# Ground-based remote sensing of atmospheric aerosols


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# Overview

- $O_4$ measurements with MAX-DOAS in Vienna
- AOD measurements with Sun photometer in Vienna
- AOD measurements with Brewer spectrophotometer at Hoher Sonnblick
- Radiative transport modeling

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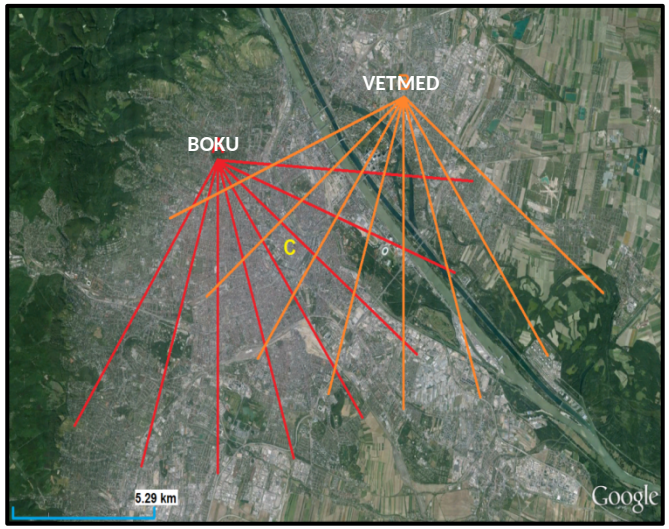
# $O_4$ measurements with MAX-DOAS in Vienna

## BOKU Site

Universität für **BO**den**KU**ltur Wien
Peter-Jordan Straße 82
Vienna, Austria
48° 14' 16.45" N, 16° 19' 54" E, 267 m asl


instrument set-up / start of measurements
in April 2017




## VETMED Site

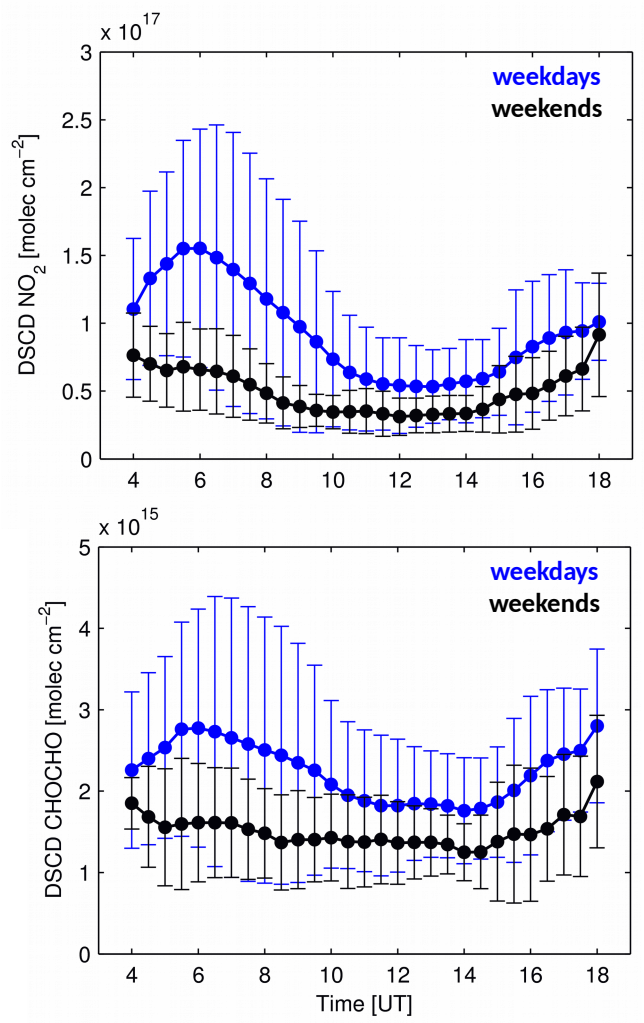
**VET**erinär**MED**izinische Universität Wien
Veterinärplatz 1
Vienna, Austria
48° 15' 26.45" N, 16° 25' 54.4" E, 171 m asl


instrument set-up / start of measurements
in December 2016

# $O_4$ measurements with MAX-DOAS in Vienna

VETMED instrument (vis):
(LOS = 93°)

BOKU instrument (UV):
(LOS = 91°)

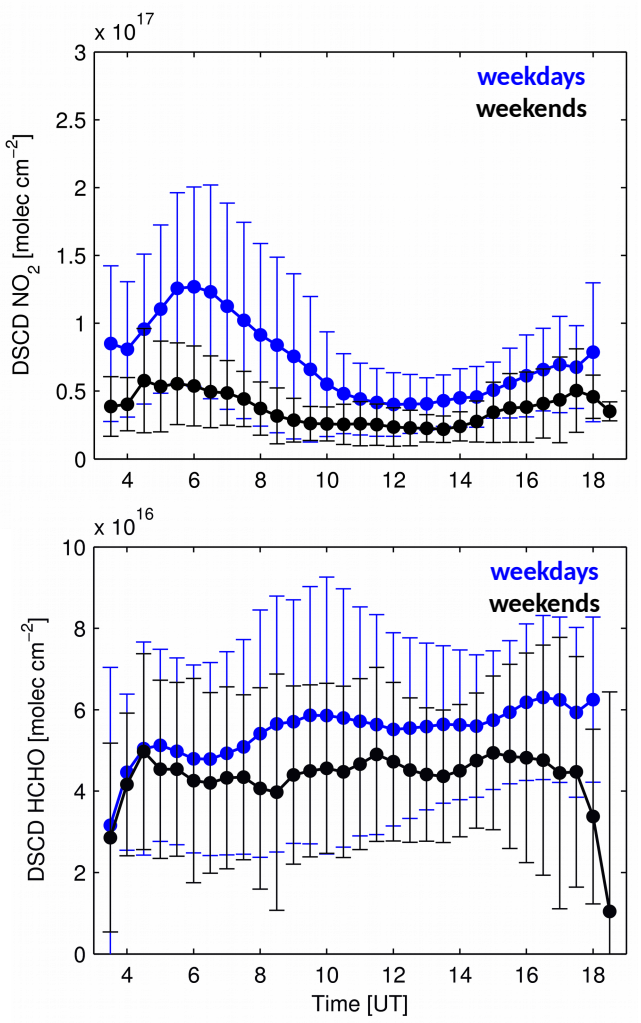



$NO_2$

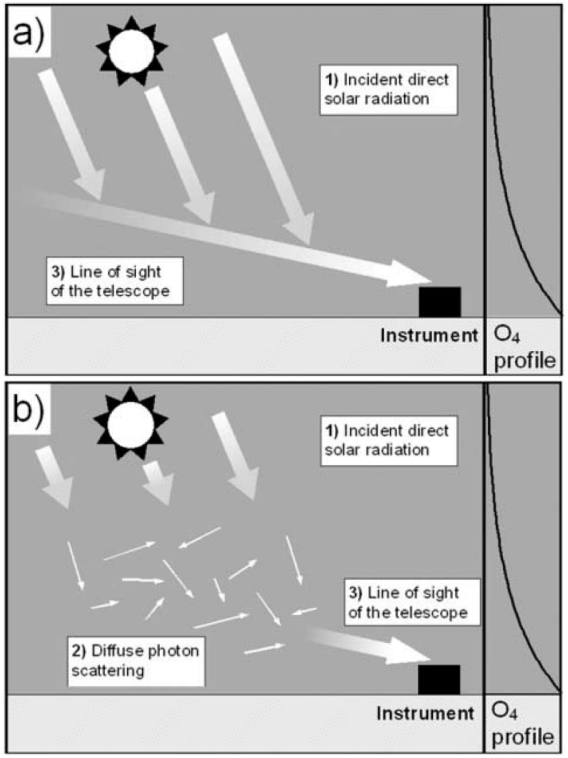
summer
(June/July/August)

