Research Cabauw tower

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Koninklijk Nederlands Meteorologisch Instituut

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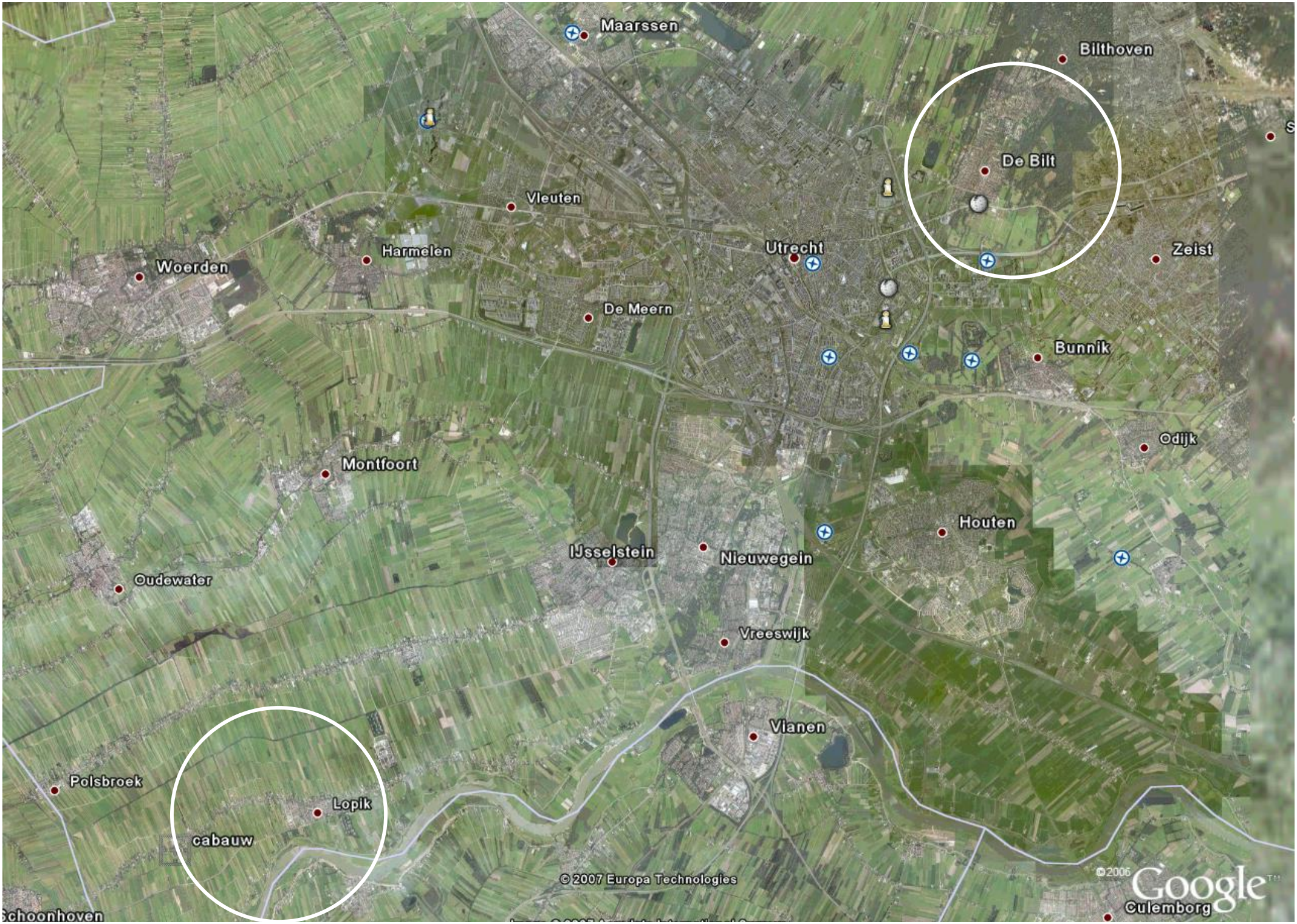
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IJsselstein
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Consortium of 7 institutes:

KNMI TU Delft rivm ECN esa TNO

http://www.cesar-observatory.nl/

- - - -

CESAR: national atmospheric observatory

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Research themes:

- Clouds, aerosols, radiation
- Land-atmoshere-exchange

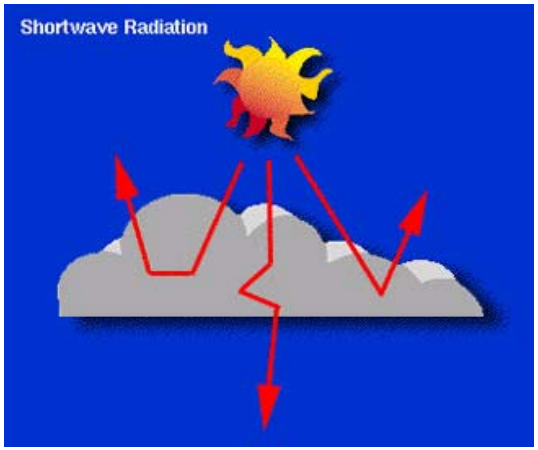
Applications:

- Process studies
- Model evaluation
- Climate monitoring
- Satellite validation

Background:

- Climate change
- Improvement of weather/climate models

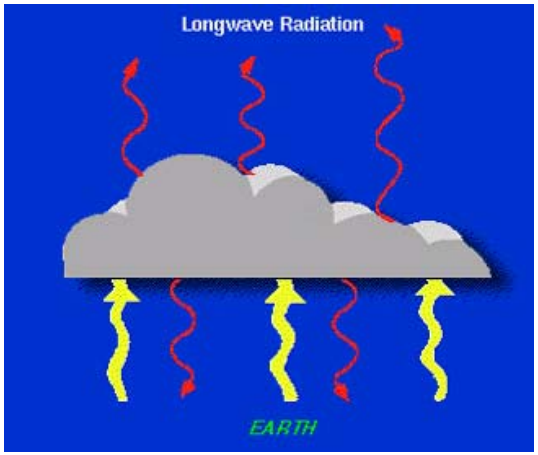
Example: clouds and radiation



Shortwave radiation

Clouds increase the amount of solar radiation that is reflected back into space and reduce the available energy for the earth-atmopshere system.

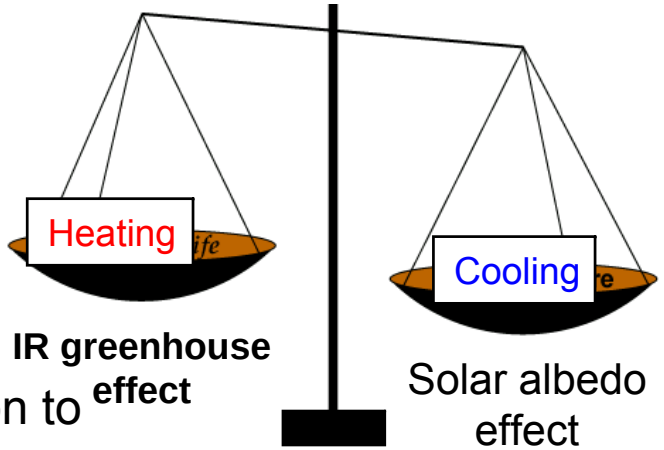
“Solar albedo effect” → cooling



Longwave radiation

Clouds reduce the longwave emission to space by means of absorption of longwave radiation of the earth’s surface and emission at the (cold) cloud top.

