RYF – Repeat Year Forcing for JRA55-do

Kial Stewart
Andy Hogg
Aidan Heerdegen

Stephen Yeager
Who Kim
Gokhan Danabasoglu

Satoru Urakawa
Hiroyuki Tsujino
Hideyuki Nakano

+ many others…

Australian National University

Australian Government

National Environmental Science Programme

UNSW AUSTRALIA

ARC CENTRE OF EXCELLENCE FOR CLIMATE SYSTEM SCIENCE

Why should we move on from COREs?

Coordinate Ocean-ice Reference Experiments (COREs) have provided common protocols for performing ocean-sea ice simulations.

COREs forcing dataset is based on Large & Yeager (2009)

- -CORE-NYF (Normal Year Forcing)
- -CORE-IAF (Inter-Annual Forcing)

Readily accessible, suitable for a variety of topics, experiments and methodologies

Widely used to evaluate and compare ocean-sea ice models, and understand their biases

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Readily accessible, suitable for a variety of topics, experiments and methodologies

Widely used to evaluate and compare ocean-sea ice models, and understand their biases

Not updated since 2009 – not suitable for investigations of recent events

Based on NCEP: coarse ~200km, 6 hour resolution

-not ideal for high-resolution or regional simulations

International consensus among modelling groups that it is time to revisit the methodologies and reference datasets

CLIVAR OMDP adopted the Japanese 55-year Reanalysis "JRA-55"

JRA55-do :- the ocean-sea ice model forcing set derived from JRA-55

Comparison of JRA55-do and CORE-IAF

JRA55-do is higher resolution, self-consistent, and near real-time

	JRA55-do (~55km)	CORE-IAF (~200km)
Atmospheric state T, q, U, SLP	JRA55 **(3-hr)**	NCEP **(6-hr)**
Radiation Q_{SW} & Q_{LW}	JRA55 **(3-hr)**	GISS ISCCP-FD **(daily)**
Precipitation	JRA55 **(3-hr)**	GPCP/CMAP/Serreze **(monthly)**
Runoff	JRA55-based **(daily)***	Dai et al. (2009) **(monthly climatology)**
Available Period	1958-persent	1948-2009#

*Suzuki et al. (2017), includes solid & liquid runoff from Greenland (Bamber et al., 2012) & Antarctica (Depoorter et al., 2013)

#interannually varying only after 1979 & 1983 for precip. & rad., respectively

Courtesy Who Kim

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Atmospheric state	JRA55 (3-hr)	NCEP (6-hr)
Available Period	1958-present	1948-2009

JRA55-do is the Inter-Annual Forcing
The reference year for JRA-55 doesn't yet exist…

*Suzuki et al. (2017), includes solid & liquid runoff from Greenland (Bamber et al., 2012) & Antarctica (Depoorter et al., 2013)

#interannually varying only after 1979 & 1983 for precip. & rad., respectively

Courtesy Who Kim

Developing a reference year for JRA55-do

Reference year forcing is useful scientific tool for ocean-sea ice models

Able to be repeated *ad nauseum*

Retains seasonal and propagating synoptic variability

Vital for spin-up, perturbation, inter-comparison studies, among others

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Criteria for **CORE-NYF: Large & Yeager (2004)**

1: Same forcing infrastructure as the CORE-IAF

2: Seasonal cycle retained

3: Realistic propagation of weather, so that the ocean can experience high-frequency forcing and associated turbulent fluxes

4: Climatological average fluxes of NYF-OGCM are as close as possible to observations

5: Smooth transition from December to January so as to minimise disturbances

6: The NYF should not be overly weighted to any individual year

Developing a reference year for JRA55-do

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Criteria for **RYF- Stewart et al., in prep.**

1: Same forcing infrastructure as the IAF- taken directly from the satellite-era IAF (post-1970s)

2: Avoid recent years so as to minimise contamination by anthropogenic warming

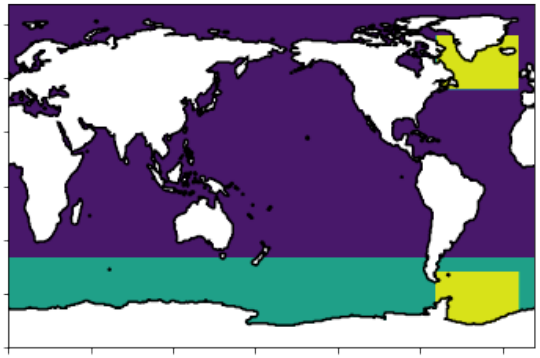
3: Minimise anomalies in major modes of climate variability

4: Minimise the disturbance generated by the annual transition to beginning of year

JRA55-do RYF: minimising disruption of annual transition

Relax the assumption that the ideal period is a calendar year

What day of the year has least weather?*



*focus on regions of deepwater formation

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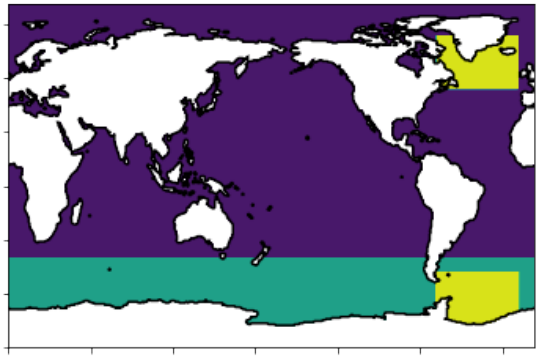

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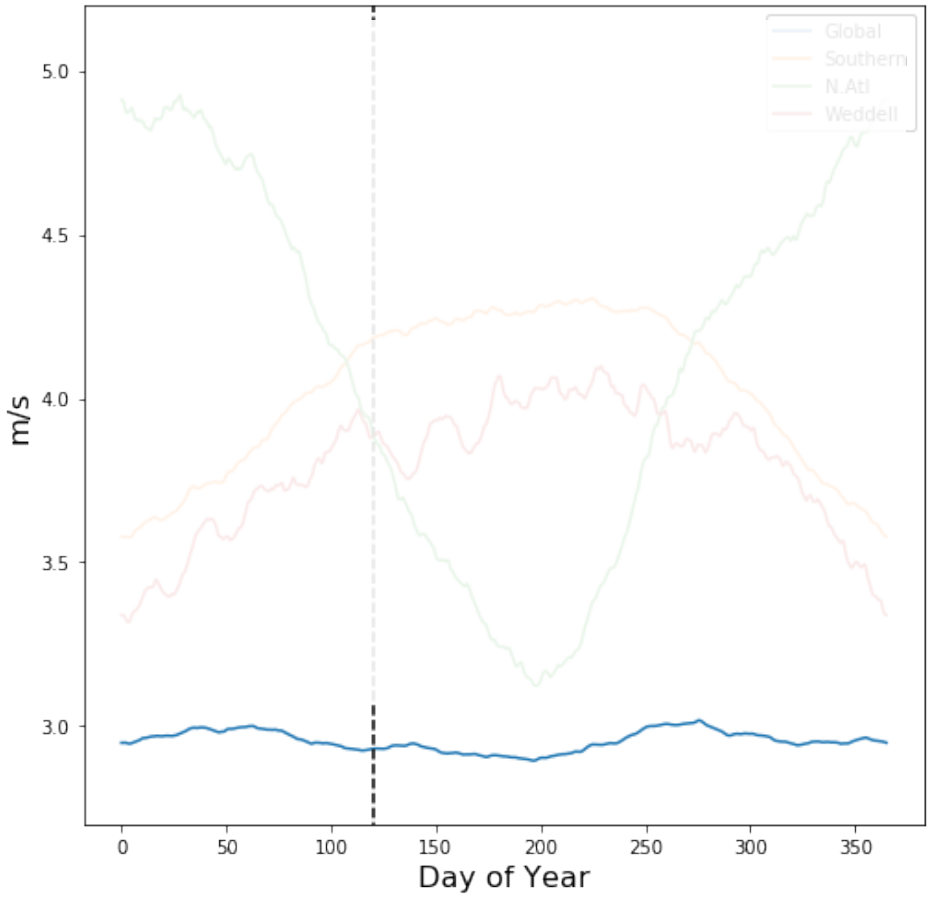
Standard deviation of 10m winds



