ACCESS-CM2 Development

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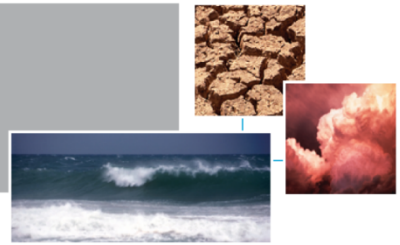
ACCESS-CM2 Development Plan



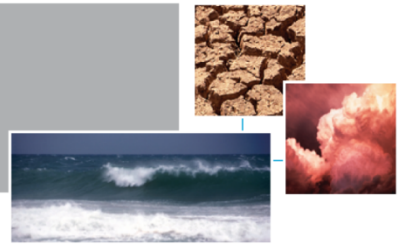
Features:

- Comprises all new component codes within the ACCESS1.4 framework. i.e.,
  - Atmosphere: UM10.x GA7
  - Land: Jules/CABLE2
  - Ocean: MOM5
  - Sea ice: CICE5 (or GIS8)
  - Coupler: OASIS3-MCT

Goals:

- Principal contribution of Australia to CMIP6/IPCC AR6.
- To be used for climate change and climate variability research/applications by the Australian Climate Community including BoM, Universities.

Prototype ACCESS-CM2



- UM8.5/GA6 atmosphere
- Jules land surface model
- Three versions – different horizontal resolution

Resolution	Atmosphere	Ocean	Trial Simulation completed	Computing
Standard "N96O1"	N96 (~130 km)	1 deg.	200 years	496 cores, 5 y/d
Mixed "N96O.25"	N96	0.25 deg.	350 years	2112 cores, 6 y/d
High "N216O.25"	N216 (~60 km)	0.25 deg.	2 years	2688 cores, 1.5 y/d

- Strong collaboration with ARCCSS in ¼-deg oceans.
- NCI machine raijin "unstable" (frequent false "crashes")

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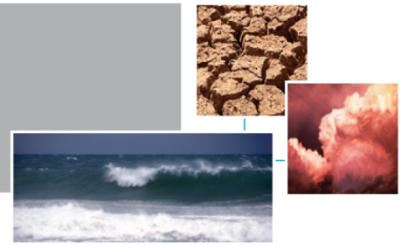
Prototype version tests (PI forcing)

- So far all (long) tests have been conducted using the prototype CM2 which comprises UM8.5/GA6. Major tests (with mixed-resolutions) include:

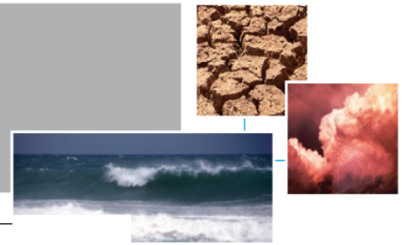
Config-Res.	UM8.5	MOM5/CICE5	Job Status	Comp-Efficiency	Note
N96O1	N96	1-deg (PT)	200 years	496 cores, 5 y/d	unreproducible
N96O1(r)	N96	1-deg (PT)	200 years	496 cores, 5 y/d	reproducible
N96OQ	N96	¼-deg (PT)	200 years	2112 cores, 5.6 y/d	unreproducible
N96OQn	N96	¼-deg (PT)	86 years	2112 cores, 5.6 y/d	nphy ON (aredi=300) unreproducible
N216O1	N216	1-deg (PT)	56 years	1376 cores, 2.5 y/d	UM fails
N216OQ	N216	¼-deg (PT)	2 years	2688 cores, 1.5 y/d	UM fails
N96OQct	**N96**	**¼-deg (CT)**	**> 350 years**	**2112 cores >5 y/d**	**standard PI control**
N96OQn	**N96**	**¼-deg (CT)**	**100 years**	**2112 cores**	**nphy on (aredi=100)**
N96OQgm	**N96**	**¼-deg (CT)**	**30 years**	**2112 cores**	**GM on (50-600)**
N96OQngm	**N96**	**¼-deg (CT)**	**>180 years**	**2112 cores**	**nphy & GM both on**

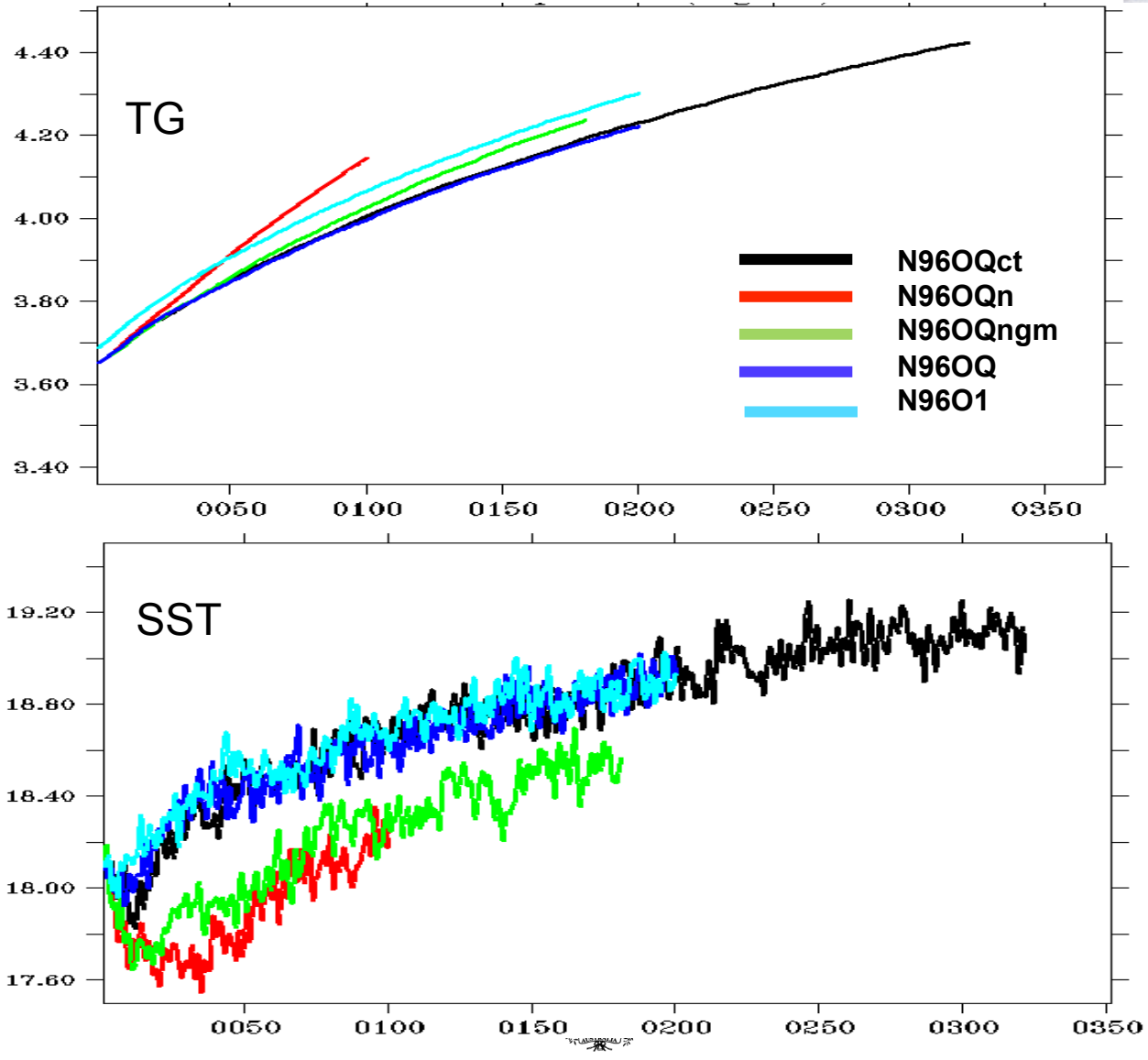
Some simulated ocean features



- Global ocean water temperature and global average annual mean SST
- SST bias (relative to PI condition)
- Ocean water transports: MOC and ACC
- ENSO and IOD Variabilities
- Sea ice

Thermal “drifts” in the ocean interior (TG) and at the surface (SST)





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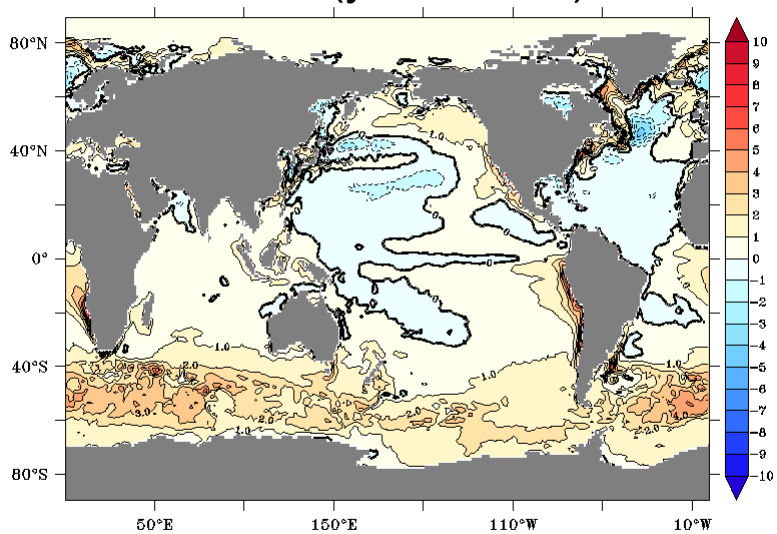
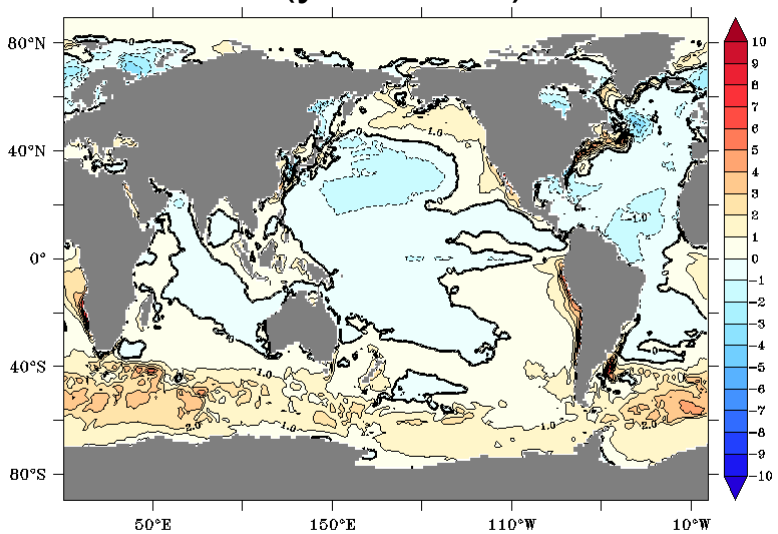
SST biases

