Abyssal Circulation in the Indian Ocean from a high resolution HYCOM Simulation

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Outline:

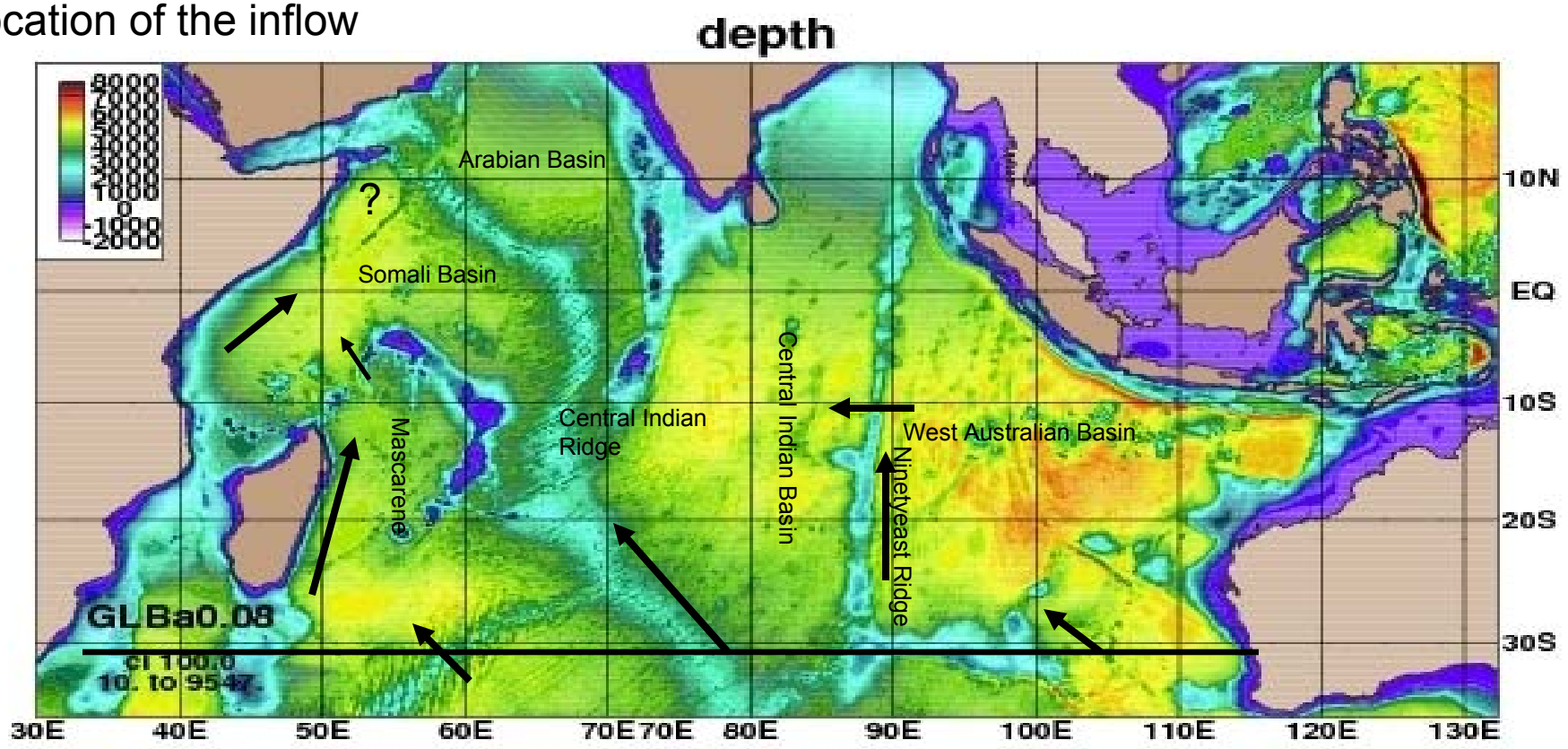
Abyssal flow pathways
Meridional Overturning
Variability in the abyssal western IO

Abyssal Indian Ocean Flow Pathways and Circulation Issues

• widely varying estimates of meridional overturning and bottom water inflow – 2 to 28 Sv; O(12) Sv ~= Pacific

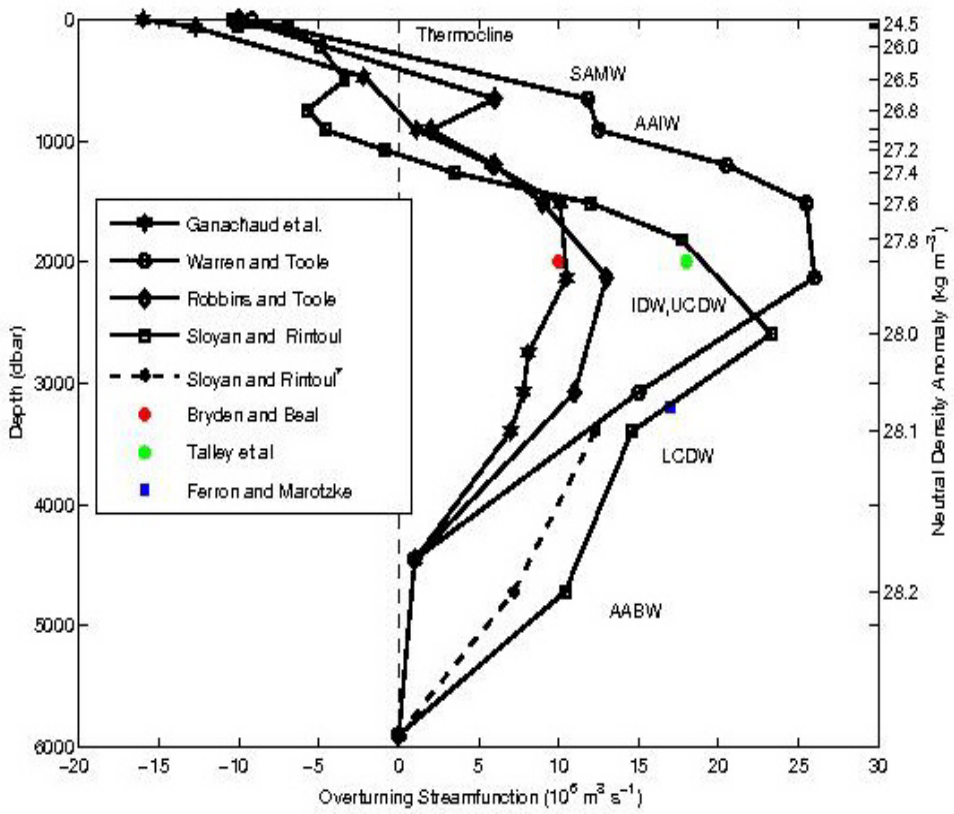
• can it really be that large? If so what is the role of the IO in global thermohaline circulation

• Location of the inflow



where are the return flow pathways?
does the abyssal northwest IO display seasonal circulation like the upper ocean?

Estimates of IO Meridional Overturning north of 32S



Courtesy B. Sloyan & F. Schott

Section analyses

- Toole and Warren (1993) 27 SV
- Robbins and Toole (1998) 12 Sv
- Bryden and Beal(2001) 10 Sv
- Talley et al., 18 SV

Inverse models

- Sloyan and Rintoul (2001) 23 Sv
- Sloyan(2005): 20 Sv
- Ganachaud et al. (2000) 8 Sv
- Lumpkin and Speer (2005) 9 Sv

