GODAE OceanView

STRATEGIC PLAN 2015-2020

The GODAE OceanView Science Team

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EXECUTIVE SUMMARY

The purpose of the GODAE OceanView Science Team (GOVST) is to accelerate improvement and exploitation of operational ocean forecast systems. The core GOVST members are scientists that lead the world's major research and development programs for real-time operational ocean forecasts, hindcasts and reanalysis. The acceleration of R&D activity is achieved through the exchange of information and expertise as well as the undertaking of joint assessments. The activities which the GODAE OceanView Science Team focuses on are:

- Assessments of forecast system and component performance combined with component improvements;
- Initiatives aiming to exploit the forecasting systems for greater societal benefit;
- Evaluations of the dependence of the forecasting systems and societal benefits on the components of the observation system.

To enable societal benefits from these forecast systems, GODAE OceanView collaborates with other international teams and experts. Targeted societal benefits include improvements in the day-to-day management of coastal waters, management of marine ecosystems, weather prediction from hours to weeks ahead, decadal predictions and identifying the two way influence between expected climate change and ocean state (coastal and global). The GODAE OceanView systems and their important societal benefits depend critically on the Global Ocean Observing System's (GOOS) satellite and in-situ observation components. Observation data provided by GOOS must be accessible and readily available for near-real time assimilation by GOV partners. Through the development of improved Observing System Evaluations (OSEs) GODAE OceanView can contribute to coherent, effective and scientifically robust advocacy of the case for and prioritisation of the components of the GOOS. The reanalysis, hindcast and forecast systems developed by GODAE OceanView Science Team members require inputs from and contribute valuable knowledge to the oceanographic research community. Cooperation between research and operational groups is both facilitated by and a key strategic element of GODAE OceanView.

The GODAE OceanView Science Team consists of 30+ members supported by a program office located at the Met Office, UK. It works on a five-year planning and review cycle and meets at least once a year. Financial and in-kind support required to run the program office, promote GODAE OceanView activities, organize Science Team meetings, symposia and summer schools will be provided by stakeholder agencies and national groups who are represented in the GODAE OceanView Patrons Group. This group provides guidance to the Science Team and promotes visibility and recognition of the value of GODAE OceanView at national, international and intergovernmental levels.

To achieve its objectives, GODAE OceanView will:

- Consolidate the science team, establish collaboration and synergies with other groups (e.g. WGNE, GSOP, ET-OOFS) seeking to minimise fragmentation, avoid duplication and ensure that the work plan and workshop/meetings are productive;

- Foster joint task teams (or pilot projects), conducting practical assessments, establishing links with science experts outside GODAE OceanView (e.g. for ecosystem modeling) aiming to realise the benefits of the GODAE OceanView systems;
- Work collaboratively with the GOOS Scientific Steering Committee, JCOMM and CEOS to find the most efficient and effective way for GODAE OceanView to contribute to the prioritisation, advocacy, implementation and exploitation of the GOOS.
- Encourage agencies affiliated with GODAE OceanView to develop tools and products in the area of operational oceanography that:
    - are fit-for-purpose by users and the scientific community,
    - represent value for money by its participating operational centres,
    - take into account developments of global and regional observing systems,
    - meet the needs of intermediate users of global systems such as coastal and biogeochemical prediction systems,
    - are consistent with JCOMM and ET-OOFS guidelines regarding applications further down-stream.
- Strive to organize symposia and summer schools to nurture a larger community of scientists and students, communicate to them the progress of operational oceanography accomplished in the GODAE OceanView framework, and consequently increase general awareness and recognition for the Global Ocean Observing System (GOOS), the ocean modelling and ocean data assimilation science and technology, the real-time operational ocean forecast, hindcasts and reanalysis activities and their benefit to the society through related downstream services. Ocean Data Assimilation is a key discipline that GODAE OceanView needs to continue to foster and encourage through the above activities.

Within the GODAE OceanView science community, all members will adhere to the principles of free, open and timely exchange of data and products, sharing of scientific results and experience developing applications. The GOVST recognises that free publication of products developed by GODAE OceanView partners is governed by the terms and conditions of the institution which created the data. Nevertheless, where appropriate, GODAE OceanView promotes the free access to these data by the public to enhance the awareness, uptake and impact of ocean reanalysis and forecasting products by the wider society.

GODAE OceanView will result in the long-term international collaboration and cooperation required for the next, sustained, phase of operational oceanography. GODAE OceanView has received wide support from the international community and its efforts have been endorsed by a panel of external experts as part of a review conducted in November 2013. Based on these inputs this Strategic Plan has been developed.

This Strategic Plan contains a central section 4 (Implementation Concepts) describing the vision and primary priorities of GODAE OceanView for the next 5 and 10 years. This section is

supplemented through specific short-term plans (published separately) which will be updated on an annual basis. These short-term plans describe proposed collaborative activities with expected outcomes and required investments and will be agreed on an annual basis by the GOVST and endorsed by the Patrons group. The performance against the previous year's plan will be summarized by the GOVST and the return on investments assessed by the Patrons Group.

1 Introduction

The Strategic Plan will serve as a living reference document for members of GODAE Ocean View, its Task Teams, the broader scientific community and stakeholders with an interest in operational oceanography including in particular research agencies and operational centres.

This document describes the strategy to be adopted by GODAE OceanView (GOV hereafter), as agreed by its Patrons and Partners, to continuously improve operational oceanography for societal benefit and to facilitate collaboration among the scientific community working in this research domain. The Strategic Plan begins with some background on GODAE and GODAE Ocean View. It then defines the scope of GOV and a discussion of expected outcomes. This is followed by an outline of the guiding principles and general implementation strategy adopted by GOV. A description of the overarching implementation process based on the functional components of GOV provides the strategic background for annual work plans of each of the Task Teams of GOV (which are provided and updated annually). The document concludes with a discussion of key performance indicators.

2 Background, Context and Scope

In early 1997, the Global Ocean Data Assimilation Experiment (GODAE) concept emerged from discussions of the Ocean Observation Panel for Climate (OOPC). The concept was developed in the belief that attracting the resources necessary for an adequate long-term global ocean observing system for monitoring the ocean depends upon a clear demonstration of the feasibility and value of such a system (Smith and Lefebvre, 1997). Using the First GARP Global Experiment (FGGE) as a model, OOPC proposed GODAE as an experiment in which a comprehensive, integrated observing system would be established and held in place for several years and the data assimilated into state-of-the art models of the global ocean circulation in near real-time (GODAE Strategic Plan, 2000).

GODAE finished in 2008 after a decade of successful development of the tools and demonstration of the utility of the ocean observing system for assimilating observations into state-of-the-art models of the global ocean circulation in near real-time (*quote 2008/2009 Oceanography papers*).

After consultation among the scientific community and the stakeholders in observing systems and operational oceanography it was decided that a new initiative was needed which would build on the legacy of GODAE to further mature the underpinning science of operational oceanography in support of an enhanced utility of associated products to end users.

GODAE has had a major impact on the development of global operational oceanography capability. Global modeling and data assimilation systems have been progressively developed, implemented and inter-compared. In-situ and remote sensing data are now routinely assimilated in global and regional ocean models to provide an integrated description of the ocean state. Observation, analysis and forecast products are readily

accessible through major data and product servers. There has been increased attention to development of products and services and the demonstration of their utility for applications such as marine environmental monitoring, weather forecasting, seasonal and climate prediction, ocean research, maritime safety and pollution forecasting, national security, the oil & gas industry, fisheries management and coastal and shelf-sea forecasting.

GODAE as an experiment ended in 2008 having achieved most of its goals. It has been demonstrated that global ocean data assimilation is feasible and GODAE has made important contributions to the establishment of an effective and efficient infrastructure for global operational oceanography that includes the required observing systems, data assembly and processing centres, modelling and data assimilation centres and data and product servers. The inescapable need for multi-national support for the required operational observing system, gave rise to a group strongly motivated to accelerate international progress through improved coordination, collaboration and sharing of real-time information, scientific knowledge and results.

GODAE OceanView has been in existence since 2008. In 2012 the GOV Patrons Group requested a formal and independent review of GOV which was conducted in 2013. The primary purpose of the review was to seek to improve the future effectiveness of GOV, more specifically the performance of the GOV Science Team, its Task Teams and the GOV Program Office (see Annex II). This Strategic Plan is a direct response to the findings and recommendations of the independent review.

Despite remaining major challenges (such as sustaining the global ocean observing system being an obvious one), global operational oceanography is now transitioning for most GODAE participating countries from a demonstration to a permanent and sustained capability. Furthermore, most ocean applications, including climate research, now need increasingly operational[1] data and products. To satisfy these new requirements (e.g. for coastal protection, ecosystem monitoring & forecasting, climate monitoring) GOV operational oceanography systems must adapt and constantly improve their performance and adjust their supporting research activity to remain relevant.

GODAE OceanView's collaboration and coordination of both operational and research activities related to ocean analysis and forecasting must continue during this sustained operational phase. The challenges and expectations are very demanding and can only be achieved through international collaboration.

The fundamental rationale which underpinned GODAE still applies to GOV: firstly, the increasing and genuine user demand for timely products, for a range of time and space scales and, secondly, the capability for providing regular ocean (re-)analyses which supports scientific research and development. Both require a robust, routine, permanent and well-supported network of ocean observations (GODAE Strategic Plan, 2000). However, with the maturing of prototype tools and applications to robust systems and user services

[1] Following the GODAE Strategic Plan (2000), "operational" is used here "*whenever the processing is done in a routine and regular way, with a pre-determined systematic approach and constant monitoring of performance. With this terminology, regular re-analyses may be considered as operational systems, as may be organized analyses and assessment of climate data*".

new opportunities have arisen. New areas of scientific research along with increased end use and demand have flourished in areas like

- biogeochemical, biological and ecological observations, analyses and forecasting;
- coastal operational oceanography with its increasing demand to provide accurate information to decision makers working at the interface between land and sea;
- high-latitude (Arctic & Antarctica) operational oceanography, including sea-ice analysis and forecasting; and
- short and medium term coupled ocean-atmosphere prediction with its promising developments, one of its foci being on improving the prediction of tropical cyclones.

On top of these scientific developments recent efforts by major consortia (e.g. IOOS in the US and MyOcean/Copernicus in Europe) have highlighted the need for and benefit from coordinated multi-scale data and product dissemination efforts which provide value and viability to a rapidly increasing number of users.

3 General Strategy and Guiding Principles

3.1 Overarching principles

This Strategic Plan provides a high-level view -with 5 and 10 year horizons- defining, with clear priorities for GOV and its task teams, the following planning parameters (as adopted from the review recommendations):

- expected investments and outcomes;
- "returns on investment" as reflected in robust metrics.

Additionally, the principles for prioritization in the Strategic Plan for GOV and its task teams include efforts and actions that:

- can be done more effectively on a collective basis;
- impact major practical applications;
- that intersect community scientific interest and Patrons' expectations or requirements;
- are aligned with Patrons' core interests and priorities.

The Strategic Plan will be subject to updates, with a focus on clear basic objectives, with clear proposed actions. Annual GOV Task Team work plans will adhere to the above overarching principles (see also section 4).

3.2 Relationship with JCOMM Expert Team on Operational Ocean Forecasting Systems (JCOMM-ETOOFS)

As GOV prototype systems transition to operational systems, international collaboration on product standardization and interoperability between systems must be maintained and developed. The joint WMO/IOC Technical Commission JCOMM provides an appropriate intergovernmental mechanism to coordinate this role and has established an Expert Team on Operational Oceanographic Forecasting Systems (ET-OOFS) within its Services Program Area for this purpose. The terms of reference of ET-OOFS are:

- Develop and maintain "The Guide to Operational Oceanographic Forecasting systems of the World"
- Provide advice to JCOMM teams and member states on the application, nomenclature, symbology and standards used by operational ocean forecasting systems;
- Develop and operate an inter-comparison framework for near real-time monitoring of OOFS outputs building on the legacy of GODAE;
- Work effectively with the scientific community developing and maintaining OOFS

- Provide observation requirements for OOFS to the JCOMM Observations Program Area;
- Provide advice to the JCOMM Data Management Program Areas;
- Provide advice to Members/Member States on operational ocean forecast systems.

