All You Wanted To Know About Drifters

Training CD

Prepared by: Mayra Pazos
Drifter Data Assembly Center
NOAA/ AOML, Miami, Florida
Contents

- Global Drifter Program Overview
- What Is A Drifter?
- Things You Need To Know Before Deploying A Drifter
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- How To Obtain Deployment Information On The Web
- Some Drifter Facts
- Partners
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- Importance Of Metadata
- Delayed Mode Quality Control Procedures
- Web Access To Data and Products
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The Global Drifter Program (GDP) is the principle component of the Global Surface Drifting Buoy Array, a branch of the National Oceanographic and Atmospheric Administration (NOAA) Global Ocean Observing System (GOOS) and a scientific project of the Data Buoy Cooperation Panel (DBCP)
Components of the Global Drifter Program

- Drifter Operations Center (DOC)
- Drifter Data Assembly Center (DAC)
- Manufacturers
- Operational Partners
Drifter Operations Center

Objectives:
To maintain a global 5x5 array of Argos tracked Lagrangian Drifters to meet the need for accurate and global in-situ observation of SST and surface circulation. These data support:

- Short term climate prediction
- Satellite observation calibration
- Climate research and monitoring
Drifter Data Assembly Center

Objectives:

The goal of the Drifter Data Assembly Center is to assemble and provide uniform quality controlled data of research quality for sea surface temperature and surface velocity measurements.
The **DOC** and The **DAC** Work Together
But ...They Have Different Tasks

**DOC**
- Takes care of logistics, from the request of the Argos IDS, to the deployment of the buoy
  - Develops & coordinates drifter deployment plans
  - Finds ships for deployments
  - Distributes IDS to manufacturers
  - Maintains Metadata

**DAC**
- Maintains a database with drifter data from deployment until buoy stops transmitting, and QC data
  - Decodes raw data & applies calibrations
  - Quality controls and interpolates data
  - Makes data available through web and distributes for archiving
  - Disseminate buoys going on/off GTS

*Mayra Pazos, Jessica Redman and Erik Valdes*
What Is A Drifter?

The modern drifter is a high-tech version of the "message in a bottle". It consists of a surface buoy and a subsurface drogue (sea anchor), attached by a long, thin tether. The buoy measures temperature and other properties, and has a transmitter to send the data to passing satellites. The drogue dominates the total area of the instrument and is centered at a depth of 15 meters beneath the sea surface.
Basic SVP Drifter

Spherical plastic float
Poly Urethane impregnated wire
Holey Sock drogue centered at 15-m depth
D-cells batteries inside the float

**Sensors:**

**Drogue:** Observes the submersion rate of the float. Float stays on the surface if drogue is lost.

**SST:** To measure Sea Surface Temperature

**Voltage:** Indicates batteries’ life

**Cost:** ~$1800

Other Sensors that can be added:

Barometric pressure, wind, salinity, etc
SVP + Barometer + Wind

Barometer to measure air pressure.
Wind Direction is measured by a vane on the surface float
Wind speed by a subsurface hydrophone.

Cost: ~$3000.00
We offer option to upgrade!

MINIMET Drifter
- 0 m, Surface Float
- 3 m, Subsurface Float
- 10 m, Hydrophone

Ø40 cm Surface Float
Barometer Port
Wind Vane 40 x 40 cm
Sea Surface Temperature Probe

Acoustic Hydrophone
Wind Speed Sensor
(0.089 - 22.3 kHz)

SVP with Barometer

Mullif et al., 2003
Drifter Packaging

Hulls covered with cardboard

Uncovered Hulls

Deployment Instructions

Plastic wrap
Pull-Pin Activation Magnet

- Some drifters have a pull-pin magnet to activate the buoy.
- Without removal of the magnet, the buoy remains “off”.
- Some drifters have the magnet attached with water-soluble tape, that don’t require removal prior to deployment.
Drifter Ready To Be Deployed

- Paper tape: **DO NOT REMOVE!!!**
- Surface float
- Tether
- Drogue (sea anchor)
1- Remove **ONLY** plastic shrink wrap

Some drifters have cardboard around the float. **DO NOT** remove the cardboard surrounding the surface float.
How To Deploy A Drifter (Cont.)

