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Temperate-zone reforestation as a tool for local climate adaptation?

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In addition to dramatic reductions to anthropogenic greenhouse gas emissions, most pathways for limiting global warming to less than 2 degrees C rely on managed alterations to the land surface designed to increase land carbon uptake and storage (so-called “natural climate solutions”, or NCS). Reforestation is the NCS with the largest estimated climate mitigation potential, and at least in energy-limited temperate climates, evidence is mounting that transitions from short-stature ecosystems (croplands, grasslands) to forests substantially reduce surface temperature. In this way, reforestation, at least in some places, may also represent a useful tool for local climate adaptation. However, existing work on the topic has tended to focus on how reforestation affects mean annual and seasonal surface temperature, with comparatively less attention paid to the biophysical impacts of reforestation when local cooling would be most beneficial (i.e. at mid-day, and especially droughts and heat waves). Moreover, while surface temperature is a critical driver of ecosystem processes, arguably the near-surface air temperature is the more relevant target for climate adaptation. The duality between reforestation impacts on surface and air temperature has historically been challenging to deconvolve, and thus we do not yet understand the extent to which forest surface cooling extends to the air. In this talk, new strategies are discussed for blending flux tower data and remote sensing observations to uncover the links between reforestation, surface energy balance, and near-surface air temperature dynamics, with a particular emphasis on how plant water use strategies mediate these relationships during summer days and periods of hydrologic stress.