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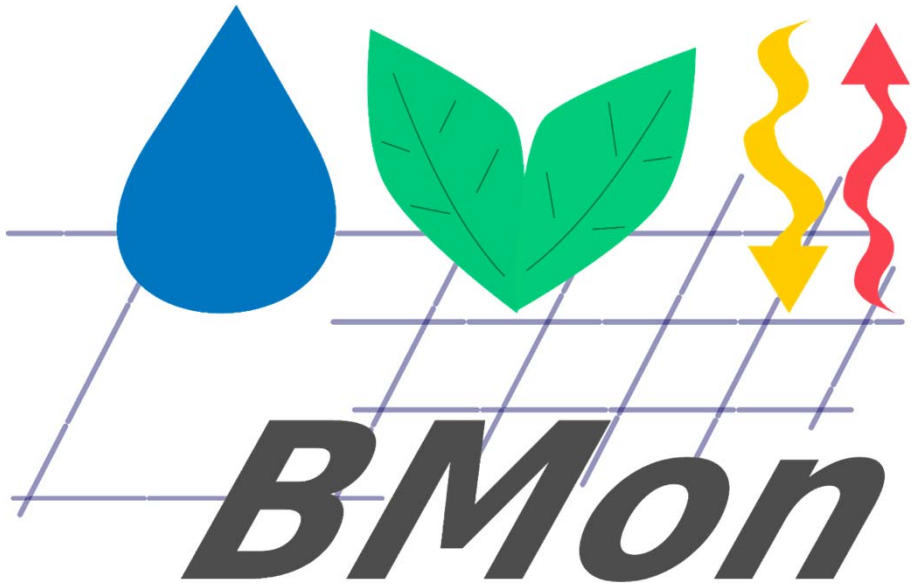
BUNDESMINISTERIUM
FÜR NACHHALTIGKEIT
UND TOURISMUS

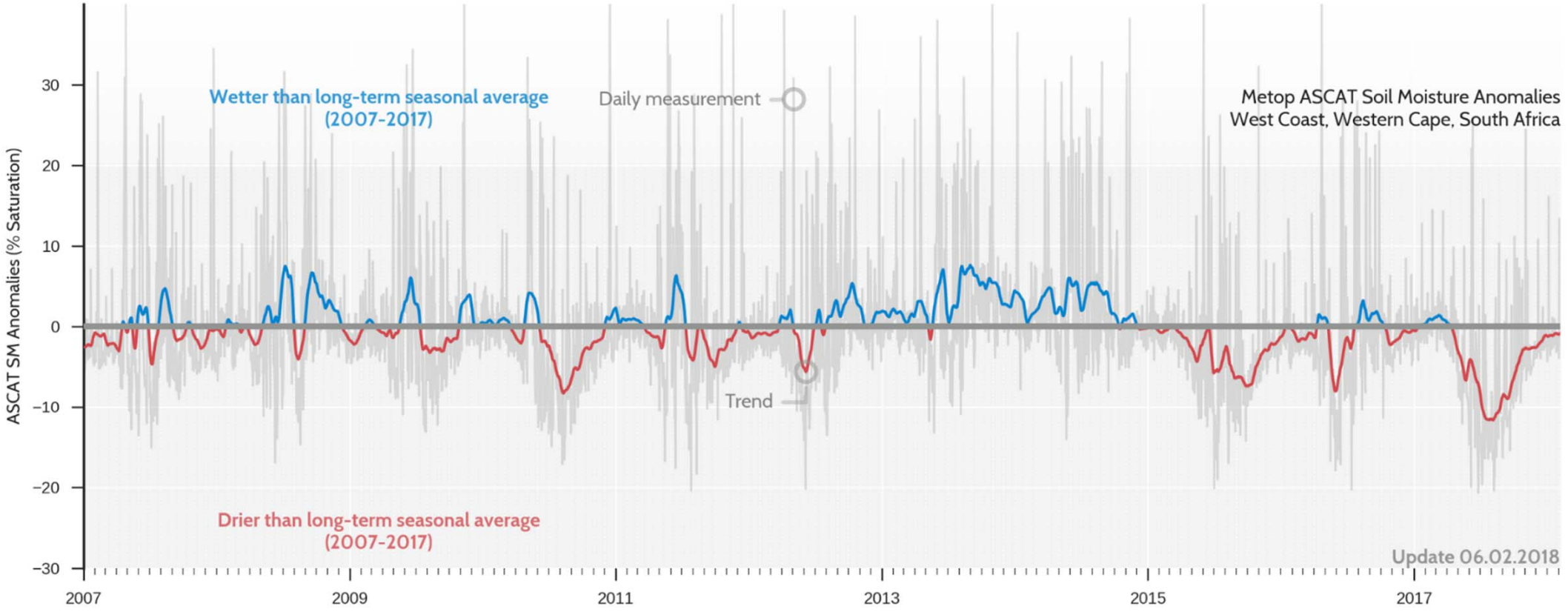


A CLOUD-BASED SYSTEM FOR HIGH RESOLUTION SOIL MOISTURE MONITORING OVER AUSTRIA

Mariette Vreugdenhil, Wolfgang Wagner, Franz Schmid, Ingo Schnetzer, Günter Blöschl, Juraj Parajka, Jürgen Komma, Christian Briese, Richard Kidd, Stefan Schneider, Klaus Haslinger, Josef Eitzinger, Gerhard Kubu, Lukas Künzer, Lucas Scheiber, Friedrich Teichmann, Ammar Wahbi

