SCIAMACHY NIR retrieval

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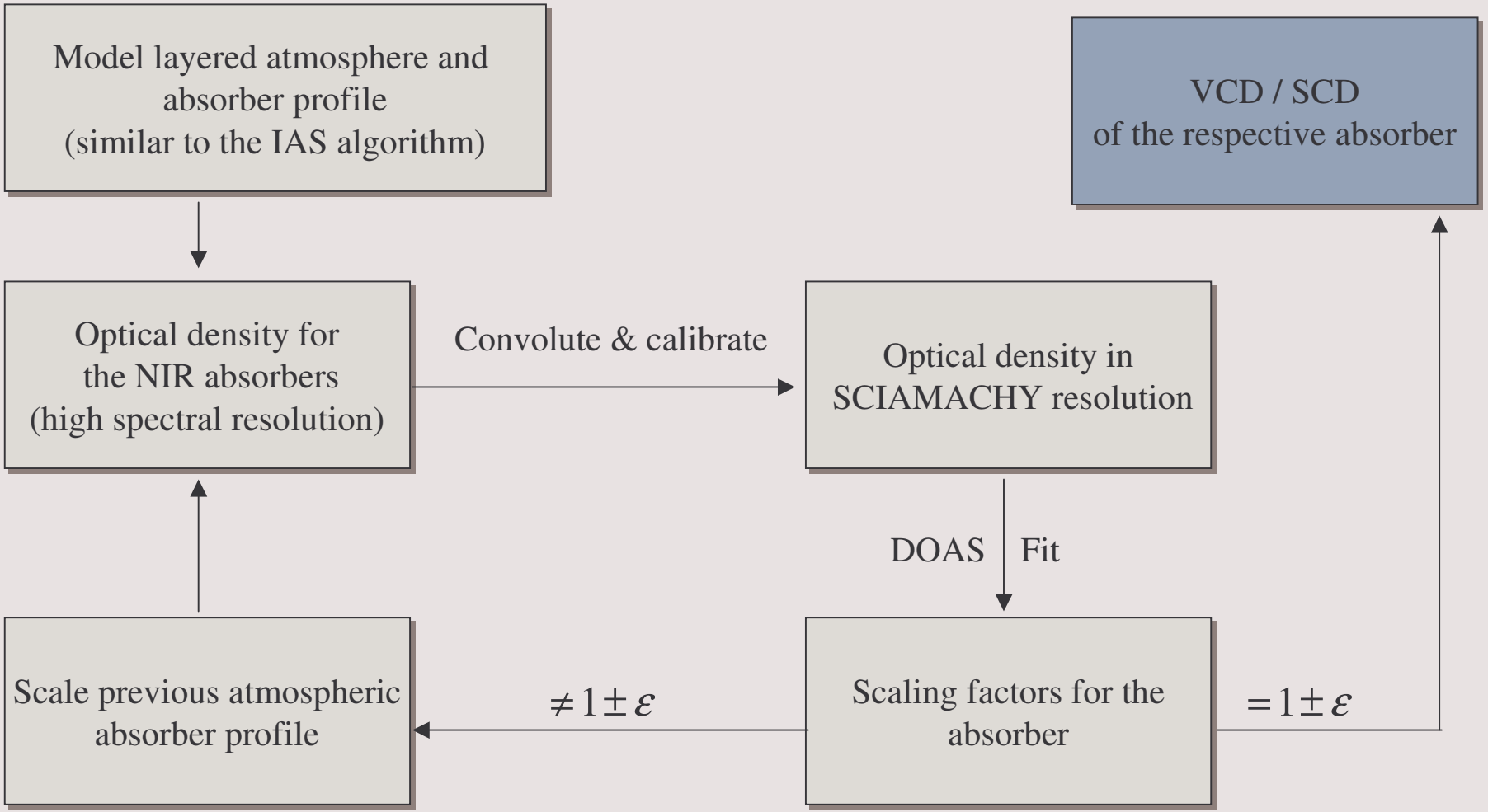
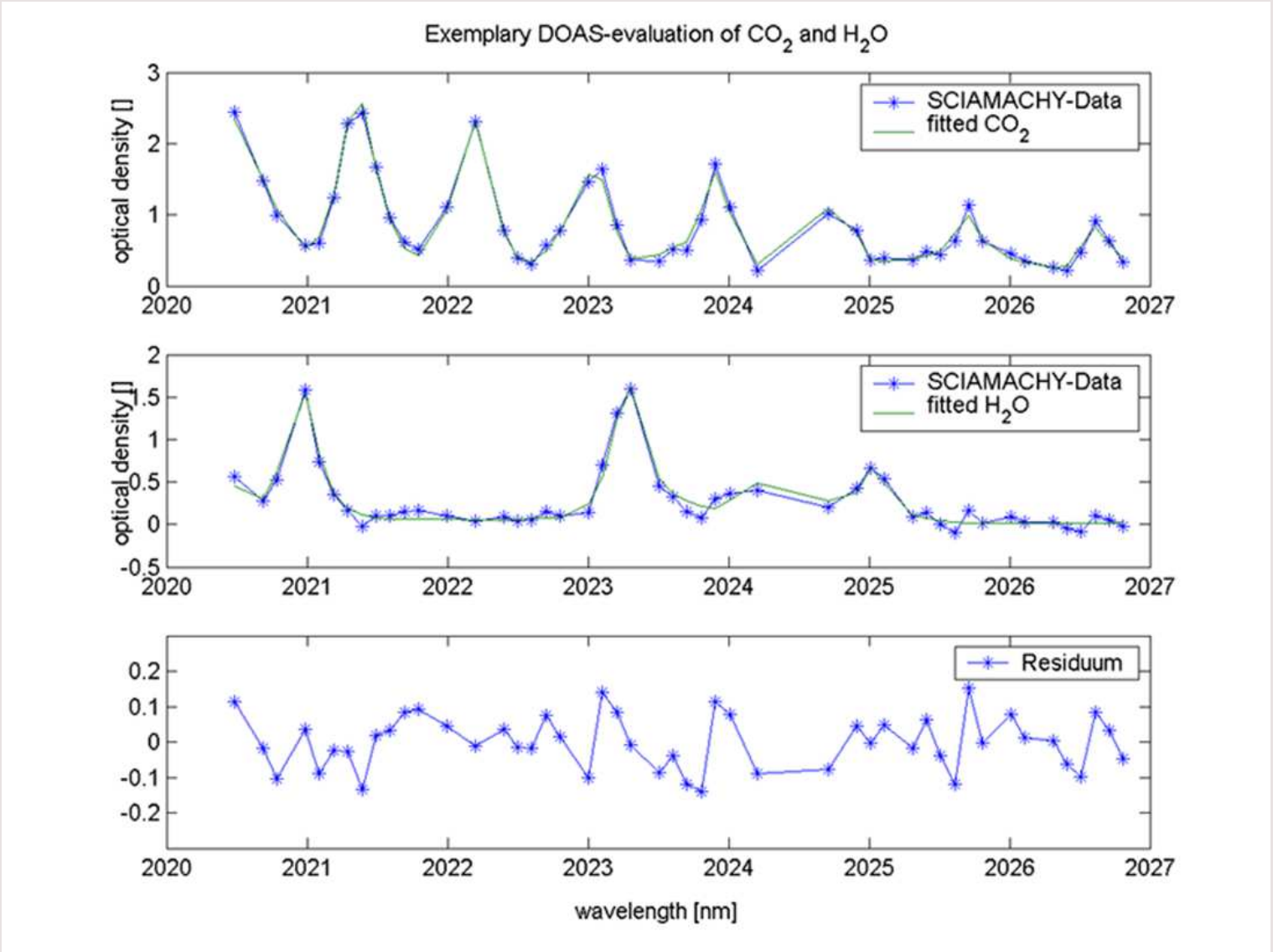
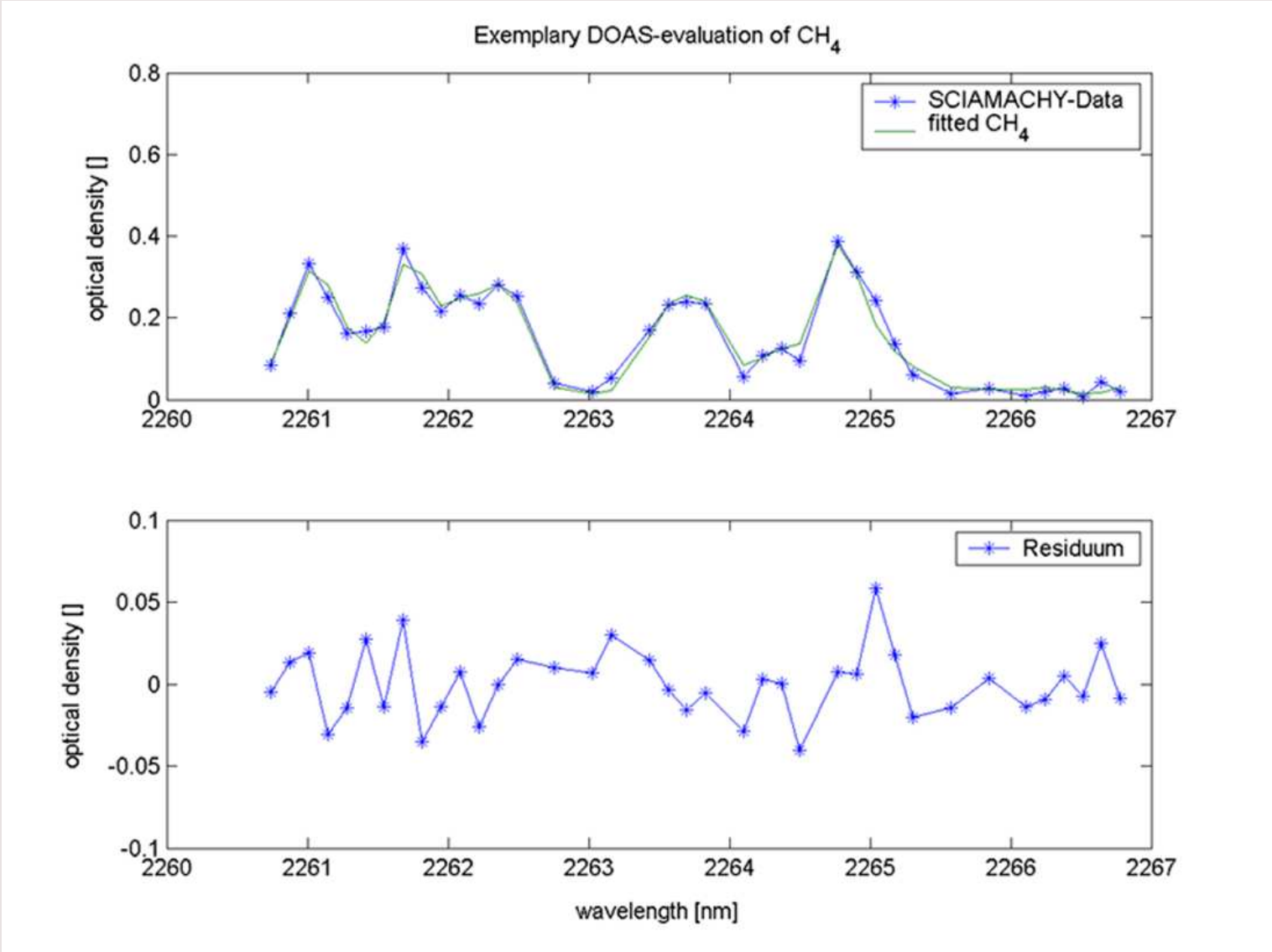
Overview

