27.5	56.82	0.1028515	0.2089988	117.09	0.1716848
28.5	35.5	62.94	0.0969734	0.1780348	118.82	0.1490530
36.5	43.5	71.16	0.0691802	0.1056739	118.21	0.0950324
44.5	51.5	74.10	0.0370670	0.0556411	110.73	0.0454905
52.5	59.5	73.42	0.0159316	0.0250931	106.09	0.0183177
60.5	67.5	70.91	0.0078966	0.0135156	105.59	0.0093055
68.5	75.5	91.12	0.0031041	0.0048809	89.07	0.0023835
76.5	83.5	108.32	0.0008724	0.0013309	116.35	0.0005011
84.5	89.5	169.51	0.0007063	0.0007820	200.00	0.0000777

Table A0.31: Season (sept/oct/nov) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and November 2009 daily values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	69.65	0.0063491	0.0053915	35.39	0.0037799
-83.5	-76.5	69.59	0.0088698	0.0068920	68.03	0.0085287
-75.5	-68.5	97.47	0.0155550	0.0118107	96.97	0.0163978
-67.5	-60.5	91.78	0.0187840	0.0185712	97.10	0.0197237
-59.5	-52.5	91.13	0.0170393	0.0177023	93.87	0.0173282
-51.5	-44.5	81.83	0.0279705	0.0324649	92.53	0.0305263
-43.5	-36.5	77.20	0.0493325	0.0626253	96.53	0.0581373
-35.5	-28.5	65.56	0.0680575	0.1056819	96.36	0.0921728
-27.5	-20.5	64.81	0.0783197	0.1324927	100.47	0.1104482
-19.5	-12.5	58.17	0.0845026	0.1620659	107.15	0.1321692
-11.5	-4.5	61.53	0.0871442	0.1669900	112.35	0.1345526
-3.5	3.5	52.26	0.0802440	0.1735453	112.41	0.1432109
4.5	11.5	56.58	0.0909420	0.1850016	113.67	0.1511657
12.5	19.5	58.41	0.0984870	0.2148446	113.53	0.1568039
20.5	27.5	56.89	0.0872271	0.2089988	124.95	0.1435779
28.5	35.5	70.43	0.0861528	0.1780348	129.83	0.1101350
36.5	43.5	87.28	0.0600392	0.1056739	126.14	0.0541350
44.5	51.5	92.26	0.0332571	0.0556411	125.36	0.0219263
52.5	59.5	105.65	0.0164883	0.0250931	120.77	0.0080559
60.5	67.5	137.46	0.0105042	0.0135156	103.79	0.0024635
68.5	75.5	168.04	0.0043531	0.0048809	103.73	0.0004306
76.5	83.5	200	0.0013309	0.0013309	nan	nan
84.5	89.5	200	0.0007820	0.0007820	nan	nan

Table A0.32: December 2008 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	22.73	0.0039296	0.0197737	24.83	0.0048126
-83.5	-76.5	49.71	0.0103280	0.0215863	58.83	0.0112941
-75.5	-68.5	86.29	0.0209153	0.0272840	89.20	0.0214110
-67.5	-60.5	97.13	0.0208203	0.0247384	101.62	0.0203425
-59.5	-52.5	85.64	0.0183594	0.0245521	90.38	0.0180426
-51.5	-44.5	76.59	0.0324845	0.0487312	91.51	0.0358709
-43.5	-36.5	80.63	0.0571376	0.0814018	99.50	0.0630699
-35.5	-28.5	69.74	0.0808431	0.1348166	102.95	0.1072977
-27.5	-20.5	70.50	0.0936475	0.1499757	102.56	0.1209217
-19.5	-12.5	75.74	0.0995573	0.1576586	107.56	0.1295044
-11.5	-4.5	59.97	0.0892990	0.1748709	112.94	0.1455021
-3.5	3.5	62.16	0.0863592	0.1601743	112.55	0.1347285
4.5	11.5	65.31	0.0957926	0.1646322	112.05	0.1376753
12.5	19.5	65.74	0.0915628	0.1597788	115.24	0.1338155
20.5	27.5	65.71	0.0745982	0.1317794	126.70	0.1137026
28.5	35.5	62.48	0.0545292	0.0981178	135.16	0.0871256
36.5	43.5	72.15	0.0264437	0.0395204	128.77	0.0351136
44.5	51.5	75.61	0.0094374	0.0133924	120.66	0.0116641
52.5	59.5	63.64	0.0023307	0.0038382	106.66	0.0030592
60.5	67.5	61.50	0.0005794	0.0010498	115.48	0.0008642
68.5	75.5	nan	nan	nan	nan	nan
76.5	83.5	nan	nan	nan	nan	nan
84.5	89.5	nan	nan	nan	nan	nan

Table A0.33: January 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	34.45	0.0052488	0.0171490	35.44	0.0060317
-83.5	-76.5	55.97	0.0097106	0.0183214	64.34	0.0105734
-75.5	-68.5	92.93	0.0167873	0.0206687	95.54	0.0174919
-67.5	-60.5	101.39	0.0139273	0.0159145	104.59	0.0138277
-59.5	-52.5	88.88	0.0165487	0.0215377	94.32	0.0162440
-51.5	-44.5	79.89	0.0297306	0.0428012	93.05	0.0318198
-43.5	-36.5	74.31	0.0554873	0.0843462	95.26	0.0640178
-35.5	-28.5	69.61	0.0791531	0.1312111	100.87	0.1025267
-27.5	-20.5	74.76	0.0930715	0.1442903	103.69	0.1162419
-19.5	-12.5	77.33	0.0969470	0.1509279	109.21	0.1249980
-11.5	-4.5	68.48	0.0900781	0.1541735	109.40	0.1292241
-3.5	3.5	63.46	0.0855559	0.1553450	116.27	0.1328556
4.5	11.5	65.55	0.0965306	0.1682487	117.12	0.1430383
12.5	19.5	66.39	0.0895578	0.1559103	115.85	0.1304508
20.5	27.5	59.05	0.0695749	0.1315690	121.14	0.1109904
28.5	35.5	68.86	0.0554770	0.0909206	127.54	0.0800039
36.5	43.5	71.95	0.0282980	0.0424850	128.81	0.0377195
44.5	51.5	76.47	0.0106005	0.0148406	119.48	0.0128872
52.5	59.5	71.62	0.0029180	0.0041430	98.43	0.0032701
60.5	67.5	64.81	0.0007410	0.0011611	91.06	0.0008570
68.5	75.5	89.33	0.0001884	0.0002304	104.69	0.0001875
76.5	83.5	nan	nan	nan	nan	nan
84.5	89.5	nan	nan	nan	nan	nan

