A Direct Broadcast Demonstration of CSPP and IMAPP at McMurdo Station, Antarctica

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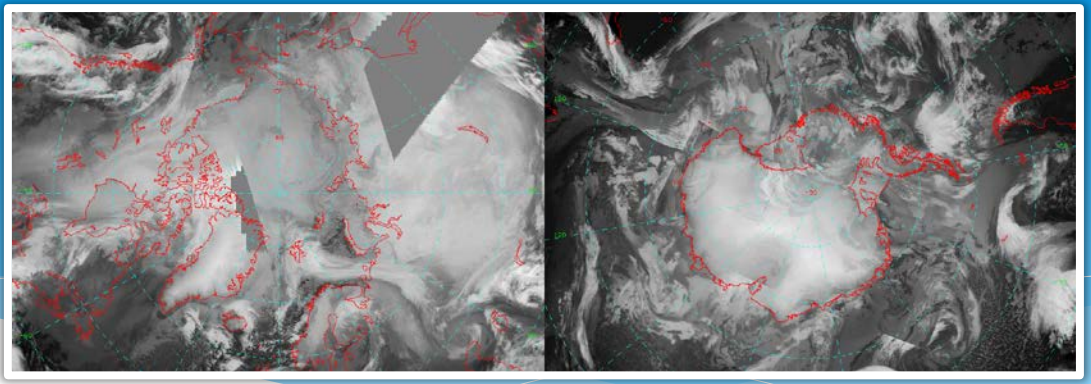
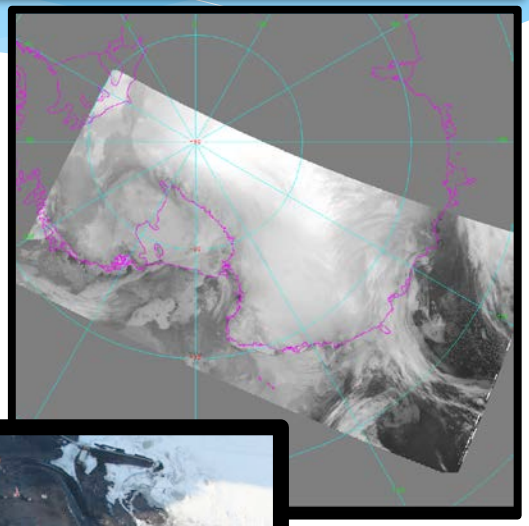
Outline

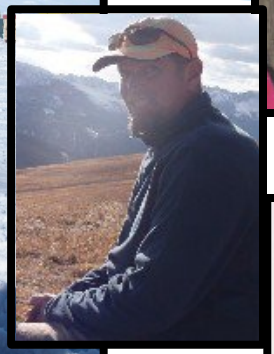


- About Us
- What we do
  - Observational research
  - Automatic Weather Stations(AWS)
    - Data Collection Services..
- United States Antarctic Program Direct Broadcast Reception System
  - History
  - Current status
- Objectives & Applications
  - Satellite Composites
  - Atmospheric Motion Vectors
- IMAPP
- CSPP
- The Uncertain Future…



The AMRC/AWS Team

Dr. Matthew Lazzara



Andy Archer

Dr. Melissa Richards, Dr. John Cassano,
Dr. Matthew Lazzara, Shelley Knuth

George Weidner

Linda Keller

Jonathan Thom

Carol Costanza

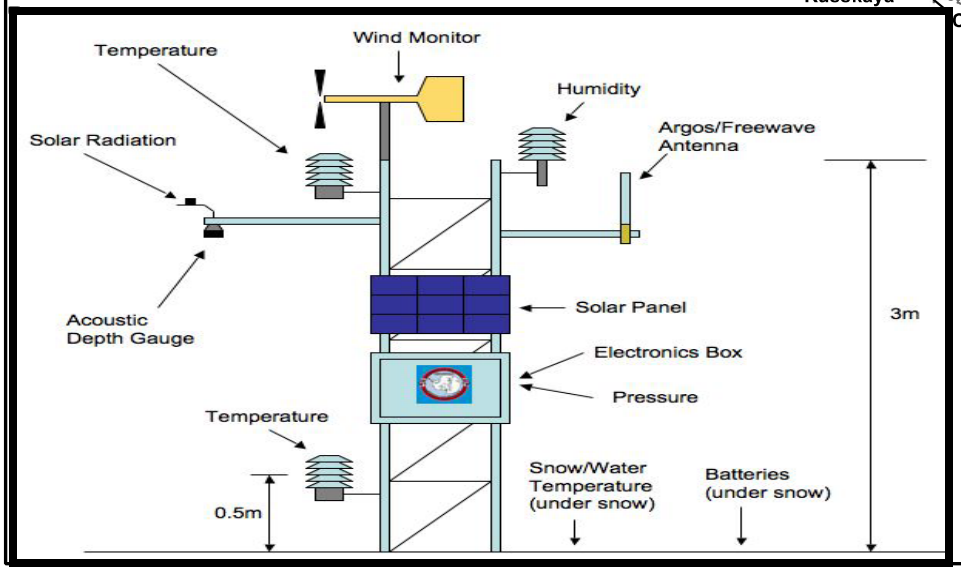
Dr. Masha Tsukernik

Dave Mikolajczyk

Katie Stockwell

Nick Weber

Lee Welhouse



Ekstrom & Ekstrom Shelf Ice
Atka & Atka Bay
Halvfarryggen
Camp Maudheimvida
Utsteinen
Molodeznaya
Kohnen Base
Mizuho
JASE2007
Relay Station
Dome Fuji (JPN)
Dome Fuji
Shackleton
Plateau Station B
Baldrick
AGO-3
Pole of Inaccessibility
Druznaja-4
Whoop Whoop
PANDA-North
Eagle
Dome A
PANDA-South
Mt Brown
AGO-2
Union Glacier
Thiel Mountains
Henry
Nico
AGO-4
AGO-1
Joinville Is
AWS 17
AWS 14
AWS 15
Larsen Ice Shelf
AWS 3
AWS 2
AWS 1
Butler Is
Dismal Is
Fossil Bluff
Limbert
Sky Blu
Jurassic
Thurston Island
Evans Knoll
Lindsey Island
Bear Peninsula
Kominko-Slade (WAIS)
Harry
Byrd
Theresa
Erin
Brianna
Sabrina
Tom
Elizabeth
Marlene
Elaine
Janet
Siple Dome
Lettau
Eric
Schwerdtfeger
Carolyn
Margaret
Mt Siple
Russkaya
Cape Burks
Nascent
Vito
Skinner Saddle
Marilyn
Darwin Gl
Central Valley
Mary
AGO-5
DC N/S
Dome C
Dome C II
Concordia
Haupt Nunatak
Snyder Rocks
Casey Skiway
Law Dome Summit/A
Cape Poinsett
Wilkins Runway West 4m / East ICAO
Giulia
D-85
E-66
D-47 (FRN)
D-47
D-0
D-1
D-3
D-10
D-17
Port Martin
Cp Denison
Modesta
Sofia-B
Irene
Paola
Cape Hallett
Possession Is
Leningradskaya
See Inset Map B
See Inset Map A
aland
New Zealand
Belgium/Netherlands
France
Germany
Japan
Other AWS
Commercial

AWS Data Relay

Data Collection Service (DCS)

AWS Project over 30 year user!

