Radiative Forcing of the 2004 Alaska Fires

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summer 2004 record fire season in alaska

How much pollution (trace gas and particulates) is coming from the fires?

Pfister et al., Constraints on Emissions for the Alaskan Wildfires 2004 using Data Assimilation and Inverse Modeling of MOPITT CO, *Geophys. Res. Lett., 2005*

What is the local, regional and global impact on atmospheric composition ?

Pfister et al., Ozone Production from the 2004 North American Boreal Fires", *J. Geophys. Res.*, 2006

What is the radiative impact of the fires?

Pfister et al., Radiative Forcing of the Summer 2004 Alaska Fires, submitted to *J. Geophys. Res*.

work flow

Inverse Modeling of CO Fire emissions using MOPITT CO and MOZART

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Derive emissions for other trace species and **aerosols** by scaling using ER from literature.

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CAM-Chem Simulations (offline)

- Simulations for 2000 (reference year, low fire activity) and 2004 (fire year)

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MODIS & MISR AOD

CERES TOA
LW & SW Fluxes

work flow

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Derive emissions for other trace species and **aerosols** by scaling using ER from literature.

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- Simulations for 2000 (reference year, low fire activity) and 2004 (fire year)
- Simulations with individual emissions off

MODIS & MISR AOD

CERES TOA LW & SW Fluxes

Range of emission scenarios for OC & BC

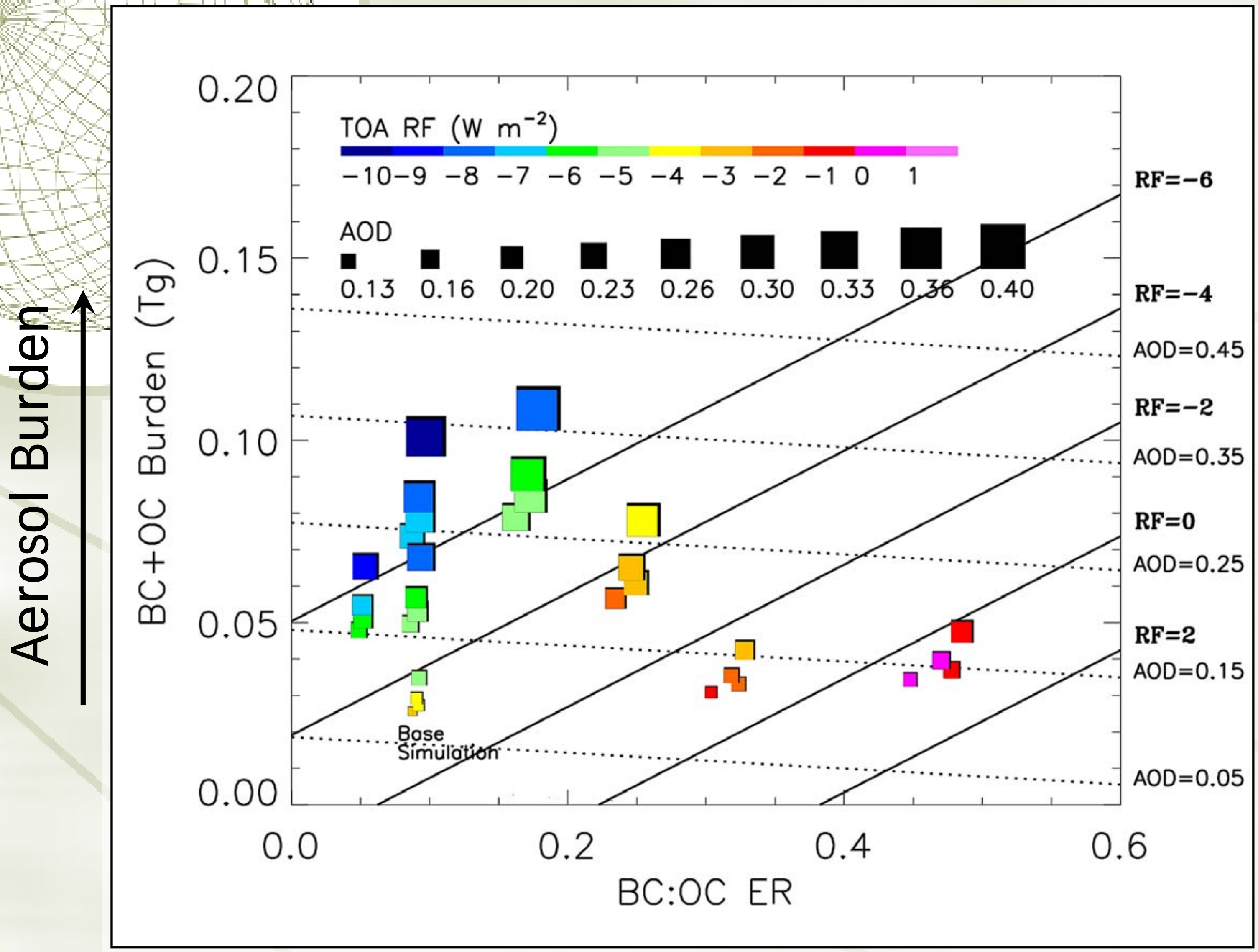
Separate radiative impacts of T_{srf}, greenhouse gases, aerosols

