



DEPARTMENT FÜR
PHYSIOLOGIE UND
MEDIZINISCHE PHYSIK

UV@INNSBRUCK



MEDIZINISCHE UNIVERSITÄT
INNSBRUCK

Actinic Flux in Mountainous Areas under Cloudless Conditions



Measurement Campaign Innsbruck, September 2007

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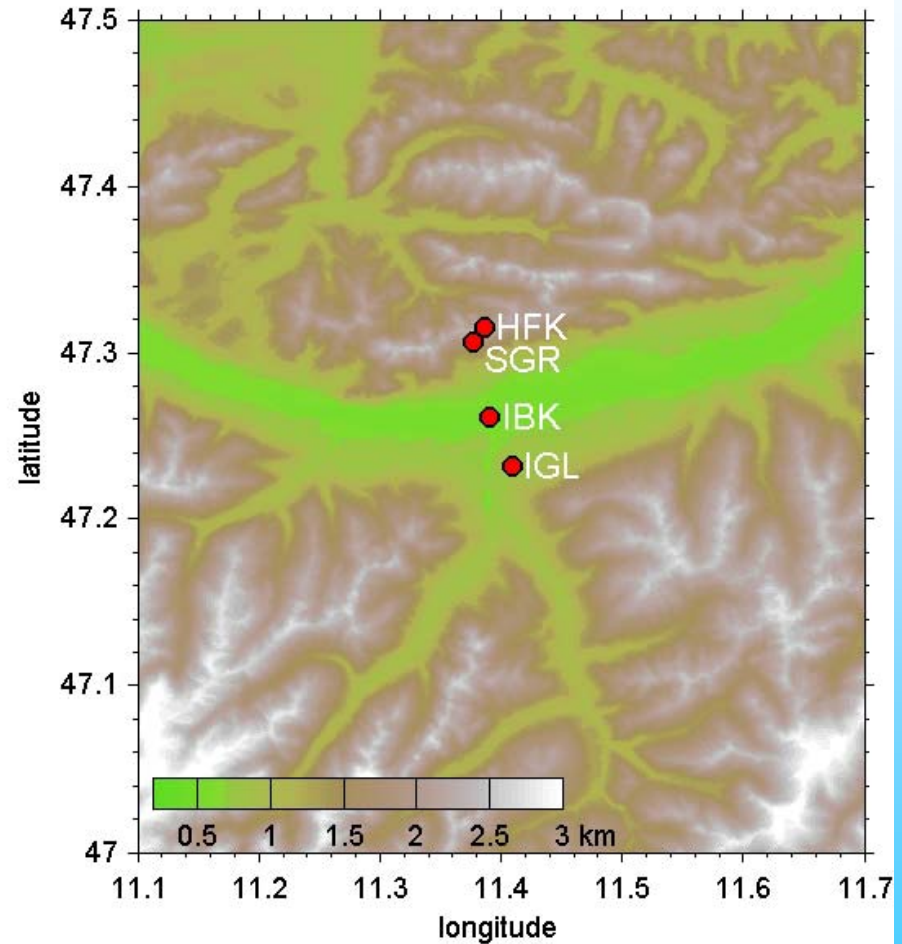
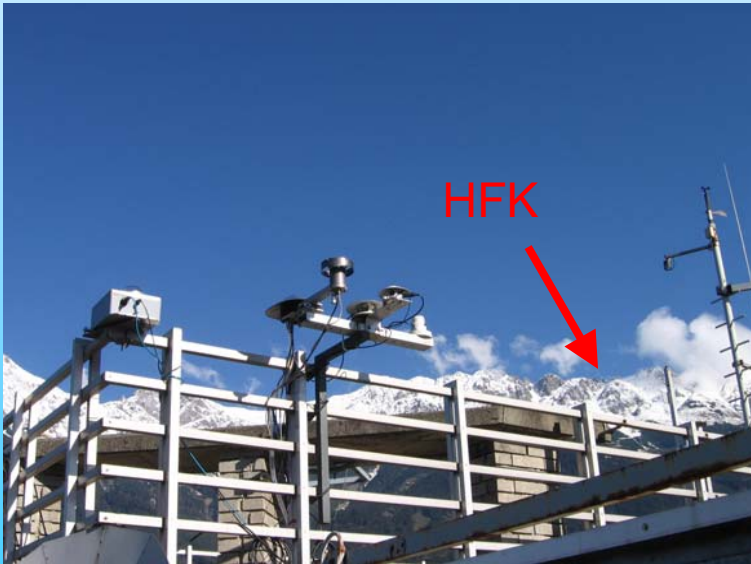
Introduction

- UV radiation pivotal role in atmospheric photochemistry
- Photolysis rate e.g. for O_3 , NO_x directly proportional to actinic flux (flux density incident on a sphere)
- Validation of 3D model of UV-radiation field in a complex topography
- Important atmospheric factors:
 - Clouds
 - Topography + Albedo
 - Aerosols
 - Ozone

Method

Measurement site in Innsbruck
(IBK, 630 masl)

Mountain measurement site at Hafelekar
(HFK, 2276 masl)



