

# Evaluation of SMOS and ASCAT soil moisture products over Norway using in situ observations

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- Norway is one the most difficult and challenging areas for measuring soil moisture remotely (presence of snow, ice, water bodies, orography, rocks, very high coastline-to-area ratio)
- Comparison with in situ data: different spatial scales, different penetration depth  
=> Satellite observations filtered using exponentially weighted moving average filter (Wagner et al., 1999), normalized to match mean & variance of in situ data

| station name | wetland fraction | topographic index | soil type  |
|--------------|------------------|-------------------|------------|
| Øverbygd     | 5 %              | 21 %              | sand       |
| Kvithamar    | 48 %             | 8 %               | clay       |
| Værnes       | 6 %              | 9 %               | sand       |
| Kise         | 17 %             | 7 %               | silty sand |
| Særheim      | 32 %             | 4 %               | silty sand |
| Ås           | 1 %              | 2 %               | silty clay |



Fig. 1: Map of the in situ stations (Opdahl and Colleuille, 2009).

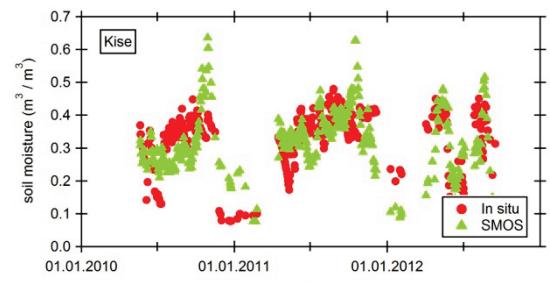
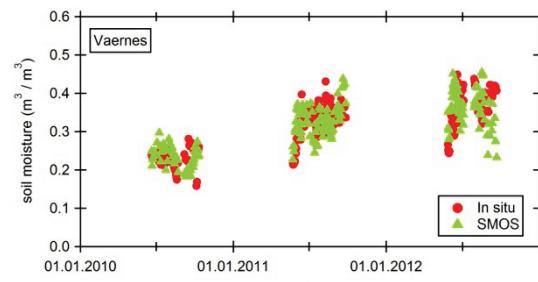
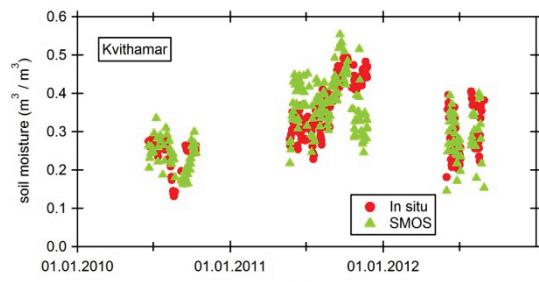


Fig. 2: Time series of filtered and normalized SMOS and in situ data over Kvithamar, Værnes, and Kise in  $\text{m}^3/\text{m}^3$ . The in situ data are shown as red dots, the SMOS data as green triangles.

