NASA GES DISC support of CO_2 data from OCO-2, ACOS and AIRS

Jennifer Wei[1,2], Bruce Vollmer[2], Andrey Savtchenko[1,2], Thomas Hearty[2,3], Arif Albayrak[1,2], and Barbara DeShong[1,2]

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[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 xCO_2 monthly …etc
  - Interoperability– OPeNDAP, and WMS
  - Data distribution metrics
  - Exploring CO_2 data applicability: assess multi-sensor CO_2 data

- **GES DISC Support to OCO-2 data**
  - OCO_2 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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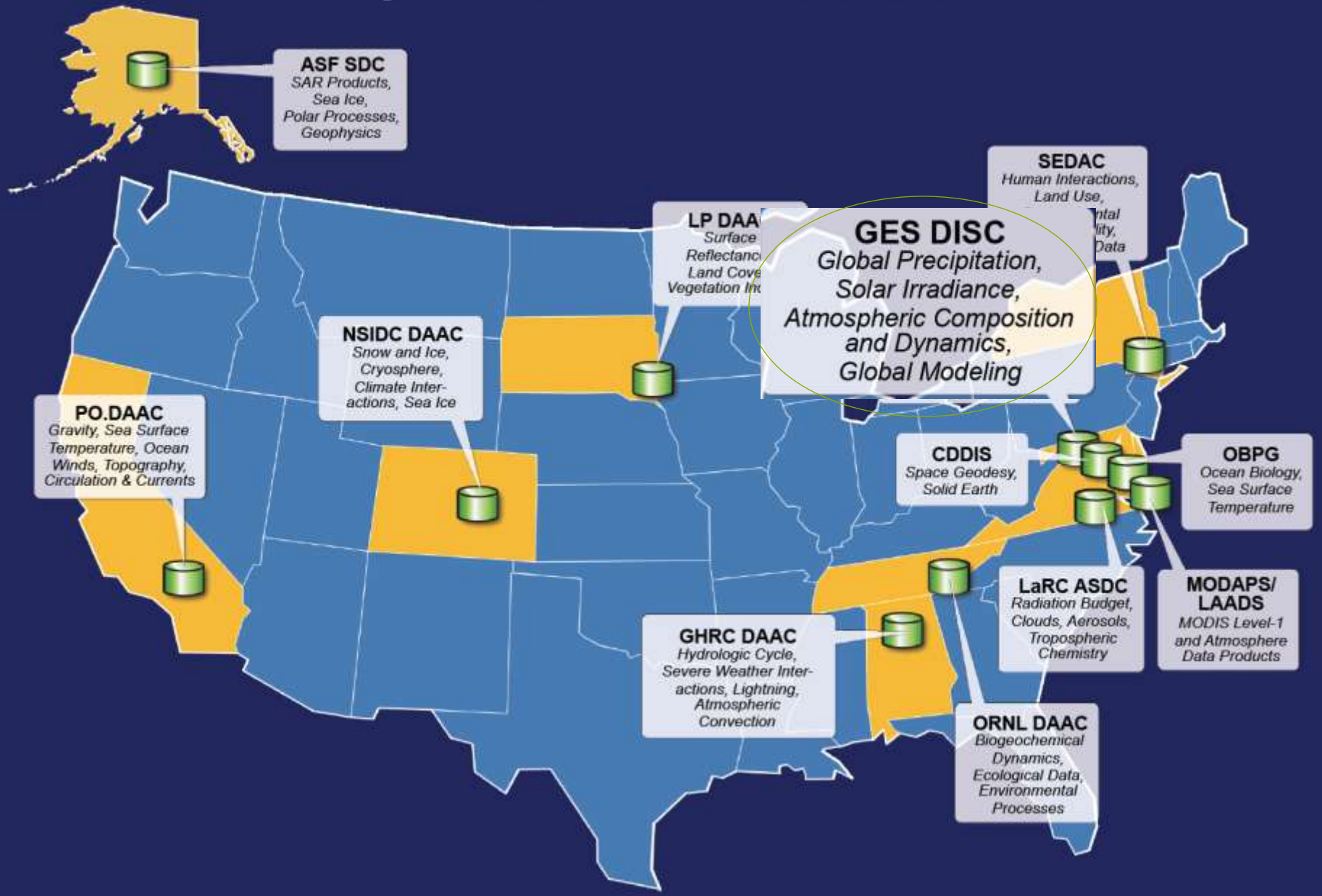
Discipline-oriented Data Centers



Source: M.Maiden, SURA Information Technology Committee, 11/1/12

GES DISC Data Holdings

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

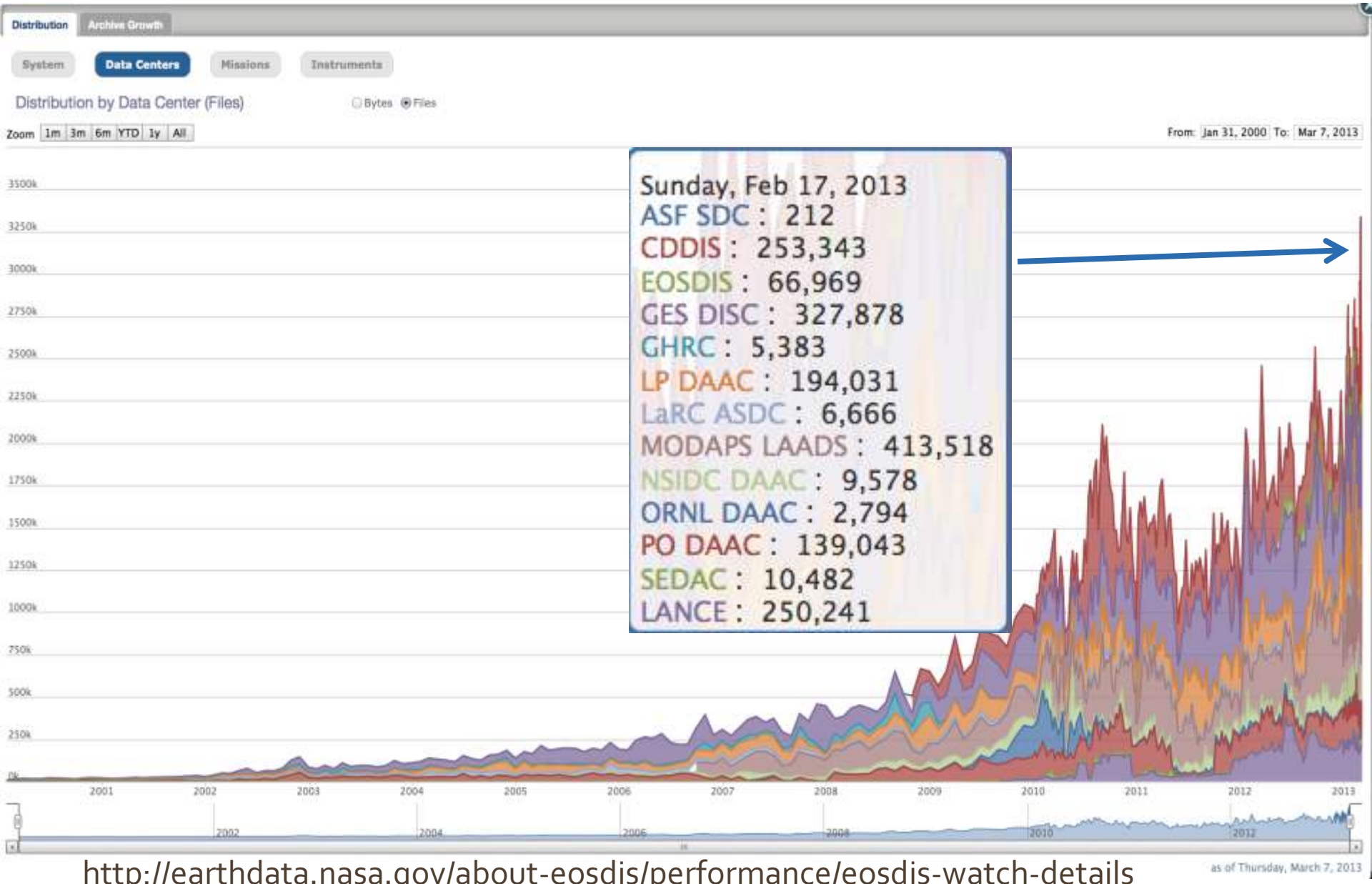
- TIROS Operational Vertical Sounder (TOVS) Pathfinder
- Aqua: Atmospheric Infrared Sounder (AIRS)
- Solar Radiation and Climate Experiment (SORCE)

