Investigate aerosol effects on clouds using WRF Model

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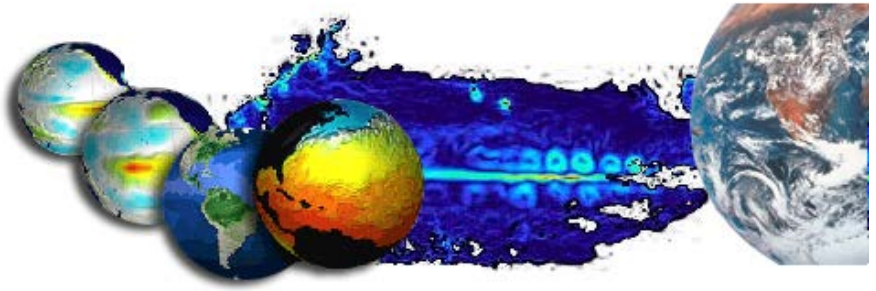
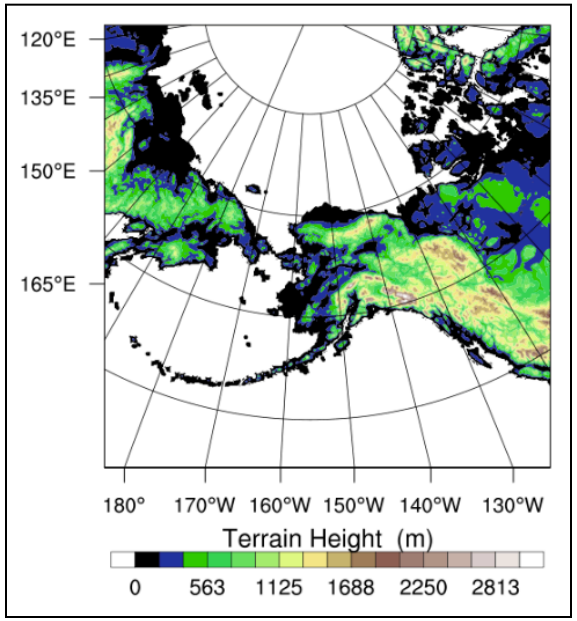


AOES

WRF Model

- Use WRF/Chem model to examine a polluted event on 18-21 April, 2008 at Barrow, and compare results with baseline simulation with corresponding meteorology-only model run



WRF/Chem model domain

- Initialize WRF/Chem with reanalysis chemistry and aerosol fields from MOZART-4 global chemistry model

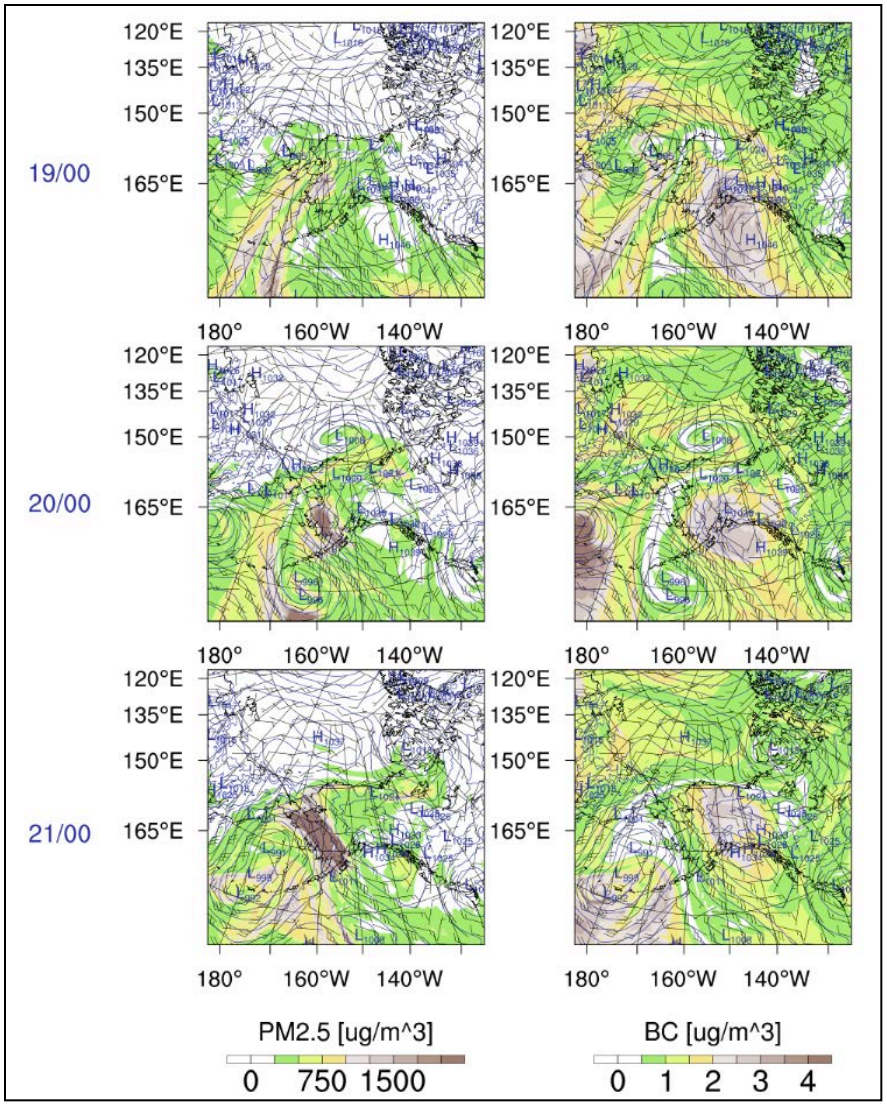
Setup-of experiments and goals:

