A golden era for alpine catchments: the convergence of high-resolution atmospheric modeling, remote sensing, and hydrology

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Hydrology is often a data starved science. The amount of information required to fully characterize the hydrologic response of a basin is vastly greater than the number of observations available, even in heavily instrumented research basins. Key data gaps range from the precipitation and wind fields required for input to hydrologic models, to the vegetation and soil properties required to parameterize a hydrologic model, to the hydrologic states such as groundwater levels, soil moisture content, and snow water equivalent required to characterize the hydrologic processes and assess how well our hypotheses – often in the form of numerical models – match reality.

The nature of this problem is now changing such that hydrologists are often overwhelmed by data, though not always the data they would like. Estimates of precipitation and near surface wind speeds can be greatly improved through integrating recent advances in high-resolution atmospheric modeling, with satellite and surface precipitation radars adding additional information about both precipitation and even wind fields. In addition, novel remote sensing measurements from airborne lidar to high-frequency cube-sat imagery to hyperspectral imaging spectrometry provide enormous volumes of data for assessing the response of snow and vegetation. Finally, a long history of surface thermal measurements from satellites provides an untapped reservoir of information about the land surface. The challenge facing hydrologists now is how best to integrate and make use of these disparate data sources to better understand the hydrologic response of alpine catchments.