



Sensor Technologies and Unmanned Aerial Vehicles to Measure Ecosystem Processes in Semi-arid Environments

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Objective: Capture heterogeneity in carbon fluxes in space and time in response to woody plant expansion

Broader goal: Enable predictions of carbon and water dynamics under projected climate change

This requires a multi-scale (so a multi-tool) approach!

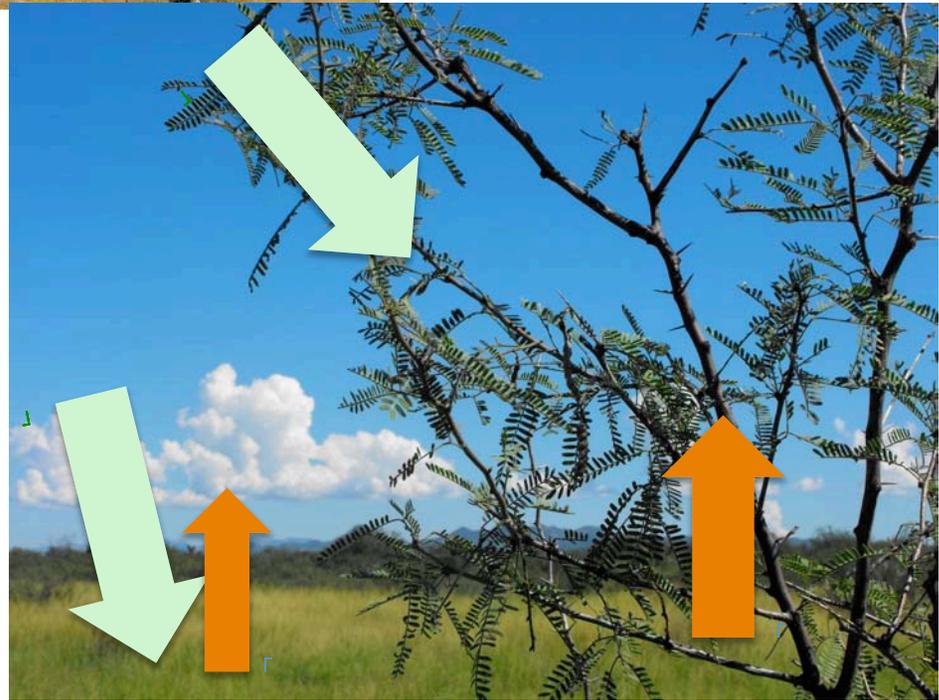


Ecosystem-scale measures integrate over processes

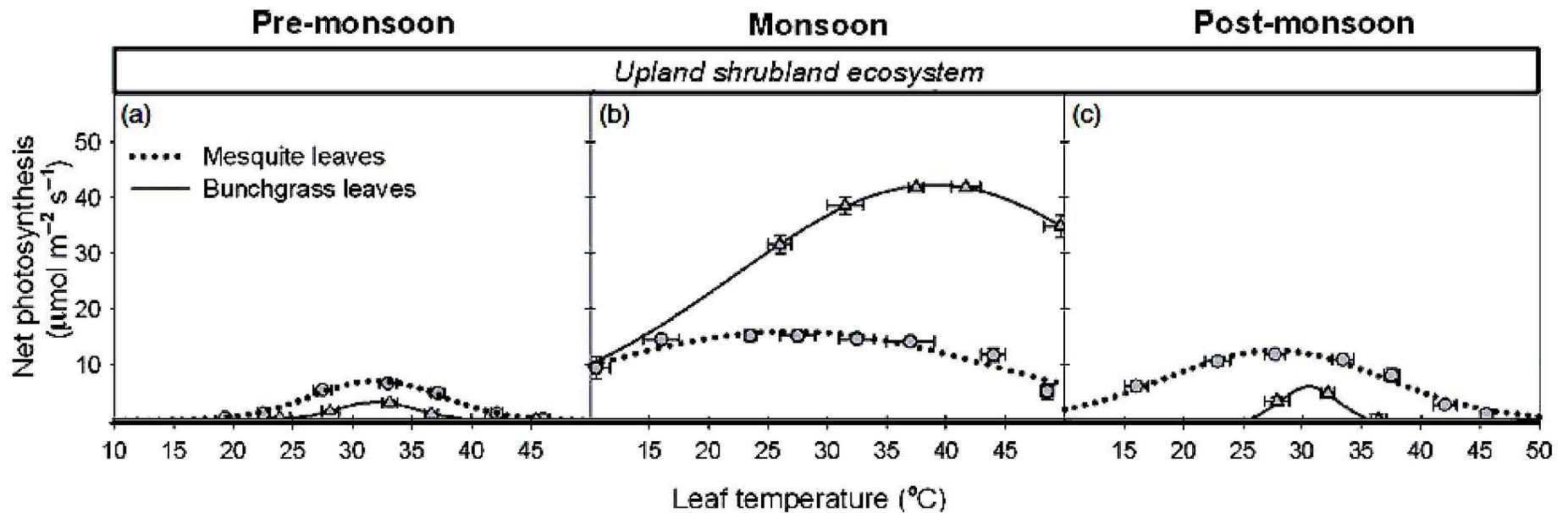


NEE = *Net* Ecosystem
Exchange of carbon
dioxide (CO₂)

*Makes modeling
difficult!*



... And we know there are important differences between members of a community



Barron-Gafford et al. Journal of Ecology 2014

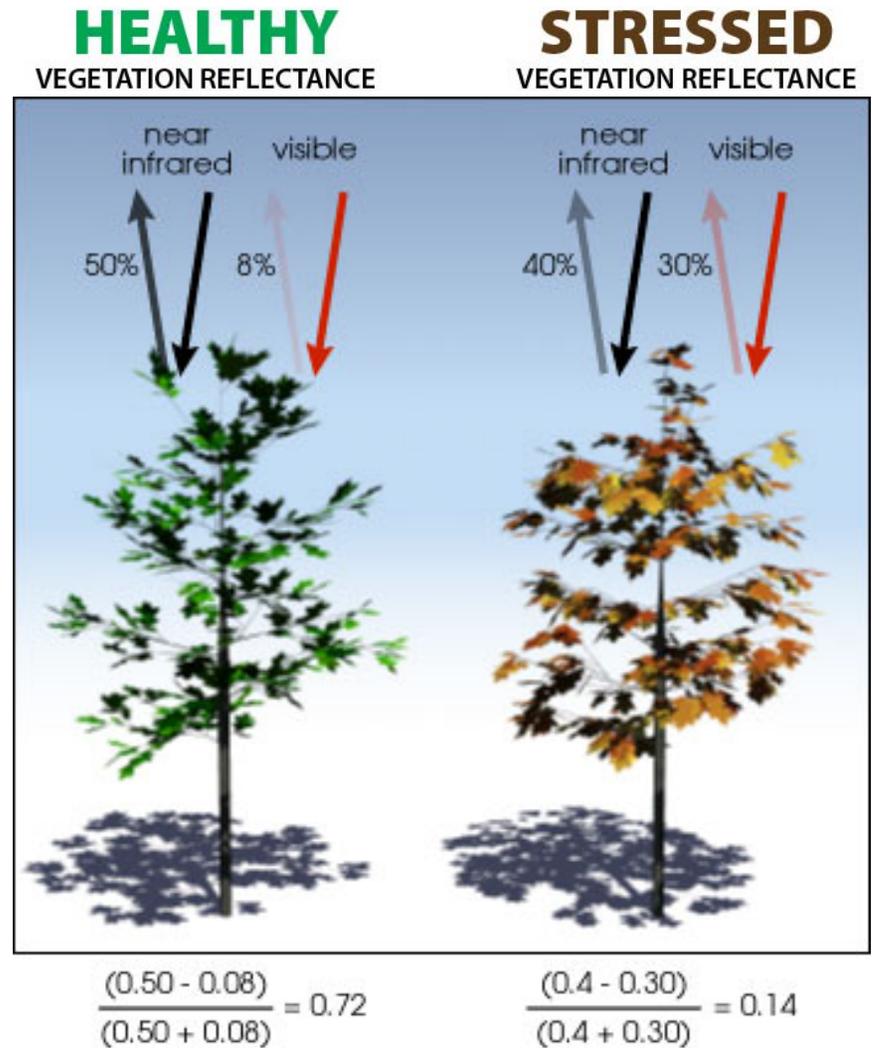
$$\text{Ecosystem} = f(\text{structure} * \text{activity})$$