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)



http://earthdata.nasa.gov/about-eosdis/performance/eosdis-watch-details

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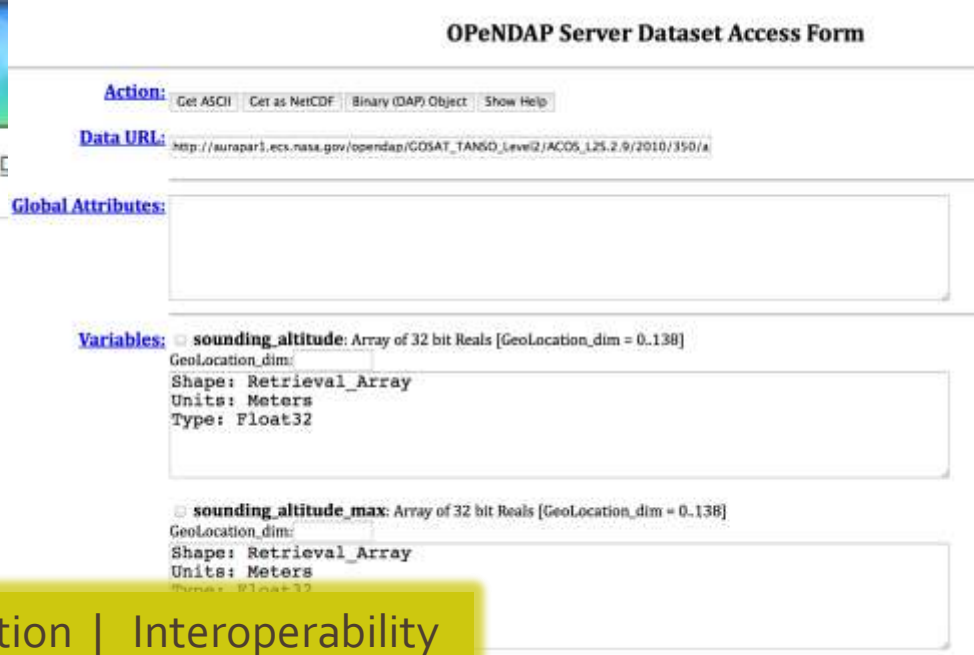
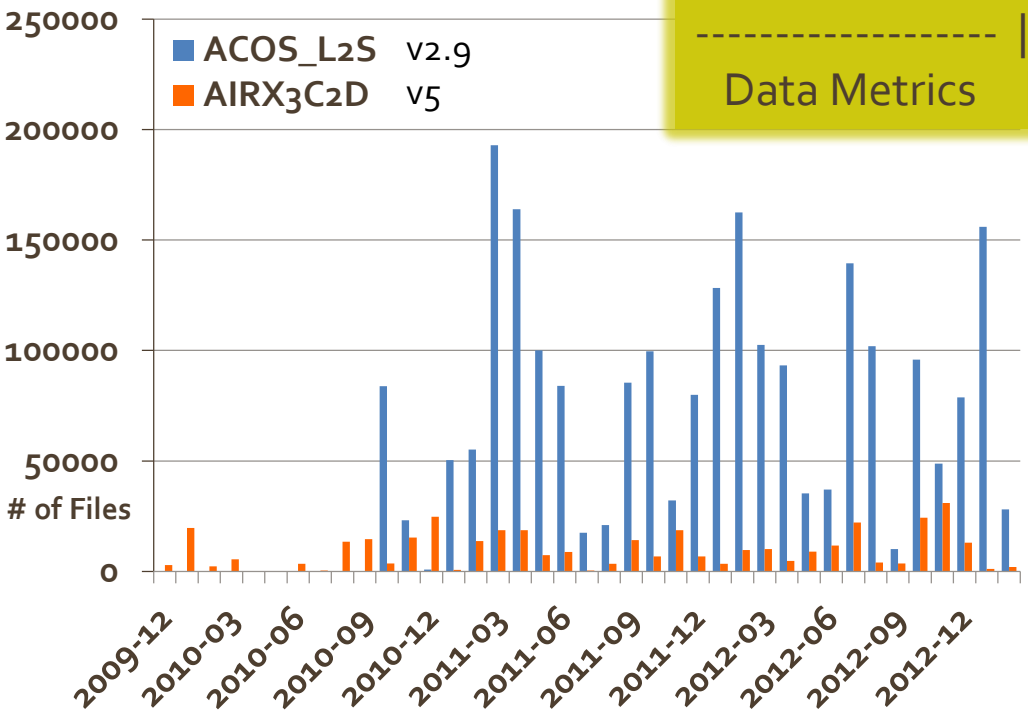
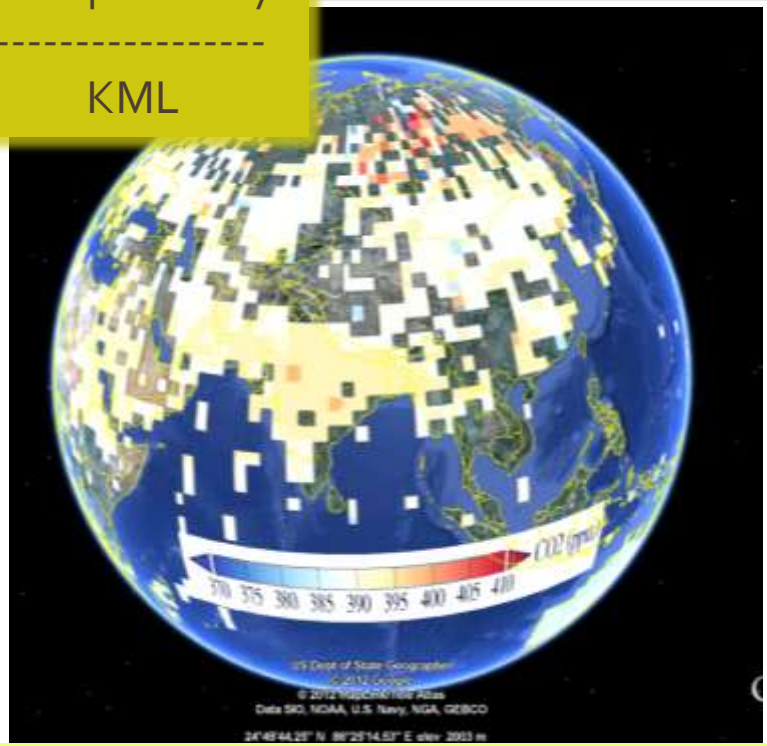
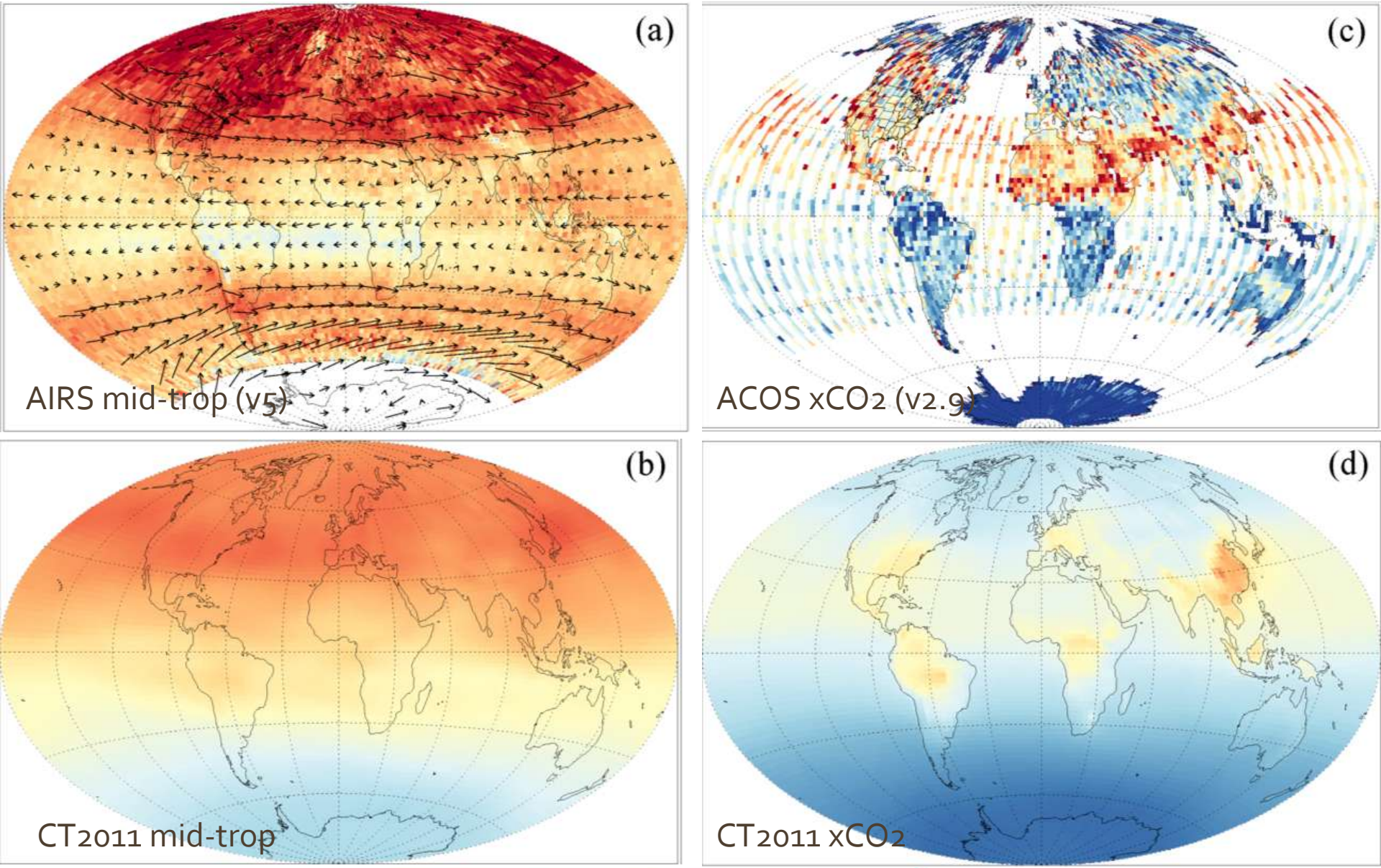


