# Supplementary Figures

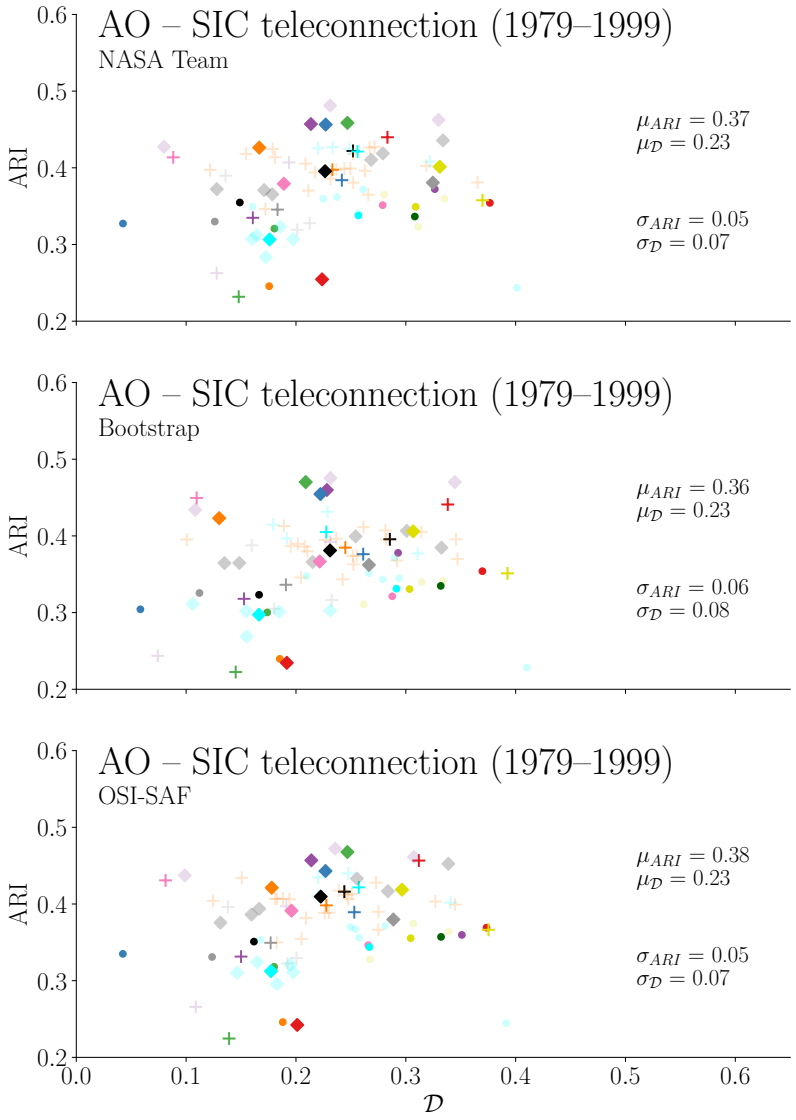


**Figure S1.** ARI and $\mathcal{D}$ metrics for comparing observation and CMIP6 model summer sea ice concentration networks and the winter AO to summer sea ice teleconnection between 1979–1999, for every ensemble member for 31 different CMIP6 models (74 realisations). ARI and $\mathcal{D}$ are computed relative to (top) NASA Team, (middle) Bootstrap, and (bottom) OSI-SAF observational networks. $\mathcal{D}$ values are computed from observation and model 'link maps' as shown in Fig. 10. The symbols and colours of each point are consistent with Fig. 4.

