

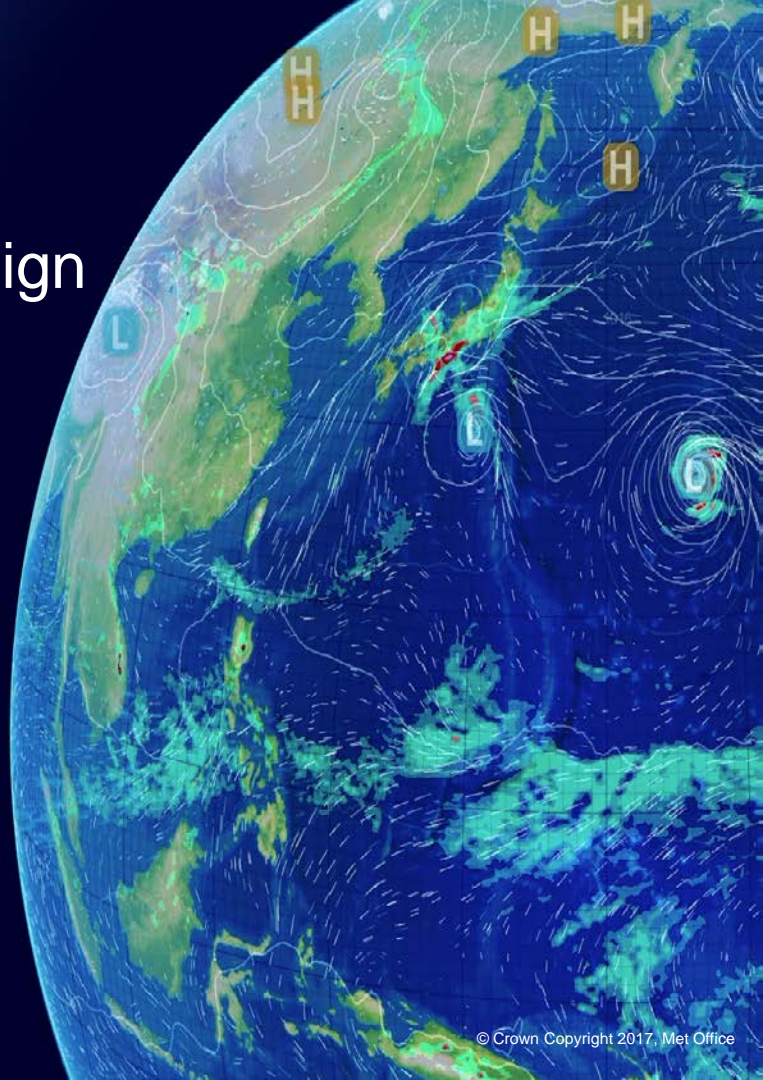
Observing system design and impact studies: the NWP experience

