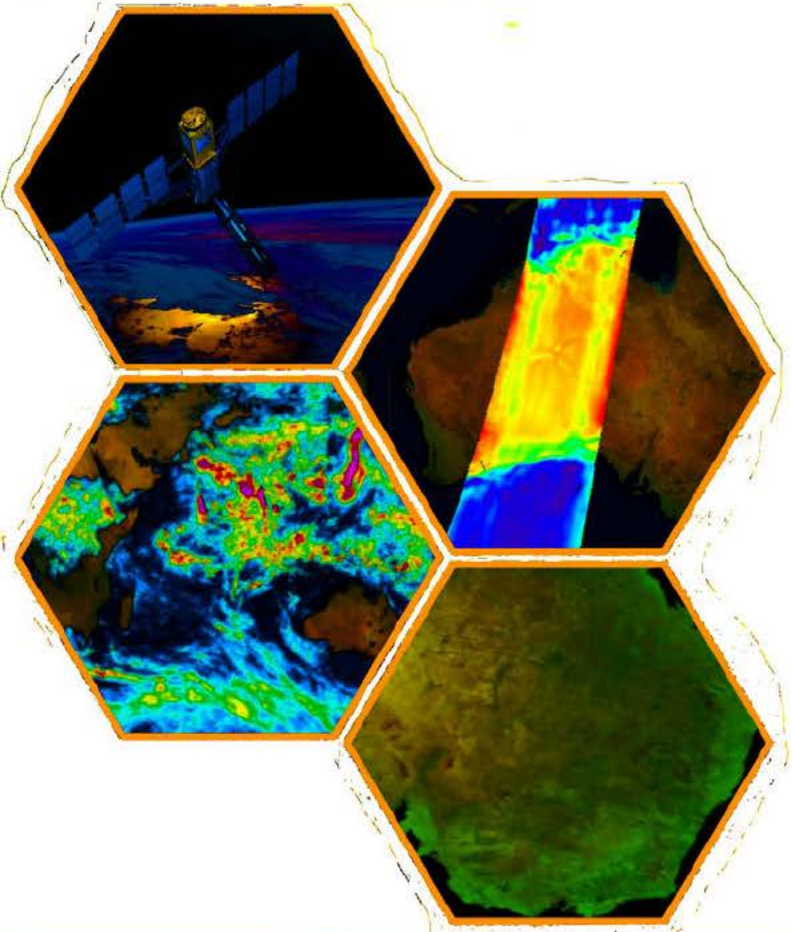


Hydras+

Multisource data assimilation into land surface models for soil moisture monitoring

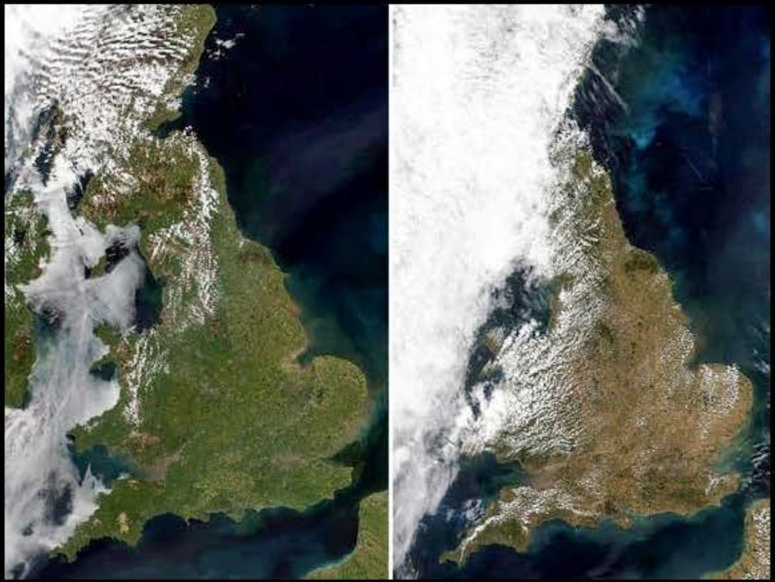
Dominik.Rains@ugent.be

belspo
HYDRAS+
JÜLICH FORSCHUNGSZENTRUM
LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY LIST
UNIVERSITEIT GENT

Challenge

Managing hydrological extreme events requires accurate data …

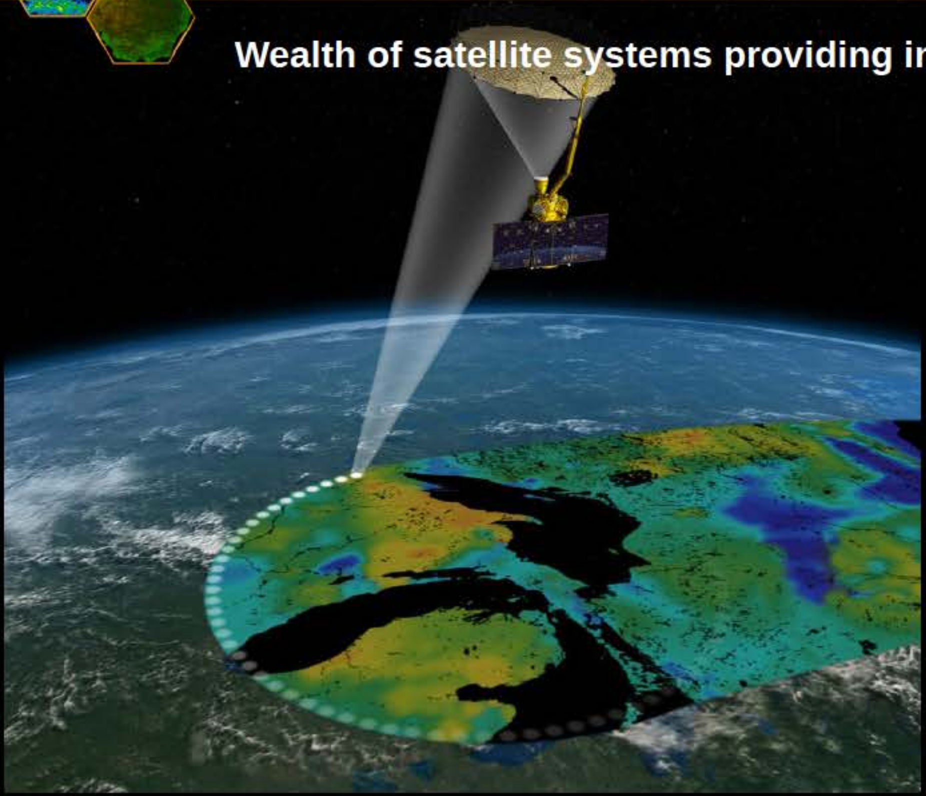
Hydras+ focuses on improving soil moisture monitoring



