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**INTERGOVERNMENTAL OCEANOGRAPHIC  
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**First Workshop of the WMO-IOC Centre for Marine  
Meteorological and Oceanographic Climate Data (CMOC) in  
Tianjin, China (CMOC/China)**

Tianjin, China  
29 August-1 September 2016

**JCOMM MEETING REPORT NO. 130**

**FINAL VERSION**

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## NOTES

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## EXECUTIVE SUMMARY

The First Workshop of the WMO-IOC Centre for Marine Meteorological and Oceanographic Climate Data (CMOC) in Tianjin, China (CMOC/China) was held in Tianjin, China, from 29 August to 1 September 2016 at the kind invitation of the National Marine Data and Information Service (NMDIS) State Oceanic Administration (SOA) of China.

The workshop recalled the importance of appropriate marine meteorological and oceanographic climatological data, and particularly long term climate monitoring, seasonal to inter-annual climate forecasts, for the Global Framework for Climate Services (GFCS), and ocean climate requirements of Global Ocean Observing System (GOOS).

The workshop participants received background information regarding the establishment of IOC-WMO Centres for Marine Meteorological and Oceanographic Climate Data (CMOCs) per Recommendation 1 (JCOMM-IV), and in particular the recent formal establishment of the CMOC at the NMDIS, Tianjin, China through WMO Resolution 4.2.3(3)/1 (Cg-XVII) and IOC Decision 7.1.3 (IOC-XXVIII).

The workshop reviewed the biennium Work Plan for 2015-2016, reported on the progress and advised on the way forward. The workshop also revisited guidance from the WMO and IOC on the Marine Climate Data System (MCDS) and CMOCs. An open session was conducted to discuss data and metadata, historical data rescue, and the MCDS implementation.

The participants acknowledged the need for high quality marine meteorology and oceanographic measurements of the world oceans, and received comprehensive information on the implementation of MCDS and CMOC/China.

The workshop issued a series of recommendations to CMOC-China detailed in [Annex IV](#).

The workshop thanked China, SOA, and the NMDIS for providing data and information products and capacity building support on met-ocean data QC, marine data and information management and services to the countries of the Asia Pacific Region and their strong commitment to operate the CMOC/China.

## 1. Opening

Dr YU Ting (Julia) from the National Marine Data and Information Service (NMDIS) of China, opened the First Workshop of WMO-IOC Centre for Marine Meteorological and Oceanographic Climate Data, Tianjin/China (CMOC/China), at 10:00 hours on Monday, 29 August 2016, at the conference room 1# fifth floor, Holiday Inn Riverside Hotel, Tianjin, China.

On behalf of the Local organizing committee, Dr YU welcomed all participants to the workshop, and expressed her appreciation for the strong support of the participants. She then conveyed her sincere appreciation to the WMO and IOC Secretariat for helping preparing and organizing the workshop.

Mr CHU Jun, Division Chief of Environment Information Support, Department of Marine Forecast and Disaster Mitigation, SOA, on behalf of State Oceanic Administration (SOA) of China, extended his warmest welcome and heartfelt gratitude to all the distinguished guests coming from afar. He reviewed the importance of oceanographic and marine-meteorological data as the basis for human beings to understand, utilize and protect the world's oceans, which can also be regarded as an important information resource for the marine natural disasters prevention and mitigation. Mr CHU then briefed the participants on the functions of the Marine Forecast and Disaster Mitigation Department of the SOA. WMO-IOCCMOCs were recognized as an important part of the Marine Climate Data System (MCDS) in the field of data integration by the JCOMM. SOA pays high attention to the construction of CMOC/China. He expressed confidence that the workshop will provide a solid foundation for promoting the progress of CMOC/China for the next two years. The Marine Forecast and Disaster Mitigation Department will continue to provide full support to the operation of the CMOC/China.

Mr FENG Jun, Division Chief of International Organizations and Conferences, Department of International Cooperation, SOA, explained that SOA, through the Department of International Cooperation and the subordinate agencies/institutes, has been actively participating in JCOMM activities for many years. He reviewed the history of CMOC/China and believed it is a successful example of China's cooperation with IOC and WMO, and also an example of China's contribution to the international ocean community. He also pointed out that, being the first CMOC in the MCDS, there was no experience from others to use for reference and the CMOC/China was leading a large effort and would be building and providing experience to future CMOCs and Centres of the MCDS. All suggestions from the meeting are important to China and to the development of CMOC/China.

Mr Eric Freeman (USA), Chair of the JCOMM Expert Team on Marine Climatology (ETMC), conveyed his sincere appreciation to the Chinese Government, especially NMDIS for organizing and hosting the workshop. He also expressed appreciation to NMDIS for all the efforts on coordinating and implementing the CMOC/China project during the past years. He referred to the CMOC role in the MCDS and expressed the

hope that CMOC/China could be further utilized by both IODE and WESTPAC. He ended by wishing great success to the workshop.

Mr YAO Yong the Deputy Director-General of National Centre of Ocean Standards and Metrology (NCOSM), SOA, extended his sincere congratulations to CMOC/China's official establishment. He pointed out that NCOSM has a close relationship with NMDIS working to improve observation quality and promote the data utilization. Acting as WMO-IOC Regional Marine Instrument Center for the Asia-Pacific Region (RMIC for Asia-Pacific) since 2011, NCOSM will support CMOC/China to fulfill its duties. He also expressed the hope that WMO, IOC and their working groups could carry out closer cooperation with CMOC/China and RMIC for Asia-Pacific, in sharing advanced technologies, experiences, and networks. Together with CMOC/China, RMIC for Asia-Pacific would like to make more contributions to establish a uniform quality control system for the Global Ocean Observation System (GOOS) and enhance capacity building for the region.

Mr XIANG Wenxi, Deputy Director-General of NMDIS, as the Coordinator of CMOC/China, welcomed all participants and expressed his appreciation to all of the distinguished experts for participating in the workshop. He especially thanked the WMO Secretariat for support and help in coordinating and organizing the workshop. He briefly reviewed the progress of CMOC/China since its official approval in 2015 by WMO and IOC. According to the "CMOC/China Workplan for 2015-2016" designated by JCOMM, a number of activities had been implemented. He then introduced the ongoing efforts in terms of international and regional cooperation at NMDIS, all of which will facilitate the operation of CMOC/China. He emphasized that the establishment and operational capabilities of CMOC/China is a further commitment in participating and contributing to the integration of global oceanographic and meteorological data management systems, as well as regional marine capacity building. He ended by thanking the participants for their valuable comments and suggestions going forward.

