Plans for data analysis

* ~~Find a whirlpool~~
  + ~~Local area of recirculation, where a drifter or a group of nearby drifters remain over time~~
* ~~Track a hurricane~~
  + ~~If general area is known, a drifter in the path will travel in a fairly straight line in the direction of the hurricane’s motion~~
* Effects of variables on current direction (regression analysis)
  + ~~Wind~~
  + Temperature
  + Latitude/longitude
  + Drogue attachment
* Compare local (by ocean) current function over time: 3D plot, smoothing, sorting (necessary for anything but annually)?, wavelet?
  + Daily
  + Monthly
  + Seasonally
  + Annually
* Effect of density of drifters in a given area on the accuracy of current measurements

Presentation

* What is a drifter? – details <http://www.aoml.noaa.gov/phod/dac/drifter_climatology.html>
* What data does it collect (specifically), how is the data organized
* Describe which data are statistically significant and why
* Regression analysis on effect of variables (Lat, Long, Current [ew,ns], SST?)
* Comparisons of current “functions” over time : smoothing, by ocean, annually
* Wavelets
* Further Study: wind, effect of drifter density

**Currents**

Important in dispersal of ocean-dwelling life forms

Study of marine debris

Effect on temperature: currents bring warm water up the north Atlantic

**Drifters are floating devices to investigate**[**ocean currents**](http://en.wikipedia.org/wiki/Ocean_current)**.**

**Drifters provide**[**real-time**](http://en.wikipedia.org/wiki/Real-time)**information about**[**ocean circulation**](http://en.wikipedia.org/wiki/Ocean_circulation)**which aids scientists in**[**climate modeling**](http://en.wikipedia.org/wiki/Climate_modeling)**.**

**SVP (Surface Velocity Program) Drifter**

* Spherical float 30-40 cm in diameter, made of plastic or fiberglass
* (Optional) Barometer on top of float (measure atmospheric pressure)
* Small metal thermistor attached to bottom of float (measure SST)
* GPS transmitter
* Cylindrical, “holey-sock” drogue
  + Attached to float by a tether that centers it 15 m below sea surface
  + Original design is 7 sections, each 92 cm long and 92 cm in diameter, for a total length of 6.44 m (mini design not yet standardized)
  + Designed such that the drag area ratio = 40 (DA\_drogue/DA\_all other components)
  + Average life span of about 400 days
* Original design weight = 45 kg (100 lbs), mini design weight = 20 kg (44 lbs)
* GOOS attempts to maintain a 5 degree by 5 degree network of drifters—requires minimum of 1250 drifters (first achieved in Sept. 2005)

**Drifter Data**

* Buoy Id
* Observation Date and Time
* Observation Latitude
* Observation Longitude
* Sea Surface Temperature (degrees C, measured 20-30 cm below sea surface)
* East-West Current (m/s, +East)
* North-South Current (m/s, +North)
* Latitude Uncertainty (error, degrees)
* Longitude Uncertainty (error, degrees)
* Experiment number
* WMO Number (batch of buoys)
* Drogue on/off (binary)
* Missing data is represented as 999.9999

**Kernel**

General idea: estimate a real valued function when the parametric model is unknown.

Want to determine if there is an underlying function that is followed over certain time periods.

Corrientes-oceanicas

A **kernel smoother** is a statistical technique for estimating a real valued function by using its noisy observations, when no parametric model for this function is known. The estimated function is smooth, and the level of smoothness is set by a single parameter.

