Multi-Instrument Intercalibration (MIIC) Status

Chris Currey, Aron Bartle, Dave Johnson,
Costy Lukashin, Jay Morris, Lea Crandall

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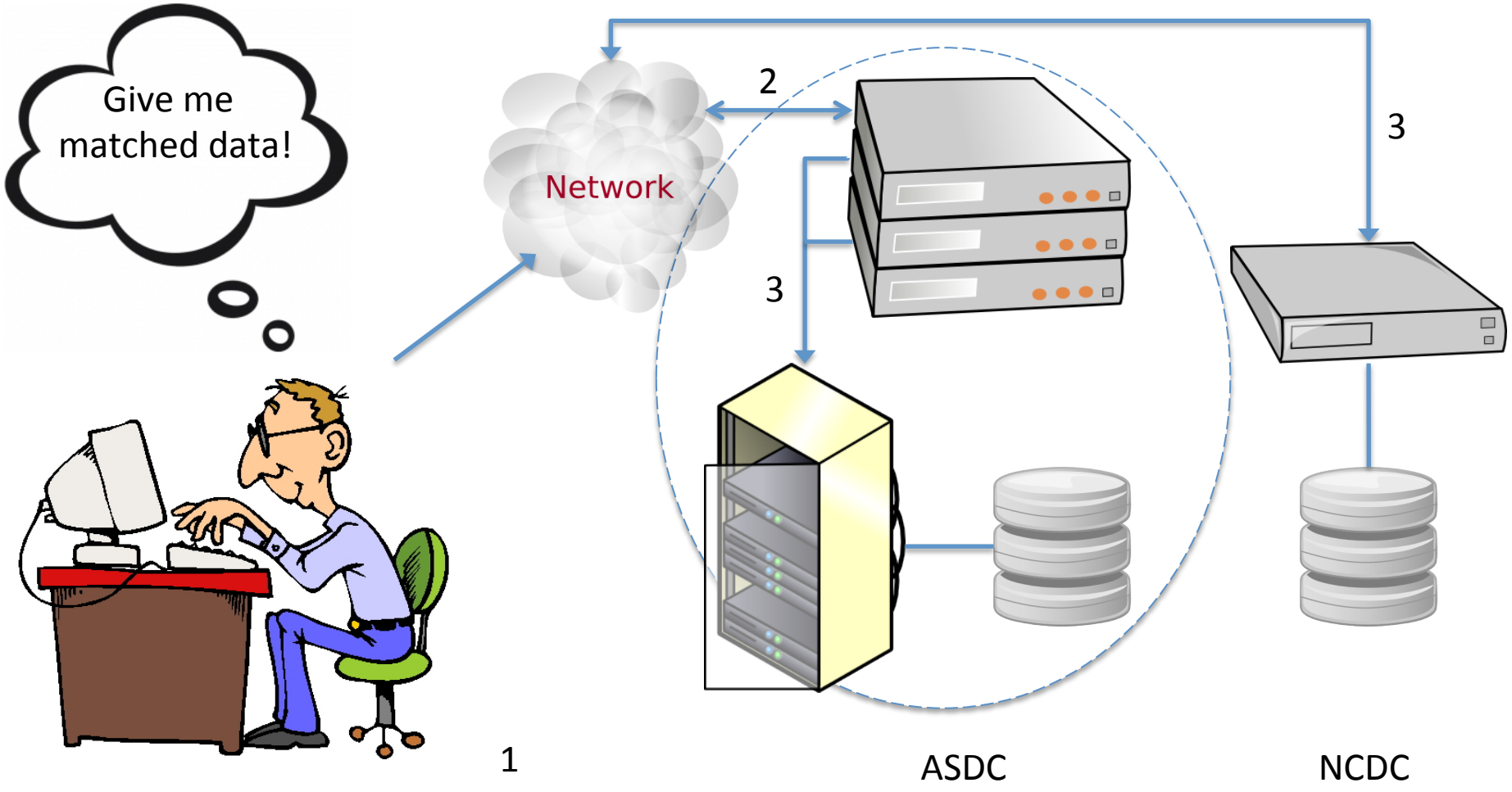
MIIC Project

- A ROSES ACCESS 2013 project (2 years) to deploy web services at NOAA NCDC and NASA ASDC to improve access to select data products in support of intercalibration and intercomparison studies

MIIC Deployment Cartoon



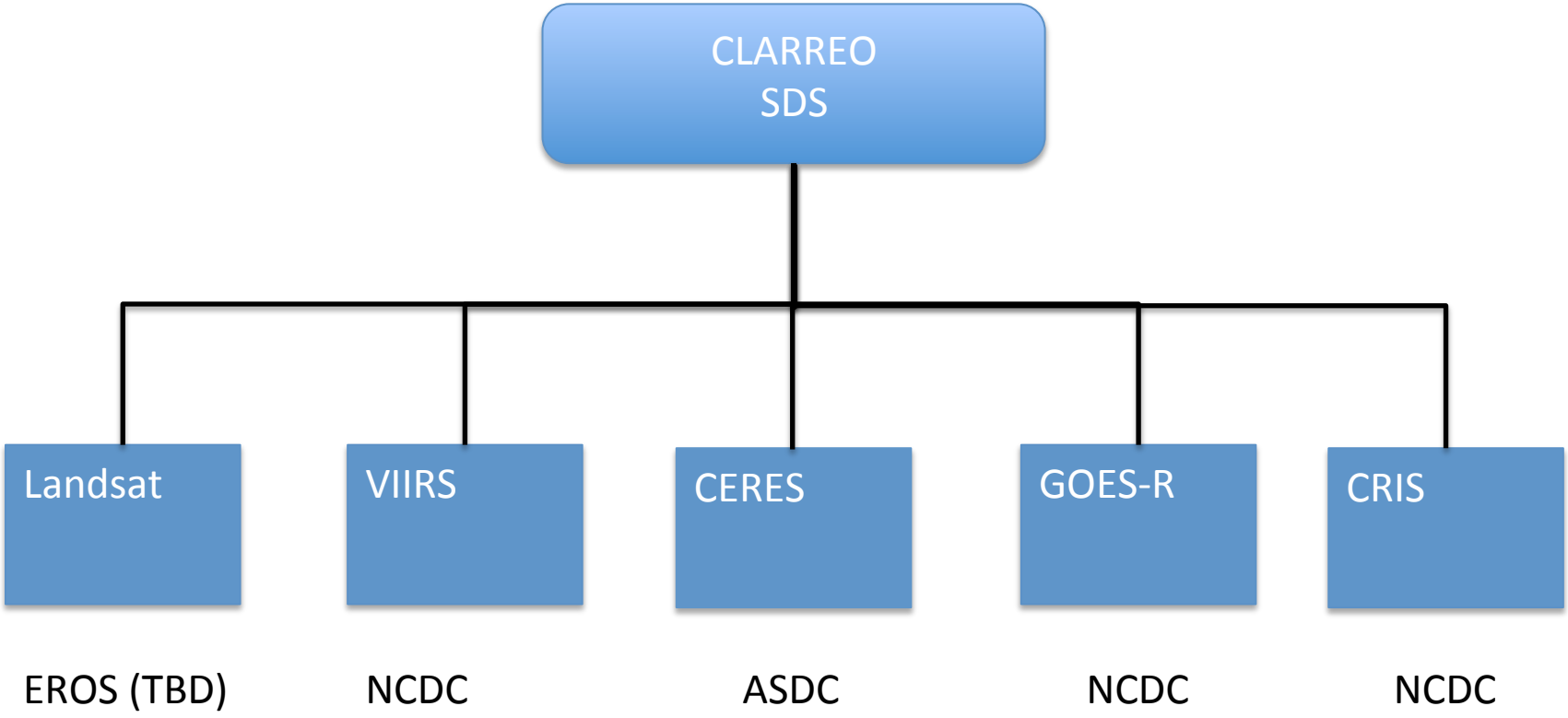
MIIC Objectives

- Access matched observations (time, view angles) from multiple satellite instruments within large datasets distributed across multi-agency data centers
- Filter large data products within server-side functions at remote centers prior to network transmission
- Support GSICS, Cal-Val and CLARREO teams
- Demonstrate benefit of OPeNDAP server-side functions
- Demonstrate successful deployment of a NOAA and NASA collaborative distributed data system
- Demonstrate feasibility of accessing remote hyperspectral OSSE datasets for comparison with observations

Future MIIC/ASDC Opportunities?

