High resolution model-observation comparison at key locations for heat and freshwater transport to the Arctic

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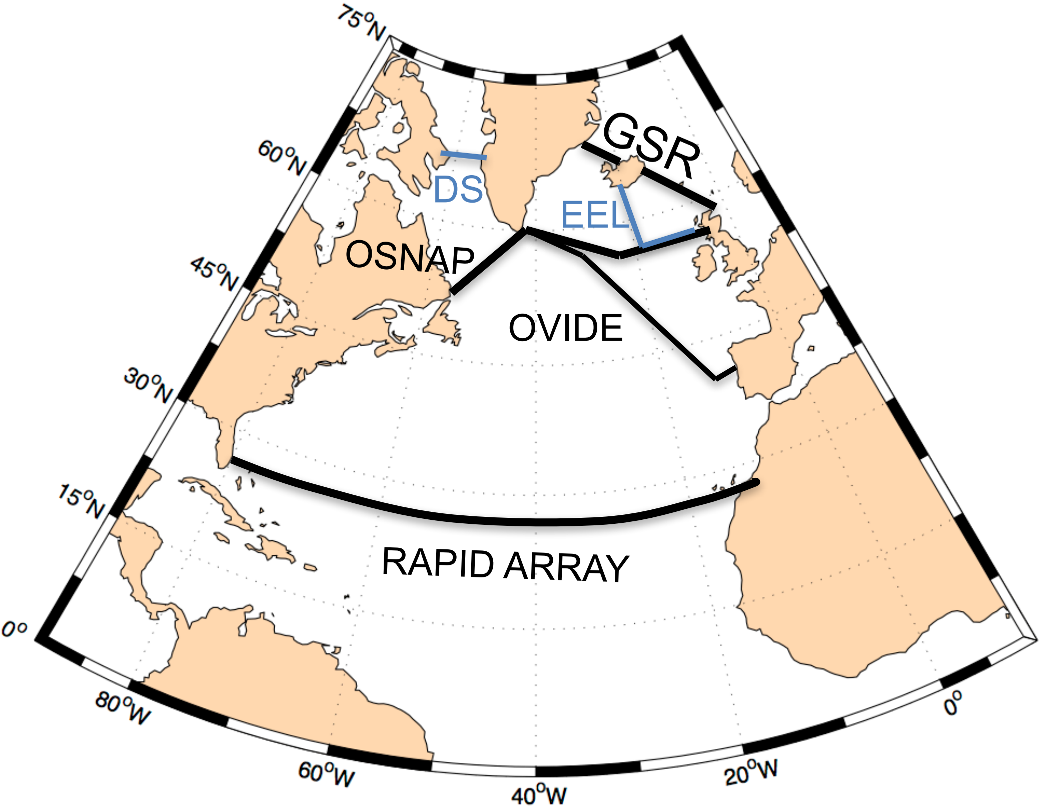


ACSIS

PRIMAVERA

BLUE ACTION

Bologna, 19th September 2018

Observational Data Sets

- **RAPID 26N (2004 to Feb 2017)**
  AMOC time series release 2005 to 2017 (**http://www.rapid.ac.uk/rapidmoc/)**
  Heat transport time series 2004 to 2015 (**online – update to 2017 soon)**
  Freshwater transport time series 2004 to 2017 **available soon**

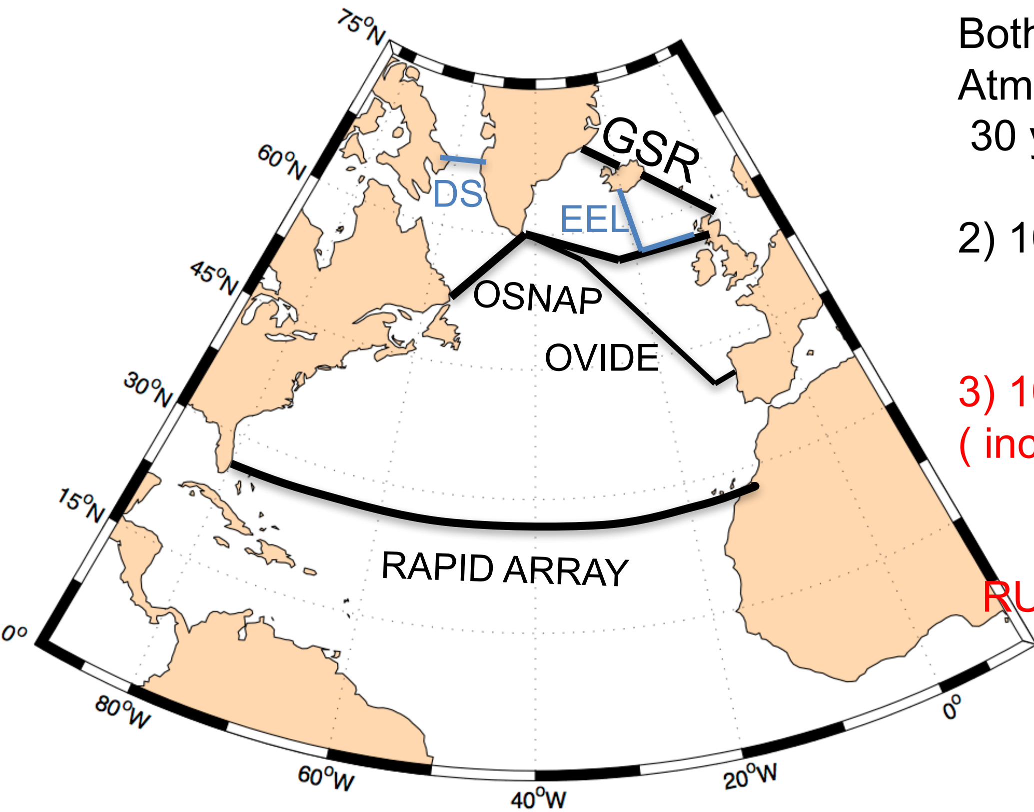
- **OVIDE (every 2 years since 2002)**
  MOC and temperature transport (**http://www.seanoe.org/data/00353/46445/**)

