



soil moisture
cci

climate change initiative

European Space Agency

ESA CCI Soil Moisture

Wouter Dorigo & CCI Soil Moisture team

eodc



GeoVille
Group

transmissivity



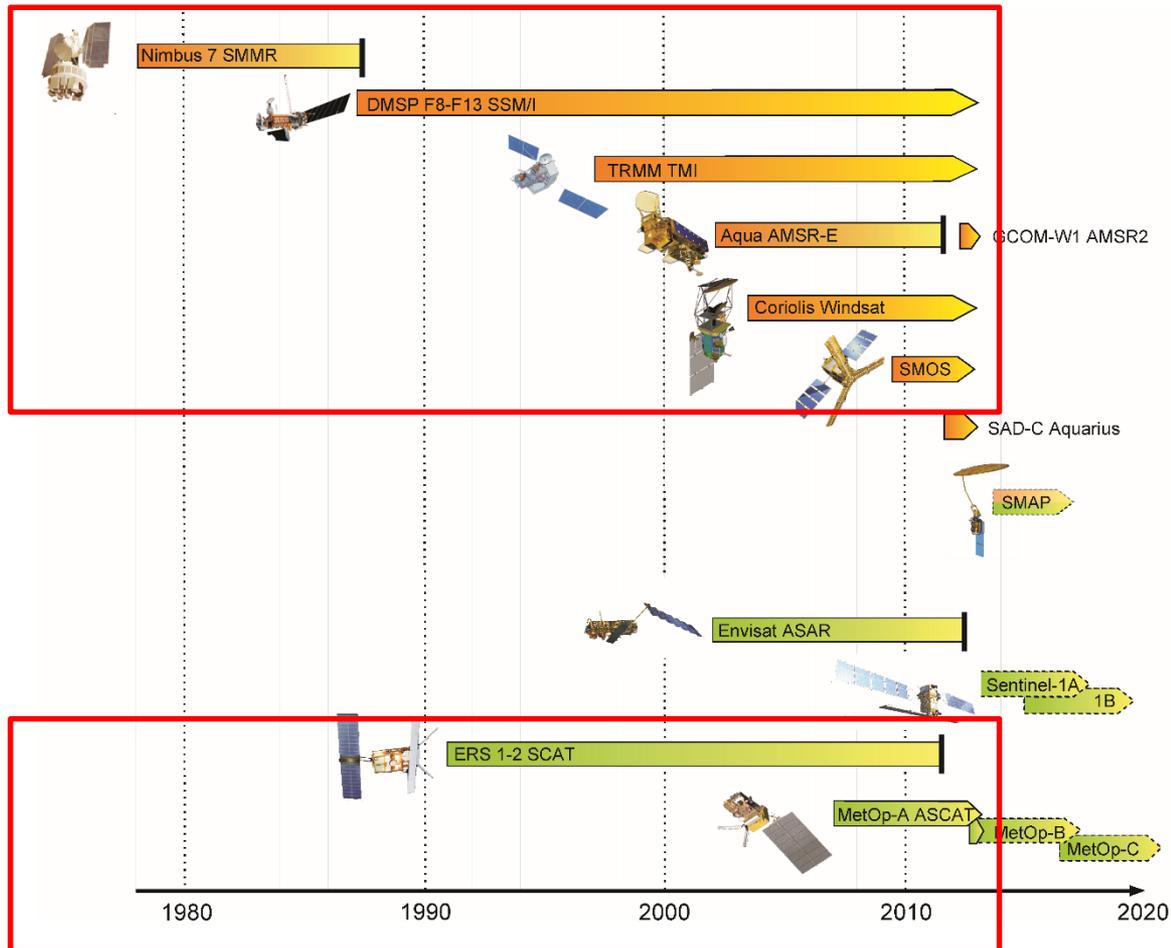
ETH zürich





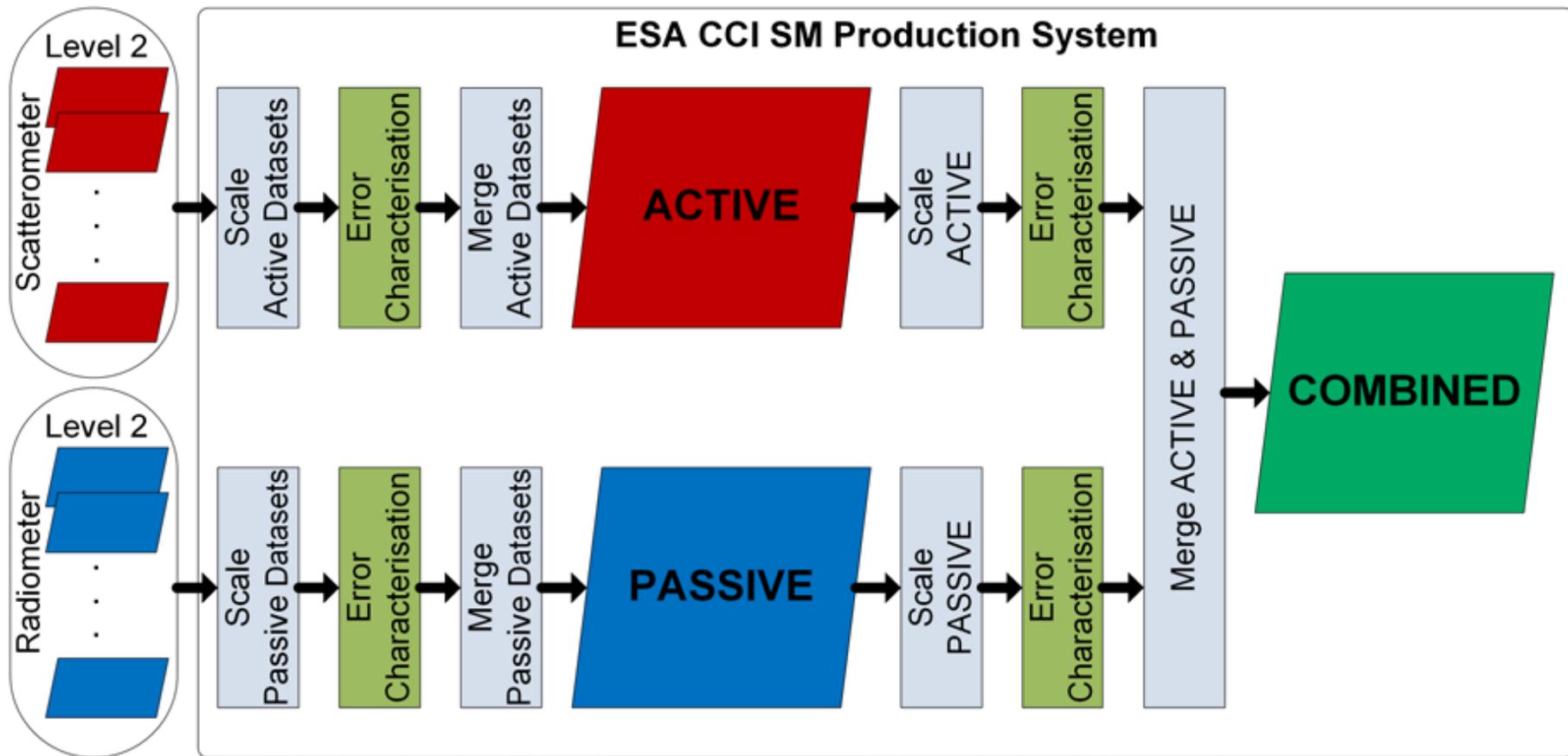
Overview - Available coarse resolution data

- The CDR makes best use of existing European and international programmes





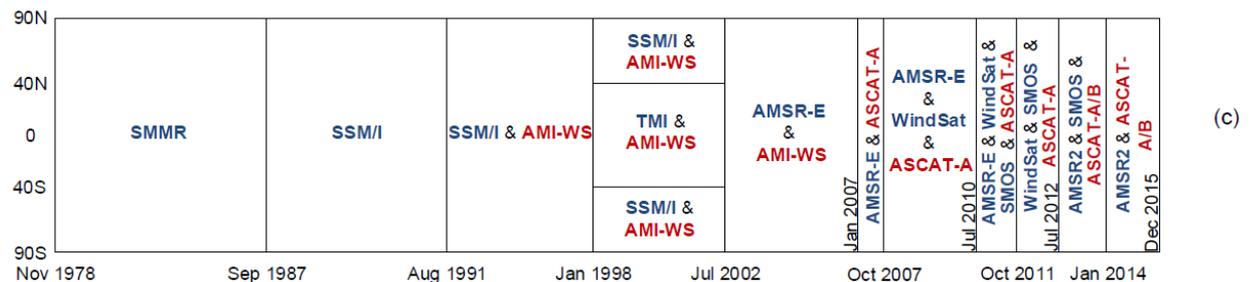
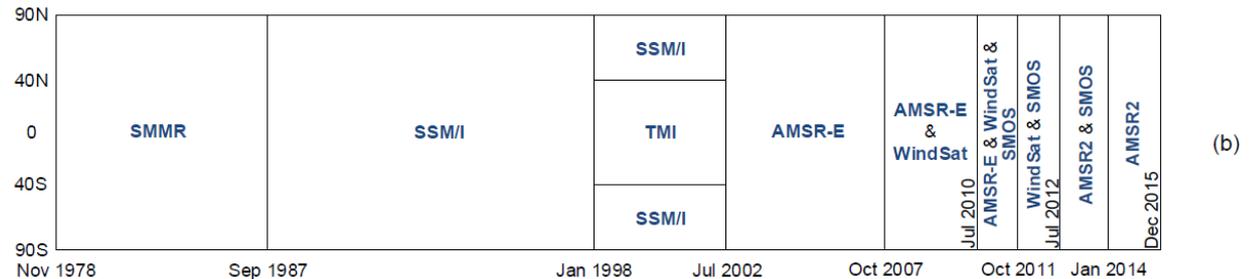
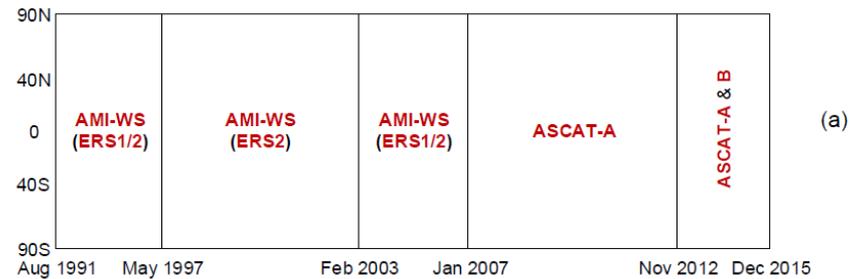
Generates 3 products





Features - v03.2 (released today)

