Towards Improved Estimates of Ocean Heat Flux: (TIE-OHF)

Project Management Plan

In response to ESA ITT ESRIN/AO/1-7712/13/I_AM

(Reference: Improvement and Calculation of Global Long Time Series of Ocean Heat Fluxes from Satellite Remotely Sensed Data)

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TABLE OF CONTENTS

Towards Improved Estimates of Ocean Heat Flux: 1
(TIE-OHF) 1
Project Management Plan 1
1. Introduction 4
2. Project description 9
3. Team composition 11
4. Names and competences of key participants 13
Dr Abderrahim Bentamy (IFREMER, Senior Scientist) 13
Dr Bertrand Chapron (IFREMER, Expert Scientist) 14
Jean-Francois Piollé (IFREMER, Expert Engineer) 14
Frédéric Paul (IFREMER, Research Engineer) 14
Dr. Clément de Boyer Montégut 15
Prof. Johnny A. Johannessen (NERSC) 15
Dr Richard Danielson (NERSC) 19
Dr. Igor Esau (NERSC) 19
Dr. Shubha Sathyendranath (PML) 22
Prof. Trevor Platt (PML) 25
Dr. Stephane Saux-Picart (PML) 26
Dr. Karina von Schuckmann (MIO) 27
Dr. Carol Anne Clayson (WHOI, Senior Scientist) 28
Dr Semyon A. Grodsky (DMUM) 29
Professor R. T. Pinker (DMUM) 30
Dr Sergey Gulev (IORAS) 32
Dr. Axel Andersson (EUMETSAT) 33
Prof. Keith Haines (University of Reading) 34
Dr. Maria Valdivieso (University of Reading) 35
Prof. Chris Merchant (University of Reading) 36
5. Science Leader and Project manager 40
6. Key personnel roles and responsibilities 42
7. Project planning and reporting 48
8. Financial & Contractual Proposal 76

1. Introduction

1.1 Applicable documents

The table list of the applicable documents to this proposal:

Id	Title	Reference	Issue	Rev.
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	Draft Contract OHF	Appendix 2		

Table 1 : Applicable documents

1.2 Reference documents

The [SoW] contains a large number of documents and web sites that our consortium confirms to be familiar with.

1.3 Abbreviations and Acronyms

AATSR	Advanced Along Track Scanning Radiometer (ESA instrument)
ADB	Actions Data Base
AMSRE	Advanced Microwave Scanning Radiometer – E (of NASA's EoS Aqua)
API	Application Programming Interface
ATSR-1	Along Track Scanning Radiometer onboard ERS-1 (ESA instrument)
ATSR-2	Along Track Scanning Radiometer onboard ERS-2 (ESA instrument)
AMSR-E	Advanced Microwave Scanning Radiometer for EOS (NASA instrument)
AOD	Aerosol optical thickness
AOT	Aerosol optical depth
ASAR	Advanced Synthetic Aperture Radar

ASCAT	Advanced SCATterometer (of MetOp)
ATBD	Algorithm theoretical basis document
AVHRR	Advanced Very High Resolution Radiometer (NOAA instruments)
CCI	Climate Change Intiative
CDR	Critical Design Review
CEOS	Committee on Earth Observation Satellites
CERSAT	Centre de Recherche et d'Exploitation Satellitaire (IFREMER Satellite Data Center)
CLIVAR	Climate and Variability
DARD	Data Access and Requirements Document
DIR	Directory
DMSP	Defense Meteorological Satellite Program (of the USA)
DVP	Development and Validation Plan
DWD	Deutscher Wetterdienst
ECMWF	European Centre for Medium-Range Weather Forecasts
ENVISAT	Environment Satellite
EO	Earth observation
EOS	Earth Observing System
ERS	European Remote Sensing satellite (ESA instrument)
ERSEM	European Regional Seas Ecosystem Model
ESA	European Space Agency
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FOAM	Forecast Ocean Assimilation Model
FR	Final Report
FP	Final Presentation
FTP	File transfer protocol
GCOS	Global Climate Observing System
GHRSST	Group for High Resolution Sea Surface Temperature
GMES	Global Monitoring for Environment and Security
GOCE	Gravity field and steady-state Ocean Circulation Explorer
GSICS	Global Space-based Inter-Calibration System
Hs	Significant Wave Height (also SWH)
ICD	Interface Control Document
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer
IOCCG	International Ocean Colour Coordinating Group
IOWAGA	Integrated Ocean Waves for Geophysical and other Application
IOVWST	International Ocean Vector Wind Science Team

IR	Infra-red (a piece of the electromagnetic spectrum)
ITT	Invitation To Tender
Jason-1	Altimetry mission (NASA/France instrument)
Jason-2	Altimetry mission (NASA/France instrument)
HOAPS	Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data
KO	Kick Off
LHF	Latent Heat Flux
LW	Long Wave
MERIS	Medium Resolution Imaging Spectrometer (ESA instrument)
MODIS	Moderate Resolution Imaging Spectrometer (NASA instrument)
MR	Monthly Report
NASA	National Aeronautics and Space Administration (US)
NCDC	National Climatic Data Center
NERC	UK Natural Environment Research Council
NetCDF	Network Common Data Form
NetCDF CF	NetCDF Climate and Forecast Metadata Convention
NOAA	National Oceanographic and Atmospheric Administration (US)
NOC	National Oceanography Centre (UK)
NOP	Numerical Ocean Prediction
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NRT	Near Real Time
NTC	Non Time Critical
NWP	Numerical Weather Prediction
NWC	Numerical Weather nowCasting
OAFlux	Ocean Atmosphere Flux
OC	Ocean colour
OC-flux	ESA STSE project – Open ocean and Coastal CO_2 fluxes in support of carbon cycle monitoring
OHF	Ocean Heat Flux
OPeNDAP	Open-source Project for a Network Data Access Protocol
OSTIA	Operational Sea Surface Temperature and Sea Ice Analysis (UK Meteorological Office)
PaaS	Platform as a Service
PAR	Preliminary analysis report
PI	Principal Investigator
PML	Plymouth Marine Laboratory
PR	Progress Report
PMR	Passive Microwave Radiometry
RA2	Radar altimeter 2 (ESA instrument)

RB	Requirements Baseline
RD	Reference Document
RRS	Remote Sensing Reflectance
RUG	Reference User Group
SaaS	Software as a Service
SAP	Scientific Analysis Plan
SAR	Scientific Assessment Report
SAR	Synthetic Aperture RADAR
SeaWIFS	Sea-viewing Wide Field-of-view Sensor
SEVIRI	Spinning Enhanced Visible and Infrared Imager (of Meteosat Second Generation)
SIAR	Scientific and Impact Assessment Report
SRR	
SOLAS	Surface Ocean and Lower Atmosphere Study
SoW	HR-DD Statement of Work
SR	Scientific Roadmap
SRR	System Requirements Review
SSH	Sea Surface Height
SSM/I	Special Sensor Microwave Imager (of DMSP)
SSS	Sea Surface Salinity
SST	Sea Surface Temperature
SST-VC	SST Virtual Constellation (of CEOS)
STSE	Support to Science Element
TBC	To Be Confirmed
TBD	To Be Determined
TDP	Technical Data Package
TDS	Test Data Set
TN	Technical Note (short report 10-50 pages)
TO	Technical Officer (of the Agency)
TOA	Top of Atmosphere
TR	Technical Report (long report > 50 pages)
TS	Technical Specification
TOPEX	TOPEX-Poseidon altimetry mission (NASA/France)
UM	User Manual
URL	Universal Resource Locator
VIIRS	The NOAA Visible Infrared Imager Radiometer Suite
WCRP	World Climate Research Programme

WGASF	Working Group on Air-Sea Fluxes
WHOI	Woods Hole Oceanographic Institu
WGSF	Working Group on Surface Fluxes
WP	Work package
1D	One dimensional
3D	Three dimensional

Table 2 List of abbreviations and acronyms

2. Project description

2.1 Project organization structure

The project team has been organized to facilitate efficient and effective operation and to ensure that lines of responsibility are clear. IFREMER appoints **Dr Abderrahim Bentamy** for the OHF science **leader** who has overall responsibility for the management and coordination of the project. Figure 1 illustrates the team structure, gives the names of the key personnel with their role, and shows the lines of communication. The proposed organization has already been tested and experienced in projects involving several partners and the user community to design and offer EO data high level service (HIPOCAS, MERSEA, MyOcean, Medspiration, GlobWave, NSF …).

The IFREMER **science leader** will act as the single management point of contact across the project, and will be responsible for the successful outcome of the project. He will be the primary point of contact with ESA for day-to-day project matters, and will also be the formal point of contact for team members. He will be responsible for generating the monthly progress reports, minutes of meetings, and reports of the project reviews. He will issue the project staff with their tasks as identified in the Work Breakdown Structure created at the time of the proposal, and updated if necessary as the project evolves.

The nominated Project Manager is also supported by **Xavier Rebardy** as **Contracts Manager**. He will in charge of the overall management and administrative issues of the project.

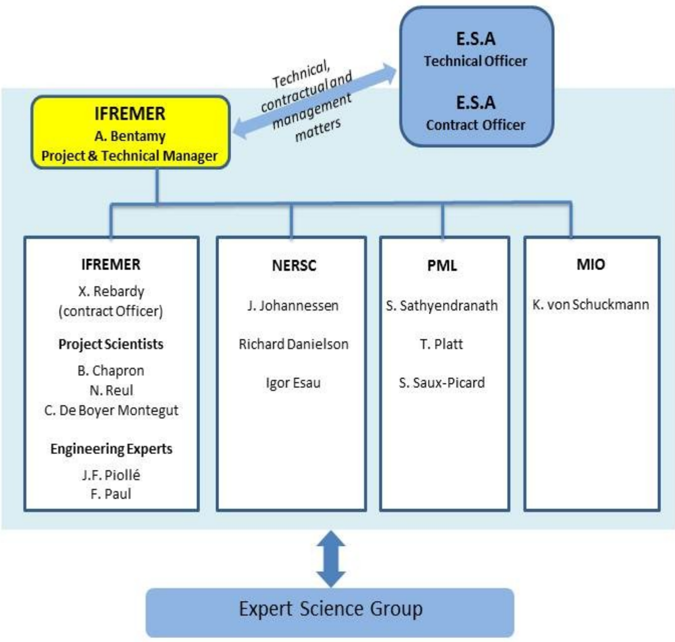

Figure 1: Proposed TIE-OHF project organization showing lines of communication within the project team

During the whole project, the science leader will be backed by all scientific and technical partners providing support for all EO data related issues and system requirements definition, bringing their scientific and technical expertise and user perspective in a very effective way by their proximity to the technical experts and project team. Furthermore, a team of international experts will support the project by contributing their expertise to the project.

During the implementation phase mainly dealing with flux processing and portal development, the integration of existing system components and development of additional back-end and front-end software will be coordinated by the **System Implementation Manager** Jean-François Piollé. He will be supported by a team of **Engineering Experts** from the partner institutes. They will provide documented and proved existing software components, support and guidance for the implementation of additional new back-end and front-end software components, support for system deployment, validation and operation on site and on the cloud computing facility supplied by IFREMER.

Communications within the team will be both formal and informal, and will comprise meetings or liaison by telephone and email, shared workspaces and project documentation and items repositories, reporting together with regular and ad-hoc meetings. Some **internal meetings** will be planned to coincide with professional meetings (e.g. ESA, EumetSat) where all project participants and collaborators will gather to report progress and to address problems and some specific issues related to the project.

The management of this project will be carried out at IFREMER. All deliverables and documents on project progress will be made available to ESA by email and ftp. The project website will be the main conduit of communication between all of the project partners. Additionally, emails, teleconferences, faxes and skype (voice over internet) will be used to provide cost effective and efficient communications between all involved. All project documentations and communications will be in the English language and stored on the dedicated website. A secure area of the website will include a 'Trac wiki' for project management. This will contain records (termed tickets) describing each of the current active tasks and those responsible. Communications between project partners will primarily use email, teleconferencing and telephones.

3. Team composition

The following table provides name, affiliation and country (nationality) of all contributors: (partners* and experts).

Name	Affeliation	Country
Abderrahim Bentamy*	IFREMER	France
Axel Andersson	DWD	Germany
Bertrand Chapron*	IFREMER	France
Carol Anne Clayson	WHOI	U.S.
Chris Merchant	UR	U.K
Clément de Boyer Montégut *	IFREMER	France
Frédéric Paul*	IFREMER	France
Igor Esau*	NERSC	Norway
Jean-François Piollé*	IFREMER	France
Johnny Johannessen*	NERSC	Norway
Karina Von Schuchmann*	MIO	France
Keith Haines	UR	U.K
Nicolas Reul *	IFREMER	France
Rachel Pinker	DMUM	U.S
Rainer Hollmann	DWD	Germany
Rick Danielson*	NERSC	Norway
Stéphane Saux-Picard*	PML	U.K
Semyon Grodsky	DMUM	U.S.
Sergey Gulev	IORAS	Russia
Shubha Sathyendranath*	PML	U.K
T. Platt*	PML	U.K

Table : List of TIE-OHF partners

A - some experience B - significant experience C- expert

Expertise / Skill	A. Bentamy (Ifremer)	JF Piollé (Ifremer)	F. Paul (Ifremer)	B. Chapron (Ifremer)	N. Reul (Ifremer)	C. de Boyer Montégut (Ifremer)	S. Sathyendranath (PML)	T Platt (PML)	S. Saux-Picart (PML)	J. Johannessen (NERS)	R. Danielson NERS)	Igor Esau NERS)	K. Von Schuckmann (MIO)
Project management	B	C	A	C	C	A	B	A	B	C	A	B	B
Requirement for flux products	B	B	A	B	B	B	B	B	B	B	B	C	A
Specification of flux product	B	A	A	B	B	B				B	B	C	A
Flux parameter-rization	B	A	A	C	C					B	B	C	A
Flux processing	B	B	A	A						B	B	C	A
Flux evaluation and validation	B	B	A	A						B	B	C	A
Characterization of flux uncertainty	B	C	C	A						B	B	B	A
Marine science expertise	C	A	A	C						C	B	B	C
Involvement in scientific community and projects	B	C	A	C	C	C				C	B	C	B
Eo and In-situ data analysis	C	C	B	C	C	C				C	B	B	C
Sensor Cal/Val	C	C	B	C	C	C				C	B	A	A
Sensor synergy	C	C	B	C	C					C	B	A	A
Sea Surface Winds	C	B	A	C	C					B	B	C	A
Sea Surface Temperature	A	C	A	B	B					B	B	B	B
Sea State	A	C	A	C	C					C	B	B	B
Humidity	B	A	A	A	A	A				B	B	B	A
Turbulent Fluxes	B	A	A	C	C	A				B	B	C	A
Communication and outreach	B	B	A	C	C	C				C	A	B	B
Web portal implementation	A	C	C			B							A
Web tool		C	C										A

development													
Provision of EO operational services			C										A
Project management	B												B
Ocean Coulour OC CCI	C	B	B				C	B	B				
Modelling light penetration under-water	C	C	B				C	C	B				
GOTM Model							B	B	C				
Programming							A	A	C				

Table: staff skills and knowledge map

4. Names and competences of key participants

- **Dr Abderrahim Bentamy (IFREMER, Senior Scientist)**

Senior scientist. He received the PH.D degree in numerical analysis and fluid mechanics from the institut des Sciences Appliquées (INSA) France, in 1986 for his numerical and theoretical studies on Newtonian and non Newtonian fluid modeling. Experiences on the calibration and validation of scatterometers, radiometers, and altimeters, development of direct and inverse models used to retrieve geophysical parameters from remotely sensed measurements, determination of high space and time resolutions of surface winds and associated turbulent fluxes at both global and regional scales, determination of spatial and temporal structures of the main parameters involved in the determination of the oceanic forcing function.

Recent Publications

Bentamy, A., K. B. Katsaros, A. M. Mestas-Nuñez, W. M. Drennan, E. B. Forde and H. Roquet, 2003. Satellite estimates of wind speed and latent heat flux over the global oceans. J. Climate, 16, 637-656.

Bentamy, A., H.-L. Ayina, P. Queffeulou, and D. Croize-Fillon ,2007: Improved Near Real Time Surface Wind Resolution over The Mediterranean Sea, Ocean Sci., 3, 259-271.

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Bentamy A., D. Croizé. Fillon, 2011: Gridded Surface Wind Fields from Metop/ASCAT Measurements. International Journal of Remote Sensing, 33, pp 1729-1754.

Bentamy, A., S. A. Grodsky, J. A. Carton, D. Croizé-Fillon, and B. Chapron, 2012: Matching ASCAT and QuikSCAT winds, J. Geoph. Res., 117, C02011, doi:10.1029/2011JC007479.

