ECM Analysis, GSI, Forecasts and QC

"Dropout Team"

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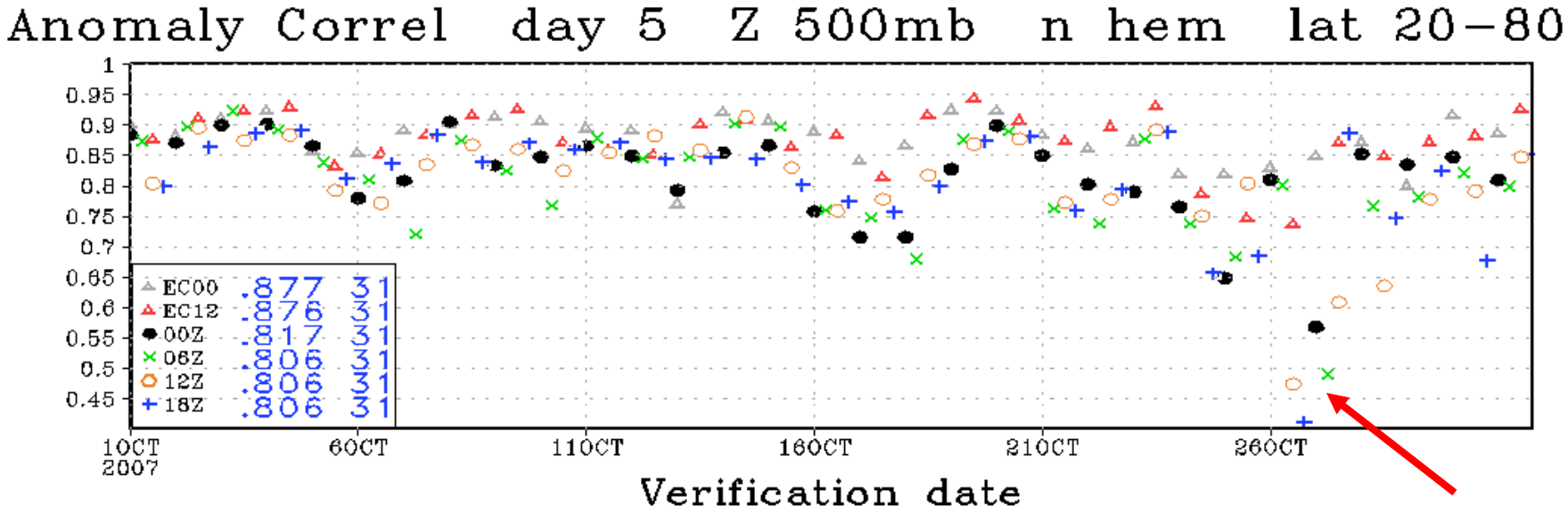
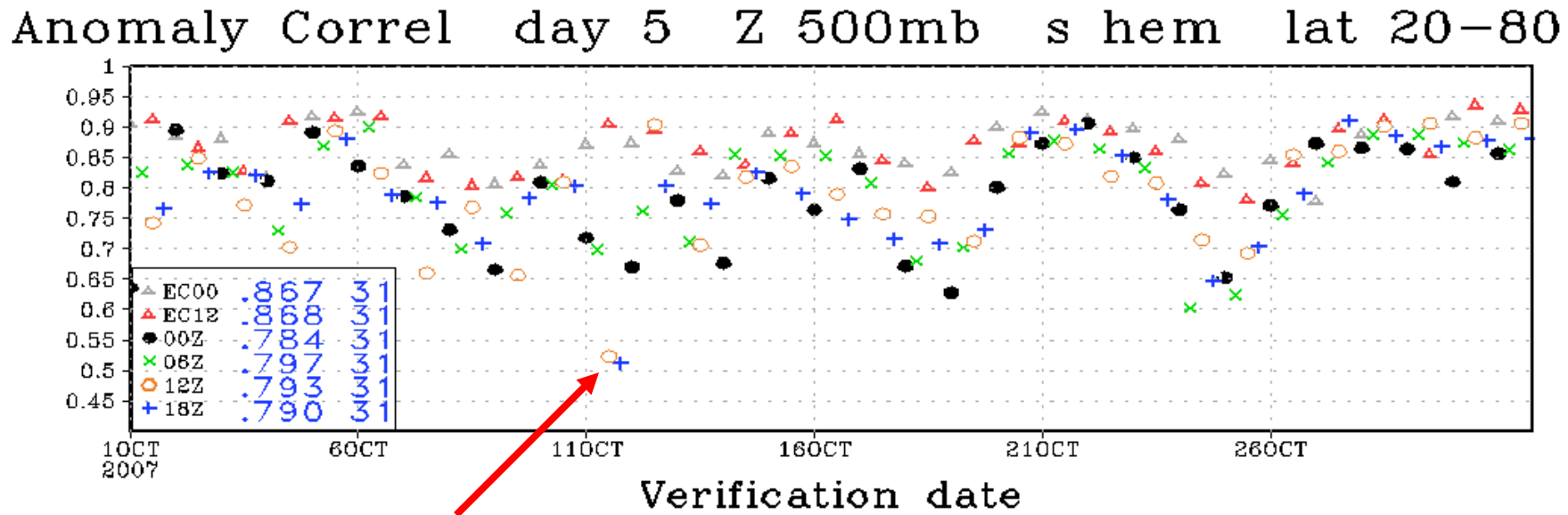
On approximately a monthly basis, poor forecasts or "Skill Score Dropouts" plague GFS performance.



NH AC



SH AC

Forecast Skill Differences
GFS vs ECMWF

In addition to those enumerated for COPC, Differences in forecast skill:

- **Between ECMWF and GFS can be due to differences in observations ingested**
- **From the data use and quality control (QC)**
- **Can be due to the analysis draw for the observations**
- **The analysis Guess which comes from the forecast model which come from the analysis, which comes from the guess, which comes from the analysis, which • • •**

Forecast Skill Differences

To analyze differences:

- **Create variety of tools for case study analysis,**
- **Create criteria to determine cases and procedures to find key areas.**
- **Experiments using the ECMWF analysis as input to the GSI/GFS (ECM runs) show positive impact in dropout cases where the GFS did poorly**
- **Here the GSI analysis is run using ECMWF analysis values on a 1x1 degree grid and mandatory pressures as pseudo radiosonde data, with its forecast labeled as ECM GFS**
- **Experiments are run using the ECM analysis only in select areas (overlays)**
- **Rerunning the operational GSI with changes in observations by type and location to isolate QC problems**

Causes and Remedies for the Dropouts

Goal: Determine if "dropouts" are from QC, available observations, GSI analysis, GFS forecast model

- Define Dropout (use of verification web page stats)
- Quantify Dropout Event and automate diagnostics
- Determine if QC is responsible per particular Ob type
- Construct (implement) an improved QC system
- Weekly meetings w/ Director EMC and "Dropout" Team continue, and work with Analysis groups.

