COORDINATED OCEAN WAVE CLIMATE PROJECT (COWCLIP) REVIEW

Final Report of the Review Meeting
Banff, Canada, 1-2 November 2013
NOTES

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EXECUTIVE SUMMARY

This report summaries the Coordinated Ocean Wave Climate Project (COWCLIP) review meeting which was held on November 1-2, 2013 at the Fairmont Banff Springs Hotel, Banff, Canada, with the support of the Joint Technical Commission for Oceanography and Marine Meteorology of the World Meteorological Organization and the Intergovernmental Oceanographic Commission of UNESCO (JCOMM). The meeting aimed to review the status of COWCLIP and the research being carried out within its community, assess the continued need for COWCLIP, clarify COWCLIP’s mission and objectives, and reassess the organizational structure of the COWCLIP Working Group. It was attended by twenty-one researchers from twelve countries.

The meeting was opened with a brief overview of COWCLIP. This outlined the objectives and scope of COWCLIP, which span:

- Global projections of wind-wave climate under future climate scenarios
- Regional projections of wind-wave climate under future climate scenarios
- Coupled wind-wave-climate modelling
- Historical wave climate variability and change.

Achievements since the 2011 workshop at which the COWCLIP working group was formed were reviewed, and the aims of the meeting outlined.

On the first day of the meeting, attendees were invited to present brief updates on progress and future planned research activities that overlap with the interests of the COWCLIP, and 9 contributing research groups provided updates. This was followed by a broad discussion which covered several areas, including:

(i) Have the Coupled Model Intercomparison Project 5 (CMIP5) experiments met the wave community needs? What could be improved for CMIP6? COWCLIP recommendations for Climate Variability and Predictability (CLIVAR)
(ii) Climate-wave model coupling
(iii) Assessing skill of Global Climate Models (GCM) for wave climate studies
(iv) Regional studies
(v) Extremes
(vi) Forcing conditions other than wind (e.g., ice coverage, sea surface temperature (SST), tropical cyclones, etc)

The second and final day of the meeting provided the opportunity for targeted discussion on how COWCLIP should proceed into the future. The aim of COWCLIP was clarified; to raise the profile of wind-waves as a variable in the global climate system - both to foster and support determination of:

- the effects of climate variability and change on the wave climate, and
- the feedback influences of waves on the coupled ocean-atmosphere climate system.

To maximize exposure of the activities of the COWCLIP working group, it was agreed that the group should aim to integrate with other programs/working groups for which overlap exists. Much work was identified to progress the COWCLIP aims, and a more defined organizational structure was agreed to meet these demands. The meeting was closed with agreement of success.
REVIEW MEETING REPORT

1. Introduction

1.1. The Coordinated Ocean Wave Climate Project (COWCLIP) review meeting was held on November 1-2, 2013 at the Fairmont Banff Springs Hotel, Banff, Canada, with the support of the Joint Technical Commission for Oceanography and Marine Meteorology of the World Meteorological Organization and the Intergovernmental Oceanographic Commission of UNESCO (JCOMM).

1.2. The review meeting followed the 13th International Workshop on Wave Hindcasting and 4th Coastal Hazards Symposium which commenced at the same location on October 27.

1.3. The meeting aimed to review the status of COWCLIP and the research being carried out within its community, assess the continued need for COWCLIP, clarify COWCLIP’s mission and objectives, and reassess the organizational structure of the COWCLIP Working Group.

1.4. The meeting follows the Coordinated Ocean Wave Climate Projections (COWCLIP) workshop held in Geneva, April 2011 (Hemer et al., 2011), at which the COWCLIP was defined, and a smaller COWCLIP meeting held in Hawaii, November 2011.

1.5. Twenty one researchers from 12 countries attended the review meeting (see appendix 1).

1.6. The first day of the meeting aimed to assess the current status of COWCLIP and lessons learnt since the Geneva workshop. The second day focused on how COWCLIP should progress into the future. A copy of the meeting schedule is appended to this document as appendix B.