Documentation	Interoperability
Data Metrics	KML



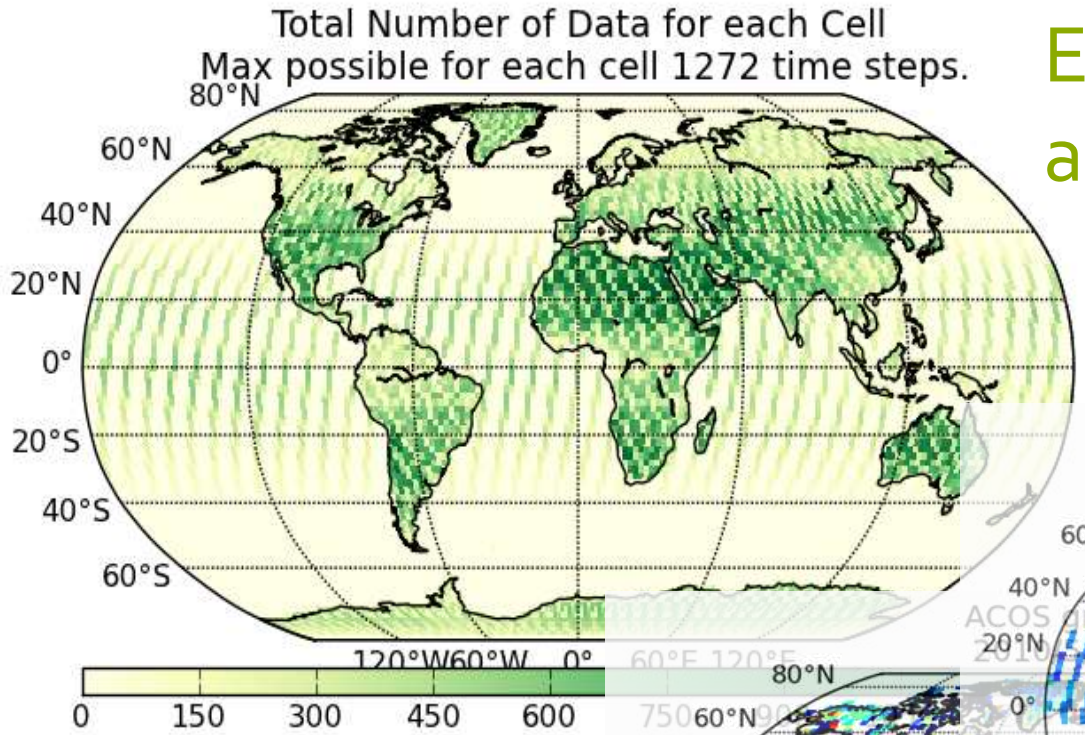


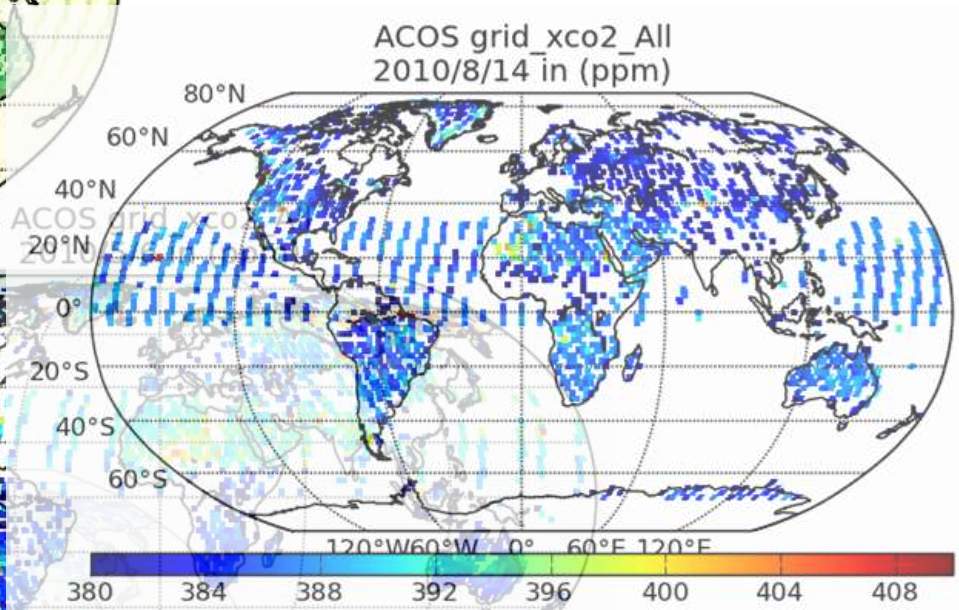
Global CO_2 distribution (yr 2010)