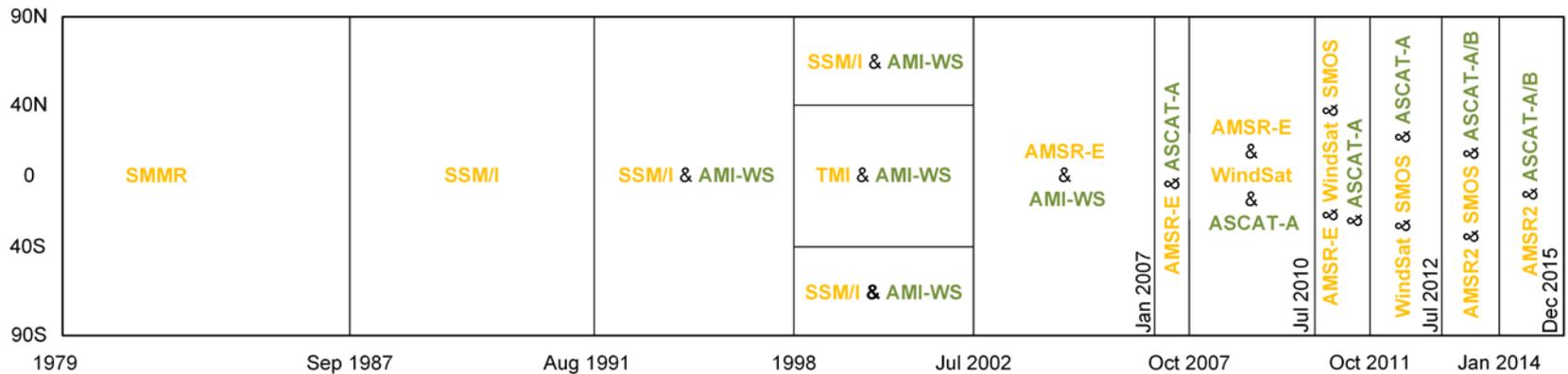
- Temporal extent from Nov 1978 – Dec 2015 (Global Product 37 Years)
- Input data from 11 satellite sensors (**NEW**: SMOS, MetOp-B ASCAT)





features - v04.0 (internal release soon, final release as v04.2 end of 2017)

- Temporal extent from Nov 1978 – Dec 2016 (Global Product 38 Years)
- 11 satellite sensors

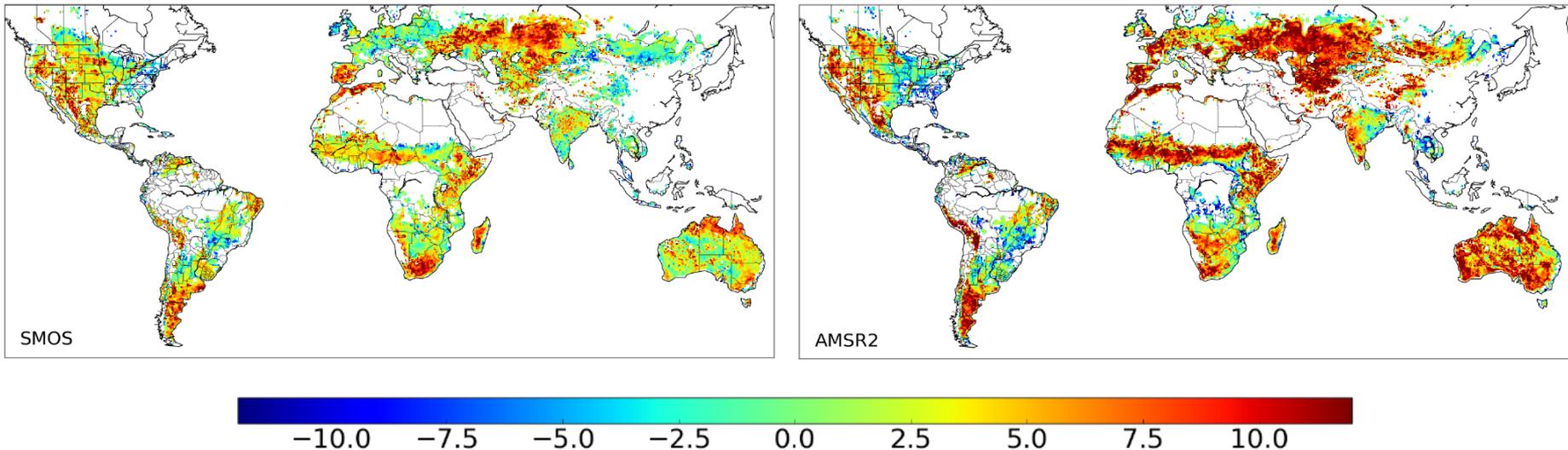


- Generates 3 products:
 - Passive Product: 1978/11-2016/12
 - Active Product: 1991/07-2016/12
 - Combined Product : 1978/11-2016/12



Improved error characterisation

- Signal-to-noise ratio (SNR) in dB, computed with triple collocation (Gruber et al., 2016, JAG SI)

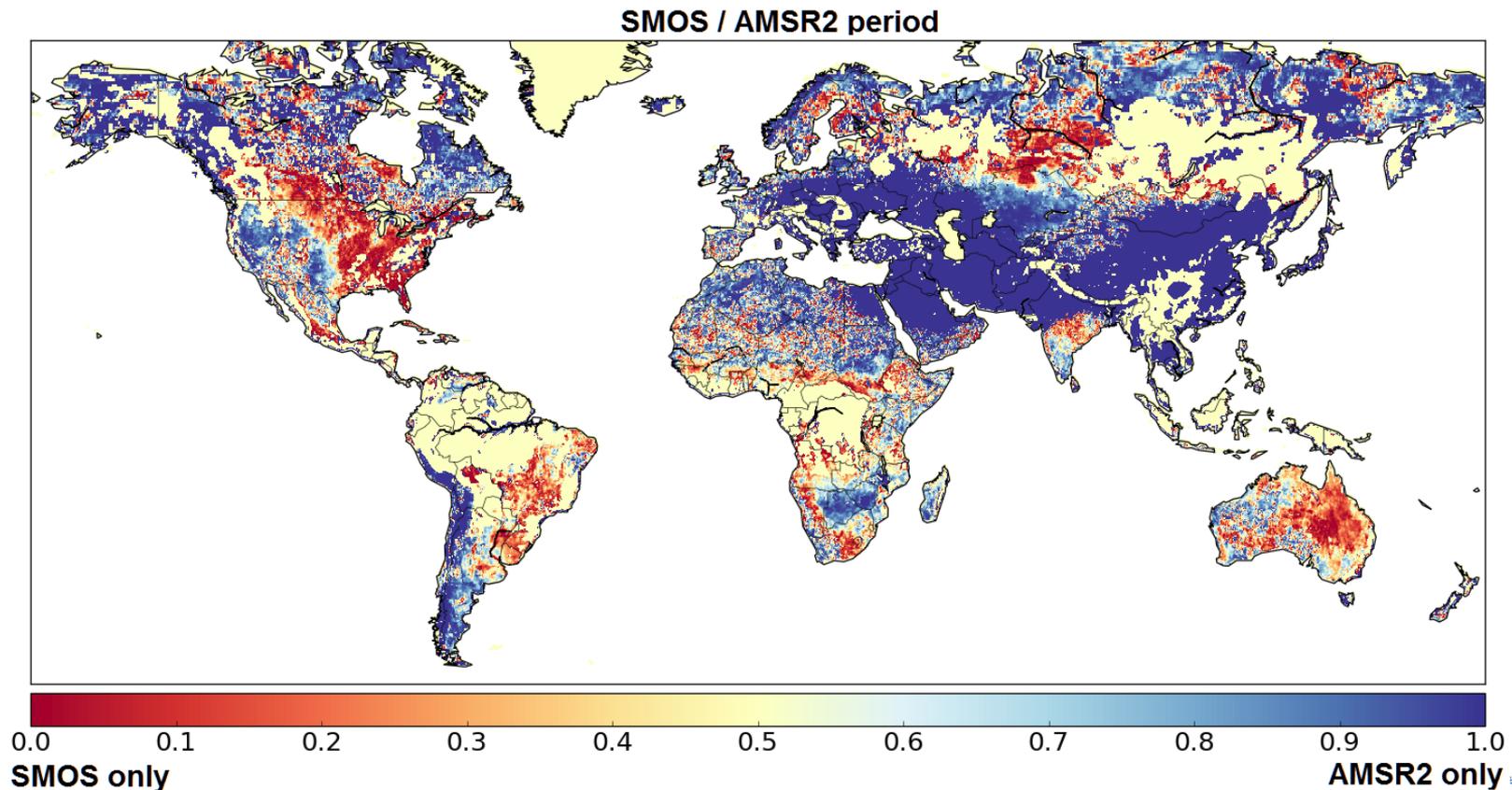




Merging passive observations

- **NEW:** Blending weights based on SNR estimates

$$w_a = \frac{SNR_a}{SNR_a + SNR_p} \quad w_p = \frac{SNR_p}{SNR_a + SNR_p}$$

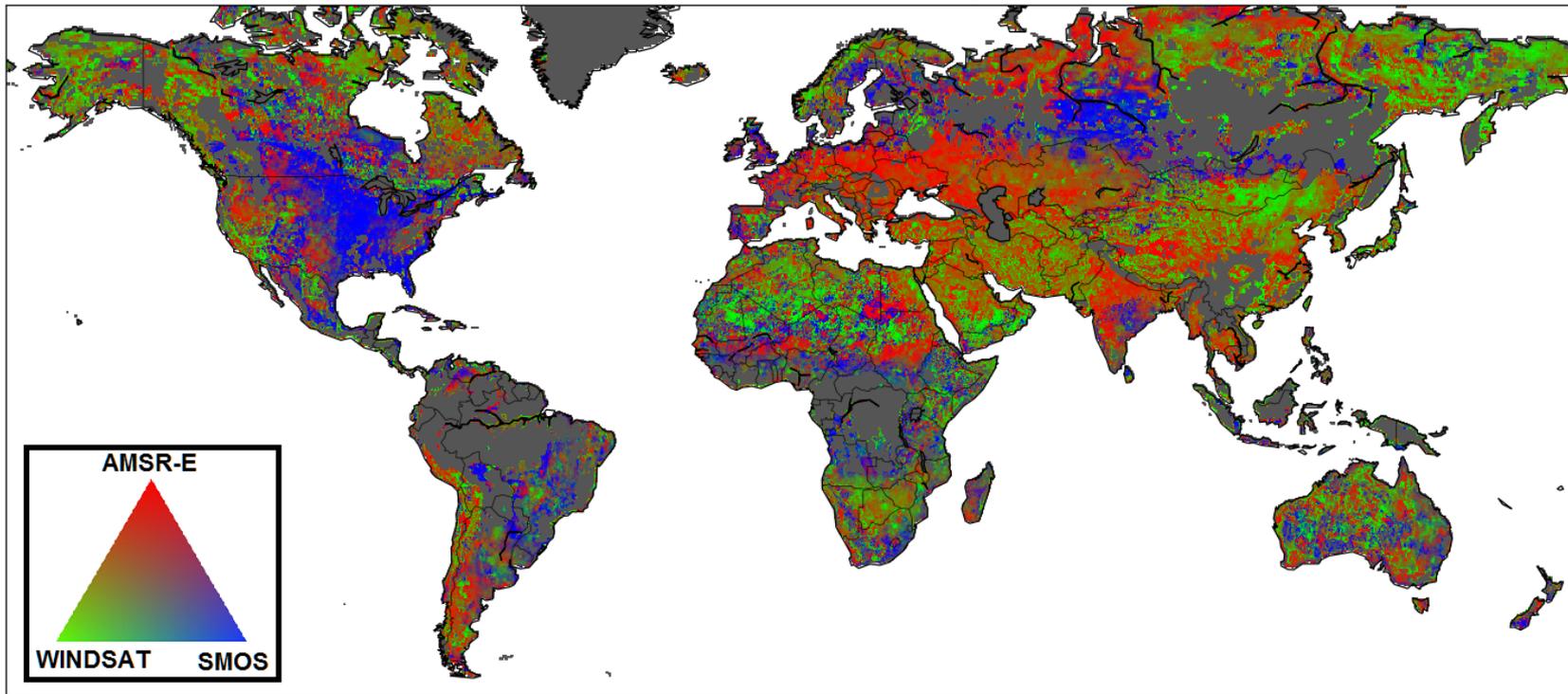




Merging passive observations

- The previous blending scheme did not allow for combining >2 datasets in a single period
- -> New merging scheme theoretically allows for an infinite number of sensors

