Comparison and validation of a downscaled remote sensing soil moisture product (SMOScat) and a land surface model (SURFEX) over Catalonia (Spain).

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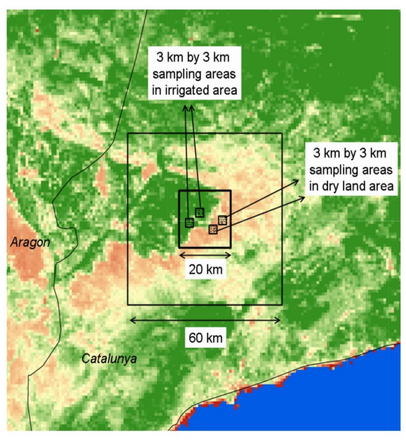
Introduction

Soil wetness is a critical variable in many applications. Unfortunately, we lack *in situ* observations of this variable, thus we don't have enough information on its time evolution and its spatial structure.

New satellite remote sensing products allow us to estimate soil moisture on the first centimeters of soil over large spatial domains. The SMOS mission is obtaining, every 2 or 3 days, global maps of soil wetness with a resolution of about 40 km. But this resolution is too coarse for many applications, therefore downscaling is needed.

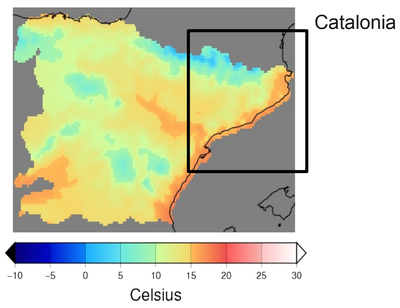
SMOScat

SMOScat is developing an operational product that will provide soil wetness maps at a resolution of 1 km (every 2 or 3 days) and 100 km (every 15 days) over Catalonia (Spain). A downscaling algorithm is applied to L2 SMOS data, which have a resolution o 40 km., using MODIS and LandSat or ASTER data in order to obtain 1 km or 100 m. maps respectively.

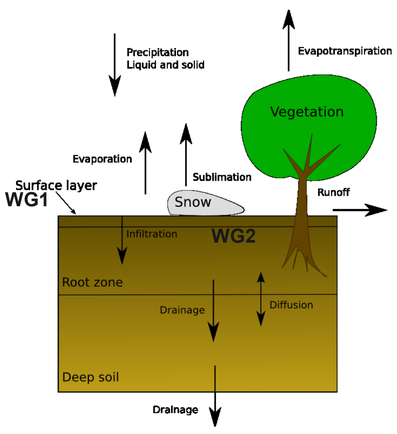


Àrea de la campanya de mesures.

SAFRAN/SURFEX



SAFRAN provides atmospheric fields, combining the observations with a meteorological model. This figure shows the T field over the SAFRAN domain in Spain.



ISBA-3L is the land surface scheme that we use, within the SURFEX framework, in order to simulate natural soils.

The resulting model, SAFRAN/SURFEX, is applied to the NE of the Iberian Peninsula at 5 km of resolution.

Validation

In order to validate the downscaled SMOScat product, monthly *in situ* measurements were done in the Urgell area (close to the city of Lleida, Catalonia), including irrigated and non irrigated fields. The spatial scope of these data is very limited, therefore, in order to validate the large scale spatial patterns of soil moisture (over Catalonia), we realized a land-surface simulation at a resolution of 5 km, using SAFRAN/SURFEX. This simulation was compared to SMOScat.

Results

SMOS is a low resolution product, therefore, the value of each pixel aggregates information corresponding to a large area. As a consequence, it doesn't correlate well with point measurements.

The downscaled product (SMOScat) is able to considerably improve the correlation between the estimated and observed soil moisture.

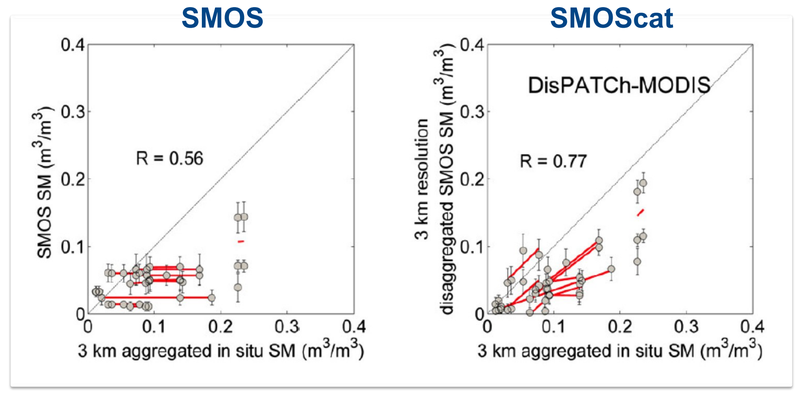
The comparison with SAFRAN/SURFEX allows us to study large areas, as Catalonia.

