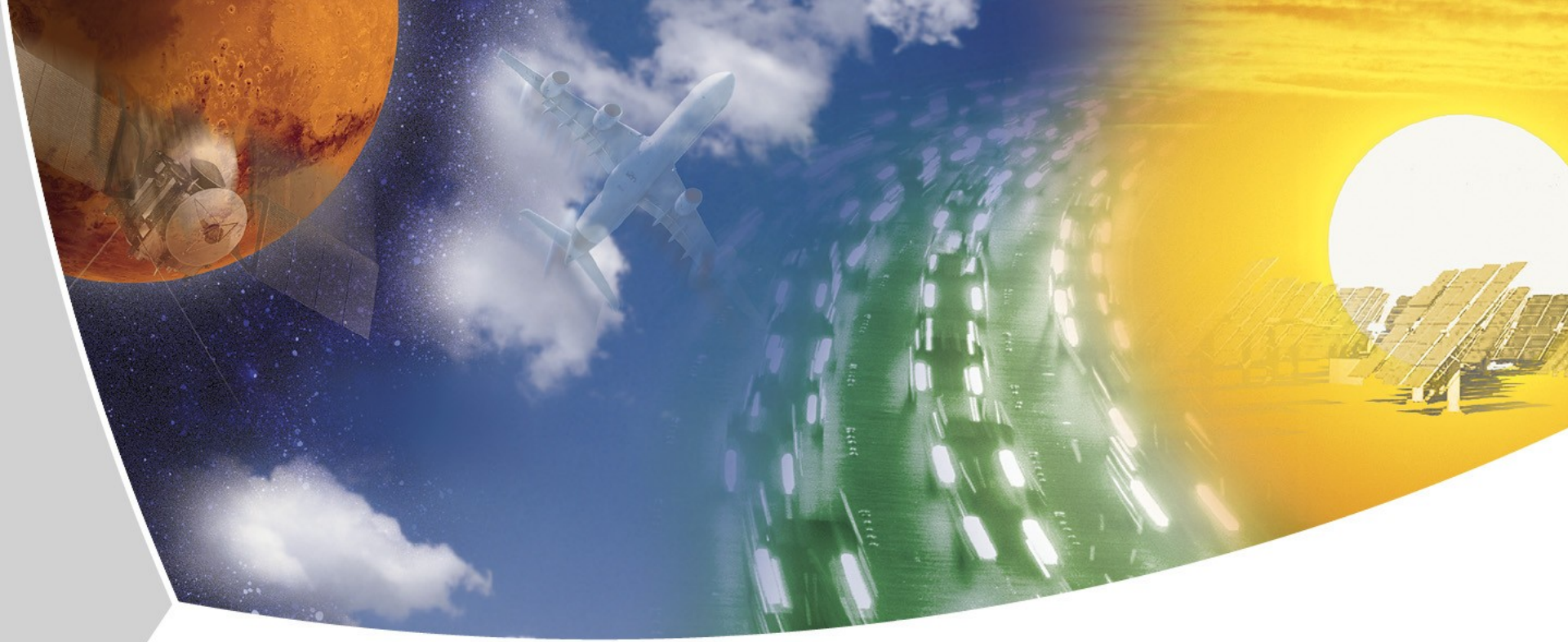


New means of airborne water cloud remote sensing

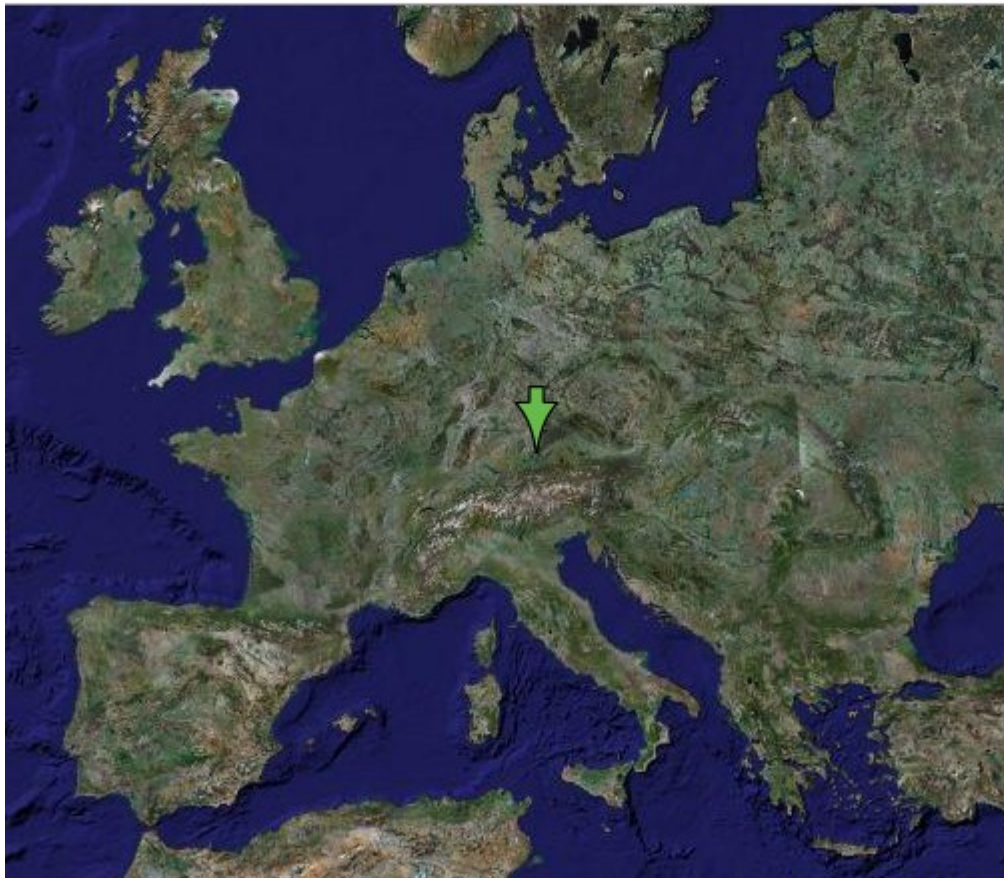
Tobias Zinner (currently NASA Goddard), Bernhard Mayer

Institut für Physik der Atmosphäre

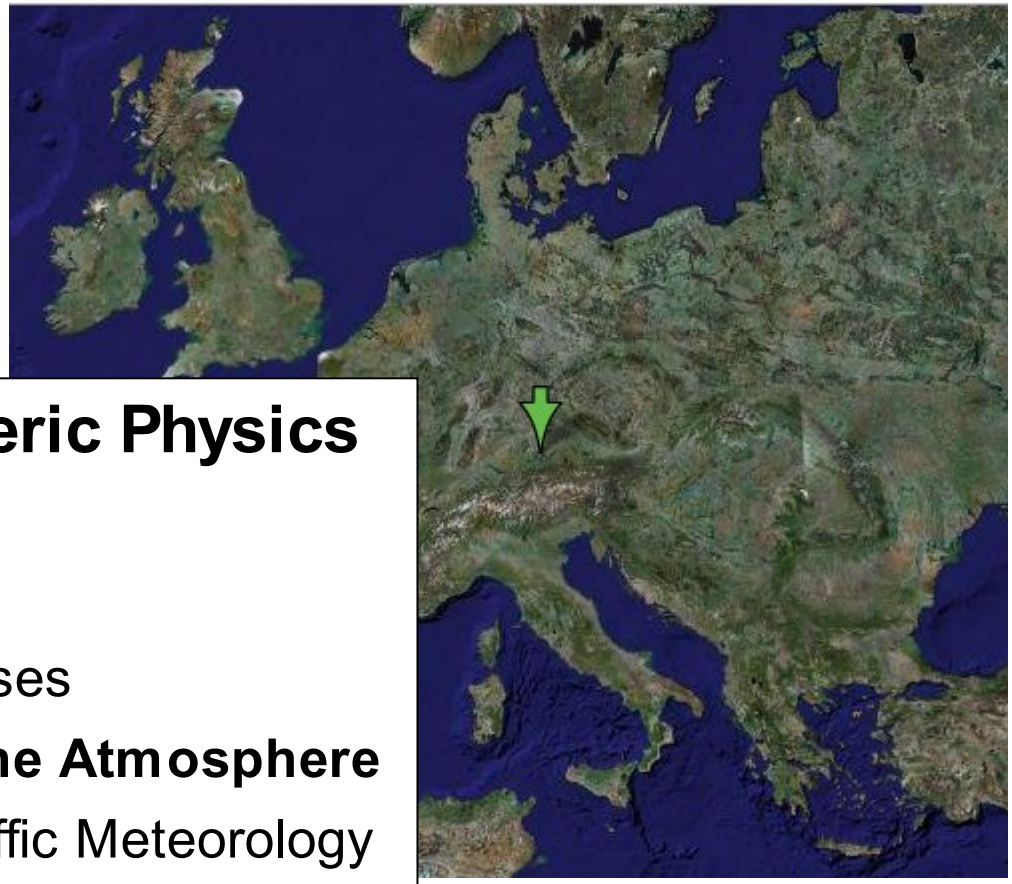
Deutsches Zentrum
für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