- Retrieval method
- Retrieval problems
  [1] Deviations using different wavelength regions
  [2] Unexplainable spectral structures over the Mediterannean
  [3] Reflectance deviations PMD_6 and Channel 8
- Future plans

Retrieval method



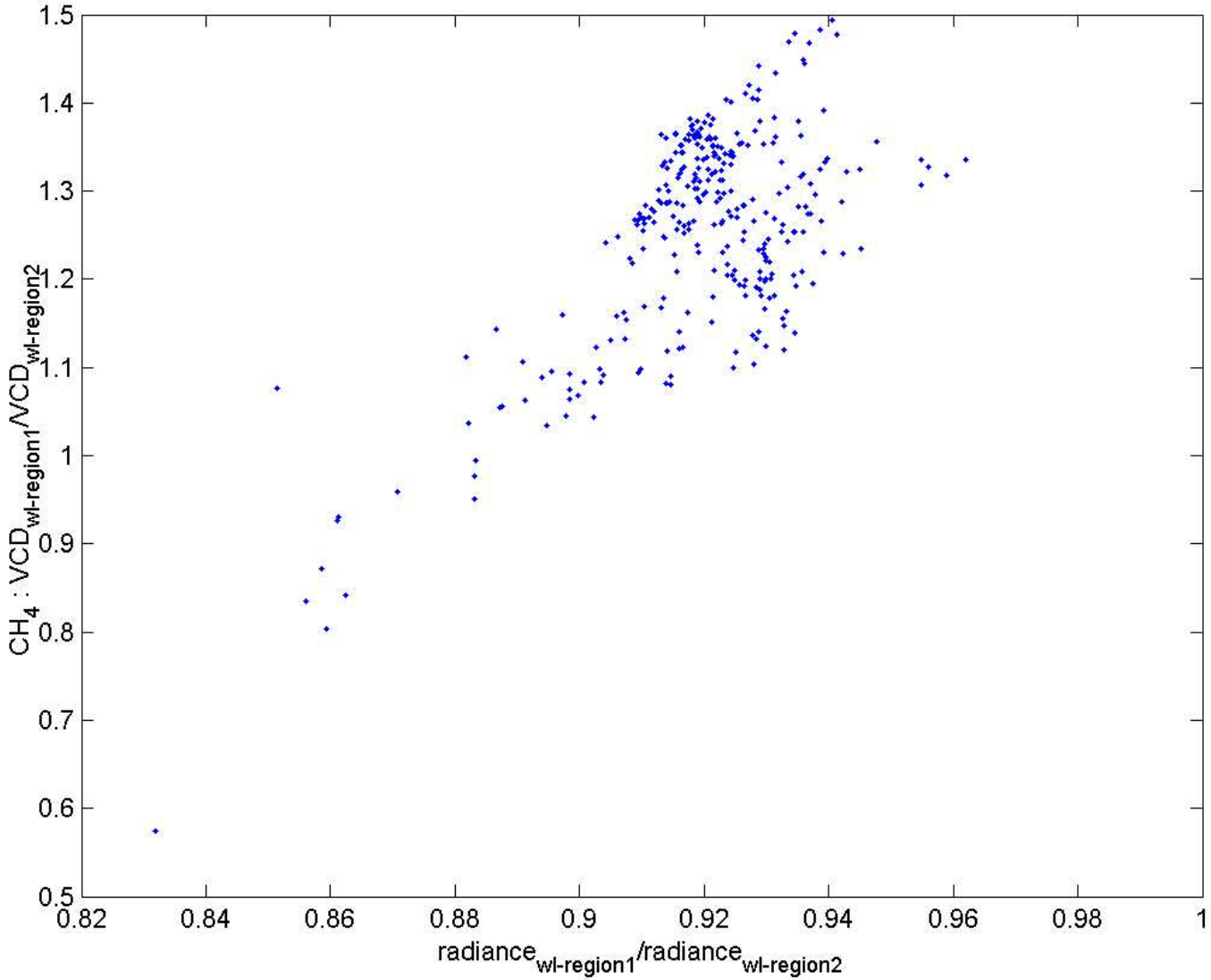

Exemplary DOAS-evaluation of CO_2 and H_2O
optical density []
SCIAMACHY-Data
fitted CO_2
SCIAMACHY-Data
fitted H_2O
Residuum
wavelength [nm]


Exemplary DOAS-evaluation of CH4
SCIAMACHY-Data
fitted CH4
optical density []
0.8
0.6
0.4
0.2
0
2260
2261
2262
2263
2264
2265
2266
2267
Residuum
optical density []
0.1
0.05
0
-0.05
-0.1
wavelength [nm]

Retrieval problems [1]

- Retrieval depends on the radiance
- Clouds, mountains etc. also affect the radiance (inducing artificial correlation between radiance & retrieval)

- To avoid the artificial correlation CH4 fits were performed using different spectral regions. The ratios of the VCD‘s are supposed to be independent on the radiance ratios


1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.82
0.84
0.86
0.88
0.9
0.92
0.94
0.96
0.98
1
CH4 : VCDwl-region1/VCDwl-region2
radiancewl-region1/radiancewl-region2