IMPORTANCE OF SOIL MOISTURE MONITORING

- Forecasting river **runoff** and ground water replenishment
- Improving **weather forecasts**
- Preparedness for **extreme events**
- Anticipate **droughts** and **water demands**
- Plan **irrigation** and field management practices to optimize yields



Time series of soil moisture anomalies over South Africa

IMPORTANCE OF SOIL MOISTURE MONITORING

- plan **irrigation** and field management practices to optimize yields
- forecasting river **runoff** and ground water replenishment
- improving **weather forecasts**
- preparedness for **extreme events**
- anticipate **droughts** and **water demands**

Develop a **cloud-based system for near-real-time monitoring of soil moisture** conditions over Austria at high spatio-temporal sampling (twice daily at 100 m sampling)

DRIVERS OF SOIL MOISTURE AT DIFFERENT SCALES

At **large scale** soil moisture is driven by:

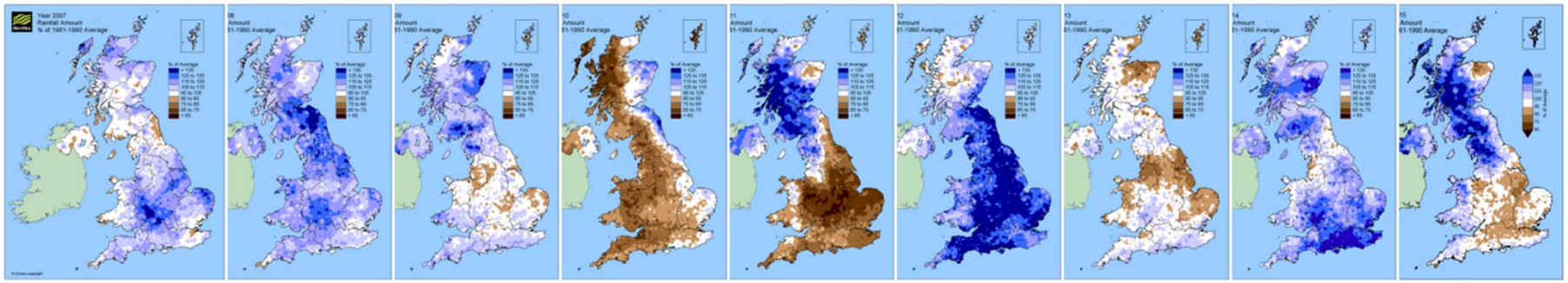
- Large scale weather patterns
- Climate

At **local scale** soil moisture is driven by:

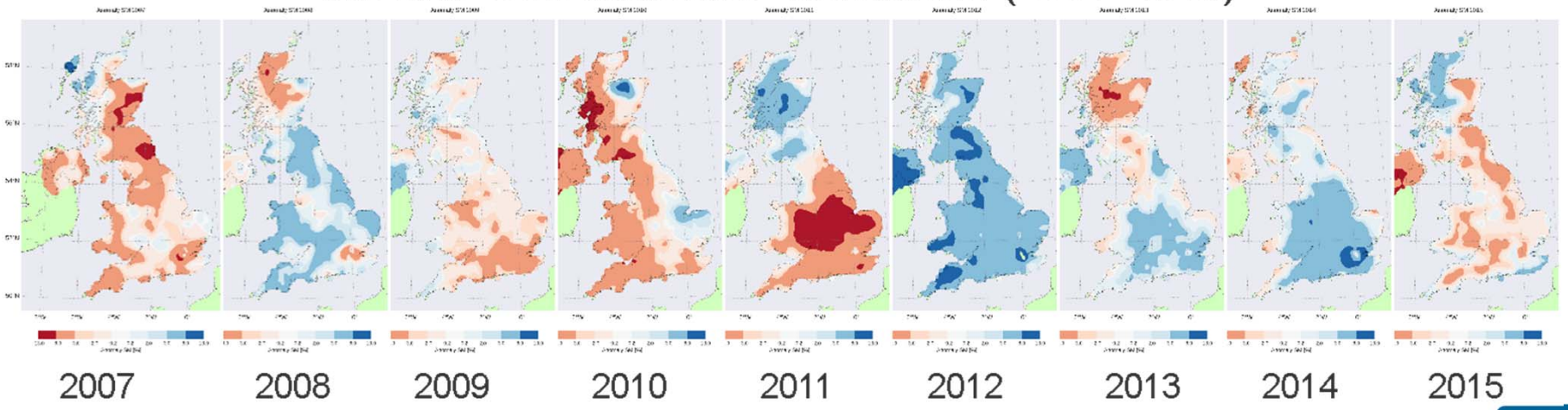
- Land cover
- Topography
- Soil characteristics

LARGE SCALE SOIL MOISTURE DYNAMICS

MetOffice Precipitation anomalies (1961-1990)

