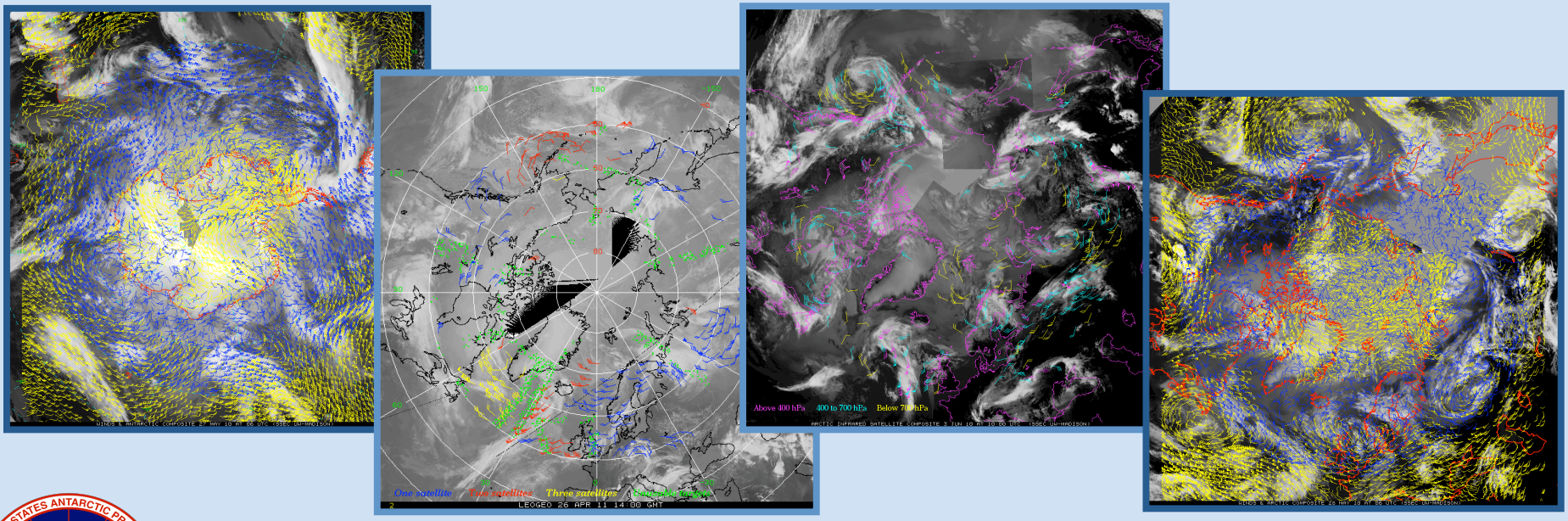
Polar Satellite Composite Atmospheric Motion Vectors



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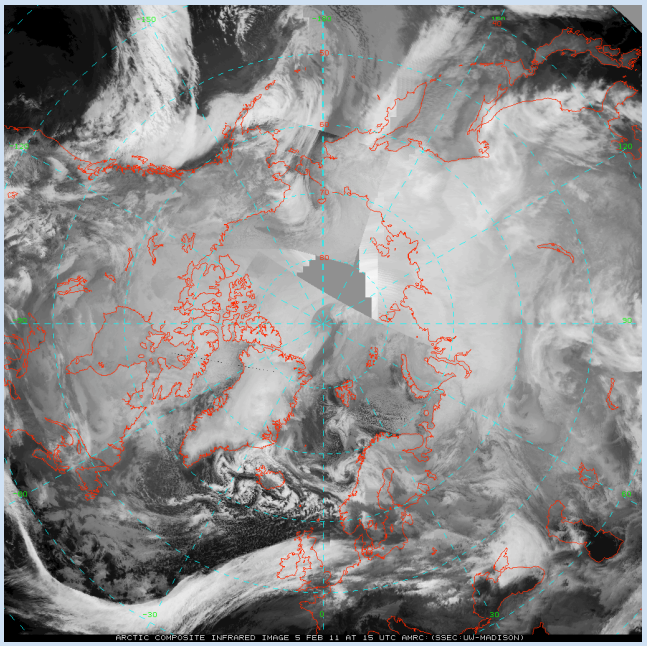
University of Wisconsin-Madison

[3]NOAA/NESDIS/STAR

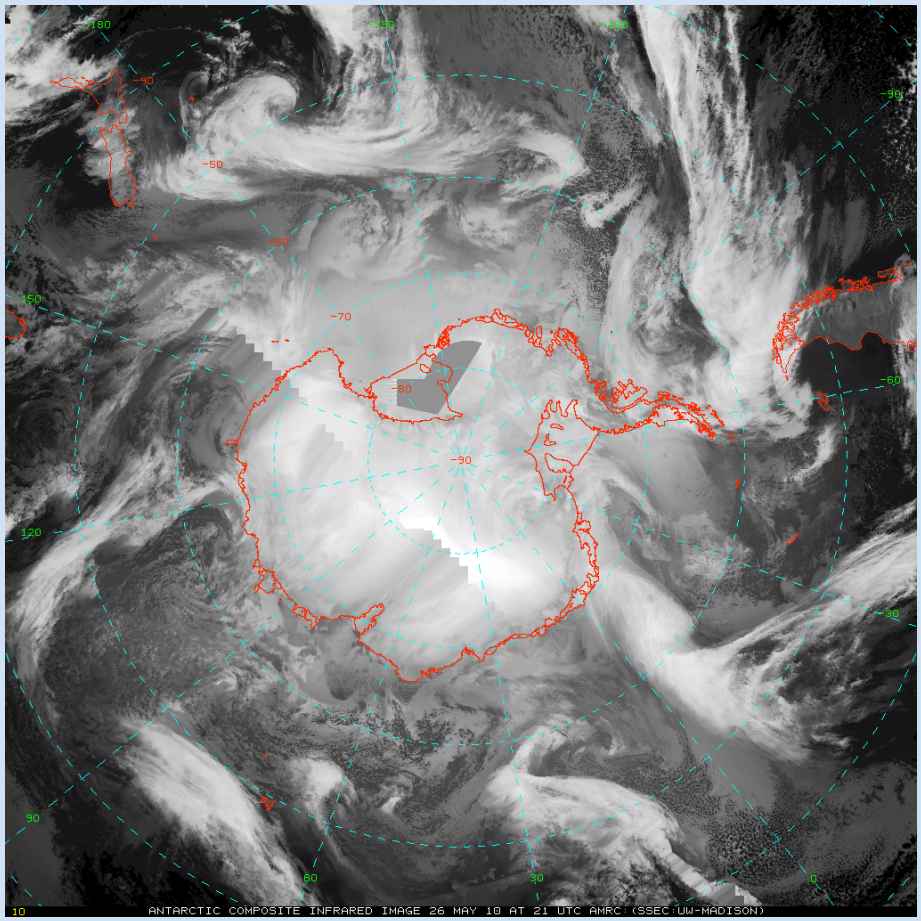
Outline: Polar Satellite Composite Atmospheric Motion Vectors (AMV)