Table A0.34: February 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	44.03	0.0017958	0.0044578	62.19	0.0034615
-83.5	-76.5	76.27	0.0043516	0.0060505	81.15	0.0048760
-75.5	-68.5	109.27	0.0090460	0.0095301	112.10	0.0099736
-67.5	-60.5	90.28	0.0095403	0.0122408	96.40	0.0095298
-59.5	-52.5	84.15	0.0145148	0.0198613	93.53	0.0146894
-51.5	-44.5	78.77	0.0292052	0.0425185	95.36	0.0320736
-43.5	-36.5	72.37	0.0540289	0.0849699	99.63	0.0650864
-35.5	-28.5	74.98	0.0783410	0.1228100	105.24	0.0986684
-27.5	-20.5	67.46	0.0895916	0.1519598	102.61	0.1220378
-19.5	-12.5	69.98	0.0948002	0.1636575	107.34	0.1347816
-11.5	-4.5	70.10	0.0935763	0.1563590	110.91	0.1323637
-3.5	3.5	64.48	0.0938677	0.1702693	119.80	0.1479868
4.5	11.5	65.01	0.1112668	0.1979484	119.37	0.1696452
12.5	19.5	64.27	0.1050359	0.1903347	115.51	0.1575291
20.5	27.5	66.87	0.0889470	0.1518748	120.51	0.1280300
28.5	35.5	74.96	0.0685647	0.1065086	126.98	0.0928625
36.5	43.5	70.31	0.0388543	0.0603292	122.69	0.0521023
44.5	51.5	74.07	0.0175036	0.0256010	114.59	0.0216959
52.5	59.5	76.92	0.0059597	0.0083413	97.96	0.0066092
60.5	67.5	85.11	0.0024161	0.0030499	90.59	0.0023500
68.5	75.5	78.58	0.0005153	0.0006616	77.13	0.0004738
76.5	83.5	112.17	0.0000931	0.0000915	94.10	0.0000725
84.5	89.5	nan	nan	nan	nan	nan

Table A0.35: March 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	86.70	0.0005479	0.0006930	86.65	0.0005970
-83.5	-76.5	100.34	0.0012750	0.0013805	98.38	0.0012111
-75.5	-68.5	86.63	0.0038298	0.0048154	93.25	0.0040374
-67.5	-60.5	86.80	0.0054922	0.0071751	95.04	0.0055102
-59.5	-52.5	82.90	0.0104886	0.0142677	94.73	0.0107039
-51.5	-44.5	83.34	0.0230429	0.0317021	99.46	0.0245262
-43.5	-36.5	71.39	0.0448481	0.0707003	95.87	0.0534046
-35.5	-28.5	71.50	0.0696978	0.1131482	101.13	0.0887717
-27.5	-20.5	70.99	0.0868677	0.1386519	99.91	0.1101604
-19.5	-12.5	62.80	0.0902224	0.1706631	111.61	0.1409024
-11.5	-4.5	62.93	0.0888388	0.1666188	116.14	0.1424044
-3.5	3.5	64.22	0.0974440	0.1784045	121.48	0.1560152
4.5	11.5	63.90	0.1201332	0.2177151	120.02	0.1881137
12.5	19.5	61.42	0.1173676	0.2210748	112.59	0.1806659
20.5	27.5	61.49	0.1011170	0.1859844	114.26	0.1521437
28.5	35.5	67.10	0.0884304	0.1511524	120.26	0.1279004
36.5	43.5	73.41	0.0631387	0.0969222	120.02	0.0827211
44.5	51.5	75.03	0.0365526	0.0536851	115.39	0.0451632
52.5	59.5	81.04	0.0172978	0.0227398	99.97	0.0182646
60.5	67.5	91.71	0.0085371	0.0103050	99.81	0.0083648
68.5	75.5	97.90	0.0031031	0.0033764	93.16	0.0027903
76.5	83.5	95.43	0.0005439	0.0005964	88.73	0.0004701
84.5	89.5	111.07	0.0000959	0.0001030	110.04	0.0001255

Table A0.36: April 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	153.43	0.0000382	0.0000270	142.63	0.0000317
-83.5	-76.5	100.14	0.0001661	0.0001851	99.41	0.0001418
-75.5	-68.5	83.61	0.0007601	0.0009182	77.58	0.0006799
-67.5	-60.5	85.35	0.0019052	0.0024597	90.75	0.0018512
-59.5	-52.5	82.31	0.0049781	0.0066716	91.92	0.0049452
-51.5	-44.5	79.78	0.0143987	0.0201227	96.07	0.0153864
-43.5	-36.5	73.96	0.0334824	0.0505740	99.23	0.0387868
-35.5	-28.5	70.26	0.0556049	0.0900180	101.83	0.0705684
-27.5	-20.5	67.00	0.0726579	0.1221621	101.98	0.0968610
-19.5	-12.5	64.83	0.0822798	0.1497239	109.35	0.1230087
-11.5	-4.5	63.06	0.0831602	0.1543234	112.83	0.1306961
-3.5	3.5	63.13	0.0910195	0.1692401	116.10	0.1449701
4.5	11.5	63.93	0.1195257	0.2203379	114.82	0.1848375
12.5	19.5	57.10	0.1227496	0.2443963	106.99	0.1940921
20.5	27.5	72.59	0.1196379	0.1904403	107.00	0.1533046
28.5	35.5	74.45	0.1143896	0.1776013	112.56	0.1470438
36.5	43.5	77.97	0.0887295	0.1298570	112.41	0.1075659
44.5	51.5	74.44	0.0572772	0.0867002	108.22	0.0695741
52.5	59.5	84.72	0.0347203	0.0461216	102.77	0.0367838
60.5	67.5	88.01	0.0250323	0.0319159	100.95	0.0253066
68.5	75.5	99.21	0.0113654	0.0124645	98.57	0.0103369
76.5	83.5	94.49	0.0027524	0.0030950	91.03	0.0024594
84.5	89.5	72.68	0.0010637	0.0016437	69.00	0.0010259