Constrain emissions and ER for OC and BC

OC … organic carbon aerosols (mostly scattering)

BC … black carbon aerosols (mostly absorbing)

constraining aerosol emissions

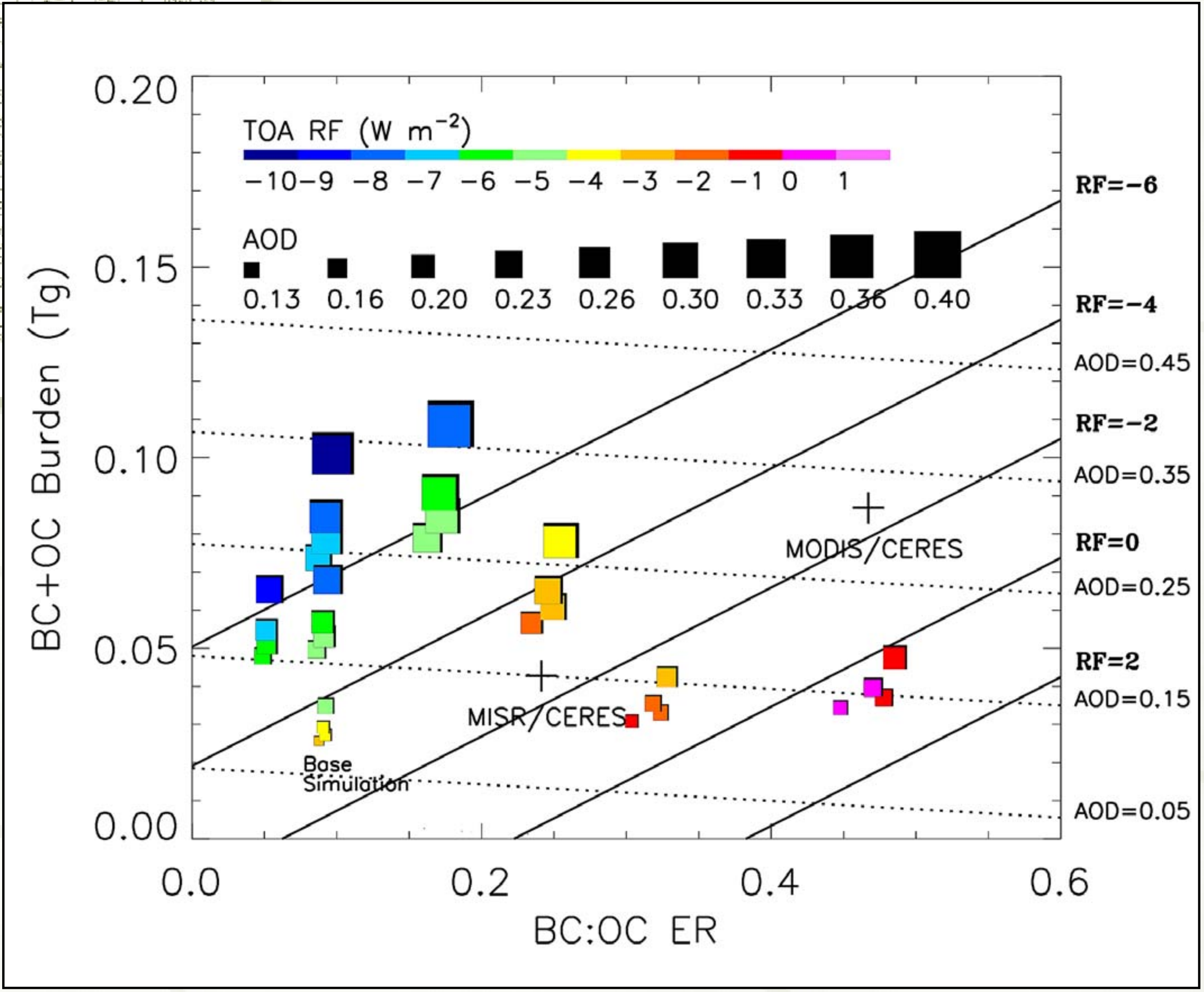


Isolines for TOA RF and AOD

Emission Ratio: Black to Organic Carbon

