Annex III: Models

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This annex provides information on the numerical models used in this assessment.

AIII.1 Regional Climate Models (RCMs) participating in CORDEX

The Coordinated Regional Climate Downscaling Experiment (CORDEX, (Gutowski et al., 2016)) coordinates regional downscaling experiments worldwide over a number of domains, which are defined as regions for which the regional downscaling is taking place (note that regional downscaling is performed over limited geographical domains, driven at the boundaries by global model simulations). Table AIII.1: lists the details of the current CORDEX domains illustrating the different resolutions (from the lowest 0.44º, to the highest 0.11º) with data available at the Earth System Grid Federation (ESGF), for any of the following experiments: "evaluation" (ERA-Interim driven simulations), and CMIP5-era experiments "historical", "rcp26", "rcp45", "rcp85" (Taylor et al., 2012). Note that 0.44º is the prioritized resolution and only some domains provide information for higher resolutions. The Regional Climate Models (RCMs) contributing to CORDEX (as available from ESGF) are listed in Table AIII.2: Table AIII.3: shows the different CMIP5 models used as boundary conditions for the CORDEX domains (the numbers in each cell indicate the available simulations –RCM runs– for each scenario).

[START TABLE AIII.1 HERE]

Table AIII.1: CORDEX regional domains

CORDEX domains. Column 1: name, Column2: code (as in ESGF specification); Column3: horizontal grid resolutions. Interpolated domains not considered. (a) MED-CORDEX data is stored in a dedicated server (details at http://www.medcordex.eu).

Domain	Code	Resolution (deg)
Region 1: South America	SAM	0.44
Region 2: Central America	CAM	0.44
Region 3: North America	NAM	0.11, 0.22, 0.44
Region 4: Africa	AFR	0.44
Region 5: Europe	EURO	0.11, 0.22, 0.44
Region 6: South Asia	WAS	0.44
Region 7: East Asia	EAS	0.44
Region 8: Central Asia	CAS	0.44
Region 9: Australasia	AUS	0.44
Region 10: Antarctica	ANT	0.44
Region 11: Arctic	ARC	0.44
Region 12: Mediterranean	MED	(a)
Region 13: Middle East North Africa	MENA	0.22, 0.44
Region 14: South-East Asia	SEA	0.22

[END TABLE AIII.1 HERE]

[START TABLE AIII.2 HERE]

Table AIII.2: Regional Climate Models (RCMs) participating in CORDEX

Regional Climate Models (RCMs) participating in CORDEX. Column 1: sponsoring institution(s); Column2: names of models; Column3: model versions and/or different configurations of the same model (e.g. model parameterizations). (*) Indicate community models.

Institution	**Model**	**Versions (if several)**
	ALADIN	52, 53, 63
	ALARO-0	
	CCAM	
	CCLM(*)	4-8-17, 5-0-2, 5-0-6
	CRCM	5, 5-SN
	Eta	Eta
	HadGEM3-RA	
	HadRM3P	
	HIRHAM5	
	MAR36	
	RACMO	21P, 22E, 22T
	RCA	4, 4-SN
	RegCM4	1, 2, 3, 4
	REMO	2009, 2015
	RRCM	
	WRF(*)	331F, 331G, 341E, 341I, 361H, 360J, 360K, 360L, 381P

[END TABLE AIII.2 HERE]

[START TABLE AIII.3 HERE]

Table AIII.3: CMIP5 models used for downscaling in the different CORDEX domains

Climate models participating in CMIP5 (rows) used as boundary conditions for the CORDEX regional simulations in the different domains (columns). Each cell indicates the number of simulations available for |historical|rcp45|rcp85|rcp26| experiments. Salient features of these models are described in IPCC-AR5 Appendix 9.A (model names are taken from table 9.A.1).

