Integration of Unique Weather Data Inputs to Improve Short-Term and Long-Range Forecast Accuracy – New Forecasting Products to Meet New Challenges

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ABSTRACT
The frequency of severe and inclement weather is increasing on a global basis impacting not only public safety but business operations and global supply chains. The value of accurate forecasts in a variety of industries and government functions, such as emergency management, water management, energy utilities, and aviation, is increasing as severe weather becomes more frequent and damaging.

Earth Networks integrates unique surface observation and total lightning data into its global forecast engine at high spatial and temporal resolutions, and uses recent forecast performance, bias at forecast points, and ensemble techniques to produce highly accurate forecasts for 19 different data elements. Error improvements when comparing gridded to statistical forecasts for a unique sensor point can be significant – especially in the 0-24 hour range, but as well as into the 7-15 day extended range.

IMPROVED FORECAST MODEL PERFORMANCE
The infusion of localized, real-time weather information into numerical weather prediction improves the accuracy of short-term forecasts, as does utilizing the highest-resolution models and updating the forecast frequently with the latest observations. Research confirms that model performance is increased with the integration of current observation data regardless of location and season (Huang et al, 2012).

The Earth Networks proprietary global forecast engine, ENcast, utilizes the largest available set of global models as inputs to generate highly accurate forecast outputs. The Earth Networks surface observation network of 10,000 proprietary sensor locations contribute near real-time data inputs into the forecast engine which contribute to the accuracy improvements of forecast outputs.

The forecast engine uses the ECMWF (12.5 km global resolution) and GFS ensemble groups, the Canadian GEM, the NAM and hourly updated solutions such as the RUC and LAMP MOS. The high resolution of the ECMWF along with its 15-day temporal resolution allows global forecast generation for any point at high accuracy. A high resolution nested-grid of 4km over the U.S. and Europe increases accuracy by allowing the forecast engine to generate improved forecasts using the high resolution proprietary lightning and surface observation inputs. The assimilation of near real-time global and total lightning inputs into the forecast engine contribute to the highly accurate convective initiation and probability forecast within the engine providing significant improvements in forecasting thunderstorm and severe weather events. Once integrated forecast accuracy is improved to provide the best forecast with the lowest RMSE.
VALIDATION

Validation is performed by comparing the ENCast forecast for a particular variable (temperature in the case of this document) with that produced by US National Weather Service (NWS) and international weather service forecast models.

In the following plots, each curve reflects the forecast from one such model, with each model identified in the legend. Note that the model output has been bias-corrected using a MOS or DMOS rather than using the raw model data.

In each case, the average forecast error (vertical axis) is plotted in degrees Celsius against the lead time of the forecast (horizontal axis). All plots correspond to forecasts made at 1200 UT.

AVERAGE OVER ALL METARs

METAR sites represent the most standard and widely used set of weather stations. They are typically located at airports or at permanent weather stations and employ a standardized group of observing instruments. In the US, there are approximately 1800 METAR sites. As such, an aggregate metric showing forecast performance averaged over the complete set of US METAR sites provides a relatively standard example for validation.

The figure below presents the results for a lead time out to 96 hours (4 days). For all models, the forecast error increases as a function of lead time, as would be anticipated, ranging from about 2 °C to 3.5 °C. ENcast (black line) performs better than all of the comparison models at all lead
times, with an improvement typically on the order of 0.25-0.5 °C depending on the comparison model.

The Earth Networks forecast engine, ENcast, provides improved forecast accuracy for global coverage through its proprietary weather station, METAR and custom sensor locations to deliver sensor-, city- and location forecasts.