The MISR NRT CMV product: MISR cloud motion vectors within 3 hour latency

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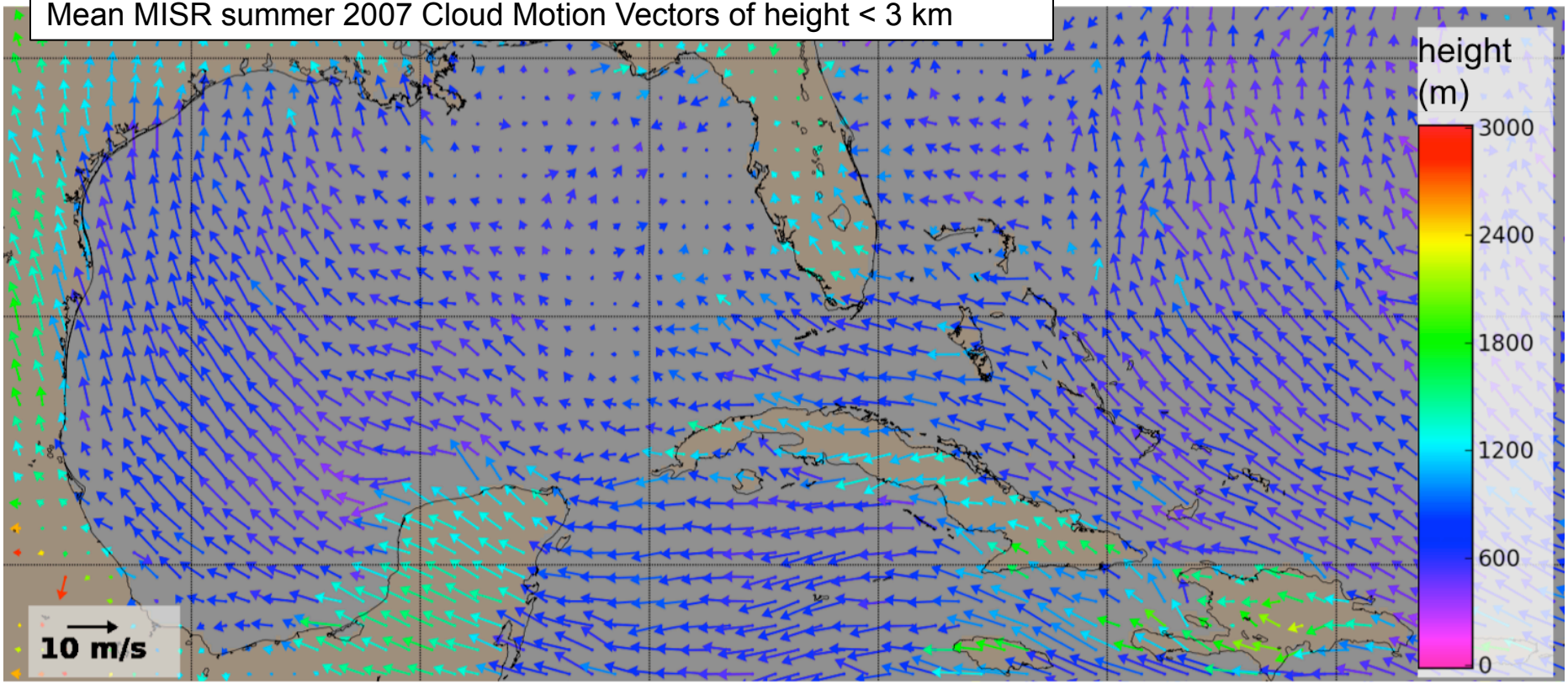
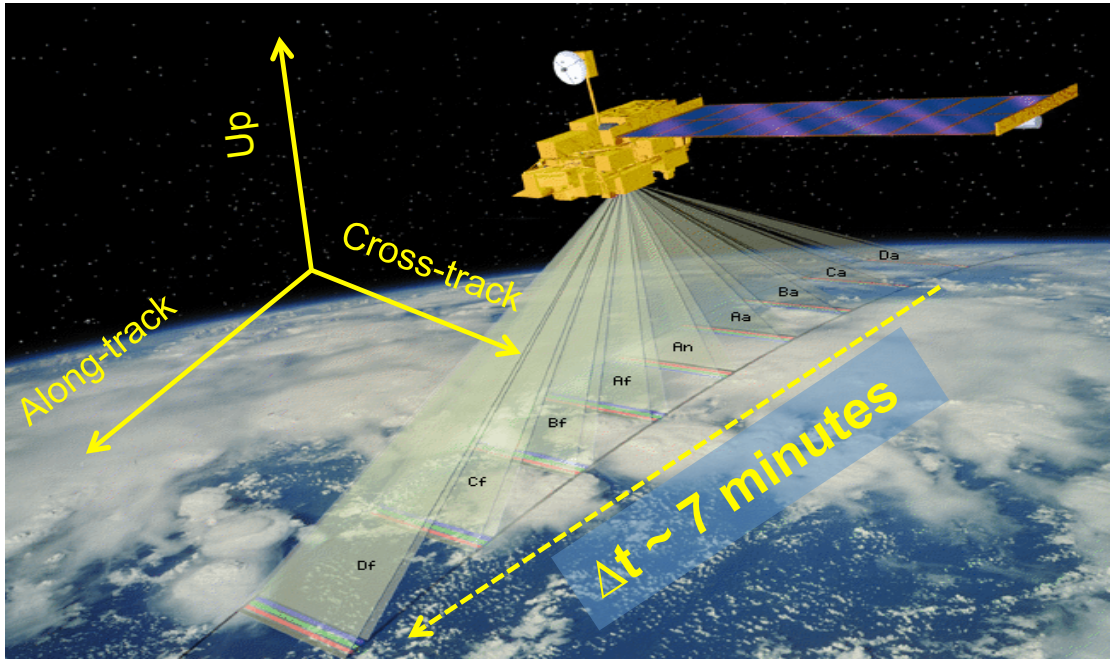
Mean MISR summer 2007 Cloud Motion Vectors of height < 3 km

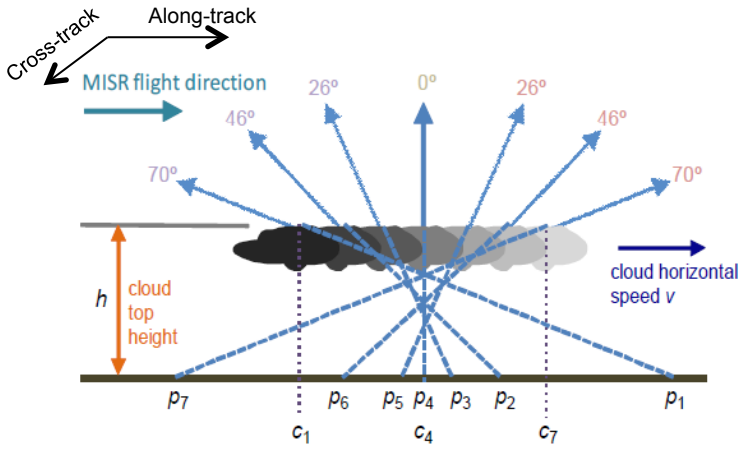


Multi-Angle Imaging SpectroRadiometer (MISR) Wind Products

MISR instrument

- **Mission Lifetime**
  - **1999 -> 2018+**
- Swath Width ~ 380 km
- 9 Camera View Angles
  - 0º (Nadir)
  - ±26.1º, ± 45.6º
  - ±60.0º, ± 70.5º
  - 7 minute overpass
- B, G, R, & NIR Bands
- Spatial Resolution
  - **275 m for Nadir and Red Band**
  - 1100 m all else





