GODAE OceanView

Coastal Oceans and Shelf Seas Task Team (COSS-TT)

International Coordination Workshop 3 (ICW3)

Rincon, Puerto Rico

21-24 January 2014

Workshop report

Prepared by

Villy Kourafalou and Pierre De Mey

(COSS-TT co-chairs)

Enquiries should be addressed to:
Kirsten Wilmer-Becker
GODAE OceanView Project Office Coordinator

Kirsten.Wilmer-Becker@metoffice.gov.uk
The Met Office FitzRoy Road, Exeter, EX1 3PB, UK

COSS-TT ICW3 workshop participants, Puerto Rico, Rincon Beach Resort

Many thanks to the University of Texas at Dallas and CariCOOS for an outstanding local organization

Presentations referred to in this report are available from the GODAE OceanView website at https://www.godae-oceanview.org/outreach/meetings-workshops/task-team-meetings/coss-tt-workshop-2014/presentations/

Table of contents

1. Introduction

1.1. The workshop

Following two previous workshop (in 2012 & 2013), this third workshop (COSS-ICW3) of the COSS-TT (Coastal Ocean and Shelf Seas Task Team) continues to focus on reaching out and establishing community links between coastal ocean forecasting projects. It provides a platform for communication and collaboration in support of building a sound scientific basis for sustainable multidisciplinary downscaling and forecasting activities in the world coastal oceans.

Workshop attendees included COSS-TT members or substitutes and scientist from the broader COSS community, as well as interested members of the regional/coastal ocean monitoring and forecasting communities.

The task team effort is coordinated and supported through the GOOS (Global Ocean Observing System) and the GODAE OceanView Science Team (GOVST). A recent GOV review looking into the aims, achievements, issues and plans of the GOV task Teams, including the COSS-TT, has provided useful findings and recommendations on the continuation of GOV. This third COSS-TT workshop was organised timely to respond to the review outcomes, in particular to the request on setting up a science strategy for GOV and the COSS-TT.

Besides the science focus this workshop also included discussions and agreements (discussed in working groups) regarding the Memorandum of Understanding (MoU) which has now matured to an agreed format, and the plans for improved exchange of information within the community (which also links to the aim to set up a science strategic plan for the COSS-TT.

The workshop allowed time for exchange and socialising in a beautiful setting, including a typical Puerto Rican dinner and an evening excursion to the bio-luminescent bay.

This document summarizes the material that was presented as well as the outcomes from the discussions.

1.2. Our host

The workshop was held at the Rincon Beach Resort, Puerto Rico on the 21-24 January 2014, and hosted by UT Dallas and CariCOOS. A particular thank you goes to Stefano Leonardi, UT Dallas who invested a lot of time and effort to organise the hotel, transfers and all the local activities including the tour to the bio-luminescent bay.

1.3. Presentations

All presentations are available on the GOV website at: https://www.godae-oceanview.org/outreach/meetings-workshops/task-team-meetings/coss-tt-workshop-2014/presentations/.

2. Workshop objectives

The main foci on the workshop were the science and coordination sessions. These provided the opportunity for discussions and exchange on science and technical details, as well as on the question of how to continue and improve collaboration within the task team and with the COSS community.

The five **Science** sessions (see section 3.) covered:

- Progress of **coastal ocean forecasting systems**, networks and applications *(6 papers)*
- **Downscaling** the ocean estimation problem and assimilating local data *(6 papers)*
- Towards fine-scale coastal ocean **modelling** *(2 papers)*
- Coastal-scale atmosphere-waves-ocean **couplings** *(6 papers)*
- The **coastal ocean climate**: long-term monitoring, array design and OSSEs in coastal regions *(5 papers)*

The three **Coordinatio**n topics (see section 4.) focussed on:

- Towards the implementation of the "COSS-TT Initiative" **Memorandum of Understanding** → update on implementation & discussion
- Towards a COSS-TT **Science Strategy Plan** (SSP) → Working Groups
- **Exchanging information** in the COSS Community → update & discussion
- Discussions on response to the review, community paper, etc.

2.1. Task Team objectives

The overall TT mission is to provide a sound scientific basis for sustainable multidisciplinary downscaling and forecasting activities in the world coastal oceans. To achieve this, the TT is establishing community links between ongoing coastal forecasting projects and convenes forums to foster discussions of targeted science issues.

The TTs strategic goal is to help achieve a seamless framework from the global to the coastal/littoral scale.

"The influence of coastal ocean processes is felt far beyond the shelf break, thus interacting with open ocean dynamics and controlling the connectivity of remote ecosystems"

2.2. Membership

The TT membership was updated at the 2014 workshop. The current list of members is provided below:

Name	Institution, City	Country
Barth, Alexander	U. Liège	Belgium
Chao, Yi	RSS and UCLA, Los Angeles, CA	USA
Chassé, Joël	DFO, Mont-Joli, QC	Canada

Choi, Byoung-Ju	Kunsan National University	Korea
Cirano, Mauro	REMO, Rio de Janeiro	Brazil
Craig, Peter	CSIRO, Hobart	Australia
De Mey, Pierre	CNRS / LEGOS, Toulouse	France
Dumas, Franck	IFREMER / Previmer, Brest	France
He, Ruoying	NCSU, Raleigh, NC	USA
Herzfeld, Mike	CSIRO, Hobart	Australia
Hirose, Naoki	Kyushu U., Fukuoka	Japan
Jianping, Gan	Hong Kong U. of S&T	China
Kourafalou, Villy	U. Miami / RSMAS, Miami, FL	USA
Kurapov, Alexander	Oregon State U. / COAS, Corvallis, OR	USA
Liu, Guimei	NMEFC, Beijing	China
O'Dea, Enda	UK Met Office, Exeter	UK
Oddo, Paolo	INGV, Bologna	Italy
Pinardi, Nadia	U. Bologna	Italy
Pullen, Julie	Stevens Institute of Technology	USA
Richman, Jim	NRL, Stennis Space Ctr., MS	USA
Stanev, Emil	HZG, Hamburg	Germany
Van der Westhuysen, Andre	NOAA/NWS/NCEP	USA
Zhu, Jiang	IAP, Shenzhen	China

Table 1: Task Team membership, January 2014

2.3. Activities

The Task Team represents the interests of the international Coastal Ocean Forecasting community in GODAE OceanView. Three International Coordination Workshops have been organized so far; these have been successfully embraced by the community as a much needed forum to discuss latest scientific advances, promote international networking and update strategic planning.

A Memorandum of Understanding has been drafted to further consolidate the TT and promote sustainable member engagement.