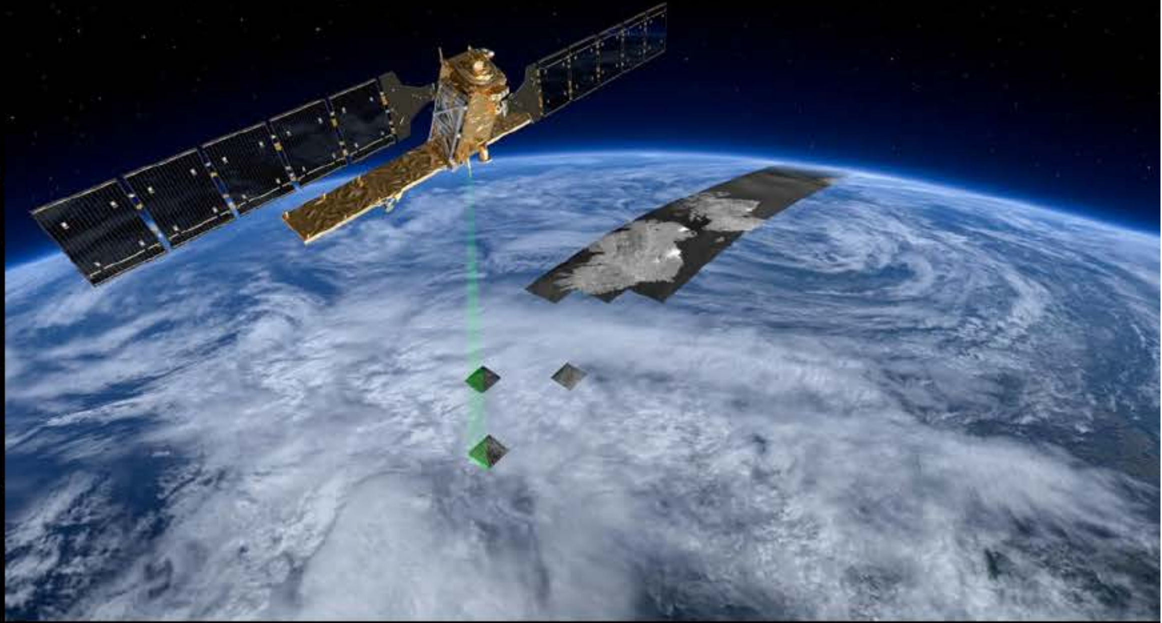
→ Soil moisture deficit precedes vegetation reaction and plays a vital role in the evolution of a drought, i.e. further heating of the land surface
→ Soil moisture is of great importance for agricultural productivity
→ accurate information also improves flood forecasting

Opportunity

Wealth of satellite systems providing information for land surface conditions...



Passive systems (Radiometers),
e.g. SMOS and SMAP
measuring brightness temperatures



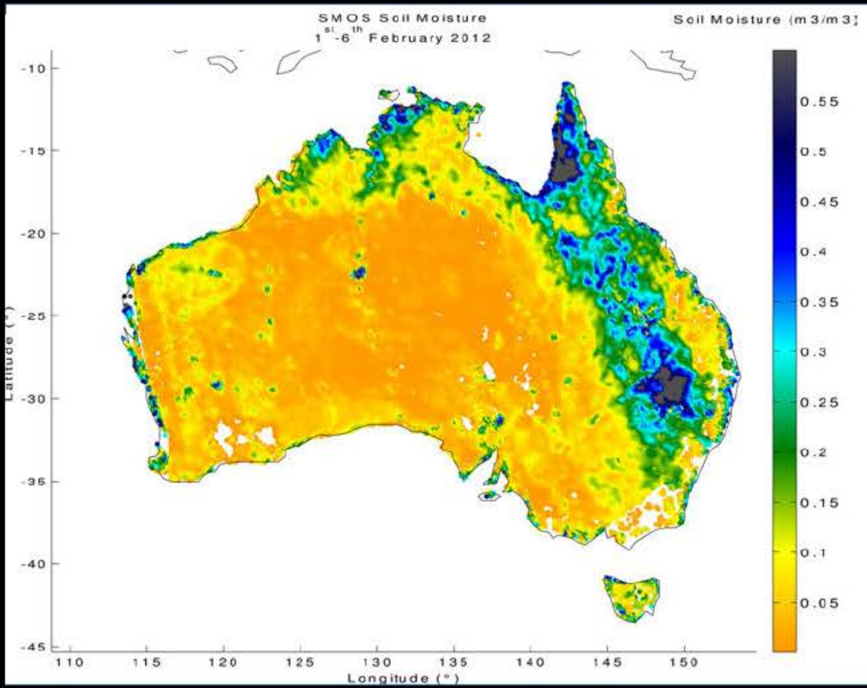
Active systems (SAR or Scatterometers),
e.g. Sentinel 1 and ASCAT
measuring backscatter

