March 2010 Interagency Research Review Meeting (Overview)

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Washington, DC

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Agenda and Highlights of Day 1

Monday, March 22, 2010 *(Room GC-402)*		Presenter
1:00 pm	Welcome/Opening Remark	Roger Pierce
1:15 pm	Interagency Collaboration/Research Themes	D. Davis/J. Haynes/ R.Moy
2:00 pm	R&D considerations for the NextGen Weather and the 4-D Cube	Steve Abelman
2:15 pm	NextGen 4-D Functional Requirements Update/Summary	James Tauss
2:30 pm	AWC – Operations to Research	Bruce Entwistle
2:45 pm	Break	
3:00 pm	Convective Weather and Thunderstorms	Steve Abelman (NOAA), Jenny Colavito (FAA)
	CoSPA Update	M. Wolfson, S. Benjamin
	SPC Perspective	R. Schneider
	NASA SATCAST Project	J. Mecikalski
	Oceanic Convection	C. Kessinger/Huaqing Cai
	NSSL/Warn on Forecast	Howard/Hondl/Stensrud
	LAPS/STMAS gust fronts	S. Albers, Y. Xie
	AutoNowcaster	R. Roberts/J. Wilson
	GPSmet	S. Gutman
	Satellite-detected signatures	K. Bedka
	MDL/LAMP – Thunderstorms	S. Smith/S. Olson
5:15 pm	Wrap-up	Cecilia Miner

Congressional Mandate

- NASA Authorization FY08

"Directs the Administrator [NASA] and the Administrator of NOAA to develop a collaborative research plan on convective weather events, with the goal of significantly improving the reliability of 2-hour to 6- hour aviation weather forecasts."

- FY09 Repeated but generalized this language.

Roger Pierce

NOAA Vision

- Meeting Agenda
  - Hazards
    - Convection
    - Ceiling & Visibility
    - Icing & Turbulence
    - Obscurations
    - Space Weather
  - Foundational Improvements
    - NWP
    - Observations

- NOAA NWS and OAR will meet these goals incorporating
  - Research
    - OAR Labs
    - Academia
    - Other Federal Labs
  - Testbeds
    - Scientific
    - Operational
  - Transition to Operations

NOAA and NextGen

NOAA's NextGen research is an enabler for NOAA's Weather Ready Nation

- **"NOAA envisions a future with communities, businesses, and governments that prepare for and respond to sudden and prolonged high-impact events"**
- **Enhance transportation efficiency and safety**
- **Support and enhance the Nation's infrastructure and homeland security**
- **Reduce loss of life and disruption from high-impact events**

Roger Pierce

NOAA Goals of this Meeting

- Broader understanding of the current state of weather research across our agencies
- A path forward for finalizing and implementing the interagency (NOAA/NASA) weather coordination plan as mandated by Congress
- Highlight interagency research improvements and opportunities

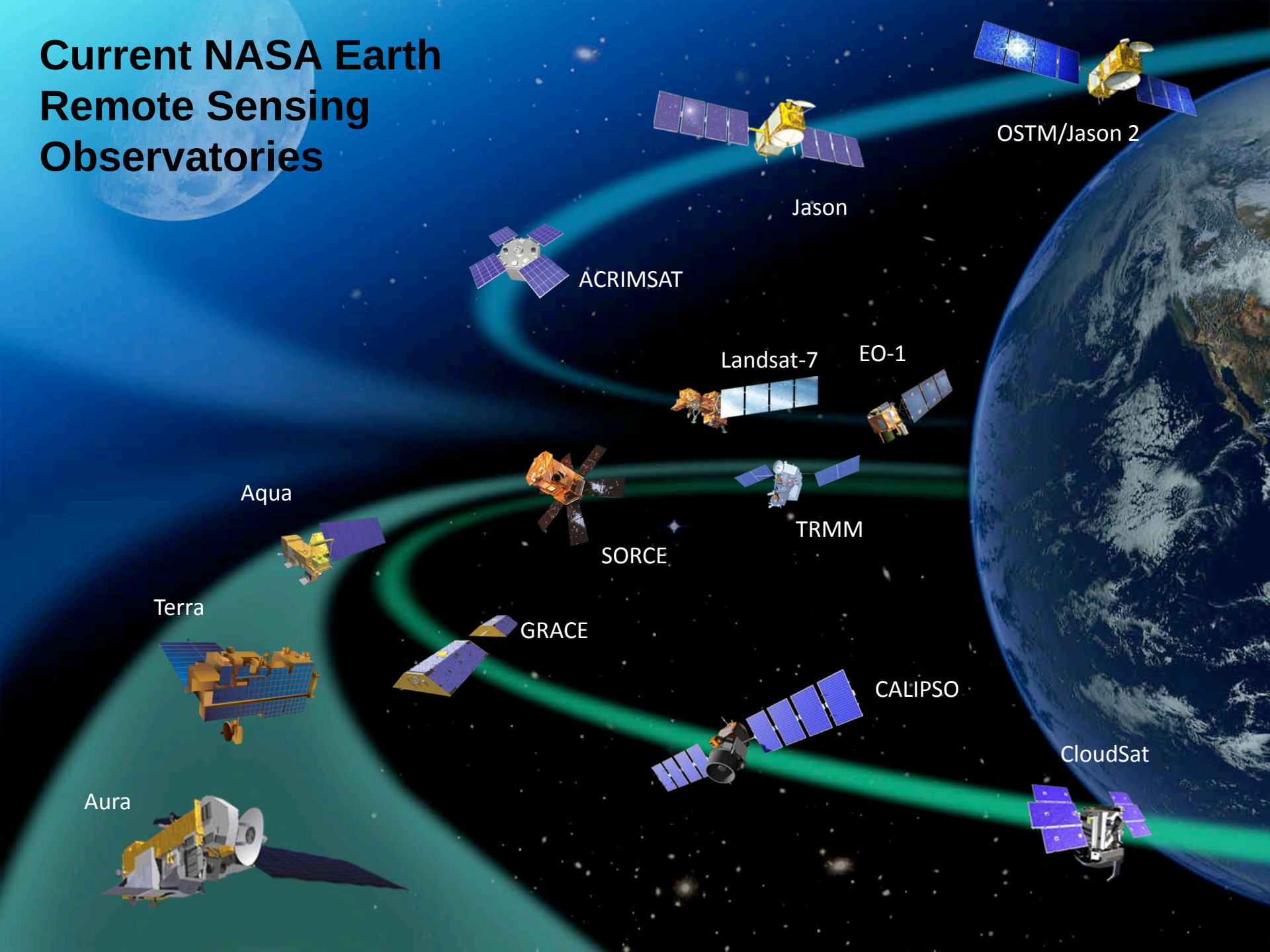
Roger Pierce

3 NASA Goals of this Meeting

- Update of progress on current projects
- Explore opportunities for collaboration or leveraging results between projects and agencies, including possible joint solicitations
- Obtain community input on potential topics for the NASA ROSES 2010 solicitation.

John Haynes

Current NASA Earth Remote Sensing Observatories



Future Observations – Near Term

- **Aquarius** – 2010
  - Sea surface salinity (SSS) observations needed for studies of ocean circulation, climate and the global water cycle. SSS observations will allow the monitoring of variations in the water cycle including: land runoff, sea ice freezing and melting, evaporation, and precipitation over the oceans.
- **Glory –** 2010
  - Collect data on the properties of aerosols, including black carbon, in the Earth's atmosphere and climate system; collect data on solar irradiance for the long-term effects on the Earth climate record.
- **NPOESS Preparatory Mission (NPP)** -- 2011
  - NPP will serve as a bridge mission between the NASA Earth-observing research satellites Terra, Aura, and Aqua and the operational Joint Polar Satellite System (JPSS).
- **Landsat Data Continuity Mission (LDCM)** -- 2013
- **Global Precipitation Mission (GPM)** – 2013
  - Will provide accurate observations of the intensity and distribution of global precipitation. GPM builds on the heritage of the TRMM mission and is in partnership with JAXA.

2013
OSTM/Jason 2
Aquarius
GPM Core
Landsat-7
Aqua
Glory
SORCE
TRMM
Terra
NPP
LDCM
SMAP
CALIPSO
CloudSat
Aura

Selected Future Observations – Decadal Survey

- **Hyperspectral Infrared Imager (HyspIRI)** – NET 2015
  - HyspIRI will employ a hyperspectral imager and a thermal infrared scanner to monitor a variety of ecological and geological features at a wide range of wavelengths, including data on changes in vegetation type and deforestation for ecosystem management .
- **Soil Moisture Active Passive (SMAP)** – 2013
  - SMAP will use a combined radiometer and high-resolution radar to measure surface soil moisture and freeze-thaw state.
- **Deformation, Ecosystem Structure, and Dynamics of Ice (DESDynI)** – NET 2015
  - DESDynI is a dedicated InSAR and LIDAR mission optimized for studying hazards and global environmental change, including the effects of changing climate on land use and species habitats.

2015
DesDynI
Aquarius
OSTM/Jason 2
Landsat-7
ICESat II
Aqua
Glory
SORCE
NPP
LDCM
SMAP
GPM Core
GPM Low
HyspIRI

FAA Perspective

- NextGen concept requires that aviation weather nowcast and forecast information be integrated into user decision support tools.
- Purpose of Aviation Weather Research Program (AWRP) was applied research aimed at minimizing impact of weather on the National Airspace System and accomplishing NextGen goals. AWRP research areas include storms, turbulence, icing, and ceiling/visibility; weather hazard research is facilitated by advances in modeling and weather radar techniques.
- Strong collaboration exists between FAA, NOAA, and NASA in AWRP.
- Takeaway: Focus on ongoing collaborative research and consider participation in FAA Research-to-Operations (RTO) efforts to move research solutions into operations