Several special sessions have been sponsored by the Task Team at AGU and OSM over the years; these have consolidated the outcomes of the TT workshops and allowed exposure of TT goals and outcomes through outreach to the broader scientific community. The next such session will be in Hawai'i.

With support from contributing projects, the TT has compiled a Systems Information Table (SIT) showing details of system domains, project objectives, products, etc.

Pilot affiliated regional working groups are being created, and are expected to serve as a model for further regional initiatives and links with other active international communities, such as the Coastal Altimetry community have been established and more links are planned.

2.4. Attendance

Workshop attendance and TT membership is consistent and shows the continued interest in the community to support the COSS-TT.

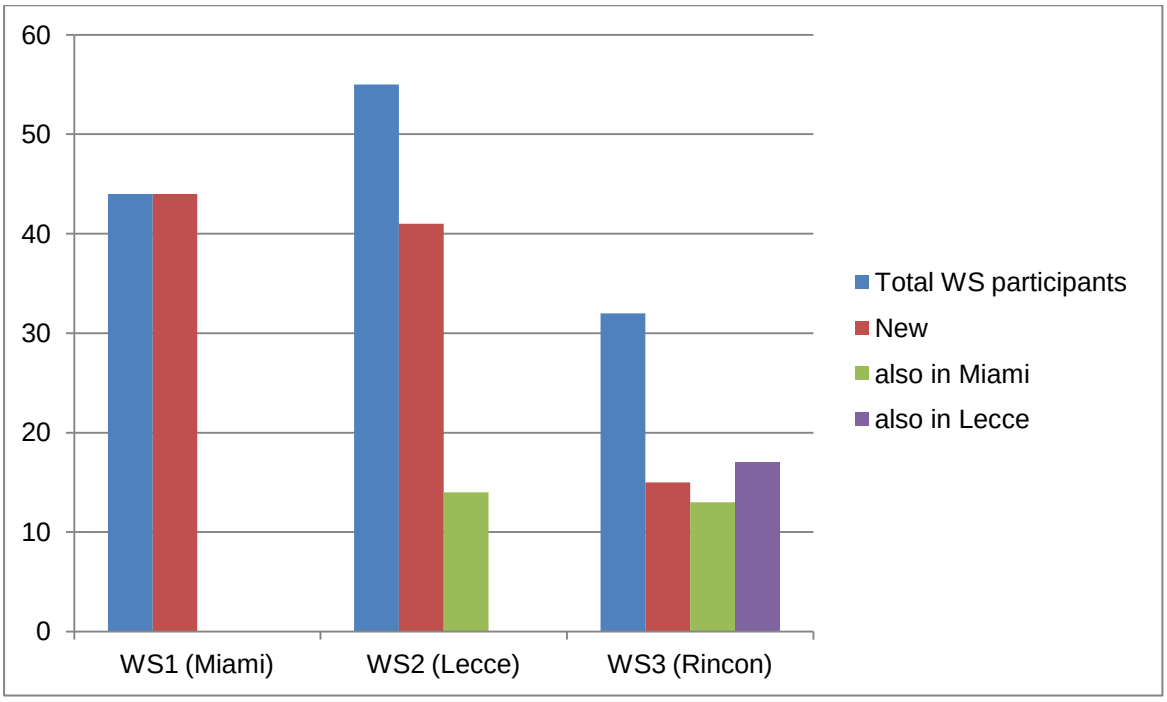

Fig 1: Distribution of participants (new, at other workshops) per WS

The first workshop in Miami attracted 44 participants, the Lecce workshop 55 participants and the Rincon workshop saw 32 participants in total with many people having attended previous workshops. Twelve people attended all three workshops among which were 11 task team members.

3. Science Sessions

The science sessions are a central part of the workshop providing attendees with an opportunity to exchange and learn of progress and achievements at other coastal forecasting systems. Five science sessions were selected and the contributions from attendees are detailed in this chapter. These five science sessions are listed in *chapter 2.*, for which 25 abstract submissions were received (available on the GOV website).

3.1. *Session 1* – Progress of coastal ocean forecasting systems, networks and applications

Session chairs: Mauro Cirano and Byoung-Ju Choi

In this session presenters (6 oral and 2 poster presentations) provided an overview of the progress made at a variety of operational systems covering the Puerto Rico and Virgin Islands, South China Sea, Mediterranean, Bay of Biscay, South West Atlantic (Brazil), Yellow Sea and East China Sea and US coasts and ports.

Development of real time ocean circulation forecast for the area of Puerto Rico and Virgin Islands: Cartagena et al. informed about the coastal ocean forecasting systems for Puerto Rico and Virgin Islands. The system has been built with 1 km grid spacing using American Seas NCOM (3 km) as open boundary data in order to produce a 5-day forecast. The forecast products have been validated against tide station (elevation) and buoys (T, S, u, v) using forecast skill measure (Willmott, 1981).

Operational oceanography forecasting systems in the China seas: Xiaodi et al. introduced a brief history of NMEFC of China, which was found at 1965. NMEFC built a new Chinese GOFSv1.0 system in October 2013 which covers global prediction to shelf seas forecast. The system assimilates SST, SSH, Argo floats data using 3DVAR and EnOI methods. The South China Sea (25 km) simulation were presented, 1/8 gridded SLA product was assimilated using FGAT. The plan is to explore the wave mixing effect on water column.

The Mediterranean forecasting system network, from regional to coastal scale: the MONGOOS working group has two divisions, one that takes care of observations and the other that does the model forecasting. Data and prediction products are serviced through a webpage (www.mongoos.edu). Many coastal forecasting systems from various nations and institutes are part of MONGOOS. It also includes physical and biogeochemical prediction systems as well as calibration-validation system.

On-going data assimilation work with an Ensemble Kalman Filter in the Bay of Biscay: Ayoub et al. have used 55 ensemble members for the assimilation of SST in the Bay of Biscay. Each ensemble member is perturbed by winds and observation data. Twin experiments were performed to examine the effect of SST assimilation on offshore and shallow shelf regions. This research will be expanded to assimilation of SSH data and real observed SST and SSH data. (Poster)

The Brazil Current Variability from the AX97 high density XBT line: Lima et al. have studied the Brazil Current variability using both XBT data and numerical models outputs provided by

the Ocean Forecasting and Analysis Systems. The observation and models were compared in terms of Temperature and currents. A multi-model comparison is planned at the region. (Poster)

Patterns of SST short-term forecast bias in the coastal and marginal seas around China and test of a running-mean bias correction scheme: Zhu and Xie have developed a forecasting system for coastal and marginal seas around China based on HYCOM. Their study focused on the improvement of the SST short-term forecast by calculating model bias for 20 days and using the bias to correct the forecast product in the operational system.

