GOME Total Ozone Column Retrieval Development

MidTerm Meeting

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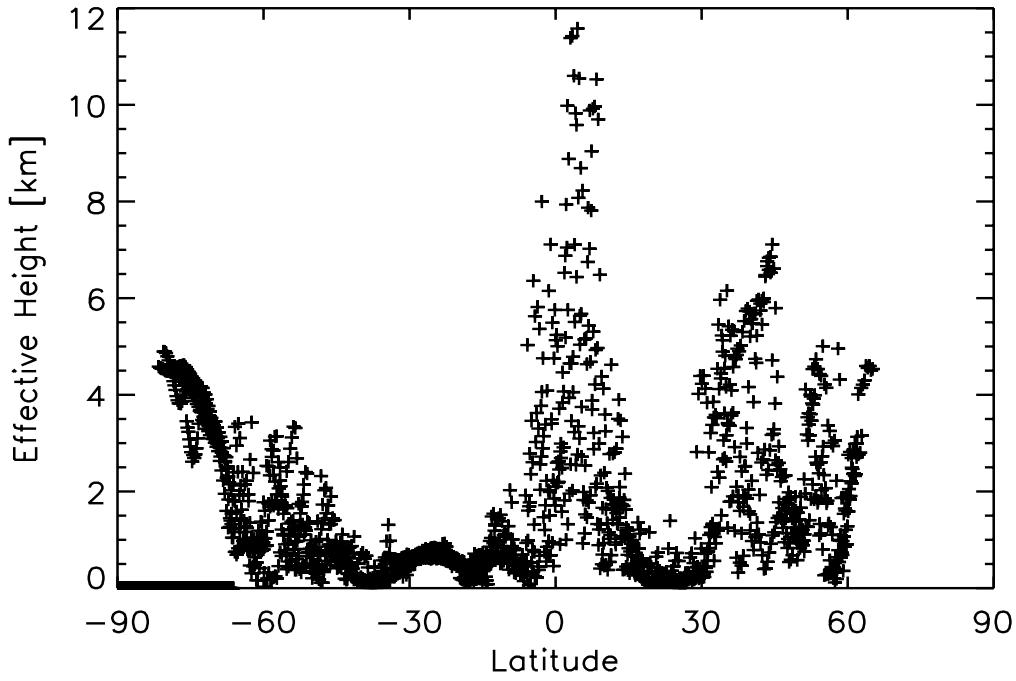
Phase 2

- Algorithm Implementation
- Generation of complete LUT
- Precalculation of FRESCO Output
- Interface to GOME Level 1 and 2
- Generation of Ring Database

Optimum parameter space for Look-up-table I

Atmospheric Parameter	Min	Max	Δ	N
Total Ozone (high latitudes)	125 DU	575 DU	50 DU	10
Total Ozone (mid latitudes)	125 DU	575 DU	50 DU	10
Total Ozone (low latitudes)	225 DU	475 DU	50 DU	6
Solar Zenith Angle	15°	92°	5° if SZA $\leq$ 70° 1° if SZA $>$ 70°	34
Line-Of-Sight	-34.5°	34.5°	11.5°	7
Relative Azimuth Angle	(*)	(*)		3
Surface Albedo	0.02	0.98	$\sim$0.2	6
Ground Altitude	0 km	12 km	2 km	7

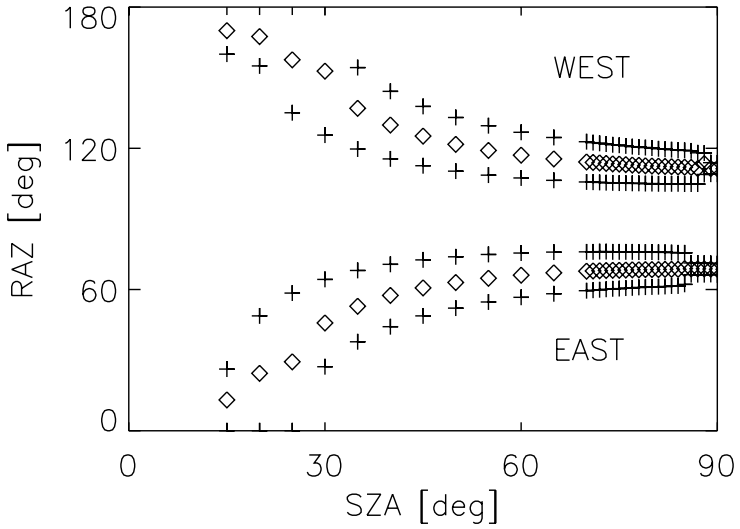
Effective Height as Function of Latitude



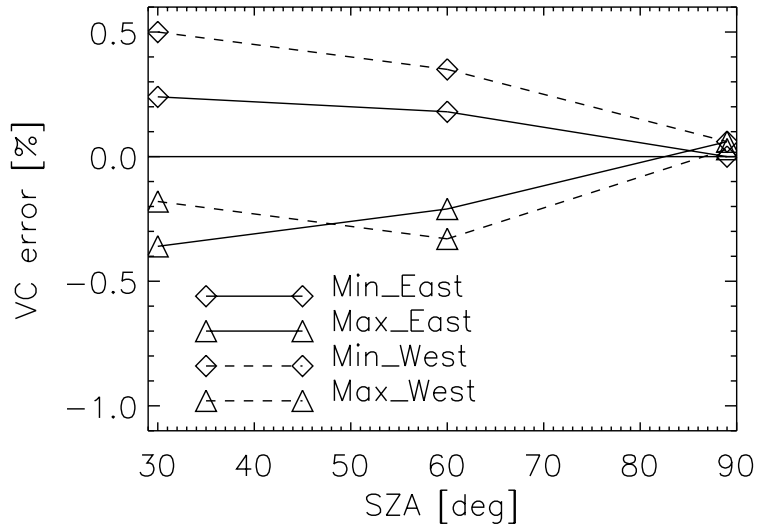
Optimum parameter space for Look-up-table II