The GOVST will report to ET-OOFS on scientific and operational developments, while ET-OOFS will provide recommendations on service provision (for instance standardization) based on users' needs.

The GOV Task Team on Intercomparison and Validation (IV-TT) will provide inputs and recommendations to the ET-OOFS on standardization of validation activities, e.g. a minimum set of metrics that should be implemented in operational systems to monitor the quality of analyses and forecasts (responsibility: IV-TT co-chairs). Similarly, the GOV Task Team on Observing System Evaluation (OSEval-TT) will provide advice to ET-OOFS on the impact of the global observing system on the performance and skill of operational systems (responsibility: OSEval-TT co-chairs). We anticipate that the two groups (GOVST and ET-OOFS) will work very closely in the coming years: the ET-OOFS chair will be a de facto member of GOVST; and GOV systems will be represented within ET-OOFS.

Through its co-chairs and project office, GODAE OceanView will interact with and report to JCOMM. The GOVST will provide updates about GODAE OceanView to the co-chairs of JCOMM as requested. As a minimum, the GOVST will provide the co-presidents of JCOMM with annual meeting reports of the science team and other information that might be of interest to JCOMM. Furthermore, in collaboration with OOPC and JCOMM, GOV will re-explore reporting lines to OOPC and JCOMM. This will include the ability for both bodies to seek advice from, and specific requests specific to GOV (responsibility: GOVST co-chairs).

3.3 Down-stream activities

There is a large and increasing range of down-stream activities linked to ocean forecasting and the work coordinated through GOV (and JCOMM ET-OOFS). Only small subsets of these are within the control and direct influence of GOV. Operational oceanography is an application-driven science and the focus of GOV is on providing the underpinning science that enables transition to operational implementation and provides credibility of operational systems. Consequently, the role of GODAE OceanView in down-stream applications requires a definition of what is in and out-of-scope. This allows GOV to focus on its strengths maximising return on investment and appropriately engageing other groups for their expertise. GOV should facilitate information exchange for groups involved in offering services associated with operational oceanography.

Down-stream applications vary from direct end use of GOV products (open sea or coastal ocean forecasting products) to derived use, where a value-adding intermediary further transforms GOV products for specific end users (search and gas, oil industry operations…). GOV can collaborate easily with direct end users as well as some of the value adding

intermediary end users. Contact with end users of derived GOV products are typically, but not exclusively through national system and consortiums.

GOV coordinates the underpinning science with the support from national groups. GOV is linking into the services domain through its science which is mainly driven by the need for useful applications. However, JCOMM and/or ET-OOFS will facilitate information systems, catalogues, etc. and GOV will create the necessary links but will not address service delivery itself.

In summary, GOV will:

- maintain a constructive dialogue with global and regional observing systems (responsibility: GOVST co-chairs and TT co-chairs);
- coordinate R&D efforts with users (responsibility: GOVST co-chairs and TT co-chairs);
- liaise with JCOMM and ET-OOFS on applications further down-stream. If GOV identifies a requirement for further information about the status of users or services in this category it will ask JCOMM and ET-OOFS if it could coordinate its collection (responsibility: GOVST co-chairs and ET-OOFS chair).
- solicit ocean forecast system end use information and feedback from national representatives

4 Implementation Concepts

4.1 GODAE OceanView Science Team

The GOVST has been created, with the mission to define, monitor, and promote actions aimed at coordinating and integrating research associated with multi-scale and multidisciplinary ocean analysis and forecasting systems, thus enhancing the value of GOV outputs for research and applications. The GOVST has ownership of this Strategic Plan and provides oversight of its Task Teams. The Task Teams address specific topics of particular importance to GOV in collaboration with external experts or representatives of other international research programs (e.g. OOPC, CLIVAR, IMBER). The objectives of GOVST and its Task Teams are to

- foster and coordinate the development of new ocean monitoring, modeling and assimilation systems for ocean forecasting both for operational and for research applications with the goal of demonstrating improved accuracy and utility of ocean analysis and forecasting products;
- promote access to data and information products and enhanced uptake of ocean analysis and forecasting products with governments, the public and private sector. GOVST will ensure that tools and products developed under its auspices are fit-for-purpose by users and represent value for money by its participating operational centres by maintaining a constructive dialogue with global and regional observing systems, coordinating R&D efforts with intermediate users such as coastal and biogeochemical prediction systems, and liaising with JCOMM and ET-OOFS on applications further down-stream.
- support the transition from the demonstration of new services based on ocean forecasting to the provision of timely, robust and reliable operational services. The Science Team will report to JCOMM ET-OOFS on relevant scientific developments whilst JCOMM ET-OOFS will make recommendations to the Science Team on what improvements would be most useful to users.
- demonstrate the value of ocean observing systems, in order to ensure access to a sustained real-time and high-quality ocean observing system, and liaise with major observing system programs (e.g. OOPC, CEOS, GOOS, GCOS) and science teams (e.g. Argo, Ocean Surface Topography, GHRSST) on observing system issues. In particular, the science team will collaborate with the Argo Science Team on the evolution of the global Argo array (e.g. sampling, data & products, biogeochemical measurements, deeper measurements).
- coordinate the development of new capabilities, in cooperation with other relevant international research programs, through a number of Task Teams (see sub-sections 4.4 to 4.8).

- organize symposia and summer schools to nurture a larger community of scientists and students, communicate to them the progress of operational oceanography accomplished in the GODAE OceanView framework, and consequently increase general awareness and recognition for the Global Ocean Observing System (GOOS), the ocean modelling and ocean data assimilation science and technology, the real-time operational ocean forecast, hindcasts and reanalysis activities and their benefit to the society through related downstream services. The scale, frequency and feasibility of symposia and summer schools depend on the level of financial support to be provided by Patrons and associated stakeholders.

In addressing above objectives and consistent with the governing priorities mentioned in section 3.1, the GOVST provides oversight of the Task Teams -with their respective 5 and 10 year horizons- defining, with clear priorities as mentioned under sub-section 3.1. The progress made by GOV and the case for continuation will be reviewed every five years and its terms of reference will be adjusted as necessary.

The GOV membership should reflect all major activities supported by GOV but be limited to about 30 members to allow for an efficient and effective operation of the team. The GOVST will be co-chaired by two of its members. New members will be proposed by the chair or co-chairs and are subject to approval by the Science Team itself. New co-chairs of GOVST need to be endorsed by the Patrons group. The term of membership will normally be 5 years but can be extended with the agreement of the co-chairs. The chair of ET-OOFS and the chairs of the Task Teams are de facto members of GOVST. Representatives from Argo, GHRSST, and OSTST are also ex-officio members of the science team.

4.2 GODAE OceanView Patrons' Group

The Patrons Group consists of representatives of those agencies or groups which are well placed to provide guidance to the members of the Science Team and or be kept informed of its discussions and to provide resources for GOV activities. The objectives of the Patrons Group are to:

- provide visibility for and promote the value of GOV and its activities;
- provide a focus for national participation in GOV;
- obtain or provide appropriate national and international resources for GOV;
- provide advice to the GOVST on matters of resources, international coordination and funding priorities;
- assist the GODAE OceanView Science Team in questions of advocacy for the ocean observing system and enable the ocean community to speak with one voice on this issue;
- provide advice to the GODAE Task Teams on matters of resources, international coordination and funding priorities. Typically, each Task Team will have at least one

member of the Patron's Group acting as a champion for their work who promotes the activity.

4.3 GODAE OceanView Functional Components

Organizational structure of Task Teams

GODAE OceanView (GOV) coordinates the development of new capabilities through its Task Teams (or TTs). These teams are active working groups focussing on specific scientific topics of particular importance to GOV. A central part of the TTs set-up is the establishment of collaborations with other international research programs and initiatives (e.g. WGNE, OOPC, CLIVAR or IMBER) contributing to coordinated, scientifically sound and internationally recognised outcomes.

The Task Teams were originally chosen on the basis of (a) the core interests of the operational groups and space agencies and (b) the need and potential for collaborative work. The current Task Teams are (Fig. 1):

1. Task Team for Intercomparison and Validation (IV-TT)
2. Task Team for Observing System Evaluation (OSEVal-TT)
3. Task Team for Coastal and Shelf Seas (COSS-TT)
4. Task Team for Marine Ecosystems Analysis and Prediction (MEAP-TT)
5. Task Team for Coupled Prediction (CP-TT)
6. Task Team for Data Assimilation Techniques (DA-TT)

The alignment of the Task Teams with the GOV organisational structure is displayed in Fig. 1:

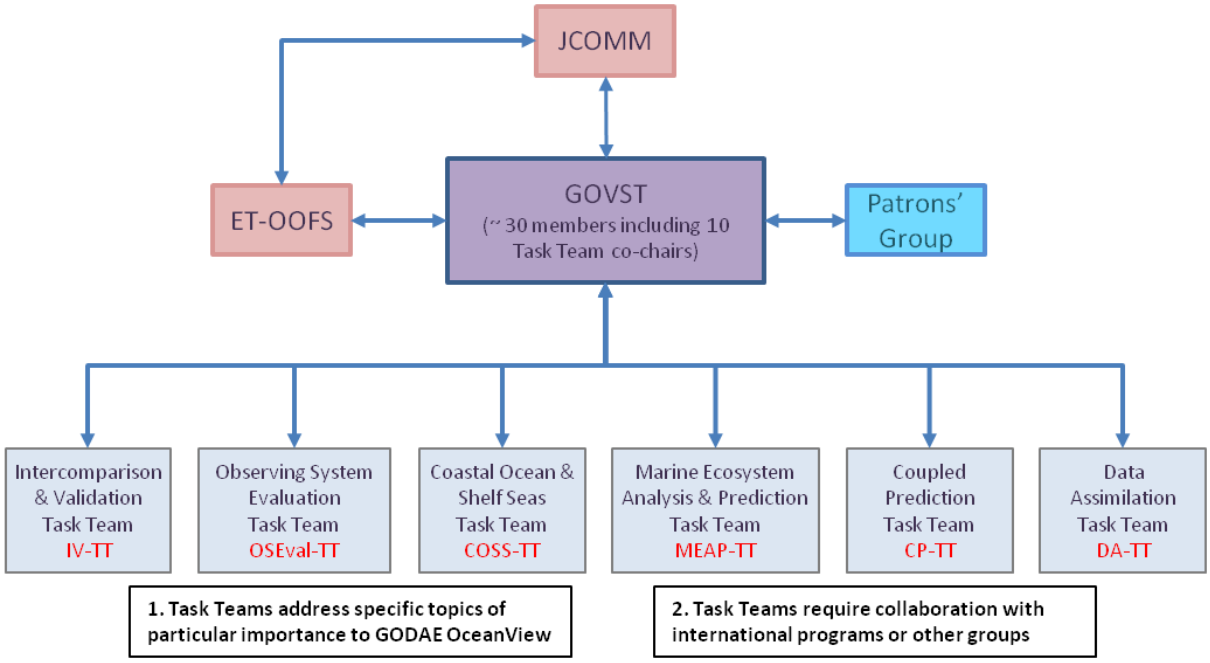

Fig 1: *GODAE OceanView organisational chart*

GOV Task Teams also interact internally to accomplish consistent, scientifically sound, evidence-based outcomes. The organisational structure and linkages between the TTs are shown in figure 2.

