Final Project Proposal

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My research project over the last two summers has been to complete preliminary analysis on a huge dataset, looking to map the *diffuse radiation fertilization effect*, aiming to answer the question:

> How can we map ecosystem response to large scale wildfire smoke events in terms of Net ecosystem exchange (CO_2 uptake)?

The theory is this: Photosynthesis in a canopy is proportional to the amount of light received – smoke and other aerosols scatter light, illuminating all sides of a given leaf/plant/canopy rather than just the side facing the sun, increasing the total light received and thus increasing the rate at which photosynthesis occurs. Under light/moderate aerosol loading, the canopy can become a stronger CO_2 sink. At some aerosol concentration, the effect saturates and CO_2 fluxes decrease (or become negative and the canopy becomes a CO_2 source), either because a large fraction of light is scattered back to space, or other effects dominate, i.e. heat stress on plants from longwave aerosol effects, high ozone concentrations in the smoke itself, etc.

1 Data

So far my task has been to acquire and process a satellite imagery, eddy-covariance measurements, and sun photometry data from a number of co-located sites near lake Waskesiu, SK, CAN. The scrubbed dataset is 66 variables (although not all of them are relevant and some are fairly sparse), measured hourly since 2003, yielding $\approx$ 130000 time points. The aim of the project is to map CO2 uptake as a function of smoke level, but there are a number of confounding variables that are correlated with both CO2 and smoke. For example – wildfires tend to occur in the summer, which is already the peak growing season where we expect the greatest CO_2 uptake. The task is to isolate the effects that are attributable to smoke and determine the relative significance compared with other input variables.

2 Methods

Its a complex problem, so the best approach to processing this data isn't totally clear, but RPCA seems like a good place to start. If smoke is indeed a significant control on CO_2 uptake, then further analysis could be done looking for the effective timescale by applying multichannel singular spectrum analysis.