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Radiometri satellitari: potenzialità e limiti nelle valutazione di irraggiamento UV a terra e parametri sulla qualità dell'aria

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VI Convegno Nazionale Agenti Fisici
Alessandria, 6-8 giugno 2016

Outline

- OMI (Ozone Monitoring Instrument)
- O3 and solar UV radiation at surface
- Air quality monitoring: NO2
- Volcanic emissions monitoring: SO2

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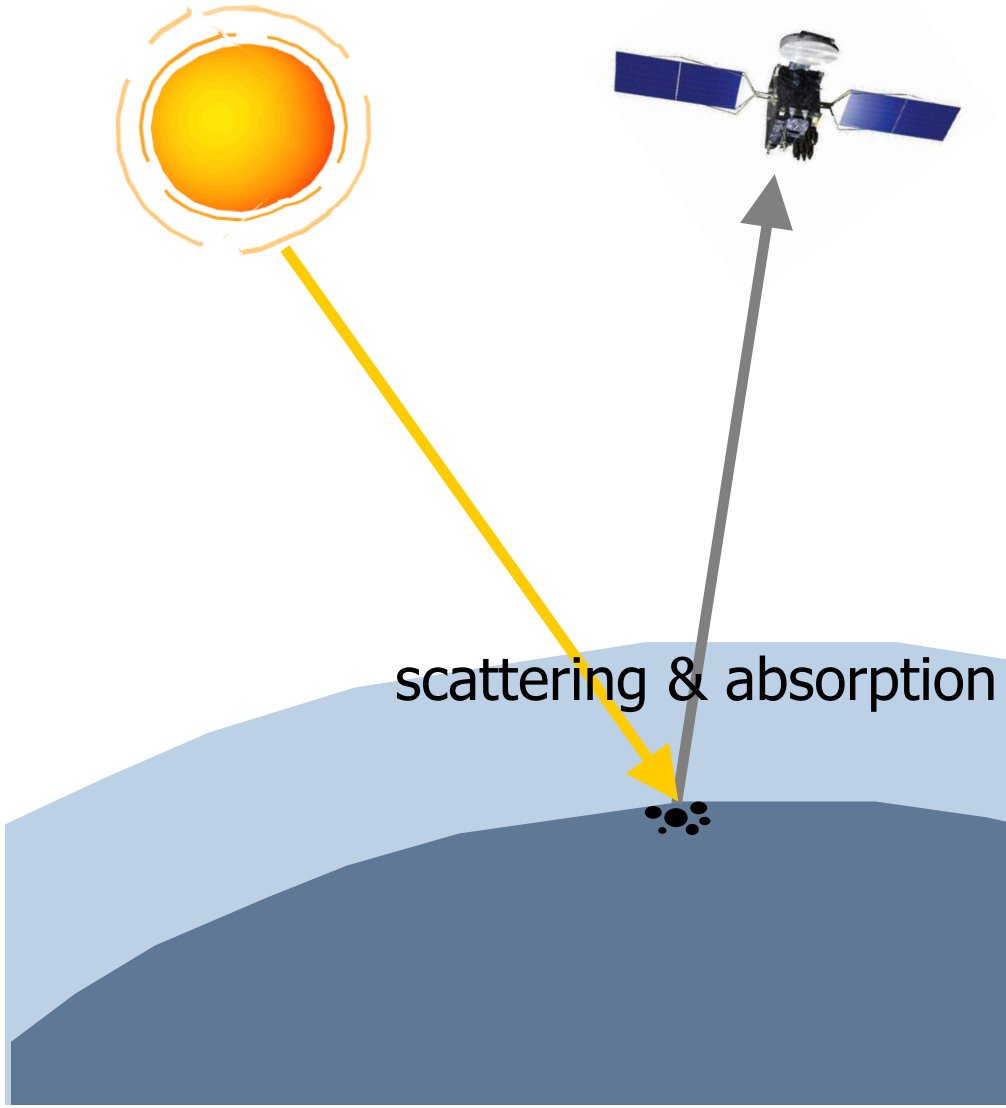
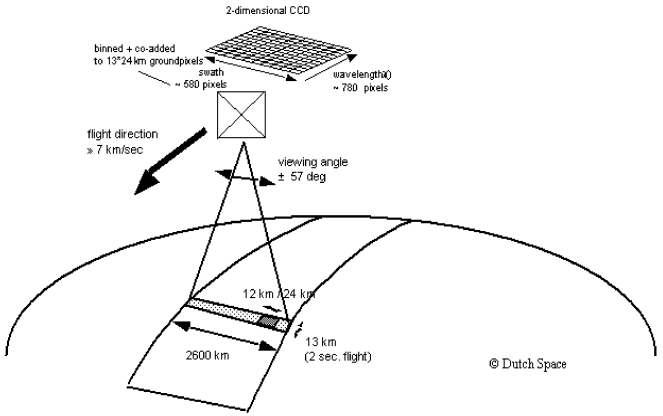
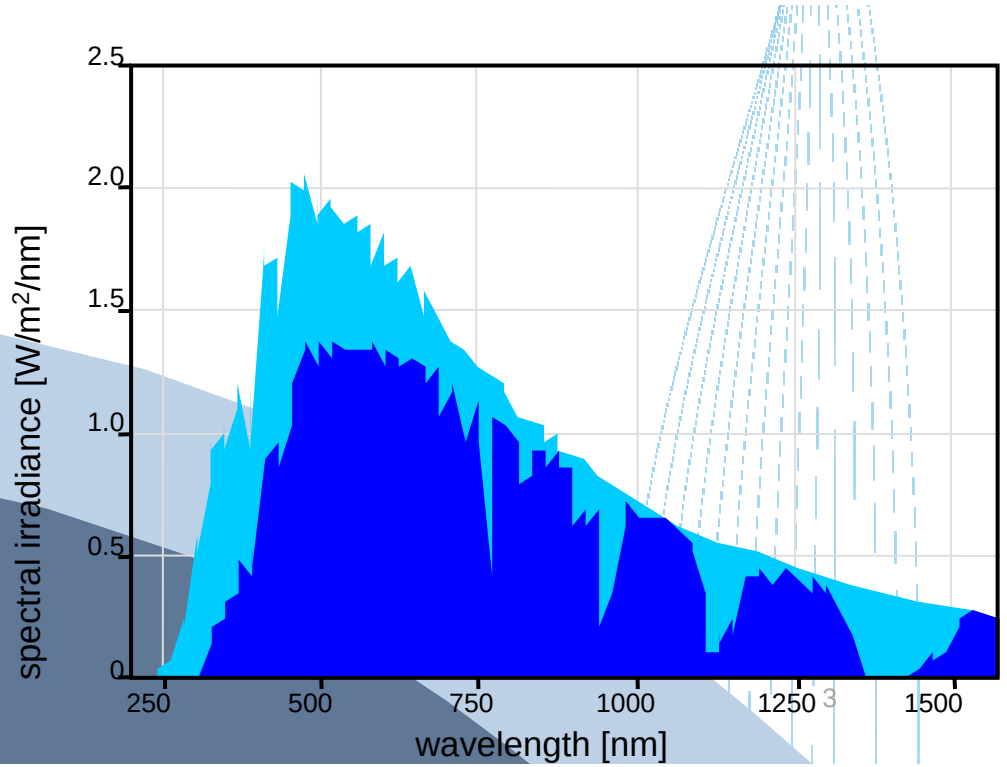
OMI