“Activity” = Ecophysiological measurements

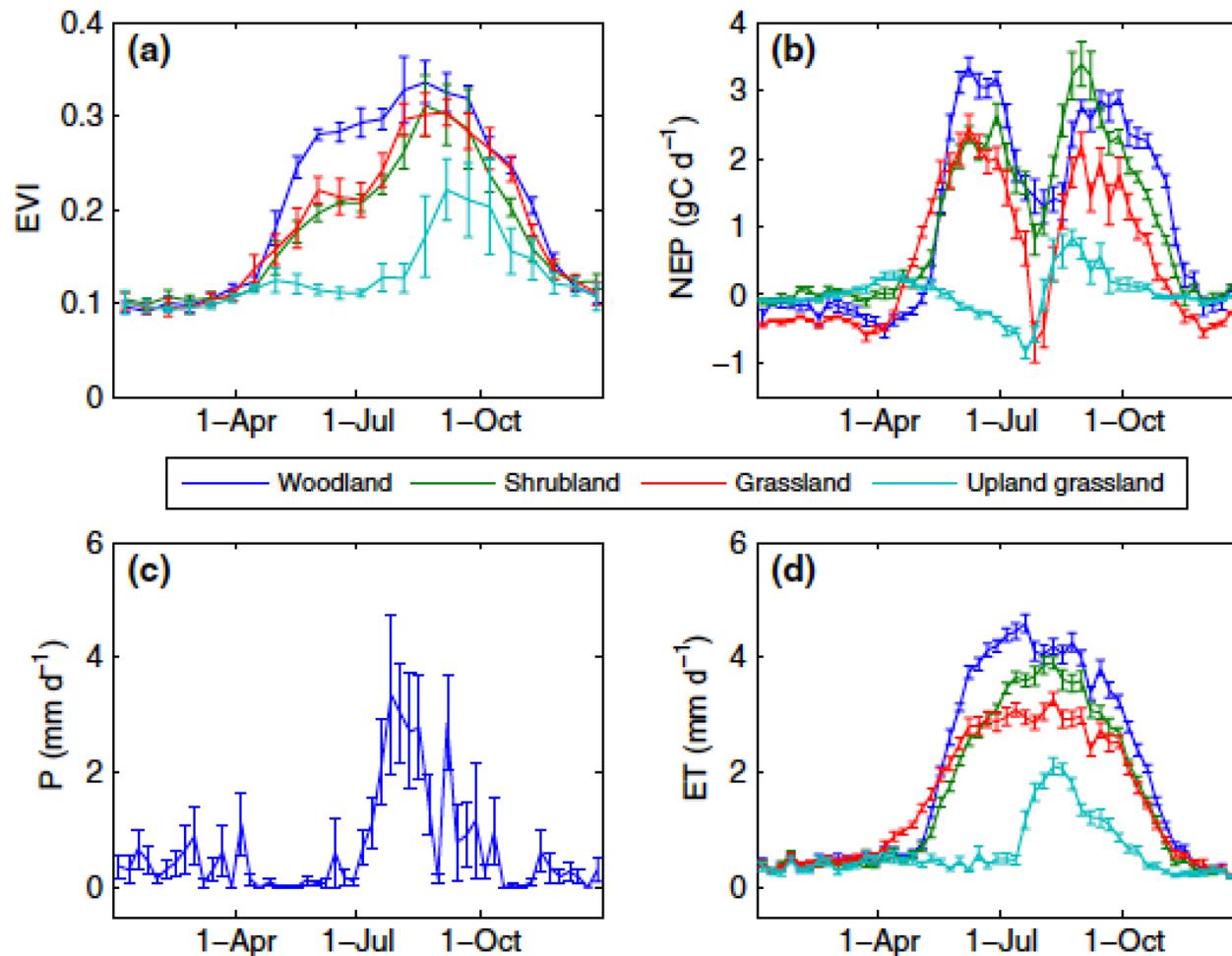


“Activity” = Normalized Difference Vegetation Index

$$\text{NDVI} = \frac{(\text{NIR} - \text{Red})}{(\text{NIR} + \text{Red})}$$



Satellite-based Remote Sensing has lots of utility!

