# Variability of Aerosols Forcing on the Surface UV Radiation, Analysis of the Data Taken at Belsk, Poland, in Spring 2007

A. Pietruczuk, J.W. Krzyścin
Institute of Geophysics,
Polish Academy of Sciences, Warsaw, Poland

- Aerosols impact on short-term UV variability is as important as the ozone forcing in periods when „natural” UV level is high (summer)
- Aerosol properties measured routinely on AERONET network ( UV-A range, 340 nm)
- Unique measurements of aerosols properties in UV-B range (Brewer spectrophotometers)
- Aerosols in UV-B range usually extrapolated from aerosols properties in visible range

THIS PRESENTATION

Comparison of measured versus extrapolated Aerosol Optical Depth (AOD) in UV range


**Central Geophysical Laboratory, Institute of Geophysics, Polish Academy of Sciences Belsk, φ=51°50.2' , λ=20°47.5'**

## Important for UV:

**$O_3$, $O_3$ Profile, UV broadband, UV spectra, aerosols characteristics, aerosol extinction profile, albedo**

International Networks:

AEROSOL ROBOTIC NETWORK (AERONET)
EUROPEAN AEROSOL LIDAR NETWORK (ERLINET)

# Instrumentation at Belsk Observatory

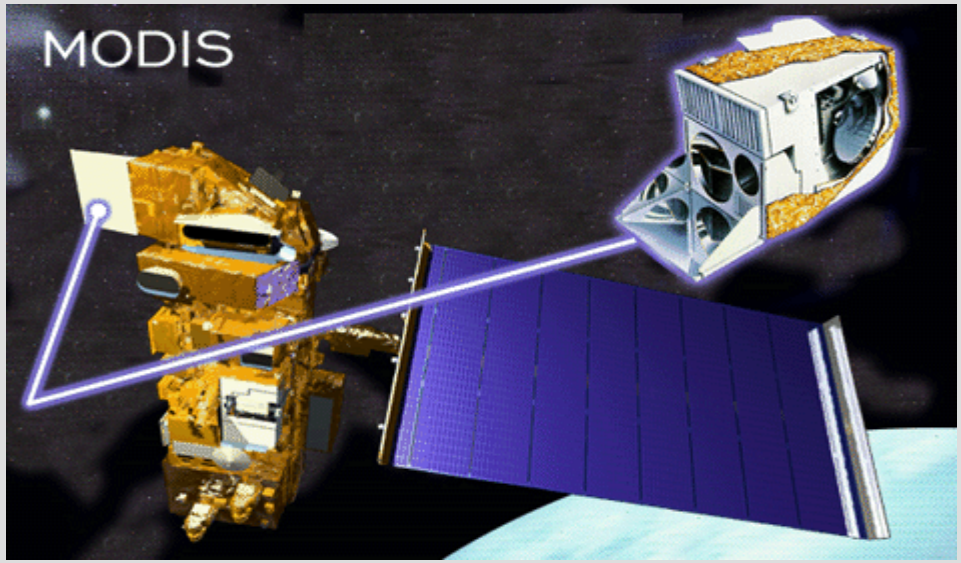
- Brewer spectrophotometer
  - AOT @ 320, 316, 313, 310 nm

- CIMEL Sun-photometer
  - AOT @ 1020, 870, 675, 500, 440, 380, 340 nm
  - Aerosol microphysical properties

- LIDAR
  - Profile of aerosol backscatter coefficient @ 1064, 532, 355 nm

# Instrumentation

- Moderate Resolution Imaging Spectroradiometer (MODIS) at *Terra, Aqua* satellite
  - AOT @ 470, 660 nm (twice a day)
  - Other atmospheric products