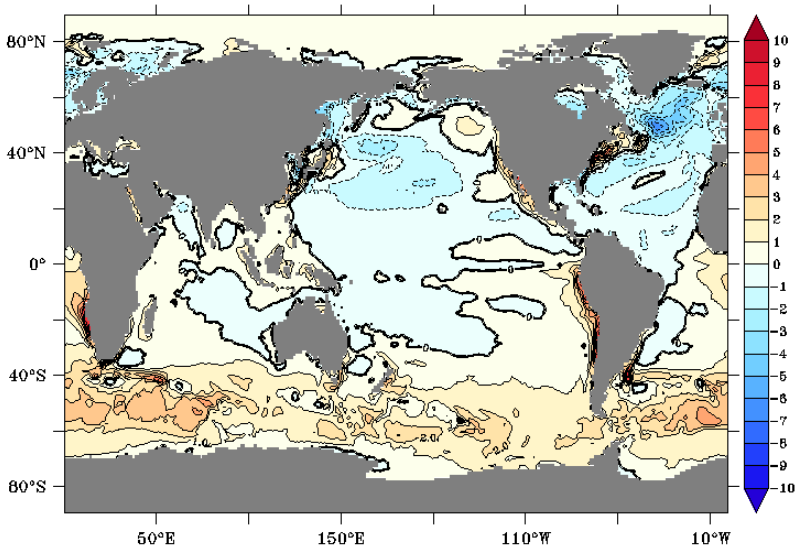
N96OQct (yrs 91-100)



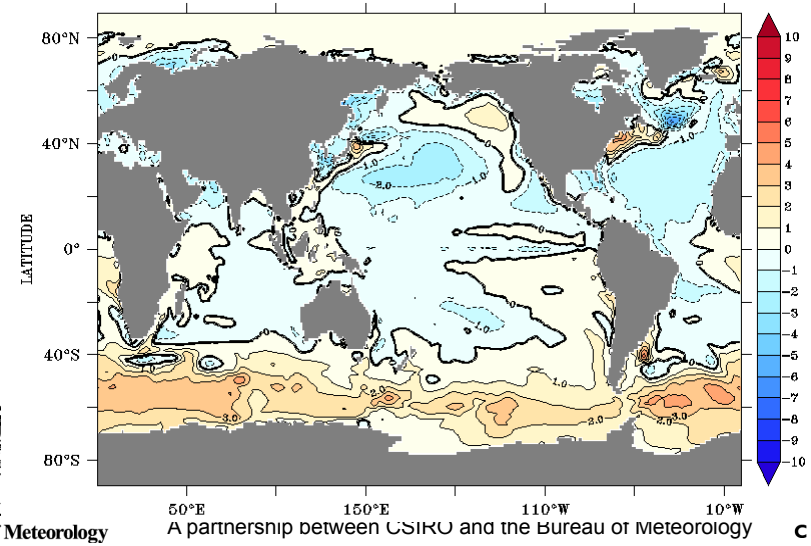
N96OQn (yrs91-100)



N96OQngm (yrs 91-100)



N216O1 (yrs 46-55)



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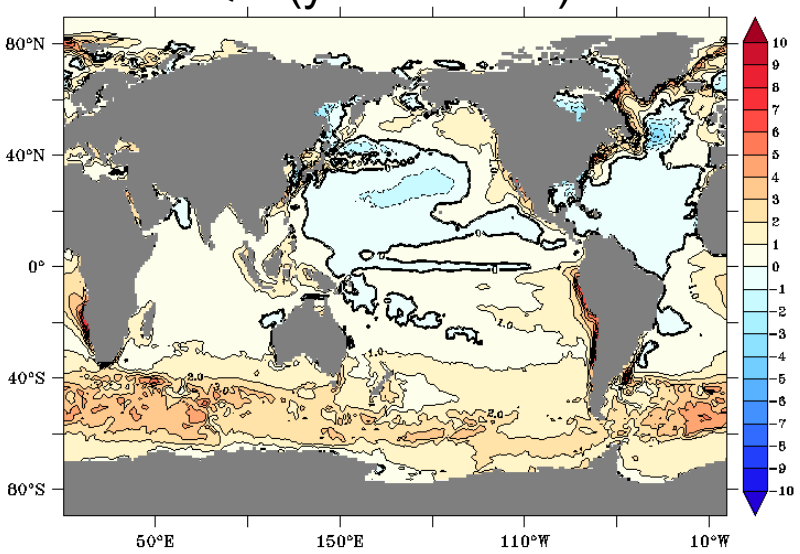
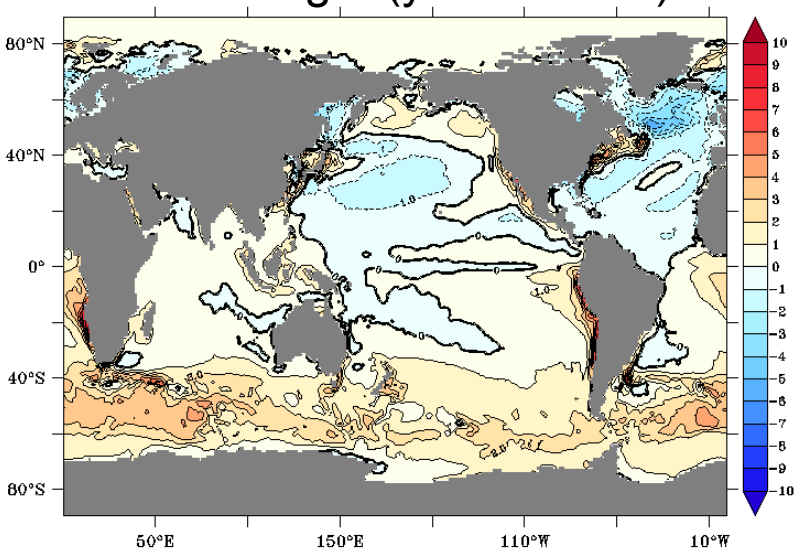
SST biases (continue)

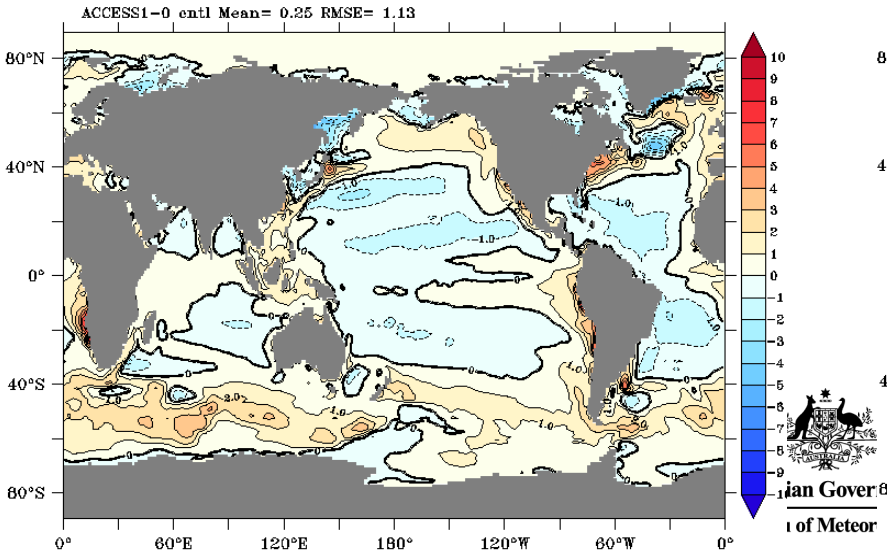
N96Qct (yrs 171-180)



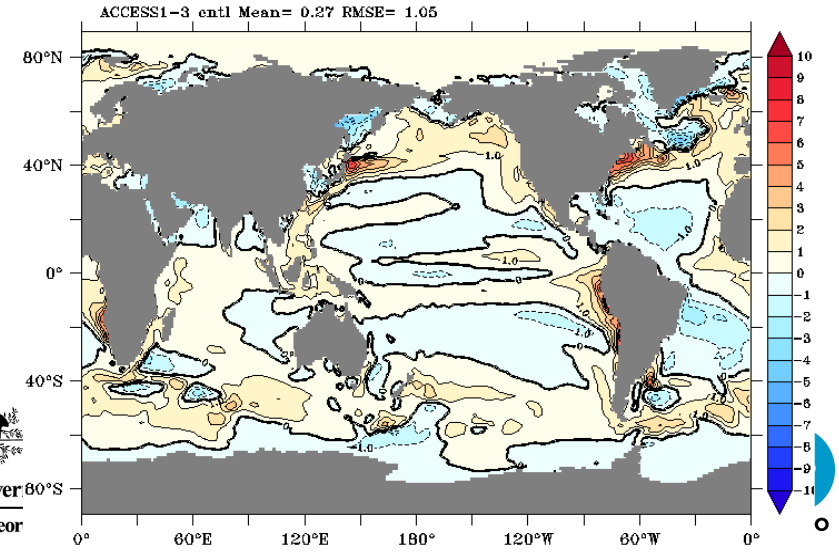
N96Qngm (yrs 171-180)