- Deploy MIIC-OPeNDAP module at GSFC LAADS, access L1 and L2 MODIS data and reprocessed VIIRS SDR and EDR (Atmospheres) (*E. Masuoka*)
- Deploy MIIC-OPeNDAP module at GSFC DAAC, access L1 and L2 AIRS data and reprocessed CRIS data (*S. Kempler*)
- Deploy MIIC OPeNDAP server(s) at EUMETSAT, access Metop-A,B (*P. Miu*, *T. Hewison*)
- Deploy MIIC OPenDAP server(s) at UW, access reprocessed VIIRS EDRs (Land) (*L. Gumley*)
- Provide MIIC link on the Earth Data Web portal (http://earthdata.nasa.gov)
- Collaborate with NOAA Calibration Data Center to provide SNO data (http://ncc.nesdis.noaa.gov/SNOPredictions)
- Provide GIOVANNI access to MIIC REST API or integrate w/ "Federated Giovanni" (*Kempler, Lynnes*)
- Provide GSICS Global Space-based Inter-Calibration System access to MIIC REST API; NOAA NESDIS 20 day cache at http://gsics.nesdis.noaa.gov/thredds/
- Serve as basis for Reference Intercalibration architecture for CLARREO Pathfinder (2016 – 2021)

CLARREO Pathfinder and MIIC Infrastructure for Reference Intercalibration



Data Products for Initial MIIC Deployment

Product	Center	Type	Temporal Coverage	Size
CERES L2	ASDC	Footprints	hour	50 MB
CALIPSO L1	ASDC	Profile	orbit	500 MB
CALIPSO L2	ASDC	Layer, Profile, and VFM	orbit	40-108 MB
CRIS SDR	NCDC	Spectra	6.8 min	257 MB
ATMS SDR	NCDC	Swath scans	7 min	2.6 MB
VIIRS SDR	NCDC	Swath scans	5 min	350 MB
VIIRS EDR	NCDC	Aerosol, Cloud, Ice, Land, Sea Surface,… 14 types	~ 5.8 min	1.1- 9 MB
GOES13	NCDC	Full disk scans	15 min.	2.7 GB

- Sizes are approximate; temporal and spatial coverage vary with product type
- Geolocation and science data may be in separate files at NCDC (use OPeNDAP NcML)
- VIIRS channels stored in separate files

MIIC Use Cases

- Intercalibration (*LEO-GEO and LEO-LEO*) ✔
  - Acquire and analyze matched data using the MIIC event predictor instrument models
  - Use MIIC OPeNDAP server-side functions to acquire, filter, and grid L1 or L2 data
  - Demonstrated capabilities with SCIAMACHY, MODIS, VIIRS, GOES and CERES
- Intercomparison (*support NPP Validation study*) ✔
  - Acquire matched NPP and CALIPSO data
  - Data used for offline validation of CriMSS (T, H_2O) using RTM (*X. Liu*)
  - Acquire CrIS SDR, ATMS SDR, VIIRS SDR, VIIRS EDR, CriMSS EDR, CALIPSO L1 & L2 data for matched events
- Surface Site Data Mining ✔
  - Acquire data over geographic surface sites (eg., Libya-4, Dome C)
  - Use MIIC OPeNDAP server-side functions to acquire, filter, and grid L1 or L2 data
  - For CERES and CALIPSO use ASDC PostGIS to speed up predictions
- OSSE Data Access (*support OSSE vs. SCIAMACHY analysis*)
  - Demonstrate efficient access to large hyperspectral multi-year OSSE datasets
  - Develop spectral resample and spatial average server-side functions
  - OSSE vs. SCIAMACHY offline analysis (*Y. Roberts)*

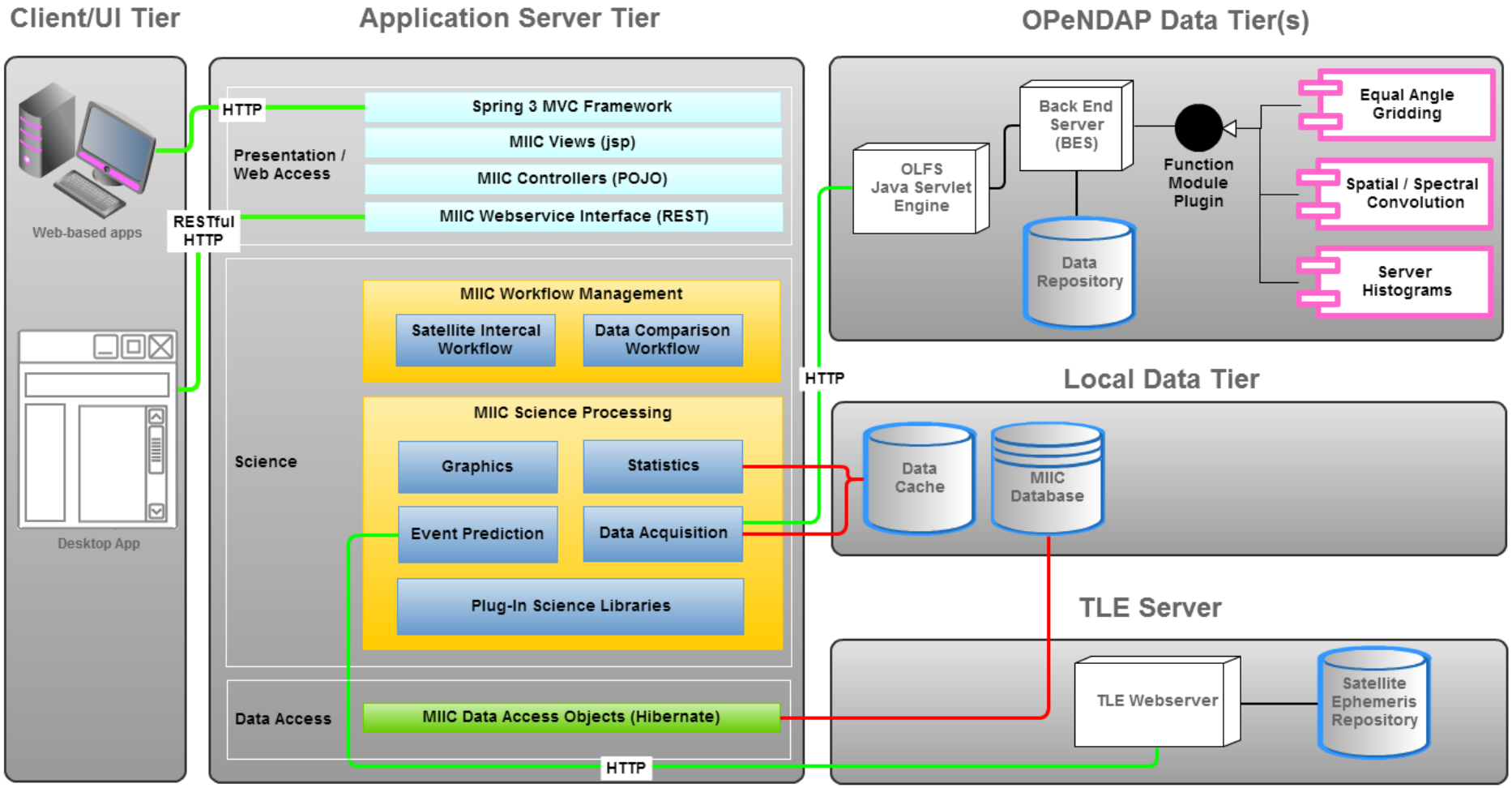
What can you do with MIIC?