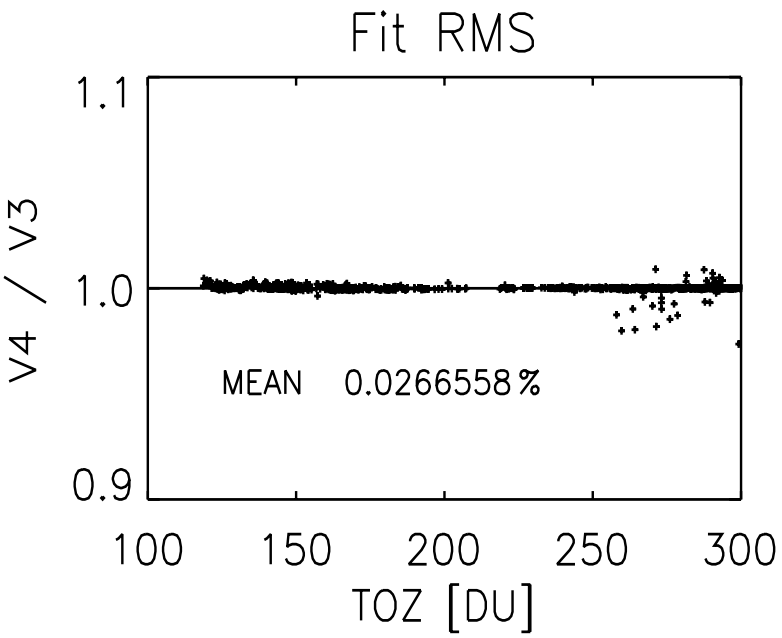
1. Relative Azimuth Angle :

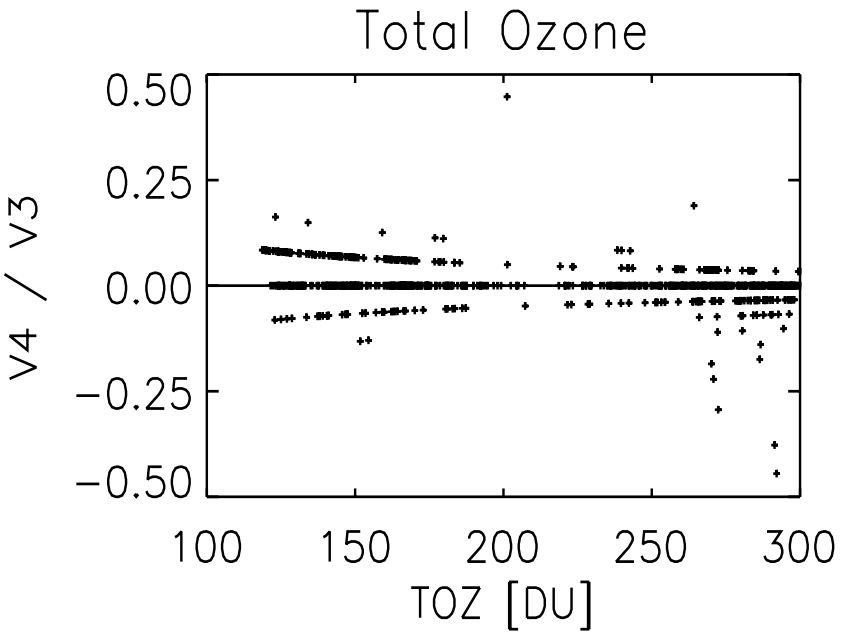
RAZ as function of SZA and LOS



Vertical Column Error vs. SZA and LOS

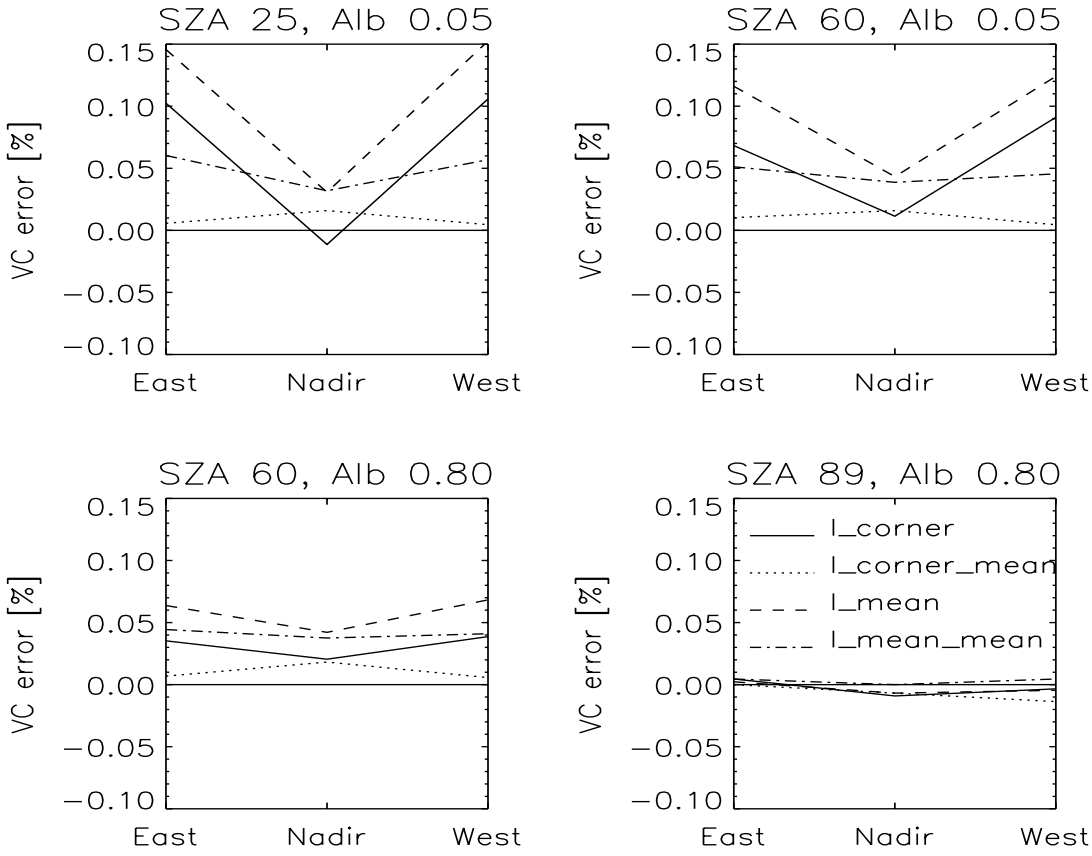



Fit RMS
1.1
1.0
0.9
V4 / V3
MEAN 0.0266558%
100
150
200
250
300
TOZ [DU]