<table>
<tr><th></th><th>AFR-44</th><th>ANT-44</th><th>ARC-44</th><th>AUS-44</th><th>CAM-44</th><th>EAS-44</th><th>EUR-11</th><th>EUR-44</th><th>MNA-22</th><th>MNA-44</th><th>NAM-44</th><th>SAM-44</th><th>SEA-22</th><th>WAS-44</th></tr>
<tr><td>ACCESS1-0-r1i1p1</td><td></td><td></td><td></td><td>|3|-|-|-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ACCESS1-3-r1i1p1</td><td></td><td></td><td></td><td>|3|-|-|-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CanESM2-r0i0p0</td><td>|1|1|1|-</td><td></td><td>|1|1|1|-</td><td></td><td>|1|-|1|-</td><td></td><td></td><td>|1|2|1|-</td><td></td><td></td><td>|1|1|1|-</td><td>|1|1|1|-</td><td></td><td>|1|1|1|-</td></tr>
<tr><td>CanESM2-r1i1p1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>|1|1|1|-</td><td></td><td></td><td></td></tr>
<tr><td>CNRM-CM5-r0i0p0</td><td>|2|2|2|-</td><td></td><td></td><td></td><td>|1|-|1|-</td><td></td><td>|2|2|2|-</td><td>|2|1|2|-</td><td></td><td>|1|1|1|-</td><td></td><td></td><td></td><td>|1|1|1|-</td></tr>
<tr><td>CNRM-CM5-r1i1p1</td><td></td><td></td><td></td><td></td><td></td><td>|1|1|1|-</td><td>|4|1|3|1</td><td>|2|1|1|-</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CSIRO-Mk3-6-0-r0i0p0</td><td>|1|1|1|-</td><td></td><td></td><td></td><td>|1|-|1|-</td><td></td><td></td><td>|1|1|1|-</td><td></td><td></td><td></td><td>|1|1|1|-</td><td></td><td>|1|1|1|-</td></tr>
<tr><td>EC-EARTH-r0i0p0</td><td>|3|3|3|2</td><td></td><td>|2|1|2|1</td><td></td><td>|1|1|1|1</td><td></td><td>|3|2|3|3</td><td>|2|1|2|1</td><td>|1|-|1|-</td><td>|1|1|1|1</td><td>|1|1|1|1</td><td>|1|1|1|1</td><td></td><td>|1|1|1|1</td></tr>
<tr><td>EC-EARTH-r1i1p1</td><td>|1|1|1|-</td><td>|1|1|1|-</td><td></td><td></td><td></td><td></td><td>|2|1|2|-</td><td>|1|1|1|-</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>EC-EARTH-r3i1p1</td><td>|1|1|1|-</td><td>|1|1|1|-</td><td>|1|1|1|-</td><td></td><td></td><td>|1|1|1|-</td><td>|2|1|2|-</td><td>|1|1|1|-</td><td></td><td></td><td>|1|1|1|-</td><td></td><td></td><td></td></tr>
<tr><td>EC-EARTH-r12i1p1</td><td>|1|-|-|1</td><td>|1|-|-|1</td><td></td><td>|1|1|1|-</td><td></td><td>|1|1|1|-</td><td>|2|1|2|1</td><td>|1|-|-|1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>GFDL-ESM2G-r0i0p0</td><td>|1|-|-|1</td><td></td><td></td><td></td><td></td><td></td><td>|1|-|-|1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>GFDL-ESM2M-r0i0p0</td><td>|1|1|1|-</td><td></td><td></td><td></td><td>|1|-|1|-</td><td></td><td></td><td>|1|1|1|-</td><td>|1|-|1|-</td><td>|1|1|1|-</td><td></td><td>|1|1|1|-</td><td></td><td>|1|1|1|-</td></tr>
<tr><td>HadGEM2-ES-r0i0p0</td><td>|3|2|3|2</td><td></td><td></td><td></td><td>|1|1|1|1</td><td></td><td>|2|2|2|2</td><td>|2|1|2|1</td><td></td><td></td><td></td><td>|1|1|1|1</td><td>|1|1|1|-</td><td>|1|1|1|1</td></tr>
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<tr><td>HadGEM2-ES-r1i1p1</td><td>|1|1|1|1</td><td>|1|1|1|1</td><td></td><td></td><td></td><td>|1|1|1|-</td><td>|2|1|2|1</td><td>|1|1|1|1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>IPSL-CM5A-LR-r0i0p0</td><td>|1|-|1|1</td><td></td><td></td><td></td><td></td><td></td><td>|1|-|-|1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>IPSL-CM5A-MR-r0i0p0</td><td>|1|1|1|-</td><td></td><td></td><td></td><td>|1|-|1|</td><td></td><td>|2|2|2|-</td><td>|2|2|2|-</td><td></td><td></td><td></td><td>|1|1|1|-</td><td></td><td>|1|1|1|-</td></tr>
<tr><td>MIROC5-r0i0p0</td><td>|2|1|2|2</td><td></td><td></td><td></td><td>|1|-|1|1</td><td></td><td>|-|-|-|2</td><td>|2|1|2|1</td><td></td><td></td><td></td><td>|1|1|1|1</td><td></td><td>|1|1|1|1</td></tr>
<tr><td>MPI-ESM-LR-r0i0p0</td><td>|3|3|3|2</td><td></td><td>|2|1|2|-</td><td></td><td>|1|1|1|1</td><td></td><td>|3|3|4|2</td><td>|4|3|4|2</td><td></td><td></td><td></td><td>|2|2|2|2</td><td></td><td>|1|1|1|1</td></tr>
<tr><td>MPI-ESM-LR-r1i1p1</td><td></td><td></td><td>|-|-|1|-</td><td>|1|1|1|-</td><td></td><td>|1|1|1|-</td><td></td><td></td><td></td><td></td><td>|1|1|-|-</td><td></td><td></td><td>|1|1|1|1</td></tr>
<tr><td>NorESM1-M-r0i0p0</td><td>|1|1|1|1</td><td></td><td>|1|1|1|-</td><td></td><td>|1|-|1|1</td><td></td><td>|2|-|2|1</td><td>|1|1|1|1</td><td></td><td></td><td></td><td>|1|1|1|1</td><td></td><td>|1|1|1|1</td></tr>
<tr><td>NorESM1-M-r1i1p1</td><td>|1|1|1|-</td><td></td><td></td><td></td><td></td><td></td><td>|1|1|1|-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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[END TABLE AIII.3 HERE]

AIII.2 Models participating in CMIP6

Detailed and structured information about climate models, simulations and their conformance to common experimental protocols is not only important for scientific interpretation but, under increased scrutiny from society, it is also demanded of climate science that purports to be mature, credible, open, transparent and reproducible (Guilyardi et al., 2013). Scientific publications remain an essential way of documenting models, but remain largely scattered and not easily accessible by the growing community of users of model output. To address these challenges, the Earth System Documentation (ES-DOC) project offers an eco-system of tools and services in support of Earth System modelling documentation creation, analysis and dissemination. ES-DOC is coordinated with other community efforts such as CMIP and ESGF via the World Climate Research Programme work group on Climate Modelling (WGCM) and its Infrastructure Panel WIP (Balaji et al., 2018).

