Towards seamless GDPFS: Weather and Climate marriage

26 November 2018, Cairo, Egypt

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

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Vision of future seamless GDPFS

The proposed vision for the Future GDPFS is:

The GDPFS will be an effective and adaptable monitoring and prediction system enabling Members and partners to make better-informed decisions;

The GDPFS will facilitate the provision of impact-based forecasts and risk-based warnings through partnership and collaboration;

The GDPFS will do so through the sharing of weather, water, climate and related environmental data, products and services in a cost effective, timely and agile way, with the effect of benefitting all WMO Members, while also reducing the gaps between developed and developing Members.

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A seamless approach

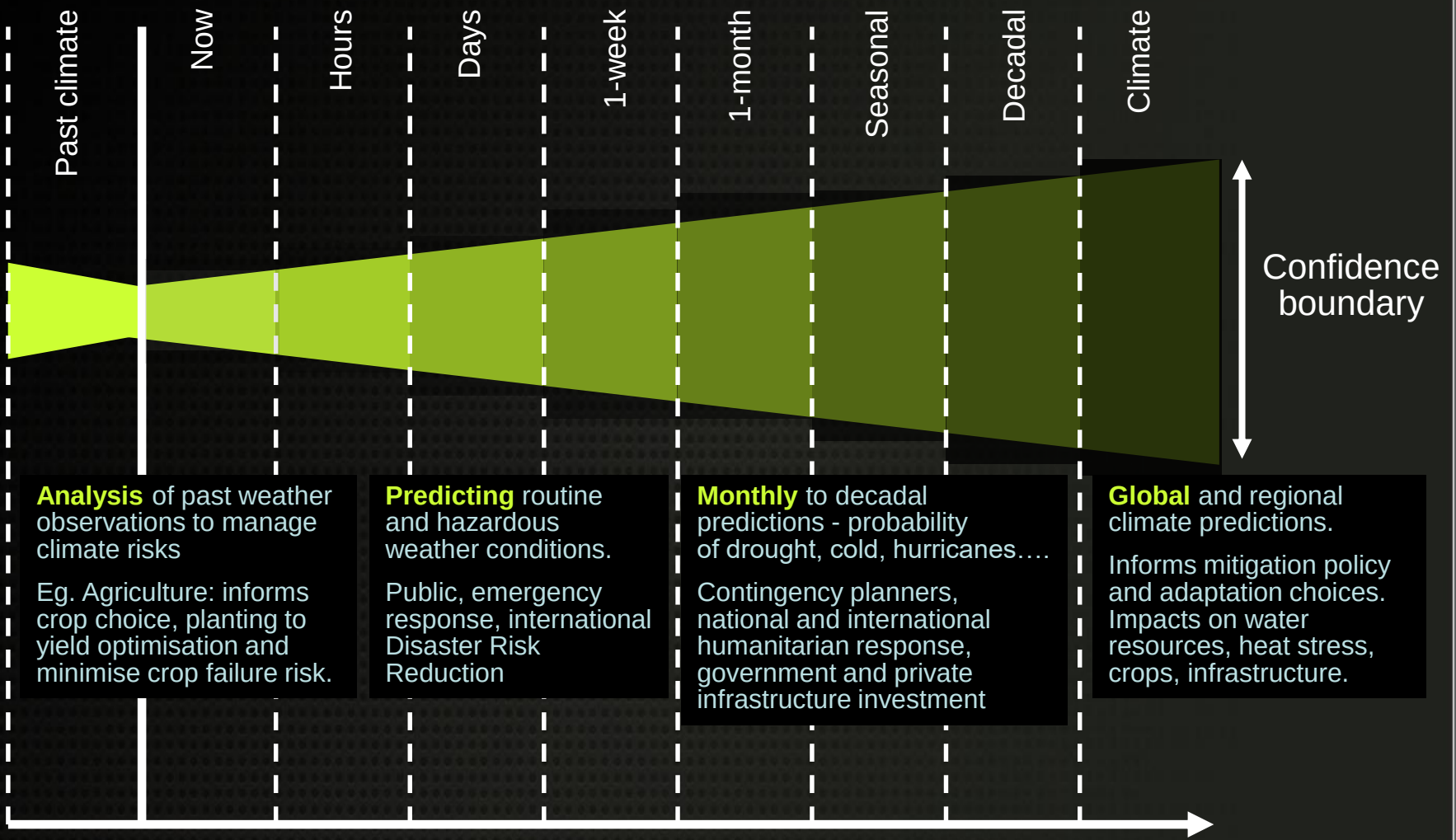
WMO's mechanism to foster and progress cooperative research for improved weather and environmental prediction services from minutes to months

Seamless Definition

In the context of WMO, seamless prediction considers not only all compartments of the Earth system, but also all disciplines of the weather–climate–water–environment value chain (monitoring and observation, models, forecasting, dissemination and communication, perception and interpretation, decision-making, end-user products) to deliver tailor-made weather, climate, water and environmental information covering minutes to centuries and local to global scales.

Seamless Prediction

Essential support to decision making on all timescales



Analysis of past weather observations to manage climate risks

Eg. Agriculture: informs crop choice, planting to yield optimisation and minimise crop failure risk.

Predicting routine and hazardous weather conditions.

Public, emergency response, international Disaster Risk Reduction

Monthly to decadal predictions - probability of drought, cold, hurricanes….

Contingency planners, national and international humanitarian response, government and private infrastructure investment

Global and regional climate predictions.

Informs mitigation policy and adaptation choices. Impacts on water resources, heat stress, crops, infrastructure.

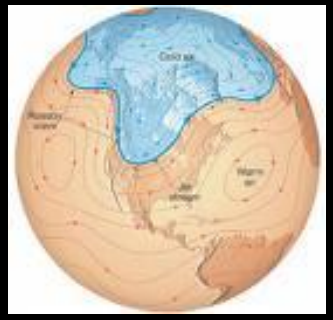
Precision, Predictability & Accuracy

smaller
quicker
less predictable
& more intense

Tornado
1km
10 Minutes

Thunderstorm
10 kms
1 Hour

Front
100 kms
12 Hours



Jet stream
10000 kms
3 days

…but if we have an accurate large scale forecast for 9 days ahead, we may be able to give an accurate probabilistic tornado forecast

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The WMO Global Basic Observing Network (GBON)

A WIGOS approach to securing observational data for critical global weather and climate applications

Robert Varley and Lars Peter Riishojgaard,
WMO Secretariat,
Anthony Rea, Bureau of Meteorology

