



ESA Support to Science Element

# **Ocean Heat Flux (OHF) – Activity Progress Report**

ESA Contract No. 4000111424/14/I-AM

**Deliverable: D6.4**

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# 1 INTRODUCTION

This document is the monthly periodic activity report for January to March 2015 for the ESA project “Ocean Heat Flux”, and forms deliverable [D6.4] of the project documents.

## 1.1 DOCUMENT STRUCTURE

The information within this document is structured as follows:

- Section 1: This introduction.
- Section 2: Provides an overview of the project.
- Section 3: Progress, problems and forthcoming activities for all major work packages.
- Section 4: A summary of the management activities addressing contractual and financial aspects, status of deliverables, milestones and travel expenditure, actions.

The work package sections will concentrate on describing the objectives, achievements, deliverables, and plans for the current and forth coming reporting periods.

## 1.2 AMENDMENT HISTORY

Version	Date	Change Description	Author
1.0	2 April 2015	Initial version	JF Piollé (IFREMER)

*Table 1 : history table*

## 1.3 DISTRIBUTION

Name	Role	Company
Pierre-Philippe Mathieu	ESA Technical Officer	ESA
Abderrahim Bentamy	OHF Scientific Leader	IFREMER
Jean-François Piollé	OHF Project Manager	IFREMER

*Table 2 : distribution table*

#### 1.4 APPLICABLE DOCUMENTS

The following table lists the applicable documents to this report.

*Table 3: Applicable documents*

<b>Id</b>	<b>Title</b>	<b>Reference</b>	<b>Issue</b>	<b>Rev.</b>
LET	Letter-Invitation to Tender	Act.Ref.: 13.155.28	15 Nov. 2013	
SOW	Statement of Work	EOP-SA/0261/PPM-ppm	1	1.
SCOT	Special Conditions to Tender	Appendix 3 to AO/1-7712/13/I-AM		
DC	OHF Contract	Appendix 2		

#### 1.5 REFERENCE DOCUMENTS

The following table lists the reference documents to this report.

*Table 4: Reference documents*

<b>Id</b>	<b>Title</b>	<b>Reference</b>	<b>Issue</b>	<b>Rev.</b>
D1.1	Reference Baseline Document		3 April 2015	1.0

## 2 PROGRESS OF ACTIVITY

### 2.1 WP 1 REQUIREMENT BASELINE ANALYSIS

*(task 1.8 Draft, assemble and deliver the Requirement Baseline D1.1)*

A presentation of the first RB outline was done during the team meeting in Paris in January and it was sent to team members. Ifremer and MIO have been reworking on the structure of this early draft of the requirement baseline, on the model of other ESA requirements baseline in similar projects (OceanFlux GHG, Pathfinder/Ocean Acidification, GlobCurrent). This draft will be sent early April to partners for them to fill in their section. It is planned to complete this document in April.

*(task 1.3, 1.4 Consolidation of flux methods and algorithms , Identification of the product algorithm strengths and limitations)*

Progress was made on the requirements section dealing with the product strengths and limitations, based on the existing flux products from IFREMER, HOAPS, OAFlux, SeaFlux, J-OFURO, ERA Interim, CFSR, and NOCS2. The team mainly investigated the methods used to estimate turbulent fluxes including bulk variables and parameterizations. The objective is to summarize the main characteristics of each product (period, spatial and temporal resolutions, accuracy as derived from publications, origin of wind speed, specific air humidity, sea and air temperatures, bulk parameterization, objective/subjective method). The is also required for further flux product intercomparison purpose.

*(task 1.5, Consolidation the strategy of the flux product evaluation and validation)*

The development of the strategy plan and method description for the cages, as part of the RB was started, in collaboration between MIO and IORAS.

IORAS also worked on building estimates of accuracy requirements for surface fluxes for estimation of global, regional and local energy budgets and variability at different time scales. During the reporting period they consolidated surface flux estimates from 7 reanalyses (ERA-Interim, MERRA, NCEP-CFSR, JRA-25, JRA-55, NCEP-DOE) at 6-hourly resolution, 3 satellite-based products (HOAPS, IFREMER, SEAFLUX) and provided a tool for interpolation at the unified latitude-longitude grid using the Akima method of local procedures. Generated fields were used for intercomparison of conventional characteristics of air-sea fluxes for several periods of overlap (1979-onwards for reanalyses) and 2000-2007 (for all products).

