The Forecasting Ocean Assimilation Model (FOAM) system

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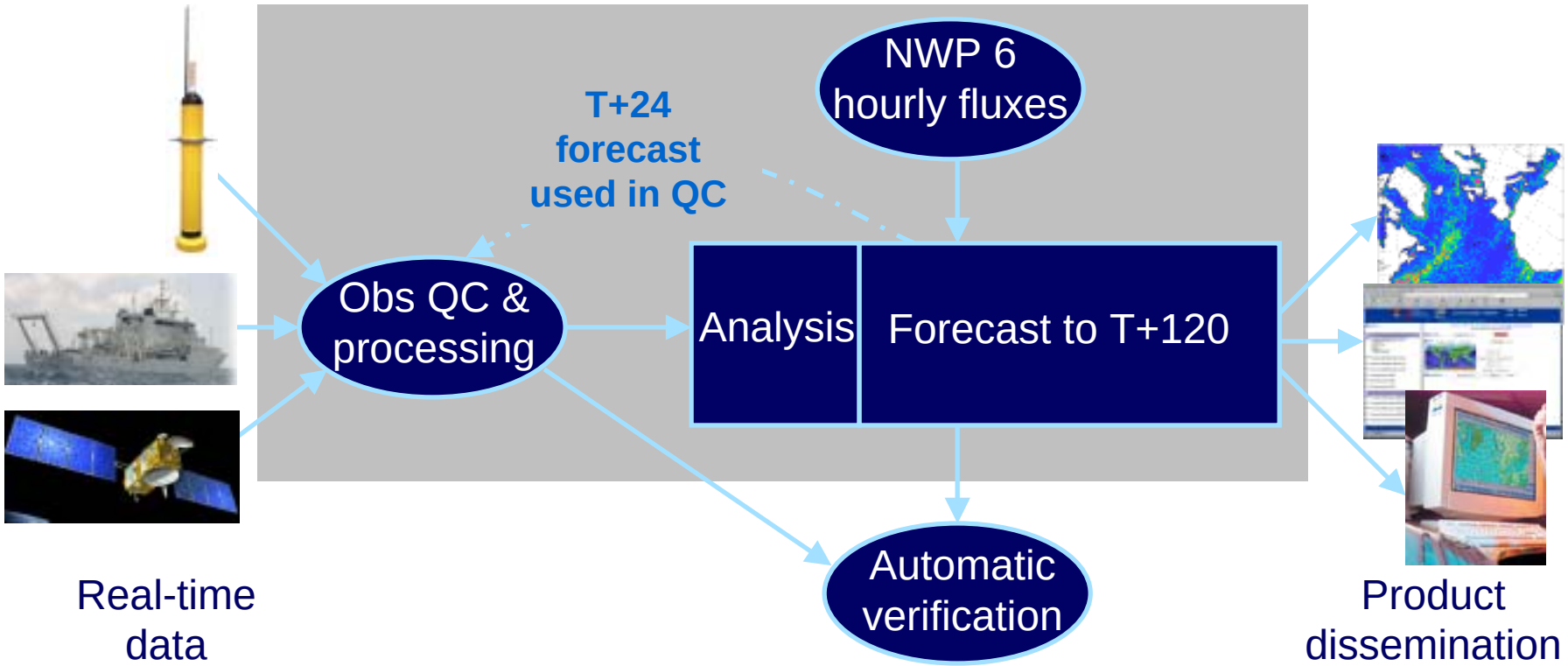
Contents

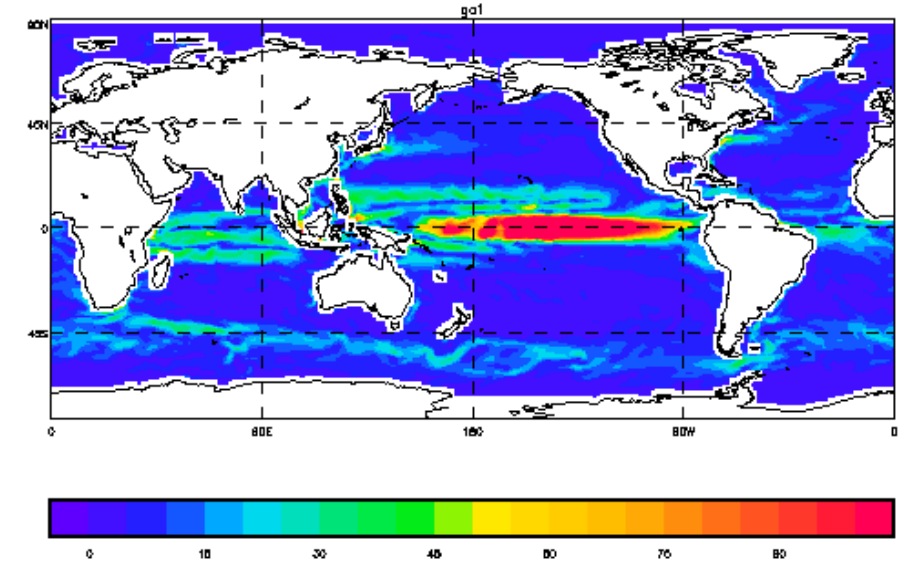
FOAM system

- Operational daily forecasts of the physical properties of the deep ocean
- Based on z-level, rigid-lid ocean model with mixed layer and sea-ice models (Hadley Centre)
- Driven by 6 hourly NWP surface fluxes
- Assimilates both in situ and satellite data
- Daily automated production of verification stats
- Relocatable high resolution nested modelling capability
- Output available on web: www.nerc-essc.ac.uk/godiva

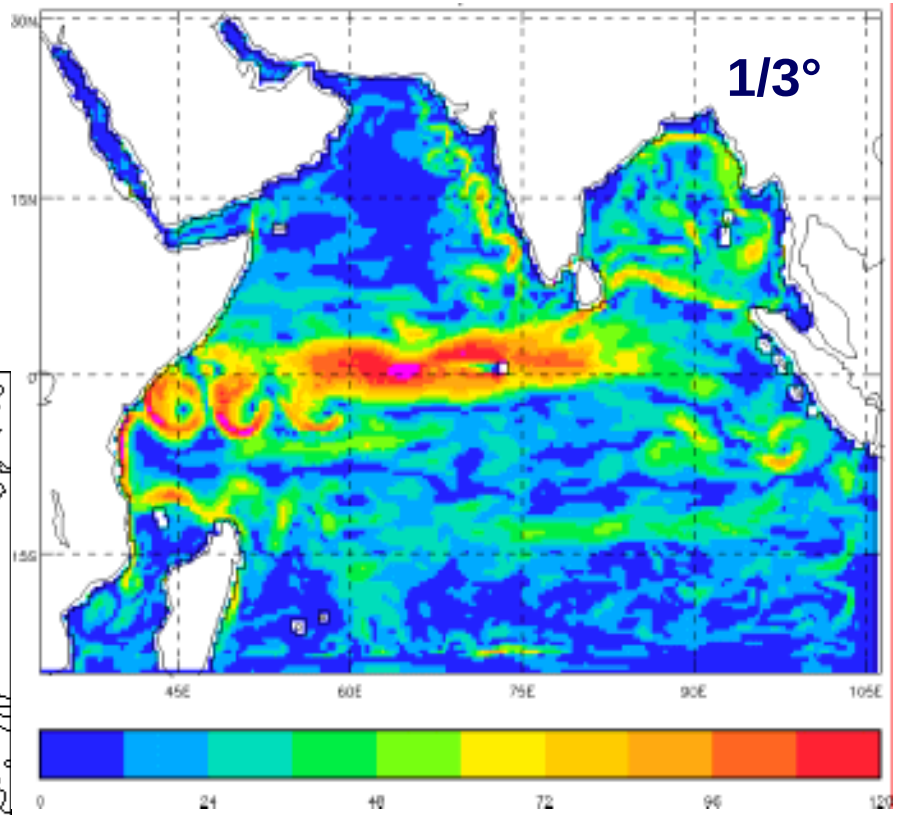
FOAM system



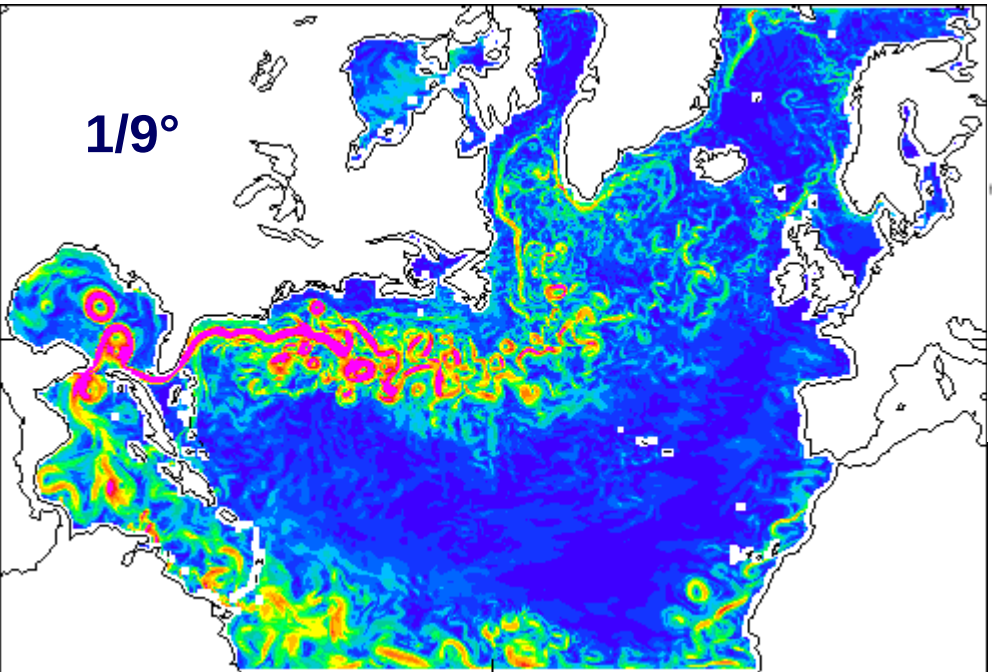
Operational models



1°



1/3°



1/9°

Model formulation

- Bryan-Cox ocean model:
  - Rigid lid + z-levels (so unsuitable for shallow tidal waters)
  - Biharmonic viscosity
  - QUICK 3rd order advection of tracers
  - Kraus-Turner + K-profile vertical mixing
  - Same base model as Hadley Centre models
- Simple advective sea-ice model (moving to EVP)
- Flow Relaxation Scheme at open boundaries for nested models

