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# Matching pixels, plots and catchments

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A common problem in environmental modeling is connecting the available spatial information to our understanding of processes. Often the spatial support offered by data from remote sensing apparatus is not scale-appropriate to the support required by the end user in geomorphology or hydrology. Furthermore the definitions and terminologies used by scientists in different disciplines to explain the scaling problem are not interchangeable.
This problem is illustrated when comparing the different definitions of the term "up-scaling" used in hydrology and geomorphology, i.e. by scientists with an understanding of surface processes; and in remote sensing, i.e. by spatial scientists studying the Earth's reflectance properties for spatially distributed environmental modeling. There is a degree of semantic uncertainty that needs to be considered when thinking about up-scaling in a cross-disciplinary sense.
Geomorphologists and hydrologists consider up-scaling as the way in which an overview of a set of processes can be understood or quantified, e.g. from slopes to catchments, at the cost of resolution at the process level. This may include a shift in the factors which dominate the hydrologic or geomorphic response of the observed catchment, e.g. sediment delivery by rivers into oceans as compared to sediment delivery from hill slopes into rivers during a given event.
In remote sensing, up-scaling describes the process for transitioning data through different spatial scales, from fine scale data to coarser scale data, perhaps through a transition from ground-based to airborne to spaceborne data. The effect of up-scaling is for data to become more spatially integrated as the spatial resolution of data is coarsened, and resultantly, the heterogeneity of land cover and/or spectral classes in a pixel usually becomes more heterogeneous or mixed as pixel size increases. Earth observation scientists use a range of methods for up-scaling ground-based observations to the spatial resolution of airborne or satellite pixels.
Similar issues to the remote sensing problem occur when plot data are used to model the hydrologic or geomorphic response of a much larger hillslope: the end-of-pipe erosional response "signature" of a plot may not be suited to estimate the cumulative signature of a slope, or the small-scale processes on the plot, unless the slope has uniform surface properties and the effects of increasing slope length and morphology on hydrology and erosion are known. Understanding the processes that determine the quality of plot data may therefore offer a bridge to connect the different perspectives on upscaling in hydrology, geomorphology and remote sensing. In this presentation, we offer some conceptual thoughts on bridging the gap between pixels, plots and catchments by comparing the factors which define the "response" of each unit, identifying analogues and limits to using information from either unit to explain the hydrologic, erosional or spectral response of the others.