

# The WMO Global Atmosphere Watch (GAW) programme

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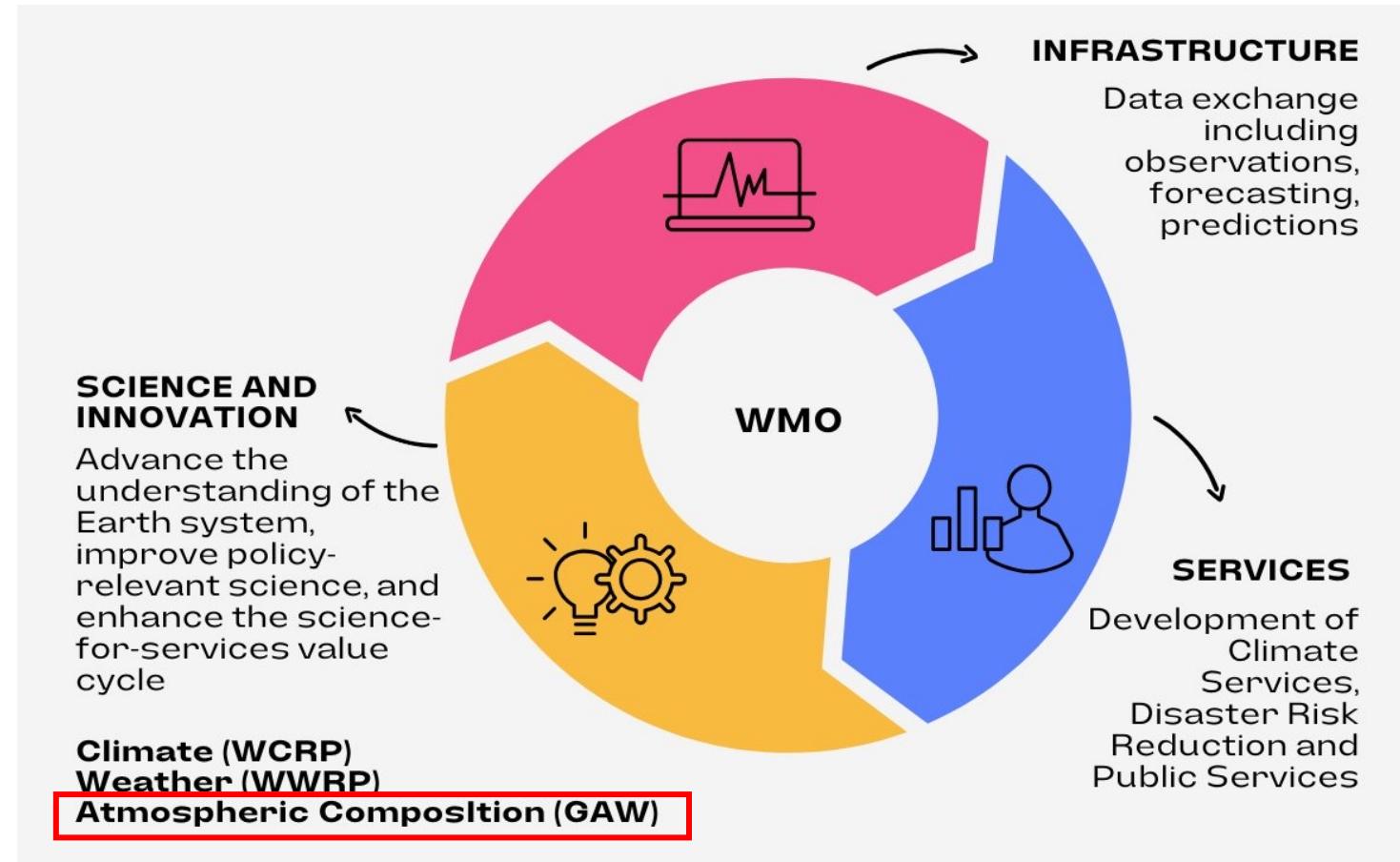
WMO Science and Innovation Department



WORLD  
METEOROLOGICAL  
ORGANIZATION

# World Meteorological Organization (WMO)

- UN specialized agency on weather, climate and water.
- It's supported by 193 Members and the headquarters is in Geneva (Switzerland).
- Coordinates work of > 300,000 national experts from meteorological and hydrological services, academia and private sector.
- Co-Founder and host agency of IPCC.