Table A0.37: May 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	nan	nan	nan	nan	nan
-75.5	-68.5	95.98	0.0001505	0.0001800	90.11	0.0001215
-67.5	-60.5	62.45	0.0004424	0.0007239	68.77	0.0004520
-59.5	-52.5	79.70	0.0020317	0.0027189	85.87	0.0019839
-51.5	-44.5	72.04	0.0075428	0.0112664	96.60	0.0086837
-43.5	-36.5	65.48	0.0218053	0.0357740	102.76	0.0280006
-35.5	-28.5	70.81	0.0420354	0.0678342	110.84	0.0549154
-27.5	-20.5	70.50	0.0600953	0.0963045	102.42	0.0762725
-19.5	-12.5	66.72	0.0740468	0.1302872	107.79	0.1057447
-11.5	-4.5	63.10	0.0794641	0.1462025	110.51	0.1219995
-3.5	3.5	63.24	0.0848025	0.1579744	111.49	0.1325854
4.5	11.5	63.04	0.1128352	0.2078213	113.57	0.1740954
12.5	19.5	73.05	0.1356958	0.2158917	109.54	0.1769032
20.5	27.5	68.28	0.1314873	0.2207684	108.87	0.1794186
28.5	35.5	68.40	0.1356877	0.2253247	111.99	0.1860725
36.5	43.5	78.60	0.1146380	0.1681176	114.01	0.1389559
44.5	51.5	79.14	0.0718866	0.1031239	102.62	0.0816579
52.5	59.5	86.00	0.0465405	0.0610670	97.92	0.0478307
60.5	67.5	87.27	0.0404617	0.0524687	95.85	0.0404335
68.5	75.5	100.76	0.0256117	0.0284445	101.58	0.0241177
76.5	83.5	68.95	0.0108259	0.0163817	75.88	0.0111815
84.5	89.5	42.48	0.0047279	0.0121414	52.07	0.0057703

Table A0.38: June 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	nan	nan	nan	nan	nan
-75.5	-68.5	nan	nan	nan	nan	nan
-67.5	-60.5	47.40	0.0001523	0.0003356	62.38	0.0001595
-59.5	-52.5	69.63	0.0010612	0.0015455	70.18	0.0010155
-51.5	-44.5	60.56	0.0048919	0.0082507	103.00	0.0064300
-43.5	-36.5	69.27	0.0155226	0.0243532	104.11	0.0192877
-35.5	-28.5	58.84	0.0318641	0.0592635	110.51	0.0474200
-27.5	-20.5	51.75	0.0470584	0.0989021	109.50	0.0775446
-19.5	-12.5	67.74	0.0699015	0.1209892	109.54	0.0977052
-11.5	-4.5	64.77	0.0803124	0.1452367	110.22	0.1191838
-3.5	3.5	63.28	0.0819600	0.1524520	107.35	0.1245107
4.5	11.5	62.25	0.1036074	0.1925703	113.44	0.1612645
12.5	19.5	71.97	0.1323748	0.2131044	110.11	0.1751638
20.5	27.5	65.80	0.1359584	0.2365401	111.20	0.1936197
28.5	35.5	65.94	0.1451672	0.2471272	107.87	0.1998652
36.5	43.5	79.82	0.1280516	0.1826159	104.65	0.1476330
44.5	51.5	75.63	0.0826120	0.1218156	97.33	0.0954673
52.5	59.5	77.70	0.0495542	0.0688944	89.49	0.0522936
60.5	67.5	84.67	0.0379564	0.0485561	90.84	0.0385901
68.5	75.5	88.36	0.0316444	0.0401481	90.51	0.0312000
76.5	83.5	54.72	0.0167898	0.0323515	63.18	0.0185438
84.5	89.5	29.37	0.0073912	0.0283956	36.61	0.0096233

Table A0.39: July 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	nan	nan	nan	nan	nan
-75.5	-68.5	112.09	0.0001023	0.0001050	91.85	0.0000751
-67.5	-60.5	53.44	0.0002945	0.0005479	71.34	0.0003343
-59.5	-52.5	67.26	0.0013673	0.0021010	79.68	0.0014460
-51.5	-44.5	74.53	0.0050697	0.0073206	95.27	0.0055811
-43.5	-36.5	68.25	0.0158862	0.0252420	102.39	0.0197410
-35.5	-28.5	58.48	0.0321265	0.0597949	108.71	0.0474580
-27.5	-20.5	59.68	0.0478993	0.0887216	97.77	0.0670016
-19.5	-12.5	67.62	0.0704439	0.1225578	105.14	0.0960977
-11.5	-4.5	64.38	0.0837561	0.1531024	107.77	0.1223463
-3.5	3.5	63.77	0.0865380	0.1597290	105.20	0.1283367
4.5	11.5	63.42	0.1032616	0.1869241	110.15	0.1550905
12.5	19.5	74.15	0.1329778	0.2091193	112.38	0.1733860
20.5	27.5	68.68	0.1441514	0.2433686	115.74	0.2038460
28.5	35.5	65.53	0.1543466	0.2667894	111.37	0.2183864
36.5	43.5	72.19	0.1319254	0.2044499	100.20	0.1635210
44.5	51.5	77.94	0.0809812	0.1143777	95.35	0.0906723
52.5	59.5	80.47	0.0484570	0.0643334	91.26	0.0503214
60.5	67.5	86.37	0.0340502	0.0423103	99.90	0.0374222
68.5	75.5	94.67	0.0293156	0.0347366	98.27	0.0291256
76.5	83.5	63.69	0.0182466	0.0305576	71.85	0.0198377
84.5	89.5	34.53	0.0077987	0.0253359	42.15	0.0099372

