Theme 2: Modeling, Data Assimilation and Advanced Computing

Forecast Uncertainty:
Ensembles, statistical post-processing, and decision support
Uncertainty in Weather Forecasts

- All weather forecasts are uncertain, some more than others
- Today's NWS forecasts are mostly deterministic, e.g., $T_{max} = 70^\circ F$
  - Exceptions: PoP, hurricane graphics
- Quantitative expression of uncertainty is required to "complete the forecast"
  - e.g., $P (67^\circ < T_{max} < 72^\circ) = 80\%$

uncertainty associated with forecasts from 3 initial states on Lorenz '63 attractor.
c/o Tim Palmer, ECMWF
NWS takes action, ESRL is there

- 2006 NRC report: *Completing the Forecast*
  Characterizing and Communicating Uncertainty for Better Decisions Using Weather and Climate Forecasts

- NWS Forecast Uncertainty Program
  - Requirements research
    - Ensemble workshops (Toth)
    - AMS Committee on Uncertainty in Forecasts (Hamill, Schultz, Toth)
      - *Important report coming soon!*
  - AWIPS prototypes (Schultz)
    - Ensemble browsing
    - Probabilistic forecasting
  - Role of the forecaster
    - Two workshops here at DSRC
  - New products and services
Probabilities

- 10/50/90 expression for temperature, dewpoint
  - Proposed at NCEP workshops
  - Vetted by NWS forecasters at ESRL workshops
- PQPF
- All on NDFD grid (2.5 km CONUS)
Multiple Scenarios

- Some users want to see the effects of weather forecast uncertainty in their decision support modules
  - Hydrology: family of hydrographs
  - Aviation: aircraft routing alternatives
- Bias-corrected ensemble members
  - NAEFS
  - ESRL/NCEP partnership
Decision Support by Forecasters

- Expanding on 100+ years of NWS tradition
  - IMET, Spot forecast program (forest fires, conventions)
    - Thin clients, smart phones
  - GoToMeeting support for airports, media, state DoT’s
- Probabilities and alternative scenarios inform forecasters
  - AWIPS tools developed by GSD
  - Forecaster workshops conducted at DSRC
Ensemble numerical weather prediction is critical to all three!
Ensemble Research at ESRL, p1

- Hydrometeorological Testbed
  - Supplemental forecasts for West Coast
  - Cloud-system resolving ensemble
  - PQPF
- NAEFS multiple scenarios
  - Based on US, Canadian ensembles
  - Bias corrected and downscaled to NDFD
- Experimental products for aviation (NextGen)
  - Probabilistic convection forecasts
Ensemble Research at ESRL, p2

- GFS reforecasts (see poster)
  - Improved treatment of rare events
  - Operational at NCEP
- Ensemble Kalman filter
  - Initializing ensembles
  - Improvements to 4DVAR
    - Collaboration with EMC
- Parameterizing model uncertainty
  - Spread correction in ensemble forecasts
- Stochastic physics experiments
ESRL Forecast Uncertainty Activities with NWS

- AWIPS developments
  - Ensemble manipulation, weighting, visualization
- NWS workshops:
  - forecasters + AWIPS developers
  - Probabilistic forecasting, Oct 08
  - Communicating uncertainty and decision support, Aug 09
  - Next-generation tactical weather info technology, Oct 09
- Personal Weather Advisor (see electronic poster)
  - Web-based decision support tool prototype
  - Interface to NWS probabilistic forecasts
End