WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

The WMO Global Basic Observing Network (GBON)

(CGMS-47-WMO-WP-06)

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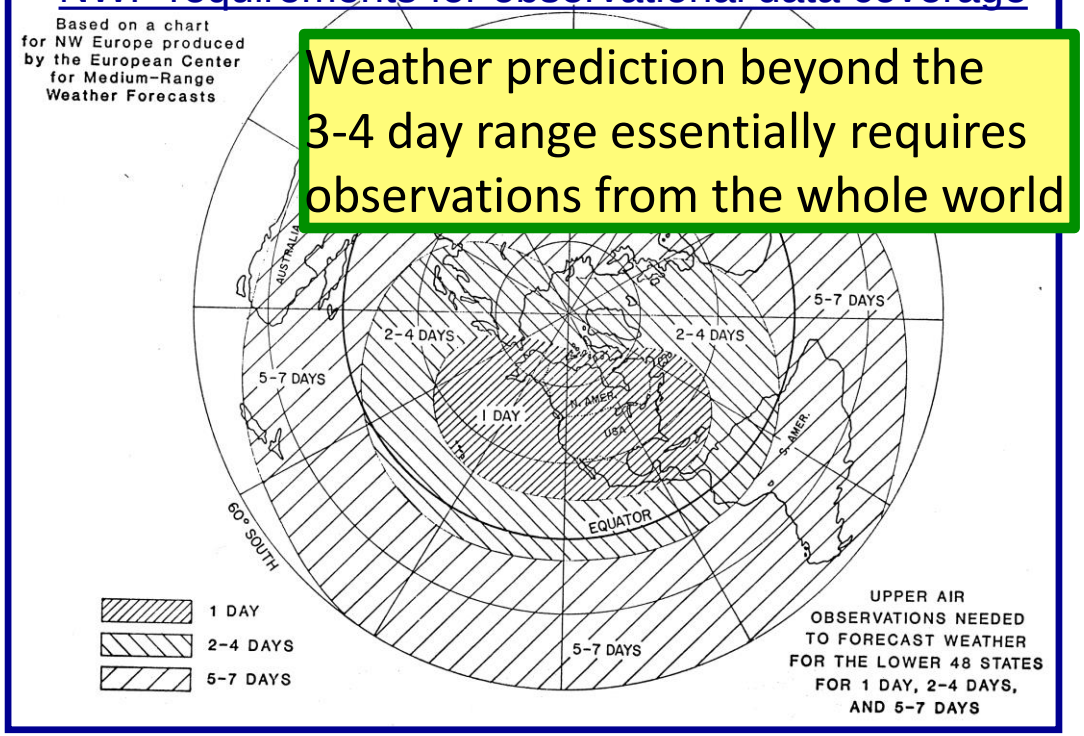
Overview

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. 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?
6. Relevance to CGMS

1. Why is it important to have observations everywhere?

- Generally, any lack of observations over one area of the globe will limit our ability to understand and predict weather and climate patterns everywhere else.
  - ***"In meteorology, ignorance knows no boundaries"***
- Global Numerical Weather Prediction is a foundational capability for all weather prediction and most climate monitoring activities;
- Global Numerical Weather Prediction depends on availability of global coverage of observations;

NWP requirements for observational data coverage



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WMO Application Areas listed in the RRR (May 2019)

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
13. Climate applications
14. Space weather