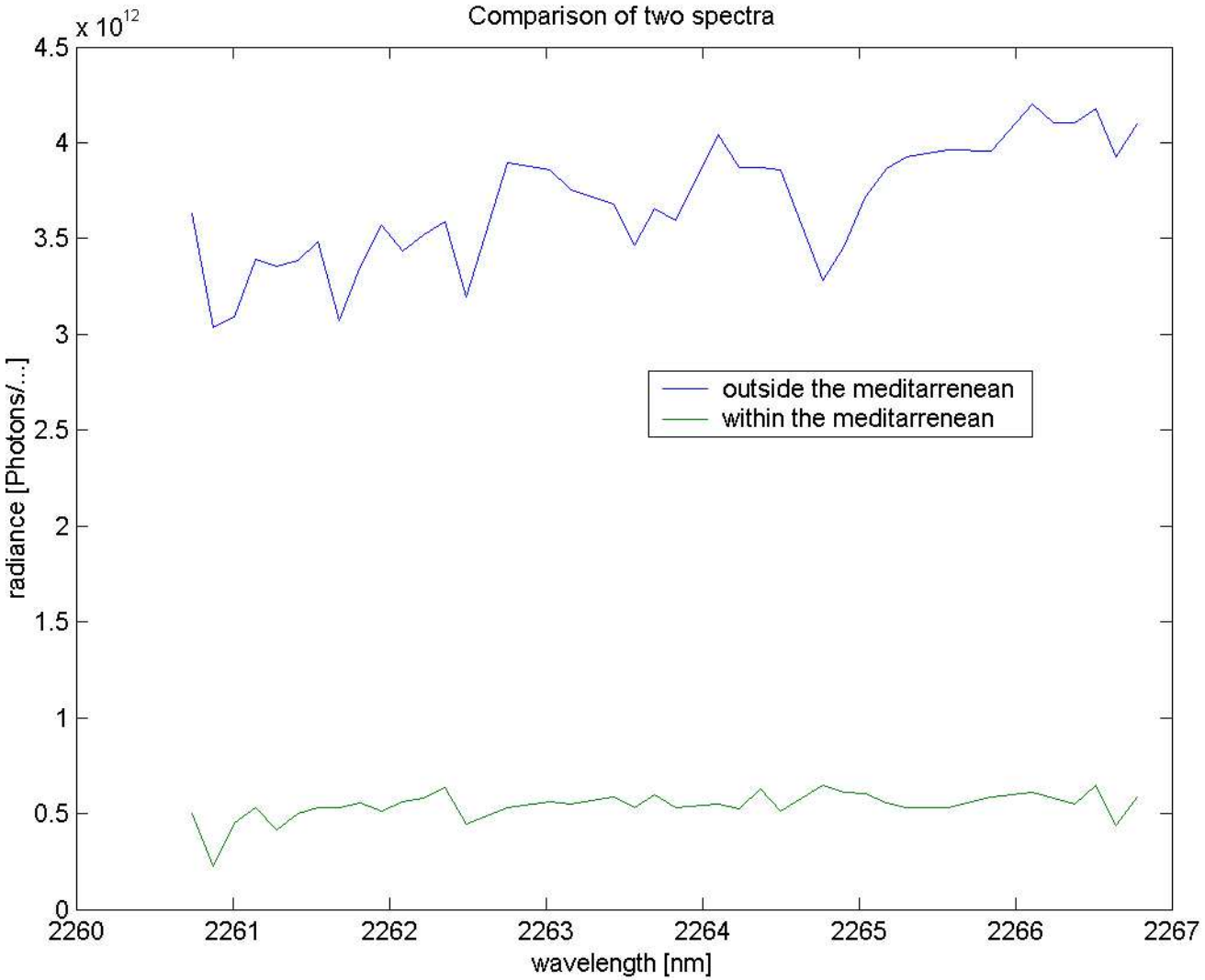
- Correlation indicates incorrect dark current correction
- Correlation is different using other spectral regions or orbits (dark current not quantifiable)

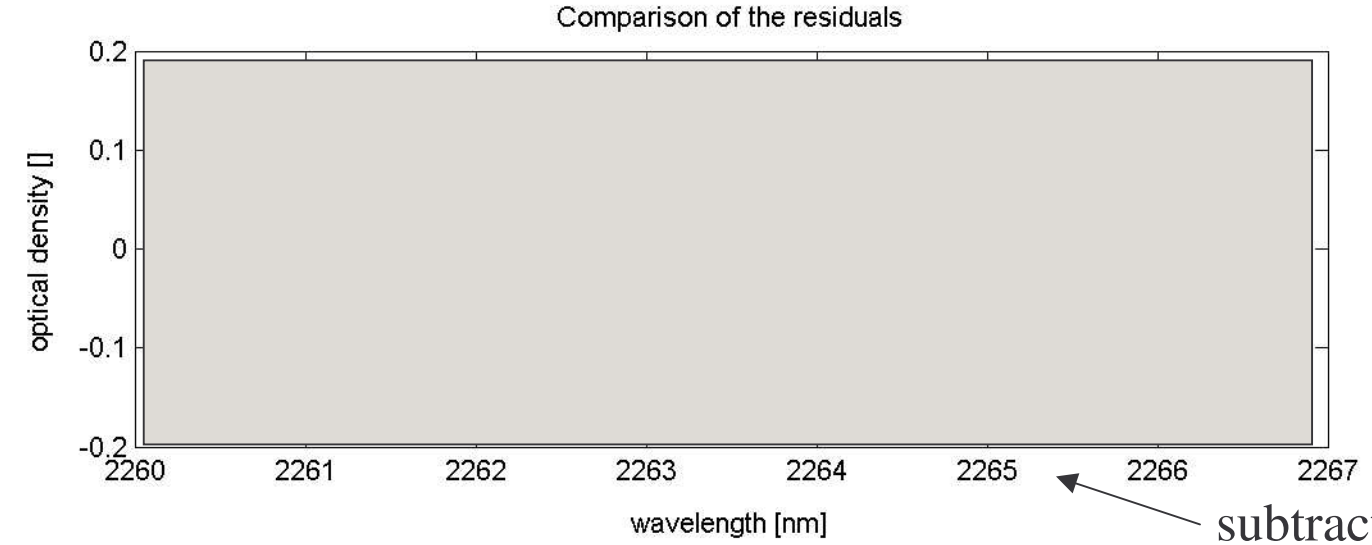
à This method will only be used for quality control

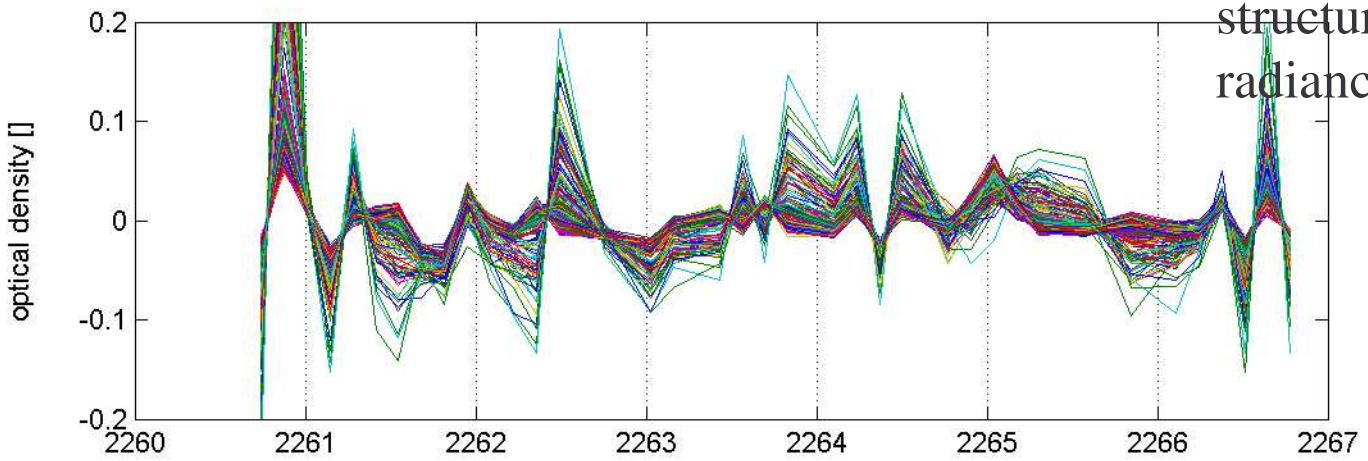
Retrieval problems [2]

- Over the Mediterranean the radiance is quite low and no absorption structures are identifiable
- However there is a spectral structure in these spectra (Why?)

