Exploit Diurnal Cycles to Evaluate Vegetation Responses to Heat and Drought Stress

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o Leaf Level
  • How ET, photosynthesis, stomatal conductance, and SIF respond to a range of water and temperature stress?

o Site Level
  • GPP & ET: Synchronization vs. Asynchronization?

o Regional Level
  • Variations of energy, water, and carbon cycles for different land cover types in the climate sensitive Central Great Plains and the OzFlux Australia transits.

- Parallel efforts in ecosystem modeling - CliMA
  - test theories of stomatal optimization and their impacts on carbon and water fluxes
  - interpolate regional ECOSTRESS observations captured at different local times.
Site Level: case study in semi-arid vegetation

LST Distribution (~12 pm, Jun 29, 2019, Yatir Forest, Israel)

- Surface albedo (and surface slopes) and ET are both important for LST
ECOSTRESS Sampling over Yatir forest/shrubland
Differences in LST between forest and shrub sites

- Forest has a cooler surface at noon, but the differences are more diverse at other times.
Regional Level: drought and fire in Australia 2019-2020

2019-2020 Extreme heat and bush fire in Southeast Australia

Next: ECOSTRESS LST & ET data for energy balance & vegetation stress analysis before and after the bush fire
- burned vs. unburned
- forest vs. shrub
ECOSTRESS LST retrievals at Australia Ozflux sites

Lower LST, smaller diurnal amplitude after the drought spell

Arcturus

Boyagin

drought

After rain
Challenges: varying temporal sampling with interannual, seasonal, synoptic, and diurnal variations

Important tool: CliMa-Land model
Model Framework

Stomatal Models (decision making)

Canopy Radiation

Photosynthesis

Plant Hydraulics

Image adapted from Wang et al. (2020)
Canopy Radiation

Supported Models
- mSCOPE + FluSpect model
- Big leaf model
How could CLiMA help Ecostress community?

LST directionality effects
(Canopy-Observer directional radiance can be computed)

Emissivity could be state-dependent (example here for soils)

Emissivity of leaves is not always 0.98
(change of 0.02 can be almost 2K LST error)

From Susan Meerdink:

Stomatal Models (decision making)

Statistical models

Optimization models

Empirical Models
- Ball-Berry
- Leuning
- Medlyn
- Gentine

Optimization Models
- Wolf-Anderegg-Pacala
- WAP MOD
- Sperry
- Eller
- Wang

+ prognostic stomatal conductance, delayed response

Images from Medlyn et al. (2011) and Wang et al. (2020)
Thank you!