Short-range NWP Statement of Guidance for the EUCOS region

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In 2018, WMO completed a rolling requirement review (RRR) process for the High-resolution/Short-range NWP application area which delivered: 1) an updated record of user requirements listed in the WMO's Observing Systems Capability Analysis and Review database (OSCAR database); 2) a critical analysis to assess the gaps by comparing capabilities versus requirements, 3) and finally an analysis (led by Thibaut Montmerle, Météo-France) to produce a gap analysis and a Statements of Guidance (SoG) for WMO for the High-resolution NWP Application Area. This SoG was developed to guide the evolution of networks (both ground-based and space-based) over the globe and therefore does not necessarily represent the priorities for EUMETNET members for the EUCOS region. Following on from this WMO RRR process, the EUMETNET Observations Programme led a similar exercise in collaboration with the C-SRNWP expert team (from the EUMETNET Forecasting Programme) to develop a SoG for Short-range NWP specifically for the EUCOS region.

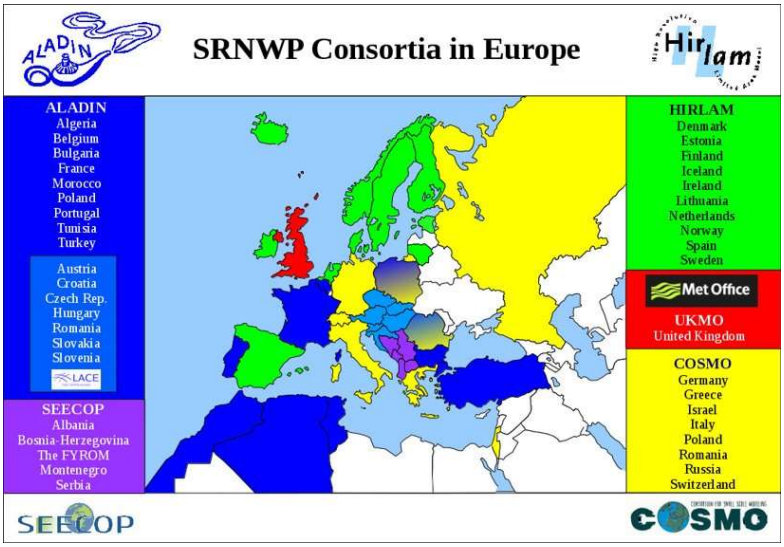
The SoG captures the most important observation gaps that users wish to be addressed in order to help tackle some high priority challenges in NMHS's service delivery. The SoG does not provide a record of all user requirements; these are documented in the WMO OSCAR database which has been used to inform the SoG. The consensus view from the EUMETNET Short-range NWP community is that the EUCOS and NMHS observing networks are not currently fulfilling their requirements, with some significant key weaknesses. The starting assumption for this SoG is that existing networks should be maintained, forming the basis on which enhanced capabilities are introduced in an optimal manner to enhance the overall performance of composite network over the EUCOS region.

The EUMETNET Short-range NWP (SR-NWP) community is organised around 6 consortia:

- ALADIN consortium (Aire Limitée Adaptation dynamique Développement InterNational) focuses on the development of a limited-area model (LAM) code that is derived from ARPEGE (Météo-France global model) and IFS (ECMWF global model providing medium range weather forecasts). From this common ALADIN code, two LAM base versions are defined (so-called canonical model configurations). These configurations typically differ in terms of their physics packages and a few other model settings (see below). The models are run using boundary conditions provided either from ARPEGE or IFS. The ALADIN consortium is engaged in the development of two physical parameterization packages for the convection resolving scale: AROME (Applications of Research to Operations at MesoscalE) and ALARO; AROME and ALARO are using the same variational data assimilation system.
- LACE consortium (or RC-LACE for Regional Cooperation for Limited Area modelling in Central Europe) uses the ALADIN code and from an administrative point of view all LACE members are also members of ALADIN. The ALARO physical package was historically developed by LACE, and all LACE countries are running ALARO. However, some LACE countries (Austria, Hungary) also run AROME as their first priority is high resolution modelling.
- HIRLAM consortium (High Resolution Limited Area Model) focuses on the development of a short and very short-range NWP system. HIRLAM is engaged in a close collaboration with the ALADIN consortium with the aims to develop a common LAM model (based on the IFS/ARPEGE/AROME codes cited above). At present, HIRLAM has

defined a third canonical model configuration derived from the common LAM codes, named HARMONIE-AROME. From a consortium-level point of view, HIRLAM and ALADIN (including LACE) aim at forming one single consortium by the end of 2020.