## **2. Organization of the workshop**

### **2.1 Adoption of the Agenda**

The participants agreed on the working hours and other arrangements for conducting the workshop.

The workshop adopted the revised agenda, noting that it would be flexible depending on the time needed for each agenda item. The Agenda is attached as [Annex I](#).

### **2.2 Designation of the Chair and Rapporteur for the workshop**

The workshop designated Mr Eric Freeman (USA) as the Chair of the meeting and Mr GAO Zhigang (China) as the rapporteur of the meeting. The workshop was conducted

in English only.

## 2.3 Local information

The local host introduced the local arrangements for the meeting, including the welcome reception at 18h00 on 29Aug 2016.

## 2.4 Group photo

A group photo was taken at the lobby of the Holiday Inn Tianjin Riverside. The list of participants is provided in [Annex II](#).

## 3. Report of CMOC/China on work plan 2015-2016 and progress

### 3.1 Progress report of CMOC/China

Dr YUTing (Julia) recalled the successful evaluation by JCOMM of the application of NMDIS/SOA in Tianjin, China to become a CMOC, the adoption by WMO-CG-17 of Resolution CG-17 4.2.3(3)/1 (Designation of the Centre for Marine Meteorological and Oceanographic Climate Data—CMOC in Tianjin, China), and the approval by the IOC Assembly through Decision IOC-XXVIII, Dec. 7.1.3.

She described the progress of CMOC/China in general since the JCOMM Expert Group visited NMDIS in November 2014<sup>1</sup>. She pointed out that the work plan drafted by the expert group was the essential document for implementing the project during the past two years. The 2015 annual report submitted to JCOMM was based on the activities listed in the workplan.

She reported that a number of actions were initiated on data rescue, met-ocean integration and quality control (including duplicate elimination). Climate statistical products and regional and global reanalysis datasets were produced.

Dialogues with the regional international officers were conducted. The Head of Intergovernmental Oceanographic Commission (IOC) Sub-Commission for the Western Pacific (WESTPAC) Office, Mr. Zhu Wenxi and IODE Co-Chair Professor Yutaka MICHIDA (Japan) visited NMDIS in July and October 2015, respectively. They both encouraged CMOC/China to play a greater role in the Western Pacific region in terms of

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<sup>1</sup> JCOMM Expert Team visited NMDIS in November 2014 China, per decision of the Data Management Coordination Group (DMCG). The Expert Group was leading by Scott Woodruff (USA), representative of the Expert Team on Marine Climatology (ETMC) and International Comprehensive Ocean-Atmosphere Data Set (ICOADS). The other two members were Yutaka Michida (Japan), representative of the Expert Team on Data Management Practices (ETDMP); and Nelly Florida Riama (Indonesia), representative of JCOMM on Capacity Development issues.

The purposes of the Expert Group's visit were to address the recommendations of the CMOC/China evaluation report, and discuss with NMDIS and SOA how the conditions stated in the report for establishing CMOC/China can be met and future collaborations



international ocean data and information exchanges and to enhance the cooperation between WESTPAC member states.

Two capacity building activities were carried out:

- Training Course: The Use of the Global Temperature and Salinity Profile Programme Data for the WESTPAC region, 8-10 December 2015, Tianjin, China
- Ocean Data Assimilation Summer Training Course, 13-24 July 2015, Harbin, China

### 3.2 Metadata and data integration of DBCP

Ms YUE Xinyang from Marine Data Center, NMDIS, presented the background and progress of metadata and data integration of DBCP drifting buoys during the past two years. As one of CMOC/China's most important tasks, research on integrating DBCP drifting buoy data and metadata based on the dataset sample from ISDM and metadata from AOML was carried out. The prototype dataset is available on the CMOC/China website. The data files are organized by drifter ID. Currently there are over 20 thousand drifters and 3.7GB of data. The dataset is from year 1979 to 2016 and is continually being updated. Issues encountered while developing the database include lack of metadata, or in some cases, incomplete metadata information. Future work will include continued metadata collection, data quality evaluations, automatic QC on drifting buoy data, and generation of related products.

The workshop suggested it is important that these dataset is different from other DBCP dataset and make sure they are available online. According to YUE, the integrated DBCP data and dataset produced at CMOC/China aim at providing a more complete drifting buoy dataset and would give as more information as possible. And all products will be released on line once the reconstruction of the CMOC/China website is finished.

The workshop noted that the real-time data-flows from the drifting buoys through the Global Telecommunication System (GTS) to ISDM and Météo France. The two entities process global data and thus act as GDACs and mirror with each other. Météo-France focuses on the generation of derived products aimed at real time use. ISDM processes data in semi-real-time, applies Minimum Quality Control (MQC) and then archives and makes available the QCed observations. For the metadata sources, NOAA AOML and JCOMMOPS are two entities managing the drifting buoy metadata. AOML generates products on a yearly or twice yearly schedule, to produce derived products in a delayed-mode. JCOMMOPS AOML publishes their delayed-mode data through various means including the web and also sends a copy to ISDM who mirrors these derived products on their web site.

The workshop focused on identifying the current gap in drifting buoy data and metadata services. It is recommended that CMOC/China continue its work on integrating the data and metadata. The resulting discussion determined that connections with all the GDACs of drifting buoy and the AOML and JCOMMOPS should be established under

the coordination of JCOMM.

### 3.3 Integration and duplication remove of the global and regional marine and meteorology data

Dr LIU Yulong from the Marine Data Center, NMDIS, presented on quality control methods of temperature/salinity data and meteorological data. CMOC/China adopts uniform quality control methods and procedures in processing ocean data. Temperature and salinity data QC include 5 checks: the basic check of time and space, the section check, climatic characteristics check, consistency check and visual check. Marine meteorological data processed at CMOC/China include 3 kinds of data, the station data, the sea surface and the upper atmosphere data. A total of 15 test methods are applied in marine meteorological data QC.