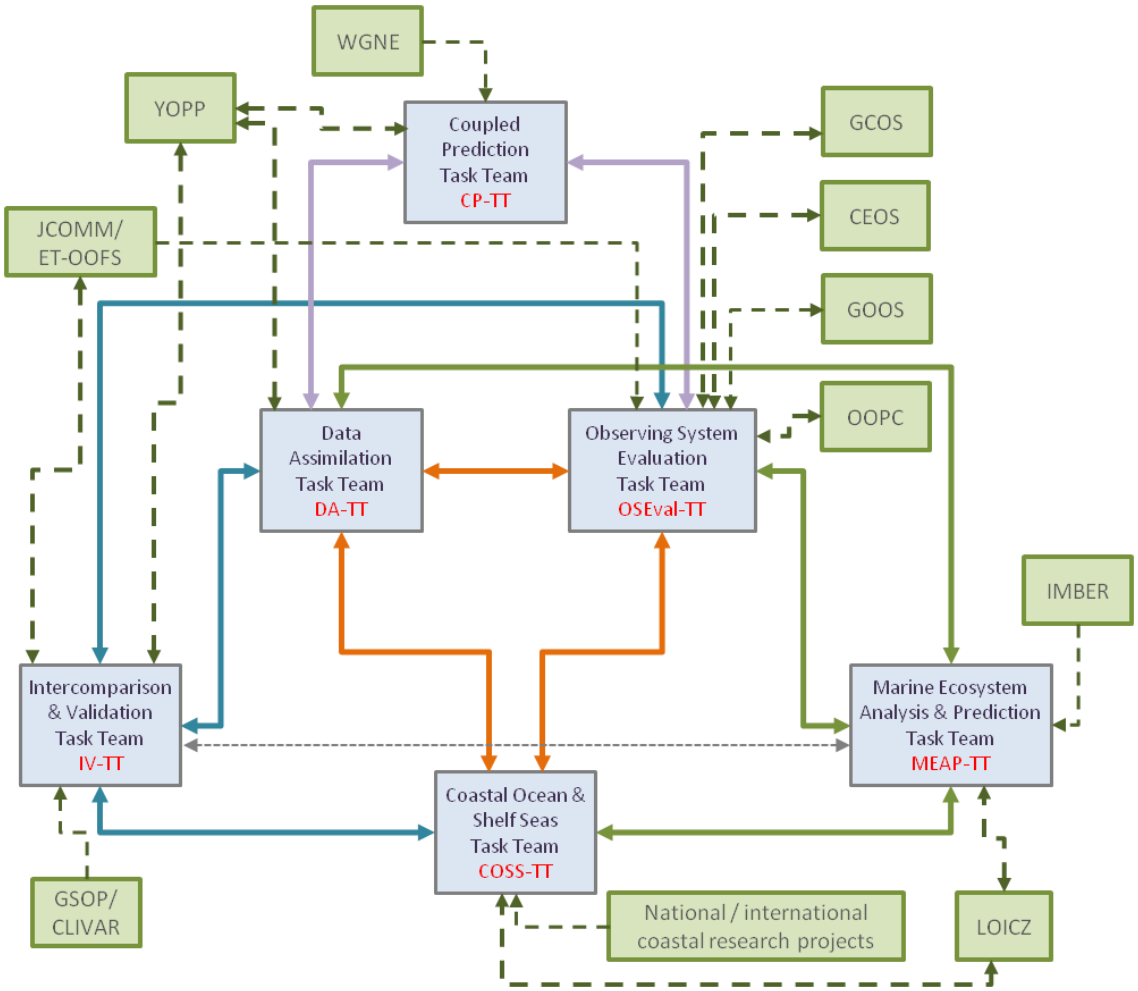

Fig 2: *GOV Task Teams organisational structure*

Reporting from the Task Teams

The variety and complexity of activities being carried out in the GOV Task Teams requires an organised and structured way of reporting. It is expected that Task Team co-chairs provide (at least) annual reports on their activities with short intermittent reports when requested. Concise reporting will be off particular high value to the Patrons' group who only have limited time to evaluate and exploit TT activity outcomes.

Task Team annual activities

The chapters 4.4 to 4.9 in this section articulate in detail

- the chosen structure of the Task Teams in strategic terms;

- the rationale for the definition of the Task Teams;
- how the strategic goals of each TT are linked with the implementation of the principles for prioritization as identified in section 3 and short-duration (~1 year) targeted activities; and
- how the activities of each Task Team will be integrated within GOV and with other partners (e.g. CLIVAR, IMBER, WGNE) to advance the goals of GOV in the next 5 and 10 year time scales, respectively.

The Strategic Plan is supplemented with specific short-term plans that will be updated annually (separate documents). These short-term plans describe proposed collaborative activities with expected outcomes and required investments and will be agreed on an annual basis by the GOVST and endorsed by the Patrons group.

The performance against the annual plan from the previous year will be scrutinized and summarized by the GOVST and the return on investments assessed by the Patrons Group. The subsequent flowchart *(Fig. 3)* outlines the individual steps of the annual project cycle.

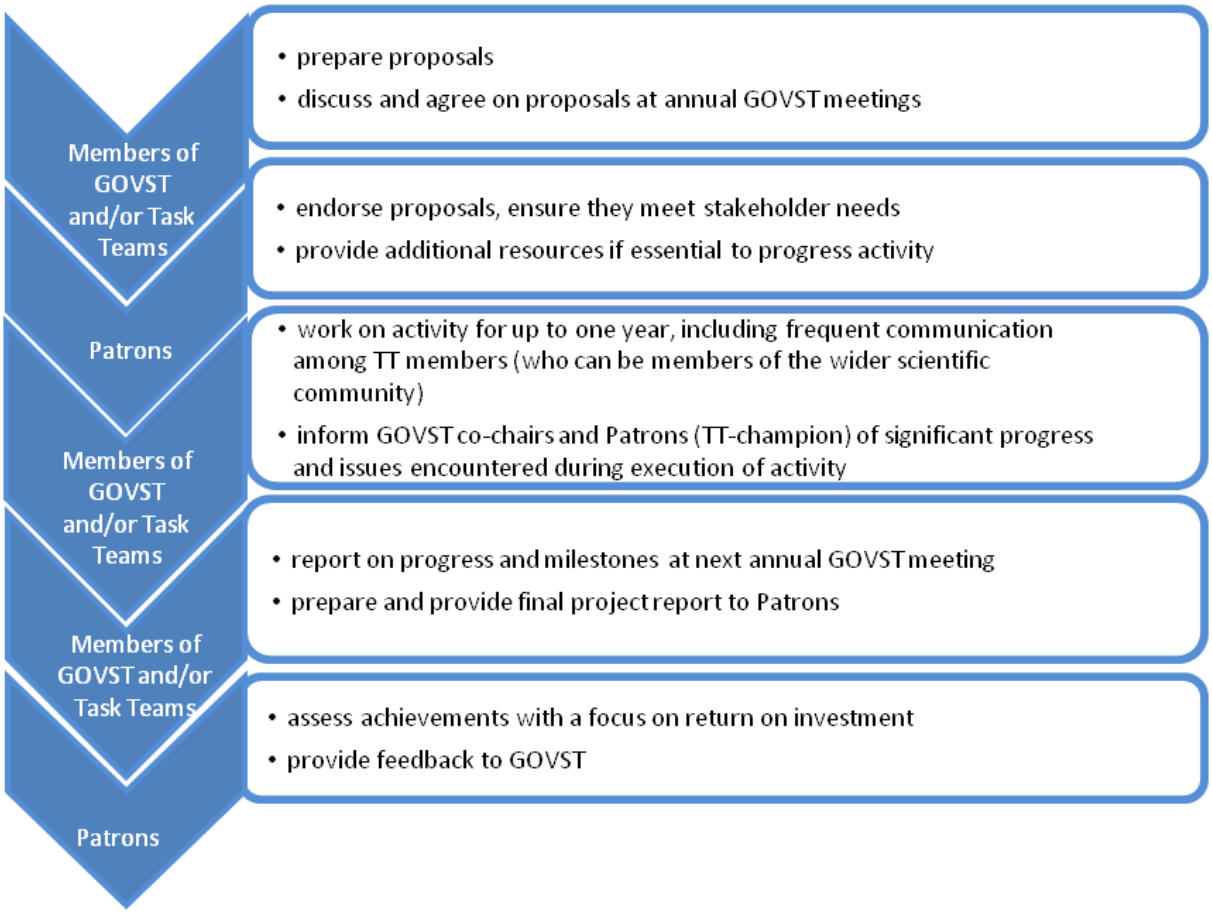

Fig 3: *Flowchart of annual project cycle*

4.4 Task Team for Intercomparison and Validation (IV-TT)

The IV-TT will coordinate and promote the development of scientific methods for validation and intercomparison of operational oceanography systems, including techniques for intercomparing model products and observations. Historically, these methodologies focused on the scientific assessment of mesoscale open ocean hindcasts and forecasts of physical parameters. This scope is considered in a broader view, due to the extension of operational oceanography activities toward coastal areas, biogeochemical and ecosystem predictions, and the provision of ocean reanalyses over the past decades. GOV has experimented with a number of approaches, including the so-called Class-4 metrics, and is probably the leading player in this area, including for seasonal climate applications. There is a clear link to observing system evaluation activities and to any immediate downstream applications coordinated through GOV.

The IV-TT objectives include

- the definition of valuable, reliable, robust, and peer-reviewed metrics to assess the quality of analyses and forecasts (e.g. forecast skills) both for physical and biogeochemical parameters, in particular but not only with respect to observed parameters;
- the design and execution of specific global and regional intercomparison experiments;
- defining metrics related to specific applications;
- enhancing the visibility and relationship of GOV with other community groups, e.g. WCRP/WWRP.
- Defining standard evolving forecast performance verification curves to show case and intercompare performance of GOV systems and their improvement over time

Such work has a number of benefits including:

- Improving confidence in model products and thus enhancing uptake;
- Providing reliable guidance on systematic errors and model improvement (including approaches to assimilation);
- Providing robust and independent measures of system performance; and
- Providing metrics of model skill at the interfaces into down-stream applications (fitness-for-purpose metrics).

Activities of the Task Team include assembling a representative for each national prediction group to participate, holding bi-annual teleconferences or meetings, and correspond via email on design, implementation and analysis of joint validation/inter-comparison exercises. This includes producing an annual update to GOVST on the status of the quality of GOV systems through the implemented intercomparison among GOV operational centres, like

Class 4 metrics. In addition, the IV-TT will also further develop cooperation and collaboration with several external groups including: CLIVAR/GSOP for ocean climate monitoring issues; WWRP-S2S for the support and development of monthly-to-seasonal ice-ocean forecasting capabilities; WWRP-PPP for coupled polar predictions and participation in the Year of Polar Prediction; the JWGFVR for the development of more sophisticated verification metrics (scale-dependent, spatial verification); and the IICWG for sea ice verification.

The IV-TT will also liaise with the JCOMM ET-OOFS (Expert Team for Operational Ocean Forecasting Systems) for the definition of requirements and standards. ET-OOFS has responsibility for publishing and providing guidance and to handle the implementation and routine monitoring for operational ocean forecasting systems. Together with research groups and other partners of GOV, the IV-TT develops and provides the underpinning expertise for the establishment of appropriate standards and metrics for use by operational systems and ET-OOFS will ensure these standards meet user needs and are distributed to external parties and parties developing new capacities. GOV plans will focus on the development (finite term defined tasks within a project frame) and not on routine activities which should fall to ET-OOFS.

The IV-TT has already implemented an achievable, cost effective, sub-set of the measures originally proposed. There remains value in the refinement and extension of the range of metrics beyond that achieved thus far. The TT has a role to continue to drive this innovation and make recommendations for implementation that can be promoted in terms of guidance by ET-OOFS.