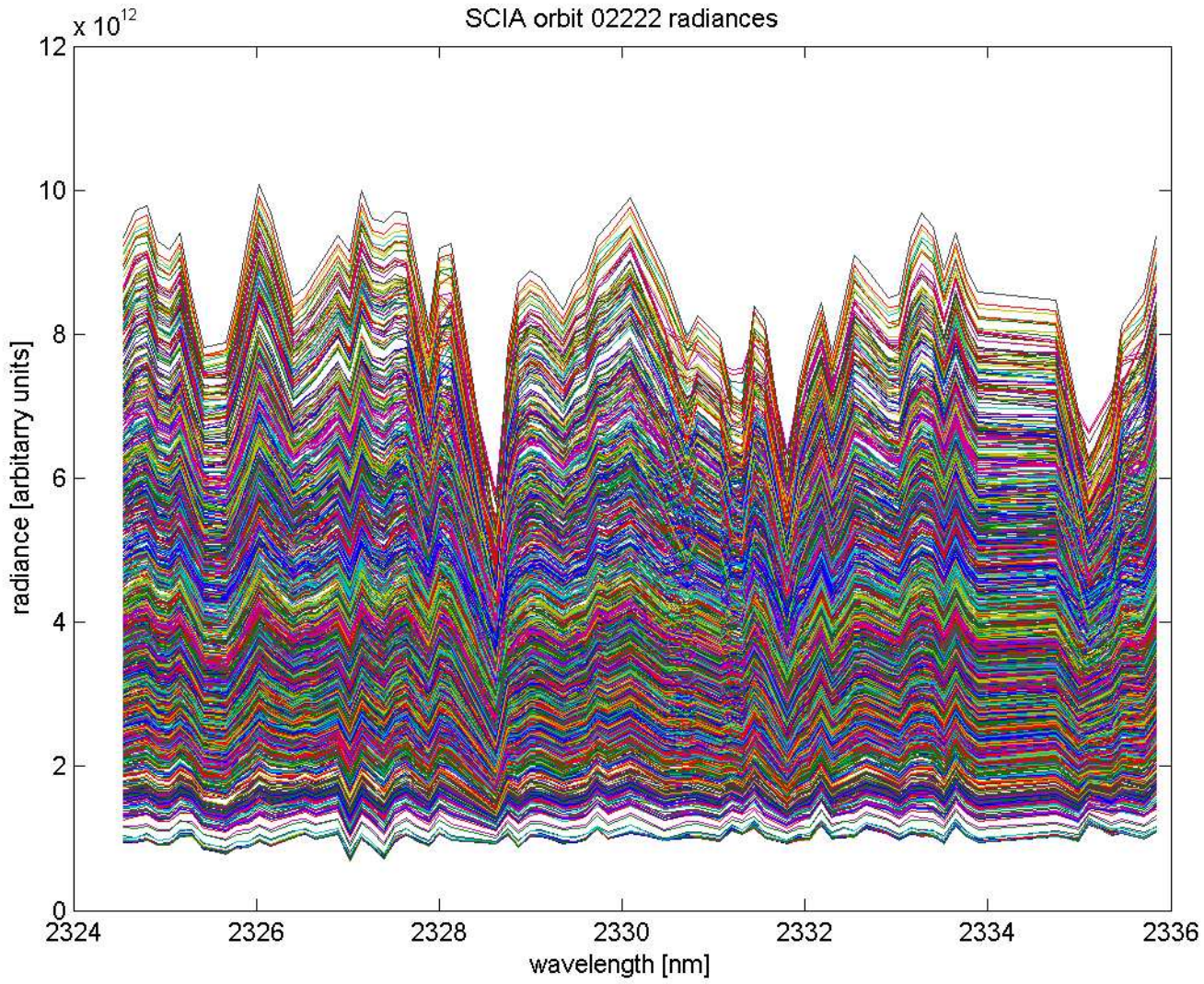
- Residuals are typically quite high and correlate with these structures!!


Comparison of two spectra
x 10^12
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
radiance [Photons/...]
2260
2261
2262
2263
2264
2265
2266
2267
wavelength [nm]
outside the meditarrenean
within the meditarrenean





subtracting the structure from the radiance

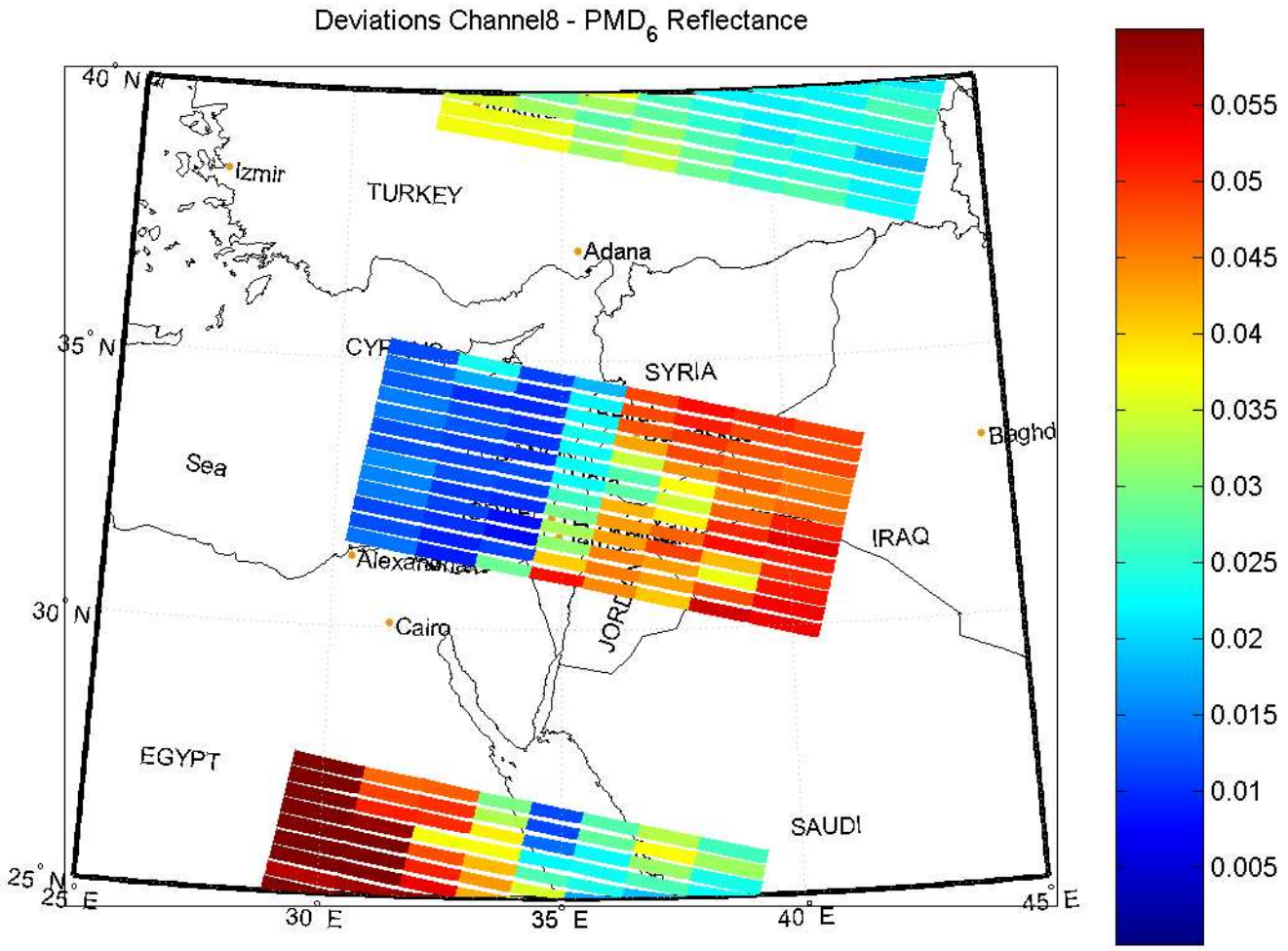

SCIA orbit 02222 radiances
x 10^12
radiance [arbitarry units]
wavelength [nm]
0
2
4
6
8
10
12
2324
2326
2328
2330
2332
2334
2336

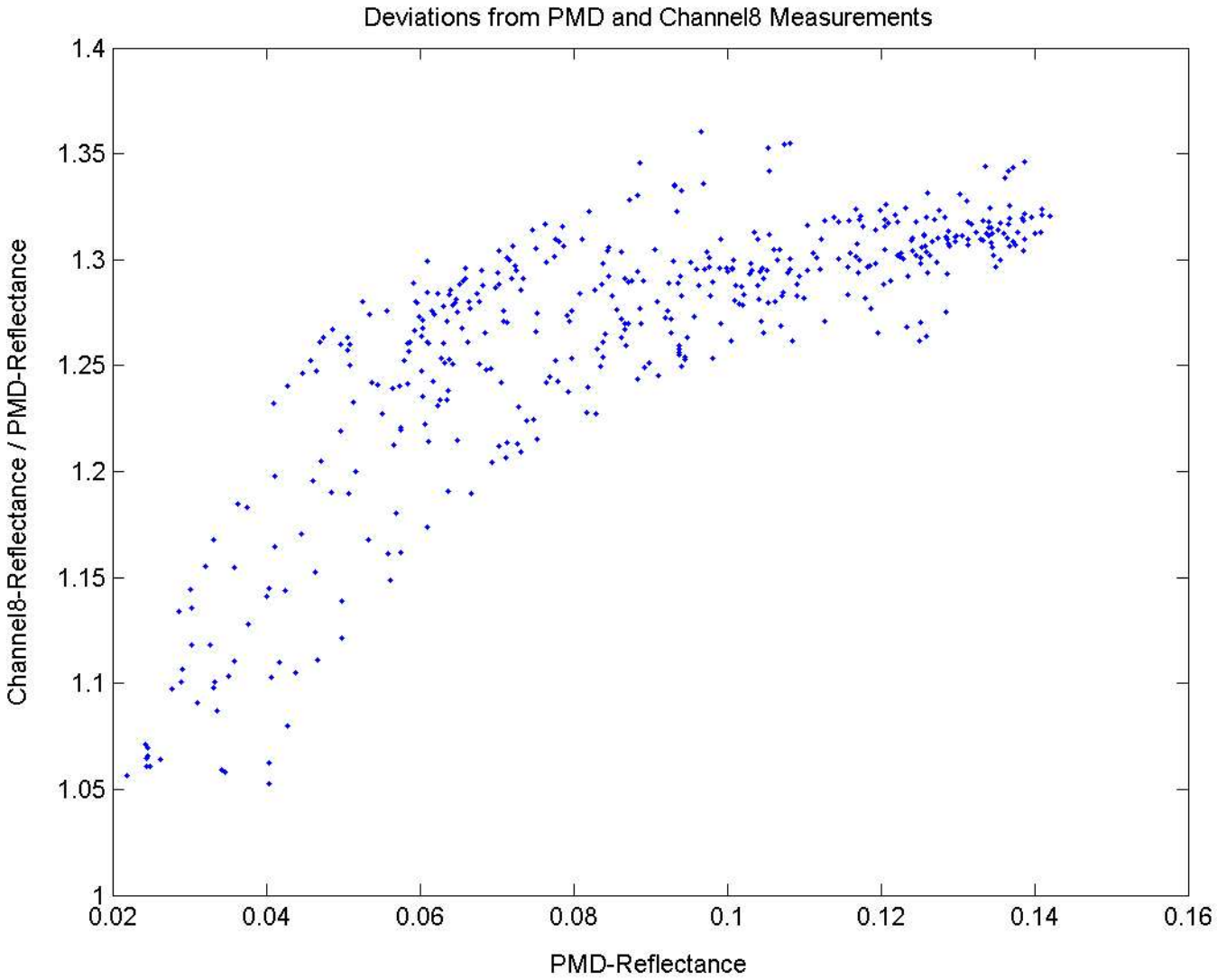
Retrieval problems [2]