Table A0.40: August 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	128.56	0.0000602	0.0000533	118.06	0.0000529
-75.5	-68.5	91.19	0.0004242	0.0004861	85.97	0.0003923
-67.5	-60.5	82.03	0.0018997	0.0024442	83.87	0.0018019
-59.5	-52.5	69.65	0.0034619	0.0053196	83.63	0.0037377
-51.5	-44.5	82.46	0.0090984	0.0123070	96.96	0.0094786
-43.5	-36.5	78.36	0.0229162	0.0327650	100.07	0.0256231
-35.5	-28.5	72.33	0.0432206	0.0670101	102.26	0.0527324
-27.5	-20.5	66.47	0.0609092	0.1022308	97.59	0.0778788
-19.5	-12.5	65.07	0.0796790	0.1430070	101.90	0.1105981
-11.5	-4.5	63.50	0.0886930	0.1639485	106.70	0.1312602
-3.5	3.5	62.32	0.0903201	0.1685307	106.45	0.1363082
4.5	11.5	64.14	0.1071650	0.1911768	109.52	0.1584429
12.5	19.5	65.27	0.1354373	0.2376985	112.13	0.1959027
20.5	27.5	71.46	0.1483558	0.2418327	118.03	0.2042289
28.5	35.5	69.77	0.1529098	0.2497159	112.78	0.2075867
36.5	43.5	70.25	0.1256862	0.2010925	103.92	0.1628068
44.5	51.5	78.49	0.0739174	0.1030206	93.27	0.0811609
52.5	59.5	74.22	0.0356915	0.0497788	85.85	0.0380382
60.5	67.5	76.93	0.0237448	0.0319391	88.22	0.0258989
68.5	75.5	106.52	0.0169313	0.0175126	111.42	0.0170050
76.5	83.5	82.41	0.0108930	0.0145232	88.41	0.0111256
84.5	89.5	45.95	0.0049625	0.0120973	55.15	0.0061039

Table A0.41: September 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	120.37	0.0003586	0.0003533	121.16	0.0003695
-83.5	-76.5	98.93	0.0009046	0.0009919	99.99	0.0008153
-75.5	-68.5	91.33	0.0037563	0.0043755	91.45	0.0034360
-67.5	-60.5	85.30	0.0069906	0.0092047	96.68	0.0071633
-59.5	-52.5	79.67	0.0083400	0.0117190	88.72	0.0084411
-51.5	-44.5	79.73	0.0167893	0.0239298	95.99	0.0180658
-43.5	-36.5	78.64	0.0326946	0.0476422	99.75	0.0365202
-35.5	-28.5	64.41	0.0534842	0.0917416	97.16	0.0697899
-27.5	-20.5	60.82	0.0693379	0.1258926	95.25	0.0947978
-19.5	-12.5	61.11	0.0853978	0.1626971	102.17	0.1270540
-11.5	-4.5	62.11	0.0938932	0.1766745	108.72	0.1440930
-3.5	3.5	61.87	0.0932436	0.1754162	108.07	0.1434410
4.5	11.5	64.67	0.1047762	0.1866972	109.79	0.1550168
12.5	19.5	59.90	0.1231748	0.2351949	115.18	0.1949357
20.5	27.5	56.43	0.1259890	0.2526814	120.49	0.2116202
28.5	35.5	58.71	0.1209912	0.2336502	117.57	0.1951852
36.5	43.5	79.16	0.1004677	0.1445252	107.15	0.1187528
44.5	51.5	78.66	0.0611243	0.0869779	101.01	0.0694075
52.5	59.5	75.56	0.0306556	0.0433814	94.14	0.0333833
60.5	67.5	71.78	0.0176545	0.0259937	86.70	0.0192081
68.5	75.5	86.08	0.0088642	0.0109700	88.30	0.0083392
76.5	83.5	98.71	0.0031122	0.0034061	98.36	0.0028153
84.5	89.5	79.51	0.0016007	0.0022734	87.38	0.0016534

Table A0.42: October 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	71.21	0.0026034	0.0040834	74.28	0.0026896
-83.5	-76.5	90.35	0.0042605	0.0053582	88.87	0.0040827
-75.5	-68.5	115.03	0.0100652	0.0114464	99.80	0.0097458
-67.5	-60.5	85.19	0.0155126	0.0210165	99.10	0.0166881
-59.5	-52.5	86.71	0.0139153	0.0184314	93.04	0.0137964
-51.5	-44.5	82.40	0.0226622	0.0318499	95.44	0.0237605
-43.5	-36.5	74.09	0.0415650	0.0633282	92.97	0.0468341
-35.5	-28.5	68.77	0.0631438	0.1051241	99.49	0.0810160
-27.5	-20.5	69.54	0.0807998	0.1327011	105.65	0.1077041
-19.5	-12.5	70.01	0.0942421	0.1597308	108.48	0.1309779
-11.5	-4.5	71.87	0.0991052	0.1637357	114.47	0.1390260
-3.5	3.5	60.69	0.0913676	0.1745854	109.30	0.1441725
4.5	11.5	64.65	0.1085026	0.1907075	112.46	0.1605577
12.5	19.5	60.92	0.1190007	0.2214237	115.89	0.1847492
20.5	27.5	61.00	0.1112898	0.2056433	117.09	0.1716848
28.5	35.5	67.21	0.1034190	0.1751333	118.82	0.1490530
36.5	43.5	73.90	0.0730836	0.1110951	118.21	0.0950324
44.5	51.5	75.97	0.0381590	0.0544876	110.73	0.0454905
52.5	59.5	74.10	0.0156237	0.0224830	106.09	0.0183177
60.5	67.5	70.88	0.0076241	0.0115121	105.59	0.0093055
68.5	75.5	86.02	0.0025993	0.0031449	89.07	0.0023835
76.5	83.5	95.25	0.0004920	0.0005865	116.35	0.0005011
84.5	89.5	80.83	0.0000771	0.0000780	200.00	0.0000777

Table A0.43: November 2009 8°x10° monthly mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	27.63	0.0029677	0.0116822	35.39	0.0037799
-83.5	-76.5	58.07	0.0079749	0.0143260	68.03	0.0085287
-75.5	-68.5	93.88	0.0163034	0.0196104	96.97	0.0163978
-67.5	-60.5	88.99	0.0194962	0.0254924	97.10	0.0197237
-59.5	-52.5	88.78	0.0175391	0.0229567	93.87	0.0173282
-51.5	-44.5	79.51	0.0286116	0.0416148	92.53	0.0305263
-43.5	-36.5	76.56	0.0516733	0.0769055	96.53	0.0581373
-35.5	-28.5	70.48	0.0740806	0.1201798	96.36	0.0921728
-27.5	-20.5	72.05	0.0884042	0.1388844	100.47	0.1104482
-19.5	-12.5	68.16	0.0943389	0.1637698	107.15	0.1321692
-11.5	-4.5	71.79	0.0964375	0.1605598	112.35	0.1345526
-3.5	3.5	62.23	0.0914570	0.1706344	112.41	0.1432109
4.5	11.5	64.75	0.1030445	0.1776001	113.67	0.1511657
12.5	19.5	64.28	0.1055670	0.1879151	113.53	0.1568039
20.5	27.5	59.98	0.0881170	0.1686717	124.95	0.1435779
28.5	35.5	69.26	0.0750772	0.1253210	129.83	0.1101350
36.5	43.5	77.85	0.0431079	0.0614014	126.14	0.0541350
44.5	51.5	69.10	0.0165799	0.0254578	125.36	0.0219263
52.5	59.5	69.67	0.0060939	0.0094148	120.77	0.0080559
60.5	67.5	68.80	0.0019674	0.0030409	103.79	0.0024635
68.5	75.5	90.94	0.0004305	0.0005279	103.73	0.0004306
76.5	83.5	nan	nan	nan	nan	nan
84.5	89.5	nan	nan	nan	nan	nan

