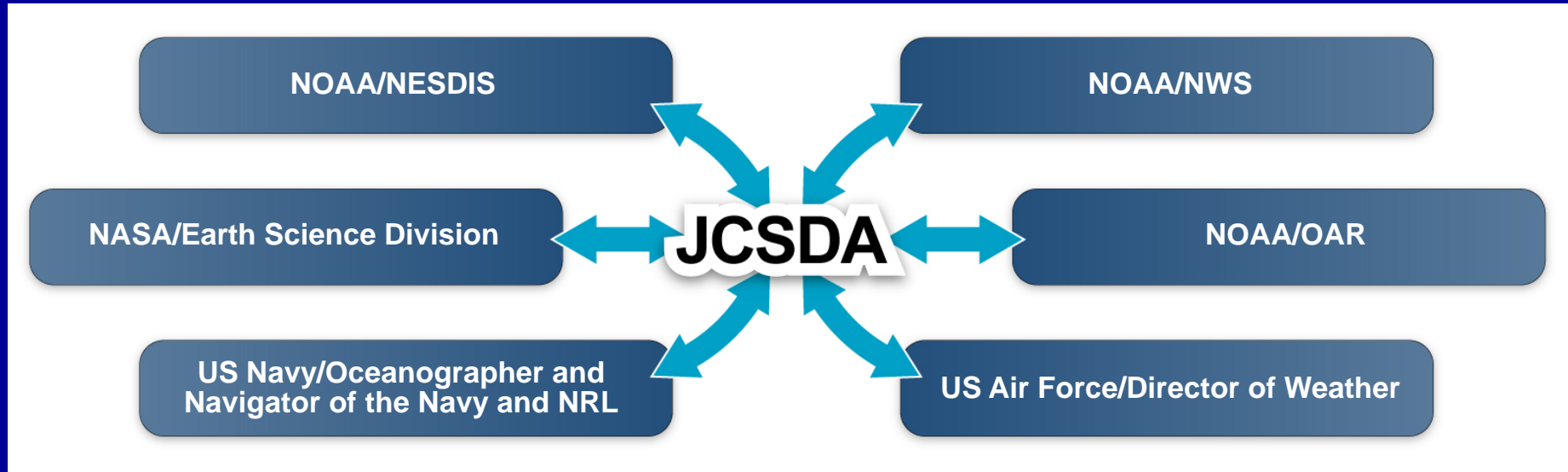


# JCSDA Program Update and Overview

Lars Peter Riishojgaard, JCSDA Director

# Overview

- JCSDA structure, goals, mode of operation
  - R2O, Internal and external research
- Highlights from the past year
  - External research in the future
  - JCSDA computing
- Outlook, charter to workshop and breakout groups



**Vision:**

*An interagency partnership working to become a world leader in applying satellite data and research to operational goals in environmental analysis and prediction*

**Mission:**

*...to accelerate and improve the quantitative use of research and operational satellite data in weather, ocean, climate and environmental analysis and prediction models.*



# JCSDA Science Priorities

*Overarching goal: Help the operational services improve the quality of their prediction products via improved and accelerated use of satellite data and related research*


- Radiative Transfer Modeling (CRTM)
- Preparation for assimilation of data from new instruments
- Clouds and precipitation
- Assimilation of land surface observations
- Assimilation of ocean surface observations
- Atmospheric composition; chemistry and aerosol

*Driving the activities of the Joint Center since 2001, approved by the Science Steering Committee*