ES-DOC is documenting all aspects of CMIP6. Building on the Common Information Model concepts and standards (Lawrence et al. 2012), a number of documents are created for the CMIP6 Project, as illustrated on https://es-doc.org/cmip6/. These include documents to describe experiments, ensembles simulations, models, conformance to the numerical requirements of the CMIP6 protocol (see (Eyring et al., 2016) and (Pascoe et al., 2019) (revised) for CMIP6 experiments) and other important aspects of the CMIP6 model data. These different documents are either produced automatically or provided in a standard way by modelling groups. Hundreds of clearly structured properties are harvested and stored on a database to be used by clients and portals (e.g. https://search.es-doc.org/ and https://explore.es-doc.org/). Another entry point to the database is provided by the one-stop-shop "further_info_url" global attribute in each CMIP6 netcdf data file. ES-DOC also includes the CMIP6 errata system, which tracks issues with the model data and the potential corrections made. [Note: at the time of the SOD writing, some aspects of CMIP6 documentation are still in development or test and some groups are still providing the documentation for their models and simulations].

It is expected that a "frozen" version of ES-DOC will be designed for AR6 and will contain a full documentation of the models used in this report. Table 8 is a summary of the main features of these models.

[START TABLE AIII.4 HERE]

Table AIII.4: Models participating in CMIP6 Deck and ScenarioMIP

Salient features of the General Circulation Models (GCMs) and Earth System Models (ESMs) participating in CMIP6. Column 1: sponsoring institution(s), Column2: names of model configurations; Column3: main reference(s); subsequent columns for each of the model components, with names and main component reference(s). In addition, there are standard entries for the atmosphere component: horizontal grid resolution, number of vertical levels, grid top; and for the ocean component: horizontal grid resolution, number of vertical levels, vertical coordinate type. A blank entry indicates that information was not available.

institution **full name** **country**	**Models**	**Main references**	**Atmosphere** **Component name nominal horizontal resolution** **number of levels** **Top** **references**	**Aerosol** **1) component name** **2) interactive or prescribed** **3) references**	**Atmospheric Chemistry** **1) component name** **2) references**	**Ocean** **1) component name** **2) nominal horizontal resolutions** **3) vertical grid** **4) number of levels** **5) references**	**Sea Ice** **1) component name** **2) reference**	**Land Ice** **1) component name** **2) reference**	**Land surface** **1) component name** **2) reference**	**land interactive vegetation**	**ocean interactive biogeochemis try**
AS-RCEC Research Center for Environmental Changes, Academia Sinica, **Taiwan**	**TaiESM1.0**		TaiAM1 (0.9x1.25 degree; 288 x 192 30 levels; top level ~2 hPa)	SNAP	SNAP	1) POP2 2) 320x384 3) z 4) 60 levels;	CICE4	none	CLM4.0		**none**
AWI Alfred Wegener Institute, **Germany**	**AWI-CM-1-1-LR** **AWI-CM-1-1-MR** **AWI-CM-1-1-HR** **AWI-ESM-1-1-LR** **AWI-ESM-2-1-LR**	(Sidorenko et al., 2015)	ECHAM6.3.04p1 **HR &MR**: T127, 95 levels; top level 80 km **LR:** T63, 47 levels; top level 80 km	none	none	1) FESOM1.4 2) HR &MR: 25km LR : 50km 3) z 4) 47 levels	FESOM1.4	none	JSBACH 3.20	none	none

BCC Beijing Climate Center, **China**	**BCC-CSM2-HR** **BCC-CSM2-MR** **BCC-ESM1**	**BCC-CSM:** (Wu et al., 2019) **BCC-ESM**: (Wu et al., 2019)	AGCM3 **HR**: T266, 56 levels; top level 0.1 hPa **MR**: T106, 46 levels; top level 1.46 hPa **ESM1**: T42; 26 levels; top level 2.19 hPa	**CSM2: prescribed** MACv2-SP **ESM1: interactive** (Bulk aerosols model)	CSM2: none ESM1: BCC-AGCM3-Chem	**CSM2-MR and ESM1:** 1) MOM4 2) 50km average 3) z 4) 40 levels **CSM2-HR:** 1) MOM5 2) 25km average 3) z 4) 50 levels	**CSM2-MR and ESM1**: SIS1 **CSM2-HR**: SIS2	none	BCC_AVIM2 (Li et al., 2019)	none
BNU Beijing Normal University **China**	**BNU-ESM-1-1**	(Ji et al., 2014)	CAM4 (2deg; 144 x 96; 26 levels; top level 2.194 mb)	CAM-chem; semi-interactive	none	1) MOM4 2) 1° 3) z 4) 50 levels	CICE4.1	none	ColM	Dynamic ecosystem-carbon model version 1
CAMS Chinese Academy of Meteorological Sciences **China**	**CAMS-CSM1-0**		ECHAM5_CAMS (T106; 320 x 160; 31 levels; top level 10 mb)	none	none	1) MOM4 2) 1° 3) z 4) 50 levels	SIS1.0	none	CoLM 1.0	none
CAS Chinese Academy of Sciences **China**	**CAS-ESM1-0**		IAP AGCM4.1 (Finite difference 256 x 128; 30 levels; top level 2.2 hPa)	IAP AACM	IAP AACM	1) LICOM2.0 2) 1deg; 362 x 196 longitude/latitude; 3) z 4) 30 levels	CICE4	none	ColM	IAP OBGCM

