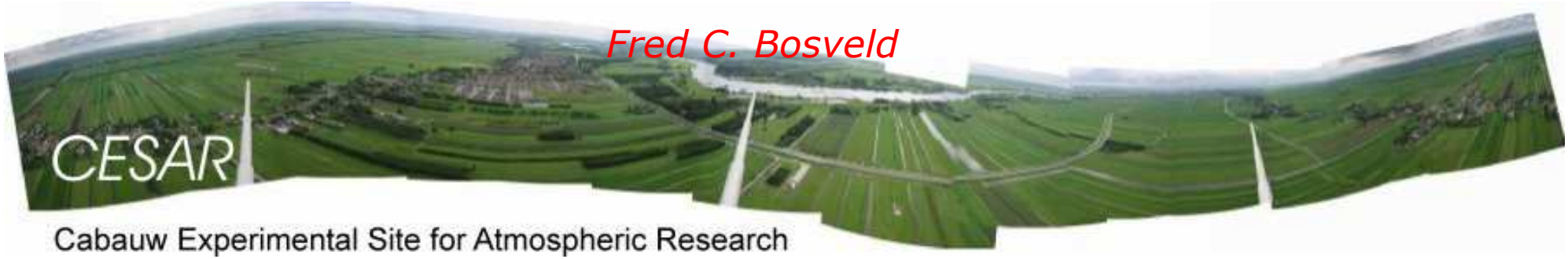
The CESAR observational program:

New developments in the land-atmosphere observation

Fred C. Bosveld

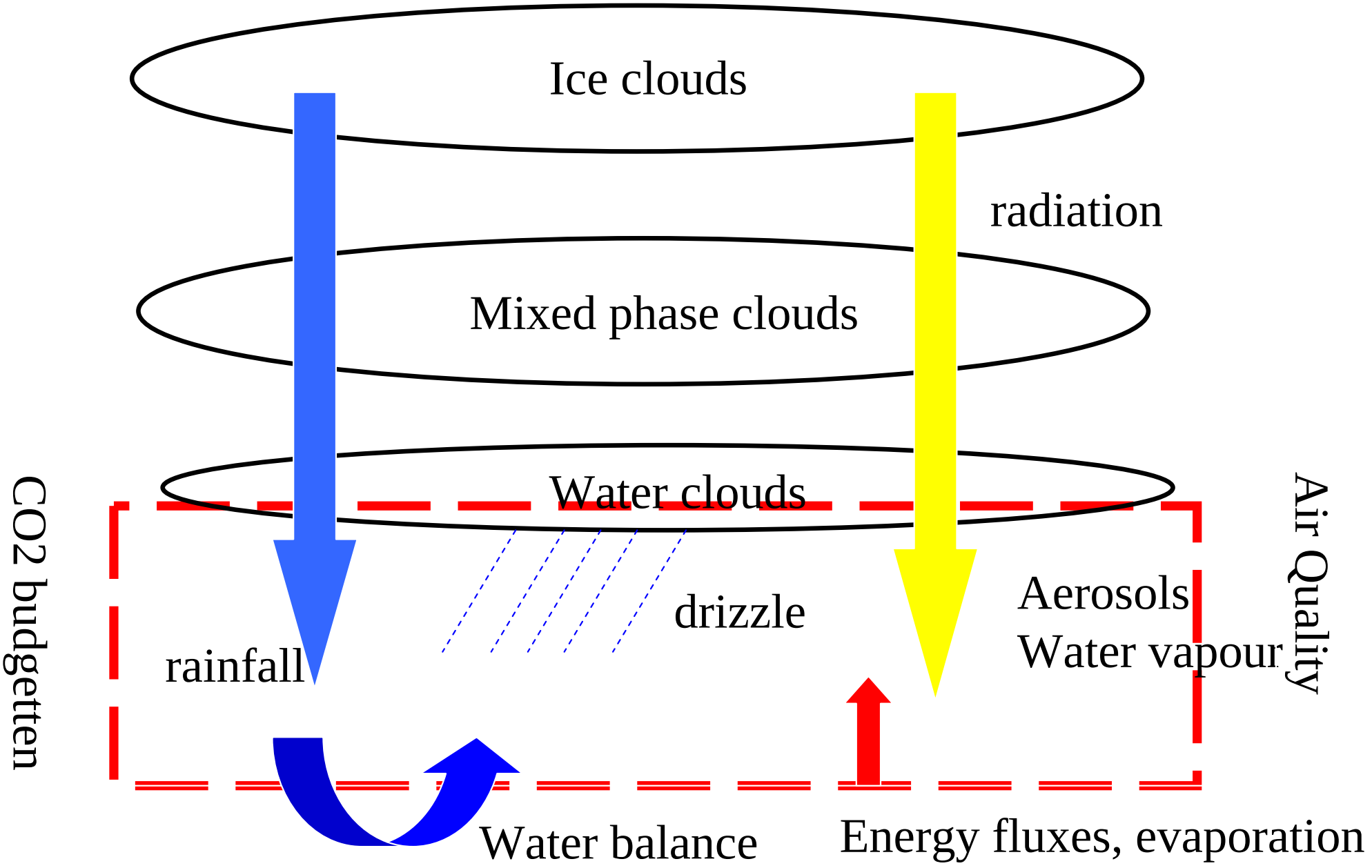


Consortium of 8 institutes:

KNMI, TU Delft, rivm, ECN, esa, TNO, Universiteit Utrecht

http://www.cesar-observatory.nl

CESAR Research Themes



Long term boundary layer observations

Since 1986
- Tower profiles
- Surface energy budget (all components)

Since 1994
- Boundary layer wind and height

Reconstruction 1997-1999
Since 2000 - Turbulent fluxes (+CO2)
Since 2003 - Soil water

Regional scale flux program
Since 2005 - Tower fluxes
Since 2008 - Scintillometer

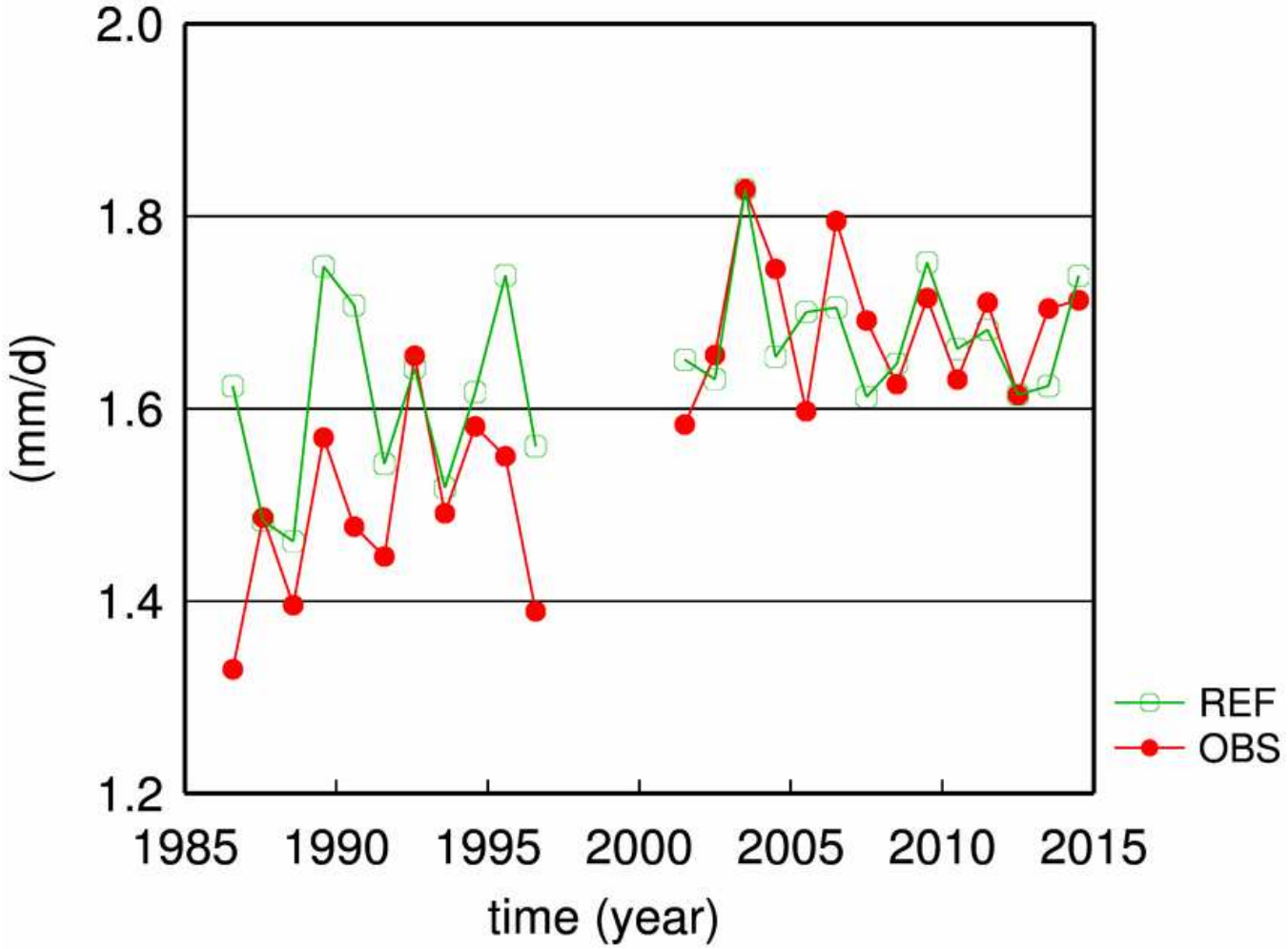
Fog program
Since 2011 – Visibility tower profile
Since 2011 – Radiation at 213 m

Improvements since 2010
-Improved surface radiation
-Improved Soil heat and water
-Surface radiation temperature
-Boundary layer height

Where possible we make use of KNMI operational facilities:

- Instruments
- Data logging, transport
- Quality control

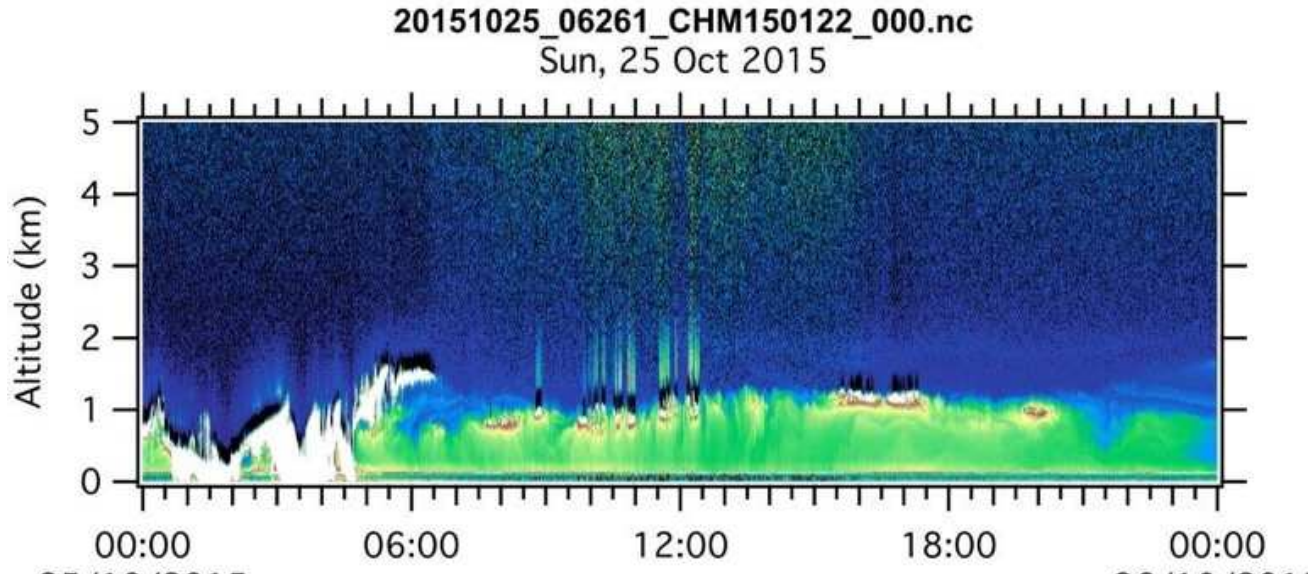
Cabauw 26 year Evaporation time series
Energy budget residual method *(Beljaars and Bosveld, 1997)*



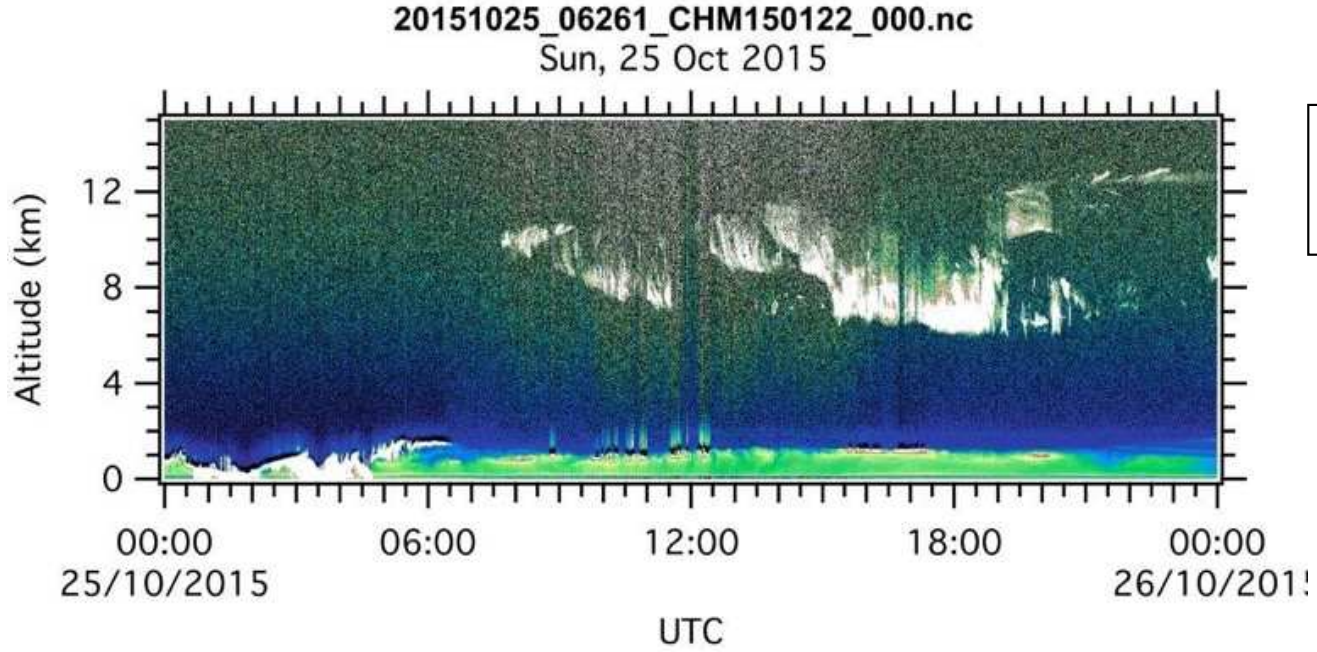
Yearly mean observed evaporation (OBS).