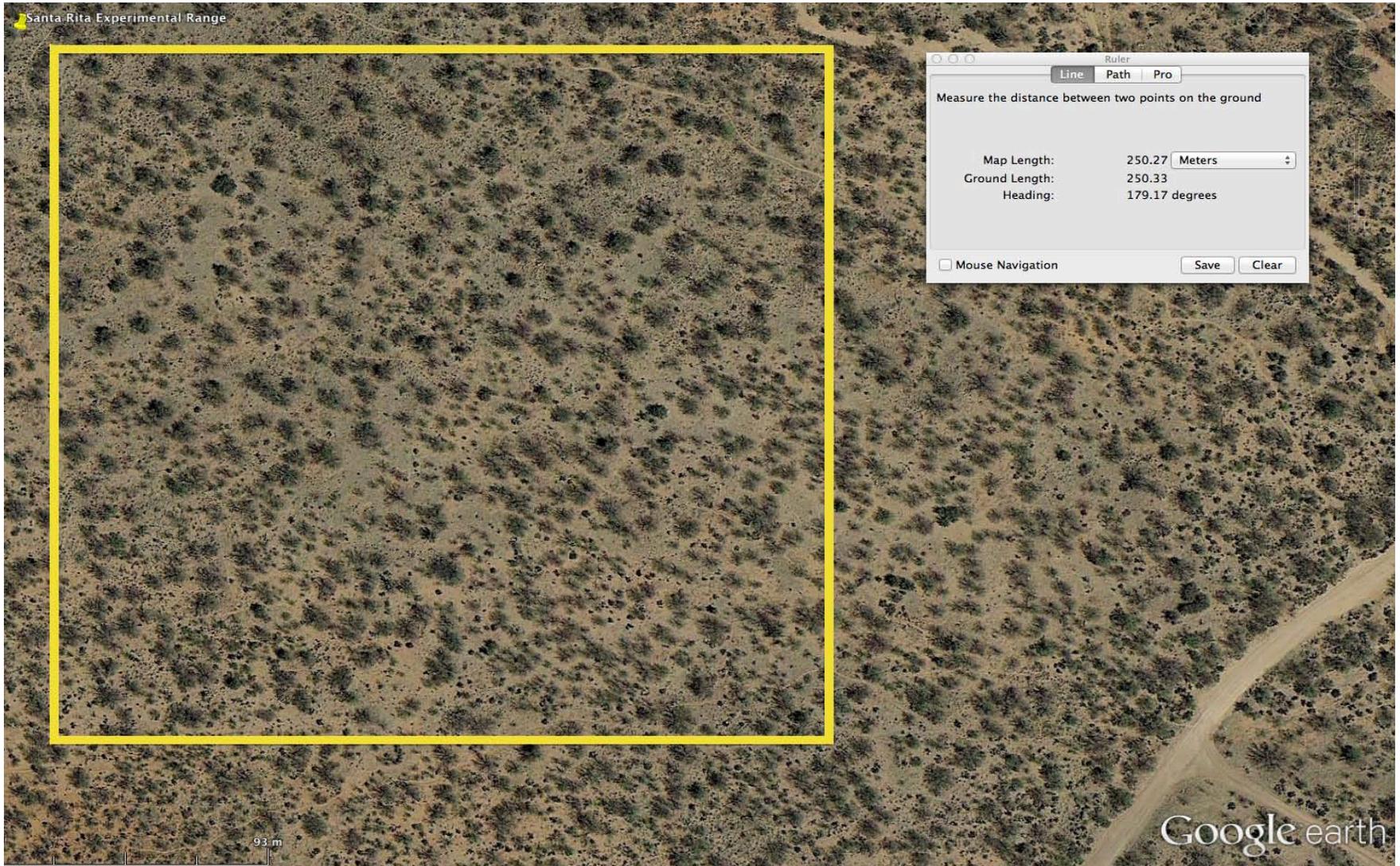


... In identifying longer-term patterns and correlations with other ecosystem-scale parameters

