



TEXAS A&M
UNIVERSITY

Impact of Horizontal Resolution on Aerosol Modeling over East Asia using Variable-Resolution CESM2

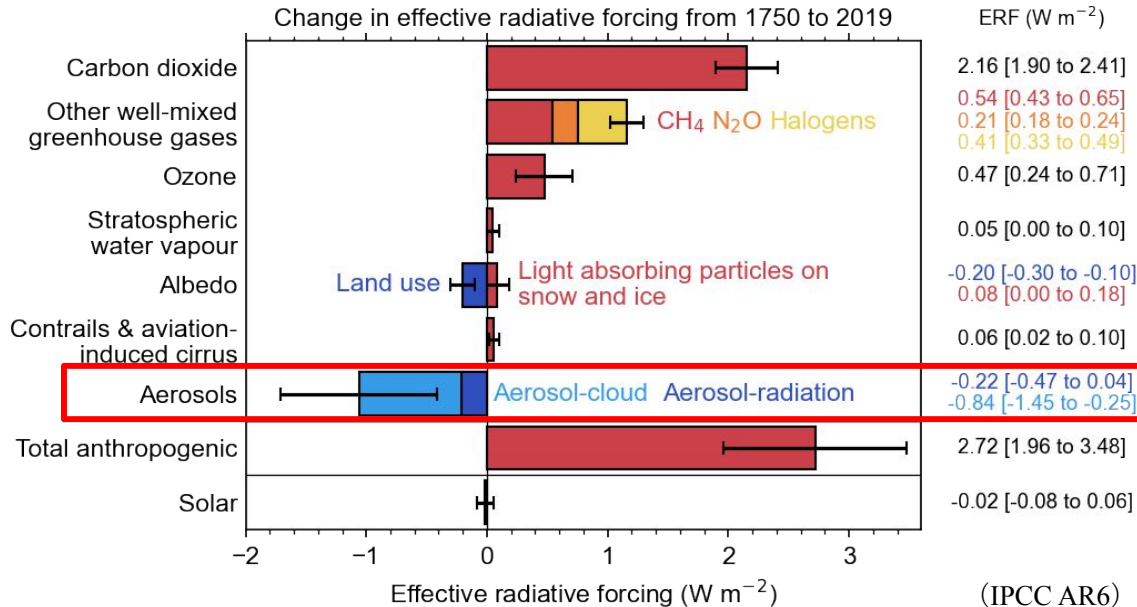
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June 14, 2023