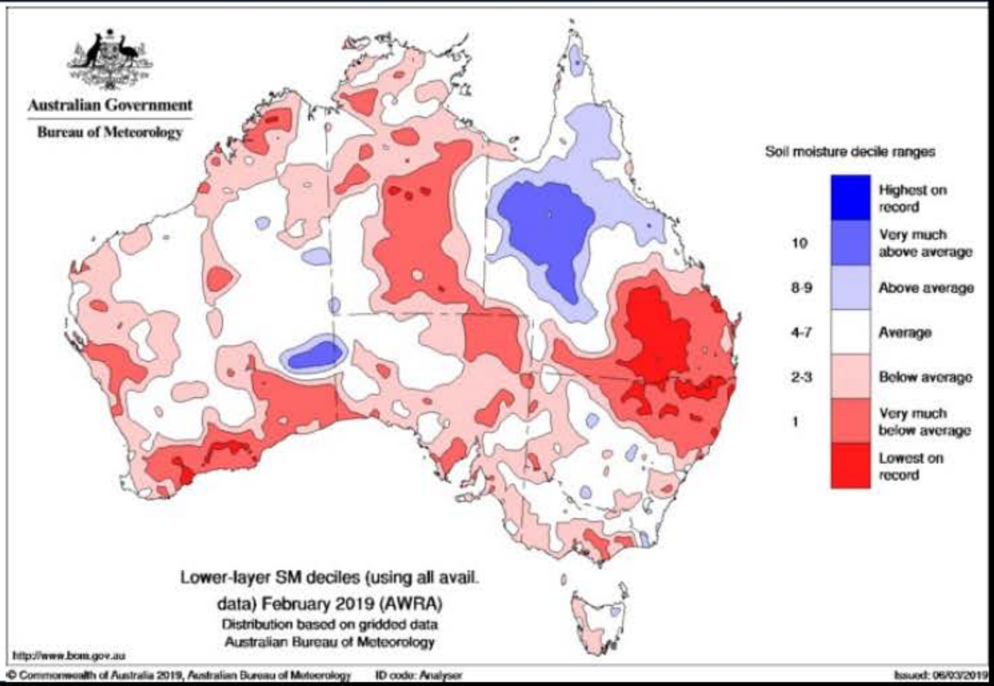
HYDRAS+

Shortcomings

Geophysical retrievals of soil moisture

Requirements from stakeholders



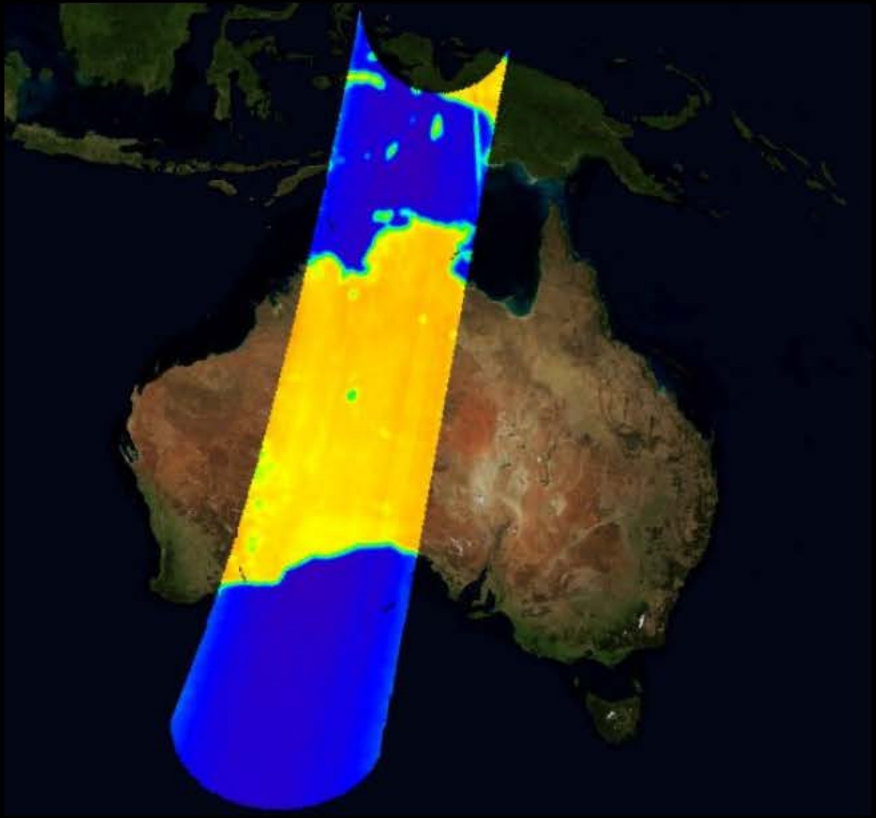


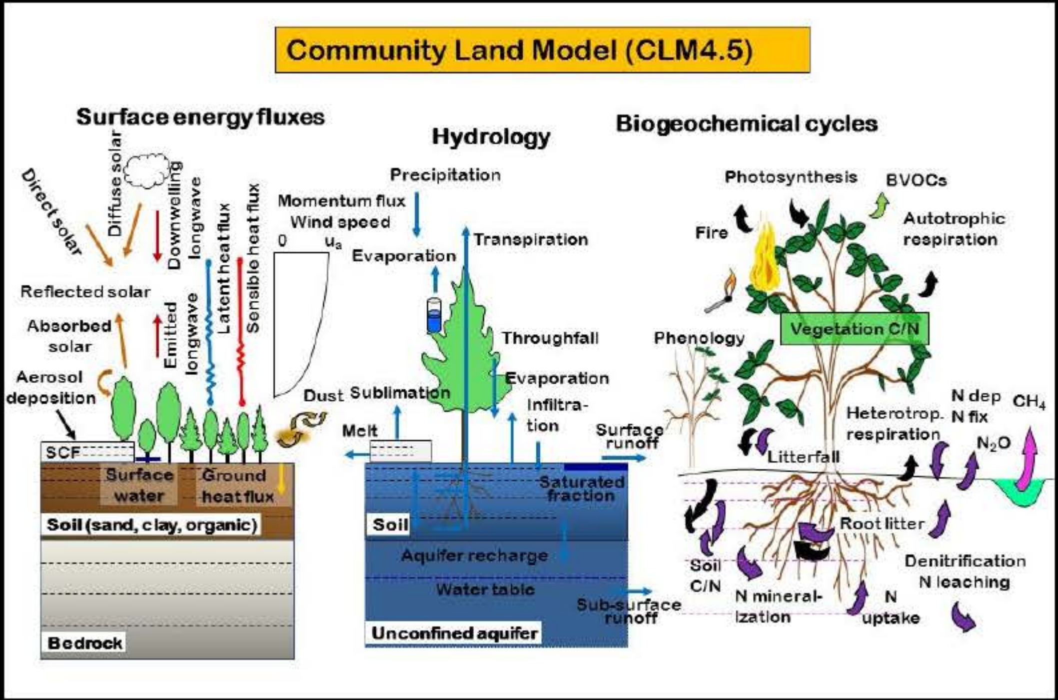
- → complex and require ancillary data (vegetation, temperature etc..)
- → limited to space and time of satellite overpass
- → often don't come with uncertainties

- → Continuous data required for robust statistics (probabilities)
- → Information on uncertainty useful
- → forecasts should be possible

Methodology

Assimilation of Level 1 observations into land surface models





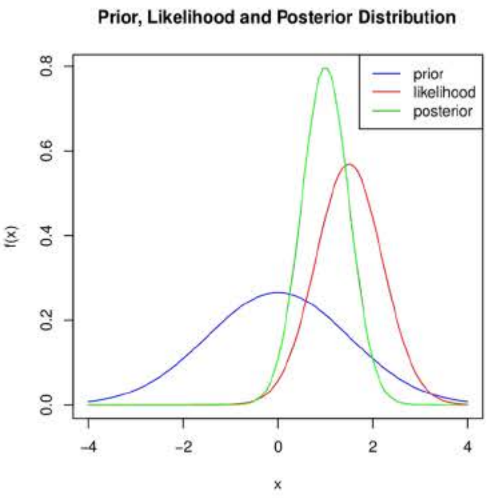
Methodology

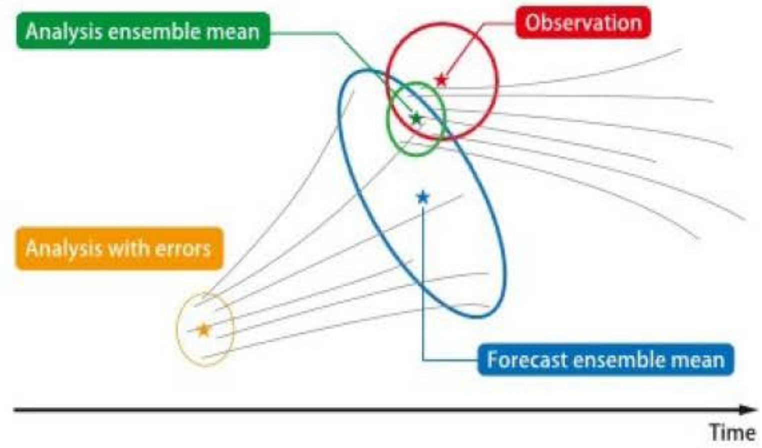
Data assimilation tackles some important issues ...

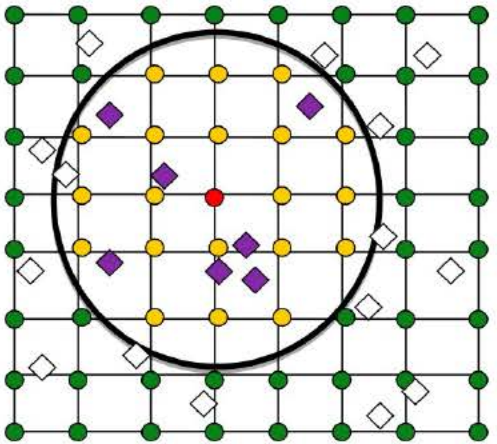
1. Uncertainty of observation and model is taken into account