CHOCHO ←

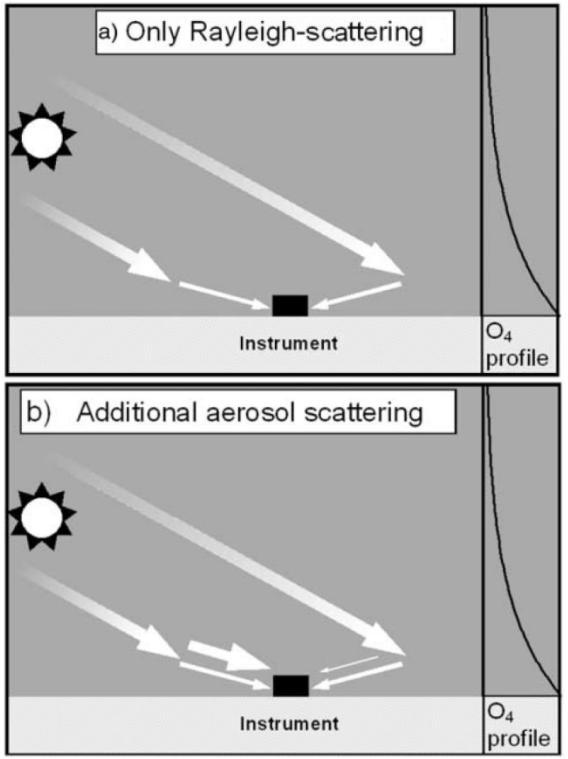
HCHO →



# $O_4$ measurements with MAX-DOAS in Vienna




*Wagner et al. (2004):*
*MAX-DOAS $O_4$ measurements: A new technique to derive information on atmospheric aerosols – Principles and information content*




**Reduction of the visibility**

- Reduction of the direct light path along the line of sight
- Influence on the penetration depth of the incident sunlight

**Increased probability of multiple scattering**

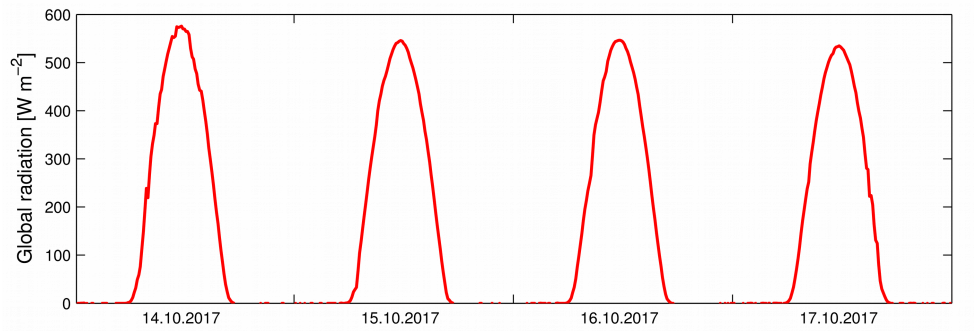
- Effect of multiple scattering

**Modification of the received intensity**

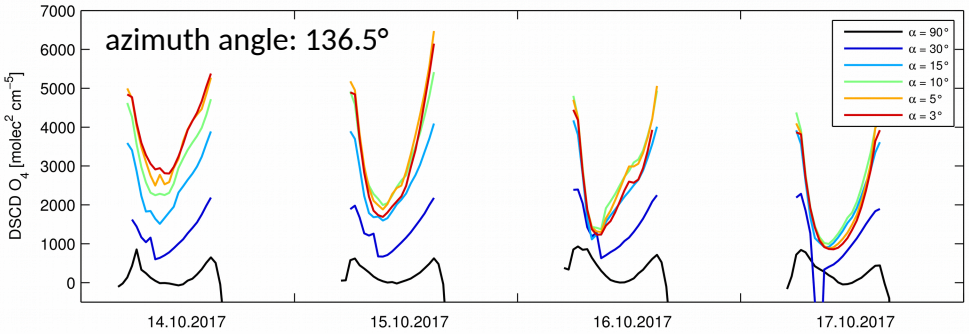
- Influence of aerosol absorption
- Influence of the aerosol scattering phase function

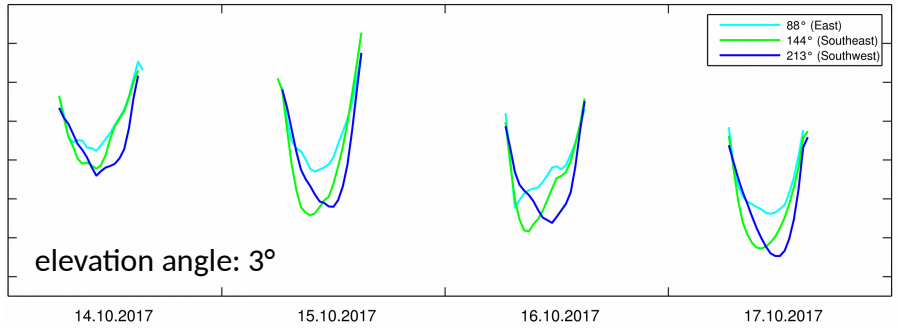
# $O_4$ measurements with MAX-DOAS in Vienna

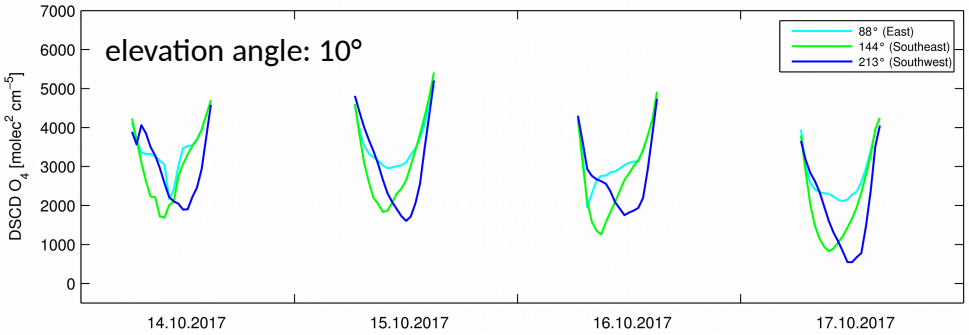
https://meteo.boku.ac.at/wetter/mon-archiv/2017/201710/201710.html

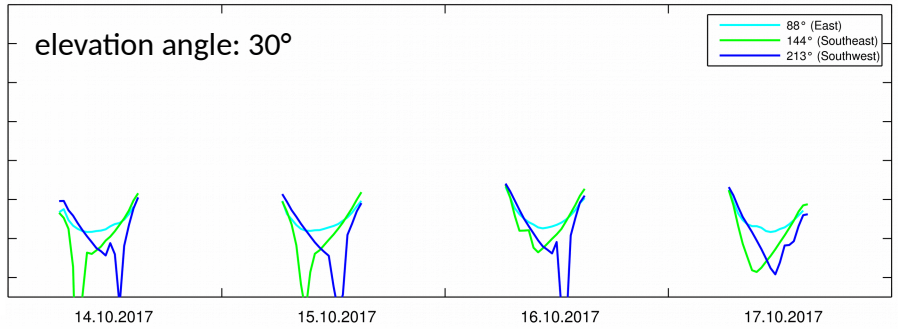



BOKU instrument (UV)