WMO Research-Operations Departments

# The WMO Global Atmosphere Watch (GAW) Programme

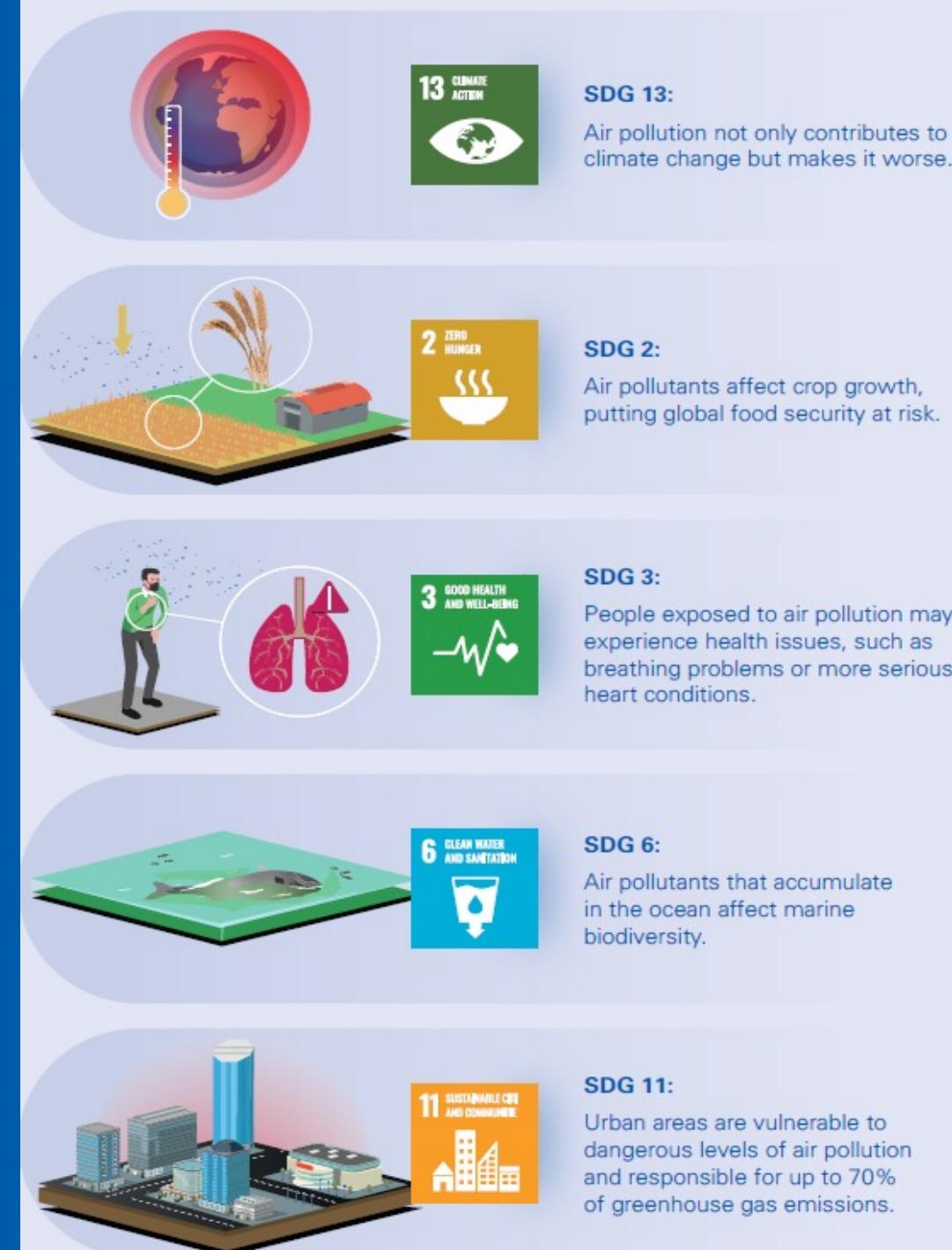


**Advance and enhance science, services and infrastructure related to atmospheric composition, and support policies for society through applied research aimed at improving the understanding of the roles of aerosols, reactive gases, stratospheric ozone and greenhouse gases and their interactions in the Earth System**



# Support to international conventions and SDGs

- The Convention on Long-range transboundary Air pollution (LRTAP)
- The Montreal Protocol and Vienna Convention (*ozone*)
- The UN Framework Convention on Climate Change (UNFCCC)
- Climate and Clean Air Coalition (CCAC)
- The Convention on Biodiversity
- The Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)
- UN Coalition for Combating Sand and Dust Storms



# The GAW Programme: 4 pillars

- **Scientific assessments:** advancing scientific understanding through analysis of global data sets,
- **Monitoring Infrastructure:** provision of atmospheric composition data;
- **Capacity Building and education:** provide training opportunities for all GAW users from all regions
- **Science-for-Services Initiatives:** engage with user communities for supporting services and policies,

# GAW Scientific Assessments

- Publish community assessment reports and high-level scientific papers on the state of the atmosphere and its evolution,
- Provide technical recommendations for monitoring atmospheric composition and modelling
- Contribute to international reports

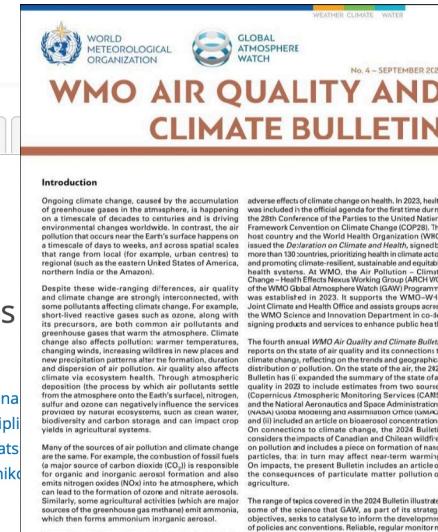
<https://doi.org/10.5194/acp-21-87-2021>  
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Research article |  

AeroCom phase III multi-model evaluation of the aerosol life cycle and optical properties using ground- and space-based remote sensing as well as surface in situ observations

Jonas Gliß, Augustin Mortier, Michael Schulz, Elisabeth Andrews, Yves Balkanski, Susanne E. Bauer, Anna Huisheng Bian, Ramiro Checa-Garcia, Mian Chin, Paul Ginoux, Jan J. Griesfeller, Andreas Heckel, Zak Kipli, Harri Kokkola, Paolo Laj, Philippe Le Sager, Marianne Tronstad Lund, Cathrine Lund Myhre, Hitoshi Mats, David Neubauer, Twan van Noije, Peter North, Dirk J. L. Olivé, Samuel Rémy, Larisa Sogacheva, Toshihiko Kostas Tsigaridis, and Svetlana G. Tyro

[Article](#) [Assets](#) [Peer review](#)



WORLD METEOROLOGICAL ORGANIZATION  GLOBAL ATMOSPHERE WATCH  No. 4 – SEPTEMBER 2024

## WMO AIR QUALITY AND CLIMATE BULLETIN

**Introduction**

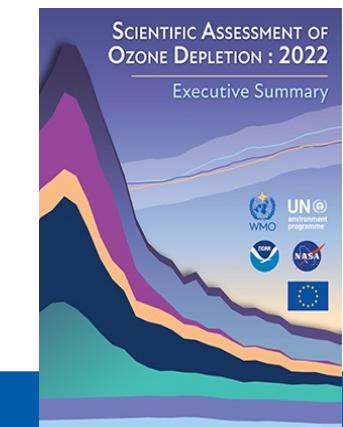
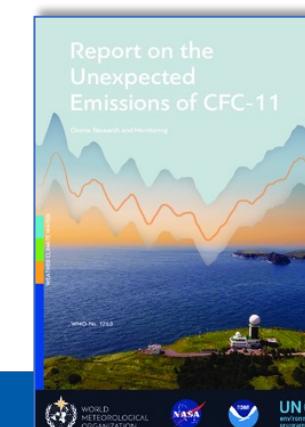
Ongoing climate change, caused by the accumulation of greenhouse gases in the atmosphere, is happening on a timescale of decades to centuries and is driving environmental and societal changes. Air pollution that occurs near the Earth's surface happens on a timescale of days to weeks, and across spatial scales that range from local to global, and from regional (such as the eastern United States of America) to northern India or the Amazon.

Despite these wide-ranging differences, air quality and air pollution are both important as indicators of some pollutants affecting climate change. For example, stratospheric reactive nitrogen as well as ozone with its precursor both contribute air pollution and greenhouse gases that warm the atmosphere. Climate change is also having an impact on the atmosphere, changing winds, increasing wildfires in new places and new precipitation patterns after the formation, duration and intensity of tropical cyclones. These changes affect ecosystems health. Through atmospheric deposition, the process by which air pollutants settle from the atmosphere to the surface, sulfur and nitrogen, sulfur and ozone can negatively influence the service provided by ecosystems. These changes are also impacting biodiversity and carbon storage and can impact crop yields in agricultural systems.