2. Because model is used data is spatially and temporally continuous

3. Multiple observations can be used to update model making analysis more robust, gaps can be filled

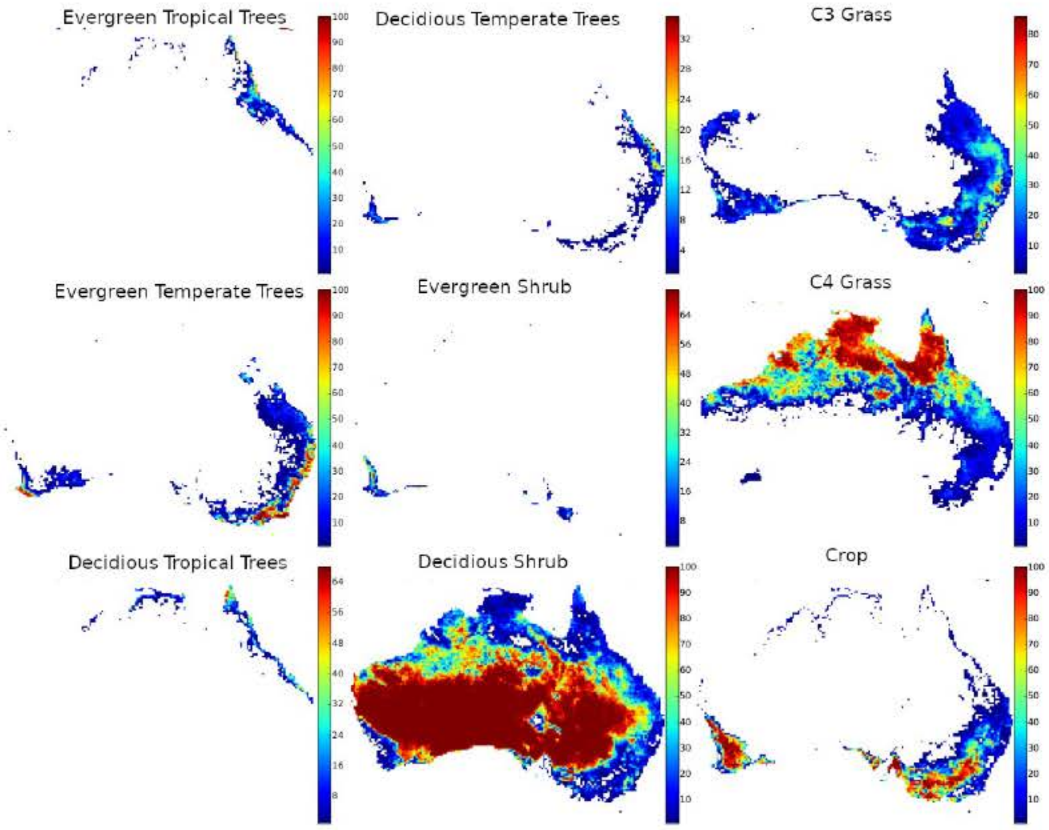


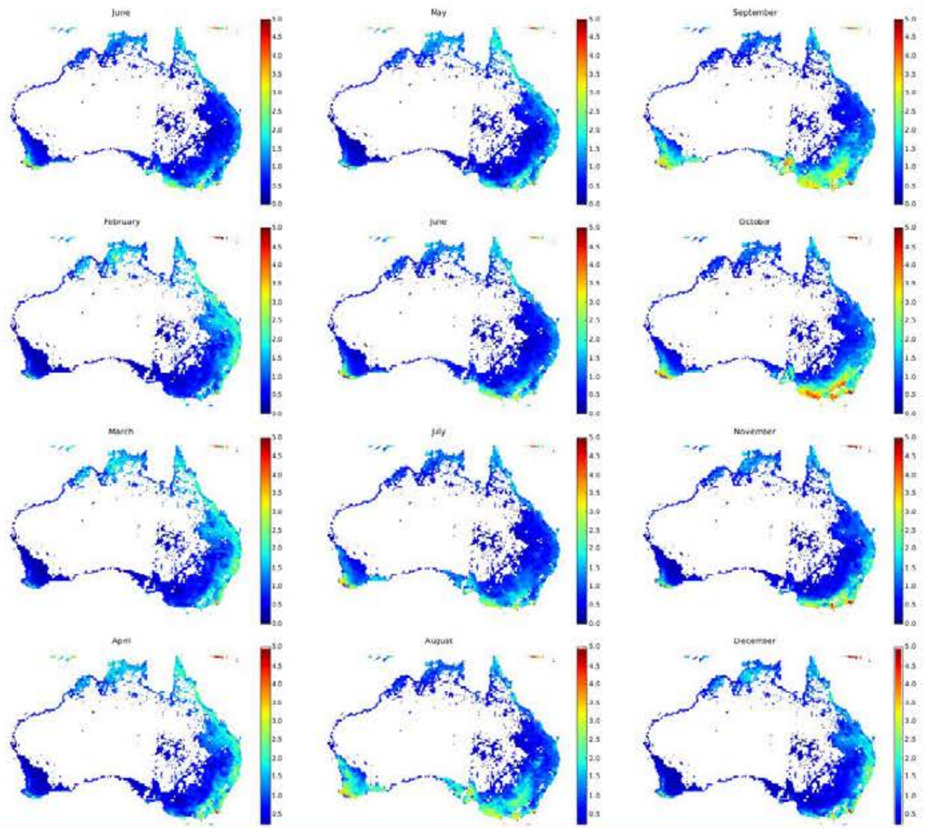




Methodology

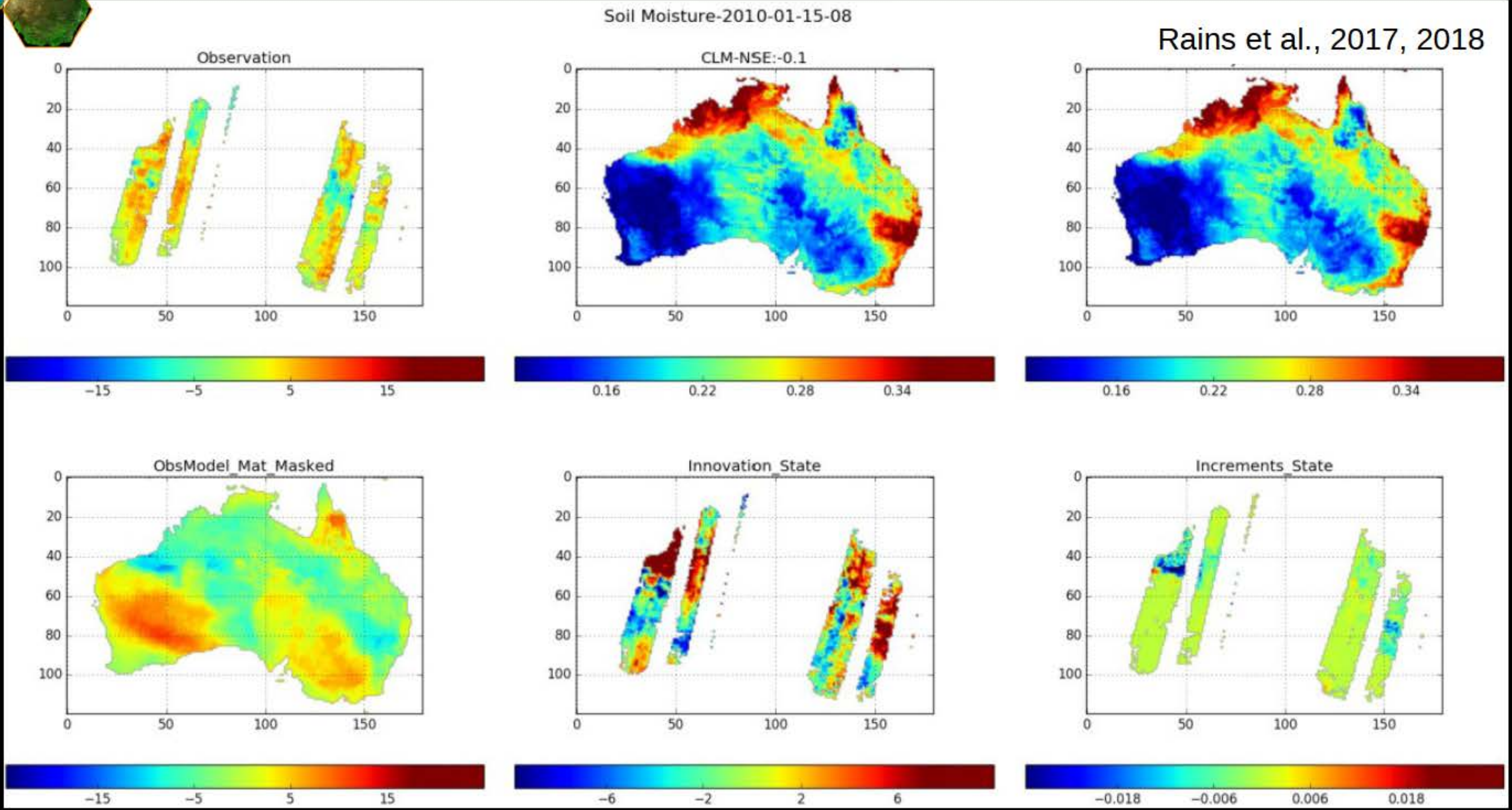
Land surface requires precise description