Methods of duplicate removal for marine environmental data was discussed. According to current marine observation methods, instrument transmission mode, instrument precision, and methods of dataset production, key information and main principles of duplicate removal were decided. The critical value of the duplicate data was determined and adjusted according to the spatial and temporal distribution of the data and the result of the applied weighting<sup>2</sup>. Examples of the collection, processing and integrating of Argo, GTSP, WOD, ICOADS at CMOC/China were demonstrated in the report.

The workshop acknowledged the value of the QC and data integration of the CMOC/China. It is suggested that as ICOADS and WOD are also doing duplicate elimination and data integration, the work of CMOC/China will be more valuable if shared with the international community to improve the quality of the aggregated dataset of the WOD and ICOADS.

### 3.4 Climate statistical product R&D

Mr. Li Huan from the Division of Marine Forecast and Disaster Mitigation/NMDIS reported on the development of climate statistical products produced during 2015-2016. They focus on the climate characteristics of the China Seas, climate variability and the potential causes, climate variations in Northwest Pacific, tropical Pacific and Indian Ocean as well as changes in the Asian Monsoon system.

- 17 issues of *Monthly report of sea level and climate change of China* were completed from Jan 2015 to May 2016, giving the variations of sea level, sea surface temperature, air temperature, and sea level pressure variations along

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<sup>2</sup> Different levels of original data collector and datasets producers are set. Taking Argo data as example, Argo data released by GDACs are set as level 1. Argo data in WOD are set as level 2. For complete duplicate data, level 1 data are preferentially retained.

For the quasi duplicate cases, data with more additional information, higher accuracy, longer profile sequence, and more advanced observation instrument are kept.

the coast of China Sea, the variation of Asian Monsoon system and tropical sea surface temperatures.

- Using the methods of statistical averaging, annual and seasonal mean climatic distribution graphics of sea temperature and sea salinity over North West Pacific in each standard level had been made (12 levels).
- The *Annual report of sea level and climate change of China* (2014), including the information on sea level, sea temperature, air temperature and sea level pressure along the coast of China Seas, was compiled and translated.

### 3.5 Reanalysis product

Dr Fu Hongli from the Key Lab of Marine Environmental Information Technology (MEIT)/SOA presented 2015-2016 work progress of ocean reanalysis datasets and the work plan for the next two years. Effects of surface wave breaking and tide mixing were introduced in turbulent mixing parameterization schemes and the effect of sea spray was taken into account in the air-sea turbulent flux parameterization scheme so as to improve the reanalysis ocean dynamic model. The self-developed multi-grid 3D-Var ocean data assimilation scheme had been further improved through using the water column adjustment algorithm, the new T-S relationship establishment algorithm and a fully conserved minimal adjustment algorithm.

Global reanalysis datasets from 2009 to 2015 were produced and compared with the SODA (Simple Ocean Data Assimilation) reanalysis datasets. Based on the improved multi-grid 3D-var ocean data assimilation scheme and the regional ocean dynamic model POMgcs, the trial regional (99°E-170°E, 20°S-66°N) ocean reanalysis system with the 1/12° horizontal resolution and 50 vertical levels was established., the trial global (0°E-360°E, 90°S-90°N) ocean reanalysis system with the horizontal resolution of 18km and 50 vertical levels was also established, based on Global ocean dynamic model MITgcm and sea ice model CICE.

Ocean dynamic models will continue to be improved in the next stage, including the turbulent mixing and flux parameterization schemes, and the multi-grid 3D-Var assimilation scheme. High resolution ocean reanalysis systems will be studied to produce a high-resolution reanalysis product. Efforts will be spent on coupled data assimilation algorithm research and development (R&D) based on the air-sea coupled model and used for developing the air-sea coupled reanalysis products.

The workshop noted with appreciation the work done by CMOC/China on improving the regional data reanalysis datasets available to the users. It is recommended that further evaluation of the ocean reanalysis datasets, through comparing with the current international ocean reanalysis datasets, should be carried out.

### 3.6 Website development design

Ms HAN Luyao from the Marine Data Center, NMDIS, presented the current status of

the CMOC/China website and the proposal for upgrades in the near future. The main structure, data and products access, and website functionality to meet the increasing demand of data service were addressed.

The workshop welcomed the idea of providing easily accessible service to the end users proposed by CMOC/China. It's recommended that state-of-the-art information technology and web protocols should be fully considered in the upgrade of website.

#### **4. Review and discussion the work plan 2015-2016, including recommendations and way forward**

##### **4.1 Existing problems / difficulties encountered**

CMOC/China since its official approval by WMO and IOC in 2015 has been endeavouring to fulfil its responsibility under the framework of MCDS. However, due to many reasons, the mirroring with other CMOCs and interoperability with ODP and/or WIS, are not fully implemented. The data flow from other GDACs to CMOC/China still needs to be established.

The workshop noted the difficulties encountered by CMOC/China at the current stage. The MCDS is scheduled to be operational in 2020. Considering the fact that CMOC/China is the only CMOC right now, the problems discovered during its operation will serve as experience and lessons learned for other potential CMOCs. The workshop agreed that recommendations at the technical level could be submitted to JCOMM to assist in MCDS implementation.

##### **4.2 Work items to be continued in 2017-2018**

The workshop appreciated the efforts made by CMOC/China during 2015-2016 (July), and discussed the working items to be continued in the next two years. The detailed items are listed in [Annex III](#).

##### **4.3 Suggestions on the way forward**

The workshop noted with appreciation and satisfaction the continued support of NMDIS for the development of the MCDS in general, and CMOC/China in particular. Based on the discussion, the recommendations are listed in [Annex IV](#).

#### **5. Revisit guidance from WMO, IOC (including IODE) on MCDS development and CMOC network**

##### **5.1 Report on the development of MCDS and CMOCs network**

The Chair of ETMC, Mr. Freeman briefly reviewed the history of establishing the Marine Climatological Summaries Scheme (MCSS) in 1963 for the purpose of the international

exchange of delayed-mode marine climatological data in particular from delayed mode Voluntary Observing Ship (VOS) data. He highlighted the efforts to modernize the MCSS initiated by JCOMM through the development of a new Marine Climate Data System (MCDS) for the exchange and long-term preservation of marine climate data from various sources. The MCDS Strategy and implementation plan were then proposed and endorsed in 2012 by JCOMM-IV. He reviewed the goals, overall structure, plans for its implementation as well as the benefits for stakeholders of the system.