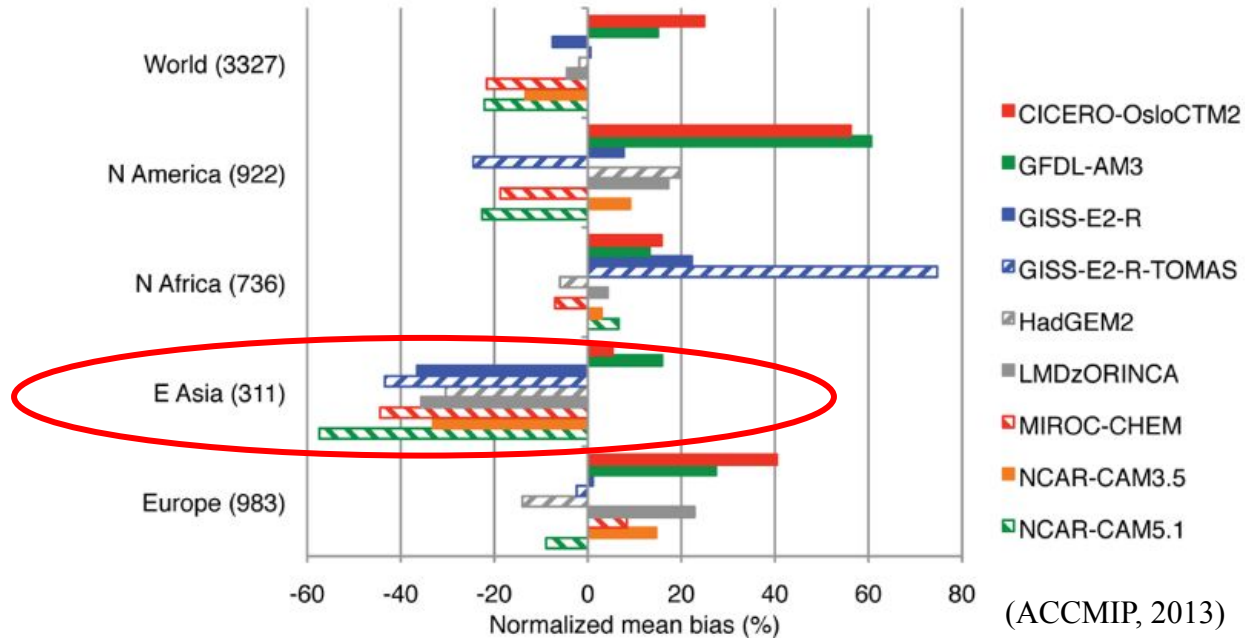
Background

Large uncertainty in the aerosols' radiative forcing



Background

Underestimation of aerosol optical depth (AOD) in East Asia



Motivation

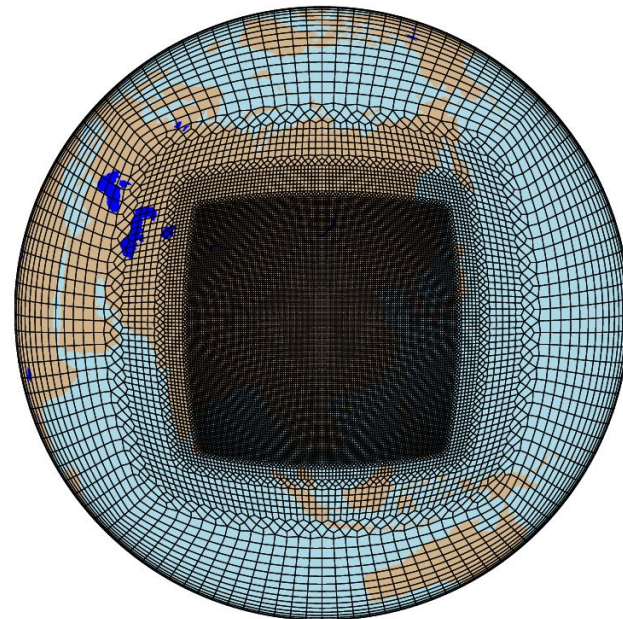
- Model resolution affects aerosol emission, transport, water uptake, aerosol-cloud interaction, etc.
- Higher-resolution models with regional mesh refinement have been developed.

Impact of horizontal resolution on aerosol modeling over East Asia using variable-resolution CESM2.2 (VR-CESM2)?