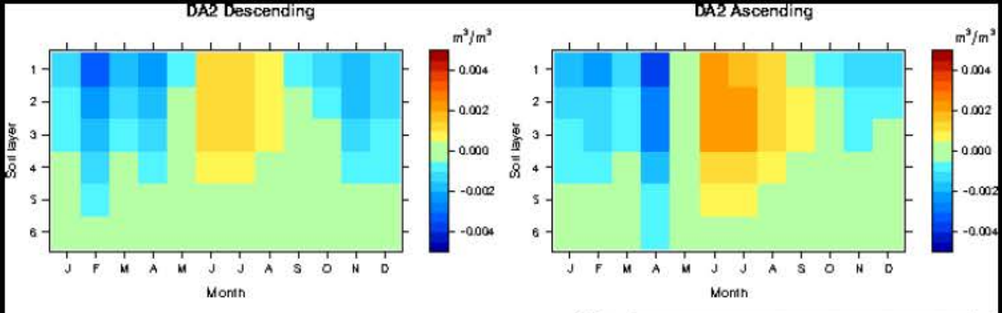
Methodology

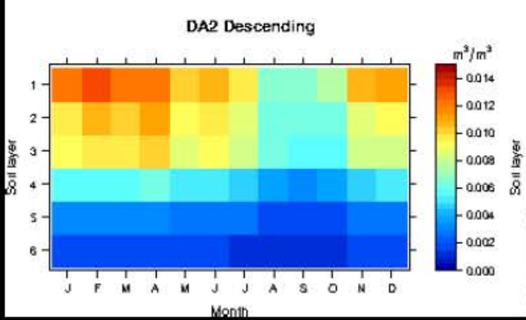
Rains et al., 2017, 2018



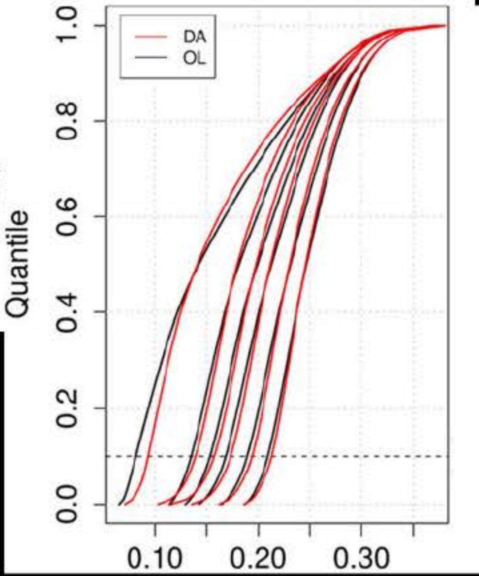
Results

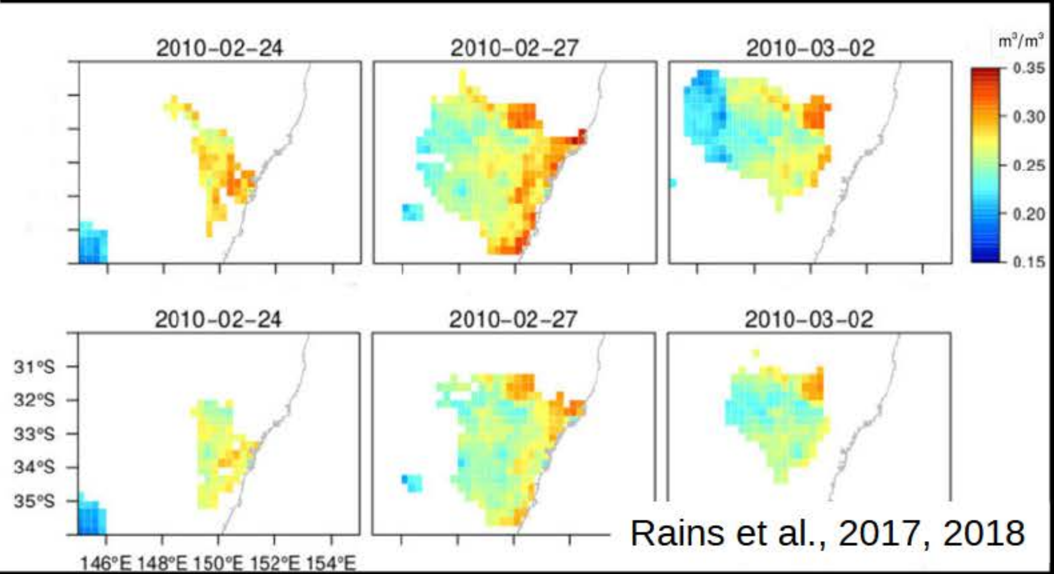
Long-term assimilation of SMOS brightness temperatures into CLM over Australia





Long-term affects on soil moisture quantiles and root-zone soil moisture relevant for monitoring applications



