Discussion on Training GLM, Total Lightning, Apps

Brian Motta

National Weather Service/Training Division

GOES-R Lightning Science Team Meeting

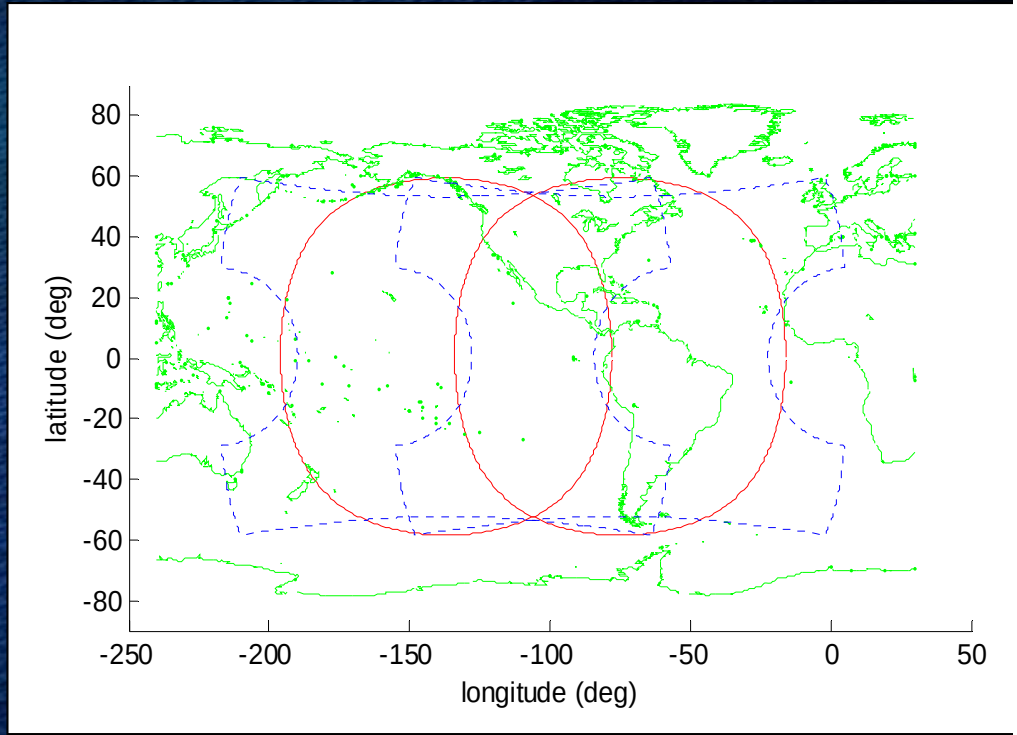
September 2011

Mission Goal

Working Together To Save Lives

Geostationary Lightning Mapper (GLM)

- Detects total strikes: in cloud, cloud to cloud, and cloud to ground
  - Compliments today's land based systems that only measures cloud to ground (about 15% of the total lightning)
- Increased coverage over oceans and land
  - Currently no ocean coverage, <u>and</u> limited land coverage in dead zones



GOES R Lightning Mapper

- **Predict onset of tornadoes, hail, microbursts, flash floods**
  - *Tornado lead time -13 min national average, improvement desired*
- **Track thunderstorms, warn of approaching lightning threats**
  - *Lightning strikes responsible for >500 injuries per year*
  - *90% of victims suffer permanent disabilities, long term health problems, chiefly neurological*
  - *Lightning responsible for 80 deaths per year (second leading source after flooding)*
- **Improve airline/airport safety**
  - *routing around thunderstorms, saving fuel, reducing delays*
  - *In-cloud lightning lead time of impending ground strikes, often 10 min or more*
- **Provide real-time hazard information, improving efficiency of emergency management**
  - **Large venue public safety, HAZMAT safety, & outdoor/marine warnings**
- **NWP/Data Assimilation**
- **Locate lightning strikes known to cause forest fires, reduce response times**
- **Multi-sensor precipitation algorithms**
- **Assess role of thunderstorms and deep convection in global climate**
- **Seasonal to interannual (e.g. ENSO) variability of lightning and extreme weather (storms)**
- **Provide new data source to improve air quality / chemistry forecasts**

Large Venue Lightning -1

Large Venue Lightning -2

Large Venue Lightning -3

Large Venue Lightning -4

Beth A. Keiser / AP

Large Venue Lightning -5

Large Venue Lightning -6

Currently Available Training

RAMMB: VISIT - Training Sessions - Windows Internet Explorer

http://rammb.cira.colostate.edu/training/visit/training_sessions/

File Edit View Favorites Tools Help

Favorites | noa... | NOA... | NOA... | UW-... | Mia... | NOA... | Wea... | nws... | NOA... | Nex... | Per... | GSD... | Nat... | JCS... | NCE... | web... | Sug... | NOA... | Fed... | Nat... | Tim... | Lin...

RAMMB: VISIT - T... | Joint Planning and D... | City of Lafayette - Re... | USAJOBS - Search Jo... | GLM Agenda | GOES-... | EWP 2011 - HWT Sp...

Page Safety Tools

VISIT

- VISIT Home
- Training Sessions
- Training Calendar
- Blog Sites
- The VISIT Program
- VISIT People
- VISIT FAQ
- Links / Tutorials
- RAMSDIS Online
- VISIT Training DVD

Training Sessions

Below you'll find a list of all of the VISIT training sessions currently available, listed in reverse chronological order. To sort them by a different column, click the column heading at the top to reorder them.

Title	Topic	Developed	Level	Instructor(s)	Recorded	Talking points	Live Training	Length (Min)
Synthetic Imagery in Forecasting Orographic Cirrus	GOES-R Proving Ground	2011	Basic	Bikos	Y	Y	Y	30
Synthetic Imagery in Forecasting Severe Weather	GOES-R Proving Ground	2011	Int	Bikos	Y	Y	Y	60
Objective Satellite-Based Overshooting Top and Enhanced-V Anvil Thermal Couplet Signature Detection	GOES-R Proving Ground	2011	Basic	Lindstrom	Y	Y	Y	60
Volcanoes and Volcanic Ash Part 2	Aviation / Satellite	2011	Basic	Braun	Y	Y	N	90
Ensemble Tropical Rainfall Potential (eTRaP)	Tropical	2010	Basic	Bikos	Y	N	N	18
POES and AVHRR Satellite Products in AWIPS	Satellite	2010	Basic	Lindstrom, Bachmeier	N	Y	Y	45
The UW Convective Initiation Product	GOES-R Proving Ground	2010	Int	Lindstrom	Y	Y	Y	45
Water Vapor Imagery Analysis for Severe Weather	Severe / Sat	2010	Int	Bikos	Y	Y	Y	75
The UW NearCasting Product	GOES-R Proving Ground	2010	Basic	Lindstrom	Y	Y	Y	45
Basic Satellite Imagery Interpretation in the Tropics	Tropical / Sat	2010	Basic	Bikos	Y	Y	Y	60
Volcanoes and Volcanic Ash Part 1	Aviation /Sat	2010	Basic	Braun	Y	Y	N	140
Regional Satellite Cloud Composites from GOES	Satellite	2010	Basic	Connell	Y	Y	N	50
Morphed TPW Detection (MIMIC)	Satellite	2010	Basic	Lindstrom	Y	Y	Y	45

Internet 150%

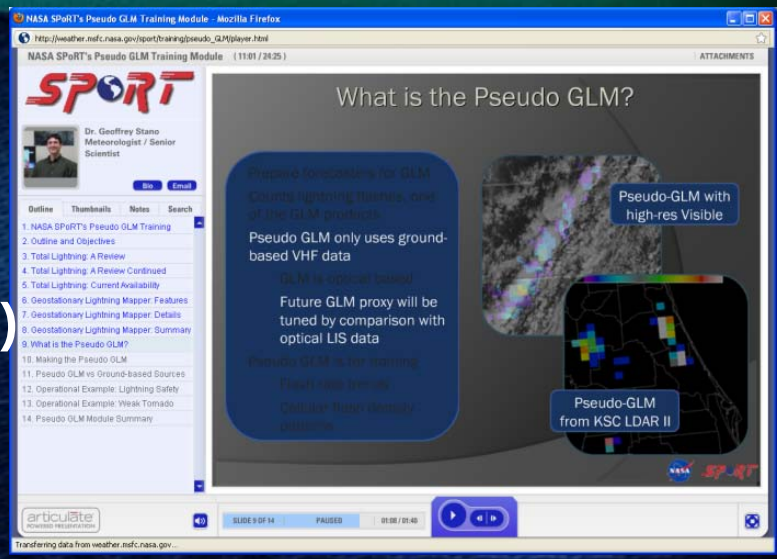
Currently Available Training

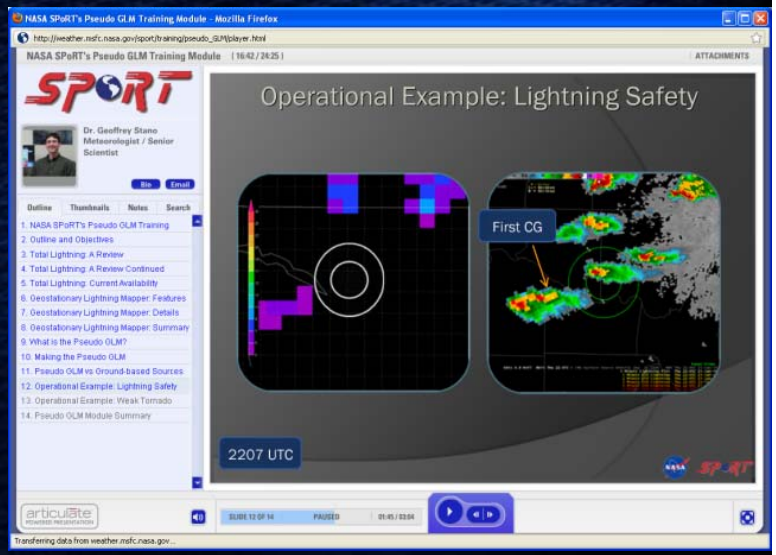
- VISIT **CONUS Lightning**
- VISIT **Lightning Meteorology I**
- VISIT **Lightning Meteorology II**
- COMET **Intro to Tropical Met**
- COMET **Fire Weather Climatology**
- COMET **GOES-R Benefits**
- VISIT **GOES-R 101**
- SPoRT **Lightning Mapping Array**
- SPoRT **PGLM Training**
- VISIT **Use of GOES/RSO Imagery w/Remote Sensor Data for Diagnosing Severe Weather**
- COMET **Weather and Health (Broadcasters)**
- COMET **Summer Faculty Satellite Class**

Currently Available Training

- Developed for 2010 & 2011 Spring Program
- Described three features
  - ✓ Total lightning
  - ✓ Geostationary Lightning Mapper (GLM)
  - ✓ Pseudo GLM product
- Included operational examples
- Intended for use before arrival
- Available on Learning Management System
- Available on SPoRT web page

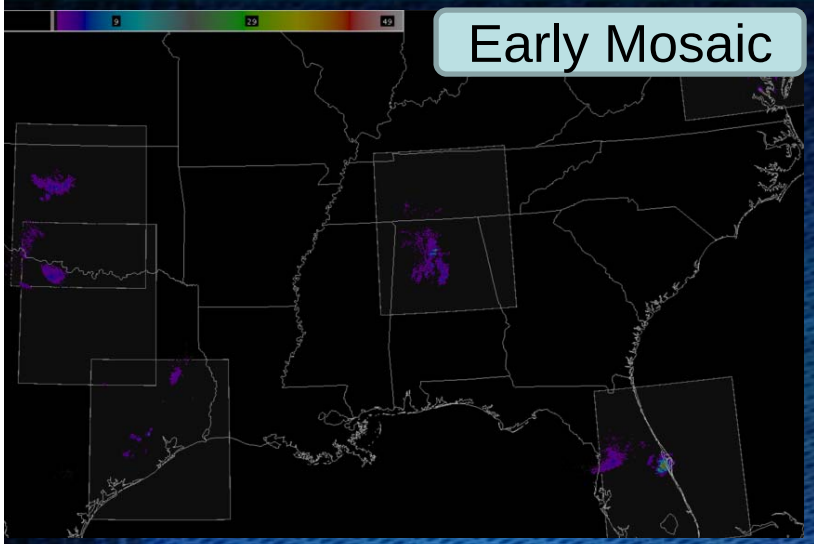
http://weather.msfc.nasa.gov/sport/training/

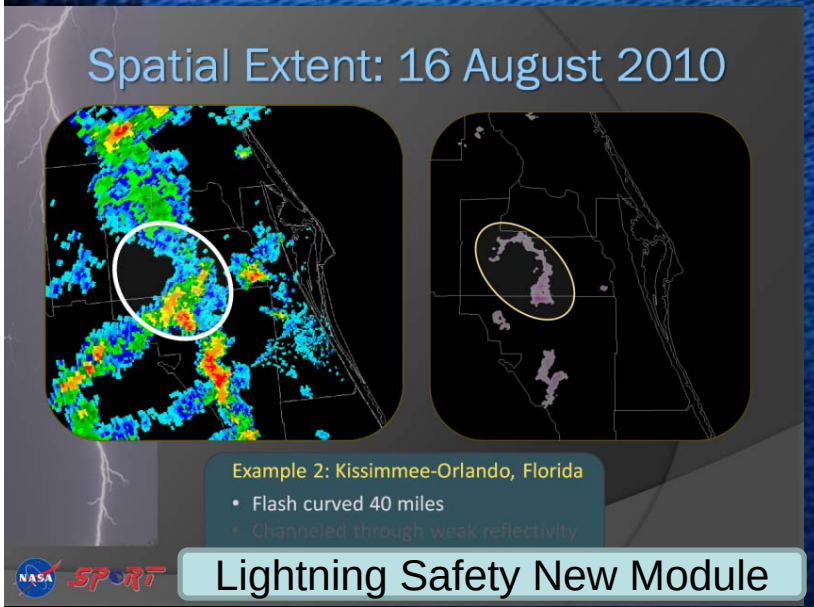




Courtesy Dr. Geoffrey Stano

Future Training Activities





New activities

- ➢ Mosaic product (all networks product)
- ➢ New visualizations (maximum density)