Ray Moy

Technical Highlights of Day 1

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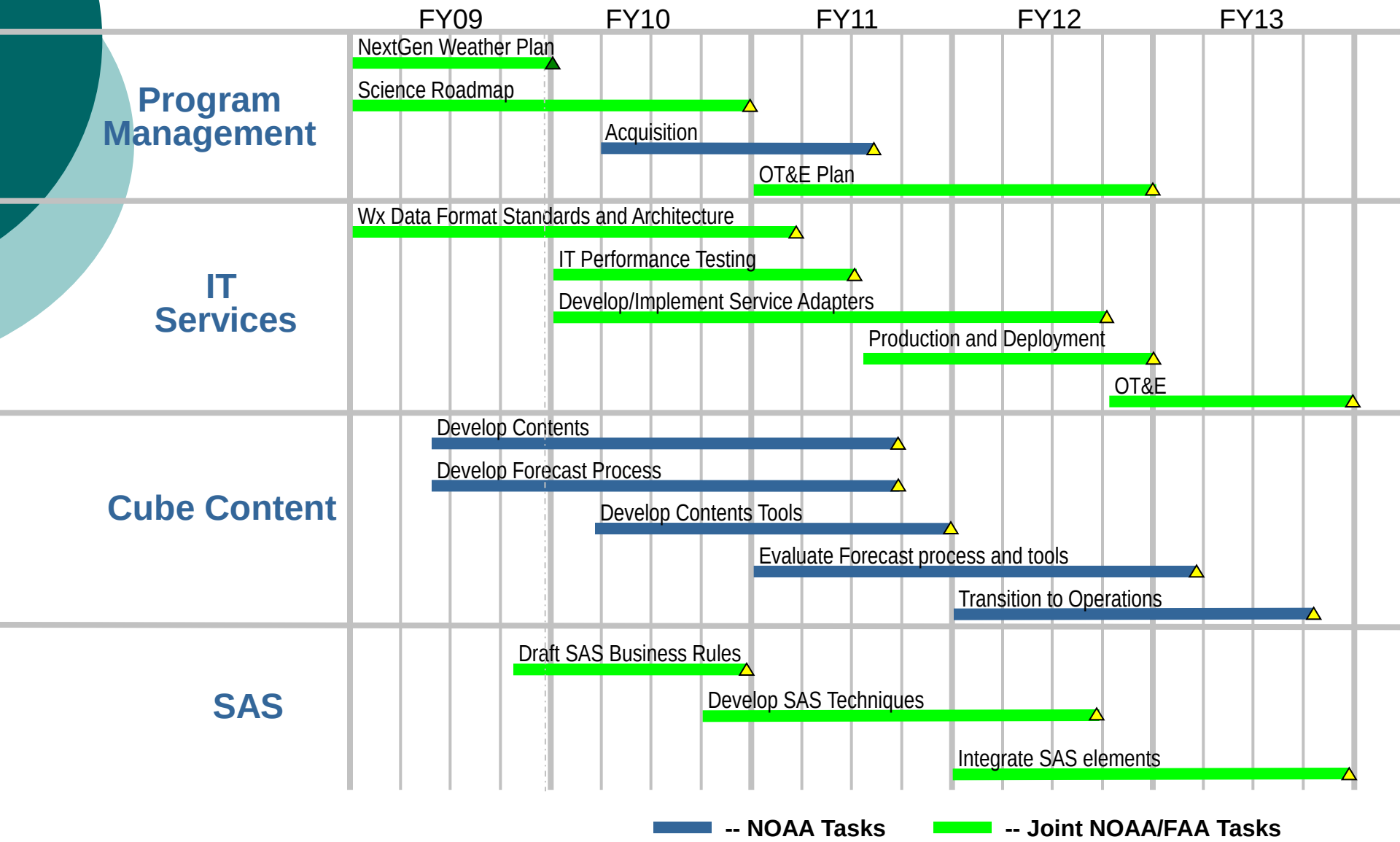
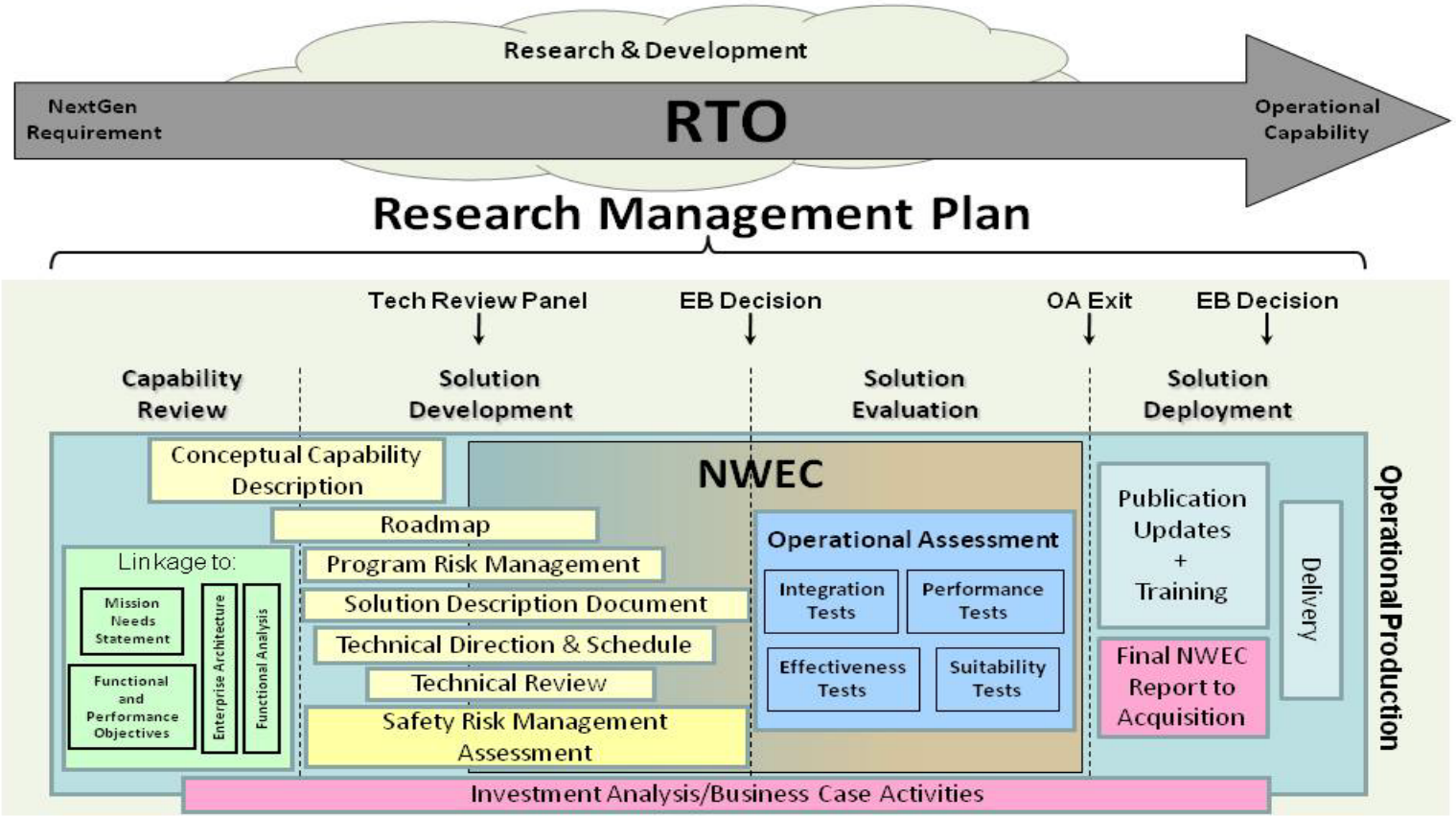
Program Management

Integrated Schedule (Ableman)



The new Research to Operations Process (RTO)

(Ableman)



Next Generation Air Transportation System (NextGen) Weather Requirements: An Update

Federal Aviation Administration

Presented to: Joint Interagency Weather Research Planning and Coordination Meeting

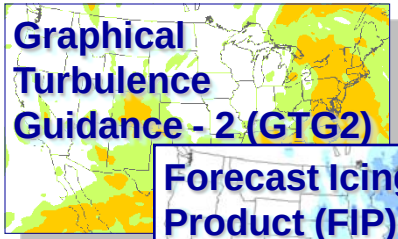
By: James Tauss

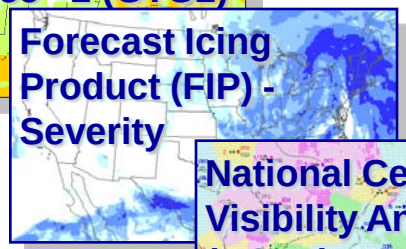
Date: March 22, 2010

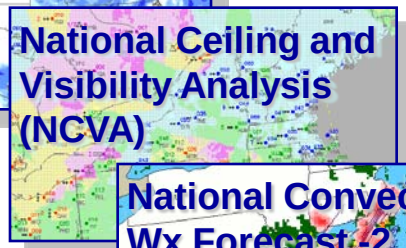
Co-Authors: Cheryl Souders, Cecilia Miner, Ernie Dash, Steve Abelman, Jack May, Bob Showalter, Lorraine Leonard Tom Kay, Sue Spincic & Fran Bayne

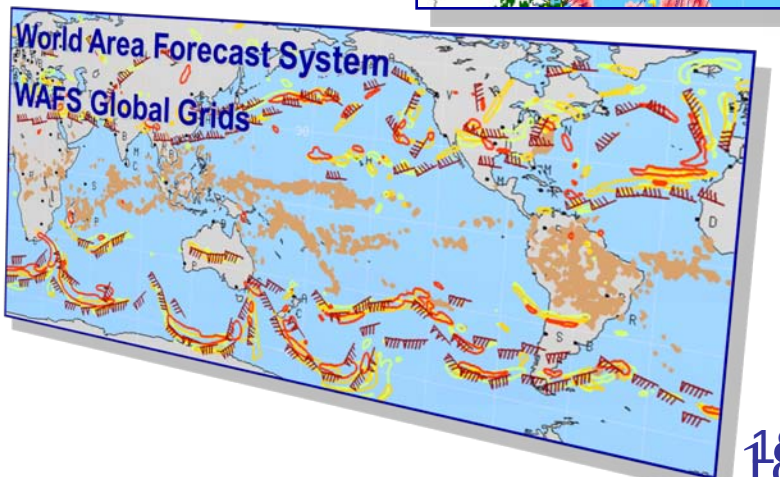
Research-to-Operations (R↔O)

- AWRP Algorithms
  - GTG, CIP/FIP, NCVA, NCWF
- National Weather Service
  - WAFS Global Grids "High Glance"
    - FAA & WAFCs Washington & London
  - Integration of hourly SREF & Enhanced Thunder into CCFP
    - NCEP: SPC, NCO & EMC
  - Space Weather effects/hazards on aviation
    - NCEP: SWPC
- Enhanced CWSU Decision Support Software



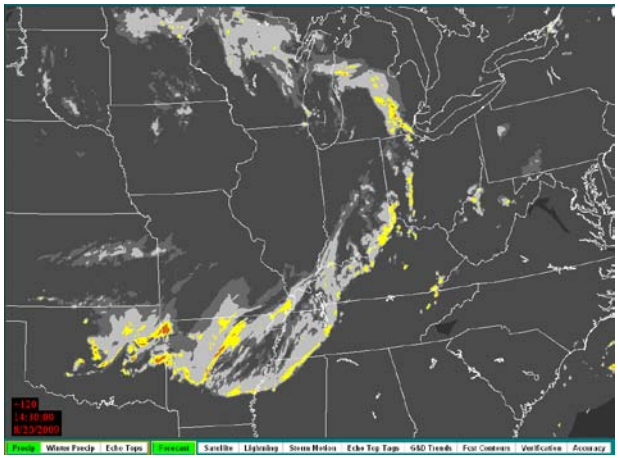






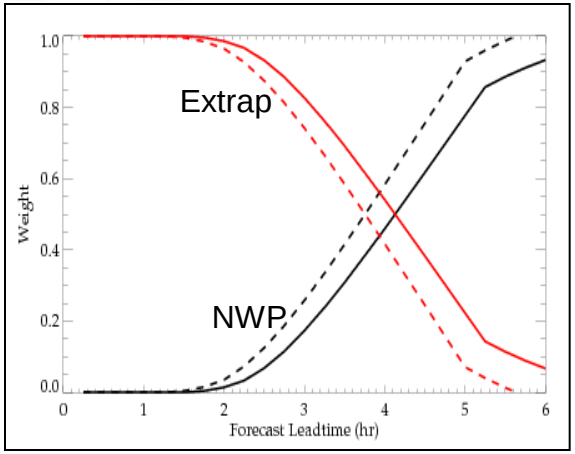
CoSPA 0-8 Hour Forecast
Main Components (Wolfson, Benjamin)