- **Extended Ellett Line (EEL)** (annually - 1975 to present)

- **OSNAP**
  Time series → release early 2018 (Aug 2014 to April 2016)
  MOC, heat transport and fresh water transport

- **GSR**
  A number of components - Need to produce a single time series

High resolution Models



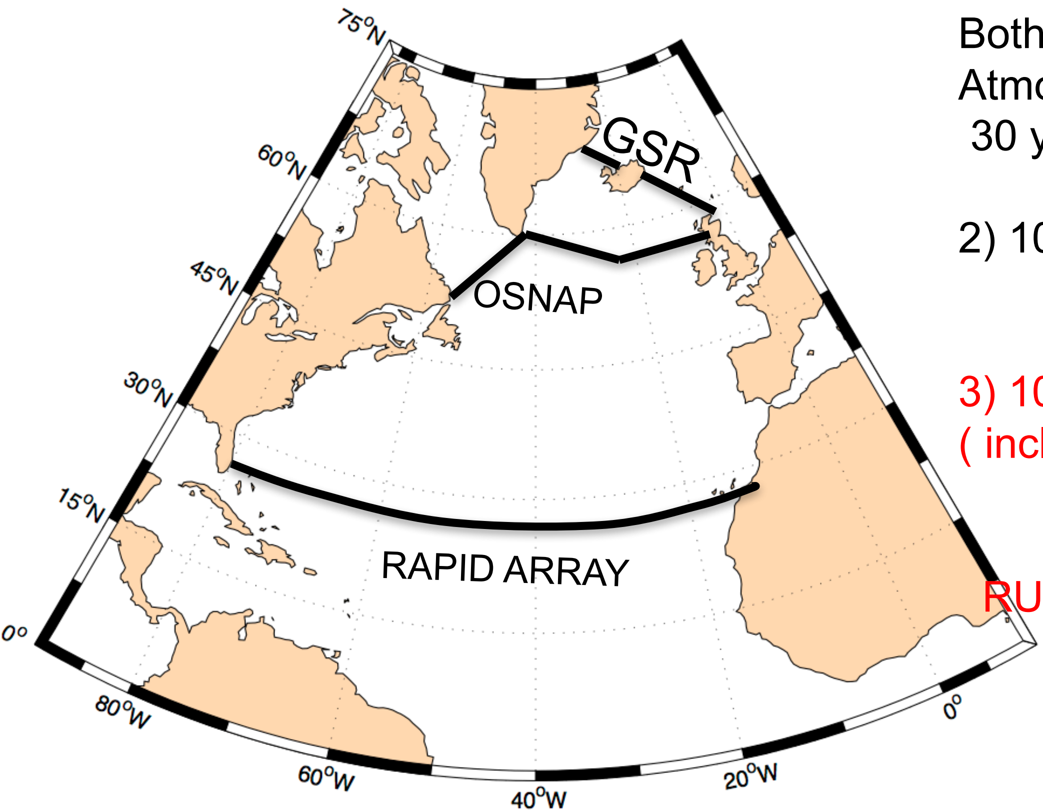
NEMO Ocean only HINDCAST
1) 1/12° 1958 to 2015

Two (HadGEM3) - Coupled simulations
Both are 1/12° NEMO Ocean with N512 Atmosphere
30 year spin up with N216 atmosphere

2) 100 year **CONTROL** run fixed present day CO_2
RUNNING NOC, UK – 1950 to **1976**

3) 100 year **HISTORICAL** run to present day (includes: **volcanoes, solar, aerosols, greenhouse gases**)
and then a RCP scenario
RUNNING at UK MET OFFICE 1950 –to **2014**