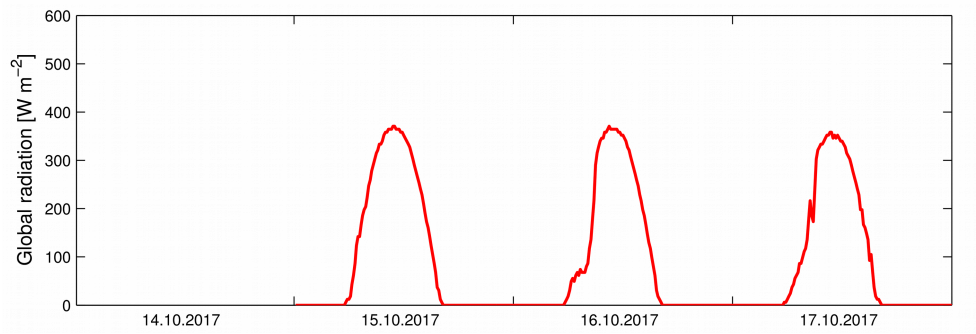



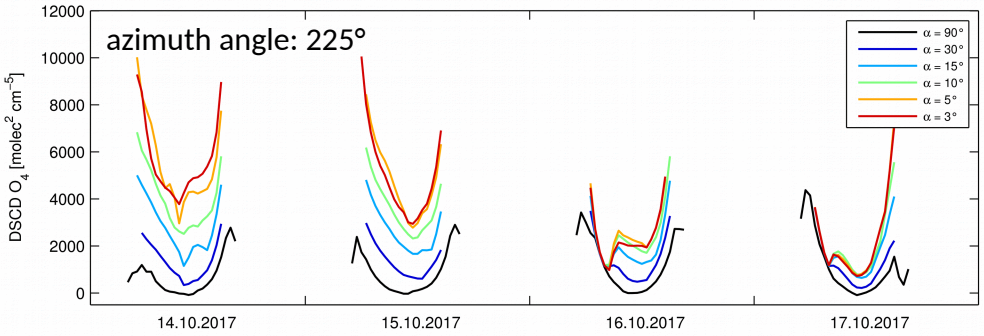



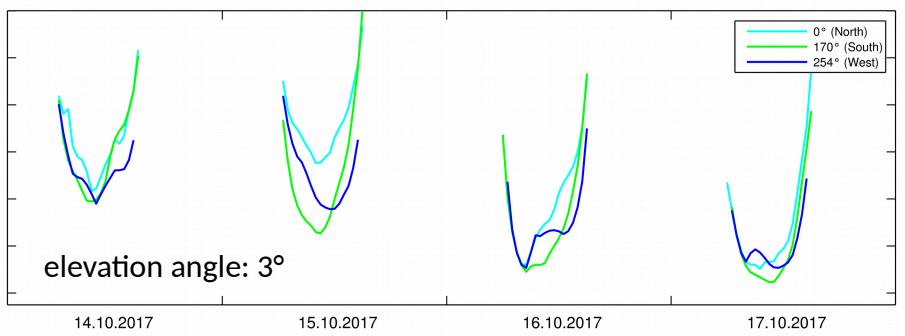
# $O_4$ measurements with MAX-DOAS in Vienna

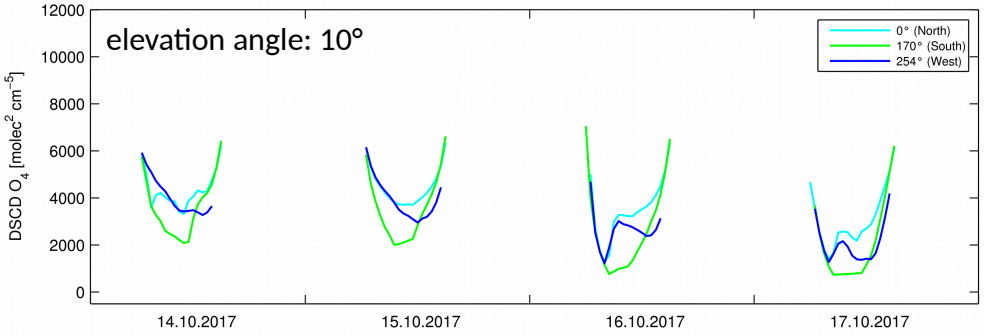
(raw) data provided by Alois Schmalwieser

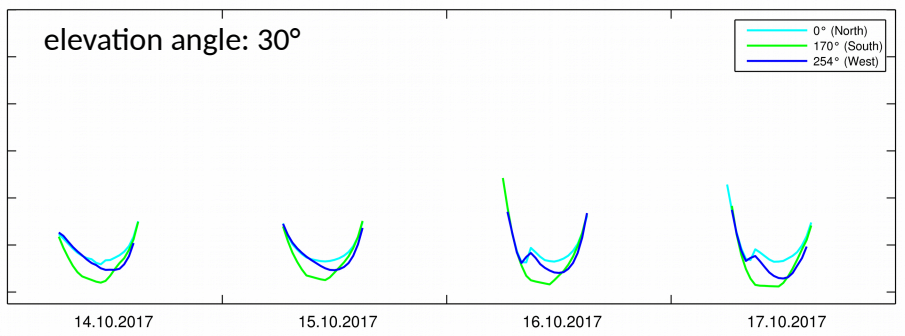



VETMED instrument (vis)



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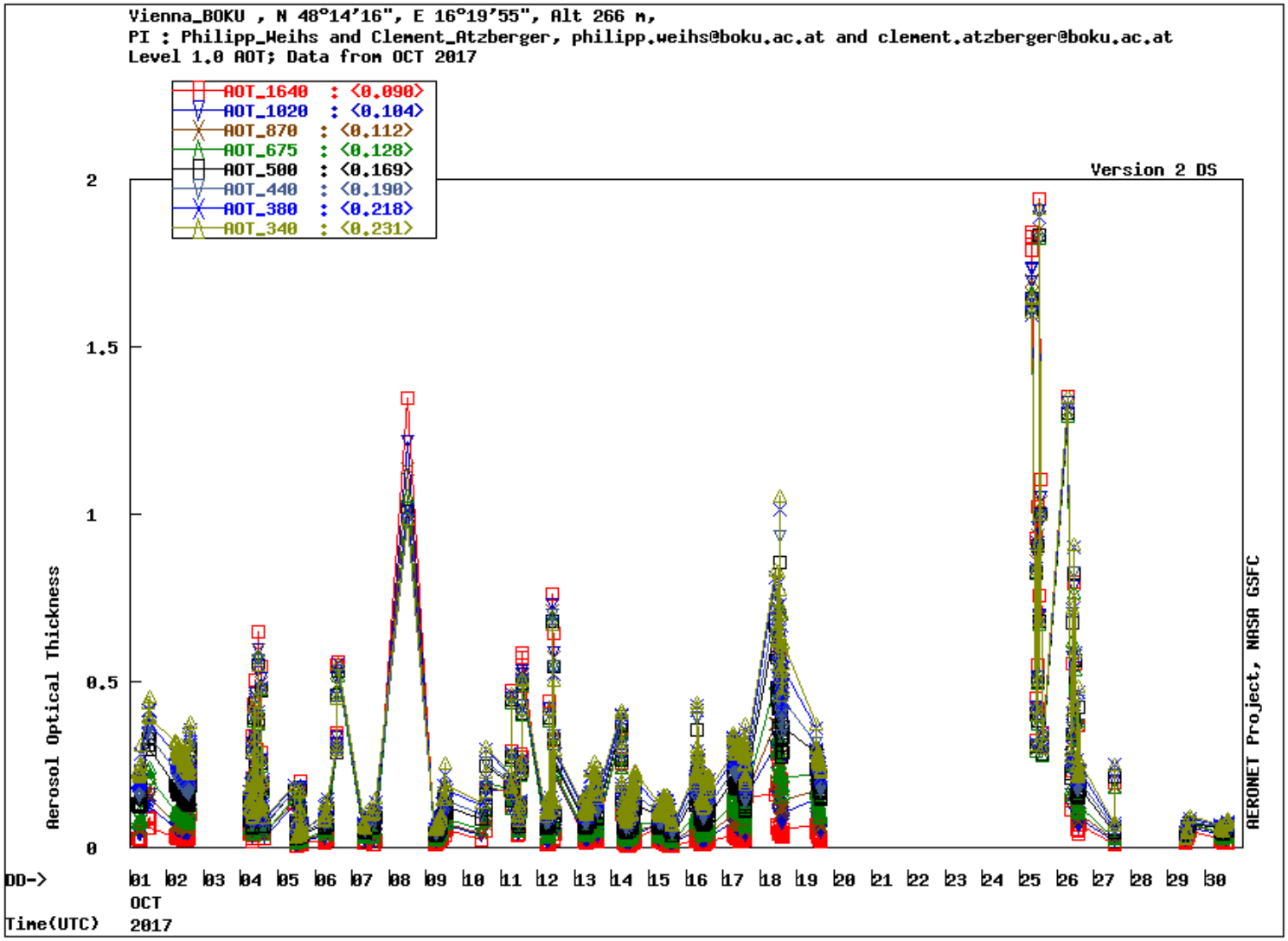
# AOD measurements with Sun photometer in Vienna