CAS	**FGOALS-f3-H** **FGOALS-f3-L** **FGOALS-g3**	**FGOALS-g3**	**Fgoals-f3 :** FAMIL2.2 H: c384; L: c96 32 levels; top level 2.16 hPa (He et al., 2019) **FGOALS-g3** GAMIL3 (180 x 80 longitude/latitude; 26 levels; top level 2.19hPa	None/prescribed MACv2-SP	none	LICOM3.0, 2) Fgoalsf3-H: 0.1°; Fgoals-F3-L & g3: 1deg; 360 x 218 longitude/latitude; 3) z 4) 30 levels	CICE4.0	none	CLM4.0 / CAS-LSM (Xie et al., 2018)		none
CCCMa Canadian Centre for Climate Modelling and Analysis **Canada**	**CanESM5** **CanESM5-CanOE**	(Swart et al., 2019)	CanAM5 (T63L49 native atmosphere, T63 Linear Gaussian Grid; 128 x 64; 49 levels; top level 1 hPa)	2) interactive 3) (von Salzen et al., 2013)	2) specified oxidants for aerosols 3) (von Salzen et al., 2013)	NEMO3.4.1 2) ORCA1° 361 x 290 3) z 4) 45 vertical levels	LIM2	none	CLASS3.6/CTEM1.2		CanESM5: CMOC CanESM5-CanOE: CanOE
CCCR-IITM Centre for Climate Change Research, Indian Institute of Tropical Meteorology, **India**	**IITM-ESM**		IITM-GFSv1 (T62L64, Linearly Reduced Gaussian Grid; 192 x 94; 64 levels; top level 0.2 mb)	prescribed MAC-v2	none	MOM4p1 (tripolar, primarily 1deg; 360 x 200 longitude/latitude; 3) z 4) 50 levels	SISv1.0	none	NOAH LSMv2.7.1		TOPAZv2.0
CMCC Centro Euro-Mediterraneo sui Cambiamenti Climatici **Italy**	**CMCC-CM2-HR4** **CMCC-CM2-VHR4** (VHR4 only for highresmip)	(Cherchi et al., 2019)	HR4: CAM4 1deg; VHR4: CAM4 1/4°, 26 levels; top at ~2 hPa)	prescribed MACv2-SP	none	NEMO3.6 2) ORCA0.25 1/4° 1442 x 1051; ° 3) z 4) 50 levels	CICE4.0	none	CLM4.5 SP mode	none	none

CMCC	**CMCC-CM2-SR5** **CMCC-ESM2**	(Cherchi et al., 2019)	CAM5.3 (1deg; 288 x 192; 30 levels; top at ~2 hPa)	MAM3	none	NEMO3.6 2) ORCA 1° 3) z 4) 50 levels	CICE4.0	none	CLM4.5 BGC model	CLM4.5 BGC model	ESM2: BFM5.1 CM2: none
CNRM Centre National de Recherches Meteorologiques, **and CERFACS** Centre Europeen de Recherche et de Formation Avancee en Calcul Scientifique **France**	**CNRM-CM6.1** **CNRM-CM6.1-HR** **CNRM-ESM2-1** **CNRM-ESM2-1-HR**	(Voldoire et al., 2019)	Arpege 6.3; T127: 150km ; **for HR**: T359 50km 91 levels, top 78.4km	TACTIC_v2 interactive, (prescribed for CNRM-CM6.1-HR)	1) OZL_V2 (CNRM-CM6); REPROBUS-C-V2 (CNRM-ESM2)	1) NEMO3.6 2) 100 km (e-ORCA1) and **HR**: 25 km (e-ORCA025) 3) z coordinate 4) 75 levels	1) gelato 6.1	none	Surfex 8.0c		1) Pisces 2.s for CNRM-ESM2
CSIRO Commonwealth Scientific and Industrial Research Organisation **Australia**	**ACCESS-ESM1-5**	(Ziehn et al., submitted)(	**ESM1-5:** HadGAM2 (r1.1, N96; 192 x 145 longitude/latitude; 38 levels; top level 39255 m	CLASSIC (v1.0)	none	ACCESS-OM2 GFDL-MOM5 2) 1deg; 360 x 300 longitude/latitude 3) z 4) 50 levels	CICE4.1	none	CABLE2.4		Wombat1.0
CSIRO-ARCCSS Commonwealth Scientific and Industrial Research Organisation **Australia** Australian Research Council Centre of Excellence for	**ACCESS-CM2**	(Bi et al., submitted)	HadGEM3-GA7.1 (N96; 85 levels; top level 85 km	UKCA-GLOMAP-mode	none	ACCESS-OM2 GFDL-MOM5 2) 1deg; 360 x 300 longitude/latitude 3) z 4) 50 levels	CICE5.1.2 (Ridley et al., 2018)	none	CABLE2.5		none