High resolution Models



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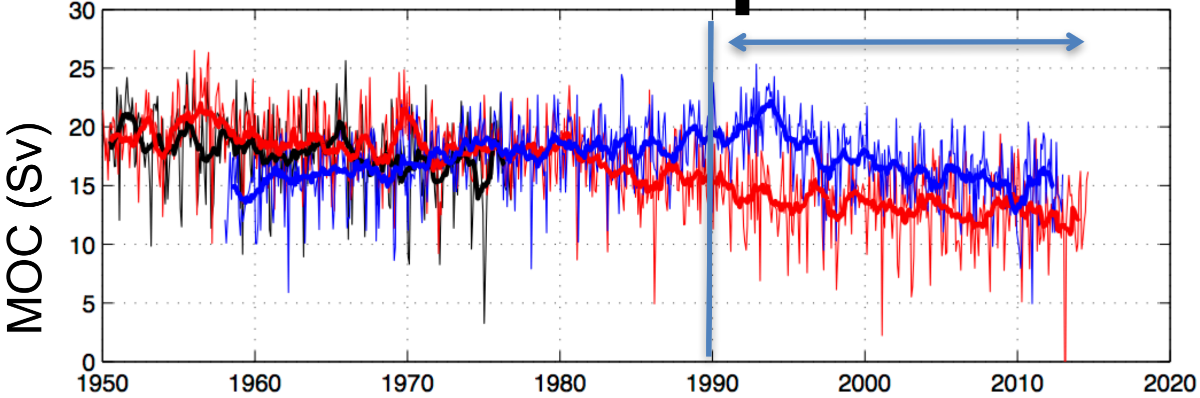
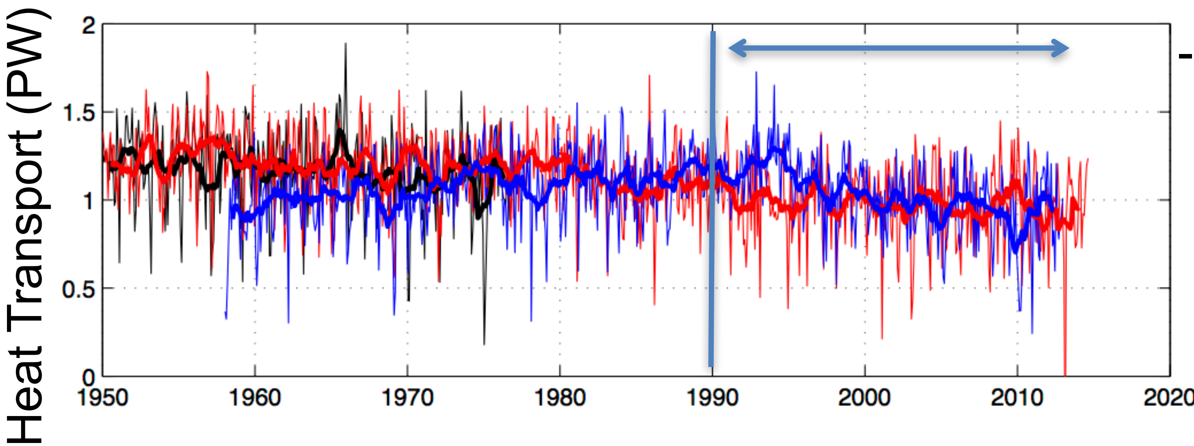
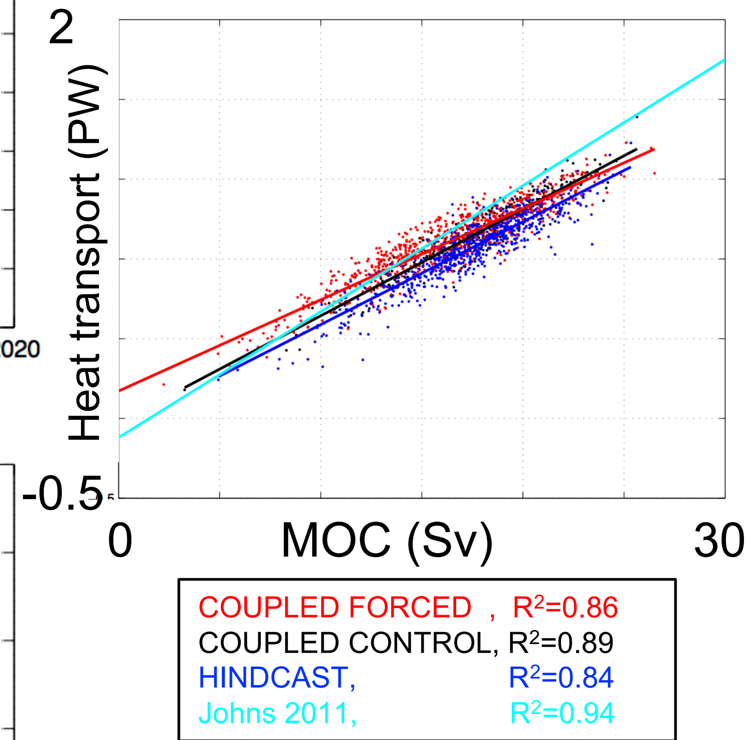
Transports at 26.5°N