Total Ozone
0.50
0.25
0.00
−0.25
−0.50
V4 / V3
100
150
200
250
300
TOZ [DU]

Optimum parameter space for Look-up-table III

2. Line of Sight :

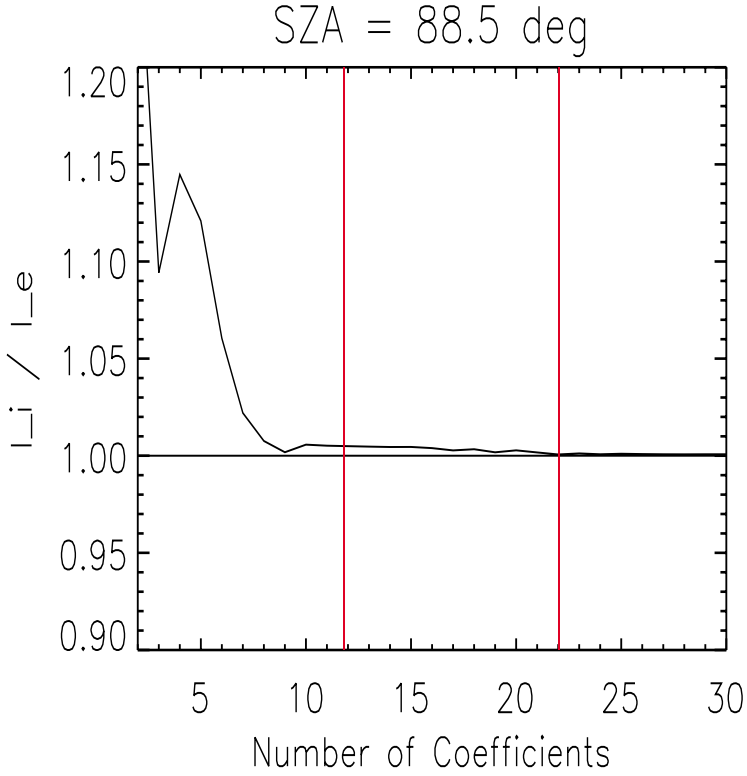


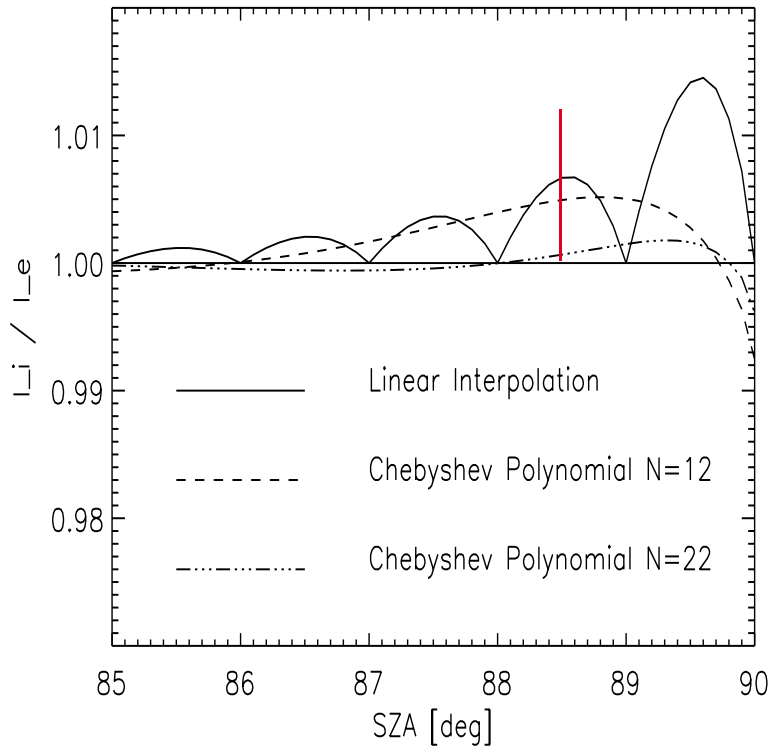
▷ OLD : Three LOS fits, then weighted average of O_3