- Residuals consists of a strongly varying and a relatively stable part
- Varying part due to an incorrect dark current correction (with spectral structure as seen before) ?!
- Stable part cannot be explained by dark current or wrong absorber profiles, but by wrong sun reference or gain factors ?!
- Retrieval over oceans possible (with low SZA)??

Retrieval problems [3]

- Reflectances determined from PMD_6 deviate from Channel 8 mean reflectances (same wavelength region)
- PMD reflectance quite low (wrong reference?)
- also indicates wrong dark current correction


Deviations Channel8 - PMD6 Reflectance
40° N
35° N
30° N
25° N
25° E
30° E
35° E
40° E
45° E
Izmir
TURKEY
Adana
SYRIA
Sea
Baghd
IRAQ
Alexandria
Cairo
EGYPT
SAUDI
0.055
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005


Deviations from PMD and Channel8 Measurements
Channel8-Reflectance / PMD-Reflectance
PMD-Reflectance
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16

Conclusion & Questions

- Calibration still bad (will it improve, what will improve?)
- Residual structures (at least the varying part) are time dependent (due to icing? problem solvable in the near future?)
- Albedo over water surface at low SZA‘s too low for sensible retrieval (the same holds for ice)??
- Reflecting properties of surfaces, clouds in the NIR totally different from UV/VIS

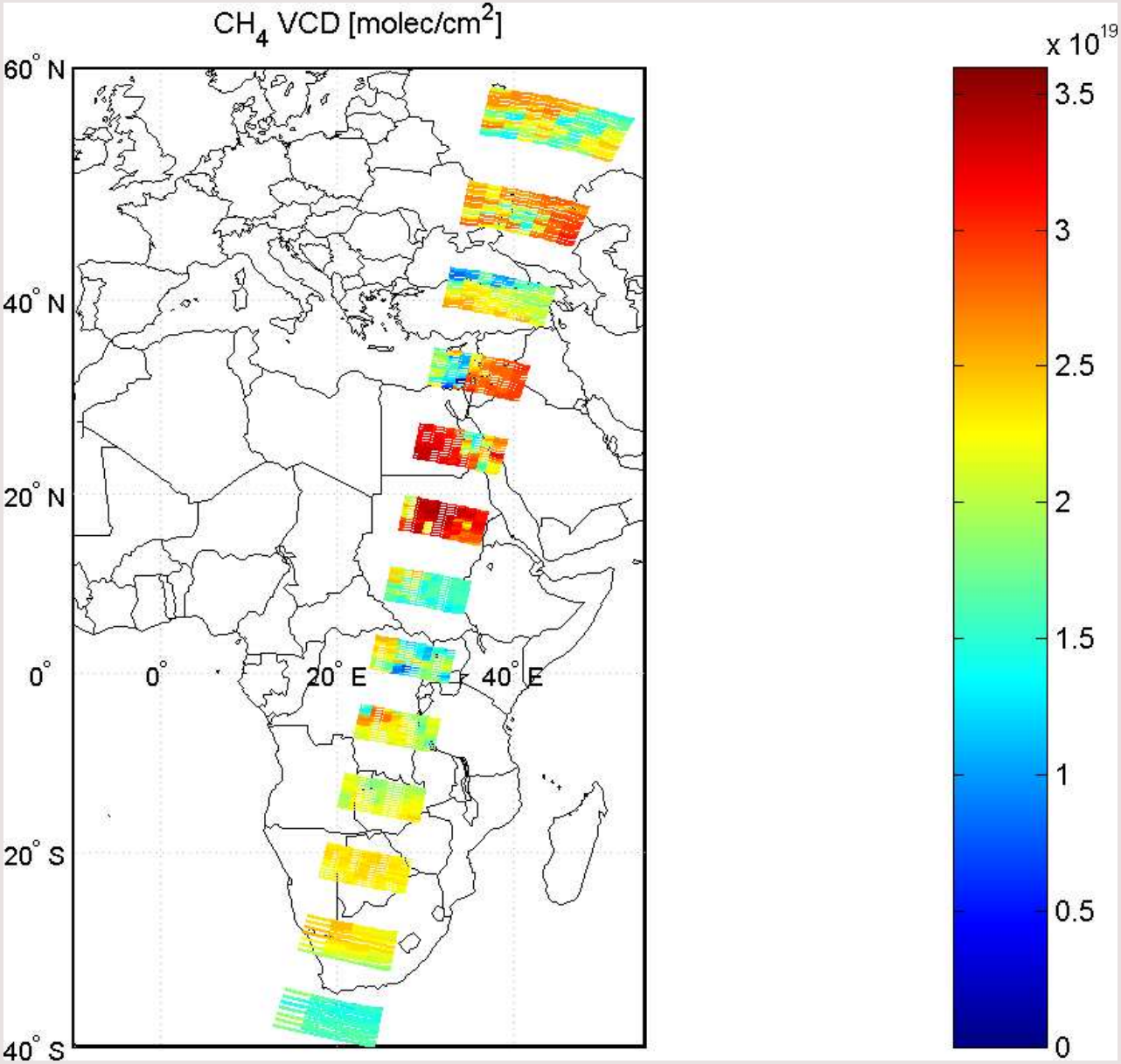
Conclusion & Questions (2)

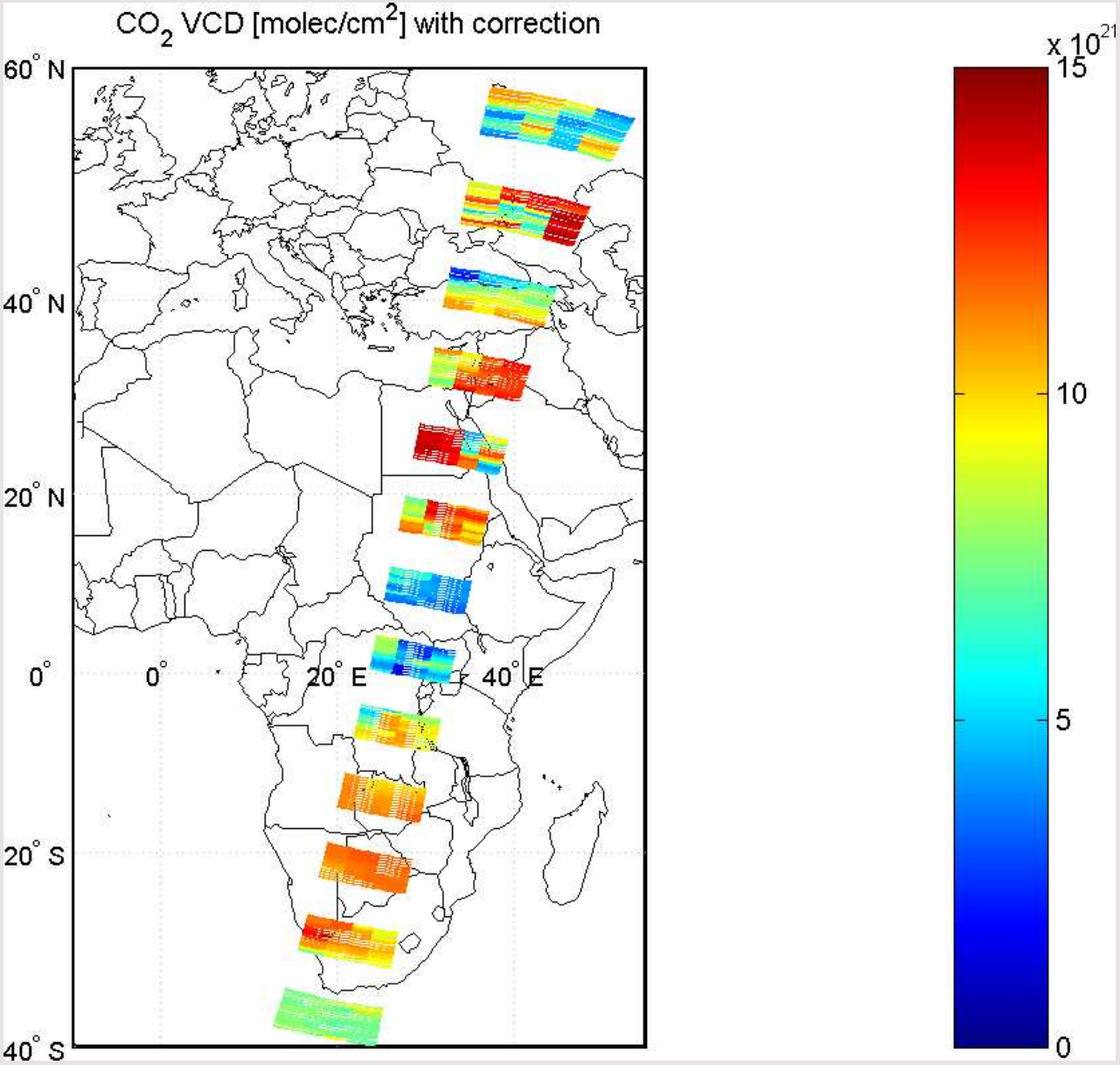
- use as little DOAS-fit parameters as possible (we try not to fit mean residuals but take them into account before DOAS fit)
- CO absorption structures not identifiable with the nacked eye (but the retrieval nearly always yields positive VCD‘s)
- PMD – Channel8 comparison suitable for determining dark current offset?

