EUMETNET Observations CA R&D Plan

EWGLAM – September 2019

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on behalf of Jacqueline Sugier

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Content

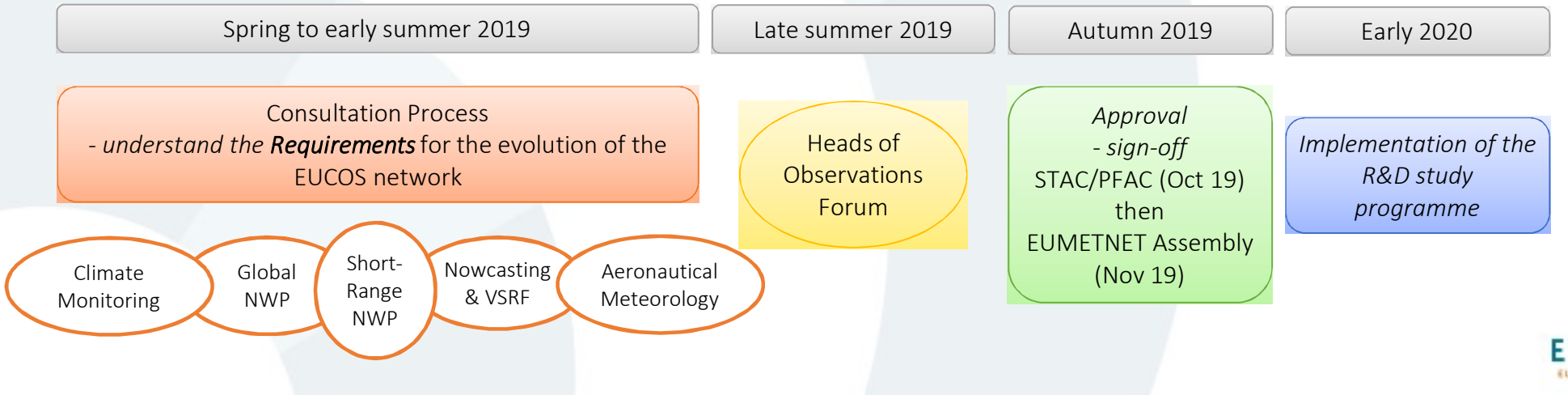
- Process followed to develop the plan
- User consultation: Priority challenges and observations gaps
- Statement of Intent for Obs CA R&D Plan
- Summary

Obs CA R&D: Objective and Approach

High-level objective

…. to lead the development and implementation of new R&D studies with a focus on improving Nowcasting, NWP, Aviation Meteorology and Climate Monitoring over Europe, in order to inform the future evolution of EUCOS and NMS networks.

Developing the R&D programme



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Application areas – Highest priority Challenges

Forecasting and issuing of Impact Oriented Warning for:

- Convective events and associated hazards (thunderstorm, sting jet, strong wind/wind gust, tornadoes, high rainfall rate, hail storms)
- Localised fog formation, depth, and dispersion (particularly important for the transport industry).
- Winter and polar region hazards (e.g. polar low, freezing precipitation, snowfall, snow depth, ice, avalanche forecast in mountainous areas)
- Weather events in complex terrain including locally forced precipitation and high impact winds.
- Precipitation types in the boundary layer (e.g. freezing precipitation, hail, snow) as well as the amount reaching the surface for hydrological applications and transport services.

WMO OSCAR database / EUCOS gap analysis

- Best served application area is Global-NWP which has historically been the focus for investment for EUCOS
- Major gaps relating to the horizontal and the observation cycle

Land Domain	Application Areas	Accuracy		Horizontal resolution		Vertical resolution		Observation cycle		Timeliness	
in-situ at the Surface	Global NWP	T q	w P	T q	w P			T q	w P	T q	w P
	Short-range NWP	T q	w P	T q	w P			T q	w P	T q	w P
	VSRF & Nowcasting	T	w P	T	w			T	w	T	w
	Aeronautical Meteorology		w P						w P		w P
Atmospheric column	Global NWP	T q	w iwv	T q	w iwv	T q	w	T q	w iwv	T q	w iwv
	Short-range NWP	T q	w iwv	T q	w iwv	T q	w	T q	w iwv	T q	w iwv
	VSRF & Nowcasting	T q	w iwv	T q	w iwv	T q	w	T q	w iwv	T q	w iwv
	Aeronautical Meteorology	T q	w	T q	w	T q	w	T q	w	T q	w

Ocean Domain	Application Areas	Accuracy		Horizontal resolution		Vertical resolution		Observation cycle		Timeliness	
in-situ at the Surface	Global NWP	T q	w P	T q	w P			T q	w P	T q	w P
	Short-range NWP	T q	w P	T	w P			T q	w P	T q	w P
	VSRF & Nowcasting	T	w P	T	w			T	w	T	w
	Aeronautical Meteorology		w P						w P		w P
Atmospheric column	Global NWP	T q	w	T q	w	T q	w	T q	w	T q	w
	Short-range NWP	T q	w	T q	w	T q	w	T q	w	T q	w
	VSRF & Nowcasting	T q	w	T q	w	T q	w	T q	w	T q	w
	Aeronautical Meteorology	T q	w	T q	w	T q	w	T q	w	T q	w

T = temperature; w = wind; q = specific humidity; P = pressure; iwv = integrated water vapour

