Seasonal Patterns of Carbon Fluxes in Three Representative Ecosystems in the Northern Foothills of the Brooks Range, Alaska

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Background

Understanding the carbon and water fluxes in the Arctic is essential for accurate assessment and prediction of the responses of these ecosystems to climate change. We established three eddy covariance flux towers in northern Alaska during September 2007, and have now collected carbon (C), water, and energy flux data continuously for over three years. These flux towers are located in a transect through three tundra ecosystems (heath tundra, tussock tundra, and wet sedge tundra). *Here, we examine the carbon fluxes net ecosystem exchange (NEE), gross primary production (GPP), and ecosystem respiration (ER) across these ecosystems, emphasizing the role that early and late growing season temperature and precipitation regimes play in the cumulative growing season carbon uptake.*

Findings

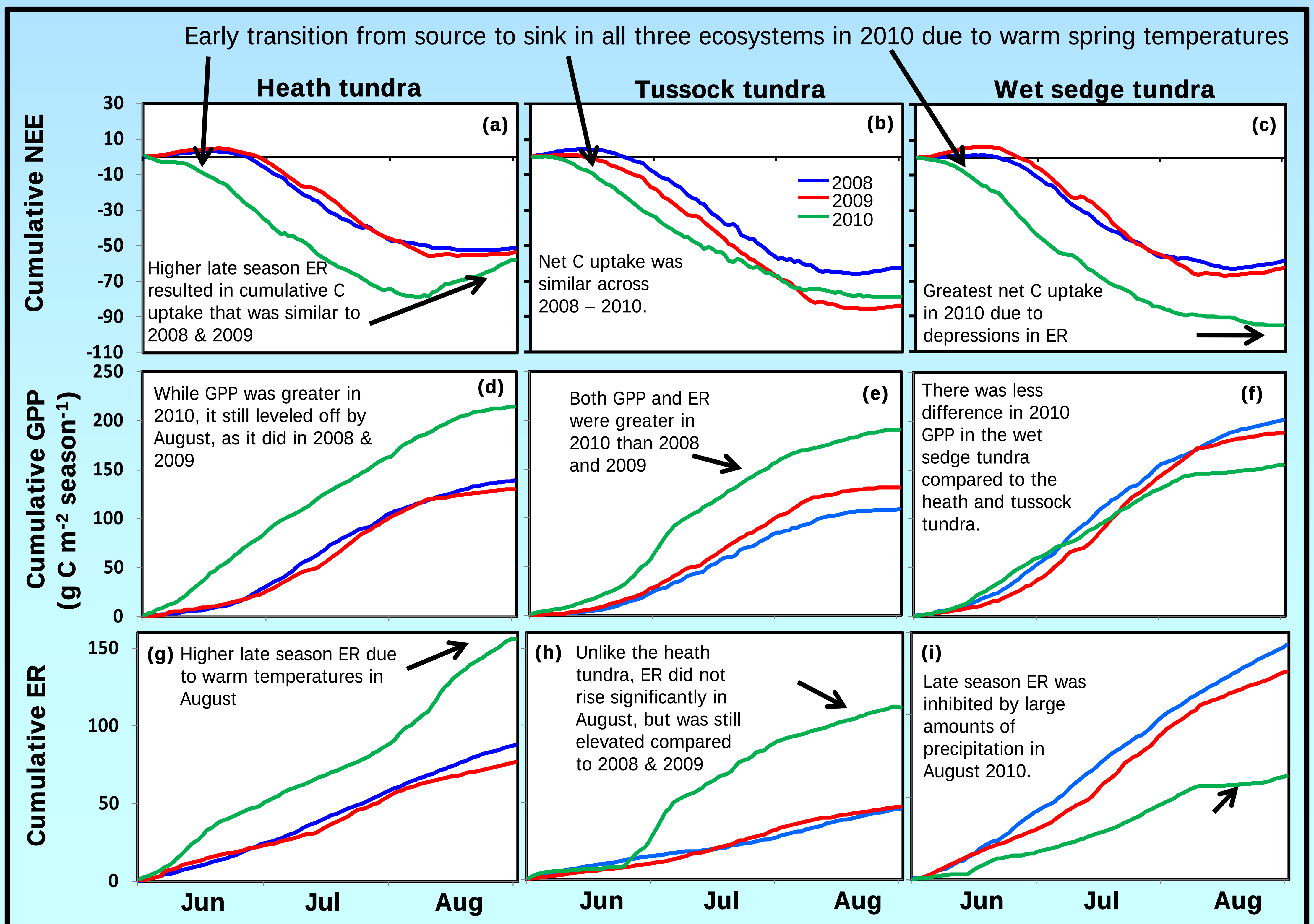

Figure 1. Cumulative NEE (e.g., net C uptake; a-c), cumulative GPP (d-f), and cumulative ER (g-i) from the heath tundra, tussock tundra, and wet sedge tundra for June – August of 2008 - 2010.

