Assimilation of the SCATSAR-SWI with SURFEX: Impact of local observation errors*

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ZAMG Zentralanstalt für Meteorologie und Geodynamik

TU WIEN

LACE-DAWD
Prague, 19.09.2019

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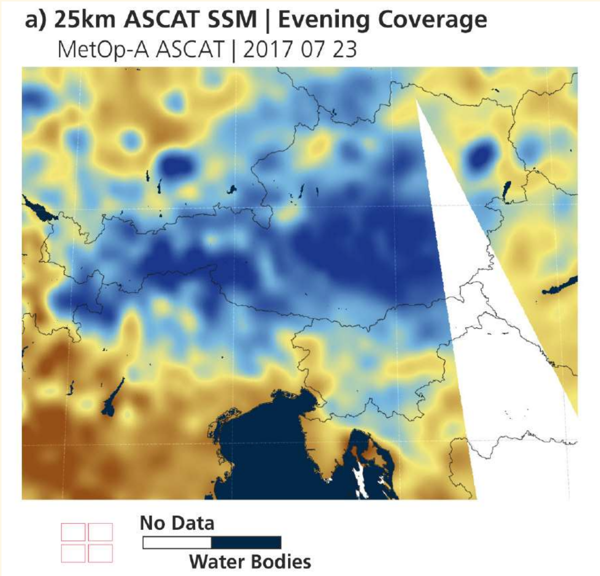
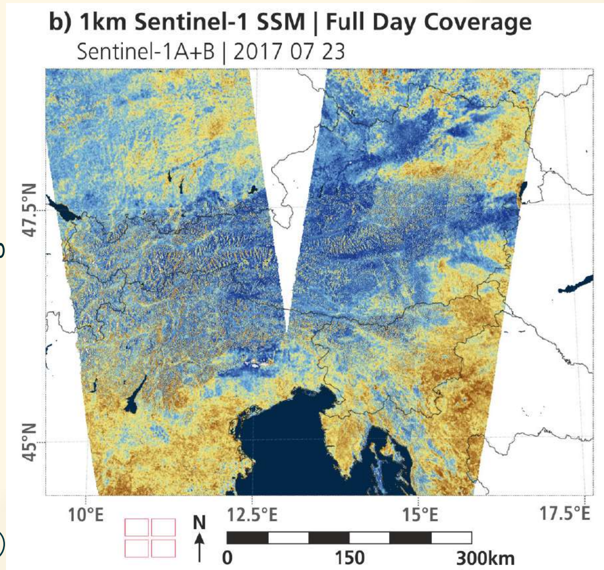
Introduction

- Constant (“global”) observation error for whole domain in data assimilation with SURFEX:
  e.g. `XERROBS_M` = 0.2
- Approach:
  estimate observation error for each grid point (“local”)
  ⇒ **Triple Collocation Analysis** *(Stoffelen 1998)*

Observations: SCATSAR-SWI





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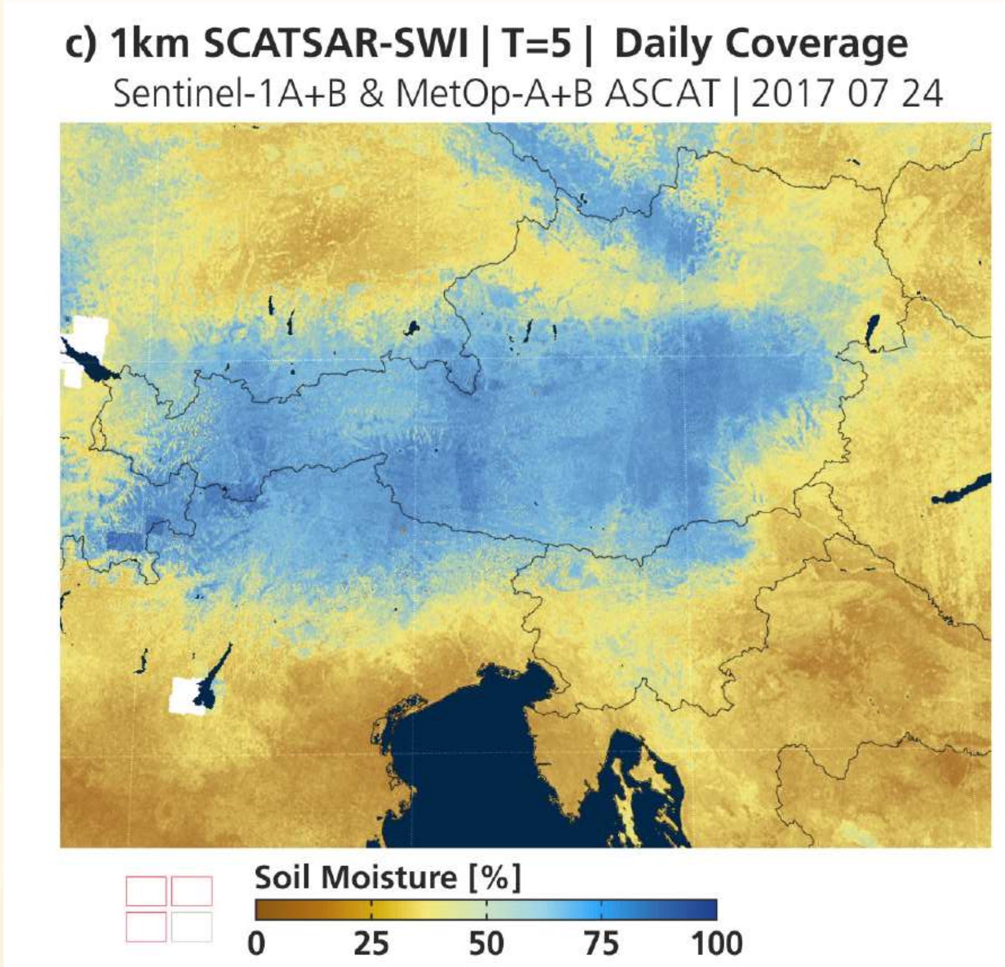

- temporal resolution: 1 day
- spatial resolution: 1 km
- vertical resolution: 8 layers

provided freely via the Copernicus Global Land Service

Triple Collocation Analysis

- Linear error model

$$\Theta_{\mathrm{meas}} = \alpha + \beta\Theta_{\mathrm{true}} + \epsilon$$
$$\Rightarrow \sigma_{\epsilon}^{2}$$

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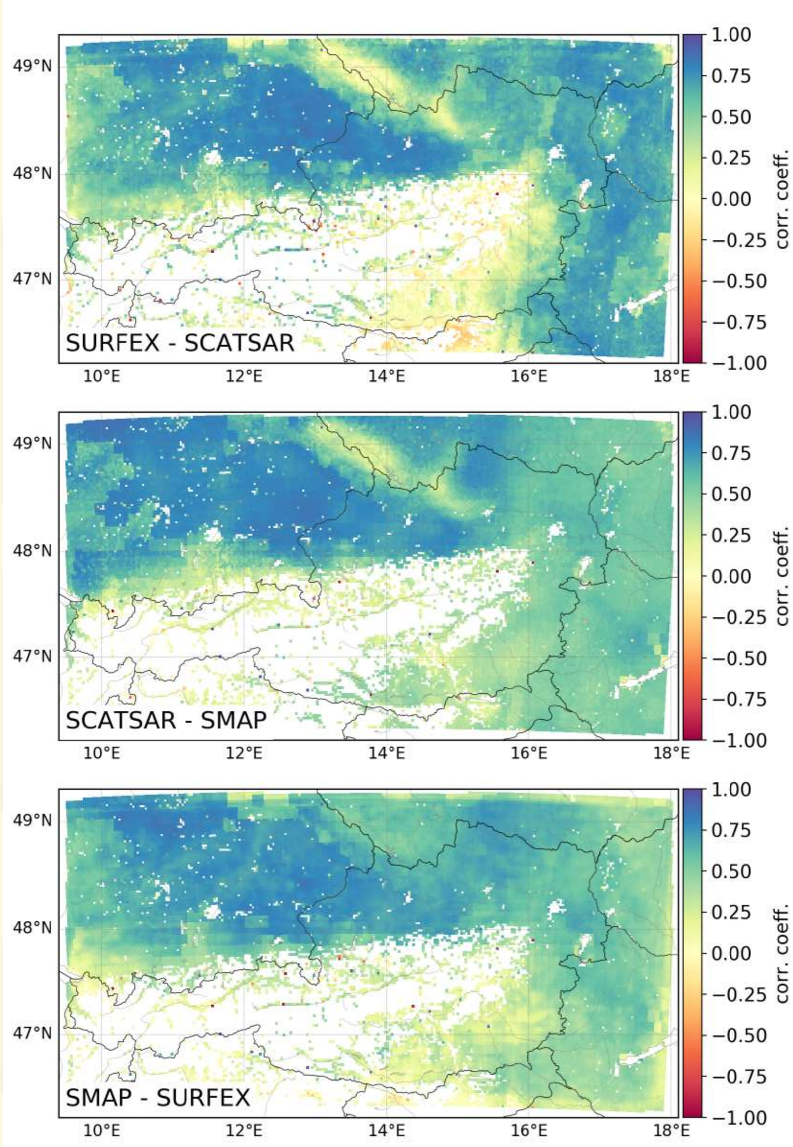
- Data sets (zero error cross-correlation!):
  - ▷ active sensor: SCATSAR-SWI
  - ▷ passive sensor: SMAP (L3, 9 km)
  - ▷ model: SURFEX

Triple Collocation Analysis – Correlation

soil level 1

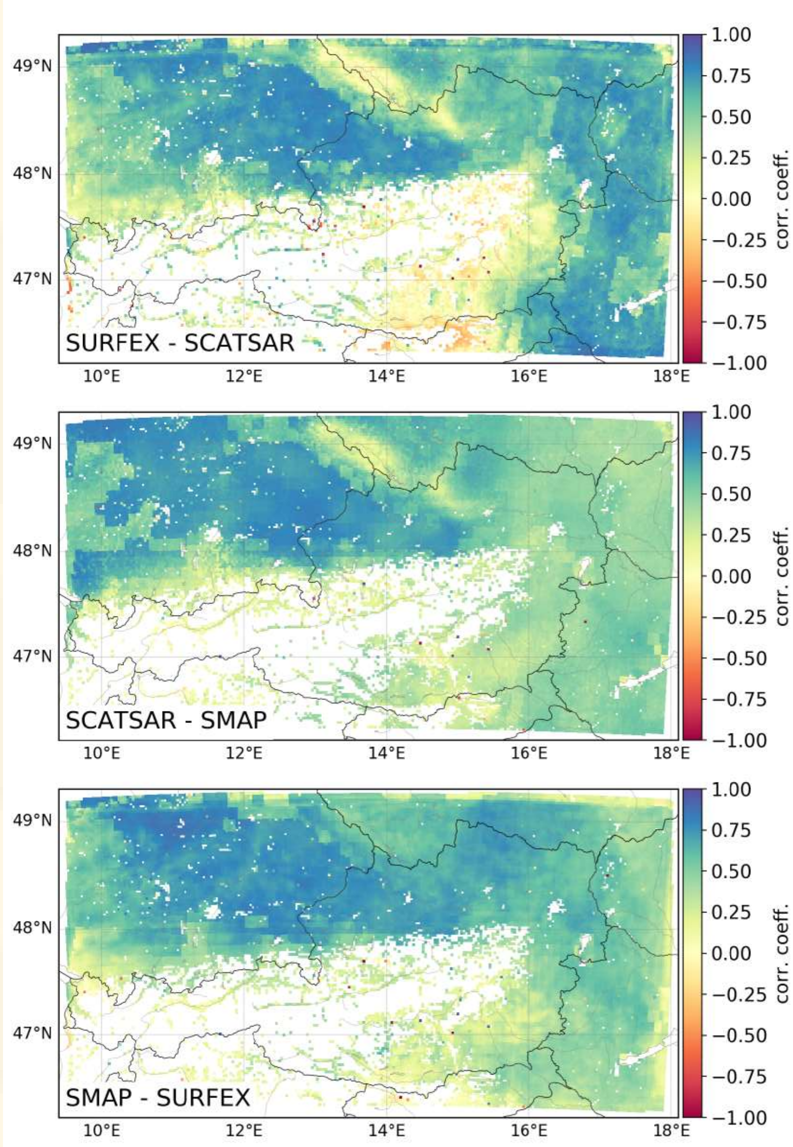
- Correlation SURFEX-SCATSAR:
  - ▷ worse with increasing depth for hills
  - ▷ better for flatlands
- Correlation with SMAP (single layer):
  - ▷ worse with increasing depth