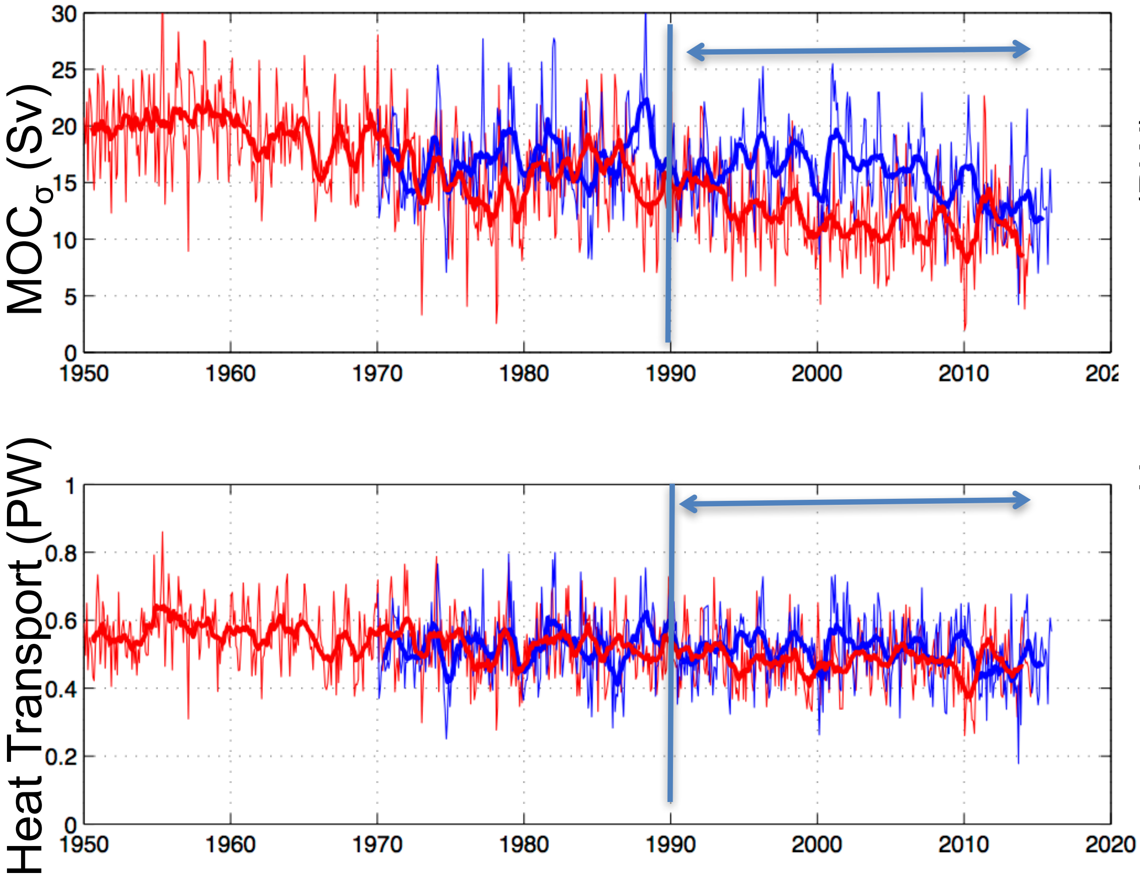


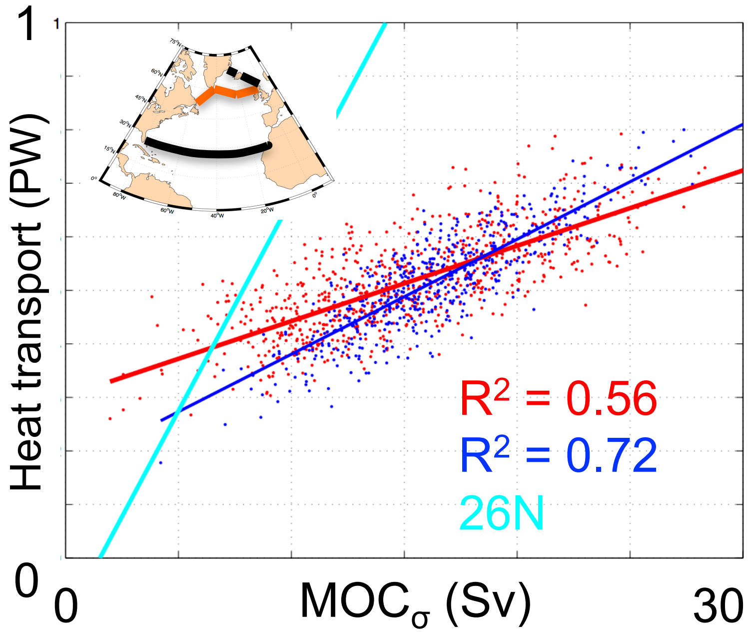


	MOC (Sv)	HT (PW)
HISTORICAL	13.3 ± 3.2 Sv	1.05 ± 0.23 PW
HINDCAST	17.5 ± 3.1 Sv	1.06 ± 0.22 PW
OBSERVATION	17.0 ± 4.4 Sv	1.22 ± 0.11 PW