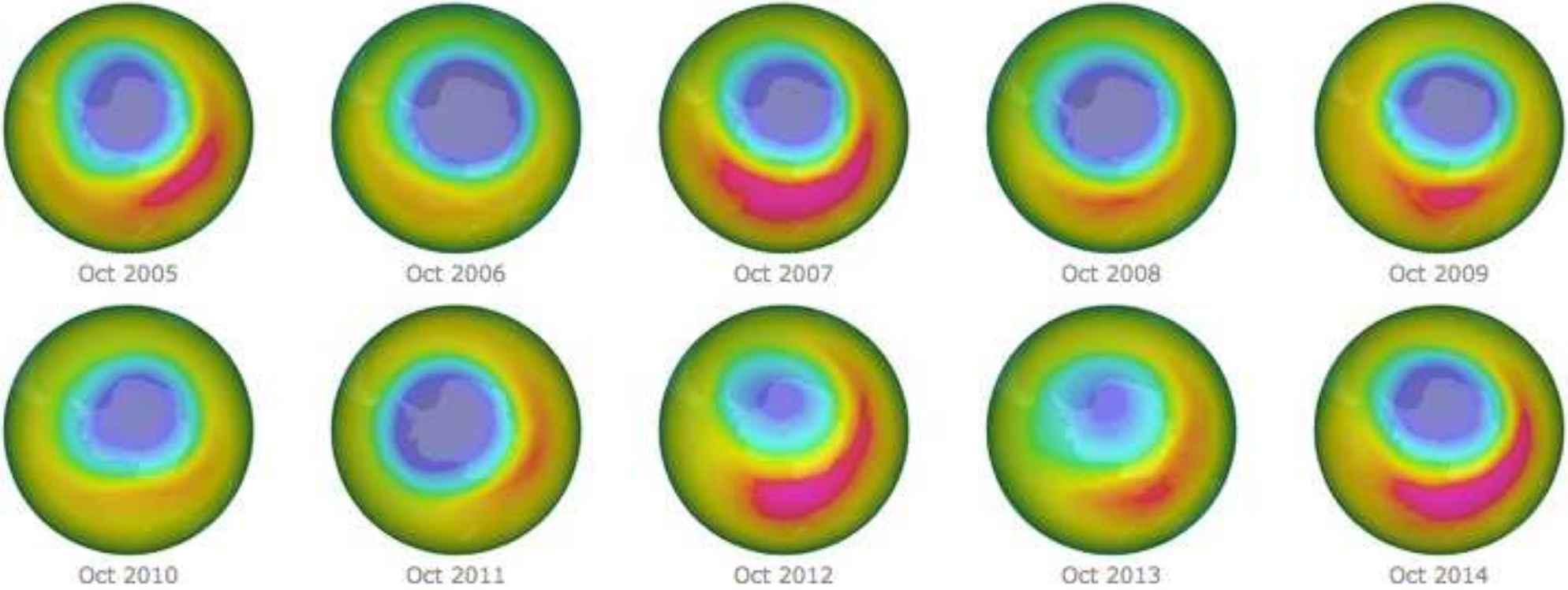
Ozone Monitoring Instrument







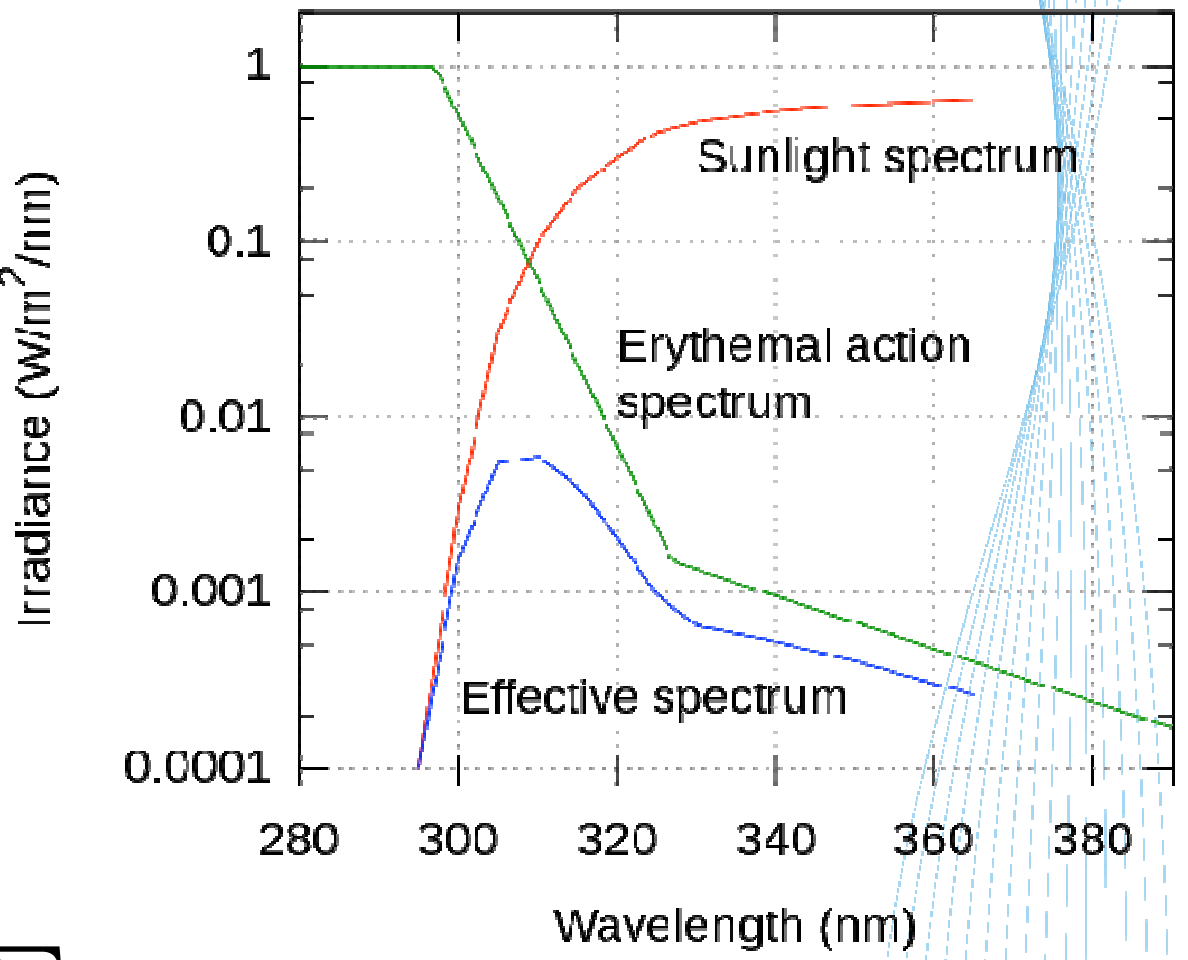
OMI total ozone (O3)



Erythemal dose rate

$$EDR = \int_{280nm}^{400nm} S(\lambda) I(\lambda) d\lambda$$

$I(\lambda)$ -> solar energy reaching the surface per unit area and wavelength



Erythemal Daily Dose

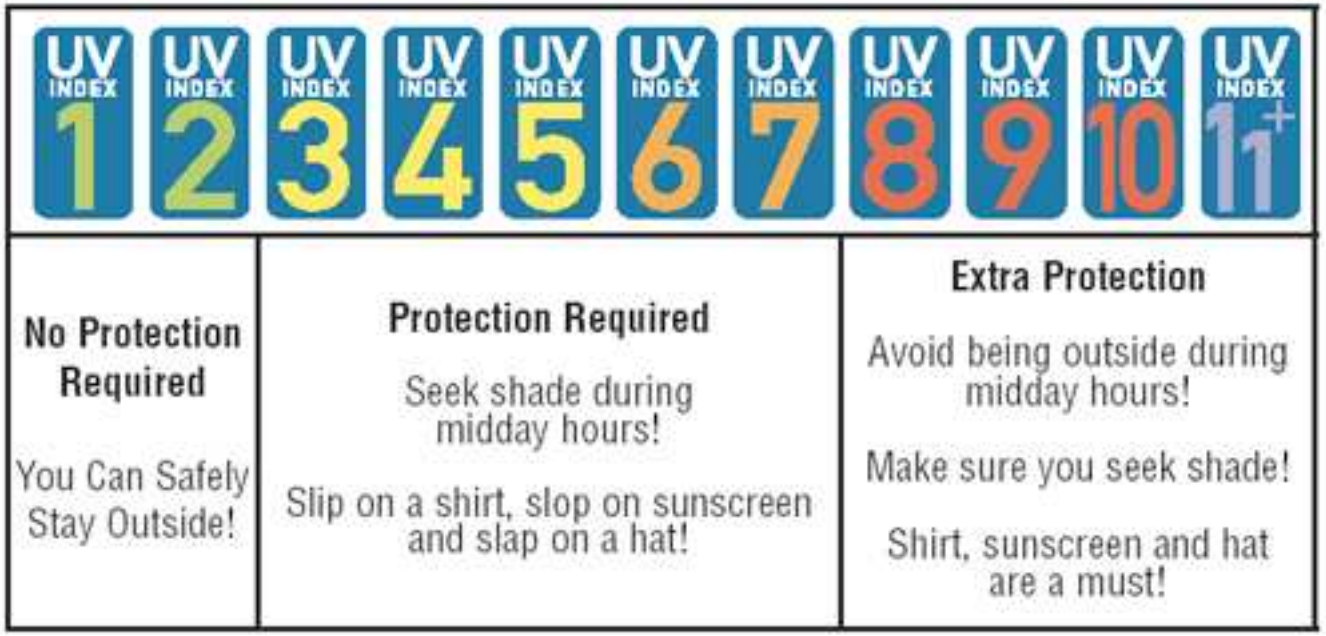
$$EDD = \int EDR(t)dt = \sum EDR(t)\Delta t$$

