# Symposium on the 50th Anniversary of Operational Numerical Weather Prediction

14-17 June 2004
University of Maryland
University College Inn and Conference Center

**Co-chair: Dr. Louis Uccellini, Director, National Centers for Environmental Prediction**
**Co-chair: Dr. Eugenia Kalnay, Distinguished University Professor, University of Maryland**

**Program Committee**

**Ken Campana**
**Ken Carey**
**R. Michael Clancy**
**Lt Col Robert Falvay**
**Kris Harper**
**Marjorie Huntington**
**Joe Irwin**
**Lauren Morone**
**Al Moyers**
**Anders Persson**
**Carl Thormeyer**
**Major Jimmie Trigg**

## Monday, June 14

### Evening

5:00-8:30pm Registration

**5:00pm** **Ice Breaker Reception - Hosted by Team NPOESS**

**6:00-8:00pm** **Historical Overview of Operational NWP**

Moderator: Jim Fleming, President, International Commission on the History of Meteorology

Presenters

Al Moyers, Air Force Weather Agency (AFWA)
Joe Irwin, National Centers for Environmental Prediction (NCEP)
Kris Harper, American Meteorological Society (AMS) History Committee
Anders Persson, Swedish Meteorological and Hydrological

Institute

Tuesday, June 15

Morning

7:30am-6:00pm Registration

**8:00am** **Welcoming Remarks**

Louis Uccellini, NCEP Director
Colonel John Lanicci, AFWA Commander
Captain Christopher Gunderson, Fleet Numerical Meteorology and Oceanography Center (FNMOC) Commanding Officer
Dean Steve Halperin, College of Computer, Mathematical and Physical Sciences, University of Maryland

**8:20am** **Opening Remarks**
John Jones, Deputy Assistant Administrator for Weather Services, NOAA

**Session 1:** **Operational Forecasting and the JNWPU**
Session Chair: Ronald McPherson, AMS Executive Director

8:40am Richardson's Forecast: What Went Wrong?
*Peter Lynch, Assistant Director, Irish Meteorological Service*

**9:05am** **Historical Round Table Discussion***
Moderator: Ronald McPherson, AMS

Norm Phillips, MIT (NMC/NCEP, ret.)
Fred Shuman, National Meteorological Center (NMC/NCEP ret.)
Harry E. Nicholson, FNMOC (CAPT, USN, ret.)
Bo Doos, Global Environmental Management, Stockholm, Sweden

***Group Photo Opportunity**

**10:00-10:30am** **Break**

**Session 2:** **Evolution of Supercomputers and Forecast Models**
Session Chair: Bob Plante, Raytheon (ret.)

10:30am 2.1 30 Years of Navy NWP Modeling and Supercomputers: An Anecdotal History
*Tom Rosmond, Naval Research Laboratory (NRL), Monterey, CA*

## Tuesday, June 15

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| 10:55am | 2.2 and | The Interplay of Computer Power, Computer Architecture, and Numerical Algorithms in the progress of Numerical Weather Prediction<br>*Anthony Hollingsworth, European Centre for Medium-Range Weather Forecasts* |
| 11:20am | 2.3 | The 1953 North Sea Gale in Perspective of Historical NWP Efforts<br>*H. M. van den Dool, R.E. Kistler and S. Saha NOAA/NCEP/Climate Prediction Center* |
| 11:35am | 2.4 | A Historical Perspective on the Role of NWP Models in the Prediction of Severe Local Storms<br>*Steven Weiss and Joseph Schaefer, NOAA/NWS Storm Prediction Center, Norman, OK* |

## Afternoon

**12:00-1:30pm** **Poster Discussion and Lunch**
Poster Session Chair: Kris Harper, Independent Scholar/Historian of Science