AMSR-E / WINDSAT / SMOS period



Blending weights for merging AMSR-E, Windsat, and SMOS into a merged passive dataset (July 2010- October 2011)

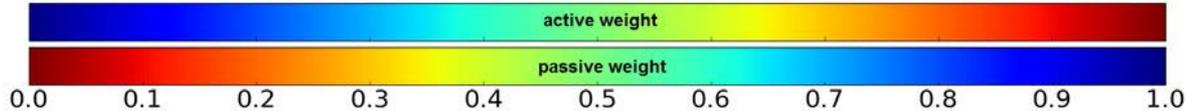
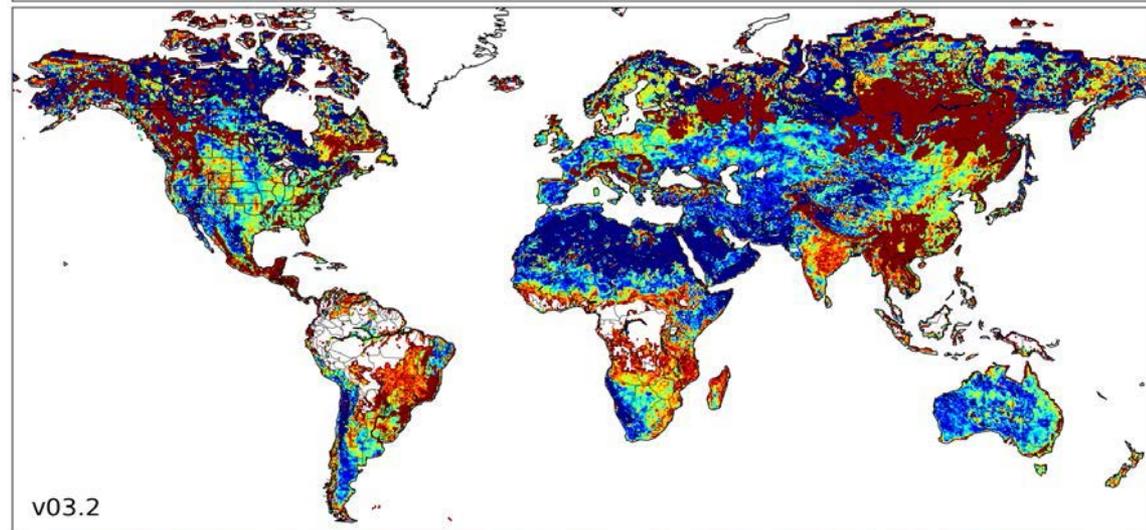
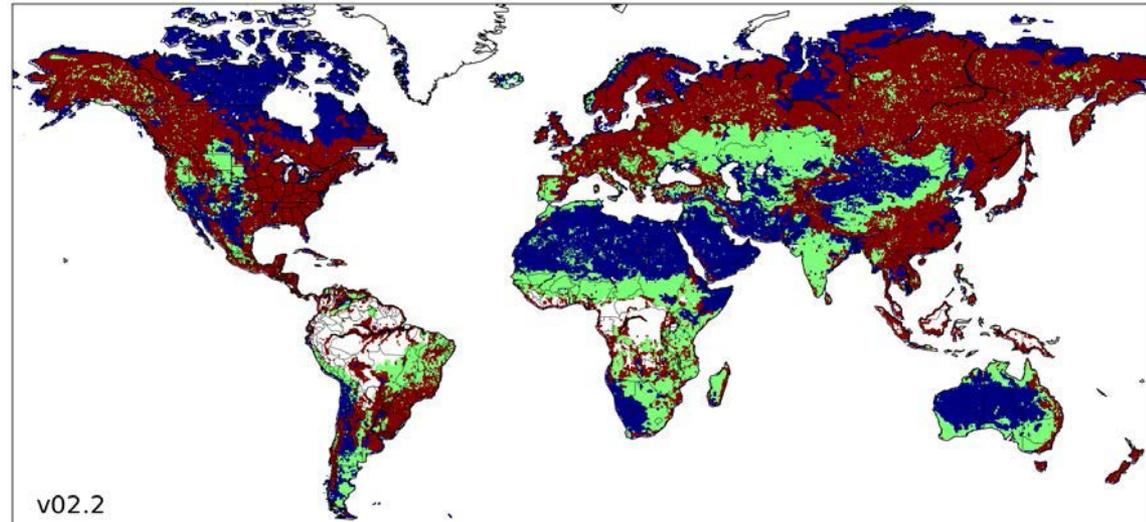


Merging active+passive v03.0 >

- **NEW:** weighted average based on the signal-to-noise ratio computed from the merged active and merged passive datasets (see previous slides)

$$w_a = \frac{SNR_a}{SNR_a + SNR_p}$$

$$w_p = \frac{SNR_p}{SNR_a + SNR_p}$$

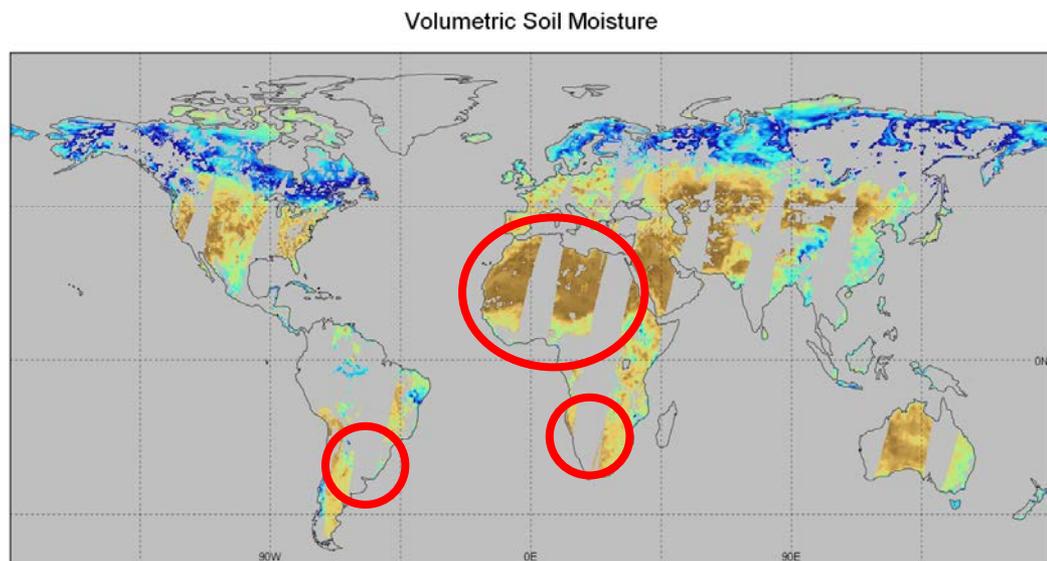




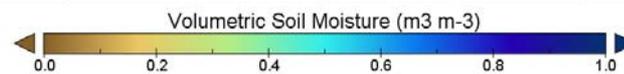
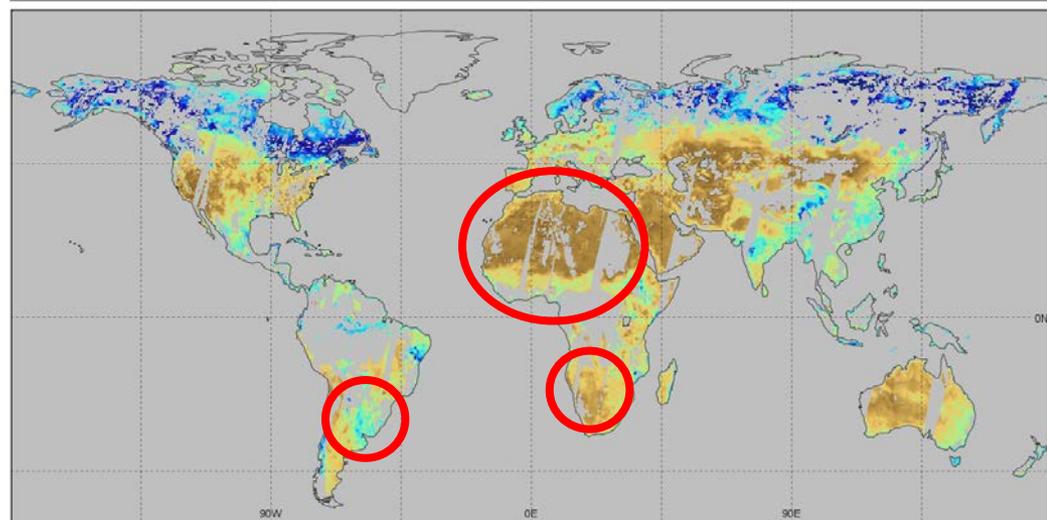
Improved coverage

