Systematic Observations Financing Facility

Second Potential Funders' Forum

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

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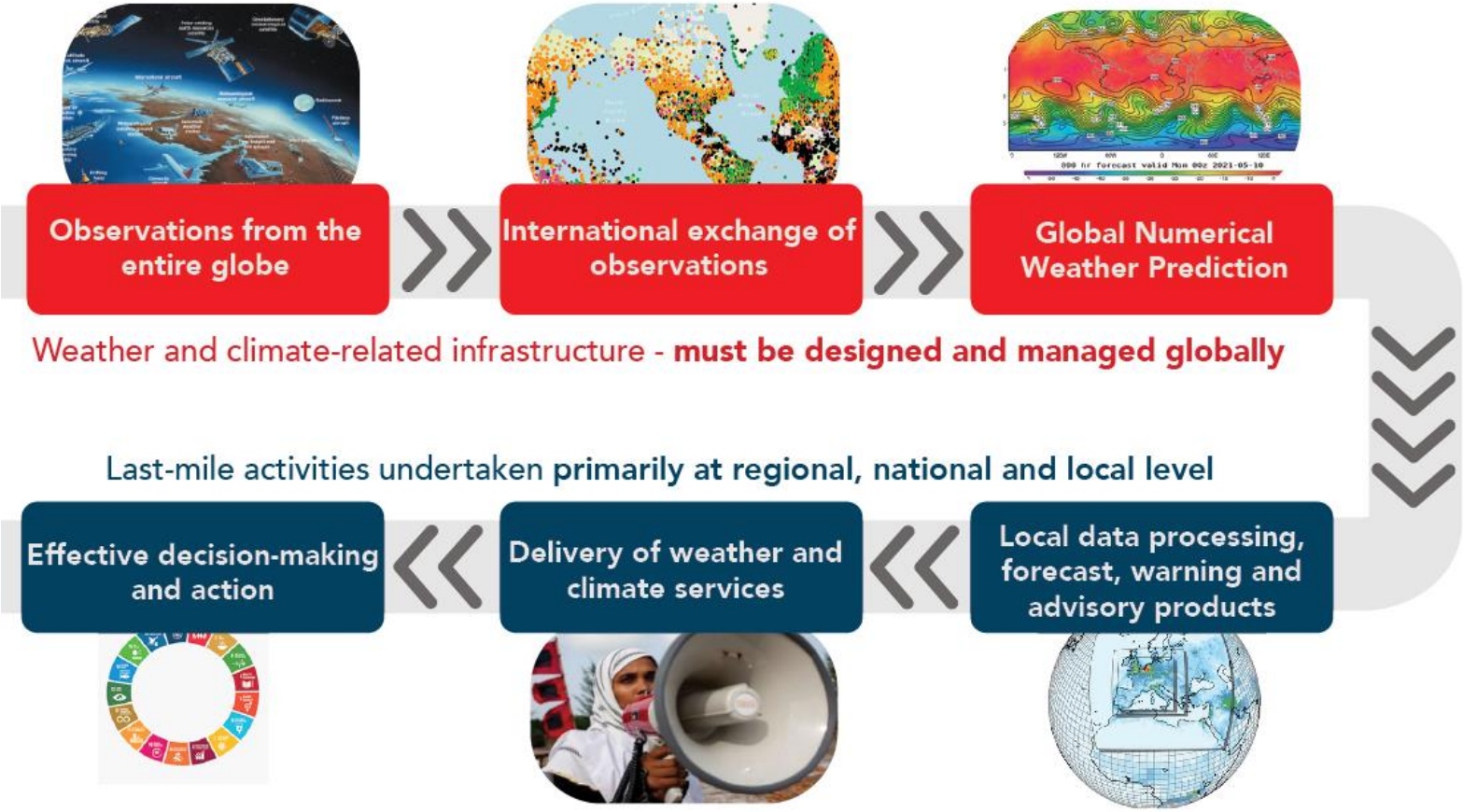
Three main points (beyond what was covered in the First Funders Forum):