Data assimilation

- Operational models assimilate:
  - Temperature and salinity profiles (including ARGO data)
  - In situ and satellite SST (2.5º AVHRR)
  - Satellite altimeter SSH (Jason-1, GFO, ERS-2)
  - SSMI-derived seaice data from CMC
- Sequential scheme based upon the Analysis Correction scheme of Lorenc et al. (1991) – approximation to OI.
- Operational upgrade implemented on Oct 2003 includes:
  - Implementation of salinity assimilation
  - Significant developments to original system
  - Upgraded QC of data from ENACT project

The NEMO system

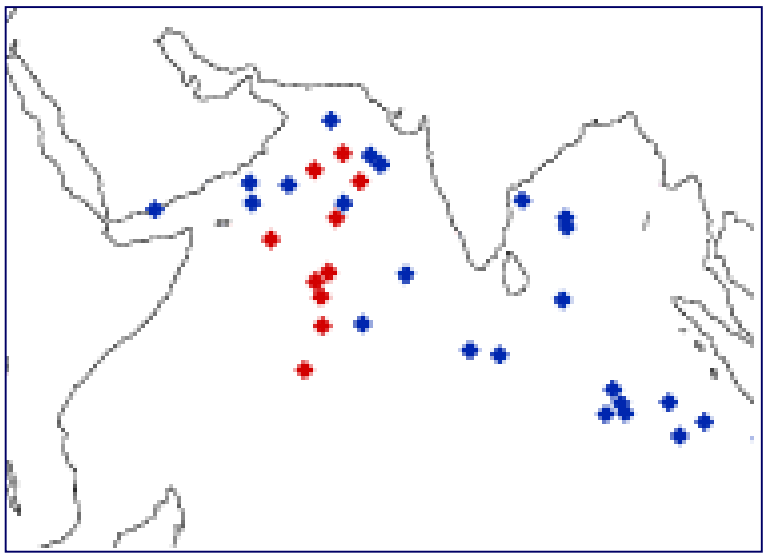
- MERSEA group is seeking to co-ordinate operational forecasting in Europe
- French OPA code will evolve into a shared European ocean model framework – NEMO
- FOAM will transition to using NEMO in the next 3-4 years
- Advantages:
  - European collaboration
  - FOAM and Shelf Seas groups can pool resources
  - Cleaner coding environment
- NEMO is freeware.

National Centre for Ocean Forecasting (UK)

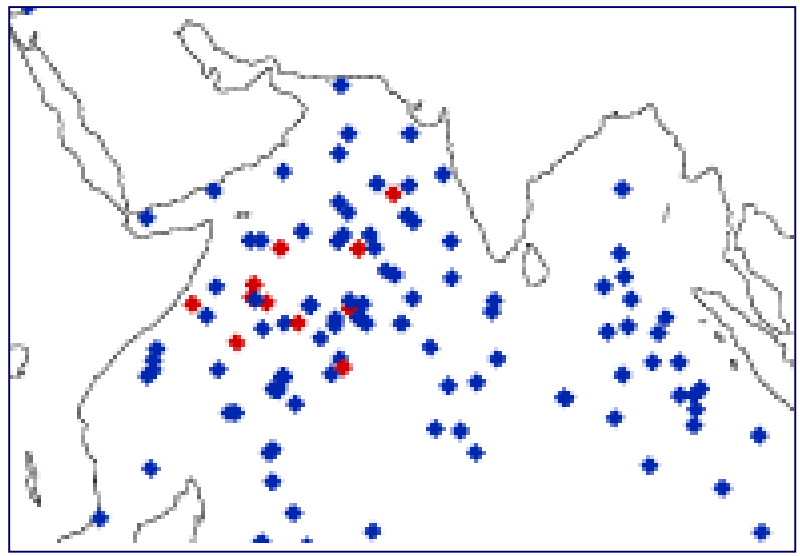
- Formal opening expected Feb - Mar 2005
- Will include development of deep ocean, shelf seas and surface wave forecasting
- Will build on and merge existing capabilities
- In association with NERC science laboratories: PML, POL, SOC, ESSC
- Will assist coordination of UK activities both nationally and internationally

Indian Ocean results

- Weekly analyses Oct 2002 – Oct 2004
- Seasonal means
- ARGO floats:

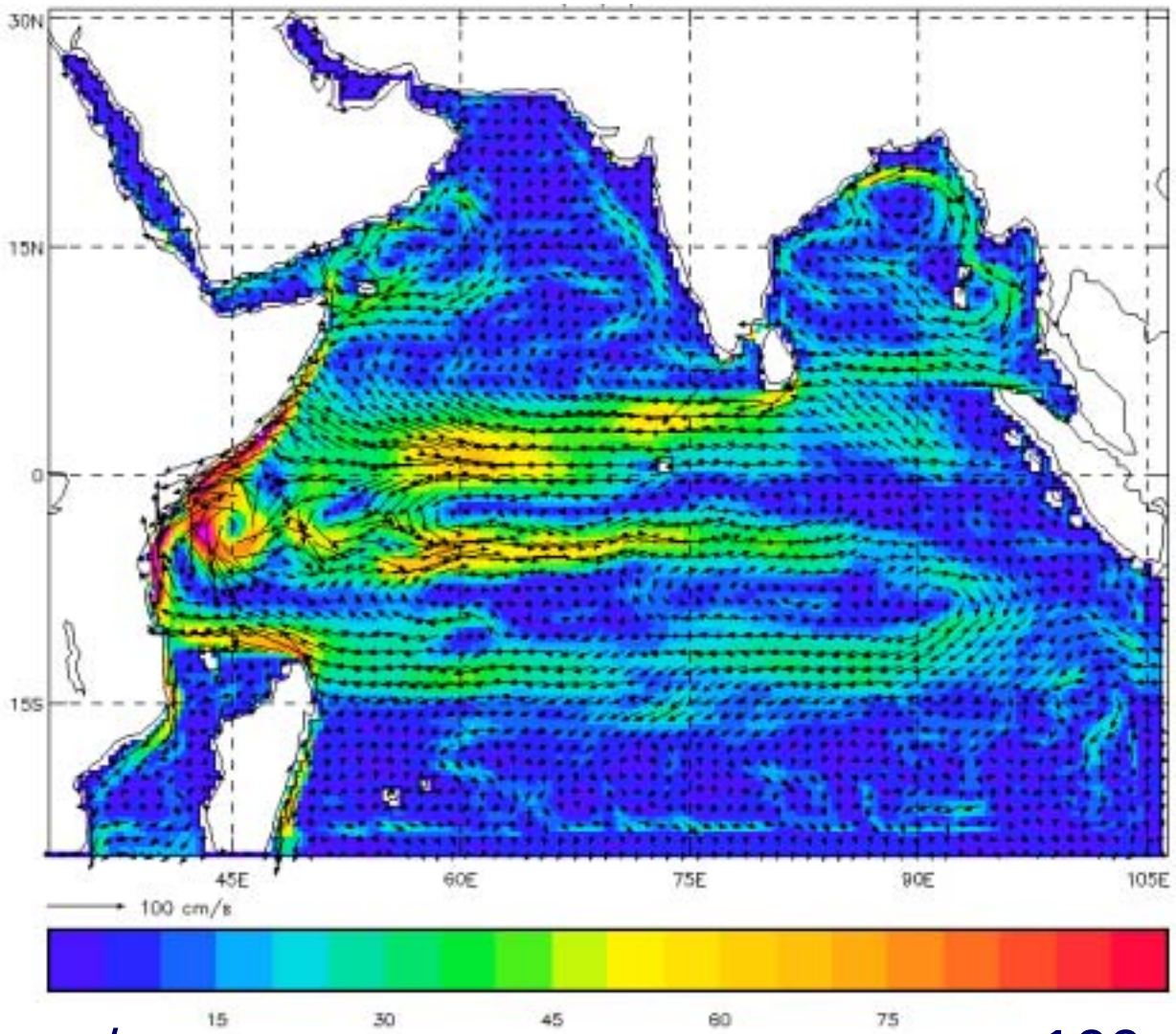


Oct 2002



Sep 2004

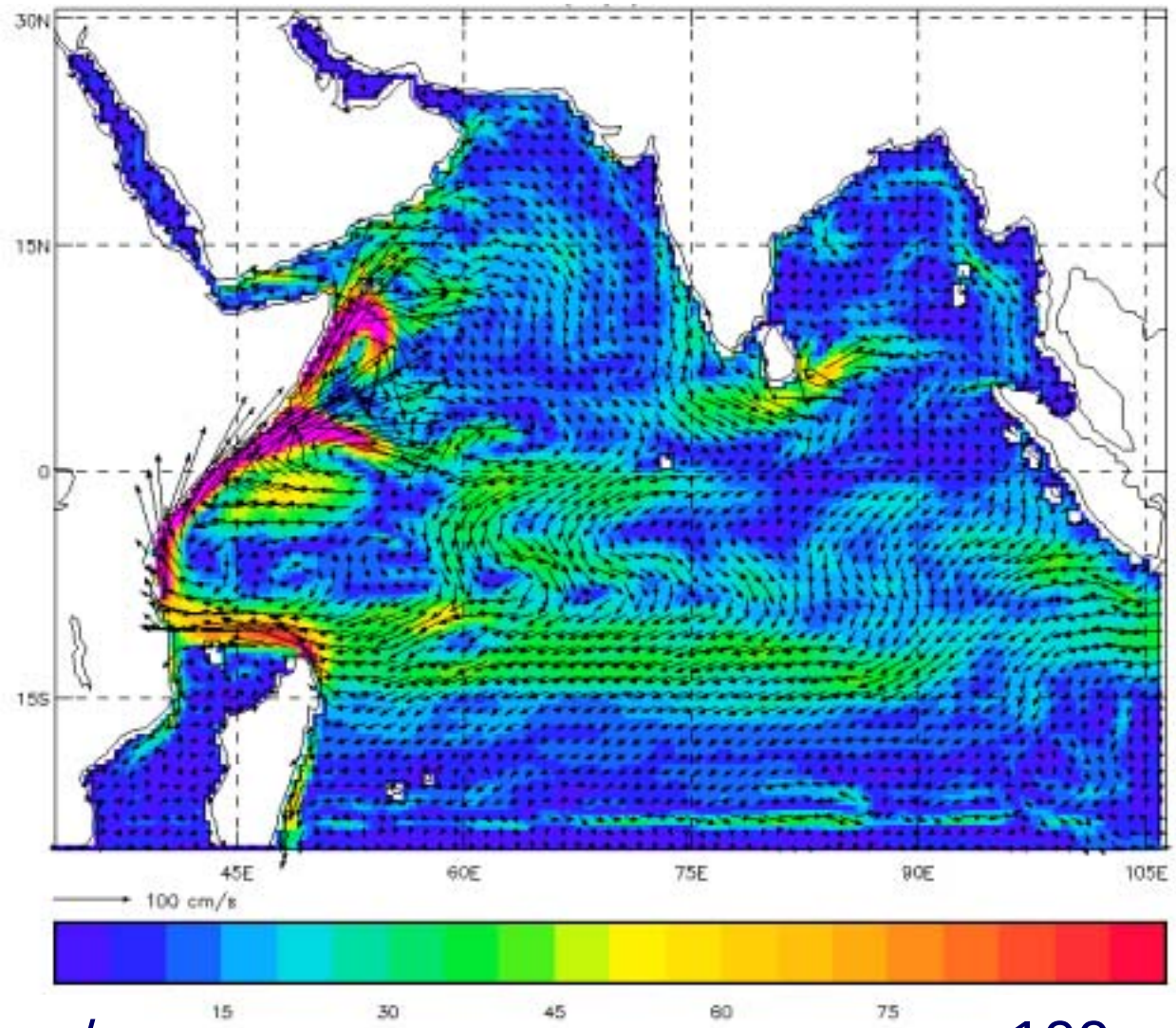
Surface currents: JFM (2-year mean)



0 cm/s

100 cm/s

Surface currents: JAS (2-year mean)

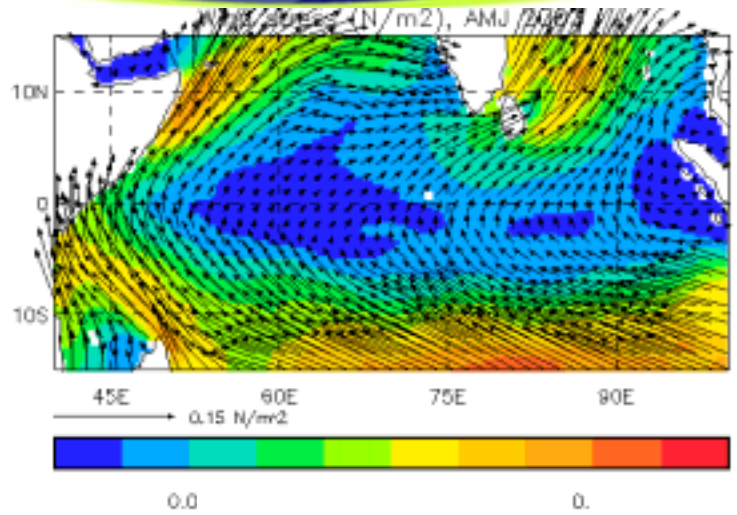


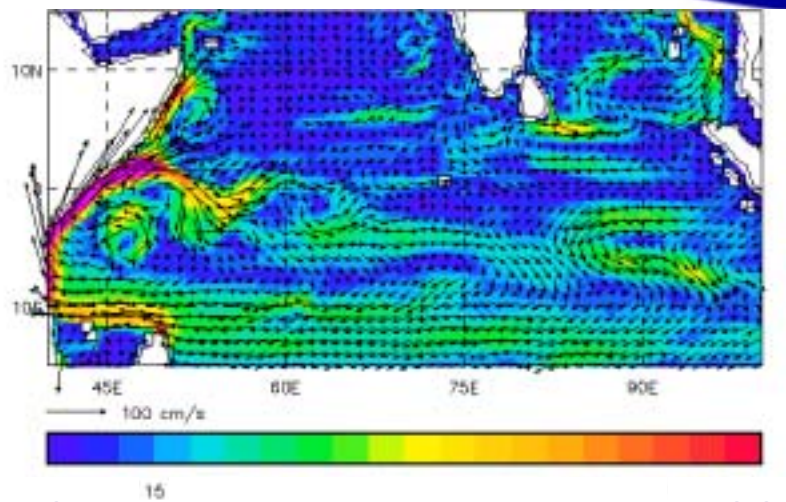
0 cm/s

100 cm/s

Inter-annual variability: Wyrtki jets (AMJ)