Triple Collocation Analysis – Correlation

soil level 2

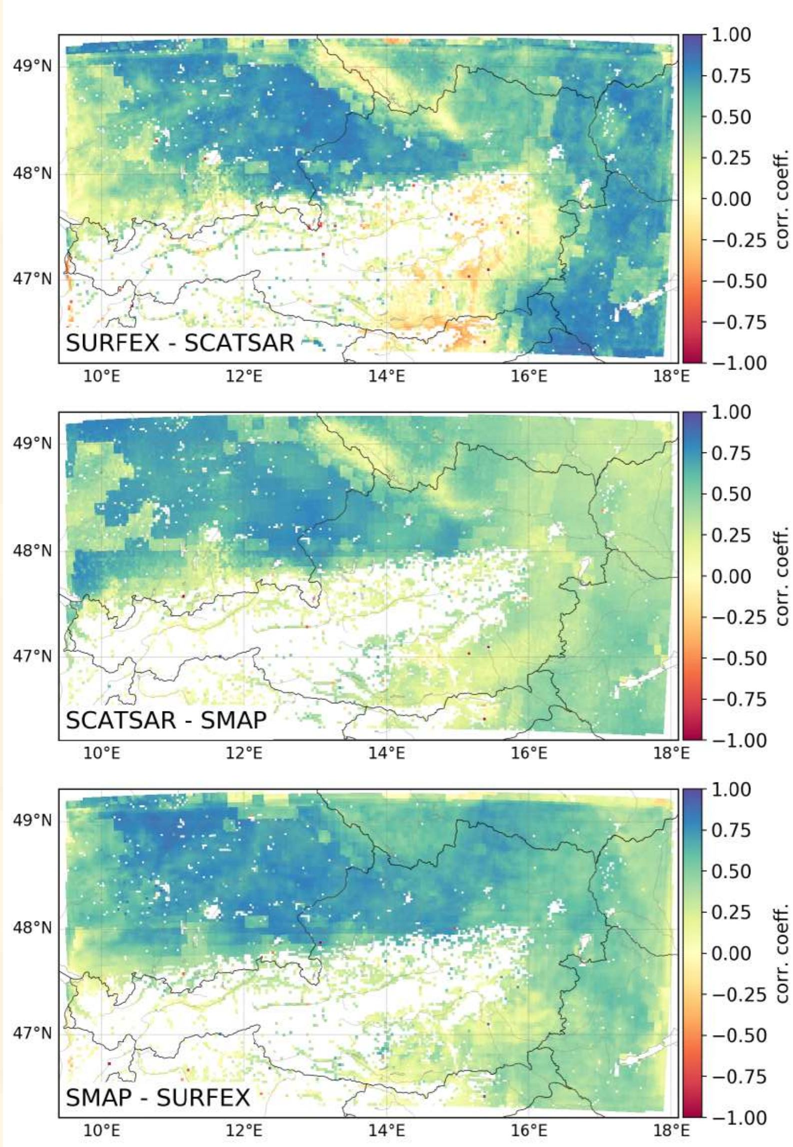
- Correlation SURFEX-SCATSAR:
  - ▷ worse with increasing depth for hills
  - ▷ better for flatlands
- Correlation with SMAP (single layer):
  - ▷ worse with increasing depth



Triple Collocation Analysis – Correlation

soil level 3

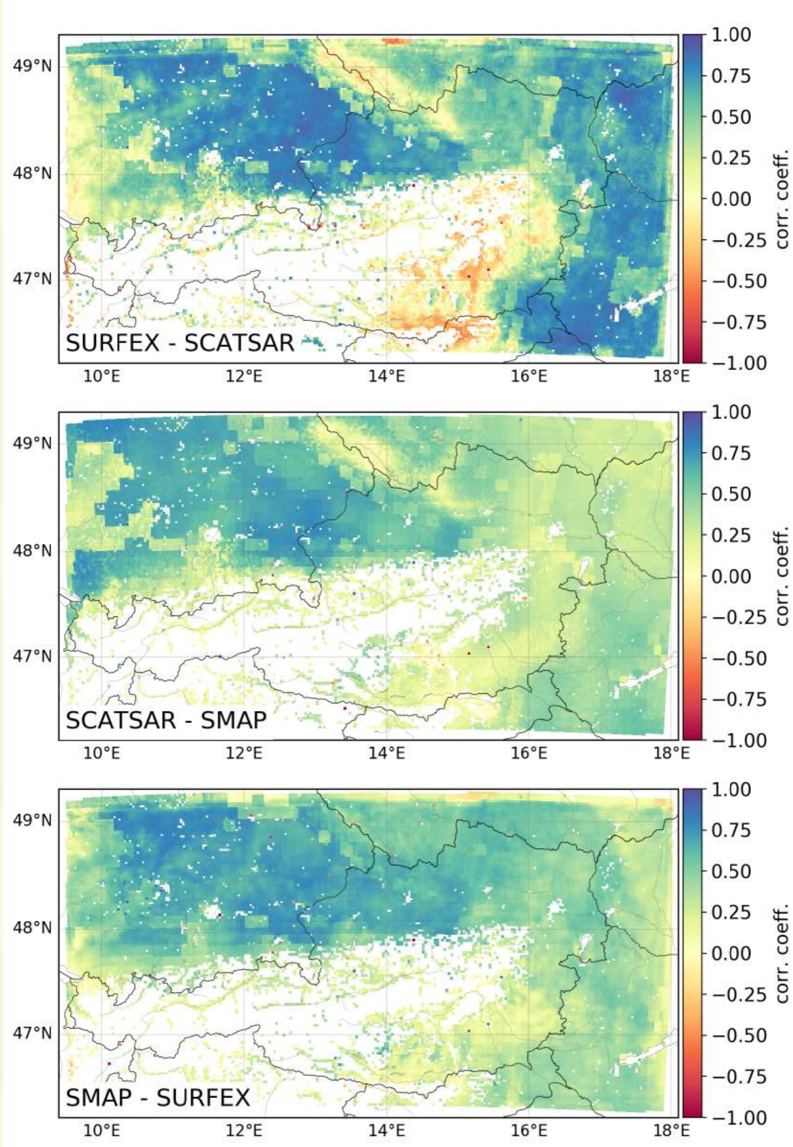
- Correlation SURFEX-SCATSAR:
  - ▷ worse with increasing depth for hills
  - ▷ better for flatlands
- Correlation with SMAP (single layer):
  - ▷ worse with increasing depth



Triple Collocation Analysis – Correlation

soil level 4

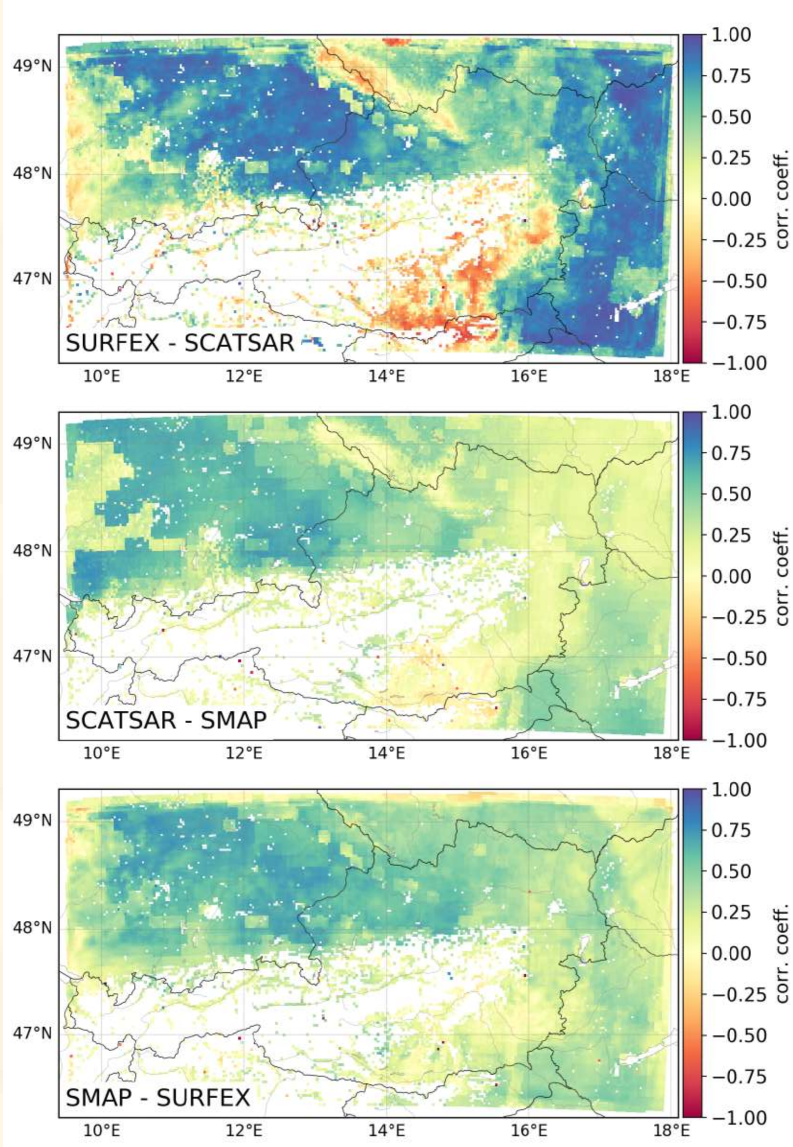
- Correlation SURFEX-SCATSAR:
  - ▷ worse with increasing depth for hills
  - ▷ better for flatlands
- Correlation with SMAP (single layer):
  - ▷ worse with increasing depth



Triple Collocation Analysis – Correlation

soil level 5

- Correlation SURFEX-SCATSAR:
  - ▷ worse with increasing depth for hills
  - ▷ better for flatlands
- Correlation with SMAP (single layer):
  - ▷ worse with increasing depth