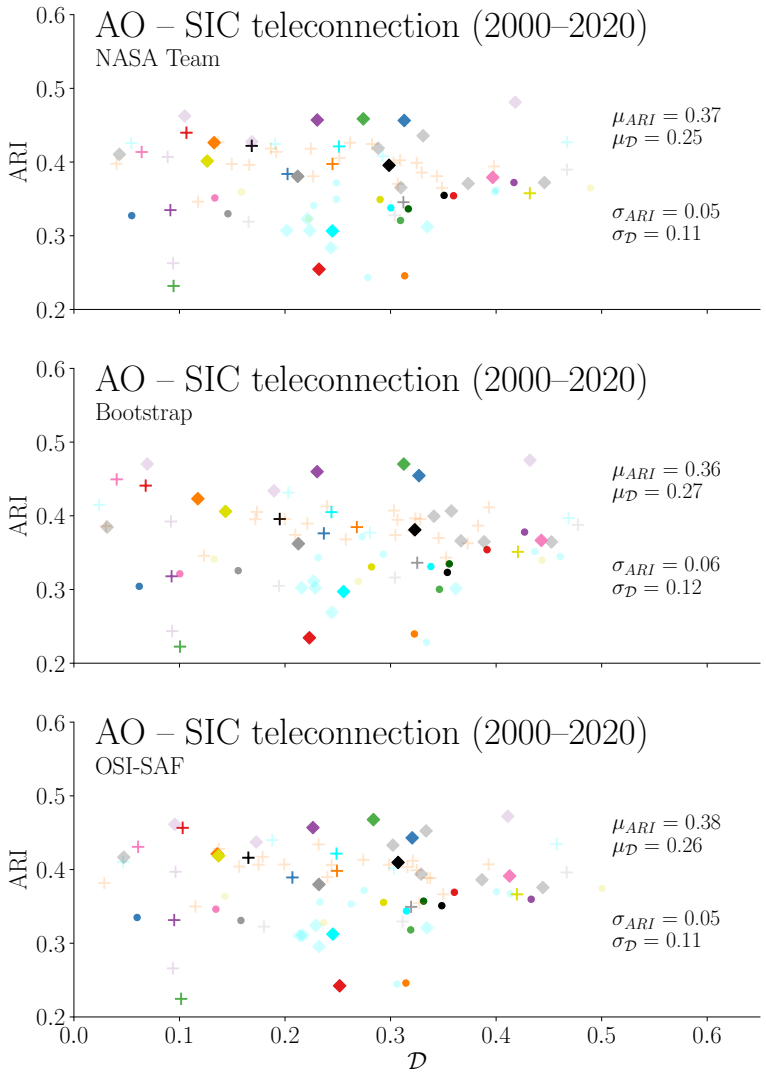


**Figure S2.** ARI and $\mathcal{D}$ metrics for comparing observation and CMIP6 model summer sea ice concentration networks and the winter AO to summer sea ice teleconnection between 2000–2020, for every ensemble member for 31 different CMIP6 models (74 realisations). ARI and $\mathcal{D}$ are computed relative to (top) NASA Team, (middle) Bootstrap, and (bottom) OSI-SAF observational networks. $\mathcal{D}$ values are computed from observation and model 'link maps' as shown in Fig. 10. The symbols and colours of each point are consistent with Fig. 4.

