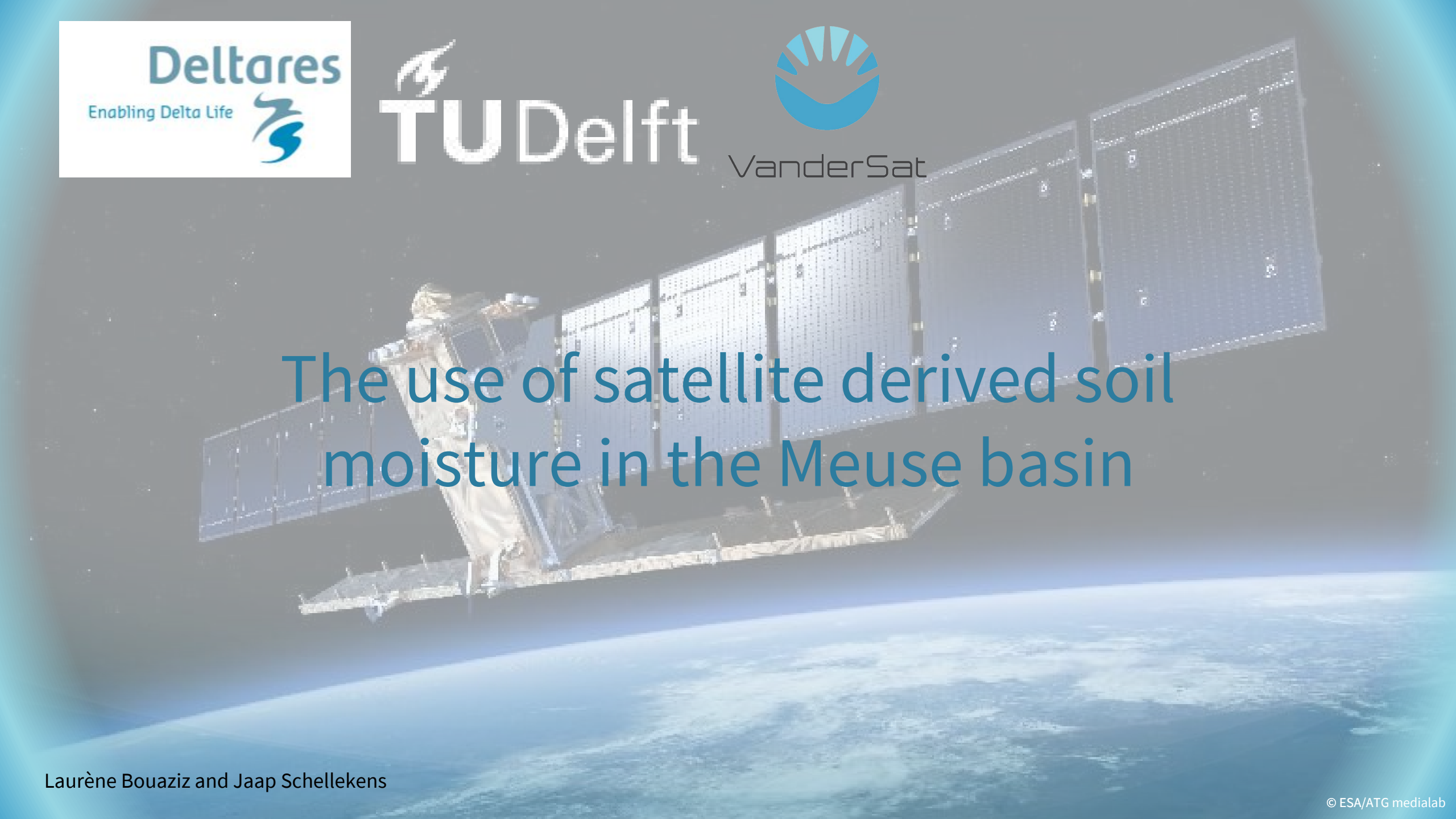


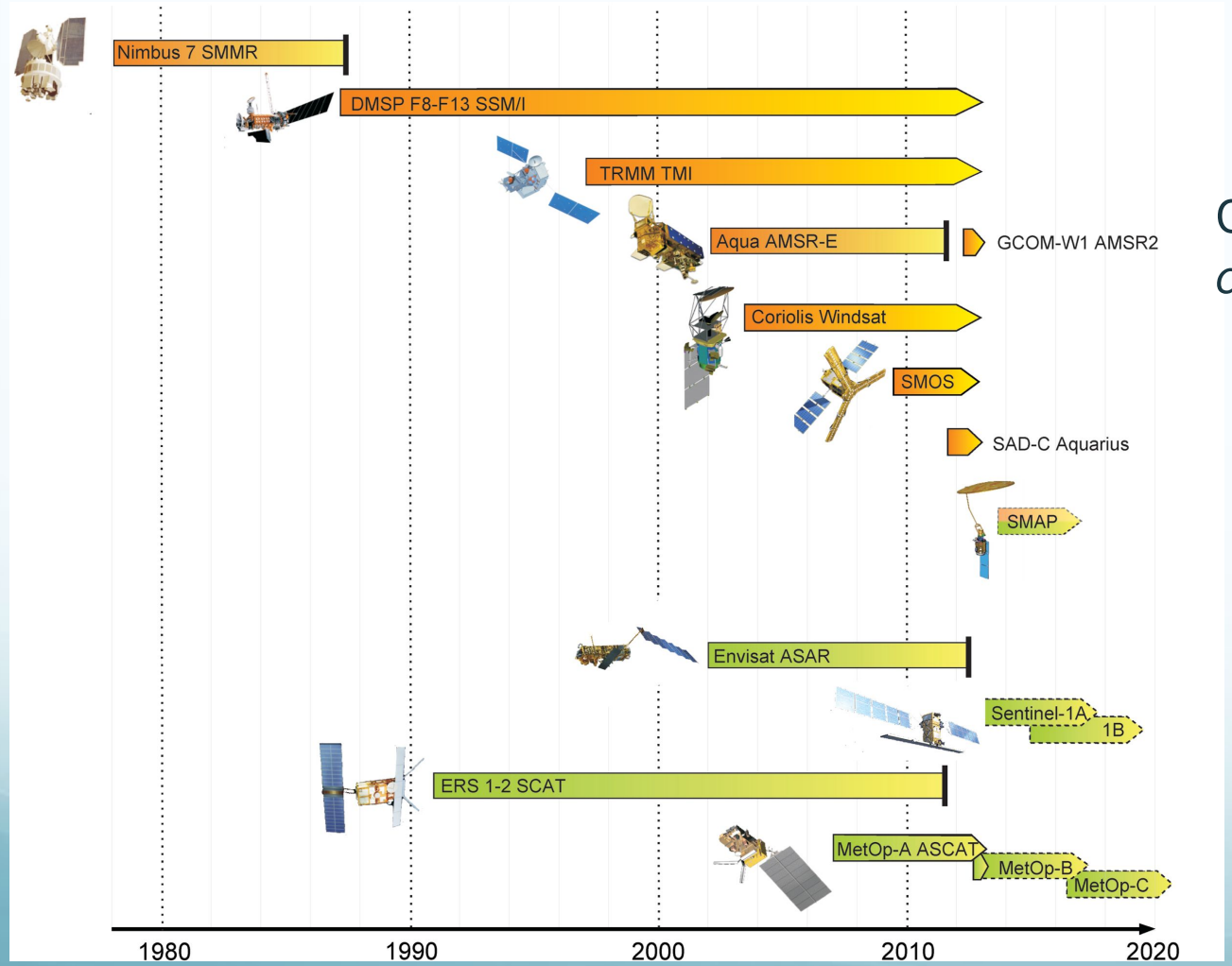
The use of satellite derived soil moisture in the Meuse basin

Laurène Bouaziz and Jaap Schellekens

Contents

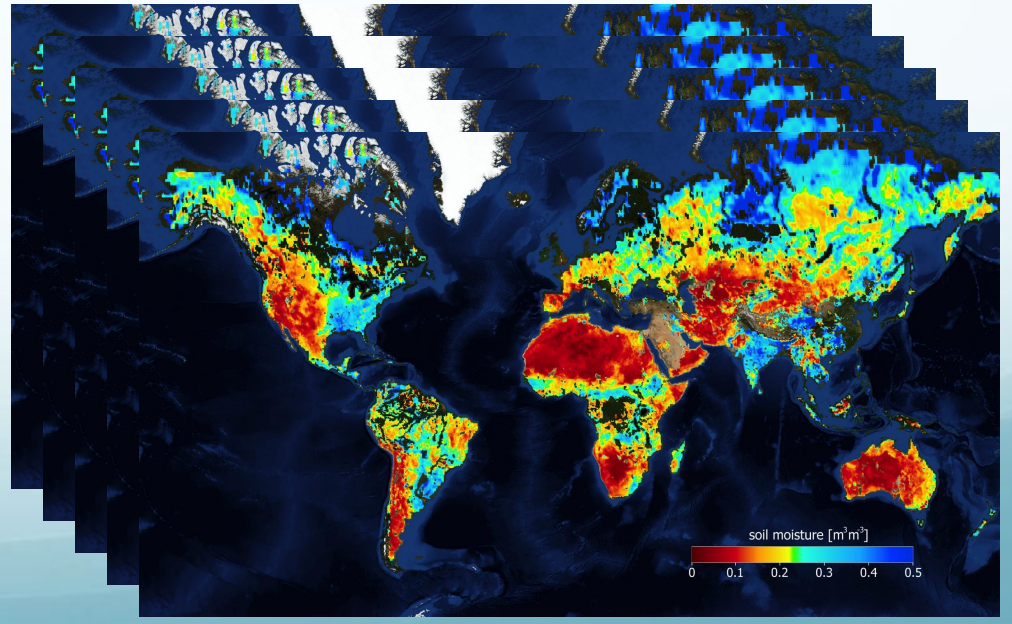
- Introduction into soil moisture
- Soil moisture for the Meuse
- Relation between soil moisture and discharge
- Future work