Argos Satellite
NOAA series
(Metop series)
(JPSS/FreeFlyer…)

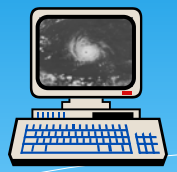
AWS Observations

UW/SSEC

Reception via

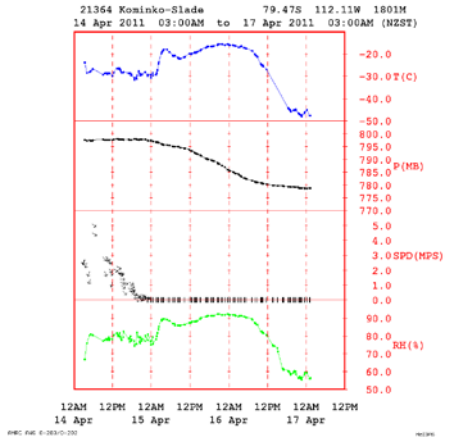
- HRPT
- GAC Relay
- (FRAC Relay)

McMurdo & Palmer Stations



SSEC Desktop Ingestor (SDI)

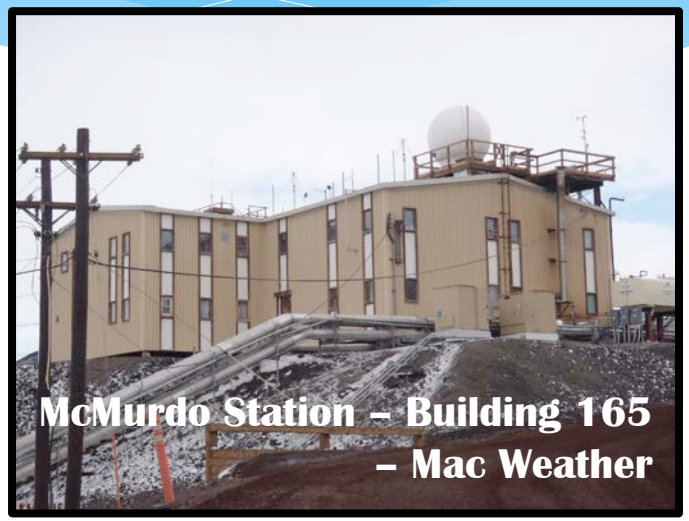
AWS Decode Software



Distribution

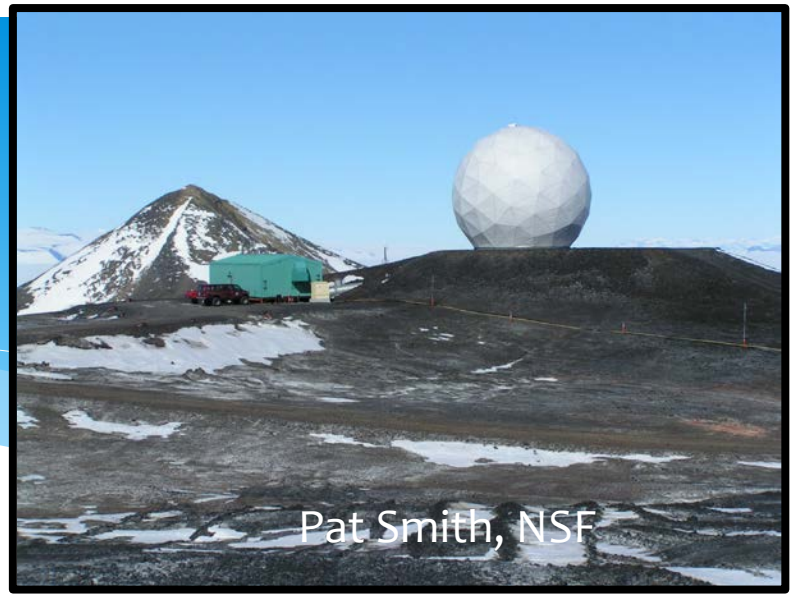
United States Antarctic Program Direct Broadcast Reception System

* McMurdo Station & Palmer Station, Antarctica & USAP research vessels
* History of McMurdo… (next slides)
* Modern day:
  * TeraScan system
    * L-band/S-band
    * X-,L-,S-band
  * AMRC "science side" processing
    * Wisconsin SSEC Desktop Ingestor (SDI)
    * IMAPP
    * CSPP
  * Successfully collecting:
    * NOAA-18 & 19, DMSP F-17 & 18, Aqua, Terra, Suomi-NPP and Metop-B
    * Aqua, Terra and Suomi-NPP at McMurdo only
  * 24x7 operations
  * All data is delivered in real-time/near real-time for forecasting and research…



What This System Isn't…

* Not the NASA Ground Station aka McMurdo Ground Station (MGS)
* nor the JPSS (formally NPOESS) Common Ground System (CGS) receptor sites



McMurdo Station's First Direct Broadcast Reception System

Circa 1967

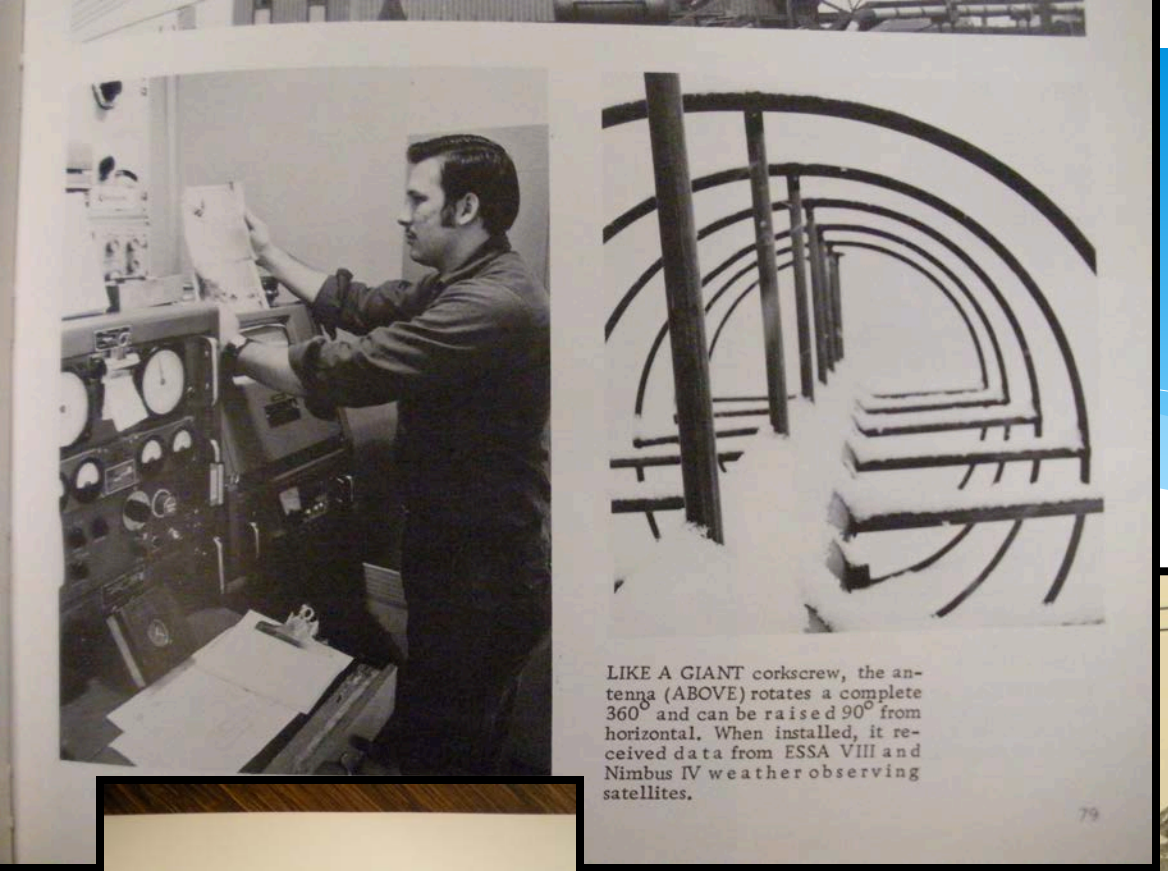
First Generation System - 1967

- ESSA VIII
- Nimbus IV

Automatic Picture Transmission (APT)