Four simulations:

Simulation	Details	Notes
WRF	No chemistry	Clean case, baseline run
CHEM	Initialized from MOZART-4	"real world" case initialized from reanalysis fields
CHEM2	Same as CHEM but with BC concentration doubled	Examine sensitivity of atmosphere to BC
CHEM0	Same as CHEM but with BC concentration zeroed-out	Is semi-direct effect apparent without BC?

- Examine changes in vertical stability and cloud cover between WRF/Chem and baseline WRF simulations (i.e. CHEM-WRF)
- Sensitivity of semi-direct effect to changes in the BC concentration

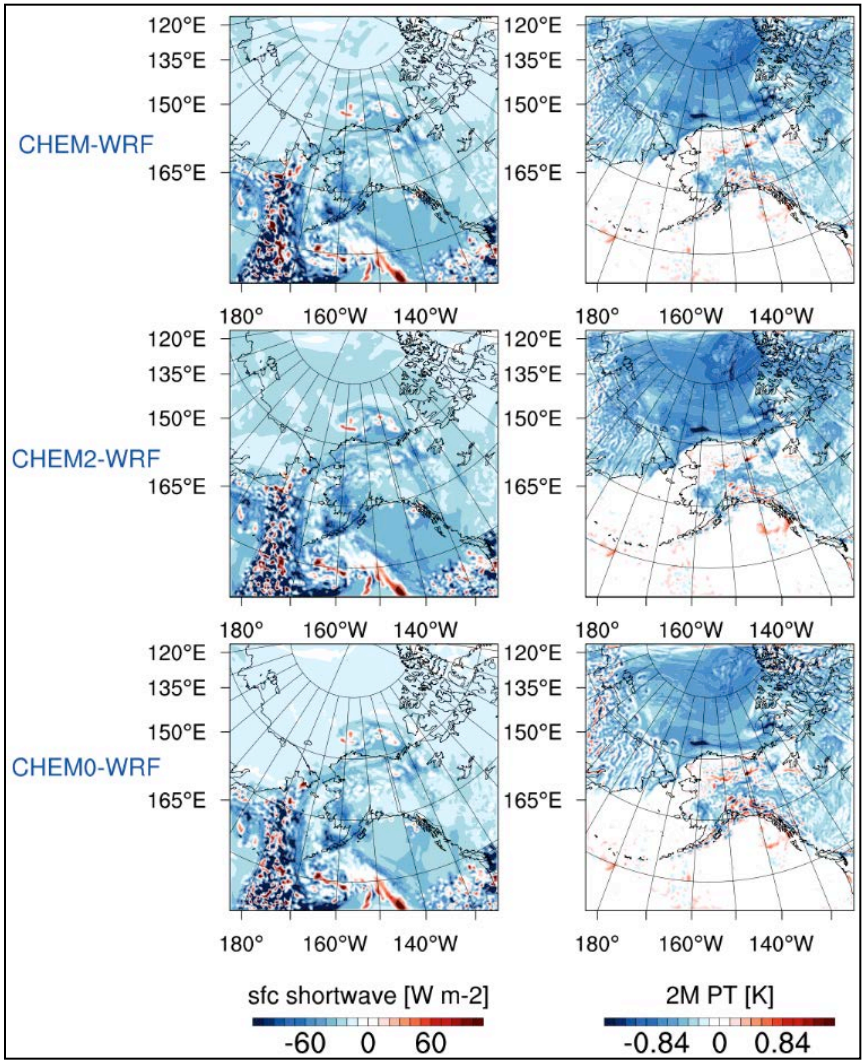
Results: PM2.5 and BC fields



Results show column-integrated BC and PM2.5 fields being advected around model domain