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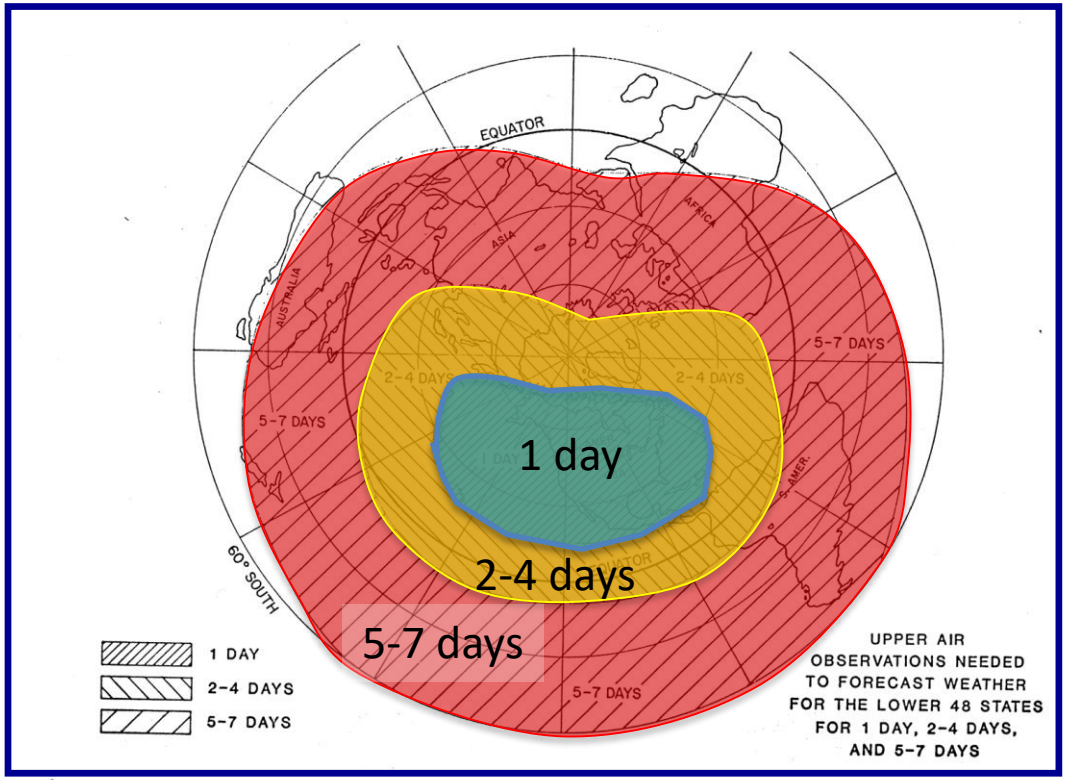
Overview

1. Why is it important to have weather and climate observations everywhere on the globe?
2. What do we need to measure from the surface?
3. Why and where are we currently missing observations?
4. What is WMO doing about this problem?
5. What is the expected impact of GBON on WMO Members?

1. Why is it important to have observations everywhere?

Global NWP:

- is a **foundational capability** for weather forecasting climate reanalysis
- needs observations **everywhere** for accurate predictions **anywhere**



Weather prediction beyond the 3-4 day range essentially requires observations from the whole world

WMO is the only organisation with the mechanisms to provide these observations

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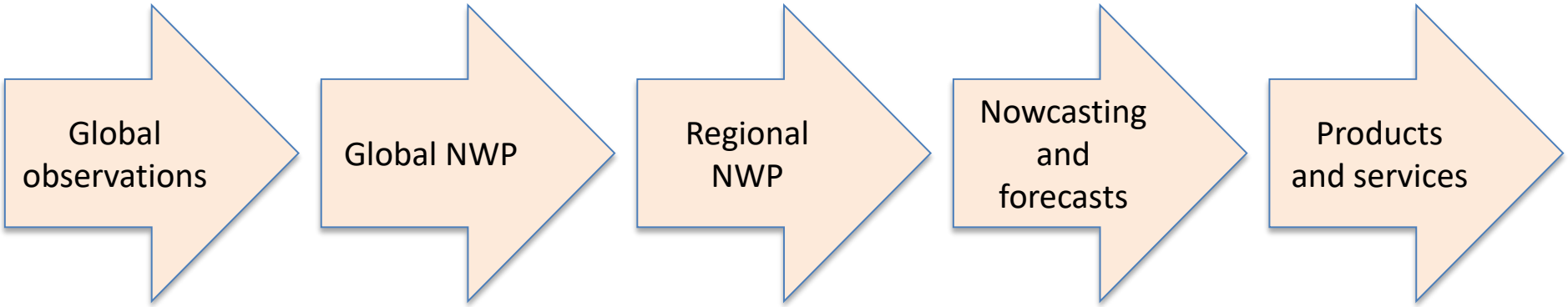
WMO Application Areas listed in the RRR

1. Global numerical weather prediction
2. High-resolution numerical weather prediction
3. Nowcasting and very short range forecasting
4. Seasonal and inter-annual forecasting
5. Aeronautical meteorology
6. Forecasting atmospheric composition
7. Monitoring atmospheric composition
8. Atmospheric composition for urban applications
9. Ocean applications
10. Agricultural meteorology
11. Hydrology
12. Climate monitoring *(currently under revision by GCOS and WCRP)*
13. Climate applications *(currently under revision by GCOS and WCRP)*
14. Space weather

Foundational capability for nearly all weather and climate applications

Importance of Global NWP



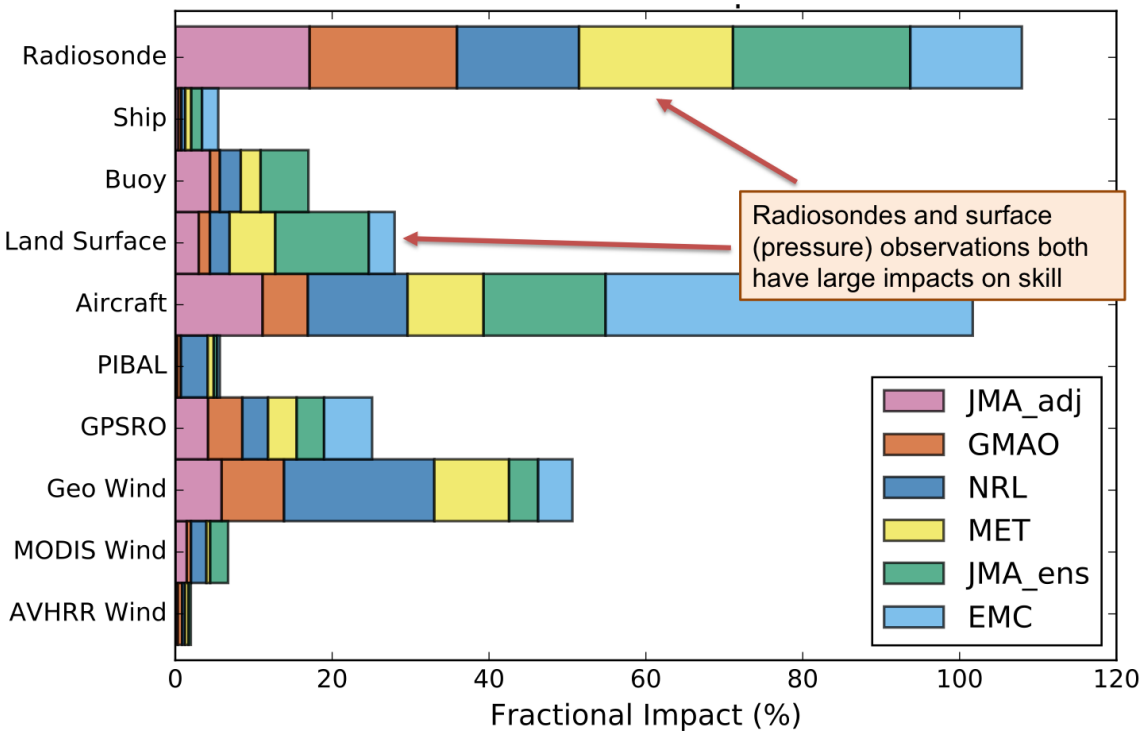
Without **local observations**, NWP guidance will be poor

- Leading in turn to poor services
- This is particular issue in the tropics

2. What do we need to measure from the surface?
(and why not just use satellite data?)

- Certain key variables are currently not measured from space
  - e.g. **surface pressure, wind profiles**
- Some variables are difficult to measure from space
  - over land, over snow and ice, beneath dense cloud

- Reference data for satellite calibration and validation
- Evidence from impact studies



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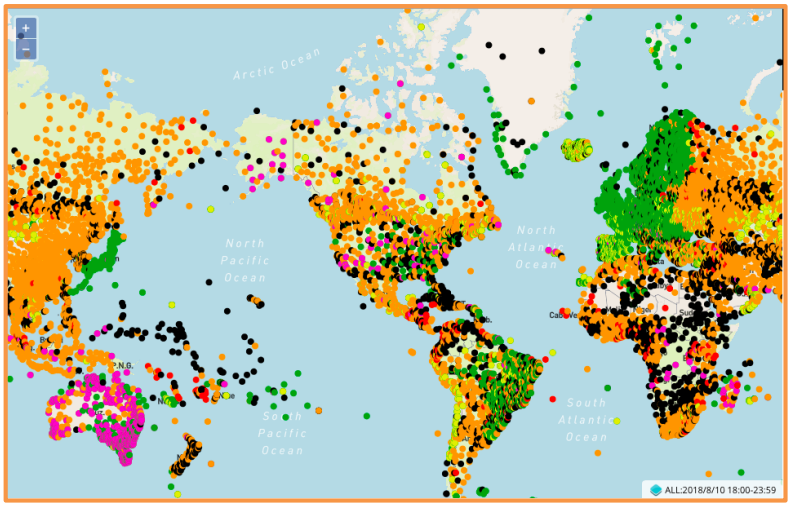
3. Why are we currently missing observations?

