WMO – International activities

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

Lorenzo Labrador, Oksana Tarasova and Sara Basart

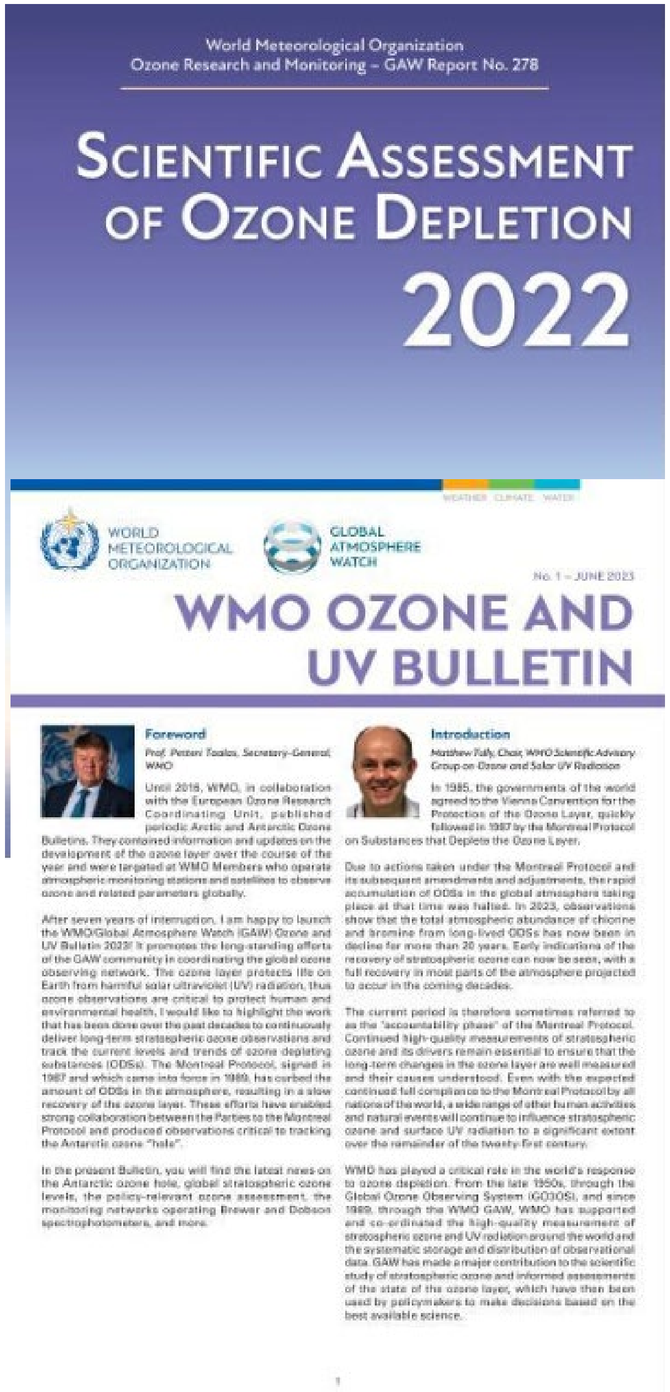
Forum for International Cooperation on Air Pollution's meeting
Geneva, 13 and 14 February 2024

Support to the Montreal Protocol

- WMO has played a critical role in the world's response to ozone depletion since the late 1950s supporting and coordinated high-quality measurement of stratospheric ozone and UV radiation around the world and the systematic storage and distribution of observational data.

- The Scientific Assessment of Ozone Depletion 2022:
  - -highlights advances and updates in the scientific understanding of ozone depletion since the 2018
  - -provides policy-relevant scientific information on current challenges and future policy choices

- 2023 WMO Ozone and UV Bulletin:
  - -highlights the work of the stratospheric ozone research community and the WMO GAW Scientific Advisory Group on Ozone and Solar UV radiation
  - -latest news on the Antarctic Ozone hole, global stratospheric ozone levels, the monitoring networks operating Brewer and Dobson spectrophotometers, and more



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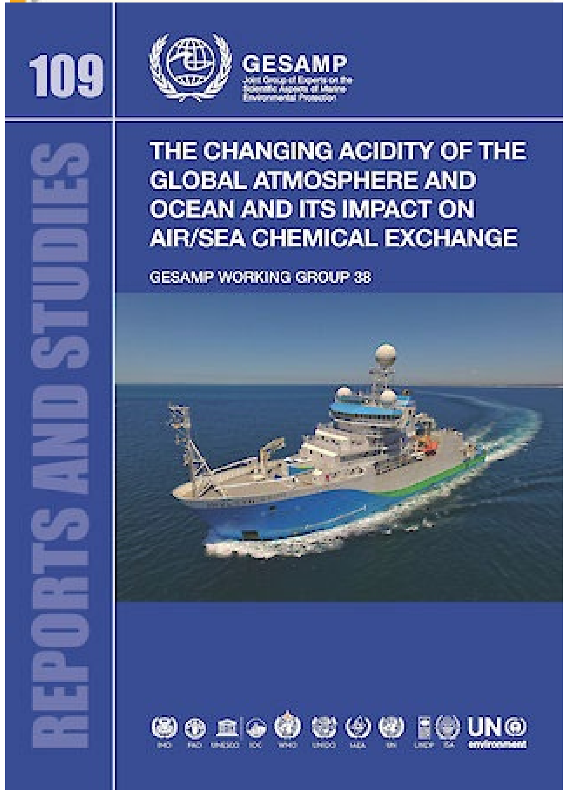
Atmospheric Deposition