- Event Prediction ✔
- Acquisition of matched events ✔
- Analysis and visualization of events

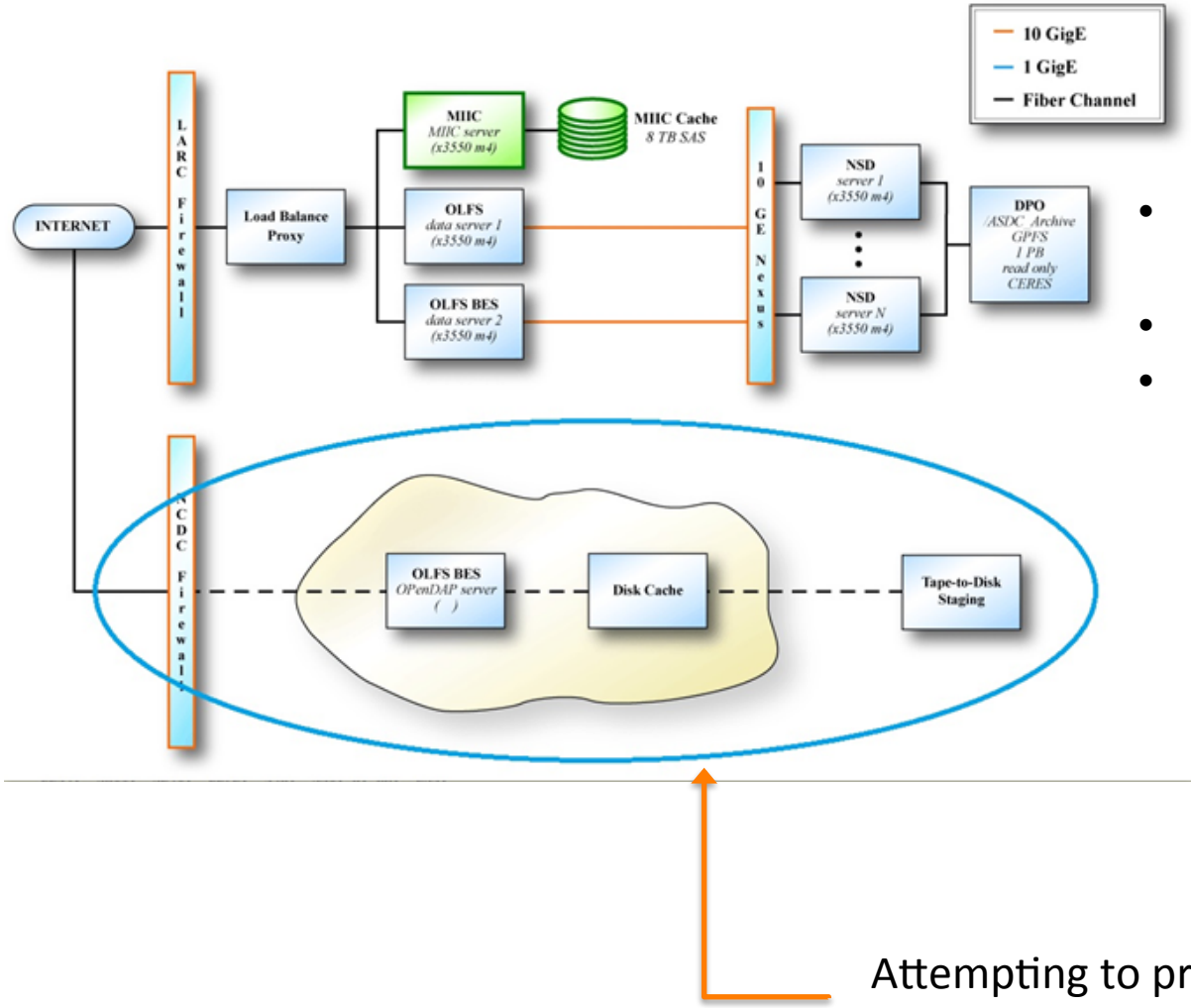
Type	Target	Reference	Date range	Performance	Volume Processed
Event prediction	GOES13 FD	NPP VIIRS	2013	1492 events, 30 sec.	N/A
Event prediction	Aqua MODIS	NPP VIIRS	2013	948 events, 1 min.	N/A
LEO-GEO 2DGridded	GOES13 FD	NPP VIIRS	Jan. 1, 2013	4 events, 5 min.	14 GB
LEO-GEO Tuple	GOES13 FD	NPP VIIRS	Jan. 1, 2013	4 events, 7 min.	14 GB
LEO-LEO 2DGridded	Aqua CERES	NPP VIIRS	Jan., 2013	27 events, 4 min.	40 GB
LEO-LEO Tuple	NPP VIIRS	CALIPSO	Aug. 12, 2013	1 event, 2 min.	4 GB
Surface Site Tuple	NPP VIIRS	N/A	2014	274 events, 18 min.	100 GB
Surface Site Tuple	CALIPSO	N/A	2013	182 events, 4 min.	91 GB
Surface Site 2DGridded	NPP VIIRS	N/A	2014	274 events, 18 min.	100 GB

All products staged on ASDC servers, surface site (10 degree box at 75 W), data volumes are approximate

MIIC Architecture



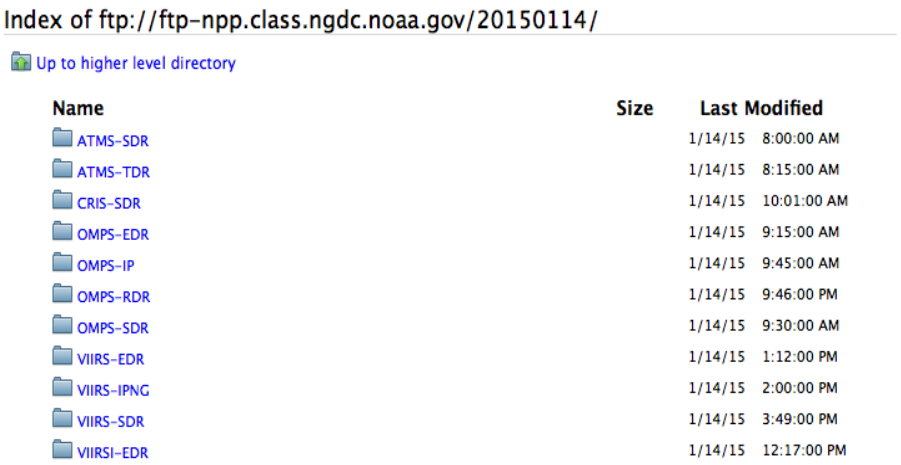
NOAA - NASA Collaborative Deployment



- New SGI servers installed at ASDC
- 10 GE connectivity to DPO
- Need to provide Internet access

