Medium resolution soil moisture dataset

Downscaling techniques over central Europe

Marcela Doubkova

Institute of Photogrammetry and Remote Sensing (IPF), Vienna University of Technology, Austria

Contact: mdo@ipf.tuwien.ac.at

Soil moisture data from the active microwave instruments:

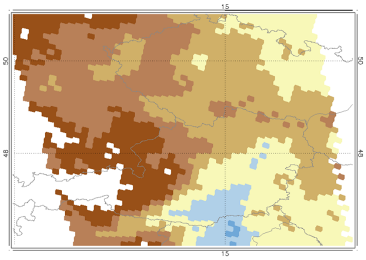
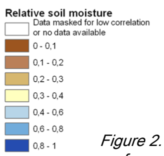


*Figure 1. An example of the surface relative soil moisture from the **ERS** scatterometer with 50km resolution (April 11, 2007).*



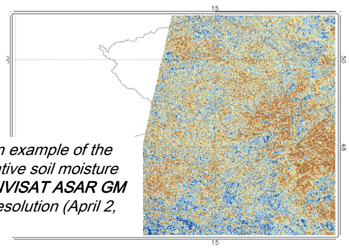


*Figure 2. An example of the surface relative soil moisture from the **ENVISAT ASAR GM** with 1 km resolution (April 2, 2007).*

Soil moisture algorithm

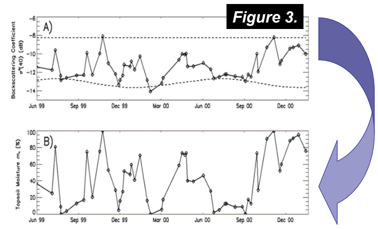


Figure 3.

$$\sigma^0 = \sigma^0_{dry,l} + S_l \theta_l \quad (1)$$

Soil moisture — Sensitivity — Dry backscatter — Backscatter

The soil moisture algorithm is based on the change detection approach. The actual radar measurements (backscatter) are scaled between the historically lowest ("dry reference") and highest ("wet reference") measurements. The final result is a relative measure of soil moisture (0 – 100%).

ASAR GM coverage over Europe

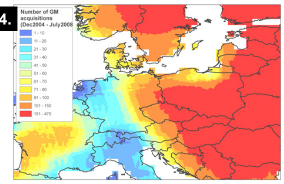


Figure 4.

The low coverage of ASAR GM over the European continent does not allow for derivation of high resolution soil moisture datasets.

→ ***Need for downscaling techniques of coarse resolution datasets***

PROBLEM STATEMENT & THEORY:

- Numerous coarse resolution (25 – 50 km) soil moisture products available (ERS, METOP, AMSR-E).
- Hydrologist, however, express the need for high to medium resolution soil moisture measures.

→Downscaling techniques based on analyzes of long-time series of ASAR GM

1

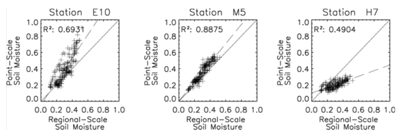


Figure 5. Soil moisture measurements over the REMEDHUS Network.

Soil moisture measured at specific location is correlated to the mean soil moisture over an area (→ is temporally stable).

2

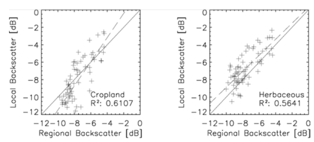


Figure 6. ASAR WS backscatter over the Remedhus network.

Considering the linear dependency of the ***backscatter*** on soil moisture (1) → also the backscatter is expected to be invariant in time.

3

Linear downscaling coefficients a (intercept) and b (slope), derived from the ASAR GM data, represent the relation between the local and the regional backscatter...

4

… and form the base for the soil moisture linear downscaling parameters:

$$\theta_{dis} = c + d * \theta_{ERS} \quad (2)$$

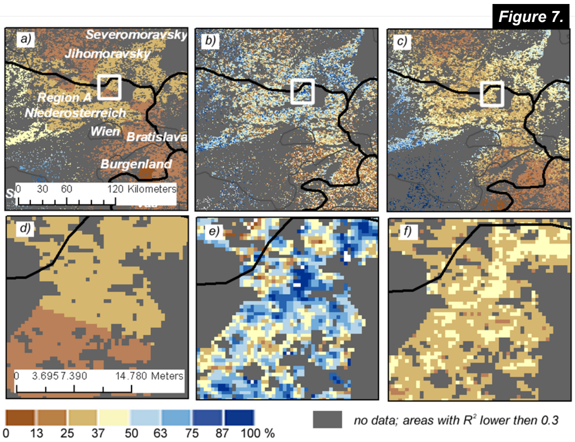
,where θ_{dis} represents the final downscaled soil moisture, θ_{ERS} stands for the coarse resolution ERS data and c and d are the downscaling soil moisture parameters.

Results:

Soil moisture at 50km (ERS) (a), 1km (ENVISAT ASAR GM) (b) and the 1 km downscaled product (c) covering the area of northeastern Austria at 1 km resolution on March 13th, 2006 are demonstrated in Figure 7 (upper part).

While the relative spatial patterns of the ERS and ASAR GM soil moisture data correlated, the soil moisture levels differed

Figure 7.



While narrow range (13 – 37 %) soil moisture values were measured with the ERS data, highly heterogeneous soil moisture patterns were evident in the ASAR GM (13 – 87%). Clearly, large amount of information can not be detected by the ERS coarse measurements.

Figure 7f then demonstrates the added spatial information at the 1 km scale via downscaling coefficients *c* and *d*. The patterns in the downscaled product corresponded to the ASAR GM soil moisture patterns (Figure 1e).

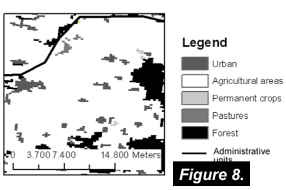


Figure 8.

W. Wagner, C. Pathe, M. Doubkova, D. Sabel, A. Bartsch, S Hasenauer, G. Blöschl, K. Scipal, J. Martínez-Fernández and A. Löw (2008) Temporal stability of soil moisture and radar backscatter observed by the Advanced Synthetic Aperture Radar (ASAR), Sensors, Volume 8, 1174-1197.

Wagner, W., G. Blöschl, P. Pampaloni, J.-C. Calvet, B. Bizzarri, J.-P. Wigneron, Y. Kerr (2007), Operational readiness of microwave remote sensing of soil moisture for hydrologic applications, Nordic Hydrology, Volume 38, No 1, Pages 1–20. DOI 10.2166/nh.2007.029

CONCLUSION

- An innovative approach of retrieving 1 km soil moisture information from the coarse resolution products is presented.
- The results are of relevance for interpreting and downscaling coarse resolution soil moisture data retrieved from active (METOP ASCAT) and passive (SMOS, AMSR-E) instruments.