-Borne of its approach to deliver integrated products and services related to atmospheric composition of relevance to users, WMO GAW created and coordinates the Measurement-Model Fusion for Total Global Atmospheric Deposition (MMF-GTAD),

-MMF-GTAD aims to review the state-of-the-science on measurement-model fusion techniques applied to atmospheric Deposition and develop global maps of total atmospheric deposition of Ozone, nitrogen and sulphur on a semi-operational basis

-2021-2026 MMF-GTAD Implementation Plan

-Connection to the Joint Expert Group on the Scientific Aspects of Marine Environmental Protection’s (GESAMP) Working Group 38



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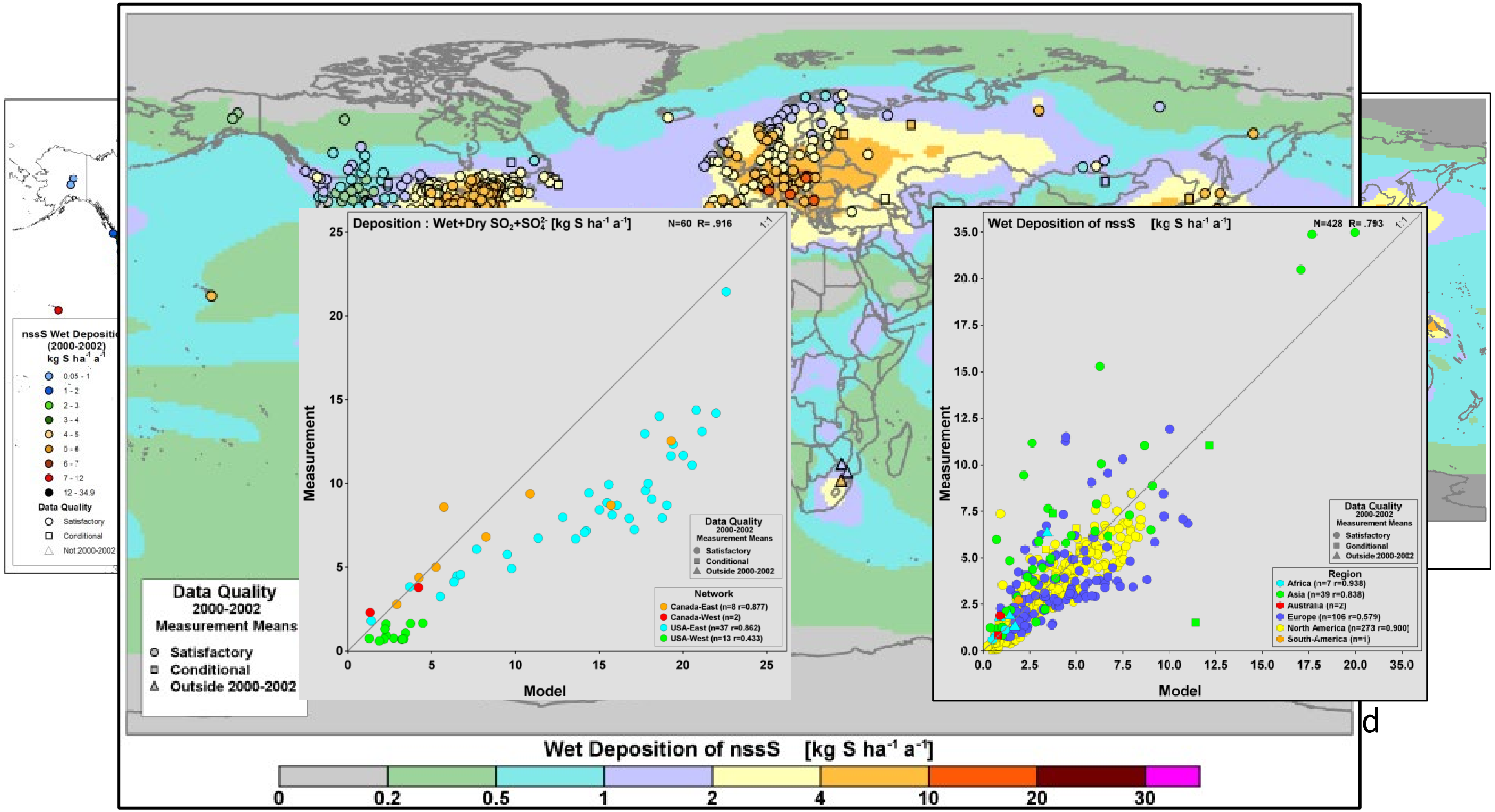
Combined measurement-model global maps of atmospheric deposition