Climate System Science **Australia**											
CSIR-CSIRO Council for Scientific and Industrial Research - Natural Resources and the Environment, **South Africa,** Commonwealth Scientific and Industrial Research Organisation and Bureau of Meteorology, **Australia**	**VRESM-1-0**		**VCAM-1.0** (C192; 192 x 192 x 6; 35 levels; top level 35km)	Rotstayn-1.0		VCOM-1.0 C192- 25km 384 x 384 x 6; 3) z 4) 35 levels	CSIR-ICE (visco-plastic)		CABLE v2.2.3		PISCES v3.4socco
E3SM National laboratories consortium **U.S.A**	**E3SM 1.0** **E3SM-1-1** **E3SM-1-1-ECA**	(Golaz et al., 2019)	E3M v1.0 C90 72 levels; top level 0.1 hPa (Rasch et al.)	MAM4 with resuspension, marine organics, and secondary organics	Troposphere specified oxidants for aerosols. Stratosphere linearized interactive ozone (LINOZ v2)	MPAS-Ocean v6.0 2) resolution 60 km to 30 km; 3) z 4) 60 levels (Petersen et al., 2019)	MPAS-Seaice v6.0	none	ES3M 1.0: ELM v1.0	ES3M1.1: ELM v1.1, active soil carbon chemistry	none
EC-Earth consortium **Europe**	**EC-Earth3** **EC-Earth3-HR** **EC-Earth3-LR** **Options:** **AerChem,**		**IFS cy36r4** **EC-Earth3** TL255, 512 x 256 91 levels; top level 0.01 hPa) **EC-Earth3-HR** T511 91 levels; top level 0.01 hPa	Stratospheric aerosols prescribed Tropospheric Aerosols **EC-Earth3-AerChem** TM5	**EC-Earth3-AerChem** TM5	**NEMO3.6** 2) **EC-Earth3 & LR** ORCA1 1° **EC-Earth3-HR** ORCA025 1/4°	LIM3	none ; PISM v1 for EC-Earth3-GrIS	HTESSEL	none; LPJ-GUESS v4 for EC-Earth3-Veg	none; PISCES v2 for EC-Earth3-CC

	Van Noije et al., EC-Earth3-AerChem, a global climate model with interactive aerosols and atmospheric chemistry participating in CMIP6, in preparation. **Veg,** **CC,** **Grls**		**EC-Earth3-LR** TL159, 320 x 160 62 levels; top level 5 hPa	Interactive 3x2 degrees (lon x lat), 34 levels (van Noije et al., 2014); **Other configurations** Prescribed : MACv2-SP and TM5 pre-industrial climatology	Interactive 3x2 degrees (lon x lat), 34 levels (van Noije et al., 2014); **Other configurations** none	3) z 4) 75 levels					
FIO-QNLM First Institute of Oceanography , Ministry of Natural Resources and Pilot National Laboratory for Marine Science and Technology (Qingdao), **China**	**FIO-ESM-2-0**	(Song et al., 2019) (in Chinese)	CAM5 (0.9x1.25 finite volume grid; 192 x 288 longitude/latitude; 30 levels; top level ~2 hPa) Neale eta al, 2012	2)prescribed 3) (Stevens et al., 2017)	none	POP2-W with MASNUM surface wave model, 320 x 384 3) z 4) 61 levels for sea temperature, and 60 levels for all other variables; 5) (Qiao et al., 2013)	1) CICE4.0 2) (Hunke and Lipscomp, 2008)	none	1)CLM4.0 2)(Lawrence et al., 2011)	CLM4CN	BEC
HAMMOZ-Consortium **Switzerland, Germany, UK, Finland**	**MPI-ESM-1-2-HAM**	(Neubauer et al., 2019)	ECHAM6.3 T63; 192 x 96 47 levels; top level 0.01 hPa	HAM2.3 Interactive (Tegen et al., 2019)	Sulfur chemistry	MPIOM 1.63 2) GR1.5, 1.5deg; 256 x 220 3) z 4) 40 levels	(Notz et al., 2013)	none	JSBACH3.20	JSBACH3.20	HAMOCC6
INM Institute for Numerical Mathematics **Russia**	**INM-CM4-8** **INM-CM5-0** **INM-CM5-H**	INM-CM4-8: (Volodin Evgenii M et al., 2018) INM-CM5-0:	2°x1.5°; 180 x 120; CM4, INM-AM4-8 : 21 levels; top level sigma = 0.01	INM-AER1 interactive (Volodin and Kostrykin, 2016)	none	INM-OM5 2) 1°, 360 x 318; 3) sigma coordinate 4) 40 levels	INM-ICE1 (Yakovlev, 2009)	none	INM-LND1	none?	none