Background

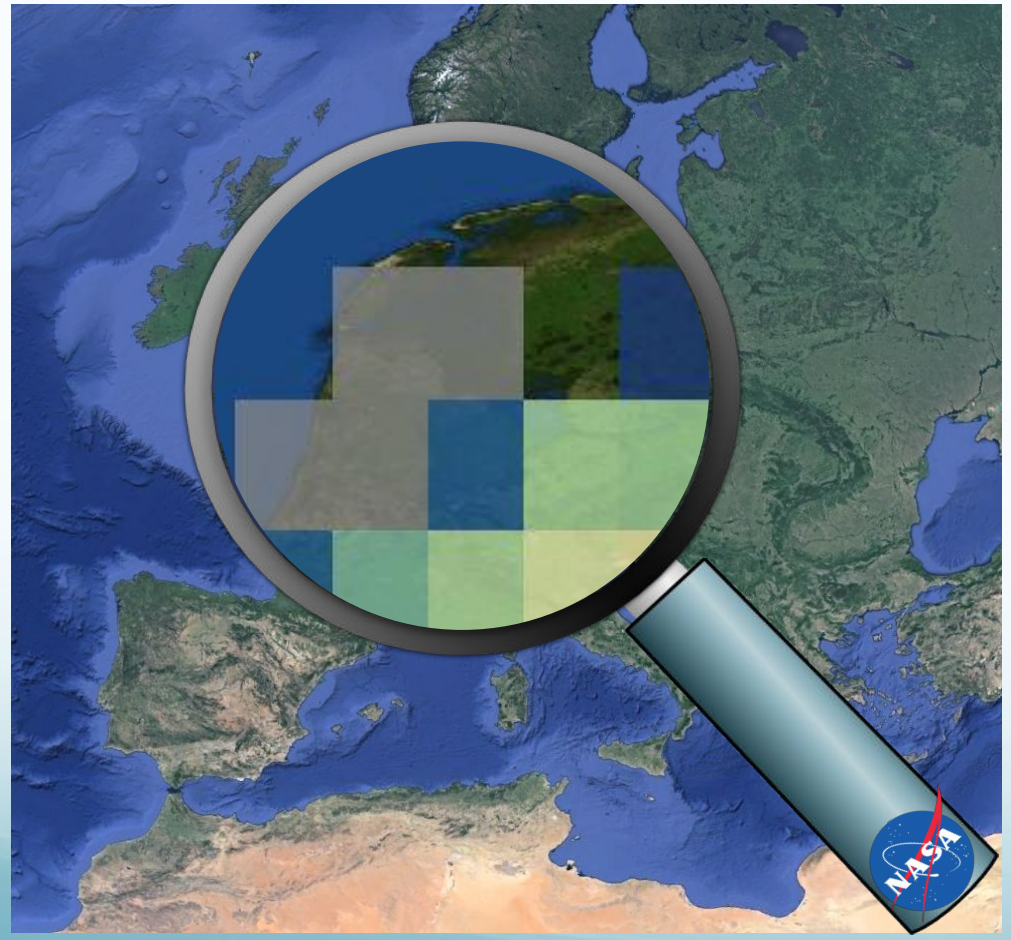


- 38+ year satellite soil moisture (~4000 users)
  - ESA CCI
  - Copernicus Climate Services (C3S)

One problem: with a resolution of 25 km it is often *too coarse* for (commercial) applications



Background: DiffSat



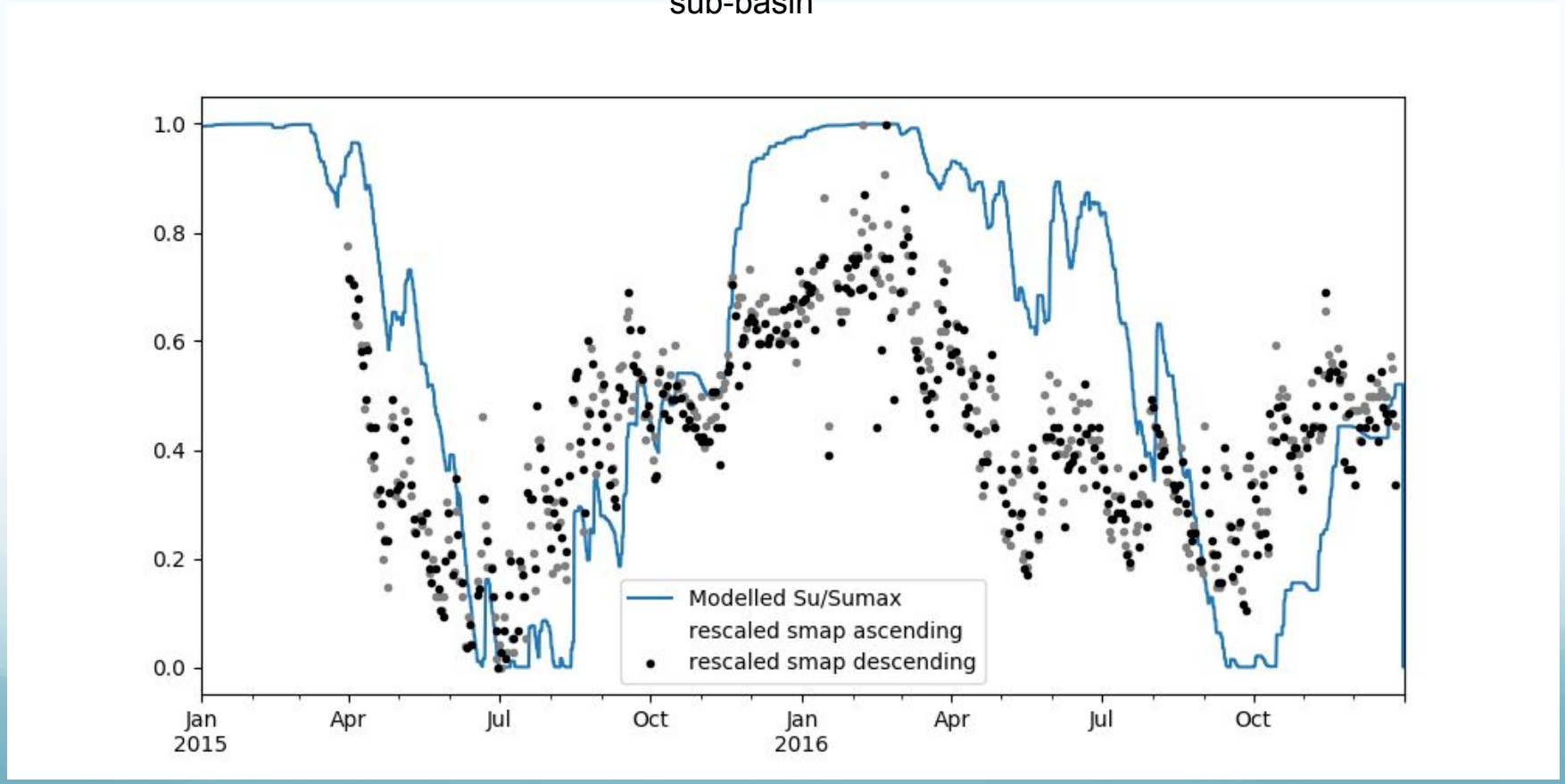
From informative……

to actionable!

Would it work for the Meuse?

- A first test with coarse scale data looks promising so we generated the high resolution data

Initial testing with coarse scale SM using SMAP in Meuse sub-basin



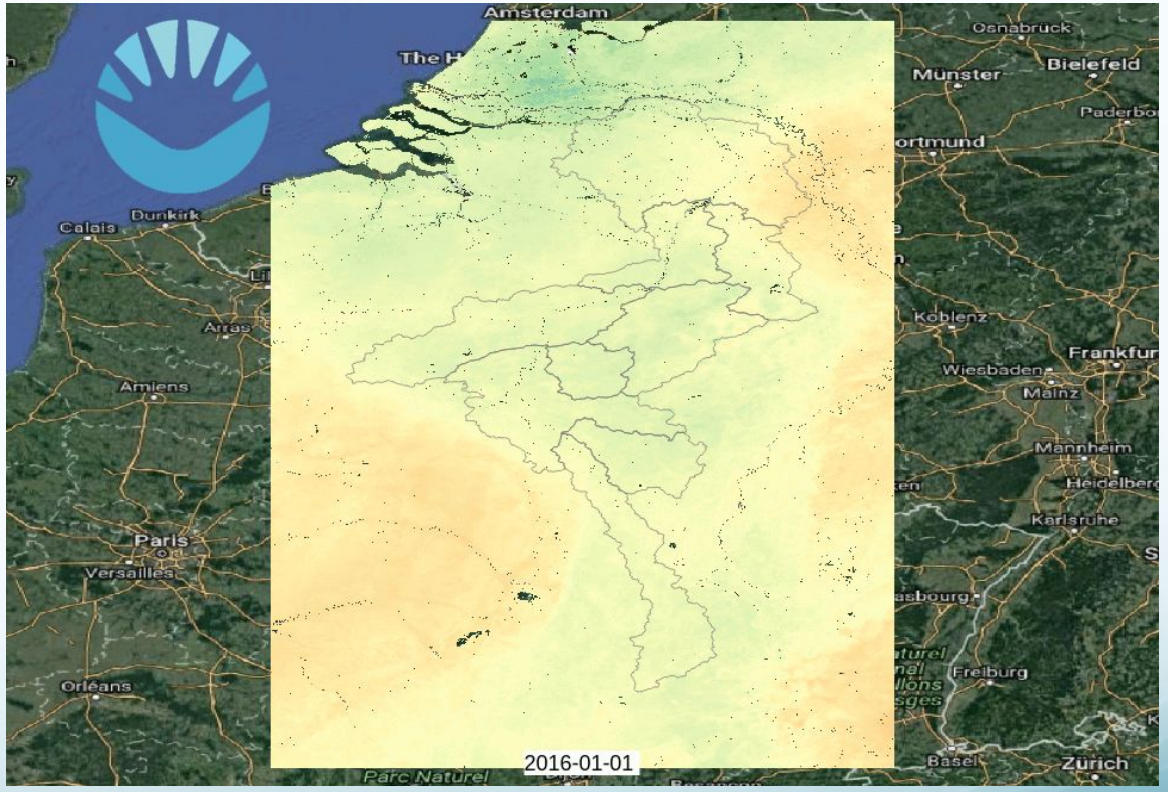
Available for the Meuse basin

- All parameters based on passive Microwave (no problems with clouds, many operational satellites available)
- 100 m Soil moisture (daily, global, 2002-now)
- 100 m Land surface Temperature (daily, global, 2002-now)
- 100m Vegetation Optical Depth (daily, global, 2002-now)