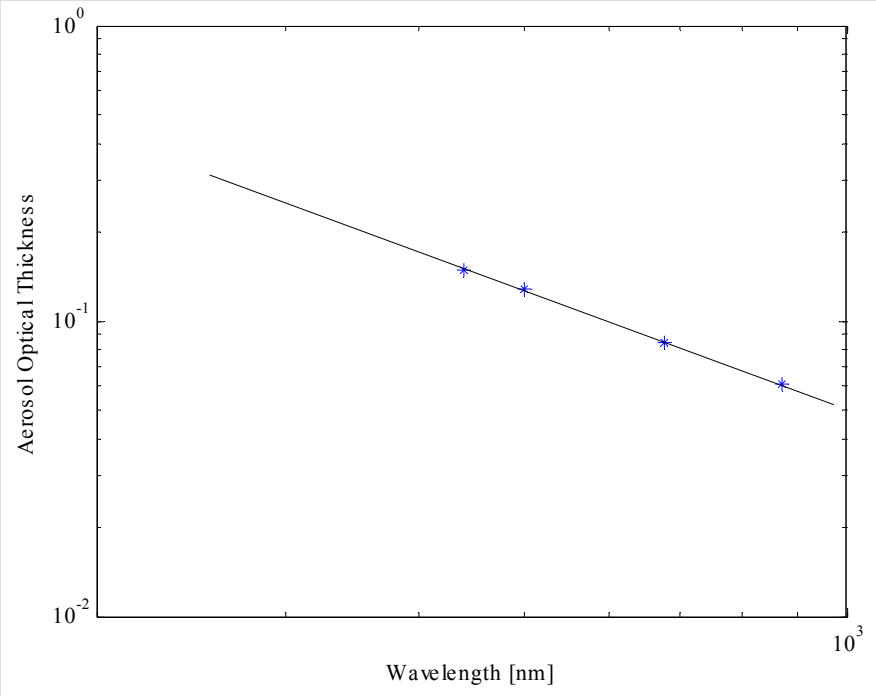


# Retrieval of AOT in UV range

- Direct measurements
  - Brewer spectrometer
  - Sun-photometer (CIMEL up to 340 nm)

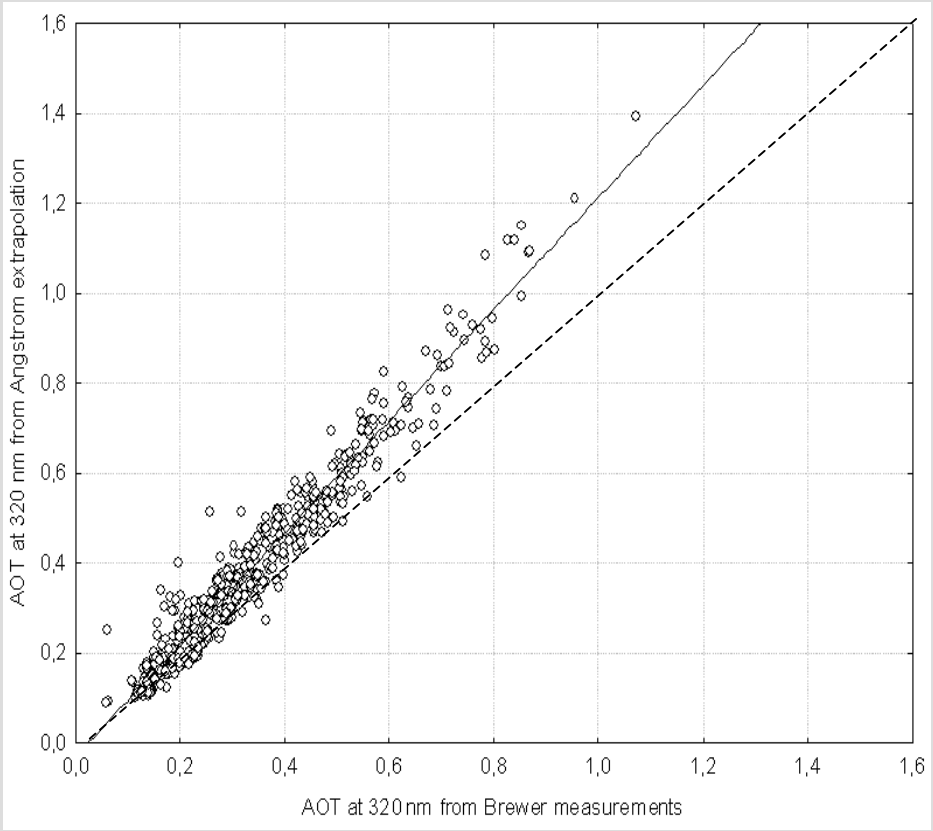
# Retrieval of AOT in UV range

- Extrapolation of AOT from visible range
  - Direct measurements in VIS
  - Angstrom law extrapolation $\tau(\lambda) = \beta \cdot \lambda^{-\alpha}$