Corridor Integrated Weather System (CIWS)

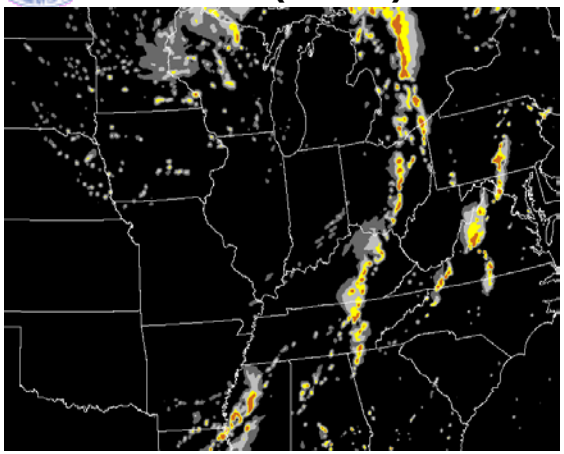


Extrapolation

Blending Module



High Resolution Rapid Refresh (HRRR)



Numerical Weather Prediction

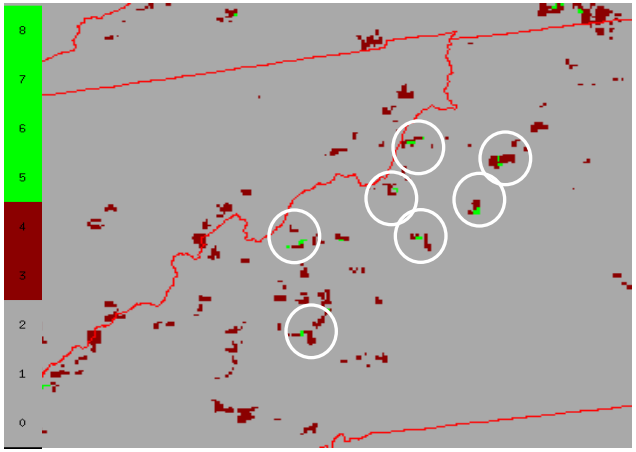
0 Hour → 8 Hour

Forecast Lead

Air Traffic Management (ATM) Planning
- **'Tactical' Planning (0-2hr)**
- **'Strategic' Planning (2-8hr)**

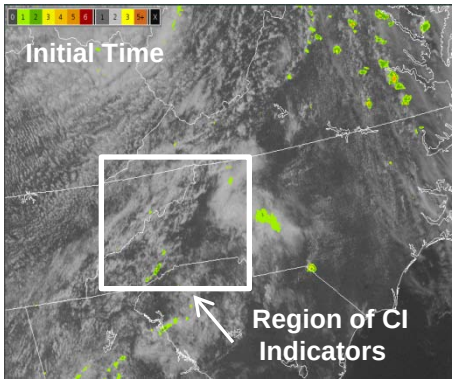
CoSPA Research
Convective Initiation (Iskendarian)

Eight Satellite CI Indicators

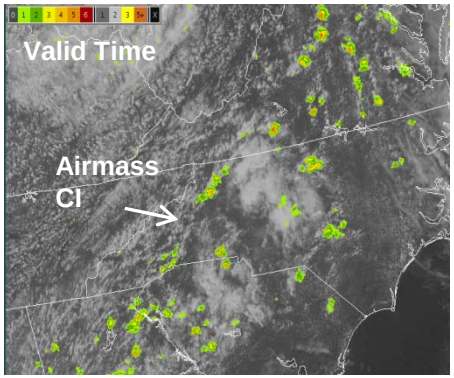


- SATCAST running in real-time CoSPA testing environment
- Algorithms being designed and tested to use SATCAST in CoSPA
- SATCAST data being sent to NCAR and NOAA ESRL for their research

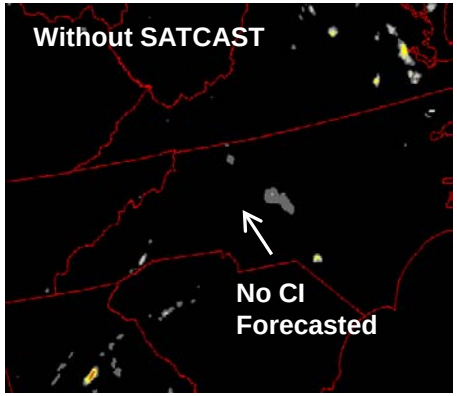
Radar Precipitation & Satellite



Radar Precipitation & Satellite



1 Hour Precipitation Forecast



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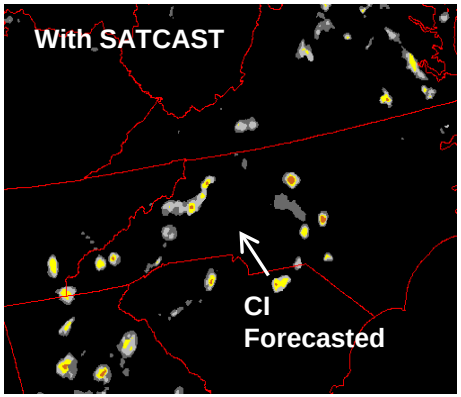
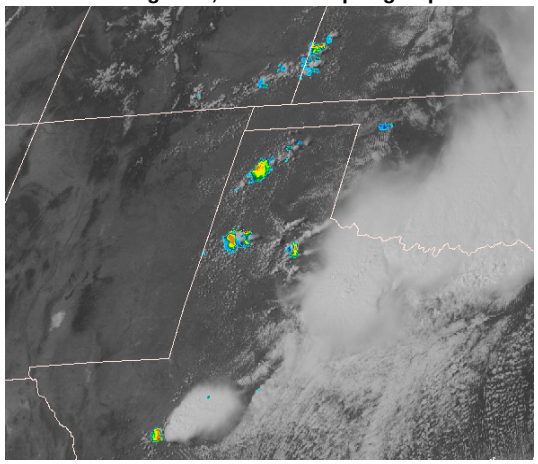


Pixel-Based vs. Cloud Object Tracking

UWCI Cooling Rate, 2009 SPC Spring Experiment

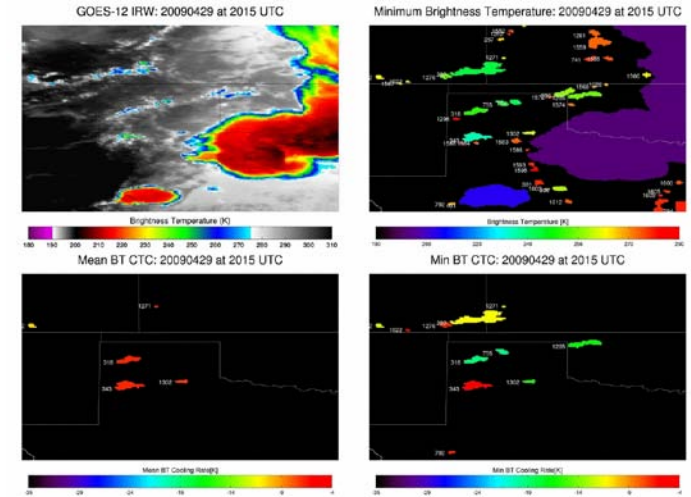


- **Current convective initiation (CI) nowcast methods attempt to monitor cloud top time trends at the pixel scale**
  - Proper handling of cloud movement between images and product validation are significant challenges for these pixel-based frameworks (UWCI and SATCAST)
  - Each 15-30 min sequence of images is an independent event, no "memory" of past cloud behavior
  - These methods "shut off" after CI has occurred, what about mature convection nowcasting?

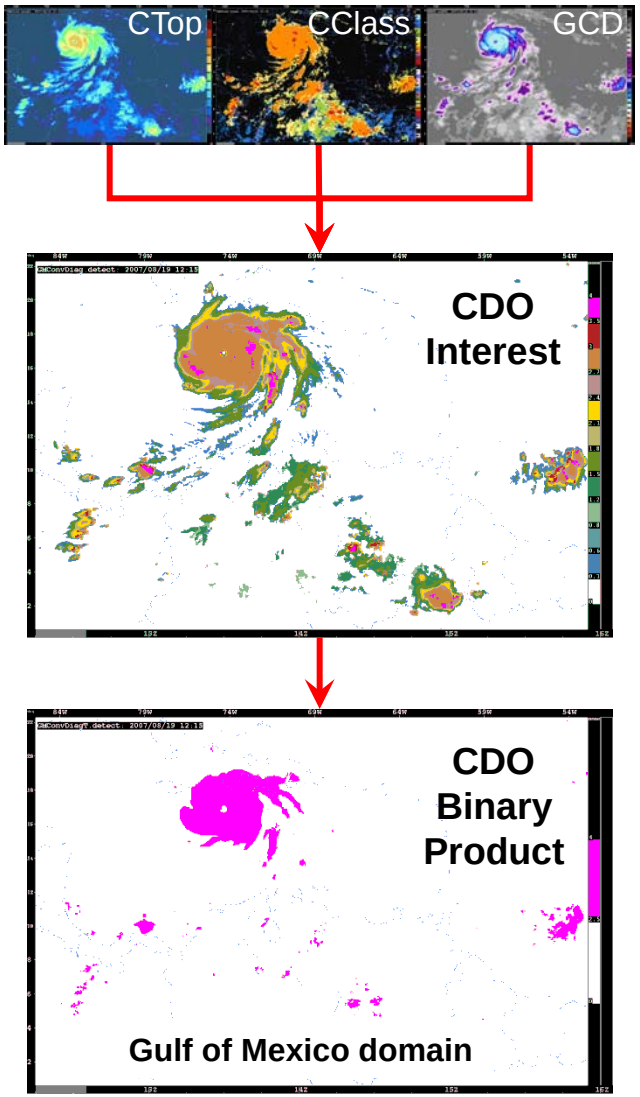
- **Efficient methods such as the NSSL/OU-CIMMS Warning Decision Support System (WDSS-II, Lakshmanan et al. 2007) are now available for clustering cloud pixels into coherent objects**
  - Objects can be tracked from initial development to storm decay and cloud trends are accurately monitored over time
  - This object-based framework offers significant advantages in that the full spectrum of satellite-derived cloud property information, NWP fields, and validation datasets can be carried along with the object to produce or assess:

1. **Convective Initiation Nowcast**
2. **Storm Lifetime Forecast**
3. **Mature Storm Intensification/Decay**
4. **Storm Future Position Forecast**
5. **Storm Severity Potential**
6. **Turbulence Potential**

WDSS-II Objects and Cloud Top Cooling Rates For the Above Case



Convection Diagnosis Oceanic (CDO) Product (Kessinger)



Satellite-based detection of deep convection for remote regions

- Data fusion of 2-3 algorithms creates interest field
  - Cloud top height
  - Cloud classification
  - Global convective diagnosis
- Threshold applied for binary product
- TRMM provides validation (Donovan et al., 2009)

Implemented over regional and global domains

Category	POD	FAR	Bias	CSI
All	**0.72**	**0.26**	**0.98**	**0.58**
Day	**0.82**	**0.26**	**1.10**	**0.64**
Night	**0.47**	**0.28**	**0.66**	**0.40**
Ocean	**0.70**	**0.26**	**0.94**	**0.56**
Land	**0.74**	**0.26**	**1.01**	**0.59**

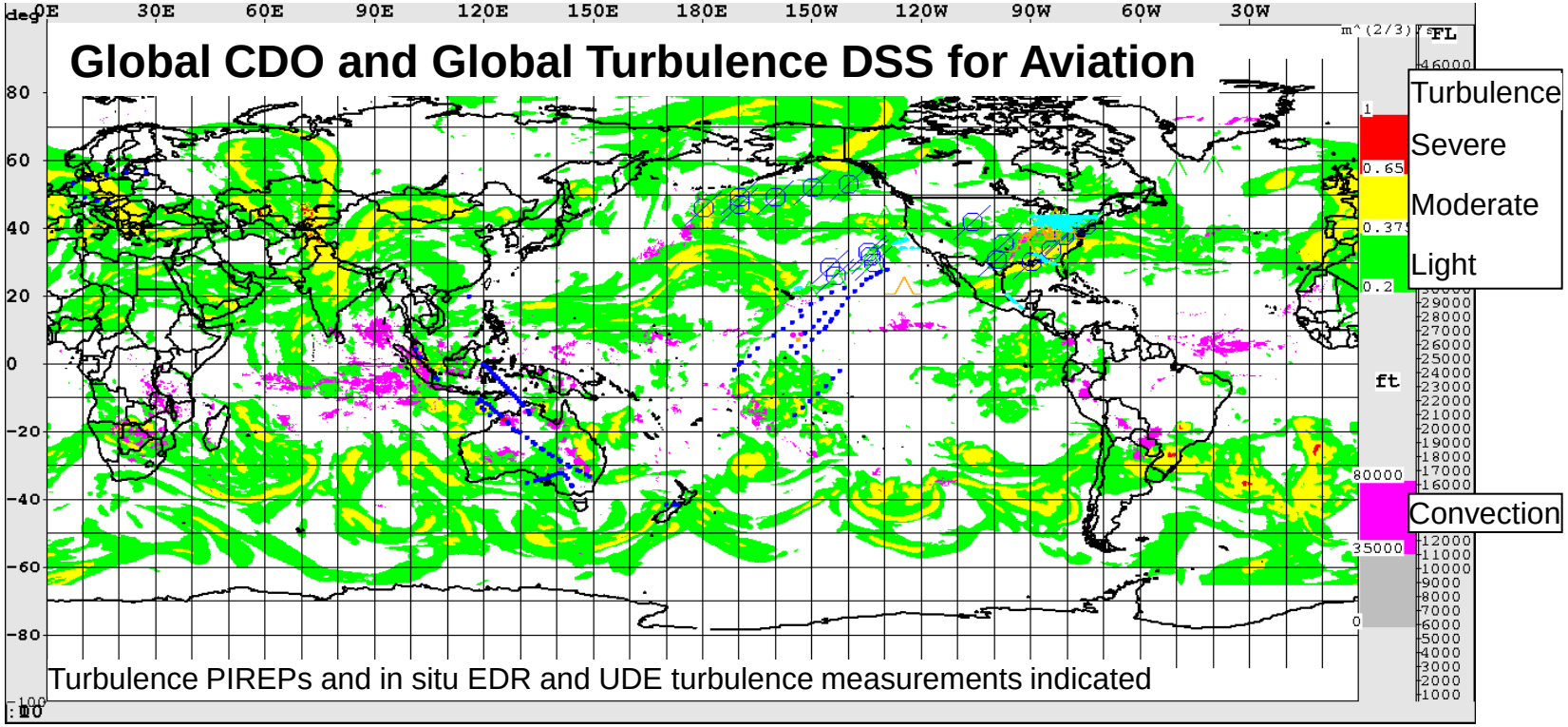
Manual TRMM Validation of CDO

1817 cells analyzed

12-22 Aug 2007 Hurricane Dean

Global Convection and Global Turbulence

- Expand CDO/CNO to global domain for convection
- Create Global CDO/CNO for inclusion in the Global Turbulence DSS for Aviation as an indicator for convectively-induced turbulence
  - CDO simplified to use cloud top height and global convective diagnosis
  - CNO uses the gridded nowcast technique to 8 hours



NDFD Precipitation Elements (Olson)

NDFD contains the following precipitation elements:

- Predominant Weather
- Probability of Precipitation (PoP)
- 6-Hour Quantitative Precipitation Forecast (QPF6)
- 6-Hour Snow Accumulation

Available for CONUS and 16 pre-defined CONUS sectors

Agenda and Highlights of Day 2, Morning

8:00 am	Observations – Right Sizing	Victor Passetti
8:30 am	Satellite Obs and Products	Steve Goodman, John Murray
	GOES-R Aviation Algorithm Working Group	W. Feltz
	JPSS	TBD
	Calipso	C. Trepte
	Cloudsat	G. Stevens
	NASA Decal Survey Mission applications	D. Johnson
10:00 am	Break	
10:15 am	Obscurations	Steve Fine (NOAA)
	LAPS Fog Dissipation	S. Albers
	Visibility, volcanoes, and fires with WRF/Chem variations	G. Grell
	Dust and smoke with HYSPLIT	R. Draxler
11:00 am	Cloud Properties	Pat Minnis
	Crosscutting Cloud Properties Apps at NASA	Pat Minnis
	NESDIS Cloud Properties System	Feltz
	Dual-pole radar applications	NSSL

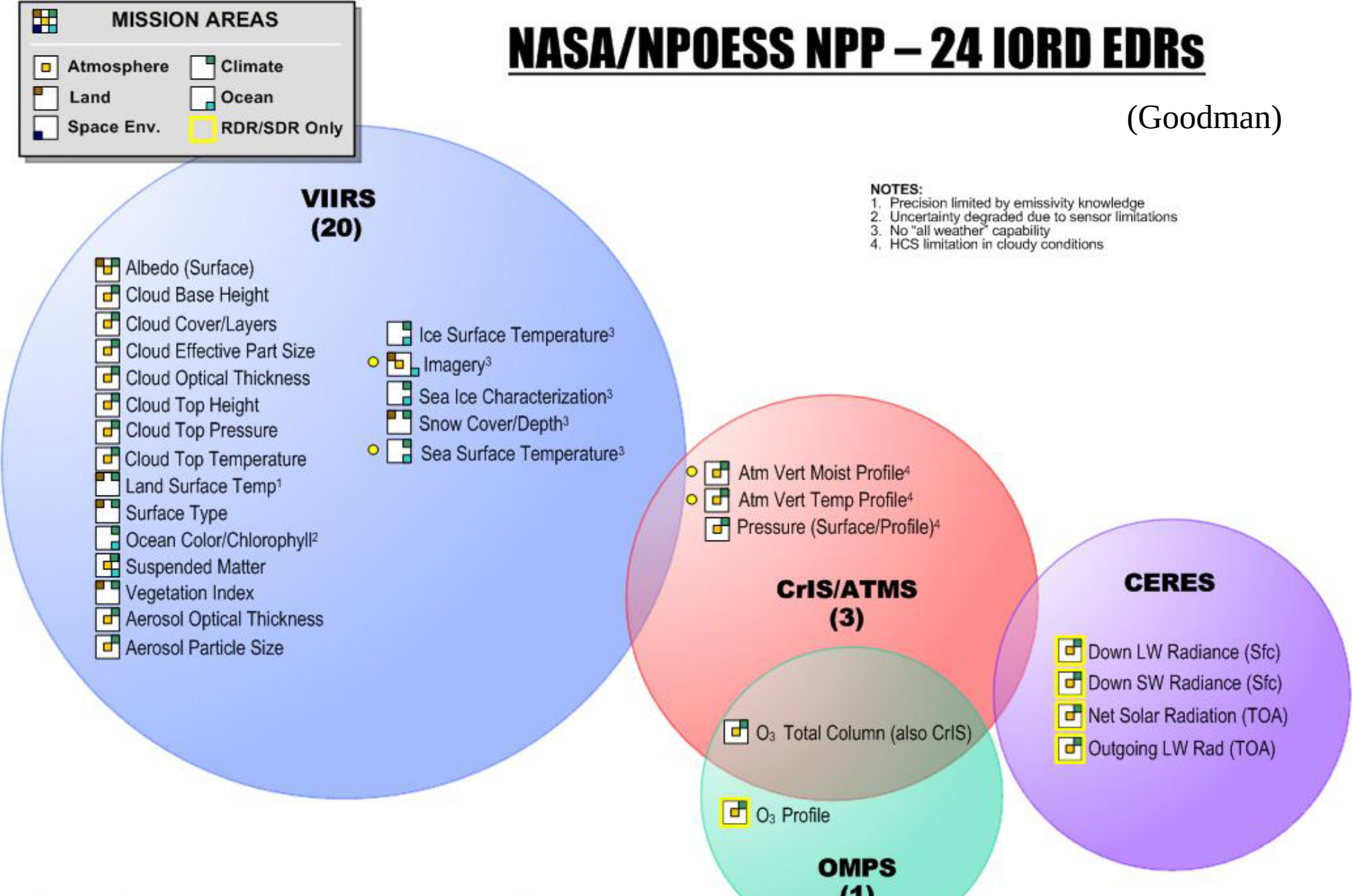
GOES-R Improvements vs Current GOES

Performance Capability	GOES I-M	GOES N-P	GOES R
Imaging			
Visible Resolution	1 km	1 km	0.5 km (0.64 um)
IR Resolution	4-8 km	4-8 km N 4 km O/P	1-2 km
Full Disk Coverage Rate	30 min	30 min	5 min
Rapid Scan Imaging Mode	7.5 min	7.5 min	30 sec
# of Channels	5	5	16
Solar Monitoring	GOES-M only	Yes	Yes
Lightning Detection	No	No	Yes 8km <20 sec latency
Operate through Eclipse	No	Yes	Yes
Ground System Backup	Limited	Limited	Limited
Archive and Access	Limited	Limited	Yes
S/C Raw Data Volume	2.6 Mbps	2.6 Mbps	75 Mbps