		(Volodin et al., 2017)	CM5, INM-AM5.0: 73 levels; top level sigma = 0.0002			(Zalesny et al., 2010)				
INPE National Institute for Space ResearchNational Institute for Space Research **Brazil**	**BESM-2-7**		BAM (v1.0, T062L28; 192 x 96 longitude/latitude; 28 levels; top level 3 hPa	none	none	MOM-5 2) 1°, 360 x 300 3) z 4) 50 levels	SIS1.0	none	SSIB 2.0	TOPAZ2.0
IPSL Institut Pierre-Simon Laplace **France**	**IPSL-CM6A-LR** **IPSL-CM6A-ATM-HR**	(Boucher et al., submitted)	LMDZ (NPv6, N96; 144 x 143 longitude/latitude; 79 levels; top level 40000 m (Hourdin et al., submitted)	none	none	NEMO 3.6 2) eORCA1.3, 1deg; 362 x 332 3) z 4) 75 levels;	NEMO-LIM3	none	ORCHIDEE (v2.0, Water/Carbon/ Energy mode)	PISCES
KIOST Korea Institute of Ocean Science & Technology **Korea**	**KIOST-ESM**		GFDL-AM2.0 (cubed sphere (C48); 192 x 96 longitude/latitude; 32 vertical levels; top level 2 hPa	Simple carbon aerosol model (emission type)	none	GFDL-MOM5.0 (tripolar - nominal 1.0 deg; 360 x 200 longitude/latitude; 52 levels	GFDL-SIS		NCAR-CLM4	TOPAZ2
MIROC **consortium** JAMSTEC, AORI, NIES, R-CCS **Japan**	**MIROC-ES2L** **MIROC-ES2H** **MIROC6** **NICAM16-7S** **NICAM16-8S** **NICAM16-9S**	ES2L:(Hajima et al., submitted), ES2H: (Hajima et al., submitted) MIROC6:(Tatebe et al., 2019) NICAM16-7S, -8S, -9S: (Kodama et al., submitted)	CCSR AGCM **ES2L**: T42; 128 x 64 ;40 levels; top level 3 hPa **ES2H & MIROC6:** T85; 256 x 128; 81 levels; top level 0.004 hPa **NICAM16-7S:** glevel-7 (56 km); 38 levels; top level 40 km **NICAM16-8S:** glevel-8 (28 km); 38	SPRINTARS **NICAM16-7S, -8S, -9S:** Prescribed & MACv2-SP	ES2H: CHASER Others:none	COCO4.9 2) 1deg; 360 x 256; 3) z 4) 63 levels	COCO4.9	none	MATSIRO6.0 plus visit-e ver 1.0 for ES2L & ES2H	OECO v2.0

			levels; top level 40 km **NICAM16-9S:** glevel-9 (14 km); 38 levels; top level 40 km								
MOHC Met Office Hadley Centre **U.K.**	**HADGEM3-GC31** **versions: LL,LM,MH,MM,HH,HM** **UK-ESM1.0-MMh** **UK-ESM1.0-LL**	(Williams et al., 2018) (Kuhlbrodt et al., 2018) (Sellar et al.)	MetUM-HadGEM3-GA7.1 **LL & LM**: N96; 192 x 144 **MH &MM**: N216; 432 x 324 **HH & HM** : N512; 1024 x 768 85 levels; top level 85 km	UK-GLOMAP	none; UKCA-StratTrop for UK-ESM1.0 Archibald GMD in revision	NEMO-HadGEM3-GO6.0 2) **LL** : eORCA1 **LM, MM & HM**: eORCA025 1/4° **MH, HH**: eORCA12 1/12° 3) z 4) 75 levels	CICE HadGEM3-GSI8 (Ridley et al., 2018)	none	JULES-HadGEM3-GL7.1		none; MEDUSA2 for UK-ESM
MPI-M Max Planck Institute for Meteorology **Germany**	**MPI-ESM1-2-LR** **MPI-ESM1-2-HR** **MPI-ESM1-2-XR** **MPI-ESM_HAM**	**MPI-ESM** (Mauritsen et al., 2019) **MPI-ESM1-2-HR** (Müller et al., 2018)	**ECHAM6.3** **LR:** T63; 192 x 96 47 levels; top level 0.01 hPa **HR:** spectral T127; 384 x 192; 95 levels; top level 0.01 hPa **XR:** T255; 768 x 384 95 levels; top level 0.01 hPa	prescribed MACv2-SP	**MPI-ESM-HAM** (Neubauer et al., 2019; Tegen et al., 2019)	**MPIOM 1.63** **2) LR:** GR1.5, 1.5deg; 256 x 220 **HR & XR**: TP04, 0.4deg; 802 x 404 3) z 4) 40 levels	(Notz et al., 2013)	none	JSBACH3.20		HAMOCC6
MPI-M	**ICON-ESM-LR**		ICON-A (icosahedral/triangles; 160 km; 47 levels; top level 80 km			ICON-O (icosahedral/triangles; 40 km; 40 levels;	(Notz et al., 2013)		JSBACH3.20		HAMOCC6
MRI Meteorological Research Institute **Japan**	**MRI-AGCM3-2-H** **MRI-AGCM3-2-S** **MRI-ESM-2.0**	**MRI-ESM-2.0** (YUKIMOTO et al., 2019)	**MRI-AGCM3.5** (TL159; 320 x 160 longitude/latitude; 80 levels; top level 0.01 hPa)	1) **MASINGAR mk-2r4c** 2) interactive	1) **MRI-CCM2.1** 2) (Deushi and Shibata, 2011)	**1) MRI.COM4.4** 2) 1° 360 x 364 3) z 4) 61 levels	**1) MRI.COM4.4** 2) (Tsujino et al., 2017)	none	1) HAL 1.0 2) (YUKIMOTO et al., 2012)	MRI-LCCM2 (Obata and Shibata, 2012; Obata	MRI.COM4.4 (Nakano et al., 2015)

