IAHS2017-190-1
IAHS Scientific Assembly 2017


# Streamflow estimation in ungauged basins using remote sensed hydrological data

Nicolas Vasquez (1) and Ximena Vargas (2)

(1) Universidad de Chile, Santiago de Chile, Chile (nvasquez.plac@gmail.com), (2) Universidad de Chile, Santiago de Chile, Chile (xvargas@uchile.cl)

In several parts of the world the scarcity of streamflow gauging stations produces an important deficit of information, and calibrating these basins remains a challenge for hydrologists. Improvements in remote sensing have provided significant information about hydrological cycle, which can be used to calibrate a hydrological model when streamflow information is not available. Several satellite products related to snow, evapotranspiration, soil moisture, among other variables, provide essential information about hydrological processes, and can be used to calibrate physically based hydrological models. Despite this useful information, other aspects are unknown like aquifers dimensions or precipitation heterogeneity.

We calibrated three snow driven basins in the Coquimbo Region in Northern Chile, using fSCA from MODIS (MOD10 and MYD10) and NDSI from Landsat. We also considered the MOD16 product to estimate evapotranspiration. Soil Moisture from AMSR-E was considered but it was not useful due to the spatial resolution of the product and the high heterogeneity of the terrain.

The Cold Regional Hydrological Modal (CHRM) was selected to represent the hydrological processes due to the importance of snow processes which are, by far, the most important in this area, where precipitation falls as snow principally in winter (June to August) and the melting period begins in spring (September) and ends in the beginning of summer (December and January).

The inputs used in the model are precipitation, temperature, short wave radiation, wind speed and relative humidity. The meteorological information was obtained from stations available in the area, and distributed spatially using orographic gradients for wind and precipitation and lapse rates for air temperature and dew point temperature. Short wave radiation was computed and corrected by cloud cover data from MODIS. Streamflow data was available but it was not used in the calibration process.

The three basins are Cochiguaz river at Peñón (676 $km^2$), Derecho river at Alcohuaz (338 $km^2$) and Toro river in confluence with La Laguna river (468 $km^2$). These sub-basins are part of the Elqui river basins and are located in the Andes Cordillera, Chile. The mean altitude are 3508 ($m.a.s.l$), 3543 ($m.a.s.l$) and 3625 ($m.a.s.l$) respectively. For the calibration period (2002 to 2014), the NSE of the fSCA are 0.85 and 0.87 for Cochiguaz and Derecho rivers. The Toro river was separated in two rivers: Vacas Heladas and Malo. NSE for these two last basins are 0.77 and 0.78. For ET, the analysis relies on the number of pixels inside each basin, but annually, the R2 are 0.62, 0.43, 0.46 and 0.58 for the four sub-basins. Some biases are noticed when ET is analyzed. For streamflow, the NSE were 0.64, 0.34 and 0.08 for Cochiguaz, Derecho and Toro river in the calibration period. Additionally, due to the uncertainty about the aquifers dimensions, a sensitivity analysis was performed.