Air temperature, humidity, pressure, precipitation,
wind speed and direction at the BOKU weather station

# AOD measurements with Sun photometer in Vienna



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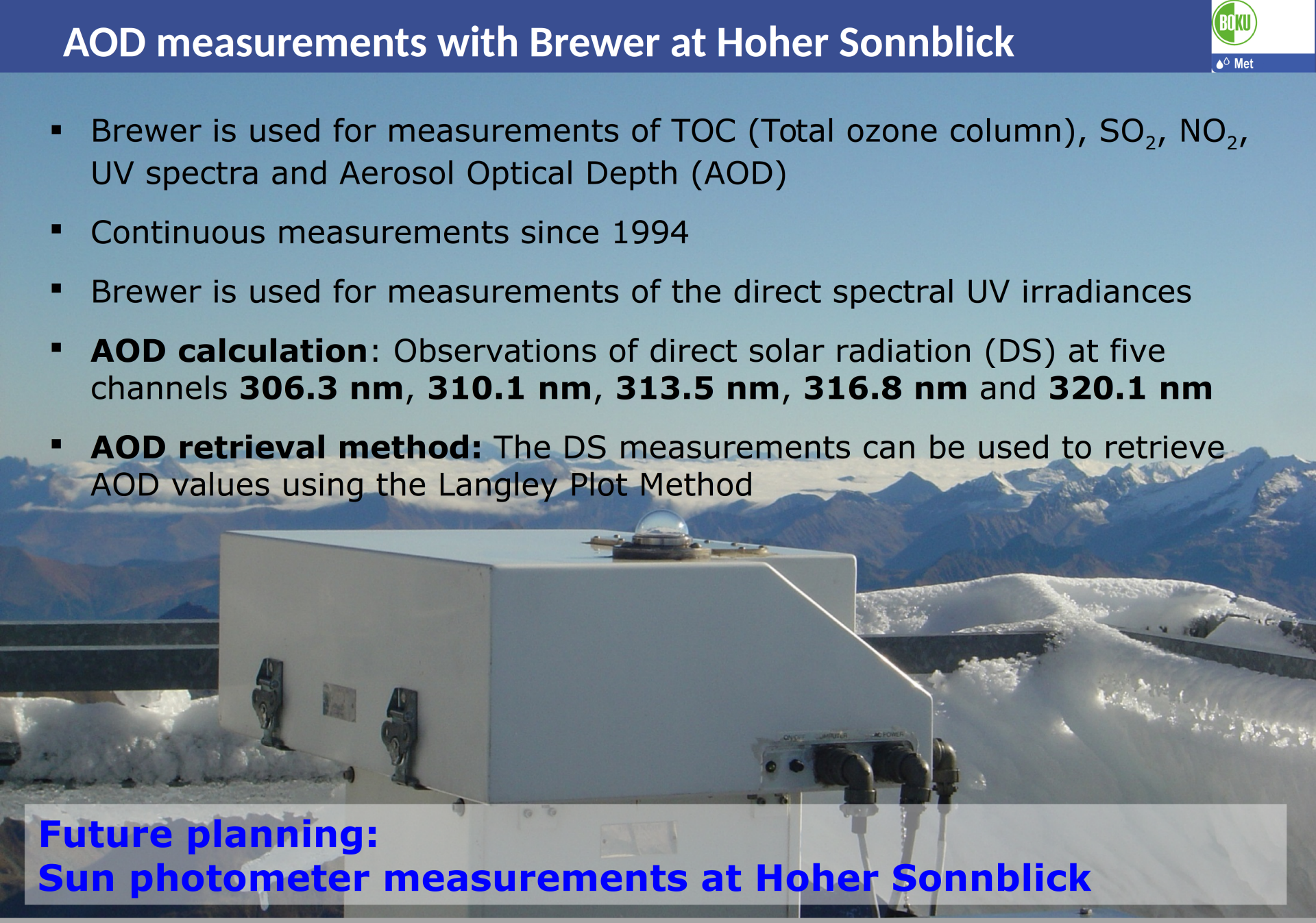
# AOD measurements with Brewer at Hoher Sonnblick

- Brewer is used for measurements of TOC (Total ozone column), $SO_2$, $NO_2$, UV spectra and Aerosol Optical Depth (AOD)
- Continuous measurements since 1994
- Brewer is used for measurements of the direct spectral UV irradiances
- **AOD calculation**: Observations of direct solar radiation (DS) at five channels **306.3 nm**, **310.1 nm**, **313.5 nm**, **316.8 nm** and **320.1 nm**
- **AOD retrieval method:** The DS measurements can be used to retrieve AOD values using the Langley Plot Method



**Future planning:**
**Sun photometer measurements at Hoher Sonnblick**

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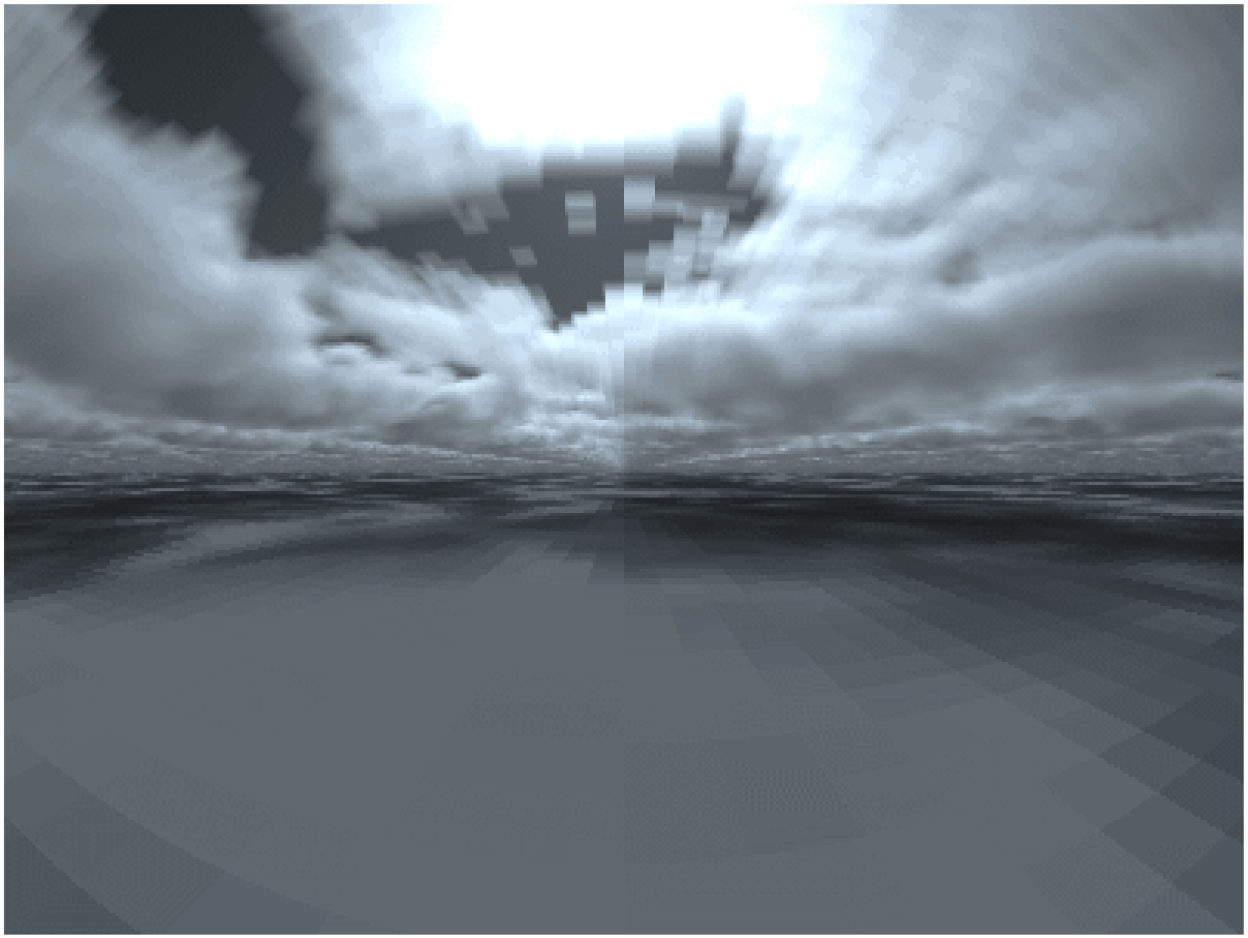
# Radiative transport modeling