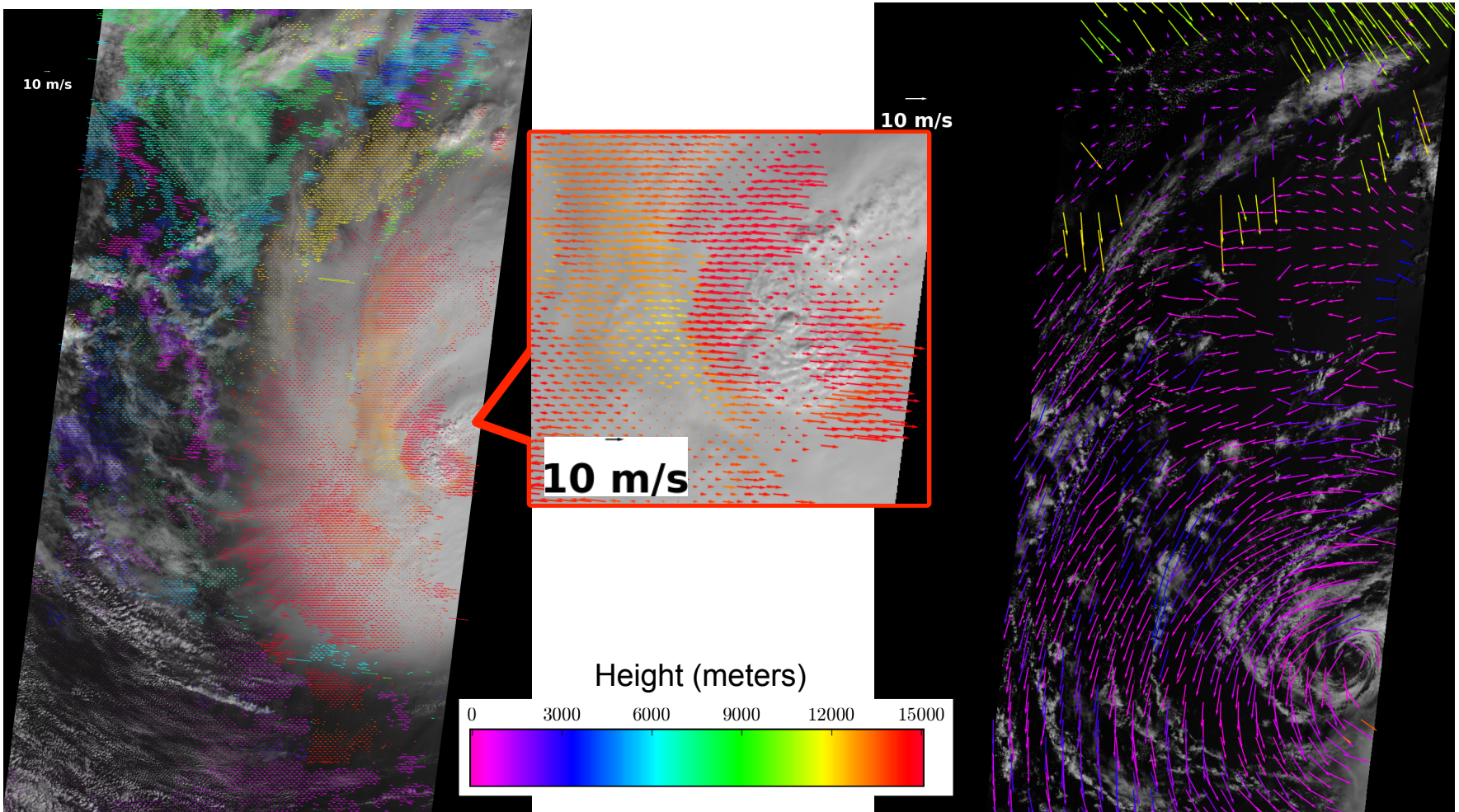
MISR Wind Products

- Height-resolved Cloud Motion Vectors (CMV)
  - **Geometric height obtained from parallax**
  - Retrieved from redundant forward and aft camera triplets
  - Time interval **Δt = 200 seconds**
  - Gridded resolution **Δx = 17.6 km**
- Height-resolved cross-track cloud motions:
  - **Geometric height obtained from parallax**
  - Retrieved from redundant forward and aft camera pairs
  - Time interval **Δt = 46 seconds**
  - Gridded resolution **Δx = 1.1 km**

Example MISR Wind Product Retrievals

Height resolved cross-track cloud motion (1.1 km resolution) *(Hurricane Ida)*

Height resolved cloud motion vectors (17.6 km resolution) *(Hurricane Francis)*

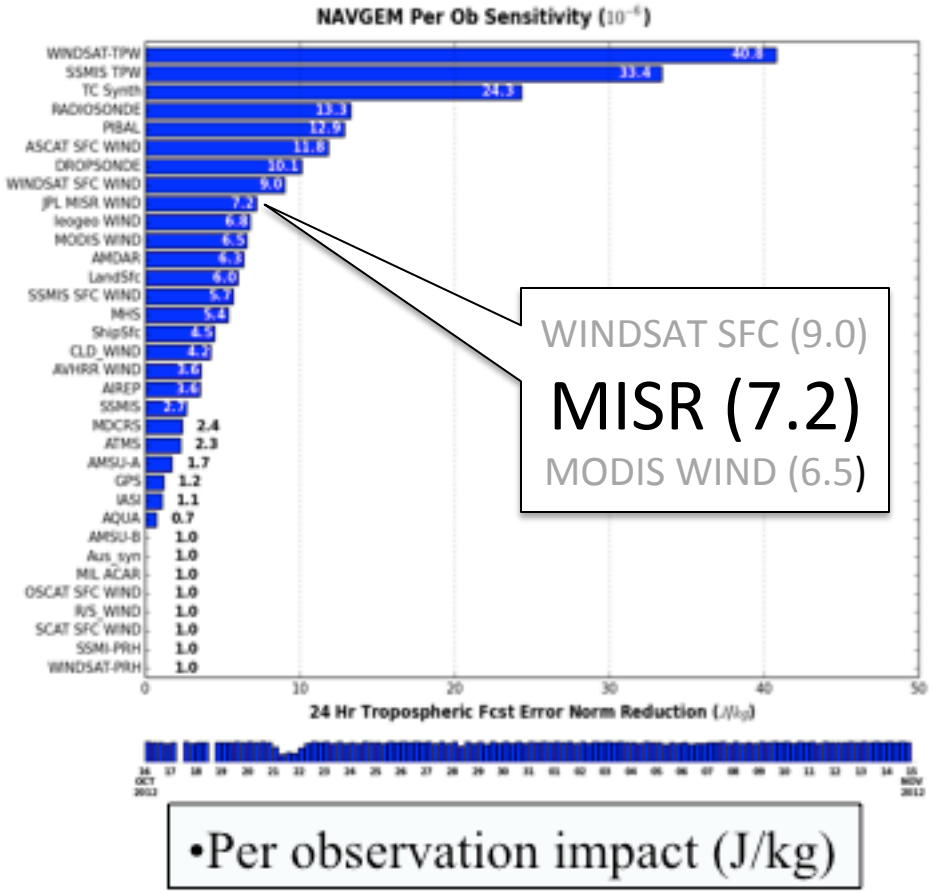


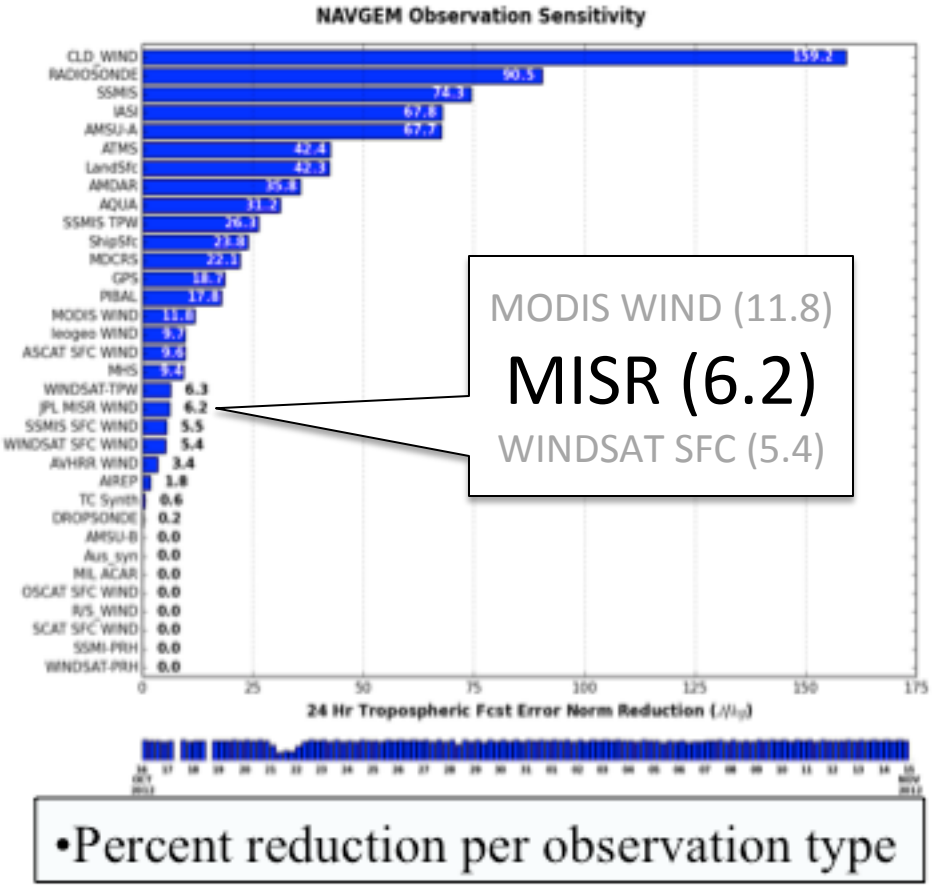
Revisiting IWW-11 NWP WG Recommendations

Recommendation	Progress
"NWP centres to evaluate MISR winds in offline assimilation tests"	• Naval Research Lab (NRL) obtained significant positive forecast impact with study continuing. Study led by N. Baker • Japan Meteorological Agency (JMA) obtained mixed, but overall positive forecast impact. Study led by K. Yamashita • German Weather Service (DWD) obtained mixed, but mostly positive forecast impact. Study led by A. Cress. • JPL study under way with support from NASA Global Modeling and Assimilation Office (GMAO) using GEOS-5 DAS
"JPL to provide MISR winds with improved latency (~5hr)"	• Near Real Time (NRT) MISR wind product to enter production by **August 2014** • *Currently in final end-to-end testing at NASA Langley Research Center* • MISR NRT wind product to have well **under 3 hour latency**
"Agencies to provide data in BUFR format"	• MISR NRT wind product will be offered in BUFR and HDF-EOS4 format