The fourth annual WMO Air Quality and Climate Bulletin reports on the state of air quality and its connections to climate change, reflecting on the trends and geographical distribution of air quality and climate change. The 2024 Bulletin has (i) expanded the summary of the state of air quality in order to include estimates from two sources (i) a global assessment of air quality and (ii) regional air quality; (ii) included an article on greenhouse gas concentrations; and (iii) included an article on biogeochemical concentrations.

On connections to climate change, the 2024 Bulletin continues to highlight the links between air quality and climate change, including the impact of air pollution on climate and includes a piece on formation of nitrates. The 2024 Bulletin also includes an article on the impact of air pollution on health, and an article on the consequences of particulate matter pollution on agriculture.

The range of topics covered in the 2024 Bulletin illustrates the breadth of the science that GAW, as part of its strategic objectives, seeks to catalyse to inform the development of policies and conventions. Reliable, regular monitoring



# GAW: Monitoring Research Infrastructure

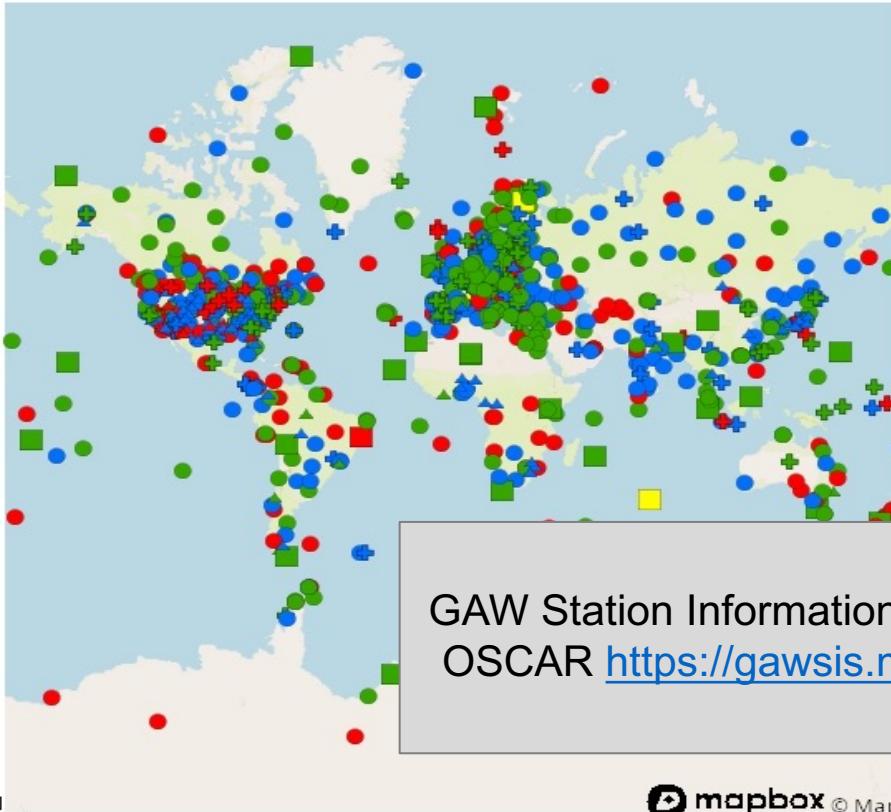
*Strengthen the atmospheric composition measurement and data infrastructure and contribute to understanding trends and variability and extremes.*

- More than 200 parameters
- Intercomparisons
- Measurement guidelines
- World Data Centers

*Open access with emphasis in QA and QC*



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra  
Swiss Confederation  
Federal Department of Home Affairs FDHA  
Federal Office of Meteorology and Climatology MeteoSwiss



GAW Station Information System (**GAWSIS**) part of OSCAR <https://gawsis.meteoswiss.ch/GAWSIS/#/>

 mapbox © Mapbox © WMO © OpenStreetMap

Global  
Regional  
Contributing networks  
Local  
Other networks

Operational  
Partly operational  
Non-reporting  
Closed  
Planned  
Pre-operational  
Stand-by

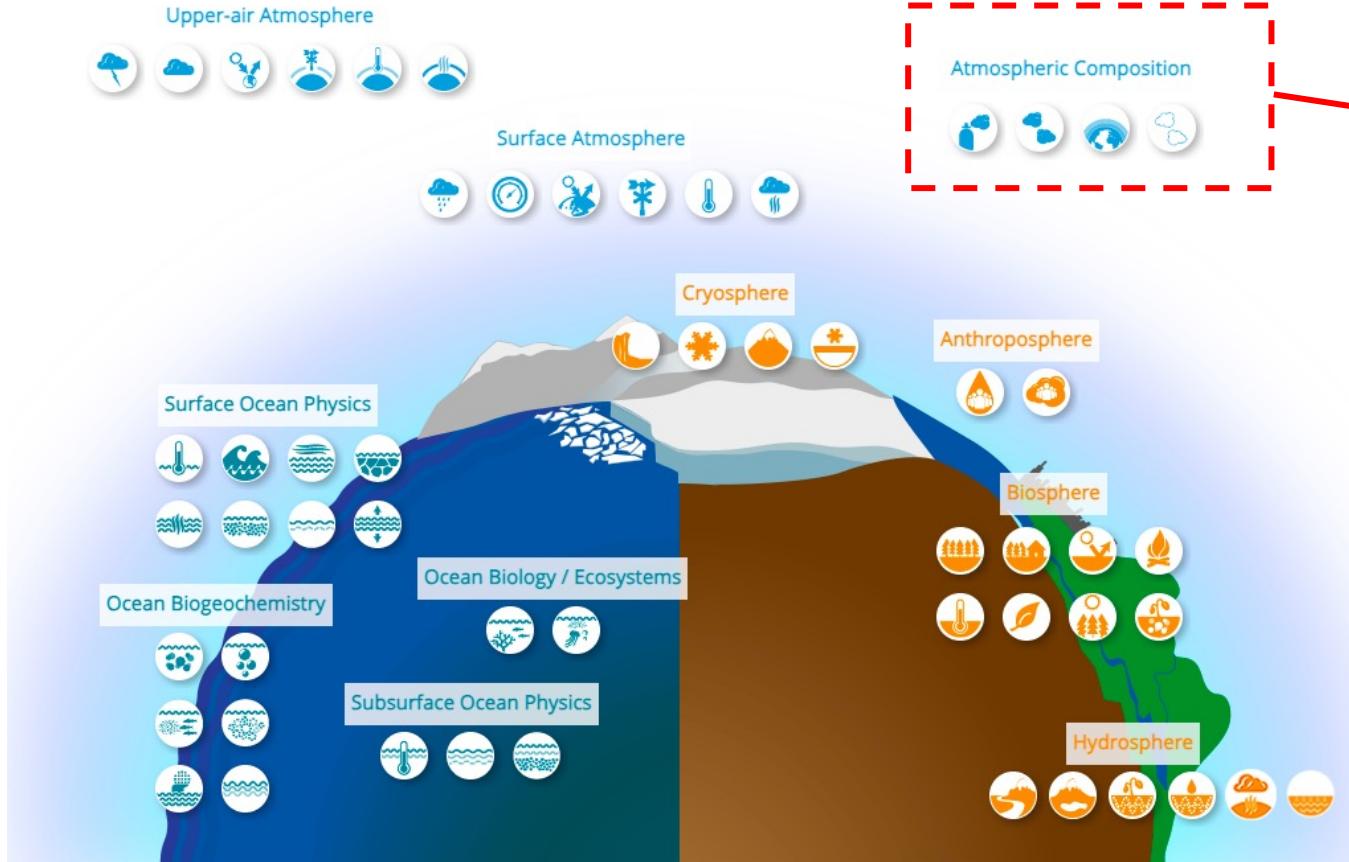
# GCOS – Global Climate Observing System