Table A0.44: 8°x10° season (dec/jan/feb) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and December 2008 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	34.39	0.0061700	0.0137779	24.83	0.0048126
-83.5	-76.5	50.42	0.0102751	0.0153194	58.83	0.0112941
-75.5	-68.5	86.91	0.0198955	0.0191609	89.20	0.0214110
-67.5	-60.5	98.43	0.0194059	0.0176312	101.62	0.0203425
-59.5	-52.5	85.72	0.0177808	0.0219837	90.38	0.0180426
-51.5	-44.5	76.11	0.0314154	0.0446836	91.51	0.0358709
-43.5	-36.5	77.21	0.0544012	0.0835726	99.50	0.0630699
-35.5	-28.5	60.05	0.0717727	0.1296125	102.95	0.1072977
-27.5	-20.5	60.85	0.0810539	0.1487419	102.56	0.1209217
-19.5	-12.5	66.19	0.0905630	0.1574147	107.56	0.1295044
-11.5	-4.5	50.49	0.0783952	0.1618011	112.94	0.1455021
-3.5	3.5	52.54	0.0752616	0.1619295	112.55	0.1347285
4.5	11.5	56.32	0.0842130	0.1769431	112.05	0.1376753
12.5	19.5	61.31	0.0852102	0.1686746	115.24	0.1338155
20.5	27.5	62.60	0.0704407	0.1384077	126.70	0.1137026
28.5	35.5	56.98	0.0491206	0.0985157	135.16	0.0871256
36.5	43.5	67.82	0.0251730	0.0474449	128.77	0.0351136
44.5	51.5	73.89	0.0099715	0.0179447	120.66	0.0116641
52.5	59.5	62.14	0.0025138	0.0054409	106.66	0.0030592
60.5	67.5	71.21	0.0008204	0.0017536	115.48	0.0008642
68.5	75.5	200	0.0002974	0.0002974	nan	nan
76.5	83.5	200	0.0000305	0.0000305	nan	nan
84.5	89.5	nan	nan	nan	nan	nan

Table A0.45: 8°x10° season (dec/jan/feb) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and January 2009 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	38.11	0.0159443	0.0137935	35.44	0.0060317
-83.5	-76.5	55.25	0.0094506	0.0153194	64.34	0.0105734
-75.5	-68.5	93.10	0.0165654	0.0191609	95.54	0.0174919
-67.5	-60.5	101.80	0.0145387	0.0176312	104.59	0.0138277
-59.5	-52.5	88.98	0.0166882	0.0219837	94.32	0.0162440
-51.5	-44.5	80.16	0.0303008	0.0446836	93.05	0.0318198
-43.5	-36.5	74.58	0.0554854	0.0835726	95.26	0.0640178
-35.5	-28.5	69.25	0.0788171	0.1296125	100.87	0.1025267
-27.5	-20.5	74.30	0.0934000	0.1487419	103.69	0.1162419
-19.5	-12.5	77.69	0.0977681	0.1574147	109.21	0.1249980
-11.5	-4.5	68.46	0.0906199	0.1618011	109.40	0.1292241
-3.5	3.5	63.35	0.0859527	0.1619295	116.27	0.1328556
4.5	11.5	65.51	0.0974116	0.1769431	117.12	0.1430383
12.5	19.5	66.36	0.0909644	0.1686746	115.85	0.1304508
20.5	27.5	59.57	0.0708767	0.1384077	121.14	0.1109904
28.5	35.5	69.87	0.0572373	0.0985157	127.54	0.0800039
36.5	43.5	74.01	0.0297484	0.0474449	128.81	0.0377195
44.5	51.5	79.96	0.0116472	0.0179447	119.48	0.0128872
52.5	59.5	79.00	0.0034622	0.0054409	98.43	0.0032701
60.5	67.5	78.40	0.0010354	0.0017536	91.06	0.0008570
68.5	75.5	93.24	0.0002136	0.0002974	104.69	0.0001875
76.5	83.5	200	0.0000305	0.0000305	nan	nan
84.5	89.5	nan	nan	nan	nan	nan

Table A0.46: 8°x10° season (dec/jan/feb) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and February 2009 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	108.95	0.0050735	0.0137935	62.19	0.0034615
-83.5	-76.5	108.75	0.0103226	0.0153194	81.15	0.0048760
-75.5	-68.5	116.49	0.0137823	0.0191609	112.10	0.0099736
-67.5	-60.5	92.62	0.0113326	0.0176312	96.40	0.0095298
-59.5	-52.5	84.26	0.0149683	0.0219837	93.53	0.0146894
-51.5	-44.5	78.90	0.0296644	0.0446836	95.36	0.0320736
-43.5	-36.5	72.55	0.0540663	0.0835726	99.63	0.0650864
-35.5	-28.5	75.74	0.0795233	0.1296125	105.24	0.0986684
-27.5	-20.5	69.24	0.0903428	0.1487419	102.61	0.1220378
-19.5	-12.5	70.80	0.0957062	0.1574147	107.34	0.1347816
-11.5	-4.5	70.25	0.0941911	0.1618011	110.91	0.1323637
-3.5	3.5	65.86	0.0946233	0.1619295	119.80	0.1479868
4.5	11.5	66.34	0.1120036	0.1769431	119.37	0.1696452
12.5	19.5	65.77	0.1059899	0.1686746	115.51	0.1575291
20.5	27.5	67.82	0.0887279	0.1384077	120.51	0.1280300
28.5	35.5	75.24	0.0679366	0.0985157	126.98	0.0928625
36.5	43.5	69.70	0.0376154	0.0474449	122.69	0.0521023
44.5	51.5	74.07	0.0168596	0.0179447	114.59	0.0216959
52.5	59.5	76.75	0.0056688	0.0054409	97.96	0.0066092
60.5	67.5	83.70	0.0022318	0.0017536	90.59	0.0023500
68.5	75.5	80.29	0.0004821	0.0002974	77.13	0.0004738
76.5	83.5	105.21	0.0000800	0.0000305	94.10	0.0000725
84.5	89.5	nan	nan	nan	nan	nan