- Example daily image: introduction SMOS

V02.2

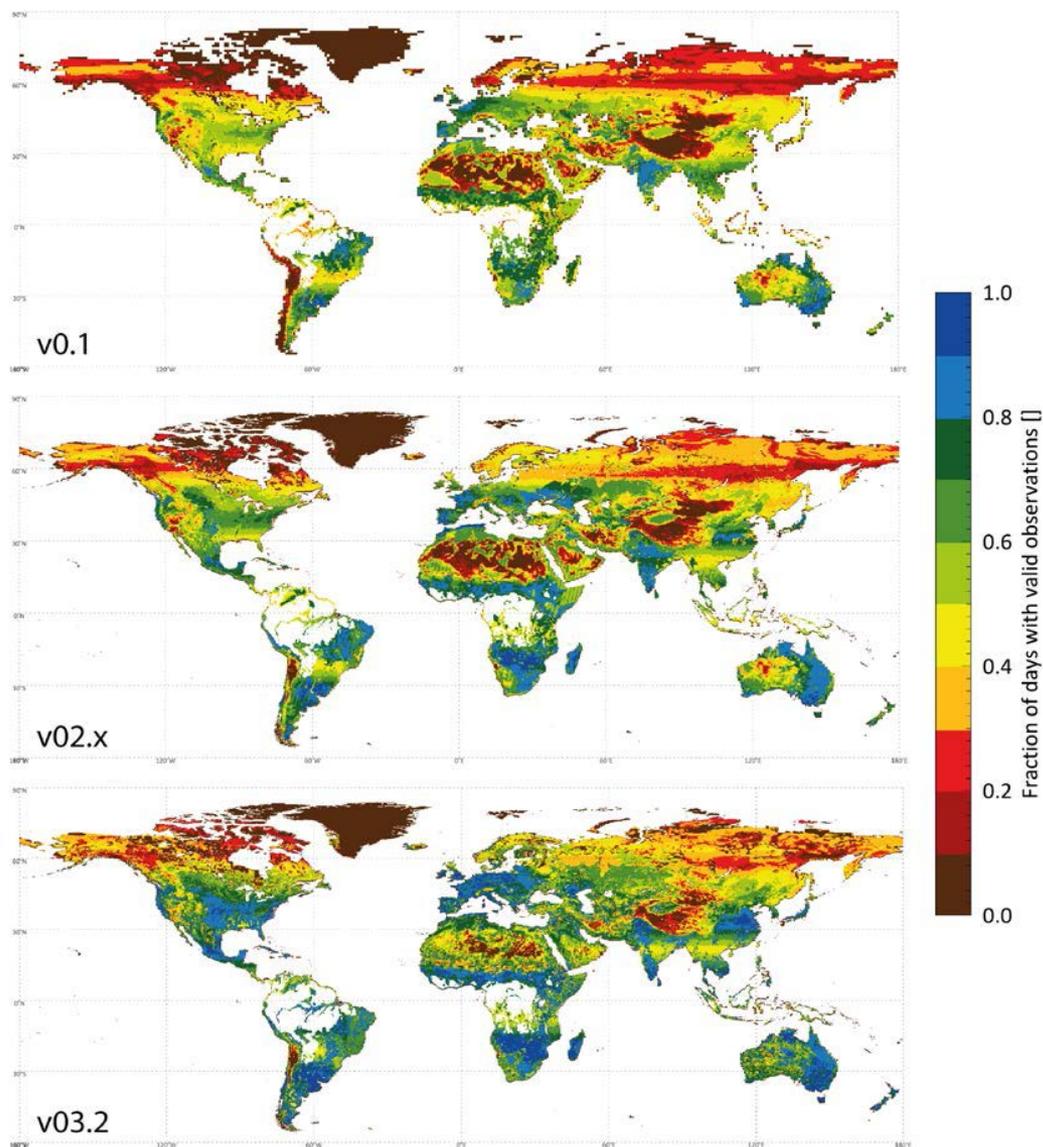


V03.2





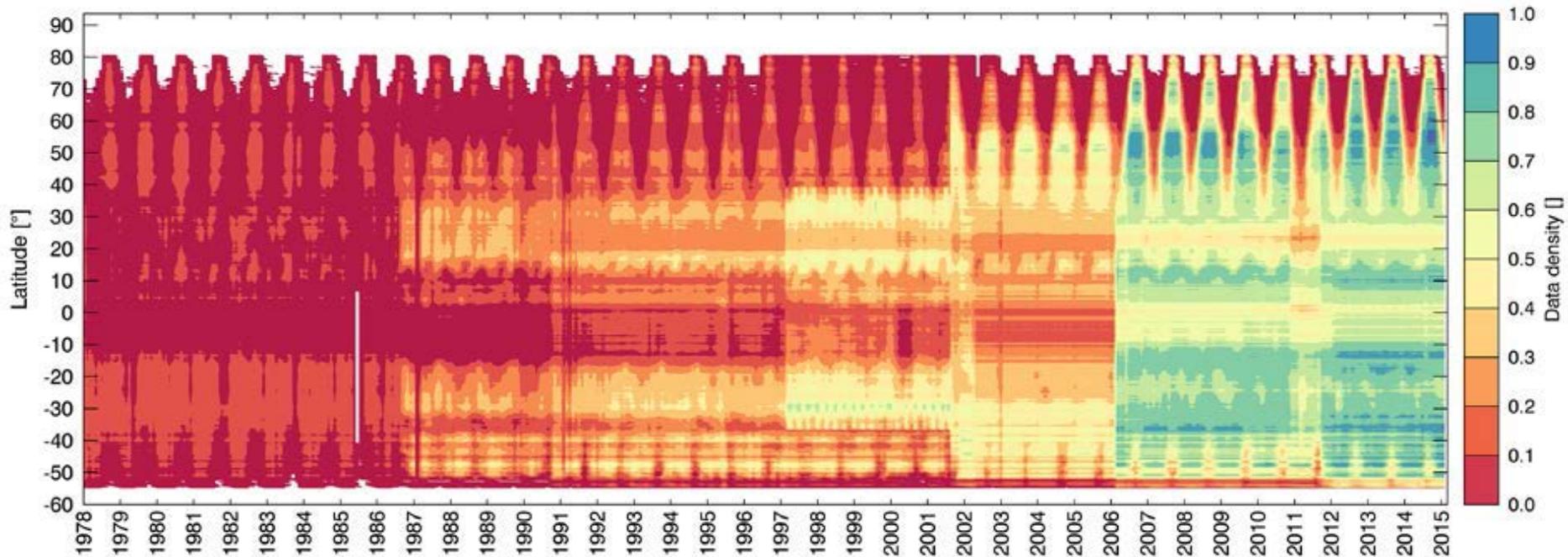
Improved coverage



[Dorigo et al., in rev., RSE]



Coverage improves through time

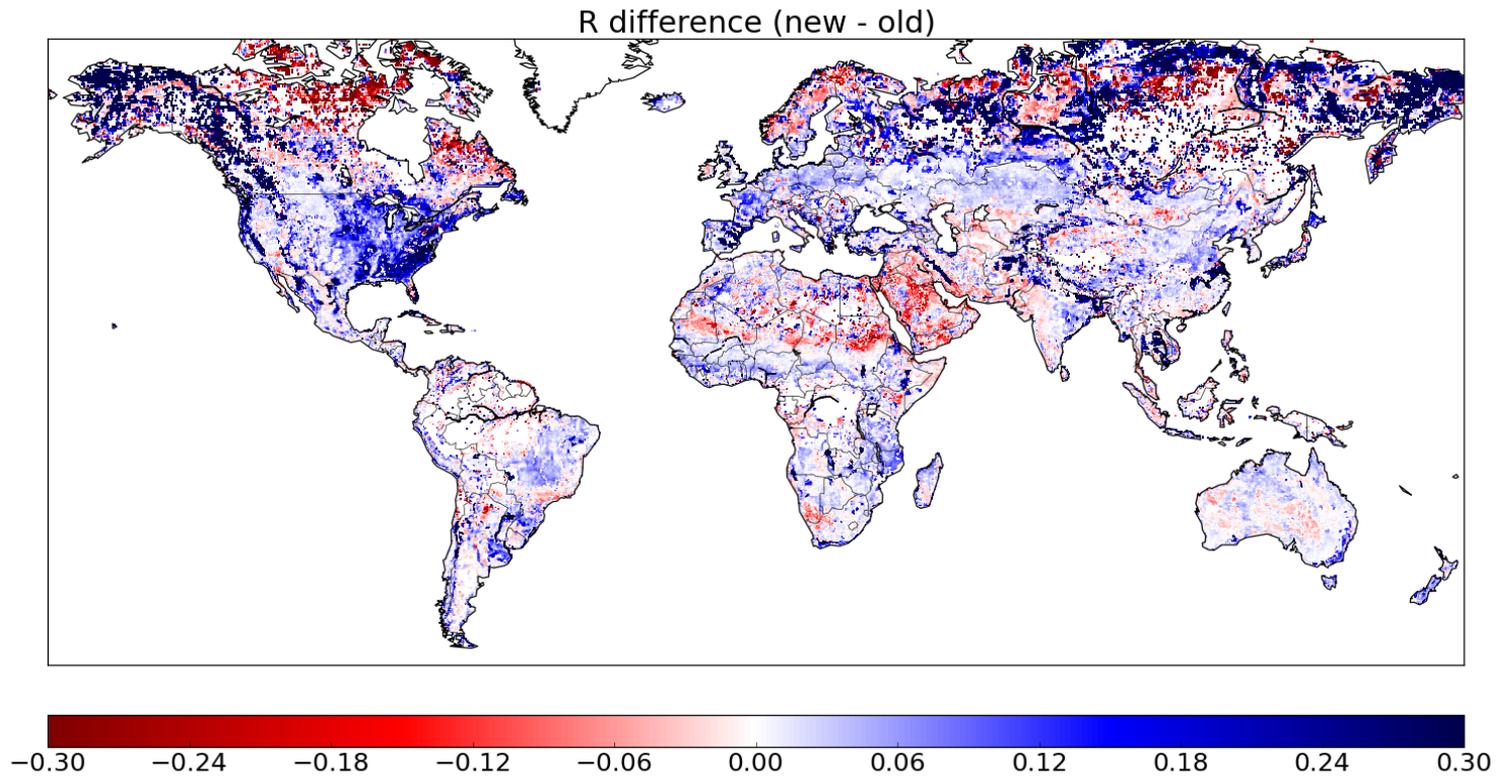


[Dorigo et al., in rev., RSE]



Scientific improvements

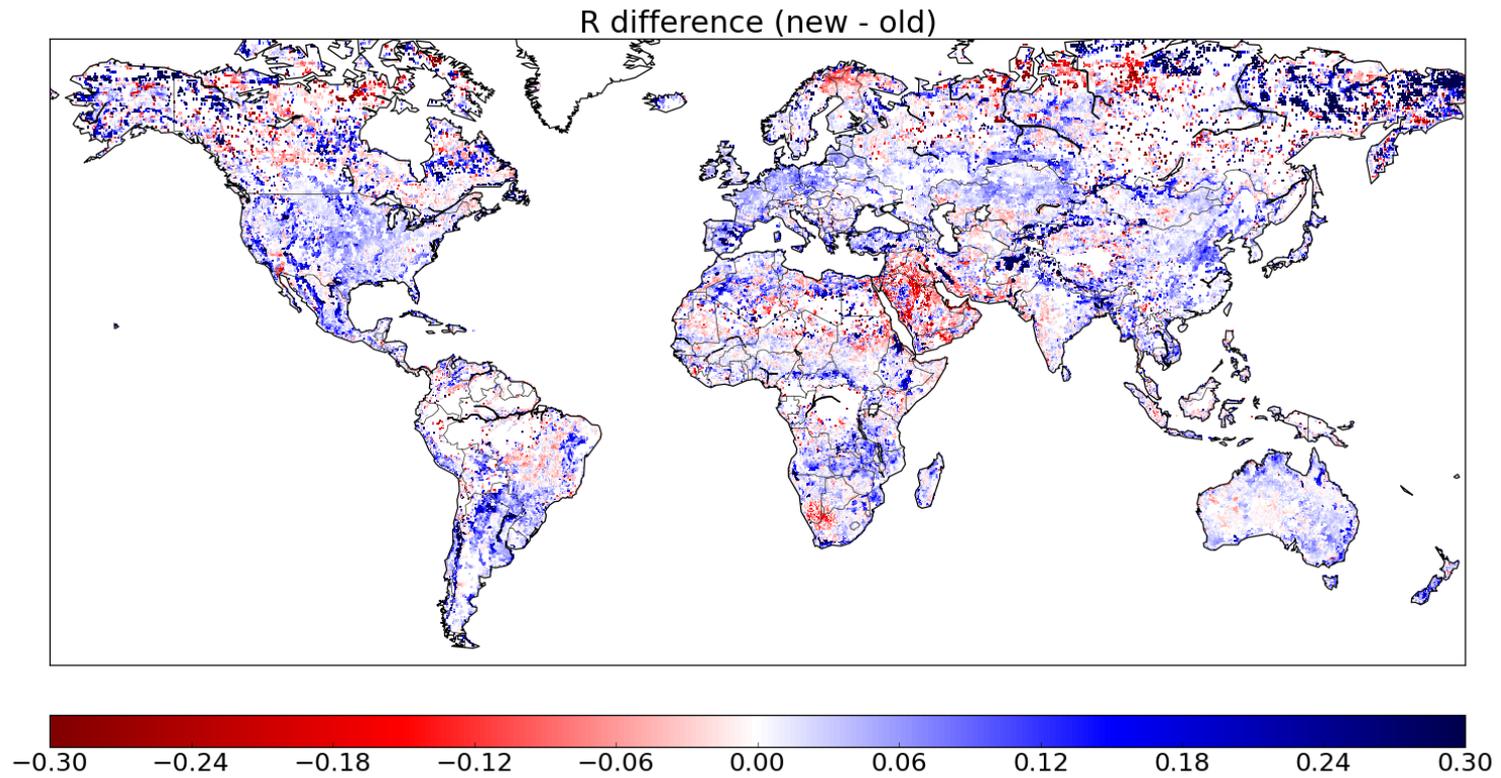
- Correlation improvement (**absolute**) between old and new blending scheme for the ASCAT / AMSR-E period (reference: ERA-Land)