- GCOS regularly assesses the status of global climate observations and produces guidance for its improvement. GCOS works towards a world where climate observations are accurate and sustained, and access to climate data is free and open.
  - GCOS expert panels maintain definitions of **Essential Climate Variables (ECVs)**.
  - It is GCOS' task to make sure, that the totality of all climate observation networks **is more than the sum of the individual networks**, forming together the one Global Climate Observing System, providing the full picture of our climate.



# GCOS – Global Climate Observing System

## Essential Climate Variables



### Atmospheric composition Focal Areas

- **Aerosols (chemical and physical properties, AOD)**
- Carbon Dioxide, Methane & Other Greenhouse Gases
- Ozone and vertical ozone distribution
- Precursors for Aerosols and Ozone (CO, SO<sub>2</sub>, NO<sub>2</sub>)

### GAW Research Infrastructure

<https://gcos.wmo.int/en/essential-climate-variables>



<https://gcos.wmo.int/en>

# Capacity Development

- Provision of training to GAW station operators through the Global Atmosphere Watch Training & Education Centre (GAWTEC)
- GAW stations instrument intercomparison and calibration campaigns
- Training on data quality control, data use, modelling tools and quality assurance procedures

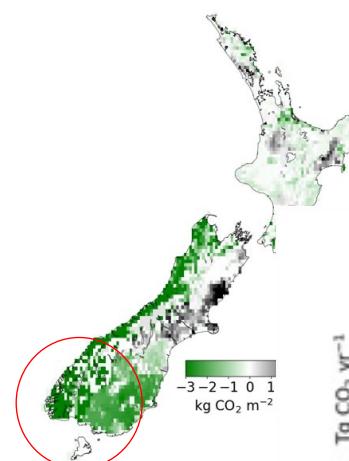
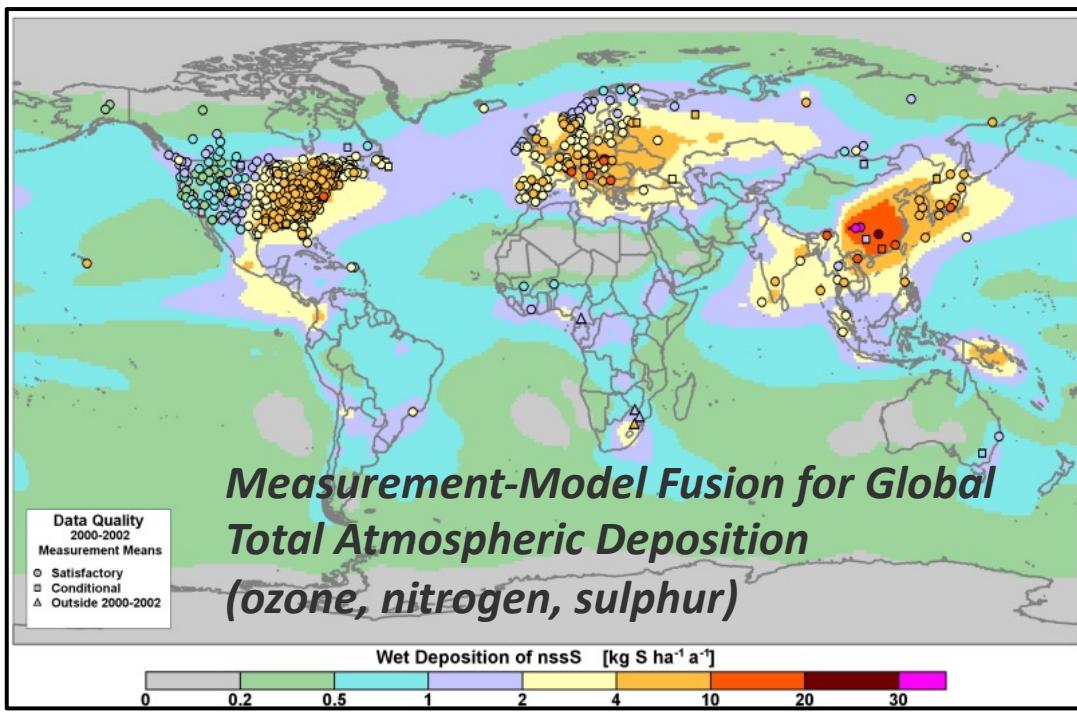


# Science for Services

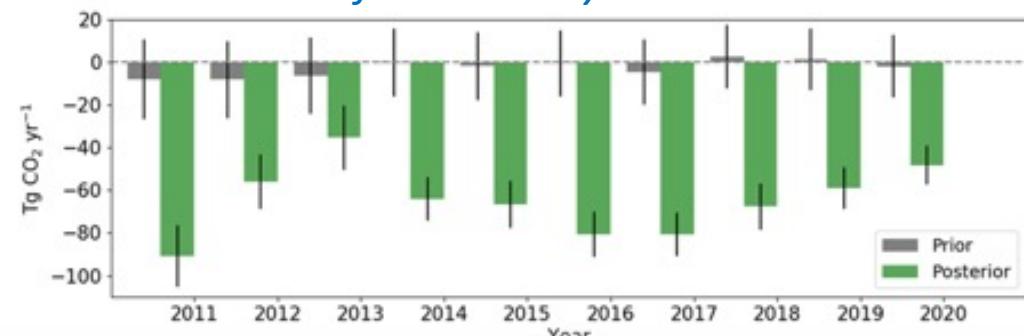


*Advance the application of atmospheric composition information in support of policies and conventions, and expand **societal services** related to air quality, human and ecosystem health, **climate change** and food production.*

