Assessing the Impacts of Forest Landcover Change on Surface Energy Fluxes in Four Different Corners of the Continental U.S.

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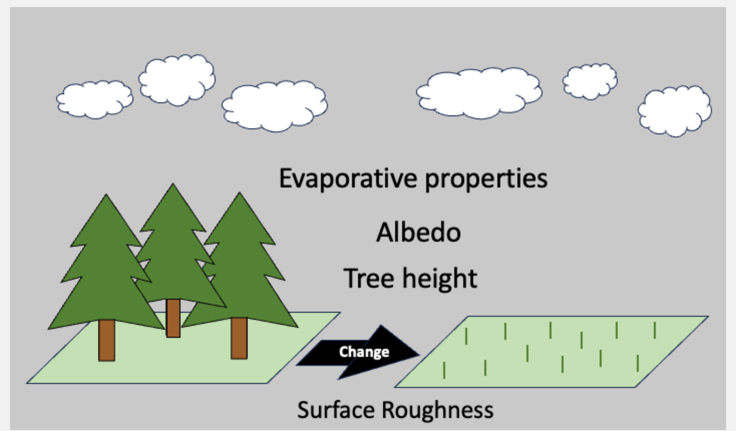
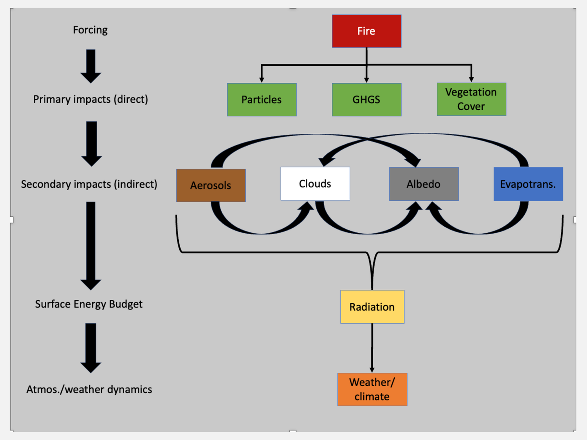
I. Background

Energy fluxes between the land surface and the atmosphere are modulated by complex biogeophysical processes (1). Forests are essential in regulating these fluxes because they govern atmospheric response mechanisms that alter the surface energy budget (2). Modifying these forest landscapes can impact surface climate through changes in the surface energy budget (2 & 3).

Simulations of forest loss have been conducted for years, as they are important for our understanding of how these changes affect climate (4). While previous studies have assessed these fluxes mainly on a global scale, more information needs to be generated about their effect on the continental U.S., specifically in different domains of the national ecological observatory network (NEON).





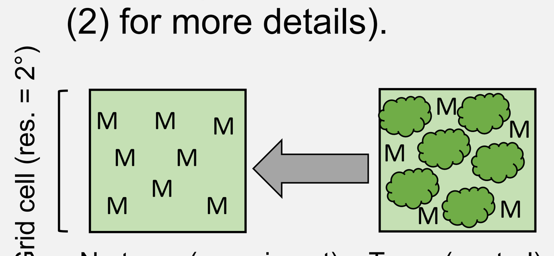
II. Objectives

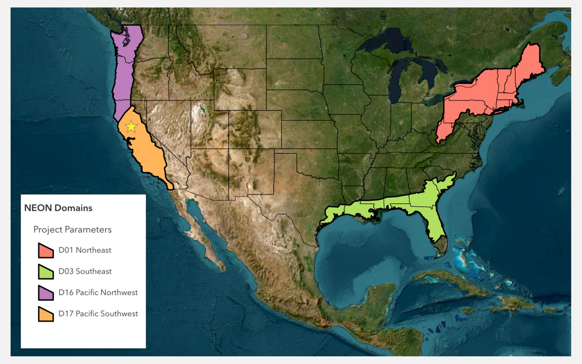
1) Identify how forest landcover modification impacts the surface energy budget in each chosen NEON domain.
2) Explain how patterns of energy flux change affect indirect radiative forcing/atmospheric responses and it's influence regional weather and climate.

III. Methods

1) Identified NEON domains (nd16, nd17, nd1, nd3) and reference coordinates per domain for each grid cell where simulation occurs.
2) Analyzed output from the Community Earth System Model in Python (CHPC, v. 3.10.3) to calculate the net change in each energy flux from each NEON domain (See Swann et al., 2018 (2) for more details).

- Subtracted forested flux values (ctrl) from grass flux values (exp).
- Plotted and mapped the change in energy fluxes using *matplotlib*.





