NASA GES DISC support of CO₂ data from OCO-2, ACOS and AIRS

Jennifer Wei¹,², Bruce Vollmer², Andrey Savtchenko¹,², Thomas Hearty²,³, Arif Albayrak¹,², and Barbara DeShong¹,²

¹Adnet Systems Inc.
² NASA GES DISC Code 610.2
³ Wyle Information Systems

Goddard Earth Science Data and Information Services Center
OCO-2 Science Team Meeting
March 27-29, 2013
Overview

• Goddard GES DISC within Earth Observing System Data Information System (EOSDIS)
  • EOSDIS DAACs – Discipline-Oriented Data Centers
  • Data Files Distributed Metrics in DAACs

• Activities for exploring Data Access, Usability and Applicability
  • Documentation – data recipes, ACOS spatial search, KML for ACOS xCO2 monthly ... etc
  • Interoperability – OPeNDAP, and WMS
  • Data distribution metrics
  • Exploring CO2 data applicability: assess multi-sensor CO2 data

• GES DISC Support to OCO-2 data
  • OCO2 Data Table (Products scheduled for archive at GES DISC)
  • DOIs, Landing pages, Data Citation

• Value-added services (i.e., NASA ROSES)
  • Data Quality Screening Services (DQSS)
  • Simple Subset Wizard (SSW)
  • A-Train Data Depot (ATDD)
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Discipline-oriented Data Centers

- **ASF SDC**: SAR Products, Sea Ice, Polar Processes, Geophysics
- **ASD**: Human Interactions, Land Use, Data
- **GES DISC**: Global Precipitation, Solar Irradiance, Atmospheric Composition and Dynamics, Global Modeling
- **PO.DAAC**: Gravity, Sea Surface Temperature, Ocean Winds, Topography, Circulation & Currents
- **NSIDC DAAC**: Snow and Ice, Cryosphere, Climate Interactions, Sea Ice
- **CDDIS**: Space Geodesy, Solid Earth
- **LaRC ASDC**: Radiation Budget, Clouds, Aerosols, Tropospheric Chemistry
- **MODAPS/ LAADS**: MODIS Level-1 and Atmosphere Data Products
- **ORNL DAAC**: Biogeochemical Dynamics, Ecological Data, Environmental Processes

Source: M. Maiden, SURA Information Technology Committee, 11/1/12
**Atmospheric Composition**
- Total Ozone Mapping Spectrometer (TOMS)
- Upper Atmosphere Research Satellite (UARS)
- Aura: Ozone Monitoring Instrument (OMI), High Resolution Dynamics Infrared Sounder (HIRDLS), Microwave Limb Sounder (MLS)
- Atmospheric CO2 Observations from Space (ACOS)
- Historical datasets from Nimbus, Tiros, SME, others
- *Coming*: Orbiting Carbon Observatory 2 (OCO-2)

**Modeling**
- Global Modeling Assimilation Office (GMAO)

**Hydrology/Modeling**
- Global Land Data Assimilation System (GLDAS)
- North American Land Data Assimilation System (NLDAS)

**Atmospheric Dynamics**
- TIROS Operational Vertical Sounder (TOVS) Pathfinder
- Aqua: Atmospheric Infrared Sounder (AIRS)
- Solar Radiation and Climate Experiment (SORCE)

**NASA MEaSUREs Earth System Data Records (ESDRs)**

**Precipitation**
- Tropical Rainfall Measuring Mission (TRMM)
- Hydrology Data Collections
- *Coming*: Global Precipitation Mission (GPM)
Data files distributed by DAACs (EOSDIC Metrics)

<table>
<thead>
<tr>
<th>Data Center</th>
<th>Files</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASF SDC</td>
<td>212</td>
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<tr>
<td>CDDIS</td>
<td>253,343</td>
</tr>
<tr>
<td>EOSDIS</td>
<td>66,969</td>
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<tr>
<td>GES DISC</td>
<td>327,878</td>
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<tr>
<td>GHRC</td>
<td>5,383</td>
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<tr>
<td>LP DAAC</td>
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<td>LaRC ASDC</td>
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<td>MODAPS LAADS</td>
<td>413,518</td>
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<td>NSIDC DAAC</td>
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<td>ORNL DAAC</td>
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<td>PO DAAC</td>
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<tr>
<td>SEDAC</td>
<td>10,482</td>
</tr>
<tr>
<td>LANCE</td>
<td>250,241</td>
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</tbody>
</table>

http://earthdata.nasa.gov/about-eosdis/performance/eosdis-watch-details
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Global CO2 distribution (yr 2010)

(a) AIRS mid-trop (v5)

(b) CT2011 mid-trop

(c) ACOS xCO2 (v2.9)