Attempting to provide dedicated MIIC S-NPP 30 Day Cache w/ OPeNDAP access

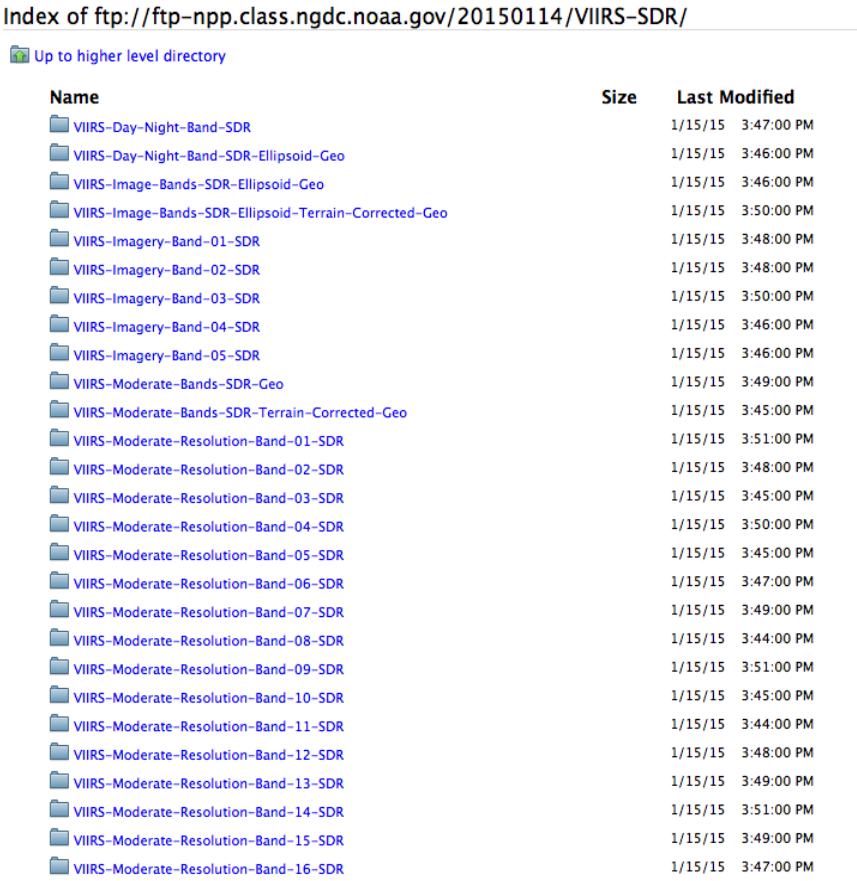
S-NPP MIIC 30 Day Cache



Index of ftp://ftp-npp.class.ngdc.noaa.gov/20150114/

Up to higher level directory

Name	Size	Last Modified
ATMS-SDR		1/14/15 8:00:00 AM
ATMS-TDR		1/14/15 8:15:00 AM
CRIS-SDR		1/14/15 10:01:00 AM
OMPS-EDR		1/14/15 9:15:00 AM
OMPS-IP		1/14/15 9:45:00 AM
OMPS-RDR		1/14/15 9:46:00 PM
OMPS-SDR		1/14/15 9:30:00 AM
VIIRS-EDR		1/14/15 1:12:00 PM
VIIRS-IPNG		1/14/15 2:00:00 PM
VIIRS-SDR		1/14/15 3:49:00 PM
VIIRSI-EDR		1/14/15 12:17:00 PM



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Up to higher level directory

Name	Size	Last Modified
VIIRS-Day-Night-Band-SDR		1/15/15 3:47:00 PM
VIIRS-Day-Night-Band-SDR-Ellipsoid-Geo		1/15/15 3:46:00 PM
VIIRS-Image-Bands-SDR-Ellipsoid-Geo		1/15/15 3:46:00 PM
VIIRS-Image-Bands-SDR-Ellipsoid-Terrain-Corrected-Geo		1/15/15 3:50:00 PM
VIIRS-Imagery-Band-01-SDR		1/15/15 3:48:00 PM
VIIRS-Imagery-Band-02-SDR		1/15/15 3:48:00 PM
VIIRS-Imagery-Band-03-SDR		1/15/15 3:50:00 PM
VIIRS-Imagery-Band-04-SDR		1/15/15 3:46:00 PM
VIIRS-Imagery-Band-05-SDR		1/15/15 3:46:00 PM
VIIRS-Moderate-Bands-SDR-Geo		1/15/15 3:49:00 PM
VIIRS-Moderate-Bands-SDR-Terrain-Corrected-Geo		1/15/15 3:45:00 PM
VIIRS-Moderate-Resolution-Band-01-SDR		1/15/15 3:51:00 PM
VIIRS-Moderate-Resolution-Band-02-SDR		1/15/15 3:48:00 PM
VIIRS-Moderate-Resolution-Band-03-SDR		1/15/15 3:45:00 PM
VIIRS-Moderate-Resolution-Band-04-SDR		1/15/15 3:50:00 PM
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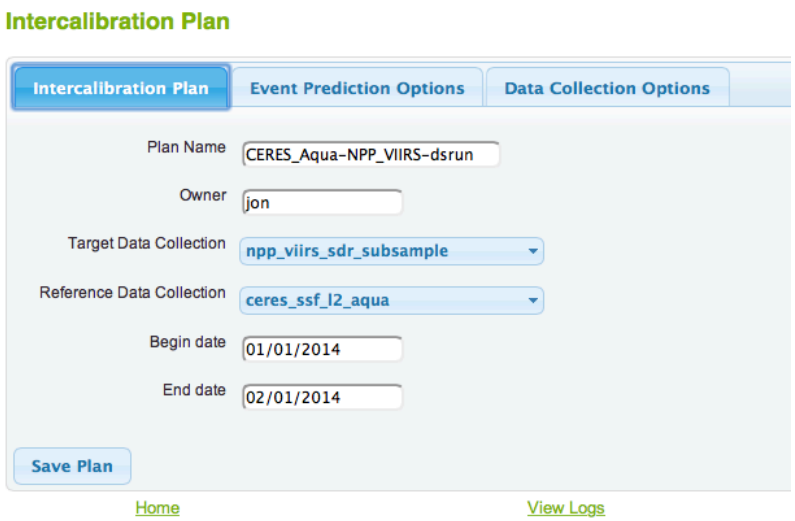
VIIRS-Moderate-Resolution-Band-06-SDR		1/15/15 3:47:00 PM
VIIRS-Moderate-Resolution-Band-07-SDR		1/15/15 3:49:00 PM
VIIRS-Moderate-Resolution-Band-08-SDR		1/15/15 3:44:00 PM
VIIRS-Moderate-Resolution-Band-09-SDR		1/15/15 3:51:00 PM
VIIRS-Moderate-Resolution-Band-10-SDR		1/15/15 3:45:00 PM
VIIRS-Moderate-Resolution-Band-11-SDR		1/15/15 3:44:00 PM
VIIRS-Moderate-Resolution-Band-12-SDR		1/15/15 3:48:00 PM
VIIRS-Moderate-Resolution-Band-13-SDR		1/15/15 3:49:00 PM
VIIRS-Moderate-Resolution-Band-14-SDR		1/15/15 3:51:00 PM
VIIRS-Moderate-Resolution-Band-15-SDR		1/15/15 3:49:00 PM
VIIRS-Moderate-Resolution-Band-16-SDR		1/15/15 3:47:00 PM

- Submitted request to NOAA for NPP file types
- ATMS, VIIRS, and CRIS products (19 TB/mo.)
- Current ftp server not setup for OPeNDAP, files need to be untarred and uncompressed, ftp://ftp-npp.class.ngdc.noaa.gov/
- NCDC to stand up dedicated 30 day MIIC cache with OPeNDAP access (*J. Morris, L. Crandall*)

MIIC Web Page Demo

1



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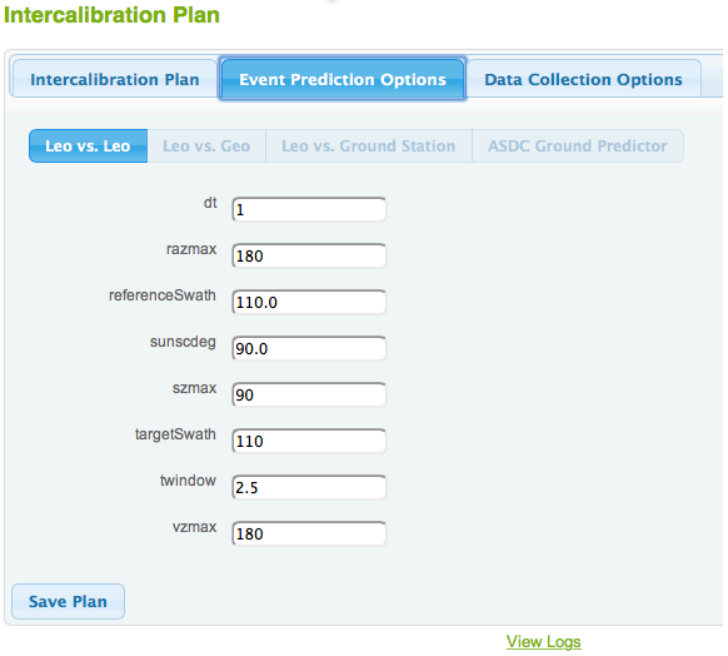