Compared with Makkink reference evaporation (REF)

New Ceilometers (CHM15k) in NL-meteo-network (25+) including Cabauw

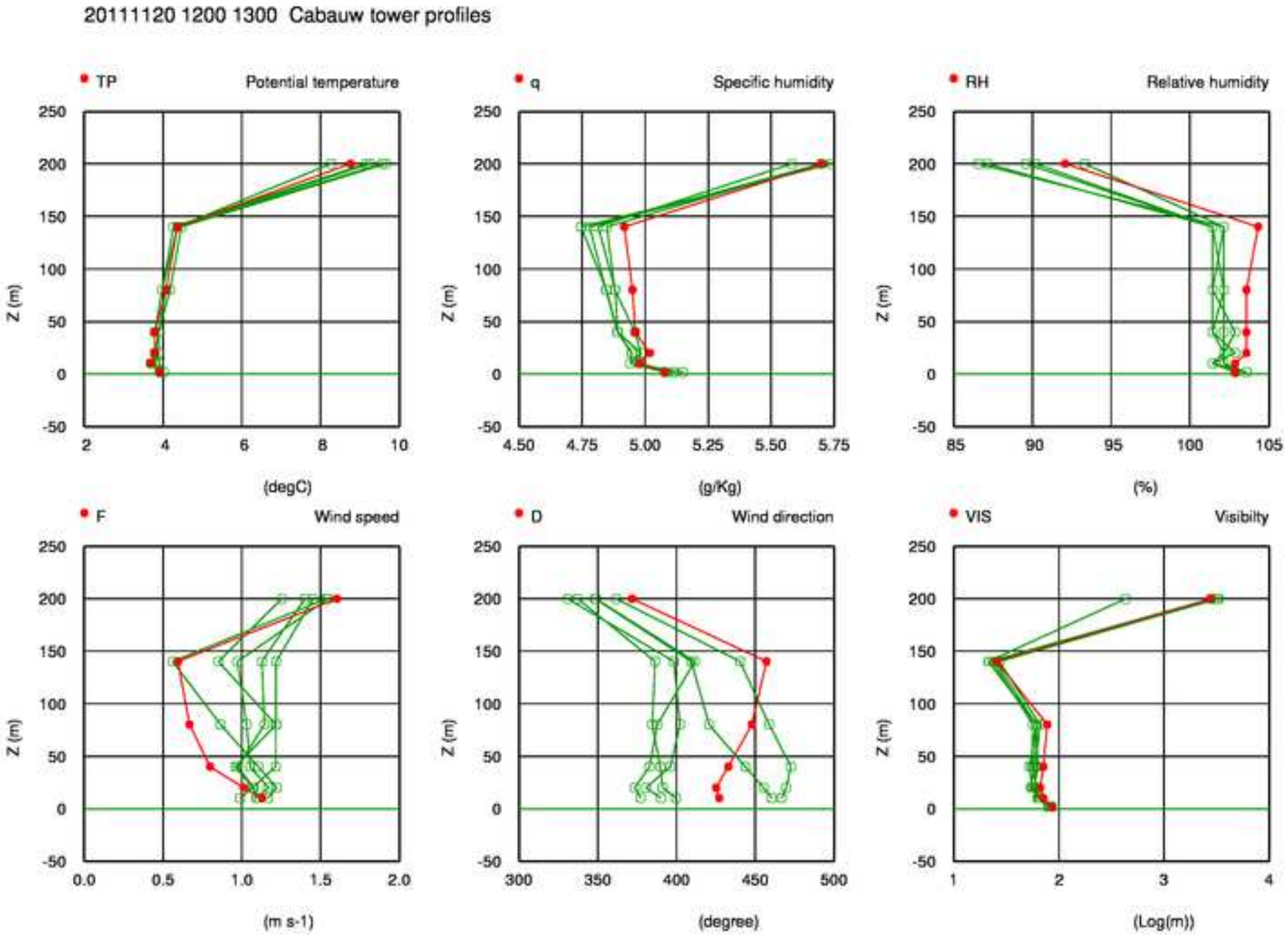


Improved BLH



