ASP Fellows’ Presentations
Climate Science Theme

I. Andrea Sealy
Dust and Rain in the Sahel

II. Mark Flanner
Climate Warming from Dirty Snow

III. Ethan Gutmann
Soil Hydraulic Properties

IV. Cecile Piret
Mathematics for Climate Modeling

V. Lars Rippe
What Absorbs the CO₂?
Interactions between dust, dynamic vegetation and Sahel precipitation

Observations show a fourfold increase in dust from 1960s to 1980s

Comparison of Sahel rainfall anomaly to dust anomaly—years of higher dust correspond to years of lower rainfall
Interactions between dust, dynamic vegetation and Sahel precipitation

When using dynamic vegetation:
- larger increase in dust from 1950s to 1990s
- precipitation decreases more during that time period
- precipitation trend and amount closer to observations
Snow Albedo Feedback

Pure snow reflects 80% of incident solar energy.

Snow containing soot absorbs more solar energy and melts earlier, exposing a darker surface (“Ice Albedo Feedback”), and thus heating Earth’s climate system.
Climate Warming from Dirty Snow

“Equilibrium” climate response caused by soot in snow.

Sources of soot include fossil fuels, biofuels, and wildfires.

Additional energy absorbed by snowpack from added soot
Soil Hydraulic Properties in Land Surface Models

Soil Water Potential (cm)
Improvements with Satellite Data

Default

Satellite

Optimal

Latent heat Flux (W/m²)

SHP_txt  SHP_Ts  SHP_opt
Advection

- Core necessity for modeling the horizontal dynamics of the atmosphere
- Presents a difficulty since many methods give dispersion which do not keep atmospheric features intact
- Goal is to find an algorithm that keeps features intact and correctly advects but yet is computationally robust and accurate

Fornberg & Merrill [1997]
Pure Advection Problem on the Sphere

Radial Basis Functions method (RBFs)

- Young method used for interpolation of data and modeling physical phenomena
- Extremely highly accurate method, that is independent of geometry, coordinate systems or grids

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Flyer & Wright [2007]
C I L A S
Carbon dioxide Isotope Laser Absorption Spectrometer
Lars Rippe

CO₂ emission

50 %
50 %

CO₂ absorption

Preferably absorbs $^{12}$CO₂

Further more, different types of vegetation has different isotope ratio uptake
C I L A S
Carbon dioxide Isotope Laser Absorption Spectrometer
Measuring CO₂ isotope ratio

Transmitted light

Flowing air

Laser

Transmitted light

Laser frequency

1³CO₂
1²CO₂

1²CO₂ 1³CO₂

Light intensity

Time