



The Joint Center for Satellite Data Assimilation (JCSDA) and the NOAA Cooperative Institutes

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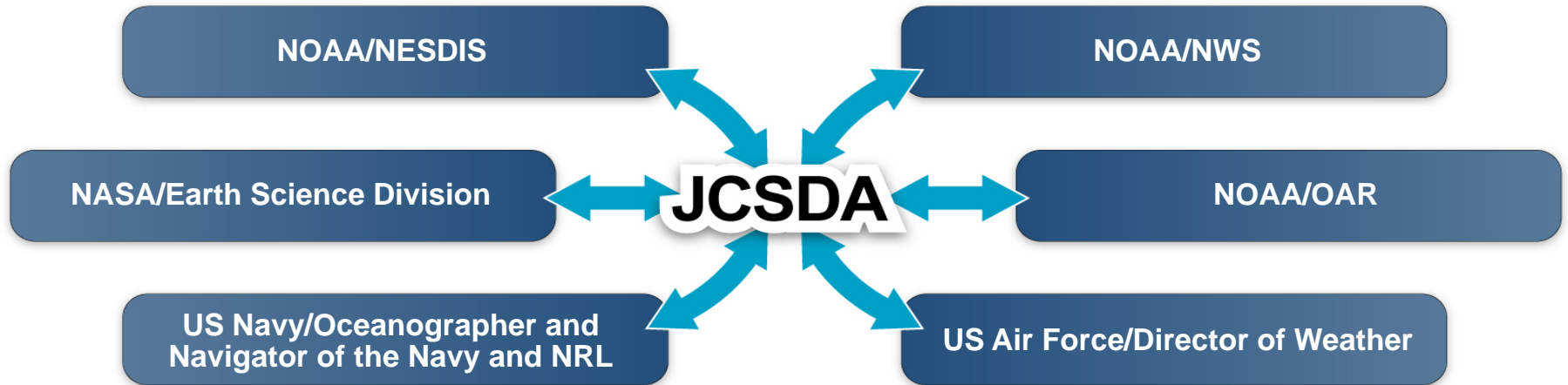
Overview

Intro & Description

- JCSDA Partners & Management Structure
- JCSDA Vision, mission, priorities, goals
- Mode of Operation / Research Implementation:
 - Internal Research (JSDI)
 - External Research (grants+contracts)
 - Visiting Scientist Program (sponsors, partners)
- Challenges
 - Readiness for upcoming flow of satellite and data
 - Science upgrades (4DVAR, humidity, cloud, rain, surface- impacted data, etc)
 - Computer Resources (for R2O <-> O2R, OSSE/OSE)
- Strategy for the future
- JCSDA and the NOAA CI's

Issues and what we do to address them

JCSDA Partners



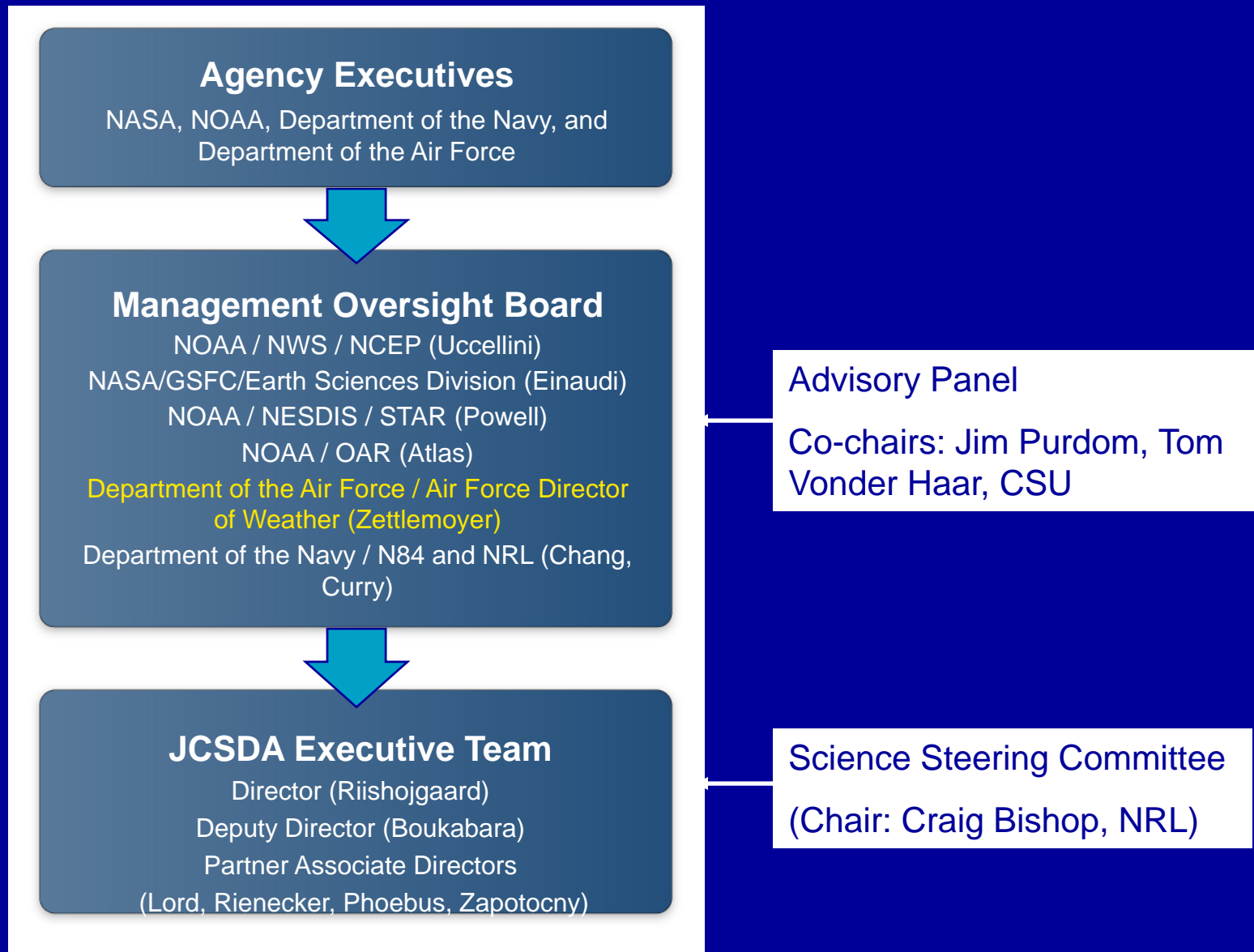
Vision:

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 Management Structure



New JCSDA short-term goal:

(adopted 03/2008)

- *“Contribute to making the forecast skill of the operational NWP systems of the JCSDA partners internationally competitive by assimilating the largest possible number of satellite observations in the most effective way”*

Why is it Important?

Value of weather forecasting

- Department of Commerce: “20% of overall US economy is weather sensitive”: *~\$2.8 trillion/year*
 - Impact to air and surface transportation, agriculture, construction, energy production and distribution, etc.
- Assume that half of this is “forecast sensitive”: *\$1.4 trillion/year*
- Assume that the potential savings due to weather forecasting amount to 5% of the “forecast sensitive total”: *~\$70B/year*
- This implies that the value to the United States economy of NWP is *~200M per hour of forecast range per year !*

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

JCSDA Mode of operation

- **Directed research**
 - Carried out mainly by the partners
 - Mixture of new and leveraged funding
 - JCSDA plays coordinating role
 - Also accessible to external community (including CIs)
- **External research**
 - Historically implemented as a NOAA-administered FFO, open to the broader research community
 - Typically ~\$1.5 M/year available => revolving portfolio of ~15 three-year projects
- Results and progress from both directed and external work reported at annual JCSDA Science Workshop (most recent held on May 12-13, 2009)

Directed Research

- A portion is directly funded by JCSDA
- Most directed research is internal research by JCSDA partners (In-kind contribution to JCSDA activities)
- JCSDA plays a coordination role
- Working groups have been established to help coordinate and leverage efforts
 - Objective is to spread knowledge, leverage efforts
 - By field of expertise
 - Open to all experts (not just partners)

JCSDA Working Groups

- Composed of working level scientists from (in principle) all JCSDA partners, plus additional members where appropriate
- Tasked with sharing information and coordinating work where possible
- Roles and scope still under evolution
- Five WGs formed so far
 - CRTM
 - IR sounders
 - Microwave sensors
 - Ocean data assimilation
 - Atmospheric constituents
- Next:
 - Land data assimilation
 - GPSRO

Directed Research Funding

- Only NOAA has a JCSDA budget line item
 - NESDIS appropriation of \$3.247M in FY 2009
 - Joint Center Science Development and Implementation (JSDI) project funding amounts to \$2.1M
 - JSDI competed internally in NOAA (including CI's)
- GMAO funding from NASA in response to proposal (\$1.67M in FY2008)
- DoD partners have no direct JCSDA funding

External Research Program

- Complements internal efforts and expertise of JCSDA partners, e.g.
 - CRTM upgrades, spectroscopy, algorithms
 - Clouds and precipitation
- Engages research community in R2O transition activities of vital national importance, e.g.
 - Data assimilation methodology
 - Diagnostics of data impact and model performance
- No announcement in FY 2009 due to lack of funds
- **FY 2010 announcement is on track**
 - Program will be split between grants and contracts
 - Longer term plans still being worked out
- JCSDA in continued need of engaging external research community
 - Targeted contracts/grants to accomplish specific investigations and/or transition activities