John Eyre

Met Office, UK

WMO Data Conference Preparatory Workshop 4

28 October 2020



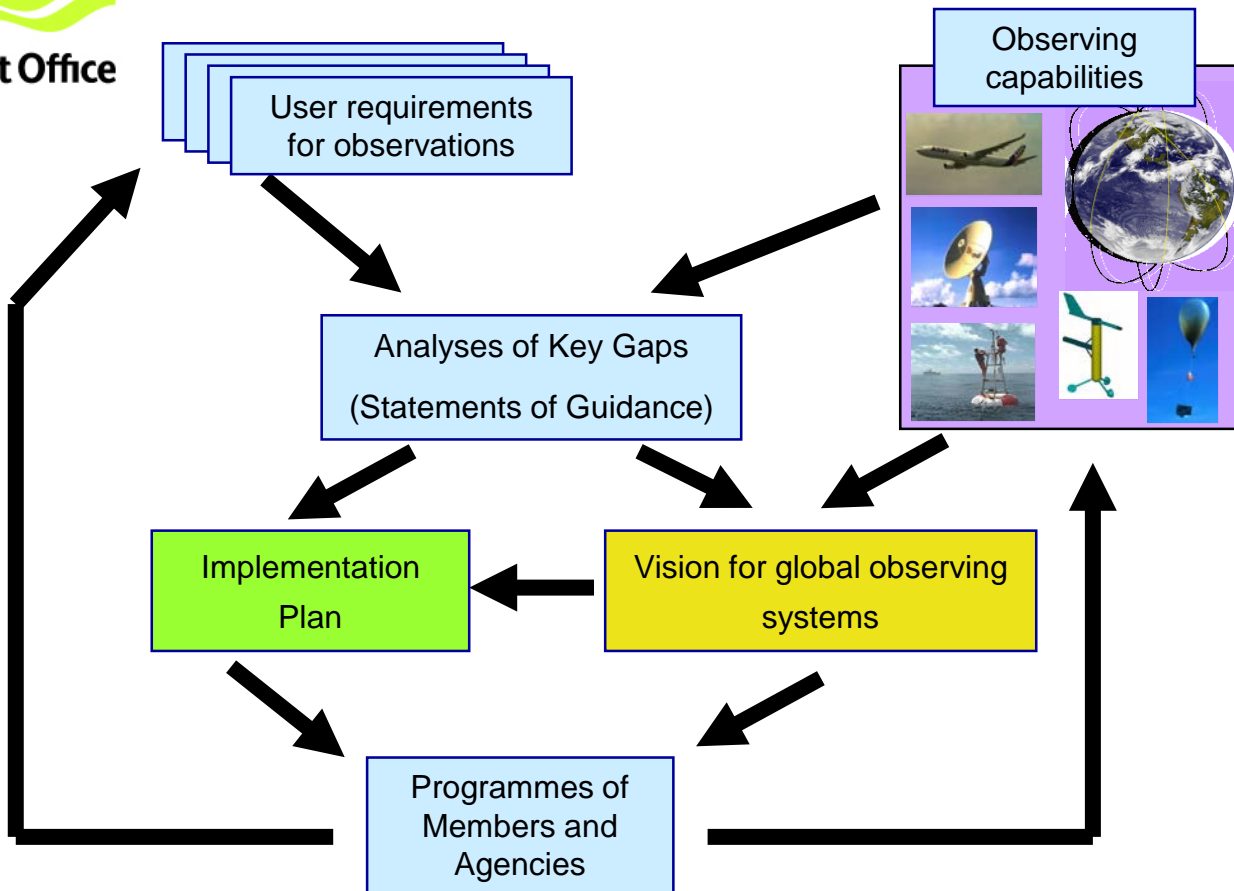


Observing system design and impact studies: the NWP experience

- The WMO/WIGOS Rolling Review of Requirements process
- NWP impact studies
- Concluding remarks

WIGOS = WMO Integrated Global Observing System

The WIGOS RRR process: Rolling Review of Requirements





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WMO/WIGOS RRR process: history

1995-1998

- WMO Working Group on Satellites

1999-2019

CBS Expert Teams

- Expert Team on Observational Data Requirements and the Redesign of the GOS (ET-ODRRGOS)
- Expert Team on Evolution of the GOS (ET-EGOS)
- Inter-Programme Expert Team on Observing System Design and Evolution (IPET-OSDE)

2020-

INFCOM Expert Team

- Joint Expert Team on Earth Observing System Design and Evolution (JET-EOSDE)



WIGOS RRR process: Application Areas (an evolving list)

Global NWP

High-resolution NWP

Nowcasting and Very Short-Range Forecasting

Sub-seasonal to Longer-range Forecasting

Aeronautical Meteorology

Forecasting Atmospheric Composition

Monitoring Atmospheric Composition

Atmospheric Composition info → services in urban and populated areas

Ocean Applications (Met-Ocean Forecasts and Services)

Agricultural Meteorology

Hydrology

Climate Monitoring (GCOS) - now including GFCS requirements

Climate Science

Space Weather



WIGOS RRR process: documentation

RRR Webpage, with Gap Analyses (Statements of Guidance):

<https://community.wmo.int/rolling-review-requirements-process>

RRR Process:

<https://wmoimm.sharepoint.com/:b:/s/wmocpdb/ETZhhknsfYJAICBkkiMfftUBPsJpvtw64vNwiLUisgB-Ug?e=PEveDf>