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| Poster Session #1 | P1.1 | Trends in HPC Productivity for NWP Applications<br>*Stan Posey, HPC Applications Development, SGI* |
| | P1.2 | NPOESS Interface Data Processing Segment Architecture and Software<br>*Kevin Souza, Chad Fox, Kerry Grant and Scott Turek Raytheon Company* |
| | P1.3 | A Posteriori Improvement to Background Quality Control<br>*Leonid Rukhovets, SAIC and Global Modeling and Assimilation Office, NASA/Goddard Space Flight Center* |
| | P1.4 | A Simulation of the Interface between Binary Fluids with Different Densities by Lattice Boltzmann Method<br>*Jianhong Wang, Department of Mechanical Engineering, University of British Columbia, Canada*<br>*Chunsheng Miao, Nanjing Institute of Meteorology, P.R. China* |
| | P1.5 | Roots of Ensemble Forecasting<br>*John Lewis, National Severe Storms Laboratory, Norman, OK, Desert Research Institute, Reno, NV* |

Tuesday, June 15

**Session 3:** **Evolution of Operational Numerical Weather Prediction**
Session Chair: R. Michael Clancy, FNMOC

1:35pm 3.1 Numerical Weather Prediction at the Air Force Weather Agency
*Mark Surmeier, AFWA Air & Space Science Directorate*

2:00pm 3.2 NMC/NCEP Supercomputers and the Models that Consumed
Them: A Sordid Tale of Codependence
*Geoff DiMego, National Weather Service (NWS)/NCEP*

2:25pm 3.3 The Eta Model: Design, History, and Performance: What Lessons
Have We Learned?
*Fedor Mesinger, NCEP/Environmental Modeling Center (EMC),*
*and the University Corporation for Atmospheric Research, Camp Springs, MD*

2:40pm 3.4 The Spectral Method: Its Impact on NWP
*Ferdinand Baer, Department of Meteorology, University of Maryland*

**2:55-3:25pm** **Break**

3:25pm 3.5 The Emergence of Land-surface modeling in Modern-Era Numerical Weather Prediction: The NCEP Experience and Collaborations
*Kenneth E. Mitchell, NCEP/EMC*

3:40pm 3.6 Mesoscale Weather Prediction with the RUC Hybrid Isentropic-
Sigma Coordinate Model and Data Assimilation System
*Stan Benjamin[1*], Rainer Bleck[2], John Brown[1], Kevin Brundage[1], DezsoDevenyi[1], Georg Grell[1], Dongsoo Kim[1], Geoff Manikin[3], Barry Schwartz[1], Tanya Smirnova[1], Tracy Smith[1], and Steve Weygandt[1]*
*[1]NOAA Research/Forecast Systems Laboratory, Boulder, CO*
*[2]Los Alamos National Laboratory, Los Alamos, NM*
*[3]NCEP/EMC, Camp Springs, MD*

Tuesday, June 15

**Session 4:** **From Model Predictions to Forecasters: Then and Now**
Session Chair: Carlyle H. Wash, Naval Postgraduate School (NPS)

**4:00pm** **Panel Discussion***
Moderator: Carlyle H. Wash, NPS

Participants
Bob Glahn, NWS
Captain Chris Gunderson, FNMOC
Colonel John Lanicci, AFWA
Louis Uccellini, NCEP

***Group Photo Opportunity**

**5:00-6:00pm** **Poster Discussion and Historical Exhibition**
Poster Session Chair: Kris Harper, Independent Scholar/Historian of Science
Historical Exhibit Chair: Major Jimmie Trigg, AFWA Liaison to NCEP

Poster Session #2 Forecasts

P2.1 Intercomparison of Global Research and Operational

*Jennifer C. Roman, University of Utah, Gonzalo Miguez-Macho, Rutgers University, Lee Byerle and Jan Paegle, University of Utah*

P2.2 Recent Update of NCEP Operational Regional Spectral Model
*Jongil Han, RSIS at NCEP/EMC, and Hann-Ming Henry Juang*
*NCEP/EMC*

P2.3 A Vorticity Equation for Numerical Long Range Forecasting of the Coriolis Parameter in the Solar System
*John C. Freeman, Jill F. Hasling, and Robert A. Stacy*
*Weather Research Center, Houston, TX*

P2.4 Stratospheric Forecasting with NOGAPS-ALPHA
*Douglas R. Allen, Stephen D. Eckermann, and Lawrence Coy, Naval Research Laboratory, Washington, DC; Timothy F. Hogan and Young-Joon Kim, Naval Research*