The new system will provide a JCOMM-wide unified approach to data management and higher quality climate observations. This system is now in the implementation phase and encompasses a data flow structure with defined roles and tasks to be applied to all data types across JCOMM. The MCDS will also support the Global Framework for Climate Services (GFCS) and will provide data held to higher quality control standards.

He provided the general principles for the flow of marine-meteorological and oceanographic data within the MCDS, including the future establishment (or recognition of existing) of Data Acquisition Centres (DACs), Global Data Assembly Centres (GDACs), and CMOCs as an interface to the serve coherent marine/ocean data sets of known quality with associated metadata to end users. He appreciated the very first CMOC currently of the MCDS, CMOC/China, for focusing on the integration of drifting buoy data and metadata, climatological product R&D, and data rescue. He hoped the participants of the workshop could help the CMOC/China to establish the data flow and guarantee its key function. He also mentioned the potential offer of the US on establishing the CMOC-ICOADS and COMC-WOD.

The workshop discussed the efforts to organize existing entities (Météo-France, ISDM Canada, and NOAA's AOML) into the MCDS DAC and GDAC structure. The workshop noted that the data center structure of WMO and IOC are different, thus from a technical perspective, the design and establishment of future MCDS DACs and GDACs should fully consider the existing structure of both sides.

## 5.2 Mirroring issues for CMOCs network

Mirroring marine-meteorological and oceanographic data, metadata and products according to procedures documented in relevant WMO and IOC Publications is a requirement of the CMOC network. Attempts on study the mirroring mechanism were made at CMOC/China since its pre-operation in 2012.

The workshop noted that CMOCs act as a network, applying HQCS, making datasets available to the user interface and advising member/members states is the final vision of MCDS. To avoid potential loss from e.g. technological failures, mirroring with other CMOCs is required and takes considerable effort in exploring the means of mirroring at the CMOC level and to identify the resources and meet the needs of different centers

and their security requirements. From the perspective of better service, the users' need for data should be the priority for consideration. Therefore, at the technical level it is the data or datasets to be mirrored, instead of the website or system. Given the fact that CMOC/China is the only CMOC approved by WMO and IOC, it is recommended that CMOC/China initiate the dialogue with the potential CMOC-ICODS on how data and metadata are stored in line with defined JCOMM standards to ensure data integrity and universal interoperability. The time-scales of mirroring data, metadata, products and processes should be defined by the mirroring centres.

### 5.3 Interoperability with ODP and WIS

The workshop recalled the capacity requirement that each CMOC must have, or have access to, interoperability with the WMO Information System (WIS) and/or IODE Ocean Data Portal (ODP). The purpose of the requirement was to guarantee the data and metadata are stored in line with defined JCOMM standards and to ensure data integrity and universal interoperability. NMDIS, the host of CMOC/China, is currently also serving as the WESTPAC regional node of ODP. The workshop encouraged CMOC/China to explore the possible approach to make maintained datasets and corresponding metadata discoverable through and interoperable with ODP.

## 6. Open discussion on met-ocean data and metadata

### 6.1. Data rescue

#### 6.1.1 CSSP China: WP1 - ACRE CHINA

Mr Robert Allan from Met Office Hadley Centre, UK, briefed the workshop on the background, implementation status and plans of ACRE China. To meet the need of climate applications, extensive efforts are required to recover worldwide historical weather observations. The Atmospheric Circulation Reconstructions over the Earth (ACRE) Initiative was established with the goal of facilitating research on data recovery, data assimilation and related analysis by coordinating existing national and international projects, and also encouraging and undertaking the additional work needed to produce and use "reanalyses for climate applications." ACRE China as part of the initial Memorandum of Understanding (MoU) between the Met Office (MO) and the Chinese Meteorological Administration (CMA)/Beijing Climate Centre (BCC) for the period of 2011-2013, it is now an integral part of WP1 within the Climate Science for Service Partnership China (CSSP China), working closely with many other regional projects focusing on the regional historical meteorological data rescue and digitization. He mentioned the on-going efforts of ACRE China in contributing more observations in the China region to the global climate reconstruction, as well as the future plans.

The workshop noted with appreciation the progress made by ACRE China and welcomed the cooperation proposal on historical data rescue. The workshop encouraged CMOC/China to seek collaboration with ACRE China to recover and

digitize historical weather records for China and the surrounding Asian Pacific region. Communication with Hong Kong Observatory should be conducted immediately to avoid overlapping of current rescue efforts of ship logbooks from the 19th Century. Digitized historical meteorological observations are needed in existing international datasets, such as ICOADS.

#### 6.1.2 Work that is being done on the early marine record and how it improves our understanding of climate variability

Mr Philip Brohan from the Met Office, UK, provided visualizations of reconstructed weather in the Southern Ocean using current data and reconstructions in the early 20th century. Due to the lack records there in the early period (and even into the modern period), it's very difficult to have a full picture. Efforts have been made on collecting the weather observations taken during that time, such as the 'Imperial Trans-Antarctic Expedition', which was never published and still preserved in the archives until recently. The digitized observations were added to ICOADS and contributed to the weather reanalysis. He pointed out that there are many data to be rescued from the voyages of discovery, scientific expeditions, whaling, fishing, trading and military ship logs. Including these data in ICOADS will benefit the study of historical climate. He also introduced the progress made over the last few years through contributions of citizen science volunteers to digitize the data through [Weather.org](http://www.Weather.org).

CMOC/China is encouraged to join in these on-going efforts in rescuing the historical data over the Asia-Pacific region.

#### 6.1.3 Present Marine Data Recovery Status: NW Pacific, China & SE Asia

Mr Clive Wilkinson from Climatic Research Unit, University of East Anglia, UK, introduced the current status of marine data recovery over the NW Pacific, China and SE Asia. He pointed out that in ICOADS 2.5, many observations in China seas are concentrated along a narrow track, which is not enough to satisfy requirements for climate reanalysis. Attempts have been conducted to find as many observations as possible outside of the primary shipping tracks, as well as adding observations to the main shipping routes. He briefed the workshop that the inventory of UK naval and merchant marine logbooks c. 1850-1950, from the National Archives (London) and the National Meteorological Archive (NMA - Exeter), along with Navy remark books from the UK Hydrographic Office (Taunton), are the main sources of historical meteorological and oceanographic data for the North-West Pacific and sea areas of China and South-East Asia.

