Day	Time	Location	Presenter	Title
Talks				
Monday	11:45 AM	221A-C	Bill Lapenta	The Next Generation Global Prediction System
Wednesday	10:30 AM	132AB	Woody Roberts	Services Update
Wednesday	10:45 AM	229A	Jim Doyle	Revisiting Kalnay's "Rules for Physics Interoperability" 25 Years Later
Wednesday	1:45 PM	224B	Melinda Peng	Navy Global Coupled System Developed under the Earth System Prediction Capability (ESPC)
Wednesday	4:30 PM	232A-C	Jessie Carman	The National Earth System Prediction Capability - Update
Wednesday	4:45 PM	224A	Carolyn Reynolds	Navy Global Predictions for the DYNAMO Time Period
Thursday	8:30 AM	232A-C	Fred Toepfer	The NWS Research to Operations Initiative: The Next Generation Global Prediction System
Thursday	9:30 AM	128AB	John Michalakes	Next Generation HPC and Forecast Model Application Readiness at NCEP
Posters				
Monday	2:30-4:00 PM	Hall 4 391A	Patrick Tripp	A Generalized Physics Interface for Operational NWP Models
Wednesday	2:30-4:00 PM	Hall 4 884	Mark Iredell	The NCEP Global Forecast System in 2015
Wednesday	2:30-4:00 PM	Hall 4 839	Hong Guan	A Robust Post-processing Algorithm Based on Bayesian Model Averaging
ESPC Related Topics				
Monday	11:00 AM - 2:00 PM	Sheraton South Mountain Room	Zoltan Toth	Final Meeting of the U.S. THORPEX Executive Council (USTEC) and Initial Planning Meeting for the (Ad-hoc) U.S. Weather Research Coordination Committee
Wednesday	12:15 PM - 1:15 PM	126BC	Sharanya Majumdar	Town Hall Meeting: Post-THORPEX Legacy Projects: High-Impact Weather and a new proposed US Initiative

Monday, 5 January 2015: 11:45 AM
221A-C (Phoenix Convention Center - West and North Buildings)

***Bill Lapenta**, NOAA/NWS/NCEP, College Park, MD; and F. Toepfer*
The new NWS Research to Operations Initiative has an overarching goal to design, develop, and implement the Next Generation Global Prediction System (NGGPS). The current Global Forecast System (GFS) is the backbone of today's operation Numerical Weather Prediction suite. Over the next few years, NWS will upgrade its current operational Global Forecast System (GFS) to run operationally as a fully coupled atmosphere-ocean-ice-wave-land-aerosol system The current GFS will most likely be retrofitted with a new dynamic core enabling enhanced operational performance along with the capability to scale efficiently to 10-100 K (or

more) processors. The re-architected GFS software will expose and exploit orders of magnitude more thread and fine-grained parallelism, taking fullest possible advantage of the next-generation of High Performance Computing systems. This improvement, along with continued improvements to the GFS physics, data assimilation, system horizontal and vertical resolution as well as continued improvement to the other component forecast systems and software engineering will position the NWS to continue advancing the operational performance and associated skill of its current operational NWP skill to longer periods while remaining competitive with other international systems at shorter time periods. This undertaking is intended to advance the Nation's readiness and resilience to high impact weather events by improving accuracies and lead-times of forecasts. It can only succeed with the combined efforts of the broad weather community in the US, both Government and the private sector. This paper will outline our vision of the future NGGPS, describe the broad strategy needed to achieve a world-class operational Next Generation System and outline our approach to ensure the participation of the community.

Wednesday, 7 January 2015: 10:30 AM-12:00 PM
132AB (Phoenix Convention Center - West and North Buildings)

Host: **31st Conference on Environmental Information Processing Technologies**
Facilitator: William Roberts, ESRL Global Systems Division, OAR, Boulder, CO
Papers:

10:30 AM	Welcoming Remarks
10:35 AM	Discussion
11:45 AM	Concluding Remarks
Panelists:	Dr. Sullivan, Dr. Uccellini, Dr. Kaye, and RADM White

Wednesday, 7 January 2015: 10:45 AM
229A (Phoenix Convention Center - West and North Buildings)