(d) CT2011 xCO2

CO2 (ppm)
Exploring CO2 data applicability

Can we see some signal under extreme emission event?
Global Slope Map ($\frac{\Delta(xCO_2)}{\Delta t}$)

- Russia
- Alaska
- Amazon

Map showing global slope with color-coding for (ppm/yr) and regional focus on Russia, Alaska, and Amazon.
Case: 2010 Russian Wildfire Event

Fire on July 31, 2010

Area: 40N-65N; 35E-70E

Daily Area Averaged Mean

4-year Monthly Climatology

Area-averaged series of:
(a) Detrended daily xCO2, and corresponding 4-year monthly climatology
(b) Daily departures (anomaly) from monthly climatology
Event Transect

AIRS CO Distribution at 500 mb on Aug. 14, 2010

ACOS

CO_2010.08.14_Lon038to115_Lat040to060_WEtransect
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## OCO-2 Data Table
(Products scheduled for archive at GES DISC)

*Total mission volume ~ 20 TB/year*

<table>
<thead>
<tr>
<th>Type</th>
<th>ShortName</th>
<th>#/day</th>
<th>Description</th>
<th>Data Format</th>
<th>Granule Size(GiB)</th>
<th>Yearly volume (GiB)</th>
<th>Public Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housekeeping Telemetry</td>
<td>OCO2_HK</td>
<td>1</td>
<td>Housekeeping telemetry file generated by EDOS</td>
<td>Binary</td>
<td>21</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Science Telemetry</td>
<td>OCO2_L0</td>
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<td>Science telemetry file generated by EDOS</td>
<td>CCSDS packets</td>
<td>4,100</td>
<td></td>
<td>No</td>
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<tr>
<td>Node Time File</td>
<td>?</td>
<td>1/week</td>
<td>Predicted nodal crossing times generated by OCO-2 MOC</td>
<td>ASCII</td>
<td>Very small</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Predicted Ephemeris File</td>
<td>?</td>
<td>1/week</td>
<td>Spacecraft ephemerides predicted by OCO-2 MOC</td>
<td>ASCII</td>
<td>Very small</td>
<td></td>
<td>No</td>
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<tr>
<td>Attitude Files</td>
<td>OCO2_ATT</td>
<td>14-15</td>
<td>OCO-2 spacecraft attitude data for one specific orbit</td>
<td>HDF5</td>
<td>2.0</td>
<td></td>
<td>Public</td>
</tr>
<tr>
<td>Ephem Files</td>
<td>OCO2_EPH</td>
<td>14-15</td>
<td>OCO-2 spacecraft ephemerides for one specific orbit</td>
<td>HDF5</td>
<td>2.5</td>
<td></td>
<td>Public</td>
</tr>
<tr>
<td>L1aIn Product</td>
<td>OCO2_L1ALN</td>
<td>180-193</td>
<td>Collated, parsed, OCO-2 Science Data for one specific orbit and one specific viewing mode</td>
<td>HDF5</td>
<td>4,100</td>
<td></td>
<td>Public</td>
</tr>
<tr>
<td>L1bSc Product</td>
<td>OCO2_L1BSC</td>
<td>18-19</td>
<td>Calibrated, geolocated OCO-2 science spectra for one specific orbit and one specific viewing mode</td>
<td>HDF5</td>
<td>7,300</td>
<td></td>
<td>Public</td>
</tr>
<tr>
<td>L1bCl Product</td>
<td>OCO2_L1BCL</td>
<td>30-35</td>
<td>Calibrated, geolocated OCO-2 calibration spectra for one specific orbit and one specific viewing mode</td>
<td>HDF5</td>
<td>0.24</td>
<td></td>
<td>Public</td>
</tr>
<tr>
<td>L2Dia Product</td>
<td>OCO2_L2DIA</td>
<td>14-15</td>
<td>Geolocated XCO2 retrieval results for selected soundings for one specific orbit and one specific viewing mode, plus algorithm diagnostic information</td>
<td>HDF5</td>
<td>&lt;4,400</td>
<td></td>
<td>Public</td>
</tr>
<tr>
<td>L2Std Product</td>
<td>OCO2_L2STD</td>
<td>14-15</td>
<td>Geolocated XCO2 retrieval results for selected soundings for one specific orbit and one specific viewing mode</td>
<td>HDF5</td>
<td>&lt;200</td>
<td></td>
<td>Public</td>
</tr>
</tbody>
</table>
DOIs for EOSDIS Data

• **Background**
  - unique and lasting data identifiers for publication
  - more frequent and consistent citation of EOSDIS datasets

• **A DOI will be assigned for each EOSDIS standard data product**
  - A major new version would be assigned a new DOI.
  - DOIs of old versions that are no longer available would have updated locators that point to new version (with explanation)

• **DOIs registered via subscription provider (EZID) with Registry Agent (DataCite)**