New training module

- ❖ Initial use for NWS forecasters
- ❖ Examples to be converted to PGLM

New training has more operational focus

- ✓ Severe weather applications
- ✓ Airport Weather Warnings
- ✓ Lightning safety applications
- ✓ Aim for release before Spring 2012
- ✓ Update current PGLM training

Courtesy Dr. Geoffrey Stano

Common Themes for Next HWT

Training begins before arrival in Norman

- ➢ Complete learning path for NWS staff
- ➢ Conduct mix of GotoMeeting, VISIT, and Recorded training modules
- ➢ Time is precious, Monday to orient & spin-up
- ➢ Need improved rapid display procedures/bundles for complex displays/analysis

Need a comprehensive simulation case

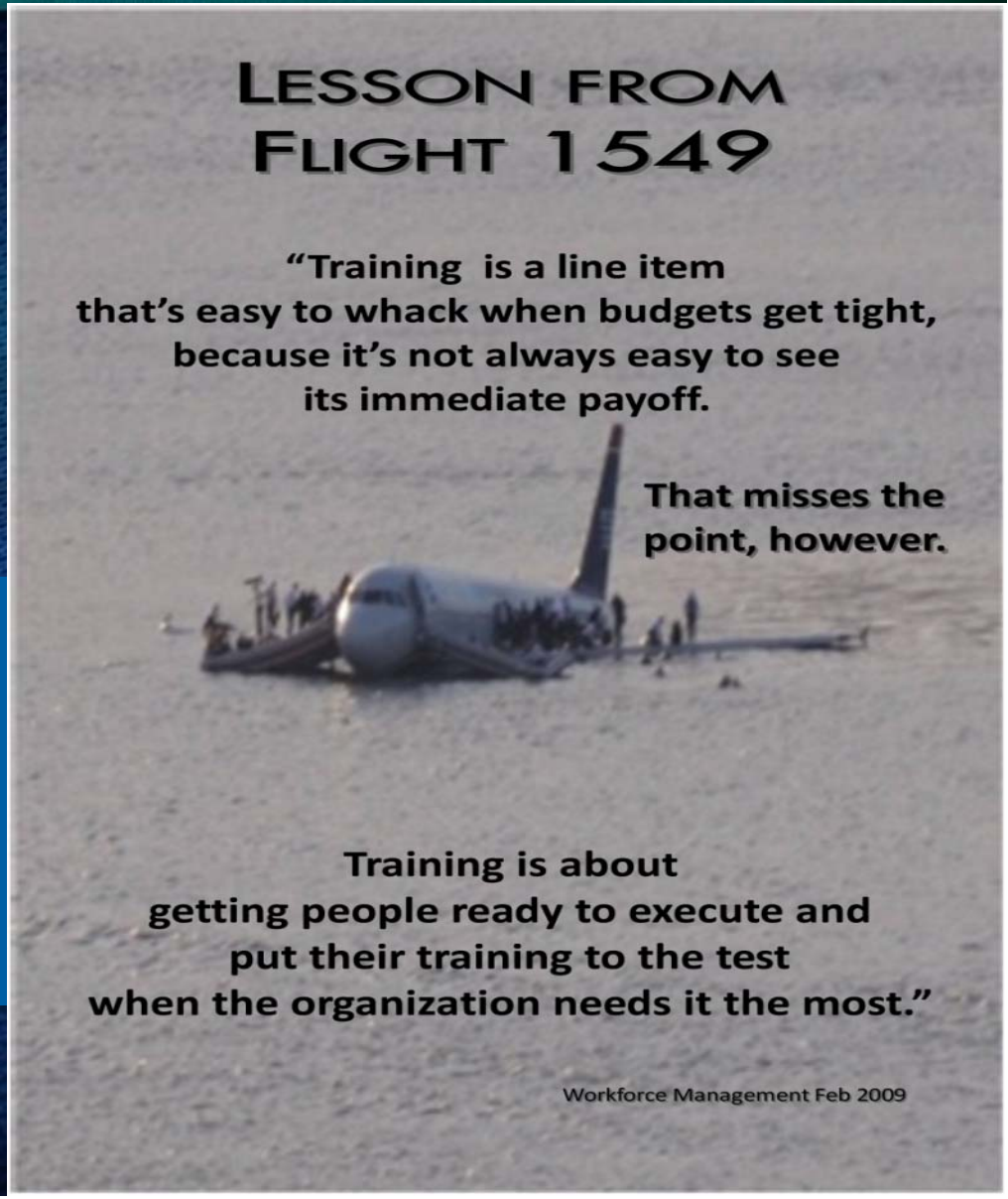
- ✓ Facilitated, guided learning
- ✓ Need to fix issue with total lightning playback in case mode

What is Training ?

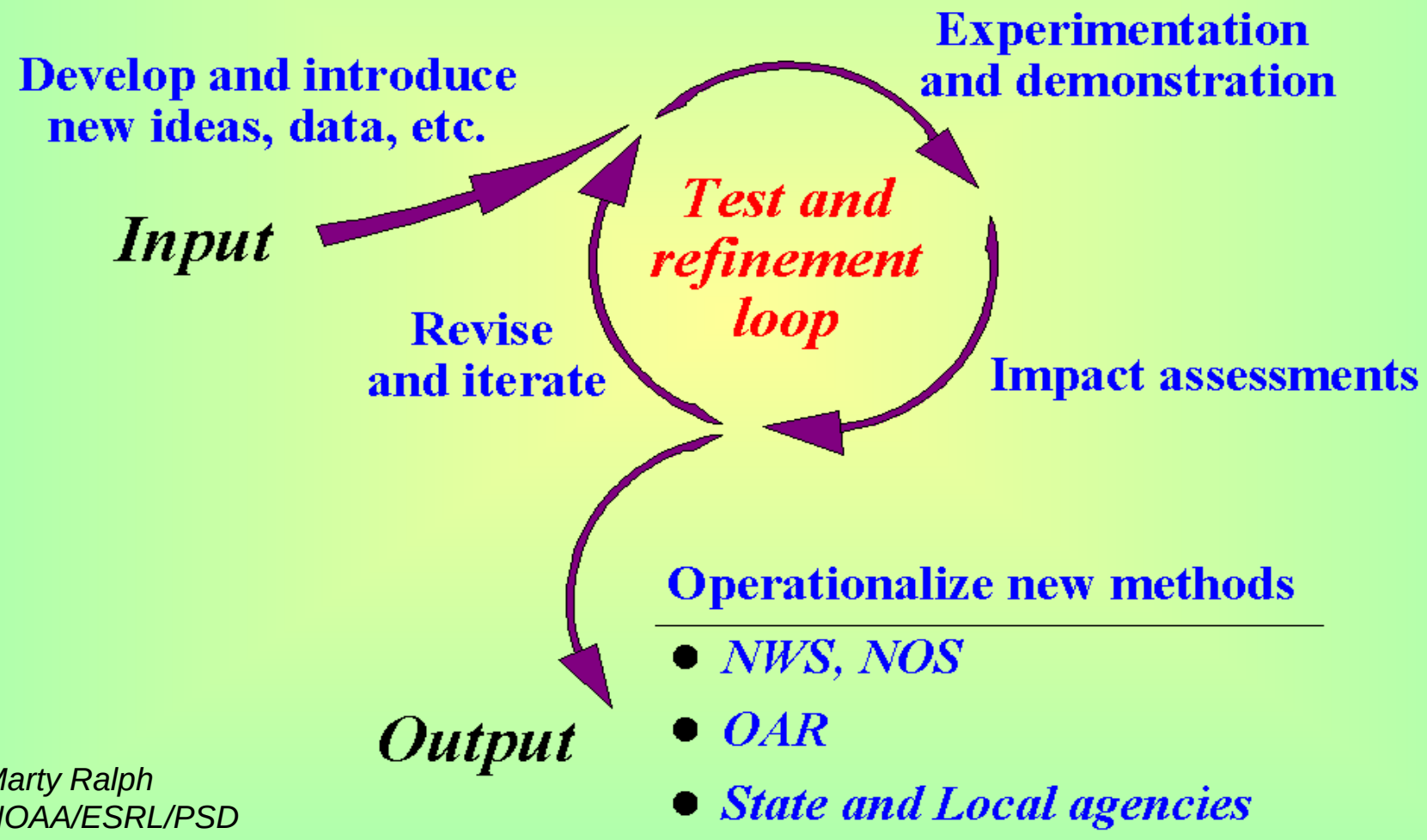
Leveraging Training for Performance Improvement

"Training is about getting people ready to execute and put their training to the test when the organization needs it the most."

(104 seconds from birds to water)



NOAA HydroMet Testbed (HMT)
Testbed as a Process



Marty Ralph
NOAA/ESRL/PSD

See: Dabberdt et. al. 2005 Bull. Amer. Meteor. Soc.

Info Systems Development

ESRL / GSD Prototypes and Activities

Integrated Hazards Information Services

USWRP/NOAA Testbeds

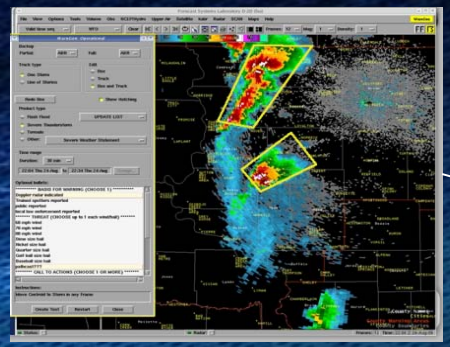
HWT, HydroMeteorology Testbed & Others

AWIPS II Remote Sensing

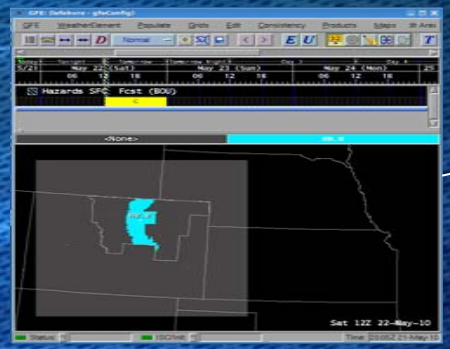
Vis, IV&V, TIMs

Purpose -- Integrate Hazard Tools Phase 2

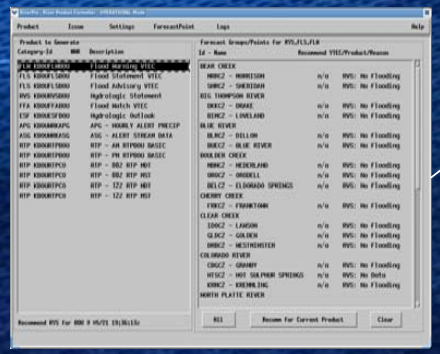
WARNGEN
(< 1 hour)

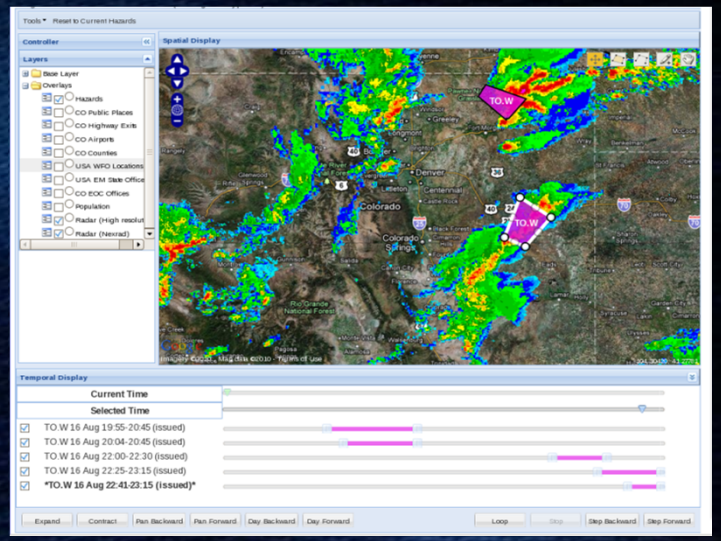


GHG
(Hours-Days)

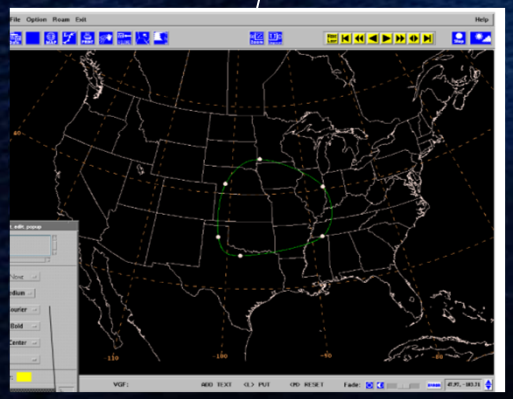


RiverPro
(Days)





IHIS

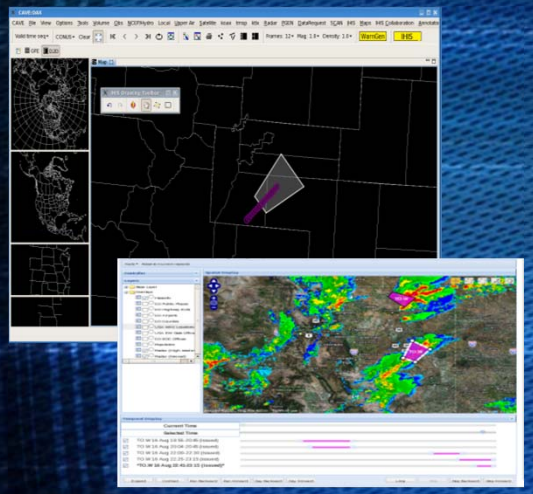


NMAP
(National)