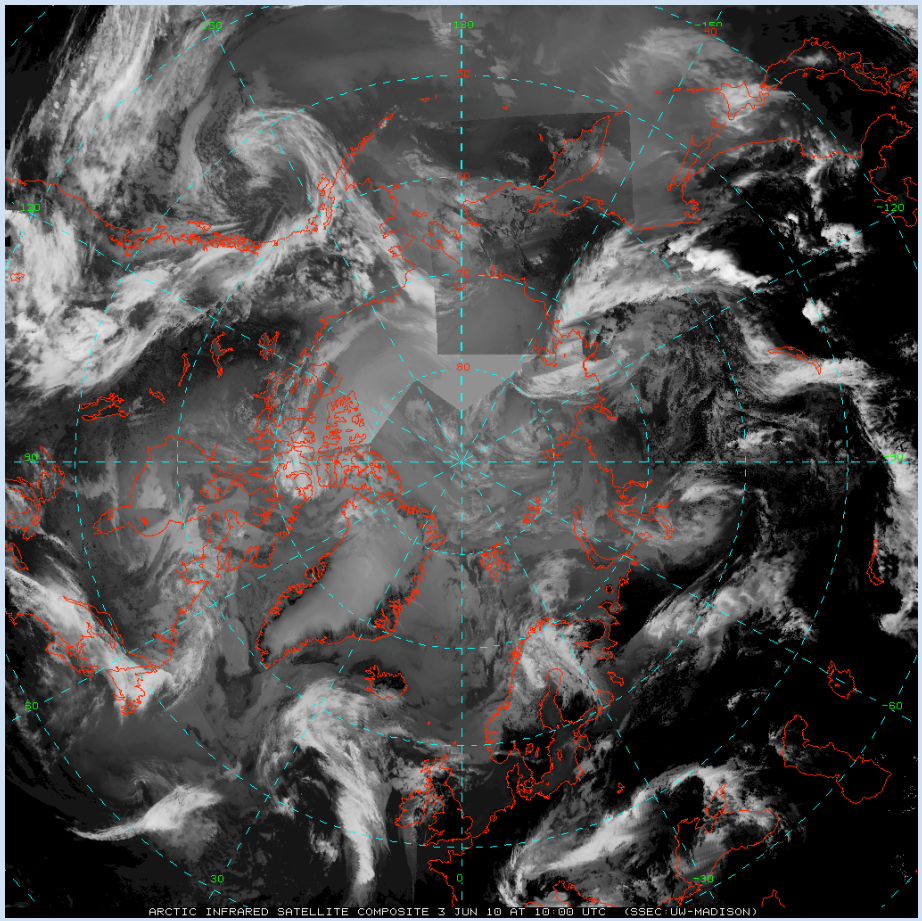
- Phase I: Testing
- Phase II: Refining
- Future
  - AMVs and Composites
- Thanks:
  - Rick Kohrs, Jerry Robaidek, Steve Wanzong, Scott Lindstrom, Utkan Kolat, & Jamie Daniels
  - National Science Foundation/Office of Polar Programs
  - NOAA GOES-R Risk Reduction Program

Original Polar Satellite Composites

Antarctic



Arctic



Combined via selecting the coldest pixel
- *Reduces limb darkening
- *Smooth transition between satellites
- *Intended for visualization

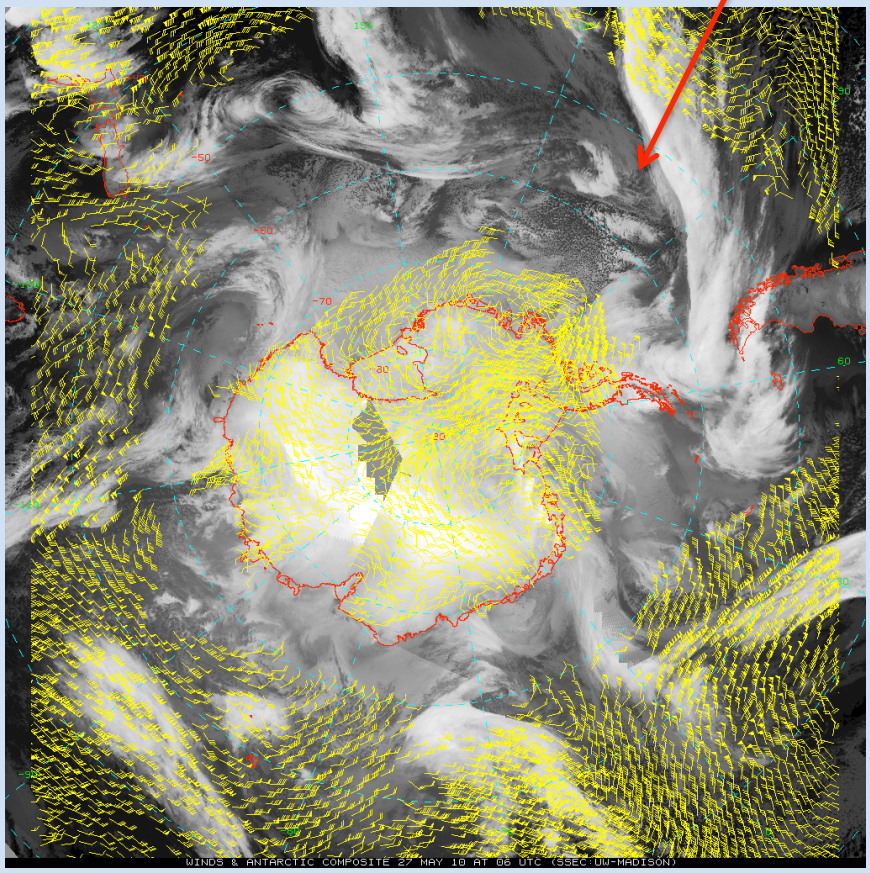
Geostationary:
- *GOES, Meteosat, FY-2, MTSAT

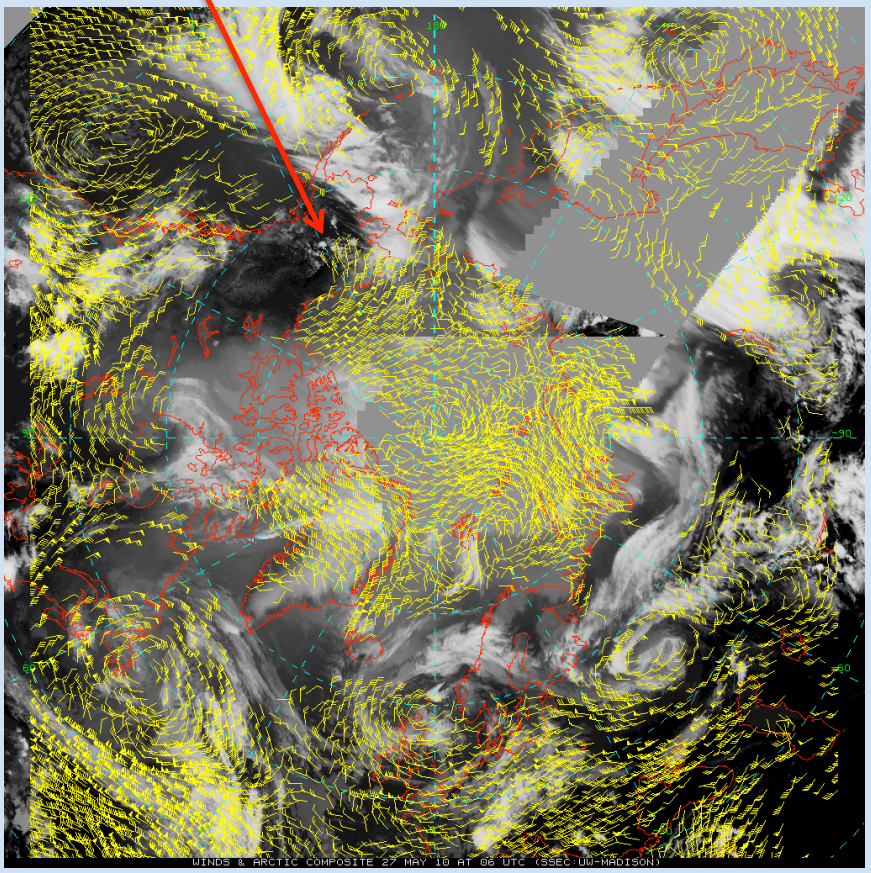
Polar-orbiting:
- *NOAA, MODIS, Metop

Geostationary and Polar-orbiting Atmospheric Motion Vectors

Missing winds – gap in coverage

- NWP centers: the polar jet stream can be located in this gap; improper model initialization can lead to errors in the forecasts.
- CIMSS research: the addition of the wind information is important in this region.