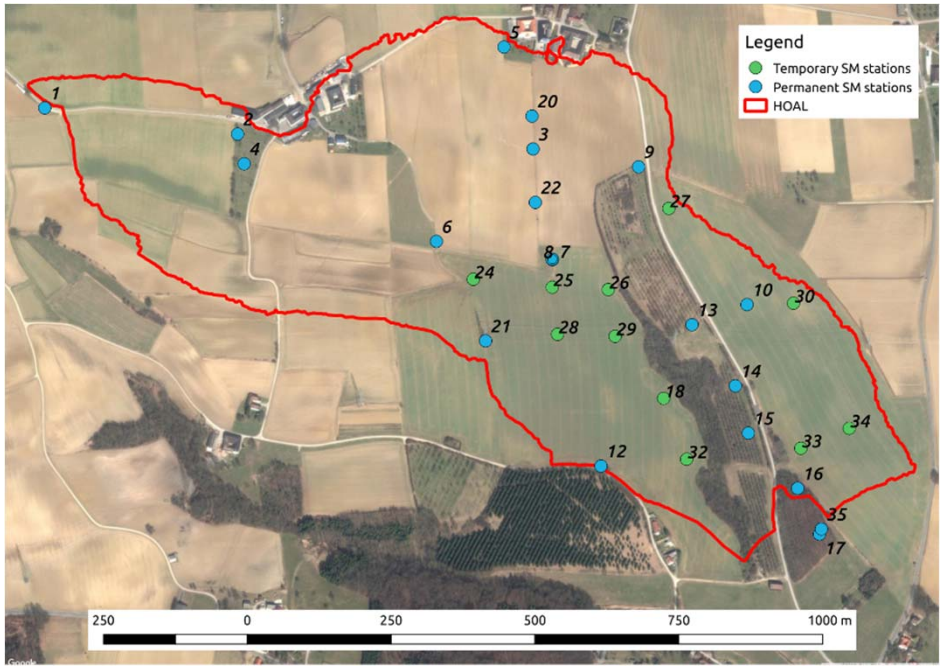


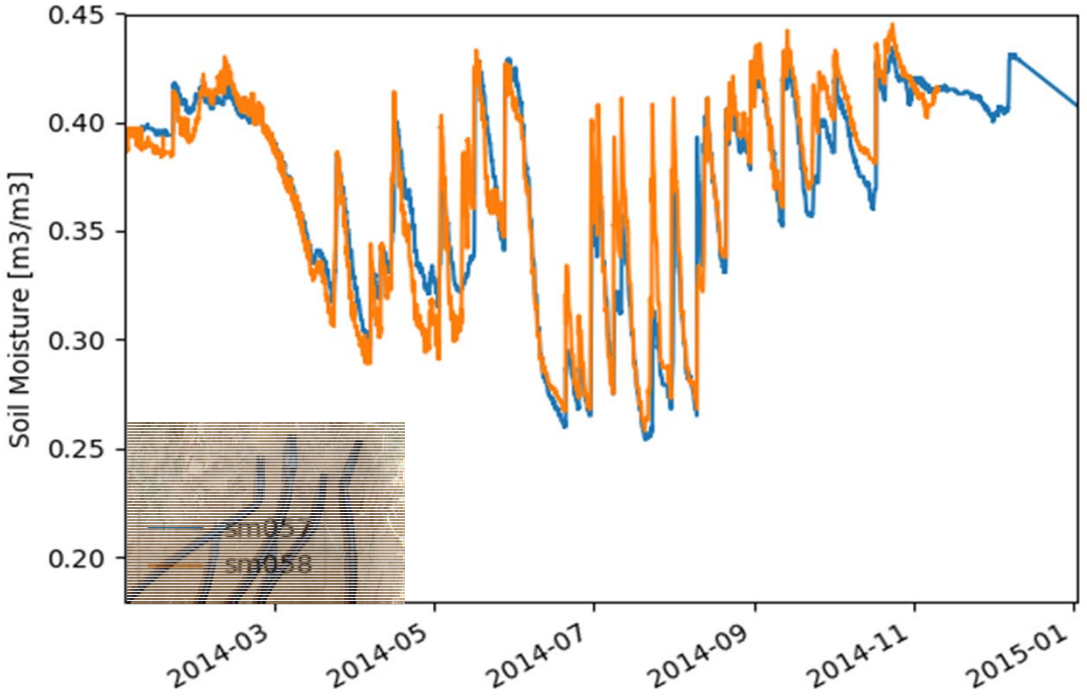
ASCAT Soil Moisture anomalies (2007-2015)



Yearly averages of precipitation and soil moisture anomalies over the UK.