▷ NEW : Weighted average of Reference Spectra, then only one fit

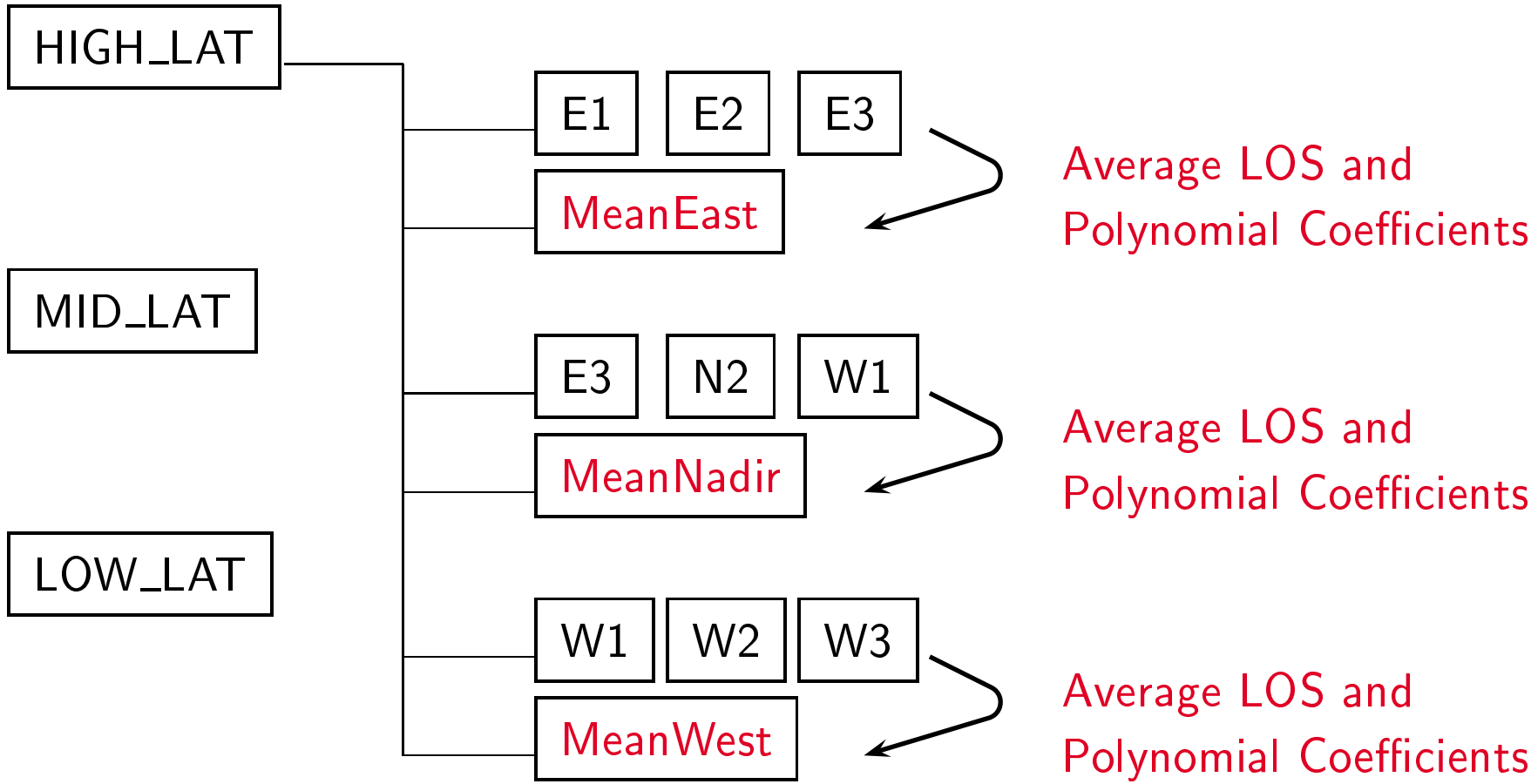
Optimum parameter space for Look-up-table IV

3. Solar Zenith Angle: Interpolation





Reference Spectra LUT I



Different Viewing Modes

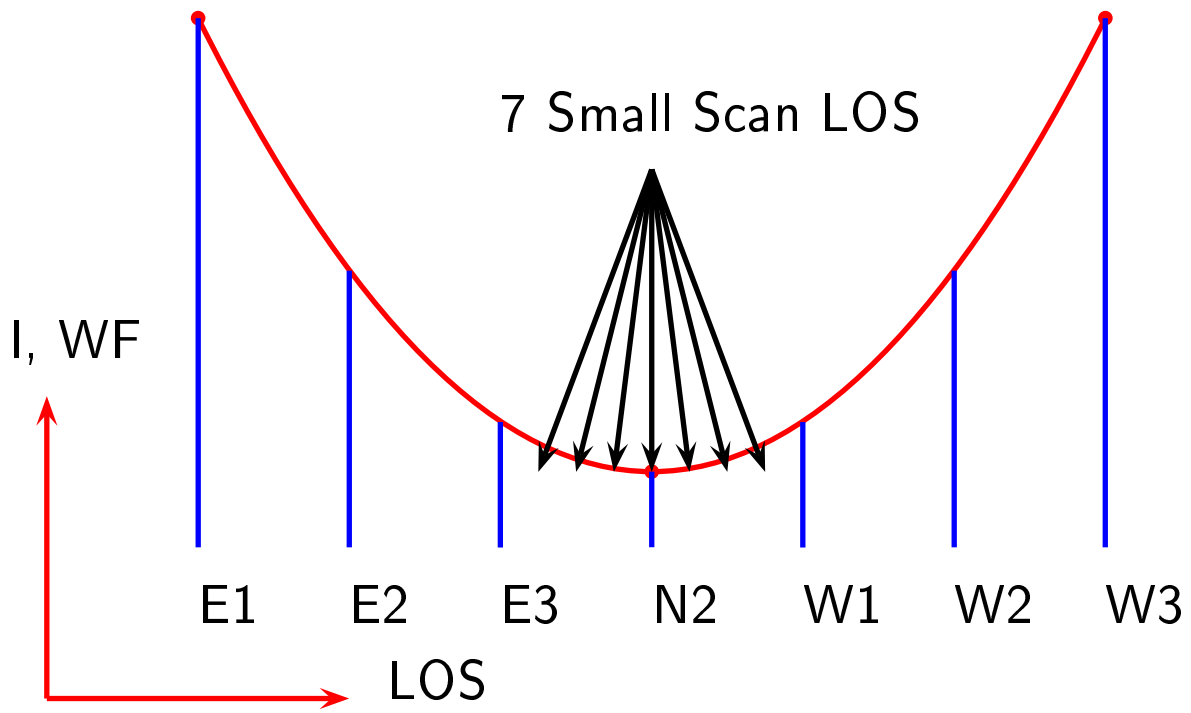
1.) Normal Mode ▷ Average 3 LOS per pixel :
$-34.5°$ to $+34.5°$ with $\Delta = 11.5°$

2.) Small Swath Width ▷ $-9.45°$ to $+9.45°$ with $\Delta = 3.15°$
New grid points in LUT required ???

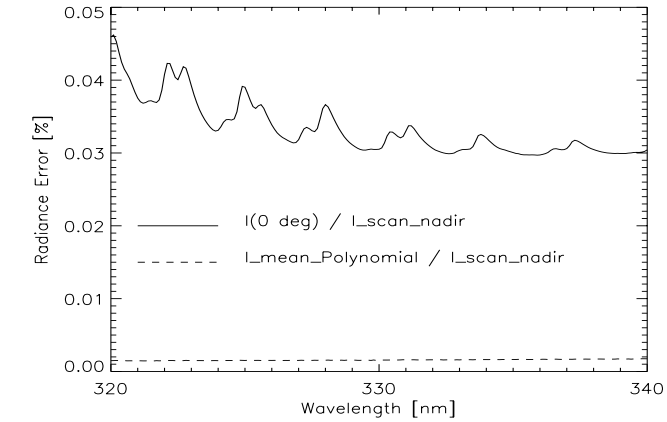
3.) Polar Viewing Mode ▷ $-46.0°$ to $46.0°$
Additional grid points in LUT required ???

