0-6 hour Weather Forecast Guidance at The Weather Company

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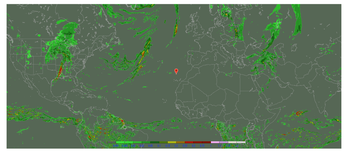
As part of The Weather Company's Forecast On Demand system (Neilley et al., 2015), 0-6 hour forecasts are derived from a combination of 1) extrapolated radar-based nowcasts, 2) rapid-update regional convective-allowing and Global NWP forecasts, 3) surface observations and 4) government issued weather warnings. Forecasts of precipitation (intensity, probability and type) and other sensible weather parameters (e.g. , temperature, cloud cover, wind speed) are rapidly updated to provide forecasts to 6 hours. In areas where radar data is available (including North America, Europe, Japan and Korea), forecasts are updated every 5-15 minutes. In other areas, forecasts are updated at the frequency of available NWP forecasts (at present time, hourly). In order to provide a complete forecast of sensible weather, the NWP forecasts also provide temperature, dew point, wind speed and direction, cloud cover, visibility and precipitation type. To assure consistency with observations and to provide increased skill, forecasts of temperature, dew point, cloud cover and wind are corrected by subtracting an error value that decays from the total error at the observation time to nil several hours into the forecast.

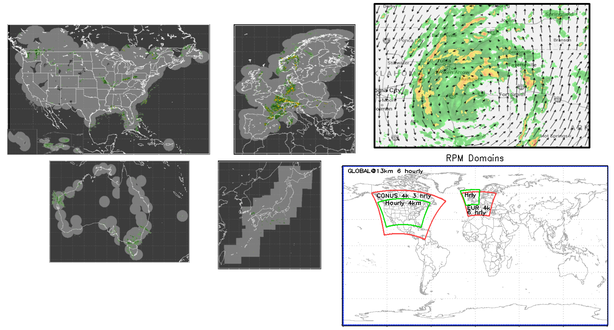
Domain Details

The Weather Company's 0-6 hour forecasts are generated on a global scale broken into 10 degree longitudinal sections across each hemisphere. These are then ingested by downstream applications which collate them into the final forecasts.



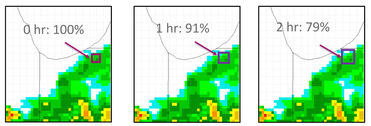
Input Datasets

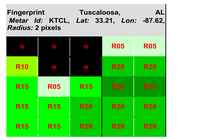
A combination of input datasets are used to generate the short term precipitation forecast. These include input from The Weather Company's NOWRad product which includes various global radar data sources including NEXRAD, OPERA, ABOM and JMA datasets. From the NOWRad dataset, precipitation motion vectors are generated. These motion vectors are also used as input to provide a radar based advection for the first few forecast hours. Finally The Weather Company's WRF based RPM model is used as the NWP component for the short term forecast. These RPM forecasts are run at convective-allowing scales (4 km) each hour over North America and Europe and at coarser resolution (13 km) globally every 6 hours.



Radar Extrapolation Probability of Precipitation

- Intensity-weighted spatial analysis at each grid point
  - Example: 20 km box on 4km grid
- Analysis box increases from 12 km to 40 km between 0 and 2 hours, then remains constant to 7 hours



