

A COMPARISON OF EARLY HOLOCENE AND PRESENT DAY CLIMATE CHANGE IN ALASKA

A SENSITIVITY EXPERIEMENT USING NCAR'S CESM

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Introduction

- ◆ Examine the effects of different warming scenarios and their impacts on seasonality, hydrologic cycle, and land processes.
- ◆ For Example
 - ◆ Runoff
 - ◆ Net Primary Production (NPP)
 - ◆ Permafrost Thawing
 - ◆ Expanse of Peatlands

The Model Components

- Community Earth System Model 1.0

- Land – CLM-CN

- Atmosphere – CAM

- Sea Ice – CICE

- Ocean – SOM

- Land Ice – SGLC

- Coupler – CPL

- Resolution = f19_g16

- 1.9° x 2.5° Land/Atmosphere

- ~1° x 1° Ocean/Sea Ice

Lehigh Beowulf Cluster (GCM)

- 9 nodes, 8 cores/node
- Dual Intel Xeon quad-core 64-bit processors
- 2.5 GHz core clock speed
- 2 Gigabytes of RAM per core
- 56 Terabytes of storage
- Infiniband node interconnects
- Ethernet at 10 Gigabit/sec



Running CESM 1.0 at Lehigh

Component	Horizontal	Vertical	Temporal
CLM	1.9° X 2.5°	15	18 minutes
CAM	1.9° X 2.5°	26	100 minutes
CICE	~ 1° X 1°	1	70 minutes
SOM	~ 1° X 1°		1 minute

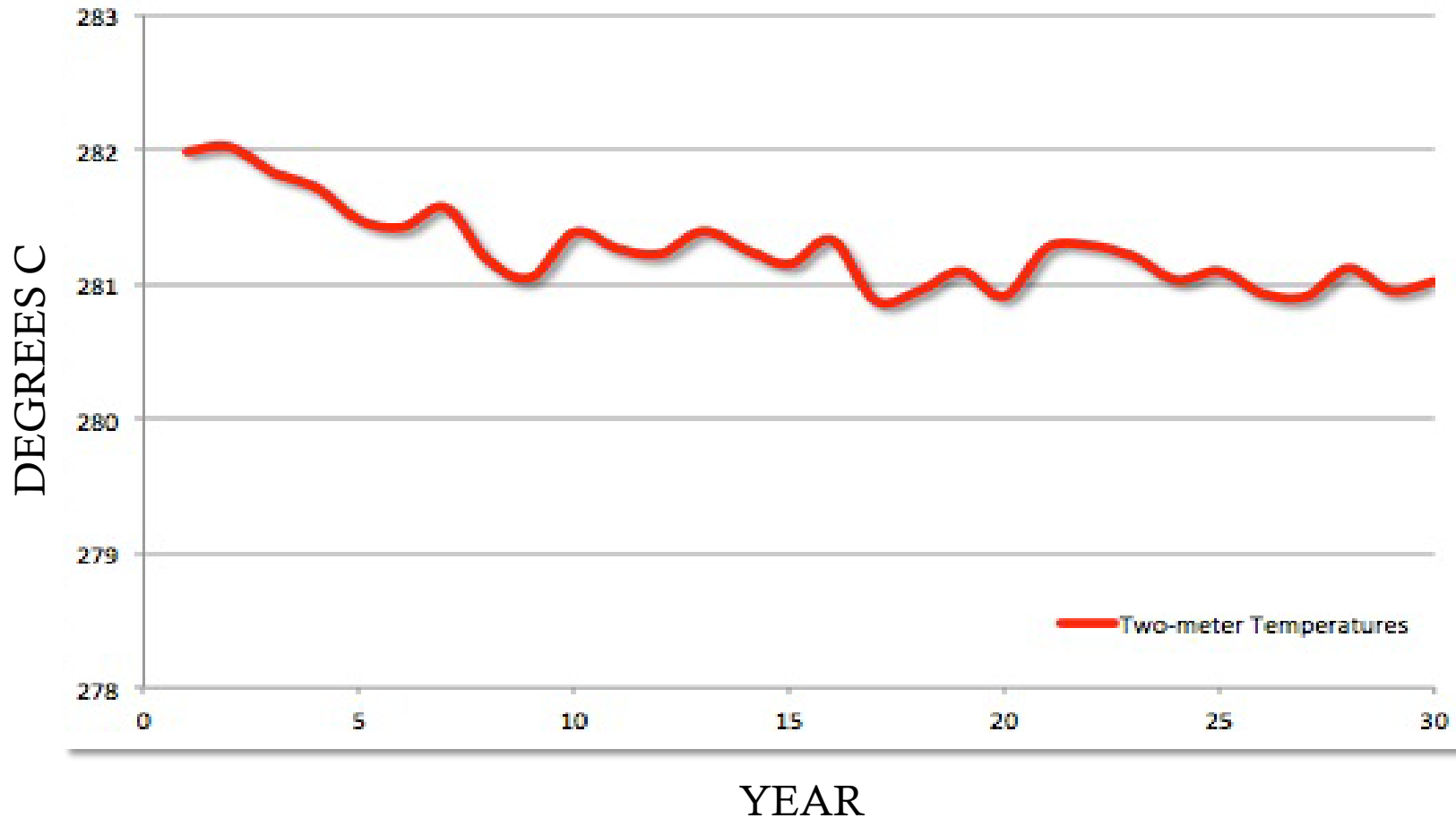
- All 64 cores allocated to each component running at any given time
- Wall Clock: 34.4 seconds / model day
- 6.9 model years / day
- Approximately 3.5 GB of data output / model year calculated