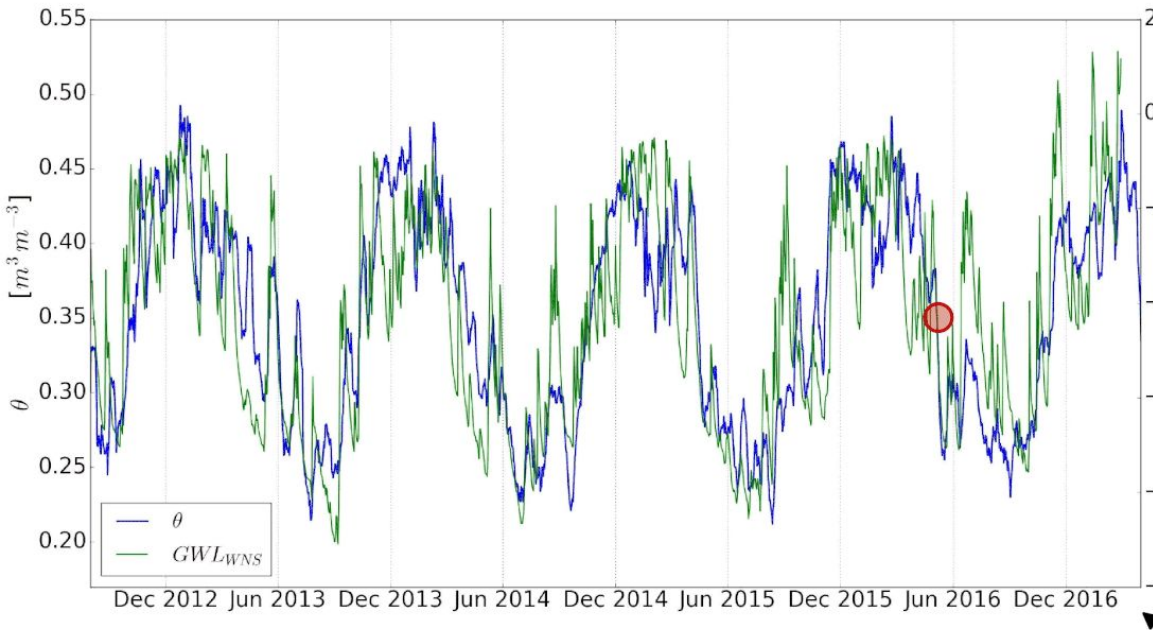
We used L-band (SMAP, ascending) only for now (2015 onwards). When including C-band we can go back to 2002 and have more images.

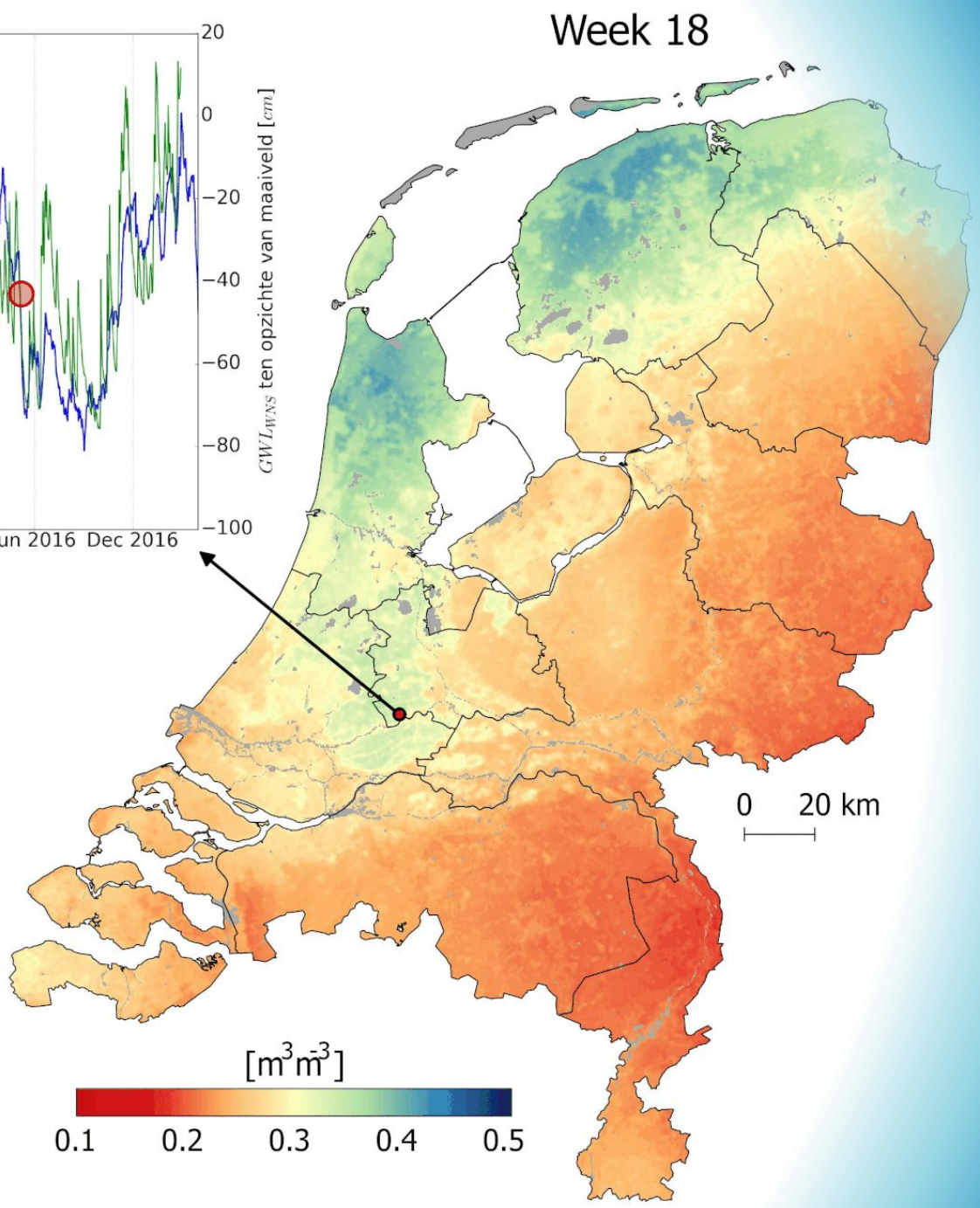
Sensitive to:

- Proper open water map (needs updating for the Meuse)
- RFI
- Frozen soil and Snow