Orange = meeting the OSCAR minimum requirement

Green = meeting the OSCAR breakthrough requirement

Blue = meeting the OSCAR goal requirement

Grey = observation gaps

Shaded = no listed requirement

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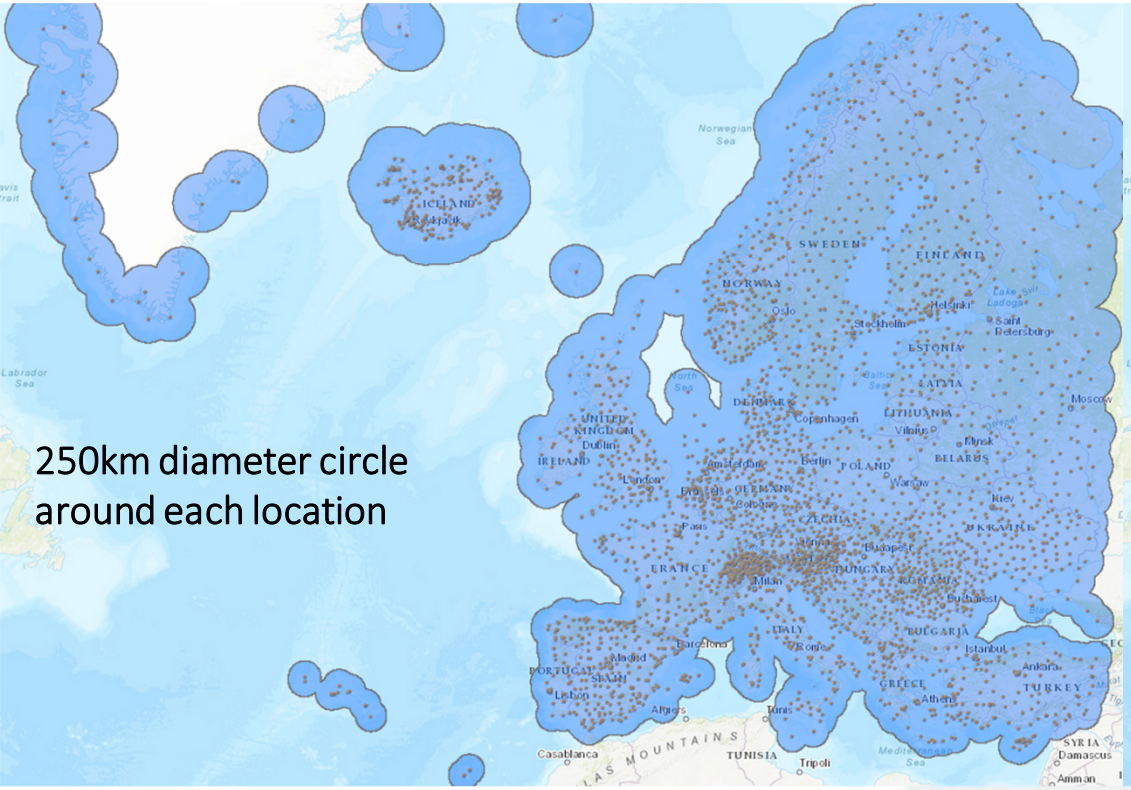

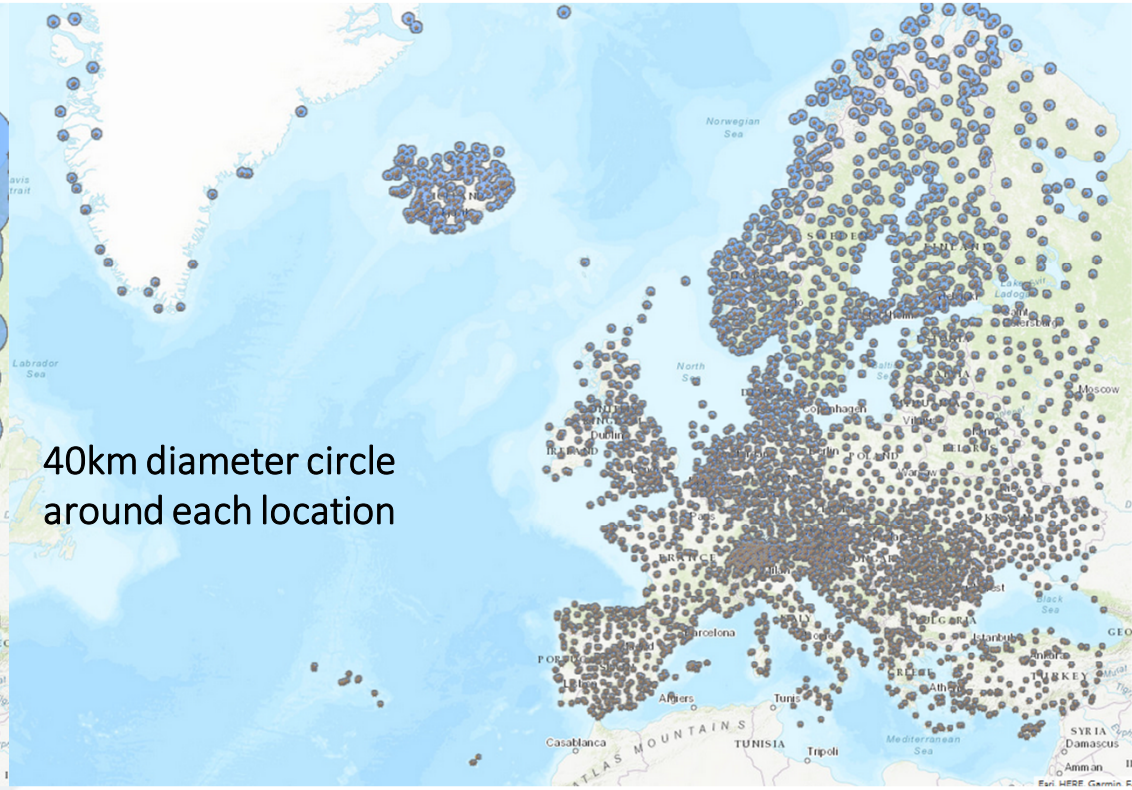

Provision of surface observations over land

Minimum requirement for Global-NWP
for temperature, wind and humidity:
250km horizontal spacing,
For pressure:
500km

Minimum requirement for SR-NWP
for wind and pressure:
40km horizontal spacing,
for temperature and humidity:
20km

