SOUTH DAKOTA SCHOOL OF MINES & TECHNOLOGY

Linking Weather Forecast Ensemble Spread to Forecast Risk and Confidence

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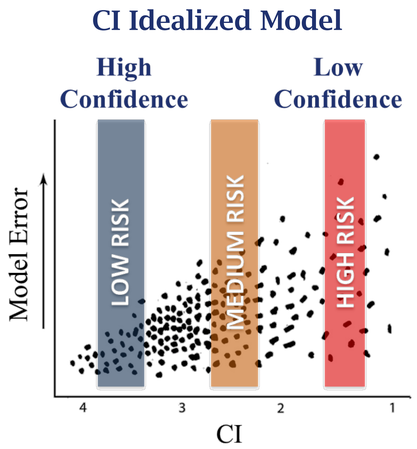
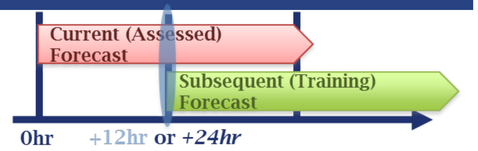
BIG WEATHER WEB

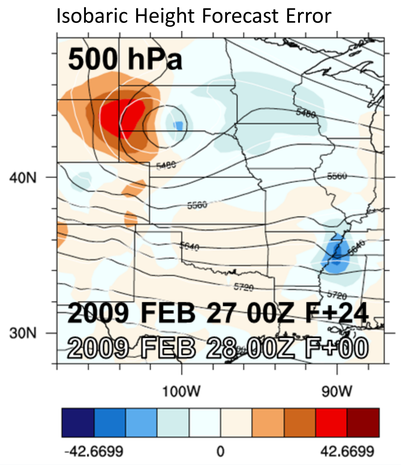
Forecast Confidence and Error

- Weather is inherently variable and unstable, but certain features within a system can affect uncertainty, making predictability high or low
- Confidence Index (CI) attempts to quantify meteorological hazards based on synoptic (large-scale) features
- CI identifies weather features that tend to result in model error. After features are assessed, a CI "score" is assigned
- A "high CI" implies a low range of possible error while a "low CI" implies a potential for both high and low forecast errors (some difficult forecasts verify)





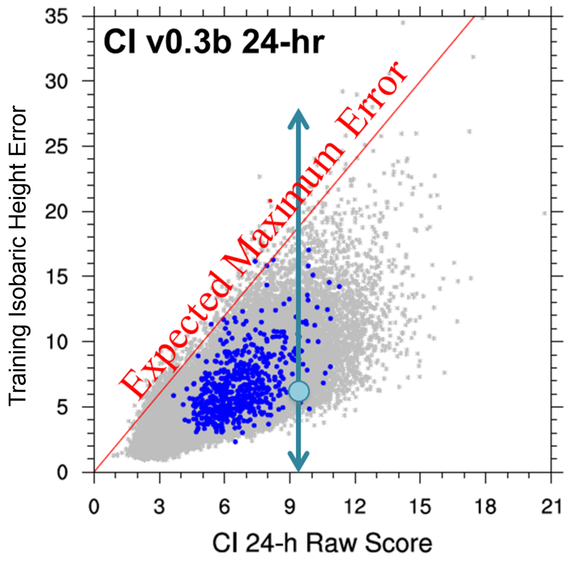
The 500-hPa height is currently used to examine forecast error



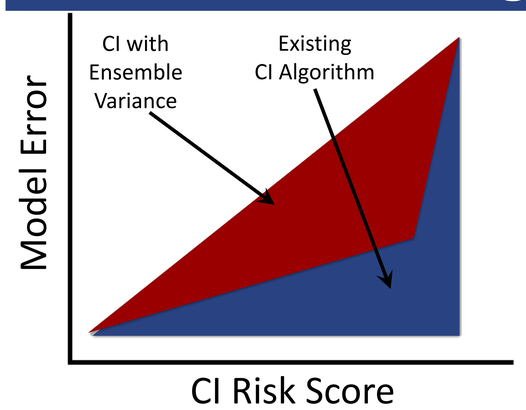
Quantifying Risk: The CI Approach

- To train CI_{raw} for a given region (which is analogous to system Fragility), we compare the assessed forecast to the subsequent forecast's analysis to obtain the expected CI_{raw} in a multivariate regression
- Meteorological Hazards ($Hazard_i$) are quantified and a multivariate regression is made to create the fitting coefficients, a_i
- Weather feature hazards commonly examined include
  - Closed lows and closed highs
  - Previous model performance
  - Size of observed gradients
  - Upper-level convergence and divergence
  - Jet streams
  - Convection
  - ***Ensemble Variance***
- These rules and fitting coefficients can then be applied to *new* forecasts as a decision-making tool