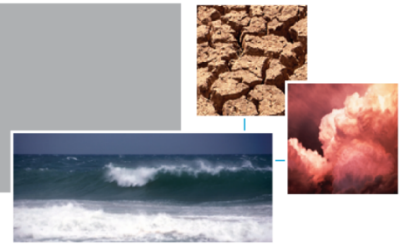
ACCESS1.0 (PI control)

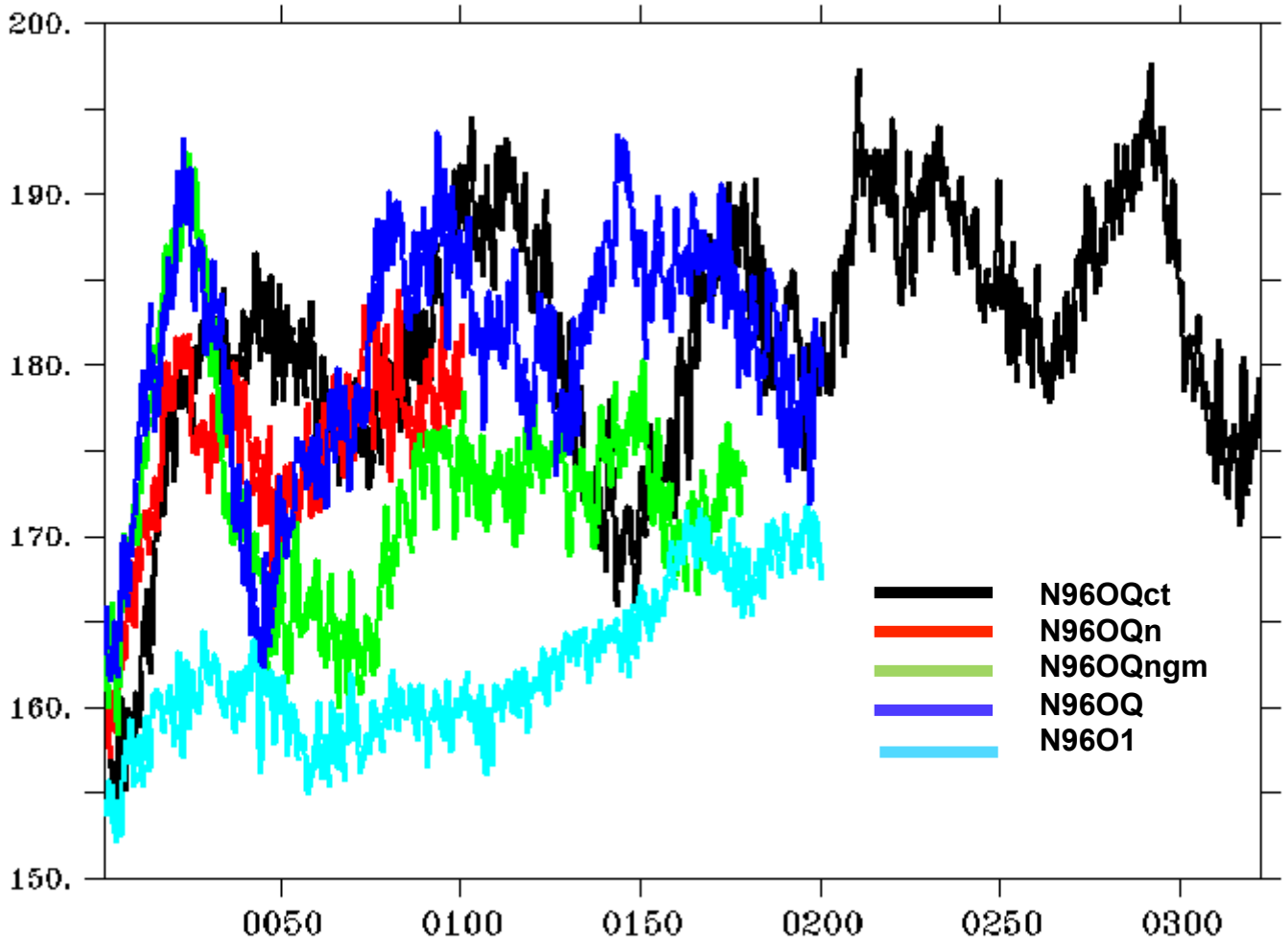


ACCESS1.3 (PI control)



Water transport (Sv): ACC through Drake Passage





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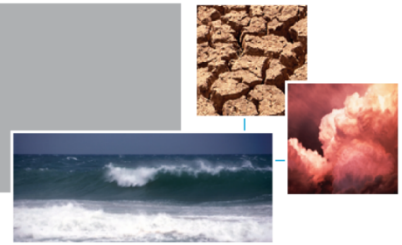
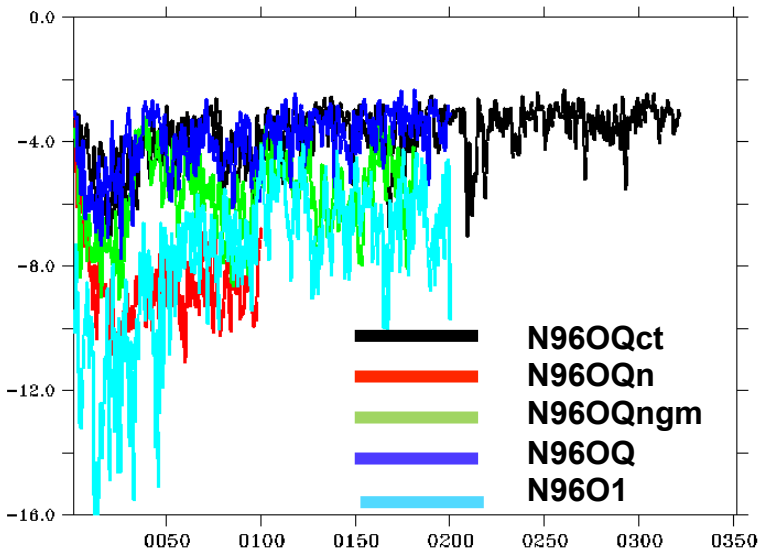
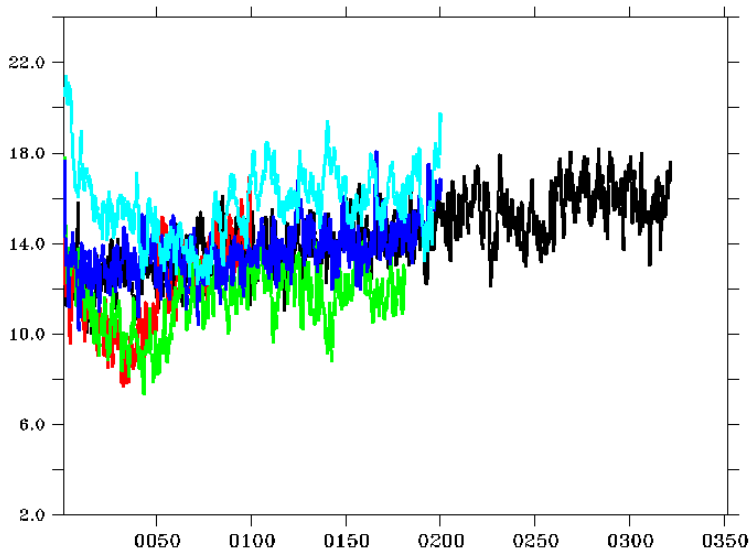
Meridional Overturning Circulation (Sv)



▪AABWF



▪NADWF



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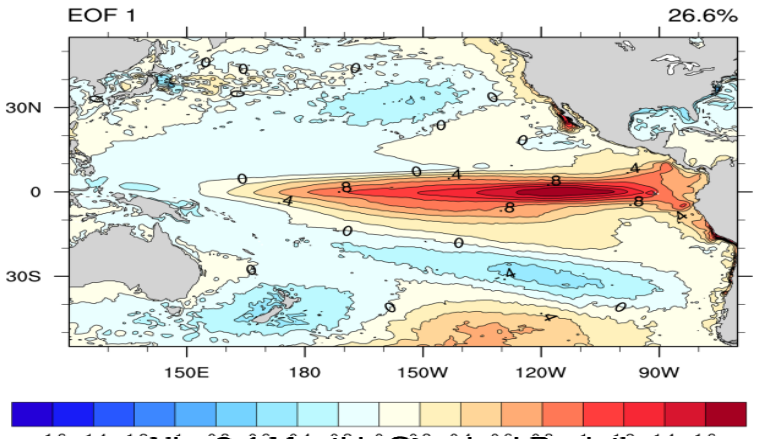
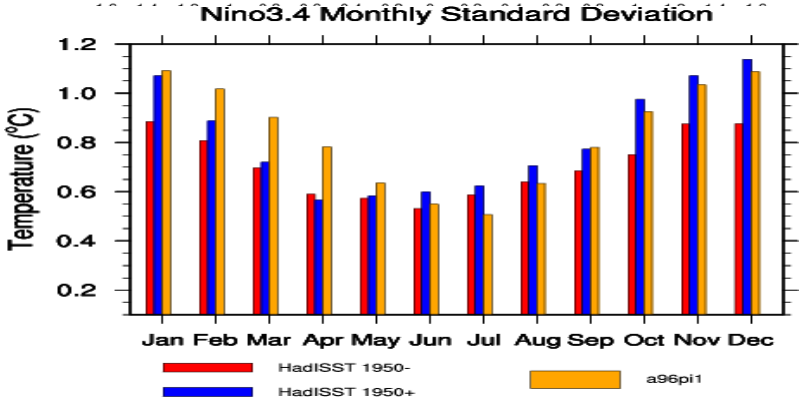
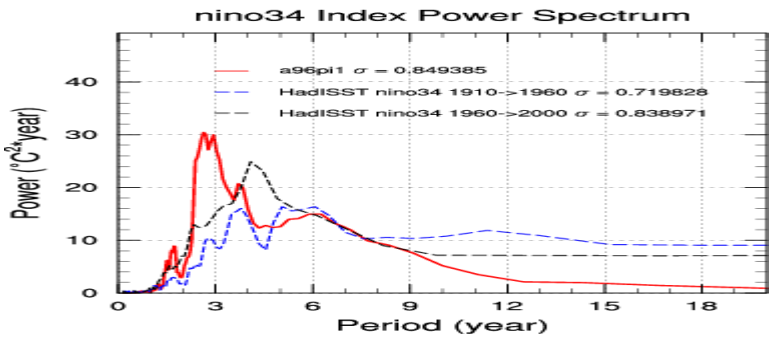
ENSO (DJF)