4.5 Task Team for Observing System Evaluation (OSEval-TT)

GOV makes heavy use of the world's ocean observing system. GOV has a role to play to demonstrate the uptake and impact of observations from the Global Ocean Observing System (GOOS), and to contribute to the design of new observing systems. To this end, GOV plans to continually assess the impact of the physical and biogeochemical observing systems on ocean forecast and reanalysis systems. Similarly, GOV plans to facilitate the design and assessment of new observing systems, to identify "gaps" in the GOOS, and to propose optimised observation arrays on coastal, regional, and global scales. Through the Observing System Evaluation Task Team (OSEval-TT) – in partnership with OOPC, CLIVAR/GSOP, and the COSS-, DA-, and IV-TT – GOV seeks to provide consistent, scientifically sound, evidence-based service-data requirements to agencies and organizations that sustain global, regional, and coastal ocean observing systems. This activity requires clear protocols for observation impact assessment [e.g. Observing System Evaluation (OSEs)], common tools for routine production of metrics that quantify observation impacts (with the DA- and IV-TT), and objective recommendation methodologies. A long-term objective is to formulate and regularly apply an evaluation strategy for identifying observing system requirements for targeted end-users/application categories. The Task Team will develop its international collaboration through regular meetings and workshops.

Through work undertaken by the OSEval-TT, GOV will provide unbiased, evidence-based assessments of mature observing systems, and will propose new observing systems to observing system agency providers. This will be achieved through system-wide evaluations of observation impact on ocean forecast and reanalysis systems, including routine monitoring of observation impacts, and through the application of a range of different observing system design experiments. The OSEval-TT will work with the assigned Patrons Group champion to effectively engage with observation groups. The Task Team, comprised of representatives of GOV system and GOV TTs, seeks to clearly communicate the scope, limitations of its observation system assessment and design studies.

4.6 Task Team for Coastal and Shelf Seas (COSS-TT)

The mission goal of the Coastal Ocean and Shelf Seas Task Team (COSS-TT) is to work in coordination with GOVST and GOOS towards the provision of a sound scientific basis for sustainable multidisciplinary downscaling and forecasting activities in the world coastal oceans. The Task Team fosters international collaboration to advance science and applications on coastal and shelf dynamics, open ocean processes that control shelf break exchanges, as well as land-sea interactions through estuaries and inlets. The strategic goal of the Task Team is to help achieve a seamless transition framework from the global to the coastal/littoral scale. The main disciplines considered by the Task Team are physics and the interaction between physical and biogeochemical processes.

Two key areas of activity have been identified so far: firstly, to establish community links by convening co-sponsored forums to discuss cross-cutting issues and secondly to define and implement international coordination between coastal ocean forecasting projects.

Shelf seas and coastal services are a critically important area for most of the sponsors of GOV; several of the sponsors already make real-time predictions of the shelf seas and/or coastal areas in their vicinity. However, whilst there is a long history of storm surge predictions, many components necessary for current and future coastal ocean forecasting, such as the assimilation of observational data in the shelf seas, modern downscaling approaches, and monitoring and prediction of the broader ecosystem, to name a few, are relatively immature.

Collaboration with groups whose primary focus is on coastal prediction is highly desirable. This has already been embraced by the Task Team, by integrating new Task Team members who have relevant expertise and will be tasked with advancing such connections.

The Task Team has taken on the role of advancing science in support of ocean forecasting in the coastal and shelf seas. This has been done by engaging a broader community, from both academic and operational origins, in a series of open global forum activities for exchange of information which was previously lacking in this area. These include Task Team workshops that include both Task Team members and external experts from the international community, as well as well attended special sessions at international conferences. Future work will continue to consolidate the international community engaged in monitoring and

prediction in the coastal and shelf seas. In particular, the Task Team will focus on the following strategic priorities:

(1) provide scientific support for the development of integrated Coastal Ocean Forecasting Systems (COFS) and applications that benefit society;

(2) promote the integration between COFS and basin-scale or global models, toward best practices for downscaling across appropriate scales;

(3) facilitate linkages with scientific communities of ancillary interests, especially the coastal altimetry community.

In addition, the Task Team will collaborate with other GOV Task Teams under specific activities of common interest in the coastal and shelf seas. These include: the development of best practices for prediction assessments (with the IV-TT); quantifying the impact of observations to guide array design (with the OSEval-TT), coastal data assimilation (with the DA-TT) and the interface between open ocean and shelf models, as well as interaction with the MEAP-TT.

4.7 Task Team for Marine Ecosystems Analysis and Prediction (MEAP-TT)

The focus of this Task Team is on developing the underpinning science and tools which will eventually enable full integration of biogeochemistry and, ultimately, ecosystems in existing physical operational systems. Its mission is to contribute to the improvement of the biogeochemical observing systems, assimilation and modelling of Essential Biogeochemical Variables (EBV) and bridging the gap with end-users. This is an area of growing interest to nearly all the sponsors of GOV.

The integration of new models and assimilation components for ocean biogeochemistry and marine ecosystem monitoring and prediction is required to bridge the gap between the current status of the GODAE capabilities and new applications in areas such as fisheries management, marine pollution and carbon cycle monitoring. Although in the foreseeable future the focus of this Task Team will be on biogeochemistry and the lower trophic level it is anticipated that scientific advances in these areas will foster closer collaboration with ecosystem research in the medium to long term.

Following the outcome of a first IMBER-GODAE working group established in 2007, the Marine Ecosystem Analysis and Prediction Task Team (MEAP-TT) has been established with the goal to define, promote and coordinate actions between developers of operational systems and experts in biogeochemical, respectively ecosystem modeling, in tight connection with IMBER.

Although alternatives to the current Task Team have been considered in the form of incorporating MEAP-related activities into the work of other Task Teams (all teams covering not just physical systems but also biogeochemistry) it was found that such an arrangement

would not adequately support the biogeochemistry/ecosystem-related work within GOV better than the existing arrangement.

The objectives of this Task Team are to

- Demonstration of improved biological/biogeochemical model skill through data assimilation
- Promote the exploitation of biogeochemical products in support of management and monitoring of ecosystems, fisheries and carbon;
- Demonstrate usefulness of green OO products to end-users through identification of metrics for system evaluation in view of transfer to operational services
- Assessment of dependence of model skill on biological/biogeochemical model complexity with emphasis on model portability and predictive skill
- Contribute to the design of Essential Biogeochemical Variables observing systems
- Research and develop downscaling methods from global to regional systems for biological/ biogeochemical model applications

A re-prioritisation of these topic areas will be developed collectively during the first TT meeting in 2015. These objectives will be further developed in synergy with other GODAE/GOV TTs and in dialogue with the group of patrons. This approach will enable to better identify the added value and to quantify the benefits of this particular Task Team. One of the issues in determining the objectives for the group is that the interests of the Patrons extend from biogeochemistry to ecosystems. Interests are further divided between the shelf seas and the open ocean. The open ocean focus is closer to the original core of GODAE, but many immediate applications lie within the shelf seas and coastal regions. The choice to focus the MEAP-TT solely on the open ocean has been re-evaluated and extended to also include the shelf-sea areas.

The measures of effectiveness as expressed in terms of mission needs of the Patrons are:

- MEAP-TT seen as a source of expertise and advice for decisions to be made by Patrons, e.g. about prioritizations of and investments in the biogeochemical/ecological ocean and coastal observing system with information derived from Observing System Simulation Experiments (OSSEs);

- the integration of new satellite-based biogeochemical data (either as radiation data or in derived form, e.g. chlorophyll-a) in data assimilating coupled bio-physical models.

- the determination and implementation of metrics for evaluating operational biogeochemical predictions

The Task Team activities will be facilitated by annual workshops. Additionally, future work of this Task Team will engage the sponsors and encourage collaboration through symposia, workshops, and other similar community efforts.

4.8 Task Team for Coupled Prediction (CP-TT)

The majority of applications for both the atmospheric and ocean weather prediction lie within the coupled ocean-atmosphere boundary layers. Even those industries that operate above or below this zone frequently must transit through or operate within it (i.e. airline and offshore industries). Natural systems including the terrestrial and marine ecosystems interact strongly with and are critically dependent on the coupled boundary layers.

There is an increasing emphasis in research of the ocean in seamless predictability from medium-range (3-16 days) to seasonal time scales. The GOV community is well positioned to contribute, through collaboration with the Working Group on Numerical Experiments (WGNE) and other seasonal groups, toward achieving the goal of a seamless operational forecasting capability from weather through to seasonal climate variability, and to demonstrate the needs for ocean observations to support such a capability.

The mission goal of this Task Team is draw together the international scientific and technical expertise in ocean, sea-ice and wave prediction and to seek collaboration with equivalent expert groups in atmospheric-land surface-hydrology prediction to accelerate the scientific and technical development of fully coupled systems for short- to medium-range prediction.

The critical objectives of this Task Team are to

- Coordinate and promote the scientific and technical development of coupled prediction for extending the performance of ocean, marine and sea-ice forecasts
- Facilitate establishing the communication of the scientific and technical community within GOVST within the atmospheric and coupled community ocean
- Quantify and document the impact of coupling and the relative contribution attributable to ocean, sea-ice and wave prediction;
- Identify and define specific activities to address deficiencies of coupling methodologies;
- Through collaboration with the OSEval –TT, help define observational requirements for coupled prediction systems.

Maintaining the established links with WGNE, and developing links with other groups such as the longer-range prediction groups (e.g. seasonal prediction), and with the waves and sea-ice communities will be a critical success factor for this Task Team. Specific initiatives for joint forum will be pursued as the primary method for addressing these objectives

This task team will retain a view across the full range of activities of coupled prediction inclusive of relevant DA but with coordination with DA-TT. Specific activities to extend the methods of DA for coupled systems would be core to DA-TT. The behaviour of the DA methods as part of a coupled prediction system will be of mutual and cross-cutting interest and will be coordinated.

The observational requirements will be developed through leveraging established methods and planned initiatives of the Observing System Evaluation Task Team. The OSEval-TT has established a linkage with these communities.

The measures of effectiveness:

- GOVST recognised within the atmospheric and coupled community for expertise in ocean, sea-ice and wave prediction science
- Review publications available that document progress in coupled prediction
- Monitoring the completion of specific activities in the work plan

4.9 Task Team for Data Assimilation (DA-TT)

The DA-TT will foster the development and evaluation of data assimilation systems relevant to GOV. This addresses the issue identified in the GOV review of the need to coordinate fundamental and challenging issues in the ocean forecasting process, of which data assimilation is a significant part. The DA-TT will address this issue with the following objectives:

1. To coordinate and improve the assimilation of ocean and sea-ice data into ocean, sea-ice and coupled models by:
    a. providing a forum for discussion of DA algorithms and their development, and fostering improved communication between DA researchers outside and within the GOV groups.
    b. creating a framework for inter-comparison of aspects of data assimilation schemes, distinct from those studied in the Inter-comparison and Validation Task Team (IV-TT).
2. To provide a focus for diagnosing and understanding model and observation biases through the use of data assimilation techniques, and discussing the results with model developers and observation specialists.

The scope of the task team is defined as covering:

- Global and regional scales, including coastal ocean data assimilation.
- Systems used for near-real time ocean forecasting, seasonal forecasting, reanalysis, and research and development.
- Physical ocean and sea-ice, coupled ocean/atmosphere/sea-ice/waves DA systems, and biogeochemical DA.
- All aspects of the data assimilation process including: observation operators; error covariance estimation and representation (including both background and observation error covariances); minimisation algorithms; observation and model bias correction; initialisation; ensemble generation; analysis error estimation.