Gaussian Kernel

2D gaussian.png

A=1

σ*x* = σ*y* = 1

Presentation Visuals

world - lat and long

12 Year Arctic Raw E-W Current - common axes

12 Year Arctic Raw E-W Current - common axes – yz

12 Year Arctic Raw E-W Current - common axes – xz

12 Year Arctic Raw N-S Current - common axes

12 Year Arctic E-W Current - common axes

12 Year Arctic N-S Current - common axes

12 Year Arctic E-W Current - common axes – yz

12 Year Arctic N-S Current - common axes – yz

1999 Arctic E-W Current

2007 Arctic E-W Current

1999 Arctic E-W Current - yz

2007 Arctic E-W Current - yz

1999 Arctic Monthly E-W Current - common axes

2007 Arctic Monthly E-W Current - common axes

1999 Arctic Monthly E-W Current - common axes – yz

2007 Arctic Monthly E-W Current - common axes – yz

12 Year Arctic Raw SST - common axes

12 Year Arctic SST - common axes

1999 Arctic SST

2007 Arctic SST

1999 Arctic Monthly SST - common axes

2007 Arctic Monthly SST - common axes

1999 Arctic Monthly SST - common axes – yz

2007 Arctic Monthly SST - common axes – yz

Paper

Knowledge of surface ocean currents is essential in reducing costs of shipping, since they reduce fuel costs. In the sail-ship era knowledge was even more essential. A good example of this is the [Agulhas current](http://en.wikipedia.org/wiki/Agulhas_current), which long prevented Portuguese sailors from reaching India. Even today, the round-the-world sailing competitors employ surface currents to their benefit. Ocean currents are also very important in the dispersal of many life forms. An example is the [life-cycle of the eel](http://en.wikipedia.org/wiki/Eel_story).

Ocean currents are important in the study of [marine debris](http://en.wikipedia.org/wiki/Marine_debris), and vice versa. These currents also affect temperatures throughout the world. For example, the current that brings warm water up the north Atlantic to northwest Europe stops ice from forming by the shores, which would block ships from entering and exiting ports.

The surface float ranges from 30.5 cm to 40 cm in diameter. It contains: batteries in 4-5 packs, each with 7-9 alkaline D-cell batteries; a transmitter; a thermistor to measure sea surface temperature; and possibly other instruments measuring barometric pressure, wind speed and direction, salinity, and/or ocean color. They also have a submergence sensor or a tether strain sensor to verify the presence of the drogue.

The drogue is centered at 15 meters beneath the surface to measure mixed layer currents in the upper ocean. The outer surface of the drogue is made of nylon cloth. In the original design it is 7 sections, each 92 cm long and 92 cm in diameter, for a total length of 6.44 m. Mini drogues are not yet standardized among the manufacturers: they are 4 (Pacific Gyre) or 5 (Marlin-Yug) sections of original dimensions, or 4 (Clearwater) or 5 (Technocean) redesigned sections of diameter 61 cm, length 1.22 m per section. Throughout the drogue, rigid rings with spokes suport the drogue's cylindrical shape. The drogue is a "holey-sock": each drogue section contains two opposing holes, which are rotated 90 degrees from one section to the next. These holes act like the dimples of a golf ball by disrupting the formation of organized lee vortices.

While the size of the surface float and drogue vary, the manufacturers all aim for a specific nondimensional goal: a drag area ratio of 40. This ratio is the drag area (drag coefficient times cross-sectional area) of the drogue, divided by the drag area of all other components. At a drag area ratio of 40, the resulting downwind slip (defined later) is 0.7 cm/s in 10 m/s winds (Niiler and Paduan, 1995).

Once deployed, a modern SVP drifter lives an average of around 400 days before ceasing transmission. Occasionally, drifters are picked up by fishermen or lose their drogue and run aground.

The Global Ocean Observing System (GOOS) goal of maintaining a 5 degree by 5 degree network of drifters requires 1250 drifters. [This goal was achieved on September 18, 2005](http://www.ogp.noaa.gov/events/20050918_globaldrifter/).

Source:

Lumpkin, R. and M. Pazos, 2006: Measuring surface currents with Surface Velocity Program drifters: the instrument, its data, and some recent results. Chapter two of [Lagrangian Analysis and Prediction of Coastal and Ocean Dynamics (LAPCOD)](http://www.rsmas.miami.edu/LAPCOD/book.html#_blank) ed. A. Griffa, A. D. Kirwan, A. J. Mariano, T. Ozgokmen, and T. Rossby.

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