The Experiments

- ◆ Currently Three Model Runs
 - ◆ 1850 Control Simulation
 - ◆ 2000 Simulation with Elevated CO₂ (~369 PPMV)
 - ◆ 10 KA BP Simulation with Altered Orbital Parameters

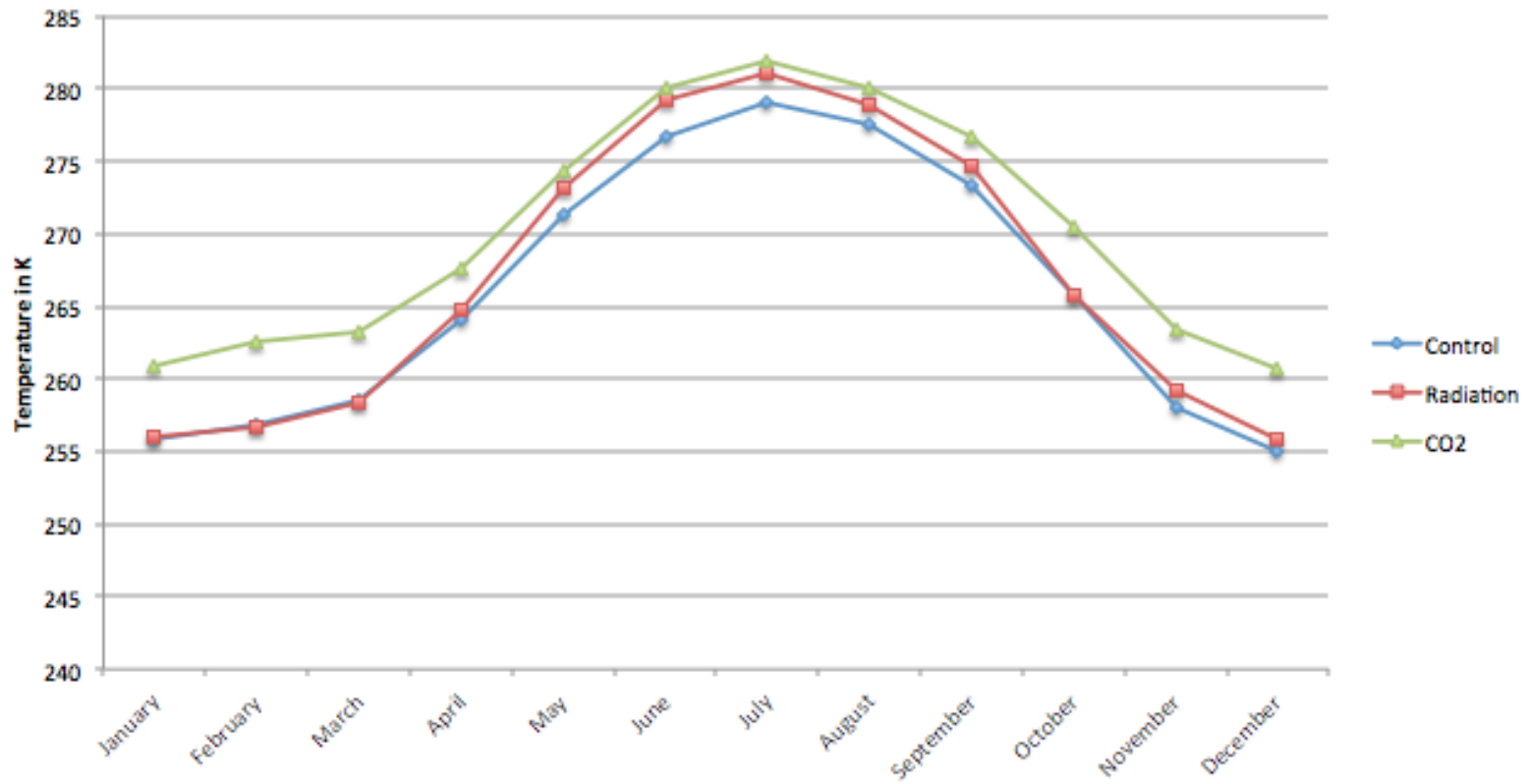
CESM Equilibration

Globally Averaged Two-meter Temperatures

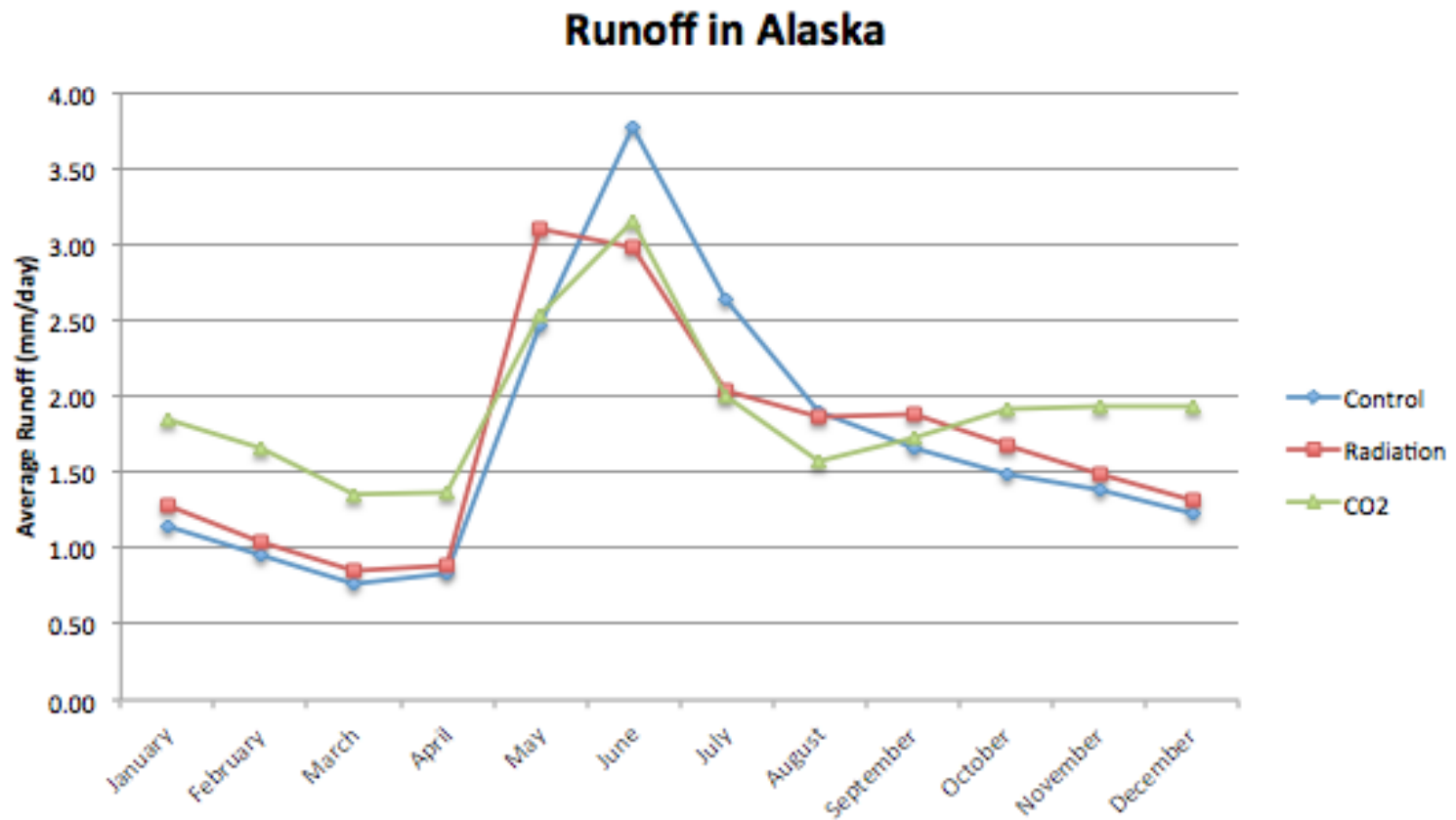