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Bentamy A., Grodsky S. A., Chapron B., Carton J. A., 2013: Compatibility of C- and Ku-band scatterometer winds: ERS-2 and QuikSCAT. J. Marine System 117-118, 72-80

- **Dr Bertrand Chapron (IFREMER, Expert Scientist)**

He is a Senior Research Scientist. He, received a PhD in Fluid Mechanics at Aix-Marseille in 1988, is presently head of the Spatial Oceanography Laboratory at IFREMER, responsible of the CERSAT (Centre ERS Archivage et Traitement, http://cersat.ifremer.fr). Experience and publications (over 80 publications in refereed journals): in applied mathematics, physical oceanography (upper ocean dynamics), electromagnetic wave theory and its application to ocean surface remote sensing. Co-I or PI in several ESA (ENVISAT RA2 and ASAR, SMOS), NASA and CNES (TOPEX/POSEIDON, JASON) projects. Co-responsible for the ENVISAT ASAR -Wave Mode algorithms and scientific preparation for the ENVISAT and SENTINEL 1 wind, wave and current.

- **Jean-Francois Piollé (IFREMER, Expert Engineer)**

He is an engineer with > 15 years experience. From 1996 to 1999, he worked as a computer engineer at Cap Gemini, contributing to the development of several processing and analysis tools for marine data. From 1996-onwards he works as a data manager at CERSAT/IFREMER. His main realizations include the development of an open objective analysis chain for the production of various gridded fields of sea-surface parameters (wind, fluxes, gas exchange coefficient), management of the WOCE satellite winds data center. He has been responsible for the EO data management and dissemination at CERSAT since 2003. In the context of several ESA and EU projects (Medspiration, GlobWave, Mersea, O&SI SAF, MyOcean2), he has been responsible for the design and development of automated NRT processing systems and frameworks able to cope with large volume of data (hundreds of GB/day) from EO missions. He is strongly involved in the sea surface temperature community, through several ongoing projects as leader or contributor. He has played a leading and active role in the GHRSST specification development, is also co-author of the ODYSSEA multi-sensor SST analysis. He also placed IFREMER at a central position of GHRSST system, setting up a European GDAC and developing the central GHRSST Match-Up Database. He is also involved in the wave activities through SAR wave mode Cal/Val works for Envisat and upcoming Sentinel-1, reprocessing activities and as the manager of the central processing and data center for GlobWave project.

- **Frédéric Paul (IFREMER, Research Engineer)**

He holds an engineering diploma in Computer Science ('04) from the Ecole Nationale d'Ingénieurs de Brest, France. He works since '06 in the Center for Satellite Exploitation and Research (IFREMER CERSAT, Brest) as software architect, where he is responsible for the design, development and integration of multi-mission tools to manage satellite data for operational oceanography and research projects. He focuses on new technologies based on big data concepts and cloud computing to build scalable processing infrastructures at petascale.

- **Dr. Clément de Boyer Montégut**

Research scientist, he received his Ph.D. in physical oceanography at université Pierre et Marie Curie Paris VI, France, in 2005. Presently at Ifremer, Spatial Oceanography Laboratory, he is member of the ocean in-situ data research and development group. He has experience in estimation and analysis of oceanic surface layer characteristics and variability from in-situ observations, and has a focus on the role of salinity on surface stratification. Understanding air-sea interactions in Indian Ocean area through investigations of surface temperature/salinity regulation mechanisms is also one of his main research interests. He is author and co-author of 25 peer reviewed publications. One of them was selected as a fast breaking paper by ISI Web of Knowledge in December 2005.

- **Prof. Johnny A. Johannessen (NERSC)**

Name: Johnny A. Johannessen
Born: 9 December 1953
Nationality: Norwegian
Present position: Vice Director

Academic degrees:

1997: Dr. Philos., University of Bergen, Norway
1979: Cand. Real., Physical Oceanography, Geophysical Institute, University of Bergen, Norway.
1977: Cand. Mag., Mathematics and Natural Sciences, University of Bergen, Norway.

Work experience:

2010: Vice director Nansen Environmental and Remote Sensing Center

2008-2010. Research Director Mohn-Sverdrup Center at Nansen Environmental and Remote Sensing Center (NERSC), Bergen, Norway.

1999-2007: Research Director in Ocean Remote Sensing Section, Nansen Environmental and Remote Sensing Center (NERSC), Bergen, Norway.

2000: Appointed Professor 2 in Satellite Oceanography, Geophysical Institute, University of Bergen, Norway.

1994-1999: Head of Ocean and Sea Ice Unit, Earth Sciences Division, European Space Agency (ESA) ESTEC, Noordwijk, The Netherlands.

1992-1994: Research Director, Marine Monitoring and Remote Sensing Unit, Nansen Environmental and Remote Sensing Center (NERSC), Bergen, Norway.

1987-1991: Senior Scientist, Nansen Environmental and Remote Sensing Center (NERSC), Bergen, Norway.

1988-1989: Visiting Scientist at Environmental Research Institute of Michigan, Ann Arbor, Mi., US for 6 months from September 1988 to February1989.

1983-1986: Research Scientist, Geophysical Institute, University of Bergen, Norway.

1981-1982: Research assistant to Arctic Chair hold by O.M. Johannessen at Naval Postgraduate School, Monterey, Cal., US from August 1981 to July 1982.

1979-1981: Research Assistant, Geophysical Institute, University of Bergen.

Recent Publications: International Review Journals

Milutinović, S., M. J. Behrenfeld, **J. A. Johannessen**, and T. Johannessen (2009), Sensitivity of remote sensing–derived phytoplankton productivity to mixed layer depth: Lessons from the carbon-based productivity model, *Global Biogeochem. Cycles,* 23, GB4005, doi:10.1029/2008GB003431.

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O. R. Godø, A. Samuelsen, G. J. Macaulay, R. Patel, S. S. Hjøllo, J. Horne, S. Kaartvedt, **J. A. Johannessen**, (2012) Mesoscale eddies are oases for higher trophic marine life, *Public*

Library of Science, PLoS ONE 7(1): e30161. doi:10.1371/journal.pone.0030161.

Vladimir Kudryavtsev, Alexander Myasoedov, Bertrand Chapron, **Johnny A. Johannessen,** Fabrice Collard, (2012), Imaging mesoscale upper ocean dynamics using SAR and optical data, *Journal of Geophysical Research,* Vol. 117, C04029, 2012.

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Michael Berger, Jose Moreno, **Johnny A. Johannessen**, Pieternel Levelt, and Ramon F. Hanssen, (2012), ESA's Sentinel Missions In Support to Earth System Science, *Remote Sensing of Environment*. doi:10.1016/j.rse.2011.07.023, 2012.

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A. Samuelsen, S. S. Hjøllo, J. A. **Johannessen**, R. Patel, (2011) Particle aggregation in anticyclonic eddies and implications for distribution of biomass in the upper ocean. *Ocean Sciences*., doi:10.5194/os-8-389-2012.

I. Panet, J. Flury, R. Biancale, T. Gruber, **J. A. Johannessen,** M. van den Broeke, T. van Dam, P. Gegout, C. Hughes, G. Ramillien, I. Sasgen, L. Seoane, M. Thomas, (2012) Earth System Mass Transport Mission (e.motion): A Concept for future Earth Gravity Field Measurements from Space, *Surveys in Geophysics* (DOI 10.1007/s1072-012-9209-8).

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D. Petrenko, D. Pozdnyakov, A. Korosov, **J.A. Johannessen**, F. Counillon, (2013) Satellite derived multi-year trend in primary production in the Arctic Ocean, *International Journal of Remote Sensing*, Vol. 34, No. 11, 3903–3937, http://dx.doi.org/10.1080/01431161.2012.762698.

J. A. Johannessen, R. P. Raj, J. E. Ø. Nilsen, T. Pripp, P. Knudsen, F. Counillon, D. Stammer, L. Bertino, O. B. Andersen, N. Serra and N. Koldunov (2014) Toward Improved Estimation of the Dynamic Topography and Ocean Circulation in the High Latitude and Arctic Ocean: The Importance of GOCE, *Survey in Geophysics*, Springer, DOI 10.1007/s10712-013-9270-y.

Recent Publications : Book Articles with Peer Review

Lyzenga, D.R., G.O. Marmorino, **J.A. Johannessen**: Ocean Currents and Current Gradients (Chapter 8), in Synthetic Aperture Radar Marine Users Manual. Editors: C.R. Jackson, J.R. Apel, pp. 207-220, NOAA, US Dept of Commerce, ISBN 0-16-073214-X, September 2004.

Shuchman, R., R.G. Onstott, **O.M. Johannessen, S. Sandven, J.A. Johannessen**: Processes at the Ice Edge - The Arctic (Chapter 18), in Synthetic Aperture Radar Marine Users Manual. Editors: C.R. Jackson, J.R. Apel, pp. 373-395, NOAA, US Dept of Commerce, ISBN 0-16-073214-X, September 2004.

J.A.Johannessen, P.-Y. Le Traon, I. Robinson, K. Nittis, M. Bell, N. Pinardi, P. Bahurel, and B. Furevik, Marine Environment and Security for the European Area: Lessons Learned from MERSEA Strand-1, European Operational Oceanography: Present and Future, 4th EuroGOOS Conference, eds. Hans Dahlin, Peter Ryder, *Elsevier Oceanography Series*, 2006.

Johannessen, J.A., B. Hackett, E. Svendsen, N. Winther, H. Søyland, P. Budgell, J. Albretsen, L.P. Røed, L. Bertino, M. Skogen, L. Pettersson, and D. Danielssen, Monitoring the Norwegian Coastal Zone Environment – The MONCOZE approach, European Operational Oceanography: Present and Future, 4th EuroGOOS Conference, eds. Hans Dahlin, Peter Ryder, *Elsevier Oceanography Series*, 2006.

J.A. Johannessen, V. Kudryavtsev, D. Akimov, T. Eldevik, N. Winther and B. Chapron, On Radar Imaging of Mesoscale Eddies and Fronts, European Operational Oceanography: Present and Future, 4th EuroGOOS Conference, eds. Hans Dahlin, Peter Ryder, *Elsevier Oceanography Series*, 2006.

Hackett, B., J. Albretsen, L.P. Røed, **J.A. Johannessen** and E. Svendsen, 2006: The MONCOZE Pilot Ocean Monitoring System (POMS); A Tool for Marine Environmental Monitoring. European Operational Oceanography: Present and future. *In Proceedings of 4th International Conference on EuroGOOS*, Ed. by H. Dahlin, N. C. Flemming, P. Marchand and S. E. Petersson, European Communities, pp. 242-247.

Johannessen, J.A., L.H. Pettersson, T. Eldevik**,** D. Durand, G. Evensen, N. Winther and Ø. Breivik: Coastal Physical and Biochemical Processes. Chapter 6, pp.179-196, in Remote Sensing of the Marine Environment (ed. J. Gower), Manual of Remote Sensing, Third Edition, Volume 6, Published by American Society for Photogrammetry and Remote Sensing, 2006, Maryland, USA, 338 pp.

J.A. Johannessen, B. Hackett, E. Svendsen, H. Søiland, L.P. Røed, N. Winther, J. Albretsen, D. Danielsen, L. Pettersson, M. Skogen and L. Bertino (2007), Operational oceanography-Challenges and possibilities, The Norwegian Coastal Current – Oceanography and Climate, Ed. R. Sætre, tapir academic press, Trondheim, Norway, pp. 139-150.

Romeiser, R., **J.A. Johannessen**, B. Chapron, F. Collard, V. Kudryavtsev, H. Runge, and S. Suchandt, Direct surface current field imaging from space by along-track InSAR and conventional SAR. , In Oceanography From Space, Revisited, V. Barale, J.F.R. Gower, and L. Alberotanza (eds.), 73-91, *Springer Science+Business Media*, 2010.

Bahurel Pierre, Frédéric Adragna, Mike J. Bell, Fabienne Jacq, **Johnny A. Johannessen**, Pierre-Yves Le Traon, Nadia Pinardi, Jun She: Ocean monitoring and forecasting core services, the European MyOcean example. OceanObs09, Venice Italy, 21-25 Sept. 2009. Publisher: European Space Agency, *in press*.

B. Chapron, A. Bingham, F. Collard, C. Donlan, **J.A. Johannessen**, J.-F. Piolle, N. Reul, Examples of Ocean Remote Sensing Data Integration, OceanObs09, Venice Italy, 21-25 Sept. 2009. Publisher: European Space Agency, *in press*.

- **Dr Richard Danielson (NERSC)**

06/08/1968, Canadian
Currently working for Nansen Environmental and Remote Sensing Center since 2013

Title of post in proposed work

Senior Scientist

Outline of responsibilities in proposed work

Contributor to data set generation, inter-comparison, and uncertainty characterization

Academic and professional qualifications

Prior to joining the Nansen Center, Rick Danielson was a UCAR visiting scientist at the National Hurricane Center (2010-2012), where the operational use of OSCAT, and a QuikSCAT neural network wind retrieval, were evaluated. As a physical scientist at Environment Canada (2008-2010), he introduced and made the first assessment of SAR assimilation in an operational high-resolution numerical forecast model. The basis for this was his postdoctoral work at Dalhousie Oceanography (2004-2008), where the added benefit of considering SAR backscatter in marine wind analysis was derived. Rick received his B.Eng. in 1992 (Queen's) and M.Sc. and Ph.D. in synoptic marine meteorology in 1996 and 2003 (McGill), where he developed an understanding of in situ observations as a reference for passive and active microwave satellite observations.

Selected committees and projects

2011-2012 National Oceanic and Atmospheric Administration scatterometer data exploitation science team member
2009-2010 Canadian Space Agency Radarsat Constellation user and science team member

Selected publications

B. W. Stiles, **R. E. Danielson**, W. L. Poulsen, M. J. Brennan, S. M. Hristova-Veleva, T.-P. J. Shen, and A. J. Fore (2013) Optimized tropical cyclone winds from QuikSCAT: A neural network approach, under external review (IEEE-TGRS)

R. E. Danielson and J. R. Gyakum, (2010) A composite look at short-time-scale sea-surface temperature changes in the western North Pacific based on ships and buoys, *Quart. J. Royal Met. Soc.*, **136,** 319–332.

R. E. Danielson, M. Dowd, and H. Ritchie, (2008) Objective analysis of marine winds with the benefit of the Radarsat-1 synthetic aperture radar: A nonlinear regression framework, *J. Geophys. Res. (Oceans)*, **113,** C05019, doi:10.1029/2007JC004413.

- **Dr. Igor Esau (NERSC)**

Igor Esau, born 15.10.1969 in Omsk, Russia
Ph.D. in meteorology (Uppsala University, Sweden),
Ph.D. in mathematics and physics (Inst. for Numerical Mathematics, Russia), Present position – Research Director and Head of the GC Rieber Climate Institute, Nansen Environmental and Remote Sensing Centre, Bergen, Norway

Education and Appointments

2003: Ph.D. in meteorology, Department of Geosciences, University of Uppsala, Uppsala, Sweden
1996: Ph.D. in mathematics and physics, Institute for Numerical Mathematics, Russian Academy of Science, Moscow, Russia
1992: Diploma with honors degree, Chair of Meteorology and Climatology, Tomsk State University, Russia

Record of employment

March 2009 on: Research Director, GC Rieber Climate Institute of Nansen Environmental and Remote Sensing Center, Bergen, Norway
2003-2009: Researcher, Nansen Environmental and Remote Sensing Center, Bergen, Norway
1997-1998: Research Associate, Institute for Numerical Mathematics, Russian Academy of Science, Moscow, Russia
1992-93: Engineer, Regional Agency for Hydrometeorology and Environment Monitoring, Omsk, Russia

Professional associations

Member of European Geophysical Union; Member of American Geophysical Union; Member of Bergen Geophysical Society; Member of the International Eurasian Academy of Science.

Research and Networking Projects Participated in 13 completed projects. Current projects:
2010-2013: Norwegian Research Council project RECON 200610/S30: A user-defined approach to utilize climate change information in local implementation of national construction standards.

2009-2014: European Research Council Advanced Grant, FP7-IDEAS, 227915: Atmospheric planetary boundary layers: physics, modelling and role in Earth system

2012-2015: GC Rieber Foundation research project, Bergen Air Quality

2013-2015: Norwegian Research Council and Russian Foundation for Basic Research, CLIMARC: Climate variability and change in the Eurasian Arctic in the 21st century

List of Publications

Bibliometric information:
Author/co-author on 54 peer-reviewed papers, 18 other registered publications, 112 conference presentations; Total number of citations without self-citations (ISI Thompson) – 414; Individual impact factor (number of refs/number of papers) – 7.6; h-factor - 13;

Relevant recent peer-review publications

Esau, I., T. Wolf, E. Miller, I. Repina, Y. Troickaya, S. Zilitinkevich, 2013: Analysis of remote sensing monitoring of the lower atmosphere temperature profile in Bergen, Norway, *Meteorology and Hydrology*, **7**, in print

Smedsrud L.H., I. N. Esau, R. B. Ingvaldsen, T. Eldevik, P. M. Haugan, C. Li, V. Lien, A. Olsen, A.

