Congratulations to WMC(Beijing) GBA Branch!

Guangzhou, China (Nov. 20-21, 2023)

The WMO New Global Initiatives and their importance to the Global Socio-Economic Development

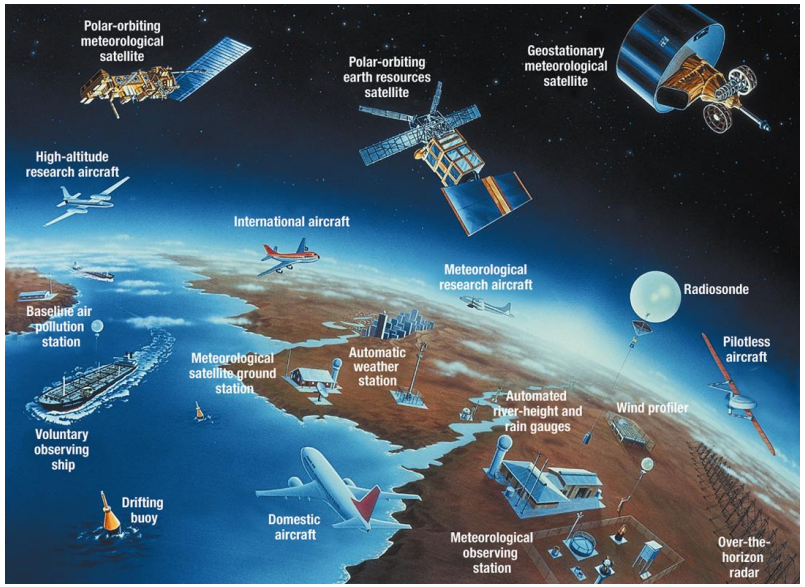
I: Early Warning for All (EW4ALL) &

2: Global Greenhouse Gas Watch (GGGW)

Dr ZHANG Wenjian (张文建)
Assistant Secretary-General
World Meteorological Organization(WMO)
wzhang@wmo.int

WMO OMM

World Meteorological Organization



- UN Specialized Agency on weather, climate & water
- 193 Members, HQ in Geneva
- 2nd oldest UN Agency, 1873-
- Coordinates work of > 200 000 national experts from meteorological & hydrological services, academia (& private sector)
- Co-Founder and host agency of IPCC (1st World Climate Conference)
- Co-Founder of UNFCCC (2nd World Climate Conference)
- WMO SG UN Climate Principal (1/3)

WMO OMM

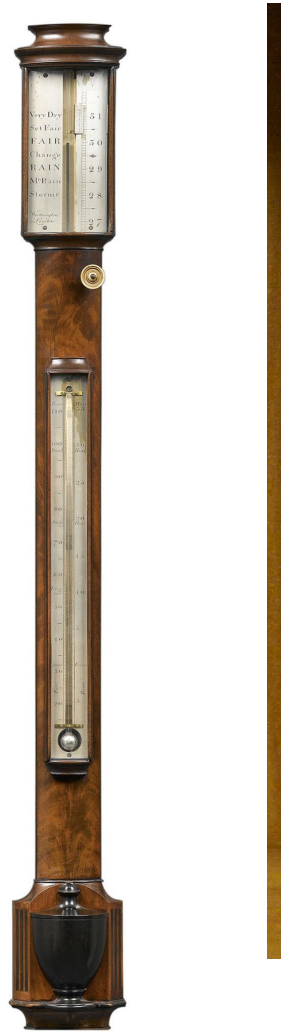
I: The Origin of WMO

Early Days Collaborations Driven by World Trade Requirements across Oceans

WMO OMM

Early days Met observations & data exchanges-1

- First thermometer in 1638
- First barometer was invented by Evangelista Torricelli in 1643, which are especially important for weather monitoring and prediction
- First regional weather map in 1783 (39 stations) after observations (not real time)

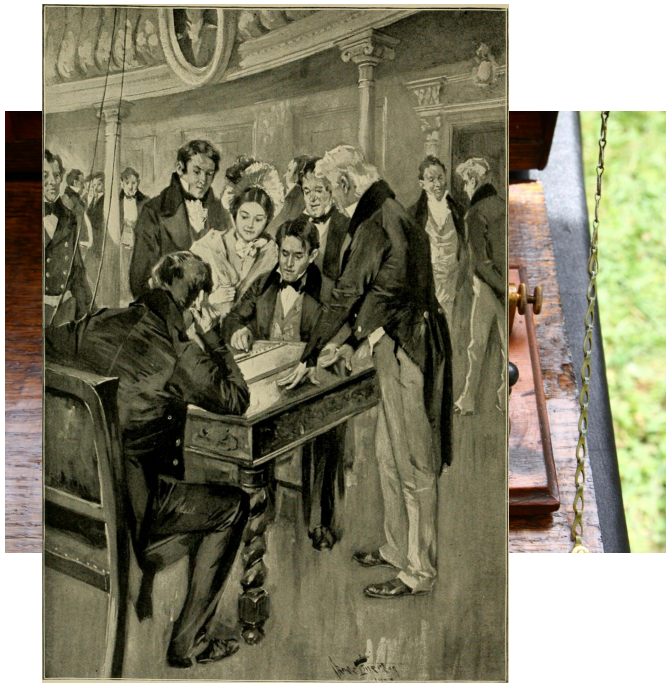


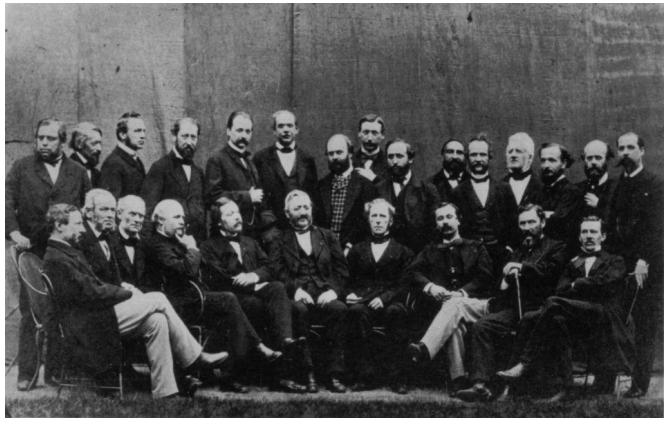
English Stick Barometer by Worthington of London

WMO OMM

Early days Met observations & data exchanges-2

- In 1837 Mr Morse invented the Telegraph， in 1851, a conference in Vienna of countries in the German-Austrian Telegraph Union (which included many central European countries) adopted the Morse telegraph as the system for international communications.
- In **1865**, a conference in Paris adopted Gerke‘s code as the International Morse code and was henceforth the international standard. – International Telecommunication Union **(ITU)** established





WMO OMM

DEVASTATING STORMS DURING THE SIEGE OF SEBASTAPOL

WMO OMM

PIONEERS OF INTERNATIONAL COOPERATION IN METEOROLOGY AND OCEANOGRAPHY

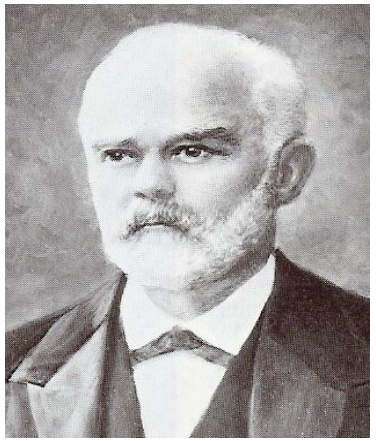
M F Maury（USA Navy）

G B von Neumayer (German Maritime Service)

R FitzRoy (UK DG)

C H D Buys Ballot (Belgium)

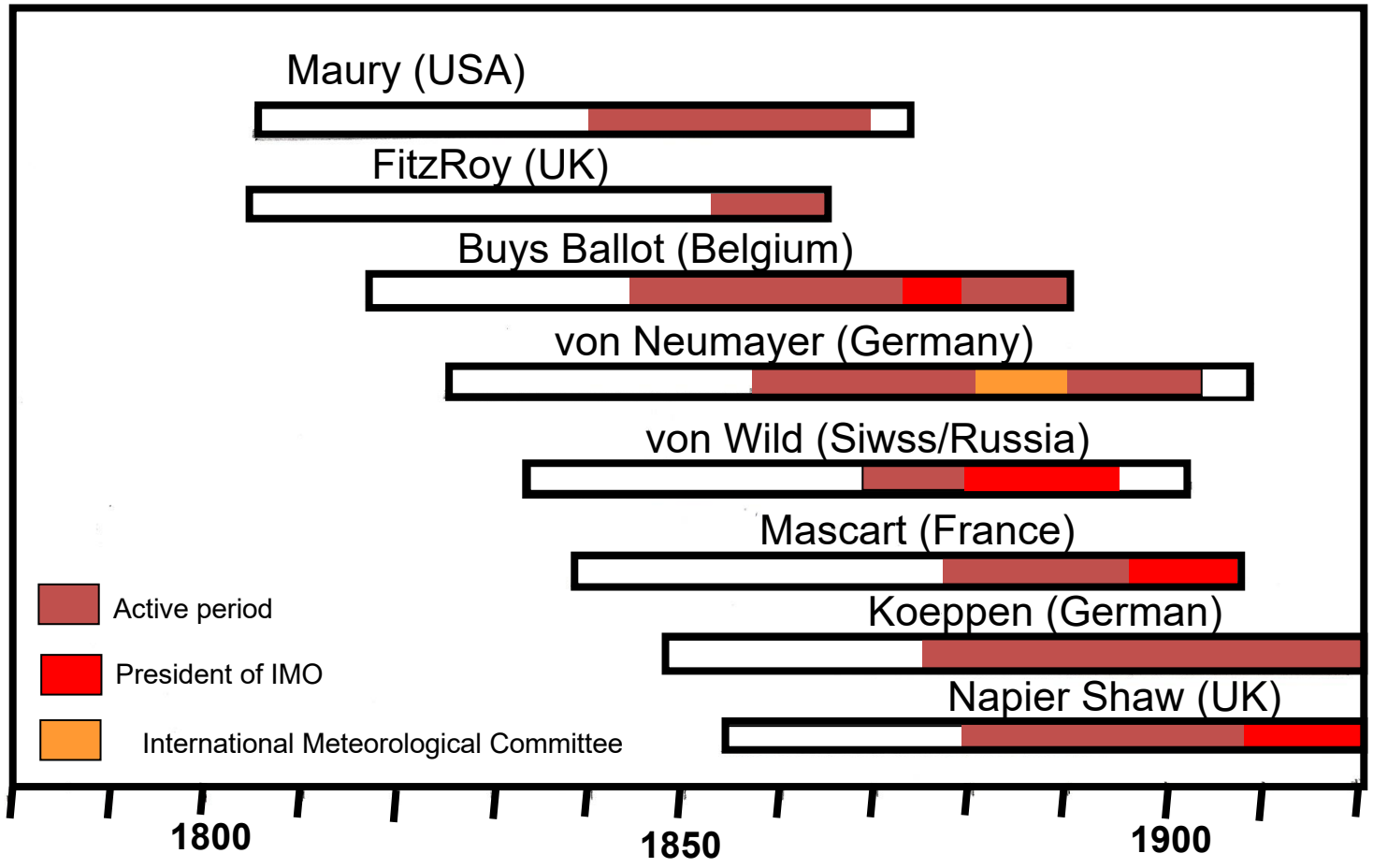
H von Wild (Swiss, DG of Russain Met Services)



E Mascart (France)

WMO OMM

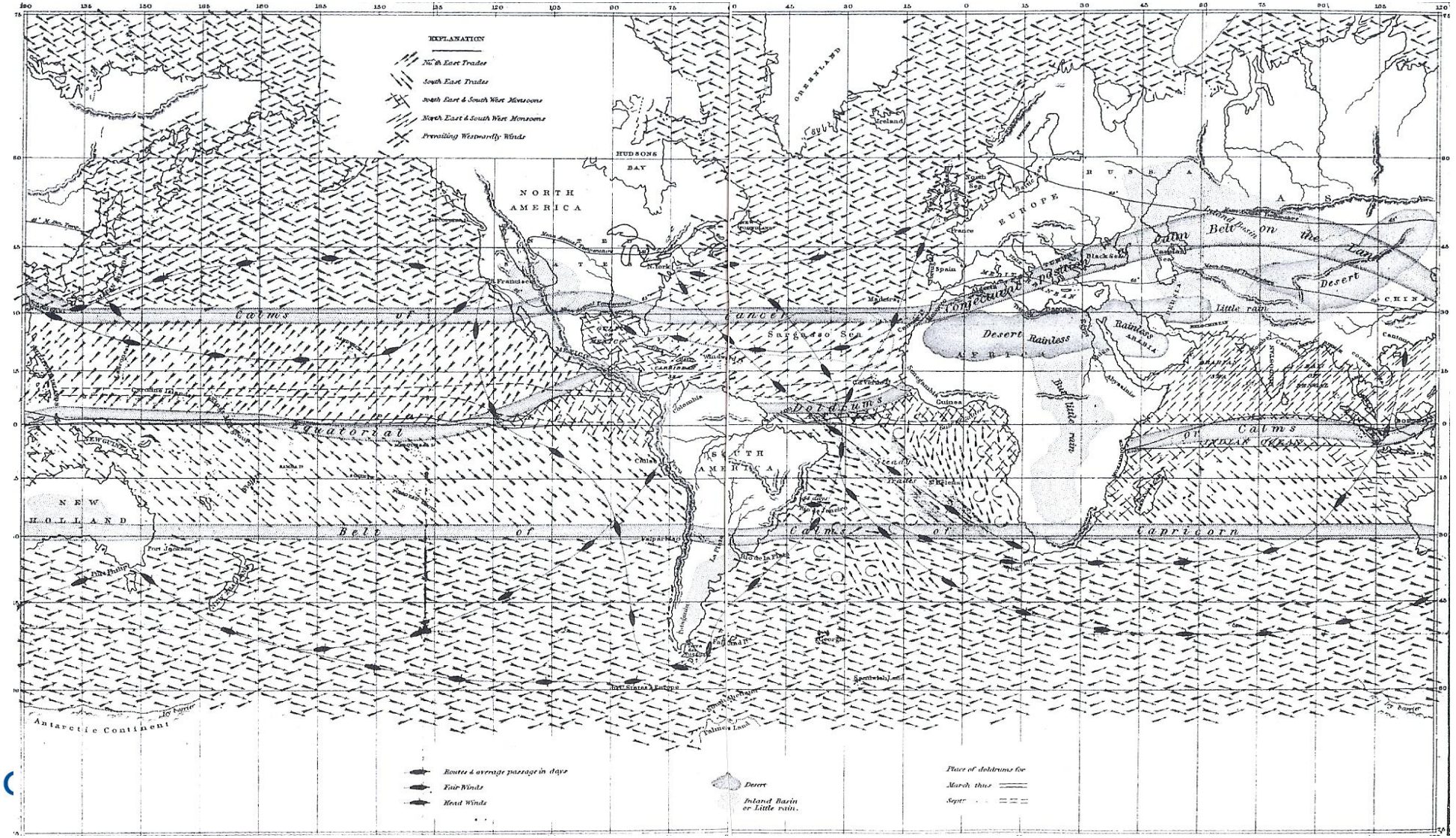
PIONEERS OF INTERNATIONAL COOPERATION IN METEOROLOGY AND OCEANOGRAPHY



MATTHEW FONTAINE MAURY 1806-1873

WMO OMM

MAURY'S CHART OF WINDS AND OCEAN ROUTES (Climate Map)
莫里绘制的第一幅全球风和海流图



The Origin of WMO (IMO)

- ***August 1853 (Brussels)***：First International Meteorological Conference
- ***September 1873 (Vienna)*** *:* Sept 1873，Vienna：A **non-intergovernmental** International Meteorological Organization (IMO) was established, with governing and technical structures.
- Even IMO was non-intergovernmental organization, from this time onwards rapid development in meteorology took place, and family culture for open and sharing data and know-how started.

WMO OMM

International Meteorological Organization (IMO)

First Congress on Meteorology (Vienne, 1873)

To facilitate the exchange of weather information across national borders

Convention 1947: from IMO to WMO

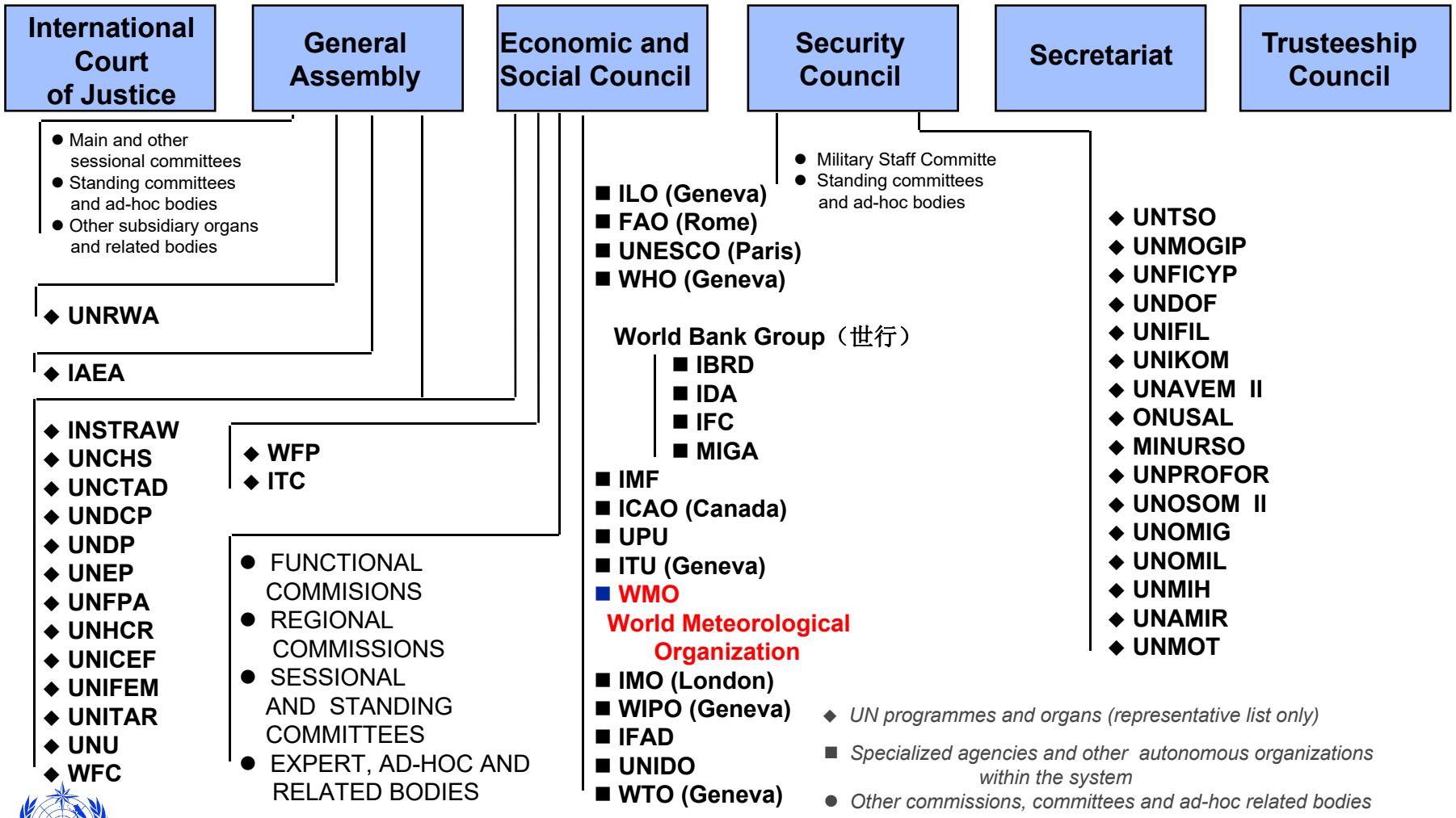
Conference of Directors (Washington, 1947)

WMO OMM

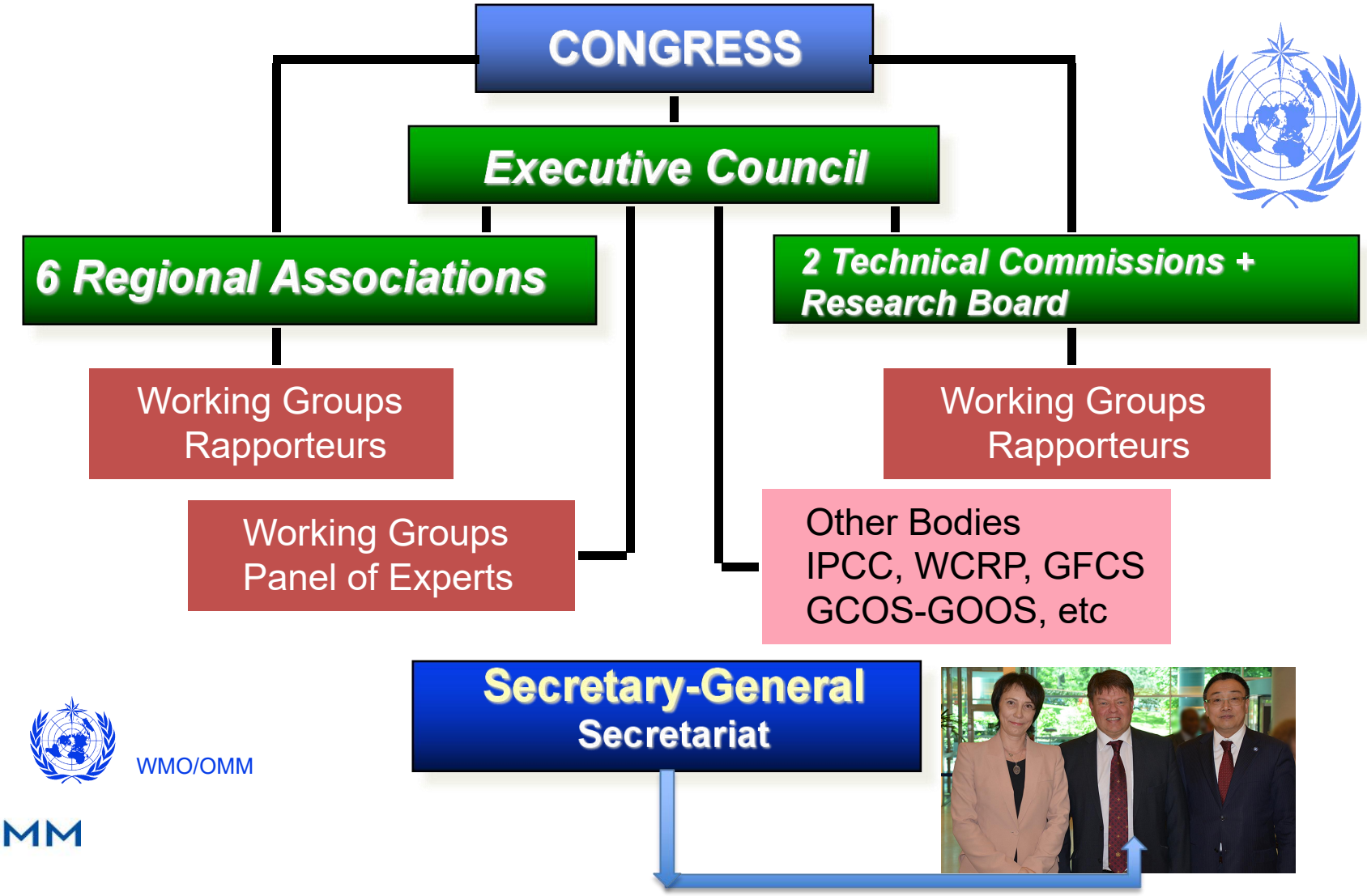
The Origin of WMO-2

- ***September 1947 (Washington)*** : The Conference of Directors of National Meteorological Services votes unanimously for the WMO Convention
- ***23 March 1950 :*** **The WMO Convention was approved by Governments and it comes into force, creating the World Meteorological Organization （WMO） as a successor to IMO.**
- ***December 1951 :*** WMO becomes a specialized agency of the United Nations by an agreement between the UN and WMO

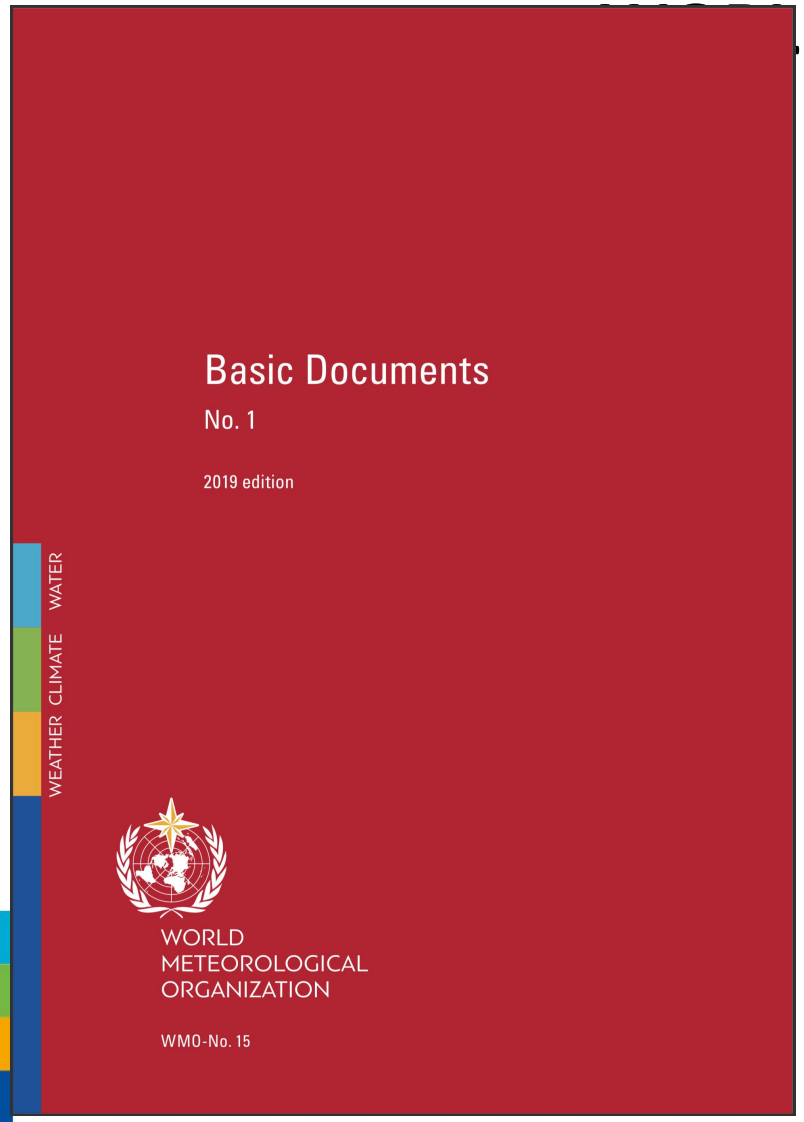
WMO in the UN system



Organizational Structure of WMO (*193 Members*)



CONVENTION OF THE
D METEOROLOGICAL ORGANIZATION



- **Considering the need for sustainable development, the reduction of loss of life and property caused by natural disasters and other catastrophic events related to weather, climate and water, as well as safeguarding the environment and the global climate for present and future generations of humankind**,
- **Recognizing** the importance of an integrated international system for the observation, collection, processing and dissemination of meteorological, hydrological and related data and products,
- **Reaffirming** the vital importance of the mission of the National Meteorological, Hydrometeorological and Hydrological Services in observing and understanding weather and climate and **in providing meteorological, hydrological and related services** in support of relevant national needs which should include the following areas:
  - (a) Protection of life and property,
  - (b) Safeguarding the environment,
  - (c) Contributing to sustainable development,
  - (d) Promoting long-term observation and collection of meteoro-logical, hydrological and climatological data, including related environmental data,
  - (e) Promotion of endogenous capacity-building,
  - **(f) Meeting international commitments,**
  - **(g) Contributing to international cooperation.**

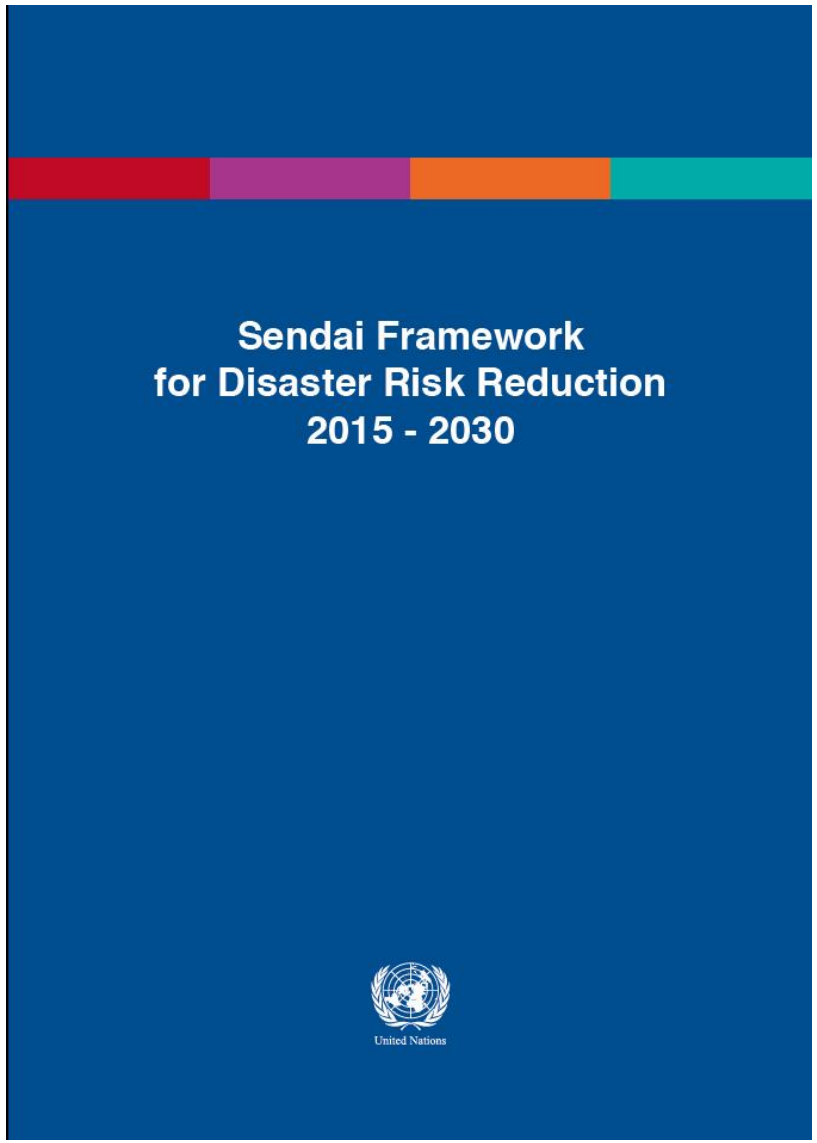
WMO OMM

WMO contributions to the SDGs

COP21 · CMP11

PARIS 2015

UN CLIMATE CHANGE CONFERENCE



WMO OMM

WMO Technical Governance- TG

- **1. Purpose of the Technical Regulations**
- 2. The Technical Regulations of the World Meteorological Organization are determined by Congress in accordance with Article 8(*d*) of the Convention.
- 3. These Regulations are designed:

(a) To facilitate co-operation in meteorology and hydrology between Members;

(b) To meet, in the most effective manner, specific needs in the various fields of application of meteorology and operational hydrology in the international sphere; and

(c) To ensure adequate uniformity and standardization in the practices and procedures employed in achieving *(a)* and *(b)* above.