Upgraded – GODDESS

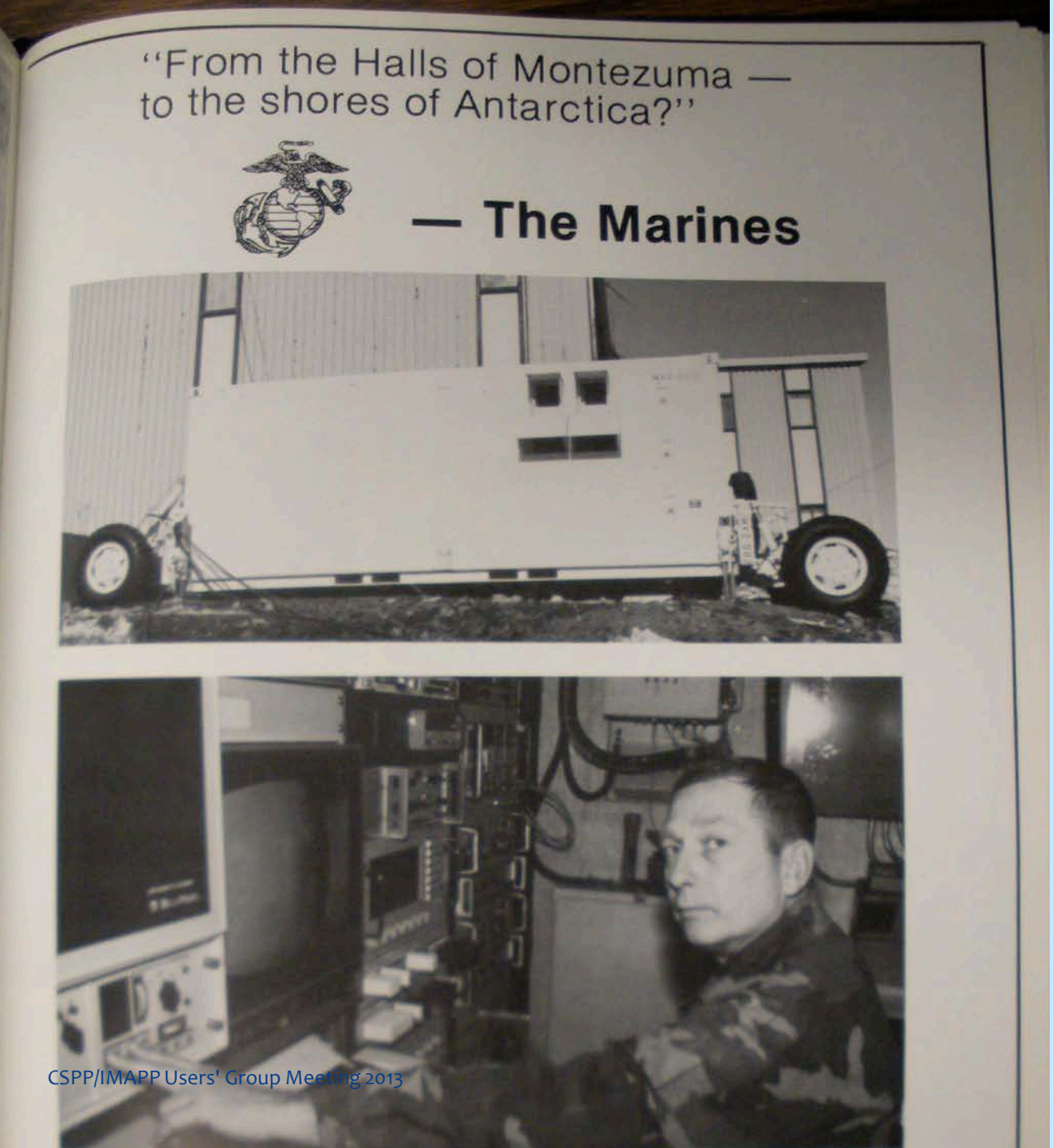
- Geophysical Operational Data Display Environmental Satellite System



LIKE A GIANT corkscrew, the antenna (ABOVE) rotates a complete 360° and can be raised 90° from horizontal. When installed, it received data from ESSA VIII and Nimbus IV weather observing satellites.

79

Automatic Picture Transmission



New Reception System

- Early/Mid-1980s
- Defense Meteorological Satellite Program (DMSP) Satellites
- Marines
- Mark IV System

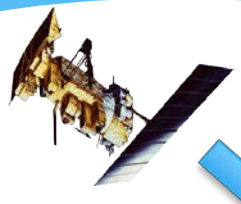
Upgrade – Modern Reception

- Mid/Late-1980s
  - Terascan Systems
  - (McIDAS & SSEC Desktop Ingestors)

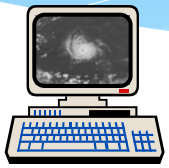
Today:

- IMAPP and CSPP

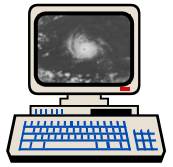
McMurdo DB Data Flow…



X-,S-,& L-Band
Reception (2)

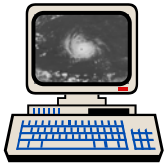


AMRC SDI
NOAA/POES
(DMSP)



AMRC
CSPP
Suomi-NPP

AMRC
IMAPP
Aqua/Terra



Terascan
Operational Weather
Forecasting

Objectives, Uses, & Applications

* #1 - Operational Support
  * Weather forecasting
  * Emergency operations
  * Logistics
* #2 - Science Support
  * AMRC – "science" composites
  * Other science support
  * R&D
* IMAPP
  * Atmospheric Motion Vectors
  * Satellite Composites
  * Forecaster Demonstration
* CSPP
  * Satellite Composites
  * Forecaster Demonstration

Computing

IMAPP

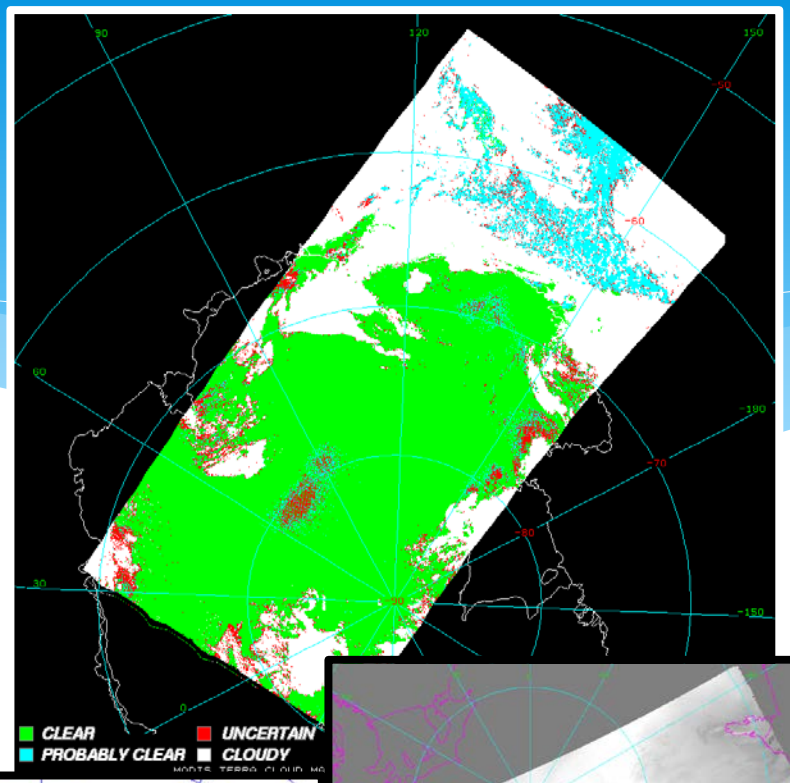
* Original setup with a Dell 2850
  * IMAPP with AMV Winds Software and modifications
* Now using a Dell R710
  * 16 CPUs
  * 2.4 Ghz Xeon
  * ~24 Gb RAM
* AMV Winds to be added Summer 2013
  * Backup CSPP