Define Dropout

The criteria that a 5-day AC Height score must meet in order to be considered a dropout:

- At least two of the following criteria must be met:

- a) ECMWF minus GFS > 15 anomaly corr. points (using 500 mb heights AC score)
- b) GFS Anomaly corr < 0.70
- c) ECMWF AC < 0.75
- d) Monthly avg GFS AC score minus GFS forecast > 15
- e) Monthly avg ECMWF AC score minus ECMWF forecast > 15

- Criterion is for NH and SH dropouts.

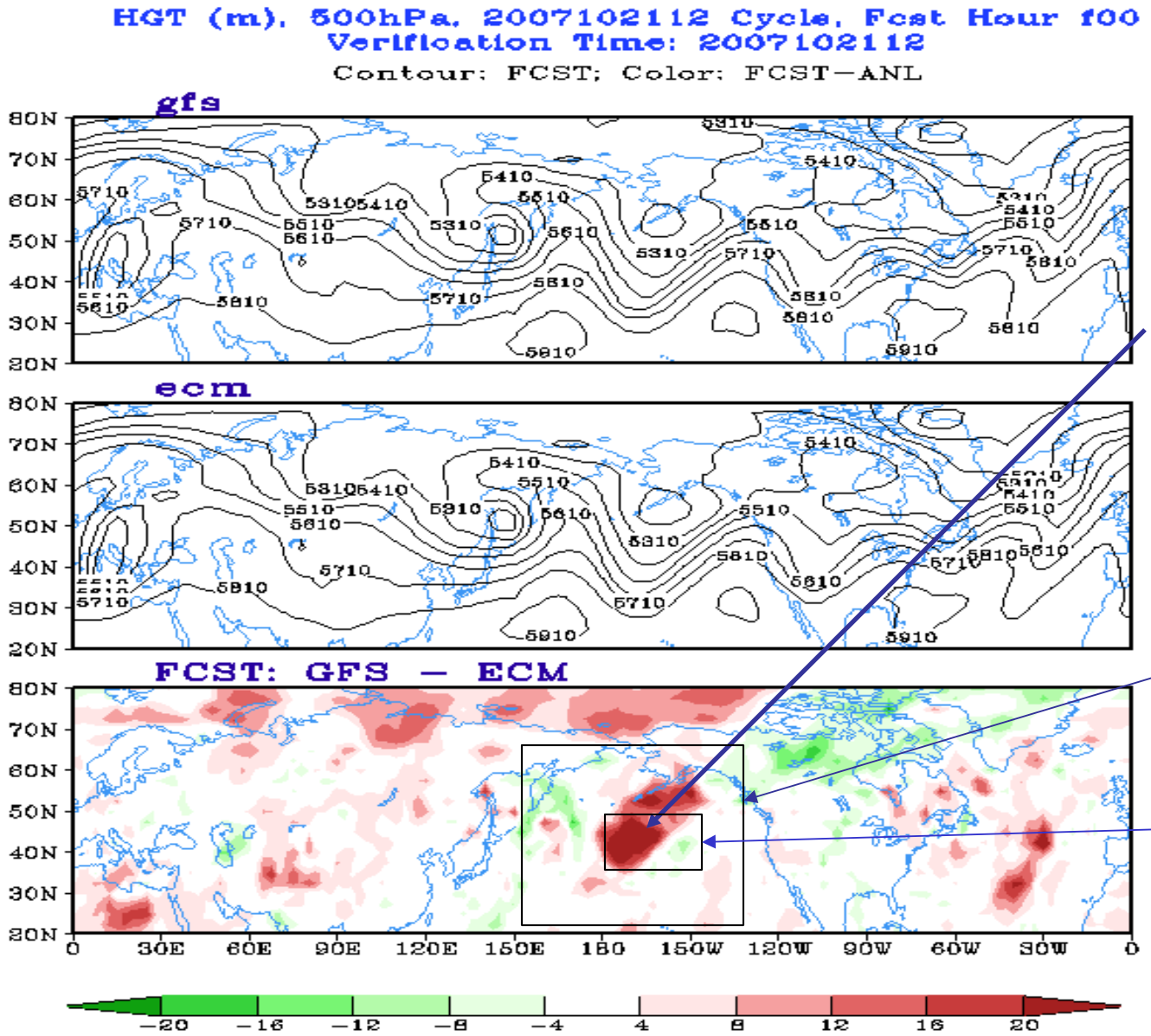
Dropout Event Dates
2007OCT – 2008MAY (00 or 12Z)

- Northern Hemisphere- (Initialization date)
- 2007102000
- 2007102112
- 2007102200
- 2007102212
- 2007102312
- 2007122012
- 2008012100
- 2008021712
- 2008030112
- 2008030412
- 2008030400

- Southern Hemisphere-
- 2007100212
- 2007100412
- 2007100612
- 2007100700
- 2007101300
- 2007101400
- 2007102000
- 2007111912
- 2007121612
- 2007122000
- 2007122012
- 2008010712
- 2008020100
- 2008020300
- 2008021700
- 2008030300
- 2008030312
- 2008030912
- 2008031012
- 2008031300
- 2008031800
- 2008031812
- 2008032012
- 2008040900
- 2008042500
- 2008042512
- 2008042600
- 2008050900
- 2008051000
- 2008051512
- 2008052200

Array of Dropout Analysis Tools

- Display maps of Analysis vs Guess vs Increments (Anl-Obs)
- GSI IC or guess (to test GSI "memory") from ECMWF analysis ("**ECM Runs"**) to study the effects of the difference between the European Center and GFS systems and define action areas
- Using ECM Runs, **overlay "patches"** of ECMWF analysis choices over GSI analysis (and visa versa) in selected "action" areas where profound differences occur
- Experiments that alter the conventional and non-conventional observation GSI files ("PREPDA/QC") to confirm QC problems
- Develop correction algorithms to correct observations and improve QC based on above analysis