6. In accordance with the above definitions, Members **shall do their utmost to implement the standard practices and procedures**.

- In accordance with Article 9(*b*) of the Convention and in conformity with the provisions of Regulation 125 of the General Regulations, **Members shall formally notify the Secretary-General, in writing, of their intention to apply the *standard* practices and procedures of the Technical Regulations**, except those for which they have lodged a specific deviation.
- **Members shall also inform the Secretary-General, at least three months in advance**, of any change in the degree of their implementation of a *standard practice or procedure* as previously notified and the effective date of the change.

WMO is a legal-binding organization
(Great progress from governance perspective !)

Since 1951, WMO Cg-I

II: UN GA on WWW
(World Weather Watch)

Political Decisions of UN GA with Modern Technology Progress Promoted the WMO Global Collaboration to Great Success !

WMO OMM

Man-made satellites triggered WMO speedy development

- On 4 October 1957, the Union of Soviet Socialist Republics (USSR) launched the first Earth-orbiting satellite SPUTNIK-1, followed later in the same year by SPUTNIK-2 and the EXPLORER-1 satellite launched by the United States of America (USA) on 2 January 1958.
- The world's first dedicated weather satellite, the Television Infrared Observation Satellite (TIROS-1), was launched by the US on 1 April 1960.
- The Third World Meteorological Congress in 1959 adopted the resolution 28 on the policy of using Satellites for Meteorology, namely
  - a) to encourage the development of meteorological satellites as a means of providing data, and
  - b) to collaborate on the subject with the UN, other specialized agencies, and the scientific community

WMO SG nominated Satellite Experts Team

- The Secretary General of WMO, Dr. D.A. Davies, immediately enlisted Prof. V. Bugaev (USSR) and Dr. H Wexler (USA) to undertake the requested study. Supported by Dr M. A. Alaka (USA) and the staff of the WMO Secretariat, the *First Report on the Advancement of Atmospheric Sciences and Their Application in the Light of Developments in Outer Space* (WMO, 1962) was prepared for submission to the United Nations in June 1962. This *First Report* discussed in broad outline the concept, structure and function of the World Weather Watch [see box].

Dr H. Wexler (USA) and Academician V. Bugaev (USSR), two of the founders of the World Weather

WMO OMM

UN GA Resolution No. 1721 (XVI)

"The General Assembly, Noting with gratification the marked progress for meteorological science and technology opened up by the advances in outer space, Convinced of the world-wide benefits to be derived from international co-operation in weather research and analysis,

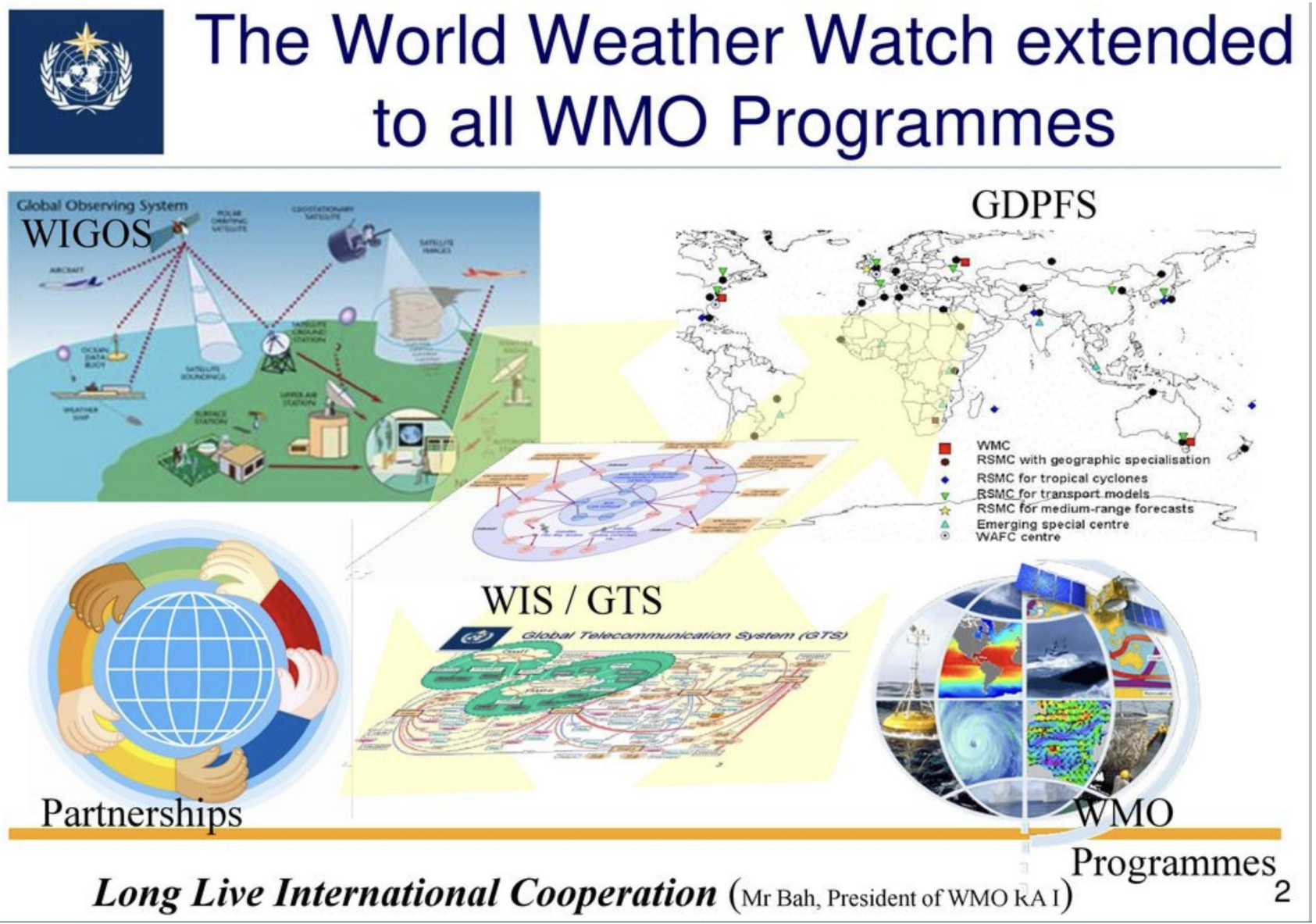
1. Recommends to all Member States and to the World Meteorological Organization and other appropriate specialized agencies the early and comprehensive study, in the light of developments in outer space, of measures;

(a) To advance the state of atmospheric science and technology so as to provide greater knowledge of basic physical forces affecting climate and the possibility of large-scale weather modification;

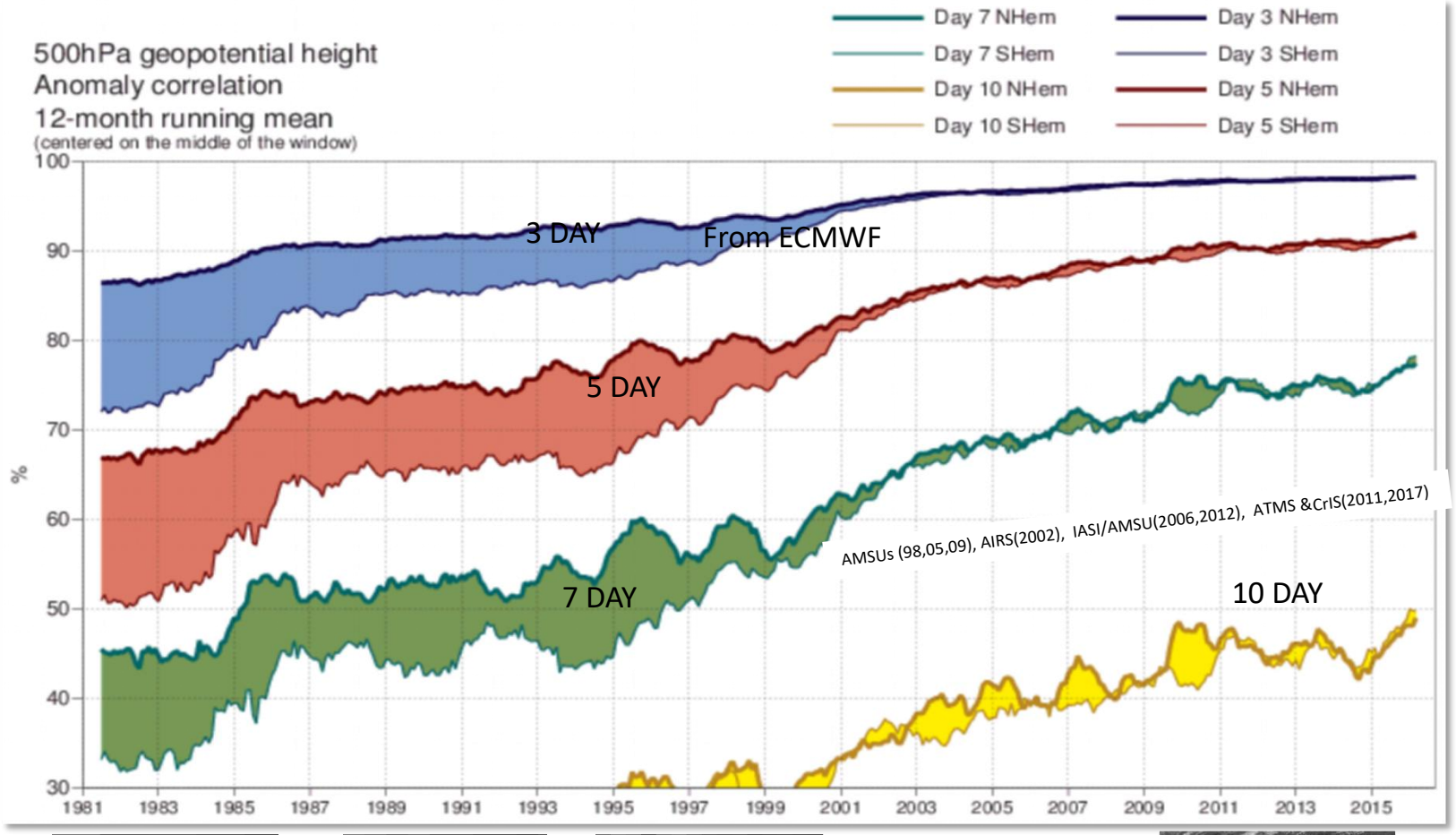
(b) To develop existing weather forecasting capabilities and to help Member States make effective use of such capabilities through regional meteorological centres;

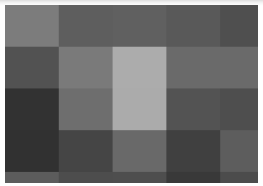
2. Requests the World Meteorological Organization, consulting as appropriate with the United Nations Educational, Scientific and Cultural Organization and other specialized agencies and governmental and non-governmental organizations, such as the International Council of Scientific Unions, to submit a report to the Governments of its Member States and to the Economic and Social Council at its thirty-fourth session regarding appropriate organizational and financial arrangements to achieve those ends, with a view to their further consideration by the General Assembly at its seventeenth session..."

WWW: WMO Flagship Programme (1963-2023): 60 years success

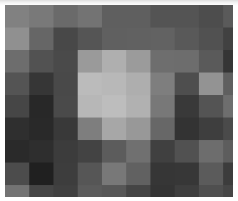


WMO Community has produced great returns over the years to the global society: WWW/GGGW: pathway of progress !

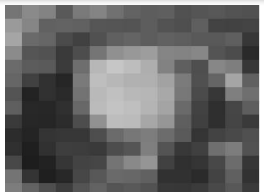




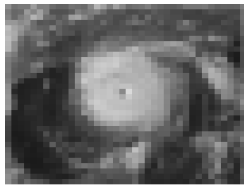
~210km



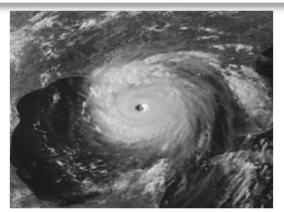
~63km



~39 km



~16km



~8-10km

WMO OMM

III: WMO Achievements on Climate and Climate Change

WMO Strategic Roadmaps and Great Achievement for Climate and Climate Change !

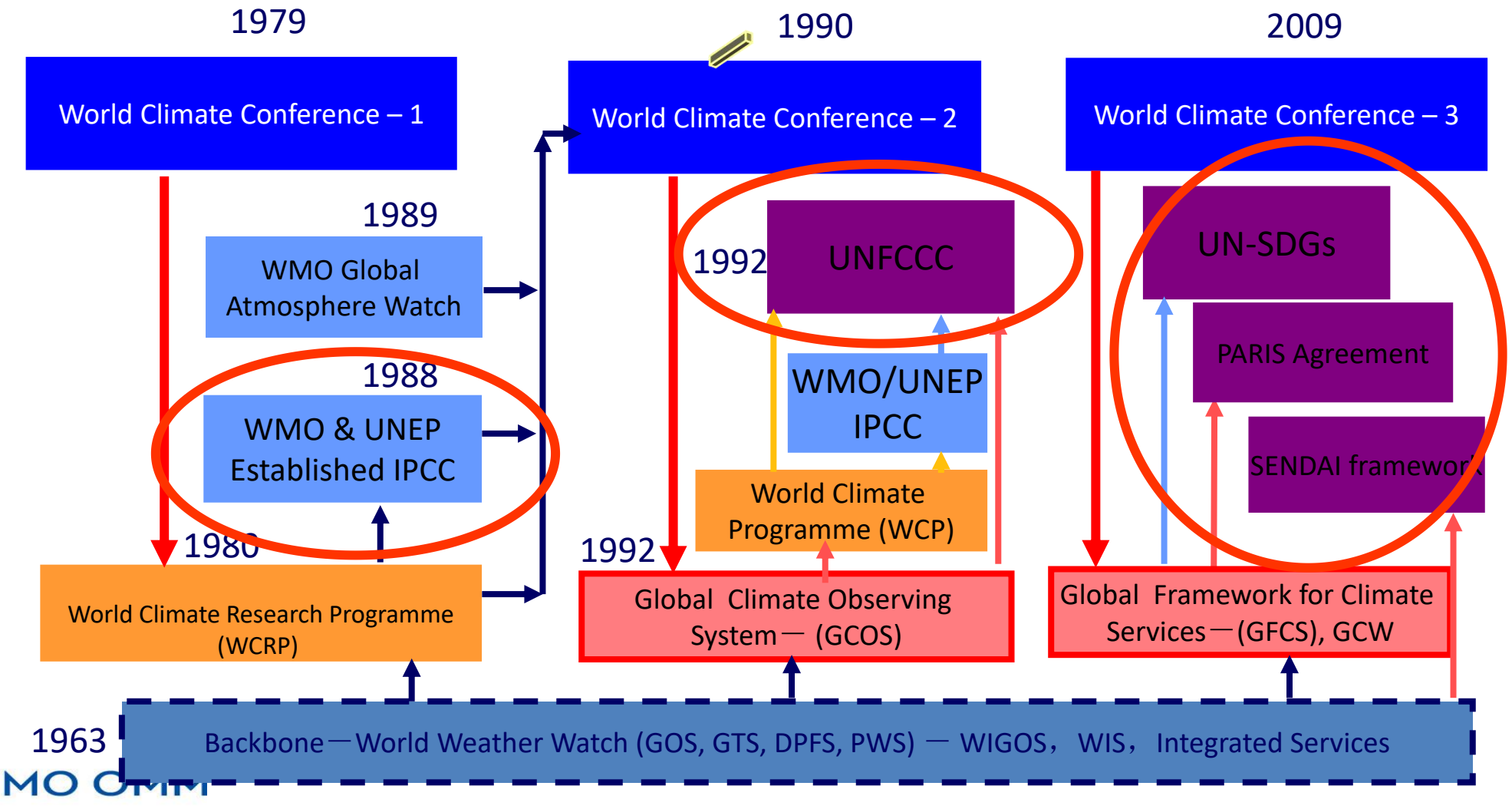
WMO OMM

WMO Overarching Priority-2

Supporting climate-smart decision making to build or enhance **adaptive capacity or resilience to climate risk.**

WMO OMM

WMO Milestone achievements for Global Climate and Climate Change



WMO OMM

1. WMO established the global backbone observing and data exchange mechanism, greatly

Climate Change Assessments - IPCC

The Nobel Peace Prize 2007

IPCC
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
WMO UNEP

-
Intergovernmental Panel on Climate Change (IPCC)
Prize share: 1/2

Photo: Ken Opprann
Albert Arnold (Al) Gore Jr.
Prize share: 1/2

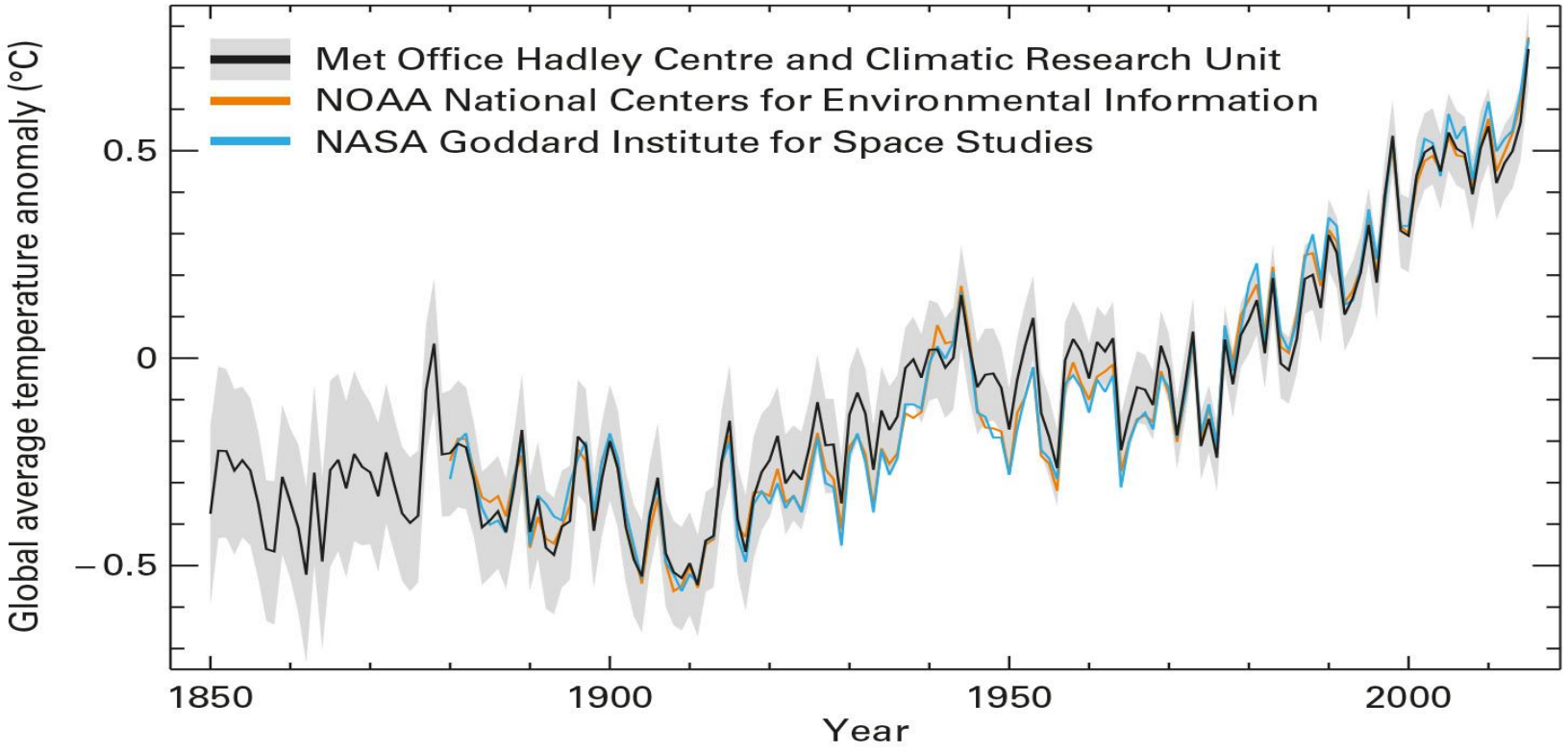
The Nobel Peace Prize 2007 was awarded jointly to Intergovernmental Panel on Climate Change (IPCC) and Albert Arnold (Al) Gore Jr. "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change."

WMO OMM

Climate Change Monitoring: WMO Annual Statement on the Status of Global Climate

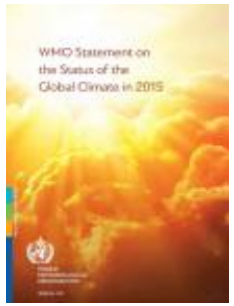
- **Provide an update on yearly basis on global and regional temperature change**

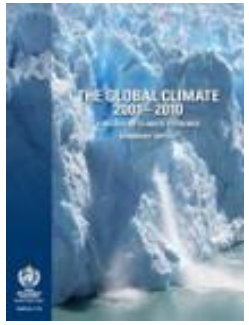
Very useful in tracking climate variability and climate change



WMO OMM

WMO flagsh remes





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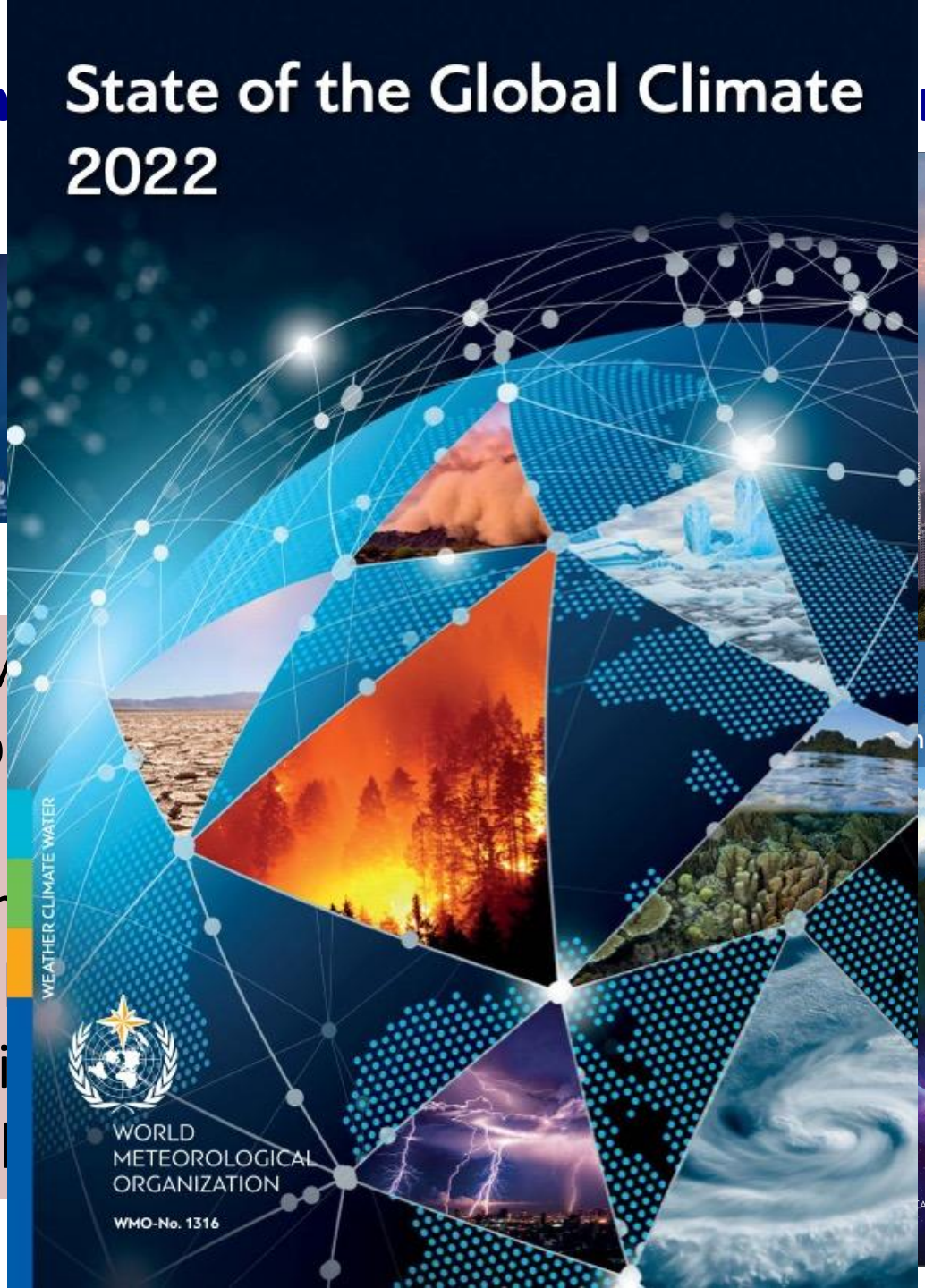
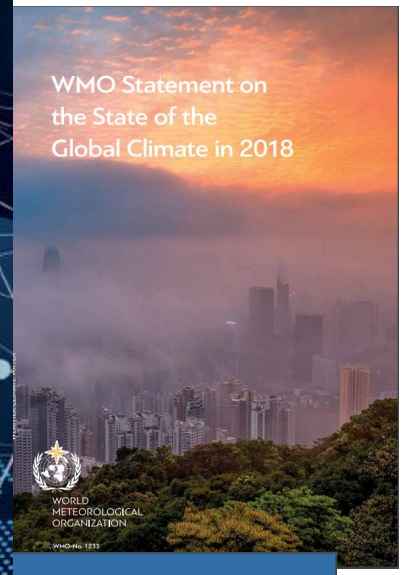
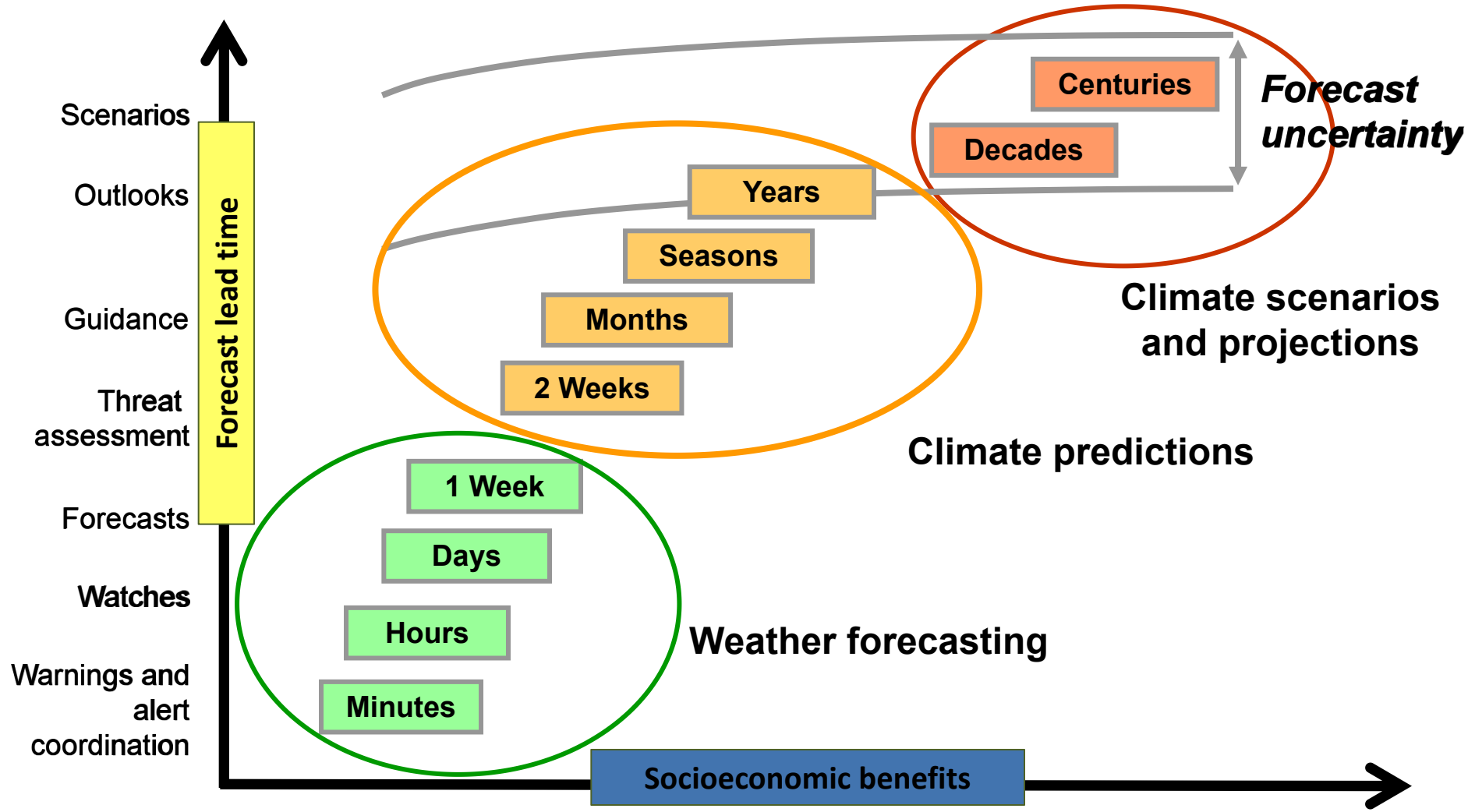




WMO OMM

Weather-climate: seamless framework

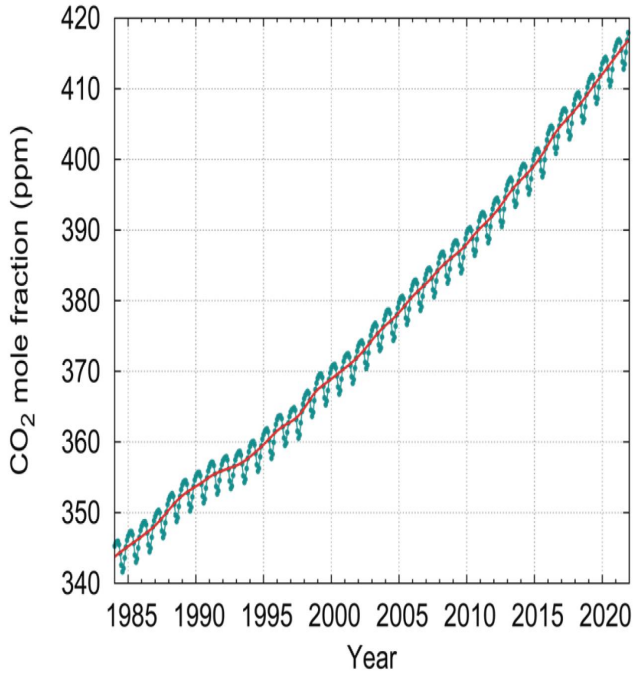


Adapted from NOAA 2011

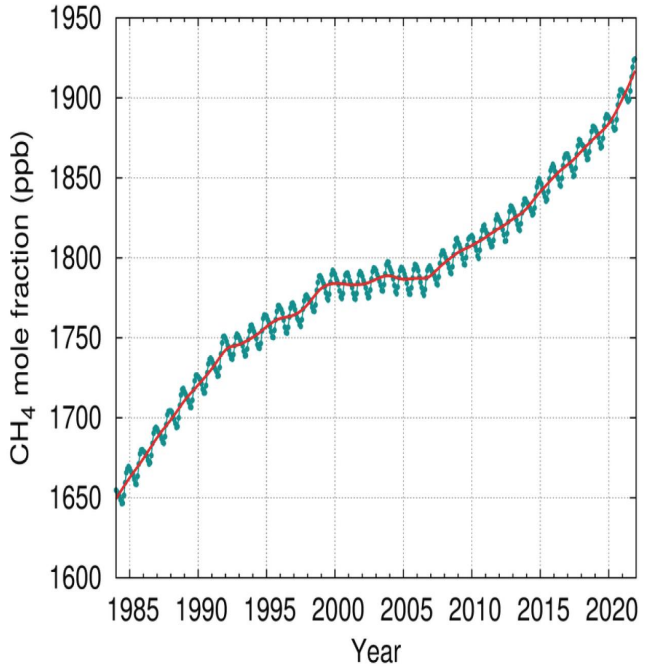
IV: Global challenges we are facing !