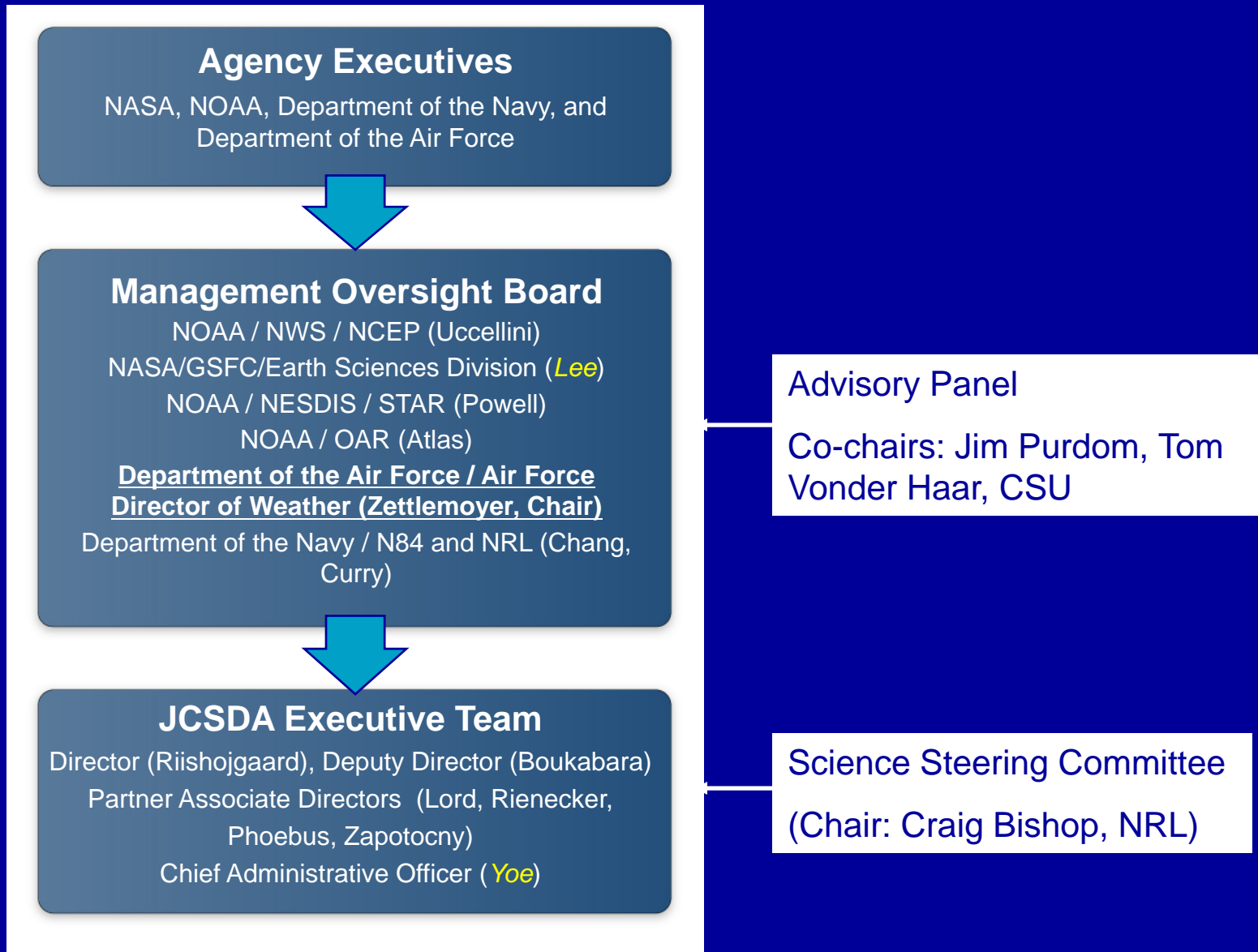


# From idea to implementation (R2O)

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- Basic research
  - Applied research
  - **Research to Operations transition (JCSDA)**
  - Operational implementation (NCEP, AFWA, FNMOC, ...)

# JCSDA Management Structure



# JCSDA Mode of operation

- Directed research
  - Carried out by the partners
  - Mixture of new and leveraged funding
  - JCSDA plays coordinating role
- External research
  - Early years:
    - Implemented as a NOAA-administered FFO, open to the broader research community
    - ~\$1.4 M/year available => revolving portfolio of ~15 three-year projects
- Results and progress from both directed and external work reported at JCSDA Science Workshop

# Who is working in the Joint Center?

- Staff from the JCSDA partners
  - JCSDA funded
  - “In kind” contributions, i.e. not funded by JCSDA but work aligned with JCSDA priorities
- Funded investigators
- Visiting scientists
- Working Group members
- ...