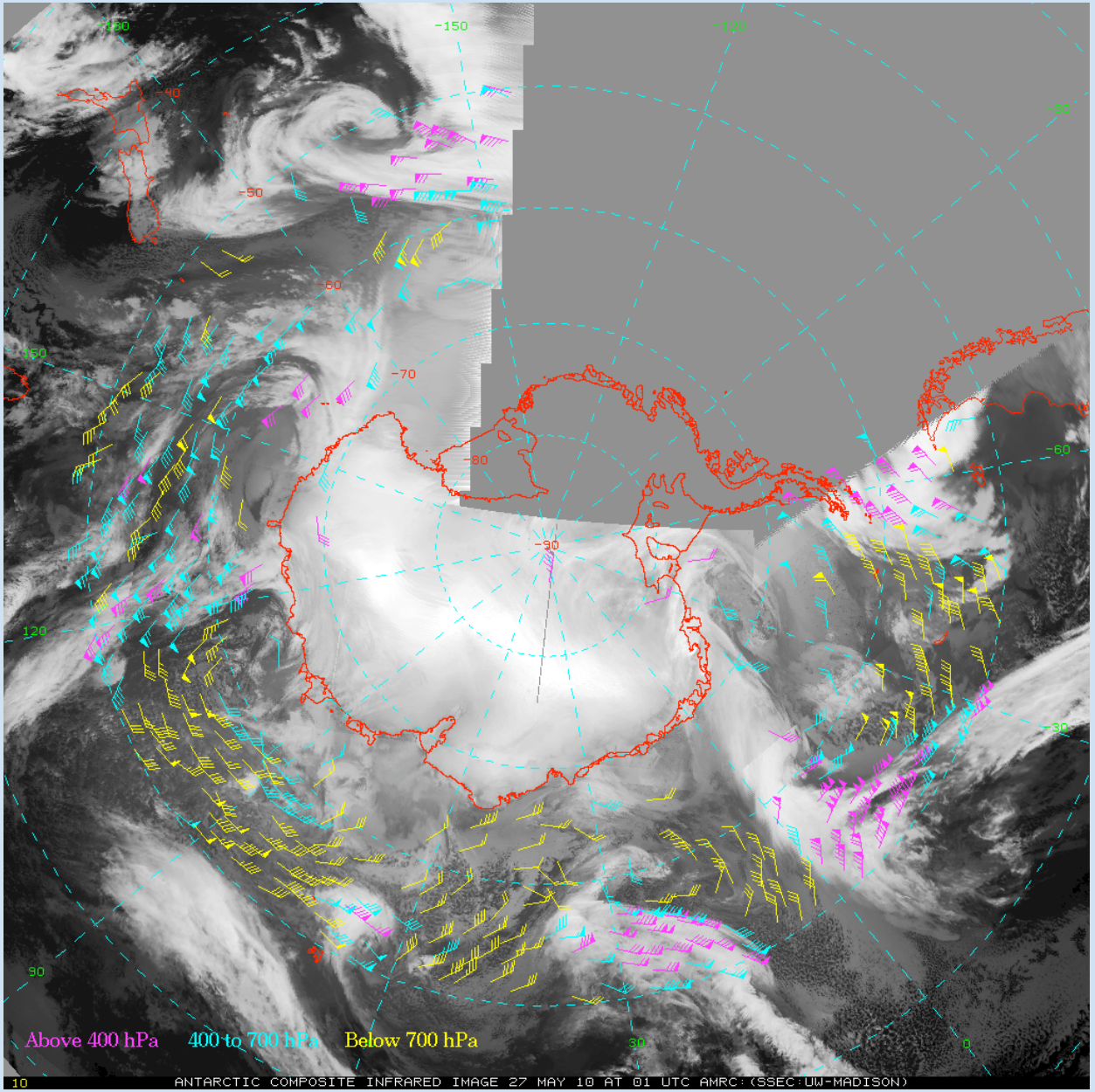
Phase I: Test Composite AMV

Moderate RMS errors…

(Antarctic only…..)

All Vector RMSE:	7.91
All Vector Difference:	6.34
Speed Bias:	0.15
60-70º Vector RMSE:	7.95
60-70º Vector Difference:	6.40
Speed Bias:	0.08

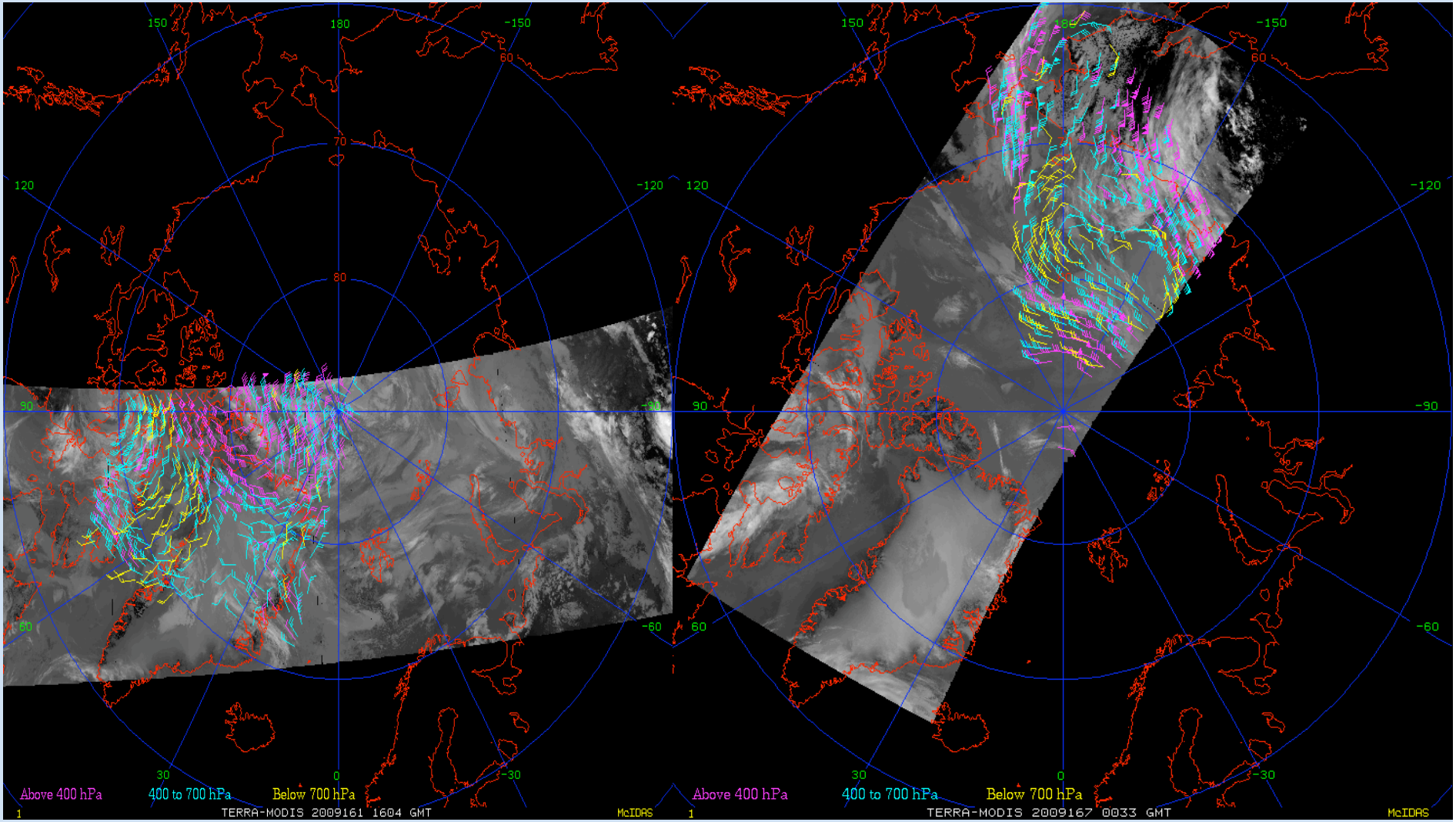
Need a new composite method to reduce error…



Proof of concept study – Fill the Gap!

Why is it important to have accurate time stamps?

Example: MODIS Mixed (Terra and Aqua) winds with varying time stamps (Dworak, 2009)



CASE #1 (Aqua-Terra-Terra)

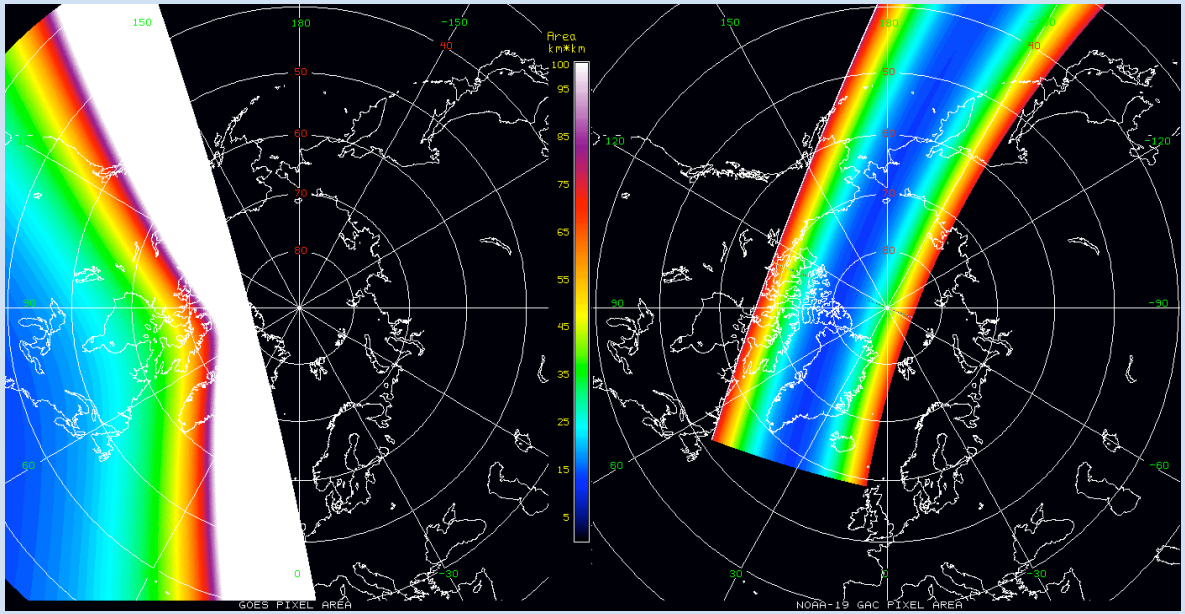
CASE #2 (Aqua-Terra-Aqua)