Station locations as received by ECMWF during March 2019

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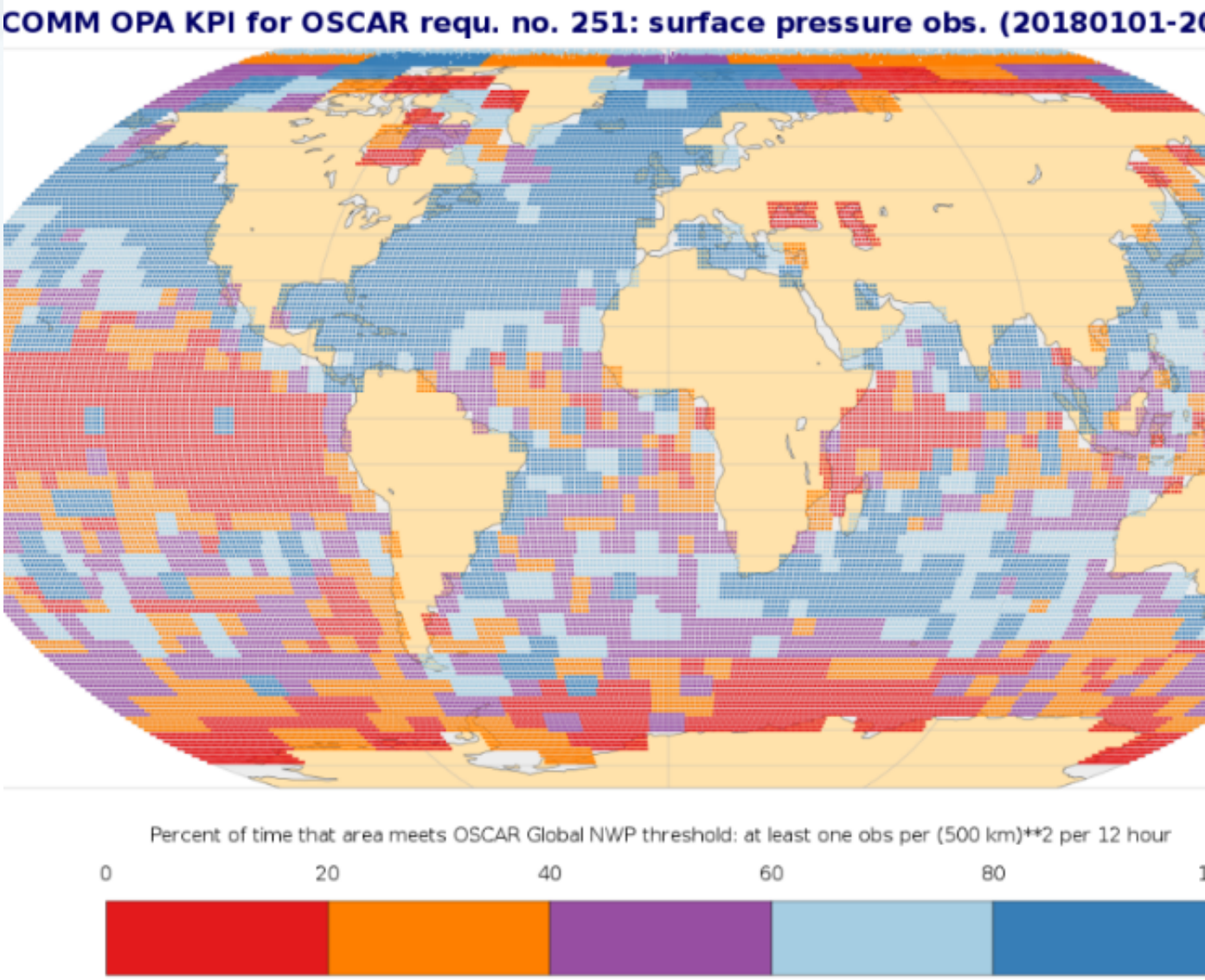
Provision of marine surface observations

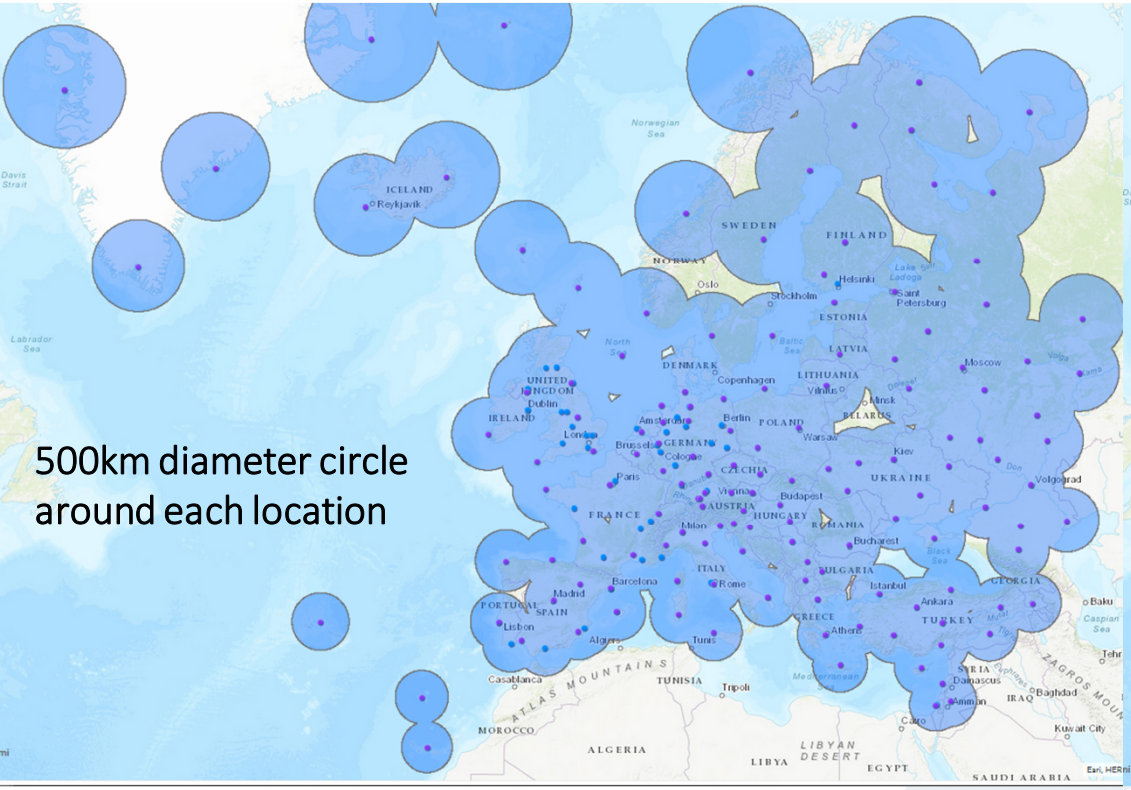
Minimum requirement for Global-NWP for temperature, wind and humidity:
250km horizontal spacing,
For pressure:
500km.

