Introduction of Japanese Ocean Flux data sets with Use of Remote sensing Observations (J-OFURO)

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Abstract:

Accurate ocean surface fluxes with high resolution are critical for understanding a mechanism of global climate. However, it is difficult to derive those fluxes by using ocean observation data because the number of ocean observation data is extremely small and the distribution is inhomogeneous. On the other hand, satellite data are characterized by the high density, the high resolution and the homogeneity. Therefore, it can be considered that we obtain accurate ocean surface fluxes by using satellite data. Recently we constructed ocean surface data sets mainly using satellite data. The data set is named by Japanese Ocean Flux data sets with Use of Remote sensing Observations (J-OFURO). Here, we introduce J-OFURO. The data set includes shortwave radiation, longwave radiation, latent heat flux, sensible heat flux, and momentum flux etc. Moreover, sea surface dynamic topography data are included in the data set. Radiation data sets covers western Pacific and eastern Indian Ocean because we use a Japanese geostationally satellite (GMS) to estimate radiation fluxes. On the other hand, turbulent heat fluxes are globally estimated. The constructed data sets are used and shows the effectiveness for many scientific studies.

Key words:

shortwave radiation flux, longwave radiation flux, latent heat flux, sensible heat flux, momentum flux, air sea interaction

1. Introduction

Ocean actively changes heat, water and momentum with atmosphere at ocean surface. The exchanged heat, water and momentum are transported by general ocean and atmospheric circulation on the globe. Since the exchanging and transporting processes are essential components for global climate, estimates of those fluxes between atmosphere and ocean and of those transports by ocean and atmospheric circulation are quite important for understanding a mechanism of global climate. However, it is difficult to globally estimate those fluxes and transports by using in situ observation data such as ship observation data because in situ data are extremely sparse in time and space. However, we can derive considerably homogeneous data with high resolution using analysis and satellite data. Therefore, it is considered that analysis and satellite data are suitable for estimating global flux between ocean and atmosphere.

Recently we constructed ocean surface data sets mainly using satellite data. The data set is named by

Japanese Ocean Flux data sets with Use of Remote sensing Observations (J-OFURO). Here, we introduce J-OFURO.

2. Data sets

We constructed data sets for shortwave radiation flux , longwave radiation flux , latent heat flux, sensible heat flux, momentum flux , and sea surface dynamic topography. Maps for shortwave radiation and latent heat fluxes are shown in Fig.1 and 2 as examples. Also detailed descriptions for each data set are as follows:

2-1. Shortwave Radiation Flux

Geographical area: 60N - 60S, 80E - 160W

Time period: Mar.1987 - Sep.1998

Grid:(space/time): 0.25deg.x 0.25 deg., monthly

Variables: solar radiation at the sea surface

Data sources: GMS/VISSR, SSM/I, NOAA/AVHRR, TOMS

Comments:RMSE : 10% or smaller (condition dependent)

2-2. .Longwave Radiation Flux

Geographical area: 80E-160W, 60S-60N

Time period:
October 1992 through September 1993

Grid:(space/time):
1.0 deg. x 1.0 deg., monthly

Variables: Upward and downward long wave radiation fluxes at sea surface

Formulae used:

Clear sky radiation: The narrow band model, proposed by Goody, was used. The H_2O rotation band, the H_2O continuum, the CO_2 15 micro-meter band and the H_2O 6.3 micro-meter were included in the radiation model. The parameters in the model were given by Rogers and Walshaw (1966), Goldman and Kyle (1968) and Roberts et al. (1976). Spectral rang was 0-2200 cm^{-1}. The spectral band was divided into 23 narrow bands for the radiation computation. Upward long wave radiation: The flux was computed following the black body theory with the emissivity of sea surface of 0.984 given by Konda et al.(1994).

Data sources:GMS/VISSR,COADS,MCSST,BSRN, NCEP Reanalysis

2-3. Turbulent Heat Flux

Geographical area:Global

Time period:1988-1995

Grid:(space/time):
1.0 deg. X 1.0 deg., Monthly

Formulae used:

(1) Bulk formula:Kondo(1975)

(2) Specific Humidity:
Schlussel et al.(1995),
Schulz et al.(1993)

(3) Sensible Heat Flux :
Kubota and Mitsumori(1997)