October 2007
Dropout cases
10/21 – 10/22
12,18,00,06,12Z

Trough in central Pacific shows differences between ECMWF (no dropout) and GFS (had dropout)

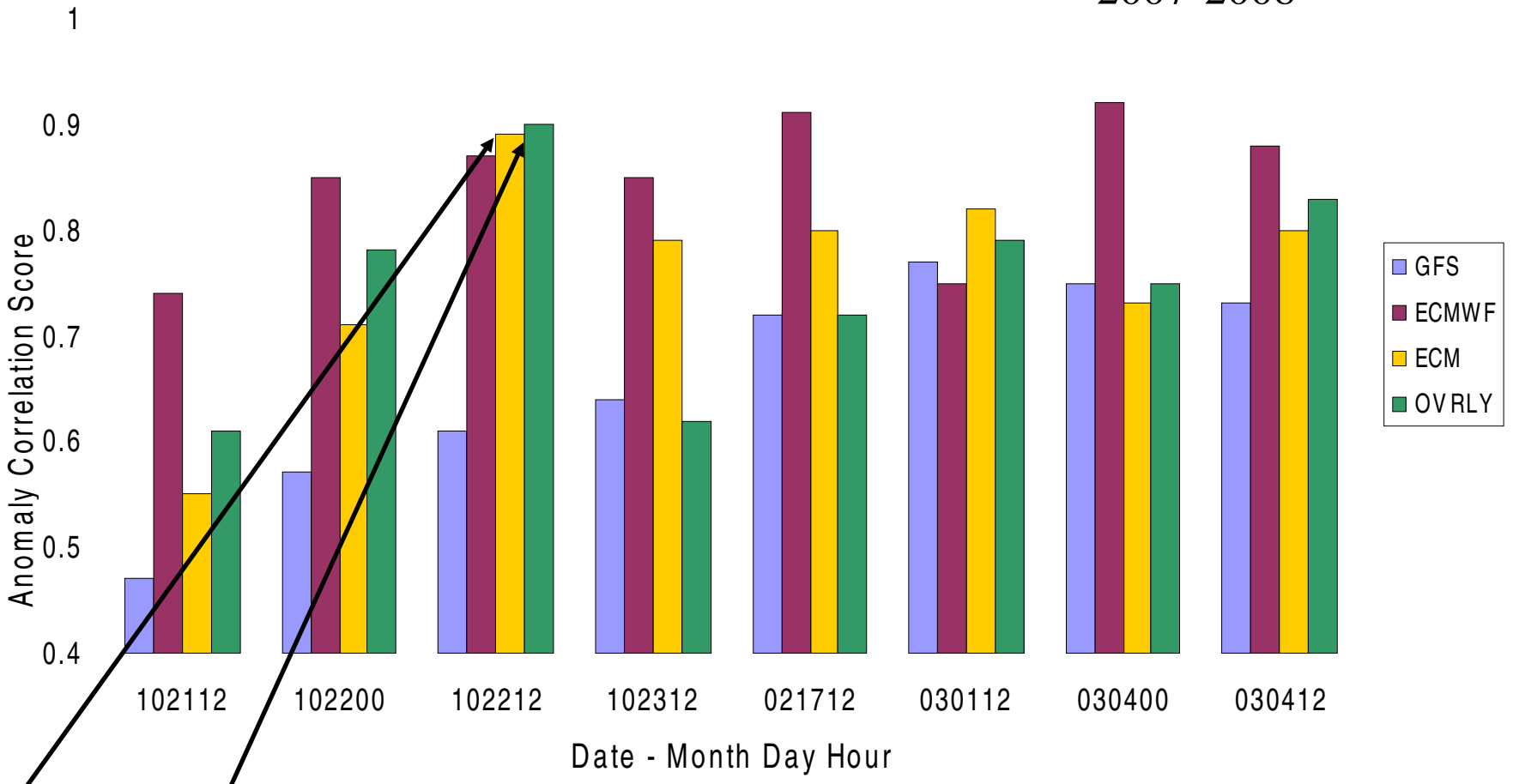
Ovrly "patch" box

Quick Scat Observation Delete Area

Detailed analysis shows significant differences in a number of wind maxes inside broad Pacific trough. (First of a number of dropouts…)

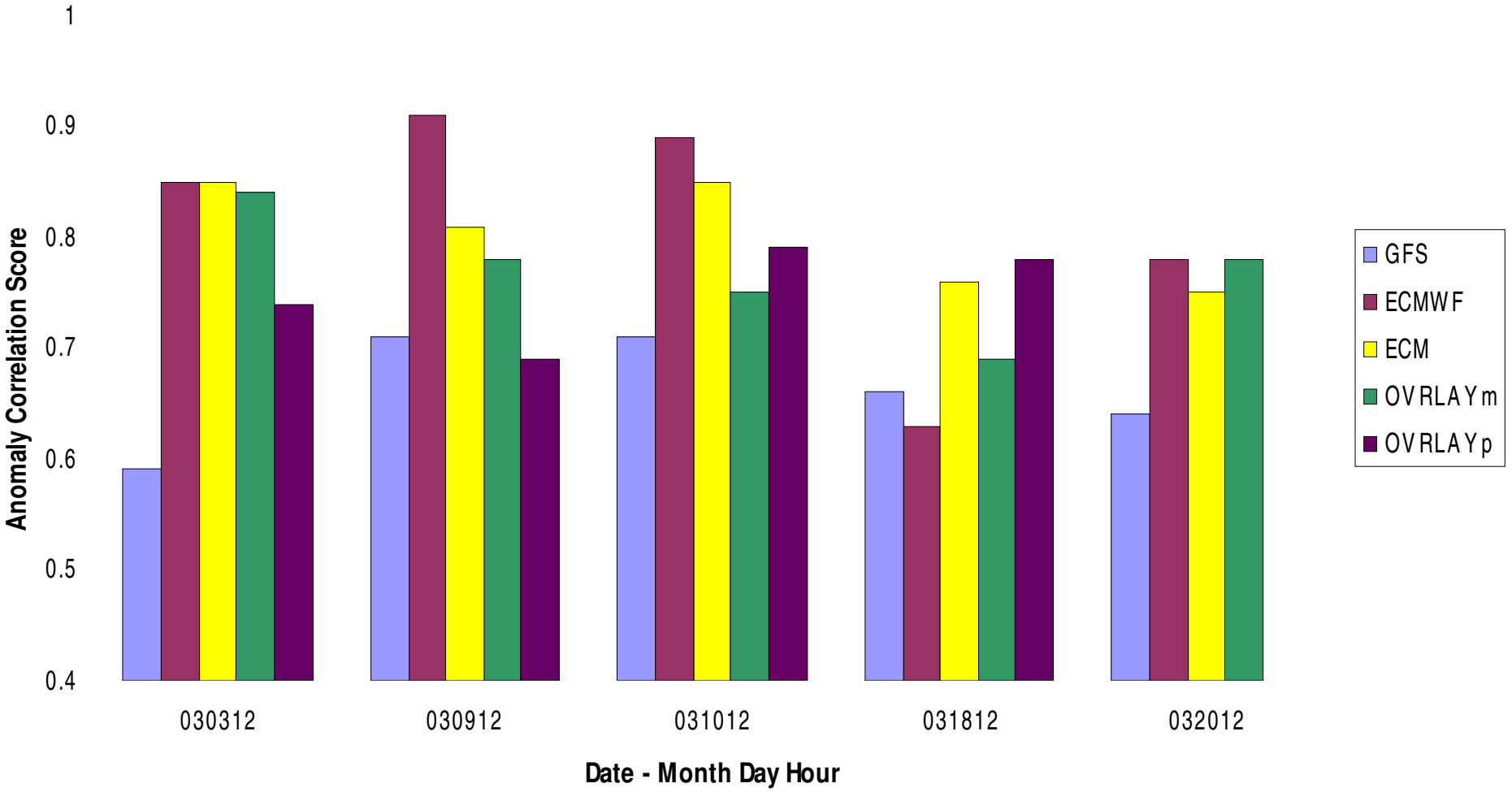
5 Day Anomaly Correlation Scores at 500 hPa for Dropout Cases
ECM Performs Better than GFS (NH)