Visiting Scientist Program

- Having a visiting scientist at JCSDA or its partners is a great way to collaborate, leverage, coordinate efforts.
- JCSDA is interested to launch an official visiting scientist program
- Details and sponsoring are still being worked out
- Example of ECMWF: has reaped substantial benefits from long-term visits from many scientists (also from the US)
 - Sponsored by national institutions, universities, institutes, space agencies, internal ECMWF funding

Some of JCSDA Past Accomplishments

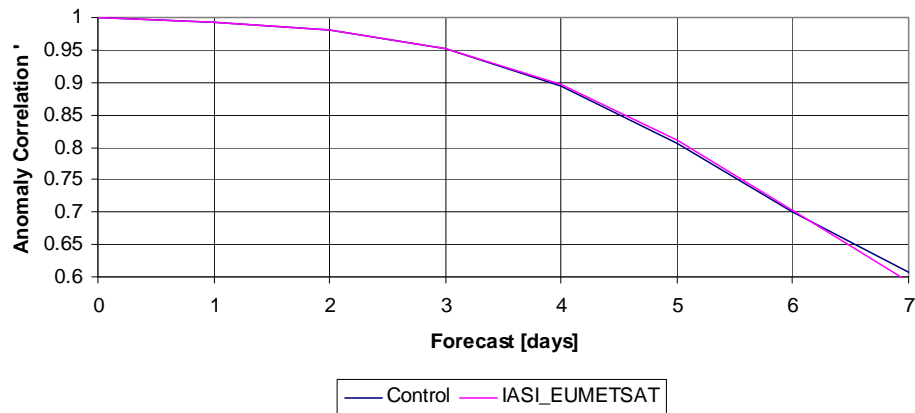
- Common assimilation infrastructure (NCEP/EMC, NASA/GMAO)
- Community radiative transfer model (all partners)
- Common NOAA/NASA land data assimilation system (EMC, GSFC, AFWA)
- Interfaces between JCSDA models and external researchers
- Snow/sea ice emissivity model – permits 300% increase in sounding data usage over high latitudes (EMC)
- MODIS polar winds (EMC, GMAO, FNMOC)
- AIRS radiances assimilated (EMC, GMAO)
- COSMIC data assimilation (EMC)
- Improved physically based SST analysis (EMC)
- Advanced satellite data systems such as DMSP (SSMIS), CHAMP GPS, WindSat tested for implementation (EMC)
- Data denial experiments completed for major data base components in support of system optimization (GMAO)

IASI Impact on Standard Verification Scores

1-31 August 2007

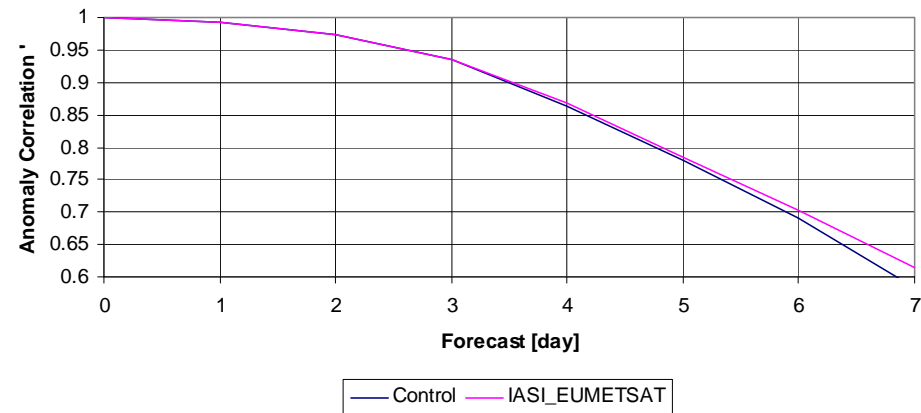
NH 500 hPa Height Anom. Cor.

