PML | Plymouth Marine Laboratory

Marine Matters

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Combining Satellite EO and In Situ Data within OGC Compliant Web Services

in the

GEOSS Architecture Implementation Pilot – Phase 3 (AIP-3)

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PML Response to the GEOSS AIP-3 CFP

1 Overview

PML's remote sensing group routinely processes data from multiple polar orbiting satellites monitoring ocean parameters . We produce approximately 9000 data products daily over various areas of interest globally. These data products are made available in near real time, and are also stored in an online archive. PML also collects local in-situ measurements, including automatic meteorological measurements and weekly sampling in the English Channel. Furthermore, PML has considerable expertise in ecosystem modeling and produces daily model forecasts for the UK regional seas.

PML seeks to increase the availability of environmental monitoring data and participates in projects with this aim. Some current examples include DevCoCast (EU FP7, providing ocean monitoring data to African and South American countries via EUMETCAST), NCOF (a UK initiative encouraging collaboration between researchers, data providers and operational forecasters) and NETMAR (EU FP7, extending the capabilities of OGC/web-based visualisation and analysis). The societal benefit areas we most frequently seek to address are ocean-related aspects of ecosystems, health and disasters.

A significant amount of PML's data output is made available by OGC WxS services. We offer these data as a contribution to GEOSS and are interested in participating as a data provider within the pilot project. Where the GEOSS AIP-3 objectives overlap with existing funded projects, or where they can be justified as a dissemination or collaboration activity, we offer staff time as a data/service provider. In particular, we will undertake necessary modifications to ensure the data services mesh smoothly with GEOSS.

2 Proposed Contributions

2.1 Societal Benefit Area Alignment and Support

Not contributing to this part of the call.

2.2 Component and Service Contributions

2.2.1 Descriptions of components and services to be registered with GEOSS

Data services offering:

- Satellite time series of optical properties, chlorophyll-a concentrations, sea surface temperature and sea-surface elevation processed from NASA & ESA source data.

- In situ measurements of phytoplankton or physical properties from time series either in single locations (such as the L4 station off Plymouth) or along track series (such as, for example, ships of opportunity or ferrybox systems).
- Ecosystem model output for the UK waters.

Also, Web Processing Services combining and comparing satellite time series with in situ and model data. The NETMAR project focuses on improving visualisation and analysis tools – a number of additional WPS services may become available as a result.

2.2.2 Relationship of the components and services to the AIP Architecture. Comments to support the refinement of the AIP Architecture are encouraged

Components will consist of standards-based services such as WMS, WFS, OPeNDAP and WPS. INSPIRE compliant metadata will be created. The relationship to the AIP architecture is that of a data provider.

2.2.3 Examples of SBAs that the components and services support, e.g., relevant data, processing capabilities and/or client applications,

The following use cases / case studies have been developed as part of the EC FP7 NETMAR project and are provided as examples of the SBA impacts of the services proposed. The primary SBA targeted by PML in NETMAR is Ecosystems, but the data services have wider applicability – we have previously worked on projects addressing the Disaster and Health SBAs (e.g. risk management of harmful algal blooms).

2.2.3.1 Use Case 1:Relationships between physical and biological variables

2.2.3.1.1 Purpose

There are two purposes: first, using long-term time series to quantify ecosystem responses to natural variability, climate change or the impact of anthropogenic activities. Examples may include comparing long term change in zooplankton concentration to water temperature or relating optical properties to chlorophyll concentration. Second, comparisons can be made in near-real time between contemporary satellite or in situ data to provide input to water quality monitoring systems, for example, on phytoplankton chlorophyll-a concentration.

The data are usually stored in different formats, usually produced by different suppliers in different locations (and often in different countries). Hence, there is a clear need to extend on current activities to make data sets accessible via the web using inter-operable open standards approaches and to develop open-standards approaches to quantitatively combine and compare the datasets.

2.2.3.1.2 Input data

• Satellite time series of optical properties, chlorophyll-a concentrations, sea surface temperature and sea-surface elevation

• In situ measurements of phytoplankton or physical properties from time series either in single locations (such as the L4 station off Plymouth) or along track series (such as, for example, ships of opportunity or ferrybox systems)

2.2.3.1.3 Processing requirements

The use case is split in two: as a test we will use a UK-based, long-term sampling station in the western English Channel (http://www.westernchannelobservatory.org.uk/); then we will extend the methods to an international GEO-sponsored project (ChloroGIN, http://www.chlorogin.org/).

- The Western English Channel Observatory (WECO) provides a range of biological, chemical physical and optical measurements, available through an existing database linked to an existing web feature server (WFS). The WECO will form the test case for combining in situ satellite and modelling data (using a WPS) and then methods will be extended to the wider scale.
- The Chlorophyll Global Integrated Network (ChloroGIN) project is linking together data providers in Europe, Africa, North and South America and in India, with in situ data. ChloroGIN is mentioned in the GEO 2009- 2011 workplan within EC-09-01, and is the focus for the African marine component of the EC FP7 DevCoCast project. In essence, ChloroGIN is building components of the GEO System of Systems focusing on marine ecosystems, and inherent in the project is the concept of distributed data providers.

2.2.3.1.4 Expected results

The use of inter-operable data sets and on-line inter-comparison tools will enable greater use of the time series by the GEOSS and ChloroGIN scientific community by widening the user base able to easily access and analyse the data. Results will be in the form of greater understanding of natural processes in response to climate change or anthropogenic forcing leading through to publication in peer-reviewed journals.