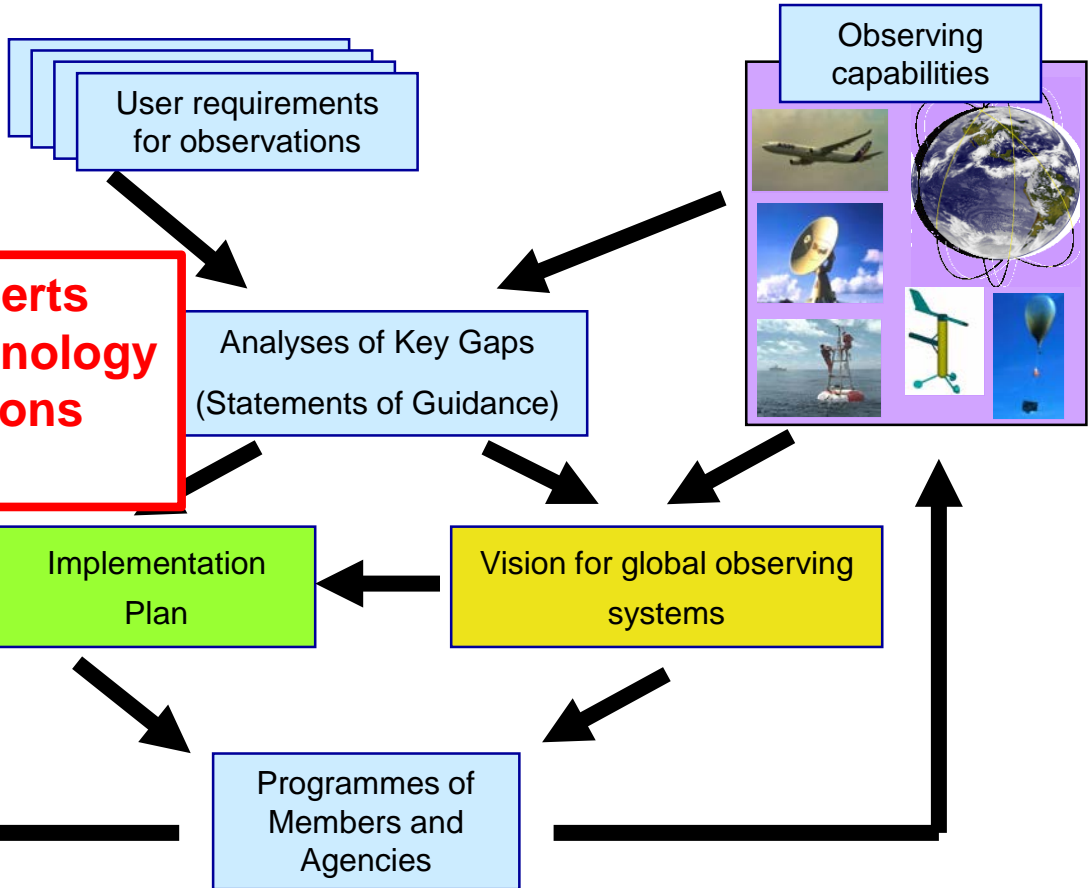
WIGOS Vision 2040: <https://community.wmo.int/vision2040>

Implementation Plan (EGOS-IP)

<https://www.wmo.int/pages/prog/www/OSY/gos-vision.html#egos-ip>

OSCAR – data bases of observation requirements and of space-based and surface-based observing capabilities: <https://oscar.wmo.int>

The WIGOS RRR process: Rolling Review of Requirements



Role of experts

- **obs technology**
- **applications**
- **impacts**



NWP impact studies: WMO Workshops

I	April 1997	Geneva, Switzerland
II	March 2000	Toulouse, France
III	March 2004	Alpbach, Austria
IV	May 2008	Geneva, Switzerland
V	May 2012	Sedona, USA
VI	May 2016	Beijing, China
VII	Nov/Dec 2020	(Seoul, Korea → virtual)

Reports:

<https://www.wmo.int/pages/prog/www/CBS-Reports/IOS-index.html>

https://www.wmo.int/pages/prog/www/WIGOS-WIS/reports/WMO-NWP-6_2016_Shanghai_Final-Report.pdf

- Contributions from all major operational NWP centres and some leading NWP data assimilation research centres
- Summary assessments of the impacts of observations in NWP
- Recommendations relevant to the evolution of observing systems



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NWP impact studies

Types of impact study

Observing System Experiments (OSEs)

- measure the impact on forecast accuracy of **adding or removing existing** observations to/from an NWP system. The latter are often called **Data Denial Experiments (DDEs)**.

Observing System Simulation Experiments (OSSEs)

- as OSEs, but use simulated observations for **new** (and existing) observing systems.

