Interaction of Typhoon and Ocean Project (ITOP) Data Management and Operations Support

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LONG-TERM GOALS

The creation and maintenance of a long-term data archive for ITOP field and supporting data sets.

OBJECTIVES

The three primary objectives of this project were to develop an ITOP project web site, to develop an ITOP Field Catalog for use in daily project planning in the field as well as post-field analysis, and the development and long-term maintenance of a long-term distributed ITOP data archive.

Additional objectives included the collection and processing of dropsonde data sets from the United States Air Force (USAF) C-130 and Dropwindsonde Observations for Typhoon Surveillance near the TAiwan Region (DOTSTAR) Astra aircraft, leading to the development of a high resolution radiosonde and dropsonde composite data set. A focused effort was made to generate a quality control processing system for the USAF C-130 Airborne eXpendable BathyThermograph (AXBT) data.

APPROACH

The ITOP project web site was developed at the National Center for Atmospheric Research/Earth Observing Laboratory (NCAR/EOL) by Scot Loehrer and Steve Williams with input from Jim Moore (also EOL) and Eric D'Asaro (University of Washington). The web page is the central location for all ITOP-related information. It contains links to the data archives at EOL and the Monterey Bay Aquarium Research Institute (MBARI), the field catalogs from ITOP "dry run" 2009 and 2010 field deployments, meetings, publications, and documents. For all of the ITOP meetings, EOL has generated web pages that include links to all of the presentations given at the meeting. The ITOP publications page is meant as a single location to see all of the publications that are generated from the ITOP project. EOL also made available to investigators an ITOP Wiki page for the discussion of research topics.

The ITOP Field Catalog was developed, deployed, and maintained via substantial team effort of EOL staff and ITOP investigators. The effort was led by EOL (Scot Loehrer, Greg Stossmeister, Susan Stringer, Jim Moore, and Steve Williams) who did the primary work of developing the field catalog

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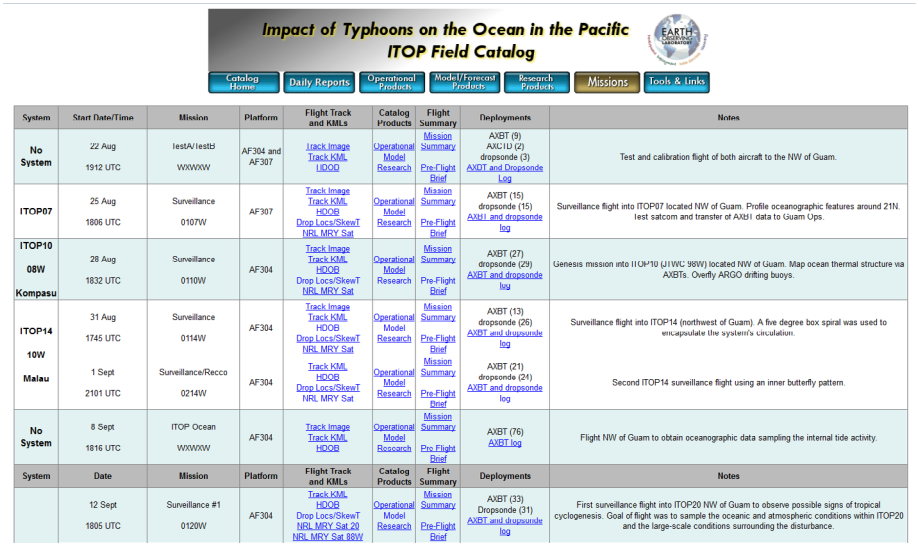
software, developing scripts to create products or pull in products from other web sites, creating the mission table and general maintenance. Several non-EOL ITOP investigators (including Pat Harr, Robert Creasey, Grant Elliott, Peter Black, Eric D'Asaro, Sue Chen, Rosalinda Fortier) provided input into the contents of the Field Catalog and also provided products from their instrumentation or models during the field deployments. The Field Catalog contains complete documentation of the ITOP field phase. It contains a suite of imagery and data plots documenting the atmospheric and oceanic conditions in the ITOP region, both by operational systems such as routine satellite products (e.g. the Japanese Meteorological Agency (JMA) Multifunctional Transport Satellites (MTSAT)) as well as research products developed in near real time in the field by investigators (e.g. deopsonde skewts) Additionally, analysis and forecast products from 15 different operational (e.g. European Centre for Medium-Range Weather Forecasts (ECMWF)) and research (e.g. Naval Research Laboratory (NRL)) models were collected and included in the field catalog. These products were a mixture of products generated locally at EOL, products generated by ITOP investigators, and products pulled into the Catalog via automated scripts developed at EOL. A set of daily reports are also available that were generated by project participants during the field phase covering items such as daily weather and ocean forecasts, operations plans, status summaries, and science mission summaries. The Field Catalog also contains a Mission Summary table (Figure 1) that summarizes all operations during the field phase, including their dates, the platforms participating, Google Earth KML files (containing flight tracks, High Density OBservations (HDOBs), dropsonde locations and skewts, and satellite imagery), links to all of the field catalog products during the mission, a summary of expendables (e.g. dropsondes) utilized in the mission, and mission summary reports developed by the investigators.