Triple Collocation Analysis – Correlation

soil level 6

- Correlation SURFEX-SCATSAR:
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  - ▷ better for flatlands
- Correlation with SMAP (single layer):
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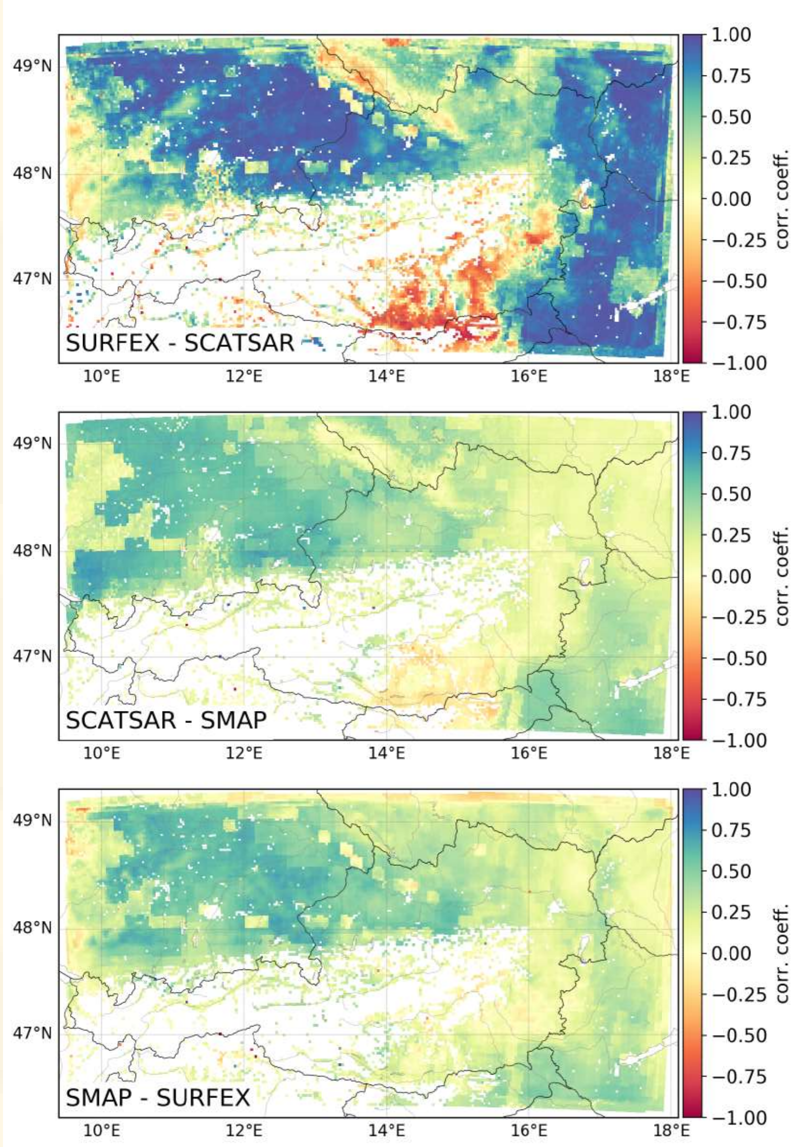
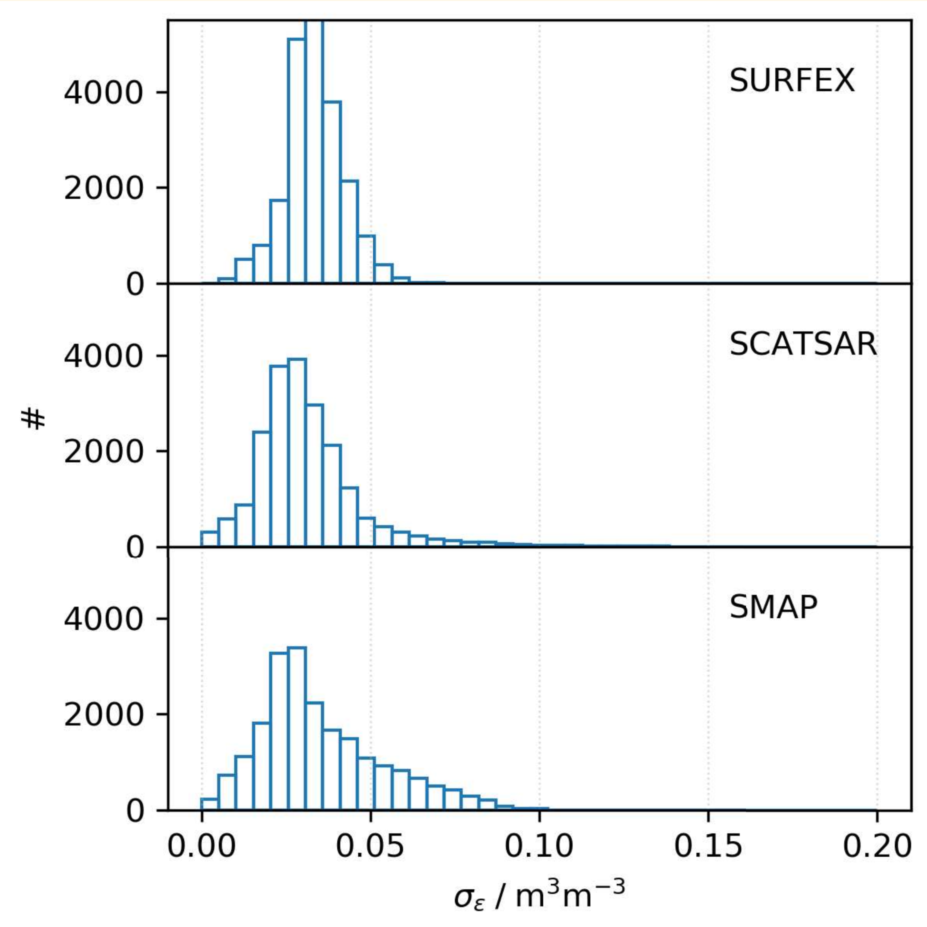


Triple Collocation Analysis – SCATSAR error STD



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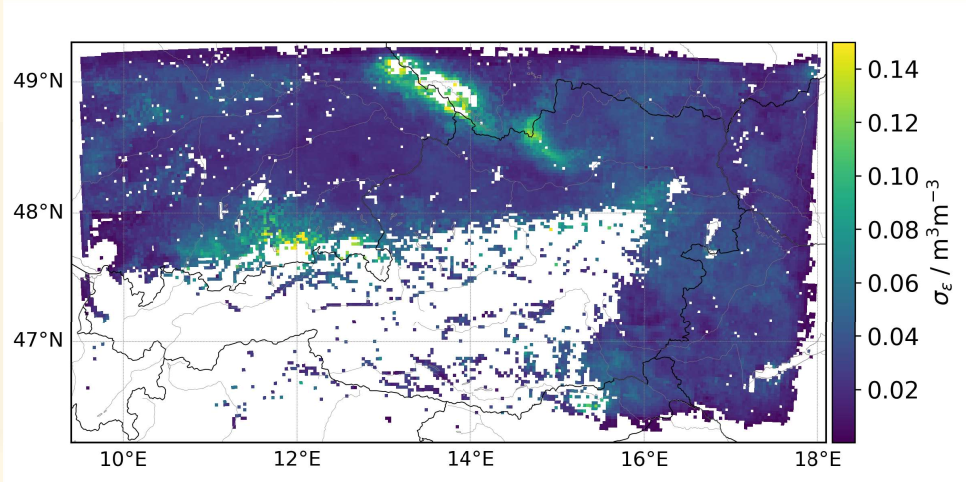

- SURFEX & SCATSAR error STD smaller with depth $\Leftarrow$ smoother deeper levels
- SMAP error STD larger with increasing depth $\Leftarrow$ lack of representativeness

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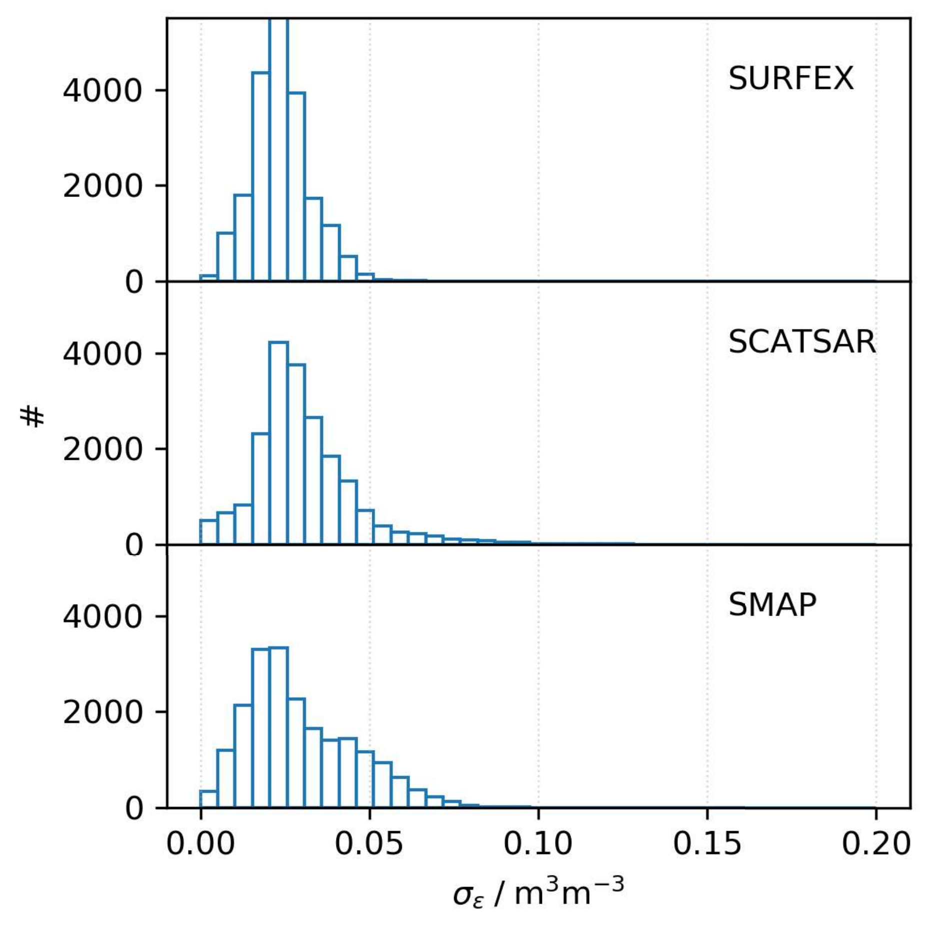
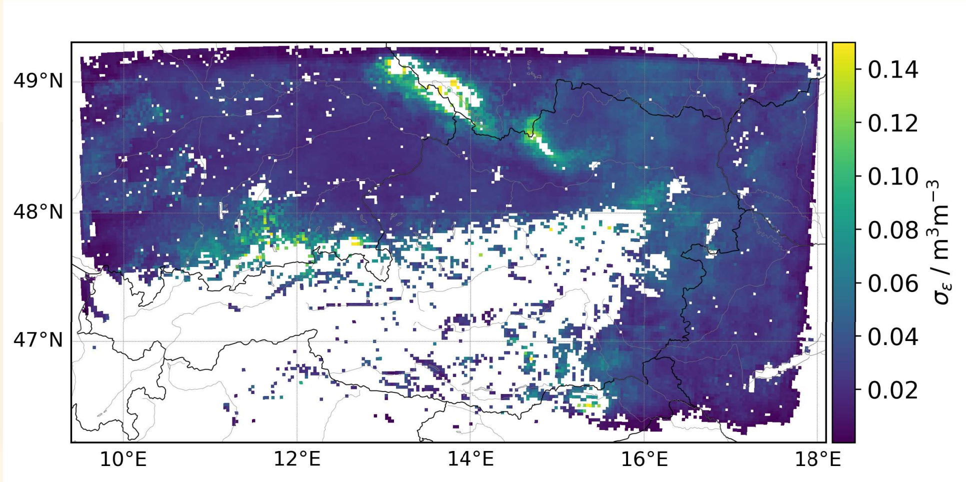