Instrumentation IBK

Instrument	Wavelength	Sampling Interval
Spectroradiometer Bentham DTM300 Actinic, global spectra Direct spectra / Sky radiance	290nm - 500nm (0.5nm)	15 minutes Around noon
Sunphotometer (Precision Filter Radiometer)	368nm, 412nm, 500nm, 862nm	1 minute
Lidar Backscatter + Depolarisation	532nm	~1 hour
Vaisala ceilometer	IR	~ms
All-Sky camera	Visible	15 minutes

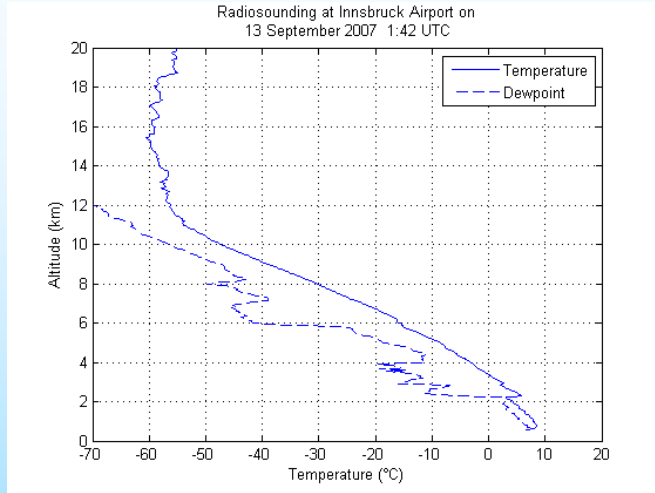


Instrumentation HFK

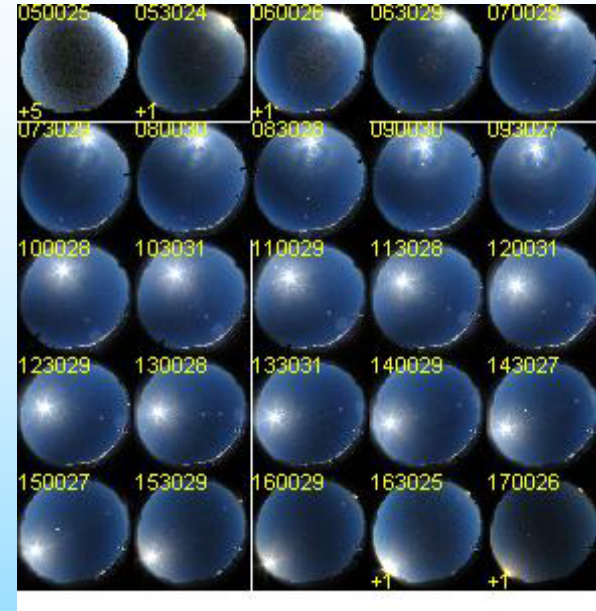
Instrument	Wavelength	Sampling Interval
Spectroradiometer Bentham DTM300 Actinic, global spectra Direct spectra	290nm - 500nm (0.5nm)	30 minutes Around noon
Diodearray spectrometer Actinic, global spectra	305nm – 900nm (~1nm)	1 minute
Portable diodearray, actinic spectra	305nm – 900nm (~1nm)	