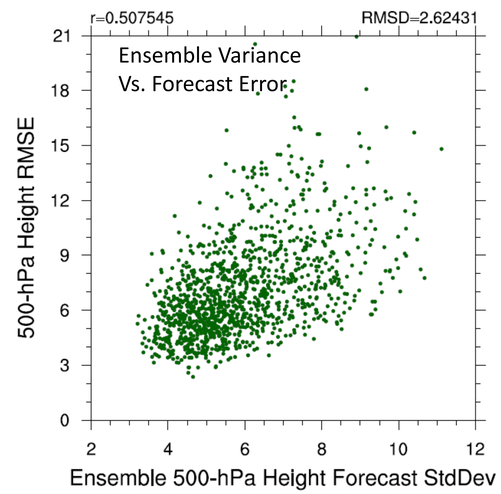
$$\overbrace{a_o + \sum_{i=1}^{N} a_i Hazard_i}^{Fragility\ or\ Error} = CI_{raw}$$

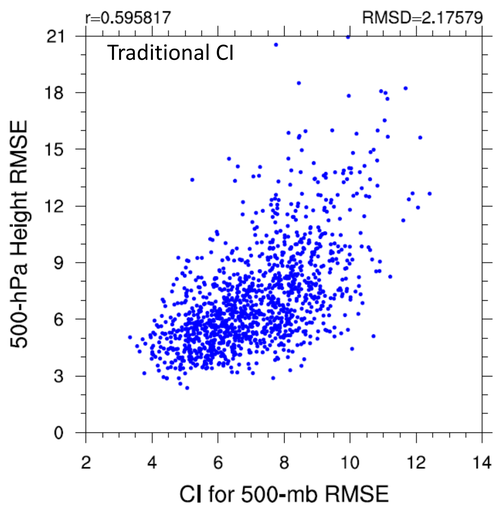


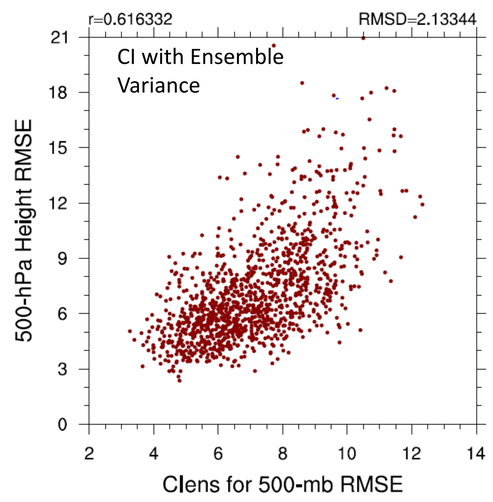
Combining CI and Ensembles



Can adding ensemble variance as an additional weather hazard to the other existing hazards used in CI improve the overall estimation of forecast confidence by creating a "tighter" wedge in CI/Error State Space?







- Traditional CI utilizes data acquired from the Global Forecast System (GFS)
- CI with Ensemble Variance utilizes data acquired from the Global Ensemble Forecast System (GEFS)
- The r-value improves when the ensemble data is added to the CI algorithm. Though the improvement is slight, our results did show an improved over all wedge shape, forming a tighter grouping, per our hypothesis
- The Root Mean Squared Difference (RMSD) also showed slight improvement

Reference: Capehart, W. J., D. V. Kliche, M. R. Hjelmfelt, R. D. Farley, G. Kierstead, P. Pick, and P. A. Haines, 2013: A confidence index for numerical weather prediction forecasts. Special Symposium on Advancing Weather and Climate Forecasts: Innovative Techniques and Applications, American Meteorological Society. **This work was supported by National Science Foundation Awards EEC-1461190, ACI-1450170, and US Army Contracts W15QKN-06-D-0006 Tasks 07 & 10. NSF# EEC-1461190**