Table A0.47: 8°x10° season (march/april/may) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between mean and March 2009 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	94.81	0.0005416	0.0002400	86.65	0.0005970
-83.5	-76.5	102.75	0.0011472	0.0005219	98.38	0.0012111
-75.5	-68.5	95.17	0.0037514	0.0019712	93.25	0.0040374
-67.5	-60.5	95.20	0.0054699	0.0034529	95.04	0.0055102
-59.5	-52.5	89.96	0.0104201	0.0078861	94.73	0.0107039
-51.5	-44.5	87.70	0.0226637	0.0210304	99.46	0.0245262
-43.5	-36.5	74.65	0.0451184	0.0523494	95.87	0.0534046
-35.5	-28.5	74.70	0.0706376	0.0903335	101.13	0.0887717
-27.5	-20.5	72.68	0.0868598	0.1190395	99.91	0.1101604
-19.5	-12.5	63.84	0.0912412	0.1502247	111.61	0.1409024
-11.5	-4.5	63.52	0.0891461	0.1557149	116.14	0.1424044
-3.5	3.5	64.51	0.0975293	0.1685396	121.48	0.1560152
4.5	11.5	64.01	0.1205455	0.2152915	120.02	0.1881137
12.5	19.5	61.58	0.1182268	0.2271209	112.59	0.1806659
20.5	27.5	61.46	0.1024627	0.1990644	114.26	0.1521437
28.5	35.5	68.64	0.0954997	0.1846928	120.26	0.1279004
36.5	43.5	78.95	0.0745939	0.1316323	120.02	0.0827211
44.5	51.5	84.21	0.0477560	0.0811697	115.39	0.0451632
52.5	59.5	98.97	0.0283019	0.0433095	99.97	0.0182646
60.5	67.5	124.02	0.0228075	0.0315632	99.81	0.0083648
68.5	75.5	142.72	0.0118870	0.0147618	93.16	0.0027903
76.5	83.5	171.35	0.0061036	0.0066910	88.73	0.0004701
84.5	89.5	191.75	0.0044033	0.0046294	110.04	0.0001255

Table A0.48: 8°x10° season (march/april/may) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and April 2009 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	174.19	0.0002120	0.0002400	142.63	0.0000317
-83.5	-76.5	125.50	0.0003888	0.0005219	99.41	0.0001418
-75.5	-68.5	108.78	0.0014146	0.0019712	77.58	0.0006799
-67.5	-60.5	90.18	0.0022686	0.0034529	90.75	0.0018512
-59.5	-52.5	83.75	0.0053386	0.0078861	91.92	0.0049452
-51.5	-44.5	80.09	0.0146181	0.0210304	96.07	0.0153864
-43.5	-36.5	74.11	0.0338436	0.0523494	99.23	0.0387868
-35.5	-28.5	70.27	0.0557566	0.0903335	101.83	0.0705684
-27.5	-20.5	67.78	0.0729108	0.1190395	101.98	0.0968610
-19.5	-12.5	65.42	0.0828787	0.1502247	109.35	0.1230087
-11.5	-4.5	63.60	0.0836059	0.1557149	112.83	0.1306961
-3.5	3.5	63.35	0.0911903	0.1685396	116.10	0.1449701
4.5	11.5	64.16	0.1196805	0.2152915	114.82	0.1848375
12.5	19.5	58.01	0.1237640	0.2271209	106.99	0.1940921
20.5	27.5	73.03	0.1212775	0.1990644	107.00	0.1533046
28.5	35.5	74.28	0.1150963	0.1846928	112.56	0.1470438
36.5	43.5	77.99	0.0890683	0.1316323	112.41	0.1075659
44.5	51.5	74.66	0.0568927	0.0811697	108.22	0.0695741
52.5	59.5	84.98	0.0344299	0.0433095	102.77	0.0367838
60.5	67.5	88.20	0.0250156	0.0315632	100.95	0.0253066
68.5	75.5	101.41	0.0122500	0.0147618	98.57	0.0103369
76.5	83.5	113.96	0.0048592	0.0066910	91.03	0.0024594
84.5	89.5	109.95	0.0030032	0.0046294	69.00	0.0010259

Table A0.49: 8°x10° season (march/april/may) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and May 2009 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	200	0.0002400	0.0002400	nan	nan
-83.5	-76.5	200	0.0005219	0.0005219	nan	nan
-75.5	-68.5	168.36	0.0017912	0.0019712	90.11	0.0001215
-67.5	-60.5	136.28	0.0027338	0.0034529	68.77	0.0004520
-59.5	-52.5	115.39	0.0054763	0.0078861	85.87	0.0019839
-51.5	-44.5	90.43	0.0125962	0.0210304	96.60	0.0086837
-43.5	-36.5	75.50	0.0286584	0.0523494	102.76	0.0280006
-35.5	-28.5	73.19	0.0480393	0.0903335	110.84	0.0549154
-27.5	-20.5	70.90	0.0642968	0.1190395	102.42	0.0762725
-19.5	-12.5	66.80	0.0761372	0.1502247	107.79	0.1057447
-11.5	-4.5	63.37	0.0801364	0.1557149	110.51	0.1219995
-3.5	3.5	63.12	0.0853569	0.1685396	111.49	0.1325854
4.5	11.5	63.58	0.1138153	0.2152915	113.57	0.1740954
12.5	19.5	72.70	0.1364702	0.2271209	109.54	0.1769032
20.5	27.5	69.80	0.1320384	0.1990644	108.87	0.1794186
28.5	35.5	70.77	0.1369360	0.1846928	111.99	0.1860725
36.5	43.5	81.15	0.1134886	0.1316323	114.01	0.1389559
44.5	51.5	80.43	0.0704154	0.0811697	102.62	0.0816579
52.5	59.5	87.61	0.0448607	0.0433095	97.92	0.0478307
60.5	67.5	92.03	0.0393560	0.0315632	95.85	0.0404335
68.5	75.5	103.24	0.0236887	0.0147618	101.58	0.0241177
76.5	83.5	76.73	0.0112607	0.0066910	75.88	0.0111815
84.5	89.5	82.82	0.0077293	0.0046294	52.07	0.0057703