2007-2008



ECM runs are a good representation for ECMWF analysis.
OVRLY defines sensitive/potential areas for QC improvements.
Dropouts are dependent on regime and causes may vary.

5 Day Anomaly Correlation Scores at 500 hPa for Dropout Cases
ECM Performs Better than GFS (SH)



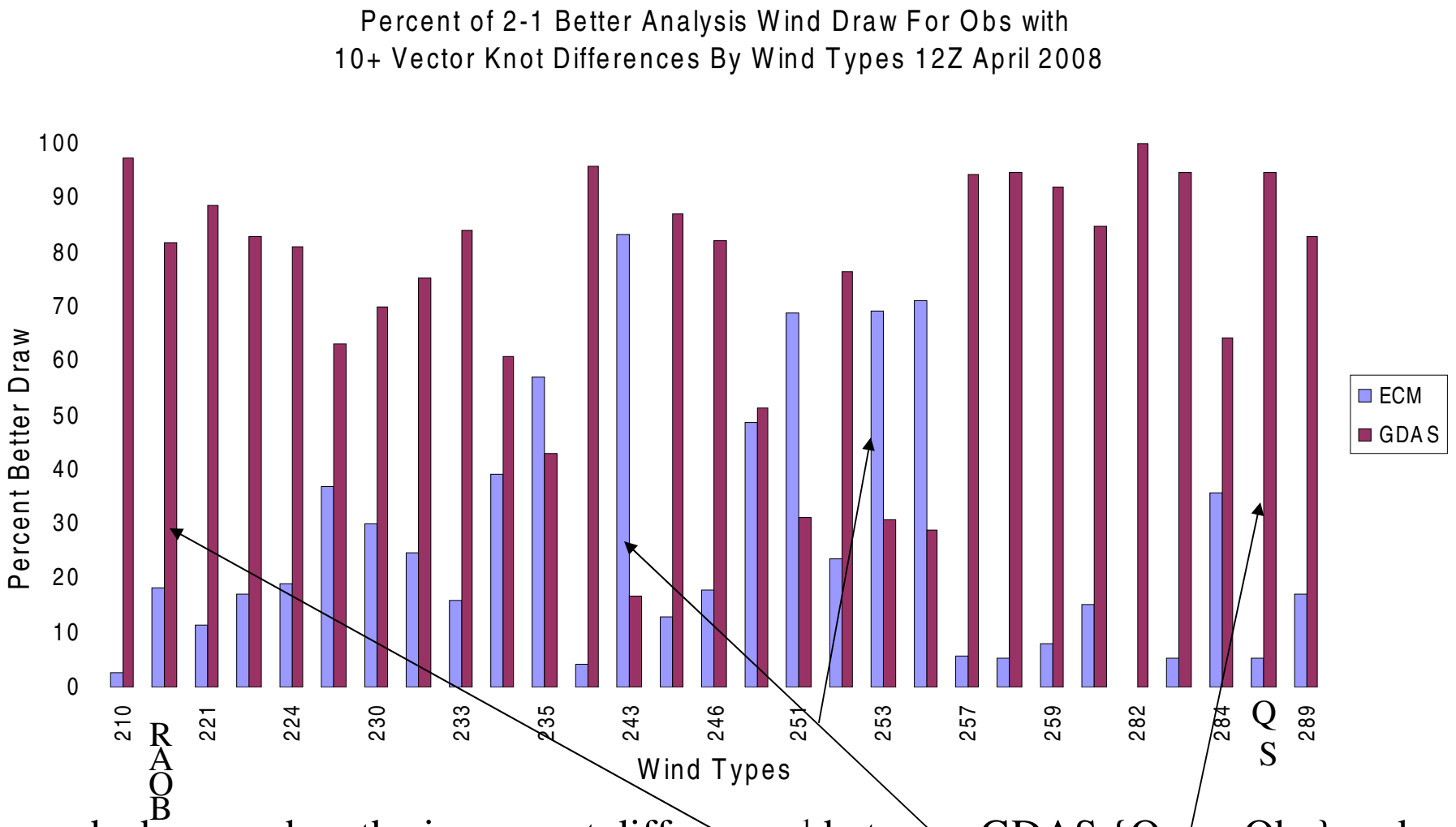
OVRLYm- Midlatitude OVRLY

OVRLYp- Polar OVRLY

SH ECM runs consistently improve GFS forecasts for dropout events and in general.

How the analyses fit wind observations

- To compare analysis fits with observations, sigma analyses are interpolated to observation points and differences calculated
- Globally averaged stats on differences between the obs and analysis are fairly similar for ECM and GDAS with ECM tending to fit closer – but …
- When we stratify the data by differences in fits to the obs for moderate outliers, then there are large differences in the ECM and GDAS system….