Good agreement between HT in models, but lower than observation

OSNAP SECTION

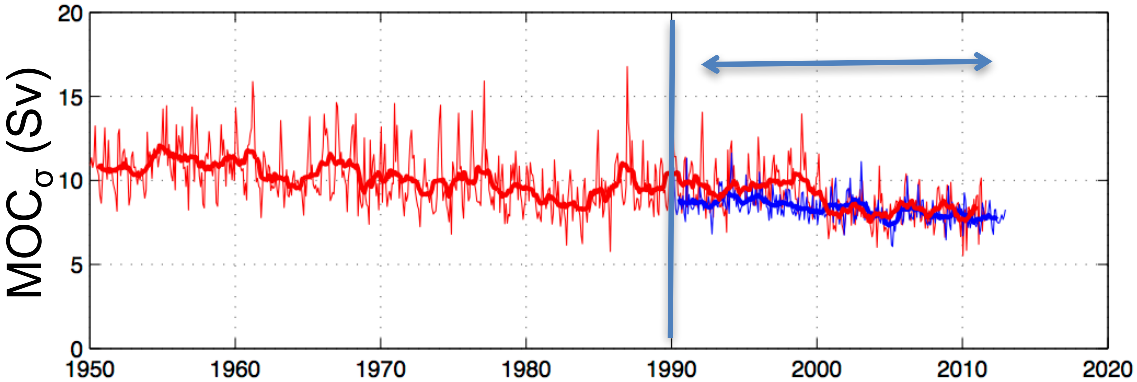


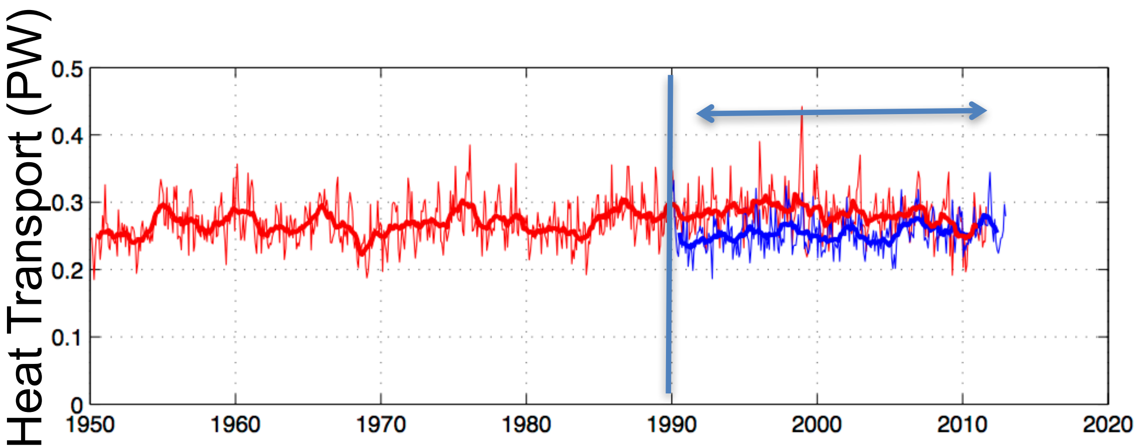


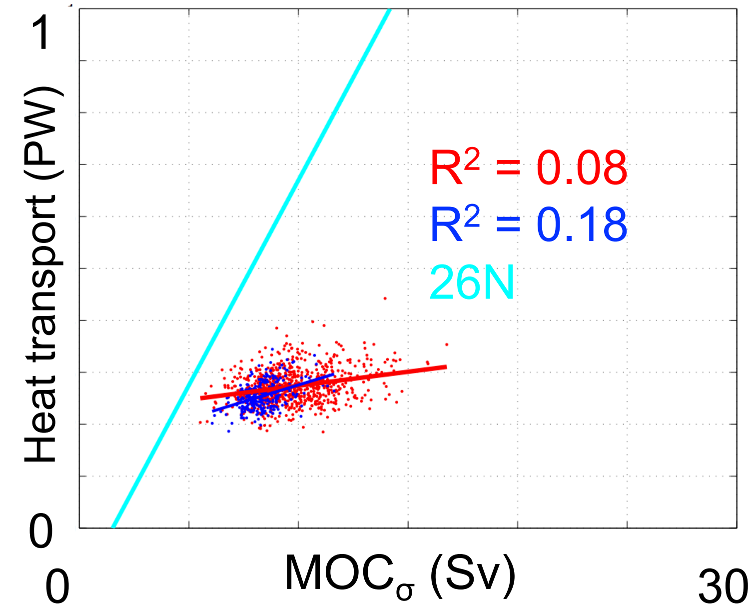
MOC vs HT relationship not as strong as that at 26N

	MOC (Sv)	HT (PW)
HISTORICAL	11.9 ± 3.5 Sv	0.48 ± 0.08 PW
HINDCAST	15.6 ± 3.5 Sv	0.51 ± 0.09 PW
OBSERVATION	13.2 ± 3.3 Sv	early 2018