NRL obtains good overall forecast impact

- NRL conclusion: Good overall impact from MISR winds
  - Low level MISR winds appear to fill data gap
- *details in poster…*





•Per observation impact (J/kg)

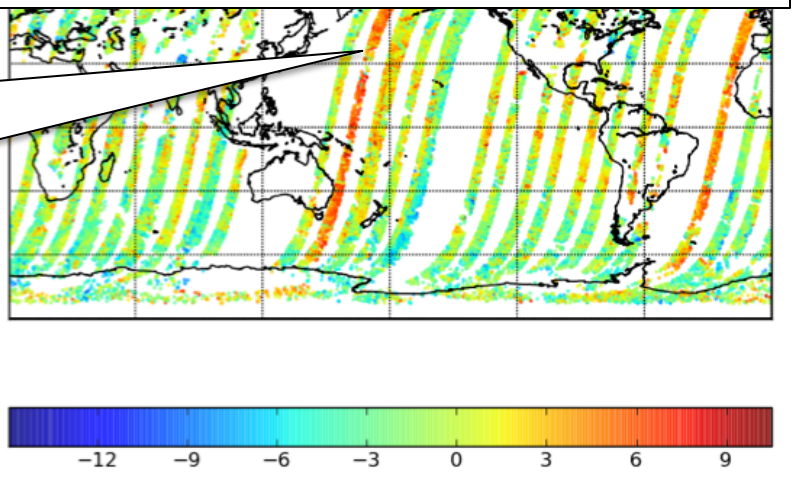
•Percent reduction per observation type

NRL expecting improved impact with fine-tuning

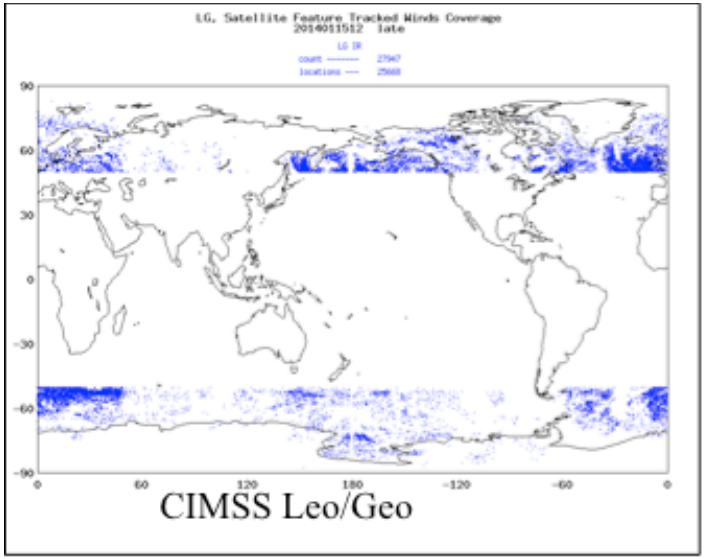
- NRL opportunities to improve MISR impact
  - Revisit quality control and assimilation procedures
  - Make use of MISR QI along with observation
  - Find optimum observation density
  - Screen per retrieval and per orbit to identify MISR orbits with suspect georegistration

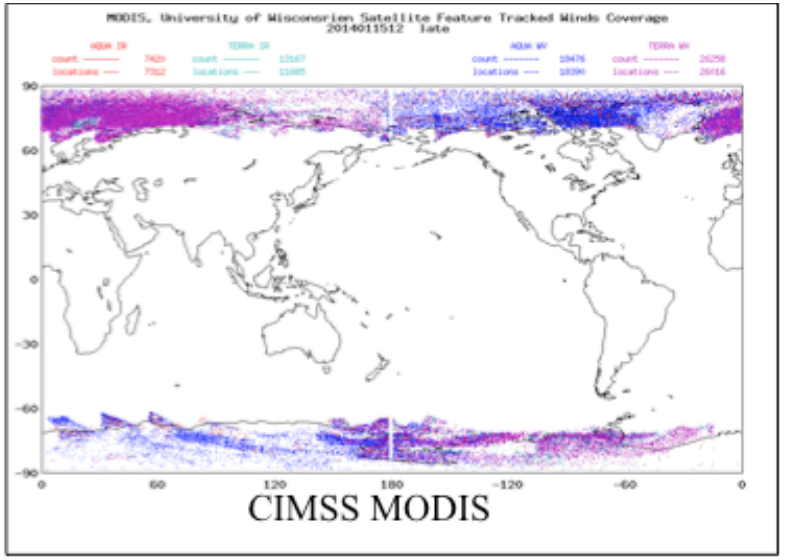
Screening observations per orbit as well as per retrieval will benefit MISR impact

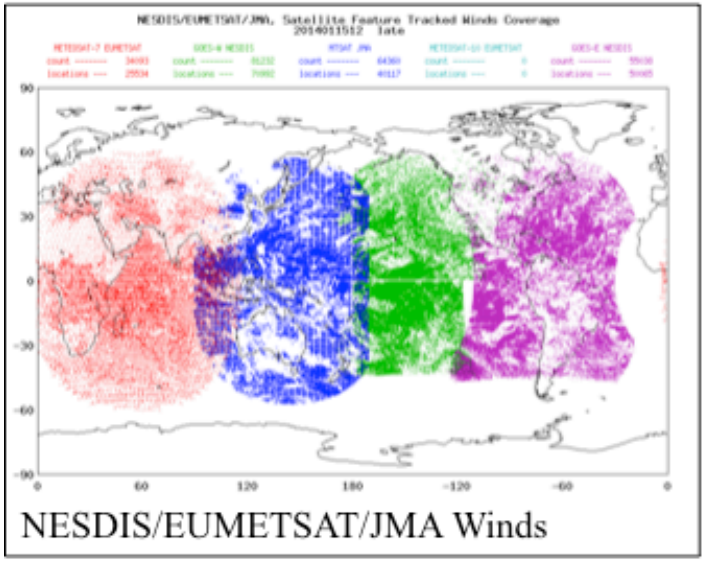
MISR v-wind innovation

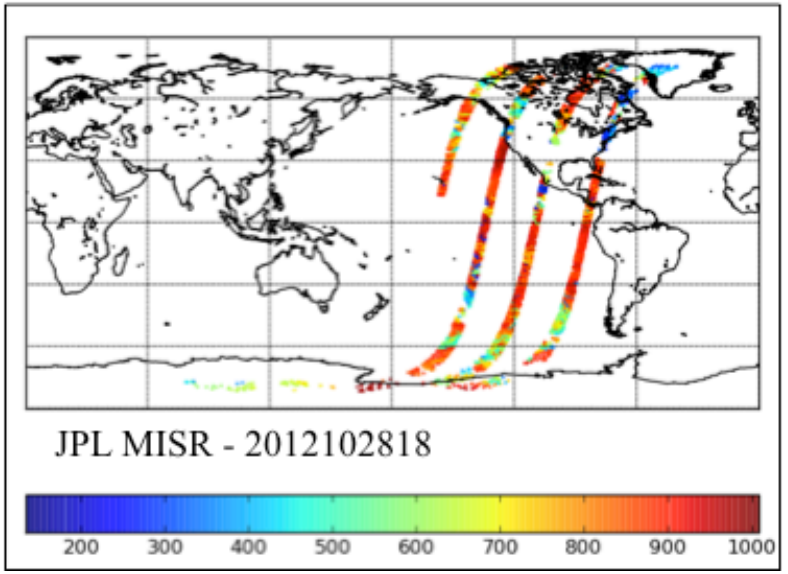


MISR horizontal coverage is pole-to-pole, potentially filling observational data gaps