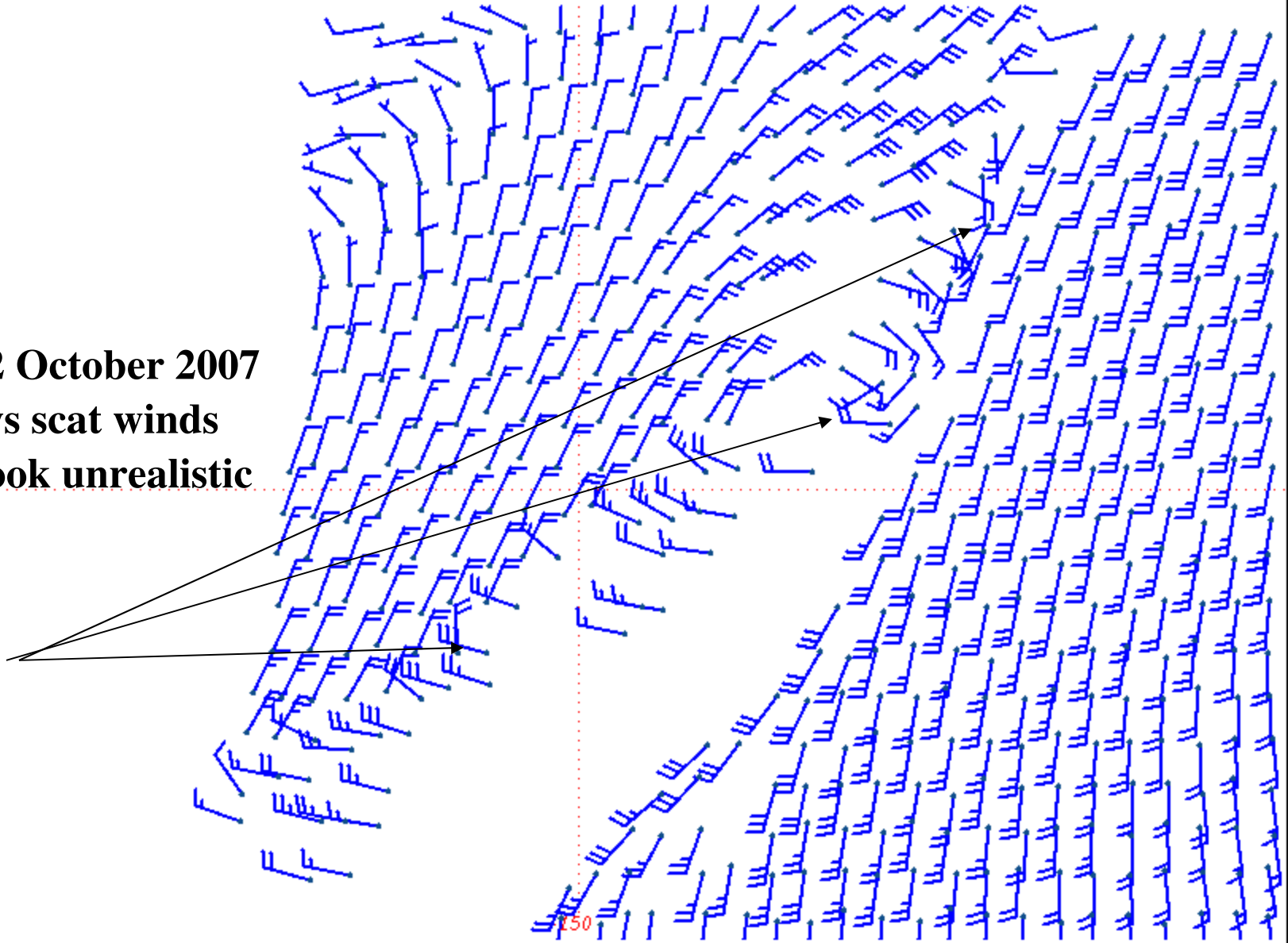
This graph shows, when the increment differences[1] between GDAS {Ops – Obs} and ECM analysis each exceed a moderate amount, the number of instances where each analysis draws 2 times closer for the observations. (RAOB 220, Quick Scat 285 – GSI draws close to Obs when differences are larger than ECM) (UMETSAT 243, 253, 254 & Canadian AMDAR 235 – ECM draws closer to Obs than GSI)

[1]Sigma analysis is interpolated to observations points and differences calculated.

