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Global surface wind product J-OFURO V2: Drake Passage Oscillation Index (DPOI) and its correlated wind field over the southern ocean

Introduction of our Gridded Products of Surface Flux (Heat & Momentum) constructed by Satellite Data

M. Kubota, K. Kutsuwada, M. Akiyama, S. Iwasaki (Tokai University)
and H. Tomita (JAMSTEC)

Study base on our wind product

Wind changes over southern (Antarctic) ocean: DPOI and its correlated feature

Kunio Kutsuwada, Junya Kondo (Tokai University)
and Mikio Naganobu (Fisheries Research Agency)

Our Data Server for the Satellite-derived Surface Flux Products in J-OFURO

Japanese Ocean Flux Data Sets with Use of Remote Sensing Observations

Available for any users via http and ftp

- ***http://dtsv.scc.u-tokai.ac.jp/j-ofuro/***
- **ftp://dtsv.scc.u-toaki.ac.jp**
- ***supply in some formats :***

netCDF, Fortran Binary, ASCII

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J-OFURO Web

http://dtsv.scc.u-tokai.ac.jp/j-ofuro/

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- Data Set Information
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J-OFURO

Japanese Ocean Flux Data sets with Use of Remote Sensing Observations

– School of Marine Science and Technology,Tokai University –

J-OFURO Data Set Information

[Surface Hear Fluxes Products]

- Latent Heat Flux(LHF)
- Sensible Heat Flux(SHF)
- Net Heat Flux(NHF)
- Scalar Wind speed at 10m Height(MWND) +
- Saturated Specific Humidity at Surface(QS)
- Surface Air Humidity at 10m Height(QA)

+ Please note that scalar wind speeds "MWND" and "WND" are constructed
by different procedures(see below).

[Surface Momentum Fluxes Products]

- Scalar Momentum Flux(TAU)
- Zonal Momentum Flux(TAUX)
- Meridional Momentum Flux(TAUY)
- Scalar Wind Speed at 10m Height (WND)
- Zonal Wind Speed at 10m Height(UWND)
- Meridional Wind Speed at 10m Height(VWND)

[Surface Momentum Fluxes Products]

- Scalar Momentum Flux(TAU)
- Zonal Momentum Flux(TAUX)
- Meridional Momentum Flux(TAUY)
- Scalar Wind Speed at 10m Height (WND)
- Zonal Wind Speed at 10m Height(UWND)
- Meridional Wind Speed at 10m Height(VWND)

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Download datasets

You can download datasets by choosing the items from the following list. Also note that archive format(Binary_gz, NetCDF_gz) are compressed every for a year. Please click here (Heat_flux, Momentum_flux) if you want to see the data set entry in the J-OFURO data base.

DATA-SET	Time-Interval	Format
TAUX	MONTHLY	NetCDF_gz

Year1	Month1		Year2	Month2
2000	1–12	→	2008	1–12

Submit

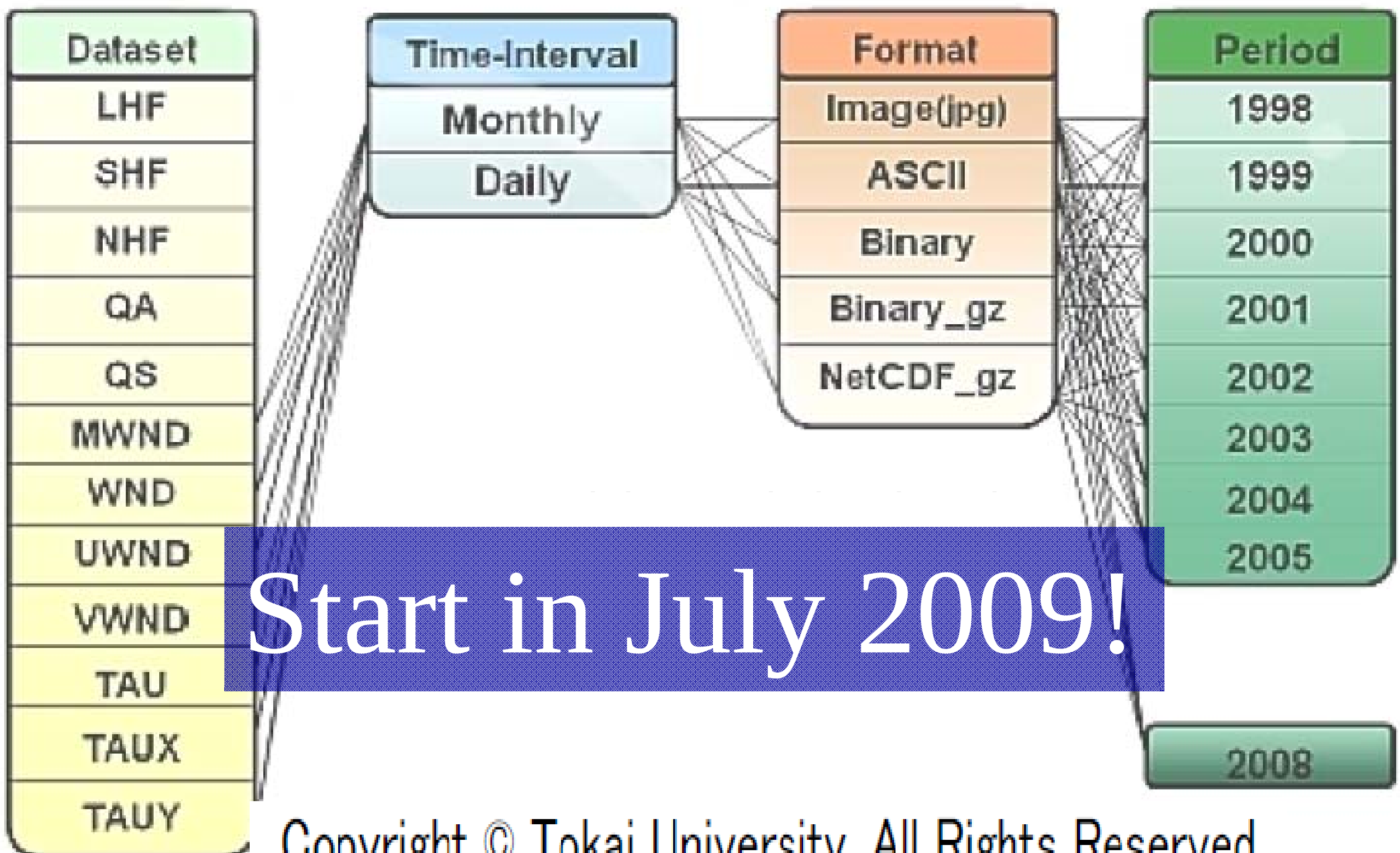
Download file lists   Select files!

J-OFURO Web

Japanese Ocean Flux Data sets with Use of Remote Sensing Observations

– School of Marine Science and Technology, Tokai University

Entry datasets of the momentum flux in the J-OFURO Database



Examples of Figures → jpg format

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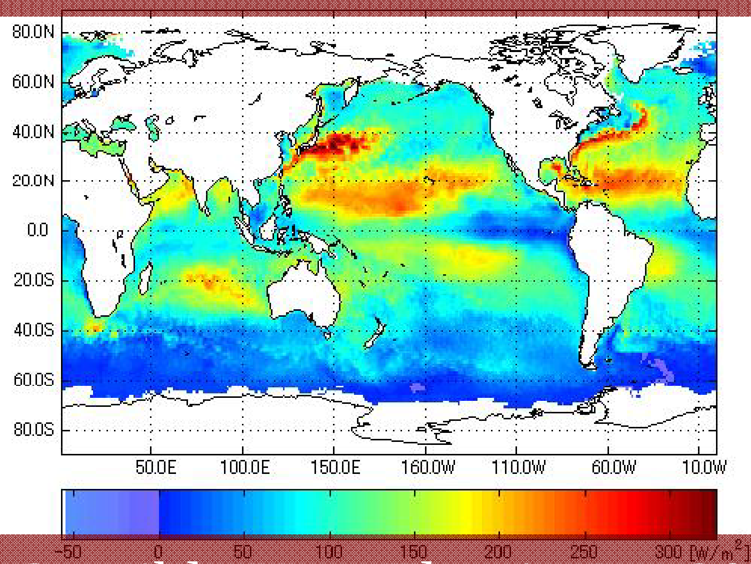
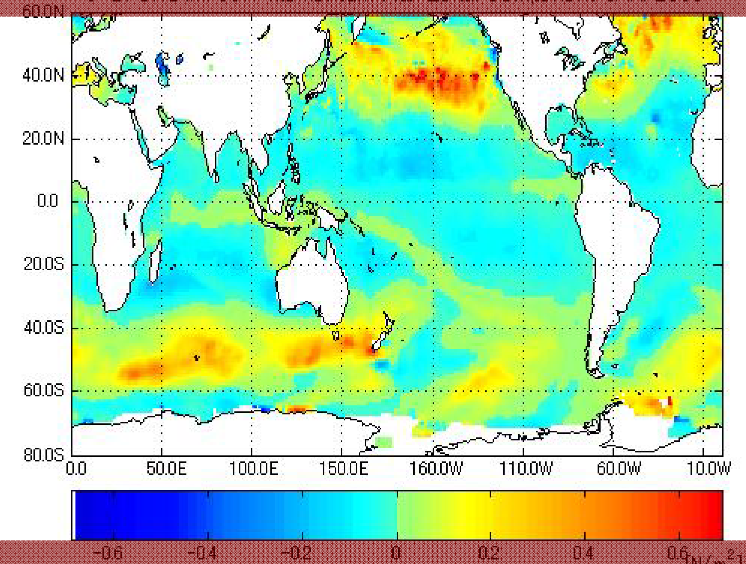
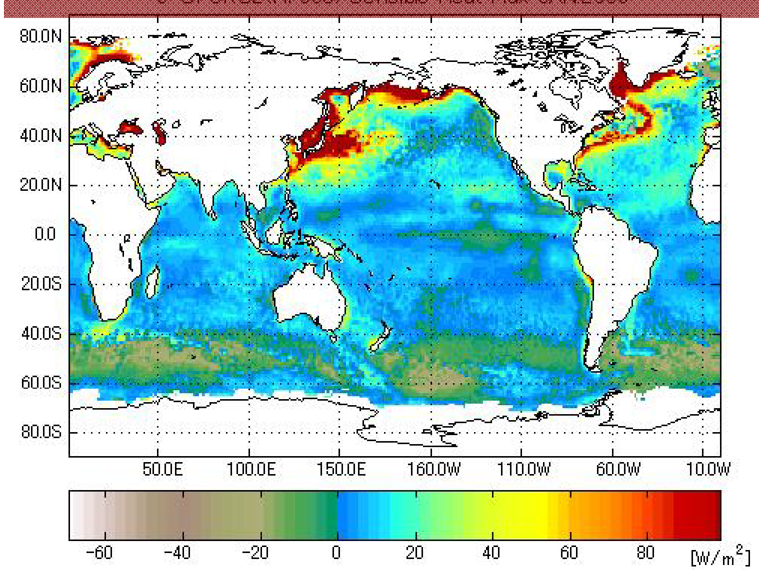
Latent Heat Flux in Jan 2006