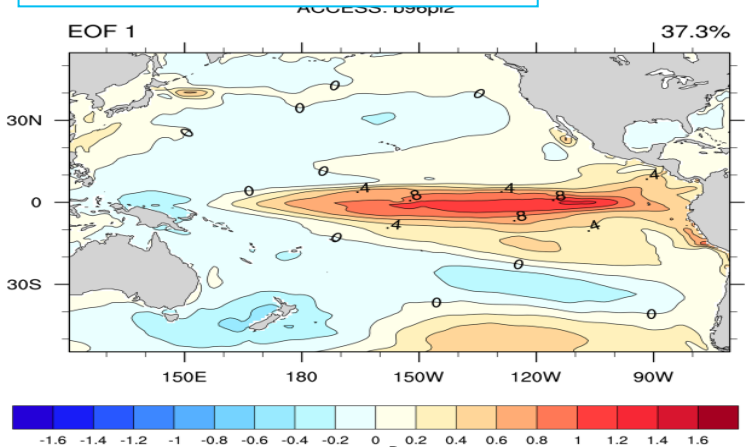
- N96OQ yr 101-200

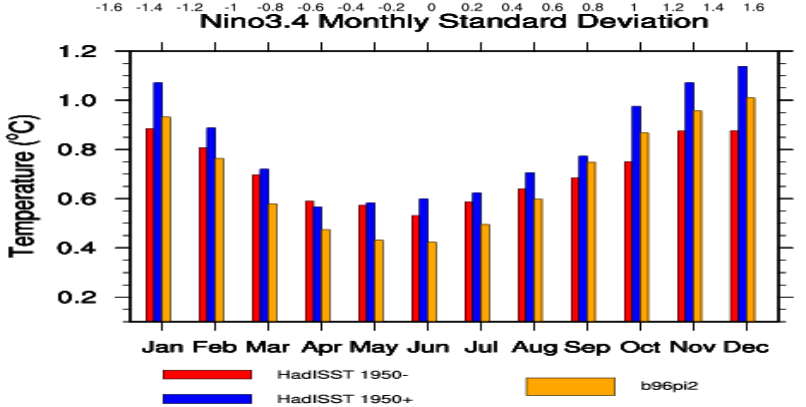


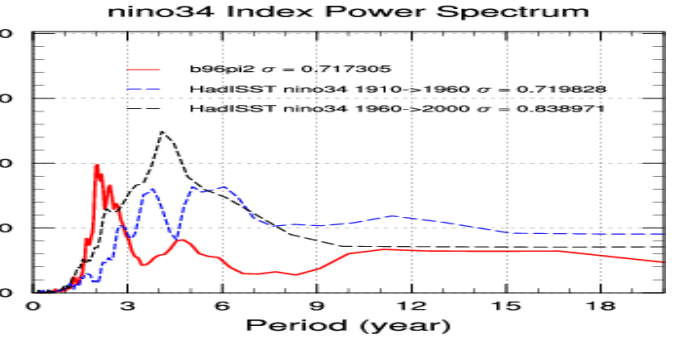




- N96O1 yr 101-200







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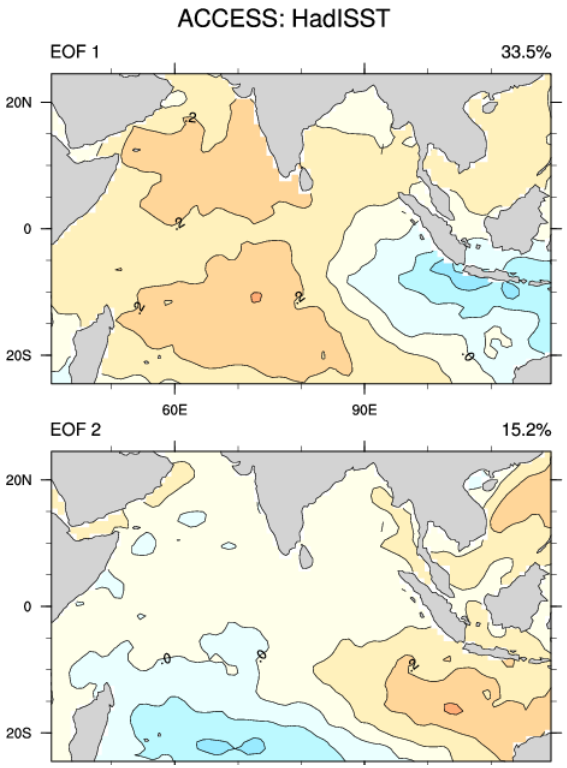
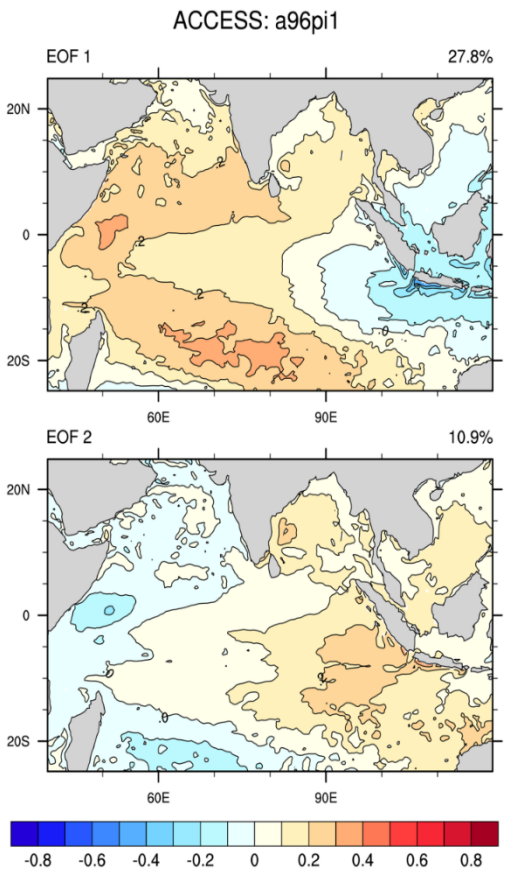
Dipole Mode

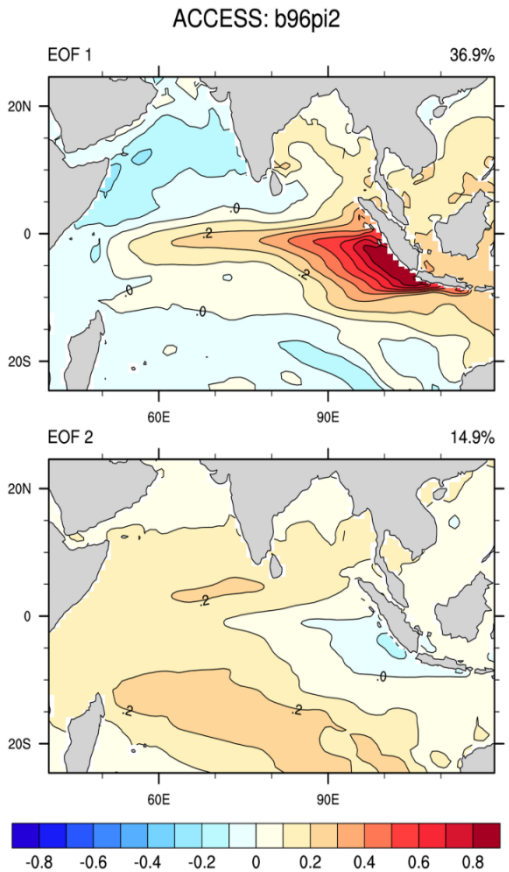
▪HadISST



▪N96OQ



▪N96O1



▪Year 1950-2012

▪Year 101-200

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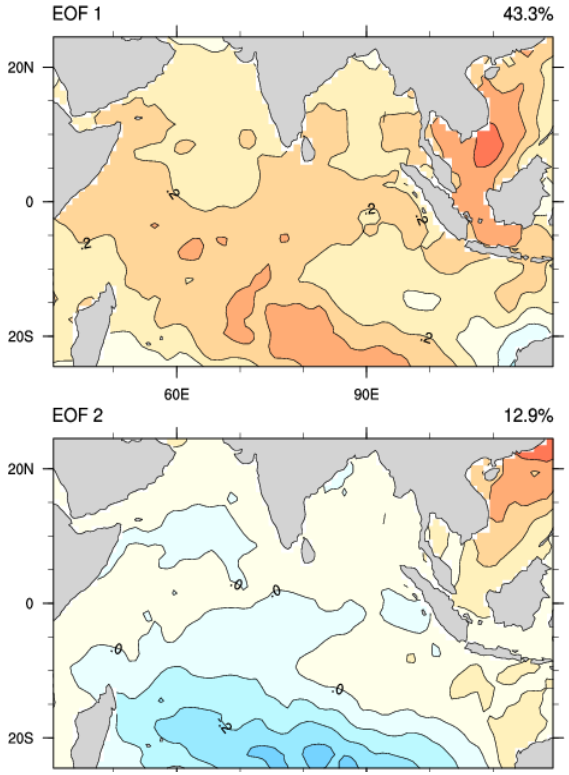
▪IOD-DJF