Temperature

Temperatures in Alaska

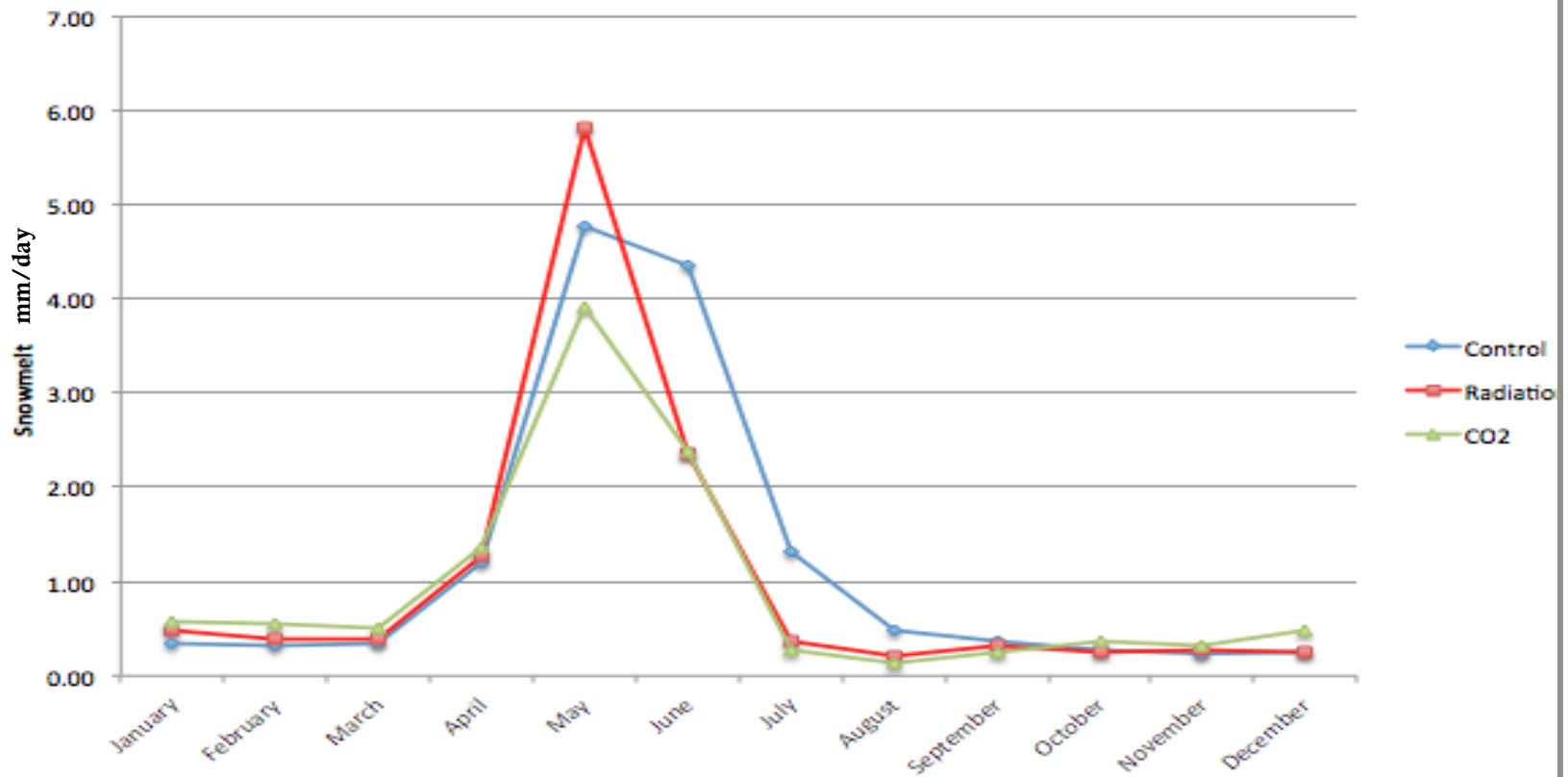


Runoff

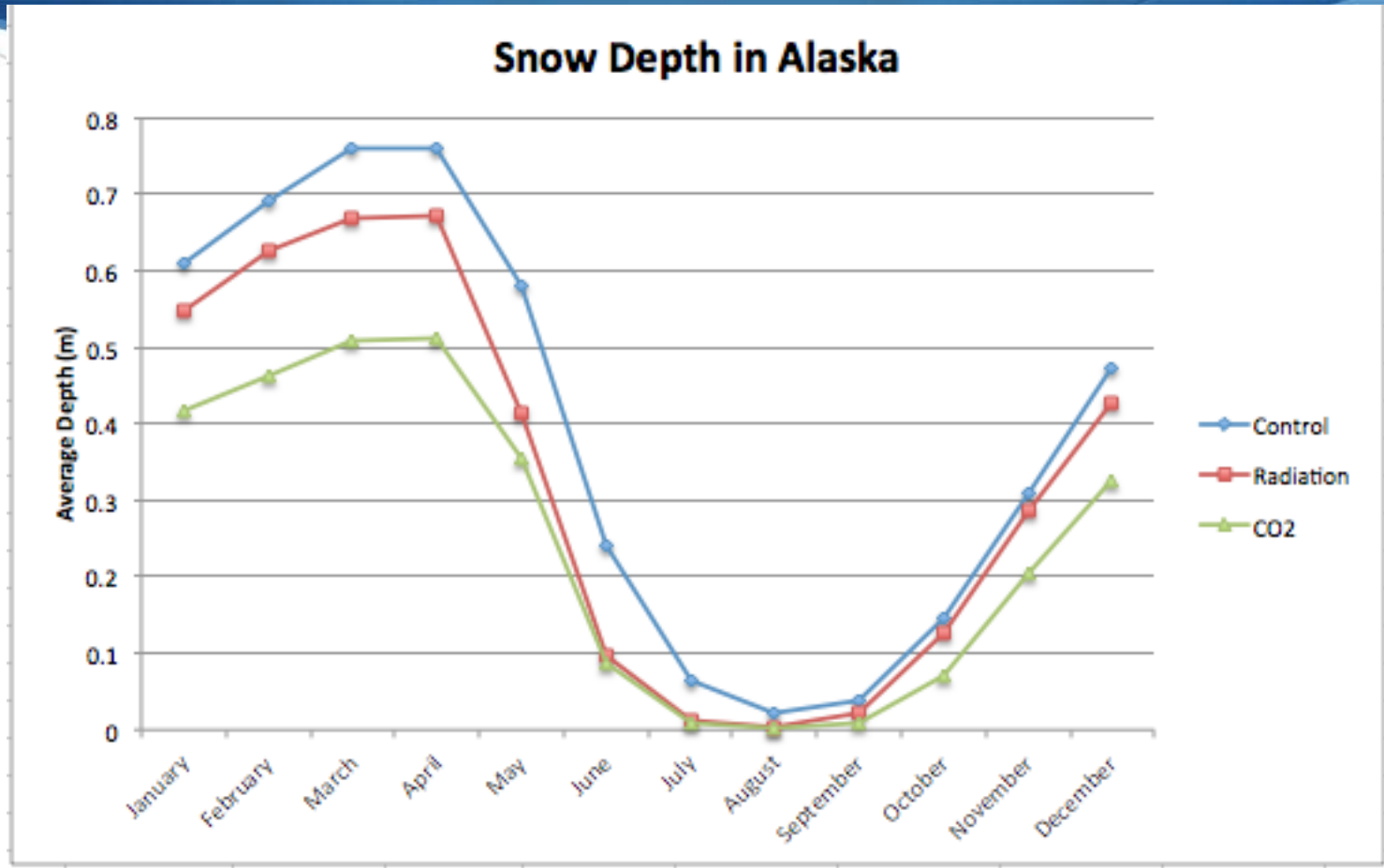


Snowmelt

