NOAA Products Validation System (NPROVS)

Tony Reale
NOAA/NESDIS
Center for Satellite Applications and Research (STAR)

Bomin Sun, Michael Pettey, Frank Tilley and Charles Brown
(IM System Group)

IGARSS 2011
NPP Users Workshop

May 10-11, 2011
NOAA Products Validation System (NPROVS)

Routine
day to day
soundings products monitoring at STAR
(characteristic differences)
using
conventionally available observations

* first ever routine GOES vs POES
NOAA Products Validation System (NPROVS)

Centralized Radiosonde and Collocation Processing

- NASA-EOS-Aqua AIRS
- COSMIC (UCAR)
- DMSP F-16 MIRS
- NOAA-18: ATOVS MIRS
- NOAA-19: ATOVS MIRS
- GOES (11,13 ... R)
- MetOp: ATOVS MIRS IASI (NOAA) IASI (EU)

Collocated radiosonde and multiple satellite products dataset

NWP:
- GFS 6-hr
- CFSR Re-anal
- CFSR back
- GDAS Anal

April 2008 ...

Single Closest
... distribution of collocated satellite products around radiosonde
NPROVS- Environmental Data Graphical Evaluation (EDGE) Analytical Interface
NPROVS - EDGE

ODS: orbital products display

Daily H2O Vapor @ 850mb
Raw data as stored on product data record

<table>
<thead>
<tr>
<th>IASI Satellite Data - NOAA IASI/RAOB</th>
<th>Level Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrieval QC Flag</td>
<td>Level</td>
</tr>
<tr>
<td>Data Frame</td>
<td>80</td>
</tr>
<tr>
<td>Scan Line</td>
<td>81</td>
</tr>
<tr>
<td>Field Of View</td>
<td>82</td>
</tr>
<tr>
<td>View Angle</td>
<td>83</td>
</tr>
<tr>
<td>Solar Zenith Angle</td>
<td>84</td>
</tr>
<tr>
<td>Satellite Height</td>
<td>85</td>
</tr>
<tr>
<td>Surface Height</td>
<td>86</td>
</tr>
<tr>
<td>Land Fraction</td>
<td>87</td>
</tr>
<tr>
<td>MW Surface Class</td>
<td>88</td>
</tr>
<tr>
<td>Surface Pressure</td>
<td>89</td>
</tr>
<tr>
<td>Skin Temperature</td>
<td>90</td>
</tr>
<tr>
<td>MIT Skin Temperature</td>
<td>91</td>
</tr>
<tr>
<td>1st Guess Skin Temperature</td>
<td>92</td>
</tr>
<tr>
<td>MW Surface Emissivity</td>
<td>93</td>
</tr>
<tr>
<td>Column Averaged CO2</td>
<td>94</td>
</tr>
</tbody>
</table>

Raw data is always available for displayed for PDISP and ODS...
NPROVS - EDGE
NARCS: long term summary of sampling, sat-minus sonde

NOAA/NESDIS/STAR NPROVS Collocation Summary Statistics (NARCS)
800 mb temperature

SAT-minus-RAOB
SD
BIAS
NPROVS Web Site

http://www.star.nesdis.noaa.gov/smcd/opdb/poes/NPROVS.php

NPROVS Overview

NPROVS routinely (daily) compiles datasets of collocated radiosonde, dropsonde and appended numerical weather prediction (NWP) data with the following satellites and sounding (temperature and moisture) product suites:

- NASA- EOS-Aqua (AIRS)
- NOAA-18: ATOVS MIRS
- JPSS NPP PROXY
- COSMIC (UCAR)
- NOAA-19: ATOVS MIRS
- DMSP F-16 MIRS
- GOES-12, 13
- MetOp: ATOVS MIRS IASI (NOAA) IASI (EU)
PDISP

(common denominator sampling)
NPROVS - EDGE

PDISP: display and analysis of collocated data
PDISP Sampling Options for Display/Statistics

- **Radiosonde (dropsonde)**
  - Terrain (land, coast, ship, island)
  - Cloud amount
  - Synoptic time (0, 6, 12, 18)
  - *Day/nite (coming soon)*
  - Superadiabatic
  - Moisture profile shape
  - *UT/LS ... supsicous moisture*
  - T inversions (surface, aloft)
  - Rad Correction (site, NCEP)
  - Sampling network (GCOS, GRUAN)
  - Site id
  - Instrument type
  - Time period
  - Region

