

Supplementary Information for
An analytic theory for the degree of Arctic Amplification

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Supplementary Table 1

Supplementary Figures 1-6

Model Number	Model Name	Historical	SSP2-4.5	SSP1-2.6	SSP5-8.5
1	ACCESS-CM2	r1-10	r1-5	r1-5	r1-10
2	ACCESS-ESM1-5	r1-40	r1-10	r1-10	r1-10
3	AWI-CM-1-1-MR	r1-5	r1	r1	r1
4	BCC-CSM2-MR	r1-3	r1	r1	r1
5	CAMS-CSM1	r1-2	r1-2	r1-2	r1-2
6	CAS-ESM2	r1-4	r1,3	r1,3	r1,3
7	CESM2	r1-10	r4,10,11	r4,10,11	r4,10,11
8	CIESM	r1-3	r1	r1	r1
9	CMCC-CM2-SR5	r1	r1	r1	r1
10	CNRM-CM6	r1-28	r1-6	r1-6	r1-6
11	CNRM-ESM2	r1-10	r1-10	r1-5	r1-5
12	CanESM5	r1-25	r1-10	r1-10	r1-10
13	EC-Earth3	r1-10	r1-7,9,10	r1-6,8,9,11,13	r1,3,4,6,9,11,13
14	EC-Earth3-Veg	r1-10	r1-6	r1-4,6	r1-4,6,10
15	FGOALS-g3	r1-6	r1-4	r1-4	r1-4
16	GFDL-ESM4	r1-3	r1-3	r1	r1
17	GISS-E2-1-G	r1-10	r1-10	r1-5	r1-5
18	GISS-E2-1-H	r1-5	r1-5	r1-5	r1-5
19	HadGEM3-GC31-LL	r1-5	r1-5	r1	r1-4
20	IITM-ESM	r1	r1	r1	r1
21	INM-CM4-8	r1	r1	r1	r1
22	INM-CM5	r1-8	r1	r1	r1
23	IPSL-CM6A-LR	r1-33	r1-6	r1-6	r1-6
24	KACE-1-0-G	r1-3	r1-3	r1-3	r1-3
25	MIROC-ES2L	r1-10	r1-10	r1-10	r1-10
26	MIROC6	r1-50	r1-10	r1-10	r1-10
27	MPI-ESM1-2-LR	r1-10	r1-10	r1-10	r1-10
28	MPI-ESM1-2-HR	r1-10	r1-2	r1-2	r1-2
29	MRI-ESM2	r1-10	r1-5	r1-5	r1-5
30	NESM3	r1-5	r1-2	r1-2	r1-2
31	NorESM2-MM	r1-3	r1,2	r1	r1
32	UKESM1-0-LL	r1-19	r1-4,8,13	r1-10	r1-4,8

Table S1: The CMIP6 models and their realizations used in this study for the historical and SSP experiments.

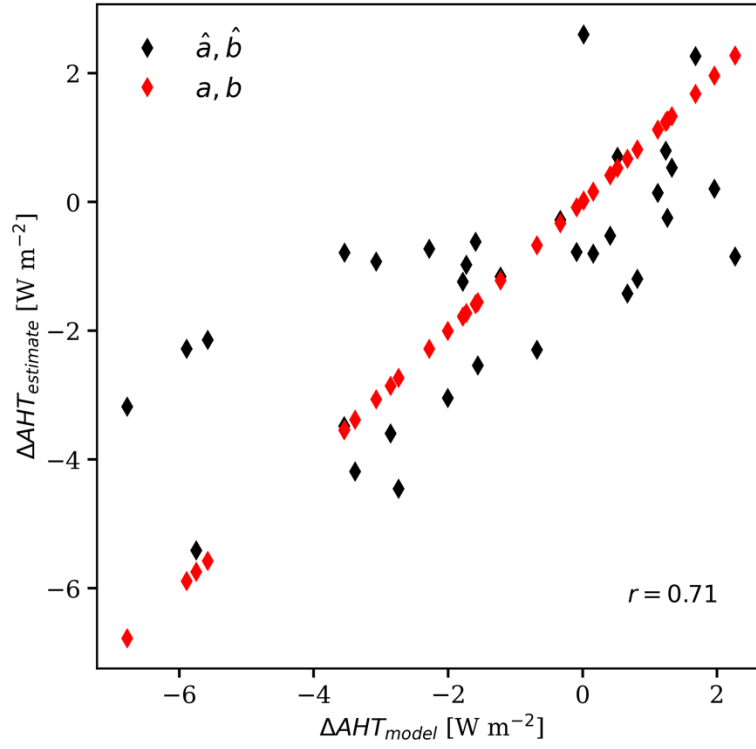


Figure S1: The change in atmospheric heat transport into the Arctic simulated by models (ΔAHT_{model}) versus that estimated as a function of changes in global and Arctic mean surface temperature ($\Delta AHT_{estimate}$; Eq. 5) using constant $\hat{a}$ and $\hat{b}$ (black) and model-dependent a and b (red).

