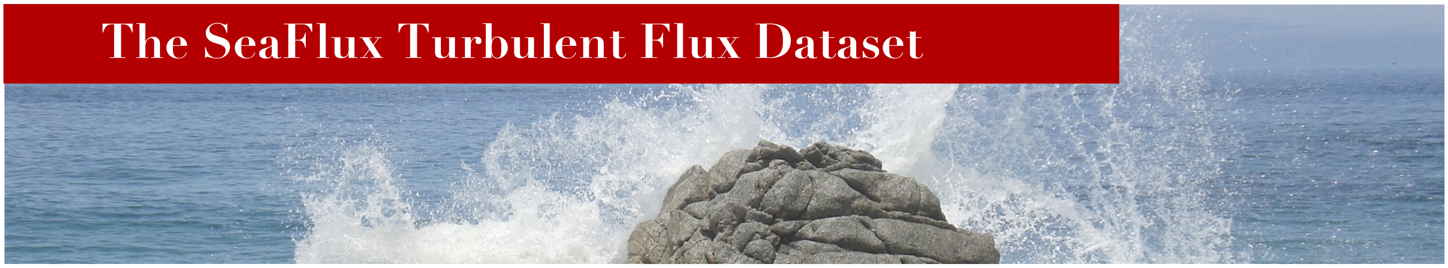

The SeaFlux Turbulent Flux Dataset Version 1.0 Documentation

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What's New?

Version 1.0 (**February 3, 2012**) – The SeaFlux Version 1.0 dataset is now publically available. Please visit www.seaflux.org for more information. Initial documentation release.

Request to Users

The SeaFlux dataset is developed and maintained through the international SeaFlux project. The SeaFlux producers kindly request that a citation for publications and/or presentations is provided to *seaflux@whoi.edu* to better gauge utilization of the SeaFlux product. Your cooperation will help in the future development of the SeaFlux product. Thank you.

The SeaFlux Turbulent Flux Dataset

About SeaFlux

Under the auspices of the World Climate Research Programme (WCRP) Global Energy and Water cycle EXperiment (GEWEX) Data and Assessment Panel (GDAP), the SeaFlux Project was created to investigate producing a high-resolution satellite-based dataset of surface turbulent fluxes over the global oceans. The most current release of the SeaFlux product is Version 1.0; this represents the initial release of turbulent surface heat fluxes, associated near-surface variables including a diurnally varying sea surface temperature. The product is available at 0.25 x 0.25 degree spatial and 3-hourly temporal resolution covering the period 1998-2007. For more information, please visit www.seaflux.org. For any inquiries, please email us at *seaflux@whoi.edu*.

Available Data

- *Latent Heat Flux* - The latent heat flux (LHF) is proportional to the evaporation rate, dependent upon the air-sea humidity difference, wind speed, and sea surface roughness. Units: W/m^2
- *Sensible Heat Flux* - The sensible heat flux (SHF) is proportional to the temperature difference between the atmosphere and the sea surface, and dependent on the wind speed and sea surface roughness. Units: W/m^2
- *Near-Surface Temperature* – The near-surface temperature (T_a) is calculated using a neural network algorithm based on Roberts et al. (2010) and explained in more depth in the Definitions & Algorithms section. The near-surface temperature is valid at 10m.Units: °C
- *Near-Surface Specific Humidity* – The near-surface specific humidity (Q_a) is calculated using a neural network algorithm based on Roberts et al. (2010) and explained in more depth in the Definitions & Algorithms section. The near-surface temperature is valid at 10m. Units: g/kg
- *Wind Speed* - Based on the Cross-Calibrated Multi-Platform (CCMP) Ocean Surface Wind Components and the neural network algorithm based on Roberts et al. (2010), the SeaFlux wind speed is an equivalent neutral wind valid at 10m. Units: m/s
- *Sea Surface Temperature* - A diurnally varying sea surface temperature (DVSST) is used in the calculation of LHF and SHF. The DVSST is based on Bogdanoff and Clayson (2012) and further described in Clayson et al. (2012). Units: °C
- *Diurnal Sea Surface Temperature* - The diurnal sea surface temperature (dSST) is the difference between the maximum and minimum sea surface temperature due to diurnal warming over a 24-hour period defined from 0000Z to 0000Z of the next day. The dSST is based on the Bogdanoff and Clayson (2012) parameterization, which is an updated version of the Webster, Clayson, and Curry (1996) parameterization. Units: °C

Definitions & Algorithms

A day is defined as 24 hours from 0000Z to 2400Z (or 0000Z of the next day).

The algorithms used to create the swath-level near-surface temperature and near-surface specific humidity, as well as wind speeds under high cloud liquid water conditions, is based on the Neural Network methodology of Roberts et al. (2010). In this version of the SeaFlux dataset, the beta version 3 Colorado State University (CSU) Inter-calibrated Brightness Temperatures (IBTs) from the SSM/I Sensors for the time period of 1998 through 2007 is used (http://rain.atmos.colostate.edu/FCDR). The length of this version of the IBT dataset limits the time coverage of this version of the dataset. The next

SeaFlux version will encompass the entire SSM/I time period. The atmospheric variables are valid at 10m.

The diurnally varying sea surface temperature uses the Reynolds Optimally-Interpolated Version 2.0 AVHRR-only sea surface temperature (Reynolds et al. 2007) as the foundation (or temperature at which there is no diurnal variability). The temperature in the upper-most ocean most resembles a foundation SST just before sunrise due to nighttime convective mixing. This temperature is used as the base temperature from which the daytime curve is applied, using the estimated daytime warming from Bogdanoff and Clayson (2012). In cases where there is 24-hours of sunlight, the foundation temperature is used at the time when the sun is lowest in the horizon.