*(task 1.5.3 Justification for the selection of "cages" based upon pilot studies)*

Under this work stream we started to develop methodology for application of 2D probability distribution for estimating time- and areal-averaged surface fluxes. Methodology is based on the analysis of 2D distributions of surface turbulent heat fluxes, merging the MFT (Modified Fisher-Tippett, see section 2.3) distribution for surface temperature and humidity gradients and Weibull distribution for wind speed. This methodology has been applied in a pilot mode for the analysis of integrated surface fluxes over the North Atlantic from 25 N to 60 N (potential cage area for OHF) and for the Red Sea. Integrations were performed for reanalysis fluxes and for VOS-based estimates of surface fluxes for the period from 2000 to 2007. Currently the methodology for minimizing sampling uncertainty and for further application of the method to satellite based products is under development.

## **2.2 WP 2 REFERENCE DATASET GENERATION**

*(task 2.1.3 Collecting and archiving of all required in situ data necessary for flux calculation or quality assessment)*

The collection of the input data has progressed, in particular with the addition of new in-situ data (SAMOS) collected to further investigate the quality of fluxes and to assess the impact of bulk variables and of the parameterization at various scales. These high quality data are archived on SeaFlux (campaigns data) web site or provided by COAPS team (<https://coaps.fsu.edu/>). They originate from a number of selected ships providing high resolution (in space and time) measurements including oceanic and atmospheric data. They are available over global oceans including high latitudes where “ground references” are highly undersampled. Campaign and SAMOS data are used to estimate daily fluxes suitable for comparisons with existing and produced OHF flux estimates.

*(task 2.4.2 Construction of an online product catalogue)*

All collected data are traced in general OHF product catalogue accessible on OHF web site (<http://www.oceanheatflux.org/index.php/data/catalogue>). Whenever possible the DOI will be referred to (none could be found for the currently collected datasets).

*(task 2.2 Homogenization of turbulent flux data)*

All the collected data are systematically homogenized to a common format (defined in a dedicated OHF Interface Control Document) and on the same spatial and temporal grid (daily, 0.25° resolution) over the same period 1999 to 2009. This task has been performed on Ifremer, OAFlux and SeaFlux turbulent flux products (J-Furo and HOAPS are still ongoing).



The resampling tools will be made available as open source software. IORAS also contributed to this task by providing a tool for interpolation at the unified latitude-longitude grid using the Akima method of local procedures

*(task 2.4 Make data available to project members through (preliminary) portal)*

These reference data are all made available on the OHF portal:

FTP access : [ftp://eftp.ifremer.fr/oceanheatflux/data/standardized\\_fluxes/](ftp://eftp.ifremer.fr/oceanheatflux/data/standardized_fluxes/)

SSH access on Ifremer cloud *Nephele* :

/home/cercache/project/oceanheatflux/data/standardized\_flux\_data/

### **2.3 WP 3 PRODUCT GENERATION, INTERCOMPARISON AND UNCERTAINTY ESTIMATION**

*(task 3.3.4 Development and adjustment of methodology for estimation of probability density functions and its application for budget studies)*

A methodology for the fitting of MFT (Modified Fisher-Tippett) distribution and estimation of the distribution parameters has been developed. It allows for accurate estimation of the location and scale parameters and approximation of PDFs as well as for estimation of extreme fluxes corresponding to different percentiles. Special analysis has been performed to estimate the dependence of MFT distribution parameters on the time scales, thus estimating scaling factors for surface turbulent flux probability distributions. The Fortran code is currently available and the web-robotics is under development. Comparative assessment of PDF characteristics and extreme fluxes for different products is under the way. Further, this methodology can be applied for the assessment of skills of different algorithms used for computation of fluxes (both in-situ and satellite based).

*(task 3.3.9 cage studies)*

Side meeting with UR group (K. Haines, M. Valdivieso) during COST ES1402 on cage experiments and one telephone call with K. Haines were held, as well as three telephone calls with DWD (A. Andersson) for cage experiments. A first analysis started for Mediterranean Sea.