DLR Oberpfaffenhofen

Oberpfaffenhofen?



DLR Oberpfaffenhofen



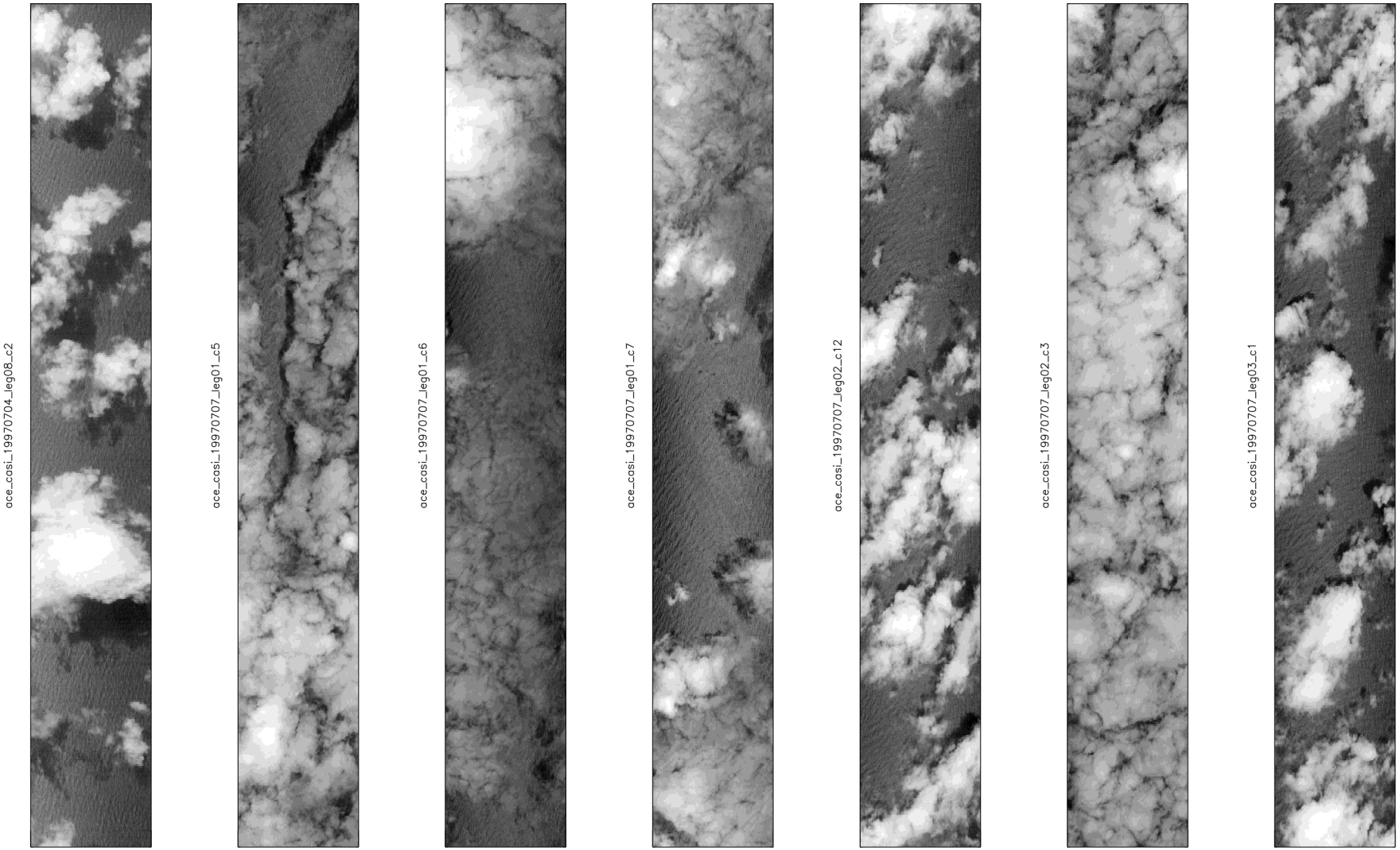
Institute of Atmospheric Physics

Departments:

- Atmospheric Dynamics
- Atmospheric Trace Gases
- **Remote Sensing of the Atmosphere**
- Cloud Physics and Traffic Meteorology
- Lidar

Cloud Properties from Passive Remote Sensing

CASI (Compact Airborne Spectrographic Imager, FU Berlin)
radiance at 753 nm, 1.3 x10 km², horiz. res. 15 m, marine stratocumulus



