Improve Usage of Satellite Winds in NCEP Data Assimilation System

Xiujuan Su John Derber Dana Carlis Russ Treadon

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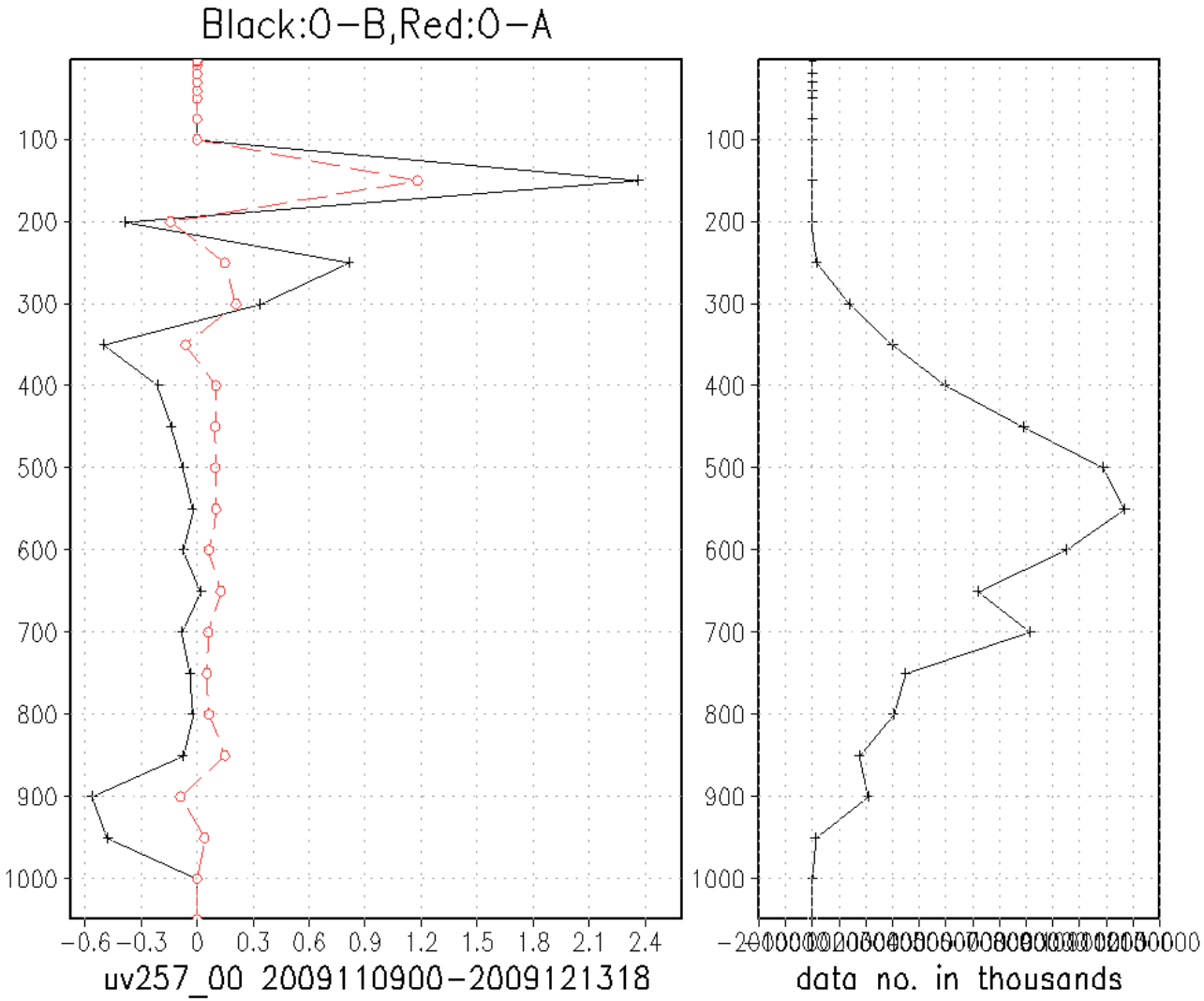
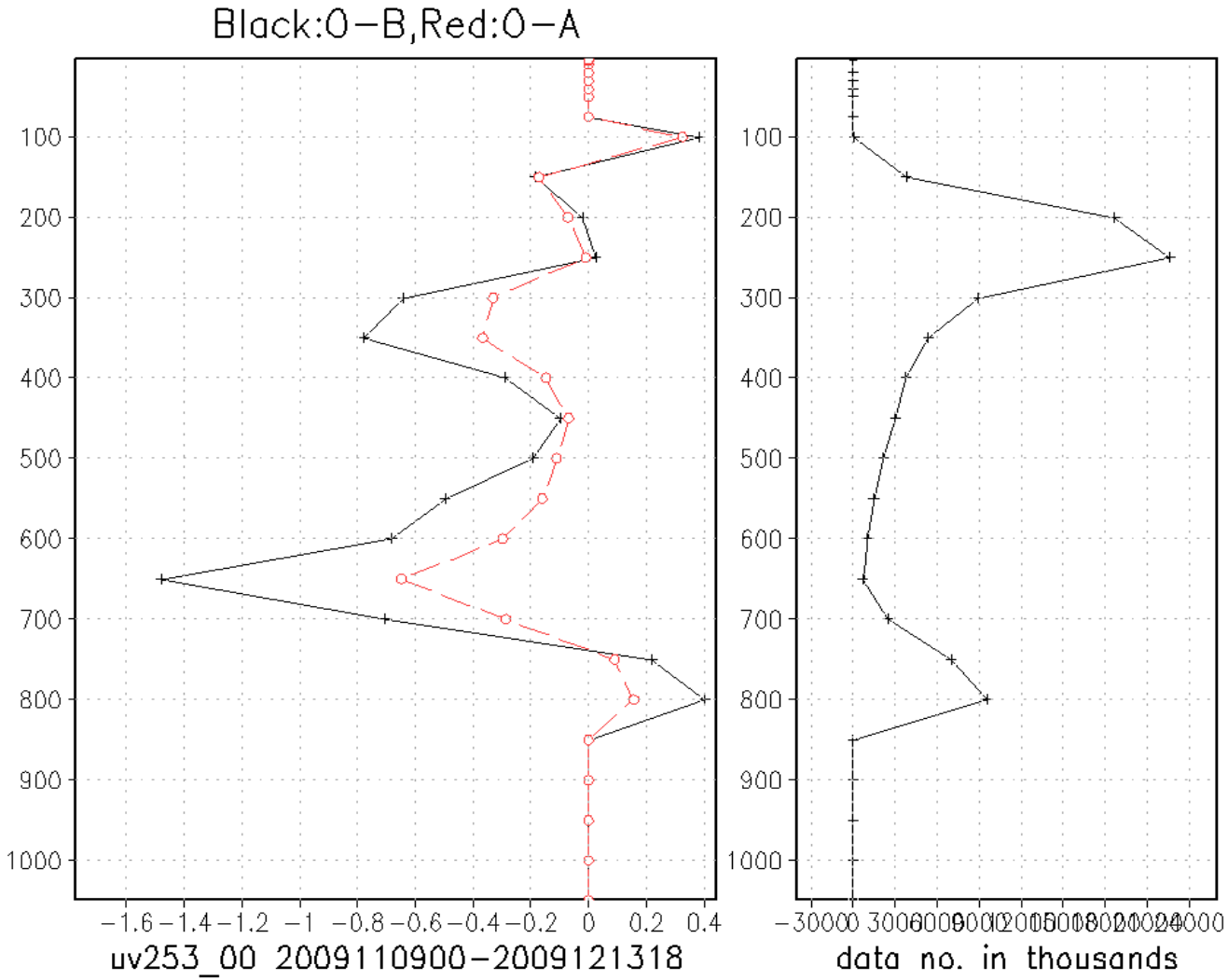
Background