- Current data exchange based on WMO 540 (Manual on the GOS)
  - and WMO Resolution 40 (Cg-11)
- Resolution 40 was adopted in 1995
  - NWP requirements vastly different now
  - inconsistent implementation by Members
- More recent guidance issued
  - CBS recommendations, implementation plans, etc.
- Many Members only follow regulations
- Many more observations are being made, but not exchanged
- Current WIGOS monitoring shows unacceptable gaps in coverage



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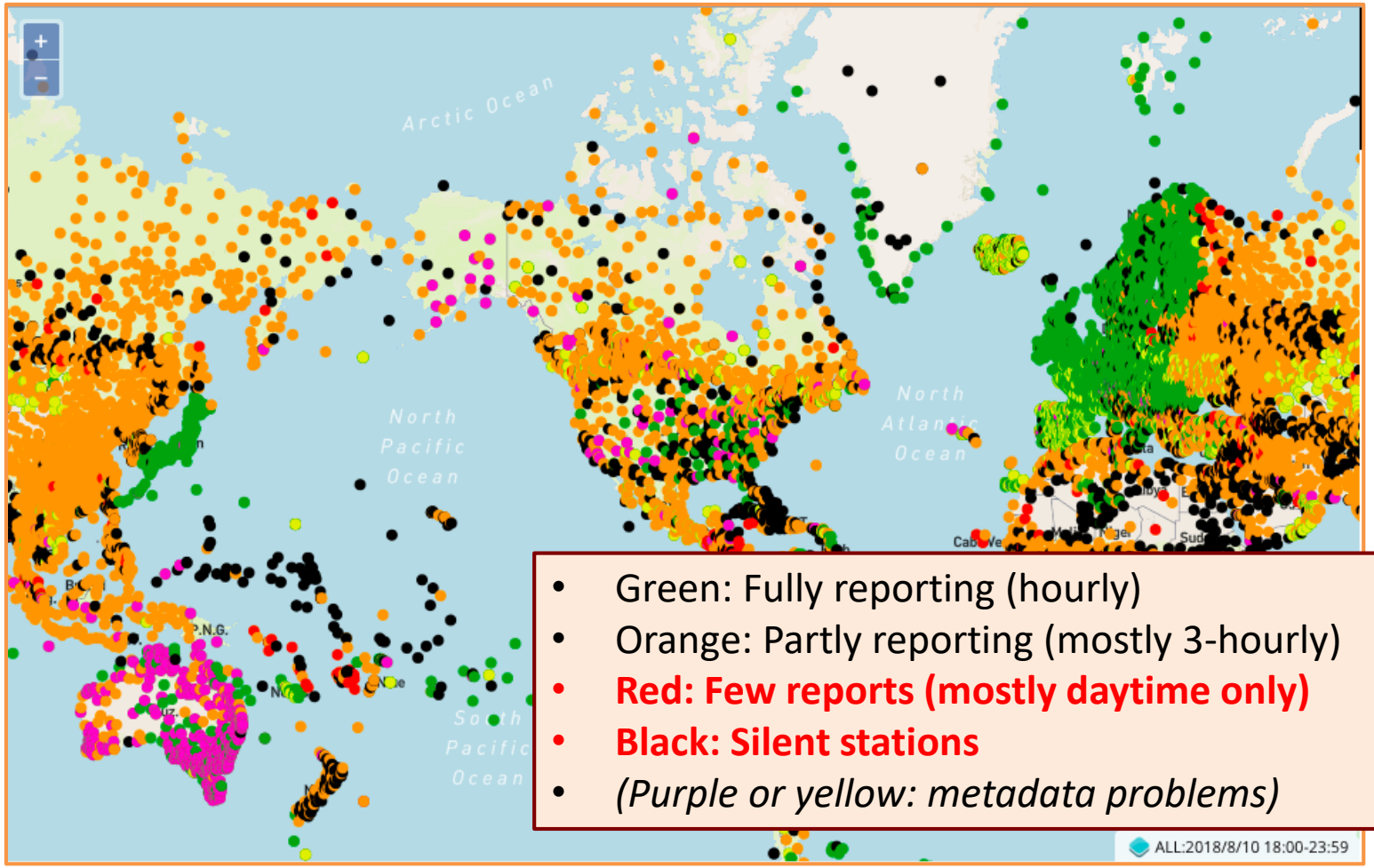
3. Where are we currently missing observations?



- Green: Fully reporting (hourly)
- Orange: Partly reporting (mostly 3-hourly)
- **Red: Few reports (mostly daytime only)**
- **Black: Silent stations**
- *(Purple or yellow: metadata problems)*

Land-based surface pressure obs available to global NWP Centres, 10 August 2018, 18Z

