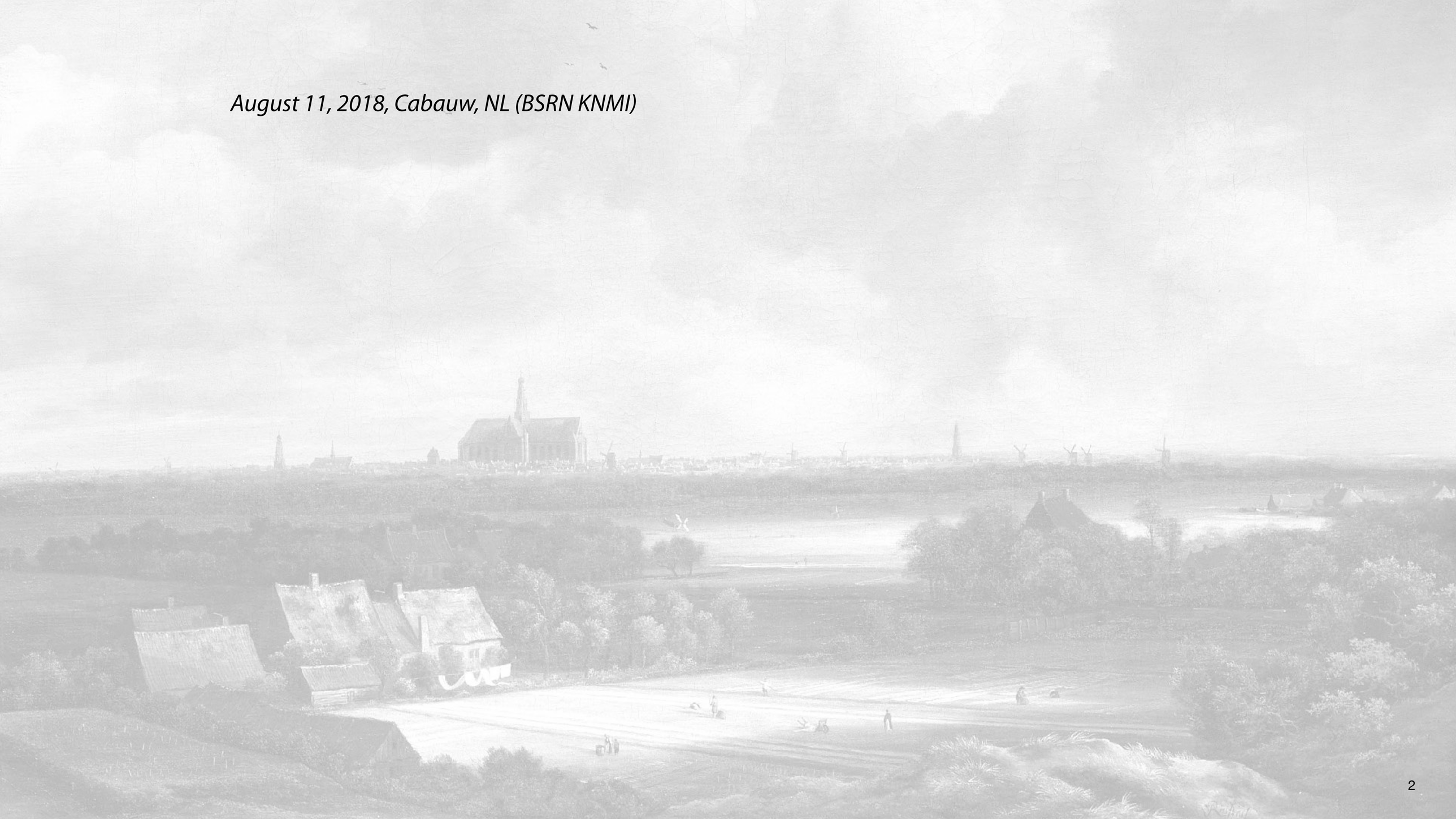
Shedding light on cloud shadows

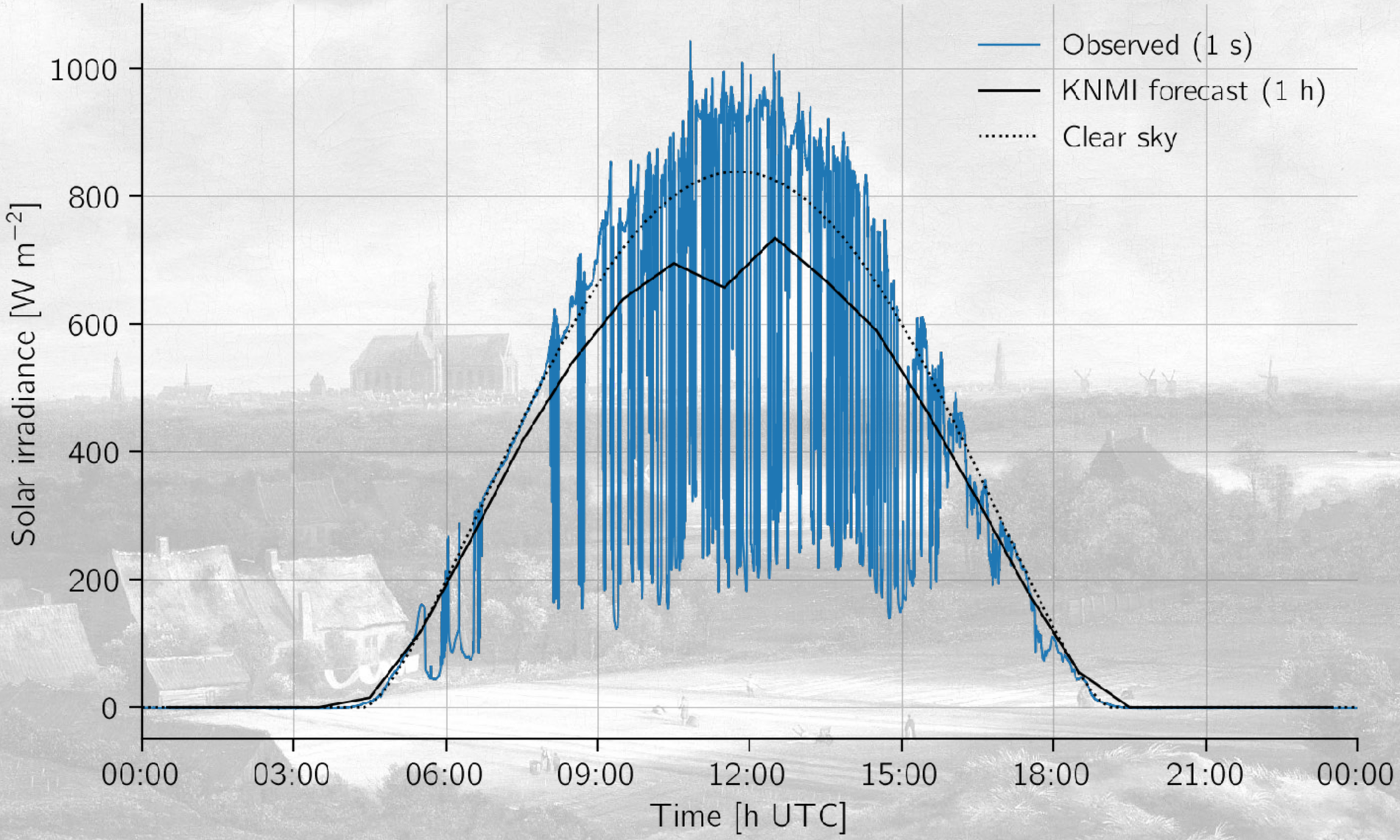
Chiel van Heerwaarden
Bert Heusinkveld, Wouter Mol, Bart van Stratum, Mirjam Tijhuis, Menno Veerman, Job Wiltink,
Maike Ahlgrimm, Mirjana Sakradzija, Sophia Schäfer
EMS Annual Meeting, 9 September 2022