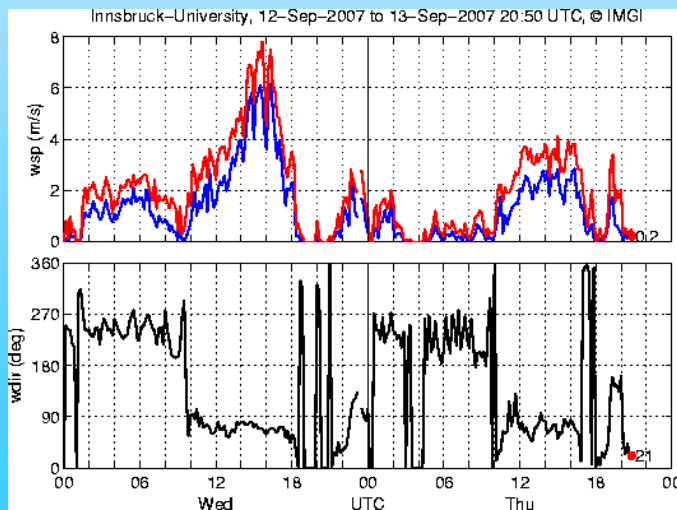
Radiosounding



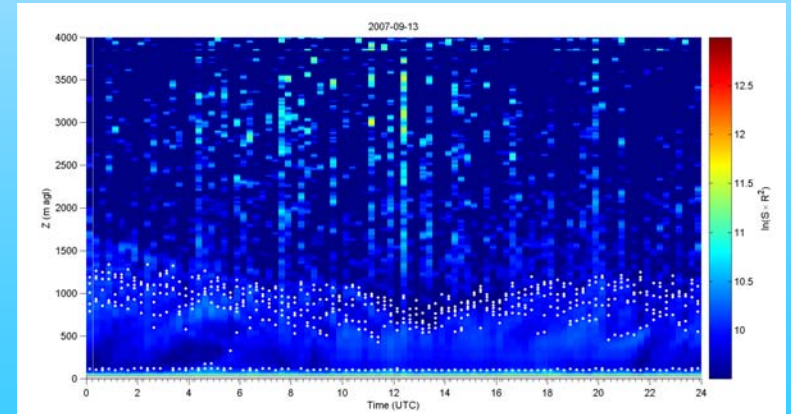
All-sky camera



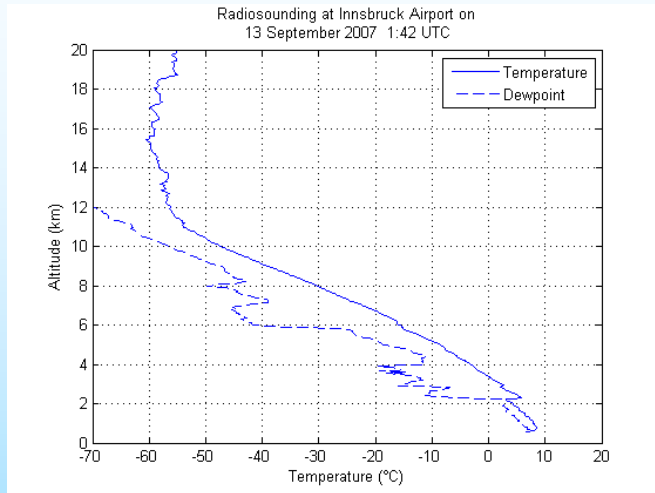
Wind



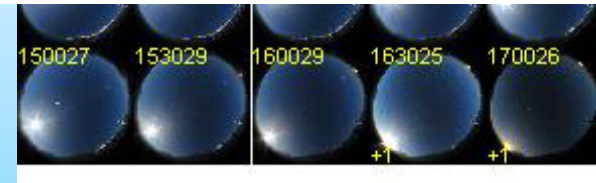
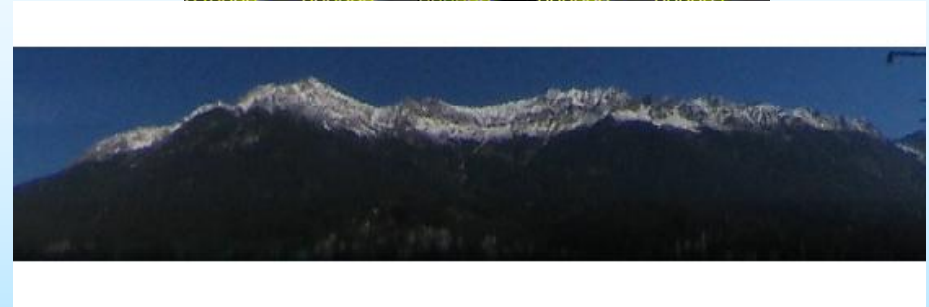
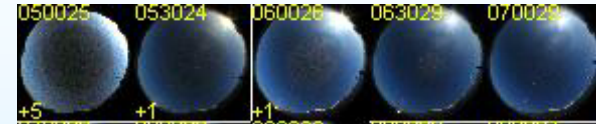
Ceilometer



