CMS: Simulated Physical-Biogeochemical Data, SABGOM Model, Gulf of Mexico, 2005-2010

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Documentation Revision Date: 2017-11-13

Data Set Version: 1

Summary

This dataset contains monthly mean ocean surface physical and biogeochemical data for the Gulf of Mexico simulated by the South Atlantic Bight and Gulf of Mexico (SABGOM) model on a 5-km grid from 2005 to 2010. The simulated data include ocean surface salinity, temperature, dissolved inorganic nitrogen (DIN), dissolved inorganic carbon (DIC), partial pressure of CO2 (pCO2), air-sea CO2 flux, surface currents, and primary production. The SABGOM model is a coupled physical-biogeochemical model for studying circulation and biochemical cycling for the entire Gulf of Mexico to achieve an improved understanding of marine ecosystem variations and their relations with three-dimensional ocean circulation in a gulf-wide context.

The dataset has eighteen netCDF files, with two files per year for the surface current data and one file per year containing all other variables.

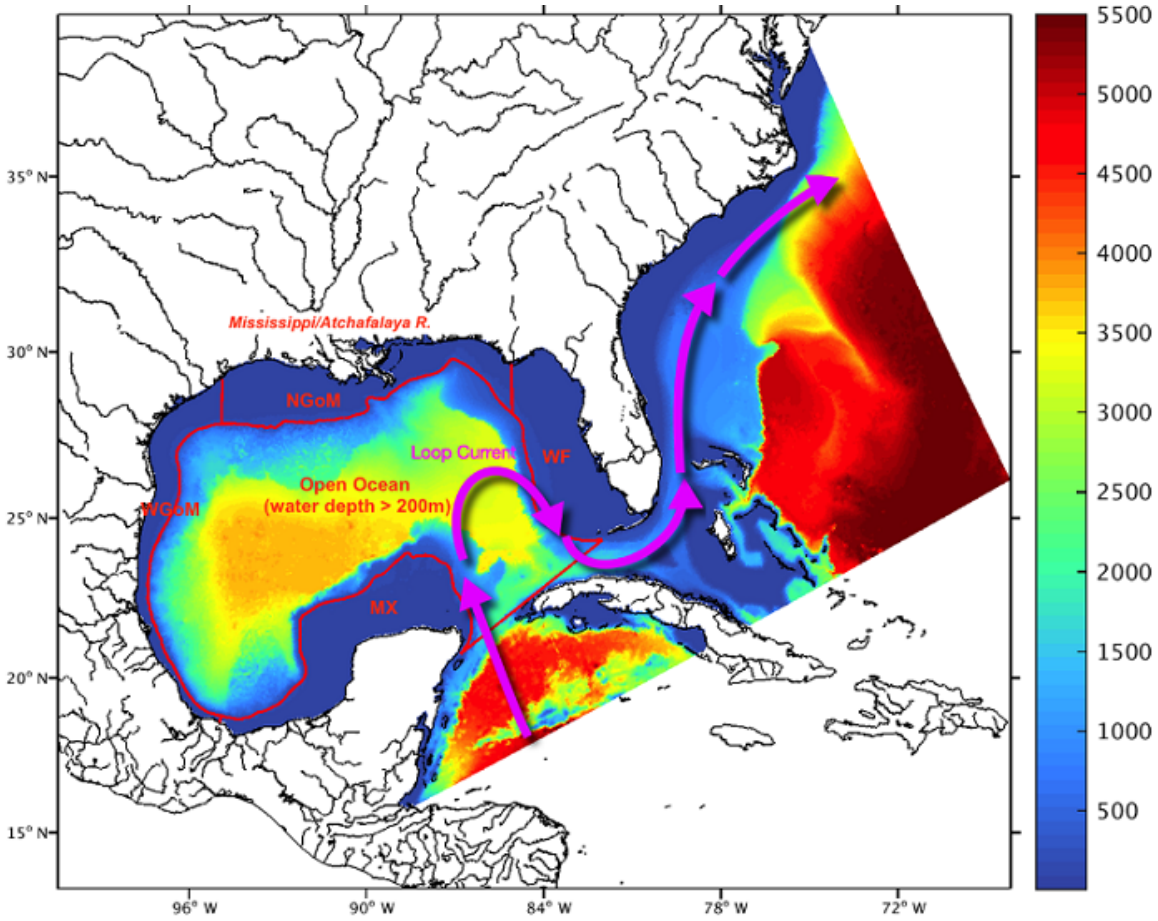

Figure 1. Domain of the South Atlantic Bight and Gulf of Mexico (SABGOM) model with water depth in color (unit: m). For analysis, the GOM was divided into five subregions used in this study, which are Mexico Shelf (MX), Western Gulf of Mexico Shelf (WGoM), Northern Gulf of Mexico Shelf (NGoM), West Florida Shelf (WF), and open ocean. Also shown is a schematic for the Loop Current (Xue et al., 2016).