Scientific improvements

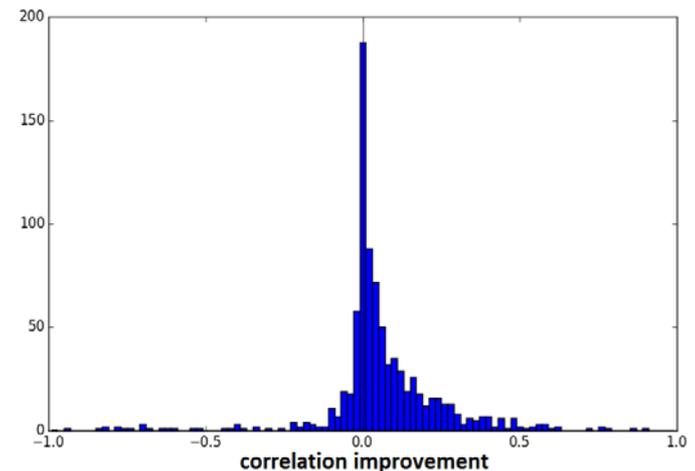
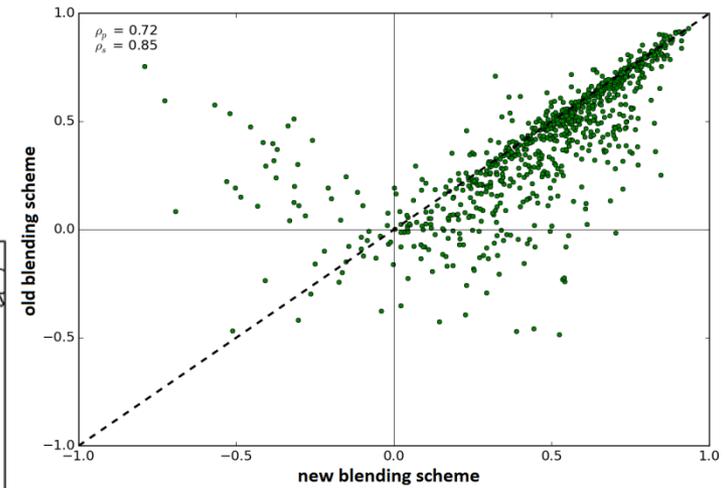
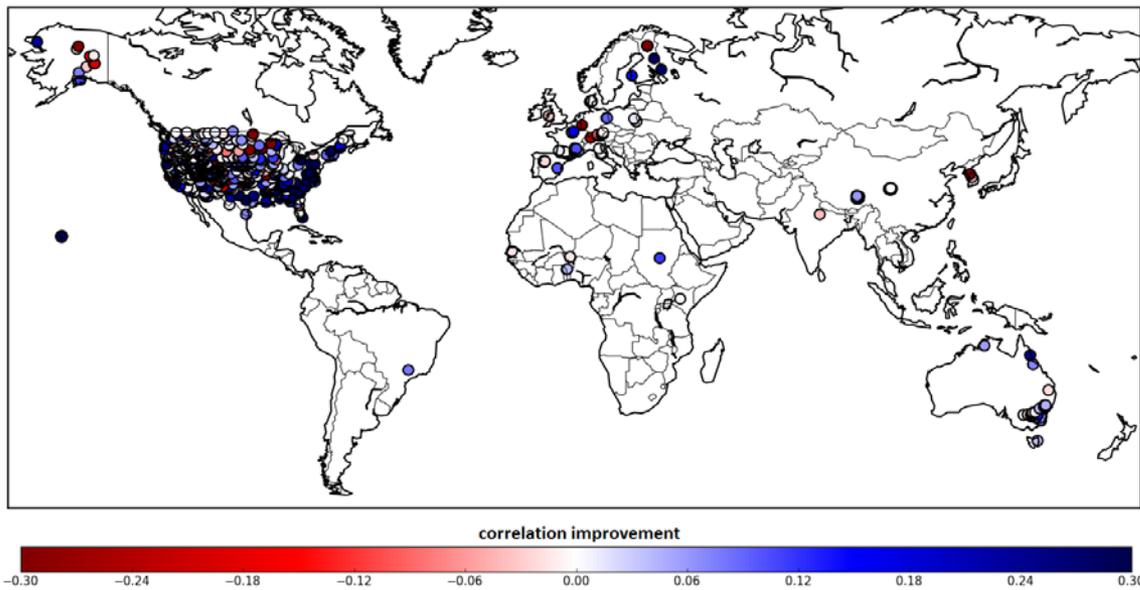
- Correlation improvement (**anomalies**) between old and new blending scheme for the ASCAT / AMSR-E period (reference: ERA-Land)





Scientific improvements

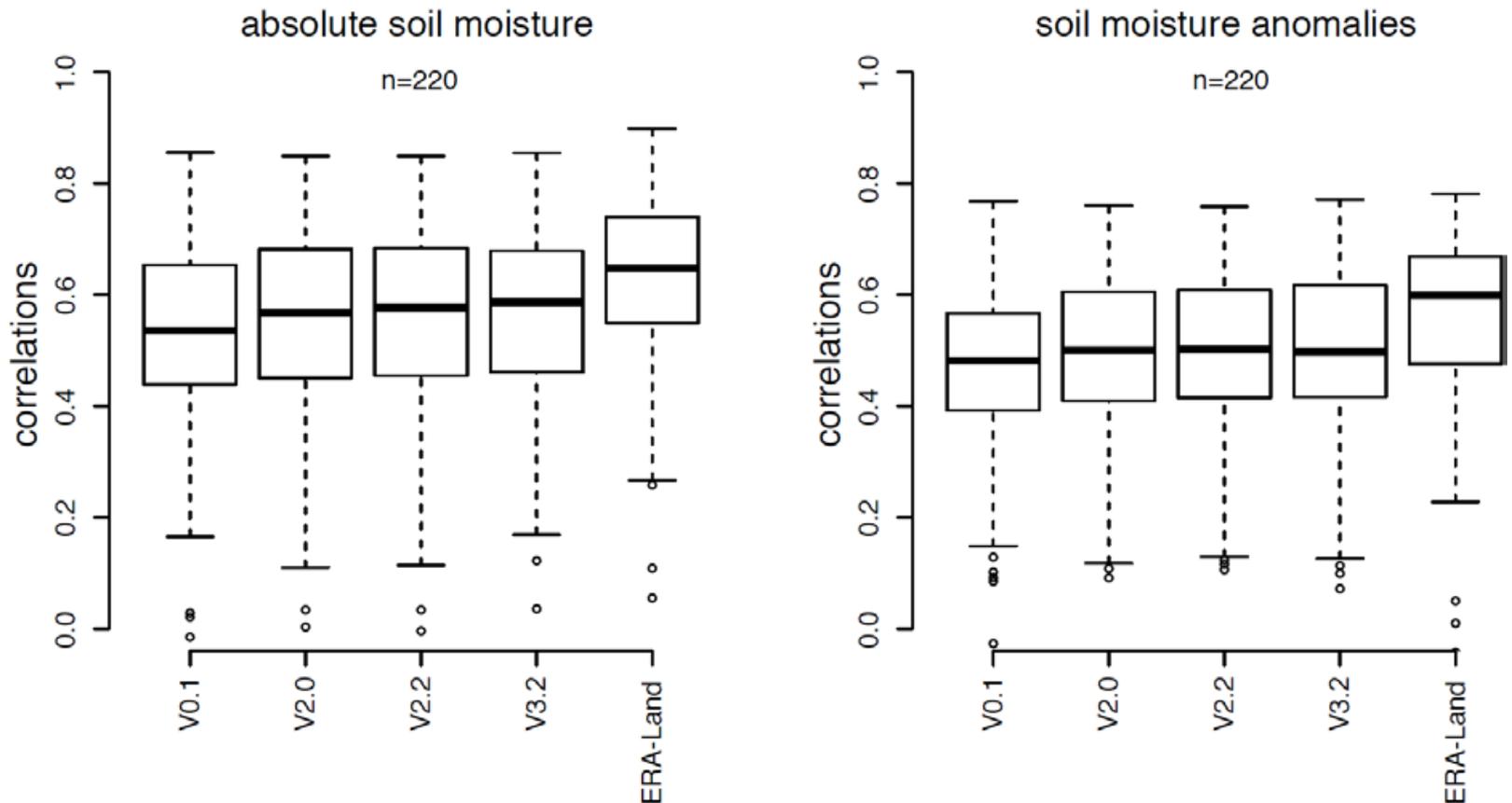
- Correlation improvement (absolute) between old and new blending scheme for the ASCAT / AMSR-E period (Reference: ISMN-all available stations)
 - Notice: inhomogeneous station distribution!