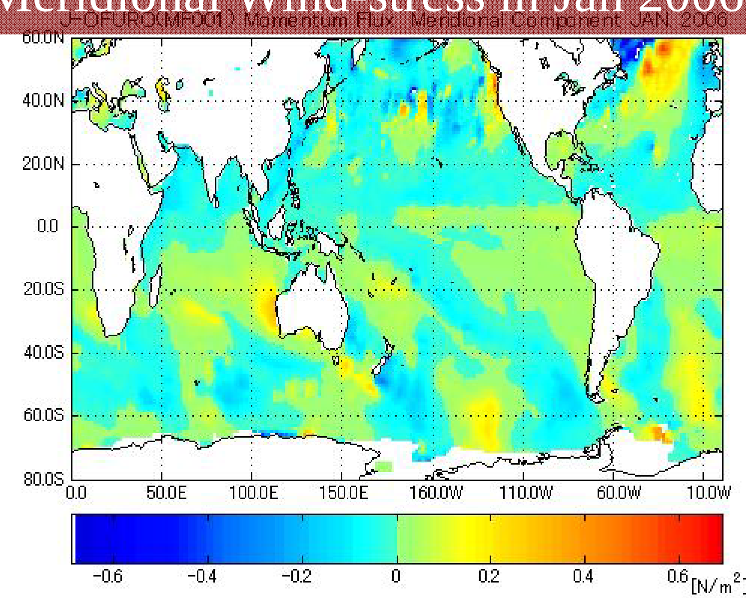
Zonal Wind-stress in Jan 2006



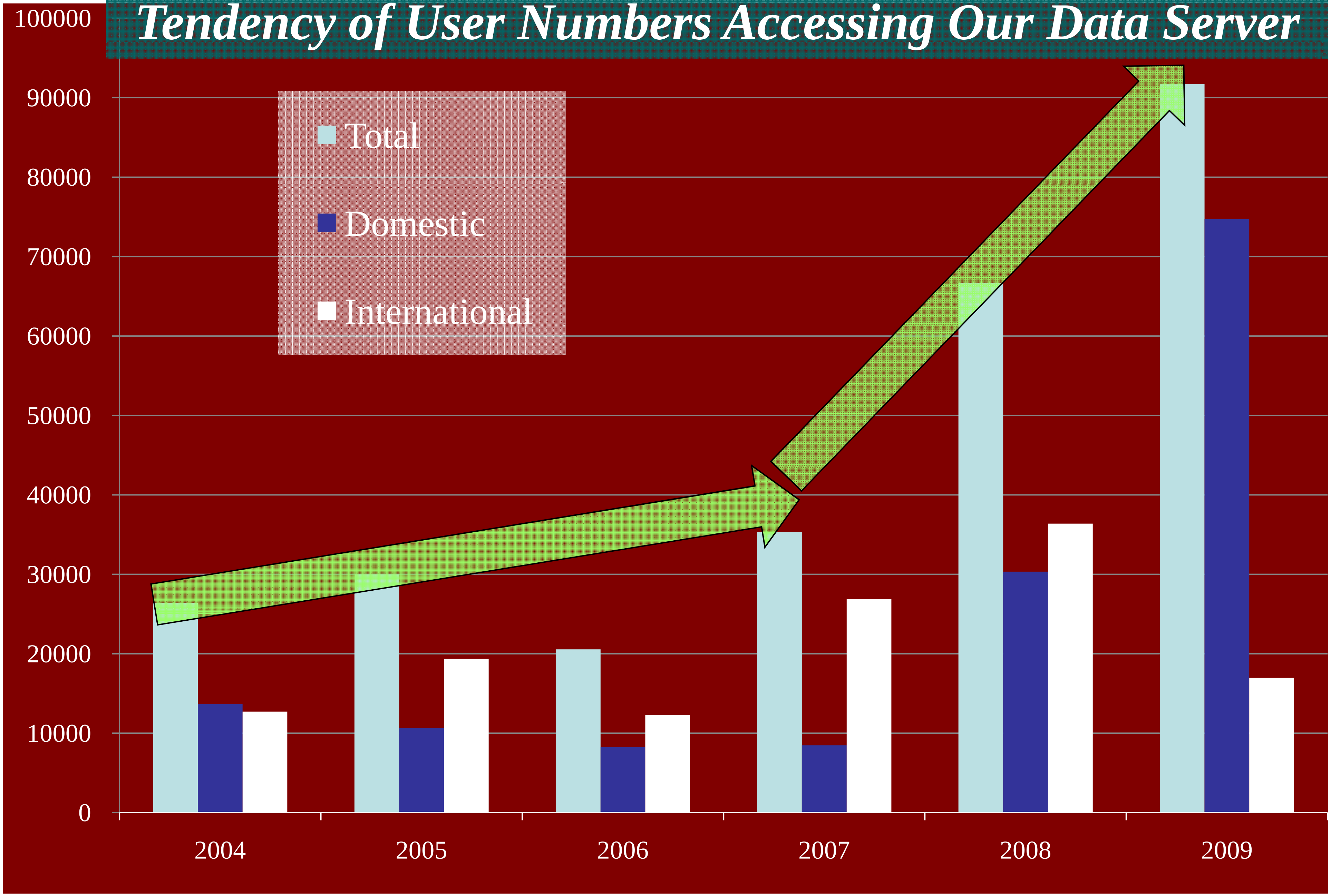
Sensible Heat Flux in Jan 2006



Meridional Wind-stress in Jan 2006



Tendency of User Numbers Accessing Our Data Server



Our Gridded Products

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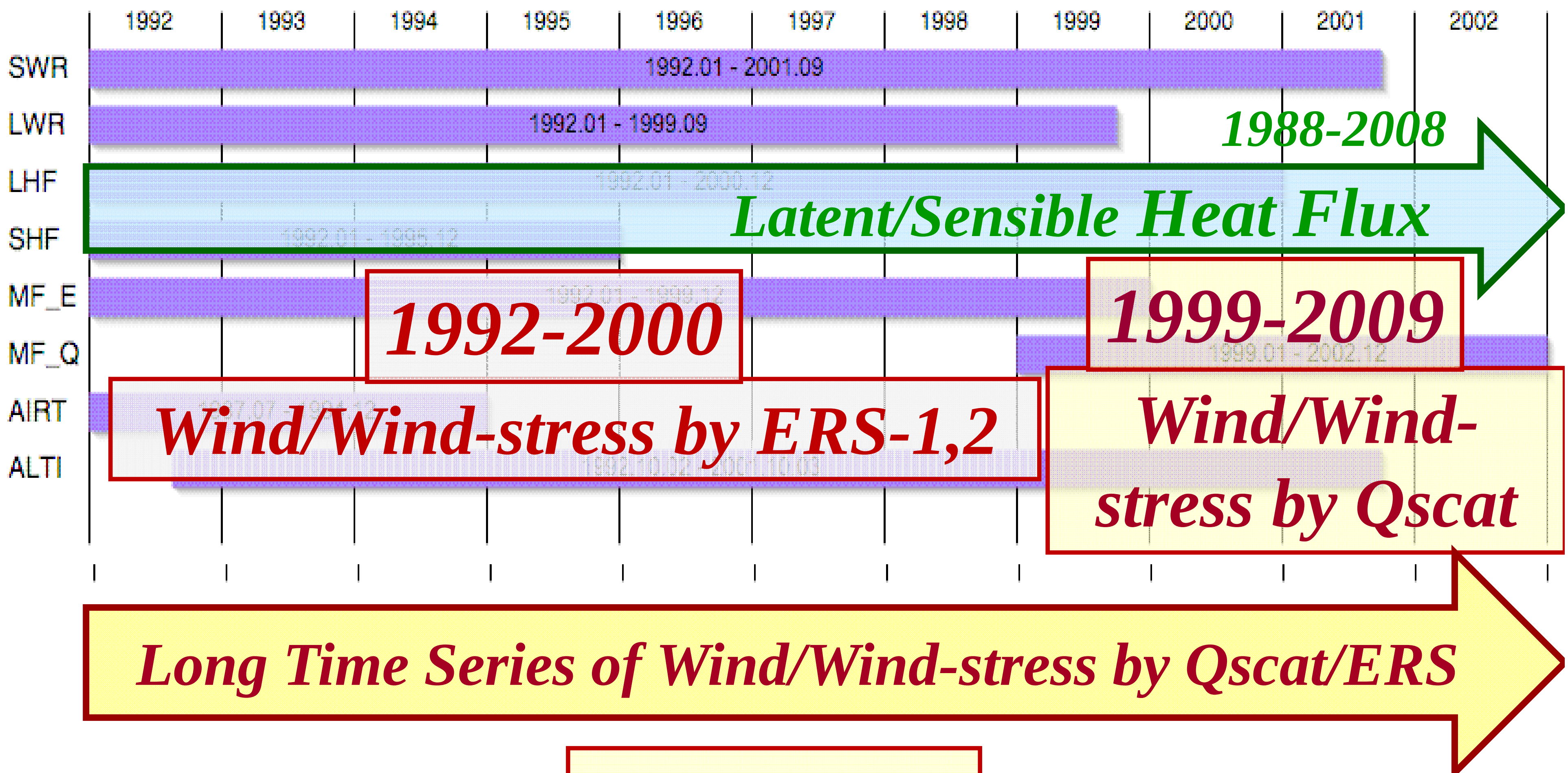
Present Data Availability



1992-2009

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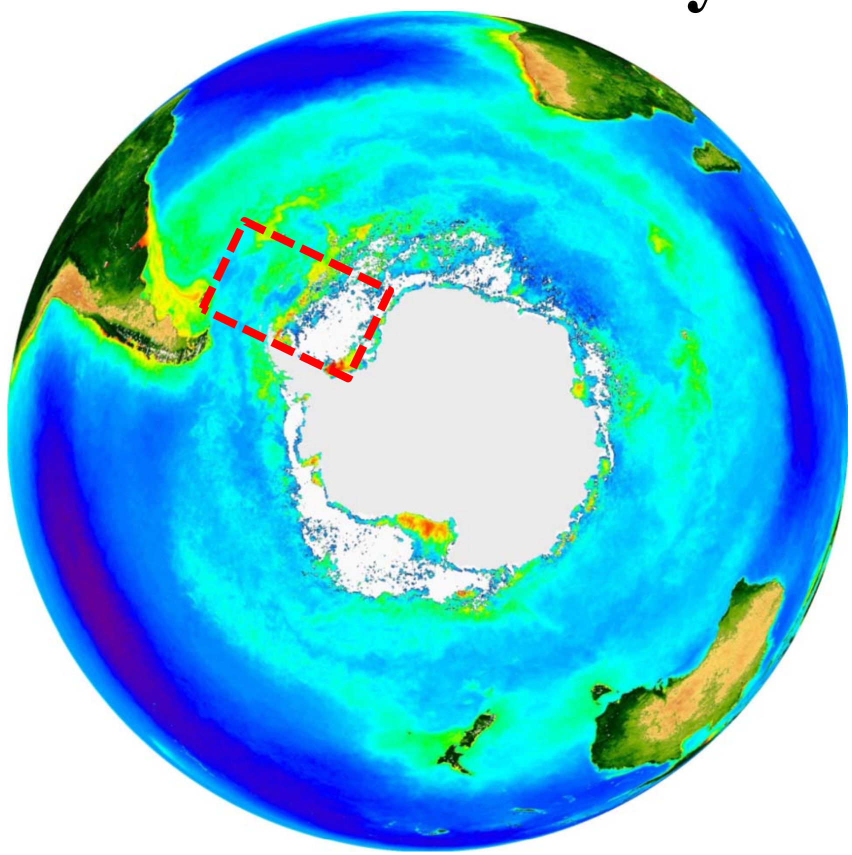
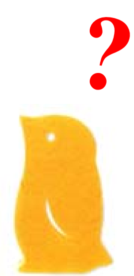
Long-term analysis of Drake Passage Oscillation Index (DPOI) and its influence on variability of Antarctic krill ecosystem





Mikio Naganobu (Fisheries Research Agency),
Junya Kondo and Kunio Kutsuwada (Tokai University)

Background

1) **Environmental and ecological change in the Antarctica is one of key issues for the global climate change.**

2) **When focusing the Antarctic marine ecosystem, an assessment of the environmental processes influencing variability in the recruitment and density of Antarctic krill (*Euphausia superba* DANA) is important as variability in krill stocks affects the Antarctic marine ecosystem.**

3) **We have been studying the relationships between krill ecosystem, oceanography and climate variability in the Antarctic Peninsula area using the environmental index; DPOI (Drake Passage Oscillation Index).**

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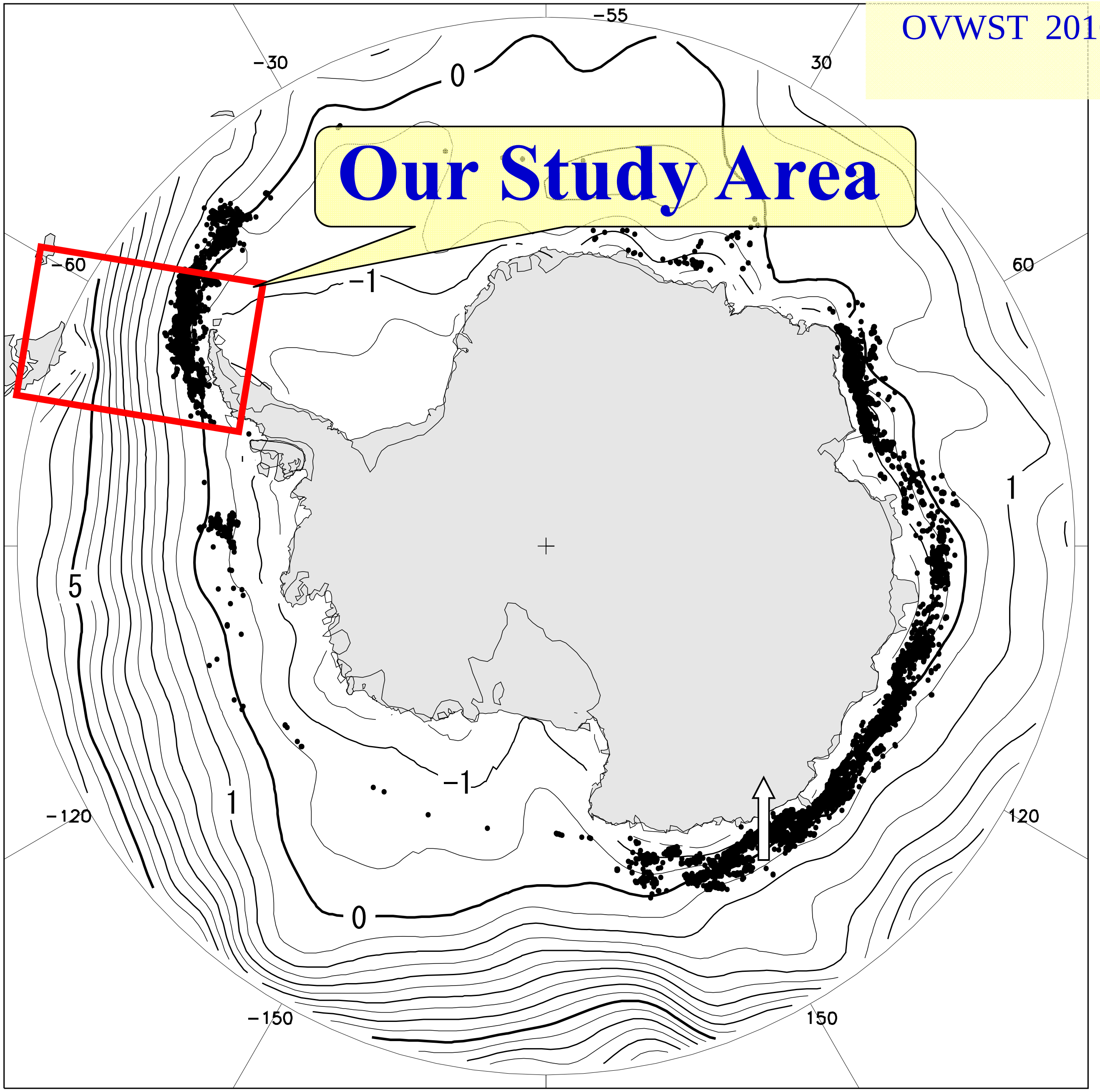


Historical krill fishing positions (black points) based on the oceanic environmental index (MTEM-200 (^{o}C); Naganobu et al., 2008) in the Entire Antarctic Ocean.