Citation

He, R., and Z. Xue. 2017. CMS: Simulated Physical-Biogeochemical Data, SABGOM Model, Gulf of Mexico, 2005-2010. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1510

Table of Contents

1. Data Set Overview

This dataset contains monthly mean ocean surface physical and biogeochemical data for the Gulf of Mexico simulated by the South Atlantic Bight and Gulf of Mexico (SABGOM) model on a 5-km grid from 2005 to 2010. The simulated data include ocean surface salinity, temperature, dissolved inorganic nitrogen (DIN), dissolved inorganic carbon (DIC), partial pressure of CO2 (pCO2), air-sea CO2 flux, surface currents, and primary production. The SABGOM model is a coupled physical-biogeochemical model for studying circulation and biochemical cycling for the entire Gulf of Mexico to achieve an improved understanding of marine ecosystem variations and their relations with three-dimensional ocean circulation in a gulf-wide context.

Project: Carbon Monitoring System (CMS)

The NASA Carbon Monitoring System (CMS) is designed to make significant contributions in characterizing, quantifying, understanding, and predicting the evolution of global carbon sources and sinks through improved monitoring of carbon stocks and fluxes. The System will use the full range of NASA satellite observations and modeling/analysis capabilities to establish the accuracy, quantitative uncertainties, and utility of products for supporting national and international policy, regulatory, and management activities. CMS will maintain a global emphasis while providing finer scale regional information,

utilizing space-based and surface-based data and will rapidly initiate generation and distribution of products both for user evaluation and to inform near-term policy development and planning.

Related Publication:

Xue, Z., R. He, K. Fennel, K., W.J. Cai, S. Lohrenz, W.J. Huang, H. Tian, W. Ren, and Z. Zang. 2016. Modeling pCO_2 variability in the Gulf of Mexico, Biogeosciences, 13, 4359-4377, https://doi.org/10.5194/bg-13-4359-2016

2. Data Characteristics

Spatial Coverage: South Atlantic Bight and Gulf of Mexico

Spatial Resolution: 5 km

Temporal Coverage: 2005-01-01 to 2010-12-31

Temporal Resolution: Monthly

Study Area (All latitudes and longitudes are given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
South Atlantic Bight and Gulf of Mexico	-100.4329	-68.19012	39.37353	13.16374

Data file information

The dataset has eighteen netCDF files; three files for each of the six years. The surface current data is provided in two files for each year (described in Table 1) and all other variables are provided in a single file (*_**rho.nc4**) for each year. The surface current data were separated from the other variables because they use different coordinate systems and extents. See Xue et al. (2016) for more information.

Table 1. Data file names and descriptions. In each filename, XXXX represents the year, ranging from 2005 to 2010.

Data file	Description
Sabgom_output_XXXX_rho.nc4	Six files with data for air to sea CO2 flux, DIC, DIN, PP, and ocean surface measurements for pCO2, salinity, and temperature.
Sabgom_output_XXXX_u.nc4	Six files with data for ocean surface currents U: east-west component.
Sabgom_output_XXXX_v.nc4	Six files with data for ocean surface currents V: north-south component.

Variables in the data files

Fill value and missing values are -9999 for all files.

Table 2. Variables in the files **Sabgom_output_XXXX_rho.nc4**

Variable name	Units/format	Description
CO2_airsea	millimole meter-2 day-1	Air-sea CO2 flux
DIC	millimole meter-3	Ocean surface dissolved inorganic carbon
DIN	millimole meter-3	Ocean surface dissolved inorganic nitrogen
lat_rho	degrees	latitude in degrees
lon_rho	degrees	Longitude in degrees
p_Production	millimole meter-3 day-1	Ocean surface primary production
pCO2	uatm	Ocean surface partial pressure of CO2
salinity		Ocean surface salinity
SST	celcius	Ocean surface temperature
time	months since 2005-01-01	Time-standard calendar

Table 3. Extent of all ***_rho.nc4** data files

Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
-100.4329	-68.19012	39.37353	13.16374

Table 4. Variables in the file **Sabgom_output_XXXX_u.nc4**

Variable name	Units/format	Description
lat_rho	degrees	latitude in degrees
lon_rho	degrees	Longitude in degrees
time	months since 2005-01-01	Time-standard calendar
u	meter second-1	Ocean surface currents U: east-west component

Table 5. Extent of all ***_u.nc4** data files

Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
-100.4044	-68.21913	39.35918	13.17855

Table 6. Variables in the file **Sabgom_output_XXXX_v.nc4**

Variable name	Units/format	Description
lat_rho	degrees	latitude in degrees
lon_rho	degrees	Longitude in degrees
time	months since 2005-01-01	Time-standard calendar
v	meter second-1	Ocean surface currents V: north-south component

Table 7. Extent of all ***_v.nc4** data files

Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
-100.4222	-68.20146	39.35283	13.18507

3. Application and Derivation

The South Atlantic Bight and Gulf of Mexico (SABGOM) model is a coupled physical-biogeochemical model for studying circulation and biochemical cycling for the entire Gulf of Mexico to achieve an improved understanding of marine ecosystem variations and their relations with three-dimensional ocean circulation in a gulf-wide context. These data could be useful to climate change studies and marine carbon cycle studies.