*Laboratory, Monterey, CA*

P2.5 From Flatland to Himalayas: The Historical Orogeny of Model Orography,
*Torsten Duffy, FNMOC*

Tuesday, June 15

P2.6 NOGAPS-ALPHA: A Prototype High-Altitude Global NWP Model
*Stephen P. Eckermann, John P. McCormack, Lawrence Coy, and John McCormack, Middle Atmosphere Physics Section, NRL*
*Douglas Allen, Middle Atmosphere Dynamics Section, NRL, Washington DC; Tim Hogan and Young-Joon Kim, Global Modeling Section, NRL, Monterey, CA*

P2.7 The Interactive Gridded Analysis and Display System (IGrADS) for the U.S. Armed Forces
*R. Bruce Telfeyan and Jeremy J. Wesely, AFWA, Offutt Air Force Base, Nebraska*

P2.8 Implementing and Evaluating the Weather Research and Forecast (WRF) Model at the NWS WFO Jacksonville, Florida
*Pat Welsh and Art Wildman, NOAA/NWS Weather Forecast Office, Jacksonville, FL*
*Brent Shaw, John Smart, Jennifer Mahoney, and Mike Kay NOAA Forecast Systems Laboratory, Boulder, CO*

P2.9 The NRL Mountain Wave Forecast Model (MWFM)
*Stephen D. Eckermann, NRL, Washington DC*
*Jun Ma and Dave Broutman, Computational Physics, Inc., Springfield, VA*

P2.10 GEMS: A Revolutionary Observing System to Support the Next 50 Years of Numerical Weather Prediction
*John Manobianco, Randolph J. Evans, and Jonathan L. Case, and Joseph Dreher, ENSCO Inc., Cocoa Beach, FL*

P2.11 Ocean Hindcasts and Simulations from the new NCEP Global Coupled Forecast System
*Sudhir Nadiga, Jiande Wang, Wanqui Wang (SAIC at NCEP/EMC), and Suranjana Saha, Hua-Lu Pan and David Behringer, NCEP/EMC, Camp Springs, MD*

P2.12 Simulation of the Tropical Air-Sea Coupled System in the New NCEP coupled Forecast Model
*Jiande Wang, Sudhir Nadiga, Wanqui Wang (SAIC at NCEP/EMC), and Suranjana Saha, Hua-Lu Pan, Glenn White and David Behringer, NCEP/EMC, Camp Springs, MD*

## Tuesday, June 15

### Evening

**6:00pm** **Ice Breaker Reception - Hosted by Northrop Grumman Corporation**

## Wednesday, June 16

### Morning

7:30am-6:00pm Registration

**Session 5:** **From Model Predictions to Forecasters: Then and Now (cont.)**
Session Chair: Bill Bonner, NMC/NCEP (ret.)

8:00am 5.1 A Vision for Environmental Services as Numerical Weather Prediction Enters the Next 50 Years
*Jack Hayes, National Weather Service (NWS) Office of Science and Technology (Colonel, USAF, ret.)*

8:25am 5.2 A Customer Perspective on the Evolution of Numerical Weather Prediction as Applied to Naval Operations - The Real Story
*Carl Thormeyer, FNMOC*

8:50am 5.3 Evolution of the Relationship between Weather Forecasters and Numerical Models over the Last 50 Years
*James E. Hoke, NCEP*

9:05am 5.4 Initial State Sensitivity Experiments in a Real Data Model
*Celeste A. Saulo, University of Buenos Aires, Argentina, and Lee A. Byerle, Jennifer C. Roman, Jan Paegle, and Julia Nogues-Paegle, University of Utah, Salt Lake City, UT*

9:20am 5.5 HPC Operations
*Michael Schichtel and Peter Manousos Hydrometeorological Prediction Center, NOAA/NWS/NCEP*

9:35am 5.6 30 Years of Operational Ocean Wave Forecasting at Fleet Numerical Meteorology and Oceanography Center
*Paul Wittmann and R. Michael Clancy, FNMOC*