UV INDEX

It describes the level of solar UV radiation at the Earth's surface in respect to human health.

$$UV\ Index = k_{ery} \cdot \int_{250nm}^{400nm} E(\lambda) \cdot w(\lambda) \cdot d\lambda$$

k_{ery}=40 m²/W



OMI UV products

UV: Ecloud = Eclear * C_T

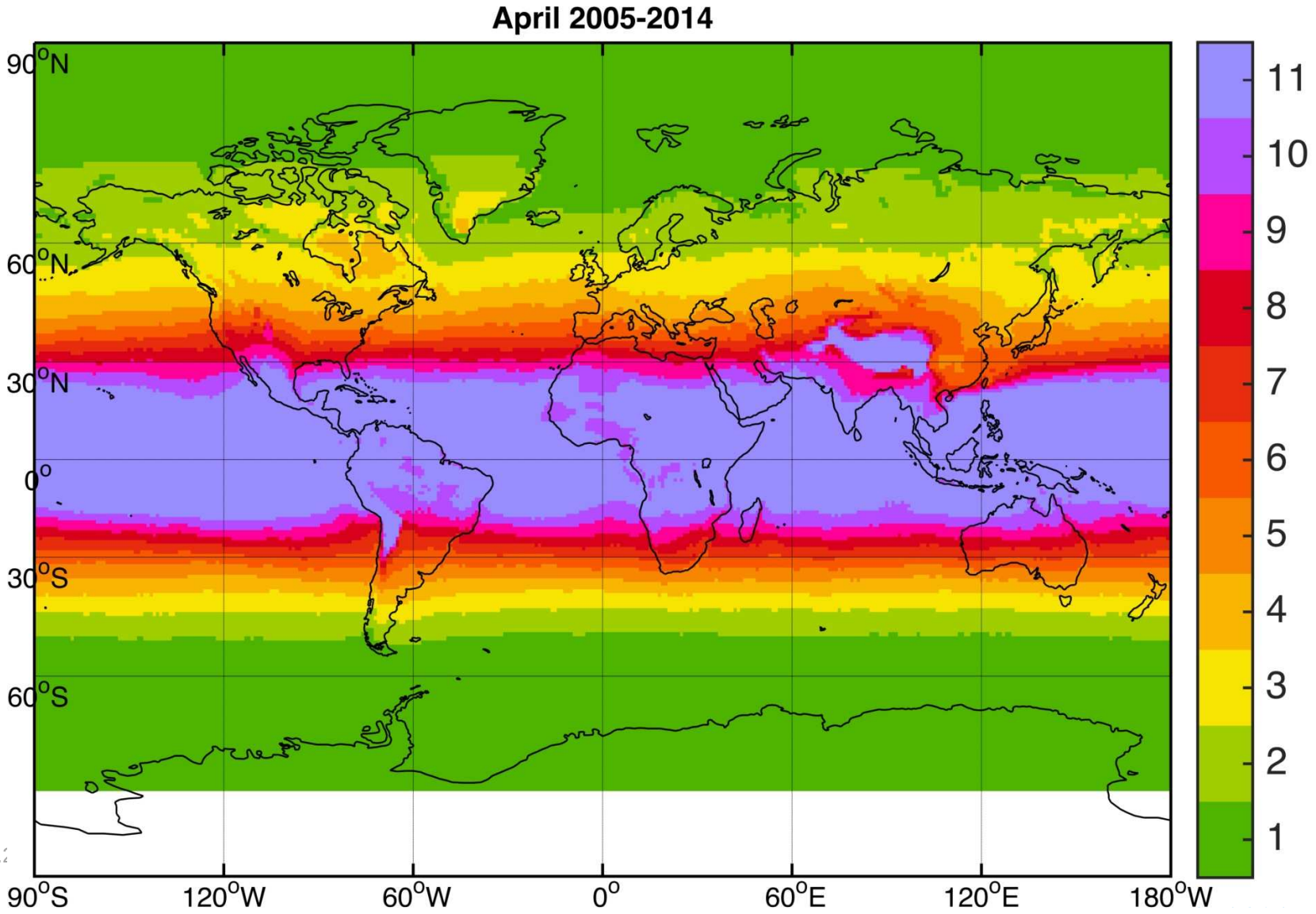
C_T = cloud-aerosol (no absorption) transmittance factor = (1-LER)/(1-SA)

where LER = Lambertian Equivalent Reflectivity
and SA = Surface Albedo (TOMS climatology)

Products:

- **spectral irradiance at 305.1, 310.1, 324.1 nm and EDR/UVI at noon and OMI overpass time**
- **EDD**

OMI UVI


April 2005-2014
90°N
60°N
30°N
0°
30°S
60°S
90°S
120°W
60°W
0°
60°E
120°E
180°W
11
10
9
8
7
6
5
4
3
2
1
UV index

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Validation

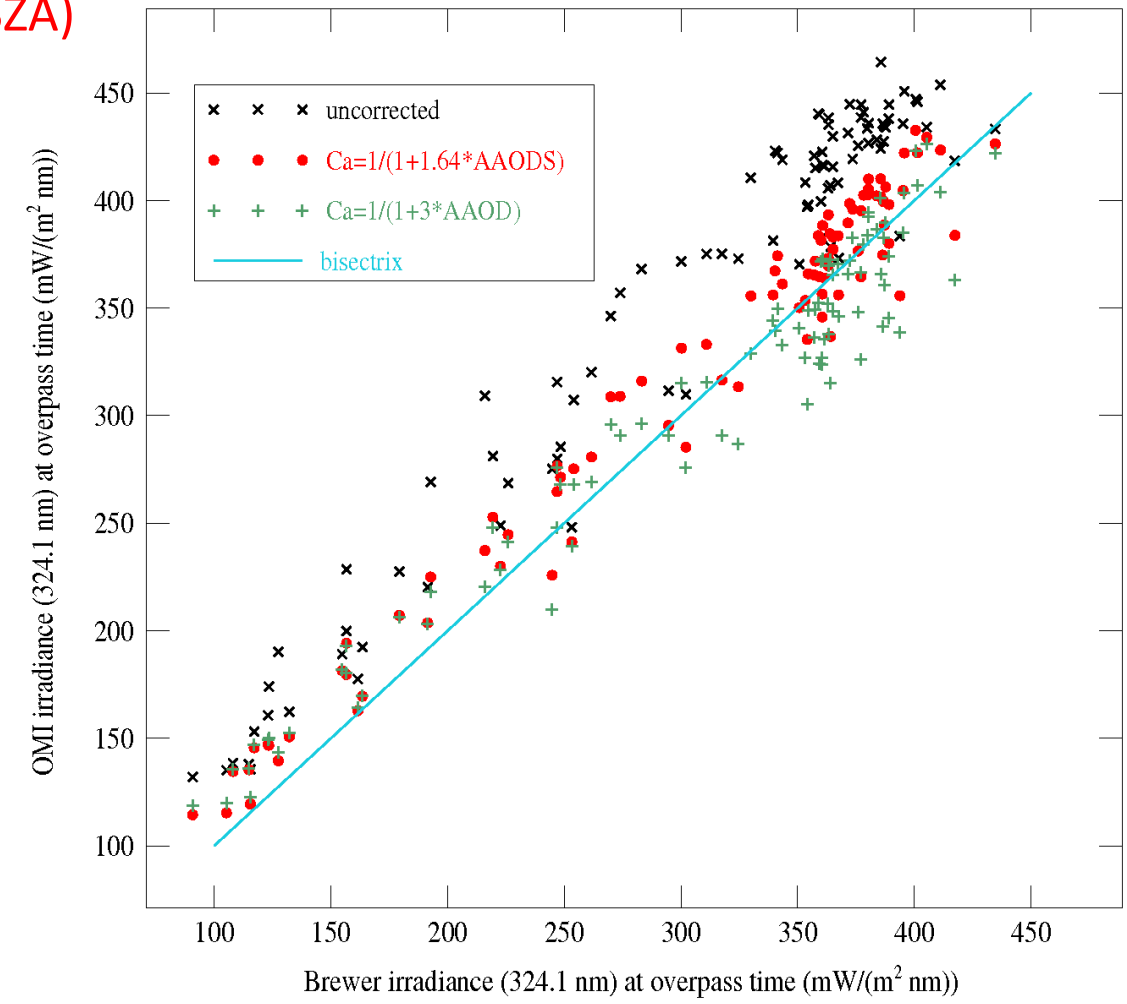
$$E_{CORR} = C_A \cdot E_{CLOUD}$$

1. $C_A = 1/(1+s \cdot AAOD)$; s=slope
2. $C_A = 1/(1+s \cdot AAODS)$; AAODS=AAOD/cos(SZA)
3. $C_A = 1/(1+3 \cdot AAOD)$; Krotkov et al., 2005