2- **DO NOT** remove the paper tape securing the tether and drogue

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**DANGER!**

If you do, the drogue and/or tether can unfurl during deployment and cause injury!!!
How To Deploy A Drifter (Cont.)

3- Record the five digit ID number of the drifter. This number can be found on the shipping container, the plastic shrink wrap or the protective cardboard box. It is also inscribed on the surface float.
4- If testing the buoy is desired prior to deployment, the magnet can be removed from the drifter by separating it from the surface float. This action will start the Argos transmitter for testing, reattaching the magnet in the same position, will turn off the transmitter.

Remove magnet through hole in the box.
Test if transmitting.

Hole in box to remove magnet
Some drifters don’t have a safety pin magnet to be removed, instead they have the magnet attached with soluble tape that will dissolve once the drifter is in the water.

**Read instructions carefully to know if you need to pull the magnet manually or not.**
5- Throw the drifter from the stern, lowest possible deck (preferably less than 10 meters including heave) into the sea. The ship may be traveling between 2-25 knots. The tether and drogue are secured with paper tape that will dissolve in the water.

Throw buoy from stern, lowest possible deck.
Tether and drogue secured with paper tape that will dissolve in water

Drogue starts sinking minutes after deployment

Drogue stretches vertically, when tape dissolves
6- Record the five(5) digit Buoy ID, Date of Deployment, Time (GMT) of Deployment, Longitude and Latitude of deployment and send this information to the Global Drifter Program.

Contact Persons:

Shaun.Dolk@noaa.gov

and

Mayra.Pazos@noaa.gov
Instructions Included With Each Drifter

DEPLOYMENT INSTRUCTIONS

Read Carefully

(Page 1)

1. Remove plastic wrap

2. DO NOT REMOVE paper tape, cardboard, or anything BUT plastic.

3. Throw buoy in water.
1) Remove the buoys from the shipping container. **REMOVE ONLY** the plastic shrink-wrap.

2) **DO NOT REMOVE** paper tape securing the drogue and tether. **DO NOT REMOVE** cardboard surrounding the float.

**DANGER:** **DO NOT REMOVE** the paper tape securing the tether and drogue. If you do, the drogue and/or tether can unfurl during deployment and cause injury!!!

3) Record the five digit ID number of the drifter. This number can be found on the shipping container, the plastic shrink-wrap or the protective cardboard box. It is also inscribed on the surface float.

4) If testing the buoy is desired prior to deployment, the magnet can be removed from the buoy by separating it from the float through a hole in the box surrounding the float. This action will start the ARGOS transmitter for testing. Re-attaching the magnet in the same position will turn off the transmitter and reset the program starting point. The transmitter will restart on its original program when the magnet is again removed.

5) Throw the buoy from the stern, lowest possible deck (preferably less than 10 meters including heave), into the sea. The ship may be traveling between 2 - 25 knots. The tether and drogue are secured with paper tape that will dissolve in the water.

6) Record the date, time (GMT) and location of deployment as well as the five digit ID, and send this information to the Global Drifter Program.

Thank you very much for your help!

CONTACT PERSON
Drifters Are Deployed From:

- Cruise ships
- Cargo ships
- Research Vessels
- Aircrafts

Assistance from national and international Governmental Agencies
Drifters Deployed By Aircrafts

• Drifters are also deployed by aircraft to help seed those regions that otherwise it would be hard to reach.

• Every year during the hurricane season in the Atlantic Ocean (June 1 – November 30) NOAA/AOML has coordinated Deployments with NAVOCEANO in the past, and also with the National Hurricane Center in Miami, Florida, to deploy drifters in front of hurricanes using the hurricane hunter planes from the air force to provide forecasters and researchers with surface meteorological data to help in the prediction and forecast of hurricanes.