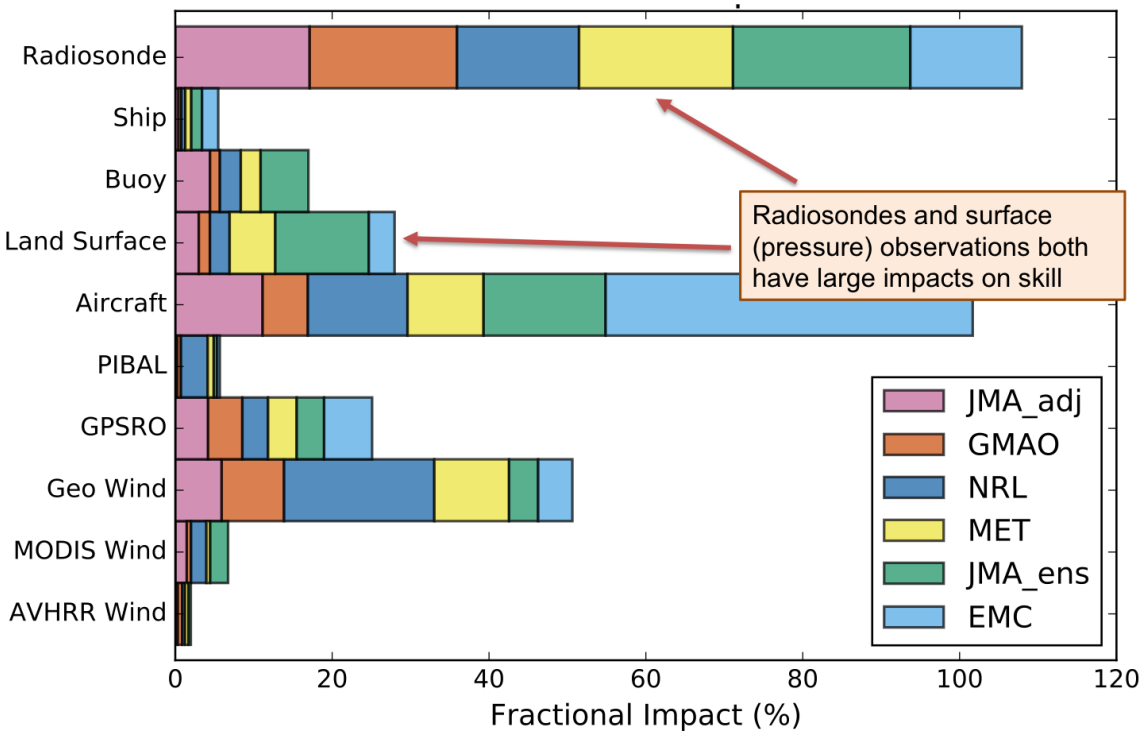
Importance to WMO and its Members of Application area 1: Global NWP

- Numerical Weather Prediction is a foundational capability for nearly all weather and climate applications;
  - Of the 14 application areas currently included in the WMO Rolling Review of Requirements, 13 are thus either fully or partly dependent of the availability of robust Global NWP input;
- Global Numerical Weather Prediction depends on global coverage of observations; WMO is the only organization providing the mechanisms required to acquire and exchange these observations.

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

- Certain key variables for NWP are currently not measured from space, e.g. **surface pressure, vertical distribution of winds**;
- Some satellite data are difficult to use over land, over snow and ice surface, and in areas with dense cloud cover;

- Reference data for calibration and validation of satellite data are needed;
- The continued importance of surface data is borne out also by impact studies (see panel on the right)