AMJ 2003

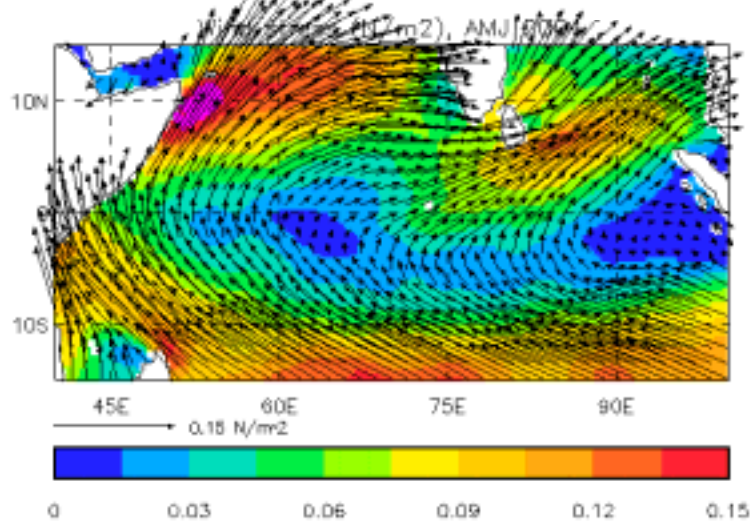


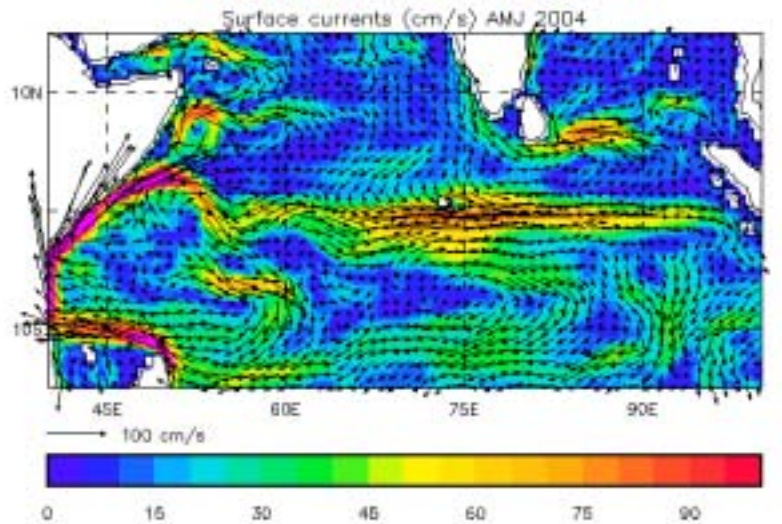


0 N/m2 wind stress 0.15 N/m2

0 cm/s surface currents 100 cm/s

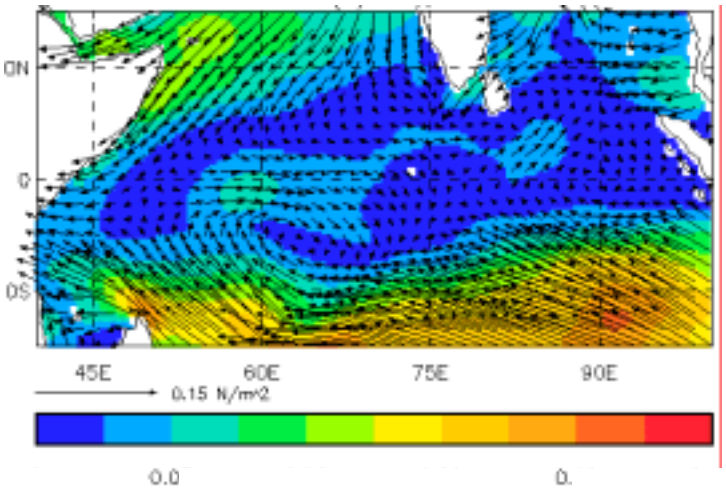
AMJ 2004



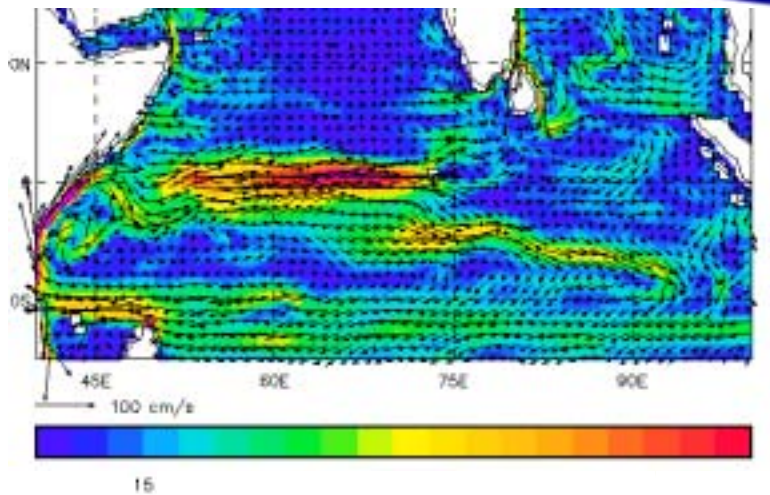


Inter-annual variability: Wyrtki jets (OND)