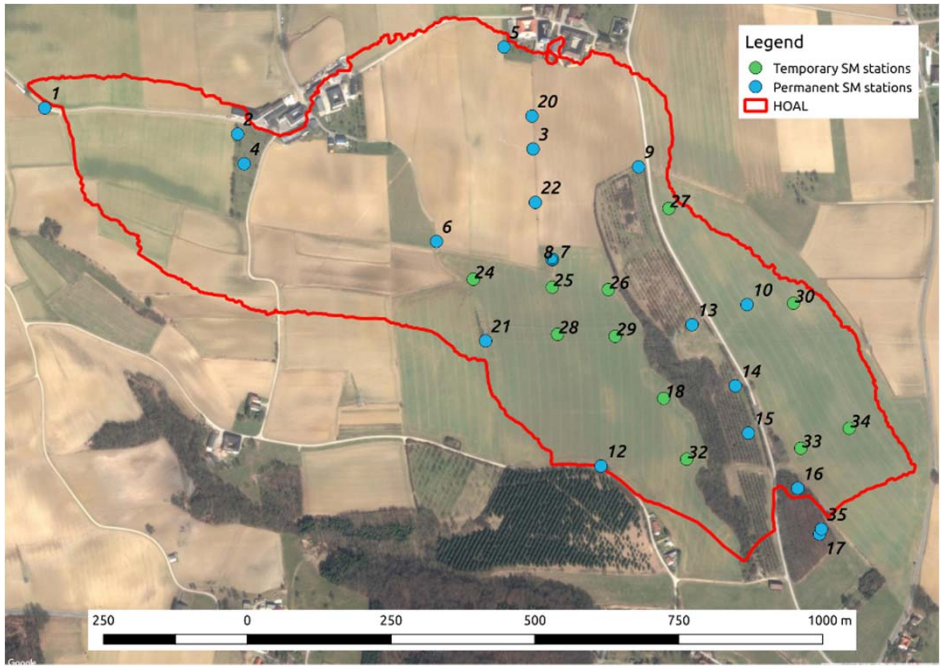
LOCAL SCALE SOIL MOISTURE DYNAMICS

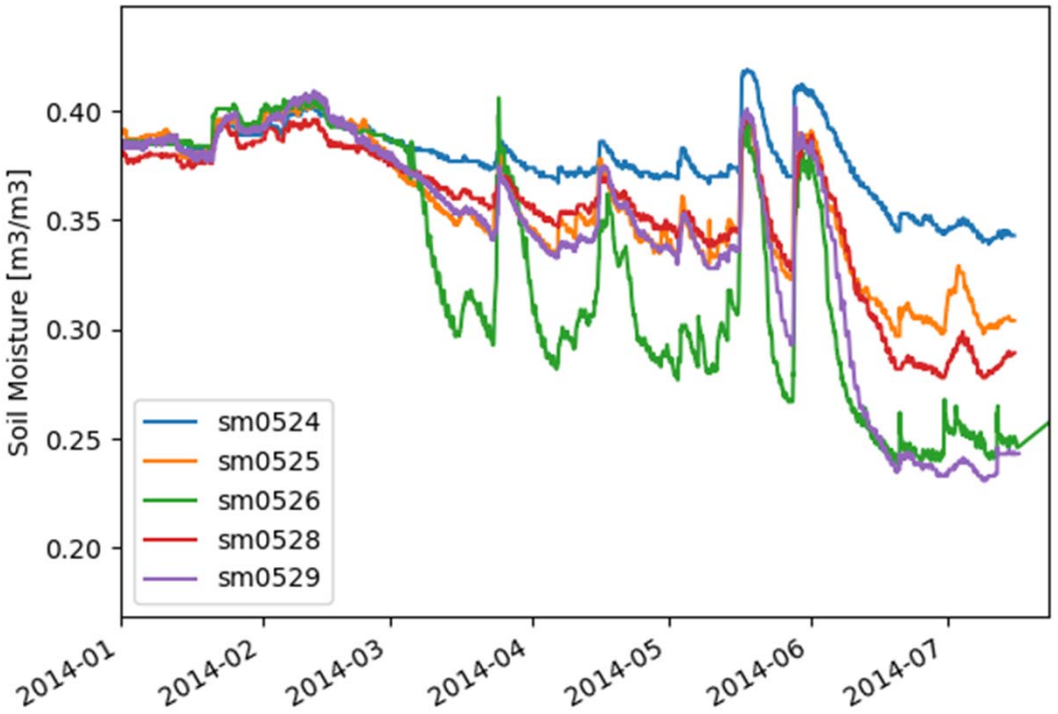




Soil moisture is controlled by land cover, soil properties and topography.
But can vary within 5 cm of each other.
Controls on soil moisture are not straightforward.

LOCAL SCALE SOIL MOISTURE DYNAMICS





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SOIL MOISTURE MONITORING

Soil moisture is driven by land surface processes acting at different spatial scales.

SOIL MOISTURE MONITORING

Soil moisture is driven by land surface processes acting at different spatial scales.

Soil moisture can be estimated:

1. Remote sensing – **average over a footprint**
2. In situ – **point measurement**
3. Modelling – **different scales**

All methods have strengths and weaknesses.

