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Synergy of the SimSphere land surface process model with ASTER imagery for the retrieval of spatially distributed estimates of surface turbulent heat fluxes and soil moisture content

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Accurate information on spatially explicit distributed estimates of key land-atmosphere fluxes and related land surface parameters is of key importance in a range of disciplines including hydrology, meteorology, agriculture and ecology. Estimation of those parameters from remote sensing frequently employs the integration of such data with mathematical representations of the transfers of energy, mass and radiation between soil, vegetation and atmosphere continuum, known as Soil Vegetation Atmosphere Transfer (SVAT) models.

The ability of one such inversion modelling scheme to resolve for key surface energy fluxes and of soil surface moisture content is examined here using data from a multispectral high spatial resolution imaging instrument, the Advanced Spaceborne Thermal Emission and Reflection Scanning Radiometer (ASTER) and SimSphere one-dimensional SVAT model. Accuracy of the investigated methodology, so-called as the "triangle" method, is verified using validated ground observations obtained from selected days collected from nine CARBOEUROPE IP sites representing a variety of climatic, topographic and environmental conditions. Subsequently, a new framework is suggested for the retrieval of two additional parameters by the investigated method, namely the Evaporative (EF) and the Non-Evaporative (NEF) Fractions.

Results indicated a close agreement between the inverted surface fluxes and surface moisture availability maps as well as of the EF and NEF parameters with the observations both spatially and temporally with accuracies comparable to those obtained in similar experiments with high spatial resolution data. Inspection of the inverted surface fluxes maps regionally, showed an explainable distribution in the range of the inverted parameters in relation with the surface heterogeneity. Overall performance of the "triangle" inversion methodology was found to be affected predominantly by the SVAT model "correct" initialisation representative of the test site environment, most importantly the atmospheric conditions required in the SVAT model initial conditions.

This study represents the first comprehensive evaluation of the performance of this particular methodological implementation at a European setting using the SimSphere SVAT with the ASTER data. The present work is also very timely in that, a variation of this specific inversion methodology has been proposed for the operational retrieval of the soil surface moisture content by National Polar-orbiting Operational Environmental Satellite System (NPOESS), in a series of satellite platforms that are due to be launched in the next 12 years starting from 2012.

KEYWORDS: micrometeorology, surface heat fluxes, soil moisture content, ASTER, triangle method, SimSphere, CarboEurope IP