Earth System Approach to Weather, Climate, Water and Environment

a new WMO science for service strategy (WMO reform)

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Ship barometer ca. 1840



Standard meteorological logs for ships at sea



Atmospheric circulation after Maury (ca. 1860)

First International Meteorological Congress (Vienna, 1873)

The 1947 Convention: from IMO to WMO...

Conference of IMO Directors (Washington D.C., 1947)

WMO and its Members

WMO has 192 Members (countries) and coordinates the activities of all the National Meteorological and Hydrological Services (NMHSs) of the planet because weather, climate and water know no national or political boundaries.

Biggest risks for world economy 2019

World Economic Forum Global Risks Landscape 2019

Distribution on natural disasters 1998-2017 90.6 % weather related

~4.5 billion people affected 1998-2017 96 % weather related

Tropical Cyclone IDAI

Carbon dioxide level highest in 3 million years CO₂ CH₄ N₂O

Warming so far

Regional warming in the decade 2006-2015 relative to preindustrial

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Source: IPCC Special Report on Global Warming of 1.5°C

WMO State of Climate 2018

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- 2018 0.98±0.12°C above pre-industrial (1850-1900), 2018 set to be 4th warmest year on record
- 2015 and 2016 were affected by strong El Nino
- 2015, 2016, 2017 and 2018 are the 4 warmest years on record
- In contrast to the two warmest years, 2018 began with weak La Niña conditions, typically associated with lower global temperatures.

 By October, sea-surface temperatures in the eastern Tropical Pacific were showing signs of a return to El Niño conditions. If El Niño develops, 2019 is likely to be warmer than 2018.
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Tropical storms today vs. 2 C warmed climate

Uneven economic impact of current warming Impact of 1°C temperature increase on per capita output

Source: International Monetary Fund (IMF) World Economic Outlook

21st CENTURY CHALLENGES IN AN INTERCONNECTED WORLD

Exposure to extreme weather and climate events threatens to derail the sustainability of economic development and social welfare across the globe, and to threaten the securities on which we rely for our health and well-being.

There is no logical scientific argument for separating the physical climate system from full Earth system science

New Tools in the Toolbox:

Seamless Prediction Across Timescales

Forecast lead-time

Weather and Climate Research

Weather and Climate Research

WIND UMIN

WORLD CLIMATE RESEARCH PROGRAMME WCRP

... a new challenge – how will our (near) future (climate & wether) models look like?

ExtremeEarth

ExtremeEarth will revolutionize Europe's capability to predict and monitor environmental extremes and their impacts on society enabled by the imaginative integration of edge and exascale computing and beyond, and the real-time exploitation of pervasive environmental data

Learn More

- Why do we need *ExtremeEarth*?
- What is the scientific reasoning behind ExtremeEarth?
- What are the key technologies for realizing ExtremeEarth?

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cmcc

- How will ExtremeEarth produce socio-economic impact?
- What is the ExtremeEarth partnership?

www.extremeearth.eu

OXFORD

ExtremeEarth

Deltares

Science center Enabling Delta Life

UK Research and Innovation

STRATEGIES

REVOLUTION IN CLIMATE PREDICTION IS BOTH NECESSARY AND POSSIBLE

A Declaration at the World Modelling

Despite tremendous progress in climate modelling....our ability to provide robust estimates of the risk to society...is still constrained by...(many things)

> Institute, Imperial College and Department of Meteorology, University of Reading, Reading, England; KINTER—Center for Ocean–Land–Atmosphere Studies, Calverton, Maryland; MAROTZKE—Max Planck Institute for Meteorology, Hamburg, Germany; SUNGO—The Walker Institute, University of Reading, Reading, England

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resolution, complexity, length and numbers of simulations, and assimilating observational data.