North Atlantic

Southern Ocean

Weddell Sea

Global

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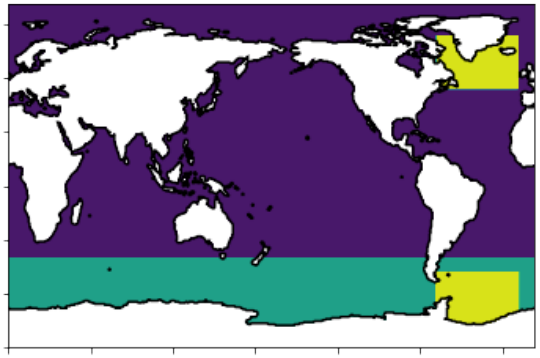

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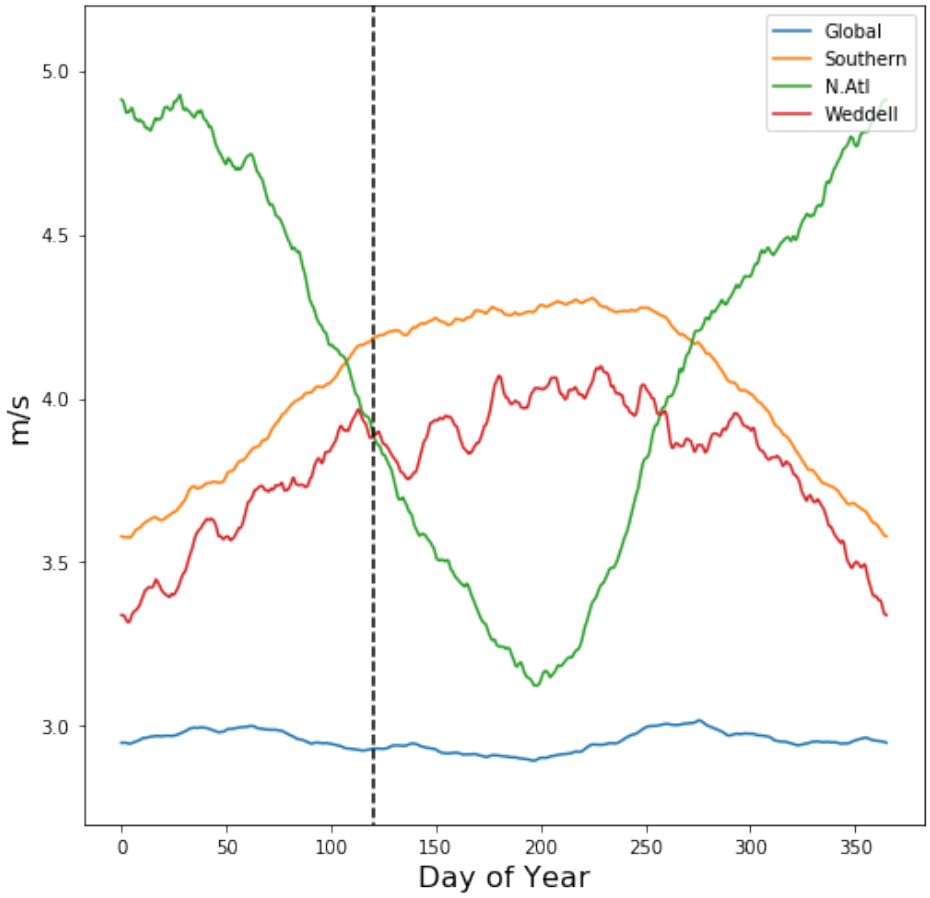


Seasonality in regions of deepwater formation, peaks during winter

North Atlantic

Southern Ocean

Weddell Sea

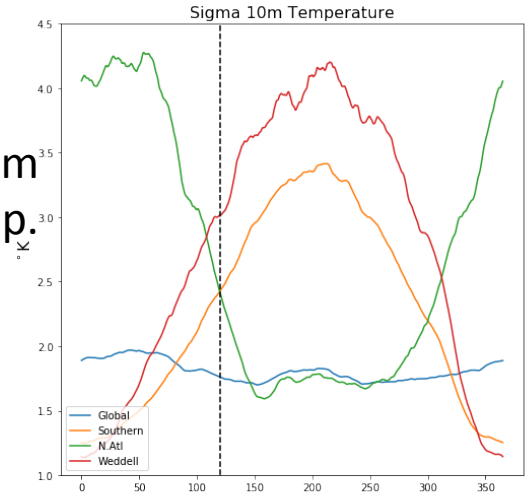
Global

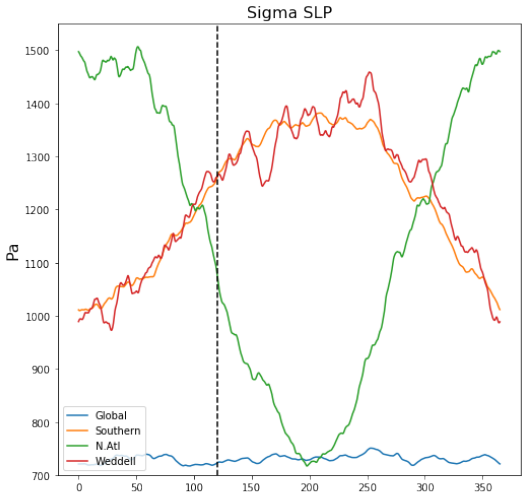
JRA55-do RYF: minimising disruption of annual transition

Relax the assumption that the ideal period is a calendar year

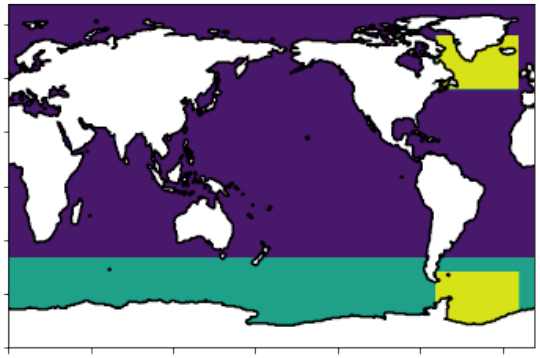
What day of the year has least weather?*

10m Temp.