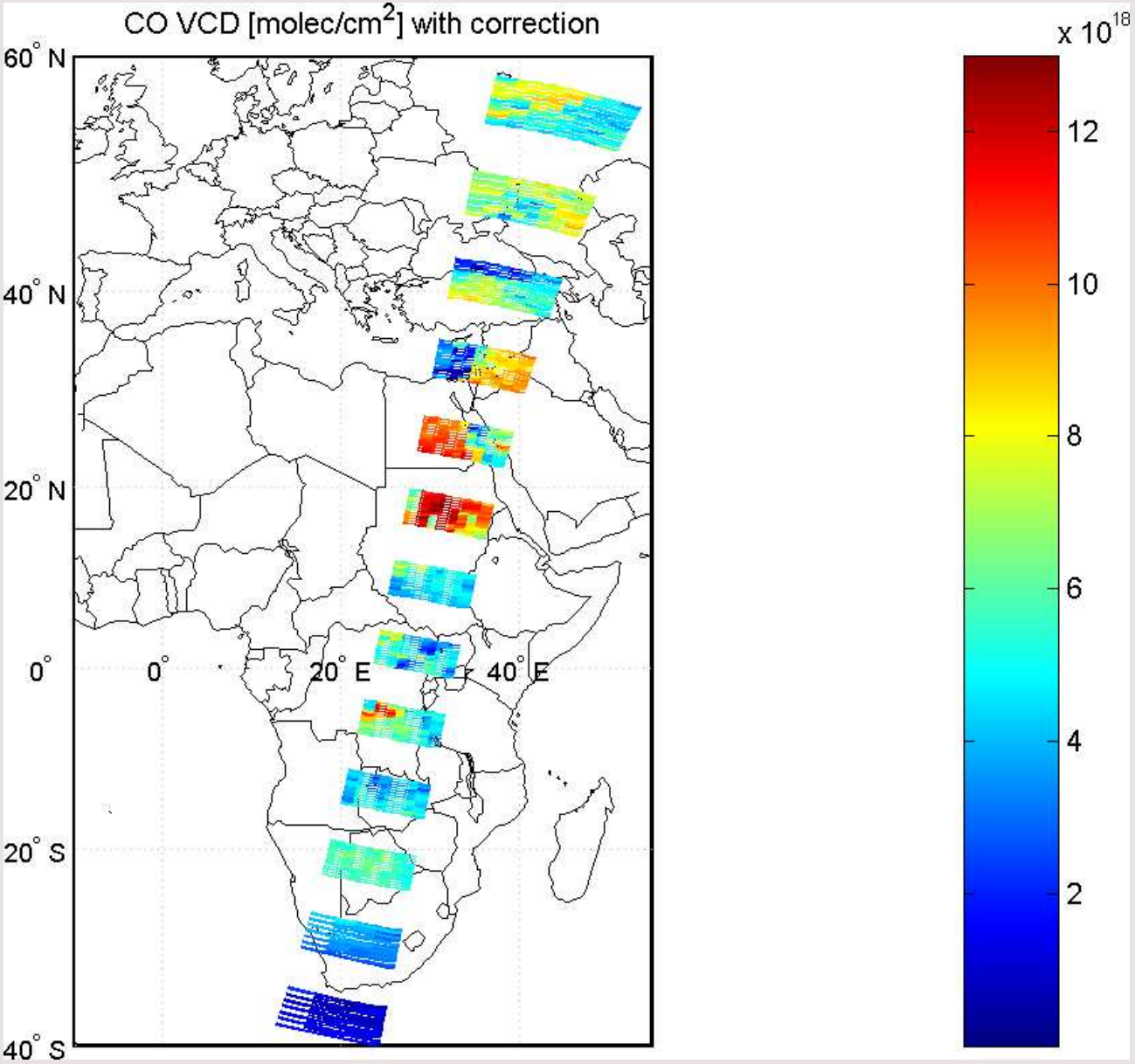
Near-Future plans

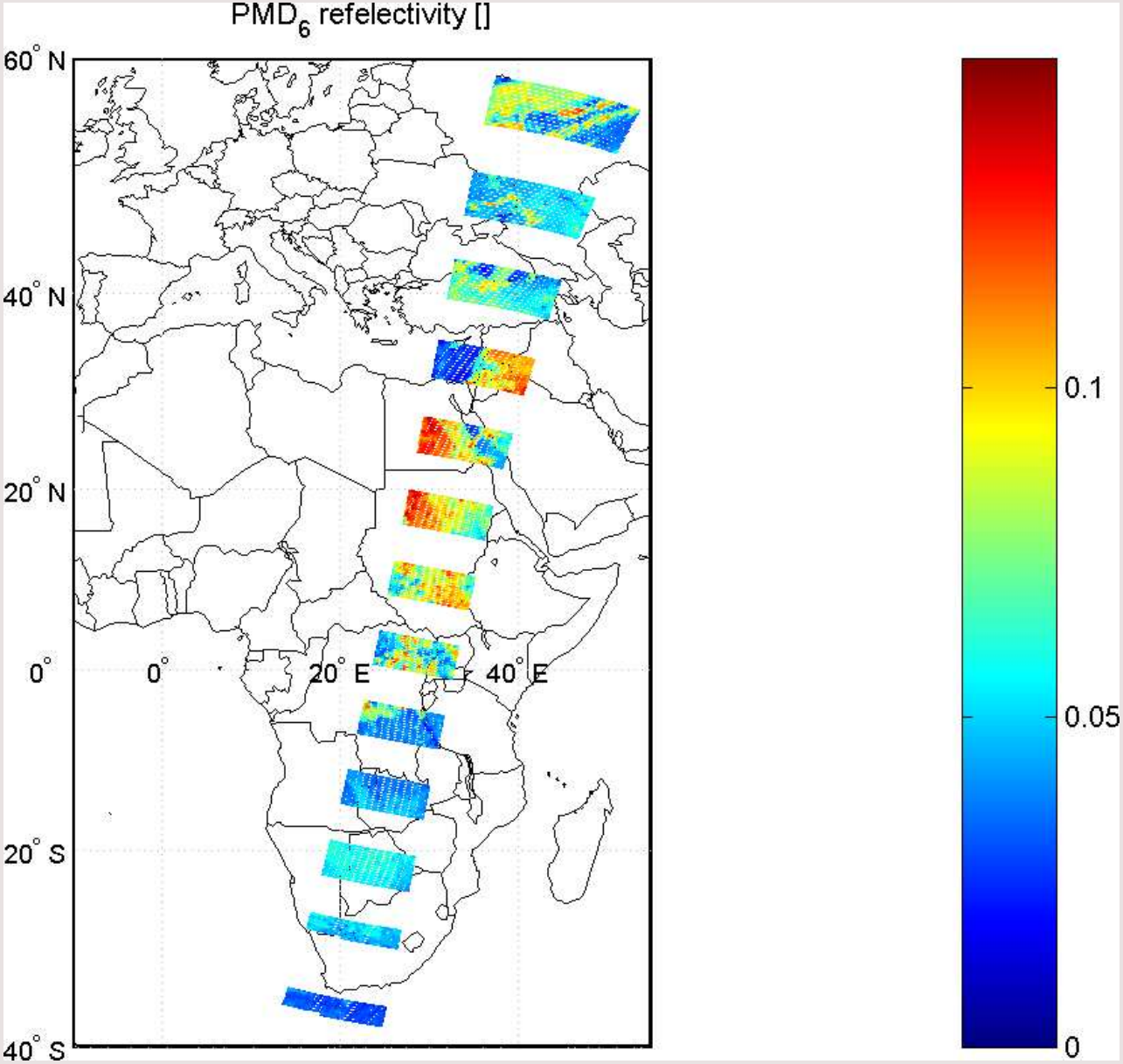
- Optimizing convolution parameters (voigt shape)
- examinig influence of changing atmospheric concentration-profiles, extreme temperature&pressure profiles
- using elevation information
- identifying CO
- using relational database for results storage and management

The preliminary end...

