Boundary-Layer Meteorol (2011) 138:263–284
DOI 10.1007/s10546-010-9559-z

ARTICLE

Evaluation of a Photosynthesis-Based Canopy Resistance Formulation in the Noah Land-Surface Model

**Anil Kumar · Fei Chen · Dev Niyogi ·
Joseph G. Alfieri · Michael Ek · Kenneth Mitchell**

Received: 9 October 2009 / Accepted: 26 October 2010 / Published online: 16 November 2010

Abstract Accurately representing complex land-surface processes balancing complexity and realism remains one challenge that the weather modelling community is facing nowadays. In this study, a photosynthesis-based Gas-exchange Evapotranspiration Model (GEM) is integrated into the Noah land-surface model replacing the traditional Jarvis scheme for estimating the canopy resistance and transpiration. Using 18-month simulations from the High Resolution Land Data Assimilation System (HRLDAS), the impact of the photosynthesis-based approach on the simulated canopy resistance, surface heat fluxes, soil moisture, and soil temperature over different vegetation types is evaluated using data from the Atmospheric Radiation Measurement (ARM) site, Oklahoma Mesonet, 2002 International H_2O Project (IHOP_2002), and three Ameriflux sites. Incorporation of GEM into Noah improves the surface energy fluxes as well as the associated diurnal cycle of soil moisture and soil temperature during both wet and dry periods. An analysis of midday, average canopy resistance shows similar day-to-day trends in the model fields as seen in observed patterns. Bias and standard deviation analyses for soil temperature and surface fluxes show that GEM responds somewhat better than the Jarvis scheme, mainly because the Jarvis approach relies on a parametrised minimum canopy resistance and meteorological variables such as air temperature and incident radiation. The analyses suggest that adding a photosynthesis-based

A. Kumar · F. Chen
National Center for Atmospheric Research, Boulder, CO, USA

A. Kumar · D. Niyogi · J. G. Alfieri
Purdue University, West Lafayette, IN, USA

M. Ek · K. Mitchell
National Center for Environmental Prediction, Camp Springs, MD, USA

A. Kumar (✉)
Hydrological Science Branch (Code-614.3), NASA Goddard Space Flight Center,
Greenbelt, MD 20771, USA
e-mail: anil.kumar@nasa.gov

Present Address:
J. G. Alfieri
Hydrology and Remote Sensing Laboratory, USDA-ARS, Beltsville, MD, USA