Table A0.50: 8°x10° season (june/july/august) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and June 2009 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	200	0.0000178	0.0000178	nan	nan
-75.5	-68.5	200	0.0001970	0.0001970	nan	nan
-67.5	-60.5	111.99	0.0007768	0.0011092	62.38	0.0001595
-59.5	-52.5	91.47	0.0018401	0.0029887	70.18	0.0010155
-51.5	-44.5	63.03	0.0052260	0.0092928	103.00	0.0064300
-43.5	-36.5	70.95	0.0164024	0.0274534	104.11	0.0192877
-35.5	-28.5	59.14	0.0323385	0.0620228	110.51	0.0474200
-27.5	-20.5	51.97	0.0471510	0.0966182	109.50	0.0775446
-19.5	-12.5	68.20	0.0709663	0.1288513	109.54	0.0977052
-11.5	-4.5	65.77	0.0812854	0.1540959	110.22	0.1191838
-3.5	3.5	63.78	0.0826896	0.1602372	107.35	0.1245107
4.5	11.5	62.83	0.1036942	0.1902237	113.44	0.1612645
12.5	19.5	72.13	0.1335022	0.2199741	110.11	0.1751638
20.5	27.5	65.76	0.1363507	0.2405805	111.20	0.1936197
28.5	35.5	65.92	0.1460073	0.2545442	107.87	0.1998652
36.5	43.5	79.69	0.1303199	0.1960528	104.65	0.1476330
44.5	51.5	75.90	0.0823779	0.1130713	97.33	0.0954673
52.5	59.5	78.04	0.0489683	0.0610022	89.49	0.0522936
60.5	67.5	85.66	0.0372621	0.0409352	90.84	0.0385901
68.5	75.5	89.04	0.0306755	0.0307991	90.51	0.0312000
76.5	83.5	55.94	0.0169269	0.0258108	63.18	0.0185438
84.5	89.5	200	0.0219429	0.0219429	36.61	0.0096233

Table A0.51: 8°x10° season (june/july/august) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and July 2009 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	200	0.0000178	0.0000178	nan	nan
-75.5	-68.5	117.15	0.0001484	0.0001970	91.85	0.0000751
-67.5	-60.5	85.38	0.0006500	0.0011092	71.34	0.0003343
-59.5	-52.5	75.63	0.0017186	0.0029887	79.68	0.0014460
-51.5	-44.5	78.16	0.0057394	0.0092928	95.27	0.0055811
-43.5	-36.5	69.22	0.0164448	0.0274534	102.39	0.0197410
-35.5	-28.5	58.80	0.0325721	0.0620228	108.71	0.0474580
-27.5	-20.5	60.35	0.0491826	0.0966182	97.77	0.0670016
-19.5	-12.5	67.79	0.0711920	0.1288513	105.14	0.0960977
-11.5	-4.5	64.46	0.0839155	0.1540959	107.77	0.1223463
-3.5	3.5	63.48	0.0865831	0.1602372	105.20	0.1283367
4.5	11.5	63.62	0.1038721	0.1902237	110.15	0.1550905
12.5	19.5	74.25	0.1347359	0.2199741	112.38	0.1733860
20.5	27.5	69.09	0.1447007	0.2405805	115.74	0.2038460
28.5	35.5	65.75	0.1540341	0.2545442	111.37	0.2183864
36.5	43.5	72.49	0.1315360	0.1960528	100.20	0.1635210
44.5	51.5	78.75	0.0814612	0.1130713	95.35	0.0906723
52.5	59.5	81.09	0.0482596	0.0610022	91.26	0.0503214
60.5	67.5	90.68	0.0347811	0.0409352	99.90	0.0374222
68.5	75.5	94.97	0.0286986	0.0307991	98.27	0.0291256
76.5	83.5	62.98	0.0177326	0.0258108	71.85	0.0198377
84.5	89.5	200	0.0219429	0.0219429	42.15	0.0099372

Table A0.52: 8°x10° season (june/july/august) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and August 2009 daily 1°x1° values for sunrise hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for sunrise hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	nan	nan	nan	nan	nan
-83.5	-76.5	131.84	0.0000514	0.0000178	118.06	0.0000529
-75.5	-68.5	91.65	0.0003836	0.0001970	85.97	0.0003923
-67.5	-60.5	83.30	0.0017993	0.0011092	83.87	0.0018019
-59.5	-52.5	74.81	0.0034845	0.0029887	83.63	0.0037377
-51.5	-44.5	83.84	0.0087890	0.0092928	96.96	0.0094786
-43.5	-36.5	79.02	0.0223819	0.0274534	100.07	0.0256231
-35.5	-28.5	72.65	0.0427859	0.0620228	102.26	0.0527324
-27.5	-20.5	67.20	0.0608181	0.0966182	97.59	0.0778788
-19.5	-12.5	66.34	0.0803288	0.1288513	101.90	0.1105981
-11.5	-4.5	63.94	0.0889197	0.1540959	106.70	0.1312602
-3.5	3.5	62.69	0.0904568	0.1602372	106.45	0.1363082
4.5	11.5	63.75	0.1069253	0.1902237	109.52	0.1584429
12.5	19.5	65.64	0.1349734	0.2199741	112.13	0.1959027
20.5	27.5	71.34	0.1480733	0.2405805	118.03	0.2042289
28.5	35.5	70.12	0.1540125	0.2545442	112.78	0.2075867
36.5	43.5	71.21	0.1267340	0.1960528	103.92	0.1628068
44.5	51.5	80.72	0.0773942	0.1130713	93.27	0.0811609
52.5	59.5	81.35	0.0402345	0.0610022	85.85	0.0380382
60.5	67.5	85.45	0.0277029	0.0409352	88.22	0.0258989
68.5	75.5	117.22	0.0237047	0.0307991	111.42	0.0170050
76.5	83.5	97.74	0.0163398	0.0258108	88.41	0.0111256
84.5	89.5	200	0.0219429	0.0219429	55.15	0.0061039