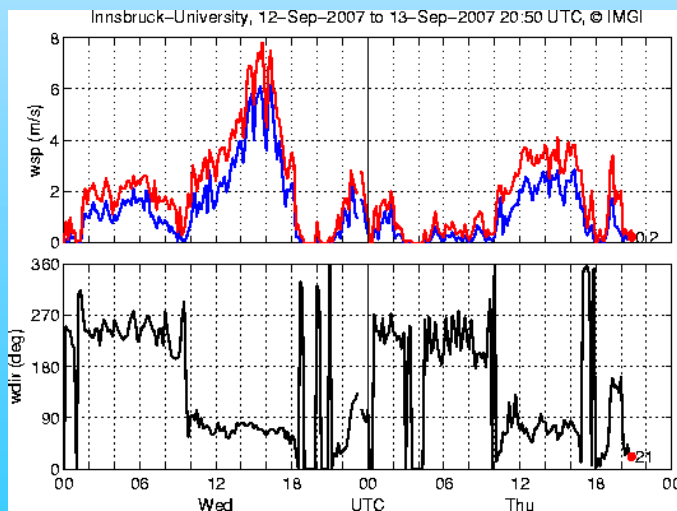
Radiosounding



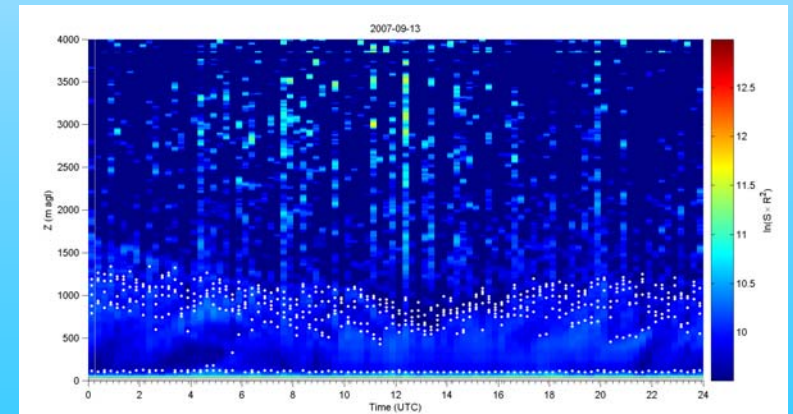
All-sky camera



Wind



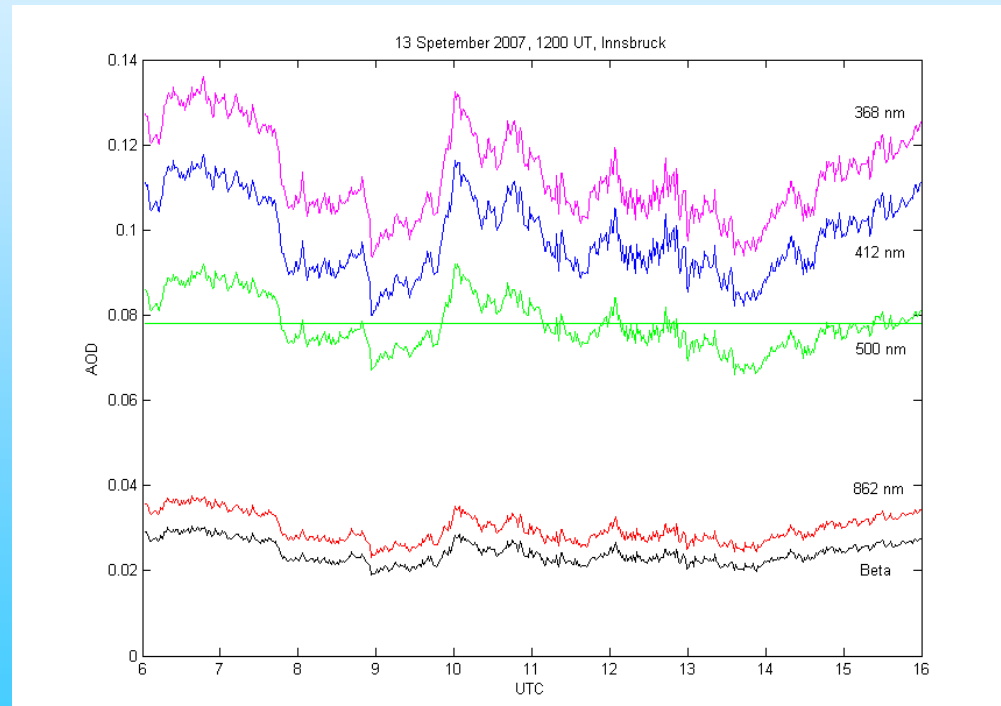
Ceilometer



First Results: Aerosols

Aerosol Optical Depth (AOD)
from Sunphotometer

Daily mean AOD=0.078 (0.006) at 500nm

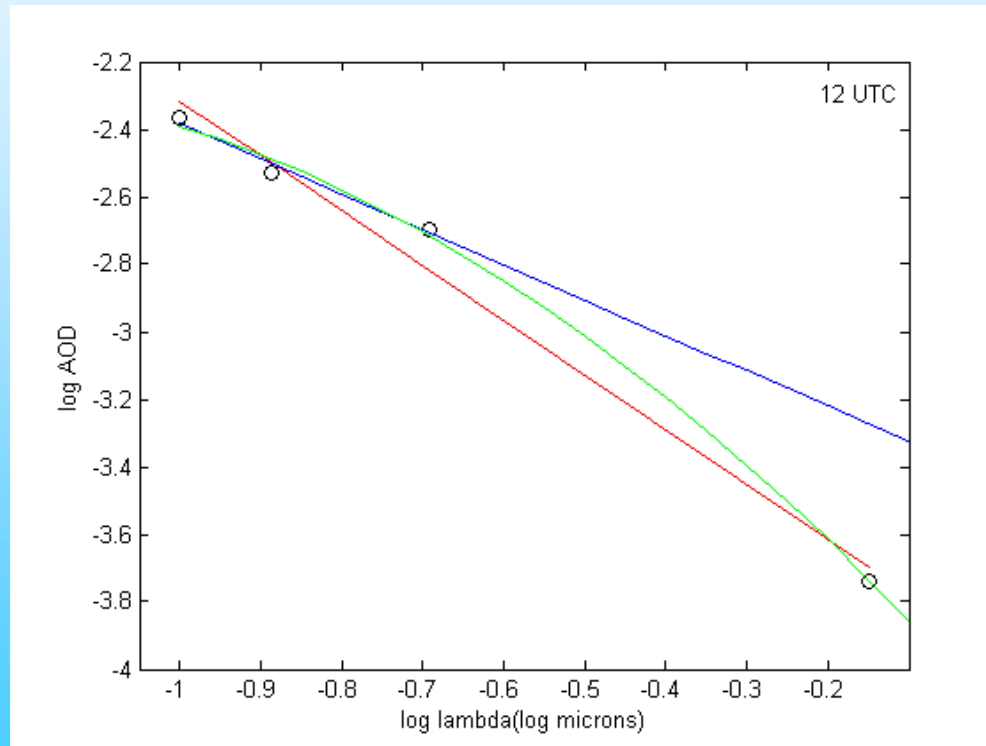


First Results: Aerosols

Angström coefficients α and β

$$\alpha(368\text{nm}-500\text{nm}) = 1.1$$

$$\alpha(368\text{nm}-862\text{nm}) = 1.6$$