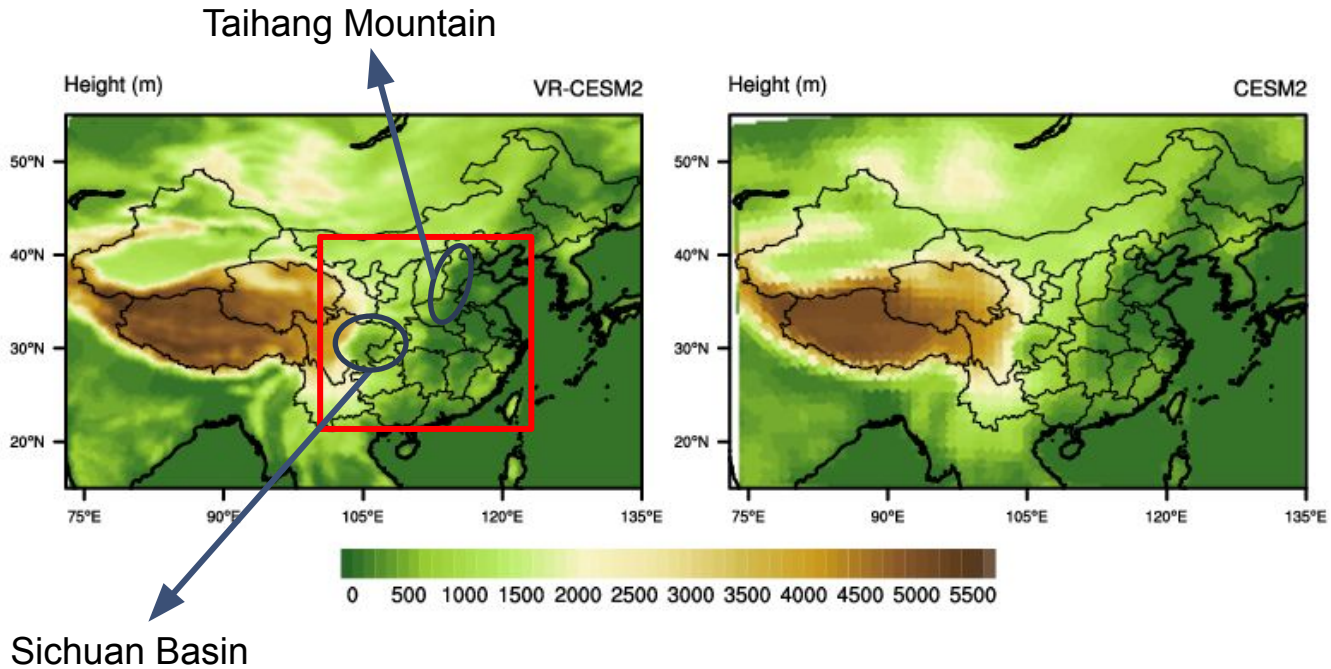
Experiment Design

CASE	Resolution	dtime
CESM2	$\sim 1^\circ$	1800 s
VR-CESM2	$\sim 1^\circ \rightarrow \sim 0.125^\circ$	600 s

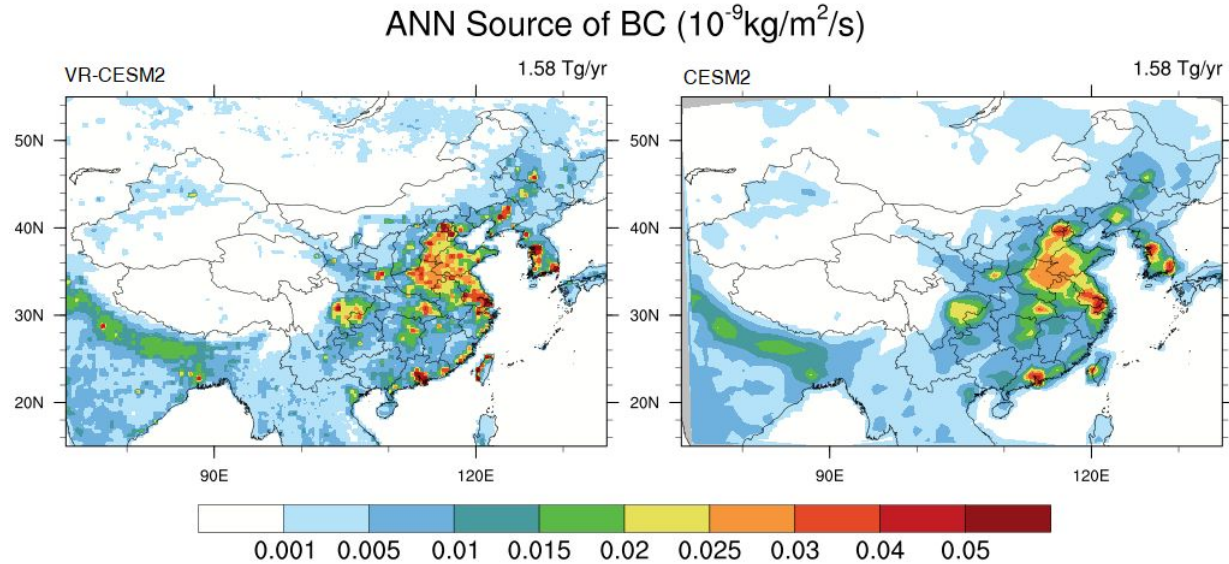
- Regional refinement over East Asia
- Free-running for 11 years
- 2000 climatology