		MRI-AGCM3-2 (Mizuta et al., 2012)	**MRI-AGCM3-2-H** (TL319; 640 x 320, 64 levels; top level 0.01 hPa) **MRI-AGCM3-2-S** (TL959; 1920 x 960, 64 levels; top level 0.01 hPa)	3) (Tanaka et al., 2003; YUKIMOTO et al., 2019)		5) (Tsujino et al., 2017)				and Adachi, 2019)	
NASA-GISS Goddard Institute for Space Studies **U.S.A.**	**GISS-E2-1-G** **GISS-E2-1-H** **GISS-E2.1-G-CC**	(Kelley et al., submitted)	**GISS-E2.1** (2.5x2 degree; 144 x 90 longitude/latitude; 40 levels; top level 0.1 hPa)	Varies with physics-version (p==1 none, p==3 OMA, p==4 TOMAS, p==5 MATRIX)	Varies with physics-version (p==1 Non-interactive, p>1 GPUCCINI)	**GISS-E2-1-G : GISS ocean** 1°, 40 levels **GISS-E2-1-H** **HYCOM** 1°, hybrid coordinate, 32 levels	**GISS-SI**	none	**GISS-LSM**		**NOBM** (in GISS-E2-1-G-CC only)
NASA-GISS	**GISS-E2-2-G**	(Rind et al., submitted)	**GISS-E2-2-G:** 2.5x2°, 102 levels; top level 0.002 hPa	Varies with physics-version (p==1 none, p==3 OMA, p==4 TOMAS, p==5 MATRIX)	Varies with physics-version (p==1 Non-interactive, p>1 GPUCCINI)	**GISS-E2-2-G : GISS ocean** 1°, 40 levels	**GISS-SI**	none	**GISS-LSM**		
NASA-GISS	**GISS-E3-G**		**GISS-E3** Cubed sphere, C90;; 102 levels; top level 0.002 hPa)	Varies with physics-version (p==1 none, p==3 OMA, p==4 TOMAS, p==5 MATRIX)	Varies with physics-version (p==1 Non-interactive, p>1 GPUCCINI)	**GISS ocean** 1°, 40 levels	**GISS-SI**		**GISS-LSM**		
NCAR National Center for Atmospheric Research **U.S.A.**	**CESM2** **CESM2-FV2** **CESM2-SE** **CESM1-1-CAM5-CMIP6** **CESM1-WACCM-SC** **CESM2-WACCM**	(Danabasoglu et al., submitted)	**CESM2:** 0.9° (lat) x1.25° (lon) 288 x 192; 32 levels; top level 2.25 hPa **CESM2-FV2**: 1.9° (lat) x2.5° (lon) 144 x 96; 32 levels; top level 2.25 hPa **CESM2-SE**: 0.25° 777602 cells; 30	**CESM2 Variants:** MAM4 (Liu et al., 2016) **CESM1 Variants:** MAM3 (Liu et al., 2012)	**CESM2 Variants:** MAM4 (Liu et al., 2016) **CESM1 Variants:** MAM3 (Liu et al., 2012)	**All Variants:** POP2 ; nominal 1° w/ equatorial meridional reolution of 0.27°; 320 (lon) x 384 (lat); 60 vertical (z) levels)	**CESM2 Variants :** CICE5.1, (Hunke et al., 2015) **CESM1 Variants :** CICE4, (Hunke and Lipscomp, 2008)	**CESM2 Variants:** CISM2.1, (Lipscomb et al., 2019) **CESM1 Variants :** none	**CESM2 Variants :** CLM5, (Lawrence et al.)**CESM1 Variants :** CLM4, (Lawrence et al., 2011)	**none**	**CESM2 Variants :** MARBL, Moore et. al, 2013 **CESM1 Variants:** BEC (Moore et al., 2013)

	CESM2-WACCM-FV2	levels; top level 2.25 hPa **CESM1-1-CAM5-CMIP6:** 0.9° (lat) x1.25° (lon) 288 x 192; 32 levels; top level 2.25 hPa **CESM1-WACCM-SC:** 1.9° (lat) x2.5° (lon) 144 x 96; 66 levels; top level $6x10^{-6}$hPa **CESM2-WACCM**: 0.9° (lat) x1.25° (lon) 288 x 192; 70 levels; top level $6x10^{-6}$hPa **CESM2-WACCM-FV2**: 1.9° (lat) x2.5° (lon) 144 x 96; 70 levels; top level $6x10^{-6}$hPa							
NCC NorESM Climate Modelling Consortium **Norway**	**NorESM2-LM** **NorESM2-MM** **NorCPM1**	**CAM6-Nor** **NorESM2-LM:** 2°; 144 x 96; 32 levels; top 3 mb **NorESM2-MM:** 1°; 288 x 192; 32 levels; top 3 mb **NorCPM1:** 2°;; 144 x 96; 26 levels; top 3 mb	**NorESM2** : CAM6-Nor-Aero **NorCPM1** : OsloAero4.1	**NorESM2** : CAM6-Nor-Aero **NorCPM1**: OsloChemSimp4.1	**NorESM2:** 1) BLOM 2) 1° 360 x 384; 3) isopycnal; 4) 53 levels; **NorCPM1 :** 1) MICOM1.1 2) 1° 320 x 384 4) 53 levels	**NorESM2**: CICE5.1 (ocean grid) **NorCPM1** : CICE4	none	**NorESM2**: CLM5 (atmospheric grid) **NorCPM1** : CLM4	**NORESM2** : iHAMOCC **NorCPM1** : HAMOCC5.1