results averaged over Alaska fire region

constraining aerosol emissions



Aerosol Burden

Isolines for TOA RF and AOD

Emission Ratio: Black to Organic Carbon

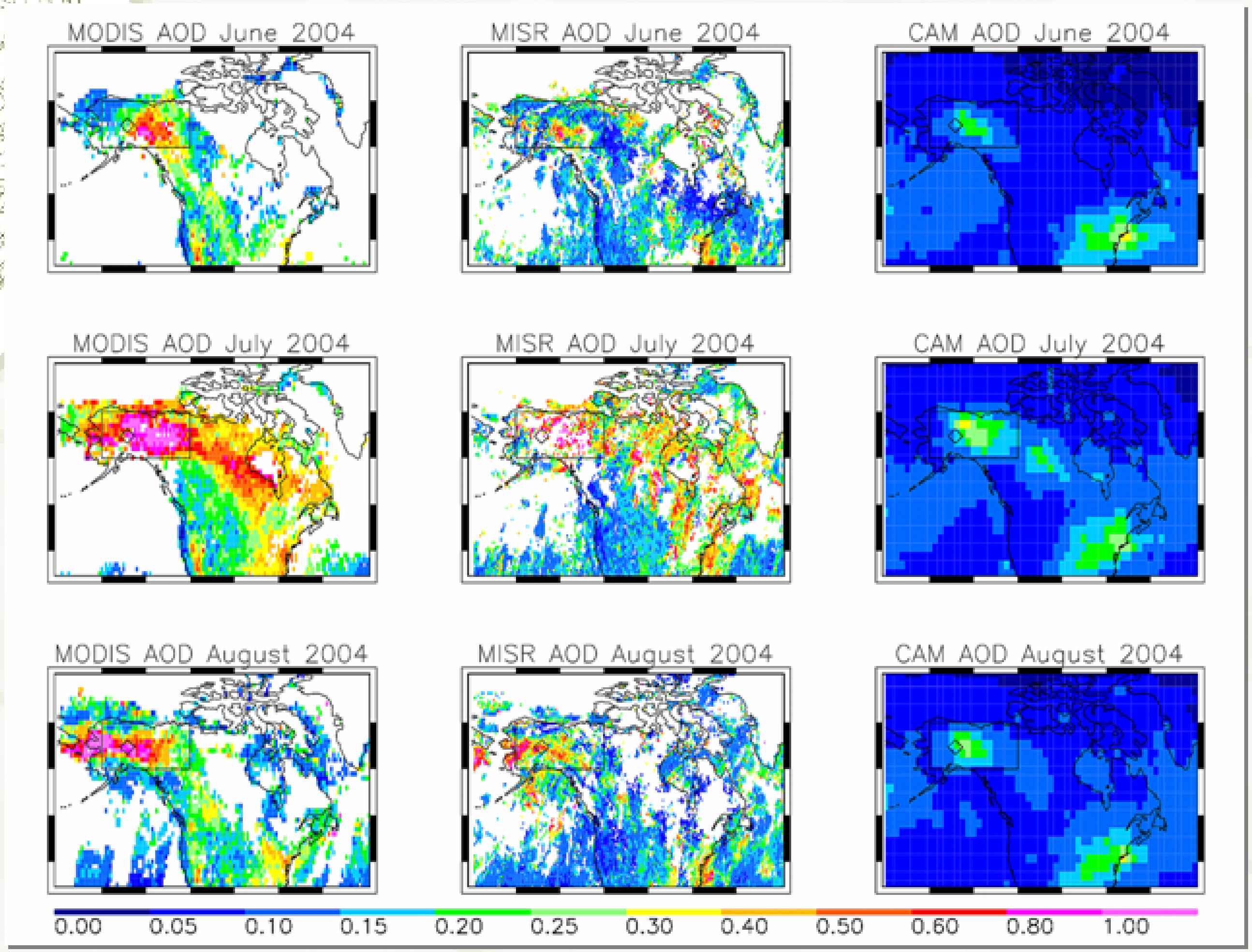
results averaged over Alaska fire region

