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Coupling Earth Observation Data into a hydrological model for an andean basin

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A numerical model was developed for estimating the components of the hydrologic cycle on a 271.97 km2 basin in Cajamarca – Peru (basin centroid 78°24'27"W 7°0'9"S). The study area is located between 3037 and 4240 masl and is covered mainly by grasses and shrubs. Annual average precipitation in the area of interest for the period 2006-2009 ranges from 869mm on the basin outlet to 1474mm at the highest basin edge.
The selected model was the U.S. Geological Surveys Precipitation Runoff Modeling System (PRMS), which is a deterministic, distributed-parameter hydrologic model that runs on a daily time step and has a modular design. The capability of PRMS includes the evaluation of various combinations of precipitation, climate variation and land use on the watershed response. The model can include snow components into the analysis but in this modeling work the corresponding modules remained inactive due to the absence of precipitation as snow.
The input data of the model was coupled with two products from the MODIS (or Moderate Resolution Imaging Spectroradiometer) mission which deal with seasonal vegetation density and land cover type. This earth observation data became parameters of the module that accounts soil moisture, and computes actual evapotranspiration and seepage to the subsurface and groundwater reservoirs. MODIS raster resolution is 500m.
Model results were calibrated with flow measurements over a period of 41 months in six gauging stations. Spatial distribution of modeled and observed precipitation, maximum and minimum temperature and potential evapotranspiration with observed data were taken as well into account on the calibration phase. There was a special emphasis in analyzing the correlation of these parameters with elevation.
In an analysis of the whole watershed, water consumption by plants takes the biggest part of precipitation, with a mean consumption of 626 mm for the period 2006-2009 (54% of total precipitation). Recharge to the groundwater flow regime range from 6% to 19% of the total precipitation. Actual evapotranspiration on the area of interest accounts for 62% of the potential evapotranspiration.
Model results show a complex pattern on the spatial and temporal distribution of the water cycle components. The use of Earth Observation Data provides a handy tool to assess the ecosystem variables and land cover characteristics which are critical on evaluating the water balance of an area of interest. Results from the numerical model are key inputs for water rights management plans and water regulation policies. Climate change scenarios as decrease in precipitation and increase in temperature can be evaluated on predictive runs.