“IR greenhouse effect” → heating



IR greenhouse effect

Solar albedo effect

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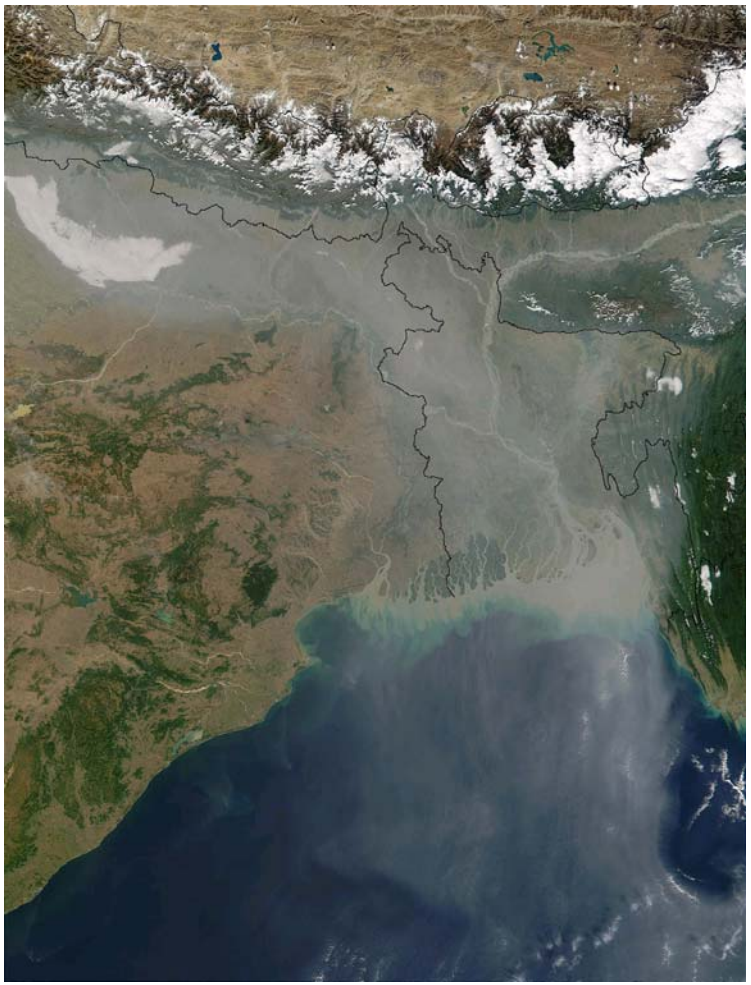
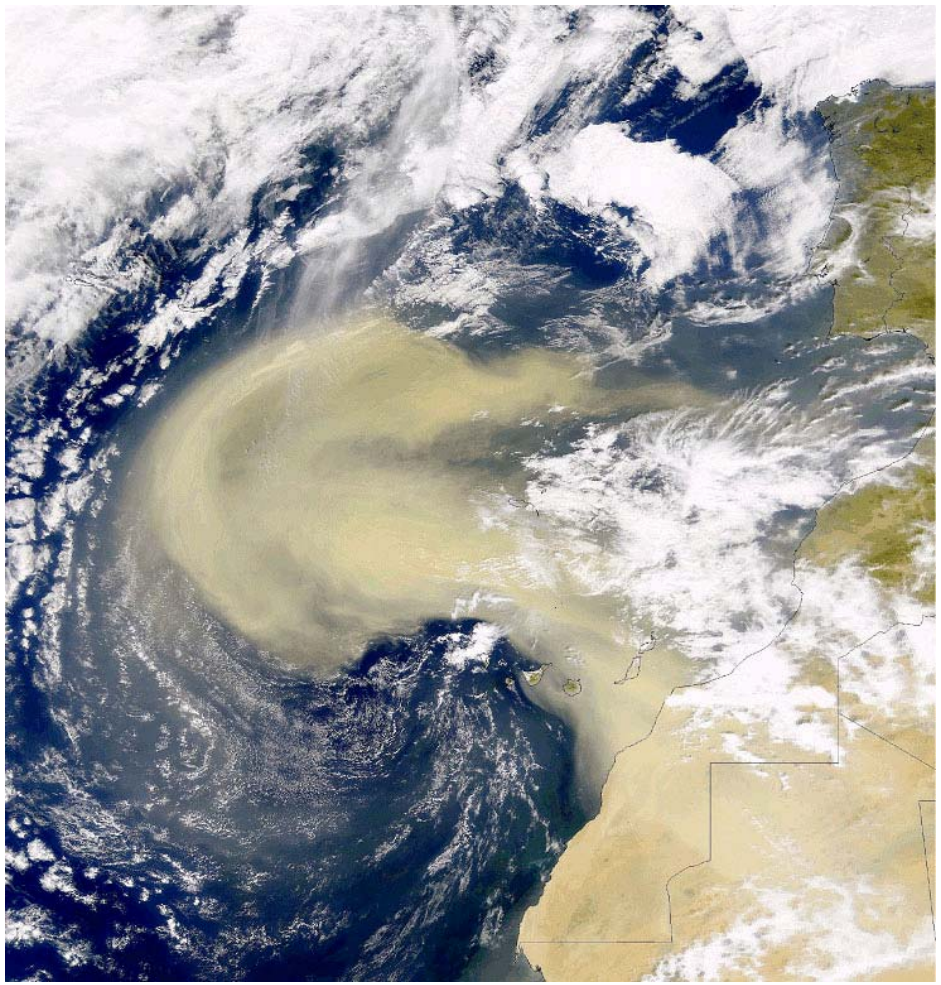
•••• Example: aerosols and radiation

Direct aerosol effect



Aerosol pollution over Northern India and Bangladesh



Dust outbreak over Northwest Africa on February 26th, 2000, observed by SeaWiFS (NASA)

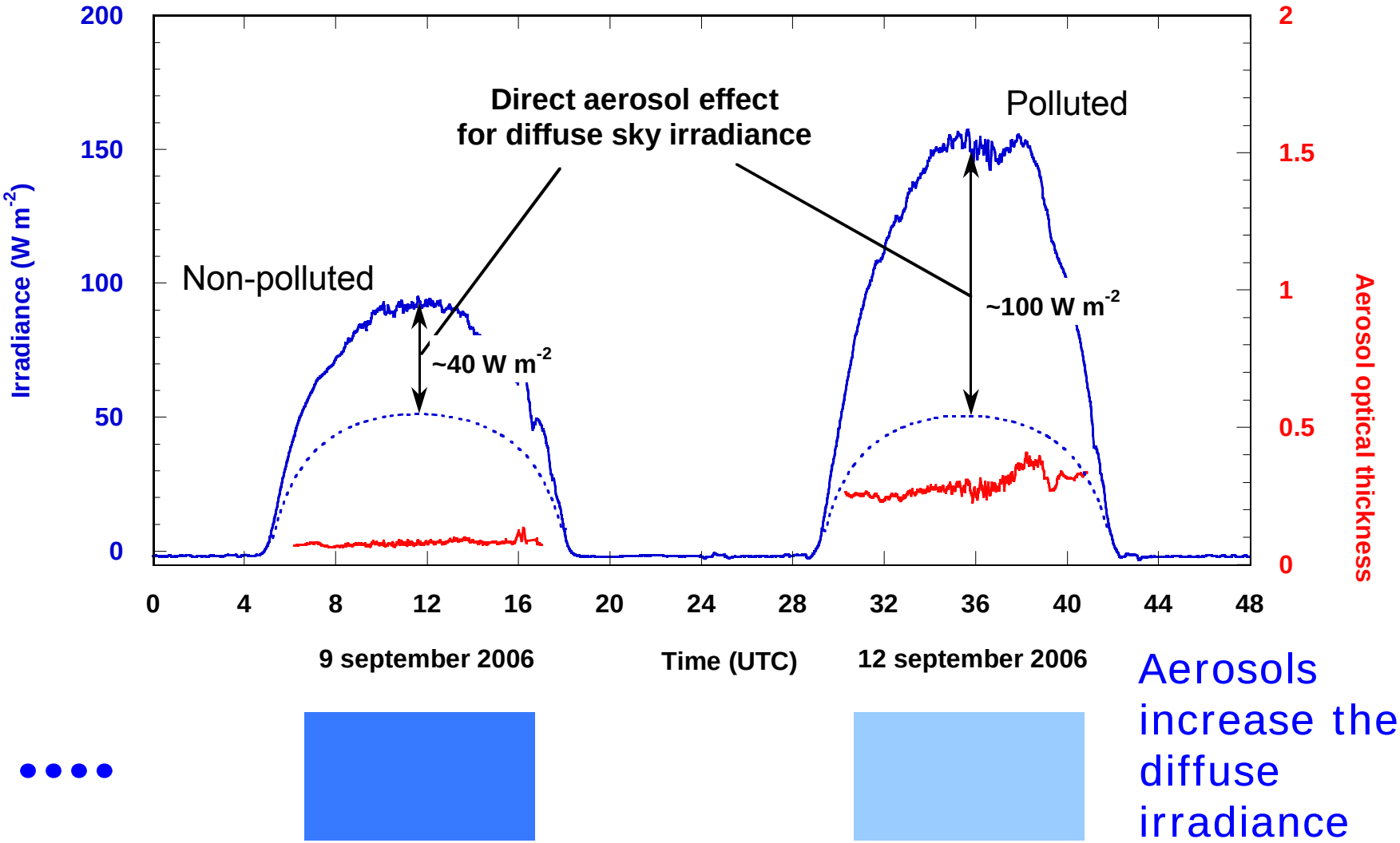
Direct aerosol effect

Cabauw: very different air masses

Strong impact on radiation!