- **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?**

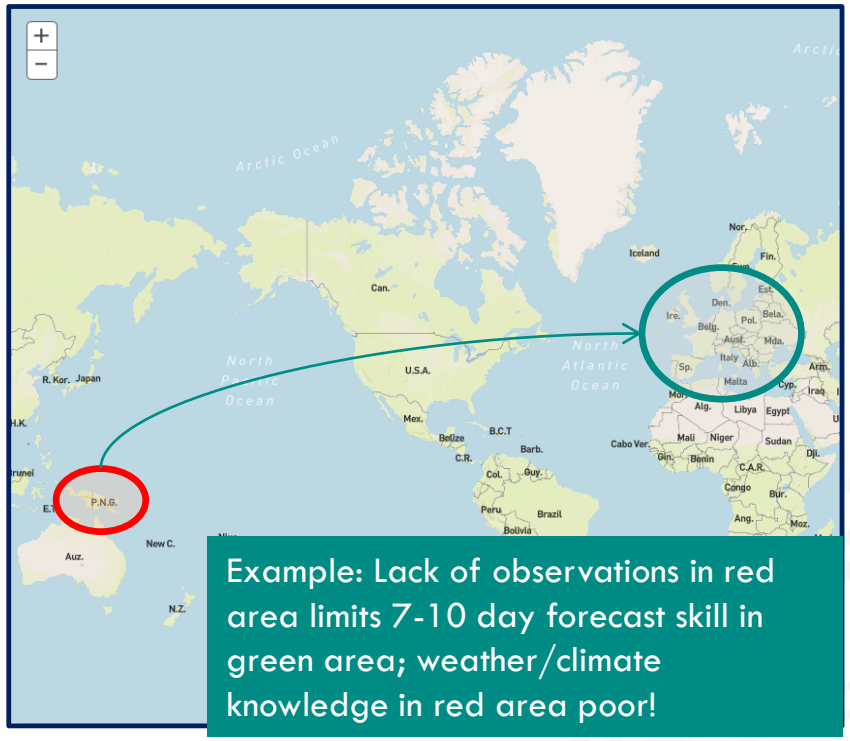
Successful application of weather and climate services depend on a functioning meteorological value chain



“Weather and climate know no boundaries”

- *the atmosphere has no horizontal boundaries*

- **<u>In order for us to predict it, weather must be modeled globally</u>,;** 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;**

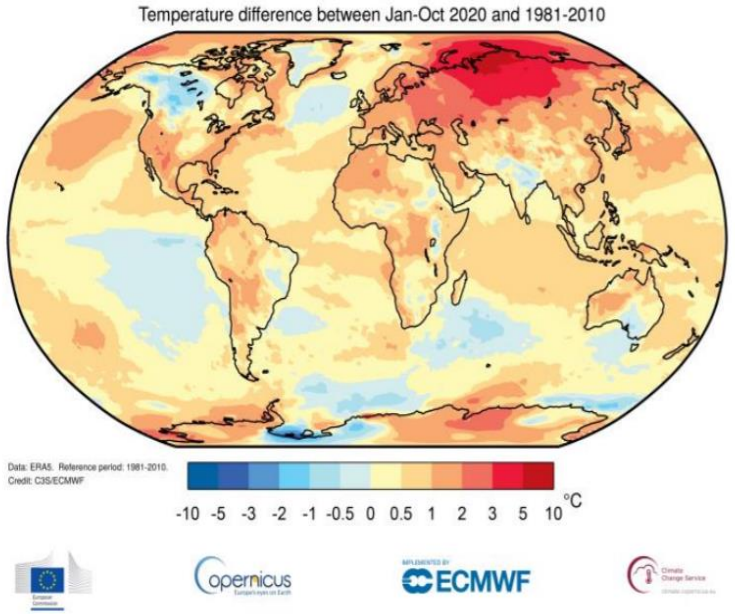
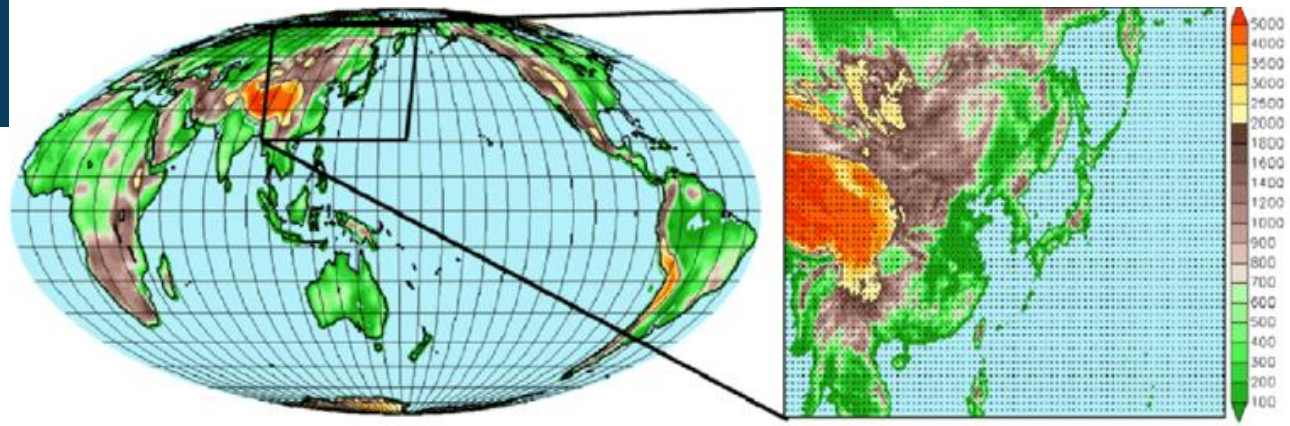


