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AEROSOL-CLOUD INTERACTION IN THE TWILIGHT ZONE



ITaRS

Initial Training for
atmospheric Remote Sensing



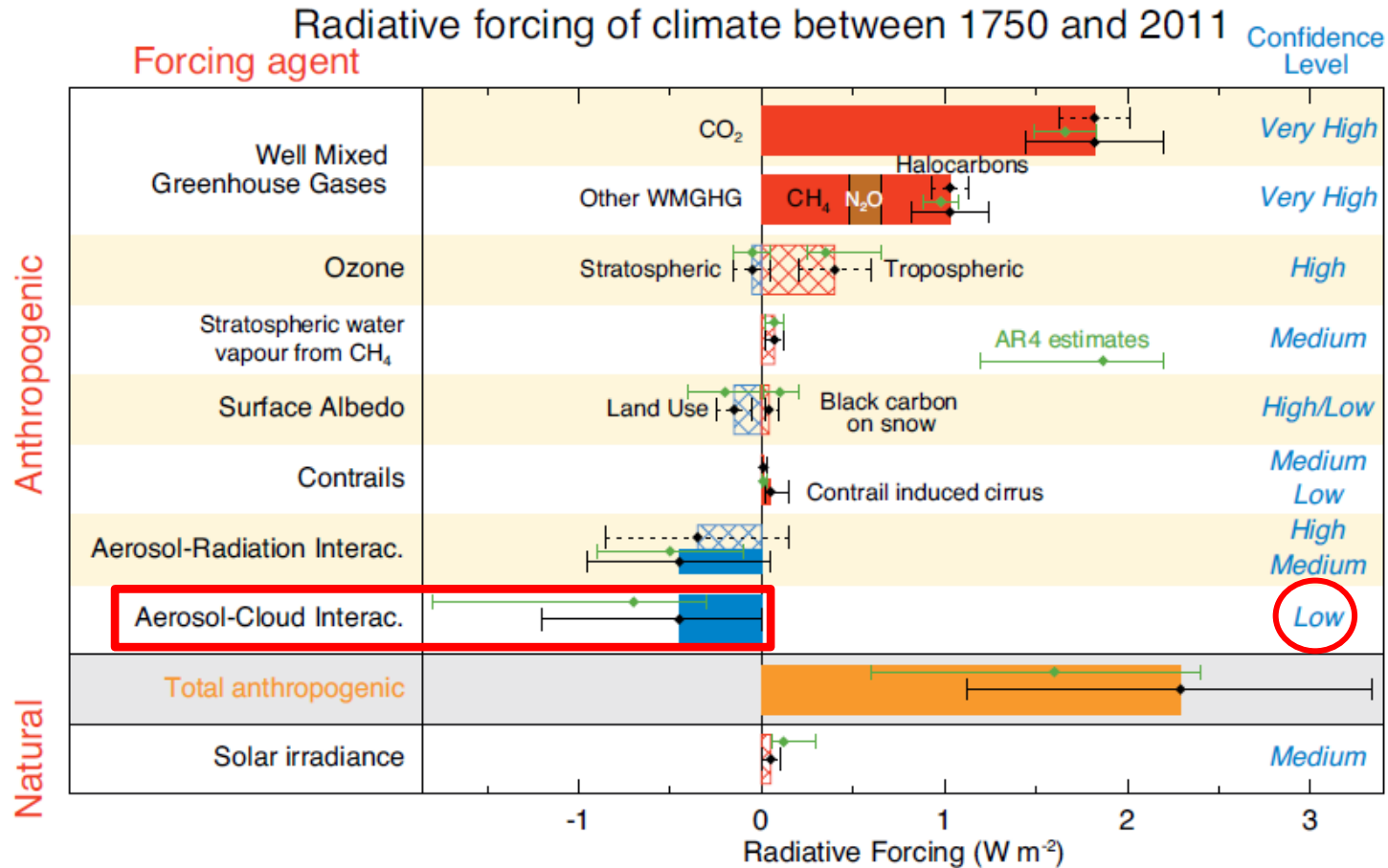
Who? Where? What?

- Who? – Nicolae Ajtai
 - PhD in Environmental Science – 2012 – ground based remote sensing
 - Assistant professor at Babeş-Bolyai University, Romania
 - Marie Curie post-doc since 2014 – ITaRS
- Where?
 - CIAO Atmospheric Observatory, Potenza, Italy
- What?
 - to improve the knowledge of aerosol-cloud interactions by investigating the “twilight zone”, characterizing the physical processes that occur in this zone, and estimating the associated radiative forcing



Why?

IPCC, 2013



The “twilight zone” between aerosols and clouds

- What is the “twilight zone”?

- undetected cloud fragments
- aerosol humidification
- supercooled liquid water
- scattering of solar radiation by clouds

either ...



The areas around clouds that appear cloud-free in the VIS imagery (a), reveal a significant “twilight zone” after background subtraction (b) and image enhancement (c) (Koren et al., 2007).