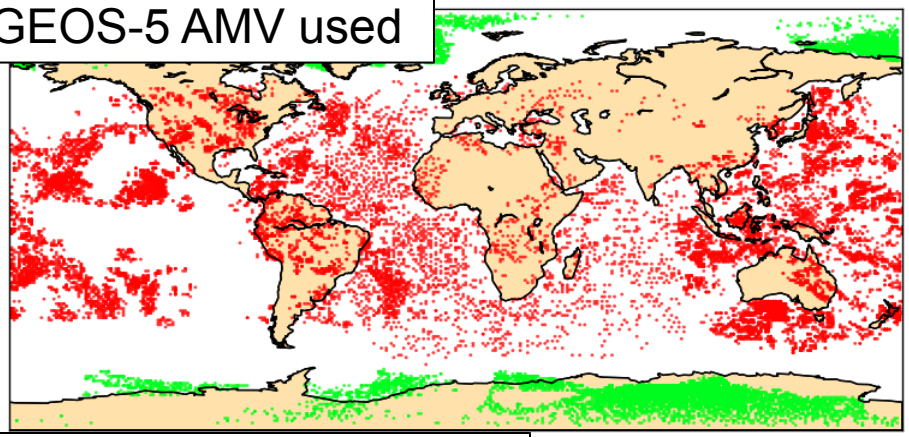


Figures courtesy N. Baker

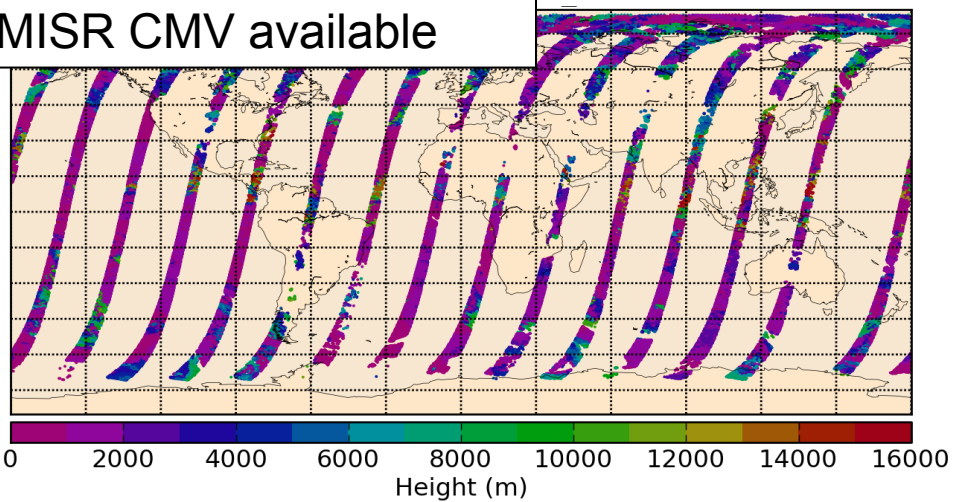
MISR has potential niche in excellent boundary layer sampling

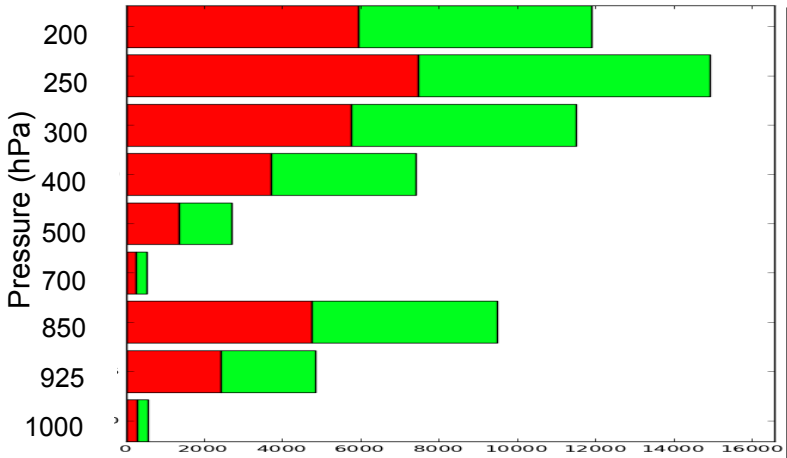
- Quantity of MISR CMV at low level comparable to quantity currently assimilated by GEOS-5 DAS
- MISR produces winds in GOES view where winds from GOES ought to have been assimilated but were not
- *Above:* Atmospheric Motion Vectors assimilated in GEOS-5 DAS at 00Z, August 20, 2010
  - *Green*: polar orbiting instruments
  - *Red*: geostationary instruments
- *Below:* MISR Cloud Motion Vectors available that day

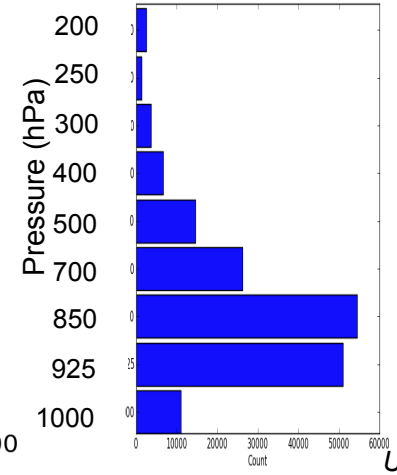
GEOS-5 AMV used



MISR CMV available







Motion vectors per pressure level

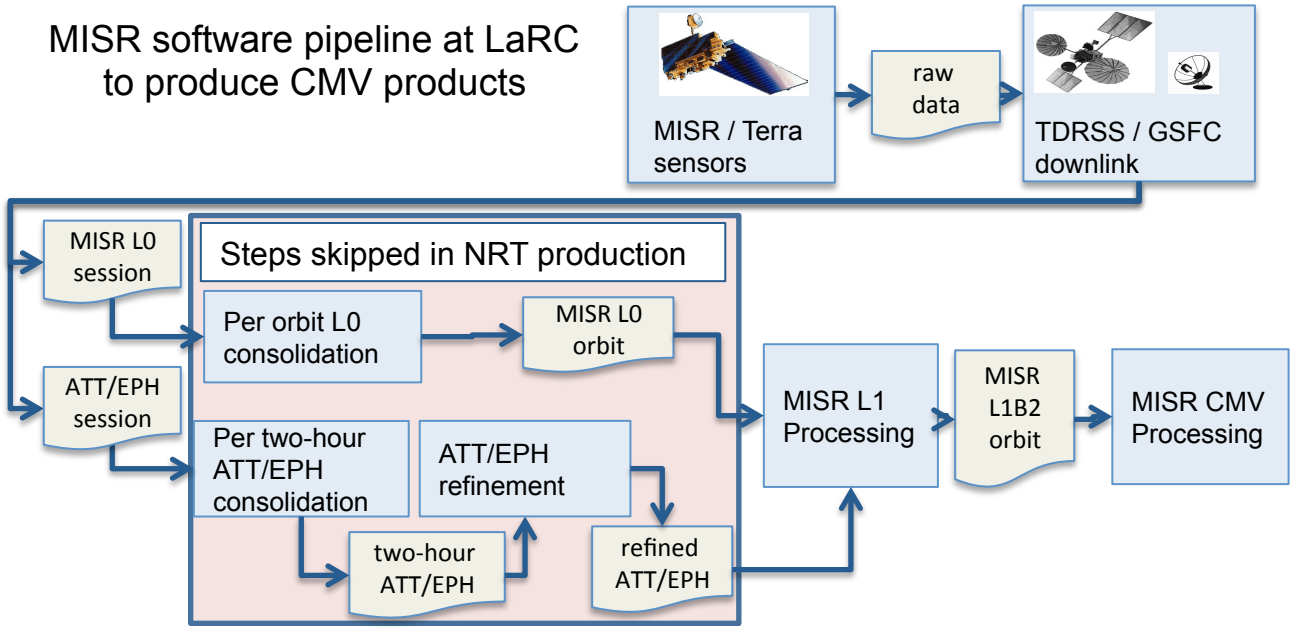
Upper figures from Merkova & Gelaro

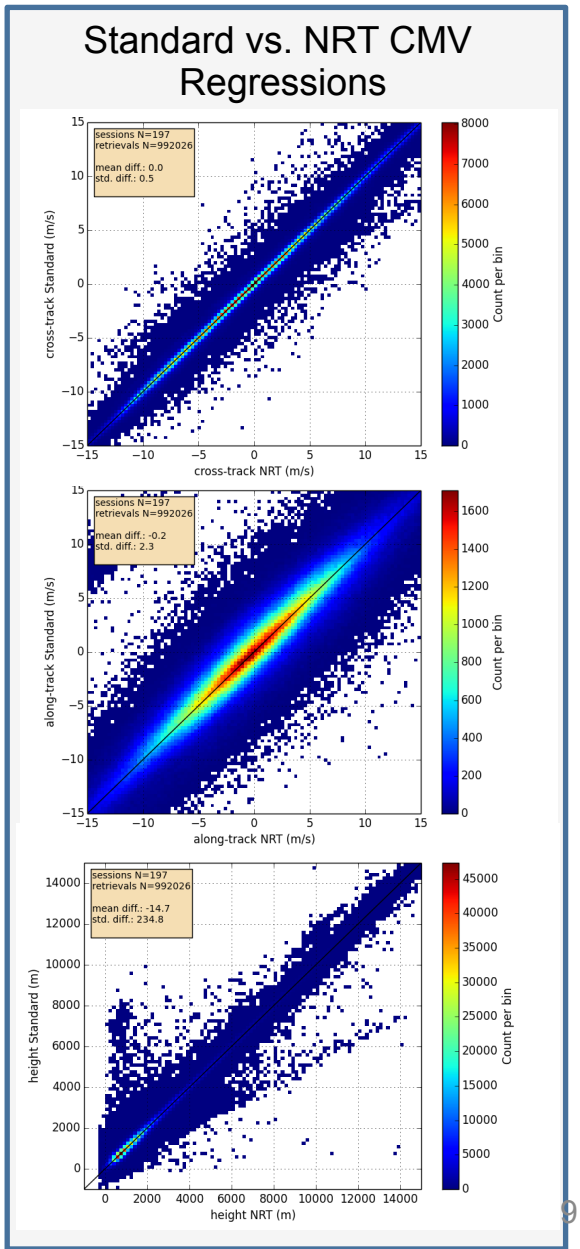
Upcoming NRT MISR CMV leverages existing heritage