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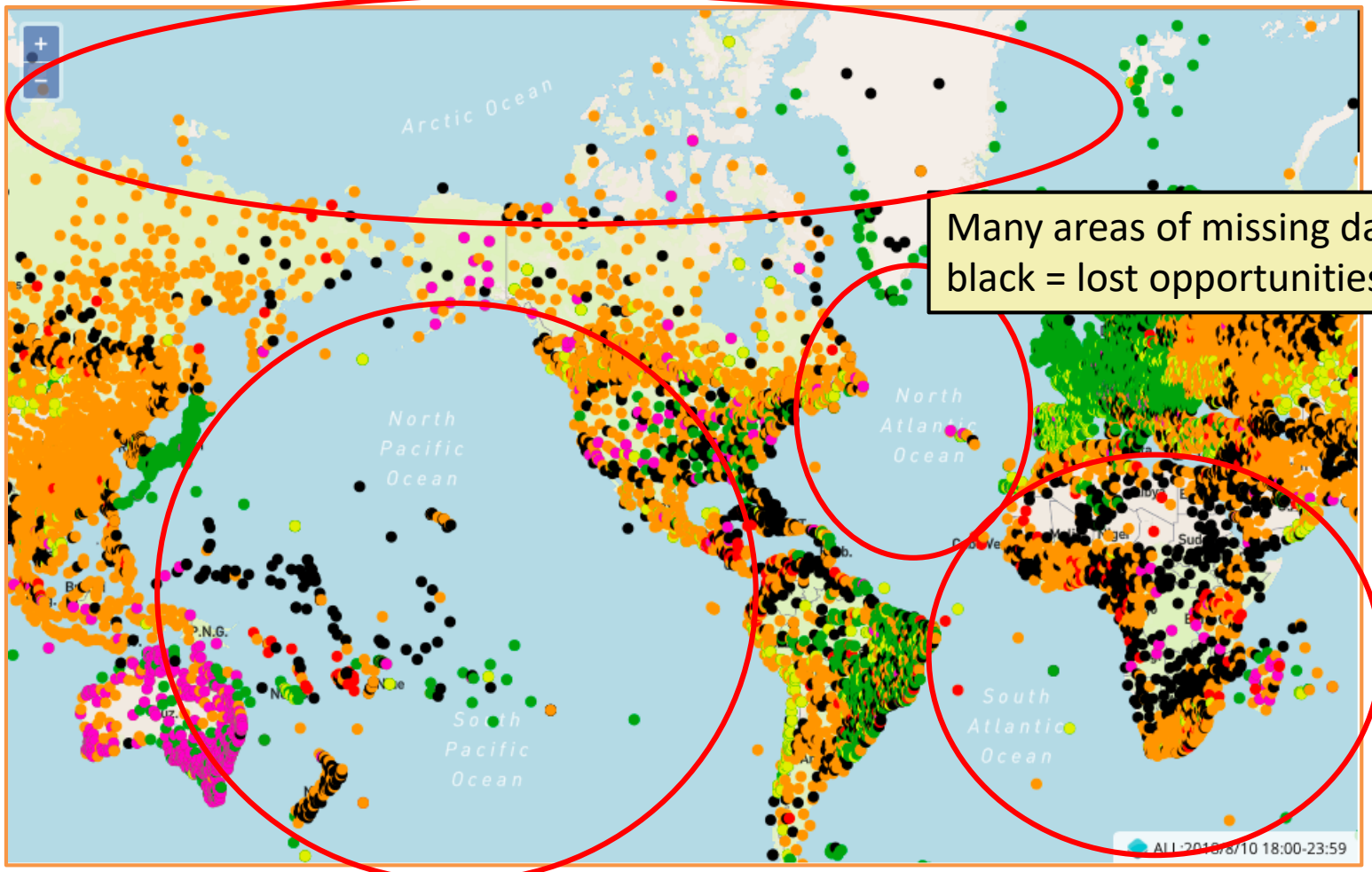
3. Where are we currently missing observations?



Land-based surface pressure obs available to global NWP Centres, 10 August 2018, 18Z

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3.2 Why is it urgent to strengthen the observational basis for Global NWP?

- Current data exchange practice is largely based on WMO Publication 540 (Manual on the Global Observing System) and on WMO Resolution 40 (Cg-11);
  - Resolution 40 was adopted in 1995; NWP has made immense progress since that time and current requirements are vastly different;
  - Congress resolutions define policy and do not contain sufficient technical detail to allow for consistent implementation by all Members;
  - Additional material is available in guidance documents such as CBS recommendations, implementation plans, etc.; many Members will, as a matter of principle, base their practice only on regulatory material;
  - Current WIGOS monitoring data show unacceptable gaps in data coverage over many areas (previous slide);
    - **In many cases additional observations are being made, but not currently exchanged, due to a lack of clarity from WMO regarding the obligation of the Members.**

4. What is WMO doing about this problem?

- To increase observations for global NWP, EC-70 requested:
  - CBS to *develop an overarching design for the **Global Basic Observing Network (GBON)** to meet threshold requirements for Global Numerical Weather Prediction and Global Climate Monitoring (Analysis) as established by the Rolling Review of Requirements Process…*
  - the Intercommission Coordination Group on WIGOS to *develop relevant provisions of the Manual on WIGOS regarding the implementation of the GBON and propose them to Cg-18 in 2019*

- *By WMO standards, this is an extremely rapid development schedule*
- *Testament to the EC view of the importance of this issue!*

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Draft GBON provisions: Surface Observations
(to be submitted to Cg-18 for approval)

- 3.2.2.4 Members **shall** operate a set of surface land observing stations/platforms that observe atmospheric pressure, air temperature, humidity, horizontal wind, precipitation and snow depth, located such that the GBON has **measurements spaced 500 km or less apart** for all of these variables, with an **hourly frequency**.

- 3.2.2.5 Members **should** make available additional surface land observations of atmospheric pressure, air temperature, humidity, horizontal wind, precipitation and snow depth that enable GBON to have **measurements spaced 100 km or less apart** for all of these variables, with an **hourly frequency**.

Draft GBON provisions: Upper air observations
(to be submitted to Cg-18 for approval)

- 3.2.2.7 Members **shall** operate a set of upper air stations over land that observe temperature, humidity and horizontal wind profiles, with a vertical resolution of 100 m or higher, **twice a day** or better, up to a level of 30 hPa or higher, located such that GBON has **measurements spaced 500 km or less apart** for these observations.

- 3.2.2.8 Members **should** operate a subset of the selected GBON upper air observing stations that observe temperature, humidity and horizontal wind profiles up to 10 hPa or higher, at least once per day, located such that, where geographical constraints allow, GBON has **measurements spaced 1000 km or less apart** for these observations.

Draft GBON provisions: Marine observations
(to be submitted to Cg-18 for approval)

- Members **should** operate a set of surface marine observing stations/platforms that observe atmospheric pressure and sea surface temperature located such that the GBON has **measurements spaced 500 km or less apart** for both of these variables.
- Members **should** operate a set of upper air measurements over sea that observe temperature, humidity and horizontal wind profiles, with a vertical resolution of 100 m or higher, **twice a day** or better, up to a level of 30 hPa or higher, located such that GBON has **measurements spaced 500 km or less apart** for these observations.
- Members **should** operate a set of flight level measurements over sea that observe temperature and horizontal wind, located such that GBON has **measurements spaced 100 km or less apart** for these observations.

5. What is the expected impact of GBON on WMO Members?

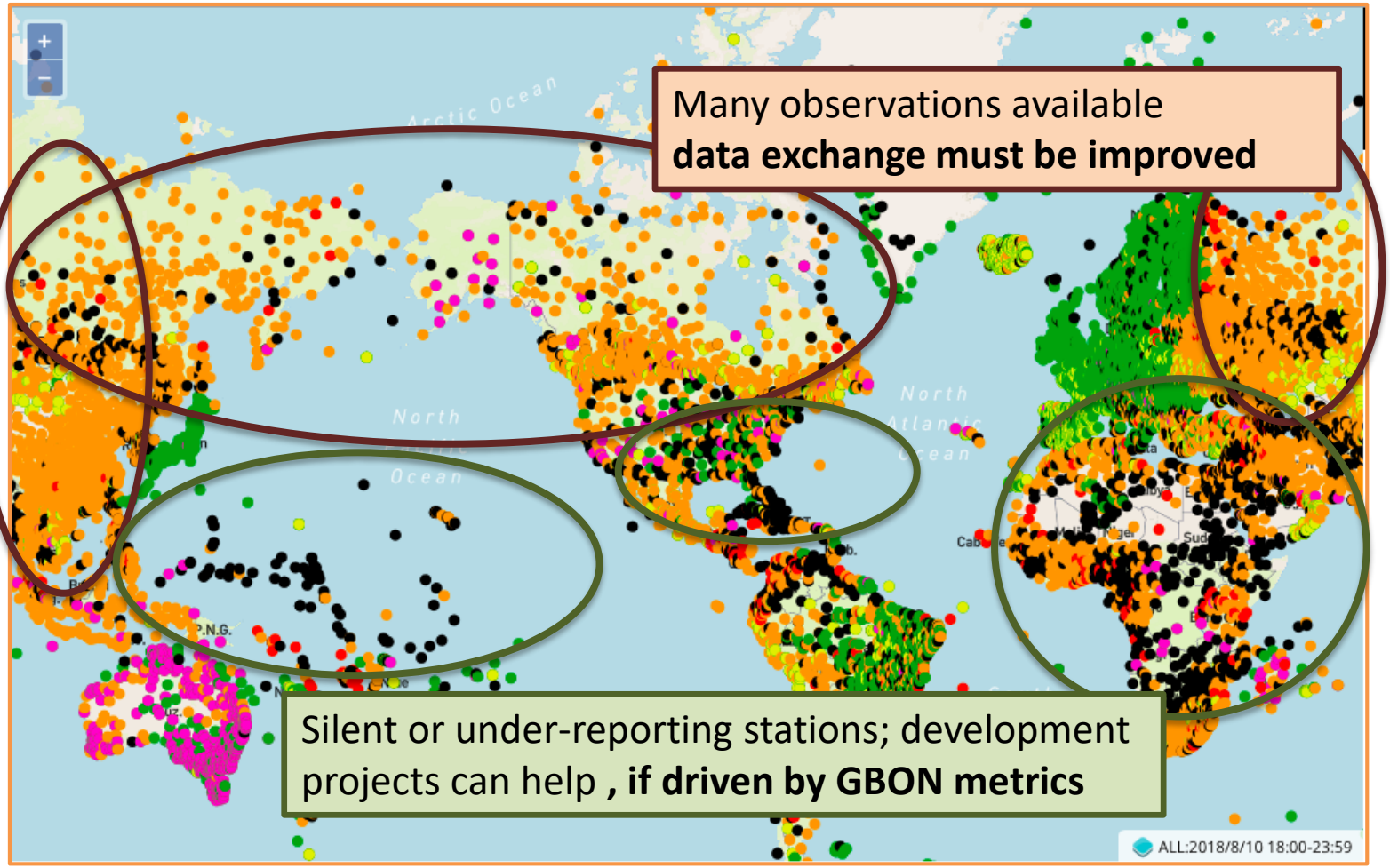
- **Access to better NWP and climate analysis products**