An introduction to a new Yellow Sea and East China Sea Operational Forecasting System: Xueming et al. presented a regional system based on a ROMS 1/30° horizontal grid with 30 vertical layers. This system was used to substitute the previous forecast system, which was based on POM. The new system includes the interaction with tides and river discharges and represents an improvement of the previous POM forecast system.

Coastal and Port Security Applications at the DHS National Center for Maritime Security: Pullen et al presented a range of products developed with the use of coastal land-based radar, passive acoustics and satellite imagery to enhance maritime domain awareness for littoral and offshore operation. An interesting end-user web-based tool for emergency response called Magello (www.magello.org) was shown to demonstrate the applicability of some tools.

3.2. *Session 2* – Downscaling the ocean estimation problem and assimilation local data

Session chairs: Matthieu Le Haneff and Andre Van der Westhuysen

This session consisted of three oral presentations. All three presentations addressed aspects related to data assimilation, with both technical and scientific considerations.

The first presenter was Alexander Barth, who presented recent progress in implementing localization after estimating the model error covariance matrix within an ensemble approach. This new localization technique, named bootstrapping, is based on the splitting of the whole ensemble into two sub-ensembles, in order to retain only the area around an observation point where the covariance values estimated from both sub-ensembles are consistent. The technique has been successfully implemented in an ensemble simulation of the Northwestern Mediterranean Sea. In a second part of his presentation, Alexander Barth presented on-going work on preserving conservation constraints in the case of localized error correction, as performed in ensemble approaches, which originally does not respect these constraints. The method has been implemented in a simple case of 1D equation, and needs to be tested with a more realistic ocean model.

The second presenter was Alexander Kurapov, who presented the efforts made at Oregon State University to implement realistic river forcing and constraining their data-assimilative regional model. The model without data assimilation already shows a realistic signature of the Columbia River plume along the Oregon coasts. Alexander Kurapov then discussed the issues of implementing DA in the context of a river plume. In particular, the covariance

matrix of the model error with respect to initial conditions (involved in the 4D-Var scheme used here) induces smoothing that one wants to avoid in the presence of river plume, whose signature at the ocean surface is naturally sharp. Alex Kurapov suggested using a model error covariance matrix estimated from an ensemble of 50 simulations, generated by perturbing the local winds. He then discussed issues with the localization procedure in the 4D-Var implementation, and introduced a localization technique based on Bishop and Hodyss (2011), which was successfully implemented in the group's model configuration.

The final presenter was Andy Moore, who presented a novel technique for forecasting the analysis error covariance matrix, in the 4D-Var framework. This forecast is based on the EOF decomposition of a matrix Q consisting of the square root of the model analysis error, to which the tangent linear model is applied. The approach was applied to analyze the evolution of the analysis and forecast errors from a box model of a baroclinically unstable jet. Although the true analysis error projects for a large part on an unknown space, as opposed to the space described by the EOF modes, the eccentricity of the spectrum from the EOF decomposition was found to be a good predictor of that error. Such approach should be tested on more realistic ocean model configuration.

Reference

Bishop, Craig H., Daniel Hodyss, 2011: Adaptive Ensemble Covariance Localization in Ensemble 4D-VAR State Estimation. *Mon. Wea. Rev.*, **139**, 1241–1255.

3.3. *Session 3* - Towards fine-scale coastal ocean modelling

Session chairs: Nadia Ayoub and Paolo Oddo

This session consisted in three presentations.

Yi Chao presented progress on the forecasting system for the California coastal ocean and the San Francisco bay/estuary. One of the objectives is to model the salmon migration through the San Francisco bay. The system includes a regional configuration based on ROMS and a multiscale 3D-var. ROMS is coupled to the biogeochemical CoSine model. Outputs from ROMS are used to force a finite-element model (SELFE) configuration of the San Francisco estuary and lower Sacramento River. Some results were shown with comparison to in-situ temperature data. The next step of this work will couple SELFE with CoSine. The system is meant to provide information on the estuary from tides to climate and from physics to ecosystem.

Emil Stanev's work aimed to better understand what we can get from unstructured grid models in straits, with hydraulic processes, in estuaries and for studies on morphodynamic changes in the North Sea coast. Different configurations of the finite-element model SELFE, nested into MyOcean model outputs, were shown. The first example was the study of the response to inter-basin exchange to extreme events, with an application to storm Xaver (Dec. 2013). Other illustrations included: sediment dynamics in the Wadden Sea, impact on dynamics (mainly tides) of changes in bathymetry and dynamics in the Elm estuary.

Mike Herzfeld showed some progress within the eReefs project which aims to develop an information system for the Great Barrier Reef (GBR). Phase 1 of the project, aiming at building the system, is completed. The system comprises of 4 km and 1 km resolution models nested in the OCEAN Maps 10km operational system. Several issues were addressed: open-boundary conditions in the presence of tides, accurate river input at the coast and subgridscale parameterization. Data assimilation, based on EnKF, is used for parameter estimation (short wave radiation parameters) and to adjust open-boundary conditions as biases are found in the large-scale forcing fields. The on-going effort to improve the river inflow forcing was presented.

Recommendations from the above presentations include:

- Need for a precise bathymetry which is most critical when we move towards the near-shore area and towards finer scales; main process impacted: barotropic and internal tides, surges, wetting and drying cycles.
- Presentations illustrated work with unstructured grid either with finite elements (Y. Chao and E. Stanev) or with finite-difference model (M. Herzfeld). Unstructured grids are necessary to represent the complexity of the coastline (e.g. estuaries, straits, inlets); they furthermore provide a seamless transition from the regional to the near-shore scales, as an alternative to several nested configurations.
- High resolution modeling involves issues related to downscaling; here we discussed :
    - options for the boundary conditions scheme, including the specific issue of separating high-frequency tidal flows and lower-frequency open-boundary forcing;
    - the nature and 'quality' of the open-boundary forcing fields: for instance, climatological fields have been found to give the best results for the forcing of the regional ROMS model in the California area instead of outputs from larger scale models. Such feedback could be given to the 'deep ocean community of GOV' as part of a COSS-TT effort to reinforce the interface between both communities (deep and coastal ocean forecasters).
    - handling possible inconsistencies between the low- and high-resolution model topography
    - adjusting open-boundary forcing fields with a data assimilation (DA) method
- Observations for DA at very high resolution are found insufficient in the GBR experiments; this result can probably be generalized to many other coastal regions. Y. Chao considers that HF radars provide the most important data set for forecasting in COSS areas because of the coverage; he underlines however the difficulty to work with such data set, because of the relatively large uncertainties (of the order of 10 cm/s).
- Modeling the near shore area involves taking into account accurately the continental runoff; some work is on-going within the e-Reef project to improve the numerical scheme of river flow input.

