Polar Satellite Composite
Atmospheric Motion Vectors

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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

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

Arctic

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

60-70° Vector RMSE: 7.95
60-70° 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
Multiple Satellite Usage?

Northern Hemisphere...

Southern Hemisphere...
14 April 09:45 Z
Arctic Composite
53°N / 32°W
14 April 10:30 Z
Arctic Composite
53°N / 32°W
14 April 11:15 Z
Arctic Composite
53°N / 32°W
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:** 7.78
- **All Vector Difference:** 6.16
- **Speed Bias:** -0.62

### Phase II
- **# Observations:** 6,246
- **All Vector RMSE:** 7.20
- **All Vector Difference:** 5.65
- **Speed Bias:** -0.98

### Southern Hemisphere Validation Statistics

### Phase I
- **# Observations:** 518
- **All Vector RMSE:** 8.32
- **All Vector Difference:** 6.97
- **Speed Bias:** -0.39

### Phase II
- **# Observations:** 39
- **All Vector RMSE:** 6.91
- **All Vector Difference:** 6.12
- **Speed Bias:** 0.57

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**Update!**

**Northern Hemisphere:**
- **POES #Obs = 357**  \[ V_{\text{rmse}} = 6.14 \]
- **GOES #Obs = 84570**  \[ V_{\text{rmse}} = 6.10 \]
- **MIX #Obs = 11690**  \[ V_{\text{rmse}} = 6.83 \]

**Southern Hemisphere:**
- **GOES #Obs = 1248**  \[ V_{\text{rmse}} = 8.05 \]
- **MIX #Obs = 68**  \[ V_{\text{rmse}} = 7.85 \]
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