



Overview of the Joint Center for Satellite Data Assimilation

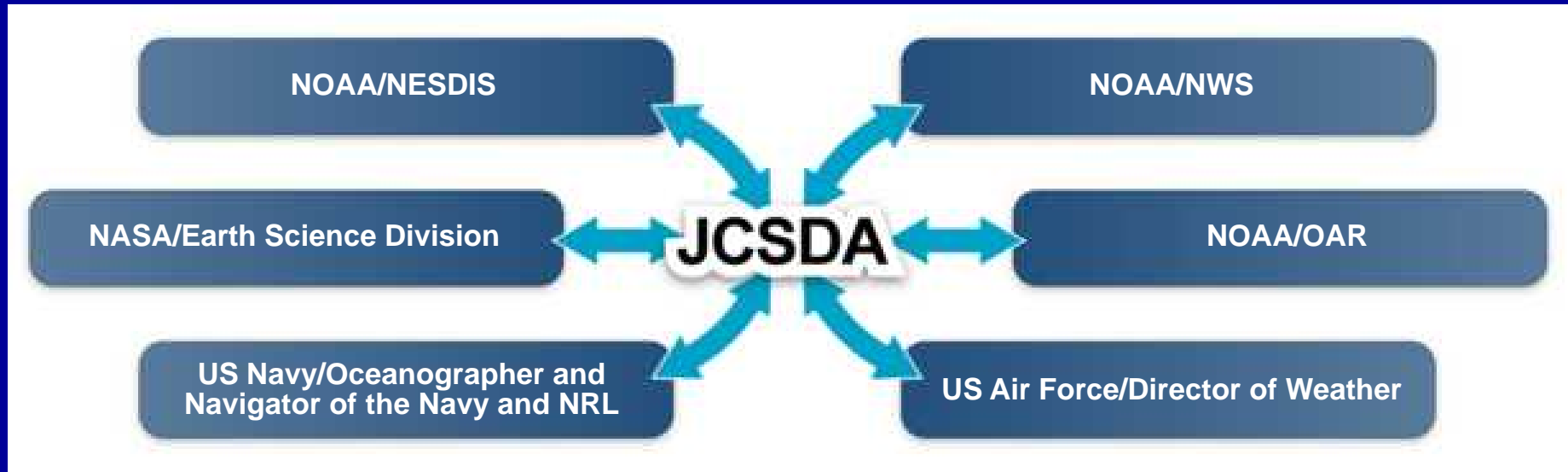
Lars Peter Riishojgaard, JCSDA Director

Overview

- JCSDA structure, goals, mode of operation
- R2O, Internal and external research
- Recent events and accomplishments
- Outlook, concluding remarks

JCSDA

- A distributed center involving NASA, NOAA, DoD set up to
 - Accelerate and improve the use of satellite data for environmental prediction
 - Created in 2001 (initially as a NASA/NOAA collaboration)
 - US perceived to be better at developing new satellite data and research than at making operational use of the data