***James D. Doyle**, NRL, Monterey, CA; and **M. Iredell**, P. Tripp, J. Dudhia, T. Henderson, J. Michalakes, J. A. Ridout, J. Rosinski, S. Rugg, R. Adams Selin, T. R. Whitcomb, K. Lutz, and D. McCarren*
One of the motivations for the Kalnay et al. (1989, BAMS, 620-623) rules for interchange of physical parameterizations was that “progress in operational numerical weather prediction and atmospheric modeling has been slowed by the difficulties of testing new schemes developed at different centers, and even within a center….”. These guidelines or rules to help facilitate the interchange of Fortran subroutines for physical parameterizations have been widely adopted over the past 25 years, and the operational and research numerical weather prediction (NWP) communities have benefited from this insightful contribution from Dr. Kalnay and collaborators. However, during this 25 year time span, computational hardware and software needed for operational NWP have changed considerably. For example, parallel computing technology, Message Passing Interface (MPI), accelerators, new Fortran standards (e.g. Fortran 90, Fortran 95, etc.), more complex physical parameterizations, have become more widely used in the past two decades. To address some of these new technical challenges, a multi-agency Physical Interoperability (PI) group has formed to modernize the Kalnay rules, as part of the National Unified Operational Prediction Capability (NUOPC). In this presentation, we will highlight some of the recommendations the PI group has made to the original Kalnay rules in order to address some of the new computational and technical challenges. Additionally, we will discuss the design and development of a software driver interface that will allow for the incorporation of

physical parameterizations into operational and research NWP models in an efficient and standardized manner, much in line with the original vision of Kalnay et al. (1989).

Wednesday, 7 January 2015: 1:45 PM
224B (Phoenix Convention Center - West and North Buildings)

***Melinda Peng**, NRL, Monterey, CA*
In the face of public awareness of high-impact weather events around the globe and the changing climate environment, a number of calls have appeared seeking revolutionary collaboration among agencies and between the weather and climate communities to significantly advance our prediction capability to benefit citizens, warfighters, and policymakers. The Earth System Prediction Capability (ESPC) represents the national response to this need and many challenges, both present and future. It is recognized that the nation needs a new operational global earth system model consisting of high-resolution atmosphere, ocean, ice, land, and space components capable of seamless prediction from zero hour to three decades within the next ten years. The ESPC will address the scientific, technical, computational, and organizational challenges to meet this ambitious goal. ESPC will leverage collaborative strengths among agencies while recognizing differences in participants' specific requirements. Earth system modeling requires collaboration between scientists specializing in fields from the seabed to outer space and requires participation from public, private, and academic entities and will connect agencies in both research & operations. This presentation entails the Navy's effort in developing a global full coupled system including NAVGEM (atmosphere), HYCOM (ocean), CICE (sea ice), wave (WW III) and land model under ESPC. Current status, challenge, and future plan of the system will be discussed.

Wednesday, 7 January 2015: 4:45 PM
224A (Phoenix Convention Center - West and North Buildings)

***Carolyn A. Reynolds**, NRL, Monterey, CA; and J. A. Ridout, M. Flatau, J. Chen, J. G. Richman, T. G. Jensen, and J. F. Shriver*
The performance of 30-day simulations of the Navy Global Environmental Model (NAVGEM) is evaluated under several metrics. The time period of interest is the DYNAMO (Dynamics of Madden Julian Oscillation) field experiment period, starting late October 2011. The NAVGEM experiments are run at an effective 37-km resolution with several different SST configurations. The in the first set of experiments, the initial SST analysis, provided by the NCODA (Navy Coupled Ocean Data Assimilation) system, is either held fixed to the initial value (fixed SST) or updated every 6 hours. These forecasts are compared with forecasts in which the SST is updated with 3-h analyses from the Hybrid Coordinate Ocean Model (HYCOM), and forecasts in which NAVGEM is interactively coupled to HYCOM. Experiments are also performed with different physical parameterization options. The extended integrations are verified using observed OLR, TRMM precipitation estimates, and global analyses.
The use of fixed SSTs is clearly sub-optimal. Biases in monthly mean fields are far more pronounced in the simulations where the SST is held fixed as compared to those in simulations where updated SST analyses are used. Biases in the monthly mean fields are further reduced when NAVGEM is coupled to HYCOM. Differences in SST can “migrate” to substantial changes in the time-mean land-surface temperatures, illustrating the substantial impact of SSTs over the full domain. Concerning the simulation of the MJO, some improvement is noted when the system is fully coupled, although the simulations still exhibit deficiencies such as eastward propagation that is too slow, and difficulty propagating over the maritime continent. Simulations that are started every 5 days indicate that the NAVGEM uncoupled system has difficulty predicting MJO initiation, but simulations started when the MJO is active in the Indian Ocean are able to capture eastward propagation characteristics. The

coupled NAVGEM-HYCOM system shows ability to capture the initiation of an MJO event 20 days into the forecast.

