8th International Conference on Fog, Fog Collection and Dew
Taipei, Taiwan, 14–19 July 2019
IFDA2019-84

The wisdom of age: how old alpine forests regulate the global hydrological cycle

Leonardo Montagnani (1), Nikolaus Obojes (2), and Glenda Garcia-Santos (3)

(1) Free University of Bolzano, Faculty of Science and Technology, Italy (leonardo.montagnani@unibz.it), (2) EURAC Research, Via Druso ,Bozen, Italy (nikolaus.obojes@eurac.edu), (3) Alpen-Adria Universität Klagenfurt,Klagenfurt, Austria (glenda.garciasantos@aau.at)

The capacity of the hydrological cycle for dampening the increasing radiative forcing due to climate change is challenged in the last years, as an increasing land surface area is becoming water limited. Understanding and quantifying sources of water in terrestrial ecosystems, and the role of the different structural properties of the vegetation canopy in the response to climate forcing is urgently needed. In particular, we were interested in understanding the role of the water intercepted in the canopy of alpine coniferous forests in the water cycle, quantifying it and defining the different constraints influencing direct evaporation from the wet canopy and leaf transpiration.

To this end, we performed a comprehensive research in a subalpine coniferous forest, at the site of Renon, in the Italian Alps, where a dense, old-growth spruce forest is monitored by the eddy covariance technique. We installed 12 sap flow sensors in different trees representative of the forest tree age and diameter distribution. We installed on the meteorological tower a visibility sensor connected with a fog sampler. Through an extensive set of small samplers placed below the canopy, disposed with a stratified strategy as a function of leaf area index, we quantified the relative role of canopy interception as a function of LAI density, precipitation intensity and duration. By inverting the Penman-Monteith equation, we modeled the canopy conductance as a function of main environmental parameters.

We found that at our study site the water intercepted by the canopy represents a large water reservoir, largely decoupled from the ground hydrological cycle. We found also that the dew deposed on the canopy represents a secondary but not negligible addition to canopy water reservoir. Interesting, the amount of leaves are a variable strongly and positively linked to the forest capacity to store canopy water, and it is therefore positively correlated with the capacity of the forest to respond to radiative forcing by increasing emission of latent heat instead of sensible heat. This research gives evidence to the potentially large and yet undetected role of the forest canopy age and structure in the global hydrological cycle.