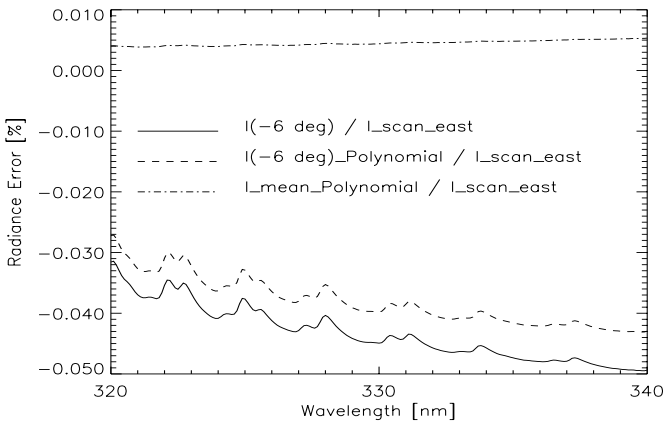
Small Scan Width

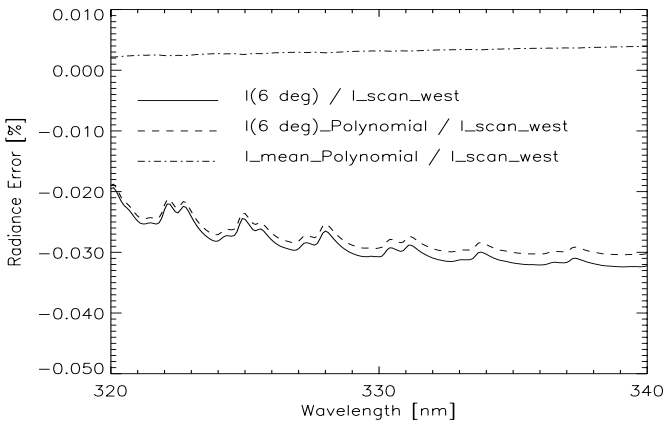
- ▷ Fit Polynomial through 7 existing LOS
- ▷ Calculate values for Small Scan LOS ($-9.45°$, ...
- ▷ Then take average over 3 LOS



Small Scan Width







Shift and Squeeze

1. Calculate reference spectra using cross sections shifted by +0.017 nm (M.v. Roozendael)

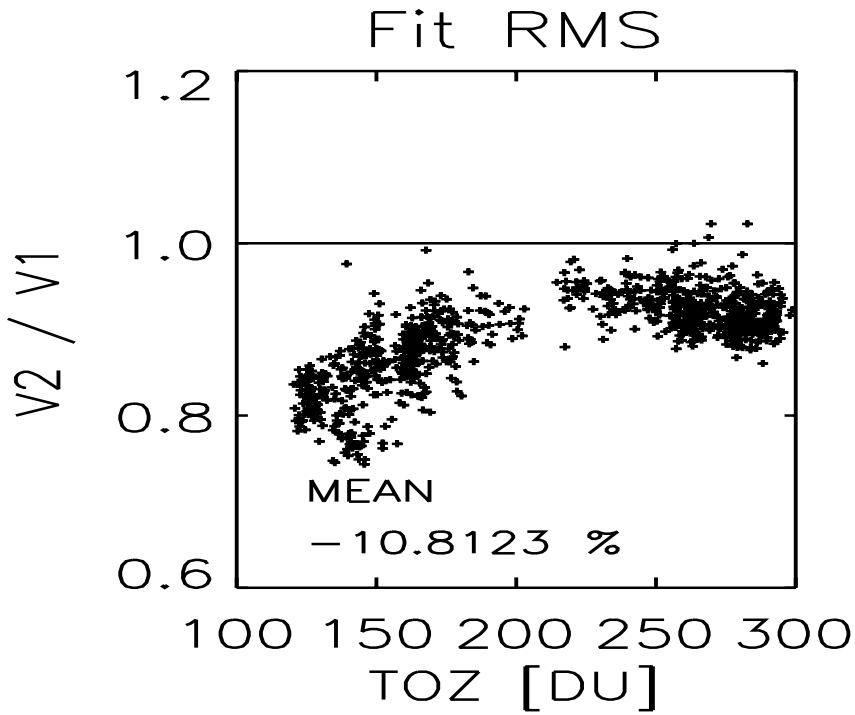
▷ Avoid online shift of modelled intensity and WF

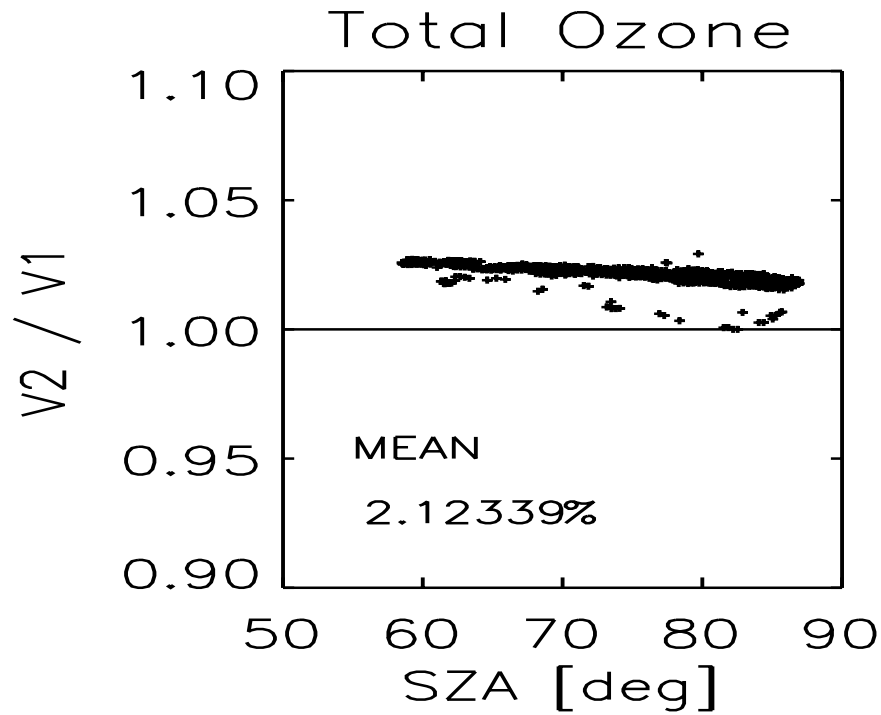
2. Shift and Squeeze of GOME solar spectrum on Kurucz spectrum before the fit

