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Use of satellite remote sensing in a medium range global flood prediction system

N. Voisin (1), A. W. Wood (1), D.P. Lettenmaier (1) and E. F. Wood (2)

(1) Civil and Environmental Engineering, University of Washington, Seattle, USA, (2) Civil and Environmental Engineering, Princeton University, Princeton, USA, (nathalie@hydro.washington.edu)

Examples abound of extreme property damage and loss of life due to floods in the underdeveloped world. Flooding of the Mekong River and its tributaries in Cambodia, Vietnam, Laos and Thailand in July-August 2000 displaced more than 6.5 million people. The February-March 2000 floods in the Limpopo River of Mozambique displaced over 700 thousand people, and caused extreme disruption to that country's fledgling economy. Mitigation of these events through advance warning has typically been modest at best. While weather and climate forecast methods have advanced greatly over the last two decades, this capability has yet to be evidenced in mitigation of water-related natural hazards (primarily floods and droughts), especially in the developing world. In particular there is at present no system for forecasting of floods globally, although the potential now exists. We describe a prototype system for medium range (up to two week lead) flood prediction in large rivers, which is intended eventually for global implementation. The procedure draws from the experimental North American Land Data Assimilation System (NLDAS) and the companion Global Land Data Assimilation System (GLDAS) - for development of nowcasts-, and the University of Washington Experimental Hydrologic Prediction System for hydrologic forecasting. Hydrologic forecasts based on Numerical Weather Prediction (NWP) are developed to serve both as nowcasts and provide forecasts for lead times as long as fifteen days. The use of forecast models and satellite remote sensing in this procedure reduces the need for in situ precipitation and other observations in parts of the world where surface networks are critically deficient. The heart of the hydrologic modeling system is the Variable Infiltration Capacity (VIC) macroscale hydrology model. In the prototype (tested using retrospective data), VIC is driven globally up to the time of fore-

cast with daily ERA40 precipitation (rescaled on a monthly basis to a station-based global climatology), ERA40 wind, and ERA40 average surface air temperature (with temperature ranges adjusted to a station-based climatology). In the retrospective forecasting mode, VIC is driven by global NCEP ensemble 15-day reforecasts provided by Tom Hamill (NOAA/ERL), bias corrected with respect to the adjusted ERA40 data and further downscaled spatially using two higher spatial resolution satellite products: Global Precipitation Climatology Project (GPCP) 1dd daily precipitation in latitudes beyond 50 degree South or North, and Tropical Rainfall Measuring System (TRMM) 3B42 precipitation within the 50 degree latitude band. Downward solar and longwave radiation, surface relative humidity, and other model forcings are derived from relationships with the daily temperature range during both the retrospective (spinup) and forecast period, and are compared with satellite products (e.g., ISCCP solar radiation) where available. The initial system is implemented globally at one-half degree spatial resolution and is valid for the 1979-1999 period. To make the system operational in near-real time, this initial system is then extended in time by using the NCEP analysis, bias corrected with respect to the adjusted ERA40, as spinup from the end of 1999 until the day of the forecast. We evaluate model performance retrospectively for predictions of major floods for the Mekong River in 2000, the Limpopo River in 2000 and the Danube in 2002 and 2006.