Geophysical Research Abstracts, Vol. 9, 10053, 2007
SRef-ID:

Integrated assessment in a data-scarce environment: the use of model ensembles to enable rational water management in the Volta Basin, West Africa

Constanze Leemhuis (1), **Charles Rodgers** (1) and Wilson Agyare (2)

(1) Center for Development Research (ZEF), Bonn University(2) Savanna Agricultural Research Institute (SARI), Ghana Council for Scientific and Industrial Research

Model ensembles are used increasingly to provide scientifically credible decision support for integrated water resources assessment and management. Examples of coupled model ensembles utilized at basin-scale include Draper and Jenkins, et al.'s (2003; 2004) California study linking the network flow hydrologic optimization model California Value Integrated Network (CALVIN) to the Statewide Agricultural Production Model (SWAP), which maximizes farm profit given water, land, technology and capital inputs; Quinn, et al.'s (2004) study of climate change and water resources in the San Joaquin Basin, California, in which climate scenarios generated by HadCM2/PRM are linked to the PRISM rainfall-runoff model, coupled in turn to the CALSIM water demand-allocation model, the APSIDE salinity control and the DSM2-SJR surface water quality models, respectively; and the DANUBIA project in the transboundary Danube Basin, Western Europe (Barth, et al. , 2005), in which up to thirteen models emerging from physical (meteorology, hydrology, ecology,. . .) and social (agricultural economics, tourism, environmental psychology, ..) sciences are dynamically coupled. In these and related applications developed primarily in the North, access to data of acceptable coverage and quality is not a factor constraining model development. By contrast, in many other regions, including sub-Saharan Africa, scarcity of climatic, hydrologic and socio-economic data impose severe limitations on the process of developing, testing and applying model ensembles. Yet, these are often precisely the regions in greatest need of tools for comprehensive, sustainable water and land management. The GLOWA Volta Project (GVP), initiated in 2000, is a 9-year study of global and regional environmental change and their respective impacts on the hydrology of the Volta Basin, a trans-national river system in West Africa. The basin covers

400,000 km^2 with 42% in Ghana, 43% in Burkina Faso and the remainder in Côte d'Ivoire, Mali, Togo, and Benin. The region is characterized by erratic rainfall patterns, and domestic and agricultural water users in the upper regions of the Basin complete with hydropower generation in the south for increasingly scarce water resources. The major scientific objective of the GVP is to create a decision support framework to guide future development of water resources and infrastructure. As historical (gauge) data are relatively scarce within the Volta, and often of questionable accuracy, the GVP scientific approach makes extensive use of remotely sensed data and physically based numerical models to simulate the linked behavior of climate, hydrology and land surface processes. We describe our experience and results to date in developing and utilizing a prototype model ensemble for the allocation and management of water resources within the White Volta tributary of the Volta River, shared by Burkina Faso and Ghana. GCM output (ECHAM4) is dynamically downscaled to facilitate detailed regional climate simulation using the mesoscale model MM5, which is linked to the physical hydrology model WaSim ETH, which simulates surface and subsurface hydrology. These models provide inputs to the planning and management model MIKE BASIN. The prototype ensemble is used to evaluate transboundary water management protocols under assumed conditions of global climate change.