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Big Data challenges in NWP and its Application

Ken Mylne (1,2)

(1) Met Office, Weather Science, Exeter, United Kingdom (ken.mylne@metoffice.gov.uk), (2) Chair Data Processing and Forecasting System, WMO Commission for Basic Systems

With increasing model resolutions and supercomputer power, today's NWP systems produce increasingly vast quantities of forecast data which present a real challenge to meteorologists and technical systems to process and exploit. Historically, meteorologists were often presented with data on model grids, first on paper and then on forecasters' workstations, typically updated every 6 hours, although data exchanged around the world, for example on the GTS were often shared at substantially reduced resolutions. As model resolutions have increased such systems have frequently struggled to keep up with data volumes, and the increasing use of ensembles and more frequent update cycles – a number of centres are moving towards hourly updating of convective scale systems – makes the problem much more acute. So the challenge is to find new and innovative ways to exploit forecast data, to summarise and interpret data so that meteorologists and end-users can rapidly extract the important signals, in terms of weather impacts and related uncertainties, and focus on effective decision-making. Ensemble outputs may be summarised in terms of statistics relevant to high impact weather, such as probabilities of extreme events and percentile values, but potentially there are so many options that this can sum to more than the raw ensemble data! The management of data may be greatly improved by decoupling the data formats and grid resolutions used for exchange and visualisation from the underlying model grids. By using standard grids and forecasts extracted for specific locations, the forecaster workstations and forecast product generation systems do not need to be upgraded each time the models are changed – allowing for better planning of the requirements of workstations and communication bandwidth, and allowing new science to be pulled through in improved models, and better forecasts, without delays while downstream systems are tested and upgraded. Blending and updating forecast fields from multiple models and ensembles can not only improve forecast quality, but reduce the number of different models that forecasters are expected to examine at the same time. Technologies such as Web Map Services mean that forecaster workstations may not need to access the data at all, but pull map layers as images created closer to the data source, reducing bandwidth and capacity demands. The WMO Severe Weather Forecasting Demonstration Project, which supports developing country Met Services in their ability to provide basic warning services by cascading forecast information from advanced global and regional centres, provides chart images of selected forecast fields in formats like .png which can be downloaded on simple low bandwidth internet connections, getting the output from the most advanced global ensembles into use in some of the least developed countries.