OND 2002

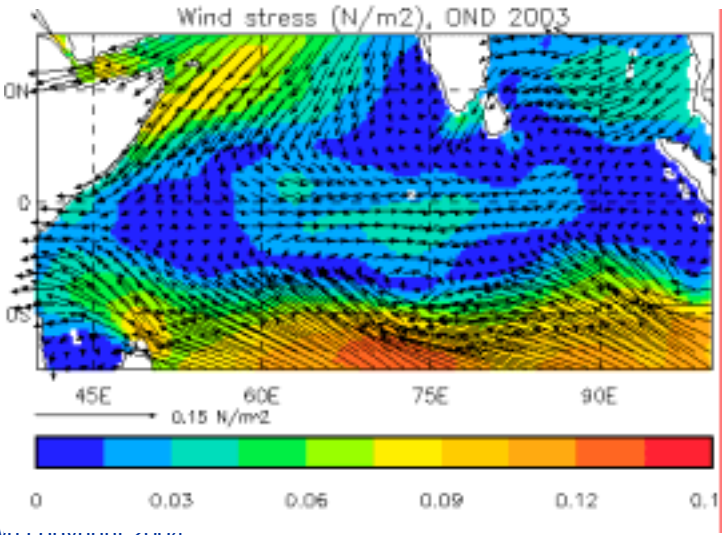


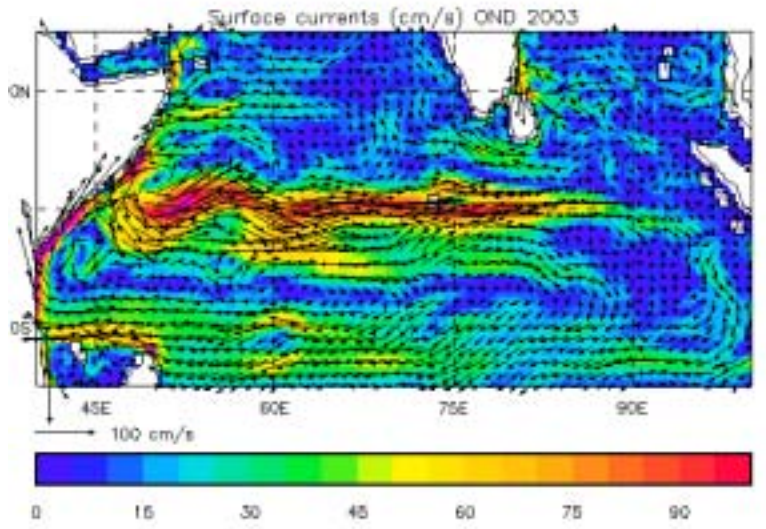
0 N/m2 wind stress 0.15 N/m2



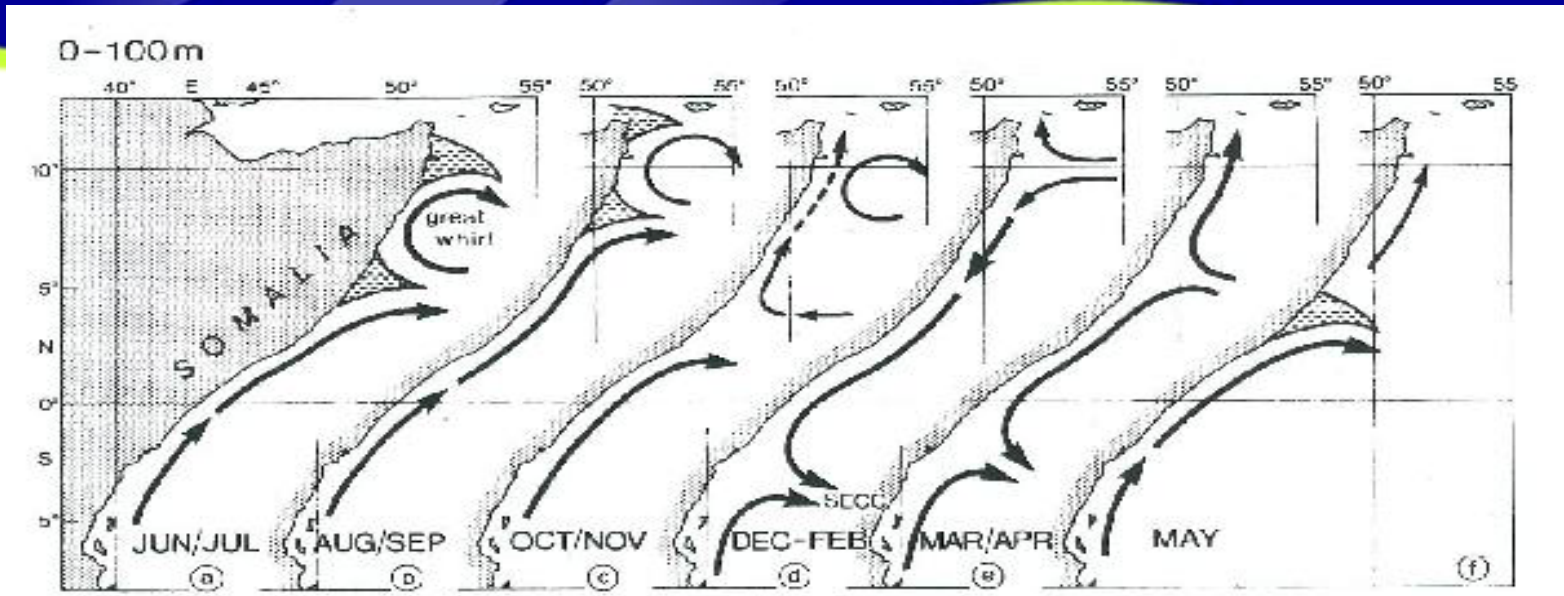
0 cm/s surface currents 100 cm/s

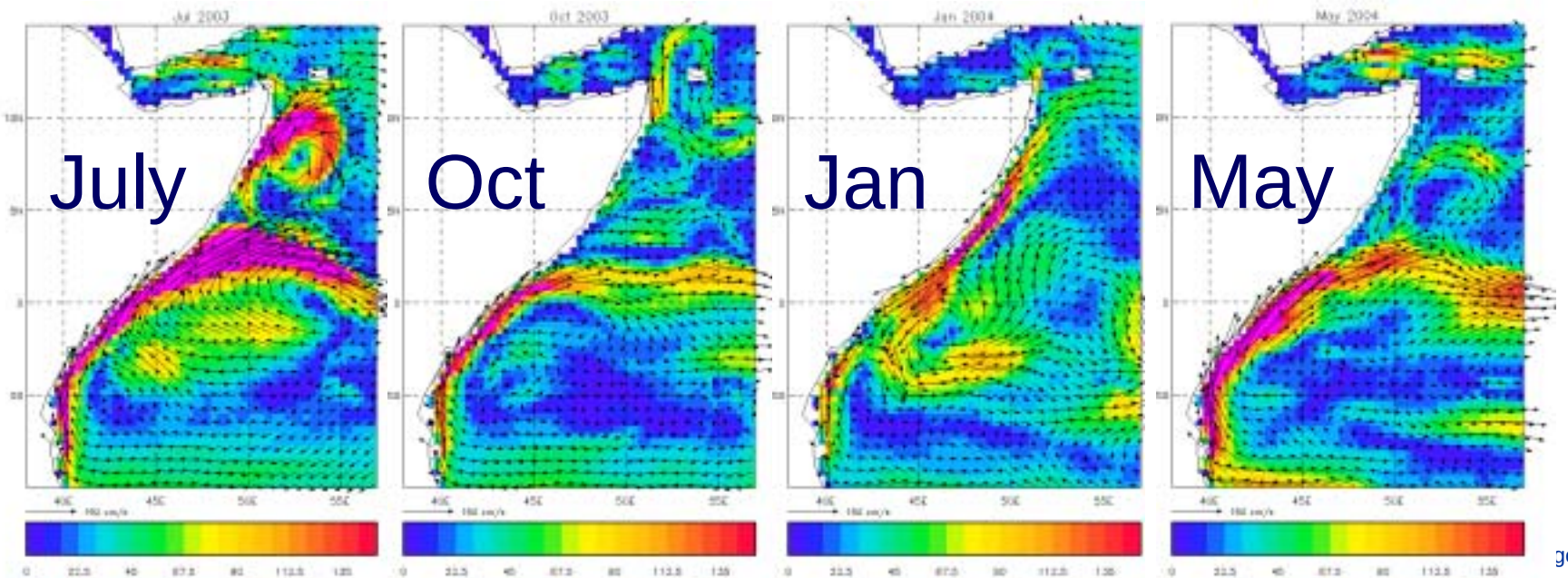
OND 2003



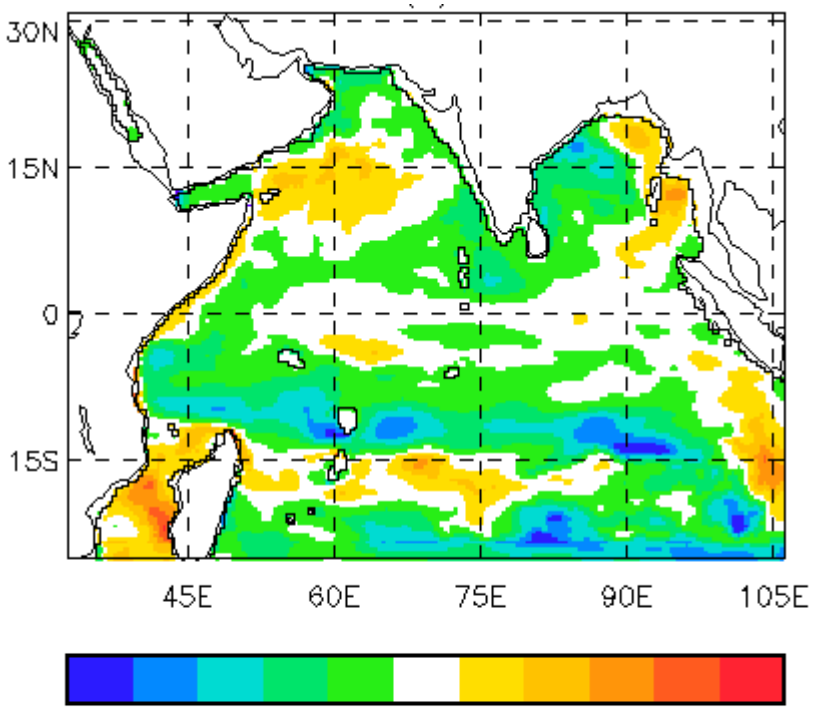


Somali Current System (surface currents)