Omar, O.H. Otterå, B. Risebrobakken, A.B. Sandø, V. Semenov and S.A. Sorokina, 2013: The role of the Barents Sea in the Arctic climate system, *Reviews of Geophysics*, in print

Davy, R. and I. Esau, 2013: Surface air temperature response in global climate models, *Atmos. Sci.*

Letters, in print

Outten, S., Davy, R. and I. Esau, 2013: Eurasian winter cooling: Intercomparison of Reanalyses and CMIP5 data sets, *Atmos. Oceanic Sci. Letters*, in print

Esau, I., V. Alexeev, I. Repina, S. Sorokina, 2013: Contrasting vertical structure of recent Arctic warming in different data sets, *Atmos. Climate Sciences*, **3**, 1-5

Outten, S. and I. Esau, 2013: Extreme winds over Europe in the ENSEMBLES regional climate models, *Atmos. Chemistry and Physics*, **13**, 5163-5172, doi:10.5194/acp-13-5163-2013

Zilitinkevich, S. S., Elperin, T., Kleeorin, N., Rogachevskii, I. and I. Esau, 2013: A hierarchy of energy- and flux-budget (EFB) turbulence closure models for stably stratified geophysical flows, *Boundary-Layer Meteorology*, **146**(3), 341-373, DOI: 10.1007/s10546-012-9768-8

Esau, I., R. Davy and S. Outten, 2012: Complementary explanation of temperature response in the lower atmosphere, *Environmental Research Letters*, **7**, 044026

Esau, I. and I. Repina, 2012: Wind Climate in Kongsfjorden, Svalbard, and Attribution of Leading Wind Driving Mechanisms through Turbulence-Resolving Simulations, *Advances in Meteorology*, Article ID 568454, doi:10.1155/2012/568454

Alexeev, V.A., Esau, I., Polyakov, I.V., Byam, S.J., and S. Sorokina, 2012: Vertical structure of recent Arctic warming from observed data and reanalysis products, *Climatic Change*,**111(2)**, 215-239, DOI 10.1007/s10584-011-0192-8

Outten, S. and I. Esau, 2011: A link between Arctic sea ice and recent cooling trends over Eurasia, *Climatic Change*, **110**, 1069-1075, DOI 10.1007/s10584-011-0334-z

Canuto, V.M., Cheng, Y., Howard, A.M., and Esau, I., 2008: Stably stratified flows: A model with no Ri(cr), *J. Atmos. Sci.*, **65**, 2437-2447

Zilitinkevich, S. S., Elperin, T., Kleorin, N., Rogachevskii, I., Esau, I., Mauritsen, T., and Miles, M., 2008: Turbulence energetics in stably stratified geophysical flows: strong and weak mixing regimes, *Quarterly J. Royal Meteorol. Soc.*,**134**, 793-799, doi: 101002/qj.264

Byrkjedal, Ø., Esau, I., and Kvamstø, N.-G., 2008: Sensitivity of simulated wintertime Arctic atmosphere to resolution in the ARPEGE/IFS model, *Climate Dynamics*, **30**(1-2), 687-701

Esau, I., 2007: Amplification of turbulent exchange over wide Arctic leads: Large-eddy simulation study, *Journal of Geophysical Research*, **112**(D), D08109, doi:10.1029/2006JD007225

Esau, I., and Grachev, A., 2007: Turbulent Prandtl Number in Stably Stratified Atmospheric Boundary Layer: Intercomparison between LES and SHEBA Data, *e-WINDENG journal*

Mauritsen, T., Svensson, G., Zilitinkevich, S. S., Esau, I., Enger, L., and Grisogono, B., 2007: A total turbulent energy closure model for neutral and stably stratified atmospheric boundary layers, *J. Atmos. Sci.*, **64**(11), 4117-4130

2013-2015: Norwegian Research Council bilateral collaboration with International Arctic Research Centre, Fairbanks, Alaska, USA, 227137: BjerknesARC - Bjerknes Compensation Mechanism: Historical perspective, geographical pattern, and Arctic multi-decadal predictability

Relevant popular science publications

[1] Uneven climate change due to atmospheric heat capacity, 2012 http://environmentalresearchweb.org/cws/article/news/51788
[2] Esau, I., Bergh, J., Davy, R., Outten, S., Xu, Y., 2012: Micro-climate on Mega-computers, *META*, 1,13-17
[3] Esau, I., 2011. Klimaendringer utfordrer ingeniørene, *Klima*, 4, 30-31 [4] Esau, I., 2011. Dårlig luft i Bergen. Forskning.no (Kronikk)
[5] Esau, I., 2011. Vi kan skaffe mer kunnskap om giftlokket. Bergens Tidende
[6] Baklanov A., et al., 2010: MEGAPOLI: concept of multi-scale modelling of megacity impact on air quality and climate, Adv. Sci. Res., 4, 115-120, doi:10.5194/asr-4-115-2010
[7] Esau, I., 2007: Methods and Measurement Tools in PBL: On combination of artificial neural network and hydro-dynamic turbulence-resolving modelling for turbulent flows in urban environment, ENEA special report issue on "ATMOSFERA"

- **Dr. Shubha Sathyendranath (PML)**

She is the science lead on the ESA ocean colour CCI intiative. She has worked on marine optics and remote sensing of ocean colour for over three decades. Work relevant to biogeochemical cycles include marine primary production, new production, estimation of particulate and phytoplankton carbon from satellite data, detection of phytoplankton functional types and size structure from optical data, both satellite and in situ. She has also worked on extending ocean-colour algorithms to optically-complex coastal waters, and chaired an International Ocean-Colour Coordinating Group (IOCCG) Working Group on ocean-colour algorithms in coastal waters, which led to a definitive report on the subject, and is now an active member of the CoastColour Project of the European Space Agency.

Scholarships & Awards

1. Gold Medal, First Rank, Oceanography Dept., Cochin University (1974)
2. French Government Scholarship for Higher Studies (1977-1981)

3. International Scientific Exchange Award of NSERC (Canada) (1987-1988)
4. The Eurosense Prize of the Remote Sensing Society (1990)
5. Editor's citation for excellence in reviewing, *Journal of Geophysical Research* (1995)
6. Benjamin Meaker Visiting Professorship, University of Bristol, UK (2005)
7. Panikkar Memorial Lecture and Medal, UNESCO/IOC (2013)
8. La Grande Médaille, Albert Premier (2013)

Recent Publications

Budge, SM, Devred, E, Forget, M-H, Stuart, S, Trzcinski, K, Sathyendranath, S, Platt, T (2013) Estimating concentrations of essential omega-3 fatty acids in the ocean: Supply and demand. *ICES J. Mar. Sci.* (submitted).

Brewin, RJW, Sathyendranath, S, Lange, PK, Tilstone, G (2013) Comparison of two methods to derive the size-structure of natural populations of phytoplankton. *Deep-Sea Res. I.* In press.

Brewin, RJW, Sathyendranath, S, Müller, D, Brockmann, C, Deschamps, P-Y, Devred, E, Doerffer, R, Fomferra, N, Franz, B, Grant, M, Groom, S, Horseman, A, Hu, C, Krasemann, H, Lee, ZP, Maritorena, S, Mélin, F, Peters, M, Platt, T, Regner, P, Smyth, T, Steinmetz, F, Swinton, J Werdell, J, White, GN, III (2013) The Ocean Colour Climate Change Initiative: III. A round-robin comparison on in-water bio-optical algorithms. *Remote Sens. Env*. http://dx.doi.org/10.1016/j.rse.2013.09.016

Brotas, V, Brewin, RJW, Sá, C, Brito, A, Silva, A, Mendes, CR, Diniz, T, Kaufman, M, Tarran, G, Groom, G, Platt, T, Sathyendranath, S (2013). Deriving phytoplankton size classes from satellite data: validation along a trophic gradient in the Eastern Atlantic Ocean. *Remote Sens. Env*. http://dx.doi.org/10.1016/j.rse.2013.02.013

Hollmann, R, Merchant, CJ, Saunders, R, C. Downy, Buchwitz, CM, Cazenave, A, Chuvieco, Defourny, EP, de Leeuw, Forsberg, GR, T. Holzer-Popp, T, Paul, F,Sandven, S, Sathyendranath, S, M. van Roozendael, M, Wagner, W (2013) The ESA Climate Change Initiative: satellite data records for essential climate variables. *Bull. Am. Met. Soc*. doi: 10.1175/BAMS-D-11-00254.1

Martinez-Vicente, V, Dall'Olmo, G, Tarran, G, Boss, E, Sathyendranath, S (2013) Optical backscattering is correlated with phytoplankton carbon across the oligotrophic Atlantic Ocean. Geophys. Res. Lett. 40, doi:10.1002/grl.50252.

Roy, S, Sathyendranath, S, Bouman, H, Platt, T (2013) Modelling global distribution of phytoplankton cell diameter and size spectrum from light-absorption spectra. *Remote Sens. Env*. 139:185-197.

Saux-Picart, S, Sathyendranath, S, Dowell, M, Moore, T, Platt, T (2013) Remote sensing of assimilation number for marine phytoplankton. *Remote Sens. Env.* In press.

Tett, P, Gowen, RJ, Painting, SJ, Elliott, M, Forster, R, Mills, DK, Bresnan, E,Capuzzo, E, Fernandes, TF, Foden, J, Geider, RJ, Gilpin, LC, Huxham, M,McQuatters-Gollop, AL, Malcolm, SJ, Saux-Picart, S, Platt, T, Racault, M-F, Sathyendranath, S, van der Molen, J, Wilkinson, M (2013)Framework for understanding marine ecosystem health. *Mar. Ecol. Prog. Ser*. 494: 1-27.

Trzcinski, MK, Devred, E, Platt, T, Sathyendranath, S (2013) Variation in ocean colour may help predict cod and haddock recruitment. *Mar. Ecol. Prog. Ser.* 491: 187-197.

Zhai, L, Platt, T, Tang, C, Sathyendranath, S, Walne, A (2013) The response of phytoplankton to climate variability associated with the North Atlantic Oscillation. *Deep-Sea Res. II*. 93: 159-168.

Brewin, RJW, Hirata, T, Hardman-Mountford, NJ, Lavender, SJ, Sathyendranath, S, Barlow, R (2012) The influence of the Indian Ocean dipole on interannual variations in phytoplankton size structure as revealed by Earth observations. *Deep Sea Res*. 77–80: 117–127.

Brewin, RJW, Dall'Olmo, G, Sathyendranath, S, Hardman-Mountford, NJ (2012) Particle backscattering as a function of chlorophyll and phytoplankton size structure in the open-ocean. *Optics Express*. 20 (16): 17632–652.

Martinez-Vicente, V, Tilstone, GH, Sathyendranath, S, Miller, PI, Groom, SB (2012) Contributions of phytoplankton and bacteria to the optical backscattering coefficient over the Mid-Atlantic Ridge. *Mar. Ecol. Prog. Ser*. 445: 37–51, doi: 10.3354/meps09388

Racault, M-F, Le Quéré, C, Buitenhuis, E, Sathyendranath, S, Platt, T (2012) Phytoplankton phenology in the global ocean. *Ecological Indicators*, 14: 152–163. doi:10.1016/j.ecolind.2011.07.010

Roy, S, Broomhead, DS, Platt, T, Sathyendranath, S, Ciavatta, S (2012) Sequential variations of phytoplankton growth and mortality in an NPZ model: A remote-sensing-based assessment. *J. Mar. Sys.* 92: 16–29.

Zhai, Li, Gudmundsson, K, Miller, P, Peng, W, Guđfinnsson, Debes, H, Hátún, H, White, GN, Walls, RH, Sathyendranath, S, Platt, T (2012) Phytoplankton phenology and production around Iceland and Faroes. *Cont. Shelf Res.* 37: 15-25. doi:10.1016/j.csr.2012.01.013

Brewin, RJW, Devred, E, Sathyendranath, S, Hardman-Mountford, NJ, Lavender, SJ (2011) A model of phytoplankton absorption based on three size classes. *Appl. Optics*, 50: 4535-4549.

Bouman, HA, Ulloa,O, Barlow, R, Li, WKW, Platt, T, Zwirglmaier, K, Scanlan, DJ Sathyendranath, S (2011) Water-column stratification governs the community structure of subtropical marine picophytoplankton. *Environmental Microbiology Reports*. doi:10.1111/j.1758-2229.2011.00241.x

Devred, E, Sathyendranath, S, Stuart, V, Platt, T (2011) A three component classification of phytoplankton absorption spectra: Application to ocean-color data. *Remote Sens. Environ.* 115: 2255-2266. doi:10.1016/j.rse.2011.04.025

Forget, M-H, Platt, T, Sathyendranath, S, Fanning, P (2011) Phytoplankton size structure, distribution and primary production as the basis for trophic analysis of Caribbean ecosystems. *ICES J. Mar. Sci.* 68: 751-765 doi:10.1093/icesjms/fsq182.

Jackson, T, Bouman, HA, Sathyendranath, S, Devred, E (2011) Regional-scale change in diatom distribution in the Humboldt Current as revealed by remote sensing: implications for fisheries. *ICES J. Mar. Sci.* 68: 729-736 doi:10.1093/icesjms/fsq18

Ouellet, P, Fuentes-Yaco, C, Savard, L, Platt, T, Sathyendranath, S, Koeller, P,Orr, D, Siegstad, H (2011) Surface ocean characteristics influence recruitment variability in population of northern Shrimp, *Pandalus borealis* Krøyer in the Northwest Atlantic. *ICES J. Mar. Sci.* 68: 737-744 doi:10.1093/icesjms/fsq174.

- **Prof. Trevor Platt (PML)**

Research interests

Ocean colour modelling, spectral characteristics of light penetration underwater, bio-optical properties of phytoplankton, modelling primary production, bio-geochemical cycles in the sea, climate change, biological-physical interactions in the marine system, ecological provinces in the sea, ecological indicators, phytoplankton functional types.

Current projects

Dynamical assignment of boundaries of ecological provinces by remote sensing; discrimination of phytoplankton functional types from ocean colour; variability in carbon-to-chlorophyll ratio of phytoplankton at sea; ecological indicators from space; bio-optical traits of phytoplankton functional types in the sea.

Recent publications

Platt, T., White Iii, G.N., Zhai, L., Sathyendranath, S. & Roy, S. (2009) The phenology of phytoplankton blooms: Ecosystem indicators from remote sensing. Ecological Modelling, 220(21), 3057-3069.

Barlow, R., Stuart, V., Lutz, V., Sessions, H., Sathyendranath, S., Platt, T., Kyewalyanga, M., Clementson, L., Fukasawa, M., Watanabe, S. & Devre, E. (2007) Seasonal pigment patterns of surface phytoplankton in the subtropical southern hemisphere. Deep-Sea Research Part I-Oceanographic Research Papers, 54(10), 1687-1703.

Devred, E., Sathyendranath, S. & Platt, T. (2007) Delineation of ecological provinces using ocean colour radiometry. Marine Ecology-Progress Series, 346, 1-13.

Devred, E., Sathyendranath, S. & Platt, T. (2007) Relationship between the Q factor and inherent optical properties: Relevance to ocean-colour inversion algorithms. *Geophysical Research Letters*, 34(18).

Forget, M.H., Sathyendranath, S., Platt, T., Pommier, J., Vis, C., Kyewalyanga, M.S. & Hudon, C. (2007) Extraction of photosynthesis-irradiance parameters from phytoplankton production data: demonstration in various aquatic systems. Journal of Plankton Research, 29(3), 249-262.

Platt, T., Sathyendranath, S. & Fuentes-Yaco, C. (2007) Biological oceanography and fisheries management: perspective after 10 years. Ices Journal of Marine Science, 64(5), 863-869.

Sathyendranath, S. & Platt, T. (2007) Spectral effects in bio-optical control on the ocean system. Oceanologia, 49(1), 5-39.

Son, S., Platt, T., Fuentes-Yaco, C., Bouman, H., Devred, E., Wu, Y.S. & Sathyendranath, S. (2007) Possible biogeochemical response to the passage of Hurricane Fabian observed by satellites. Journal of Plankton Research, 29(8), 687-697.

Wu, Y., Tang, C.C.L., Sathyendranath, S. & Platt, T. (2007) The impact of bio-optical heating on the properties of the upper ocean: A sensitivity study using a 3-D circulation model for the Labrador Sea. Deep-Sea Research Part II-Topical Studies in Oceanography, 54(23-26), 2630-2642.

Wu, Y.S., Peterson, I.K., Tang, C.C.L., Platt, T., Sathyendranath, S. & Fuentes-Yaco, C. (2007) The impact of sea ice on the initiation of the spring bloom on the Newfoundland and Labrador Shelves. Journal of Plankton Research, 29(6), 509-514.

Fuentes-Yaco, C., P.A. Koeller, S. Sathyendranath, and T. Platt (2006) Shrimp (Pandalus borealis) growth and timing of the spring phytoplankton bloom on the Newfoundland-Labrador Shelf, Fisheries Oceanography, doi: 10.1111/j.1365-2419.2006.00402.

Platt, T., H. Bouman, E. Devred, C. Fuentes-Yaco, and S. Sathyendranath (2005) - Physical Forcing and Phytoplankton Distributions, Scientia Marina. Vol 69 (Suppl. 1): 55-73.

Fuentes-Yaco, C., E. Devred, S. Sathyendranath, T. Platt, L. Payzant, C. Caverhill, C. Porter, H. Maass, and J.G. White III (2005) - Comparison of in situ and remotely-sensed (SeaWiFS) chlorophyll-a in the Northwest Atlantic, Indian Journal of Marine Sciences, Vol 34(4), 341-355. (special issue on ocean colour, edited by Trevor Platt and Shailesh Nayak)

- **Dr. Stephane Saux-Picart (PML)**

Research interests

Primary production algorithm from remote sensing data, climate versus anthropogenic impact on the marine ecosystem, influence of land use on coastal waters, ecological indicators for eutrophication, model vs satellite comparison, time series analysis, signal processing.

