AOGS 2005

Land Surface Model Data Assimilation for Atmospheric Prediction

JEFFREY P. WALKER[1]

[1]*Department of Civil and Environmental Engineering, the University of Melbourne, Australia*

Accurate flux prediction in response to land surface soil moisture at mid-latitudes has been shown to be as important as sea surface temperature in making accurate precipitation prediction. Unfortunately, land surface models typically give a poor prediction of soil moisture and atmospheric feedback, with large differences between different model predictions even when using the same parameters, inputs and initial conditions. To overcome this limitation, assimilation of observed quantities has been pursued. One of the earliest approaches has been the assimilation of screen level air temperature and relative humidity, which are only weakly related to soil moisture and not widely observed in remote areas. A subsequent approach is the assimilation of remotely sensed near-surface soil moisture. While these passive microwave observations yield physical soil moisture content estimates over large areas at 50km resolution, they are only for the top few centimeters of soil and for regions of low to moderate vegetation. Hence, areas such as the Amazon, where land surface feedback has also been shown to be important, are unaffected by this approach. Alternatively, stream flow observations are an integrated response to upstream profile soil moisture conditions that can be used to constrain model predictions, but these measurements typically have a lower spatial resolution than soil moisture remote sensing can provide. A new and novel remote sensing system is the Gravity Recovery And Climate Experiment, which provides precise measurements of temporal changes in the Earth's gravity field that are related to changes in terrestrial water storage. While this type of observation yields information on profile soil moisture and groundwater and is unaffected by vegetation, these estimates are for very large areas, on order 1000km. Moreover, a key assumption of most of the foregoing approaches is that a correct physical soil moisture content estimate for the land surface model will result in an improved flux estimate. As most land surface models used by atmospheric models have historically used soil moisture as simply a tuning parameter rather than a physical quantity, improved flux prediction is not guaranteed. Since land surface fluxes can be estimated from thermal remote sensing, it is also possible to constrain model soil moisture and temperature predictions using these observations under cloud free conditions. Hence a combination of these approaches is required to yield the accurate flux and soil moisture predictions required for atmospheric prediction.

Keywords: Soil Moisture, Stream Flow; Latent Heat Flux; Sensible Heat Flux; GRACE; Temporal Gravity; Data Assimilation; Land Surface Model.