

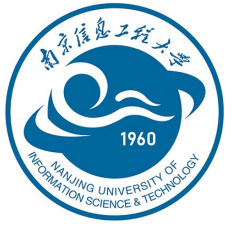
南京信息工程大学
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Fast Climate Responses to Aerosol Emission Reductions During the COVID-19 Pandemic

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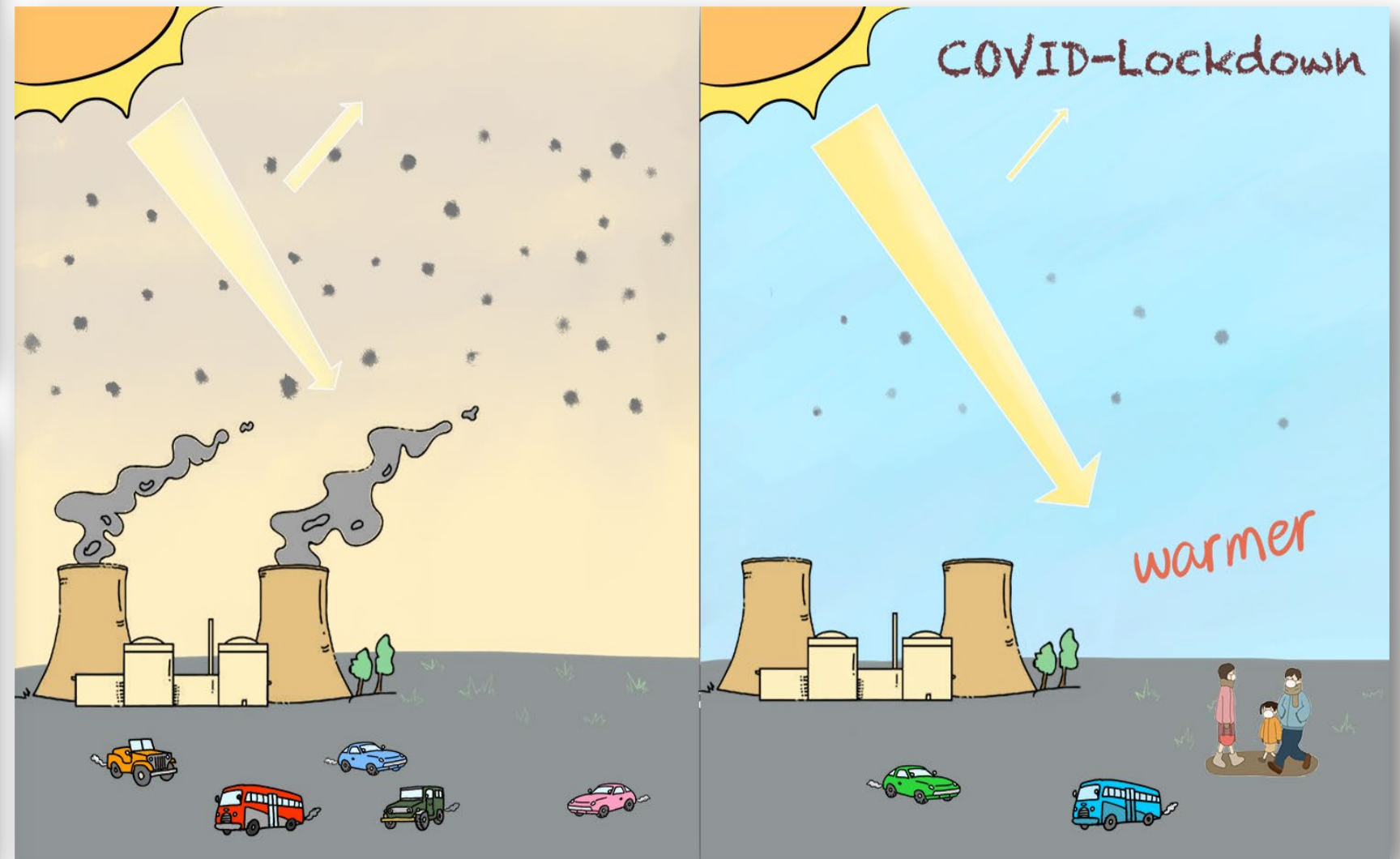
August 24, 2021

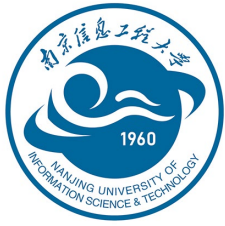


Background



Detectable Climate Response ?