Current projects

NERC NC Ecosystem Modelling, EU FP6 ECOOP, NCOF, Ocean Colour CCI-ESA

Recent publications

Saux Picart S., Allen J. I., Butenschön M., Artioli Y., de Mora L., Wakelin S., and Holt J.: What can ecosystem models tell us about the risk of eutrophication in the North Sea? Submitted to Climatic Change, January 2013.

Saux Picart S., Sathyendranath S., Dowell M., Moore T., and Platt T.: Remote sensing of assimilation number for marine phytoplankton. Submitted to Remote Sensing of Environment, November 2012.

Saux Picart, S., Butenschön, M., and Shutler, J. D.: Wavelet-based spatial comparison technique for analysing and evaluating two-dimensional geophysical model fields (2012), Geosci. Model Dev., 4, 223-230, doi: 10.5194/gmd-5-223-2012

Hirata T., **Saux Picart S.**, Hashioka T., Aita-Noguchi M., Sumata H., Shigemitsu M., Allen J. I., Yamanaka Y.: A comparison between phytoplankton community structures derived from a global 3D ecosystem model and satellite observation (2012), Journal of Marine Systems, Available online 31 January 2012, ISSN 0924-7963, doi: 10.1016/j.jmarsys.2012.01.009

Ciavatta S., Torres R., **Saux Picart S.**, Allen J. I.: Can ocean color assimilation improve biogeochemical hindcasts in shelf seas? (2011), Journal of Geophysical Research, Vol. 116, C12043, 19 PP., doi: 10.1029/2011JC007219

Shutler J. D., Smyth T. J., **Saux Picart S.**, Wakelin S. L., Hyder P., Orekhov P., Grant M. G., Tilstone G. H., and Allen J. I. (2011), Evaluating the ability of a hydrodynamic ecosystem model to capture inter- and intra-annual spatial characteristics of chlorophyll-a in the north east Atlantic, Journal of Marine Systems, doi: 10.1016/j.jmarsys.2011.03.013

Verhoef A., Ottlé C., Cappelaere B., Murray T., **Saux Picart S.**, Zribi M., Maignan F., Boulain N., Demarty J., Ramier D.: Spatio-temporal surface soil heat flux estimates from satellite data; results for the AMMA experiment at the Fakara (Niger) supersite (2012), Agricultural and Forest Meteorology, Volumes 154-155, 15 March 2012, Pages 55-66, ISSN 0168-1923, doi: 10.1016/j.agrformet.2011.08.003

Reul, N., **S. Saux Picart**, B. Chapron, D. Vandemark, J. Tournadre, and J. Salisbury (2009), Demonstration of ocean surface salinity microwave measurements from space using AMSR-E data over the Amazon plume, /Geophys. Res. Lett./, 36, L13607, doi:10.1029/2009GL038860

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- **Dr. Karina von Schuckmann (MIO)**

Her interests lie on the role of the ocean in climate change, in particular its role within the climate energy budgets and the sea level budget at global scale and for the Mediterranean Sea by using in situ measurements and remote sensing data. She has in particular strong expertise on the estimation of OHF from the Argo array. She is contributing author of the upcoming IPPC report, scientific coordinator of the new WCRP-CLIVAR research opportunity (http://www.clivar.org/science/clivar-research-opportunities#six), leader of the ISSI work group on energy budget constraints, and contributes to the scientific coordination of the European FP7 program E-AIMS. In addition, she participates on 3 national programs (Ocean indicators, SOERE-CTDO2 and SiMED) and has coordinated the agreed quality control procedures of global and regional in situ data within the European marine core system of Copernicus/MyOcean (also endorsed by SeaDataNet and IOC).

Selected publications:

von Schuckmann, K., J.-B. Sallée, D. Chambers, P.-Y. Le Traon, C. Cabanes, F. Gaillard, S. Speich, M. Hamon, 2014: Monitoring ocean heat content from the current generation of global ocean observing systems, Ocean Science, accepted

Abraham, J.P., M. Baringer, N.L. Bindoff, T. Boyer, L.J. Cheng, J.A. Church, J.L. Conroy, C.M. Domingues, J.T. Fasullo, J. Gilson, G. Goni, S.A. Good, J. M. Gorman, V. Gouretski, M. Ishii, G.C. Johnson, S. Kizu, J.M. Lyman, A. M. Macdonald, W.J. Minkowycz, S.E. Moffitt, M. Palmer, A. Piola, F. Reseghetti, K.E. Trenberth, I. Velicogna, K. **von Schuckmann**, S.E. Wijffels, J.K. Willis, 2013: Monitoring systems of global ocean heat content and the implications for climate change, a review, Rev. Geophys., 51, 450–483, doi:10.1002/rog.20022.

von Schuckmann, K. and P.-Y. Le Traon, 2011: How well can we derive global ocean indices from Argo data?, Ocean Science, 7, 783–791, www.ocean-sci.net/7/783/20.

von Schuckmann, K., F. Gaillard and P.-Y. Le Traon, 2009: Global hydrographic variability patterns during 2003-2008. Journal of Geophysical Research, 114, doi:10.1029/2008JC005237.

- **Dr. Carol Anne Clayson (WHOI, Senior Scientist)**

She received the Ph.D. in Aerospace Engineering Sciences and the Program in Atmospheric and Oceanic Sciences from the University of Colorado, Boulder in 1995. Her research covers the areas of high-resolution air-sea interaction, satellite remote sensing, and ocean modeling, and she has received funding for her research from NASA, NOAA, the Office of Naval Research, and NSF. She is the recipient of an NSF CAREER award and the Office of Naval Research Young Investigator Award. She received a Presidential Early Career Award for Scientists and Engineers from President W. Clinton. Dr. Clayson is the author or co-author of over 40 journal articles, 2 books, 2 book chapters, and 3 National Research Council reports, has served on several committees for the American Meteorological Society and the National Research Council, and is currently a member of the AMS Committee on Coastal Environments and the . She is also serving as the chair of the GEWEX SeaFlux project, an international group of scientists working on improved estimations of air-sea turbulent heat fluxes from satellite, under the auspices of the GEWEX Data and Assessments Panel.

Dr. Clayson has had a long-term involvement in the improvement of techniques for determining air-sea fluxes, including development of flux parameterizations and methods for estimating fluxes from satellite observations. Her current work on flux parameterization incorporates recent observational enhancements of the skin layer of the ocean and sea spray parameterizations. Another area of her research has focused on diurnal warming of the sea surface temperature, in its effects on both upper ocean heat development and air-sea fluxes. Dr. Clayson has also contributed to a number of improvements in upper ocean modeling and understanding of turbulent mixing, including issues related with the improvement of second moment closure models, the inclusion of wave breaking and Langmuir circulation into these one dimensional models, and the effects of internal waves on upper ocean energy budgets. Through her involvement with GEWEX and the NASA NEWS program she have been collaborating with both atmospheric and land-surface researchers to resolve issues regarding the global energy and water cycles.

<u>10 recent relevant publications:</u>

Bogdanoff, A. S., D. L. Westphal, J. R. Campbell, J. A. Cummings, E. J. Hyer, J. S. Reid, and C. A. Clayson, 2014: Impact of airborne dust on sea surface temperature retrievals, Rem. Sens. Environment, in revision.

Clayson, C. A., J. B. Roberts, and A. Bogdanoff, 2014: SeaFlux Version 1: a new satellite-based ocean-atmosphere turbulent flux dataset. Int. J. Climatol., revised.

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Bourassa, M., S. Gille, S. Bitz, D. Carlson, I. Cerovecki, C. A. Clayson, M. Cronin, W. Drennan, C. Fairall, R. Hoffman, , R. Hoffman, G. Magnusdottir, R. Pinker, I. Renfrew, M. Serreze, K. Speer, L. Talley, and G. Wick, 2013: High-Latitude Ocean and Sea Ice Surface Fluxes: Challenges for Climate Research. Bull. Amer. Meteorol. Soc., 94, 402-423.

Stephens, G., J. Li, M. Wild, C. A. Clayson, N. Loeb, S. Kato, T. L'Ecuyer, P. Stackhouse Jr., M. Lebsock, and T. Andrews, 2012: An update on the Earth's energy balance in light of new surface energy flux estimates. Nature Geosciences, 5, 691-696, doi:10.1038/ngeo1580.

Liu, J., J. A. Curry, C. A. Clayson, and M. A. Bourassa, 2011. High-resolution satellite surface latent heat fluxes in North Atlantic hurricanes. Monthly Weather Review, 139, 9, 2735-2747.

Roberts, J. B., C. A. Clayson, F. R. Robertson, and D. Jackson, 2010. Predicting near-surface characteristics from SSM/I using neural networks with a first guess approach. J. Geophys. Res., 115, D19113, doi: 10.1029/200d9JD013099.

Romanou, A., G. Tselioudis, C. S. Zerefos, C. A. Clayson, J. A. Curry, and A. Andersson, 2010. Evaporation-precipitation variability over the Mediterranean and the Black Seas from satellite and reanalysis estimates. J. Climate, 23, 5268-5287.

Clayson, C. A. and D. Weitlich, 2007. Variability of tropical diurnal sea surface temperature. J. Climate, 20, 334-352.

Clayson, C. A., and J. A. Curry, 1996. Determination of surface turbulent fluxes for TOGA COARE: Comparison of satellite retrievals and in situ measurements. J. Geophys. Res., 101, 28,515-28,528.

- **Dr Semyon A. Grodsky (DMUM)**

Education:

1986: PhD (Phys-Math) " Internal Wave Observations with Applications to Remote Sensing", Marine Hydrophysical Institute (MHI), Sevastopol, USSR

1981: MS (Phys) "High power mode-locked CW Neodymium-doped Garnet laser with intracavity frequency doubling", Moscow Institute of Physics and Technology (MIPT), Moscow, USSR

Experience:

2001-pres: Assistant Research Scientist, Atmospheric and Oceanic Science, UMD
1999-2001: Visiting scientist, Atmospheric and Oceanic Science, UMD
1988-1999: Senior Research Scientist, Remote Sensing Department, MHI
1984-1988: Research Scientist, Department of Ocean Dynamics, MHI

Area of expertise:

- Ocean data analysis
- Data assimilation
- Ocean remote sensing

Recent Publications (2012-2014)

Bentamy, A., S. A. Grodsky, J. A. Carton, D. Croizé-Fillon, and B. Chapron (2012), Matching ASCAT and QuikSCAT winds, *J. Geophys. Res.*, **117**, C02011, http://dx.doi.org/10.1029/2011JC007479 .

Grodsky, S. A., J. A. Carton, S. Nigam, and Y. M Okumura, 2012: Tropical Atlantic Biases in CCSM4, *J. Clim.*, **25**, 3684-3701, doi: http://dx.doi.org/10.1175/JCLI-D-11-00315.1

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Grodsky, S.A., J. A. Carton, and F.O. Bryan (2014), A curious local surface salinity maximum in the northwestern tropical Atlantic, *J. Geophys. Res.*, **119**, doi: 10.1002/2013JC009450, http://dx.doi.org/10.1002/2013JC009450

- **Professor R. T. Pinker (DMUM)**

Rachel T. Pinker is a Professor in the Department of Atmospheric and Oceanic Science, at the University of Maryland, College Park since 1995. Her research interests are remote sensing, surface-atmosphere interactions, and climate applications. Research activity is focused on the development of methods to derive radiation budgets by methods of remote sensing. Professor Pinker has published over 140 refereed papers in scientific journals, contributed articles to encyclopedias, presented numerous papers at conferences and invited workshops. Google

Scholar lists 6748 Citations, h-index of 35 and i10-index of 93.

Professor Pinker maintains extensive collaboration with major scientific institutions in the U.S. and abroad. Results from her work in addition to advancing Land Data Assimilation methods, have also led to improvements in hydrological modeling at various scales (basin to global), improving estimation of Net Primary Productivity, understanding long term trends in solar radiation, evaluating the impact of aerosols radiative fluxes, and improving estimation of heat fluxes over the Atlantic Ocean. Her research activity was supported over the years by grants by such major agencies as NOAA, NASA, NOAA/NESDIS, NOAA/Office of Global Programs, USDA, NSF, CICS, NASDA, EOS/IDS, NOAA/NASA, UMCP, NSF, and DST-NSF Science and Technology Cooperation Program. She has hosted numerous visitors to the Department for various length of stay from months to 2-3 years and directed M.Sc. and Ph. D. theses of over 25 students.

Selected Publications

Wonsick, M. M., R.T. Pinker and Yves Govaerts, 2009. Cloud Variability over the Indian Monsoon Region as Observed from Satellites. *JAMC*, 48 (9), 1803-1821.

Wang, H; Pinker, R. T, 2009. Shortwave radiative fluxes from MODIS: Model development and implementation. *J. Geophys. Res-A.*, 114, D20201.

Pinker, R T; Wang, H., Grodsky, S. A., 2009. How good are ocean buoy observations of radiative fluxes? *GRL*, 36, L10811.

Nussbaumer, E. A. and R. T. Pinker, 2012. Estimating Surface Longwave Radiative Fluxes from Satellites utilizing Artificial Neural Networks. *J. Geophys. Res.-A.*, 117, Article Number: D07209 DOI: 10.1029/2011JD017141.

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Randles, C. A., S. Kinne, G. Myhre, M. Schulz, P. Stier, J. Fischer, L. Doppler, E. Highwood, C. Ryder, B. Harris, J. Huttunen, Y. Ma, R. T. Pinker, B. Mayer, D. Neubauer, R. Hitzenberger, L. Oreopoulos, D. Lee, G. Pitari, G. Di Genova, J. Quaas, Fred G. Rose, S. Kato, S. T. Rumbold, I. Vardavas, N. Hatzianastassiou, C. Matsoukas, H. Yu, F. Zhang, H. Zhang, and P. Lu, 2012. Intercomparison of shortwave radiative transfer schemes in global aerosol modeling: Results from the AeroCom Radiative Transfer Experiment *Atmos. Chem. Phys.*, Discuss., 12, 1–74, www.atmos-chem-phys-discuss.net/12/1/2012/

- **Dr Sergey Gulev (IORAS)**

He is the Head of Sea-Air Interaction and Climate Lab (SAIL) at IORAS and professor of oceanography and meteorology at Moscow state University. He has a broad experience in the development of surface flux fields (both turbulent and radiative fluxes) from Voluntary Observing Ship data. He also developed global fields of wind waves and wind wave associated stress over global ocean. Considerable effort was invested in the development of global estimates of sampling biases in surface flux fields and validation of reanalyses and satellite products. He is also an expert in the analysis of mesoscale and synoptic variability of surface fluxes using in-situ, remotely sensed and NWP flux estimates. Secondary fields of expertise are synoptic atmospheric dynamics, climate diagnostics and ocean modelling. He was co-chair of WCRP Working Group on Surface Fluxes, member and offices of the Joint Scientific committee for WCRP, currently he is a member of CLIVAR Scientific Steering Group. He is a Lead Author for IPCC 4th and 5th Assessment Reports (chapters on ocean observations, including surface fluxes).

Gulev, S.K., V.Grigorieva, A.Sterl, and D. Woolf, 2003: Assessment fo the reliability of wave observations from voluntary observing ships: insights from the validation of a global wind wave climatology based on voluntary observing ship data. *J. Geophys. Res. – Oceans*, 108(C7), 3236, doi:10,1029/2002JC001437.

Gulev S. K., B. Barnier, Knochel H., J.-M. Molines, and M. Cottet, 2003: Water mass transformation in the North Atlantic and its impact on the meridional circulation: insights from on ocean model forced by NCEP/NCAR reanalysis surface fluxes. *J. Climate*, 16, 3085-3110.

Gulev, S.K. and V. Grigorieva, 2004: Last century changes in ocean wind wave height from global visual wave data. *Geophys. Res. Lett*., 31, L24302, doi:10.1029/2004GL021040.

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Gulev S.K., S. A. Josey, M. Bourassa, L.-A. Breivik, M. F. Cronin, C. Fairall, S. Gille, E. C. Kent, C. M. Lee, M. J. McPhaden, P. M. S. Monteiro, U. Schuster, S. R. Smith, K.E. Trenberth, D. Wallace, S.D. Woodruff, 2010: Surface energy and CO2 fluxes and sea ice for ocean monitoring and prediction. *ESA special volume* on OceanObs'09. Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society, Venice, Italy, 21-25 September 2009, ESA Publication WPP-306. doi:10.5270/OceanObs09

Rudeva, I.A., and S.K.Gulev, 2011: Composite analysis of the North Atlantic extratropical cyclones in NCEP/NCAR reanalysis. *Mon. Wea. Rev*., 139, 1419-1436.