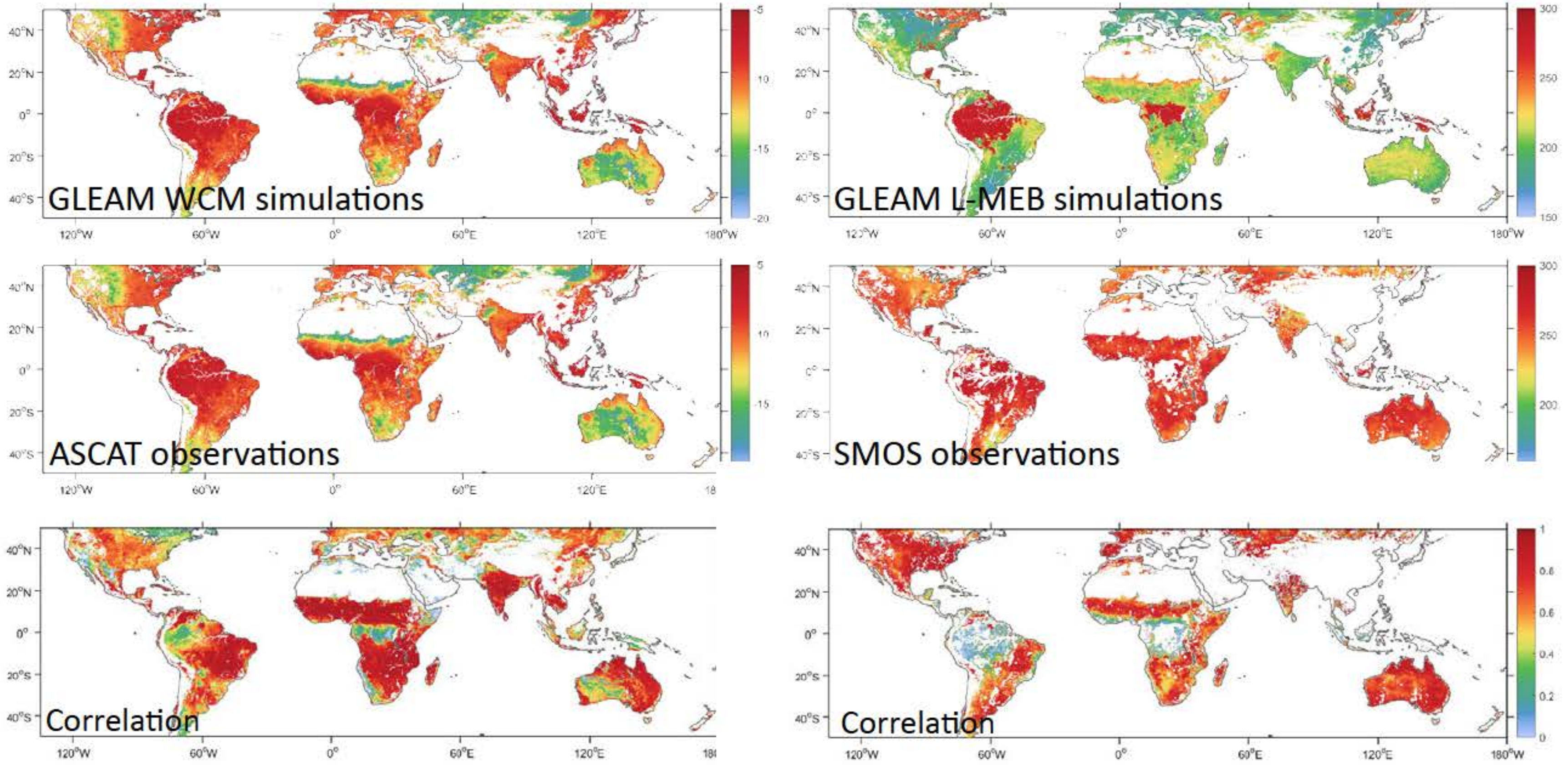


Rains et al., 2017, 2018

Results

Simultaneous assimilation of ASCAT and SMOS into GLEAM

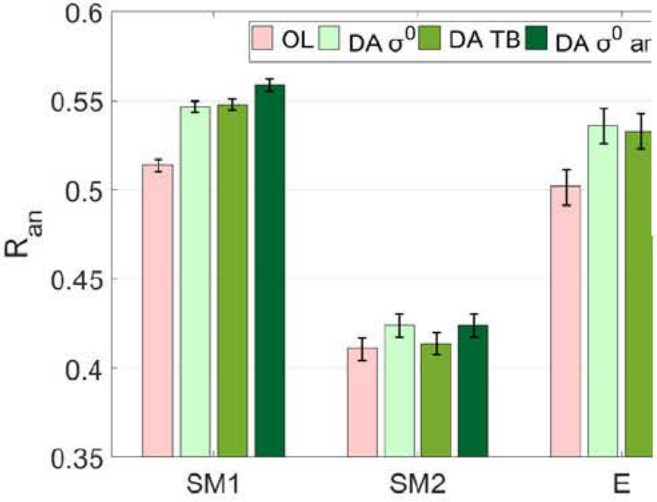
Lievens et al., 2017



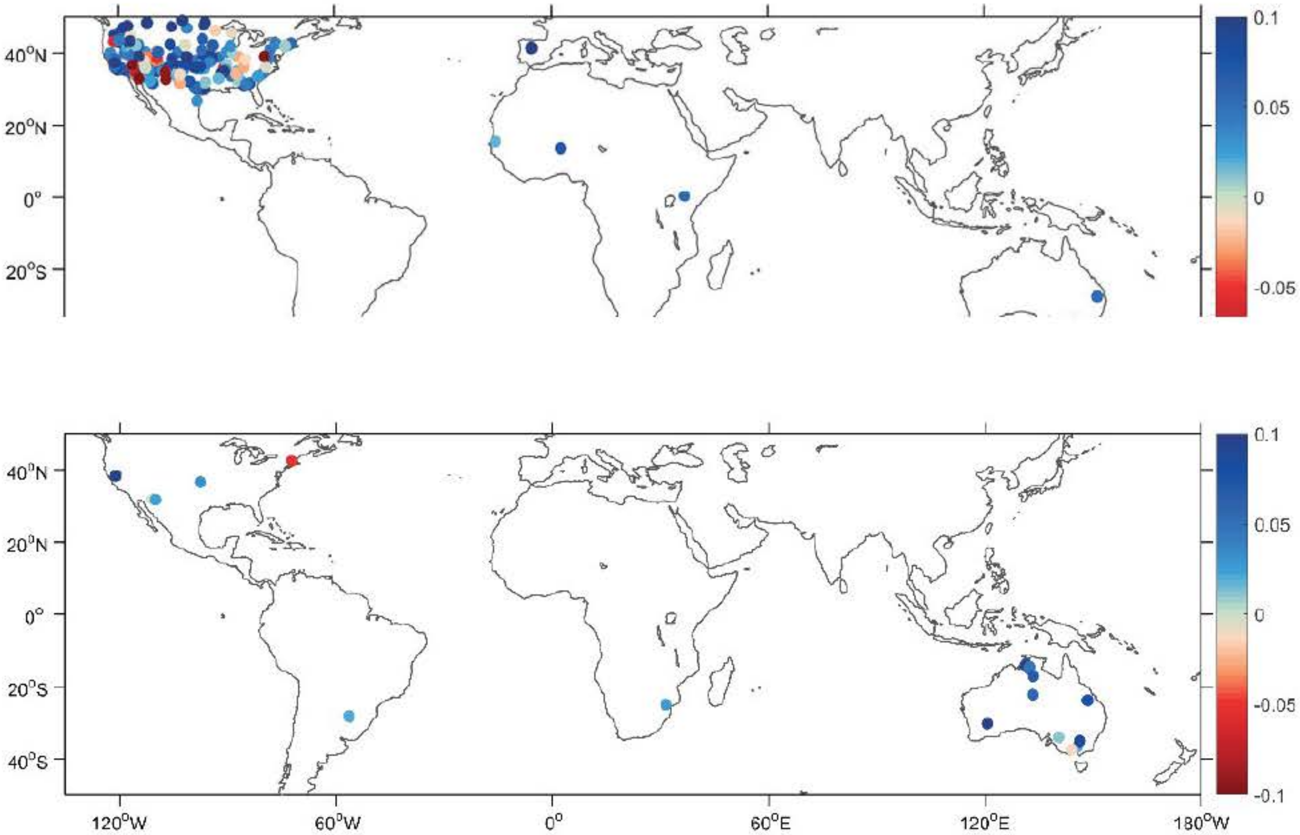
Results

Simultaneous assimilation of ASCAT and SMOS into GLEAM

Added value of assimilating two types of observations: brightness temperatures and backscatter