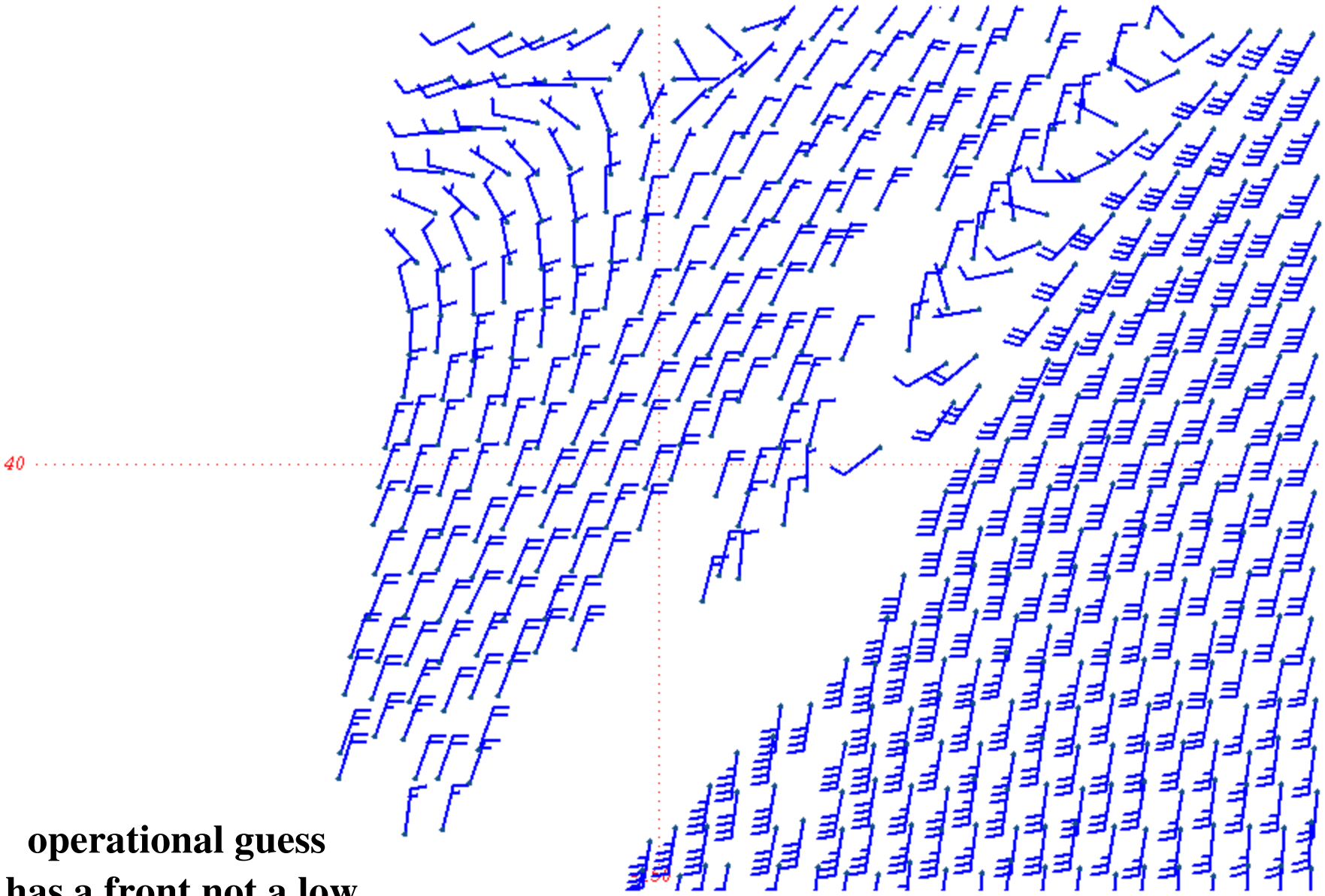
Problem Scat Wind Case

- First slide for 06Z 22 October 2007 shows scat winds that look unrealistic
- Second slide shows operational guess has a front not a low
- Third slide shows ECMWF analysis also has just a front
- Forth slide shows operational analysis has spurious low pressure area
- Fifth slide shows analysis results after scat deletions – low is gone
- Sixth slide show visible satellite imagery, courtesy of SAB, with no indication of a low