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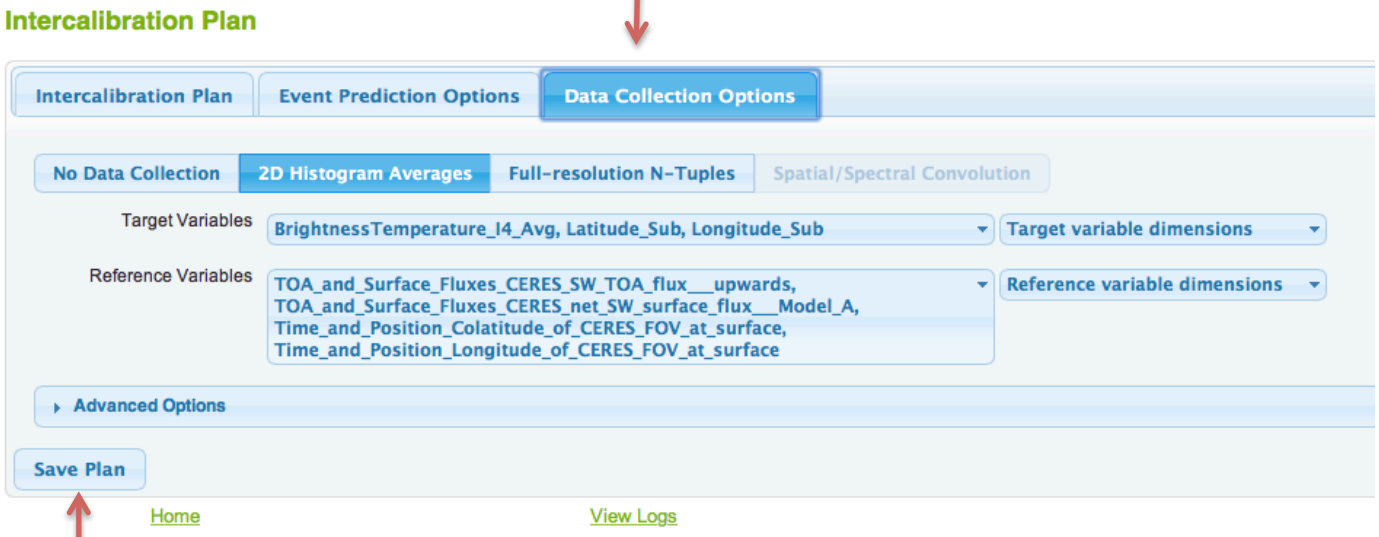


4

User creates ICPlans to predict, acquire, and analyze data

MII Multi Instrument Inter-Calibration

Welcome! jon Login Logout

Plan: CERES_Aqua-NPP_VIIRS-dsrun

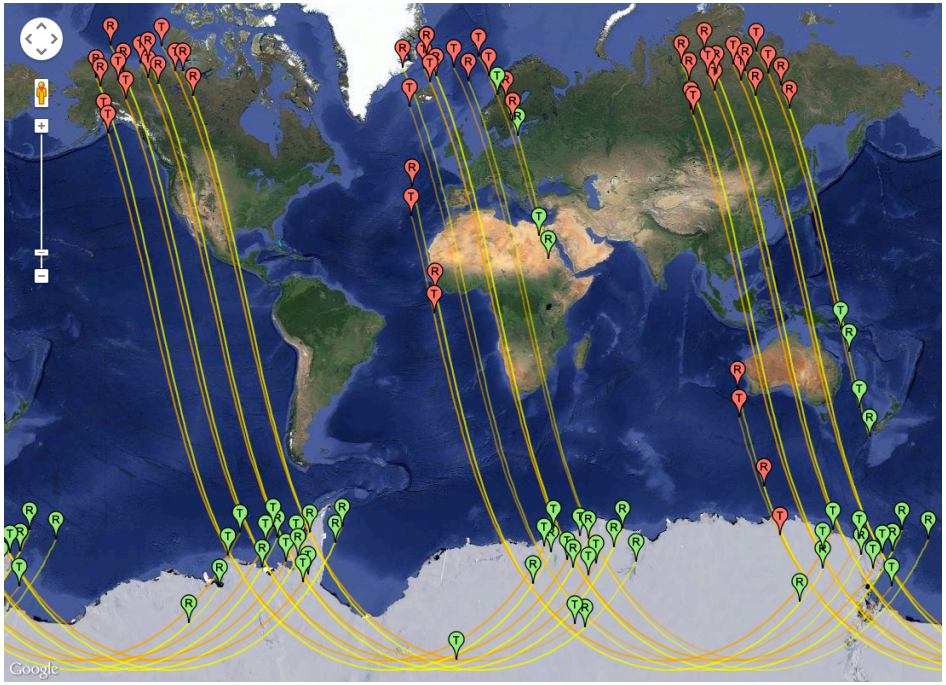
Current State: ACQUIRING_DATA

Start Execution

Show 10 entries Search:

Begin	End	Lat South	Lat North	Lon West	Lon East	State
Fri, 24 Jan 2014 13:59:35 GMT	Fri, 24 Jan 2014 14:28:38 GMT	-89.00324197697755	-2.269774608270527	-179.9761271374854	179.96991327080818	DATA_ACQUIRED
Mon, 27 Jan 2014 03:12:34 GMT	Mon, 27 Jan 2014 03:44:32 GMT	-40.79488007908672	71.49217490581624	93.67320698173019	176.74090509262373	DATA_ACQUIRED
Mon, 27 Jan 2014 04:35:32 GMT	Mon, 27 Jan 2014 05:24:59 GMT	-88.99962790759989	69.95656783254812	0.37544132975204914	-0.05534390474684869	DATA_ACQUIRED
Mon, 27 Jan 2014 06:16:47 GMT	Mon, 27 Jan 2014 06:27:00 GMT	-88.9996738904554	-60.816009775757145	0.07700780640099117	-0.6418072707076021	DATA_ACQUIRED
Wed, 29 Jan 2014 19:13:21 GMT	Wed, 29 Jan 2014 20:01:43 GMT	-88.99989074878894	72.18100616579439	-179.34322853682022	179.8608894261324	DATA_ACQUIRED
Wed, 29 Jan 2014 20:52:28 GMT	Wed, 29 Jan 2014 21:41:41 GMT	-88.99990601738796	68.98370623285292	-179.65961033892637	179.66108203012388	DATA_ACQUIRED

Showing 21 to 26 of 26 entries Previous 1 2 3 Next



- Event Prediction results depicted on Google Maps
- Need to develop analysis and visualization capabilities for single events and collections of events

TLEs Available for MIIC Event Prediction

(red implemented)

- Can run predictions for any spacecraft with TLEs from Space-Track.org
- Current plans to access only instrument data hosted at ASDC or NCDC
- User can run predictions w/o accessing data
- Extend list of satellites in current deployment? Run IC and access only data from 1 satellite
- Extended CLARREO algorithm (*C. Roithmayr*)

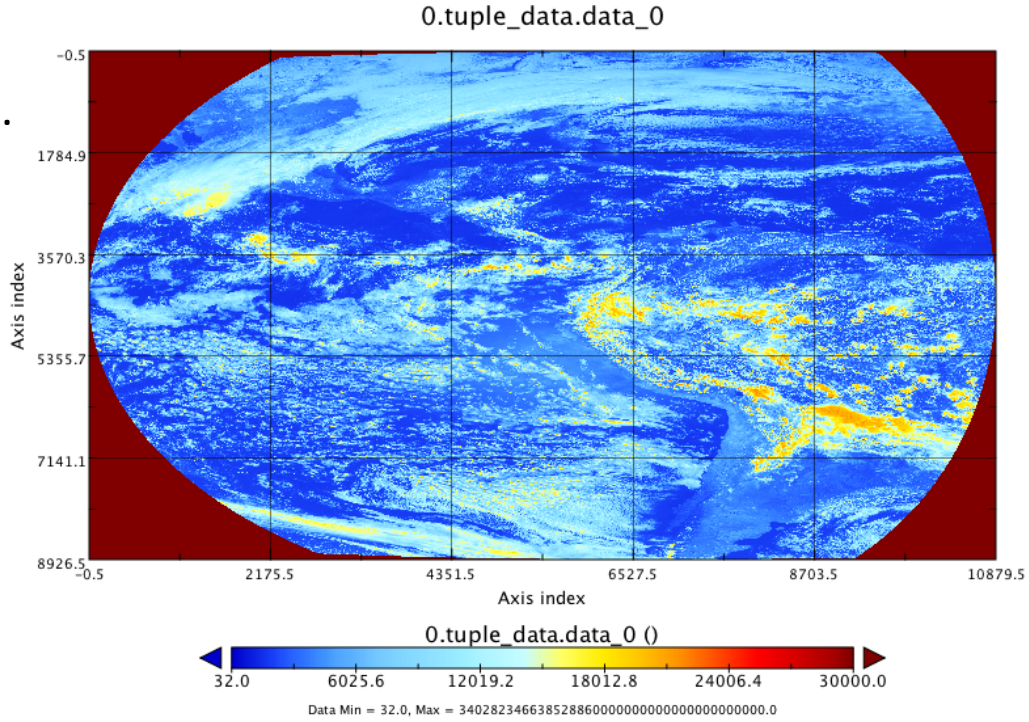
http://www-angler.larc.nasa.gov/cgi-bin/site/showdoc?mnemonic=TLE&c=satellite-list