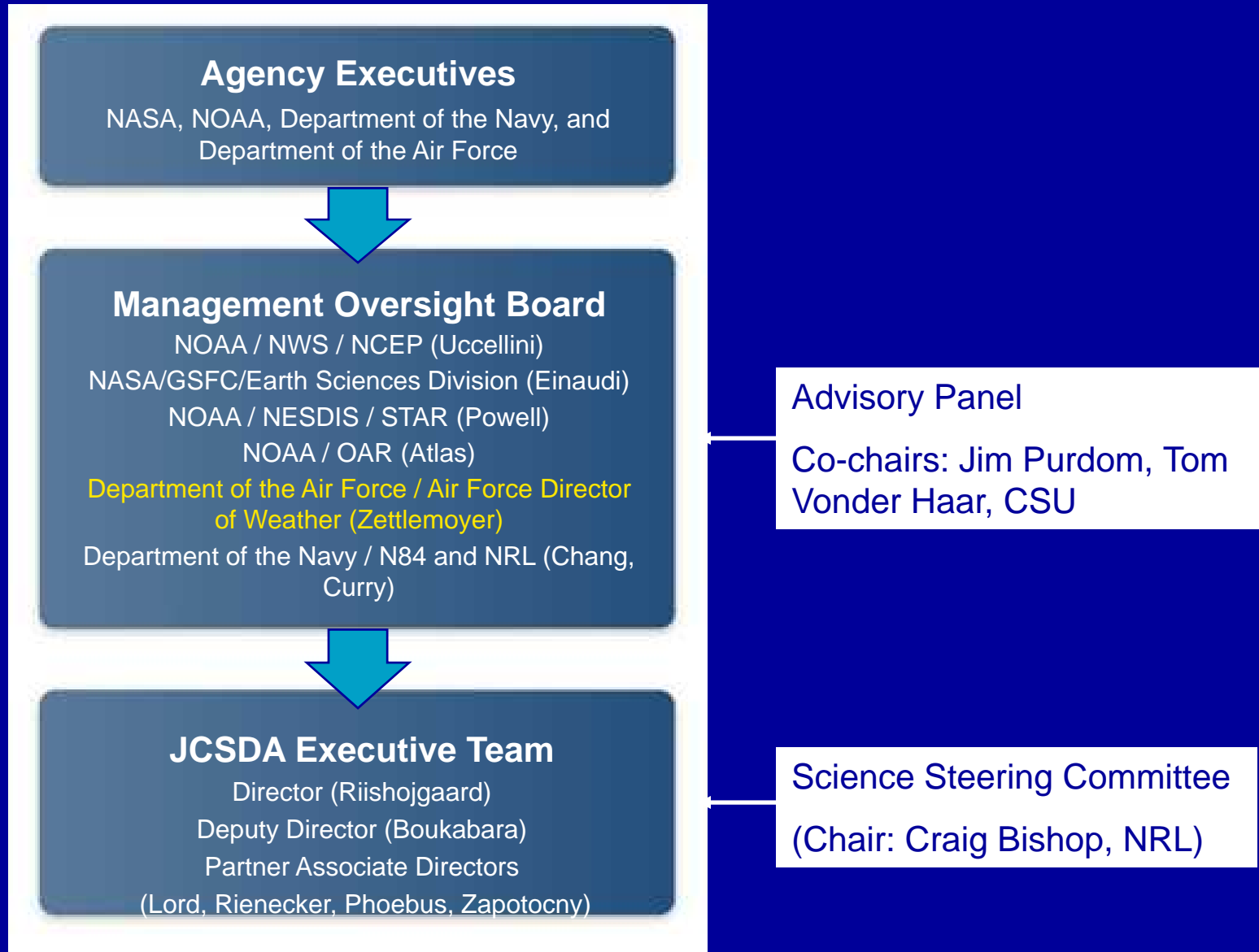
Vision:

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





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

Accomplishments

- JCSDA Memorandum of Agreement signed by NASA, NOAA, DoD in May 2008
- 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 – 300% increase in number of satellite soundings used in high latitudes (STAR, EMC)
- MODIS polar winds implemented (EMC, GMAO, FNMOC)
- AIRS radiances implemented (EMC, GMAO)
- COSMIC implemented (EMC, AFWA)
- IASI radiances implemented
- Improved physically based SST analysis (EMC)
- Advanced satellite data systems such as DMSP (SSMIS), CHAMP GPS, WindSat, ASCAT tested for implementation (EMC, NRL)
- Adjoint-based sensitivity diagnostics developed and implemented (NRL, GMAO)
- Data denial experiments for major components of GOS (GMAO)

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 renewed NWP focus?

