Supplemental Material

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Assessing the Quality of Southern Ocean Circulation in CMIP5 AOGCM and Earth System Model Simulations
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Assessing the quality of Southern Ocean circulation in CMIP5 AOGCM and Earth System Model simulations.

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SUPPLEMENTAL MATERIAL

Model	Annual S.I.E. million km^{-2}	Maximum S.I.E. million km^2	Minimum S.I.E. million km^2	Max - Min million km^2
Observations	11.62 ± 0.26	18.42 ± 0.34	3.09 ± 0.35	15.33 ± 0.52
BSOSE	11.85	18.74	2.46	16.28
HadCM3	***10.70***	**20.41**	***2.20***	**18.21**
GISS-E2-R-CC	***5.10***	***10.02***	***0.20***	***9.82***
GISS-E2-H-CC	***7.69***	***14.09***	***0.58***	***13.51***
ACCESS1.3	11.51	***17.67***	**4.75**	***12.92***
HadGEM2-CC	***7.05***	***13.14***	***1.00***	***12.14***
HadGEM2-ES	***7.60***	***13.97***	***1.18***	***12.79***
MIROC-ESM-CHEM	11.09	**19.85**	***1.88***	**17.97**
MIROC-ESM	***10.27***	18.71	***1.58***	**17.13**
BCC-CSM1.1(m)	***9.34***	***16.02***	***0.44***	15.58
CCSM4	**14.85**	**20.24**	**5.83**	14.41
BCC-CSM1.1	***10.84***	18.28	***1.22***	**17.06**
GFDL-CM3	***4.37***	***9.00***	***0.18***	***8.61***
CanESM2	***10.63***	**19.57**	***2.29***	**17.28**
FGOALS-g2	**13.37**	**20.20**	**5.475**	14.73
CESM1-CAM5	***11.04***	***16.74***	2.92	***13.82***
ACCESS1.0	***9.50***	***17.49***	***1.53***	15.97
GFDL-CM2.1	***5.74***	***11.48***	***0.06***	***11.42***
CNRM-CM5-2	***8.32***	***15.29***	***1.59***	***13.70***
FGOALS-s2	**13.04**	**19.87**	**5.81**	***14.06***
ESM2M	***4.71***	***9.465***	***0.05***	***9.41***
NorESM1-M	***10.52***	***16.34***	3.76	***12.58***
NorESM1-ME	**13.96**	**19.82**	**5.52**	14.31
ESM2G	***5.91***	***11.53***	***0.25***	***11.28***
MRI-CGCM3	**12.29**	**19.68**	3.09	**16.59**
MRI-ESM1	12.00	**19.72**	2.77	**16.95**
CSIROMk3.6.0	11.61	***17.08***	**5.36**	***11.72***
IPSL-CM5A-MR	***6.15***	***14.34***	***0.30***	***14.04***
BNU-ESM	**16.99**	**26.56**	**4.64**	**21.92**
IPSL-CM5A-LR	***7.24***	***15.83***	***0.71***	15.12
IPSL-CM5B-LR	***2.61***	***6.55***	***0.13***	***6.42***
CNRM-CM5	***6.52***	***15.83***	***0.03***	15.81

TABLE S1. Parameters related to the representation of Antarctic Sea Ice Extent (S.I.E) for the models considered in this study. The observed S.I.E metrics and their associated uncertainty (1σ) reported in the paper are from the monthly average (January 1986 – December 2005) sea ice extent data set (https://nsidc.org/data/g02135) from the National Snow and Ice Data Center Sea Ice Index (http://nsidc.org/data/seaice_index). All CMIP5 values are time-averaged data from January 1986 to December 2005. BSOSE values are computed from the time-averaged data from January 2008 to December 2012 for the BSOSE Iteration 105 solution. In all calculations of S.I.E., only grid cells which had a sea ice concentration greater than 15% were included. Mean values that are 2σ above the mean of the observational metric are in bold and values which lie 2σ below are bold and italicized.