2. COWCLIP Status

2.1. The meeting was opened with a brief COWCLIP overview presentation given by Mark Hemer, COWCLIP co-chair, which outlined the objectives and scope of COWCLIP, COWCLIP achievements since the Geneva workshop, and the aims of the meeting.

2.2. The previously defined aims of COWCLIP had been to generate projections of wind-wave climate (ultimately of global extent) and aid comprehensive assessments of their cascading uncertainty by:

- Providing a systematic, community-based framework and infrastructure to support validation, intercomparison, documentation and data access for wave climate projections forced from Coupled Model Intercomparison Project 5 (CMIP) datasets,
- To describe best practice for regional wave climate projections, and
- To engage the interests of the wind-wave community into the wider climate community and ultimately developing coupled wind-wave atmosphere-ocean general circulation models in order to derive quantitative estimates of wind-wave driven feedbacks in the coupled climate system.
2.3. COWCLIP’s scope spans four themes:

- Global wave climate projections
- Regional wave climate projections
- Coupled wind-wave-climate modelling
- Historical wave climate variability and change.

2.4. Key achievements of COWCLIP since the Geneva workshop include

- Completion of the pilot phase of COWCLIP – the inter-comparison of the first community ensemble of global wave climate projections which was documented in a high profile manuscript (Hemer, Fan, Mori, Semedo & Wang., 2013, Nature Climate Change).

- High uptake of COWCLIP outcomes into the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5), Working Group 1 (WG), Chapter 13: Sea-Level Change. Assessments of projected future wave climate change were strongly derived from COWCLIP studies. Relative to the fourth assessment report, the COWCLIP body of work enabled a more rigorous assessment of wave climate projection studies, which considered wave period and direction variables in addition to wave height. The AR5 assessment is low confidence in projections of future storm conditions and hence in projections of ocean waves. A medium confidence is assigned to projected increase in Southern Ocean wave heights. Unfortunately, historical wave climate variability did not receive increased attention within Chapter 3: Observations – Oceans. The AR5 assessment of historical change in wave conditions was limited to wave height only, stating with medium confidence the positive trend in North Atlantic wave heights north of 45N, seen in ship observations and reanalysis forced hindcasts.

- Inclusion of COWCLIP into the inter-sessional workplan of JCOMM (June, 2011)


- Commenced compilation of a second phase COWCLIP ensemble of wave climate projections, with contributions from Commonwealth Scientific and Industrial Research Organization (CSIRO), Environment Canada and U.S. Geological Survey (USGS) received. Contribution from other groups is under negotiation.

- Open availability of global wave climate projections via web (COWCLIP wiki).

2.5. In reference to recommendations following the Geneva workshop, it was considered COWCLIP had made good progress in forming a collaborative working group with interests in wave climate research. Documentation of key science questions and methodology being applied has resulted. A recommendation from the previous workshop where COWCLIP has made little progress has been in the development of a technical framework to support COWCLIP objectives, including project data server, quality-control, file format and standard variable protocols.
3. Individual Group Updates

3.1. Following the introductory COWCLIP overview, nine members presented details of related research being carried out within their groups. These included:

(i) Judith Wolf, National Oceanographic Centre (NOC), UK. Presented the wave model framework being implemented to develop wave and surge projections for the North West (NW) European shelf and NOC’s intention for development of a coupled Nucleus for European Modelling of the Ocean - Wave Watch 3 (NEMO-WW3) system, building on their prior work coupling Proudman Oceanographic Laboratory Coastal Ocean Modelling System – Wave Model (POLCOMS-WAM). A newly underway 7th European Union Framework Programme (EU FP7) project, Responses to coastal climate change: Innovative Strategies for high End Scenarios – Adaptation and Mitigation (RISES_AM), was introduced, which aims to explore the need for adaptation to climate change. Working Package 2 (WP2) of that project aims to refine understanding of the likelihood of future extreme events focusing on the spatial distribution of sea-level change and changes in storm climate.