SMOScat and SAFRAN/SURFEX use very different methods to estimate soil moisture. Thus, if they are similar, we will have good reasons to have confidence in both systems.

The temporal correlation maps for each pixel show where both systems agree and where they don't. Fortunately, we can explain most of the differences, as these are often due to limitations in one of the methods.

Our application of the land-surface model doesn't take irrigation into account. We see that in an irrigated field both products differ from the first irrigation. Contrary, in a non irrigated field, both products have a very similar behavior

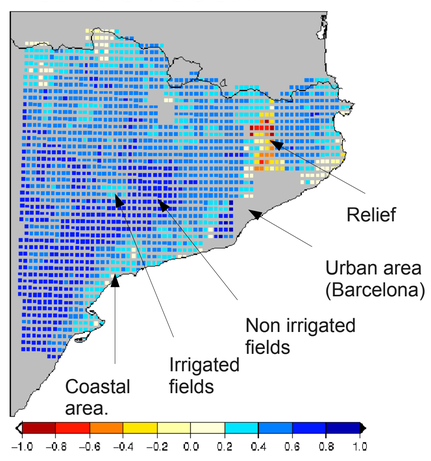
Comparison with *in situ* observations



Maps of temporal correlation

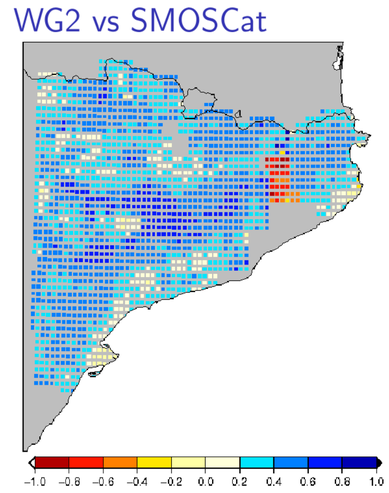
WG1 = First layer of ISBA.

WG1 vs SMOSCat

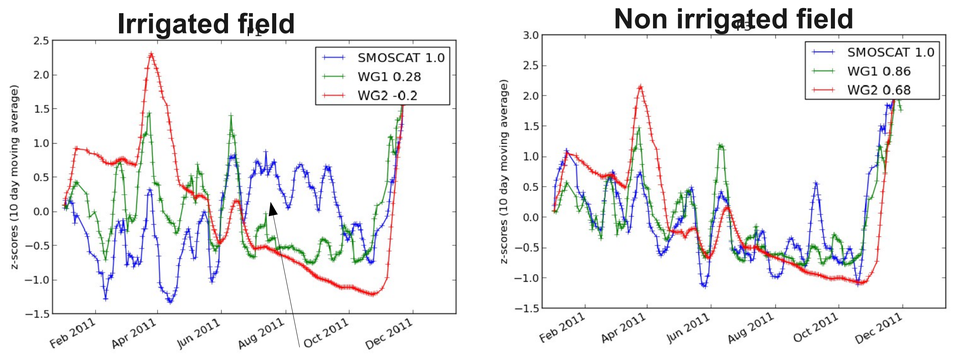


WG2 = Root zone of ISBA

WG2 vs SMOSCat



Comparison of the evolution of soil wetness: SMOScat vs land-surface model.



Date of the first irrigation. The model doesn't simulate irrigation, SMOScat can see it perfectly.

Conclusions

The comparison shows a good agreement in the time series simulated on flat areas of dry land that are far from the sea.

This result gives us confidence, since both methods are very different. However, the comparison also shows the limitations of both products. First, the method based on remote sensing has problems in areas close to the sea and areas with steep relief. Moreover, the surface model, in our configuration, is not able to simulate anthropic processes such as irrigation. Therefore, these comparisons are not only useful for validation purposes, but also to define the priorities for improvement of both products.

In the future, we want to continue working on improving both products used in this study and the extension of their spatial and temporal scope. Also, we want to further exploit the synergies between the two types of methods.

Bibliography

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