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Can old growth alpine forests be biophysical barriers against current heat waves?

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The current climate crisis requires an urgent understanding of ecosystem features dampening and alleviating the increasing radiation forcing. To this end, emission of latent heat from forests emerges with its relevance among the terrestrial ecosystem properties. It is not clear, however, if the different forest structures and ages act similarly, depending on the species composition, or if their structure has a role.

We performed a research on the hydrological cycle in the highly instrumented research facility in Renon forest, Italian Alps, belonging to the ICOS European infrastructure. The site is covered by a dense but structurally heterogeneous spruce forest, characterized by a young sector, with 30 years trees and an old forest sector composed by 200 years old trees.

Energy and water balance are quantified by eddy covariance instrumentation, 12 sap flux sensors in trees representative of the forest tree ages and 20 below-canopy pluviometers in each of the two forest structures. With these pluviometers, we quantified the relative role of canopy interception as a function of LAI density, precipitation intensity and duration. Water discharge and fog interception measurements allowed the closure of the water cycle at catchment scale.

Interestingly, we found that the water cycle is largely decoupled from the ground. In the old forest section, the fraction of water reaching the ground in the old sector is the 0.42±0.17 (vs. 0.67±0.17 in the young sector) of incoming precipitation. This suggests that in old alpine forests the hydrological cycle takes place largely in the crown and the old forest is using a large fraction of precipitation to dissipate heat.

Our results support the view of stand age as emerging property in the atmosphere-biosphere interaction and highlight the relevance of old forests in dampening the recurrent heat spells spreading across Europe, with the Alps and their remaining old growth forests standing as biophysical barriers.