(ii) Fernando Mendez, Instituto de Hydraulica (IH) Cantabria, Spain. Presented recent developments of the statistical downscaling methodologies at regional and local scales from their group. These techniques have been applied to identify regional wave climate drivers, assess skill of GCMs and support intercomparison between statistical and regional dynamical downscaling studies. A focus of recent work has been seasonal prediction of wave characteristics, and downscaling of tropical cyclone activity and subsequent wave fields. The ability of Global Climate Models (GCM) to represent El Niño Southern Oscillation (ENSO), and how this influences prediction of wave fields is an area of interest.

(iii) Li Erikson, USGS, USA. Expanded on her presentation of wave climate projections for the Pacific North American coast, which nested a higher resolution regional model within a global model. The objectives of this work are to guide and support understanding of coastal geomorphological response to climate change. The global data has been contributed to COWCLIP and USGS intend to make their data publically available. Also presented wave projections research being carried out for the Beaufort and Chukchi Seas, with consideration of the decreasing sea-ice coverage in the Arctic.

(iv) Nobuhito Mori, Kyoto University, Japan. Presented on the Sousei program in Japan, of which the impact assessment component will span 2012-2016. Nobuhito is a program leader for the coastal risk component of Theme D: Projection of climate effects and chief secretary of Theme D itself. The project spans the physical processes (sea-level, waves, storm surges, with high interests in typhoons as the primary driver of extremes in the region), application (to coastal morphology, tidal flats, coastal flooding and infrastructure) to the socio-economic impacts (to guide adaptation, assess disaster risk and life-cycle costs). Techniques being applied include both statistical and dynamical approaches. Future plans include time-slice experiments from which a wave climate ensemble will span different Representative Concentration Pathways (RCP) scenarios, and different Sea Surface Temperature (SST) clusters, with 60km resolution global wave model runs planned for completion early 2015, and 20km resolution runs to be completed by late 2015.

(v) Alvaro Semedo, Naval Research Centre (CINAV, Centro de Investigação Naval) Portugal. Presented ongoing work to assess projected changes in sea and swell
using the CMIP3 based projections dataset. Future plans to commence regional studies, most likely nested using Coordinated Regional Climate Downscaling Experiment (CORDEX) winds.

(vi) Xiaolan Wang, Environment Canada. Reiterated the results presented during the wave workshop. Future plans to carry out in-depth analysis of their CMIP5-based 20-model global projections of wave heights to characterize uncertainty of various sources and to commence projections of mean wave direction. Stressed the need for ongoing planned intercomparison using a designed approach.

(vii) Francois Paris, Bureau de Recherches Géologiques et Minières (BRGM), France. Presented the regional projection dataset for the Bay of Biscay, following the work of Elodie Charles, comparing to the results of other projection studies for which data is available in the region.

(viii) Oyvind Breivik, European Centre for Medium-range Weather Forecasts (ECMWF), UK. Presented the atmosphere-wave-ocean coupling work which is being carried out at ECMWF. ECMWF are in the process of coupling WAM with NEMO, implementing Stokes-Coriolis forcing, wave driven stress of the surface ocean layer, and wave breaking as an additional source of turbulence to the surface ocean. Improvements in the seasonal prediction system were documented.

(ix) Mark Hemer, CSIRO, Australia. Presented an update of the dynamical ensemble which has been carried out by CSIRO (8 GCMs, 3 time-slices, 2 scenarios). Research effort is focusing on the performance of these runs to represent historical variability, and on compiling the second phase COWCLIP intercomparison. Other developments include investigation of ability of climate models to represent the synoptic systems driving realistic wave fields and identifying the information loss obtained through application of 1degree climate models relative to higher resolution hindcasts.

4. Lessons Learnt within COWCLIP

4.1. At the conclusion of the first day, an open discussion was held. A number of topics were raised, and this section of the report aims to summarise the discussion.