3.4. *Session 4* – Coastal-scale atmosphere-wave-ocean couplings

Session chairs: Jiang Zhu and Ananda Pascual

This session consisted of five oral presentations on coastal air-sea interactions and ocean-wave coupling.

Julie Pullen analyzed the ocean response related to the interaction of mountainous island terrain with synoptic disturbances. A high resolution coupled air-sea operational system was used for Philippines and Madeira islands highlighting the importance of eddy formation and shedding processes in the ocean and atmosphere.

Miguel Solano explored the sensitivity to wind forcing resolution of a ROMS simulation for the Caribbean Sea. The strong tidal currents with enhanced wind driven interaction stressed the need of very high-resolution wind fields.

Joanna Staneva described the Coastal Observing System for Northern and Arctic Seas (COSYNA), including the pre-operational systems with nested models, validation of seasonal variability, and public access to data. Recent developments of WAM including the impact of hydrodynamic forcing on waves were also presented as well the response of the sediment transport to wind, wave and tidal forcing, with a particular emphasis to the application to several extreme events (hurricanes Xavier and Britta).

Andre van der Westhuysen presented the Nearshore Wave Prediction System (NWPS) for the area of Puerto Rico and the Virgin Islands. The system is currently being developed to provide a response to society needs, as these islands are frequently impacted and devastated in some occasions by destructive cyclones resulting in high waves, storm surge and river flooding. NWPS features the SWAN and WAVEWATCH wave models with NCEP forcing and the validation takes profit of the array of IOOS observations available in the region.

Cecillie Wettre presented a joint collaborative effort between researchers from Cuba and Norway towards setting up an operational, high-resolution ocean-atmosphere-wave coupled forecasting system. The system is used to force an operational oil spill trajectory-forecasting model. Focusing on this application, two oil spill models were compared. The results pointed out the need of validation by performing an intensive drifter experiment.

3.5. *Session 5* – The coastal ocean climate: long-term monitoring, array design and OSSEs in coastal regions

Session chairs: Marina Tonani and Julie Pullen

This session featured a series of talks focussed on the long-term climate of the coastal ocean. Topics under discussion included the role of open boundary conditions in facilitating accurate projections.

For example in the first talk by Dr. Choi, Japan East Sea simulations were dominated by internal variability as the dominant driver of inter-annual variability. It was recognized that

careful attention to the implementation of boundary conditions is required, especially when simulating long time scales.

This theme was echoed by Jianping Gan who noted high sensitivity to the location of the open boundary, depending on the operative physics in the geographical region of interest. He showed South China Sea process simulations in increasing CO_2 in the atmosphere leading to strong uptake by coastal regions out 50 and 100 years.

The remaining talks centred on the observing system.

Dr. Pascual reported on multi-sensor experiments and documented the improved performance of a bathymetry constraint on the OI of altimetry next to the coast for the Mediterranean. The algorithm has proven to be effective and is on its way to operations. This should provide a measurable improvement in the fidelity of data-assimilating models near the coast.

Dr. Le Haneff, using a Gulf of Mexico OSSE experiment showed that airborne profiles can contribute much value. With good spatial sampling the results can be a 50% reduction in model RMS error.

These talks both pointed the way to using observing systems to improve coastal ocean models on longer time horizons.

The final speaker, Xochitl Perez, discussed contaminant sampling in the San Juan estuary. This talk synthesized biology and human health and reminded us that coastal ecosystems are at risk and in need of long-term monitoring for impacts.

4. Task Team coordination session

4.1. MoU implementation

The Memorandum of Understanding (MoU) represents an initiative of the COSS-TT to establish a sustainable mechanism to consolidate its membership and continue its work, under the overarching objective to advance science in furtherance of multi-disciplinary downscaling and forecasting activities in coastal oceans and shelf seas around the world (COSS-TT initiative).

The full version of the MoU was agreed at the workshop and is being circulated to the COSS-TT members for signature. Signing the MoU is an important TT action item and all COSS-TT members are strongly encouraged to arrange the signing; the list of signatories will be continuously updated.

4.2. Science Strategy for the COSS (response to the GOV review)

The COSS-TT will contribute to the GOV Science Strategy following the recommendation from the GOV review. A plan for the structure of the COSS-TT science strategy is outlined below. The strategy needs to be agreed by the TT before implantation.

Outline:

- Mission statement and long-term outlook
- Description of **science drivers** (see list below)
- Challenges and priorities for science in support of coastal ocean forecasting and applications
- Role(s) of the Task Team towards those priorities
- Specific areas where collective action by the TT can make a difference

Identified **science drivers** in support of coastal forecasting:

1. The coastal ocean climate: long-term monitoring and projections in coastal regions
2. Development of fine-scale coastal ocean models
3. Downscaling the ocean estimation problem from large-scale to coastal-scale models, data and forcings, including coastal data assimilation
4. Coastal-scale atmosphere-waves-ocean couplings
5. Coastal ecosystem response to the physical drivers
6. Probabilistic approaches and risk assessment in the coastal ocean, including extreme events

A preliminary **timeline** for the preparation of the science strategy was proposed as:

- March 2014: Provide outline with synthesis of 3 WG reports: VK+PDM → DG
- March 2014: DG decides (or not) to expand to other experts
- End of June 2014: Full draft to be reviewed by TT ~end of June 2014

4.3. Communication with the COSS community

The need for closer collaboration between members of the task team and the wider COSS community led to the suggestion to implement new tools for communication. The recent twiki page set up through the GOV project office proved unsuitable for easy knowledge exchange. A new approach is exploring the uses and opportunities of an online forum.

4.3.1. Online forum

In Lecce it was proposed that the COSS Task Team should implement a mechanism to better facilitate the exchange of information within the COSS community. One idea was to set up a hierarchical online forum, including sections such as *systems information with links to individual system web sites*, *general announcements, job adverts, training opportunities, publications, and open discussion spaces with direct-input option.* Such forum should include free text search, delegating moderation to topic creators, RSS feeds and access to member profiles. It could help many new systems evolve better and faster, the forum can allow them to receive support from more advanced systems. However, this the frorum need regular and active input/contributions from the community.