- **Asymmetric gross check all satellite and thinning on Geostationary winds will be used to improve satellite wind usage.**
  - **Negative bias was found in NCEP data assimilation system (GSI) for some satellite winds**
  - **NESDIS GOES satellite winds has highest density leading large correlated errors which are not explicitly accounted for in GSI**

Examples: NESDIS MODES IR cloud drift



Examples: MET-7 IR and visible cloud drift



Method

- **Gross Check for winds in GSI**

  C=vector difference (O-B)/observation error

- If C > gross check limit, observation rejected
- Asymmetric gross check for satellite winds
  - If Speed difference O-B <0 and
  - if C > f* gross check limit, observation rejected, f<1.0

- **GOES thinning**

- Observation with higher EE+QI, closer to center box and cycle time combining was chosen
- 100(km)X100(km)X100(mb) thinning box chosen

Experiment Results

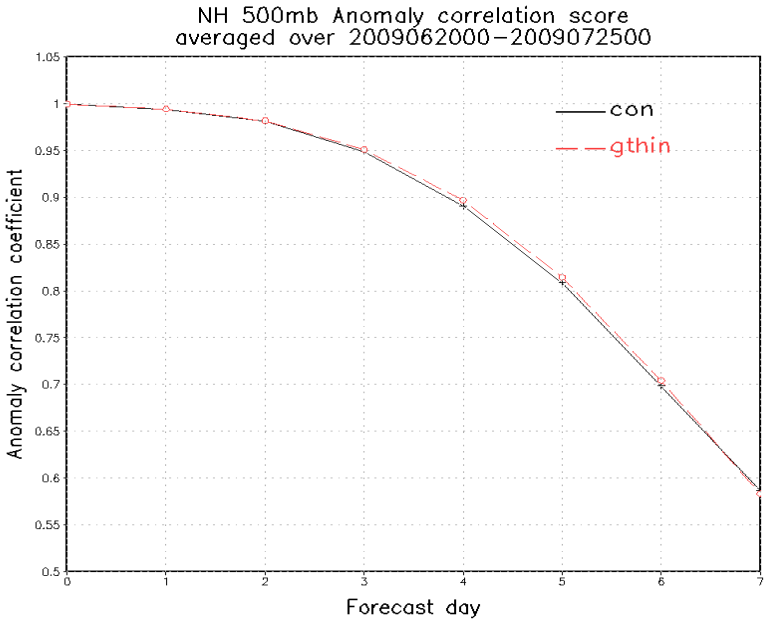
- **Satellite winds used in GSI**
  - **JMA IR and visible cloud drift**
  - **NESDIS IR cloud drift and water vapor (cloud top) (GOES and MODES)**
  - **EUMETSAT IR and visible cloud drift (not in 20090610-20090727 period)**

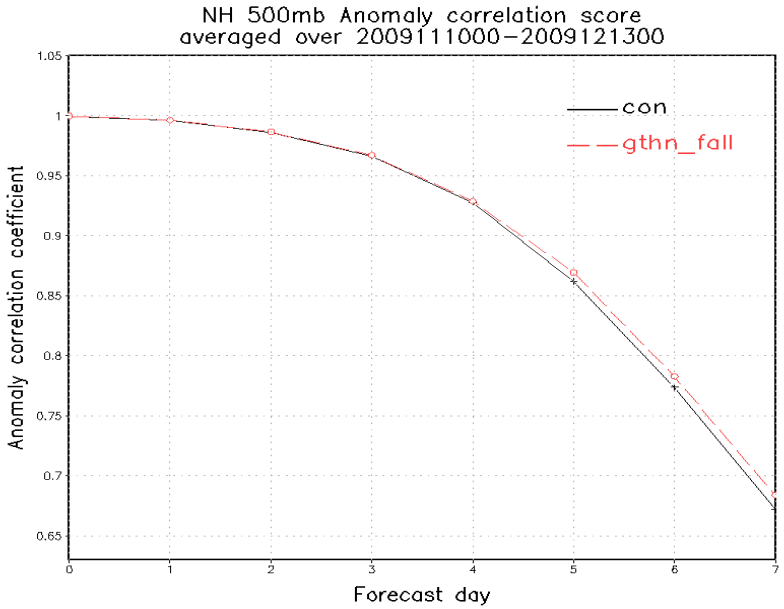
- **Experiment period and systems**
  - 20090610-20090727
    - Current operational forecast (T382L64) and data assimilation system (since December 2009)
  - 20091101-20091215
    - Current operational forecast model (implemented in December)
    - Data assimilation system (GSI) is December 03 version (subversion no. 5932)