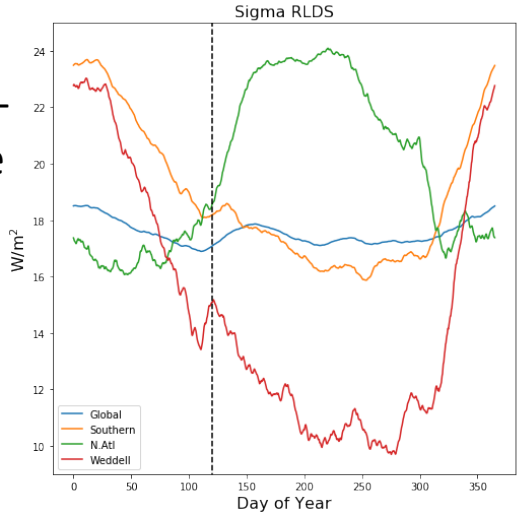


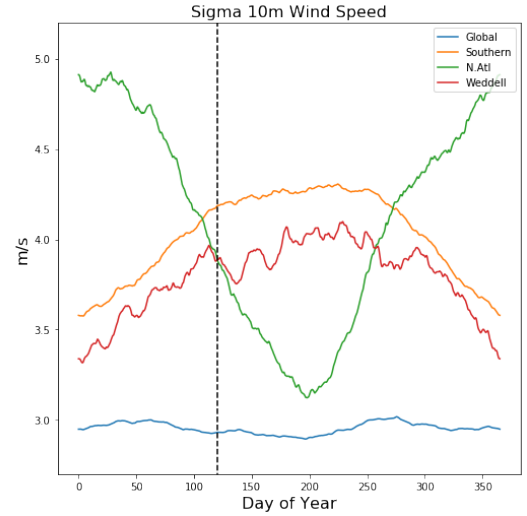
SLP



*focus on regions of deepwater formation

Long-wave





10m Winds

North Atlantic

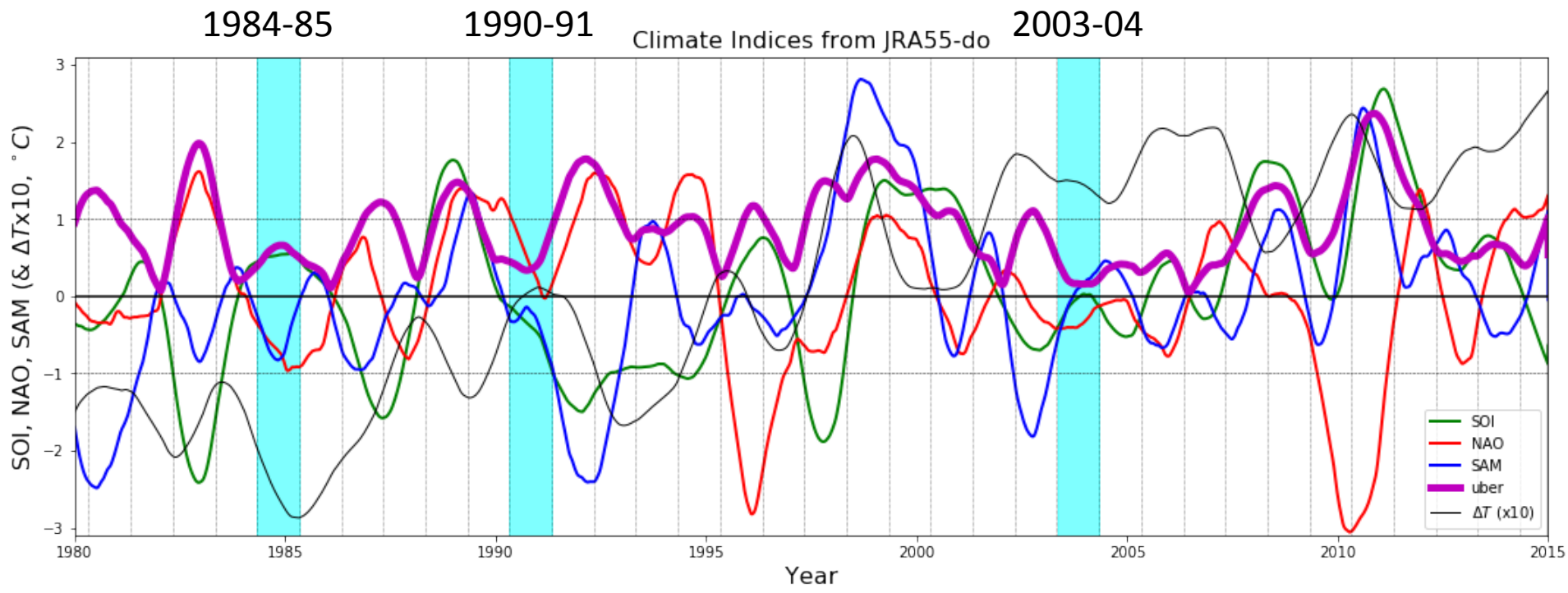
Southern Ocean

Weddell Sea

Global

May 1st

JRA55-do RYF: minimising major modes of climate variability



Southern Oscillation Index (SOI) − MSLP difference between Tahiti & Darwin
North Atlantic Oscillation (NAO) − MSLP difference between Lisbon & Reykjavík
Southern Annular Mode (SAM) − MSLP difference between 40°S and 65°S

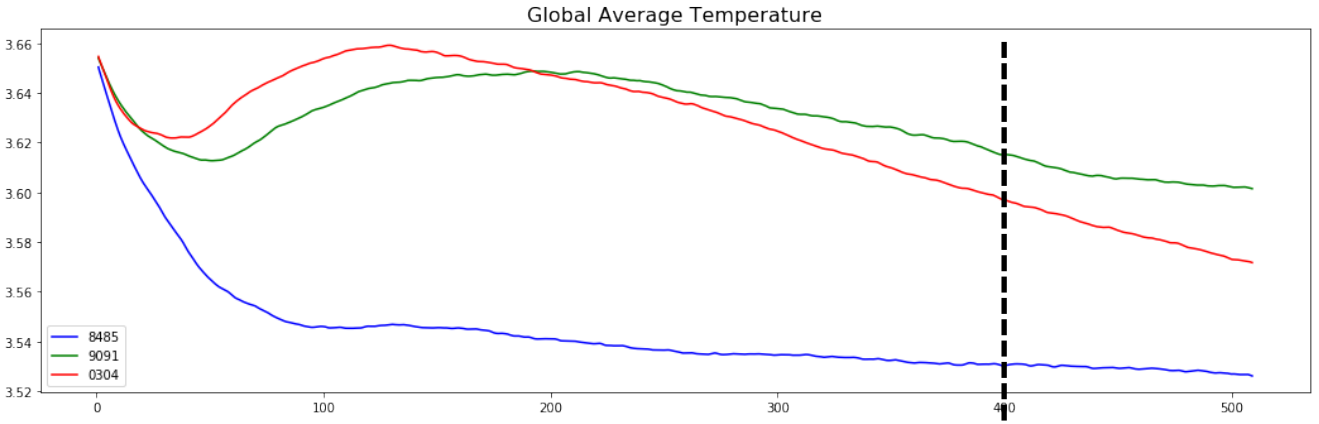
Ubër index - $\sqrt{4SOI^2 + 2SAM^2 + NAO^2}$