Climate Change & Increased Extreme Events Globally/Regionally

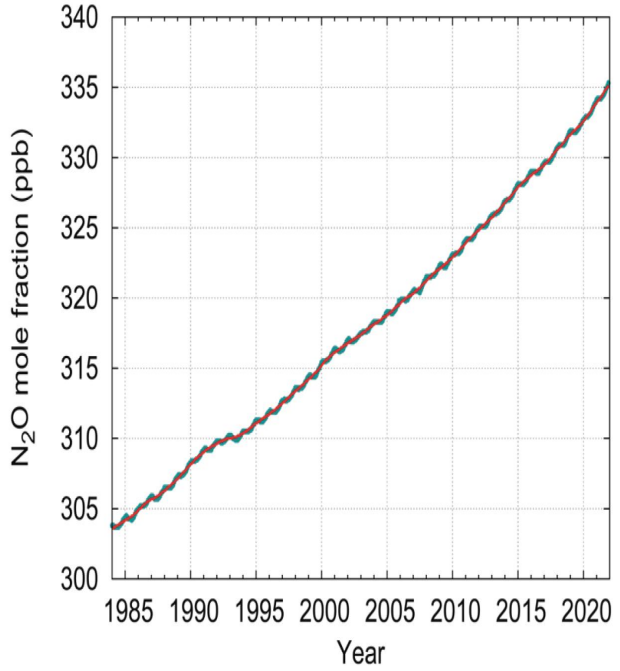
Greenhouse gas concentrations (CO2, CH4 and N2O) continue to rise to new record highs



Carbon dioxide levels **+149%**



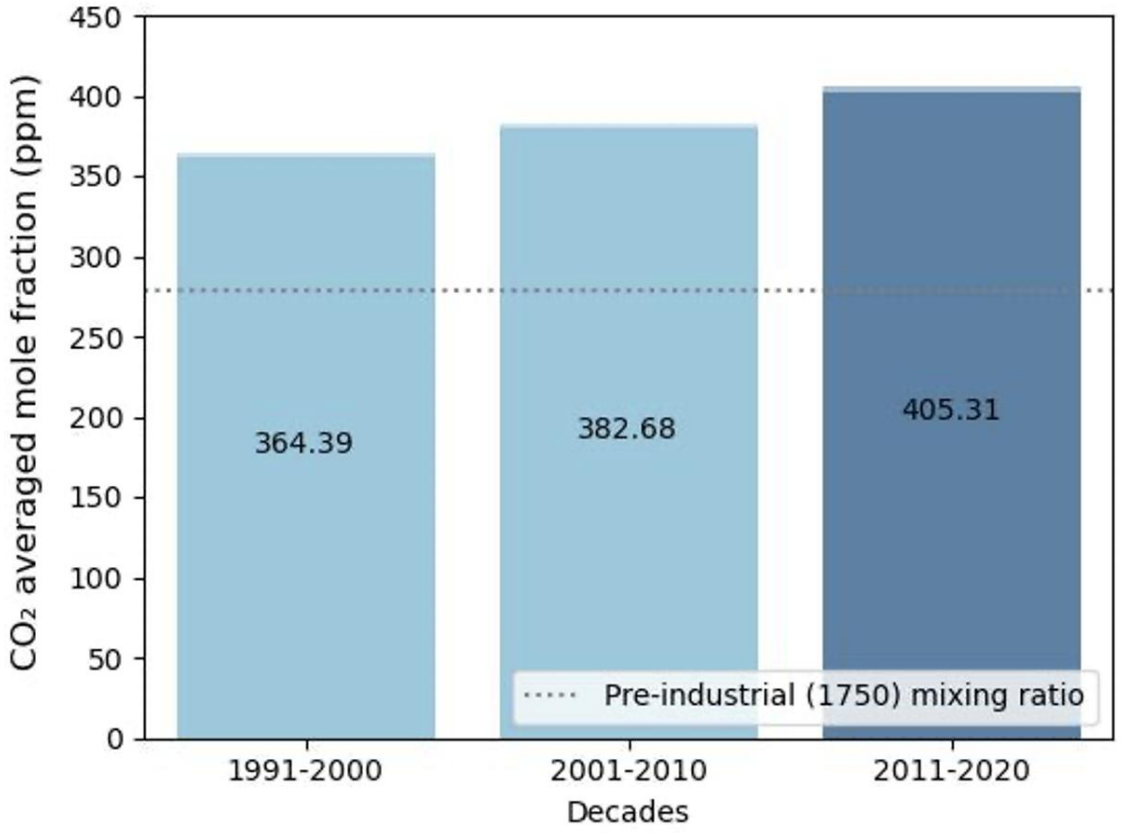
Methane levels **+262%**



Nitrous oxide levels **+124%**

of pre-industrial levels (before 1750)

Decadal State of the Climate: 2011-2020 (CO2)



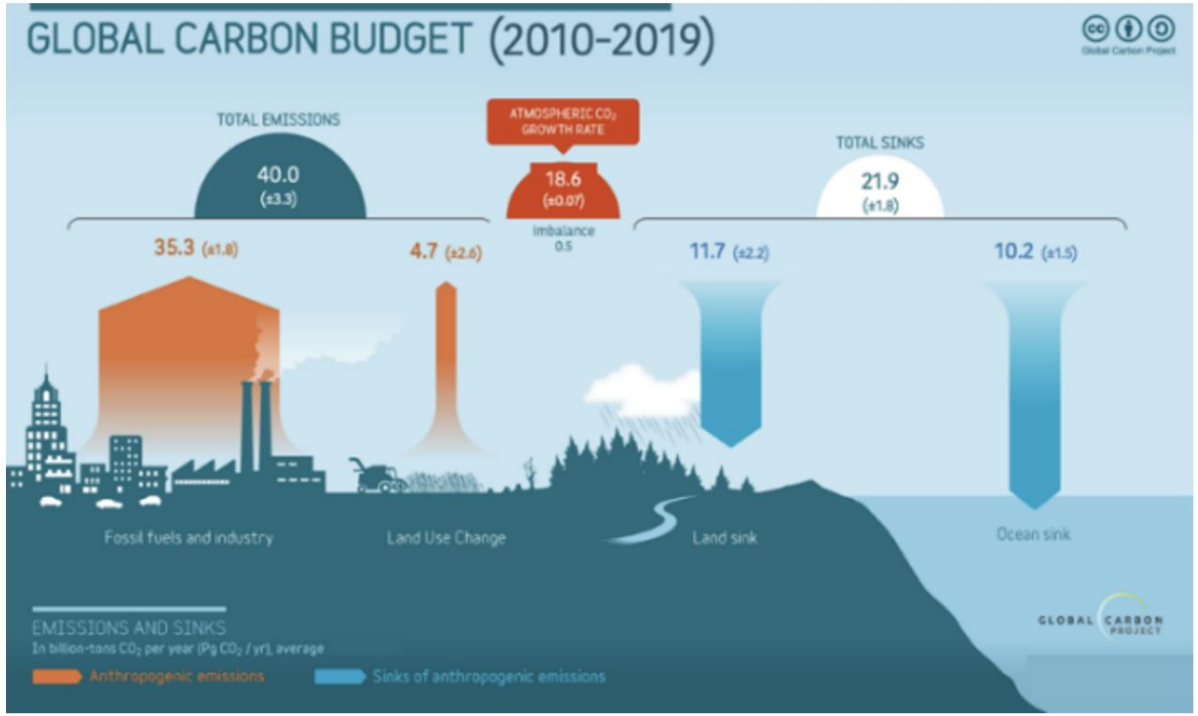


Figure 1. Left: Decadal averaged mole fraction in parts per million (ppm) of carbon dioxide (CO_2) from 1991-2020. Pre-industrial levels indicated in red dashed line. Source: WMO. Right: Global carbon budget from 2010-2019 highlighting sources of anthropogenic emissions and sinks. Source: Global Carbon Project.

Decadal State of the Climate: 2011-2020 (T)

Temperature¶

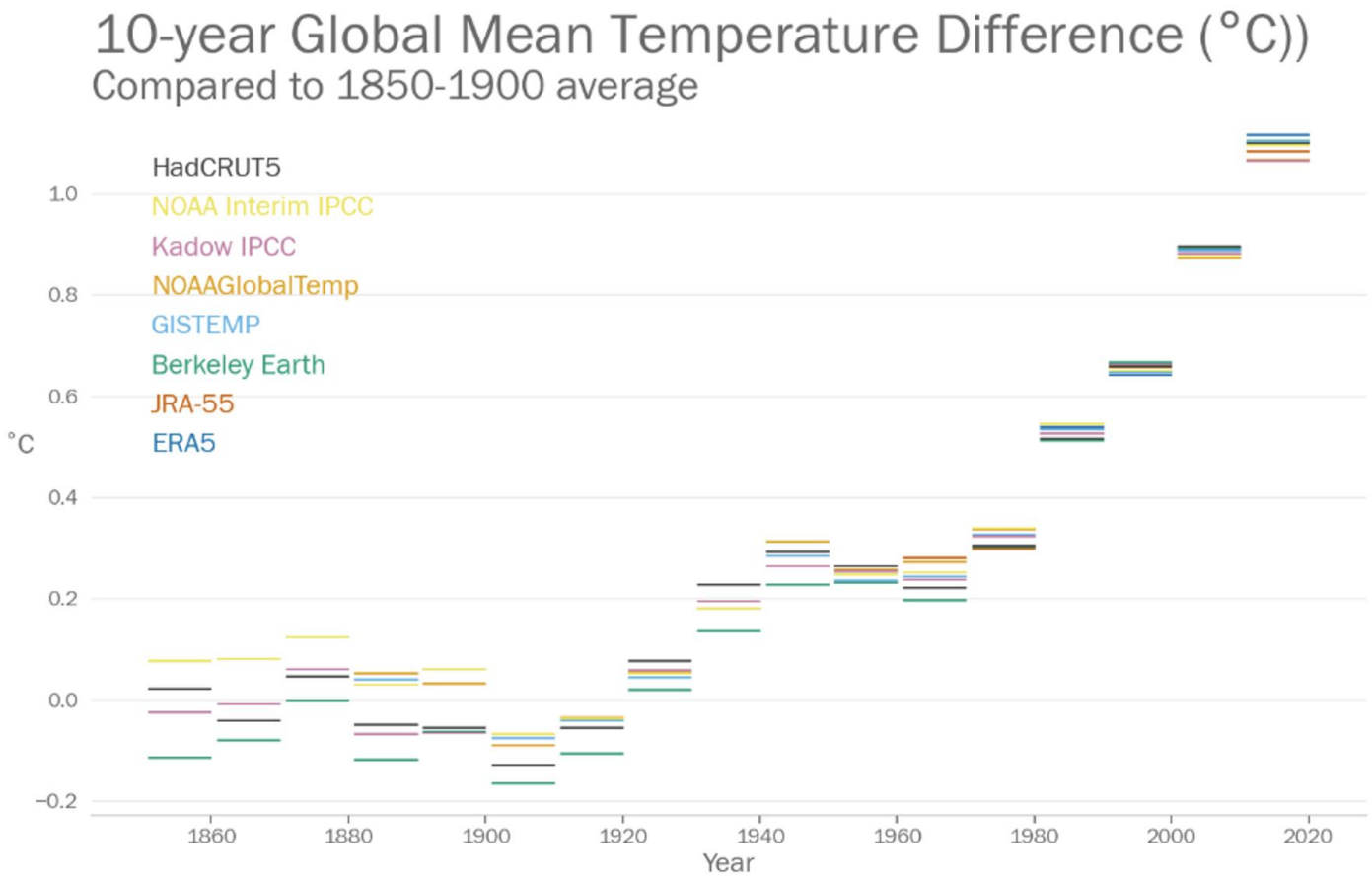


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Figure 5: Decadal-average global mean temperature difference from 1850-1900, for the periods 1851-1860 to 2011-2020. Decadal averages from eight datasets are shown as horizontal-coloured lines. Source: John

Percentage of reporting countries which observed their highest temperature of the 1961-2020

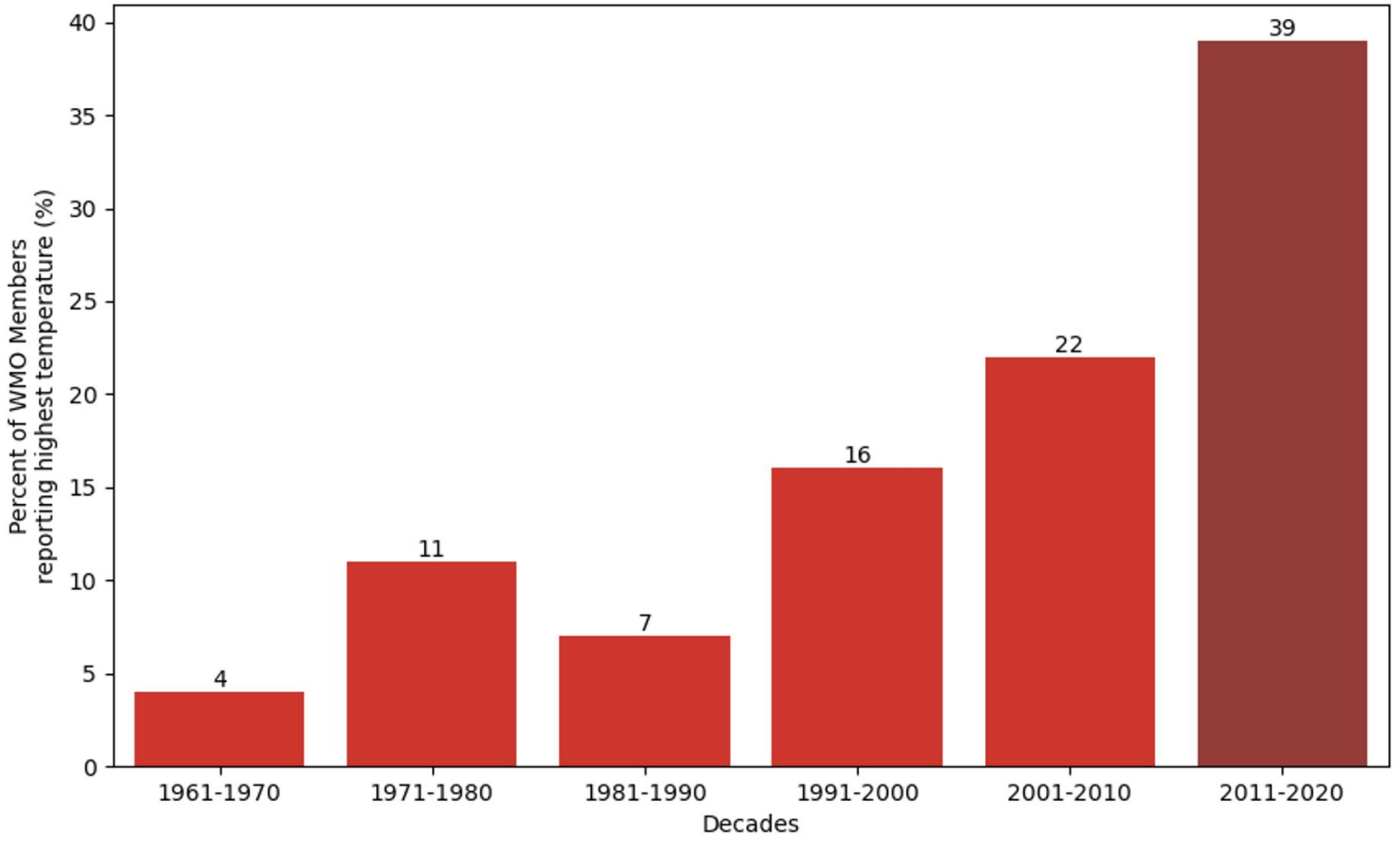


Figure 8. Percentage of reporting countries which observed their highest temperature of the 1961-2020 period in the stated decade.

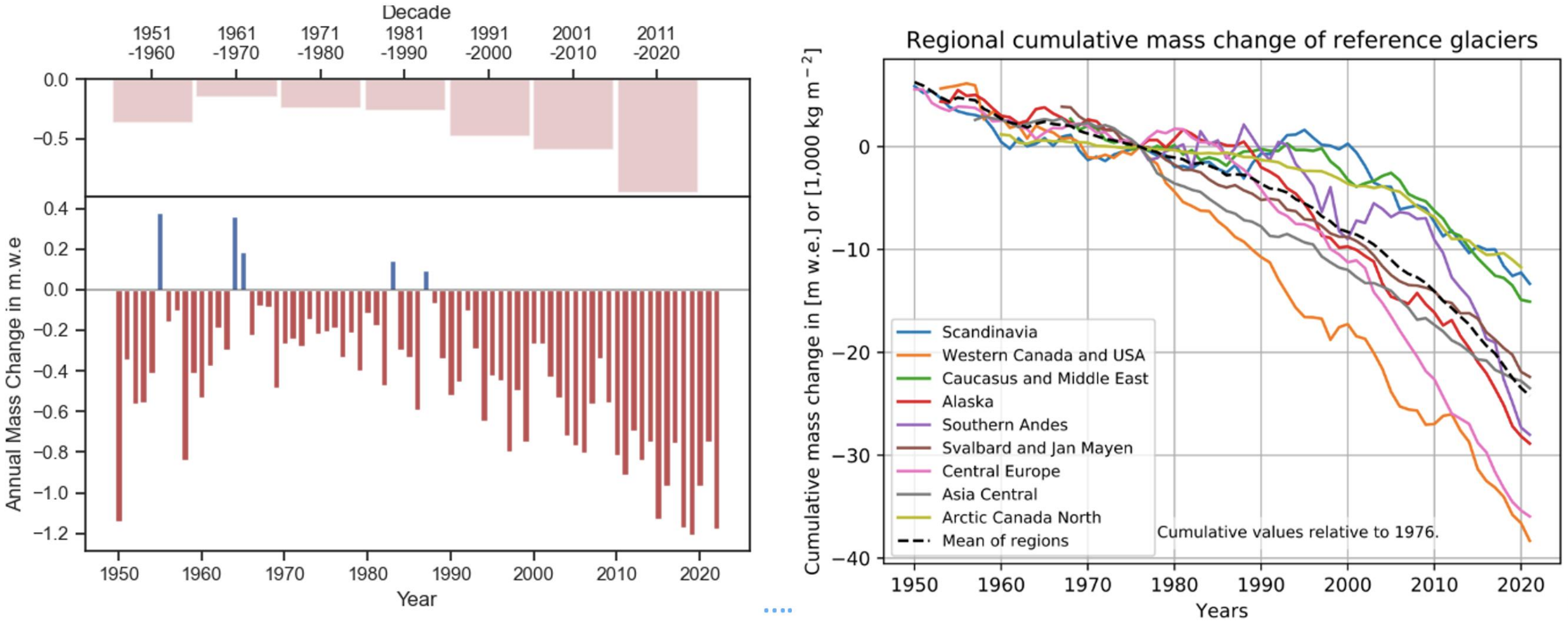


Figure 14: (Left) Annual and decadal mass changes of reference glaciers with more than 30 years of ongoing glaciological measurements. (Right) Cumulative mass change relative to 1976 for regional and global means based on data from reference glaciers. Annual mass change values are given on the y-axis in the unit meter water equivalent (m w.e.) which corresponds to tonnes per square meter (1,000 kg m^{-2}). Source: WGMS (2021, and earlier reports).

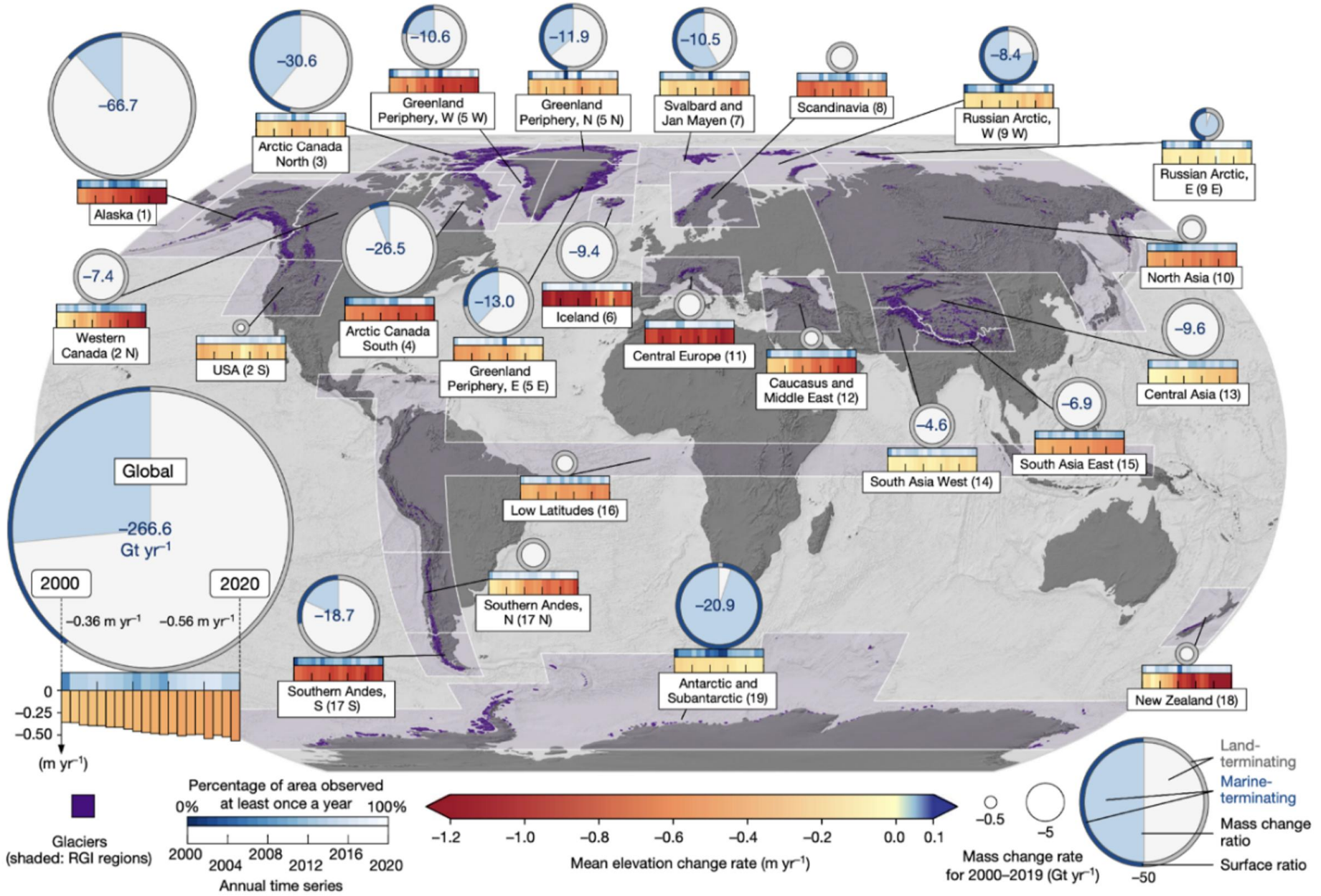


Figure 15: Regional and global glacier elevation change rates (m yr^{-1}) and mass change rates (Gt yr^{-1}) from 2000 to 2020. Source: Hugonnet et al. (2021).

High-Impact and Extreme Events

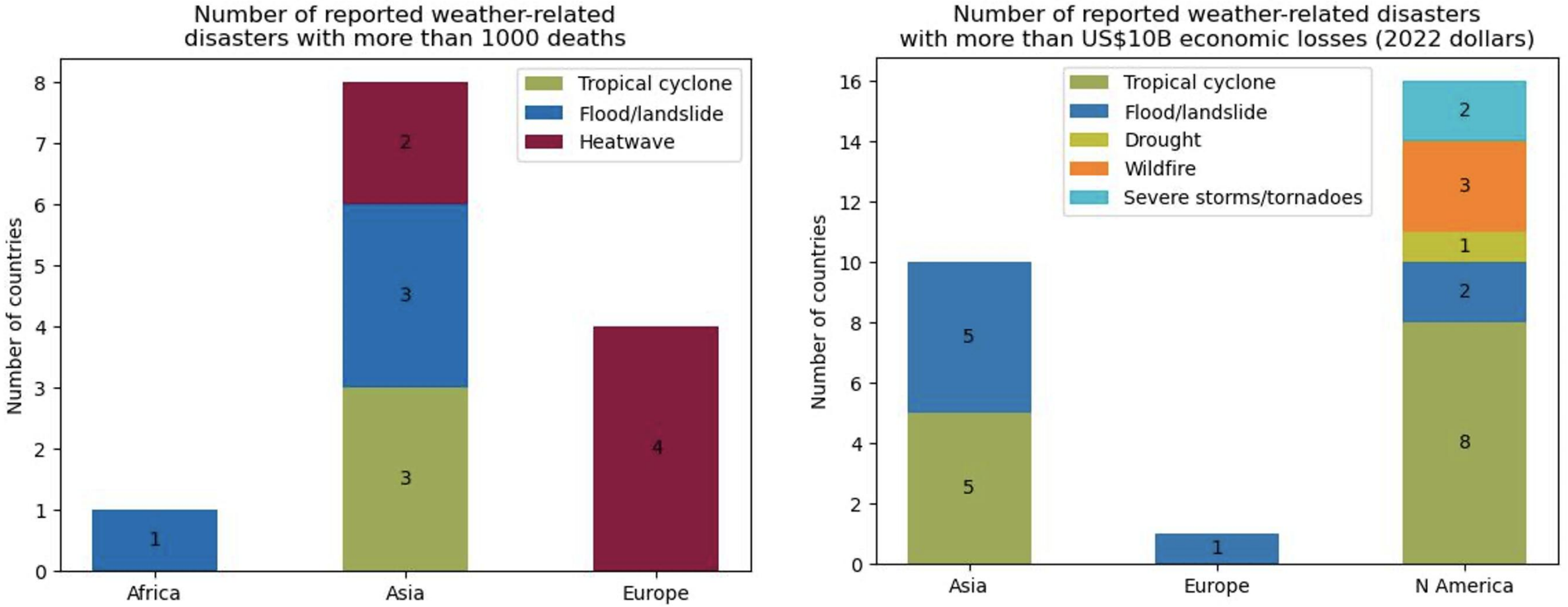


Figure 21. Top: Number of reported weather-related disasters with more than 1000 deaths by disaster type and region. Bottom: Number of reported disasters with more than US$10B economic losses (2022 dollars) by disaster type and region. Source: EM-DAT.