(Goodman)

NASA/NPOESS NPP – 24 IORD EDRs

(Goodman)



NOTES:
1. Precision limited by emissivity knowledge
2. Uncertainty degraded due to sensor limitations
3. No "all weather" capability
4. HCS limitation in cloudy conditions

KEY ○ = NPOESS Key Performance Parameters

EDRs not delivered by NPOESS are not counted in totals

20 June 2008

DoD, NOAA, NASA,
Integrated Program Office
M. Haas, F. Eastman
G. Mineart, J. Whitcomb

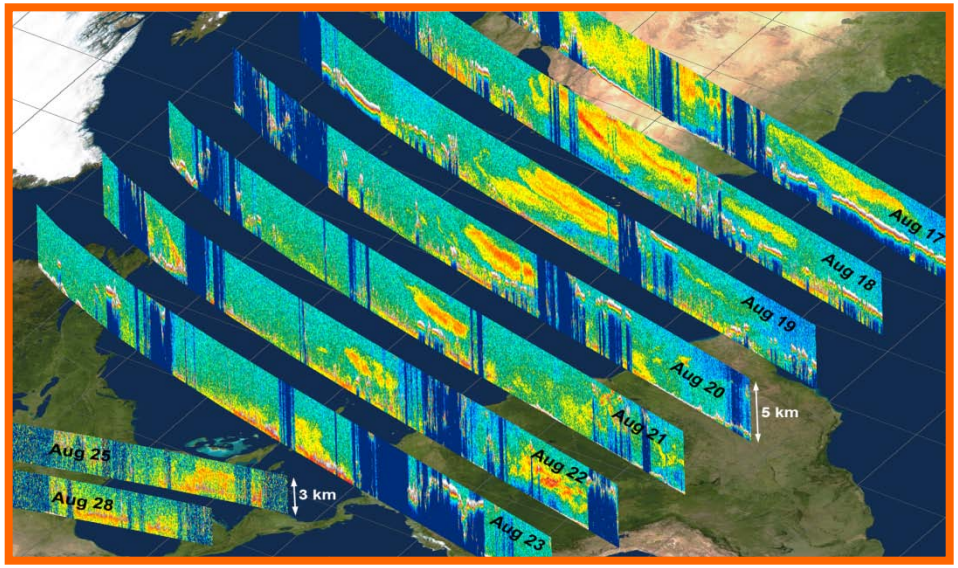
NPP-V16

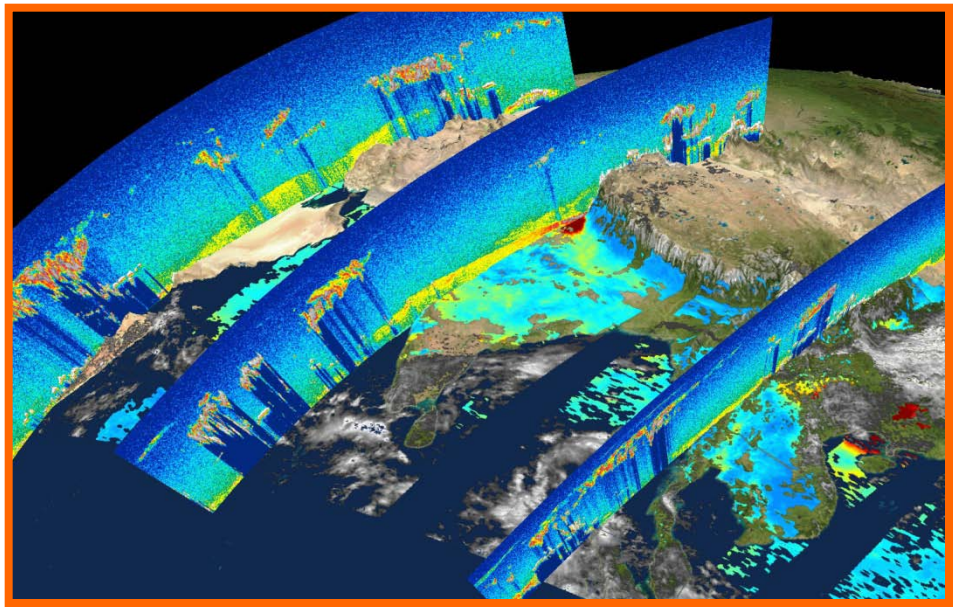
Assimilation of CALIPSO Products

New techniques are being employed to ingest CALIPSO observations in support of air quality and hazard warning forecasts

Studies include

- model verification
- parameterization development
- data assimilation and fusion
- experimental forecast products
- skill assessment





Trepte

NASA Earth Observing Missions Applications Workshop
February 1-3, 2010
Colorado Springs, Colorado

Summary report by David Johnson, NCAR
with Garry Jedlovek (NASA) & Wayne Feltz (CIMSS)

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Earth Science and Applications from Space:
National Imperatives for the Next Decade and Beyond (2007)

Decadal Survey Missions:

NEAR TERM	TIER I	TIER II
NPP/NPOESS (now JPSS)	CLARREO	ASCENDS
GPM (follow on to TRMM)	SMAP	HYSpiri
LDCM	DESDyni	SWOT
OCO (try again)	ICESAT-2	GEOCAPE
		ACE

Obscuration Requirements (Fine)

- Obscuration Types
  - Fog
  - Haze
  - Smoke
  - Volcanic ash
  - Low cloud
  - Blowing snow
  - Blowing spray
- Issues
  - Observations
  - Forecasting

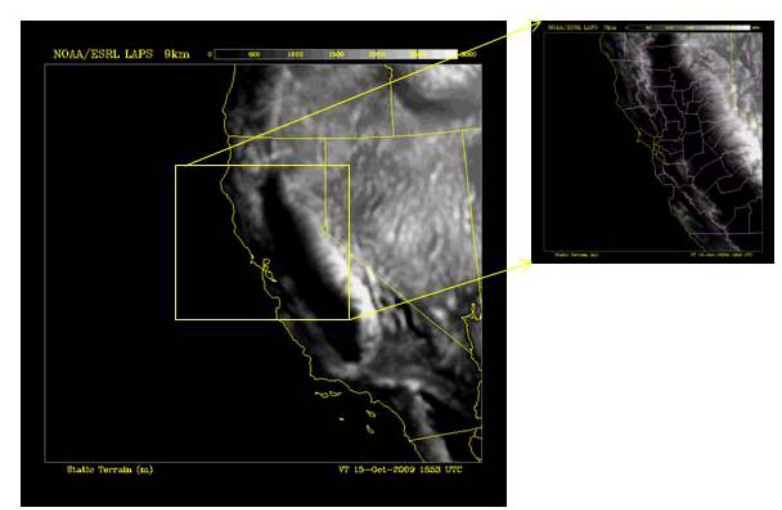
Agenda and Highlights of Day 2, Afternoon

8:00 1:00 pm	Precipitation		Cecilia Miner
		HMT Ensemble	I. Jankov
		QPE	K. Howard, J. Zhang
		QPF	TBD
		MDL/NDFD	S. Olson
2:00 pm	Lightning		Steve Goodman (NOAA)
		GOES-R Lightning Mapper	S. Goodman
		Lightning Data Network	TBD
		Radar as a proxy for Lightning @Univ Of HI	S. Albers
3:00 pm	Boundary Layer Observations and Forecasts		Tom Schlatter (NOAA)
		TAMDAR	B. Moninger
		Profilers	TBD
		WVSS-IIv3	D. Helms
		Weather radars 88D, dual-pol, and CASA for observing hydrometeors	T. Schuur
		GPS moisture	S. Gutman
		Importance of land surface observations	C. Marshall
5:00 pm	Wrap Up		Steve Abelman (NOAA)

QPF related activities (Jankov)

- HMT ensemble precipitation forecasting
  - mixed model/mixed physics /mixed LBCs ensemble
  - 9 members
  - nested domain
  - LAPS analysis

Yuan et al. 2008, Jankov et al. 2007, Jankov et al. 2009



- Convective Precipitation forecasting
  - high resolution diabatical initialization (LAPS/STMAS)

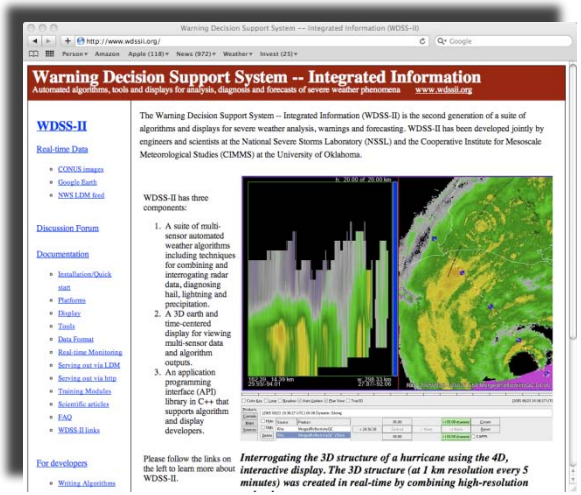
    Etherton and Santos 2006, Jankov 2007 a,b
  - high spatial/temporal resolution numerical model runs
  - frequent update

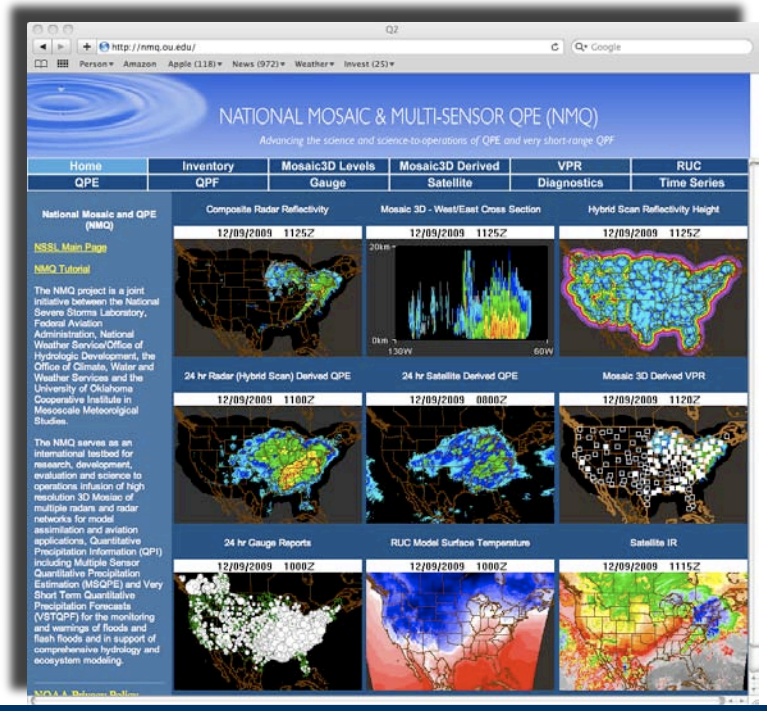
NSSL's MRMS Approach

http://nmq.ou.edu http://wdssii.nssl.noaa.gov

Provide a flexible 'real time' framework for seamless aggregation of multi radars, multi sensors observations into seamless solutions.