The MIO also started to work on a scientific publication on ocean heat content indicator development for one of the cages to be developed within OHF: Mediterranean Sea (natural cage). Planned to be submitted in the end of April 2015.

*(task 3.3.10 sensitivity of estimated fluxes and the oceanic heat budget to changes in the optical properties of the water)*

To increase understanding of the factors influencing ocean heat flux, the OHF project includes a sensitivity study investigating how upper ocean physical dynamics respond to variability in the optical properties of ocean waters. A modelling approach has been developed, including a multi-component bio-optical model coupled to the General Ocean Turbulence Model (GOTM). A range of sensitivity experiments have been run, quantifying how sea surface temperature, mixed layer depth and heat flux respond to changes in optical properties on diurnal scales. Further experiments will be run to consider the effects of regional meteorological variability and variable chlorophyll depth profiles.

The same bio-optical model is also being applied with input from satellite products including the Ocean Colour Climate Change Initiative (OC-CCI) chlorophyll concentrations. Global maps of light penetration and heating through the mixed layer are produced. Based upon the results of the planned sensitivity experiments, further parameterisation of chlorophyll depth profiles may be included in this application.

## **2.4 WP4 DATA PORTAL DEVELOPMENT**

*(task 4.2 access to Ifremer cloud)*

Access to the platform Nephelae at Ifremer has been set for any OHF project partner (<http://oceanheatflux.cersat.fr/index.php/data/nephelae-platform>). This has been tested with Rick Danielson from NERSC during a visit at Ifremer premises.

*(task 4.3 access through ftp and OpenDAP)*

The access to the current reference dataset through ftp has been also set. The login/password can be obtained from the following registration page:

## **2.5 WP 5 STRATEGIC DEVELOPMENT**

No activity on this workpackage.

## **2.6 WP 6 PROJECT MANAGEMENT AND COMMUNICATION**

### 2.6.1 COMMUNICATION WITH PARTNERS AND EXPERTS

An OHF project meeting was held on 26 – 27 January at IFREMER Headquarters in Paris. The related details and conclusions were reported in the MoM. The latter was distributed to all OHF partners and collaborators. The OHF materials including presentations were made available on OHF web site at: <http://oceanheatflux.cersat.fr/index.php/magazine/documents> (you need to be logged in).

A report providing details of flux accuracy determined mainly through comprehensive comparisons with mooring estimates was distributed to all OHF partners and collaborators. It provides the results needed for meeting WP2 and WP3 requirements.

### 2.6.2 COMMUNICATION WITH USER COMMUNITY

A paper describing OHF project aims and the methods used to assess the quality of various turbulent fluxes was submitted. It is published in FluxNews Journal available on CLIVAR web site ([http://www.clivar.org/sites/default/files/documents/FluxNews\\_7.pdf](http://www.clivar.org/sites/default/files/documents/FluxNews_7.pdf)).

Here is a summary table of OHF publications that will be updated in the next progress reports:

Reference	Authors	Status
TIE-OHF: towards improved estimates of ocean heat flux, Flux News, A. Bentamy and K. von Schuckmann, Issue 7, February 2015	A Bentamy K Von Schuckmann	Published

The team also planned further communication through conferences and workshops, in particular with:

- the submission of an abstract for upcoming EGU meeting, in Seaflux session
- the organization of a joint CLIVAR RF CONCEPT-HEAT/CLIVAR GSOP/COST ES1402 workshop where, as already mentioned during the last meeting in January (Paris) and during the previous telephone meeting, the key people of

OHF should attend in order to advance on the scientific part of the project; the OHF project is now officially integrated as joint component in this workshop in agreement with all organisers/partners, and will take place 28.09.-02.10. at Metoffice, Exeter, UK. Agenda planning is currently ongoing, which will include a time frame for a OHF project partner meeting. Moreover, a proposal to US Clivar is under the way to ask for additional travel funding for US-colleges to attend this workshop.

- The organization of a session on *“The Earth’s energy imbalance and exchanges at the atmosphere-ocean interface: from fundamental research to societal concern”* at <http://www.commonfuture-paris2015.org/>

Last, intensive exchanges (telephone & emails) occurred with PML to establish link of ocean color data with surface flux data validation. The implementation of a new method and addition of a new scientific expert (L. Jullion, MIO, France) in the group was proposed.