Experimental Design

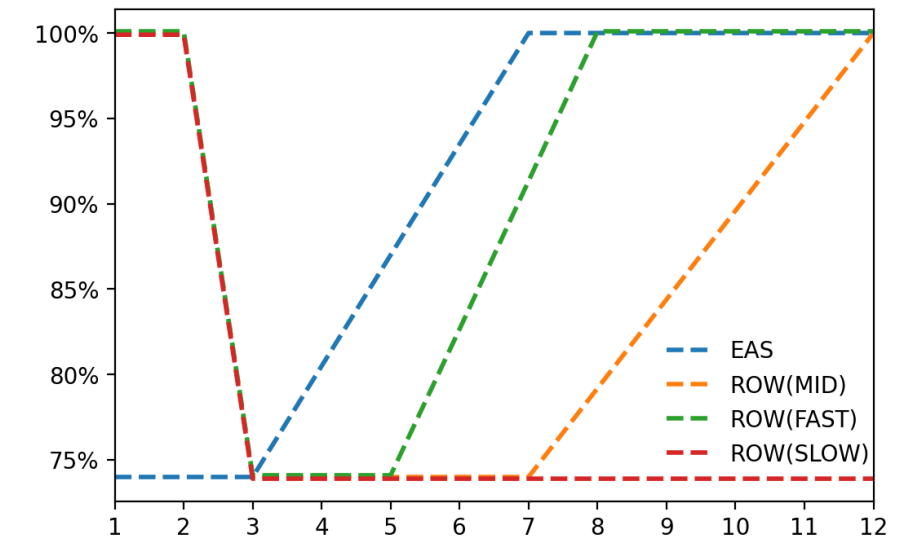
Model	Year	Meteorology	Emission
CAM5	2020	Nudged to MERRA-2	CMIP6 + MEIC