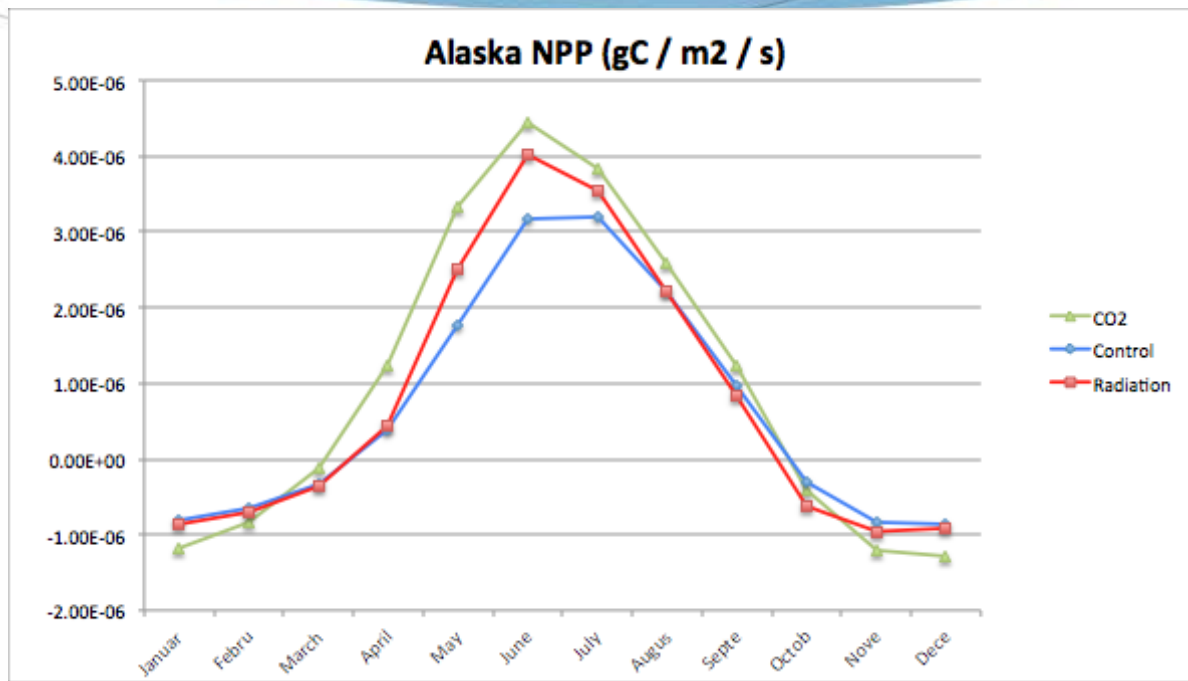
Snowmelt in Alaska



Snow Depth



NPP



Seasonality Index

◆ Seasonality Index (S.I.) =

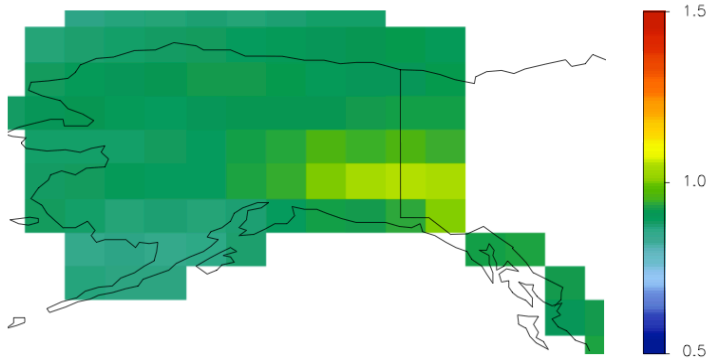
$$(\text{July } T_{\text{experiment}} - \text{January } T_{\text{experiment}}) / (\text{July } T_{\text{control}} - \text{January } T_{\text{control}})$$