Impact on Human Systems: Health

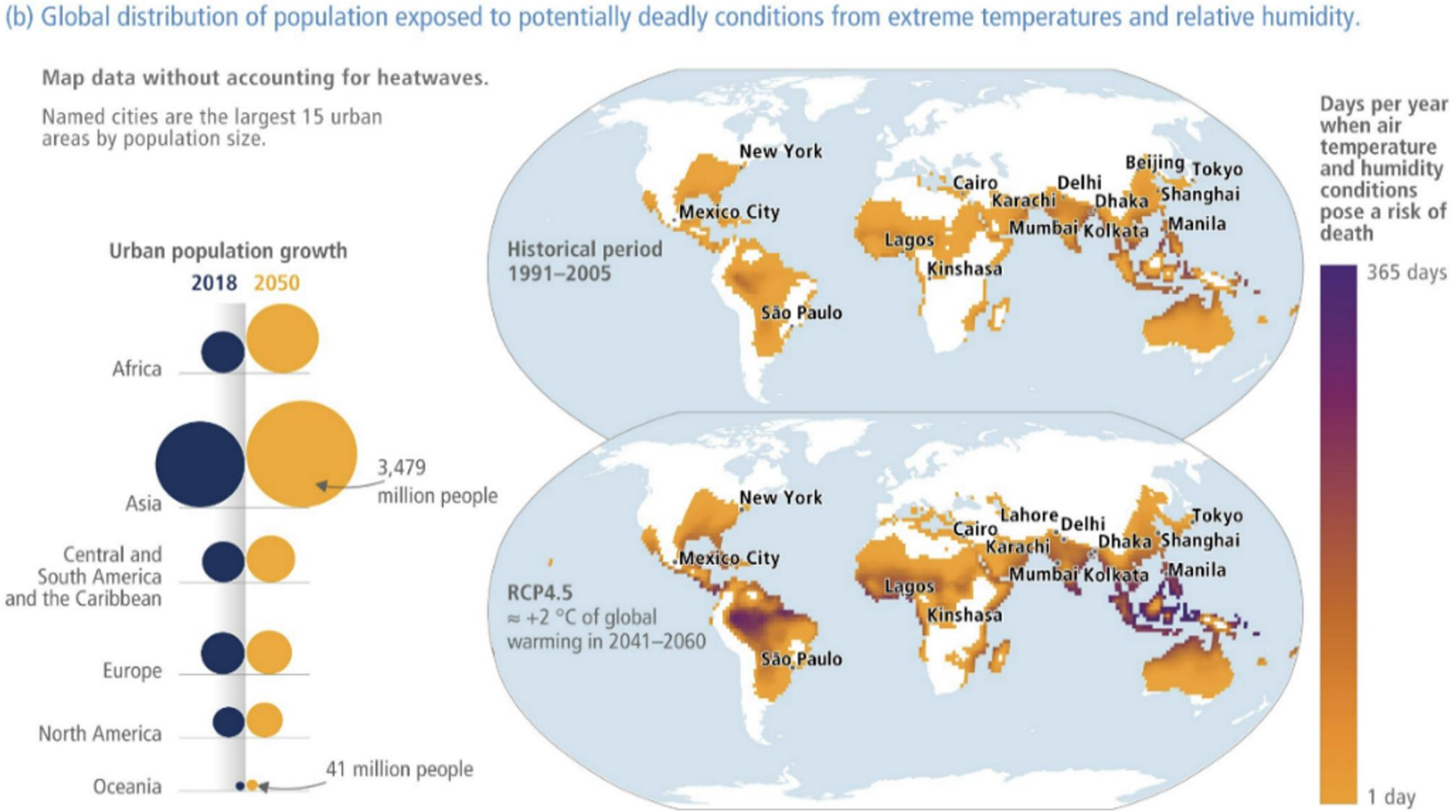
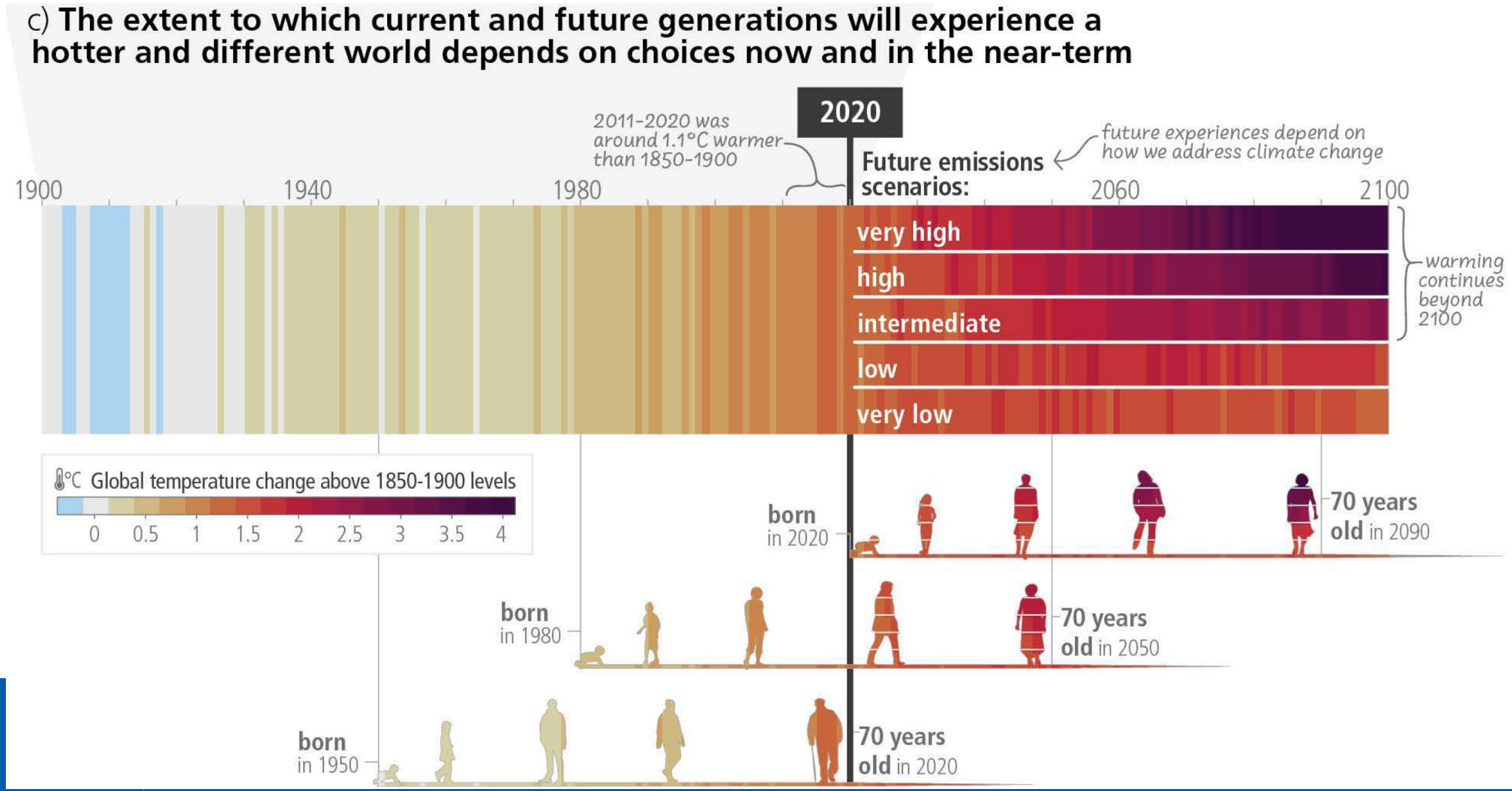


Figure 34. Global distribution of population exposed to potentially deadly conditions from extreme temperatures and relative humidity. Note: the data does not consider heatwaves which are also projected to increase and can cause thousands of deaths in higher latitudes. Source: IPCC Sixth Assessment Report, WG1 2021.

Possible climate scenarios 1900-2100



WMO Regional Climate Statement (Reports)
1-Key findings of the State of the Climate in Asia 2022

State of the Climate in Asia 2022

3rd of its kind for Asia region, led by the WMO Regional Association of Asia

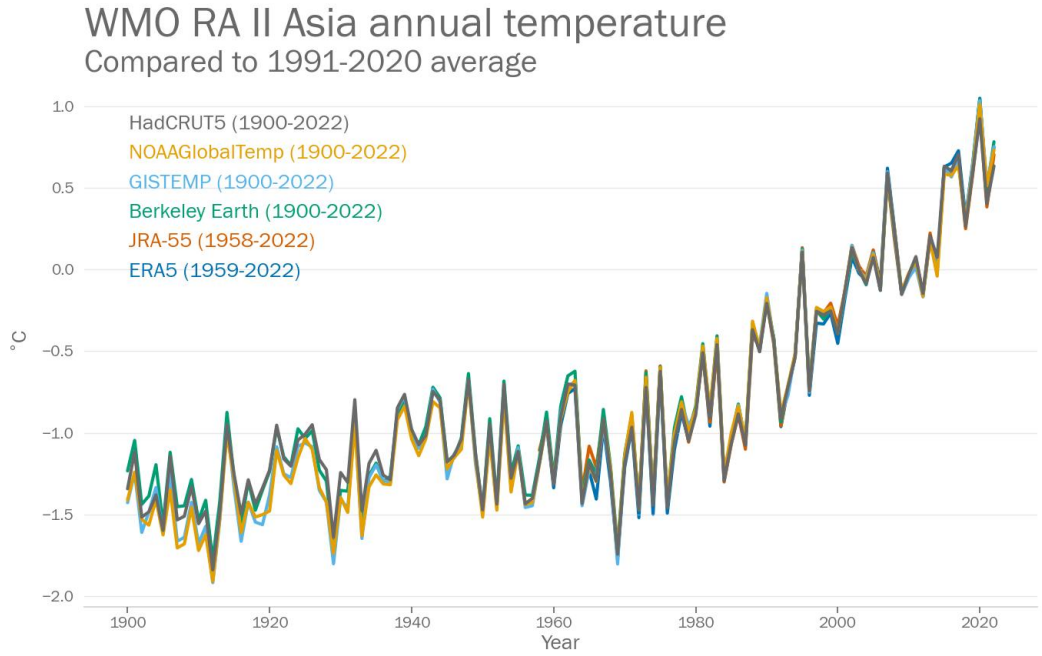
60 Experts from the region and around the world

11 International and Regional institutions (including United Nations agencies)

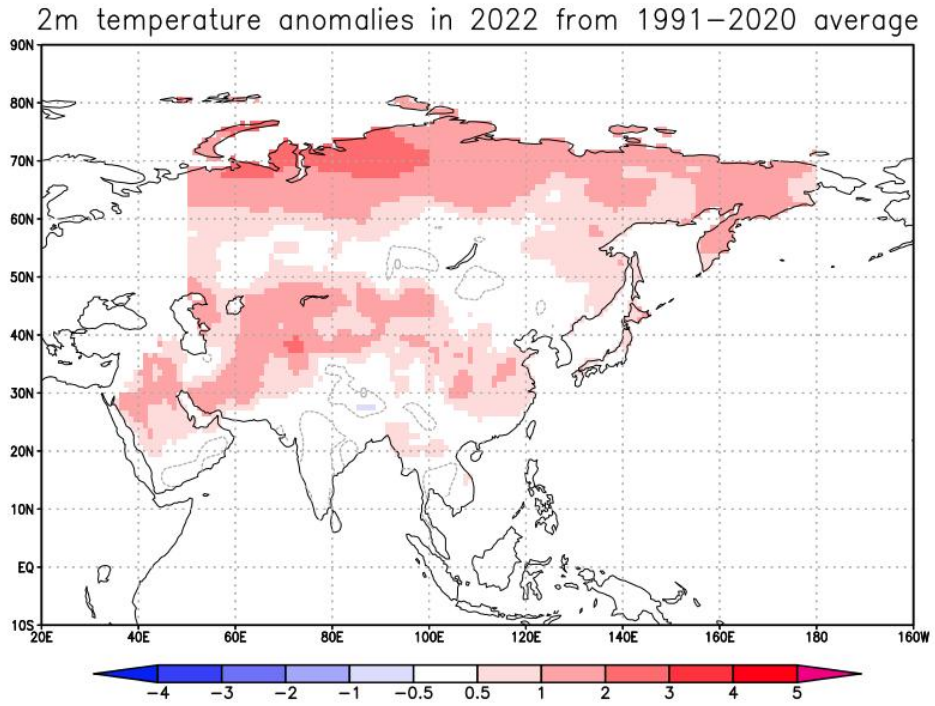
17 Members from WMO Regional Association II (Asia)

Temperature

- The mean temperature over Asia for 2022 was the 2nd or 3rd warmest on record (the ranking depends on dataset used for estimation) and was 0.72 °C [0.63 °C–0.77 °C] above the 1991–2020 average.
- The warming trend in Asia in 1991–2022 was almost doubled compared to the warming trends in the 1961–1990 period.
- Above average temperatures were recorded in Northern Siberia, the northern Middle East, Central Asia and western to coastal areas of China.



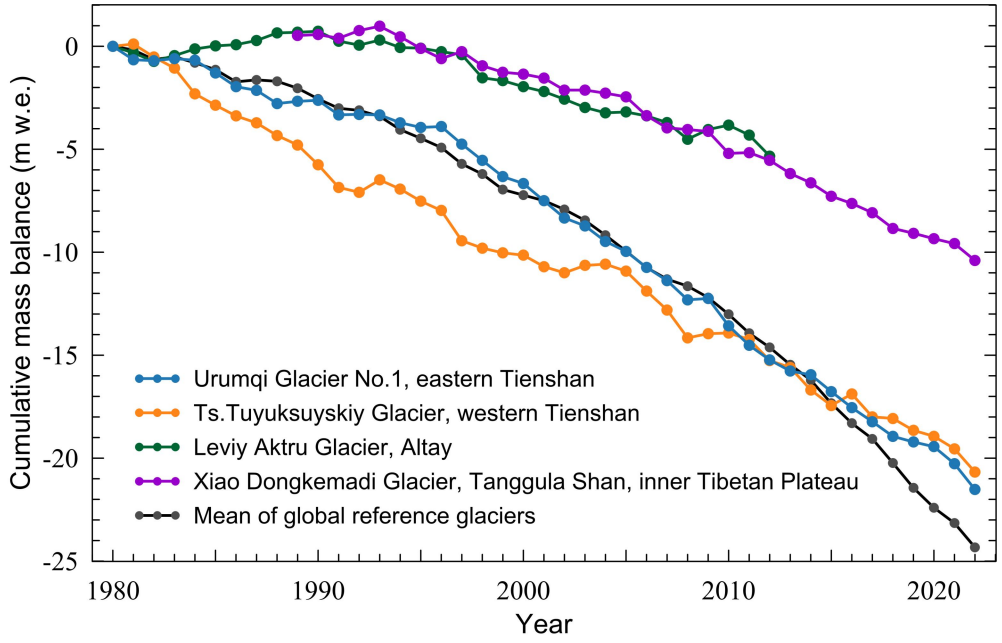
Annual mean temperature anomalies (°C), 1900–2022, averaged over Asia, relative to the 1991–2020 average for six global temperature data sets.



Temperature anomalies (°C) relative to the 1991–2020 long-term average from the JRA-55 reanalysis for 2022.

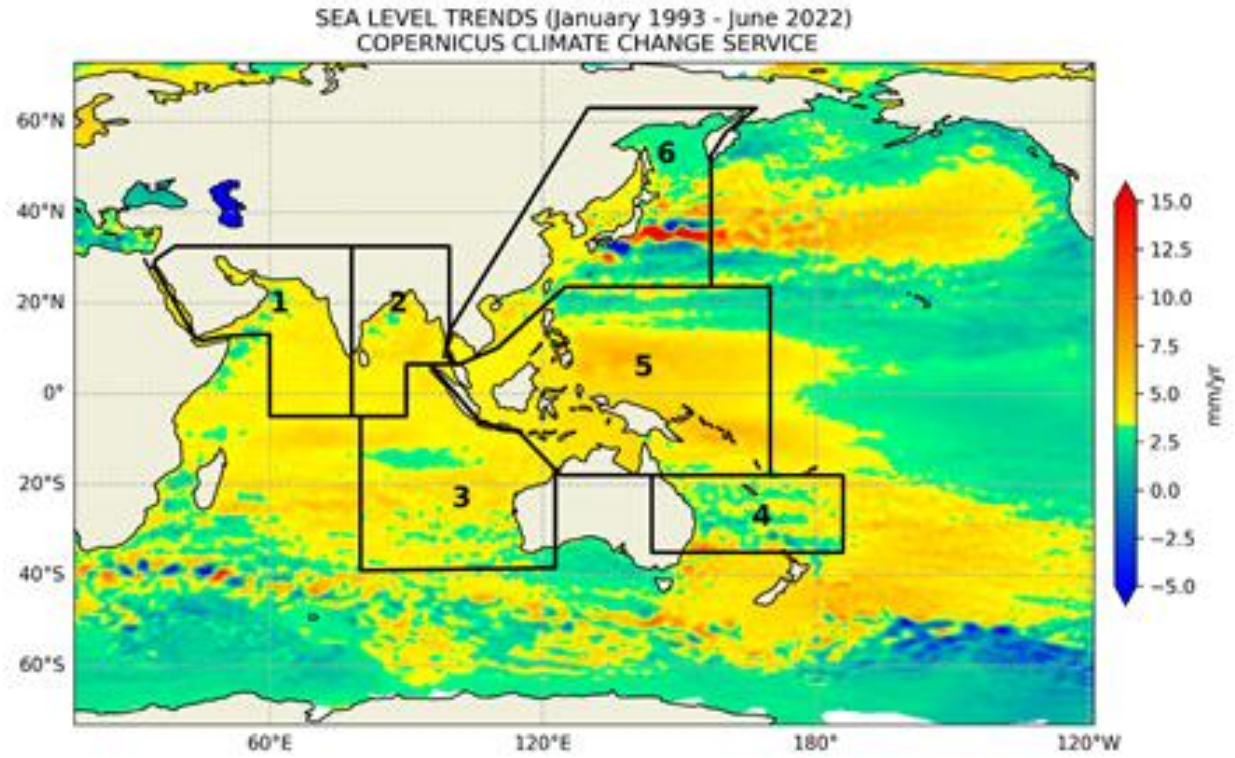
Glaciers

- Most glaciers in the High Mountain Asia region suffered from intense mass losses as the result of exceptionally warm and dry conditions in 2022.
- In the past 40 years, four glaciers with long-term observations in the High-Mountain Asia region recorded significant mass losses, with an accelerating trend since mid-1990s.
- In May 2022, Pakistan experienced a major Glacier Lake Outburst Flood (GLOF) event on Shishper glacier. That brought widespread impacts, causing significant destruction to homes in downstream villages, to irrigation systems and agricultural lands, and to highways and bridges.



Cumulative mass balance (in metres water equivalent (m w.e.)) of four reference glaciers in the High-Mountain Asia regions and the average loss of global reference glaciers.

Damage of major GLOF event on Shishper glacier on the infrastructure in Pakistan in May.



Subregion number	Area	Trends in rate of sea-level rise (in mm per year)
1	North-West Indian Ocean	3.80 ± 0.1
2	North-East Indian Ocean	4.13± 0.2
3	South-East Indian Ocean	3.85 ± 0.1
4	Sea off the eastern coast of Australia	3.39 ± 0.1
5	Western tropical Pacific region	4.19 ± 0.3
6	North-West Pacific region	3.59 ± 0.1
	Global mean	3.4 ± 0.3

Rate of area-averaged sea-level change over the period from January 1993 to June 2022 satellite measurement period. Subregions are defined in the above figure.

Sea Level

- The rates of sea level rise in 5 subregions are slightly larger than the global mean rate over 1993-2022, with values above 4 mm/year in north-east Indian Ocean and western tropical Pacific region.
- The regional sea-level shows strong year-by-year variability, mostly driven by the El Niño–Southern Oscillation (ENSO), especially in the eastern Indian Ocean and tropical Pacific Ocean.

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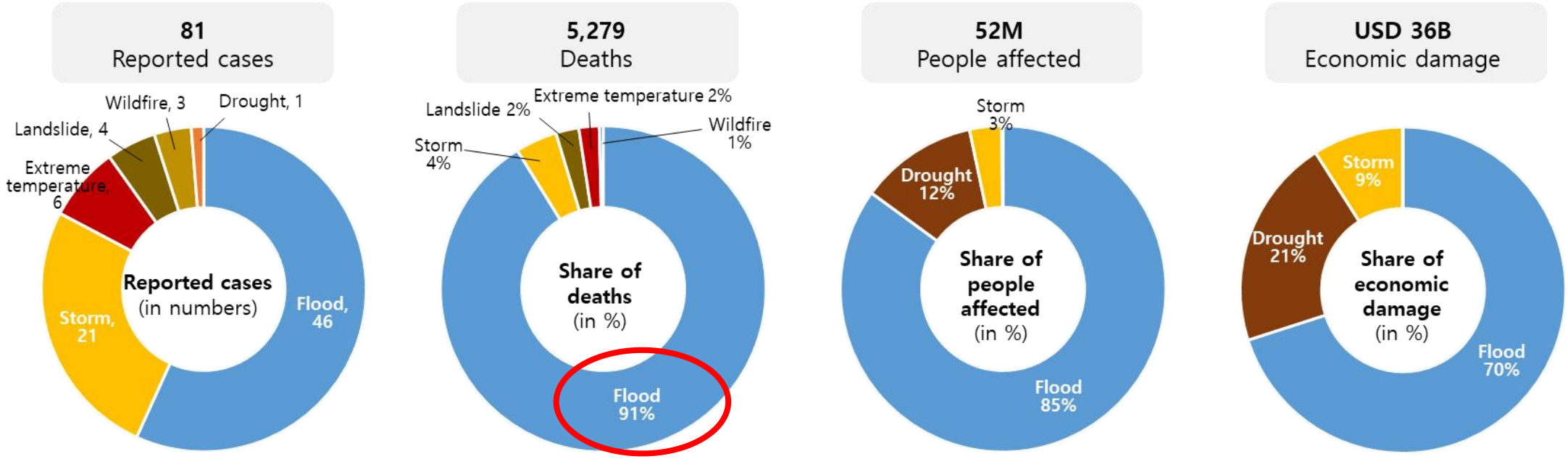
Affected populations and damage

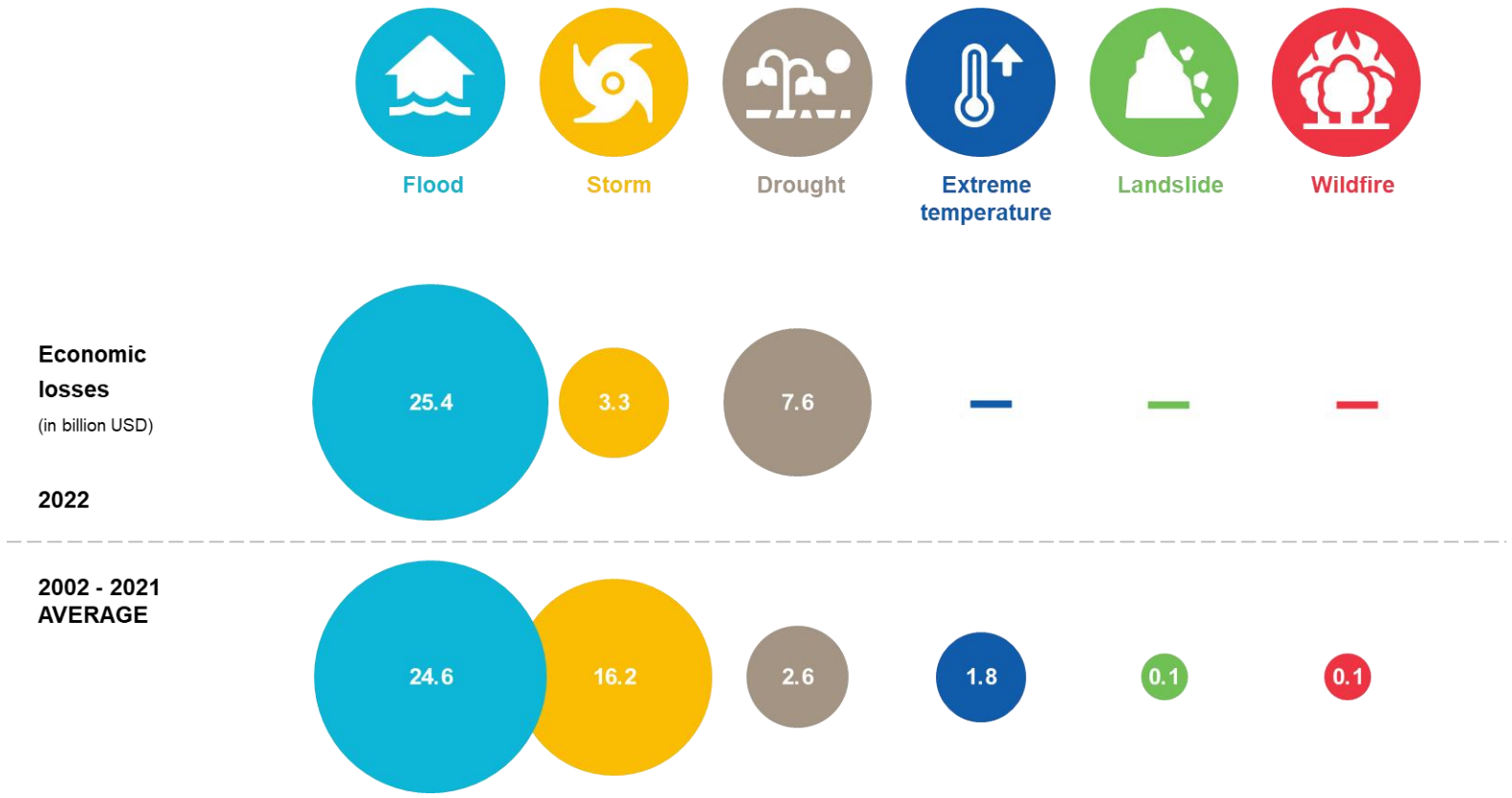
- According to the Emergency Events Database (EM-DAT), flood and storm events led to over 5 000 fatalities, 90% of which were associated with flooding, and more than 50 million people were directly affected.
- Floods were the leading cause of death, people affected, and economic damage in 2022 by a substantial margin.



Overview of 2022 disasters in the Asia region.

Source: Economic and Social Commission for Asia and the Pacific (ESCAP); EM-DAT. ESCAP calculations are based on data from EM-DAT.
Note. The economic damages of some disaster occurrences are not presented in the figure due to data unavailability. In the figure, only cases reported in EM-DAT are considered.

Impacts on the economy



Economic losses in Asia in 2022 from disasters, compared to the 20-year average (2002–2021)

- Overall, disasters led to a total economic damage of over US$ 36 billion.
- The economic losses associated with floods in 2022 exceeded the average over the past 20 years (2002–2021). This was due to the significant economic losses from floods in Pakistan, China and India.
- The economic losses associated with drought in 2022, which mainly occurred in China, exceeded by nearly 200% the 20-year average from 2002 to 2021.

Source: ESCAP calculations based on EM-DAT.
Note. The economic damages of some disaster occurrences are not presented in the figure due to data unavailability.

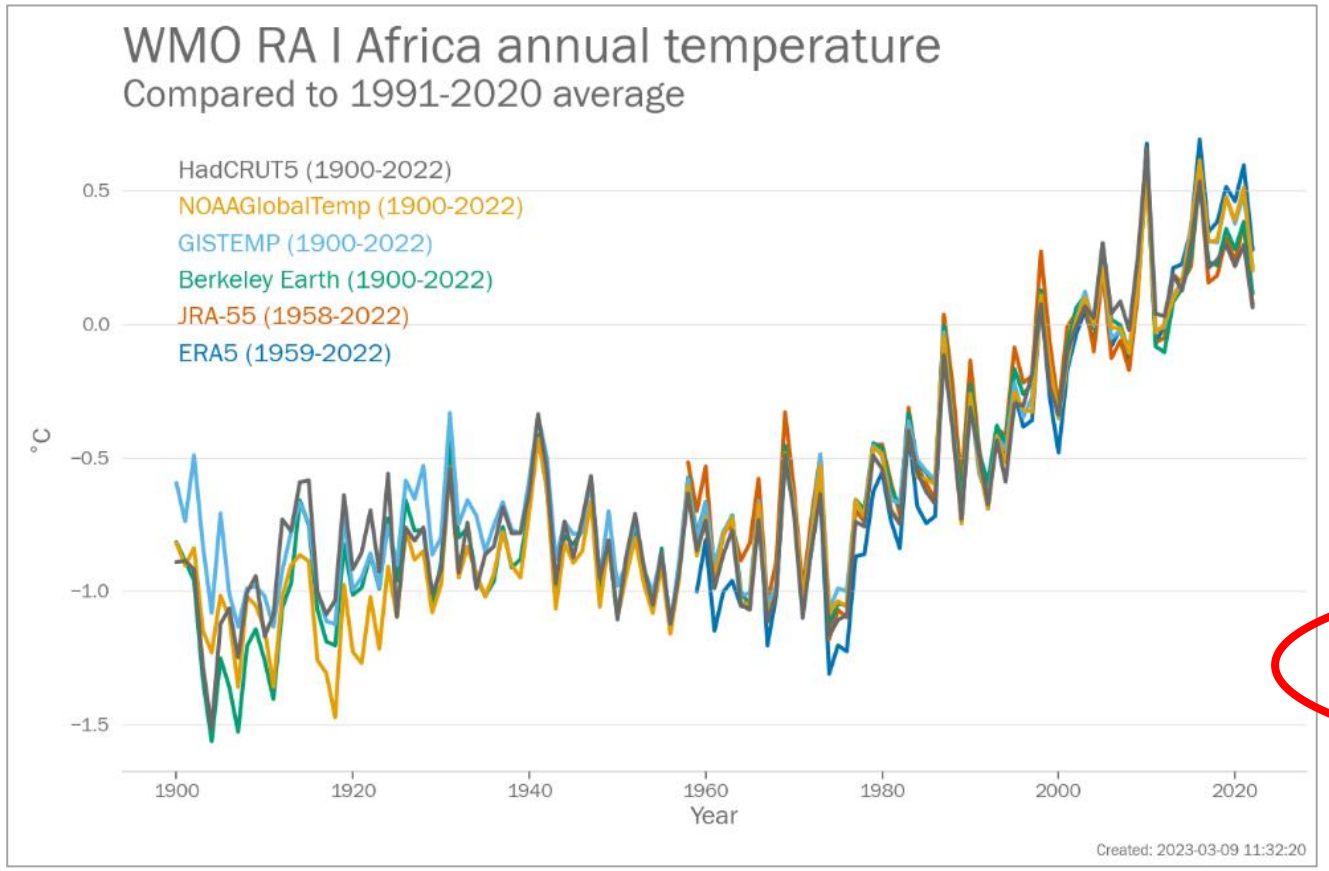
State of the Climate in Africa 2022

Prof. Petteri Taalas
WMO Secretary-General

WORLD METEOROLOGICAL ORGANIZATION

1873 2023 IMO-WMO

Annual mean temperature anomalies in Africa



Annual temperature anomalies in Africa from 1900 to 2022 (climatological reference: 1991-2020)

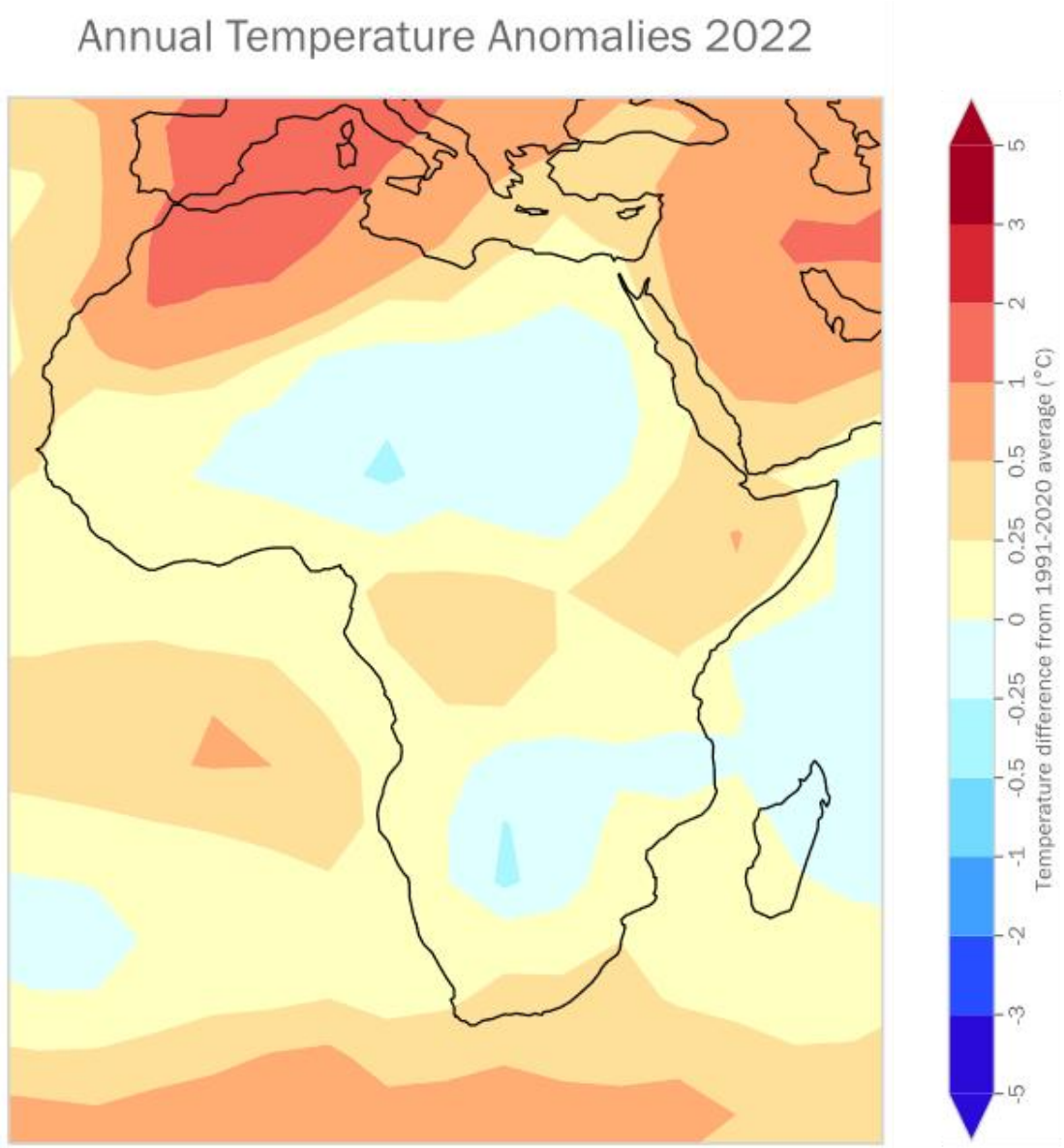
2022 mean temperature anomaly

- 0.16 °C above the 1991–2020 average
- 0.88 °C above the 1961–1990 average
- 1.37 °C above the 1850–1900 average

Warming rate greater than the global average (1991–2022)

- **Africa:** +0.3 °C/decade
- **Global:** +0.2 °C/decade

WMO | 1873 2023 IMO-WMO



2022 temperature anomalies (climatological period: 1991–2020)

In 2022, most of Africa recorded temperatures above the 1991–2020 average, except in the desert areas of Northern and Southern Africa.