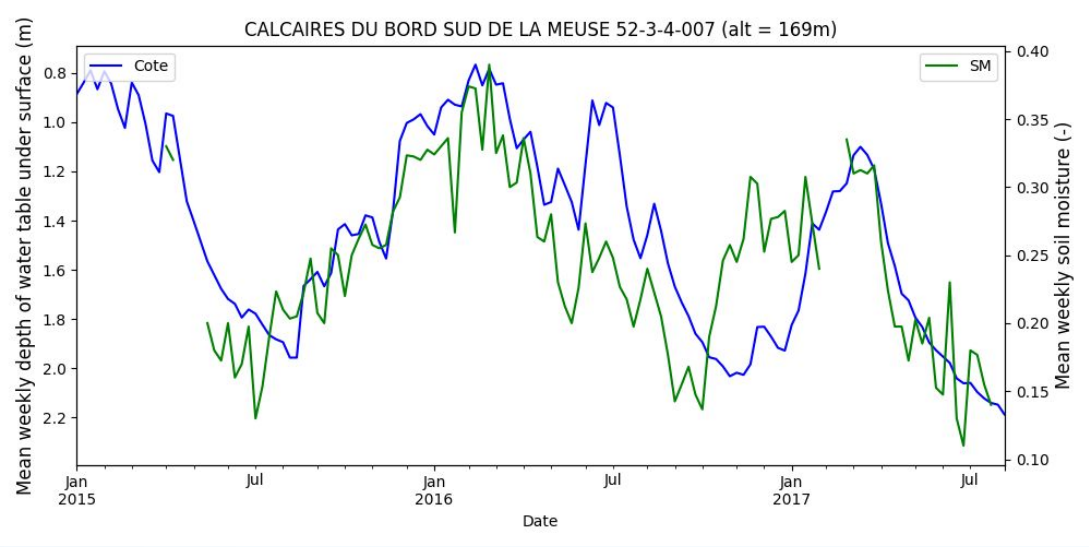
VanderSat

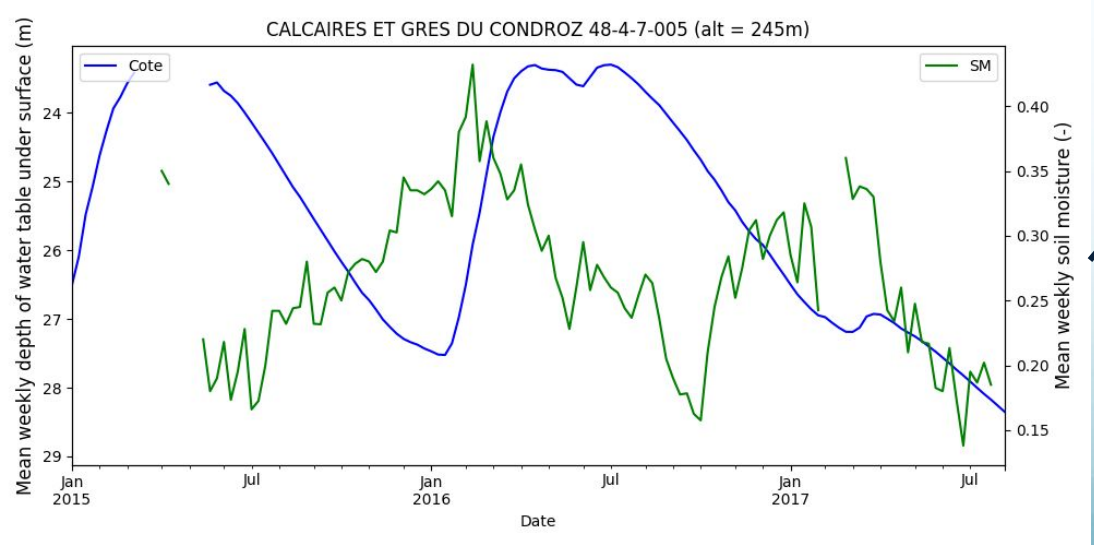


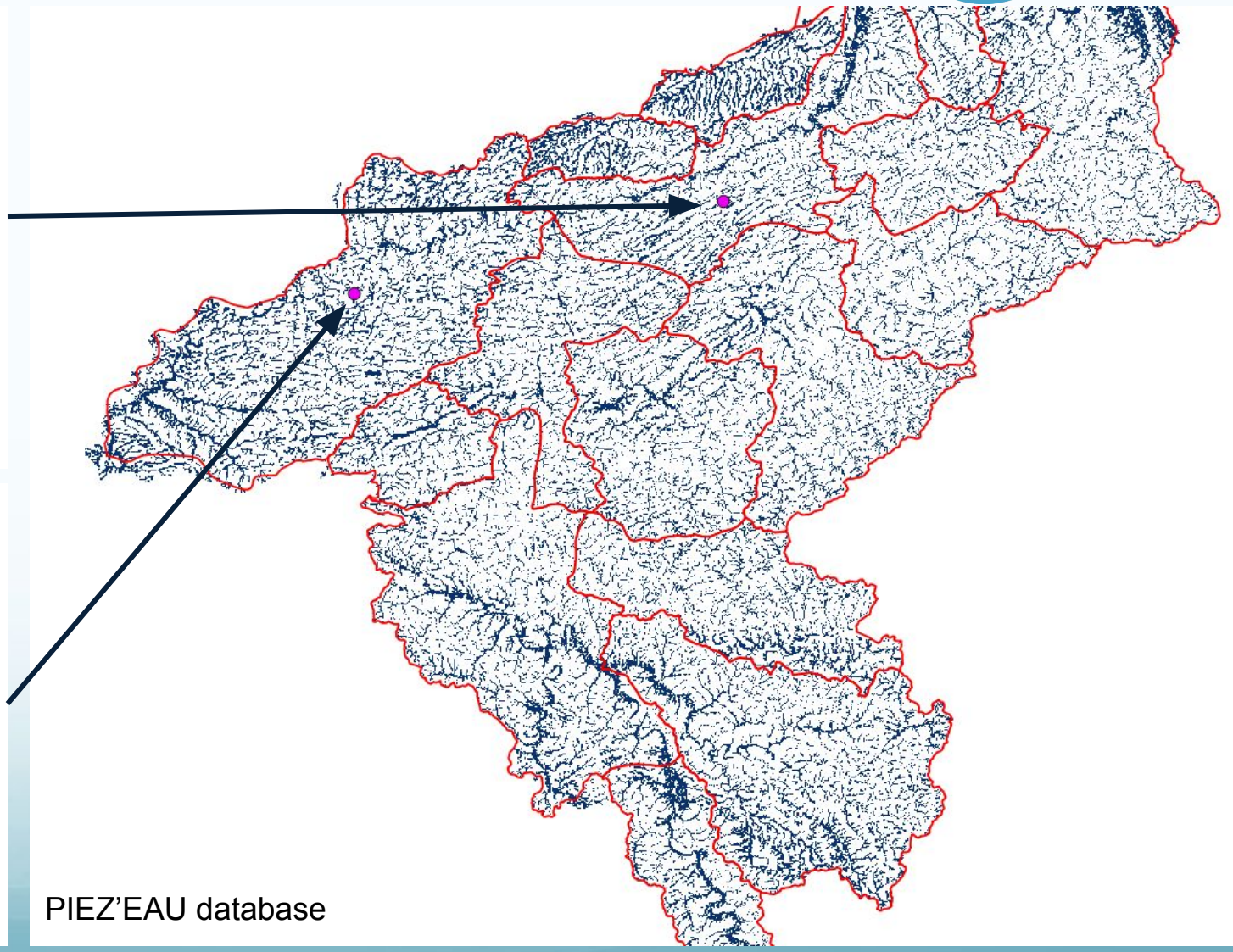


- Depending on the hydrological conditions Soil moisture can be representative for the top 5 cm only (which we measure directly) or have a strong link with groundwater for example