N. Hemisphere 500 hPa AC Z
20N - 80N Waves 1-20
1 Aug - 31 Aug 2007



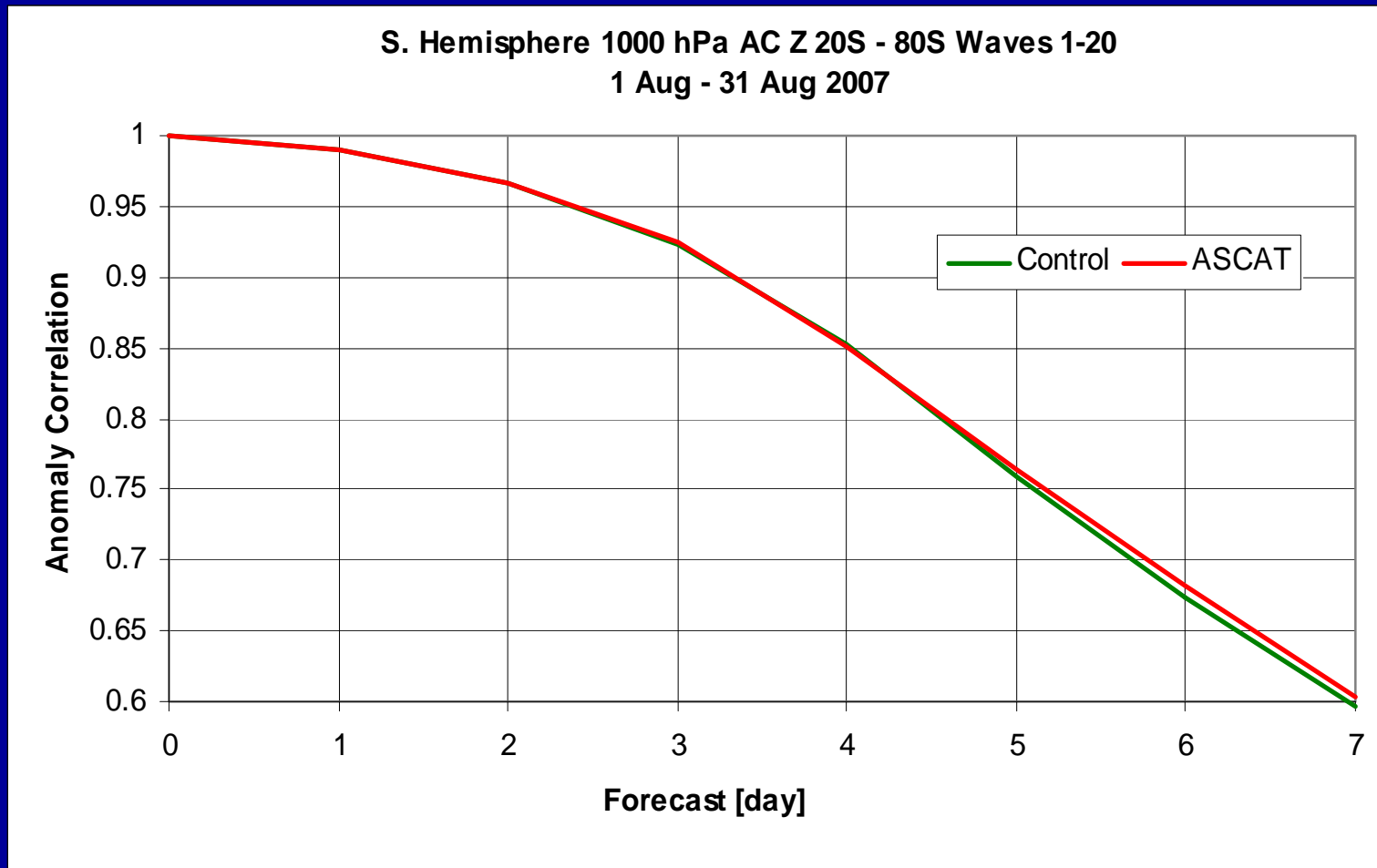
SH 500 hPa Height Anom. Cor.