- **Inhomogeneous conditions: variable cloudiness**

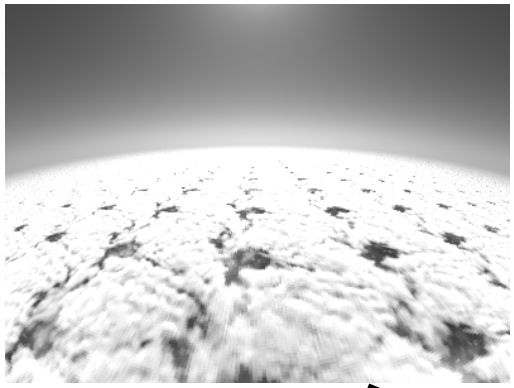


# Radiative transport modeling

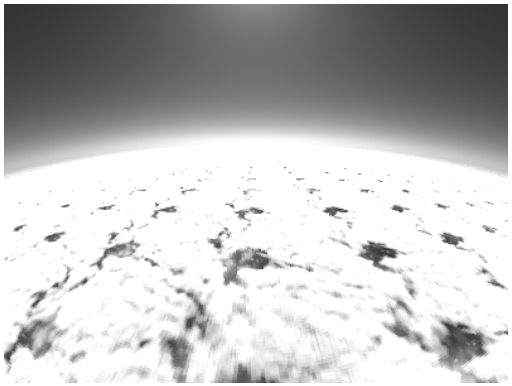
- **Inhomogeneous conditions: variable cloudiness**

MCARaTS (Monte Carlo Atmospheric Radiative Transfer Simulator)

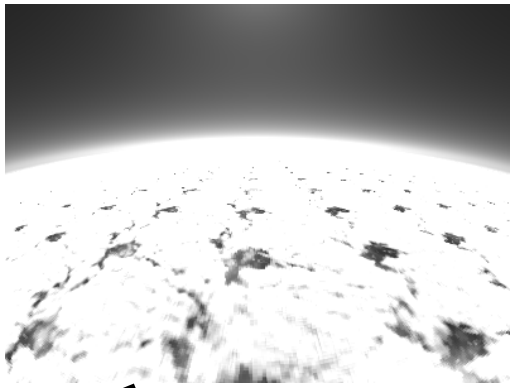
blue (0.45 µm)



green (0.55µm)

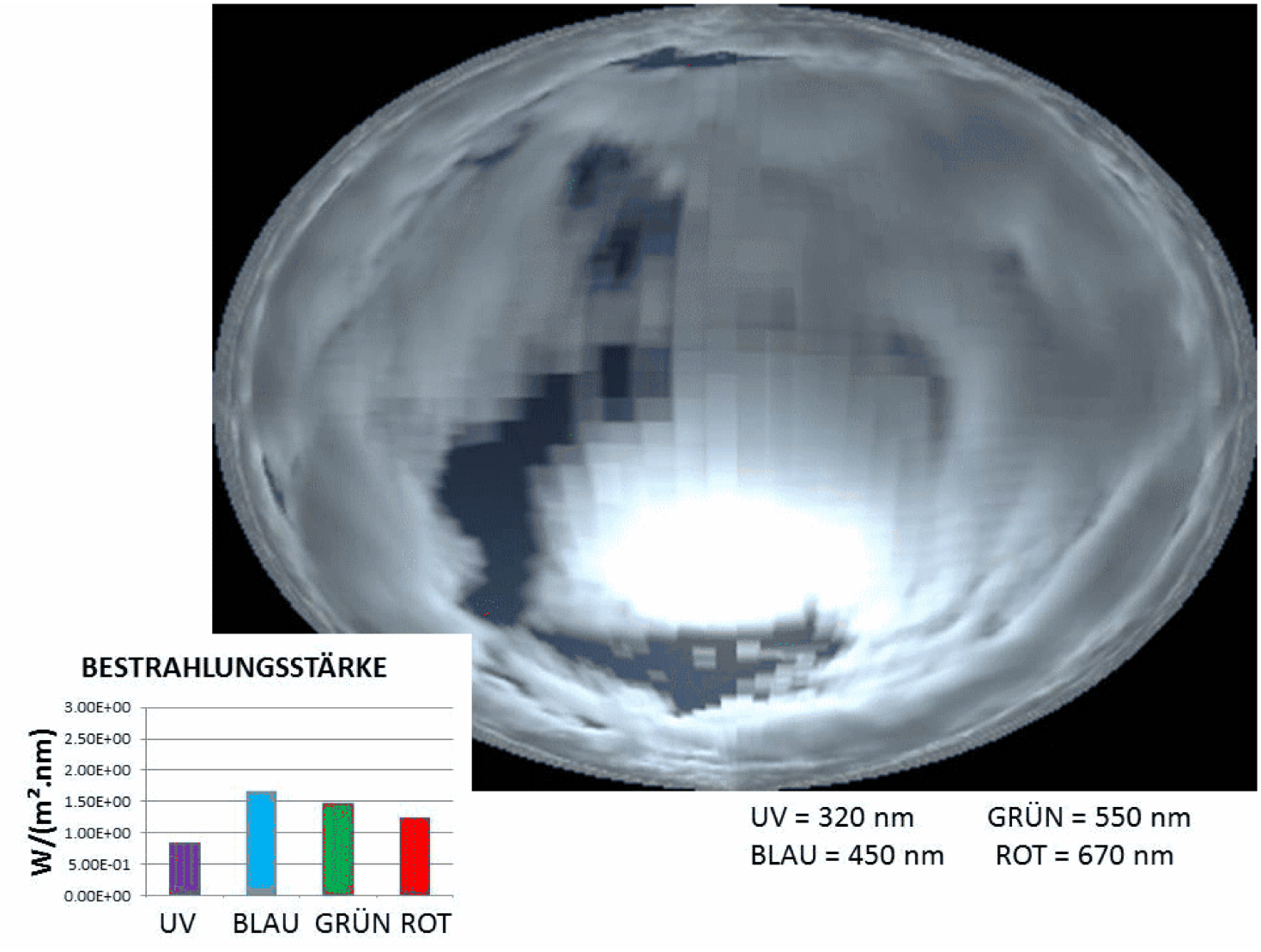


red (0.67µm)