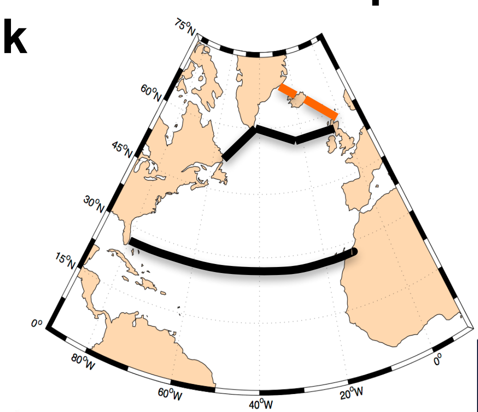
Greenland Scotland Ridge (GSR)





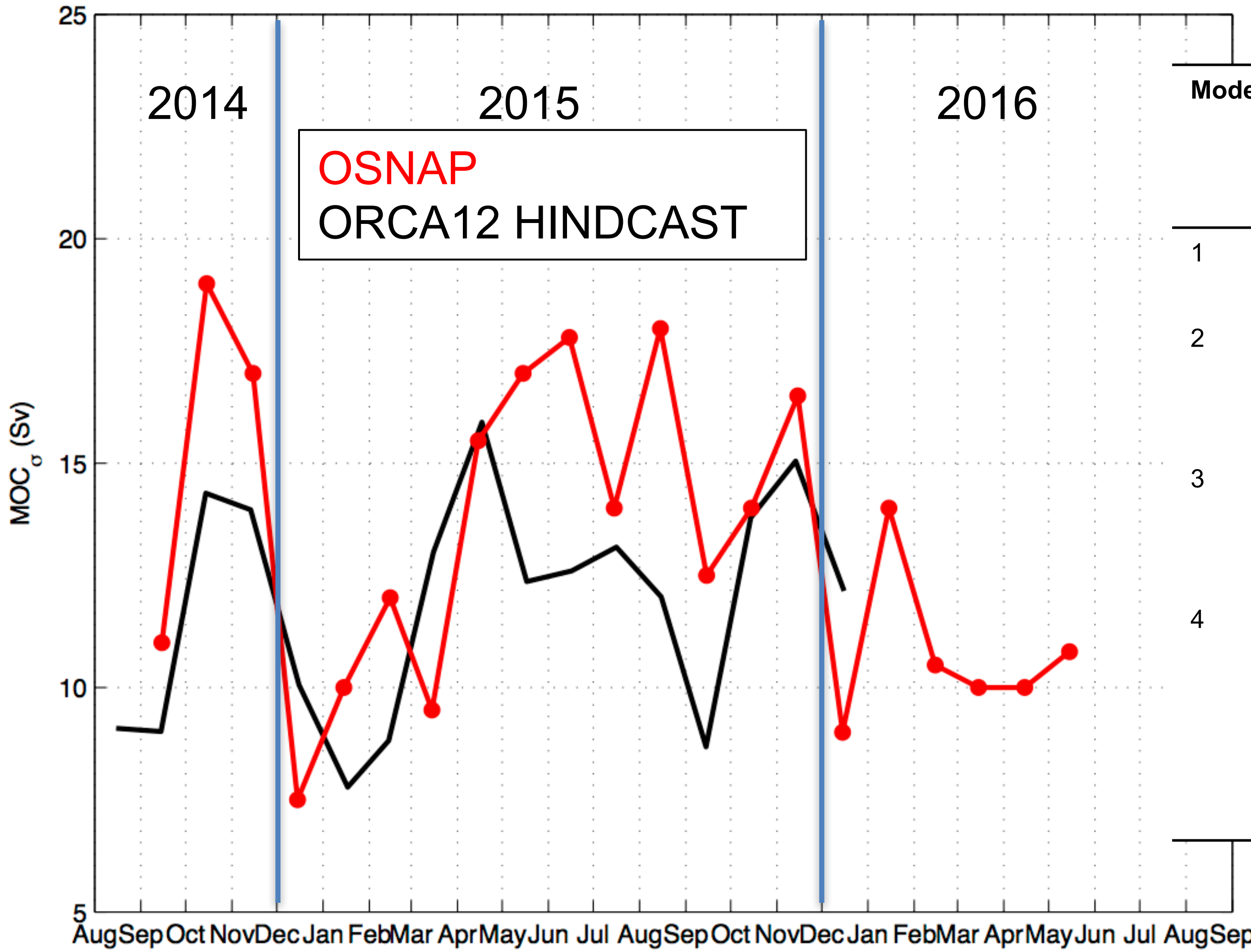


MOC vs HT relationship is weak



	MOC (Sv)	HT (PW)
HISTORICAL	8.9 ± 1.42 Sv	0.28 ± 0.03 PW
HINDCAST	8.3 ± 0.84 Sv	0.25 ± 0.03 PW
OBSERVATION	7.4 Sv	0.26 PW