# Retrieval of AOT in UV range

- Direct measurements vs. calculations
  (BREWER vs. Extrapolated CIMEL results)

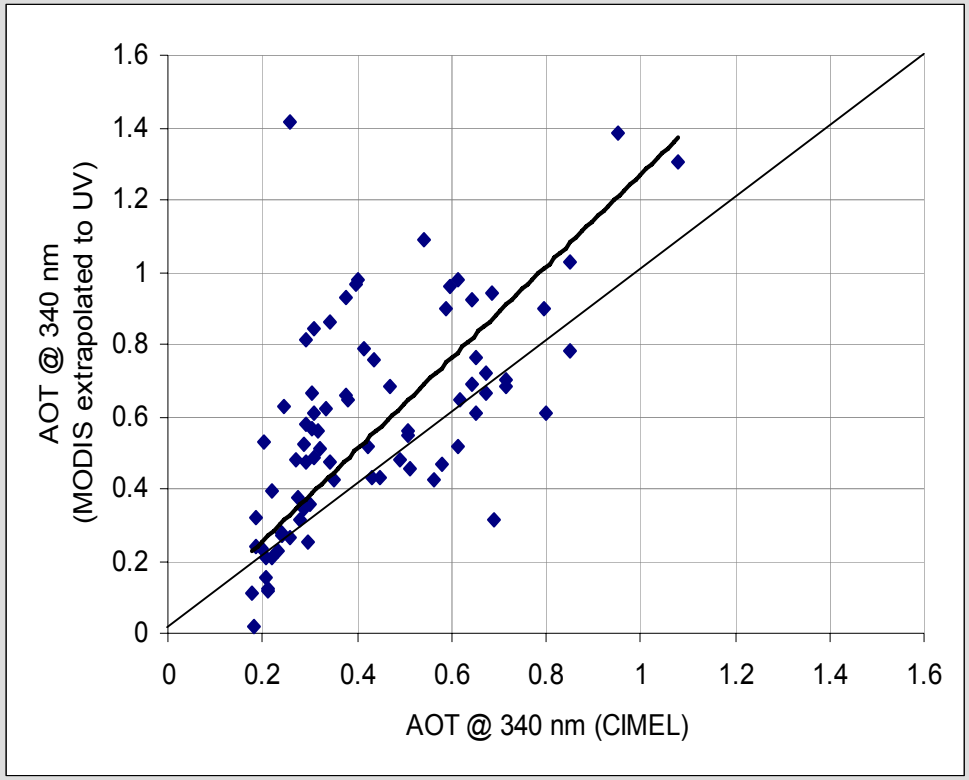



| mean | AOT @ 320 nm |
|---|---|
| **BREWER** | **0.43±0.02** |
| **Extrapolated VIS CIMEL** | **0.58 ±0.03** |

Data collected during 2005,
over 500 measurements

# Retrieval of AOT in UV range

- Direct measurements vs. calculations
  (CIMEL vs. Extrapolated MODIS results)