GAW



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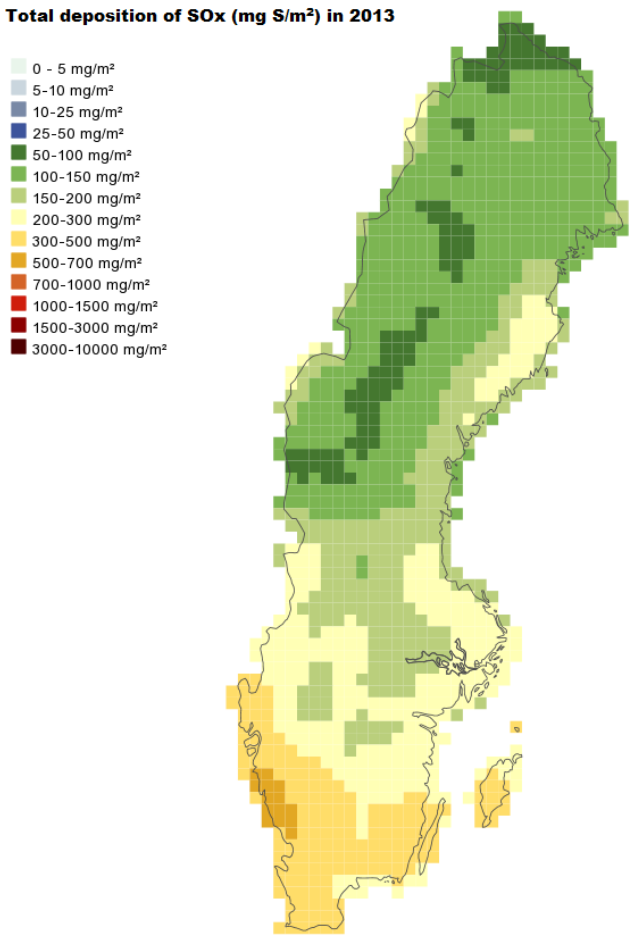
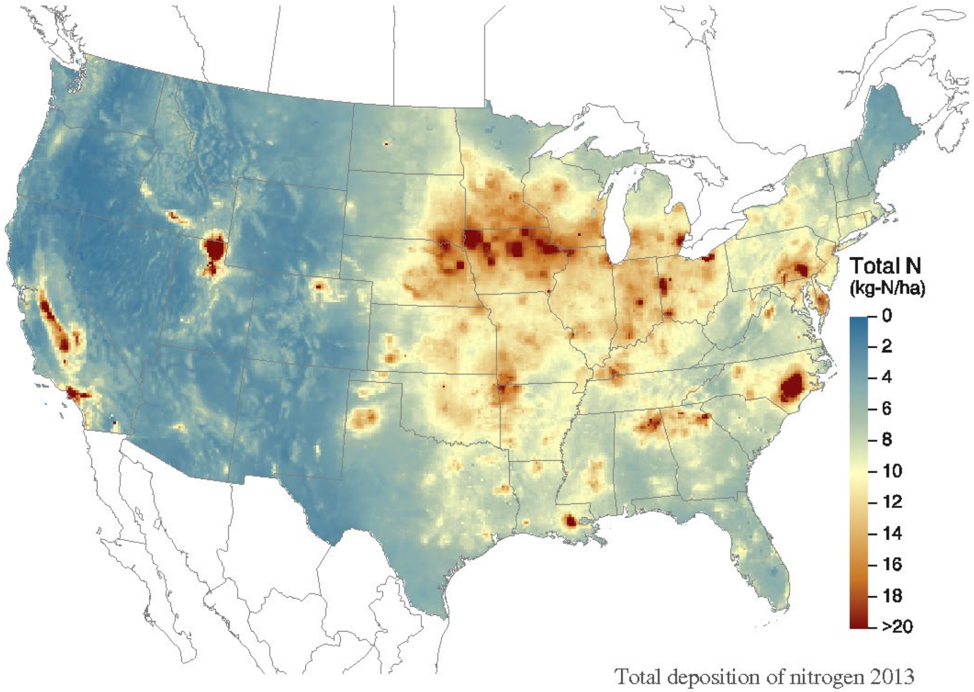
Measurement-Model Fusion of Total Atmospheric Deposition: Sweden and U.S.A.

2013 Total Deposition of Sulfur





Total deposition of nitrogen 2013

Source: CASTNET/CMAQ/NTN/AMON/SEARCH

USEPA 10/15/14

Source: *Alpfjord, H. and Andersson, C., 2015. Nationell miljöövervakning med MATCH Sverige-systemet - ny metodik, utvärdering och resultat för åren 2012-2013, Swedish Meteorological and Hydrological Institute, Nr 2015-7*

Source: *Schwede D. and Lear G., 2014. Atmospheric Environment, Volume 92, August 2014 and http://nadp.sws.uiuc.edu/committees/tdep/tdepmaps/ .*

WMO

WMO Air Quality and Climate Bulletin

- First edition in 2021
- Supersedes the Reactive Gases Bulletin and Aerosol Bulletin
- Borne of the collaboration of the GAW Scientific Advisory Groups on Aerosol, Reactive Gases and Total Atmospheric Deposition
- **Message: air quality and climate cannot be treated as separate subjects**
- Topic of each year’s Bulletin decided on by an Editorial Board
- Launched each year to coincide with the UN-sanctioned “Clean Air for Blue Skies” – wide international press coverage
- Translated into Spanish, French, Russian and Chinese
- One of the WMO’s flagship publications

WEATHER CLIMATE WATER

https://public.wmo.int

WORLD METEOROLOGICAL ORGANIZATION

GLOBAL ATMOSPHERE WATCH

No. 3 – SEPTEMBER 2023

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 changes worldwide. In contrast, the 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 (for example, urban centres) to regional (such as the eastern United States of America, northern India or the Amazon). Despite these wide-ranging differences, air quality and climate change are strongly interconnected. The *WMO Air Quality and Climate Bulletin* reports annually on the state of air quality and its connections to climate change, reflecting on the geographical distribution of and changes in the levels of traditional pollutants.