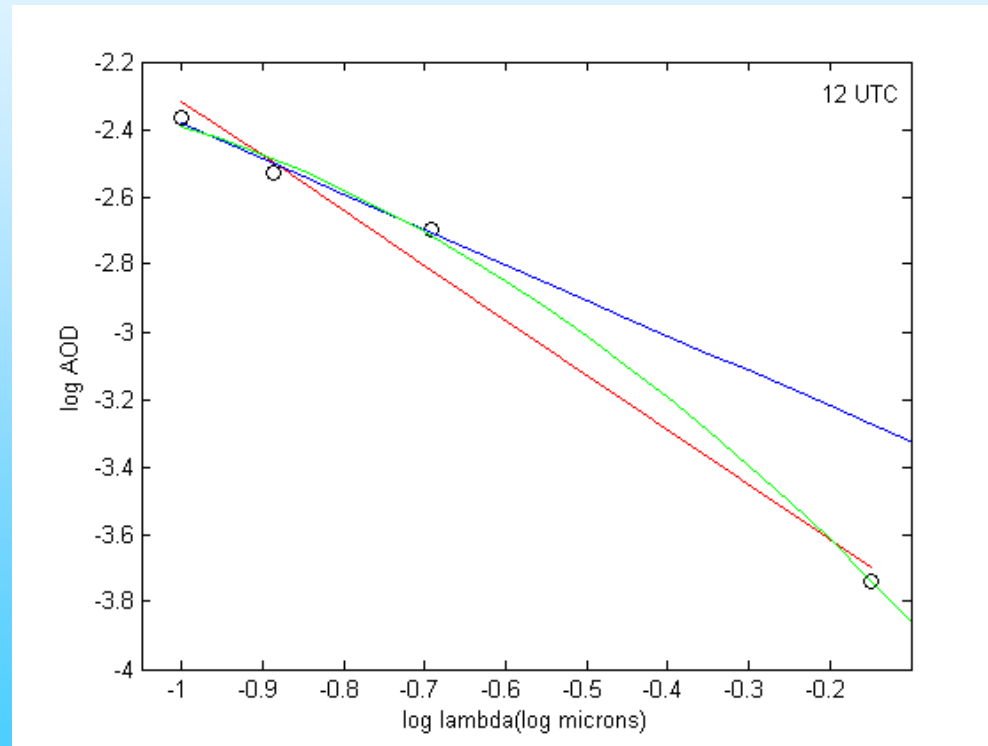
$$\tau = \beta \lambda^{-\alpha}$$

First Results: Aerosols

Angström coefficients α and β

$$\alpha(368\text{nm}-500\text{nm}) = 1.1$$

$$\alpha(368\text{nm}-862\text{nm}) = 1.6$$

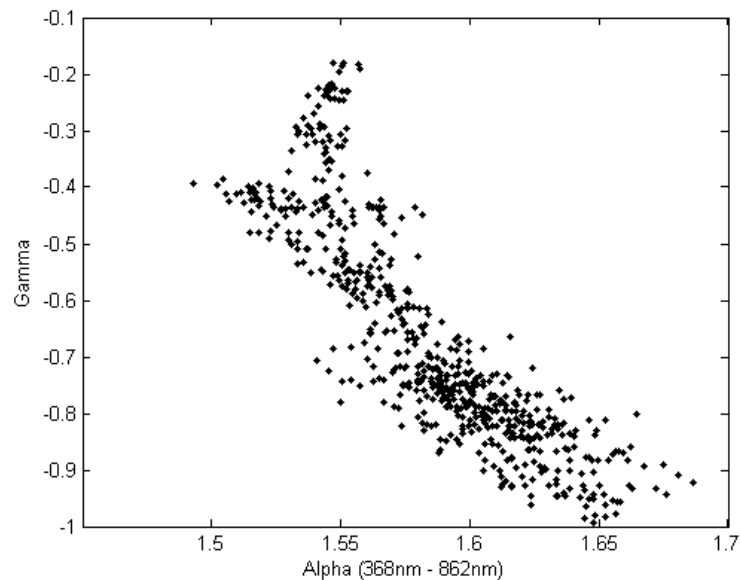
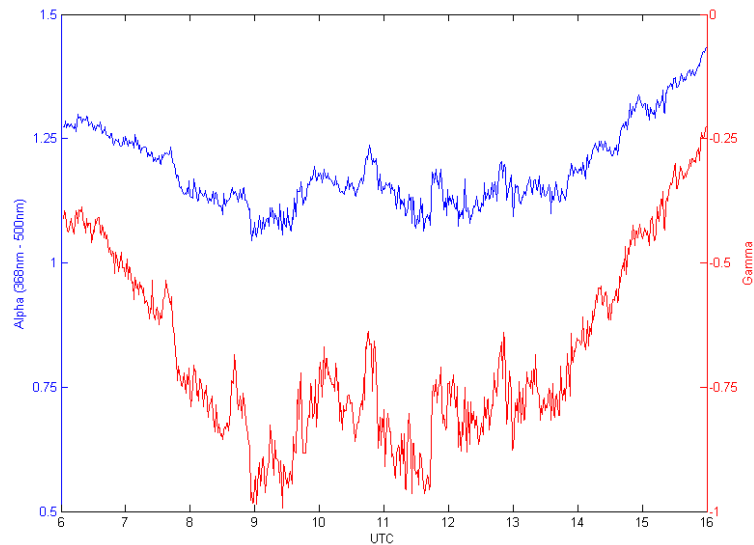


$$\log(AOD) = \log(\beta') - \alpha' \log(\lambda) + \gamma \log^2(\lambda)$$

First Results: Aerosols

Curvature characteristic for Aerosol type
(Size Distribution)