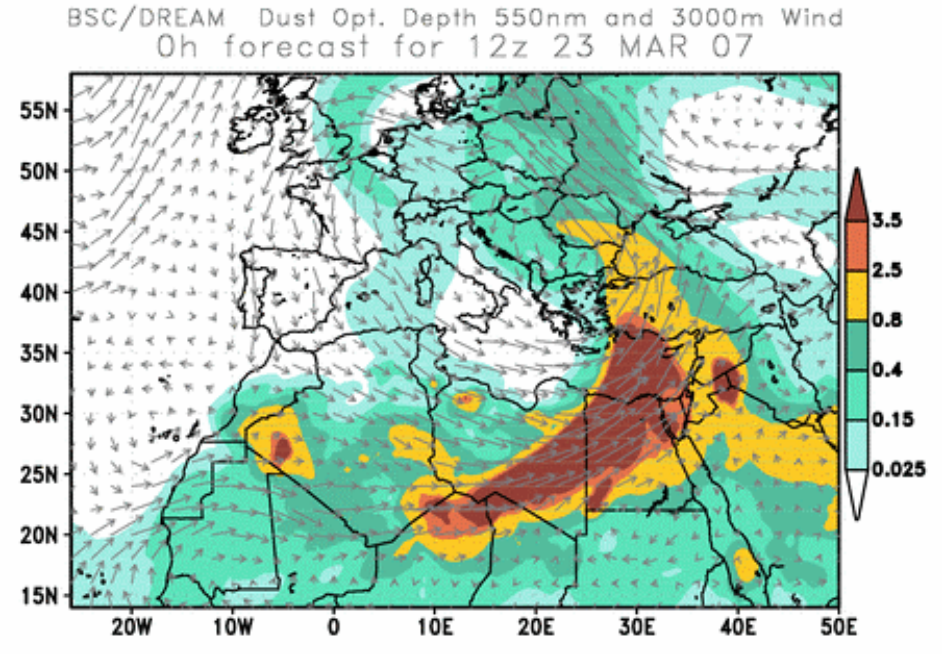

| mean | AOT @ 340 nm |
|---|---|
| CIMEL | 0.45±0.02 |
| Extrapolated VIS MODIS | 0.62±0.03 |