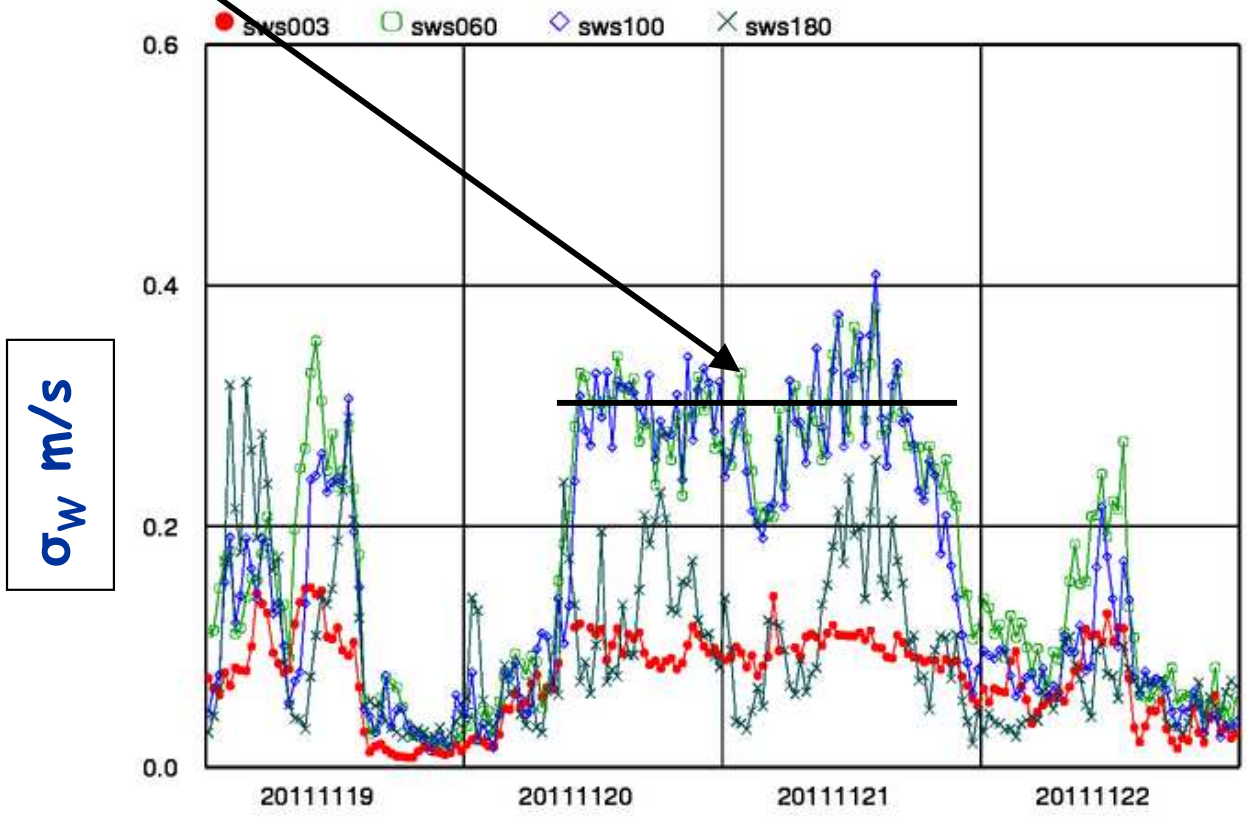
High clouds

Profiles from 200m tower. Fog period 20-22 Nov 2011

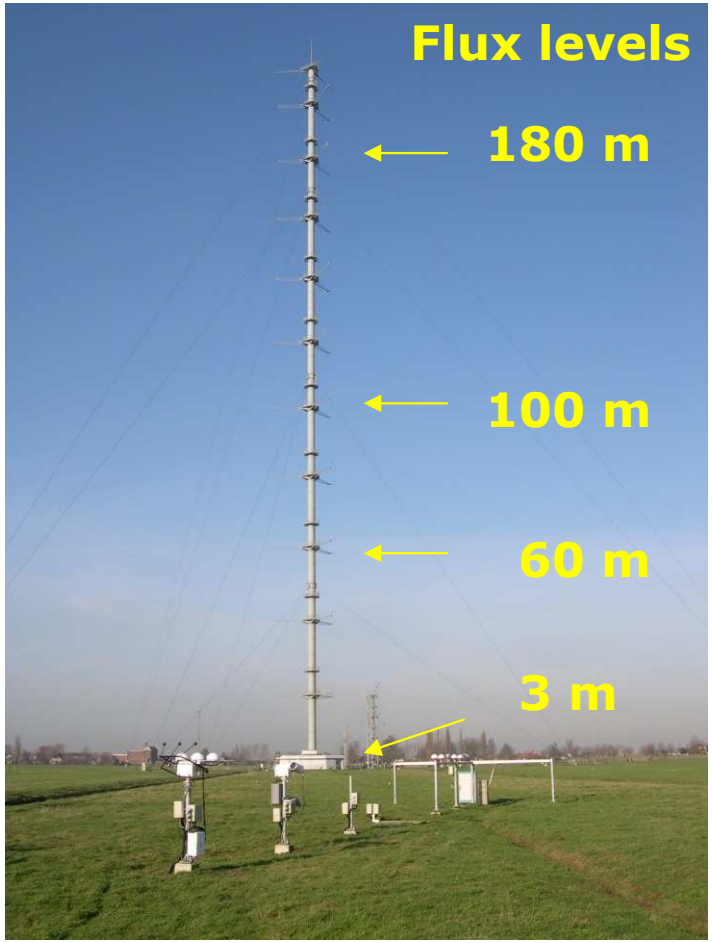


Downward convection of top of fog-layer