Figure 2: Temperature anomalies relative to the 1981-2010 long-term average from the ERA5 reanalysis for January to October 2020. Credit: Copernicus Climate Change Service, ECMWF.

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!**

Global Model



Limited Area Model
(Detailed representation of local geography)

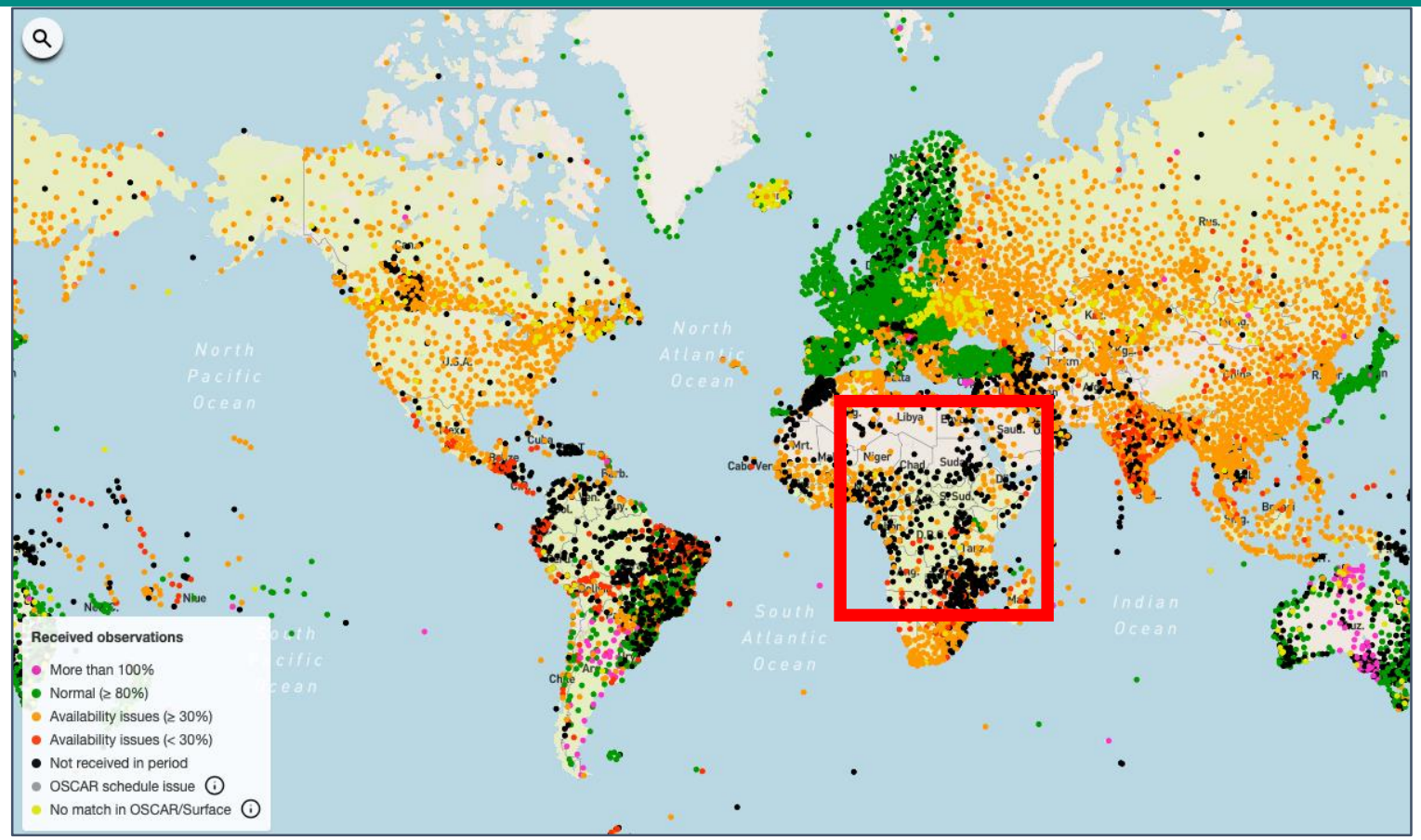
Current state of international exchange of observations;

