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QUANTIFYING BIOPHYSICAL EFFECTS OF LAND USE CHANGE AT GLOBAL SCALE WITH SATELLITE EARTH OBSERVATIONS

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ABSTRACT:

Land use change has well-known biogeochemical repercussions on the climatic system since it alters the distribution of stocks and fluxes of terrestrial carbon with direct impacts on the atmospheric CO2 concentration. However, changes in land uses also have biophysical effects, such as changes in evapotranspiration and in the surface energy budget, that may alter land surface temperature (LST) and affect the local and regional climate. Dynamic global vegetation models (DGVMs), which simulate shifts in potential vegetation and its associated biogeochemical and hydrological cycles as a response to shifts in climate, are currently the main tools to quantify such effects. However, biophysical effects of land use change are still poorly represented in DGVMs. We have thus developed an approach to quantify such effects by exploiting global satellite observations, namely LST, albedo, and evapotranspiration (ET) MODIS products at 0.05° spatial resolution. Because detecting land use change at global scale can be difficult, the approach relies on the space for time analogy. Based on static land cover products, we examine for every pixel if its neighbouring pixels have a different land cover. It they do, the difference between them in terms of LST, ET or albedo is recorded. By aggregating these values for all land cover transitions within a given region, a transition matrix is obtained summarizing the change in biophysical variables that can be expect when converting one land cover to another. This approach has been applied within 2° by 2° cells to provide global maps estimating the intensity of land use change effects. The seasonality of the effects is also characterized by repeating the process in time. The objectives of the resulting datasets are twofold: a) to directly quantify the main biophysical effects induced by land cover change and b) to serve as a benchmark for better DGVM calibration and validation.

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