Scott et al. Global Change Biology 2014

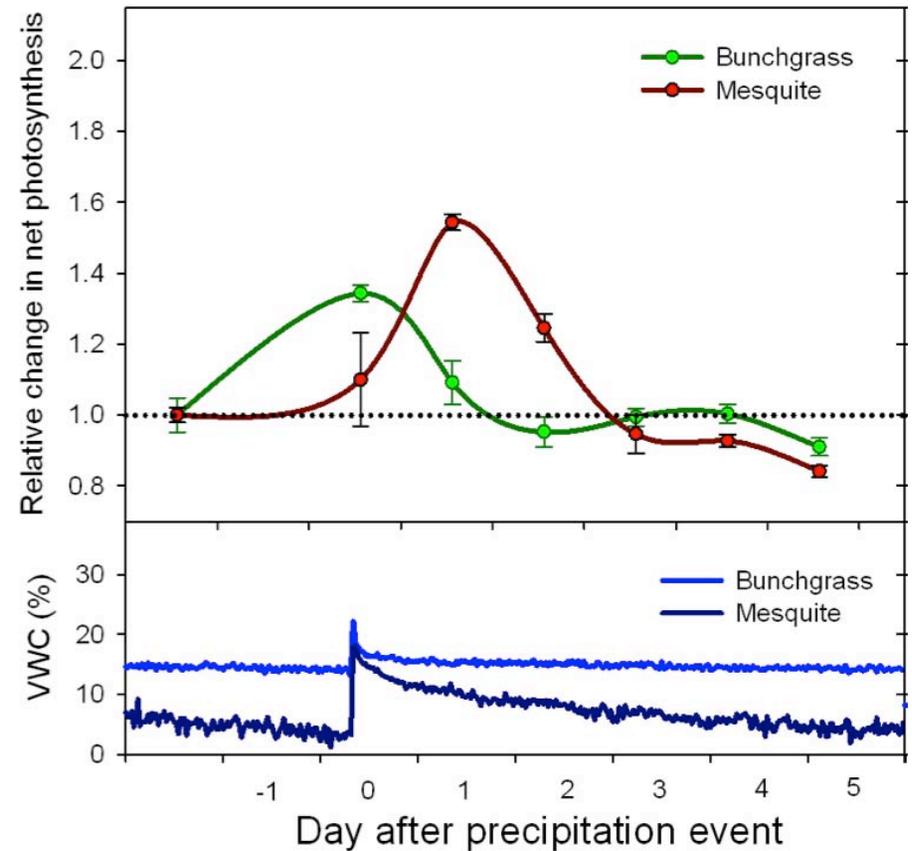
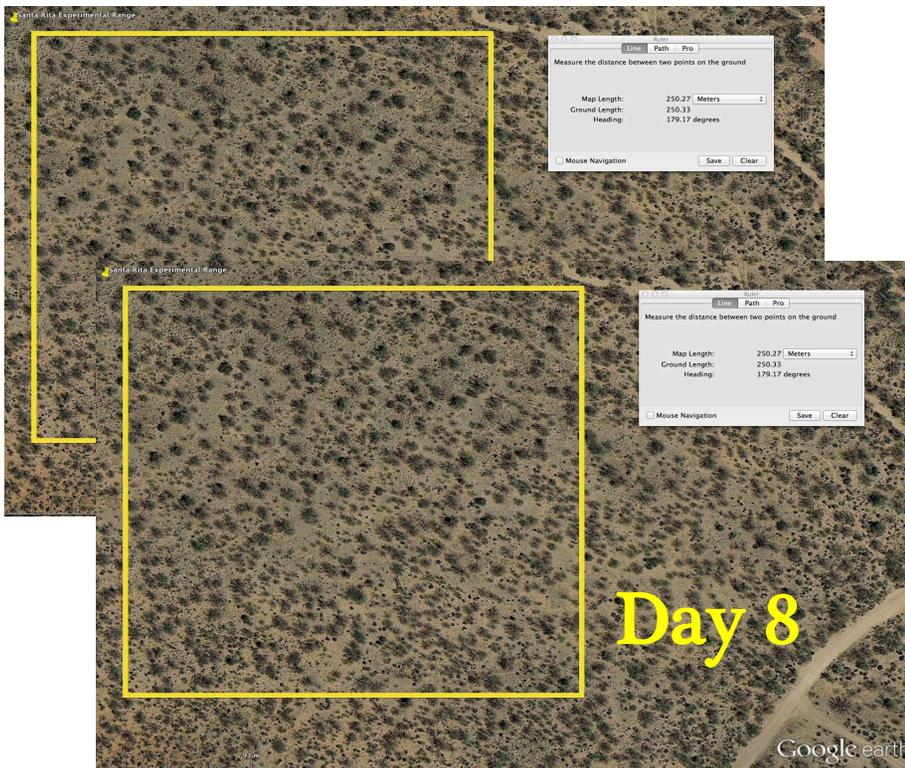
Satellite-based Remote Sensing also is limited...