soil level 2



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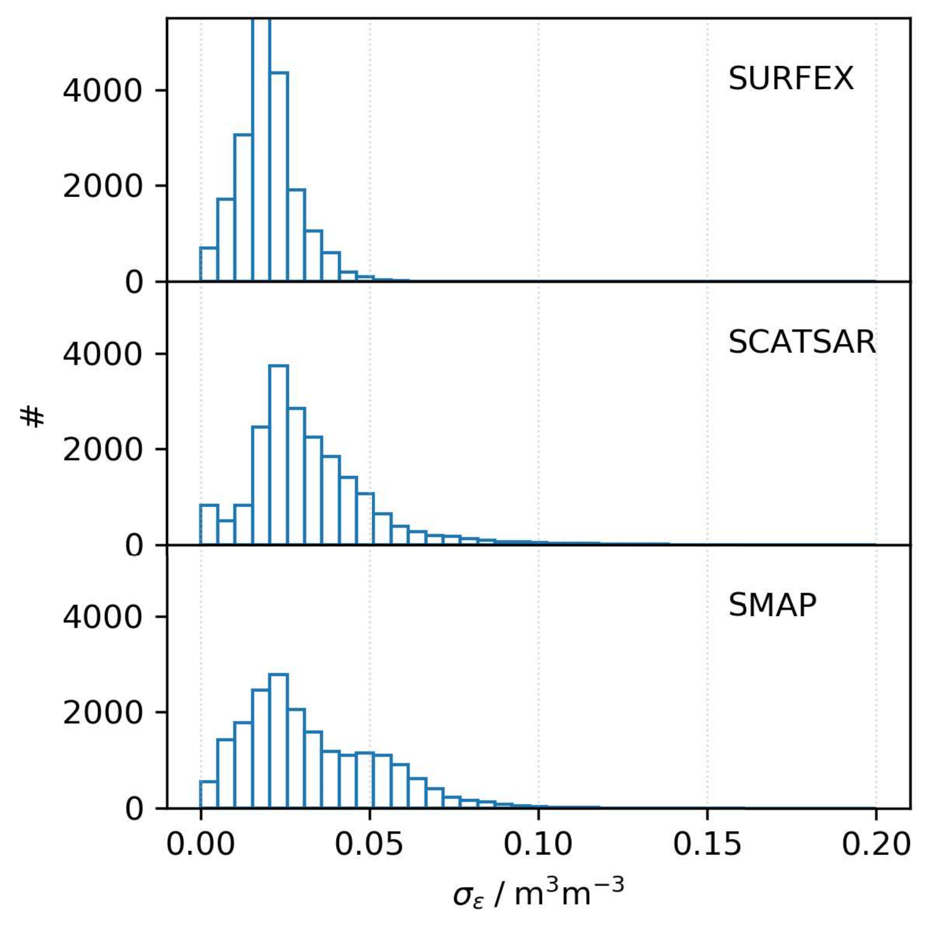
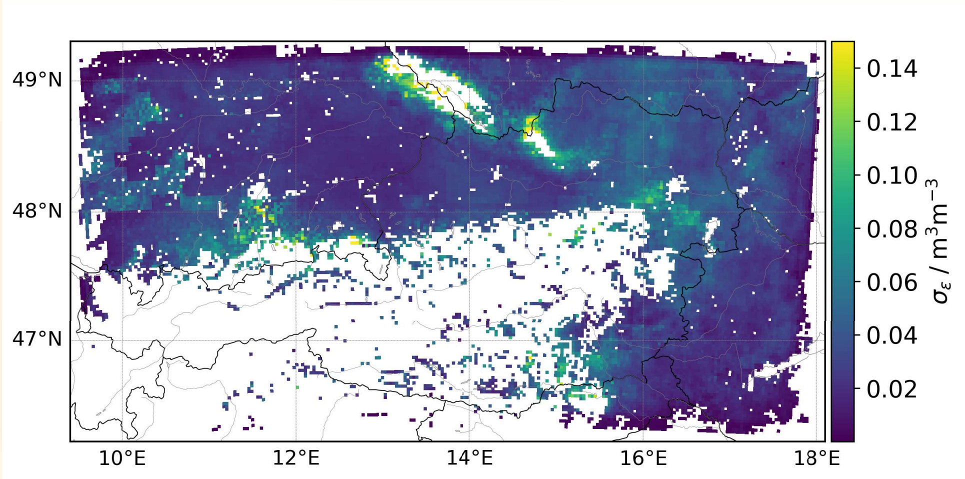


soil level 3



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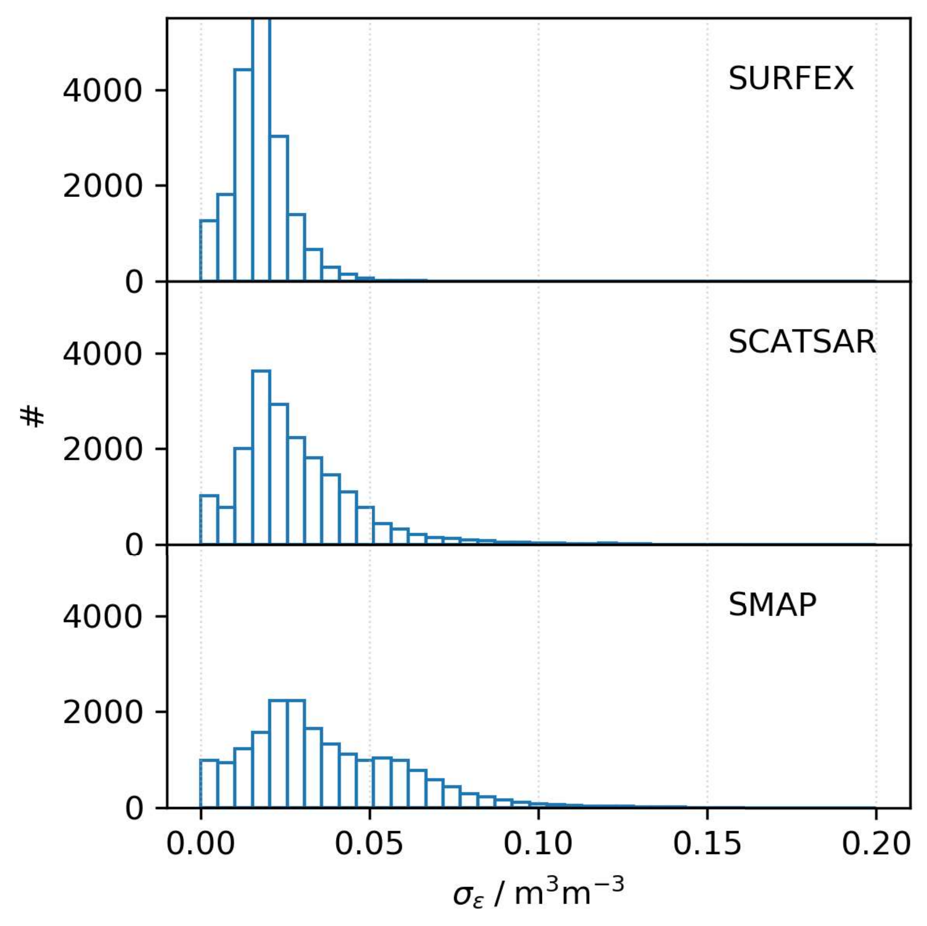
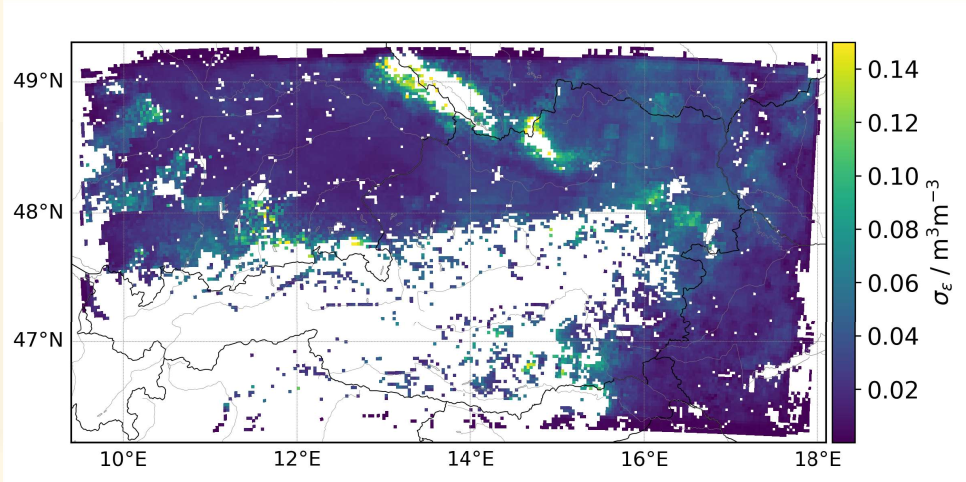


soil level 4



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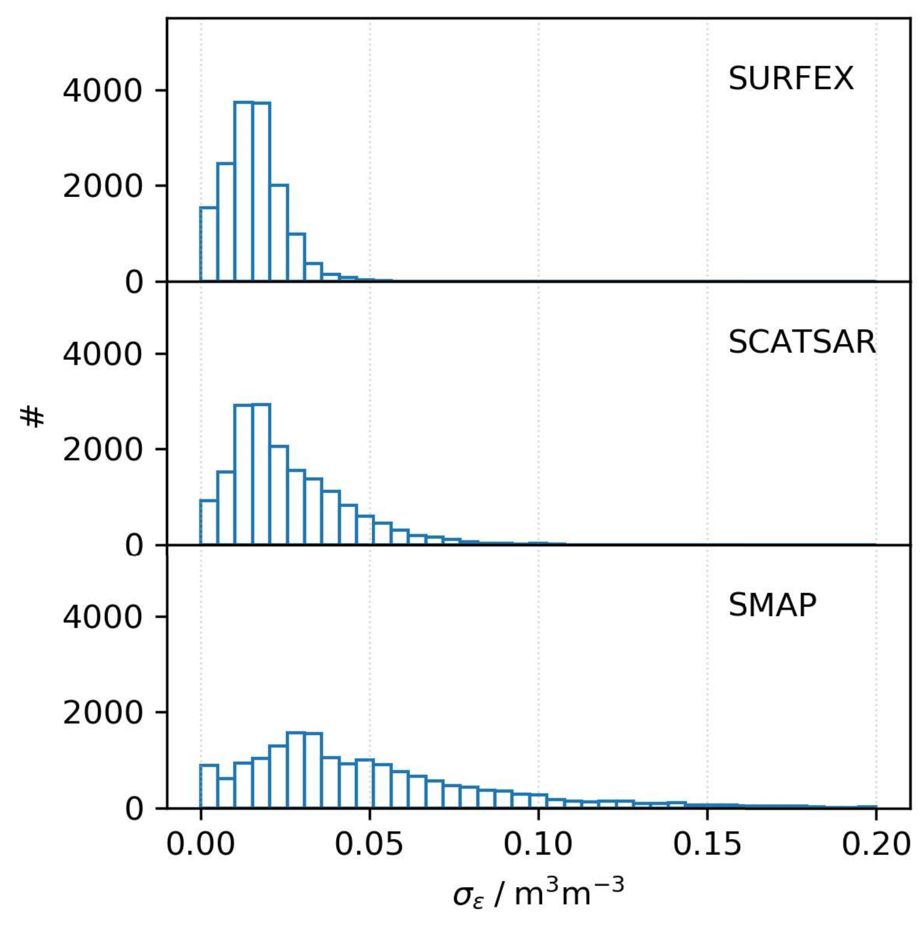