- Economic impact
 - Weather: \$2.5 trillion annual impact on US economy
 - Even modest advances in forecast skill lead to huge economic gains for sectors such as agriculture, aviation, energy
 - Avoidance of danger to life and property (hurricanes, severe weather, etc.)
 - “Total value to US economy of NWP activities ~\$200M per hour of useful forecast range per year”
- Impact on military operations
- US falling behind internationally in terms of NWP skill

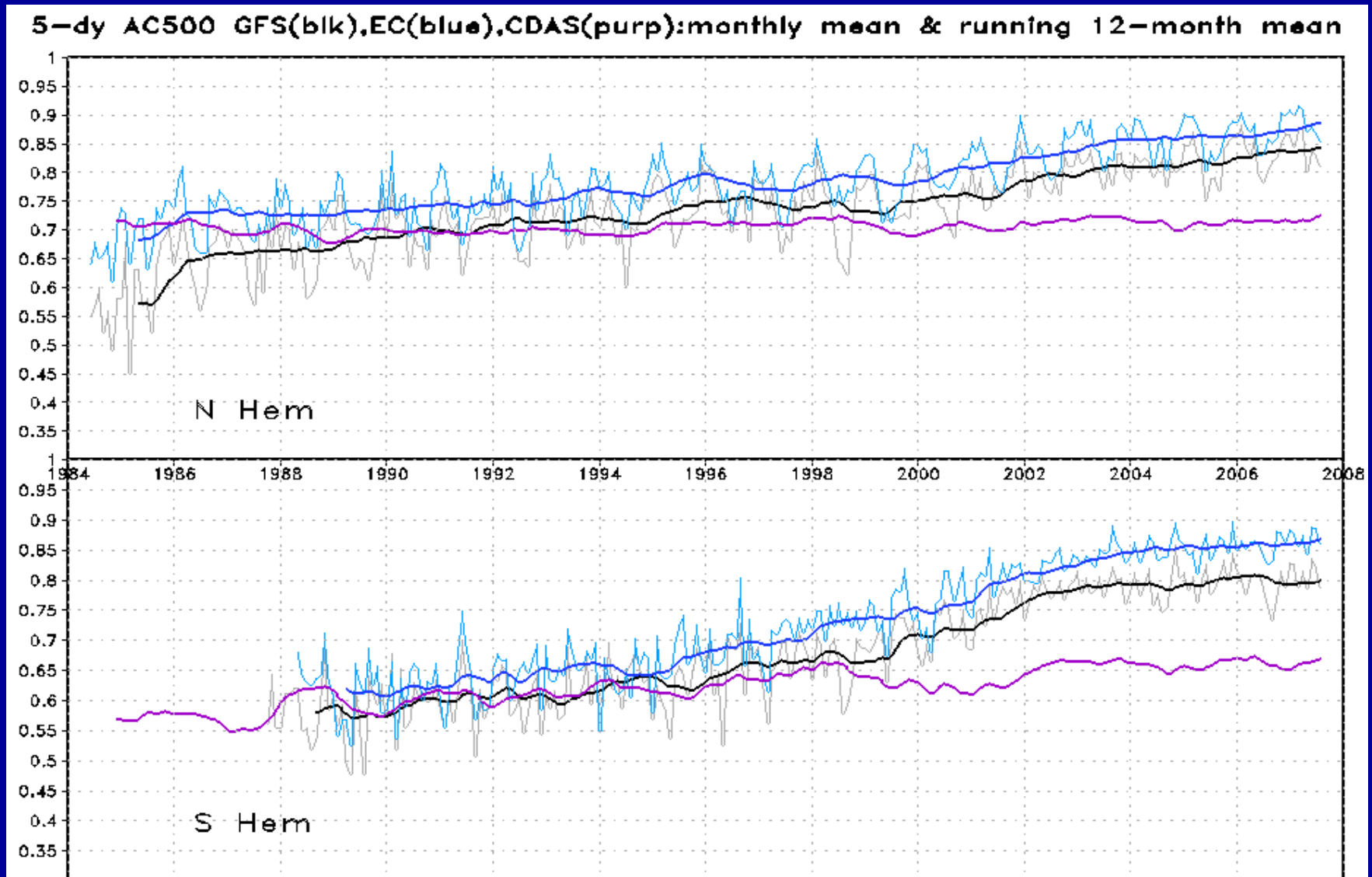
Two category 3-4 hurricanes

- “Galveston hurricane”
 - Landfall in Texas at 5 PM 09/08/1900
 - > \$500M (2008 dollars) in property damage
 - ~10,000 fatalities (out of a population of ~40,000)
 - No satellite data, no upper air network, no NWP
- Katrina
 - Landfall (2nd) in Louisiana at 6 AM 08/29 2005
 - > \$90B in property damage (2008 dollars)
 - > 1800 fatalities (out of a population of ~1.5M)
 - Extensive satellite and conventional observations, good forecast






NOAA/NCEP vs. ECMWF skill over 20+ years





From idea to implementation (R2O)

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

JCSDA Mode of operation

- Directed research
 - Carried out by the partners
 - Mixture of new and leveraged funding
 - JCSDA plays coordinating role
- External research
 - Historically implemented as a NOAA-administered FFO, open to the broader research community
 - Typically ~\$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 (May 12-13, 2009)

Directed Research, 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
- Four WGs formed so far
 - CRTM
 - IR sounders
 - Microwave sensors
 - Ocean data assimilation

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 (NOAA and NASA, respectively)
 - Longer term plans still being worked out



7th 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, ...

Recent JCSDA highlights

- CRTM
- IASI
- ASCAT
- COSMIC

JCSDA Community Radiative Transfer Model (CRTM)