He informed the workshop of significant numbers of logbooks identified in 2016, such as US Navy logbooks archived in US National Archives (NARA) Washington DC. Enquiries are on-going and many other logbooks still need to be found.

The workshop noted with appreciation the on-going historical data rescue progress during past decades. CMOC/China is encouraged to step into the work of rescuing the historical data and metadata recorded by the Navy and commercial ships over the Asian Pacific region.

## 6.2 User report from the region

Dr. Weihao from Tianjin University delivered her presentation on the Variations of water temperature in the East China Sea during the last five decades. She reported the observed long-term SST variations in East China Sea from China oceanographic stations, and the model outputs of temperature and circulation from the two-way nested model NEMO 2.3, which includes changes due to local & large-scale forcing, e.g., monsoon and Kuroshio. Large warming trends were observed in the ECS in the recent five decades. She suggested that Kuroshio surface intrusion in winter & subsurface intrusion in summer compete with coastal waters, and strongly influence inter-annual variation of temperature on middle and outer shelf in East China Sea.

Dr. Zheng Xiaotong from Ocean University of China introduced the recent research activities on climate change in the tropical Indo-Pacific carried out at the Key Laboratory of Physical Oceanography, Ministry of Education of China. He first reported on the hypothesis of Ocean Dynamical Thermostat (ODT) on the slowdown of the atmospheric overturning circulation. The multi-model ensemble mean in CMIP5 models and inter-model uncertainty, and the role of warming patterns, were introduced. He pointed out that the challenges of detecting climate trend patterns could be summarized as 1) time-varying observational biases, 2) sparse observations in the tropics, and 3) inhomogeneity in reanalysis data.

The workshop noted with appreciation current studies on oceanography and climatology by scientists in the region. Historical data bias correction such as wind biases due to anemometer height increases was discussed. The workshop noted that this could be a very important aspect in future data quality control.

The workshop encouraged users to continue use of the data, metadata and products of MCDS centres and to conduct related research. CMOC/China was recommended to collect more feedback from users in order to further improve the quality of the data and to produce user-oriented products that address specific scientific or social needs.

## 6.3 Report by RMIC for Asia Pacific

Mr. Jiang Fan, on behalf of the RMIC for Asia Pacific, introduced the progress of the marine instrument calibration and test services, observation standard establishments and regional capacity building support, and expressed the hope of carrying out further cooperation with CMOC/China on improving the quality of met-ocean data available to the end-users.



The workshop appreciated the work carried out by RMIC-AP, especially its capacity building contributions to improve the regional marine instrument calibration and the process of establishing uniform standards. CMOC/China welcomed the collaboration with RMIC-AP, and would like to conduct collaborative studies on data quality control and oceanographic data and metadata standards.

## 7. Workplan proposal of CMOC/China for 2017-2018

### 7.1 Proposal by NMDIS

The proposed workplan of CMOC/China for 2017-2018 is listed in [Annex III](#).

The workshop noted with appreciation that CMOC/China is doing much work contributing to the Asia-Pacific region. It is recommended that CMOC/China identify its role in the MCDS, and focus on the most beneficial work such as integrating the drifter buoy data and associated metadata. The scope of CMOC/China products was encouraged to be narrowed down, e.g. to cut off the projects/programmes such as Argo and GTSP, and focus more on the drifting buoy archive development.

### 7.2 Suggestions on the way forward by the workshop

Discussion on the way forward for CMOC/China were covered previously in agenda item 5. The recommendations are listed in [Annex IV](#).

### 7.3 Recommendation from WMO Secretariat

The workshop revisited the recommendations from Etienne CHARPENTIER, Chief of Observing Systems Division, WMO, that the forthcoming developments within CMOC shall comply with WMO Strategic Plan and WMO Technical Regulations, noting that new Technical Regulations for the MCDS are going to be submitted to JCOMM-5 in 2017.

The workshop noted that the proposed technical regulations on the MCDS (TR No 85) have yet to be drafted and will need the assistance of the new Scientific Officer to have ready for JCOMM-5. CMOC/China is encouraged to participate in the process.

## 8. Summary of recommendations and actions

The workshop reviewed and agreed on series of recommendations which are detailed in [Annex IV](#).

The workshop, while satisfied with the effective discussion on the development of CMOC/China and CMOCs in general, agreed that for the future operations, more communication between the candidate CMOCs on mirroring and interoperability should be pursued.

The workshop recognized that some countries in the Asia Pacific Region do not have adequate ocean observing systems, and there was strong expectations from these countries to receive capacity building support from the CMOC/China regarding data quality control and calibration, assimilation and reanalysis, and data and information management so that they can enhance their ability of utilizing ocean data and products. User-oriented climate statistic products and capacity building activities in the region should also be encouraged by JCOMM.

## 9. Other Matters

No other matters were discussed at the workshop.

## 10. Adoption of Recommendations and Report

The workshop reviewed the text of recommendation listed in [Annex IV](#) and agreed to embrace the comments and suggestions from WMO Secretariat through email after the workshop. The final report of the workshop will be drafted by CMOC/China and circulated to all the participants and relative organizations/agencies.

## 11. Joint session with The 4th IOI training programme on Regional Ocean Governance for the Western Pacific Region.

The joint session with The 4th IOI training programme on Regional Ocean Governance for the Western Pacific Region was conducted at the Thames Hall, Astor Plaza Tianjin, 1 Sep 2016.