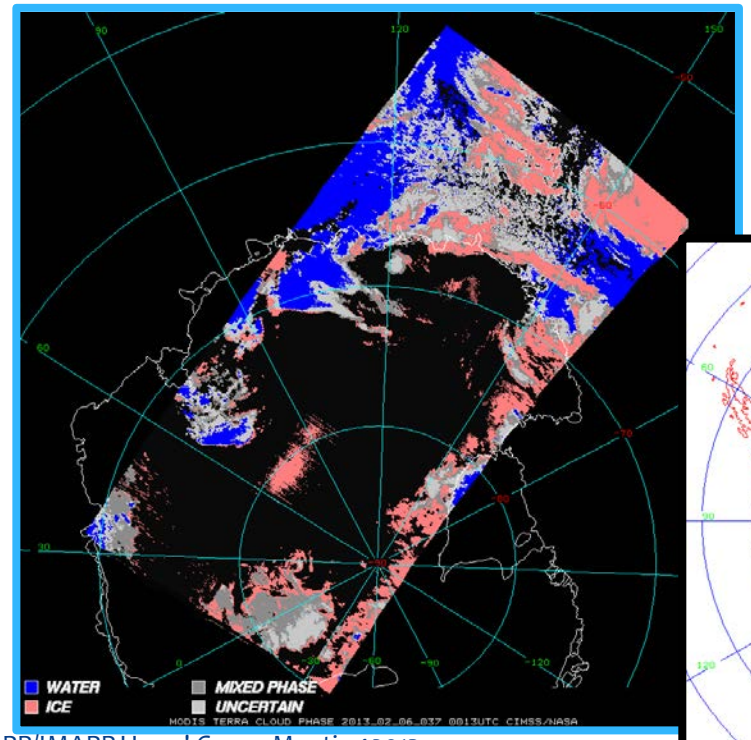
CSPP

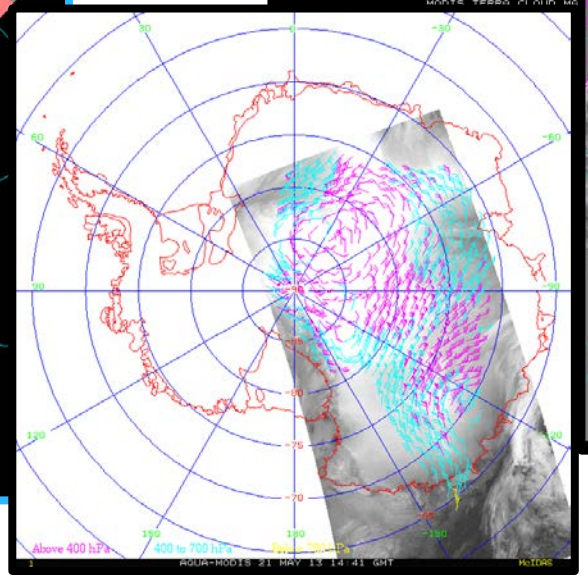
* Dell PowerEdge R720
  * 32 CPUs
  * 2.6 Ghz Xeon
  * ~82 Gb RAM
* Backup IMAPP and AMV Winds

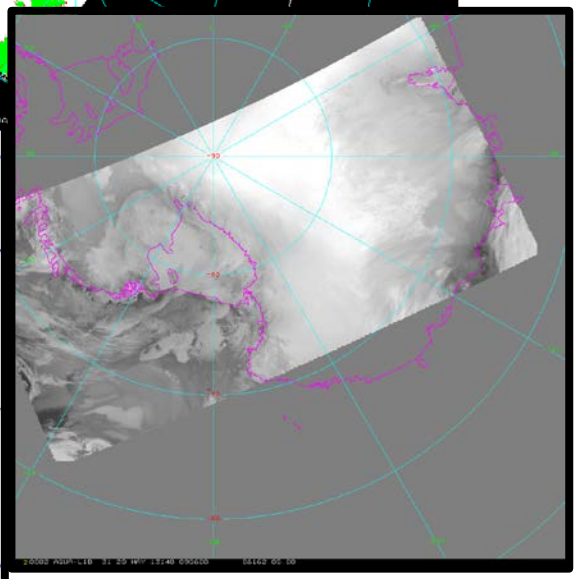
IMAPP Examples…

* Real-time:
  * http://stratus.ssec.wisc.edu/cgi-bin/db_main?site=mcmurdo



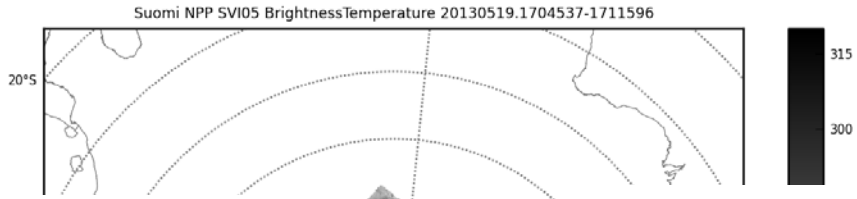


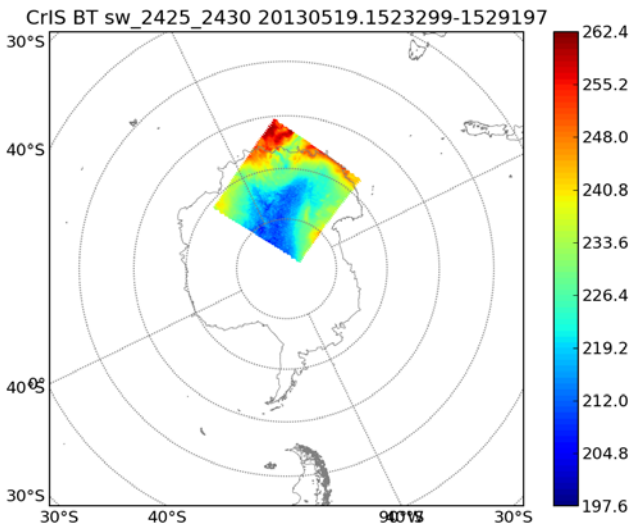


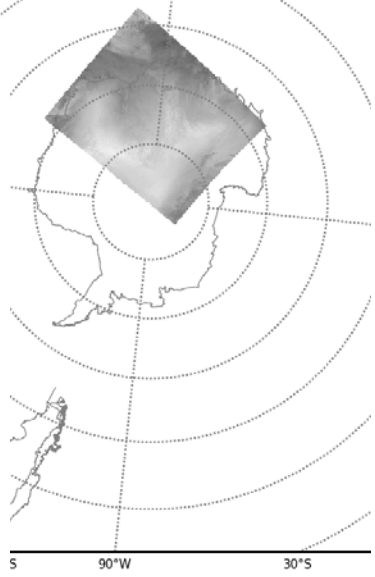


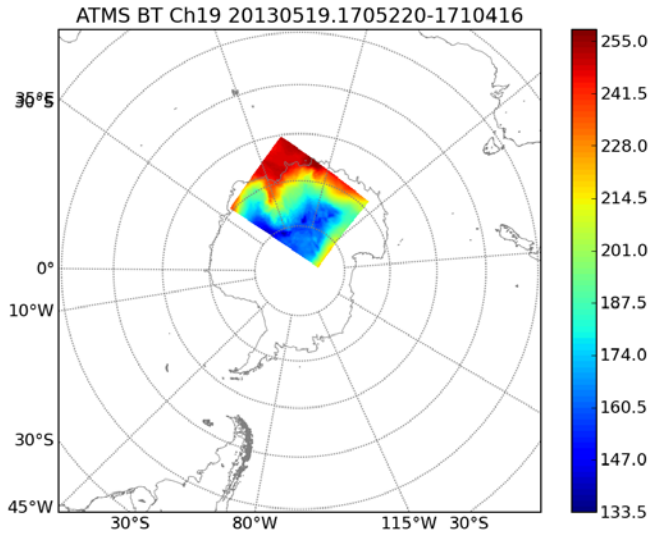
Sample Suomi-NPP Quicklooks

* Realtime:
  * http://amrc.ssec.wisc.edu/data/view-data.php?action=list&product=satellite/S-NPP



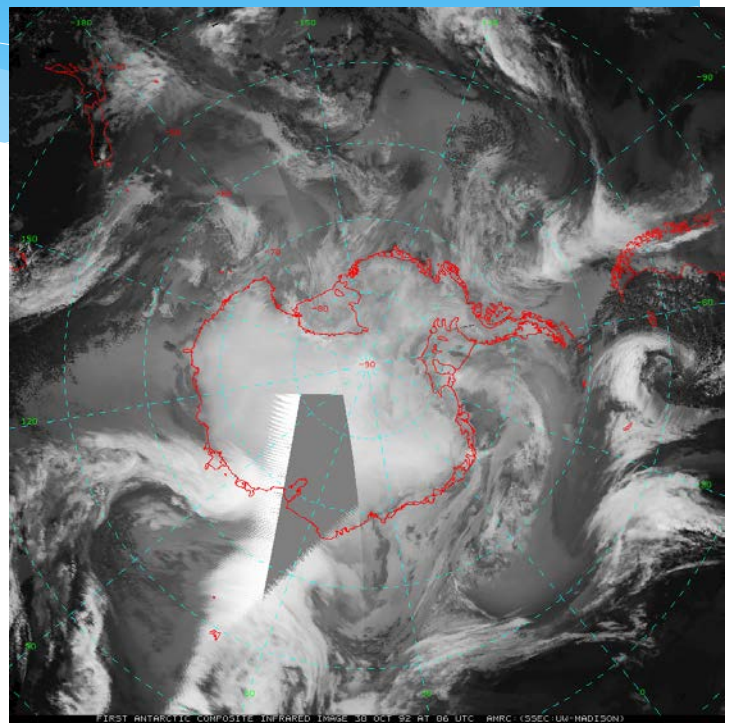






History of the Antarctic (and Arctic) Satellite Composite Imagery

* Dr. Charles Stearns:
  * Inspired by one-time composites made from Defense Meteorological Satellite Program (DMSP) imagery of late 1980s.
  * Why not do this all the time with more satellites?
    * Both Geostationary and Polar-orbiting
  * SSEC Data Center offerings
  * McMurdo Station direct broadcast
  * Aim for the composites:
    * Operations/Forecasting
    * Research
    * Education