Groundwater and soil moisture in the Meuse

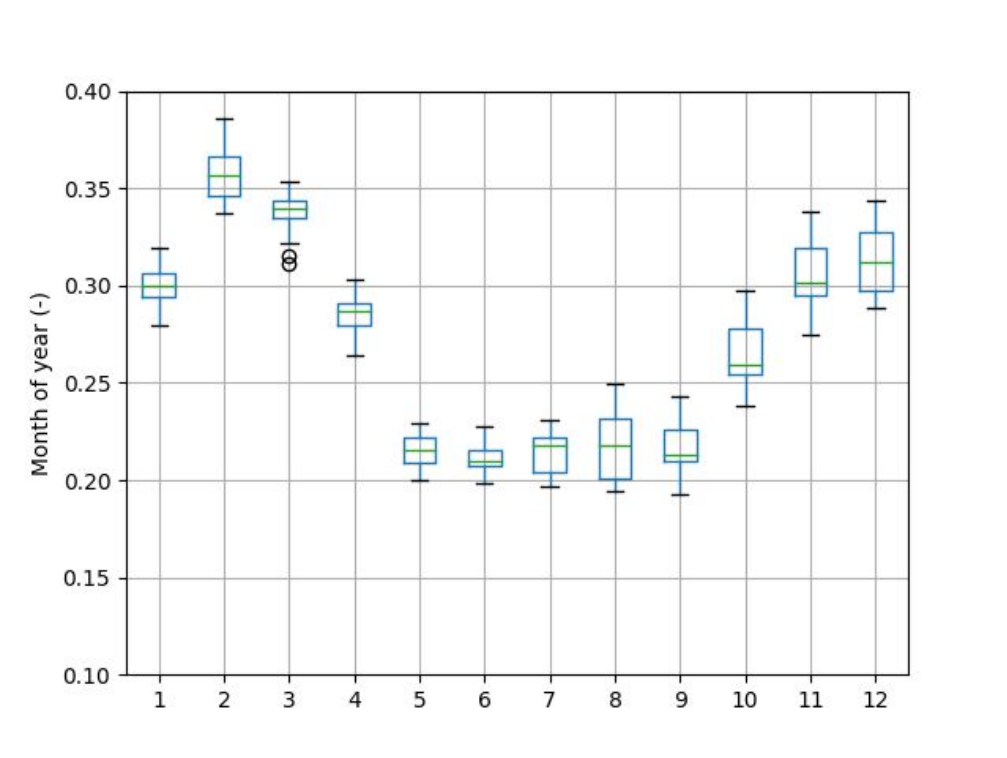


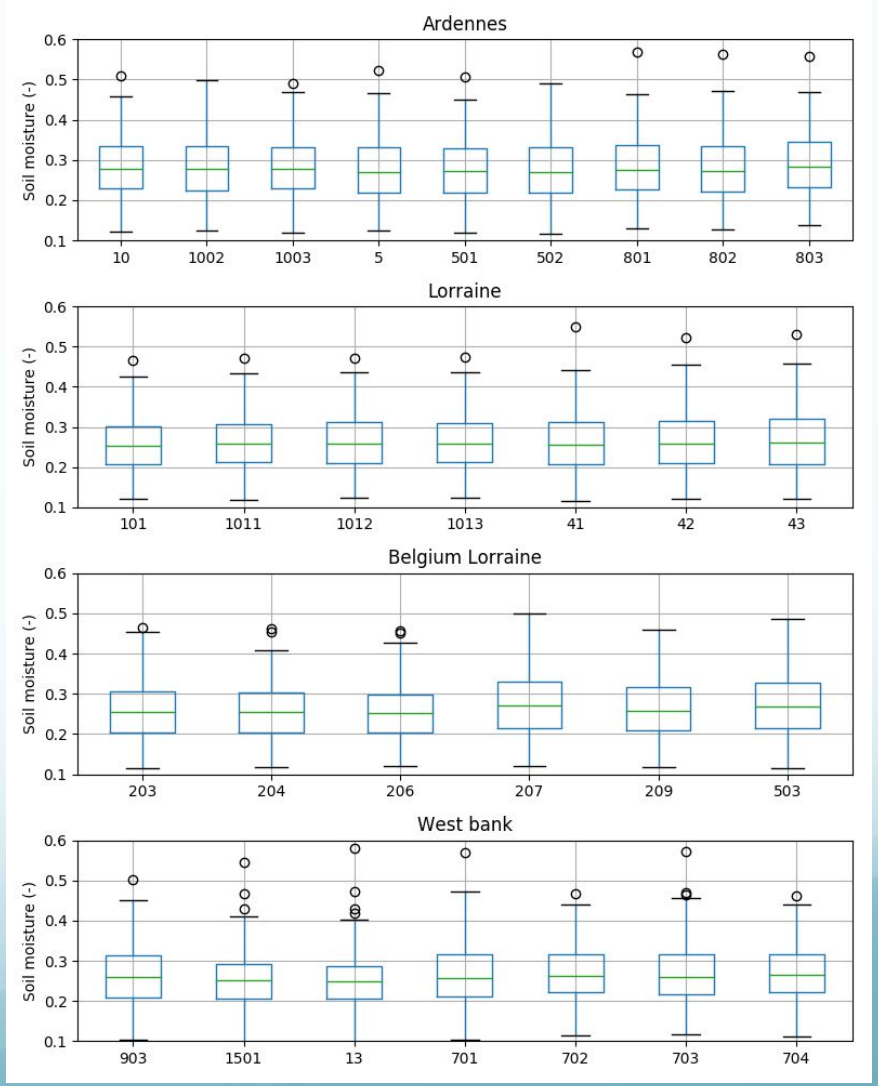




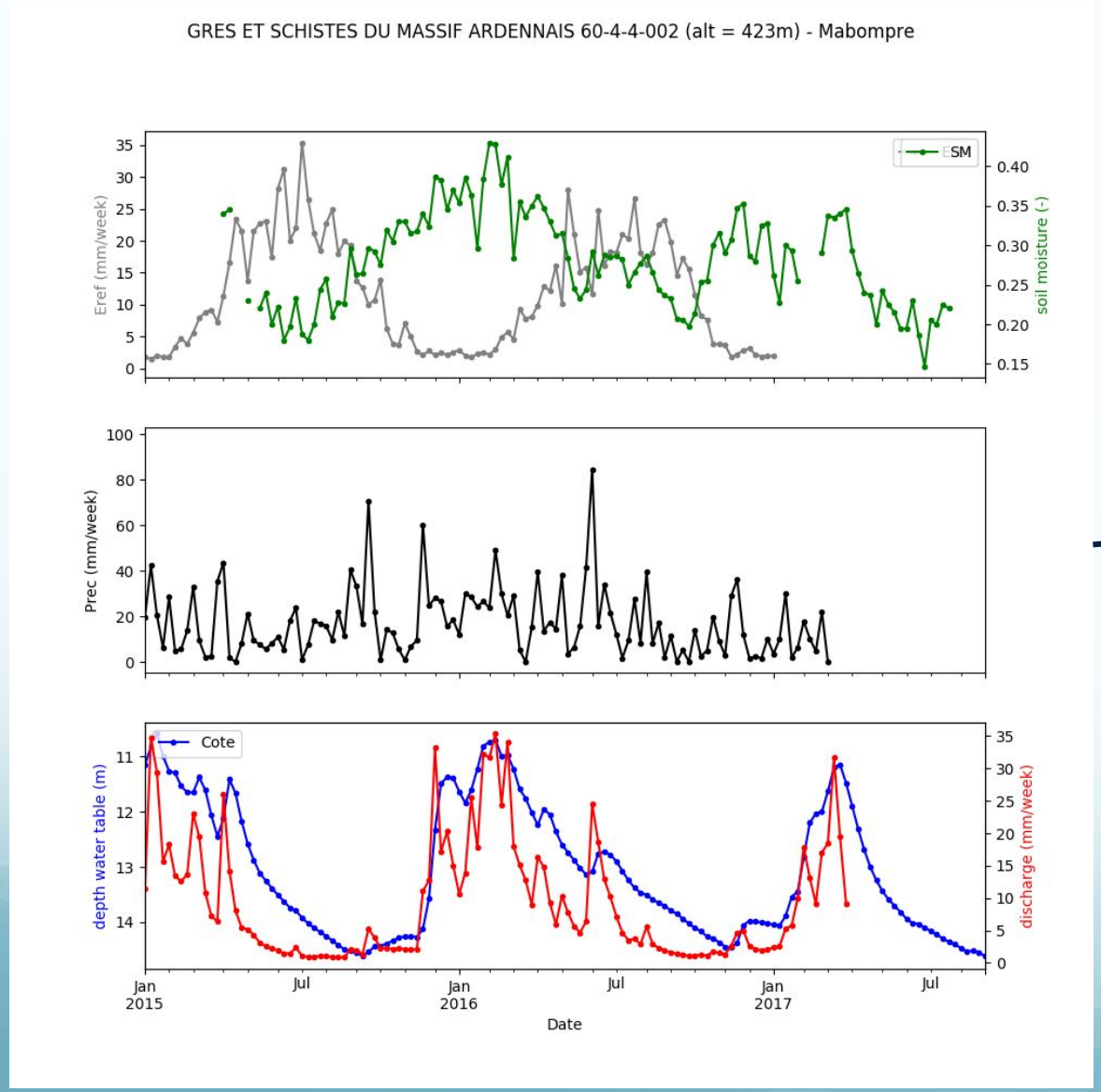
Spatial and temporal variability

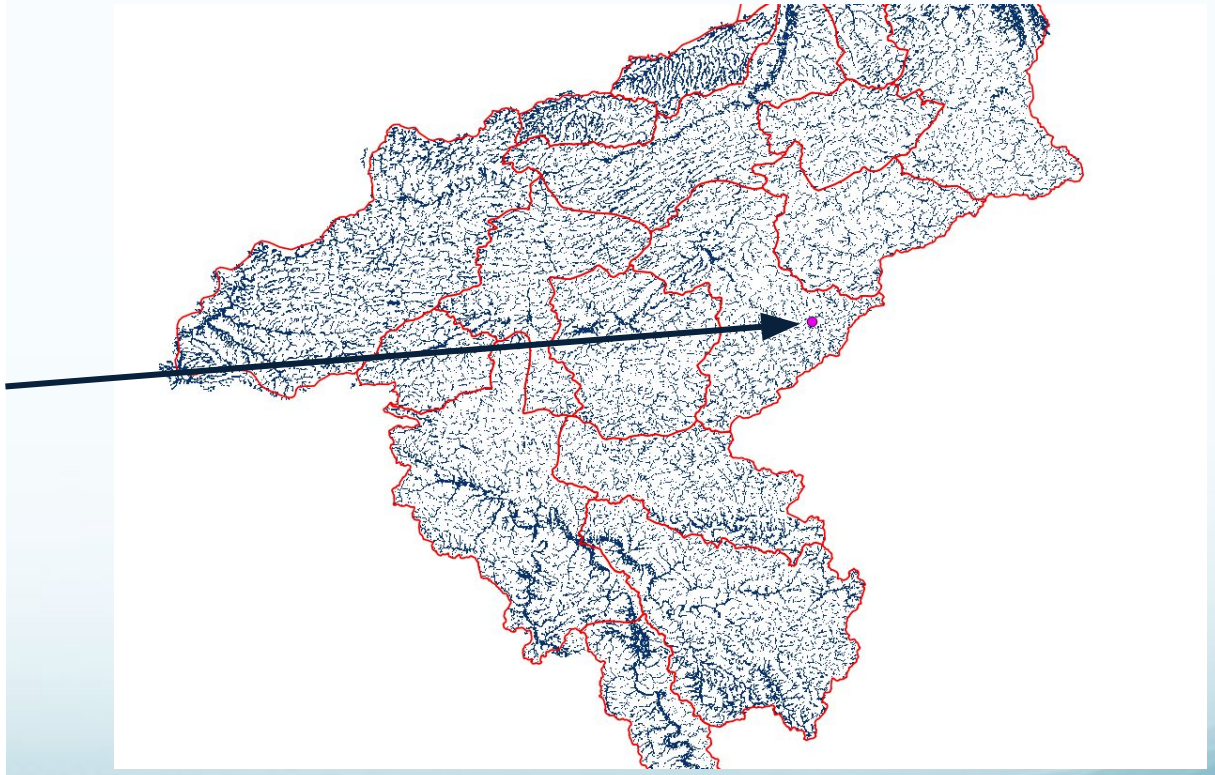
Temporal variability larger than spatial variability





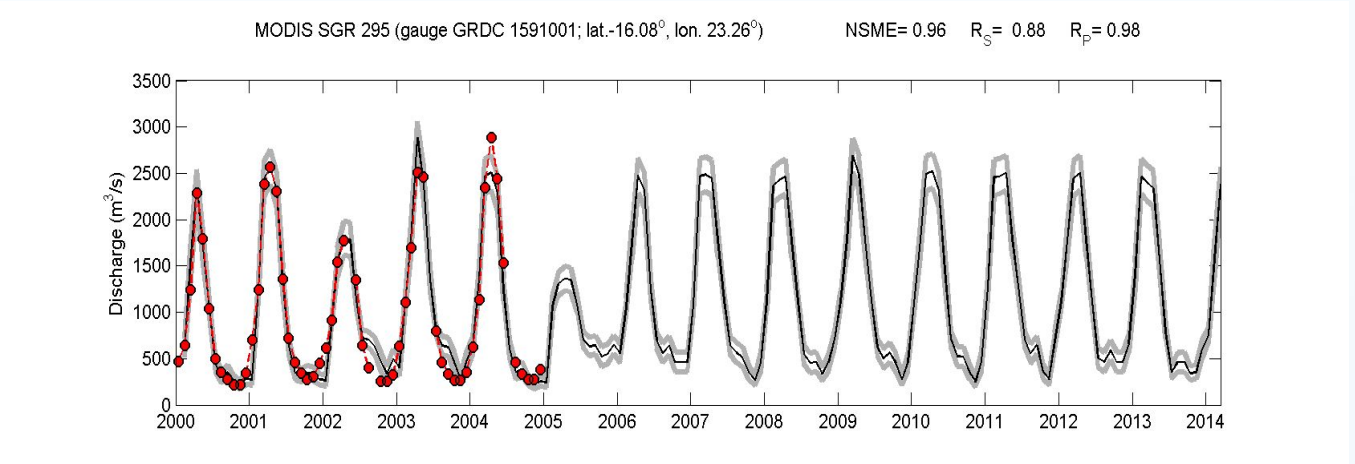
How does soil moisture relate with other variables?

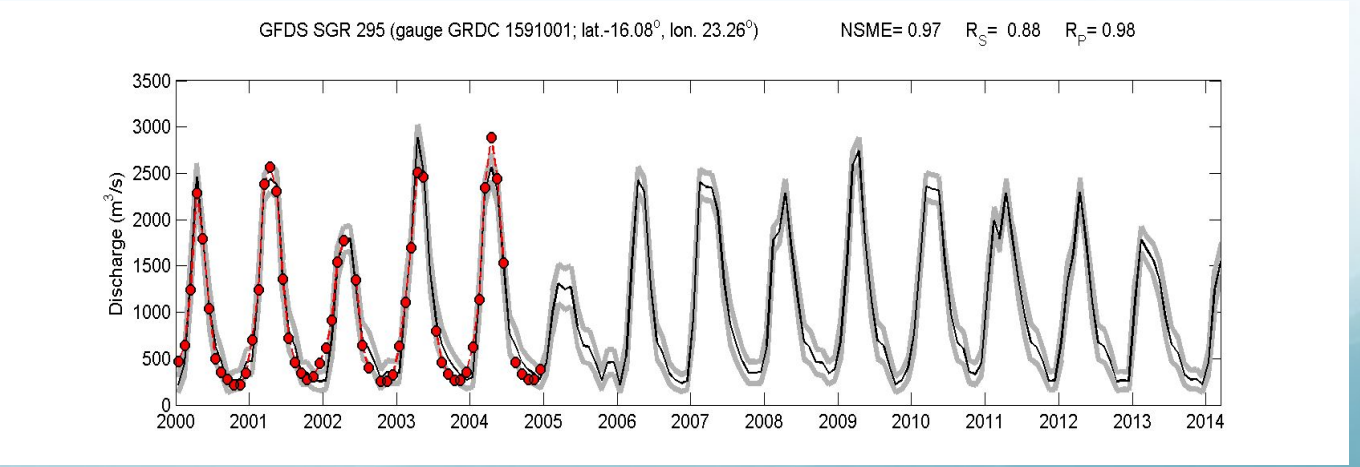


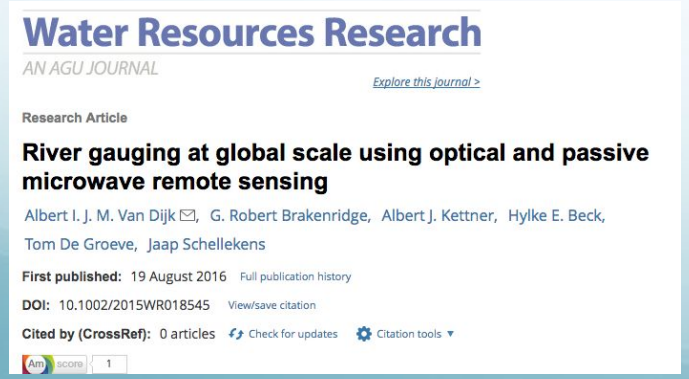


Previous work on estimate Q from space

- Van Dijk et. al. used Microwave and MODIS (5x5km)
- Worked good in natural rivers (monthly timesteps) but no good signal in rivers in western Europe







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River gauging at global scale using optical and passive microwave remote sensing