Lievens et al., 2017



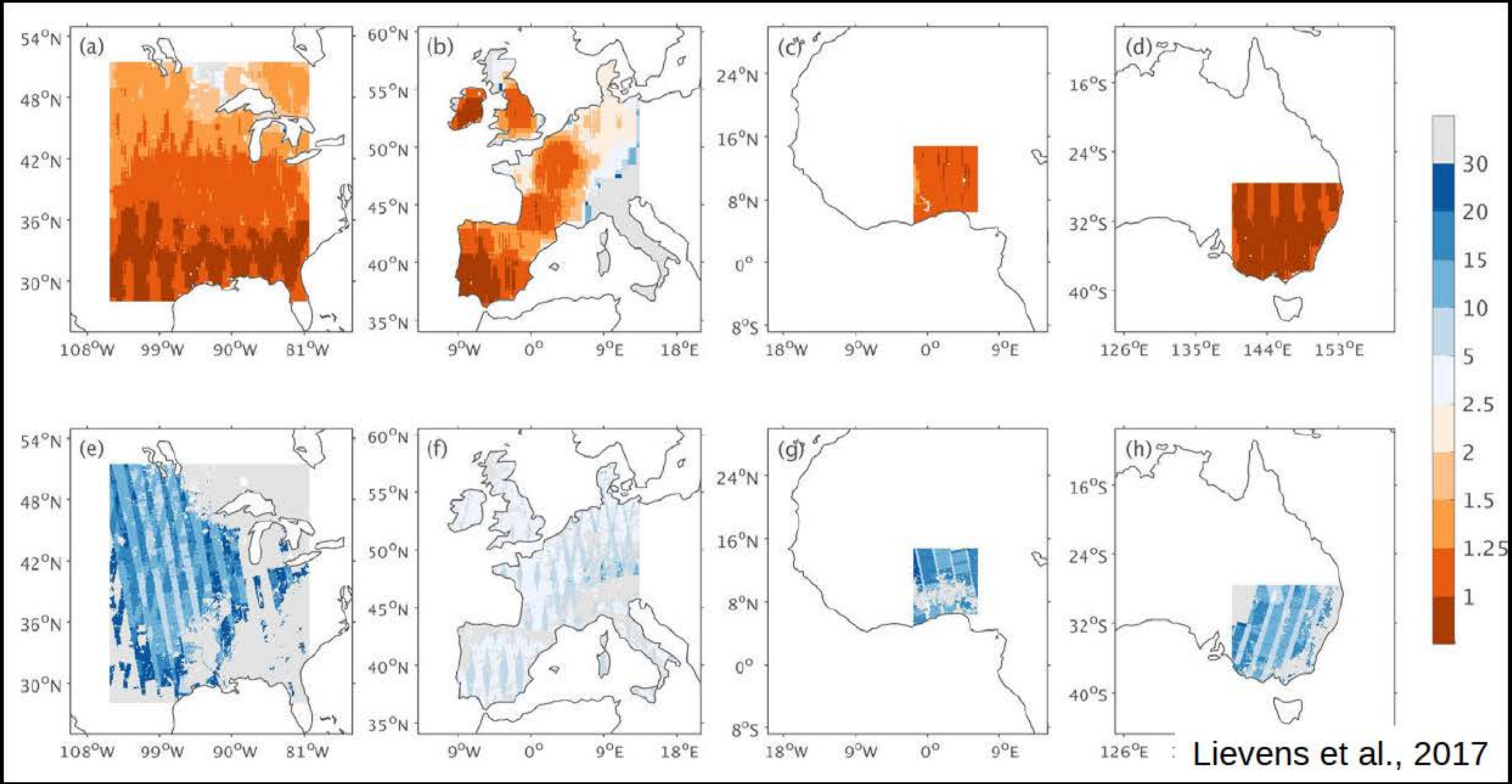
Results

Simultaneous assimilation of Sentinel 1 and SMAP into CLSM

Number of observations

SMAP TB

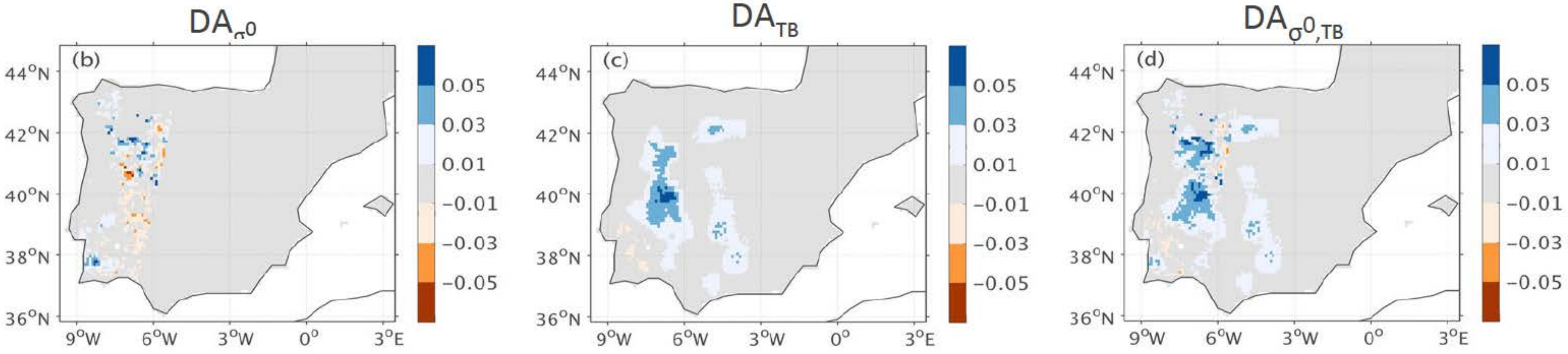
Sentinel-1 σ⁰



Results

Simultaneous assimilation of Sentinel 1 and SMAP into CLSM

$DA_{\sigma 0}$ in 1D has more spatial detail (local hydrologic conditions)
DA_{TB} in 3D is smoother and extra/interpolated over unobserved grid cells
$DA_{\sigma 0,TB}$ in 1D & 3D combines assets of both



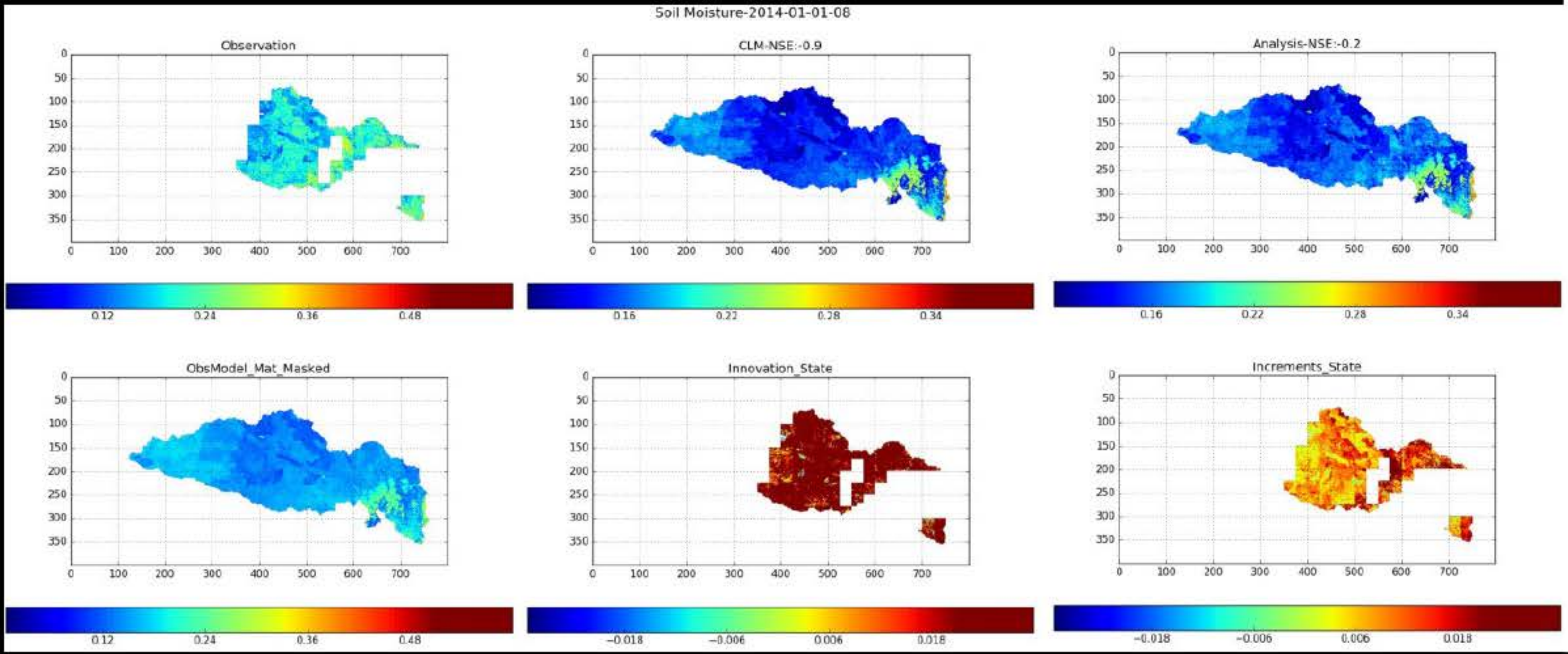
Lievens et al., 2017

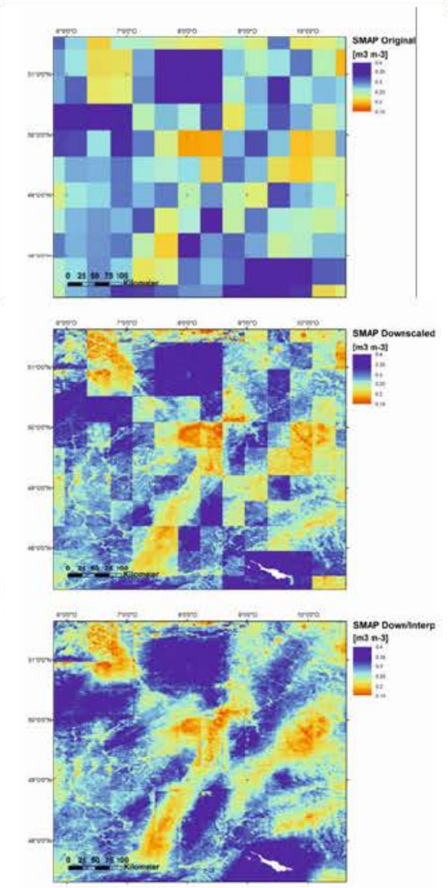
Results

Downscaling of coarse-scale observations

Coarse-scale observations are downscaled using fine resolution information from land surface model, e.g. either soil moisture or simulated brightness temperatures