- Four broad categories of implementation impact:
  1. GBON-compliant observations already made and exchanged internationally
  2. GBON-compliant observations currently made, but not all exchanged
  3. GBON-compliant observations are not made, but could conceivably be made with additional resources
  4. Achieving GBON compliance is unrealistic with currently available technology

5. What is the expected impact of GBON on WMO Members?

- Four categories of implementation (examples):
  1. Members already complying with the GBON provisions (e.g. Japan, Western Europe) – *no further action is needed*
  2. GBON observations made, but not currently exchanged (e.g. USA, China); *new data exchange practices adopted*
  3. Insufficient national resources available (e.g. Africa, South Pacific); *use GBON to help steer internationally funded development projects*
  4. GBON requirements not met due to geographic constraints (e.g. Indian Ocean, North Pacific) *clear role for new or emerging technologies, space-based remote sensing*

5. What is the expected impact of GBON on WMO Members?



Land-based surface pressure obs available to global NWP Centres, 10 August 2018, 18Z

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5. What is the expected impact of GBON on WMO Members?

- Better global coverage
- Massive global multiplier on investment in observations
- Like a jigsaw puzzle, the full potential realized only if all the pieces are available

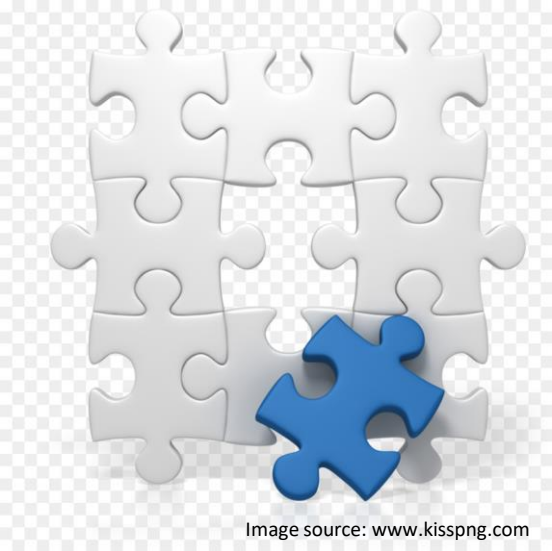
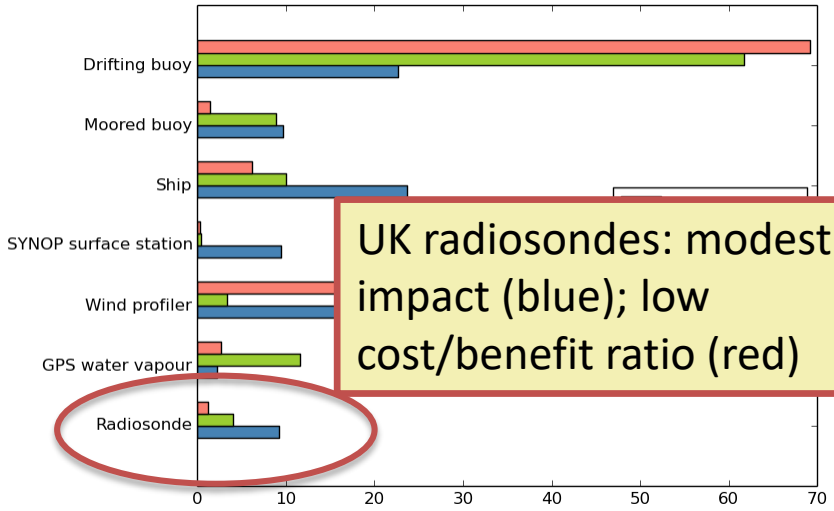
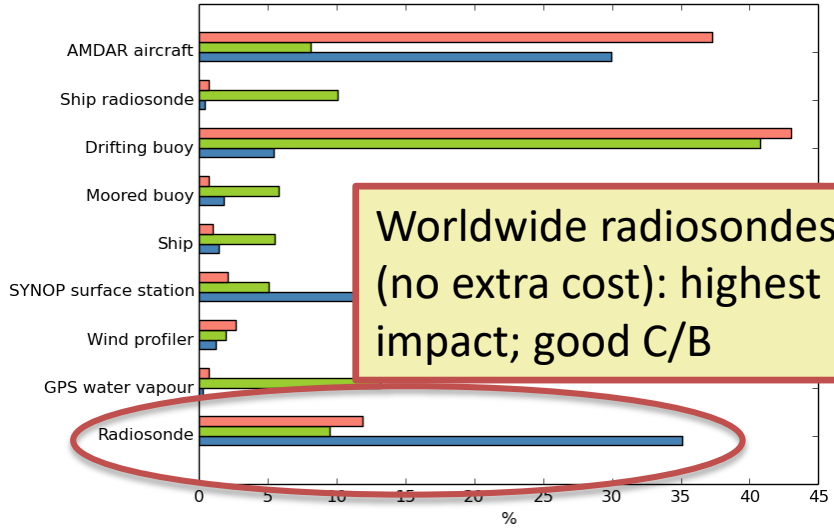


Image source: www.kisspng.com



UK radiosondes: modest impact (blue); low cost/benefit ratio (red)