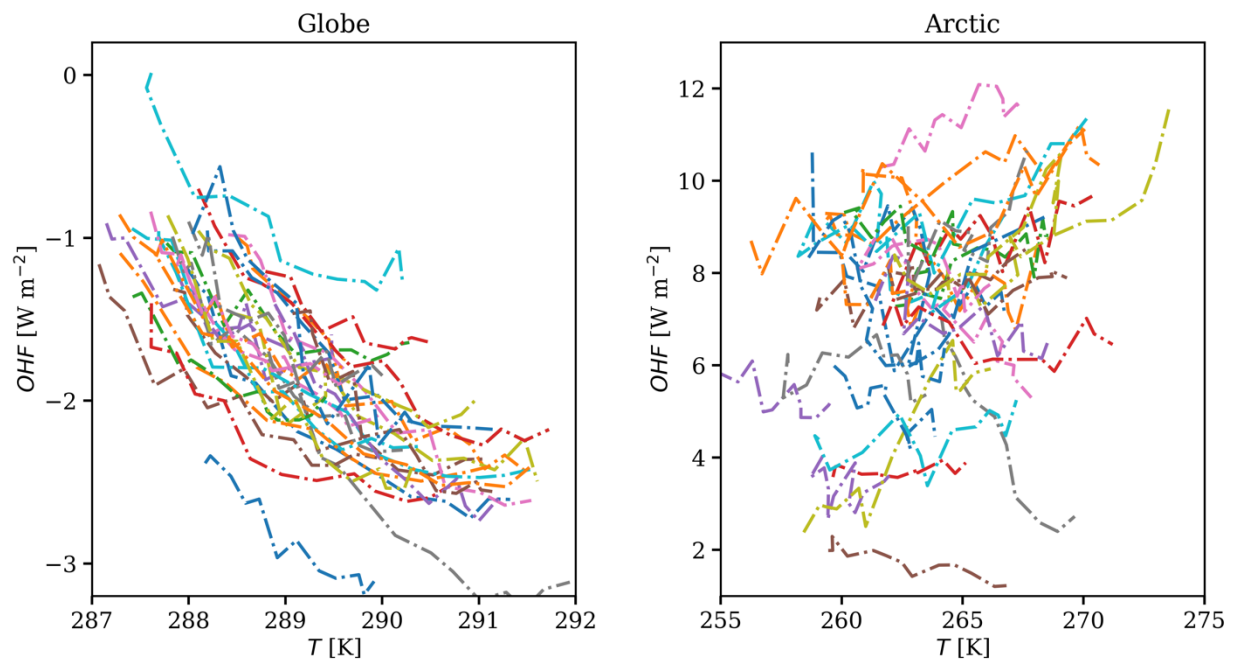


Figure S2: Changes in ocean heat convergence and uptake, ΔO , as a function of temperature for the global and the Arctic. Each line represents a model.