Since the Lecce workshop, the co-chairs installed a prototype forum using one of the existing web-based blog platforms at WordPress → http://cossnet.wordpress.com/ (by invitation). So far the site has proven useful, but perhaps it is not hierarchical enough. Delegating moderation seems not possible and the site is a bit complex for easy use. Profile handling is external.

4.3.2. System Information Table (SIT)

The system information table (SIT) provides valuable information of the groups, projects and systems contributing to the COSS-TT and the COSS community. So far there are 31 entries from a variety of systems. Updating the SIT is a vital requirement to keep this resource useful to all. It is planned to update the SIT later this year following the last update in spring 2013.

The SIT is currently maintained by the GOV project office (KWB), and is separate from the envisaged forum system. It remains unclear how the SIT information should be used and publicized and how the information could be kept up to date. It was proposed to update the SIT at least once a year and PDM will check with KWB how this can be achieved best.

4.3.3. Sharing tools

It was suggested that the COSS-TT should also hosts an inventory (or more ambitiously a depot) of general-interest tools: coastal data processing tools, data assimilation tools, modelling tools, diagnostic tools, conversion/interpolation tools, and application tools. This can be of practical importance, as the development of coastal ocean forecast systems (where the focus is on a limited coastal area) is often challenged by limited resources and partial funding. The inventory would help the users identify schemes that are optimally

suited for their requirement of applications, so that they perform under funding limitations and enhance opportunities for attracting sustainable resources.

- Such an inventory would be complementary to the forum and SIT mentioned above, although it could as well be integrated with them.
- It was suggested that some of these issues are tackled in the MyOcean2 European ocean forecasting project, and could be expanded to a global level by interlinking with other groups (in the COSS-TT).

Such tool repository would need a volunteer to be set up and it might be useful to wait for the forum to be installed before moving forward with this plan.

4. Working group discussion

Three independent working groups discussed a set of questions focussing on the main science challenges, priorities, and role of the task team with particular view on the science strategy for the COSS-TT. These discussions were set up to support consolidating the TT future path and to prepare the response to the GOV review.

The **following questions** were addressed:

1) **As of 2014, what are the main challenges and priorities for science in support of coastal ocean forecasting and applications?**

2) **What should be the role(s) of the Task Team towards those priorities?**

3) **In which specific areas can collective action by the TT make a difference?**

4.1. Main discussion outcomes

The following common themes emerged from the working group break-out sessions:

Q1: As of 2014, what are the main challenges and priorities for science in support of coastal ocean forecasting and applications?

1. Imperfect observing systems
2. OSSE/OSE array design
3. Errors in observation, surface forcing, open boundary conditions, model dynamics, missing or incorrectly parameterized physics)
4. Predictability and ensembles
5. Interface with large-scale models (boundary conditions - evaluation, and give feedback)
6. A need for inventories (e.g. of models, methods, data, tools, etc)
7. Uncertainties in bathymetry

Q2: What should be the role of the Task Team towards those priorities?

1. The TT is unique and occupies and important
2. Enhance and facilitate international collaborations
3. Develop standard metrics to quantify error
4. Promote research and applications, via pilot studies, to assess progress
5. Facilitate interaction with global modeling community

Q3: In which specific area can collective action by the Task Team make a difference?

1. Convene coordinated meetings with other interested groups
2. Promote the formation of regional working groups
3. Promote the exchange of experience and ideas
4. Promote and encourage collaborative projects
5. Promote the sharing tools and data

6. Promote connections to the user community and stake holders
7. Define best practices

In addition, a new driver for the COSS TT was proposed aimed at the ecosystem response to the physical environment.

Specific, more detail discussion outcomes from each of the working groups are provided in the next three paragraphs.

4.2. Working group 1

Members of this Working Group were Nadia Ayoub, Mike Herzfeld, Stefano Leonardi, Andy Moore, Paolo Oddo, Xochitl Perez, Miguel Solano, Emil Stanev, Andre van der Westhuysen, Xueming Zhu (groups co-chairs are uncerlined).

All questions as described in the previous chapter were addressed. The outcomes from the discussions are listed below:

Q1: As of 2014, what are the main challenges and priorities for science in support of coastal ocean forecasting and applications?

1) Current observing systems:

i) The need for (near) real-time data (and different level of products) for data assimilation and forecasting was identified as a priority.

ii) OSE/OSSE experiments for quantifying the impact of different levels of remotely sensed data products (e.g. HF radar, altimetry) and other data types were viewed as important activities.

iii) Quantifying observation errors and error covariance modelling in general were deemed very important.

iv) Quality control issues hamper some data assimilation and forecast efforts.

v) The development of common data processing and visualization tools, and data formats for observations and models is important.

2) High resolution modelling and data assimilation:

i) While data assimilation at high resolution is very important, it was recognized that there will never be enough observations to constrain the burgeoning numbers of degrees of freedom (i.e. the curse of dimensionality) so probabilistic approaches will probably be crucial for quantifying uncertainty.

ii) Boundary conditions for coastal models are a significant issue, and the idea whether high resolution models can provide information about errors in global models should be explored.

iii) Techniques for data assimilation within nested models need to be explored.

iv) The interface between structured and unstructured grids is technically challenging and needs more attention.

v) Uncertainties in bathymetry are a serious issue in many coastal regions.

vi) Increased synergy between the coastal modelling and engineering community would be beneficial to both communities.

3) *Coupled models:*

i) More time and effort need to be invested in coupled models such as ocean-wave models, ocean-atmosphere models, ocean-biogeochemical models, ocean-hydrology models, and ocean-ice models, as well as more comprehensive combinations.

ii) Data assimilation in coupled models is in its infancy and would benefit from a coordinated effort.

Q2: What should be the role of the Task Team towards those priorities?

1) The feedback to question 1 (above) was further prioritized with potential collaborative pilot projects in mind to address the following:

i) OSE and OSSEs.

ii) Probabilistic approaches (e.g. for predictability & extreme events)

iii) Development of standard metrics and standard measures for quantifying error.

iv) Data assimilation at high resolution (nested DA, feedback of regional models to global models). One particular recommendation was that the TT should conduct a census of existing methods that are used.

2) Other activities:

i) Explore international funding opportunities to potentially support pilot projects or collaborations.

ii) Invite experts from other areas (e.g. meteorology, ocean biology) to participate in TT and project meetings.

iii) Distribute and update lists of new relevant publications.

Q3: In which specific area can collective action by the Task Team make a difference?