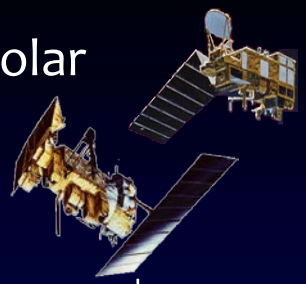


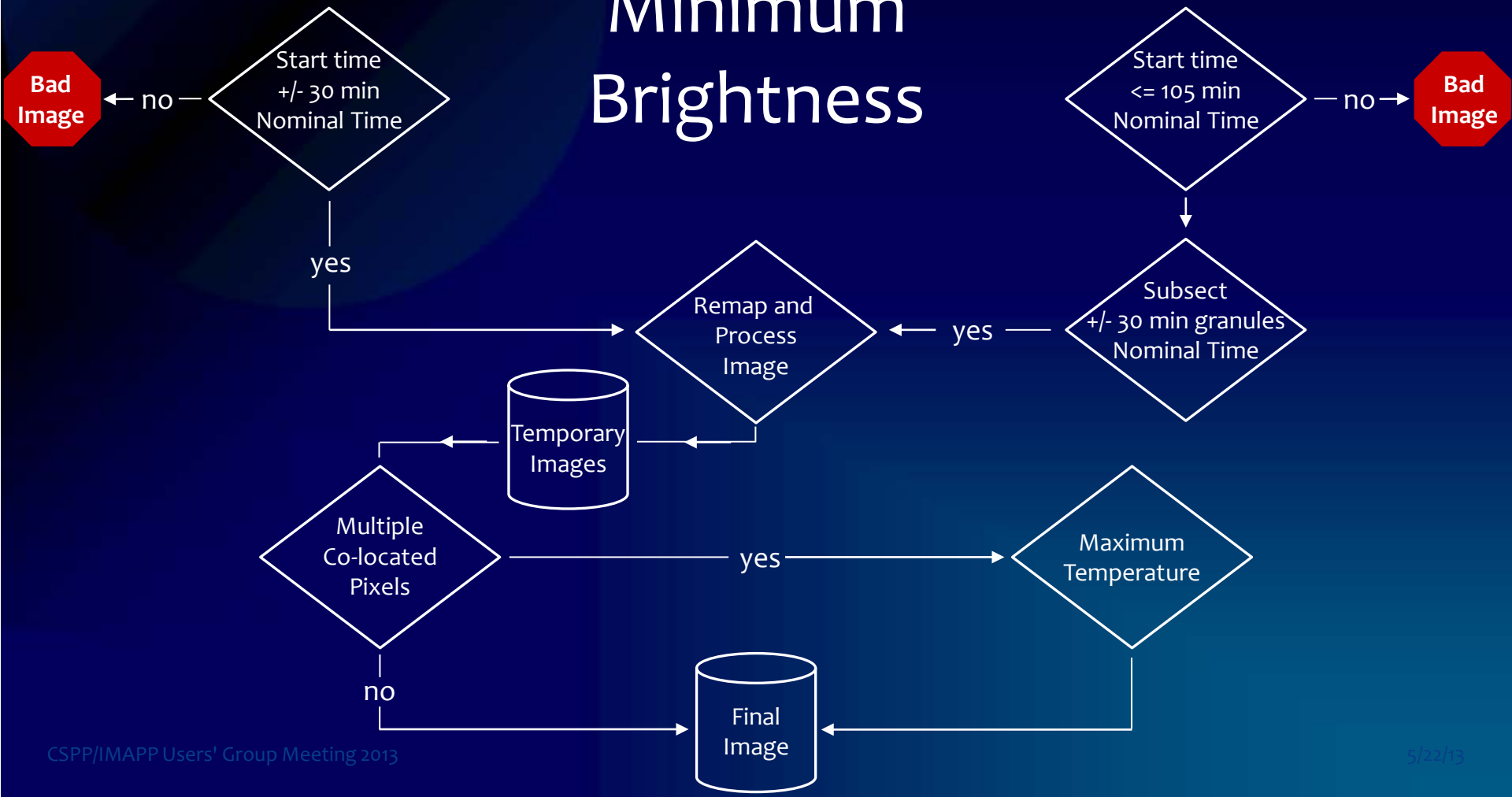
First Antarctic Infrared Composite
6 UTC 30 Oct 1992 11.0 µm

Maximum Temperature Minimum Brightness

Geostationary

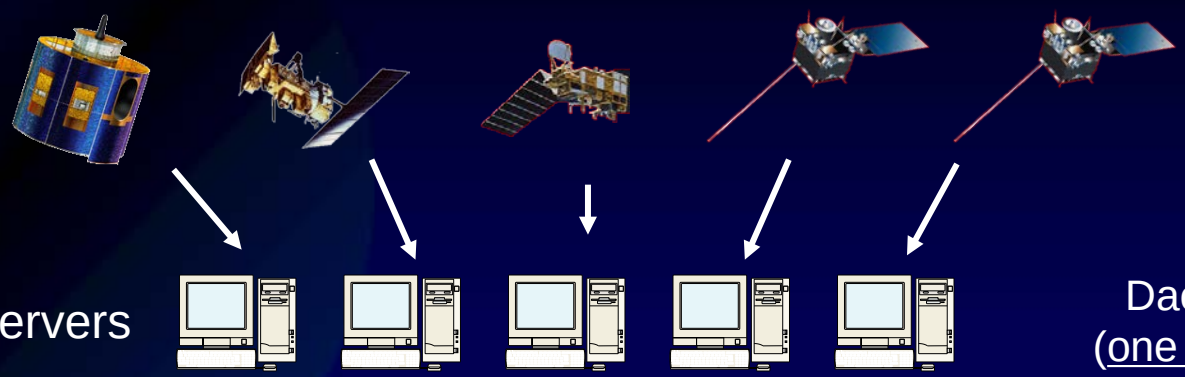
Polar





Next Generation -- Algorithm Overview – Data Flow

Daemons check for new images on servers and create files to be processed



Servers

Daemon List
(one per server)

GOES-East	NOAA-15
GOES-West	NOAA-16
GOES-SA	NOAA-18
INDOEX	NOAA-19
MSG	MTSAT
FY2	Terra
COMS	Aqua
INDOEX	Metop
MSG	*Suomi-NPP*

Queue Files
(Satellite Projection)

Daemons

Process
(hourly)

Parallax
Age
Brightness

Remap

Temporary Files
(Common Projection)