Effect of aerosols on diffuse sky radiation

Example: 9 and 12 september 2006 (cloudless)



Aerosols increase the diffuse irradiance

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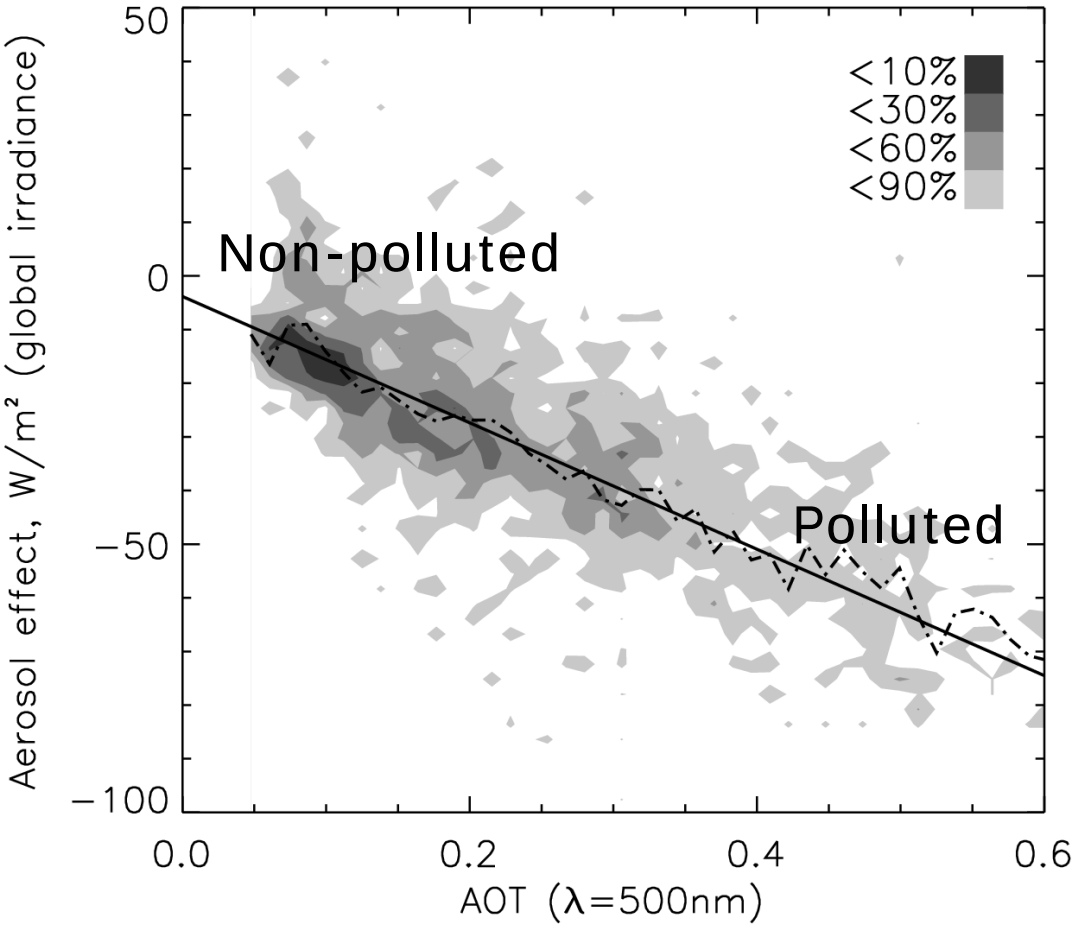
Effect of aerosols on global radiation



- Aerosolen reduce the global irradiance (dimming)

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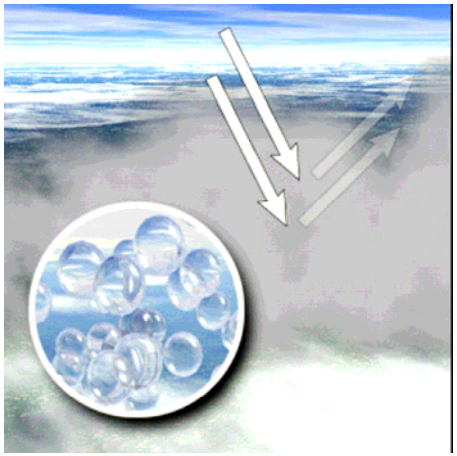
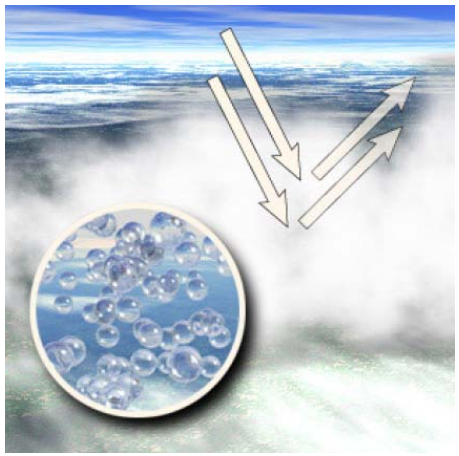
Example: aerosols and radiation

1e indirect aerosol effect (Twomey)

Change in cloud albedo caused by change in the number and size of cloud droplets

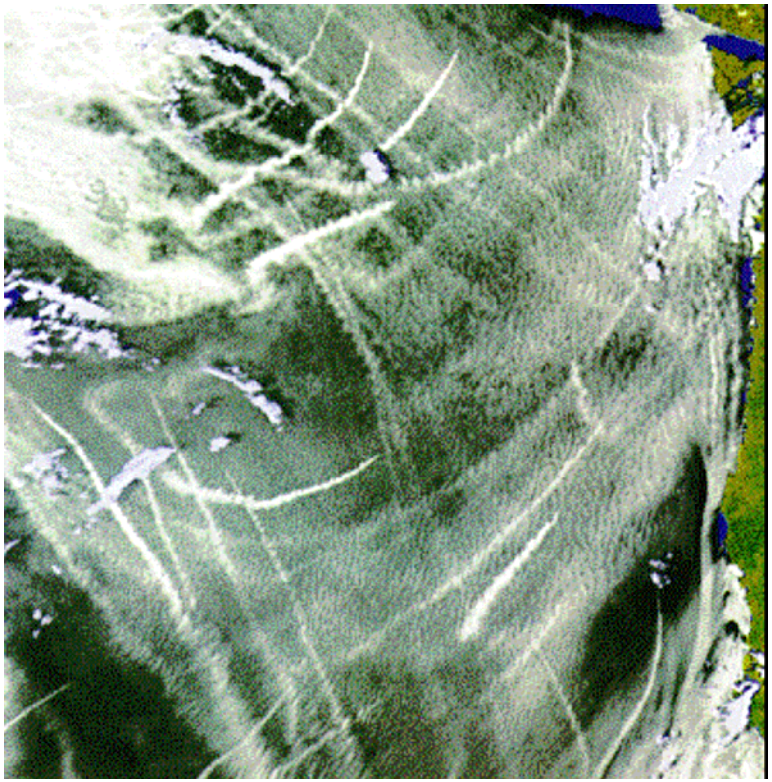
Clean air		Polluted air
less aerosols (CCN)		more aerosols (CCN)
↓		↓
less cloud droplets (larger)		more (small) cloud droplets
↓		↓
less reflection of sunlight (darker cloud)		more reflection of sunlight (brighter cloud)