9:50am 5.7 Forecasting Oceanic Cyclones at the NOAA Ocean Prediction Center
*Joseph Sienkiewicz, Scott Prosise, and Anthony Crutch*
*NOAA/NWS/NCEP Ocean Prediction Center*

10:05am 5.8 Objective Interpretation of Numerical Weather Prediction Model Output – A Perspective Based on Verification of Temperature and Precipitation Guidance
*J. Paul Dallavalle and Valery J. Dagostaro*
*Meteorological Development Laboratory*
*Office of Science and Technology, NOAA/NWS*

## Wednesday, June 16

**10:20-10:50am Break**

**Session 6: Evolution of Data Assimilation**
Session Chair: Eugenia Kalnay, University of Maryland

10:50am 6.1 A History of the U.S. Navy's Numerical Objective Analysis and Data Assimilation
*Edward H. Barker, NRL*

11:15am 6.2 Maturation of Data Assimilation Over the Last Two Decades
*John Derber, NCEP*

11:40am 6.3 Exploring New Pathways in Precipitation Assimilation
*Arthur Y. Hou and Sara Q. Zhang*
*Global Modeling and Assimilation Office*
*NASA Goddard Space Flight Center, Greenbelt, MD*

11:55am 6.4 Introduction of Temperature Observation of Radiosonde in Place of Geopotential Height to the Global Three-dimensional Variational Data Assimilation System in JMA
*Akio Narui*
*Numerical Prediction Division, Japanese Meteorological Agency*

12:10pm 6.5 Impact Experiments on GMAO Data Assimilation and Forecast

Systems with MODIS Winds during MOWSAP
*Lars Peter Riishojgaard and Yanqiu Zhu*
*Global Modeling and Assimilation Office, NASA/GSFC*

## Wednesday, June 16

## Afternoon

**12:25-2:00pm** **Poster Discussion and Lunch**
Poster Session Chair: Kris Harper, Independent Scholar/Historian of Science

Poster Session #3 Weather

P3.1 Application of Data Assimilation Techniques for Space

*Tim Fuller-Rowell, Space Environment Center*

P3.2 Assimilation of GPS occultation data into the NRL Atmospheric Variational Data Assimilation System (NAVDAS)
*Gerald E. Nedoluha[1], Axel von Engeln[2], Nancy L. Baker, Clay B. Blankenship and, Edward H. Barker[3]*
*[1]Naval Research Laboratory, Washington, DC, [2]Institute of Environmental Physics, University of Bremen, Germany*
*[3]Naval Research Laboratory*

P3.3 Applications of Data Assimilation in Improving Atmospheric Modeling
*Zhaoxia Pu, Department of Meteorology, University of Utah, Salt Lake City, UT*

P3.4 The Local Ensemble Kalman Filter of the University of Maryland
*Istvan Szunyogh, Eric Kostelich[1], Gyorgyi Gyarmati, Brian R. Hunt, Edward Ott, Aleksey V. Zimin, Eugenia Kalnay, Dhanurjay Patil, and James A. Yorke, University of Maryland and [1]Arizona State University*

P3.5 A Modular, Efficient design of the Local Ensemble Kalman Filter

*Eric Kostelich, Arizona State University, and Istvan Szunyogh, Gyorgyi Gyarmati, Brian R. Hunt, Edward Ott, Aleksey V. Zimin, Eugenia Kalnay, Dhanurjay Patil, and James A. Yorke, University of Maryland*

P3.6 Extension of Ensemble Kalman Filtering to 4-dimensions
*Tim Sauer, George Mason University, and B.R. Hunt,*

*J.A.Yorke, A.V. Zimin, E. Ott, E.J. Kostelich, I. Szunyogh, G. Gyarmati, E. Kalnay, D.J. Patil, University of Maryland*

P3.7 On the Importance of the Precipitation Mass Sink In Tropical Cyclones and Other Heavily Precipitating Systems
*Gary Lackmann and Richard Yablonsky*
*North Carolina State University*