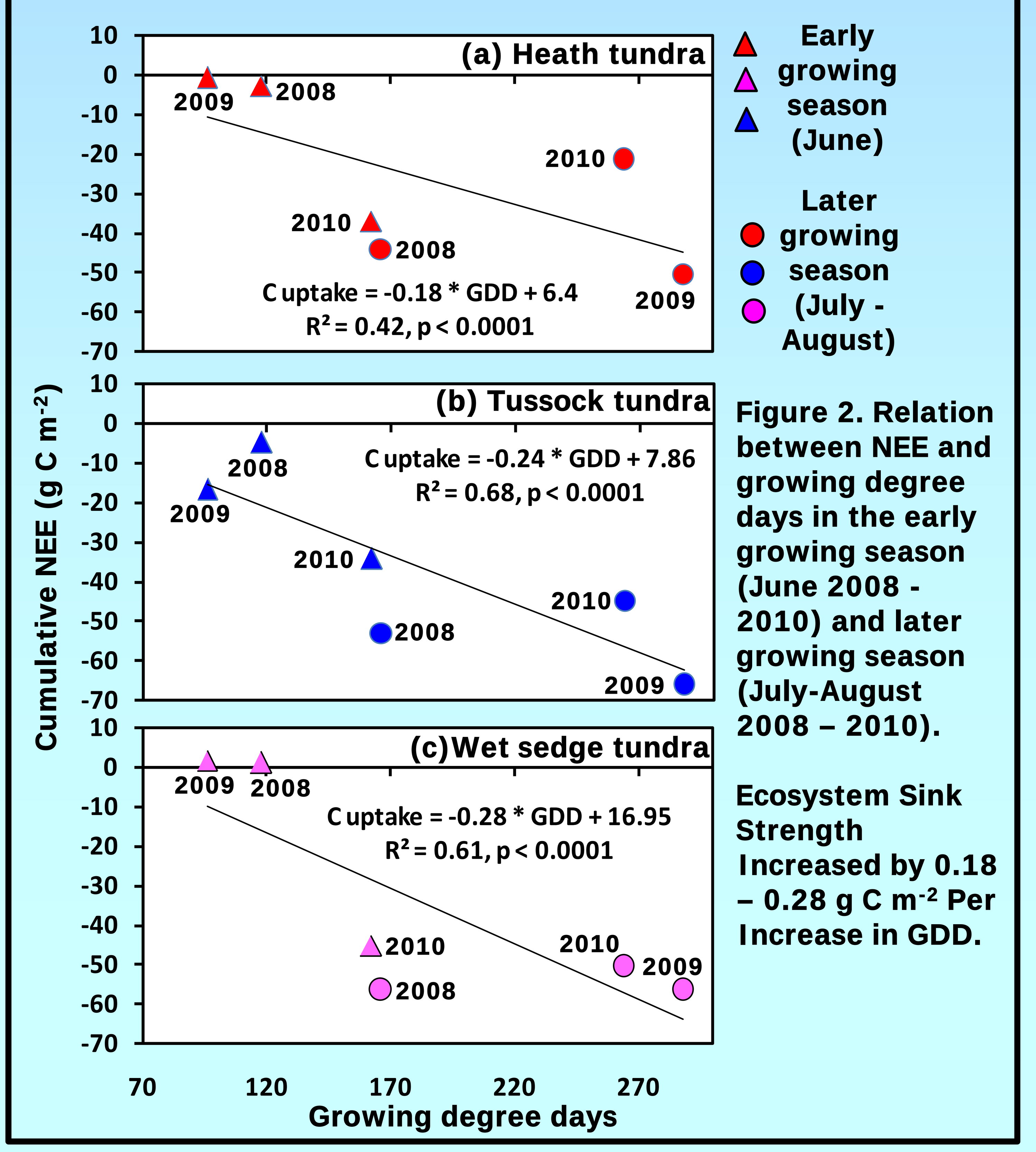

Figure 2. Relation between NEE and growing degree days in the early growing season (June 2008 - 2010) and later growing season (July-August 2008 – 2010).

Ecosystem Sink Strength Increased by 0.18 – 0.28 g C m^{-2} Per Increase in GDD.