IPCC (2001)

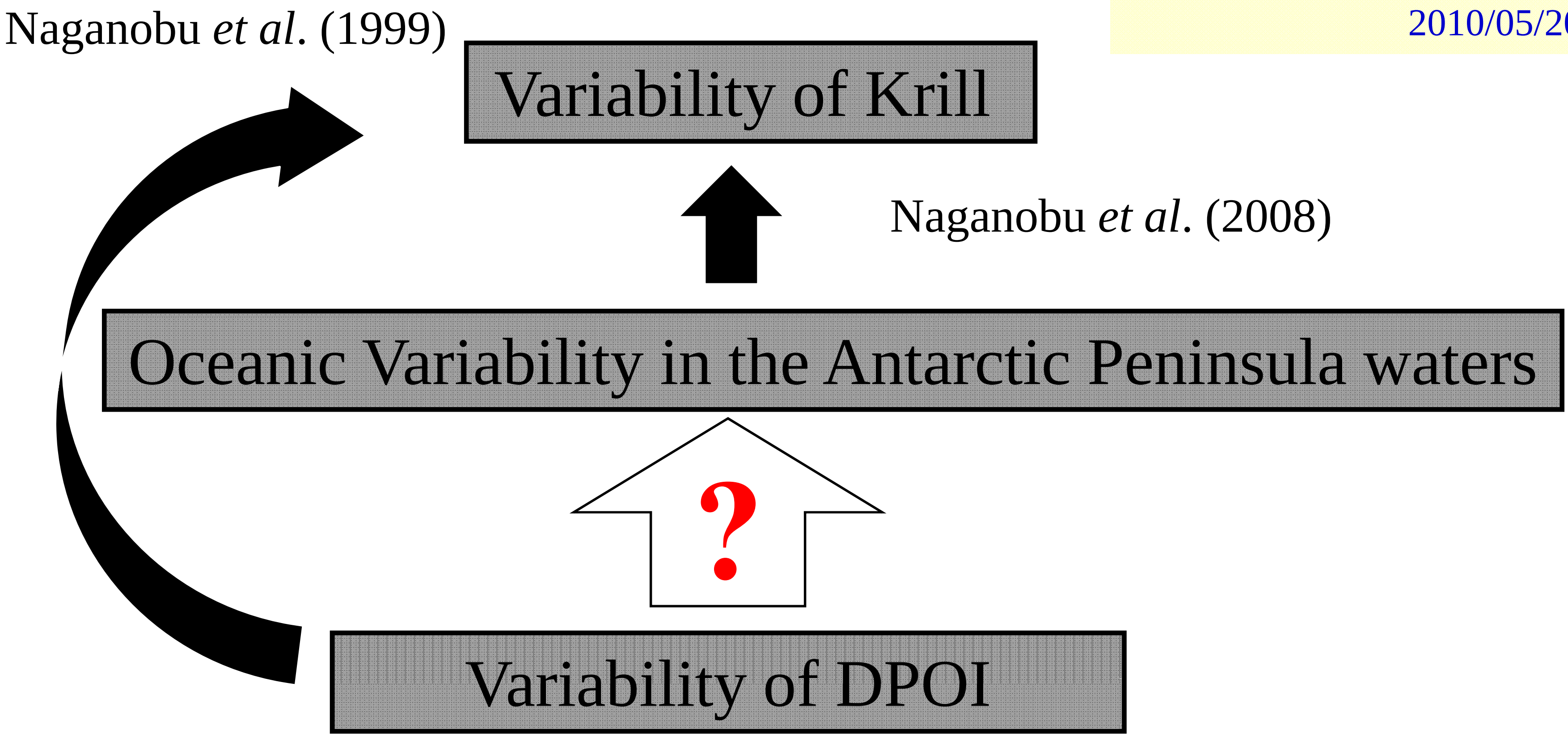
16.2.3.4. Impacts on Biology of Southern Ocean

- **DPOI**:

  A 20% decline in winter and summer sea ice since 1973 west of the Antarctic Peninsula region (Jacobs and Comiso, 1997) has led to a decline in Adelie penguins, which are obligate inhabitants of pack ice. By contrast, Chinstrap penguins in open water have increased in numbers (Fraser *et al*., 1992; Ainley *et al*., 1994). **Krill recruitment around the Antarctic Peninsula seems to be dependent on the strength of the westerlies (DPOI) and sea-ice cover, with a 1-year lag (Naganobu *et al*., 2000). Both will decrease in the future, so there will be less krill.**

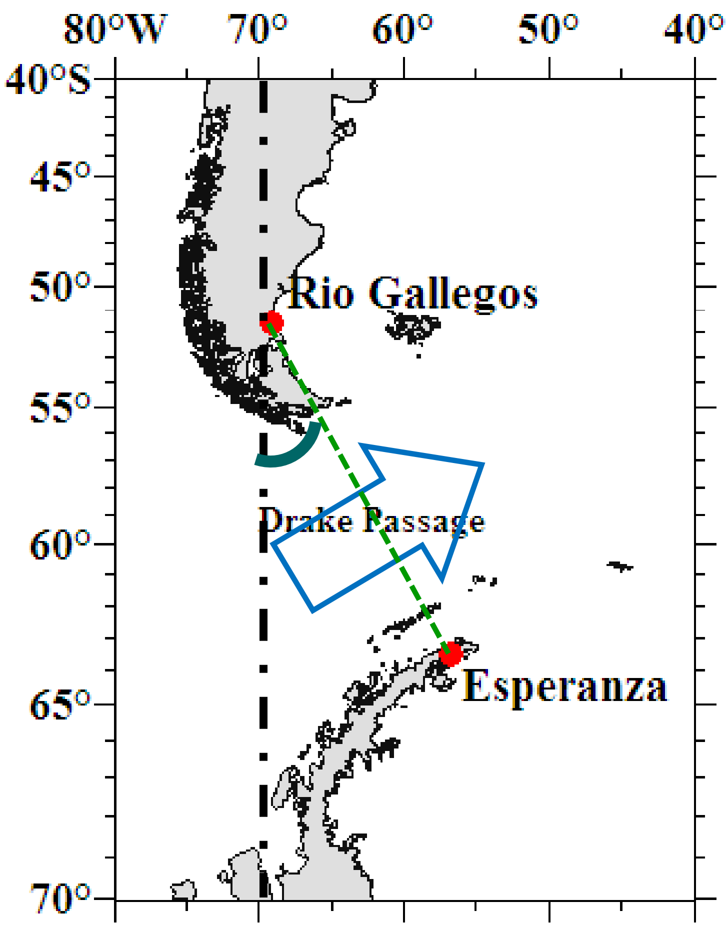
- **Ozone Depletion**:

  Any reduction in sea ice clearly represents a change in habitat for organisms that are dependent on sea ice, such as Crabeater seals and Emperor penguins. Some species of penguins and seals are dependent on krill production. Increased ultraviolet irradiance from ozone depletion is likely to favor the growth of organisms with UV-protecting pigments and/or repair mechanisms (Marchant, 1997; Davidson, 1998). This will lead to a change in species composition and impact trophodynamics and vertical carbon flux. **Naganobu *et al*. (2000) show evidence that ozone depletion impacts directly and indirectly on krill density. The growth, survival, and hatching rates of penguin chicks and seal pups are directly influenced by krill abundance in the sea.**



**Relationship between DPOI (Westerlies)
and Oceanic Environmental Variability
in the Surface Layer**

What is DPOI?



Concept image of DPOI in the Drake Passage

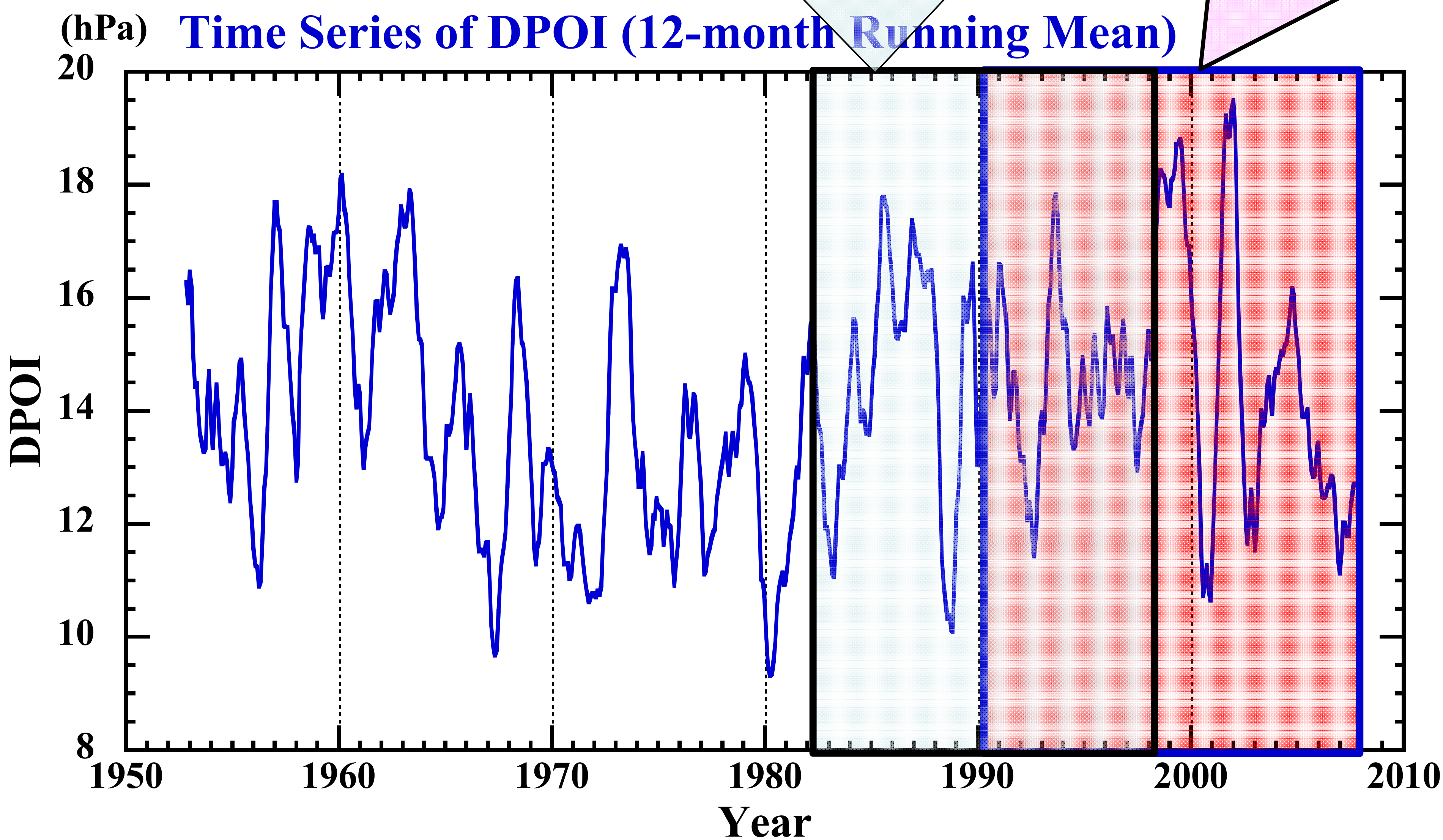
Drake Passage Oscillation Index : DPOI
(Naganobu et al., 1999)

DPOI = SLP(Rio) – SLP(Esp)

Strength of westerly winds determined from sea-level pressure differences across the Drake Passage, between Rio Gallegos, Argentina, and Base Esperanza, at the tip of the Antarctic Peninsula

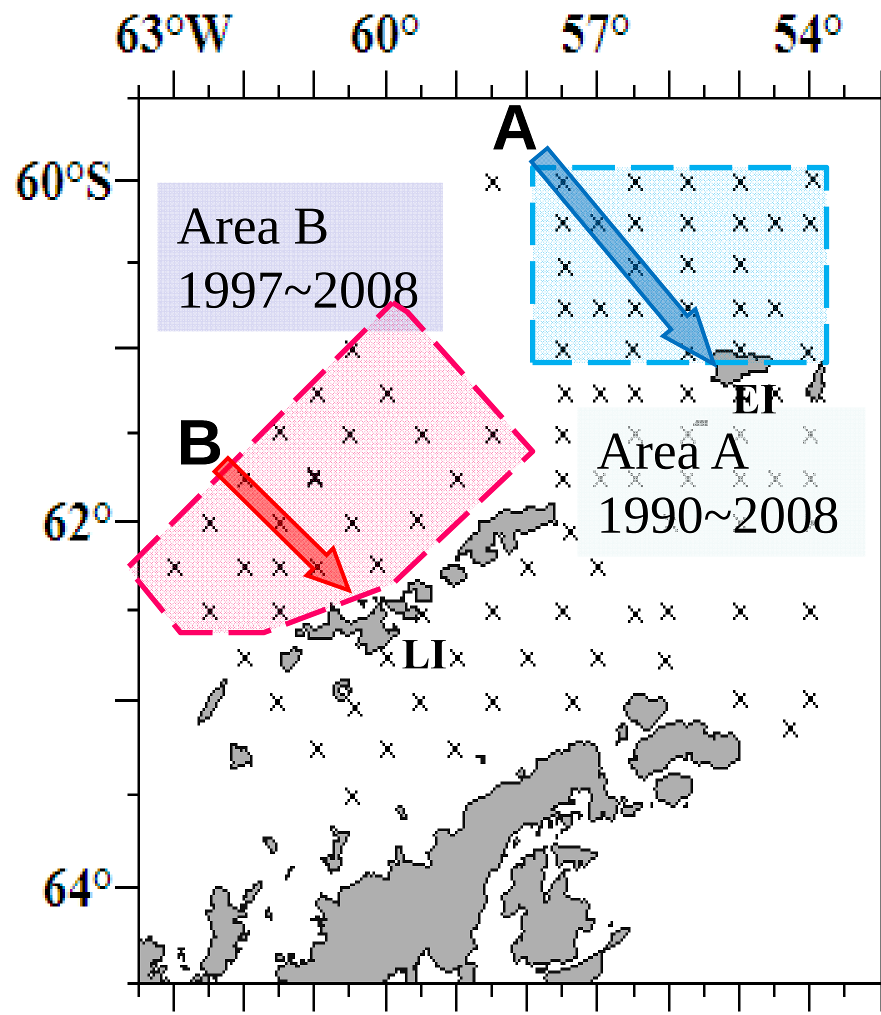
Naganobu et al.(1999):
DPOI vs Krill Variability during the period (1982-1998)

Focus period of this study



Oceanographic Data

- USA-AMLR (Antarctic Marine Living Resources) Program
  CTD data (Temperature, Salinity and Density; 0-750m)
- Survey Period :
  1990 - 2008 (January – March)
- Survey Area :
  60°S~64°S, 53°30'W~63°W
- Provider: Dr. Christian Reiss
  (Southwest Fisheries Science Center)