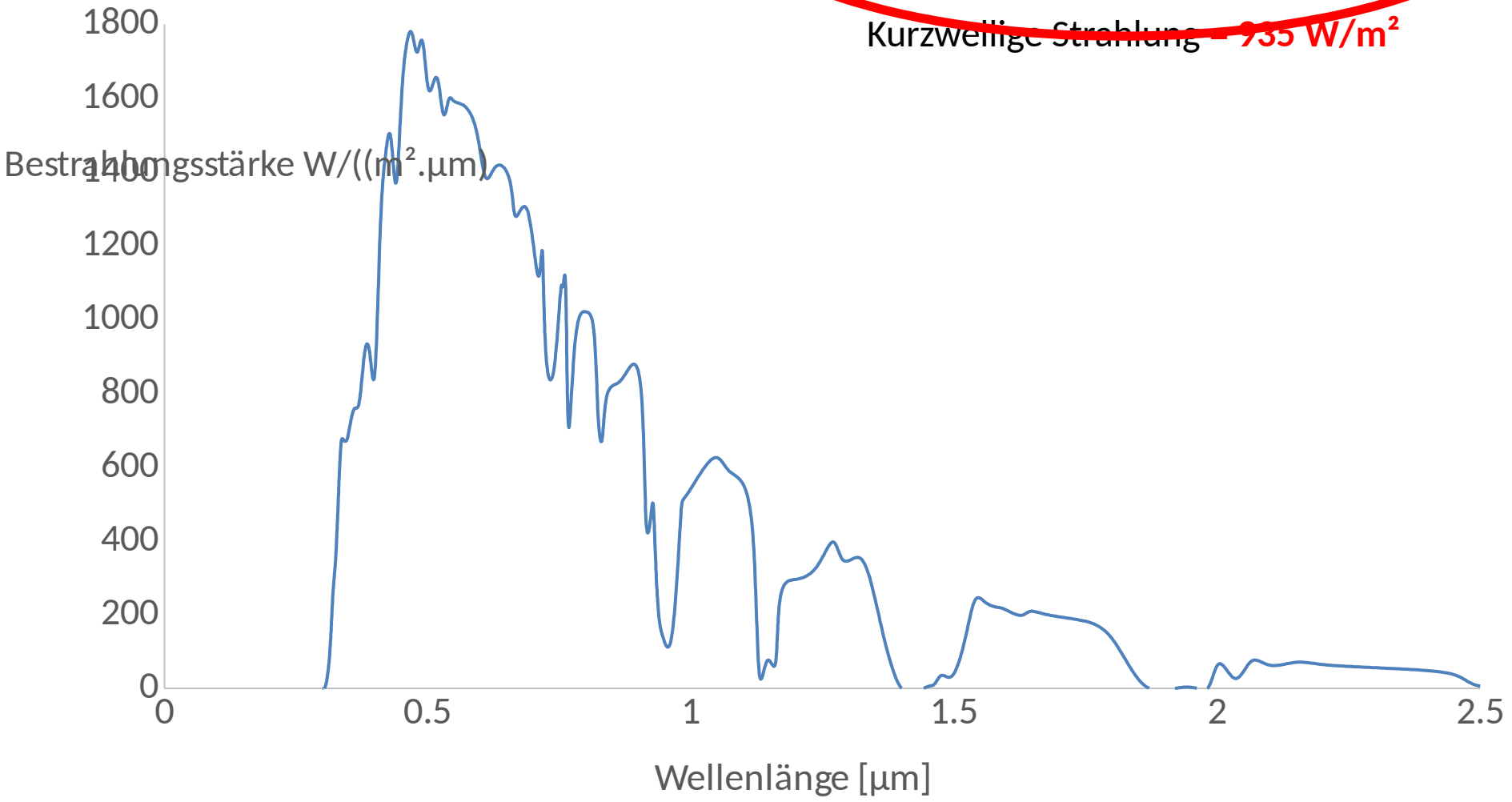
# Radiative transport modeling

- **Inhomogeneous conditions: variable cloudiness**



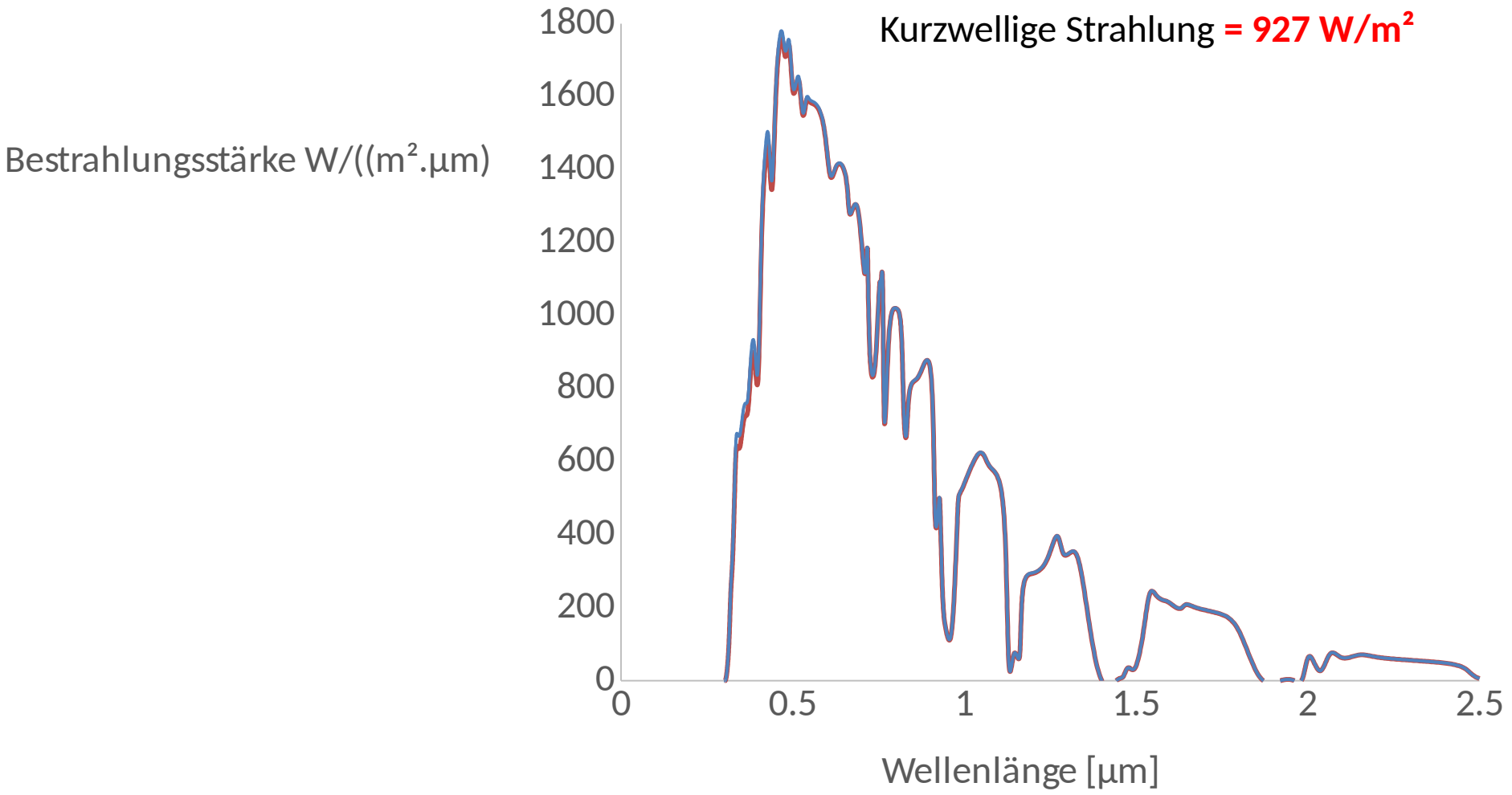
# EINFLUSS DER AEROSOLE

15. Mai 13h MEZ
Sonnenzenitwinkel = 32°
Ozonschichtdicke = 350 DU
Angström Trübungskoeffizient = **0.01**
UV Index = **6.5**
Kurzwellige Strahlung = **935 W/m²**