• These drifters besides measuring SST, also measure:
  - Barometric pressure
  - Wind speed and wind direction
A total of 20 drifters were deployed in front of the cat 5 hurricane Rita. All drifters survived and sent good data.

Air pressure, SST, wind direction and wind speed were reported and transmitted onto the GTS. The 8 ADOS drifters were also equipped with 100m thermister chains and measured temperature to 100m depth.

These data provided an excellent data set for improvements of wind speed algorithms from hydrophone observations. SST was measured at much higher resolution than many satellite products and helped calibrate these products.

www.cora.nwra.com/~morzel/drifters.rita.html
Deployment Information On The Web
www.aoml.noaa.gov/phod/dac

The Global Drifter Program
Satellite-tracked surface drifting buoy observations of currents, sea surface temperature, atmospheric information

STATUS OF GLOBAL DRIFTER ARRAY
May 21, 2007

Click to see the current status of the array

The Drifter Data Assembly Center
Processing, Analysis, and Distribution
Data Products Available

The Drifter Operations Center
World Wide Drifter Deployments

Enter DOC page
## Sample Drifter Deployment Log

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Some Drifter's Facts

Drifters average life: \(~450 \text{ days}\)

Longest Lived: \(10 \text{ years, 4 months, 21 days}\)

Drogue average life: \(~300 \text{ days}\)

Longest Drogue on: \(5 \text{ years, 6 months, 21 days}\) (and still on)

Average failure on deployment: \(~3\%\)

Death Reasons: Run aground, picked up by fishermen, stop transmitting
Global Drifter # 1250

Scientific design of the global drifting network called for 1250 buoys to be deployed and maintained worldwide to ensure total coverage of the global ocean and to calibrate the satellites.

Retrieved after crossing North Atlantic, off the cost of Brest, France

Traveled for 521 days, with drogue on to the end, and transmitting good SST, and barometric pressure. All data went out on the GTS.
Tracks of Drifters During 2006

2006 Drifter Data

(J. Redman)
Our appreciation to the following Operational Partners for their contributions to GDP activities

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<th>Ships of Opportunity program</th>
<th>Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (Mexico)</th>
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<td>Raytheon Polar Services … and many others</td>
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Quality Control
Practical implementation at the Drifter Data Assembly Center

- Importance of Metadata
- Web Access to Data and Products
- Delayed Mode Quality Control Procedures
- GTS Distribution
Importance of Metadata
Metadata describes the characteristics of the data. The drifter metadata describes:

- Argos ID number
- GDC unique ID
- WMO number
- Program number
- Contact Information
- Deployment time, latitude and longitude
- Manufacturer
- Buoy type
- Drogue type, length, and brief description of its characteristics
- Sensors transfer functions
- Track inventory of drifters, both in storage and in transit

Metadata helps share reliable information, and maintain homogeneity of the database.

**Without METADATA no data set is complete**
Manufacturers are required to send DAC specification sheets

Argos ID(s) 70850-70857

Manufacturer
Technocean

Sensor array
SVPB Battery voltage, drogue sensor, SST, barometer

Surface float description
41 cm. diameter, ABS plastic surface float.

Tether description
a) 0.32 cm OD polypropylene-impregnated wire rope between surface float and drogue.
b) Tether attachment to 2.0 cm steel ring at base of surface float; marine epoxy filled cavity surrounding ring for restraint.
c) 5 cm dia. by 32 cm long polyurethane strain relief molded below surface float. Attachment point of tether to drogue hub covered by 5 cm dia. by 32 cm long polyurethane strain relief.

Drogue description
a) Holey sock made from Cordura nylon cloth; diameter 61 cms, length 610 cms. construction consists of 5 cylindrical sections, each 122 cms long. Two 30 cm dia. holes cut opposite each other in each section. Axis joining holes is rotated by 90° between successive sections. Drogue is centered at 15 m.