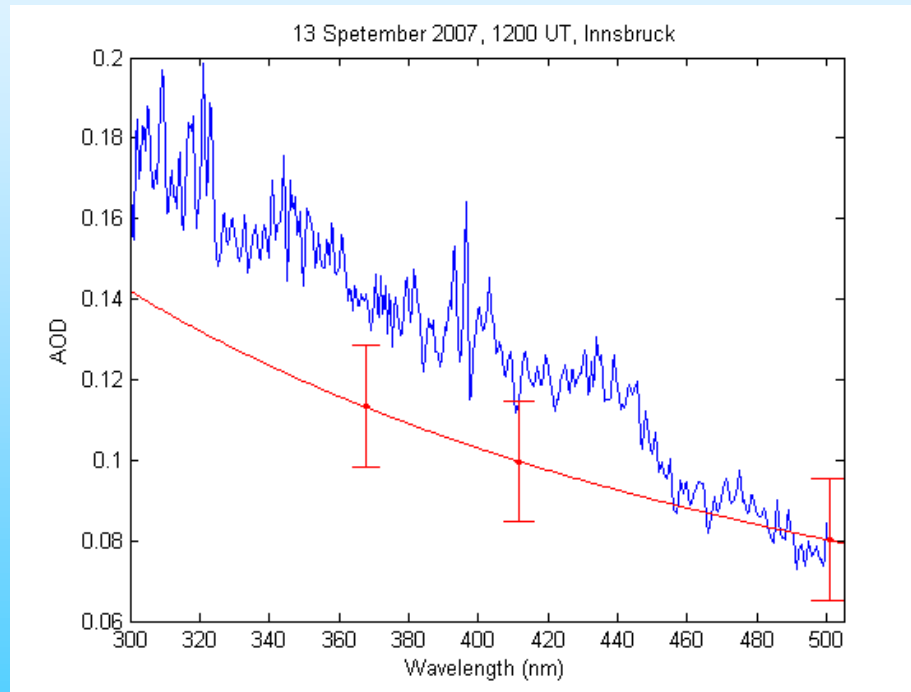
γ - α space indicator for fine particle mode
Radius and extinction



