THE UNIVERSITY OF ARIZONA

School of Natural Resources and the Environment

Seminar Series: Fall 2018

The Role of Climate in Tree Response to Rising CO2

SPEAKER: **Soumaya Belmecheri, *Tree Ring Laboratory, University of Arizona***

DATE: **Wednesday, September 12th, 2018**

TIME: **3:00-4:00 pm**

LOCATION: **ENR2, Room S107**

ABSTRACT: The terrestrial biosphere has been responding to rising atmospheric carbon dioxide concentration (c_a), through increased plant photosynthesis and reduced stomatal conductance. The resulting enhancement in gross primary production contributes to the strengthening of the land carbon sink, which currently sequesters 30% of total anthropogenic c_a emissions. Elevated c_a leads to an increase in CO_2 concentration within the leaf (c_i), and plants adjust their stomatal conductance towards a proportional ratio of c_a and c_i (*i.e.* constant c_i/c_a), resulting in an increase of water use efficiency (*WUE*- ratio of carbon gain per unit of water loss). Under elevated c_a, the increase in *WUE* has been widely observed in laboratory and ecosystem experiments and in tree-ring records in response to rising c_a since 1850 CE. These observations are consistent with recent atmospheric evidence of greater photosynthetic carbon isotopic discrimination by the terrestrial biosphere, however, they contradict analysis of above-canopy CO_2 and water vapor fluxes, which showed a larger increase in *WUE* over the past 20-years requiring trees to close their stomata to preserve a constant c_i. While observational, proxy-based measurements and process-based models support a *WUE* enhancement with rising c_a, the magnitude and underlying mechanisms of plant physiological responses to elevated c_a remain highly uncertain. The implication of CO_2 effect on forests *WUE*, global evapotranspiration, and continental runoff should therefore be regarded with caution. These findings have significant implications in predicting future terrestrial C sink and thus require exploring whether these responses represent a short-term acclimation or long-term response of plant functional traits to environmental changes. Analyses of tree ring stable C isotope ratios ($d^{13}C$) since the onset of the industrial period allow examination of c_i–regulation in response to rising c_a, including the role of climate in modulating leaf-gas exchange strategies. Data suggest that *WUE* is still recently increasing in most species but that the rate of increase is less than expected and may have reached a plateau in the recent decades. This evidence demonstrates that a broadly conserved suite of functional traits allows woody plants to adapt their leaf gas exchange to elevated CO_2.

The School of Natural Resources and the Environment
ENR2, 3N
1064 E. Lowell St.
Ph.: (520) 621-7255 | Fax: (520) 621-8801