(i) Have the CMIP5 experiments met the wave community needs? What could be improved for CMIP6? COWCLIP recommendations for Climate Variability and Predictability (CLIVAR)

- In general the community felt that the CMIP5 experiments, with the archival of high temporal resolution winds and pressure data, enabled the objectives of COWCLIP to be pursued.
- The availability of only short, 20-yr, time-slices of the high temporal resolution was deemed a limiting factor, and a preference for access to full time-series of high temporal resolution archived winds and Sea Level Pressure (SLP) for future climate was expressed. A full time-series would allow improved assessment of the potential impacts of climate change on coastal morphology, and enable study of decadal wave climate variability. Availability of 30-yr time-slices as a minimum was suggested to improve robustness of derived climatology.
- The limitation of the quality of surface winds from the general circulation models, and the high level of uncertainty which surround them, was acknowledged in the context of limiting the potential achievements of COWCLIP. The wave
community would welcome increased attention from the climate modelling community on assessment of surface wind performance as a diagnostic tool in tuning general circulation models.

- It was expressed that COWCLIP may not be maximizing usefulness of the available CMIP experiments, and that additional guidance on how the experiments/ensembles are used by other communities might be useful. Reference was provided to the IPCC AR5 from WG-1 as a good information source on the CMIP5 models and experiments.

- A consensus view of the community was that waves should be considered as a standard climate variable within the CMIP and IPCC process. This progressed to discussion on the relative benefits of un-coupled statistical and dynamical un-coupled approaches and coupling of wave and general circulation models for which there has been continued progress within the community. The uptake of this activity within the WGCM should be championed. It was recognized that this will not extend to all CMIP modelling groups, nor does the group anticipate deterministic wave model simulations be carried out for all CMIP model experiments.

(ii) Climate-wave model coupling

- It was noted that by not parameterising the influence of waves at the air-sea interface, important components of the exchanges are being overlooked. The ECMWF experience has identified notable improvements in operational and seasonal simulations by coupling wave and atmosphere models; and ECMWF is now pursuing development of a coupled atmosphere-wave-ocean model. This presents advantages of improving the model physics, and providing wave climate variables at no extra cost.

- ECMWF’s experience in coupling the atmospheric and wave models, for operational and seasonal applications, indicates the wave model adds only a 10% overhead in computation.

- The approach of Geophysical Fluid Dynamics Laboratory (GFDL) has been to implement a coarse resolution wave model (3 degrees) to limit computational cost, but to provide a prognostic wave field to improve model physics. Their coupled Atmosphere-wave-ocean climate model shows significant improvements to winter mixed layer depth simulations. Strong deepening is observed in the Labrador Sea while reduction of mixed layer depth is found in the Weddle and Ross Sea, all bringing the coupled simulations into better agreements with observations. The enhanced vertical mixing through Langmuir turbulence parameterization coupled with enhanced lateral transport is found to be the key for improving mixed layer depth simulations.

- However, it was noted that it is difficult to argue the advantages of wave coupling. The number of degrees of freedom within the GCMs is large, and addition of new physics requires retuning other model settings.

- COWCLIP should aim to coordinate an activity to identify robust conclusions on the benefit of wave coupling in GCMs to communicate to the climate modelling community. With 4-5 major groups now pursuing coupled climate-wave models, there may be opportunity within the CMIP framework.

(iii) Assessing skill of GCMs for wave climate studies.

- Attention is being given to identifying the GCMs which best reproduce the wave generating weather systems. However, assessments of the relation between model performance for the historical period and projected wave conditions are limited. A large statistical ensemble presented by Xiaolan Wang, Environment Canada, indicated that there was no correlation between model resolution and
model skill in reproducing historical trends and low frequency variability of wave heights. Evaluation studies, in line with Chapter 9 of the IPCC Working Group I (WGI) AR5 report, using waves as a diagnostic are required.

- At the Geneva meeting, the community suggested that a standard procedure for evaluation of the climate model derived wave fields should be defined. This suggestion arose again, but to date no progress has been made.