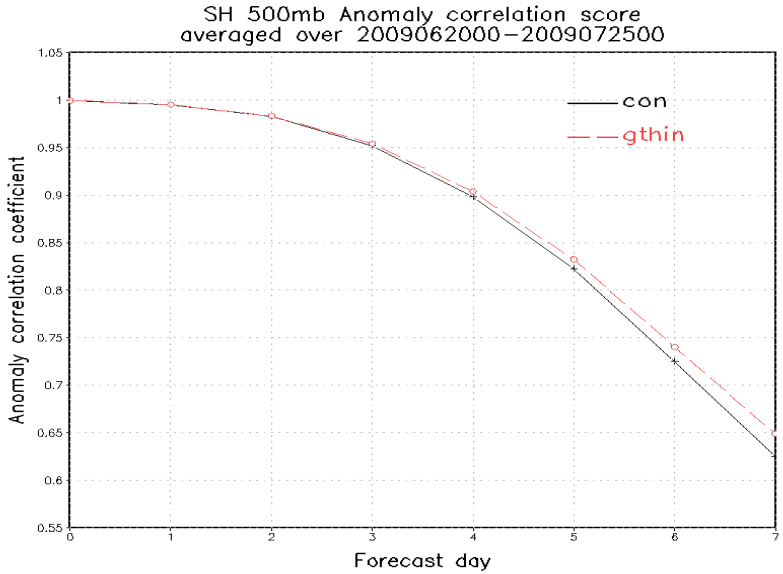
Results

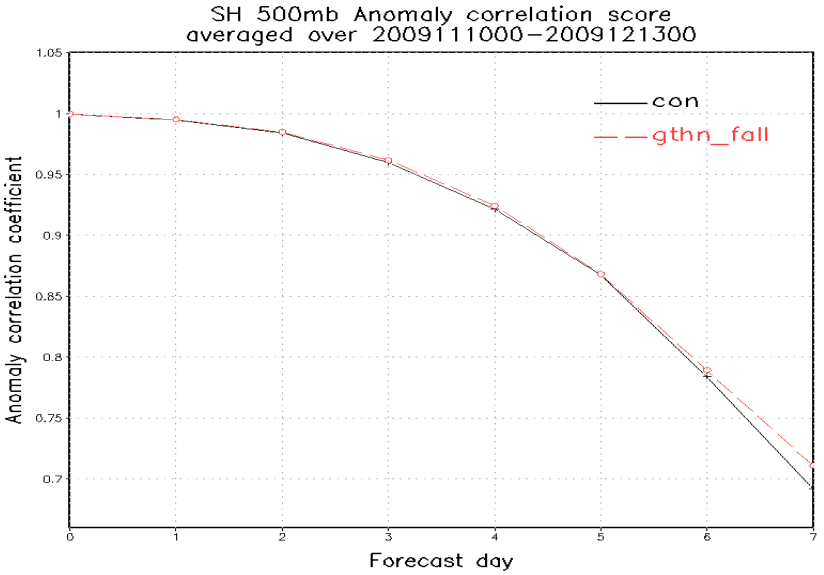
- **Forecast Impact**
- **NH and SH 500mb anomaly correlation score**
- **850 and 200mb wind RMS**