Basin warming mode

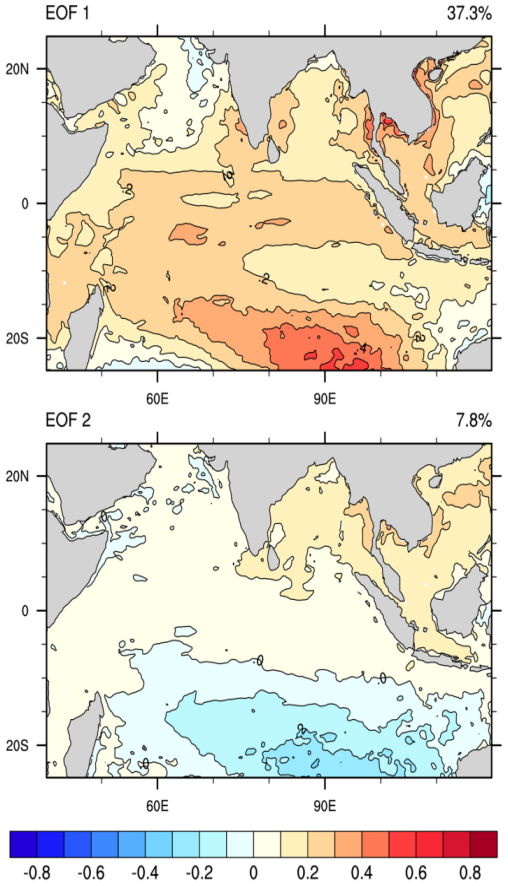
▪HadISST

ACCESS: HadISST



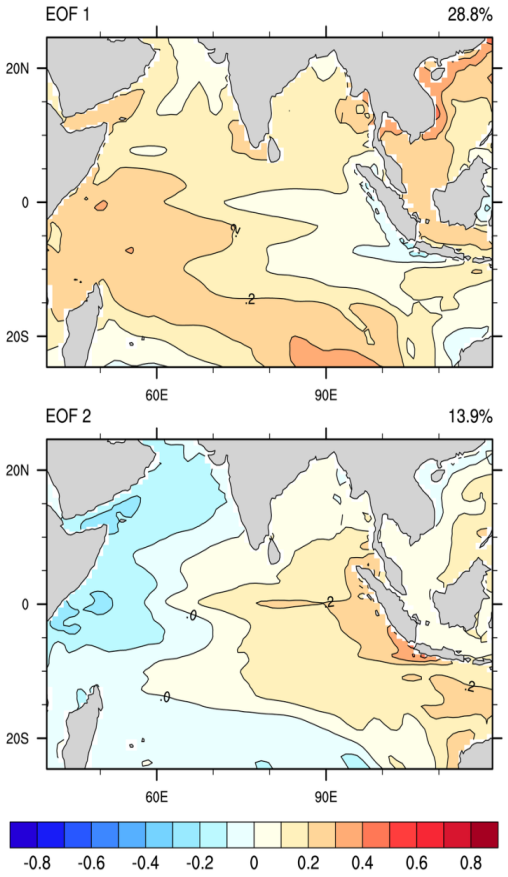
▪N96OQ

ACCESS: a96pi1



▪N96O1

ACCESS: b96pi2



▪Year 1950-2012

▪Year 101-200

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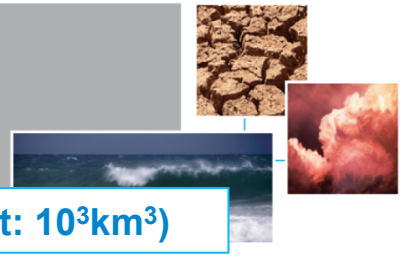
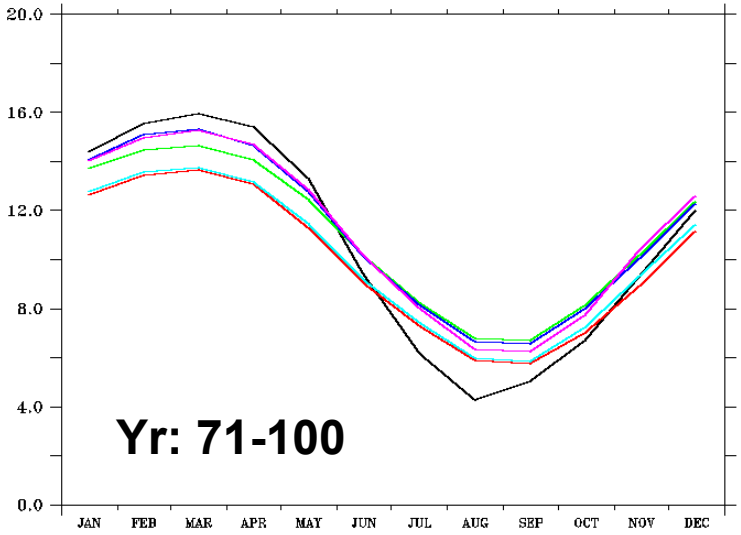
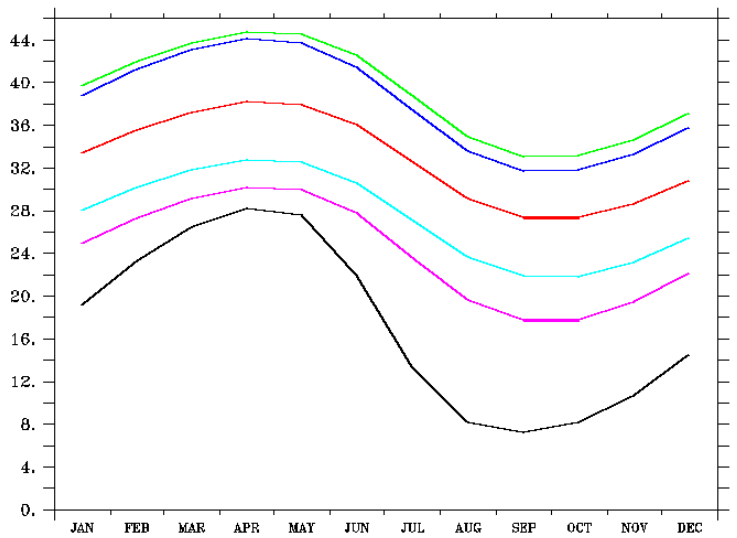
Sea Ice Climatology (annual cycle)



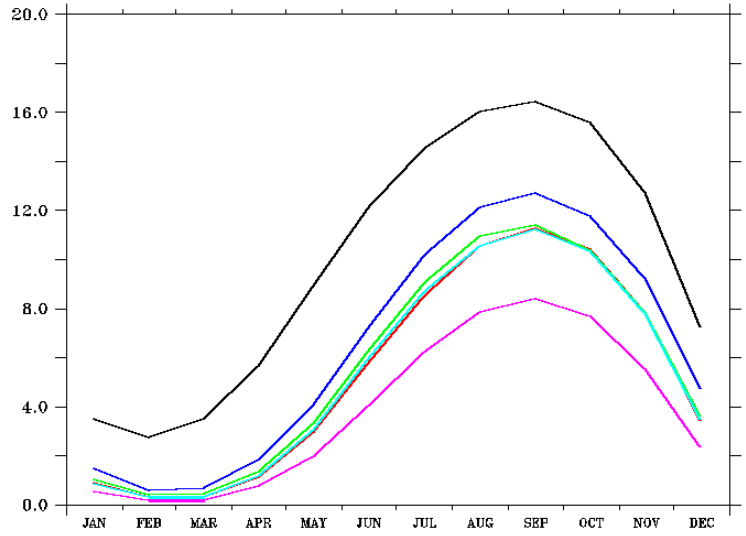
▪NH: Icea Area (unit: $10^6 km^2$)



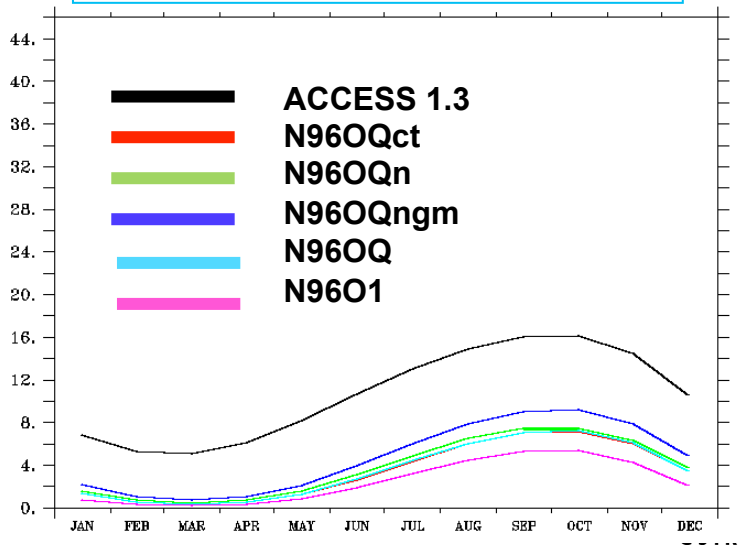
▪NH: Icea Vol. (unit: $10^3 km^3$)



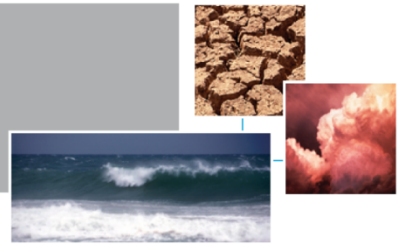
▪SH: Icea Area (unit: $10^6 km^2$)



▪SH: Icea Vol. (unit: $10^3 km^3$)



Summary



- ACCESS-CM2 prototype version with mixed-resolution configurations has been under extensive tests
- Multi-century PI tests with ¼-deg ocean-sea ice shows better ENSO and IOD variabilities
- Some issues worse than ACCESS1.x, e.g.,
  - Larger Southern Ocean warm bias and thus little sea ice stays through summer)
  - Larger water imbalance in the ocean (not shown here) (bug identified and partially fixed in UM10.1)

- Current work: UM10.4/GA7 (with multi-layer CICE—GIS8) implementation ➔ Official version of ACCESS-CM2 for CMIP6
- Soon future: CABLE2.x replacing Jules, hopefully.

