Systematic Observations Financing Facility
Second Potential Funders’ Forum

Agenda item 1 – The meteorological value chain and the role of observations

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Three main points (beyond what was covered in the First Funders Forum):

• Role of global modeling and observations for climate monitoring, climate prediction, adaptation, ...

• Role of global modeling and observations underpinning local, fine-scale weather and climate information;

• Verification and the risks of flying blind; how can you know how well (or how poorly) you are doing in areas with no data?
Successful application of weather and climate services depend on a functioning meteorological value chain.

Weather and climate-related infrastructure - must be designed and managed globally.

Last-mile activities undertaken primarily at regional, national and local level.

- Effective decision-making and action
- Delivery of weather and climate services
- Local data processing, forecast, warning and advisory products
"Weather and climate know no boundaries"

- **the atmosphere has no horizontal boundaries**

- In order for us to predict it, weather must be modeled globally; all modern weather prediction beyond 24 hours depends on global Numerical Weather Prediction (NWP);

- NWP requires observations from the entire globe;

- Lack of observations is a key limiting factor to monitoring and predicting weather and climate, both locally and globally;

- Any local lack of observations will initially lead to poor local prediction quality; over time this will spread globally.

Example: Lack of observations in red area limits 7-10 day forecast skill in green area; weather/climate knowledge in red area poor!
Global numerical weather prediction (NWP); core capability for both weather and climate

- **Global NWP** systems are used also for **reanalysis**: Reprocessing of multi-year sequences of past weather events using historical observations;

- **Reanalysis output** has become the primary source of information about climate, climate change; used as a basis for climate prediction, projection and adaptation;

- The dual use of NWP for weather prediction and climate analysis means that **the exact same observations are needed** to improve both **climate monitoring** and **weather prediction**;

*Figure 2: Temperature anomalies relative to the 1981-2010 long-term average from the ERA5 reanalysis for January to October 2020. Credit: Copernicus Climate Change Service, ECMWF.*
Global NWP: A critical backbone for weather and climate also at local scales

- Weather and climate services typically require detailed, fine-scale information about local impacts;
- This can be obtained via downscaling, using a detailed Limited Area Model as a "magnifying glass" within the global model.
- Without adequate supply of local observations to the global model, downscaling will not work!
Current state of international exchange of observations;

Satellite data are very important for weather and climate and provide excellent global coverage. However,
• Not all required variables can be measured from space;
• Need to be complemented by surface-based observations, especially over land areas, snow and ice surfaces;

In many areas the exchange of surface-based observations has been stagnant or declining since 1995;
Areas with red/black dots far from meeting data requirements.

Weather forecasts over areas with few observations (black dots and/or few dots) cannot be reliably verified!
Indirect verification via satellite data or reanalysis data indicate consistently poor quality of forecasts of convective weather;
Climate reanalysis fields used for monitoring, adaptation and prediction will also be of poor quality.

Surface pressure observations received by global NWP Centers on Apr 27 2021, 12Z
(source: WIGOS Data Quality Monitoring System)
WMO’s Global Basic Observing Network (GBON) - securing adequate observational input to global NWP

GBON: Global commitment agreed between 193 countries to turn data coverage map green;

- Regulatory material specifying obligation to acquire and exchange certain observations at set minimum horizontal resolution and at set minimum frequency;
- Once approved by WMO Congress, GBON can be implemented immediately in the developed world;

Estimated benefits of full implementation of GBON in countries with largest data coverage gaps: USD 5 billion per year, due to improved weather prediction (potential climate-related benefits not yet assessed)
Density of observing network versus national resources

WMO Convention and Paris Agreement implicitly assume that observations is solely a national responsibility.

| Ability to observe (left panel): Observing systems in countries depicted in red fail to meet minimum observations requirements for weather and climate analysis and prediction |
| Ability to pay (right panel): Affordability of observing responsibility (GDP/km2 of surface area) of countries in yellow up to ten million times higher than for countries in dark blue |

Figure 2. This map shows the horizontal resolution of surface observations in different countries based on stations actively reporting in January 2020. Source: WMO Secretariat.
Limited track record of past hydromet development projects

**Basic problem:** Generally, the observations that are most important for weather forecasting in any given country come from outside its borders; traditional single-country, last-mile focused projects therefore do not see a reasonable value proposition in investments in local observing systems.

**Finance delivery problem:** Project-based approach to support observation systems are generally recognized, also by donors and implementing entities as having at best short-term impact. However...

Past experience in Africa shows that short-term internationally funded projects can temporarily boost performance of observing network; however, they do not lead to sustained data exchange: **50% decrease in upper air observations over Africa between 2015 and 2020**