JRA55-do RYF: evaluation with ACCESS-OM2

8485
9091
0304

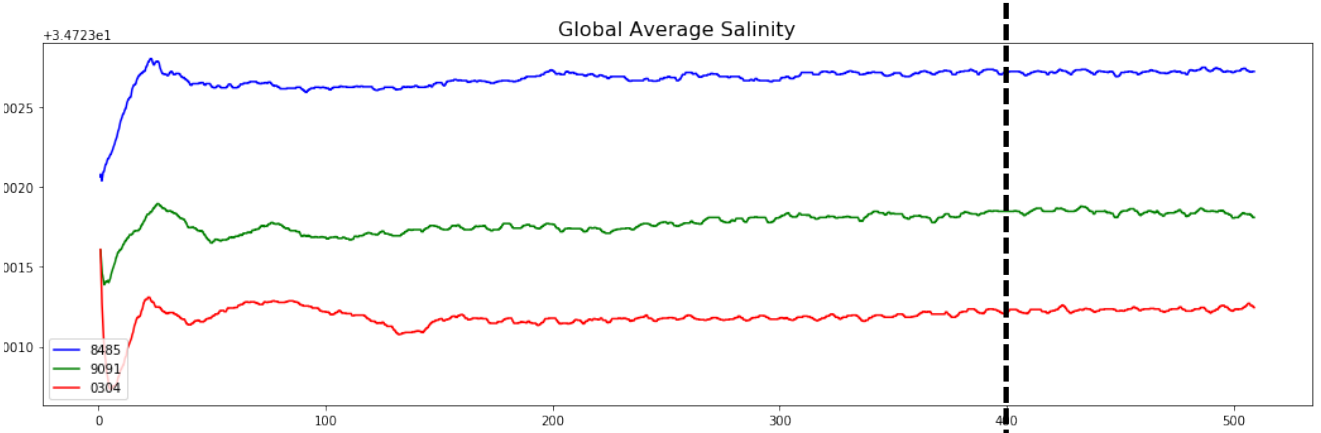
Global Temp. (°C)

3.66



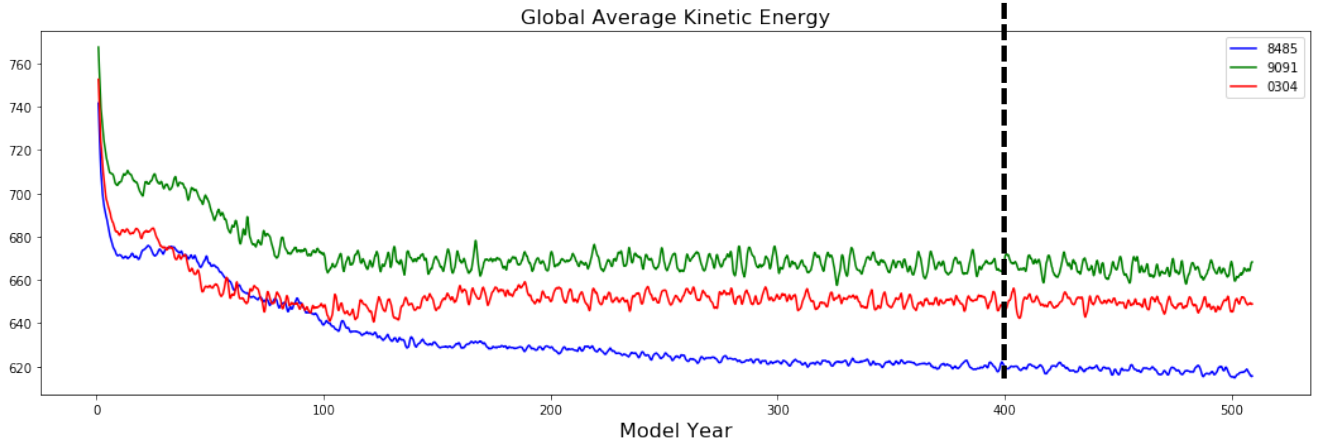
3.52

Global Salinity (psu)



760

Global KE (PJ)



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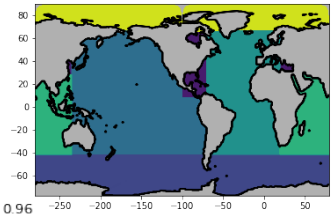
JRA55-do RYF: evaluation with ACCESS-OM2