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Thank you

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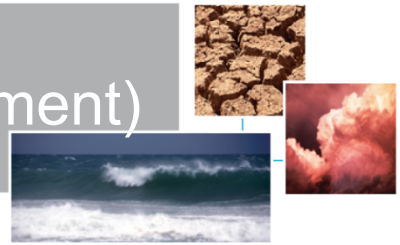
ACCESS-CM2/ESM2 timeline (- subject to reassessment)



Time	Step
Sept 2016	Final code in place (GA7 – UM10.x, CABLE2)
Oct 2016 – Mar 2017	Testing and tuning (N96O1, N96O.25)
April – Sept 2017	Perform final trial simulations
Sept 2017	Select final configuration(s)
Oct 2017 – Mar 2018	CMIP6 DECK and Tier 1 scenarioMIP simulations
2018	Other MIP simulations conducted

- N216 version – continue in background next two years; lag above by ~2 years.

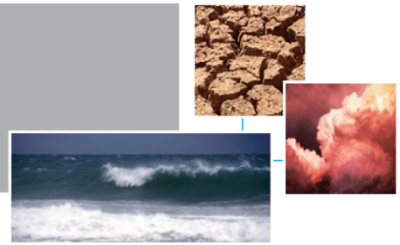
- ACCESS-ESM version (N96) with atmospheric chemistry – continue testing UKCA next two years; lag above by ~2 years.

Time Line for ACCESS-2 Development:

- June 2014 is stated as the target deliverable date in the ACCSP for completing the technical coupling of a ACCESS-CM2/ESM2 prototype, low-res model. Then,
- Debugging/tuning this low-res ACCESS-2 ("ever-lasting" work), targeting release in 2016 for community applications.
- In parallel, configuring high-res ACCESS-CM2/ESM2 for CMIP6/AR6, ready for multi-year tests by 2015/2016.
- Tuning high-res ACCESS-CM2 for acceptable climatology and freeze the model for CMIP6 experiments by 2017.
- Conducting parallel CMIP6 experiments from 2017 onward.

- Risks to such rapid assembly include:
  - Possible delay to the GFDL release of MOM6;
  - Dependency on adequate computing at NCI;
  - Possible failure in ……

CMIP Timing



CMIP5:

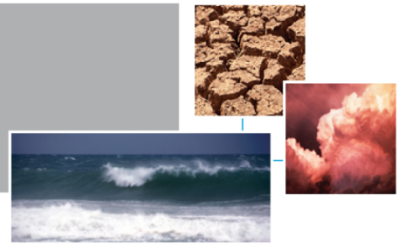
- exploratory Aspen Global Change Institute workshop: August 2006
- Iterations on experimental design in research community: 2006-2008
- WGCM approved experimental design: 2008 (duration of CMIP5 2008-2013)
- Modeling groups receive scenario info from IAM groups: 2010 and start runs
- CMIP5 model analysis workshop: March 2012
- deadline for papers assessed in IPCC AR5: July 2012
- WGI AR5 report published: late 2013
- Ongoing analysis of CMIP5 data: 2013 until CMIP6 data available ~2017

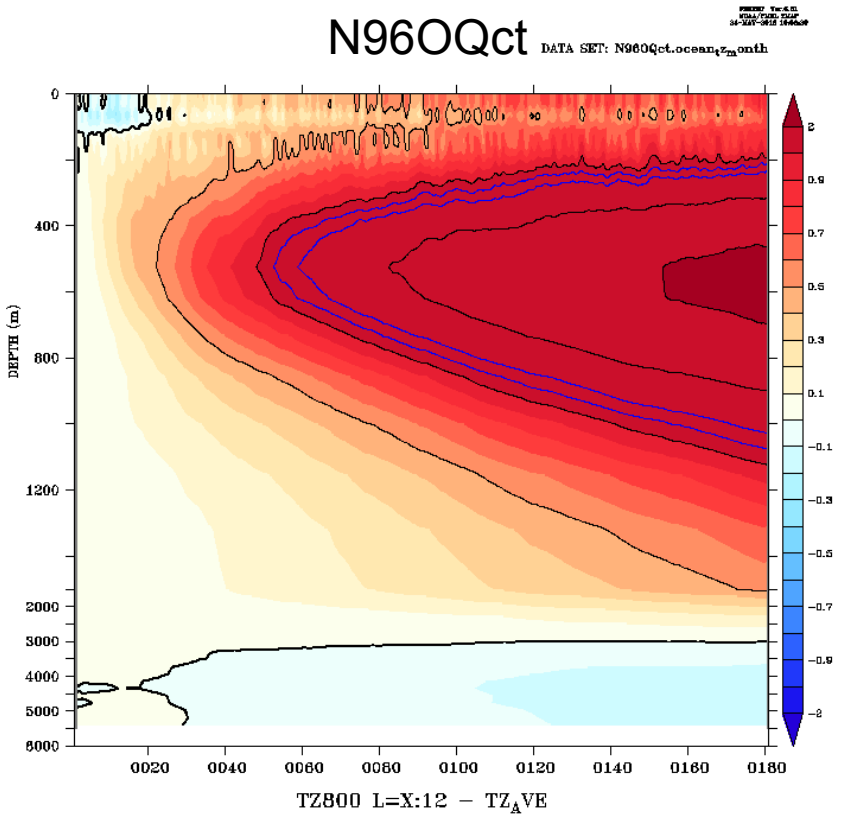
CMIP6:

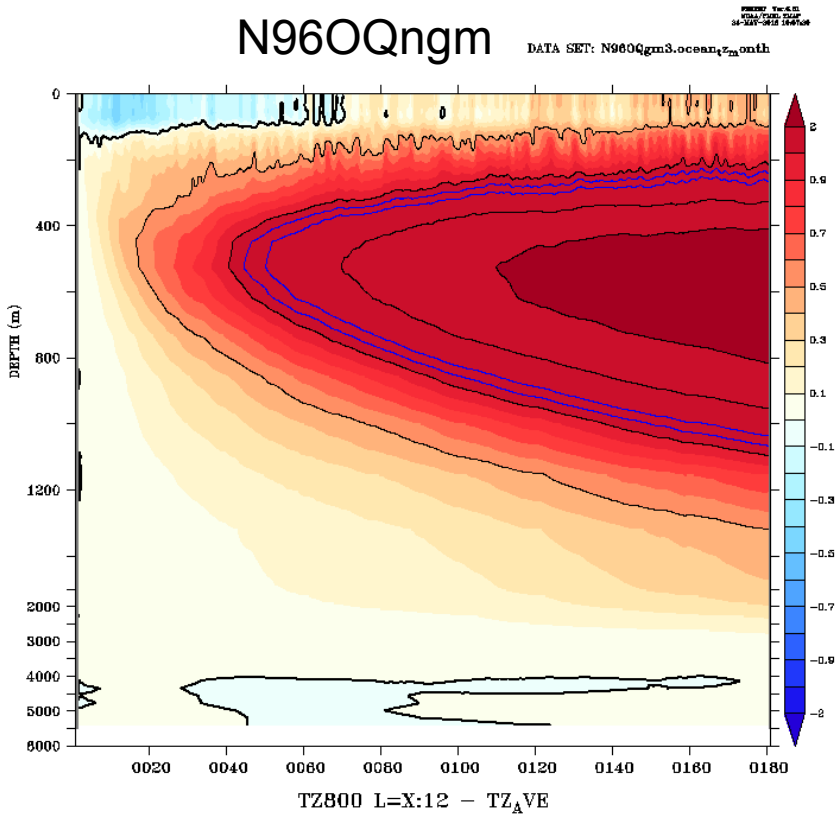
- exploratory Aspen Global Change Institute workshop: August 2013
- Iterations on experimental design in research community: 2013-2015
- WGCM approve experimental design: 2015 (duration of CMIP6 2015-2020)
- Modeling groups receive scenario info from IAM groups: 2017 and start runs
- CMIP6 model analysis workshop: 2018
- deadline for papers assessed in IPCC AR6: 2019
- WGI AR6 report published: 2020
- Ongoing analysis of CMIP6 data: 2020 onward