Forecast Sensitivity to Observation Impacts (FSOI)

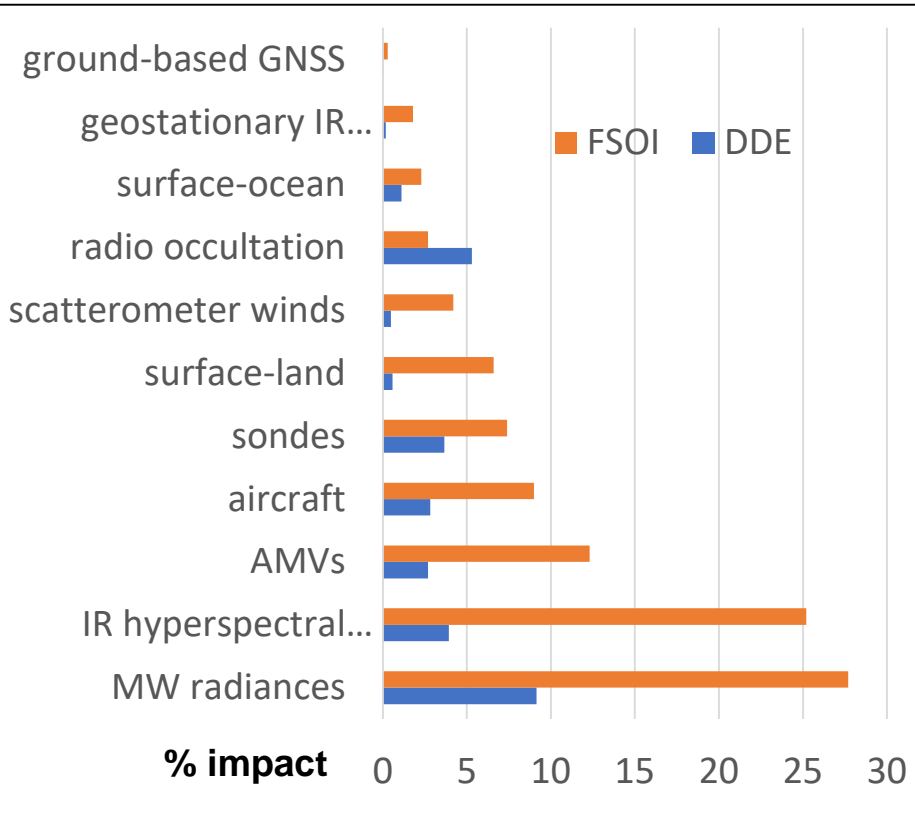
- measure the contribution of a set of observations to reducing forecast error, **in the presence of all other observations**, within an NWP data assimilation system.

... and others



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NWP impacts – example (1)



Percentage impacts of various observation types on global NWP 24-hour forecast error variance, as measured by OSE/DDE and FSOI

Met Office, UK.
B Candy et al 2020
(report in preparation)

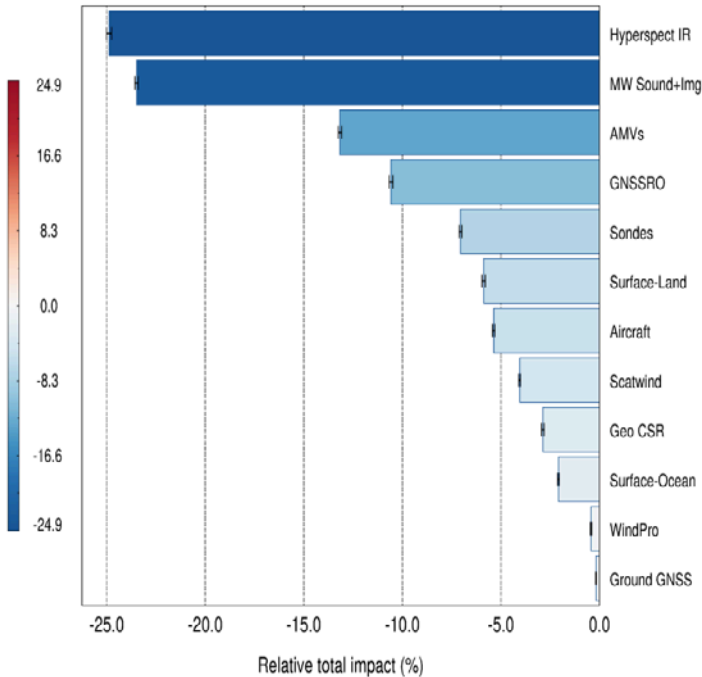


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NWP impacts – example (2)

