

## README FILE

October 15, 2014

### Dynamics of the Loop Current in U.S. Waters

#### Data DVD

This DVD contains mooring data collected during Deployments 1 and 2 of the Dynamics of the Loop Current in U.S. Waters, data from the Pressure-equipped Inverted Echo Sounder (PIES) array, mooring data collected by CANEK group at the Centro de Investigación Científica y Educación Superior de Ensenada (CICESE), Mexico under BOEM funding (Dr. Julio Sheinbaum, Program Manager), CTD, AXCTD, AXBT, and AXCP profiles collected during the study, where the air-deployed probes were from a companion program (Principal Investigator, Dr. Nick Shay, RSMAS, University of Miami), and ancillary meteorological and tide data from public sources (NDBC and NOS). Under the **Data** directory, the files are organized under the subdirectories **SAIC**, **PIES**, **CICESE**, **CTD** and **Met**. All data from instruments are stored using *netcdf* and follow *COARDS* and/or *CF-1* conventions. Netcdf files are self-describing, but a guide to the data structures, attribute and variable names is given at <http://www.saicocean.com/SAICdocs/>. Mooring, PIES and Met data use time series formats, and ship or flight CTD/XCP profile data use cruise formats, where the cast data is aggregated into a single cruise netcdf file.

#### Time Series

**Warning: Data from the moored array were distributed to a few outside investigators prior to this final DVD. The main issue is that velocity data from the 900 and 1300 m depths on the full-depth SAIC moorings had calibration issues that were not resolved with the manufacturer until the summer of 2013, with the result that earlier issued records from these instruments have speeds that are approximately a factor two too small. This DVD supersedes any previous distributions or copies of LC mooring data. CD's of velocity data and copies of their files from this program with dates prior to October 2014 should be destroyed and files deleted.**

Two deployments from both the SAIC<sup>1</sup> and CICESE instruments have been concatenated with rotation gaps, generally less than 2-days, filled with spectrally equivalent data. Vertical coherence was maintained for ADCP velocities. These data are east and north currents and scalars (temperature, salinity and pressure) where applicable. Under the SAIC and CICESE directories, subdirectories for **Currents** and **Scalars**, which have further subdirectories **raw**, **3hlp**, and **40hlp**, for original, 3-hour low pass, and 40-hour low pass filtered data, respectively. Raw data (basic data from the instrument) has the following processing: calibrations applied; resolved in-water start/stop times, magnetic variation corrections applied and any single point spikes removed. Files with a ‘\_1’ in the 7<sup>th</sup> and 8<sup>th</sup> positions of the filenames are interpolated data, taking the 120-minute sampling interval of some instruments and linearly interpolating it to 60 minutes. The **raw** directory includes the individual deployments as well as concatenated time series, the filtered data applies to concatenated data only. All dates and times are in GMT. The “U” component of the current velocity files is the current in the east/west direction with east positive. The “V” component is the north/south direction with north positive. Units are cm/s. Temperature values are in degrees Celsius, salinity is in PSU, pressure is in dbar. The 75 kHz ADCPs were all directed upwards and generally produce good velocity data between ~ 60 and 440 m in the

water column. Some of the ADCP's on CICESE moorings were directed downwards. In the netcdf files, depth/time arrays are always arranged with the depth coordinate increasing.

Full details of the data processing are given in the study's final report, which may be obtained from BOEM [Environmental Studies Program Information System](#). The report reference is:

Hamilton, P., K. Donohue, C. Hall, R. R. Leben, H. Quian, J. Sheinbaum, and D. R. Watts. 2014. Observations and dynamics of the Loop Current. Technical Report. US Dept. of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2014-xxx. 417 pp.

Meteorological data from NDBC buoys and CMAN stations are included in the *Met* directory.

A map (*Hurricane\_w\_Moorings.pdf*) in the **Docs** directory shows the locations of all the moorings. During the 2.5-year deployments, hurricane activity in the eastern Gulf was fairly minimal. Tracks and times of hurricanes in the eastern Gulf are included on the map.

Timelines of data return are given by; *timlinSAIC.pdf*, *timlinCICESE.pdf*, and *timlinNDBC.pdf*, are included in the **Docs** directory for SAIC, CICESE, and Met data, respectively. In the timeline figures, the solid line represents currents, and the dashed line is for a scalar quantity (T, S or P). The NDBC time lines show the data from NDBC buoys and CMAN stations, along with the Key West tide station that are available for the period of the program. Locations of moorings and met/tide stations are given in *Mooring\_Map.pdf* and *Met\_Map.pdf*, respectively.

Filename are identified as follows:

Character 1:	<i>a</i> – Program identifier
Characters 2-3:	2-character mooring ID (e.g., <i>a1</i> )
Character 4:	( <i>1 – 9, a, b, c</i> , etc.) Instrument position on mooring, numbering down from the surface with <i>a=10, b=11</i> , etc. There are some out of sequence instruments that were added to some moorings for the second deployment.
Character 5:	Deployment number <i>1, 2</i> or <i>a</i> . <i>a</i> =concatenated data. <i>3,4</i> = splits of deployment 2 because of large gaps (primarily the upper levels of the ADCP's).
Character 6:	Data type ( <i>c</i> – east/north current velocity, <i>t</i> – Temperature and <i>p</i> – Pressure.) For Microcats, T files usually contain salinity data, or for instruments that measure pressure, pressure data.
Characters 7-8:	' <i>_d</i> ' for raw data, ' <i>_I</i> ' for hourly interpolated data, and ' <i>_4</i> ' for 40-HLP filtered data.
Characters 9-11:	' <i>.nc</i> ' – designation for a netcdf file.

