FY2010 Work Plan For
NOAA's Climate Observations Program

High Resolution Climate Data from Research and Volunteer Observing Ships

November 2009

Period covered by this workplan: Oct 1, 2009 - Sept 30, 2010

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PROJECT SUMMARY

This project involves the measurement of direct high-resolution air-sea fluxes on one to two cruises per year and the development and deployment of a roving standard flux measuring system to be deployed on a series of NOAA and UNOLS research vessels to promote the improvement of climate-quality data from those platforms. An adjunct task is maintenance and operation of the C-band scanning Doppler radar and the stabilized wind profiling radar on the NOAA ship *Ronald H. Brown*. Because buoys and most ships and satellites rely on bulk methods to estimate fluxes, another aspect of this project is the use of direct measurements to improve the NOAA/COARE bulk flux algorithm. Originally one cruise was the annual TAO buoy tending cruise to 95W and 110 W on the *Ronald Brown*, but after several years participation in the TAO cruise was discontinued in favor of participation in the annual cruise to the equatorial Atlantic Ocean with NOAA/AOML as part of the African Multidisciplinary Monsoon Analyses (AMMA) and Saharan Dust studies (now part of the PIRATA Northeast Extension; PNE). In 2000, a second cruise was added to participate in the annual turn-around of the Stratus climate buoy at 20S 85W. Due to the success of the Stratus cruise participation and the fruitful collaboration with WHOI and in order to maintain a more relevant connection with the climate reference buoys, ESRL now participates in the annual turn-around of the Northwest Tropical Atlantic Station (NTAS).

A full suite of direct, inertial-dissipation, and bulk turbulent fluxes are measured along with IR and solar radiative fluxes, precipitation, and associated bulk meteorological properties. This effort represents a partial transition of research from the OGP CLIVAR PACS program to operations under the Climate Observations Program (COP).

The project development is the result of a NOAA-sponsored workshop on high-resolution marine measurements (Smith et al., 2003, *Report and Recommendations from the Workshop on High-Resolution Marine Meteorology*, COAPS Report 03-01, Florida State University, pp38) which identified three important issues with the planned NOAA air-sea observation system: 1) the need for a data quality assurance program to firmly establish that the observations meet the accuracy requirements, 2) the need for observations at high time resolution (about 1 minute), 3) and the need to more efficiently utilize research vessels, including realizing their potential for the highest quality data and their potential to provide more direct and comprehensive observations. For seasonal time scales, the net air-sea flux (sum of 5 flux components) must be constrained within 10 Wm^{-2}. Buoys and VOS systems are required to operate virtually unattended for months, so considerations of practical issues (e.g., power availability, instrument ruggedness, or safe access) are balanced against inherent sensor accuracy and optimal sensor placement. As discussed above, an important function of the in situ measurements is to provide validation data to improve NWP and satellite flux fields. High time resolution and more direct observations are invaluable for interpreting surface flux measurements and diagnosing the source of disagreements; such information can be provided by suitably equipped research vessels (R/V). Thus, the accuracy of buoy and VOS observations must be improved and supplemented with high-quality, high time resolution measurements from the US R/V fleet (which is presently underutilized). The necessity for both high time resolution and high accuracy places extreme demands on measurements because some sources of error (such as the effect of ship flow distortion on wind speed) tend to average out over a large sample. To accomplish this task will

require a careful intercomparison program to provide traceability of buoy, VOS, and RV accuracy to a set of standards.