- **Satellite**
  - Product system (ATOVS, IASI, COSMIC...)
  - QC flag
  - Clear, partly cloudy, cloudy
  - Sea, nonsea
  - Day, night
  - Time window increments
  - Space window
**PDISP Sampling Option Examples**

**NOAA/NESDIS/STAR Satellite/Radiosonde Collocations**

<table>
<thead>
<tr>
<th>Radiosonde Location</th>
<th>7810(797) available out of 7810</th>
<th>Coast</th>
<th>Land</th>
<th>Island</th>
<th>Coast</th>
<th>Island</th>
<th>Inland</th>
<th>Ship</th>
<th>Dropsonde</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>7810</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

-May 28, 2011 (14z) to June 3, 2011 (13z)-

**NOAA/NESDIS/STAR Satellite/Radiosonde Collocations**

<table>
<thead>
<tr>
<th>Radiosonde Location</th>
<th>310(80) available out of 7810</th>
<th>Coast</th>
<th>Land</th>
<th>Island</th>
<th>Coast</th>
<th>Island</th>
<th>Inland</th>
<th>Ship</th>
<th>Dropsonde</th>
</tr>
</thead>
<tbody>
<tr>
<td>IASI (QC) ... 7619, (4770)</td>
<td>AIRS (QC) ... 4481, (3610)</td>
<td>Island + Ship ... 673</td>
<td>Vais RS92 ... 328</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

-May 28, 2011 (14z) to June 3, 2011 (13z)-
PDISP Displays Individual Collocation

NOAA/NESDIS/STAR Collocated Profile Display

Vertical Density Options:
- Original *
- ATOVS/GOES 40
- IASI / AIRS 100
- GDAS 26
- NPP 30 Layers

Radiosonde 03005 (80) 5/28/2011 23:23 60.13 N 1.17 W
AIRS AQUA (0) 5/29/2011 02:07:12 59.95 N 1.69 W 34.9 km from Raob
IASI NOAA 5/28/2011 21:38:52 60.10 N 1.47 W 16.8 km from Raob
NOAA/NESDIS/STAR Scatter Plot
Retrieved Temperature (kg/m^3) ~ 650 mb
May 20, 2011 to June 2, 2011

NOAA/NESDIS/STAR Scatter Plot
Retrieved Temperature (kg/m^3) ~ 114 mb
May 20, 2011 to June 2, 2011

PDISP Scatter Plot

650 mb

114 mb

RAOB Radiosonde (GFS)
AIRS AQUA (MODIS)
IASI NPP (MODIS)

IASI
AIRS
Raob

All vs RAOB
Scatter Plot Outlier

NOAA/NESDIS/STAR Collocated Profile Display

Temperature (deg K)

<table>
<thead>
<tr>
<th>Radioonde 72493 (87)</th>
<th>5/28/2011</th>
<th>23:00</th>
<th>37.74 N</th>
<th>122.21 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRS AQUA (I)</td>
<td>5/28/2011</td>
<td>20:48:22</td>
<td>37.6 N</td>
<td>122.07 W</td>
</tr>
<tr>
<td>IASI NOAA</td>
<td>5/28/2011</td>
<td>18:38:46</td>
<td>37.68 N</td>
<td>121.67 W</td>
</tr>
</tbody>
</table>
NARCS
(independent sampling)
NARCS Interface
NARCS (independent samples)
new NARCS multi-level interface
Upgrades / Expansions / Research

- JPSS / NPP / EDR’s
- Levels to layers; T and Precipitable water
  - 40 TOVS; 100 IASI; 26 NWP; 30/20 layers
- CFSR, Forecast and Analysis @ Raob
- WMO / CIMO Radiosonde Inter-comparisons
- AEROSE
- Concordiasi Dropsonde Experiment (Oct-Dec 2010, NCAR, Jun Wang)
- Ground GPS (ESRL, JCSDA … S. Gutman)
- COSMIC (UCAR, JPL)
- Raob Radiation Correction Analysis w NWS
- GCOS Reference Upper Air Network (GRUAN)