Purpose -- Two-way Communication Phase 3

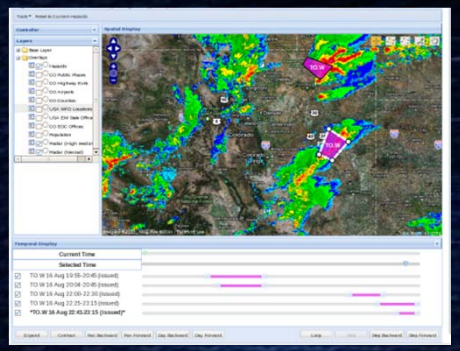
AWIPS II Cave -- Forecasters

Web -- Partners: EM's, Broadcasters Spotters, Publics



Hazards →

← Impacts



IHIS serves as a vehicle for social science (RENCI / SSWIM) research into Partner Requirements to be realized by NWS

AWG Meeting Discussion

What you said:	What I heard:
1) Forecasters want Intermediate data/displays for GLM	Reduce "black box" for forecasters so they understand the processing
2) High flash rates (5-12 per second) can be problematic for algos	Forecasters will see that it's a significant storm, what is value-add ?
3) Need GLM-compatible flash definition	LMAs provide more detailed data needed to understand storm-scale lightning science/apply GLM flash grid
4) 3D view can show flash initiation and ground strike location	This can be important information for forecasters to consider
5) Lightning info needs to be integrated with radar, vertical profile information	Optimal displays are ad-hoc. Need to build decision-making visualizations
6) Lightning Jump Algorithm	Thresholds sensitive to storm environment, type. Tornado signature ? Correlation with svrwx better. 1" hail*
7) Lightning Warning Algo	5-min Lightning Prob. Maps, merge LMA and CG point data. Output:CG lightning lead time given 1st IC.
8) SCAMPER/QPE Algo	Calibrates IR predictors to MW RR

weather.gov/training

National Weather Service

Training Portal

HOME | FAQ | CONTACT US

NWS Personnel

- Training Implementation Plan
- Residence & Virtual Courses
- Learning Center Topics - Web-based, D/L (requires login)
- Job Aids, Downloads, & Other References
- PDS Page
- IDP Guide
- Training Directives

Partners & Volunteers

- NWS Cooperative Observer Program
- Educators
- Emergency Managers
- Weather Spotters
- Government Leaders (Leadership Academy)

Partner Organizations

- FAA & DOD Personnel
- COMET/MetEd
- VISIT

Additional NWS Training Resources

- NWS Learning Center
- FDTB
- NWSTC
- WDTB
- SOO/STRC
- NWS Education Page

NWS Training Portal

Welcome to the NWS Training Portal! This portal is designed to provide access to all NWS training, including course listings, course descriptions, training schedules, and online materials. Our goal is to provide you with one stop shopping for training!

You may now subscribe to our RSS feed XML. For information on RSS you can visit the NWS RSS Library.

News & Announcements

This is the new one-stop Training Portal for all NWS training resources. This represents Version 1 of this site with enhancements to follow in subsequent versions. If you have suggestions for improvements, or note any errors, please use the webmasters link at the bottom of the page to share them with the Portal team.

- COMET has announced the publication of an updated module titled Forecasting Dust Storms, Version 2. *(01/06/11)*
- WDTB has released "CWSU Operations" for NWS forecasters and interns. This course is designed for anyone in this audience who collaborates with CWSUs (and their meteorologists) and/or provides aviation support. The course is delivered and tracked through the Commerce Learning Center (https://doc.learn.com/noaa/nws). You can find the module by searching for the title "CWSU Operations". *(01/06/11)*
- NWSTC announces the release of the "FAA Snow Measurement Training" module for FAA Weather Observers and NWS staff members who quality check and

F.A.Q.s | Travel/ Acct. Codes | Training Policies | Training Division Contacts

Page last Modified: Monday, January 3, 2011 11:22 AM

Training Events Planning Calendar

Printable Schedules: Residence/Virtual Courses, Web-Based Training Release Dates

Upcoming Training Events

Today

- Armstrong Transmitter 2010 begins
- Armstrong Transmitter 2010 begins
- VISIT - UW NearCasting Product
- **Wednesday, January 12**
- VISIT - POES and AVHRR Data in
- **Thursday, January 13**
- VISIT - UW Convective Initiation
- **Tuesday, January 18**
- VISIT - CRAS Forecast Imagery in
- **Wednesday, January 19**
- RRS Maintenance Residence Cou
- VISIT - Basic Satellite Principles T
- VISIT - Water Vapor Imagery and
- **Thursday, January 20**
- VISIT - Interpreting Satellite Signat

Google Calendar

Disclaimer

NWS Training Division

The mission of the NWS Training Program is to ensure training needs are met in a cost-effective manner by sustaining an efficient and effective workforce.

More About Us

Contact Information

Brian.Motta@noaa.gov

SPORT- http://weather.msfc.nasa.gov/sport/

VISIT - rammb.cira.colostate.edu/visit

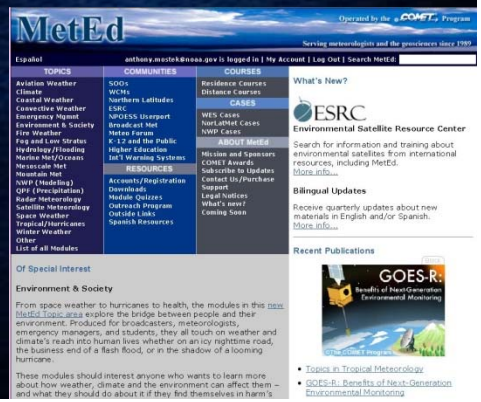
COMET METED - meted.ucar.edu

NOAA LMS – https://doc.learn.com/noaa/nws

Proving Ground – cimss.ssec.wisc.edu/goes_r/proving-ground.html

NWS FDTB – http://www.fdtb.noaa.gov

NWS Training Portal - http://weather.gov/training



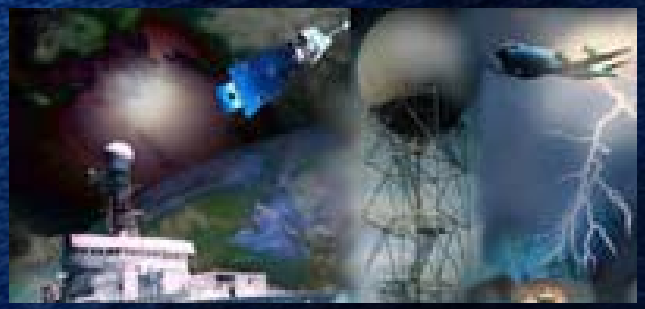
Thank You / Acknowledgements

- NESDIS GOES Program Office
- NOAA/Earth Sys Research Lab
- NESDIS STAR
- NASA SPoRT
- NOAA/NSSL
- UCAR/NCAR
- NWA Remote Sensing Comm.
- Colorado State University/CIRA
- U Wisconsin/SSEC/CIMSS
- NWS/Office Science & Tech
- NPOESS JPO

A new one-stop source for all GOES-R information.
http://www.GOES-R.gov
A joint web site of NOAA and NASA

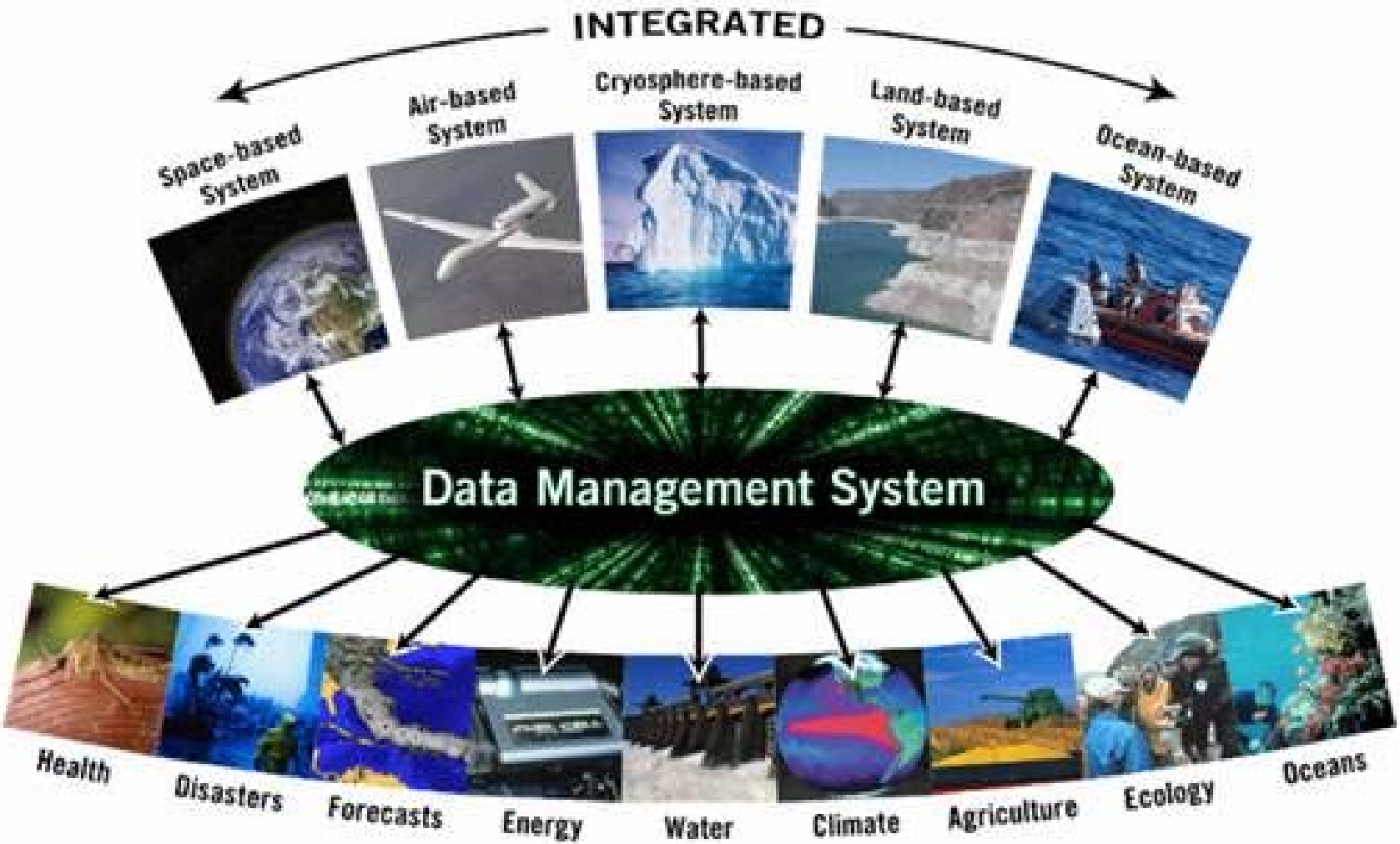
Department of Commerce

National Oceanic and Atmospheric Administration (NOAA)



Observing Systems

Global Earth Observation System of Systems



Training Ideas

Keep in mind that operational forecasters are constantly bombarded with information from satellite, radar, mesonets, unofficial observations, model guidance (both deterministic and ensemble), etc. It easily can become a data management nightmare.

To get forecasters to use any particular set of data, it must:

- ***Be easily available, on-demand, 24/7***
- ***Be understandable, accurate, reliable,***
- ***Be proven superior to (or at least equal to) other options for the problem at hand***

Prior to Data Availability

- ***The science behind the data***
- ***High resolution simulations in AWIPS***
- ***Improvements due to data inclusion***
- ***Current data gaps/solutions***

After Data is Available

- ***Case studies/simulations on AWIPS/WES showing satellite data led to improved decision-making. Current DLAC2 is a good example.***

Forecasters' Satellite Requirements

- **Latency**
  - Currently, not adequate to meet operational requirements for polar & derived products
  - Increased availability is necessary for consistent use by operational forecasters
- **AWIPS Availability**
  - Some useful, operational imagery/data/products currently unavailable in AWIPS (primary NWS tool used to issue forecasts, watches, warnings and advisories)
  - Plans must be made to incorporate new satellite products in AWIPS
  - NWS/NESDIS needs to demo increased satellite capabilities
- **Ease of AWIPS Interrogation**
  - Currently, several step process to get POES & GOES sounder data. Should be click-and-go process. Need an interactive sampling capability (similar to today's pop-up SkewT). Especially true of GOES sounder data.
- **Quick turnaround from research to operations**
  - Too cumbersome and time consuming to get new data in AWIPS. Used LDM as "backdoor" for some products, this should not have to be SOP.
  - GOES proving ground and AWIPS2 could be very helpful.

BANDWIDTH

Slide Courtesy Frank Alsheimer and Jon Jelsema, CHS, SC

GOES R Era Dataflow: Firehose or Raging River ?

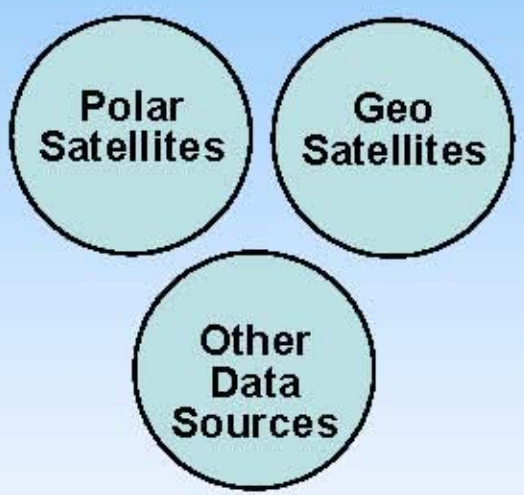
- **Leverage Human Role in Process**
  - ***Early warnings (warn on forecast)***
  - ***Super-resolution accuracy and precision in space/time***
  - ***Increased warning lead times***
  - ***Impact-based Integrated Decision Support Services***
- **Disparate pieces of complimentary data from operational and experimental systems**
- **Smarter data assimilation & modeling**
- **Consolidation of products, parameters, satellites, instruments, and visualizations**

"Data fusion should not be data confusion."