Phase II: Project Goal

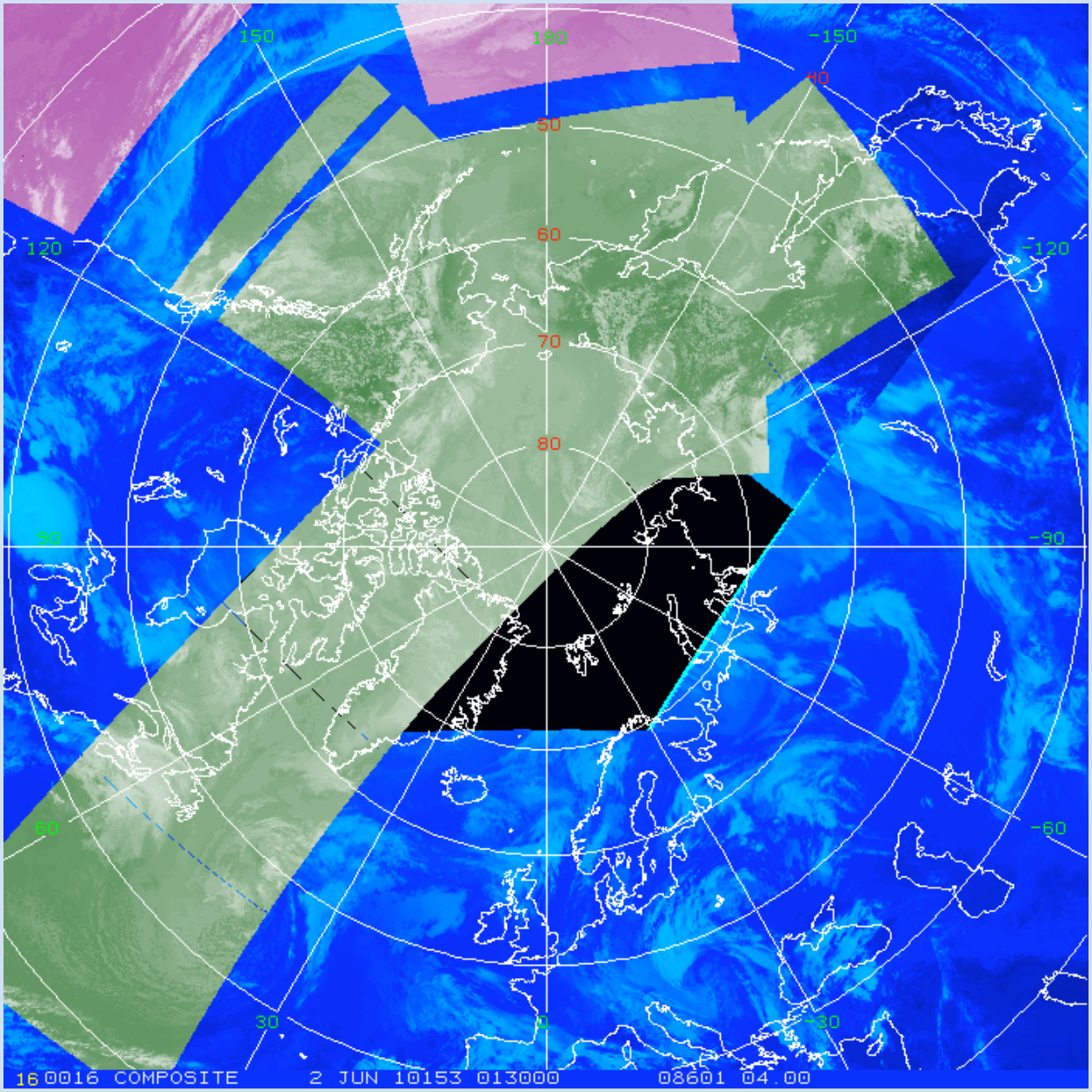
- Generate Composite Atmospheric Motion Vectors in the "gap":
  - Correcting for parallax in viewing the cloud tracers from different satellites and instruments
  - Developing the logic for applying a common time-stamp to regions within the composite that correspond to the viewing by specified satellites

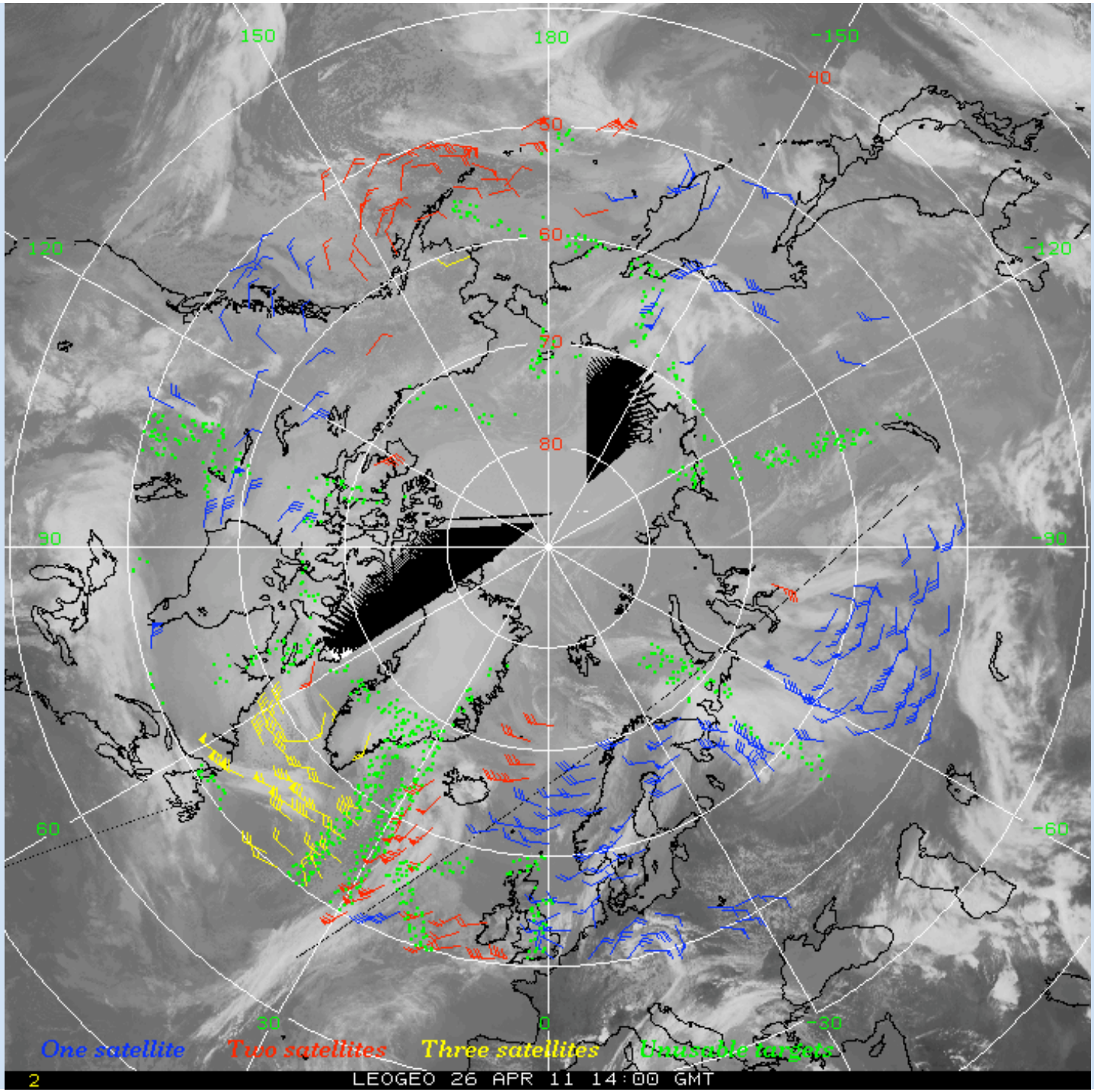
Metadata

- Brightness values
- Time difference from nominal image time
- Distance from satellite sub point
- Pixel area
- Satellite sensor
- Wavelength
- Parallax distance
- Parallax direction