- SEECOP consortium (South-East European Consortium for Operational weather Prediction), focuses on the development of a Non-hydrostatic Multiscale Model on the B grid (NMMB) developed by NCEP (National Centres for Environmental Prediction).
- COSMO consortium (COnsortium for Small Scale MOdelling) focusing on the development of a short to very short-range forecasting system at convective-scale resolution, aimed especially at high-impact weather forecast. COSMO is run using boundary conditions provided by IFS or ICON (global model of DWD).
- UKMO consortium (UK Met Office consortium) focuses on the development of the UKV model, a convective-scale LAM nested in the Global configuration of the UM (Met Office Unified Model providing medium-range weather forecasts).



The EUMETNET C-SR-NWP community (full participation listed included below) identified the dominant SR-NWP challenges within the EUCOS region which are in part due to gaps in EUCOS observing capabilities. These challenges largely revolve around providing guidance (to business, governmental agencies and the general public), with sufficient lead-time in order to put in place appropriate mitigating actions against significant weather events, including:

- fog formation, depth and dispersion, as well as low clouds including stratocumulus,
- convective events and their associated phenomena (e.g. thunderstorms, lightning, tornadoes) including heavy precipitation linked to the forecast of flash floods,
- snow events and their associated impact on transport business and hydrological applications i.e. forecasting where it is going to snow (snow/rain boundaries), what will be the snow depth, when is the snow going to melt.
- strong localised wind (e.g. Foehn, or katabatic winds such as Bora).

The C-SRNWP community also identified two additional general challenges having a direct impact on the challenges listed above:

- general drop in forecast skills due to lack of observations available to initialise coupled atmosphere-ocean models over data sparse regions (e.g. seas and oceans).
- poor forecast quality of surface radiation and related cloud cover due to a lack of direct path to assimilation of currently available aerosols' attenuated backscatter products into LAM.

Based on these short-range NWP challenges, the EUMETNET C-SR-NWP community selected and prioritised the following statements to guide the evolution of the EUCOS networks; EUMETNET C-SR-NWP community would benefit from increased:

- understanding of the observation requirements for improving fog forecasting in the vicinity of sensitive facilities (e.g. airports, motorways). This should involve supporting and taking part in field campaigns and other instrumentation trials (such as SOFOG3D led by Météo-France), which should include conducting impact studies, and providing recommendations.
- 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. Furthermore, the potential contributions of emerging technologies to bridge these gaps (e.g. Raman Lidar, DIAL lidar, radar refractivity, microwave radiometers, AMDAR humidity, MODE-S) should be investigated. This should involve taking part in field campaigns and other instrumentation trials (such as the 'Pilot' experiment run by DWD, and the 'Network design' project run by the Met Office), which should include conducting impact studies, and providing recommendations. Lastly, the C-SRNWP community would like to strongly encourage pressing ahead with studies to evaluate the operational reliability of the radiosonde descent data as an efficient path to increasing the availability of valuable high-quality profile observations for anchoring data from lower quality systems.
- assessment of the most desirable ratio between observations provided by high quality observing networks and crowdsourced or unconventional opportunities. Studies should be undertaken to provide an optimum strategy to probe the boundary layer for km-scale data assimilation and verification purposes using all those sources of meteorological observations.
- quality of reflectivity, rainfall rate and Doppler wind observations delivered by the OPERA programme. Effort and support should also be placed on increasing the coverage of the radar composite, starting by strongly encouraging countries with known national radar network to join the OPERA programme (e.g. Italy and Greece).
- 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.
- exploitation of the E-PROFILE ALC network (Automatic Lidar and Ceilometer). In particular, the C-SRNWP community encourages the development of extinction coefficient products to support data assimilation trials of aerosol profiles and the development of improved forecast of surface radiation and cloud cover. The latter would also benefit from an improved understanding of the value to km-scale forecasts that can be extracted from observations provided by cloud radars.

Participants	Organisation	Consortia
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