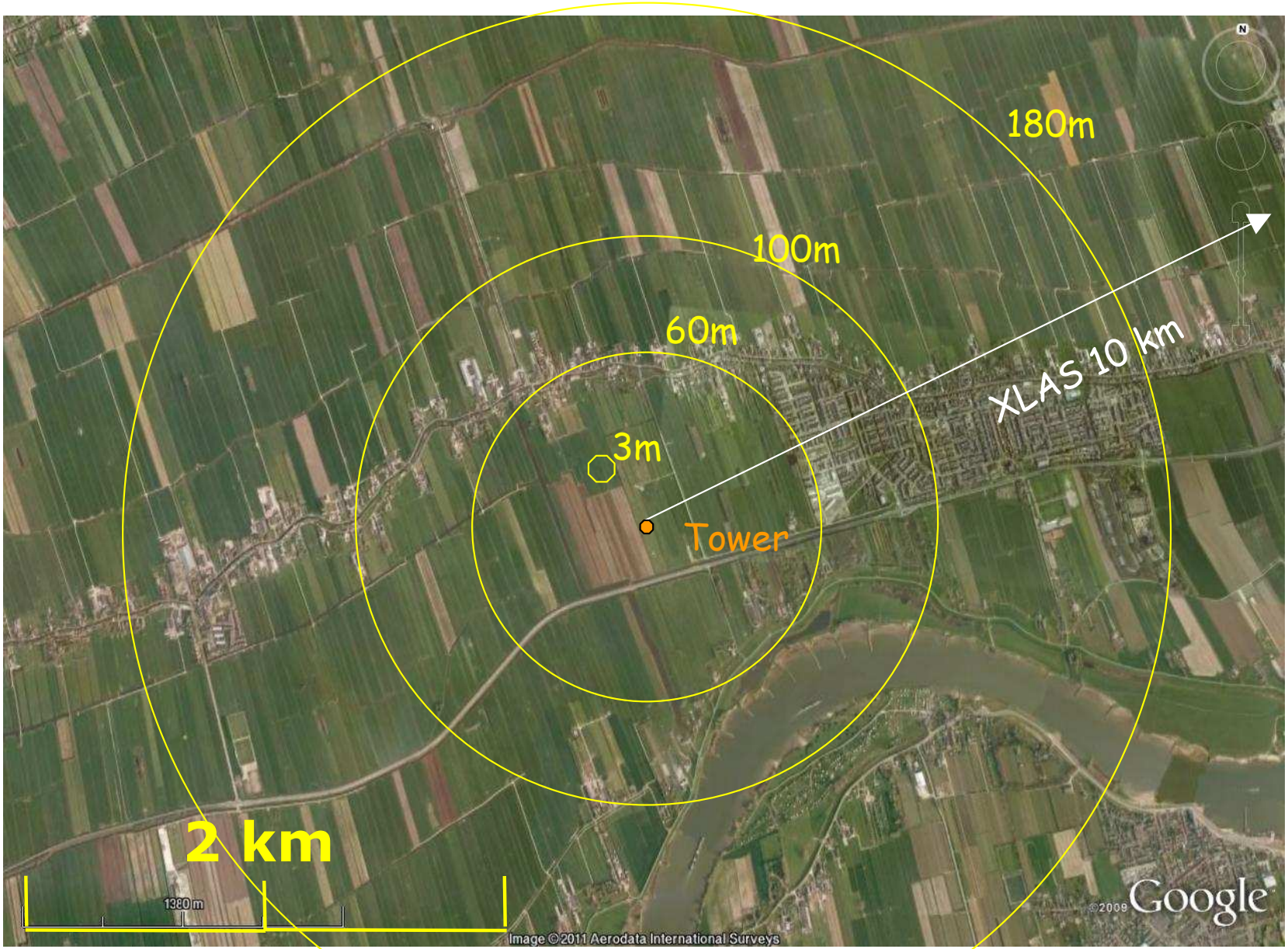
From σ_w from sonic anemometers in tower



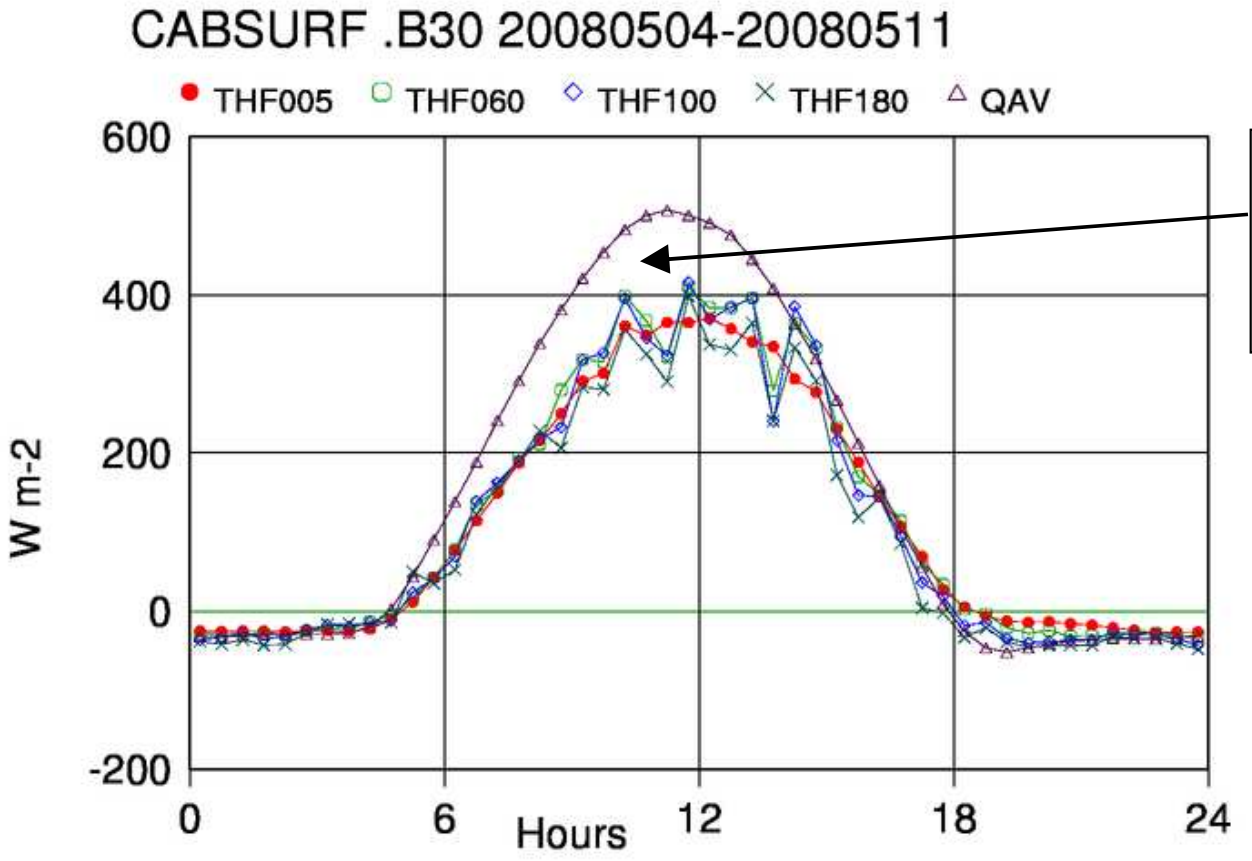
Regional scale flux observations at Cabauw



