EOSC 595F Project Proposal

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1 Overview

This project aims to use a single column model (SCAM) version of a full GCM (CAM) in order simulate the effects of intense wildfire smoke events over forested regions of western and central Canada. Of particular interest is the amount of direct solar radiation relative to that which is scattered by particles in the smoke, and how the forest canopy responds to light filtered by wildfire smoke.

We can conceptualize smoke from these events as low to medium height stratus clouds which, due to their dark color, absorb shortwave radiation as well as absorbing/emitting longwave as blackbodies. Because of this, smoke tends to weaken lapse rates (heating at height by absorbing radiation) and cooling the surface (blocking solar radiation from reaching the ground). Further, wildfires are generally most intense under high pressure synoptic conditions with subsidence. A feedback loop exists where smoke decreases the lapse rate, which prevents convective mixing, thereby more smoke is trapped in a low, thin layer of the atmosphere et cyc. This phenomenon should be resolvable with an appropriate convective-adjustment scheme applied to a model with interactive aerosols.

2 Methods

The Single Column Atmosphere Model, version 6 (SCAM-6) was developed as a sub-model for the Comminity Atmosphere Model version 6 (CAM-6) as a way of both validating certain characteristics the model and probing mechanisms which may be hard to interpret with the full-complexity model outputs. CAM6 can be run in a containerized environment using Docker:

https://www.cesm.ucar.edu/models/cesm2/atmosphere/CAM6tutorial/ And the bulk of the analysis can be done in Python using the program suite here:

https://www.cesm.ucar.edu/models/cesm2/python-tools/

3 Research Questions

1. What are the relative intensities of direct and diffuse incoming solar radiation under varying height and optical thickness of smoke layers in the atmosphere?
2. Can we demonstrate the feedback loop where smoke layers prevent convective mixing of the layer, thereby increasing smoke intensity?