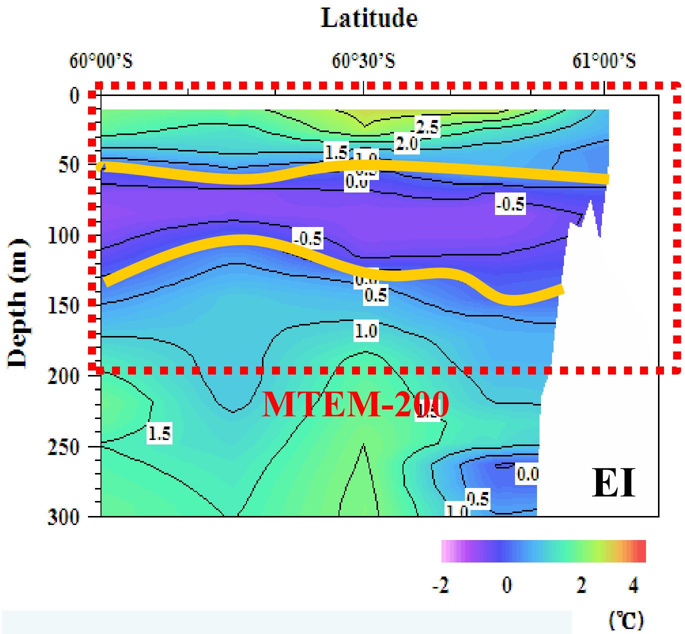


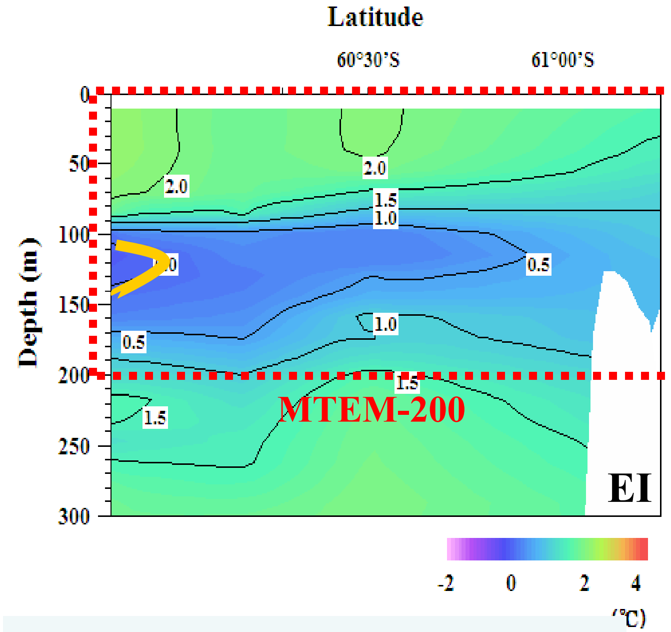
Yearly Observations every southern summer

1998 Temperature

2002 Temperature

A line

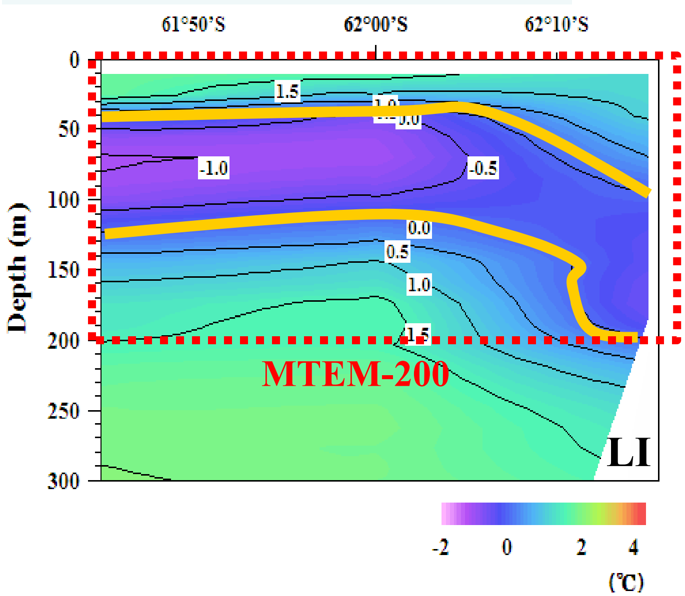


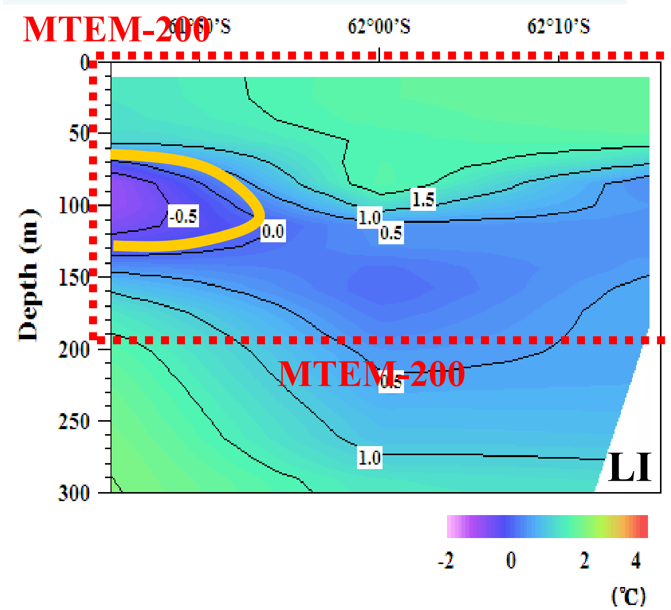


Winter Water; Larger

Winter Water; Smaller

B line





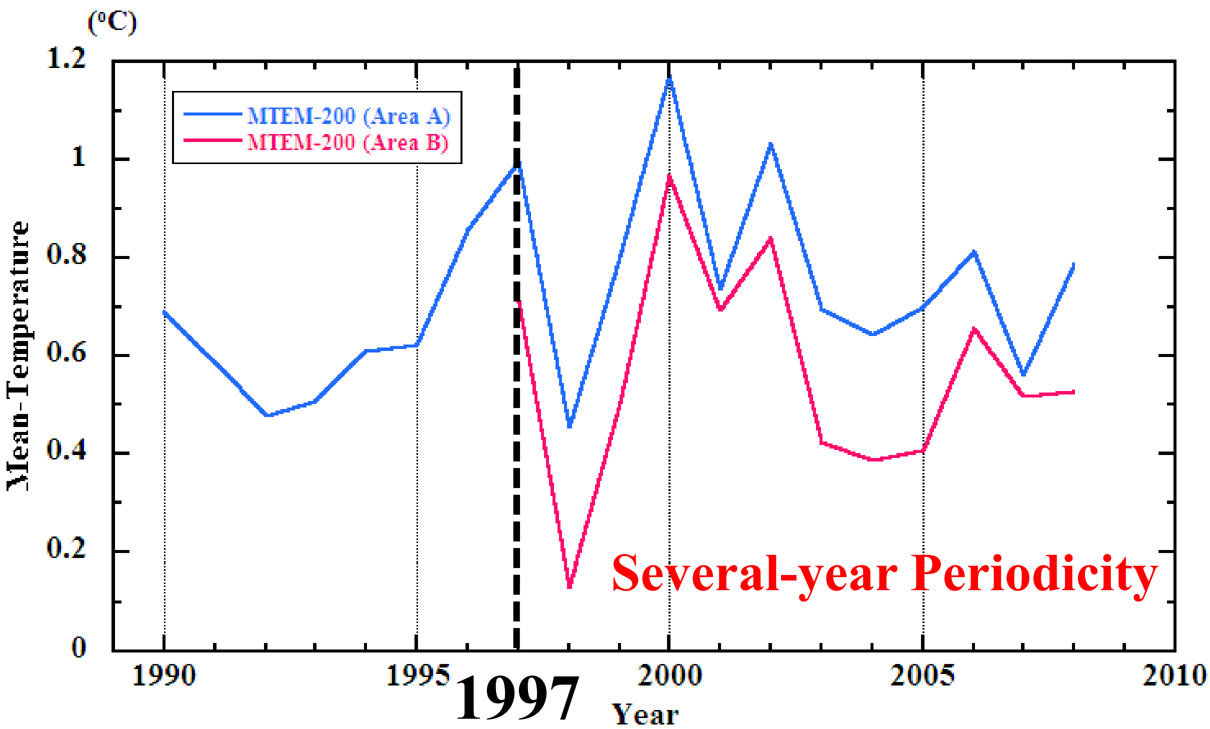
Environmental Index for Oceanic Variability

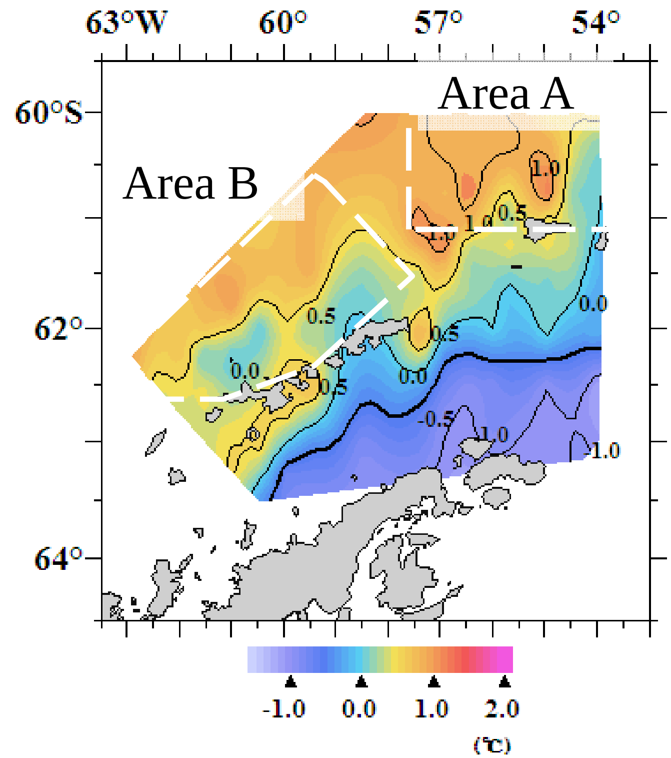
MTEM-200 : Mean TEMperature from the surface to 200m

(from Naganobu et al., 2008)

$$\text{MTEM-200} = \frac{1}{200}\sum_{d=0}^{N_{200}} T_d\, D_d$$

T_d : Water temperature at a certain depth (℃)
D_d : Height (m) of water column whose water temperature is given by T_d
N_{200} : Number of water temperature data from the surface to 200 m.





Distribution of MTEM-200 in the Area A and B.

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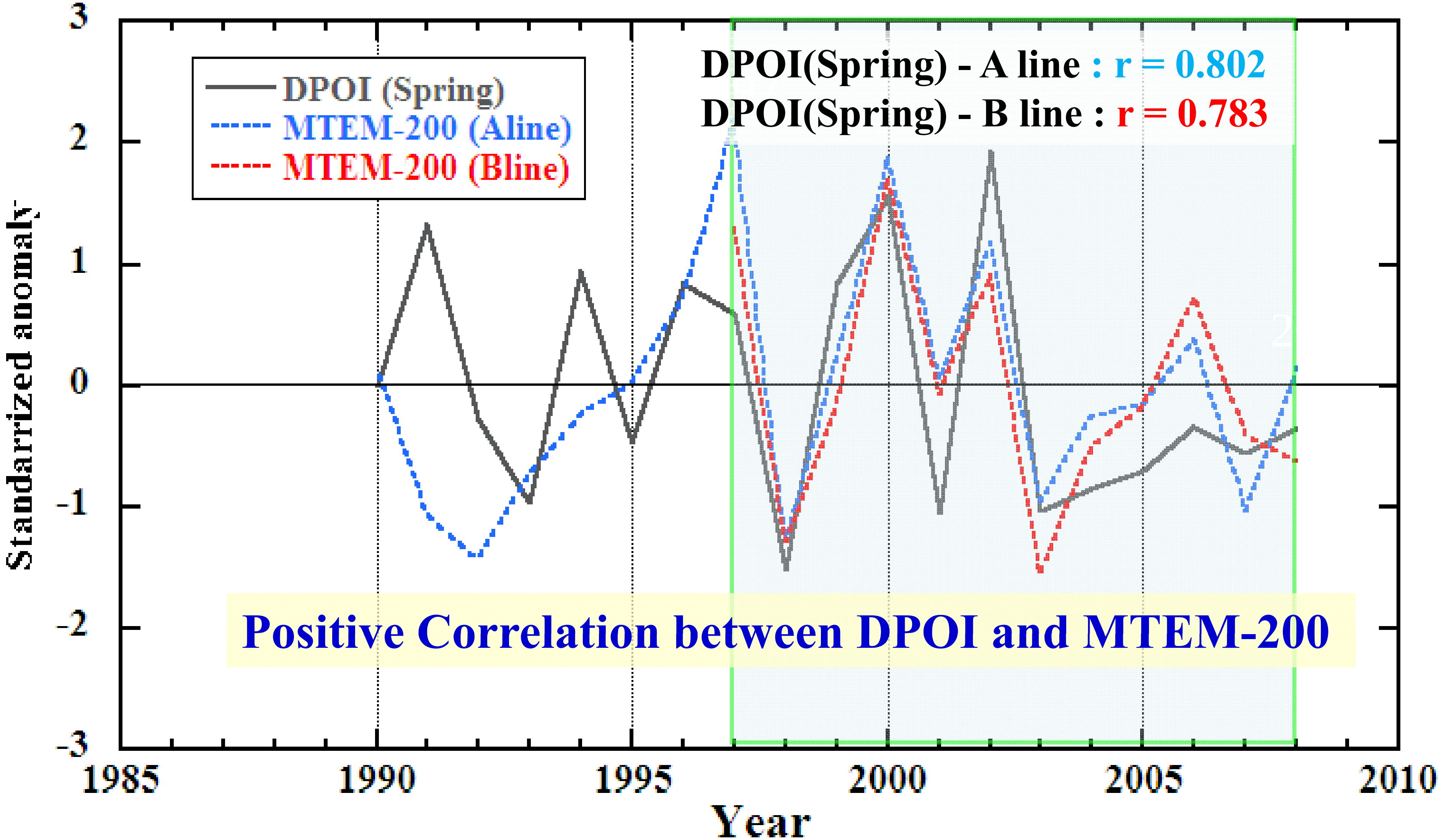
Significant Correlation between DPOI (Spring) and MTEM-200



DPOI(Spring): Mean of DPOI from October to December. Example above; DPOI (Spring) in 1990 (Spring) is the mean of DPOI from October to December 1989.