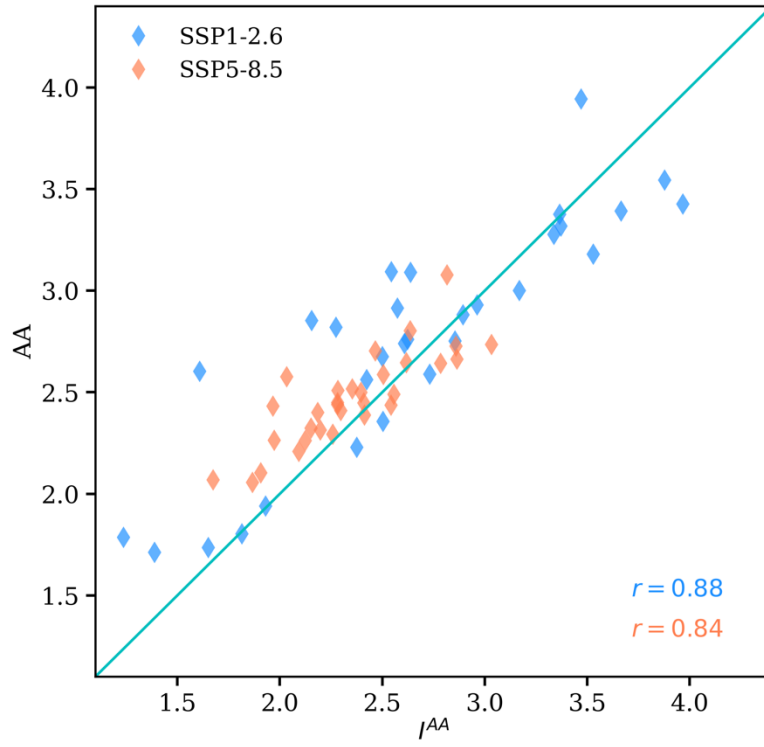


Figure S3: Scatterplot between the model-projected AA and the theoretical estimate

$(I^{AA} \equiv 1 + \frac{a + \lambda^A - \hat{\gamma} \lambda^G}{b - \lambda^A})$ for the low (SSP1-2.6) and high (SSP5-8.5) emission scenarios.

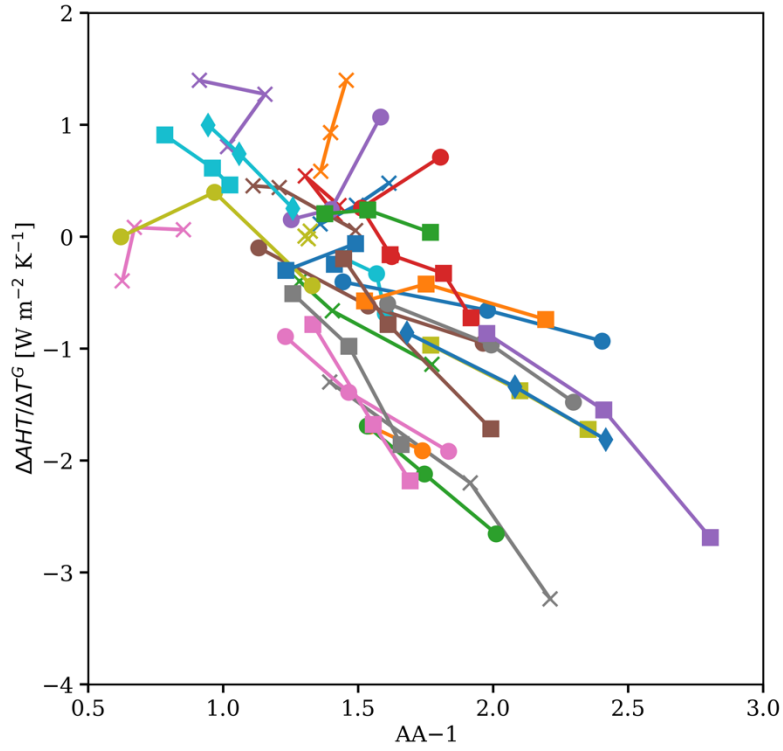


Figure S4: Scatterplot between AA-1 and the change in atmospheric heat transport into the Arctic normalized by the global mean warming ($\Delta AHT/\Delta T^G$) across models. The SSP126, SSP245 and SSP585 warming scenarios are considered and show in symbols. The results of SSPs of each model is connected by a line.