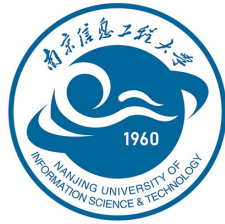
Emissions Assumption



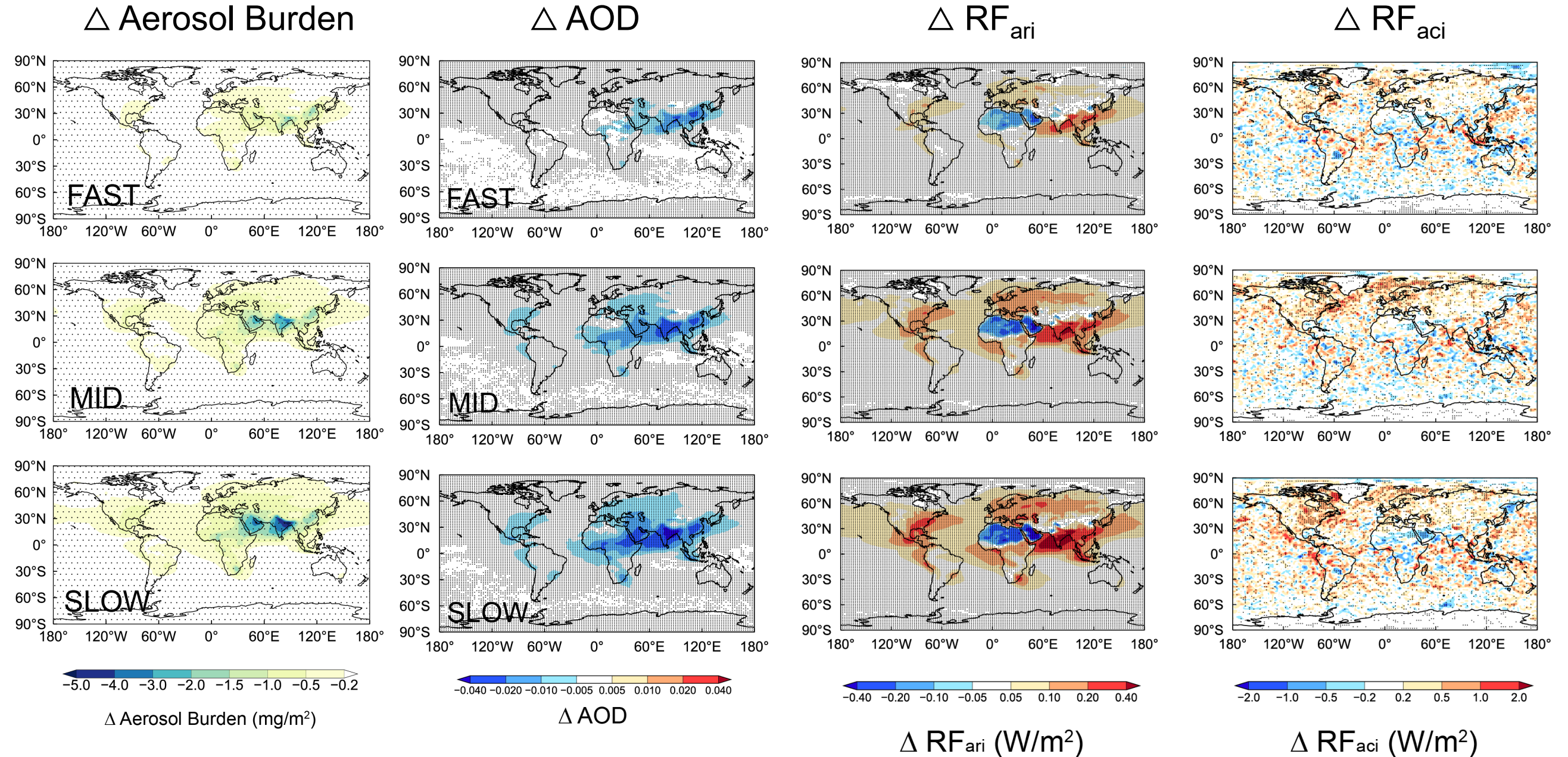
Scenarios

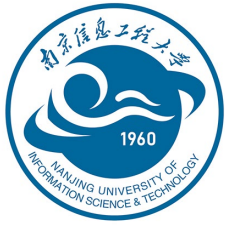
	Stage 1		Stage 2		Stage 3	
	COVID- Lock		Back to Work		Post-Lock	
	EAS	ROW	EAS	ROW	EAS	ROW
CTRL	-	-	-	-	1-12	1-12
FAST	1-3	3-5	4-6	6-7	7-12	8-12
MID	1-3	3-7	4-6	8-11	7-12	12
SLOW	1-3	3-12	4-6	-	7-12	-