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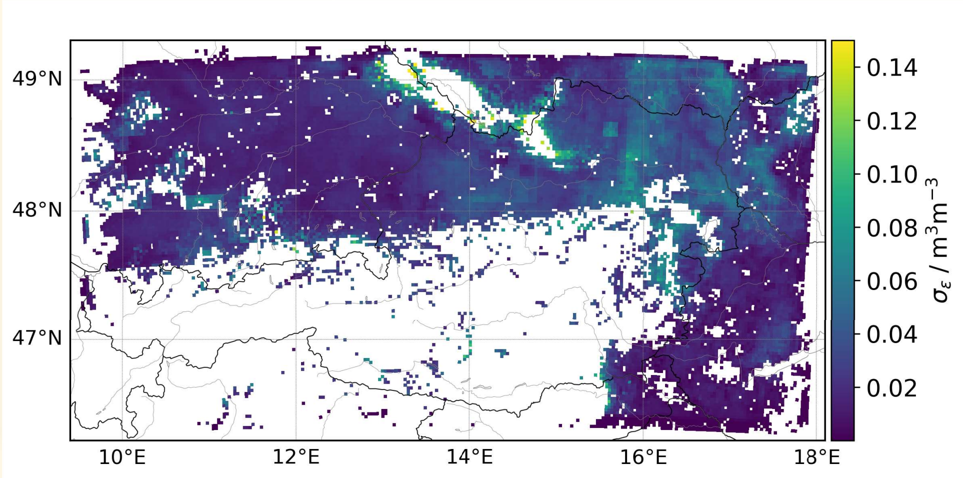

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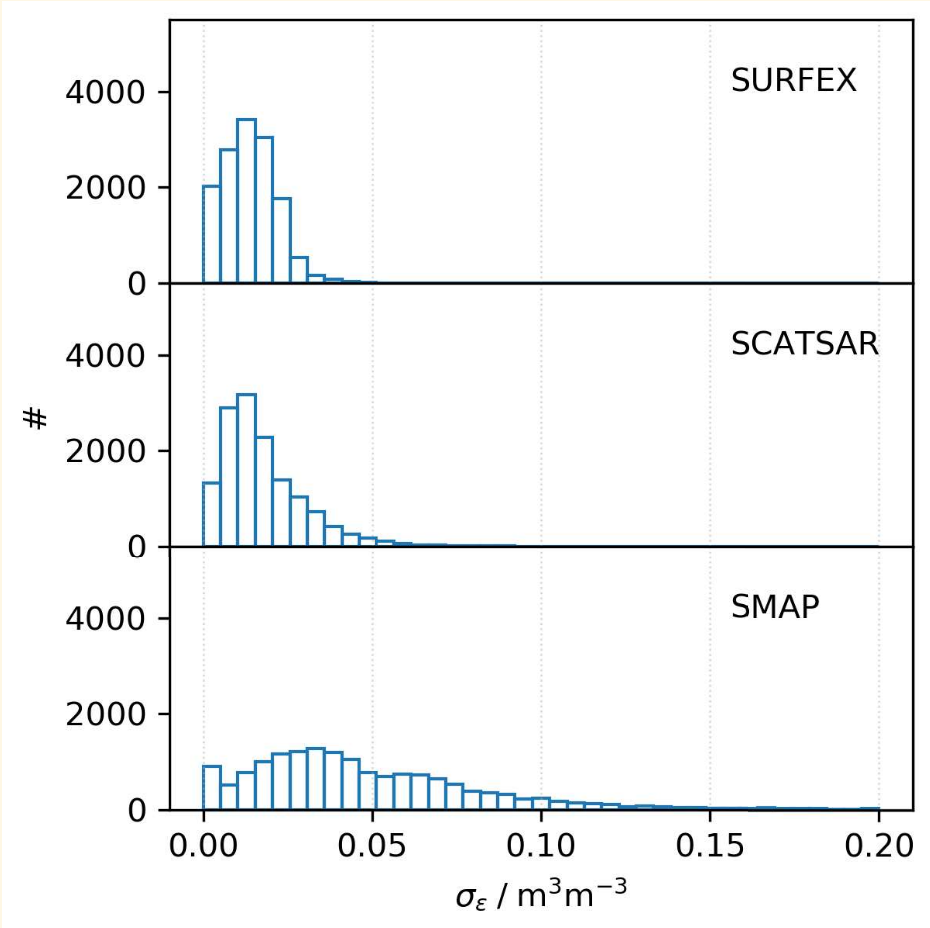

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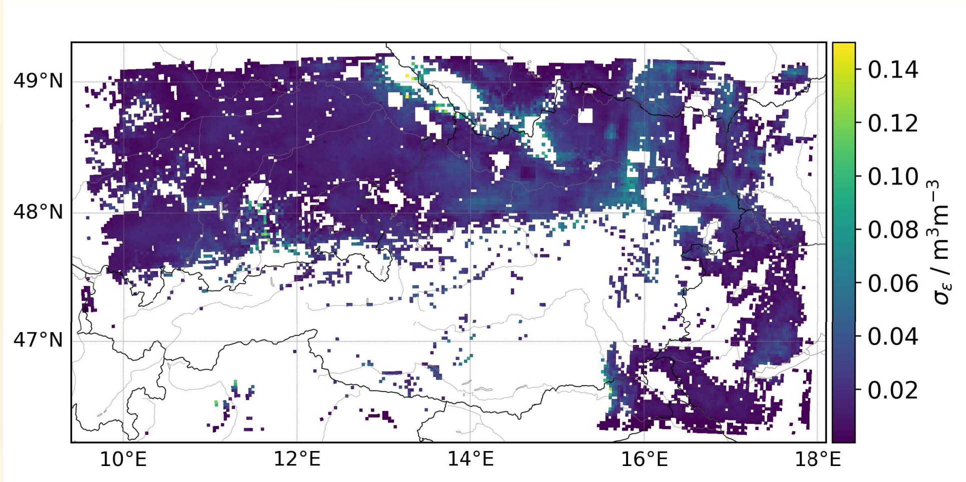

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The data assimilation system

MODEL

- AROME CY40T1 + SURFEX 7.3
- 2.5 km grid, 90 layers

SURFEX

- version 8.1
- sEKF
- `LBFIXED` removed, `LBEV` is enough
- `LERROBS = True` for local observation errors

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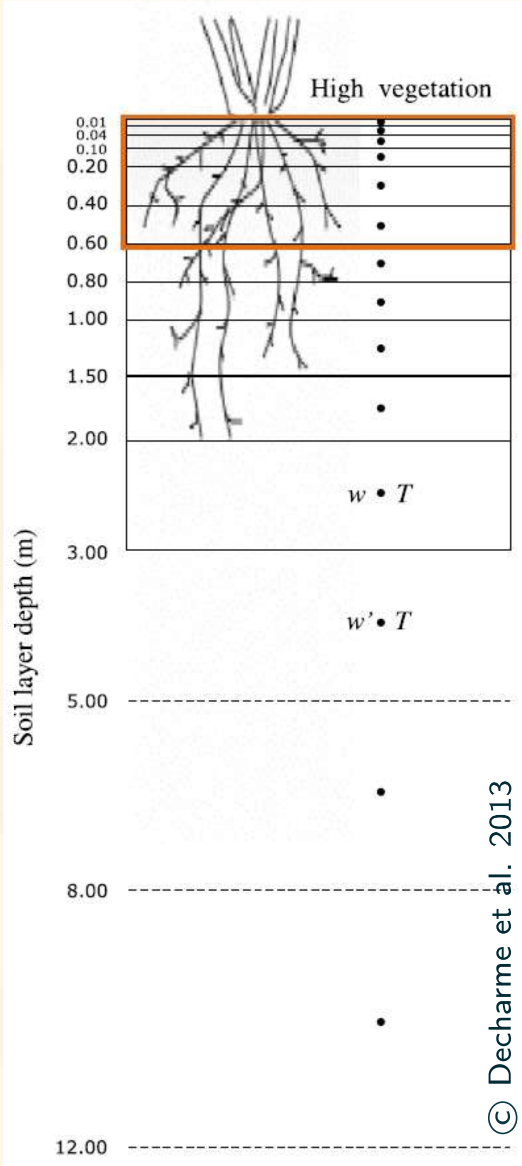
SURFEX

- version 8.1
- sEKF
- `LBFIXED` removed, `LBEV` is enough
- `LERROBS = True` for local observation errors
- `CISBA = 'DIF'`, 14 soil layers
- `NOBSTYPE = 6, NVAR = 6` (WG1-6)



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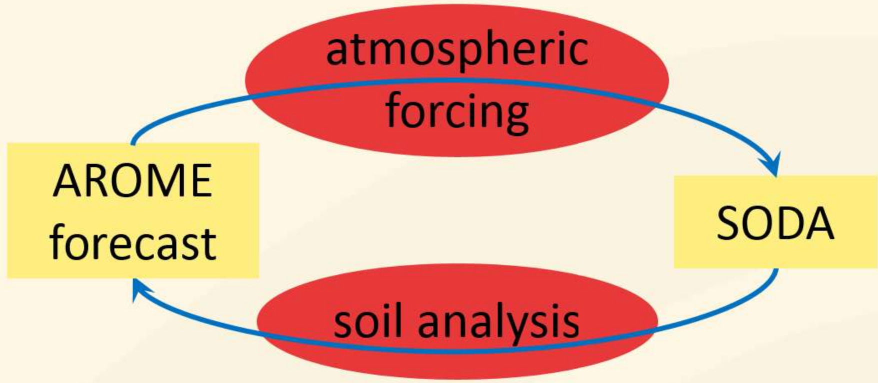

- April to September 2018
- Austrian domain
- Global vs. local observation error

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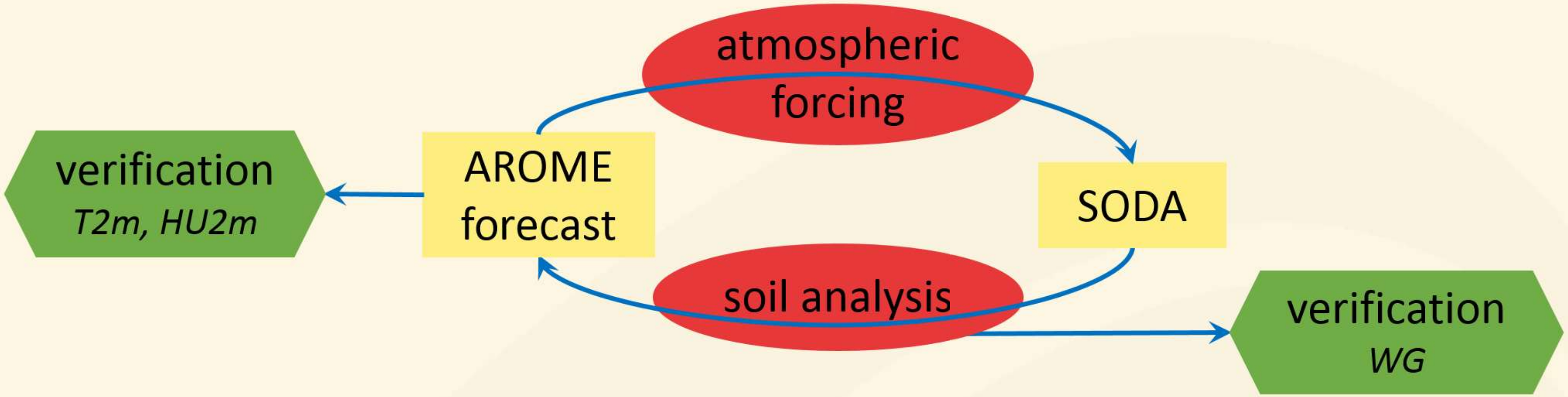