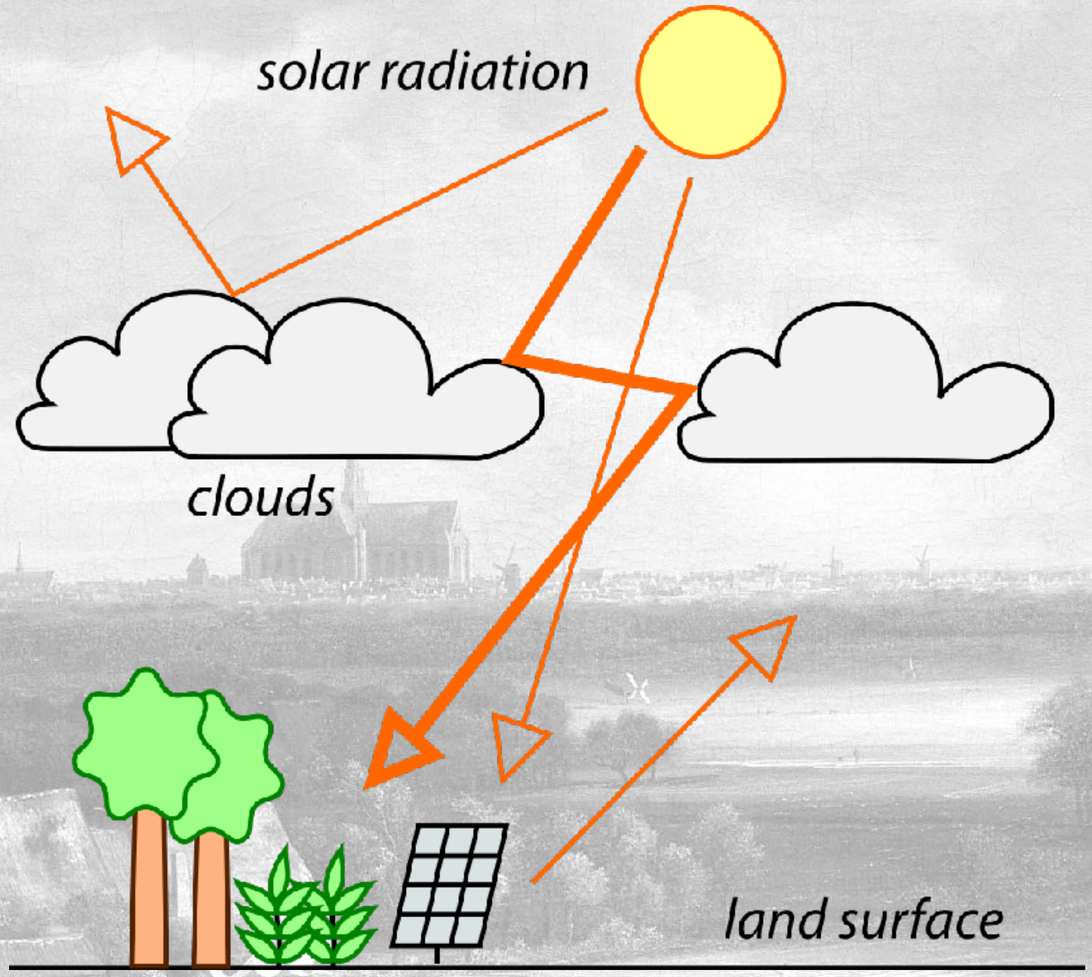
Research part of Shedding Light On Cloud Shadows project (chiel.ghost.io/slocs) funded by NWO Vidi scheme

August 11, 2018, Cabauw, NL (BSRN KNMI)