- Both theoretical and practical implementation issues, including the efficiency and scalability of DA algorithms and codes on current and future high-performance computing architectures.
- Development of metrics for assessment of data assimilation schemes.
- Development of techniques for assimilating new observation types.
- Development of observation impact and observation sensitivity techniques.

The development of techniques for assessing observation impacts and sensitivity and assimilation of new observation types will feed directly into the work of the OSEval-TT. Techniques for inter-comparison of DA outputs will be developed in conjunction with the IV-TT but will be distinct from the overall forecasting accuracy inter-comparison and validation carried out by the IV-TT as they will focus on specific parts of the data assimilation systems. Assimilation of biogeochemical variables will overlap with the work of the MEAP-TT, and the important issue of reducing the impact of physical DA on vertical velocities and therefore biogeochemistry will also address a fundamental problem in coupled physical-biogeochemical forecasting. Coupled data assimilation development will be a focus of the DA-TT, while the CP-TT will focus on the other challenges of coupled prediction. Since coastal and shelf-seas data assimilation has some common issues with deep ocean data assimilation, this will also be included in the scope of the DA-TT to provide a forum for sharing of ideas with COSS-TT.

The scope of the DA-TT therefore overlaps with the other GOV task teams. These overlaps can be managed by inviting co-chairs and/or members of the relevant task teams to attend meetings of the DA-TT, by organising joint meetings with other TTs, and by coordinating joint projects with other TTs.

The WMO data assimilation symposium series is the main international forum for discussing the scientific aspects of data assimilation and includes ocean, atmosphere, coupled and other DA. AGU, EGU and similar scientific meetings also have DA sessions. Meetings of the DA-TT will be more focussed on ocean and sea-ice than those other meetings, and are expected to lead to collaborative projects which those meetings do not foster. WMO has a data assimilation group that has a similar remit within the atmospheric community, while IICWG has a Data Assimilation Working Group, and the DA-TT will liaise with both of these groups . The collocation of DA-TT meetings with other TT meetings, and other international meetings, will therefore be required to avoid excessive travel requirements for TT members.

The DA-TT is made up of experts from the national programmes of GOV and experts in universities and other research groups with an interest in ocean, sea-ice and coupled DA. Observation and modelling experts with an interest in the data assimilation process and its outputs will also be invited to meetings in order to enable communication of developments and results.

The DA-TT will meet its objectives through the implementation of a work plan (included as an annexe to this Strategic Plan). This will include projects, prioritised from a list of potential areas of development. The primary benefits of the DA-TT will be assessed through the

monitoring of these projects and the effect they have on the operational GOV systems. The benefits associated with the fostering of communicating and discussing ideas in DA-TT workshops will be more difficult to capture.

5 Evaluating GODAE OceanView's Outcomes and Impact

5.1 Interfaces with other communities and professional bodies

As a coordination body GOV needs to interface with many other communities for optimum effectiveness. Here, we map out the key interfaces and determine where responsibility for fostering these rests across the various Task Teams. Table 1 provides a summary of current relationships and responsibilities within GOV to maintain these links with external communities. From an overarching and strategic perspective, relationships with highest priority are those with JCOMM, ET-OOFS, GOOS SSC and OOPC. It is recognised that at the level of Task Teams additional relationships such as those with IMBER and WGNE are essential to be able to address joint objectives.

It will be beneficial to also establish closer collaboration between the GOV programme office and project/programme offices of other organisations. Therefore an exchange of expertise and experience between project/programme officers is desirable, e.g. through regular meetings or telephone conferences.

	Key contacts in GOVST for establishing and fostering contacts	**Proposed minimum frequency of communication*; report at annual GOVST meeting**
GOV	**All TT co-chairs**	**At least once a year**
JCOMM & ETOOFS	Co-chairs GOVST, Co-chairs IV-TT and OSEval-TT	Biennial
GOOS SSC, OOPC, OSEVal-TT	Co-chairs GOVST and co-chairs DA-TT	6-monthly
IMAREST, MTS, SUT	Co-chairs GOVST	Annually
CLIVAR/GSOP	Co-chairs OSEval TT, IV-TT, DA-TT	Annual
LOICZ	Co-chairs COSS-TT	
IMBER, LOICZ	Co-chairs MEAP-TT	Annual
WWRP/WGNE	Co-chairs CP-TT, DA-TT	6-monthly
CEOS (SIT/VC'S)	Co-chairs OSEval TT, (OSTST)	Annually
GEOSS, GEO (Blue Planet)	Co-chairs GOVST	Annually/ 6-monthly (sub-annual)
PPP (YOPP)	Co-chairs of DA-TT, IV-TT, CP-TT	Annually
GCOS	Co-chairs of OSEval-TT	Annually

**e.g. teleconference, email exchange, circulating reports of common interest*

***Table 1**: Key external relationships of GODAE OceanView*

Interlinking with other communities via joined meetings and workshop is encouraged.

5.2 Key Performance Indicators (KPIs) for GOV

List of Key Performance Indicators (KPIs) for period October 2014 to September 2015 and expectations from Patron's Group (to be updated annually in consultation with Patrons):

Scientific:

- Demonstration of a new operational forecasting capability (physical and/or biological/bgc)

Outreach

- Recognition of GOV by other groups and bodies
- X number of publication of papers (peer reviewed) per year/ community papers / special issues
- Acknowledgment of participating in papers
- Program office newsletter including TT outcomes/activities (quarterly)
- Number /variety of nations/ organisations taking part in GOVST/TTs meetings/activities
- Scientific community engagement in special sessions/ conferences (no of seesions or no of abstract), or no of non GOV members taking part in TT workshops

Programmatic/budget

- Joint workshops with other science groups/ panels
- Establish a sustainable funding basis for GOV
- Acknowledging sponsors of GOV meeting/workshops
- Outreach TT support on adhoc basis to support larger events (e.g. summer school)

Technical

- Measure the uptake of GOV products - learn about the use of GOV products/ impact/benefit

6 References

International GODAE Steering Team (2000): The Global Ocean Data Assimilation Experiment Strategic Plan. GODAE Report No. 6, December, 2000.

Smith, N. and M. Lefebvre (1997): The Global Ocean Data Assimilation Experiment (GODAE). In “Monitoring the oceans in the 2000s: an integrated approach”. International Symposium, Biarritz, October 15-17, 1997.

7 Annexes

Annex I: GOV Science Team & Patrons' Group members

GOVST members (as of December 2014)

No	Roles	First name	Surname	Affiliation(s)	Country
GODAE OceanView Co-chairs					
1	Co-chair	Fraser	Davidson	DFO	Canada
2	Co-chair	Andreas	Schiller	CSIRO	Australia
Representatives – Forecasting Systems					
3	Australia	Gary	Brassington	BoM	Australia
4	Brazil	Clemente	Tanajura	UFBA/REMO	Brazil
5	Canada	Natacha	Bernier	Environment Canada	Canada
6	China	Guimei	Liu	NMEFC	China
7	France	Yann	Drillet	Mercator Ocean	France
8	India	Francis	Pavanathara	INCOIS	India
9	Italy	Marina	Tonani	INGV	Italy
10	Japan	Tsurane	Kuragano	MRI-JMA	Japan
11	Norway	Laurent	Bertino	NERSC	Norway
12	UK	Matt	Martin	Met Office	UK
13	ECMWF	Magdalena	Balmaseda	ECMWF	UK
14	US – ECCO/ECCOII	Tony	Lee	JPL/NASA	USA
15 16 17	US – HYCOM US – Navy	Jim Eric Pat	Cummings Chassignet Hogan	NRL Florida State University/COAPS NRL	USA USA USA
18	US-NCEP	Avichal	Mehra	NOAA	USA
Task Team co-chairs					
19 20	Coastal & Shelf Seas	Pierre Villy	De Mey Kourafalou	LEGOS University of Miami/ RSMAS	France USA
21 22	Marine Ecosystem & predictions	Marion Katja	Gehlen Fennel	LSCE Dalhousie University	Canada France
23	Observing	Peter	Oke	CSIRO	Australia

24	System Experiments	Gilles	Larnicol	CLS	France
25 26	Intercomparison & Validation	Fabrice Greg	Hernandez Smith	Mercator-Ocean Environment Canada	France Canada
27 28	Coupled Prediction	Chris Hal	Harris Ritchie	Met Office Environment Canada	UK Canada
29 30	Data Assimilation	Matt Andrew	Martin Moore	Met Office University of Santa Cruz	UK USA
Linkage representatives (other groups)					
31	Argo	Dean	Roemmich	UCSD, JCOMM	USA
32	GHRSST	Gary	Corlett	University of Leicester	UK
33	OSTST	John	Wilkin	Rutgers University	USA
34	OOPC	Eric	Lindstrom	NASA	USA
35	EUMETSAT	Hans	Bonekamp	EUMETSAT	Germany
Program Office					
36	Program office	Kirsten	Wilmer-Becker	Met Office	UK

Patrons Group members (as of December 2014)

Name		**Organisation**	**Country**
Pierre	Bahurel	Mercator Ocean	France
Rick	Bailey	BoM	Australia
Hans	Bonekamp	EUMETSAT	Germany
Paul	DiGiacomo	NOAA-space **(CHAIR)**	USA
Craig	Donlon	ESA	The Netherlands
Mark	Drinkwater	ESA	The Netherlands
Johnny	Johannessen	NERSC	Norway
Masafumi	Kamachi	MRI-JMA	Japan
Juliette	Lambin	CNES	France
Pierre-Yves	Le Traon	Ifremer	France
Eric	Lindstrom	NASA	USA
Satheesh	Shenoi	INCOIS	India
John	Siddorn	Met Office	UK
Hendrik	Tolman	NOAA-NCEP	USA
Hui	Wang	NMEFC	China

Annex II: Review Recommendations and Response by Patrons

***Version 0.1**, Mike Bell and Kirsten Wilmer-Becker based on telecoms with GOV Patrons, 31 January 2014*

***Version 0.2**, inputs from GOVST and TT co-chairs, 21 March 2013*

***Final version,** 7 April 2014*

1. RESPONSE TO FINDINGS AND RECOMMENDATIONS

2.a Overarching finding and recommendation

Finding: "GOV has demonstrated great success in continuing the direction defined by GODAE, and in meeting critical objectives. This is reflected in the improvements realized in model development, including coupled runs, higher resolution output and initial incorporation of biogeochemical processes and variables. The use of multi-model ensembles is noted as an important step forward. Additionally, the Panel recognizes the significant improvements made in assessment methodologies."

Response: Accepted

The Patrons agree that excellent progress has been made in developing ocean prediction capabilities over the last five years and that GOV has continued the very successful coordination of collaboration between the groups leading this effort. They also agree that the significant improvements in coordinated assessments are a particular success of GOV.

Recommendation: "The improvements made to date, while demonstrable and significant, would benefit from clearer direction and statement of objectives. The Panel recommends the formal development and confirmation of a strategic plan (with 5 and 10 year horizons) defining, with clear priorities, the following:

- Expected outcomes
- Expected investments
- "Returns" as reflected in robust metrics

Additionally, the principles for prioritization in the strategic plan should include:

- Actions and efforts that must be done collectively, or
- Actions and efforts that can be done more effectively on a collective basis
- Clear implications for major practical applications
- Representative of the intersection of community scientific interest and patrons' expectations or requirements
- Aligned with patrons' core interests and priorities

Regarding the plan, itself, the Panel encourages GOVST to keep it as concise as possible, adhere to a regular schedule of refreshing, focus on clear basic objectives, with clear proposed actions."

Response: **Accepted**

It is agreed by the Patrons and GOVST co-chairs that this is a key recommendation and that a strategic plan as recommended is needed.