- **Highest temperature anomaly**

North Africa: 0.50 °C above the 1991–2020 average

- **Lowest temperature anomaly**

Southern Africa: 0.01 °C above the 1991–2020 average.

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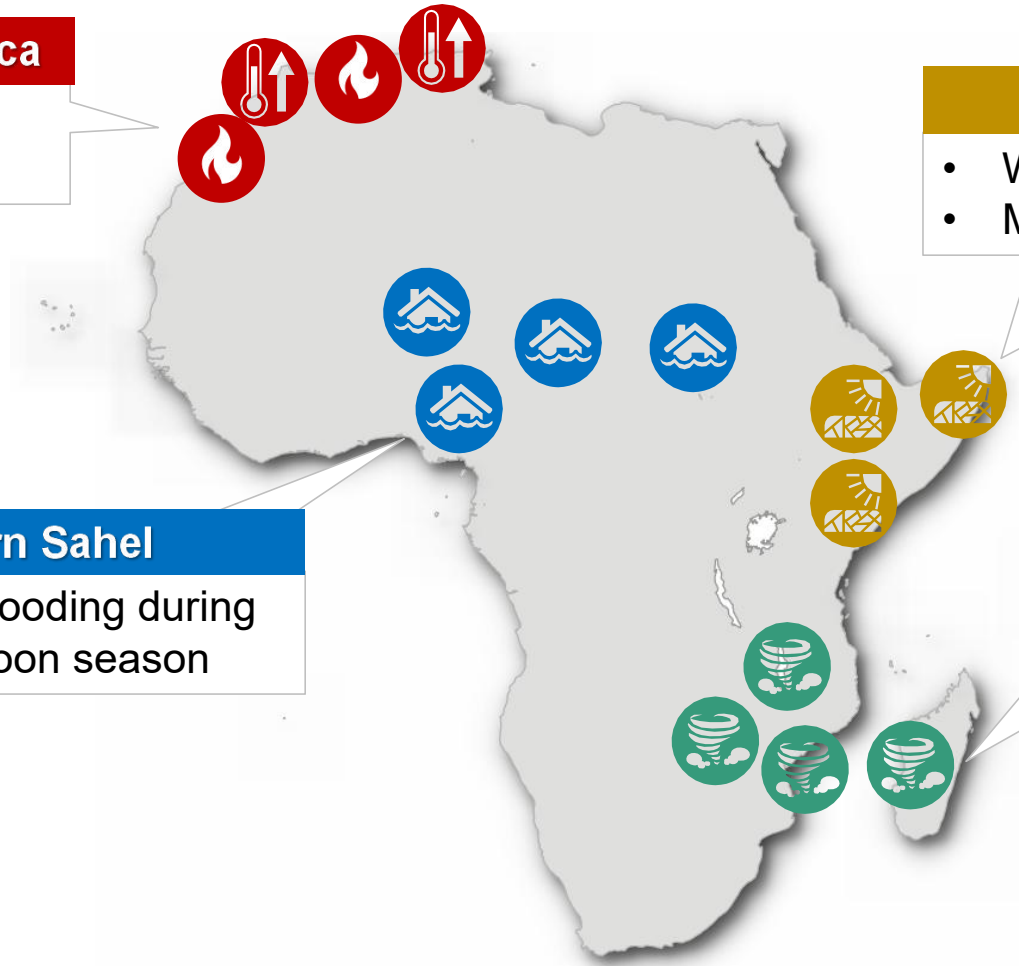
Major extreme events in 2022

North-western North Africa

Heatwaves and wildfires during the summer 2022



Horn of Africa

- Worst drought in 40 years
- Multi-seasonal drought

Eastern Sahel

Significant flooding during the monsoon season

Southern Africa and Indian Ocean

- Active tropical cyclone season
- Series of tropical cyclones and tropical storms in the first months of 2022

Impacts

Agriculture and food security

North Africa

- The aggregate cereal production in North Africa in 2022 was estimated to be **10%** below the previous 5-year average (2017-2021) and **14%** down from 2021.

West Africa

- The aggregate cereal production in 2022 was estimated to be above average, around **7%** higher than the estimated output in 2021 due to good rains during the crop season.

Southern Africa

- The 2022 total cereal output was estimated to be **38.5 million tons**, around **5%** higher than the previous five-year average (2017–2021), but about **10%** lower than the record high in 2021.
- Above-average cereal outturns were estimated in Madagascar, Malawi and South Africa.
- Substantial production downturns were registered in Zambia and Zimbabwe.

Break for 10 minutes

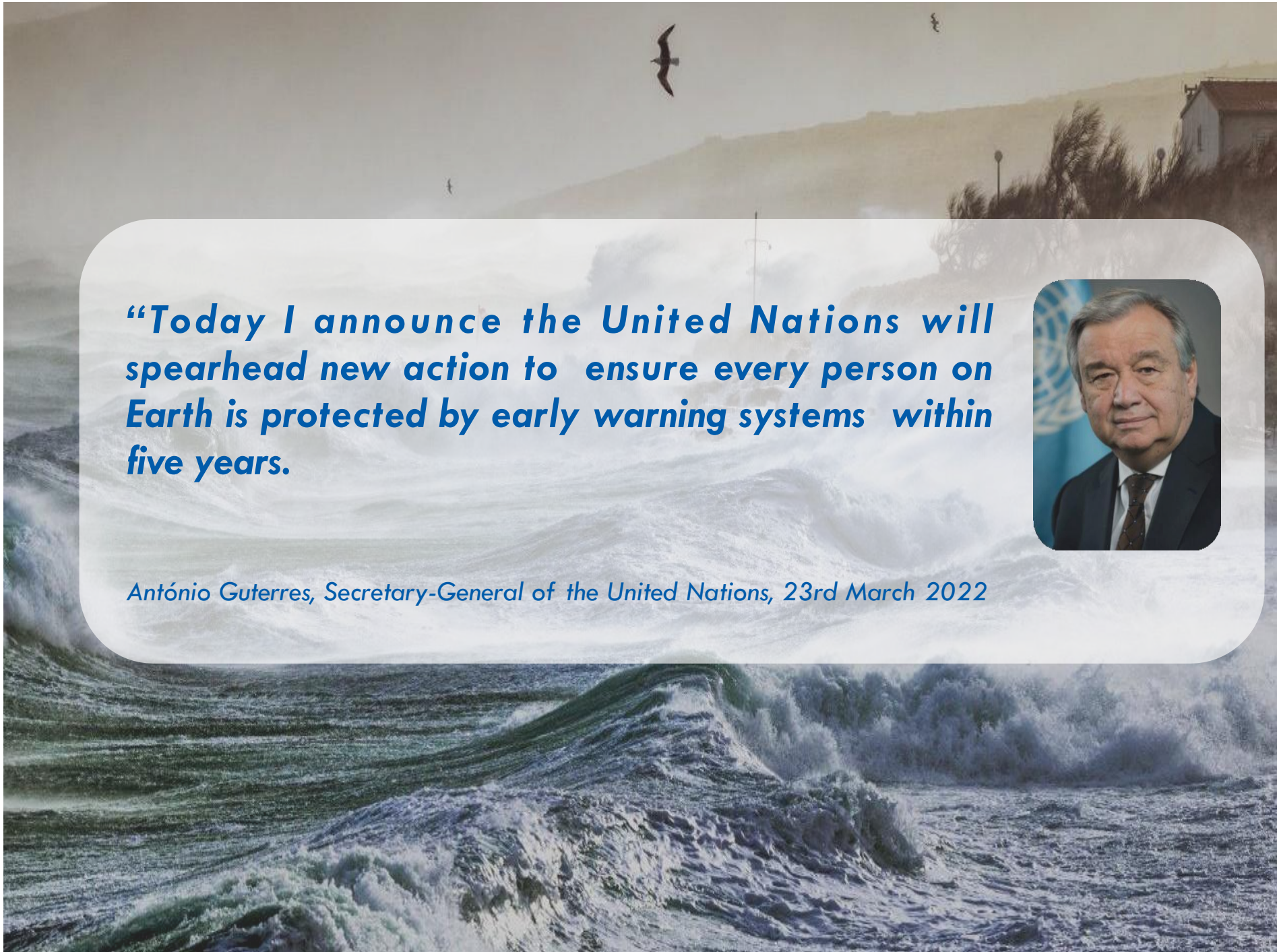
V: TWO WMO Global Initiatives addressing the global challenges

V-I: Early Warning for All

V-II: Global Green House Gas Watch

WMO Global Initiative I:

Early Warnings for All



"Today I announce the United Nations will spearhead new action to ensure every person on Earth is protected by early warning systems within five years.

António Guterres, Secretary-General of the United Nations, 23rd March 2022

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The state of MHEWS Globally

- An enhanced data collection campaign (the ***WMO Performance Monitoring System***) conducted since March 2022 shows that significant MHEWS gaps remain globally
- A **composite Early Warning Index** will be developed with Members and key partners in the months ahead. This index will better demonstrate changes in the global status of early warnings and early action going forward and highlight areas where urgent action is required.

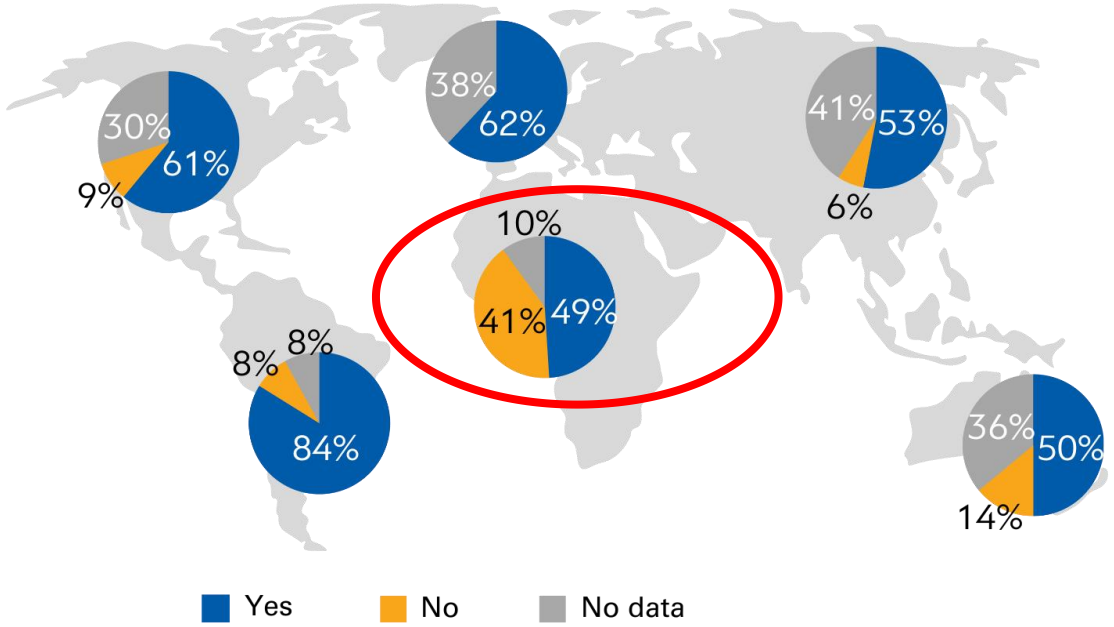
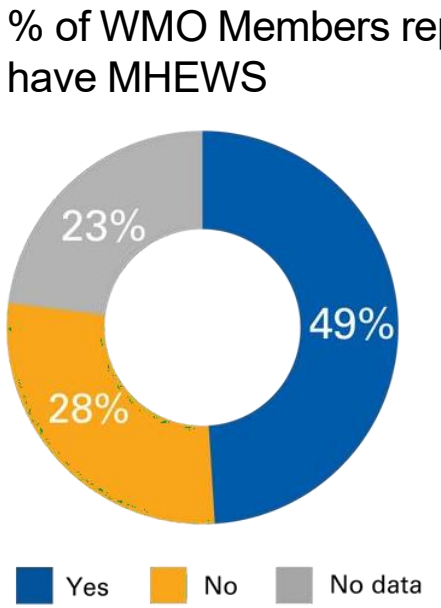
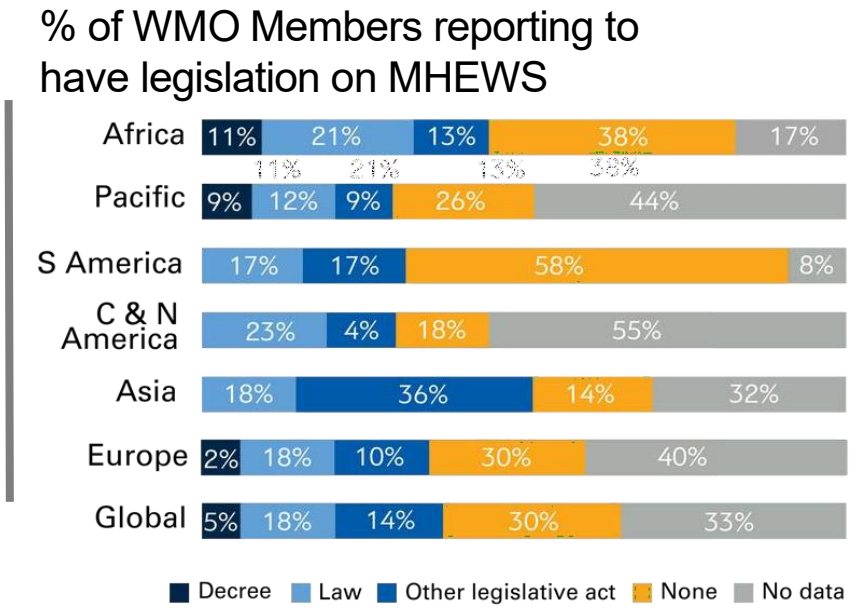
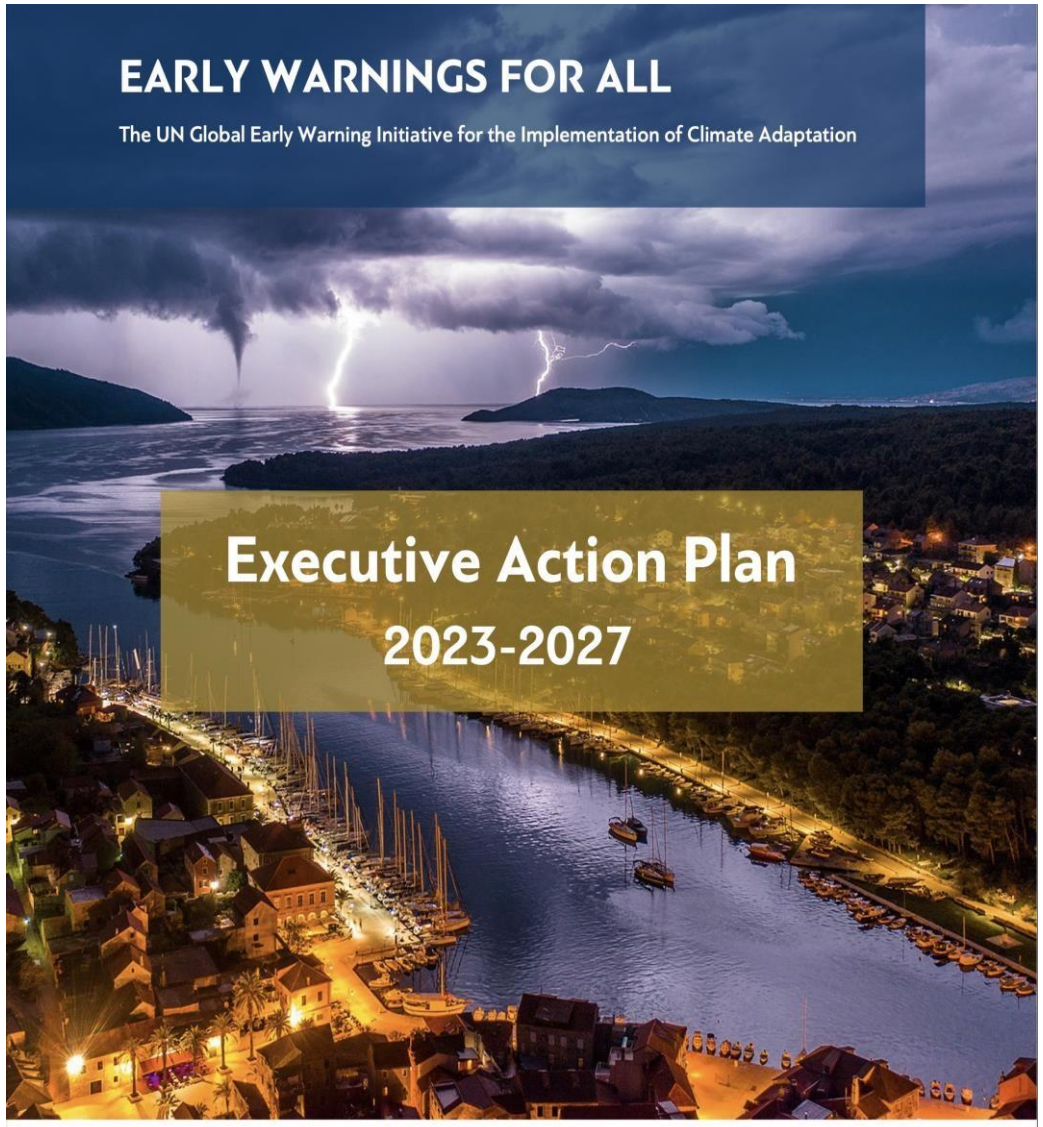


Figure 4: Percentage of countries reporting to have Standard Alerting Procedures (SAPs)







WORLD METEOROLOGICAL ORGANIZATION

COP27 SHARM EL-SHEIKH EGYPT 2022

Foreword

Ever-rising greenhouse gas emissions are supercharging extreme weather events across the planet. These increasing calamities cost lives and hundreds of billions of dollars in loss and damage. Three times more people are displaced by climate disasters than war. Half of humanity is already in the danger zone.

The world is failing to invest in protecting the lives and livelihoods of those on the front line. Those who have done the least to cause the climate crisis are paying the highest price. Entire populations are being blindsided by cascading climate disasters without any means of prior alert.

We must invest equally in adaptation and resilience. That includes the information that allows us to anticipate storms, heatwaves, floods and droughts. Communities and nations need adequate warning and the ability to respond to incoming extreme weather events. To that end, I have called for every person on Earth to be protected by early warning systems within five years, with the priority to support the most vulnerable first. This Executive Action Plan sets out the concrete way forward to achieve this goal. It describes how the United Nations system and a wide range of partners will work together to effectively deliver on this objective.

The facts are clear.Early warnings save lives and deliver vast financial benefits. COP27 is the COP for implementation. Now is the time to implement Early Warnings for All.
I urge all governments, financial institutions and civil society to support this effort.

H.E. António Guterres
Secretary-General of the United Nations

Early warnings save lives and provide vast economic benefits. Just 24 hours' notice of an impending hazardous event can cut the ensuing damage by 30 per cent. The Global Commission on Adaptation, found that spending just $800 million on such systems in developing countries would avoid losses of $3-16 billion per annum. Such progress is only possible with modern science, sustained systematic observing networks, daily international exchange of quality data, advanced supercomputing power, the translation of forecasts into impacts, plus advances in telecommunications and connectivity. We require improvements and deeper understanding of risk across all time scales, stronger National Meteorological and Hydrological Services, Disaster Risk Management Agencies, and Emergency preparedness measures, considered capacity development, regional support structures, expert technical assistance, accessible financial support, an anticipatory humanitarian sector. Overall we need a people-centred approach that prioritizes community engagement. These are the essential ingredients for protecting every person on Earth by early warnings within five years.
This Executive Action plan 2023-2027 sets out the recipe for how these ingredients can come together to achieve the goal. I thank the many partners who worked together to develop this Executive Action Plan, and count on your continued support to ensure implementation. It is our collective accountability and responsibility not to fail but to leave a legacy of implementation.

H.E. Prof. Petteri Taalas
Secretary-General
World Meteorological Organization

WORLD METEOROLOGICAL ORGANIZATION

EW4All Structure-Action Chain Approach -non traditional DRR approach

Pillar 1

Disaster risk knowledge

Systematically collect data and undertake risk assessments

- Are the hazards and the vulnerabilities well known by the communities?
- What are the patterns and trends in these factors?
- Are risk maps and data widely available?

Pillar 2

Detection, observations, monitoring, analysis and forecasting of hazards

Develop hazard monitoring and early warning services

- Are the right parameters being monitored?
- Is there a sound scientific basis for making forecasts?
- Can accurate and timely warnings be generated?

Pillar 4

Preparedness and response capabilities

Build national and community response capabilities

- Are response plans up to date and tested?
- Are local capacities and knowledge made use of?
- Are people preapred and ready to react to warnings?

Pillar 3

Warning dissemination and communication

Communicate risk information and early warnings

- Do warnings reach all of those at risk?
- Are the risks and warnings understood?
- Is the warning information clear and usable?

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*Estimate based on consulta

USD 374 MILLION

DISASTER RISK KNOWLEDGE & MANAGEMENT

- In support of comprehensive risk management
- In the context of a changing climate
- Connecting hazard recording with loss and damage accounting

EW4All: Roll-Out Workplan Pillar 1

- **Pillar 1 Toolkit:** Global Standards on Risk Knowledge for EWS (including on production & analysis, open access & use of risk information for EWS and on ILK and citizen science); sector-specific guidelines (agri-food, environment, etc.), gender-, child- & disability-sensitive EWS
- Support with assessing, compiling and using **end-to-end risk information for EWS**
- Develop **Disaster Loss Databases** & hazard tracking systems
- **Innovation, Inclusion, Indigenous and Local Knowledge (ILK)**
- **National-level activities**: capacity development, technical support
- Reporting on **Sendai Target G** & compiling Multi-Hazard EWS custom indicators

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Pillar 1: Disaster risk knowledge and management
Led by UNDRR & WMO

Seven Risk Knowledge Outcome themes

Production

Countries have the capability to produce quality, timely and relevant risk information, with vulnerable communities participating in the process.

Access

Ability to access standardized, interoperable and updated risk information to inform decisions.

Application

Relevant actors can use risk information to inform decision-making for early warning.

Monitoring and evaluation

Countries can monitor the availability and effectiveness of early warning systems and use this to update them.

Governance/ collaboration/ inclusion

Strengthened collaboration between key Ministries, academia, the private sector and vulnerable communities for risk information creation.

Robust locally-led understanding

Risk knowledge capabilities built through local, traditional, indigenous, generational and scientific knowledge.

Innovation

Innovation, drives a step change in risk knowledge capabilities at all scales and available for all.

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Pillar 1 – success criteria

- **Data and risk assessments** are systematically collected
- Hazards and vulnerabilities are **well-known by communities**
- Factor **patterns and trends** are identified
- **Risk maps** and data are widely available
- All countries have **geo-referenced data platforms and tools** to **issue impact-based forecasts**
- All NMHSs or other relevant authorities benefit from **capacity building** measures
- Sendai Target G Indicator G-5: All countries have **accessible, understandable, usable and relevant disaster risk information** and assessment available to people at national and local levels.

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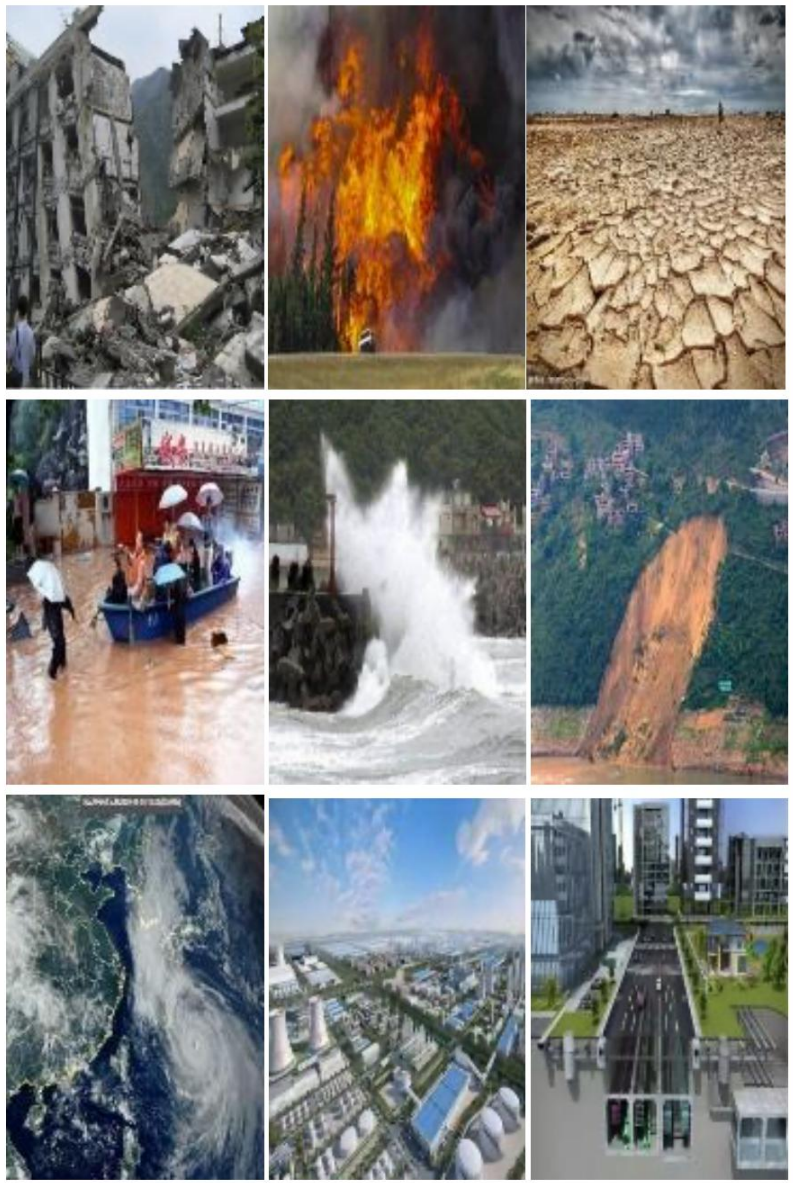
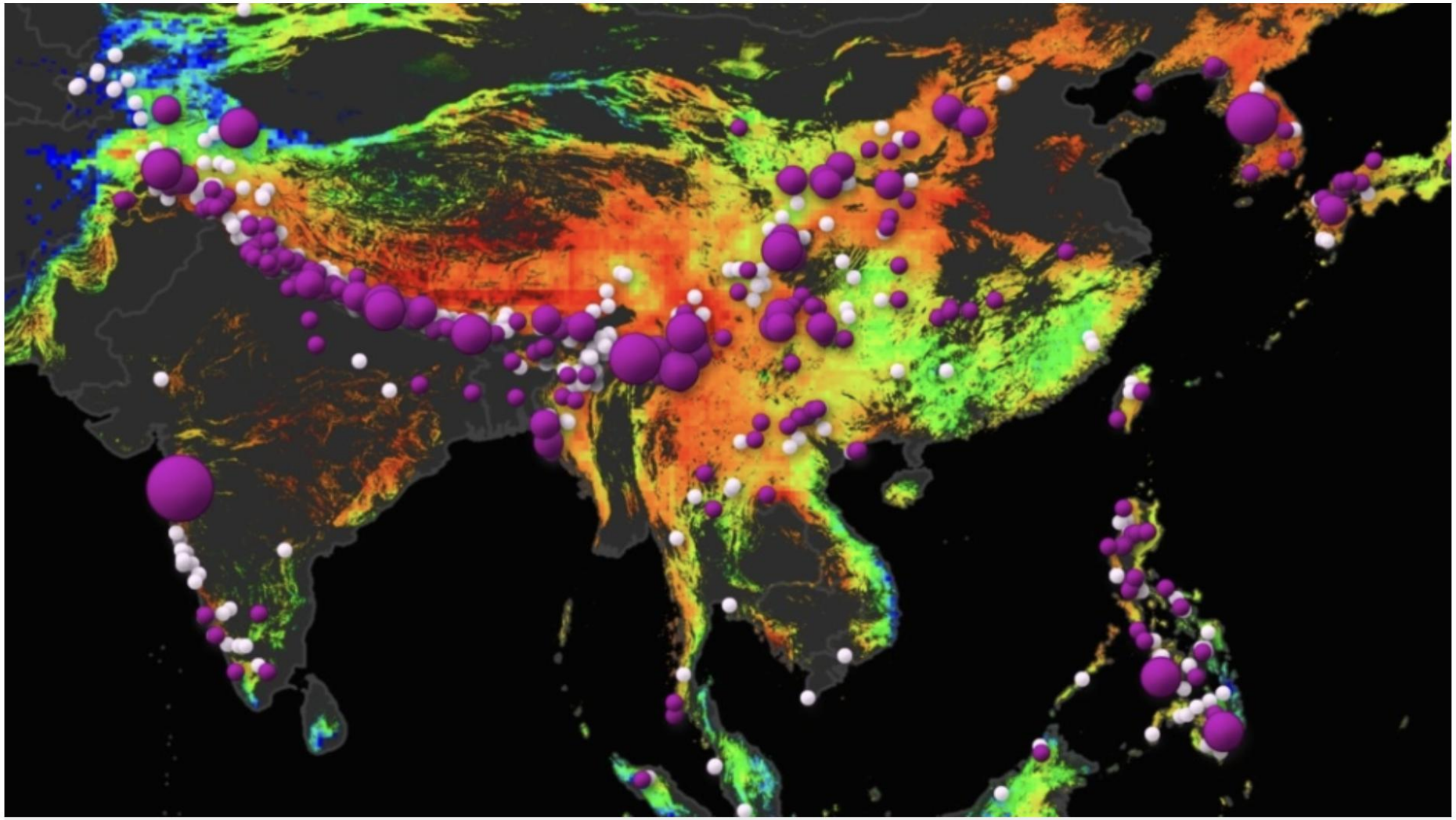
Content of the risk survey