• **Consists of two part alphanumeric string doi:[prefix]/[suffix]**
  - E.g., 10.5067/123; Prefix 10 is the DOI registry identifier; 5067 is the Registrant (ESDIS)
  - Suffix alphanumeric string identifies the data item as decided by the Registrant
    - doi: 10.5067/Aura/HIRDLS/data1234
    - doi: 10.5067/Aqua/AIRS/data1234
    - doi: 10.5067/MEASURES/GSSTF/data1234

• **Additional Product Metadata**
  - 2 files attributes embedded in data files
    - Identifier_product_doi
    - Identifier_product_doi_authority

• **A DOI resolves to a landing page**
Insert DOI attributes in each file

Resolve DOI

Landing Page (Permanent Identifier)
- Data Citation
- Data Access
- Summary
- Documentation
- Variables

identifier_product_doi: 10.5067/AQUA/AIRS/DATA201
identifier_product_doi_authority: http://dx.doi.org/
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Data Quality Screening Service (DQSS)

Initial settings are based on Science Team recommendation. (Note: “Good” retains retrievals that are Good or better). You can choose settings for all parameters at once...

- DQSS can encode the science team recommendations on quality screening
- Output file has the same format and structure as the input file
Simple Subset Wizard (SSW)

**EOSDIS** NASA's Earth Observing System Data and Information System

**SIMPLE SUBSET WIZARD (SSW) V1.07 RELEASE NOTES**

1. Search for Data Sets  
2. Select Subset Criteria  
3. View Results

Enter values for the Date Range and (optionally) the Spatial Bounding Box to search for data sets; those criteria will also be used when data sets are subsetted by Date Range and Spatial Region.

- **Data Set Keyword(s)**
- **Date Range**
- **Spatial Bounding Box**

**Available Data Sets**

- Alaska Satellite Facility Synthetic Aperture Radar Data Center
- Global Hydrology Resource Center
- Goddard Earth Sciences Data and Information Services Center
- MODIS Level 1 and Atmosphere Archive and Distribution System
- Langley Atmospheric Science Data Center
- Land Processes DAAC
- NSIDC/0
- Oak Ridge National Laboratory DAAC for Biogeochemical Dynamics
- Physical Oceanography DAAC
- Socioeconomic Data and Applications Center

Cross DAACs Access (10)

Data need to be OPeNDAP compatible
A-Train Data Depot (ATDD) was supported by NASA ACCESS (Advancing Collaborative Connections in Earth System Science) program and now is on sustaining mode.

- Started with CloudSat mission support with MODIS-CloudSat collocated subsets. Building upon the expertise, OMI, POLDER, and AIRS subsets were subsequently added in production, and distributed by ATDD.

- The collocated subsets include MODIS/Aqua L1B and L2 atmospheric products, OMI/Aura L2 products, and Polder/Parasol L2 products (Table shows detail)

** Archived On-line A-Train Subsets **


** MODIS/Aqua, Level 1B, radiances **

- **MAC021S**: 1-km radiances
- **MAC020S**: 250-m radiances

** MODIS/Aqua, Level 2, atmospheric products **

- **MAC04S**: Aerosol Optical Depth Land and Ocean, Aerosol Type over Land, Angstrom Exponent, Mass Concentration, Fine Mode Fraction
- **MAC05S**: Water Vapor IR and near IR retrievals
- **MAC06S**: Cloud Top Parameters: Pressure, Temperature, Effective Emissivity, Spectral Forcing, Cloud Phase; Cloud Optical Parameters: Cloud Optical Thickness, Effective Particle Radius; Cirrus Detection: Cirrus Reflectance.
- **MAC07S**: Temperature and Moisture (dew point temperature) profiles.
- **MAC35S**: Cloud Mask: IR, NIR, and CO2 tests; Visible test at 250-m.

** OMI/Aura, Level 2, Cloud Pressure, Ozone, and UV index **

- **OMCLDO2_CPR**: Cloud effective pressure based on O2-O2 absorption
- **OMCLDRR_CPR**: Cloud effective pressure based on Raman scattering
- **OMTO3_CPR**: Column amount O3, UV Aerosol Index, UV reflectivity.
- **OMAERUV_CPR**: UV Aerosol Index, Aerosol Absorption Optical Depth, Surface Albedo, UV Reflectivity.

** POLDER/Parasol, Level 2, Radiation Budget processing **

- **PARASOLRB_CPR**: Column Water Vapor, Cloud Pressure from O2 lines, Cloud Optical Thickness, Cloud Phase, Cloud Albedo, Clear Albedo.

*Available in 200- and 10-km swath widths; The rest are 200-km-wide, (+/-100 km) only.*
Questions?

Jennifer .C.Wei@nasa.gov