The intention is for the GOVST to write a Strategic Plan with a short central section (@ 10 pages) describing the vision and primary priorities of GOV for the next 5-10 years and to supplement that with a section describing specific short-term plans that can be updated on an annual basis. These short-term plans will describe proposed collaborative activities with expected outcomes and required investments and will be agreed on an annual basis by the GOVST and endorsed by the Patrons group. The performance against the previous year's plan will be summarized by the GOVST and the return on investments assessed by the Patrons Group.

The principles for prioritization proposed by the Review Team are agreed to be a useful starting point for the articulation of the principal priorities which will made be explicit in the Strategic Plan.

2.b Organization

Finding and recommendation on organizational structure and interface with sponsors

Finding: "The Panel believes that the organizational structure does not adequately foster engagement with the sponsors (cf. the patrons). The interface with sponsors can be improved; there is an absence of feedback on the leverage achieved through GOV."

Response: Accepted

It is agreed that specific steps (see below) should be taken to improve the interface with the sponsors and to articulate better the value of GOV to its sponsors. These steps probably do not require major changes to the frequency of the Patrons' meetings but will require pro-active engagement from and interactions between Patrons and GOVST members.

Recommendation: "The Panel believes that the most effective way of addressing the organizational disconnect with the sponsors is to develop a robust statement of return on investment that the patrons can share with the sponsors. By documenting the measure of effectiveness the GOV community is better placed to retain and expand the attention and interest of the sponsors."

Response: Accepted

It is agreed that a short document (a "one pager") describing what the Patrons expect from GODAE OceanView would be useful. It is also agreed that some robust examples of the

investments made in ocean forecasting in particular countries, and the expected investments and returns from GOV would be of value to many sponsors. Annual endorsements of plans and assessments of return on investment by the Patrons group (see response on recommendation 2a) will also improve the effectiveness of the interface between the GOVST and the sponsors.

Finding & recommendation on organizational structure of Task Teams

Finding: "The Panel finds that the organizational structure of the Task Teams is not well justified in strategic terms. The evolution of definition of the Task Teams seems to have been founded on response to immediate issues, opportunities and concerns. Their definition and structure should be more proactively based and strategic in nature."

Response: **Accepted**

The task teams were originally chosen on the basis of (1) the core interests of the operational groups and the space agencies and (2) the need and potential for collaborative work. It is accepted that the Task Teams have mainly evolved in response to less strategic concerns and that the strategic plan should articulate the chosen structure of the TTs in strategic terms.

Recommendation (Task Team organizational structure): "As part of the development of a strategic plan, GOVST should assess the governance approach, impact and efficiency of Task Team structure in light of strategic objectives, and consider redefinition. Specific elements of such a redefinition are addressed in subsequent findings and recommendations in this report."

Response: Accepted

It is agreed that the Strategic Plan should articulate the rationale for the definition of the Task Teams and their governance consistent with the Plan's principles for prioritization.

2.c Science Interface

Finding: "GODAE/GOV has evolved to a position and capability where the community can now define scientific priorities. Additionally, systematic errors in some places require process experiments to address.

From evidence provided at the Symposium, GOV partners continue to push at the forefront of ocean scientific understanding, in some cases arguably close to the 'bleeding edge'. Since the end of the World Ocean Circulation Experiment (WOCE), there have been far fewer organized experimental campaigns dedicated to understanding the limits of predictability in the ocean, other than those led from climate research. This understanding is critical on all time scales since it impacts interpretation of observations

(scales of variability) and the development of parameterizations in and validation of models and model predictions.

Fieldwork has continued at a lower level, as expected, and as a consequence has limited progress in understanding processes and mechanisms.

In the absence of such coordinated investigations, the Panel concluded that it would be timely for GOV to embrace and provide leadership and coordination for such activities, in collaboration with others as appropriate. In particular, GOV should identify those 'experiments' needed to deliver the data and improved understanding of processes important for ocean modelling and prediction, particularly those that would alleviate the levels of systematic error in ocean models of all classes.

As one example, it would seem that science and technology has advanced to a point where we may be able to observe and model boundary current regimes with significantly improved fidelity. WOCE made significant advances in this area but, ten years on, new approaches are now feasible. A joint experiment with Argo and CLIVAR might be contemplated that would include:

- High-density XBT lines and mooring 'curtains' deployed to a selected number of western and eastern boundary current zones, to resolve transports and circulation interactions;
- The use of new glider technology capable of surveying such boundary current regimes;
- Analysis of these data and coincident satellite data to close heat and transport budgets and to enhance understanding of fine-scale interactions;
- Dedicated reanalysis, nowcasting and forecasting products to guide the experiment design and to improve the understanding of variability and predictability in such zones."

Response: **Partly accepted**

It is agreed that despite CLIVAR and GEO, following WOCE there has been far less global international coordination of experiments assessing predictability. This may be in part because most experiments on predictability would not need to have global coordination. It would almost certainly over-stretch the GOVST to attempt to lead and coordinate such activities but GOV members working in partnership with other scientific groups could provide valuable contributions to the leadership and coordination of scientific experiments that are fundamental to its strategic objectives. An option which will be considered during the writing of the Strategic Plan is to form a Task Team which is devoted to the selection, formulation and coordination of scientific experiments that are critically important for ocean prediction. There are also science programmes and teams funded by the Space agencies that could provide valuable inputs to such activities.

Recommendation: "GOV should consider a strategy around scientific activities that will address barriers to progress in ocean prediction and, in particular:

- Consider a small number of experimental campaigns dedicated to improved process understanding and deeper knowledge of predictability, and contributing to the design of future monitoring systems; and
- Consider mechanisms that will formalize such a leadership role in the ocean science community (including the IOC of UNESCO)."

Response: **Partly accepted**

The options and potential for collaboration in a pilot project along these lines should be explored during the planning of the next phase of GOV in parallel with consideration of a Task Team devoted to scientific experiments of critical importance to ocean prediction. The strategic fit to GOV objectives and the commitment of resources will need to be carefully considered. Consideration of mechanisms to formalize a leadership role for GOV is probably premature at present.

2.d ET-OOFS / GOV interface

Finding: "The links between GOV and the JCOMM Expert Team on Operational Ocean Forecasting Systems (ET-OOFS) are strong and continuing to evolve. There is inevitable overlap, both in the actions being undertaken and in the capability being brought to these actions. While this Panel was not presented with a detailed outline of the ET-OOFS work program, it was clear that both groups were giving priority to addressing the coordination challenges, including through cross-population of working groups/teams and direct coordination between GOV and ET-OOFS.

The Panel found that the 'separation of concerns' could be improved, in part by further stressing the leadership roles for science and operations for GOV and ET-OOFS, respectively, and by more clearly identifying the mechanisms for seeking advice by JCOMM from GOV via ET-OOFS, and for the reporting of GOV into JCOMM and OOPC. An improved separation would lessen the burden for cross-membership of groups and reduce the transactional cost."

Response: **Accepted**

Coordination between GOVST and ET-OOFS has been given high priority and misunderstandings between the two groups have been successfully avoided. Confidence in the articulation of the differing roles of the two groups has developed since ET-OOFS was established and in future it is expected that there will be less cross-membership of groups and maintenance of a clear separation of concerns.

Recommendations: **"**GOV and JCOMM/ET-OOFS should seek a clearer 'separation of concerns', with GOV clearly identified with scientific leadership and advice, and ET-OOFS responsible for standards and operations of ocean forecasting systems. While the autonomous nature of GOV is a virtue, the Panel recommends that reporting lines to OOPC and JCOMM should be codified and include the ability for both bodies to seek advice, and make requests for action from GOV."

Response: **Accepted**

GOV and ET-OOFS share a good understanding of the separation of their concerns which is consistent with that described above. It is agreed that GOV should re-explore with OOPC and JCOMM the reporting lines to them and the potential for there to be an explicit recognition that they can seek advice and make requests for action from GOV.

2.e Transition to operations

Finding (1): **"**GOV has made significant progress in setting up frameworks that bring together operational centers for routine intercomparison and monitoring of modeling and observing systems. Absolute scientific measures of performance for observing and forecasting systems are important for both GOV as the scientific development activity, and ET-OOFS and operational implementation groups. GOV Task Teams through their liaison with ET-OOFS coordinated and developed the scientific validation and intercomparison of operational forecast and observing systems. The Intercomparison and Validation Task Team demonstrated an operational framework for intercomparison and validation of operational global ocean forecast models using class 4 metrics. Presently five operational models (Centers) are providing in real time model output to the U.S. GODAE server, allowing intercomparison against real time observations, thus enabling routine monitoring of the quality of operational modeling systems. Using scientific measures to monitor model performance through the intercomparison has resulted in identification of model deficiencies for some participating centers, illustrating the importance of scientific performance measures.

To establish a real time intercomparison practice for operational models in order to monitor performance has been a high priority task of the ET-OOFS work plans for both JCOMM-3 and JCOMM-4 inter-sessional periods. The efforts of the Intercomparison and Validation Task Team are critical for ET-OOFS to achieve an initial operational capability for real time intercomparison of operational global ocean models."

Response: **Accepted**

Significant progress has been made that is critically important for GOV, ET-OOFS and the centres participating in the intercomparisons.

Finding (2): "The Observing System Evaluation Task Team developed an approach for routine monitoring of Global Ocean Observing Systems (GOOS), and tested the approach at two operational forecasting centers. The approach leverages operational forecast systems by running routine parallel forecasts but withholding data from components of observing systems, thus enabling routine monitoring of the effect of observing system components. As a demonstration, UKMO tested the approach by conducting data denial experiment for many key components of the GOOS in a six-month period in 2011. The results could be highly valuable for many national agencies supporting these systems.

JCOMM-3 established a formal recognition and linkage between JCOMM and GOV. JCOMM-4 reiterated this strategic linkage. These major GOV achievements clearly demonstrate the value of the close tie between JCOMM/ET-OOFS and GOV."

Response: Accepted

The OSE-TT has demonstrated approaches that are very valuable for the sponsors of GOV.

Recommendation *(to Patrons):* *"*Promote the utilization of operationally-relevant metrics and applications, and grow the number of participating centers and facilitate increased use by these centers. GOV and ET-OOFS have demonstrated the scientific value and practical applications of using scientific metrics to conduct routine intercomparisons and to monitor operational models and observing systems. Although challenges remain, such as significant computing resource implications, it is important to expand the current demonstration into broad participation of operational forecast centers, thus accelerating the transition of these significant scientific advancements into operational applications. The patrons group should facilitate informing national agencies of key findings from routine monitoring of models and observing systems to assist in decision/policy making. The patrons group should also promote operational centers participation in routine real-time model intercomparisons and in coordinating routine observing system monitoring approaches through collaboration with GOV/ET-OOFS members."

Response: Accepted

It is agreed that routine intercomparisons and monitoring are very valuable and that it is important to work on the challenges remaining in this area, to accelerate the transition of advances into operational applications and to broaden the participation of operational forecast centers in these activities. Communication of key findings from routine monitoring to assist in decision/policy making is also agreed to be very important.

2.f Intercomparison and Validation Task Team (IV-TT)

Finding: "This Task Team provides the GOV focus for the development of scientific methods for validation of ocean models and ocean model forecasts, including techniques for intercomparing model products and observations. Such work has a number of benefits including:

- Improving confidence in model products and thus enhancing uptake;
- Providing guidance on systematic errors and model improvement (including approaches to assimilation);
- Providing robust and independent measures of system performance; and
- Providing metrics of model skill at the interfaces into down-stream applications (fitness-for-purpose metrics).

GOV has experimented with a number of approaches, including the so-called Class-4 metrics, and is probably the leading player in this area, including for seasonal climate applications. There is a clear link to observing system evaluation activities, and to any immediate down-stream application coordinated through GOV.

In this case, GOV provides advice on appropriate standards and metrics and facilitates their adoption by research groups and other partners of GOV; ET-OOFS is responsible for implementation and routine monitoring for operational ocean forecasting systems. The Panel found the work to be of high quality and effective within the scope of GOV's mission."