1. Investigation and evaluation of **23 disaster- inducing factors in 6 categories;**
2. Investigation and evaluation of **27 disaster-affected bodies in 6 categories;**
3. Investigation and evaluation of **historical disasters;**
4. Investigation and evaluation of **16 comprehensive disaster mitigation capabilities in 3 categories;**
5. Investigation and evaluation of **key hidden dangers;**
6. Major disaster risk **assessment and zoning;**
7. **Comprehensive national disaster risk and prevention zoning.**

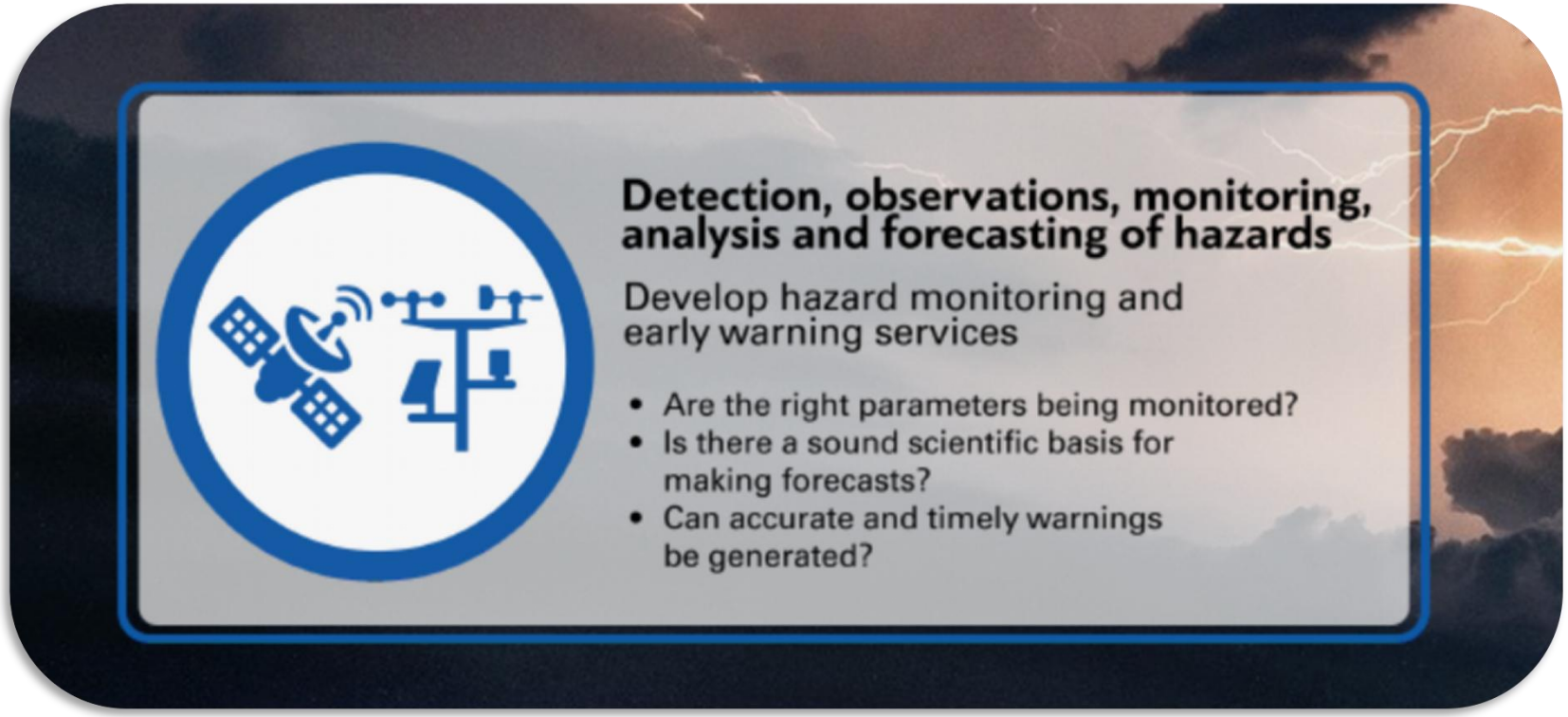
Landslide Susceptibility Mapping Using Image Satellite and GIS Technology

Landslide Hazard Assessment | Precipitation | Soil Moisture | Freeze/Thaw | Topography | NASA Disasters



A close-up view of the potential landslide activity during July, 2018 in Southeast Asia as evaluated by NASA's

Pillar 2 – Observations and forecasting – led by WMO



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USD 1.18 BILLION*

OBSERVE, MONITOR AND FORECAST

- With a full Earth system approach,
- Leveraging global and regional resources to support national efforts
- Optimizing and sustaining international exchange of data and information

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EW4All: Roll-Out Workplan Pillar 2

- Identify and address **observation, impact-based forecasting, climate** and **hydro outlooks**, and **service delivery capacity gaps** for priority hazards, such as heatwaves, floods, tropical cyclones, and droughts
- Provide **SOFF readiness and investment support**
- Accelerate **data and information sharing infrastructure** and use to support EWS
- Develop **Global Standards** for Early Warning Services
- Establish **CAP Help Desk** and scale up work with partners on the **Common Alerting Protocol** (CAP)
- Connect the WMO register of alerting authorities to Big Tech redistribution

An assessment of observation, monitoring and forecasting of hazards, reveals significant global gaps. In-situ observations fall far short of meeting the requirements of the Global Basic Observation Network (Figure 6). In the forecasting area, many countries lack the capacity to incorporate an impact-based approach to forecasting and still have challenges in accessing, analyzing and translating prediction model outputs into actionable warning messages.

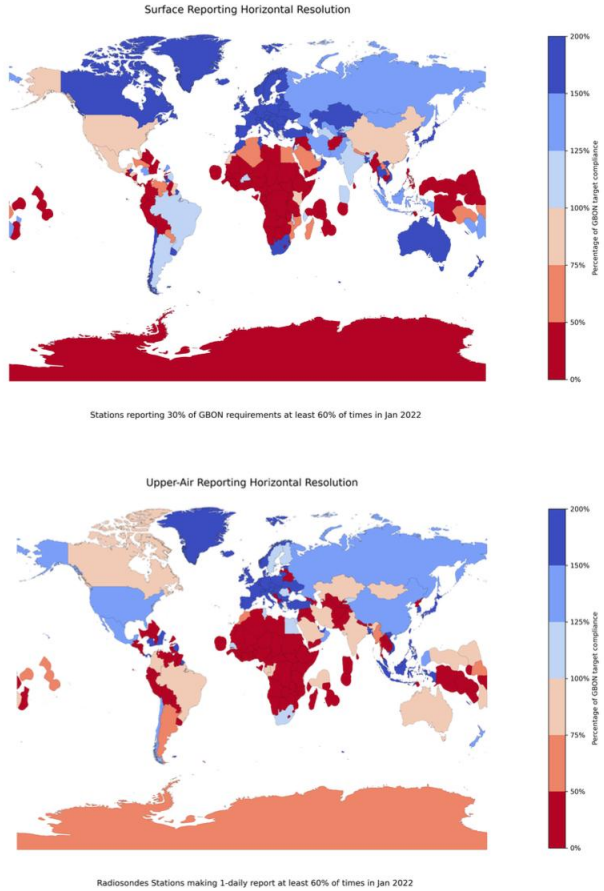


Figure 7: Global Basic Observing Network (GBON) compliance for surface (top) and upper-air (bottom) observations.

Considering **warning dissemination and communication**, the third pillar of MHEWS, alerting authorities, including national meteorological and hydrological services frequently use a variety of communication channels. Differences lie in the uptake of modern information and communication technologies in addition to the traditional mass media such as radios and TV channels, still on top in several regions. Challenges however remain in ensuring that public warnings from official sources are easily recognized, that redistribution including through relays of information at the community levels is inclusive enough to reach all people at risk, especially the most vulnerable. The implementation of the Common Alerting Protocol, although recognized as suitable and ensuring consistency for all hazards and all media is still a gap in many countries (Figure 7).

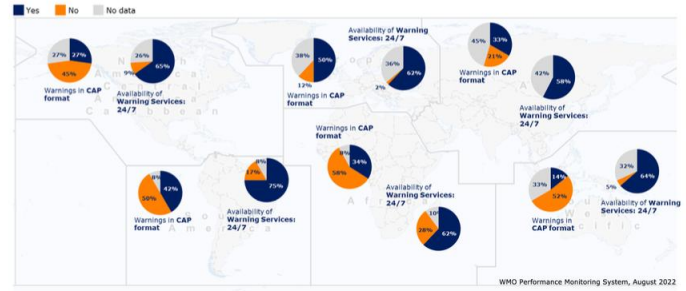


Figure 8: Warning Service Availability through the Common Alerting Protocol (CAP)
Source: WMO Performance Monitoring System, August 2022

Finally, having **preparedness and response** plans and capabilities, including at local government level is vital for responding to warnings issued by the regional or national hydro-meteorological services. Less than half of the countries which have MHWES in place report on the availability of such plans. Identified gaps in this area relate to policy development, governance, collaboration and inclusion at large.

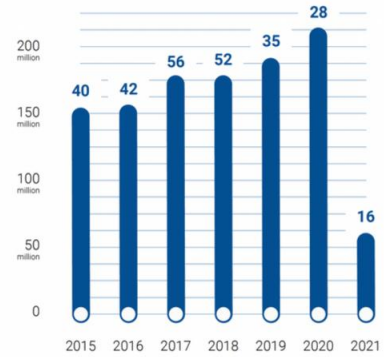
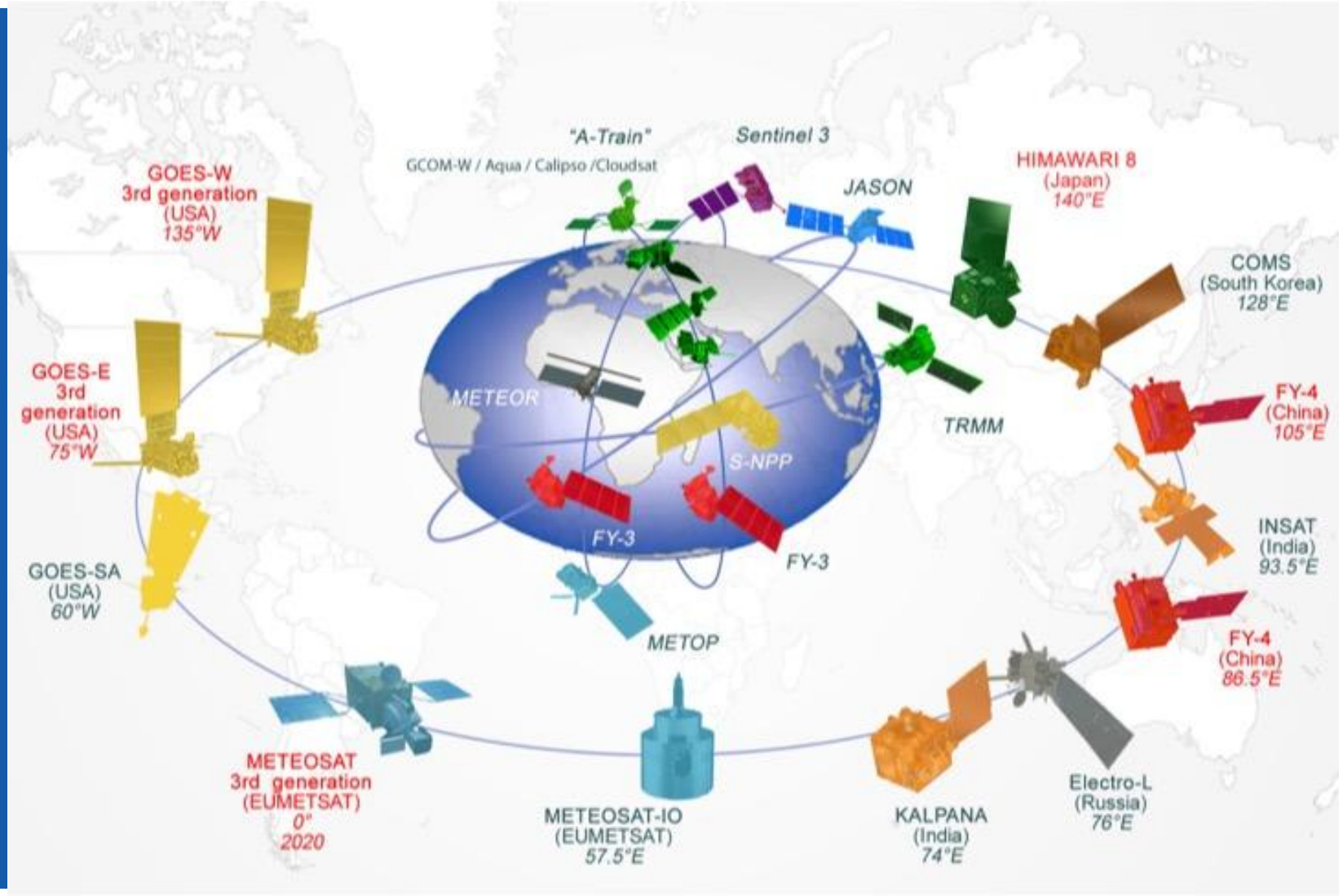


Figure 9: Number of people pre-emptively evacuated following early warnings. The numbers on top of the bars indicate the number of countries who evacuated people in that year. First shown in Target G Report. Note: The overall reporting by countries was degraded in 2021 showing a lower number and does not reflect the situation on the ground due to the lack of data.

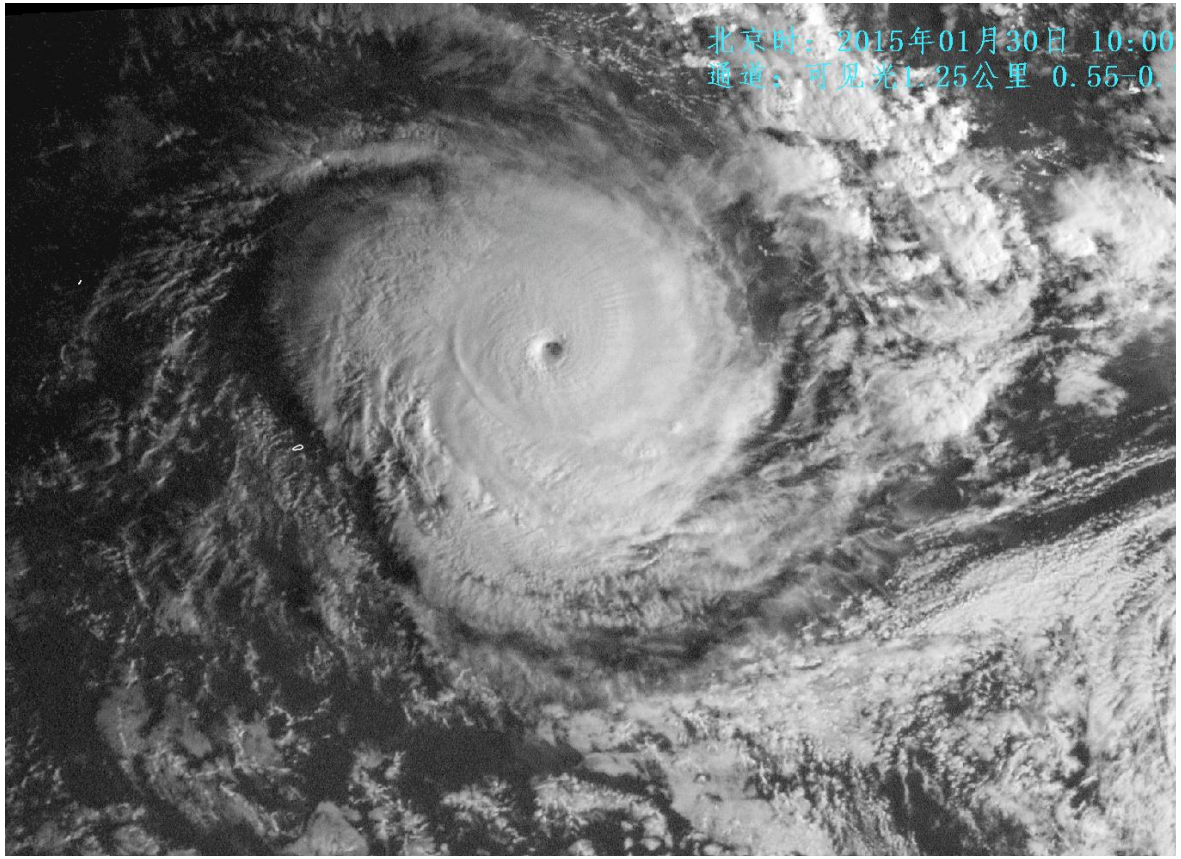
Early Warning Observational Gaps Remain Globally

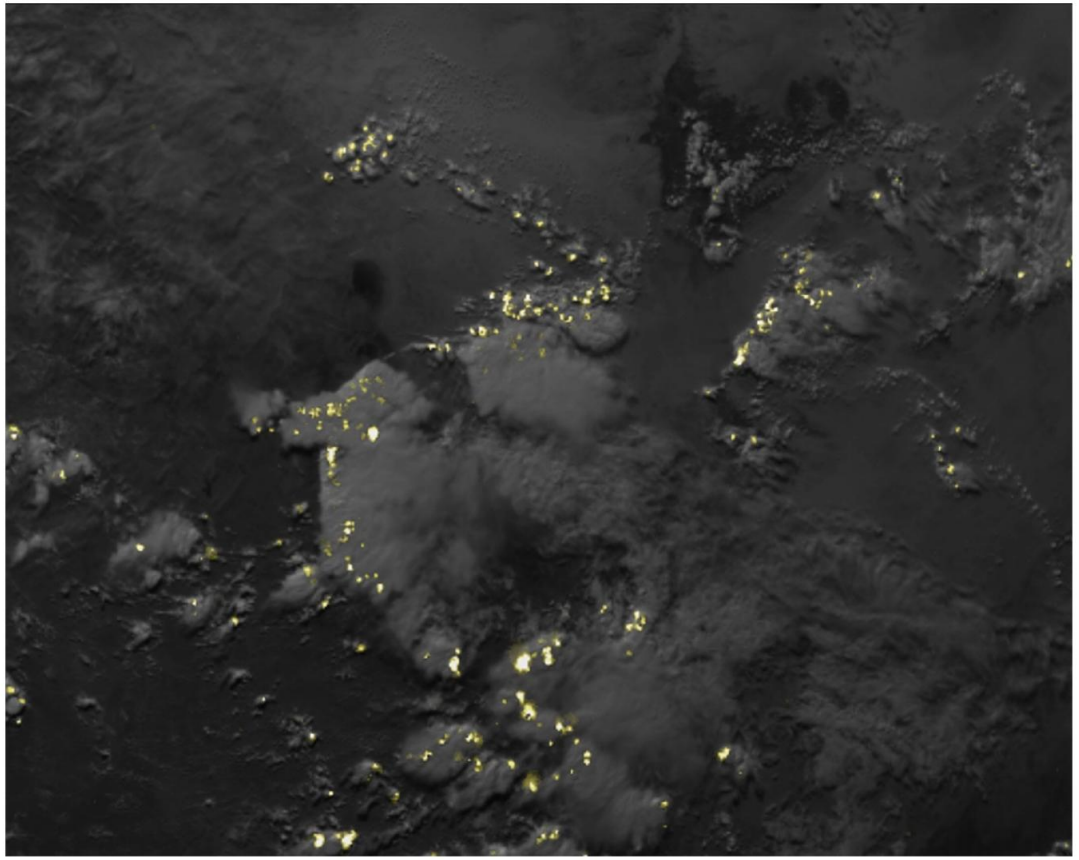
Significant gaps remain in vital underpinning observations, especially in the Small Island Developing States (SIDS) and Least Developed Countries (LDCs)

Enhanced Satellite Observations and



WMO Thanks greatly for the Satellite Operators (CMA, JMA and KMA) for the request-based satellite observation and data from the AOMSUC Members !

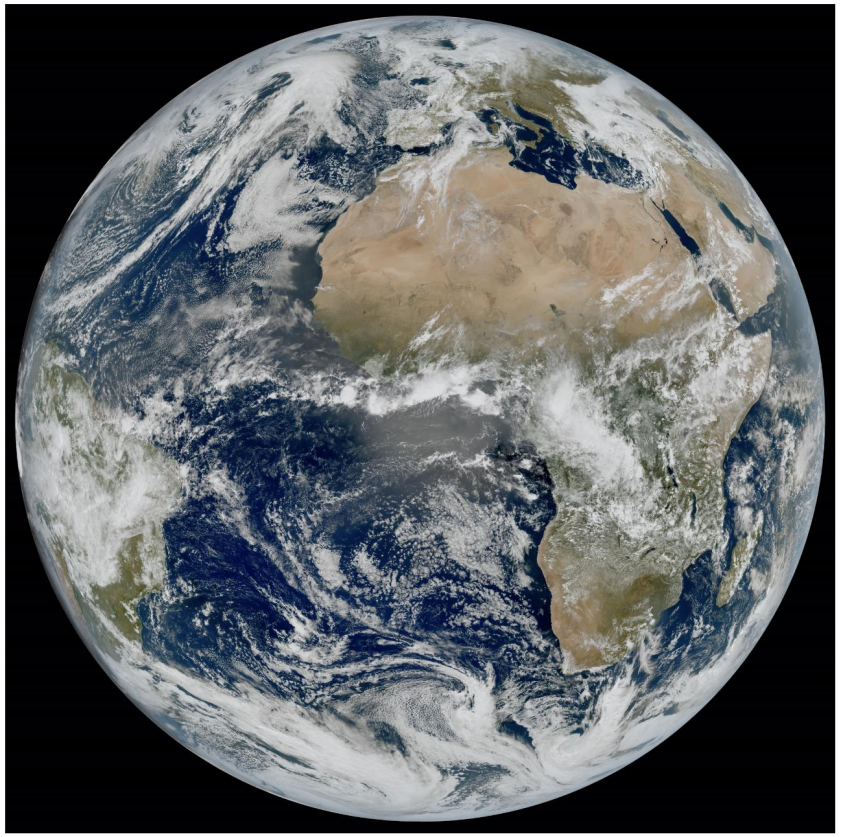




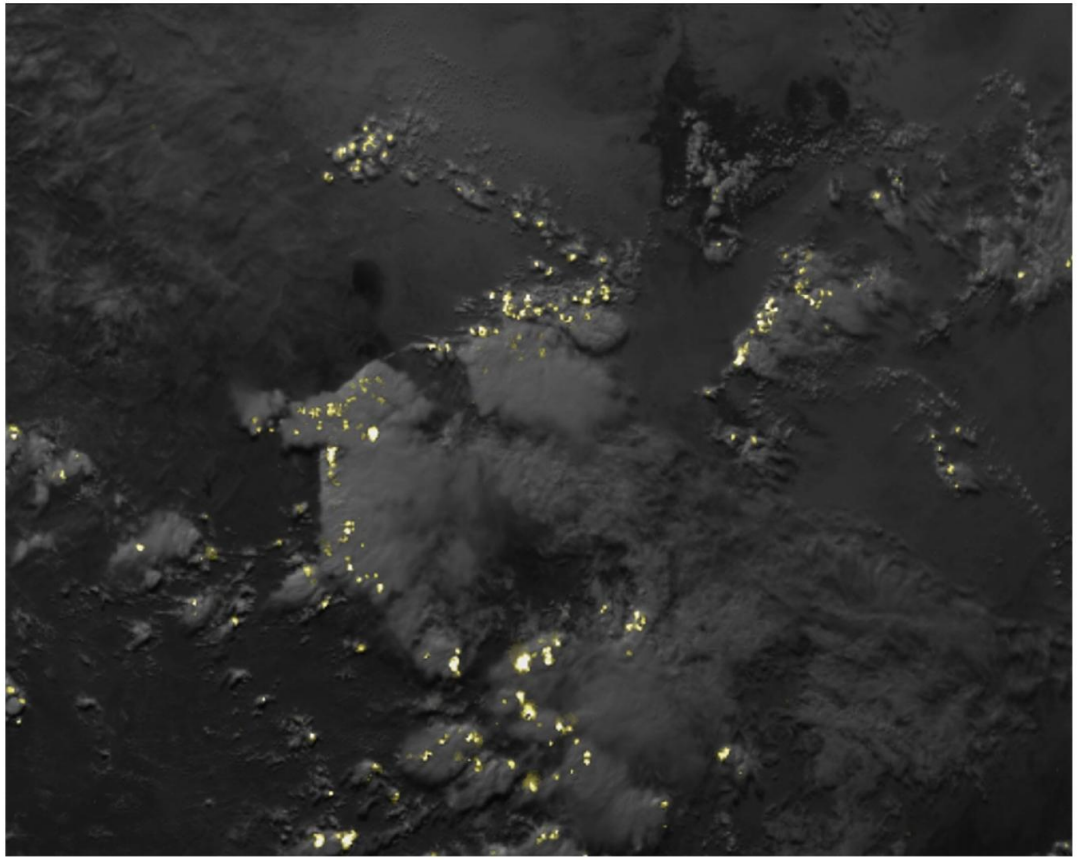
Credit ESA-EUMETSAT

WMO OMM

MTG-I1 images and Lightning Products are essential for EW4ALL for the covering regions and countries: **radar proxy products**



This animation was made using one day's worth of data from MTG-I1, from 11:50 UTC 18 March to 11:50 UTC 19 March 2023. Images of the full Earth disc are produced by MTG-I1 every 10 minutes.



Credit ESA-EUMETSAT

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3 – 4

Global Landslide Nowcast

Global Landslide Nowcast, "Nowcast" is created by comparing GPM data from the last seven days to the long-term precipitation record, Updated every 3 hours.

Imagery Layer by gwlayne

Created: Mar 28, 2019 Updated: Sep 23, 2022 View Count: 73,267

Description

Background: The global Landslide Hazard Assessment for Situational Awareness (LHASA) model is developed to provide situational awareness of landslide hazards for a wide range of users. Precipitation is a common trigger of landslides. The Integrated Multi-satellitE Retrievals for GPM (IMERG) data shows recent precipitation, updated every thirty minutes. A LHASA landslide "nowcast" is created by comparing GPM data from the last seven days to the long-term precipitation record provided by the Tropical Rainfall Measuring Mission (TRMM) Multi-satellite Precipitation Analysis (TMPA). Because IMERG data is only available starting in 2014, the record of historical rainfall was established by TMPA, comparing 2001-present. The TMPA rainfall probability distributions were then compared to that of IMERG and the rainfall thresholds were adjusted so that the IMERG data more closely mapped to those of the TMPA archive. The past 7 days of rainfall are considered, with each day is weighted according to their date before present, with the last twenty-four hours having the most impact.

Pillar 2 – key action areas

1. Enhancing capacity to detect hazards.
2. Close the observing gaps to meet the data needs for monitoring hazards.
3. Enhance the existing framework and capabilities of global data processing, forecasting, and analysis systems.
4. Sustainable data and information exchange infrastructure to support EWS.
5. Optimize international efforts on observation, monitoring, and forecasting in support of EWS and upscale regional initiatives on sharing data and forecasting products.