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IV. Results

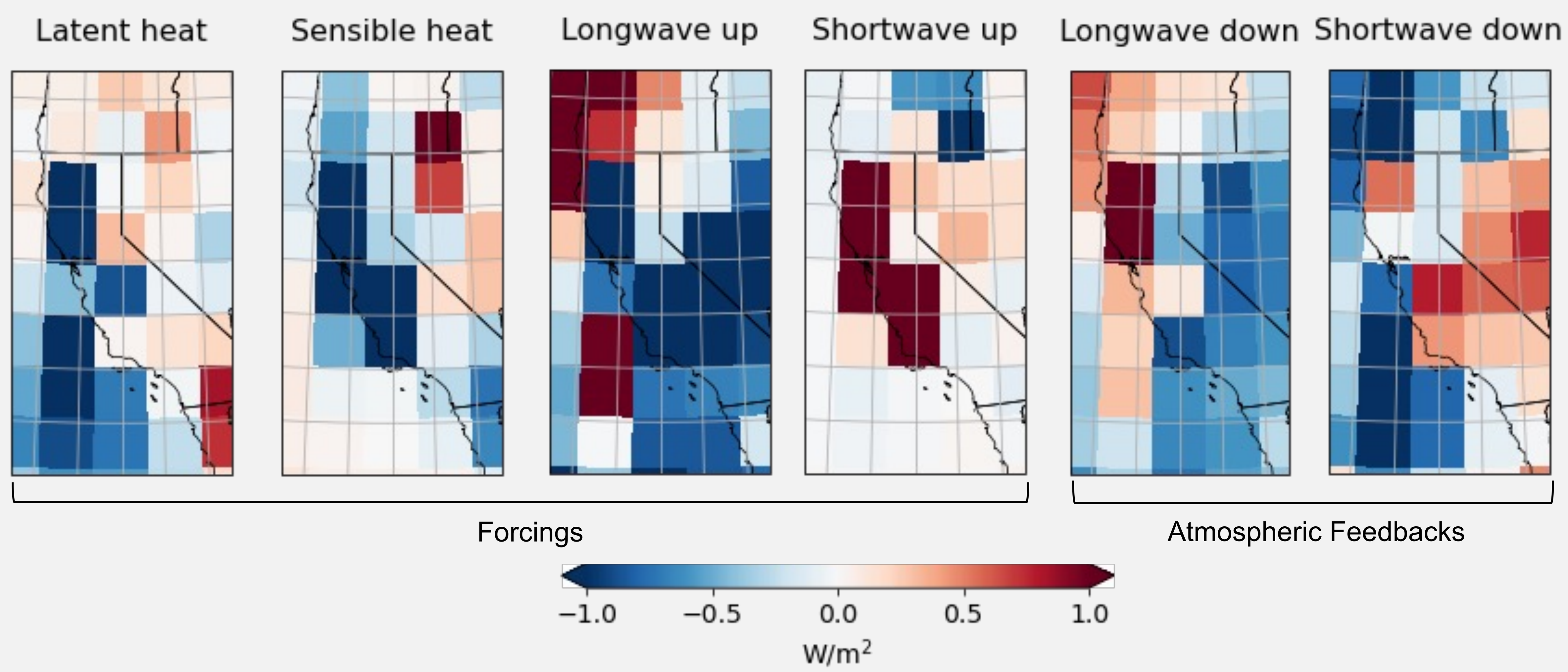


Figure 1 – Net changes in surface energy fluxes from the entire Pacific Southwest NEON domain (lat = 39, lon = -122).

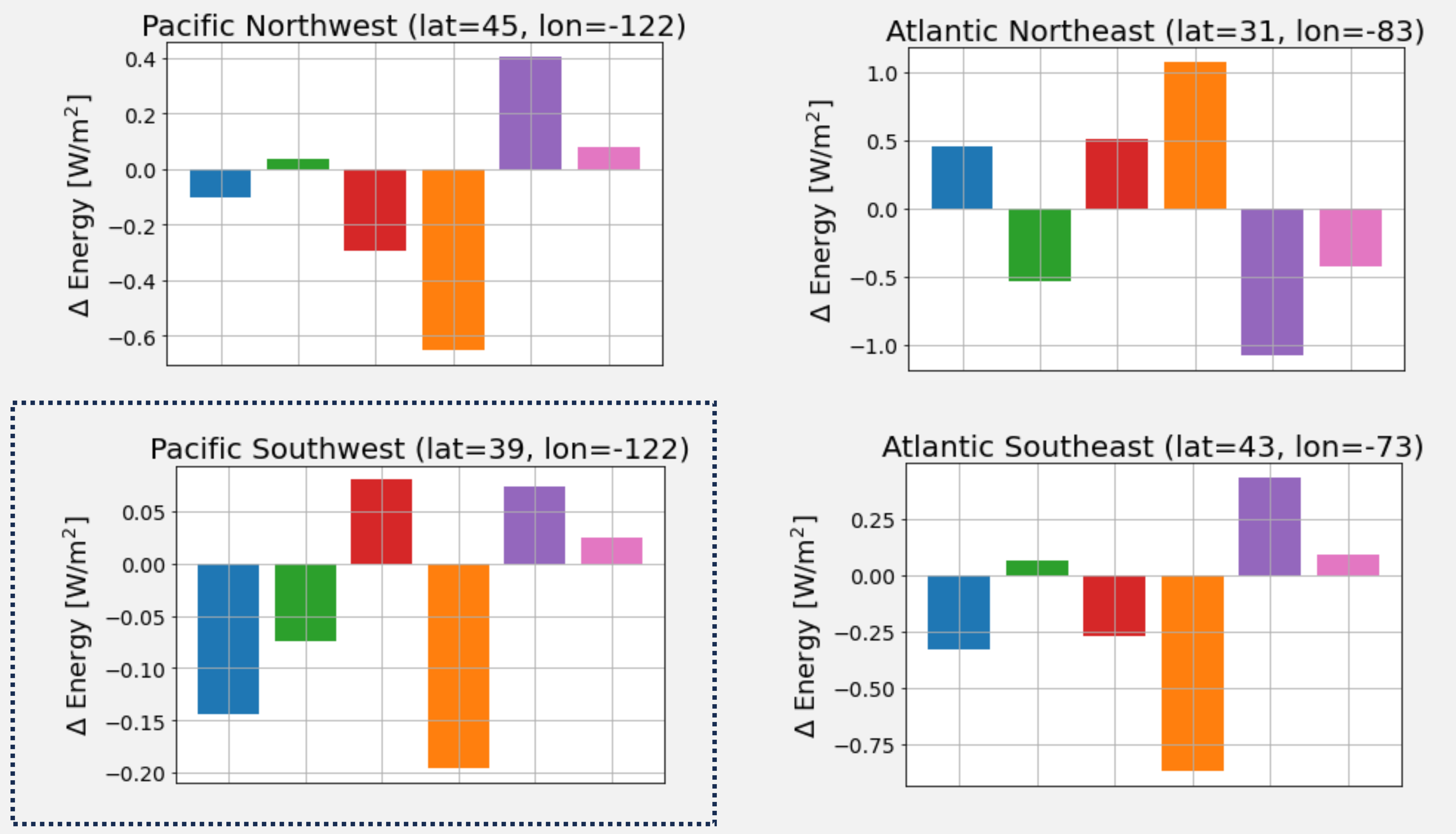
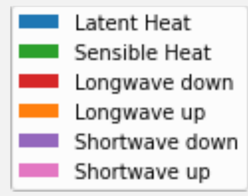