# JCSDA Working Groups

- The concept of JCSDA Working Groups originated at a JCSDA Management Retreat June 2007
  - Intent was to stimulate collaboration across agencies also at the working level
  - WG's replaced the concept of Technical Liaisons
- Composed of working level scientists from (in principle) all JCSDA partners, plus additional members where appropriate
- All working groups and working groups members approved by JCSDA Executive Team
- Each Working Group has two Co-Chairs, typically representing different JCSDA partners (and agencies)
- Working Groups charters approved by JCSDA Executive
  - Co-chairs set meeting agenda, determine meeting frequency, run meetings

# JCSDA Working Groups (II)

- So far, WG's have largely been tasked with sharing information and coordinating work "where possible"
- Ongoing discussions about more direct involvement of WG's in e.g.
  - Setting of JCSDA priorities
  - Definition and execution of joint (interagency) projects
- Six WGs formed so far
  - CRTM
  - IR sounders
  - Microwave sensors
  - Ocean data assimilation
  - Land data assimilation
  - Atmospheric constituents
- Possible future WG's: GPSRO, Wind Lidar, OSSE



# Selected highlights from the past year

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- JCSDA Science Workshop
- First JCSDA Summer Colloquium
- External Research Program back on track
- New JCSDA computing initiative
- Advanced data assimilation developments



# 7<sup>th</sup> JCSDA Science Workshop

## May 12-13, UMBC South Campus

- ~100 participants representing both internal and external JCSDA projects
- Plenary and poster sessions
- Breakout groups structured along the JCSDA Working Groups
- Very positive feedback from participants



### •Key recommendations:

- Strengthen Working Groups
- Give WGs responsibility for tangible software/hardware elements
- Create additional WGs for GPSRO, Air Quality, Land, ...



# JCSDA Summer Colloquium

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- Two-week summer school in Stevenson, WA, 07/07-07/17, 2009
- Outstanding program of lectures given by world leading experts
- 38 participants (almost all Ph.D. students or post-docs) from 8 countries, including the US
- Sponsored by all JCSDA partners
- Based on feedback from lecturers and participants it was a highly successful event
- JCSDA plans to stay engaged in training in the future; form yet to be decided



# JCSDA External Research Program

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- *(Hiatus in FY 2009 due to lack of funds)*
- Role of external activities
  - Complements internal efforts and expertise of JCSDA partners, e.g.
    - CRTM upgrades, spectroscopy, algorithms
    - Clouds and precipitation
  - Engages research community in **R20 transition** activities of vital national importance, e.g.
    - Data assimilation methodology
    - Diagnostics of data impact and model performance



# Review of output from JCSDA External Research

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- Action item from last JCSDA Agency Executive briefing: *“What have we received from the 32 projects funded so far under the JCSDA FFO?”*
- All projects were reviewed by all JCSDA Executive Team members who each assigned a score on the following scale
  - 0 - no impact, or no information available
  - 1 - potential impact shown through idea or publication, no code delivered
  - 2 - code delivered but not implemented
  - 3 - code delivered, tested, implemented in one or more JCSDA partner system



# Output from past FFOs (II)

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- Total of 32 proposals funded
  - 6 successful (average score of 2.0 or better)
  - 12 partially successful (average score between 1.0 and 1.9)
  - 14 had minimal or no impact (average score below 1.0)
- (Tolstoy: *"Happy families are all alike; every unhappy family is unhappy in its own way"*)
  - What can we learn from the successful proposals?





# Output from past FFOs (III)

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- Six successful projects (score of 2.0 or higher)
  - Four from internal JCSDA partners
  - Two from an external entities that had
    - Well-established collaborations with a JCSDA partner
    - Access to JCSDA infrastructure (CRTM)
- **Common traits**
  - **Strong collaboration with JCSDA partners**
  - **Access to JCSDA code, infrastructure, computing resources**



# Possible reasons for limited success rate of external projects

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- Investigators lacking experience with (or interest in) operational systems; poor funding decisions
- Lack of JCSDA human resources to support external investigators willing to work with operational systems
- **Lack of JCSDA computing resources for external investigators**
- **Lack of JCSDA infrastructure to take delivery of code (CRTM is the exception)**
- Decision on external proposals made separate from decisions on directed activities



# Current status of JCSDA External Research Program

- JCSDA Executive working toward securing access to
  - Additional computer resources
  - Scientific support for external investigators who want to experiment with JCSDA partner systems and codes
- NOAA FFO (grants) in FY 2010; closed
- NASA ROSES announcement (contracts) for FY 2011; will be issued shortly
  - Longer term plans still being worked out; will be based on agency rotation involving NASA, NOAA and potentially DoD



# JCSDA computing

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- Lack of JCSDA computing resources cited as a major obstacle to success by JCSDA Advisory Panel (Jan 2009)
- Major finding of internal review of past FFO project was that lack of computer resources was a significant factor in limiting the likelihood of success