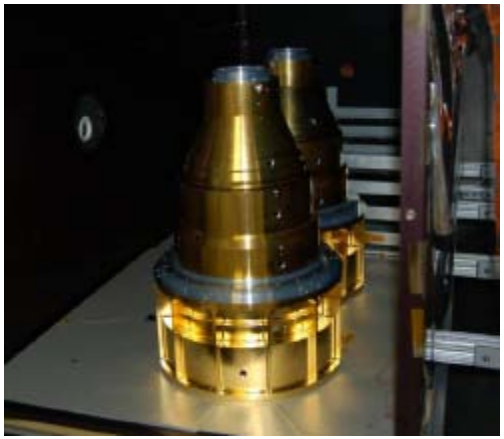
Scalable by resolution （time and space） as well as by radar systems and networks





Geostationary Lightning Mapper (GLM)

- **Detects total lightning**: in cloud, cloud to cloud, and cloud to ground
  - Improves warning lead-time for severe storms and high impact weather
  - Improves aviation safety and efficiency due to avoidance of thunderstorms
- Near-uniform storm-scale coverage over oceans and land



EDU rear lens housing

Photo credit: Shane Lear, NOAA

(Goodman)

Current Status

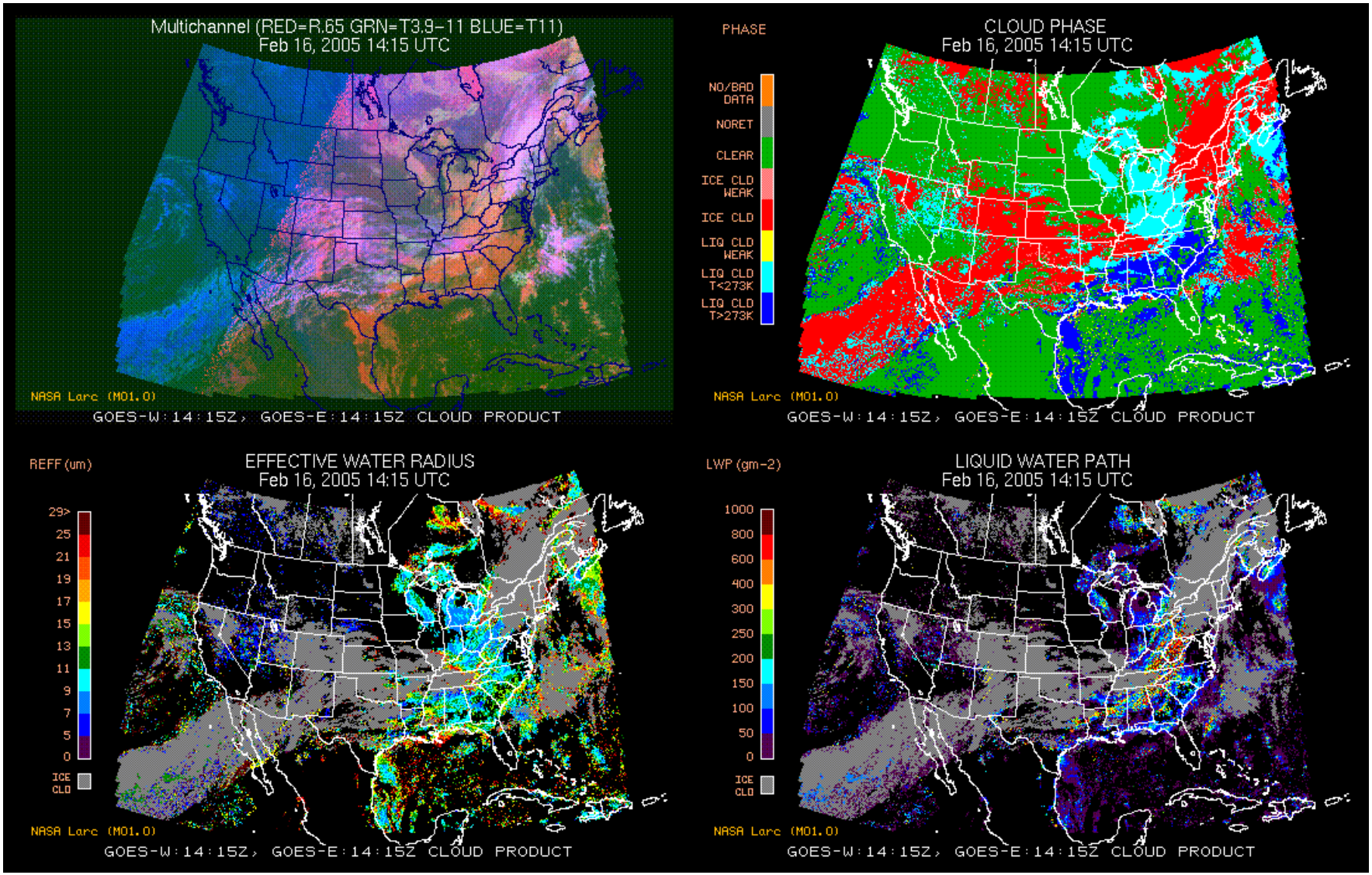
- Successfully conducted Preliminary Design Review (PDR)
- Engineering Test Units and Engineering Demonstration Unit in fabrication

Coming Soon:

- CDR in summer 2010
- GPM CHUVA Proxy Data Campaign Sao Paulo

Cloud Properties from Satellite Data

AIAA 1ST Atmosphere and Space Environments Conference, San Antonio, TX, Session 7, ASE-2 / ARAM-1



(Minnis)

Boundary Layer Observations and Forecasts

3:00 pm	Boundary Layer Observations and Forecasts	Tom Schlatter (NOAA)
	TAMDAR	B. Moninger
	Profilers	TBD
	WVSS-IIv3	D. Helms
	Weather radars 88D, dual-pol, and CASA for observing hydrometeors	T. Schuur
	GPS moisture	S. Gutman
	Importance of land surface observations	C. Marshall

(Refer to Obs Right Sizing Brief)

Agenda and Highlights of Day 3, Morning

8:00 am	Modeling Improvements		Tom Schlatter (NOAA)
		EMC	G. DiMego
		RUC and the Rapid Refresh	S. Benjamin
		Assimilation techniques to improve convective forecasts	S. Weygant
		ICAO/WAFS Grids	M. Graf
		Postprocessing model output	Z. Toth
		Microphysics: What improvements could benefit aviation	J. Brown
10:00 am	Break		
10:15 am	Icing		Tom Bond (FAA)
		FAA AWRP In-flight Icing Research	M. Politovich
		NASA ASAP Icing	J. Haggerty
		NASA LaRC Icing Support	B. Smith
		HIWC	T. Bond
		Ground Icing	J. Riley
11:15 am	Turbulence		Tammy Farrar (FAA)
		FAA and NASA Turbulence Research	B. Sharman
		WAFS and algorithms for global post-processing	M. Graf
		Satellite based inferences of Turbulence	T. Wimmers
		Remote Sensing of Turbulence	L. Cornman
		GPSmet	S. Gutman

Convergence of Deterministic NAM & RUC into hourly NARRE & HRRRE Ensembles

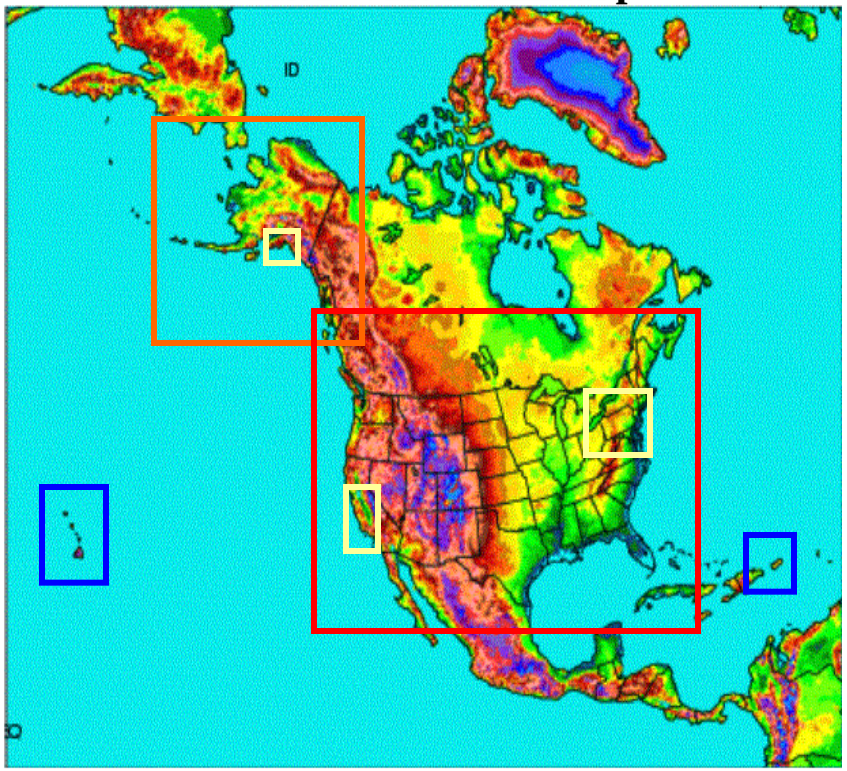
Geoff DiMego
Mesoscale Modeling Branch
EMC / NCEP
March 24, 2010

"Where America's Climate, Weather and Ocean Services Begin"

2010-2011

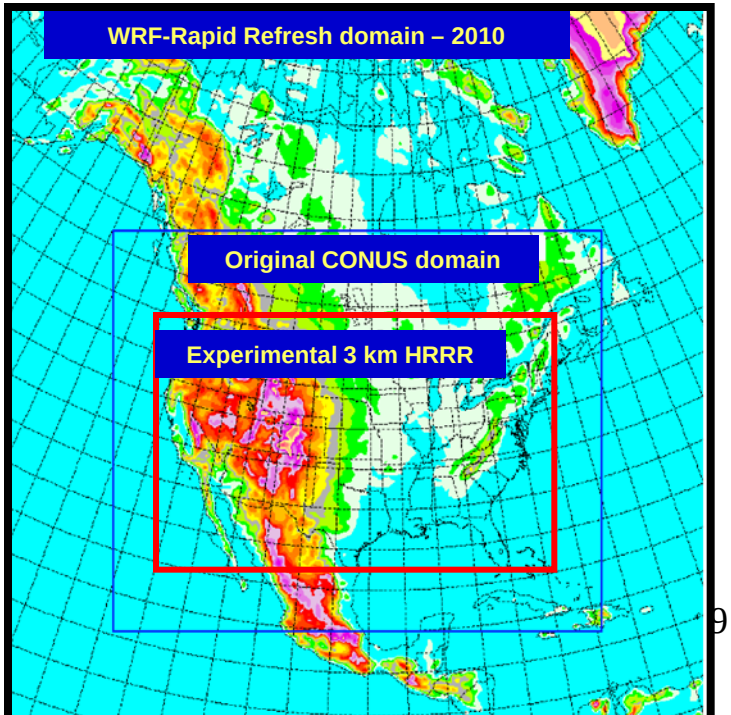
NAM

- NEMS based NMM
- Bgrid replaces Egrid
- Parent at 12 km / 70 levels
- Multiple Nests Run to 60hr
  - **~4 km CONUS nest**
  - **~6 km Alaska nest**
  - ~3 km HI & PR nests, and/or a ~2 km DHS/FWIS/Terminal **possible**