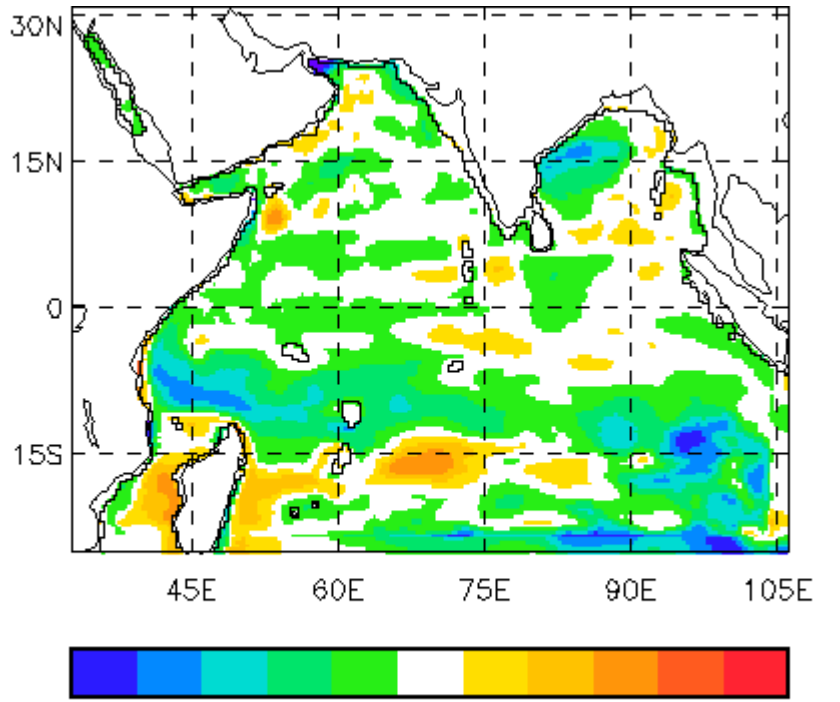




300m temperature anomaly from Levitus 98



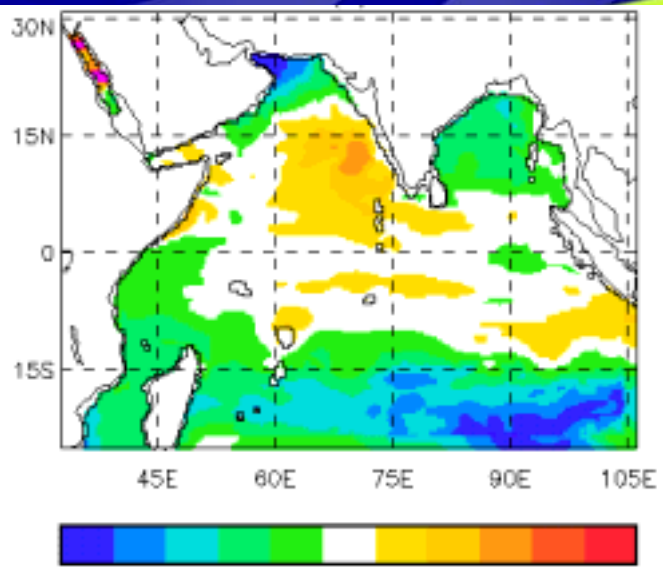
JFM



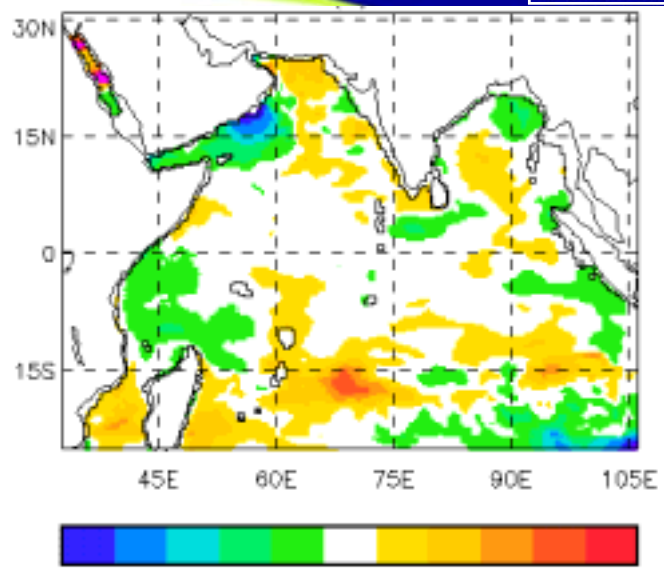
JAS

300m salinity anomaly from Levitus 98

JFM

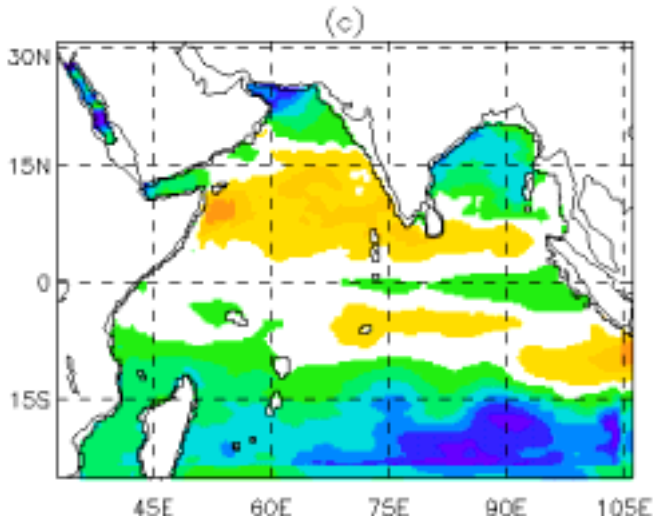


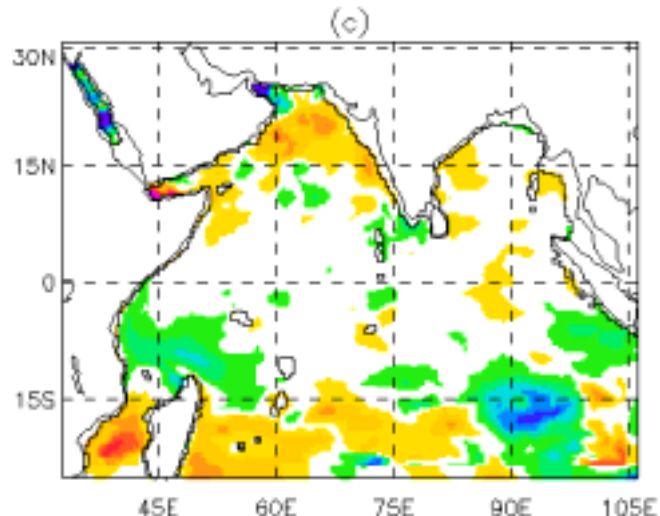
2003



2004

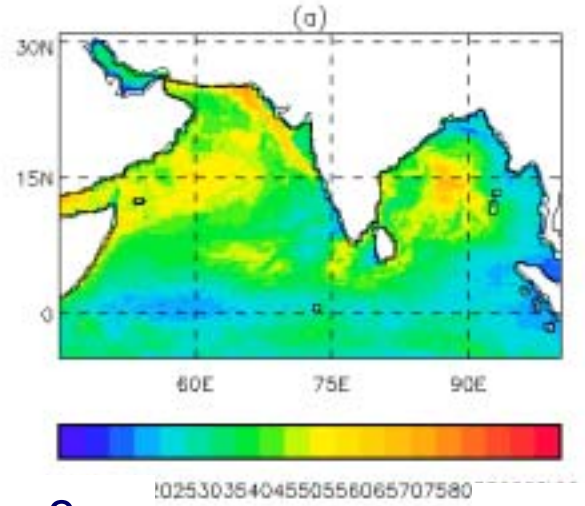
JAS



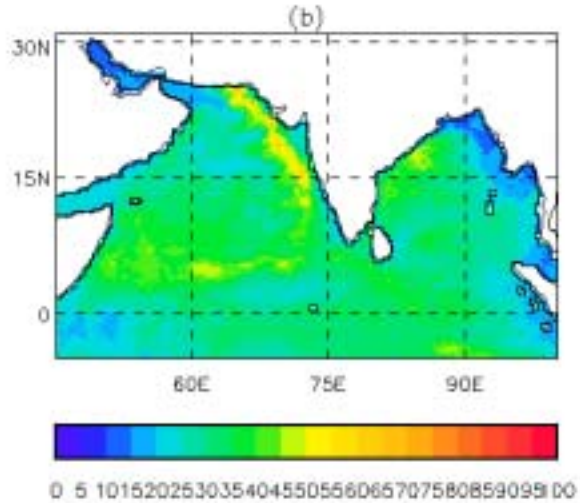


Mixed layer depth, seasonal cycle

JFM



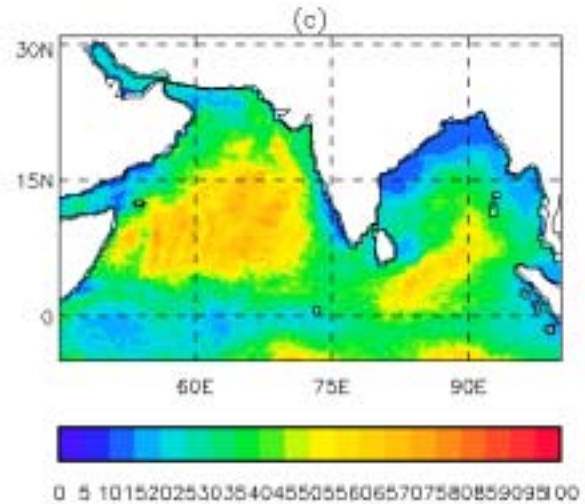
0 m

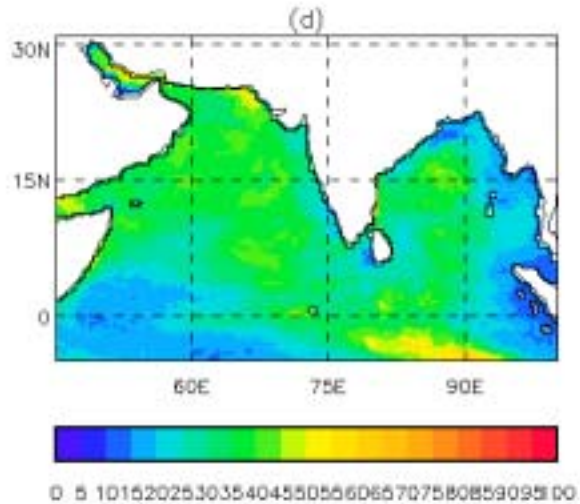


100 m

AMJ

JAS

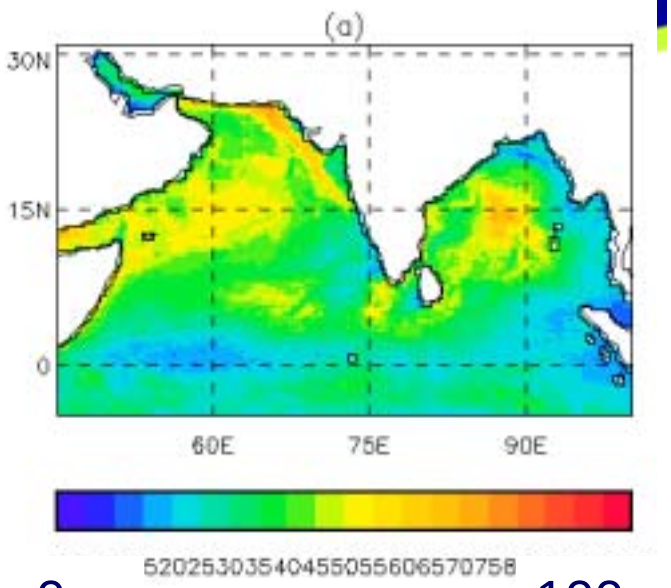




OND

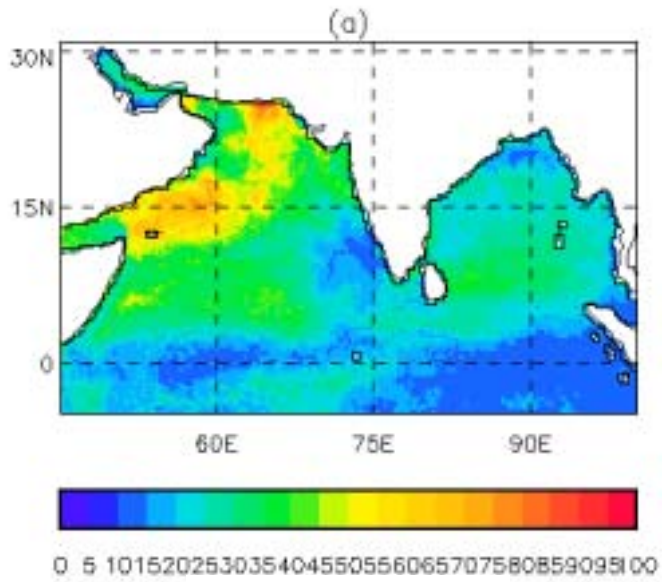
Mixed layer depth, interannual variability