Traditional pollutants include short-lived reactive gases such as ozone – a trace gas that is both a common air

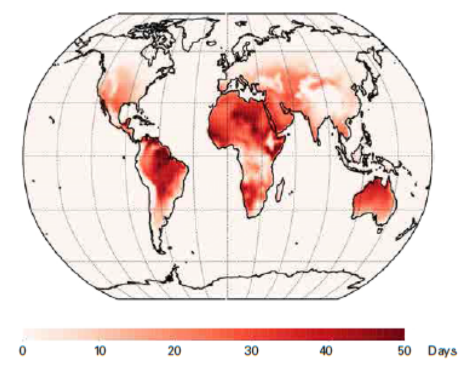


Figure 1. Change in the number of days per year with daily maximum surface temperatures above 35 °C, relative to an 1850–1900 baseline, as predicted by 27 numerical models, in a world that will have experienced 1.5 °C warming (based on the Shared Socioeconomic Pathway SSP5-8.5), globally averaged

Source: Figure produced using data from the IPCC Working Group I Interactive Atlas: https://interactive-atlas.ipcc.ch/

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tiny particles suspende
referred to as aerosols),
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can either cool or warm

Air quality and climate
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fuels (a major source of
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The present edition of th
Bulletin provides an up
of PM for 2022 and ex
heatwaves affect atmos
are expected to worsen
and several notable hea
case studies further exa
tween PM, climate and
of wildfires in heatwav
more aerosol pollution,
North America in Augu
intrusion of a desert air
Africa brought both he
dust in August 2022. Fu
of the Bulletin explores
that impacted Europe in
concentrations of grou
elucidating the role that wildfires play in driving nitrogen

The effect of heatwaves on ground-level ozone across Europe

James Lee, Beth Nelson, Will Drysdale, Sam Wilson

Although ozone is beneficial at very high altitudes, where it protects the planet from harmful ultraviolet radiation, it is damaging at ground level where exposure to high concentrations of ozone is hazardous to vegetation and human health. There is a strong link between the occurrence of heatwave events and high levels of ground-level ozone. During the July 2022 heatwave observed across Europe, hundreds of air quality monitoring sites exceeded the World Health Organization's ozone air quality guideline level of 100 $\mu g\ m^{-3}$ for an 8-hour exposure (WHO, 2021). These exceedances first occurred in the south-west of Europe, later spreading to central Europe and finally reaching the north-east (Figure 6), following the spread of the heatwave across the continent.

Ground-level ozone is created through complex chemical reactions involving nitrogen oxides (NO and NO_2, collectively known as NO_x) and reactive volatile organic

