COSMIC Data Analysis and Archive Center (CDAAC)
Overview and Status


UCAR COSMIC Program

5th FORMOSAT-3 / COSMIC Data Users Workshop & ICGPSRO 2011
COSMIC Operational Processing

Providing data to > 1,549 registered users from 59 countries
CDAAC Objectives

- Provide high quality COSMIC RO data to the community in NRT, post-processing, re-processing (re-analysis)

- Improve data processing algorithms to maximize impact of RO data on research and operations

- Support data users, TACC

- Support other RO missions of opportunity (SAC-C, C/NOFS, ..)

- Perform validation and science investigations
2.8 Million COSMIC Profiles
4/21/06 – 4/11/2011

Processed data for cosmic: 2006.111-2011.100
Total atmospheric occultations: 2,824,486
COSMIC Data Products

- LEO POD and excess phase (<15 cm, <0.15 mm/s 3D rms)
- > 2.8M neutral atmospheric profiles:
  - Bending angle noise ~1.5-2.0 μ-rad between 60-80km
  - Bending angle stability ~ 0.02 μ-rad from 13,500 COSMIC-GRAS collocations
- > 3M Absolute TEC data arcs:
  - Absolute accuracy ~ 2-3 TECU, Relative accuracy ~ 0.0024 TECU at 1-Hz
- > 2.8M Electron Density Profiles:
  - NmF2/hmF2 Accuracy ~20%/20km (compared to Ionosondes)
- Scintillation Indices (S4):
  - ~2.8M available from occultation profile events (altitudes < 120 km)
  - 1 Hz data available from > 3M line of sight tracks to all GPS in view
- TIP Night-side Radiances:
  - TIP set new standard for sensitivity of UV instruments, ~500 counts/s/Rayleigh
  - > 17,800 hours of quality controlled data
• Test new firmware version on FM1 week of April 18-22, 2011

• Firmware Capabilities
  - Improved L2C tracking
  - Collection of 50 Hz L1 phase/amplitude in F-layer data on reference satellites
  - Tracking of deep signals ~ -350 km HSL
C/NOFS CORISS Data

Refractivity statistics with ECMWF, 20<Lat<30

• USAF mission launched Apr 16, 2008, JPL/Aerospace, Closed Loop, single patch antenna
• CDAAC providing 125-150 tropical occultations per day (~ 3 COSMIC FMs) to NOAA
• Profiles below 8km altitude will be provided in GTS profiles
• Only day-side occultations, UCAR working with Paul Straus to modify occultation tracking to get night-side data
• Possibility to upload OL firmware, but cpu limited
SAC-C and COSMIC
Global Refractivity statistics vs ECMWF, 2010.335-364

- JPL BlackJack, Open Loop, single element antenna
- CDAAC providing 140-150 occultations per day to NOAA
- CDAAC working with Tom Meehan and CONAE to
  - configure GPS receiver to track rising occultations all day (now only 10-18 UTC)
  - reduce negative impact of aging oscillator
  - reduce minimum SLTA (also for TerraSAR-X)
Bending angle stability between 30 - 60km

Metop/GRAS (Zero Difference) – COSMIC (Single Difference)

- Bias of ~ 2e-8 rad
- STD of mean ~ 3e-8 rad

• ~13,500 Collocations within 2 hours/300 km, Jul-Dec 2009

Statistical comparison of Metop/GRAS and COSMIC with ECMWF bending angles (2007.274-276, Lat<30deg)

- METOP (1) Down to first gap, trunc.
- METOP (2) Down to < 4 sec of gaps, trunc.
- METOP (3) Down to bottom, no trunc.

Schreiner et al., AMT, 2011
TEC Precision from Collocated Tracks
COSMIC (2006.230-245)

Statistical of difference between collocated TEC:

✓ Mean difference: 0.12 tecu
✓ RMSE: 1.36 tecu
# CDAAC Processing Status

<table>
<thead>
<tr>
<th>Mission</th>
<th>Mission Duration</th>
<th>Near Real-Time</th>
<th>Re-Processed Data</th>
<th>Re-Processed Product Version (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAC-C</td>
<td>2001 – present</td>
<td>YES</td>
<td>Now Starting</td>
<td>2010.2640</td>
</tr>
<tr>
<td>C/NOFS</td>
<td>2008 – present</td>
<td>YES</td>
<td>Now Starting</td>
<td>2010.2640</td>
</tr>
<tr>
<td>TerraSAR-X</td>
<td>2008 – present</td>
<td></td>
<td>Now Starting</td>
<td>2010.2640</td>
</tr>
</tbody>
</table>

(1) Re-processing with consistent software and algorithms

Data Downloaded
~162 TB
(1/3 from univ. community)
CDAAC Near Term Plans

• CDAAC System
  - Re-structure science data processing
  - Add new data products (daily netCDF files, climatologies, ..)

• Neutral Atmospheric Products
  - Continue to investigate LT inversions
  - Explore new methods of BA optimization in upper stratosphere
  - Investigate ionospheric corrections and use of L2C

• Ionospheric Products
  - Process absolute TEC and EDPs for all CDAAC missions
  - Improve EDPs with DA methods
  - scintillation improvements (provide 10-sec average S4)

• Continue Re-processing and Validation Efforts

• Support Upcoming Missions of Opportunity (KOMPASAT-5, PAZ, ..)
Acknowledgments

- NSF
- Taiwan’s NSPO
- NASA/JPL, NOAA, USAF, ONR, NRL
- Broad Reach Engineering
- Other RO Missions, CHAMP, SAC-C, GRACE, TerraSAR-X, C/NOFS, Metop-A/GRAS