Wednesday, 7 January 2015: 4:30 PM
232A-C (Phoenix Convention Center - West and North Buildings)

***Jessie C. Carman**, OAR, Silver Spring, MD; and D. Eleuterio, D. McCarren, and F. Toepfer*
The National Earth System Prediction Capability (National ESPC) inter-agency program is an ongoing effort to improve collaboration across the environmental research and operational prediction communities for the development and implementation of improved national physical earth system prediction. The Nation's security and economic well-being rely upon accurate global analysis and prediction capabilities for the physical environment over time scales of a few days to weekly, monthly, seasonal and longer lead times. This project involves an operational ensemble capability, common post processing and product development, infrastructure to support more collaborative and interoperable model development and a shared vision and R&D goals for ongoing and future efforts. Progress in all areas has been significant over the course for the past 12 months and roadmaps and future plans continue to move forward. Efforts in the five R&D focus areas continue to strengthen as the partnering agencies continue to garner support from with their organizations and the broader community recognizes the need for this unifying project for a National direction for an improved National Capability.

Thursday, 8 January 2015: 8:30 AM
232A-C (Phoenix Convention Center - West and North Buildings)

***Fred Toepfer**, NOAA/NWS, Silver Spring, MD; and D. DeWitt and H. Tolman*
The NWS Research to Operations Initiative has an overarching goal to design, develop, and implement the Next Generation Global Prediction System. Over the next 5 years, the NWS will upgrade its current operational Global Forecast System (GFS) to run operationally as a fully coupled atmosphere-ocean-ice-wave-land-aerosol system. The re-architected GFS software will expose and exploit orders of magnitude more thread and fine-grained parallelism, taking fullest possible advantage of the next-generation of High Performance Computing systems. The current GFS will most likely be retrofitted with a new dynamic core enabling enhanced operational performance along with the capability to scale efficiently to 10-100 K (or more) processors. This improvement, along with continued improvements to the GFS physics, data assimilation, system horizontal and vertical resolution as well as continued improvement tothe other component forecast systems and software engineering will position the NWS to continue advancing the operational performance and associated skill of its current operational NWP skill to longer periods while remaining competitive with other international systems at shorter time periods. An undertaking of this magnitude can only succeed with the combined efforts of the broad weather community in the US, both Government and the private sector. This paper will outline our vision of the future NGGPS, describe the broad effort to achieve a world-class operational Next Generation System and propose specific mechanisms to ensure the participation of the broader community.

Thursday, 8 January 2015: 9:30 AM
128AB (Phoenix Convention Center - West and North Buildings)

***John Michalakes**, NOAA; and M. J. Iacono*
We describe efforts at the NOAA National Centers for Environmental Prediction to ready operational forecast models for new generations of HPC systems expected in the 2018-20 time

frame and beyond. These systems will provide dramatically higher peak floating-point rates – multi-petascale verging to exascale – but proportionately less of everything else that matters for performance: memory bandwidth, cache capacity, thread-speed, and I/O bandwidth. Efficient use of the Intel Xeon Phi Many Integrated Core (MIC) architecture, Graphics Processor Units (GPUs) from NVIDIA, and successive generations of "conventional" multi-core processors will require greater concurrency, fine-grained parallelism, and memory system performance. We characterize existing performance bottlenecks in these areas by direct measurement using hardware counters, analyses of run-time traces and timers, and static analyses (compiler generated reports and manual inspection) of loops and data structures.
Detailed analysis of column-physics components such as RRTMG radiation and other model components shows that threads executing these packages are state-heavy and thereby exhaust local storage: cache memory on conventional CPU and MIC cores or shared memory on GPUs. Fine-grained parallelism (vectorization on Xeon and thread parallelism on GPUs) is inhibited by data-dependencies in the vertical dimension of column physics. And while there is fine-grained parallelism over dependency-free horizontal dimensions of weather model domains, processing a vector of state-heavy grid columns per thread only exacerbates aforementioned per-thread pressure on local storage. In spite of these constraints, various code and data restructuring techniques have yielded performance gains for RRTMG on next-generation processors. Better still, these changes also result in improved performance on the host processor.
We will also touch on efforts to improve software architecture and processes at NCEP for developing, maintaining, and using high-performance codes for operations and research, touching on the inherent trade-offs between modularity and performance. And we will provide an overview of efforts underway to strengthen connections to the research community as we evaluate new dynamics, grid systems, and scale-appropriate physics informing development of a Next Generation Global Prediction System (NGGPS) at NCEP.

Monday, 5 January 2015: 2:30 – 4:00 PM
Hall 4 (Phoenix Convention Center – West and North Buildings)
1st Poster Session on Research to Operations: 391

Patrick Tripp**, NOAA/NWS/NCEP, College Park, MD; and **M. Iredell

Several different numerical weather prediction (NWP) models in use at the National Centers for Environmental Prediction Environmental Modeling Center (NCEP/EMC) use similar physics packages each with some differences in the interfaces, code structure, and underlying computations. As part of a multi-agency Physical Interoperability (PI) group, a part of the National Unified Operational Prediction Capability (NUOPC) program, we have developed a prototype driver enabling different models in the National Environmental Modeling System (NEMS) to use a common physics interface. In this presentation, we will describe the current progress of this work, discuss some of the design and technical issues encountered, and highlight some of the recommendations from different stakeholders in order to improve the overall design, implementation, and eventual transition into operations.