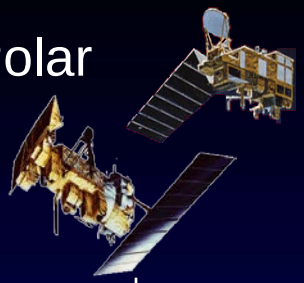
Apply
Algorithm

Parallax
Age
Brightness

Next-Generation Algorithm Overview

Geostationary

Polar



Start time +/- 30 min Nominal Time

no → Unused Image

yes → Remap and Process Image

Start time <= 105 min Nominal Time

yes → Remap and Process Image

no → Unused Image

Parallax Age Brightness

Pixel age +/- 30 min Nominal Time

no → Unused Pixel

yes → Multiple Co-located Pixels

Multiple Co-located Pixels

yes → Multiple w/ Parallax Error < 15 km

no *(single pixel)* → Final Image

Multiple w/ Parallax Error < 15 km

yes → Weighted Average

no *(use pixel with least error)* → Final Image

Weighted Average → Final Image

Final Image

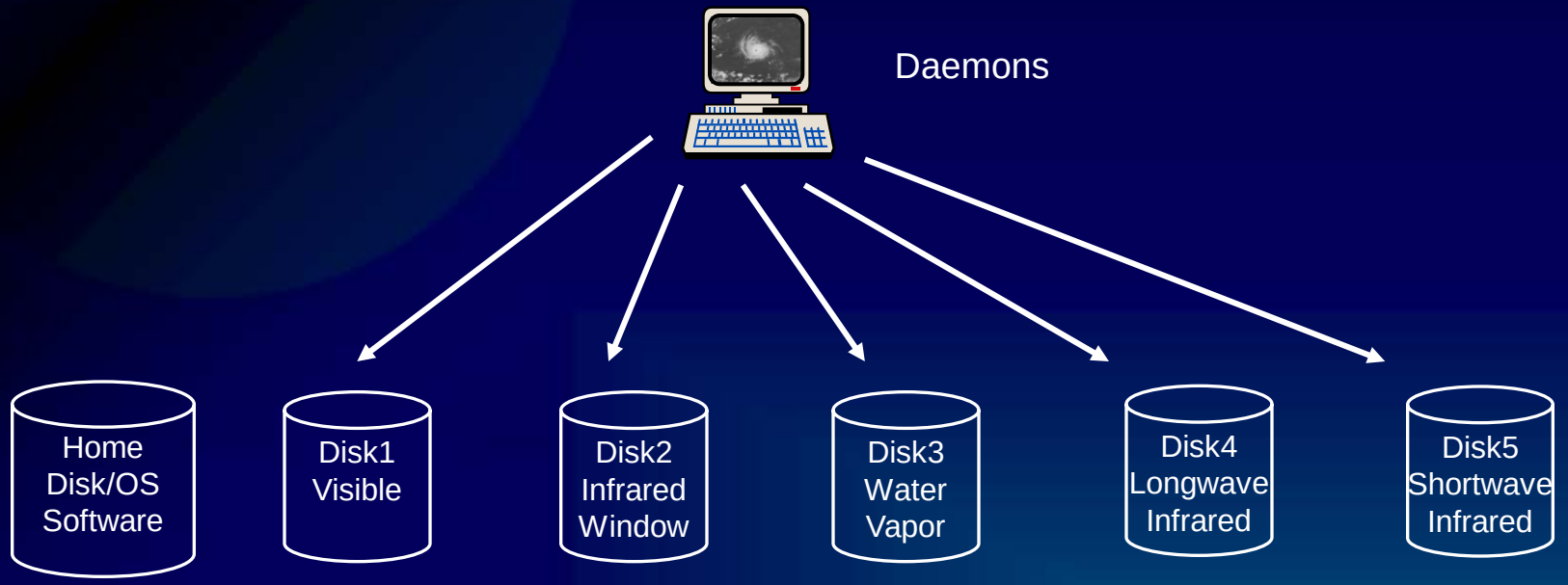
Next Generation System Architecture

Server: Dell PowerEdge R720

CPU: Intel Xeon 2 x 3.3 Ghz, 10 M Cache

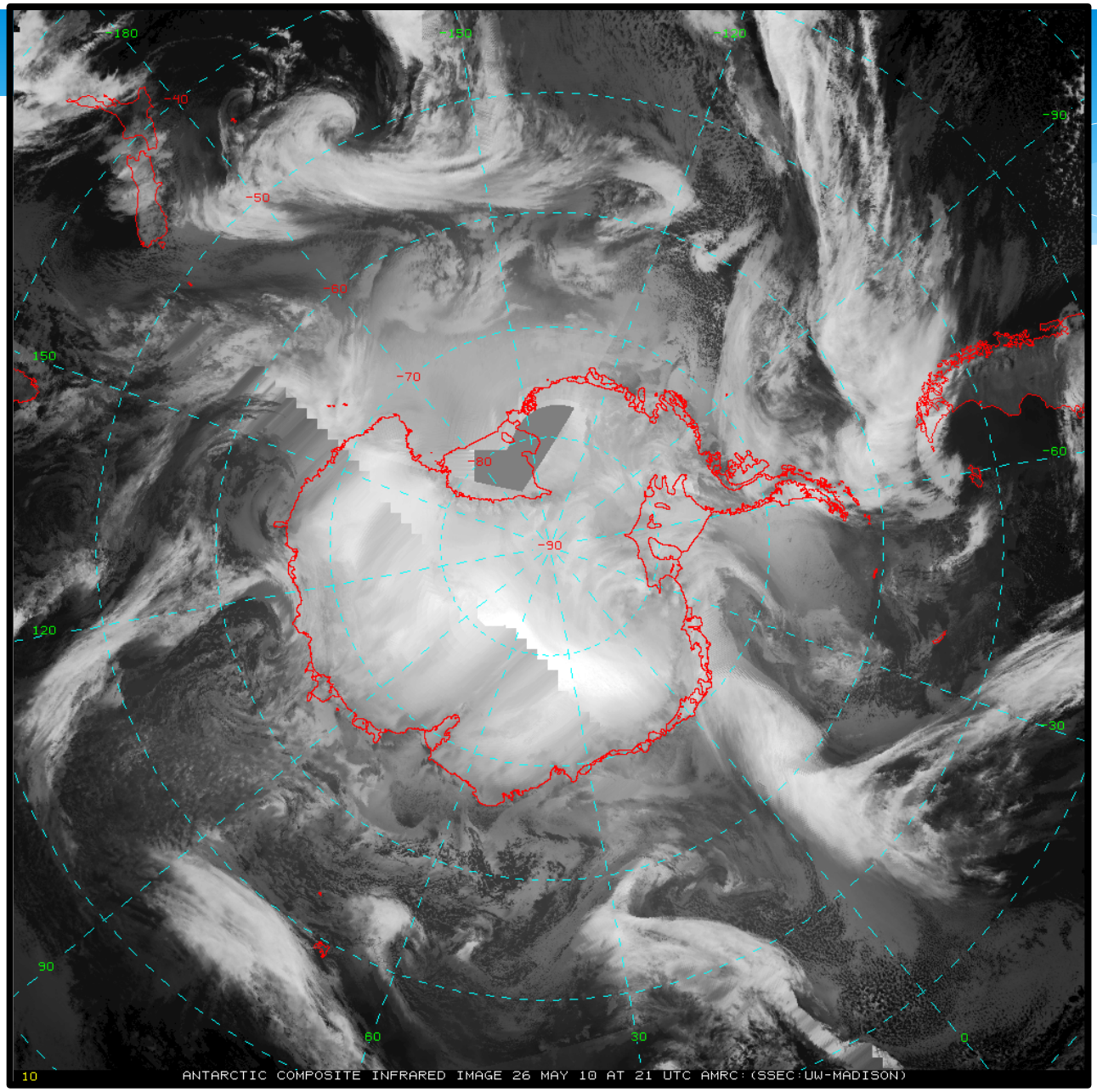