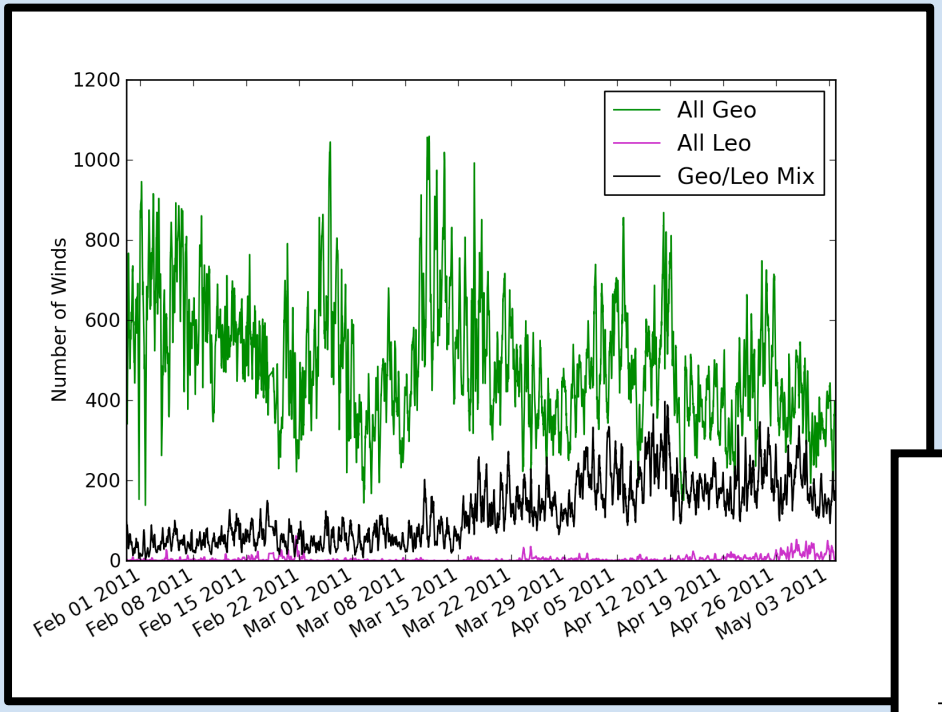


Example Mix of Satellites

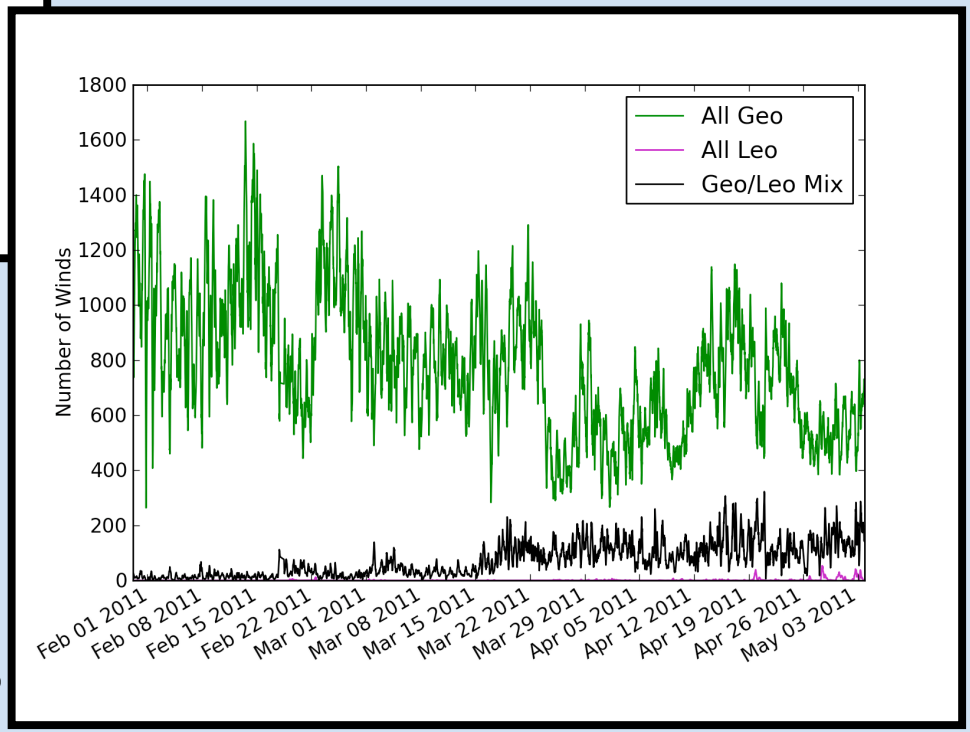



150
180
-150
40
50
60
120
-120
70
80
90
-90
60
-60
30
0
-30
One satellite
Two satellites
Three satellites
Unusable targets
2
LEOGEO 26 APR 11 14:00 GMT

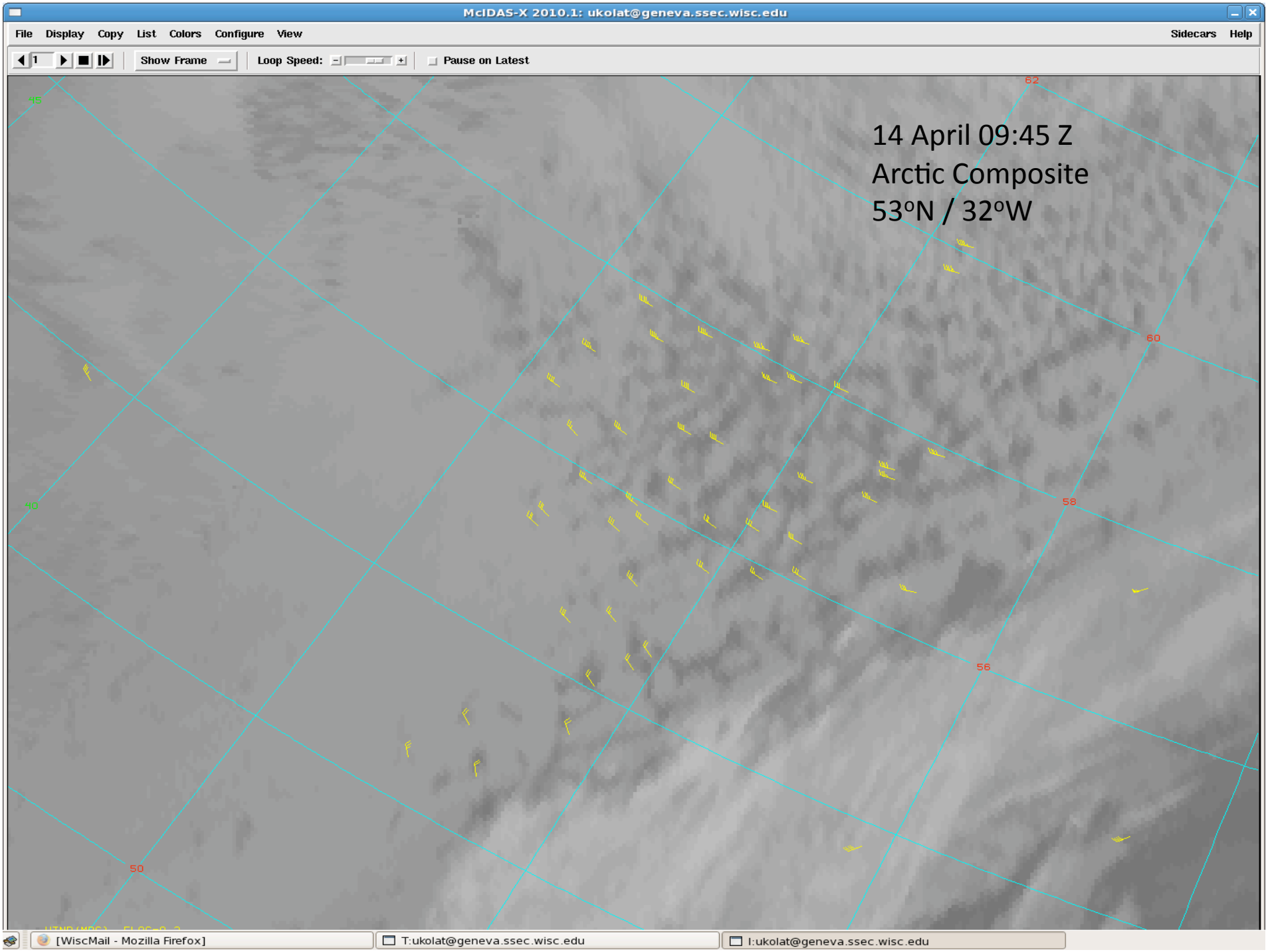
Multiple Satellite Usage?