Radiocarbon analysis

- Stuiver et al., 1983 250yr ~12 Sv
- Srinivasan etal., 2000 8.5 Sv

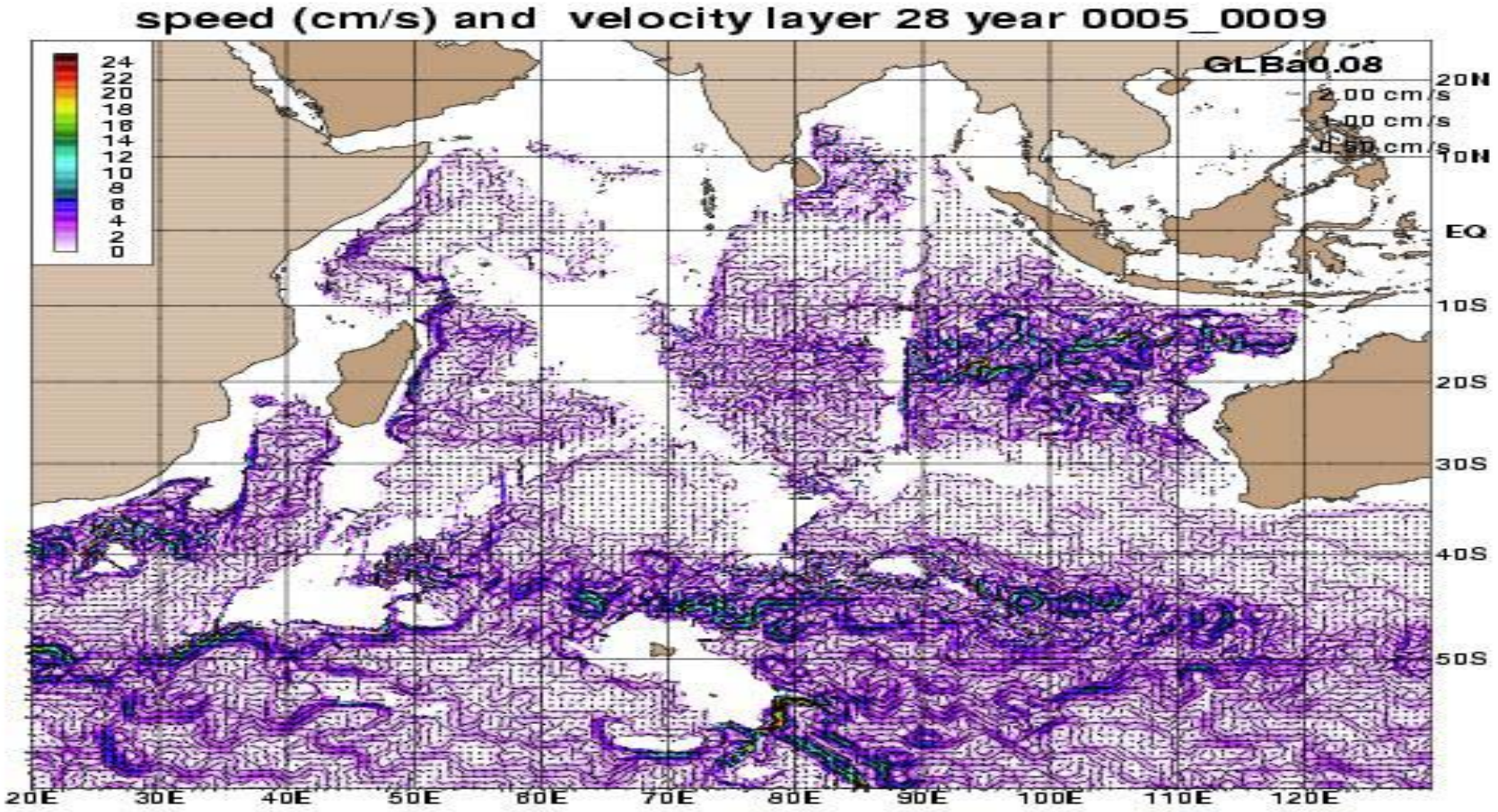
GCM's

- Sun and Bleck 2001 7 SV
- Ferron and Marotzke 2003 17 Sv
  others < 4Sv
- Lee and Marotzke (1999)
- Semtner and Chervin (1992)
- Wacongne and pacanowski (1996)
- Garternicht and Schott (1997)

1/12 Global HYCOM Configuration

- Initialized form ¼ GDEM climatology
- Climatological simulations forced by monthly mean winds from ERA15 with 6 hourly high frequency variability from September 1994-95
- 32 vertical sigma2 levels (layers 25-29 cover the abyssal IO)
- KPP/GISS vertical mixing
- precipitation, relaxation to climatological SSS
- Monthly river runoff

$\sigma_2 = 37.10$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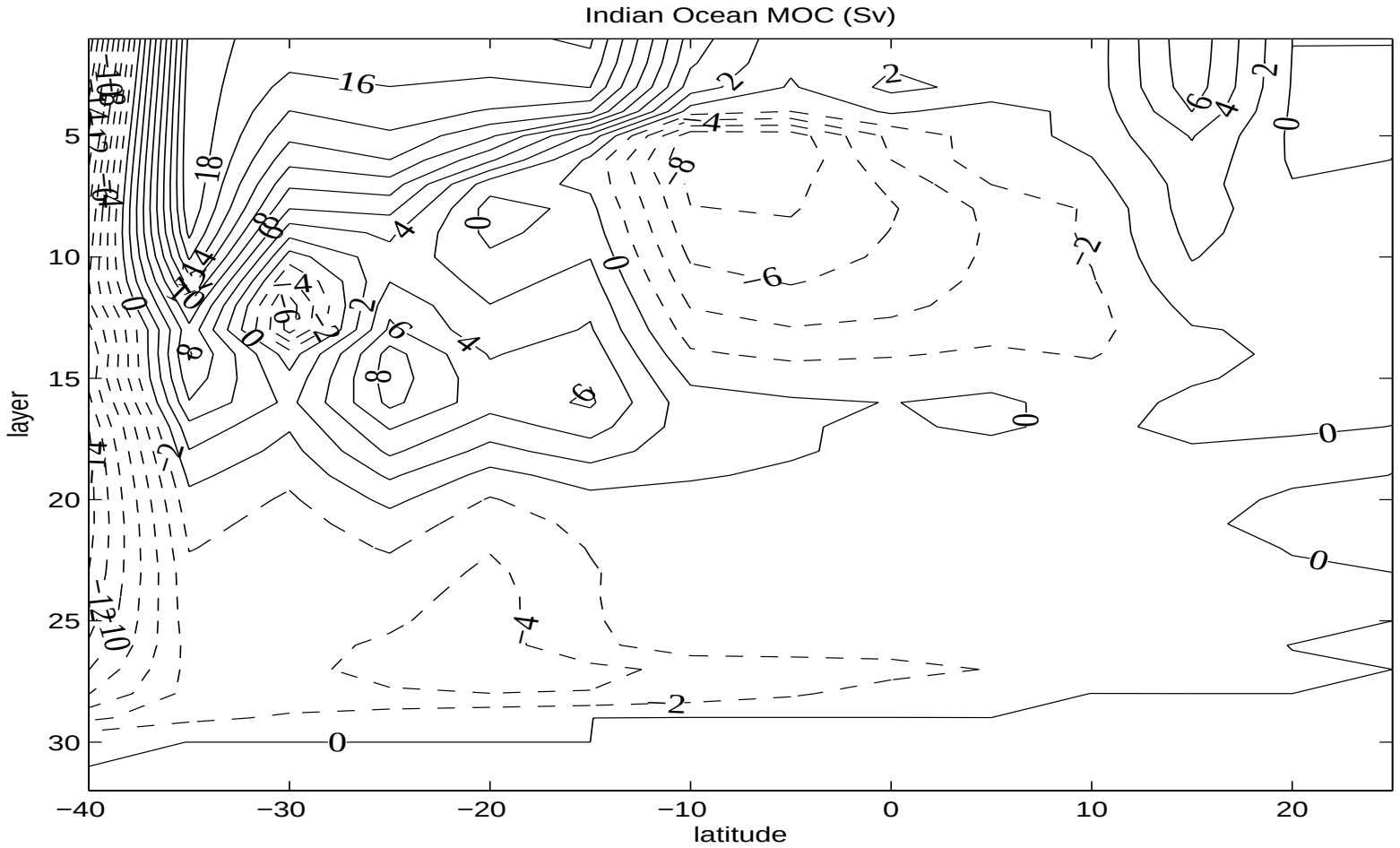
Meridional Overturning