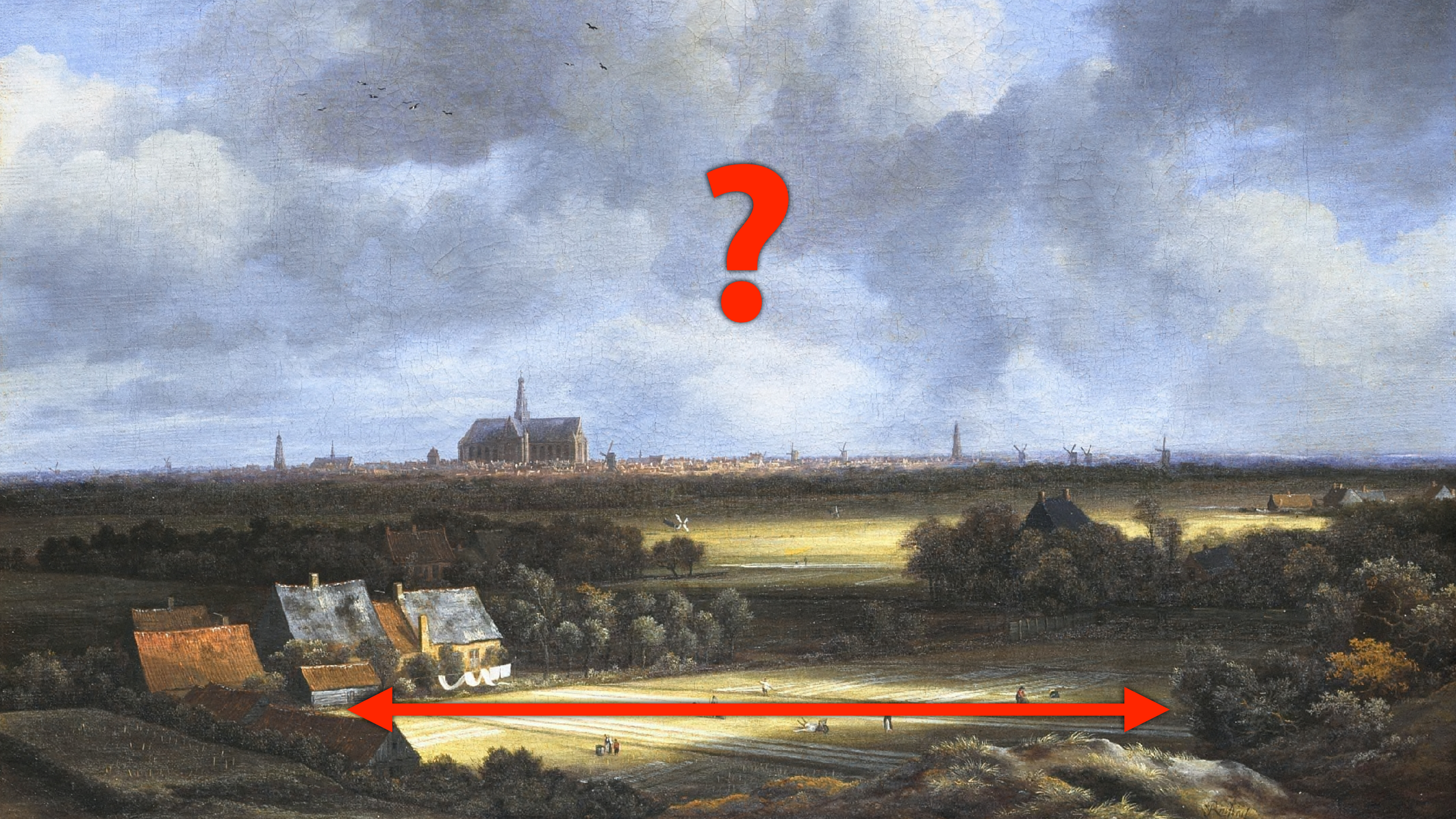


August 11, 2018, Cabauw, NL (BSRN KNMI)




solar radiation
clouds
land surface

?



Aim and objectives of the SLOCS project (2019-2024)

Quantify and understand variability in surface solar irradiance caused by cloud shadows

1. Observing *variability*

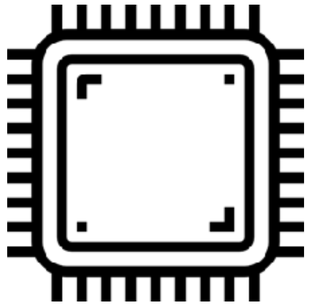
Wouter Mol ***(14:30)***

2. Simulating *variability*

Menno Veerman ***(14:45)***
Mirjam Tijhuis ***(12:30)***
Job Wiltink ***(12:45)***

3. Forecasting *variability*

Observations: quantify solar irradiance variability in the field



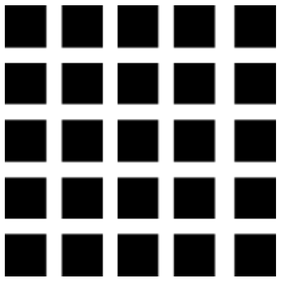
new sensor techniques



18 wave lengths
UV - visible - near-infrared



10 samples per second



50 m spacing



FESSTVaL campaign

https://doi.org/10.5194/egusphere-2022-726

Simulation: large-eddy simulation as a virtual laboratory

- Large eddy simulations set up against ECMWF ERA5 data
  - $(LS)^2D$ tool
  - Large-scale and nudging terms
  - Double periodic boundary conditions
- MicroHH large-eddy simulation model (https://github.com/microhh/microhh)
- RTE+RRTMGP radiation model (https://github.com/earth-system-radiation/rte-rrtmgp-cpp)
- Radiation computations with different complexity
  - 1D independent columns
  - **1D independent columns with postprocessing for 3D (Mirjam Tijhuis)**
  - 3D with TenStream method
  - **3D with ray tracer (Menno Veerman)**



FESSTVaL campaign provided excellent case studies

FESSTVaL
Field Experiment on Submesoscale Spatio-Temporal Variability in Lindenberg