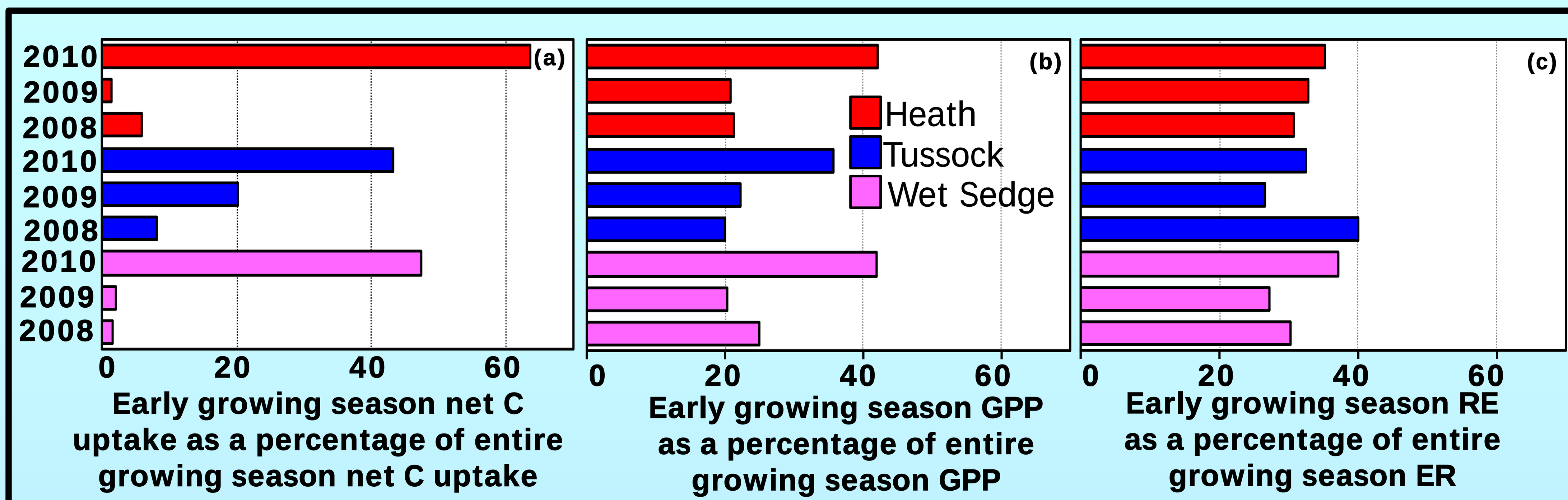

Figure 3. Early growing season (June) cumulative NEE (a), GPP (b), and ER (c) as a percentage of entire growing season (June – August) for the heath tundra, tussock tundra, and wet sedge tundra.