Albert I. J. M. Van Dijk, G. Robert Brakenridge, Albert J. Kettner, Hylke E. Beck, Tom De Groeve, Jaap Schellekens

First published: 19 August 2016 Full publication history

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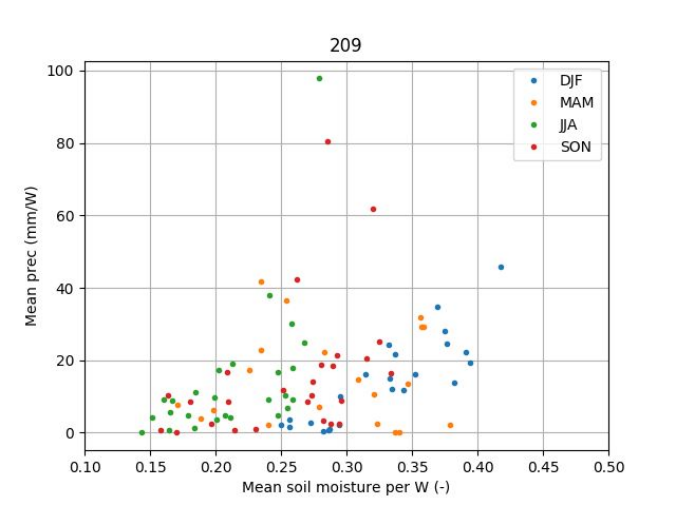
Creating soil moisture based rating curves for the Meuse catchments

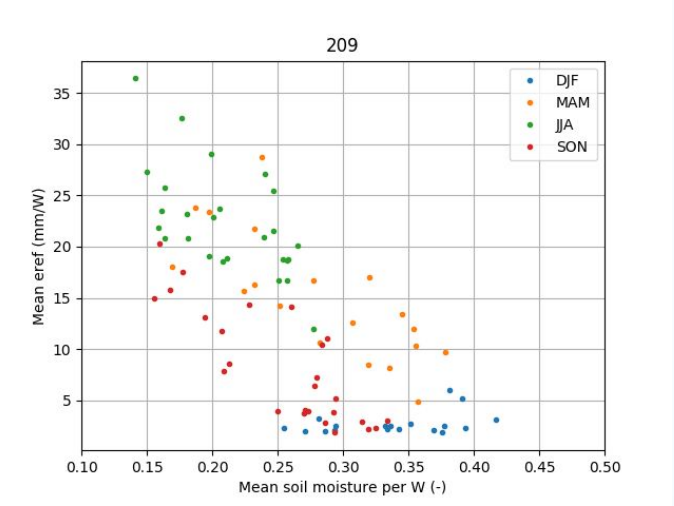
An example in the Loison River at Han les Juvigny

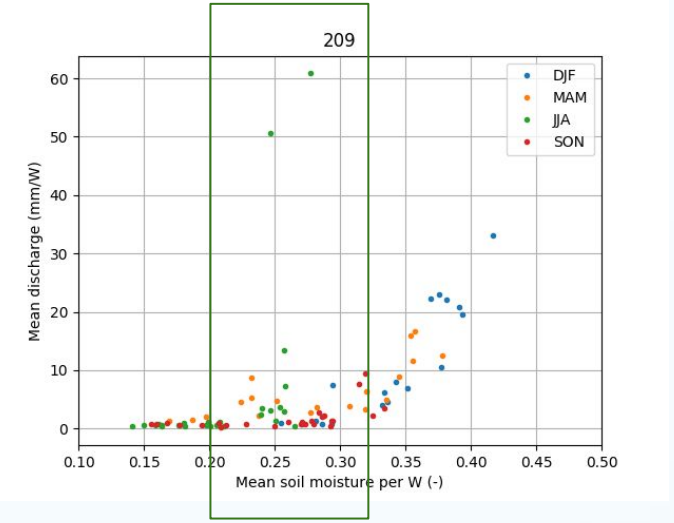
- tributary of the Chiers
- 348 km2
- 70% marl and 30% limestone (BDLISA)
- 40% forest, 35% pasture, 23% agri, 2% urban (CORINE)
- 28% wetland, 8% hillslope, 64% plateau (SRTM)

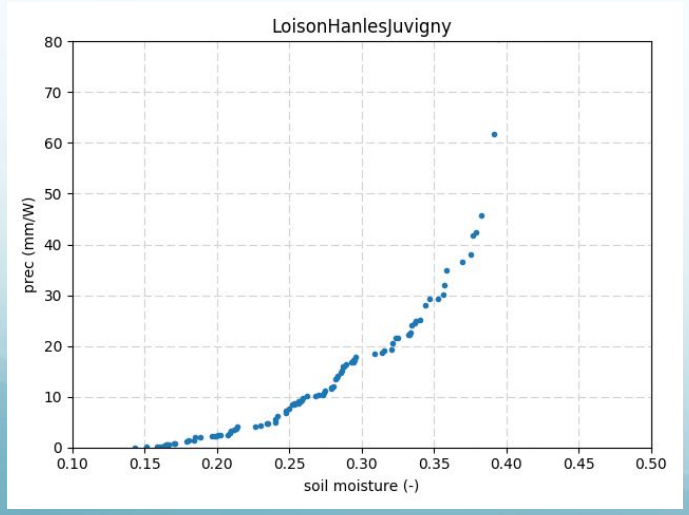
Creating soil moisture based rating curves

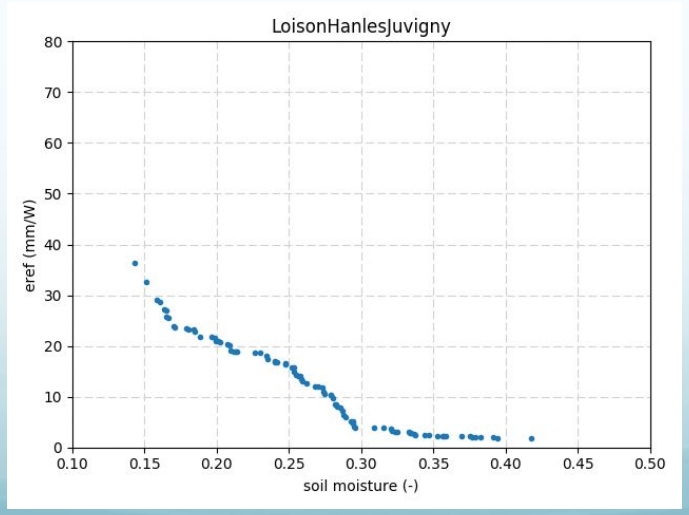
strong summer response while soil moisture is relatively low