Worldwide radiosondes (no extra cost): highest impact; good C/B

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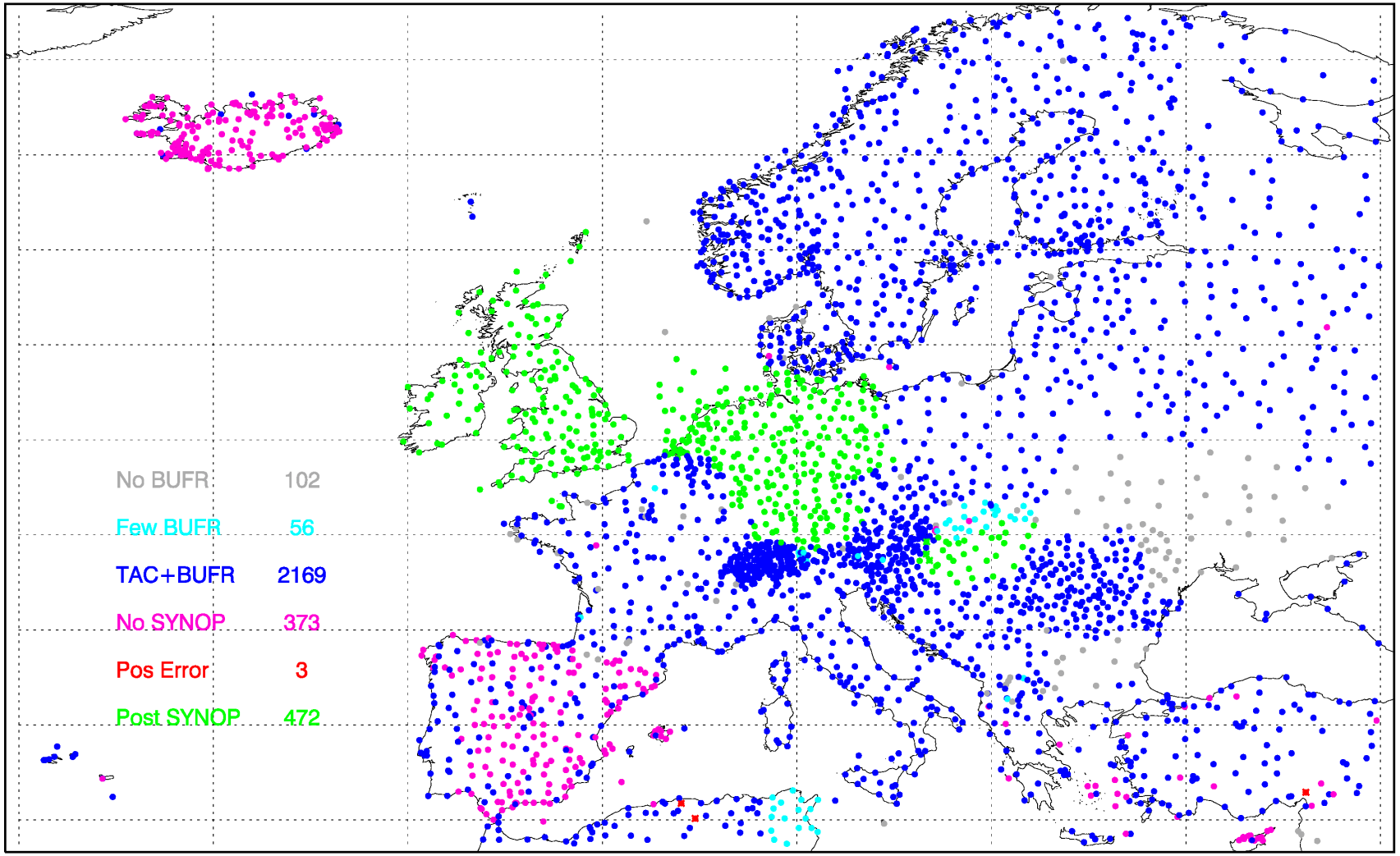
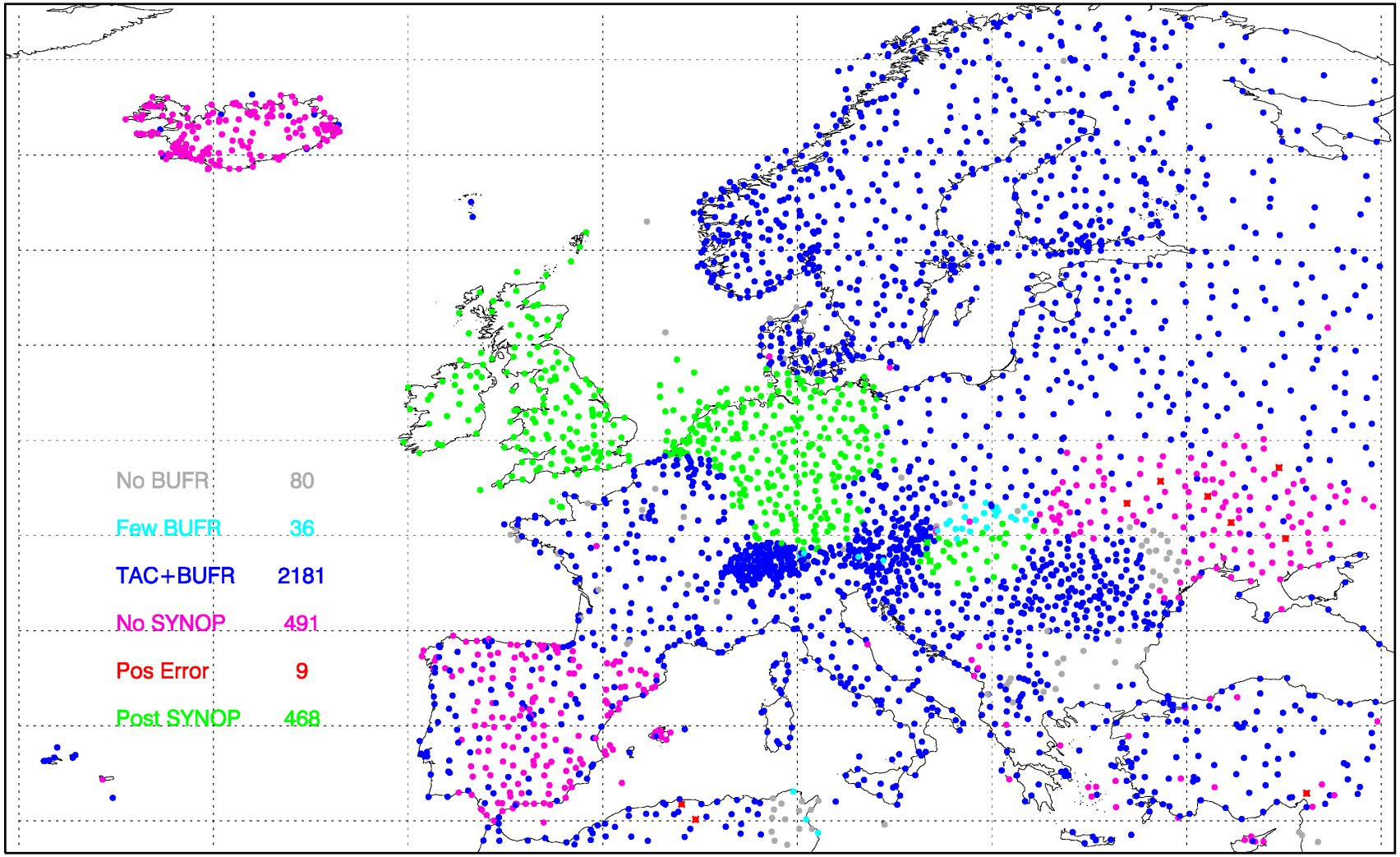
Summary and Conclusions