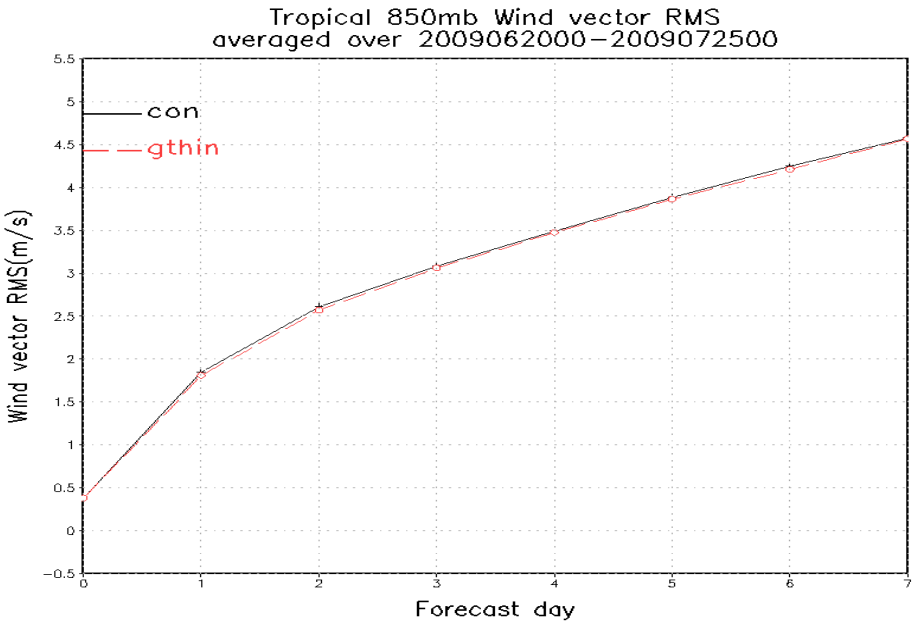
Average over experiment period

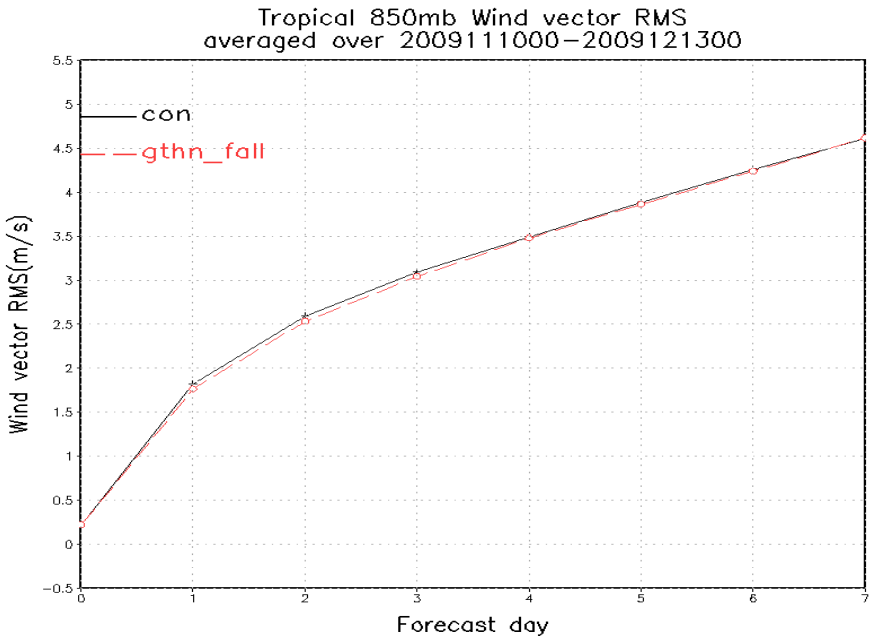


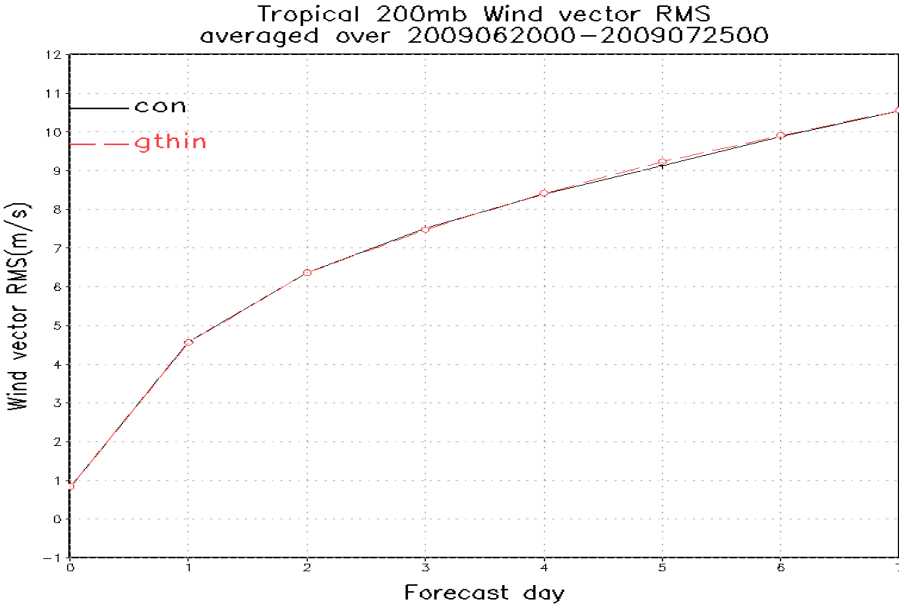


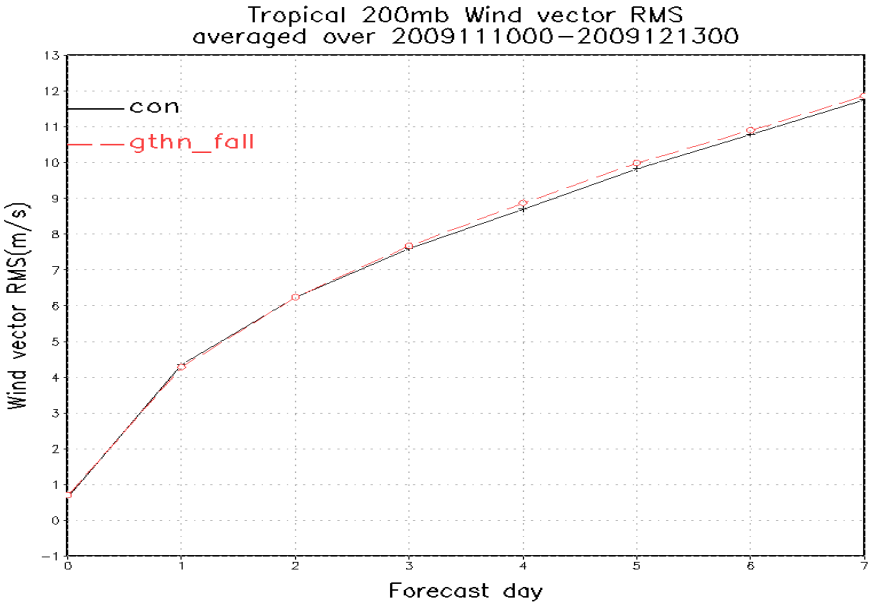




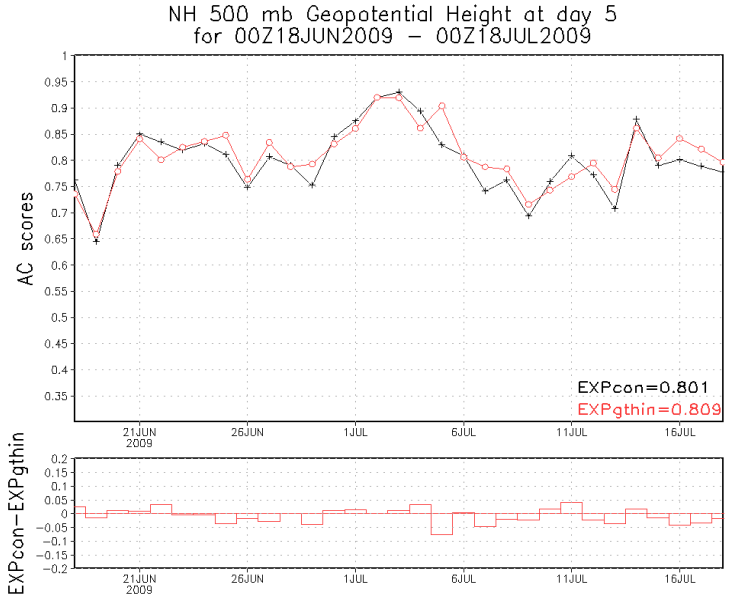

Tropical 850mb Wind vector RMS
averaged over 2009062000-2009072500
con
gthin
Wind vector RMS(m/s)
Forecast day