▷ Fit RMS reduced by 10 %

3. Shift and Squeeze of GOME radiance spectrum during fit

Fraunhofer Shift





Ring Data Base

- Calculate Ring Spectra as function of
  1. Solar Zenith Angle (34)
  2. Total Ozone and Profile Shape (10+10+6)
  3. Albedo (6)
  4. Effective Altitude (7)
- GOME solar spectrum (incl. shift and squeeze on Kurucz Spectrum)
- During fit : take nearest neighbour, no interpolation

Prepare GOME data for retrieval

1. Read GOME level 1 data (Radiance and Irradiance)

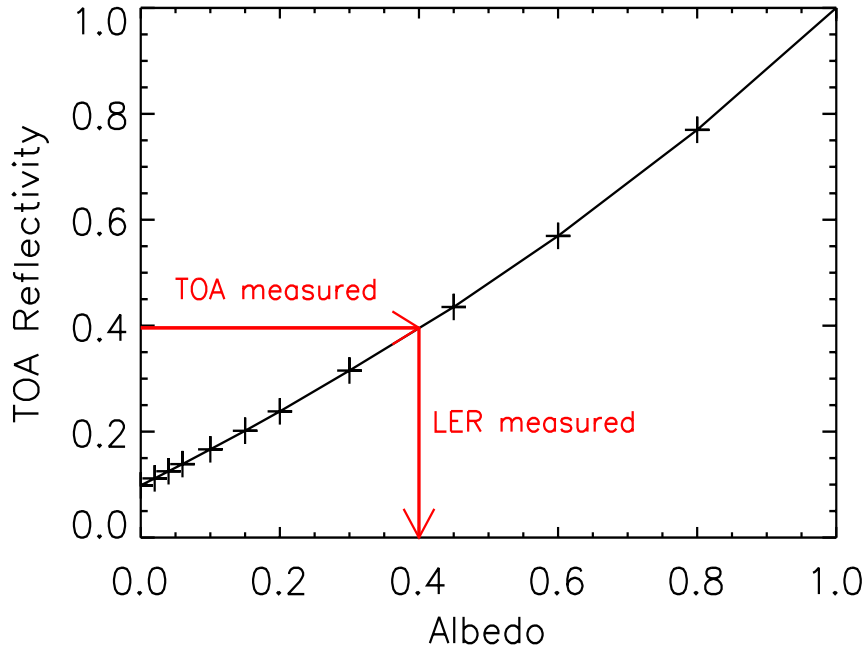
2. Read GOME level 2 data (Geolocation, Viewing Geometry, and Total Ozone)
   ▷ Calculate LER at 377 nm
   Altitude from Guzzi data base

3. Read FRESCO output data (Cloud Fraction, Cloud Top Pressure, and Surface Pressure)
   ▷ Calculate effective height and GVC
   ▷ Use GSFC or TOMS V7 climatology

4. Create output files :

   (a) `radp_/orbit/.mea` ▷ Radiance
   (b) `solp_/orbit/.mea` ▷ Irradiance
   (c) `gvc_/orbit/.dat` ▷ Ghost column and cloud information

Calculate LER at 377 nm



▷ TOA reflectivity LUT as function of :

SZA, LOS, RAZ, GRD, and ALB

from GOME

FRESCO Algorithm

▷ FRESCO output (cloud fraction, cloud top pressure, and surface pressure) has been created for all GOME data and stored in a separate data base

Ghost Vertical Column

$$\mathrm{GVC} = \mathrm{cf} \cdot \int_{\mathrm{sp}}^{\mathrm{ctp}} O_3(p)\, dp$$

ctp : cloud top pressure [hPa]
cf : cloud fraction
sp : surface pressure [hPa]
$O_3(p)$: Ozone profile

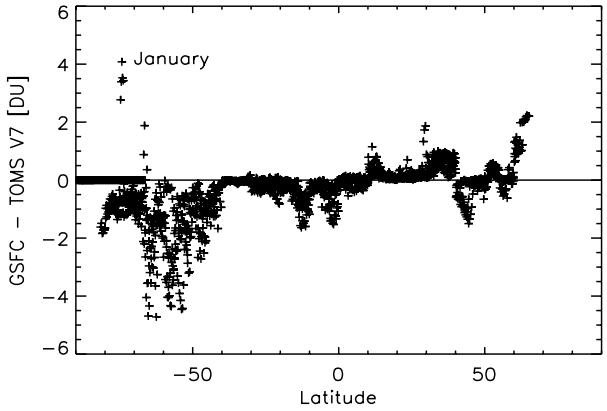
Effective Altitude

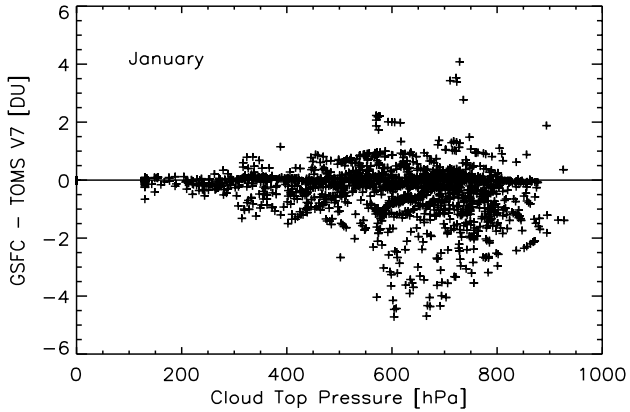
$$\mathrm{eff.Height} = \mathrm{cth} \cdot \mathrm{cf} + \mathrm{sa} \cdot (1 - \mathrm{cf})$$

cth : cloud top height [km]
cf : cloud fraction
sa : surface altitude [km]

