Global Climate Observing System, with a focus on Ocean Activities

Katy Hill, Scientific Officer
Global Climate Observing System
WCRP JSC April 2016.
GCOS follows a 3 phase approach driven by users

2015 Status Report started the 3rd assessment cycle with a new Implementation Plan due in 2016 for UNFCCC COP 22

3 Science Panels for Atmosphere, Land and Oceans; all joint with WCRP:

- Capture requirements for users of climate observations.
- Identify & review Essential Climate Variables (ECV) and their specification.
- Review adequacy of networks to measure & exchange data.
- Give recommendations for the new Implementation Plan.
- Advocating sustained networks, open data access, and future evolution.
- Coordinate with other observing systems.
- OOPC: Focus on systems based evaluations of the Observing System.
GCOS Status of the Global Observing System for Climate (GCOS-195) has been published.

It was submitted to this SBSTA at COP 21 in Paris 2015.

Describes how well climate is currently being observed, where progress has been made, where progress is lacking or where deterioration has occurred.

- provides a basis for the new GCOS Implementation Plan
- covers matters relevant to the other issues such as biodiversity, desertification, wetlands and sustainable development (SDGs).
Overall message: continuity with progress

Primary purpose (UNFCCC) remains intact

Broader context of implementation introduced

1. Energy, water and carbon cycles reinforced
2. Cross-convention use of observations (UNFCCC, CBD, UNCCD) proposed
3. Adaptation + Mitigation framed
4. Climate Services acknowledged

Supporting observations introduced

- gravity, DEM, orbit restitution...
## 2016 GCOS Implementation Plan

<table>
<thead>
<tr>
<th>Date</th>
<th>Milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-2015</td>
<td>Preparatory work in 2013 – 2015 (GCOS panel meetings and three workshops with GFCS/UNFCCC/IPCC; Publication of Status Report)</td>
</tr>
<tr>
<td>15 November 2015</td>
<td>Draft Table of Contents submitted to COP21</td>
</tr>
<tr>
<td>2-4 February 2016</td>
<td>First Writing Team meeting: Detailed outline &amp; writing assignments</td>
</tr>
<tr>
<td>2-4 March 2016</td>
<td>Open GCOS Conference: collect community views</td>
</tr>
<tr>
<td>April 2016</td>
<td>GCOS panel meetings finalize their draft chapters</td>
</tr>
<tr>
<td>24-26 May 2016</td>
<td>2nd Writing Team meeting: completes draft</td>
</tr>
<tr>
<td>June 2016</td>
<td>Limited review (including WMO, Technical Commissions and RAs)</td>
</tr>
<tr>
<td>July 2016</td>
<td>Public review (6 weeks)</td>
</tr>
<tr>
<td>September 2016</td>
<td>Final version approved by GCOS SC-24</td>
</tr>
<tr>
<td>October 2016</td>
<td>Final plan submitted to COP22</td>
</tr>
</tbody>
</table>
GCOS Open Science Conference

- 2-4 March 2016, Royal Academy of Arts and Sciences, Amsterdam, NL
- 150 participants, from 40 countries
- 100 observers using the video live stream, from 28 countries
- About 150 received abstracts
- 57 invited talks and speakers
- 62 posters being displayed
- Dedicated website:
  gcos-science.org
Focus on the

OCEAN OBSERVATIONS PANEL FOR CLIMATE
GOOS Application Areas

Climate
(through GCOS for IPCC, UNFCCC, GFCS and national monitoring, mitigation, adaptation)

Real-time Services
(through JCOMM services, GODAE OV to specific benefit areas)

Ocean Health
(with GEO BON and others for IPBES, WOA, CBD, and national applications)

GOOS separation of responsibility for disciplines (ocean variables)

Physics  Biogeochemistry  Biology

Strength of disciplinary contribution to application area

GCOS-GOOS-WCRP
OOPC: Panel for Physics variables, and Climate Theme Lead
RT Services Theme Lead.
Ocean Health Theme Support

GOOS Biogeochemistry: Panel for Biogeochemical Variables and Climate Theme Support
Ocean Health Theme Support

GOOS Biology: Panel for Biology Variables, and Ocean Health Theme Lead
Climate Theme Support
Panel needs to engage on many fronts: focusses activities and provides platform for discussions with partners.