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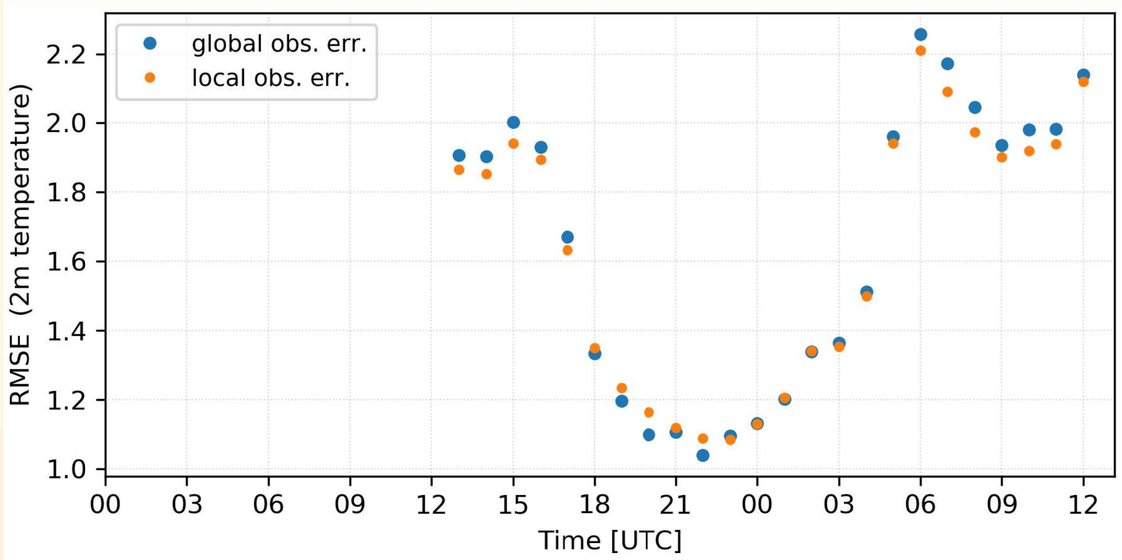
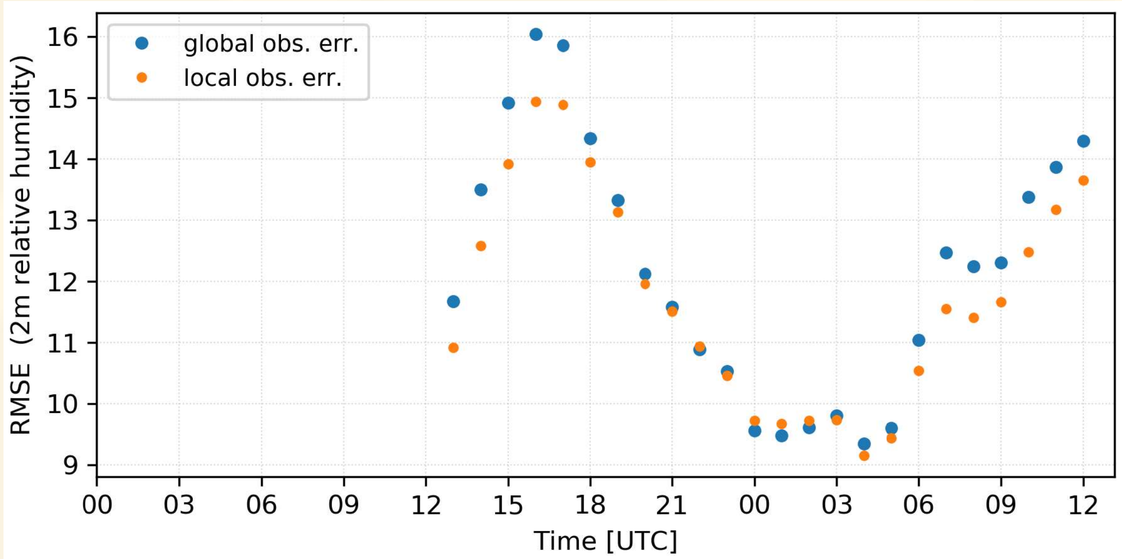
Comparison of T_{2m} & HU_{2m} with Austrian TAWES stations

- Bias & RMSE improve for some stations ...





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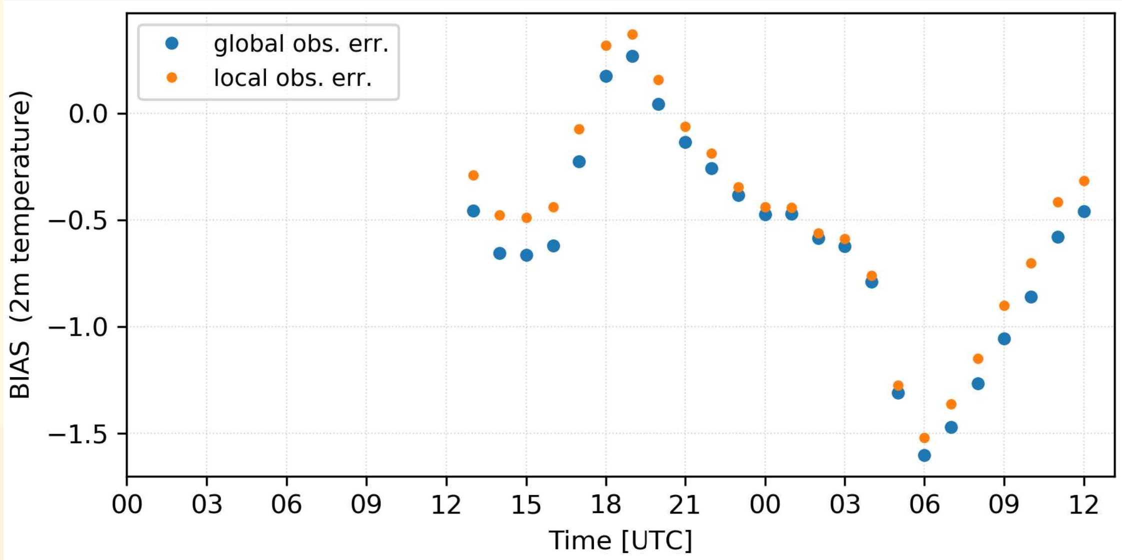

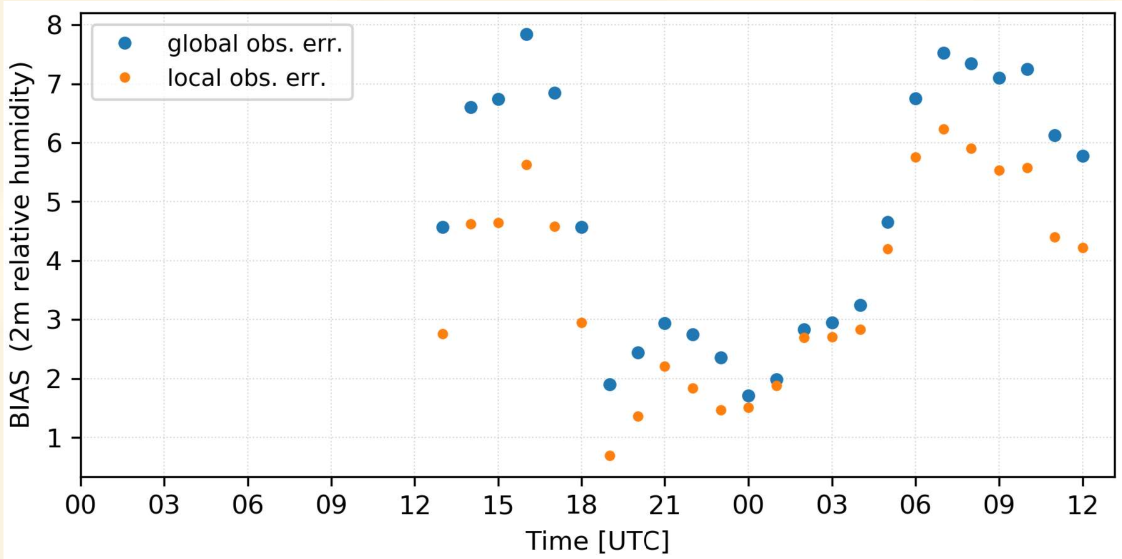

Comparison of T_{2m} & HU_{2m} with Austrian TAWES stations

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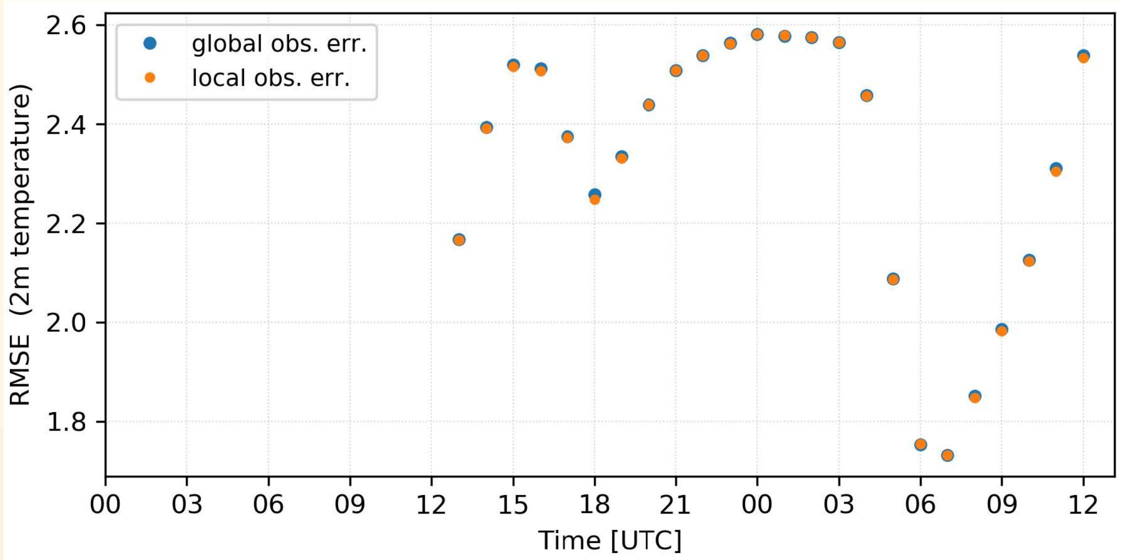
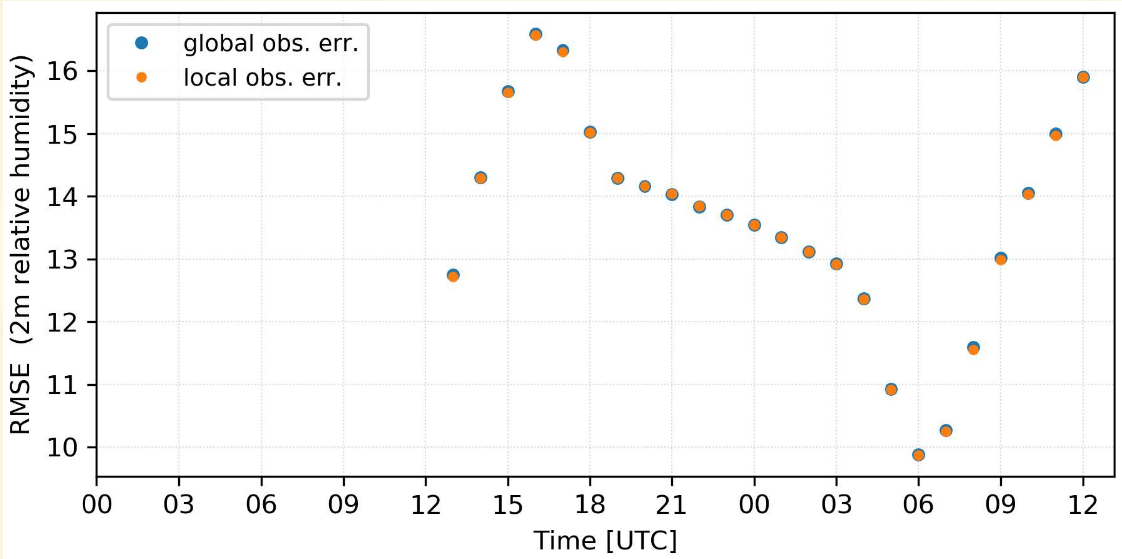
- ... but in average almost no impact