Here is also a summary of the workshops we plan to present OHF to :

Workshop	Attendant	Status
Challenges of the surface energy budget and proposed ways forward, K. von Schuckmann, S. Josey, S. Gulev, K. Trenberth, C.-A. Clayson, P.-P. Mathieu, M. Wild <i>EGU, Vienna, 12-17 April 2015</i>	K Von Schuckmann	Accepted
Session “The Earth’s energy imbalance and exchanges at the atmosphere-ocean interface: from fundamental research to societal concern” <i>“Our common future under climate change”, Paris, 7-10 July 2015, <a href="http://www.commonfuture-paris2015.org/">http://www.commonfuture-paris2015.org/</a></i>	K Von Schuckmann	Accepted
joint CLIVAR RF CONCEPT-HEAT/CLIVAR GSOP/COST ES1402 workshop <i>UK Met Office, Exeter, 28 Sept.-02 Oct.</i>	A Bentamy K Von Schuckmann	Accepted

## 3 MANAGEMENT

### 3.1 PROJECT MANAGEMENT PLAN

The project management plan was completely revised, with a new workpackage breakdown, more detailed and matching the breakdown of ESA Statement of Work. It shall provide a better understanding of the partner's respective responsibilities. It is currently circulated among project partners for approval and will be submitted to ESA mid April.

### 3.2 INVOICES

The following table summarizes the status and dates of the invoices from IFREMER and related payment from ESA.

**The first payment request has been submitted to ESA on 12<sup>th</sup> December 2014 (and resubmitted on 6<sup>th</sup> March 2015) but is still pending.**

Payment Milestone	Date	status of invoice to ESA	Payment Received
Progress payment 1, upon acceptance of deliverable D4.1 (v1)	KO + 3	Submitted for all partners	No
Progress payment 2, upon acceptance of deliverable D1.1 (v1), D2.1 (v1), D5.1 (v1) and successful critical review	KO + 8	Not submitted	
Progress payment 3, upon acceptance of deliverable D4.1 (v2), D3.2 (v1), D3.3 (v1), D3.1 (v1), D6.1 (v1) and successful acceptance review and annual meeting	KO + 12	Not submitted	
Progress payment 4, upon acceptance of deliverable D4.1 (v3,v4), D5.1 (v2) and successful critical review	KO + 18	Not submitted	
Final payment, upon acceptance of all deliverables, incl. D3.1, D3.2, D3.3, D4.1, D6.1, D6.2 and successful final presentation meeting.	KO + 24	Not submitted	

### 3.3 MEETINGS

Meeting	Venue	Date	Description	Status
KO	ESRIN	KO	Kick-off meeting	Hold on July 2014
PM1	IFREMER	KO+7	Progress meeting 1 (critical review)	Hold on 26 – 27 January 2015
PM2	ESRIN	KO+18	Progress meeting 2 (critical review)	
Final workshop	IFREMER	KO+21	Final project workshop	
FP	ESRIN	KO+24	Final Presentation Meeting – review of products, services, and remaining project deliverables. Analysis of project sustainability.	

### 3.4 PENDING AND COMPLETED ACTIONS

The Actions Database [D6.5] records actions resulting from milestone meetings with ESA. The extract below lists the actions raised and closed for the past month, and those that remain open.

ID	RESPONSIBLE	DESCRIPTION	OPEN	DUE DATE	STATUS	COMMENT
1	IFREMER/AB	Provide MoM from Paris meeting PM1	26/01/15		Open	Done
2	IFREMER/JFP	Workpackage to be renamed conforming to IT ESA SoW tasks	26/01/15		Open	Done in updated PMP
3	IFREMER/AG	Add MERRA reanalyzes to reference dataset	26/01/15		Open	
5	IFREMER/AB	Double check the product rights and especially ERA Interim	26/01/15		Open	
6	IFREMER/AG	Double check the version of each product and the associated DOI (if exists)	26/01/15		Open	Done
7	IFREMER/AB	Provide the accuracy requirements for LHF and SHF. The latter would be derived from peer review publications and from scientific project reports (e.g. <a href="http://lists-ioc-goos.org/goos-strategic-mapping-graphic/">http://lists-ioc-goos.org/goos-strategic-mapping-graphic/</a> )	26/01/15		Open	Ongoing in RB