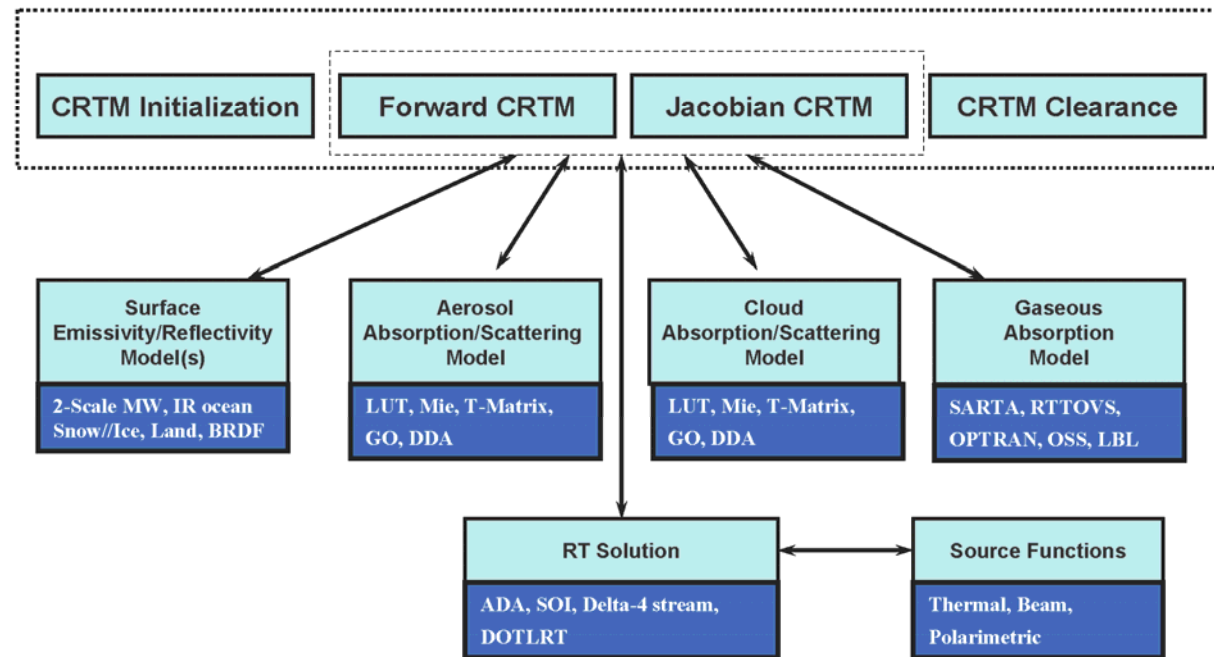


Supported Instruments

- GOES-R ABI
- Metop IASI
- TIROS-N to NOAA-18 AVHRR
- TIROS-N to NOAA-18 HIRS
- GOES-8 to 13 Imager channels
- GOES-8 to 13 sounder channel 08-13
- Terra/Aqua MODIS Channel 1-10
- METEOSAT-SG1 SEVIRI
- Aqua AIRS
- Aqua AMSR-E
- Aqua AMSU-A
- Aqua HSB
- NOAA-15 to 18 AMSU-A
- NOAA-15 to 17 AMSU-B
- NOAA-18 MHS
- TIROS-N to NOAA-14 MSU
- DMSP F13 to 15 SSM/I
- DMSP F13, 15 SSM/T1
- DMSP F14, 15 SSM/T2
- DMSP F16 SSMIS
- NPP ATMS
- Coriolis Windsat