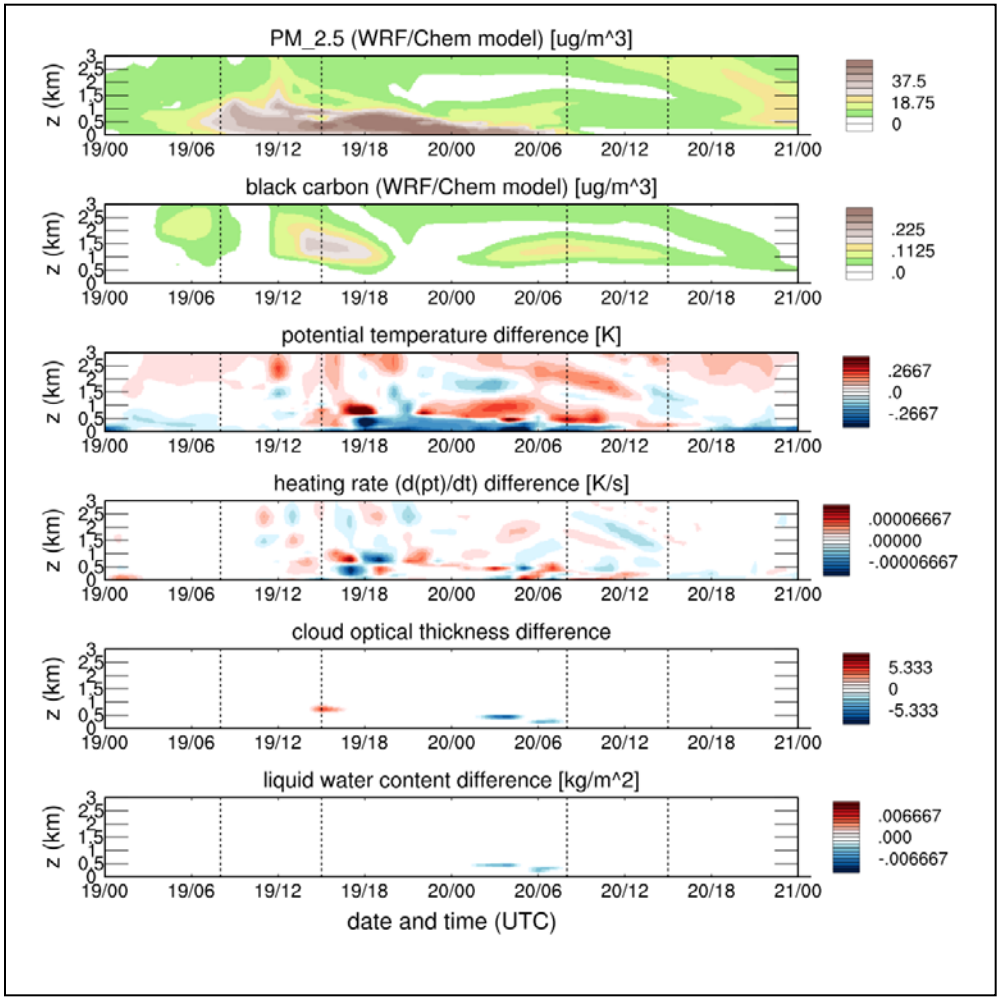
Region of BC is concentrated over Alaska 20-21 April.

Results: surface cooling



- All 3 cases show reduced solar radiation at ground level and lower temps (direct aerosol effect)
- Temp reduction is greatest over high albedo regions such as frozen Arctic and snow-covered regions.