From http://www.cesm.ucar.edu/events/ws.2013/presentations/SDWG/meehl.pdf

Drift of temperature in the ocean interior







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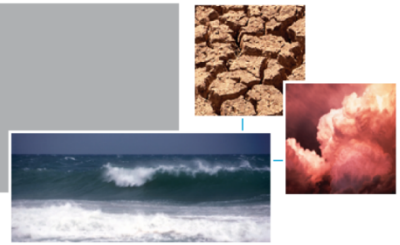
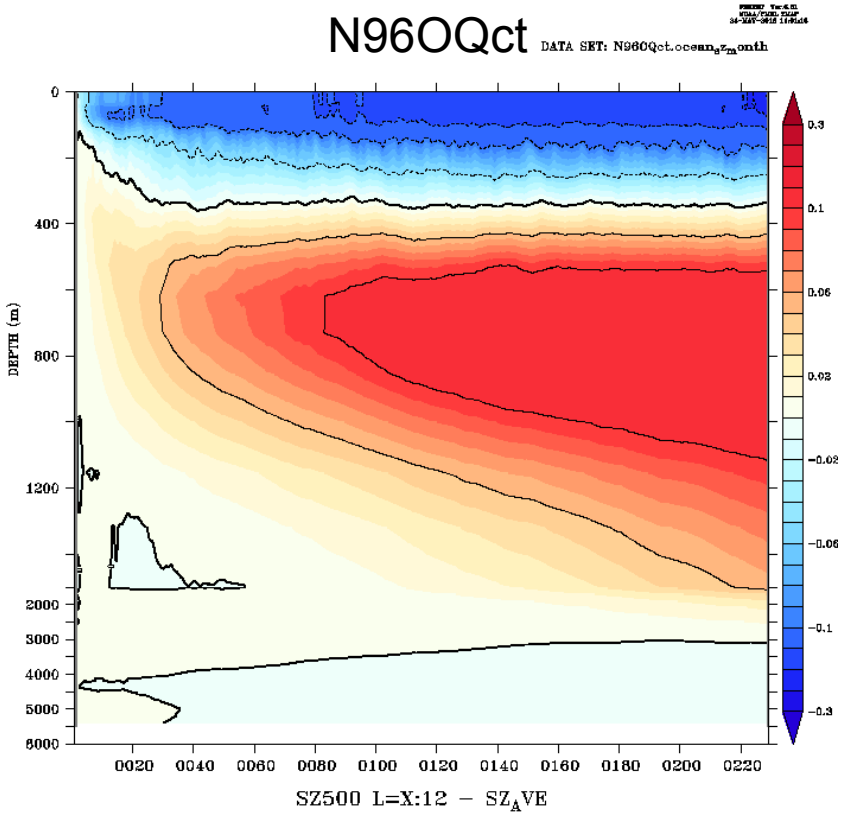
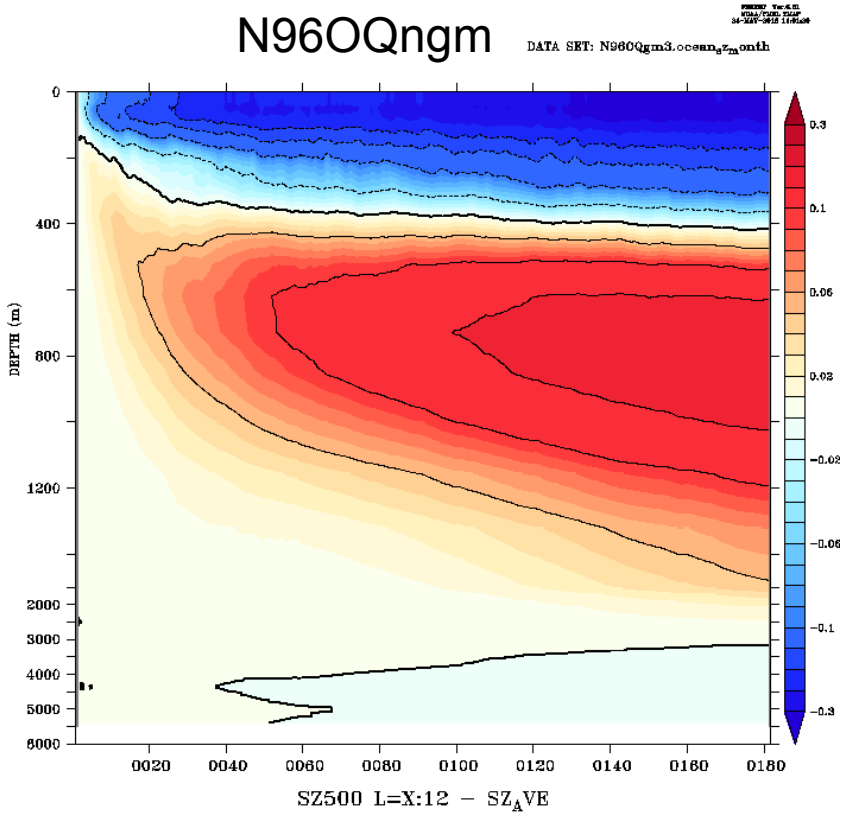
Drift of salinity in the ocean interior



N96OQct



N96OQngm



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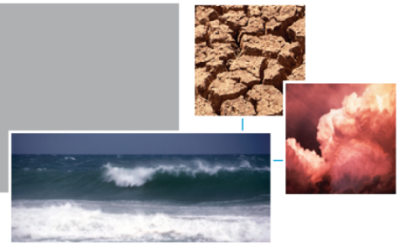
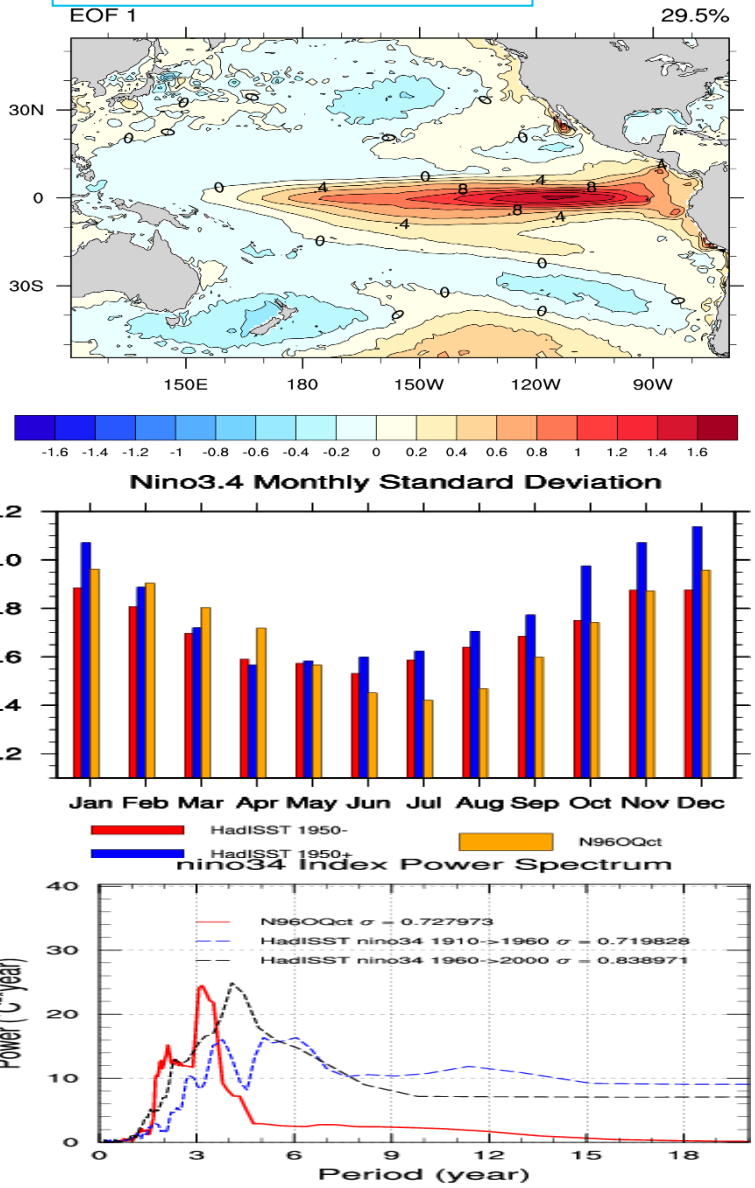
ENSO / IOD [Result of the CT run]



▪N96OQct yr 71-170 DJF



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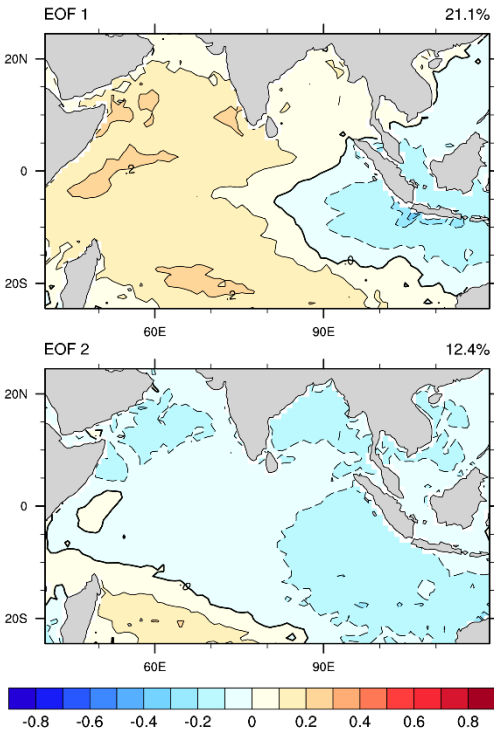

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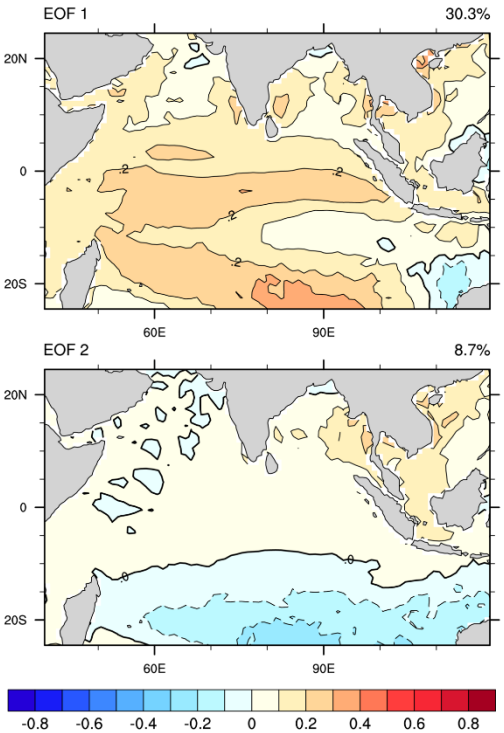

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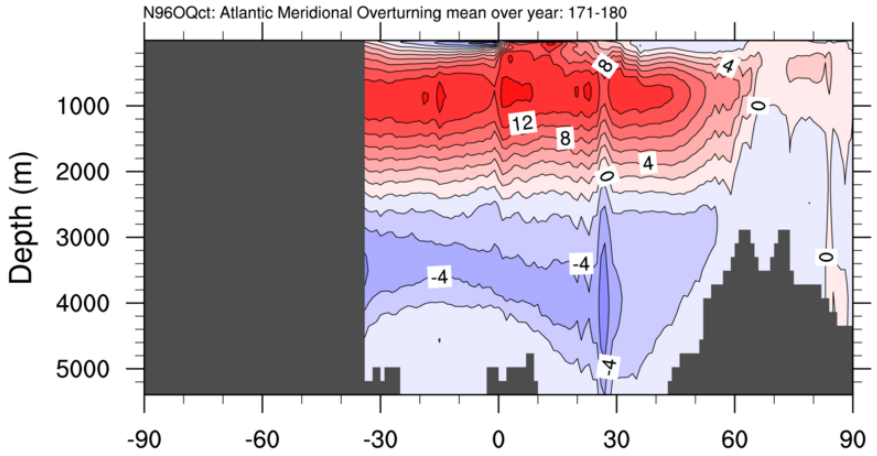
Global Meridional Overturning Circulation (Sv) (years 171 - 180)

