Comments & Recommendations for the IFPS Science Steering Team (ISST)
Optimal Spatial and Temporal Resolution
Western Region Team

Scope: Within the limits of predictability, what are the optimal spatial and temporal resolutions needed to provide a useful and versatile digital service while maintaining scientific validity?

Recommendations

General

- Recommendation 1: The NDFD should provide nearly seamless forecast grids at several spatial and temporal resolutions to meet the needs of national and regional users.

-- Comments: Would meet the needs of users who want "smooth" graphics/grids for generating displays of the national forecast, and sophisticated users of the grids for input to other applications or modeling systems.

- Recommendation 2: The NDFD verification must be done at all spatial and temporal grid scales provided to users and must include all available observations.

-- Comments: Verification at all scales would provide an objective measure of forecast skill at varying spatial and temporal resolutions and provide a means of communicating forecast uncertainty to NDFD users as a first step. We recognize limitations imposed by the current state of the science; however, this first step is essential for service evaluation by field forecasters and users. As a first step, this verification could be done at one resolution and expanded to others as science progresses.

- Recommendation 3: We echo the continuing need for the ability to communicate forecast uncertainty in the forecast grids as addressed in the SOO White Paper.

-- Comments: Quantifying and communicating uncertainty is important in many aspects of the forecast process. In regards to resolution issues addressed here, uncertainties associated with forecasting at different spatial and temporal resolutions must be accounted for. Also, any technique or process that transforms a forecast or analysis from one resolution to another spatially or temporally must explicitly account for the change in uncertainty associated with that process.

Spatial Resolution

- Recommendation 1: Spatial resolution should remain fixed with forecast lead time. We believe the finest baseline resolution on a national NDFD scale should be 2.5 km.

-- Comments: Service needs differ across the country and must be accounted for on a national level. In mountainous terrain, a spatial resolution larger than 2.5 km does not adequately address the forecast needs of valleys narrower than 5 km with population centers or travel corridors. Since service needs do vary, we envision some WFOs creating 5 km grids which could be automatically downscaled for the NDFD national scale. We further believe that other service needs (i.e. fire weather, homeland security) will begin to push the NDFD toward a finer spatial resolution than we are recommending.

While we recognize increasing uncertainty (see *Temporal Recommendation 1 below*) with increasing forecast leadtime, we can not support decreasing spatial resolution with leadtime. First, the WFO workload required to spatially downscale forecast grids as they move into shorter forecast leadtime would not be sustainable. Second, the service issues for narrow mountain valleys (noted above) would not be satisfied and would artificially degrade the forecast as leadtime increases. In addition, we recognize the difficulty of reflecting the timing and movement of evolving and transitory mesoscale features (gust fronts, thunderstorms, sea breeze, dry line). At present, they are not being explicitly reflected in the grids with skill (or at all). However, we do not believe there is an explicit link between the spatial scale implemented in the NDFD and a requirement to incorporate these evolving and transitory mesoscale features within the NDFD. However, we do believe that some terrain forced mesoscale features can be explicitly reflected in the grids with skill because of their relative stationarity. A finer resolution would allow the incorporation of these terrain forced features. As science and forecast skill advances, finer resolution would allow (but not necessarily require) the incorporation of the more difficult evolving and transitory mesoscale features.

The NDFD and national AWIPS infrastructure does not adequately support a national 2.5 km spatial resolution; however, we believe the required enhancements are technologically feasible for implementation. The pressure of increasing service needs toward even finer resolution will likely accelerate as more users access the NDFD and we should invest in the necessary infrastructure now.

- Recommendation 2: Finer resolution than the minimum baseline resolution should be allowed on a regional or local scale to meet service needs not applicable to the entire NDFD.

-- Comments: Some service needs could be satisfied on a regional level. In the mountainous west, a spatial resolution of 1 km or less is required to adequately address the forecast needs of valleys narrower than 1 km with population centers or travel corridors. Some offices in WR are already noting some pressure from the fire community for a spatial resolution of 1 km. To further address these needs, we foresee a need for regional servers to provide a regionalized version of the NDFD (maybe an RDFD).

There is presently no regional or local WFO AWIPS infrastructure to support a regional or local spatial resolution below 2.5 km; however, we believe the required enhancements are technologically feasible for implementation and we should invest in the necessary infrastructure now.

Temporal Resolution

- Recommendation 1: Temporal resolution in the native WFO forecast grids should decrease with increasing forecast lead time.