WMO OMM

Pillar 3: Warning dissemination and communication
Led by ITU

WMO OMM

EW4All: Roll-Out Workplan Pillar 3

USD 550 MILLION*

DISSEMINATE AND COMMUNICATE

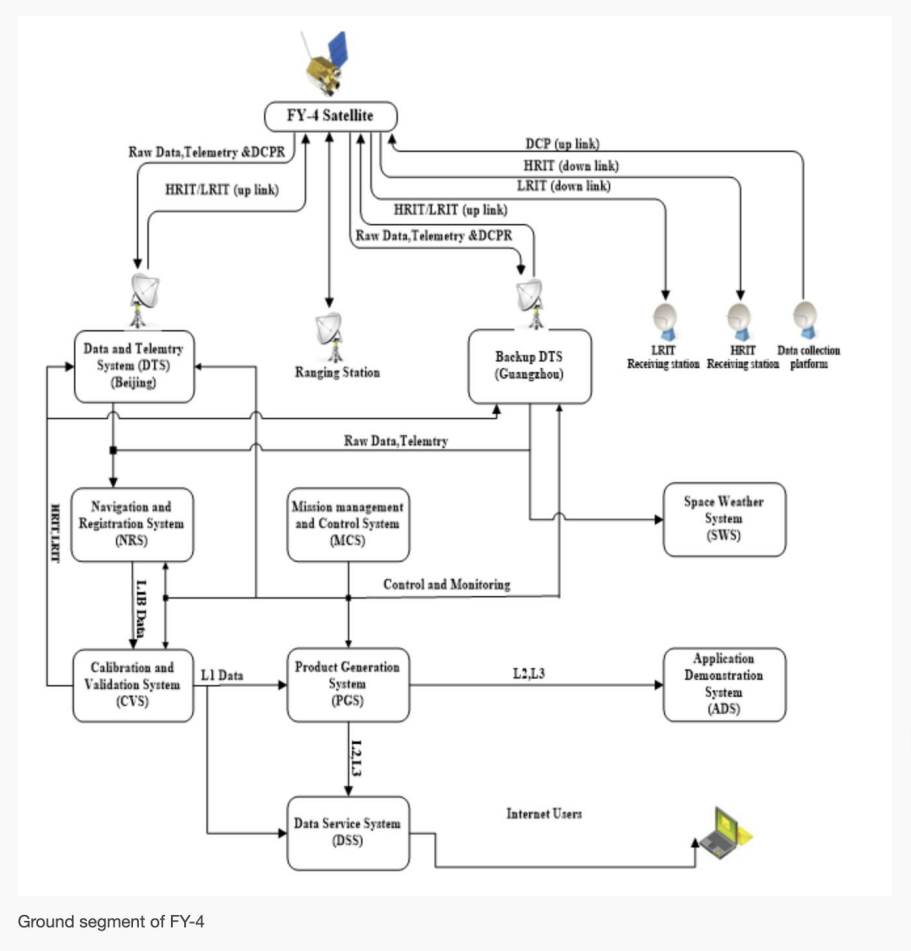
- Registering and empowering national official alerting authorities
- Leveraging geolocated cell-broadcast among multiple channels
- Using inclusive and people focused approaches to reach all people at risk

- Assessment of current EWS communication channels
- Promote a **regulatory approach for mobile EWS**
- Develop **technical guideline and high-level regulatory policy** to support adoption of mobile EWS
- **Legal analysis** of the policies, regulatory frameworks and laws around mobile EWS
- Technical support for implementing **mobile EWS on cell-broadcast and/or location-based SMS**
- Promote **Common Alerting Protocol (CAP)**, establish Alert Hub
- Build capacity and set-up a locally-led feedback systems
- Support **EWS co-design and co-production workshops** with NGOs, Civil Society Organizations (CSOs), local authorities & media

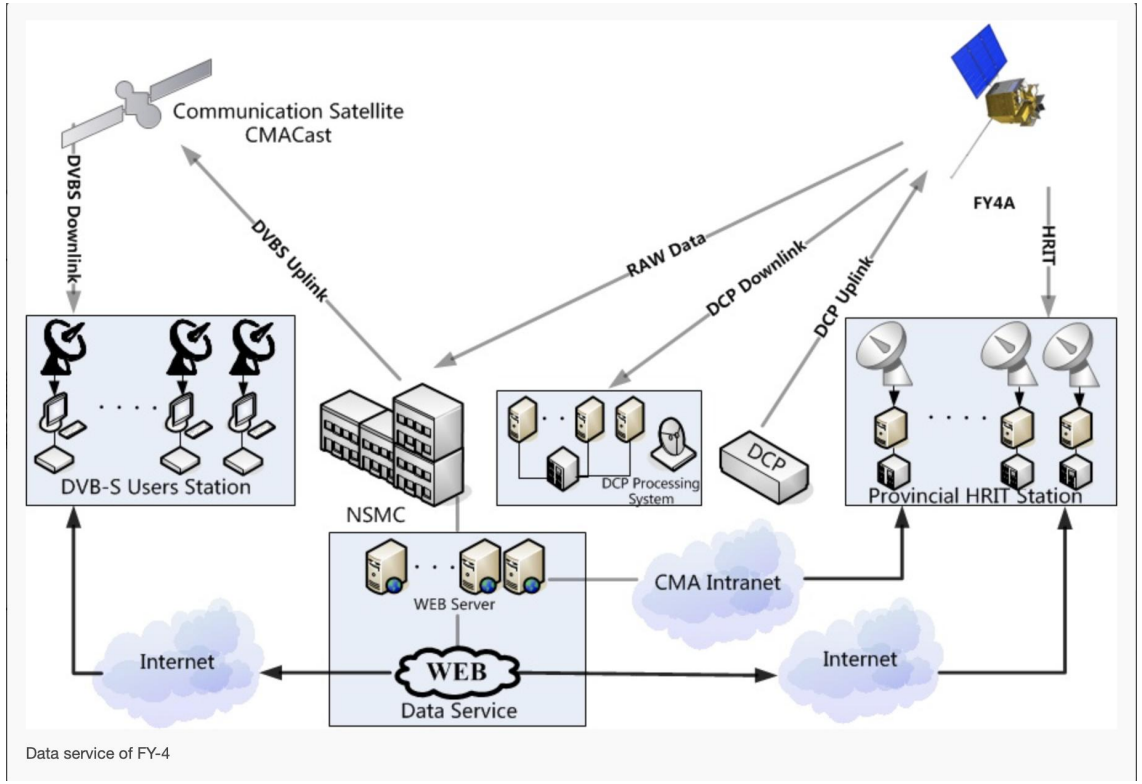
How to further develop the satellite real time broadcasting (GEO/LEO) to support the Pillar 3, especially in the areas where the land-telecommunications are still major challenges

WMO OMM

CMACast contribution to the AOMSUC Community



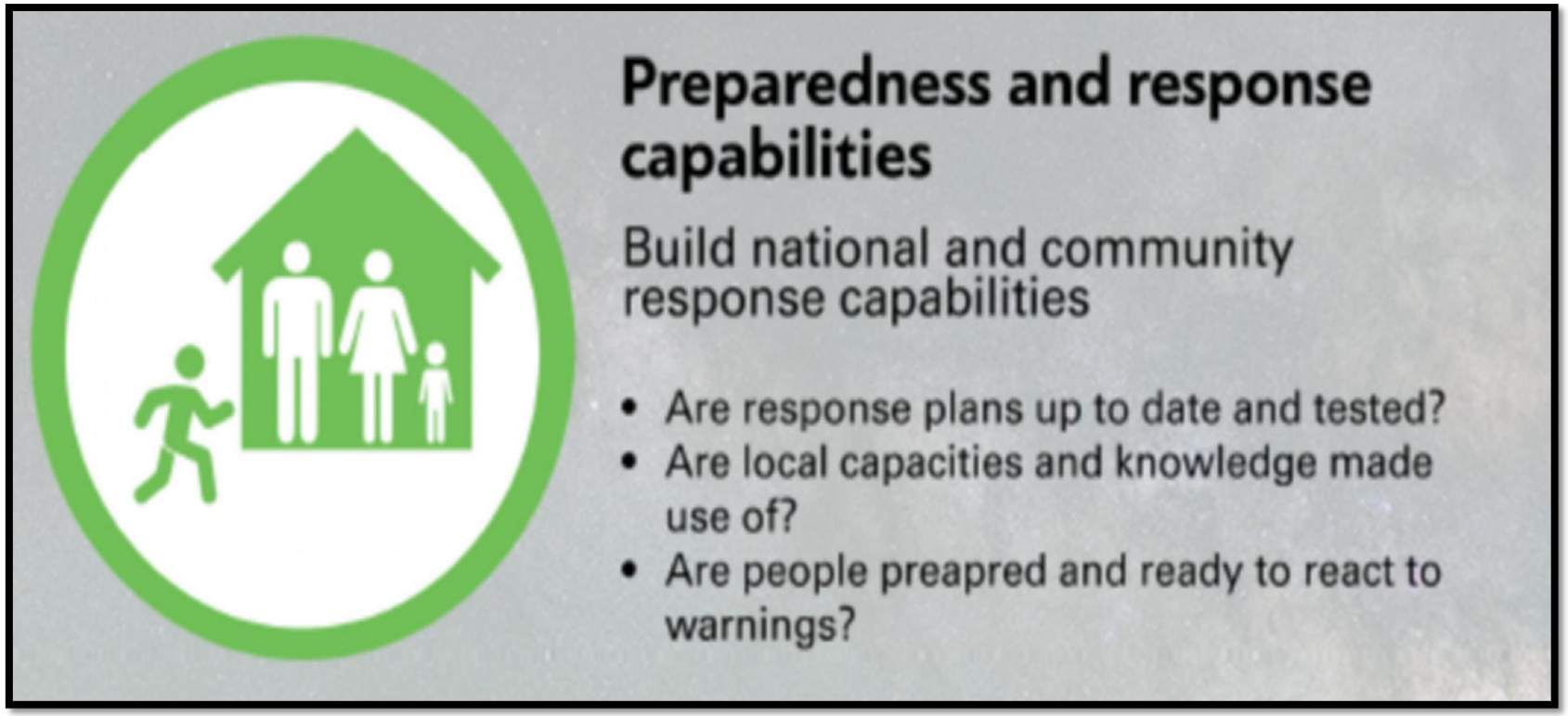
Ground segment of FY-4



Data service of FY-4

WMO OMM

Pillar 4 – Preparedness to respond – led by the IFRC



WMO OMM

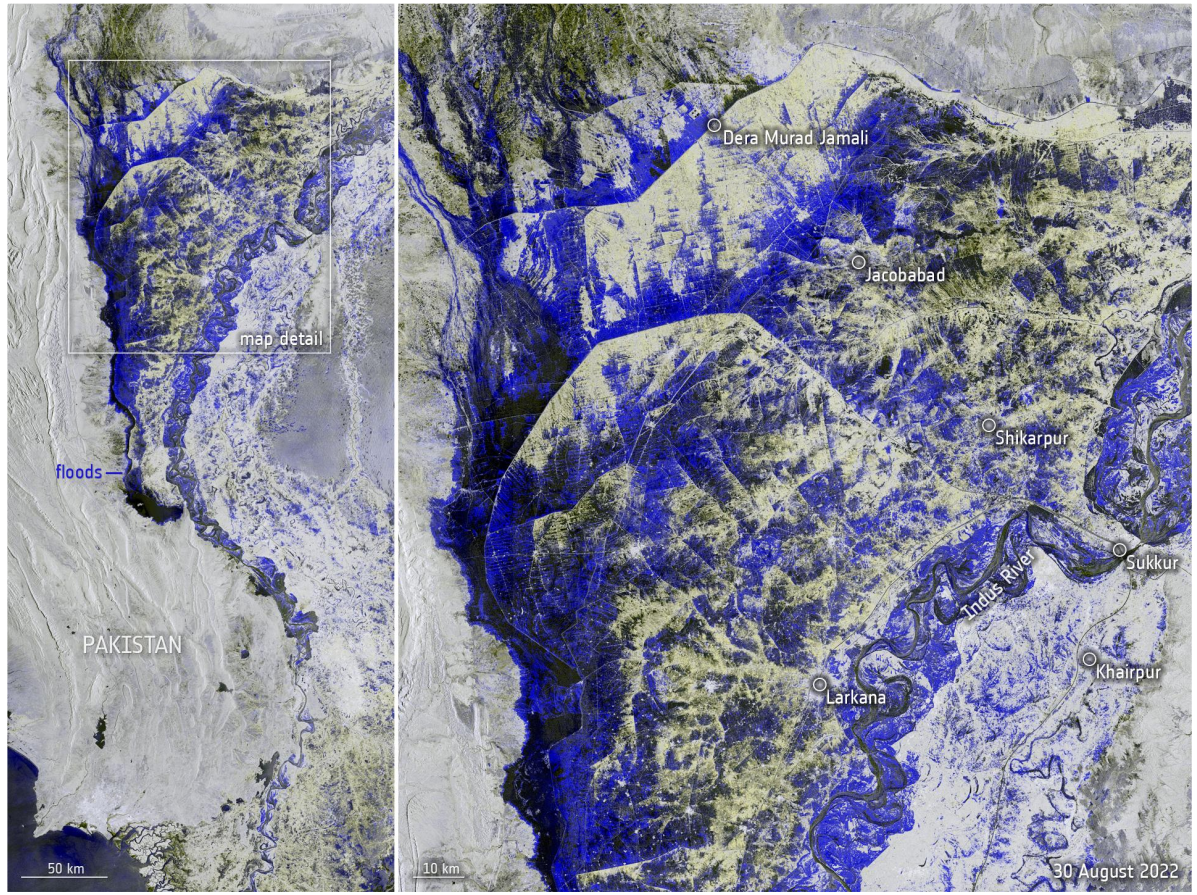
EW4All: Roll-Out Workplan Pillar 4

- Strengthen on-going activities around **AA and preparedness**
- Develop principles for **people-centered, locally-led approaches under EW4All**
- **In-country**: map on-going preparedness and anticipatory actions; coordination mechanisms; institutional and operational capacity needs; best practices
- Enable **local-level engagement and consultation** in EW4All activities
- Carry out hazard-specific **simulation exercises**
- Global and regional **collaboration dialogues** (e.g. Risk informed Early Action Partnership (REAP), Anticipation Hub, Anticipatory Action (AA) task Force, WMO Coordination Mechanism (WCM) etc.)

WMO OMM

Satellite Image Assessment of Floods in Pakistan for Disaster Rescue

- During the 2022 monsoon season, the region experienced a number of **flood** events.
- Especially, Pakistan experienced severe flooding that was associated with significant loss of life and economic damage. Pakistan received 60% of normal total monsoon rainfall within just three weeks of the start of the monsoon season in 2022.
- According to the National Disaster Management Authority (NDMA), more than 33 million people, almost 14% of the population, were affected; over 1 730 people died and almost eight million people were displaced.

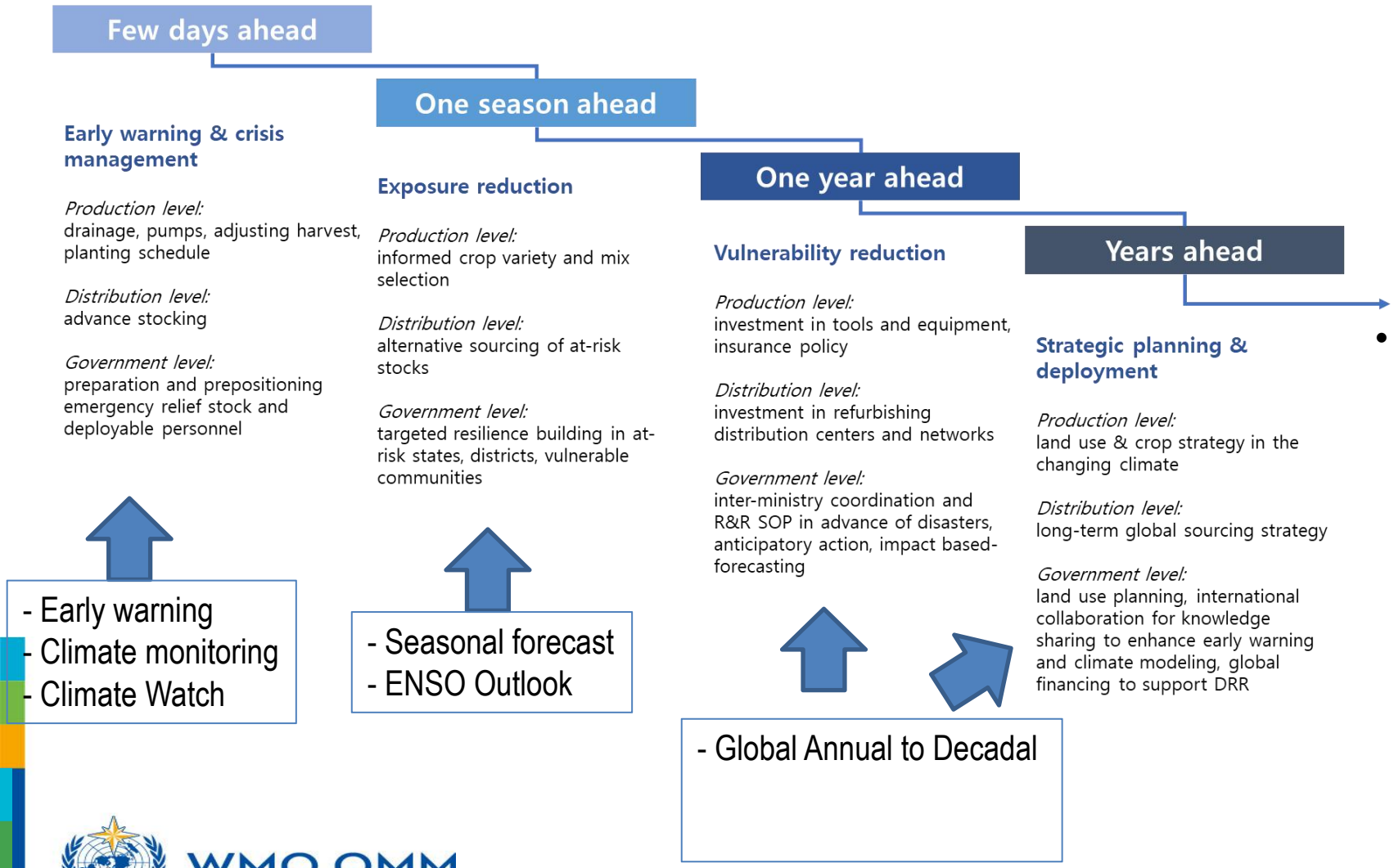


Satellite image of flooding in Pakistan on 30 August
The image on the left shows a wide view of the affected area. The image on the right zooms into the area between Dera Murad Jamali and Larkana. The blue to black colours show where the land is submerged.

WMO OMM

Improving services for food system resilience

Examples of risk-management policy mix for food system resilience



- Enhancing food system resilience is a high priority in Asia, as was emphasized in the Nationally Determined Contributions (NDC) of most of the parties to the Paris Agreement in WMO Regional Association II.
- Monitoring the past and current climate and providing forecasts on weather and climate timescales, as well as seasonal prediction and future climate projection, are fundamental tools underpinning effective early warning services for agriculture and food security.

WMO OMM

Partnership is the key for great success of EW4ALL!

REAP Risk-informed Early Action Partnership

The 4 Targets

REAP was launched with the announcement of four targets, each of which contribute to making 1 billion people safer from disaster by 2025.

Developed by the convening partners of REAP, these ambitious targets are achievable only through partnership and a shared commitment to joined-up, risk-informed early action.

NASA Partnership Launches Groundbreaking New Global Flood Early Warning Technology

News 11 January, 2023 Author name: simon.loveday

By Jacob Reed with contributions by Christian Thomas, NASA Disasters

Floods are among the most deadly and destructive disasters worldwide, and climate change has only increased their severity. To make matters worse, many smaller communities lack the tools they need to detect and respond to floods, leaving them vulnerable to the full force of their impacts.

To help protect these communities, NASA's Earth Applied Sciences Disasters program area has partnered with several leading scientific institutions to develop a new flood detection tool called "Model of Models" (MoM). This tool combines data from open-source hydrological models with Earth observing satellite data to generate global flood risk severity updates several times a day. This is the first time that comprehensive global flood early warnings have been available at the sub-watershed level, giving communities the knowledge they need to take early action to protect themselves.

Financial enablers

Outset

- *3.1 billion USD is to be injected across the 4 pillars in the next five years.*
- *Overall coherence and alignment for Global Early Warnings and Early Action Investments needed*
- *Scaling up of existing finances needed*

WMO OMM

Financial enablers – opportunities

- CREWS
- SOFF
- REAP
- Alliance for Hydromet Development
- World Bank
- Climate Investment Fund
- Regional Development Banks
- Green Climate Fund
- Adaptation Fund
- Global Environment Facility
- Private and insurance sector
- Public – private partnership

WMO OMM

Strengthening capacity for adaptation to extreme weather and climate events in support of EW4All

Weather

Severe Weather Forecasting Programme (SWFP)

Climate

Climate Watch system,
Regional Climate Outlook Forum (RCOF)

Water

Flash Flood Guidance System with Global Coverage (FFGS)

Enabling funding mechanisms

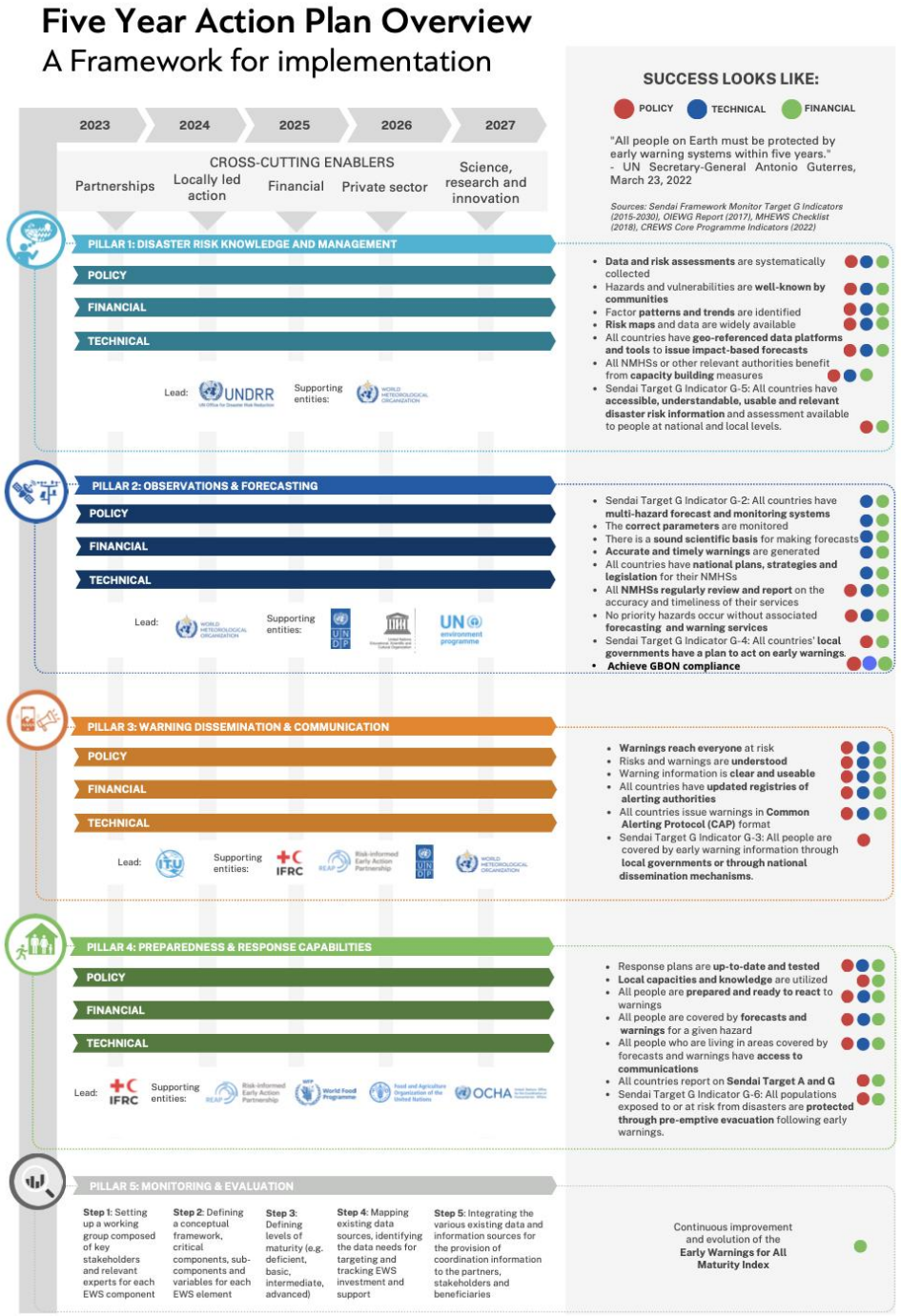
CREWS

SOFF

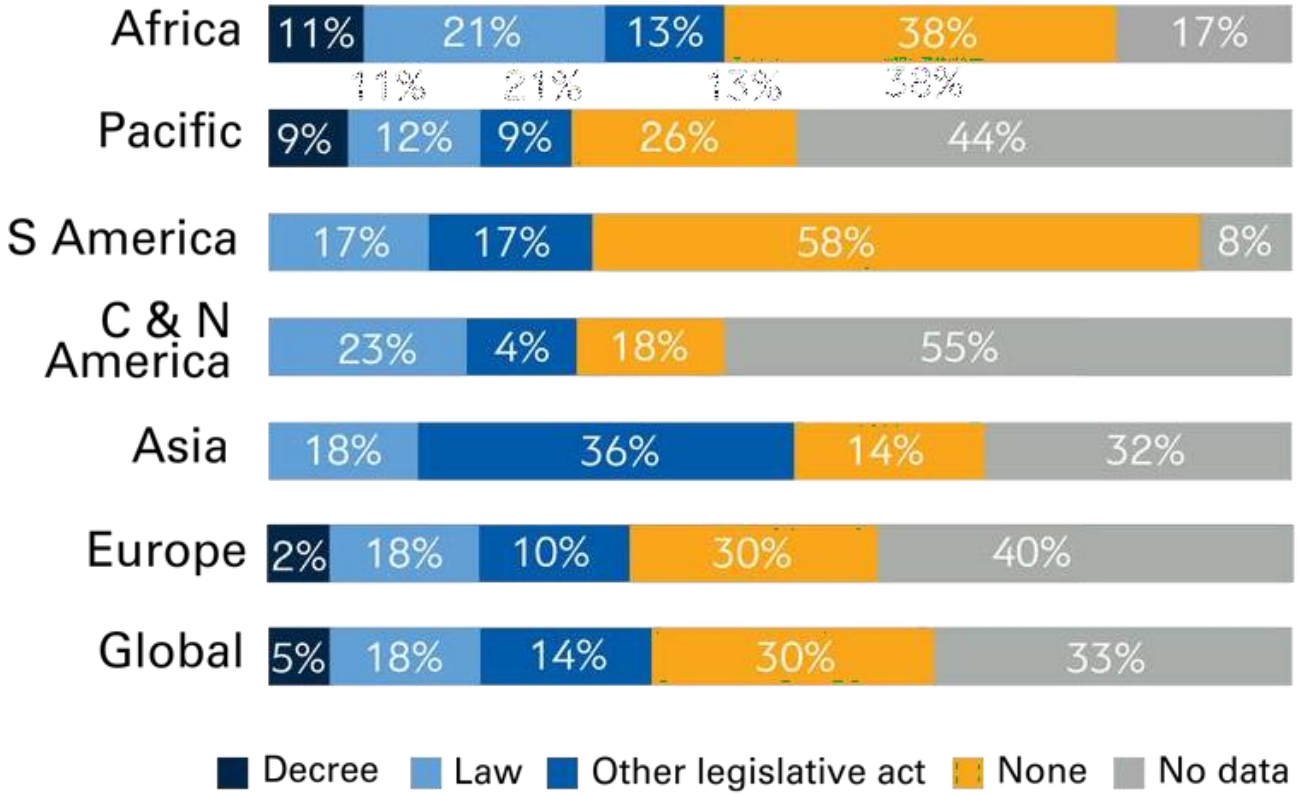
GCF

USAID

Other support mechanism



% of WMO Members reporting to have legislation on MHEWS



Laws of the People's Republic of

METEOROLOGY LAW

Meteorology Law of the People's Republic of China

(adopted at the 12th Meeting of the Standing Committee of the Ninth National People's Con People's Republic of China on October 31, 1999, is hereby promulgated and shall go into effec January 1, 2000.)

Chapter I General Provisions

Article 1 This Law is enacted for the purpose of developing meteorological service, standard meteorological activities, ensuring the accurate and timely issue of meteorological forecast, pre meteorological disasters, properly exploiting and effectively protecting climatic resources, and meteorological services for economic development, national defense, social development and p well-being.

Article 2 This Law shall be observed by units and individuals that engage in meteorologi forecasting, services, prevention of meteorological disasters, exploitation of climatic resource research in meteorological science and technology, which are carried out in the territory of the Republic of China and the sea areas under the jurisdiction of the People's Republic of China.

Article 3 Meteorological service is a basic public welfare service for economic development defense, social development and people's well being. Public welfare meteorological services sh first priority in meteorological work.

People's governments at or above the county level shall strengthen their leadership over and co of meteorological activities, and incorporate meteorological service into the national economic development plans and fiscal budgets of the central and local governments in order to ensure th function in the service of the general public, in government decision making and in economic development. Local meteorological projects initiated by local people's governments at or above level to meet the needs of local social and economic development shall mainly be financed by t governments themselves. On condition that unpaid public welfare meteorological services are g meteorological offices and stations may provide paid meteorological services in accordance wi

Chapter V Prevention of Meteorological Disasters

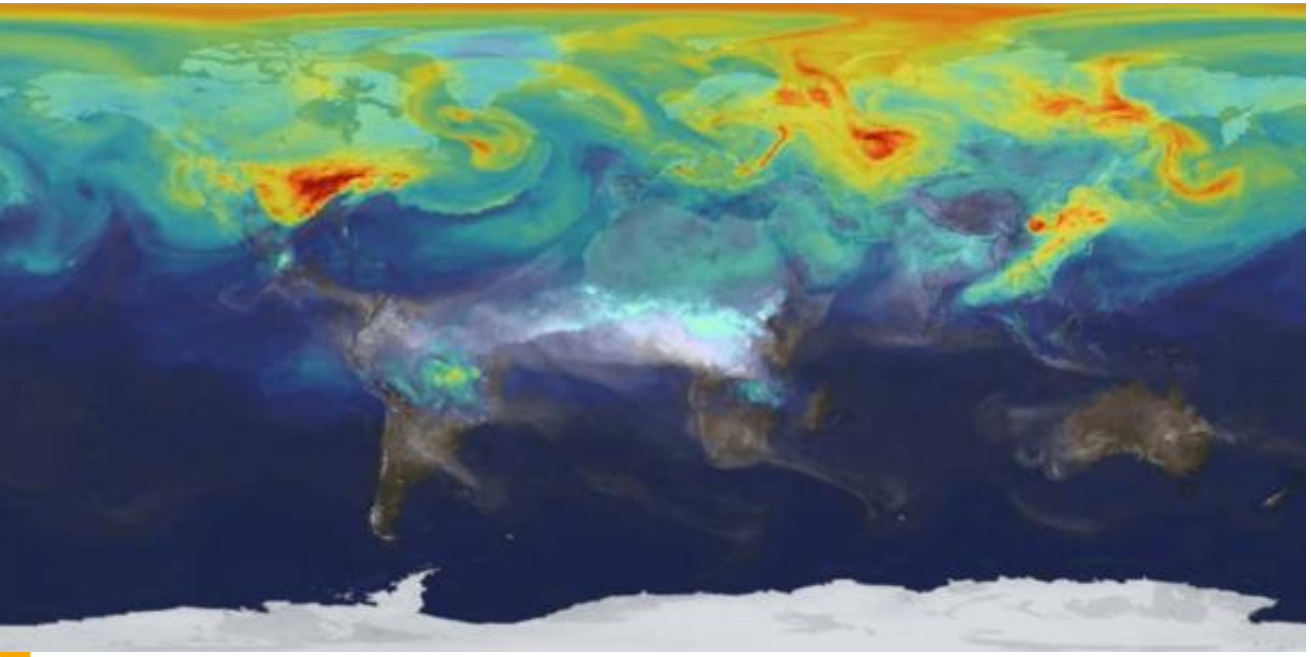
Article 27 People's governments at or above the county level shall improve their monitoring and warning systems for meteorological disasters, make arrangements for relevant departments to work out plans for prevention of meteorological disasters, and take effective measures to increase the capability of preventing such disasters. Relevant organizations and individuals shall comply with the directions given and arrangements made by the people's governments, and shall make a success of prevention of meteorological disasters.