- SSU and MSU

Community Radiative Transfer Model (CRTM)

Public Interfaces



Significance: CRTM framework is designed to accelerate transition of new radiative transfer science for assimilation of operational and research satellite data in NWP models and to improve the retrieval technology in satellite remote sensing system

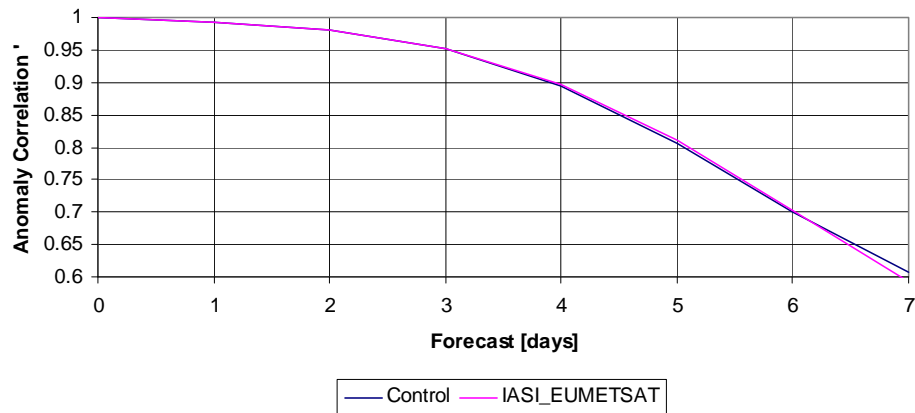
IASI Impact on Standard Verification Scores

1-31 August 2007

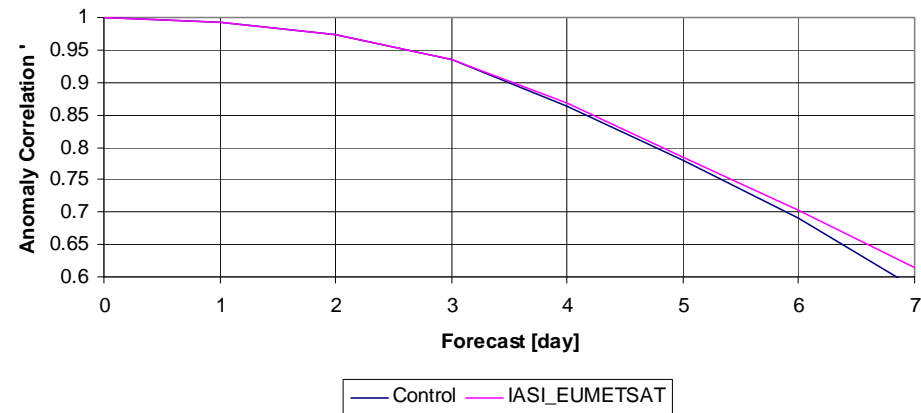
NH 500 hPa Height Anom. Cor.