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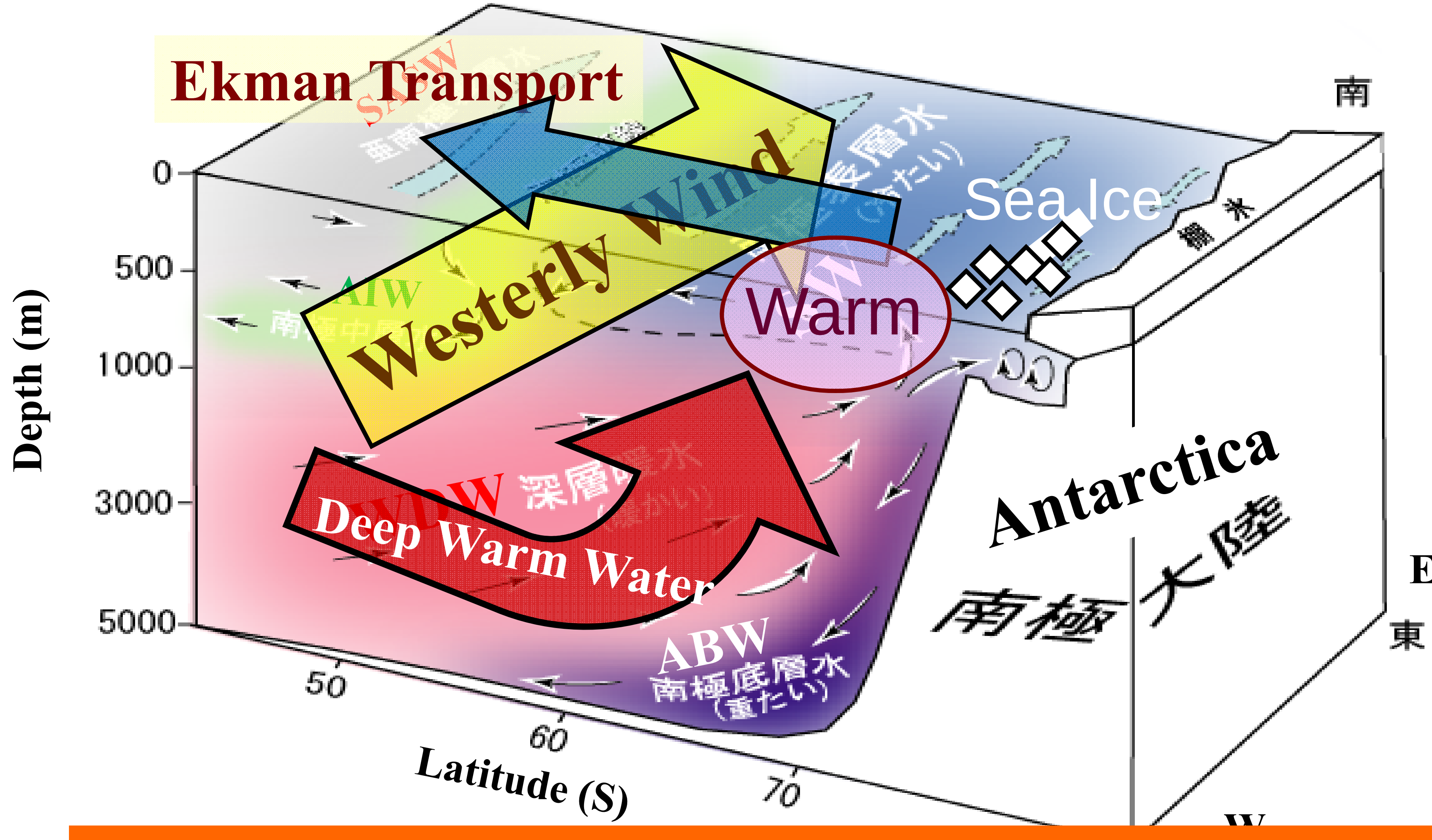
Oceanic Structure Image of the Antarctic Ocean



Intensified Westerly→Northward shift of Surface water →Upwelling of Deep Warm water→Warming of Surface layer

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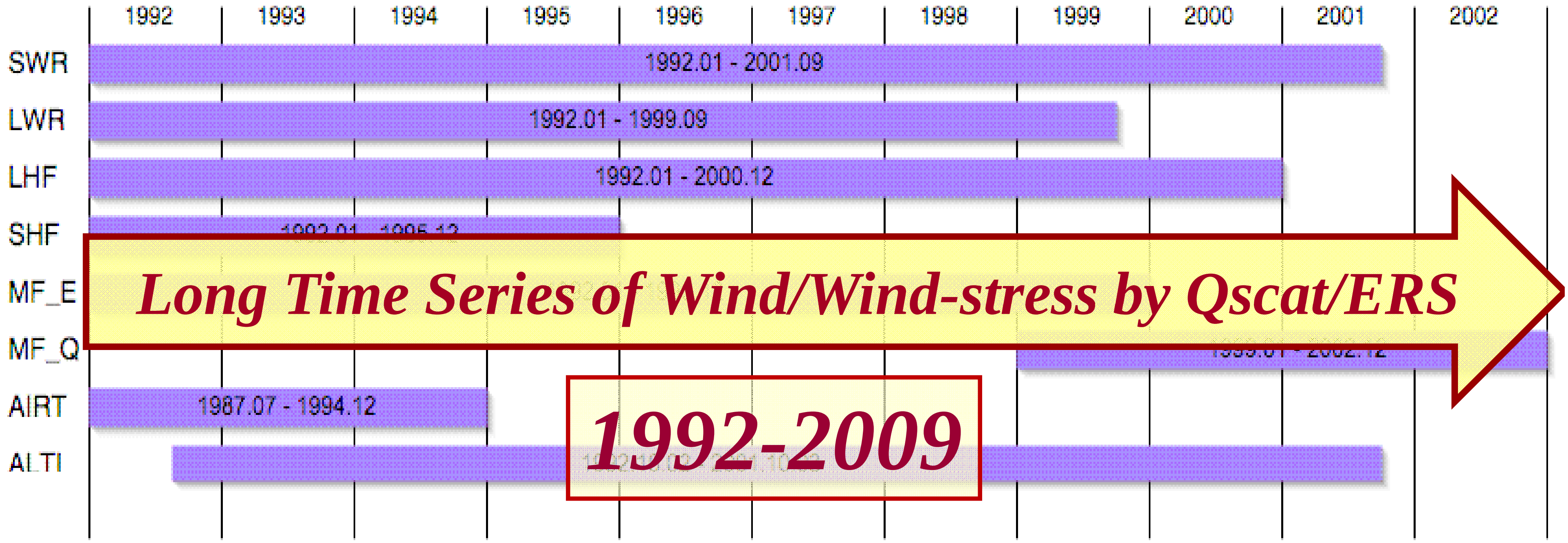
Our Gridded Products



Long Time Series of Wind/Wind-stress by Qscat/ERS

1992-2009

Investigation of DPOI –correlated wind changes over the southern ocean and their correlated features

Mean Field by Qscat/ERS (Jan. 1992–Oct. 2009)

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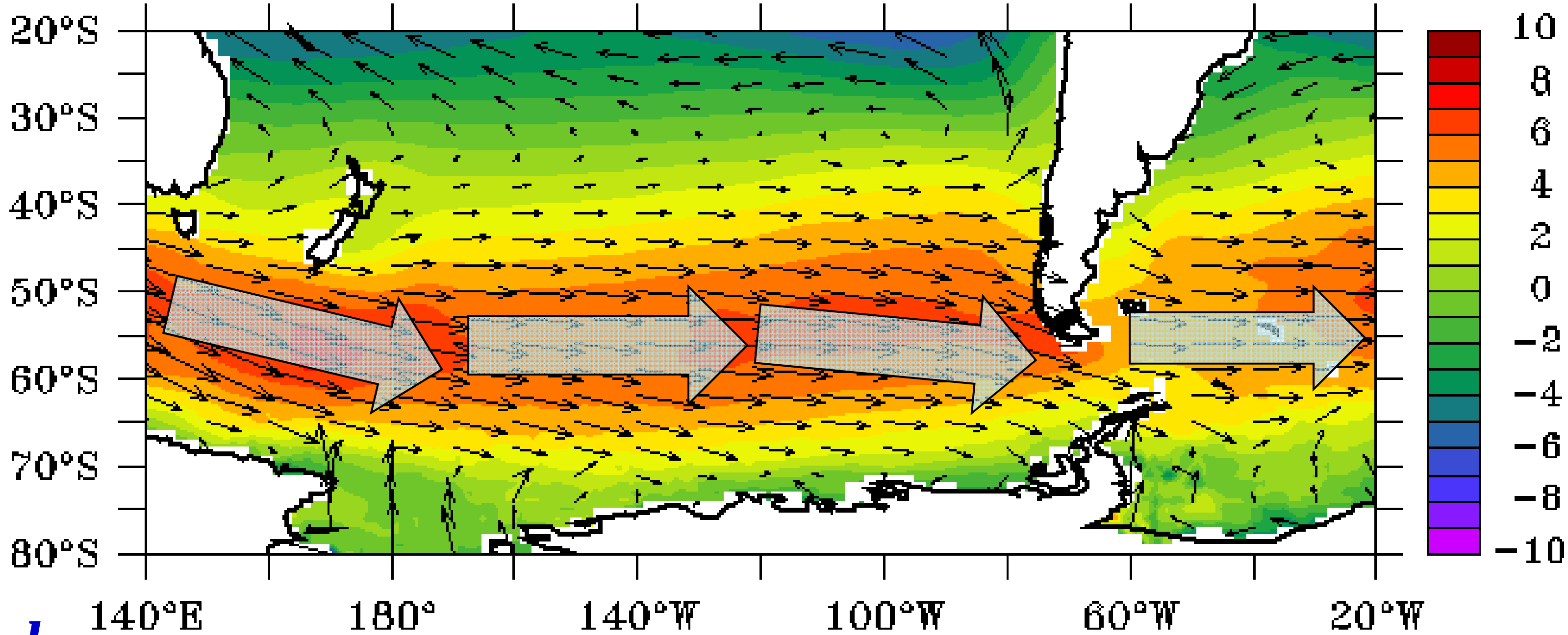
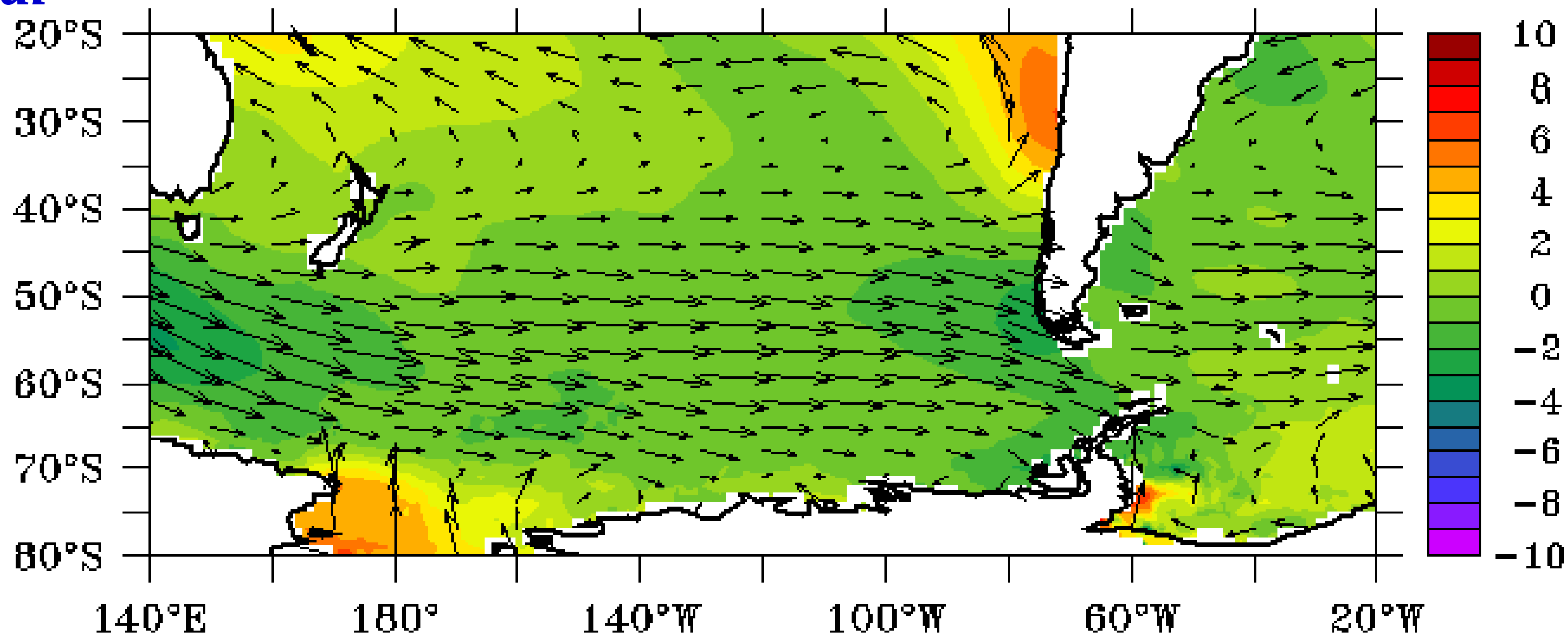
Zonal



Meridional



Correction with DPOI (Jan. 1992–Oct. 2009)