Cores: 16 Total

RAM: 12 x 8GB = 96GB Total



Home:
2 x 600 Gb
RAID1

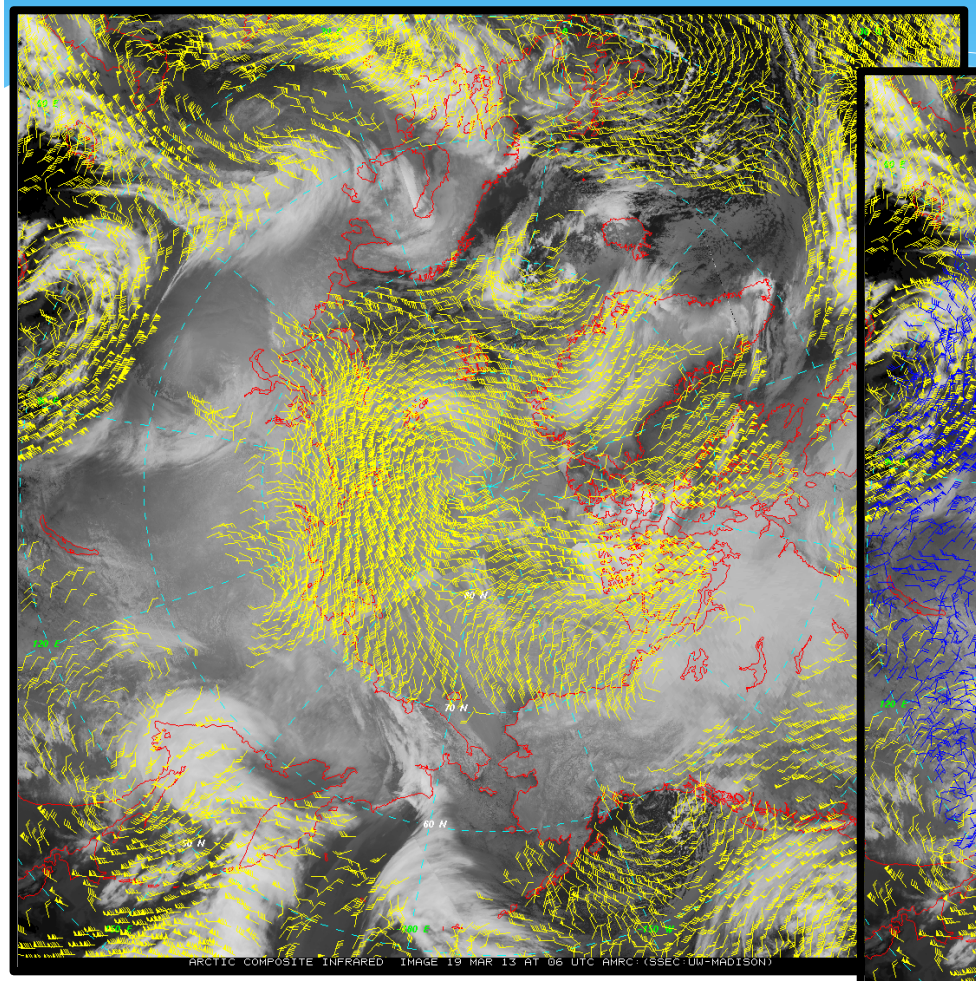
Data Disks:
6 individual 600 Gb disks
No RAID…

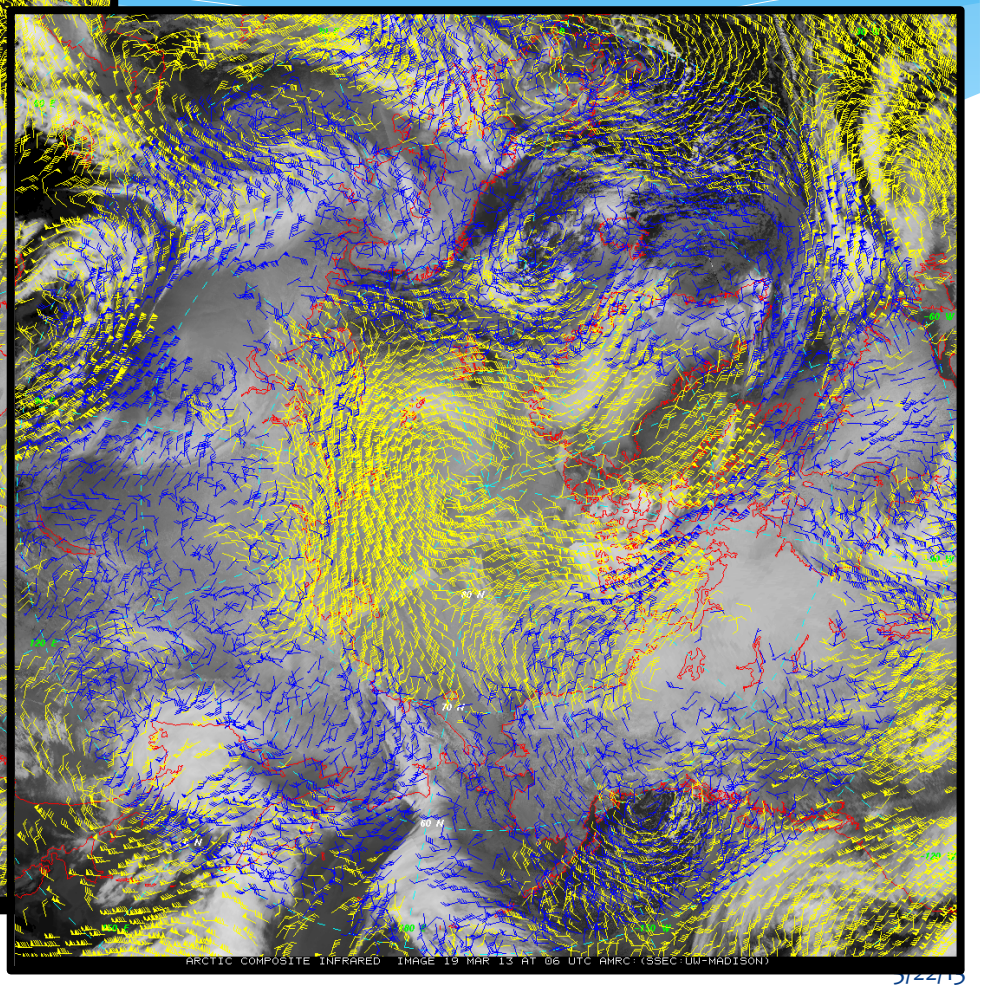

ANTARCTIC COMPOSITE INFRARED IMAGE 26 MAY 10 AT 21 UTC AMRC (SSEC UW-MADISON)

Composite Applications

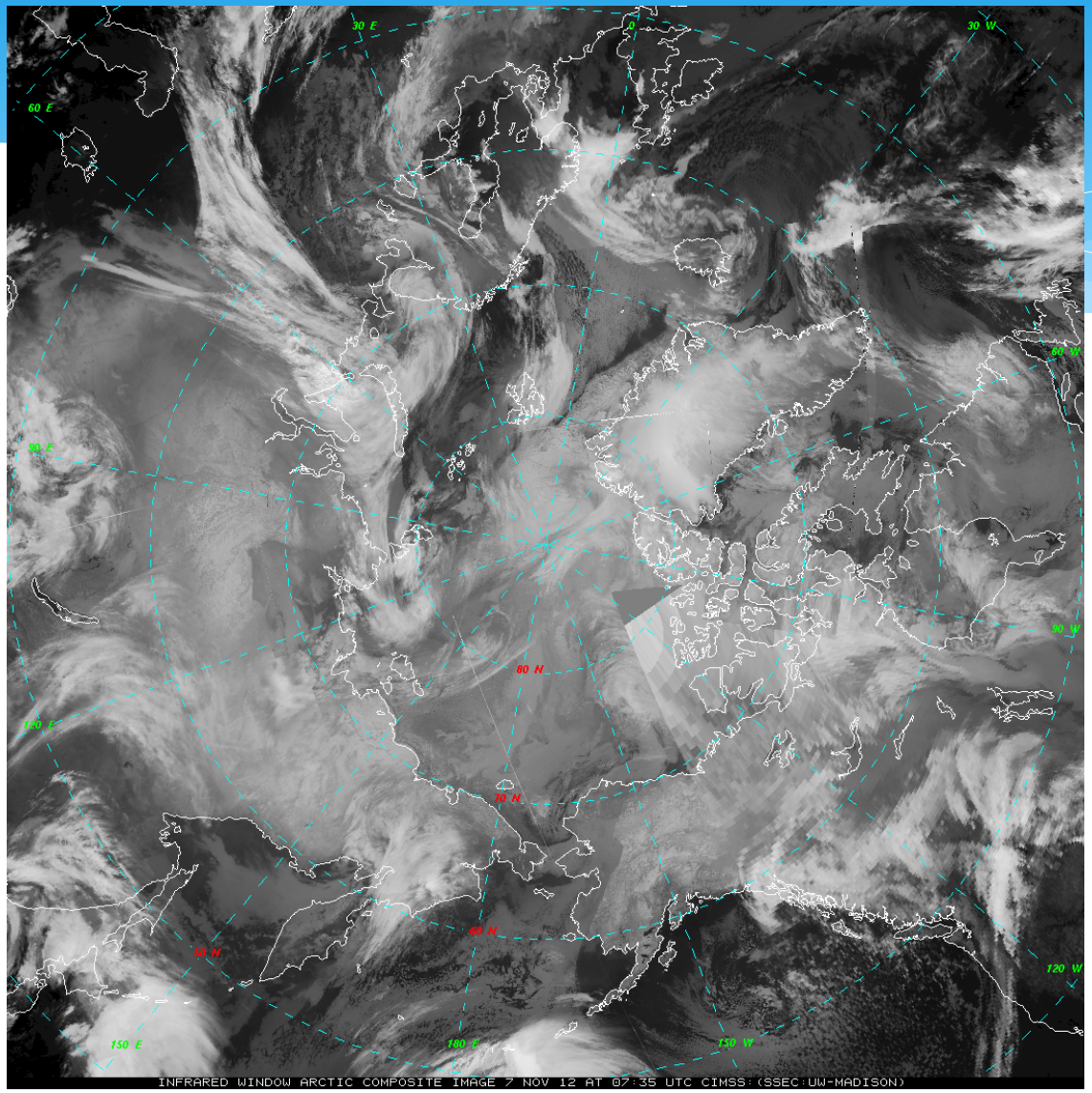
- Synoptic Weather Depiction
  - Projects (e.g. Project FROST Turner et al. 1996)
  - Case studies (e.g. Pedgley, 2005, Nigro et al. 2012)
- Weather Forecasting
  - Emergency – South Pole Rescue (e.g. Monaghan et al., 2003)
  - Routine (e.g. Lazzara et al., 2003, Cayette pers. comms.)
- Education
  - In classroom (e.g. Schlosser per. comms.)
- New Projects:
  - Cloud Mass Transport (i.e. Lazzara, in prep.
  - Atmospheric Motion Vectors - using a special version of the composite (i.e. Lazzara et al., in submission)

