Research to Operations/Applications

ESRL Physical Sciences Division
Science Review
May 12-14, 2015
# PSD Research to Operations

PSD works closely with NOAA operational entities to transition selected research advances into NOAA operations. These transitions are often funded and progress carefully monitored. A representative sample is shown below.

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Target Organization</th>
<th>Benefits/Impacts</th>
<th>TRL*</th>
<th>Transition Date</th>
<th>PSD Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Quality PM2.5 Post-Processing Algorithms</td>
<td>A set of codes to improve the skill of the NOAA/NCEP CMAQ air quality model for ozone and particulate matter forecasts through application of analog and Kalman filter post-processing schemes</td>
<td>NWS/NCEP Environmental Modeling Center</td>
<td>Post-processing of PM2.5 forecasts greatly improves model forecast skill, and an automated analog post-processing scheme reduces the need for state and local air quality forecasters to apply their own subjective corrections to the model forecasts</td>
<td>9</td>
<td>2014-2015</td>
<td>Irina Djalalova</td>
</tr>
<tr>
<td>Automated Digital Frost Forecast System</td>
<td>Gridded frost and heat forecasts for Russian River basin, CA</td>
<td>NWS Western Region</td>
<td>Forecasts allow water agency to plan for reservoir releases to accommodate crop spraying to mitigate for frost/heat. Growers can augment storage ponds prior to event to mitigate draw-downs in tributaries and mainstem Russian on frost days. Goal is to eliminate any fish strandings to restore endangered salmon species in Russian.</td>
<td>8</td>
<td>2014-2015</td>
<td>David Reynolds</td>
</tr>
<tr>
<td>C-LIM Tropical forecasts</td>
<td>Empirical model yielding forecasts (and a priori forecasts of forecast skill) for pentads (5-day running means) of tropical SSTs, OLR, and 200/850 mb winds, for forecast leads of 5-270 days.</td>
<td>NWS/NCEP Climate Prediction Center</td>
<td>CLIM will provide a nice complement and alternative for the forecast of anomalous tropical convection to that produced from purely physical models (i.e. CFS, etc.). CPC is already using the C-LIM to aid the NWS operational Global Tropics Hazards and Benefits Outlook prepared weekly at CPC, but also plans to use it as part of the upcoming experimental probabilistic Week 3-4 U.S. temperature and precipitation outlooks in the context of assessing the potential tropical - extratropical teleconnection.</td>
<td>6-7</td>
<td>2015</td>
<td>Matthew Newman</td>
</tr>
<tr>
<td>Product</td>
<td>Description</td>
<td>Target Organization</td>
<td>Benefits/Impacts</td>
<td>TRL*</td>
<td>Transition Date</td>
<td>PSD Contact</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>---------------------</td>
<td>------------------</td>
<td>------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Ensemble Kalman Filter Data Assimilation System</td>
<td>An ensemble-based data assimilation technique that incorporates flow-dependent estimates for forecast uncertainty. Became operational at NCEP in 2012.</td>
<td>NWS/NCEP Environmental Modeling Center</td>
<td>Improved accuracy of forecast initial conditions, which improves forecast skill</td>
<td>10</td>
<td>Implemented in NCEP operations May 2012, further improvements in subsequent upgrades.</td>
<td>Jeffrey Whitaker</td>
</tr>
<tr>
<td>Hydrometeorology Testbed Observations</td>
<td>Research observations collected throughout U.S., but most notably in CA</td>
<td>NWS Western Region</td>
<td>Provides real-time access to NWS offices, including RFC’s with SHEF-encoding for situational awareness</td>
<td>7</td>
<td>2013-2015</td>
<td>Daniel Gottas</td>
</tr>
<tr>
<td>Reforecasts</td>
<td>Transition of global medium-range reforecast capacity</td>
<td>NWS/NCEP Environmental Modeling Center</td>
<td>Dramatically improved weather and weather-climate forecast guidance supported by reforecast data sets and their use in statistical post-processing.</td>
<td>7-9</td>
<td>Expect funding for transition in 2015-2017 timeframe</td>
<td>Thomas Hamill</td>
</tr>
<tr>
<td>Sea Surface Temperature Diurnal Warming Amplitude Estimates</td>
<td>Modeled global estimates of instantaneous SST diurnal amplitude based on NWP analyses for incorporation in operational Global SST analysis</td>
<td>NESDIS</td>
<td>Improved SST product accuracy enabled by correction for diurnal warming influences on individual satellite retrievals</td>
<td>7</td>
<td>NESDIS Algorithm Readiness Review scheduled for April 2015; product operationalization to follow</td>
<td>Gary Wick</td>
</tr>
<tr>
<td>Stochastic Parameterizations of Model Uncertainty</td>
<td>Improves the representation of model uncertainty in ensemble forecast, improving forecast reliability and analysis accuracy. Became operational in the EnKF DA system at NCEP in 2014.</td>
<td>NWS/NCEP Environmental Modeling Center</td>
<td>Improved reliability of forecast ensembles, improved analysis accuracy.</td>
<td>9</td>
<td>Implemented in NCEP operations in 2015 for the EnKF analysis cycle, preparing for implementation in the medium range global ensemble system in 2016.</td>
<td>Jeffrey Whitaker</td>
</tr>
</tbody>
</table>

*Technology Readiness Levels*

**TRL 1: SCIENTIFIC RESEARCH**

- Basic principles have been observed and reported
- Essential characteristics and behaviors of systems and architectures have been described
- Descriptive tools are mathematical formulations or algorithms
TRL 2: APPLIED RESEARCH
- Technology concept and/or application formulated
- Theory and scientific principles are focused on specific application area to define the concept
- Characteristics of the application are described
- Analytical tools are developed for simulation or analysis of the application

TRL 3: PROOF OF CONCEPT
- Analytical and experimental critical function and/or characteristic proof-of-concept
- Active research and development is initiated with analytical and laboratory studies
- Demonstration of technical feasibility using breadboard or brassboard implementations that are exercised with representative data

TRL 4: COMPONENT VALIDATION
- Component/subsystem validation in laboratory environment
- Standalone prototyping implementation and test
- Integration of technology elements
- Experiments with full-scale problems or data sets

TRL 5: PROTOTYPE TESTING
- System/subsystem/component validation in relevant environment
- Thorough testing of prototyping in representative environment
- Basic technology elements integrated with reasonably realistic supporting elements
- Prototyping implementations conform to target environment and interfaces

TRL 6: TESTING IN AN END-TO-END ENVIRONMENT
- System/subsystem model or prototyping demonstration in a relevant end-to-end environment
- Prototyping implementations on full-scale realistic problems
- Partially integrated with existing systems
- Limited documentation available
- Engineering feasibility fully demonstrated in actual system application

TRL 7: DEMONSTRATION IN AN OPERATIONAL ENVIRONMENT
- System prototyping demonstration in an operational environment
• System prototyping demonstration in operational environment
• System is at or near scale of the operational system, with most functions available for demonstration and test
• Well integrated with collateral and ancillary systems. Limited documentation available.

TRL 8: SYSTEM DEVELOPMENT COMPLETED
• Actual system completed and “mission qualified” through test and demonstration in an operational environment
• End of system development
• Fully integrated with operational hardware and software systems
• Most user documentation, training documentation, and maintenance documentation completed
• All functionality tested in simulated and operational scenarios
• Verification and validation completed
• TRL 9: System Fully Operationally Integrated
• Actual system “mission proven” through successful mission operation
• Fully integrated with operational hardware/software systems
• Actual system has been thoroughly demonstrated and tested in its operational environment
• All documentation completed
• Successful operational experience
• Sustaining engineering support in place