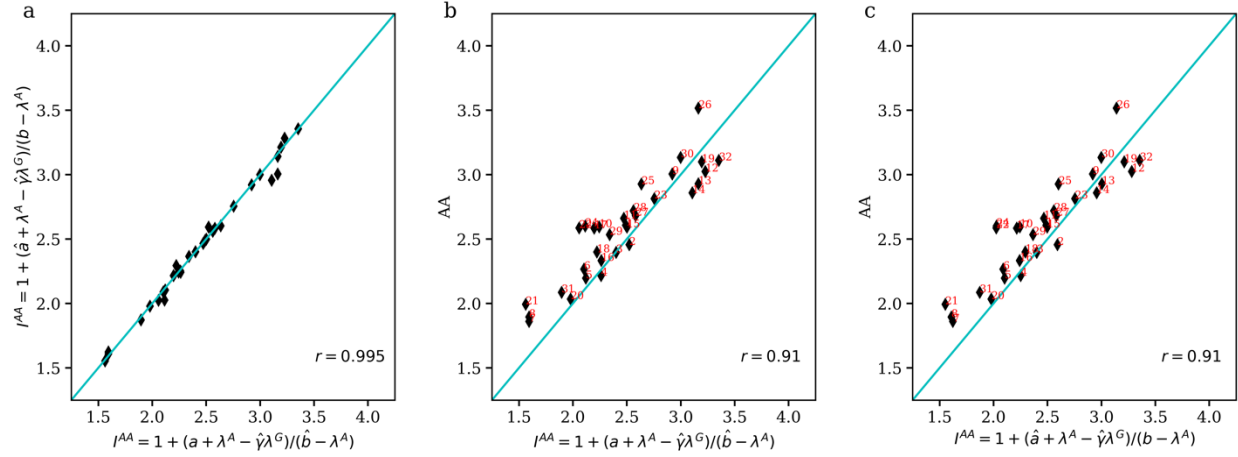


Figure S5: a, Scatterplot between the theoretical estimates with the difference between the model-projected $\frac{\Delta_{AHT}^A}{\Delta_{TG}}$ and the prior guess $\frac{\Delta_{AHT}^A}{\Delta_{TG}} = \hat{a} - \hat{b}(AA - 1)$ attributed all to a ($I^{AA} = 1 + \frac{a + \lambda^A - \hat{\gamma}\lambda^G}{\hat{b} - \lambda^A}$; x axis) or b ($I^{AA} = 1 + \frac{\hat{a} + \lambda^A - \hat{\gamma}\lambda^G}{b - \lambda^A}$; y axis). b, Scatterplot between the model-projected AA and $I^{AA} = 1 + \frac{a + \lambda^A - \hat{\gamma}\lambda^G}{\hat{b} - \lambda^A}$. c, Scatterplot between the model-projected AA and $I^{AA} = 1 + \frac{\hat{a} + \lambda^A - \hat{\gamma}\lambda^G}{b - \lambda^A}$.

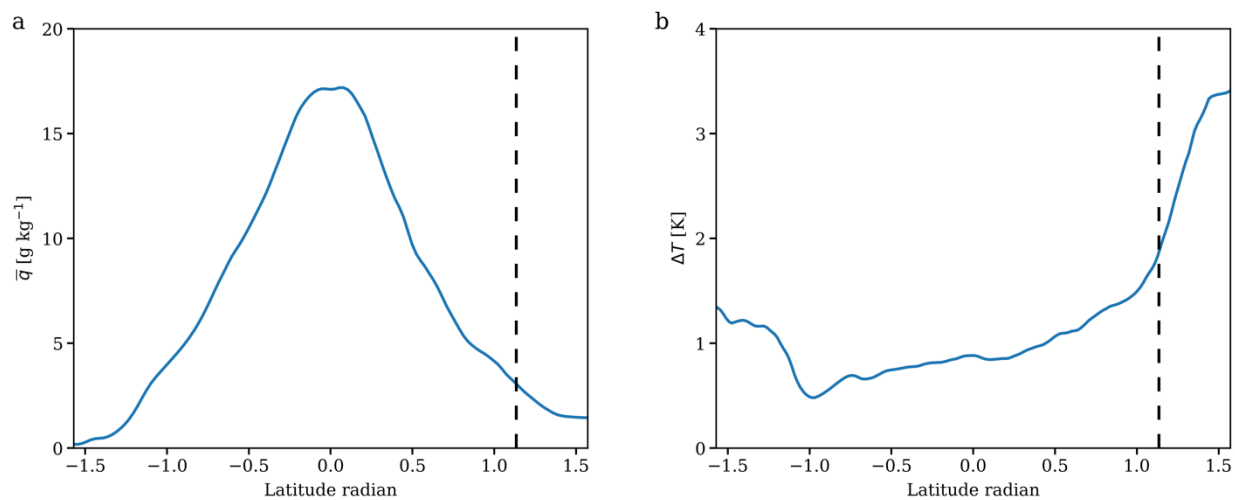


Figure S6: a, Zonal-mean annual-mean of the climatological surface (2m) specific humidity as a function of latitude radian. b, Zonal-mean annual-mean of surface warming as a function of latitude radian under SSP2-4.5. The latitude of 65°N is denoted by the dashed line.