Figure 2 – Net changes in surface energy fluxes (exp-ctrl) of latent/sensible heat, and longwave up/down & shortwave up/down for each chosen grid cell per NEON domain.



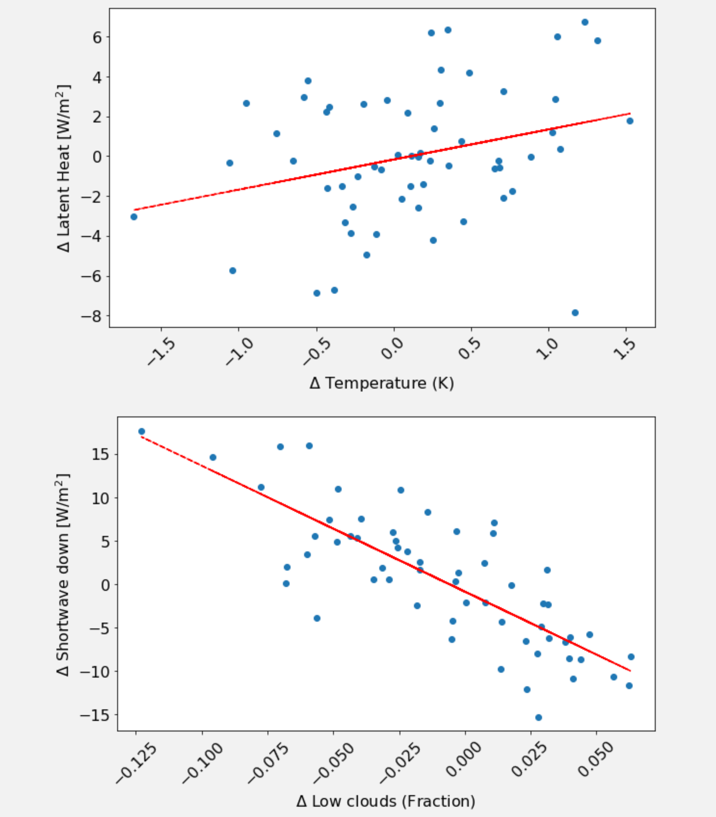


Figure 3 – Correlation between the net changes in latent heat/temperature and low clouds/shortwave down radiation in the Pacific Southwest NEON domain (lat = 39, lon = -122).

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V. Discussion

- Landcover change can modify atmospheric circulation and influence climate feedback regimes in remote locations.
- Energy flux changes are the most pronounced in areas with dense forest cover and have the largest impacts on reflected shortwave (albedo), emitted longwave radiation (temperature), and sensible heat.
- The magnitude of energy flux changes depends on the area's climate, surface characteristics and conditions leading to clouds formation.
- The surface albedo change in Northern California could offset the loss of evaporative cooling, except during years with higher energy inputs to the surface.
- Small changes in incoming radiation significantly influence the surface energy budget, resulting in a spectrum of responses varying by region.

VI. Future work

- Investigate the seasonality of when bigger and smaller changes in surface fluxes occur.
- Determine the impacts of landcover change on aerosols in the atmosphere and assess how their interactions with radiation, clouds, and snow impacts local and regional climate.

VII. Acknowledgements & References

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