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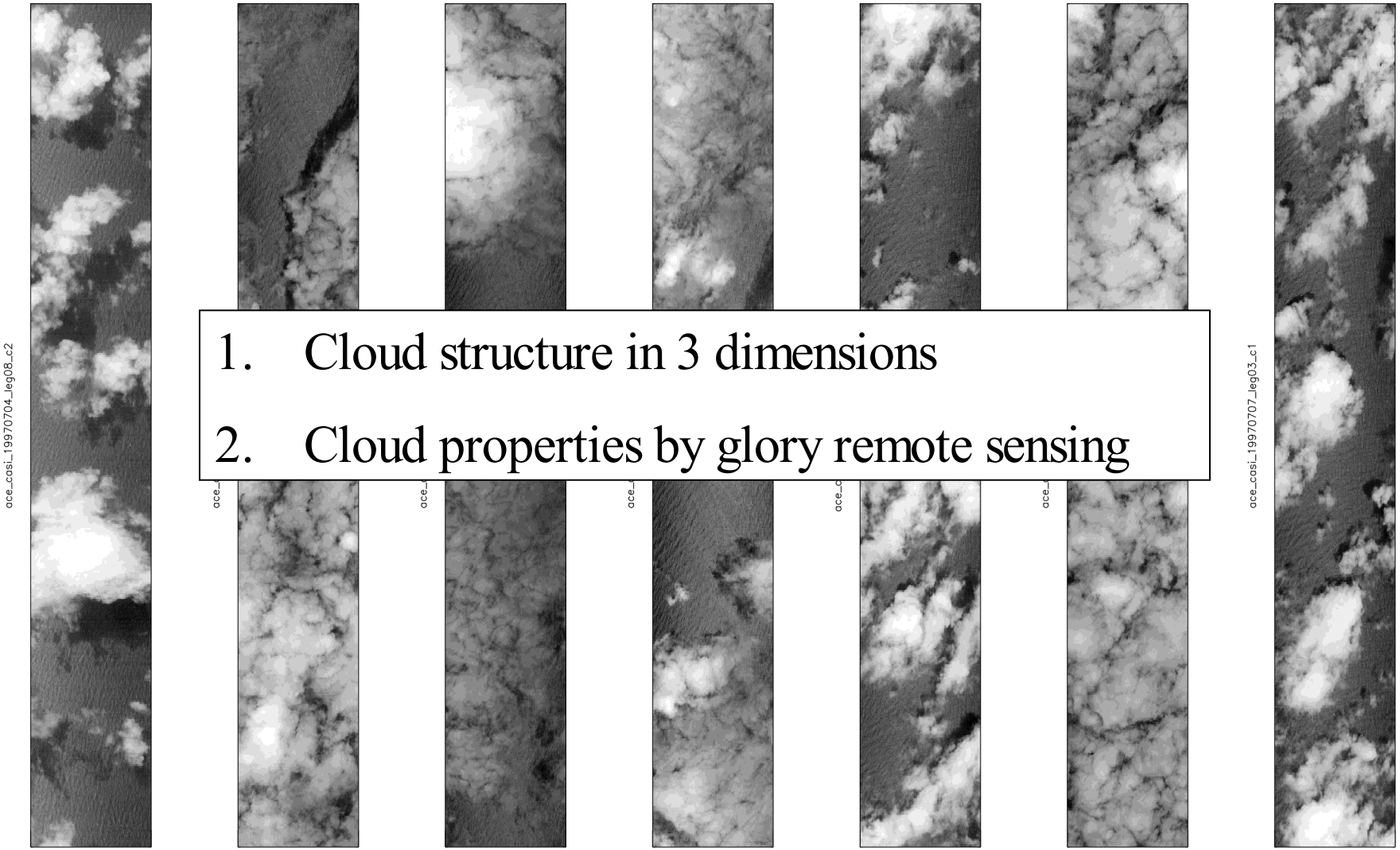


1. Cloud structure in 3 dimensions
2. Cloud properties by glory remote sensing

Cloud structure in 3 dimensions

CASI observatio

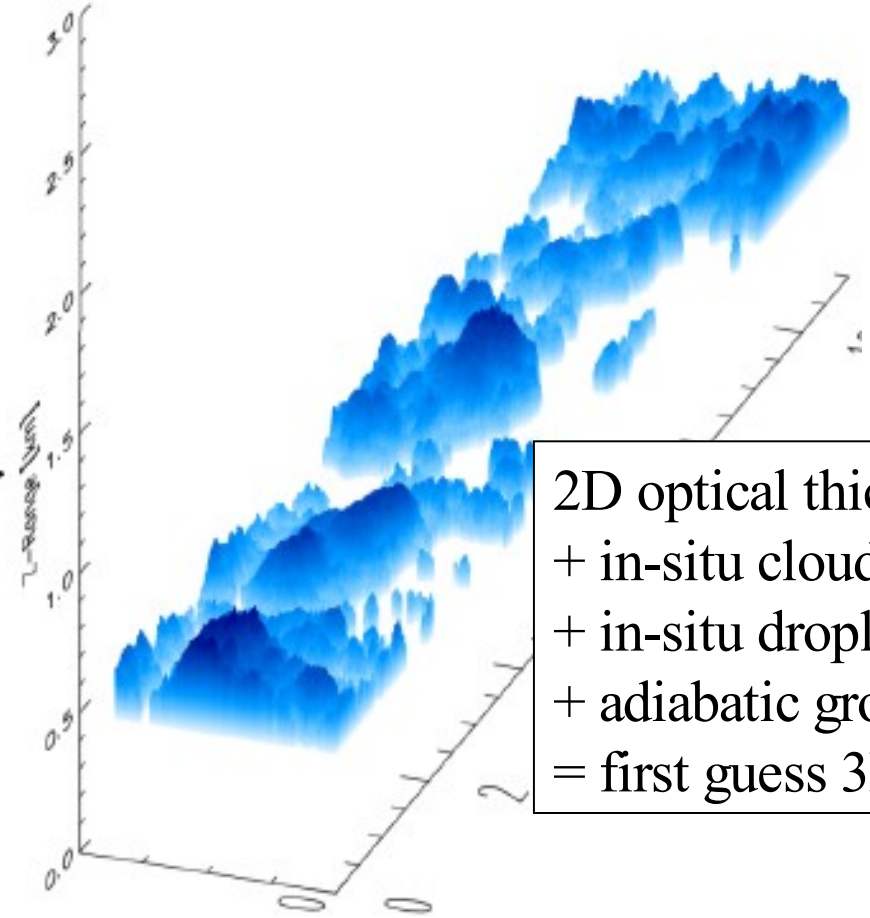
Optical thickness from 753 nm reflectivity

- Radiation transport inversion (3D)?
- Resolution?

Cloud structure in 3 dimensions

CASI observation

3D cloud structure "first guess"

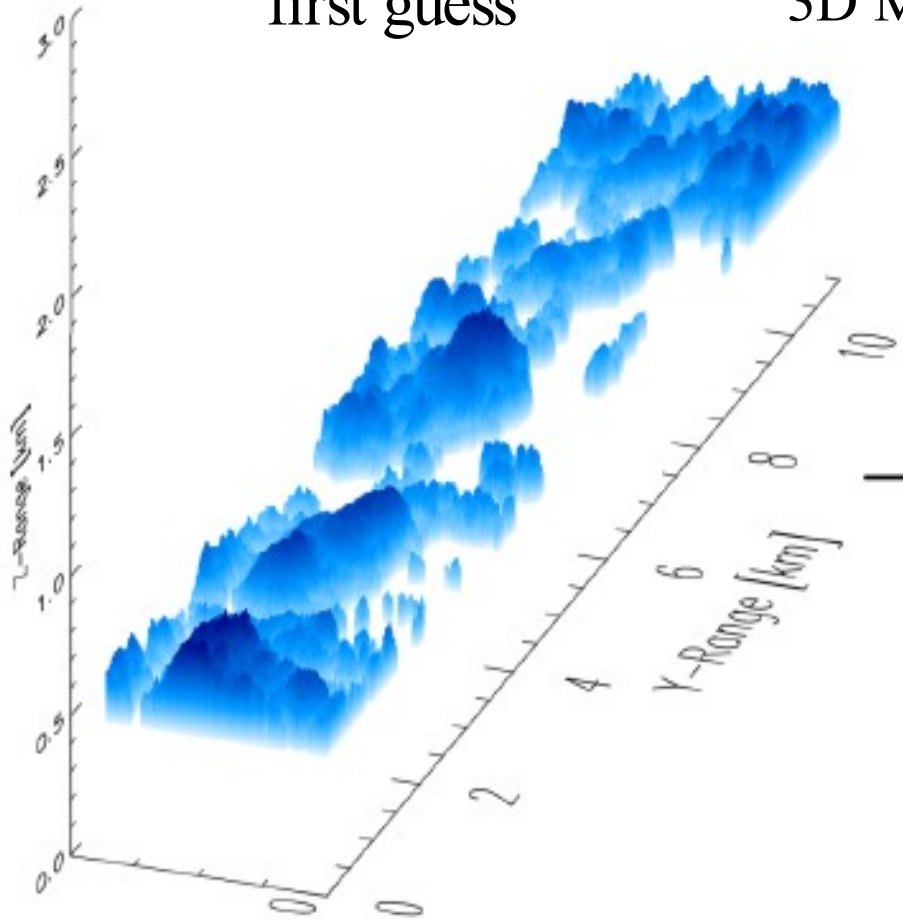


2D optical thickness
+ in-situ cloud bottom height
+ in-situ droplet number
+ adiabatic growth model
= first guess 3D structure