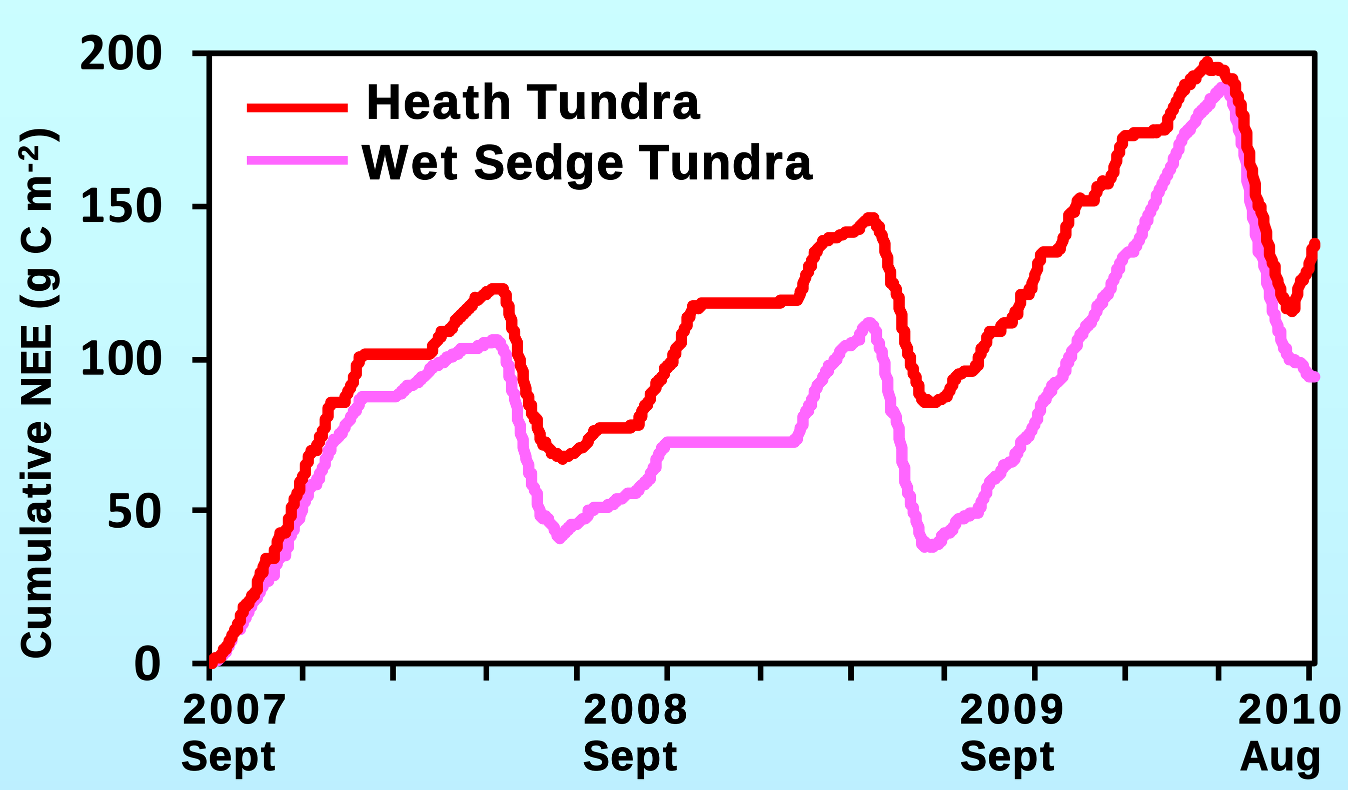

Figure 4. Cumulative NEE (g C m^{-2}) from September 2007 – August 2010 for the heath tundra and wet sedge tundra.

Study Site

- **The study site is located in the foothills of the Brooks Range of northern Alaska, at the Imnavait watershed, approximately 12 km north of the Toolik Field Station.**
- **The three tundra sites included in this analysis include a seasonally wet fen, a moist tussock site, and a drier ridge site.**
- **We collect eddy covariance data of C, water, and energy fluxes as well as basic meteorological variables.**

Figure 5. The tussock site (a) and (b) data collection continues through winter at the heath tundra and wet sedge tundra sites.

Conclusions

- **The timing of the switch from source to sink of carbon in the spring seems to be strongly regulated by the number of growing degree days.**
- **While the first month of the growing season (June) usually contributes little to net C uptake, it can be as much as the later part of the growing season (July August), if it is warm enough (e.g., enough GDDs).**
- **Due to respiration outside of the growing season, the ecosystems are a source of carbon.**
- **Although these ecosystems lie in close proximity, they clearly function differently from one another. It's important to take this spatial heterogeneity into account when making regional predictions of carbon and water budgets.**
- **Further information about this project is available from: http://aon.iab.uaf.edu/index.html**

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