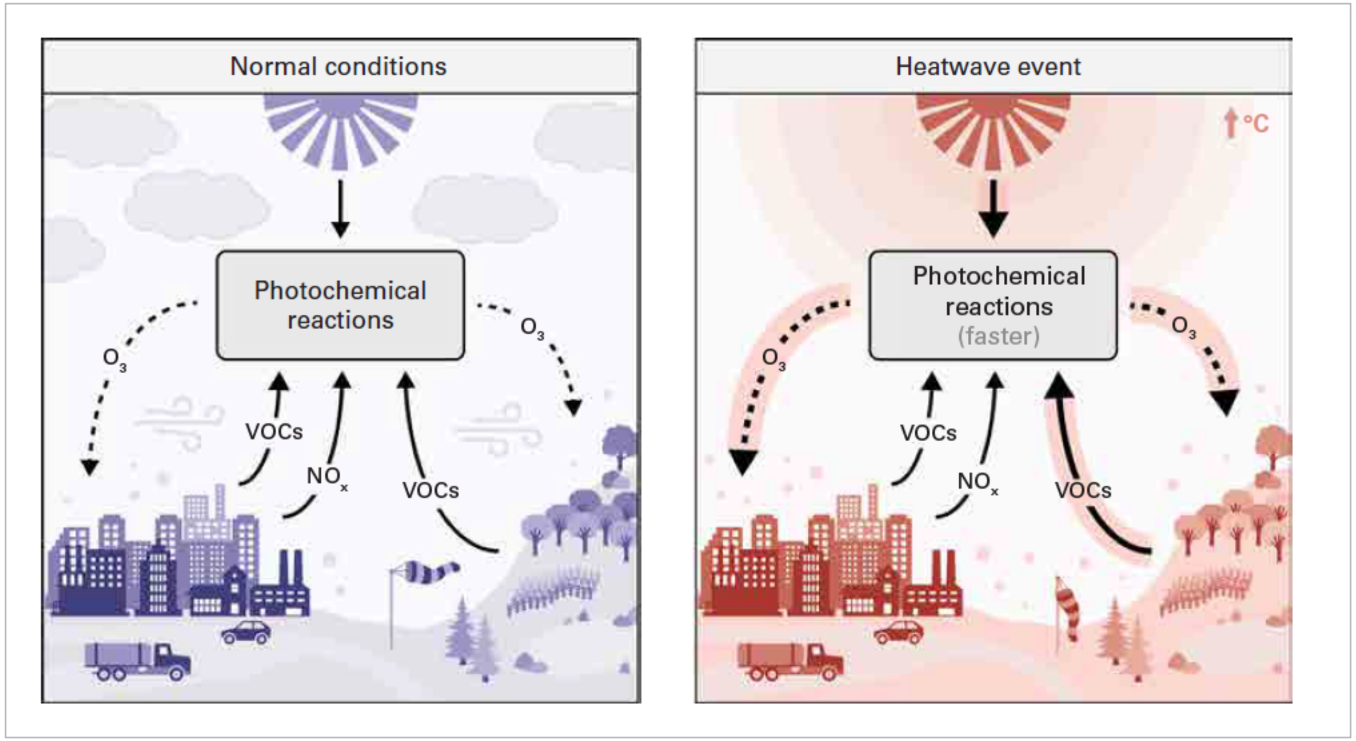
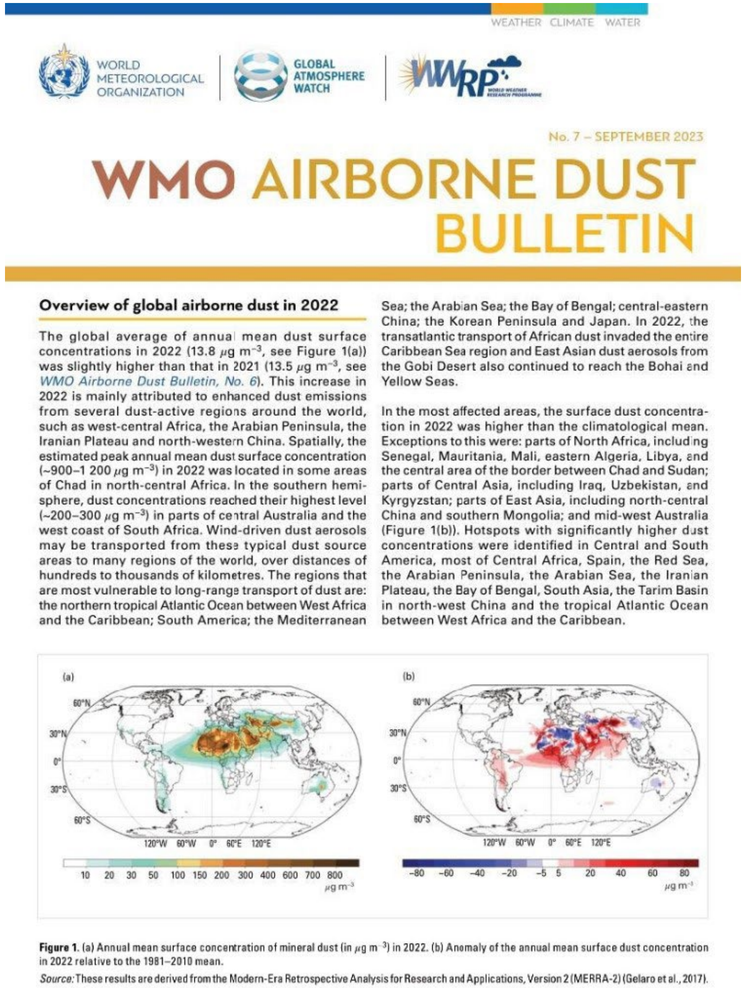


Figure 7. Ground-level ozone (O_3) is formed from the photochemical reactions (chemical reactions in sunlight) of NO_x and VOCs. Hot, stagnant conditions (right) lead to pollutant build-up, faster photochemistry and increased ozone production.

Source: University of York and National Centre for Atmospheric Science (Department of Chemistry), United Kingdom of Great Britain and Northern Ireland

WMO Airborne Dust Bulletin

- Reports on the incidence and hazards of sand and dust storms in 2022, as well as their impacts on society.
- Also looks at how climate change may potentially increase sand and dust storm hotspots.
- Coordinated by WMO's Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)
- Covers case studies of extreme sand and dust events across the world
- Published to coincide with the International Day for Sand and Dust Storms (12 July)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No. 7 – SEPTEMBER 2023