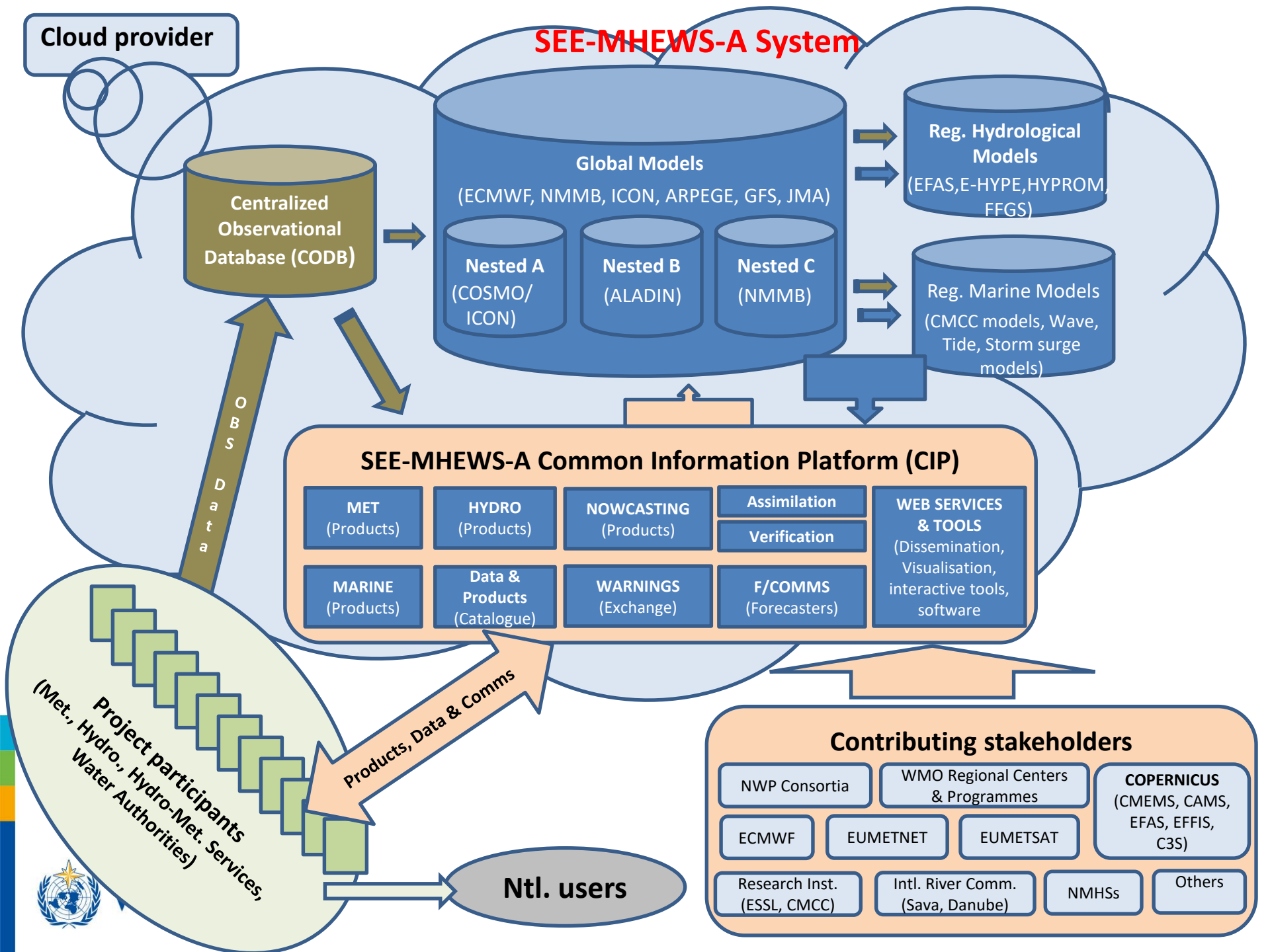
- Ensuring a continuous real-time supply of observational data from all areas of the globe to critical global NWP and climate analysis systems is **vital to product generation and service delivery capabilities of all WMO Members**
- The current availability of observational data **falls well short of agreed requirements**, this limits the ability of all WMO Members to predict and understand the atmosphere at all time-scales
- The GBON provisions in the Manual on WIGOS will **clarify the obligations of the WMO Members** in this regard, and can help guide both national WIGOS implementations and internationally funded development projects

Example of data exchange from Ukraine



Example of data exchange from Ukraine




Cloud provider
SEE-MHEWS-A System
Centralized Observational Database (CODB)
Global Models
(ECMWF, NMMB, ICON, ARPEGE, GFS, JMA)
Nested A (COSMO/ ICON)
Nested B (ALADIN)
Nested C (NMMB)
Reg. Hydrological Models
(EFAS,E-HYPE,HYPROM, FFGS)
Reg. Marine Models
(CMCC models, Wave, Tide, Storm surge models)
OBS Data
SEE-MHEWS-A Common Information Platform (CIP)
MET (Products)
HYDRO (Products)
NOWCASTING (Products)
Assimilation
Verification
WEB SERVICES & TOOLS (Dissemination, Visualisation, interactive tools, software
MARINE (Products)
Data & Products (Catalogue)
WARNINGS (Exchange)
F/COMMS (Forecasters)
Project participants
(Met., Hydro., Hydro-Met. Services, Water Authorities)
Products, Data & Comms
Ntl. users
Contributing stakeholders
NWP Consortia
WMO Regional Centers & Programmes
COPERNICUS (CMEMS, CAMS, EFAS, EFFIS, C3S)
ECMWF
EUMETNET
EUMETSAT
Research Inst. (ESSL, CMCC)
Intl. River Comm. (Sava, Danube)
NMHSs
Others

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Thank you

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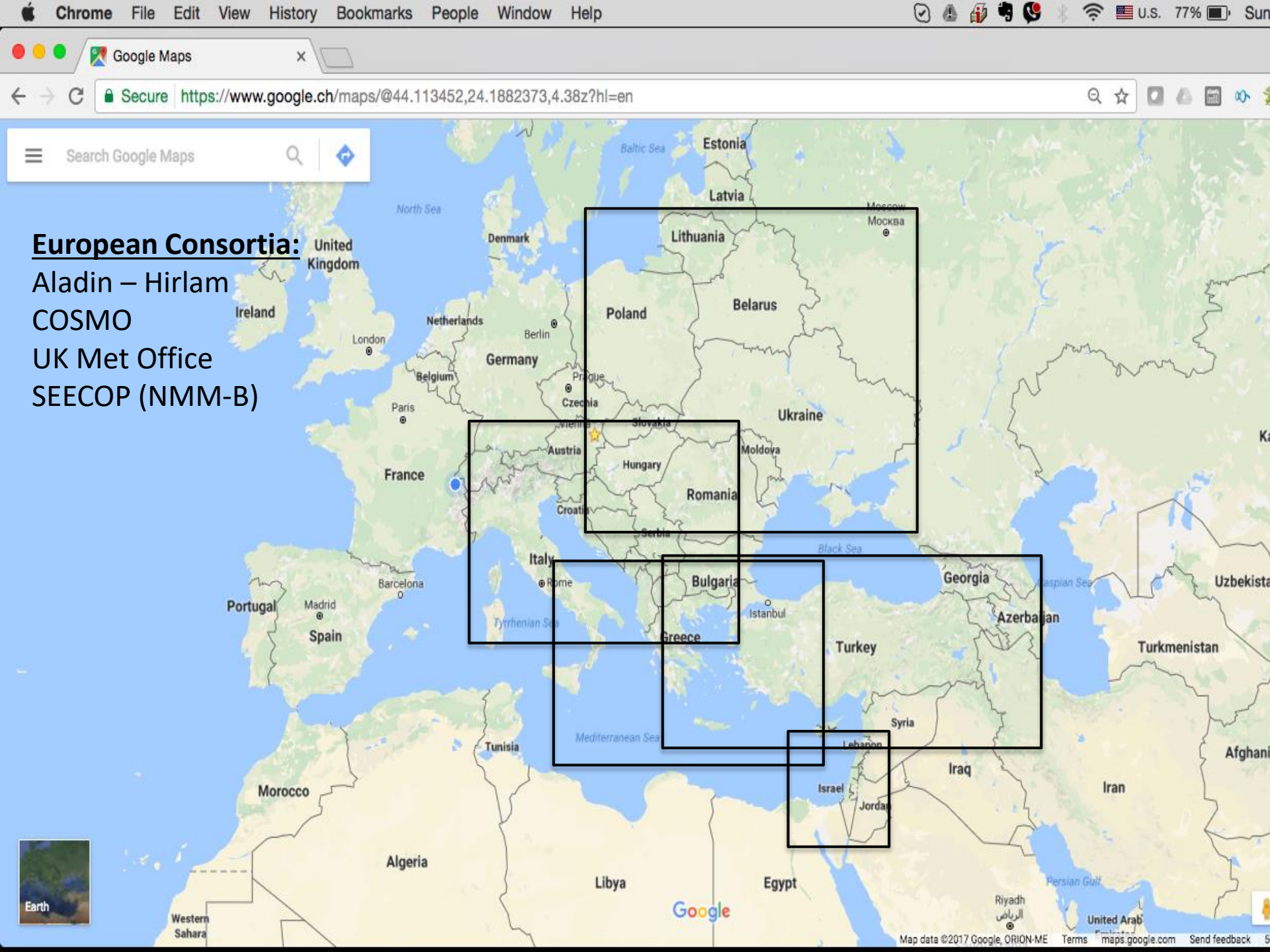
https://public.wmo.int/en/projects/see-mhews-a

