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Atmospheric teleconnection linking winter air stagnation and haze extremes in China with regional Arctic sea ice decline

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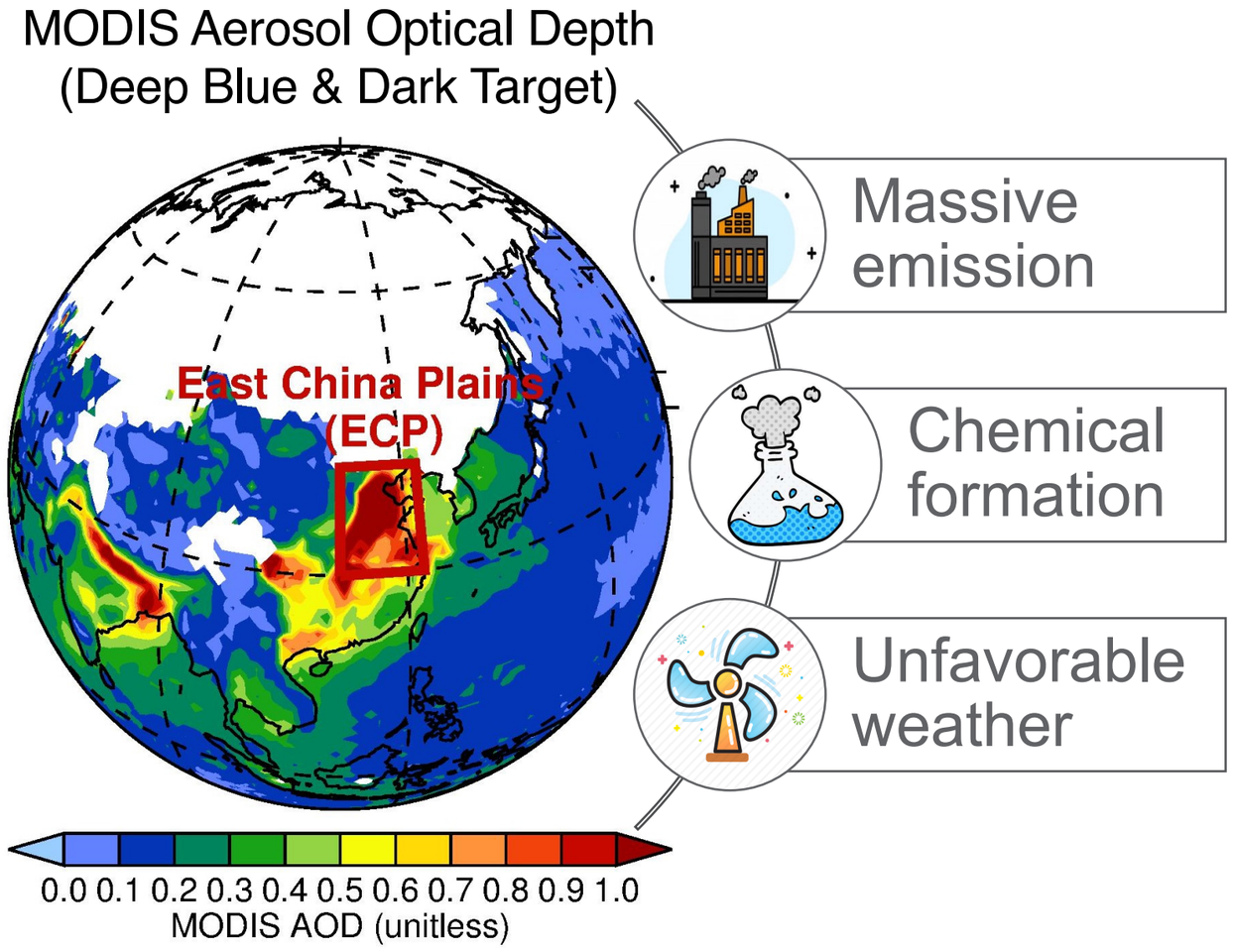
Severe Haze Pollution in China During Winter



➢ Pollution Potential Index (PPI):

$$PPI = \frac{r_1 \times WSI + r_2 \times ATGI}{|r_1| + |r_2|} \qquad r_1 = -0.73,\ r_2 = 0.70$$