National Environmental Satellite, Data, and Information Service

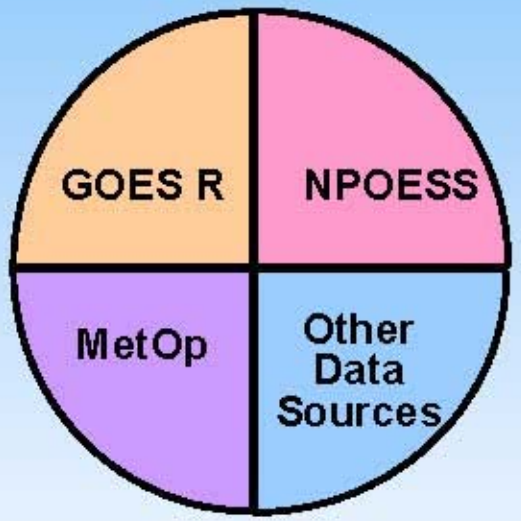
Goal - Transition Products from Individual Satellites to a "System of Systems"

Today



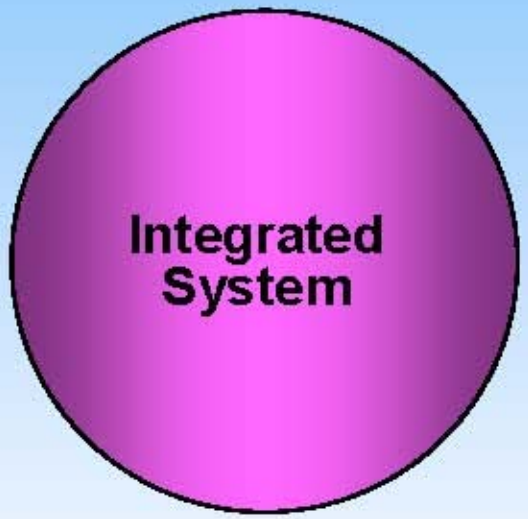
Environmental Products that are mostly generated from observations that are independent of one another

2008-2016



Formulate and Integrate Environmental products using GOES-R series, NPOESS series, and MetOp satellites along with Other Structured Data Sources

2016+



Products are formulated and produced as one integrated system

The Grand Challenge

1. Ingest, process, calibrate, correct, geolocate, transmit, display, fuse/combine within 5-30 seconds of observation so uncertainty can be determined and decisions can be made

2. Use data before lead time vanishes

3. Warn on forecast concept
   - Probability
   - Risk
   - Worst Case Scenarios

DSS User Training Requirements

1) Highly Relevant – Decision Focused
2) Time-limited
3) New spatial and temporal demands
4) Real-time decision support
5) Just-In-Time training
6) Uncertainty/probability information
7) Simulations needed

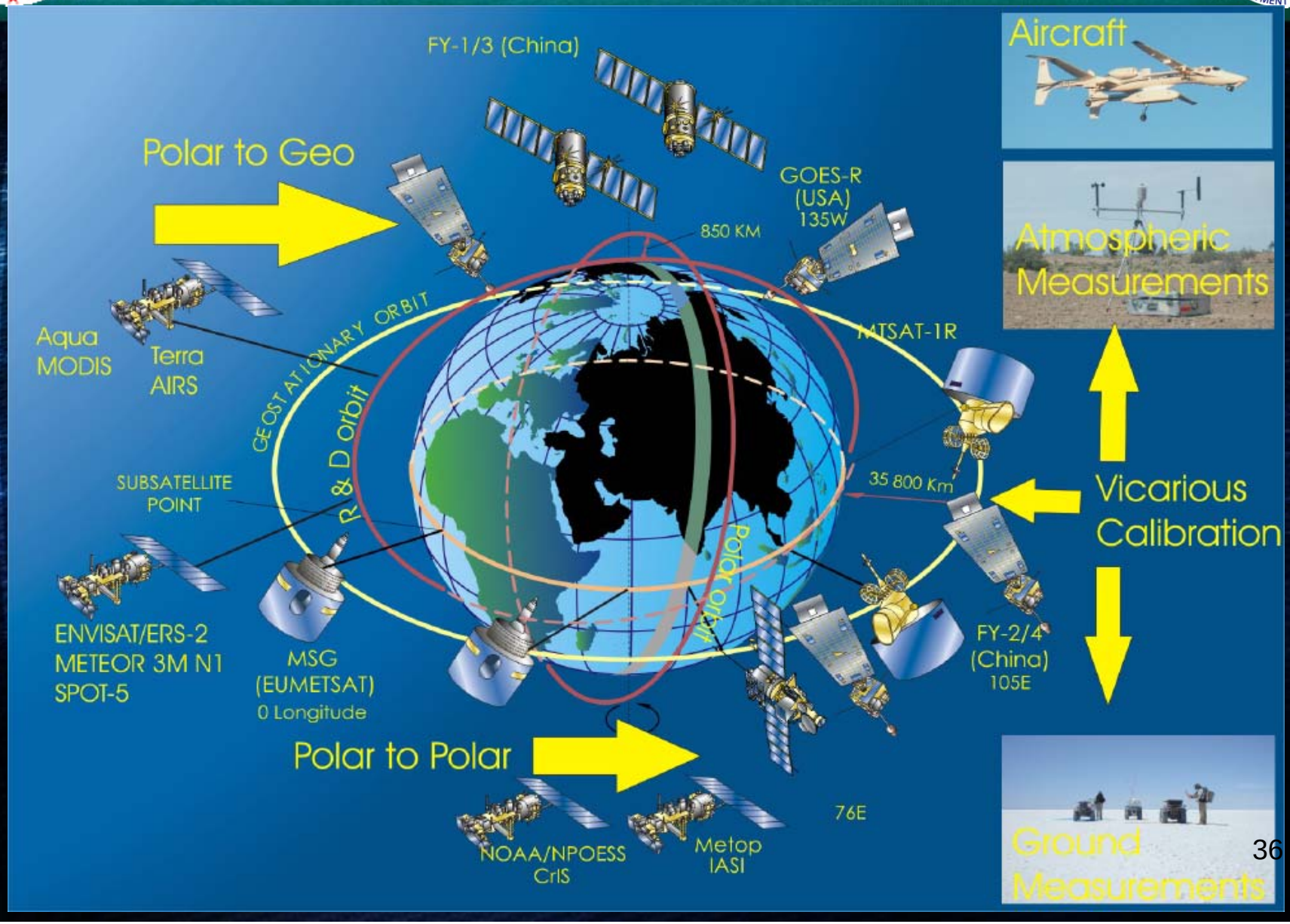
Training:Total Lightning

- Currently, 4 CWAs with LMAs
- Each has own story
- Archived data sets ?
- Any WES cases ?
- Decision-making Scenarios
- Service impacts (eg, POD, leadtimes, etc)
- Starting point(s)

Training: GLM

- Algos
- Proxy Data – Need Inventory
- Simulated data (w/other GOES-R)
- Scenarios
- Impacts
- Concepts
- Visualizations
- Decision-making

Global Space-based Inter-Calibration System (GSICS)



NOAA Developmental Test Beds

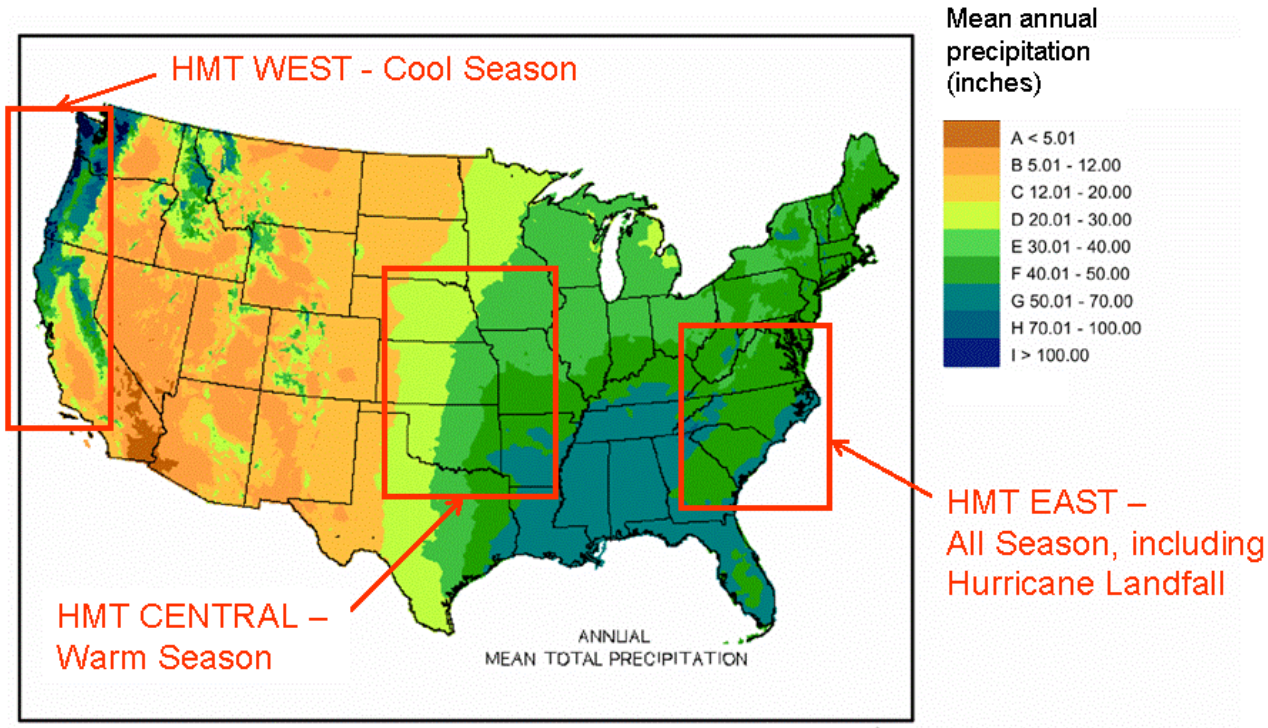
- GOES-R Proving Ground
- Hazardous Weather Test Bed (HWT)
- National Wx Radar Test Bed (NWRT)
- Hydrometeorological Test Bed (HMT)
- NOAA, Navy, NASA Joint Hurricane Test Bed (JHT)
- Climate Test Bed
- Aviation Weather Test Bed
- NOAA/NCAR Development Test Center (DTC-WRF)
- Joint Center for Satellite Data Assimilation (JCSDA)
- NOAA/USAF Space Weather Test Bed
- Unmanned Aircraft Systems Test Bed
- Short-Term Prediction Research/Transition (NASA/SPoRT)
- NextGen Transportation System – Weather Incubators

NOAA's Hydrometeorological Testbed (HMT) Program

A National Testbed Strategy with Regional Implementation

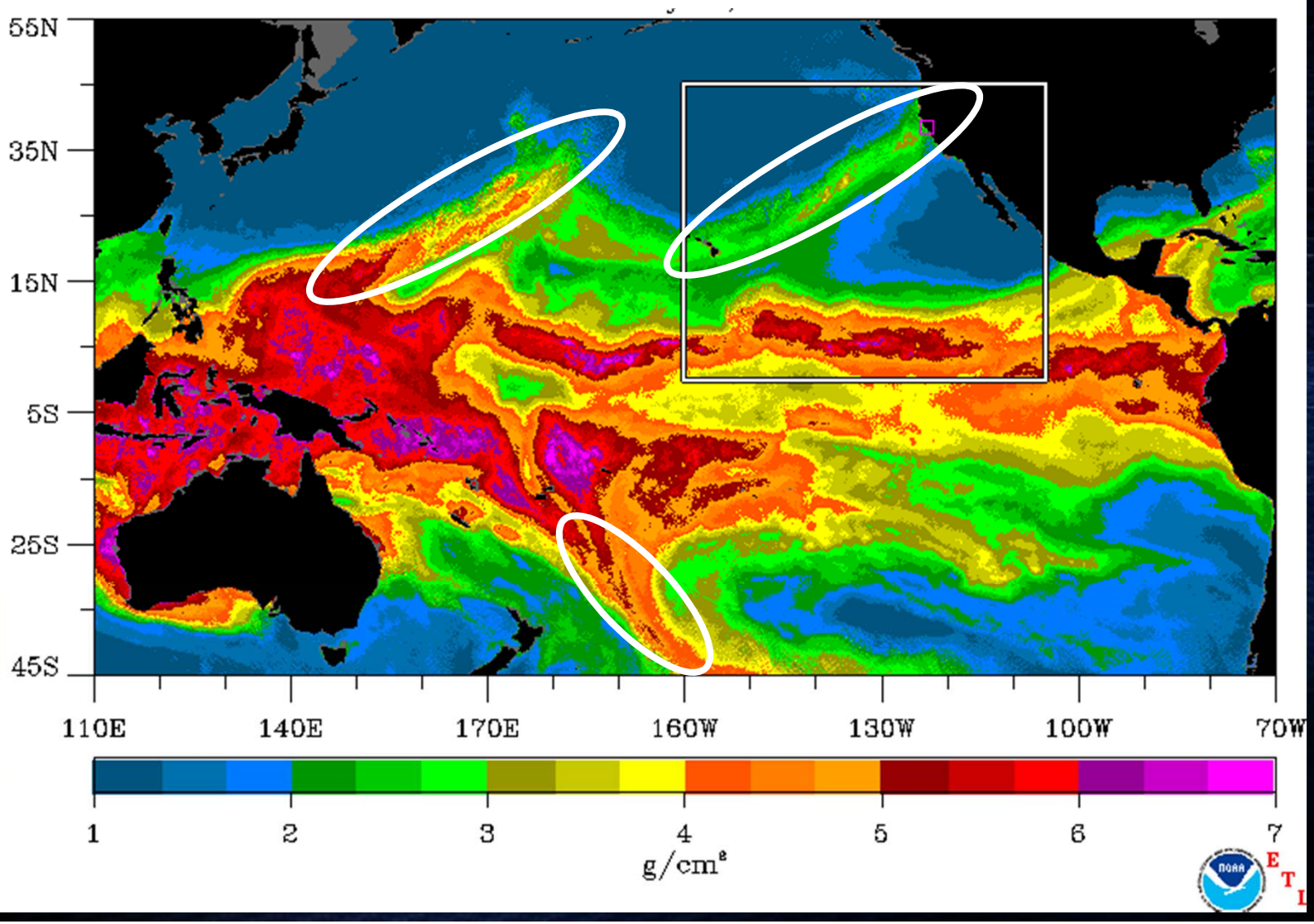
Major Activity Areas

- Quantitative Precipitation Estimation (QPE)
- Quantitative Precipitation Forecasts (QPF)
- Snow level and snow pack
- Hydrologic Applications & Surface Processes
- Decision Support Tools
- Verification
- Enhancing & Accelerating Research to Operations
- Building partnerships