-- Comments: Decreasing temporal resolution acknowledges the inherent increasing uncertainty in forecast skill with increasing lead time. We envision that each forecast element may have differing temporal resolution with time and one standard scheme would not be applied universally. An illustration follows in the attachment to this paper.

- Recommendation 2: Temporal resolution for some elements in the native WFO forecast grids should "float" to match forecast events and expectations.

-- Comments: WFO forecasters should be allowed to apply their meteorological skills and knowledge to reflect the weather scenario rather than being limited to fixed and arbitrary boundaries in time. We recognize this recommendation conflicts somewhat with Temporal Recommendation 1; however, some events are more confidently forecast than others and forecasters should have latitude to reflect that confidence. An example follows in the attachment to this paper.

- Recommendation 3: Temporal resolution in the NDFD should not "float" but rather be standardized and generated by automated processes within the NDFD database as needed by users.

-- Comments: This would allow forecasters to leverage their local skill and knowledge while providing standardized and uniform temporal resolution to national and regional users. The native WFO grids could be made available on regional grid servers for those customers that required the higher temporal resolution (see Spatial Recommendation 2). Note that a temporal downscaling process will introduce additional uncertainty into the forecast process which must be explicitly accounted for to be consistent with *General Recommendation 3* above.

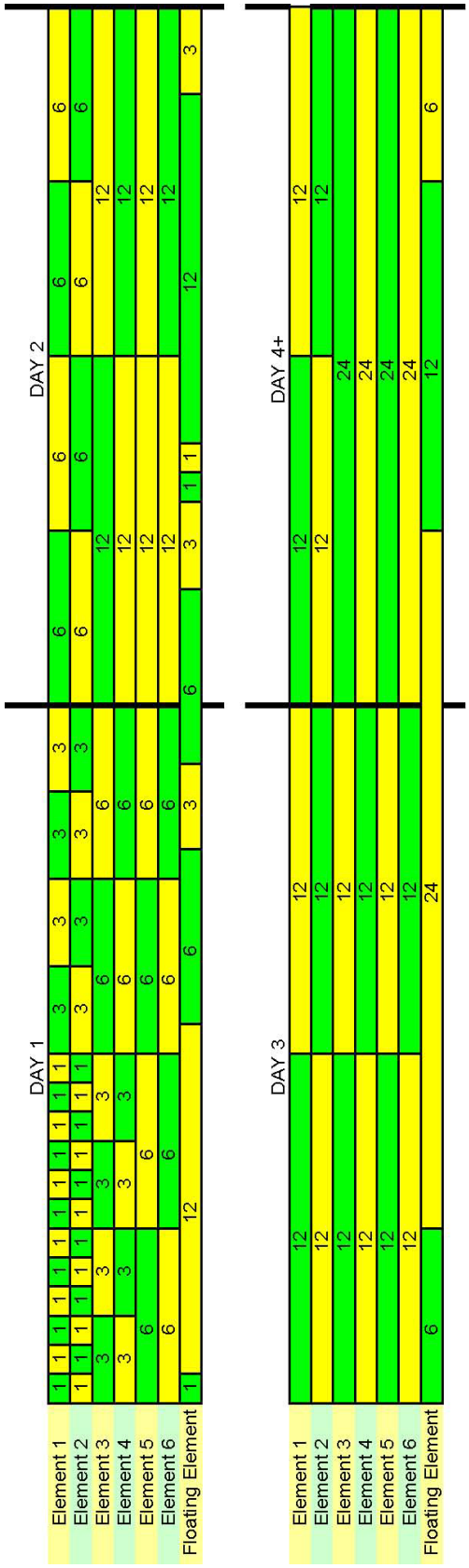
- Recommendation 4: The ISST should consider forming a working group to further examine issues surrounding NDFD temporal resolution.

-- Comments: The group could examine customer needs and forecaster workload to determine which grid elements should have floating temporal resolution. It could also research predictability theory and verification scores to determine appropriate temporal resolutions for various NDFD elements.

COMMENTS

- Comment 1: - We have purposefully and thoughtfully attempted to balance service needs with science and technology issues in our recommendations and comments above.

- Comment 2: - Our goal should be to put as much of our meteorological skill and knowledge into the forecast as possible. This is where forecasters can add the most value.

- Comment 3: - SR Report, 7/26/04, Main Response, Optimal Spatial Resolution, lines 8-11: We disagree with statement and question posed. We have historically forecast for points/locations without observations in an implicit sense. The difference today is that we are now doing it explicitly in forecast grids. In addition, we do not forecast thermodynamic and kinematic processes, we forecast elements.

Attachment Example of Temporal Resolution in Grids and Floating Grid