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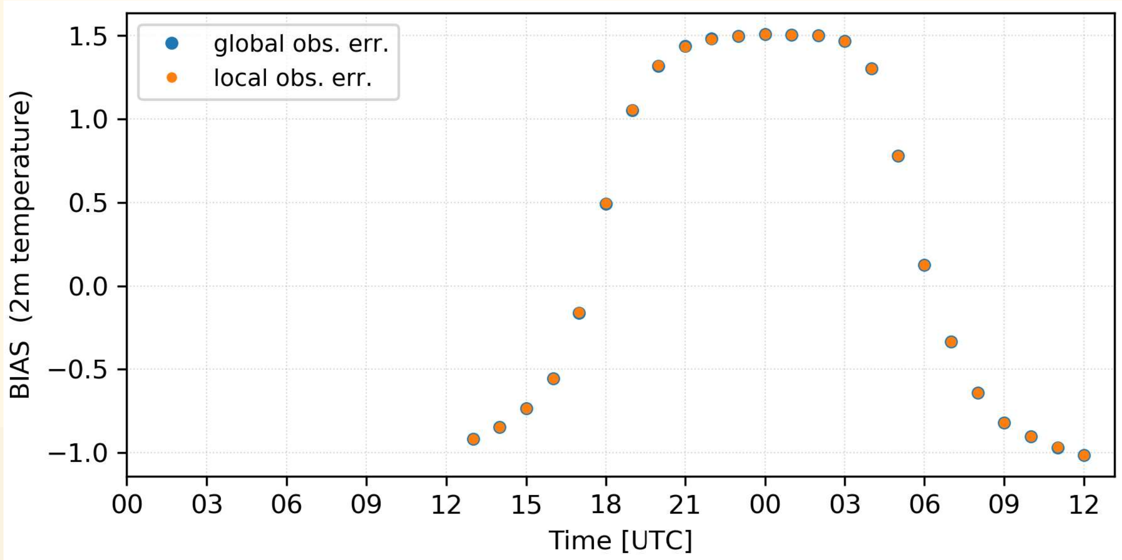

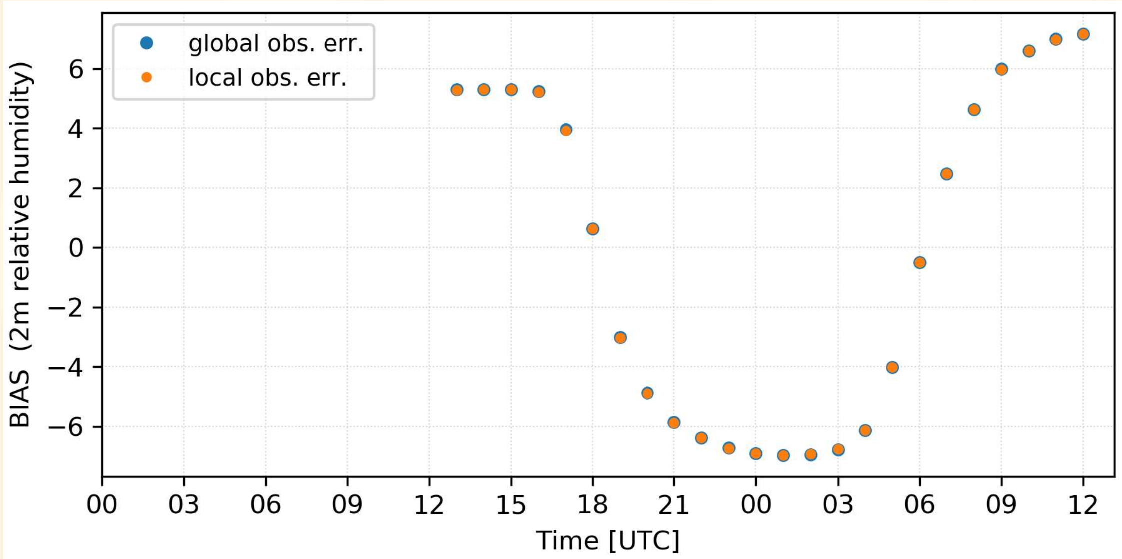

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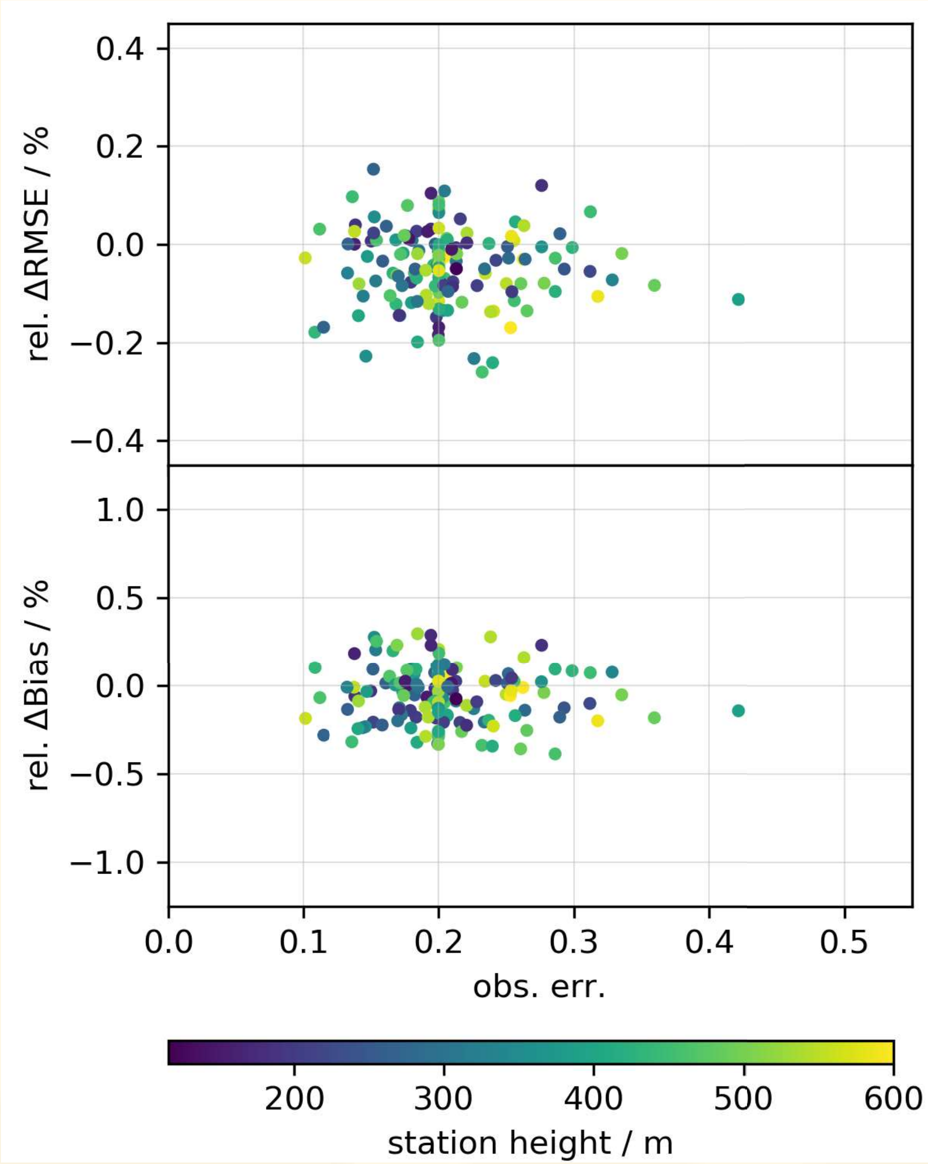
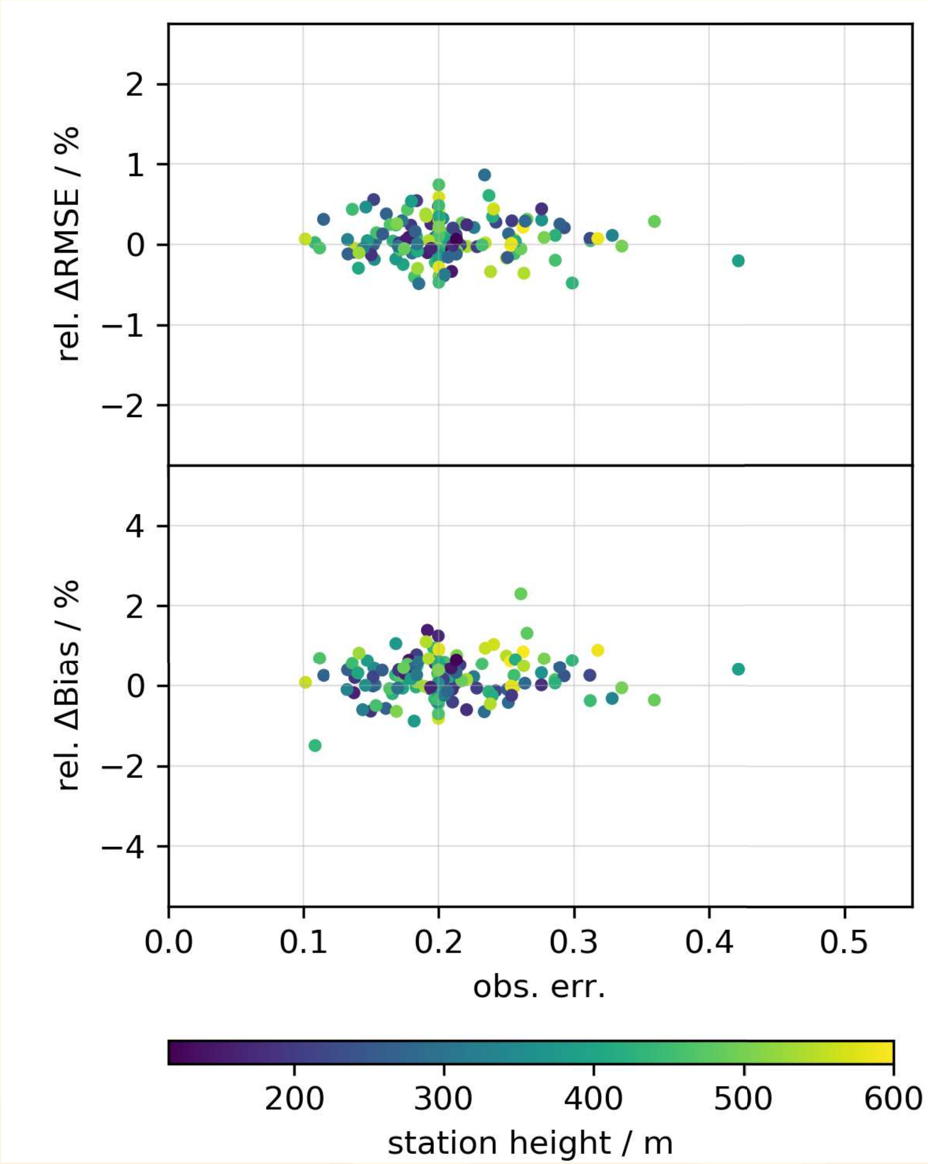