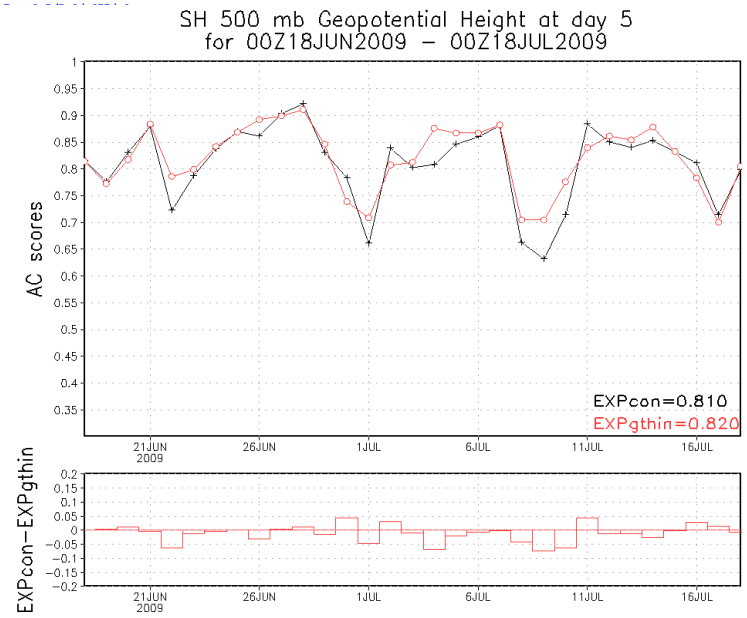

Tropical 850mb Wind vector RMS
averaged over 2009111000-2009121300
con
gthn_fall
Wind vector RMS(m/s)
Forecast day


Tropical 200mb Wind vector RMS
averaged over 2009062000-2009072500
con
gthin
Wind vector RMS(m/s)
Forecast day

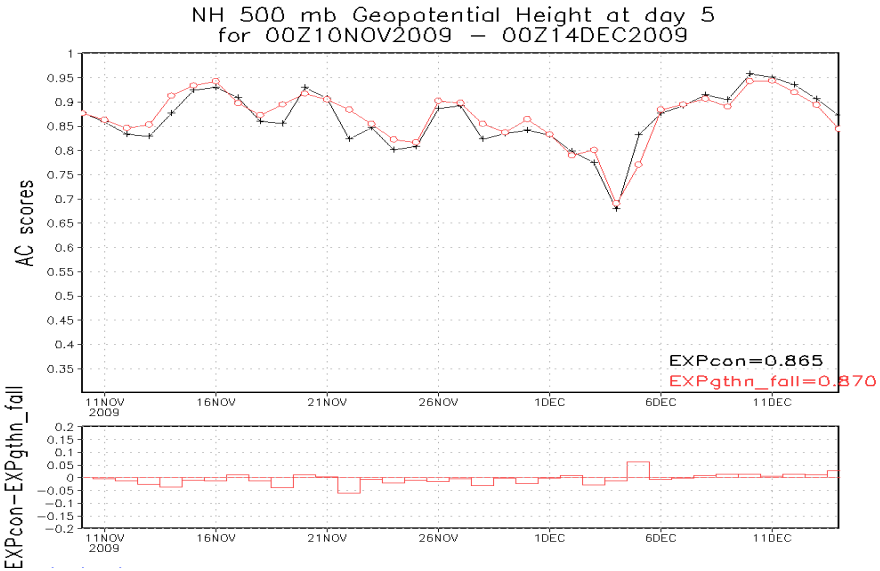

Tropical 200mb Wind vector RMS
averaged over 2009111000-2009121300
con
gthn_fall
Wind vector RMS(m/s)
Forecast day