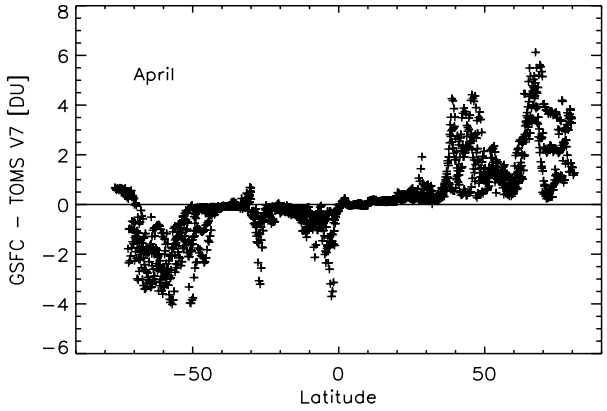
Labow Climatology vs. TOMS V7

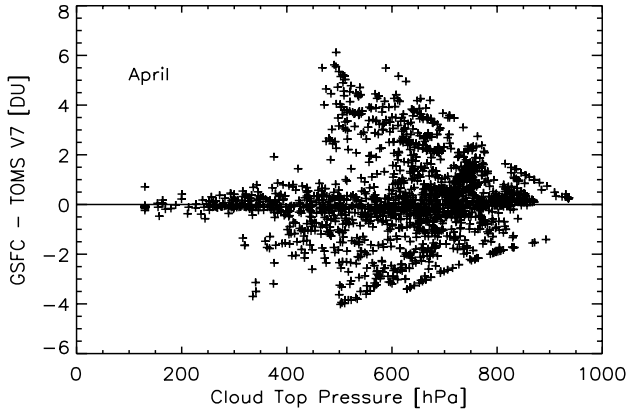
JANUARY



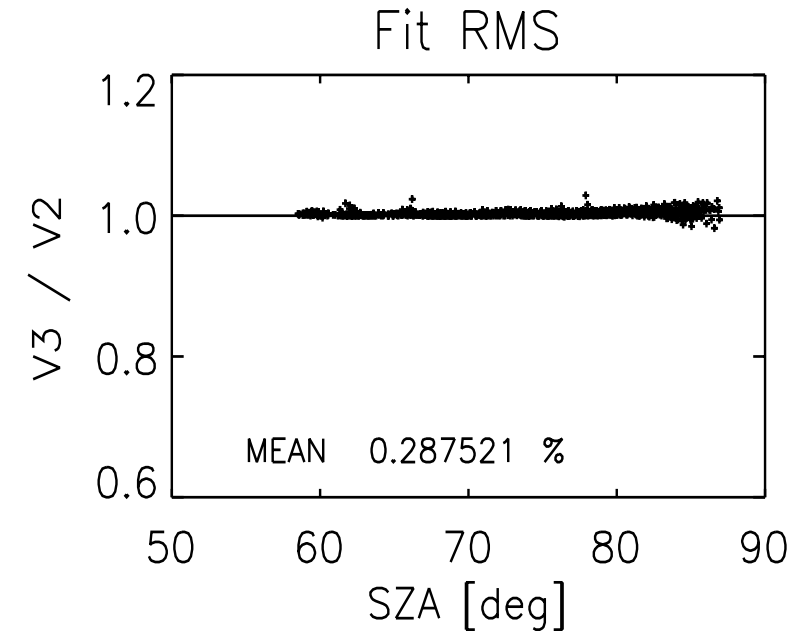


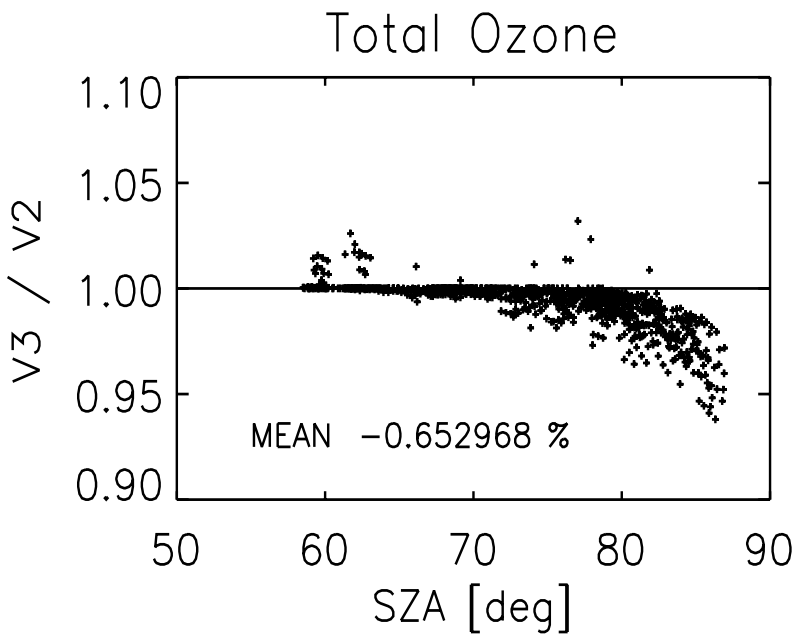
APRIL



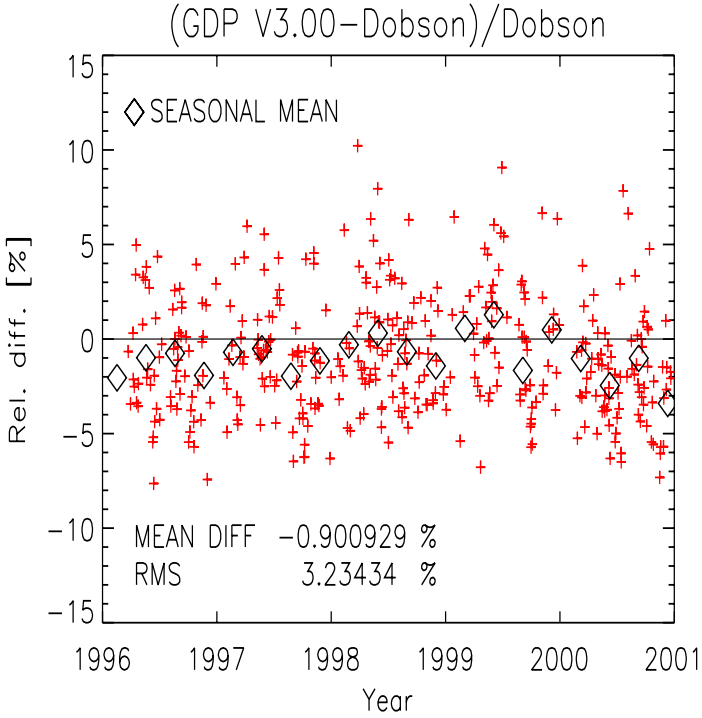


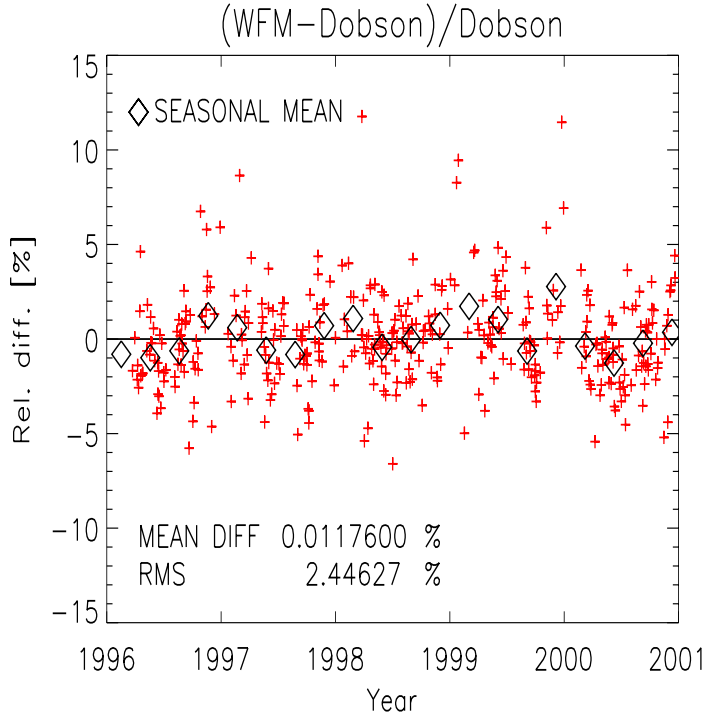
Effective Altitude



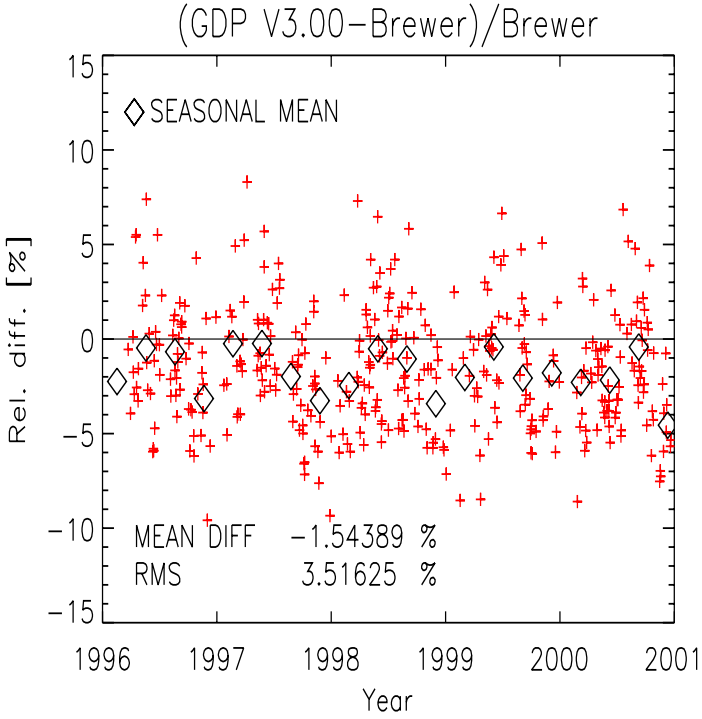