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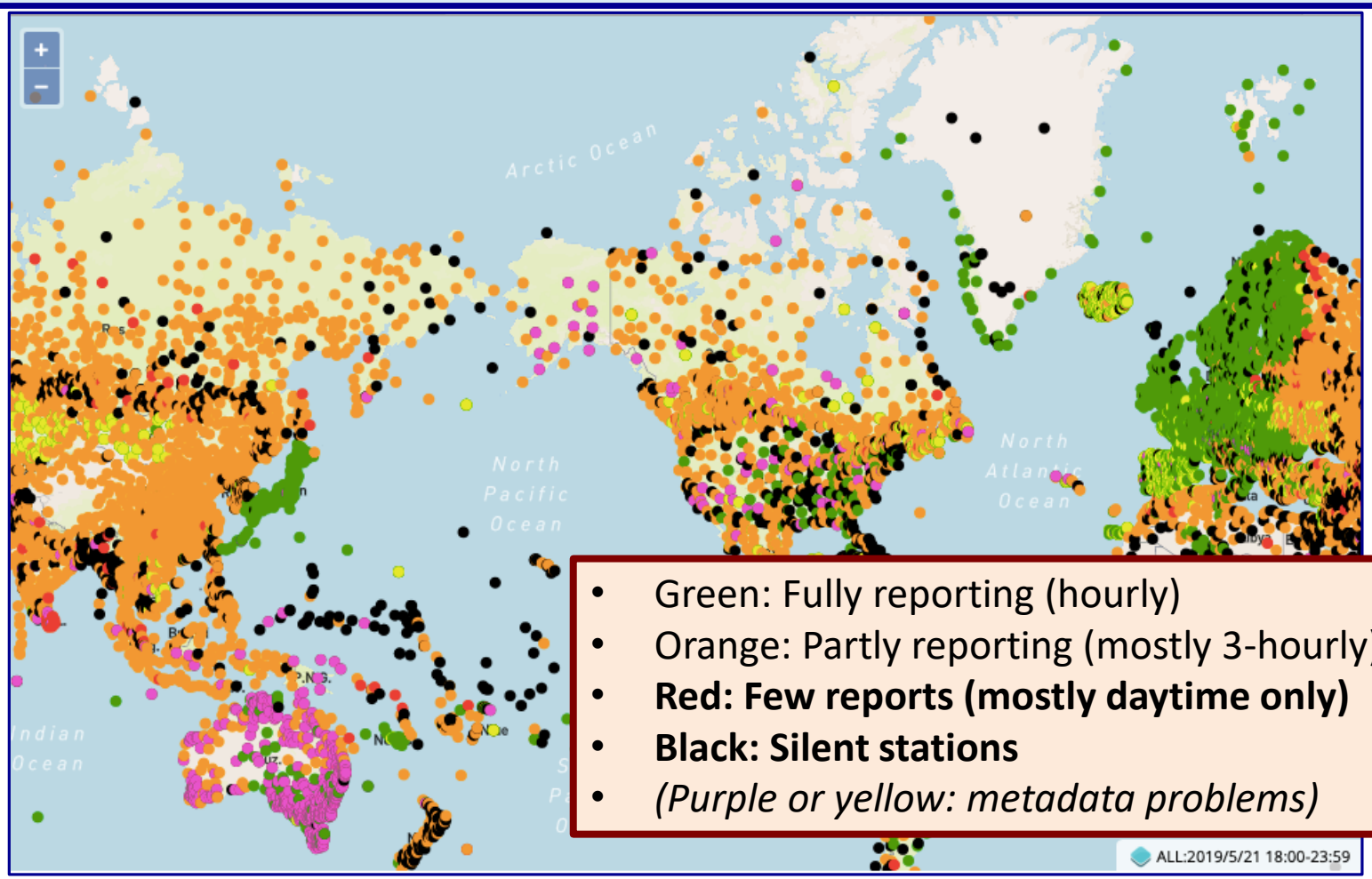
3.1 Why is it urgent to strenghthen the observational basis for Global NWP?



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

Current international exchange of data for global NWP less than optimal(example: Surface pressure observations received by global NWP Centers on May 21 2019, 18Z)

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3.2 Why is it urgent to strenghthen 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.

4.1 Action taken by WMO to increase observational data exchange for Global NWP

- In order to increase the observational input to global NWP, the WMO Executive Council recently (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 (ICG-WIGOS) to *develop relevant material for the Manual on WIGOS (WMO-No. 1160) regarding the implementation of the GBON and propose to Cg-18 in 2019*;

4.2 Example draft GBON provisions; *will be discussed by EC-72 in 2020*

- 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 a **horizontal resolution of 500 kilometres or higher** for all of these variables, with an **hourly frequency**.
- *Notes:*

1. *Many manual stations achieve a frequency less than hourly; these nevertheless provide a valuable contribution to the GBON.*
2. {…}

- 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 a **horizontal resolution of 100 kilometres or highe**r for all of these variables, with an **hourly frequency**.

4.3 *Draft GBON provisions; upper air*

- 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 a **horizontal resolution of 500 kilometres or higher** for these observations.
- *Notes:*
- *1. Radiosonde systems currently provide the means for collecting such observations.*
- *2. Upper air observations obtained over remote/isolated islands have particularly high impact on Global NWP skill, and continued operation of these stations are of high priority for GBON.*

- 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 a horizontal resolution of 1000 kilometres or higher, for these observations.