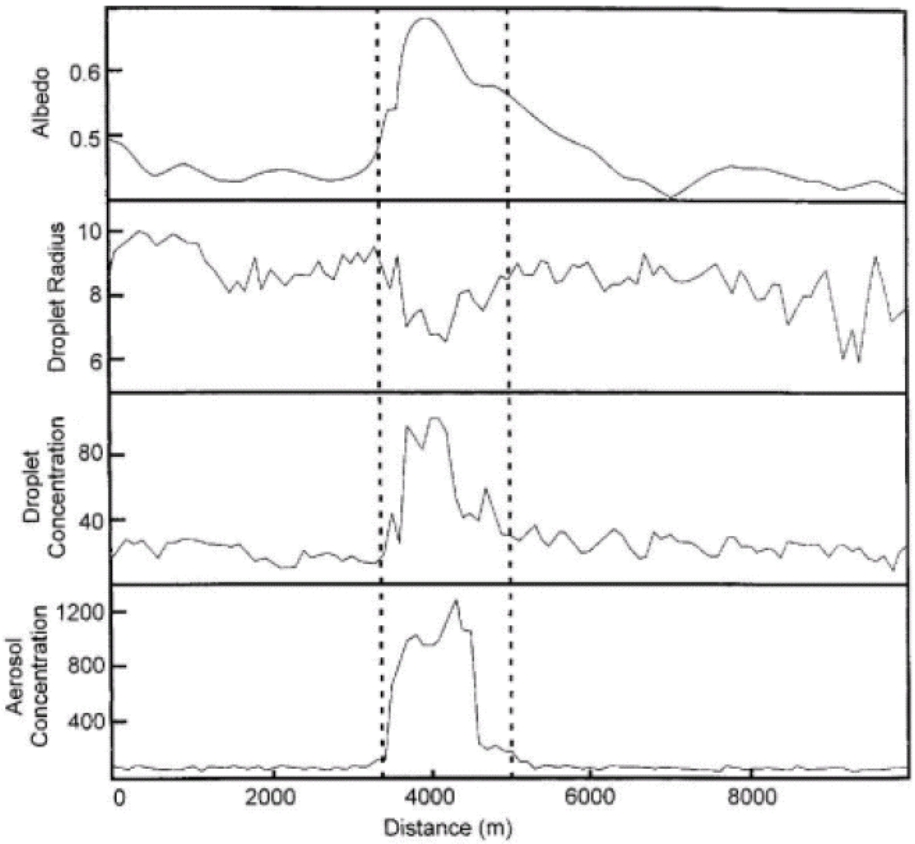


Voorbeeld: aerosolen en straling

1e indirect aerosol effect: evidence



Ship tracks at the coast of Washington, VS



Measurements along transect

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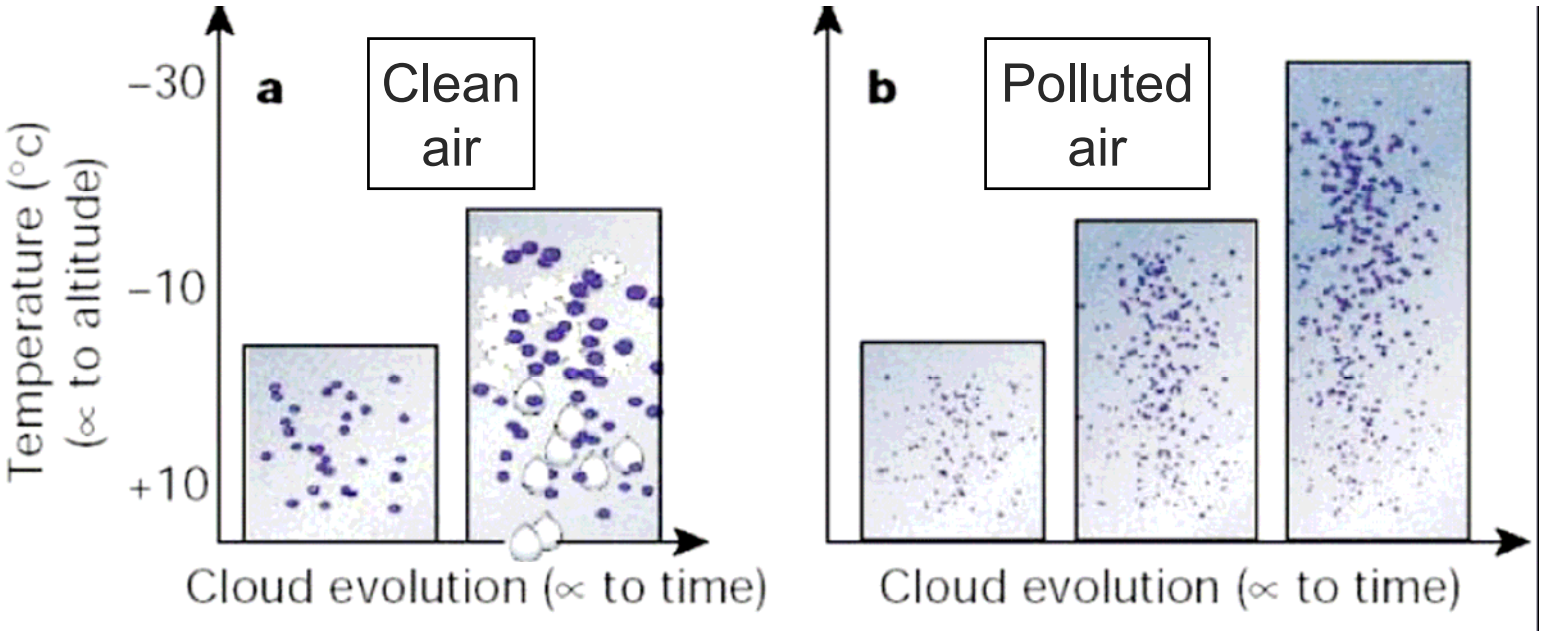
Voorbeeld: aerosolen en straling

2e indirect aerosol effect (Albrecht)

Change in the life time of clouds caused by change in cloud properties and precipitation process



Suppression of pricipitation
Life time cloud increases → albedo↑

Instruments

- Tower
- Remote sensing (active instruments)
- Straling (passive instruments)
- Aerosol in situ instruments

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Tower

- Tabs and Tdpt @ 200, 140, 80, 40, 20, 10, 2 m
- FF,DD @ 200, 140, 80, 40, 20, 10 m
- Turbulence: SONIC+IFM @ 180, 100, 60, 3 m
- X-LAS scintillometer @ 60 m
- GPS receiver

At base:

- Short/longwave in, out
- Soil water content
- Soil heat-flux
- Precipitation

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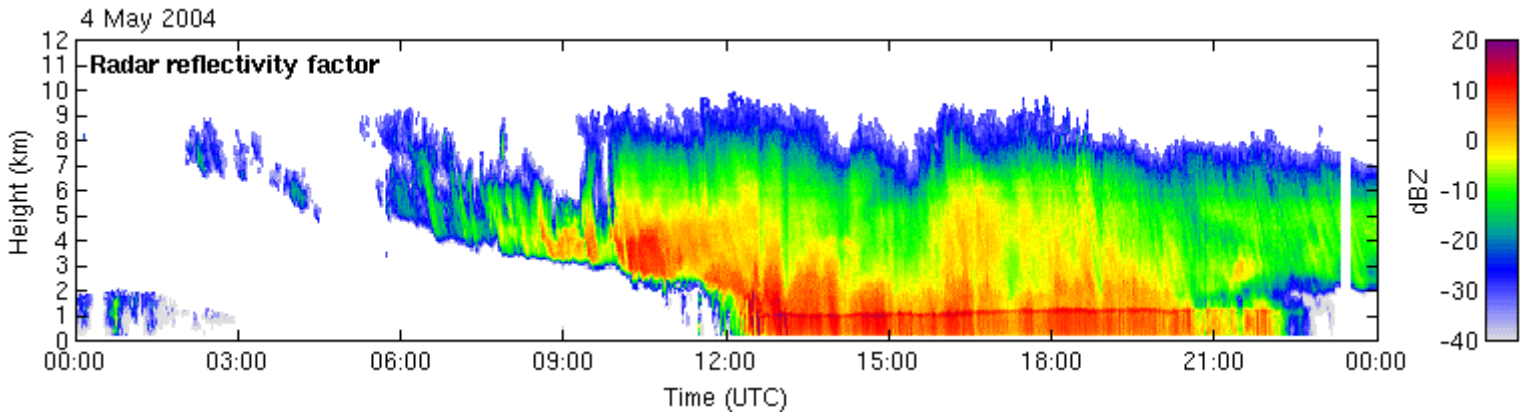
Remote sensing: radar

- KNMI cloud radar
  Frequency: 35 GHz
  Range: 0.2 – 13 km

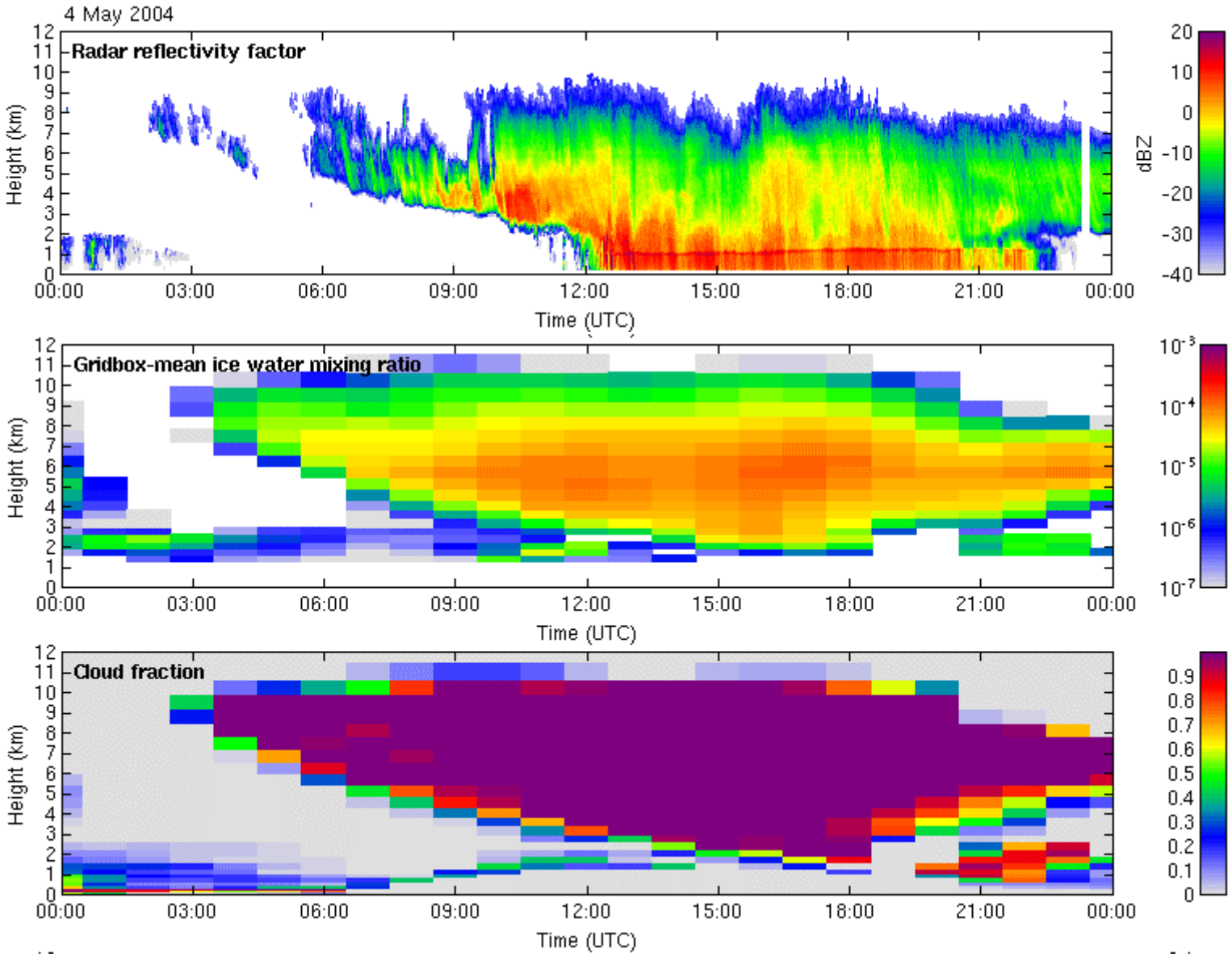


Remote sensing: radar

Obs:

Mod:

Mod:



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Remote sensing: lidar

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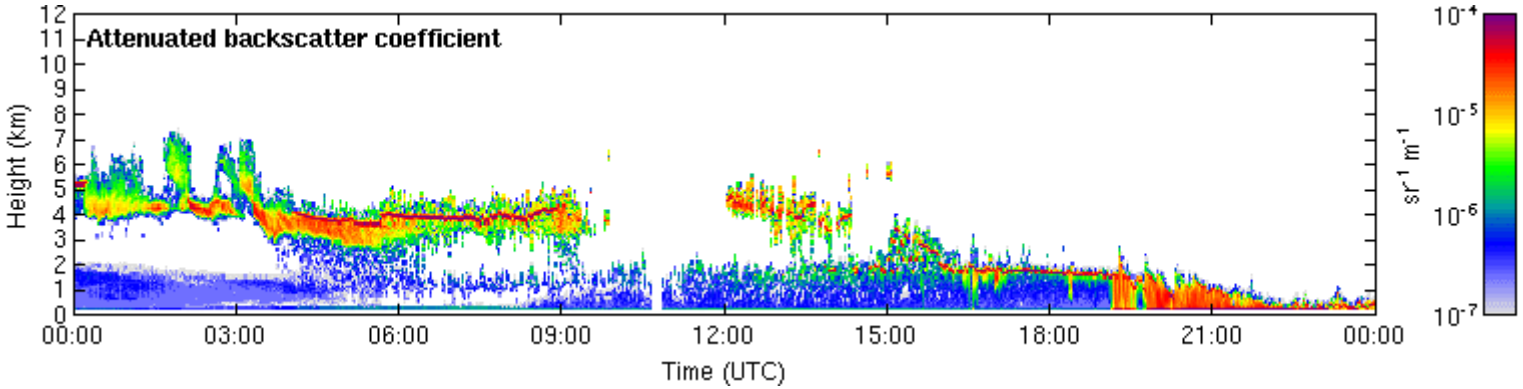
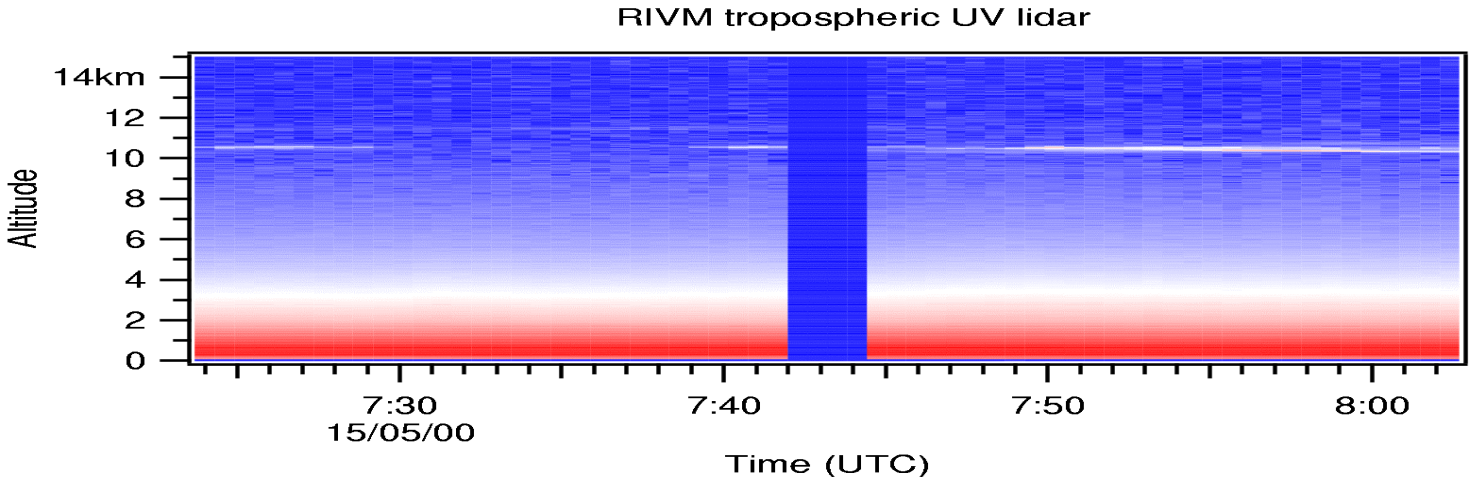
Cloud base:

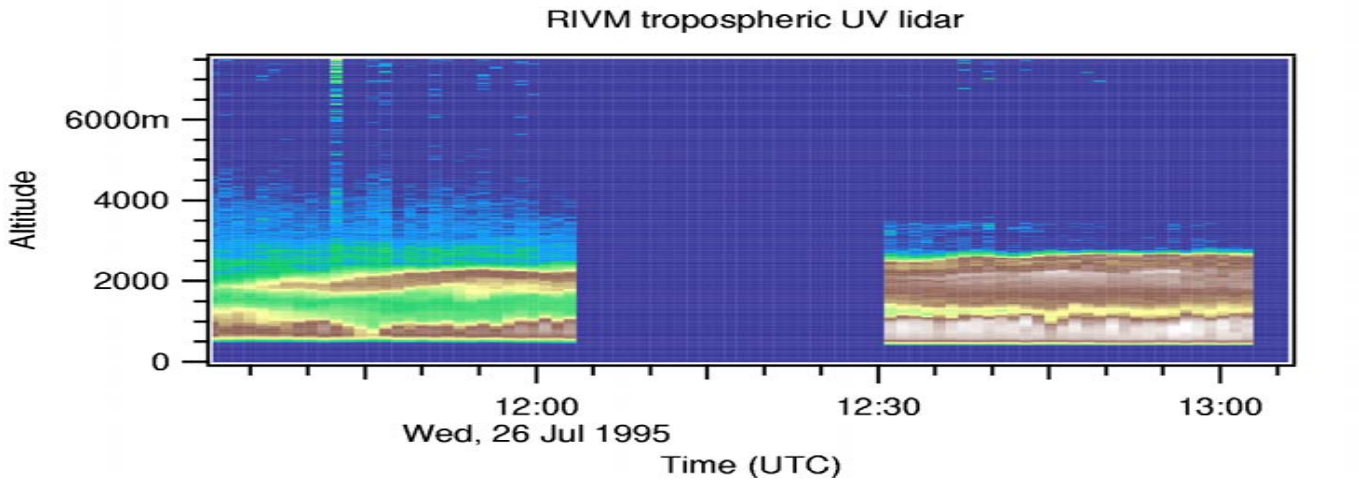


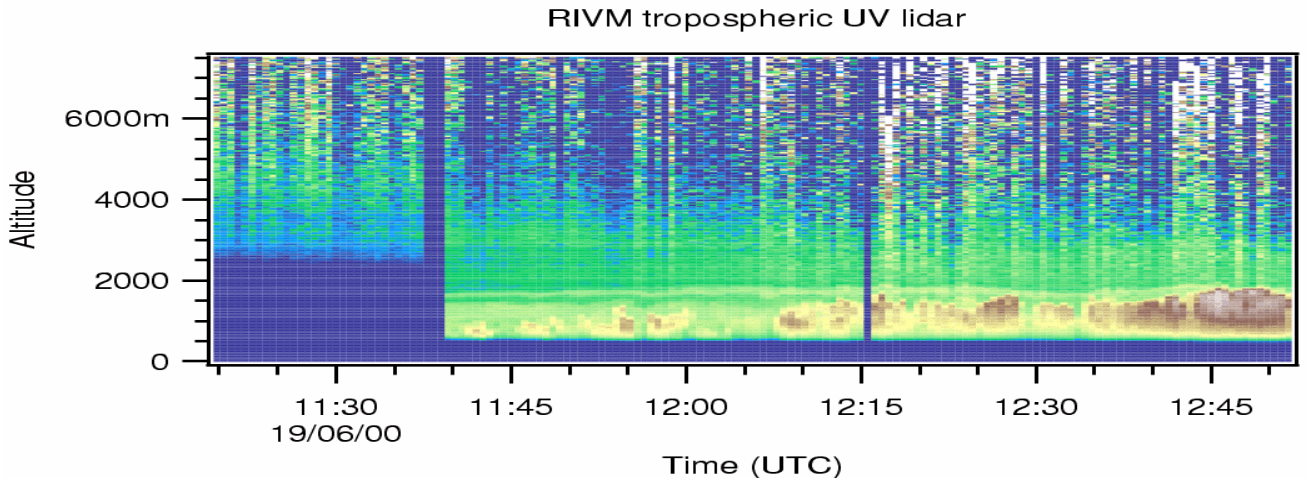
Cirrus detection:



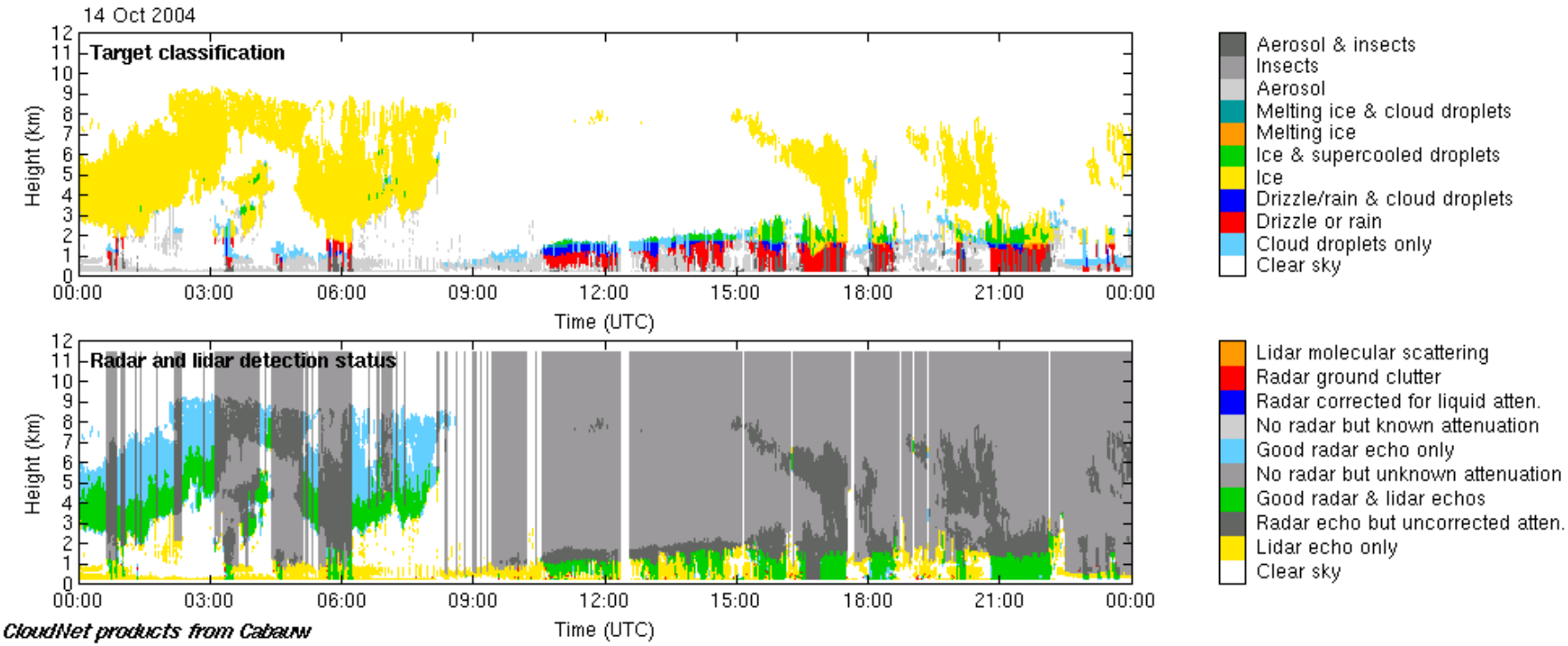
Remote sensing: lidar

Aerosols:





Remote sensing: target classification



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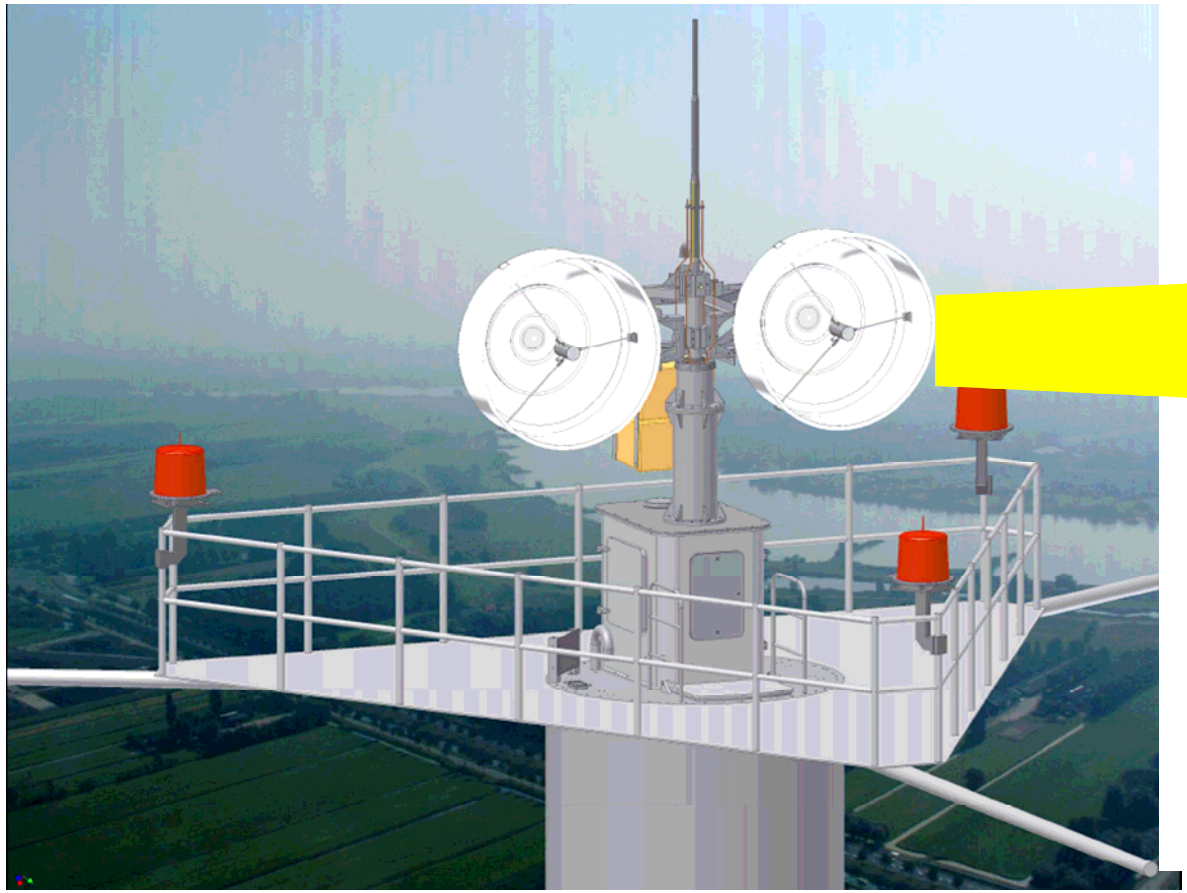
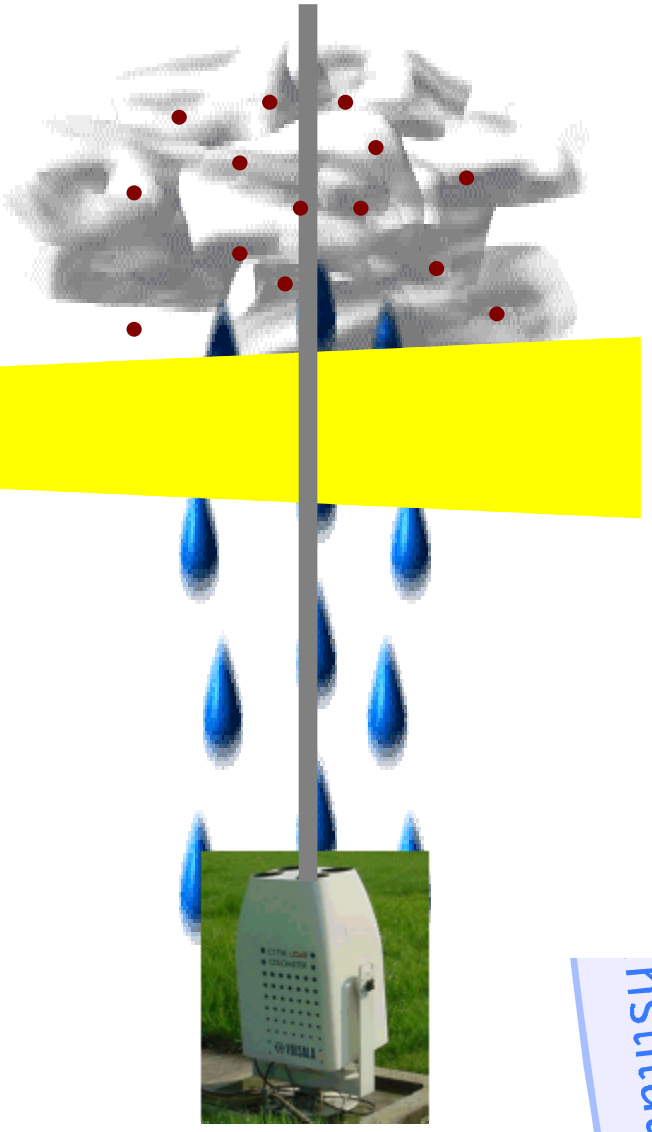
Tower / remote sensing