S.I. for 10ka orbital parameters = 1.07

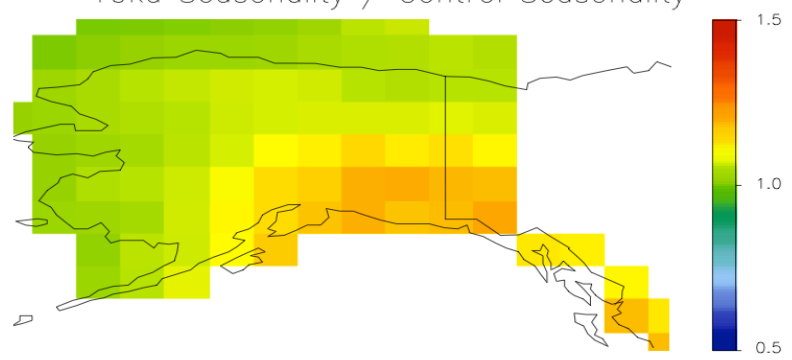
S.I. for year 2000 CO₂ levels = 0.90

Seasonality

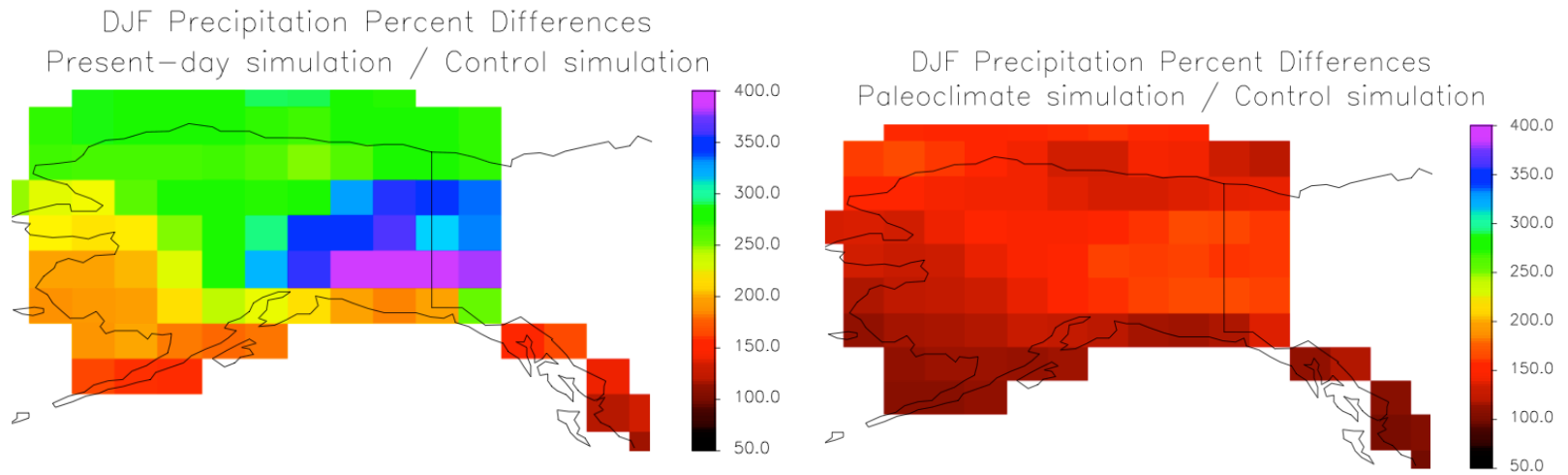
Change in Alaskan Seasonality
Present Day Seasonality / Control Seasonality



Change in Alaskan Seasonality
10ka Seasonality / Control Seasonality

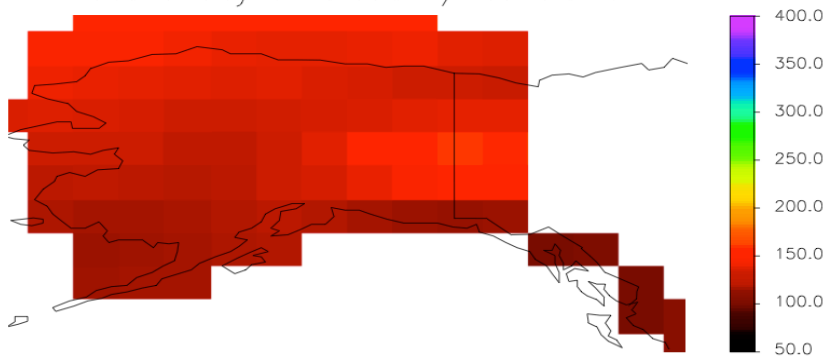


Winter Precipitation

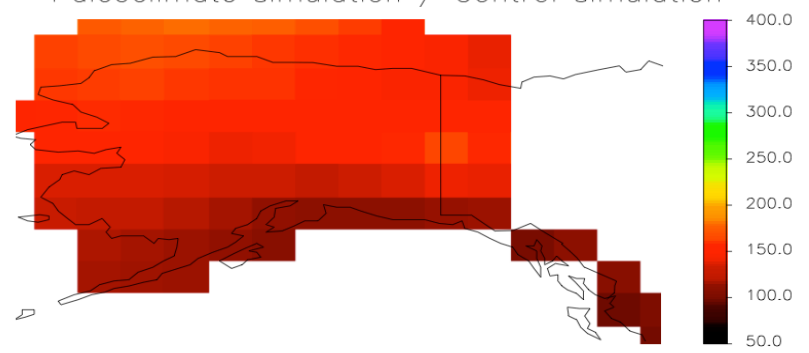


Summer Precipitation

JJA Precipitation Percent Differences
Present-day simulation / Control simulation



JJA Precipitation Percent Differences
Paleoclimate simulation / Control simulation



Future Work

- ◆ Develop Ensemble Members for each of the current simulations
- ◆ Subdivide the grids for Alaska into the four regions