Drogue depth
15 m at center

Drogue length
6.1 meters

Message Length
56 bits

Message format
8 bits Checksum
4 bits Rank
6 bits Age
11 bits Barometric pressure
9 bits Sea surface temperature
9 bits Air pressure tendency
6 bits Submergence count
3 bits Battery voltage
Delayed Mode
Quality Control Procedures
Schematic of the data flow associated with the DAC
Drifter Database Information Files

- Relational database using flat files linked by ARGOS ids
- Data starts in February 1979 and continues to present
- All buoys are standard WOCE/SVP drogued at 15 meters

DIRECTORY FILE
(information about ea. Drifter)

CALIBRATION FILE
(coefficients to calibrate each sensor)

GROUND FILE
(holds time interval not to be interpolated)

TEMPERATURE FILE
(holds last day SST is good)
Drifter Database
Data Files

Data from Argos

Apply calibrations and split into individual files by ID

B-files
B00000.DAT
(raw data for ea. buoy)

P-files
P00000.DAT
(Edited Position)

S-files
S00000.DAT
(Edited SST)

K-files
K00000.DAT
(Interpolated - Kriging)

Edit Position and SST
Split into P and S files

Reside in AOML database, available through the WEB
Quality Control Steps

• Drifter data is downloaded from Argos daily and also received at AOML once a month on CDs

• Convert raw data into engineering units and add to individual B-file by ID

• Determine deployment time and position of first good transmission from the water

• Run programs that identify buoys that are dead:
  a) Transmit from the same location after a successful deployment (grounded)
  b) Do not have any new data after last update (quit)

Such dates and positions are entered into the DIRECTORY file
Quality Control Steps (Continuation)

- Software are run to check bad locations from ARGOS raw data based on speed between consecutive locations, bad points are deleted (P-files).

- Deviant SST values are removed by applying a temperature change criterion relative to the recent temperatures measured by the buoy (S-files).

- SST’s from each drifter are compared with Reynold’s climatology to determine temperature sensor failure, last good day is entered into the TMPFL file. SST after this date will be discarded.

- We decode, archive and handle GTS data transmissions and deletions of other sensor data like pressure and wind, but NO quality control is applied to them.
• Buoys that possibly lost their drogues are identified. Drogue lost date is determined and entered in the DIRECTORY file

• All active buoys are processed and interpolated to 6 hour intervals, using the Kriging method

  \[ P \text{ (position edited) file } + S \text{ (SST edited) file} = K \text{ (interpolated) file} \]

  Refer to paper by Hansen and Poulain for details on the Editing and Kriging procedures:


• Kriged drifter data can be accessed through the WEB

  \[ \text{WWW.AOML.NOAA.GOV/PHOD/DAC/DACDATA.HTML} \]

  > Interpolated database

• Database is updated every 2-3 months and sent to MEDS for distribution and archival
## List and Details of All Buoys in Database as of October 2006

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Drifter 14176 raw file

Picked up on 11-Oct-2000
Deployed here
Ship track

QC Examples
Drifter 14176 Cleaned and Interpolated File

After editing and interpolation procedures have been applied

15-Mar-1999

30-Jul-2000

11-Oct-2000

Picked up

Deployed here
Determining drogue off time... NOT an easy task

Typical submergence record for Technocean “drogue loss” (sharp drop to zero when drifter is picked up).
Compare SST with Reynold’s Climatology

**BAD SST DAY 4/21/01**

**SST AFTER REMOVING BAD DATA**
Web Access to Data and Products
Accessing Data and Products

www.aoml.noaa.gov/phod/dac

The Global Drifter Program
Satellite-tracked surface drifting buoys

Click to see the status of the array
Accessing Data and Products
www.aoml.noaa.gov/phod/dac

The Global Drifter Program
Satellite-tracked surface drifting buoys

Enter DAC page
How To Access Drifter Data

http://www.aoml.noaa.gov/phod/dac/dacdata.html

Near real time (graph) from GTS

(Optional) for one WMO#

Select region
Results

Select results to save data
How To Access Drifter Data

Near real time (data) from GTS

http://www.aoml.noaa.gov/phod/dac/dacdata.html

(Optional) for one WMO#

Select region
### Results

Retrieve Buoy ASCII Data

Save file

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How To Access Drifter Data

Interpolated Historical Metadata

http://www.aoml.noaa.gov/phod/dac/dacdata.html
How To Access Drifter Data

Interpolated Historical Data
http://www.aoml.noaa.gov/phod/dac/dacdata.html
E-mail Received To Retrieve Data