Wednesday, 7 January 2015: 2:30 – 4:00 PM
Hall 4 (Phoenix Convention Center – West and North Buildings)
Poster Session 1, Eugenia Kalnay Symposium: 884

***Mark Iredell**, NOAA/NWS/NCEP, College Park, MD*

Eugenia Kalnay was director of the NMC Development Division, later called the NCEP Environmental Modeling Center, for over ten years. In that time, one of her most important missions was to bring the standard of global numerical weather prediction at NCEP up to the

highest international standard. Today in 2015, the Global Forecast System (GFS) is a cornerstone of numerical weather prediction in NOAA, giving 13 km horizontal resolution forecasts four times a day out to ten days. A quick history of the GFS will be reviewed, along with the current science and evaluation of the present state-of-the-art data assimilation and modeling system behind the GFS, as well as a glimpse of the future.

Wednesday, 7 January 2015 2:30 – 4:00 PM

Hall 4(Phoenix Convection Center – West and North Buildings)

Model Post-processing and Downscaling: 839

***Hong Guan**, I.M. Systems Research Group Inc./EMC/NCEP/NOAA, College Park, MD; and Y. Zhu and B. Cui*

A post-processing algorithm named as Recursive Bayesian Model Process (RBMP) has been developed to apply multi-model (ensemble) forecasts. The method is mainly based on Bayesian Model Averaging (BMA) (Raftery et al. 2005). We adopted the station-based BMA codes developed in MDL to global grid-based codes to calibrate probability distributions for each grid in the global ensemble forecasts. The major task for this method is calculating the weights for each model and a uniform variance based on most recent model performance. These parameters are recursively updated using the decaying averaging technique in order to reduce storage space in operational forecasting.

One of the most important advantages of the BMA is increasing spread and improving under-dispersive of ensemble forecasts. However, this could lead to an over-dispersive problem when the ensemble forecasts were originally not under-dispersive. Therefore we also apply a 2nd moment adjustment process to the BMA-calibrated forecasts.

The RBMP was applied to NUOPC forecasts of 2-m temperature for the summer and fall of 2013. NUOPC combines the three global ensemble forecast systems (GEFS) from the NWS, MSC, and FNMOC. The method is efficient which improves ensemble forecast skill for all lead time with a maximum improvement for short lead-time forecasts. The RBMP is being applied to 10-m wind forecasts and other variables. The result will be also presented.

Final Meeting of the U.S. THORPEX Executive Council (USTEC) and Initial Planning Meeting for the (Ad-hoc) U.S. Weather Research Coordination Committee

Monday, 5 January 2015, 11 am – 2 pm

Sheraton Phoenix Downtown Hotel, South Mountain Room, 2nd Floor

*Facilitator: **Zoltan Toth**, ESRL Global Systems Division, OAR, Boulder, CO*

Laura Furgione (US Permanent Representative to WMO and Deputy Director), NWS will provide opening remarks on US THORPEX successes and congratulate its key contributors. The second part of the meeting will focus on the way forward to post-THORPEX interagency coordination and community engagement for US weather research. (Rapporteurs: Sharan Majumdar and Carolyn Reynolds)

Town Hall Meeting: Post-THORPEX Legacy Projects: High-Impact Weather (HIWeather) and a new proposed US initiative

Location: 126BC (Phoenix Convention Center - West and North Buildings)

*Speaker: **Sharanya J. Majumdar**, Univ. of Miami/RSMAS*

This Town Hall comprises two interconnected projects: the WMO/WWRP High-Impact Weather Project (HIWeather), and a new US initiative to develop a plan that integrates US interests in

HIWeather with two other WMO/WWRP projects: the Polar Prediction and Subseasonal-to-Seasonal Prediction projects. This Town Hall will provide an opportunity to find out more about the activities that are planned and to question those involved about how to get involved. Despite dramatic improvements in forecast accuracy in the last decade, the global cost of high impact weather continues to grow at an alarming rate. HIWeather will focus global research on those aspects of the weather enterprise, both science- and service-related, that currently inhibit effective responses to forecasts and warnings, especially with regard to the impacts of urban flooding, wildfires, local extreme winds, disruptive winter weather and extreme heat/air pollution in megacities. Working together on these problems will both accelerate progress and enable less developed nations to benefit. In parallel, efforts have been underway since mid-2014 to engage the US community in the three aforementioned WMO/WWRP projects, and for participants to identify critical gaps, common scientific challenges and priorities. The next stage in the US is to develop a coordinated community project plan. In addition to introducing the structure for a US project plan, Town Hall participants are encouraged to provide feedback on the path forward, and contributions from the community to the drafting of the US project plan are encouraged.