The Japanese experience of simulating global climate with horizontal resolution of 3.5–10 km has established the basis for wider experimentation with—and application of—very high-resolution models. Thus, the experts at the summit concluded that climate modeling will need—and is ready—to move to fundamentally new high-resolution approaches to capitalize on the seamlessness of the weather–climate continuum.

This impending revolution raises issues of parameterization, regional modeling, and the balances

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Convergence of Key Technologies through EEsC

How is WMO responding....

- Weight of WMO and NMHSs on the global agenda growing
- Demand of hydromet expertise high: COP-23/24, UNSG, UN Security Council, UN High Level Climate Summitt 9/2019
- Additional emphasis on EWS/Climate adaptation by development agencies, new alliances with Green Climate Fund and World Bank
- Increase of project financing, e.g. CREWS & GFCS/ACP
- Concept for private sector engagement
- 2018 Lui Che Woo Prize

Future of WMO

- Already tripling of external funding for development projects: CREWS, EU/GFCS etc., the trend continues
- Major development agencies, like World Bank, Green Climate Fund and EU follow the guidance of WMO in targeting their development programmes
- Regional offices strengthened: project staff, secondments from Member countries
- WMO supports NMHSs in advocacy among ministers/heads of state
- Fully based on integrated, seamless approach for observations, weather, climate, water and environment, spanning a full chain from basic science to service delivery

Future of WMO

- WMO makes a serious and unique contribution to the prosperity of the countries and climate adaptation
- Meteorological, hydrological, marine and geophysical services are run at joint national joint centres
- NMHSs have fruitful partnerships with universities in research and education
- Members have legal basis for private sector role and code of ethics for PPE

Future of WMO Secretariat

- Structures aligned to serve the Constituent Body structure in an optimal way
- The administrative processes of WMO are streamlined and resources are targeted for substantive duties
- WMO is leading climate expertise agency in the UN with a coherent well organized climate programme (GFCS, WCRP, GCOS, GAW, Climatology & IPCC)
- WMO has a coherent Earth Observation Programme (weather, climate, oceans, hydrology, air quality, greenhouse gases and space weather)
- WMO supports multi-hazard early warning system (high-impact weather, tsunamis, drought, earth quakes, volcanic eruptions, forest firs, air quality episodes)
- Hydrology services are contributing actively to WMO
- WMO provides management training for NMHSs

Future of WMO Secretariat

- Research organizations are contributing to science to services approach
- WMO has systematic information on its Members, development needs and trends
- Private sector is a constructive and contributing part of WMO activities
- Secretariat has grown due to high demand of climate and disaster expertise
- More young experts are hired and exchange of staff between Member countries and Secretariat is active
- WMO has several contributing partners: WB, GCF, FAO, WHO, UNFCCC, IMO, ICAO, IOC/UNESCO

All WMO Members should have access to high

quality forecast products WMO Designated Global Data-processing and Forecasting System Centres

- Nowcasting and Weather Forecasting (upto 30 days)

Updated on 26 September 2018

Legend

- World Meteorological Centres (WMCs)* (9) 窗
- RSMCs(NRT***) Lead Centre for Coordination of Wave Forecast (1) *
- RSMCs(NRT***) Lead Centre for Coordination of EPS Verification (1)
- RSMCs(NRT***) Lead Centre for Coordination of DNV (1)
- RSMCs Numerical Ocean Wave Prediction (3)
- RSMCs Severe Weather Forecasting (2)

- RSMCs TC (6)
- RSMCs Marine Meteorological Services (24)
- RSMCs Nuclear Emergency Response** (10)
- RSMCs Non-Nuclear Emergency Response** (2) æ

 - RSMCs Sand Dust (2)

- RSMCs Nowcasting (3)
- 苔 RSMCs Limited Area Ensemble NWP(2)
- RSMCs Global Ensemble NWP (9)
- RSMCs Limited Area Deterministic NWP (6)
- RSMCs Global Deterministic NWP (9) Ŧ

* World Meteorological Centres are also Global Producing Centres for a) Deterministic Numerical Weather Prediction, b) Ensemble Numerical Weather Prediction, and c) Long-Range Forecasts. ** RSMC for nuclear and non-nuclear emergency response have Atmospheric Transport and Dispersion Modelling (ATDM) capabilities.

