Geophysical Research Abstracts
Vol. 17, EGU2015-12526, 2015
EGU General Assembly 2015

Any Way the Wind Blows does Really Matter to Ecosystem Water Use Efficiency

Nicola Montaldo (1) and Ram Oren (2)

(1) Università di Cagliari, Ingegneria civile, ambientale e architettura, Cagliari, Italy (nicola.montaldo@unica.it), (2) Nicholas School of the Environment, Duke University, Durham, NC, USA

In many regions, atmospheric conditions change frequently with shifts of wind direction, extending maritime influences far inland or continental influences to coastal ecosystems. However, depending on their origin, high velocity winds can bring dry continental air to the coast (e.g., Santa Ana winds along the mid-eastern Pacific coast2-3) or cool maritime air far inland. In these regions, water and carbon fluxes may respond to meso- and macroscale weather patterns, yet the effects of wind direction have been explicitly considered only in footprint analyses, limited mostly to <1 km around instrumented towers and focusing on the relations between the characteristics of the contributing source/sink area and measured fluxes. Thus, no explicit link has been formulated between coarse-scale weather phenomena and wind properties that ultimately affect biosphere-atmosphere exchanges of mass and energy.

Using climate and ecosystem-scale data from Sardinia, our work shows that wind direction affects biosphere-atmosphere exchange of carbon but not water. Summer Mistral winds from continental Europe remain cool as they cross the island, but warmer Saharan Sirocco winds, arriving with similar vapour pressure deficit (D) but 30$\pm$16% higher specific humidity (Qa), heat up and lose humidity, trebling D only 50 km inland. Over a mixed pasture-woodland (grass-wild olive), while soil moisture was stable and limiting, daytime net carbon exchange (NEEd) averaged 2.3-fold higher (P<0.001) in Mistral than Sirocco days, reflecting the response of canopy conductance (gc) to variation of D. Because the product of gc and D encodes the key ecosystem compensatory mechanism, the reciprocal gc-D response maintained similar ecosystem evapotranspiration (Ee). Thus, summertime ecosystem water-use efficiency (We=NEEd/Ee), $\sim$50% higher during Mistral days, reflected the Qa of sea air embarking the island. Broad alteration of dominance of maritime versus continental influences predicted with future climate will amplify or negate the positive effect of increased atmospheric [CO_2] on We, and should be considered in earth-system models.