(iv) Regional studies

- A major motivation for wave climate studies is for regional and coastal applications. While intercomparison experiments are relatively straightforward for global studies where the different groups have similar objectives, regional studies are carried out with different interests. This includes location, but also differences in physics on which attention might be given (e.g., wave-current interaction, tropical cyclones) which are not required for all studies.
- Experience of the proposed COWCLIP intercomparison for the North Atlantic region has found that presently the available ensemble is too disparate, with little overlap in region, scenarios, and techniques, to make such an intercomparison a viable option.
- It was suggested that COWCLIP regional studies align with the CORDEX regional atmospheric program, as a means to promote good practice and collaboration with the atmospheric downscaling community. See recommendations below for framework proposed by Piero Lionello.

(v) Extremes

- COWCLIP is motivated by impact and design studies in the coastal zone and offshore environment. The COWCLIP phase 1 intercomparison paper presented only an intercomparison of mean wave conditions. This is not of interest to the impacts or design community. Within the wave workshop, the design and impacts communities expressed greater interest in presentation of return value estimates of climate change projections.
- Projected extreme wave conditions have a high level of uncertainty, owing to forcing model resolution and representation of storm winds. Furthermore, the many approaches used to estimate return values introduces another source of variance within the development of wave projections. Presentation of the 99th percentile as an estimate of extreme conditions which has greater robustness was suggested, but is recognized as not being representative of extreme conditions for design applications.
- With COWCLIP identifying assessment committees (e.g., IPCC) as the intended audience, the 99th percentile was thought to be the most suitable ‘community’ variable to represent extremes, and presentation of return values be limited to individual studies. Development of a set of wave climate change indices within the framework of the joint WMO/CLIVAR/JCOMM joint Expert Team on Climate Change Detection and Indices (ETCCDI) is desirable.

(vi) Forcing conditions other than wind (e.g., ice coverage, SST, tropical cyclones, etc)

- COWCLIP activities to date have focused on the influence of projected wind changes on wave characteristics. Other climatological varying parameters also influence the wave field, including ice coverage (affecting wave fetch), SST (influencing formation of tropical cyclones). These influences should be given attention in future activities.
- Some discussion surrounded the need to understand the effects of decadal variability of climate on the wave field. While the community agreed, this was in
the sense that we must remain aware of these influences and how this is being addressed by the atmospheric community, the COWCLIP community considered this beyond the current scope.

4.2. The above 6 points summarise the open discussion, and raised several issues which require consideration by the COWCLIP community. This discussion concluded day 1 of the review meeting.

5. COWCLIP Recommendations and Path Forward

5.1. The second and final day of the meeting provided the opportunity for targeted discussion on how COWCLIP should proceed. During the first day discussion, it was pointed out that COWCLIP has not yet achieved the initial aims it intended, of carrying out a designed intercomparison of wave climate projection studies obtained through the multitude of approaches which are being developed in the broader community. Thus it was deemed that there is a need for COWCLIP to continue as a working group into the future.

5.2. The intended primary audience of the COWCLIP Working Group outcomes is assessment of climate change committees (e.g., IPCC, National climate impact reports and operational centres). Also of importance, however at a secondary level, is the intended audience of individual projects – or interested users. These include the coastal and offshore impacts and engineering community.

5.3. The aim of COWCLIP is to raise the profile of wind-waves as a variable in the global climate system – both to foster and support determination of the:

- effects of climate variability and change on the wave climate, and
- feedback influences of waves on the coupled ocean-atmosphere climate system.

5.4. The scope of COWCLIP’s interest therefore spans four general themes:

(i) Global wave climate projection studies
(ii) Regional wave climate projection studies
(iii) Wave-Climate model coupling
(iv) Historical variability

5.5. It was proposed that sub-project leaders be assigned to each of these themes. Nominations were not obtained.

5.6. To maximize exposure of the activities of the COWCLIP working group, integration with other programs/working groups for which there is overlap is required. These include:

(i) JCOMM Workshops on Advances in Marine Climatology (CLIMAR, http://www.marineclimatology.net/web/), which aims to coordinated development of marine climate data and products.