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.



Surface pressure observations received by global NWP Centers on Apr 27 2021, 12Z)
(source: [WIGOS Data Quality Monitoring System](#))

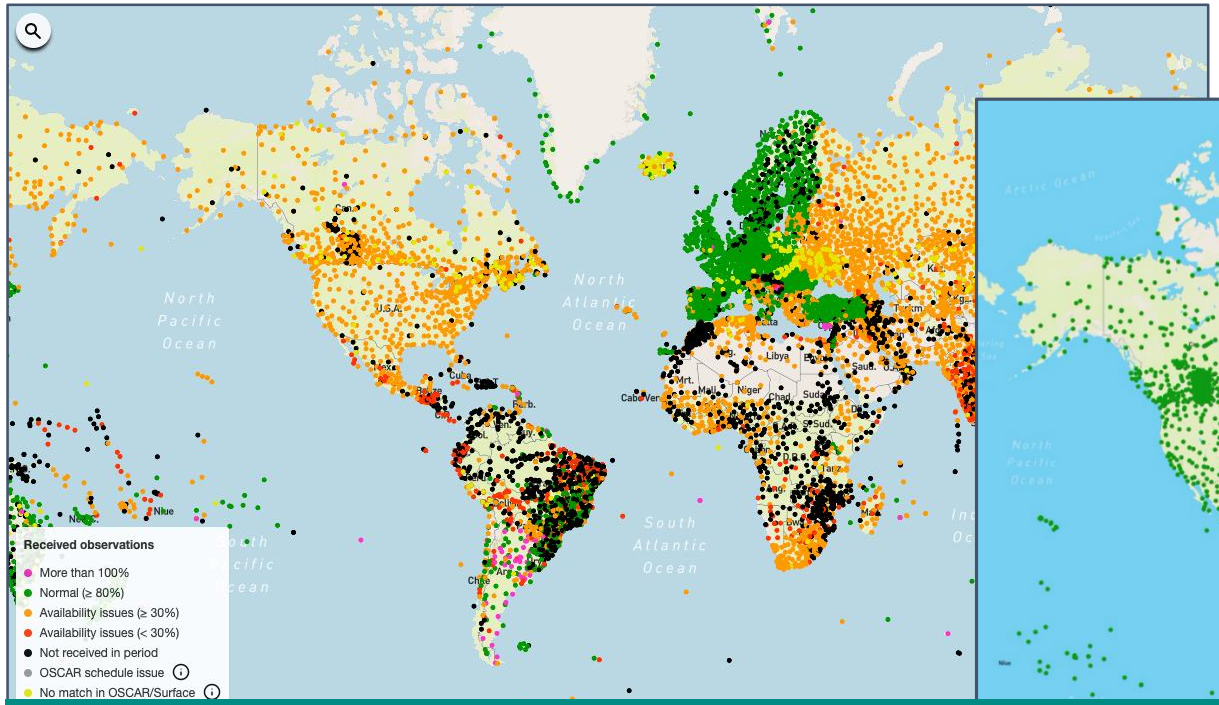
Weather forecasts over areas with few observations (black dots and/or few dots) cannot be reliably verified!