Picture by Wouter Mol

14 June 2021: clear sky



Camera of Falkenberg tower

17 and 27 June 2021: shallow cumulus of different depths

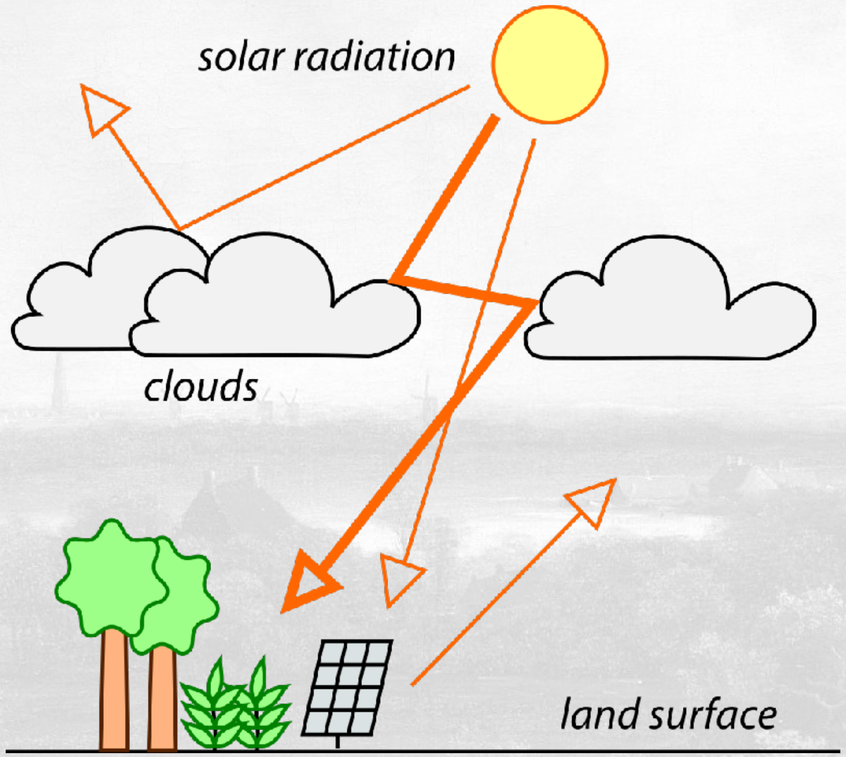




WUR sky view camera

Our plans with FESSTVaL observational data and simulations

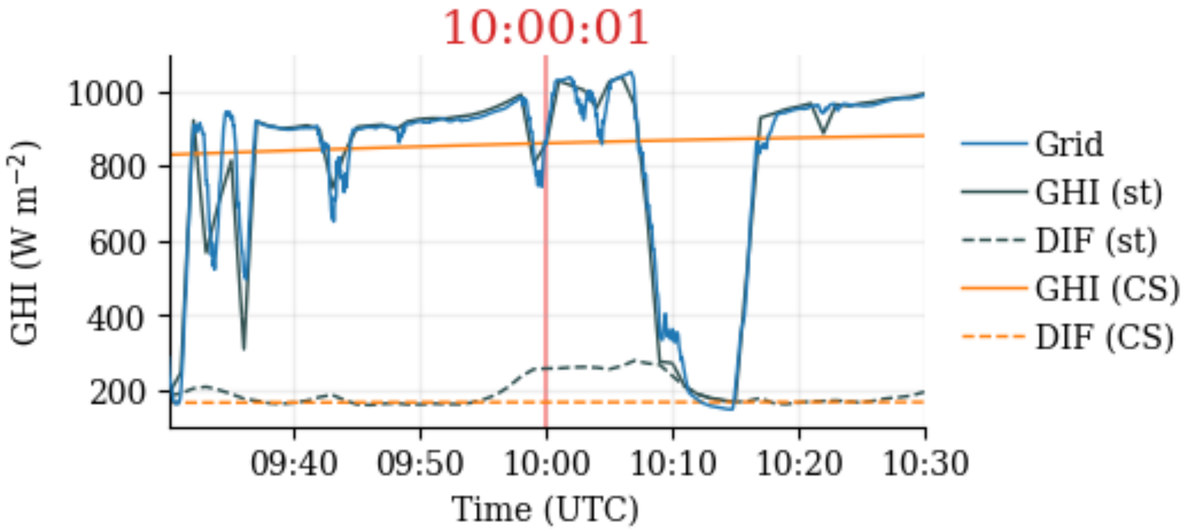
- Comparison of models in their ability to reproduce direct / diffuse radiation and variability
- Set up cases with an as good as possible validation against data
- What is needed for reproducing observed variability?
  - Model detail and resolution
  - Boundary conditions
- Compare modeling techniques of different complexity
  - Doubly periodic LES at very high resolution (MicroHH)
  - NWP (ICON, collaboration with Sophia Schäfer and Maike Ahlgrimm)
  - Realistic LES (ICON, collaboration with Mirjana Sakradzija)

