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Modelling water and carbon budgets of tropical alpine regions with satellite rader data

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Tropical mountain areas provide crucial ecosystem services. They contain important surface water resources in the form of wetlands, which provide water for the surrounding lowlands. The highly organic soils, the result of the cold and wet conditions and low atmospheric oxygen content, are a major carbon sink.

However, the water and carbon dynamics of these wetlands are very poorly known. The remote regions are difficult to access, and as a result, very few hydrological and soil data are available. In this study, remotely sensed Asymmetric Synthetic Aperture Radar (ASAR) data from the ESA ENVISAT satellite are used to model the water and carbon balance of paramo wetlands in South Ecuador. After cleaning for topographical distortions using Principal Component Analysis, monthly ASAR images show significant correlation with local precipitation records. In combination with land cover classification based on Landsat images, the monthly dynamics of ASAR are used to identify hydrologically active zones in the wetland area.

These hydrologically active zones are subsequently modelled using a carbon and water balance model constructed from local soil information. Using local field validation, it is shown that the ASAR data are successful in constraining the carbon and water balance model. An improvement in predicting the water and carbon budgets can be observed.

The study shows that satellite radar data can be used to increase understanding of spatial and temporal dynamics of the water and carbon budgets of tropical alpine regions. This information is crucial for an adequate land and water management of the ecosystem, particularly in view of water supply and climate change mitigation.