- Surface Data (Bob Yu, GOES-R …)
<table>
<thead>
<tr>
<th>Radiosonde Location</th>
<th>1814 (17) available out of 1814</th>
</tr>
</thead>
</table>

ConcordIASI

NOAA/NESDIS/STAR Satellite/Radiosonde Collocations

*Coast Land Island Coast Island Inland Ship Dropsonde*

Drops and Raobs
ConcordIASI

NOAA/NESDIS/STAR Vertical Accuracy Statistics

September 22, 2010 to December 10, 2010

(X)-minus-Raob

Baseline: RAOB Radiosonde

RAOB CFSR Forecast  RAOB CFSR Analysis  RAOB GFS Forecast

IASI NOAA
ConcordIASI

NOAA/NESDIS/STAR Vertical Accuracy Statistics

September 22, 2010 to November 12, 2010

Temperature (sat-baseline) deg K: Bias / Std Dev

Baseline: RAOB Radiosonde

RAOB CFSR Forecast  RAOB CFSR Analysis  RAOB GFS Forecast

-minus-Drop
Atlantic Aerosol and Ocean Sciences Expedition (AEROSE)
H2O vapor Mix Ratio Fraction (%)
AEROSE

Temperature (sat-baseline) deg K: Bias / Std Dev

Baseline System: RA08 Radiosonde

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Bias</th>
<th>Std Dev</th>
<th>AIRS</th>
<th>Nag Diff</th>
<th>Forg Diff</th>
<th>Nag Diff %</th>
<th>Forg Diff %</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOAA</td>
<td>-0.47</td>
<td>0.74</td>
<td>0.76</td>
<td>-1.95</td>
<td>0.96</td>
<td>40.00</td>
<td>62.00</td>
<td></td>
</tr>
<tr>
<td>AIRS</td>
<td>0.70</td>
<td>0.91</td>
<td>2.64</td>
<td>-1.79</td>
<td>0.95</td>
<td>40.00</td>
<td>62.00</td>
<td></td>
</tr>
</tbody>
</table>

Temperature (sat-baseline) deg K: Bias / Std Dev

Baseline System: RA08 Radiosonde

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Bias</th>
<th>Std Dev</th>
<th>AIRS</th>
<th>Nag Diff</th>
<th>Forg Diff</th>
<th>Nag Diff %</th>
<th>Forg Diff %</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOAA</td>
<td>-0.19</td>
<td>1.34</td>
<td>7.41</td>
<td>-1.3</td>
<td>5.19</td>
<td>22.09</td>
<td>45.00</td>
<td></td>
</tr>
<tr>
<td>AIRS</td>
<td>1.36</td>
<td>1.34</td>
<td>7.41</td>
<td>-1.3</td>
<td>5.19</td>
<td>22.09</td>
<td>45.00</td>
<td></td>
</tr>
</tbody>
</table>

July 14, 2009 to August 6, 2009

April 28, 2010 to May 22, 2010
Coordination with GCOS Reference Upper Air Network (GRUAN) (www.gruan.org)

  - Lindenburg, Germany, DWD, Lead Center
  - Implementation and Coordination Meeting-3 (ICM-2) held in March, 2011; New Zealand

- Synergy between GRUAN and satellite validation
  - Use of reference observations for global satellite products validation
  - Use of satellites to verify site instrumentation
  - Use of reference observations for RT Model validation.

… absolute accuracy (error bars)
Initial GRUAN stations
The GCOS Reference Upper-Air Network is tasked to:

- Provide long-term high-quality upper-air climate records
- Constrain and calibrate data from more spatially-comprehensive global observing systems (including satellites and current radiosonde networks)
- Fully characterize the properties of the atmospheric column
  - “site atmospheric state best estimates”
    - D Tobin et.al. …, JGR, 2006; … ARM sites
NPROVS Overview

NPROVS routinely (daily) compiles datasets of collocated radiosonde, dropsonde and appended numerical weather prediction (NWP) data with the following satellites and sounding (temperature and moisture) product suites:

- NASA-EOS-Aqua AIRS
- COSMIC (UCAR)
- DMSP F-16 MIRS
- GOES-12/13
- NOAA-18: ATOVS MIRS
- NOAA-19: ATOVS MIRS
- MetOp: ATOVS MIRS [ASI (NOAA) ASU (EU)]
- JPSS NPP PROXY