Topography

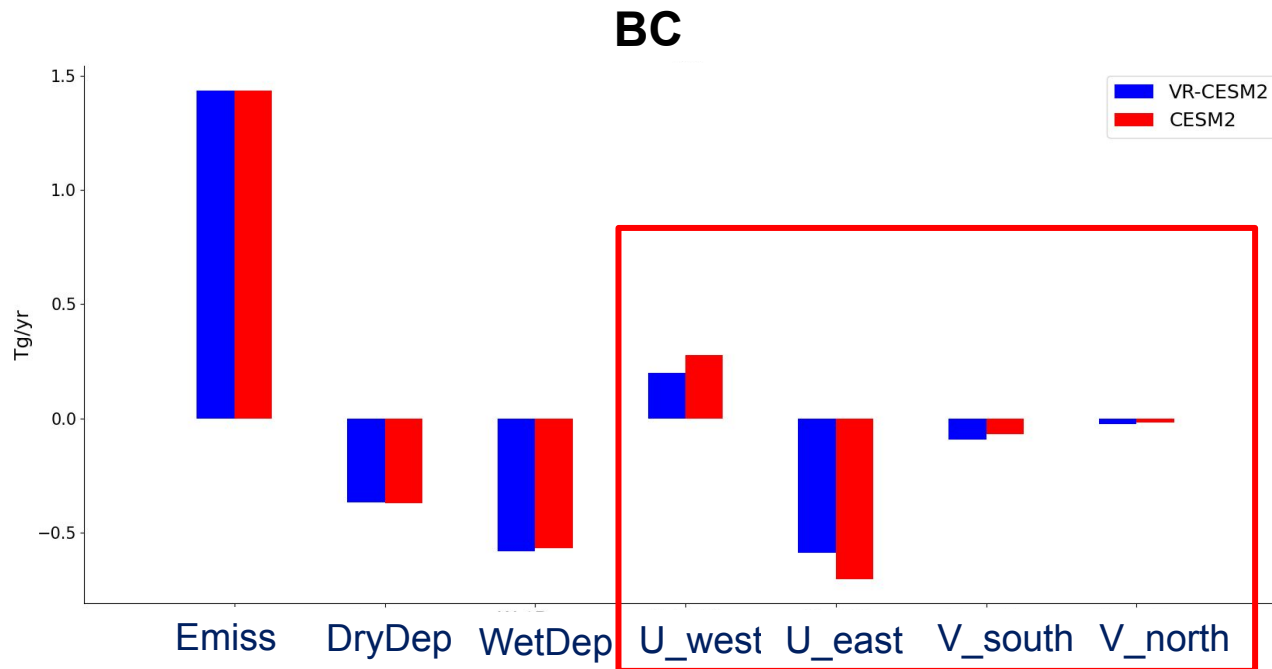


Emission



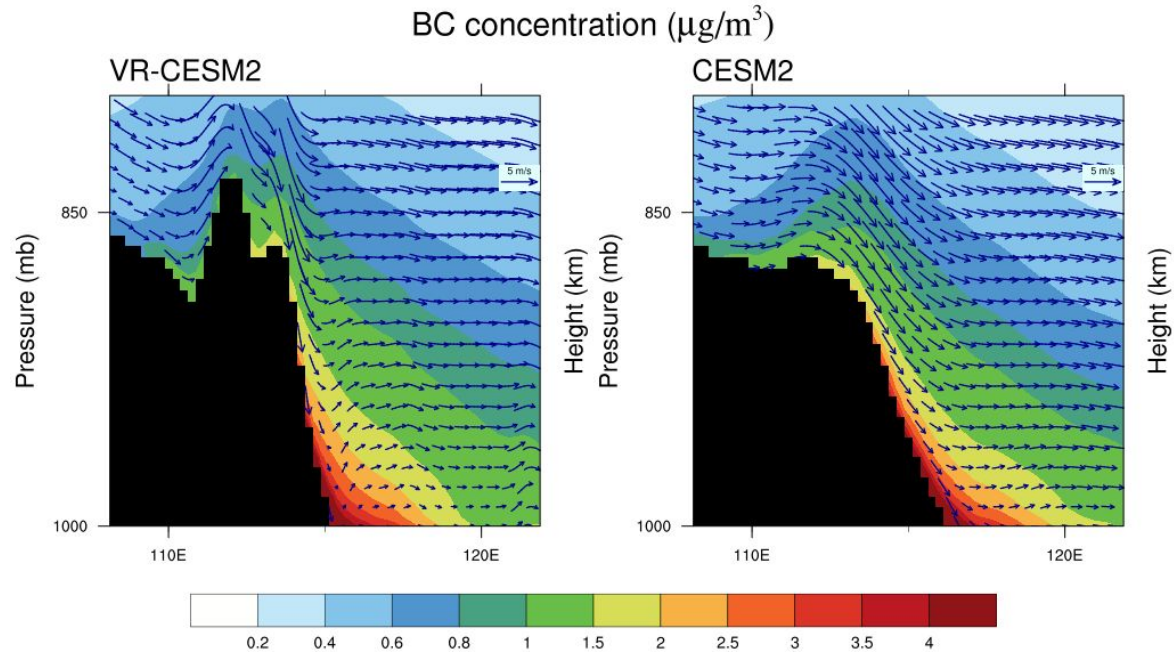
- **Local emission maximums occur as resolution increases.**
- **The spatial distribution becomes more inhomogeneous.**