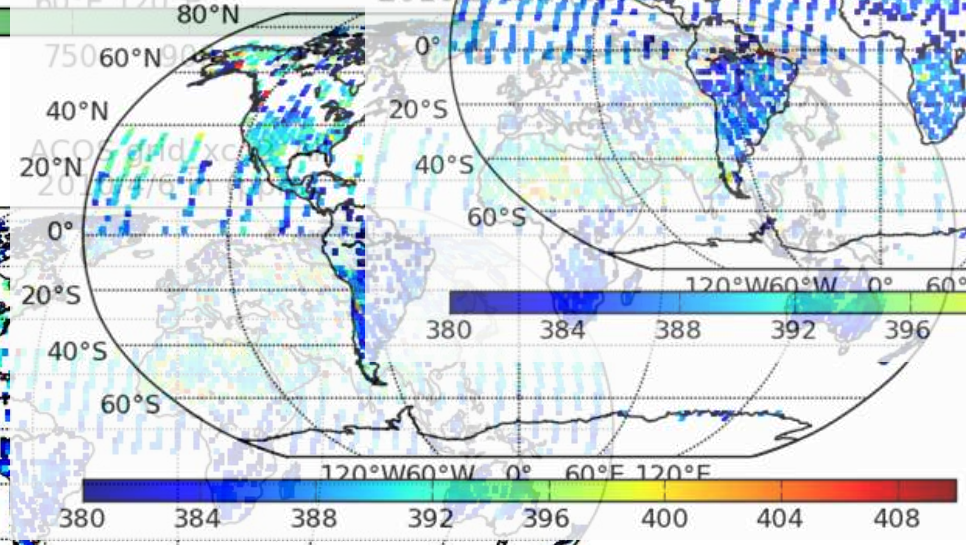


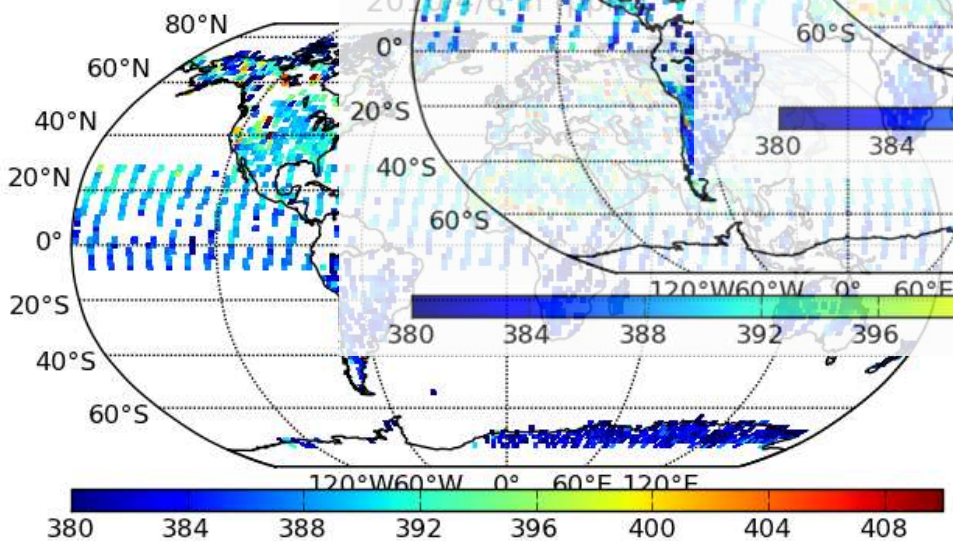
Exploring CO_2 data applicability

Can we see some signal under extreme emission event?