Task Areas

- Planning and reporting activities (through GOOS, GCOS, etc)
- Assessing Observing system performance and design (partnering with GOV, GSOP).
- Reviewing components of the observing system and focussed systems based evaluations
  - Deep Ocean Observing Strategy (becoming a project)
  - Tropical Pacific (now a project; TPOS 2020)
  - Next: Open Ocean-Shelf Interactions.
- Topics on ‘watching brief, e.g.
  - Air Sea Fluxes
  - Polar Oceans (ice-ocean interface)
Development Project

TROPICAL PACIFIC OBSERVING SYSTEM, TPOS 2020 PROJECT
ENSO is a dominant signal, has driven the development of T.P.O.S. since the beginning.

- Orientation is strongly phenomenological in addition to scale-driven.
- We must use what we know about ENSO phenomena in evaluating sampling choices.

Long history of successful seasonal forecasts made possible by tropical Pacific observations.

- Operational stakeholders: support for forecast systems
- Consider model development, model strengths and weaknesses

Fundamental coupled nature of the tropical climate and its sensitivity to coupled feedbacks:

- Planetary boundary layer as a core piece of what in other places can be primarily an _ocean_ observing system.
Models remain a weakness of ENSO prediction

TPOS 2020 will not itself build models, but much of the impact of TPOS data is through models:
Analyses and reanalyses that synthesize diverse data sources, in situ and satellite.
Bad (biased) models can degrade TPOS data products.

One example where models need observational guidance:
• The diurnal cycle surprisingly important for the transmission of surface fluxes to subsurface ocean.
• Heat and momentum are communicated downwards via mixing produced by afternoon heating/stratification.
• Models without these processes have cooler SST and weaker thermoclines (persistent biases).

Diurnal cycle composite at 2°N, 140°W.
Wind and current vectors, temperature shading.
Afternoon trapping, then downward propagation of T and u (and implied mixing) into the evening.

TPOS 2020 will support limited-term process studies to support model development

Fig. 5. Mean diurnal composite (24 May 2004–7 Oct 2004) of wind (blue vectors), temperature (color shading), and currents relative to 25 m (black vectors). The vector scale is shown at the bottom.
OSEs: “Many lives of an observation” (Balmaseda, 2014)

- Calibration of Satellite retrievals
- Model development, tuning, initialization, verification
- Trend detection
- Underpin evolving climatologies
- Process diagnosis

A typical OSE that tests only the initialization step is not a full evaluation, and the results depend on the particular model and its biases.

- How can TPOS use OSEs to assess array configurations?
- Data-based objective techniques to integrate global high-horizontal-resolution satellite data (SST, SSH) with sparse in situ profiles?
- “Armor3D”: Satellites provide mesoscale, in situ tunes for vertical structure and large-scale.
TPOS 2020 Transition Team → Permanent Coordination Mechanism
Next Evaluation Activity:

BOUNDARY CURRENTS AND THEIR INTERACTION WITH THE SHELF
The proximity of energetic boundary currents at the shelf edge is a key dynamic in mediating shelf-sea/deep-ocean exchange, and ecosystem response. Boundary Current mass, heat, and salt transports importance in basin-scale ocean budgets, and need sustained observation.
• Comprehensive coastal observing systems could measure shelf-sea/open-ocean exchange in conjunction with networks that capture variability within BC regimes and the ocean interior.

• Regional activities around the world exploring multi-platform approaches to observing boundary currents/shelf interactions

• Many core networks considering their capability to measure Boundary Current regimes, i.e. Argo, OceanSITES, Ocean Gliders, etc Need to assess multiplatform approach.

• Downscaling climate models: Need observations to assess veracity

• 3-D time-varying data assimilative model based circulation estimates in shelf and BC regimes at o(km) scales are in reach: Need observations to synthesize through DA system
AGU Ocean Sciences session:

- Sampling of Coastal Seas / Deep Ocean Connection studies
- Discussed science questions and drivers, uncertainties, observing requirements, gaps to address
- Demonstrated “realistic” and idealized modeling approaches to building process understanding
- Highlighted increasing use of integrated observing technologies, but also the present limits to the extent of observing system

Next? Workshop on Boundary Current / Shelf Sea Interaction

- Recommendations on intensive international pilot process experiments in specific boundary current/shelf-sea regimes that will guide the development of a sustained observation and modeling system
- Improved techniques for downscaling climate models, and including adequate representations of higher frequency, smaller scale processes that drive coast and shelf dynamics and ecosystem response.
Questions?

khill@wmo.int