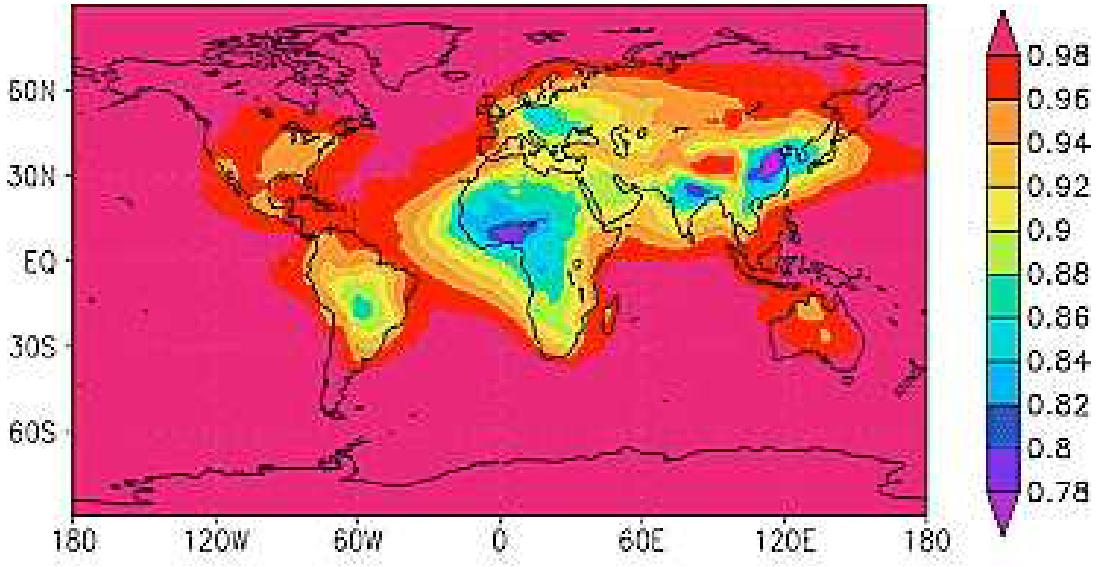
Irradiance 324nm

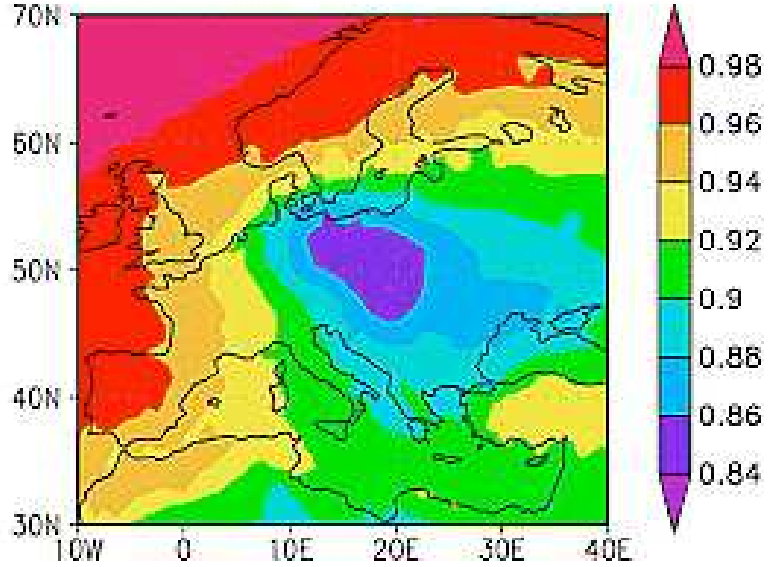
$1/C_A$	s	bias	SD
1	-	17.7	10.2
1+s·AAOD	1.32	9.9	9.1
1+s·AAODS	1.64	5.8	7.4
1+3·AAOD	3	1.6	9.7