MLD



0 m

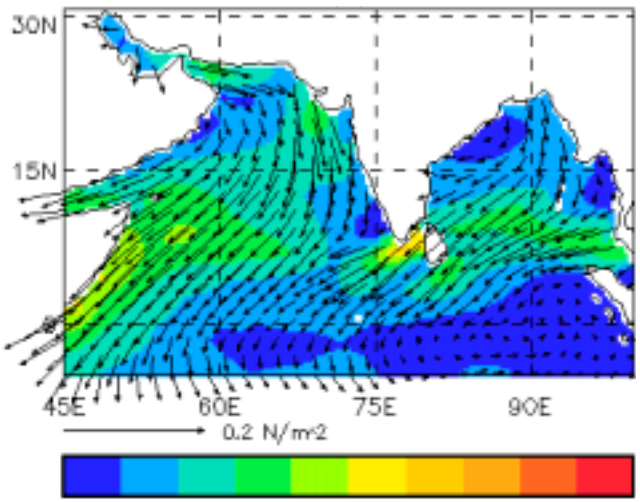
JFM 2003



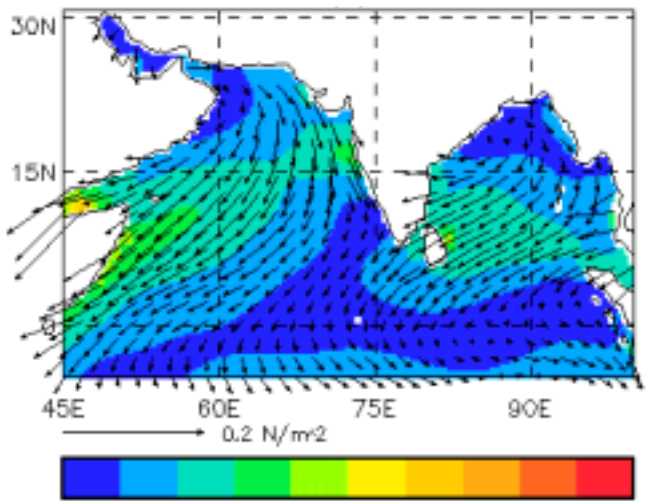
100 m

JFM 2004

wind stress



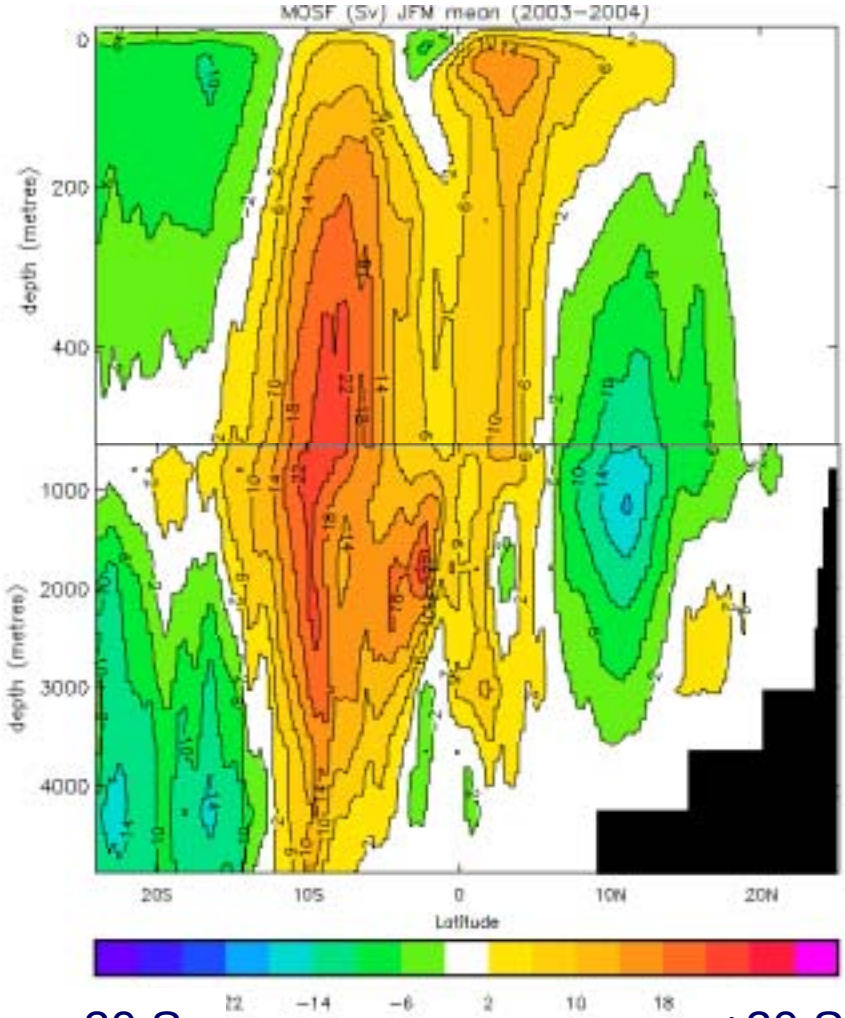
0 N/m2



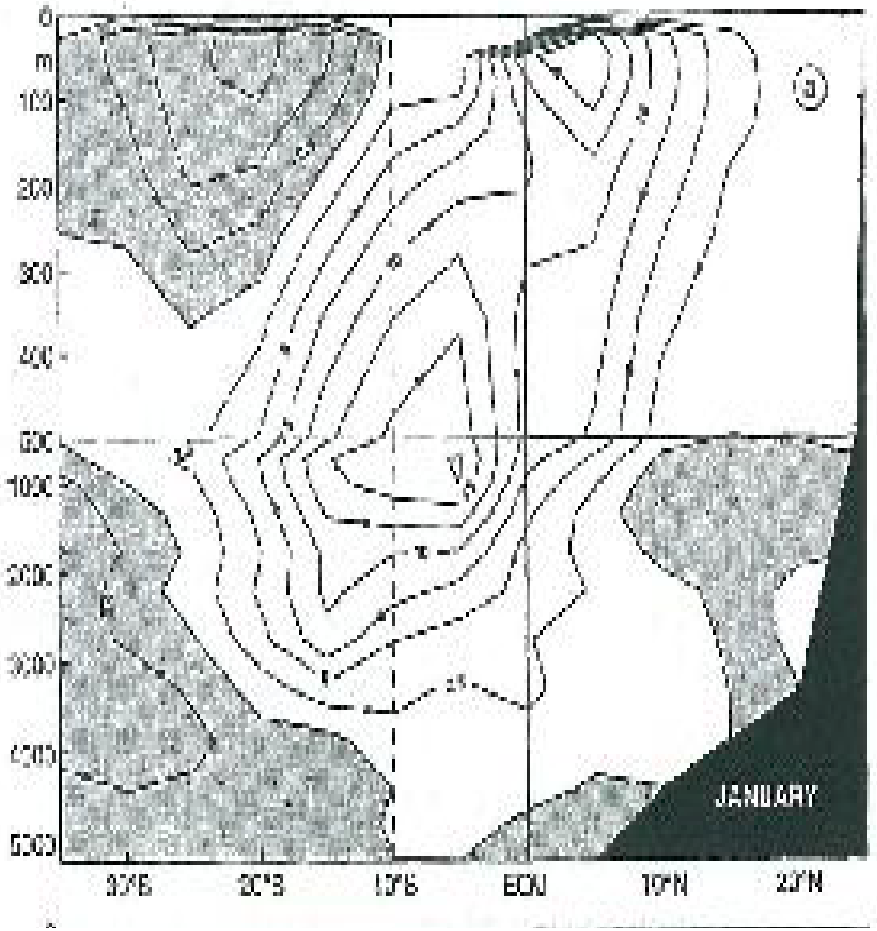
0.2 N/m2

meridional overturning streamfunction (NE monsoon)

FOAM: JFM 2003-2004

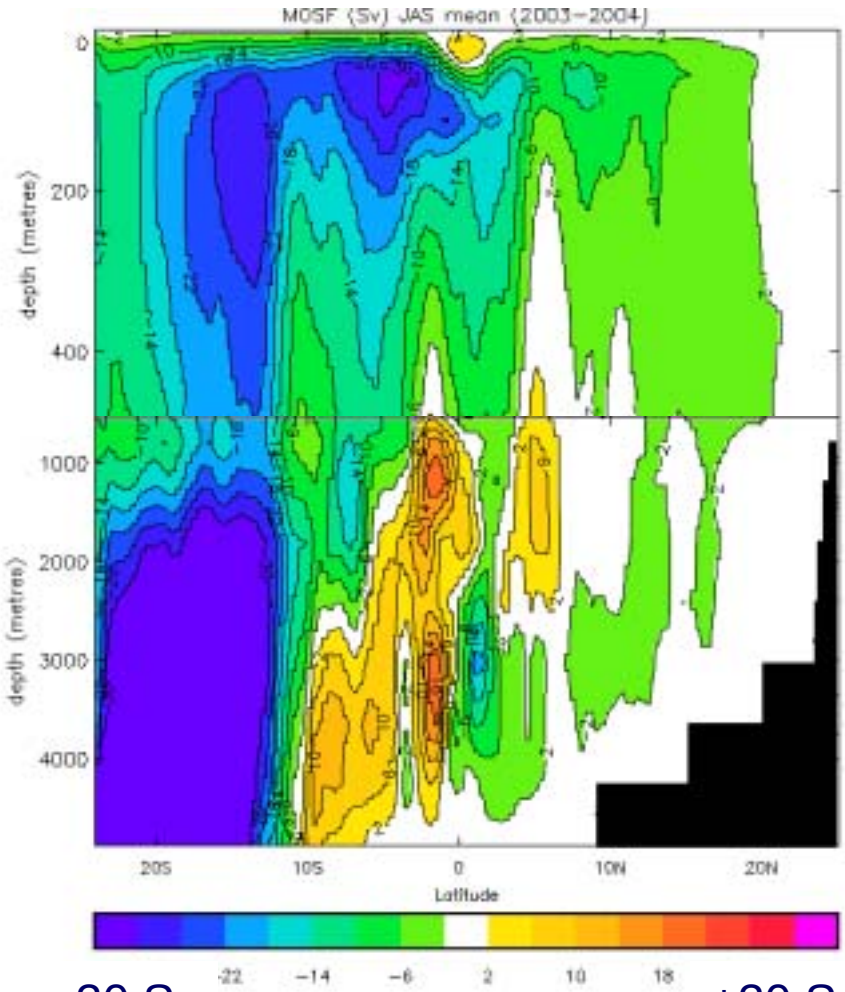


Gartenicht and Schott (1997): Jan 1987-1989



meridional overturning streamfunction (SW monsoon)