This project directly addresses the need for accurate measures of air-sea exchange in the *Program Plan for Building a Sustained Ocean Observing System for Climate* (Sections 5.2-5.4), and it is a joint effort by ESRL and Dr. Robert Weller of the Woods Hole Oceanographic Institution (WHOI). The ESRL Air-Sea Interaction Group website can be found at: http://www.esrl.noaa.gov/psd/psd3/air-sea/. ESRL also cooperates with Dr. Andy Jessup (APL University of Washington) on radiative sea surface temperature measurements, Dr. Frank Bradley (CSIRO, Canberra Australia) on precipitation and radiative flux observations, Dr. M. Cronin (PMEL) on buoy-ship intercomparisons and climate variability analysis, and Dr. Wade McGillis (Univ. Columbia) on trace gas fluxes. A new website is under construction for this project (High Resolution Climate Observations http://www.esrl.noaa.gov/psd/psd3/air-sea/oceanobs/). An associated website (http://www.esrl.noaa.gov/psd/psd3/wgsf/) contains a handbook on best practices for flux measurements plus a database of high-resolution flux data. This work will be closely monitored by the WCRP Working Group on Surface Fluxes (WGSF) which is chaired by C. Fairall. This will give the project high visibility in the CLIVAR, GEWEX, and SOLAS programs. This project will be managed in cooperation with JCOMM (and other) panels as per instructions of Mike Johnson.

This project directly addresses the Climate Observation Program deliverables for improved observations of **Air-Sea Exchange**, and for accurate measurement of **Sea Surface Temperature**.

FY2010 PLANS

FY10 figures to be a challenging year for the project, with multiple deployments of the ESRL turbulent flux measurement system and the ESRL roving flux standard. Major efforts in FY10 will be execution of two climate cruises on the NOAA ship *Ronald H. Brown* (January 2010 - WHOI Stratus with Bob Weller and September 2010 - WHOI NTAS with Al Plueddemann) and one roving standard deployment on a UNOLS research vessel for a flux system calibration cruise. This 'calibration' cruise will be the NOAA-coordinated CalNex cruise off the coast of Southern California on the *R/V Atlantis*. This campaign provides the opportunity for deployment of the roving flux standard on another UNOLS vessel, and we will coordinate closely with the WHOI vessel operators on the calibration exercise. Given unexpected delays in the schedule of the *Ronald H. Brown*, ESRL may decide to participate in the February-March CLIVAR cruise and the April-May Pacific Northeast Extension (AMMA follow-up) cruises.

We plan to continue to coordinate with the SAMOS project for calibration of observational systems on board UNOLS vessels, and we will only select ships that have elected to contribute their observational data sets to the SAMOS system.

For the *Ronald Brown* radar systems project, a major maintenance is not planned this year for the C-Band radar. The Vaisala (formerly SIGMET) IRIS software licenses and maintenance will also need to be continued (this is k$9 per year). ESRL is investigating sources of funds to significantly upgrade the hardware and software of this valuable precipitation observation system. The *Ronald Brown* wind profiler has been removed from the ship, and ESRL is investigating possibilities for upgrading the hardware and software for this radar

system.

We will continue our cooperation with Dr. Huai-Min Zhang of NOAA NCDC on the SURFA project (http://www.ncdc.noaa.gov/oa/rsad/air-sea/surfa.html). The SURFA project is in its formative phase, and ESRL has downloaded surface flux fields from the ECMWF and the German DWD operational global forecast models. We have performed preliminary comparisons of these model outputs with the in situ observations from the Stratus buoy, and we will continue to work through this valuable intercomparison of models and observations.

Outreach efforts will continue primarily through the CIRES Outreach Office projects, including participation by the PI and other members of the ESRL Air-Sea Interaction Group in the COSEE-funded annual workshop for local earth science teachers.

FY2009 BUDGET SUMMARY

The total ESRL request to OCO for this project is k$360 in FY2007. This is augmented by k$29 in PI salary and about 50 k$ in other ESRL base contributions (salary, travel, etc). The OCO budget breakdown is as follows

Salaries, including overhead	157
Capital equipment	60
Software contract	10
Travel	23
Shipping	15
Supplies	7
Sondes	25
Misc	5
IT support	26
Admin support	32

The breakdown of this budget is as follows: operations - 70%, data management - 10%, R&D - 20%. The program supports 0.60 federal FTE and 0.375 non Federal FTE; 0.30 Fed FTE are devoted to the project but not funded by it. See attached budget page for details.