4. Quality Assessment

Modeled data were validated against ship-based measurements from sea surface pCO2 database compiled by the Lamont–Doherty Earth Observatory, > 180 000 data points in the Gulf over 2005–2010, (Takahashi et al., 2015), and ship-based measurements (> 78 000 data points) from Huang et al. (2015). For the analysis, the GOM was divided into the five subregions: Mexico Shelf (MX), Western Gulf of Mexico Shelf (WGoM), Northern Gulf of Mexico Shelf (NGoM), West Florida Shelf (WF), and open ocean. The data points falling in each of the subregions was first grouped by a 10-day temporal binning and then spatially averaged to get a mean value for each subregion.

Agreement between model and observations was better during spring, fall, and winter, than during summer. The model overestimated pCO2 in June 2006, August 2007, and July 2009. Refer to Xue et al. (2016) for additional details.

5. Data Acquisition, Materials, and Methods

Study area

The Gulf of Mexico (GoM) receives enormous riverine nutrient and carbon inputs, the majority of which are from the Mississippi–Atchafalaya River system. The carbon cycling associated with such enormous terrestrial carbon and nutrient inputs remains unclear. Excessive nutrient loading causes coastal eutrophication, which triggers the well-known hypoxia phenomenon and an acidification problem. Further offshore, the circulation in the GoM is largely influenced by the energetic Loop Current (Xue et al., 2016).

Methods

The SABGOM model is a coupled physical-biogeochemical model for studying circulation and biochemical cycling for the entire Gulf of Mexico to achieve an improved understanding of marine ecosystem variations and their relations with three-dimensional ocean circulation in a gulf-wide context. For complete descriptions of input data sources, modeling methods, and information to access the input data and model code, see Xue et al. (2016)

Model inputs included:

- NCEP's high-resolution combined model and assimilated atmospheric dataset (North American Regional Reanalysis, www.cdc.noaa.gov)
- Open boundary conditions for ocean model (temperature, salinity, water level, and velocity) from a data-assimilative global ocean circulation model (HYCOM/NCODA)
- Observed freshwater and terrestrial nutrient input from 63 major rivers (Aulenbach et al., 2007; Milliman and Farnsworth, 2011; Fuentes-Yaco et al., 2001; and Nixon, 1996)
- Monthly model outputs of water, NO3, NH4, and alkalinity from the Dynamic Land Ecosystem Model (DLEM)) were used as riverine inputs

Carbon cycle parameterizations

The carbon cycle parametrization used in this study followed the same approach and values as in Fennel et al. (2008), Fennel and Wilkin (2009), and Fennel (2010).

Gas exchange calculations followed the formulas in Wanninkhof (1992).

For air pCO2, the Atmospheric Infrared Sounder (AIRS Science Team, 2008) monthly gridded observation dataset was used and averaged over the study area. The curve-fitting method using a C language program named CCGCRV was applied, and the air pCO2 in the gas exchange calculation was prescribed as:

$$pCO_{2air} = D0 + D1 + D2 \times (t^2) + D3 \times \sin(pi2 \times t)$$

$$+ D4 \times \cos(pi2 \times t) + D5 \times \sin(pi2 \times 2 \times t)$$

$$+ D6 \times \cos(pi2 \times 2 \times t)$$

Where:

pCO_{2air} represents monthly air pCO_2

t represents the number of months since January 2004 divided by 12 and

pi2 is a constant set to 6.28, D0= 375.96, D1= 2.23, D2= -0.007, D3= 1.31, D4= -0.64, D5= -0.13, and D6= 0.21.

Due to the relatively low horizontal resolution of the AIRS data (2.5×2 degrees), air pCO2 was set to be spatially uniform.

Riverine inputs

To account for riverine inputs, a climatological monthly alkalinity time series was constructed by averaging all available US Geological Survey (USGS) observations for each major river, including the Mississippi, Atchafalaya, Mobile, and Brazos in the GoM. Because direct riverine DIC measurements were not available, riverine DIC inputs using the corresponding alkalinity value plus 50 were approximated (Xue et al., 2016).

Model outputs

The model outputs provided in this data set are the monthly mean ocean surface physical and biogeochemical data for the Gulf of Mexico on a 5-km grid from 2005 to 2010. The simulated data include ocean surface salinity, temperature, dissolved inorganic nitrogen (DIN), dissolved inorganic carbon (DIC), partial pressure of CO2 (pCO2), air-sea CO2 flux, surface currents, and primary production.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

CMS: Simulated Physical-Biogeochemical Data, SABGOM Model, Gulf of Mexico, 2005-2010

Contact for Data Center Access Information:

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- Telephone: +1 (865) 241-3952

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