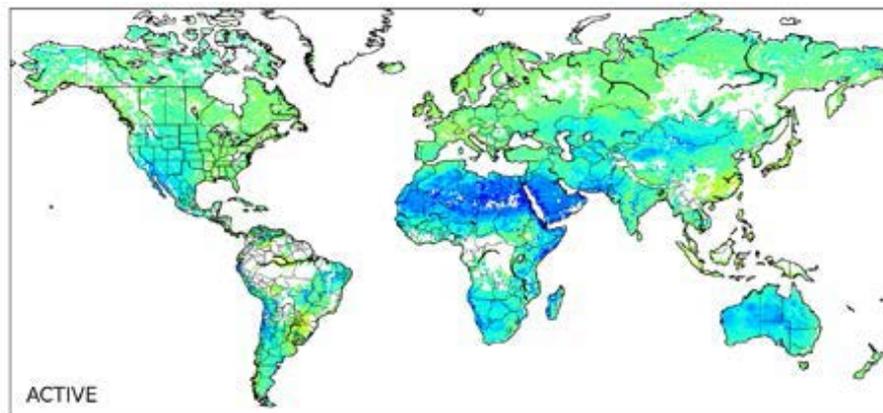
Validation – *in situ*: different product versions

- Correlation with in-situ data shows stable to slightly improving performance

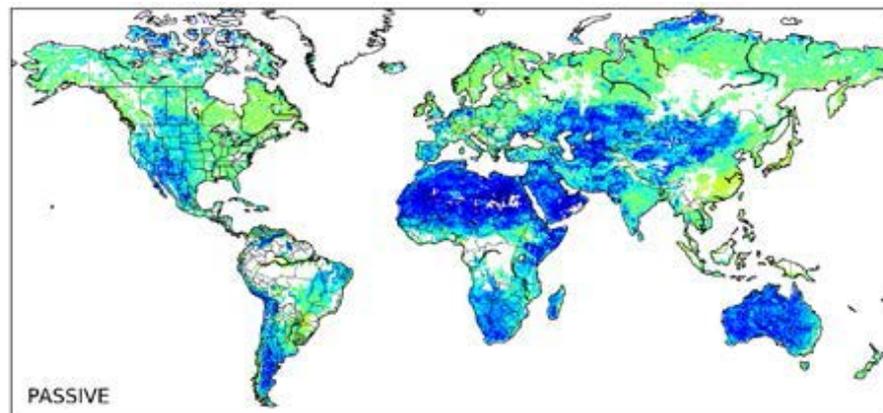
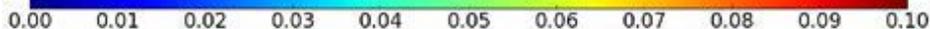




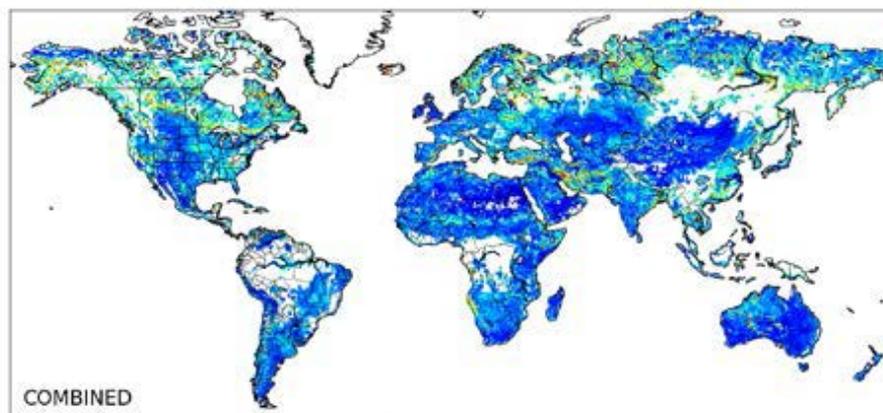
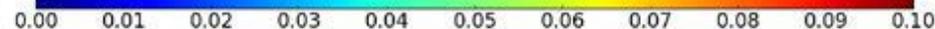
Error propagation based on triple collocation



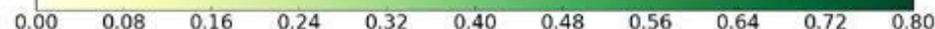
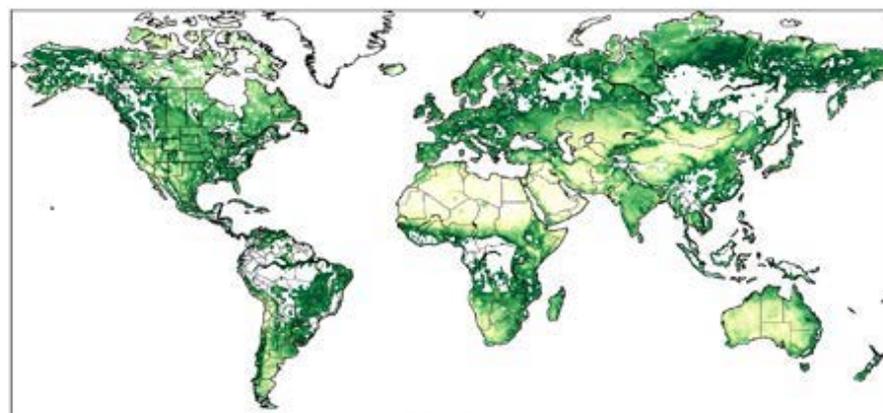
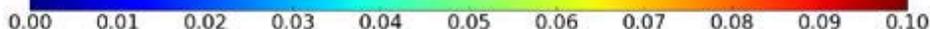
random error [m^3m^{-3}]



random error [m^3m^{-3}]



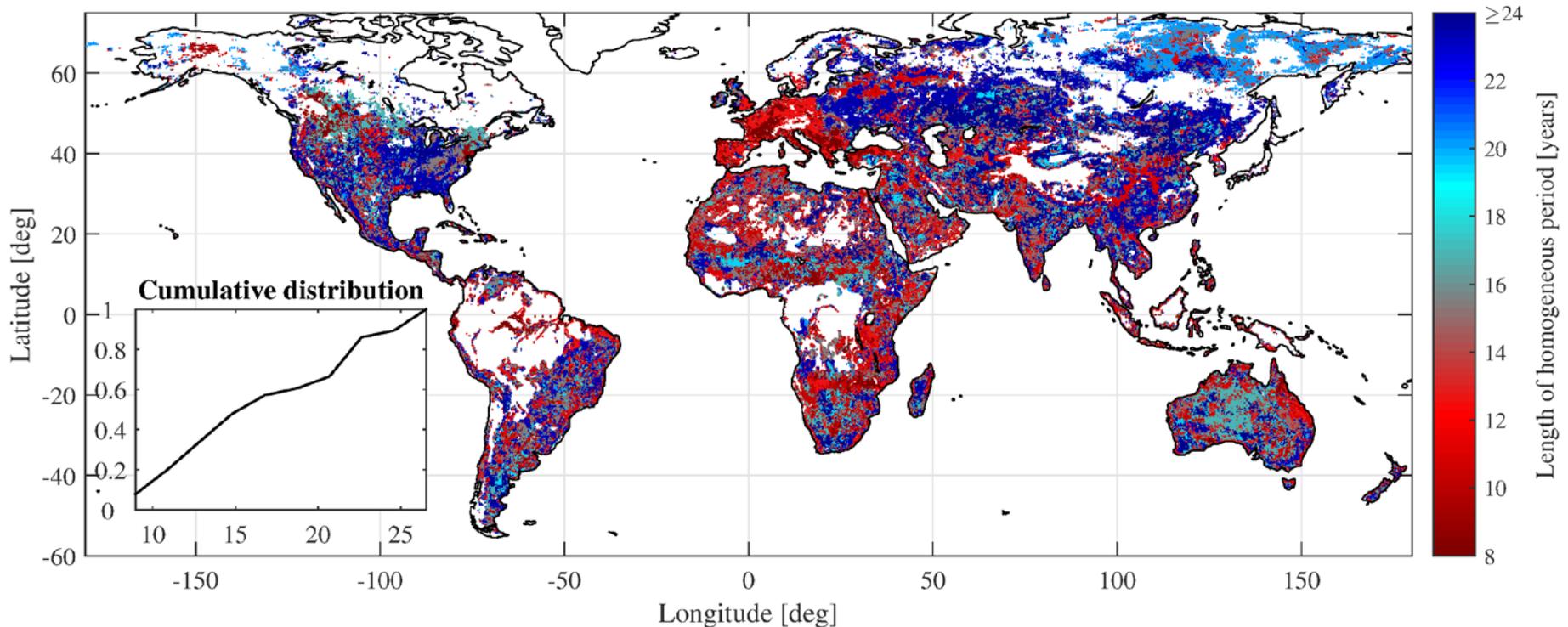
random error [m^3m^{-3}]





Error characterisation

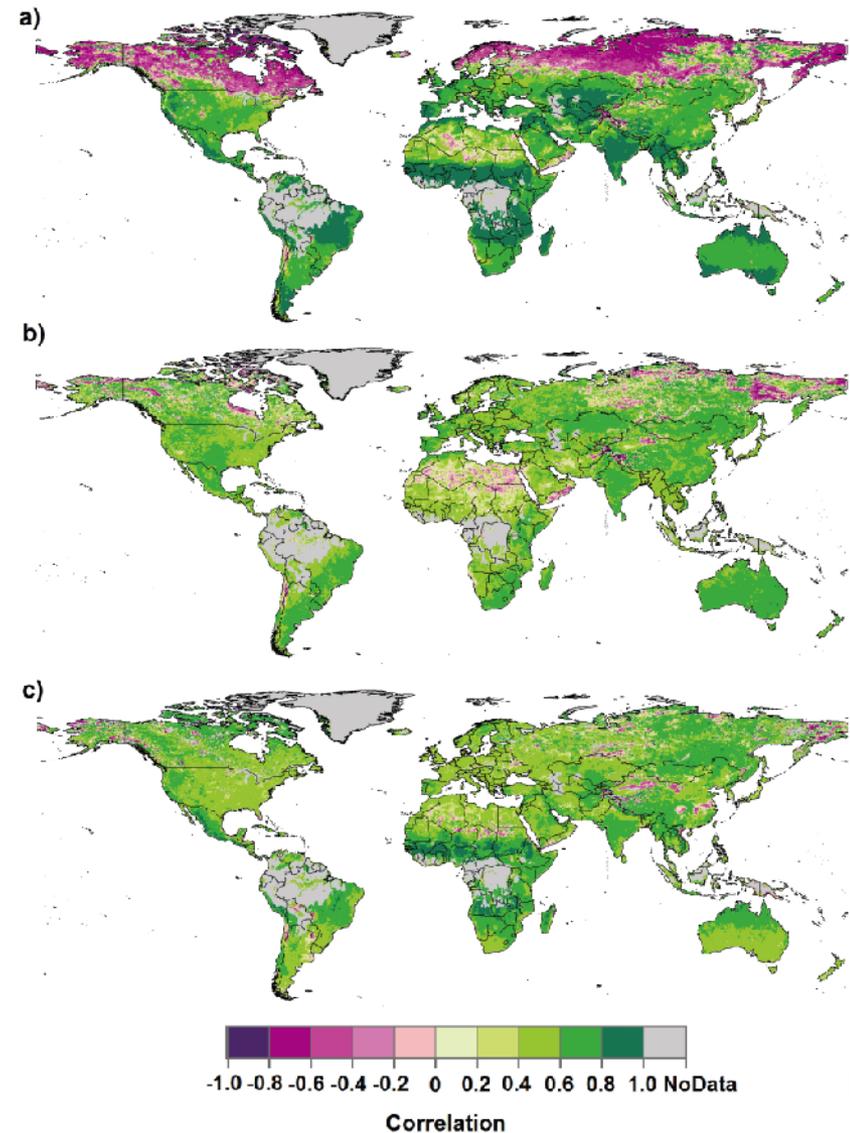
- Length of (longest) homogeneous periods in ESA CCI SM v02.2 over which non inhomogeneity is detected