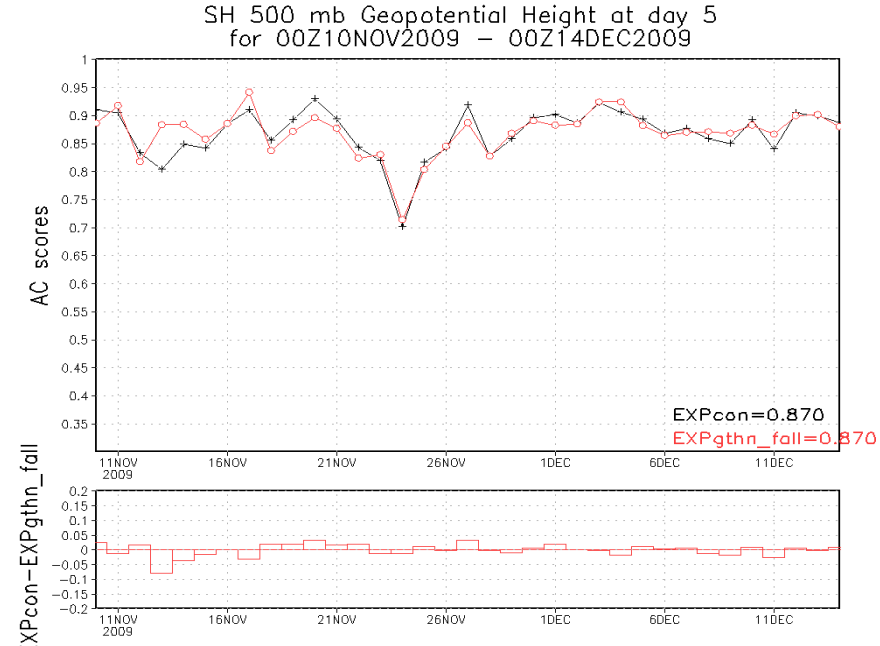
Time Series





YUEJIAN ZHU, GMB/EMC/NCEP/NOAA





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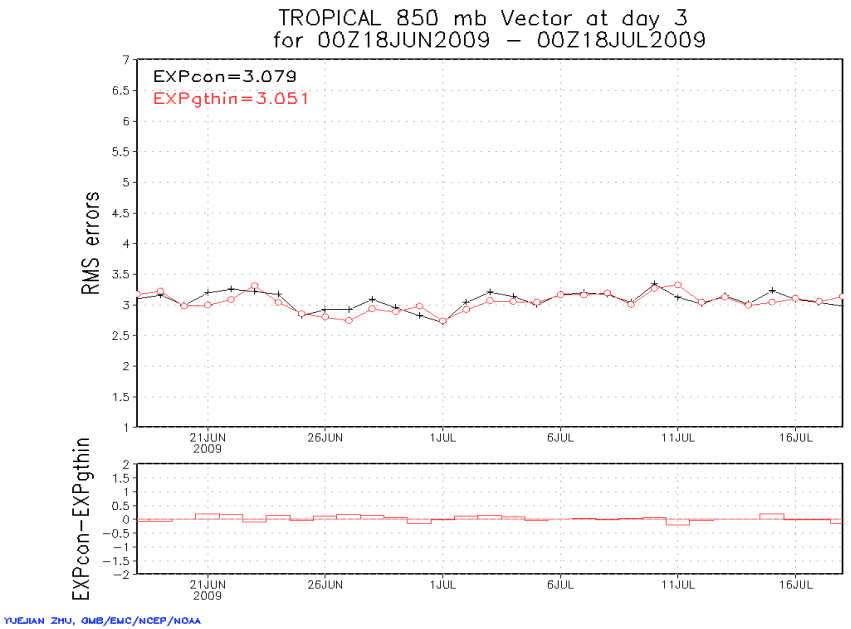
TROPICAL 850 mb Vector at day 3
for 00Z18JUN2009 – 00Z18JUL2009
EXPcon=3.079
EXPgthin=3.051
RMS errors
EXPcon–EXPgthin
21JUN 2009
26JUN
1JUL
6JUL
11JUL
16JUL
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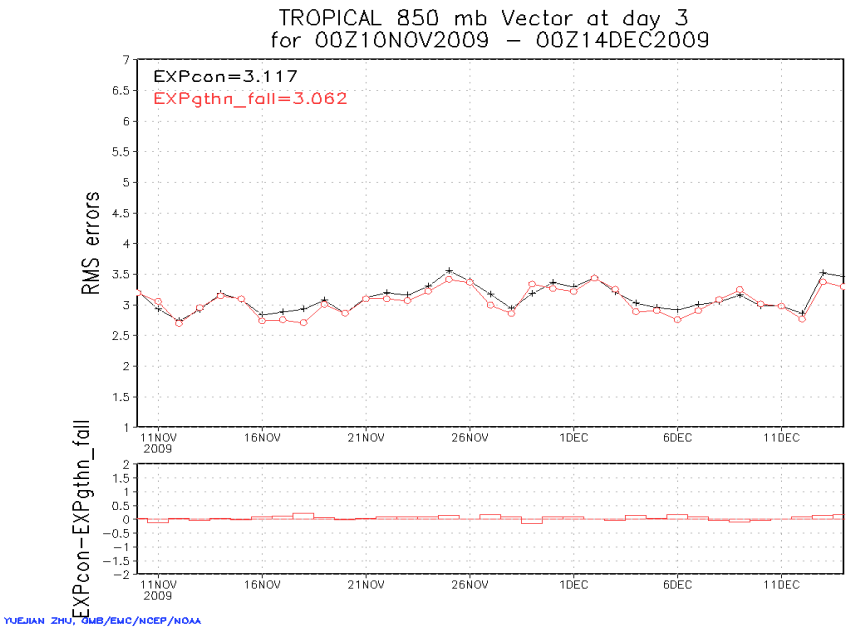
TROPICAL 850 mb Vector at day 3
for 00Z10NOV2009 – 00Z14DEC2009
EXPcon=3.117
EXPgthn_fall=3.062
RMS errors
EXPcon–EXPgthn_fall
11NOV 2009
16NOV
21NOV
26NOV
1DEC
6DEC
11DEC