Northern Hemisphere…



Southern Hemisphere…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Sidecars Help
Show Frame
Loop Speed:
Pause on Latest
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Arctic Composite
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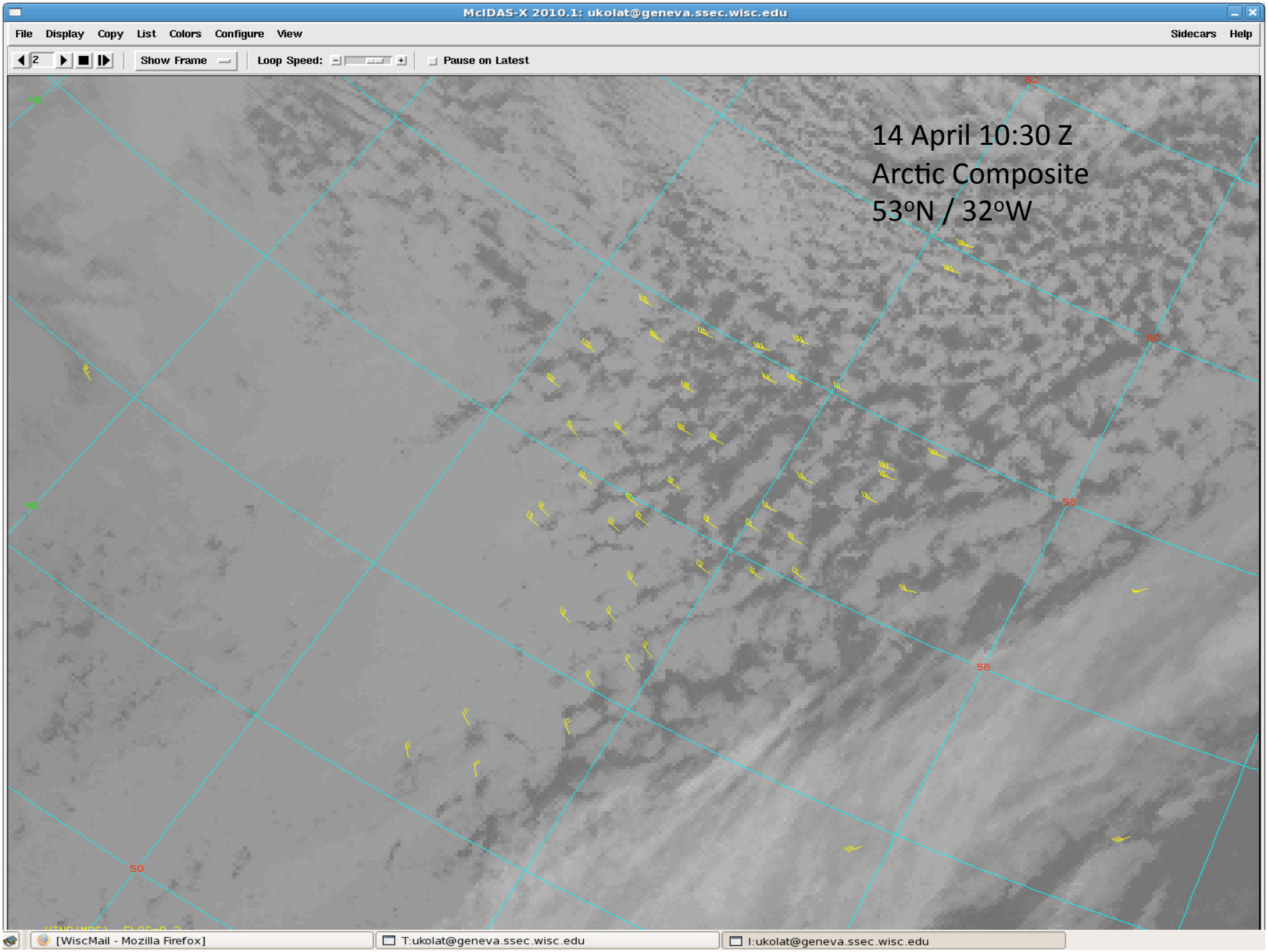
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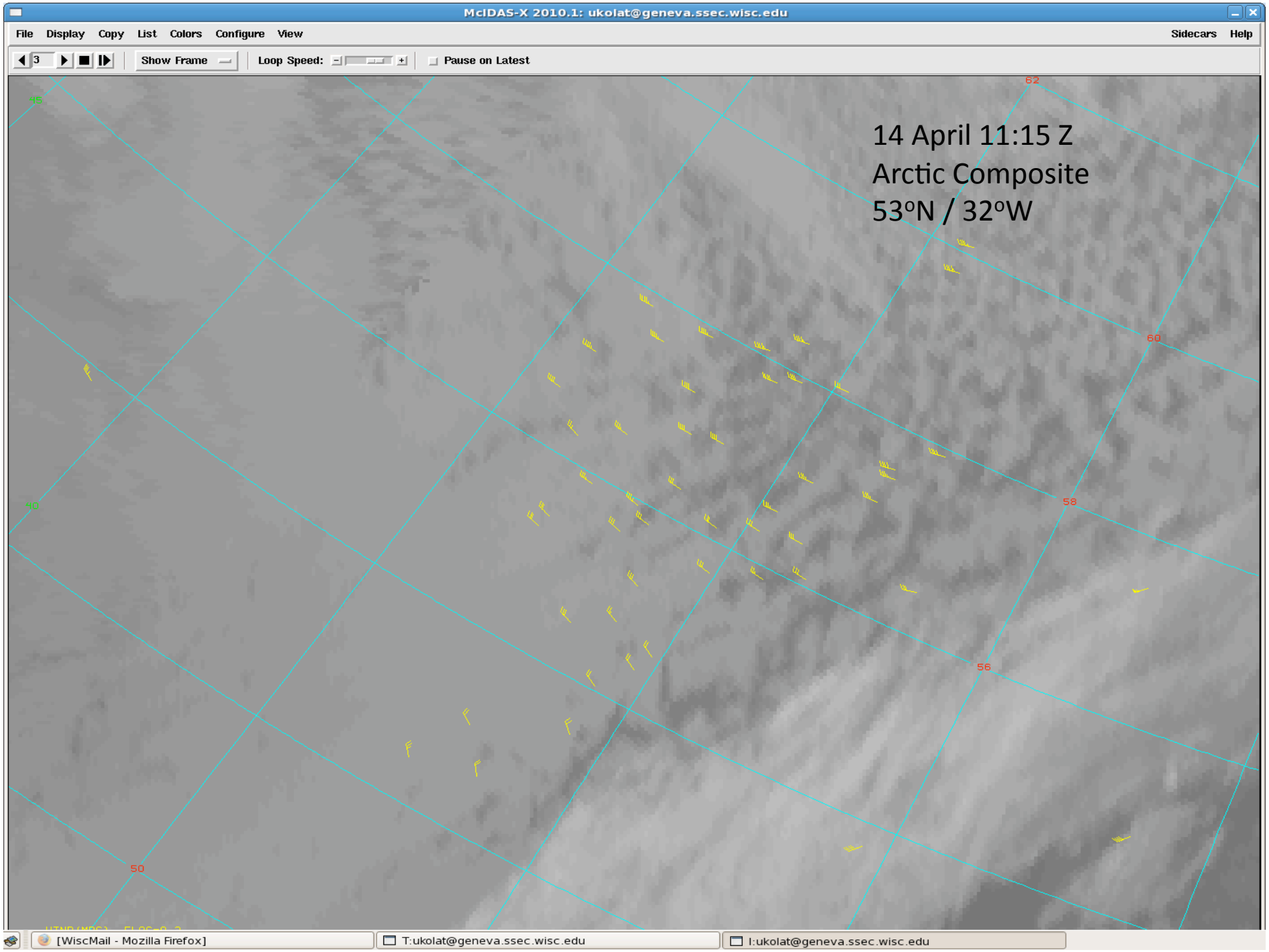
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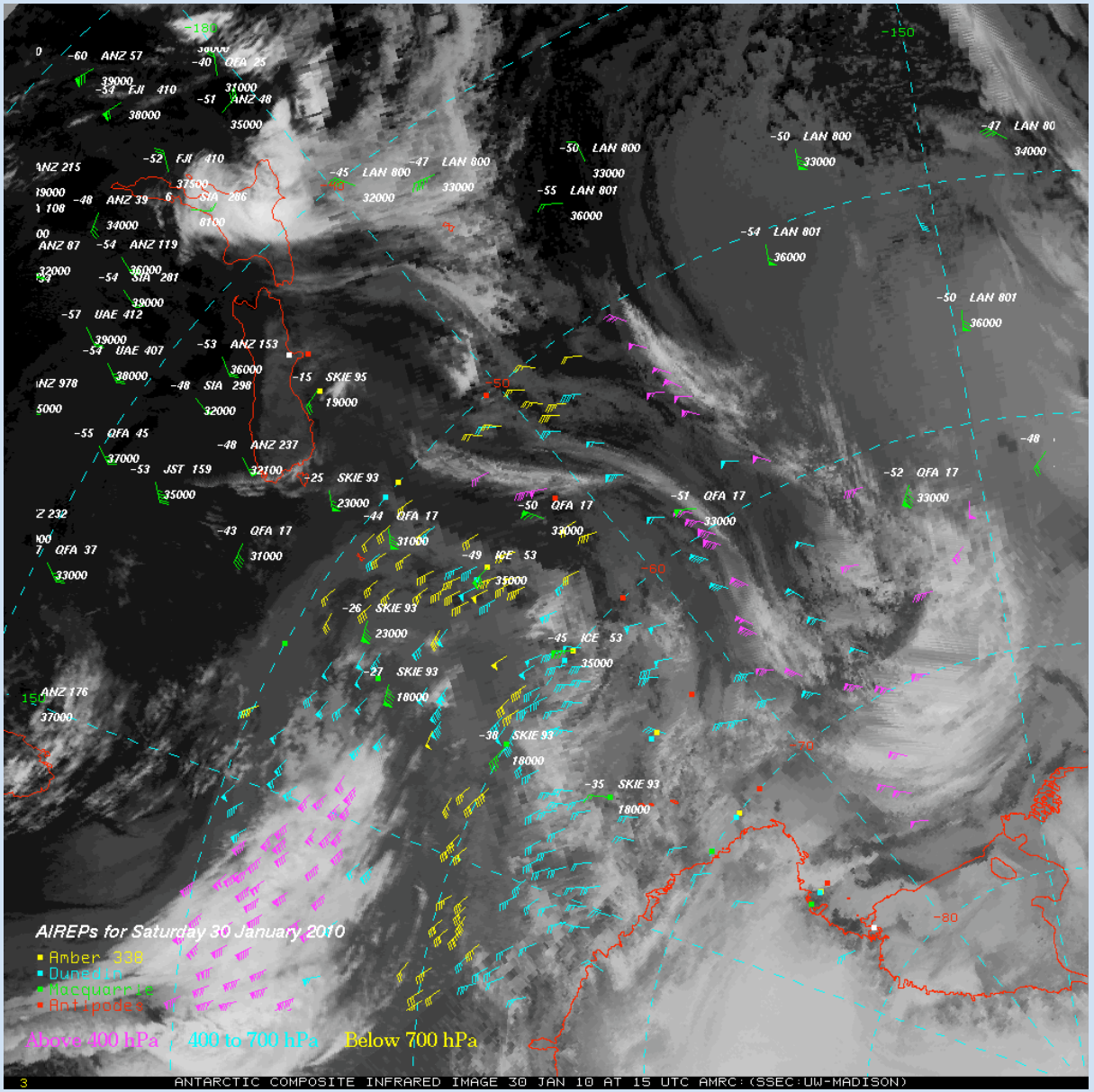
Using Aircraft of Validation…