(ii) Climate Change Initiative (CCI)/CLIVAR/JCOMM ETCCDI (http://www.clivar.org/organization/etcddi), which aims to address the need for objective measurement and characterization of climate variability and change.

(iii) World Climate Research Programme (WCRP) WGCM (http://www.wcrp-climate.org/wgcm/), which aims to review and foster the development of coupled climate models.
WCRP CORDEX (http://wcrp-cordex.ipsl.jussieu.fr/), which aims to provide a global coordination of regional climate downscaling for improved regional climate change adaptation and impact assessment.

5.7. COWCLIP’s feedback to the WCRP WGCM on the CMIP5 dataset:

(i) The 2x20 yr time-slices over which high temporal resolution archives of surface variables of interest to the waves community (uas, vas, slp) are archived restricts the depth of analysis which we as a community can pursue. It limits analysis of decadal variability, and it reduces robustness of derived climatology for a time-slice. 2x30-yr time-slices would be of more value, but continuous data would be optimal. We expect this aligns with interests of other storm analysis communities.

(ii) The quality of surface winds from the climate models limits our development of wave fields. We would like to see greater attention applied to surface winds as a diagnostic variable in development of the coupled models.

(iii) The COWCLIP community is actively developing coupled wave-climate models. Presently, different groups are focusing on the influence of different processes (wave-atmosphere, wave-ocean coupling). COWCLIP perceives benefit in integration of these activities with the WGCM, with possible CMIP6 experiments aimed at quantifying the effect of wave coupling (via different mechanisms).

5.8. COWCLIP regional studies (COWCLIP-REX, as proposed by Piero Lionello)

5.9. CORDEX provides fields of uas, vas, sea-ice with at least 6-hrly temporal resolution (some 3-hr) and at least 0.44deg spatial resolution (some higher) over a number of predefined regional domains.

5.10. CORDEX agreed runs include:

- Historical time-slice spanning Jan 1950-Dec 2005, forced with CMIP5 GCM data
- RCP4.5 and RCP8.5 continuous 2006-2100
- Downscaled European Reanalysis (ERA) - Interim, spanning 1989-2008.

5.11. It is proposed that COWCLIP-REX agree on CORDEX domains, and contributing groups run their chosen wave model (statistical or dynamical techniques) with 0.44deg resolution wind forcing, and the wave model having a resolution greater or equal. Runs to be completed include the historical, RCP4.5, RCP8.5 and ERA-Interim as defined above.

5.12. Such a model would allow the following sources of variance to be explored.

(i) Wave model resolution
(ii) Wind model forcing resolution
(iii) Wave models or model physics packages
(iv) Regional Climate Module (RCM) / GCM forcing combinations
(v) RCP scenarios
(vi) Other wave physics (e.g. coupling to currents, tides, surges; tropical cyclone parameterization...)
(vii) RCP physics (e.g., some coupled to ocean circulation models)

5.13. The above list introduces a larger list than the limited COWCLIP regional community is able to address, and prioritization is required within each regional sub-project.
5.14. Regional sub-project leaders were identified for the following regions:

- Arctic - Li Erikson, Will Perrie, Xiaolan Wang
- Australia – Mark Hemer
- East Asia - Nobuhito Mori
- Latin America and Caribbean – Fernando Mendez
- Mediterranean - Piero Lionello, Fernando Mendez
- North-West European Shelf - Fernando Mendez, Judith Wolf
- USA – Li Erikson

5.15. Regional sub-domains require open boundary conditions. Ideally, global wave conditions would be available from a global run obtained from a simulation forced with the corresponding GCM. An alternative solution might be to provide a global model ensemble mean boundary condition, but this introduces potential difficulties with defining high frequency varying time-series at the open boundaries. This issue requires ongoing discussion, and may be specific to sub-regions. Ongoing discussion suggested on the COWCLIP wiki (https://wiki.csiro.au/display/sealevel/COWCLIP - note this page is open to public editing).