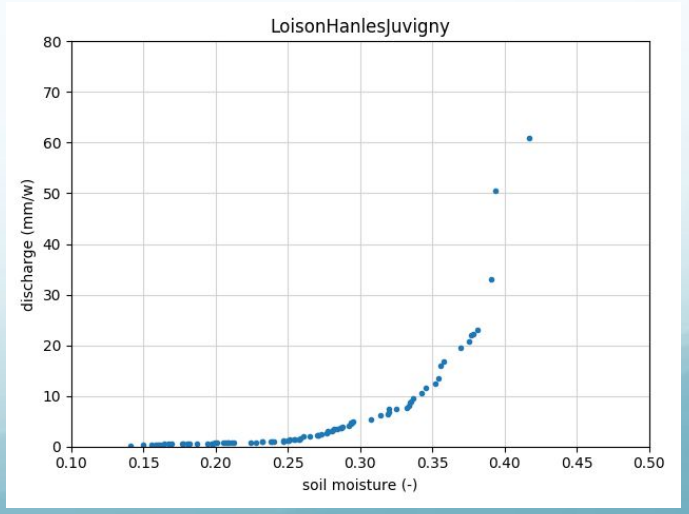






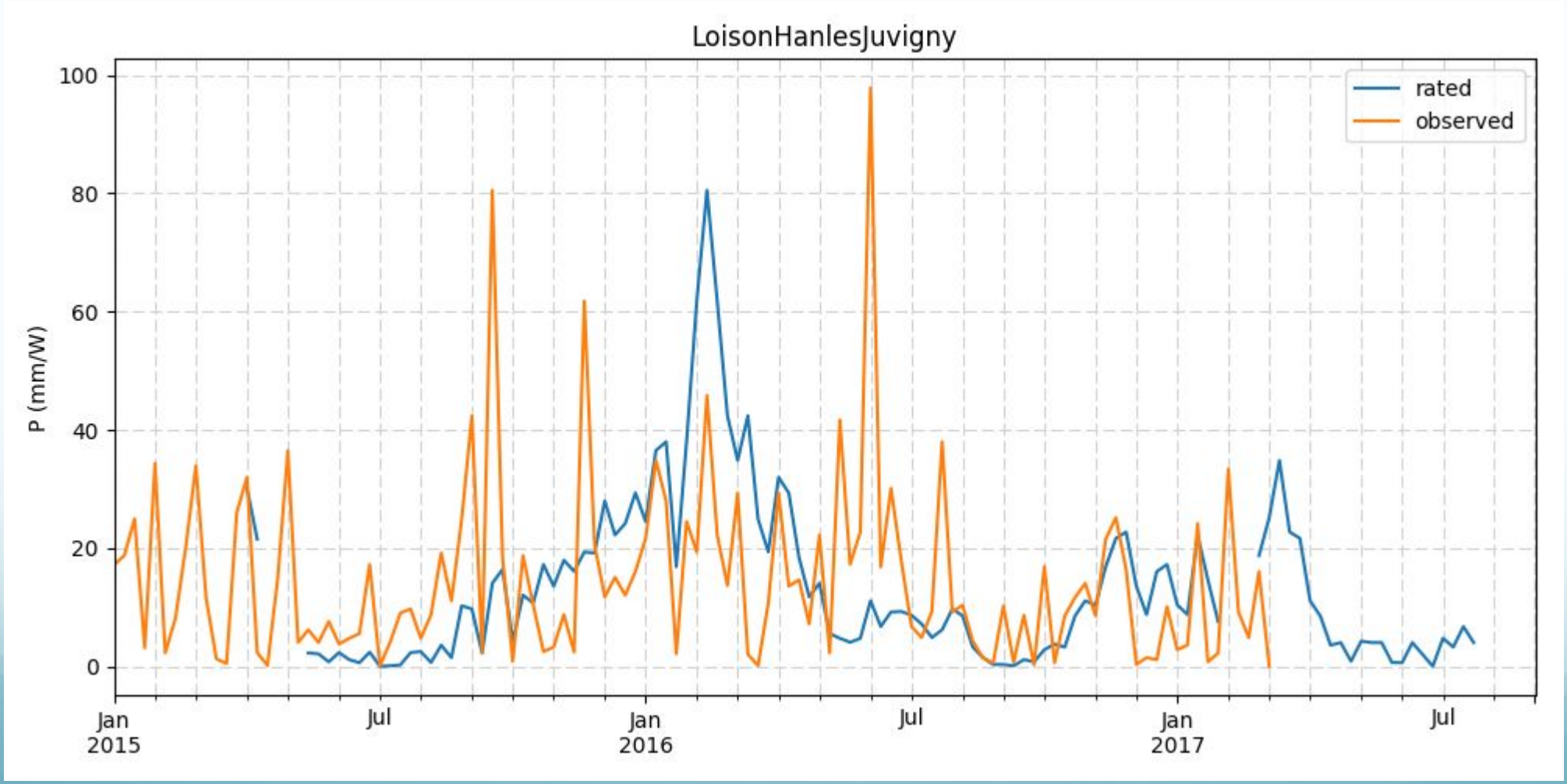




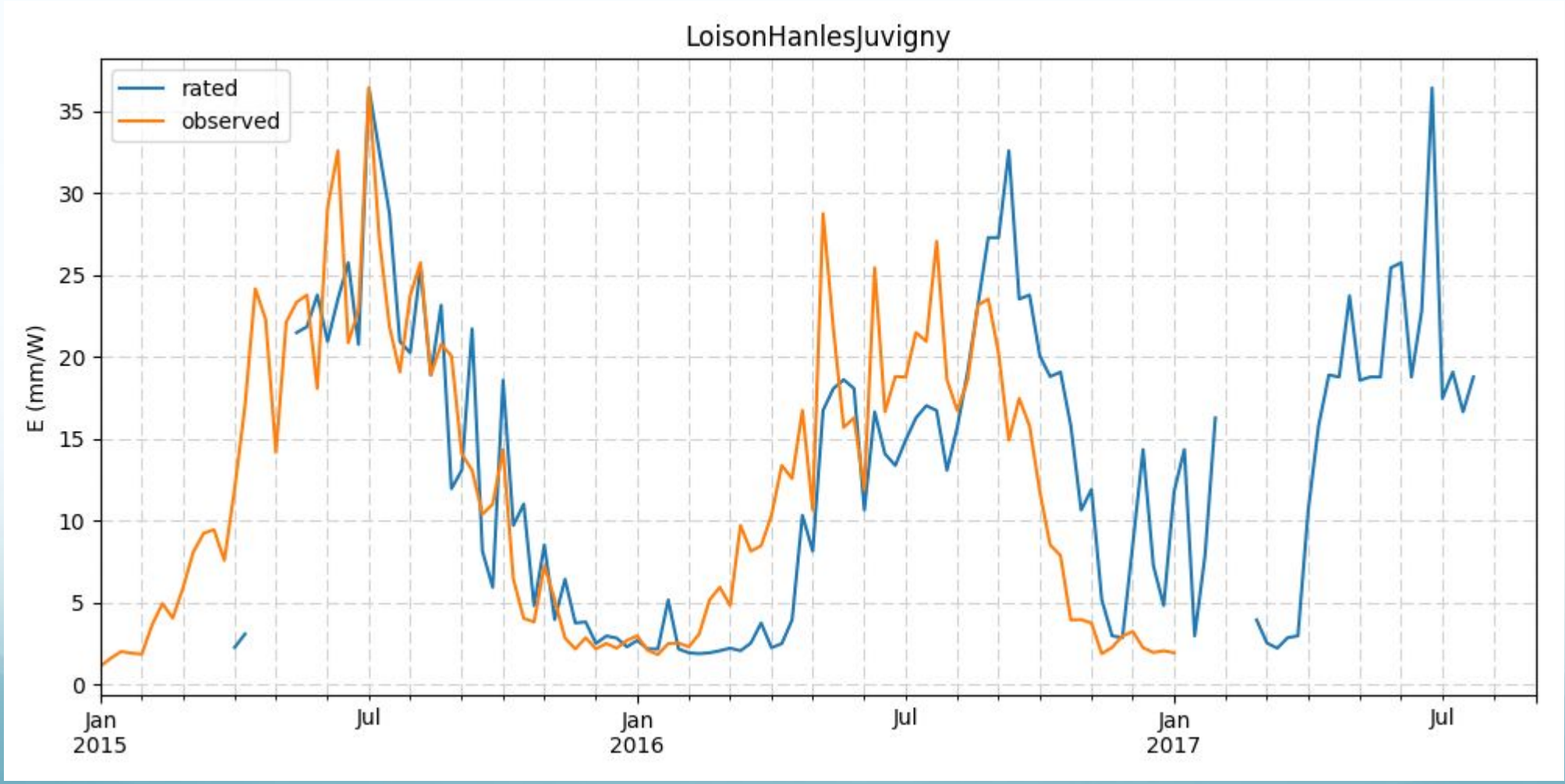


van Dijk et al. WRR 2016

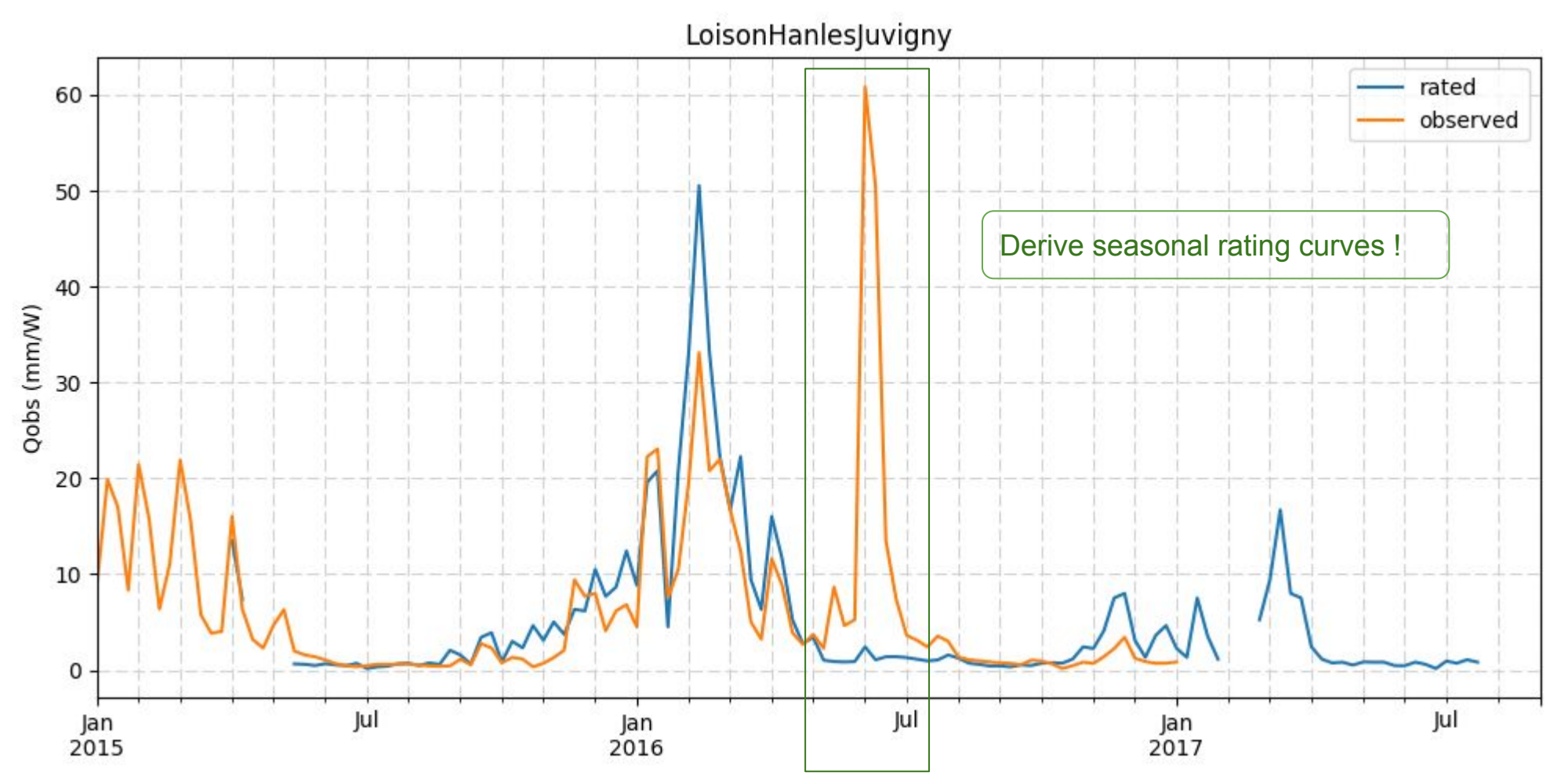
Can we infer the weekly precipitation?



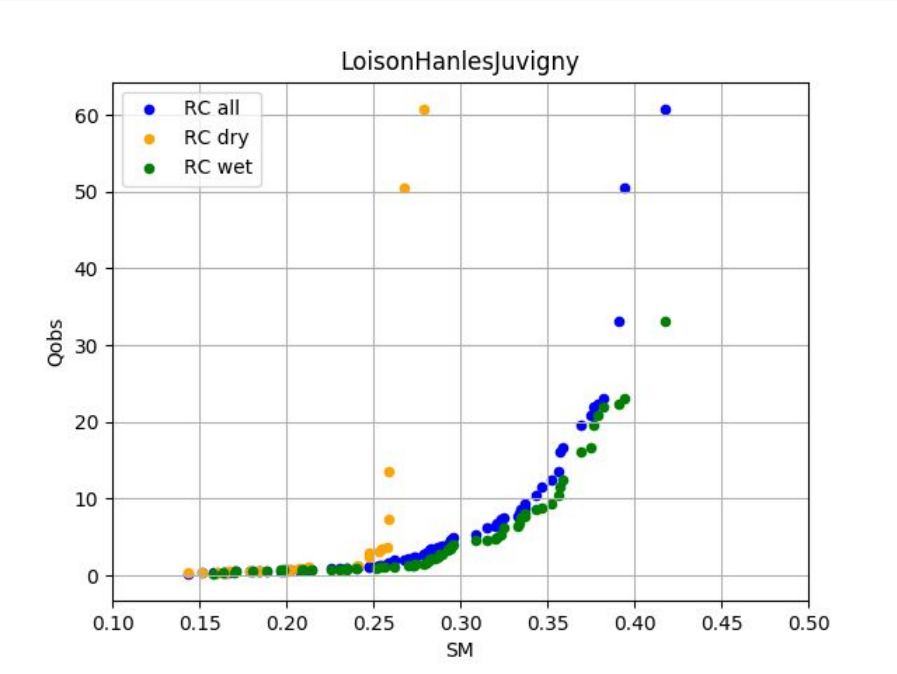
what about evaporation?