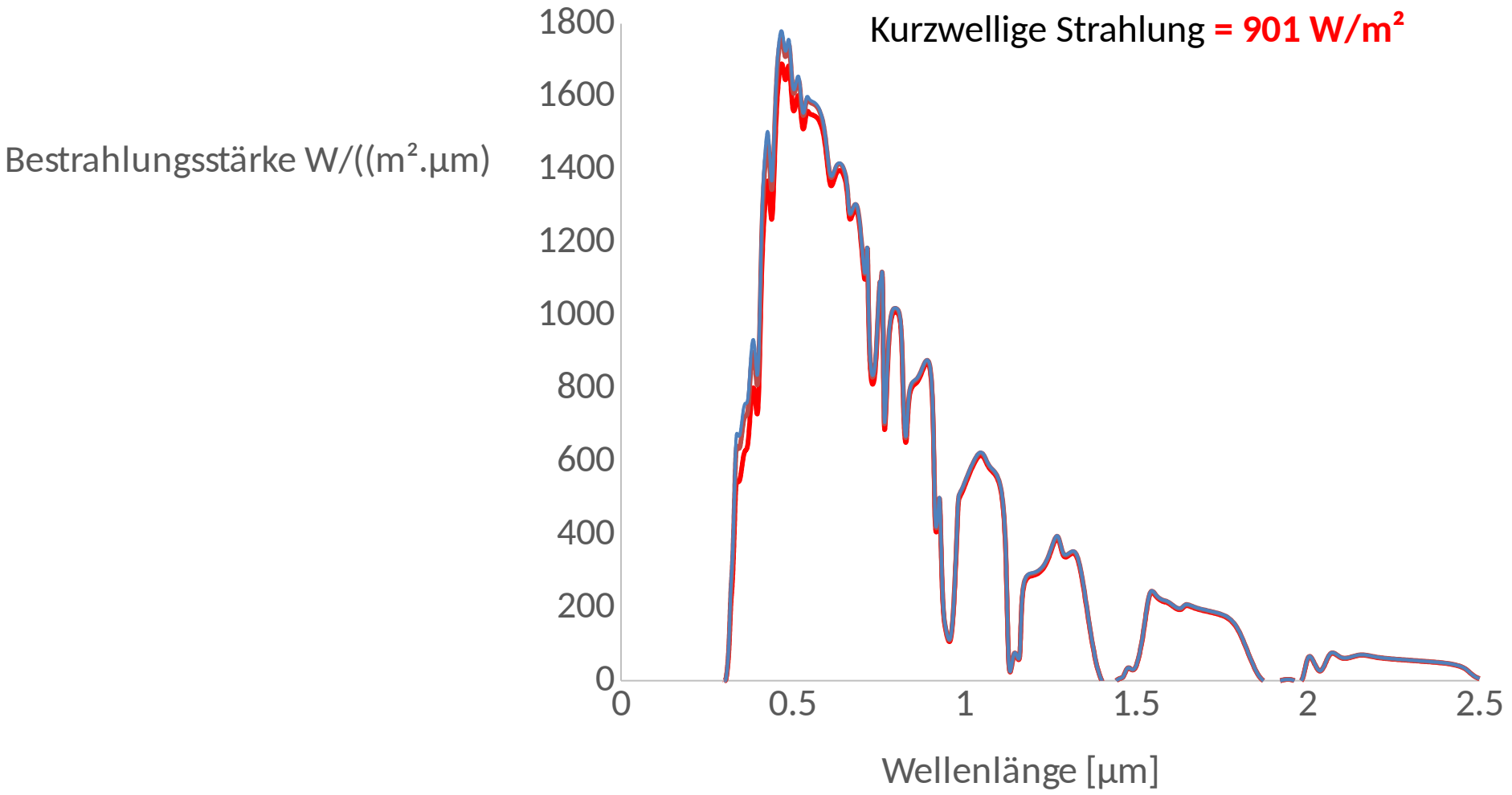
# EINFLUSS DER AEROSOLE

15. Mai 13h MEZ
Sonnenzenitwinkel = 32°
Ozonschichtdicke = 350 DU
Angström Trübungskoeffizient = **0.1**
UV Index = **6**
Kurzwellige Strahlung **= 927 W/m²**



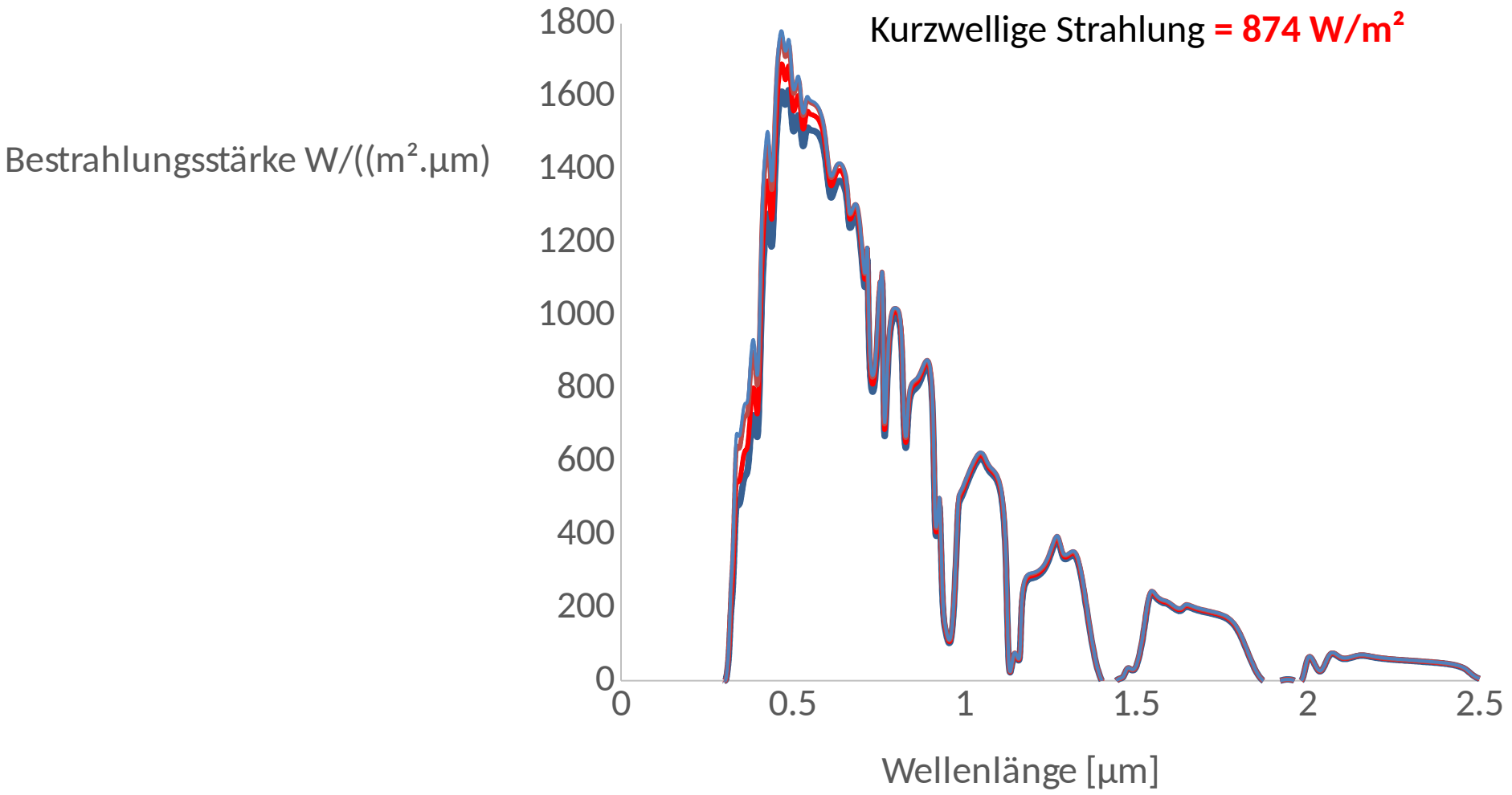
# EINFLUSS DER AEROSOLE

15. Mai 13h MEZ
Sonnenzenitwinkel = 32°
Ozonschichtdicke = 350 DU
Angström Trübungskoeffizient = **0.4**
UV Index = **4.3**
Kurzwellige Strahlung **= 901 W/m²**