- Validation and trial testing of the compositing and AMV generation process in real-time using NESDIS methods with radiosondes and exploring verification with aircraft observations

- Hasler et al., 1977



Northern Hemisphere Validation Statistics

Phase I

- # Observations: 31,373
- All Vector RMSE
- All Vector Di
- Speed Bias:

- # Observation
- 60-70° Vector
- 60-70° Vector
- Speed Bias:

Phase II

- # Observations: 6,246
- All Vector RMSE: 7.20
- 5.65
- -0.98

- 1253
- 7.43
- 6.15
- -1.92

Update!

Northern Hemisphere:

POES #Obs = 357 V_{rmse} = 6.14

GOES #Obs = 84570 V_{rmse} = 6.10

MIX #Obs = 11690 V_{rmse} = 6.83

Southern Statistics

Phase I

- # Observatio
- All Vector R
- All Vector Difference: 6.97
- Speed Bias: -0.39

- # Observations: 353
- 60-70° Vector RMSE: 7.83
- 60-70° Vector Difference: 6.57
- Speed Bias: -0.40

Southern Hemisphere:

GOES #Obs = 1248 V_{rmse} = 8.05

MIX #Obs = 68 V_{rmse} = 7.85

Phase II

- 39
- 6.91
- All Vector Difference: 6.12
- Speed Bias: 0.57

- # Observations: NA
- 60-70° Vector RMSE: NA
- 60-70° Vector Difference: NA
- Speed Bias: NA

