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An open-access software platform for modeling turbulent heat and moisture fluxes as well as surface soil moisture from the Synergy of VNIR/TIR EO Data and a Land Biosphere Model

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Today, in the face of climate change, it has been recognised by the global scientific community as a topic requiring further attention and investigation. Use of simulation process models combined with Earth Observation (EO) data provides a promising direction towards deriving accurately spatiotemporal estimates of key parameters characterising land surface interactions such as latent (LE) and sensible (H) heat fluxes as well as soil surface moisture (SSM).

Herein a software tool developed in Java for deriving regional estimates of LE and H fluxes (sensible and latent heat) as well as surface soil moisture from the implementation of the so-called "triangle" method is presented. The method is based on a contextual interpretation of a satellite-derived scatterplot of land surface temperature (Ts) versus a Fractional Vegetation Cover (Fr) combined with a land biosphere model. The tool offers a graphical user interface (GUI) to the user, with the aim to allow customisation of the noise removal of the dataset. Upper and lower edges of the trapezoid in the Fr versus normalized Ts diagram are automatically derived and visualised. The user can also enter various parameters to the SimSphere engine through a convenient form and visualisation of trapezoid matching for various simulation scenarios is also provided. Computationally it can handle one million scatter points with acceptable lag in the user interface. It is also multi-core friendly by using Java 8 parallel streams for conversions and prediction. The predictor training and histogram computation are the main serialisation bottlenecks. In contrast to other methods the trapezoid derivation and matching is automatic requiring little more than a customisation of noise removal and scenario definition. The tool is written in Java 8 and Java FX 8 for best performance, reduced maintenance and easy interaction.

The practical usefulness of the software tool is demonstrated using a variety of examples exploiting EO data from sensors provided by non-commercial vendors including SEVIRI, MODIS, Landsat and ASTER. Our work is significant to the users' community of the model and very timely, given the potential use of this modeling technique by different Space Agencies towards the development of operationally regional estimates of energy fluxes and soil moisture from EO data. Development of this software tool was supported by the European Commission Marie Curie Re-Integration Grant "TRANSFORM-EO".

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