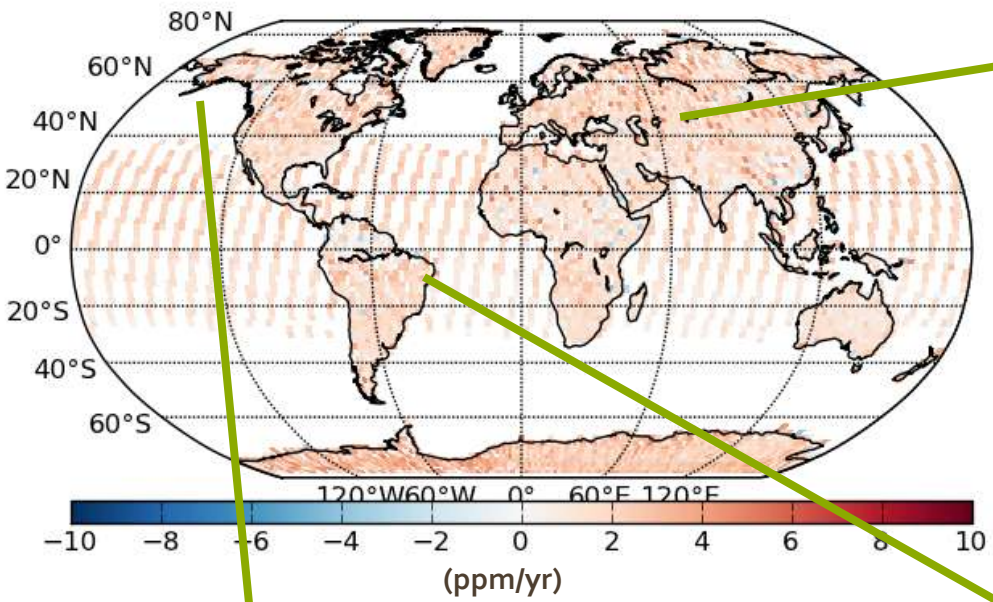




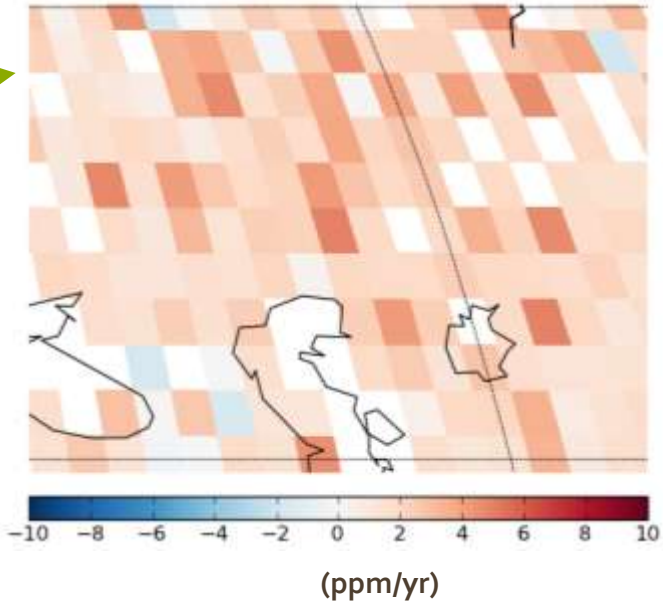




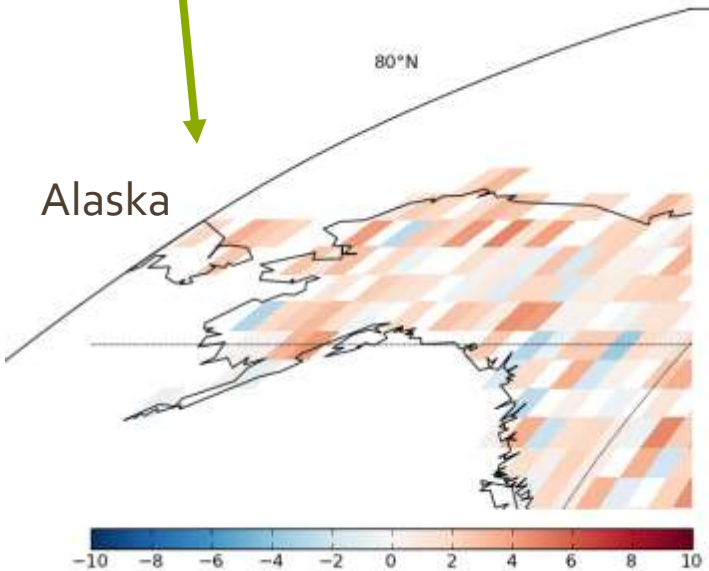
Global Slope Map ($\frac{\Delta(xCO_2)}{\Delta t}$)