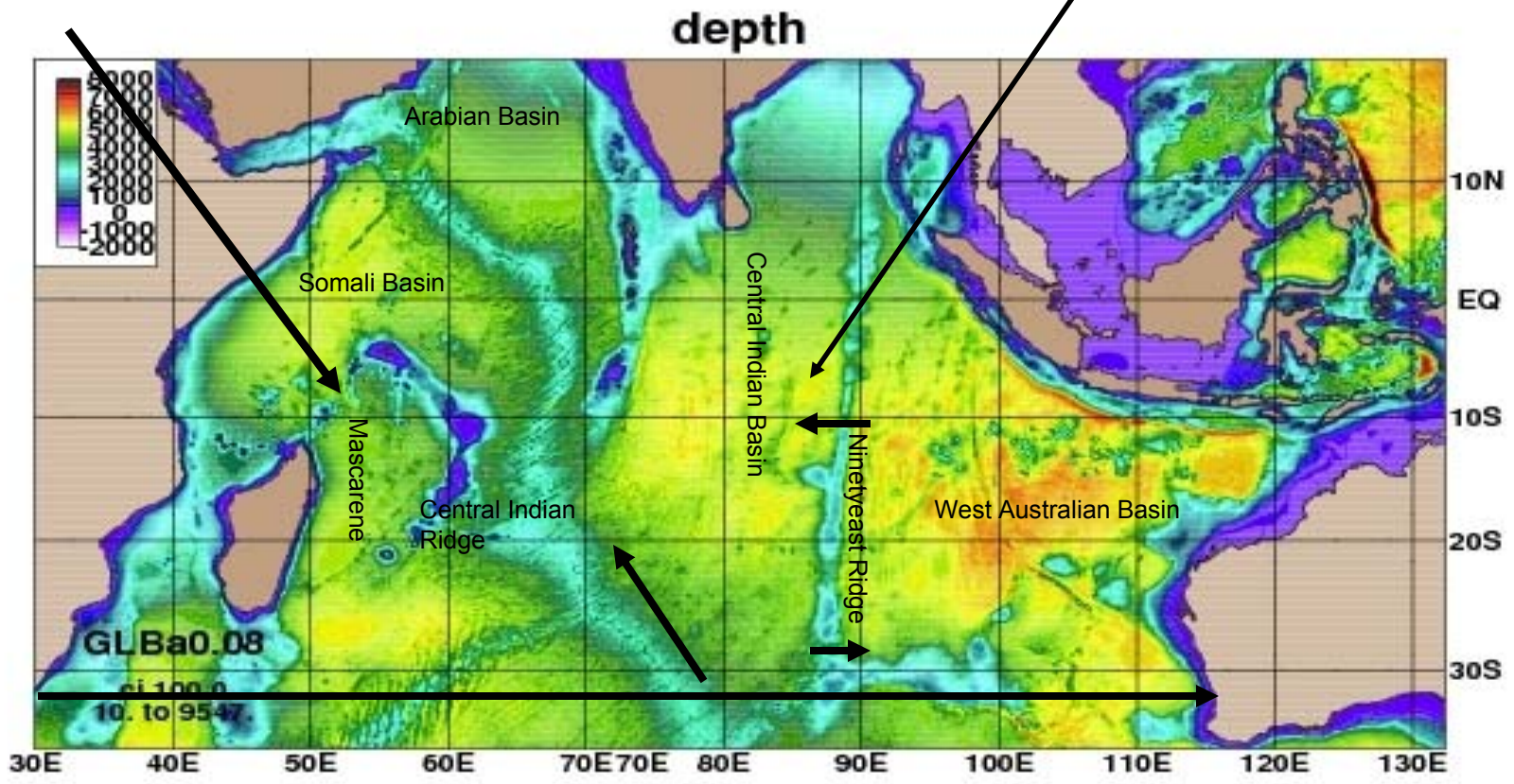
Deep Flow Pathways

Johnson et al., 1999

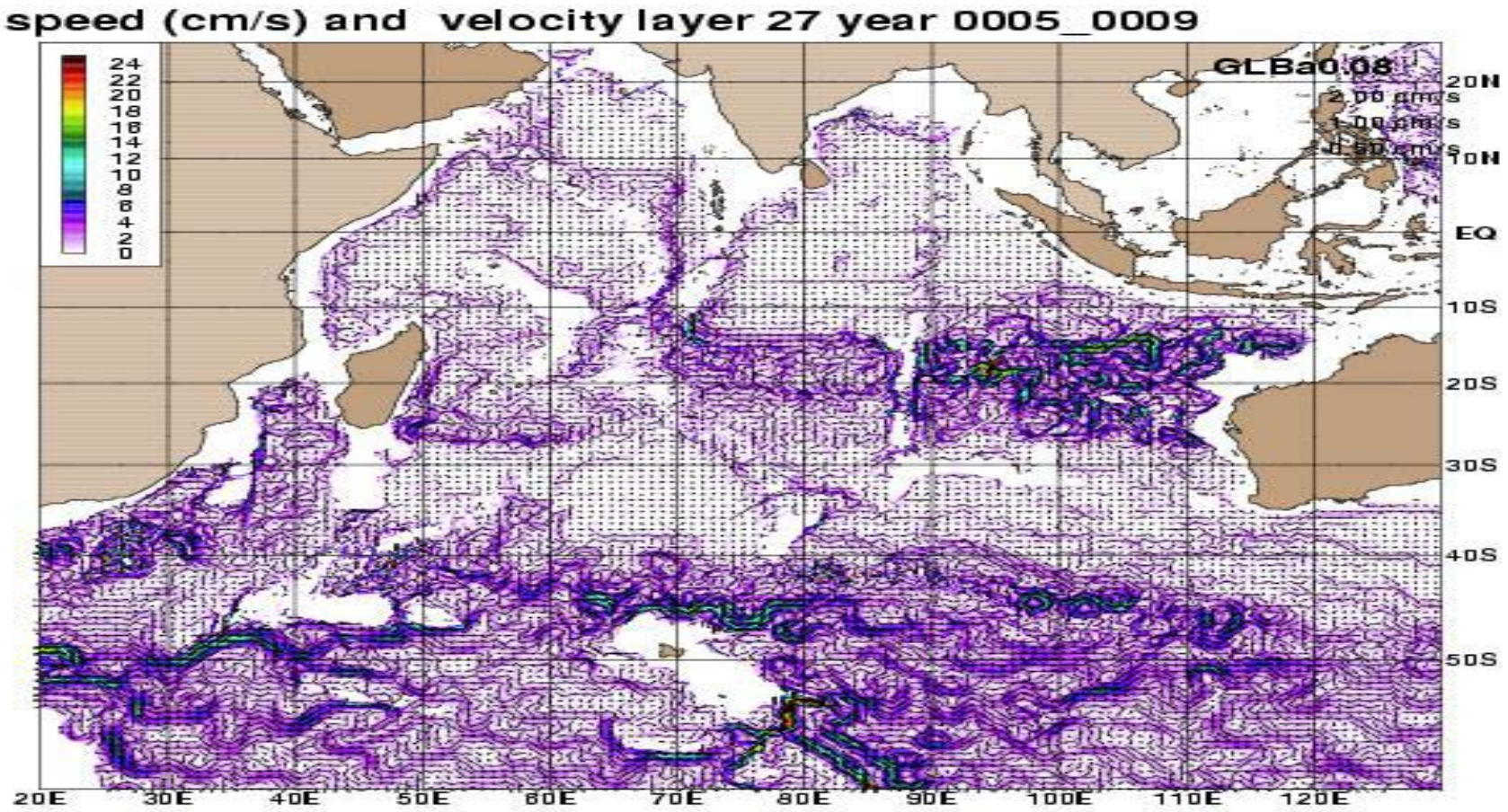
~1.7 Sv bottom water (>~3800 M)

~ 11 Sv of deep water (2000-3800m)

Warren & Johnson
7-8 Sv (2000-4000M)