Response: **Accepted**

GOV has invested a lot of effort in this area recognizing that it is important and requires collaborative activities which GOV is uniquely placed to address. Recent progress in this area has been very good. It is agreed that the division between the work of GOV and ET-OOFS should be as described.

Recommendations: "The Panel recommends that GOV continue to give priority to these activities with the ultimate goal of producing consensus among the partners on effective and implementable standards. A Task Team is appropriate for this role, but GOV should focus on the development (finite term defined tasks within a project framework) and not on routine activities which should fall to ET-OOFS. This approach needs to be reflected in the strategic plan, with specific attention on measures of impact (fitness-for-purpose metrics). **"**

Response: **Accepted**

So far the IV-TT has implemented an achievable, cost effective, sub-set of the measures originally proposed. There remains value in the refinement and extension of the range of metrics beyond that achieved thus far. This TT has a role to continue to drive this innovation and make recommendations for implementation by ETOOFS.

2.g Observing System Evaluation Task Team (OSEval-TT)

Finding: "According to the documentation presented to the Panel, the objective of this Task Team is to "support observational agencies by demonstrating the impact of observations on ocean forecast and reanalysis systems". The Panel found the work to be of high quality, achieving impact, and returning significant value for the partners and sponsors of GOV. This Task Team has worked closely with GOOS and OOPC, as well as the Global Synthesis and Observations Panel of CLIVAR. The responsiveness and production of observation impact statements were particularly noteworthy.

The good engagement with observing system partners at the working level is a model for other teams. The identification with observational agencies, and the responsiveness to their requests, is to be applauded but it does carry a small risk of being seen as advocates rather than as authoritative, independent assessors of the observing system and its impact. In this context, the Panel pondered the advantages of an "Observations Patrons group" that would more clearly provide a link to the sponsors. Together with the intercomparison activities, there is also a responsibility to understand the model impact in what is ultimately a connected set of inputs to data assimilation systems (climatologies and model forecasts sit alongside observations in the ocean estimation process; greater model skill reduces the reliance on fresh observations for a given estimation target)."

Response: Accepted

The Patrons are pleased to agree that this team performs high quality work which is of very significant value for many of its sponsors and that the team has tried very hard to be responsive to the sponsors' needs. Some Patrons have attended each of the previous OSE-Val TT meetings. This is probably the best way for the TT to link to its sponsors but the pros and cons of an "Observations Patrons group" will nonetheless be considered as suggested. It is agreed that the TT should seek to provide authoritative and independent assessments of the value of observation streams for the GOV forecasting systems. In order to do this the TT will seek to make the nature and limitations of its assessments as clear as possible. It can only assess the value of the observation streams for a particular purpose using currently available prediction systems.

Recommendations: "The Panel recommends further articulation of the OSEval work plan of action and milestones, within the context of the overall GOV strategy, with more explicit connection to partners and greater emphasis on system-wide evaluation. The strategy should seek to develop this Task Team as an objective and authoritative source of advice and evidence on the relevance and impact of the observing system, taking account of model and assimilation changes and improvements."

Response: **Accepted**

In line with the GOV strategic priorities the TT will focus on activities where collaboration is essential. The new annual process for agreeing the plans of the TT should help it to achieve the objective of providing robust assessments based on results from several centres. The TT

will seek to be an objective and authoritative source of advice, making the scope and limitations of its assessments as clear as possible.

2.h Coastal and Shelf Seas Task Team (COSS-TT)

Finding: "The core emphasis of GOV is the global ocean. However, it is clear that many of the key uses for forecast models are in coastal and shelf seas. Having a Task Team focussed on connecting GOV to research communities working in coastal and shelf seas modelling and to applications of operational coastal model systems is therefore essential.

Coastal and shelf modelling activity is relatively mature. Coastal model systems and their products have been employed for many years to underpin a wide range of research and policy applications as well as for supporting diverse operational needs. There are existing research communities at national (for example, the US IOOS modelling test-bed) and regional levels (for example, within EuroGOOS). There are also communities dedicated to specific model types, such as storm surge and coastal ecosystem models, and to particular end-uses such as fisheries management and design and operation of offshore structures.

Given the relative maturity and diversity of the coastal modelling community the Panel felt it was inappropriate for GOV to dedicate effort to the development of specific coastal and shelf model systems as this is likely to duplicate the effort of others. Similarly, it was felt that the breadth of forecast product needs and the corresponding diversity of groups working on particular application areas meant that it was unlikely that the Task Team would add significant value by working on specific coastal applications.

The focus of this Task Team should be centred on developing the interfaces where global systems can add value to coastal model development or lead to improved coastal forecast products. Particular emphasis might be placed on improvements in the ability to utilize global model outputs as boundary conditions for nested shelf and coastal models."

Response: **Partly agreed**

Shelf seas and coastal services are a critically important area for most of the sponsors of GOV; several of the sponsors already make real-time predictions of the shelf seas and/or coastal areas in their vicinity. However, whilst there is a long history of storm surge predictions, many components necessary for current and future coastal ocean forecasting, such as the assimilation of observational data in the shelf seas, modern downscaling approaches, and monitoring and prediction of the broader ecosystem, to name a few, are relatively immature. The initial focus of this TT (when it was established during GODAE) was on improving the interface between the open ocean GODAE systems and shelf sea systems and documenting how local systems could be demonstrated to add value to GODAE systems. Over the last five years, the TT has taken on the broader role of advancing science in support of ocean forecasting in the coastal and shelf seas. This has been done by engaging a broader community, from both academic and operational origins, in a lively and open global forum for exchange of information which was previously lacking in this area. It is agreed that there is a need for greater clarity on the specific focus areas for the

collaborative activities which this TT can support, but the value of the global forum for exchanging information and expertise should not be under-estimated.

Recommendations: "Consistent with the GOV strategic plan, the challenges in this Task Team's science strategy document need to be prioritized by the 'value add' of collective action. Focus should be on the interfaces between GOV systems and coastal models and applications. Finally, this Task Team should develop a dialogue with other groups working on coastal model development and applications (e.g., Delft Hydraulics, DHI, HR Wallingford, US Army Corps of Engineers, etc.)."

Response: Partly agreed

It is agreed that the prioritisation of activities within the TT should take due account of the principles described by the reviewers in recommendation 2a. More specifically the TT should focus on realising added value through collective action and take proper account of the priorities of the GOV teams who engage in the TT activities. The priorities for TT activities should of course also take into account the science drivers that have been identified in the three International Coordination Workshops which the TT has organised.

The interface between GOV and COSS systems is a natural topic for consideration within the TT but the scope of the TT should not be limited solely to this. One of the current science drivers of the TT is "downscaling": several sessions at workshops concentrated on this typically interface-related topic. One way to better focus on interfaces will be for GOV groups attending TT workshops to discuss their own coastal interfaces and how they assess the quality of their products aimed at serving the downstream needs of coastal models and applications.

It is also agreed that collaboration with groups whose primary focus is on coastal prediction is highly desirable. This recommendation has already been embraced, by integrating new TT members who have relevant expertise and will be tasked with advancing such connections.

Collective action is slightly more difficult for this TT than others because geographical overlap between the shelf seas of interest to the groups is lacking. Nonetheless there is scope to develop best practice for assessments of predictions (as in the IV-TT), the impact of observations (as in the OSE-TT), or the interface between open ocean and shelf models. The Patrons will ask the GOVST co-chairs to work with the COSS-TT co-chairs to develop a plan for a small number of carefully chosen activities of this sort as part of the development of the Strategic Plan. The GOV Strategic Plan will consider the options for funding pilot projects in support of such activities, within this and all the other TTs.

2.i Marine Ecosystem Analysis and Prediction Task Team (MEAP-TT)

Finding: "The Panel is impressed with the incorporation of work by this Task Team into the original portfolio of effort of GOV. There is good connection to the GOV systems. Additionally, the focus on four topic areas is commendable, and those topics are well chosen. The Panel believes that the focus of this Task Team on 24/7 operational systems

is too restrictive and not justified in terms of end user applications. The added value of this work to GOV writ large is not well defined."

Response: Accepted

The focus of this TT is not and should not be restricted to 24/7 operational systems. Indeed at present for most applications covered by this TT that is not the primary focus of the teams supported by the GOV sponsors. The four topic areas were well chosen but there has been relatively little collective activity on these topics within the TT.

Recommendations: "GOV must identify the added value and quantifiable benefits of this Task Team. The measures of effectiveness should be expressed in terms of mission needs of the patrons. Additionally, this Task Team would benefit from a discussion regarding an "exit strategy". That is, can this Task Team be incorporated into the overarching efforts and organizational structure of GOV, without the need for differentiation of ecosystem analysis and prediction (cf. physical system analysis and prediction). Additionally, the Panel believes this Task Team could add much value by changing the mode of operation to engage the sponsors and encourage collaboration through symposia, workshops, and other similar community efforts."

Response: **Partly agreed**

This TT again covers an area of great interest to nearly all the sponsors of GOV. It is agreed that its objectives and measures of effectiveness need to be more clearly related to the core interests and priorities of the Patrons. One of the issues in determining the objectives for the group is that the interests of the Patrons in ecosystems are divided between the shelf seas and the open ocean. The open ocean interests are closer to the original core of GODAE, but the weight of applications and the scientific community lies in the shelf seas and coastal regions. The choice to focus the MEAP-TT solely on the open ocean will be re-evaluated (see below).

An exit strategy in which the work of the MEAP-TT was incorporated into the work of the other TTs (all teams covering not just physical systems but ecosystems) will be considered but it is doubtful that this would support the ecosystem related work within GOV better than the existing arrangement.

We agree with the suggestion to encourage collaboration through symposia and workshops. The COSS-TT has been very successful in building a community through this approach and other TTs such as the OSE-TT and SMRCP-TT have also benefitted greatly from such events.

The GOVST co-chairs will be requested to consult with the former co-chairs of the MEAP-TT and to outline options and recommendations for the scope and collaborative activities for MEAP-TT. The GOV Patrons and GOVST co-chairs will choose between the proposed options.

2.j Short to Medium Range Coupled Prediction Task Team (SMRCP-TT)

Finding: "The benefits of the relationship with the numerical weather prediction (NWP) community are real, but not yet realized. The major effort of this Task Team was to hold a workshop, jointly with the Working Group on Numerical Experimentation (WGNE), to develop links between the ocean and atmosphere groups in the area of short- to medium-range coupled prediction. From the workshop, four white papers on observations, data assimilation, dynamical modelling and physical parameterizations have evolved. Growing evidence of the impact of coupling on medium-range ocean, atmosphere and sea-ice forecasts has been documented. The Panel agrees with the critical objective of this Task Team that observational requirements for coupled research and prediction systems should be defined. Those observational requirements should be discussed with the Observing System Evaluation Task Team. Common techniques for this kind of design and assessment are Observing System Experiments (OSEs) and Observing System Simulation Experiments (OSSEs).

The Panel finds that small incremental improvements would yield large benefits not only to NWP and society, but also to advocacy for ocean observations. In addition, society has been demanding reliable seasonal forecasts, which are coupled problems of atmosphere-ocean-land and other components of the earth system such as sea ice, requiring precise boundary conditions from ocean, land and sea ice. Therefore, temperature and salinity data from Argo floats as well as satellite altimetry data are critical for initializing the ocean for today's operational seasonal forecasting systems. Given the increasing role of the ocean in predictability from medium-range (3-16 days) through seasonal time scale, the GODAE community is well positioned to contribute, through collaboration with the WGNE group, toward achieving the goal of a seamless operational forecasting capability from weather through seasonal climate variability, and to demonstrate the needs of ocean observations to support such a capability. The Panel supports the future plan of this Task Team to maintain the established links with WGNE, and develop links with other groups such as the longer-range prediction groups (e.g. seasonal prediction), and with the waves and sea-ice communities."