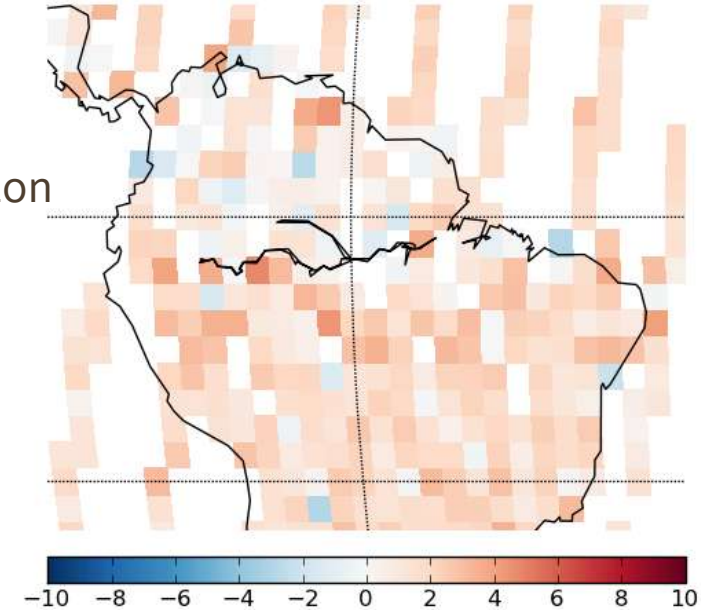
Russia



Alaska

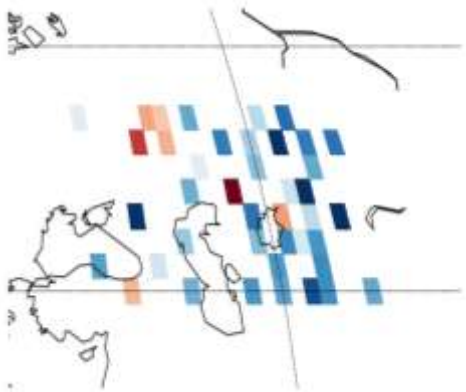


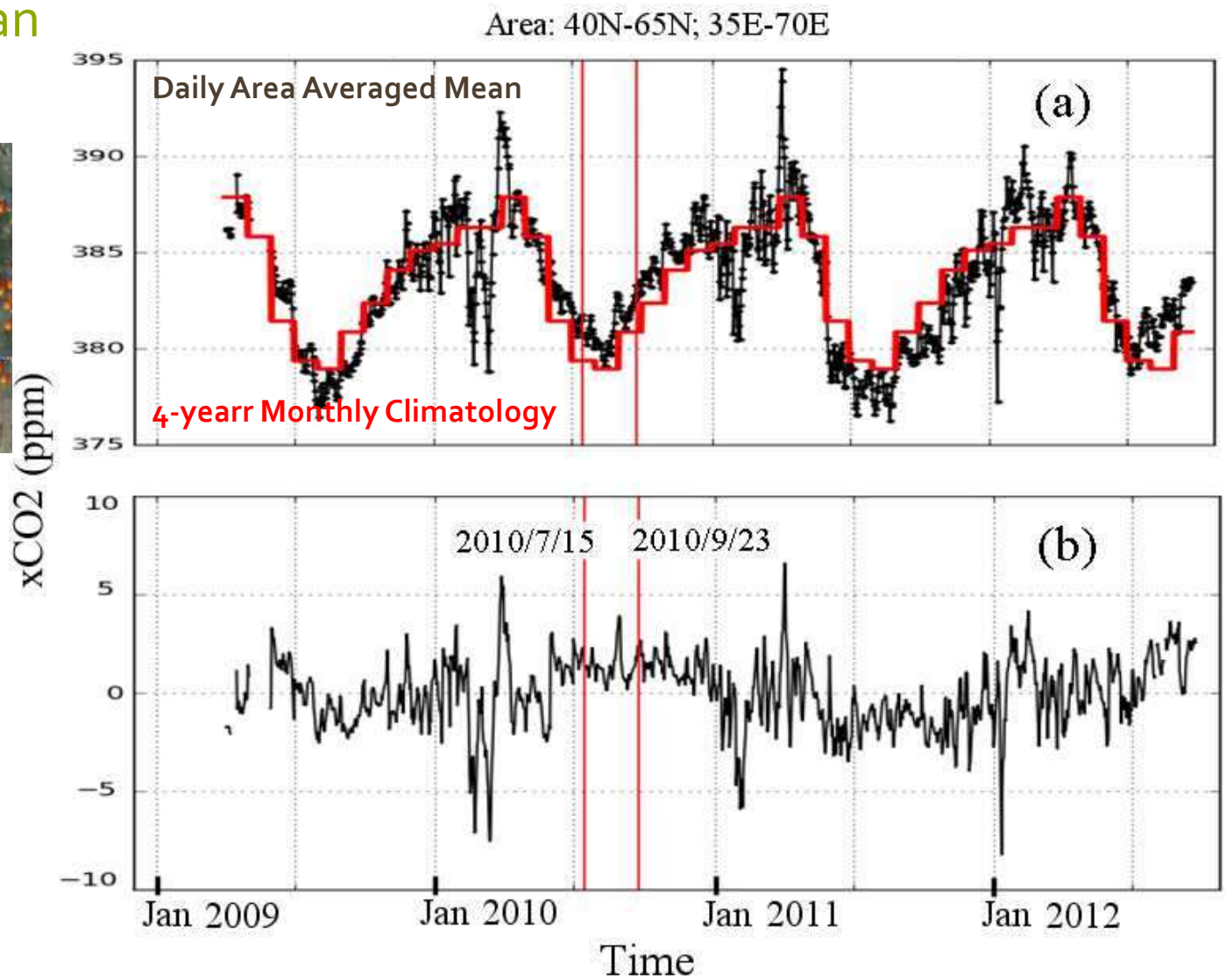
Amazon



Case: 2010 Russian Wildfire Event

Fire on July 31, 2010





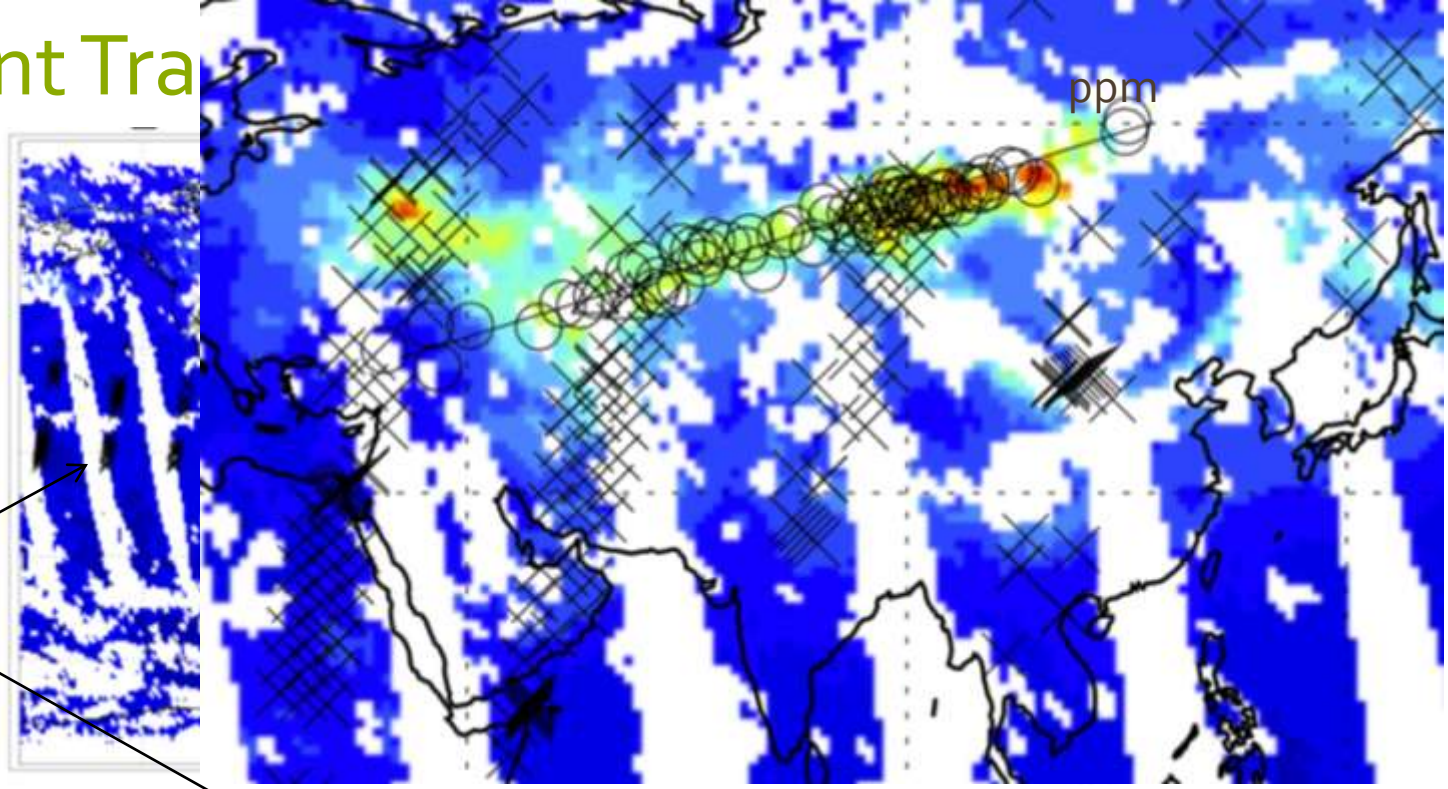
Area-averaged series of:

(a) Detrended daily xCO2, and corresponding 4-year monthly climatology

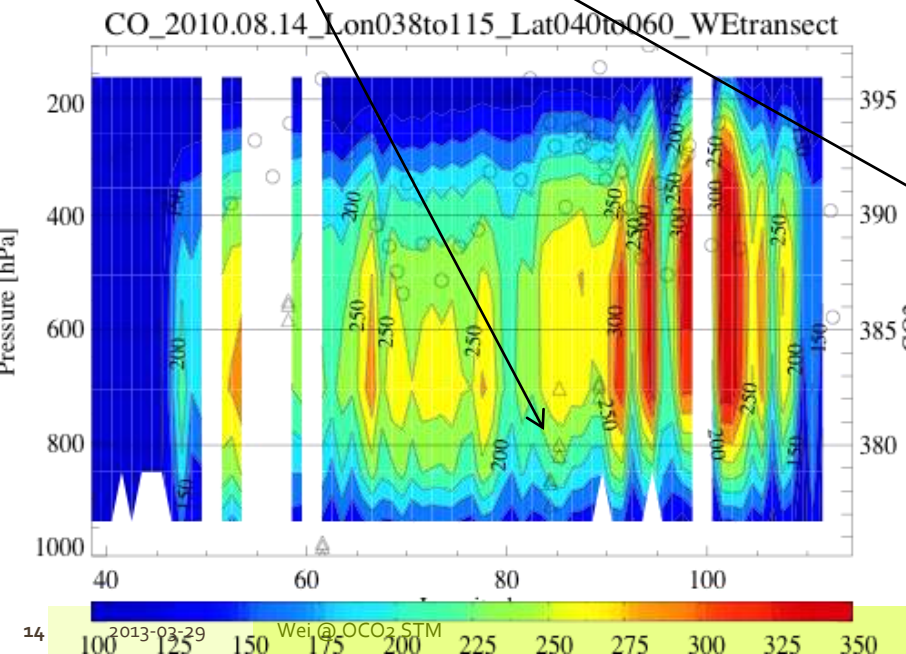
(b) Daily departures (anomaly) from monthly climatology

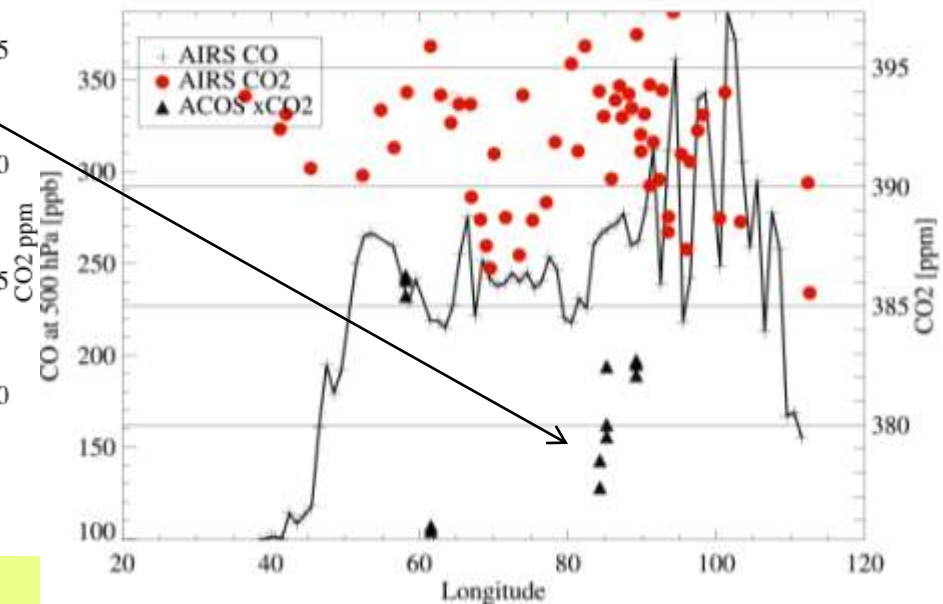
Event Tra

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



ACOS





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OCO-2 Data Table
(Products scheduled for archive at GES DISC)

