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How can we improve freezing rain forecasts using ECMWF ensemble system?

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Certain types of precipitation can be a threat to public safety and can disrupt travel and commerce, seriously affecting the economy. During the cool season freezing rain is particularly hazardous due to possible ice-loading effects on power wires, roads and vegetation. The use of ensembles (compared with deterministic forecasts) in precipitation type forecasting can help to quantify the impact of the numerous sources of uncertainty intrinsic to this forecasting problem, especially with mixed phases, such as freezing rain.

The Integrated Forecast System (IFS) ensemble forecasts (ENS) from ECMWF provide an instantaneous precipitation type (ptype) output variable that describes 6 types of precipitation at the surface: rain, freezing rain, snow, wet snow, sleet or ice pellets (plus dry). As part of ECMWF's contribution to the ANYWHERE (EnhANcing emergencY management and response to extreme WeatHER and climate Events) project two new products have been developed based on ENS forecasts of precipitation type combined with the instantaneous precipitation rate variable. These are the most probable precipitation type, shown in map format, and the instantaneous probabilities of different types, shown for a given site. The first of these shows which type is most probable whenever the probability of some precipitation is >50%. The second product depicts the temporal evolution of probabilities for a specific location in bar chart format, classified also according to three categories of instantaneous precipitation rate. A new methodology to classify dry from precipitating has been applied using a minimum value of precipitation rate for each ptype in order to try to enforce a zero frequency bias for all types (within the 4-month verification training period we used). These new instantaneous probabilistic products, combined with the continuous variables of accumulated freezing rain from HRES (ECMWF high-resolution deterministic forecast) and ENS, can improve the forecast of this type of precipitation several days in advance, as will be shown through two new freezing rain case studies from the 2017/18 winter.

Observations of present weather from manual SYNOPs in Europe for 4-months in the 2016-2017 and 2017-2018 winter periods were used to update the verification of the precipitation type products from previous results. This verification highlights that IFS is moderately skilful for freezing rain even for longer lead times. However, although results from the 2016-17 winter suggested there was no economic value in freezing rain forecasts beyond day 2, users may still benefit from using it as a first alarm bell for specific atmospheric conditions several days in advance.