First Results: Aerosols

Comparison of SPM results with direkt-sun spectroradiometer

Small absolute difference in the UV
due to different Rayleigh models*

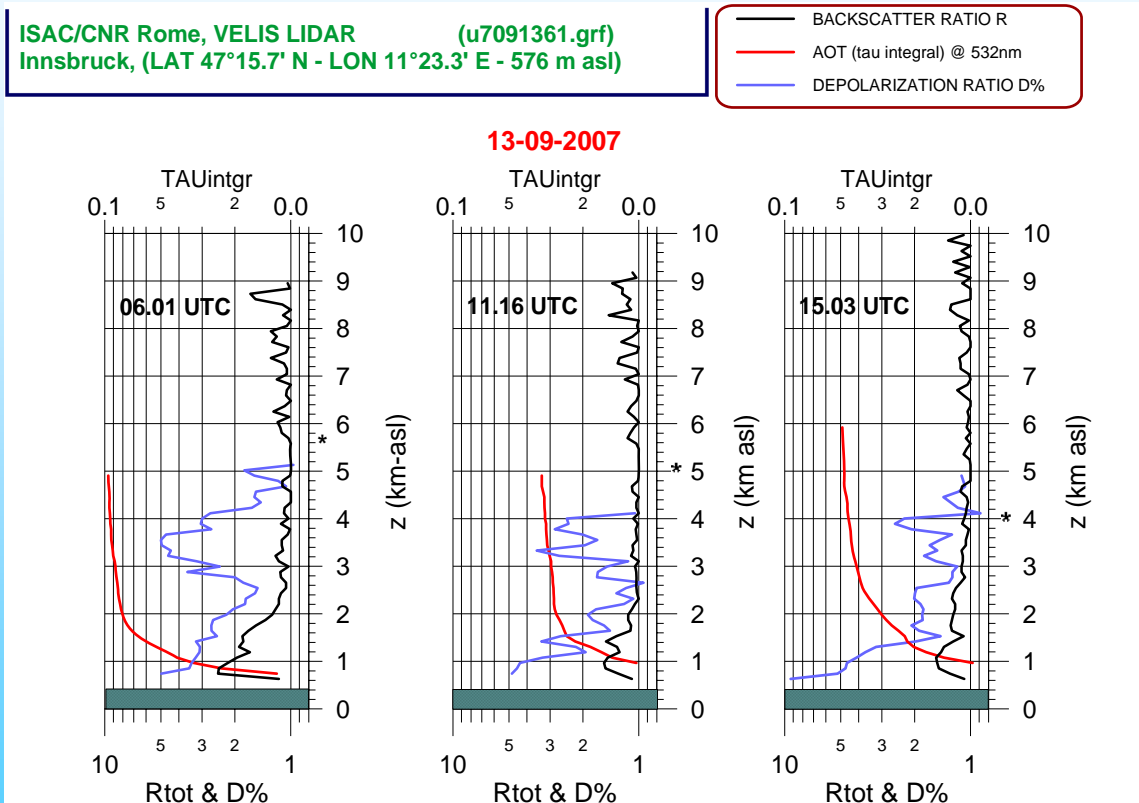


Sky scan of radiance around noon
Aerosol single scatter albedo and phasefunction

* Bucholtz vs. Bodhaine

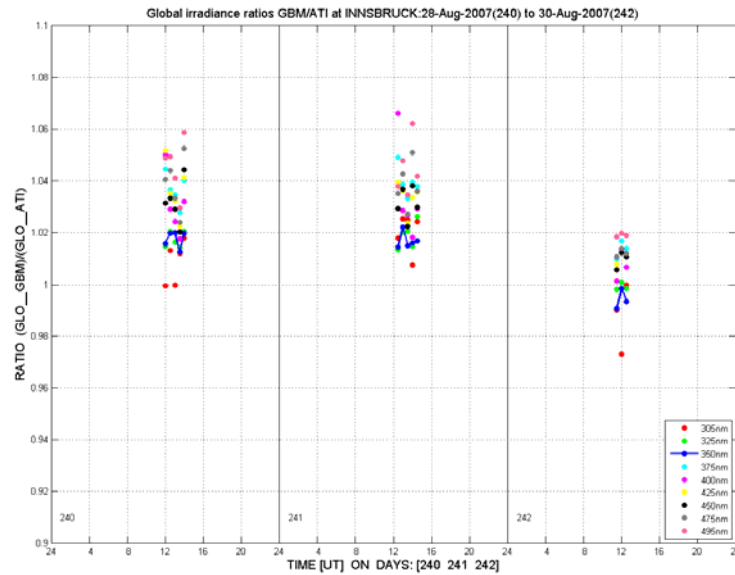
First Results: Aerosols

Lidar-Profiles Backscatter ratio, Depolarisation, AOD

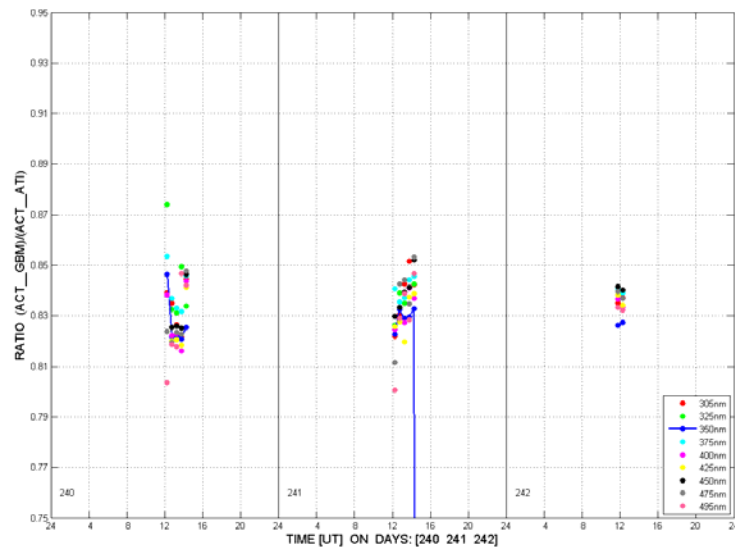


Signal near detection limit
AOD systematically lower than SPM-Data

Ratio of global spectra
Agreement ~3%

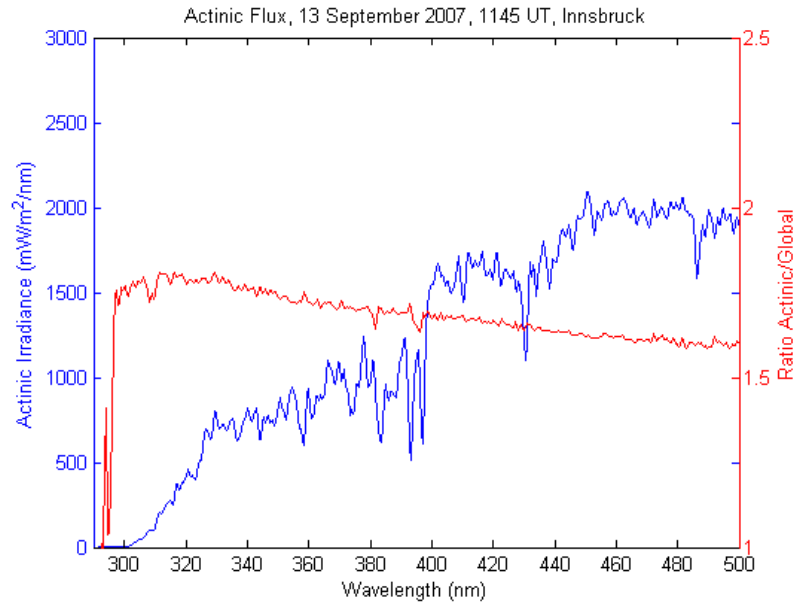


Ratio of actinic spectra
Agreement ~17%

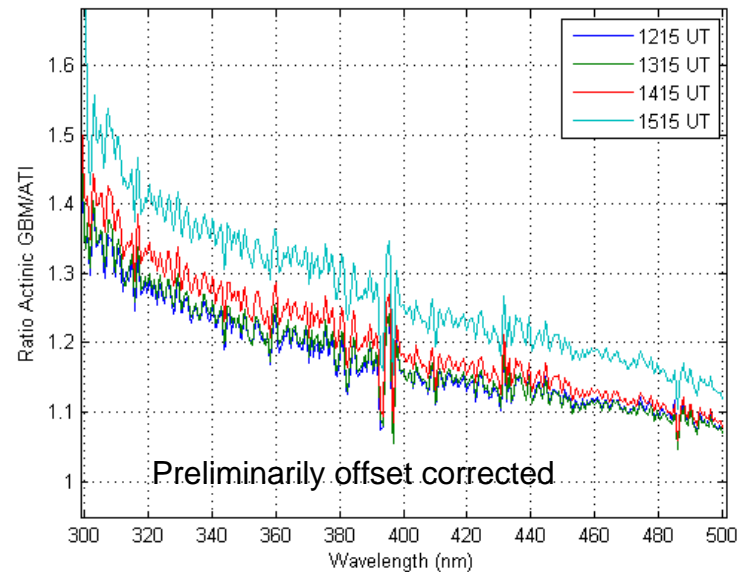


First Results: Spectroradiometer

Actinic spectrum (IBK)



Ratio of actinic spectra