SH 500 hPa Height Anom. Cor.

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



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

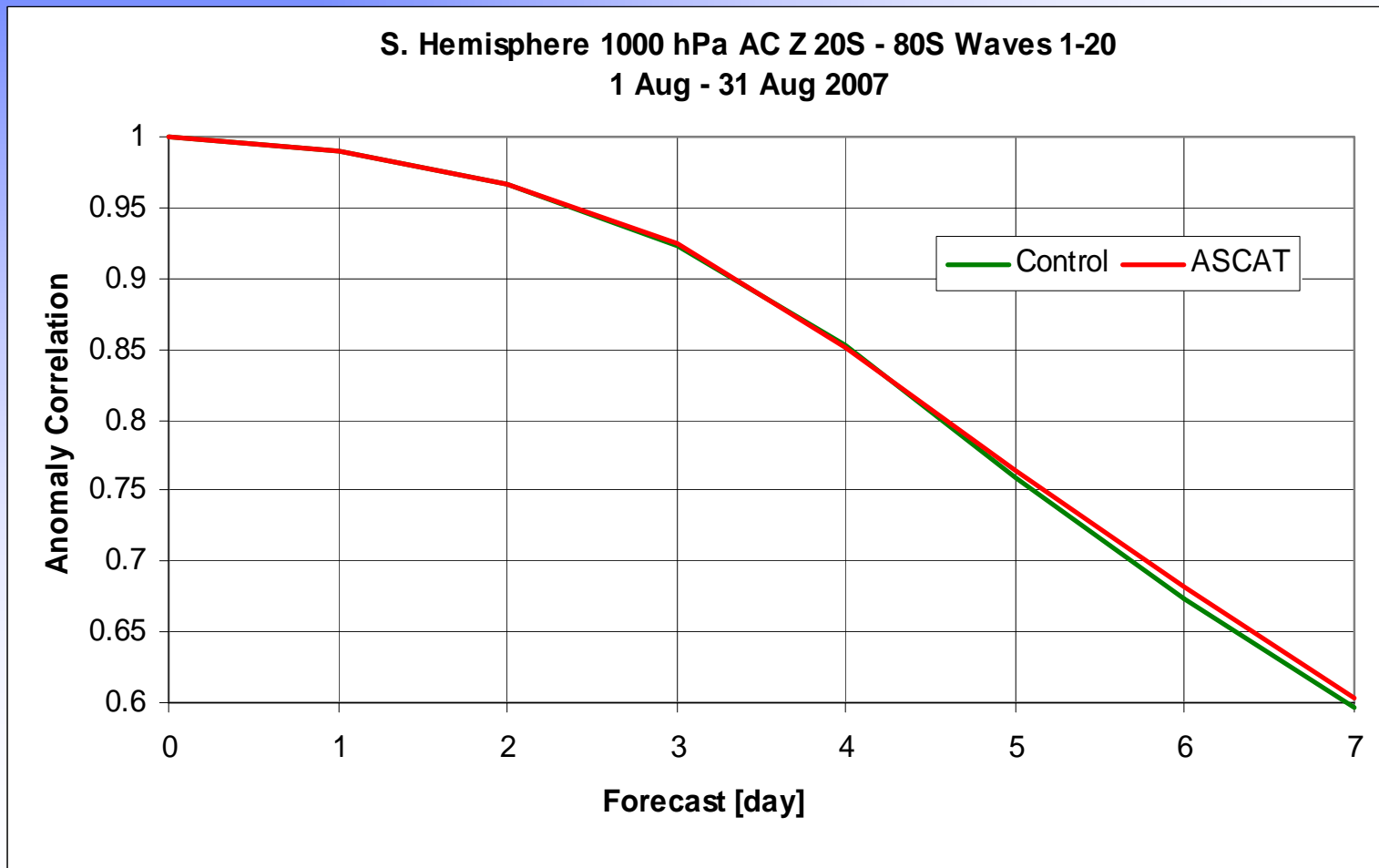


IASI
Control

J. Jung



ASCAT Impact Experiments with GFS