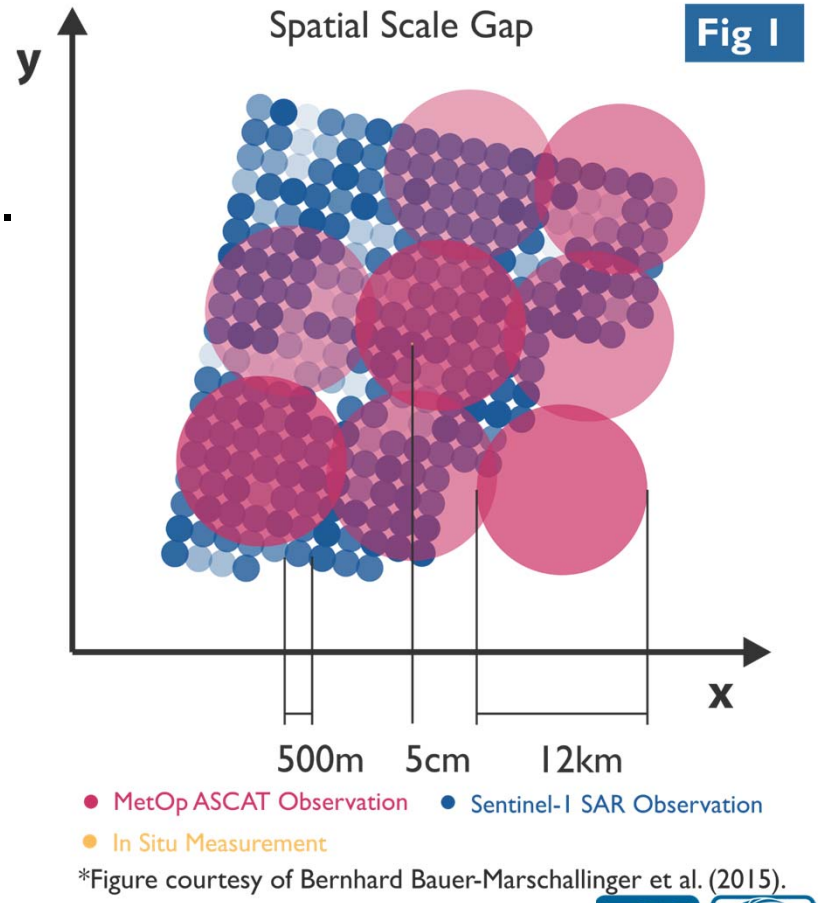
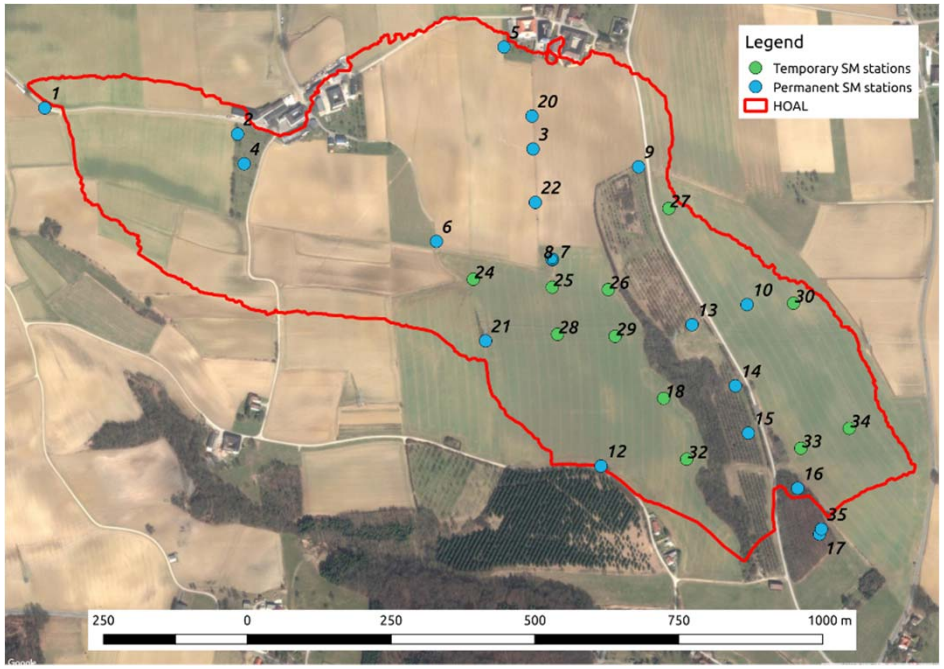
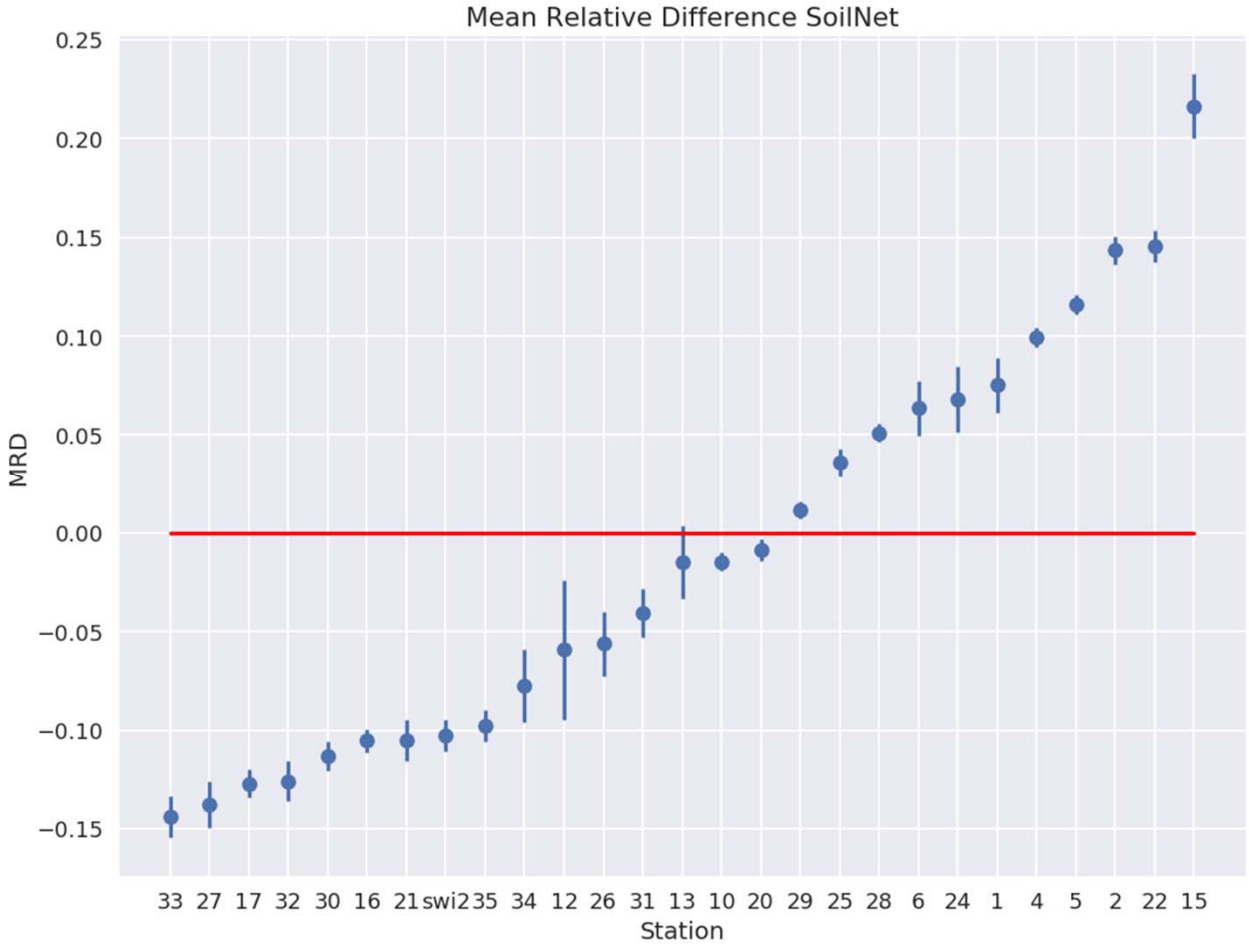