bias reduced by 10-15%
smaller bias for method 3;
smaller SD for method 2



Absorbing aerosol correction





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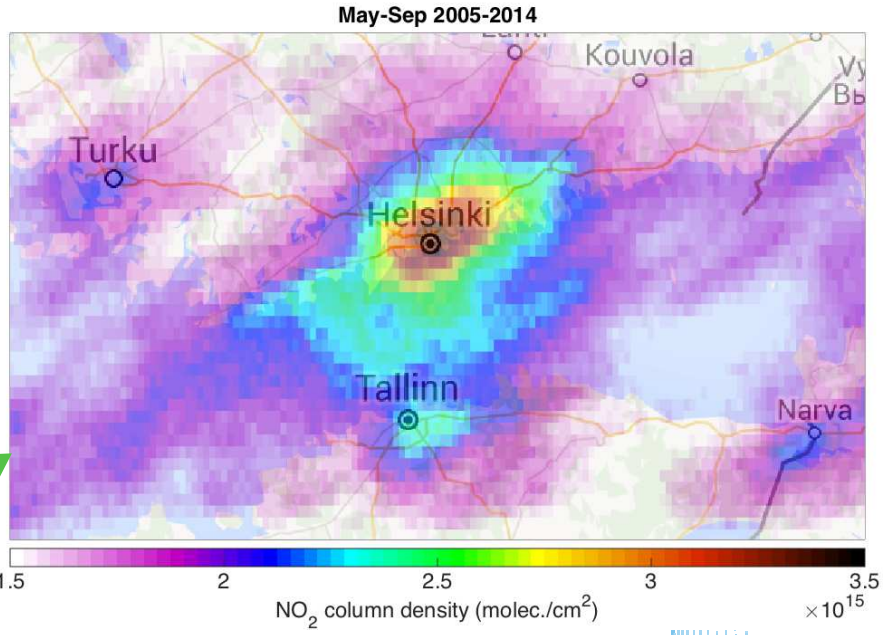
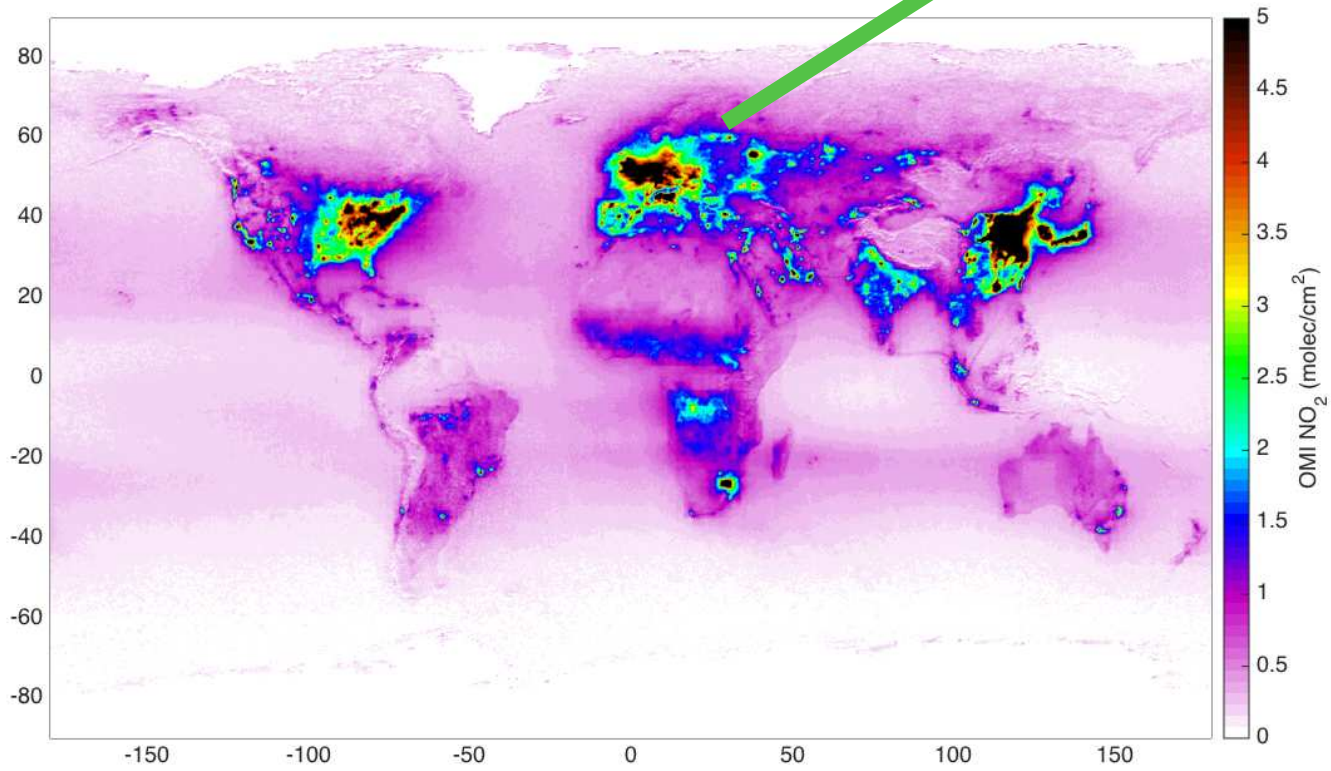
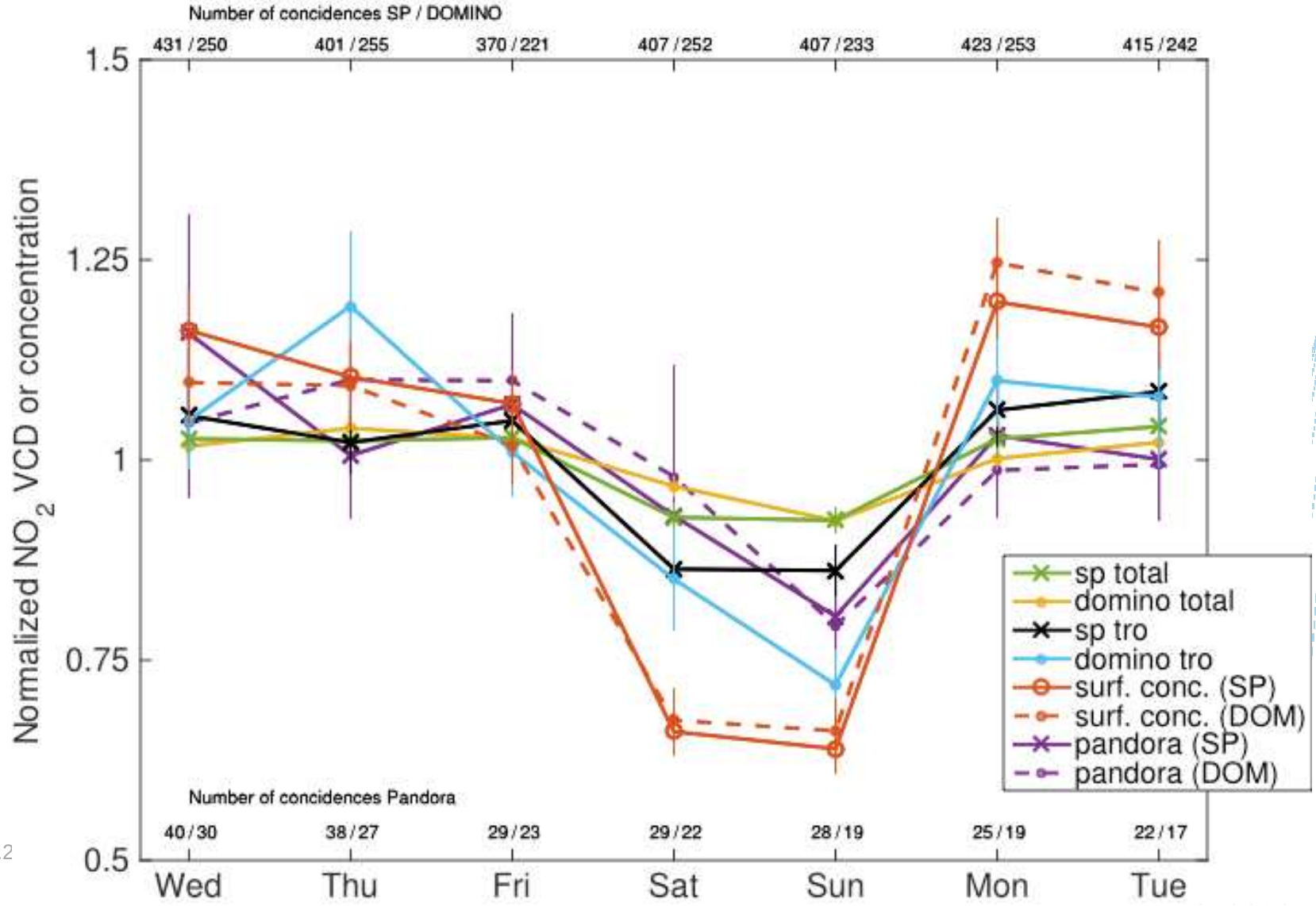
OMI NO2 observations



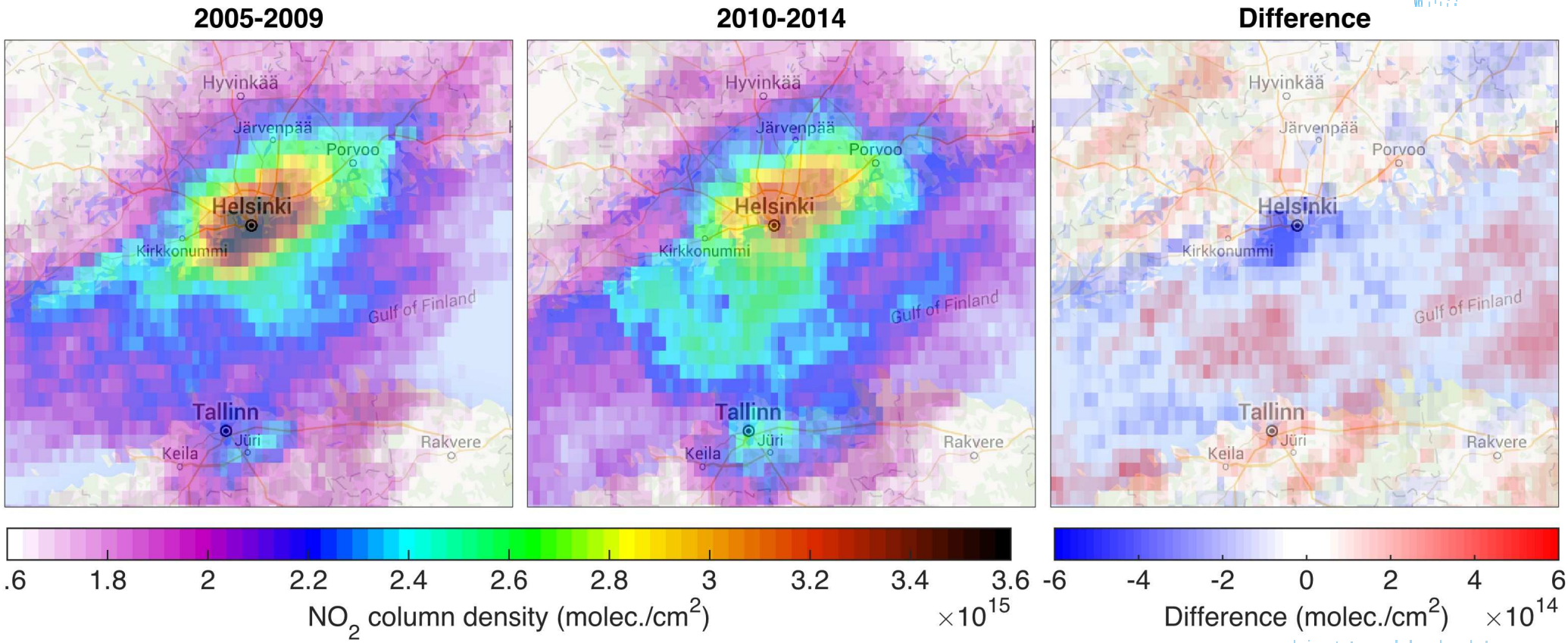


NO2 is a short-lived pollutant produced in combustion processes -> NO2 concentration are used to monitor changes in anthropogenic emissions