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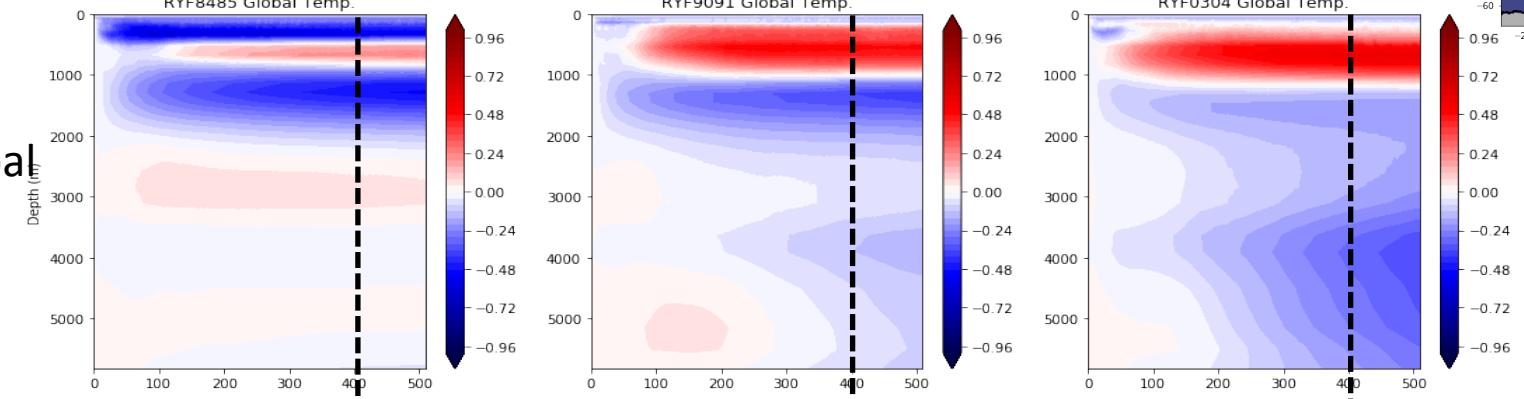
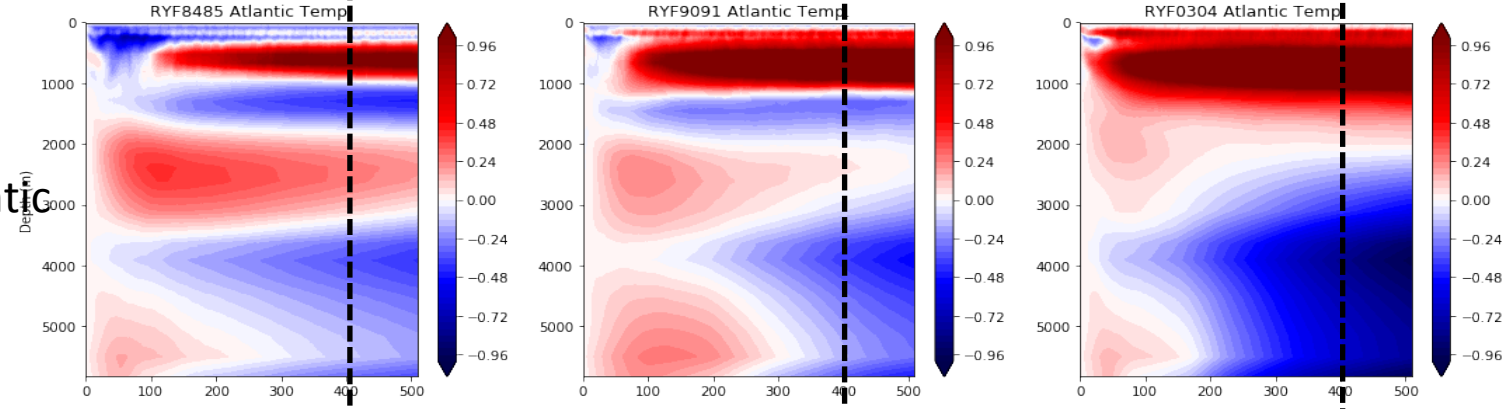
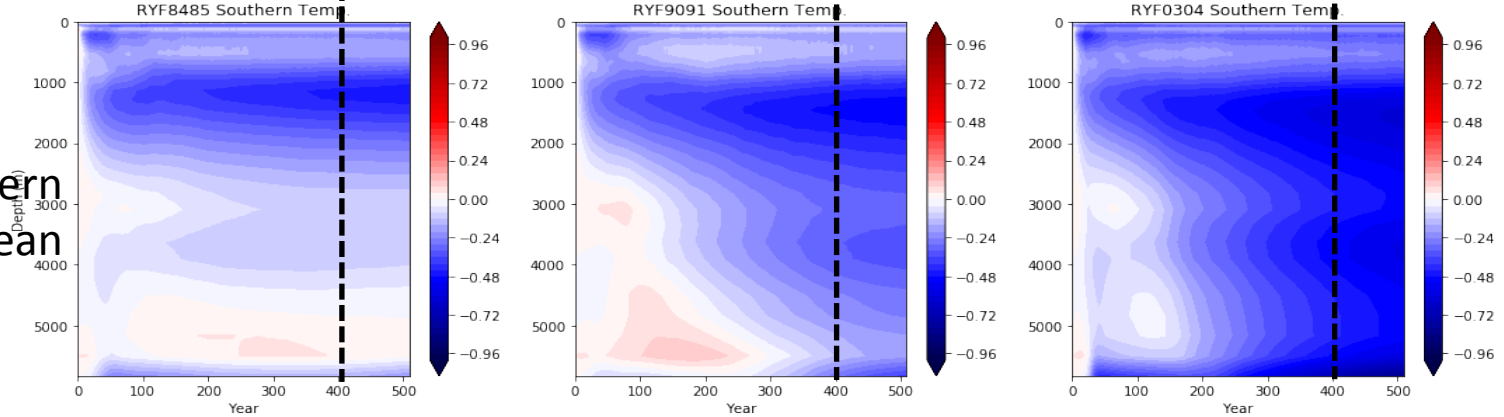
Global



Atlantic



Southern Ocean



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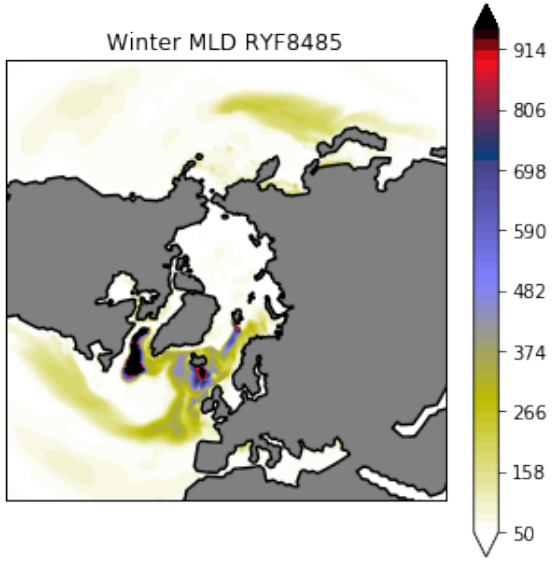
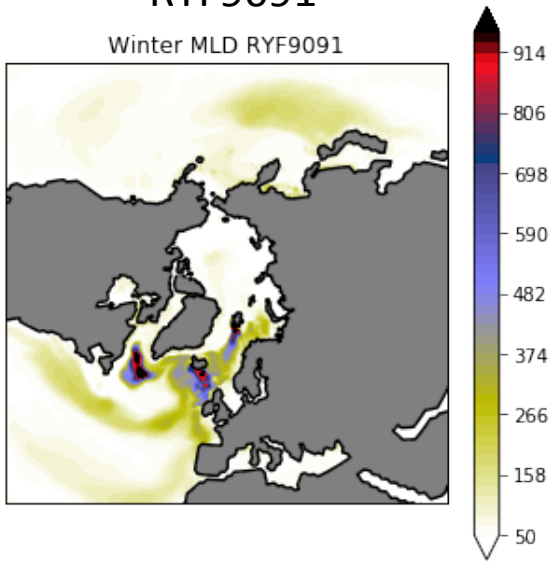
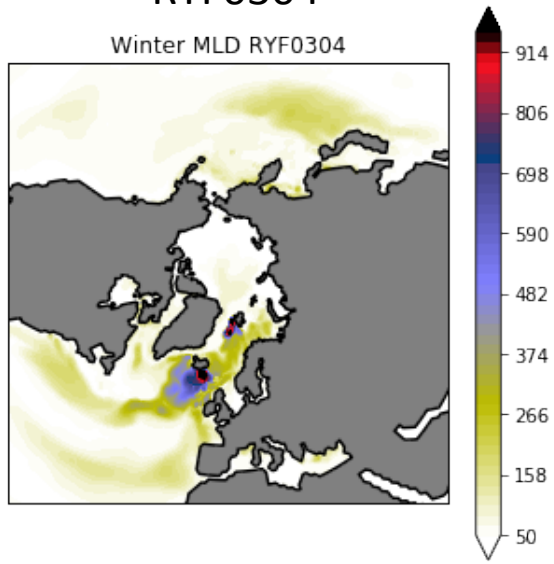
RYF8485