					ICD document has been written for format. Further discussion needed for resampling methods.
8	IFREMER/AG	Circulate the methods aiming at the homogenization of the flux products	26/01/15	Open	
9	IFREMER/AG	Foster interaction between NERSC and IFREMER aiming at comprehensive use of data and procedures including cloud procedure, Felyx, collocation, statistics	26/01/15	Open	Ongoing
10	IFREMER/AB	Contact Dr Lisan YU for the updated OAFlux	26/01/15	Open	Requested but these data are still under validation and can not be distributed
11	MIO/KVS	Provide report summarizing the main tasks relied on D1.1 (services, methods, ..)	26/01/15	Open	Ongoing in RB
12	NERSC/RD	Provide a note aiming at the clarification of work performing by NERSC in collaboration with IFREMER	26/01/15	Open	Done in updated PMP
13	IFREMER/AG	Assessment of variable names (see CF convention)	26/01/15	Open	
14	IFREMER/AG	Check the use of zenodo	26/01/15	Open	
15	IORAS/SG	Provide method and algorithms for PDF flux analysis	26/01/15	Open	
16	IFREMER/AB	Contact Dr Shawn Smith from FSU for SAMOS data	26/01/15	Open	Done
17	IFREMER/JFP	Change project acronym from TIE-OHF to OHF	26/01/15	Open	Done in updated PMP
18	IFREMER/AB	Provide justification for flux datasets made available for OHF project	26/01/15	Open	Ongoing in RB

### 3.5 DELIVERABLES

The following table lists the contractual deliverables that have been submitted to ESA during this reporting period and the change in status of documents submitted to ESA in previous months.

Each document will be submitted to ESA for ‘Approval’. Upon confirmation from ESA that the deliverables are satisfactory, the status shall be updated to ‘Accepted’. Updated documents will be marked as ‘Superseded’. A complete list of the documents delivered

to ESA to date is maintained by IFREMER and can be made available upon request.

WP	Doc ref.	Description	Responsible	Due Date	Status
Scientific Requirements Consolidation					
1	D1.1	Requirement Baseline Document	A Bentamy IFREMER	KO+4	draft
Reference Dataset Generation					
2	D2.1	Reference Dataset	A Bentamy IFREMER	KO+6	
Product generation, inter-comparison and uncertainty characterisation					
3	D3.1	Flux Assessment Report	K. Von Schuckmann	KO+11 KO+24	
3	D3.2	Product Handbook	A Bentamy IFREMER	KO+10 KO+23	
3	D3.3	Flux Product Dataset	A Bentamy IFREMER	KO+10 KO+21	
Data Portal Development					
4	D4.1	Data Portal initial version at KO+3 for project communication, with presentation content, deliverables, blog,... Updated regularly then.	JF Piollé IFREMER	KO+3 KO+8 KO+14 KO+18 KO+24	v1 provided
Strategic Development					
5	D5.1	Scientific Roadmap	B Chapron IFREMER	KO+6 KO+18	
Outreach and coordination					
6	D6.1	Outreach Material		KO+11 KO+24	
6	D6.2	Final Workshop Report	A Bentamy IFREMER	KO+24	



6	D6.6	Biannual newsletter	R Danielson NERSC	Every 6 months	
6	D6.7	Project brochures	R Danielson NERSC	Every 6 months	
Project management					
6	D6.3	Project Management Plan (PMP)	JF Piollé IFREMER	KO+1	
6	D6.4	Executive Monthly Progress Report (MR)	JF Piollé IFREMER	KO+1, every month then	
6	D6.5	Actions database (ADB)	JF Piollé IFREMER	KO+1, every month then	

### 3.6 MILESTONES

Milestone meetings are planned at critical points throughout the project lifetime. The status of these meetings to date is as follows.

Meeting	Venue	Date	Description	Status
KO	IFREMER	KO	Kick-off meeting	Completed
PM1	IFREMER	KO+7	Progress meeting 1	Completed
PM2	ESRIN	KO+18	Progress meeting 2	
Final workshop	IFREMER	KO + 21	Final project workshop	
FP	ESRIN	KO+24	Final Presentation Meeting – review of products, services, and remaining project deliverables. Analysis of project sustainability.	