Continued Search for the Carbon Sink: Considering Interactions in an Integrated Assessment Framework

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In this talk, I will address three related ideas towards the objective of help defining an integrated assessment framework.

One, in the quest to find the carbon source / sink mechanisms over the US forestlands, I will outline that it is critical to consider the interactions between the natural and anthropogenic forcing pathways. This can be reviewed as a feedback between naturally occurring drought and anthropogenic CO_2 increase. Our present understanding of this problem based on the various meta-analysis, field and chamber studies will be briefly reviewed. It will be then highlighted that the variability in the outcome for seemingly homogeneous experimental conditions is because of the interactive feedback from atmospheric / environmental conditions. Using an interaction explicit statistical analysis, we will then successfully test the hypothesis that the effect of CO_2 doubling on the terrestrial landscapes, and the ability of the terrestrial ecosystem to behave as a source / sink of the atmospheric carbon is dependent on the soil moisture availability.

Two, using observations and model analyses, it will be shown that the problem of environmental feedback on the landscape response can be explained as a resource – allocation issue. Taking soil moisture availability as the resource, I will highlight that the task in trying to develop a regional carbon sequestration policy from point observations could benefit from assuming transpiration – photosynthesis based (non causal) covariance. Assessing the allocation and exchange of one resource between the surface and the atmosphere, a question will be posed if a investment of moisture into the environment also suggest a larger uncertainty with the carbon sequestration estimate over the landscape.

Third, I will extend the above hypotheses to suggest that under an integrative framework, the carbon source / sink potential can be defined as a sum of a basal landscape based value, and a transient land – atmosphere feedback based variable value. The feedback component will show significant dependence on the soil moisture availability and could have a comparable magnitude as the basal value (with either an additive or a subtractive effect) and needs to be explicitly considered in an assessment framework.

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