Cloud structure in 3 dimensions

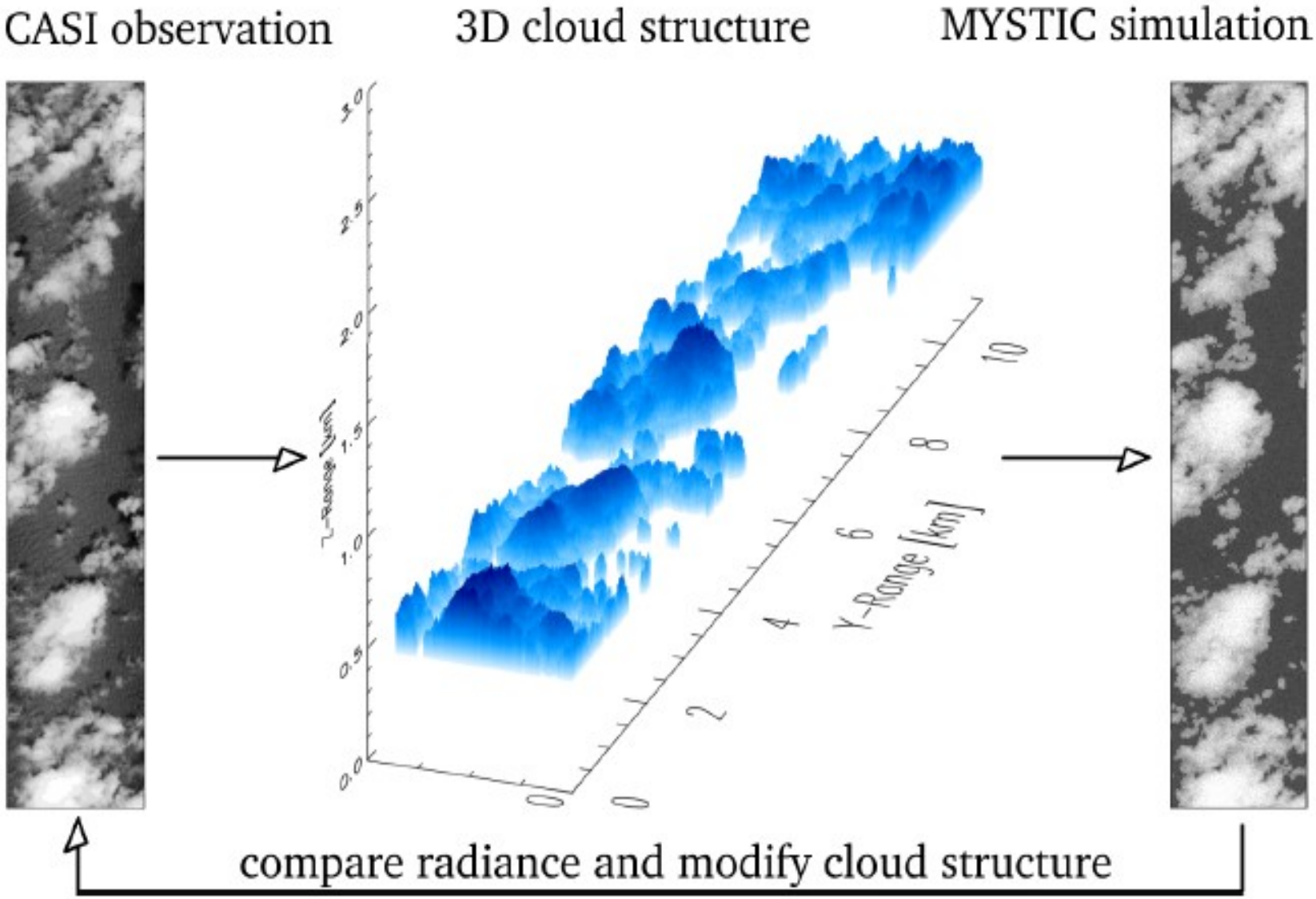
CASI observation

3D cloud structure
"first guess"



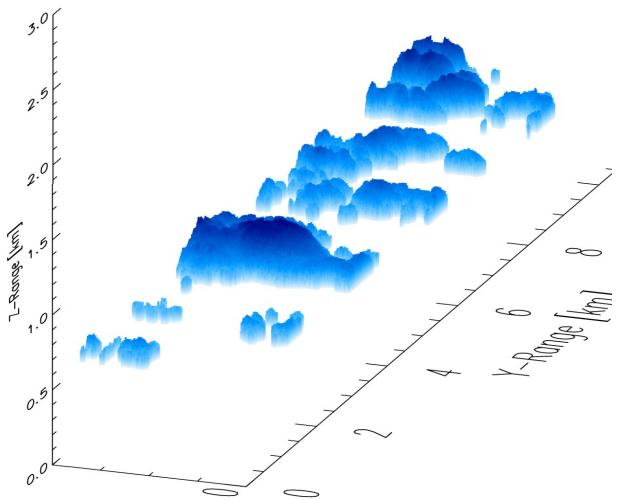
MYSTIC simulation
3D Monte Carlo

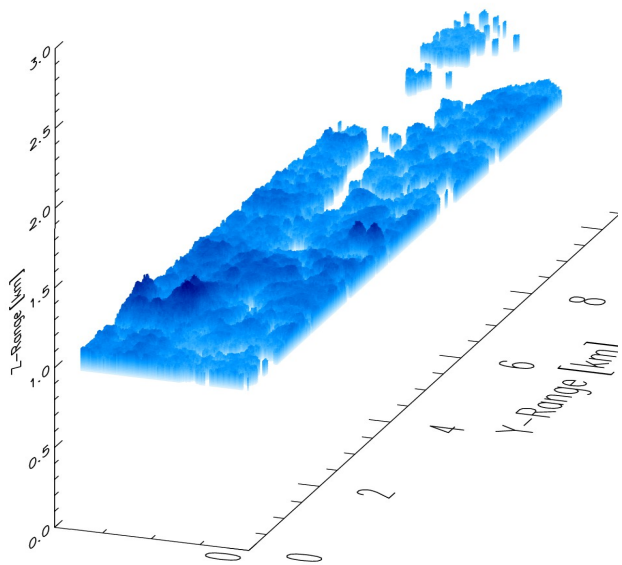
Cloud structure in 3 dimensions



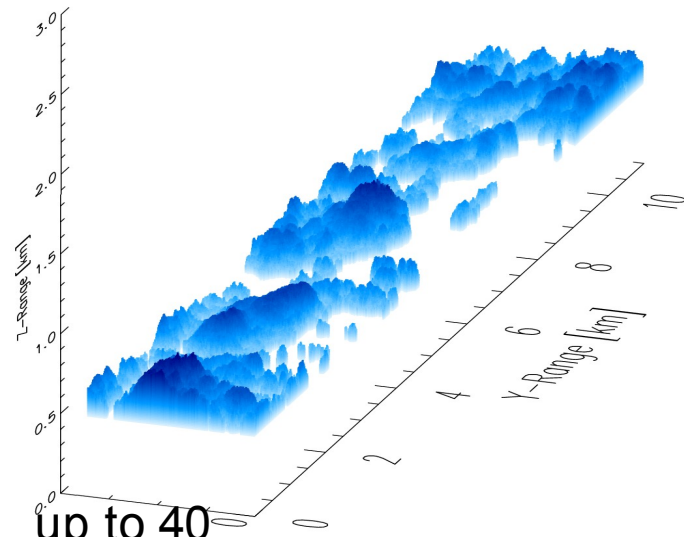
Cloud structure in 3 dimensions

27 cloud structures of low level stratocumulus
1.3 km x 10 km, resolution 15 x 15 x 20 m