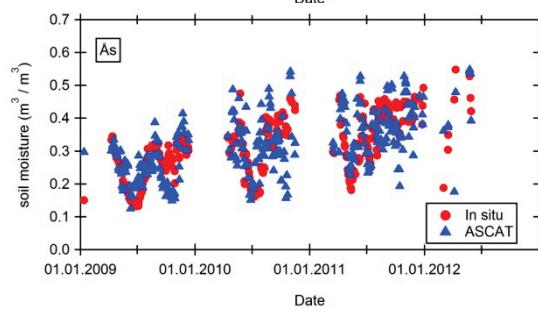
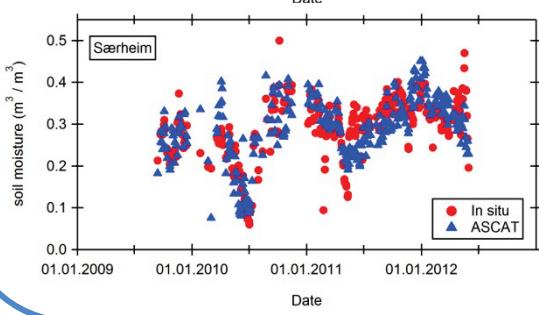
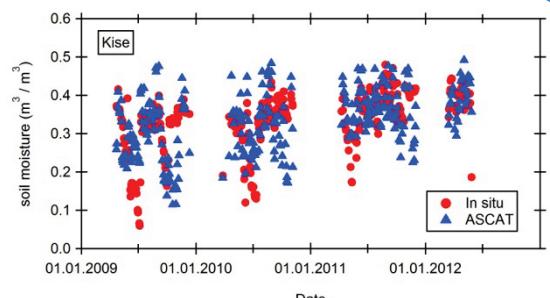
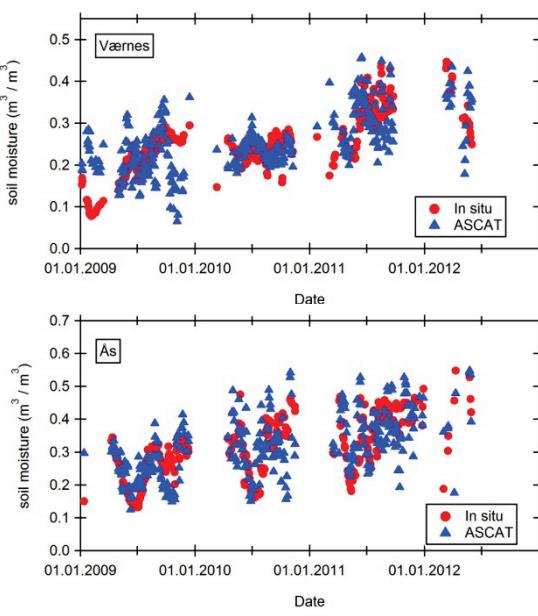
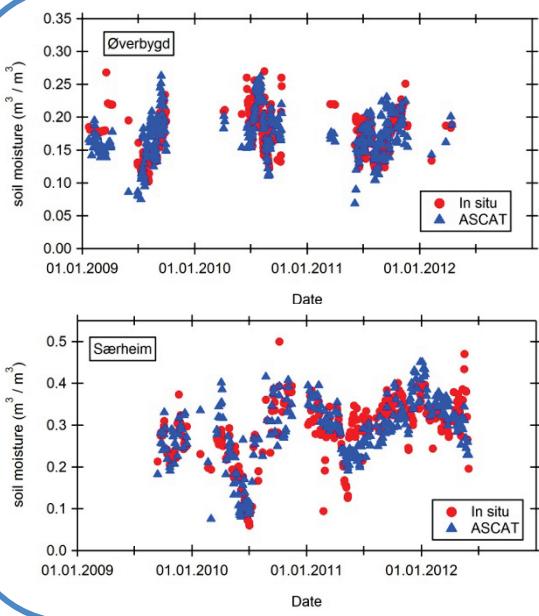


Fig. 3: Time series of filtered and normalized ASCAT data as blue triangles and in situ data over Øverbygd, Værnes, Kise, Særheim, and Ås in  $\text{m}^3/\text{m}^3$ . The in situ data are shown as red dots, the ASCAT data as blue triangles.

| Site    | N   | In-situ |       | SMOS  |       | Bias  | R    |
|---------|-----|---------|-------|-------|-------|-------|------|
|         |     | Mean    | StD   | Mean  | StD   |       |      |
| Kvith.  | 235 | 0.282   | 0.107 | 0.325 | 0.086 | 0.043 | 0.59 |
| Værnes  | 213 | 0.279   | 0.082 | 0.317 | 0.066 | 0.038 | 0.64 |
| Kise    | 357 | 0.281   | 0.117 | 0.326 | 0.095 | 0.045 | 0.50 |
| Average | 268 | 0.281   | 0.102 | 0.323 | 0.082 | 0.042 | 0.58 |

| Site    | N   | In-situ |       | ASCAT |       | Bias   | R    |
|---------|-----|---------|-------|-------|-------|--------|------|
|         |     | Mean    | StD   | Mean  | StD   |        |      |
| Overb.  | 367 | 0.183   | 0.043 | 0.172 | 0.035 | -0.011 | 0.51 |
| Værnes  | 339 | 0.256   | 0.084 | 0.253 | 0.070 | -0.003 | 0.57 |
| Kise    | 307 | 0.273   | 0.115 | 0.332 | 0.081 | 0.059  | 0.56 |
| Ås      | 317 | 0.297   | 0.101 | 0.314 | 0.094 | 0.017  | 0.69 |
| Særheim | 290 | 0.274   | 0.075 | 0.287 | 0.077 | 0.013  | 0.77 |
| Average | 324 | 0.257   | 0.084 | 0.212 | 0.071 | -0.045 | 0.62 |

- Correlation values of 0.58 for SMOS/in situ data and 0.62 for ASCAT/in situ data averaged over all sites considered; correlation comparable to correlations found in other studies
- Bias smaller than standard deviation of individual datasets, indicating that differences between datasets are within the 1- $\sigma$  error bars
- SMOS and ASCAT soil moisture products over Norway have high quality, and will be useful for various applications, including land surface monitoring, weather forecasting and hydrological modelling

## References:

- Opdahl, J. and Colleuille, H.: Nasjonalt overvåkningsnett for grunnvann og markvann (fysiske parametere). Drift og formidling 2008, NVE Rapport 04-09, 2009  
Wagner, W., Lemoine, G., and Rott, H.: A method for estimating soil moisture from ERS scatterometer and soil data, *Remote Sens. Environ.*, 70, 191-207, 1999