conclusions

- TOA cooling over the 2004 Alaska fire region mostly due to higher surface temperatures and carbonaceous aerosols emitted from the fires.
- Simultaneous observations and model simulations of TOA fluxes and aerosol loading can be used to constrain aerosol emissions.
- Model uncertainties in assumptions of aerosol optical properties, transport and removal processes and in observations place large error bars on results.
- Need for additional observations of aerosol speciation and optical properties of boreal biomass burning aerosols and more information about peat burning.

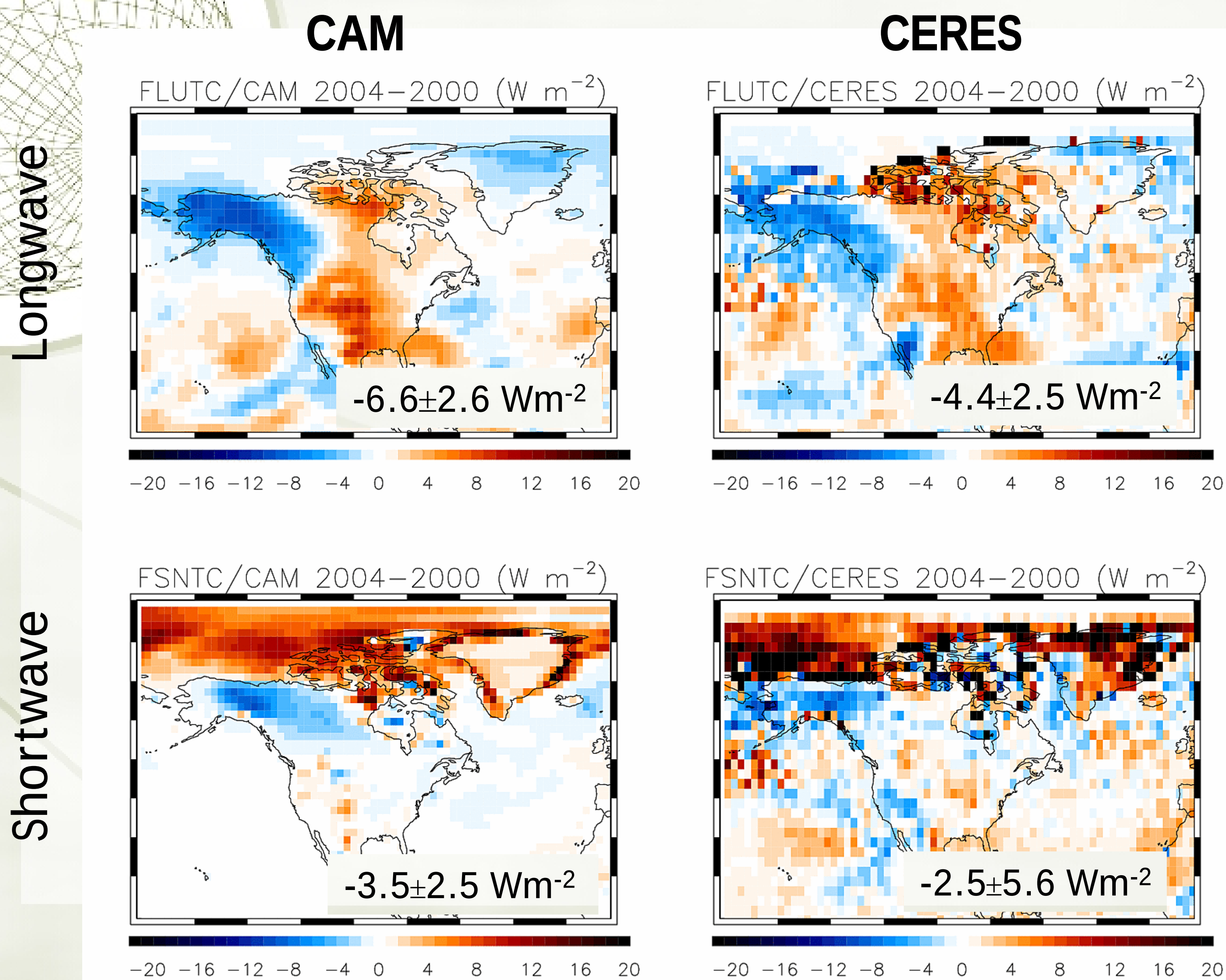