NRT MISR CMV

- **Planned release by August 2014**
  - In end-to-end testing at Langley Research Center
- **NRT MISR CMV functionally equivalent to CMV produced in standard production**
  - Std. Deviation between them is σ=0.5 ms^{-1} cross-track wind, 2.3 ms^{-1} along-track wind, 235 m height
  - Same algorithms; minor differences in upstream L1 workflow
  - Takes advantage of well understood heritage
    - Horvath, 2013; Mueller et al., 2013; Lonitz & Horvath, 2011; Hinkelman et al., 2009; … Horvath & Davies, 2001
- **Latency: 90% data in 2.5 h**
- Available in BUFR and HDF-EOS4 format

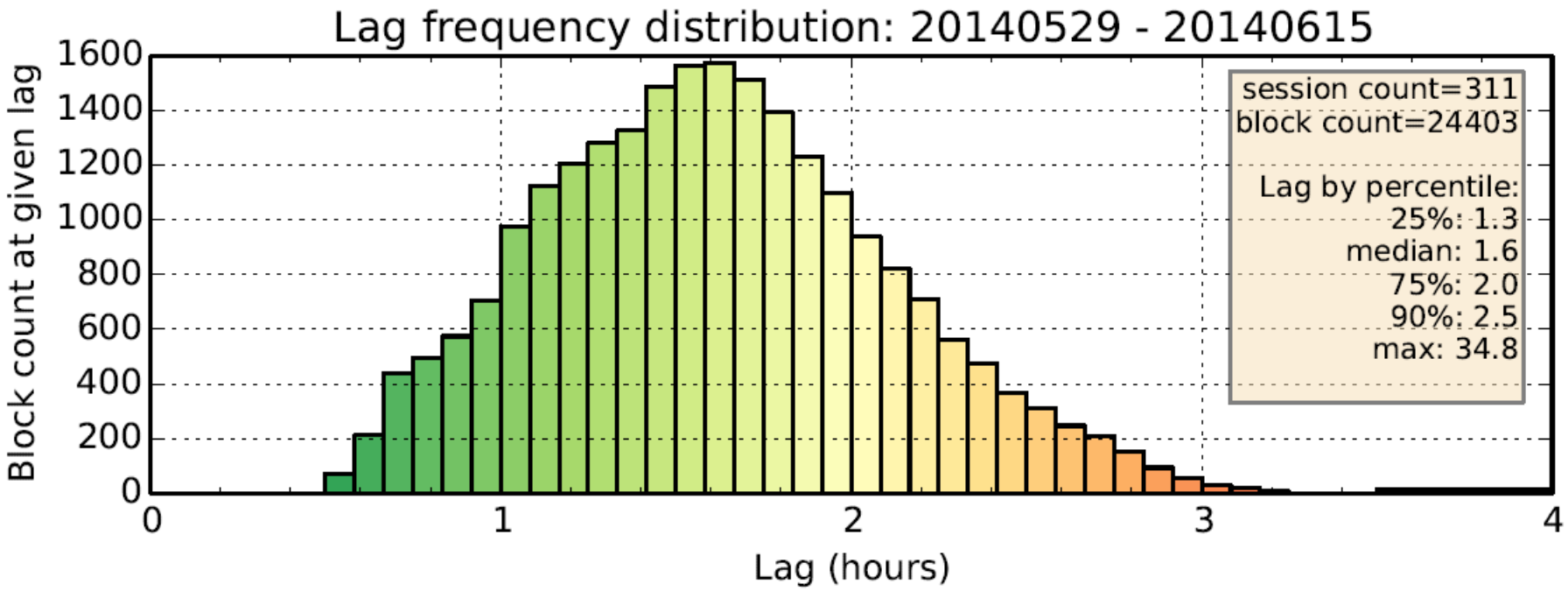
MISR software pipeline at LaRC to produce CMV products





90% of MISR NRT CMV data within 2.5 h

Figure below shows lag between observation and product availability



Summary of Status Update

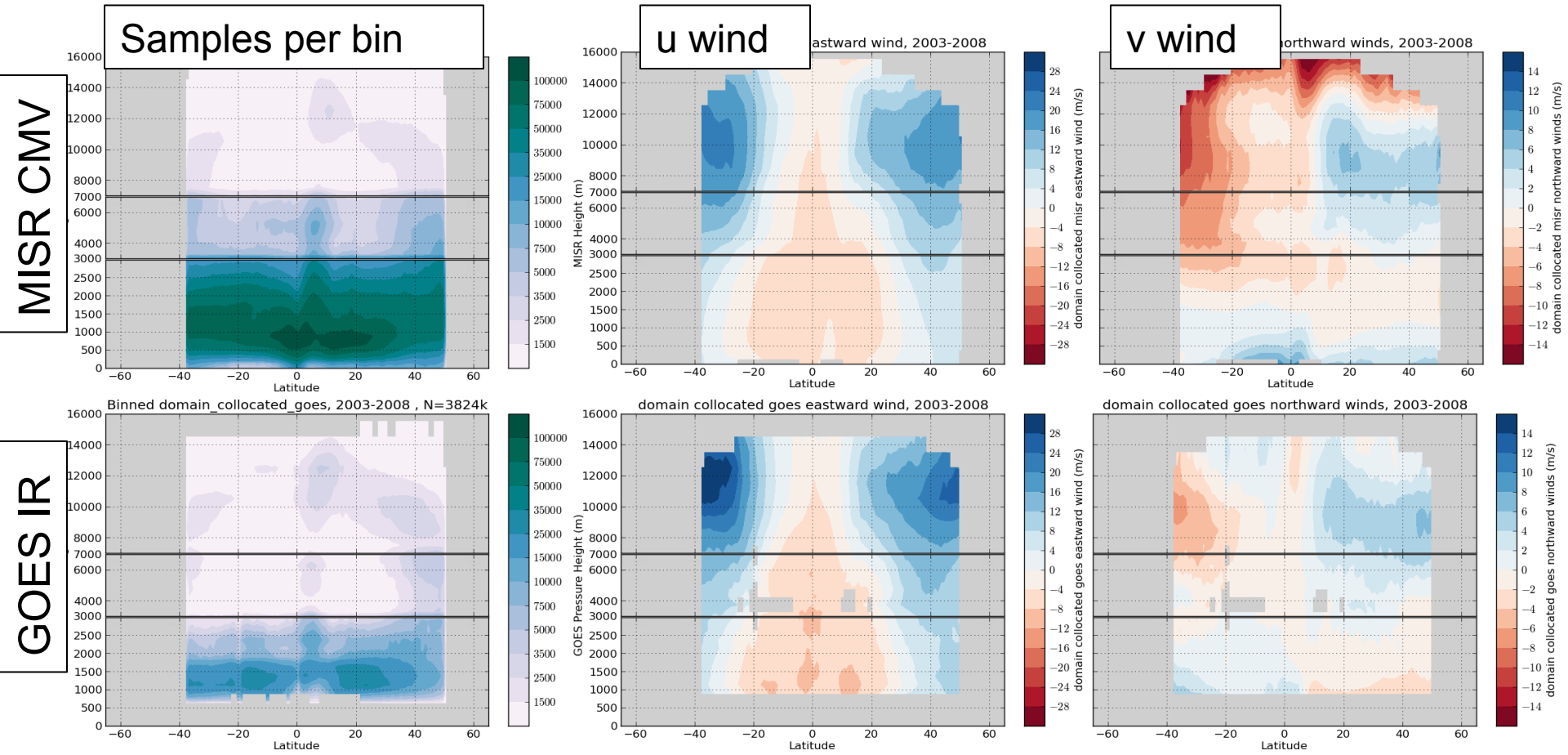
- The MISR NRT Winds product will be in production by August 2014
  - Will be functionally equivalent to monthly MISR CMV product
  - 90 % of MISR CMV data offered within 2.5 hours
  - Accuracy will be roughly comparable to MISR CMV product
- NRL has obtained positive forecast impact from MISR winds
  - Studies continue
  - Thought to be benefitting from MISR low level winds
- Additional investigations under way
  - NRL, DWD, JMA, JPL are investigating MISR winds

What further steps might the MISR team take to move forward?

- Complete production of NRT MISR winds
- Push NRT MISR winds via GTS distribution
- Assess possible weak QI correlation with true wind quality?