WMO AIRBORNE DUST BULLETIN

Overview of global airborne dust in 2022

The global average of annual mean dust surface concentrations in 2022 (13.8 $\mu g\ m^{-3}$, see Figure 1(a)) was slightly higher than that in 2021 (13.5 $\mu g\ m^{-3}$, see *WMO Airborne Dust Bulletin, No. 6*). This increase in 2022 is mainly attributed to enhanced dust emissions from several dust-active regions around the world, such as west-central Africa, the Arabian Peninsula, the Iranian Plateau and north-western China. Spatially, the estimated peak annual mean dust surface concentration (~900–1 200 $\mu g\ m^{-3}$) in 2022 was located in some areas of Chad in north-central Africa. In the southern hemisphere, dust concentrations reached their highest level (~200–300 $\mu g\ m^{-3}$) in parts of central Australia and the west coast of South Africa. Wind-driven dust aerosols may be transported from these typical dust source areas to many regions of the world, over distances of hundreds to thousands of kilometres. The regions that are most vulnerable to long-range transport of dust are: the northern tropical Atlantic Ocean between West Africa and the Caribbean; South America; the Mediterranean Sea; the Arabian Sea; the Bay of Bengal; central-eastern China; the Korean Peninsula and Japan. In 2022, the transatlantic transport of African dust invaded the entire Caribbean Sea region and East Asian dust aerosols from the Gobi Desert also continued to reach the Bohai and Yellow Seas.

In the most affected areas, the surface dust concentration in 2022 was higher than the climatological mean. Exceptions to this were: parts of North Africa, including Senegal, Mauritania, Mali, eastern Algeria, Libya, and the central area of the border between Chad and Sudan; parts of Central Asia, including Iraq, Uzbekistan, and Kyrgyzstan; parts of East Asia, including north-central China and southern Mongolia; and mid-west Australia (Figure 1(b)). Hotspots with significantly higher dust concentrations were identified in Central and South America, most of Central Africa, Spain, the Red Sea, the Arabian Peninsula, the Arabian Sea, the Iranian Plateau, the Bay of Bengal, South Asia, the Tarim Basin in north-west China and the tropical Atlantic Ocean between West Africa and the Caribbean.

(a) 10 20 30 50 100 150 200 300 400 600 700 800 $\mu g\ m^{-3}$

(b) −80 −60 −40 −20 −5 5 20 40 60 80 $\mu g\ m^{-3}$

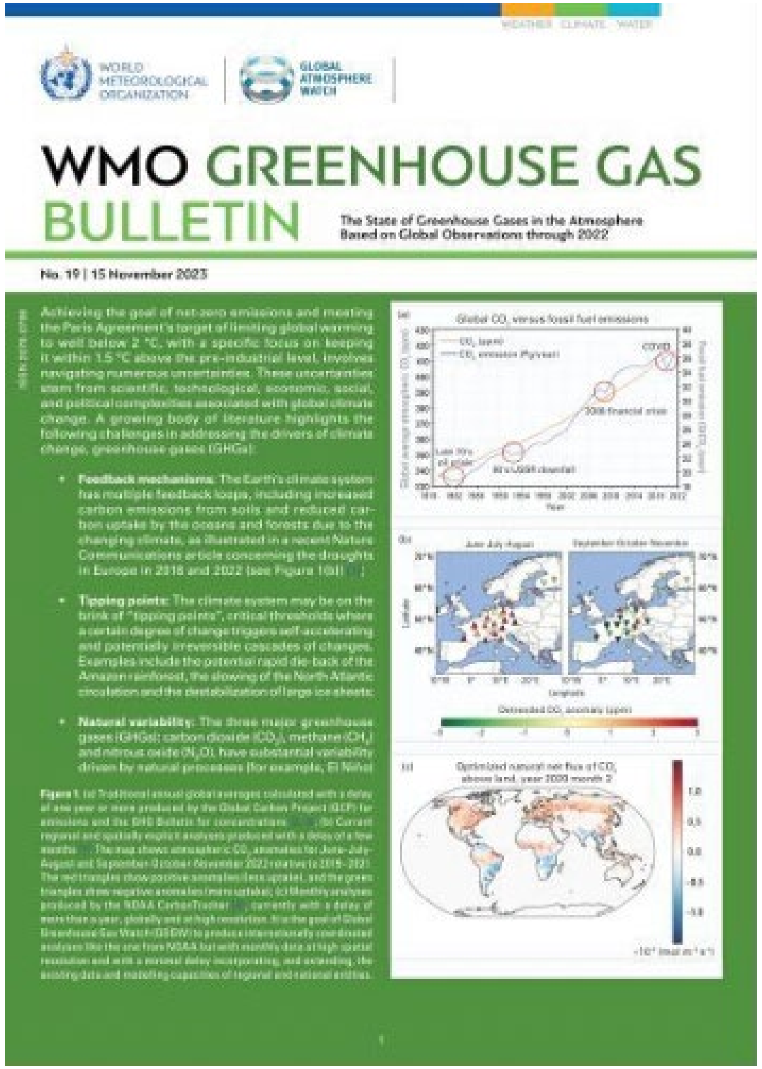
Figure 1. (a) Annual mean surface concentration of mineral dust (in $\mu g\ m^{-3}$) in 2022. (b) Anomaly of the annual mean surface dust concentration in 2022 relative to the 1981–2010 mean.

Source: These results are derived from the Modern-Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2) (Gelaro et al., 2017).

WMO Greenhouse Gas Bulletin

- Published every year in November.

- Reports on the latest trends and atmospheric burdens of the most influential, long-lived greenhouse gases; carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), as well as a summary of the contributions of lesser gases.
- Represents the consensus of a consortium of networks operated since the mid 1980s.
- Summary information from the Greenhouse Gas Bulletins is included in the WMO State of the Global Climate reports and to the "United in Science" report.
- Reflects on the added value of the atmospheric observations and highlight specific processes that control variability and trends of the major greenhouse gases.