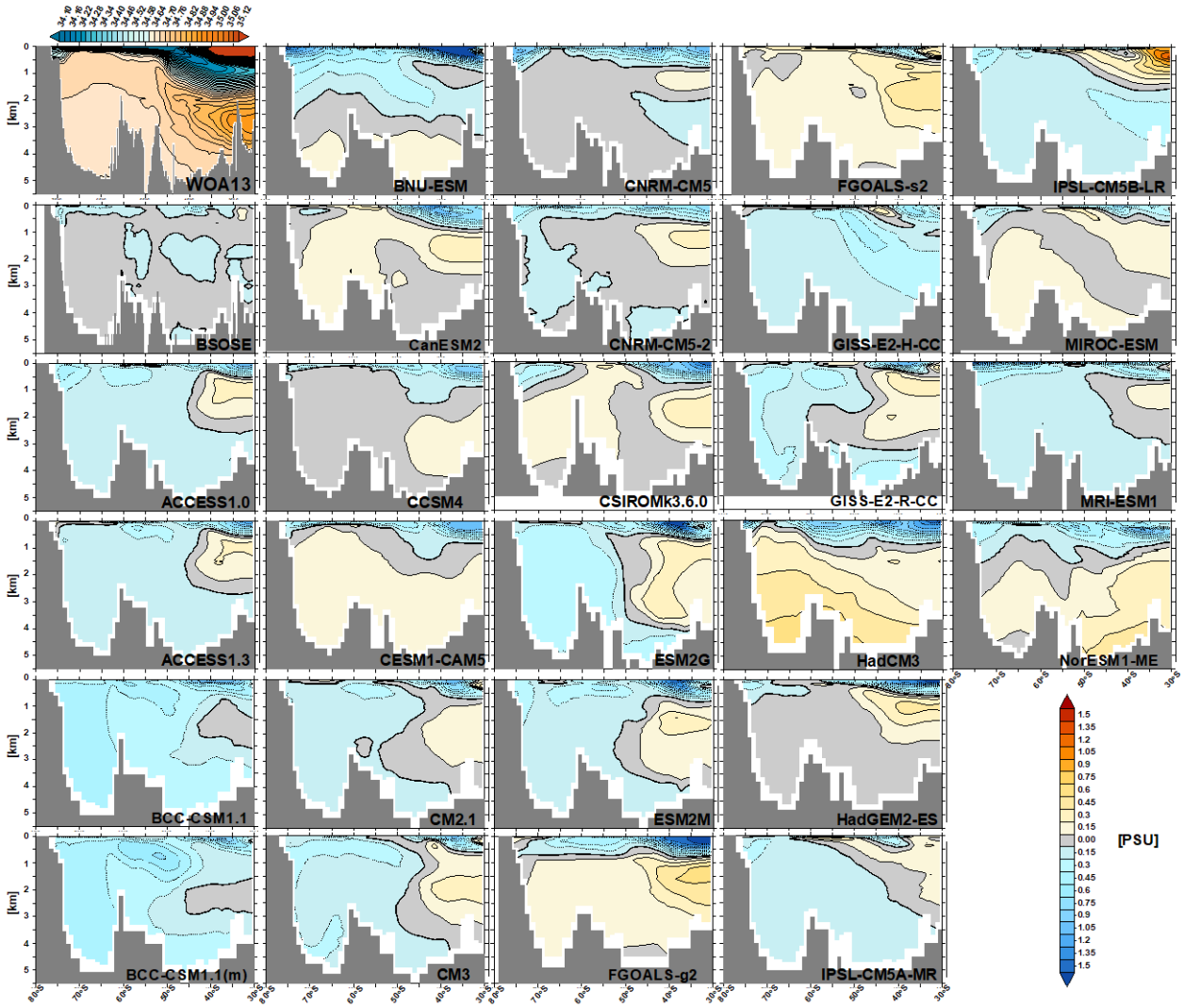

FIGURE S1a. Differences from the World Ocean Atlas 2013 (WOA13) version 2 (top left) climatological mean salinity (1985 to 2004) along 30°W in the Atlantic for the time-averaged data (January 2008 to December 2012) for the BSOSE Iteration 105 solution, and for the time-averaged data from the last twenty years of the historical simulation (January 1986 to December 2005) for all CMIP5 models. Positive (red) values indicate the model is more saline than observed. Negative (blue) values indicate the model is fresher than observed.

