Hydrol. Earth Syst. Sci. Discuss., 5, S473–S475, 2008
www.hydrol-earth-syst-sci-discuss.net/5/S473/2008/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Simulating typhoon-induced storm hydrographs in subtropical mountainous watershed: an integrated 3-layer TOPMODEL" *by* J.-C. Huang et al.

Anonymous Referee #2

Received and published: 3 June 2008

General Comments: This paper describes and tests a version of TOPMODEL (or STOPMODEL) that incorporates interflow in a novel way. The model is tested against storm hydrographs associated with typhoon events in a watershed in Taiwan. Perhaps the most innovative part of this work is uniquely linking interflow with baseflow (Eq. 3), a concept that appears to build nicely on work by Peter Troch et al. (1993 Water Resources Research 29(2), 427-434) [which should be cited in this paper]. Troch et al. (1993) suggest that baseflow is an indicator of the landscape's antecedent wetness, which plausibly also indicates the magnitude of interflow as suggested by Haung et al. In essence, this paper more fully develops the theoretical work put forth by Walter et al. (2002) and Scanlon et al. (2000) to make TOPMODEL more realistically incorporate

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interflow. Conceptually, this paper is perhaps the most intersting such work to date.

Its major shortcoming is in testing the model against typhoon-initiated runoff events. These events are very intense and it is not obvious that variable source area (saturation excess) runoff is the primary process; e.g., Hortonian flow may be important for these types of events. At the very least the authors should compare their rainfall intensities to saturated soil hydraulic conductivities (e.g., Walter et al. 2003, ASCE J. Hydrologic Engineering 8(4): 214-218) to convince the readers that they have chosen a mechanistically appropriate model.

Additionally, extremely large events are generally the easiest to simulate because most of the precipitation generates runoff. I speculate that even a very simple rainfall-runoff model like the so-called "curve number" or "rational method" would capture these events similarly well (regardless of the actual underpinning hydrological mechanisms). Scanlon et al. (2000) were unable to substantially improve hydrograph predictions with their interflow-version of TOPMODEL (I think Walter et al. 2002 did not even try) and it is unclear that this proposed version of TOPMODEL improves hydrograph predictability any better. It would be good to show whether or not the more complicated 3-Layer TOPMODEL (or STOPMODEL) performs any better than the more basic versions.

Specific Comments: 1. In Eq. 1, presumably S1 is always less than or equal to Smax? I think in the original TOPMODEL the storage could exceed the available storage with the excess going to overland flow. Somehow this detail needs to be explained here.

2. Is it sufficient to test a distributed hydrologic model against watershed discharge only? Is there any evidence that internal water distributions or fluxes are correct? See Steenhuis et al. (1999, Water Resources Research), which shows that models based on different conceptual processes can give essentially the same integrated outputs. I believe Keith Beven has also written extensively on this topic. This comment relates back to my general comments regarding matching the model with the appropriate, actual, physical mechanisms.

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Interactive Comment

3. Can any of the eight or so global variables be determined a priori or is this essentially a purely fitted model?

4. It is a little strange to see the sensitivity analysis before the comparison between observed and modeled streamflow. Perhaps switch these two parts of the manuscript.

5. On pages 1106-1107, the authors note that they do not calculate evaporation for storm events because "the vapor pressure is almost saturated." I agree that evaporation (and interception for that matter) can be neglected during most large rain events but not for this reason. Evaporation is driven by the difference between vapor pressure at an evaporating surface and the vapor pressure of the overlying air mass, i.e., even when the air is "saturated," evaporation will occur if the evaporating surface is at a high enough vapor pressure. For example, we can boil (evaporate) tea-water when the air is at the saturated vapor pressure. Please omit this misleading and physically incorrect sentence... this common misconception is a "pet-peeve" of mine.

6. Some of the English is a little awkward, albeit very understandable; perhaps have this manuscript edited for a little smoother or better readability.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 1101, 2008.