Budget



Big changes in BC transport

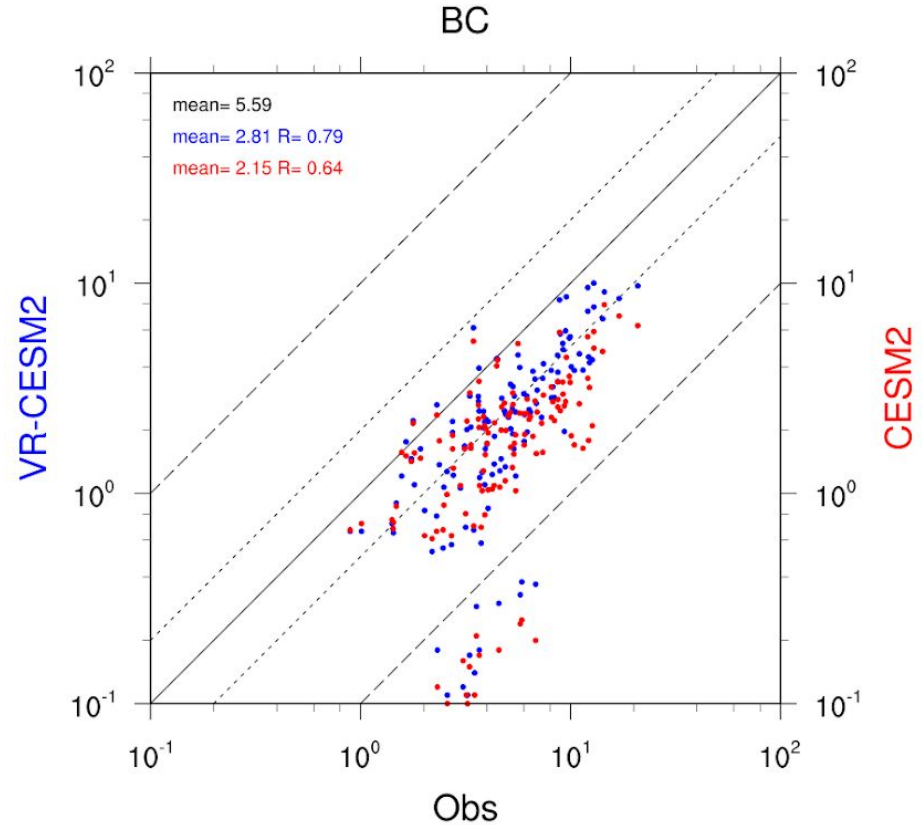
Transport



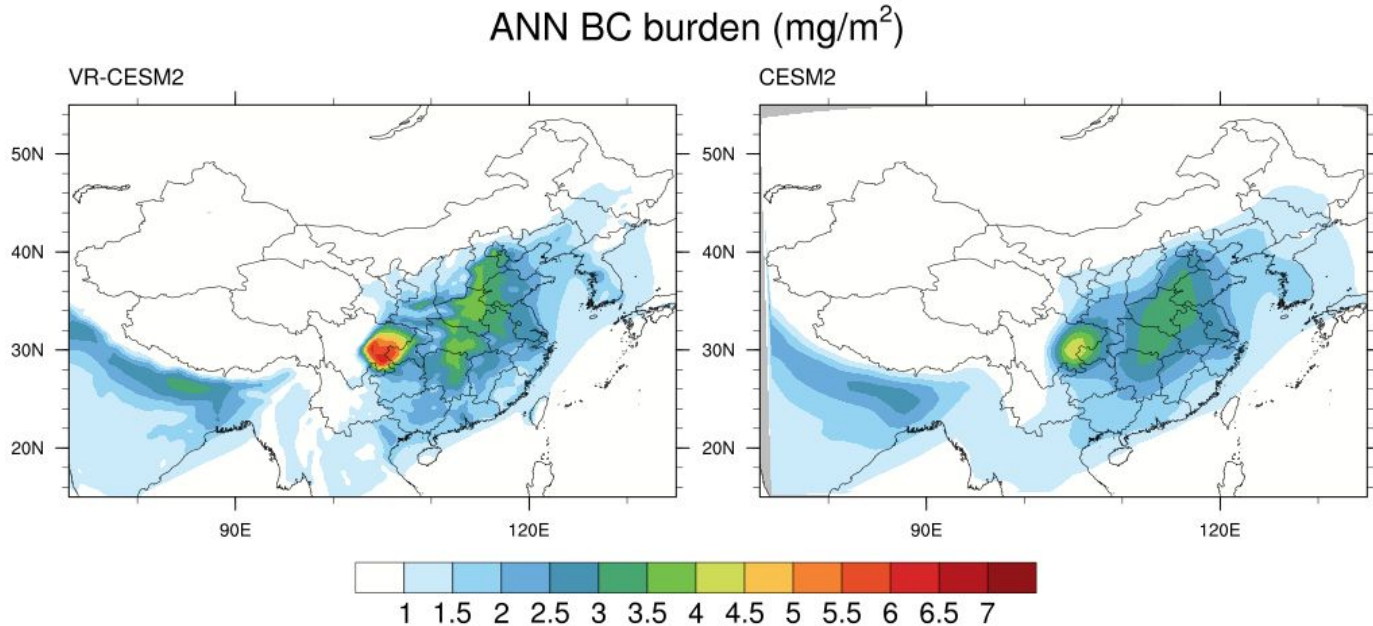
- Topography-forced descending motions in VR-CESM2 are stronger.
- The diffusion of BC is weakened due to increased resolution.

Surface concentration

- **Models tend to underestimate aerosol concentrations at the surface.**
- **Increasing resolution improves simulated aerosol concentrations.**