additional slides

comparing AOD from MODIS, MISR and CAM



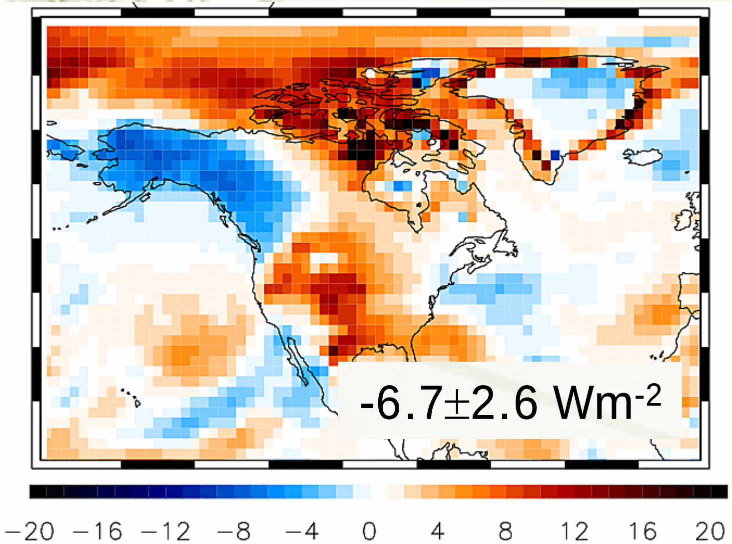
- Model underestimates observations over the fire region, and also outside the region and time period of the fires.
- MODIS and MISR also differ with MODIS > MISR

clear-sky TOA fluxes 2004 vs 2000



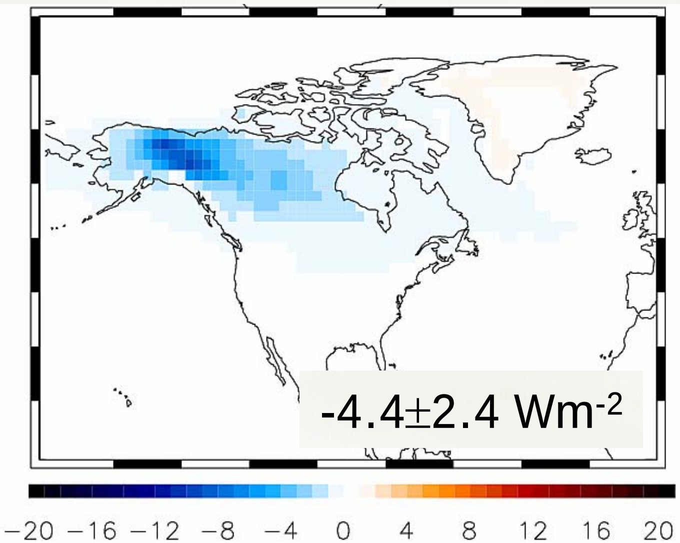
RF for individual components

Model Estimate for RF due to difference in T_{srf} for 2004 and 2000



- Longwave effect mostly explained by higher T_{srf} in 2004

Model Estimate for RF due to carbonaceous aerosols from fire



- Shortwave effect mostly due to BC and OC from fires