Consistency with ERA-Interim/Land and GPCP

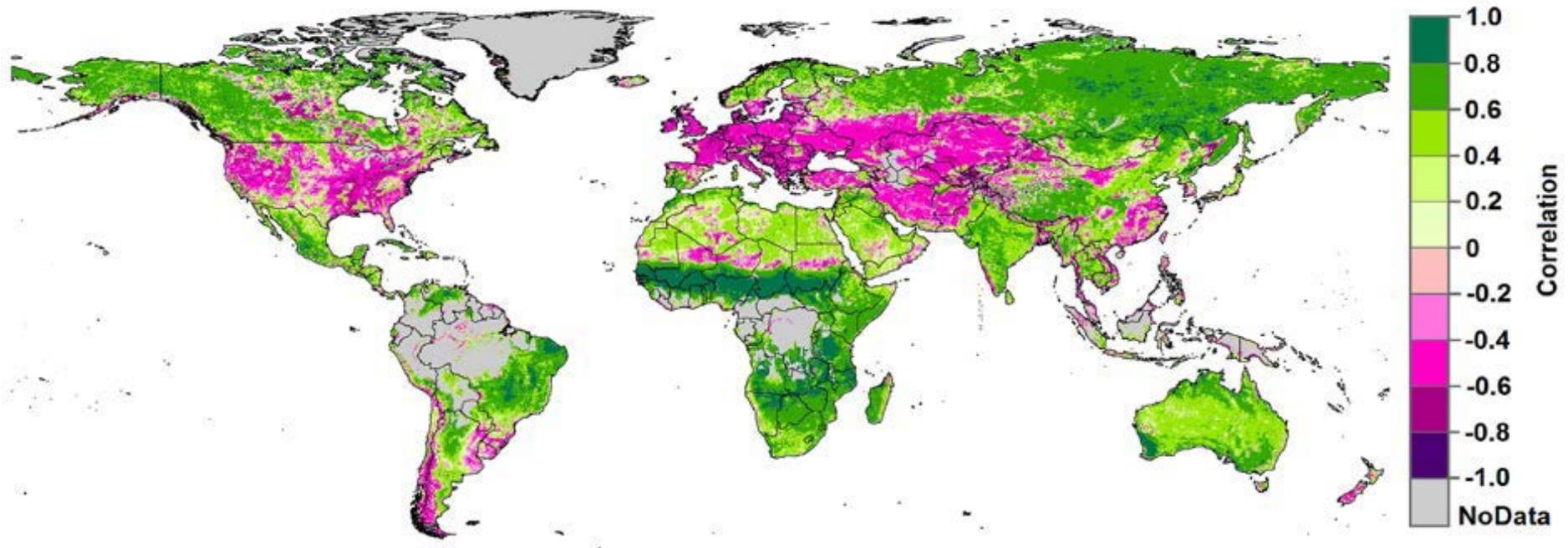
- Pearson correlation 1991-2013
 - a) CCI SM – ERA-Interim/Land surface soil moisture
 - b) CCI SM – ERA-Interim/Land anomalies surface soil moisture
 - c) CCI SM - GPCP 1DD precipitation



[Dorigo et al., in rev., RSE]



Consistency with GIMMS 3G NDVI



[Dorigo et al., in rev., RSE]



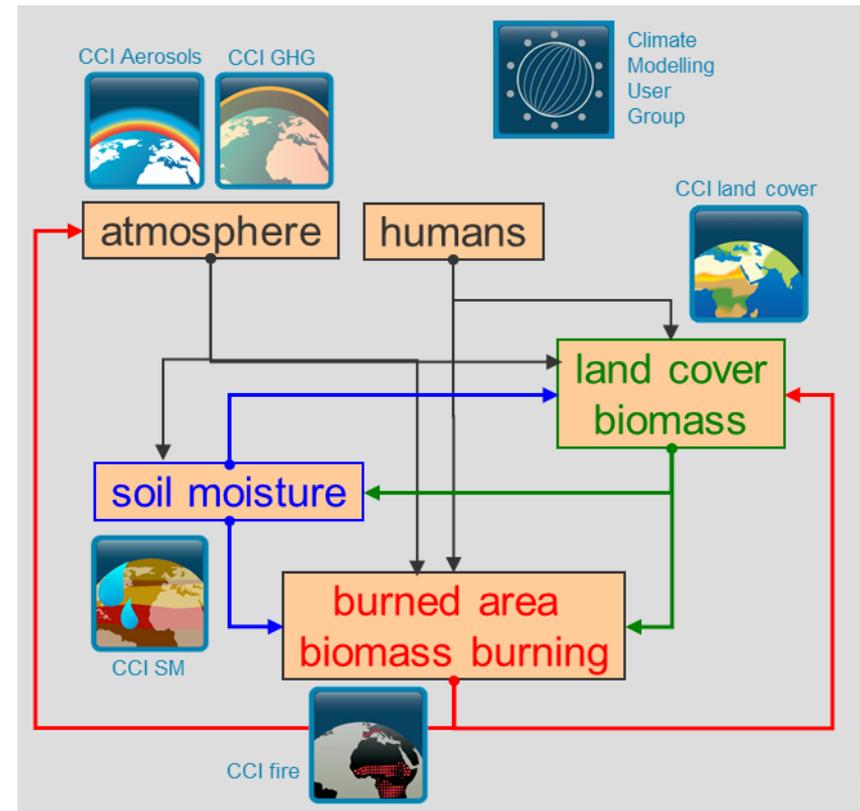
Novel applications: CCI4SOFIE

- CCI data for assessing soil moisture controls on fire emissions (Matthias Forkel)

- Sponsored by**  

- Scope:** Improve understanding of climate-vegetation-fire interactions and biomass burning emissions from (ESA CCI) EO data

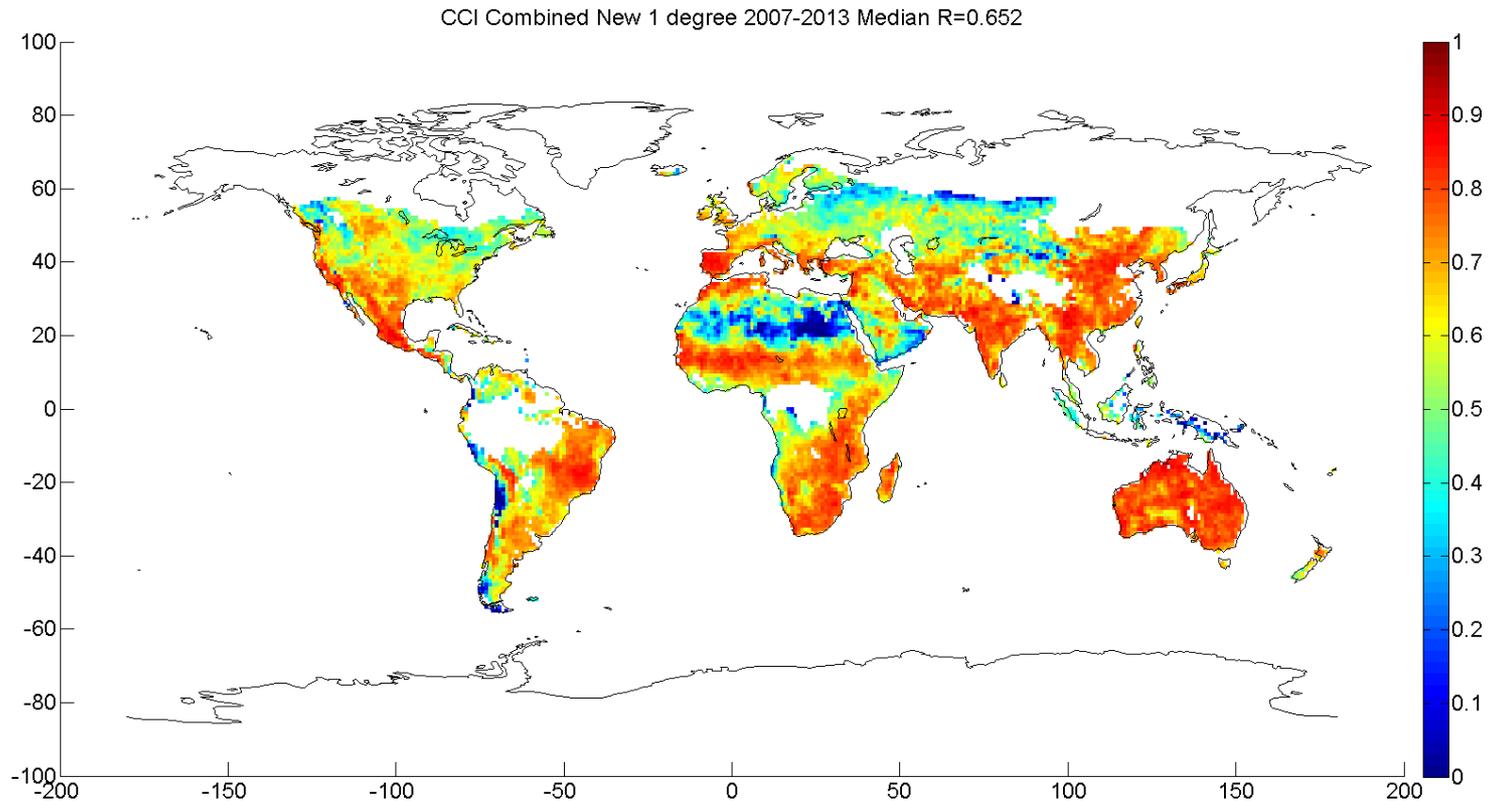
- Status of work/project**
 - New fire model 
 - Evaluation of FireMIP models





Novel applications: CCISM2RAIN

- Using a simple water balance model, SM2RAIN estimates precipitation from ESA CCI soil moisture.
 - Correlation with GPCP FDD 1°