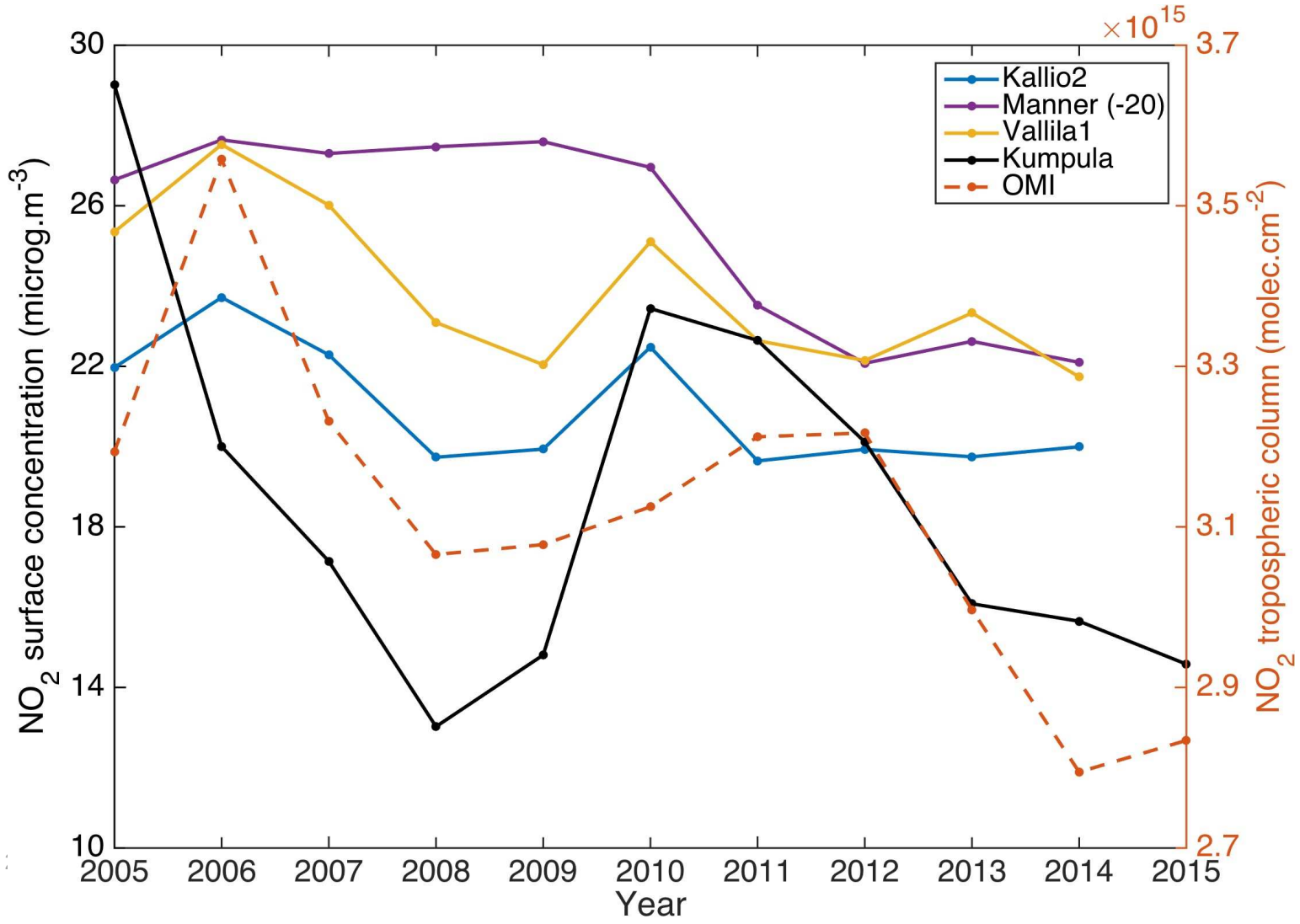
OMI NO2 weekly cycle



OMI NO2 changes in Helsinki



Surface concentrations in Helsinki



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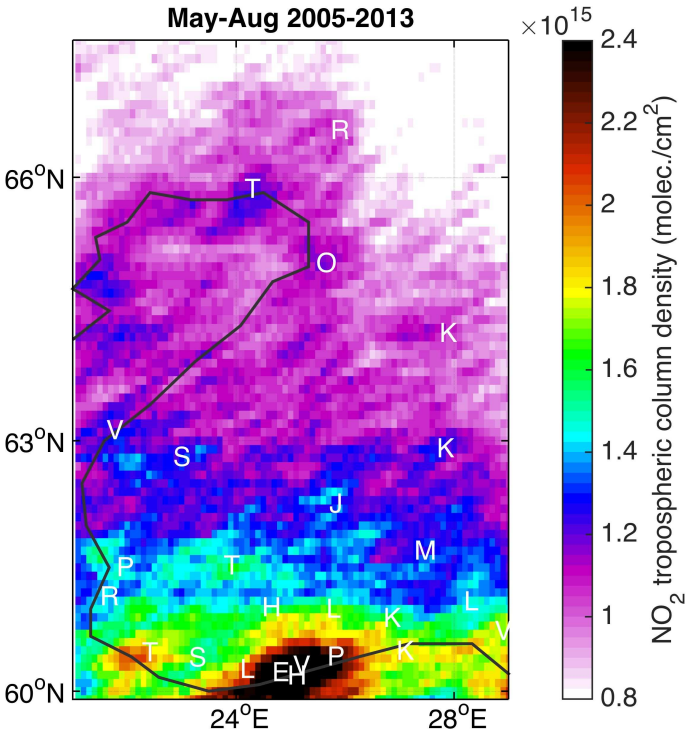
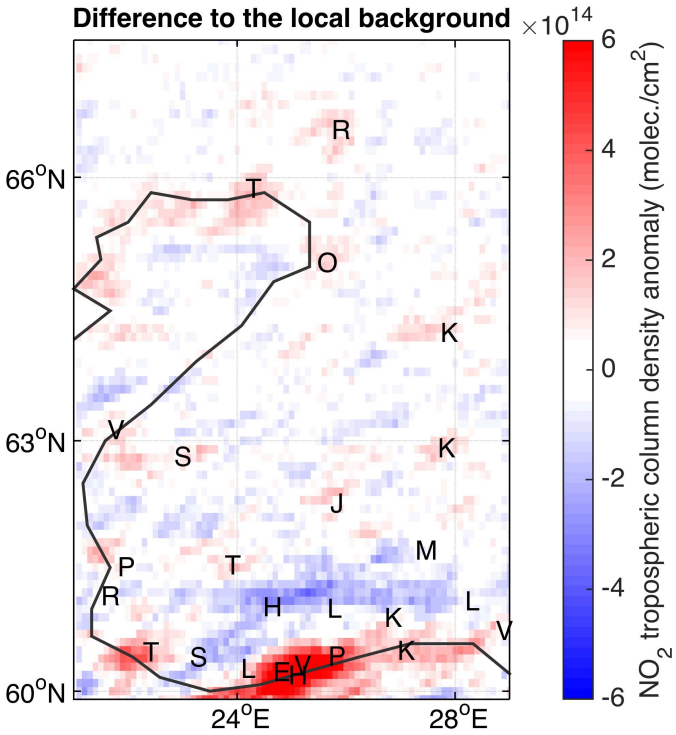
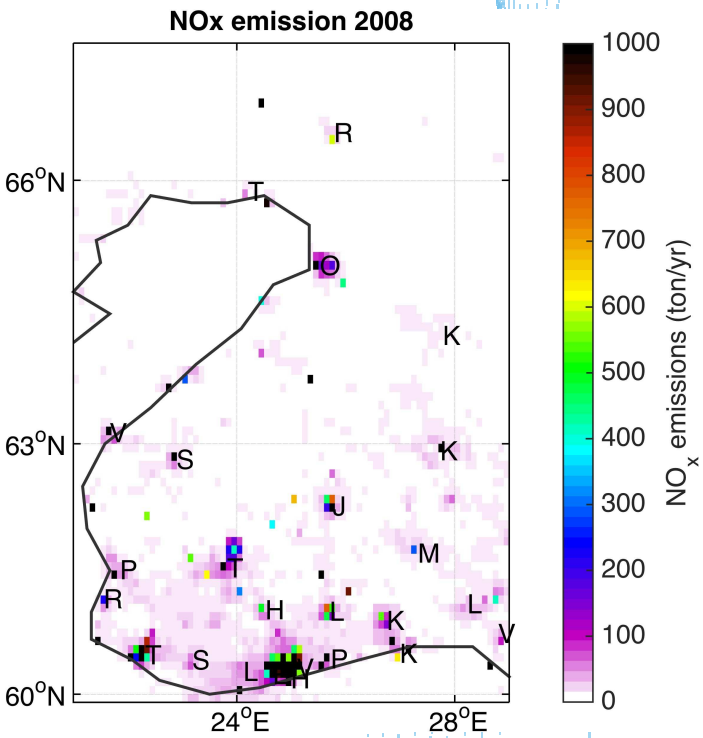
NO2 sources identification in Finland



The main cities are marked by their initial



Red pixels indicate NO2 levels higher than the local background.



