Geophysical Research Abstracts
Vol. 12, EGU2010-10046-1, 2010
EGU General Assembly 2010

Validating the Terrestrial Component of the LPX Dynamic Global Vegetation Model

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Validation of terrestrial hydrology in the Land Processes eXchange Dynamic Global Vegetation Model (LPX-DGVM, a development of the LPJ model) is presented. Simulated runoff is compared against the UNH-GRDC Composite Global Runoff Fields and observations of streamflow on an annual and seasonal basis for the period 1986-1995, at both the global and catchment scale. Gauging the context by which LPX can generate reliable simulations of terrestrial hydrology is important for both studies of future global water resources and predictions of future vegetation distributions.

Results indicate that LPX generally tends to overestimate runoff magnitudes, particularly in the tropics, but also underestimates in some other regions surrounding the equator. Total annual global runoff estimates are outside the upper bound of previous estimates. This may be due to the addition of an advanced fire regime, precipitation inaccuracies, or partly a product of the physiological effects of increasing atmospheric CO2 concentrations inducing decreased stomatal conductance – an effect not typically represented in standard hydrological models.

Runoff magnitudes at the catchment scale are generally represented reasonably, both in terms of seasonality and interannual variability. Notable exceptions occur in catchments which experience negative discharge (where streamflow actually decreases beyond a certain point downstream), as water losses via direct channel evaporation and channel bed transmission are not represented, causing substantial overestimations.

The timing of flows is generally well represented by LPX at the catchment scale, although there is a tendency towards early estimation of extremes by at least a month; in some cases however, the timing is late by approximately one month. Routing LPX runoff via a river simulation scheme is expected to improve the timing of intra-annual flows, due to the inclusion of surface water storage and topography.

Overall, LPX is shown to represent reasonable estimates of global and catchment-scale surface hydrology. However, the incorporation of river routing and freshwater extractions from the hydrosphere represents the next step in further improving the simulated water budget.