Data sources:DMSP/SSMI data, NCEP SST data, COADS , ECMWF

2-4. Momentum Flux

Geographical area: 60N-60S, 30E-70W

Time period:
Sep. 16, 1996 - Jun. 29, 1997 for NSCAT

Oct., 1992- May, 1996 for ERS-1

Mar., 1996 - Aug. 1998 for ERS-2

Grid:(space/time):

1.0 deg. x 1.0 deg., daily for NSCAT, monthly and 10-day for ERS-1& 2

Variables: Zonal and meridional components of wind and wind-stress vectors

Formulae used: Bulk formula based on Large and Pond(1981)

Data sources:

PODAAC in JPL for NSCAT

IFREMER for ERS-1 & 2

2-5. Altimeter

Geographical area: global (66S--66N)

Time period: 1992/Oct/8--1997/Oct/6

grid:(space/time):

(Dataset A) 0.5deg x 0.5deg, 10day

(Dataset B) 0.5deg x 0.5deg, 10day

(Dataset C) 0.25deg x 0.25deg, 10day

Variables:

Sea surface dynamic topography

Formulae used : Objective Mapping

Data sources: AVISO CGDR of TOPEX/POSEIDON and ERS-1/2

3. Application

Figure 3 shows time-longitude diagrams for sea surface temperature, anomaly of Ongoing Longwave Radiation (OLR), and anomaly of zonal winds in the equatorial region from July, 1996 to December, 1998. We can see westward propagation of each variable related to the 1997 El Nino in these figures. Also we can estimate heat transfer between ocean and atmosphere and understand temporal and spatial variability using these data sets. For example Fig. 4 shows results of EOF analysis applied to the latent heat flux data in the western North Pacific including marginal seas. The first EOF mode represents seasonal variability of which maximum amplitude is found along the Kuroshio region. The data sets are expected to be extensively used in various studies associated with global climate issues.

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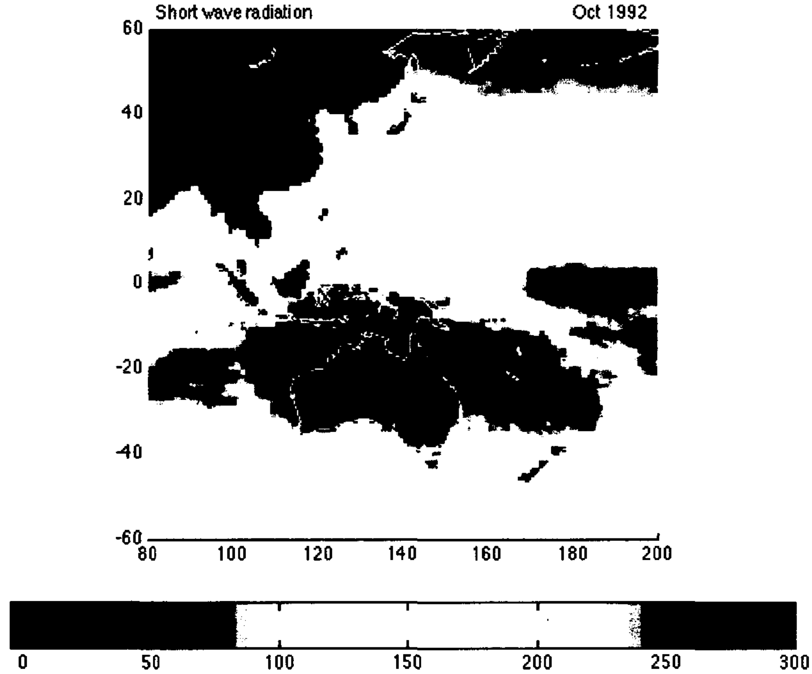

Figure 1. Shortwave radiation for October, 1992.