Low level MISR winds have more dense and consistent coverage than coincident GOES IR

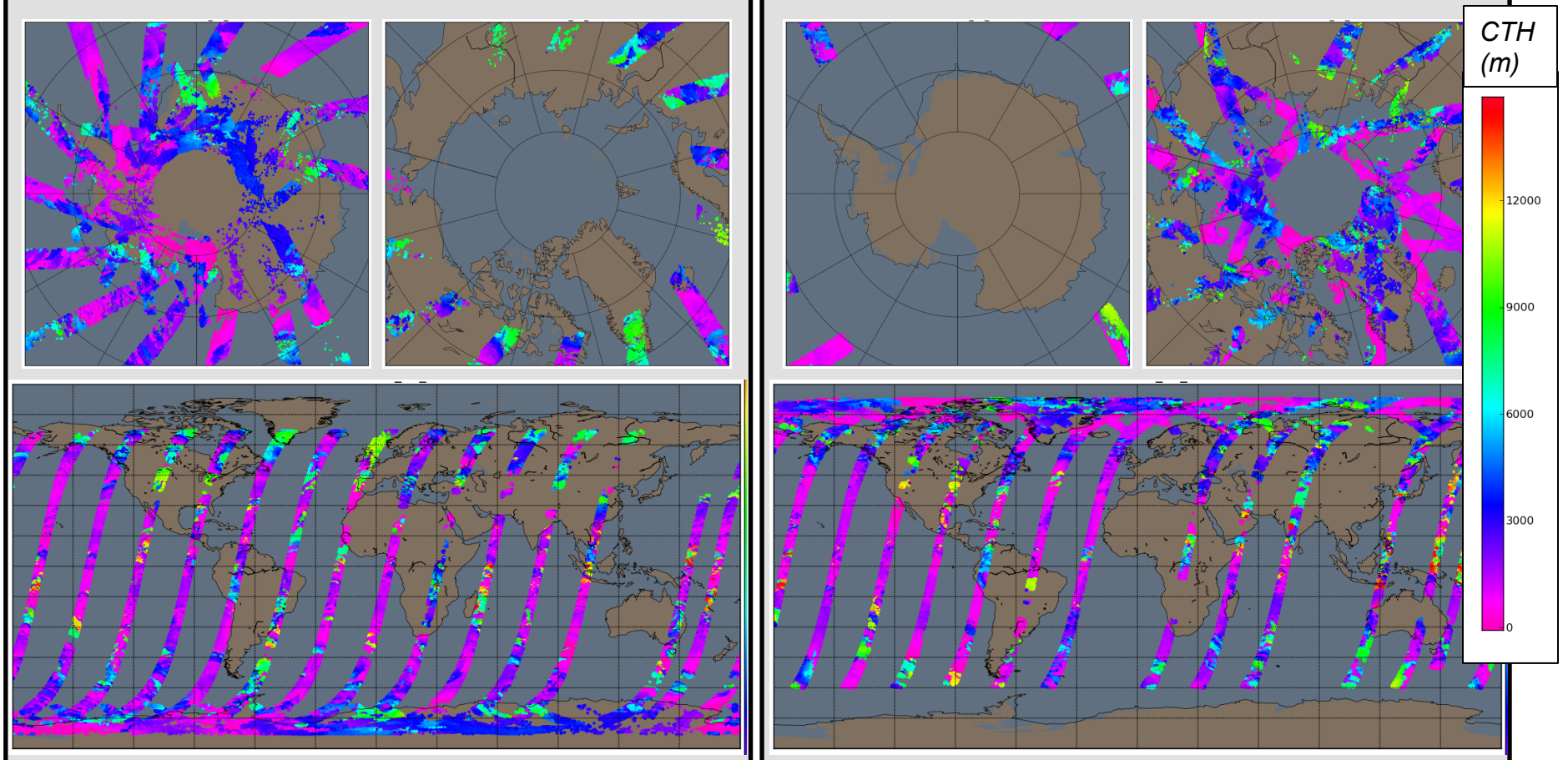
- MISR winds coverage relative to GOES IR observations captured within MISR swath at same time and projected into same coordinate grid (2003-2008)
  - Below 3 km, MISR coverage 4-fold that of GOES
  - MISR has stronger tendency to track low level clouds
  - MISR may be losing sampling of high speed winds, indicated by a weaker mean jet



Daily pole-to-pole MISR winds coverage

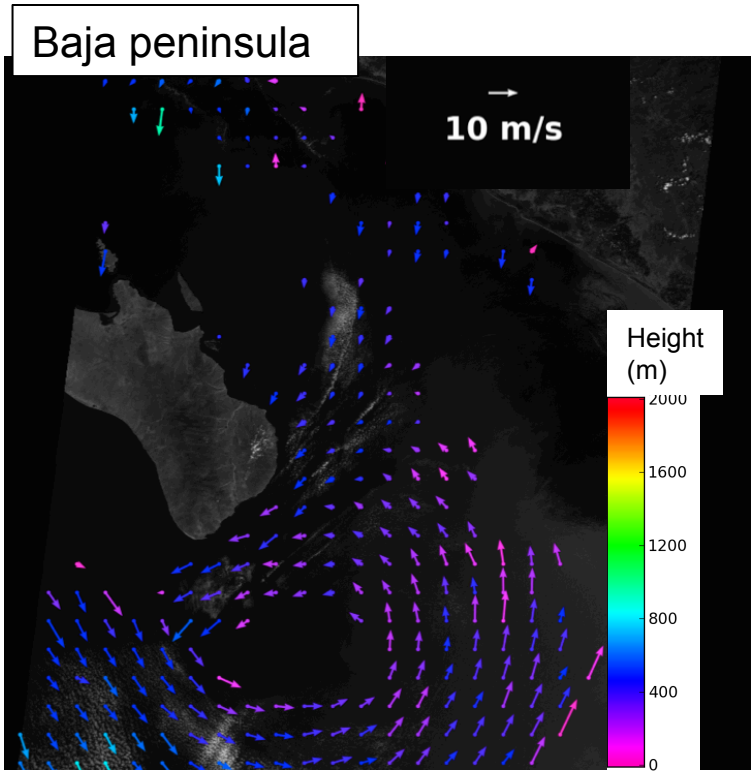
January 1, 2007
Antarctic coverage ~ twice a day
Tropical coverage ~ once per 9 days

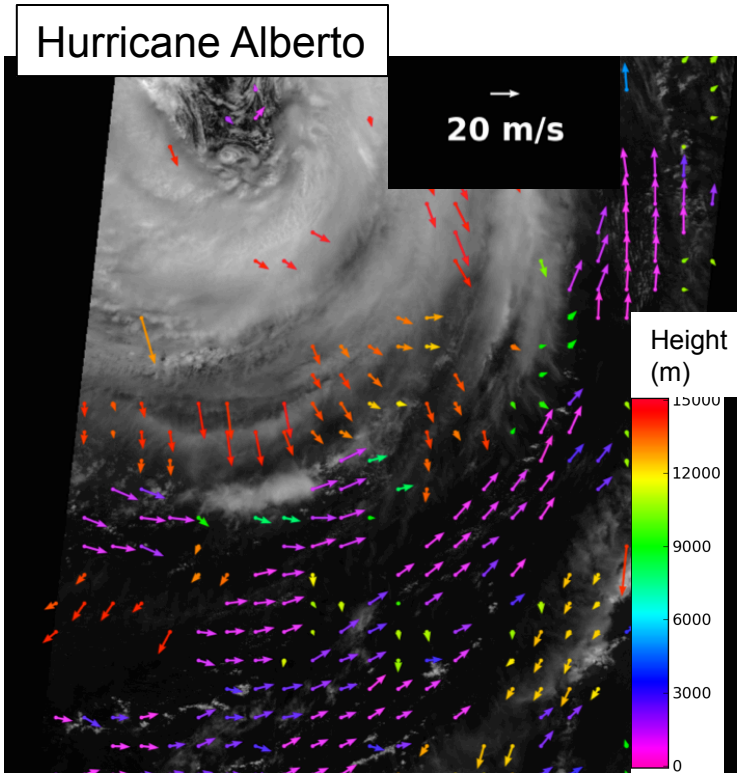
July 1, 2007
Arctic coverage ~ twice a day
Tropical coverage ~ once per 9 days



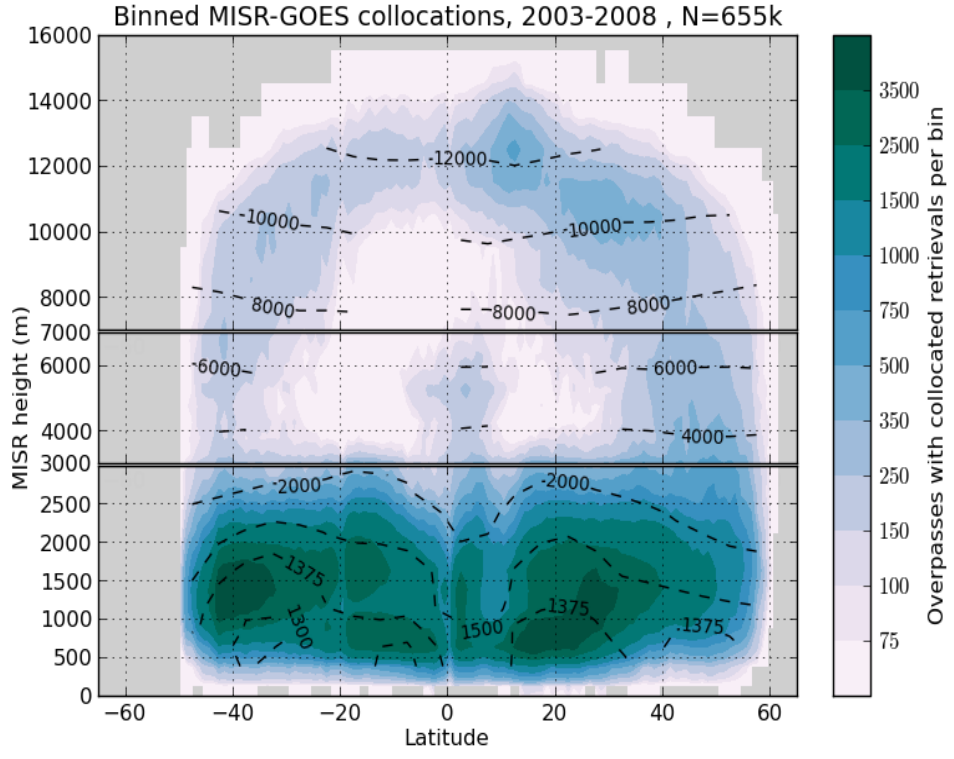
MISR Cloud Motion Vectors (CMV) characteristics