SOUTH-EAST EUROPEAN MULTI-HAZARD EARLY WARNING ADVISORY SYSTEM (SEE-MHEWS-A)

SEE-MHEWS-A aims to:

- Support the NMHSs in fulfilling their core function for providing timely and accurate warnings of hazardous weather events in order to reduce loss of lives and other impacts on people, infrastructure and industry.
- Provide operational forecasters with effective tools for forecasting hazardous weather and hydrological events and their possible impacts to improve the accuracy of early warnings and ensure early actions to support hazard-related decision-making by national authorities and others.
- Function as a cooperative platform where forecasters from different countries will work together on the identification of potential hazards and their impacts, especially when impending weather hazards may have potential impacts in several countries, including their cross-border areas.


Chrome File Edit View History Bookmarks People Window Help
Google Maps
Secure https://www.google.ch/maps/@44.113452,24.1882373,4.38z?hl=en
Search Google Maps
European Consortia:
Aladin – Hirlam
COSMO
UK Met Office
SEECOP (NMM-B)
Baltic Sea
Estonia
Latvia
Lithuania
Moscow
Москва
North Sea
Denmark
United Kingdom
Ireland
London
Netherlands
Berlin
Germany
Belgium
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Czechia
Paris
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Hungary
Moldova
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Croatia
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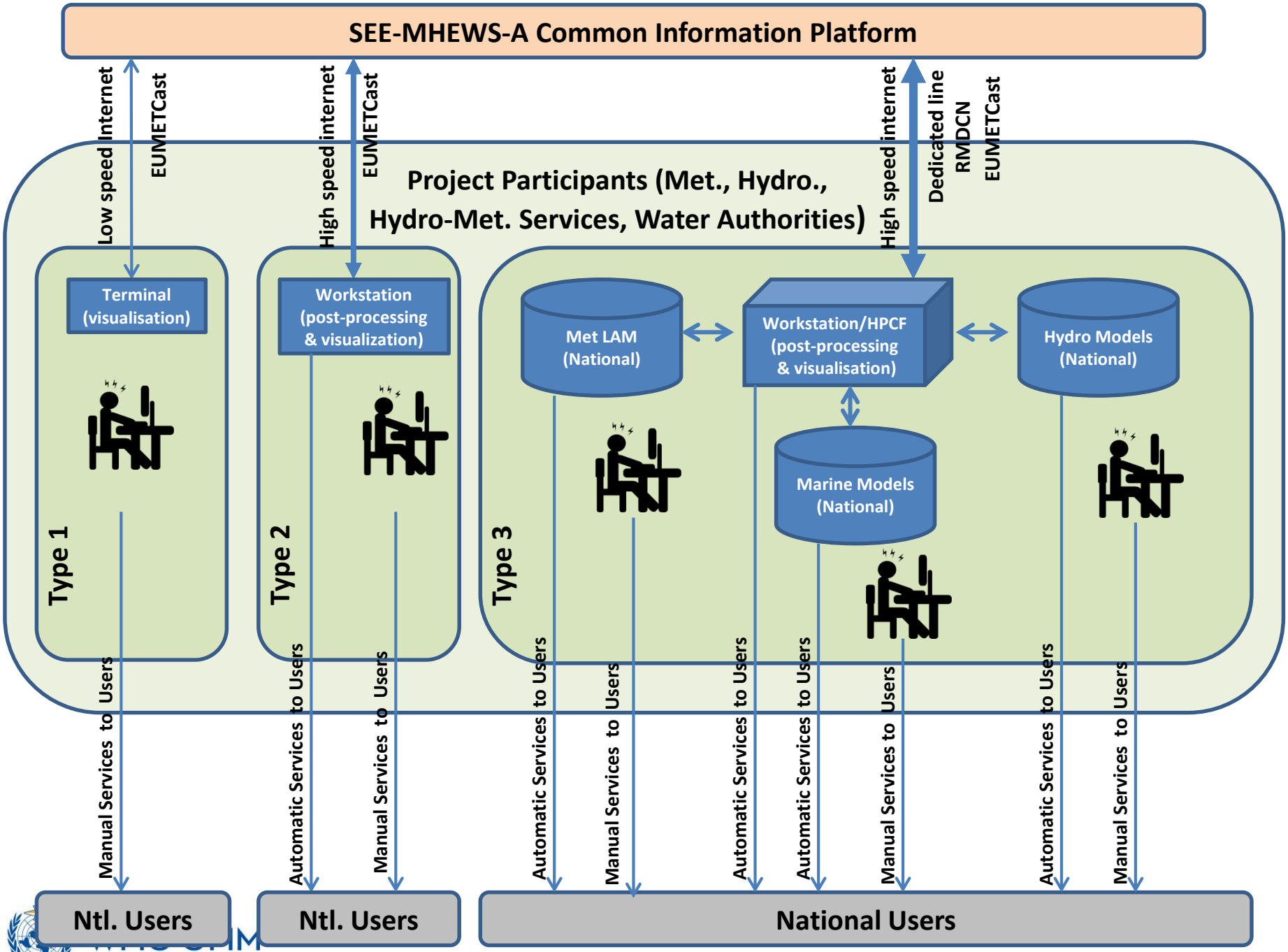
SEE-MHEWS-A Common Information Platform
Low speed internet
EUMETCast
High speed internet
EUMETCast
High speed internet
Dedicated line
RMDCN
EUMETCast
Project Participants (Met., Hydro.,
Hydro-Met. Services, Water Authorities)
Terminal
(visualisation)
Workstation
(post-processing
& visualization)
Met LAM
(National)
Workstation/HPCF
(post-processing
& visualisation)
Hydro Models
(National)
Marine Models
(National)
Type 1
Type 2
Type 3
Manual Services to Users
Automatic Services to Users
Manual Services to Users
Automatic Services to Users
Automatic Services to Users
Automatic Services to Users
Manual Services to Users
Automatic Services to Users
Manual Services to Users
Ntl. Users
Ntl. Users
National Users

Next steps in SEE-MHEWS-A Project

- Setting up technical teams from the participating countries to support the project implementation (TT-NWP, TT-OBS, TT-FNC, TT-ICT, TT-HYDRO), nominations from Turkey missing;
- Engaging experts/institutions for implementation of the activities (e.g. ECMWF, regional experts);
- Setting up a pilot version of the Centralized Observational Database;
- Assess the possibilities of running limited area numerical weather prediction models for SEE-MHEWS-A and set up model runs;
- Select pilot river catchments and implement hydrological models for these catchments;
- Continuos fundraising for further stages of the SEE-MHEWS-A Project.