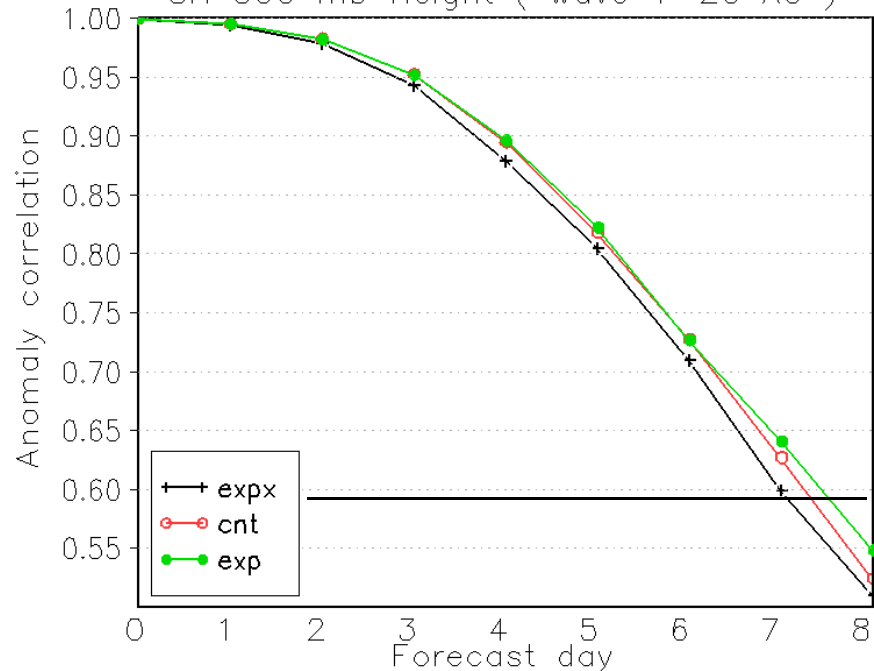




COSMIC: recent impact

- AC scores (the higher the better) as a function of the forecast day for the 500 mb gph in Southern Hemisphere
- 40-day experiments:
 - **exp** (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