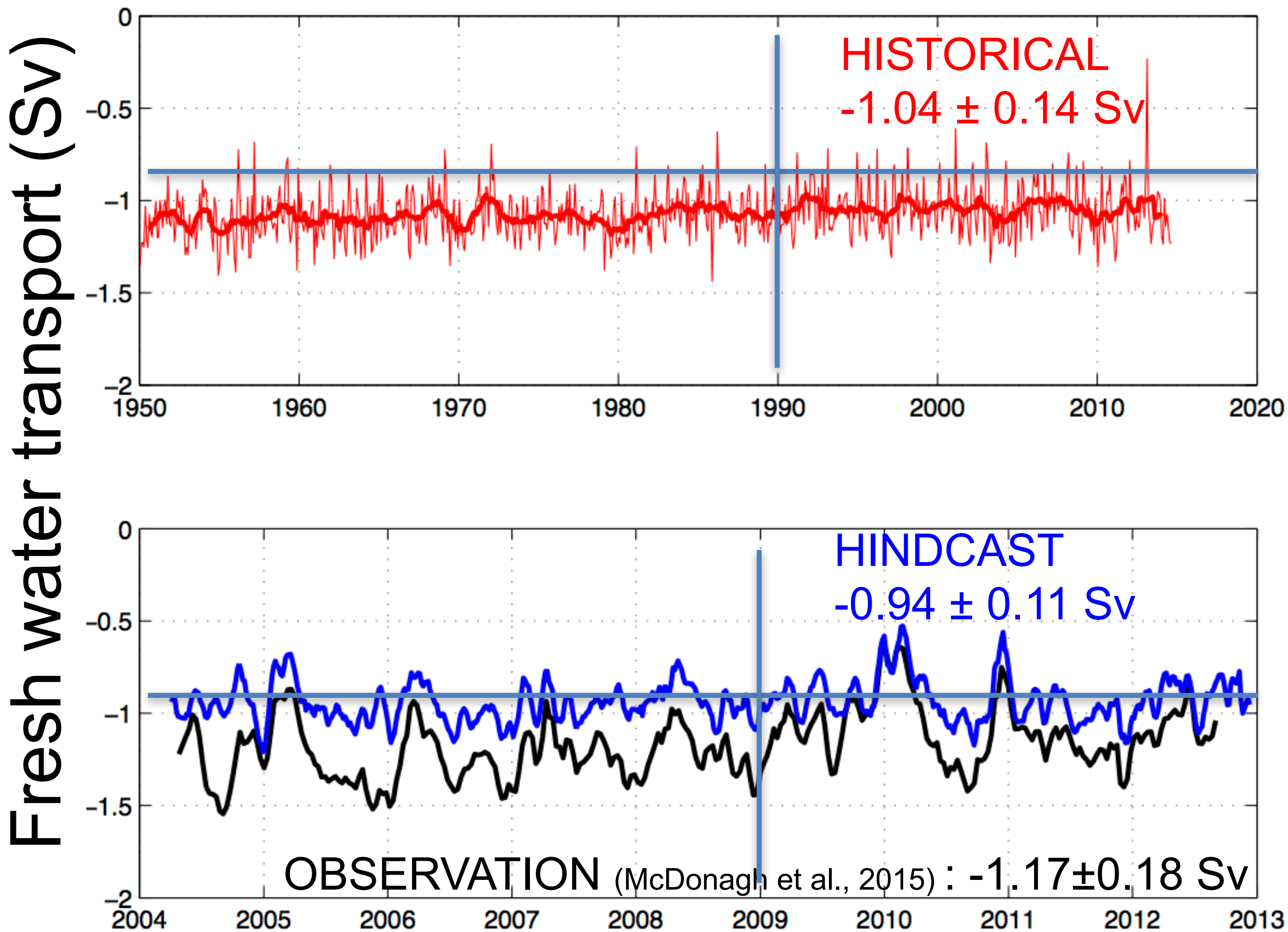
OSNAP Challenge 2017 (BLUE-ACTION won)



Model	Group	RMSE (Sv)	Correlation (r)
1	**Ben Moat, (NOC, UK)**	**3.3**	**0.59**
2	Charlene Feucher (Universiry of Alberta)	5.87	0.50
3	Laura Jakson (Met office, UK)	6.34	-0.14
4	Andrea Storto (CMMC, Italy)	9.86	0.33
	Mean of predictions	6.34	

