Spatial uncertainty in remote sensing generated hydrological variables

Gorka Mendiguren González and Simon Stisen

GEUS (Geological Survey of Denmark and Greenland), Hydrology, Copenhagen K, Denmark (gmg@geus.dk)

The use of satellite remote sensing (RS) has proven its potential to generate different hydrological variables such as Land Surface Temperature (LST), Leaf Area Index (LAI) or Evapotranspiration (ET) among others. In the case of ET different methods combine spectral and thermal information to estimate Actual ET (aET) coincident with satellite overpass.

These estimates from space has become popular in the hydrological modeling community. The information obtained from RS estimates can be used to calibrate and validate hydrological models not just at single points or catchment averages, but also the simulated spatial patterns.

It is a common assumption that although the RS estimates are uncertain, their strength lies in the spatial pattern information, due to the unprecedented spatial coverage of the observations. When spatial patterns obtained from remote sensing estimates are intended for evaluating the spatial patterns of distributed hydrological models, it will however be necessary to challenge that assumption.

This study aims at quantifying the uncertainty of the estimated spatial pattern of temporally aggregated monthly LST and AET maps derived from the MODIS satellite. The proposed approach is based on a cluster analysis performed on hundreds of possible realizations of the estimates generated by sampling within the uncertainty of the individual pixels estimates and taking into account temporal variation and the correlation length of the error.

The result is not only monthly maps of LST and AET, but also maps of the uncertainty of the spatial pattern. This type of information is critical when evaluating the spatial pattern performance of hydrological models, because the performance criteria can be adjusted for areas of high and low confidence in the observational data set. The resulting maps are finally utilized for an evaluation of the spatial performance of the 43,000 km2 national hydrological model of Denmark.