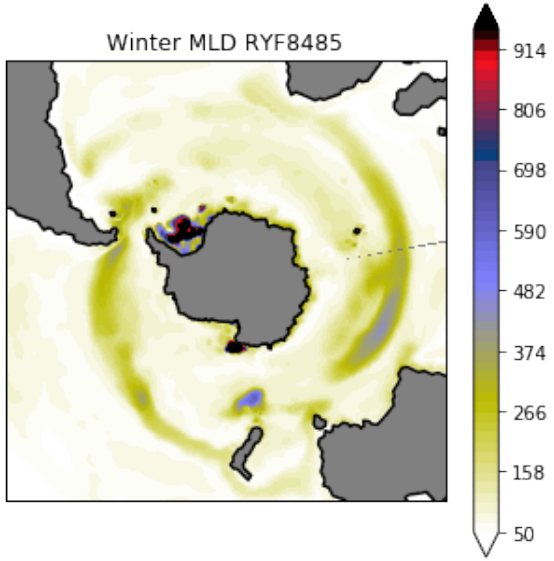
RYF9091

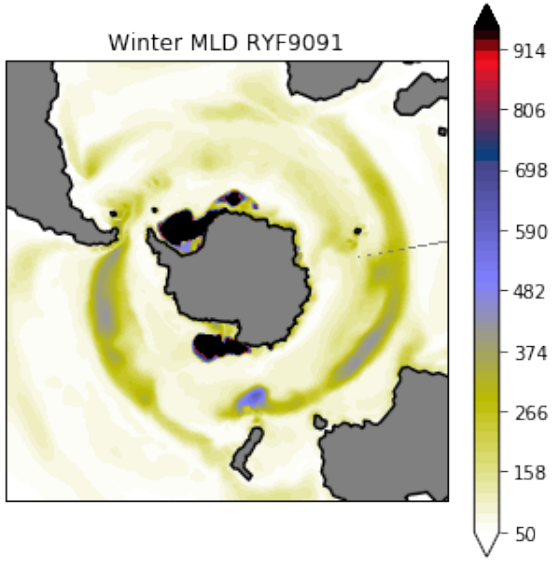


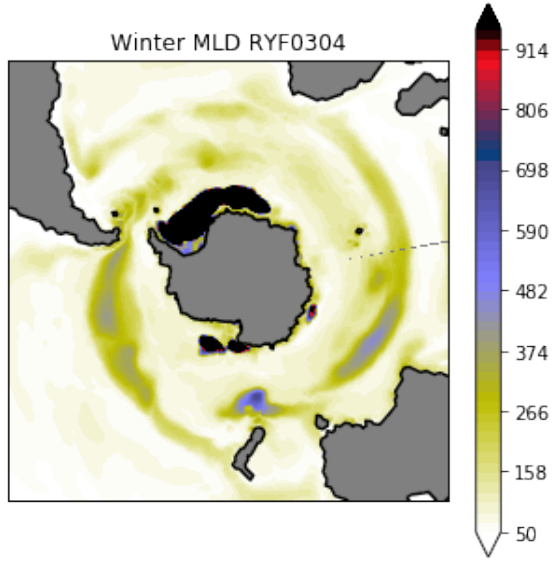
RYF0304



100-year average Winter MLD







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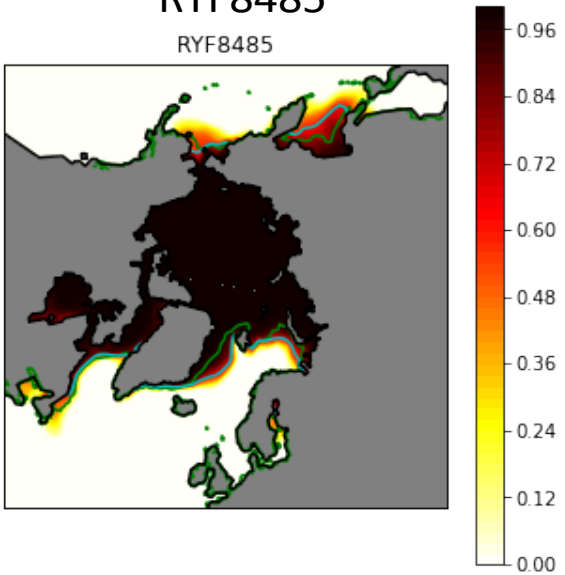
RYF8485



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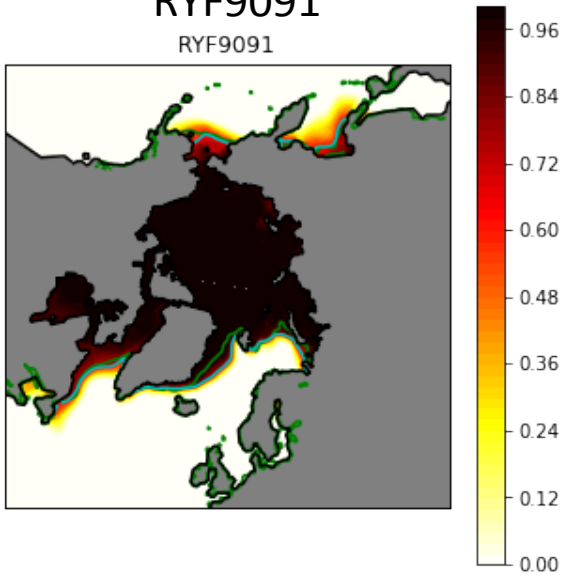