Gulev, S.K., and K.P. Belyaev, 2012: Probability distribution characteristics for surface air-sea turbulent heat fluxes over the global ocean. *J. Climate*, 25, 184-206, doi: 10.1175/2011JCLI4211.1

Kravtsov, S., and S. K. Gulev, 2013: Kinematics of eddy–mean flow interaction in an idealized atmospheric model. *J. Atmosph. Sci.*, 70, 2574-2595, DOI: 10.1175/JAS-D-12-0309.1

Gulev, S.K., M. Latif, N. Keenlyside, W. Park, K.P. Koltermann, 2013: North Atlantic Ocean control on surface heat flux on multidecadal timescales. *Nature*, 499, 464–467, doi:10.1038/nature12268

Josey, S.A., S.K.Gulev and L.Yu, 2013: Exchanges through the ocean surface. In: "*Ocean Circulation and Climate. A 21st century perspective*" (second edition). Ed. G. Siedler, S. Griffies, J. Gould, J. Church, Academic Press, 115-140. (International Geophysics, 103).

- **Dr. Axel Andersson (EUMETSAT)**

He is project scientist at the EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF) based at Deutscher Wetterdienst, Germany (www.cmsaf.eu) where he is involved with the development, processing and evaluation of the Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data (HOAPS) climatology.

He received his PhD from the University of Hamburg in 2009. His doctoral dissertation was dedicated to the improvement, reprocessing and validation of the Hamburg Ocean Atmosphere Parameters and fluxes from Satellite data (HOAPS) satellite climatology. From 2010 to 2012 he was with the Max Planck Institute for Meteorology (MPI-M), Hamburg, where he worked on climate model evaluation with a focus on using satellite data sets. Since 2013 he is with the DWD and working on the further development, evaluation and climatological analysis of global ocean surface freshwater flux product of the HOAPS data set. His work includes the retrieval of the relevant parameters for ocean surface fluxes as well as other water cycle parameters such as precipitation and water vapor from passive microwave satellite data using a full processing chain from L0/1 satellite raw data to L2 and L3 products.

He is involved in several collaborations dealing with the validation and error characterization of surface flux and precipitation satellite retrievals using in-situ data and climate model evaluation studies.

Furthermore, he is actively participating in meetings of the International Precipitation Working Group (IPWG) and the Seaflux working group.

Publications:

Fennig, K., Andersson, A., Schröder, M.: Fundamental Climate Data Record of SSM/I Brightness Temperatures. Satellite Application Facility on Climate Monitoring. doi:10.5676/EUM_SAF_CM/FCDR_SSMI/V001, 2013

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Fennig, K., Andersson, A., S. Bakan, C. Klepp, M. Schröder: Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data - HOAPS 3.2 - Monthly Means / 6-Hourly Composites. Satellite Application Facility on Climate Monitoring. doi:10.5676/EUM_SAF_CM/HOAPS/V001. electronic publication, 2012

Andersson, A., C. Klepp, K. Fennig, S. Bakan, H. Graßl, and J. Schulz: Evaluation of HOAPS-3 ocean surface freshwater flux components, Journal of Applied Meteorology and Climatology, 50, 379-398, 2011

Andersson, A., K. Fennig, C. Klepp, S. Bakan, H. Graßl, and J. Schulz: The Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data - HOAPS-3, Earth Syst. Sci. Data, 2, 215-234, 2010

Romanou, A., G. Tselioudis, C. S. Zerefos, C.-A. Clayson, J. A. Curry and A. Andersson: Evaporation - Precipitation variability over the Mediterranean and the Black Seas from satellite and reanalysis estimates, Journal of Climate, 23, 5268-5287, 2010

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Romanova, V., A. Köhl, D. Stammer, C. Klepp, A. Andersson, and S. Bakan: Sea surface freshwater flux estimates from GECCO, HOAPS and NCEP, Tellus A, 62(4), 435-452, 2010

Winterfeldt, J., A. Andersson, C. P. Klepp, S. Bakan, and R. Weisse: Comparison of HOAPS, QuikSCAT and buoy wind speed in the eastern North Atlantic and the North Sea, IEEE Trans. Geosci. Remote Sens, Volume 47, Issue 11, 2009

Andersson, A., S. Bakan, K. Fennig, H. Graßl, C. Klepp, and J. Schulz, Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data HOAPS-3 monthly mean, World Data Center for Climate, doi:10.1594/ WDCC/HOAPS3 MONTHLY, electronic publication, 2007

Andersson, A., S. Bakan, K. Fennig, H. Graßl, C. Klepp, and J. Schulz, Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data HOAPS-3 twice daily composite, World Data Center for Climate, doi: 10.1594/WDCC/HOAPS3 DAILY, electronic publication, 2007

Andersson, A., S. Bakan, K. Fennig, H. Graßl, C. Klepp, and J. Schulz, Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data HOAPS-3 5-days mean, World Data Center for Climate, doi:10.1594/WDCC/ HOAPS3 PENTAD, electronic publication, 2007

- **Prof. Keith Haines (University of Reading)**

University of Reading: The Department of Meteorology at Reading is the largest of its kind in Europe with 50 academic staff, 20 senior research staff and fellowship holders, around 90 postdocs and around 70 PhD students. In the 2008 Research Assessment Exercise, 75% of our research was graded as world leading or internationally excellent. Our weighted score places us third in the country in the "Earth Systems and Environmental Science" category, and makes us the highest-graded department focusing on the fundamental science of weather and climate. We received the highest rating of 5* in all previous Research Assessment Exercises. The Department hosts around 25 Met Office scientists, the Climate Division of the National Centre for Atmospheric Science (NCAS-Climate), as well as the directorate of NCAS Models and Data.

Prof. Keith Haines is the BMT (British Maritime Technology) Professor of Marine Informatics, Director of the Reading e-Science Centre and currently one of 4 Heads of the Reading Meteorology department. He has lead pioneering work in the field of ocean data assimilation, including contributions to data assimilation algorithms now used at several operational centres. He has also worked on coupled data assimilation and on novel methods for estimating ocean heat content and on air-sea fluxes form ocean reanalyses.

- Palmer, M., K. Haines, S. Tett and T. Ansell (2007) Isolating the signal of ocean global warming. Geophys. Res. Lett., 34, L23610, doi:10.1029/2007GL031712.
- Pimentel, S., K. Haines, and N. K. Nichols (2008), The assimilation of satellite-derived sea surface temperatures into a diurnal cycle model, J.Geophys. Res., 113, C09013, doi:10.1029/2007JC004608.
- Palmer, M., and K. Haines (2009) Estimating oceanic heat content change using isotherms. J. Climate, Vol. 22, No. 19, 4953–4969.
- Palmer, M.D., S.A. Good, K. Haines, N.A. Rayner, and P.A. Stott (2009) A new perspective on warming of the global oceans. GRL, doi:10.1029/2009GL039491

- **Dr. Maria Valdivieso (University of Reading)**

Dr Maria Valdivieso is a research fellow currently based in NCEO working on Ocean Reanalysis and model evaluations. She has worked extensively on ocean reanalysis and diagnostics of reanalysis products including the AMOC. She also has wide experience running reanalyses at ECMWF with special project resources. Maria can use all the data analysis tools that have been developed for the NEMO model, and is already contributing to AMOC intercomparison work for CLIVAR GSOP and in the context of ESF COST program on Reanalysis comparisons.

- Haines, K., Valdivieso, M., Zuo, H., and Stepanov, V. N.: Transports and budgets in a 1/4 ° global ocean reanalysis 1989–2010, Ocean Sci., 8, 333-344, doi:10.5194/os-8-333-2012, 2012.
- Haines K., Stepanov V. N., Valdivieso M. and Zuo H. (2013) Atlantic meridional heat transports in two ocean reanalyses evaluated against the RAPID array, Geophys. Res. Lett., 40, 343–348, doi:10.1029/2012GL054581
- Valdivieso, M., K. Haines, H. Zuo and D. Lea (2013), Freshwater and heat transports from global ocean syntheses, J. Geophys. Res. Oceans, 119, doi:10.1002/2013JC009357.
- Valdivieso, M. and Co-authors (2013) Heat fluxes from ocean and coupled reanalyses. Clivar Exchanges Issue 64, 28-31.

- **Prof. Chris Merchant (University of Reading)**

Personal Details

Role: Science Leader
Nationality: UK
Qualifications: 1999, PhD Climate Physics, UCL
1989, MA Physics, Oxford
Prof Merchant is an internationally recognized expert in the remote sensing of sea surface temperature for climate applications.

Relevant Experience

Merchant is or has been Principal Investigator for 12 major and numerous minor grants under national and international funding, whose total value at current costs exceeds €7M. Merchant has long-standing collaborations with centres of remote sensing expertise and marine climatology (Meteo-France, Met No, Leicester, Swansea, KCL, NOAA, Met Office, Rhode Island, Southampton, Hadley Centre, etc). His international standing in the field is evidenced by chairmanship of working groups for the international GHRSST science team, leadership of the EarthTemp Network, membership of the award-winning US Multi-sensor Improved SST (MISST) science team, chairmanship of and participation in EUMETSAT advisory panels, joint international authorship of many SST papers in leading journals and textbooks, and serving on ESAs Earth Science Advisory Committee. During CCI Phase 1 he has chaired the 6-monthly meetings of Science Leaders.

Career History

2013-present The University of Reading
Professor of Ocean and Earth Observation
Merchant is building a significant team in Reading, with three researchers in place already, including Embury who has transferred with Merchant from Edinburgh. He has created with the National Physical Laboratory a joint position in Earth Observation Metrology, which will be taken up from November 2013.

1999-2013 The University of Edinburgh
Reader in Earth Observation
Merchant built up a strong research team in thermal remote sensing, and undertook significant research in his own right. As Reader, he also taught climate science and remote sensing, and made managerial contributions within the University department.
Merchant became Science Leader of SST CCI Phase 1 while at Edinburgh, as well as PI of the EarthTemp Network and Chair of the Climate Data Records Technical Advisory Group of GHRSST.

1998-1999 University College London
Research Assistant in Climate Physics
Undertook research into linkage of SST patterns and Atlantic Ocean hurricane activity.

1994-1995 W. S. Atkins Consulting
Consultant on air pollution

1989-1993 National Grid
Research Engineer
Research for the electricity transmission sector into alleged health effects of electric and magnetic fields, and into energy system reliability. Project leader.

Professional Societies, Advisory Groups, Science Working Groups, etc.

- ATSR Science Advisory Group
- MET-Image Science Advisory Group
- Chair of Group for High Resolution SST working group on Diurnal Variability
- Chair of Group for High Resolution SST working group on Climate Data Records
- Group for High Resolution SST Science Team
- Multi-sensor Improved SST Science Team
- NASA Interim SST Science Team
- ESA Earth Observation Science Advisory Committee

Publications since 2008

Rainer, H., C. J. Merchant, R. Saunders, C. Downy, M. Buchwitz, A. Cazenave, E. Chuvieco, P. Defourny, G. de Leeuw, R. Forsberg, T. Holzer-Popp, F. Paul, S. Sandven, S., Sathyendranath, M. van Roozendael and W. Wagner (accepted Mar 2013),The ESA climate change initiative: satellite data records for essential climate variables, Bull. Am. Meteorol. Soc.

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Good, E. J., X. Kong, O. Embury and C.J. Merchant (2012), An Infrared Desert Dust Index for the Along-Track Scanning Radiometers, Rem. Sens. Env., pp 159 - 176. DOI: 10.1016/j.rse.2010.06.016.

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5. Science Leader and Project manager

The appointed Science Leader (SL) is **Dr Abderrahim Bentamy**. The Project Manager (PM) is **Jean François Piollé**.

The IFREMER TIE-OHF Project Manager's Terms of Reference are as follows:

Responsibility (SL and PM)

- Ensure that all contract requirements are fulfilled to the Agency's satisfaction, on time, with maximum efficiency.

Authority

- Allocate tasks to IFREMER and subcontractors staff (SL);
- Accept goods and services delivered by team members (SL);
- Assign staff and resources to activities performed by IFREMER and subcontractors (PM and SL);
- Negotiate Change Requests and Contract Changes with the Agency (SL)

Duties

Project Management and Control:

- Produce and maintain project plans (PM and SL);
- Monitor the progress, schedule and quality of the project (PM ans SL);
- Ensure that all scheduled reviews are held (PM);
- Approve project documentation (SL);
- Ensure that project staff are familiar with relevant project standards and that the work is carried out in accordance with these standards (SL);
- Monitor the progress and expenditure against the project plan, and take steps to keep within the cost and schedule targets (PM and SL).

Technical Management:

- Lead the technical work in accordance with the development planning (PM).

Contractual

- Ensure that contractual cover exists for the project, in the form of a signed contract or a suitable Authorization to Proceed, and understand the terms of the contract (SL and PM);
- Ensure that IFREMER and subcontractors fulfils their contractual obligations in a timely way (PM);

- Ensure that the customer is fully aware about his obligations, monitor that customer obligations are fulfilled according to plan, and in case of deviation, record the fact and raise a formal notification with the customer if appropriate (SL and PM);
- Changes to the contract deliverables may be authorized by the Project Manager in conjunction with ESA, provided that a) no formal Contract Change Notice is required and b) there is no increase in the cost to completion (SL);
- Monitor team's work to ensure that they fulfill their contractual obligations according to plan, and in case of any deviation, raise the appropriate notification (SL);
- Ensure that confidentiality of all proprietary information (belonging to the Agency or to IFREMER and subcontractors) is respected (SL and PM);
- Ensure that acceptance certificates are obtained from the customer (SL and PM);

Financial

- Submit invoices on payment milestone achievement, confirm that correct payments are received from the Agency, and approve payments to contractors (PM);
- Authorize Purchase Orders consistent with the project plan (SL and PM);
- Authorize expenses booked to the project, in accordance with the project plan (SL and PM).

Personnel Management

- Allocate tasks to staff within IFREMER and subcontractors and exercise first-line supervision over them (SL and PM);
- Secure the availability of IFREMER and subcontractors staff to work on the project and monitor their performance (SL and PM);
- Ensure that staff morale is maintained and that staff are motivated to work to the best of their abilities (SL and PM);
- Ensure that IFREMER and subcontractors staff have the necessary knowledge for their assigned project tasks (SL and PM);
- Help to develop the abilities of staff by increasing their skills and levels of responsibility and guiding them as necessary (SL and PM).

Reporting

- Produce progress reports for a) the Agency and b) IFREMER management. The Project Manager has access to IFREMER's management hierarchy in the event that conflicts need to be resolved at higher levels (PM).

6. Key personnel roles and responsibilities

The key personnel and their average allocation to the project are shown in the table below. The time percentage is provided for each task (T1 through T6). This has been calculated based on averages, using 1 year = 1600 hours as the basis.

Table :allocated time to the project

Name &Project Role	Summary of responsibilities	% time allocated to project	% time allocated per WP
Abderrahim Bentamy Expert Scientist	Project management and scientific and technical coordination , interface with ESA, communication with scientific community, demonstration on OHF data	42%	WP1: 15% WP2: 30% WP3: 30% WP4: 5% WP5: 10% WP6: 10%
Jean-Francois Piollé IFREMER Project Manager Techninal management	Portal development, web site feeding, communication with end users Baseline analysis and technical specification	25%	WP1: 30% WP2: 10% WP3: 10% WP5: 40% WP6: 10%
Frederic Paul IFREMER	Support for requirement baseline analysis and system design and API. Support for web site set up, support to existing software integration, implementation of cloud computing and data intensive processing Support to setting up the OHF demonstration	15%	WP2: 10% WP3: 10% WP4: 20% WP5: 60%
Bertrand Chapron IFREMER	Expert Scientist	10%	WP1: 10% WP2: 30% WP3: 10% WP5: 10% WP6: 40%
Nicolas Reul IFREMER	Expert Scientist	10%	WP2: 20% WP3: 30% WP4: 30% WP5: 10% WP6:10 %
Clément de Boyer Montégut IFREMER	Expert Scientist	20%	WP2:30 % WP3: 30% WP4: 30% WP6: 10%
Shubha Sathyendranath	Modelling light penetration in the ocean using ocean-colour data; study sensitivity of ocean heat budget and	8%	WP1: % WP2: % WP3: %

PML	air-sea heat fluxes to parameterization of light penetration underwater		WP4: 100% WP5: % WP6: %
T. Platt PML	Modelling light penetration in the ocean using ocean-colour data; study sensitivity of ocean heat budget and air-sea heat fluxes to parameterization of light penetration underwater	8%	WP1: % WP2: % WP3: % WP4: 100% WP5: % WP6: %
A. Nother PML	Junior scientist, programming	28%	WP1: % WP2: % WP3: % WP4: 100% WP5: % WP6: %
Johnny Johannessen NERSC	Contributor to data set generation, inter-comparison, and uncertainty characterization, portal development	10%	WP2: 15% WP3: 20% WP4: 20% WP5: 30% WP6: 15%
Rick Danielson NERSC	Contributor to data set generation, inter-comparison, and uncertainty characterization, portal development	10%	WP2: 15% WP3: 20% WP4: 20% WP5: 30% WP6: 15%
Igor Esau NERSC	Contributor to data set generation, inter-comparison, and uncertainty characterization, but specifically from the point of view of evaluating turbulent transfer between mixed layers (a contribution to the uncertainty in bulk transfers)	5%	WP2: 20% WP3: 30% WP4: 30% WP6: 20%
Karina Von Schuchmann, MIO	Workpackage management (WP2) and validation development and scientific requirement consolidation and communication with scientific community	40%	WP2: 50% WP3: 50%
Carol Anne Clayson WHOI			WP1: % WP2: % WP3: % WP4: % WP5: % WP6: %
Rachel Pinker DMUM			WP1: % WP2: %

			WP3: % WP4: % WP5: % WP6: %
Semyon Grodsky DMUM			WP1: % WP2: % WP3: % WP4: % WP5: % WP6: %
Keith Haines UR			WP1: % WP2: % WP3: % WP4: % WP5: % WP6: %
Chris Merchant UR		5%	WP1:10 % WP2: 40% WP3: 40% WP6: 10%
Sergey Gulev IORAS	Development of algorithms for validation of surface flux estimates, analysis of sampling uncertainties, provision of VOS-based fluxes, validation of satellite surface flux products against VOS and in-situ data. Computation of regionally averaged surface flux estimates and their comparison to OHF estimates.	20%	WP1: 15% WP2: 40% WP3: 25% WP4: 15% WP5: 5%

Below is the project directory for the main project partners and personnel.