Wednesday, June 16

Afternoon

**Session 7:** **Evolution of Data Assimilation (cont.) and Ensemble Forecasting**
Session Chair: Steve Tracton, Office of Naval Research (ONR)

2:00pm 7.1 Ensemble Forecasting: History and Future
*Eugenia Kalnay, University of Maryland*

2:25pm 7.2 Present Status and Future Directions for Ensemble Forecasting at NCEP
*Zoltan Toth, Jeff Mcqueen, Yuejian Zhu, Richard Wobus, Jun Du and Dingchen Hou, NOAA/NWS/NCEP/EMC*
*Mozheng Wei, Visiting UCAR Scientist at NCEP*

2:40pm 7.3 Applications of Ensemble Prediction – A Historical Perspective
*Steven Tracton, ONR*

2:55pm 7.4 The National Polar-orbiting Operational Environmental Satellite System: Delivering Global Data for Improved Numerical Weather Prediction
*John D. Cunningham[1], John M. Haas[2], Robert S. Turek[3], Craig S. Nelson[4]*
*[1]System Program Director, NPOESS Integrated Program Office*
*[2]The Aerospace Corporation, [3]Raytheon Company, [4]General Dynamics Advanced Information Systems*

3:10pm 7.5 Tests of an Ensemble Kalman Filter for Mesoscale Data Assimilation
*Fuqing Zhang, Zhiyong Meng and Altug Aksoy*
*Department of Atmospheric Sciences, Texas A&M University*

3:25pm 7.6 Assimilation of Satellite Cloud Data into the GMAO Finite-volume Data Assimilation System using Variational Parameter Estimation
*Arlindo da Silva, Global Modeling and Assimilation Office, NASA Goddard Space Flight Center, Greenbelt, MD*
*Peter Norris, Goddard Earth Science and Technology Center, University of Maryland, Baltimore County, MD*

**3:40-4:10pm** **Break**

Wednesday, June 16

**4:10-6:00pm** **Poster Discussion and Historical Exhibit**

Poster Session Chair: Kris Harper, Independent Scholar/Historian of Science

Historical Exhibit Chair: Major Jimmie Trigg, AFWA Liaison to NCEP

Poster Session #4

P4.1 Intercomparison of the ECMWF, MSC, and NCEP Global Ensemble Forecast Systems
*Zoltan Toth, NCEP, Roberto Buizza, European Centre for Medium-Range Weather Forecasts*
*P. L. Houtekamer and Gerald Pelleri, Meteorological Service of Canada,*
*Mozheng Wei, UCAR Visiting Scientist, NCEP/EMC*
*Yuejian Zhu, NCEP/EMC*

P4.2 Hybrid Ensemble Predicting System: A New Ensembling Approach
*Jun Du, EMC, NOAA/NWS/NCEP and SAIC*

P4.3 Medium Range Predictability Associated with Anomalous Zonal Flows over Western North America during Winter
*Lee A. Byerle and Jan Paegle, University of Utah*

P4.4 Week 2 Forecasting Skill Characteristics and Flow Regime Association
*Peiqun Zang, National Meteorological Center, China*
*Wilbur Chen, Climate Prediction Center, NOAA/NWS/NCEP*

P4.5 Flow and Regime Dependent Mesoscale Predictability
*Fuqing Zhang, Chris Snyder and Rich Rotunno, Texas A&M University*

P4.6 Improvements in Extended-Range Temperature and Probability of Precipitation Guidance
*Kevin Carroll and Joseph Maloney, III, Meteorological Development Laboratory, NOAA/NWS*

P4.7 Improving Predictability of Seasonal Forecasting by NCEP Regional Spectral Model
*Jun Wang, SAIC at NCEP/EMC, and Hann-Ming Henry Juang, NCEP/EMC*

P4.8 Forecasting Week 2 Forecasting Skill
*Wilbur Y. Chen, Climate Prediction Center*

Wednesday, June 16

P4.9 The Numerical Schemes on the Base of the Hermitian Approximation
*Ireneusz Winnicki, Military University of Technology, Warsaw, Poland*

