Geophysical Research Abstracts,
Vol. 11, EGU2009-13278, 2009
EGU General Assembly 2009

Understanding the hydrological behavior of a steep watershed in the Swiss Alps through a time series analysis of river flow data.

S. Simoni (1), A. Porporato (2), H. Huwald (1), S. Padoan (1), and M. Parlange (1)

(1) EPFL-ENAC-ISTE-EFLUM, Lausanne, Switzerland (silvia.simoni@epfl.ch, +41 21 693 8094), (2) Duke University, Durham, NC, USA

Hydrological components of river flow discharge in a steep alpine watershed have been investigated via nonlinear time series data analysis and modeling techniques, with the purpose of understanding complex interactions among hydro-climatic forcing, including snowmelt, glacier dynamics and evapotranspiration, occurring over multiple spatial and temporal scales.

High-frequency streamflow data have been collected during a 5-month field campaign in the Swiss Alps; the 20 km^2 study is unaffected by any man-made structures such as dams, pipelines and turbines, so that the watershed hydrological response to hydro-climatic input could be understood in its essence.
The investigated $20 - km^2$-area represents the upper part of the Dranse de Ferret watershed, close to the Gd-St-Bernard pass. It is characterized by steep and complex terrain, mainly inaccessible by roads, usually covered with snow from December to late May; it also includes a small glacier, and precipitations are relatively intense during the spring season. The spring is the most critical season for this area because the snow melt adds to the precipitation and highly increases the soil moisture, the relative river discharge and the proneness of the site to debris flow and shallow landslides. Monitoring discharges in such an area is challenging but essential to investigate the catchment's behavior. A first attempt has been made by monitoring continuously, from June to November 2008, meteorological forcing such as precipitation, air temperature and humidity, solar radiation, soil moisture, matric suction and water levels at the watershed outlet; in addition, discharge measures have been carried out weekly using the salt dilution method in order to build a stage-discharge relation for the given watershed.

The time series analysis of the water level signal for the period June-November, reveals a seasonal decreasing trend which reflects discharge from the shrinking snow cover. The analysis also showed a superimposed daily cycle which describes the glacier response to meteorological forcing, and a component due to rainfall-run off contribution. In addition, a clear temperature effect can be quantified in the decrement of the daily cycle amplitude. Physically based modeling techniques have been applied to reproduce the measured stream data and to capture the essential mechanisms characterizing alpine watershed hydrology. In the phase space we could separate the three main components and model each of them separately using minimalist models, which, despite their simplicity, can capture the main dynamics of the system and the role played by external forcing.