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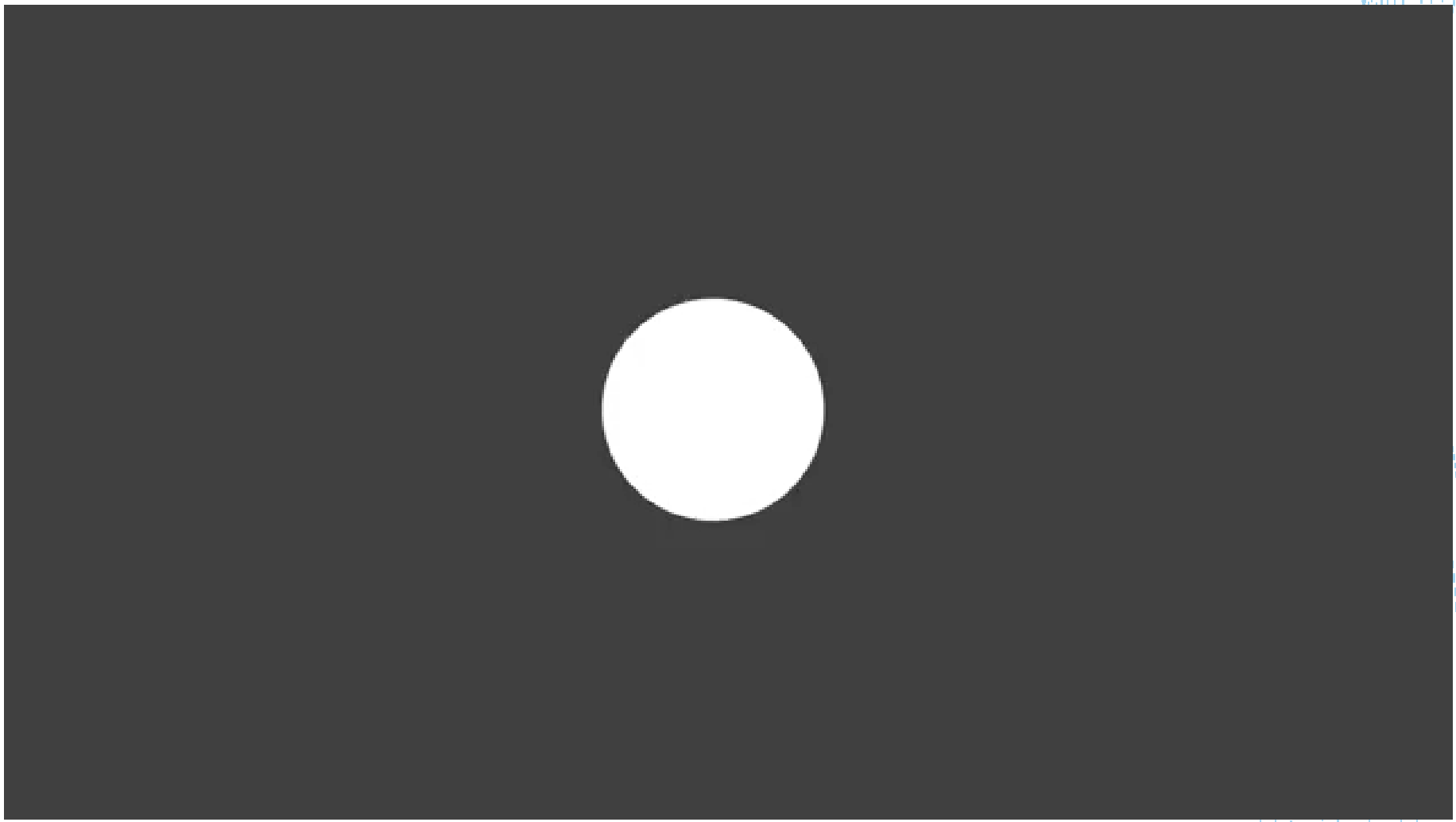
OMI impact



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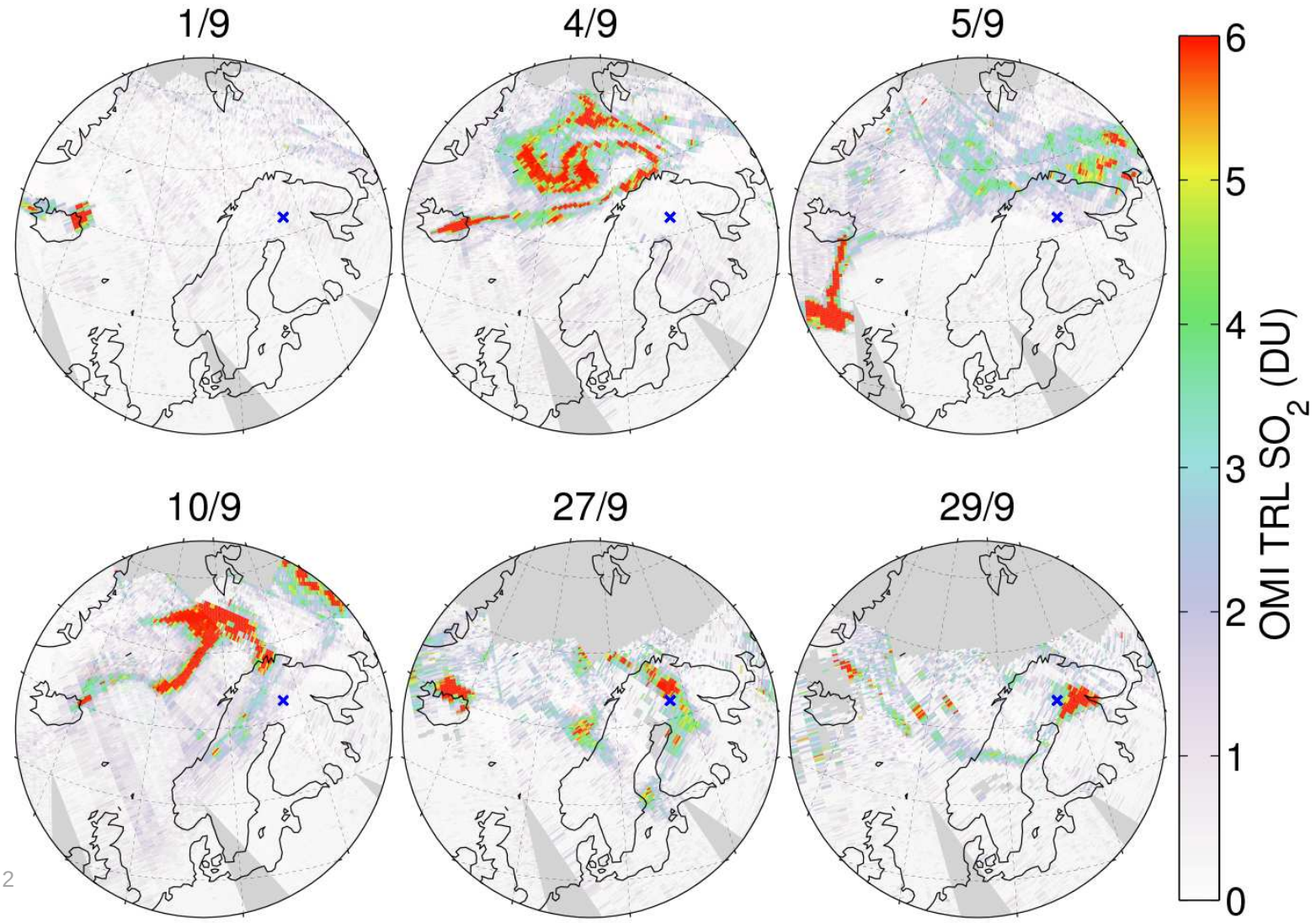
Volcanic SO_2 during Holuhraun eruption