→ downscaled observations can then be assimilated



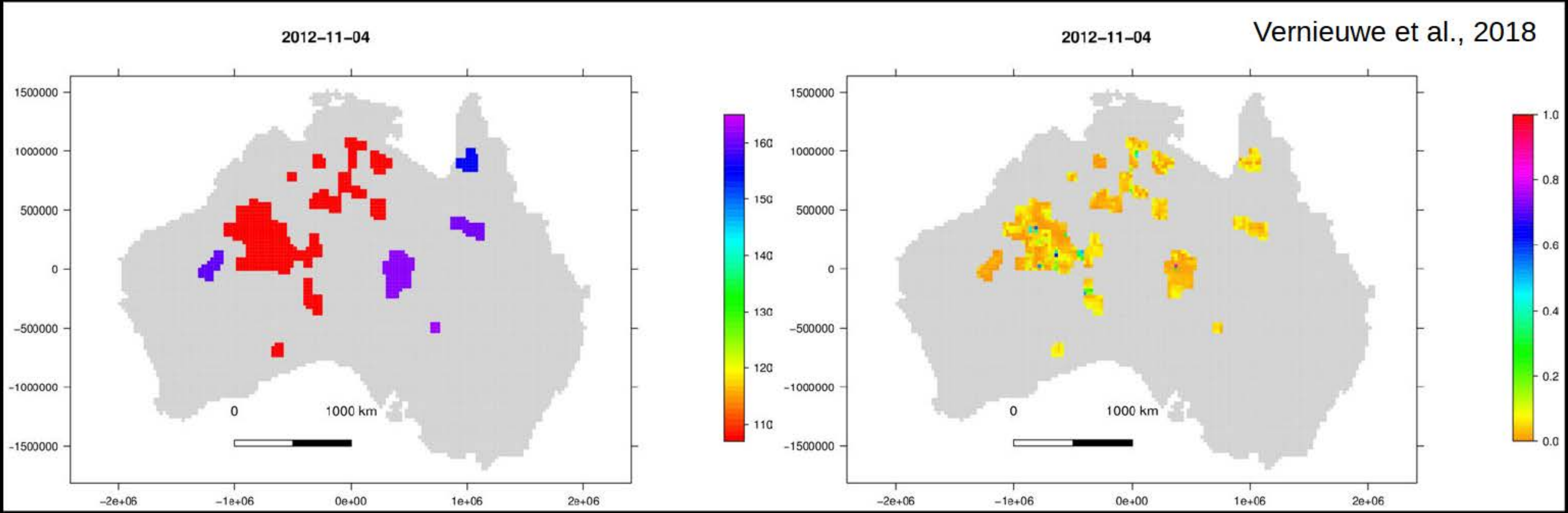


Montzka et al., 2018

Results

Drought clustering and classification with Copula approach

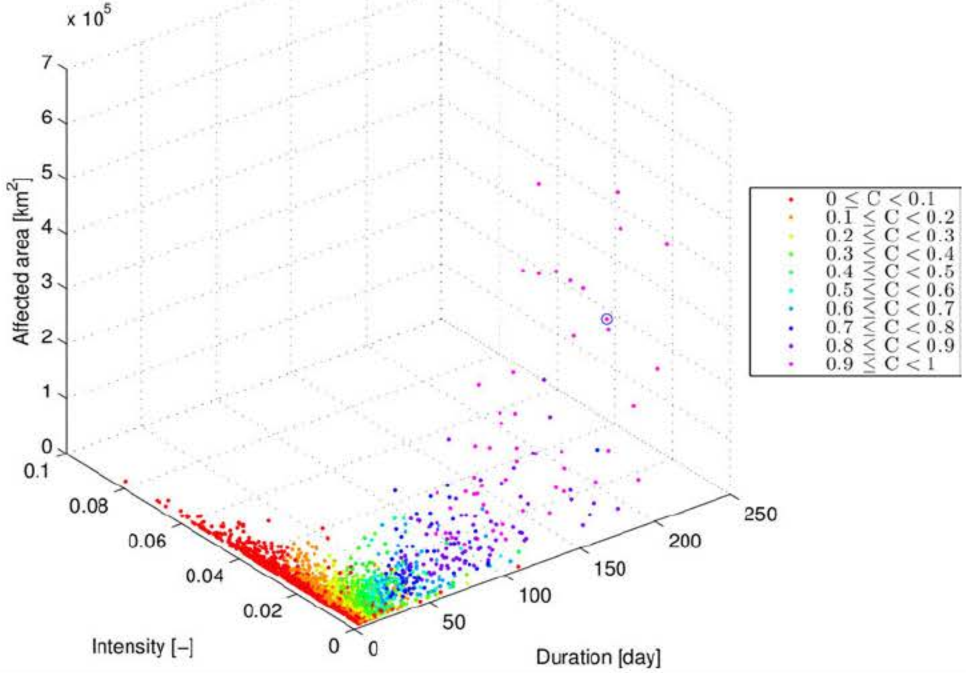
Droughts, such as defined at a specific quantile level, can be tracked over space and time.
→ Classification using intensity, duration and spatial extent.



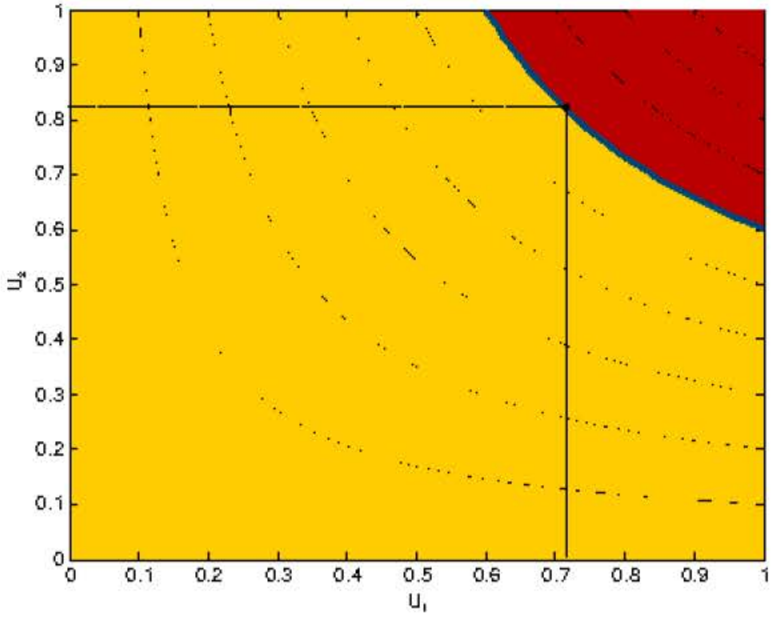
Results

Drought clustering and classification with Copula approach

Different applications possible, such as computing the likelihood of a super-critical event.



Vernieuwe et al., 2018



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Thank you.