## Deposition to ecosystems and crops + climate action



*Integrated Global Greenhouse Gas Information System*



*Aotearoa New Zealand's terrestrial carbon uptake*

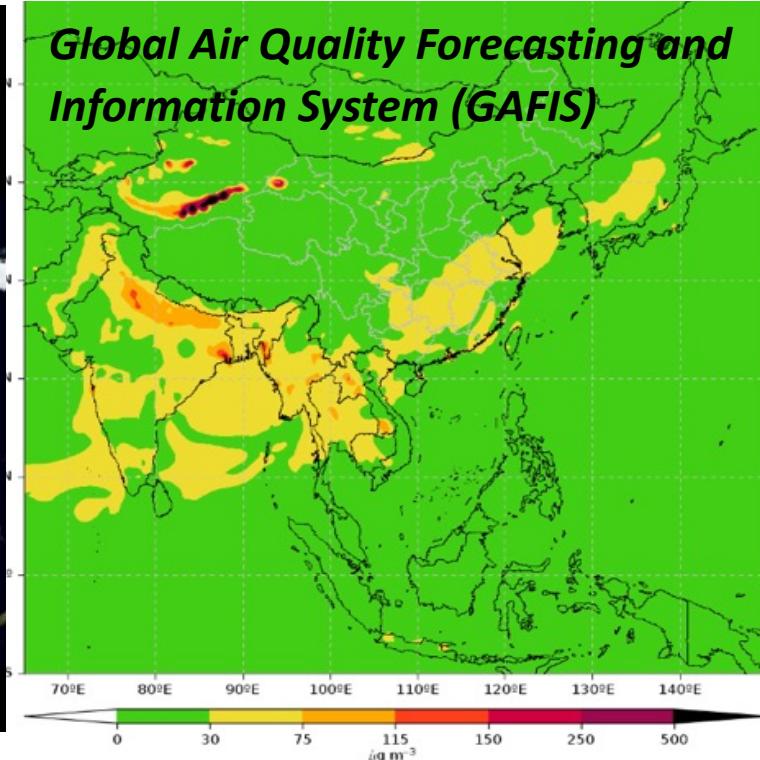
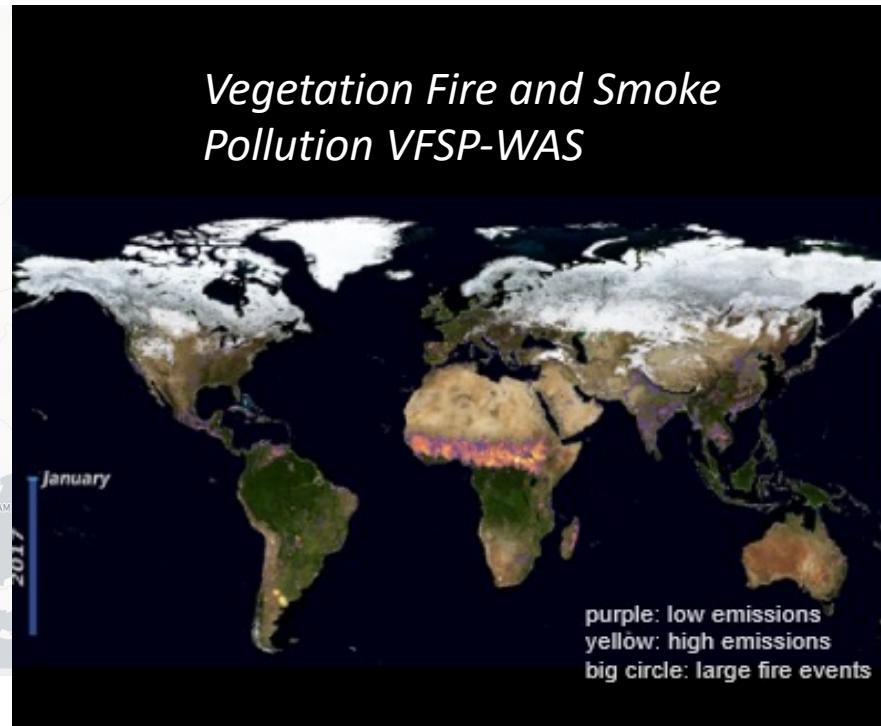
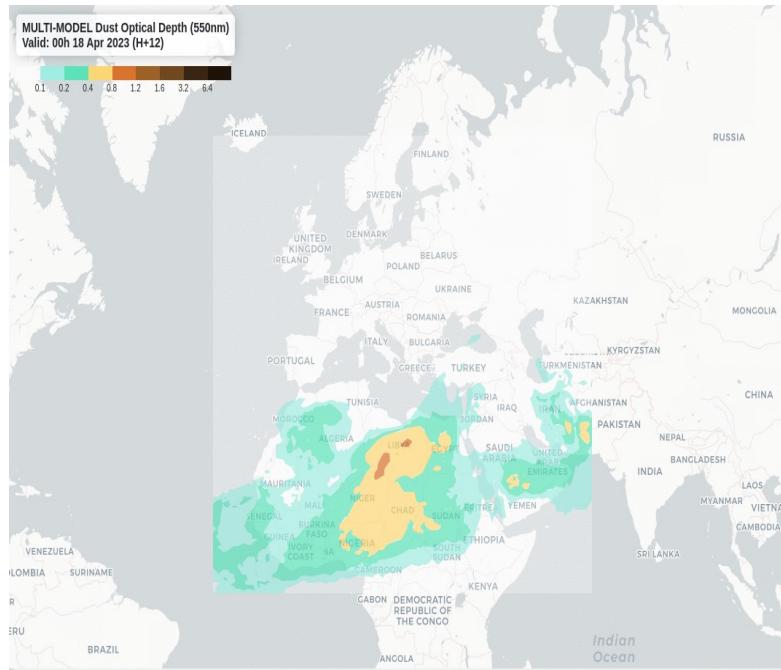
# Science for Services



*Advance the application of atmospheric composition information in support of policies and conventions, and expand **societal services** related to air quality, human and ecosystem health, climate change and food production.*