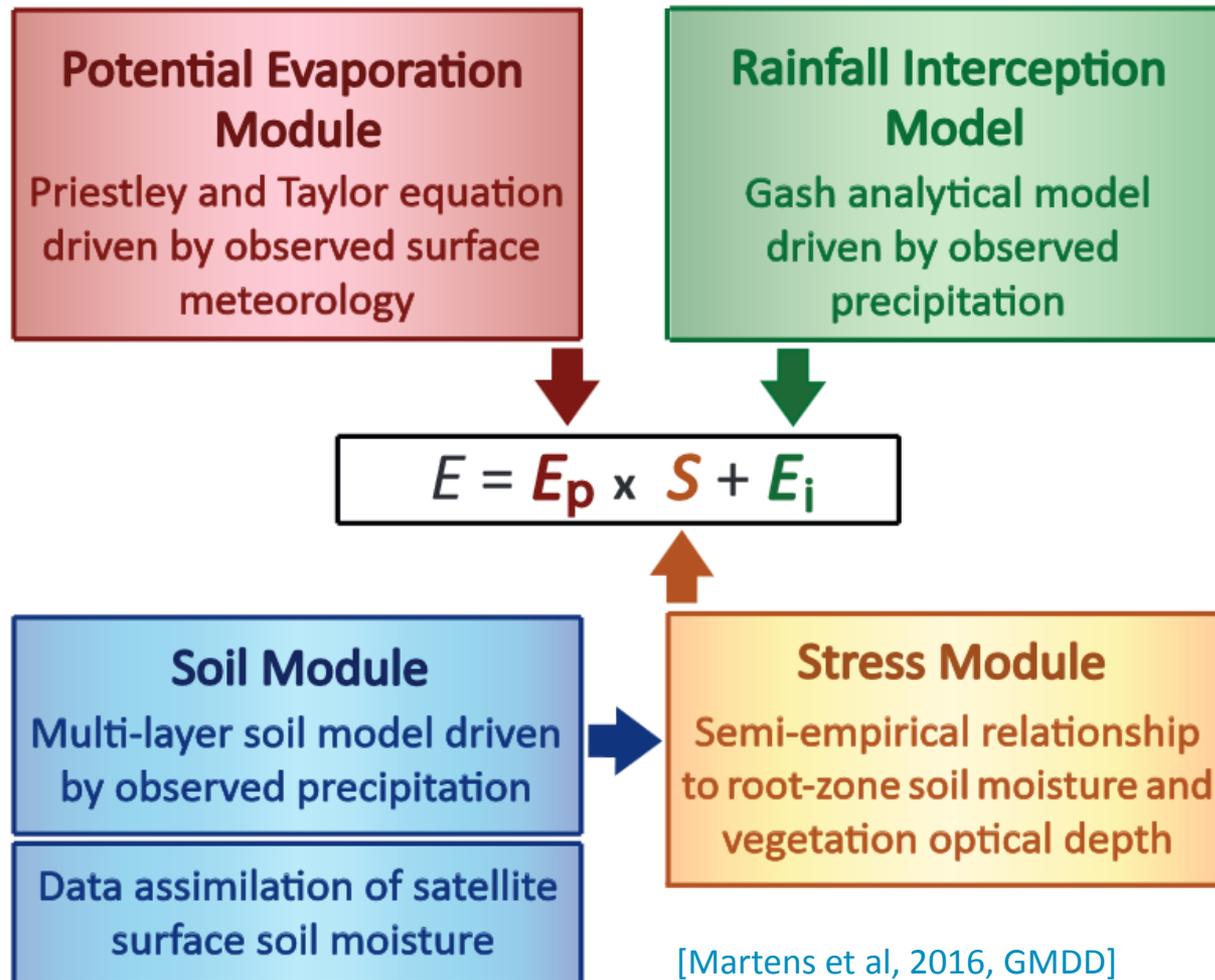


[Ciabatta et al., in prep]



Novel applications: ET modelling

- Assimilation into GLEAM



[Martens et al, 2016, GMDD]

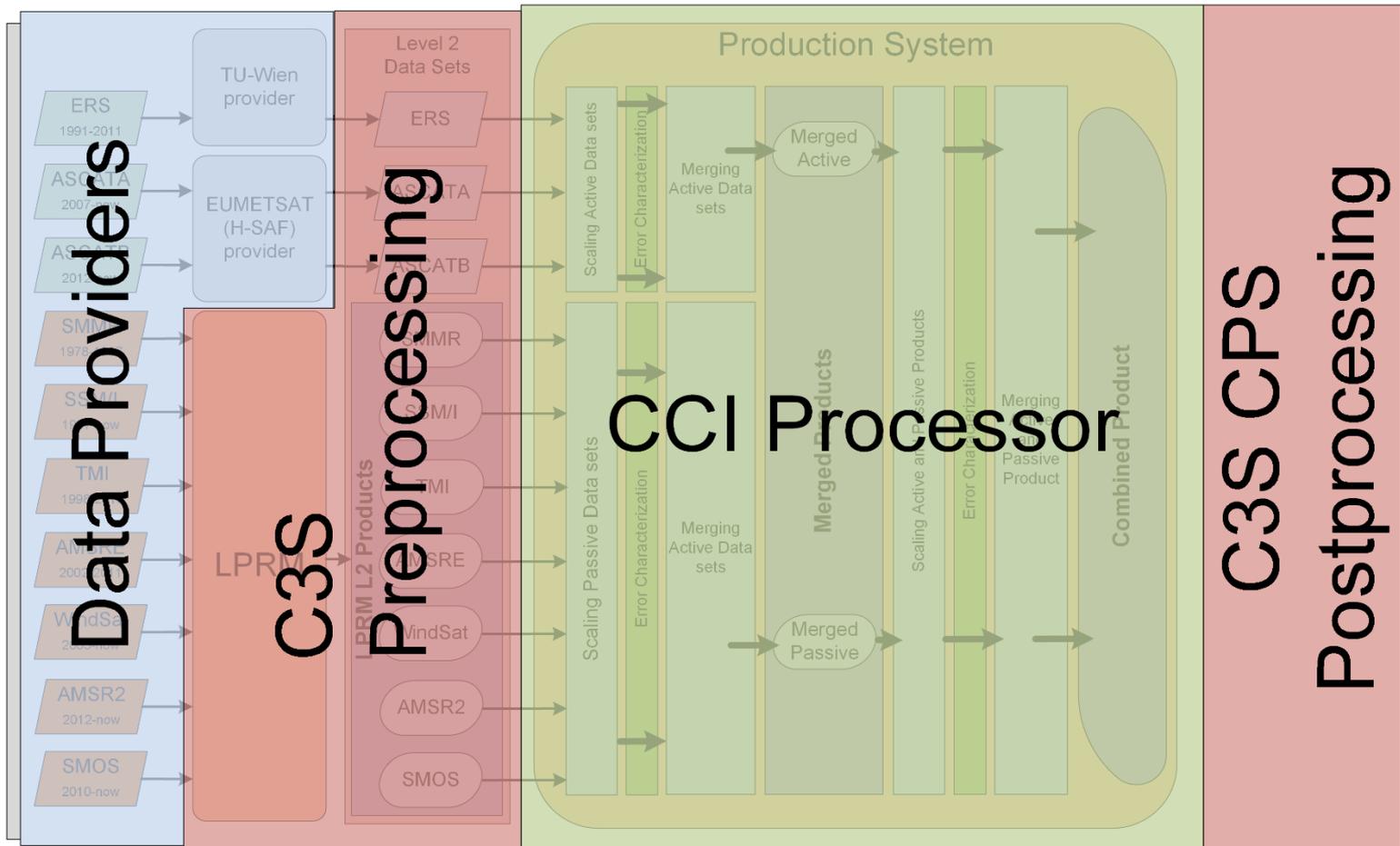


Future research

- Integration of Novel missions: MetOp-C, SMAP, FengYun, Sentinel-1
- Improved characterisation of errors and product improvements through novel methods: triple collocation, SM2RAIN, data assimilation
- CCI SM products completely independent of land surface model estimates (currently GLDAS-Noah is being used as scaling reference) -> currently testing whether SMOS can provide the climatology
- Root-zone soil moisture product from CCI SM
- Improved flagging of frozen soils, water bodies
- Using inhomogeneity testing to detect and **correct for** breaks
- Additional metadata
 - Vegetation optical depth
 - Surface water
 - Land surface state (freeze/thaw)



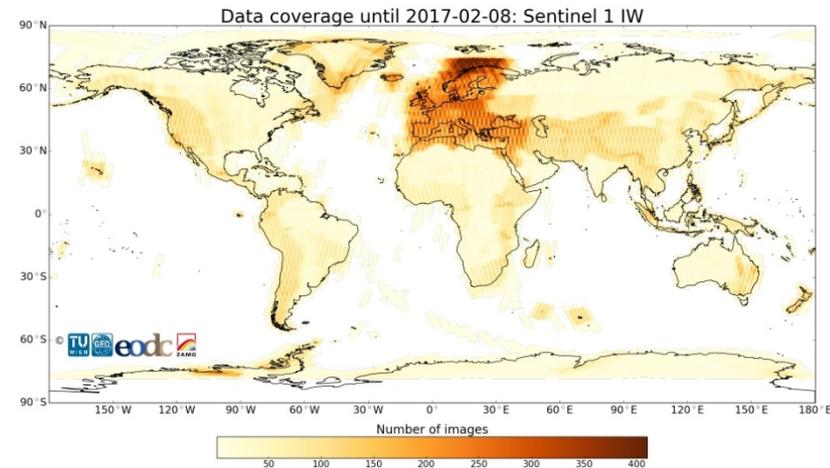
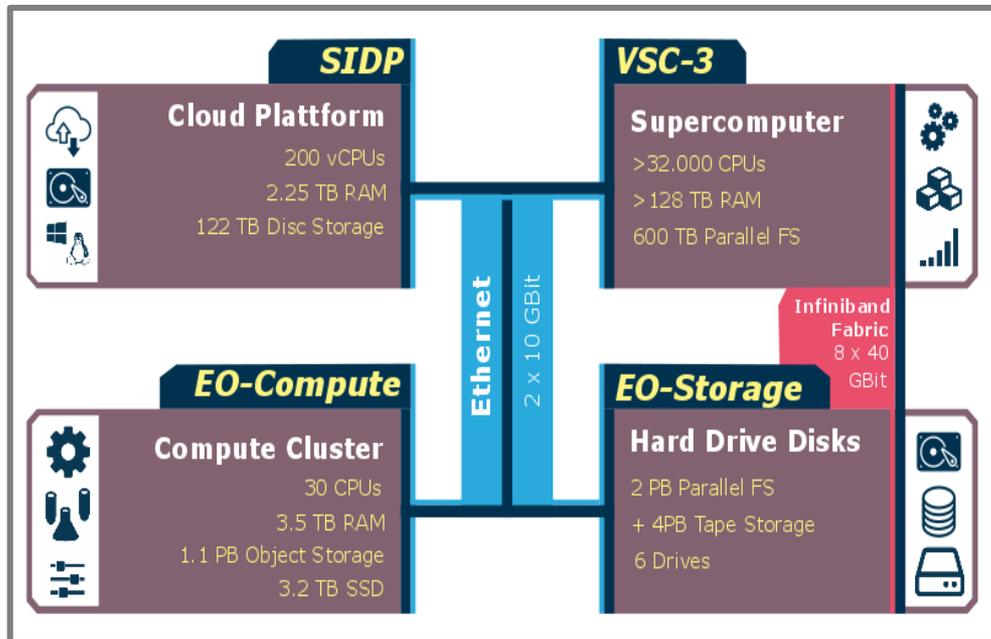
ESA CCI SM at the core of C3S soil moisture





Future CCI SM production on EODC

- EODC is a public-private partnership for promoting collaboration in earth observation and moving EO data processing into the cloud
 - Hosts (almost) complete Sentinel data archives (Sentinel 1-3)
 - Connection to two supercomputers (VSC-3 and VSC-4 from 2018)
- Global scale processing of Sentinel-1 data @ 10 m grid possible
 - Water bodies, forest mapping (biomass), freeze/thaw (permafrost), snow melt





International activities

- Obs4MIPs: Data submitted in March 2016; no feedback
- Yearly contribution to BAMS State of the Climate Report (since 2010)