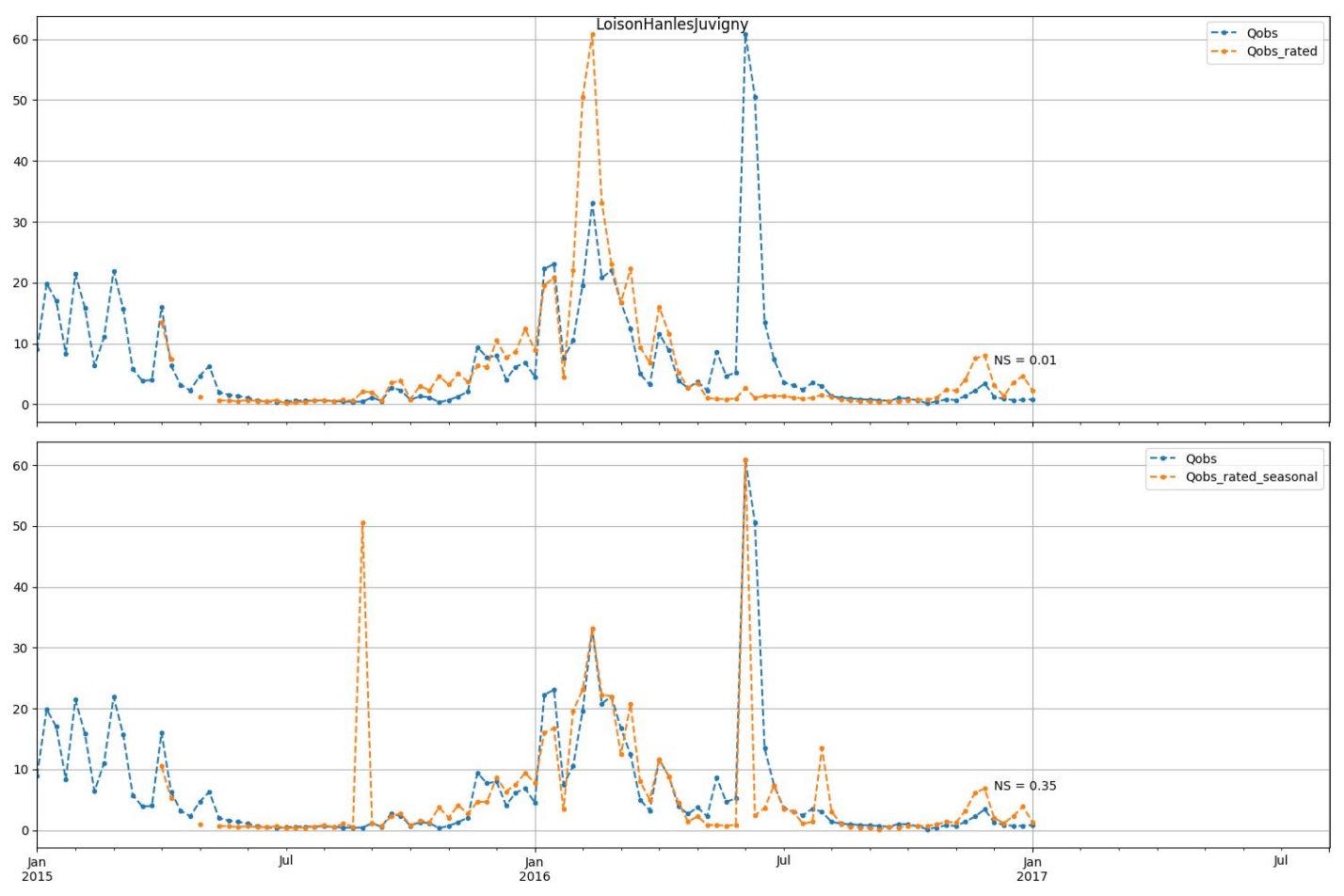


and discharge?



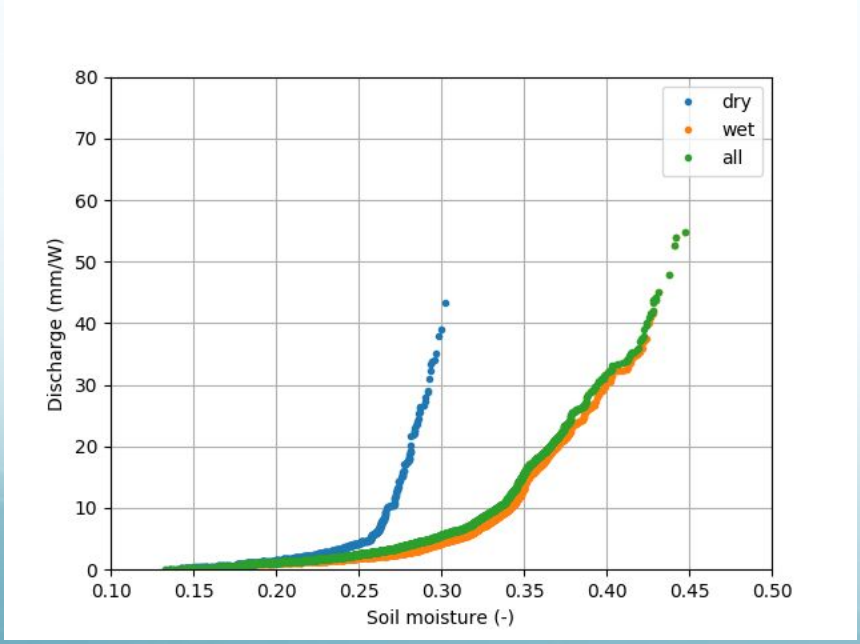
Wet and dry rating curves

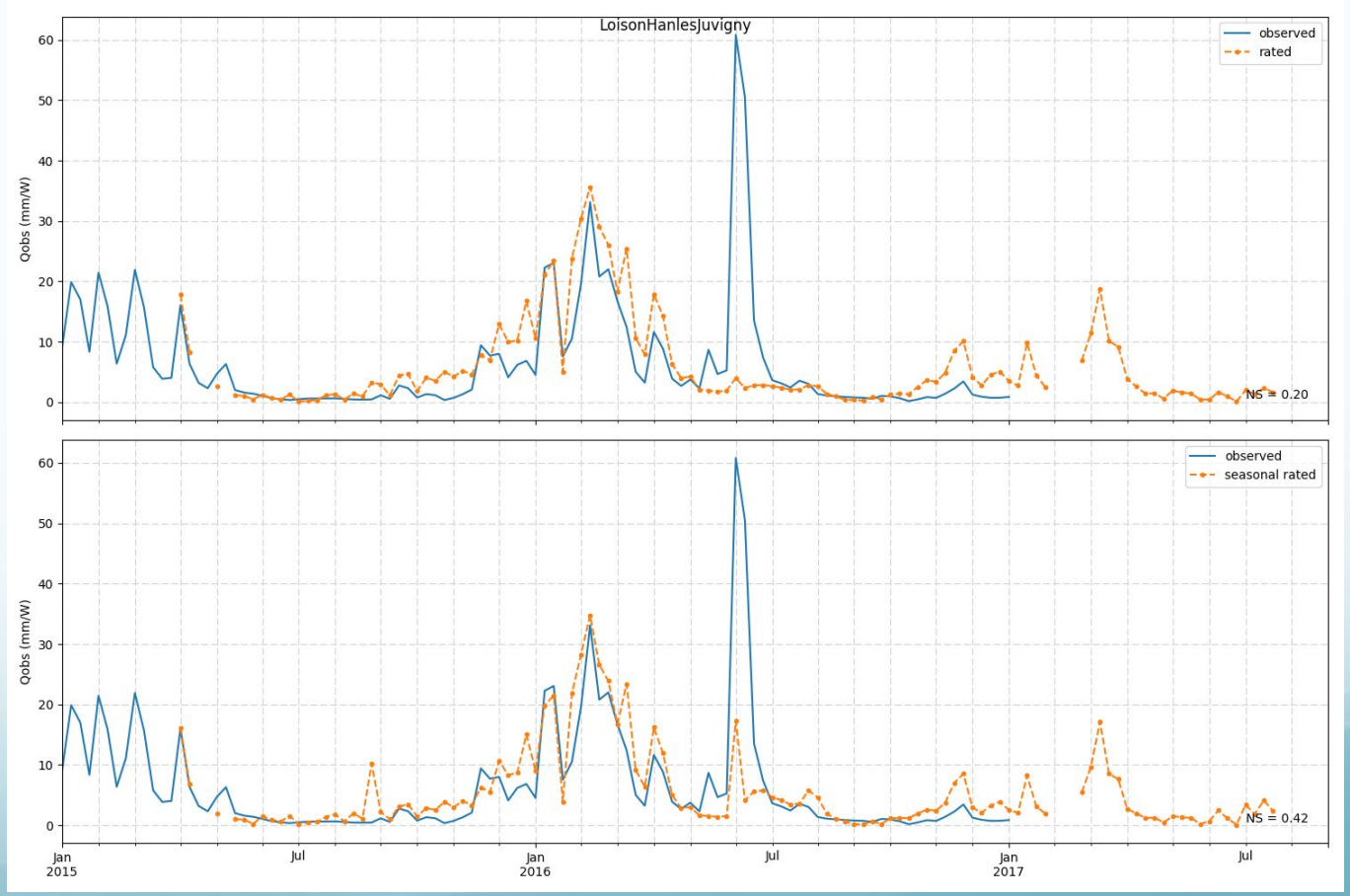




Spatial validation

- Master rating curve based on data of 25 catchments and applied on 25 other catchments





Conclusion

- Strong relation between weekly discharge and weekly soil moisture
- Temporal variability in soil moisture is strongly controlled by the seasonal cycle of reference evaporation
- Different processes occur in summer and in winter (also related to more intense precipitation events)
- The strong relation of soil moisture to discharges suggests that data assimilation could improve discharge prediction in models

Future work

- Understand how the performance is affected by different physical catchment characteristics
- Assess the daily relation between soil moisture and discharge
- Include C- Band (back to 2002) data to have more data points and perform a validation in time
- Assess the value of additional information for model structure development
  - is the relation between Q-SM also present in our models?
  - how should we integrate the summer response in our models?
  - how is the connection between soil moisture and groundwater?
- Assess the value of the soil moisture product during data assimilation to improve predictions