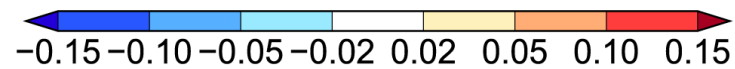
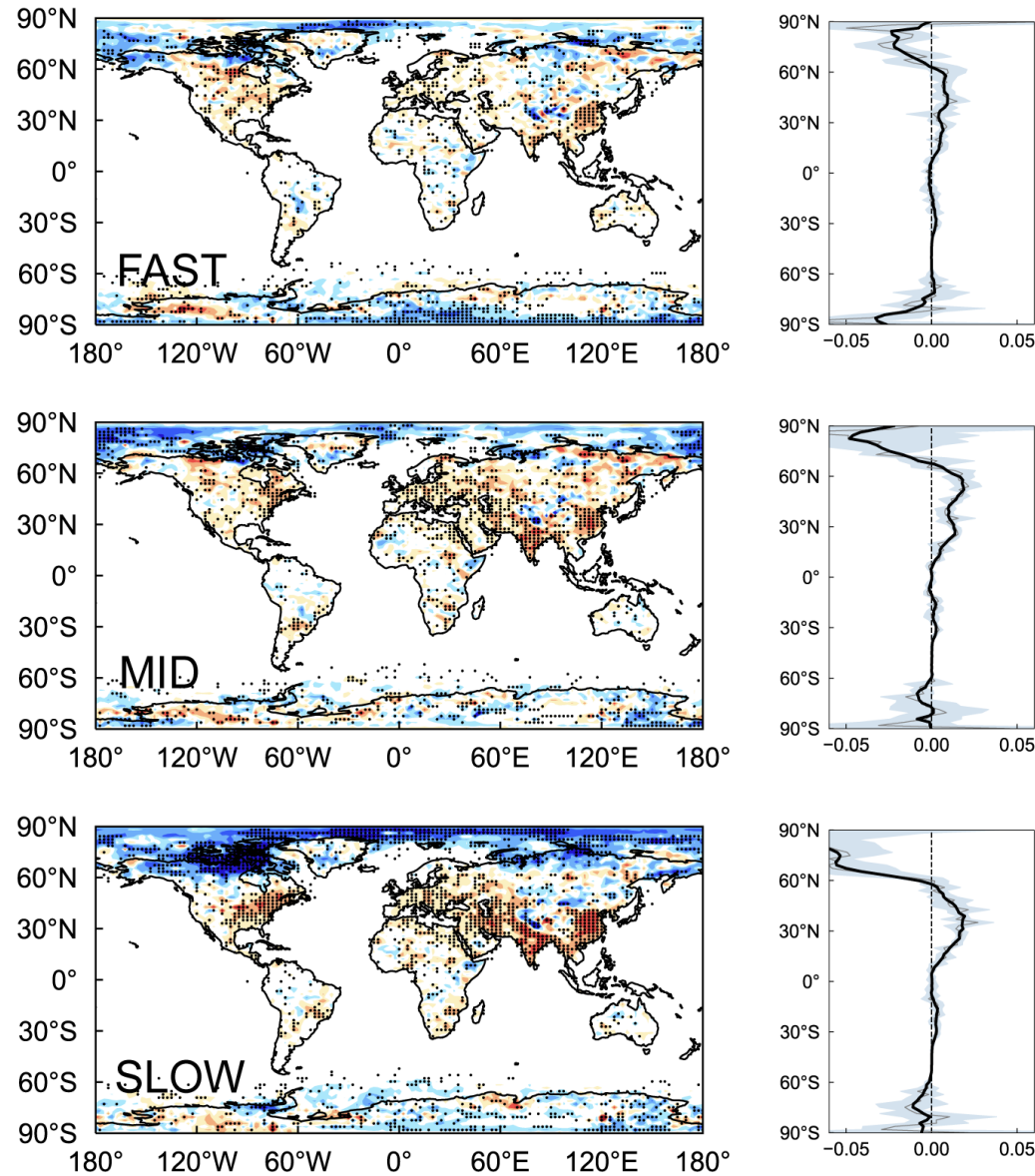


Changes in aerosol burden, optical depth and radiative forcing





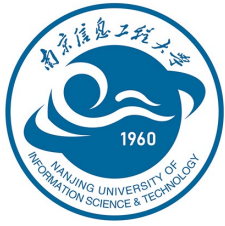
Surface warming in response to aerosol reductions