WSI: standardized surface wind speed index;
ATGI: standardized air temperature gradient index;
r_1/r_2: correlation coefficients between PM_{10} and WSI/ATGI;

❖ Correlations between PPI and Air Pollution Indices

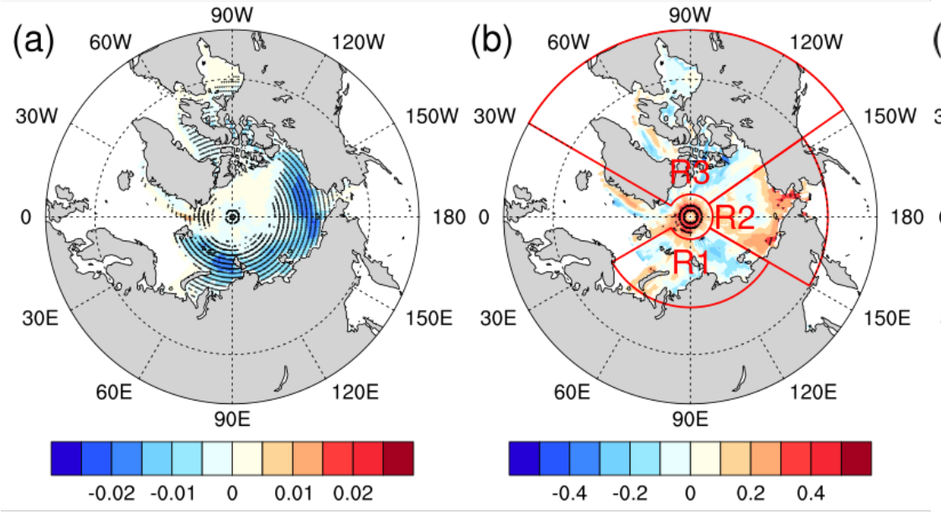
Index	Data Availability	WSI (1981-2015)		ATGI (1981-2015)		PPI (1981-2015)	
		r	p-value	r	p-value	r	p-value
PM_{10}–ECP	2005-2015	-0.73	<1E-2	0.70	<1E-2	0.92	<1E-3
$PM_{2.5}$–BJ	2010-2015	-0.80	0.01	0.58	0.09	0.79	0.07
ViI	1981-2013*	-0.63	<1E-3	0.36	0.17	0.62	<1E-3
Terra AOD	2001-2015	-0.43	0.08	0.33	0.26	0.44	0.08

(Zou et al., SA, 2017)

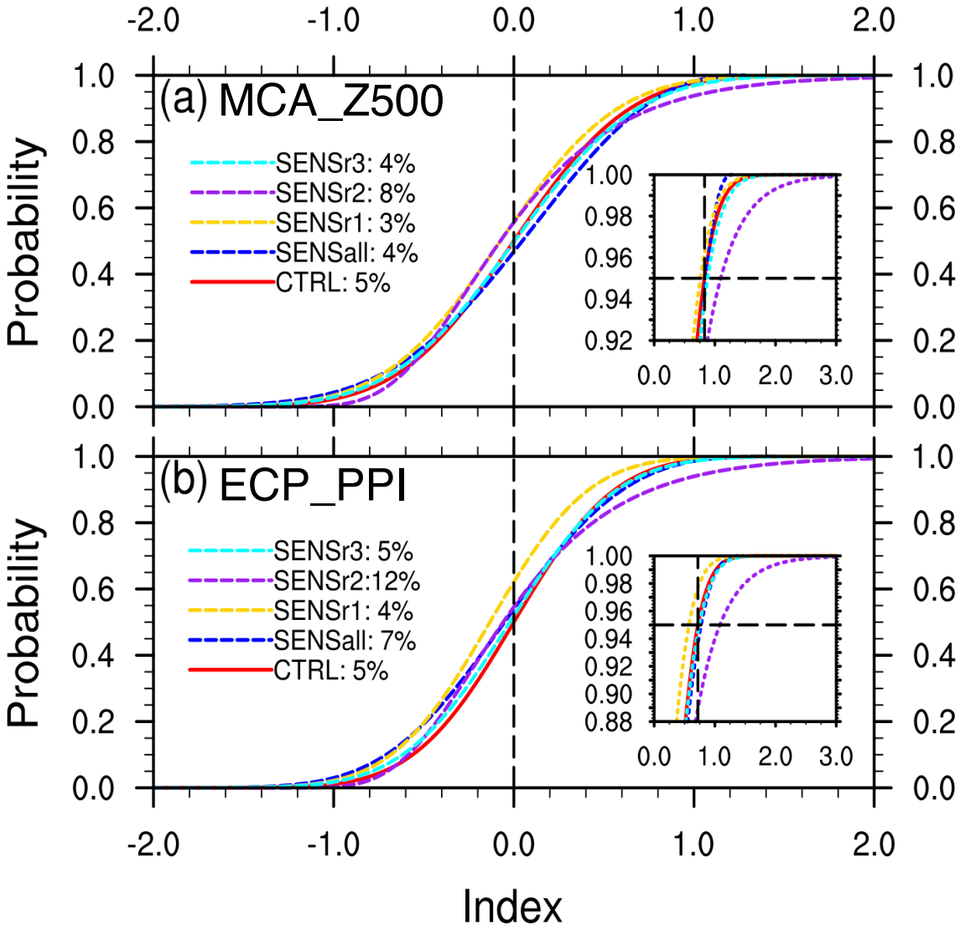
Climate Sensitivity Experiments Using WACCM