CAT#	NAME	TLE_LAST_UPDATED
13367	"Landsat 4"	"2013-06-20 08:05:02"
14780	"Landsat 5"	"2013-06-20 08:05:02"
15354	"ERBS"	"2013-06-20 08:05:02"
15427	"NOAA-09"	"2013-06-20 08:05:02"
16969	"NOAA-10"	"2013-06-20 08:05:02"
19531	"NOAA-11"	"2013-06-20 08:05:02"
21140	"Meteosat-5"	"2013-06-20 08:05:02"
21263	"NOAA-12"	"2013-06-20 08:05:02"
21574	"ERS-1"	"2013-06-20 08:05:02"
23051	"GOES-8"	"2013-06-20 08:05:02"
23455	"NOAA-14"	"2013-06-20 08:05:02"
23522	"GMS-5"	"2013-06-20 08:05:02"
23560	"ERS-2"	"2013-06-20 08:05:02"
23581	"GOES-9"	"2013-06-20 08:05:02"
23940	"TOMS-EP"	"2013-06-20 08:05:02"
24786	"GOES-10"	"2013-06-20 08:05:02"
24883	"OrbView-2"	"2013-06-20 08:05:02"
24932	"Meteosat-7"	"2013-06-20 08:05:02"
25063	"TRMM/VIRS"	"2013-06-20 08:05:02"
25260	"SPOT-4"	"2013-06-20 08:05:02"
25338	"NOAA-15"	"2013-06-20 08:05:02"
25682	"Landsat 7"	"2013-06-20 08:05:02"
25789	"QuikSCAT"	"2013-06-20 08:05:02"
25991	"DMSP 5D-3 F15 (USA 147)"	""
25994	"Terra"	"2013-06-20 08:05:02"
26352	"GOES-11"	"2013-06-20 08:05:02"
26536	"NOAA-16"	"2013-06-20 08:05:02"
26871	"GOES-12"	"2013-06-20 08:05:02"
27386	"EnviSAT"	"2013-06-20 08:05:02"
27421	"SPOT-5"	"2013-06-20 08:05:02"
27424	"Aqua"	"2013-06-20 08:05:02"
27453	"NOAA-17"	"2013-06-20 08:05:02"
27509	"Meteosat-8 (MSG-1)"	"2013-06-20 08:05:02"
27525	"Kalpana-1"	"2013-06-20 08:05:02"
27642	"ICESat"	"2013-06-20 08:05:02"
28054	"DMSP 5D-3 F16 (USA 172)"	""
28376	"Aura"	"2013-06-20 08:05:02"
28451	"Feng Yun 2C"	"2013-06-20 08:05:02"
28622	"MTSAT-1R"	"2013-06-20 08:05:02"
28622	"MTSAT-1R/Aqua"	"2013-06-20 08:05:02"
28654	"NOAA-18"	"2013-06-20 08:05:02"
28912	"Meteosat-9 (MSG-2)"	"2013-06-20 08:05:02"
28912	"Meteosat-9/Terra (MSG-2)"	"2013-06-20 08:05:02"
28912	"Meteosat-9/Aqua (MSG-2)"	"2013-06-20 08:05:02"
28937	"MTSAT-2"	"2013-06-20 08:05:02"
29107	"CloudSAT"	"2013-06-20 08:05:02"
29108	"Calipso"	"2013-06-20 08:05:02"
29155	"GOES-13"	"2013-06-20 08:05:02"
29499	"MetOp-A"	"2013-06-20 08:05:02"
29522	"DMSP 5D-3 F17 (USA 173)"	"2011-11-15 08:12:53"
29640	"Feng Yun 2D"	"2013-06-20 08:05:02"
32382	"RadarSat-2"	"2013-06-20 08:05:02"
33463	"FY2E"	"2012-07-12 15:57:39"
33492	"GOSAT"	"2013-06-20 08:05:02"
33591	"NOAA-19"	"2013-06-20 08:05:02"
35951	"DMSP 5D-3 F18 (USA 210)"	""
36411	"GOES-15"	"2013-06-20 08:05:02"
37838	"Megha-Tropiques"	"2013-06-20 08:05:02"
37849	"Suomi National Polar Orbiting Partnership"	"2013-06-20 08:05:02"
38552	"Meteosat-10 (MSG-3)"	"2013-06-20 08:05:02"
38771	"MetOp-B"	"2013-06-20 08:05:02"

LEO-GEO Full Resolution (Tuple) Data for VIIRS vs. GOES13 Event

Jan. 1, 2013

a.



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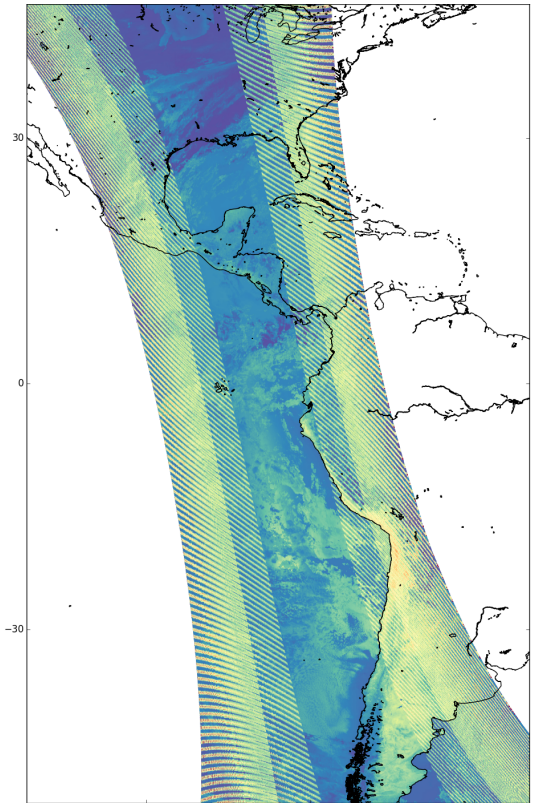
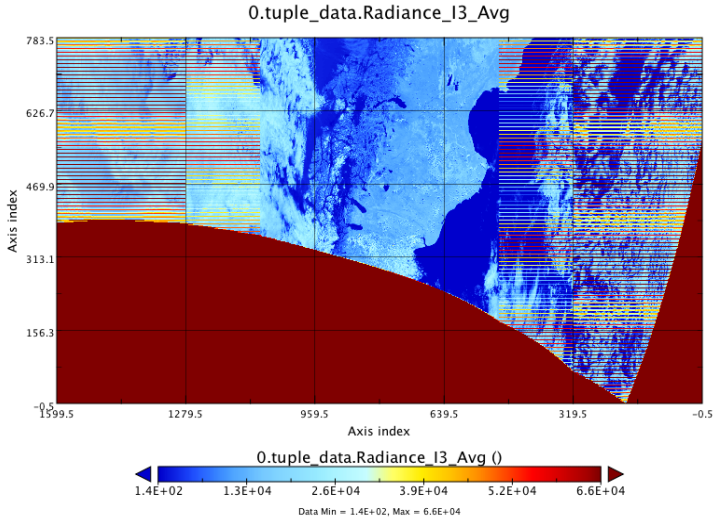


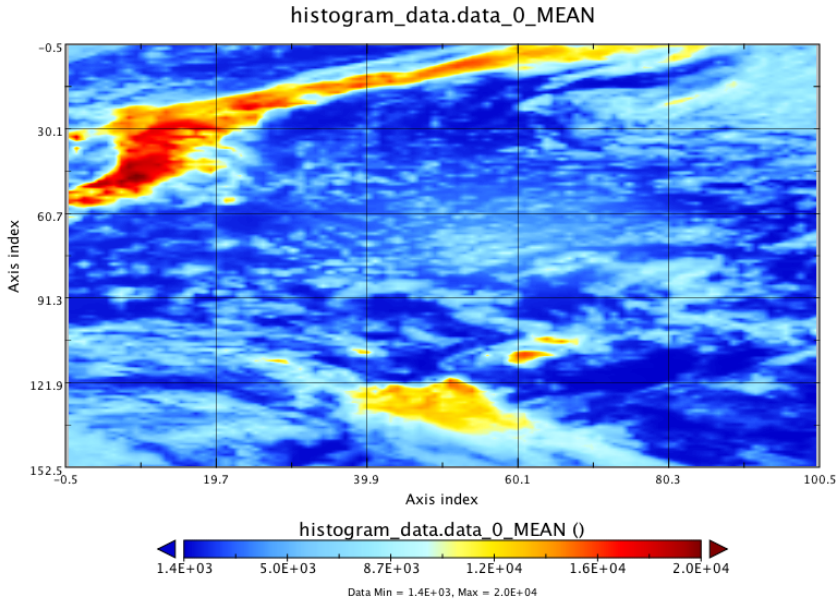
c.