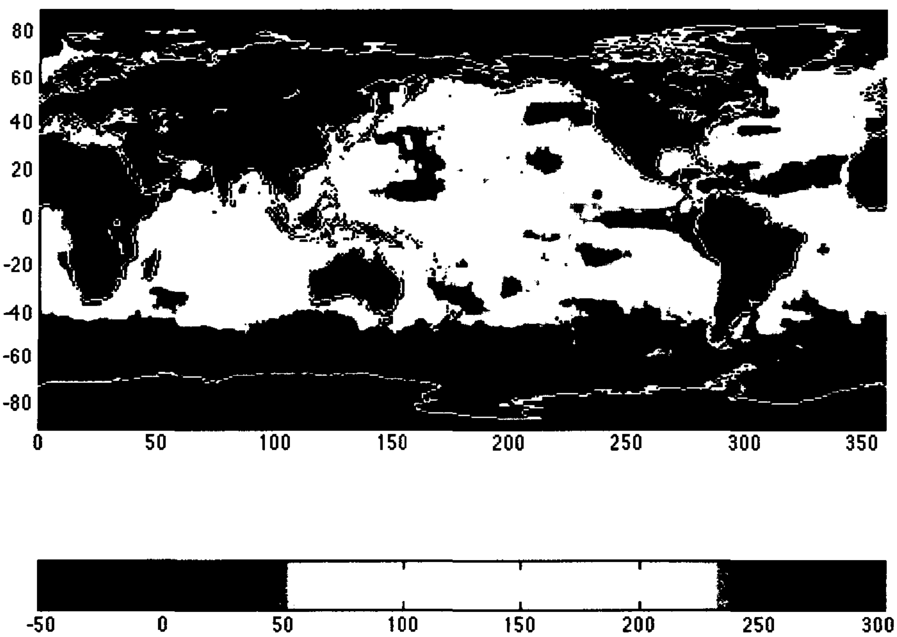

Figure 2. Latent heat flux for January, 1989.