Impact of Typhoons on the Ocean in the Pacific
ITOP Field Catalog

Catalog Home | Daily Reports | Operational Products | Model/Forecast Products | Research Products | Missions | Tools & Links

System	Start Date/Time	Mission	Platform	Flight Track and KMLs	Catalog Products	Flight Summary	Deployments	Notes
No System	22 Aug 1912 UTC	testA/testB WXWXW	AF304 and AF307	Track Image Track KML HDOB	Operational Model Research	Mission Summary Pre-Flight Brief	AXBT (9) AXCTD (2) dropsonde (3) AXDT and Dropsonde Log	Test and calibration flight of both aircraft to the NW of Guam.
ITOP07	25 Aug 1806 UTC	Surveillance 0107W	AF307	Track Image Track KML HDOB Drop Locs/SkewT NRL MRY Sat	Operational Model Research	Mission Summary Pre-Flight Brief	AXBT (15) dropsonde (15) AXBT and dropsonde log	Surveillance flight into ITOP07 located NW of Guam. Profile oceanographic features around 21N. Test satcom and transfer of AXBT data to Guam Ops.
ITOP10 08W Kompasu	28 Aug 1832 UTC	Surveillance 0110W	AF304	Track Image Track KML HDOB Drop Locs/SkewT NRL MRY Sat	Operational Model Research	Mission Summary Pre-Flight Brief	AXBT (27) dropsonde (29) AXBT and dropsonde log	Genesis mission into ITOP10 (JTWC 98W) located NW of Guam. Map ocean thermal structure via AXBTs. Overfly ARGO drifting buoys.
ITOP14 10W Malau	31 Aug 1745 UTC 1 Sept 2101 UTC	Surveillance 0114W Surveillance/Recco 0214W	AF304 AF304	Track Image Track KML HDOB Drop Locs/SkewT NRL MRY Sat Track KML HDOB Drop Locs/SkewT NRL MRY Sat	Operational Model Research Operational Model Research	Mission Summary Pre-Flight Brief Mission Summary Pre-Flight Brief	AXBT (13) dropsonde (26) AXBT and dropsonde log AXBT (21) dropsonde (24) AXBT and dropsonde log	Surveillance flight into ITOP14 (northwest of Guam). A five degree box spiral was used to encapsulate the system's circulation. Second ITOP14 surveillance flight using an inner butterfly pattern.
No System	8 Sept 1816 UTC	ITOP Ocean WXWXW	AF304	Track Image Track KML HDOB	Operational Model Research	Mission Summary Pre-Flight Brief	AXBT (76) AXBT log	Flight NW of Guam to obtain oceanographic data sampling the internal tide activity.
System	**Date**	**Mission**	**Platform**	**Flight Track and KMLs**	**Catalog Products**	**Flight Summary**	**Deployments**	**Notes**
	12 Sept 1805 UTC	Surveillance #1 0120W	AF304	Track KML HDOB Drop Locs/SkewT NRL MRY Sat 20 NRL MRY Sat 88W	Operational Model Research	Mission Summary Pre-Flight Brief	AXBT (33) Dropsonde (31) AXBT and dropsonde log	First surveillance flight into ITOP20 NW of Guam to observe possible signs of tropical cyclogenesis. Goal of flight was to sample the oceanic and atmospheric conditions within ITOP20 and the large-scale conditions surrounding the disturbance.

Figure 1. A portion of the ITOP 2010 Field Catalog Missions Table.

The long-term distributed ITOP data archive is a team effort between EOL (Scot Loehrer, Steve Williams, Jim Moore, Greg Stossmeister, John Allison) and MBARI (Michael Godin and Dorota Kolber). EOL is the lead archive for the atmospheric data sets and MBARI the lead for the oceanographic data sets. EOL works with MBARI and the investigators to ensure that all ITOP data sets are archived for the long-term use of ITOP investigators and the larger community. EOL also collected and archived a number of supporting operational data sets for investigators including Global Telecommunication System (GTS) hourly surface meteorological observations, three-hourly synoptic observations, ship and buoy observations, and radiosonde observations from around the globe, radar

data from the National Weather Service Guam station and high resolution radiosonde data from the National Weather Service stations at Chuuk, Guam, Koror, Majuro, Ponape, and Yap.