Composite Atmospheric Motion Vectors (AMVs)



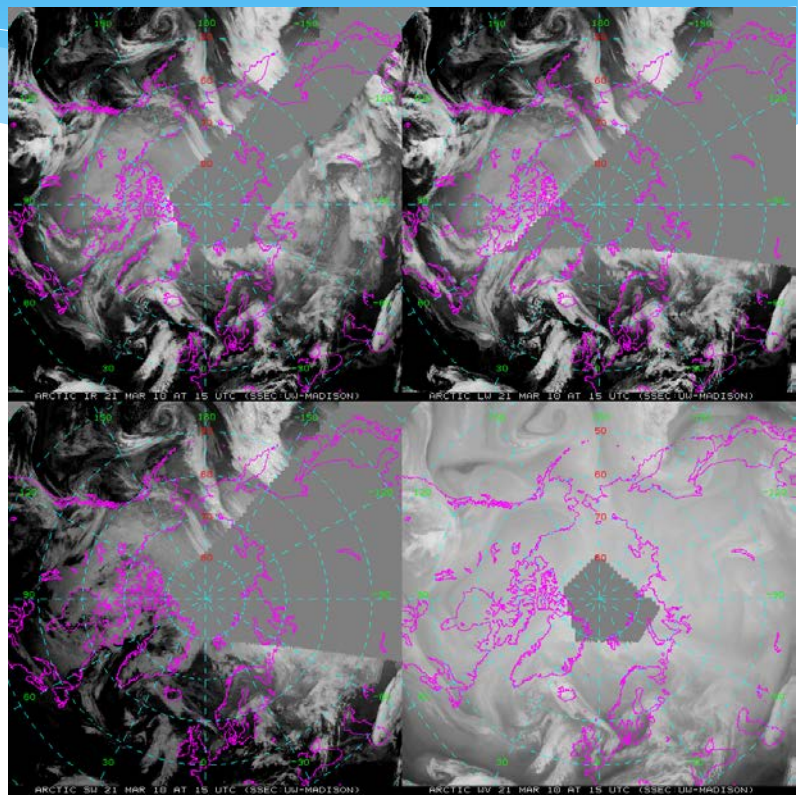


Sample Arctic Infrared Composite

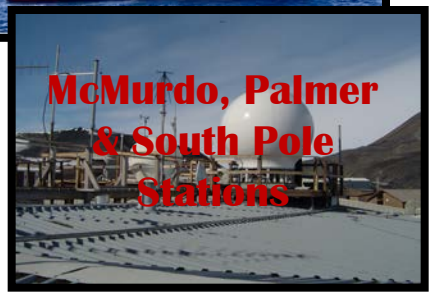


Arctic Satellite Composite

- Tested starting in 2000
- Funded activity by NSF Arctic Natural Sciences 2007 for IPY
- Funded activity by NOAA/NESDIS
  - Transition to NESDIS/OSPO Operations
  - Request by Ocean Prediction Center
  - Additional support by NIC, WPC (formerly HPC), NWS Alaska
- Archive
  - ACADIS project
  - NCDC (coming soon)

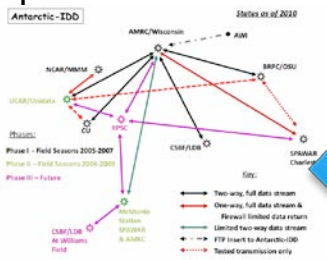


AMRC R&D Data Flow



Source Data

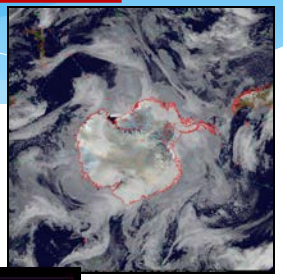
Limited Data Quality Control

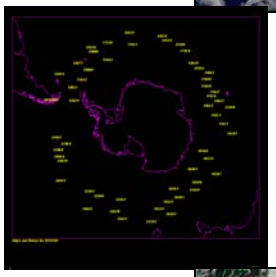


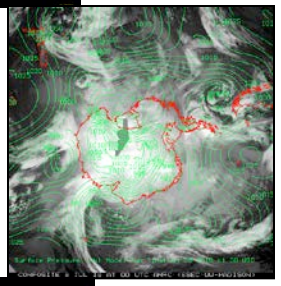
Antarctic-IDD LDM

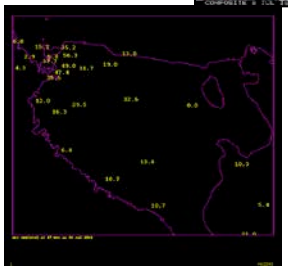
Product Generation

Products/Data:









Real-time & Archive Availability

* Web: http://amrc.ssec.wisc.edu/
* FTP: ftp://aws.ssec.wisc.edu/
* rsync service…
* McIDAS ADDE:
  * Group: AMRC on AMRC.SSEC.WISC.EDU
  * Group: AWS on AWS.SSEC.WISC.EDU
  * Group: ARCHIVE on AWS.SSEC.WISC.EDU
* LDM – Antarctic-Internet Data Distribution
* RAMADDA - http://amrc.ssec.wisc.edu/repository/
  * Repository for Archiving and Managing and Accessing Diverse Data
* Changes due in Summer 2013
  * New amrc.ssec.wisc.edu to be the lead for all of this…

Future Plans

* Antarctic Composites:
  * Upcoming changes due Summer 2013:
    * Create composites rotated with 0 degrees/Grid North-up
    * Re-Create composites 12 to 24 hours later for more complete satellite coverage
      * Currently they are built ~2.5 hours after the hour they are for…
* Arctic Satellite Composites:
  * Are moving to NOAA 2013/2014-ish…
    * Funded project!

The Uncertain Future

- Antarctic Satellite Composites unclear future:
  - NSF science/research support waning
    - AMRC is NSF grant funded based on science…
    - NSF operations/logistics may express interest/support?
  - Other possible outcomes:
    - DoD/SPAWAR/SOPP may express interest in support…
    - NOAA may express interest….
    - ?
- IMAPP and CSPP:
  - The R&D demonstration funding runs out in a year or so
- NSF USAP DB system:
  - USAP logistics spilt between Continental US and in the Antarctic
    - Debate: Use store & forward ***or*** Use direct broadcast?
- Dismantling of what is demonstrated here is a possibility…

Thank you!

Thanks to Jeff Key, Nick Bearson, Rick Kohrs, & SSEC Unix Admin for their support and patience!

The authors appreciate the support of the National Science Foundation, Directorate for Geosciences, Division of Polar Programs, grant numbers, ANT-1141908, ARC-0713483 and NOAA/NESDIS grant NA10NES4400013.