*Figure courtesy of Bernhard Bauer-Marschallinger et al. (2015).

IN SITU MEASUREMENTS





Variability in soil moisture between sensors that are located close together even though soil and land cover is the same.

MODELS

ROMAGNA (ITALY)

Sentinel-1 (1 km)

IRRIGATED PIXEL

NON-IRRIGATED PIXEL

Models are driven by different variables and do not always capture irrigation events.

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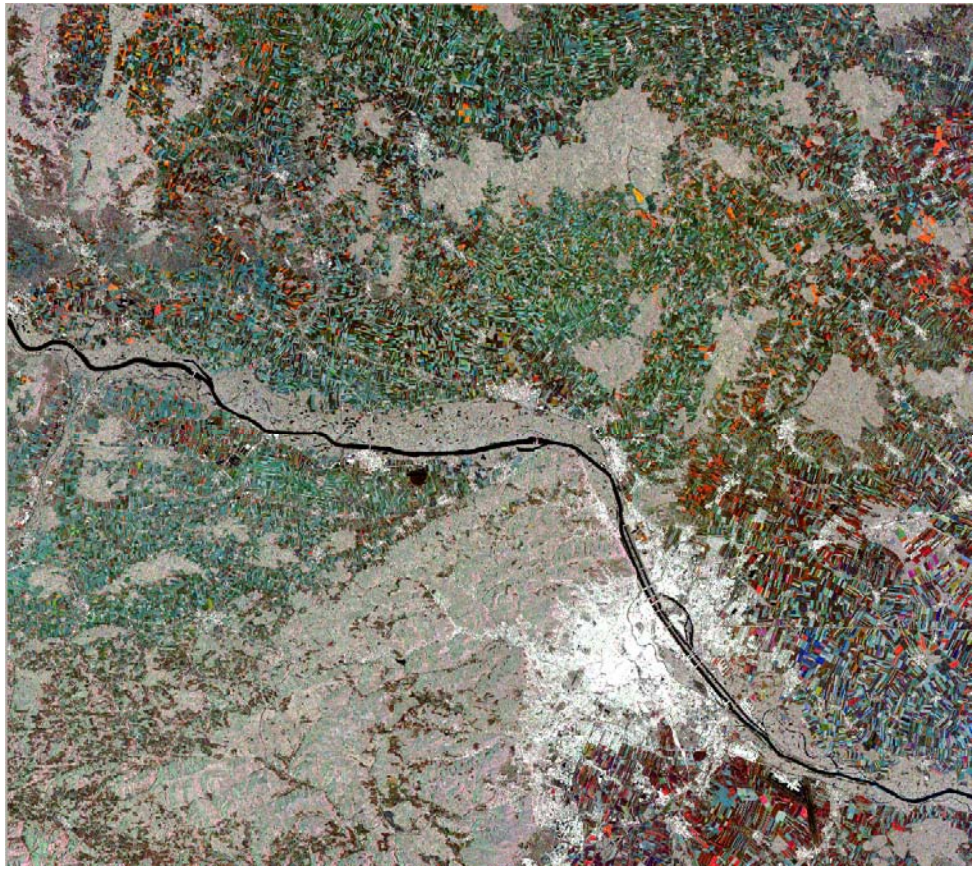
REMOTE SENSING

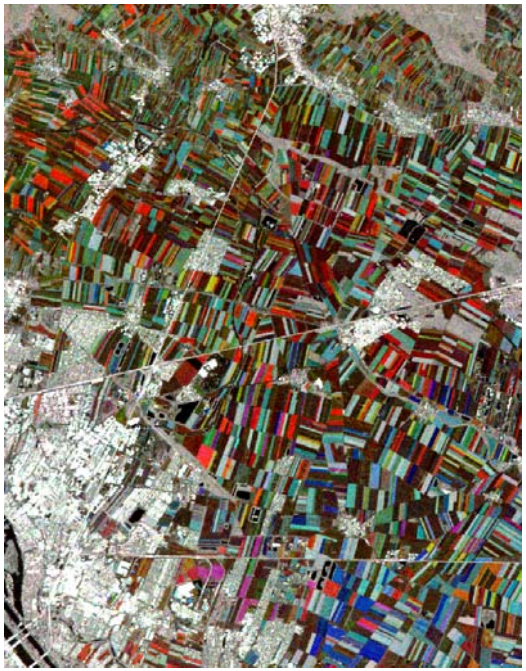


False colour composite of Sentinel-1 VH images acquired in 2015 over Vienna and surrounding areas

Red – June

Green – July

Blue – August



Effect of vegetation on backscatter signal of S-1.