NIMS-KMA National Institute of Meteorological Sciences, Korea Meteorological Administration**, Korea**	**KACE-1-0-G**	(Lee et al., 2019)	**MetUM-HadGEM3-GA7.1** (N96; 192 x 144 longitude/latitude; 85 levels; top level 85 km)	UKCA-GLOMAP-mode		**MOM4p1** 1deg; 360 x 200; 50 levels	CICE-HadGEM3-GSI8	none	JULES-HadGEM3-GL7.1		none
NOAA-GFDL National Oceanic and Atmospheric Administration, Geophysical Fluid Dynamics Laboratory **U.S.A.**	**GFDL-CM4** **GFDL-CM4C192**	(Held et al., 2019)	**GFDL-AM4.0.1 CM4:** C96) - 1 °; 360 x 180 **CM4C192**: C192- 05°, 720 x 360 33 levels; top level 1 hPa (Zhao et al., 2018a) (Zhao et al., 2018b)	GFDL-AM4.0.1; interactive	GFDL-AM4.0.1; fast chemistry, aerosol only	**GFDL-OM4p25 (GFDL-MOM6);** 0.25 degree, 1440 x 1080; hybrid; 75 levels; (Adcroft et al., 2019)	GFDL-SIM4p25 (GFDL-SIS2.0); (Adcroft et al., 2019)	GFDL-LM4.0.1	GFDL-LM4.0.1 (Zhao et al., 2018a, 2018b)	GFDL-LM4.0.1	GFDL-Bling
NOAA-GFDL	**GFDL-ESM4**	(Dunne et al., submitted)	**GFDL-AM4.1;** 1 degree, 360 x 180; 49 levels; top level 1 Pa	GFDL-AM4.0.1; interactive	GFDL-ATMCHEM4.1; full chemistry	**GFDL-OM4p5 (GFDL-MOM6);** 0.5 degree, 720 x 576; hybrid; 75 levels; (Adcroft et al., 2019)	GFDL-SIM4p5 (GFDL-SIS2.0); (Adcroft et al., 2019)	GFDL-LM4.1	GFDL-LM4.1	GFDL-LM4.1	GFDL-COBALTv2
NOAA-GFDL	**GFDL-ESM2M**	(Dunne et al., 2012)	**GFDL-AM2;** 250 km, 144 x 90; 24 levels; top level 1 hPa	GFDL-AM2; prescribed	GFDL-AM2; prescribed	**GFDL-MOM4p1** (tripolar - nominal 1 deg; 360 x 200 longitude/latitude; 50 levels;	GFDL-SIM2 (GFDL-SIS2)	GFDL-LM3.0	GFDL-LM3.0	GFDL-LM3.0	GFDL-TOPAZ2 (Dunne et al., 2013)
NUIST Nanjing University of Information Science and Technology **China**	**NESM3**	(Cao et al., 2018)	**ECHAM v6.3** (T63; 192 x 96 longitude/latitude; 47 levels; top level 1 Pa)	none	none	**NEMO v3.4** 1deg; 384 x 362 longitude/latitude46 levels	CICE 4.1	none	JSBACH v3.1	none	none
SNU Seoul National University	**SAM-UNICON**	(Park et al., 2019)	**CAM5.3 with** UNICON	MAM3 (Liu et al., 2012)	none	**POP2** 2) 320 x 384	CICE4.0	none	CLM 4.0	none	none

Korea			(1deg; 288 x 192 30 levels; top level ~2 hPa			3) z 4) 60 levels					
THU Department of Earth System Science **China**	**CIESM**		**CIESM-AM** (FV/FD; 288 x 192 longitude/latitude; 30 levels; top level 2.255 hPa)	MAM4	none	**CIESM-OM** 2) 0.5° 720 x 560; 3) z 4) 46 levels	CICE4	none	CIESM-LM (modified CLM4.5)	none	none
University of Arizona **(U.S.A.)**	**MCM-UA-1-0**	(Delworth et al., 2002)	**Manabe R30L14** 3.75°x 2.5° , 96 x 80; 14 levels; top level 0.015 sigma, 15 mb	none	none	**MOM1.0** 2) 1.875°x 2.5°, 192 x 80; 3) z 4) 18 levels	thermodynamic simplified sea ice	none	Manabe bucket scheme (Manabe, 1969)	none	none
University of Toronto **Canada**	**UofT-CCSM4** (CCSM4 with nonstandard ocean parameters)		**CAM4** (finite-volume dynamical core; 288 x 192 longitude/latitude; 26 levels; top level ~2 hPa)	none	none	**POP2** 2) 384 x 320 3) z 4) 60 levels	CICE4	none	CLM4	none	none

[END TABLE AIII.4 HERE]

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