# Warnings and Forecasting Services

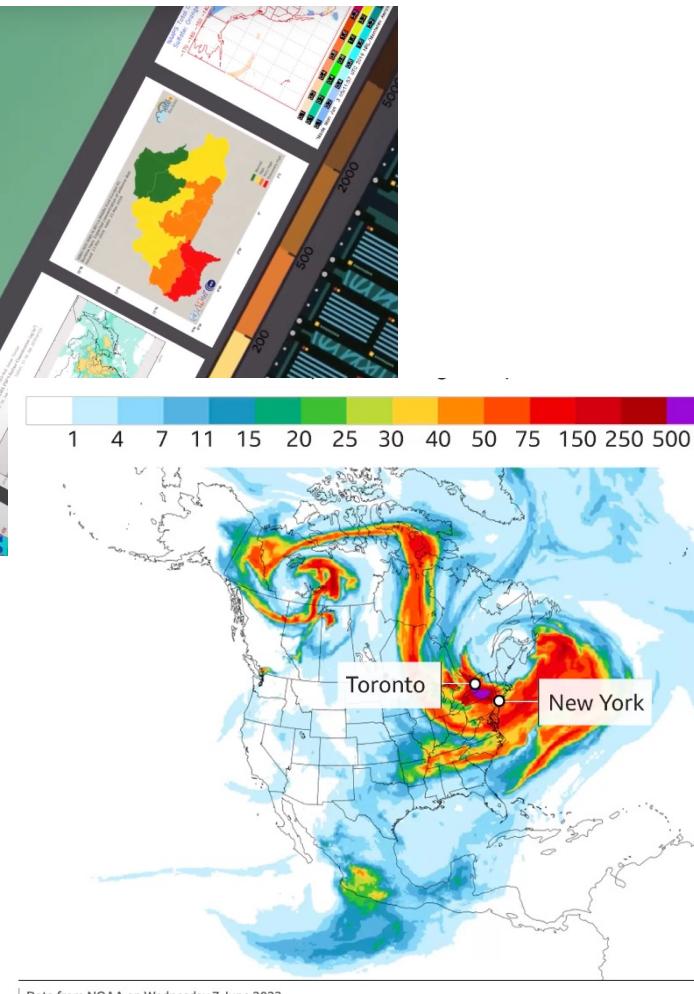
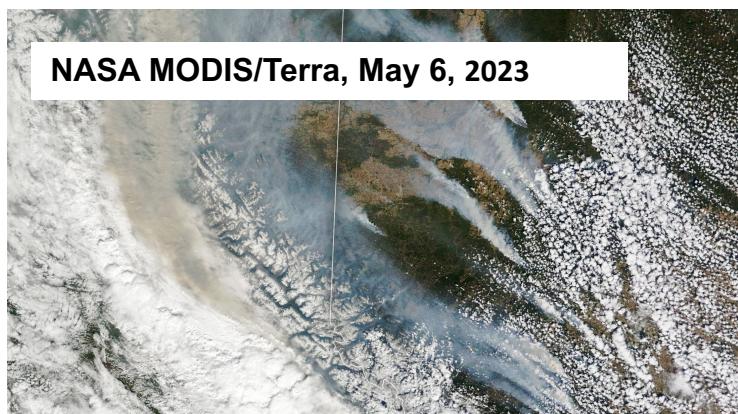
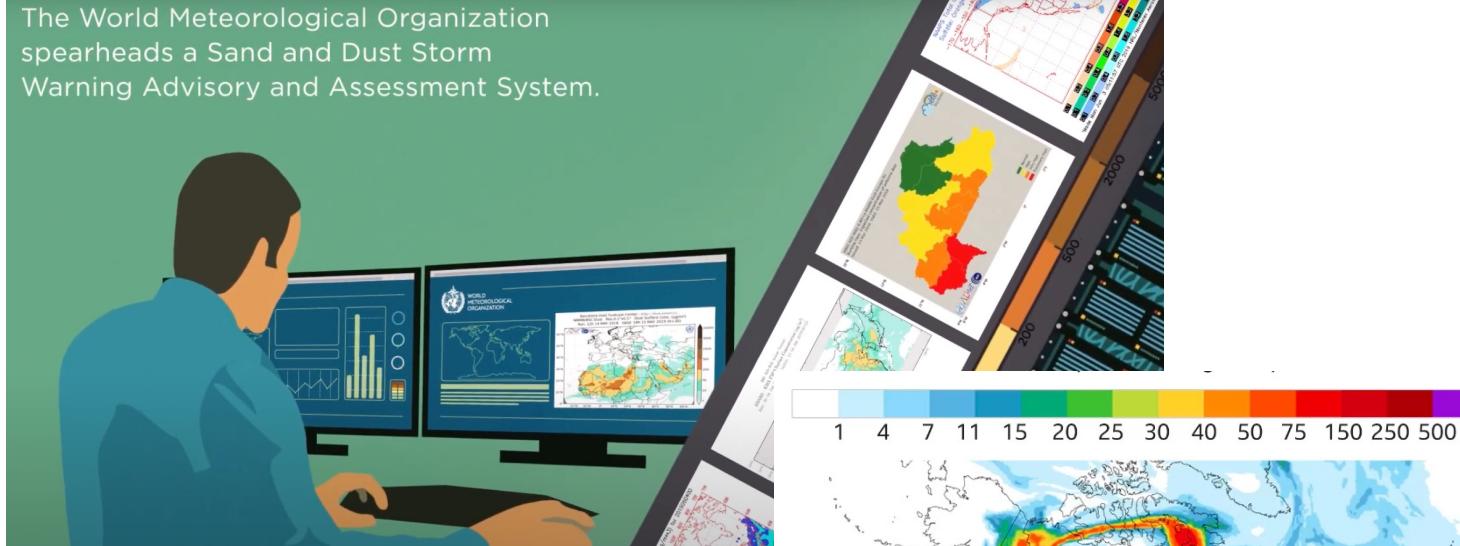
## Model intercomparisons



# WMO-GAW Warning Advisory and Assessment Systems (SDS-WAS and VFSP-WAS)



The World Meteorological Organization spearheads a Sand and Dust Storm Warning Advisory and Assessment System.