http://www.o-snap.org/news-events/osnap-challenge/

Fresh water transports at 26.5°N

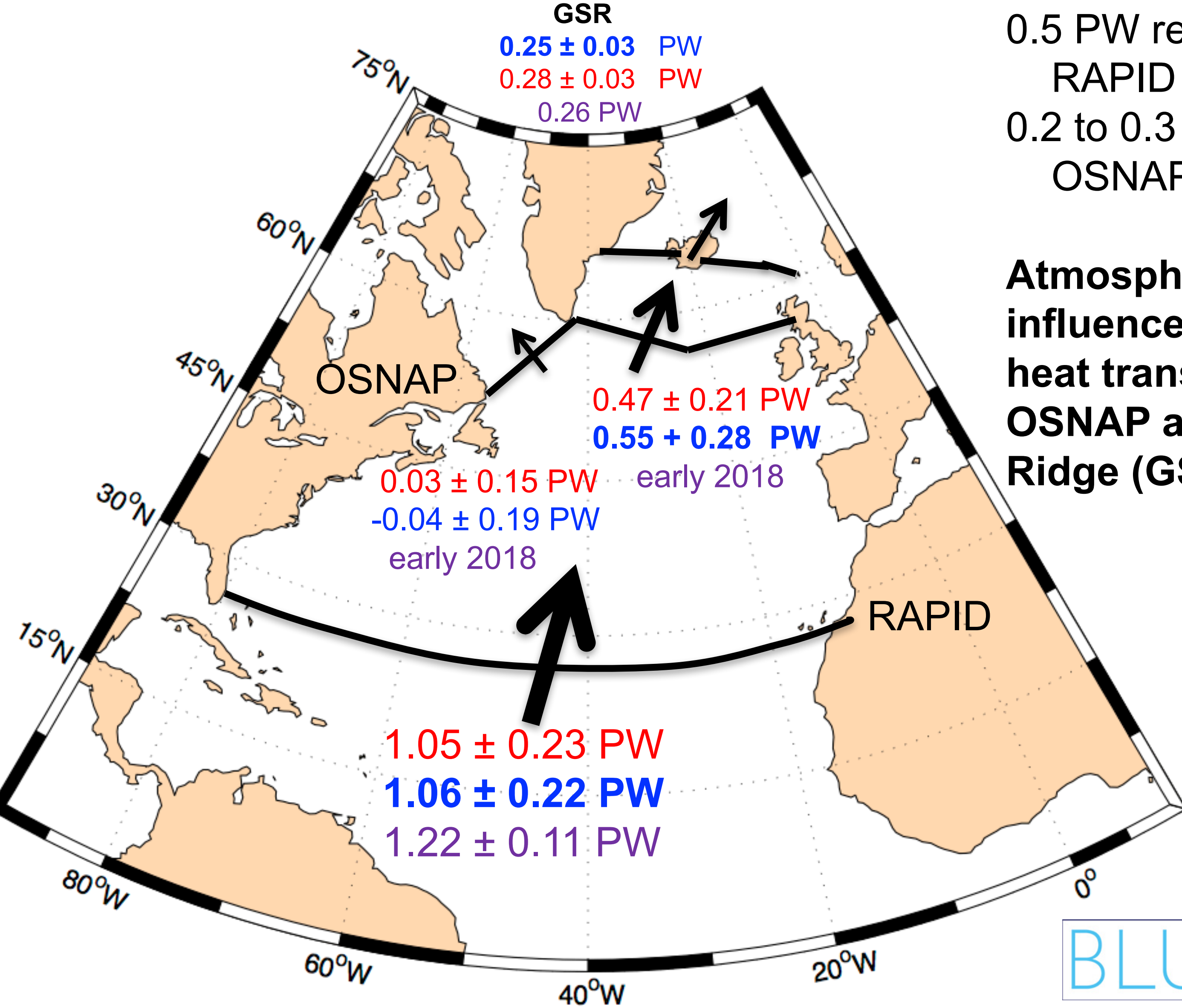


Bering Straits:
0.8 Sv at 32.5 psu
26 Sv psu

Good agreement between HINDCAST and Observation

Extend to other sections

North Atlantic Heat transport



0.5 PW reduction between RAPID and OSNAP

0.2 to 0.3 PW reduction between OSNAP and GSR

Atmosphere may have a greater influence than the MOC on the heat transport variability, at OSNAP and Greenland Scotland Ridge (GSR) sections.

COUPLED 1/12° N512
1/12° OCEAN HINDCAST
OBSERVATION

BLUE ACTION

SUMMARY

- Comparison of High resolution models and observations is encouraging
- Relationship between MOC and Heat transport is weak on the OSNAP and GSR sections

Plans

- Extend analysis to freshwater transports on all the sections (include Davis Strait)
- Need to create a time series of the whole Greenland Scotland Ridge (GSR) section.
- Extend to the 1/24° NEMO (CNRS), and IPSL, CESM.
- "... feedback between ocean heat transport estimates and atmospheric heat transport in coupled simulations"

Presentations

Modelling Workshop Evaluating climate and Earth System models at the process level, 23-24 May 2017, Brussels.

Understanding Change and Variability in the North Atlantic Climate System, ACSIS - OSNAP – RAPID Joint Science Meeting, 19-21 September 2017, Oxford, UK.

Papers

Sinha, B, B. Topliss, M. Hughes, A. T. Blaker, J. Hirschi, C. Franzke, S. X. Josey, V. Ivchenko, B. I. Moat, 2018, Impact of Arctic climate change on the North Atlantic ocean circulation: a model study, Prog. in Ocean. (in prep)

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