5.16. COWCLIP will focus efforts on the following variables:

- Monthly mean and standard deviation of Hsmax, Hs, Hs99, Tm, Tp, Dm, Dp.
- % time monthly Hs exceedances of 1, 2, 3, 4 m.

5.17. This does not restrict contributing projects from considering other variables.

5.18. Global intercomparison experimental design will be guided by the existing studies, which are documented at https://wiki.csiro.au/download/attachments/439419208/COWCLIP_phase2_summary_Aug-2013.xlsx?version=1&modificationDate=1376354266587&api=v2

5.19. Xiaolan Wang suggested two further GCMs be considered for the COWCLIP ensemble (Max-Planck-Institut (MPI) models and European Commission (EC) - Earth), being two models which bound the projection range provided by Xiaolan’s ensemble of statistical projections. Neither model has 3-hrly winds available, and thus not suitable for dynamical studies.

5.20. Standardization of data delivery. COWCLIP agreed data format will be in Network Common Data Form (NetCDF), with standardization of variables and attributes to be defined.

5.21. Contributing data will be stored by contributing groups, with a consistent format. Links will be provided from the COWCLIP website (http://www.jcomm.info/COWCLIP)

5.22. A central database of low temporal resolution ensemble mean data may be stored centrally (e.g., COWCLIP wiki).

5.23. A more formal structure for CSIRO was proposed, with COWCLIP maintaining visibility in international programmes (JCOMM, WMO, WCRP). The following roles have been defined:

- Co-Chairs (Mark Hemer and Xiaolan Wang)
- Steering Committee (Li Erikson, Piero Lionello, Fernando Mendez, Nobuhito Mori, Alvaro Semedo and Judith Wolf)
- Ex-officio (Kevin Horsburgh and Val Swail: Chair/Vice Chair of JCOMM Expert team on waves and coastal hazards, ETWCH).
5.24. A number of international meetings were identified at which it was deemed COWCLIP should have presence in order to raise the profile of the working group. These include:

- American Geophysical Union (AGU) Ocean Sciences (Feb 2014)
- EU/Asian Wave and Tidal Energy Conference (July 2014)
- European Geophysical Union (EGU) General Assembly (April 2014)
- International Conference on Chemistry Education (ICCE, July 2014)
- International Social Science Council (ISSC, Oct 2015)
- Sea level 2016
- Coastal Sediments
- European Meteorological Society (EMS)
- WISE (June 2014)
- AGU General Assembly (December)

5.25. A standard COWCLIP poster was proposed which could be presented at several meetings. A proposed logo is attached to this report.


- This report is to be circulated to attendees for comment by end November 2013.
- Following feedback, report to be circulated to JCOMM and WCRP (end of 2013)
- JCOMM COWCLIP website updated (Jan 2014), including:
  - Executive summary of report
  - List of participating groups
- A COWCLIP meeting proposed for Oct 2014 in Europe. A journal special issue is to be discussed.
- COWCLIP meeting aligned with next waves workshop (Florida?) in Oct 2015.
- Preliminary assessment of phase 2 global intercomparison in 2014.

5.27. COWCLIP has no ongoing funding mechanism to support it or the science achieved under its umbrella. The EC Horizon 2020 program was suggested as a possible mechanism to support COWCLIP aligned science. The Belmont Forum was considered a potential missed opportunity.

5.28. The meeting was deemed a success, and closed. Attendees subsequently enjoyed the snowy return to Calgary airport.
ANNEX 1. Attendees


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Email: jaw@noc.ac.uk
ANNEX 2. Meeting Schedule

Proposed schedule commencing Friday afternoon (1:30pm)
Afternoon tea - 3:10 - 3:30pm
Break at 5:30pm (or continue if nearly complete and can avoid meeting Saturday morning)

1. **A brief overview presentation of COWCLIP progress since the 2011 meeting in Geneva**
   a. Include review of COWCLIP uptake in IPCC AR5
   b. Comments/Questions/Discussion