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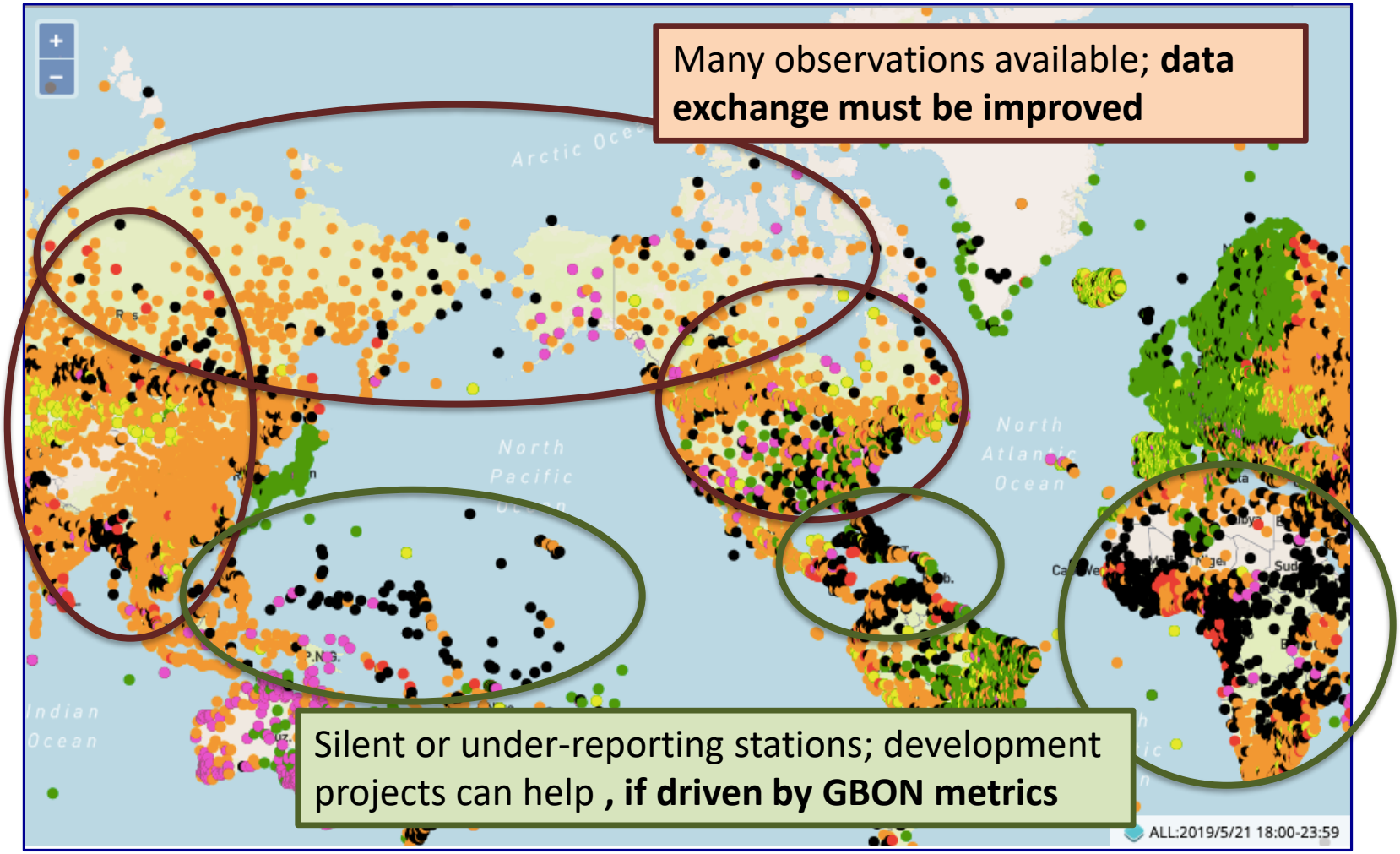
5.1 Expected impact of GBON

- **Access to better NWP model guidance and climate analysis products for all WMO Members**
- **Implementation requirements depend** on where; four broad categories (levels of difficulty of implementation) can be identified:
  1. Members already complying with the GBON provisions (e.g. Japan, Western Europe); no further action is needed;
  2. Observations complying with the GBON requirements are made, but not currently exchanged (e.g. USA, China); **new data exchange practices need to be adopted;**
  3. Insufficient local (national) resources available to meet GBON requirements (e.g. Africa, South Pacific); **use GBON provisions to help steer internationally funded development projects**;
  4. GBON requirements currently not met due to geographic constraints (e.g. Indian Ocean, North Pacific); clear role for new or emerging technologies, space-based remote sensing.

5.2 Expected impact of GBON (III)



Current availability of critical data for global NWP (example: Surface pressure observations received by global NWP Centers on May 21 2019, 18Z)

6. Relevance to CGMS

- GBON represents a reaffirmation of core WMO commitments to free and unrestricted international exchange of observational data in support of critical applications such as global NWP;
- GBON will help drive future WMO efforts toward reviewing and updating its data policies, including Resolution 40, 25 and 60 *(see CGMS-47-WMO-WP-05);*
- GBON is aspirational, but provisions cannot be met everywhere (North Pacific, Indian Ocean); space-based technologies may be able to meet requirements here.

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 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 and help guide both national implementations and internationally funded development projects.
- GBON lays out binding regulations for exchange of surface-based data; however, not all GBON requirements can be met this way.