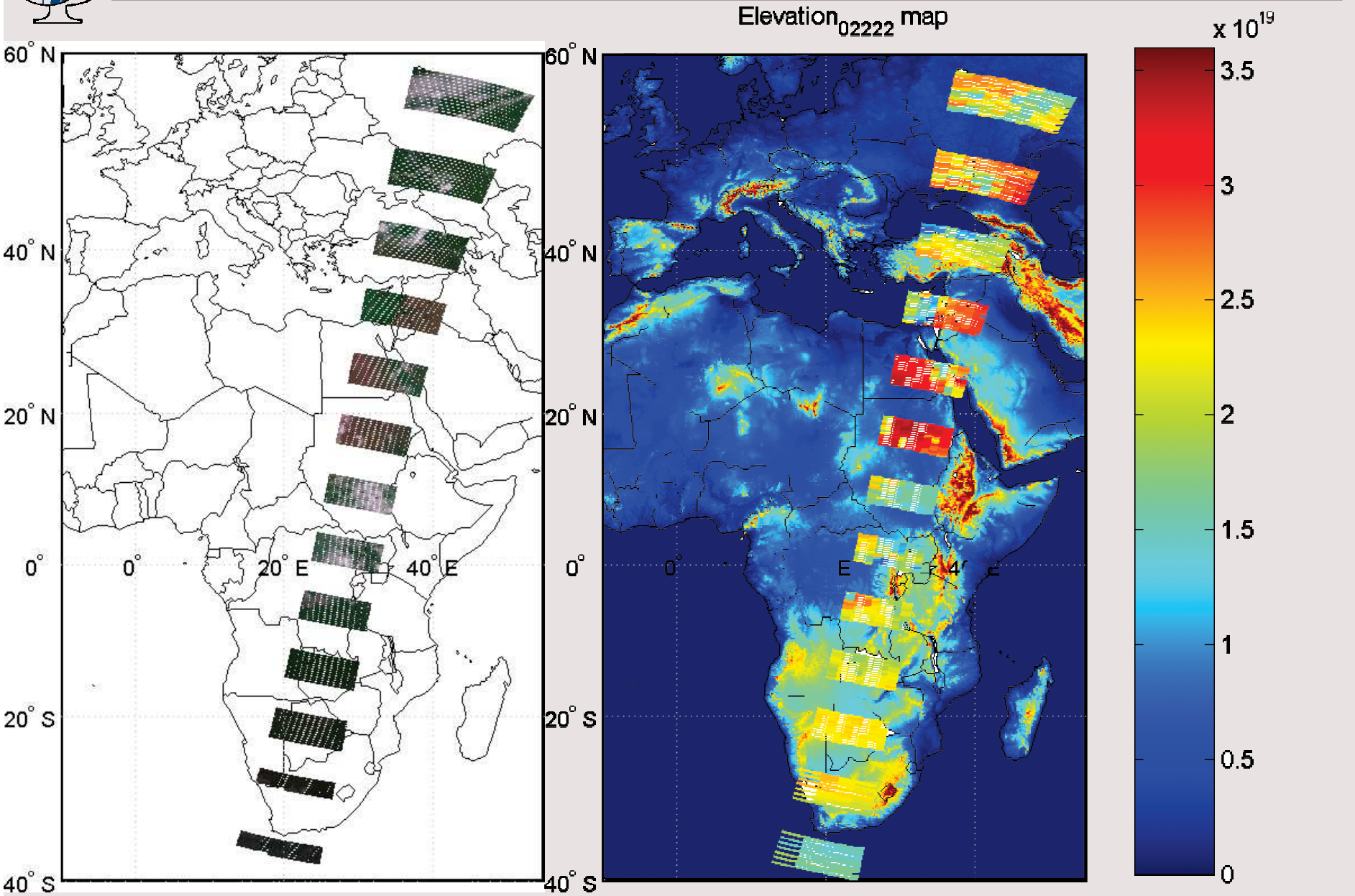

CH4 VCD [molec/cm2]
60° N
40° N
20° N
0°
20° S
40° S
0°
20° E
40° E
x 10^19
3.5
3
2.5
2
1.5
1
0.5
0

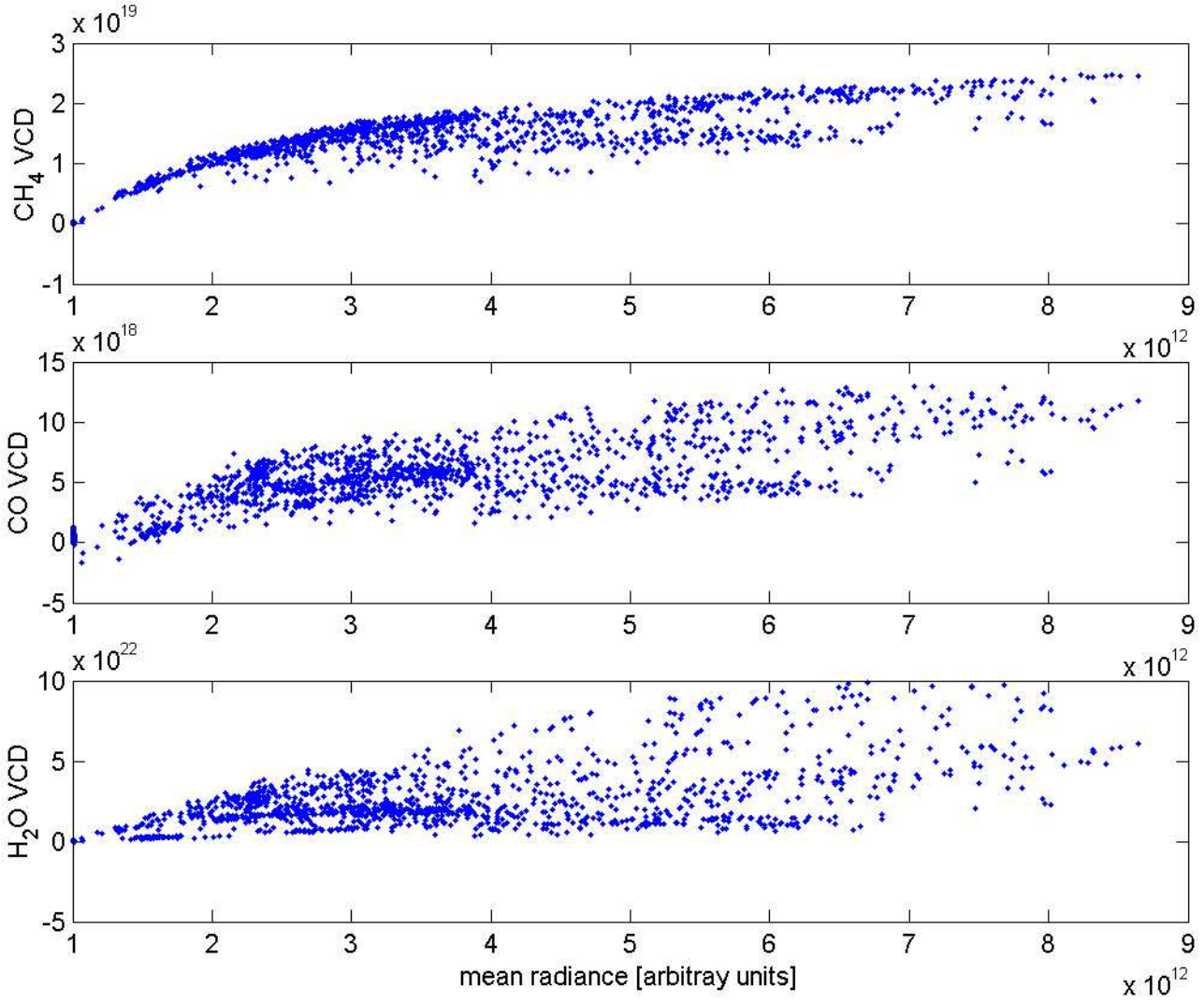

CO2 VCD [molec/cm2] with correction
60° N
40° N
20° N
0°
20° S
40° S
0°
20° E
40° E
x 10^21
15
10
5
0