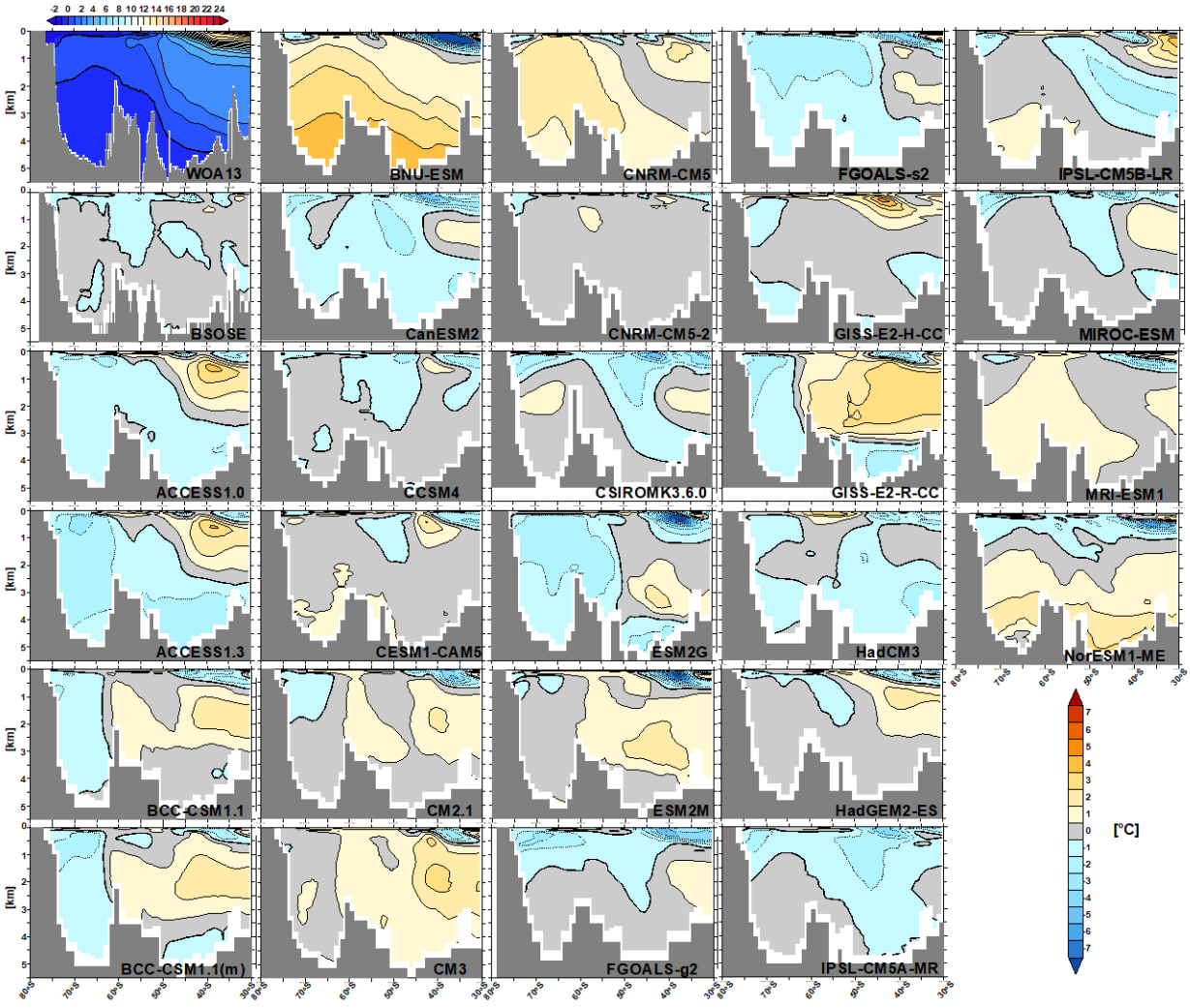

FIGURE S1b. Differences from the World Ocean Atlas 2013 (WOA13) version 2 (top left*)* climatological mean potential temperature (°C) (1985 to 2004) along 30°W in the Atlantic for the time-averaged data (January 2008 to December 2012) for the BSOSE Iteration 105 solution, and for the time-averaged data from the last twenty years of the historical simulation (January 1986 to December 2005) for all CMIP5 models. Positive (red) values indicate the model is warmer than observed. Negative (blue) values indicate the model is colder than observed.