WMO Global Greenhouse Watch (G3W)

WMO Executive Council 75 of June 2022 decided to form a joint Study, with appropriate involvement of external stakeholders, to undertake the following tasks:

- To develop the concept for WMO-coordinated GHG-related activities, its outputs and expected contributions from, and benefits for, Members, leveraging synergies with existing frameworks such as the Global Atmosphere Watch (GAW) and the Integrated Global Greenhouse Gas Information System (IG^3IS);

- To submit a final proposal of the concept for its architecture with identified key gaps between Members' operational needs and existing relevant WMO activities to the 19^{th} World Meteorological Congress in 2023

Global Greenhouse Gas Watch: elements

In its initial configuration, GGMI will consist of four main components:

(1) **A comprehensive sustained, global set of surface-based and satellite-based observations**, with an associated data management system of CO_2, CH_4 and N_2O concentrations, total column amounts, partial column amounts, vertical profiles, fluxes and supporting meteorological, oceanic, and terrestrial variables. These observations should be internationally exchanged as rapidly as possible, pending capabilities and agreements with the system operators;

(2) **Prior estimates** of the GHG emissions based on activity data and process-based models;

(3) A set of global **high-resolution Earth System models** representing GHG cycles;

(4) **Data assimilation systems**, associated with the models in component 3, that optimally combine the observations (component 1) and prior estimates (component 2) with model calculations to generate optimal estimates of concentrations and fluxes.

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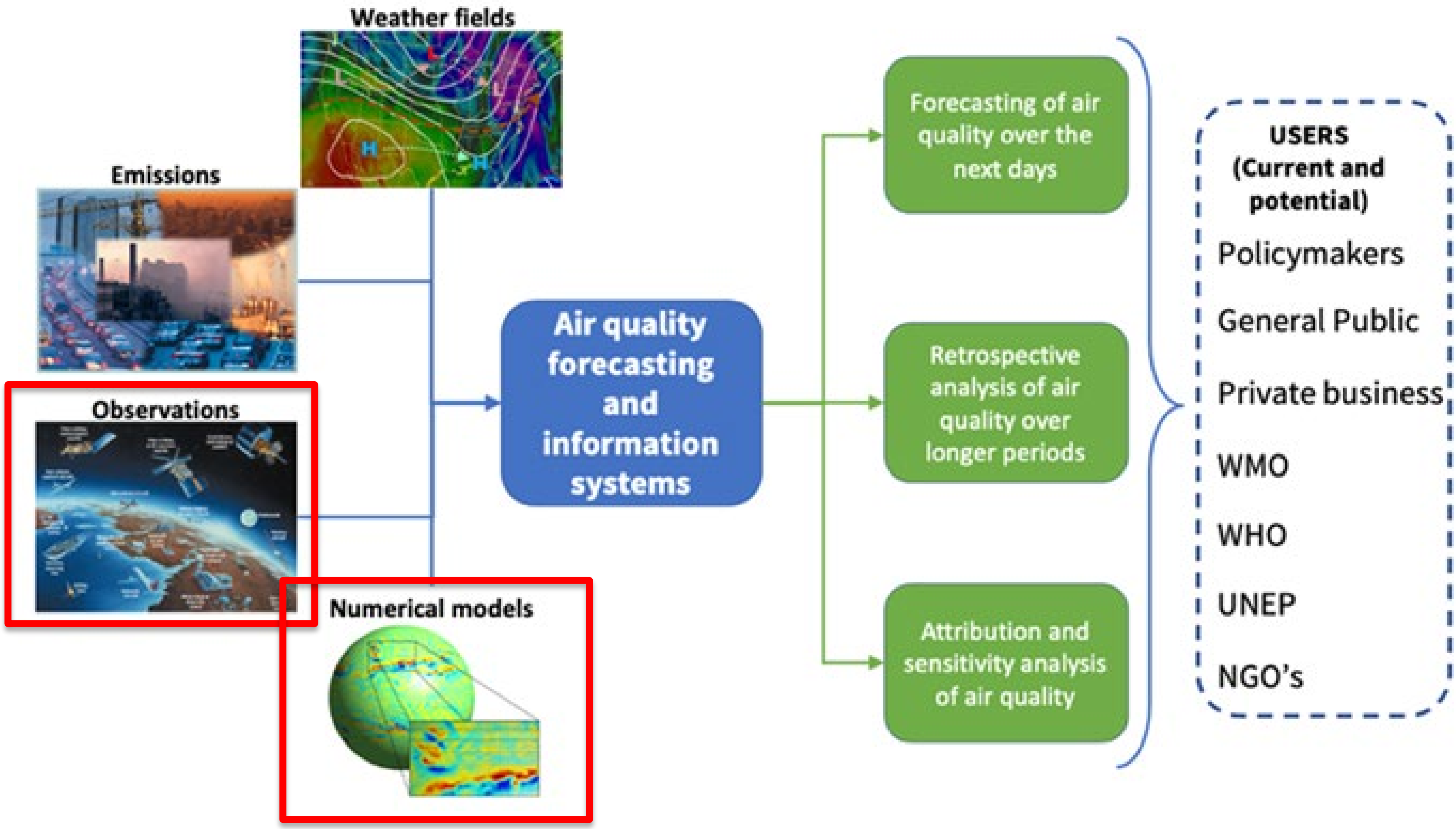
G3W Monitoring Infrastructure: outputs