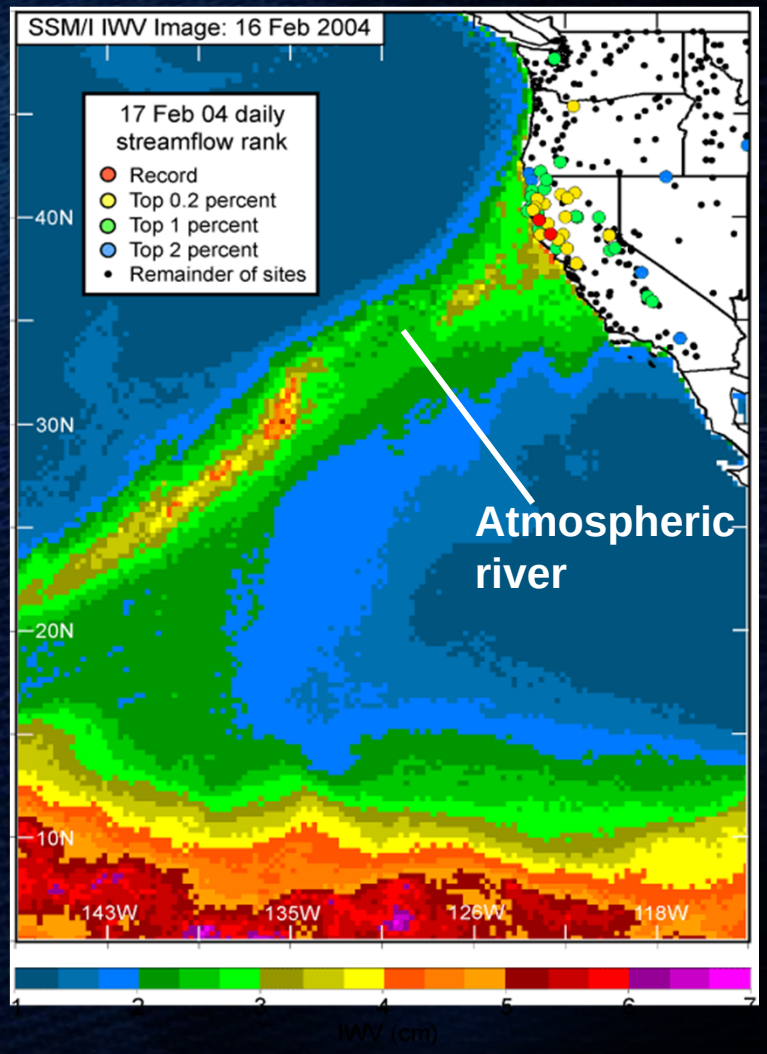
Atmospheric Rivers

A key to understanding West Coast extreme precipitation events



Pacific Mission Requirements Atmospheric Rivers

- NOAA has the operational responsibility for providing accurate forecasts of precipitation and flooding in the western US
- Atmospheric river events observed to have a connection to severe flooding events in the western coastal regions
- Observations look to provide a new resource to forecasters and a new decision support tool
- The mission is central to the Pacific Testbed focus on water, its distribution, and impacts in the western US



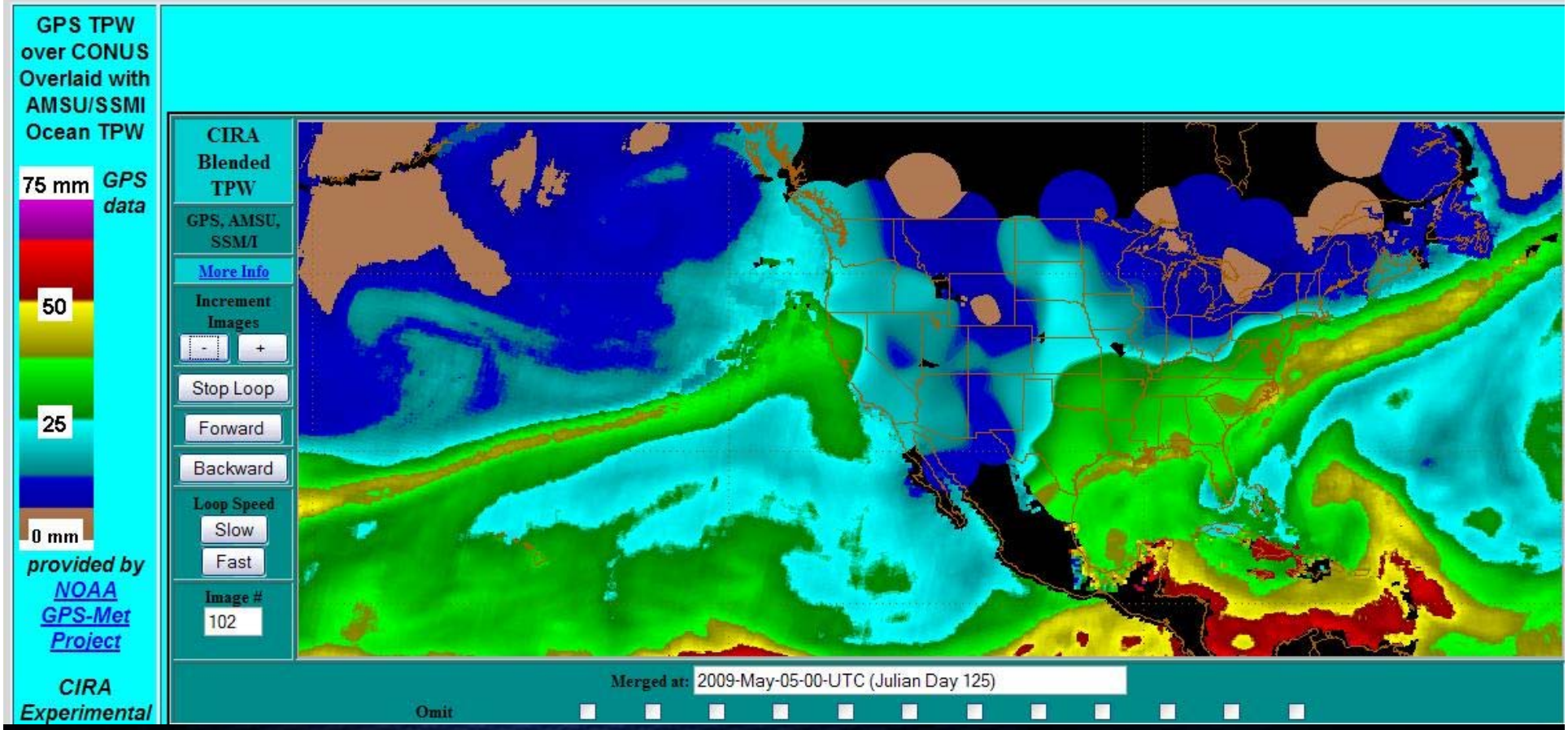
Ralph et al., GRL

Solution:

Data Integration/Synergy– Blended TPW

NOTE: GOES TPW (NESDIS) being added near CONUS where no GPS

Click Here for NOAA Operational Blended TPW Product Website (being served to AWIPS)



Blended TPW Product Operational Implementation

Lessons Learned

- What started as a global SSM/I and AMSU TPW blend was expanded to include GOES TPW and GPS-Met data

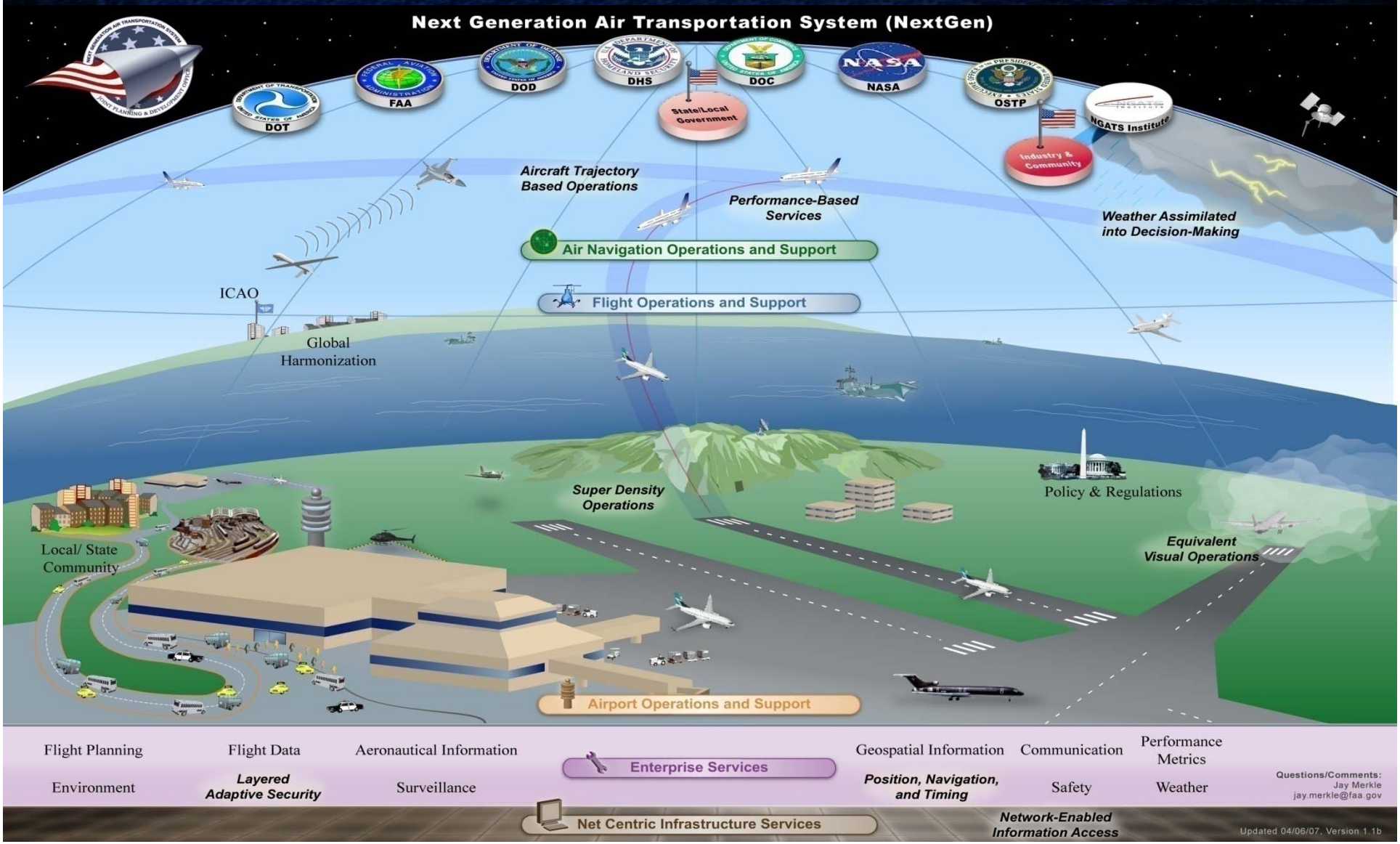
- Blend became problematic as smaller-scale over-land variations required more quality control and time for forecaster investigation of short-term signatures

- Forecasters uncomfortable with “black box” processing, prefer access to intermediate products and processing should questions arise

- Solid approach to science forms the foundation for forecasters to exploit new technology, key observations, better uncertainty info for decision makers