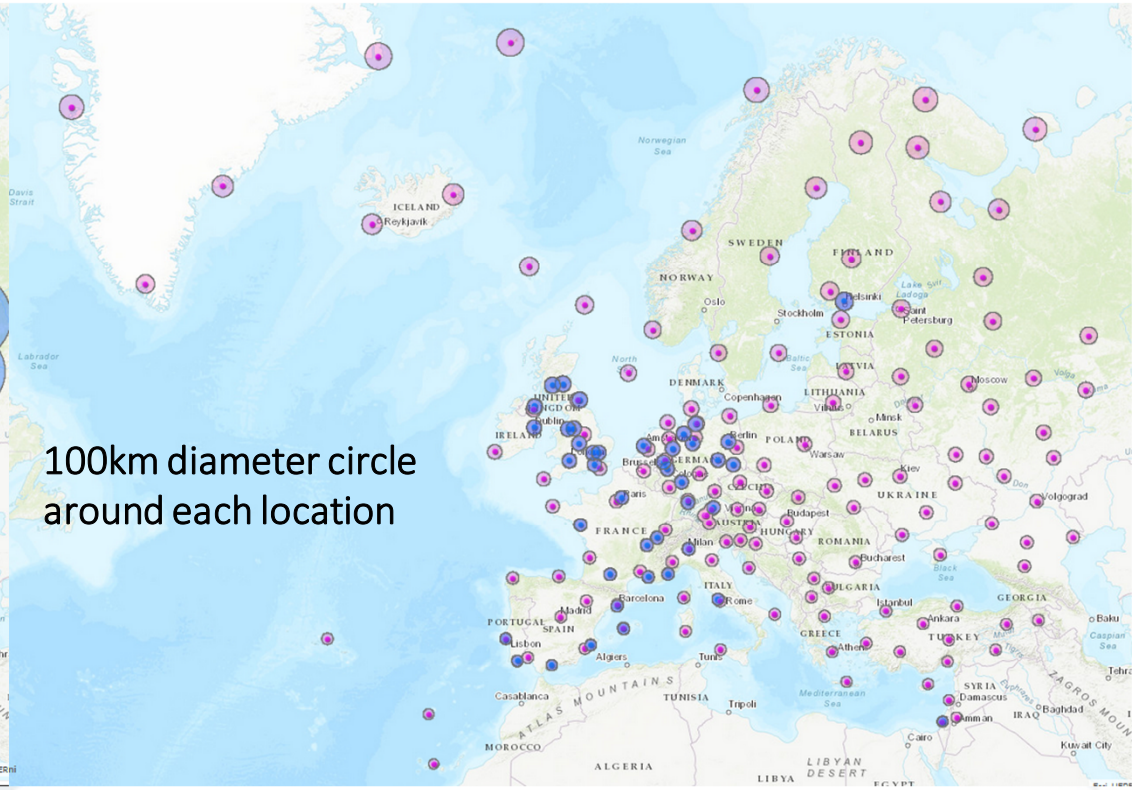
E-Surfmar provides:
1 observation
every 12 hours
every 500km
for 80-95% of the time over large parts of North Atlantic ocean.

Approaching minimum requirement for Global-NWP for surface pressure, but not meeting horizontal and temporal requirement for all application areas.



Analysis and diagram provided by Paul Poli – E-Surfmar Programme manager





Composited provision of temperature profile observations over land

Minimum requirement for temperature profile observations for:

- Global-NWP: 1 observation per day every 500km;
- SR-NWP: 1 observation every 6 hours every 10km;
- Nowcasting & VSRF: 1 observation every hour every 50km.