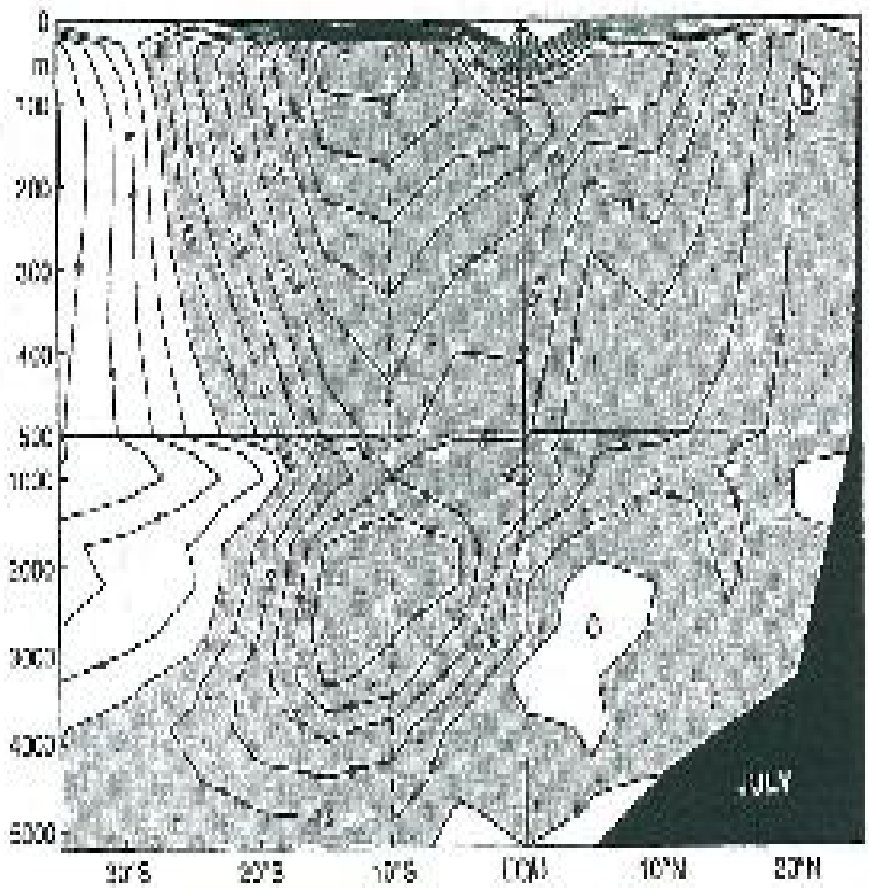
FOAM: JAS 2003-2004



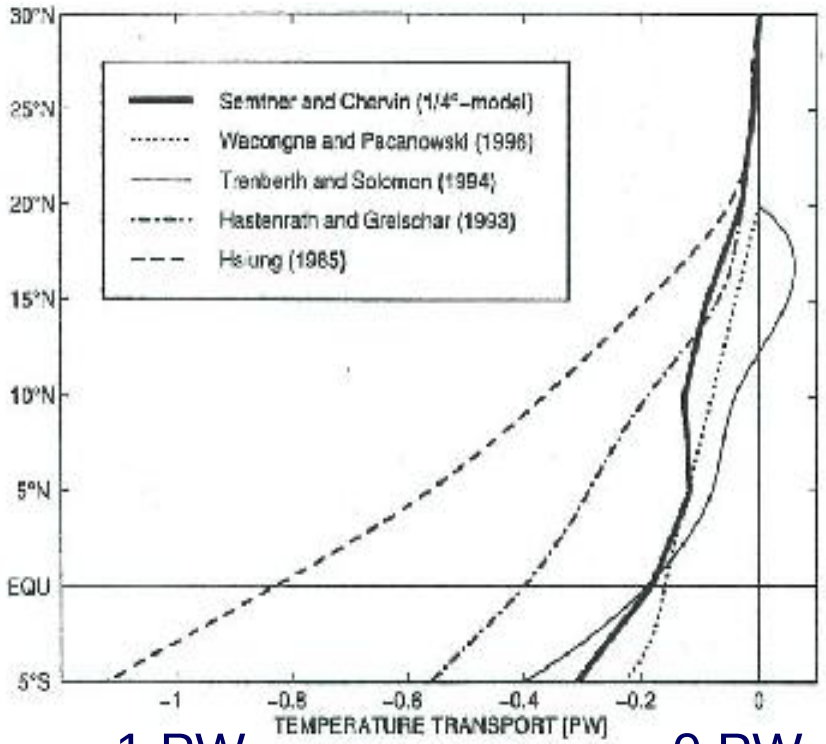
-30 Sv

+30 Sv

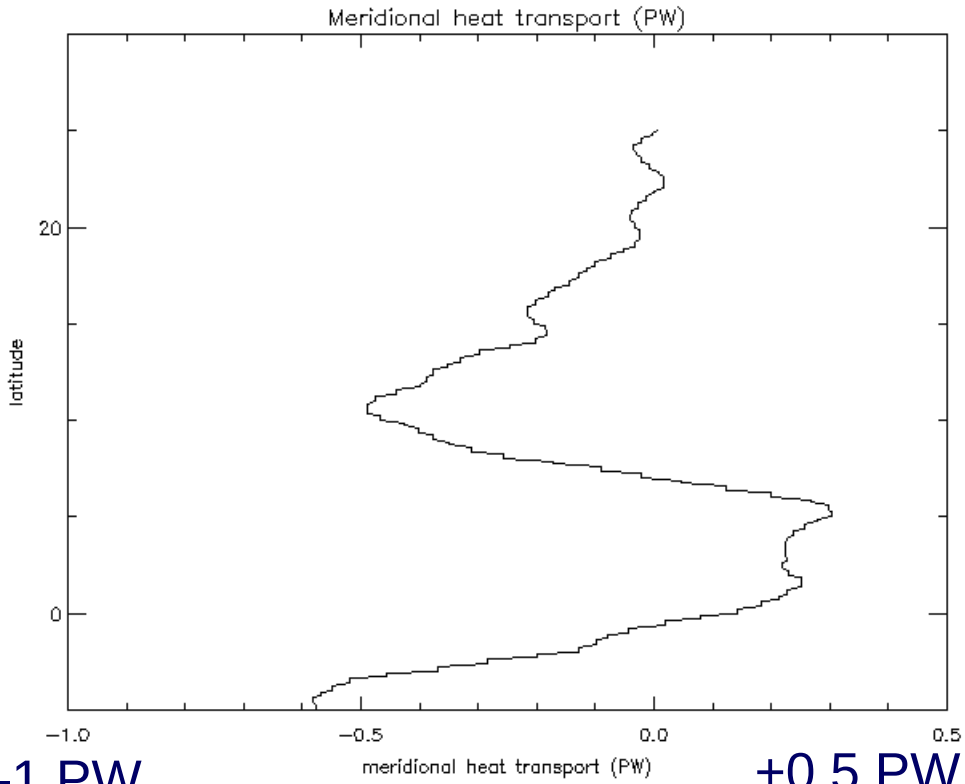
Gartenicht and Schott (1997): Jul 1987-1989



Meridional heat transport – annual mean



-1 PW 0 PW

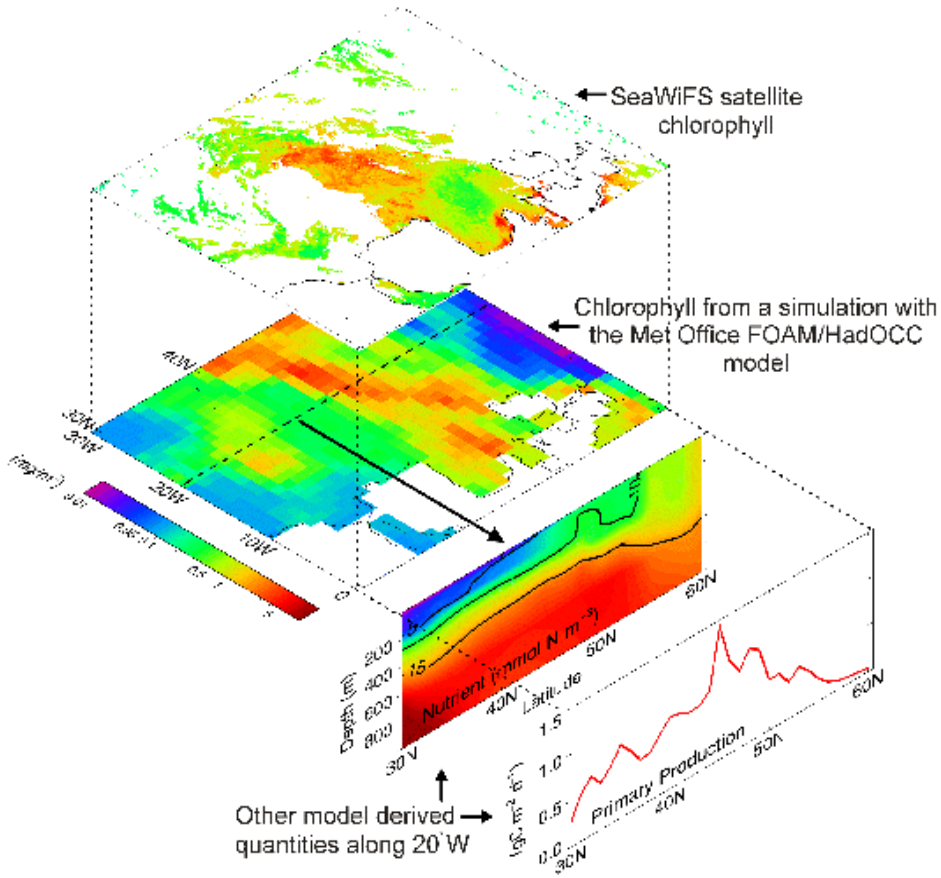


-1 PW +0.5 PW

Gartenicht and Schott 1997

FOAM

Comparison of SeaWiFS chlorophyll against FOAM-HadOCC



- Hindcasts coupling HadOCC NPZD "ecosystem" model to FOAM have started
- HadOCC developed by Hadley Centre and SOC for climate simulations
- The model captures the spring bloom signature in the SeaWiFS chlorophyll data in early March 2000
- Assimilation of surface colour data being developed with the NERC Centre for Air-Sea Interface fluXes (CASIX)
- A 10-year hindcast will be performed

FOAM – HadOCC (cont)

- Assimilation of colour data being developed at SOC with 1D test bed.
- Implentation in FOAM next year.
- 10-year hindcast runs 1997-2006 at 1 deg (global) and 1/3 deg, 1/9 deg (Atlantic).
- Assimilation of SeaWIFS, MODIS, MERIS colour data (as well as T, S etc).