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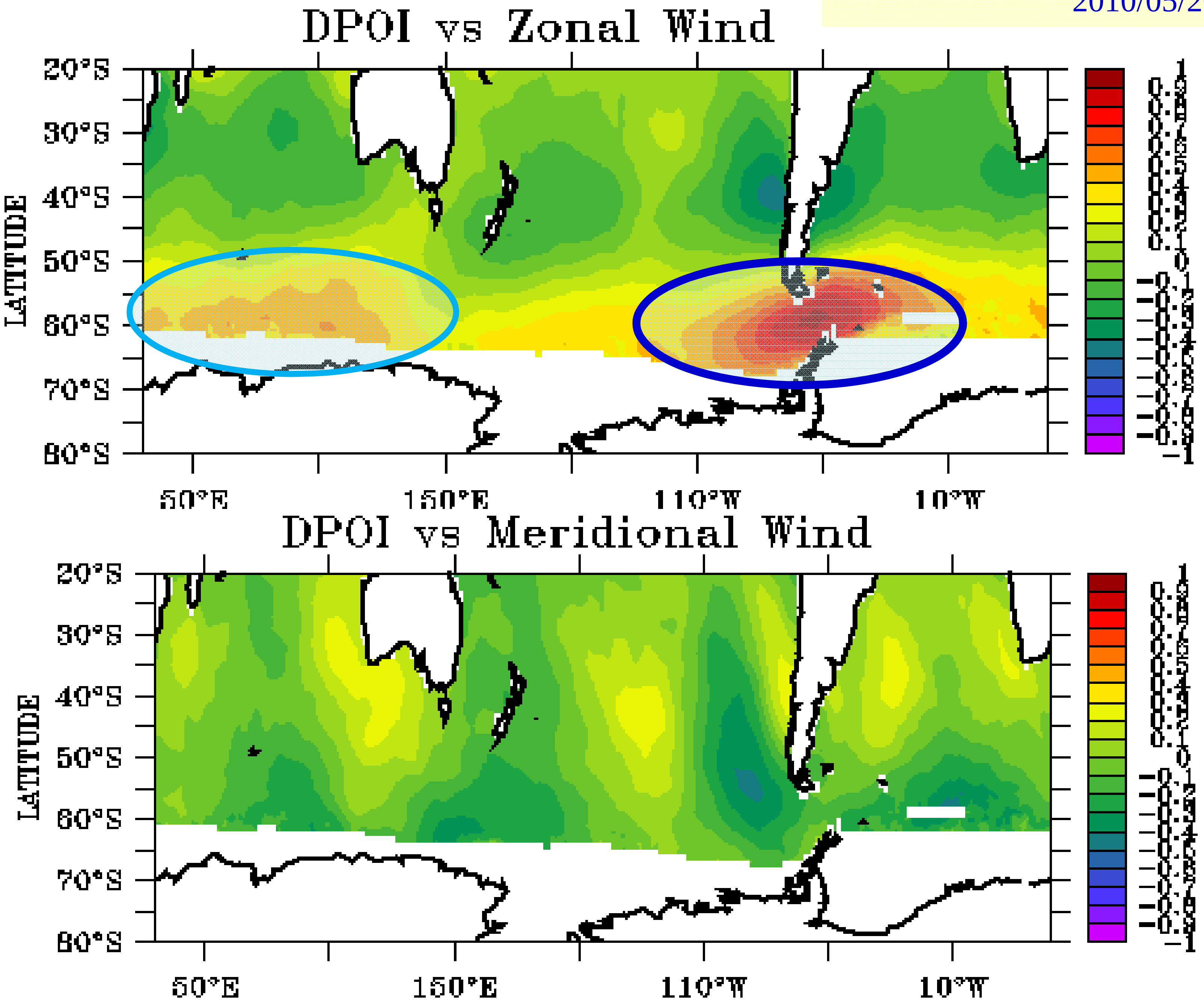
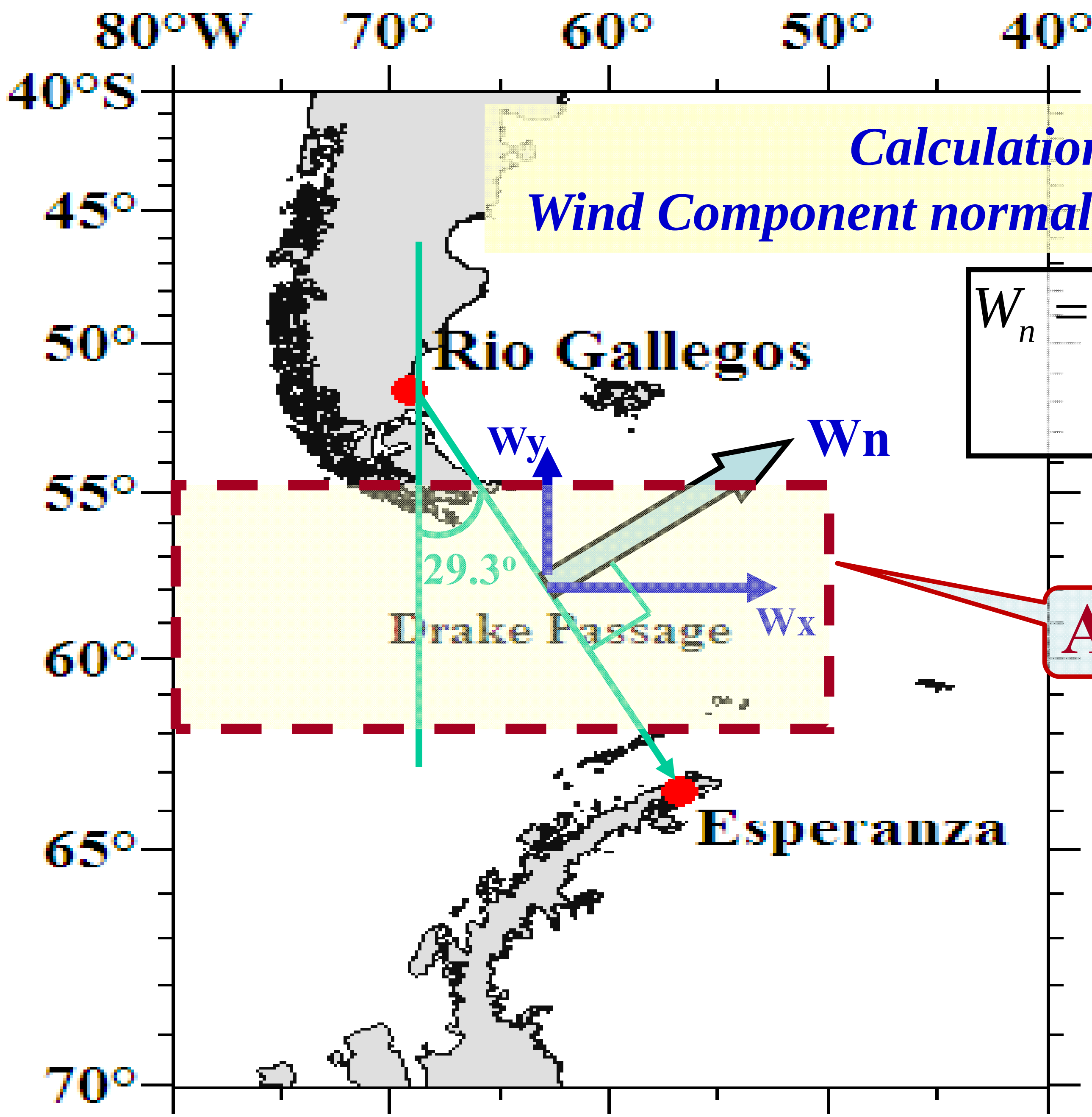


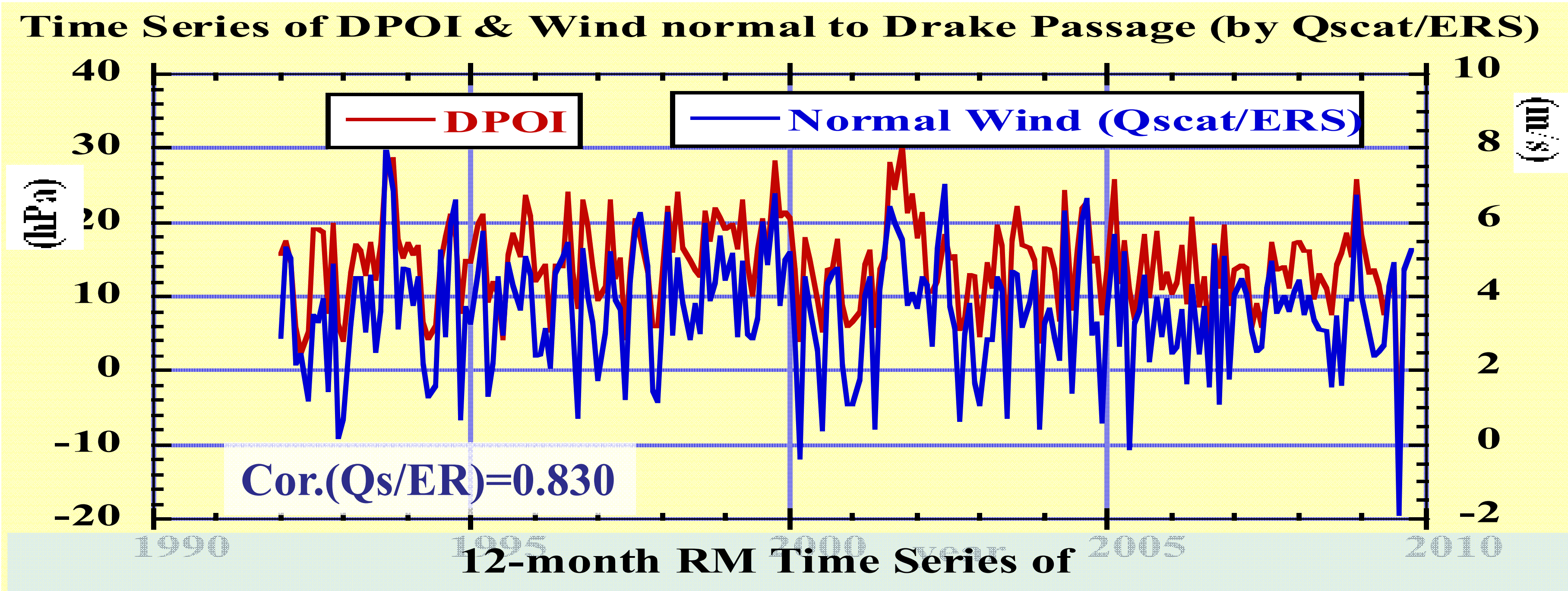
Calculation of Wind Component normal to Drake Passage

$$W_n = W_x \cos\theta + W_y \sin\theta$$

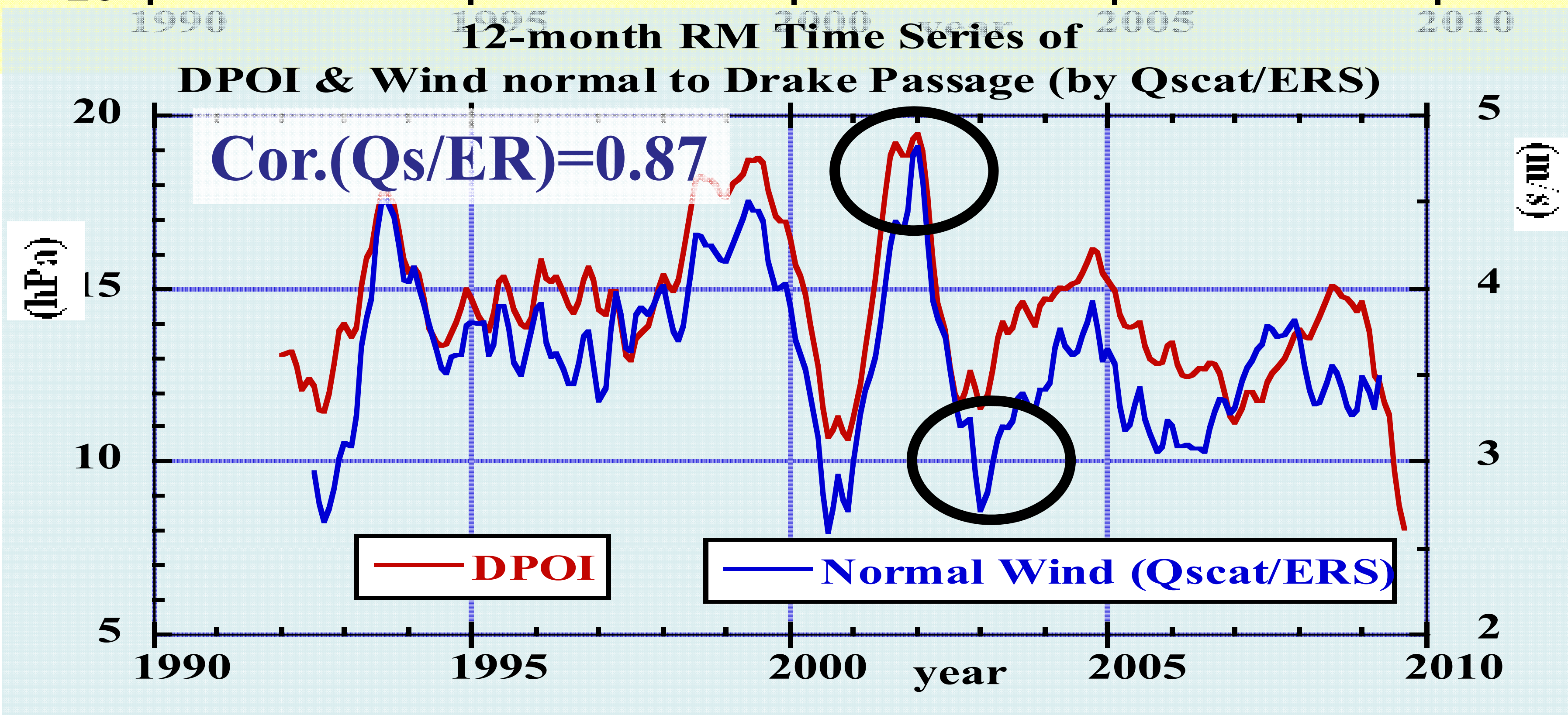
$$(\theta = 29.3^o)$$



Averaged Wind



Time Series of DPOI & Wind normal to Drake Passage (by Qscat/ERS)
DPOI
Normal Wind (Qscat/ERS)
(hPa)
(m/s)
Cor.(Qs/ER)=0.830
40
30
20
10
0
-10
-20
10
8
6
4
2
0
-2