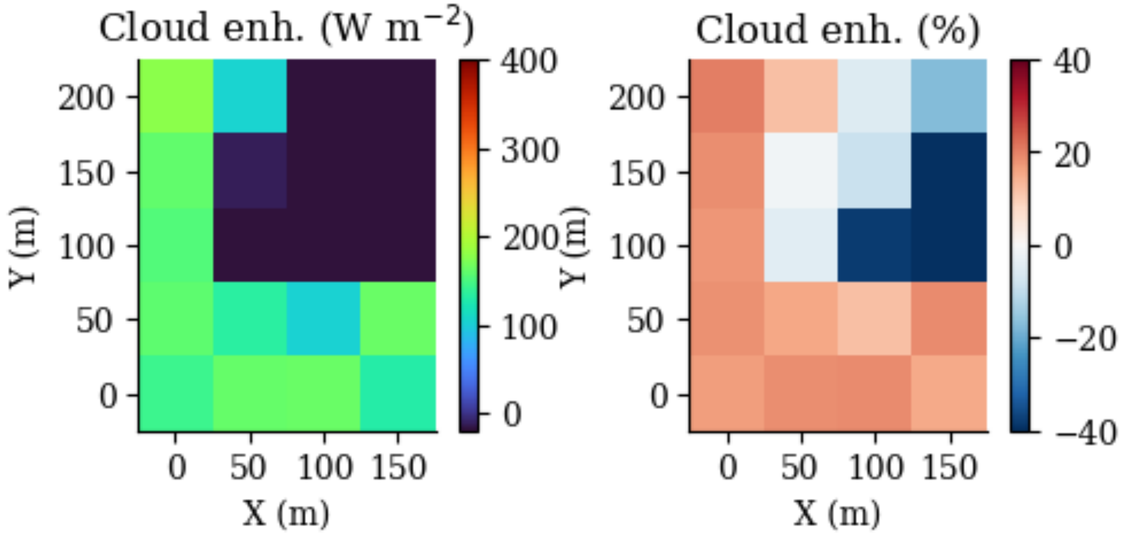


Radiation and cloud observations on 27 June (next talk by Wouter Mol)