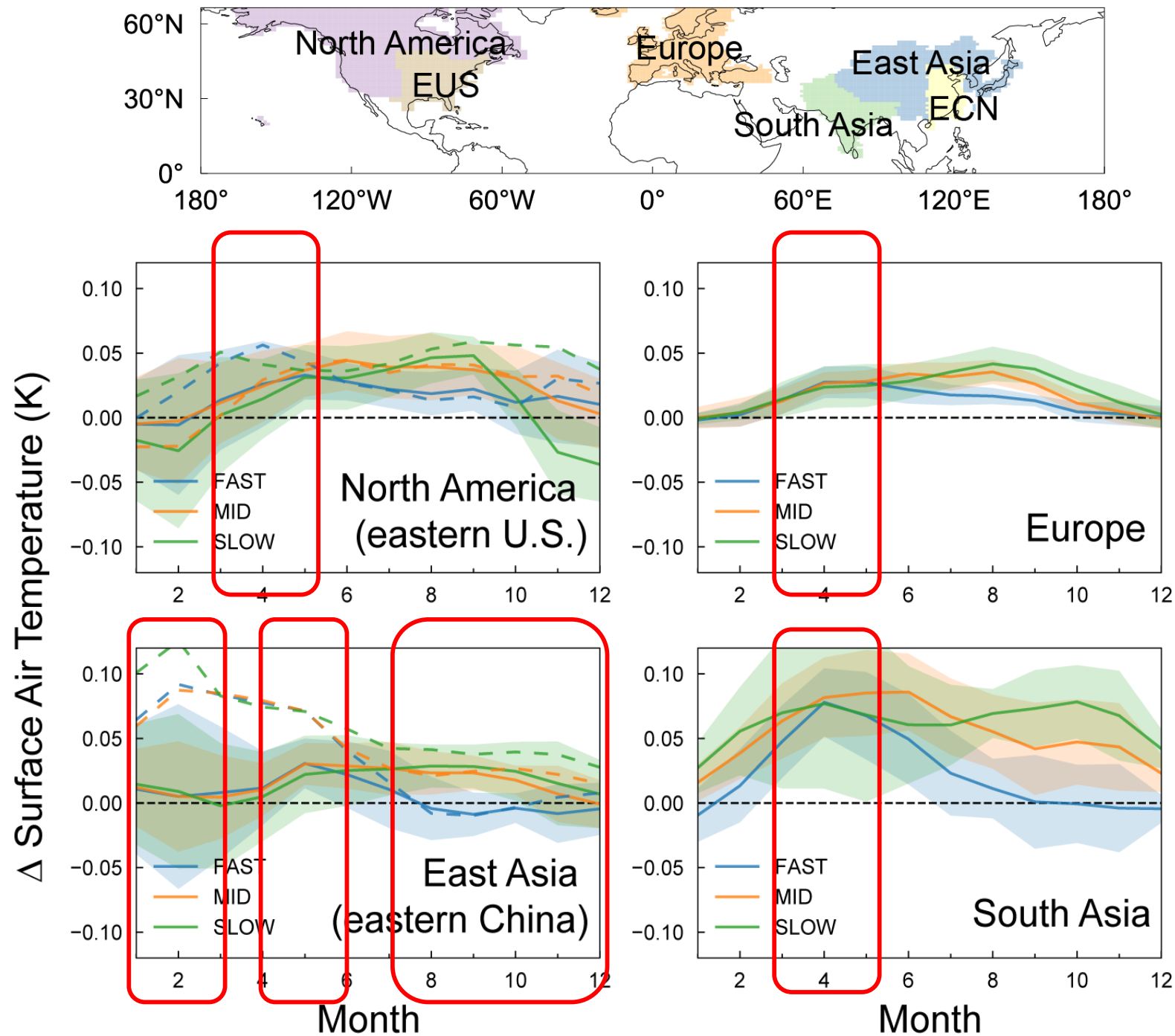
Δ Surface Air Temperature (K)

- ◆ Temperature responses are strong at regional scale.
- ◆ Surface warming appears primarily over land of the Northern Hemisphere with a zonal mean temperature increase of 0.04–0.07 K between 30°N and 50°N.
- ◆ A longer duration of global emission reductions would produce a warmer climate

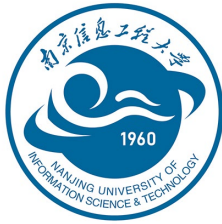
Yang Y. et al., GRL (2020)