- Slight degradation for T_{2m}

Comparison of T_{2m} & HU_{2m} with Austrian TAWES stations

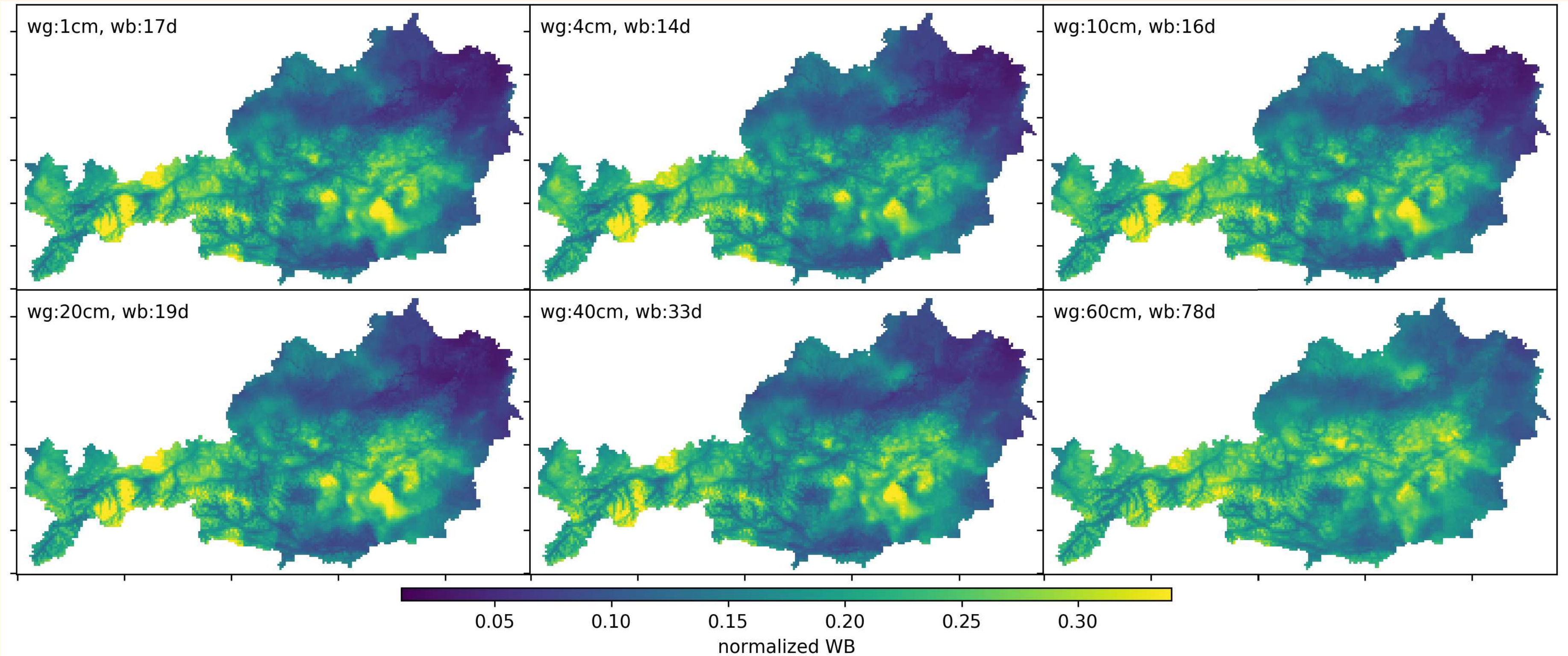


- Slight degradation for T_{2m}
- Slight improvement for HU_{2m}

- No correlation with error magnitude or station height

Water balance

- WB = RR - ET
- ET computed from temperature *(Haslinger et al. 2016)*



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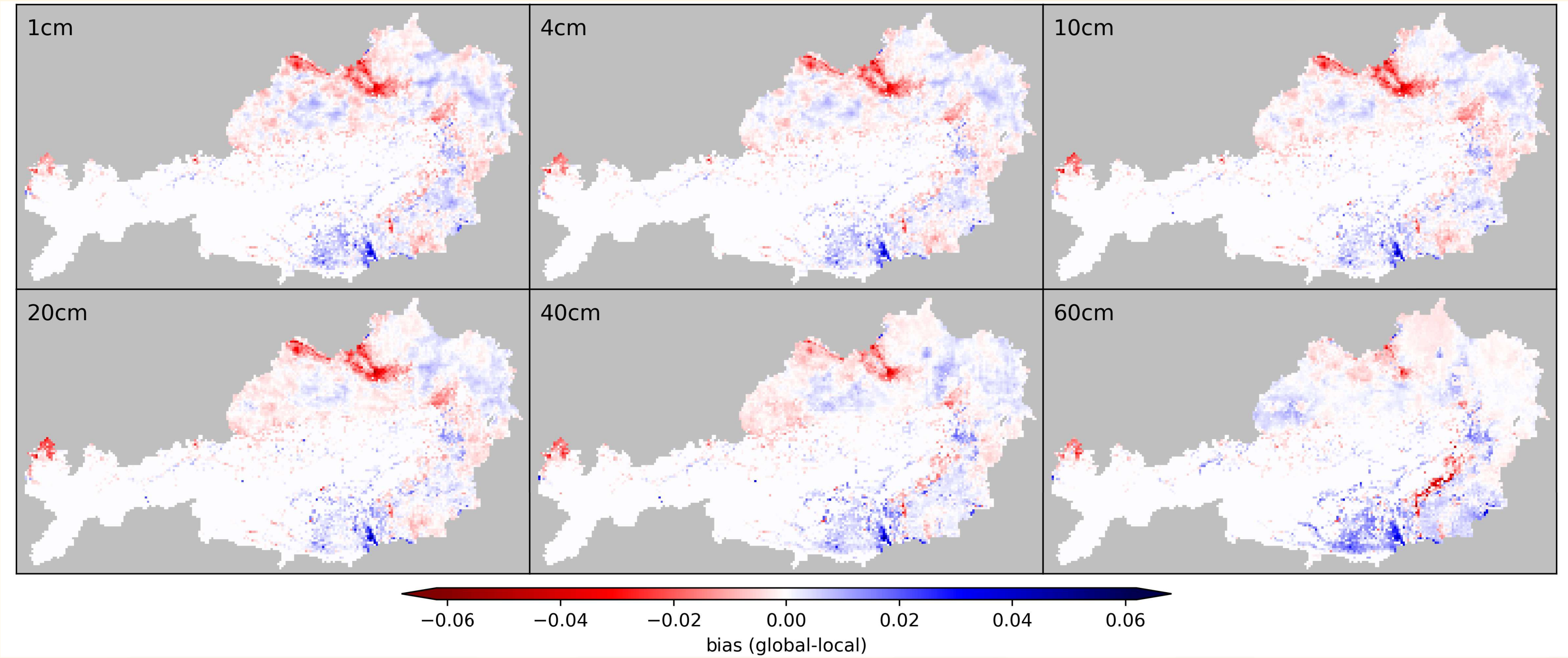

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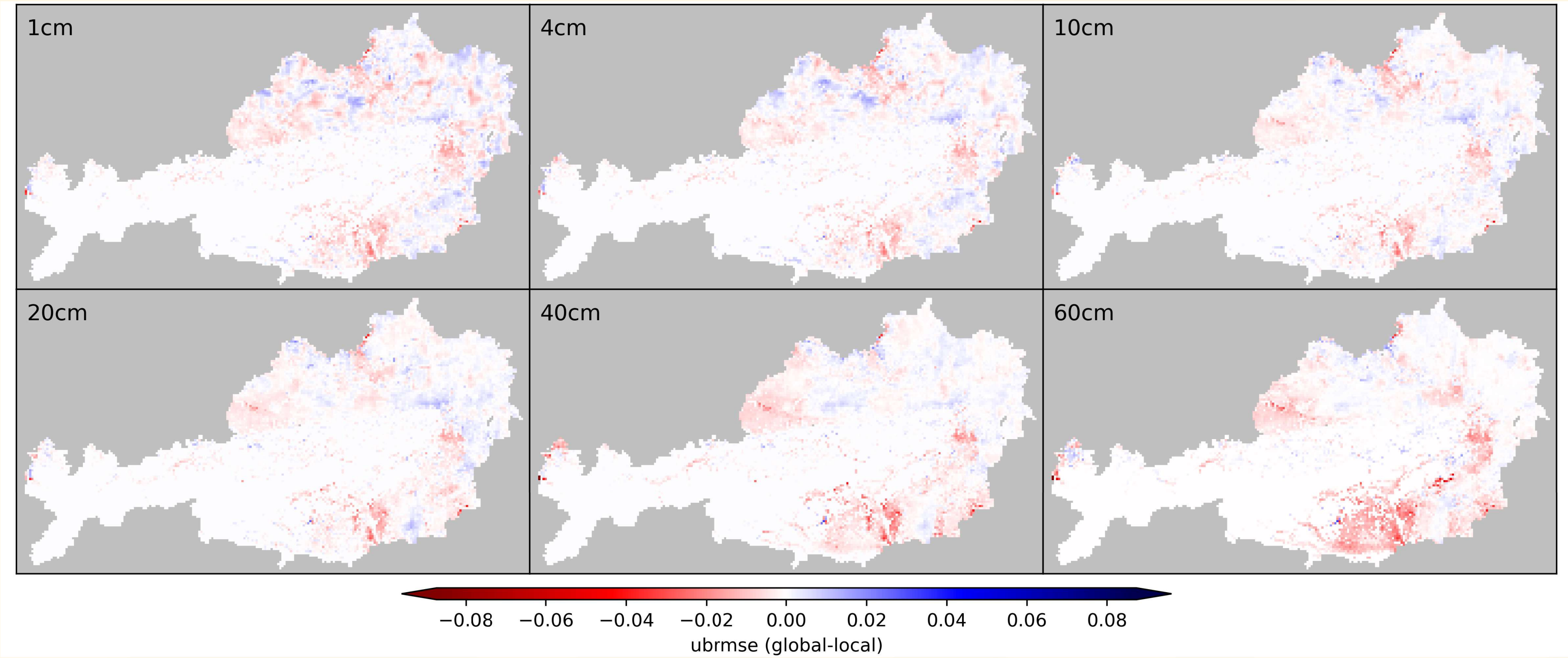

- In average, almost no change for bias ...
- ... and ubRMSE with local observation errors

Summary & Outlook

- Assimilation of SCATSAR-SWI with SURFEX
- Observation error obtained from Triple Collocation Analysis

  ▷ NWP: – small impact on T_{2m} & HU_{2m}
  – in average none

  ▷ Water balance: – visible impact on soil moisture computation
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▷ 1.25 km resolution in preparation

▷ Run computations on European domain