Name	Role	Address	Contact details
Abderrahim Bentamy (IFREMER)	Science Leader	Institut Francais Recherche Pour L ´Exploitation de la Mer - IFREMER Technopole Brest-Iroise 29280 Plouzané France	Phone: +33 2 98 224412 Fax: +33 2 98 224533 Email: Abderrahim.bentamy@ifremer.fr
Jean-Francois Piollé (IFREMER)	Project Manager and responsible for system design	Institut Francais Recherche Pour L ´Exploitation de la Mer - IFREMER Technopole Brest-Iroise 29280 Plouzané France	Phone: +33 2 98 224691 Fax: +33 2 98 224533 Email: jfpiolle@ifremer.fr
Frederique Paul (IFREMER)	Engineer / software implementation	Institut Francais Recherche Pour L ´Exploitation de la Mer - IFREMER Technopole Brest-Iroise 29280 Plouzané France	Phone: +33 2 98 224691 Fax: +33 2 98 224533 Email: fpaul@ifremer.fr
Dr. Bertrand Chapron (IFREMER)	Project scientist	Institut Francais Recherche Pour L ´Exploitation de la Mer - IFREMER Technopole Brest-Iroise 29280 Plouzané France	Phone: +33 2 98224312 Fax: +33 2 98224533 Email: Bertrand.Chapron@ ifremer.fr
Rainer Hollmann DWD	Member of expert group, Science Co-ordinator CM SAF	Deutscher Wetterdienst Satellite Application Facility on Climate Monitoring Dept. Climate and Environment Frankfurter Str. 135 63067 Offenbach Germany	Phone.: ++49 (0) 69 8062 4923 Fax.: ++49 (0) 69 8062 2512 email: rainer.hollmann@dwd.de
Axel Andersson DWD	Member of expert group, Project scientist	Deutscher Wetterdienst Satellite Application Facility on Climate Monit-	Phone: +49 (0)69 8062 4203 email: axel.andersson@dwd.de

	CM SAF	oring Dept. Climate and Environment Frankfurter Str. 135 63067 Offenbach Germany	
Shubha Sathyendranath PML	Project scientist	Plymouth Marine Laboratory, Prospect Place, Plymouth, UK	Phone: +44 1752 633 164 Fax: +44 1752 633 101 Email: shubha@dal.ca
Trevor Platt		Plymouth Marine Laboratory Prospect Place The Hoe Plymouth PL1 3DH United Kingdom	Phone: +44 (0) 1752 633164 Fax: +44 (0) 1752 633101 email: treatt@pml.ac.uk
Stéphane Saux-Picart		Plymouth Marine Laboratory Prospect Place The Hoe Plymouth PL1 3DH United Kingdom	Phone: +44 (0) 1752 633485 Fax: +44 (0) 1752 633101 email: stux@pml.ac.uk
Johnny Johannessen NERSC	Project scientist	Nansen Environmental and Remote Sensing Center Thormøhlens gate 47 N-5006,Bergen, Norway	Phone: +47 932 49 414 Fax: +47 55 20 58 01 Email: johnny.johannessen@nersc.no
Rick Danielson NERSC	Project scientist	Nansen Environmental and Remote Sensing Center Thormøhlens gate 47 N-5006, Bergen, Norway	Phone: +47 465 41 656 Fax: +47 55 20 58 01 Email: rick.danielson@nersc.no
Igor Esau NERSC	Project scientist	Nansen Environmental and Remote Sensing Center Thormøhlens gate 47 N-5006, Bergen, Norway	Phone: +47 473 99 690 Fax: +47 55 20 58 01 Email: igor.esau@nersc.no
Keith Haines UR		Director of Reading e-Science Centre, Meteorology Dept. Head of Infrastructure and Support Staff Room 177, Harry Pitt Bld 3 Earley Gate Reading University,	Phone: (44) 118 378 8742 Fax: (44) 118 378 6413 k.haines@reading.ac.uk

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Chris Merchant UR		Dept. of Meteorology, University of Reading Room 184, Harry Pitt Building, 3 Earley Gate, PO Box 238 Whiteknights, Reading, RG6 6AL UK	Phone: +44 780 821 3285 tel: +44 118 378 7335 c.j.merchant@reading.ac.uk Skype: cjmerchant
Karina Von Schuckmann MIO	Workpackage leader (WP2) and project scientist	Mediterranean Instute of Oceanography, University of Toulon Avenue de l'Université, 83957 La Garde France	Phone: +33 4 94 14 20 00 email: karina.von-schuckmann@univ-tln.fr
Carol Anne Clayson WHOI	Project scientist	WHOI USA	508 289 3626 cclayson@whoi.ed
Rachel Pinker DMUM	Expert scientist	Univ Maryland. USA	(301) 405- pinker@atmos.umd
Sergey Gulev IORAS	Project scientist	P.P.Shirshov Institute of Oceanology, RAS, 36 Nakhimovsky ave., 117997, Moscow Russia	Phone: +7 499 1247985 Fax: +7 499 1245983 Email: gul@sail.msk.ru
Semyon Grodsky DMUM	Expet scientist	Univ. Maryland. USA	301-405-5330 senya@atmos.umd.edu

INTERNATIONAL TIE-OHF SCIENCE EXPERT GROUP

The team will establish an International TIE-OHF Science Expert Group. For this, it is planned to invite international scientist to become member. The international scientist will cover the expertise and contact to CLIVAR, Seaflux, Landflux, operational climate monitoring. Annual meetings of this group are envisaged. Members of the group will be invited to attend the project team meetings.

The International TIE-OHF Science Expert Group has the responsibility to discuss the requirements with the support of the international community and to make recommendation on updates and modifications. The group also supports and advises the TIE-OHF team in the establishment of the technical requirements fulfilling the requirements as best as possible. Their support will lead to a full and seamless integration into the international communities, such as CLIVAR, GEWEX, GSOP, SeaFlux and coordination of the scientific requirements as outlined in Task 5 and 6 of the SoW.

Finally, in close cooperation with the International Flux science community this group fosters the application of the products in model evaluation exercises and climate variability analysis. The group will be able to organize a feedback mechanism for the team.

The International TIE-OHF Science Expert Group is organised as shown in Figure 1. This group has the responsibility to discuss the requirements with the support of the international community and to make recommendation on updates and modifications. The group also supports and advises the TIE-OHC team in the establishment of the technical requirements fulfilling the requirements as best as possible. Their support will lead to a full and seamless integration into the international communities, such as CLIVAR, GEWEX, GSOP, SeaFlux and coordination of the scientific requirements as outlined in Task 5 and 6 of the SoW.

Finally, in close cooperation with the International Flux science community this group fosters the application of the products in model evaluation exercises and climate variability analysis.

Members of the Expert Group will attend Project meetings and will be actively involved in the scientific discussions and give feedback to the project members.

Dr Axel Andersson will contribute 10% of his time during the duration of the project. He will support various activities of the project. As he is actively involved in the development of the HOAPS flux data set, he will provide HOAPS and other CM SAF data products to the project. Furthermore he will be involved the activities of the Expert group which will support the scientific discussions related to the requirements formulation as well as the specific tasks of the evaluation and data set generation.

Dr. Axel Andersson will coordinate the feedback from the expert group to the project team.

Dr. Rainer Hollmann will contribute 5 % of his time during the duration of the project. He will support various activities of the project. As he is involved in the development of the Radiation flux data sets, he will support the provision of CM SAF data products to the project. Mostly he will be involved the activities of the Expert group which to support the scientific discussions related to the requirements formulation as well as the specific tasks of the evaluation and data set generation.

Dr Sergey Gulev, senior scientist, will contribute about 20% of his time during the project term. evelopment of algorithms for validation of surface flux estimates, analysis of sampling uncertainties, provision of VOS-based fluxes, validation of satellite surface flux products against VOS and in-situ data. Furtehrmore, on the stage of the developemt of the products applicatiosn he will contribute to the design of methodology and the production of the regionally averaged surface flux estimates for individual basins and Cages. These inputs will be closely coordinated with the delivery of satellite products at IFREMER and will be conditioned by the timing of the provision of data streams at IFREMER. Furthermore, a close cooordintaion of validation activities will be provided by the close cooperation with WHOI, SOC and DWD whose expertise on particular flux production, algorithm development and valiadation actions will be shared with IORAS (Gulev).

7. Project planning and reporting

7.1 Workpage schedule and Ganrr charts

The overall project is 24 months. The following table summarizes the WP objectives and schedules.

WP (SoW	Name	Objective	Schedule	Responsible

Task)				
1 (6)	Project Management and Communication	Organisation, planning, communication and documentation	K0+0 - K0+24	A. Bentamy
2 (1)	Scientific Requirements Consolidation	Requirement consolidations	K0+0 - K0+9	K. Von Schuckmann
3 (2)	Reference Data Set Generation	Generation of reference data set (in Netcdf format)	K0+0 – K0+12	A. Bentamy
4 (3)	Product Generation, Inter-Comparison and Uncertainty Characterizations	Development and test of new input data and algorithms. Generation of an ensemble of realizations. Checking the consistency of flux products.	K0+6 – K0+22	A. Bentamy
5 (4)	Data Portal Development	Setting a web-based data portal aiming to provide facilities for flux use.	K0+0 – K0+22	J.F. Piollé
6 (5)	Strategic Development	Identification of opportunities and new development	K0+18 – K0+24	B. Chapron

Each WP is split in a number of tasks as listed in the following table

Table:	
WP1	
WP11	Preparation of Project Management Plan
WP12	Preparation of Progress Reports
WP13	Preparation and Maintenance of Actions Database
WP14	Review and approval of all deliverables
WP15	Preparation and organisation of regular progress meetings
WP16	Financial Management
WP17	Communications with consortium
WP18	Minutes of Meetings
WP19	Communications
WP110	
WP2	
WP21	Consolidation of flux product requirements
WP22	Consolidation of flux product specifications
WP23	Consolidation of flux method and algorithms
WP24	Identification of the product algorithm strengths and limitations
WP25	Consolidation the strategy of the flux product evaluation and validation
WP26	Consolidation of the method aiming at the generation of a suitable ensemble of realization of turbulent fluxes
WP27	Refine architecture
WP3	
WP31	Gathering and archiving EO
WP32	Homogenization of turbulent flux data
WP33	Generate regional heat constraints for the cage study
WP34	Make data available to project members through (preliminary)

	portal
WP4	
WP41	Sensitivity studies and algorithm improvement
WP42	Use improved retrieval methods for wind speed and humidity
WP43	Evaluation of data sets, Error characterization
WP44	Ensemble generation
WP45	Consistency checks ("Cage Studies")
WP46	Sensitivity Examinations
WP5	
WP51	Construct and Implement TIE-OHF Web Portal
WP52	Development of series of "light" tools
WP6	
WP61	Identifyication of the most relevant methods and ways for fostering further developments of OHF products and their transition for potential operational use.

Here follows the Gantt chart showing the project schedule and timeline

		K0			**+3**			**+6**			**+9**			**+12**			**+15**			**+18**			**+21**			**+24**
WP1																										
	WP11																									
	WP12																									
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	WP52																									
WP6																										
	WP61																									

7.2 Project breakdown

The OHF project consists of 6 tasks well defined in SoW. We have kept the same top level breakdown in 5 work packages. Each work package has been subdivided in sub work packages with a particular thematic or system level focus. Each work package will be supervised by one person. An overview of each WP is below. This is followed by detailed description of each WP

- WP1: Management and Communication (Task 6)
- WP2: Scientific Requirement Consolidation (Task 1)
- WP3: Reference Data Set Generation (Task 2)
- WP4: Product Generation, Inter-Comparison and Uncertainty Characterization (Task 3)
- WP5: Data Portal Development (Task4)
- WP6: Strategic Development (Task 5)

7.3 Work package descriptions

See following tables.

WORK PACKAGE DESCRIPTION (PSS A20)

Project:	OHF	SoW Task :	6	WP Nº :	1		
WP Title :	Project Management and Communication						
Contractor :	IFREMER			Sheet:		of	
Major Constituent :	Organisation, planning, communication and documentation						
Start Event :	KO	Planned Date:	KO	Issue:	1		
End Event :	FP	Planned Date:	KO+24	Date:			
WP Manager :	A. Bentamy – IFREMER			Effort:			
Others	Input from all project partners						

Objectives :

To provide successful management and control of the OHF project, leading communications, involving user community, reporting to ESA, and timely delivery of all deliverable items.

Task	Responsible (and contriibutors)
1. Preparation of Project Management Plan and Provision of Updates .IFREMER will provide a Project Management Plan at KO. It will be updated throughout the project lifetime, with an updated report presented at each Progress Meeting	A. Bentamy- IFREMER
2. Preparation of Progress Reports - delivery to ESA and Consortium . IFREMER will collate input from the consortium members, prepare and deliver a Progress Report to ESA every three months.	A. Bentamy– IFREMER (all partners)
3. Preparation and Maintenance of Actions Database for delivery with Progress Report . IFREMER will prepare and maintain an Actions Database throughout the project lifetime, which will be delivered with each Progress Report	A. Bentamy - IFREMER
4. Review and approval of all deliverables. IFREMER will ensure that each deliverable will undergo an internal review and approval process prior to delivery to ESA.	A. Bentamy – IFREMER (all partners)
5. Preparation and organisation of regular progress meetings and internal meetings as appropriate . IFREMER will organise regular internal progress meetings with subcontractors to measure progress against the schedule. IFREMER will also organise Progress Meetings with ESA, coordinate meetings with specified members, in accordance with the defined schedule.	A. Bentamy - IFREMER
6. Financial Management IFREMER will manage the	JF Piollé - IFREMER

financial aspects of the project.	
7. Communications with consortium, sub-contractor control, contract placement. IFREMER will organize and maintain communications with the consortium to manage sub-contractor control and contract placement.	A. Bentamy - IFREMER
8. Minutes of Meetings. IFREMER will obtain agreement from ESA and distribute the minutes of each meeting to all participants.	A. Bentamy - IFREMER
9. Communications. IFREMER will ensure that processes to maintain effective communication with internal and external parties relevant to OHF project are in place, throughout the project lifetime.	JF Piollé - IFREMER
10. Final Report. IFREMER will coordinate inputs from the OHF Consortium, prepare and deliver the Final Report to ESA within a timely manner and in accordance with the agreed schedule.	IFREMER input from all partners
Input	From
Contract	ESA
Proposal and minutes of the KO	ESA/IFREMER agreement
Sub-contractor KO‟s and minutes	Consortium
Deliverable	Delivery date
Final Report	KO+24
D10-Project Management Plan and updates	KO, each PM meeting
D20-Progress Reports	KO, trimester
D30-Actions Database and updates	KO, trimester
Certified Complete Project Manager : Date :	

WORK PACKAGE DESCRIPTION (PSS A20)							
Project:	OHF		Sow Task:	1	WP Nº :	2	
WP Title :	Scientific Requirements Consolidation						
Contracter :	IFREMER				Sheet:		of
Major Constituent :	Requirement consolidations						
Start Event :	KO	Planned Date:	KO		Issue:	1	
End Event :	FP	Planned Date:	KO+9		Date:		
WP Manager :	K. Von Schuckmann - MIO				Effort:		
Others	All partners						

Objectives :

Consolidation of OHF the requirements including spatial and temporal resolutions, accuracy, input data (basic variables), ancillary data, and error characteristics, format, metadata, online visualization, extraction, and light exploration issues.