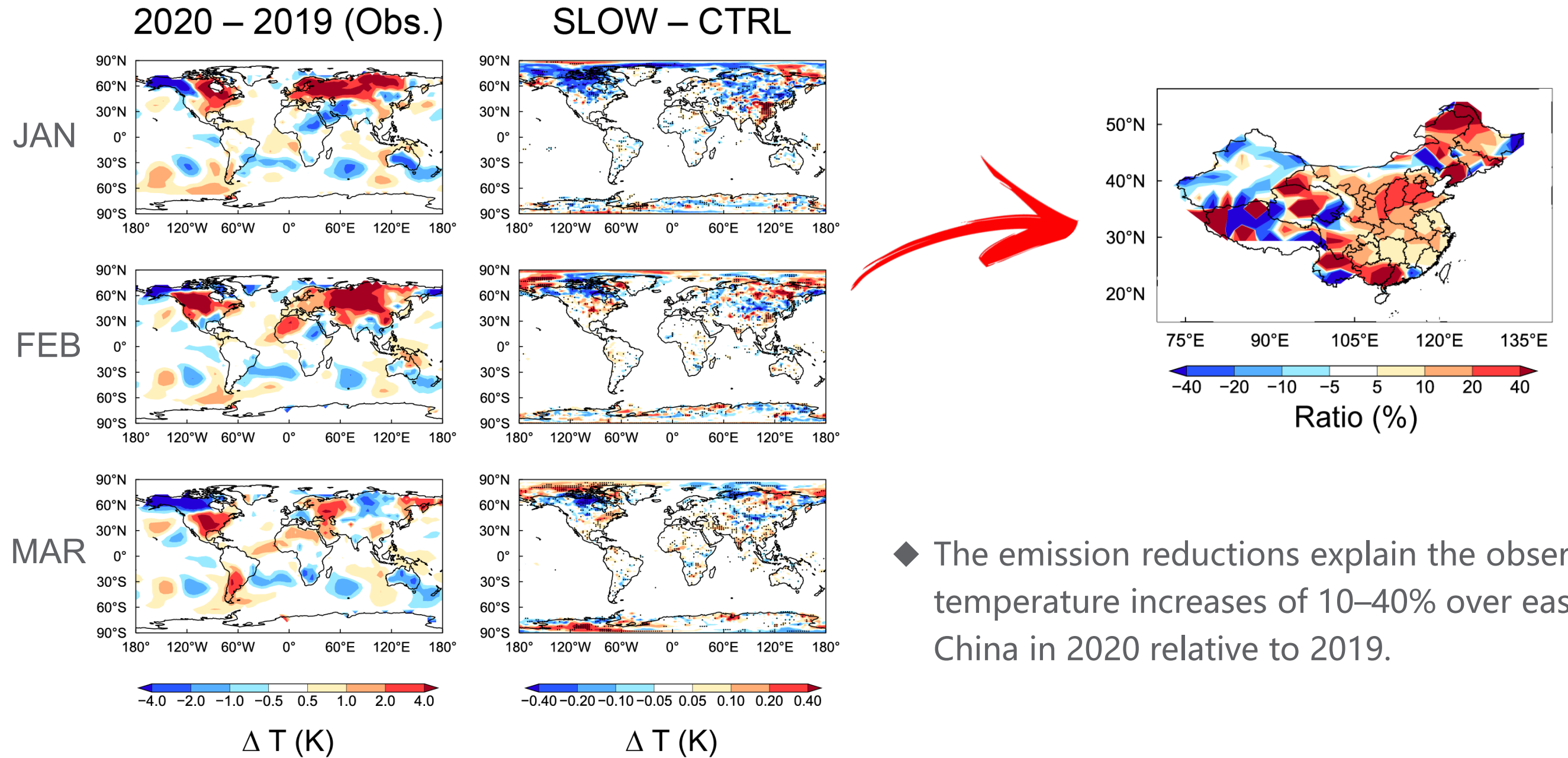
Regional surface warming during the COVID-Lock



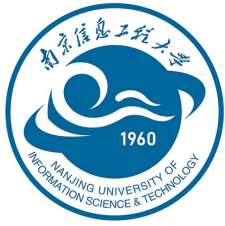
- During the COVID-Lock in January–March, eastern China is warmer than usual by 0.05–0.15 K.
- Surface air temperature is higher than normal by 0.04–0.07 K in eastern United States, Europe and South Asia in March–May.