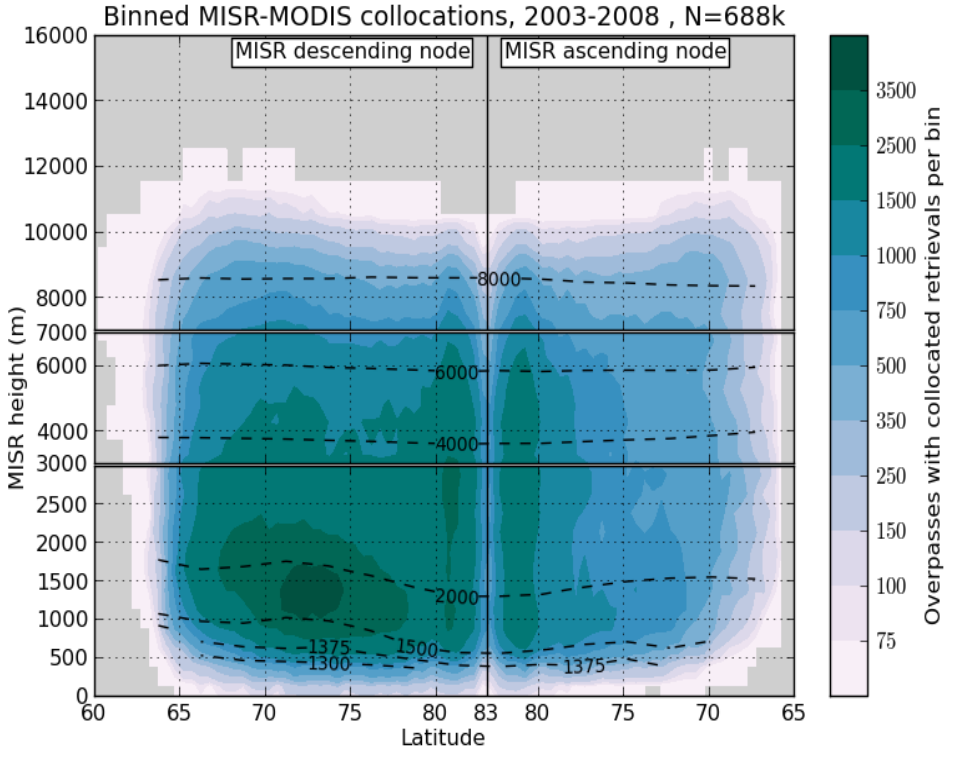
- Capture rapidly evolving scenes (eye of hurricane)
- Capture subtle small scale changes in cloud heights
- Handles multi-layer scenes





This slide is a placeholder for results I don't want to present, but want at the ready





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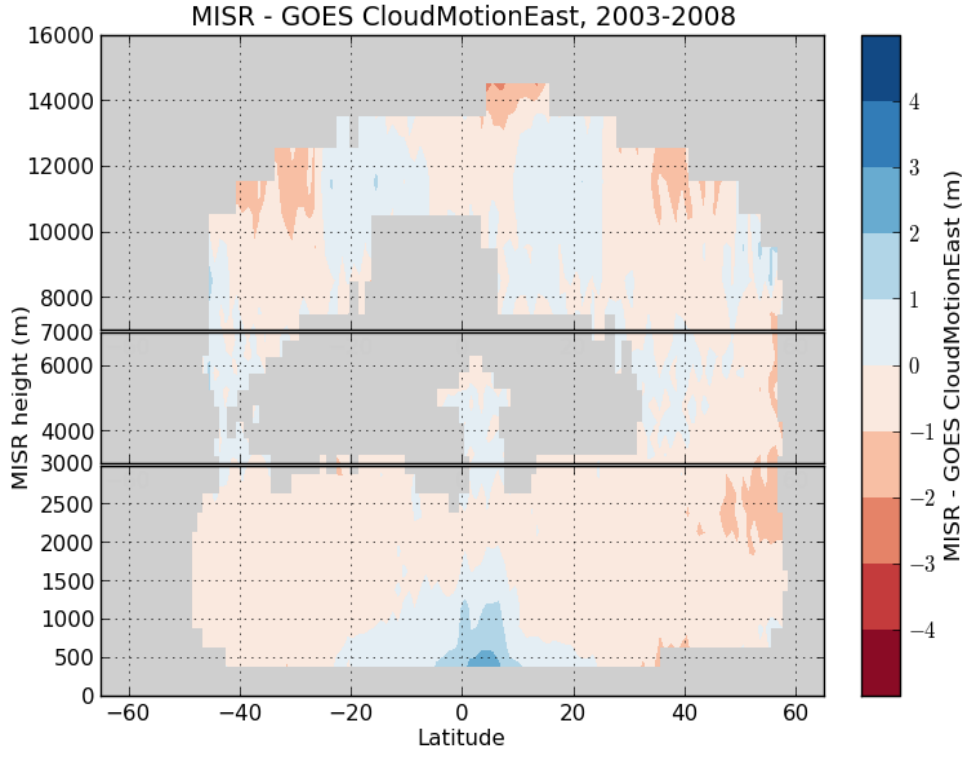

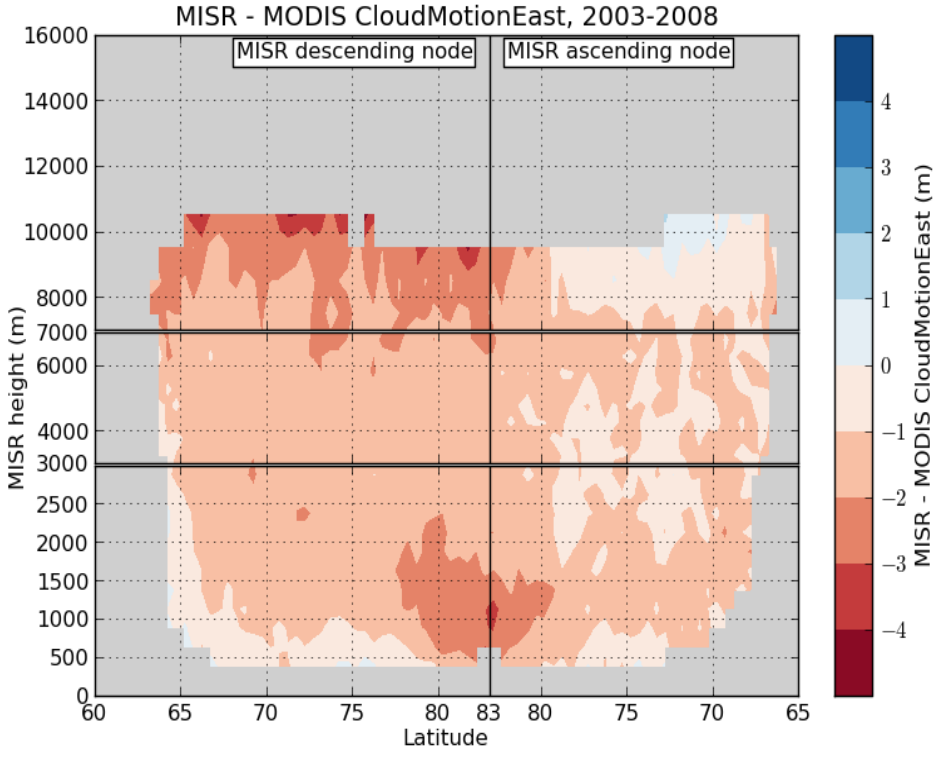

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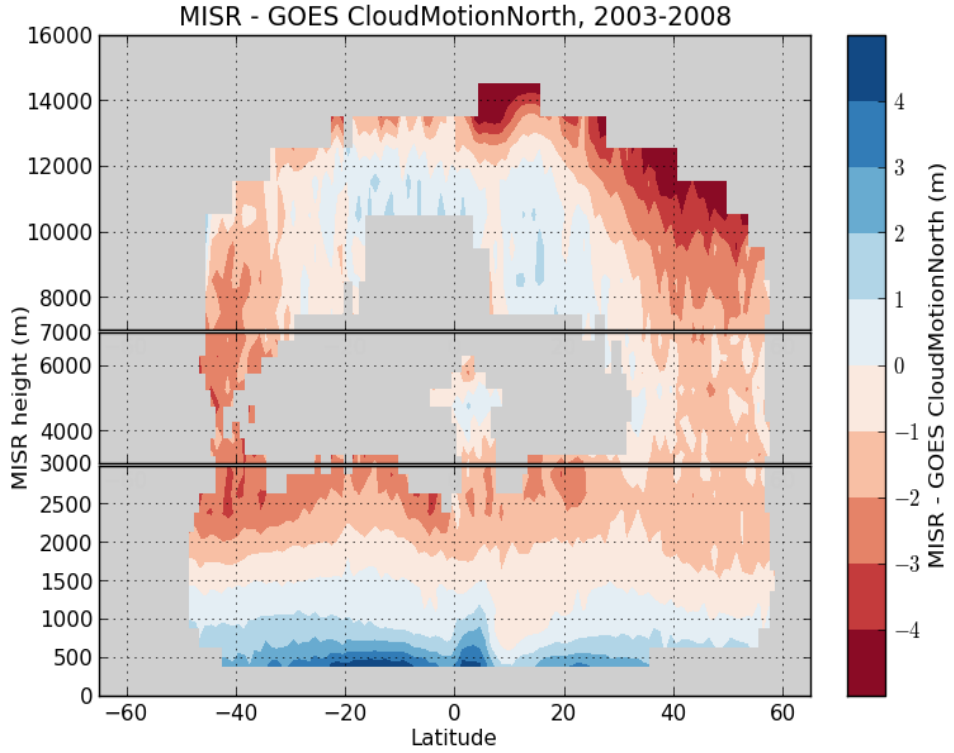