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*** NRT stands for Non-Real-Time

DESIGNATIONS USED

The depiction and use of boundaries, geographic names and related data shown on maps and included in lists, tables, documents, and databases on this web site are not warranted to be error free nor do they necessarily imply official endorsement or acceptance by the WMO.

Global observing system enhanced

- Considerably enhanced observing network and delivery for global use => enhanced quality of forecasts worldwide
- Also e.g. radar and lightning detection data freely exchanged (Resolution 40)

Global Meteoalarm System operational

- Global Meteoalarm coverage, support for NMHSs as safety authorities
- High-impact weather, seasonal and El Nino/La Nina services for UN agencies

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Urban services

• Air quality, disasters, climate adaptation

WMO Global Atmoshere Watch supports implementation of Paris Agreement

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Schweizerische Eidgenossenschaft Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Home Affairs FDHA Federal Office of Meteorology and Climatology MeteoSwi

Globa	I 🔲	Reporting	•
Regio	nal 🔴	Partly Reporting	
Contr	ibuting 🔺	Non-reporting	•
Local	*	Closed	•
		Planned	
1		Pre-operational	

CONSTITUENT BODIES REFORM (CBR)

WMO for the 21st Century

Future WMO: Integrated seamless Earth-system science and science for services approach

New WMO Strategic Operating Plan

Vision 2030	By 2030, a world where all na to the socioeconomic impact of extr and empowere through the best possib	tions, especially the most vulnerable, are more res reme weather, climate, water and other environmen of to boost their sustainable development le services, whether over land, at sea or in the air	silient ntal events,
Overarching Priorities	Enhancing preparedness for, and reducing losses of life and property from hydrometeorological extremes	oporting climate-smart decision naking to build resilience and adaptation to climate risk	cioeconomic value imate, hydrological d environmental ervices
Core Values	Accountability for Results and Transpar	ency • Collaboration and Partnership • Inclusivenes	s and Diversity •
Long-Term Goals	1 Better serve societal needs: Delivering authoritative, accessible, user-oriented and fit-for-purpose information and services	3 Advance targeted research: Leveraging leadership in science to improve understanding of the Earth system for enhanced services 4 Close the capacity gap: Enhancing service delivery capacity of developing countries to ensure availability of essential information and services	5 Strategic realignment of WMO structure and programmes: Effective policy- and decision-making and implementation
Strategic Objectives 2020-2023 focus	 1.1 Strengthen national multihazard early warning/alert systems and extend reach to better enable effective response to the associated risks 1.2 Broaden the provision of policy- and decision-supporting climate information and services 1.3 Further develop services in support of sustainable water management 1.4 Enhance the value and innovate the provision of decision-supporting weather information and services 2.3 Enable access and use o numerical analysis and prediction products at a temporal and spatial scale from the WMO seamless Global Data Processing an Forecast System 	 3.1 Advance scientific knowledge of the Earth system 3.2 Enhance the science-forservice value chain ensuring scientific and technological advances improve predictive capabilities Advance policy-relevant science Advance policy-relevant science Scale-up effective partnerships for investment in sustainable and cost-efficient infrastructure and service delivery 	 5.1 Optimize WMO constituent body structure for more effective decision-making 5.2 Streamline WMO programmes 5.3 Advance equal, effective and inclusive participation in governance, scientific cooperation and decision- making

ALIGNMENT OF WMO STRUCTURE

Alignment of WMO Structure

Interactive Model for Science for Service Innovation

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ENHANCED COLLABORATION WITH PARTNERS

WEATHER CLIMATE WATER TEMPS CLIMAT EAU

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