- Key briefing product in event timing, location, severity

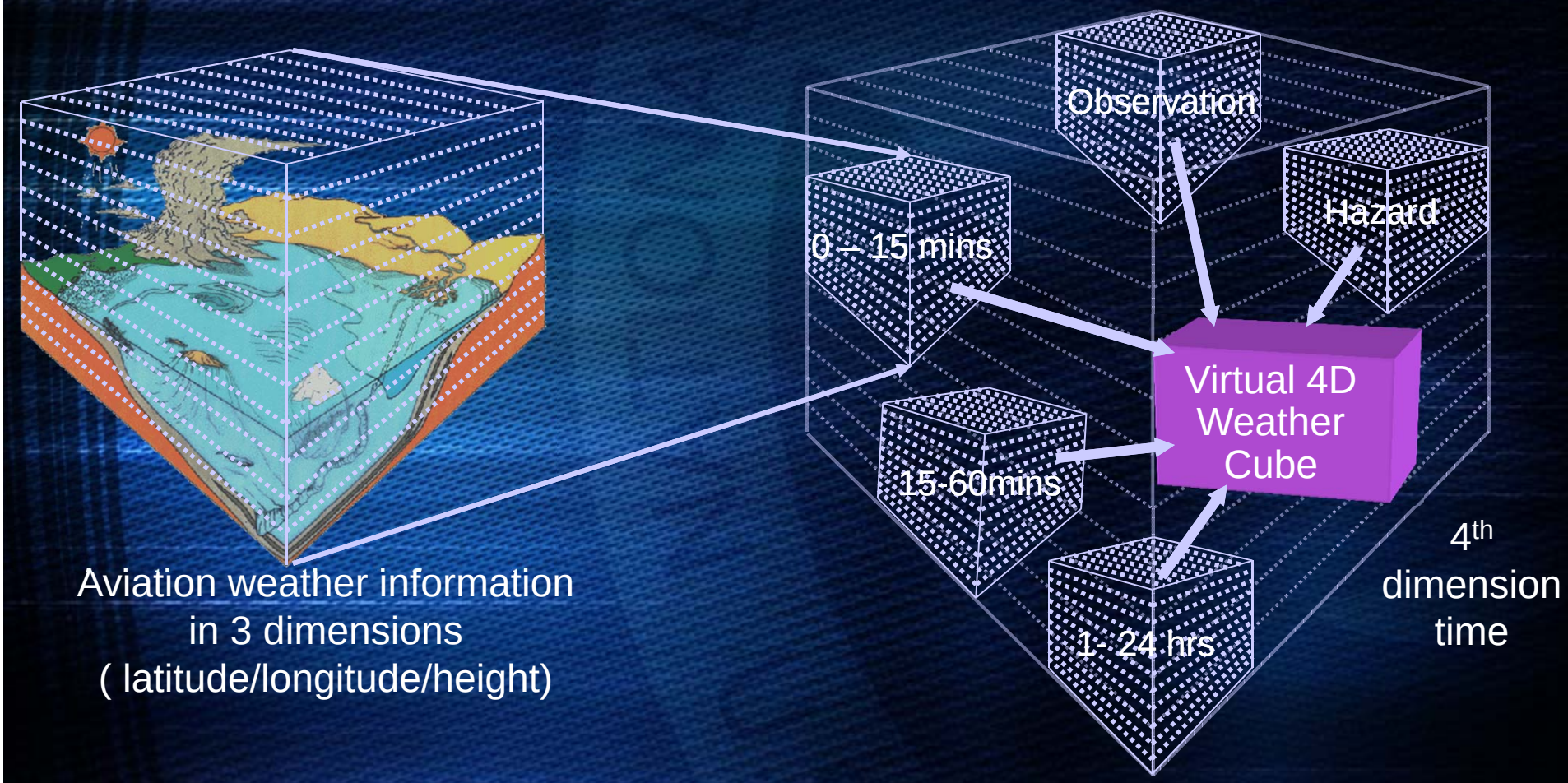
NextGen - Conceptually



Tools/Technology/Concepts

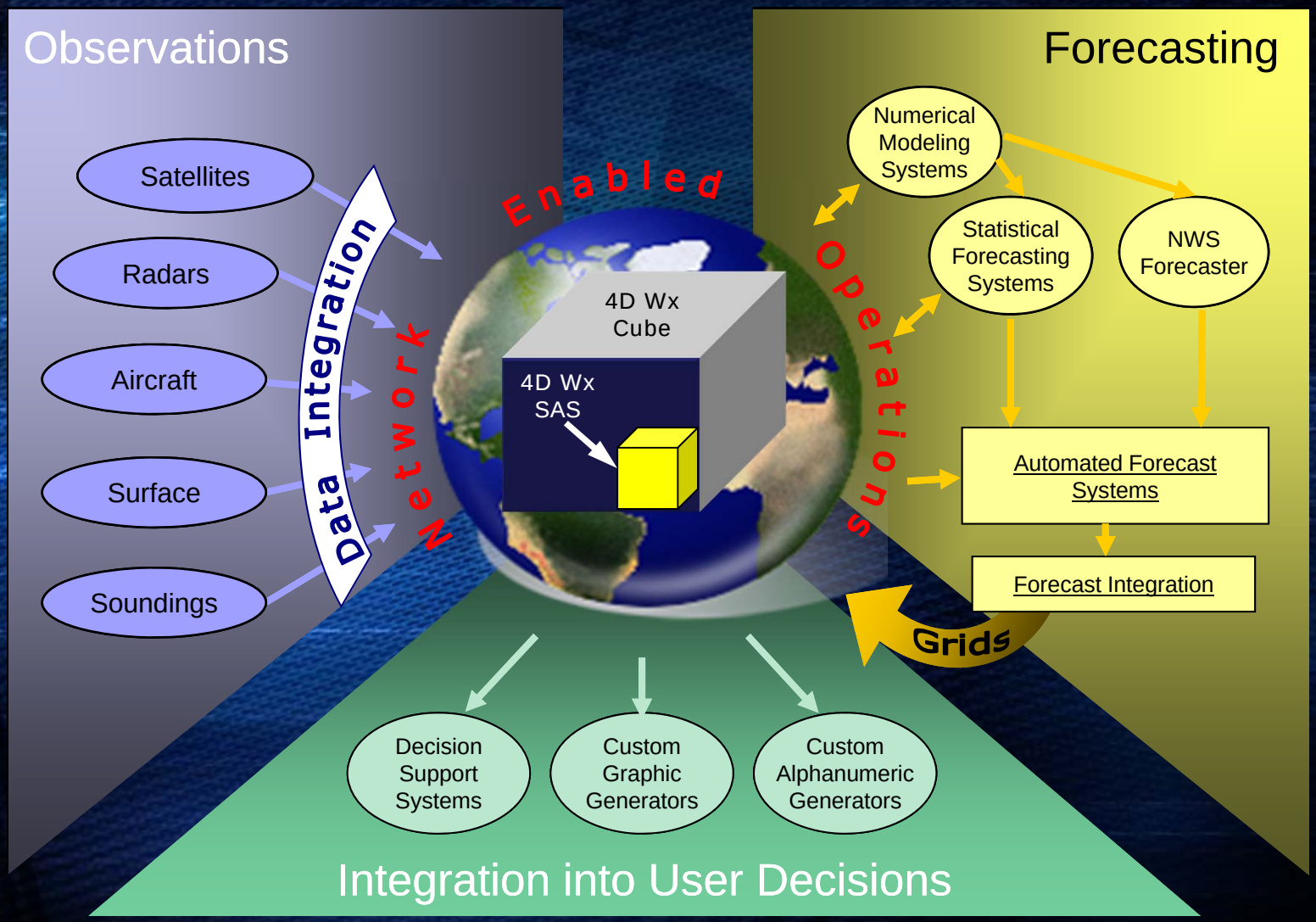
- Next Generation Joint Weather Requirements (Joint Development Project Office)
- Substantial leapfrog in communication, processing investments
- Data fusion, visualization, graphical layering, transparency, volumes, only glimpsed by today's progressive disclosure display clients like Google Earth
- Immediate all-media probabilistic product generation and distribution

Virtual 4D Weather Cube



Aviation weather information
in 3 dimensions
(latitude/longitude/height)

The 4-D Cube: A Conceptual Model



NextGen 101

Today

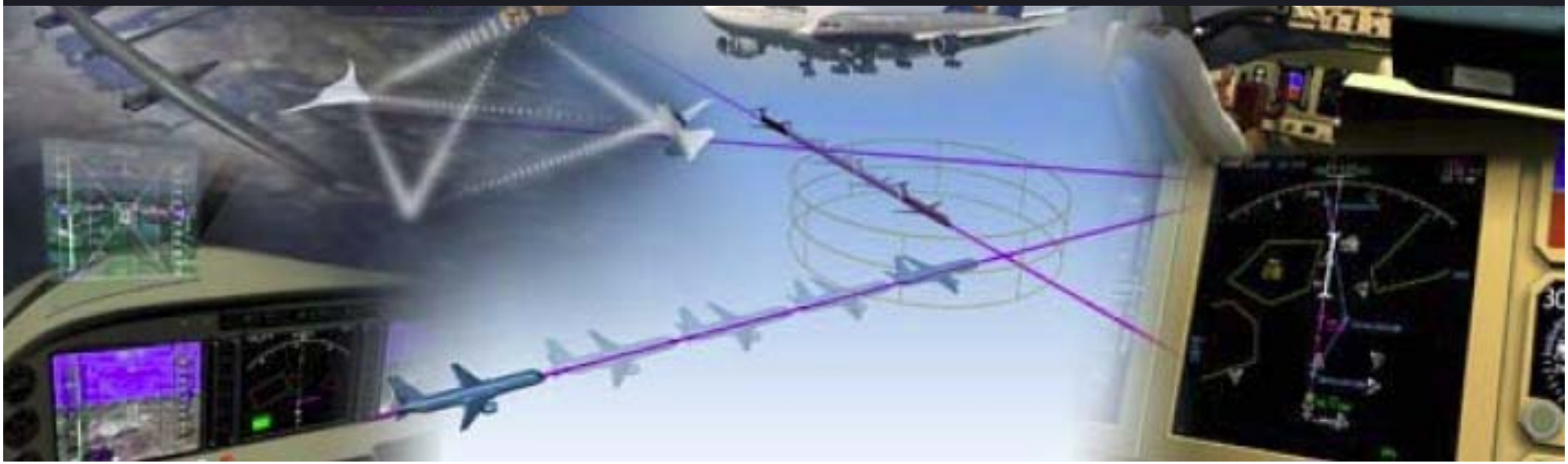
- Not integrated into aviation decision support systems (DSS)
- Inconsistent/conflicting on a national scale
- Low temporal resolution (for aviation decision making purposes)
- Disseminated in minutes
- Updated by schedule
- Fixed product formats (graphic or text)

NextGen (new requirements)

- Totally integrated into DSS
- Nationally consistent
- High temporal resolution
- Disseminated in seconds
- Updated by events
- Flexible formats

NextGen 101; Key Themes

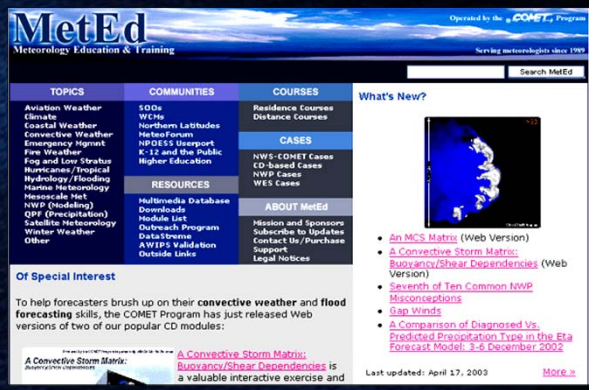
- An integrated and nationally consistent common weather picture for observation, analysis, and forecast data available to all system users



NOAA – COMET – EUMETSAT - WMO
Working Together for Satellite Training

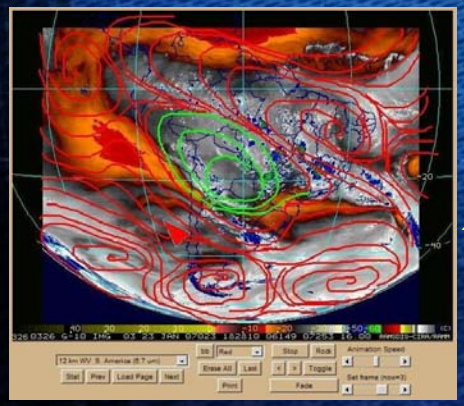
VISIT (CIRA/CIMSS)
SPoRT

NOAA/EUMETSAT
Bilateral Program



UCAR/COMET

GOES Proving
Ground

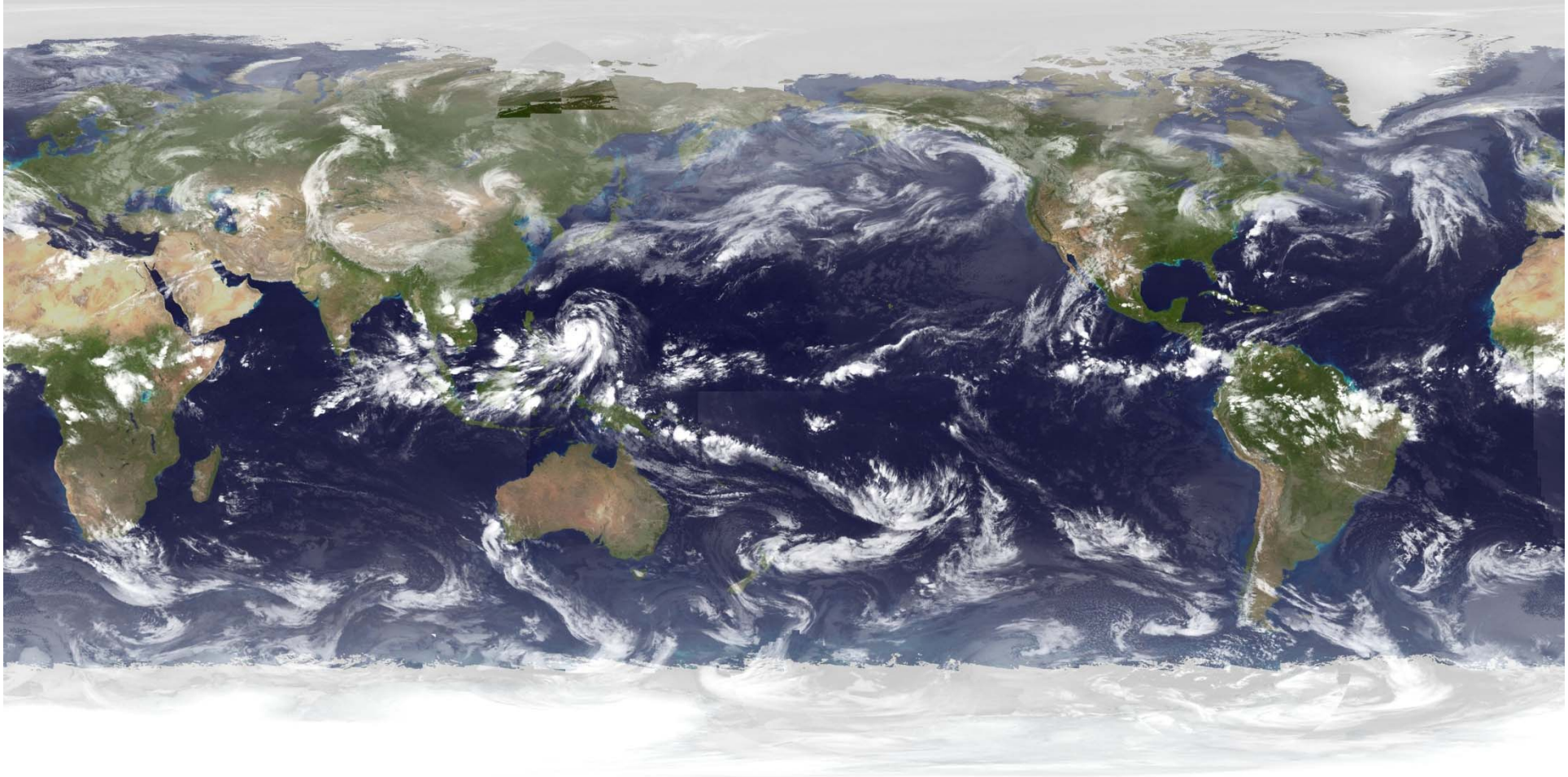


WMO (VL & FG)

Users & Developers

National Weather
Service

Global Cylindrical IR image for Science On a Sphere



•Training vs Information/Doc

Training is a special form of communication/instruction

- ❑ carefully and deliberately designed to focus attention
- ❑ needed job tasks, skills, and knowledge for application
- ❑ real-time operational decision-making environment.