Barrow: meteogram CHEM-WRF

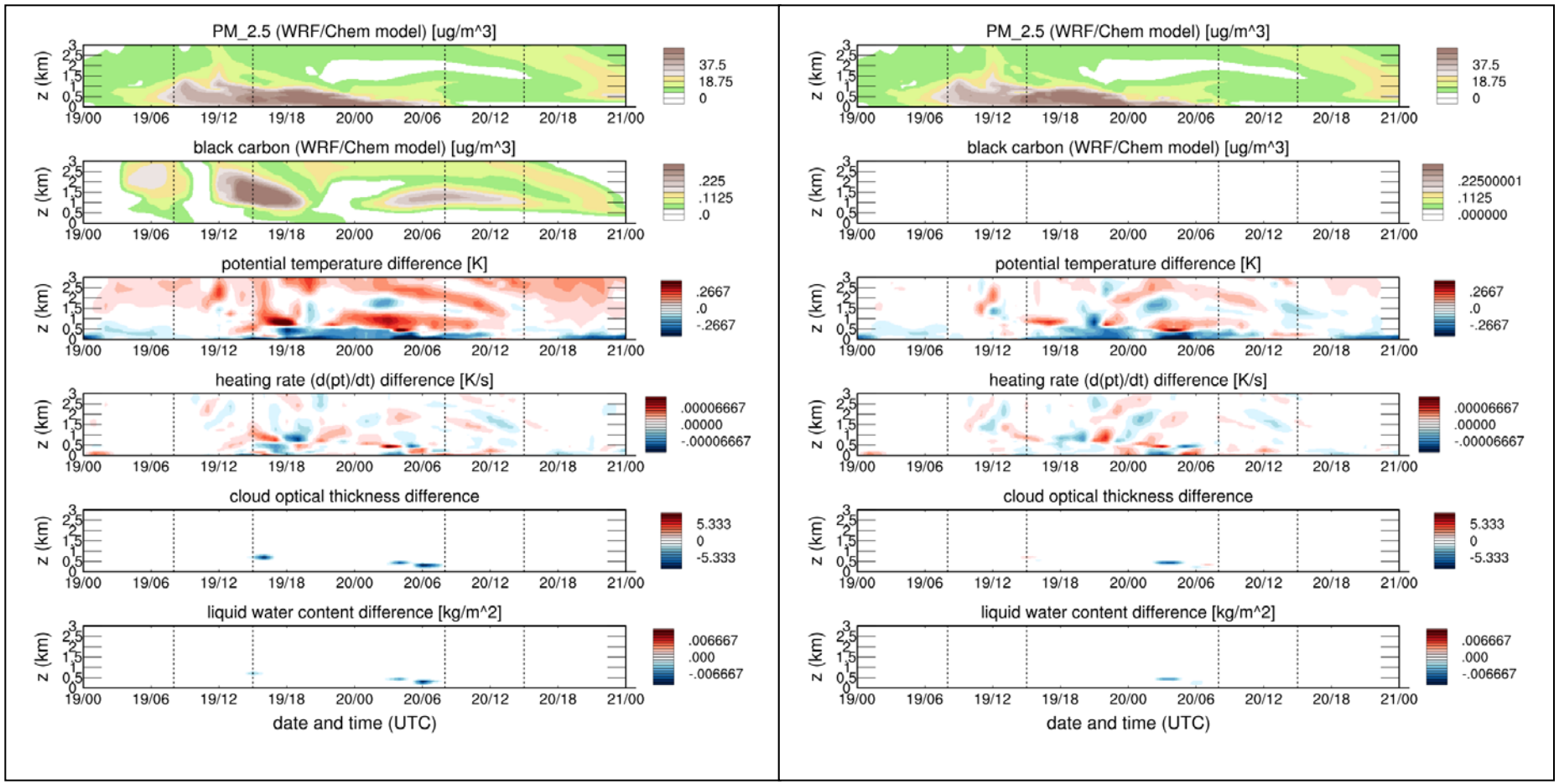


- Warming occurs in free atmosphere, particularly where BC is present
- Some drying of the atmosphere is evident on the 20th.

Barrow: meteograms

CHEM2-WRF

CHEM0-WRF



- Warming and drying are more evident in CHEM2-WRF than in CHEM0-WRF

In summary...

- Semi-direct aerosol effect (SDAE) e.g. BC at Barrow leads to greater stability, higher temps in lower troposphere, and reduced clouds and moisture.

- Consequently, the reduction in clouds and moisture alters the radiation balance and weather and climate at Barrow.

- **Future works based on only ice cloud systems need to be investigated further to study SDAE on Arctic climate changes.**