The development of the high quality dropsonde data sets from the USAF C-130 and DOTSTAR ASTRA aircraft was conducted by NCAR/EOL staff including science staff (Scot Loehrer, Kate Young, and June Wang) and engineering staff (Terry Hock, and Dean Lauristen). EOL implemented a consistent quality control procedure on the dropsonde data that consisted of examining the profiles from the raw data files, process all the data through the Atmospheric Sounding Processing ENvironment (ASPEN) software developed by EOL, examine time series plots of the quality controlled data, examine profiles of the quality controlled data and examine histograms of the quality controlled data.

The development of the high resolution radiosonde and dropsonde composite data set was conducted by NCAR/EOL staff including Scot Loehrer, Linda Cully, and Linda Echo-Hawk. This entailed converting all of the radiosonde and dropsonde data sets to a common format and conducting a common set of automated and visual data quality checks.

The development of a comprehensive quality control processing system for the USAF C-130 AXBT data was led by Kate Young (EOL) with input from others at EOL (Jim Moore, June Wang and Scot Loehrer) and Jay Schaffer (University of Northern Colorado), Pat Harr (Naval Postgraduate School) and Eric D'Asaro (University of Washington).

WORK COMPLETED

The ITOP project web site (http://www.eol.ucar.edu/projects/itop) was initially developed in July 2010 and continues to be maintained as a central location for ITOP data and information. Particualar effort is being given to updating the publications page (Figure 2) as new referred papers and theses are published. EOL is developing a new Drupal content management infrastructure for its field project web pages and initial effort has been put into moving the ITOP home page into its new location. This will provide the site with a new and more modern look and feel. The new web page will be located at http://www.eol.ucar.edu/field_projects/itop/. When the new location becomes the official ITOP home page an automatic redirection will be placed at the old location.

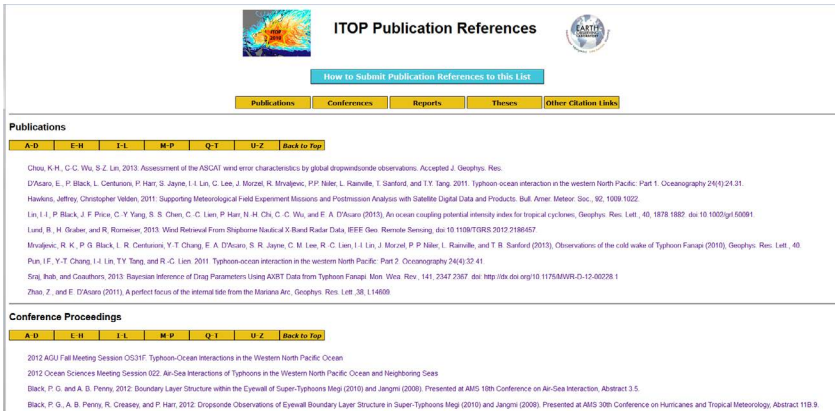


Figure 2. The top portion of the ITOP Publications web page.

The ITOP Field Catalog (http://catalog.eol.ucar.edu/itop_2010/) was developed and deployed for the ITOP 2010 field campaign. It continues to be maintained and remains available for ITOP investigators and the larger community as part of the long-term archive. It contains products and reports from July-October 2010 totalling 722,936 images, reports, and Google Earth KML files and requires 111 Gb of disk space. EOL also continues to maintain the ITOP "Dry Run" Field Catalogs from April 2010 (http://catalog.eol.ucar.edu/itop_2020_prelim/) and September-October 2009 (http://catalog.eol.ucar.edu/itop_2009/). All three Field Catalogs together contain a total of 859,658 images and reports and require 130 Gb of disk space.

The long-term distributed data archive (http://data.eol.ucar.edu/master_list/?project=ITOP) was initially developed during the field phase of ITOP and data sets were added as they became available. The ITOP data archive currently includes links to 197 data sets located at NCAR/EOL, MBARI, as well as other archives. A total of 109 data sets are currently residing at NCAR/EOL and include approximately 1.5 million files and require over 300 GB of disk space. There have been a total of 265 orders for the data housed at NCAR/EOL. NCAR/EOL is also working with MBARI to prepare for the long-term stewardship of the complete ITOP data archive by starting the work to share the research data sets collected by each so that both sites will have a complete copy of the ITOP research data archive.