06Z 22 October 2007 shows scat winds that look unrealistic

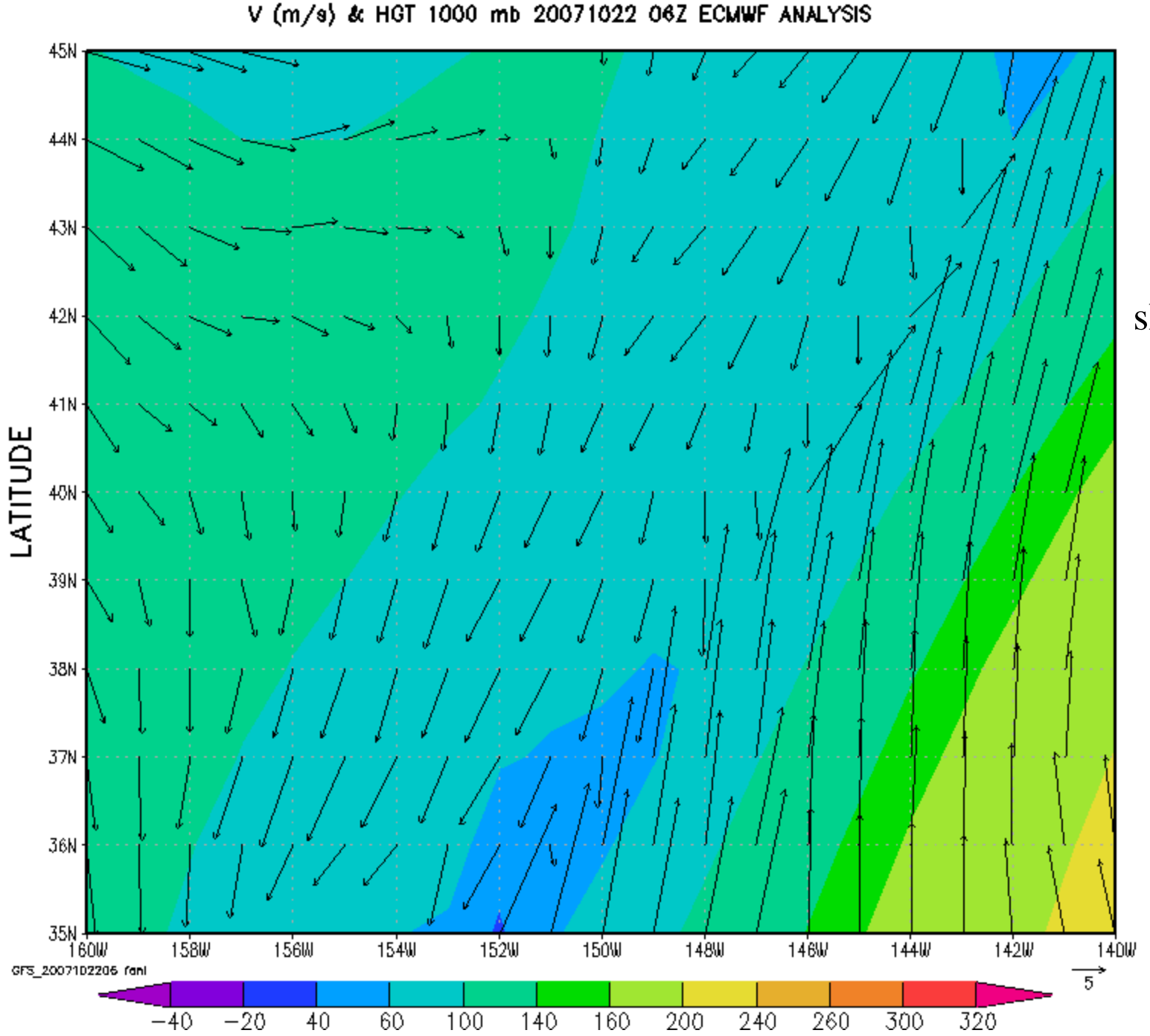


SCAT WIND OBS IN KNOTS 06Z 22 OCT 2007



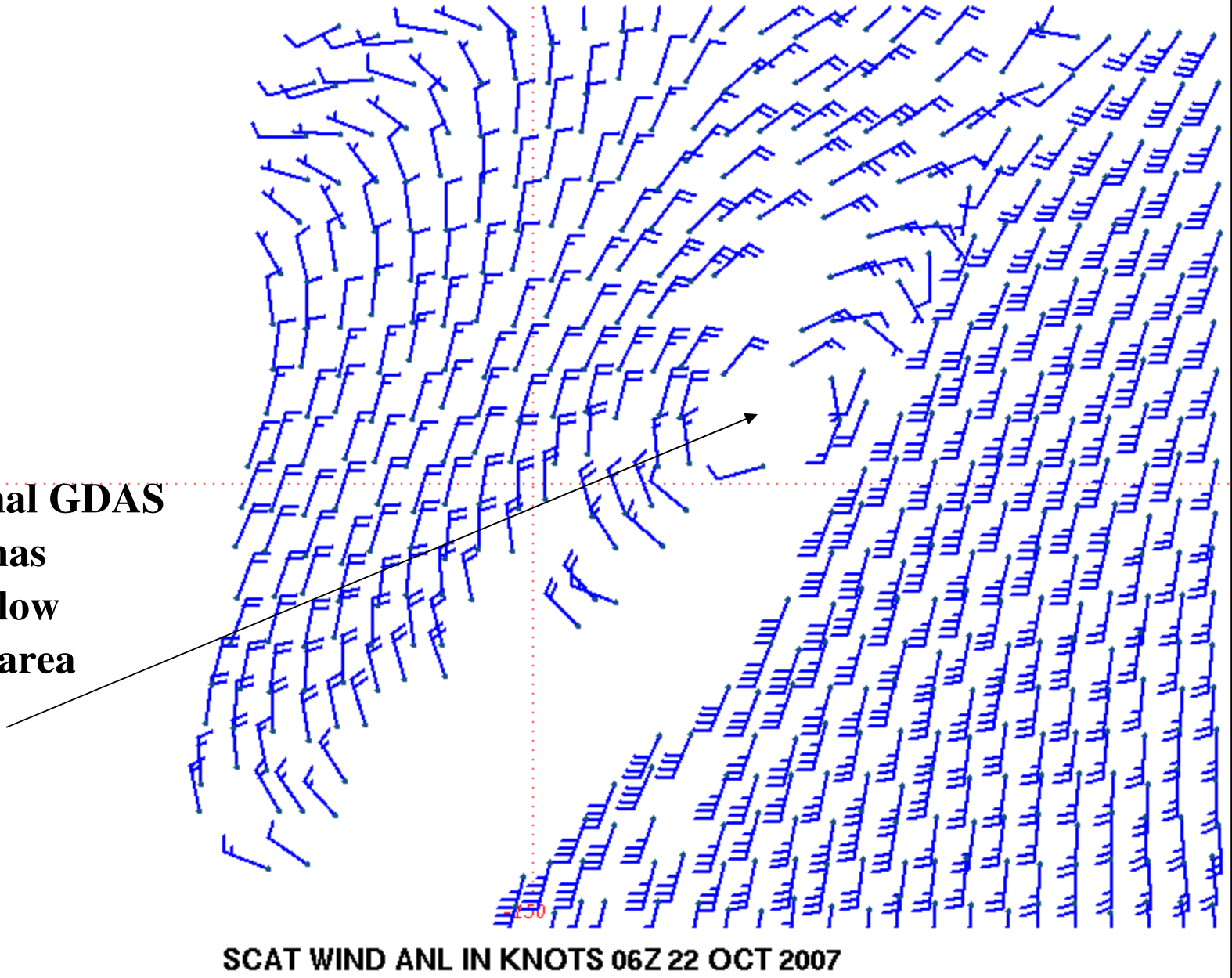
operational guess has a front not a low

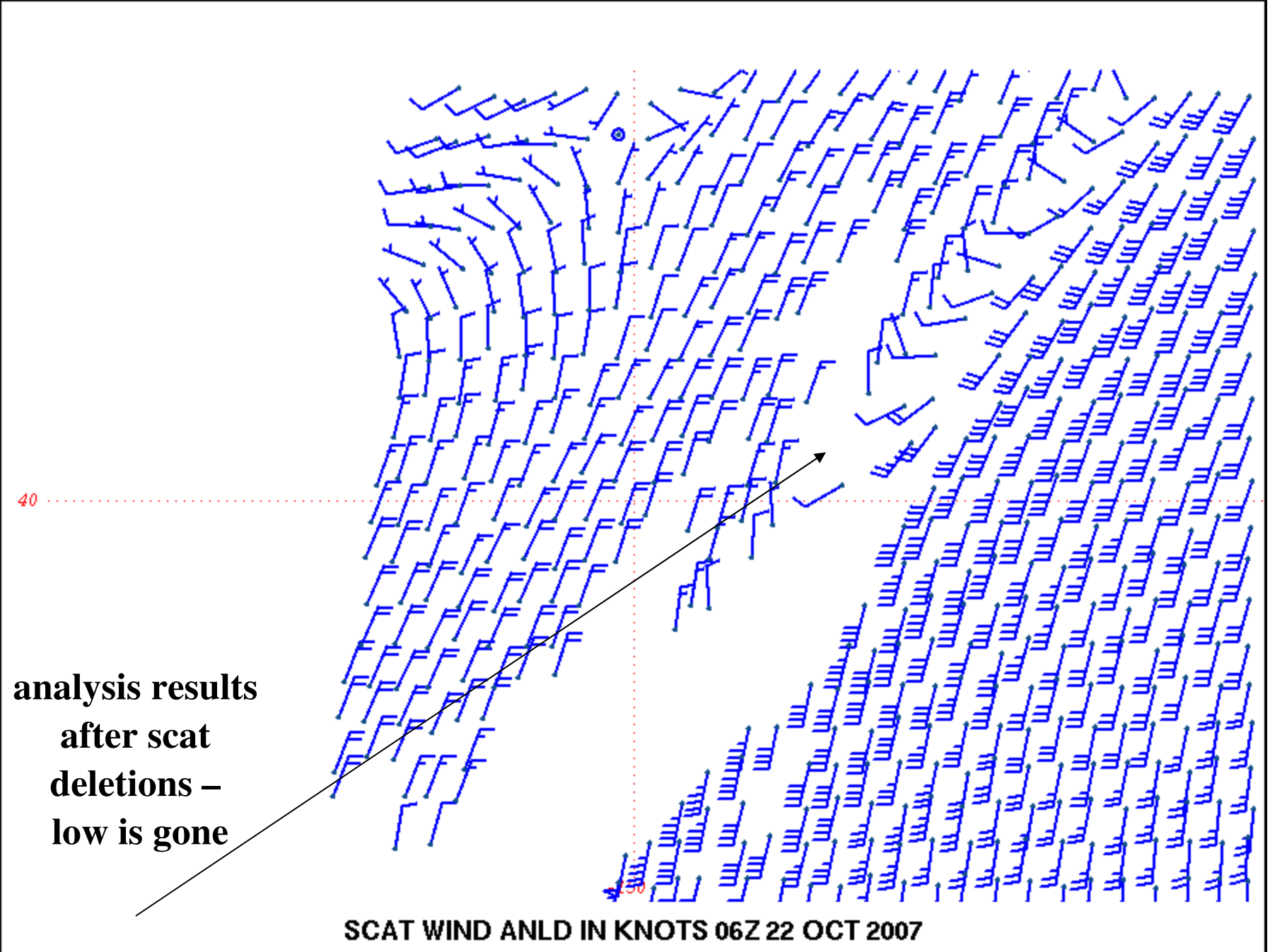
SCAT WIND GES IN KNOTS 06Z 22 OCT 2007



ECMWF Ops show just a front

operational GDAS analysis has spurious low pressure area

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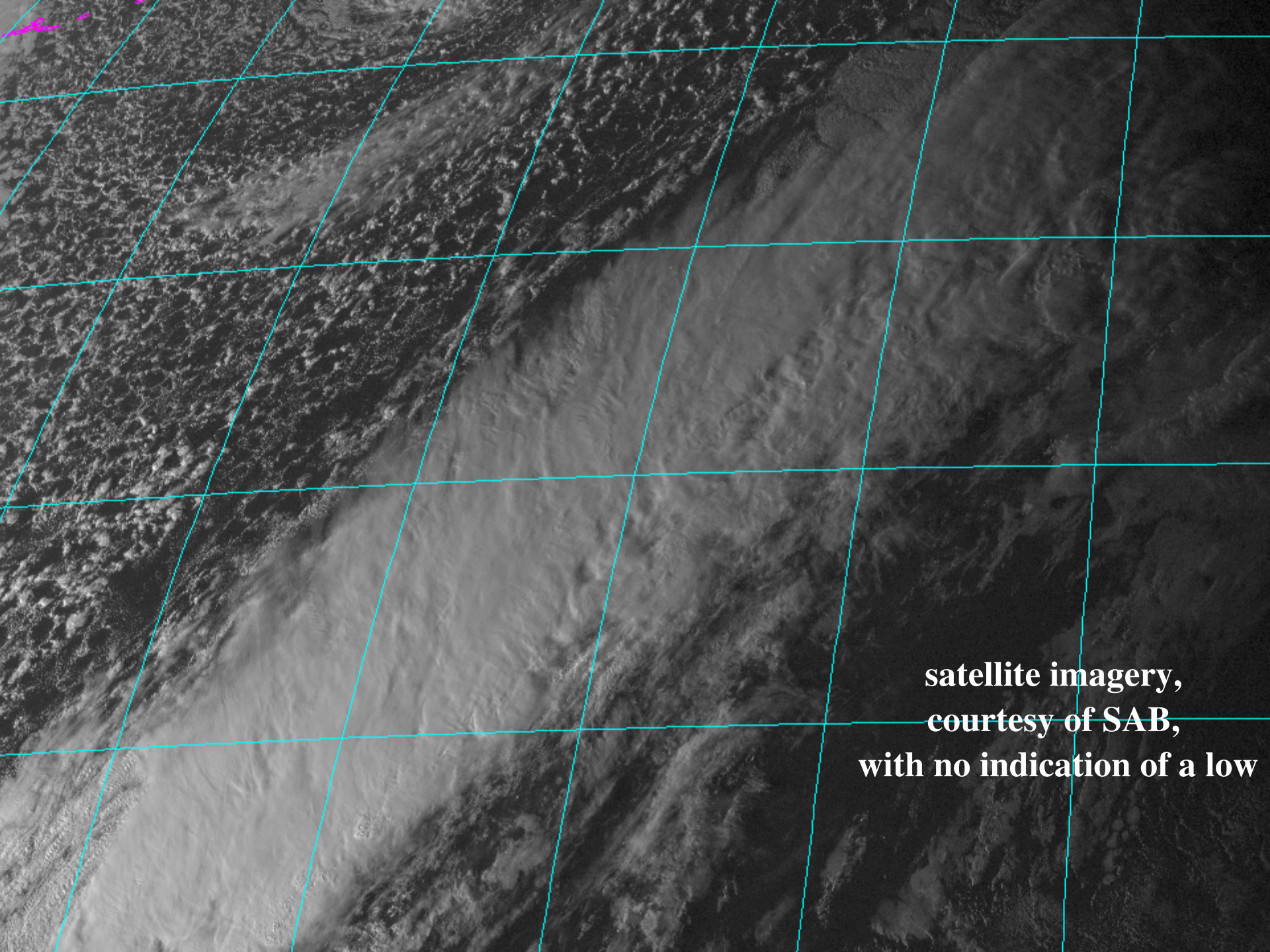
analysis results after scat deletions – low is gone
SCAT WIND ANLD IN KNOTS 06Z 22 OCT 2007


satellite imagery,
courtesy of SAB,
with no indication of a low

Observation Corrections for Quick Scat Winds
(Zap the Quick Scat)

- Scores for 10/22/2007 06Z 5-d AC for 500mb forecast Dropout Experiment (see observations delete area shown on slide 9):

- GFS Operations: .493
- GDAS Control .587
- Quick Scat Zap .768

Summary

ECM experiments have been successful in

- Investigating Dropouts,
- Improving GFS forecasts, and
- locating sensitive areas of interest

- Quickscat observation errors appear to have played a significant role in the 06Z 10/22/2007 NH dropout.

Future Work

- Investigations of the Guess input influence to the GSI is underway to study the "memory" of the GSI
- Continuation of the OCT dropout case from 06 to 12Z 10/22 to test the extent of the GSI "memory" and sensitivity to observation errors
- Determination of sensitive areas and times when dropouts may occur and automate analysis.
- QC Quick scat problem and other observation types need further investigation.