$\sigma_2 = 37.06$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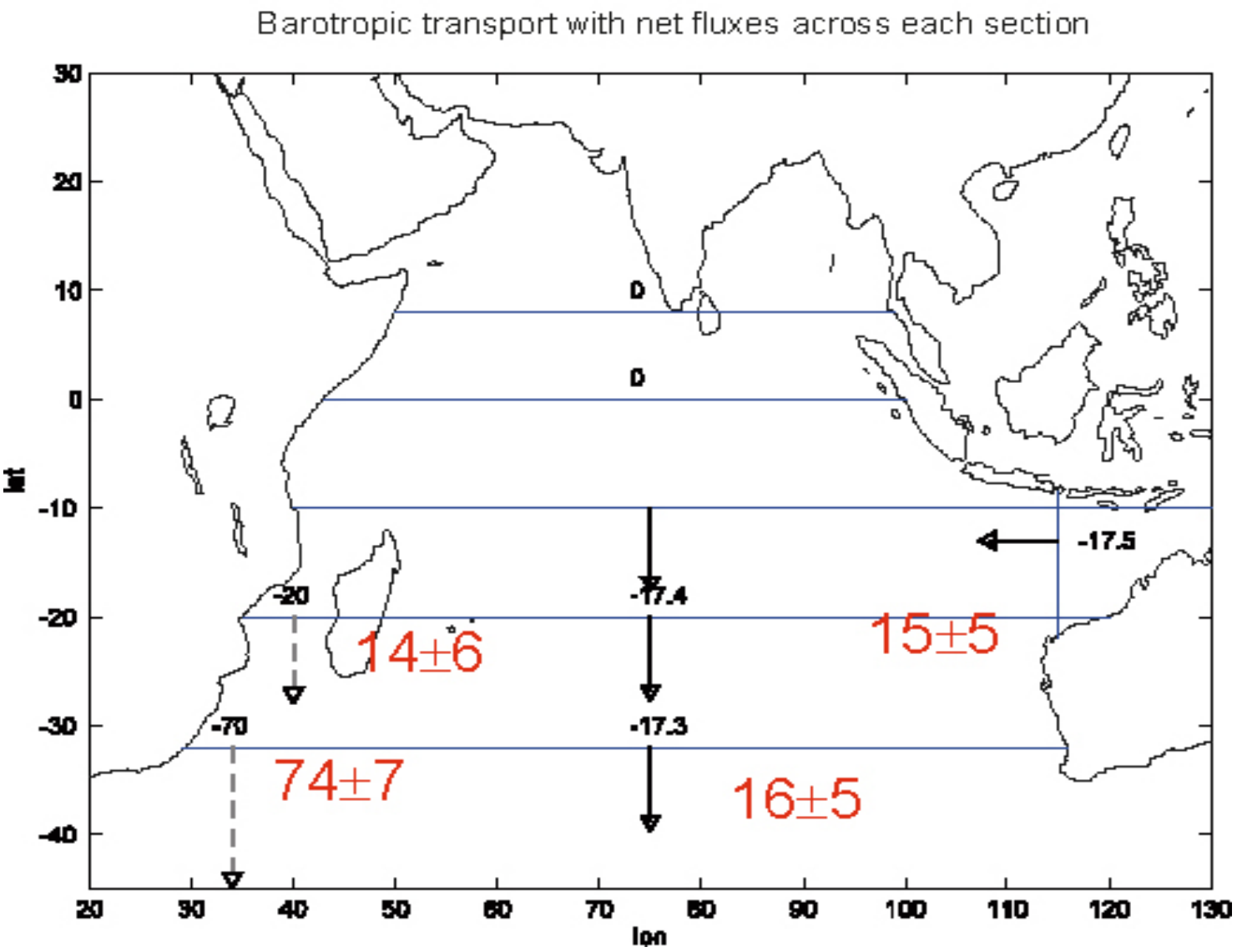
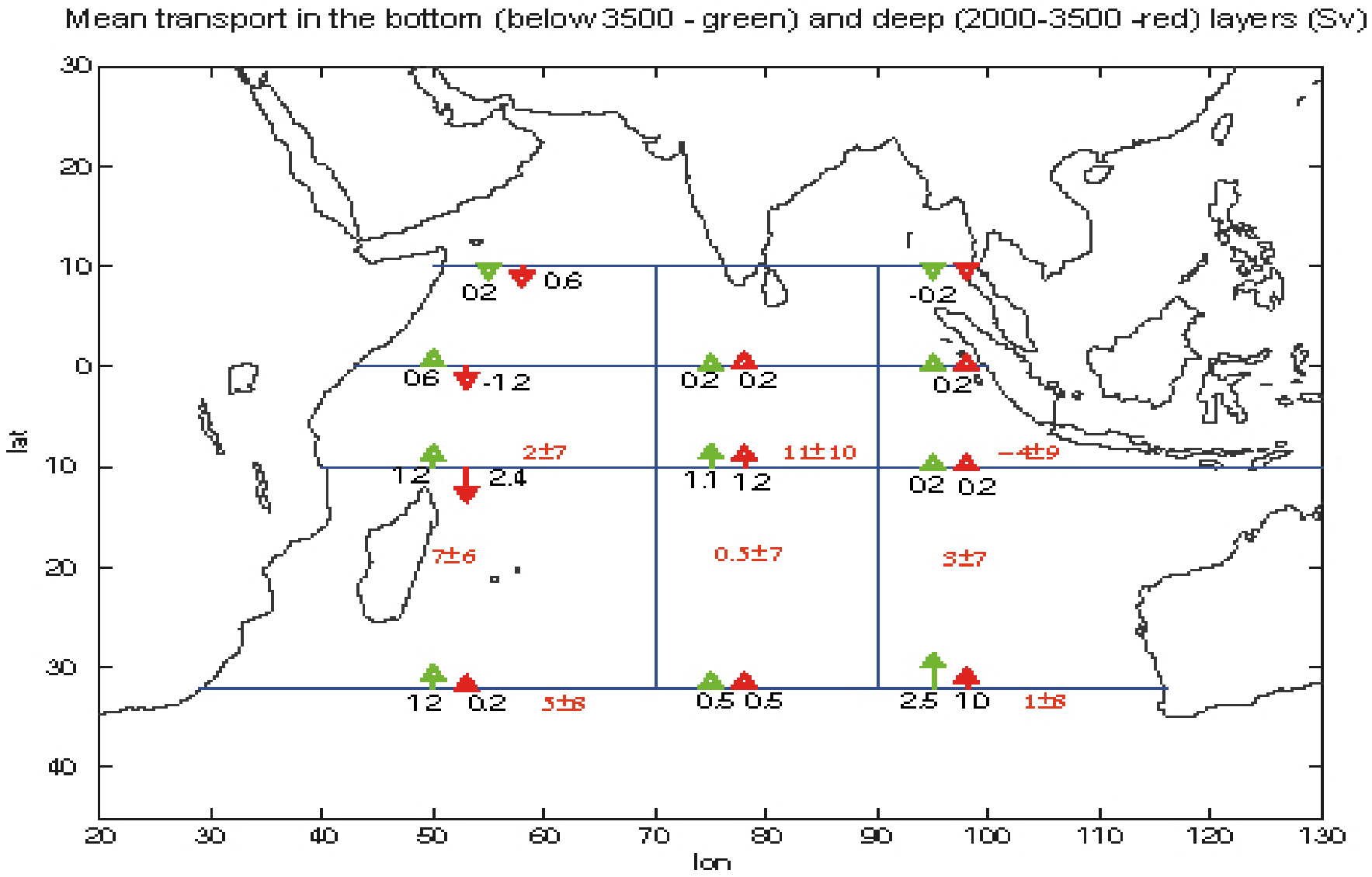


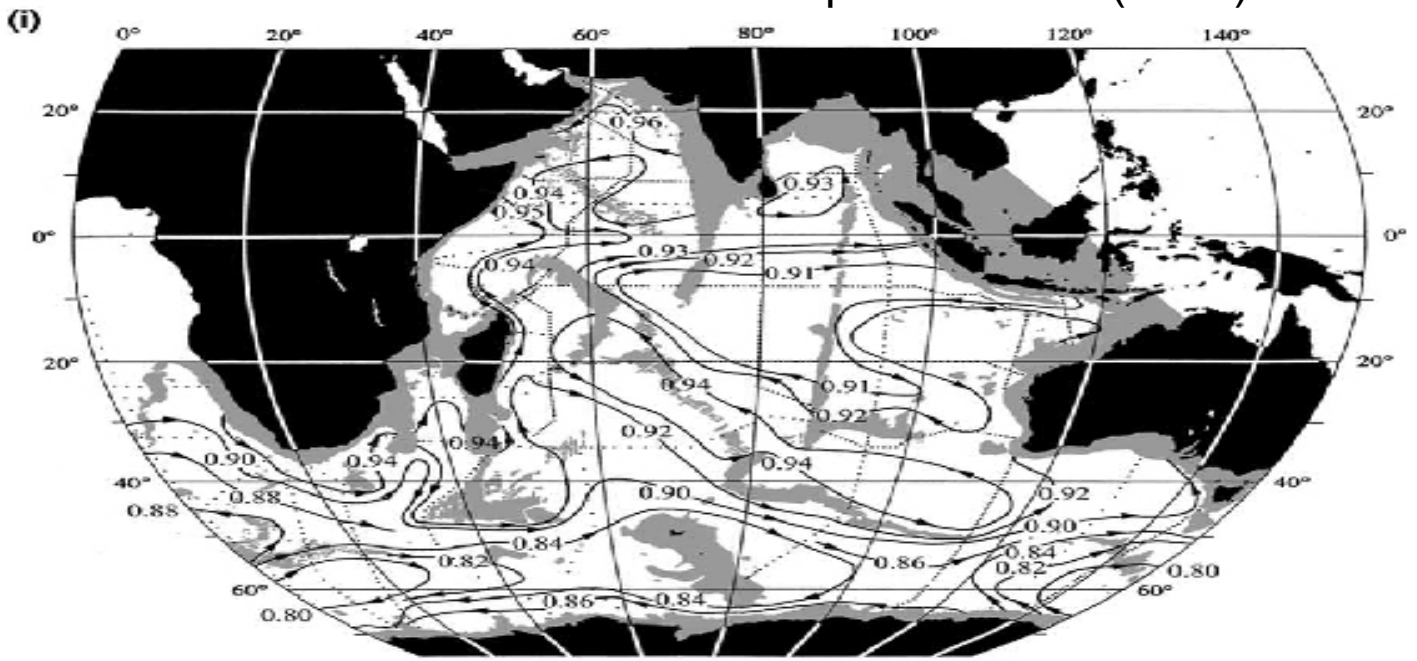
Numbers in red from (Ganachaud et al., 2000)