12-month RM Time Series of
DPOI & Wind normal to Drake Passage (by Qscat/ERS)
Cor.(Qs/ER)=0.87
(hPa)
(m/s)
DPOI
Normal Wind (Qscat/ERS)
20
15
10
5
5
4
3
2
1990
1995
2000
2005
2010
year

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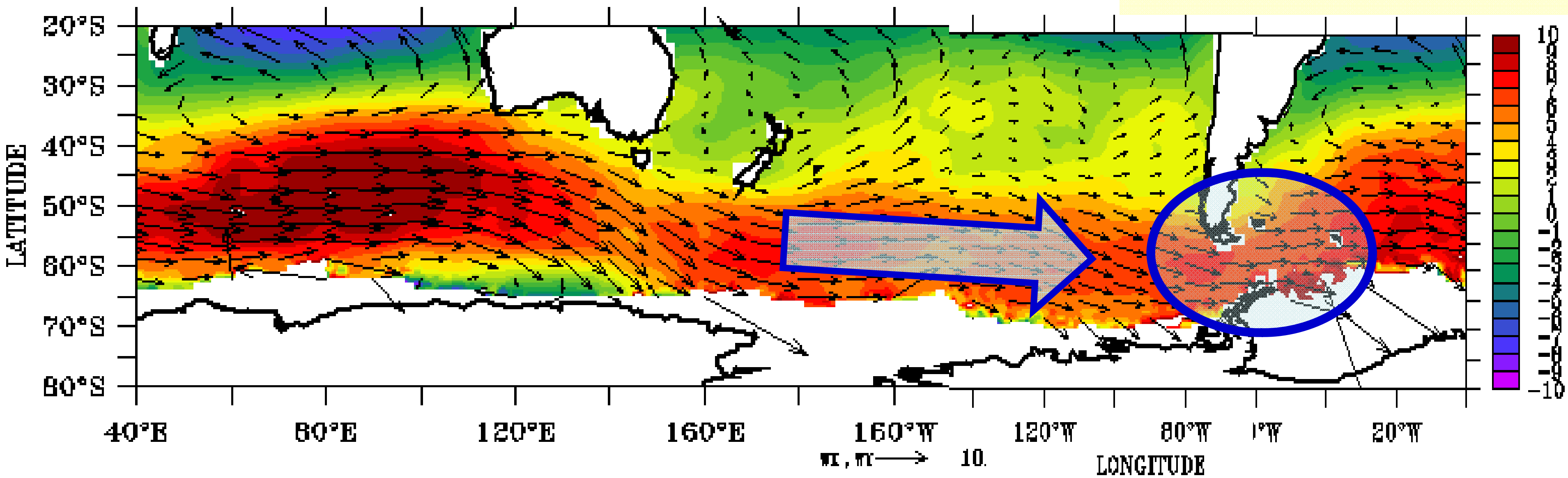
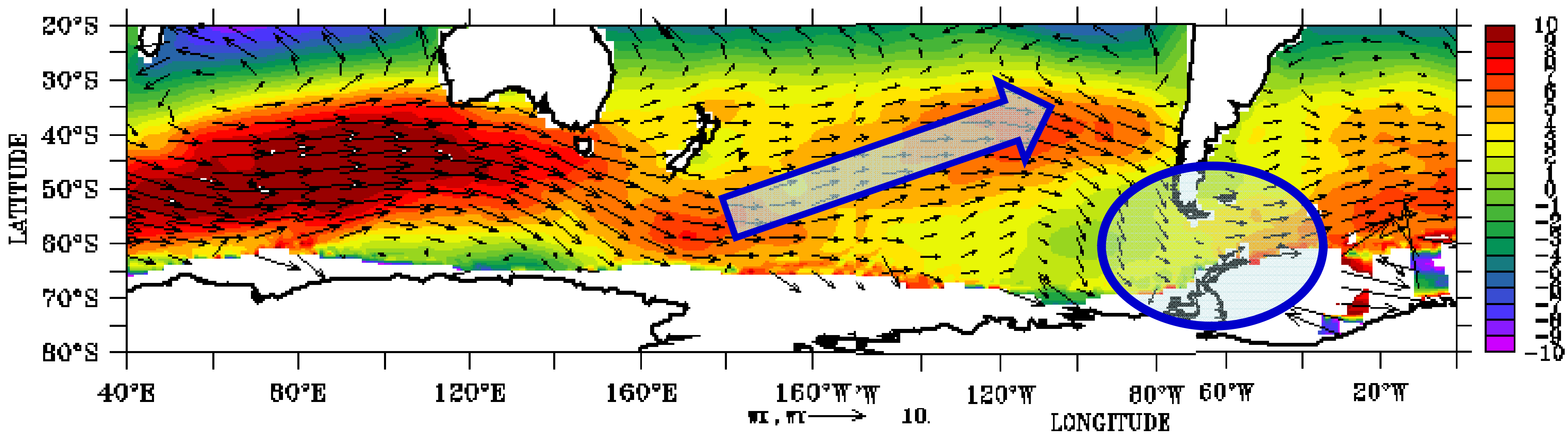
Jul.-Sep. in 2001



Jul.-Sep. in 2002



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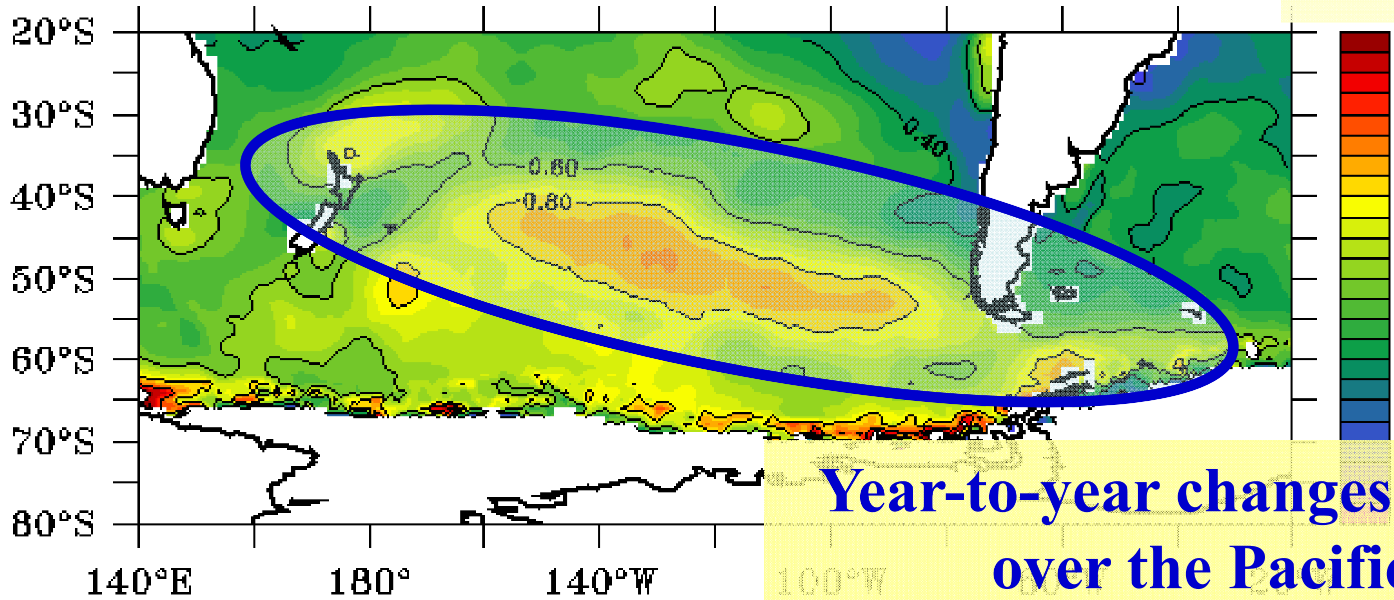
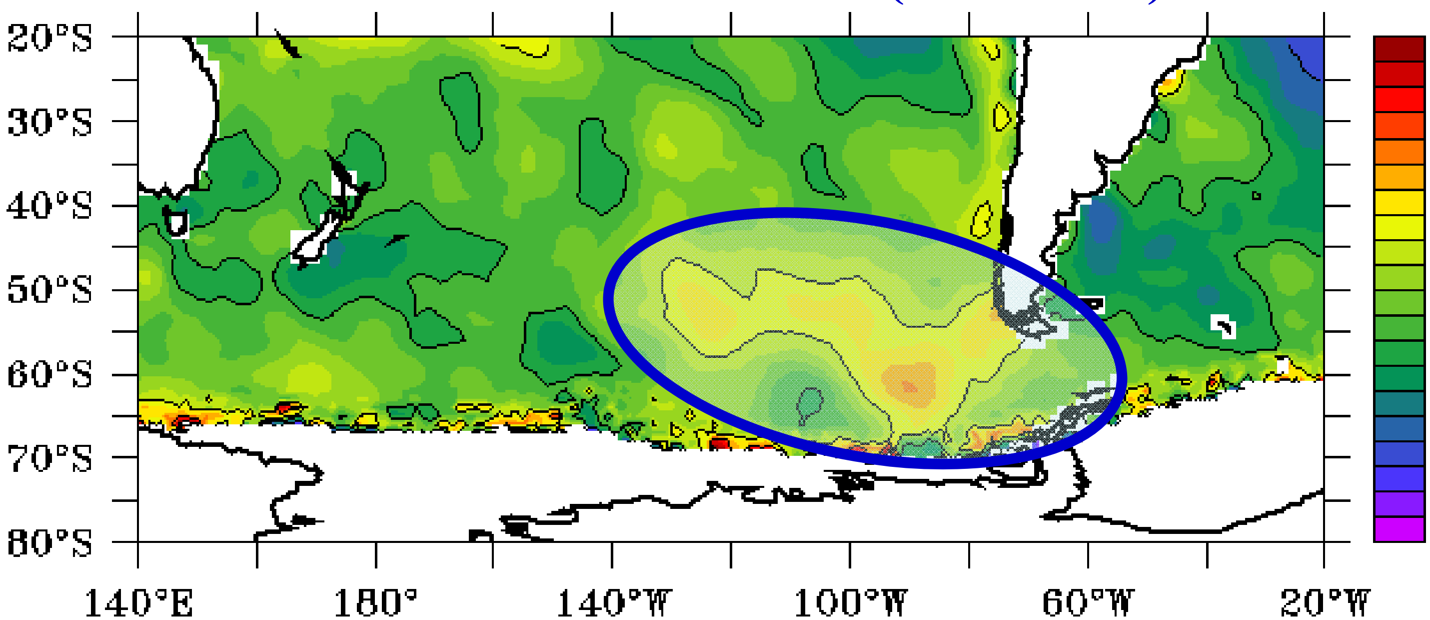
Standard Deviation of Zonal Wind (12-mo.RM) 1992-2009

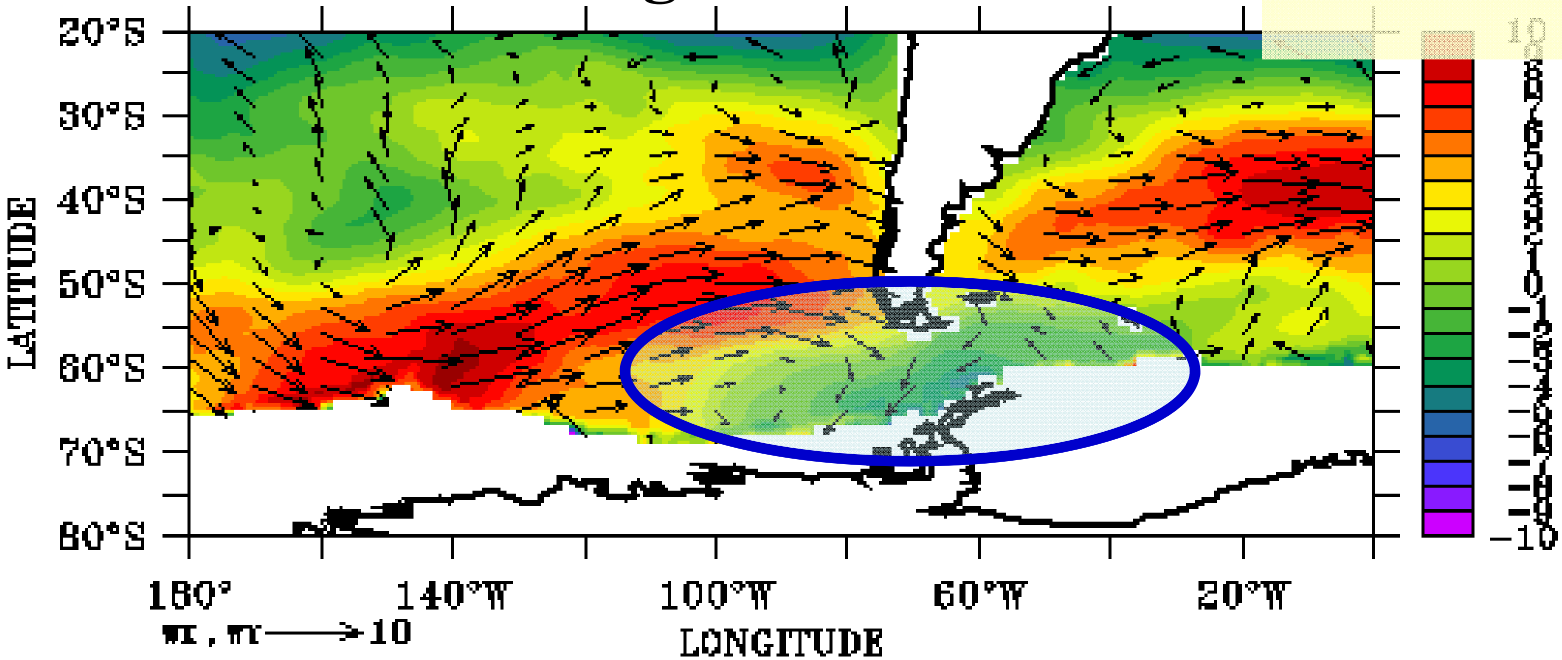


Year-to-year changes are dominant over the Pacific sector.