***Total mission volume ~ 20 TB/year**

Type	ShortName	#/day	Description	Data Format	Granule Size(GiB)	Yearly volume (GiB)	Public Distribution
Housekeeping Telemetry	OCO2_HK	1	Housekeeping telemetry file generated by EDOS	Binary		21	No
Science Telemetry	OCO2_L0	3	Science telemetry file generated by EDOS	CCSDS packets		4,100	No
Node Time File	?	1/week	Predicted nodal crossing times generated by OCO-2 MOC	ASCII		Very small	No
Predicted Ephemeris File	?	1/week	Spacecraft ephemerides predicted by OCO-2 MOC	ASCII		Very small	No
Attitude Files	OCO2_ATT	14-15	OCO-2 spacecraft attitude data for one specific orbit	HDF5	.00038	2.0	Public
Ephem Files	OCO2_EPH	14-15	OCO-2 spacecraft ephemerides for one specific orbit	HDF5	.00047	2.5	Public
L1aIn Product	OCO2_L1ALN	180-193	Collated, parsed, OCO-2 Science Data for one specific orbit and one specific viewing mode	HDF5	0.71	4,100	Public
L1bSc Product	OCO2_L1BSC	18-19	Calibrated, geolocated OCO-2 science spectra for one specific orbit and one specific viewing mode	HDF5	1.4	7,300	Public
L1bCl Product	OCO2_L1BCL	30-35	Calibrated, geolocated OCO-2 calibration spectra for one specific orbit and one specific viewing mode	HDF5	0.22	0.24	Public
L2Dia Product	OCO2_L2DIA	14-15	GeolocatedXCO_2 retrieval results for selected soundings for one specific orbit and one specific viewing mode, plus algorithm diagnostic information	HDF5	<0.82	<4,400	Public
L2Std Product	OCO2_L2STD	14-15	GeolocatedXCO_2 retrieval results for selected soundings for one specific orbit and one specific viewing mode	HDF5	<0.037	<200	Public

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**

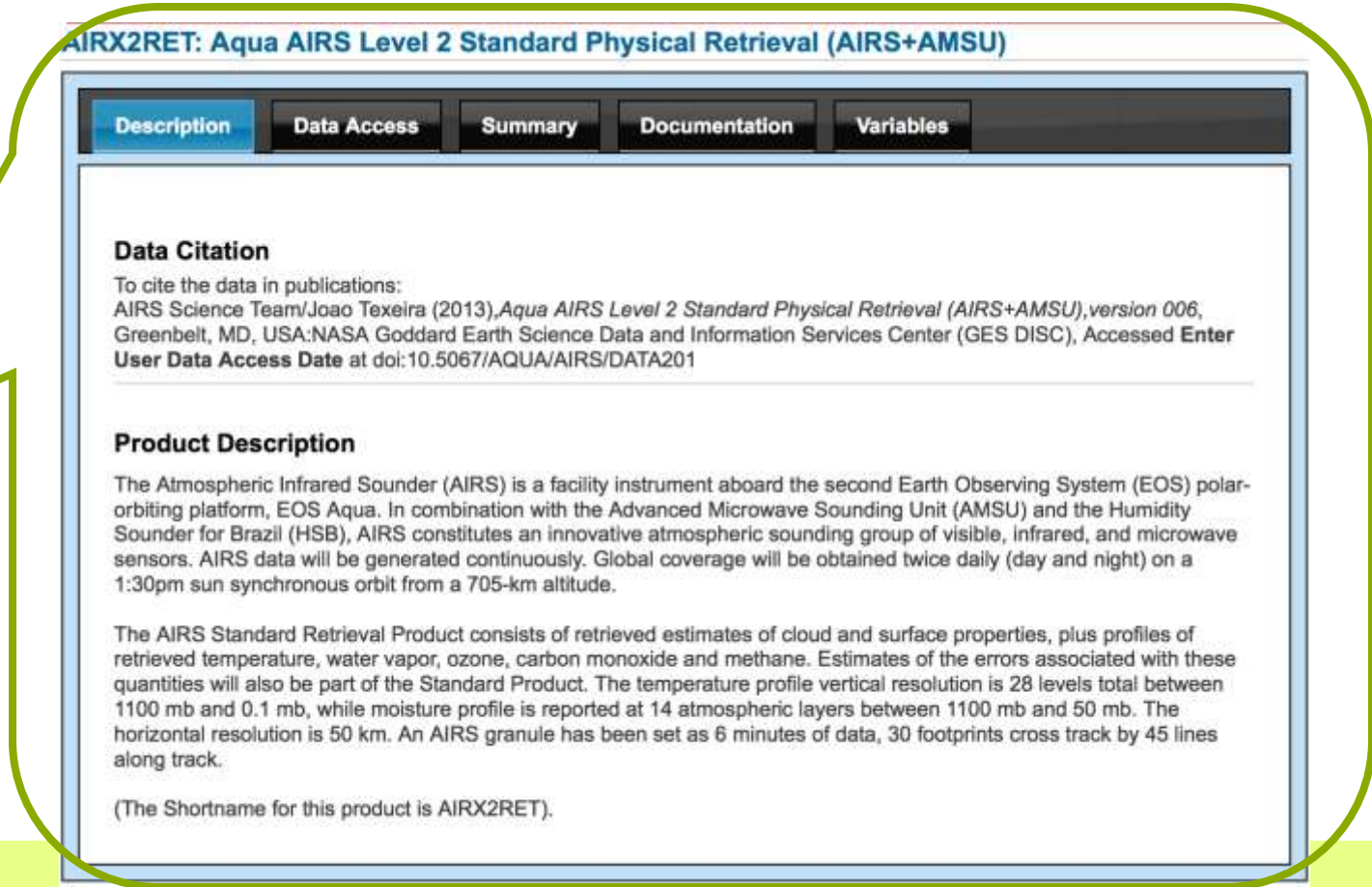
Insert DOI attributes in each file

```
identifier_product_doi : 10.5067/AQUA/AIRS/DATA201
identifier_product_doi_authority : http://dx.doi.org/
```

Resolve DOI

Landing Page (Permanent Identifier)

- Data Citation
- Data Access
- Summary
- Documentation
- Variables



AIRX2RET: Aqua AIRS Level 2 Standard Physical Retrieval (AIRS+AMSU)

Description | Data Access | Summary | Documentation | Variables

Data Citation

To cite the data in publications:
AIRS Science Team/Joao Texeira (2013),*Aqua AIRS Level 2 Standard Physical Retrieval (AIRS+AMSU),version 006*, Greenbelt, MD, USA:NASA Goddard Earth Science Data and Information Services Center (GES DISC), Accessed **Enter User Data Access Date** at doi:10.5067/AQUA/AIRS/DATA201

Product Description

The Atmospheric Infrared Sounder (AIRS) is a facility instrument aboard the second Earth Observing System (EOS) polar-orbiting platform, EOS Aqua. In combination with the Advanced Microwave Sounding Unit (AMSU) and the Humidity Sounder for Brazil (HSB), AIRS constitutes an innovative atmospheric sounding group of visible, infrared, and microwave sensors. AIRS data will be generated continuously. Global coverage will be obtained twice daily (day and night) on a 1:30pm sun synchronous orbit from a 705-km altitude.

The AIRS Standard Retrieval Product consists of retrieved estimates of cloud and surface properties, plus profiles of retrieved temperature, water vapor, ozone, carbon monoxide and methane. Estimates of the errors associated with these quantities will also be part of the Standard Product. The temperature profile vertical resolution is 28 levels total between 1100 mb and 0.1 mb, while moisture profile is reported at 14 atmospheric layers between 1100 mb and 50 mb. The horizontal resolution is 50 km. An AIRS granule has been set as 6 minutes of data, 30 footprints cross track by 45 lines along track.

(The Shortname for this product is AIRX2RET).