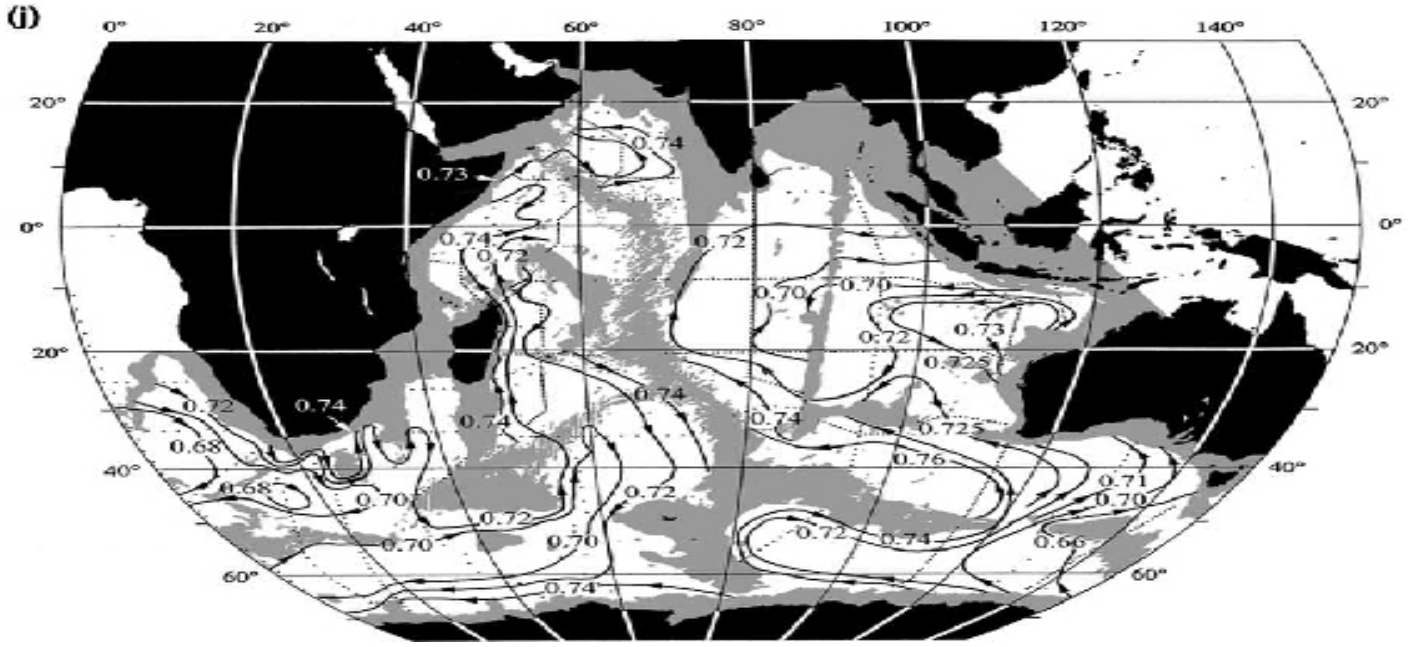
Numbers in red from (Ganachaud et al., 2000)

Circulation maps from Reid (2003)