❖ Climate Sensitivity Experiment Settings

Boundary forcing	WACCM (1.9°×2.5°; 70 lev; 30 years)				
	CTRL	SENSall	SENSr1	SENSr2	SENSr3
Sea Ice	Clim.	2012 ASON Arctic SIC	2012 ASON R1 SIC	2012 ASON R2 SIC	2012 ASON R3 SIC
SST	Clim.	2012 ASON Arctic SST	2012 ASON R1 SST	2012 ASON R2 SST	2012 ASON R3 SST



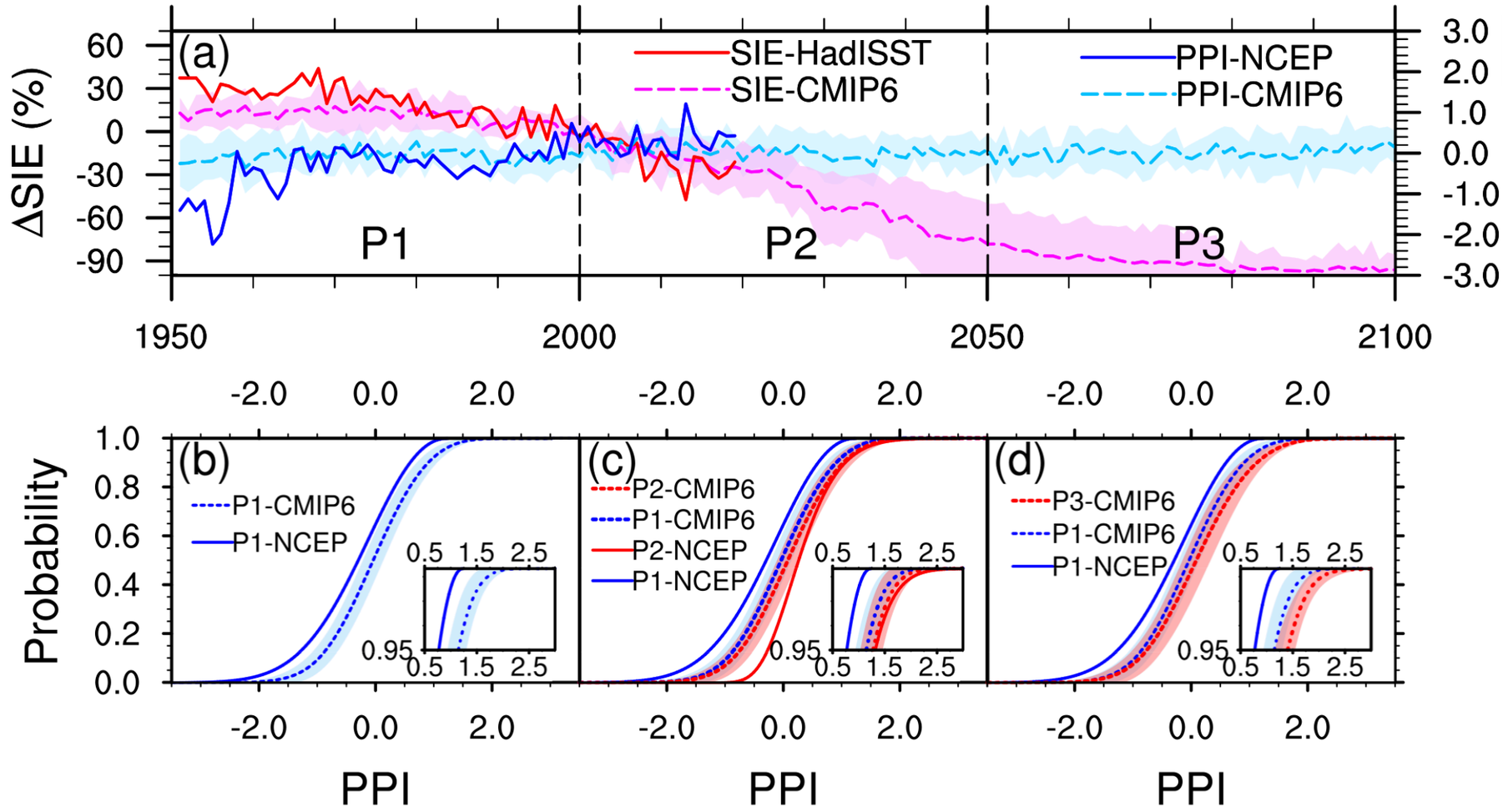
❖ Regional Circulation and PPI Responses