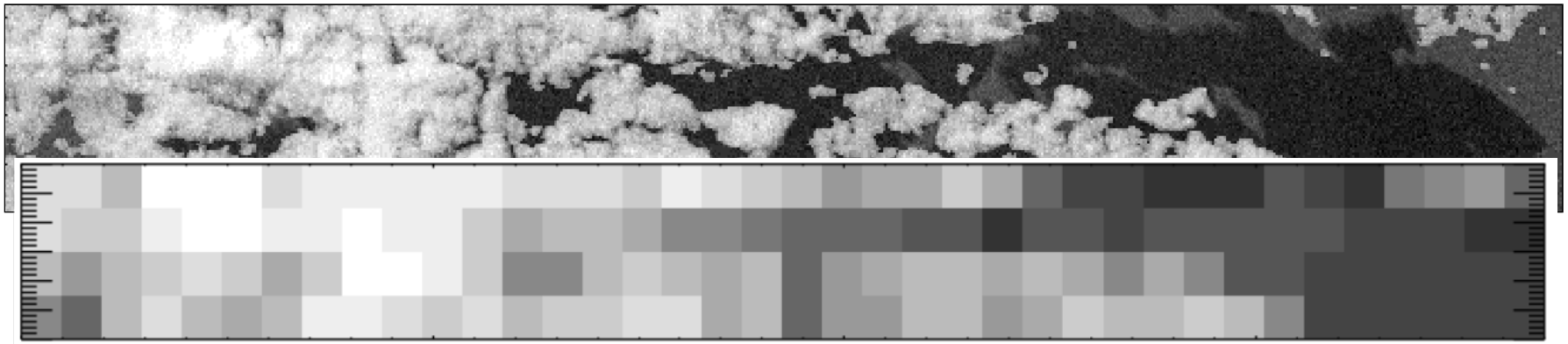
Zinner et al., JGR, 2006

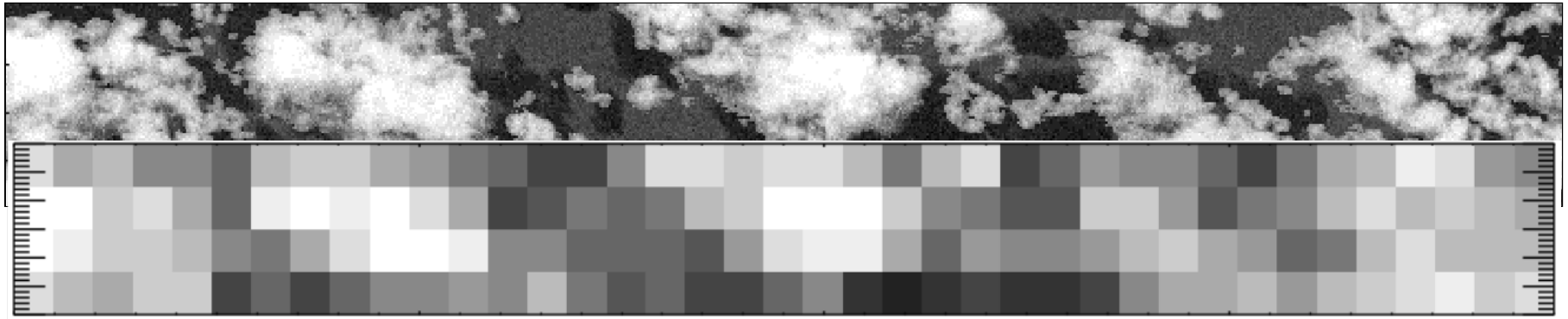


- optical thickness : up to 40
- effective radius at CT : 3 - 15 µm
- LWP: up to 300 g/m²
- CBH: 500 - 1200 m
- cloud geom. thickness: up to 500 m
- cloud cover: 5 - 100 %

Cloud structure in 3 dimensions

➔ test bed for simulation of remote sensing (airborne, satellite, ground)



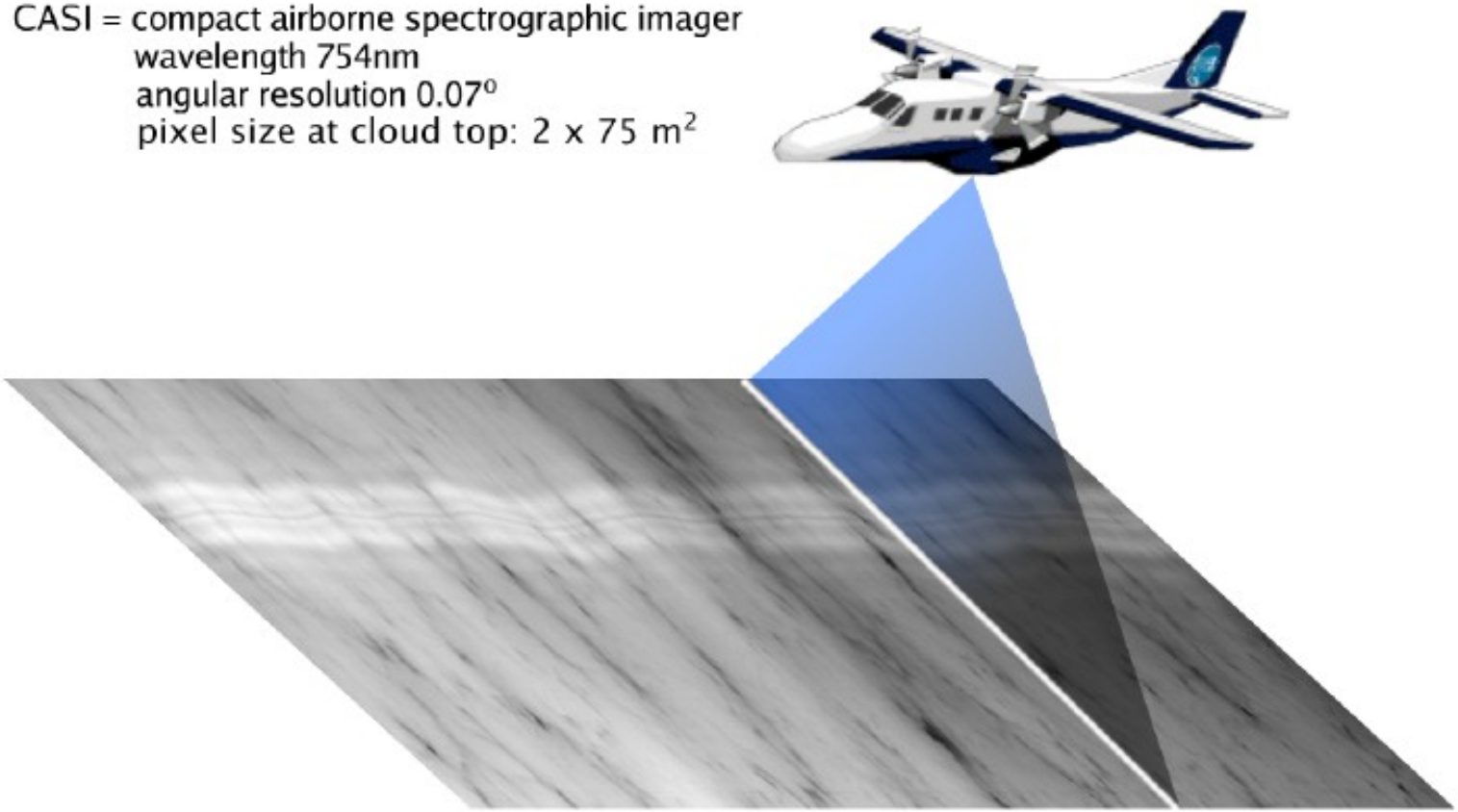


Zinner and Mayer, JGR, 2006

“The Glory of Remote Sensing”