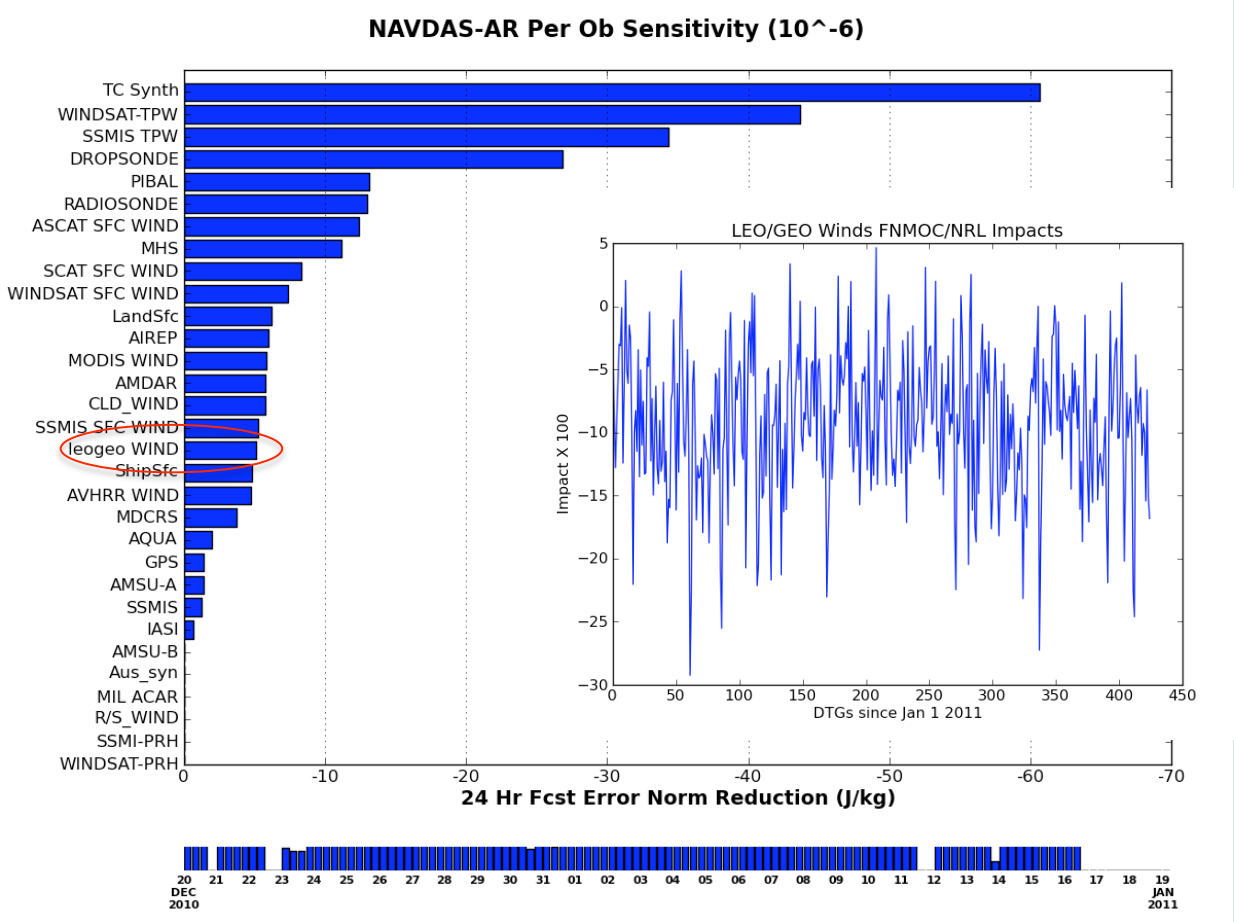
Activities in Progress…

- Continue the routine production of the composites and the winds product at CIMSS
- Create datasets for use in model forecast experiments in collaboration with NWP centers
- Evaluate the forecast impact of this blended wind product as compared to the impact from the individual geostationary and polar wind products

Impact of LEO/GEO AMVs

NOGAPS FNMOC/NRL

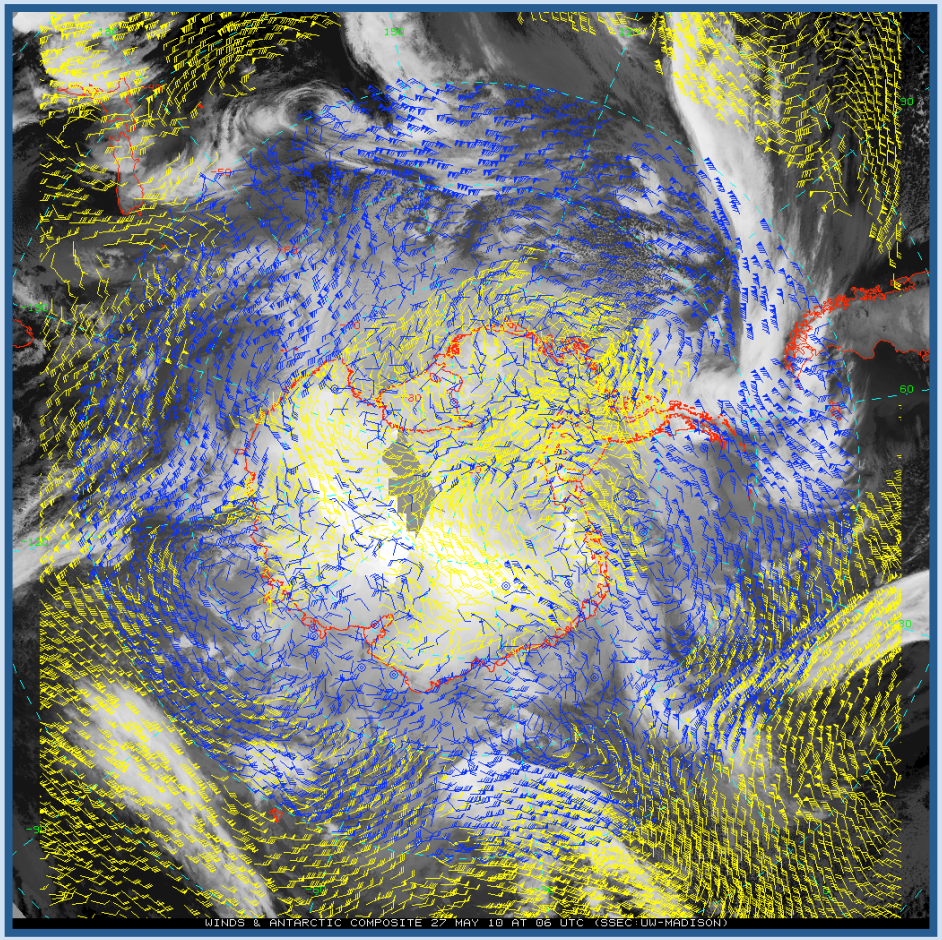
- ✓ 24-hr error reduction in the FNMOC model for various observation types.
- ✓ The reduction in error resulting from the incorporation of the LEO-GEO wind product is circled.
- ✓ This wind product will be incorporated into FNMOC's operational system after further testing.

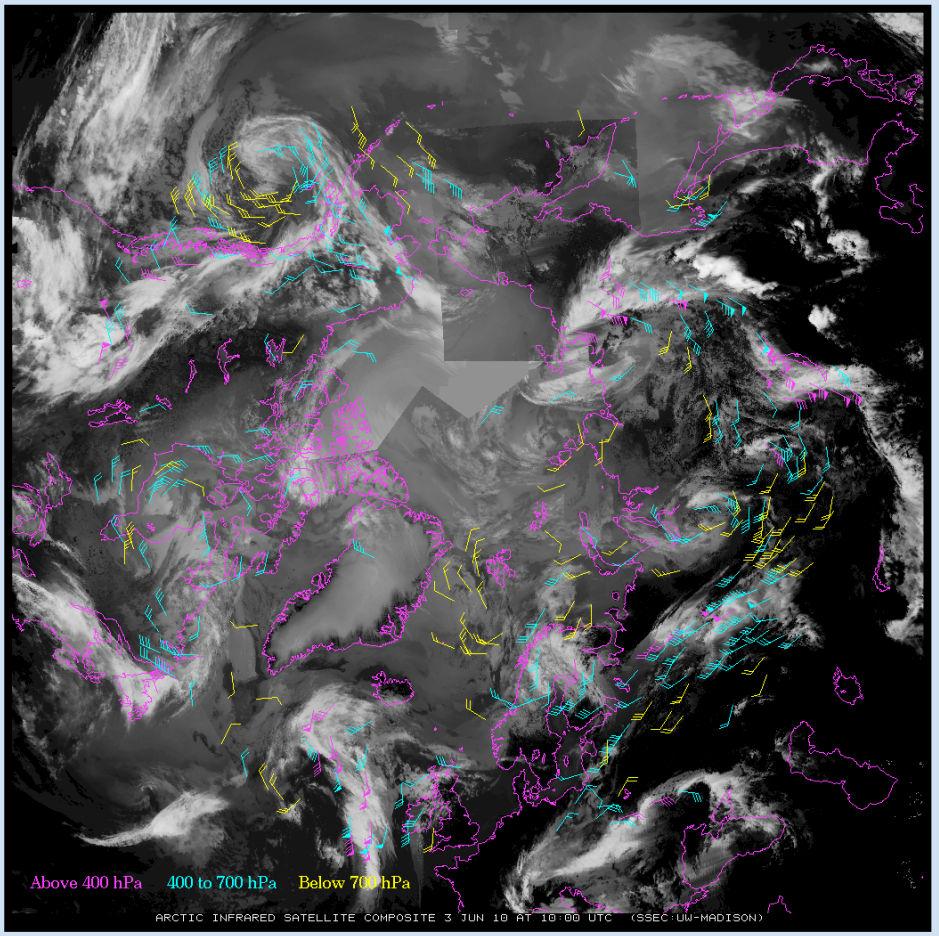


What's Next?

- Formal request for Arctic Composites to become operational with NOAA/NESDIS
  - Ocean Prediction Center
  - Hydrometeorological Prediction Center
  - National Weather Service (NWS) Alaska
  - National Ice Center
- Composite winds become operational…
  - Interest in winds from NWS Alaska for GOES-R Proving Ground
  - Numerical Weather Prediction:
    - Nancy Baker & Randy Pauley – NRL (NOGAPS)
      - JCSDA Partner
    - Jordan Powers – NCAR (Polar WRF - AMPS)
- Time stamp effort:
  - Will help out another NESDIS product – the mixed Terra and Aqua AMV – being tested operationally

Thank you! … Questions?





Acknowledgments: Phase I – Thanks to NSF Office of Polar Programs
- Grant # ANT-0537827, ANT-0838834, ARC-0713843
Phase II – Thanks to NOAA GOES-R Risk Reduction Program
- Grant # NA06NES4400002