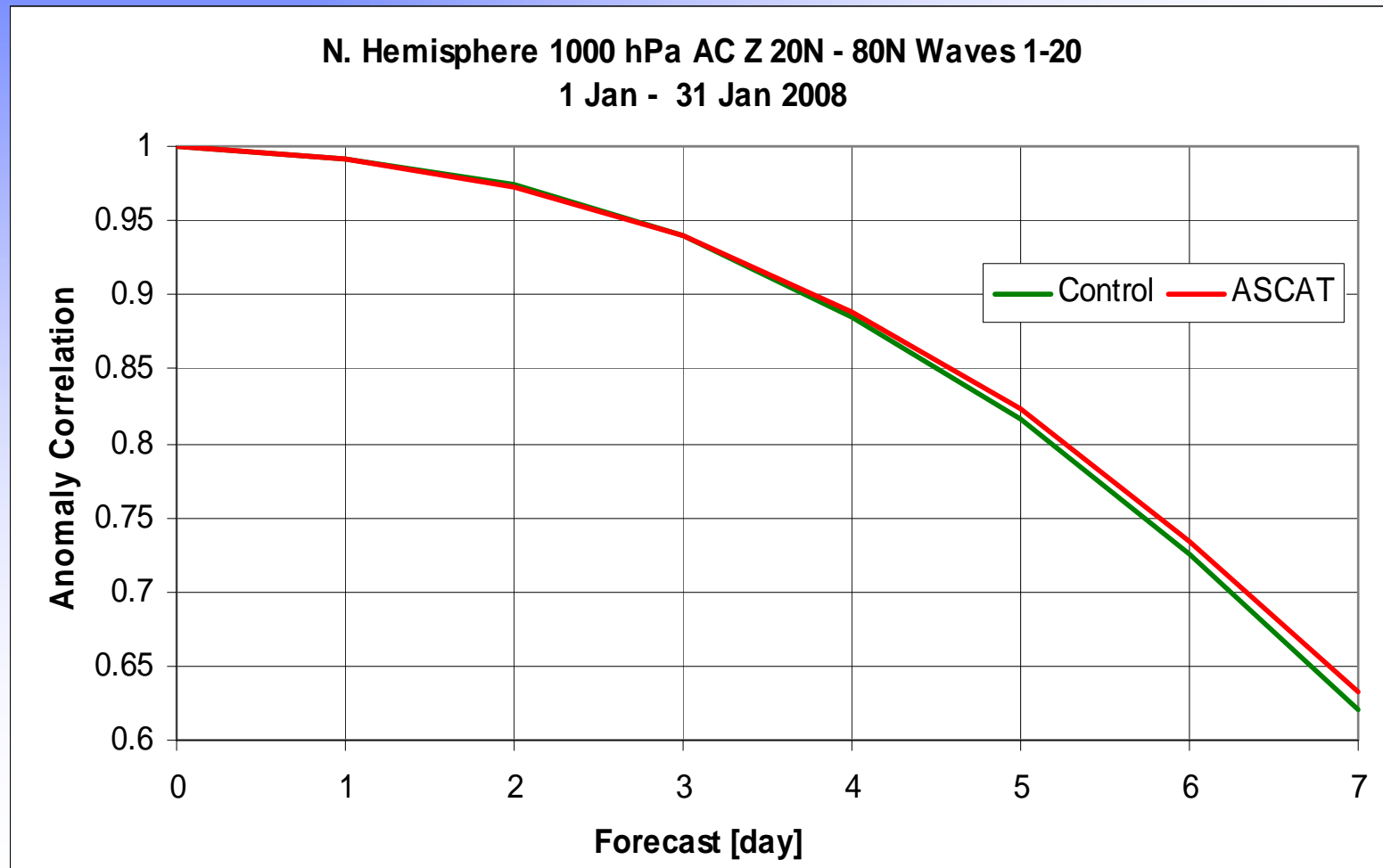
AVERAGE FOR 00Z25MAR2008 – 00Z30APR2008
SH 500 mb Height (wave 1–20 AC)



COSMIC provides 8 hours of gain in model forecast skill at day 4!!!!



ASCAT Impact Experiments with GFS (II)





Outlook

- Preparations for NPP/NPOESS, GOES-R, ADM, ...
- Technology transfer
 - IASI, ASCAT, GPSRO assimilation methodology out to all JCSDA partners
- Transition to 4D-VAR
 - NRL/Monterey: NAVDAS AR
 - NCEP/EMC: Simplified 4D-VAR
 - GMAO: Classical 4D-VAR
- New JCSDA Working Groups
 - Oceans, Atmospheric Constituents
- OSE/OSSE (lecture Thursday 07/09)
- Summer Colloquium



Preparation for new sensors

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



JCSDA Working Groups

- Oceans Working group recently established
- Atmospheric Constituents is next
- GPSRO
- ...



JCSDA Summer Colloquium

- Extremely important training component
 - No US academic program in data assimilation
- Outstanding program of lectures given by world leading experts representing all JCSDA partners, US universities and international NWP centers
- 37 participants (almost all Ph.D. students or post-docs) from 8 countries, including the US
- Sponsored by all JCSDA partner agencies



Concluding remarks

- Data assimilation is a complicated business both scientifically and organizationally
 - Intersection of many disciplines and many organizations
- Data assimilation is a challenging and very stimulating activity
 - Direct societal impact
- Enjoy the next 10 days and take a look at whether this is something you might want to become involved in!