Evening

**6:00pm** **Conference Banquet* - Co-hosted by SAIC and Raytheon**

**Keynote Speaker: Norm Phillips - "*NWP and the Appalachian Storm of November 1950*"**

***Group Photo Opportunity**

Thursday, June 17

Morning

7:30am-12:00pm Registration

**Session 8:** **Long-Range Forecasting**
Session Chair: Carl Thormeyer, FNMOC

8:30am 8.1 Notes on NWP and the History of Long-Range Forecasting
*Don Gilman, NCEP/CPC (ret) and Huug van den Dool, NOAA/NCEP/CPC*

8:55am 8.2 Dynamical Seasonal Prediction: A Personal Retrospective of the Last 30 Years (1975-2004), and Conjectures about the Future
*J. Shukla, George Mason University*

9:20am 8.3 The Infinite Forecast
*Ants Leetmaa, NOAA/GFDL*

9:45am 8.4 The NWP "Breakthrough" for Climate Analysis Center Monthly Predictions in 1981
*Robert E. Livezey, Climate Services Division, NOAA/NWS Office of Climate, Water and Weather Services*

10:00am 8.5 How Long Can an Atmospheric Model Predict?
*Peter C. Chu and Leonid M. Ivanov, NPS, Monterey, CA*

10:15am 8.6 The Long Journey of NWS Medium-Range Prediction

*Edward O'Lenic, NOAA/NWS Climate Prediction Center*

**10:30 - 11:00am** **Break**

**Session 9:** **The Future of NWP and Its Applications**
Session Chair: Louis Uccellini, NCEP

11:00am 9.1 Global Weather Prediction - Possible developments in the Next Decades
*Lennart Bengtsson, Max-Planck-Institut für Meteorologie*

11:25am 9.2 Fifteen Years of Research in the Numerical Prediction of Storm-Scale Weather: Is Operational Implementation Very Far Away?
*Kelvin K. Droegemeier, School of Meteorology and Center for Analysis and Prediction of Storms, University of Oklahoma*

Thursday, June 17

11:50am 9.3 Isentropic Diagnostic Assessments and Modeling Strategies
Appropriate to the Development of Weather and Climate Models
*Donald R. Johnson, Emeritus Professor, University of Wisconsin, NCEP Special Project Scientist*

**12:05-1:30pm Lunch - Keynote Speaker Jim Howcroft - Sponsored by Cray**
**Ceremony Honoring George Cressman***

***Group Photo Opportunity**

**Session 9: The Future of NWP and Its Applications (cont.)**

1:30pm 9.4 Mesoscale Numerical Weather Prediction with the WRF Model
*Ying-Hwa Kuo, Joseph. B. Klemp, and John Michalakes*
*Mesoscale and Microscale Meteorology Division*
*National Center for Atmospheric Research (NCAR), Boulder, CO*

1:45pm 9.5 The Next Generation Flexible Global Atmospheric Model
*Hann-Ming Henry Juang, NOAA/NWS/NCEP/EMC*

2:00pm 9.6 Implementation of a Developmental Testbed Center (DTC)
*Bob Gall, NCAR*

2:15pm 9.7 An Evolutionary Approach to Nonhydrostatic Modeling
*Zavisa Janjic, Tom Black, Matthew Pyle, Hui-ya Chuang, Eric Rogers, and Geoff DiMego, NOAA/NWS/NCEP*

2:30pm 9.8 Application of Numerical Models in the Forecast Process - From National Centers to the Local Weather Forecast Office (WFO)
*David W. Reynolds, NWS WFO, San Francisco Bay Area*

2:45pm 9.9 Translating Advances in Numerical Weather Prediction into Official NWS Forecasts
*David P. Ruth, Meteorological Development Laboratory, Office of Science and Technology, NOAA/NWS*

3:00pm 9.10 Emergence of the Earth System Modeling Framework

*Cecelia DeLuca, NCAR*

3:15pm 9.11 The Future of NWP
*Steve Lord, NCEP*

Thursday, June 17

**3:45pm** **Closing Remarks**
*Louis Uccellini, NCEP; Eugenia Kalnay, University of Maryland*