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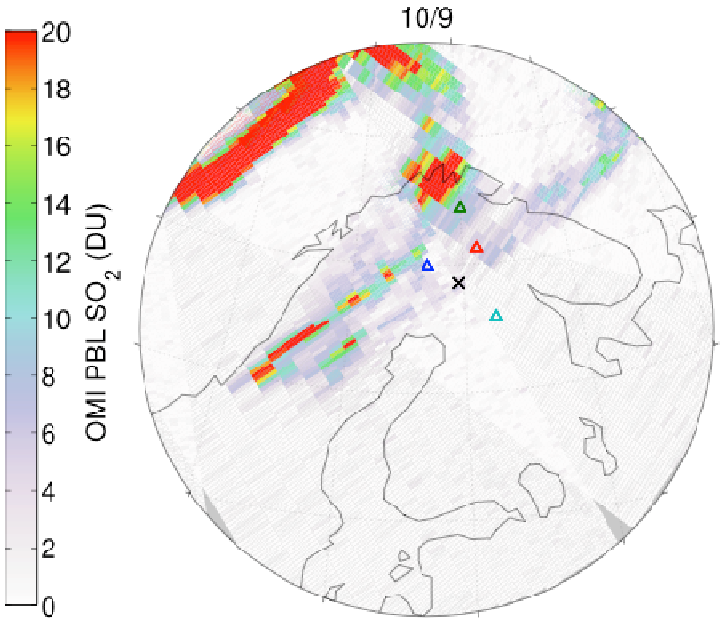
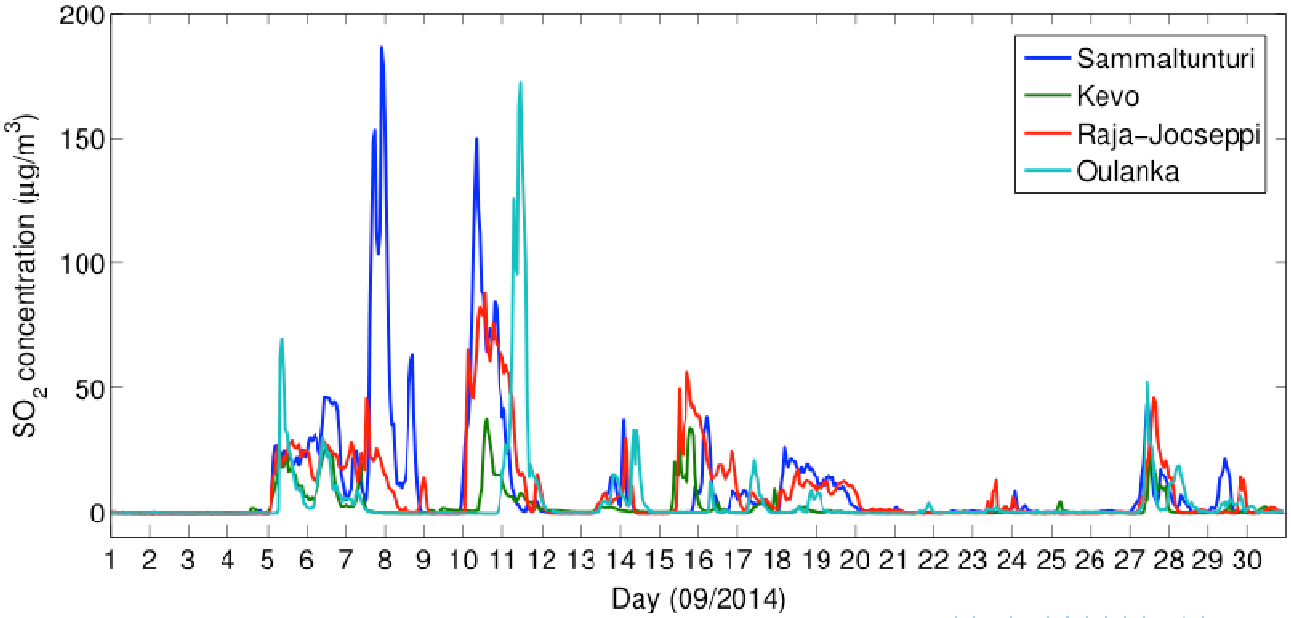
SO_2 surface concentration in northern Finland





Conclusions

Despite some limitations in urban areas, OMI measurements have been able to describe surface UV levels or more than 10 years. The absorbing aerosol correction improved the algorithm performances.

OMI NO2 retrievals have been able to describe pollution levels changes and variability fom different sources everywhere in the world.

Improved performances are expected from TROPOMI-S5P in terms of spatial resolution and signal-to-noise ratio.

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Thank you

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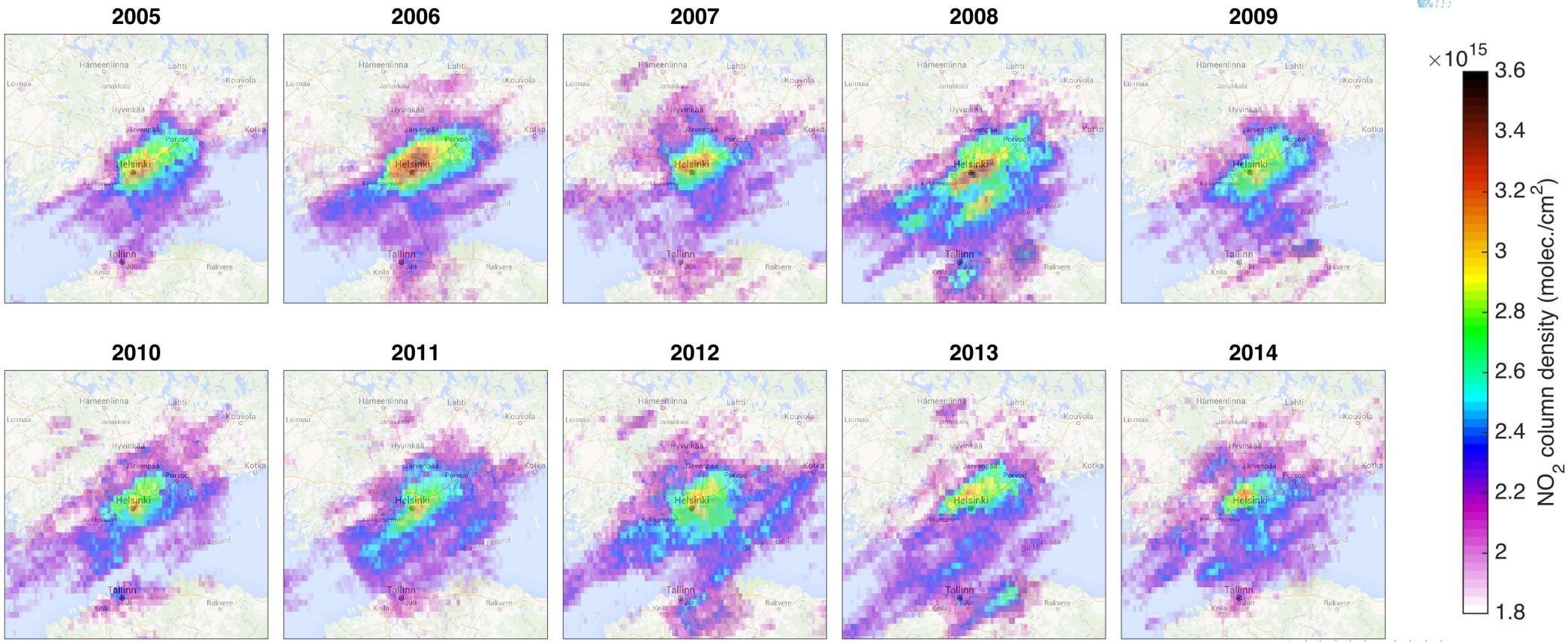
OMI NO2 trends in Helsinki



Comparison between satellite and Brewer SO_2 total column