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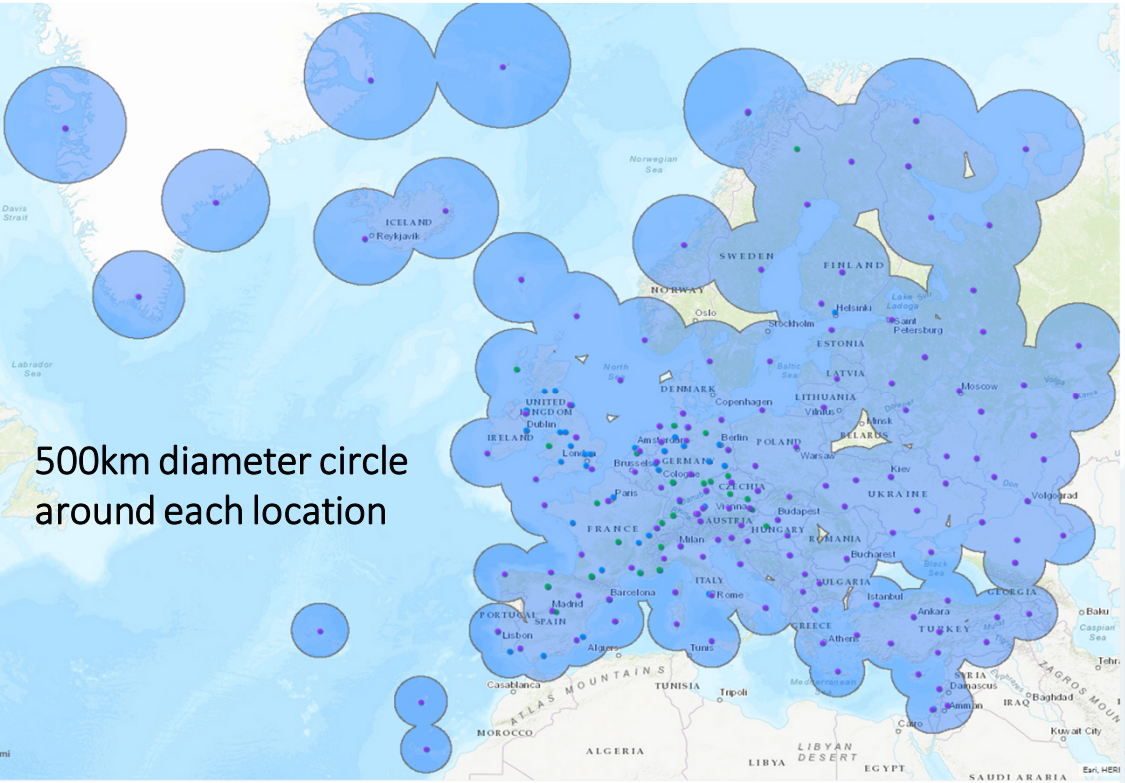
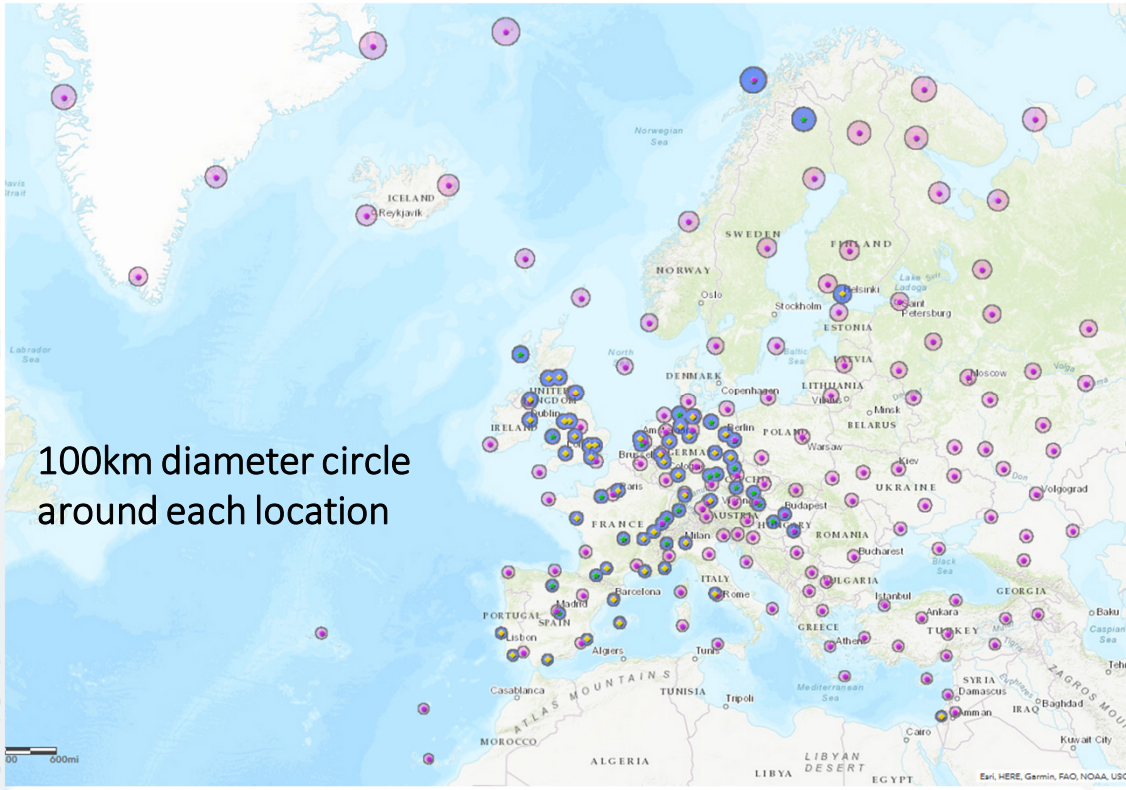
Station/Airport locations: (pink) radiosonde; (blue) AMDAR airport





Composited provision of wind profile observations over land

Minimum requirement for wind profile observations for:

- Global-NWP: 1 observation every 12 hours every 500km;
- SR-NWP: 1 observation every 12 hours every 10km;
- Nowcasting & VSRF: 1 observation every 3 hours every 20km.