Article 28 Competent meteorological departments at all levels shall make arrangements for joint monitoring and forecast of significant weather events among regions or departments, propose timely measures for preventing meteorological disasters and make assessment of severe weather disasters, which shall serve as the decision making basis for the people's governments at the corresponding levels to arrange prevention of meteorological disasters. Meteorological offices and stations subordinate to the competent meteorological departments at different levels shall improve their monitoring and forecast of severe weather which may adversely affect the local community, and promptly report to the competent meteorological departments concerned. The meteorological offices and stations subordinate to other departments and the units related to the monitoring and forecast of severe weather shall, without delay, provide the competent meteorological departments with the observed meteorological information and the monitored information on hydrological conditions, storm surge, etc. that are needed for the monitoring and forecast of severe weather.

Article 29 Local people's governments at or above the county level shall, in light of the need for preventing meteorological disasters, work out plans for the purpose and, on the basis of the meteorological information provided by the competent meteorological departments, make arrangements for carrying out such plans, in order to avert or mitigate meteorological disasters.

Article 30 People's governments at or above the county level shall enhance their leadership over weather modification and, in light of actual conditions, carry out work in this field in an organized and planned way. The competent meteorological department under the State Council shall more efficiently administer and guide weather modification throughout the country. Local competent meteorological departments at all levels shall make plans for weather modification operations and, under the leadership and coordination of the people's governments at the corresponding levels, administer, guide and arrange for such operations. Relevant departments shall, in compliance with their functions and duties and division of responsibilities, cooperate with the competent meteorological departments in weather modification. Organizations engaging in weather modification operations shall meet the qualifications prescribed by the competent meteorological departments of provinces, autonomous regions or municipalities directly under the Central Government, use the operational equipment which meets the specifications set by the competent meteorological department under the State Council, and conform to the operational rules.

WMO 2rd Global Initiative: Global Greenhouse Gas Watch



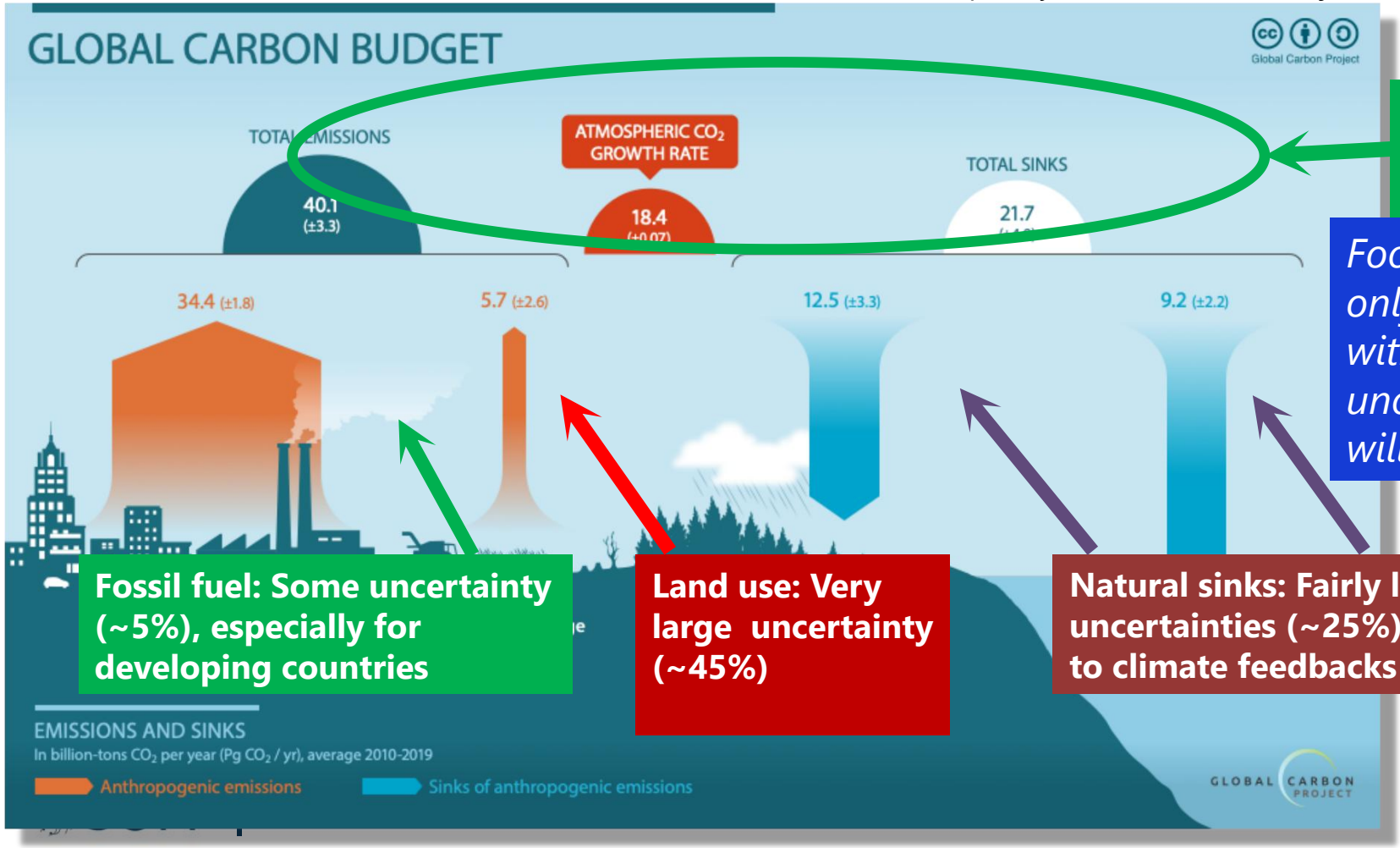
To support to mitigation action taken by the Parties to the UNFCCC and the Paris Agreement,

- Sustained and routine global monitoring of greenhouse gas (GHG) concentrations and fluxes,
- Top-down GHG gas monitoring, based on observations (including from satellites) of atmospheric GHG concentrations and fluxes, and atmospheric modelling and data assimilation

The 19th session of World Meteorological Congress in June 2023 endorsed the concept note of WMO **Global Greenhouse Gas Watch**.

How well do we understand the CO_2 fluxes ?

(Graphic by the Global Carbon Project)



Top level global budget is well understood

Focusing our efforts only on the areas with low uncertainties (green) will not work!

Fossil fuel: Some uncertainty (~5%), especially for developing countries

Land use: Very large uncertainty (~45%)

Natural sinks: Fairly large uncertainties (~25%); subject to climate feedbacks

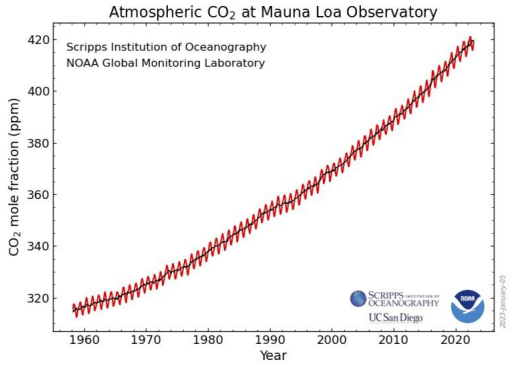
Two ways to monitor greenhouse gas concentration changes:

Bottom up: *Add up individual sources and sinks of carbon and calculate overall contributions;*

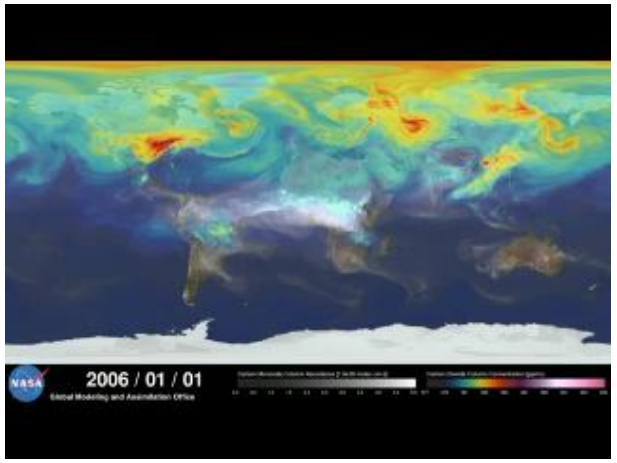
- Can provide very accurate estimation of anthropogenic ***emissions***;
- Bulk data national only, 1-2 years delayed;
- Does not work well in developing countries;
- Does not work for natural sources/sinks;

All activities under IPCC and the Paris Agreement are based on bottom up

Top down: *Use atmospheric observations and atmospheric modeling to see overall contributions:*



NWP model with CO2; NASA Goddard Space Flight Center

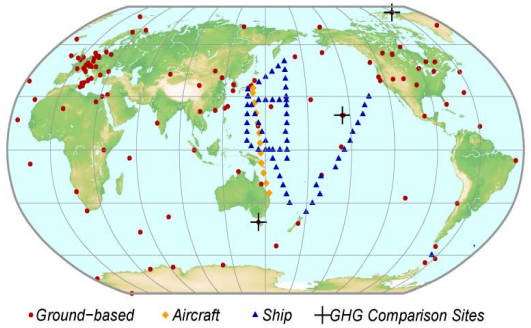


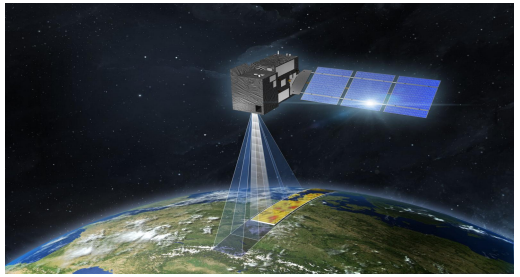
- Direct link to "centralized accounting";
- Global coverage, spatially disaggregated;
- Estimates of *net* ***fluxes*** rather than of emissions;
- Can be made available in near-real time;

Top-down technology mature, used by Parties individually, but nnot yet in context of Paris

GAW + Satellites + models →Operational greenhouse gas data

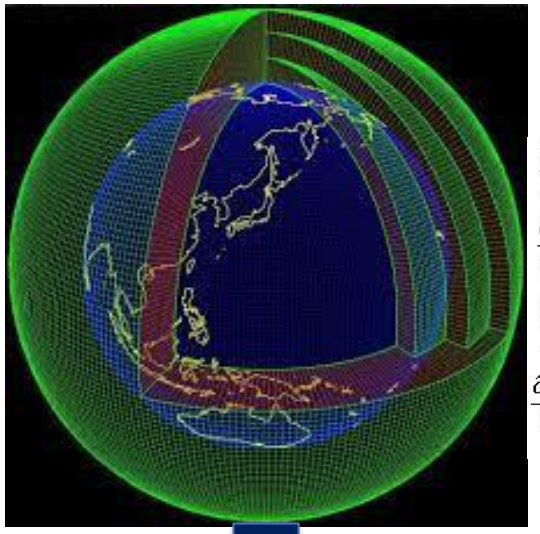
NASA OCO, JAXA Ibuki, Sennitel, CHINA Tansat, DQ… already exist





European Copernicus 2025-

+



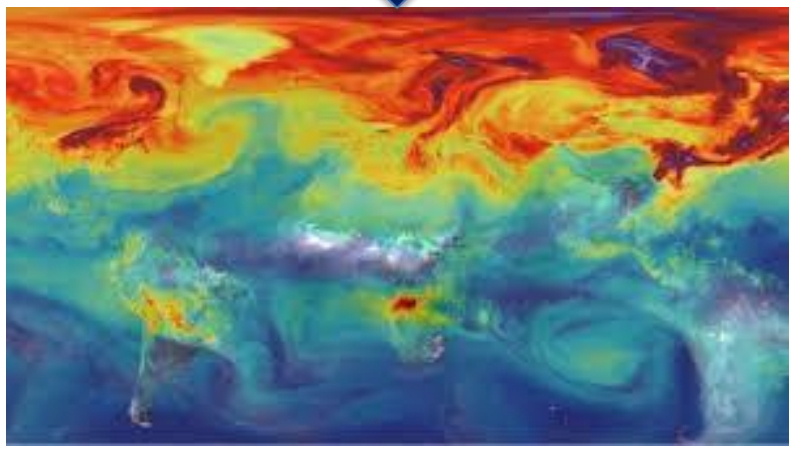
$$\frac{\partial \vec{u}}{\partial t} = -\vec{u}\cdot\vec{\nabla}\vec{u} - \dot{\eta}\frac{\partial \vec{u}}{\partial \eta} + 2\vec{\Omega}\times\vec{u} - RT\vec{\nabla}(\ln(P)) - \vec{\nabla}\phi$$

$$\frac{\partial T}{\partial t} = -\vec{u}\cdot\vec{\nabla}T - \dot{\eta}\frac{\partial T}{\partial \eta} + \frac{R}{C_p}T\frac{\omega}{P}$$

$$\frac{\partial q}{\partial t} = -\vec{u}\cdot\vec{\nabla}q - \dot{\eta}\frac{\partial q}{\partial \eta}$$

$$\frac{\partial P_s}{\partial t} = -\vec{\nabla}\cdot\int_0^1 \frac{\partial P}{\partial \eta}\vec{u}\,d\eta$$

- Integrated, internationally coordinated global greenhouse gas monitoring system
- Better understanding if sources and sinks
- Support Paris Agreement implementation



Real-time monitoring of CO_2, CH_4 and N_2O

WMO and partners are developing top-down greenhouse gas monitoring framework

Key development components (and challenges)

- Integrated global observing system **(both surface- and space-based**) – **new design & development**
- Near-real time international exchange of all observations **(WMO data policy implementation challenge);**
- 24/7 operational GHG modeling (multiple model systems), converting observations into flux estimates;
- **Routine internationally coordinated intercomparison and verification of model output;**

Primary output

- Time-continuous global fields of CO2, CH4 and N2O concentrations (Watch Concept, similar like WWW);
- Multi-party operational capability at 100 x100 km within five years;
- Operational capability at 1x1 km within 10 years, if adequately resourced;

Intended users of GGMI output

- Parties to the Paris Agreement;
- Participants in voluntary carbon markets;

WMO OMM

Workshop organized by WMO, May 2022 - "The case for a coordinated GHG Monitoring Infrastructure"

- More than 20 experts in person; 80 online participants, including representatives from NASA, NOAA, NIST, JAXA, NIES, JMA, CMA, ESA, European Commission, UNFCCC,…
- Surface- and space based observing systems;
- Ocean carbon;
- Land surface observation and modeling;
- Cryosphere;
- Modeling, data assimilation;
- Program and project managers and coordinators;
- WMO Members and their staff;

VI: Key elements for great success !

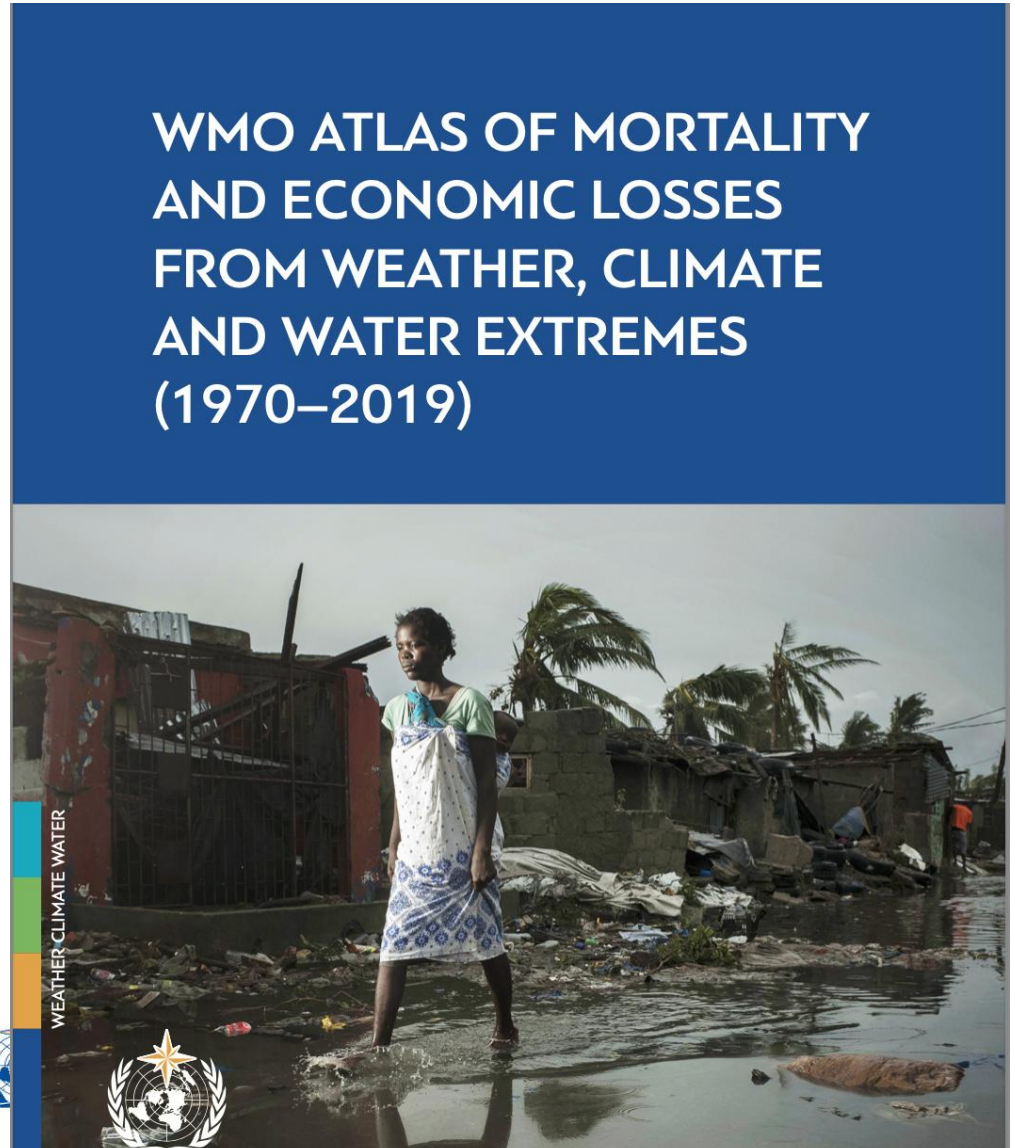
I: Stronger Global Collaborative Spirit

II: Evolving Global Operational Systems

III: Enhanced Political and Policy Support

WMO OMM

We need greater efforts to promote Socio-economic values of Meteorological services



- Of the **22 326 disasters, 11 072 have been attributed to weather, climate and water hazards.**
- These disasters resulted in **2.06 million deaths and US$ 3.64 trillion in losses .**
- The United Nations 2030 Agenda for SDG and the Sendai Framework call for countries to increase their resilience through the strengthening of risk reduction processes.

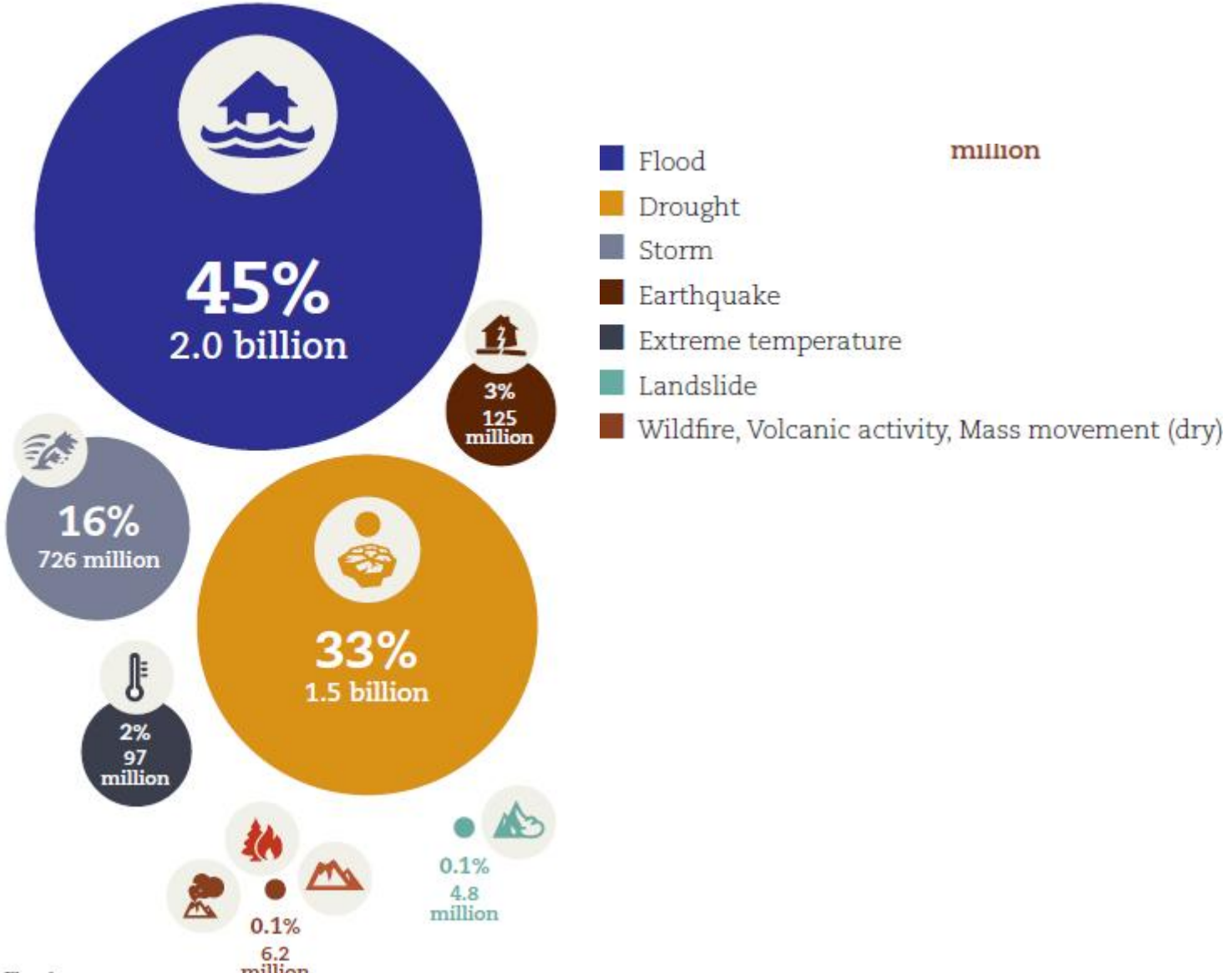
The Global Risk Report 2022 (World Economic Forum)

FIGURE 1.3

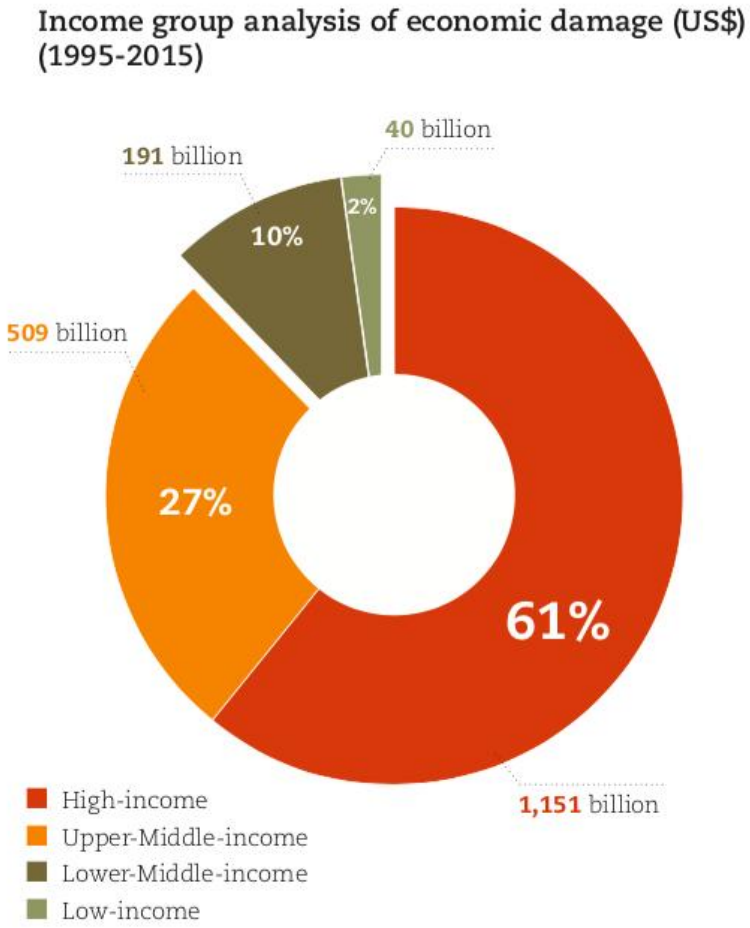
"Identify the most severe risks on a global scale over the next 10 years"

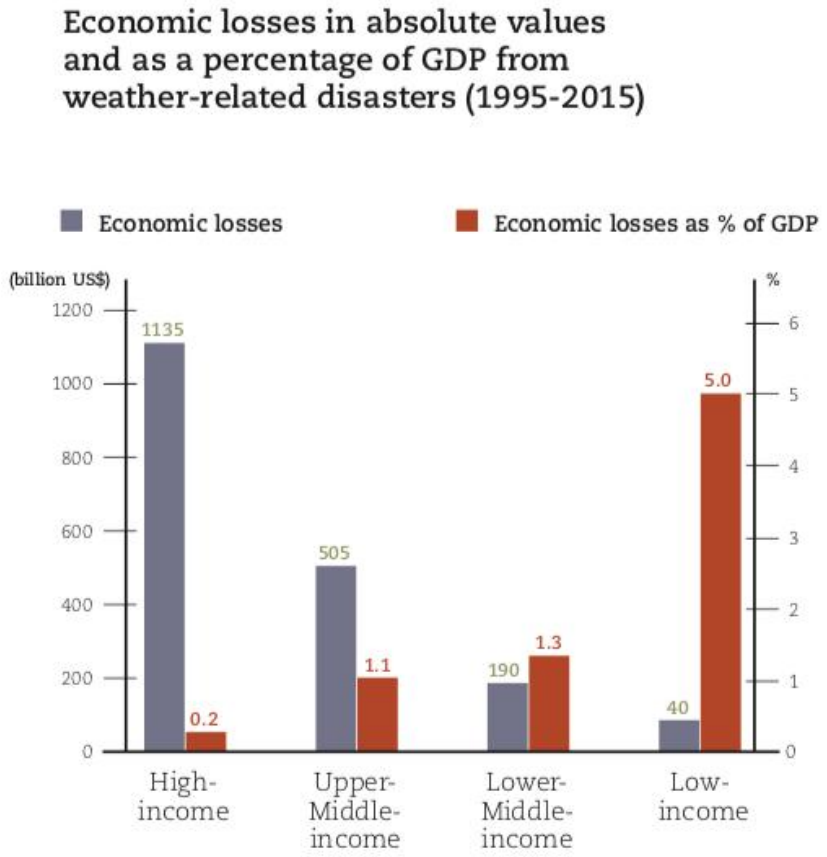
Source: World Economic Forum Global Risks Perception Survey 2021-2022

~4.5 billion people affected 1998-2017
96% of disasters weather (water SG 6) related



Economic damage vs % of GDP





WMO OMM

UN called for peaceful use of the outer space and global collaboration in weather prediction in 1961, soon after first MetSat TIROS-1 launched on April 1, 1960, leading to WWW Programme

- **Excerpt from President J.F. Kennedy's address to the UN General Assembly, 25 September 1961…, he said:**
- Reserve the outer space for peaceful use…
- we shall propose further co-operative efforts between all nations in weather prediction…
- We shall propose, finally, a global system of satellites linking the whole world in telegraph, telephone, radio and television.

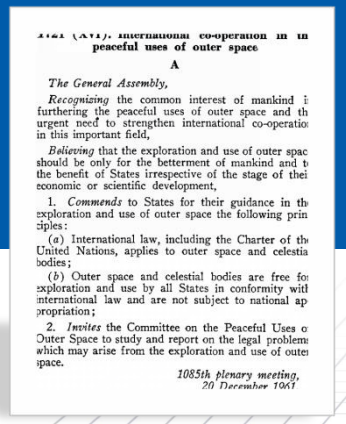
WMO OMM

Enhance political-policy support to decision makers

Two way approaches

- Enhanced political and policy support is critical for great success of WMO Initiatives (EW4ALL, GGGW) !
- WMO/NMHSs shall do more to support Global and National Policy-Makings (UNFCCC, COPs and UNGA), then to promote WMO and NMHSs political visibility & Policy influence.

UNGA: Res 1721



peaceful uses of outer space

A

The General Assembly,

Recognizing the common interest of mankind i furthering the peaceful uses of outer space and th urgent need to strengthen international co-operatio in this important field,

Believing that the exploration and use of outer spac should be only for the betterment of mankind and t the benefit of States irrespective of the stage of thei economic or scientific development,

1. *Commends* to States for their guidance in th exploration and use of outer space the following prin ciples:

(*a*) International law, including the Charter of th United Nations, applies to outer space and celestia bodies;

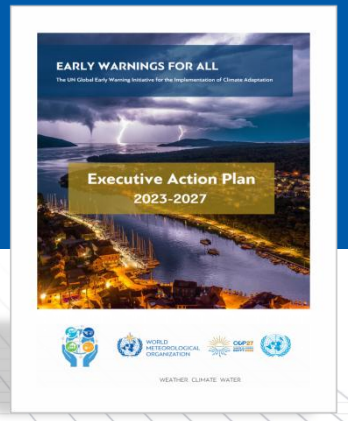
(*b*) Outer space and celestial bodies are free fo exploration and use by all States in conformity wit international law and are not subject to national ap propriation;

2. *Invites* the Committee on the Peaceful Uses o Outer Space to study and report on the legal problem which may arise from the exploration and use of outer space.

1085th plenary meeting,
20 December 1961

60 years of WWW

UN EW4ALL



150 years WMO increased Political & Policy Capacity

Launch of EW4all Action Plan at COP27

- 5 years Plan (2023 – 2027)
- Co-led by WMO and UNDRR
- Investment cost is estimated at US$ 3.1 billion, benefits are huge
- Governing Board will ensure implementation
- Annual Multistakeholder Forum

African Climate Summit (Sept 4-9, 2023, Nairobi): WMO lunched EW4ALL African Action Plan jointly with African Union Commission (AUC);
Kenya President Dr Ruto accepted WMO invitation to take the role as the African Continetal Champion for UN EW4All.

Thank You all for Supporting WMO New Initiatives

WMC RBA shall make greater contribution to WMO initiatives !

WORLD METEOROLOGICAL ORGANIZATION

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