Regional scale fluxes -> Fetch conditions



Regional scale fluxes -> Surface energy budget



Imbalance is independent of height of flux observation.

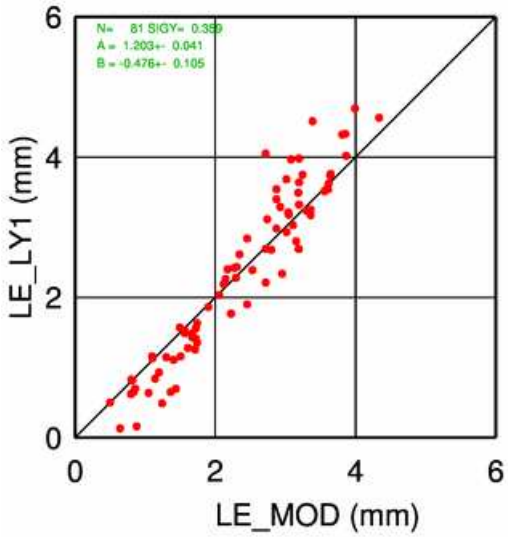
- Mean diurnal variation of 8 comparable days
- Surface total heat flux (THF=H+LE) estimated from different heights.
- Available Energy (Qav=Qnet-G)

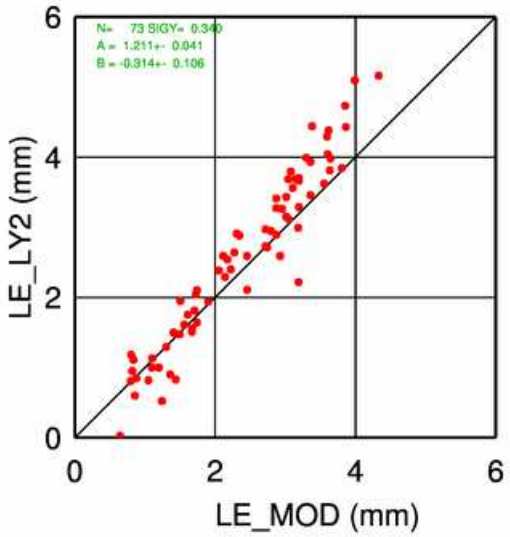
Corrections turbulent fluxes:
- Low frequency loss
- Storage below sensor height

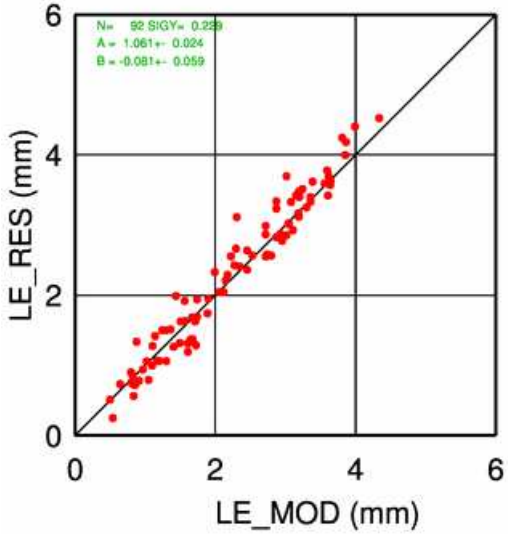
Experience with mini-Lysimeters

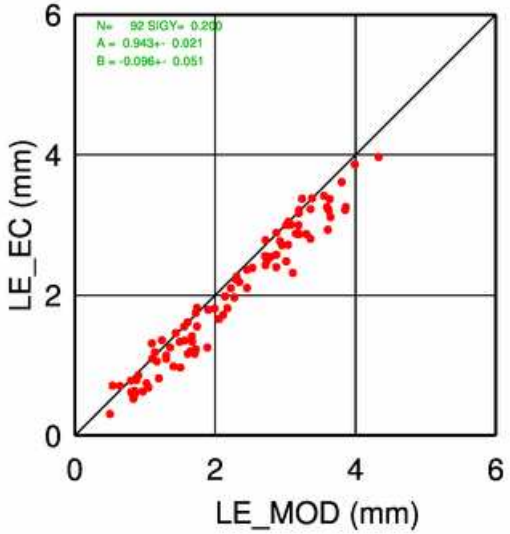
Cooperation with Bernard Voortman (KWR) and Jan Elbers (WUR)