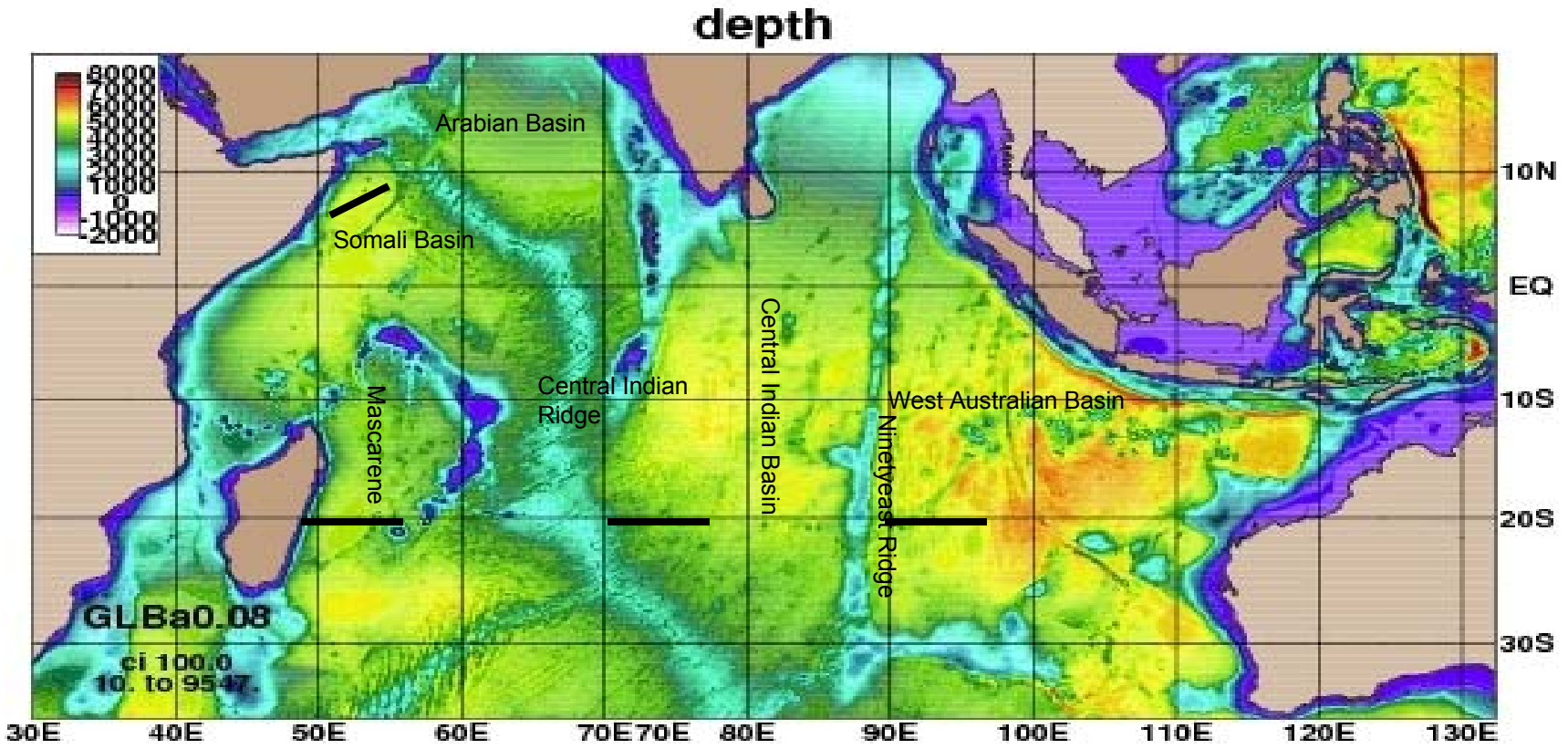
σ_3 = 41.495

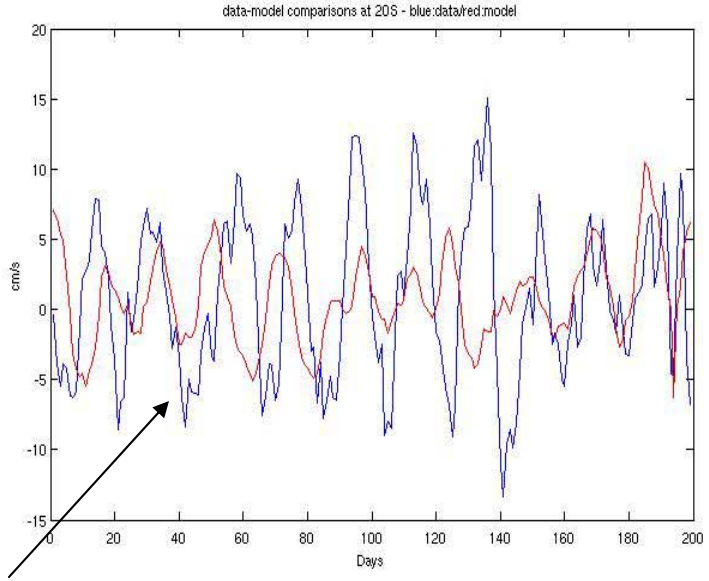


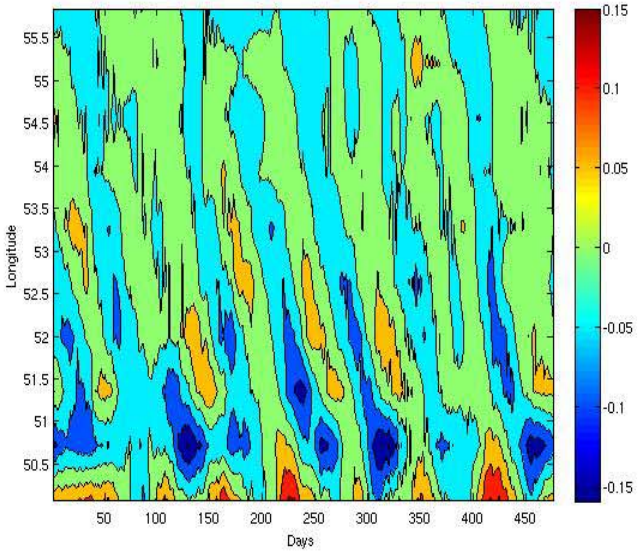
σ_4 = 45.89



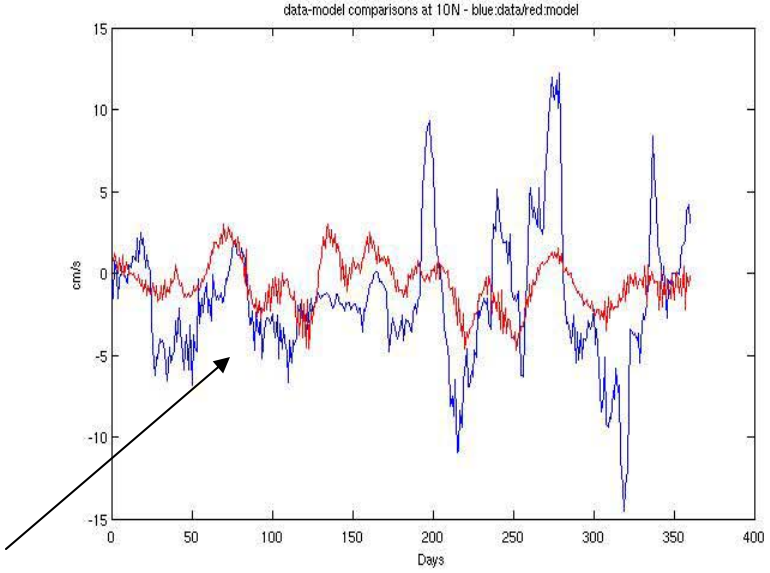
WOCE ICM (Current Meter Mooring) Locations

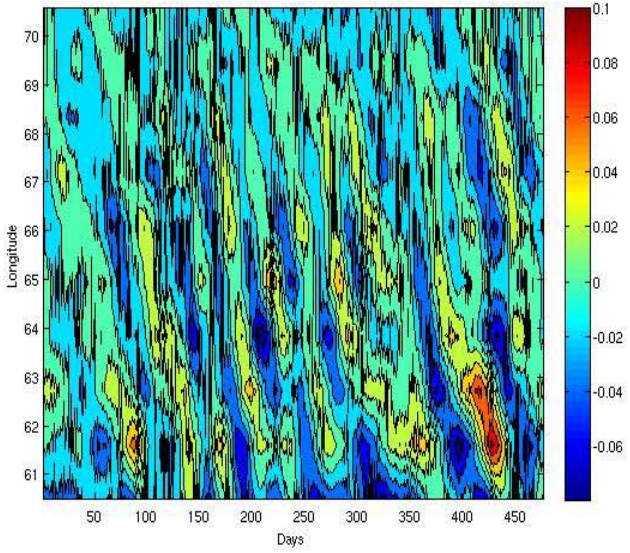




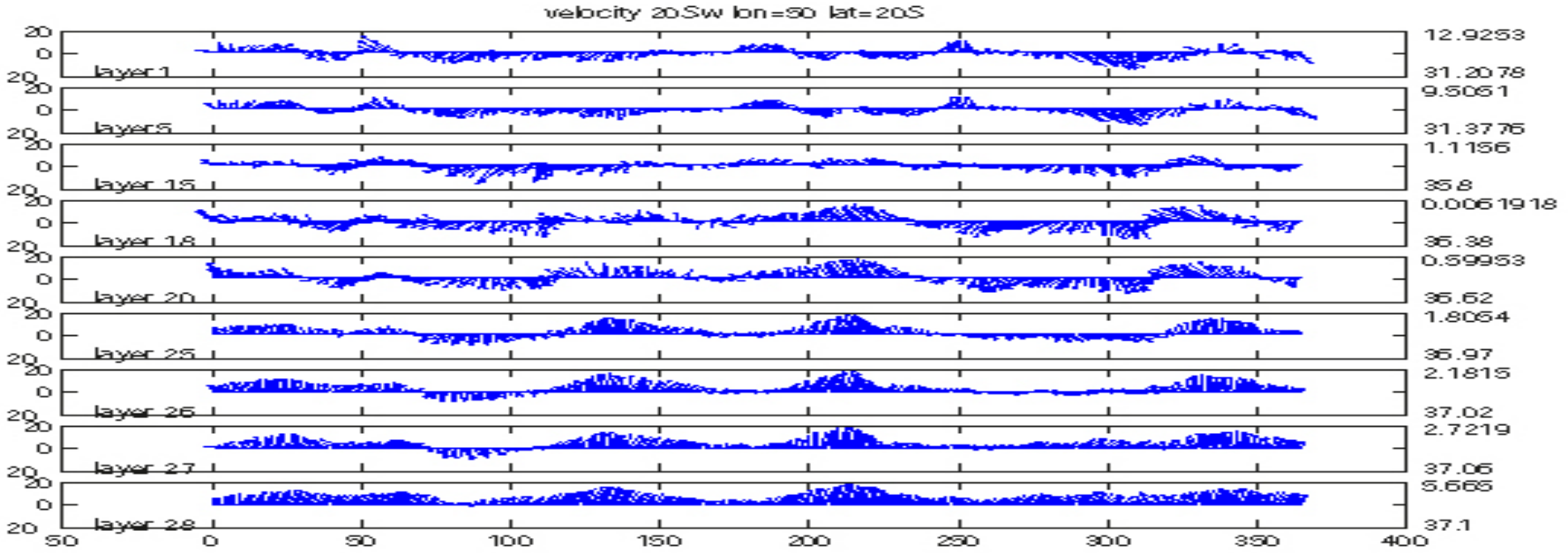


Warren et al 2002 - barotropic Rossby wave ~ bimonthly period forced by local wind stress curl