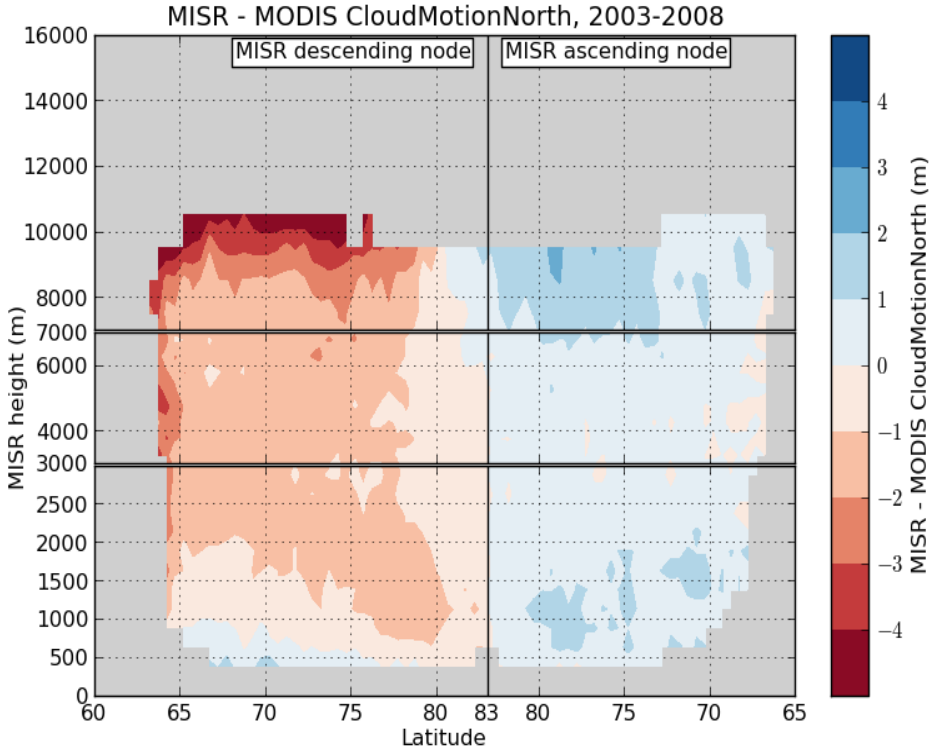

This slide is a placeholder for results I don't want to present, but want at the ready

- Objective
  - Assess how WindQA diagnostics have performed throughout mission
    - Relevant to ongoing assessment of NRT diagnostics
  - Provide context for 2013 increased frequency of L0 flagged orbits
- Technical Details
  - Block range limited to 41-140 to lessen seasonal effects
  - Raw
    - Orbits that do not have L1 "QA" flag set
    - Retrievals with comparable forward and aft values
      - Height of wind difference < 2500 m
      - Wind vector difference < 15 m/s
  - Final
    - Orbits that do not have L2 "QA Winds" flag set
    - Retrievals with QualityIndicator > 50
  - Time series statistics show monthly mean and monthly standard deviation of per orbit mean forward-aft differences
  - Per SOM path statistics show per path mission (2001-2013) mean and standard deviation of per orbit mean forward-aft differences
  - At first I limited the analysis to low clouds only, but including all wind heights did not appear to affect statistics
- Results
  - Global georegistration precision appears to maintain "final" forward-aft variance < 2 m/s and 200 m
  - Per path georegistration precision appears to maintain "final" forward-aft variance < 3 m/s
    - Particular paths with worse precision than 3 m/s
      - Off United States west coast
      - Over Panama Canal
      - Over Tibet
  - Loss of L0 sampling in 2013
    - More significant L0 flagging than any time after 2004
    - Not coincident with any apparent loss of quality in raw or final winds (need to look at sampling, though)
  - Shift in steady state of forward-aft height differences
    - Steady state height difference 2002-2008 is 0 m
    - Steady state height difference 2009-2013 is -100 m
    - Shift is also somewhat apparent in forward-aft along-track differences
    - The change coincides with an incident at end of 2008 causing spike in flagging of orbits by L2
- Future work
  - Better assessment of sampling removed by forward-aft checks.
  - Identify specific problematic SOM paths, and characterize as simple text data enabling users to handle per-path quality variability (in e.g. assimilation schemes)
  - Put this information into TC_CLOUD Quality Statement

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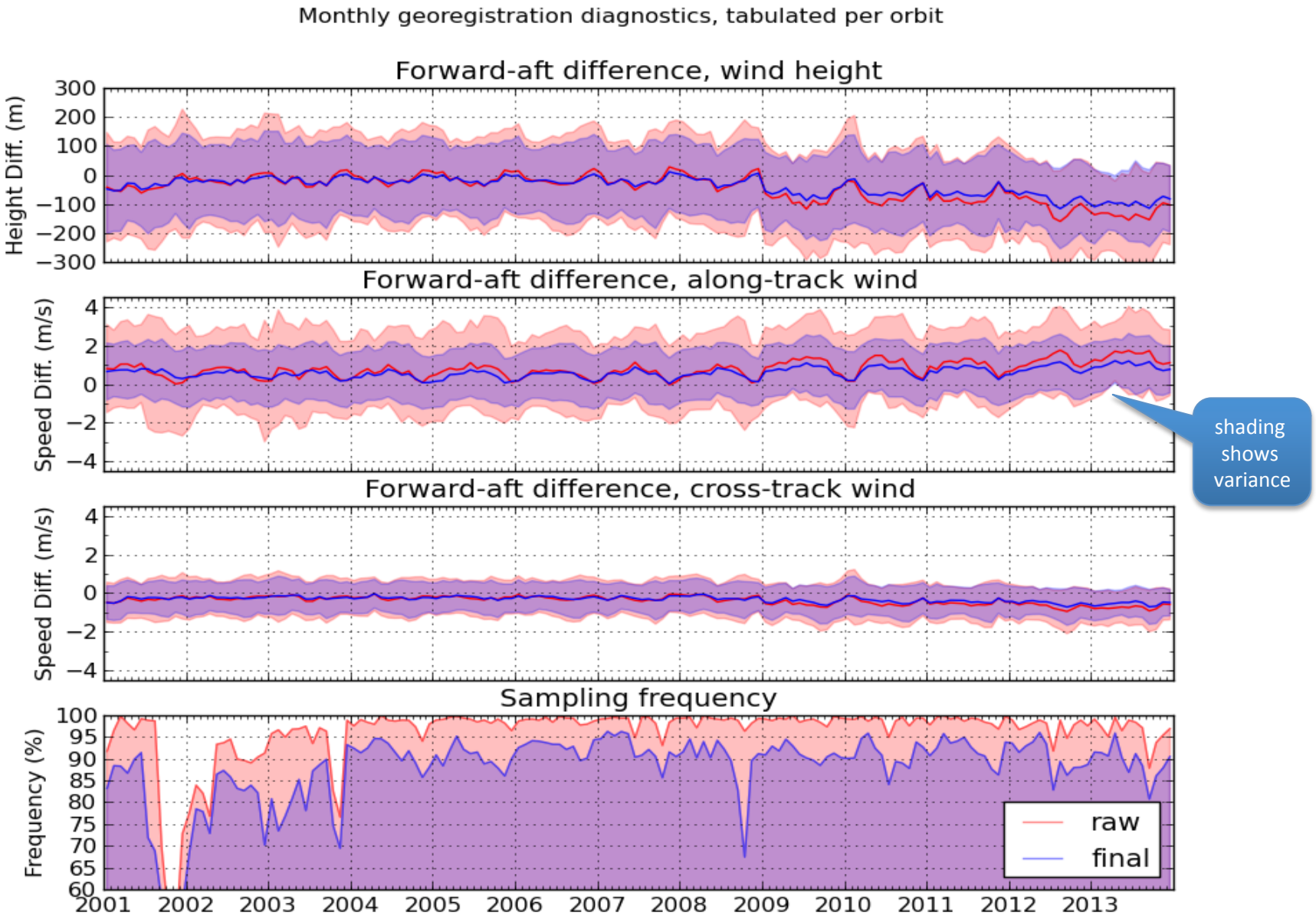

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