Improve Usage of Satellite Winds in NCEP Data Assimilation System

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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**
  
  \[ C = \text{vector difference } (O-B) / \text{observation error} \]
  
  - If \( C > \text{gross check limit} \), 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
Time Series

NH 500 mb Geopotential Height at day 5 for 00Z18JUN2009 - 00Z18JUL2009

SH 500 mb Geopotential Height at day 5 for 00Z18JUN2009 - 00Z18JUL2009

NH 500 mb Geopotential Height at day 5 for 00Z10NOV2009 - 00Z14DEC2009

SH 500 mb Geopotential Height at day 5 for 00Z10NOV2009 - 00Z14DEC2009
Impact on background fits

Observation type: uv257_00 (bias)

- (O-A) - con
- (O-B) - con
- (O-B) - gthin_fall
- (O-A) - gthin_fall

uv257_00 2009110900-2009121318

data no. in thousands
Observation type: uv253_00 (bias)

- (o-b) - con
- (o-a) - con
- (o-b) - githin_fall
- (o-a) - githin_fall

uv253_00 2009/11/09 00-2009/12/31 18

Data no. in thousands
### Data rejected by asymmetric gross check and thinning

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