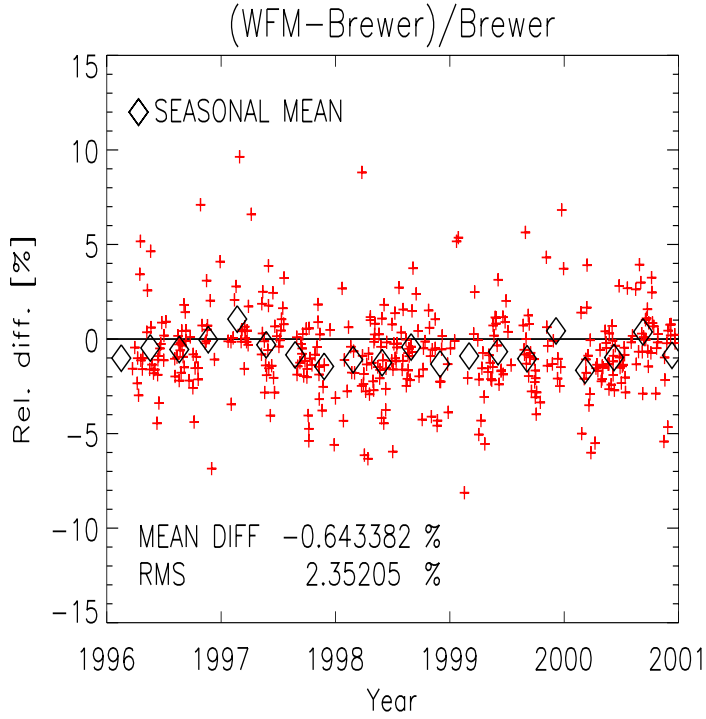
Hradec Kralove - Dobson





Hradec Kralove - Brewer





Future Work

- Finish calculation of reference data base
- Start calculation of Ring data base
- Investigate influence of 'Water Ring' on retrieval over ocean
- Optimize algorithm w.r.t. computational speed
- Prepare GOME data and start validation