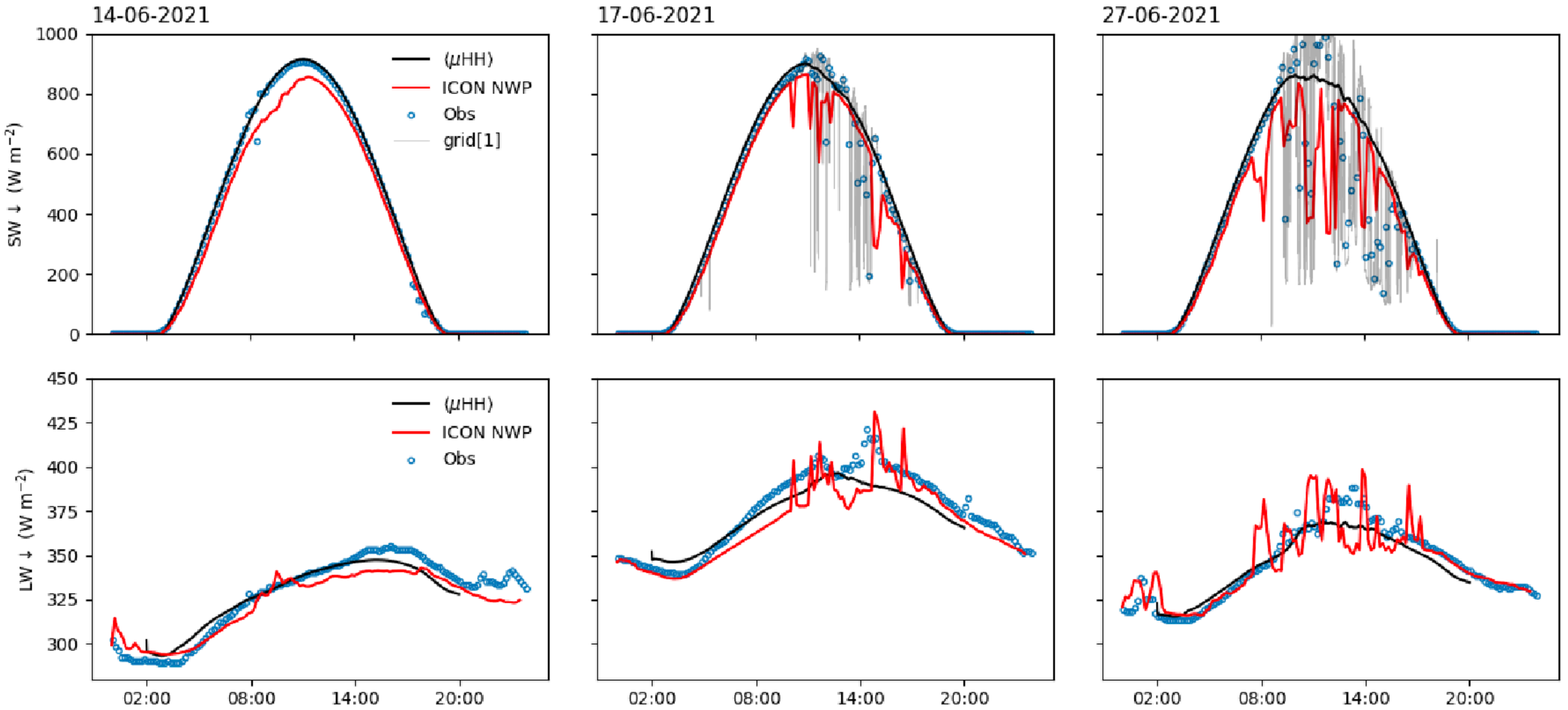




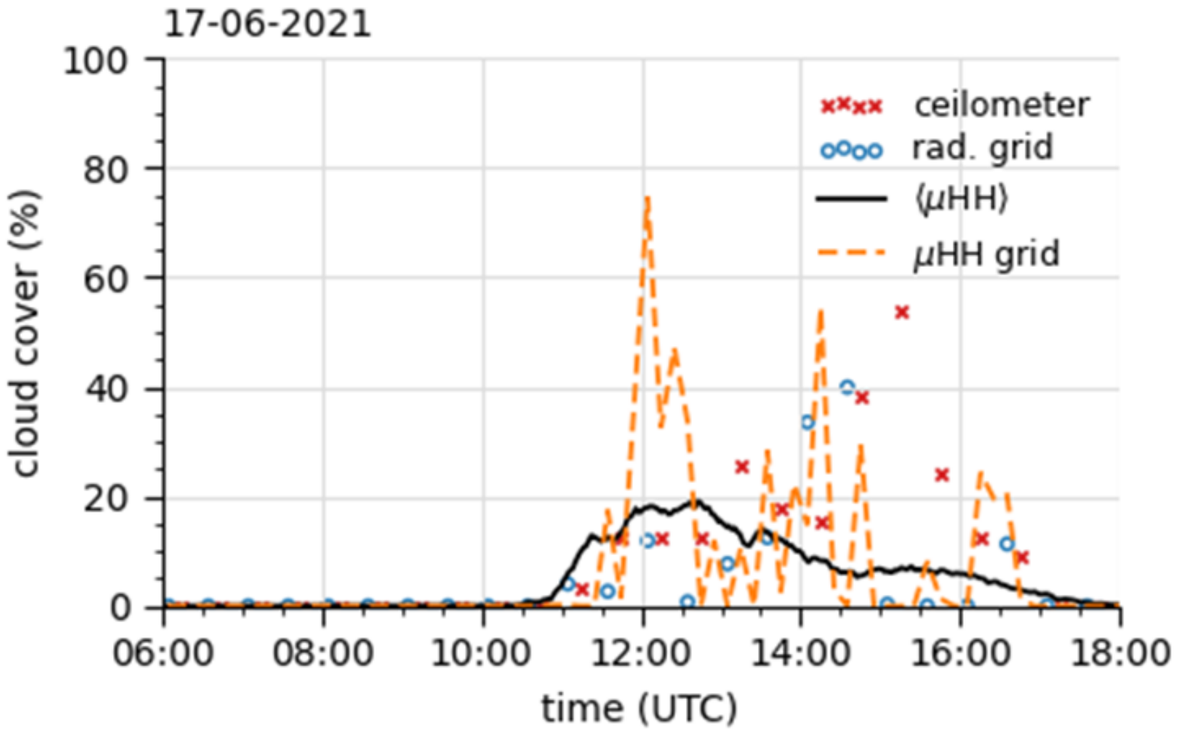


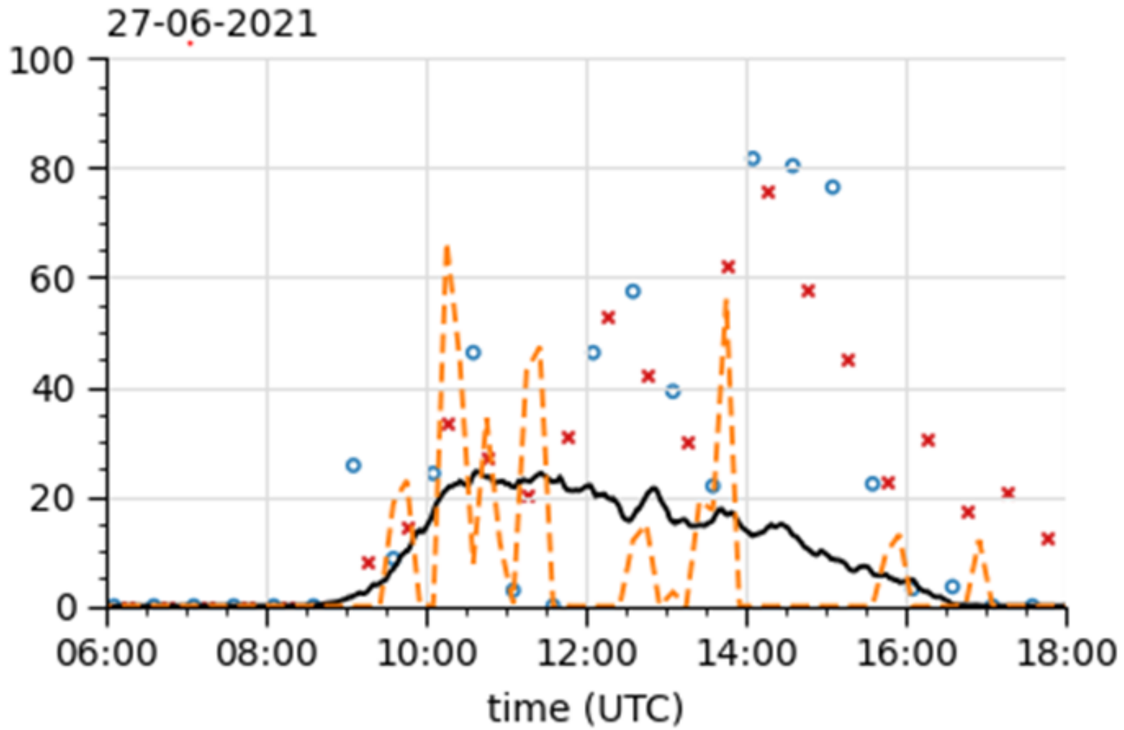


The daily evolution of surface shortwave and longwave irradiance



Cloud cover is a challenge to validate (later talk by Menno Veerman)



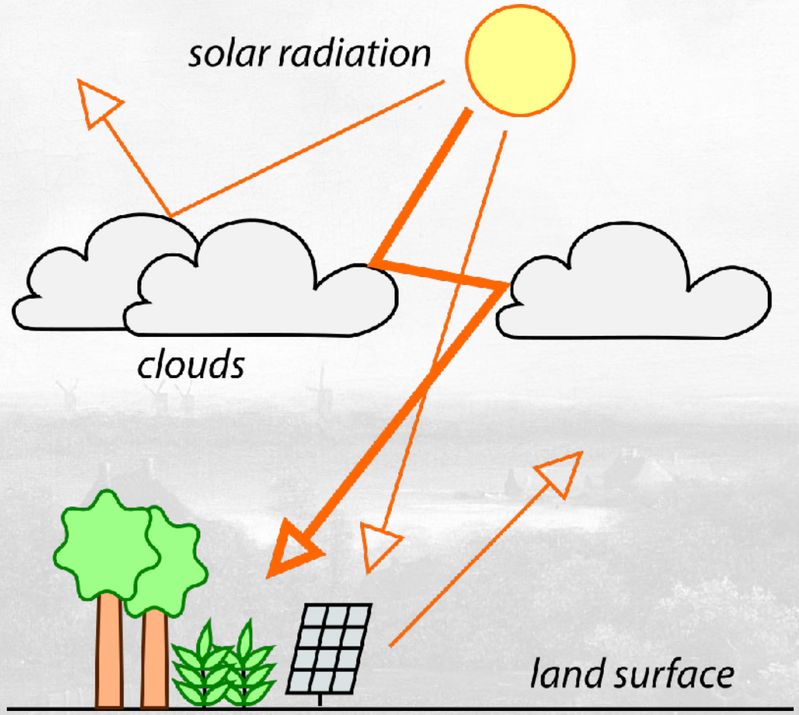


Shedding light on cloud shadows

Chiel van Heerwaarden (chiel.vanheerwaarden@wur.nl)

Conclusions

- Grid observations and 3D simulation to study fast variability
- FESSTVaL provides excellent case studies for studying cloud shadows
- Simulating cloud shadows to match observations is a challenge



What is next?

- Work out FESSTVaL case studies in more detail

Research part of Shedding Light On Cloud Shadows project (chiel.ghost.io/slocs) funded by NWO Vidi scheme