Relation between aerosols and precipitation

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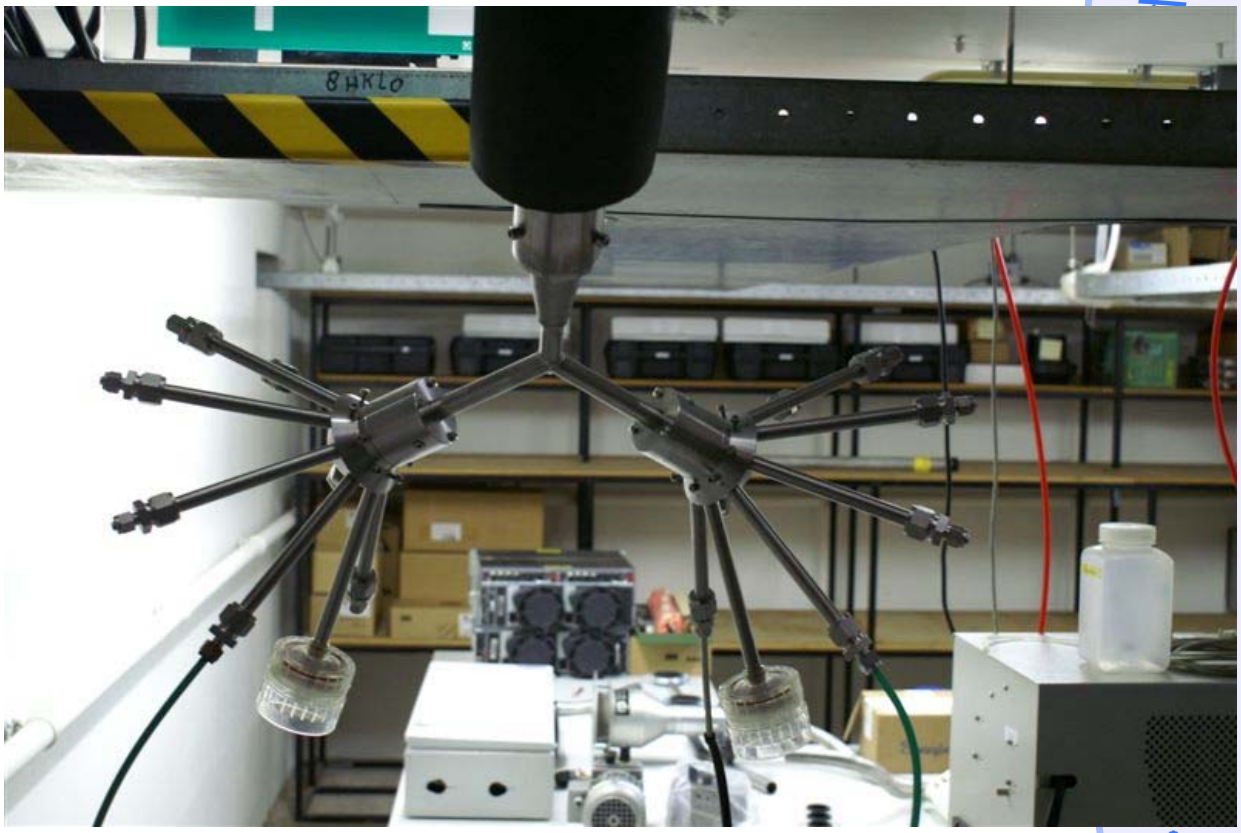
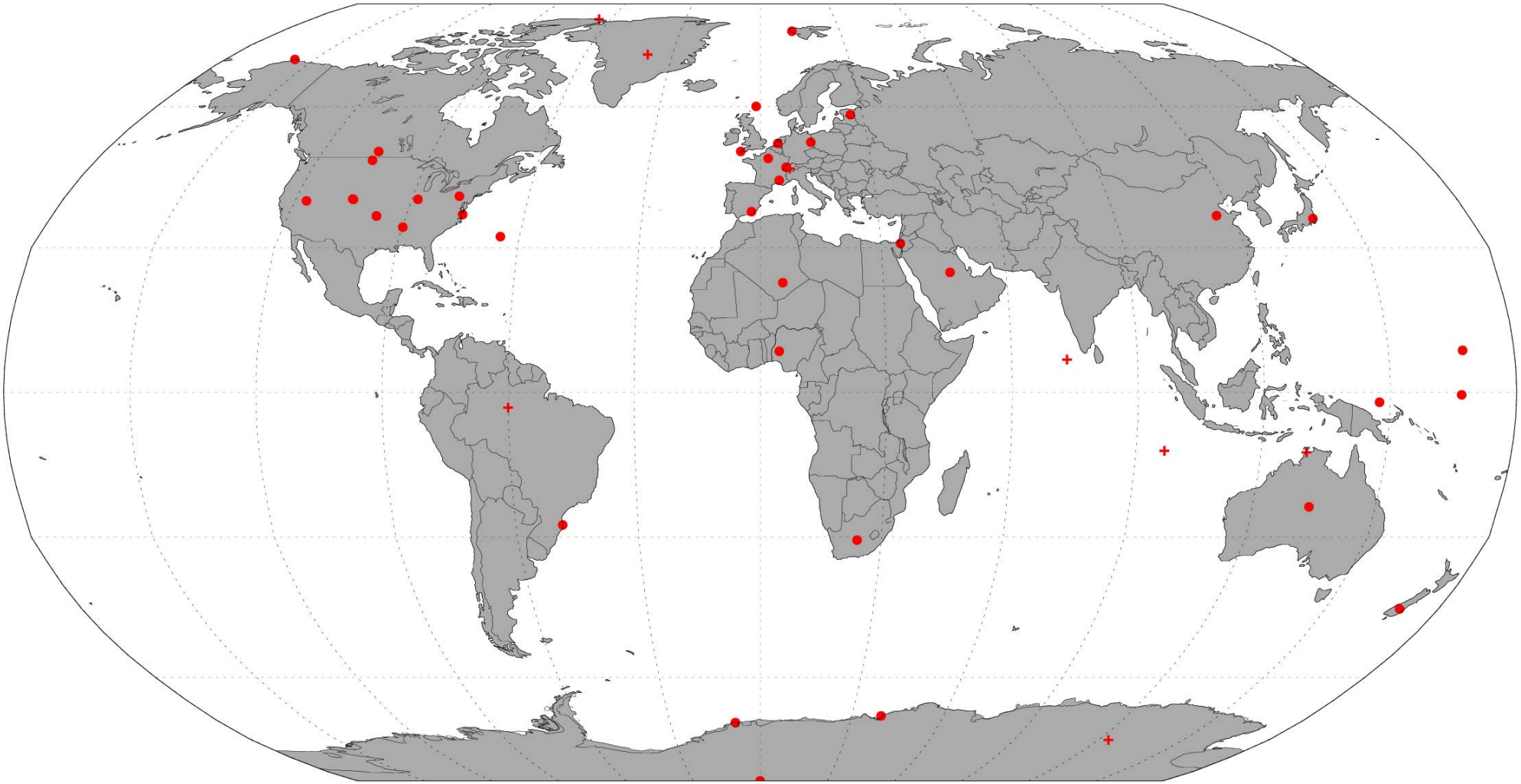
•••• Tower / aerosol in situ



Instruments: radiation (BSRN)