Data collected during 2005,
88 measurements

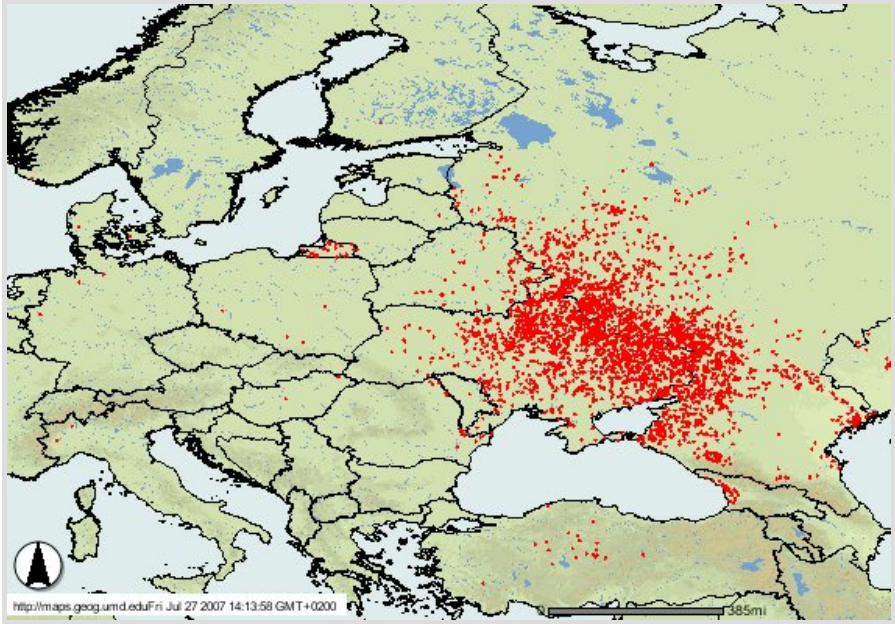
# dust/smoke event, spring 2007

- Aerosol loading – dust,
  - DREAM model results

smoke (21 – 25 March 2007)
- MODIS fire products

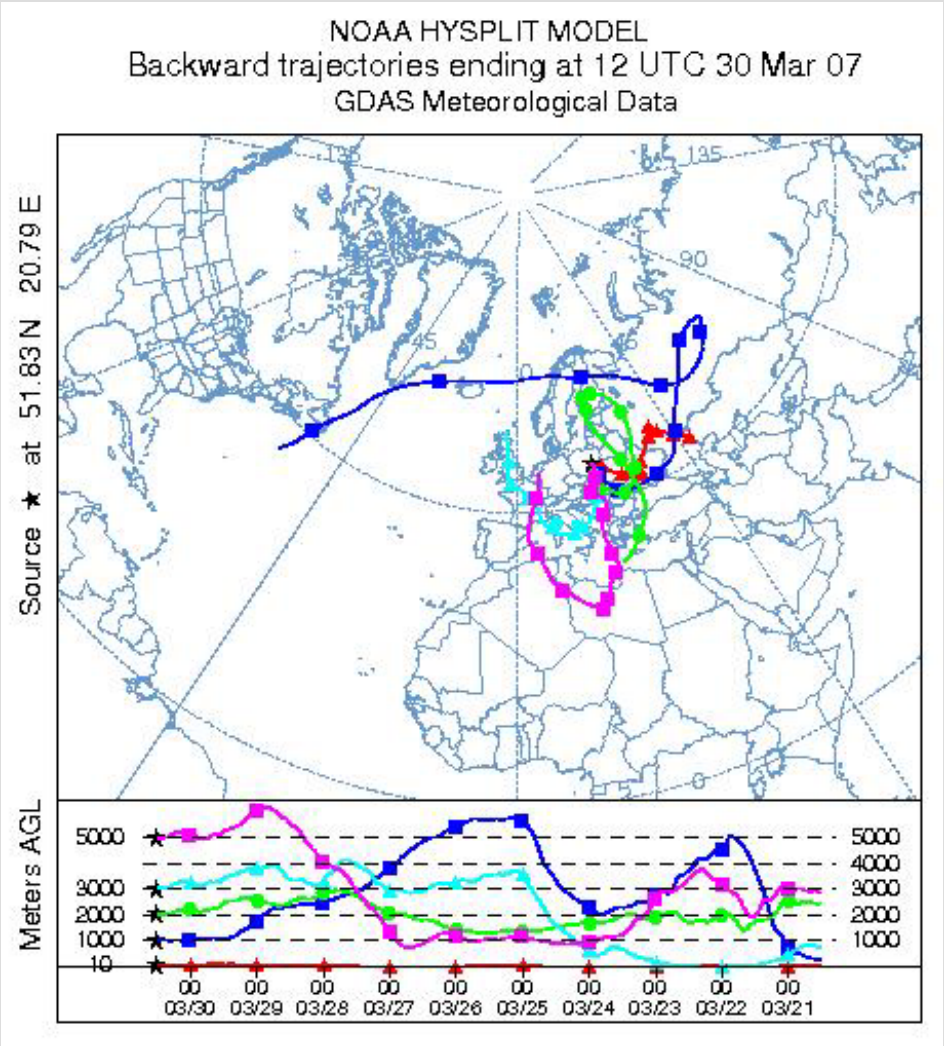



DREAM dust model, Barcelona Supercomputing Center, on-line at, http://www.bsc.es/projects/earthscience/DREAM/

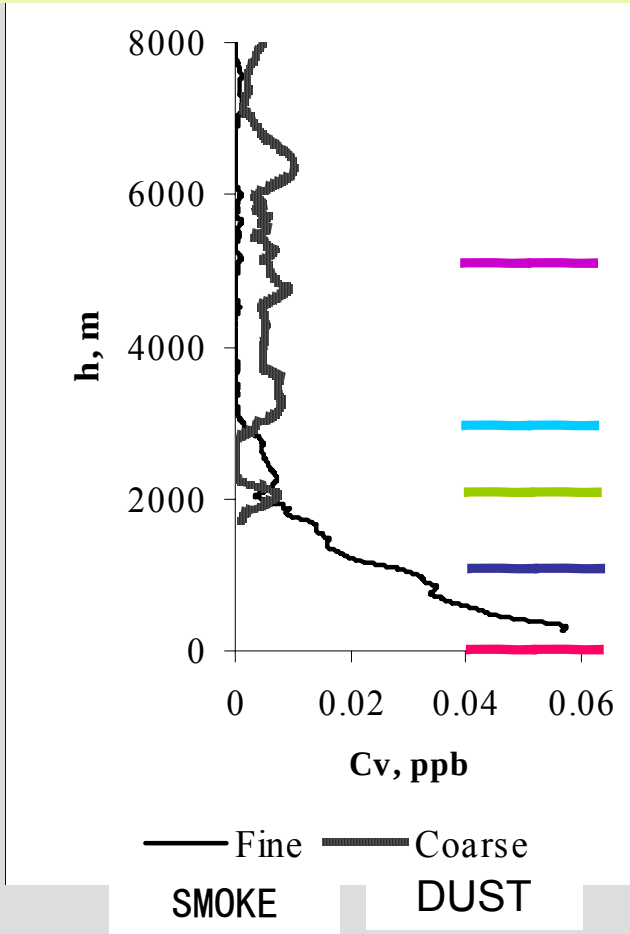


University of Maryland, Fire Information for Resource Management System (FIRMS), on-line at, http://maps.geog.umd.edu