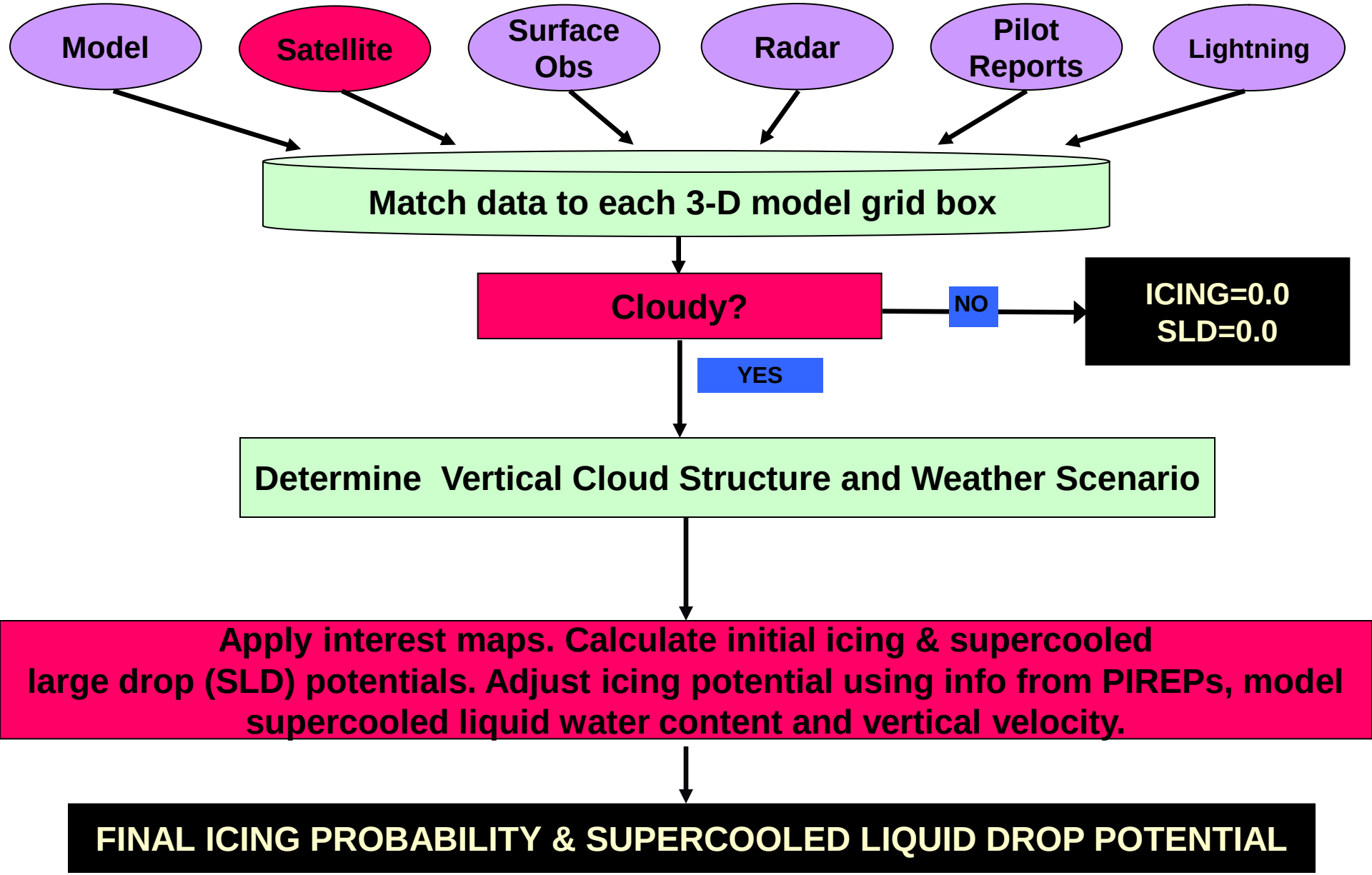


Rapid Refresh

- WRF-based ARW
- NCEP's GSI analysis
- Expanded 13 km Domain to include Alaska
- Experimental 3 km HRRR



Current Icing Product (CIP)



Flight Icing Threat Inferred from Satellite

In-flight Aircraft Icing depends on

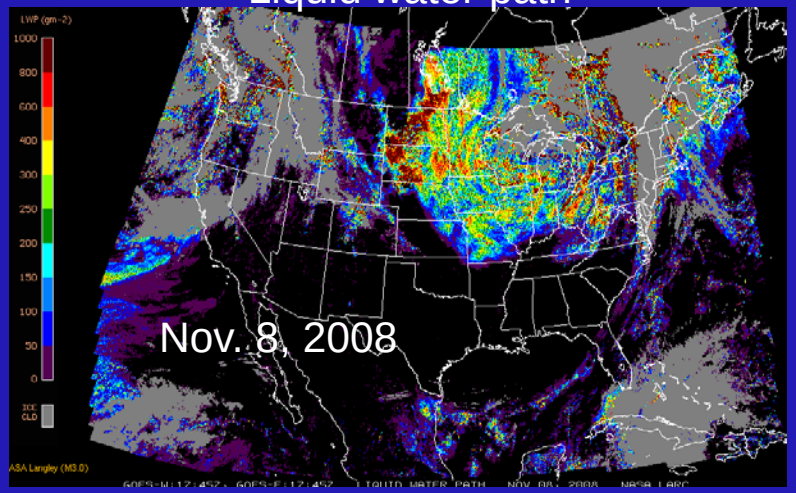
- presence of super-cooled liquid water (*SLW*)
- liquid water content, *LWC*
- Droplet size distribution, N(r)
- Temperature, T(z)

Satellite remote sensing can provide

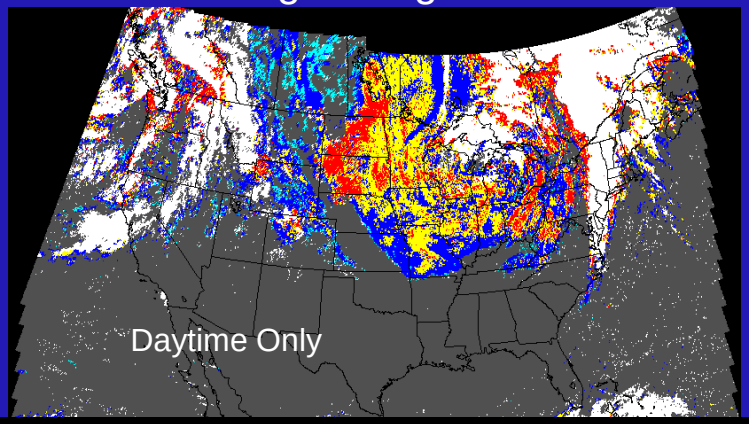
- Cloud top temperature and phase: SLW
- liquid water path: *LWP* = f(*LWC*)
- effective radius, r_e = f(*N(r)*)

- assume satellite-derived cloud parameters are correlated with the parameters that determine icing (namely, LWP proxy for LWC; R_e proxy for N(r) at some level in the cloud)

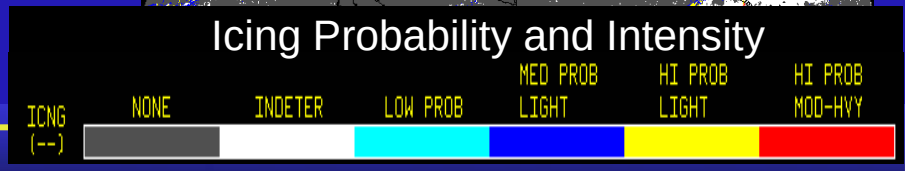
Liquid water path



Flight Icing Threat



Icing Probability and Intensity



Environment Canada Environnement Canada

Canada

Jet Engine Power Loss in Ice Particle Conditions – The High Ice Water Content (HIWC) Cloud Characterization Study

J. Walter Strapp, Environment Canada
Thomas P. Ratvasky, NASA Glenn Research Center

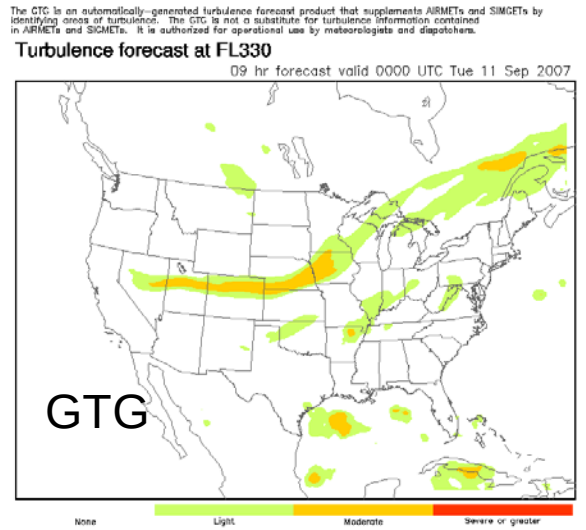
Acknowledgement: Jeanne Mason and Matt Gryzch of the Boeing Co. have contributed greatly to the knowledge-base of this work

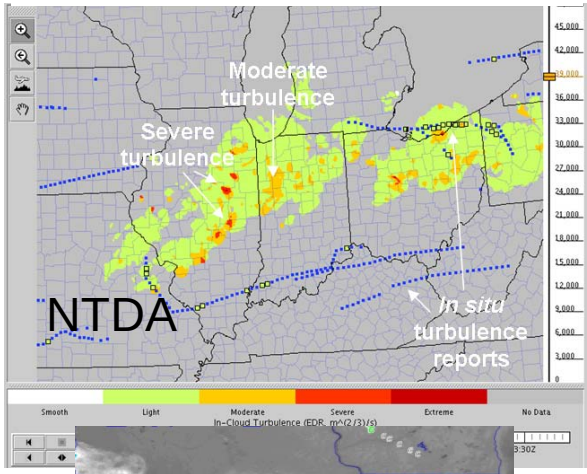
Presented to the:

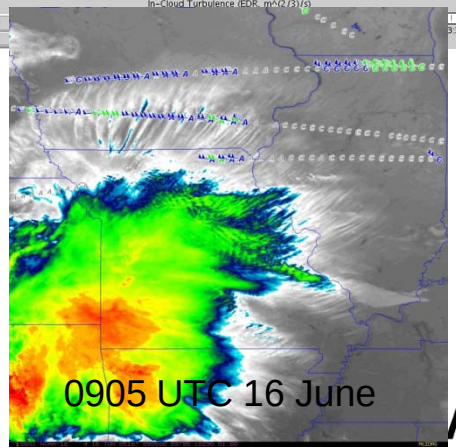
Joint Interagency Weather Research Coordination Meeting
March 22-24, 2010
NOAA David Skaggs Research Center, Boulder, Colorado

Turbulence nowcasting & forecasting products (FAA)

- **Forecasting (used for strategic planning)**
  - NWP model based
  - Updates hourly
  - Develop turbulence diagnostics from standard NWP model output fields
  - Depicts EDR on 3D grid
  - Graphical Turbulence Guidance (GTG)
- **Nowcasting (used for tactical avoidance)**
  - Observation based
    - In situ (edr + pireps)
    - Remote sensing (NTDA)
    - Inferences from CoSPA, satellite features
  - Merges all current turbulence observations with GTG
  - Depicts EDR on 3D grid
  - Updates ~ 15 min
  - Graphical Turbulence Guidance Nowcast (GTGN)







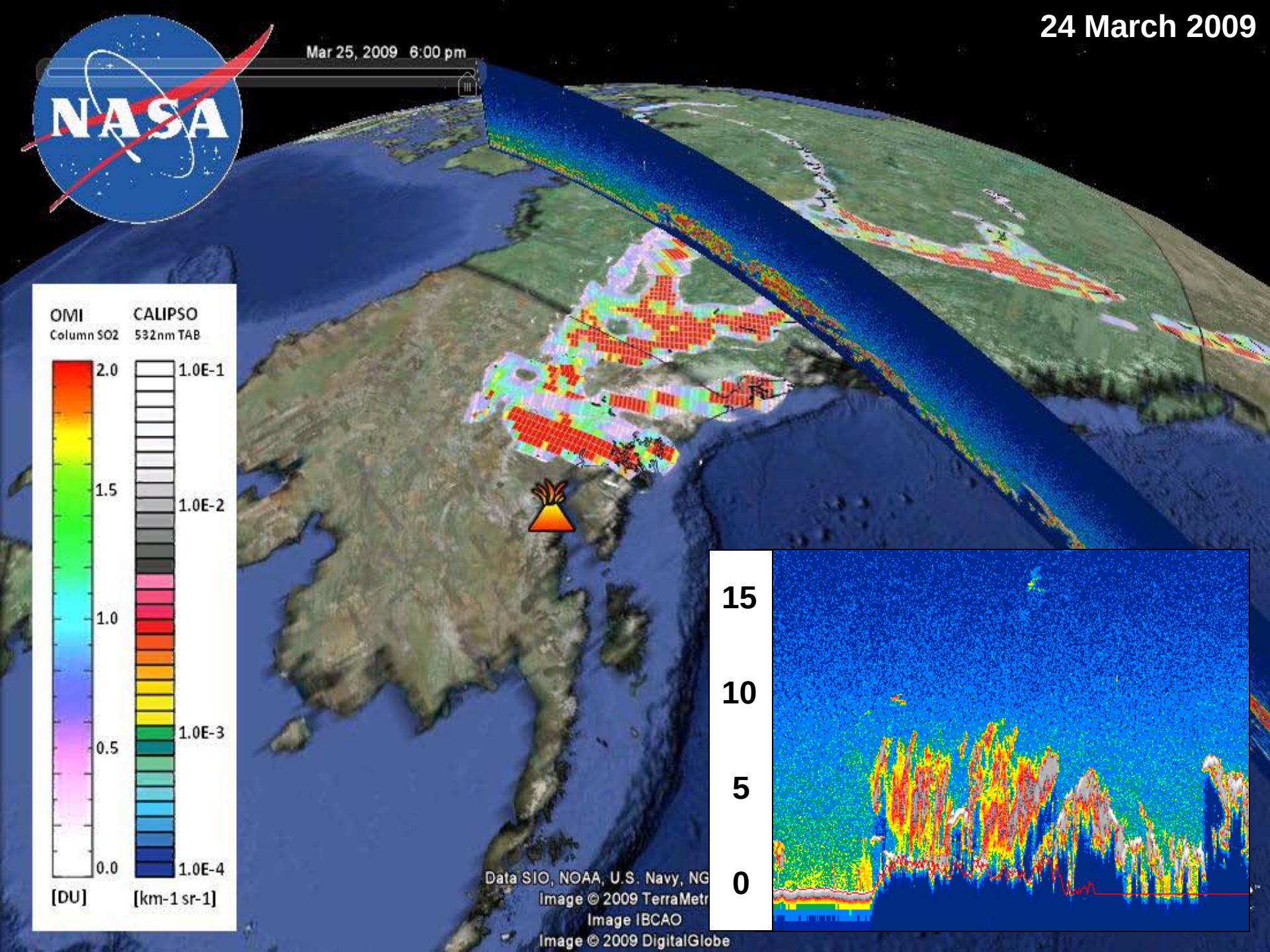
Agenda and Highlights of Day 3, Afternoon

12:45 pm	Ceiling and Visibility	Hartman (FAA)
	FAA C&V Research	Herzegh
	NOAA OAR C&V Research	S. Albers
	MIT LL C&V Research	D. Clark
	LAMP C&V	S. Smith
2:00 pm	Volcanic Ash	John Murray (NASA)
	Volash data requirements gap analysis process and progress	S. Stepney, FAA
	NASA OMI SO2 Project	Krueger and/or Krotkov
	UW CIMSS Imager Apps	W. Feltz for Pavolonis
	NOAA Volash Research	R. Draxler
	Dual Pole Applications and/or other NOAA Volash Apps	TBD
	Integrated solutions for Volash	Murray
3:00 pm	Break	
3:15 pm	Space Weather	Rodney Viereck (NOAA)
	NOAA SpWC Research and Plans	R. Viereck/W. Murtaugh
	NASA NAIRAS Project	C. Mertens
4:15 pm	Discussions	
5:00 pm	Wrap-up	Darien Davis (NOAA)

The Impacts on Air Traffic of Volcanic Ash from the Okmok and Kasatochi Eruptions during the Summer of 2008 and Mt. Redoubt in March 2009

A. Matus
Texas A&M University, College Station, TX
Lauren A. Hudnall
Christopher Newport University, Newport News, VA
A.J. Krueger
University of Maryland, Baltimore Campus, Baltimore, MD
and
J.J. Murray and C. Trepte
NASA Langley Research Center, Hampton, VA

Image source: http://www.avo.alaska.edu/image.php?id=3595


24 March 2009
Mar 25, 2009 6:00 pm
OMI
Column SO2
CALIPSO
532nm TAB
2.0
1.5
1.0
0.5
0.0
[DU]
1.0E-1
1.0E-2
1.0E-3
1.0E-4
[km-1 sr-1]
15
10
5
0
Data SIO, NOAA, U.S. Navy, NG
Image © 2009 TerraMetr
Image IBCAO
Image © 2009 DigitalGlobe

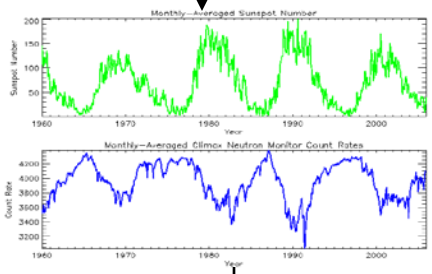
Nowcast of Atmospheric Ionizing Radiation for Aviation Safety (NAIRAS) Model

Real-time Neutron Monitor Data (e.g., IZMIRAN and LOMICKY)

↓

Fit to Climax NMC

↓



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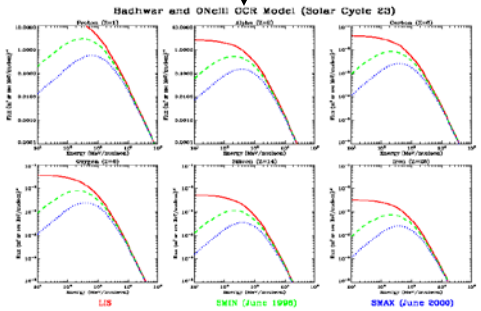
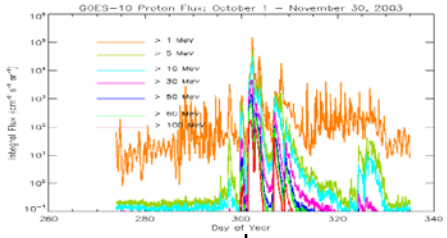
Badhwar+O'Neill GCR Model

↓



NOAA GOES Data



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Spectral Fitting

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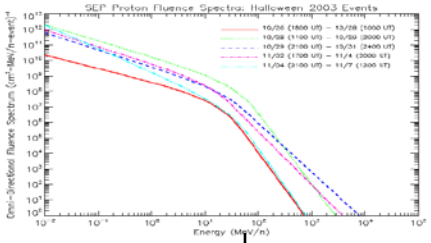

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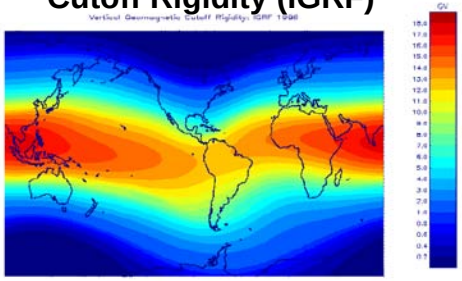
Cutoff Rigidity (IGRF)



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Magnetospheric Magnetic Field (e.g., T05) Effects on Cutoff Rigidity

← **NASA/ACE Solar Wind and IMF Data**

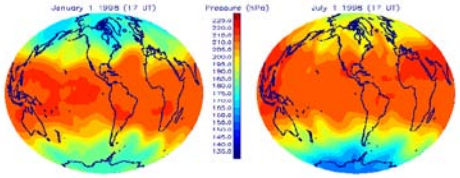
↓

HZETRN + Dosimetry

↑

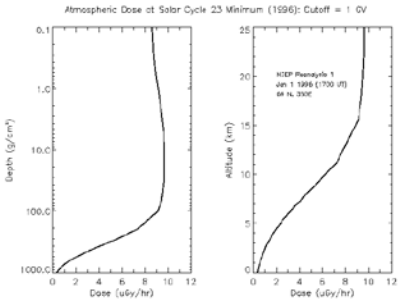
Atmospheric Density

↑



NCAR/NCEP Reanalysis

→



Atmospheric Dose and Dose Equivalent