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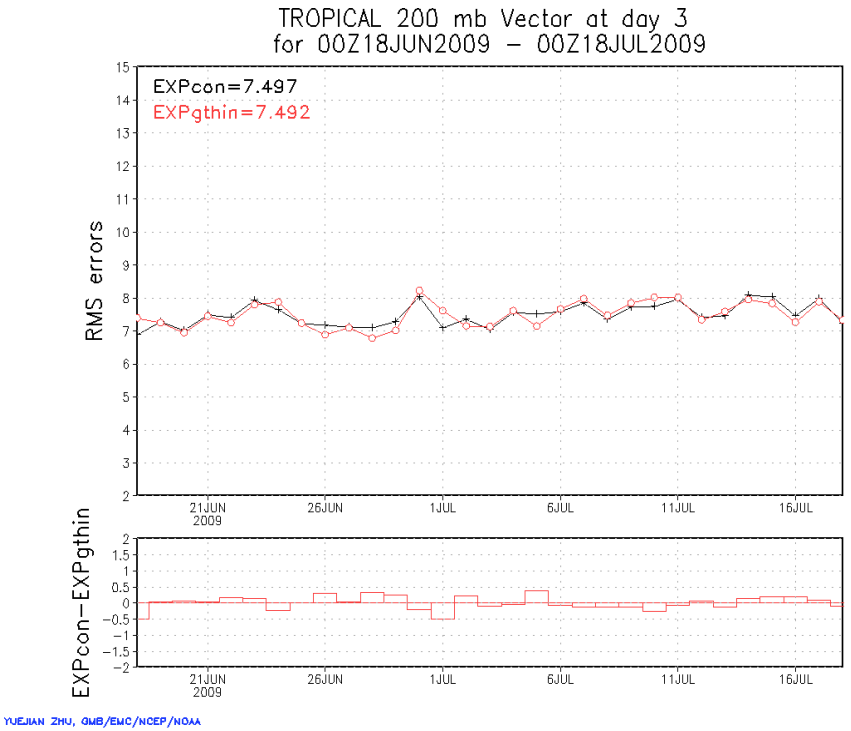
TROPICAL 200 mb Vector at day 3
for 00Z18JUN2009 – 00Z18JUL2009
EXPcon=7.497
EXPgthin=7.492
RMS errors
EXPcon–EXPgthin
21JUN 2009
26JUN
1JUL
6JUL
11JUL
16JUL
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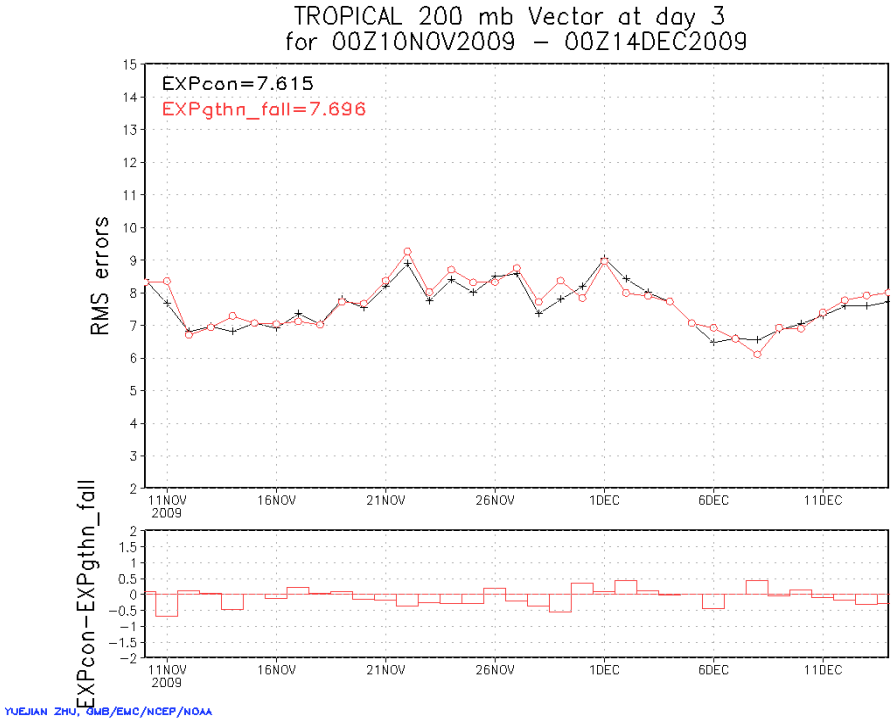
TROPICAL 200 mb Vector at day 3
for 00Z10NOV2009 – 00Z14DEC2009
EXPcon=7.615
EXPgthn_fall=7.696
RMS errors
EXPcon–EXPgthn_fall
11NOV 2009
16NOV
21NOV
26NOV
1DEC
6DEC
11DEC
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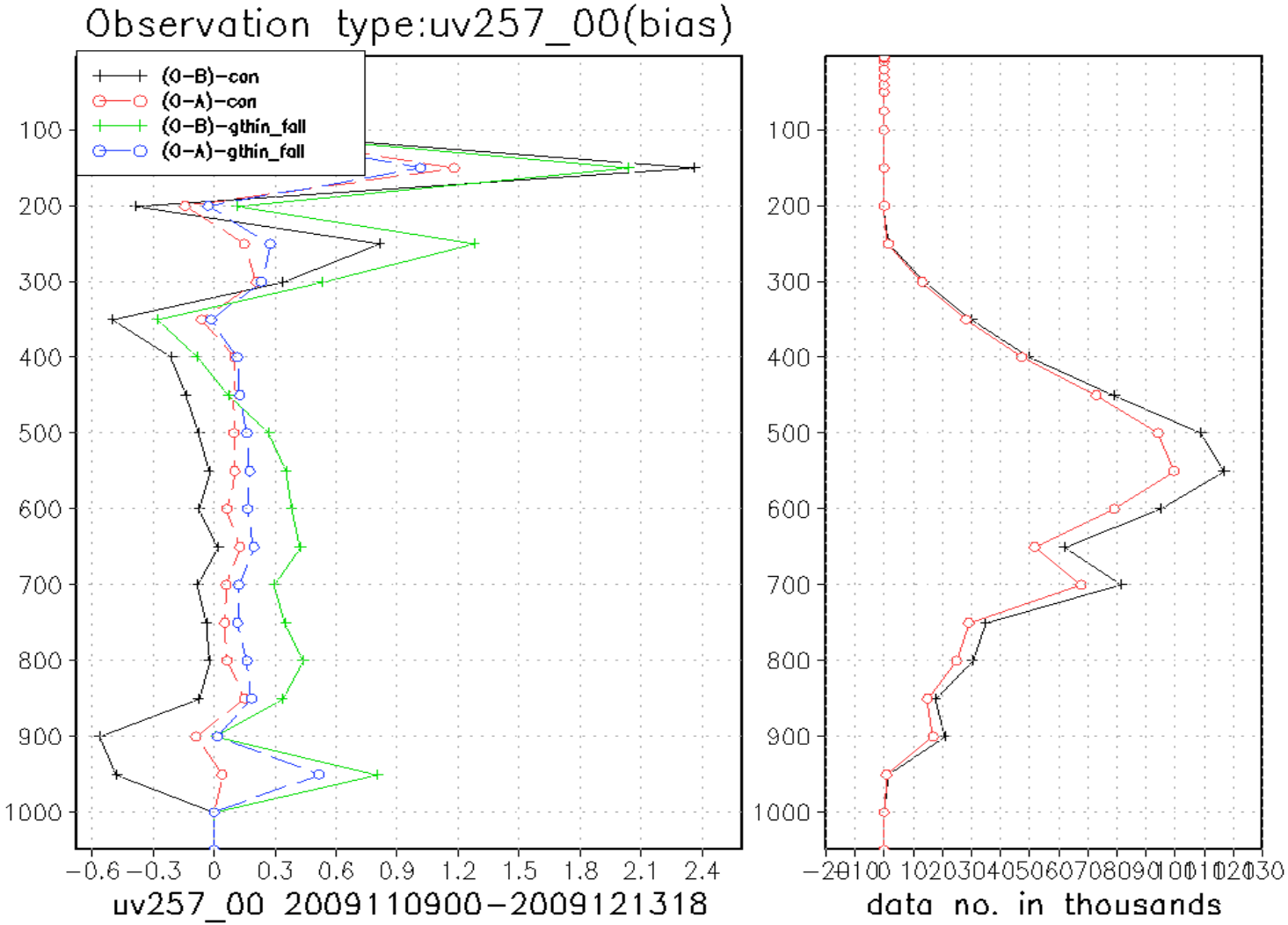
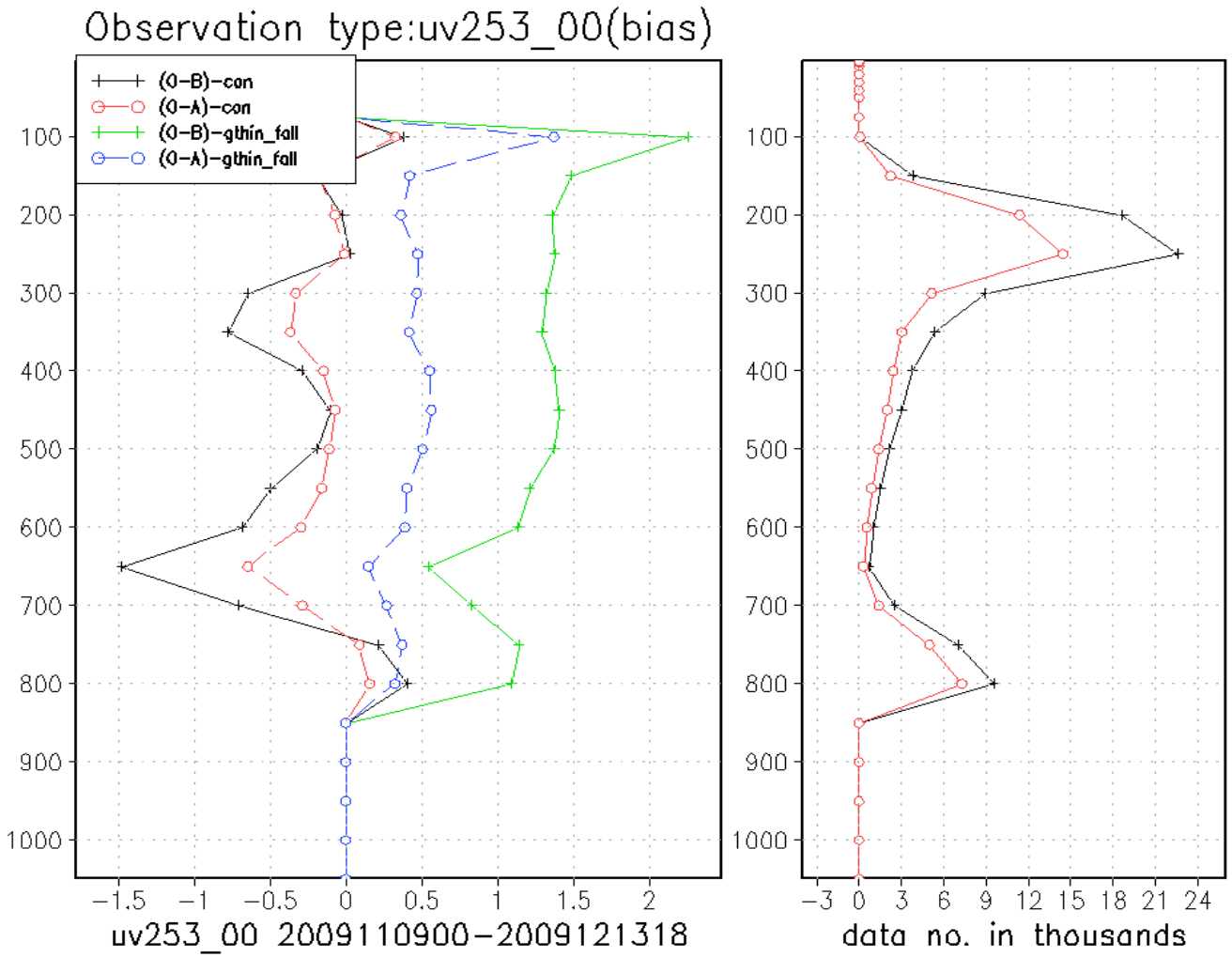
Impact on background fits