In particular, new science and technology requires a complete training process that covers:

- ❑ essential knowledge
- ❑ proven operational applications
- ❑ specific job tasks related to forecast/warning decision making
- ❑ integrated (not weather-only) simulations requiring substantial depth-of-knowledge application to the forecast and warning decision-making process.

Testbeds/proving grounds provide the best value when demonstrated improvements are “operationalized” to real-world constraints.

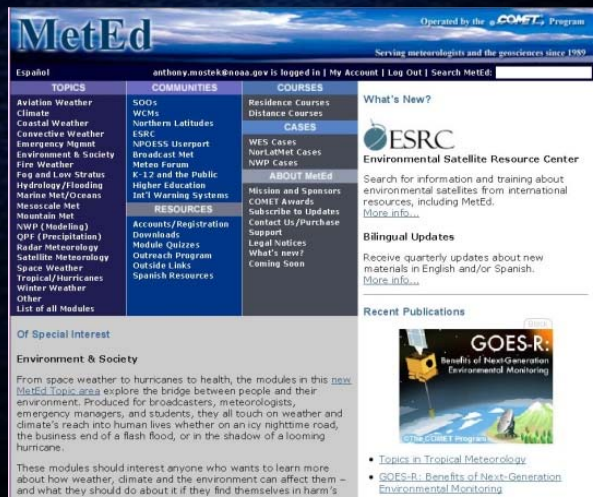
VISIT - rammb.cira.colostate.edu/training/visit/

COMET METED - meted.ucar.edu

NOAA LMS - https://doc.learn.com/noaa/nws

NWS FDTB - http://www.fdtb.noaa.gov/

NWS Training Portal http://weather.gov/training



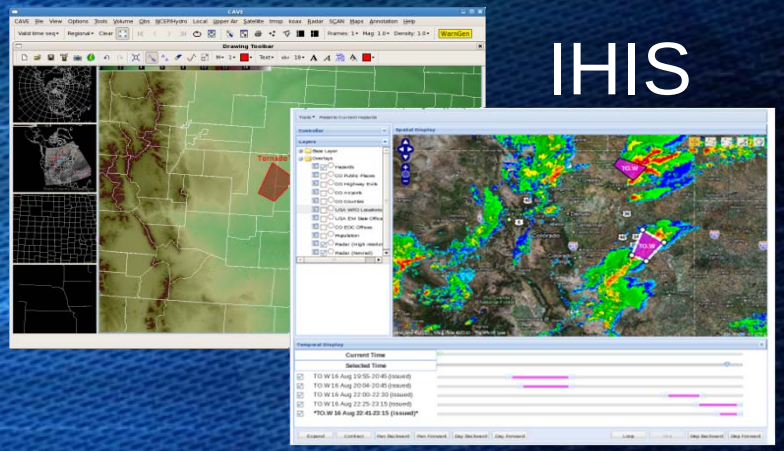
Collaborations

NWS National Centers
NCEP Development Team

NWS Partners
BOU Office

AWIPS II
Extended
Collaboration
Data Delivery
Thin Client
Verification

AWIPS II



IHIS

NWSWarn

RENCI

SSWIM
Social Science Woven
Into Meteorology

Raytheon

Iris / iNWS

MDL
Meteorological Development Laboratory

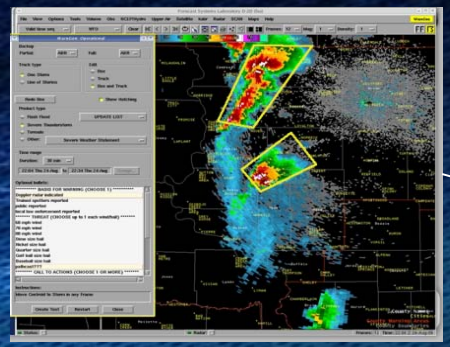
University of Wisconsin

NSSL
National Severe Storm Laboratory

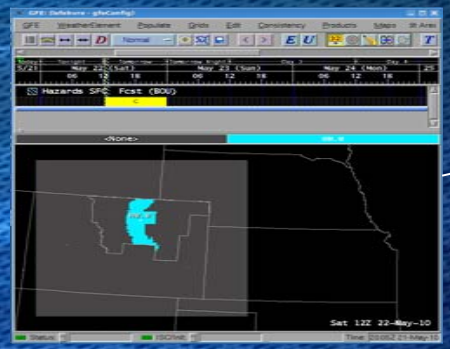
COMET

Purpose -- Integrate Hazard Tools Phase 1

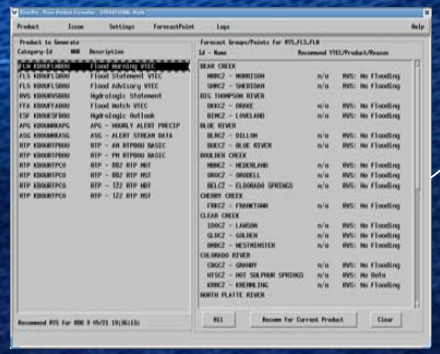
WARNGEN
(< 1 hour)

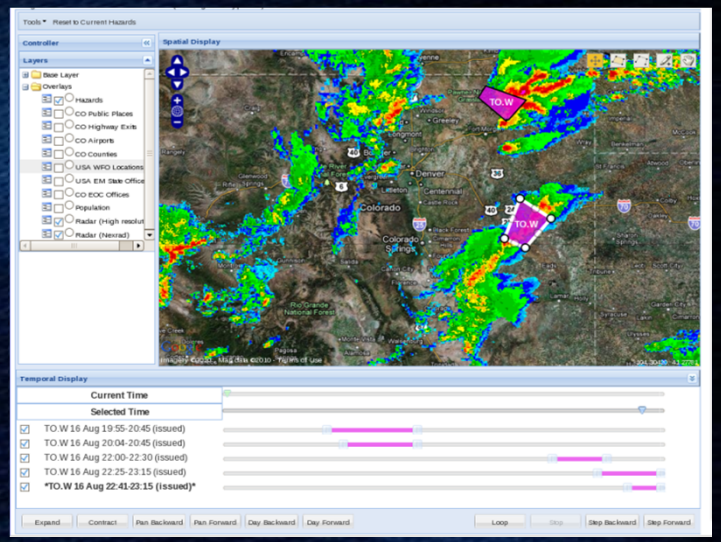


GHG
(Hours-Days)



RiverPro
(Days)