Eric Freeman from National Centers for Environmental Information (NCEI), USA, presented 'ICOADS Release 3.0 and Future Priorities – Contributions to the Marine Climate Data System'. He reviewed the history of the dataset, domestic and international partners, and the diversity of users of the International Comprehensive Ocean-Atmosphere Data Set (ICOADS). ICOADS is a global surface marine-meteorological dataset covering the global oceans, formed by merging many national and international data sources that contain environmental measurements from ships (merchant, navy, research), moored and drifting buoys, coastal stations, and other marine platforms. He introduced the data added to the latest release, Release 3.0, such as the ACRE-facilitated projects contribution of the pre-1850 observations and the Chinese/Global Oceanographic Data Archaeology and Rescue (GODAR) ships. Enhancements to the common data format, the International Maritime Meteorological Archive (IMMA1), were discussed. He also introduced the ICOADS 10-year strategic plan in terms of systems architecture and data processing, data structures, data rescue and historical ICOADS reprocessing, assessing user needs, QC/Trimming and duplicate elimination updates, metadata and documentation, and formalizing ICOADS internationally as a CMOC.

Tim Boyer from National Oceanographic Data Center (NODC), USA, introduced World Ocean Database (WOD), the largest publicly available common-formatted ocean profile dataset. It consists of subsurface ocean depth/variable observations from the surface to the ocean bottom taken between 1772 (Captain Cook's second voyage) and the present modern observations from Argo floats, gliders, etc. Ocean variables include temperature, salinity, oxygen, nutrients, carbon cycle variables, tracers, and biological variables (plankton, chlorophyll). The World Ocean Atlas (WOA) series of climatological means at standard ocean depths is calculated from the WOD for use as a baseline both for climate models and for direct investigation of changes to the oceans heat and salt content. This is achieved by using WOD measurements binned into discrete time periods (monthly, yearly, pentadal) and comparing to the long-term mean. In this way we monitor changes to global and regional ocean heat content and ocean salt content. The former is a measure of changes to the Earth's heat budget, the latter a measure of change to the Earth's freshwater cycle. Both have implications for our changing climate in general and for sea-level rise in particular.

Mr Mathieu Ouellet from Marine Environmental Data Section, Oceans Science Branch, Fisheries and Oceans Canada introduced the Global Telecommunication System (GTS), a global network for the transmission of meteorological data from weather stations, satellites and numerical weather prediction centres, to facilitate the flow of data and processed products. Background, organizational structure, data structure and format, issues in Platform Identification, and long-term data archives were presented. The GTS consists of an integrated network of point-to-point circuits, and multi-point circuits which interconnect meteorological telecommunication centres. The GTS is organized on a three level basis: the Main Telecommunication Network (MTN), the Regional Meteorological Telecommunication Networks (RMTNs), and the National Meteorological Telecommunication Networks (NMTNs). He mentioned the importance of data centers to decode the formats so users without too much knowledge of platform codes and formats names. To simplify the process, an effort for using binary format, BUFR format, carrying more information with less bandwidth to record oceanographic and meteorological observations is on-going.

Training materials and presentations of the workshop are available on the CMOC/China website<sup>3</sup>.

## 12. Closure

The meeting was closed on 1 Sep 2016 Thursday at 16h15.

In his closing words Mr Gao Zhigang, on behalf of NMDIS, thanked all participants for attending the workshop and for their active and constructive discussions. He also welcomed suggestions on future developments and looked forward to further collaborations with the partner agencies/institutes under the coordination of JCOMM.

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<sup>3</sup>[www.cmoc-china.cn](http://www.cmoc-china.cn)

He especially thanked Mr Freeman for attending and chairing the workshop. Noting the increasing needs for met-ocean data and information products to address the oceanographic and marine meteorological research and management, he expressed again the NMDIS's commitment to operate CMOC/China with the guidance of WMO and IOC Secretariats.

The workshop thanked China, SOA, and the NMDIS for operating the CMOC/China focusing on Asia Pacific Region data and product services, for providing excellent facilities, and for China's strong commitment to operate the CMOC/China, noting the substantial benefits expected from the CMOCs to addressing the needs of IODE, GOOS and JCOMM.

## ANNEX I

### AGENDA

- 1. Opening**
- 2. Organization of the workshop**
  - 2.1 Adoption of the Agenda
  - 2.2 Designation of Rapporteur for the workshop
  - 2.3 Local information
- 3. Report of CMOC/China on work plan 2015-2016 and progress**
  - 3.1 Progress report of CMOC/China
  - 3.2 Metadata and data integration of DBCP
  - 3.3 Integration and duplication remove of the global and regional marine and meteorology data
  - 3.4 Climate statistical product R&D
  - 3.5 Reanalysis product
  - 3.6 Website upgrade
- 4. Review and discussion the work plan 2015-2016, including recommendations and way forward**
  - 4.1 Existing problems / difficulties encountered
  - 4.2 Work items to be continued in 2017-2018
  - 4.3 Suggestions on the way forward
- 5. Revisit guidance from WMO, IOC (including IODE) on MCDS development and CMOC network**
  - 5.1 Report on the development of MCDS and CMOCs network (Eric Freeman)
  - 5.2 Mirroring issues for CMOCs network
  - 5.3 Interoperability with ODP and WIS
- 6. Open discussion on met-ocean data and metadata**
  - 6.1 Data rescue
    - 6.1.1 CSSP China: WP1 - ACRE CHINA
    - 6.1.2 Work that is being done on the early marine record and how it improves our understanding of climate variability
    - 6.1.3 Present Marine Data Recovery Status: NW Pacific, China & SE Asia
  - 6.2 User report from the region
  - 6.3 Report by RMIC for Asia Pacific (Jiang Fan, NCOSM)
- 7. Workplan proposal of CMOC/China for 2016-2017**
  - 7.1 Proposal by NMDIS
  - 7.2 Suggestions on the way forward by the workshop

## **8. Summary of recommendations and actions**

## **9. Other Matters**

## **10. Adoption of Recommendations and Report**

## **11. Joint session with The 4th IOI training programme on Regional Ocean Governance for the Western Pacific Region.**

11.1 ICOADS Release 3.0 and Future Priorities - Contributions to the Marine Climate Data System

11.2 Point measurement to Global Indicator – using oceanographic observations in the World Ocean Database to Understand the Earth’s Climate System