▪N96OQct: AMOC



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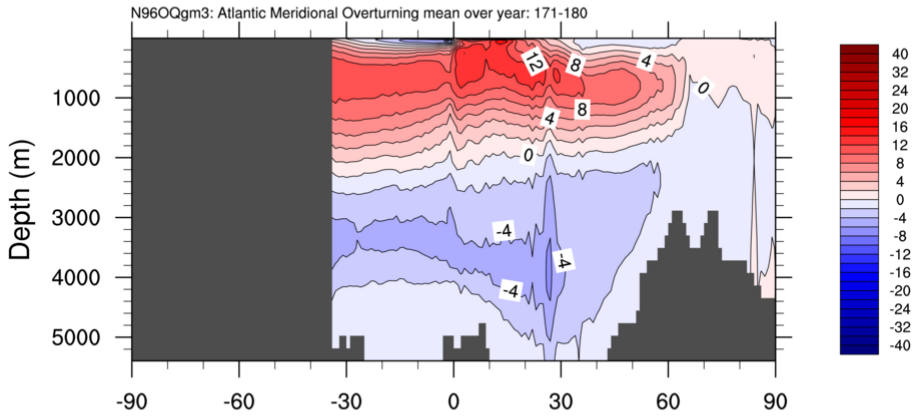

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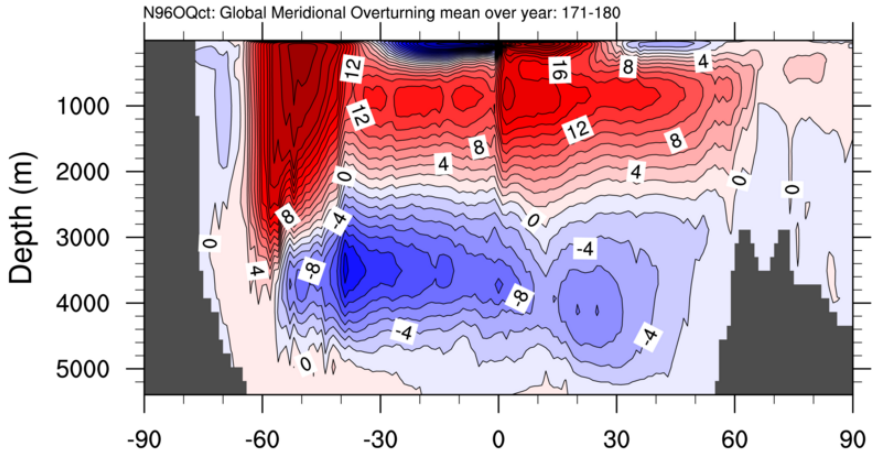

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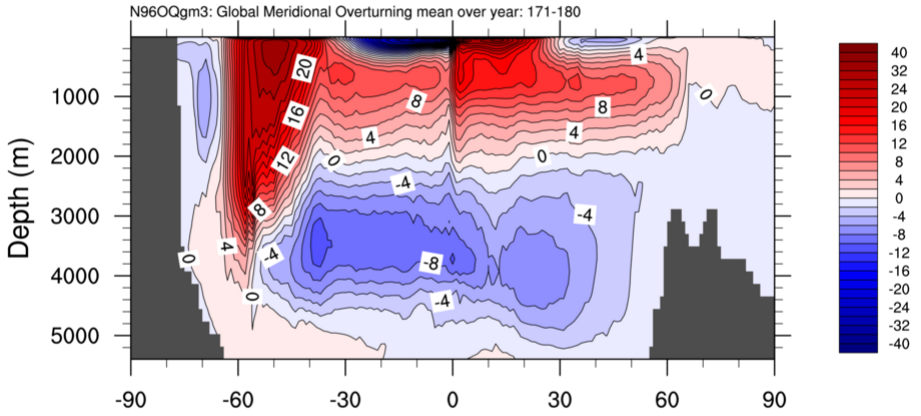

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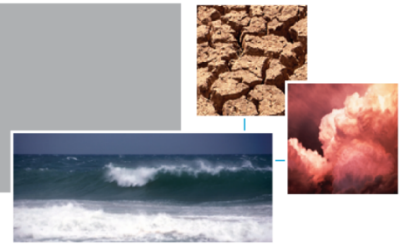
Global Meridional Overturning Circulation (Sv) (years 21 - 30)



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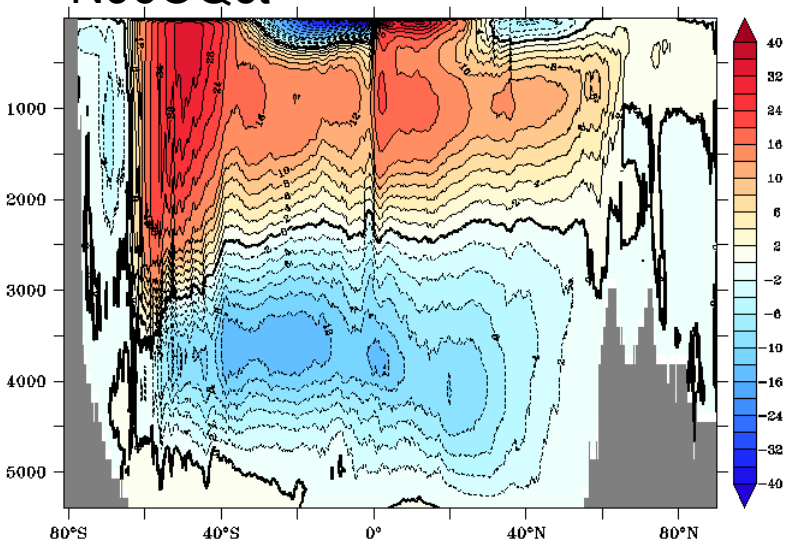

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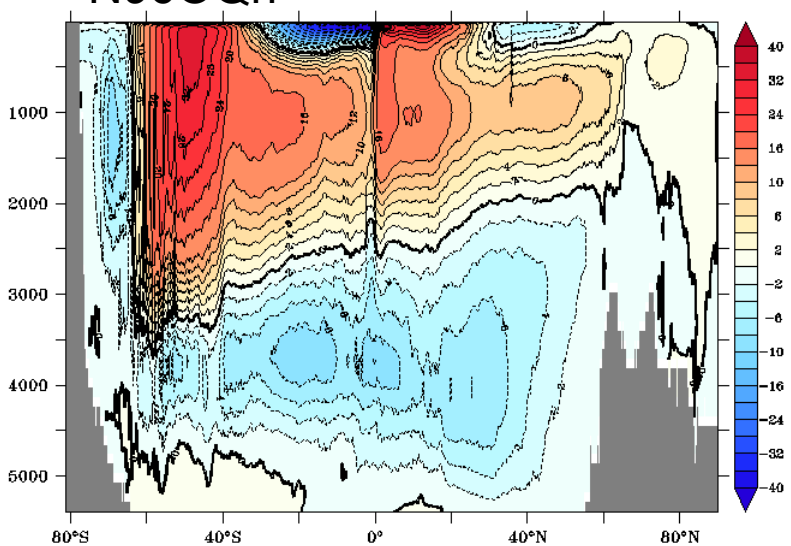

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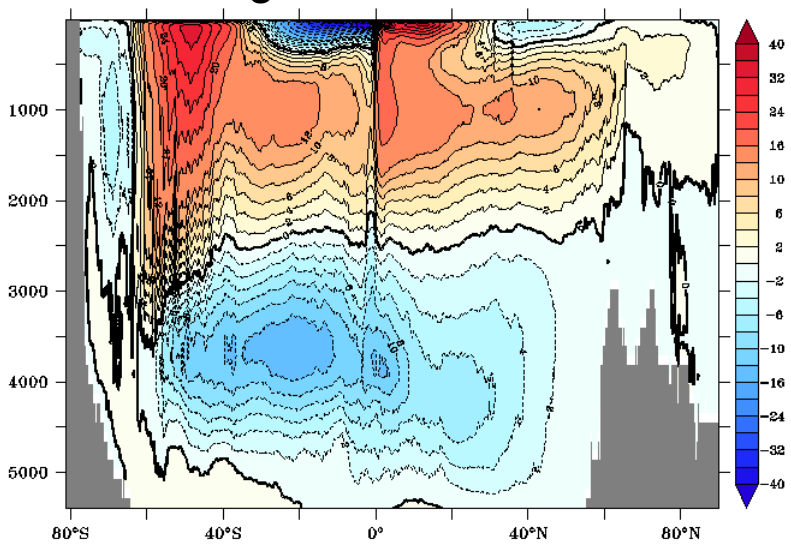

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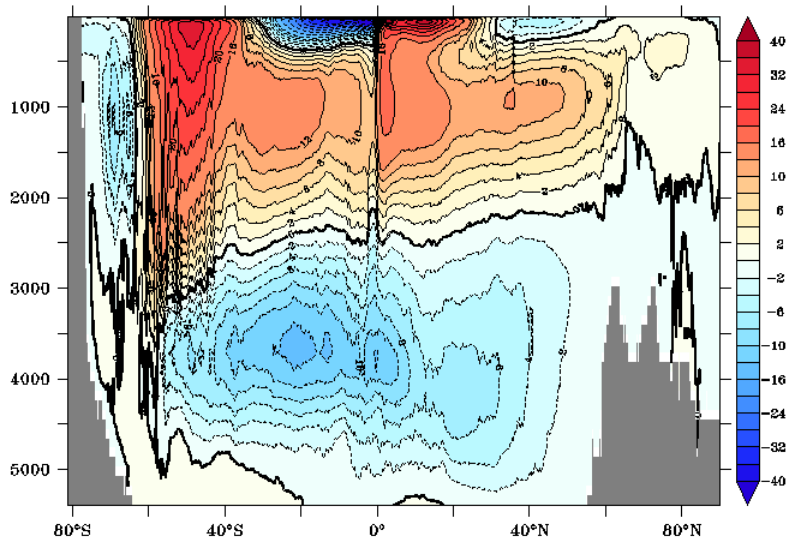

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