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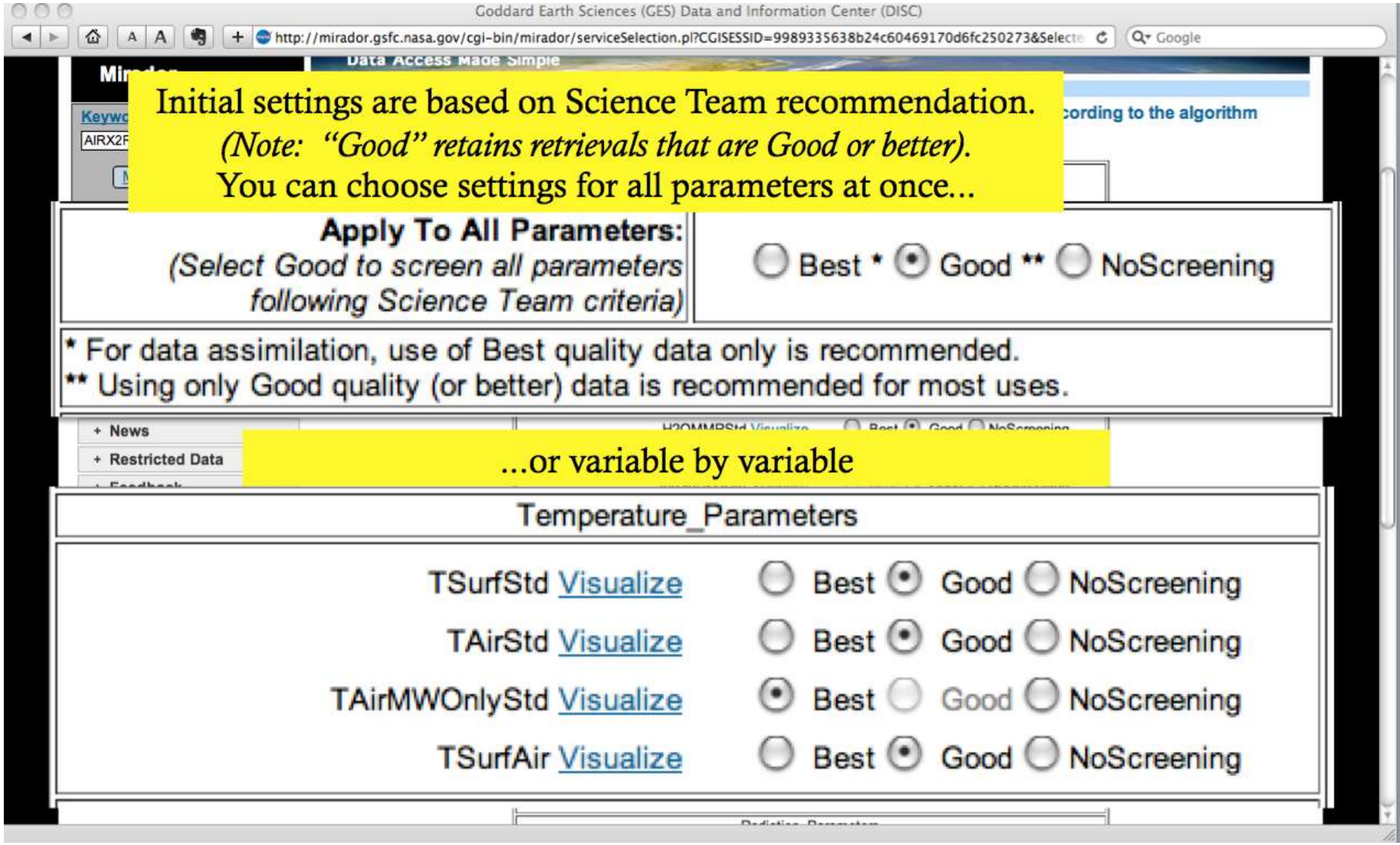
Data Quality Screening Service (DQSS)



- **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

Home | About EOSDIS | Data | Our Community | User Resources | Labs | Wiki | Search EOSDIS

EOSDIS Home

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) *Enter keywords or click the 'Select Data Sets' button.* Select Data Sets

Date Range *Enter dates as YYYY-MM-DD or use the ca* to

Spatial Bounding Box *Enter South,West,North,East coordinates c*

Search for Data Sets

Report a Problem with the Simple Subset Wizard

Available Data Sets

Data sets are sorted by the data archive center and project/mission.

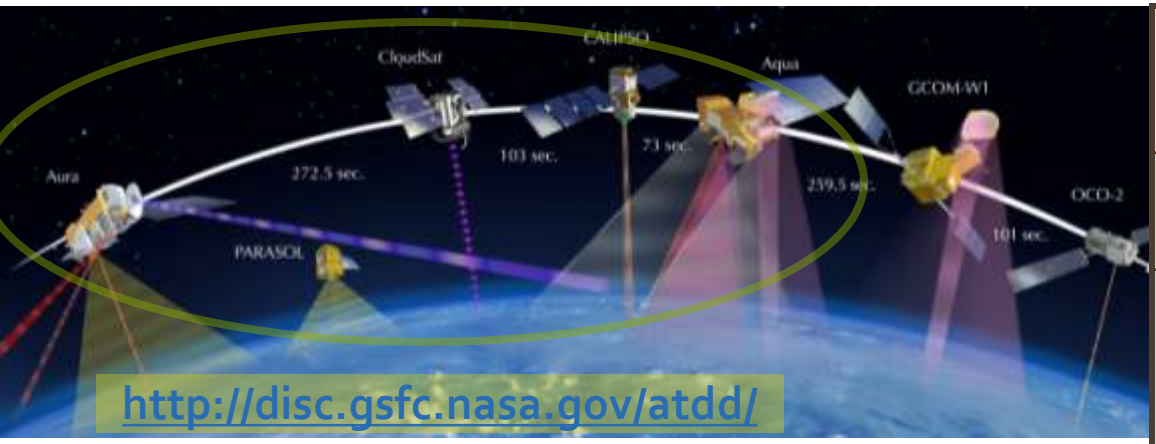
- Alaska Satellite Facility Synthetic Aperture Radar Data Center
- Global Hydrology Resource Center
- Goddard Earth Sciences Data and Information Services Center
- MODIS Level 1 and Atmosphere Archive and Distribution System
- Langley Atmospheric Science Data Center
- Land Processes DAAC
- NSIDCV0
- Oak Ridge National Laboratory DAAC for Biogeochemical Dynamics
- Physical Oceanography DAAC
- Socioeconomic Data and Applications Center

Choose | Cancel

Cross DAACs Access (10)

Data need to be OPeNDAP compatible

A-Train Data Depot (ATDD) – CloudSat Collocated Dataset



- 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

- **Mirador**: http://mirador.gsfc.nasa.gov/
- **FTP**: ftp://atrain.sci.gsfc.nasa.gov/s4pa

MODIS/Aqua, Level 1B, radiances

- **MAC021**S*:1-km radiances
- **MAC02Q**S*: 250-m radiances

MODIS/Aqua, Level 2, atmospheric products

- **MAC04**S*: Aerosol Optical Depth Land and Ocean, Aerosol Type over Land, Angstrom Exponent, Mass Concentration, Fine Mode Fraction
- **MAC05**S* : Water Vapor IR and near IR retrievals
- **MAC06**S* : Cloud Top Parameters: Pressure, Temperature, Effective Emissivity, Spectral Forcing, Cloud Phase; Cloud Optical Parameters: Cloud Optical Thickness, Effective Particle Radius; Cirrus Detection: Cirrus Reflectance.
- **MAC07**S* : Temperature and Moisture (dew point temperature) profiles.
- **MAC35**S* : 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

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