Table A0.53: 8°x10° season (sept/oct/nov) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and September 2009 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	178.35	0.0048935	0.0053730	121.16	0.0003695
-83.5	-76.5	157.63	0.0059279	0.0068920	99.99	0.0008153
-75.5	-68.5	118.74	0.0084895	0.0118107	91.45	0.0034360
-67.5	-60.5	100.43	0.0118922	0.0185712	96.68	0.0071633
-59.5	-52.5	85.44	0.0105385	0.0177023	88.72	0.0084411
-51.5	-44.5	82.72	0.0193518	0.0324649	95.99	0.0180658
-43.5	-36.5	80.98	0.0371927	0.0626253	99.75	0.0365202
-35.5	-28.5	65.14	0.0561011	0.1056819	97.16	0.0697899
-27.5	-20.5	60.99	0.0700265	0.1324927	95.25	0.0947978
-19.5	-12.5	61.49	0.0860017	0.1620659	102.17	0.1270540
-11.5	-4.5	62.50	0.0941060	0.1669900	108.72	0.1440930
-3.5	3.5	62.57	0.0938897	0.1735453	108.07	0.1434410
4.5	11.5	66.02	0.1057393	0.1850016	109.79	0.1550168
12.5	19.5	60.42	0.1232813	0.2148446	115.18	0.1949357
20.5	27.5	58.87	0.1293204	0.2089988	120.49	0.2116202
28.5	35.5	62.46	0.1263055	0.1780348	117.57	0.1951852
36.5	43.5	81.35	0.0990313	0.1056739	107.15	0.1187528
44.5	51.5	81.49	0.0602986	0.0556411	101.01	0.0694075
52.5	59.5	77.06	0.0296754	0.0250931	94.14	0.0333833
60.5	67.5	74.58	0.0174044	0.0135156	86.70	0.0192081
68.5	75.5	88.00	0.0083598	0.0048809	88.30	0.0083392
76.5	83.5	100.00	0.0028037	0.0013309	98.36	0.0028153
84.5	89.5	95.95	0.0017279	0.0007838	87.38	0.0016534

Table A0.54: 8°x10° season (sept/oct/nov) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and October 2009 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	75.76	0.0029853	0.0053730	74.28	0.0026896
-83.5	-76.5	96.38	0.0049959	0.0068920	88.87	0.0040827
-75.5	-68.5	115.77	0.0102767	0.0118107	99.80	0.0097458
-67.5	-60.5	86.33	0.0155218	0.0185712	99.10	0.0166881
-59.5	-52.5	87.45	0.0139892	0.0177023	93.04	0.0137964
-51.5	-44.5	82.46	0.0228058	0.0324649	95.44	0.0237605
-43.5	-36.5	74.26	0.0415986	0.0626253	92.97	0.0468341
-35.5	-28.5	69.39	0.0637593	0.1056819	99.49	0.0810160
-27.5	-20.5	71.15	0.0819788	0.1324927	105.65	0.1077041
-19.5	-12.5	70.91	0.0952548	0.1620659	108.48	0.1309779
-11.5	-4.5	72.23	0.0994805	0.1669900	114.47	0.1390260
-3.5	3.5	60.64	0.0912633	0.1735453	109.30	0.1441725
4.5	11.5	64.83	0.1080966	0.1850016	112.46	0.1605577
12.5	19.5	61.07	0.1188671	0.2148446	115.89	0.1847492
20.5	27.5	61.12	0.1118204	0.2089988	117.09	0.1716848
28.5	35.5	67.32	0.1041216	0.1780348	118.82	0.1490530
36.5	43.5	74.03	0.0726644	0.1056739	118.21	0.0950324
44.5	51.5	77.66	0.0392769	0.0556411	110.73	0.0454905
52.5	59.5	76.85	0.0167624	0.0250931	106.09	0.0183177
60.5	67.5	74.30	0.0083991	0.0135156	105.59	0.0093055
68.5	75.5	98.35	0.0035104	0.0048809	89.07	0.0023835
76.5	83.5	109.48	0.0008978	0.0013309	116.35	0.0005011
84.5	89.5	166.72	0.0006792	0.0007838	200.00	0.0000777

Table A0.55: 8°x10° season (sept/oct/nov) mean OH mixing ratio per latitudinal band with the differential percentage and absolute difference between the mean and November 2009 daily 1°x1° values for daytime hours. Differential percentage and absolute difference between climatological data and daily 1°x1° for daytime hours is also provided.

From latitude	**To latitude**	**Daily diff** (%)	**Absolute diff** (ppt)	**Monthly mean OH** (ppt)	**Daily diff with clim** (%)	**Absolute diff with clim** (ppt)
-89.5	-84.5	72.68	0.0065103	0.0053730	35.39	0.0037799
-83.5	-76.5	68.15	0.0088033	0.0068920	68.03	0.0085287
-75.5	-68.5	97.51	0.0155873	0.0118107	96.97	0.0163978
-67.5	-60.5	92.16	0.0190717	0.0185712	97.10	0.0197237
-59.5	-52.5	91.22	0.0171601	0.0177023	93.87	0.0173282
-51.5	-44.5	82.19	0.0283530	0.0324649	92.53	0.0305263
-43.5	-36.5	78.90	0.0513551	0.0626253	96.53	0.0581373
-35.5	-28.5	71.76	0.0742227	0.1056819	96.36	0.0921728
-27.5	-20.5	73.04	0.0883538	0.1324927	100.47	0.1104482
-19.5	-12.5	68.20	0.0944431	0.1620659	107.15	0.1321692
-11.5	-4.5	71.95	0.0972800	0.1669900	112.35	0.1345526
-3.5	3.5	62.20	0.0917024	0.1735453	112.41	0.1432109
4.5	11.5	65.21	0.1047292	0.1850016	113.67	0.1511657
12.5	19.5	64.87	0.1095038	0.2148446	113.53	0.1568039
20.5	27.5	61.02	0.0949836	0.2089988	124.95	0.1435779
28.5	35.5	73.79	0.0908573	0.1780348	129.83	0.1101350
36.5	43.5	90.84	0.0633251	0.1056739	126.14	0.0541350
44.5	51.5	95.10	0.0342752	0.0556411	125.36	0.0219263
52.5	59.5	108.03	0.0168543	0.0250931	120.77	0.0080559
60.5	67.5	137.14	0.0105594	0.0135156	103.79	0.0024635
68.5	75.5	166.15	0.0043556	0.0048809	103.73	0.0004306
76.5	83.5	200	0.0013309	0.0013309	nan	nan
84.5	89.5	200	0.0007838	0.0007838	nan	nan