In relation to the question to which specific areas can collective action by the Task Team make a difference, the following suggestions were proposed:

1) TT members should be represented on other steering committees.

2) TT should set up scientific working groups to look at specific topics (e.g. approaches to downscaling; covariance modelling).

3) Members of the COSS community should be encouraged to publish on their state-of-art research under the TT banner.
4) Provide recommendations to agencies (e.g. on observation resource deployments)
5) Provide guidance to biological and environmental monitoring community (e.g. develop metrics useful for water quality issues such as toxic blooms, management of fisheries, etc).

4.3. Working group 2

The co-chairs of the working group 2 were Villy Kourafalou and Marina Tonani.

Review of the TT science drivers

One major recommendation was to add a new driver, tentatively called: "Ecosystem response to the physical drivers". Discussion on the existing drivers pointed out that "adaptation to climate change" should be added in the driver "Probabilistic approach and risk assessment", which should include interface with large scale climate modelling (downscaling from IPCC scenarios…), address specific coastal issues (sea breeze driven by coastal SST gradient, extreme heat events/biophysical impacts, …) and have the overall theme of "toward enhanced coastal predictions" (i.e. include mitigating factors etc.).

Interface with larger scale models

Much better communication with the providers of boundary conditions must be established. COSS modellers must have direct information on system updates and the large scale modellers must encourage feedback so that updates seriously take into account the COSS needs. *Sustainability* of large scale systems is an issue, as agencies running these models sometimes decide to discontinue models that are an integral part of COSS forecasting systems. *Updated description* of large scale systems was proposed (perhaps a large scale SIT). In addition, large scale systems must encourage evaluation at the regional level, which has to be performed by the appropriate COSS systems, which then would provide the feedback. This 2-way communication has to be formalized.

COSS modelling issues

Data needs: bathymetry, high frequency forcing (atmospheric, river discharges,…), data for DA & evaluation, appropriate framework for observing system design/optimization through OSE/OSSEs.

Improvements in physics to address needs for scientific drivers: a) accommodate missing processes (river plume dynamics, waves, tides,…); b) address coupled modelling needs (which are different in coastal than in large scale models)

Going forward

The following priority actions were outlined: improvements in connection with the user community, education/outreach and international collaboration in coastal areas. Suggestions for strategically important methods include: exchange best practices; focus on

cutting edge issues and give collective answers (eg., under the overall banner of “coastal data assimilation” attempt to be more specific, like assimilation in the presence of river plumes, or using coastal altimetry data or expand to DA for biological parameters etc.)

4.4 Working group 3

All three working group questions were addressed. The outcomes from the discussions are listed below:

Q1: As of 2014, what are the main challenges and priorities for science in support of coastal ocean forecasting and applications?

- Imperfect observing system
- Lack of high resolution, high frequency, subsurface data
- OSSE/OSE array design
- Modelling
- Bathymetry, mixing schemes, BC/nesting with internal tides, atmosphere-ocean and wave-current interactions, rivers (data, spreading)
- Data assimilation (to enable prediction)
- OI (open ocean), EnOI, EnKF, 3DVAR, 4DVAR
- Model errors (missing physics)
- Predictions
- Predictability (Regional and application dependent from days to months)
- Ensembles (single & multi-model)
- Best practices
- Compromise between performance (error) and efficiency (run time) for operational models
- Requirements/Needs from different application users

Q2: What should be the role of the Task Team towards those priorities?

- Niche and unique
- Enhance international collaborations (particularly those countries sharing common regions of interests)
- Establish measure of skill of global models in providing BC for regional systems
- Define research/applications cases to assess the performance and measure progress
- Surface velocity (e.g., search and rescue, oil spill)
- SST (e.g., fishery)

Q3: In which specific area can collective action by the Task Team make a difference?

- Communication (e.g., mailing list, web forum)
- Coordinated meetings (e.g., AGU OS evening gathering)
- Form regional groups (e.g., EuroGOOS, Korea/China)
- Exchange experience, lessons learned and knowledge

- Model, DA, forcing, validation, applications
- Sharing
- Success story
- Tools (e.g., inventory)
- Data (e.g., coastal altimetry)
- Collaborative/joint projects
- Hindcast
- Nowcast/forecast (e.g., upcoming Med. Exp.)

5. Other topics

5.1 GOV review and TT response

The GODAE OceanView review panel members invited GOVST co-chairs and members to present the aims, achievements, issues and future plans of the GOV task teams, the science team and the project office. Panel members included *Albert Fischer,* IOC, France, *Shiro Imawaki*, JAMSTEC, Japan, *Ming Ji*, NOAA, USA, *Ralph Rayner*, Centre for the Analysis of Time Series, London School of Economics, UK, *Neville Smith*, BoM, Australia and was chaired by *Richard W. Spinrad*, Oregon State University, USA.

Some excerpts from the review document are listed below:

> *The Panel recommends the formal development […] of a strategic plan (with 5 and 10 year horizons)"* (regarding GOV as a whole)
>
> *"Some Task Teams may require a tighter focus to their activities (e.g., the Coastal and Shelf Seas Task Team)"*
>
> *"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."*
>
> *"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.)."*

A response to the review has been invited to be submitted by end of February 2014, and will require the input and consideration of the whole task team.

5.2 GOV Community paper

GOV is planning to publish a special Issue in the *Journal of Oceanography* (JOO) under the working title: "Progress and Future Priorities in Operational Oceanography". The special issue will represent the progress and achievements made by GOV in the last 5 years including an outlook on the plans for the future. A community paper from the COSS-TT is included provisionally titled:

"Ocean forecasting in the coastal domain: scientific challenges and user needs/benefits"

This paper is led by Villy Kourafalou and Pierre De Mey and contributions from interested co-authors have been compiled.

Action 3.1:	Villy to send an outline (and possibly suggestions for initial input) to TT members and workshop participants.
Action 3.2:	Interested co-authors should respond to Villy with section they want to contribute to.

The deadline to submit ~1 page of text (and max of 1 Fig.) is mid-February. Draft should be

back to all in mid-March. Final draft by mid-April. Submission deadline 30 April.

5.3 Upcoming year events (2014/15)

25-26 February 2014:	OSM Session 3 “Advances in Coastal Ocean Modeling, Observations, and Prediction”, Honolulu, Hawaii
27 April – 2 May2014:	EGU, OS2 – “Coastal Oceans, Semi-enclosed and Marginal Seas”, Vienna, Austria
13-17 October 2014:	GOVST-V Annual meeting, Beijing, China
28-30 October 2014:	EuroGOOS conference, Lisbon, Portugal
17-21 November 2014:	2nd International Ocean Research Conference, Barcelona, Spain

5.4 Next workshop

We are planning the next workshop in June 2015. A survey to find the best dates and location for the event are being set up and results will be circulated asap.