Brandt et al 2002 - Intra-seasonal oscillations 30-50 day period due to instabilities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layer 1
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layer 15
layer 18
layer 20
layer 25
layer 26
layer 27
layer 28
12.9253
31.2078
9.5061
31.3776
1.1156
35.8
0.0061918
35.38
0.59953
35.62
1.8064
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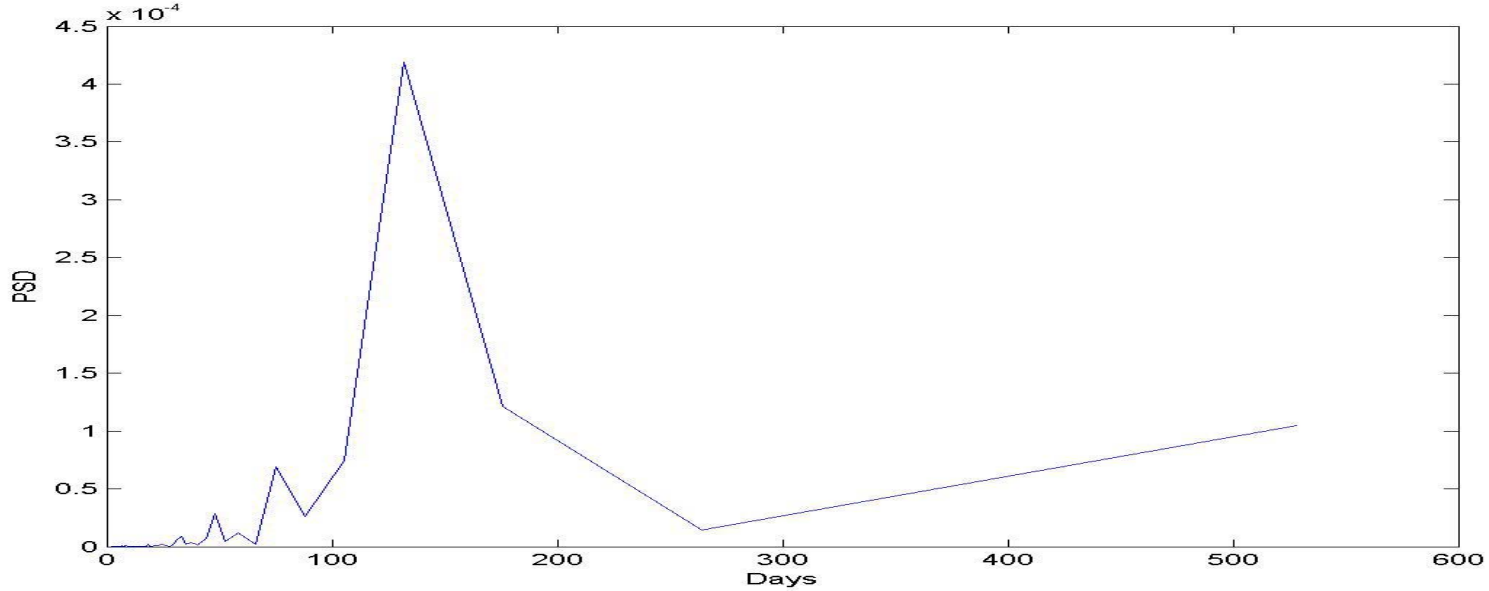
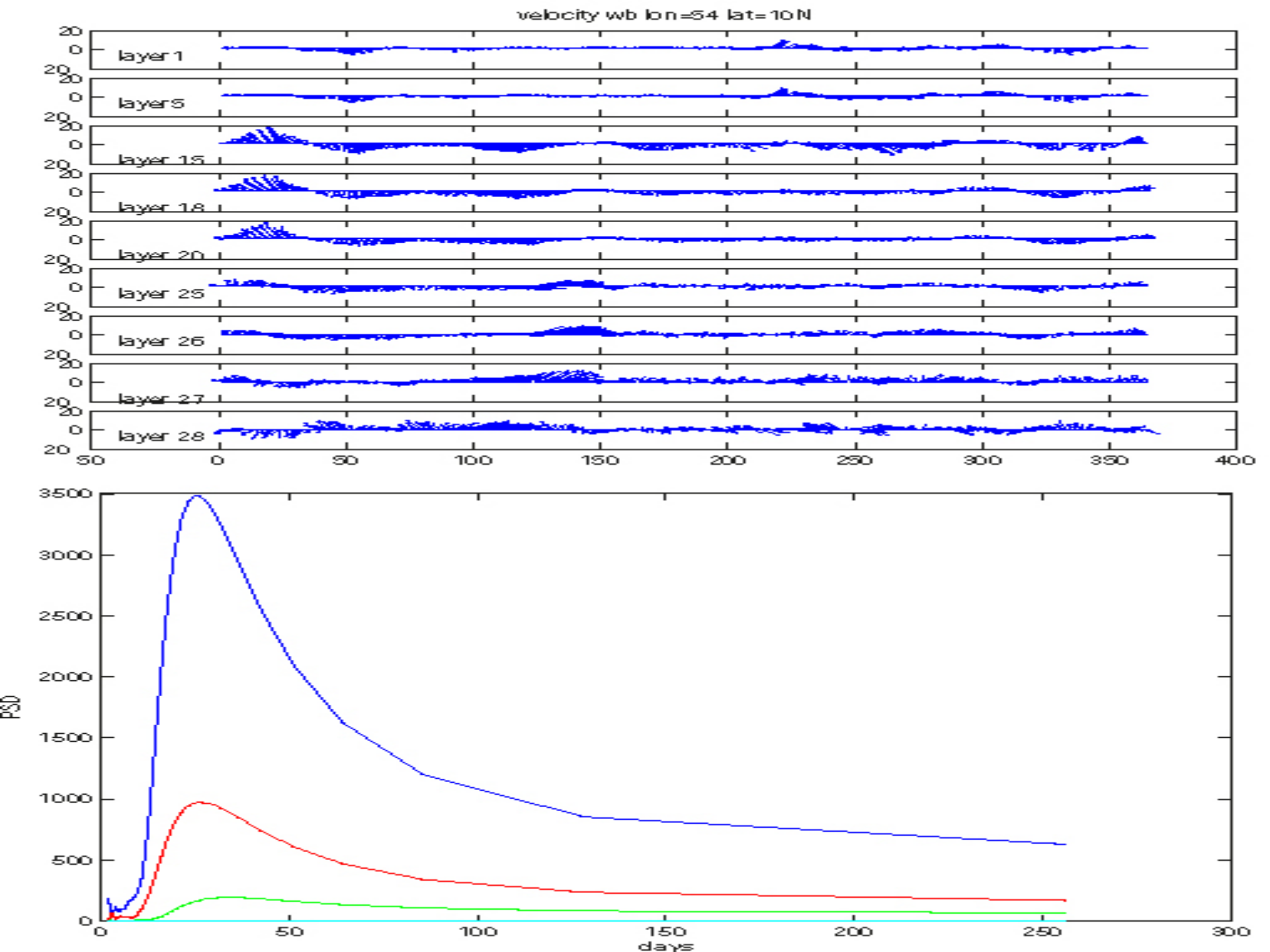
2.1815
37.02
2.7219
37.06
5.665
37.1