Response: **Accepted**

This TT formulated during the last GOV period is a new and evolving initiative that has successfully initiated a linkage with the WGNE group. The leaders of the TT are all members of meteorological centres and several national groups are already developing short-range coupled predictions which are expected to add to the coupled hurricane predictions and atmosphere-ocean-ice predictions already established in the USA and Canada respectively. So it is reasonable to expect the benefits of the relationship with NWP to start to be realized relatively rapidly. We agree with the panel that small and well targeted improvements to NWP would yield large benefits.

Recommendations: "Observational requirements should be discussed with the Observing System Evaluation Task Team and a series of Observing System Experiments (OSEs) and Observing System Simulation Experiments (OSSEs) should be implemented to demonstrate improvements in NWP skill. Links to relevant groups should be established to ensure success in establishing seamless forecasting from short-range to seasonal time scale."

Response: **Accepted**

It is agreed that the OSEVal Team should start to consider OSEs for coupled short-range NWP: some of the GOV sponsors would strongly support this activity. Similar OSEs are relatively well established (though not internationally coordinated) for seasonal forecasting. The links to groups to ensure seamless forecasting from short-range to seasonal time-scales are being pursued at national level by the teams within GOV most engaged in these activities. The TT will facilitate the sharing of experience and lessons learnt in this regard.

2.k GOV Project Office

(*Note: as a matter of nomenclature, the Review Panel was unanimous in its perception that this office is more aptly entitled a "Program" office, as its remit extends well beyond the traditional definition of a singular "Project")*

Response: **Accepted**

It is agreed that the Project Office should be renamed the GODAE OceanView Programme Office.

Finding: "The Review Panel is impressed with the overall operations, the efficiency and the effectiveness of the project office. The office is clearly operating smoothly and serving needs of internal and external users. Services provided are cost-effective and responsive. There appear to be efficiencies in the distribution of responsibilities between GOV and related entities such as Argo, GHRSST, GOOS, etc."

Response: **Accepted**

We agree that the Programme Office provides efficient and responsive support. See below for a response on the possibilities for efficiencies.

Recommendations: "While the efficiency of operations in the Project Office is inferred, there would be significant value in documenting such through an assessment of the in kind contributions for GOV, as this would clearly identify the impact of the Office as evidenced by quantified leverage and added value. Additionally, the Panel believes that there should be a stronger level of effort in communicating between secretariats on common areas of work and opportunities for enhancing collaboration."

Response: **Accepted**

As described in response to recommendation 2a, some case study examples of the investments made nationally in GOV related activities will be prepared with the aim of clarifying and quantifying the leverage obtained through investment in GOV. Contact has been made with the IOC Programme Office and opportunities for closer coordination and mutually beneficial efficiencies will be explored.

2.l GOV Website

Finding: The GOV Web site is most effective for internal GOV community activities. The site was determined to be considerably less effective for an external audience.

Response: **Accepted**

The primary focus of the web-site has been to support internal communication and activities. We agree that the web-site is not particularly effective for external audiences and that work in this regard should be kept to a minimum.

Recommendations: If the site is intended to include an external audience, messages for those audiences should be compact and timeless, and should be updated through external links, an inherently more efficient practice. The Panel recognizes why there was an initial effort to develop the twiki, but strongly recommends it be replaced with the use of free cloud-based tools for collaboration.

Response: **Accepted**

We agree that maintenance of messages for external audiences should be kept to a minimum by keeping them compact and timeless and through judicious use of web links. It is planned to replace the twiki with other more effective tools for collaboration.

2.m Other issues of concern

(1) Task Team Structure

Findings: *"*In general the Panel felt that the existing Task Team structure is well formulated and appropriate. Some Task Teams may require a tighter focus to their activities (e.g., the Coastal and Shelf Seas Task Team) and some may need to be time limited (e.g., the Marine Ecosystem Analysis and Prediction Task Team)."

Response: **Partly accepted**

It is agreed that the existing Task Team structure is generally appropriate. During the development of the Strategic Plan it will be a priority to identify the specific collaborative

activities on which the COSS-TT should focus. The scope and objectives of the MEAP will also be re-visited. The option to close the MEAP will be considered but at present that option does not appear to respond well to the demands of the Patrons group and the opportunities for future work.

Findings: **"**There was a suggestion, during the review, that GOV should form a User Task Team. The Panel did not feel that this was something that GOV should do at this time. Rather it should encourage intermediate and end-user participation in any workshops or symposia relevant to a particular target group. "

Response: **Accepted**

Experiences, particularly successes, in working with downstream service suppliers and end-users will continue to be shared at the GOVST meetings but it is not planned to form a TT focused on interactions with users at this point. Intermediate and end-users will be invited to participate in meetings when the discussions are likely to be of particular interest to them. If the GOVST identifies a specific requirement for more information on the user community it will ask the JCOMM ET-OOFS group whether it is able to take the lead in assembling the information required.

Findings: "The Review Panel expressed some concern that there was insufficient specific emphasis on the development and evaluation of assimilation techniques by the GOV Steering Team and that biogeochemical modelling was underrepresented at the Task Team level."

Response: **Partly accepted**

It is agreed that in the first five years of GOV there has been insufficient emphasis on assimilation techniques. This could be addressed either by re-shaping the TTs or by including consideration of data assimilation within the GOVST meetings. The approach that will be taken will be decided within the new Strategic Plan.

The intention of the MEAP TT was to attract a critical mass on biogeochemical modelling through a TT focused on biogeochemical issues. Distribution of the discussion of such issues across a number of TTs may allow a broader range of issues to be discussed but could make it more difficult to attract and retain a critical mass of biogeochemical expertise. The new Strategic Plan will decide which approach to take bearing these considerations in mind.

(2) Interface with other communities and professional bodies

Findings: "As a coordination body GOV needs to interface with many other communities for optimum effectiveness. The new strategic plan needs to map out the key interfaces and determine where responsibility for fostering these rests across the various Task Teams. "

Response: **Accepted**

The new strategic plan will attempt to map out the key interfaces with other communities. It will also outline which interfaces should be given highest priority and the roles and responsibilities of the GOVST and TT members for these interfaces.

Findings: "There may also be a case for strengthened relationships with key professional bodies and learned societies which could help GOV to communicate with a broader range of stakeholders. Examples of relevant professional bodies would be the Institute of Marine Engineering, Science and Technology (which has an Operational Oceanography Special Interest Group) and the various national professional bodies representing maritime civil engineering. Learned societies such as the Marine Technology Society and the Society for Underwater Technology could also be usefully engaged in connecting GOV with the wider marine science and technology community. "

Response: **Partly accepted**

Some members of GOV already have links with most of these bodies. The interfaces with them will be considered as part of the mapping exercise described above.

(3) Down-stream activities

Findings: "There is a large range of potential down-stream activities linked to ocean forecasting and to the work coordinated through GOV (and JCOMM ET-OOFS). Only small subsets of these are within the control and/or direct influence of GOV.

The published objectives do not explicitly articulate an objective around down-stream applications although various presentations in the Symposium did refer to such goals. The Panel concluded there did need to be a better articulation of the role of GOV in down-stream application, first at the initial interface between GOV coordinated global and regional observing and forecast production systems and users of that information (such as coastal prediction), and users further down the application chain such as search and rescue and the oil and gas industry."

Response: **Accepted**

One of the papers in the special journal issue being compiled following the GOV symposium is expected to summarise the present status of the services provided by the groups involved in GOV and the use of those services by downstream services and end-users. As noted earlier in this section, if GOV identifies a requirement for further information about the status of users or services it will ask JCOMM ET-OOFS if it could coordinate its collection.

Findings: "GOV needs to develop a strategy for down-stream applications, distinguishing activities under the direct influence of GOV, from those relationships with intermediate users of GOV-related capability perhaps partly coordinated through GOV, and activities/applications connected to the ultimate beneficiaries in different sectors which may not be under the influence of GOV at all. The Panel believes this can be best achieved through the articulation of a specific objective and associated actions in the strategic

approach of GOV (see Recommendations in section 2.a.). This would include identification of the value-add (return on effort invested). “

Response: **Accepted**.

It is agreed that the Strategic Plan should address this issue. It should clarify what activities relating to downstream applications are consistent with the principles for prioritisation of GOV activities and how these will be pursued within the GOV structure (e.g. by the GOVST and/or some of the TTs).

2. CONCLUDING REMARKS

Findings: “GODAE Ocean View is a solid program with clear added value. The Review Panel appreciates the opportunity to assess both the progress and plans of the Task Teams, as well as the operations of the Project Office. With attention to the recommendations indicated above, we are convinced that subsequent reviews will confirm the continued benefit of GOV for the scientific community as well as the diverse collection of end users dependent on the benefits of this research.”

Response: **Accepted**

We agree that GOV is a solid programme with clear added value. We believe the Review was conducted in a constructive spirit and are very appreciative of the commitments of time and intellectual effort made by the Review Team. The recommendations will make a valuable contribution to the structure and detail of the new GOV Strategic Plan and will help GOV to the benefits of GOV described above by the Review Team

Annex III: Acronyms/ Definitions

Acronyms

BoM	Bureau of Meteorology
CEOS	Committee on Earth Observation Satellites
CLIVAR	Climate Variability and Predictability
CNES	National Centre for Space Studies
COSS-TT	Coastal and Shelf Seas Task Team
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DHI	Deutsches Hydrographisches Institut
ECMWF	European Centre for Medium Range Weather Forecasts
ECMWF	European Centre for medium-range Weather Forecasts
ESA	European Space Agency
ET-OOFS	Expert Team for Operational Ocean Forecasting Systems
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FGGE	First GARP Global Experiment
GCOS	Global Climate Observing System
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GHRSST	Global High Resolution Sea Surface Temperature
GMES	Global Monitoring for Environment and Security
GODAE	Global Ocean Data Assimilation Experiment
GOOS	Global Ocean Observing System
GOOS SSC	Global Ocean Observing System Science Strategy Sub-Committee
GOV	GODAE OceanView
GOVST	GODAE OceanView Science Team
GSOP	Global Synthesis and Observations Panel
ICES	International Council for the Exploration of the Sea
IMAREST	Institute of Marine Engineering, Science and Technology
INCOIS	Indian National Centre for Ocean Information Services
INGV	National Institute of Geophysics and Volcanology
IOC	Intergovernmental Oceanographic Commission
IOOS	Integrated Ocean Observing System
IV-TT	Intercomparison and Validation Task Team
JCOMM	WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology
JMA	Japan Meteorological Agency
KPIs	Key Performance Indicators
MEAP-TT	Marine Ecosystem Analysis and Prediction Task Team
MRI	Japan Meteorological Institute
MTS	Marine Technology Society
NASA	National Aeronautics and Space Administration

NERSC	Nansen Environmental and Remote Sensing Center
NMEFC	National Marine Environmental Forecasting Center
NOAA	National Oceanic and Atmospheric Administration
NWP	Numerical Weather Prediction
ONR	Office of Naval Research
OO	Ocean Observation(s)
OO	Operational Oceanography
OOFS	Operational Ocean Forecasting System
OOPC	Ocean Observation Panel for Climate
OSE	Observing System Experiment
OSEval-TT	Observing System Evaluation Task Team
OSSE	Observing System Simulation Experiment
PPP	Polar Prediction Project
REMO	Oceanographic Modelling and Research Network
CP-TT	Coupled Prediction Task Team
SUT	Society for Underwater Technology
TT	Task Team
UNESCO	United Nations Educational, Scientific and Cultural Organization
VC	Virtual constellations
WGNE	Working Group for Numerical Experimentation
WWRP	World Weather Research Programme
YOPP	Year of Polar Prediction