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Fast prototyping of wavelet spatio-temporal RS fusion with Raingauge time series with GDAL and Python-DWT

Yann Chemin
Sri Lanka (yann.chemin@gmail.com)

Availability of rainfall time-series is limited in many parts of the World, and the continuity of such records is variable. This research endeavors to extend actual daily rainfall observations to ungauged areas using vegetation response as witnessed by remote sensing data and taking into account rainfall event histograms as well as cumulative total daily rainfall, over a period of 11 years.

Open Source code development permitted to gain on several aspects. The first one pertains to space, Python and its numerical part (NumPy) are scientifically concise, as a bonus to be expressive. The second is the availability of the Discrete Wavelet Transform (DWT) in Python already, which permitted to reduce the Wavelet Transform to a small set of instructions, clarifying and simplifying the understanding of the code once it reaches the Public Domain. GDAL interface permitted to load satellite imagery and write fused rainfall time-series in spatio-temporal dimensions. Other scientific tool from Numerical Python were also used in the process of developing the algorithm (scipy.stats.stats and scipy.interpolate.griddata). Due to the large amount of days (4019) and the kilometer based resolution of the vegetation RS data, it takes about a week for the code to resolve the fusion problem. An attempt at using an multicore interpolation implementation in Python (hpgl) which unfortunately was not an active project anymore, though certainly deserving interest.

Results show that rainfall events histograms can be reconstructed, and that total cumulative rainfall is estimated with 85% accuracy, using a surrounding network of rain gauges at 30-50 km of distance from the point of study. This research can strengthen various types of research and applications such as ungauged basins research, regional climate modeling, agricultural insurance systems, etc. Further development aims at porting the code to distributed computing.