DELIVERABLES

* Flux standard deployment on the *R/V Atlantis* for the CalNex cruise May-June 2010
* Stratus buoy turn-around cruise in collaboration with WHOI on the *Ronald H. Brown* January 2010, and continued operation of the flux measurement system during subsequent cruises (CLIVAR, PNE).
* NTAS buoy turn-around cruise in collaboration with WHOI on the *Ronald H. Brown* September 2010
* Process and post flux data sets from 2009 deployments to the ESRL/PSD data archive
* Finalize and publish reports from previous deployments of the roving flux standard on the USCG Icebreaker *Healy* and the *R/V Knorr* (ICEALOT).

* Prepare a joint paper with WHOI on the intercomparison of ship-based and buoy fluxes at WHOI Stratus buoy site.
* Investigate the intercomparison of SURFA model output data with the WHOI Stratus buoy and ESRL R/V *Ronald H. Brown* observations, and prepare a presentation for the AGU and/or AMS conferences.
* Prepare a paper on the intercomparison of the suite of radiometers deployed over the past several years on the ships. This paper will be in collaboration with Dr. Frank Bradley at CSIRO.

OTHER NOAA BUDGET PROPOSAL

BUDGET COVERS FISCAL YEARS:	FY 2010
AMOUNT:	$360,959.24
PERIOD OF PERFORMANCE FOR FUNDS:	
PROJECT NAME:	ESRL Base Project: Ocean Obs
PROJECT NUMBER:	NEW
SPONSOR:	NOAA - Office of Climate Observations
PRINCIPLE INVESTIGATOR:	C. Fairall

BUDGET ESTIMATE				
FEDERAL LABOR	**MO RATE**	**UNITS**	**QTY**	**AMOUNT**
Wolfe	10,073	month	1.25	12,591
Welsh	9,314	month	1	9,314
Pezoa	6,090	month	5	30,450
Hazen	7,865	month	0	0
TITLE/NAME		month		0
Subtotal, NOAA Federal salaries	**33,342**	**months**	**7**	**52,355**
Subtotal, NOAA leave	21.0%			**10,995**
Subtotal, NOAA Federal Adjusted Labor Base				**63,350**
(31.07% exempt from NOAA Proposals) NOAA Support	28.9%			**18,308**
Benefits, NOAA (charged on NOAA labor)	25.0%			**15,837**
TOTAL FEDERAL LABOR				**97,496**
CIRES LABOR	**AMOUNT PER MONTH**	**UNITS**	**NUMBER OF MONTHS**	**AMOUNT**
Bariteau	4,299	month	1.5	6,448
Hare	8,274	month	4	33,096
		month		0
		month		0
TITLE/NAME		month		0
Subtotal, CIRES labor	**12,573**	**months**	**6**	**39,544**
FICA, TIAA, Work Comp.	28.0%			**11,072**
Subtotal Cires Labor and Benefits				**50,617**
CIRES Support	20.0%			**10,123**
TOTAL CIRES LABOR				**60,740**
CONTRACT LABOR	**AMOUNT PER MONTH**	**UNITS**	**NUMBER OF MONTHS**	**AMOUNT**
TITLE/NAME		month		0
TITLE/NAME		month		0
Subtotal, CONTRACT labor	**0**	**months**	**0**	**0**
Estimated Average for Contractor Benefits and Overheads	65.0%			**0**
TOTAL CONTRACT LABOR				**0**
OTHER DIRECT COSTS				**AMOUNT**
Shipping (R/V UNOLS 10; NTAS 5)				15,000
Field Site Expenses				0
Publications				5,000
Contracts: Cband radar Software				10,000
Travel ((R/V UNOLS - 10 ; Workshop - 3; NTAS 10)				23,000
Supplies & Materials (field - 7; sondes - 25)				32,000
Equipment [x] Capital [ ] Expendable				60,000
IT Support				26,341
Administrative Support				31,383
TOTAL OTHER DIRECT COSTS				**202,724**
TOTAL				**360,959**

Preparer of Budget Sheet: Jo Novosel, Management Analyst, 303 497 6588 fax: 303 497 7287 email: josephine.c.novosel@noaa.gov

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Comments: The overheads have been adjusted to reflect "other NOAA" proposal.