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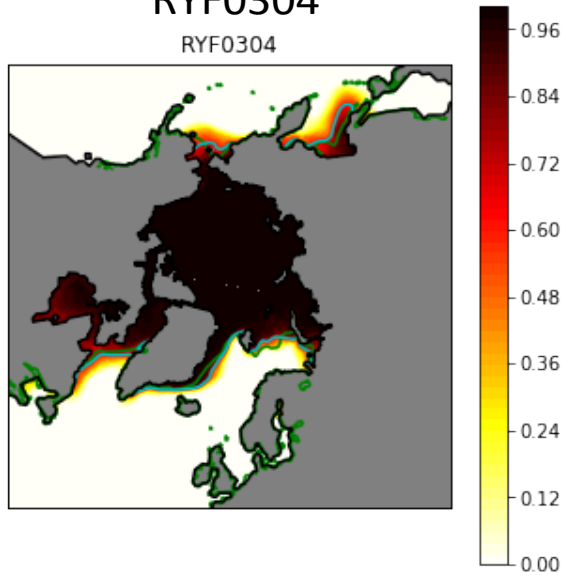
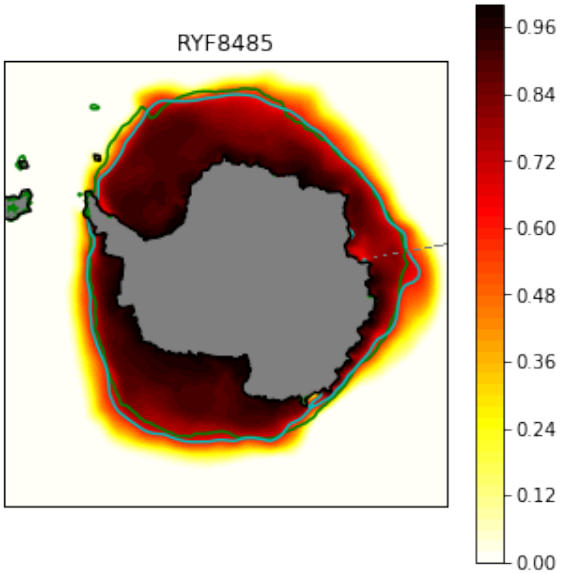
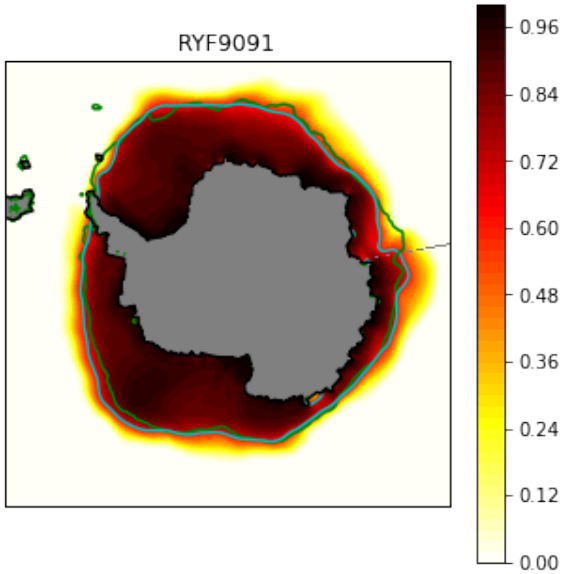
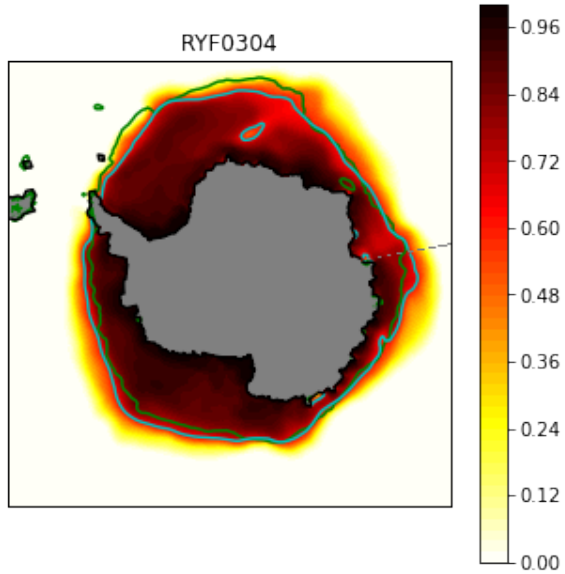