BMON – MODEL-DATA INTEGRATION

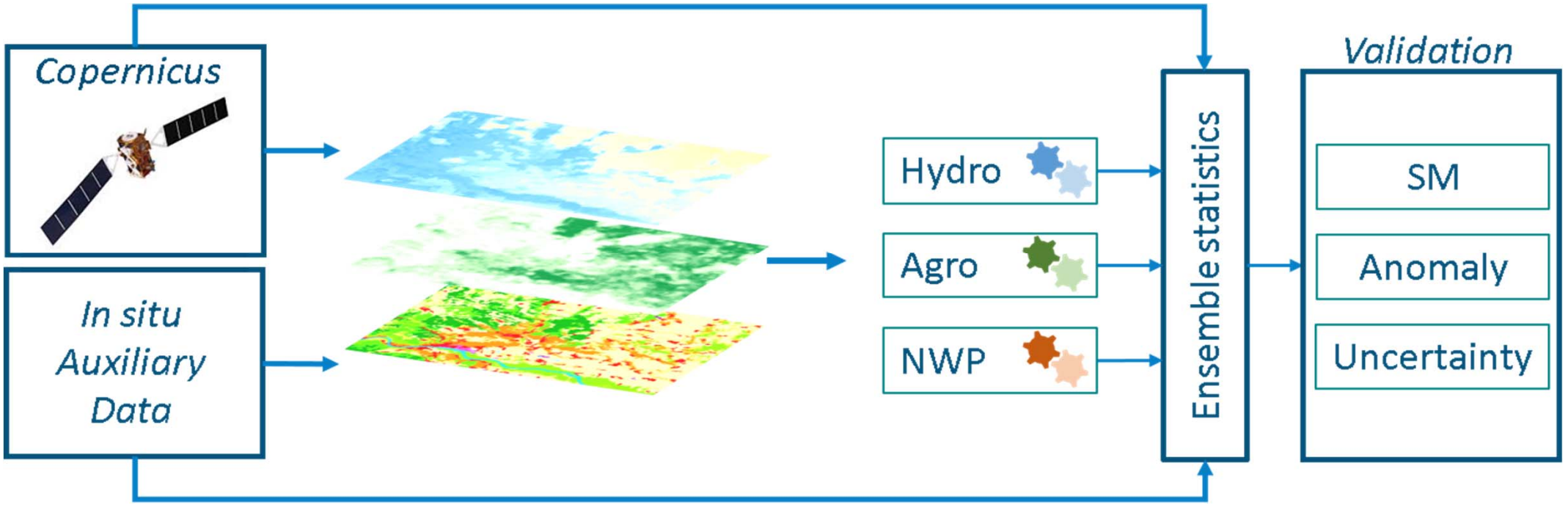
Combining the skills of EO data and three models from hydrology, agronomy and meteorology through **model-data integration** to obtain high resolution soil moisture estimates

BMON – MODEL-DATA INTEGRATION

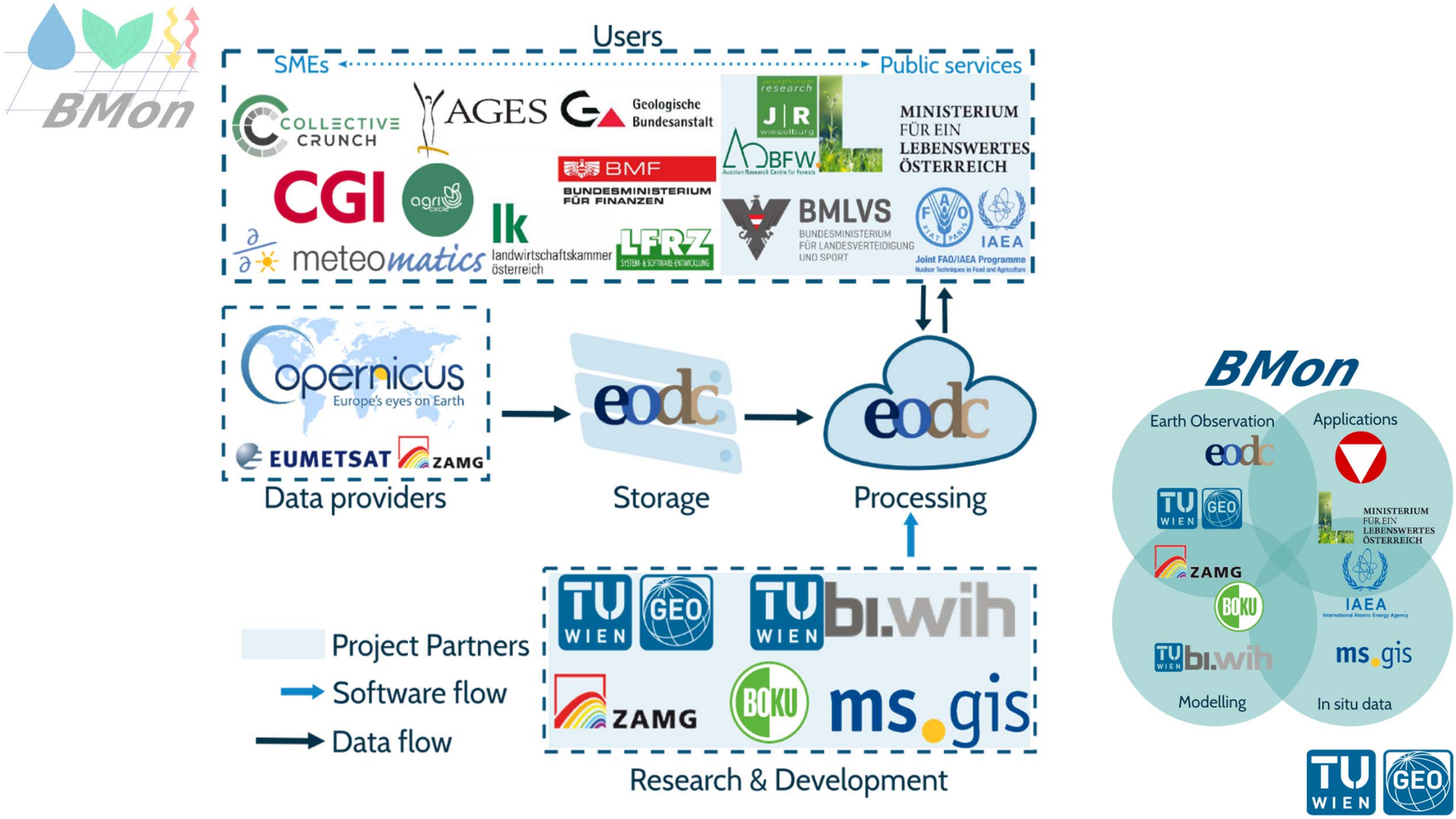
Combining the skills of EO data and three models from hydrology, agronomy and meteorology through **model-data integration** to obtain high resolution soil moisture estimates.