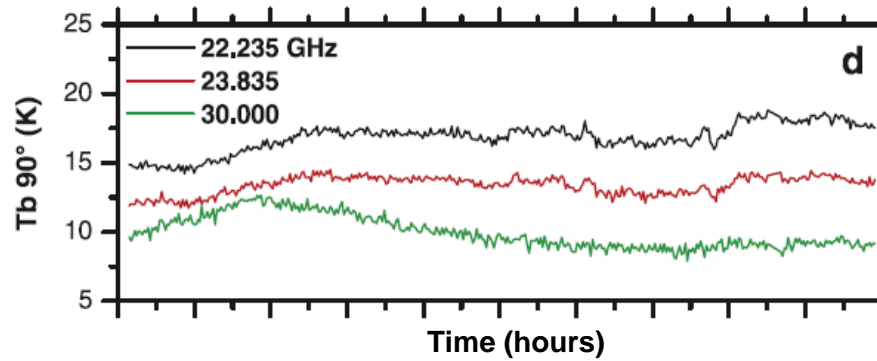


a)

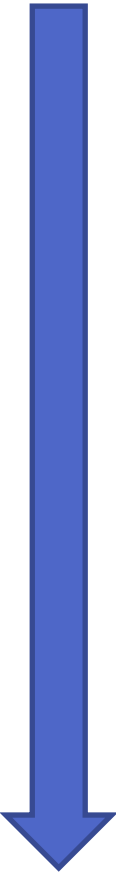
b)

c)

Existence of supercooled liquid water in an apparently cloudless atmosphere (Madonna et al., 2009). Increase in the brightness temperature measured at the 30 GHz channel of the microwave radiometer.



How?

- 
- A large, solid blue arrow pointing downwards, positioned on the left side of the slide, indicating the flow of the process.
- Analysis of CIAO archive data from multiple sensors:
 - microwave radiometer
 - multi- λ LIDAR
 - ceilometers
 - sun-photometer
 - all-sky camera

for liquid water signatures in cloud-free and broken-cloud datasets.

- Run radiative transfer models
- Estimate radiative forcing

Investigation of the “twilight zone”

- Using active - *LIDAR* and passive - *microwave radiometer (MWR)* remote sensing
- liquid water signatures in broken cloud and cloud-free datasets (all-sky camera)
- increase in brightness temperature (Tb) in the 30 GHz channel of the MWR with respect to the channels around 22-23 GHz

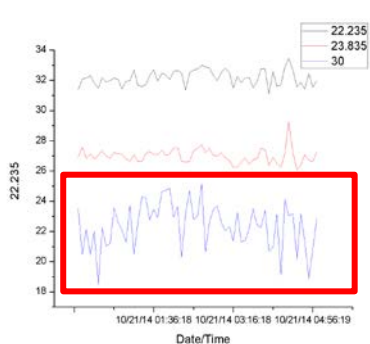


Figure 1. Tb for 22, 23 and 30 GHz channels

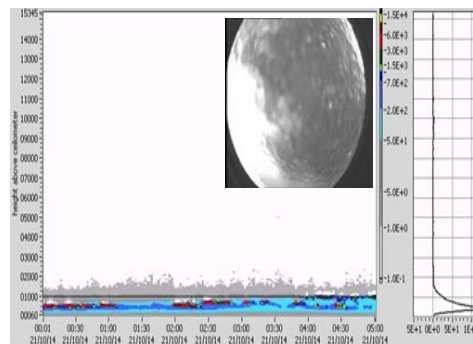


Figure 2. Clear sky reported by collocated LIDAR and sky camera

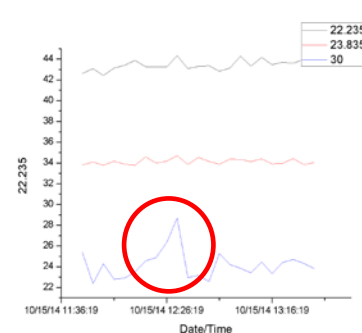


Figure 3. Tb for 22, 23 and 30 GHz channels

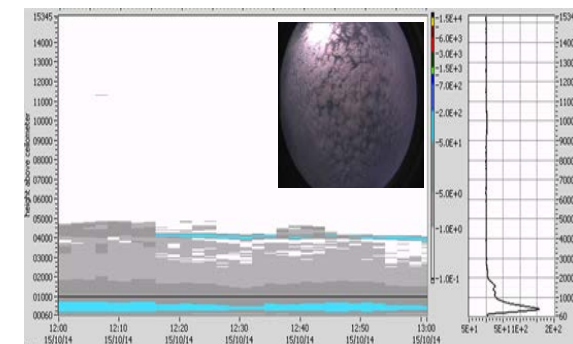


Figure 4. Broken clouds reported by collocated LIDAR and sky camera

- Different definitions of the “twilight zone”
- Multiple instruments with different ranges and sensitivities
- Aerosol instruments vs. cloud instruments
- Accounting for observational errors
- Modelling vs. measurements

Thank you for your attention !



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Meteorological World Expo 2015 – Brussels, Belgium