Task	Responsible
Consolidation of flux product requirements related to sampling, accuracy, input data, ancillary data, error characteristics	A. Bentamy - IFREMER Inputs from DWD, IORAS, WHOI, DMUM.
Consolidation of flux product specifications related to the file format, metadata, projection catalogue	J.F Piollé - IFREMER. Inputs from UR, NERSC, IFREMER
Consolidation of flux method and algorithms	A. Bentamy - IFREMER, Inputs from DWD, WHOI, DMUM, PML, IORAS.
Identification of the product algorithm strengths and limitations	A. Bentamy - IFREMER Inputs from DWD, WHOI, DMUM, PML, IORAS, UR
Consolidation the strategy of the flux product evaluation and validation	A. Bentamy - IFREMER Inputs from DWD, WHOI, DMUM, PML, IORAS, IFREMER, UR
Consolidation of the method aiming at the generation of a suitable ensemble of realization of turbulent fluxes.	A. Bentamy - IFREMER Inputs from DWD, WHOI, DMUM, PML, IORAS,

	IFREMER,UT, UR
Refine architecture	J.F Piollé – IFREMER Inputs from UR, IFREMER, NERSC
Deliverable	Delivery date
[D.1.1] Requirement Baseline Document	KO + 9
Certified Complete Project Manager : Date :	

WORK PACKAGE DESCRIPTION (PSS A20)							
Project :	OHF	Sow Task:	2	WP Nº :	3		
WP Title :	Reference Data Set Generation						
Contracter :	IFREMER			Sheet:		of	
Major Constituent :	Generation of reference data set (in Netcdf format)						
Start Event :	KO	Planned Date:	KO	Issue:	1		
End Event :	FP	Planned Date:	KO+12	Date:			
WP Manager :	A. Bentamy - IFREMER			Effort:			
Others	K. Haines, A. Andersson, S. Gulev, C. A. Clayson, S. Grodsky, J. Johansson, R. Pinker, B. Chapron, S. Sathyendranath, K. Von Schuckmann						

Objectives :

Generation and evaluation of a multi-products ensemble turbulent fluxes including EO (e.g; ESA mission projects)

Task	Responsible
Gathering and archiving EO (especially from ESA sources) and non EO data as well as satellite L3 and L4 and NWP flux products available during common period of at least 10 years.	A. Bentamy - IFREMER Inputs from, DWD, IFREMER, NERSC
Homogenization of turbulent flux data to common (NetCDF) data format, resolution	Frédéric Paul – IFREMER Inputs from UR, DWD, NERSC
Generate regional heat constraints for the cage study. Requires additional radiation data (CM SAF, GEWEX, Univ. of Maryland).	K. Von Schuckmann – MIO Inputs from UR, IFREMER, DMUM
Make data available to project members through (preliminary) portal	JF. Piollé - IFREMER
Deliverable	**Delivery date**
[D.2.1] OHF Reference data set	KO + 12
[D.2.1] Scientific and technical reports	KO + trimester

Certified Complete

Project Manager : Date :

WORK PACKAGE DESCRIPTION (PSS A20)					
Project:	OHF	SoW Task:	3	WP Nº :	4
WP Title :	Product Generation, Inter-Comparison and Uncertainty Characterizations				
Contractor :	IFREMER			Sheet:	of
Major Constituent :	Development and test of new input data and algorithms. Generation of an ensemble of realizations. Checking the consistency of flux products.				
Start Event :	KO	Planned Date:	KO+6	Issue:	1
End Event :	FP	Planned Date:	KO+22	Date:	
WP Manager :	A. Bentamy - IFREMER			Effort:	
Others	A. Andersson, Rainer Hollmann, S. Gulev, C. A. Clayson, S K. Von Schuchmann. Grodsky, J. Johannessen, R. Pinker, K. Haines, C. Merchant, B. Chapron, S. Sathyendranath				

Objectives :

- Reprocessing of satellite sources to include the best available delayed mode datasets
  - Use different SST data (including ESA CCI)
  - Use different SSM/I input data
  - Use improved retrieval methods for wind speed and humidity as well as improved flux parameterizations
- Generation of an ensemble of realizations through “smart perturbations” (e.g. based on reprocessing to above point).
- Evaluation of data sets using comparative assessments with alternative flux data sources and estimation of all sources of erros and uncertainties inherent in the generated data set, discrimination of error types and sources,
- Checks for consistency of the generated ensemble based on the assessment of potential of heat budget closure for different regions ("cage" approach), process studies (El Nino, surface flux variability in mid latitudes, etc.).

Task	Responsible
Sensitivity studies and algorithm improvement • Use different SST data (including ESA CCI) • Use different SSM/I input data • Impact of sea state on flux parameterization • Impact of marine optical properties	A. Bentamy - IFREMER Input from DWD, WHOI, UR, IFREMER

Use improved retrieval methods for wind speed and humidity as well as improved flux parameterizations	S. Sathyendranath, PML
Evaluation of data sets, Error characterization • Comparison against in-situ data Characterize specific deficiencies in the algorithms to derive the geophysical parameters, particularly cross relations between the individual variables (e.g. SST dependent biases of near surface humidity)	A. Bentamy -IFREMER Inputs from DWD, IORAS, WHOI, DMUM
Ensemble generation • Generation of an ensemble of realizations through “smart perturbations” (e.g. based on reprocessing to above point).	A. Bentamy - IFREMER Inputs from DWD, WHOI, IORAS; DMUM
Consistency checks (“Cage Studies”) of the ensemble and process studies (El Nino etc.)	K. Von Schuckmann - MIO Inputs from UR, PML, IFREMER, NERSC
Examine the sensitivity of estimated fluxes and the oceanic heat budget to changes in the optical properties of the water, using ocean-colour data and a light transmission model, combined with a General Ocean Turbulence model	S. Sathyendranath - PML Inputs from IFREMER, DWD
Deliverable	Delivery date
[D.4.1] Flux Assessment Report	KO + 18
[D.4.2] Product Handbook	KO + 22
[D.4.3] Flux Product Dataset	KO + 16
Certified Complete Project Manager : Date :	

WORK PACKAGE DESCRIPTION (PSS A20)					
Project :	OHF	SoW Task:	4	WP Nº :	5
WP Title :	Data Portal Development				
Contractor :	IFREMER			Sheet:	of
Major Constituent :	Setting a web-based data portal aiming to provide facilities for flux use.				
Start Event :	KO	Planned Date:	KO+0	Issue:	1
End Event :	FP	Planned Date:	KO+22	Date:	
WP Manager :	JF Piollé - IFREMER			Effort:	
Others	F. Paul,, J. Johansson, K. Haines, C. Merchant, A. Bentamy				

Objectives :

The portal development intends to meet real existing needs in the user community for the validation and cross comparisons of various heat flux products versus reference data. Therefore, the portal should provide easy access and use of flux products, including collocated data, generated within this project, documentations (technical and scientific reports, newsletter, references to related scientific papers), links to relevant web sites (e.g. ESA, Eumetsat (SAF), NOAA, ECMWF, NCEP, NDBC, PMEL, SeaFlux, IFREMER, CLIVAR, GEWEX, WCRP, GSOP, ICOADS). The portal should also provide users reading, display, and basic statistics facilities. The portal development will performed incrementally. .

Task	Responsible
Construct and Implement TIE-OHF Web Portal. IFREMER will construct and implement the TIE-OHF Web Portal incrementally during Phase 1, starting from an initial version which will be made available after kick-off. It will contain general project information and a password protected area containing an archive of internal project documentation, such as deliverables and minutes and presentations. IFREMER will ensure that by the end of Phase 1 the web portal will provide the full content and functionality defined in the Technical Specification.	JF Piollé - IFREMER Input from UR, IFREMER, DWD, PML, NERSC, UT.
Development of series of “light” tools enabling visualization, selection, evaluation, and inter-comparisons of flux products used and/or generated in task 2 and 3.	F. Paul – IFREMER Input from UR, IFREMER, NERSC

Deliverable	Delivery date
[D.5.1] Data Portal	KO + 22

Certified Complete

Project Manager : Date :

WORK PACKAGE DESCRIPTION (PSS A20)						
Project :	OHF	SoW Task:	5	WP N° :	6	
WP Title :	Strategic Development					
Contractor :	IFREMER			Sheet:		of
Major Constituent :	Identification of opportunities and new development					
Start Event :	KO	Planned Date:	KO+18	Issue:	1	
End Event :	FP	Planned Date:	KO+24	Date:		
WP Manager :	B. Chapron			Effort:		
Others	A. Bentamy, A. Andersson, Rainer Hollmann, S. Gulev, C. A. Clayson, S K. Von Schuckmann. Grodsky, J. Johannessen, R. Pinker, K. Haines, C. Merchant					

Objectives :

- Identification of opportunities aiming at development of new turbulent flux products
- Identification of new needs and partnerships

Task	Responsible
This task aims to identify the most relevant methods and ways for fostering further developments of OHF products and their transition for potential operational use.	B. Chapron Input from IFREMER, DWD, UR, UT, WHOI, DMUM, IORAS

Deliverable	Delivery date
[D.6.1] Scientific roadmap	KO + 24

Certified Complete

Project Manager : Date :

7.4 Project management plan

TI-OHF project manager is J.F. Piollé from IFREMER. He is familiar with management projects at national and international levels. He will use the tool called “Management d'Activités, la Gestion et l'Organisation” which is the Ifremer in-house project management system that is used by the whole institute and for all the projects managed at Ifremer. It provides in particular functions to manage budget and human resources prevision and control. This will allow the Project Manager to track progress for each work package individually, and thereby arrive at an overall status of project progress. It will also be used to check resource allocations and to re-plan the remainder of the project if necessary.

ESA will have full visibility of the updated project Gantt charts, which will be available via a secured project portal (based on Alfresco framework) as all the documentation. The PMP will be updated for each of the project progress meetings, to reflect activities that have taken place up to that point and to re-validate the plans for the remaining period of the project.

Formal progress meetings with ESA have been scheduled in accordance with the SOW. In addition, the Ifremer Project Manager will discuss progress with the ESRIN Technical Officer whenever quick action is required or to anticipate any issue.

7.5 Progress reporting – report content

Ifremer will produce and deliver a three-monthly progress report to ESA technical Officer. Each progress report will cover one full calendar trimester and will be delivered to ESA by the five first working days of the next calendar trimester. This will describe the progress of all the project activities undertaken in that three month period, progress towards completion of each work package, the schedule to completion, recovery plans, if appropriate, a current configuration list, the status of all minuted actions, any issues affecting the project or solution and risks. In particular, the progress report will include (as specified in the SOW):

- Executive summary of progress
- Progress on each major workpackage of the project, including brief description of progress, description of any difficulties, major events, and activities for the next reporting period.
- Management activities
- Extract of Actions Items Database listing the actions raised, closed and outstanding for the past month
- Status of each deliverable
- Status of each milestone
- Status vs planned and summary of the progress meetings held with ESA
- Risk and problem analysis including planned actions to mitigate each identified risk
- Problem reports
- Reasons for slippage in the schedule, and corrective actions taken
- Activities to be carried out in the following month
- A financial section summarizing the invoices issued,

IFREMER will implement an Action Control Database to ensure efficient management and completion of all minuted actions. The system will be used to track the status of all minuted actions and will record the following details for each action:

- **Date Raised**: The date the action was raised;
- **Action Title**: The short title of the action item;
- **Action Description**: The detailed description of what has to be done;
- **Raised By**: The name of the person and organization raising the action, be it ESA the User Group or from within the IFREMER team;
- **Required Completion Date**: The due date by which the action should be completed;
- **Assigned To**: The name of the person within the IFREMER consortium who is responsible for completing the action;
- **Completion Comments**: Space for the person completing the action to record any comments relating to the completion of the action, e.g. how the action was completed or a detailed explanation of why it cannot be completed;
- **Action Status**: The status of the item, which can be one of “Open”, “Propose Closed”, or “Closed”.

The Project Manager will review the list of open actions on a regular basis and will be responsible for ensuring that all actions are completed in a timely fashion. If an action remains open beyond its due date then the project manager will actively investigate with the person responsible to ascertain why it has not been completed, and take any remedial action necessary. When notified by the person assigned to completion of the action that it is complete, the Project Manager will validate that this is the case and then change the status from “Open” to “Propose Closed”.

Review of the list of actions will be a regular agenda item at the project progress meetings. Formal closure of actions (setting status to “Closed”) will only take place once ESA has agreed that the action is complete.

7.6 Project Milestones

The following tables provide the proposed key meetings and reviews for the project and their schedule.

Meeting	Venue	Date	Description
KO	IFREMER	KO	Kick-off meeting
SRC	ESRIN	KO+3	Scientific Requirement Consolidation – review of the requirement baseline and initial version of web portal
CDR	ESRIN	KO+8	Critical Review – review of scientific and technical procedures and results mostly dealing with WP1, WP2 and WP3.

AM/AR	ESRIN	KO+12	Annual Meeting (AM) and Acceptance Review (AR) – review of system design and results.
CRD	IFREMER	KO+18	Critical Review – review of scientific and technical procedures and results mostly dealing with all WP.
FP	ESRIN	KO+24	Final Presentation Meeting – review of demonstration products, services, and remaining project deliverables. Analysis of project sustainability.

7.7 Facilities and technical resources

IFREMER FACILITIES AND RESOURCES

There are two major activities at IFREMER which overlap and interact significantly with the OHF project, namely Coriolis and CERSAT. They provide the evidence of IFREMER's operational capacity to host the major part of the TIE-OHF demonstration on Sea Surface Wind, Sea Surface Temperature, Waves, Sea Ice, Humidity, Latent and Sensible Heat Fluxes. . The software for the TIE-OHF system will also be based on the existing multipurpose operational data processing software available from IFREMER, the majority of which has been developed within the scope of previous projects (MERCATOR, MERSEA, MyOcean NSF, IOWVST, OceanFlux, Medspiration,…). And will be provided as open source code for TIE-OHF project without any restriction by IFREMER.

CORIOLIS

Coriolis, (represented by IFREMER), is the central in-situ component of the MyOcean operational oceanographic system which is comprised of the following:

- Sea surface observation using satellite sensors (including altimeter Jason)
- Ocean circulation modeling with assimilation of both in situ and satellite data (Mercator)
- In-situ measurements from ships, moored and drifting autonomous systems (Coriolis).

The Coriolis project, which is currently operational and has been running since 2000, is composed of the following four major components:

- Development of a Coriolis data centre for processing and dissemination of data (in real time and delayed mode)

- Contribution to ARGO including preparation and deployments of floats
- Development of operational profilers
- Integration of national activities related to routine in situ measurements.

The Coriolis data centre was initially designed to target SST and salinity measurements but has since been extended to hydrodynamical, biological and atmospherical measurements, including wave measurements.

In the context of the TIE-OHF, Coriolis will provide the necessary quality controlled in situ data required to achieve WP2 and WP3 purposes, including atmospheric and oceanic data. One should notice that Coriolis is one of the main centre dedicated to OceanSites data processing, archiving, and dissemination. These specific data will be valuable for the calibration and validation for flux methods, algorithms, products, and inter-comparisons.

Taking into account that some in-situ data are not collected in real time and that quality control on in-situ data may increase the delivery time beyond the processing window limit for the TIE-OHF, it will be possible re-generate later the TIE-OHF granules ("miniProds") in order to provide better quality and more complete matchup datasets. This takes advantage of staging on disk at IFREMER the complete in situ and satellite (at CERSAT) dataset collections making processing or reprocessing possible at any time (and avoiding therefore to manage complex data download) with very high performances.

CERSAT

CERSAT is the IFREMER Satellite Data Center. CERSAT is deeply involved in building a global processing and archiving centre for various surface parameters retrieved from radars and radiometers onboard satellites (mostly ESA satellites): ERS-1, ERS-2, Topex/Poseidon, ADEOS-1, ADEOS-2, QuikSCAT, DMSP F10 –F18, Jason, EnviSat, Metop-A, Metop-B, OceantSat2, HY-2.

Cersat has developed a real-time operational capacity under strong timeliness and robustness requirements by oceanographic and meteorological agencies. CERSAT is also an expertise and processing centre for SMOS mission and upcoming French-Chinese wave observation mission CFOSAT.

CERSAT is therefore ideally placed to host in a very cost and effort effective way the demonstrations on Ocean Heat Flux products.

The operational centre is operated by a technical team of five sub-contractors, whereas the CERSAT engineers monitor the data processing, ensuring quality control, interfaces with the different entities of the ERS ground segment or with other collaborating data centres, as well as maintenance or improvement of the operating system. The research team is in charge of defining and validating the products.

To perform its archiving and processing activities, as well as to support its research team in their activities, CERSAT has implemented a set of resources that will support the TIE-OHF design and implementation, as well as the later system demonstrations.

- a job controller and sequencer, written in python language, which is the link between each system component within the IFREMER platform and take charge of the following tasks:
- either data driven or cron activated processing chains
- detecting files to be processed for the data driven mode
- running the related processing tasks on detection of a data driven or cron event
- sequencing the different processing steps in case of complex processing chains
- controlling status of the executed processes at each step
- re-attempting the execution of failed processes
- load balancing the processes on the available servers
- offering the ability to manage heterogeneous environments (running some processes on dedicated targets only)
- offering easy integration of new processings under the system control through simple XML configuration
- reporting to a operation interface the status of the processes, raising alarms and warnings
- computing operation statistics to assess overall system status and performances
- A light data pull system, written in python language :
- managing the mirroring at CERSAT of remote archives available through various protocols (FTP, OpenDAP,...) using performance enhanced download subcomponents (such as parallel FTP)
- detecting the availability of new data files by periodic poll and comparison to its internal file index
- downloading the newly detected files or providing their URL to the controller of the processing framework (for instance for OpenDAP access where we don't want to download the file)
- checking the integrity and timeliness
- archiving the download file in the local CERSAT archive or in a rolling archive

A specific building is dedicated to the CERSAT operations, which is operated and maintained by IFREMER’s computer department. An operator team is located at CERSAT to monitor and manage the processing chain and to control the quality of the production.

