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How observational networks can help to improve modeled water and carbon exchange processes for climatological applications.

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Land surface models (LSM's) are used to represent the terrestrial ecosystem as part of the climate system in multi-decadal climate model simulations. Therefore land-atmosphere feedback processes in such models should be tested for their suitability on the broad climatological time-scales ranging from hours to decades and for the global range of terrestrial ecosystems.

Fluxnet and NASA's EOS satellites now provide an extensive observational data source which helps ecosystem modelers to develop and validate LSM biophysics and biochemistry. The success of such analyses however depend on the careful quantification of measurement errors in both ground and satellite-based observation streams.

We have integrated biophysical and micrometeorological ecosystem observations from around 100 flux towers and from the MODIS satellite sensor in an offline LSM modeling framework in order to identify and correct serious issues of state-of-the-art LSM's like NCAR's Community Land Model (CLM3), CSU's Simple Biosphere Model (SiB 2.5/3) and JULES (ex UK Met Office MOSES2).

Simulated heat and water fluxes on the hourly-to-seasonal time scale compare much better to observed ones if ground water is explicitly accounted for. Carbon uptake

and transpiration can be validated against observations by analysis of light response curves. Such an analysis reveals large differences between big-leaf and multi-layer canopy models. We also assess the influence of LSM phyenology on the simulated water and carbon exchanges and propose a new strategy for prognostically modeling phenology.

In summary, Fluxnet tower measurements and NASA's EOS satellite data are very useful in climate research since they provide a means to develop and evaluate mechanistic formulations of heat, water and carbon exchanges prior to their application in expensive climate model simulations.