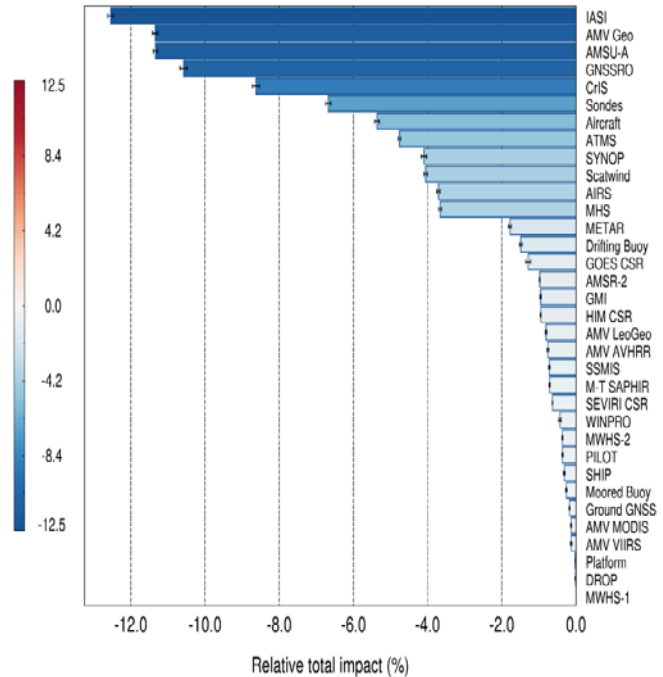
All categories / 20200901T0000Z-20200930T1800Z

Relative total impact (%)



All observations / 20200901T0000Z-20200930T1800Z

Relative total impact (%)

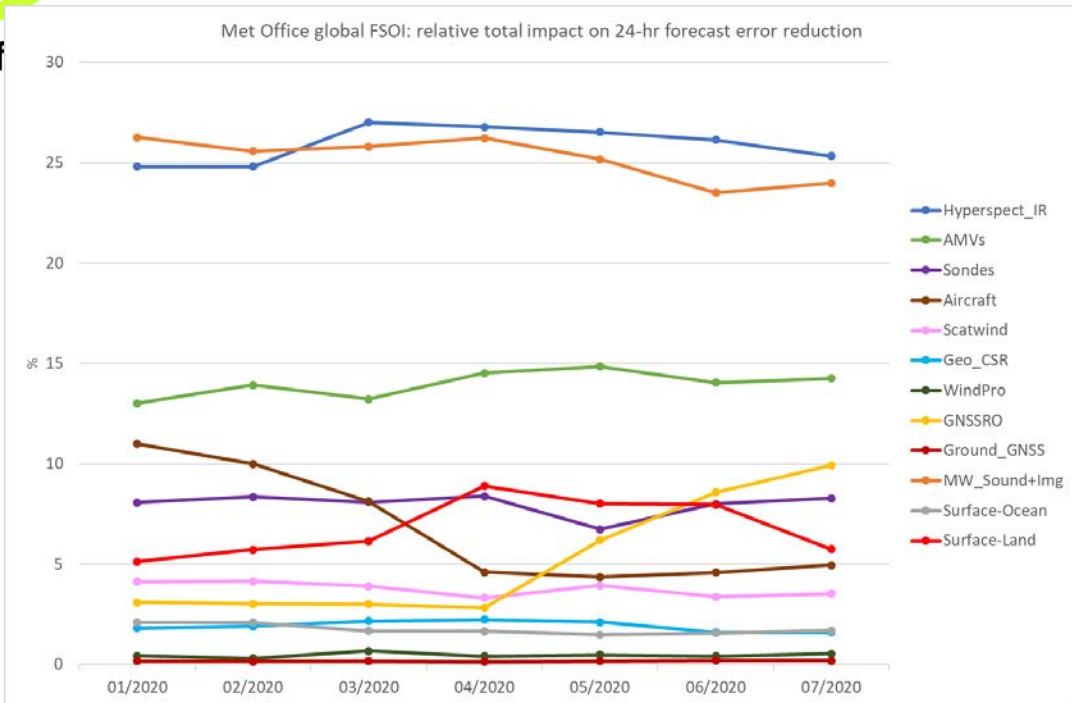


Met Office near-real time FSOI system, September 2020



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NWP impacts – example (3)