# JCSDA computing (II)

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- JCSDA management working with NASA and GOES-R program to secure JCSDA operated supercomputing resource that can be made available to external investigators to test algorithms in the context of operational partner systems
- Management and location of the resource still being discussed; will likely be collocated with existing NASA or NOAA resources



# Update on Navy Satellite Data Assimilation Accomplishments and Contributions Relevant to JCSDA Goals

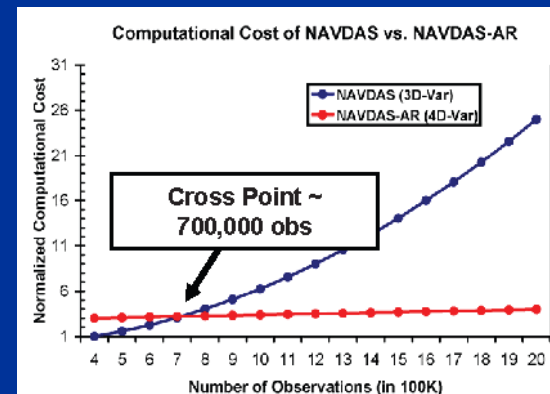
## Transitions/Operational Impacts

### ● NRL's Global 4DVAR (NAVDAS-AR) became operational at FNMOC Sept 23, 2009.

- *Efficient design for assimilating large volumes of satellite data;*
- *New pre-conditioner algorithm that significantly reduces the computational cost;*
- *Uses the JCSDA CRTM; NAVDAS used RTTOVS*
- *Satellite data assimilated at effective time of observation;*
- *Successive observations in the same assimilation window methods to extract tendency information*

### ● Developed and tested for NAVDAS-AR; Scheduled for FY10 implementation.

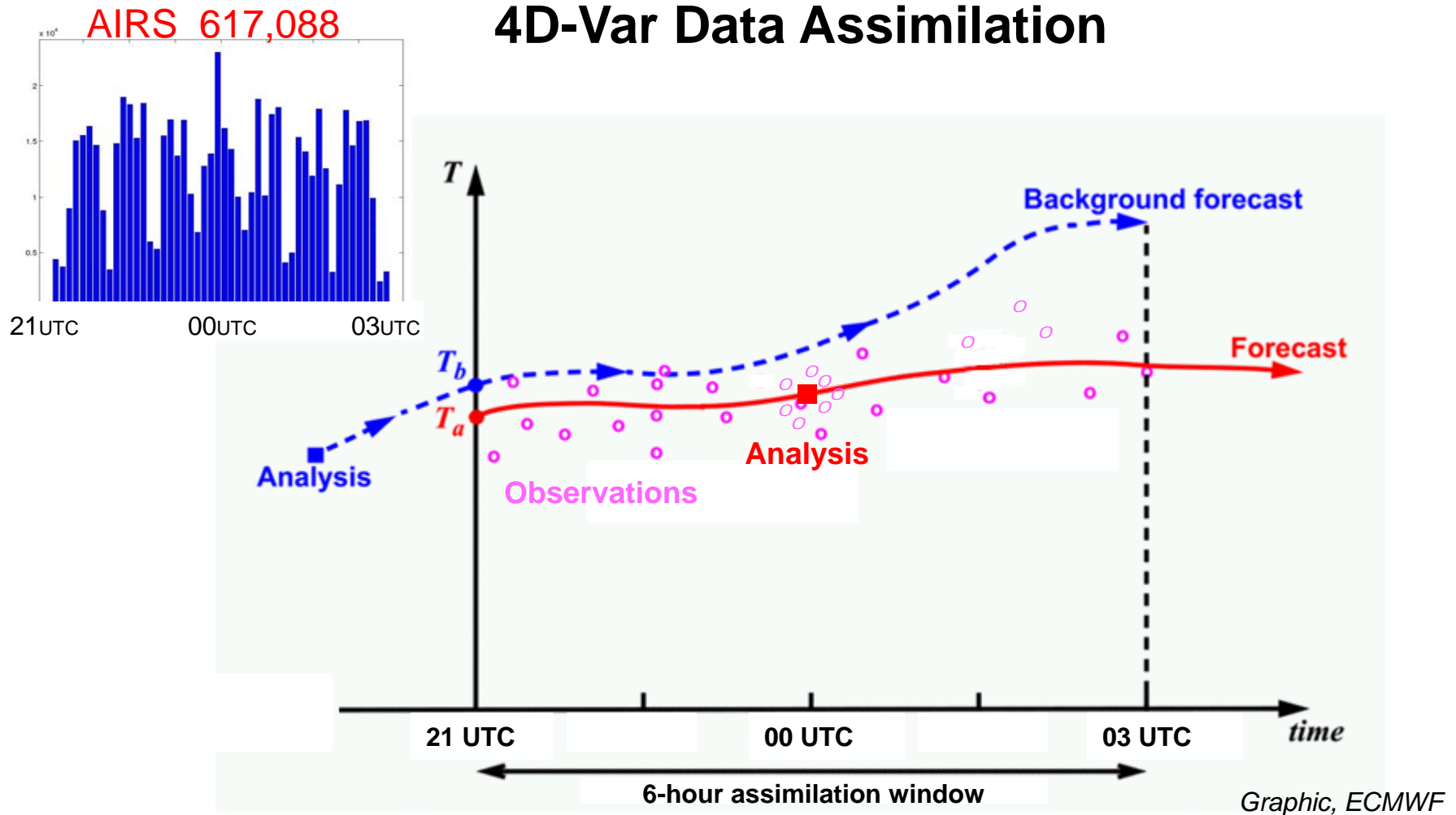
- ✓ Modifications to allow the inclusion of forecast model error (i.e., WEAK CONSTRAINT)  
-- *when implemented, this may be the first such 4DVAR system run operationally*
- ✓ Adaptive tuning of observation error variances
- ✓ Variational bias correction
- ✓ Analysis error estimation
- ✓ Updates to observation and background error covariances