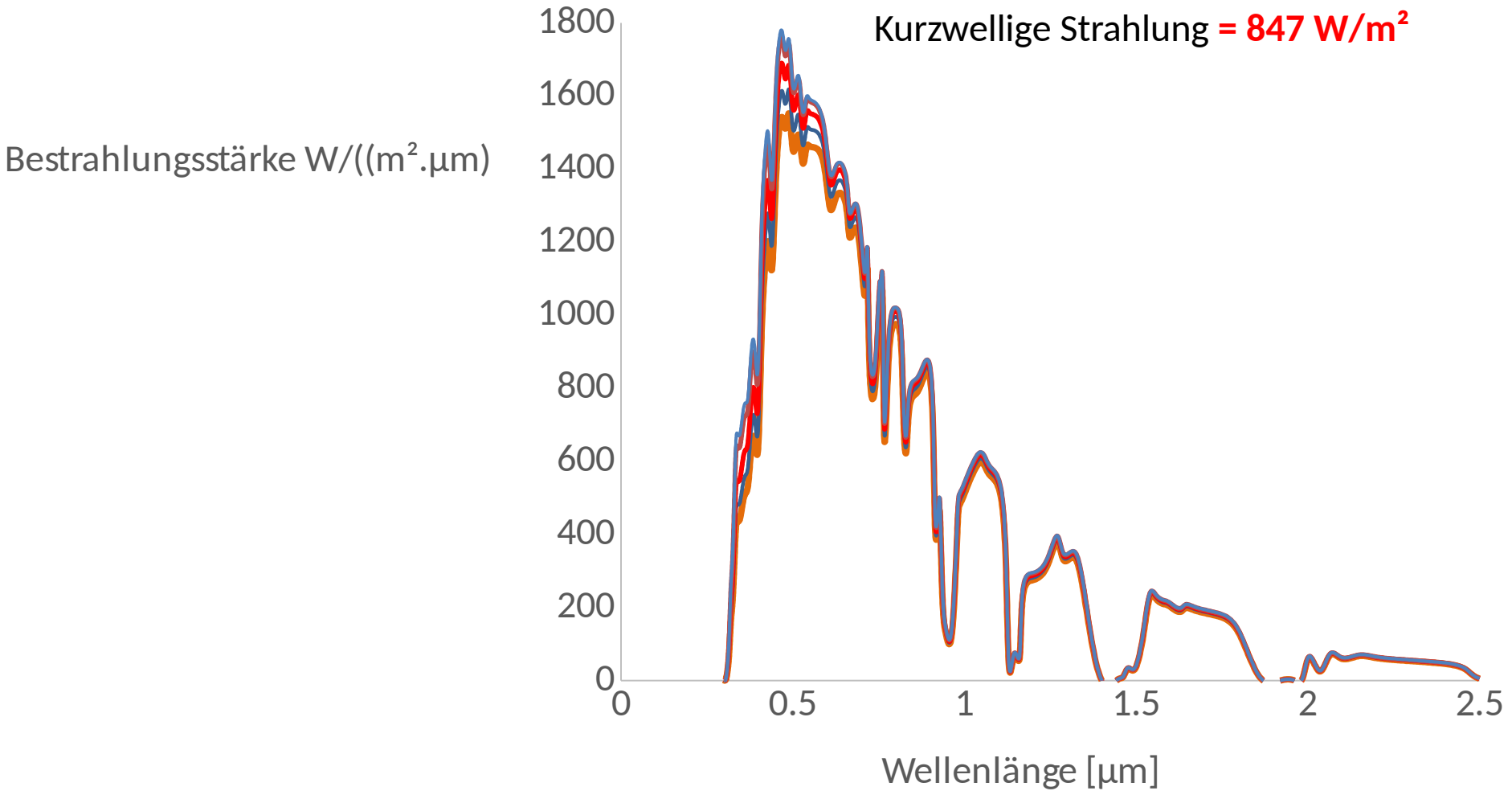
# EINFLUSS DER AEROSOLE

15. Mai 13h MEZ
Sonnenzenitwinkel = 32°
Ozonschichtdicke = 350 DU
Angström Trübungskoeffizient = **0.5**
UV Index = **4.2**
Kurzwellige Strahlung **= 874 W/m²**



# EINFLUSS DER AEROSOLE

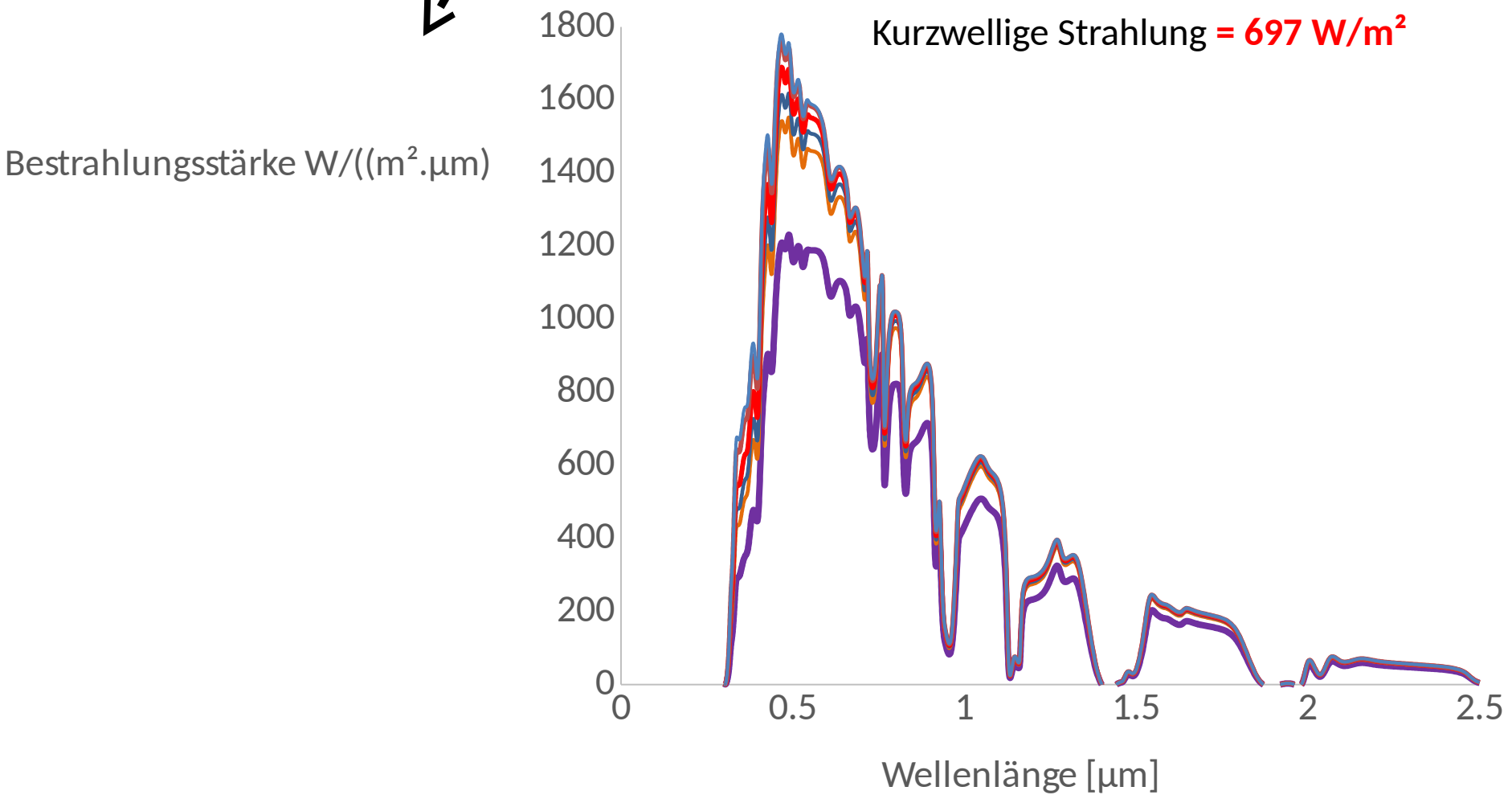
15. Mai 13h MEZ
Sonnenzenitwinkel = 32°
Ozonschichtdicke = 350 DU
Angström Trübungskoeffizient = **1**
UV Index = **3.5**
Kurzwellige Strahlung **= 847 W/m²**



# EINFLUSS DER AEROSOLE

Für Trübung = 0.01
UV Index = 6.5
KW Strahlung = 935 W/m²

15. Mai 13h MEZ
Sonnenzenitwinkel = 32°
Ozonschichtdicke = 350 DU
Angström Trübungskoeffizient = **3**
UV Index = **2.5**
Kurzwellige Strahlung **= 697 W/m²**



Thank you for your attention!