(Mountain/Valley)



Summary and Outlook

- Presentation of recent measurement campaign
First data of a cloudless day
- Final analysis of Spectroradiometer data,
Diodearray data,
Sky scan of radiance,
...
- Comparison with 3D-model calculations
(Monte-Carlo Model „GRIMALDI“ with
50m x 50m resolution, J.Wagner *et al.*)

All-Sky Camera

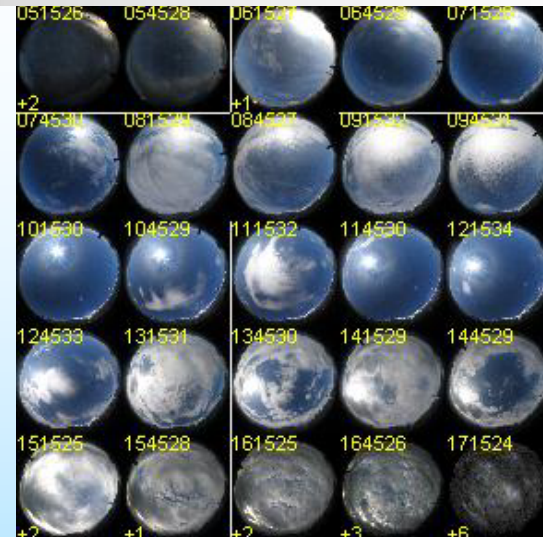
Image every 15 minutes

Polarisation:

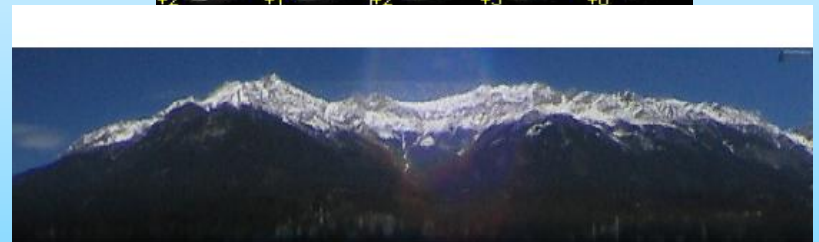
4 Settings of Pol-Filter

Sky map of Stokes Parameter

Talk M.Schwarzmann



Snowboundary

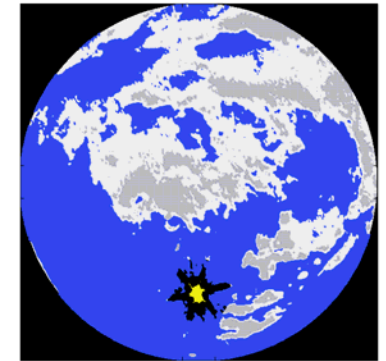


Cloud detection algorithm

Thick cloud, thin cloud,

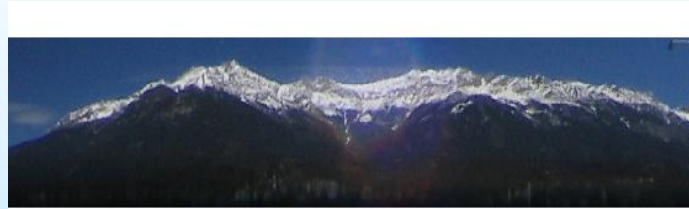
overcast/clear sky ratio

Sun obscured



Snowboundary

10.9.



12.9.



13.9. 7:00



13.9. 1415



Meteorology

