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An open source land biosphere extended for use with EO data for deriving spatiotemporally key biophysical parameters

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Use of land biosphere process models (LBPs) combined with Earth Observation (EO) data is a promising avenue towards deriving accurately spatiotemporal estimates of key land surface parameters that characterise Earth's water and energy balance. SimSphere is one such LBM that provides a mathematical representation of vertical 'views' of the physical mechanisms controlling Earth's energy and mass transfers in the soil/vegetation/atmosphere continuum. Its implementation is offered to the end user both via a graphical user interface (GUI) and as a command line. SimSphere has attracted the attention of different groups globally, being used either as a stand-alone application or synergistically with EO data to study land surface interactions.

Herein, we present recent advancements introduced to the SimSphere model in the framework of the "ENviSION-EO" Marie Skłodowska Curie EU-funded action. We have extensively tested and updated the model code to the latest Java version and enhanced it with new functionalities. One of those is that of adding another dimension to the model simulations, which is that of the spatial domain, making the model now a 2D one. The model is also possible now to be implemented in a cloud environment and is now also multi-core friendly by using Java 8 parallel streams for conversions and prediction. These features allow the model to computationally address and challenges that may post relevant to "big data" manipulation. The use of those newly added model functionalities are demonstrated herein using a variety of examples based on high resolution EO data acquired at different European sites where model predictions are also compared against reference ground measurements.

All those new functionalities introduced to the model allow now more than ever before the direct use of model by the user's community with essentially any type of appropriate EO data to derive spatiotemporal estimates of key biophysical parameters over land surface for any land surface area size for which the model can be parameterised. Our work is significant and very timely given the interest in the model's use globally, including space agencies currently exploring its use for deriving operational products of biophysical parameters.

KEYWORDS: land biosphere models, earth observation, biophysical parameters retrieval, SimSphere, triangle method