Appendix A: Workshop agenda

Tuesday, 21 January – COSS-TT International Coordination Workshop 3 (Day 1)

	Topics and presentations	*Presenter*
13:30 – 14:00	**Registration** (Payment, badges, poster hang-up, etc.)	Local hosts
	Introduction: *Welcome, presentation by the local hosts, objectives of workshop*	**Session chair: Stefano Leonardi**
14:00 – 14:15	**Welcome** Announcements, practical information, location, local hosts, posters, meals, social events, etc.	Local hosts + Co-chairs
14:15 – 15:00	**Objectives of this workshop and discussion**	Pierre De Mey and Villy Kourafalou
15:00 – 15:30	**Coffee break**	
	Science session 1: *Progress of coastal ocean forecasting systems, networks and applications*	**Session chairs: Mauro Cirano and Byoung-Ju Choi**
15:30 – 15:50	**1.1** Development of real time ocean circulation forecast for the area of Puerto Rico and Virgin Islands	Edgardo Javier Garcia Cartagena, UT Dallas, USA
15:50 – 16:10	**1.2** Operational oceanography forecasting systems in the China seas	Kuang Xiaodi, NMEFC, China
16:10 – 16:30	**1.3** The Mediterranean forecasting system network, from regional to coastal scale	Marina Tonani, Istituto Nazionale di Geofisica e Vulcanologia, Italy
	Poster presentations (one slide)	
16:30 – 16:35	**P1** On-going data assimilation work with an Ensemble Kalman Filter in the Bay of Biscay	Nadia Ayoub, LEGOS/CNRS, France
16:35 – 16:40	**P2** The Brazil Current Variability from the AX97 high density XBT line: a comparison between in situ data, Ocean Forecasting & Analysis Systems	Mateus de Oliviera Lima, UFBa and REMO, Brazil *(presented by M. Cirano)*
	Coordination topic 1: *Towards the implementation of the COSS-TT Initiative Memorandum of Understanding*	**Session chair: Villy Kourafalou**
16:40 – 16:55	**Update on the implementation of the MoU**	Villy Kourafalou
16:55 – 17:30	**Discussion**	Co-chairs + all
17:30	***End of day 1***	

Wednesday, 22 January – COSS-TT International Coordination Workshop 3 (Day 2)

	Topics and presentations	*Presenter*
	***Science session 1** (continued)*	
09:00 – 09:20	**1.4** Patterns of SST short-term forecast bias in the coastal and marginal seas around China and test of a running-mean bias correction scheme	Zhu Jiang, Institute of Atmospheric Physics, Chinese Academy of Sciences, China
09:20 – 09:40	**1.5** An introduction to a new Yellow Sea and East China Sea Operational Forecasting System	Zhu Xueming, NMEFC, China
09:40 – 10:00	**1.6** Coastal and Port Security Applications at the DHS National Center for Maritime Security	Julie Pullen, Stevens Institute of Technology, USA
10:00 – 10:30	**Coffee break**	
	***Coordination topic 2:** Towards a COSS-TT Science Strategy Plan*	**Session chairs: Emil Stanev and Andy Moore**
10:30 – 10:50	**Topic introduction** Science challenges and priorities for coastal ocean and shelf seas monitoring and forecasting – Agree on WG co-leads	Co-chairs + Session chairs
10:50 – 11:00	**CT.1** Report on Coastal Modeling and Shelf Seas working group (EuroGOOS) activities	Paolo Oddo, Istituto Nazionale di Geofisica e Vulcanologia, Italy
11:00 – 12:30	**Parallel sessions** Three (or four) working groups to discuss priority topics and recommendations of international actions for COSS monitoring and forecasting	**Each working group chaired by two co-leads**
12:30 – 15:00	**Lunch break** and time for WG co-leads to prepare slides for the plenary	
15:00 – 16:00	**Plenary discussion** The WG co-leads to present the recommendations and ideas of their morning discussions + Round table discussion on the preparation of the Science Strategy Plan	WG co-leads + all
16:00 – 16:30	**Coffee break**	
	***Science session 2:** Downscaling the ocean estimation problem and assimilating local data*	**Session chairs: Matthieu Le Hénaff and André van der Westhuysen**
16:30 – 16:50	**2.1** Local ensemble assimilation scheme with global constraints and conservation	Alexander Barth, University of Liège, Belgium
16:50 – 17:10	**2.2** Improvements in the Oregon coastal ocean forecast system: data assimilation in the presence of the Columbia River plume	Alexander Kurapov, Oregon State University, USA
17:10 – 17:30	**2.3** Using Singular Vectors to Predict Ocean Forecast Error	Andy Moore, University of California at Santa Cruz, USA
17:30 – 18:00	*Short Task Team meeting & membership discussion*	Pierre De Mey and Villy Kourafalou
18:00	***End of day 2***	

Thursday, 23 January – COSS-TT International Coordination Workshop 3 (Day 3)