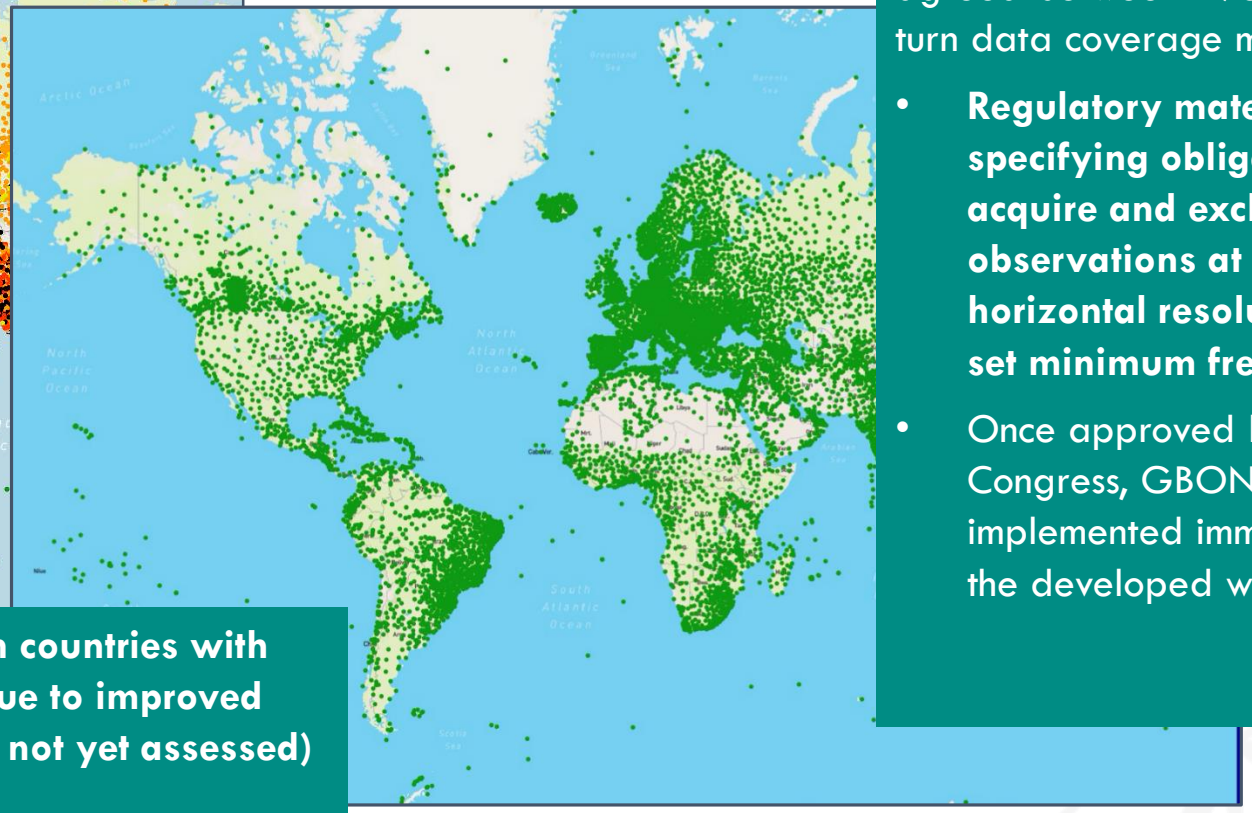
Indirect verification via satellite data or reanalysis data indicate consistently poor quality of forecasts of convective weather;

Climate reanalysis fields used for monitoring, adaptation and prediction will also be of poor quality