Daily evaporation compared with Cabauw optimized model for year=1987







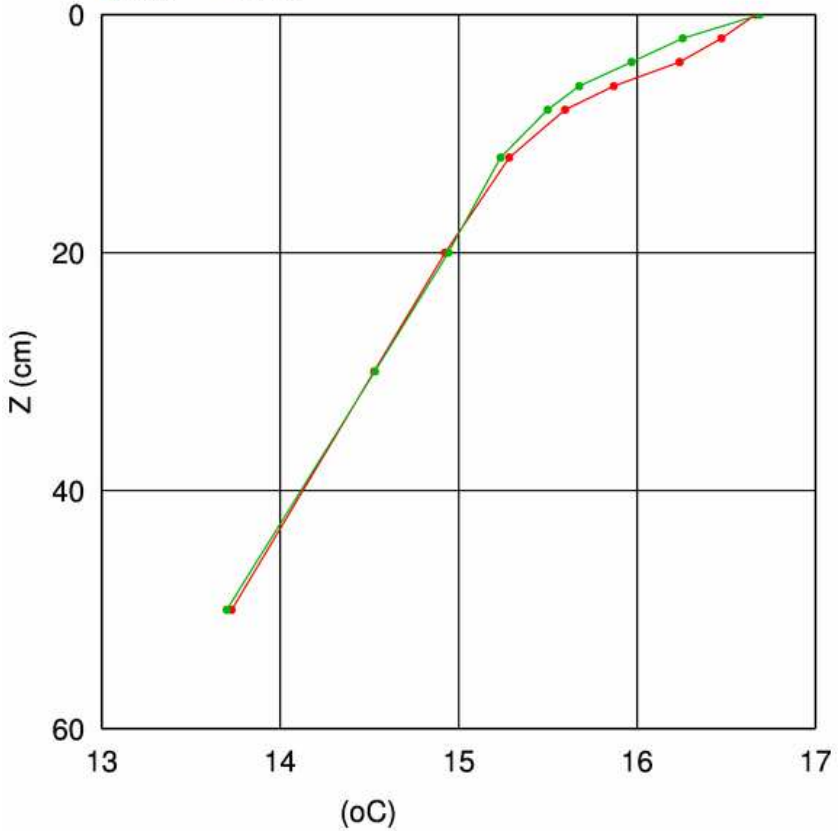


Soil temperature and an unexpected guest

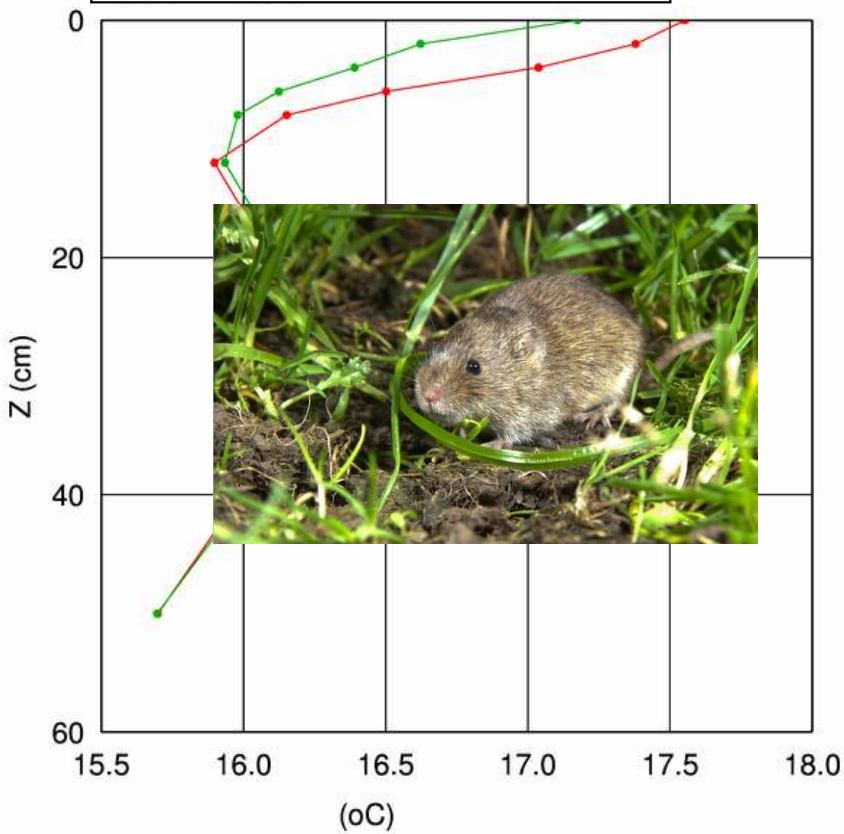
High accurate and high resolution (0.01oC) for soil heat budget

Second profile for back-up

Midday 01 July 2013



Midday 01 July 2014



How to …!

Wait for spring 2016

Looking for information about CESAR?

http://www.cesar-observatory.nl

Looking for data of CESAR?

http://www.cesar-database.nl

Or contact: fred.bosveld@knmi.nl

Thanks!