	Topics and presentations	*Presenter*
	Science session 3: *Towards fine-scale coastal ocean modelling*	**Session chairs: Nadia Ayoub and Paolo Oddo**
09:00 – 09:20	**3.1** Interactions between the San Francisco Bay/Estuary and California Coastal Ocean	Yi Chao, UCLA, USA
09:20 – 09:40	**3.2** Downscaling to Study Straits, Inlets and Tidal-Bays Dynamics: Unstructured Grid Model Simulations in the North and Baltic Seas	Emil Stanev, Institute for Coastal Research, HZG, Germany
09:40 – 10:00	**3.3** Progress in eReefs: modeling the whole of the Great Barrier Reef	Mike Herzfeld, CSIRO, Australia
10:00 – 10:30	**Coffee break**	
	Science session 4: *Coastal-scale atmosphere-waves-ocean couplings*	**Session chairs: Jiang Zhu and Ananda Pascual**
10:30 – 10:50	**4.1** Ocean Coupling to Topographically-Enhanced Atmospheric Flow	Julie Pullen, Stevens Institute of Technology, USA
10:50 – 11:10	**4.2** Response of the Upper Ocean Using High Resolution Wind Forcing in Puerto Rico and the Virgin Islands	Miguel Solano, UT Dallas/UPRM, USA/Puerto Rico
11:10 – 11:30	**4.3** Response of the German Bight Hydro and Sediment Dynamics to Wave, Tidal and Atmospheric Forcing	Joanna Staneva, Institute for Coastal Research, HZG, Germany
	Coordination topic 3: *Exchanging information in the COSS Community*	**Session chair: Pierre De Mey**
11:30 – 11:45	**Introduction, conclusions of ICW2, and prototype of online forum**	Pierre De Mey
11:45 – 12:30	**Discussion**	Co-chairs + all
12:30 – 14:00	**Lunch break**	
	Science session 4 *(continued)*	
14:00 – 14:20	**4.4** The Nearshore Wave Prediction System and IOOS Coastal and Ocean Modeling Testbed for Puerto Rico and the Virgin Islands	André van der Westhuysen, NOAA/NWS/NCEP, USA
14:20 – 14:40	**4.5** A comparative analysis on the importance of using wave information from a numerical wave model in oil spill trajectory modeling	Cécilie Wettre, Norwegian Meteorological Institute, Norway
	Science session 5: *The coastal ocean climate: long-term monitoring, array design and OSSEs in coastal regions*	**Session chairs: Julie Pullen and Marina Tonani**
14:40 – 15:00	**5.1** Interannual variability of the ocean surface circulation in the Japan/East Sea	Choi Byoung-Ju, Kunsan National University, Republic of Korea
15:00 – 15:20	**5.2** Synergy between satellite altimetry and other sensors for the study of coastal processes	Ananda Pascual, IMEDEA (CSIC-UIB), Spain
15:20	***End of day 3***	
15:45	**Departure by bus for scientific excursion and Workshop dinner**	

Friday, 24 January – COSS-TT International Coordination Workshop 3 (Day 4)

	Topics and presentations	*Presenter*
	***Science session 5** (continued)*	
09:00 – 09:20	**5.3** Circulation,biogeochemical and pCO2 trends in the China Sea from a scientifically-based numerical simulation	Jianping Gan, Hong Kong University, China
09:20 – 09:40	**5.4** Development of a regional ocean OSSE system for the Gulf of Mexico	Matthieu Le Hénaff, University of Miami/RSMAS/CIMAS, USA
09:40 – 10:00	**5.5** Spatial and temporal distribution of emerging contaminants in the San Juan Bay Estuary, Puerto Rico	Xochitl Perez, University of Puerto Rico, Puerto Rico
10:00 – 10:30	**Coffee break**	
	Final remarks and outlook	**Session chairs: Pierre De Mey and Villy Kourafalou**
10:30 – 11:30	**Synthesis on the preparation of the Science Strategy Plan** – Decisions – Calendar – Discussion	Co-chairs + all
11:30 – 12:30	**Other topics and discussion** • GOV Review and TT response • Symposium Community Paper • Hawai'i OSM'2014 • Training • Next meeting and frequency of COSS-TT workshops • Any other topic • Thanks to hosts	Co-chairs + all
12:30	***Closing of workshop***	

Posters

Abstract title	Presenter	Session
P1 On-going data assimilation work with an Ensemble Kalman Filter in the Bay of Biscay	Nadia Ayoub, LEGOS/CNRS, France	2
P2 The Brazil Current Variability from the AX97 high density XBT line: a comparison between in situ data and Ocean Forecasting and Analysis Systems	Mateus de Oliviera Lima, UFBa and REMO, Brazil	5

Appendix B: Participants list

No	Name	First name	Affiliation	Email
1	Ayoub	Nadia	LEGOS/CNRS	nadia.ayoub@legos.obs-mip.fr
2	Barth	Alexander	University of Liège	a.barth@ulg.ac.be
3	Canals	Miguel	UPRM	miguelf.canals@upr.edu
4	Chao	Yi	UCLA	ychao001@gmail.com
5	Choi	Byoung-Ju	Kunsan National University, Republic of Korea	bjchoi@kunsan.ac.kr
6	Cirano	Mauro	REMO/Brazil	mcirano@ufba.br
7	Corredor	Jorge E		
8	De Mey	Pierre	LEGOS	pdm789@gmail.com
9	Garcia Cartagena	Edgardo Javier	The University of Texas at Dallas	edgardo.garcia@utdallas.edu
10	Herzfeld	Mike	CSIRO	mike.herzfeld@csiro.au
11	Jianping	Gan	Hong Kong University of Science and Technology	magan@ust.hk
12	Kourafalou	Villy	Univ. of Miami/RSMAS	vkourafalou@rsmas.miami.edu
13	Kuang	Xiaodi	NMEFC	kuangxd@nmefc.gov.cn
14	Kurapov	Alexander	Oregon State University	kurapov@coas.oregonstate.edu
15	Le Henaff	Matthieu	University of Miami/RSMAS/CIMAS	mlehenaff@rsmas.miami.edu
16	Leonardi	Stefano	University of Texas at Dallas	stefano.leonardi@utdallas.edu
18	Moore	Andrew	University of California Santa Cruz	ammoore@ucsc.edu
19	Morell	Julio M	Dept.Marine Sciences, University of Puerto Rico	julio.morell@upr.edu
20	Oddo	Paolo	INGV	paolo.oddo@bo.ingv.it
21	Pascual	Ananda	IMEDEA (CSIC-UIB)	ananda.pascual@imedea.uib-csic.es
22	Perez	Xochitl	University of Puerto Rico	xochitl.perez@upr.edu
23	Pullen	Julie	Stevens Institute of Technology	julie.pullen@stevens.edu
24	Roberson	Loretta	San Juan University	loretta.roberson@gmail.com
25	Solano	Miguel	University of Texas at Dallas	miguel.solanocordoba@utdallas.edu
26	Stanev	Emil	HZG, Institute for Coastal Research	emil.stanev@hzg.de
27	Staneva	Joanna	HZG, Institute for Coastal Research	joanna.staneva@hzg.de
28	Tonani	Marina	Istituto Nazionale di Geofisica e Vulcanologia, Italia	marina.tonani@bo.ingv.it
29	van der Westhuysen	Andre	NOAA/NWS/NCEP	andre.vanderwesthuysen@noaa.gov
30	Wettre	Cecilie	Norwegian Meteorological Institute	ceciliew@met.no
31	Zhu	Jiang	Institute of Atmospheric Physics, Chinese Academy of Sciences	jzhu@mail.iap.ac.cn
32	Zhu	Xueming	National Marine Environmental Forecasting Center	zhuxm@nmefc.gov.cn

Appendix C: Action list

Action 3.1: Villy to send an outline (and possibly suggestions for initial input) to TT members and workshop participants.

Action 3.2: Interested co-authors should respond to Villy with section they want to contribute to.