- Monthly CO_2 net fluxes between the Earth surface and the atmosphere with 1x1 degree horizontal resolution delivered with a maximum delay of one month
- Monthly CH_4 net fluxes between the Earth surface and the atmosphere with 1x1 degree horizontal resolution delivered with a maximum delay of one month
- 3D fields of atmospheric CO_2 and CH_4 abundance with hourly resolution and the latency to be defined through user requirements and further consultation (tentatively on the order of a few days).
- N_2O abundances and net fluxes with resolution and latency still to be defined.

GAW: Science for Services

Global Air Quality Forecasting and Information System (GAFIS)



Building a Network of Air Quality Service Providers and Users

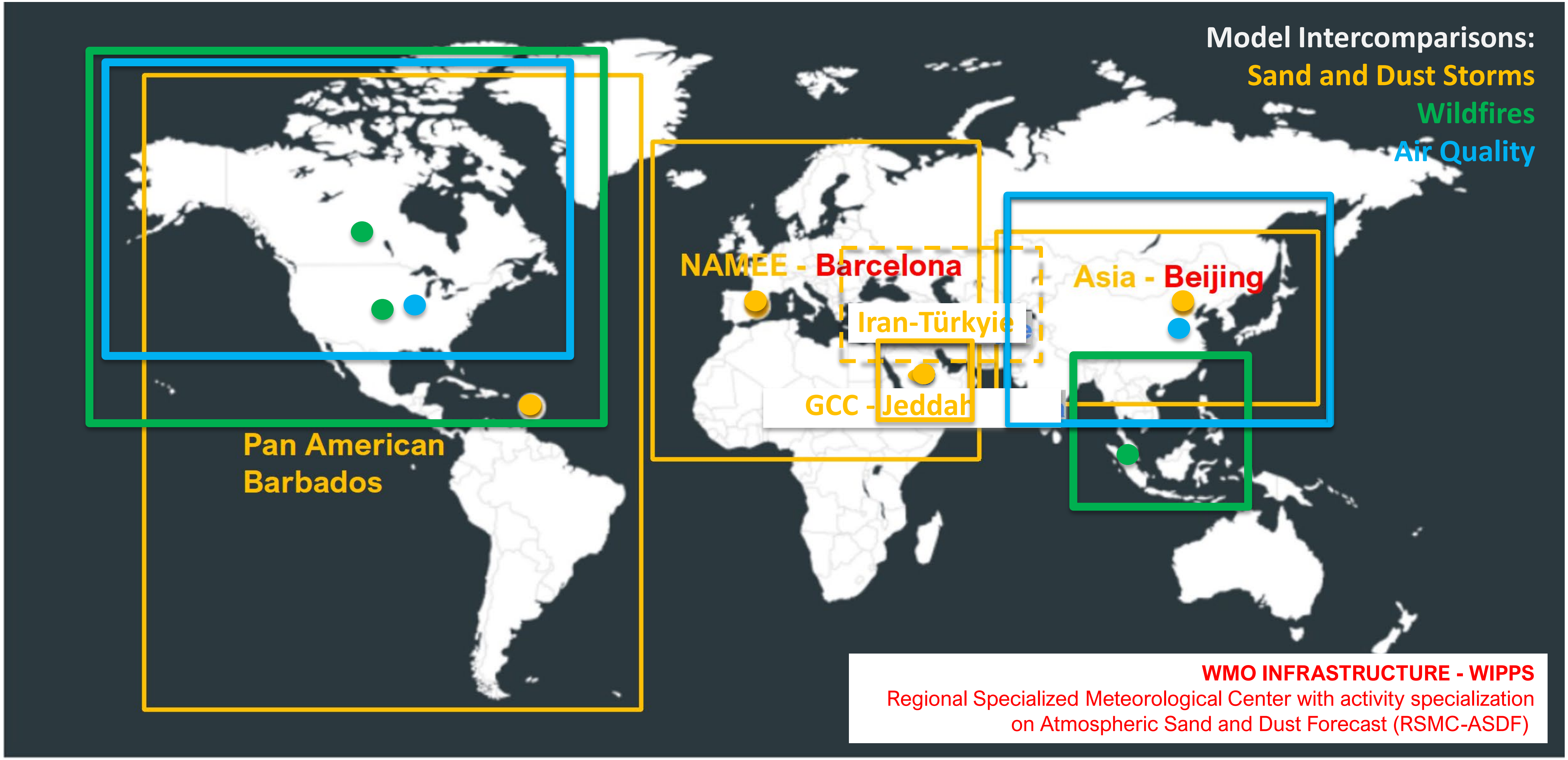
Model intercomparison in N. America and Asia

WMO OMM

Launched in 2019

GAW: Science for Services

WMO Warning Advisory and Assessment Systems



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Thank you for you attention.

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