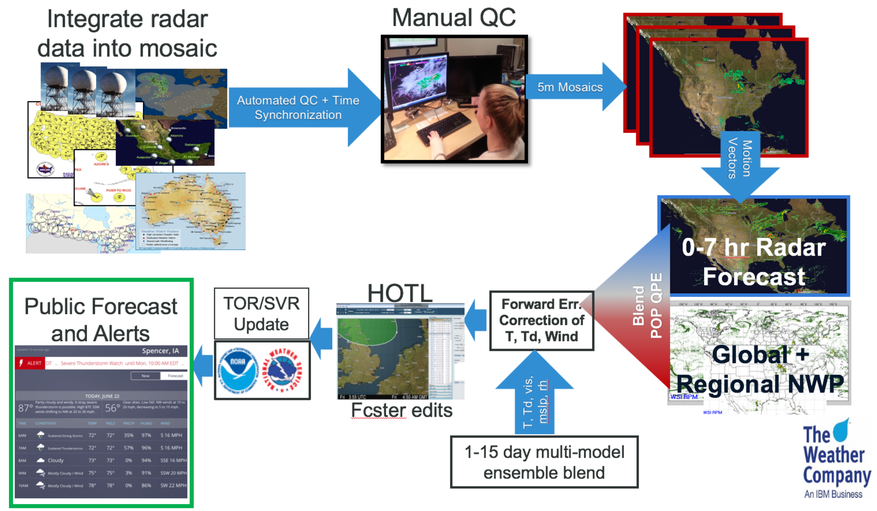


Coverage * Weighted Intensity
0.80 * 325 / 500
= 52% POP

Forecast Creation Process

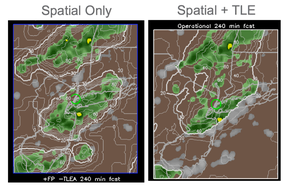
The 0-6 hour forecast begins with the collection of radar data which is then mosaiced into The Weather Company's Global NOWRad product. The NOWRad data is then quality controlled globally by using automated algorithms as well as on site meteorologists to remove anomalous propagation and false echoes. The NOWRad is then extrapolated forward out to 7 hours using a backward semi-lagrangian advection scheme based off the radar cells in previous NOWRad mosaics. This provides the radar-based forecasts of reflectivity that are then converted to QPE using Z-R relationships.. This is then temporally blended with the NWP forecasts to provide deterministic forecasts of precipitation rate throughout the 0-6 hour period. The temporal blending varies from favoring extrapolated radar forecasts early to favoring NWP forecasts later in the period. The weighting is dynamically adjusted based on local atmospheric instability to favor an earlier transition towards NWP forecasts when the atmosphere is more convectively unstable.

POP is calculated from both the radar-based nowcasts and the NWP forecasts at each forecast time by spatially analyzing the forecast precipitation rate within a radius of influence of the forecast point. NWP-based POP is further refined by weighted averaging of POP forecasts with common valid times from subsequent NWP cycles within the previous 9 hours (i.e., time-lagged ensemble). These forecasts are then temporally blended in the same way as the precipitation rate is blended. In order to provide a complete forecast of sensible weather, the NWP forecasts also provide temperature, dew point, wind speed and direction, cloud cover, visibility and precipitation type. To assure consistency with observations and to provide increased skill, forecasts of temperature, dew point, cloud cover and wind are corrected by subtracting an error value that decays from the total error at the observation time to nil several hours into the forecast. These NWP forecasted values are then run by a human over the loop (HOTL) forecaster who can modify values if needed.



Time Lagged Ensemble

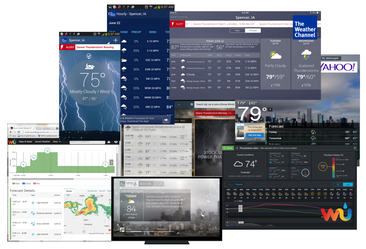
The short-term forecast POP is derived from a time-lagged ensemble of RPM model runs rather than a single RPM model run. In the US and UK, there are up to 8 time-lagged ensemble members contributing. In the rest of the world, there are 2-3 time-lagged ensemble members contributing. As shown in the figures, adding the time-lagged ensemble into the forecast allows for the 30% POP area to account for the probability of showers across the NY/CT region.



One Message, Multiple Platforms

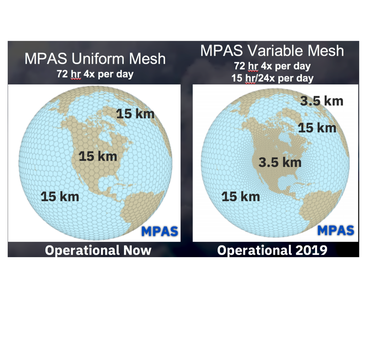
The Weather Company provides short term forecast information to multiple platforms including B2B and B2C applications. In order to maintain a clear meteorological message to the public, all government watches and warnings are presented to the users and the visual forecast message is adjusted accordingly:

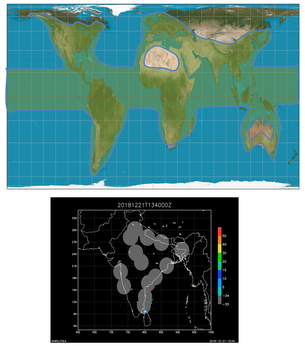
- TOR/SVR Warning "promote" textual forecasts
- NOWCAST Without Warning:
  - "Expect occasional thunderstorms to end at 3:30pm."
- NOWCAST When SVR Warning is issued:
  - "Showers and thunderstorms ending around 3:30pm. Some of the storms could be severe."



Future Enhancements

Several improvements to the 0-6 hour short term forecast process will be implemented in 2019. The Weather Company's is currently running a 15km Uniform Mesh MPAS instance which will replace the current 13km Global RPM model as the NWP component of the POP and QPE forecasts. In addition to the model replacement, an implementation of a Variable Mesh MPAS at 3.5km/15km will begin in 2019 and replace the US and UK regional RPM components. To compliment the model improvements, The Weather Company is continuing to add additional global radar datasets to its NOWRad products.





References

Neilley et al. (2015) 'Overview of The Weather Company's Principal Forecasting Methodologies', *27th Conference On Weather Analysis And Forecasting/23rd Conference On Numerical Weather Prediction*. 29 June–3 July 2015, Chicago, IL