Observation type:uv253_00(bias)
(O-B)-con
(O-A)-con
(O-B)-gthin_fall
(O-A)-gthin_fall
100
200
300
400
500
600
700
800
900
1000
−1.5
−1
−0.5
0
0.5
1
1.5
2
uv253_00 2009110900-2009121318
−3
0
3
6
9
12
15
18
21
24
data no. in thousands

Data rejected by asymmetric gross check and thinning

Satellite wind type	Thinning and asymmetric gross check
JMA IR and visible low level(242)	389530, 8.1% rejected
MET-7 IR and visible low level (243_00)	95840, 17.6% rejected
MET-9 IR and **visible low level (243_56)**	188790, 19.8% rejected
GOES IR cloud drift (245)	1115900, 52.5% rejected
GOES IR Water vapor (246)	584240, 55.1% rejected
JMA IR and visible high level(252)	312920, 20.7% rejected
MET-7 IR and visible all level (253_00)	67073, 36.8% rejected
MET-9 IR and visible all level (253_56)	138470, 36.4% rejected
MODES IR cloud drift(257)	775160, 13.5% rejected
MODES IR water vapor(258)	452690, 6.3% rejected

Summary

- An asymmetric gross check and a thinning algorithm is applied in GSI to improve satellite wind usage
- The results show positive forecast impacts on Northern and Southern Hemisphere, neutral in tropical regions over two test periods.
- The rate of data rejection by asymmetric check varies greatly from one type to another, from less than 10% for JMA low level winds and MODES water vapor to up 30% for MET winds
- The negative speed biases (O-B) for all satellite winds are reduced and become positive bias for most levels of most satellite winds

Future Plans

- **Investigate height assignment feature in GOES satellite winds**
- **Continue fine tune asymmetric gross check factor**