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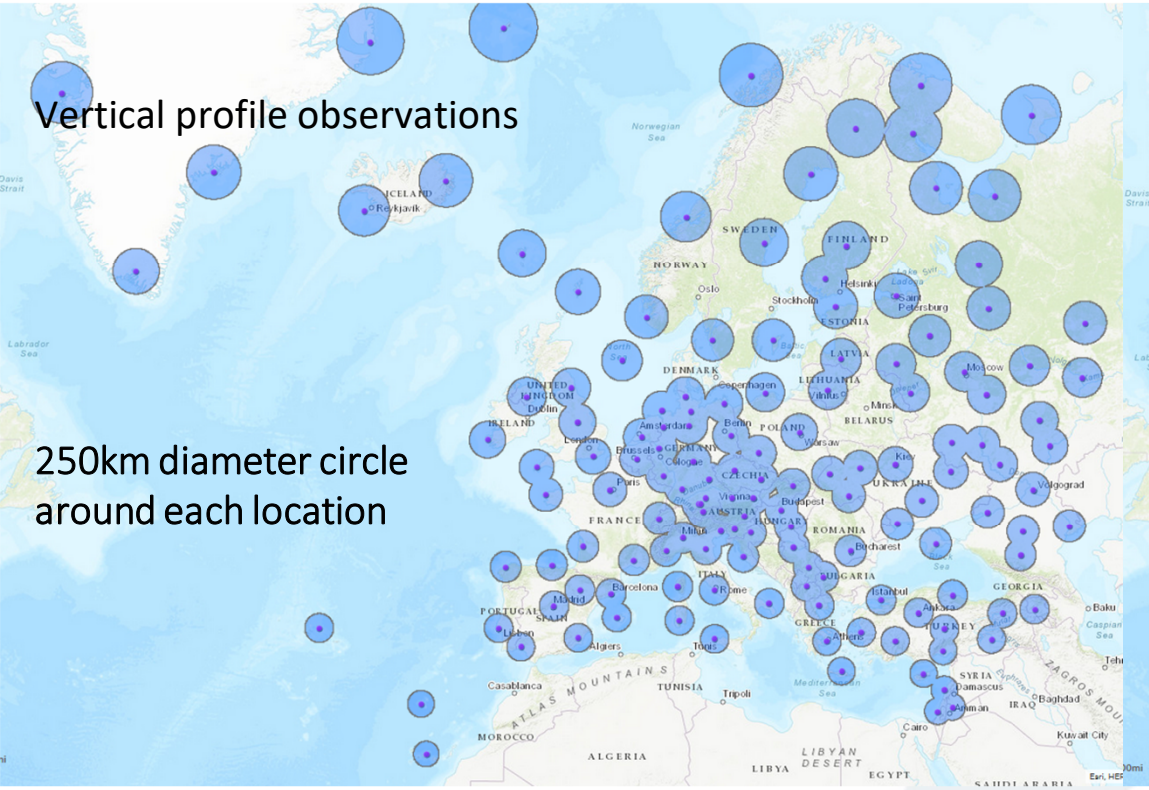
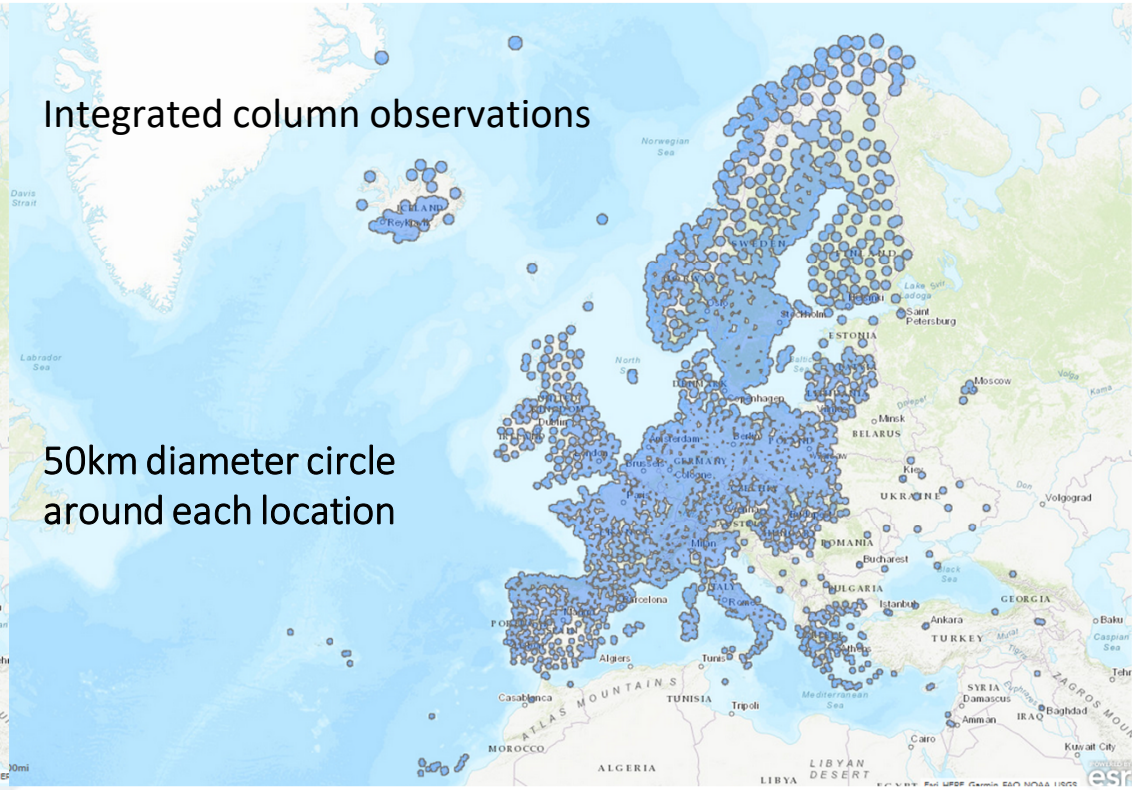
Station/Airport locations: (pink) radiosonde; (green) wind profiler; (yellow) AMDAR airport





Composited provision of upper air humidity observations over land

Minimum requirement for humidity profile observation for:

- Global-NWP : 1 observation every 12 hours every 250km;
- SR-NWP: 1 observation every 6 hours every 20km;
- Nowcasting & VSRF: 1 observation every hour every 50km

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Station locations: (left) radiosonde; (right) GNSS receiver

High priority Observation gaps

1

The provision of humidity, temperature and wind profiles

Extract from SR-NWP Statement of Guidance (SoG) for EUCOS region:

"(…) SR-NWP community would benefit from increased: (…)

- *temperature, humidity and wind profiles at the suitable spatial and temporal resolutions to improve convective scale forecasting. These spatial and temporal requirements are currently not well understood and may vary over land, overseas/oceans, and over complex terrain. (…)"*

Priority order in individual SoG:

Climate Monitoring: 4

Global-NWP: 1+2

SR-NWP: 2

Nowcasting & VSRF: 1

Aviation Meteorology: 1

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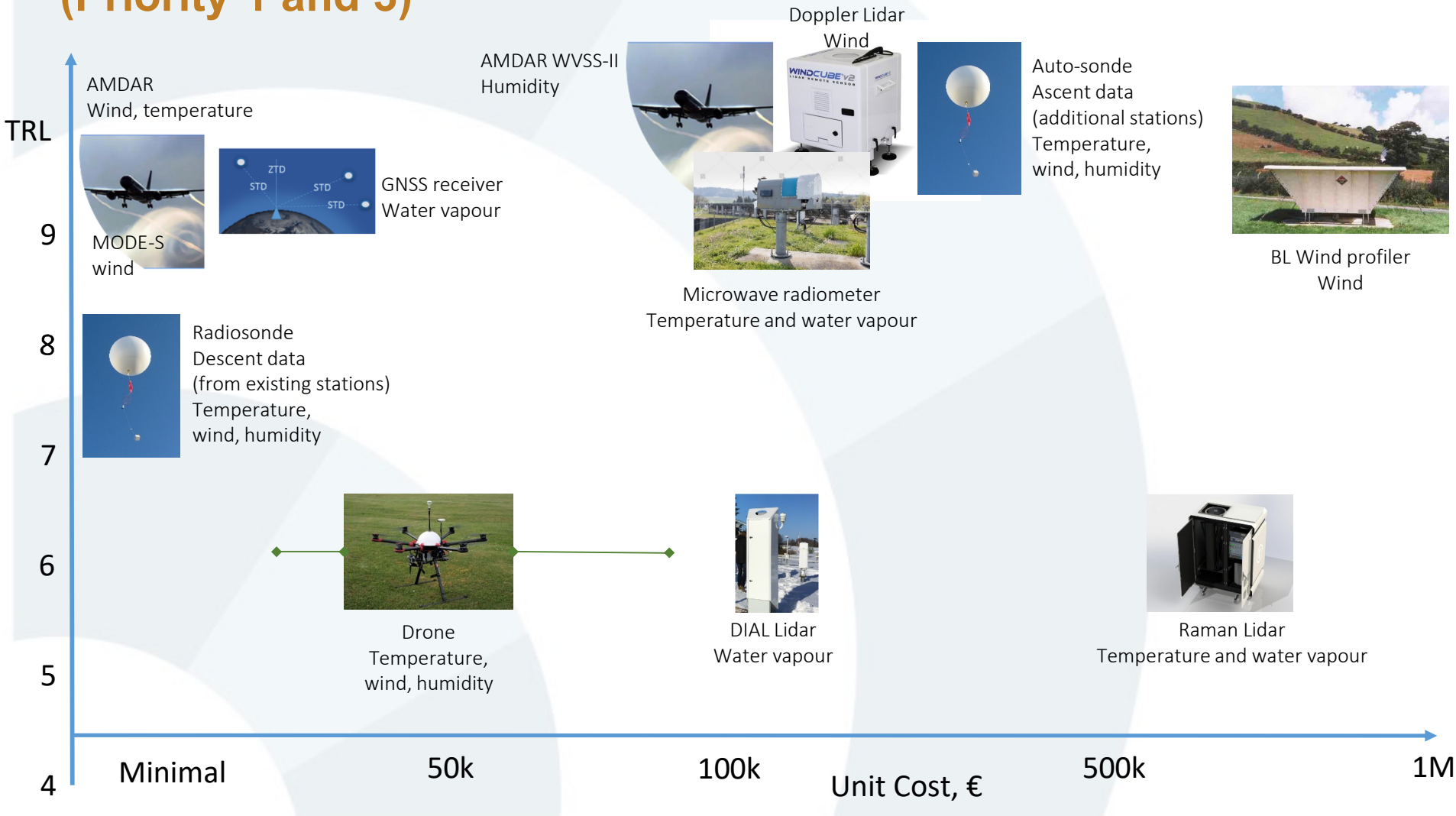
Potential candidates for Improving the provision of profile observations (Priority 1 and 3)



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High priority Observation gaps

2

The provision of surface observations including basic variables as well as snow, soil moisture, wind gust, visibility, precipitation type

Extract from SR-NWP Statement of Guidance (SoG) for EUCOS region:

"(…) SR-NWP community would benefit from increased: (…)

- *exchange of all surface observations (including ground-based GNSS derived products) gathered over land and seas/oceans; this should include expanding the density and frequency of observations available from the Mediterranean Sea, from North Africa, and from Eastern European regions, all of which are relatively poorly observed compared to other European regions. (…)"*

Priority order in individual SoG:

Climate Monitoring: 5+6
Global-NWP: 3+4+5
SR-NWP: 3+6
Nowcasting & VSRF: 3+4
Aviation Meteorology: 4

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Potential candidates for Improving the provision of surface observations (Priority 2 & 3)

- Enhancing data exchange of all observations managed by NMHS and partner agencies

Subject of discussion tomorrow led by Bruce

- Development and deployment of low cost sensor for NMHS managed networks

Subject of discussion with the Instrumentation WG on Thursday

- Amateur observations (e.g. WOW, voluntary obs),
- Crowdsourcing (e.g. phone, social media),
- 3rd party met data (e.g. cars, drones),

Offer huge potentials, several number of opportunities currently developed by members, but which has the most promising potential to be implemented across EUMETNET nations?