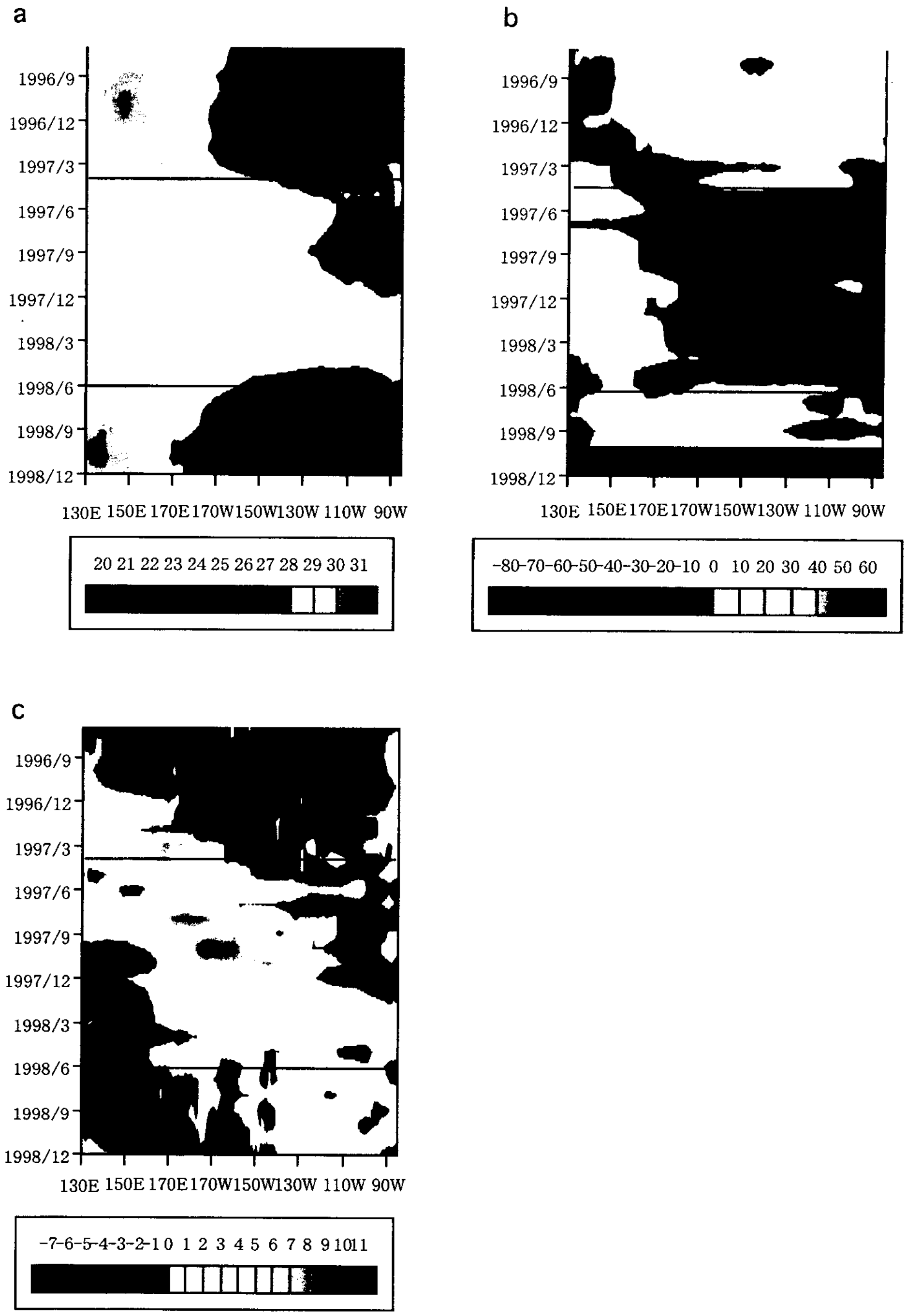

Figure 3. Time-longitude plots of (a) sea surface temperature(° C), (b) anomaly of OLR (W/m2) and (c) anomaly of zonal winds (m/s) from July, 1996 to December, 1998.

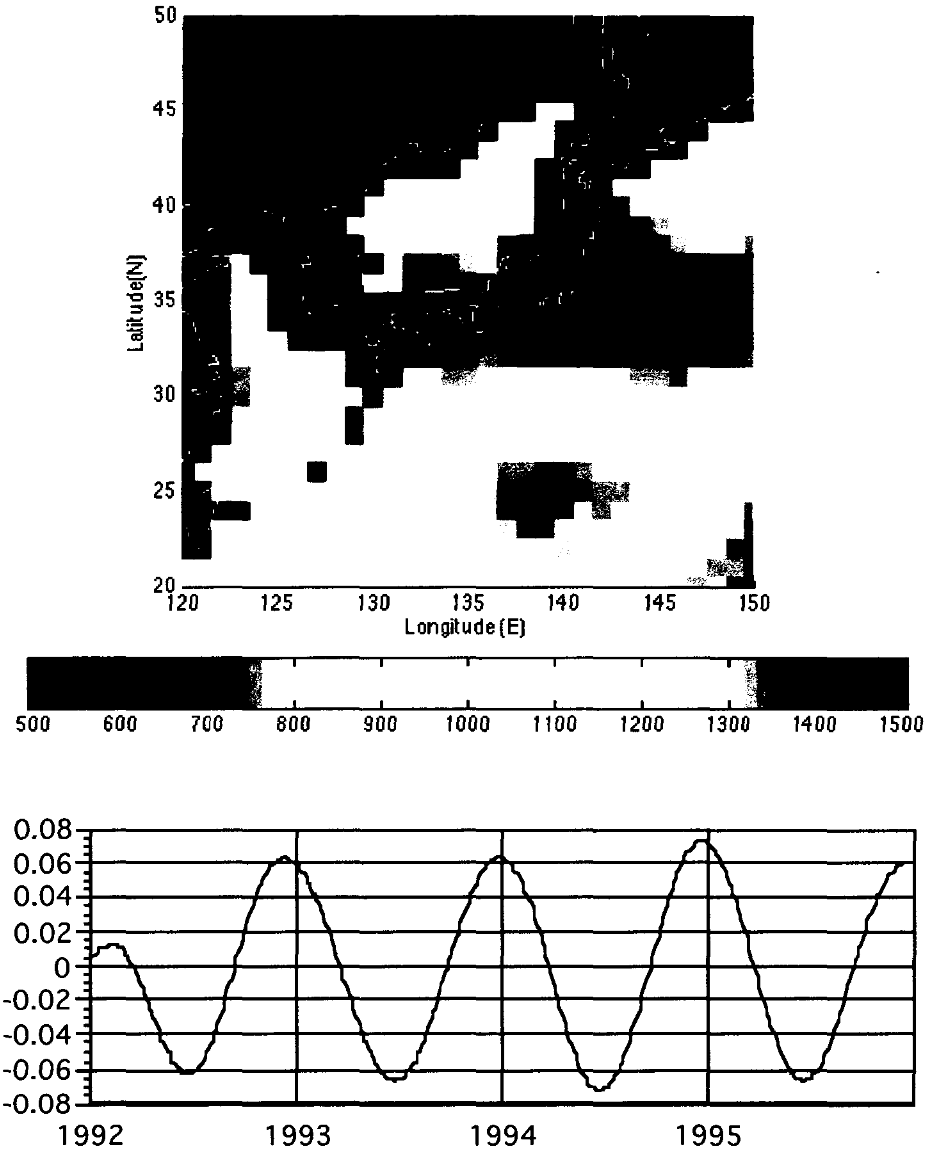

Figure 4. Spatial pattern and time series of coefficient of the first EOF mode for latent heat flux