**International coordination of research for weather and climate**

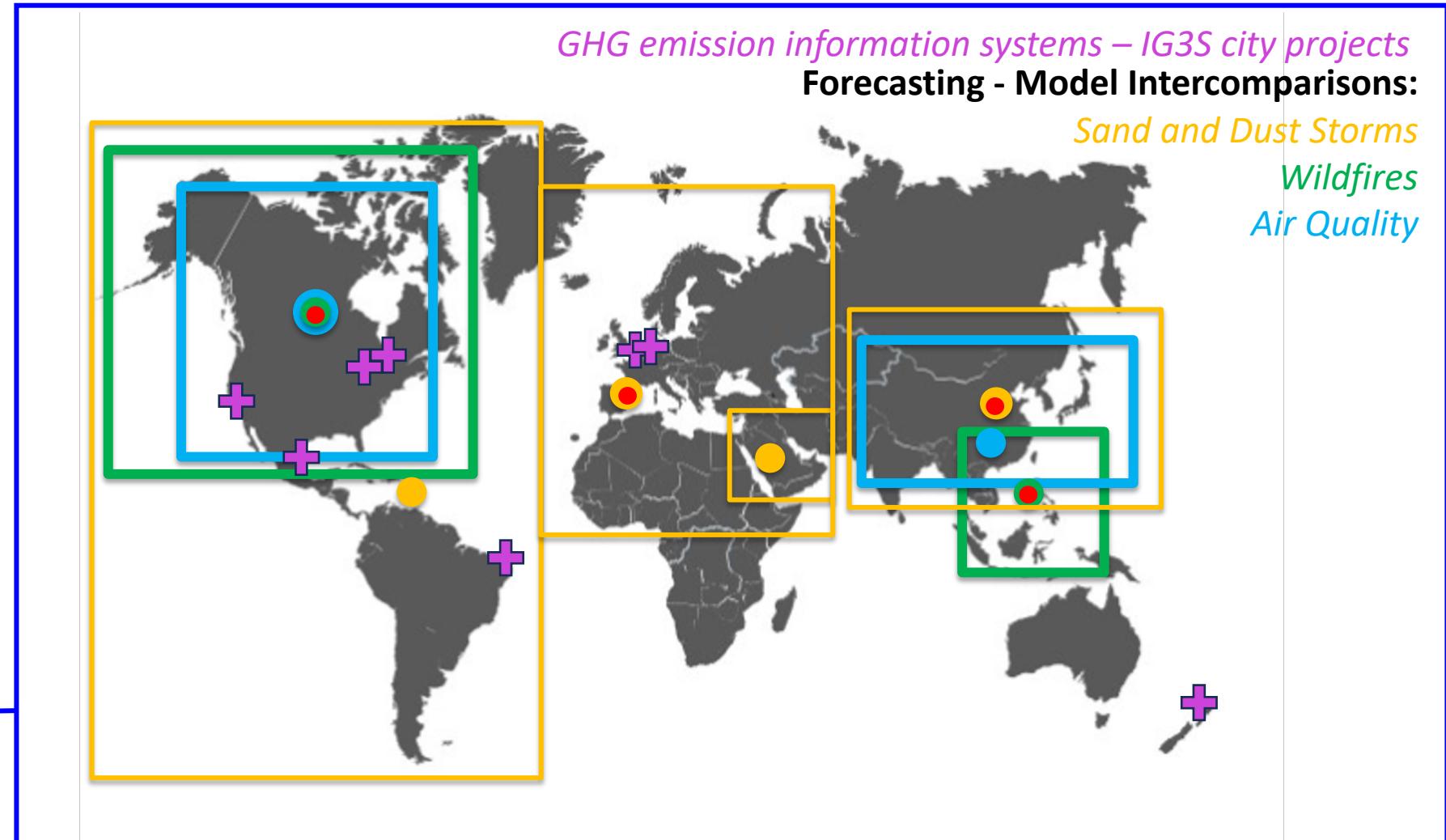
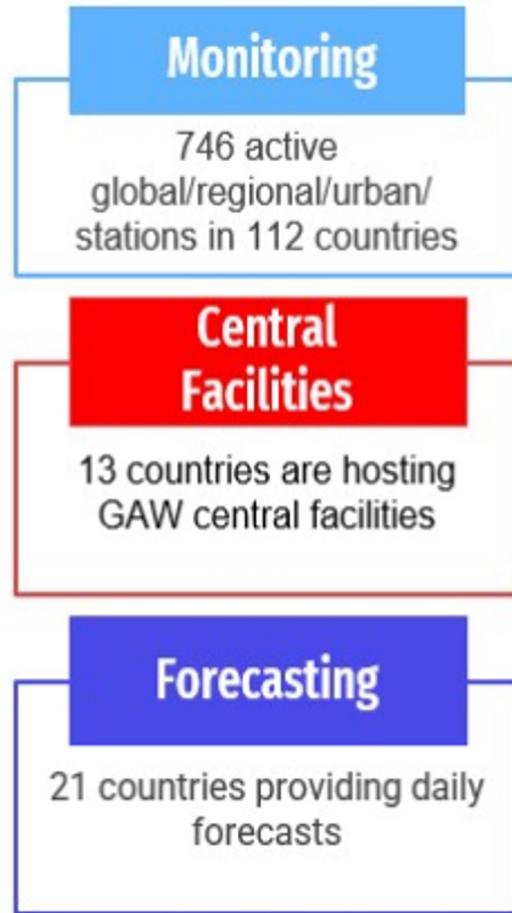
**Identification and assessment of SDS and VFSP impacts**