2.2.3.1.5 Data providers

Within NETMAR: PML for in situ data and satellite data. Outside NETMAR: NASA, GMES-MyOcean, EUMETSAT (OSI-SAF), JRC, ChloroGIN partners and other who follow OGC and INSPIRE standards.

2.2.3.2 Use Case 2: Ecosystem model validation

2.2.3.2.1 Purpose

The EU FP7 project MEECE (http://www.meece.eu/) project aims to use a combination of data synthesis, numerical simulation and targeted experiments to boost knowledge and develop the predictive capabilities needed to learn about the response of marine ecosystems. Coupled physical and biological models are being run in hindcast mode and compared to historical data for validation enabling future forecasts to observe the impacts of climate change such as changes in primary production or ocean acidification. The in situ data sets include sources such as the Continuous Plankton Recorder (CPR), long term sampling stations, such as in the western English Channel, in operation for over 100

years, and satellite remote sensing. Satellite sea-surface temperature data have been continuously available for approximately 30 years whilst ocean colour for approximately 12 years. The time series are therefore valuable "ground truthing" to test hindcast runs of numerical models.

2.2.3.2.2 Input data

Three major input data types:

1. Satellite data
2. In situ data
3. Model hindcasts

2.2.3.2.3 Processing requirements

The user requirement is to extract values for a given location or area and time from either in situ or satellite data and compare with model hindcasts allowing for differences in resolution.

Results need to be returned in a format specified by the user allowing for in situ, satellite or model error characteristics. It would also be required to use visualisation capabilities to display the data graphically. This will be achieved by creating inter-operable model and satellite servers (using WCS) in situ data servers (WFS) and defining a process component which extracted the data required from each service (WPS).

2.2.3.2.4 Expected results

Results include numerical models improved by validation against long time series: by more correctly simulating past changes it is expected that future forecasts will be better. Outputs would include scientific publications, better advice for policy makers on impacts of climate change, such as ocean acidification or changes in ocean productivity.

2.2.3.2.5 Data providers

Satellite data from PML, MyOcean, ESA, NASA. In situ data from PML and MyOcean. Model hindcasts from MEECE.

2.2.4 Support of open standards by the services, with explanation of multiple-use potential outside of a single scenario within GEOSS

Data services will be OGC compliant. EO, in situ data and processing services may be accessed using any compliant client.

2.2.5 Identify how the proposed components and services will be used in the GEOSS Common Infrastructure (GCI). If you will provide client application capabilities, identify how this may also exploit the GCI in the proposed project.

The services offered may be used as data layers (WMS, etc) or processing components (WPS).

2.2.6 Performance capability of the components including typical traffic (hits per hour) that the components support, and

The services run on a dedicated server connected to the UK academic network. The performance capability has not been measured but should easily sustain light-medium usage.

2.2.7 Availability of the components for participation in the Pilot activities including persistence.

The services are considered as an essential part of PML's data provision activities and are automatically monitored, with intervention available in office hours. They are therefore highly available and will be maintained long term.

2.3 Architecture and Interoperability Arrangement Development

We have experience in deployment and adaptation of OGC services, in particular WMS, WFS and WPS. We also have experience in the development of visualisation web portals (see http://www.npm.ac.uk/rsg/projects/interrisk). We intend to monitor GEOSS developments and may comment, but cannot specifically commit to contributions at this stage.

3 Description of Responding Organization

3.1 Provide a brief description of responding organization including its relationship to the Pilot Initiative

Plymouth Marine Laboratory (PML) is an independent and impartial collaborative research centre of the UK Natural Environment Research Council (NERC). It has world-class research capacity in Earth Observation, ecosystem modelling, and marine ecosystem functioning. Its core research programme contributes to the issues of climate change, marine pollution and sustainability. PML has considerable experience in satellite data processing through its operation of the UK NERC Earth Observation Data Acquisition and Analysis Service (NEODAAS) funded from 1995 to 2014. PML undertakes highly automated near-real time and archive EO data processing to produce information on sea-surface temperature and ocean colour (water quality, algal blooms and particulates) in coastal and oceanic waters for UK marine scientists.

PML's research programmes are focused on solving the complexities within marine ecosystems and developing relevant and integrated approaches for delivering a sustainable basis to marine ecosystem management and understanding the role of the

oceans in the Earth System. We contribute to timely and highly relevant research for both UK and international societal needs. Our research tackles areas of major concern to humankind such as global change, pollution and sustainability.

Playing an integral part in the UK's strategic marine science and technology capability for over 30 years, we advise Government, the European Union and international regulating bodies on strategic issues ranging from the 'ecosystem approach' to global change issues such as ocean acidification.

PML supports the GEOSS concept, works on projects advocating the same standards-based approach, and is a member of related initiatives to make environmental monitoring data more widely available (e.g. ChloroGIN). The nearest organisational mapping is via the UK national membership of GEO, but we also have close links with several participating organisations: we contribute data to EUMETSAT, work on ESA projects and host the POGO office.

3.2 Describe the Organizations approach to supporting the Pilot including identifying the human and system resources to be assigned to participate in the Pilot.

PML is committed to developing OGC WxS services providing access to EO data processed and hosted as part of its activities within NEODAAS. In addition to this PML intends to provide WxS access to models run within PML and more complex (multi WxS services) via WPS.

We intend to support the pilot project by exploiting linkages to related projects – in many cases there is overlap. In other cases (e.g. GEOSS specific modifications) we are willing to spend some staff time, ideally as a dissemination activity within funded projects.

3.3 Provide contact information for both a Programmatic Contact and for a Technical Contact. The contact person may be the same for Programmatic and Technical contacts.

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