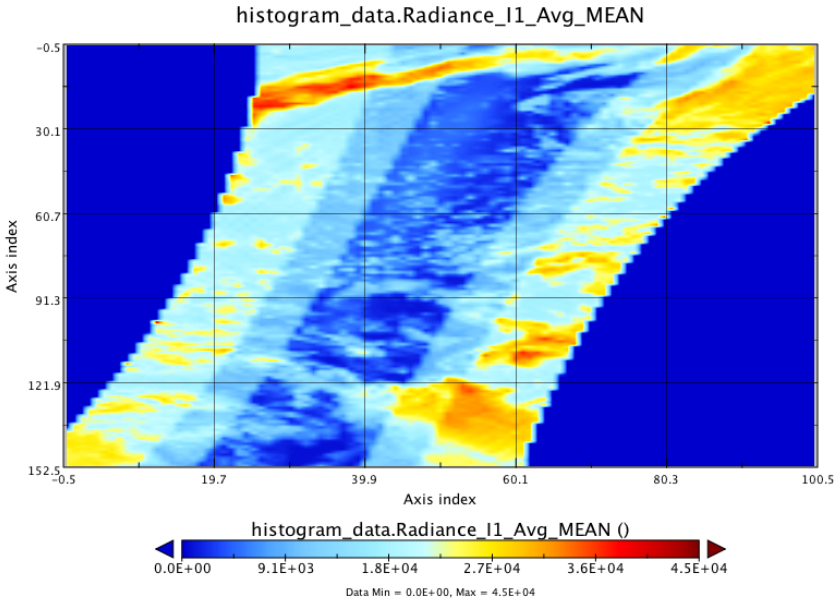
Jan. 1, 2013 NPP VIIRS-GOES13 MIIC IC Event, 46.4 N, -51.2 S, -114.7 W, -53.2 W, time 2013-01-01T18:49:40Z through 2013-01-01T19:17:00Z; **a**. 1 km GOES13 band 0 data from CLASS, **b**. Matched 2 km VIIRS SDR Radiance_I3_Avg data, **c**. one VIIRS granule (of 7) that make up matched LEO-GEO event; fill values at scan angles greater than 31.7° and 56.3° due to "bow-tie" effect. Extremely large amount of data for a single event!

LEO-GEO Gridded Data for VIIRS vs. GOES13 Event

Jan. 1, 2013



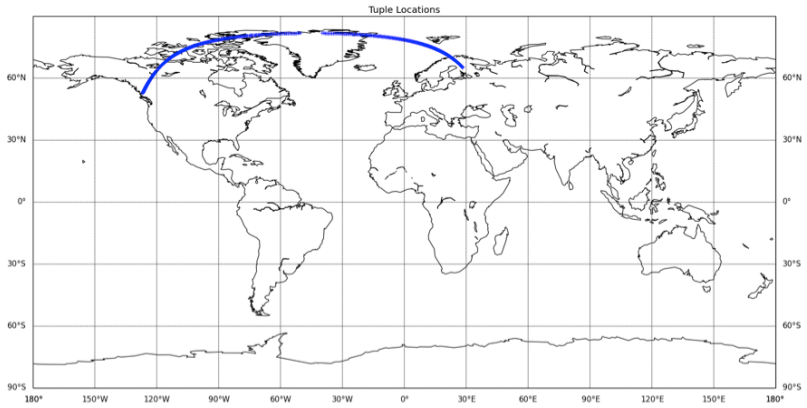
GOES13 gridded



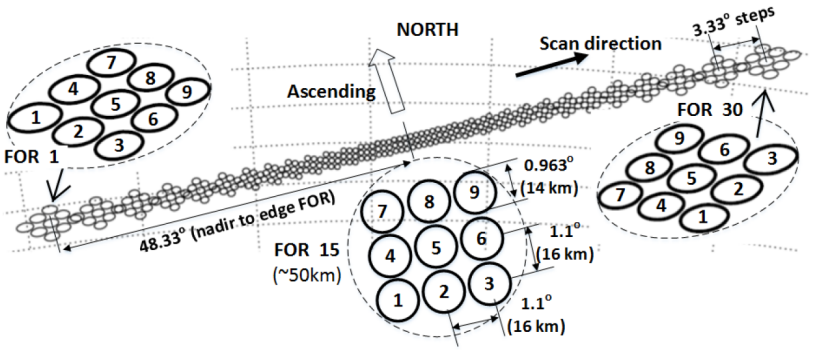
VIIRS gridded

Gridded data, 0.5 degree, returned from MIIC server-side 2DHistogram function for single LEO-GEO matched event; factor of 3500 in data reduction compared to tuple data

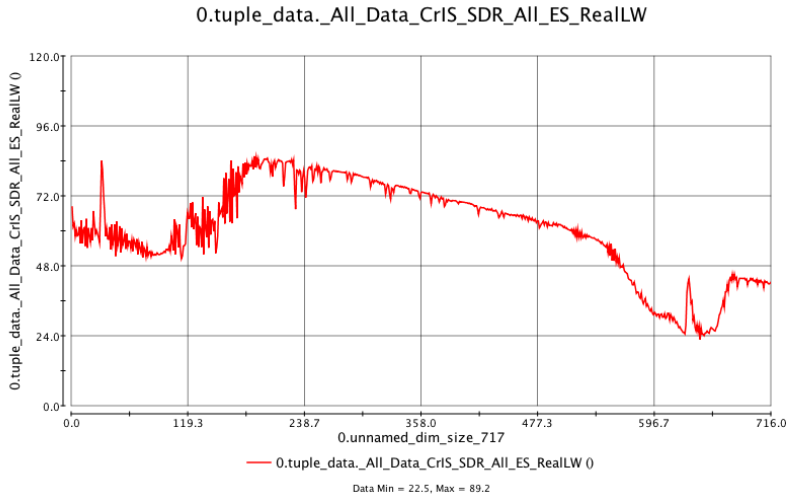
LEO-LEO Intercomparison for CrIMSS Validation Study (*X. Liu*)
Acquire CALIPSO, CrIS, ATMS, VIIRS, and CriMISS Tuple Data - *Not Collocated*
IC Event Aug. 12, 2014



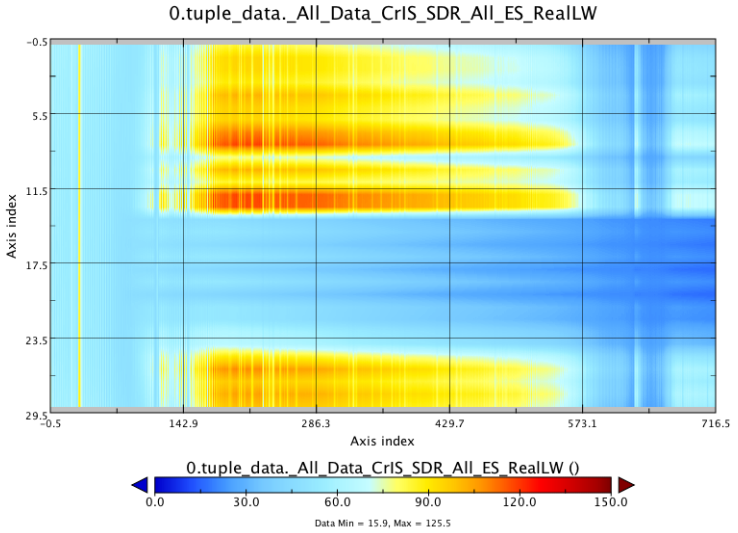
CALIPSO groundtrack for matched event w/ NPP