# HYSPLIT back trajectory results



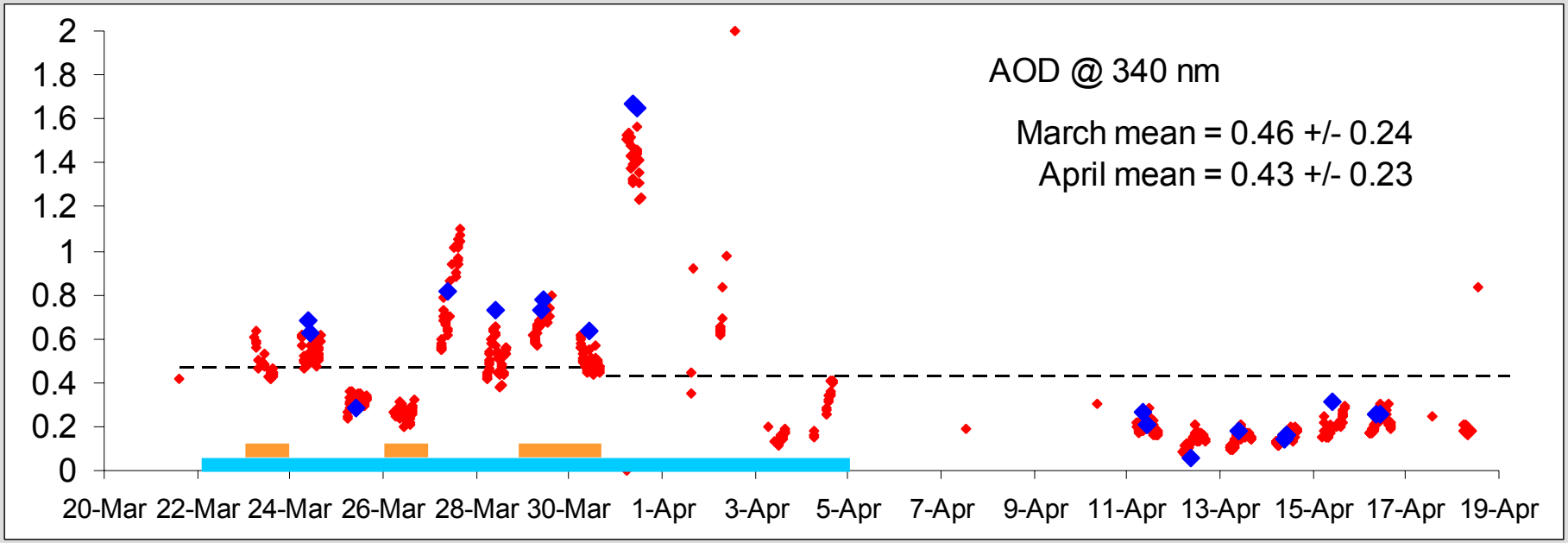

# LIDAR profile of aerosol volume concentration, Belsk, 30-03-07



# GROUND-BASED / SATELLITE AOD

Time series of AOT in UV range (340 nm)