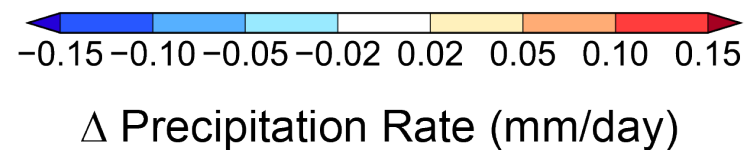
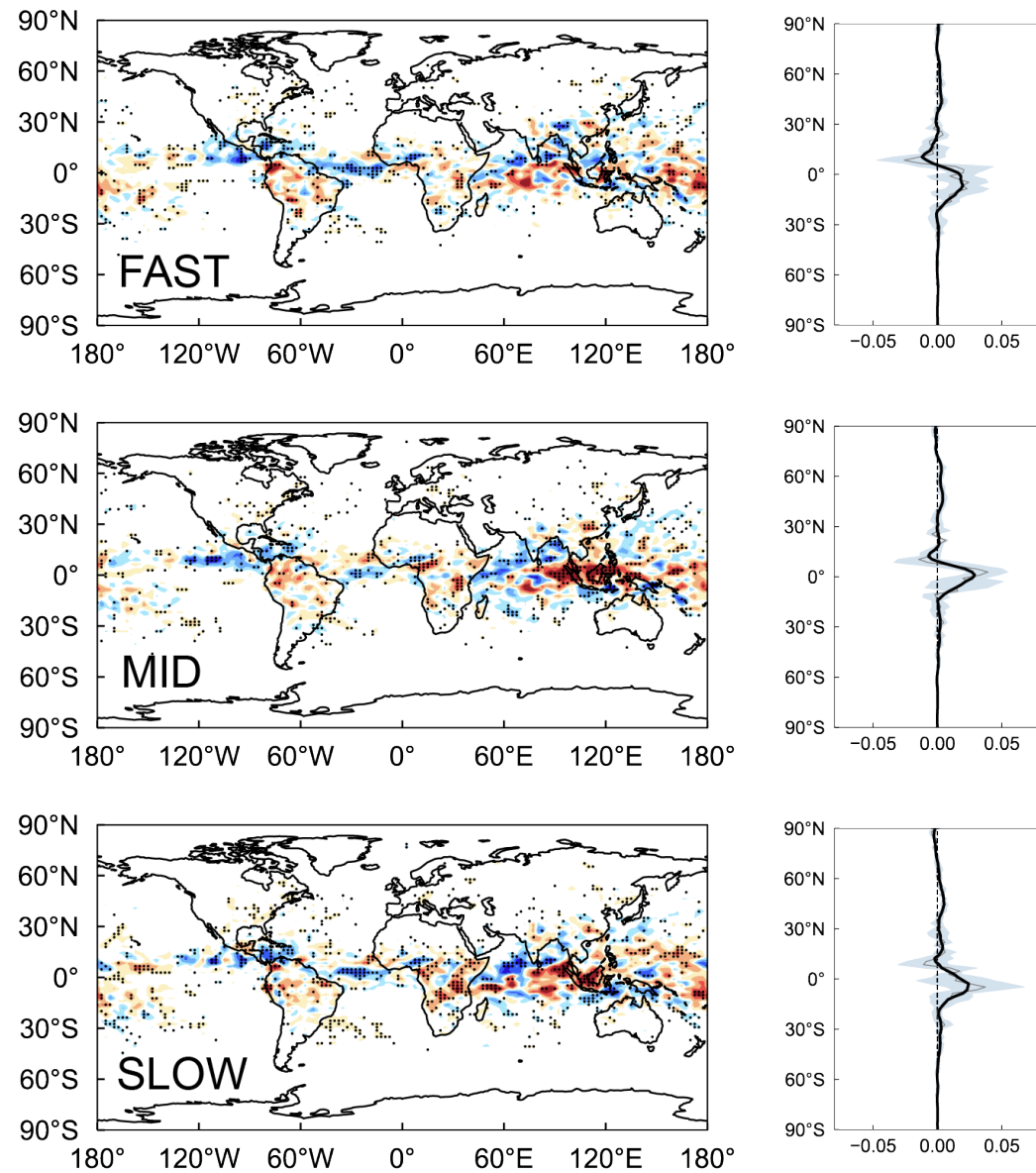
Observed warming was explained by COVID aerosol reduction



◆ The emission reductions explain the observed temperature increases of 10–40% over eastern China in 2020 relative to 2019.

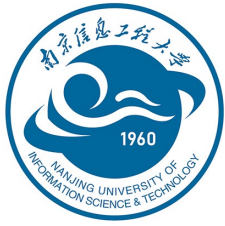


Southward shift of ITCZ due to aerosol reductions



- ◆ All emission reduction simulations exhibit an obvious southward shift of the ITCZ.
- ◆ It results from the hemispheric asymmetry in BC-induced instantaneous atmospheric heating that changes the cross-equatorial heat transport and, consequently, causes a fast precipitation response.

Yang Y. et al., GRL (2020)



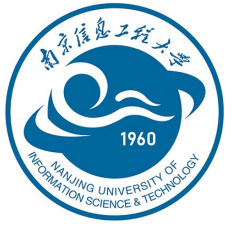
Record-breaking flooding in China during summer 2020



Natural Variability ?



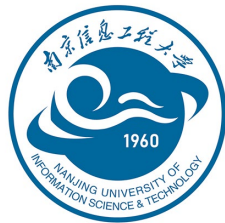
Human Influence ?
COVID-19?



Summary

- ❑ An anomalous surface warming appears over the Northern Hemisphere continents in response to aerosol reductions during COVID-19.
- ❑ The COVID-19 emission reduction explains the observed 2019-to-2020 temperature increase by 10–40% over eastern China.
- ❑ A longer duration of global emission reductions would produce a warmer climate.

Citation: Yang, Y., Ren, L., Li, H., Wang, H., Wang, P., Chen, L., Yue, X., and Hong, L., Fast climate responses to aerosol emission reductions during the COVID-19 pandemic, *Geophys. Res. Lett.*, 47, e2020GL089788, doi:10.1029/2020GL089788, 2020.



Thank You

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