In *netcdf* files for ADCP and PIES derived T/S data, the data are arranged in a depth/time 2-D array. The 75 kHz ADCP's at 450 m are processed such that the bin depth levels are constant to within +/- 8 m (1 bin). Thus, mooring drawdown has been taken into account. The 300 kHz instrument at 90 m on the second deployment of B1 (*ab1g2c\_d.nc*) has varying bin depths (these should be estimated from the pressure record at 150 m (*ab12ap\_d.nc*) because the accounting for the drawdown would have produced large gaps at all levels. Similarly, for CICESE ADCP files, depth levels of the bins have been corrected to constant depth within +/- bin height (usually 16 m) though some records are also provided with variable depths because of mooring drawdown where the appropriate pressure record that may be used to estimate bin depths as a function of time, is indicated in the *netcdf* file.

## PIES

PIES precision bottom pressure, and travel time data undergo considerable processing that is documented in the study's Final Report (see above). Records provided here are detided bottom pressure, along with the tidal signal (*a##11p\_d.nc* files, where ## is the PIES ID number), sea-surface height files (*a##11b\_d.nc* and *a##11e\_d.nc*), and depth/time files of temperature and salinity derived by the GEM method from the travel time records and the historical CTD database. Because of a limitation in the data management system the T/S profiles are provided in 3 or 4 *netcdf* files where the increasing sequence in the 5<sup>th</sup> position of the filename indicates increasing depth ranges. The T/S data is provided at 10-m intervals, and the limitation is that only 99 levels are allowed, hence the splitting into depth ranges. For example, files *a5111t\_d.nc*, *a5112t\_d.nc* and *a5113t\_d.nc* contain the complete T/S profiles covering the 2770 m water column at 10-m intervals for PIES location 51, as a function of time. Note that there is only one 2.5-year deployment of the PIES array, so the 4<sup>th</sup> character position in the filename is always '1'.

The sea-surface height files contain the SSH in cm calculated from the travel time and bottom pressure at each PIES location (*a##11e\_d.nc*), and the decomposition of this signal into the barotropic and baroclinic parts (*a##11b\_d.nc*). Details of this decomposition and calculation of SSH are given in the final report.

## Meteorological/Tides

Auxiliary data filenames are identified as follows:

Character 1:	<i>n</i> , <i>w</i> , or <i>e</i> for NDBC buoy, CMAN or tide data, respectively.
Characters 2-4:	A contraction of the buoy number or station name.
Characters 5-6:	2-digit year of the record start (e.g., <i>09</i> for 2009).
Characters 7-8:	Codes: ' <i>d</i> ' – East and North Wind Vector (direction towards). ' <i>td</i> ' – Air Temperature, Atmospheric Pressure (-1000mb) ' <i>pd</i> ' – Atmospheric Pressure (-1000mb) ' <i>sg</i> ' – SST, Wind Speed Gusts ' <i>hd</i> ' – Significant Wave Height and Mean Period ' <i>dp</i> ' – Dominant Wave Period
Characters 9-11:	' <i>nc</i> ' – designation for a netcdf file.

## Ship or Air Deployed Profile Data

The netcdf files include all the cast profile data from a single cruise or aircraft flight, i.e., individual profiles are not given separate files. The type of cast (ship based CTD, or aircraft based AXBT, AXCTD, or AXCP) is indicated by an index parameter for each station where the index definitions are given in the netcdf attributes. Station numbers are numeric only, generally increase with date and time, and may differ from the originators designation. The hydrographic CTD data was collected by the *R/V Pelican* and *R/V Weatherbird II* at each PIES location on different cruises to provide calibration data for acoustic travel time ( $\tau$ ) at each site (details in the Final Report). The flight-based casts were conducted by Dr. Nick Shay at RSMAS, and were originally planned to document the effect of hurricanes on the Loop Current. However, tropical storm activity was minimal during the field program. The *Deepwater Horizon* oil spill occurred in April 2010, and therefore the expendable probe resources were redirected to surveying conditions over the Loop Current and south of the spill site. Analysis results are given in Shay et al. (2011). Use of these flight-based data should be coordinated with Dr. Shay.

Shay, L.K., B. Jaimes, J.K. Brewster, P. Meyers, E.C. McCaskill, E. Uhlhorn, F. Marks, G.R. Halliwell Jr., O.M. Smedstad and P. Hogan. 2010. Airborne Ocean Surveys of the Loop Current Complex from NOAA WP-3D in Support of the *Deepwater Horizon* Oil Spill. In: Monitoring and Modeling the *Deepwater Horizon* Oil Spill: A Record-Breaking Enterprise, edit. by Y. Lui, A. MacFadyen, Z-G. Ji, and R.H. Weisberg, Geophysical Monograph 195, American geophysical Union, Washington, DC, 131-152, doi: 10.1029/2011GM001101.

Please let us know if you need any further information regarding these data. Please report problems to:

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<sup>1</sup> Science Applications International Corporation (SAIC) was split into two companies on September 27, 2013; the newly-named Leidos Corporation inherited the contract. References to SAIC in documents and data files pertaining to this study are superseded by the new company name.