- CIMEL – red rhomb
- MODIS@*Terra* – **blue rhomb**




**DUST, SMOKE episodes**

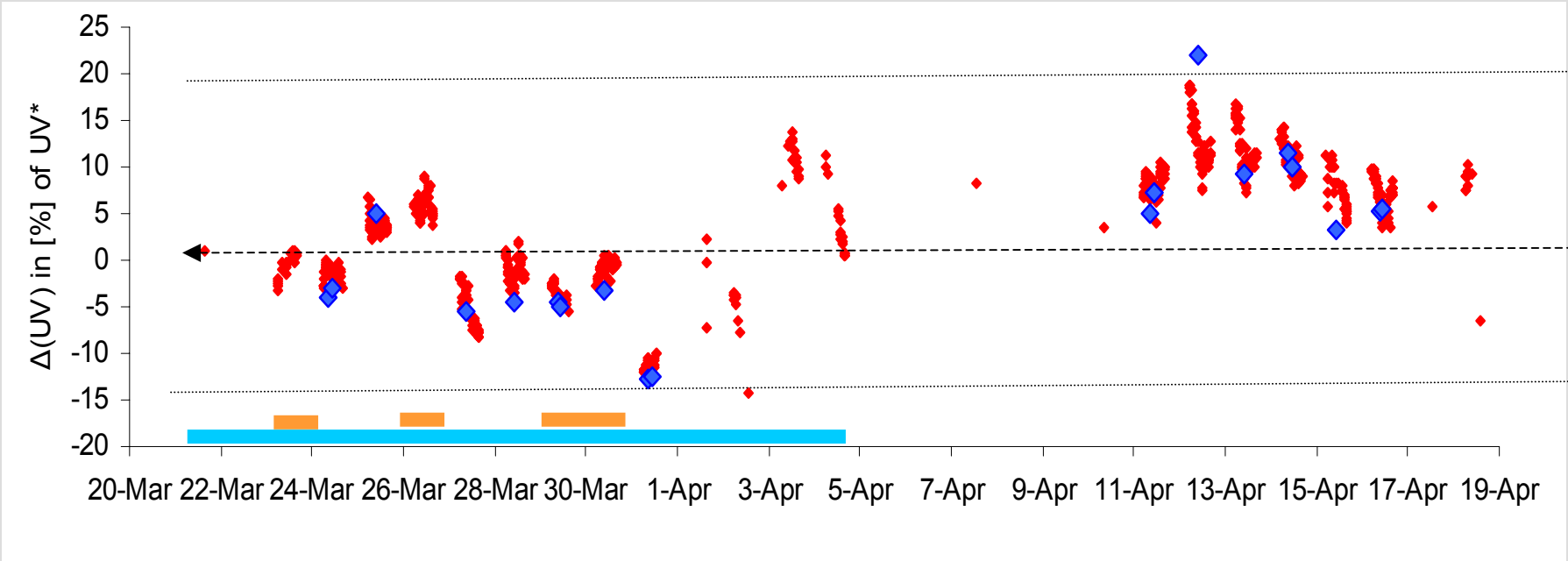
# Aerosol influence on UV radiation

- **Radiation Amplification Factor due to aerosols– $RAF_{AER}$ ~ 0.1**

$$\frac{UV}{UV^*} = \left(\frac{\tau^*}{\tau}\right)^{RAF_{AER}}$$

– $UV$ – *actual UV radiation*
– $\tau$ – *Aerosol Optical Thickness at 340 nm*
– $*$ – *overall mean*

$\tau = 2\tau^* \rightarrow$ UV= -7% ; $\tau = 3\tau^* \rightarrow$ UV= -11%




**DUST , SMOKE episodes**

- **Aerosol forcing in UV**

| Aerosol Class | Δ(UV) in [%] of UV* | |
|---|---|---|
| | CIMEL (whole day) | MODIS (noon) |
| Smoke + Dust | -1.98±1.54 | -8.82 |
| Dust | -1.77±6.50 | -4.56 |
| clear air mass | 10.97±2.80 | 10.34 |

# CONCLUSION

- EXTREME AEROSOL FORCING ON ERYTHEMALLY WEIGHTED UV AT BELSK : -15% DUST/SMOKE, + 20% CLEAN AIR
- UV MODIS AEROSOLS FOLLOW PATTERN OF AOD MEASUREMENTS
- DURING DUST/SMOKE EVENT LARGE VARIATIONS OF AOD due to :

  Changes in aerosols inflow or transformation of aerosol spectrum throughout day?
- UV MODIS/CIMEL AGREEMENT IN CLEAN DAYS
- UV MODIS/CIMEL DISAGREEMENT IN SMOKE/DUST DAYS
- LARGE UNCERTAINTY OF FORECASTING OF AOD CHANGES

  IN MIXED ATMOSPHERIC CONDISTIONS( DUST/SMOKE)