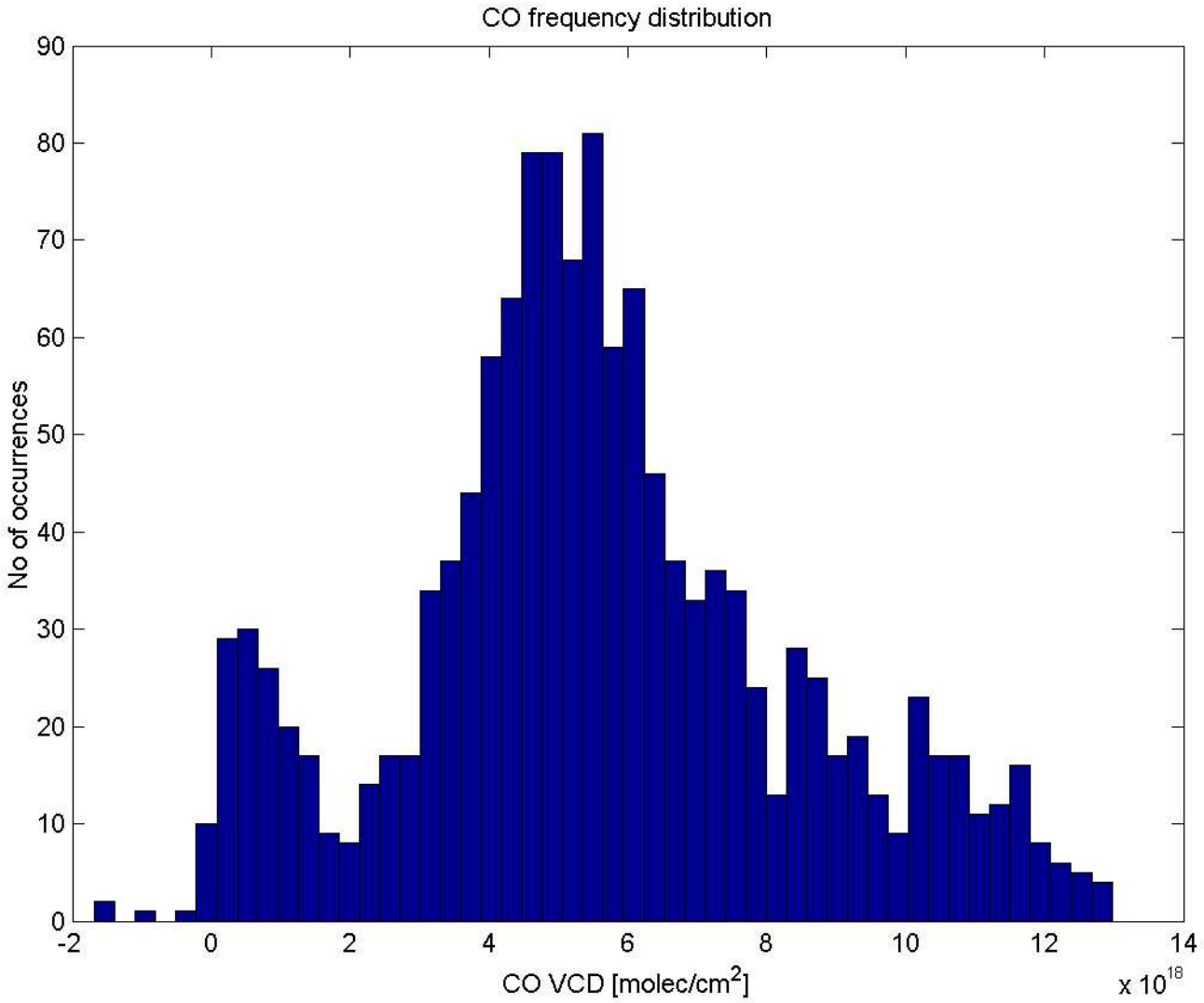

CO VCD [molec/cm^2] with correction
60° N
40° N
20° N
0°
20° S
40° S
0°
20° E
40° E
x 10^{18}
12
10
8
6
4
2

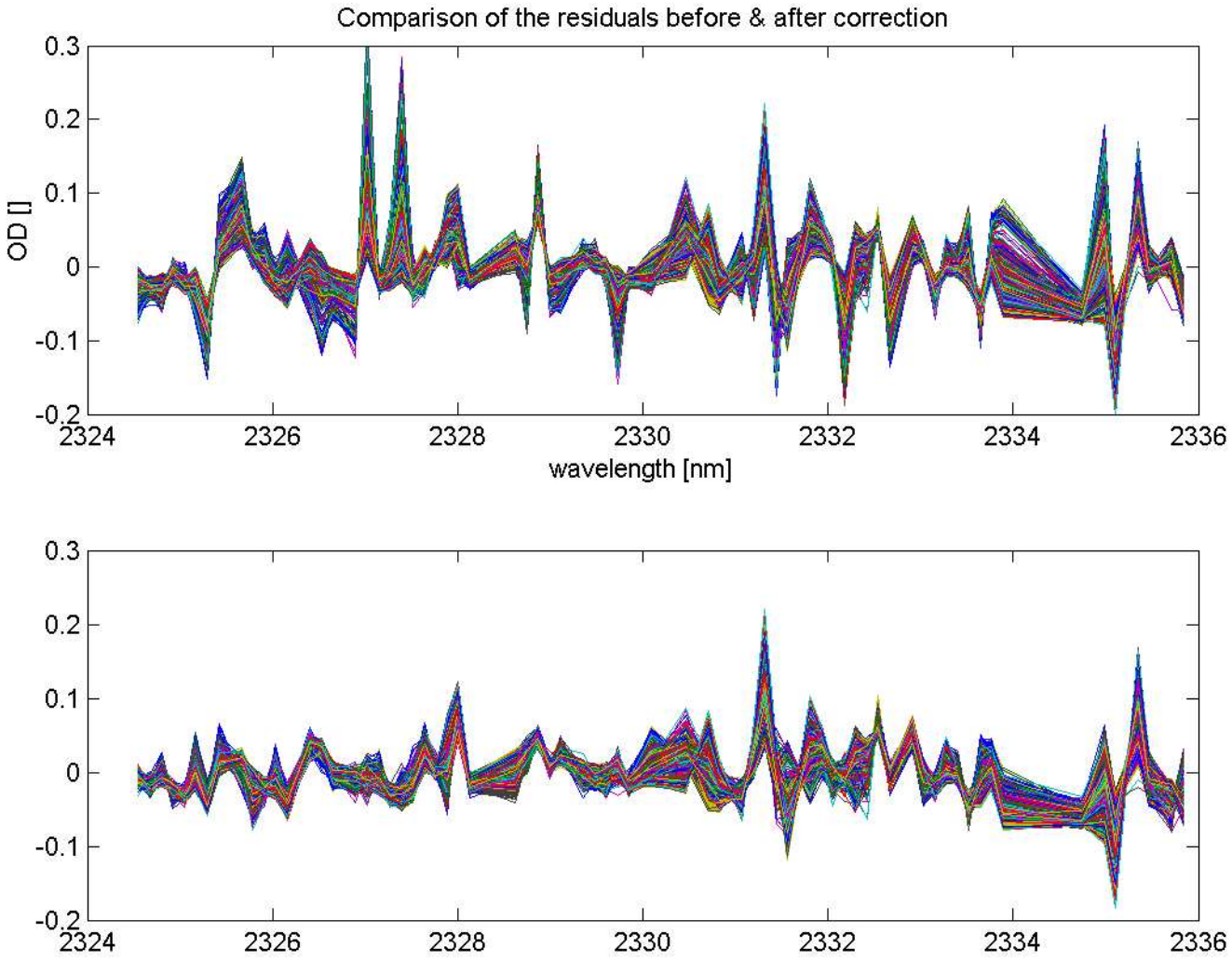

PMD6 refelectivity []
60° N
40° N
20° N
0°
20° S
40° S
0°
20° E
40° E
0.1
0.05
0

CH_4 VCD's


Elevation02222 map
60° N
40° N
20° N
0°
20° S
40° S
0°
20° E
40° E
x 10^19
3.5
3
2.5
2
1.5
1
0.5
0


x 10^19
CH4 VCD
x 10^18
CO VCD
x 10^12
x 10^22
H2O VCD
x 10^12
mean radiance [arbitray units]
x 10^12


CO frequency distribution
No of occurrences
CO VCD [molec/cm2]
x 10^18
0
10
20
30
40
50
60
70
80
90
-2
0
2
4
6
8
10
12
14


Comparison of the residuals before & after correction
OD []
wavelength [nm]
0.3
0.2
0.1
0
-0.1
-0.2
2324
2326
2328
2330
2332
2334
2336