100-year average Winter SI Concentration

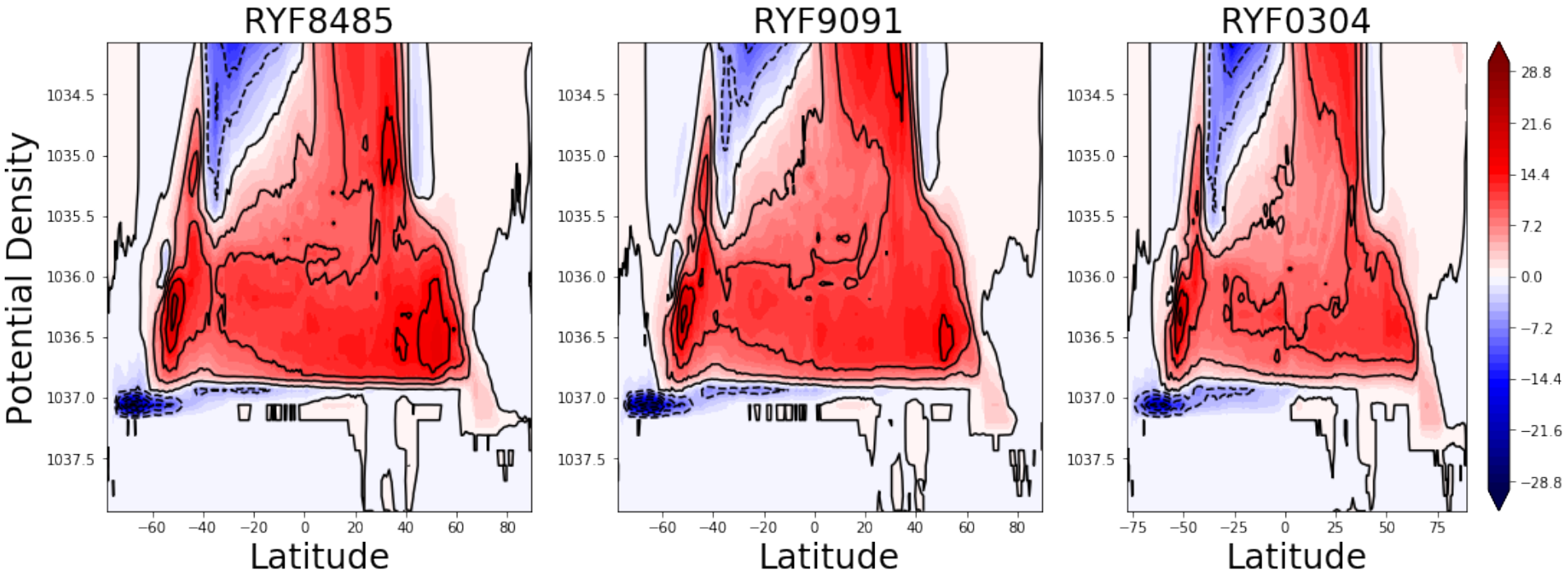






JRA55-do RYF: evaluation with ACCESS-OM2

100-year average Overturning Streamfunction



JRA55-do RYF: evaluation with ACCESS-OM2

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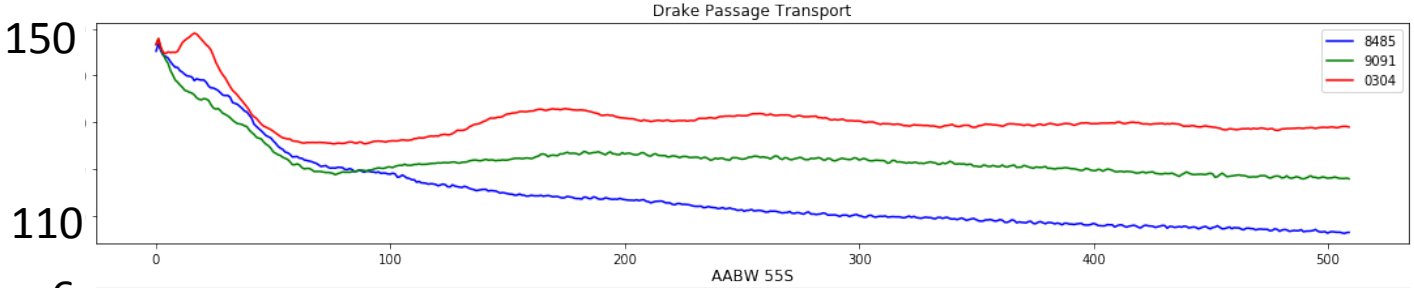
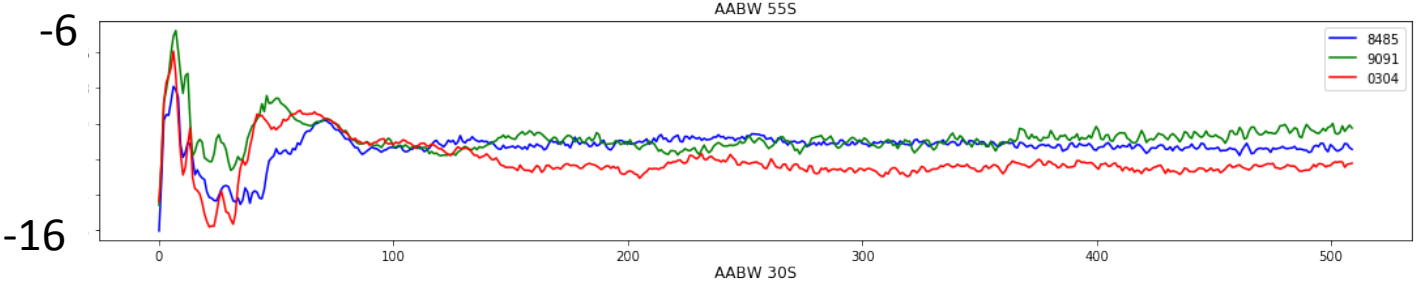
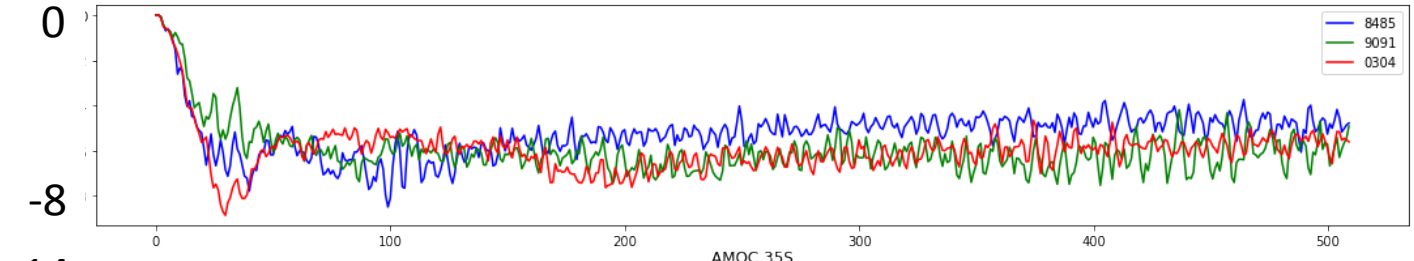
Drake Passage



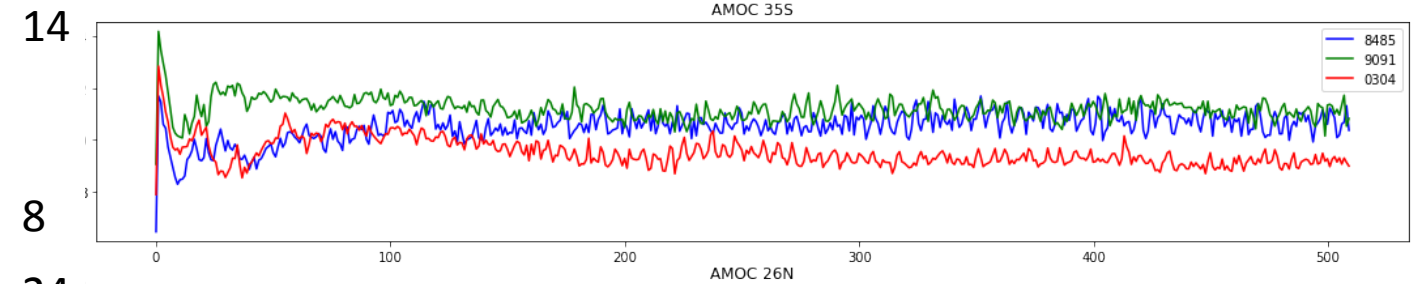
AABW 55°S



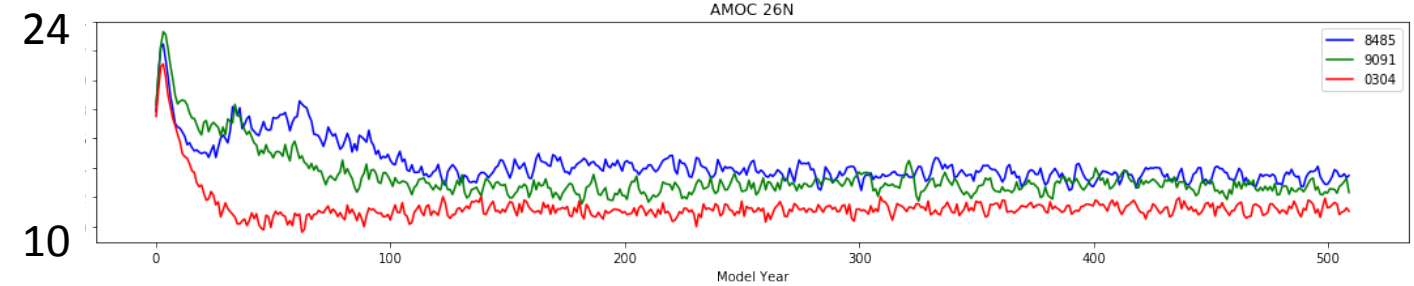
AABW 30°S



AMOC 35°S



AABW 26°N



JRA55-do RYF: where to from here…

Complete evaluation runs using ACCESS-OM2 with common set diagnostics

- Comparison of JRA55-do RYFs with collaborating modelling groups (NCAR, JMA)
- Seek submissions for a wider comparison of RYFs from additional modelling groups
- Prepare for the release of RYF protocol **with recommended year**

Explore RYF with ACCESS-OM2 across vertical (KDS suite) and horizontal resolutions

Perturbation runs with idealised RCP4.5 and/or Durack & Wijffels (2010) forcing anomalies

- Ocean heat uptake and sea ice response to perturbation forcings