Tune MIIC event predictor to use CrIS scan width



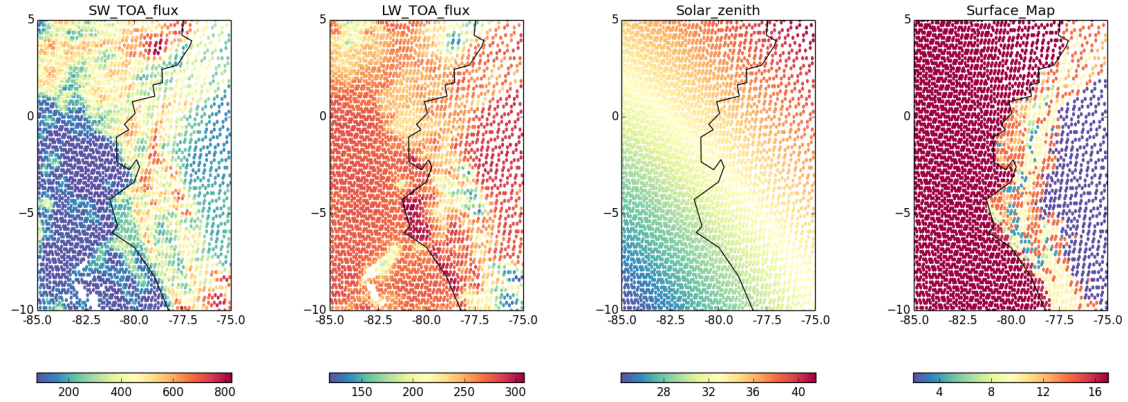
Single CrIS SDR LW spectra for FOV1



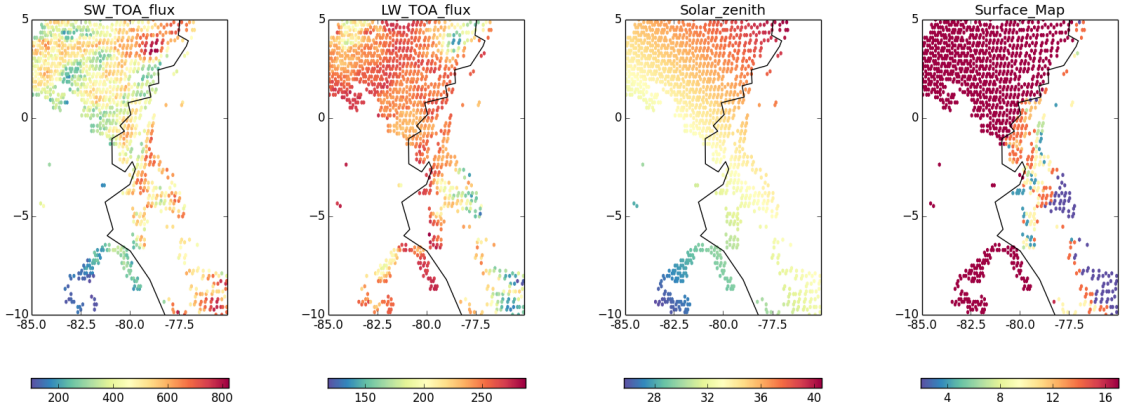
Single scan of CrIS LW spectra for FOV1 (30 FORs per scan)

Server-side Filtering for Surface Site Acquisition

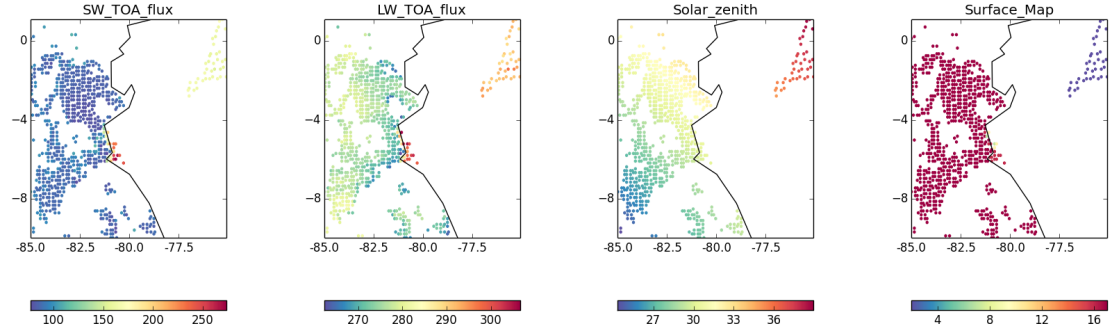
Need to provide simpler interface, CERES SSF data, Jan. 2, 2011



a. No clear sky filter



b. 5 % clear sky filter



c. 95 % clear sky filter

How to Make MIIC Operational? What is Needed?

- Stable code release, how? Code review(s), branch and tag production version
- Open up miic1 to Internet, how? When?
- Install MIIC module (rpm) on NCDC OPeNDAP server, do we need NASA Software Release?
- Connect miic1 to NCDC OPeNDAP server, how? ISA?
- Test integrated ASDC – NCDC system
- Open up MIIC to outside users (GSICS, NOAA, …)
- How to monitor system performance and anomalies?

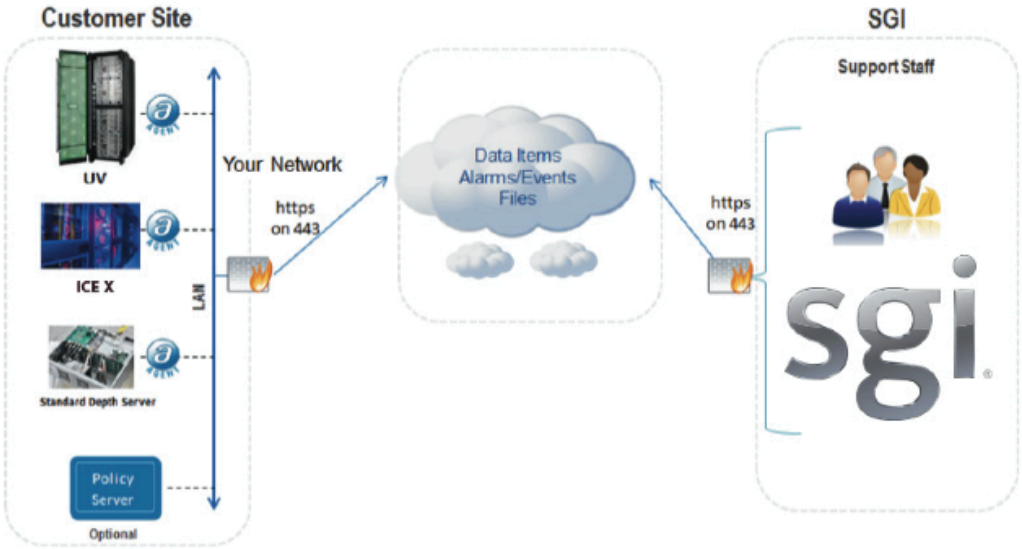
How to Work More Closely w/ NCDC?

(Jay Morris - NOAA Federal, Lea Crandall - NOAA Affiliate)

- NCDC process – define task, funding, then seek approval from NCDC Engineering Assessment board
- Currently discussing OPeNDAP server (procure, re-purpose?)
- How to get integrated master MIIC schedule?
- What is an "ISA"? Do we need?
  - Interconnection Security Agreement
  - Can we leverage an existing NOAA-ASDC document?
  - http://www.ospo.noaa.gov/Organization/About/access.html
  - The ISA documents the requirements for connecting the IT systems, describes the security controls that will be used to protect the system and data and contains a topological drawing of the interconnection. The ISA is sometimes coupled with a Memorandum of Understanding/ Memorandum of Agreement between the two parties that have an interconnection.

Long Term: Use SGI Remote Services for Monitoring?

- Discuss recent miic2 server memory (DIMMS) failure
- SGI Remote Services 7x24? http://www.sgi.com/services/support/remote_7x24.html
- Secure connections to diagnose issues
- Improved uptime
- Proactively prevent outages and speed problem resolution



Summary

- MIIC system has a lot of potential but ….
- We need a successful deployment!
- Requires an integrated ASDC/NCDC/MIIC team to define and implement operations
- Action items?