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

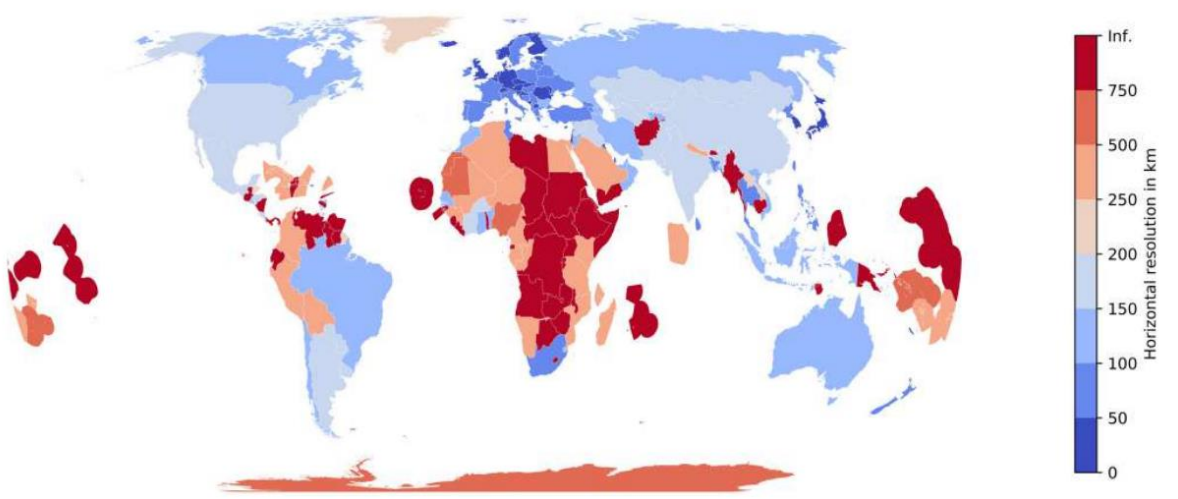
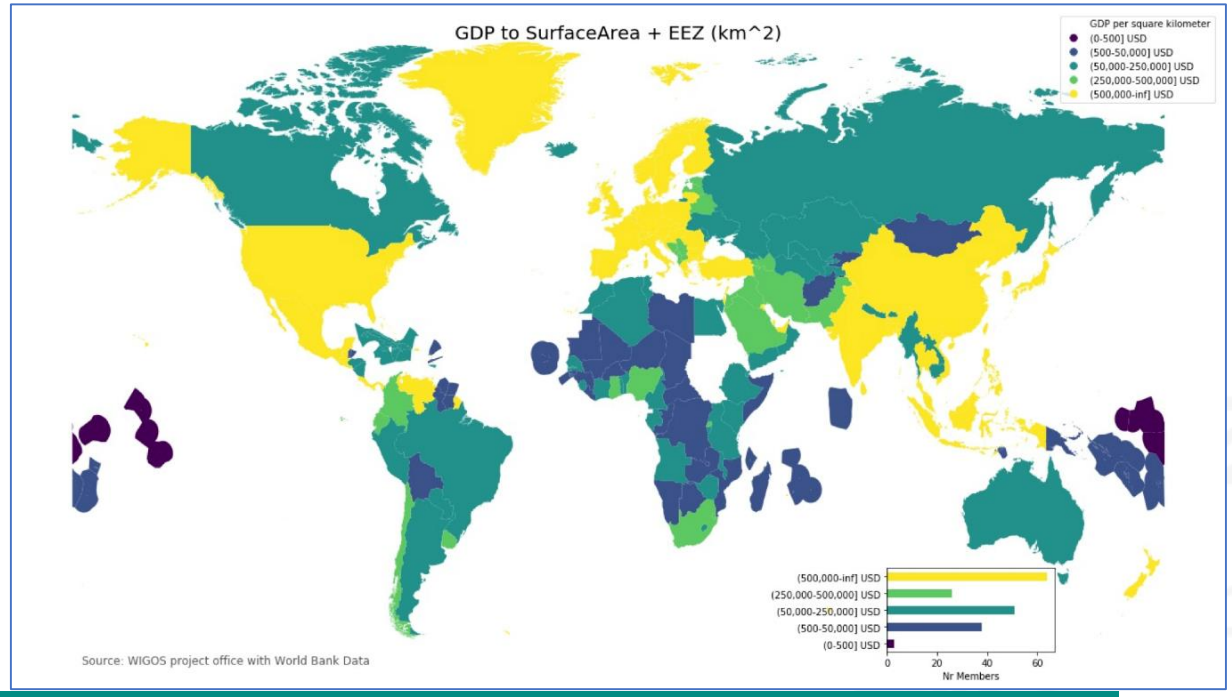


Figure 2 This map shows the horizontal resolution of surface observations in different countries based on stations actively reporting in January 2020. *Source: WMO Secretariat.*



- ***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): A***ffordability of observing responsibility (GDP/km2 of surface area) of countries in yellow up to ten million times higher than for countries in dark blue*

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**