... In that a 250m pixel represents a great deal of variation



Satellite-based Remote Sensing also is limited...

... In the frequency of data products (8 or 16-day ensembles)



We miss the physiological connections to our primary driver of ecosystem function ~ precipitation!

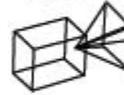
So how can we link our physiological knowledge with our needs for a broader spatial understanding?

Ecosystem = f (structure * activity)

Preliminary efforts:
UAV-based Vegetative and Surface
“Structure from Motion”



camera
image k -

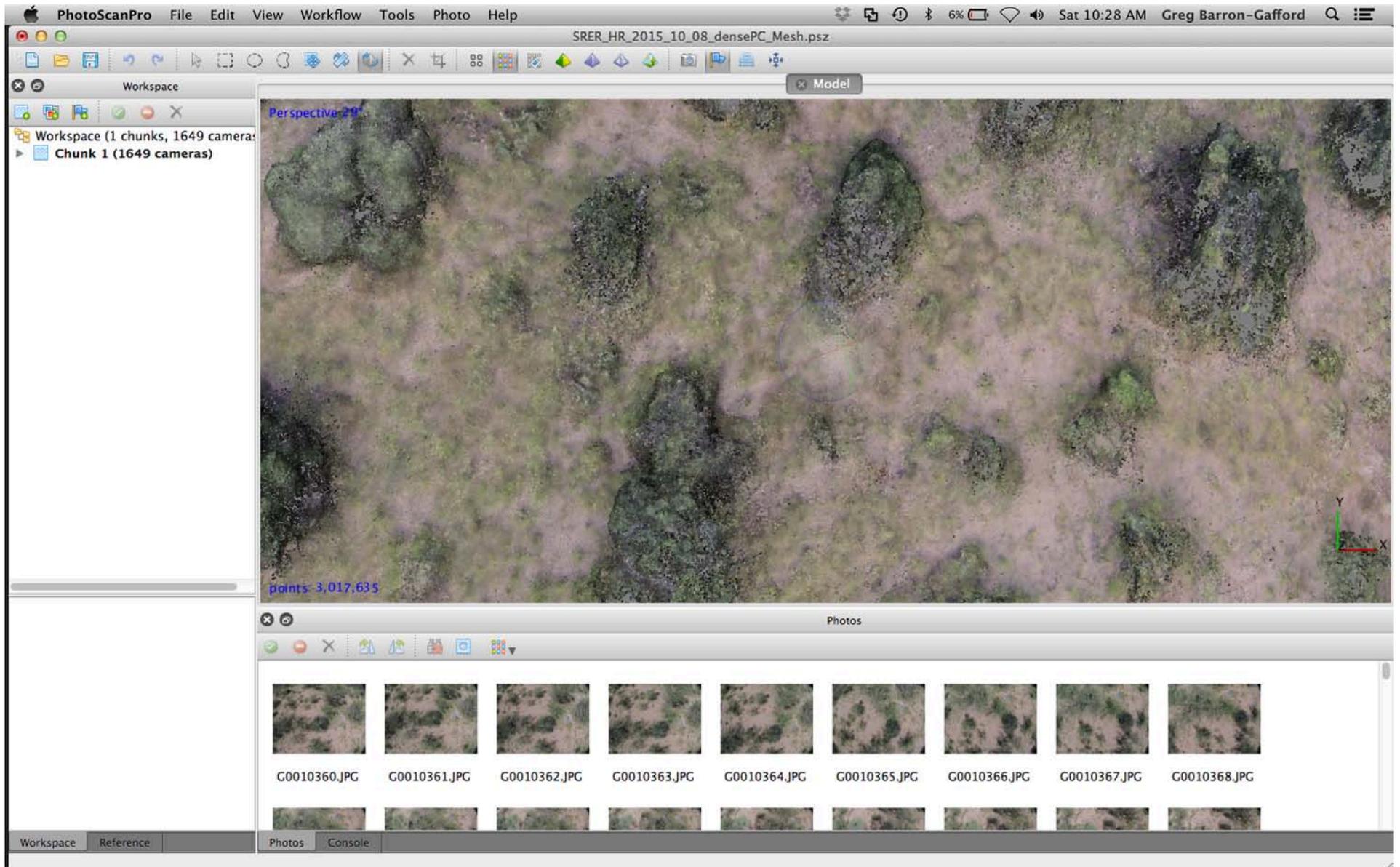


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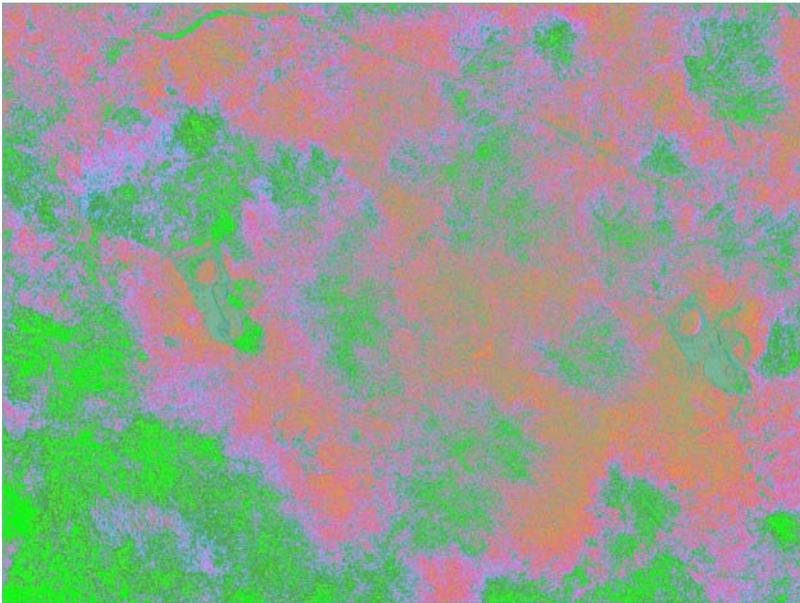
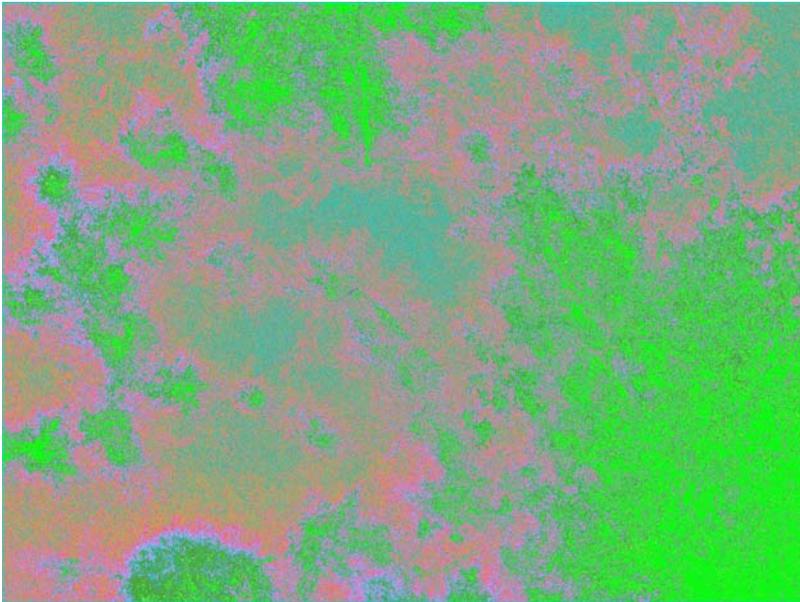
Preliminary efforts: UAV-based Vegetative and Surface Structure



