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Variation in canopy energy exchange characteristics across an ecosystem mosaic in the dry Mediterranean region

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Assessment of the plant-climatic interactions in the land biosphere requires a combined perspective of both the biogeochemical effects (BGC; such as the carbon sink), and the biogeophysical effects (BGP; such as the vegetation albedo and radiative balance), which can often have contrasting consequences for ecosystem functioning and climate. Aiming to increase our knowledge on semi-arid ecosystems that are insufficiently represented in global studies, we examine the variations in key BGP features among different vegetation types in a dry Mediterranean region in southern Israel.

The study included planted pine forest (*pinus halepensis*), natural broad-leaf oak maquis (*Quercus calliprinos*), wheat field and a managed grassland, located in close proximity (within 2 km) under the same climatic conditions (mean annual temperature = 20.8C, annual mean precipitation, P= 403 mm, aridity index = 0.4). Using a state-of-the-art mobile laboratory, we carried out measurement campaigns of eddy covariance fluxes of CO2, sensible, H, and latent, LE, heat fluxes, and the radiation balance (incoming and outgoing short- and long-wave radiations) between the ecosystems and the atmosphere in different seasons during 2016-2018.

The results showed significant differences in net radiation and in albedo among the ecosystem, with net radiation values of ~666, ~582, ~443 and 456 W m^{-2} and albedo values of ~0.13, ~0.16, ~0.19 and ~0.20 for pines, maquis, wheat and grassland, respectively. The lowest albedo of the pine stand was associated with the largest H (a 'convector effect') of ~583 W m^{-2} compared to ~313, ~198 and ~176 W m^{-2} in the maquis, wheat and grassland ecosystems (midday means of peak activity season). The pine stand was also more adjusted to stress conditions than the oak maquis ecosystem through 'avoidance' of high activities during extreme conditions of heat and drought (reducing canopy conductance and associated fluxes). It is likely that the observed differences between the pine and oak maquis stand help explain the greater expansion of pine stands into the semi-arid regions, even to areas with mean annual P of 290 mm (aridity index = 0.2) where oak maquis cannot be found.