S. Hemisphere 500 hPa AC Z
20S - 80S Waves 1-20
1 Aug - 31 Aug 2007



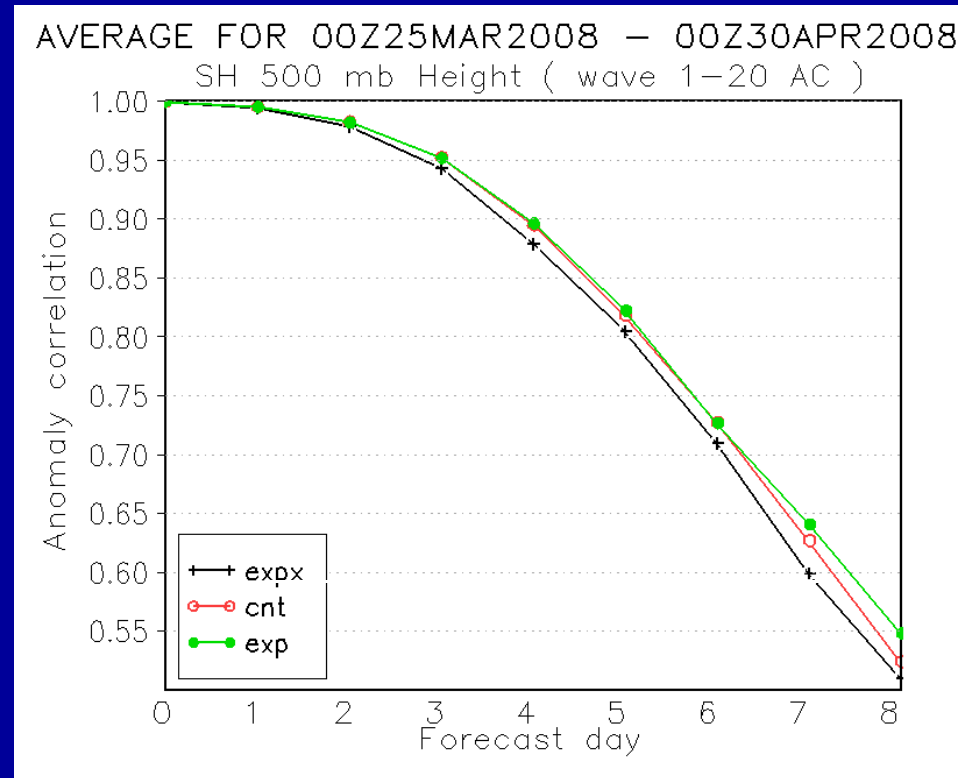
IASI
Control

ASCAT Impact Experiments with GFS



COSMIC: recent impact

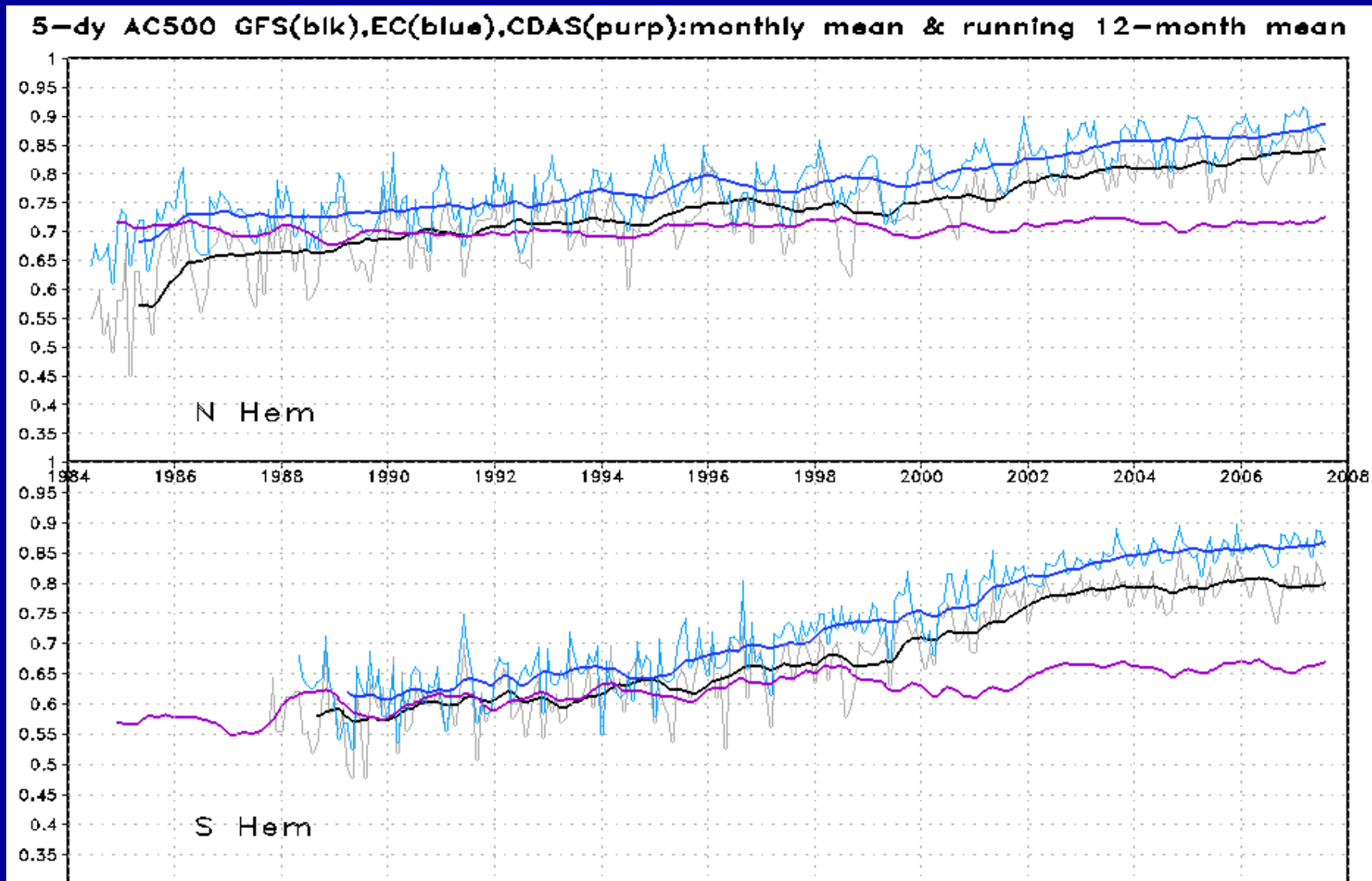
- AC scores (the higher the better) as a function of the forecast day for the 500 mb gph in Southern Hemisphere
- 40-day experiments:
 - **expx (NO COSMIC)**
 - **cnt (operations - with COSMIC)**
 - **exp (updated RO assimilation code - with COSMIC)**
 - Many more observations
 - Reduction of high and low level tropical winds error



