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Quantifying Uncertainty in the Predictions of the SimSphere Land Biosphere Model in Simulating Key Parameters Characterising Earth's Energy Balance

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Soil Vegetation Atmosphere Transfer (SVAT) models are becoming the preferred scientific tool to assess land surface energy fluxes due to their computational efficiency, accuracy and ability to provide results at fine temporal scales. An all-inclusive validation of those models is a fundamental step before those can be confidently used for any practical application or research purpose alike.

SimSphere is an example of a SVAT model, simulating a large array of parameters characterising various land surface interactions over a 24 hour cycle at a 1-D vertical profile. Being able to appreciate the uncertainty of SimSphere predictions, is of vital importance towards increasing confidence in the models' overall use and ability to represent accurate land surface interactions. This is particularly important, given that its use either as a stand-alone tool or synergistically with Earth Observation (EO) data is currently expanding worldwide.

In the present study, uncertainty in the SimSphere's predictions is evaluated at seven European sites, representative of a range of ecosystem conditions and biomes types for which in-situ data from the CarboEurope IP operational network acquired during 2011 were available. Selected sites are characterised by varying topographical characteristics, which further allow developing a comprehensive understanding on how topography can affect the models' ability to reproduce the variables which are evaluated. Model simulations are compared to in-situ data collected on cloud free days and on days with high Energy Balance Ratio. We focused here specifically on evaluating SimSphere capability in predicting selected variables of the energy balance, namely the Latent Heat (LE), Sensible heat (H) and Net Radiation (Rn) fluxes. An evaluation of the uncertainty in the model predictions was evaluated on the basis of extensive statistical analysis that was carried out by computing a series of relevant statistical measures.

Results obtained confirmed the correspondence of the model structure to real conditions for which it had been parameterised, evidencing its ability to reproduce reasonably satisfactory the examined parameters, particularly so over flat terrain sites and specific land cover types. Given the very small number of SimSphere validation studies, our work contributes decisively towards obtaining a better understanding of the model structure and correspondence to a real world system. The latter, not only provides very important information to future model users but also is of potential key value to efforts ongoing at present by different Space Agencies examining the use of SimSphere synergistically with Earth Observation data in developing operational products at a global scale.

KEYWORDS: SimSphere, Latent Heat flux, Sensible Heat fulx, Net Radiation, SVAT; Land Surface Interactions, CarboEurope.