Thesis Abstract

Modelling Evapotranspiration from satellite data using semi-empirical models: Applications to the Indian Subcontinent

The major aim of this work is to develop a framework for the estimation of Evapotranspiration (ET) over the Indian landmass using remote sensing (RS) datasets in a repeated and consistent manner with improved spatial resolution.

Different RS based ET models exist in the literature, out of which, the triangle, the S-SEBI and the Sim-ReSET models were compared for the estimation of daytime integrated latent heat flux (λE_{day}). These three models were chosen as they can be driven only with RS based inputs without the need for any ground measurements. The results showed that the application of simpler contextual models may yield better results than physically based models when ground data is limited or not available.

To improve the spatial resolution of one of the key surface variable, Land Surface Temperature (LST), the performance of five different vegetation indices Normalised Difference Vegetation Index (NDVI), Fraction Vegetation Cover (FVC), Normalised Difference Water Index (NDWI), Soil Adjusted Vegetation Index (SAVI) and Modified SAVI (MSAVI) were tested in the existing DisTrad disaggregation model. Results suggested that the most commonly used vegetation indices NDVI and FVC yielded better results only under wet conditions. Under drier surface conditions, using NDWI for disaggregation resulted in relatively higher accurate LST.

A model for spatial disaggregation of Evaporative Fraction (EF) called DEFrac (Disaggregation of Evaporative Fraction) was developed based on the relationship between EF and NDVI to obtain finer spatial resolution EF from coarser resolution estimates. The experimental results suggested that the DEFrac model developed in this study, yielded more accurate disaggregated EF. The disaggregated EF was further used to get disaggregated λE_{day}.

Finally, The issue of lack of proper ET dataset over India was addressed by developing two data products one over entire India at 0.05° spatial resolution and the second product over the Kabini basin at 1 km spatial resolution. Both the products were developed with a temporal resolution of 8-day and for the period 2001–2014. The developed ET products were validated against ground observed data at seven sites across India and against ET simulated by a hydrological model over a forested watershed. Further the developed ET products were compared with some other global ET products such as MOD16, LandFlux Eval synthesis ET and GLEAM ET. Analyses revealed that only in regions where ET is predominantly driven by rainfall and where irrigation is not applied at very large scales, the global ET products tend to capture the ET patterns satisfactorily. On the other hand, the ET products developed in this work captured the spatial and temporal patterns of ET quite realistically all across India.