CAPS Mission Statement

• The Center for Analysis and Prediction of Storms (CAPS) was established at the University of Oklahoma in 1989 as one of the first 11 National Science Foundation Science and Technology Center. Its mission was, and remains the development of techniques for the computer-based prediction of high-impact local weather, such as individual spring and winter storms, with the NEXRAD (WSR-88D) Doppler radar serving as a key data source.
Forecast Funnel

- Large Scale - provide synoptic flow patterns and boundary conditions to the regional scale flow.
- Regional Forecast - provide improved resolution for predicting regional scale events (large thunderstorm complexes, squall lines, heavy precipitation events)
- Storm Scale - predict individual thunderstorm and groups of thunderstorms as well as initiation of convection.
ARPS System

Data Acquisition & Analysis
ARPS Data Analysis System (ADAS)
- Ingest
- Quality control
- Objective analysis
- Archival

Parameter Retrieval and 4DDA
Single-Doppler Velocity Retrieval (SDVR)
4-D
Variational Velocity Adjustment
Data
Variational
Assimilation & Thermo-
dynamic Retrieval

Forecast Generation
ARPS Numerical Model
- Multi-scale non-hydrostatic prediction model with comprehensive physics

Product Generation and Data Support System
ARPS LTL and ARPS MEW
- Plots and images
- Animations
- Diagnostics and statistics
- Forecast evaluation

Incoming data
Lateral boundary conditions from large-scale models
- Gridded first guess
- Mobile Mesonet
- Rawinsondes
- ACARS
- CLASS
- SAO
- Satellite
- Profilers
- ASOS/AWOS
- Oklahoma Mesonet
- WSR-88D Wideband
Current ARPS Forecast Configuration

- ARPS is applied every day at 48, 32, 20 km at horizontal resolutions for research purposes (verification and testing new algorithms) see: http://www.caps.ou.edu/wx

### ARPS Forecasts & Analyses for Thu 12 Sep 2002

| SREF Anl | 00Z | 01Z | 02Z | 03Z | 04Z | 05Z | 06Z | 07Z | 08Z | 09Z | 10Z | 11Z | 12Z | 13Z | 14Z | 15Z | 16Z | 17Z | 18Z | 19Z | 20Z | 21Z | 22Z | 23Z | 13/00Z |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| SREF | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl | Anl |
| SREF | 00Z/10 | +48 | +50 | +51 | +52 | +53 | +54 | +55 | +56 | +57 |
| SREF | 00Z/11 | +24 | +25 | +26 | +27 | +28 | +29 | +30 | +31 | +32 | +33 | +34 | +35 | +36 | +37 | +38 | +39 | +40 | +41 | +42 | +43 | +44 | +45 | +46 | +47 | +48 |
| SREF | 00Z/12 | +01 | +02 | +03 | +04 | +05 | +06 | +07 | +08 | +09 | +10 | +11 | +12 | +13 | +14 | +15 | +16 | +17 | +18 | +19 | +20 | +21 | +22 | +23 | +24 |
Verification of ARPS Forecasts

• ARPS is verified daily to determine the accuracy of the current formulation and to test new forecast components and analyses

• Example: hourly verification of surface quantities at Oklahoma City, (temperature, dew point, pressure and wind speed and direction) for the 36 hr Southern plains region (15km resolution) forecast initiated 00UTC September 6, 2002

• Dashed lines represent observations and solid lines the model prediction
16 hr forecast valid Wed, 11 Sep 2002, 11 am CDT (16Z)
Radar, Clouds, MSL Pressure

Total Cloud Cover, filled, Min=0, Max=100 %
Composite Reflectivity, filled, Min=0, Max=52.26, Intvl=5 dBZ
Sea-Level Pressure, contour, Min=991, Max=1023, Intvl=4 mb
Future ARPS Forecast Configuration using OSCER

• Contribute to the NCEP Short Range Ensemble Forecast project (SREF)
• Conduct daily forecasts for verification of ARPS and new soil physics package
• Research in Data Assimilation (radar data retrieval)
• Weather Research and Forecast (WRF) model simulations (Ensembles)
• Perform high resolution nested forecasts for severe weather
## Proposed ARPS Forecast Configuration using OSCER

<table>
<thead>
<tr>
<th>AM</th>
<th>Local Time</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forecast Grid</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
</tr>
<tr>
<td>Conus 00Z (daily)</td>
<td>---30---</td>
<td>---30---</td>
</tr>
<tr>
<td>Conus 12Z (daily)</td>
<td>---30---</td>
<td>---30---</td>
</tr>
<tr>
<td>Conus 09Z SREF Ensembles-10 (daily)</td>
<td>240</td>
<td></td>
</tr>
<tr>
<td>Conus 21Z SREF Ensembles-10 (daily)</td>
<td>240</td>
<td></td>
</tr>
<tr>
<td>Regional-1 00Z (daily)</td>
<td>-100-</td>
<td></td>
</tr>
<tr>
<td>Regional-1 12Z (daily)</td>
<td>-100-</td>
<td></td>
</tr>
<tr>
<td>Severe Wx-1 15Z (daily)</td>
<td>-256-</td>
<td></td>
</tr>
</tbody>
</table>

Chart represents the number of processors required for each forecast and the length of the entry represents the wall time required by each forecast group. Table built by D. Weber (12/28/01).
OSCER Supercomputer Benchmarks

- ARPS was used to benchmark various computer systems during the OSCER supercomputer selection process.
- The benchmarks include single processor performance as well as parallel performance using the MPI paradigm.
- Note: a line with zero slope represents a perfect parallel machine (network and I/O) and lower numbers represent better performance.
ARPS Benchmark Timings
19x19x43 3km grid/processor

Processes:
- Itanium 733MHZ
- CAPS Origin 2000
- Platinum 1proc/node
- Platinum 2proc/node
- NCSA Origin 2000
- PSC ES-45
- PSC ES-40
- IBM WHII Power3
- IBM NHII Power3
- IBM Regatta Power4
- P4-1.6Ghz w/P3 Compile
- Compaq ES-45/EV-68 1GHz

Seconds on y-axis, Processors on x-axis.
OSCER Supercomputer Symposium

September 12, 2002

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The Center for Analysis and Prediction of Storms