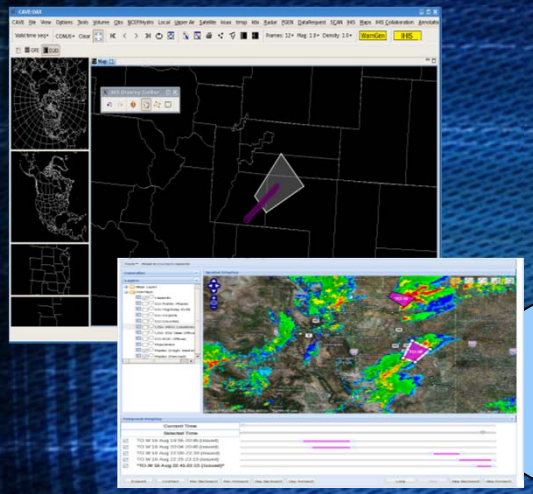




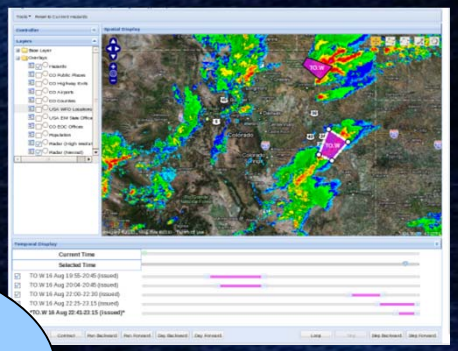
IHIS

IHIS Architecture
Conceptual Shared Data

AWIPS II Cave --
Forecasters



Web -- Partners:
EM's, Broadcasters, Spotters, Publics



National Hazard Database

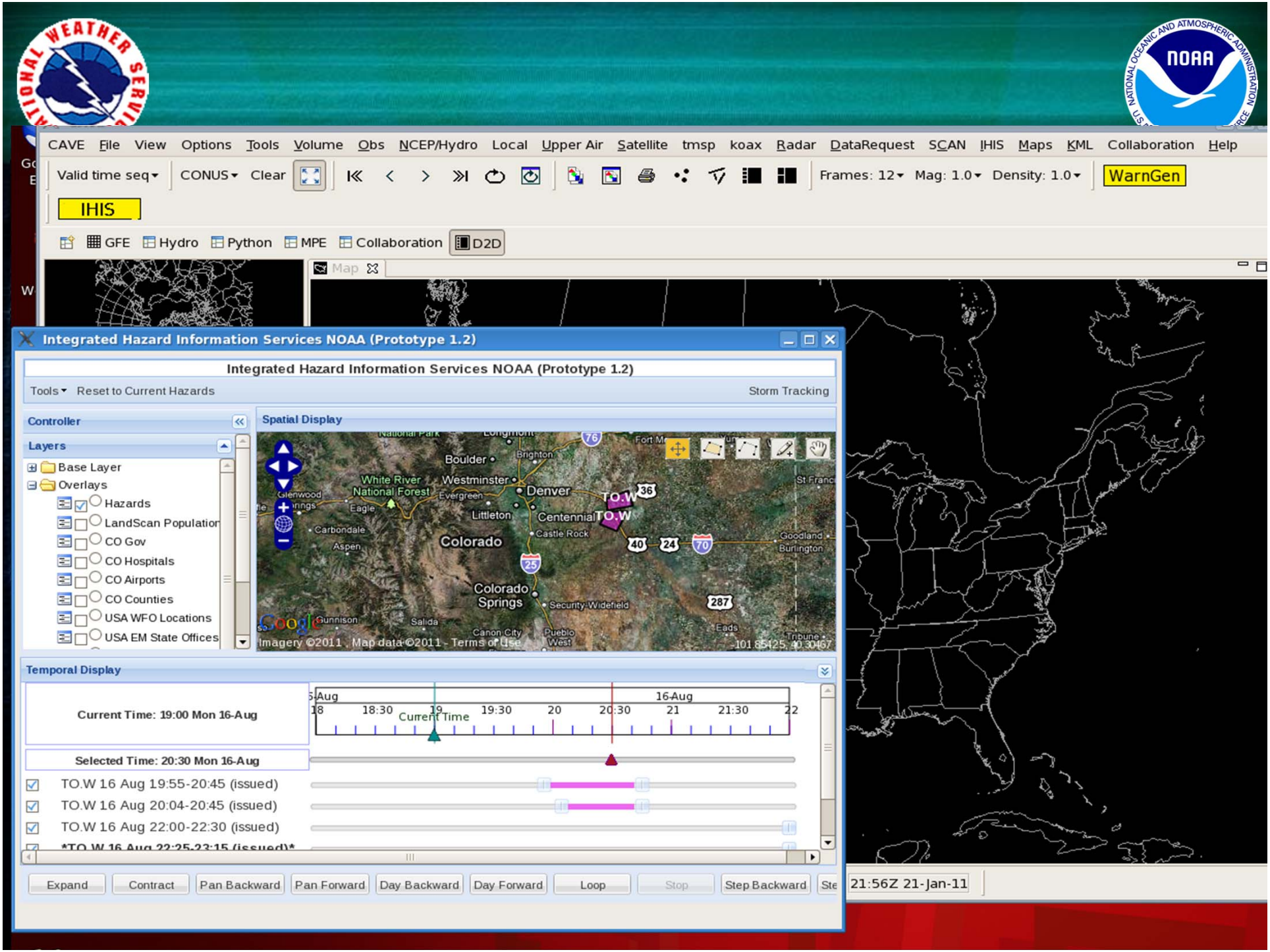
Iris

GIS

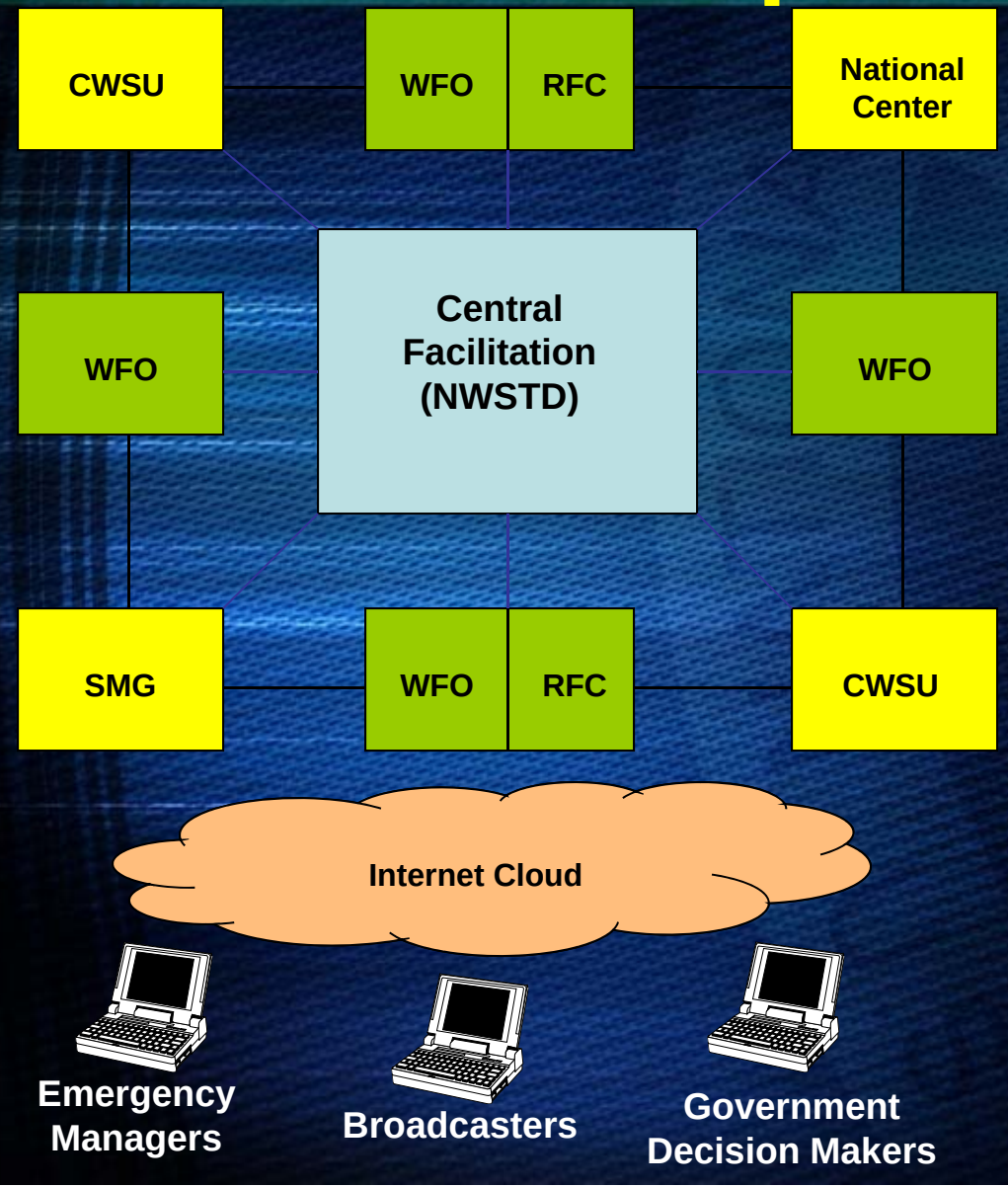
Cave
Plug-in

Shared Services
Hazard Information
User Extensions
Layer Data / GIS

Web
App


CAVE File View Options Tools Volume Obs NCEP/Hydro Local Upper Air Satellite tmsp koax Radar DataRequest SCAN IHIS Maps KML Collaboration Help
Valid time seq
CONUS
Clear
Frames: 12
Mag: 1.0
Density: 1.0
WarnGen
IHIS
GFE Hydro Python MPE Collaboration D2D
Map
Integrated Hazard Information Services NOAA (Prototype 1.2)
Integrated Hazard Information Services NOAA (Prototype 1.2)
Tools
Reset to Current Hazards
Storm Tracking
Controller
Spatial Display
Layers
Base Layer
Overlays
Hazards
LandScan Population
CO Gov
CO Hospitals
CO Airports
CO Counties
USA WFO Locations
USA EM State Offices
Boulder
Westminster
Denver
Brighton
White River National Forest
Evergreen
Eagle
Littleton
Centennial
Castle Rock
Carbondale
Aspen
Colorado
Colorado Springs
Security-Widefield
Gunnison
Salida
Canon City
Pueblo West
Goodland
Burlington
Imagery ©2011 , Map data ©2011 - Terms of Use
Temporal Display
Current Time: 19:00 Mon 16-Aug
Aug
16-Aug
18
18:30
19
19:30
20
20:30
21
21:30
22
Current Time
Selected Time: 20:30 Mon 16-Aug
TO.W 16 Aug 19:55-20:45 (issued)
TO.W 16 Aug 20:04-20:45 (issued)
TO.W 16 Aug 22:00-22:30 (issued)
Expand
Contract
Pan Backward
Pan Forward
Day Backward
Day Forward
Loop
Stop
Step Backward
21:56Z 21-Jan-11

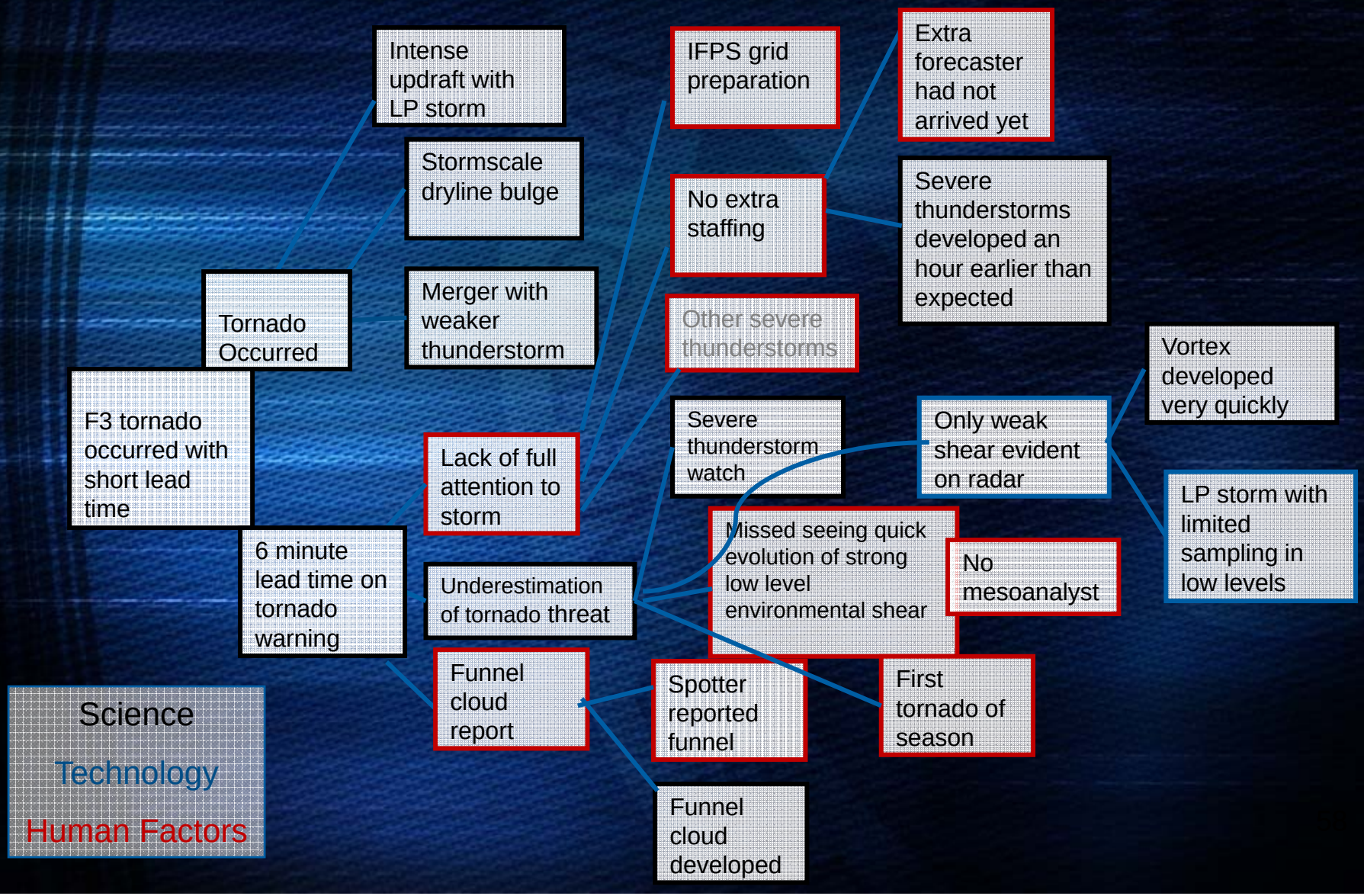
Enhanced Simulation Capabilities



- FY14 completion
- FTEs required
- 2+ Networked Simulators per WFO with Situation Awareness Capability
- Thin Clients
  - Leverage AWIPS II Thin Client Capabilities
- Decision Support Services (DSS)
  - Partnerships with Stakeholders
  - Simulation Development
  - Simulation Facilitator
  - Synchronous Instruction

Root Cause

One actual event submitted to Advanced Warning Operations Course



Data Analysis

127 tornado events

Technology
16%

- √ Radar sampling (VCP, range folding, update time, radar horizon, blockage, no closer radar, viewing angle)
- √ No radar Signature (due to sampling)

Science
20%

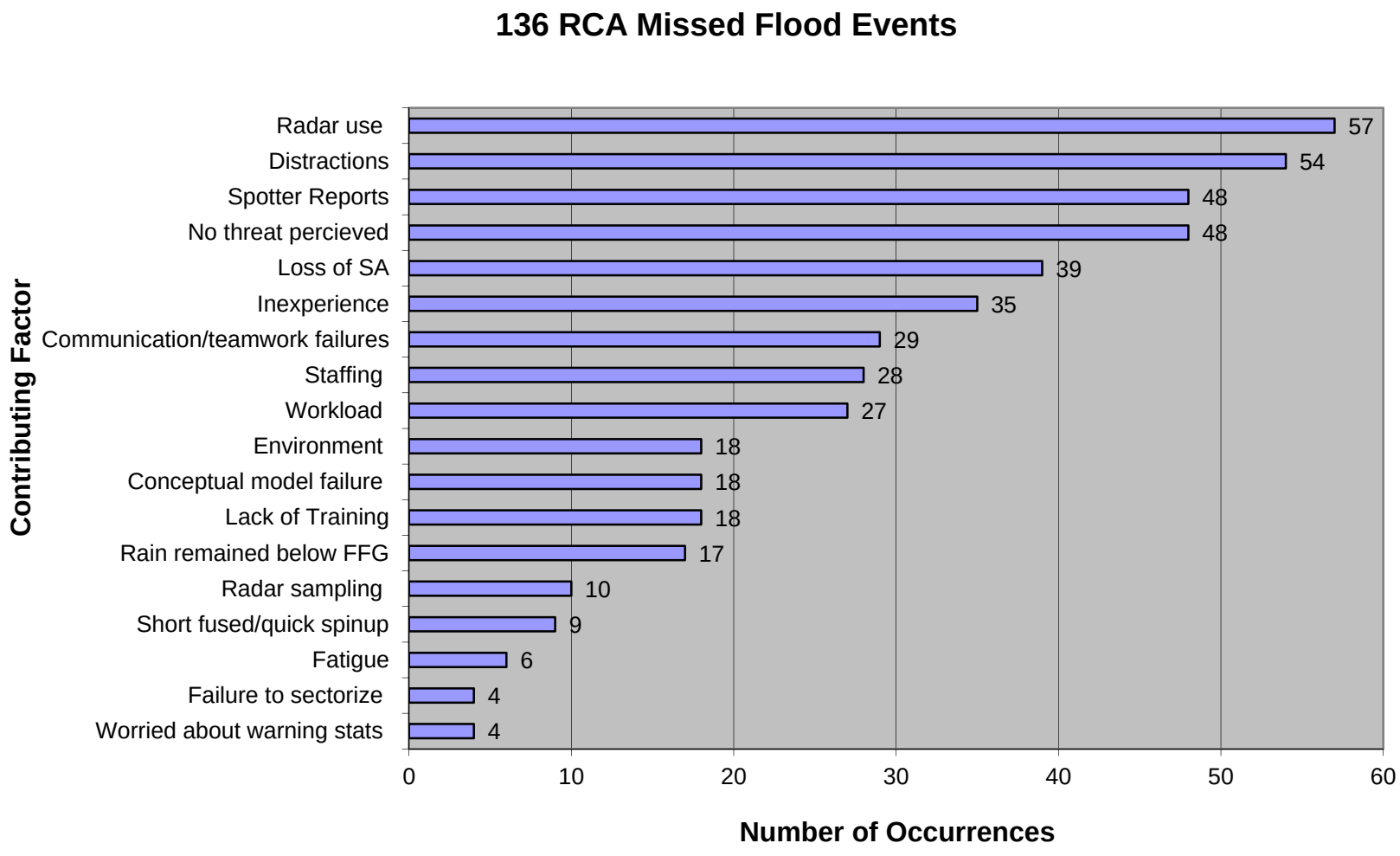
- √ Not Anticipated
- √ Environment
- √ No watch
- √ Short fused spin-up

Human Factors
63 %

- √ Spotters
- √ Communication/teamwork
- √ Workload
- √ Radar use
- √ Inexperience
- √ Distractions
- √ Loss of Sit Awareness
- √ Conceptual model
- √ Staffing
- √ Fatigue
- √ Failure to sectorize
- √ Worried about stats
- √ Lack of training

Missed Flash Floods

Root Cause Analysis 136 events (04-09)



Train as we fight

Fight as we train

Advanced Simulation Capability

Strategy

- WFO mock-up at the Training Center
(full immersion residence training)
- Advanced WES development (AWIPS II)
- Virtual synchronous mission scenarios with other WFOs, RFCs, NCEP, FEMA, EOCs and others
- Modeled after DOD, FEMA, NASA

Benefits

- Gain experience without costly or irreversible consequences.
- Experientially develops human factor competencies.
- Trains for individual & team performance
- Critical for Decision Support Services

Vision 2014: Distributed and Collaborative Simulations Focused on Human Factors and Decision-Support

- Collaborative simulations and interagency exercises: partnerships, teamwork and decision support
- Intraoffice and interoffice simulations (like FEMA, NASA/SMG, DOD)

Internet

WAN/NOAAnet/VRF