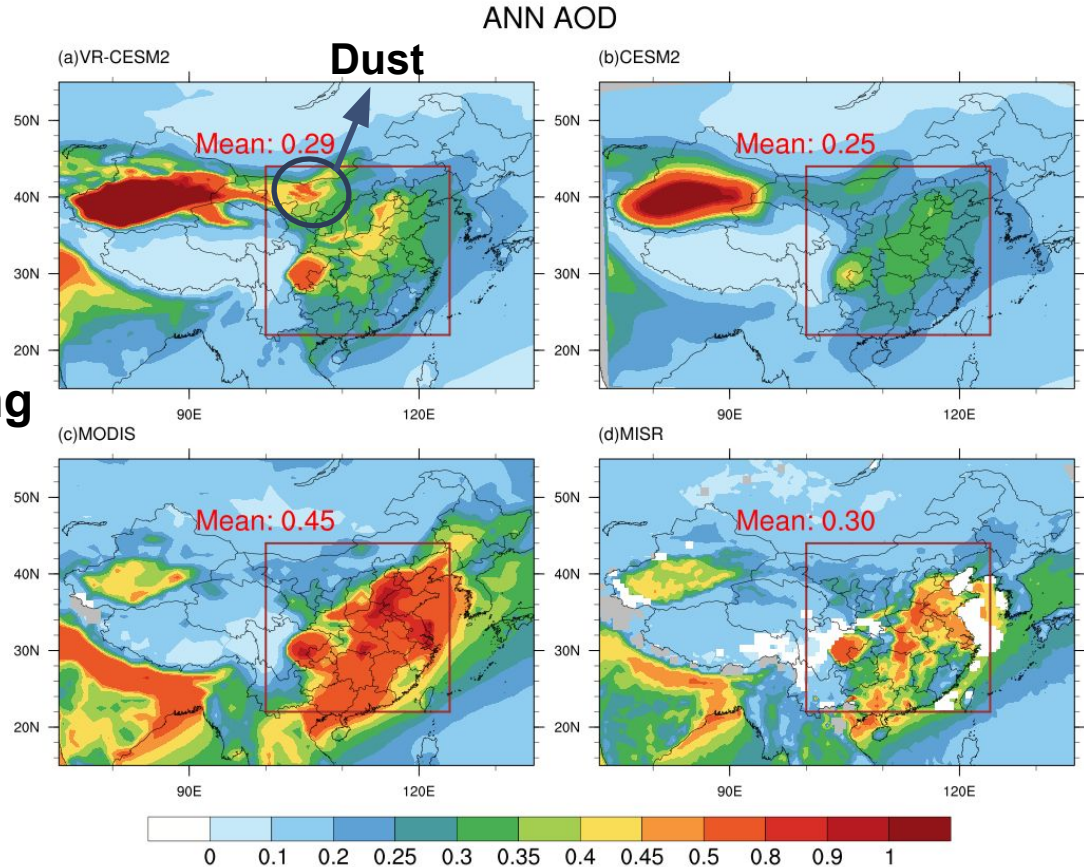
Burden



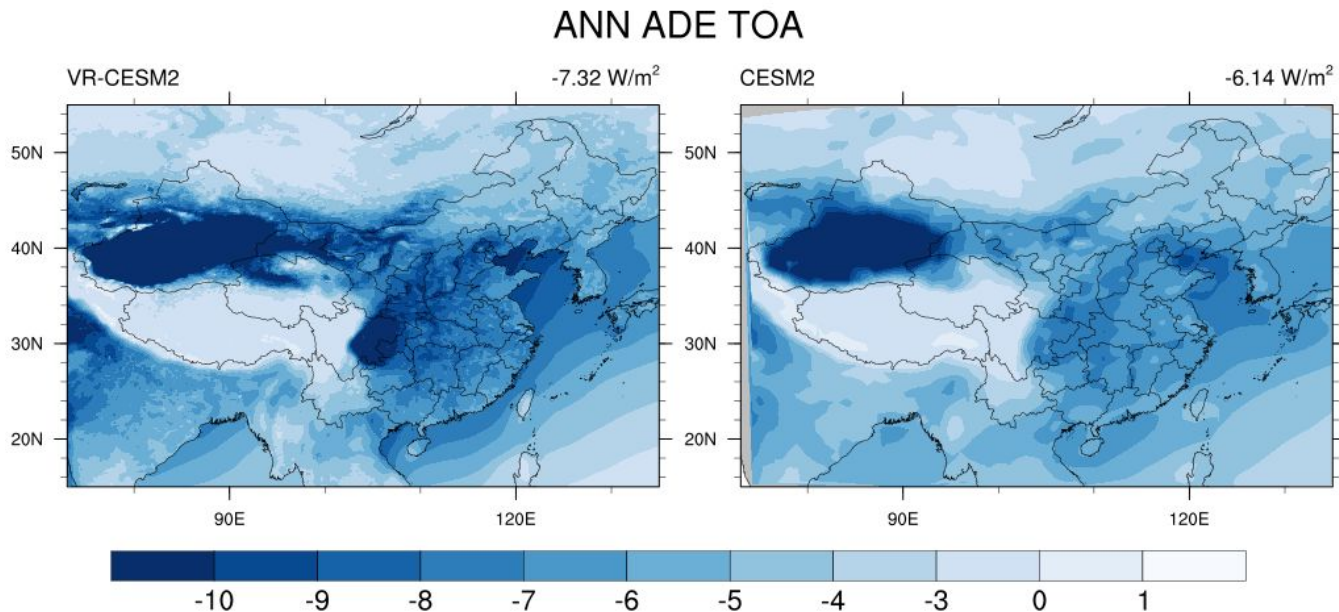
- **BC burden over eastern China increases in VR-CESM2.**
- **VR-CESM2 better captures spatial distributions at finer scales.**

AOD

- Reduced the low bias
- Uncertainty in dust modeling



Aerosol Direct Radiative Effect



Cooling effects over China increase by ~20%.

Conclusions/Implication

- **VR-CESM2 better captures sub-grid variability and local gradients of aerosol emissions.**
- **The deposition are affected little by resolution, but the transport out of eastern China decreases as resolution increases.**
- **VR-CESM2 better represents topography-induced aerosol transport.**
- **Over eastern China, increasing resolution improves the simulated AOD in terms of finer-scale spatial distribution and magnitude.**
- **VR-CESM2 needs to be further tuned to reduce uncertainty in simulation, such as dust emission.**

Thanks