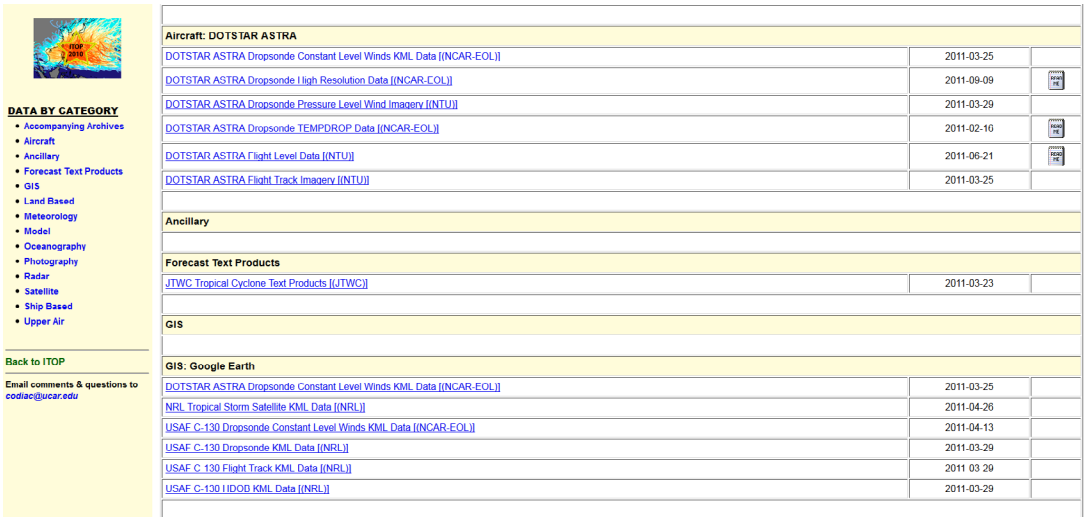


Figure 3: A portion of the ITOP Distributed Data Archive web page.

The high quality dropsonde data sets from the USAF C-130 and DOTSTAR Astra were made available to the community on 3 June 2011 and 9 September 2011 respectively. They are available from the ITOP long-term distributed data archive (http://data.eol.ucar.edu/master_list/?project=ITOP).

The high resolution radiosonde and dropsonde composite data set was finalized and made available to the community on 2 November 2011. It is available via the ITOP long-term distributed data archive (http://data.eol.ucar.edu/master_list/?project=ITOP).

A new comprehensive quality control scheme was developed for the AXBT oceanic temperature profiles collected during ITOP. The results were presented at the American Meteorological Society 30th Conference on Hurricanes and Tropical Meteorology, April 2012.

RESULTS

As part of the development of the high quality dropsonde data sets from the USAF-C130 and DOTSTAR Astra there were a number of special problems present in the raw dropsonde data that required special correction measures. One of these led to the discovery of a manufacturing problem in the expendable sonde package and resulted in its correction for future field campaings. This problem was noted in 35 files that contained significant noise in the pressure, temperature and relative humidity data. It was caused by RF energy from the dropsonde transmitter antenna inducing noise in the PTU module which was caused by a manufacturing change in the PTU module at Vaisala and tolerance of electronic components in the dropsonde. Due in part to the ITOP field campaign this problem was detected and has been resolved for this and future field campaigns. To deal with the problem in the ITOP data these data files were processed through ASPEN with more restrictive quality control parameters than are typically applied for dropsondes. This removed virtually all evidence of this noise.

A new comprehensive quality control scheme was developed for the AXBT oceanic temperature profiles collected during ITOP. It has long been an issue that there has not been a consistent quality control methodology that could be routinely applied to AXBT data collected during field programs and routine operations. For a sample of collocated dropsondes and AXBTs, the data were combined into a merged data set to create complete atmospheric-oceanic profiles and were used to characterize the structure of these unique profiles. A variety of programs were developed using the R statistical programming language to examine the raw data profiles for obvious problems, apply appropriate statistical quality control and ultimately produce the highest quality research data set. Preliminary results were presented at the AMS 30th Conference on Hurricanes and Tropical Meteorology and received substantial interest from the groups that conduct the operational flights into tropical storms for possible incorporation of this quality control process into operations much like what was done with the dropsonde quality control methods developed at EOL.

IMPACT/APPLICATIONS

There is a strong potential impact of the AXBT quality control process developed as part of the project to operations and the development of high quality, consistently quality controlled temperature profiles combined from the dropsondes and AXBTs into one merged profile.

The long-term accessiblity of the data sets generated by ITOP is a legacy of the project to the larger scientific community.

RELATED PROJECTS

None