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-tokai.ac.jp
- supply in some formats:
  - netCDF, Fortran Binary, ASCII
**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 (SHE)
- 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)
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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 database.

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Year1  Month1  Year2  Month2
2000 1-12  2008 1-12

Submit

Download file lists  Select files!
J-OFURO Web

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

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Start in July 2009!

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Examples of Figures

Latent Heat Flux in Jan 2006

Sensible Heat Flux in Jan 2006

Zonal Wind-stress in Jan 2006

Meridional Wind-stress in Jan 2006
Tendency of User Numbers Accessing Our Data Server

- Total
- Domestic
- International

Data for years 2004 to 2009.
Our Gridded Products

Present Data Availability

1988-2008

Latent/Sensible Heat Flux

1992-2000

Wind/Wind-stress by ERS-1,2

1999-2009

Wind/Wind-stress by Qscat

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

1992-2009
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).
Historical krill fishing positions (black points) based on the oceanic environmental index (MTEM-200 (°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.
Naganobu *et al.* (1999)  

Variability of Krill

Naganobu *et al.* (2008)  

Oceanic Variability in the Antarctic Peninsula waters

Variability of DPOI

Relationship between DPOI (Westerlies) and Oceanic Environmental Variability in the Surface Layer
What is DPOI?

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

\[
DPOI = SLP(\text{Rio}) - SLP(\text{Esp})
\]

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.

Focus period of this study

Time Series of DPOI (12-month Running Mean)
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
Environmental Index for Oceanic Variability

MTEM-200: Mean TEMperature from the surface to 200m
(from Naganobu et al., 2008)

\[
MTEM-200 = \frac{1}{200} \sum_{d=0}^{N_{200}} T_d D_d
\]

- \( T_d \): Water temperature at a certain depth (°C)
- \( D_d \): 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.

Several-year Periodicity

Distribution of MTEM-200 in the Area A and B.
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.
Oceanic Structure Image of the Antarctic Ocean

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

Zonal

Meridional
Calculation of Wind Component normal to Drake Passage

\[ W_n = W_x \cos \theta + W_y \sin \theta \]

\[ (\theta = 29.3^\circ) \]
Cor.(Qs/ER) = 0.830

Cor.(Qs/ER) = 0.87
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
Only one case of negative DPOI

Aug. 2009
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.

4. An abnormal case is found in Aug. 2009, in which the DPOI has negative value. What oceanic condition?
Please try to access our server and enjoy in our J-OFURO v2!
Thank you for your attention!

Tokai University
12-month RM Time Series of DPOI & Normal Wind
(Qscat/ERS & Ncep-1)

Cor.(Qs/ER) = 0.87
Cor.(Nc1) = 0.84