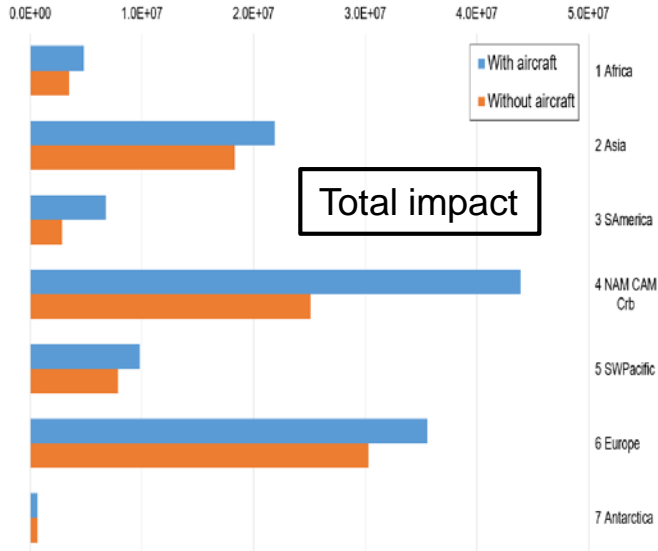
FSOI during the pandemic. Note changes in relative impacts, particularly aircraft and radio occultation observations

thanks to James Cotton, Met Office (UK)



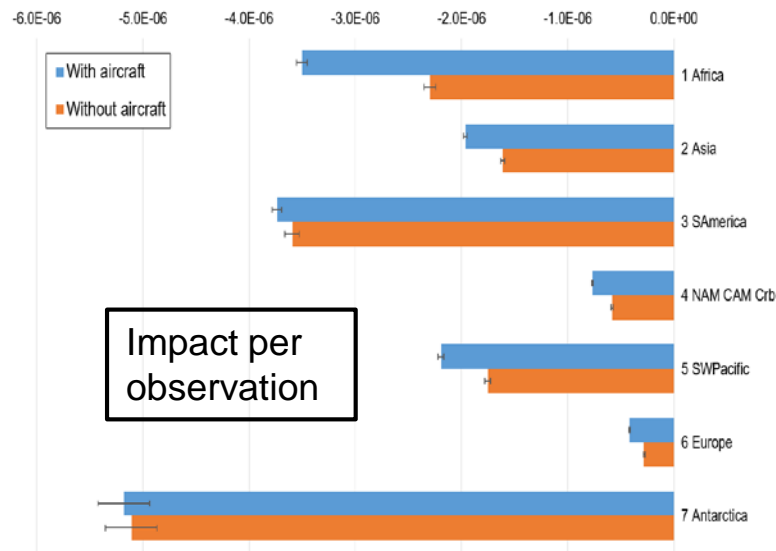
NWP impacts – example (4)

Surface-based by region / 20180926T0600Z - 20190112T0600Z
Number of observations



Total impact

Surface-based by region / 20180926T0600Z - 20190112T0600Z
Mean impact per observation (Jkg^{-1})



Impact per observation

FSOI impacts for surface-based observations by WMO Region

J Cotton and J Eyre, Met Office (UK), Forecasting Research Technical Report No.636 (2019)

<https://www.metoffice.gov.uk/research/library-and-archive/publications/science/weather-science-technical-reports>

Contribution to a WMO / World Bank study



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Concluding remarks (1)

- Through the **RRR process**, WMO has developed a mechanism for documenting **requirements** for observations, for assessing **key gaps**, and for proposing **actions** to fill these gaps.
- This process is **very mature for some applications** and is still developing for others
- For **NWP**, these assessments have been greatly assisted by the availability of results from a wide range of **observation impact studies** from many centres
- This suggests a model that might be implemented for other applications of observations within WMO programmes

Concluding remarks (2)

Availability of observations

- “Data policy actions must be taken to guarantee the continued **availability** of all essential observational data to all WMO Members, and to ensure a continued adherence to **WMO data sharing principles** irrespective of the data origin,” [from the WMO Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP)]*
- Concerning observations, **the most cost-effective action that WMO Members can take is to share the observations that are already made.**

*WMO Technical Report No.2013-4.

<https://www.wmo.int/pages/prog/www/OSY/Publications/EGOS-IP-2025/EGOS-IP-2025-en.pdf>

Thank you
for your attention!

