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Understanding terrain topography impact on snowmelt at catchment scale

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The work by [Fan et.al., 2019] calls for model experiments to evaluate the major hypothesis that energy or water-limited regions are largely controlled by hillslopes. However, the meteorological data in mountainous areas lacks accuracy due to sparse station network and coarse re-analysis grids (for example, high-resolution senorge data is only 1km). Simulation tools that model hydrologic processes at local scales require ways to overcome the lack of accuracy in the observational data, particular at high elevations.

SHyFT is a tool for distributed hydrologic modeling, which has demonstrated a high potential in the ability to model stream flow in complex and data sparse regions [Burkhart et al., 2016]. Steps are also taken to further account for hillslope-scale terrain structures carefully. This new functionality allows downscaling and translating radiation measurements or re-analysis data onto inclined surfaces improving the predictive power of the model.

Based on the SHyFT framework we are analyzing the importance of topographic details such as slope/aspect and shading on predicting snowmelt and vegetation in northern latitudes, which are characterized by energy-limited complex terrain. Observations inform us that slope/aspect and shading effects in mountainous regions impact snowmelt: sunny slopes melt earlier while shady ones store snow for longer periods. Our framework provides a unique capability to directly incorporate these effects online within the hydrologic computation, and we will further evaluate whether the aforementioned hypothesis is accurately characterized with this new functionality for operational cases. Further, we will assess whether there is a direct benefit to hydrologic simulation.

This project contributes to LATICE (Land Atmosphere Interaction in Cold Environments) initiative at the University of Oslo.

References

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