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Modeling and forecasting snowmelt runoff process using the HBV model in the eastern part of Turkey

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Water perhaps is the most valuable natural asset in the Middle East as it was a historical key for settlement and survival in Mesopotamia, “the land between two rivers”. At present, the Euphrates and Tigris are the two largest trans-boundary rivers in Western Asia where Turkey, Syria, Iran, Iraq and Saudi Arabia are the riparian countries. The Euphrates and Tigris basins are largely fed from snow precipitation whereby nearly two-thirds occur in winter and may remain in the form of snow for half of the year. The concentration of discharge mainly from snowmelt (60-70% in volume of the total yearly runoff) during spring and early summer months causes not only extensive flooding, inundating large areas, but also the loss of much needed water required for irrigation and power generation purposes during the summer season. Accordingly, modeling of areal snow cover in the mountainous regions of Eastern Turkey, as being one of the major headwaters of Euphrates-Tigris basin, has significant importance in order to use the water resources in an optimum manner.

The HBV model, being one of the well-known conceptual hydrological models used more than 45 countries over the world, is applied for the first time in Turkey to a small basin of 242 km^2 on the headwaters of Euphrates River for 2002-2005 water years. The input data are provided from the three automatic weather stations (AWS) installed at various locations and altitudes in Upper Euphrates Basin operating in real-time. Since ground based observations can only represent a small part of the region of interest, spatially and temporally distributed snow cover data are acquired through the use of MODIS(Terra/Aqua) optical satellite. Automatic model parameter estimation

method, SCE_UA, is utilized to calibrate the HBV model parameters with a multi-objective criteria using runoff as well as snow covered area to ensure the internal validity of the model. Model simulations show that the choice of study years and timing of satellite images affect the results. The benefit from the Earth Observation data may not be obvious for years when the snowpack is well simulated by the model, although showing a confirmation of the model estimate. But during unusual snow distribution conditions where large deviations are present, snow covered images may be of valuable help allowing an updating of the model to represent the actual conditions in the area of concern.

In the second part of the study, the calibrated HBV model is applied to forecast runoff with a 1-day lead time using gridded input data from numerical weather prediction models of ECMWF and MM5 for the 2004 snowmelt period. Especially predicting the timing of high snowmelt runoff events indicate promising results ($R^2 \approx 0.8$) in the possible operational use of runoff forecasting using numerical weather prediction models in order to prevent or at least take precautions before flooding ahead of time.