1. **Satellite data with high spatio-temporal sampling** have become operationally available
2. **Merging multiple satellite- and ground-based observations** in advanced **modelling frameworks**.
3. **Bring together data and models** on high-performance **cloud computing platforms**.

BMON – MODEL-DATA INTEGRATION



Scientific workflow of the BMon project.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Public services
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Geologische Bundesanstalt
CGI
agri circle
BMF
BUNDESMINISTERIUM FÜR FINANZEN
lk
landwirtschaftskammer österreich
LFRZ
meteomatics
BFW
MINISTERIUM FÜR EIN LEBENSWERTES ÖSTERREICH
BMLVS
BUNDESMINISTERIUM FÜR LANDESVERTEIDIGUNG UND SPORT
IAEA
Joint FAO/IAEA Programme
opernicus
Europe's eyes on Earth
EUMETSAT
ZAMG
Data providers
eodc
Storage
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GOALS OF BMON

User-driven cloud-based system for real-time high-resolution soil moisture monitoring:

- The **soil moisture estimates are consistent with closely related variables** (rainfall, runoff, yield)
- The **spatio-temporal resolution of the soil moisture output is improved** compared to only-satellite based approaches
- The implementation of the system on a **cloud platform** reduces operational costs by **simplifying the exchange of data and information** between the different system components.

USER BENEFITS AND INTEGRATION

- Close integration of users and project partners/developers through **user requirement inquiry** in two phases and **user workshop**.
- Providing a **modular prototype**, easily extendable for further projects/applications.
- Demonstrating platform capabilities through **test cases** (Austria and Mali) and a user workshop.


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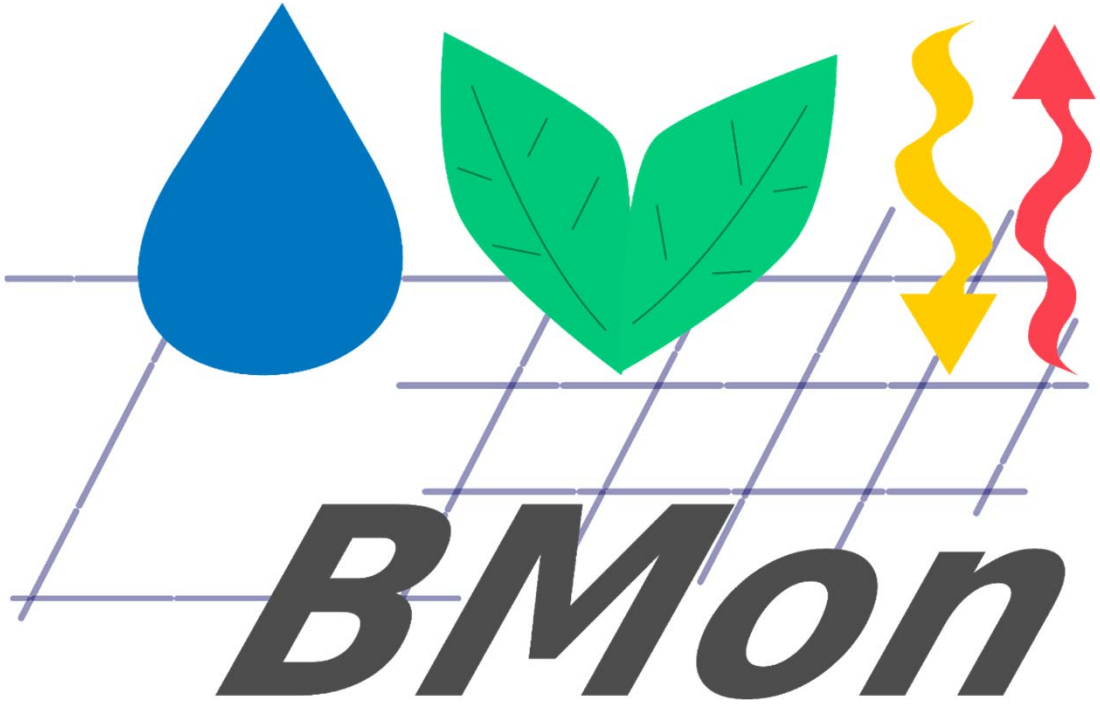
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