11.3 Oceanographic profiles and buoy measurements on the Global Telecommunication System of WMO

11.4 Buoy Data Management and Product - Drifting Buoy

11.5 CMOC/China and its near future

## **12. Closure**

## ANNEX II

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## ANNEX III

## CMOC/China 2017-2018 Action List

No.	Action	Potential collaborations/contacts
1	Integrate global drifting buoy observations and metadata <ul style="list-style-type: none"> <li>Understand and establish data connections and flows from drifter data and metadata sources.</li> <li>Explore the potential use of the data and metadata to produce new products met-ocean study</li> </ul>	AOML/NOAA, JCOMMOPS, OSD, Meteo-France, YU Ting, YUE Xinyang
2	Metadata rescue (3 Cruise Summary Report digitized in 2015) Continue to seek for potential CSR from Japan and Korea to be rescued To explore the potential of link the rescued metadata with the data in WOD and ICOADS	Tim Boyer, Eric Freeman, YU Ting, YANG Jinkun
3	Explore the possibility of contributing to ACRE as CMOC/China Find out the way forward with ACRE China Consider the possibility to formalize through the cooperation with CSSP/China	Rob Allan, Guoyu Ren (CMA), YU Ting, YANG Jinkun
4	Explore the potential to digitize recently-imaged US navy logbooks (Asia-Pacific Region)	Phillip Brohan, Clive Wilkinson, Kevin Wood, Eric Freeman, YU Ting, YANG Jinkun
5	Collaborate with Hong Kong Observatory on the historical meteorological data rescue	Mok (HKO), Rob Allan, YU Ting
6	Seek approval for making additional marine meteorological and oceanographic data from China publicly available	YU Ting
7	Investigate/inquire the possibility of adding ROSCOP records in the database maintained by ICES	Mathieu Ouellet
8	Archival transition of any unique metadata held at the former ODASMS	Mathieu Ouellet, JCOMMOPS
9	In conjunction with IQuOD, study the QC, duplicate elimination, and integration of regional and global temperature and salinity data <ul style="list-style-type: none"> <li>Understand the data flow for temperature and salinity projects/programmes such as Argo, GTSP to facilitate the integration study on the regional and global T&amp;S datasets.</li> <li>Share the information of temperature and salinity duplication with WOD</li> </ul>	Tim Boyer, Mathieu Ouellet, IQuOD, LIU Yulong
10	Study the HQC, duplicate elimination, and integration of regional marine meteorological data Share the information of duplication with ICOADS	Eric Freeman, Lydia Gates (DWD), ZHANG Dongsheng
11	Annual and seasonal climatic graphics products of salinity and temperature over North Pacific Ocean at standard levels	LI Yan, LI Huan
12	North Pacific Ocean and global oceanographic and marine meteorological climatic graphics products	LI Yan, LI Huan
13	<i>Analysis on the facts of Climate Change over China Sea and Adjacent Areas.</i> <i>China Sea Climate Change</i> (Monthly Report and Annual report)	LI Yan, LI Huan, WEI Hao
14	2009-2015 regional ocean reanalysis datasets (higher resolution) R&D Improve multi-grid 3DVar ocean data assimilation scheme; Improve the model the turbulent mixing and flux parameterization schemes.	GFDL/NOAA, HAN Guijun, Fu Hongli
15	Website upgrade, operation and maintenance <ul style="list-style-type: none"> <li>Focus on CMOC/China related operation,</li> </ul>	Eric Freeman, WMO Secretariat,

No.	Action	Potential collaborations/contacts
	<ul style="list-style-type: none"> <li>● Using latest web standards for ease of integrating with ODP/WIS/other,</li> <li>● Cloud computing to be considered.</li> </ul>	HAN Luyao, ZHANG Lei
16	Mirroring study Define procedures and timescales for mirroring aggregated datasets	NCEI (CMOC/WOD, CMOC/ICOADS), Eric Freeman, HAN Luyao, ZHANG Lei
17	Interoperability study Seeking information from Ocean Data Interoperability Platform (ODIP)	ODIP, Sergey Belov, Sissy Iona, HAN Luyao, ZHANG Lei
18	ETMC to further consult JCOMM or WMO Secretariat for the MCDS requirement for “easy accessible marine climate statistical product”. Flexibility at each CMOC should be considered to guarantee the uniqueness of each CMOC within the MCDS system.	Eric Freeman

## ANNEX IV

## RECOMMENDATIONS OF THE WORKSHOP

**Recommendation 1:** Drifting buoy datasets

CMOC/China in coordination with Atlantic Oceanographic and Meteorological Laboratory (AOML) of NOAA and JCOMMOPS who managed the DBCP metadata, and Canadian Oceanography and Scientific Data (OSD) branch and Météo-France, two mirroring GDACs for DBCP data, to establish data connections and smooth the data and metadata flow, creating an integrated dataset for drifter buoy publicly available and regularly updated.

It will facilitate the further quality evaluation of buoy observations under the framework of MCDS, and ocean current studies by the oceanographic community.