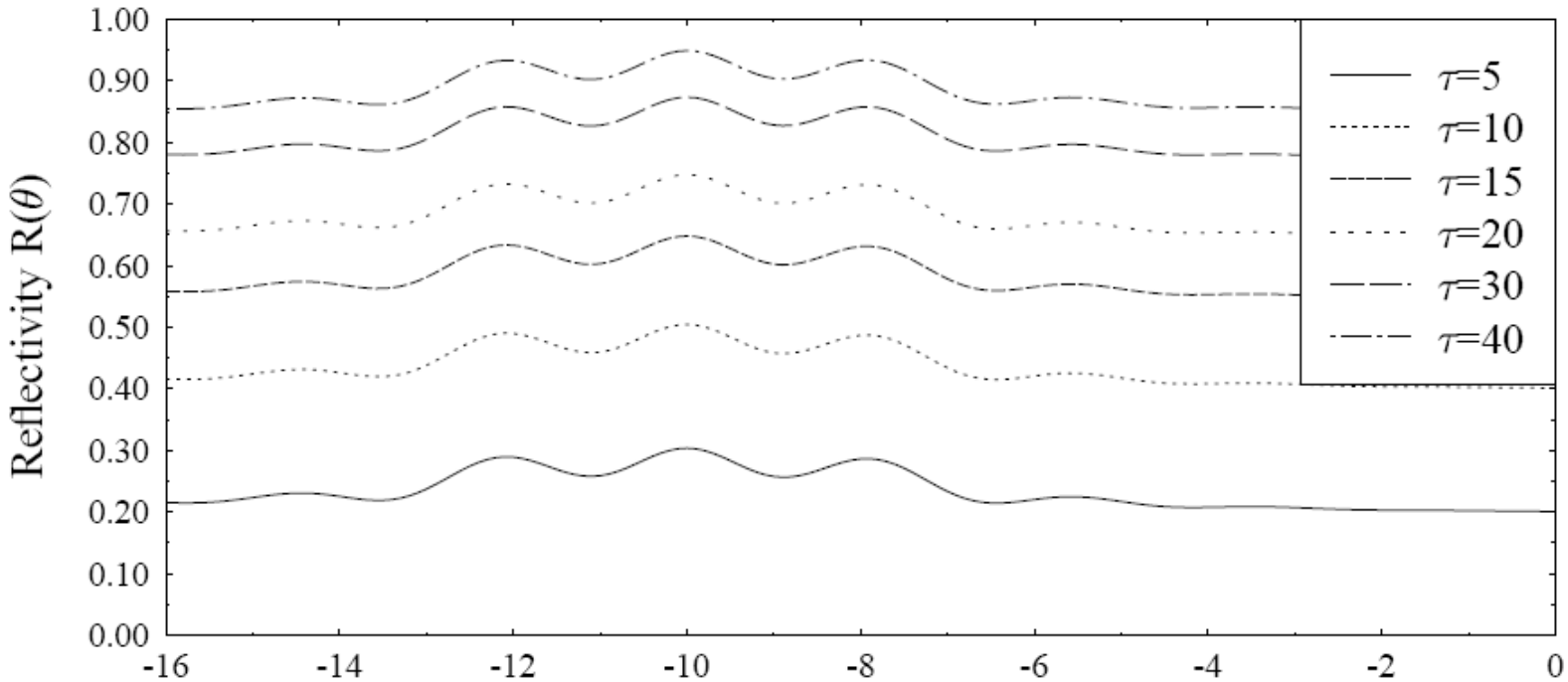
ACE-2 CLOUDYCOLUMN experiment

CASI = compact airborne spectrographic imager
wavelength 754nm
angular resolution 0.07°
pixel size at cloud top: 2 x 75 m^2