**Promoting the use of current available products (observations and monitoring)**

**Building capacity and facilitate access to the available services**

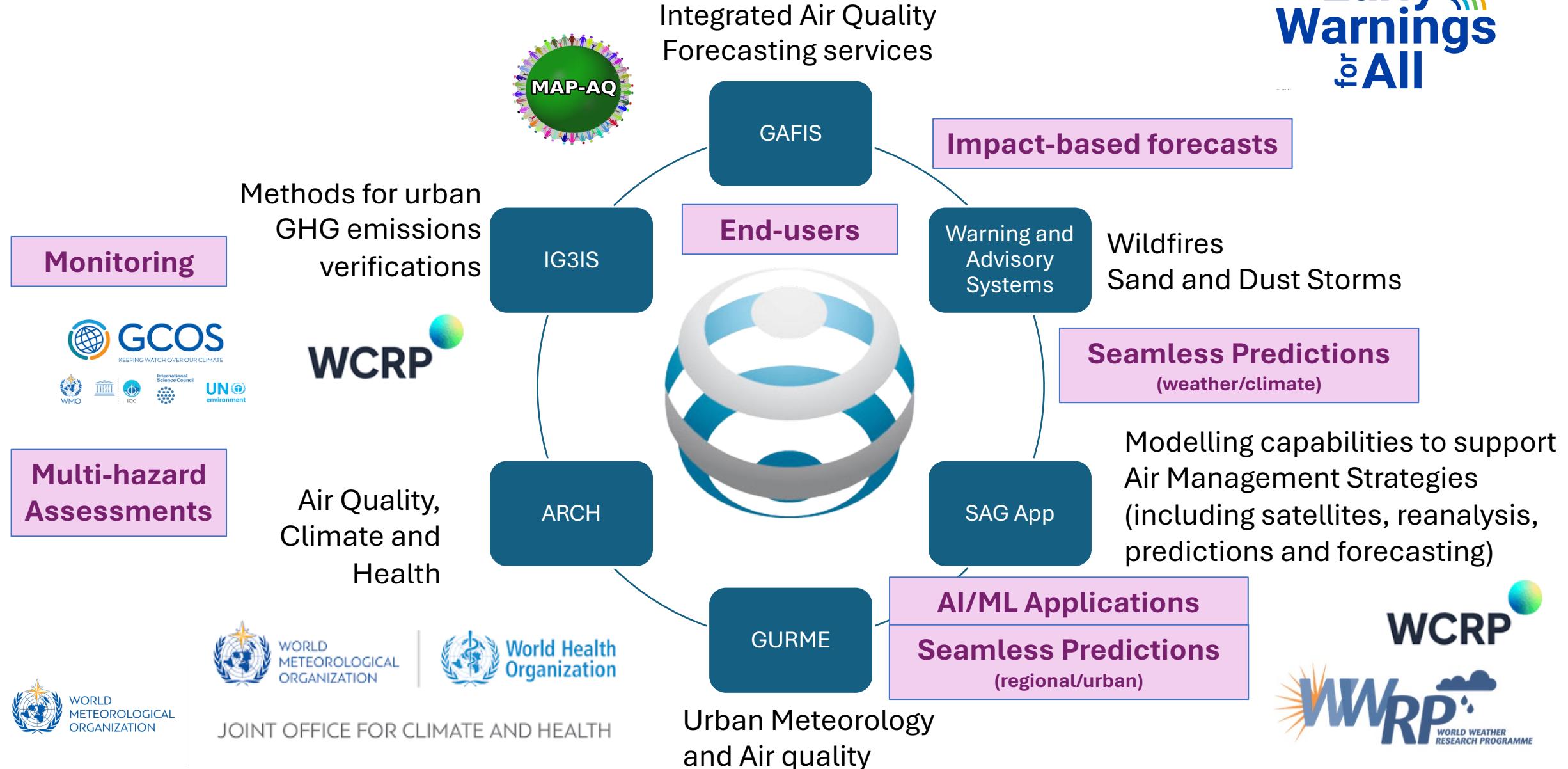
**Dissemination and awareness**

# Infrasctructure for the provision of Services

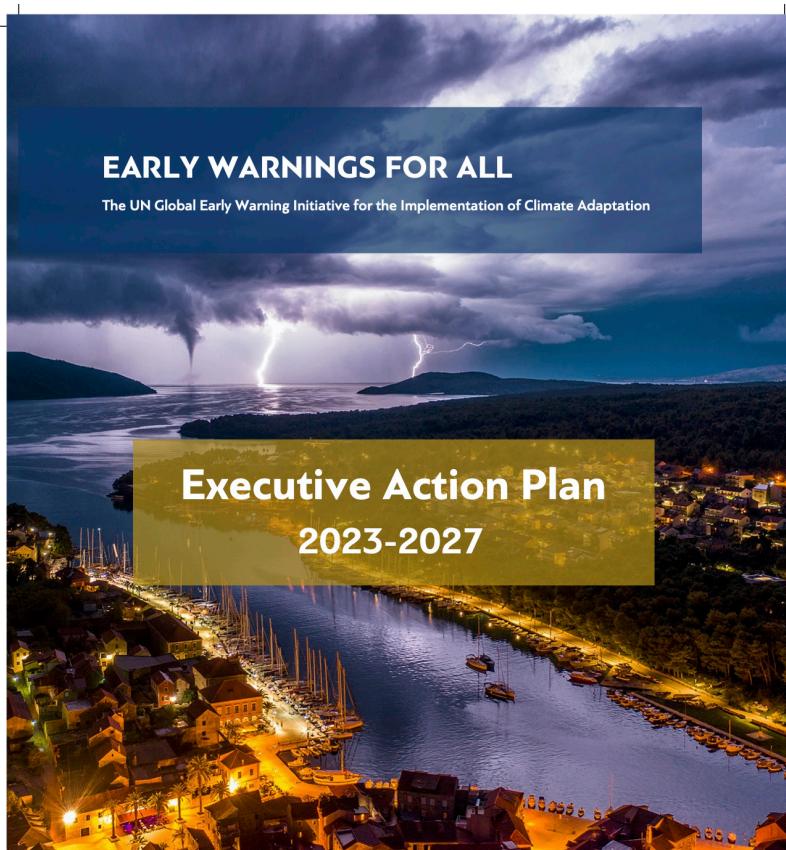


# Ongoing Cross-cutting Urban discussions

Early Warnings for All



# UN Early Warning for All | EW4All



<https://library.wmo.int/>

***"The facts are clear. Early warnings save lives and deliver vast financial benefits. I urge all governments, financial institutions and civil society to support this effort."*** – UN Secretary-General António Guterres



Strategy build in 4 pillars:

1. Disaster risk knowledge and management
2. Detection, observation, monitoring, analysis, and forecasting
3. Warning dissemination and communication
4. **Preparedness** and response capabilities

**50% of countries not protected by Early Warnings**  
**In the list of hazards are SDS and wildfires**

# Early Warning Services, e.g. wildfires

Short-range forecast: 6 hours to 3 days  
Medium-range forecast: 3 to 10 days  
Long-range forecast: 10 days to several months

## PUBLIC WARNINGS

### BEFORE FIRE

FIRE RISK

RISK ASSESSMENT

### ACTIVE FIRE

FIRE AND SMOKE  
EMERGENCY

SMOKE RISK

IMPACT ASSESSMENT

AUDITING

### AFTER FIRE

RECOVERY AND REHABILITATION PLANNING

#### PREPARADNESS STRATEGIC PLANNING

Annual and Decadal Climate Predictions (1-10 years)  
Long-term outlooks (20-100+ years): Climate Projections

# GAW community

Subscribe to the  
**GAW Newsletter**  
for staying to date  
on our activities



## GAW Symposium

*13-17 April 2026*  
*WMO Headquarters*  
*Geneva*



<https://community.wmo.int/en/activity-areas/gaw/news>

# WGNE and GAW discussion points

- **Bridging Observations and Modelling:** How can GAW observational networks and datasets be more effectively integrated into WGNE model development and evaluation to close gaps between observed and simulated atmospheric composition?
- **Model Evaluation and Verification:** What joint methodologies or metrics can GAW and WGNE develop to systematically evaluate and improve the representation of key atmospheric composition processes in models?
- **Coupled Processes and Earth System Integration:** How can GAW observations support WGNE efforts to better represent chemistry–meteorology–climate interactions, such as aerosol–cloud–radiation feedbacks, in coupled models?