Preliminary efforts: UAV-based Vegetative and Surface Structure



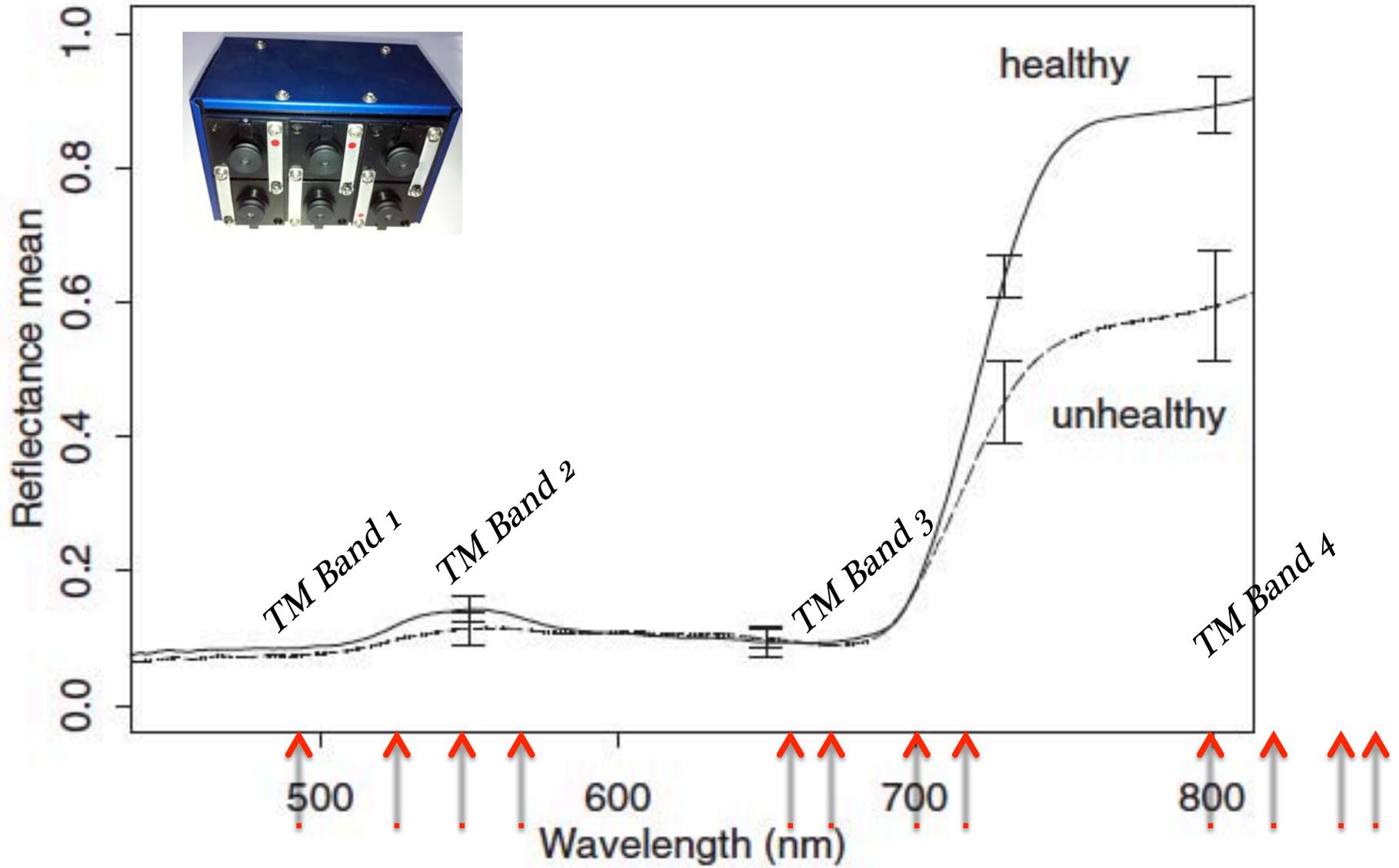
Preliminary efforts: NDVI variance across species (and time)



UAV-based Remote Sensing appears to be a great new tool to add to our toolbox



Multi-spectral imaging



Thank you ~ Any questions?



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