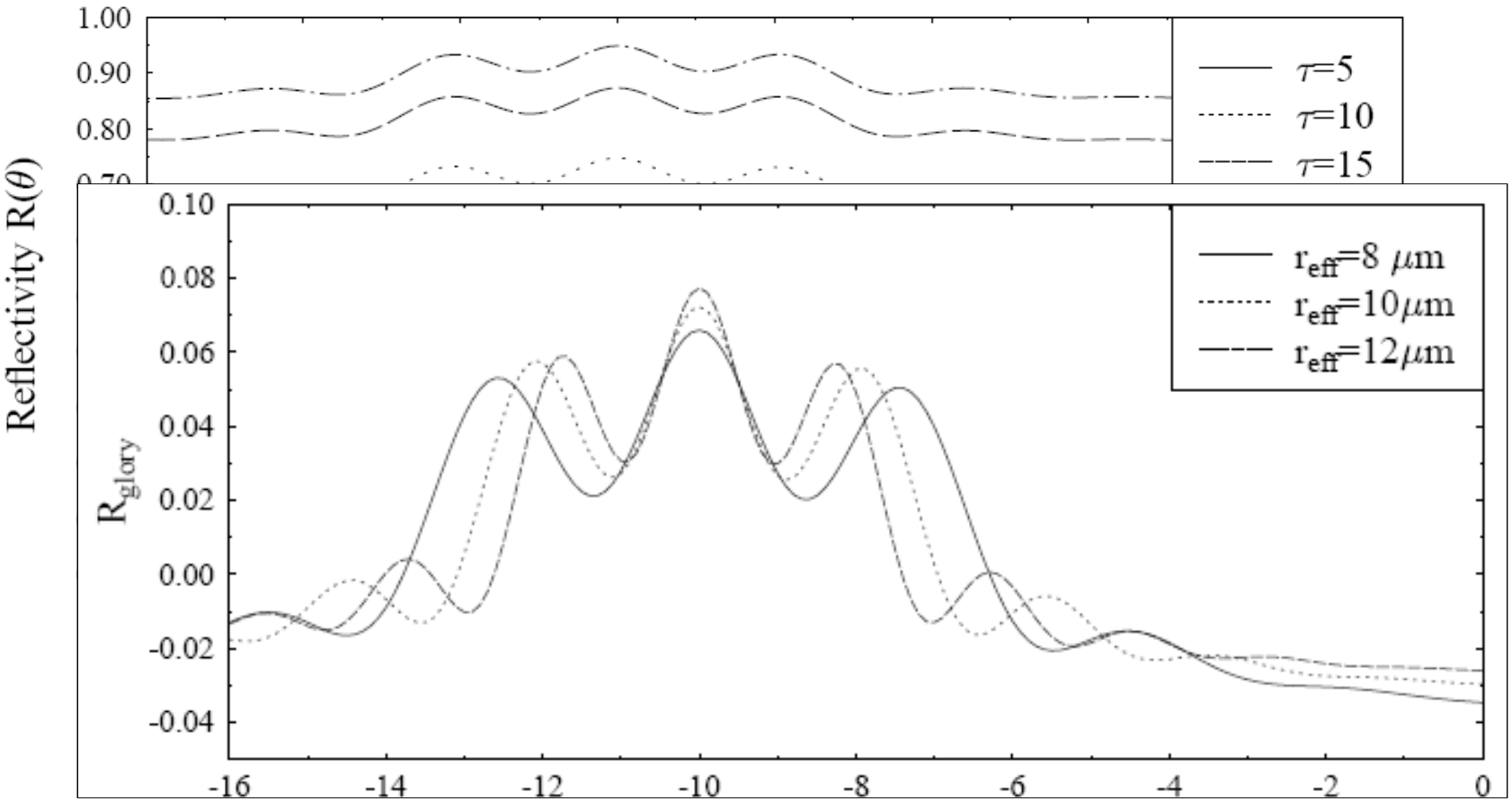


updated from Mayer et al., ACP, 2004

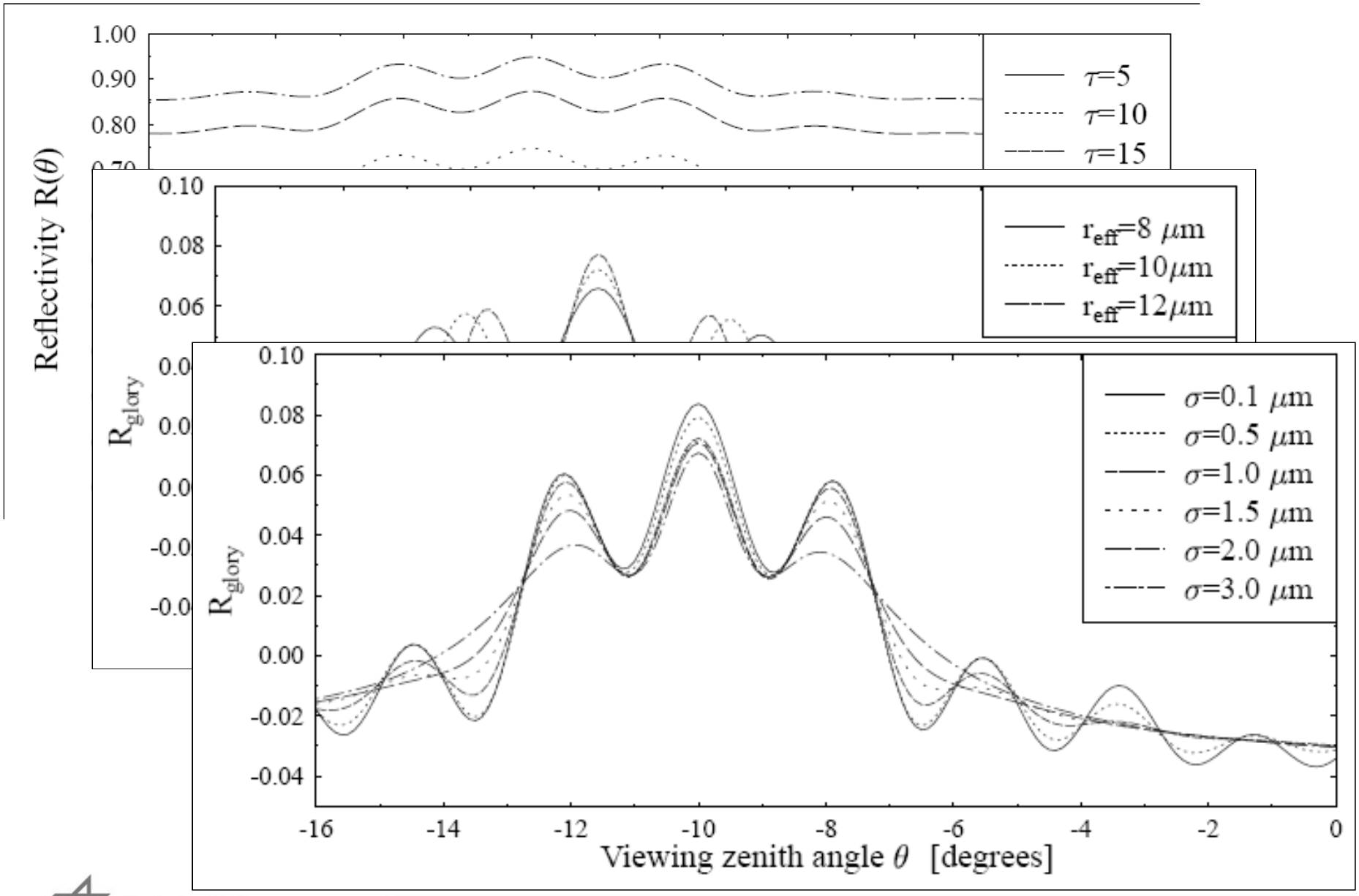
Glory Remote Sensing



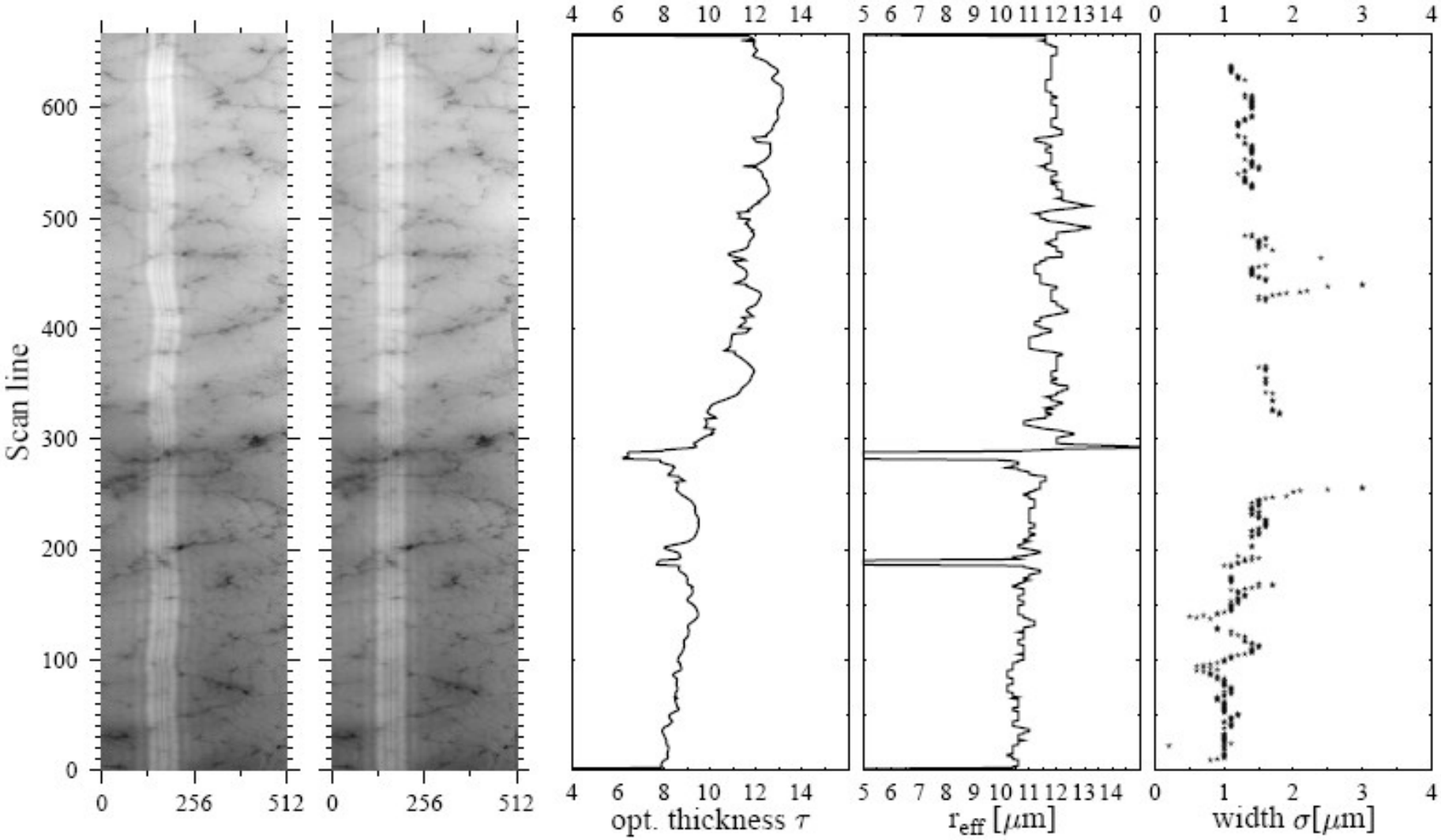
Glory Remote Sensing



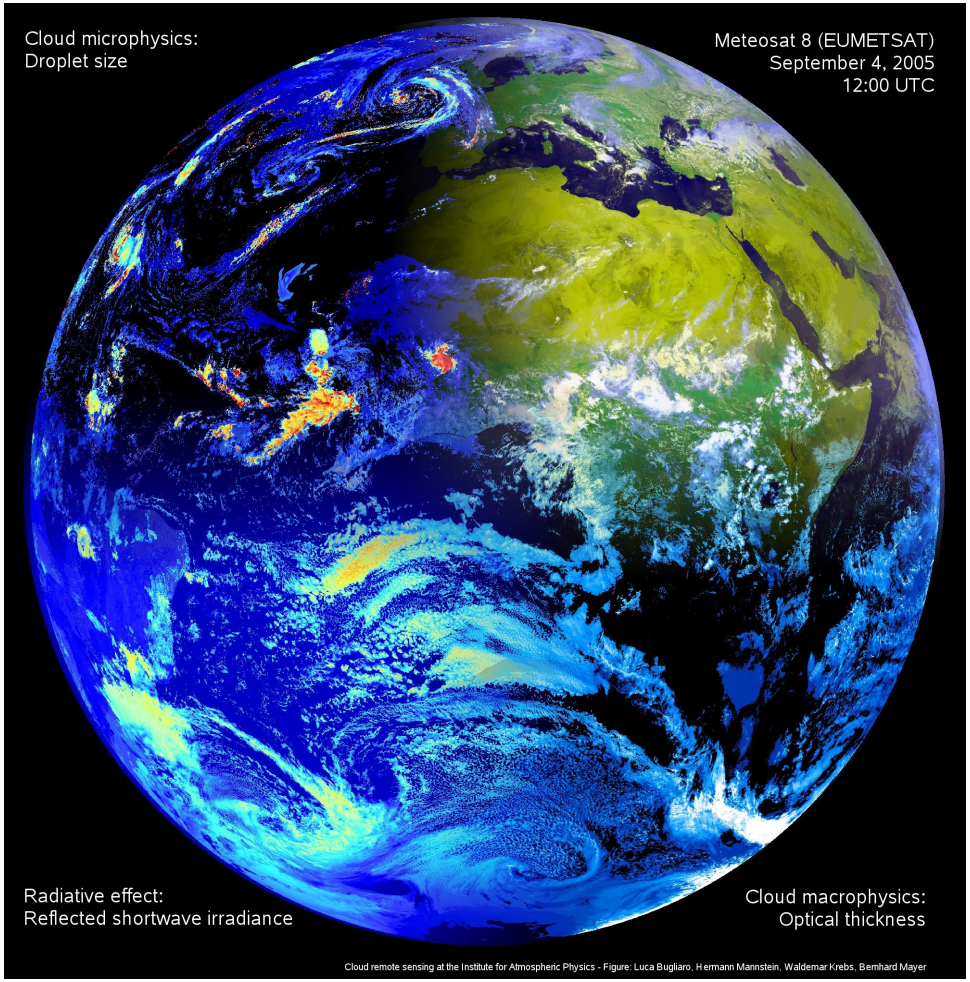
Glory Remote Sensing



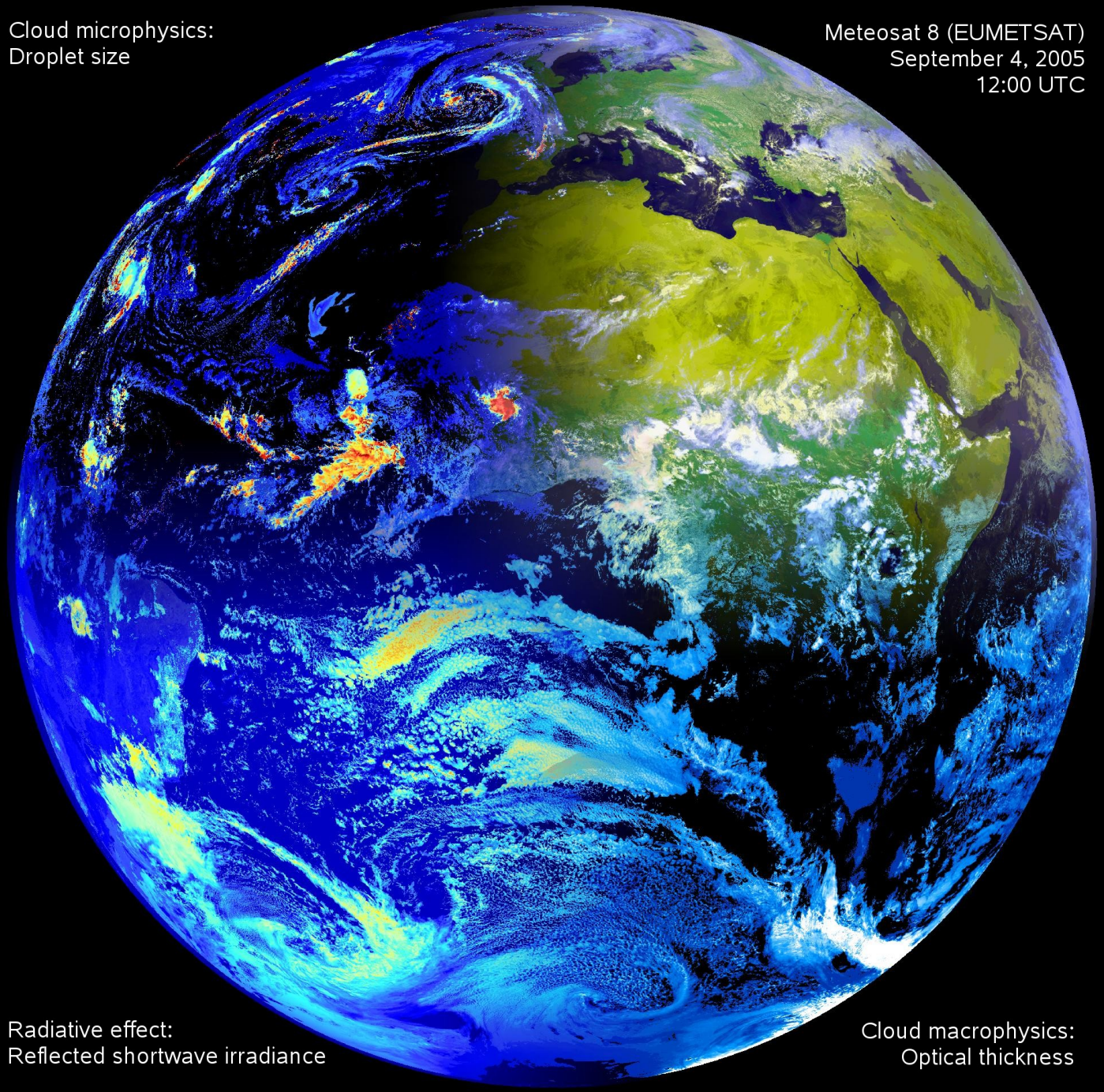
Glory Remote Sensing



Other topics in the group



- Contrails and cirrus clouds - impact of air traffic on climate
- Remote sensing methods - NOAA/AVHRR, ENVISAT/AATSR, **MSG/SEVIRI**
- Applications: solar energy resources, ultraviolet radiation
- Clouds and climate, remote sensing of inhomogeneous clouds
- Radiative transfer in the cloudy atmosphere (tools: libRadtran, MYSTIC)



Cloud remote sensing at the Institute for Atmospheric Physics - Figure: Luca Bugliaro, Hermann Mannstein, Waldemar Krebs, Bernhard Mayer