# GSI 4-D Var Status at NCEP/EMC

- Infrastructure within GSI comes from collaboration with GMAO (merger completed)
- Methodology follows Met Office strategy
  - Uses perturbation model
  - Can be used for GFS, NAM, RTMA and hurricane systems
- Perturbation model developed and working
  - Tangent linear and adjoint models being developed
  - Completion anticipated within next 2 months
- Extensive code and parallel testing over coming year
- Pre-operational global testing over following ½ year
- Inclusion of simplified physics will also be developed in parallel to dynamics
- Goal is “hybrid” system (4-D Var with ensemble input)
- Implementation dependent on operational computing resources

# 4D-Var Data Assimilation



...compute the starting point of the **forecast trajectory that best fits all available observations**



# Summary of 4DVar Progress at GMAO

- Prototype NASA GEOS DAS 4DVAR now available
- Encouraging preliminary results with prototype 6-hr and 12-hr cycle 4DVAR
- Various adjoint-based diagnostic tools now available in GEOS DAS: forecast sensitivities, singular vectors, analysis sensitivity, and observations impact.
- **Folded into latest code merge with NCEP**
- Next steps:
  - Address computational efficiency of TLM/ADM
  - Develop adjoint of physics modules
  - Bring prototype 4DVAR to Operational-readiness status
  - Work on weak constraint 4DVAR formulation

*The implementations done thus far benefited greatly from the original infrastructure of EMC-GMAO GSI and from 1-year visit by Yannick Trémolet from ECMWF*



# Coming events/activities

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- New JCSDA computing facility
- New training activities
- Visiting scientist program
- First joint ECMWF/JCSDA Workshop on Assimilating Satellite Observations of Clouds and Precipitation into NWP Models, June 15-17 in Reading
- Tentative plans for JCSDA hosting WMO GOS Impact Workshop in 2011



# Summary

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- Good progress in many areas of JCSDA activities
- External research program subject to extensive review; changes being implemented
- New initiative in JCSDA computing
- Working groups continue to evolve; some are successful, some less so; will be reviewed by JCSDA management
- Major new developments in data assimilation underway within all JCSDA partners



# Questions to the Workshop (breakout groups):

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- Based on this Workshop, how would you rate the JCSDA activities in your area of expertise?
- What should be the top priority for your subject area if additional funding were to become available?
- Are there data types or subject areas that require specific and immediate attention?
- What is the role of your JCSDA Working Group?
- What could (or should) its role?
  - Information exchange; coordination; input to JCSDA priorities; review of proposals, projects, etc.; specific projects/code; other?
- What is your opinion of this workshop?
  - Venue, duration, format, ...