2. **Achievements and Activities (COWCLIP related)**
   a. Groups present COWCLIP related results and future COWCLIP related activities/schedule/plans (suggested limit 20 minutes)
      1. Judith Wolf
      2. Fernando Mendez
      3. Li Erikson
      4. Nobuhito Mori - Ongoing and plan of wave climate projection and related study in Kyoto University group
      5. Alvaro Semedo - WAM-ECHAM5 wave climate dynamic model projections
      6. Xiaolan Wang
      7. Francois Paris
      8. Oyvind Breivik
      9. Mark Hemer
   b. What have we learnt? Discussion topics
      (i) Do CMIP5 experiments meet wave community needs? What could be improved for CMIP6? COWCLIP Recommendations for CLIVAR
      (ii) Skill of GCMs for wave studies. Does community advocate particular models, or do we follow full ensemble approach. Recommendations.
      (iii) Regional projections vs Global projections - are they comparable? Pros/cons of each?
      (iv) North Atlantic intercomparison study
      (v) Extreme wave climate considerations
      (vi) Wave climate projections have been predominantly based on projected wind changes. What are influences of other forcing parameters (i.e., changing ice coverage in ice regions, changing SST in tropics influencing TC occurrence, etc)
      (vii) What sea-state parameters are needed to support COWCLIP objectives?
      (viii) Wave driven feedback processes. Coupling developments. Review paper of waves role in coupled system
      (ix) Others?

3. **The Future**
   a. Making data available for broader community?
   b. Reconsider need for COWCLIP, it's objectives and structure

4. **Other business**

5. **Meeting close.**
ANNEX 3. Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AGU</td>
<td>American Geophysical Union</td>
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<tr>
<td>AR</td>
<td>Assessment Report</td>
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<tr>
<td>BRGM</td>
<td>Bureau de recherches géologiques et minières</td>
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<tr>
<td>CCI</td>
<td>Climate Change Initiative</td>
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<tr>
<td>CINAV</td>
<td>Centro de Investigação Naval</td>
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<tr>
<td>CLIMAR</td>
<td>JCOMM Workshops on Advances in Marine Climatology</td>
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<tr>
<td>CLIVAR</td>
<td>Climate Variability and Predictability</td>
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<tr>
<td>CMIP</td>
<td>Coupled Model Intercomparison Project</td>
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<tr>
<td>CORDEX</td>
<td>Coordinated Regional Climate Downscaling Experiment</td>
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<tr>
<td>COWCLIP</td>
<td>Coordinated Ocean Wave Climate Project</td>
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<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organization</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
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<tr>
<td>ECMWF</td>
<td>European Centre for Medium-range Weather Forecasts</td>
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<tr>
<td>EGU</td>
<td>European Geophysical Union</td>
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<td>EMS</td>
<td>European Meteorological Society</td>
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<td>ENSO</td>
<td>El Niño Southern Oscillation</td>
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<td>ERA</td>
<td>European Reanalysis</td>
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<td>ETCCDI</td>
<td>Expert Team on Climate Change Detection and Indices</td>
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<tr>
<td>ETWCH</td>
<td>Expert Team on Waves and Coastal Hazards</td>
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<tr>
<td>EU FP7</td>
<td>The 7th European Union Framework Programme</td>
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<tr>
<td>GCM</td>
<td>Global Climate Model</td>
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<tr>
<td>GFDL</td>
<td>Geophysical Fluid Dynamics Laboratory</td>
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<tr>
<td>ICCE</td>
<td>International Conference on Chemistry Education</td>
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<tr>
<td>IH</td>
<td>Instituto de Hidráulica</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<tr>
<td>ISSC</td>
<td>International Social Science Council</td>
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<td>JCOMM</td>
<td>Joint Technical Commission for Oceanography and Marine Meteorology</td>
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<td>Max-Planck Institute</td>
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<td>NetCDF</td>
<td>Network Common Data Form</td>
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<td>NEMO</td>
<td>Nucleus for European Modelling of the Ocean</td>
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<td>SLP</td>
<td>Sea Level Pressure</td>
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<td>SST</td>
<td>Sea-surface Temperature</td>
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