x 10^-4
PSD
Days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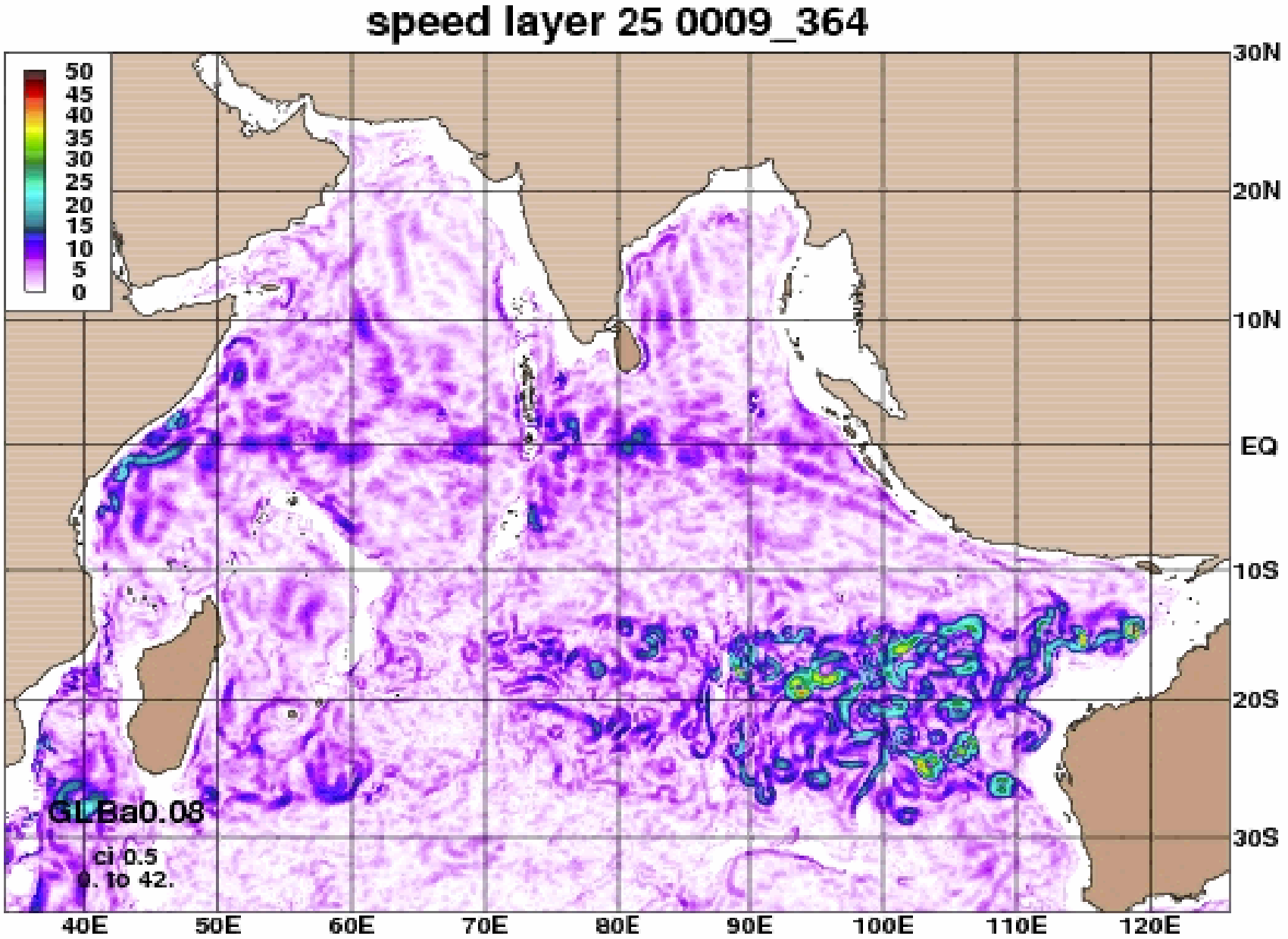
layer 27
layer 28
PSD
days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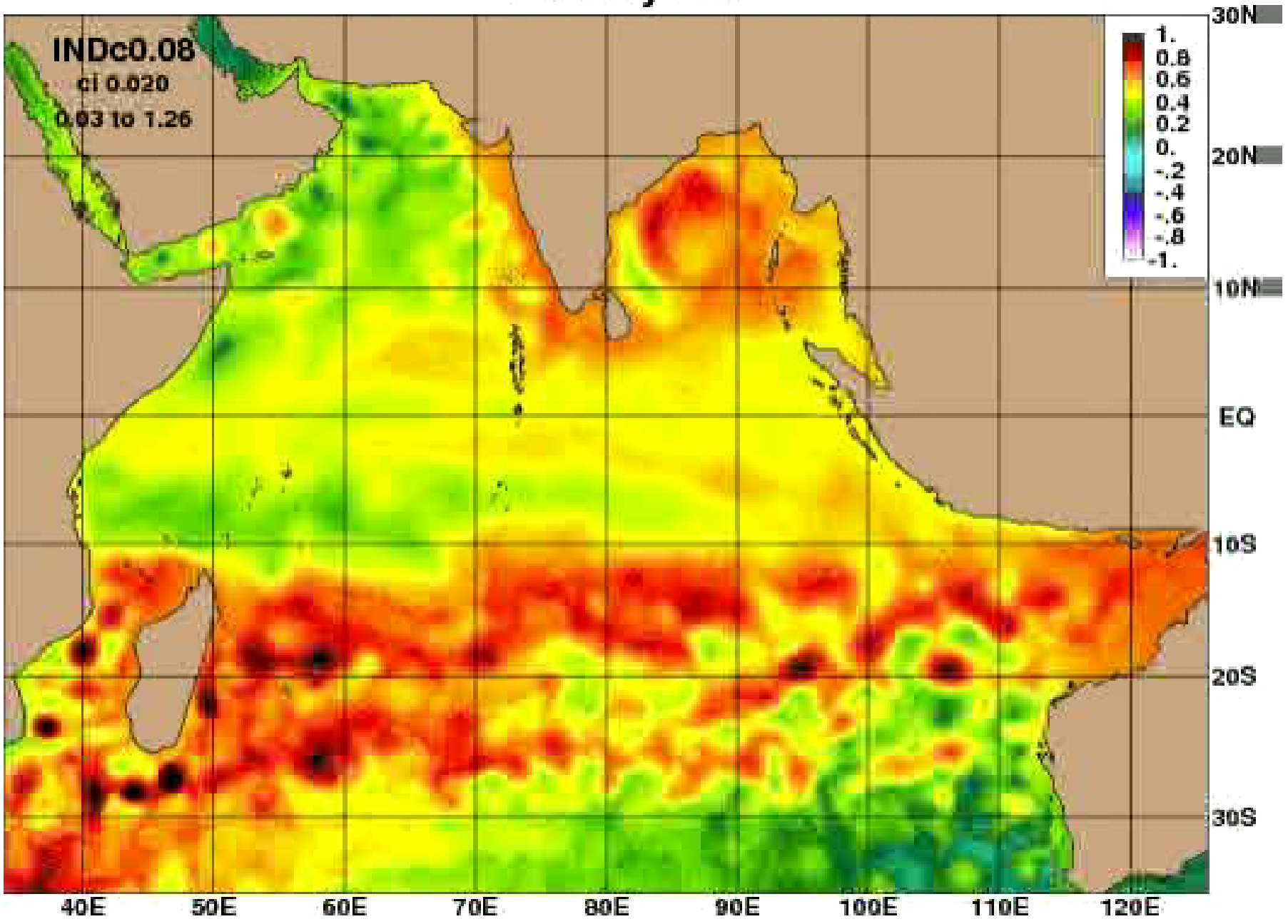
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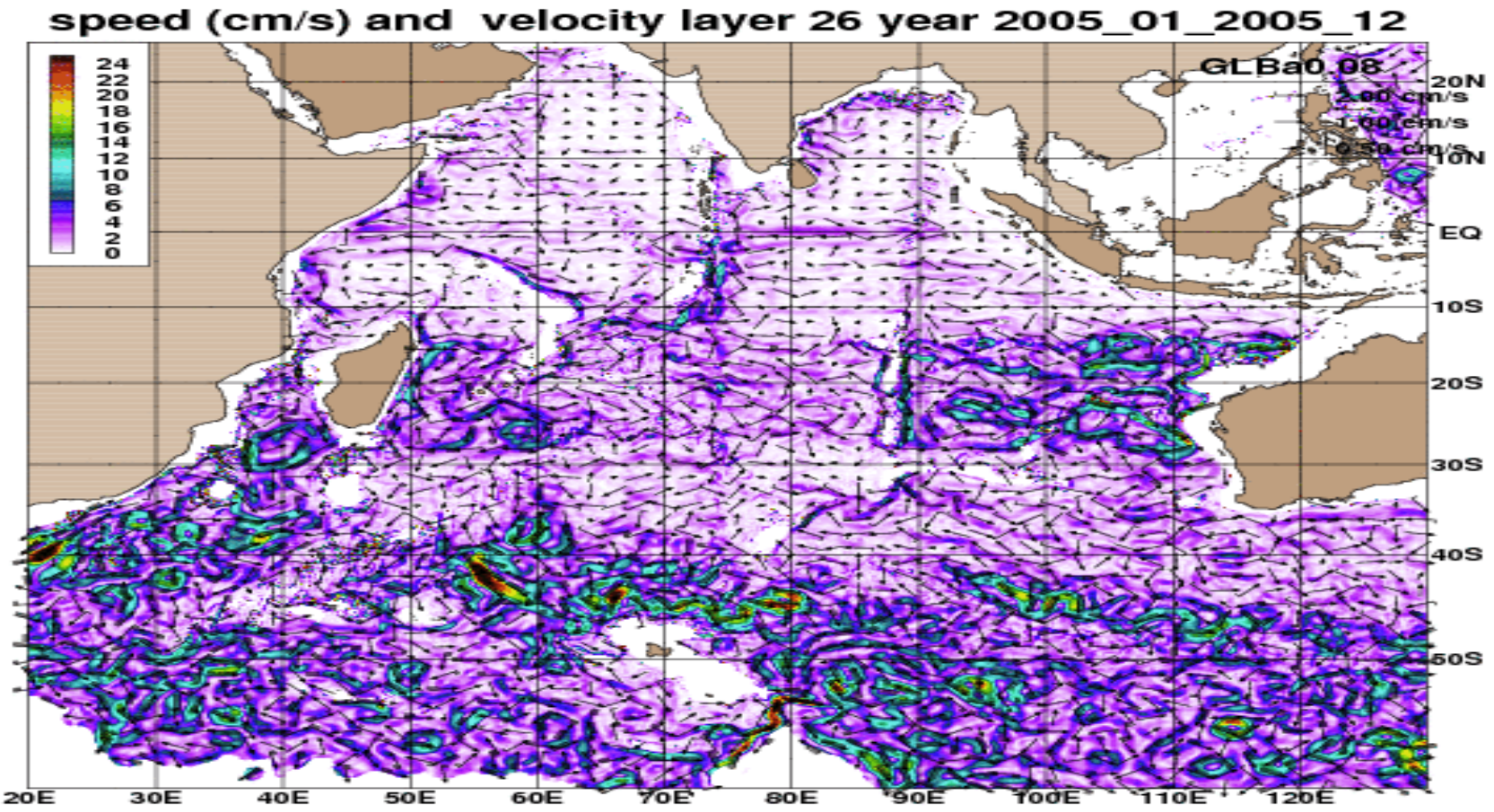
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