To download the data files(s) proceed as follows: By clicking on the following hyper-link(s)


Or By using the following ftp instructions:

1. ftp ftp.aoml.noaa.gov
2. enter 'anonymous' for userid.
3. enter your 'email address' for password.
4. enter 'binary' to set the transfer type
5. enter 'cd /od/pub/envids'
6. enter 'get metadata_gld.20070521_101943.zip'
7. enter 'get interpolated_gld.20070521_101943.zip'
8. enter 'quit' to log off. NOTICE: files are removed 5 days after creation date.
How To Access Drifter Data

Details of all drifters in DAC database

http://www.aoml.noaa.gov/phod/dac/dacdata.html

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How To Access Drifter Data
Using QC Tools to check sensors on GTS
http://www.meteo.shom.fr/qctools
How To Access drifter Data
Using QC Tools to check sensors on GTS
http://www.meteo.shom.fr/qctools

Plots of data and differences with model outputs for BUOYS and VOS...

Plots of data and plots of differences with some model outputs (QC plots) over the past two weeks for buoys or VOS.

From this form, you will have access to statistical information and graphs of the data provided by data buoys and Voluntary Observing Ships received on the GTS for the past two weeks. The procedure to fill in the form is:

1. You must exactly know either the Call Sign or the WMO Number of the station; fill in the 'Enter call sign or WMO Number' field.
2. Surface marine data received on GTS for the past two weeks may be viewed. In this case select the type of plot to generate = data Plot. If you need to view the Comparisons with model outputs select the type of plot to generate = Quality Control Plot.
3. Then, select the observation parameter you need to monitor, and confirm with the 'OK' button; you will access to the plot selected.

Please take care of the results when using the graphs produced. The model outputs do not reflect necessarily the truth. Station data can be significantly different from model outputs in sparse areas, coastal areas (due to local effects), areas with strong gradient...

A page with more explanations is available...
How To Access Drifter Data

Data Plot

or

Model Differences Plot
How To Access Drifter Products

http://www.aoml.noaa.gov/phod/dac/dacdata.html

Global Drifter Population Maps
- All Buoys since April 1995
- SST Anomalies since October 1995
- 90 Days Prediction since May 2005
- Drogue Status since May 2005

Postscript files available for download since May 2007.

Global Drifter Population Map:
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Drifter Maps

- Updated weekly
- Trajectory since August 1995
- Position and SST Anomalies since August

Tropical Atlantic Map new since June 15

Drifter Reports

- Population (Maps and Reports)
- Mean Velocity Estimates
- Animations
- Monthly SST and Current Anomalies Map
- Hurricane Array

Mixed-layer drifting buoy displacements by one-week segments

- Drogued buoys
- Buoys with drogue lost or unknown
GTS Distribution
GTS Responsibilities

- Insertion and deletion of buoy data onto the GTS
- Follow up and make sure data distributed through GTS goes out
- Monitor accuracy of data on the GTS and take off from GTS if sensor reports bad data
- Notify ARGOS after each database update of buoys that lost their drogues to be noted in the GTS message
Dr. Rick Lumpkin, Global Drifter Program Manager
  e-mail: Rick.Lumpkin@noaa.gov

Mr. Shaun Dolk, Drifter Operation Center Manager
  e-mail: Shaun.Dolk@noaa.gov

Mrs. Mayra Pazos, Drifter Data Assembly Center Manager
  e-mail: Mayra.Pazos@noaa.gov

Ms. Jessica Redman, Drifter DAC, Research Assistant
  e-mail: Jessica.Redman@noaa.gov

Mr. Erik Valdes, Drifter DAC, Research Assistant
  e-mail: Erik.Valdes@noaa.gov
Drifter Tracks

Buoys in the Southern Oceans since 1979

Drifter Data Through December 2006

Thank You!