CERSAT “*Nephelae*” cloud computing platform

IFREMER will provide through Nephelae cloud computing platform resources to PELAMIS Scientific Software for the implementation of the system and the access to complete datasets for testing, and will host the TIE-OHF demonstration instance to process the complete SST and Wave data backlog archive.

NEPHELAE HISTORY AND CONCEPT

Keeping long and massive mission archives alive by raising the level of data revisiting through multiple applications, demonstration products or services, or extensive data reprocessing is a major concern of CERSAT as a long-term multi-mission data archiving center. An increasing number of Earth Observation EO missions and improved in situ networks will further complement in the coming years this existing data stream, appending hundreds of Terabytes to the existing databases. This can provide an unprecedented capacity to observe the ocean and the atmosphere, but it is **mandatory to accelerate the development of robust dedicated processing infrastructure** to combine mining strategies, mass re-processing capabilities and simulations to fully benefit from this wealth of information.

This has to be performed keeping a minimum infrastructure cost and therefore optimizing all the available resources while allowing maximum flexibility in order to open access to these data and resources to a wider range of users and applications. It is our ambition to investigate and build on newly existing technologies and research outcomes to offer such service to the ocean community. Among the key aspects identified to provide an efficient and cost-effective access to historical massive multi-mission archives are :

- **fast and online access to massive collections of data** : all data shall be accessible in a automated way (without any human handling of media, etc...) and with very low latency time: ideally all data shall be stored on a single (or a few) virtual storage space based on clusters of hard-drives with fast response and widely extensible. The data can then be accessed quickly anytime for any usage. Nowadays, *Big Data* technologies offer cheap solutions (used in massive data centers such as Google or Facebook) providing a level of flexibility and redundancy balancing strict hardware reliability (often expensive).

- **avoiding data duplication and transfer to users** : the impossibility and inefficiency to copy and move large bunches of data that user can't store anyway dramatically reduces the exploitation that could be made of these data archives. <u>Moving the processing instead of moving the data</u> is a much more efficient way to deal with this issue, provided the processing capability is **openly available** and easily **tailored** to the user need through a **remote processing service**.

- **minimizing time from algorithm development to processing** : if a user or application remotely triggers processing on the archive and processing service, it has to be flexible enough so that heterogeneous software, environments and applications can be run seamlessly on the same physical platform

- **allowing fast and easy to manage large scale reprocessing** : a smart combination of hardware optimization - minimizing disk or network bandwidth consumption by locating the processing as close to the physical storage as possible -, of data replication, and of batch processing and reporting software tools - to easily distribute and monitor the processing load - must be sought

- **improving data storage and management** : this goes from the choice of appropriate data formats (with respect to storage occupation, community standards and long-term preservation perspective) to the organization of the data collection, the management of the processing versions, etc...

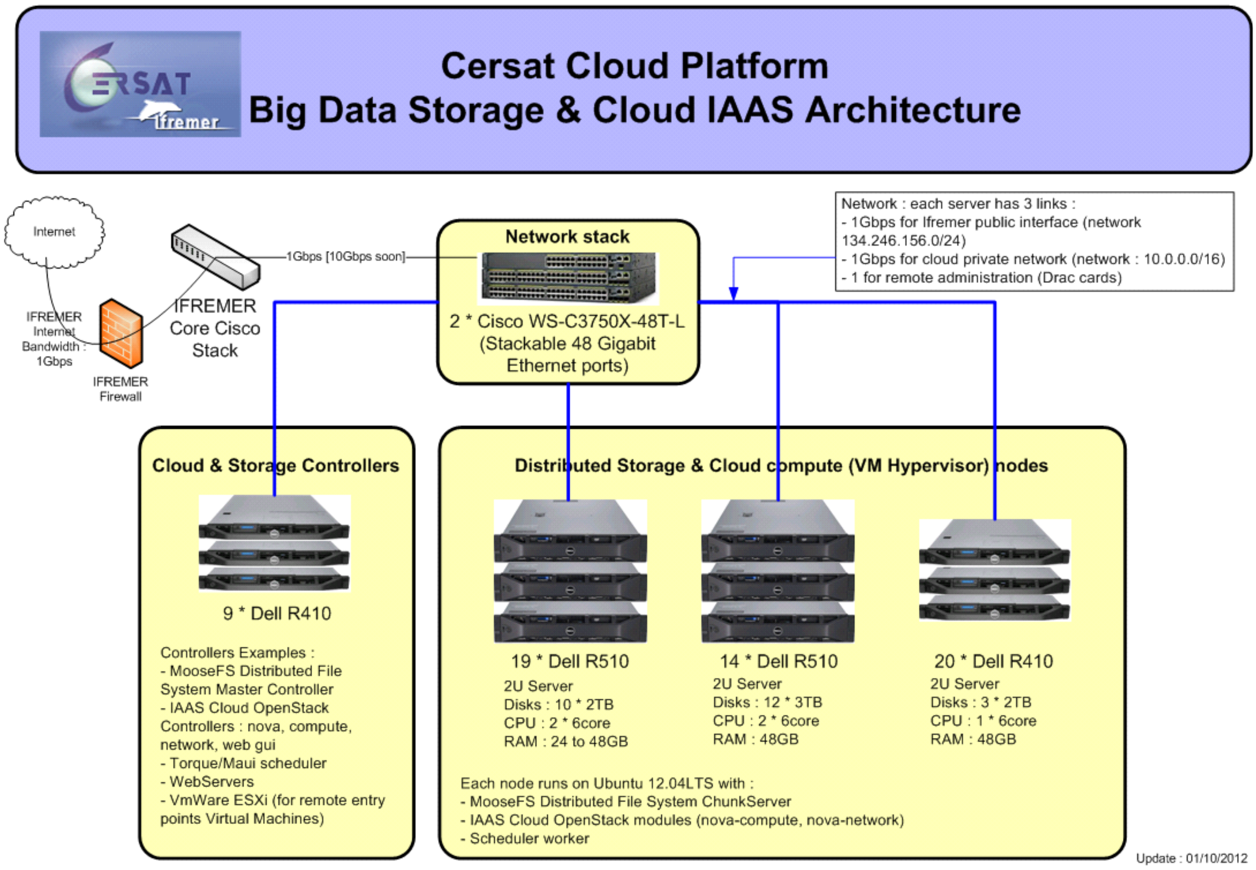
- **intelligent dynamic and thematic data indexing** : navigating through massive collections of data still requires advanced search capabilities to access straight to the relevant information with respect to the user's focus, offering comparable services to what is now widely available for web resources with search engine or semantic web.

- **reduction of the datasets** through feature extraction or data mining techniques in order to retrieve the meaningful content from sometimes a widely redundant, oversampled or irrelevant mass of information

We have recently undertaken a large effort to attempt to tackle these issues through innovative projects, partnerships and demonstrations which we intend to build over in the next coming years.

In particular, these needs have led us to investigate the different available technologies offering large distributed file systems, virtualization, on-demand allocation of processing resources, optimal job sequencing and monitoring to build a dedicated demonstration platform for mass data archiving and processing that would also allow for more traditional access (NFS, FTP, etc...) in order to ease a paced transition to these new processing paradigms. This resulted in the **Nephelae demonstration platform.**

CERSAT built the Nephelae demonstration platform to test existing "big data" technologies and serve as a "proof of concept" to support both locally and remotely managed reprocessing activities on complete satellite mission archives. It heavily relies on recent developments in the field of petascale file systems and cloud computing. The TIE-OHF demonstration on Sea Surface Temperature will be a powerful use case to demonstrate the performances and benefits of these new technologies, and the portability of the TIE-OHF system on IaaS cloud computing platforms.



NEPHELAE TECHNICAL DESCRIPTION

Physically, the platform is based on a dozen servers, each one having a good processing and large storage capacity with gigabit network connection. More precisely, Dell R510 servers with 2*CPU Intel Xeon 6core (X5650 @2.67GHz) - 24Go RAM – 10*2TB to 12*3 disk with raid5 controller and Ubuntu Operating System were used. It is to be noted that homogeneous hardware were used for the servers on this prototype to simplify this early stage implementation, but it is not a requirement: the platform must support heterogeneous hardware to address the hardware upgrades over time.

The platform is also fully reconfigurable in terms of hardware, meaning that any physical server is just a “block” that can be added or removed seamlessly and harmlessly (except for performances maybe). This is achieved by embedding the hardware with application layers managing the distributed storage, process scheduling and OS & applications deployment.

The Nephelae platform is fully operational and has been used or is currently used successfully in several projects, including:

- reprocessing of ERS-1 and ERS-2 scatterometer wind retrievals during overlapping period.
- reprocessing of the specific air humidity derived from SSM/I brightness temperatures for 1999 – 2009 period.
- reprocessing of latent and sensible heat fluxes over global ocean with high space and time resolutions.
- reprocessing of 2 years of SMOS data in one month for CNES/CATDS Center of Expertise on Salinity
- reprocessing of complete ERS1 and ERS-2 altimeter missions in one week (which was taking several months before)
- remote access and processing of ESA/OceanFlux data by project partners.
- More details on how to access and use the Nephelae platform can be found for instance on ESA OceanFlux project web site.

https://www.oceanflux-ghg.org/News/Processing-the-data/

DOCUMENT REQUIREMENT DEFINITIONS

Project Management Plan (PMP)

Deliverable	Project Management Plan (PMP)
Description	A detailed plan for the management, monitoring and control
Objectives	The PMP shall describe the project organization (Gantt charts, work packages), user list, contacts, resources, communications, project web site, the tables of contents of each document deliverable, meeting and travel plans, analyses of risk factors and mitigation strategies.
Related	ESA Statement of Work (SOW and SCOT); ESA Contract; Ifremer TIE-OHF

documents	Proposal.
Owning WP ID	
Update methodology	The PMP shall be continuously updated throughout the duration of the project, and a full and revised version shall be presented at kick-off, at each progress meeting, and at the final presentation as required.
Applicable standards	ESA ECSS-Q-80

Monthly progress report (MPR)

Deliverable	Monthly Progress Report
Description	A monthly progress report for the TIE-OHF
Objectives	Provision of a comprehensive overview of all project activities and progress against baseline for the specified period.
Related documents	PMP, ESA Contract
Preliminary contents	1. Executive summary of progress 2. General project description (will remain unchanged) 3. Progress on each major workpackage of the project, including brief description of progress, description of any difficulties, major events, and activities for the next reporting period. 4. Management activities 5. Extract of Actions Items Database listing the actions raised, closed and outstanding for the past month 6. Status of each deliverable 7. Status of each milestone 8. Status of travel expenditure vs. planned 9. Risk analysis including planned actions to mitigate each identified risk 10. Problem reports 11. Reasons for slippage in the schedule, and corrective actions taken 12. Statistics on accesses and downloads 13. Activities to be carried out in the following month
Owning WP ID	
Update methodology	The same template shall be used for each of the monthly progress reports to ESRIN within each project phase. The template will be different for each

	phase.
Applicable standards	ESA ECSS-Q-80

Actions database (ADB)

Deliverable	Actions Database
Description	An action control database
Objectives	Ongoing catalogue and control to ensure efficient management and completion of all minuted actions. For review at Progress Meetings and to be reported on in all Monthly Progress Reports
Related documents	PMP, ESA Contract, all meetings minutes
Preliminary contents	1. Date Raised 2. Action Title 3. Action description 4. Raised by 5. Required completion date 6. Assigned to 7. Completion comments 8. Action status.
Owning WP ID	
Update methodology	On a regular basis after each meeting, or monthly, as a minimum.
Applicable standards	ESA ECSS-Q-80

Travel and subsistence plan

The following table provides the travel plan costed in the Financial and Contractual Proposal (chapter 4), together with the number of participants from each organisation of the consortium.

Meeting	Venue	Date	Duration (in days)	Description
KO	IFREMER	KO	1	Kick-off meeting
SRC	ESRIN	KO+3	2	System Requirement Consolidation
CDR	ESRIN	KO+8	1	Critical Review
AM/AR	ESRIN	KO+12	2	Annual Meeting / Annual Review

CRD	IFREMER	KO+18	3	Critical Review
FP	ESRIN	KO+24	1	Final Presentation
Seaflux				
CLIVAR				

* The Budget from Ifremer includes travel support for the members of the International TIE-OHF Science Expert Group (2 DWD, …)

The deep involvement of our consortium members into the user community (being user themselves or part of user organization and department) and internationally coordinated projects is a key aspect for the project success. We will therefore use every opportunities (user and scientific workshops, projects meeting, intra-organization efforts) to present and promote the projects achievements and offered services. The corresponding travels cost are limited, except travels to attend SeaFlux and CLIVAR annual meetings.

7.8 Risk register

An initial Risk Register for the study program is provided in Table below. The risk register will be maintained and updated during the course of the project. It will be reviewed as an agenda item at the progress meetings.

ID	Risk Title &Description	Probability	Impact	Mitigation Strategy
1	Short schedule for software implementation – risk of slippage	Medium	High	Reuse of existing subsystems at IFREMER integration of generic system components start at the beginning of the project (the low level backend elements first integrated are not likely to be impacted by the Requirements outcomes)
2	Difficulty to link with the user community in a short amount of time – Risk of little feedback by end users	Medium	Medium	Create a reference user group of close partners with direct interest in ocean heat flux results. pull on our strong linkage to partners and projects to extend and strengthen the group of project followers user internal expert scientists at organizations paraticipating to the peoject (IFREMER, DWD, NERSC, PML, DMUM, UR, UT IORAS) to support Analysis and project overseeing.
3	Loss or Unavailability of Key Personnel	Very low	High	The Consortium Agreement will require any partner to inform the Science Leader and Project Manager of any circumstance of that partner affecting the future performance of the project, including unavailability of one of the Key Personnel. In the event of a (temporary or permanent) replacement being required, the partner will firstly have the opportunity of nominating a replacement. That replacement will be subject to the agreement of ESA (according to ESA General Clauses and Conditions). If a direct replacement within the partner responsible cannot be

				agreed, provision in the Consortium Agreement will be made for transferral of associated tasks to another partner (preferably one of the original consortium) where it is agreed the tasks can be satisfactorily performed.
4	It is recognised that some of the necessary contributions of IFREMER are not directly supported within the proposed contract, but are assumed on the basis that existing IFREMER activities should enable these contributions.	Low	Low	The expectation that IFREMER can provide these contributions has been affirmed by the IFREMER PI. A Consortium Agreement will specify required activities and will require IFREMER to inform the Science Leader and Project Manager of any new circumstance that may prove an obstacle to this project.
5	Failure of remotely sensed data processing systems	Low	Medium	The EO data processing systems at IFREMER as as well at satellite centers consist of multiple master nodes and processing nodes meaning that the failure of individual machines is unable to cause the failure of the complete system.
6	Failure of web and data storage systems (at each of the TIE-OHF sites)	Medium	Medium	The data storage systems at IFREMER consist of multiple file servers containing RAID arrays, meaning that the failure of individual disk is unlikely to cause the loss of data. In addition routine data backups are created at regular intervals and stored off site. The webservers to be used contain RAID storage and so in the event that the main webserver should fail, a standby server will take its place and the loss of individual disks is unlikely to cause loss of data. A copy of all project management data and deliverables will be maintained locally by the IFREMER.
7	Obtaining satellite, in situ and model data for the demonstrations.	Medium	Medium	The partners either currently hold or have access to the majority of the satellite data products, model

				data and in situ data required for the project demonstrations. If required co-author ship on any resulting publications will be offered to encourage scientists or groups outside of the partnership to contribute in situ data.

Table : Initial Risk Register

8. Financial & Contractual Proposal

8.1 Type of Price

The price is expressed in Euro and is Fixed Firm Price.

8.2 Cost Price Data

To carry out the work as outlined in our overall proposal IFREMER quotes a price that amounts to 493.000 €, broken down to the contractors as given in Error: Reference source not found.

Table 1: Price breakdown per company and participant state.

Participant State	Contractor	Total Price	
		K€	%
France	IFREMER	226	45,84
External services (expertise)	IFREMER	40	8,11
France	MIO	43	8,72
France	**Total**	**316**	
UK	PML	94	19,06
UK	**Total**	**94**	
Norway	NERSC	90	18,25
Norway	**Total**	**90**	
	Total	493	100

Four non European scientists Dr R. Pinker (DMUM), Dr C. A. Clayson (WHOI), Dr S. Grodsky (DMUM), and Dr S. Gulev (IORAS) participating as external services will be supported directly by IFREMER through TIE-OHF budget.

This also applies for the members of the International TIE-OHF Science Expert Group.

Other costs as travel cost of the Visiting Scientist programme and workshop cost as well as profit are also included.

In addition to the above costs DWD will contribute own resources for supporting activities of this project.

8.3 Profit

All organisation/institutes/universities/participating to TIE-OHF project do not apply profit.

8.4 Conversion Rates

No conversion of currency is applied. All prices are in EURO.

8.5 Geographical Distribution

The amount of the budget will be given to France (55%), United Kingdom (25%), Norway (20%), External Services included in the French part amont to 8% which shall also attract international scientist to visit TIE-OHF premises, are included.