Challenges we are facing

- US falling behind internationally in terms of NWP skill
- Risk of falling further behind if current readiness for upcoming missions is not improved

NOAA/NCEP vs. ECMWF skill over 20+ years



Why is the US falling behind?

- Limited Readiness for the use of satellite data
- Data assimilation system development; no unified US strategy toward next-generation (4D-VAR) data assimilation capability
 - JCSDA has no direct control over this, but can facilitate and coordinate collaboration on satellite data

Potential Remedies

- Bring resources to adequate levels (Human & IT)
- Bring science up to standards (4DVAR, etc)
- Better leveraging/coordination between partners
- Get help from experts (Technology transfer)

Preparation for new sensors

- Resources allocated to preparation for new sensors based on expected forecast impact
 - IPO providing initial funding for ATMS, CrIS
 - GOES-R Program providing funding for ABI preparations
 - Funding for ADM being requested through NOAA Budget Process
 - ...

JCSDA high & medium priority missions



- POES N18/N19 (AMSU, MHS), DMSP, MetOp-A (AMSU, MHS), COSMIC, GOES-O-P, JASON
- POES (AVHRR), AIRS, MODIS, JASON-2
- GOME, FY3, GOSAT, OceanSAT-2, SMOS

- MetOp-B (AMSU, MHS)
- MetOp-B (IASI, ASCAT, AVHRR), NPP (ATMS, CrIS, VIIRS)
- Aquarius, MSG-3, ADM, SMAP, GCOM-W, JASON-3, GPM

- GOES-R, MetOp-C (AMSU, MHS)
- MetOp-C (IASI, ASCAT, AVHRR)
- NPOESS (CrIS, ATMS, VIIRS), OMPS, COSMIC Follow-on

- Radiative transfer modeling
- Preparation for assimilation of data from new instruments
- Assimilation of humidity, clouds and precipitation observations
- Assimilation of land surface observations
- Assimilation of ocean surface observations
- Atmospheric composition, chemistry and aerosol

Science Priorities

Funding Status:

- Fully Funded
- Partially Funded
- Unfunded

Current

Near-Term

Long-Term

NOAA CI Meeting, CIRA, June 16-17, 2009

A key aspect to realize is that NWP assimilation efforts should be sustained for the lifetime of the sensor