The fluxes are computed using a neural network emulation of the COARE 3.0 algorithm (Fairall et al. 2003).

Resolution & Coverage

The SeaFlux product is three-hourly (averaged from 0000-0300Z, 0300-0600Z, 0600-0900Z, etc.). The SST however, is hourly, and the dSST is one value per day. All variables are currently available from January 1, 1998 through December 31, 2007. The product is currently analyzed on a 1/4-degree equal-angle grid and covers the global, ice-free oceans. The DVSST product associated with SeaFlux is 1-hourly with the same spatial coverage and resolution. The SST used in the surface flux computations is an average SST around the valid time of each 3 hourly period. For example, the 0130Z surface fluxes utilize the average SST from 1Z and 2Z for that day.

Interpolation

The interpolation technique of the SeaFlux dataset is a state-of-the-art Model Based Interpolation (MoBI) based on the time tendencies of NASA's Modern Era Retrospective-analysis for Research and Applications (MERRA) dataset (Rienecker and coauthors 2011). The methodology is intended to take advantage of the dynamical time-tendency information available from the high-resolution reanalysis to estimate missing data. Note that the methodology only fills in missing data. Where satellite retrievals are available, they are kept in the product.

Format/Reading the Data

All SeaFlux data is in 2-byte integer binary format. Reads are currently available in Matlab, Fortran, and GrADS. Should you need help reading the data with alternate software or need any assistance, please email us at *seaflux@whoi.edu*.

SeaFlux Accuracy

In comparison with other retrieval algorithms, the neural network retrieval algorithm for near-surface variables has the smallest root mean square error for all variables, and smallest bias for the near-surface temperature and humidity. The root mean square error of near-surface humidity, near-surface temperature, and wind speed are 1.31 g/kg, 1.31°C, and 1.58 m/s, respectively. Further details of the accuracy of the neural network retrieval accuracy can be found in Roberts et al. (2010). Atlas et al. (2011) denote the RMS error on the CCMP satellite-based wind estimates of 0.5 m/s. The SSM/I only datasets have a greater RMS error of about 1 m/s. Uncertainty estimates are currently being calculated on the SeaFlux variables, and once complete, will be publicly available through the SeaFlux Data Repository.

The SeaFlux Turbulent Flux Dataset

The figure below is a comparison of the SeaFlux wind speed, air temperature, and sea surface temperature for a winter season of buoy observations in the Gulf of Mexico. The biggest differences occur in the sea surface temperature and are mainly due to difference in the Reynolds SST, used as the foundation SST, and the buoy-based SST observation. It is promising to note the match up between the diurnal warming magnitudes, and timing and shape of the diurnal curves.

Future Development & Updates

1. Greater temporal coverage – We hope to extend the length of the dataset over the entire time period of the SSM/I satellite mission with SeaFlux Version 2.0.
2. Improved lag time algorithm – The lag time between solar noon and peak sea surface temperature is poorly understood. We are investigating the physics and parameterizing the lag time to create a better diurnally varying sea surface temperature.
3. Improved land and ice mask – The SeaFlux project is working with its GEWEX counterparts to create a consistent land and variable ice mask across the GEWEX community. An updated release of the product will be available once the new ice flag is applied to the SeaFlux product. Please make sure to register on the website to get updates!
4. Future versions will feature an equal area mode. The data will also be available in netCDF format.

References

Atlas, R., R. N. Hoffman, J. Ardizzone, S. M. Leidner, J. C. Jusem, D. K. Smith, D. Gombos, 2011: A Cross-calibrated, Multiplatform Ocean Surface Wind Velocity Product for Meteorological and Oceanographic Applications. *Bull. Amer. Meteor. Soc.*, **92**, 157–174.

Bogdanoff, A. S. and C. A. Clayson, 2012: Estimation of sea surface diurnal warming. *J. Phys. Oceanogr*. (In preparation).

Clayson, C. A., and A. S. Bogdanoff, 2012: The effect of diurnal sea surface temperature warming on climatological air-sea fluxes, *J. Clim*. (Submitted).

Clayson, C. A., J. B. Roberts, and A. S. Bogdanoff, 2012: SeaFlux turbulent flux data set. *Bull. Amer. Meteor. Soc.* (In preparation).

Fairall, C. W., E. F. Bradley, J. E. Hare, A. A. Grachev, and J. B. Edson, 2003: Bulk parameterization of air-sea fluxes: Updates and verification for the COARE algorithm. *J. Climate*, **16**, 571-591.

Reynolds, R. W., T. M. Smith, C. Liu, D. B. Chelton, K. S. Casey, and M. G. Schlax, 2007: Daily high-resolution-blended analyses for sea surface tempeature. *J. Clim.*, **20**, 5473-5496.

Rienecker, M. M., and Coauthors, 2011: MERRA: NASA's Modern-Era Retrospective Analysis for Research and Applications. *J. Climate*, **24**, 3624–3648.

Roberts, J. B., C. A. Clayson, F. R. Robertson, and D. L. Jackson, 2010: Predicting near-surface atmospheric variables from Special Sensor Microwave/Imager using neural networks with a first-guess approach, *J. Geophys. Res.*, **115**, D19113, doi:10.1029/2009JD013099.

Webster, P. J., C. A. Clayson and J. A. Curry, 1996: Clouds, radiation and the diurnal cycle of sea surface temperature in the tropical western Pacific Ocean. *J. Clim.*, **9**, 1712-1730.

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