- WG on crowdsourcing to define short-list of opportunity to be developed further by Obs CA R&D

- Opportunistic (e.g. webcam visibility, radar refractivity, ADS-B broadcast refractivity,)

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High priority Observation gaps

3

The provision of high resolution observations around sensitive areas

Extract from Nowcasting & VSRF Statement of Guidance (SoG) for EUCOS region:
"(…) Nowcasting & VSRF centres would benefit from increased: (…)

- *understanding the optimum requirement of additional observations to support improvement of services delivered during fog events, low cloud/low visibility events, during winter weather or in polar regions, and over complex terrain. (…)"*

Priority order in individual SoG:
Climate Monitoring: -
Global-NWP: -
SR-NWP: 1
Nowcasting & VSRF: 2
Aviation Meteorology: 2

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Draft until approved by STAC

Observations CA R&D Statement of Intent

Working in close collaboration with the Forecasting Programme and relevant STAC Working Groups, Obs CA will endeavour to address EUMETNET Members' high priority observational needs, with a focus on improving km-scale hazard forecasting and impact-oriented warnings (IOW), particularly for those events associated with convective activities and fog. More specifically, this Programme has been designed to address the following:

- *Develop a better understanding of the observation requirement for operational data assimilation into km-scale/LAM and nowcasting models, to support km-scale hazard forecasting and IOW.*
- *Develop a better understanding of the value and limitations of emerging and maturing technologies and/or of non-NMHS managed data sources, to support km-scale hazard forecasting and IOW.*
- *Develop a better understanding of what a minimum baseline observing network should look like to support km-scale hazard forecasting and IOW.*

Whilst focussing on supporting km-scale hazard forecasting, the needs of other application areas will not be ignored. Recommendations and actions will take into account the need to sustain and improve the global observing system and the associated 'anchor observations' and the importance of adhering to the climate monitoring principles.

Actions

Draft until approved by STAC

Action 1 - Sandbox

Establish a sandbox dataset of high resolution observations to support R&D impact studies, model and product development.

Potential Activities:

- Gather all observations collected by Members but not shared, for a specified time period and region (TBD in collaboration with users)
- Promote the sandbox to NWP, Nowcasting groups to support their model and product development.
- This dataset will also be made available to support machine learning development of automatic quality control algorithm for low cost sensors/dataset (e.g. WoW, webcam).

Action 2 - Technology Trials

Support Instrumentation trials to gather knowledge of the operational value and limitations of emerging technologies and/or new data sources alongside established networks.

Potential Activities:

- Collaborate with WMO on proposed drone trial in 2021
- Collaborate/support any members involved in relevant instrumental trials and field campaign.
- Deliver report on the operational value of emerging technologies e.g. drone, low cost AWS, DIAL and RAMAN Lidars.

Action 3 - Impact Studies

Deliver impact studies to inform an minimum baseline observing network design to support km-scale forecasting.

Potential Activities:

- Deliver impact study on the value of AMDAR humidity.
- Complete evaluation of radiosonde descent data and provide guidance for operational implementation.
- Optimise the use of AMDAR versus MODE-S data.
- Understand the complementary value of GNSS data alongside high resolution profiles.
- Evaluate the value of drones.
- Evaluate the value of WOW (or WOW-like) data for NWP.

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Summary of the main messages

- The user community's highest priority challenge is to improve km-scale forecasting.
- The user community's highest priority in terms of observation gap to fill, in order to improve km-scale forecasting, is to, in order of priority:

  1) dramatically increase the provision of profile observations of humidity wind and temperature,

  2) increase the provision of surface data.

However. . . .

- The exact minimum and threshold requirements for these observation gaps are not well understood.
- There is currently no clear technical opportunity to respond to this requirement due to lack of experience regarding their operational suitability and also their value to end users.

- Obs CA R&D intents to work in collaboration with the Forecasting Programme to respond to these requirements.
- 3 Actions are proposed: 1) create a sandbox observation dataset to refine the requirement, run R&D impact study, and R&D on new products for forecasters; 2) take part in instrument trial to evaluate the operational suitability of emerging and maturing potential solutions; 3) deliver impact studies to support the design of an optimum composite network.

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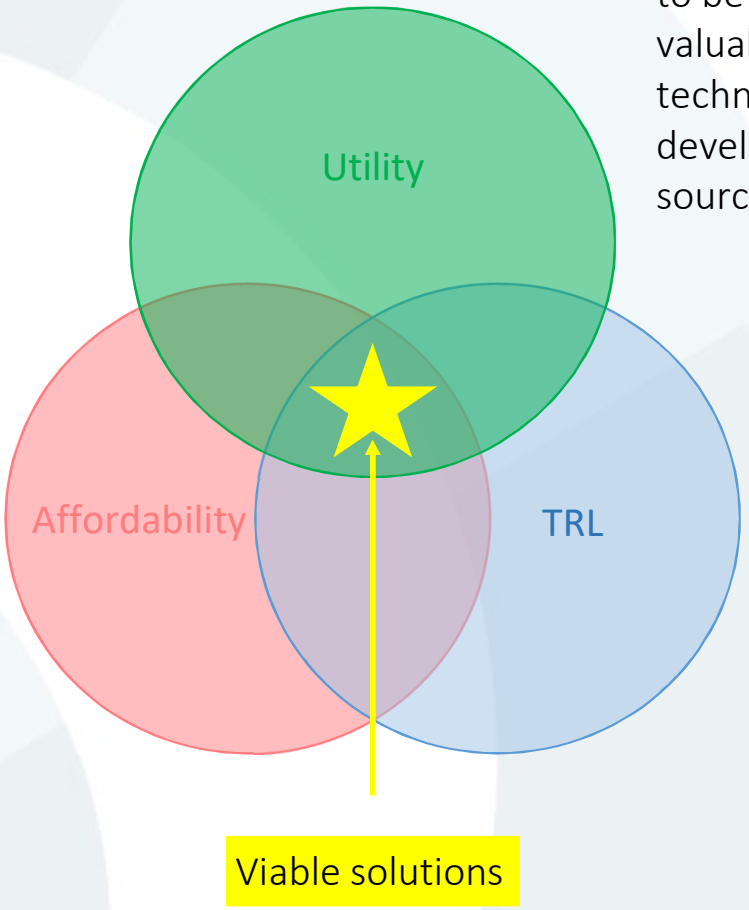
Condition for success

Utility:
What is the value of the data; will it enable relevant meteorological structures to be resolved? How long will it be valuable i.e. is there a risk that other technology or user application development would render this data source less valuable?



Affordability - Cost versus Utility:
i.e. how many system do we need to meet the requirement benefit?
Is it a sustainable investment?

TRL - Maturing versus Utility:
Is this technology/technique/data source mature enough to meet the required benefit?
Will this solution be reliable in an operational environment?

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