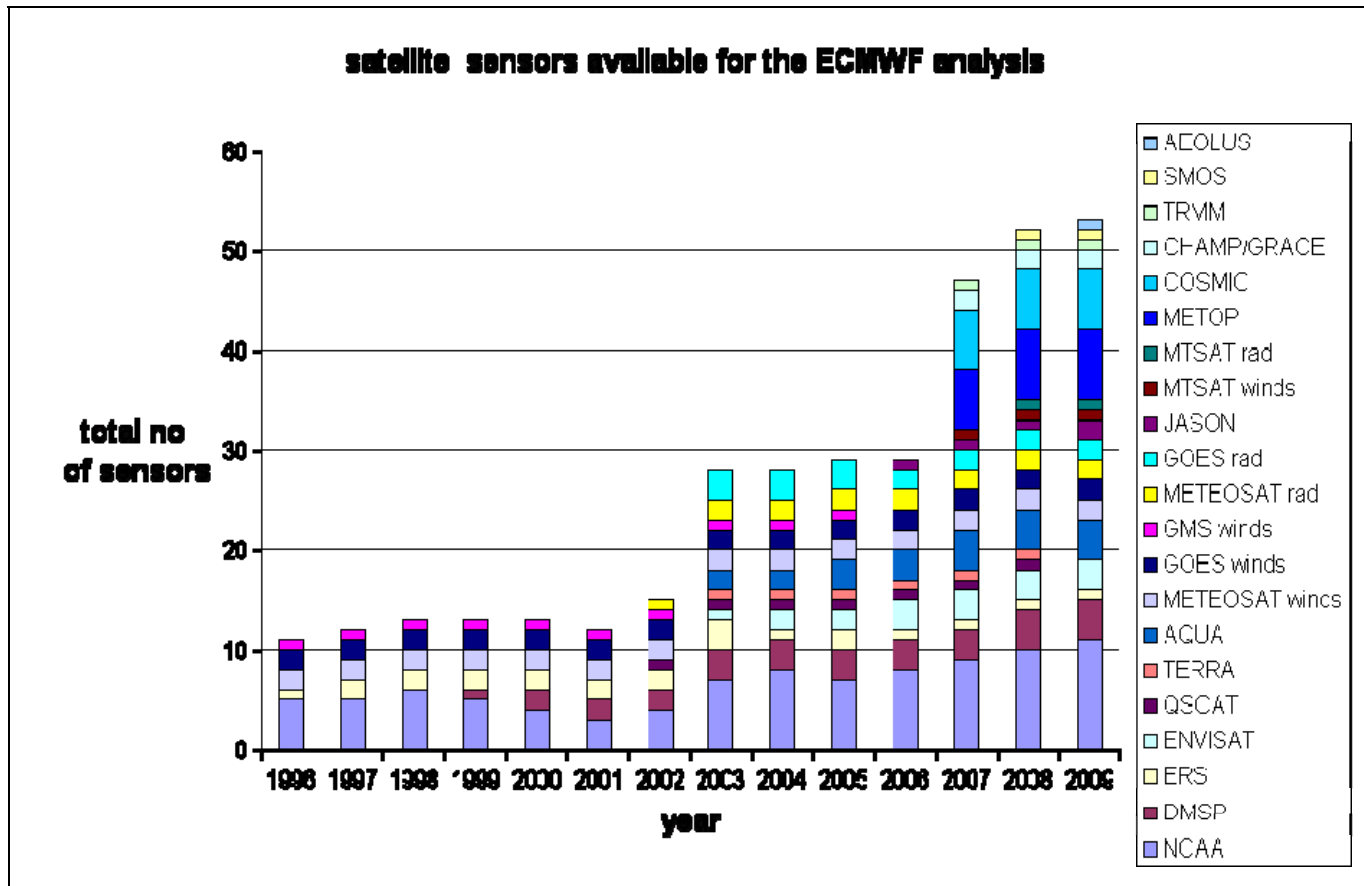
Case in Point:

Satellite Data used in US NWP

- **HIRS** sounder radiances
- **AMSU-A** sounder radiances
- **AMSU-B** sounder radiances
- **GOES** sounder radiances
- **GOES, Meteosat, GMS** winds
- **GOES** precipitation rate
- **SSM/I** precipitation rates
- **TRMM** precipitation rates
- **SSM/I** ocean surface wind speeds
- **ERS-2** ocean surface wind vectors
- **Quikscat** ocean surface wind vectors
- **AVHRR SST**
- **AVHRR** vegetation fraction
- **AVHRR** surface type
- **Multi-satellite** snow cover
- **Multi-satellite** sea ice
- **SBUV/2** ozone profile and total ozone
- **Altimeter** sea level observations (ocean data assimilation)
- **AIRS**
- **MODIS** Winds
- **COSMIC**

~33 instruments

Number of satellite sensors that are or will be soon assimilated in the ECMWF operational data assimilation.



JCSDA Strategy for R2O Improvement

(under review)

- **Big-Picture Situation:**

- US falling behind internationally in NWP forecast skill
- Some national and international sensors not used/used sub-optimally
- Expertise and resources scattered around Nation (nationwide strategy)