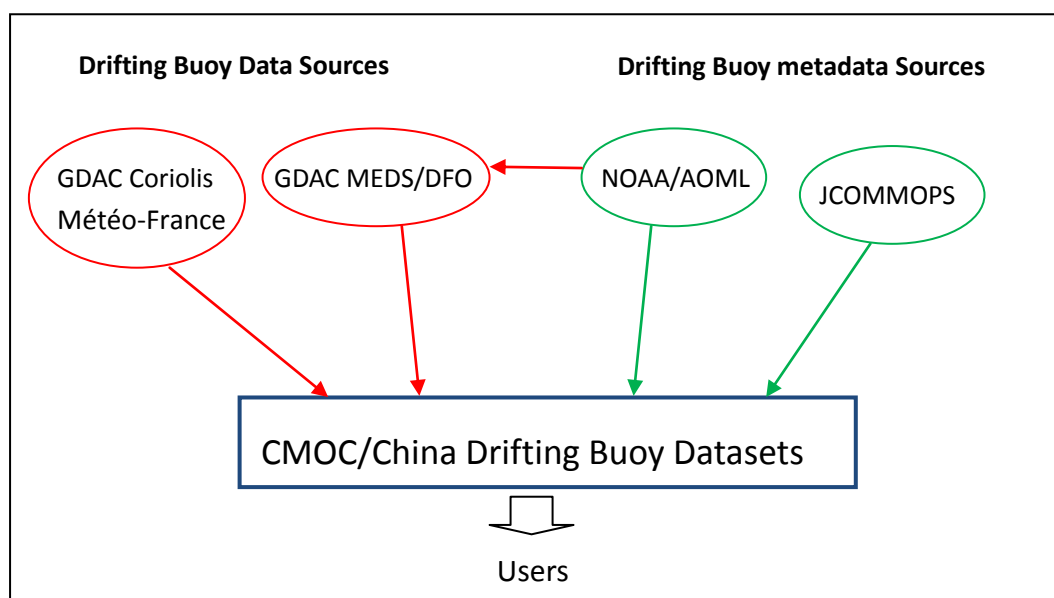


Figure 1. Proposed data flow for drifting buoy datasets

**Recommendation 2:** Data integration study focusing on Asia Pacific region to improve WOD/ICOADS

- 1) To work out the data flow for temperature and salinity projects/programmes such as Argo, GTSP to facilitate the integration study on the regional T&S datasets, therefore to seek to complement existing WOD and ICOADS activities by potentially providing regional inputs to them.
- 2) To share Duplicate Elimination/Identification information with WOD and ICOADS.
- 3) To provide a list of Argo, GTSP profiles which are not included in the latest version of WOD

**Recommendation 3:** Data Rescue

- 1) CMOC/China to work with ACRE in order to recover, image, and digitize historical marine meteorological records for the Asia Pacific region.
- 2) Seek for the possibility to formalize the role of CMOC/China in CSSP/China.
- 3) Explore the potential to digitize to be imaged US Navy Logbooks from the US National Archives and Records Administration sailing to/from Asia Pacific area.
  - Kevin Wood (NOAA/PMEL) is imaging all logbook pages and will openly share them. Consult Kevin Wood/Eric Freeman/Philip Brohan for any potential within SOA and additional information on the logbook collection. Work will benefit Chinese research agencies, CMOC-China, ACRE, and ICOADS.

#### **Recommendation 4: Quality Control**

CMOC/China is encouraged to participate in the **International Quality-controlled Ocean Database (IQuOD) project**. An expert from CMOC/China is invited to join in the 4th Annual IQuOD Workshop (3-5 Oct. 2016, Tokyo, Japan).

*Quality Control Manual for Oceanographic and Marine Meteorological Data*, the QC manual currently in use at CMOC/China, to be translated and provided to the IQuOD workshop if possible.

#### **Recommendation 5: Interoperability**

CMOC/China to contact Sissy Iona, the former IODE Co-Chair, for the best practice of Ocean Data Interoperability Platform (ODIP), seeking for information and experiences on harmonizing the diverse data systems to realize the interoperability with IODE/ODP and WIS

Research latest web standards for ease of integrating with ODP/WIS/other.

#### **Recommendation 6: Mirror**

CMOC-China and NCEI (or CMOC-ICOADS/WOD) to define procedures and timescales for mirroring aggregated drifting buoy data/metadata

CMOC-China and NCEI (or CMOC-ICOADS/WOD) establish connection and initiate official mirror partnership to satisfy CMOC requirement of mirroring data/metadata/product.

#### **Recommendation 7: Website**

Clear focus on CMOC/China activities with highest focus on Drifting Buoy work, and remove the data falling outside the scope of CMOC/China.

Website upgrade should follow standard international protocols.

## ANNEX V

## ACRONYM LIST

ACRE	Atmospheric Circulation Reconstruction over the Earth Initiative
AOML	Atlantic Oceanographic and Meteorological Laboratory
Argo	Argo International Profiling Float Programme
BUFR	FM 94BUFR GTS format: Binary Universal Form for Representation of meteorological data
BUOY	FM 18 BUOY GTS format: Report of a buoy observation
CB	Capacity-Building
Cg	Congress (WMO)
CMOC	WMO-IOC Centre for Marine Meteorological and Oceanographic Climate Data
CSSP China	Climate Science for Service Partnership China
DAC	Data Acquisition Centre
DBCP	Data Buoy Co-operation Panel (WMO-IOC)
DMCG	Data Management Coordination Group (JCOMM)
DMPA	Data Management Programme Area (JCOMM)
EC	Executive Council
ETMC	Expert Team on Marine Climatology (JCOMM)
GDP	Global Drifter Programme
GDAC	Global Data Assembly / Acquisition Centre
GLOSS	Global Sea-level Observing System (JCOMM)
GODAR	Global Oceanographic Data Archaeology and Rescue
GOOS	Global Ocean Observing System (IOC, WMO, UNEP, ICSU)
GTS	Global Telecommunication System (WWW)
GTSP	Global Temperature and Salinity Profile Programme (IODE)
ICODS	International Comprehensive Ocean-Atmosphere Data Set (USA)
ICSU	International Council for Science
IMMA	International Maritime Meteorological Archive
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IODE	International Oceanographic Data and Information Exchange (IOC)
IQuOD	International Quality-controlled Ocean Database (IODE)
ISDM	Integrated Science Data Management (formerly MEDS, Canada)
JCOMM	Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
JCOMMOPS	JCOMM <i>in situ</i> Observations Programme Support Centre
MCSS	Marine Climatological Summaries Scheme
MDCS	Marine Climate Data System
NCEI	National Centers for Environmental Information
NCOSM	National Centre of Ocean Standards and Metrology (China)
NDBC	NOAA National Data Buoy Center (USA)
NEAR-GOOS	North East Asian Regional GOOS
NMDIS	National Marine Data and Information Service (China)

NOAA	National Oceanic and Atmospheric Administration (USA)
NODC	National Oceanographic Data Center (USA)
ODAS	Ocean Data Acquisition Systems
ODASMS	ODAS Metadata Service (operated by China on behalf of JCOMM)
ODIP	Ocean Data Interoperability Platform
ODP	Ocean Data Portal (IODE)
QA	Quality Assurance
QC	Quality Control
RMIC	IOC-WMO Regional Marine Instrument Centre
SOA	State Oceanic Administration (China)
SODA	Simple Ocean Data Assimilation
SST	Sea-Surface Temperature
UNESCO	UN Educational, Scientific and Cultural Organization
USA	United States of America
VOS	Voluntary Observing Ship
WESTPAC	IOC Sub-Commission for the Western Pacific
WIS	WMO Information System
WMO	World Meteorological Organization (UN)
WOA	World Ocean Atlas
WOD	World Ocean Database
XBT	Expendable Bathy Thermograph