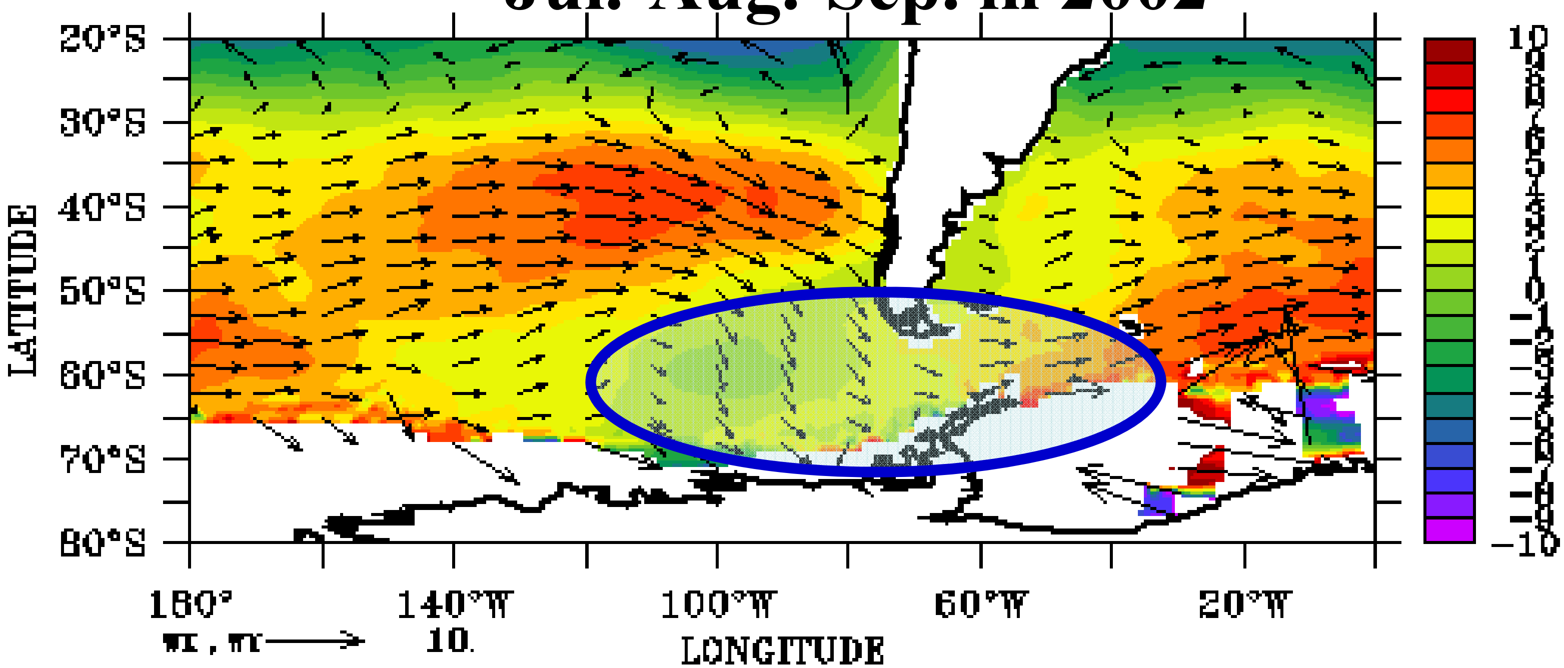
Standard Deviation of Meridional Wind (12-mo.RM) 1992-2009

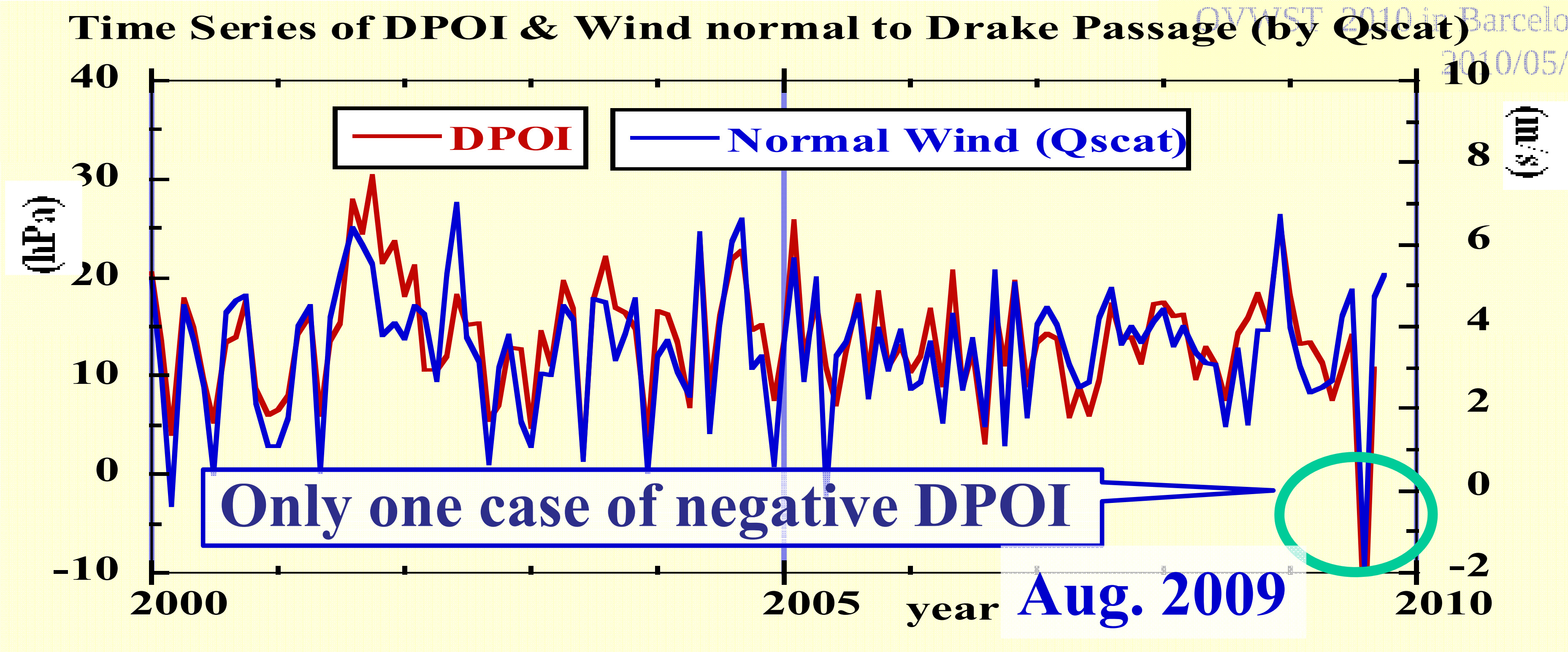


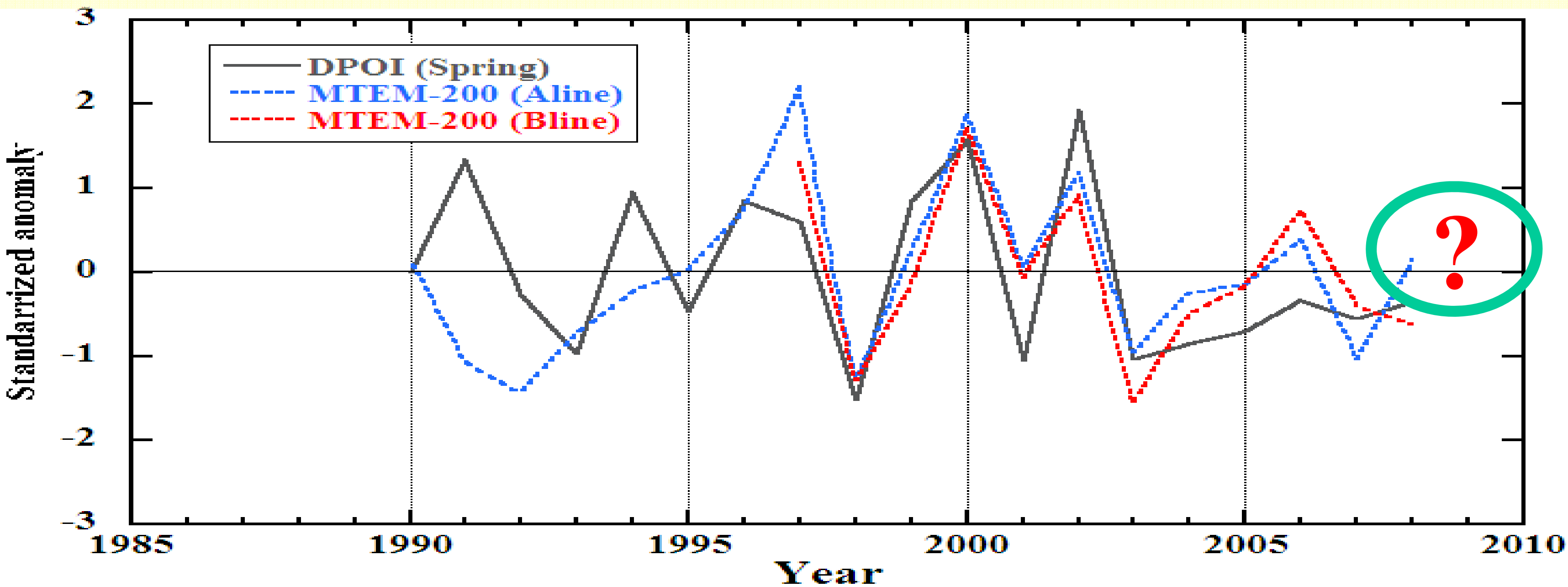
Aug. in 2009



Jul.-Aug.-Sep. in 2002




Time Series of DPOI & Wind normal to Drake Passage (by Qscat)
DPOI
Normal Wind (Qscat)
(hPa)
(m/s)
40
30
20
10
0
-10
10
8
6
4
2
0
-2
2000
2005
year
2010
Only one case of negative DPOI
Aug. 2009


DPOI (Spring)
MTEM-200 (Aline)
MTEM-200 (Bline)
Standarrized anomaly
3
2
1
0
-1
-2
-3
1985
1990
1995
2000
2005
2010
Year
?

Summary

1. **DPOI had the significant correlation with east –west zonal ocean wind and MTEM-200 in the Antarctic Peninsular area.**
2. **DPOI has high correlation with the wind changes near the Drake Passage, meaning a good measure of the strength of the westerly winds.**
3. **DPOI-related year-to-year changes are dominant over the Pacific sector, associated with the meridional shift as well as the strengthening/weakening of the westerlies.**

⇨ **Continuous time series of our gridded wind product are indispensible for these investigation.**

4. **An abnormal case is found in Aug. 2009, in which the DPOI has negative value.** ⇨ ***What oceanic condition?***

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Thank you for your attention!


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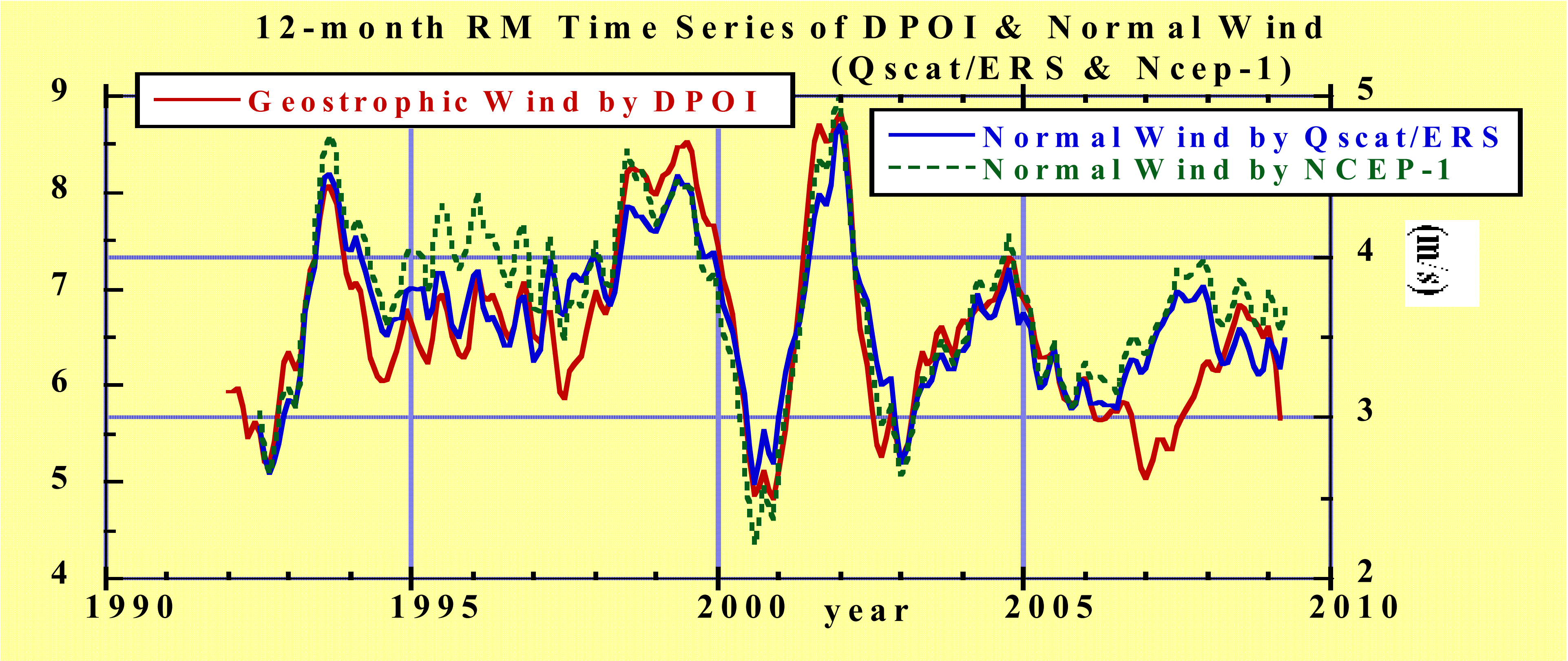

Cor.(Qs/ER)=0.87

Cor.(Nc1)=0.84