- **Concrete Impediments:**

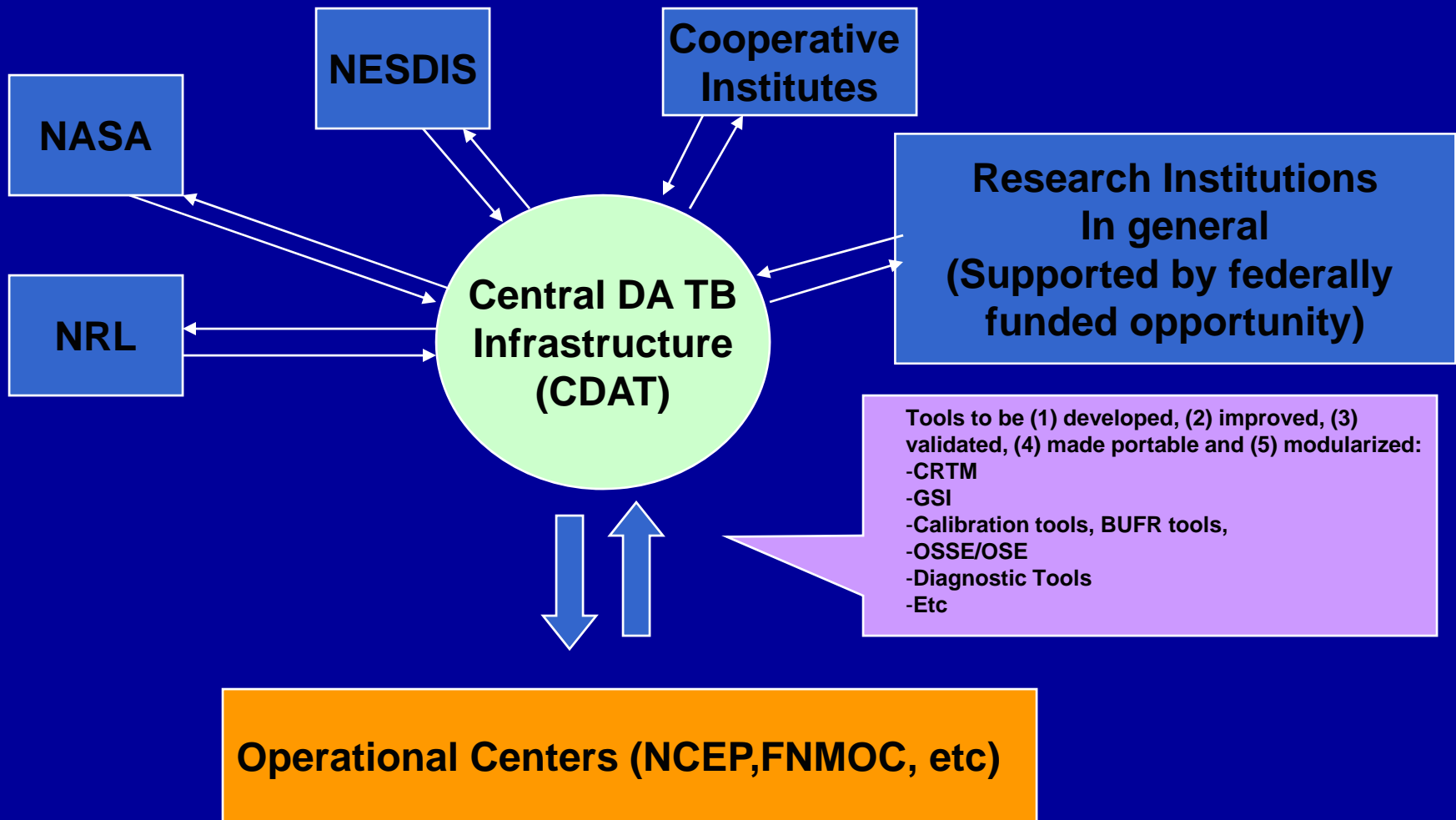
- Rigorous Mechanism (lack of) to move from a sensor/idea to operations
- Data Assimilation not up to international standard (lack of oper. 4DVAR)
- Lack of Computer and people resources (consolidation or integration)
- Lack of a 'sandbox' for science improvements (O2R)
- Redundancy and sustainability of efforts
- Insufficient diagnostic tools (adjoint methods for example)
- Lack an effective OSSE/OSE capability

- **What's Ahead:**

- Large flow of data and sensors expected (NPP, NPOESS, GOES-R, GCOM, GPM, SMAP, ADM, Decadal Missions, Foreign missions, etc)
- Readiness is sub-optimal

Potential Strategy for R2O Improvement*

*under review



All benefit from improvements being made in Central Testbed

How to help

- JCSDA and its partners share the goal of helping the 'public' by improving the forecast skills (via grants, visiting scientist, contracts, whatever it takes!).
- JCSDA partners have significant expertise but efforts are sometimes duplicated, parallel, ...
- CI and external research community at large have expertise and technology that could be helpful
- Somehow, leveraging & technology transfer (R2O) has to occur (in operational centers models), etc for this to take place (forecast skill improvement)
- To make this easy, O2R must also take place
- JCSDA plays the enabling role to make this happen

Summary

- JCSDA Recent refocus on NWP skill to address issue of underperforming US forecast skill
- Multi-level efforts needed:
 - Operational readiness for NPP/NPOESS and other missions
 - Science improvements in Data Assimilation
 - Set Up of an IT infrastructure (O2R, OSSE/OSE, etc)
 - Coordination of efforts between partners
- Continued need for interaction with outside research community, including NOAA CI's