(Zou et al., ACP, 2020)

CMIP6 Simulations and Future Projections

❖ Arctic SIE and PPI in CMIP6 Model Ensembles (historical/SSP5-8.5 scenarios)



	P1	P2	P3
NCEP	-0.38 (5%)	0.30 (19%)	—
CAMS	-0.36 (5%)	-0.16 (11%)	-0.23 (13%)
CESM2	-0.07 (5%)	0.20 (11%)	0.11 (13%)
CESM2-WACCM	0.03 (5%)	0.36 (10%)	0.27 (6%)
CanESM5	-0.02 (5%)	0.10 (7%)	0.22 (12%)
EC-Earth3	-0.27 (5%)	-0.21 (5%)	-0.25 (2%)
GFDL-CM4.0	0.06 (5%)	0.14 (6%)	0.26 (13%)
IPSL-CM6A	0.12 (5%)	0.08 (7%)	0.30 (11%)
MIROC6	0.12 (5%)	0.02 (2%)	0.00 (4%)

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Research article

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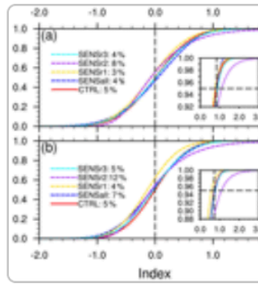
Atmospheric teleconnection processes linking winter air stagnation and haze extremes in China with regional Arctic sea ice decline



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Thank you

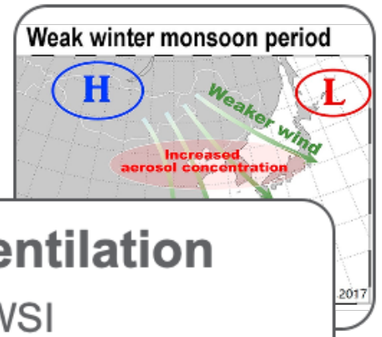
Abstract

Back to t

Recent studies suggested significant impacts of boreal cryosphere changes on wintertime air stagnation and haze pollution extremes in Chin

Cryosphere
- SIC/SST
- East Siberian and Chukchi seas

Circulation
- EU
- MCA Mode



Ventilation
- WSI
- ATGI
- PPI

Haze Pollution
- $PM_{10}/PM_{2.5}$
- VIl
- AOD