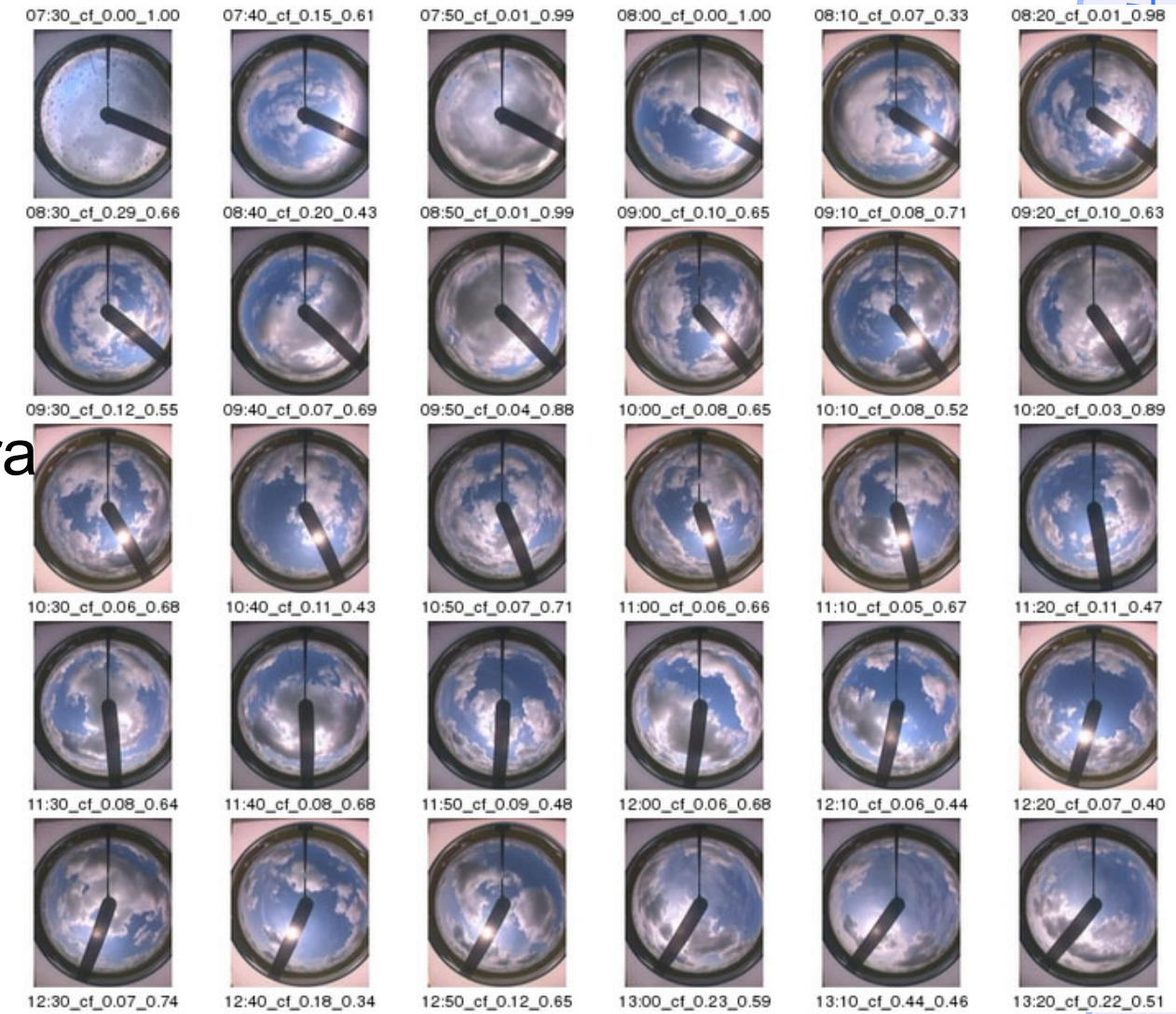
Baseline Surface Radiation Network



Calibration in Davos / Jungfraujoch

Instruments: radiation (misc)

- Total Sky Imager Producs:
  - Sky images
  - Cloud cover

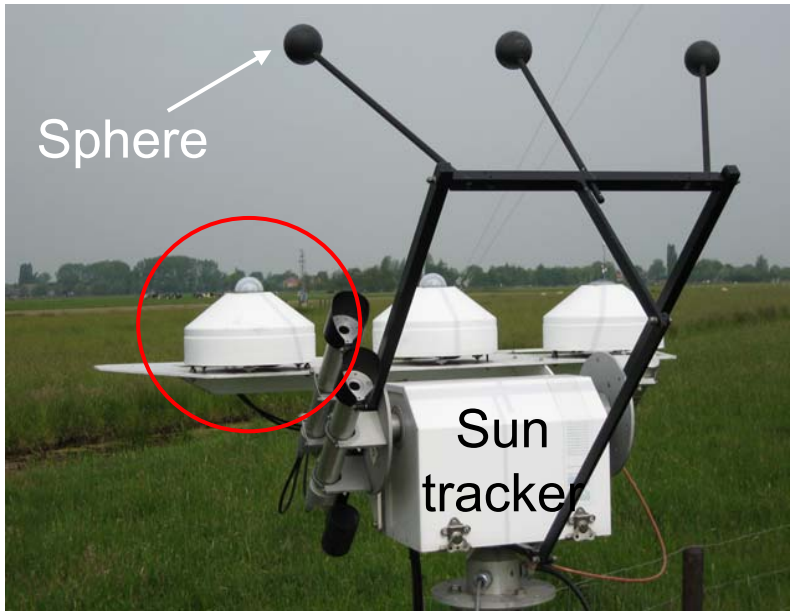


- Digital video camera

••• Instruments: pyranometer / pyrheliometer

Global radiation

Diffuse/direct radiation



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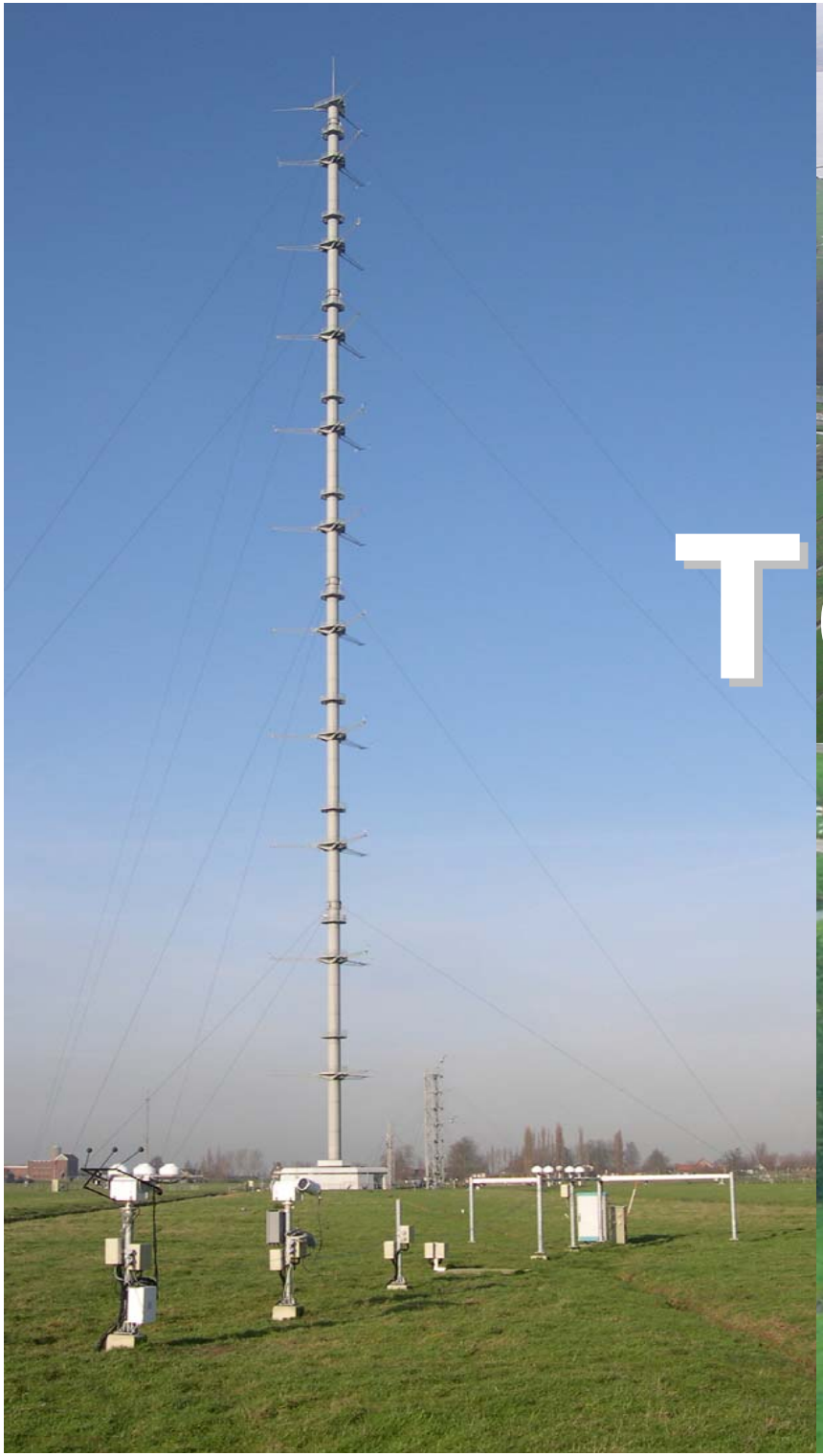

Tour!