# Supplementary Tables

| Model | RMSE Laptev | RMSE East Siberia | RMSE Beaufort | Total RMSE |
|---|---|---|---|---|
| ACCESS-CM2 (r1i1p1f1) | 1.55 | 1.59 | 1.12 | 4.26 |
| ACCESS-ESM1-5 (r1i1p1f1) | 0.92 | 0.92 | 0.76 | 2.59 |
| CESM2-WACCM (r1i1p1f1) | 1.49 | 1.41 | 1.14 | 4.04 |
| CESM2-WACCM (r2i1p1f1) | 1.47 | 1.55 | 1.23 | 4.25 |
| CESM2-WACCM (r3i1p1f1) | 1.44 | 1.44 | 1.19 | 4.06 |
| CESM2 (r4i1p1f1) | 1.18 | 0.94 | 0.89 | 3.01 |
| **CMCC-CM2-SR5 (r1i1p1f1)** | **0.84** | **0.66** | **0.54** | **2.04** |
| **CMCC-ESM2 (r1i1p1f1)** | **0.93** | **0.74** | **0.58** | **2.26** |
| **CNRM-CM6-1 (r1i1p1f2)** | **0.38** | **0.62** | **0.78** | **1.78** |
| **CNRM-CM6-1 (r2i1p1f2)** | **0.32** | **0.55** | **0.81** | **1.67** |
| **CNRM-CM6-1 (r3i1p1f2)** | **0.37** | **0.60** | **0.80** | **1.77** |
| **CNRM-CM6-1 (r4i1p1f2)** | **0.33** | **0.61** | **0.76** | **1.70** |
| **CNRM-CM6-1 (r5i1p1f2)** | **0.37** | **0.64** | **0.80** | **1.81** |
| **CNRM-CM6-1 (r6i1p1f2)** | **0.30** | **0.56** | **0.76** | **1.62** |
| **CNRM-ESM2-1 (r1i1p1f2)** | **0.34** | **0.64** | **0.87** | **1.85** |
| CanESM5 (r1i1p2f1) | 0.68 | 0.79 | 1.04 | 2.51 |
| EC-Earth3-Veg (r1i1pf1) | 2.98 | 2.81 | 2.37 | 8.16 |
| EC-Earth3-Veg (r4i1p1f1) | 3.20 | 3.08 | 2.71 | 8.99 |
| EC-Earth3 (r1i1p1f1) | 3.26 | 3.00 | 2.84 | 9.11 |
| **GFDL-CM4 (r1i1p1f1)** | **0.32** | **0.46** | **0.49** | **1.27** |
| **GFDL-ESM4 (r1i1p1f1)** | **0.32** | **0.49** | **0.46** | **1.27** |
| HadGEM3-GC31-LL (r1i1p1f3) | 1.57 | 1.69 | 1.56 | 4.82 |
| HadGEM3-GC31-LL (r3i1p1f3) | 1.50 | 1.55 | 1.46 | 4.50 |
| HadGEM3-GC31-LL (r4i1p1f3) | 1.61 | 1.71 | 1.57 | 4.89 |
| HadGEM-GC31-MM (r1i1p1f3) | 1.29 | 1.53 | 1.6 | 4.42 |
| HadGEM-GC31-MM (r2i1p1f3) | 1.33 | 1.47 | 1.57 | 4.37 |
| HadGEM-GC31-MM (r3i1p1f3) | 1.38 | 1.63 | 1.59 | 4.61 |
| HadGEM-GC31-MM (r4i1p1f3) | 1.28 | 1.49 | 1.63 | 4.41 |
| IPSL-CM6A-LR (r14i1p1f1) | 1.20 | 1.05 | 1.21 | 3.46 |
| IPSL-CM6A-LR (r1i1p1f1) | 1.10 | 1.03 | 1.05 | 3.18 |
| IPSL-CM6A-LR (r2i1p1f1) | 1.16 | 0.97 | 1.07 | 3.19 |

| | | | | |
|---|---|---|---|---|
| IPSL-CM6A-LR (r3i1p1f1) | 1.16 | 1.05 | 1.02 | 3.23 |
| IPSL-CM6A-LR (r4i1p1f1) | 1.15 | 0.91 | 1.19 | 3.24 |
| IPSL-CM6A-LR (r6i1p1f1) | 1.19 | 0.94 | 1.16 | 3.29 |
| MIROC-ES2L (r1i1p1f1) | 3.18 | 3.28 | 3.53 | 9.99 |
| MIROC6 (r1i1p1f1) | 1.10 | 1.11 | 1.34 | 3.55 |
| MIROC6 (r2i1p1f1) | 1.21 | 1.20 | 1.28 | 3.69 |
| MIROC6 (r3i1p1f1) | 1.04 | 1.02 | 1.21 | 3.28 |
| **MPI-ESM1-2-HR (r1i1p1f1)** | **0.62** | **0.59** | **0.43** | **1.63** |
| **MPI-ESM1-2-LR (r1i1p1f1)** | **0.72** | **0.61** | **0.55** | **1.89** |
| **MRI-ESM2-0 (r1i1p1f1)** | **0.87** | **0.75** | **0.80** | **2.31** |
| **NESM3 (r1i1p1f1)** | **0.24** | **0.30** | **0.61** | **1.16** |
| NorESM2-LM (r1i1p1f1) | 1.49 | 1.60 | 1.60 | 4.69 |
| NorESM2-MM (r1i1p1f1) | 1.57 | 2.07 | 2.27 | 5.91 |
| UKESM1-0-LL (r1i1p1f2) | 1.92 | 2.66 | 2.65 | 7.23 |
| UKESM1-0-LL (r2i1p1f2) | 2.29 | 2.84 | 2.74 | 7.87 |
| UKESM1-0-LL (r3i1p1f2) | 2.20 | 2.88 | 2.78 | 7.86 |
| UKESM1-0-LL (r4i1p1f2) | 1.87 | 2.47 | 2.33 | 6.67 |
| UKESM1-0-LL (r8i1p1f2) | 2.14 | 2.74 | 2.76 | 7.63 |

**Table S1.** Root Mean Square Error (RMSE) in regional mean summer (JJAS) sea ice thickness between 1979–2020 relative to PIOMAS, for 49 CMIP6 model ensemble. Bold entries are the 15 ensembles with the lowest total RMSE.