CLARREO Pathfinder Inter-Calibration Data System: Requirements, Concepts, and Status

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Outline:

- Inter-Calibration Data System Requirements
- Data Management Plan
- Inter-Project Agreement with ESDIS
- Data System Hardware Status
- Multi-instrument Inter-calibration (MIIC) System
- Issues and Challenges

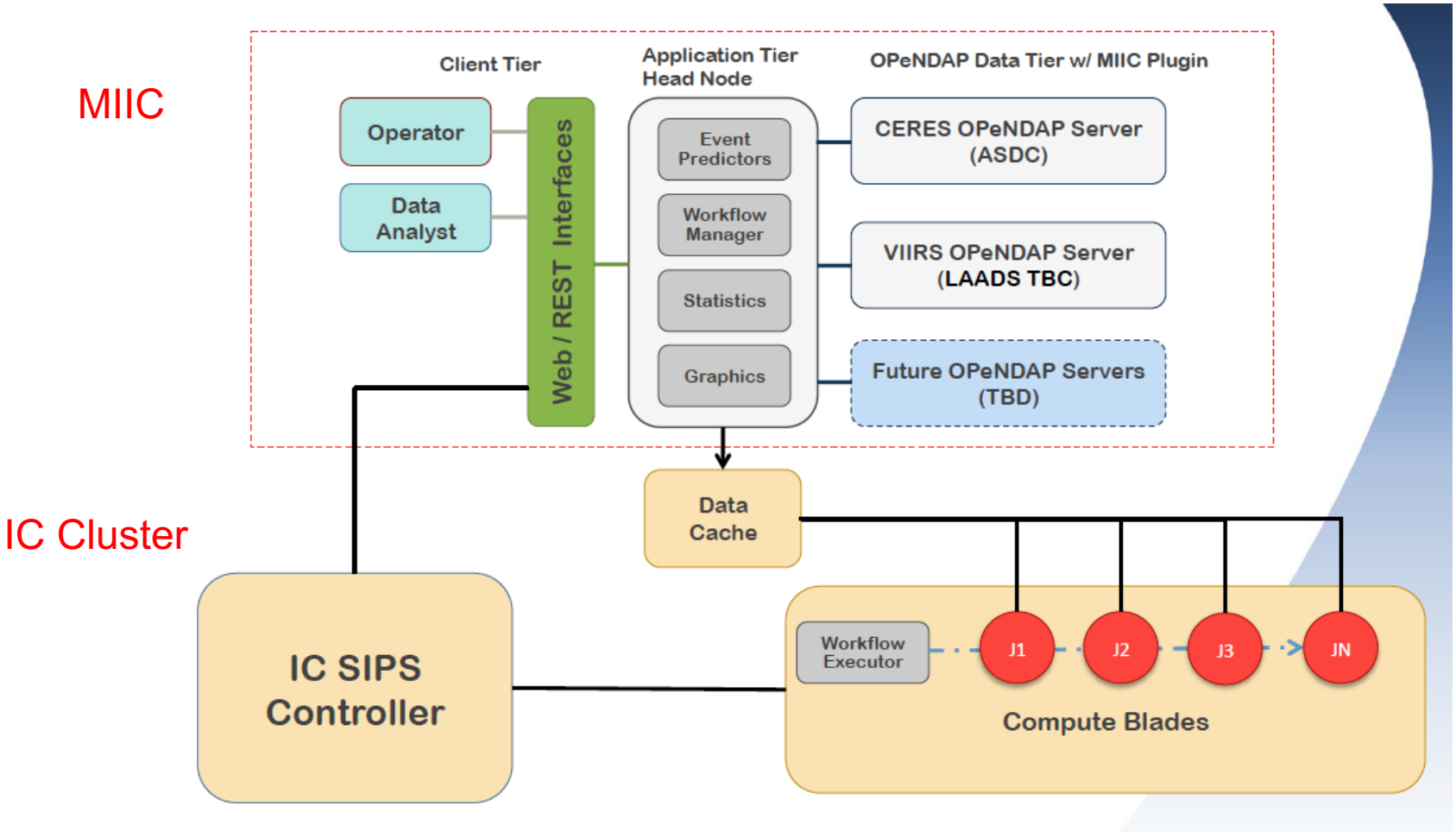
MIIC IC Data Management Requirements

- **Level 2 Data Requirements are Specified in the SMRD**
  - *SMRD SCI.24040 ESDIS Compliance*
    - *Adhere to NASA Earth Science Data and Information Policy specified at http://science.nasa.gov/earth-science/earth-science-data/data-information-policy/* - open access to data
    - NASA Earth science data systems to adhere to ESDIS standards and practices, http://earthdata.nasa.gov/data/standards-and-references - produce data products in compliant file format (HDF5, netCDF4)
  - *Data Latency*
    - CPF IC L1B: 1 month after measurement
    - L4: 6 months after measurement
    - VIIRS and CERES input TBD
  - *Data Release (available to outside users)*
    - CPF IC L1B: L+10 mos. (Beta), L+20 mos. (Ed1)
    - L4: L+12 mos. (Beta), L+24 mos. (Ed1)

CPF Data Management Planning Documents

- **Draft Data Management Plan CPF-04-014 *Draft***
  - *Implementation plan for CPF Science Segment – addresses life cycle of science data product generation: software development, data systems, science operations, data assessment, …*
- **Inter-Project Agreement (IPA) with ESDIS**
  - *Define DAAC and Project responsibilities to archive and distribute data products to the science community*
  - *Need draft IPA by SRR*
  - *Jeff Walter (ASDC) leading the effort*
  - *Help explain "ESDIS compliance" requirements*

CPF Inter-Calibration Data System



- New hardware procured and installed for small cluster and shared storage (GPFS)
- Need to interface to MIIC system

Inter-Calibration New Data System Hardware

- ***Excellent ASDC support***: Dave Johnson, Chris Jones, Andrei Vakhnin, Chris Harris

- New CPF data system being configured and tested
  - Head node
  - 6 compute nodes, 16 Intel cores/node
  - Local GPFS storage (185 TB, RAID6)
  - MIIC blades (3)

- Benchmark results (48 jobs, 512KB bsz)

	GPFS_local /Pathfinder RAID6	ext4_local /data2 RAID5	GPFS_remote /data3_3500 RAID6
ibm_seq_write	2.7 GB/s	1.0 GB/s (per RAID)	59 MB/s
ibm_seq_read	1.8 GB/s	cache biased	1.8 GB/s
Iozone			
gpfsperf			

- HP (SGI) meeting 1/10 to verify system configuration and perform system tuning
- Univa Grid Engine installed, runs on top of GPFS
- Run multiple processes (1-16 per node) using UGE or MPI; only 3 compute nodes configured!

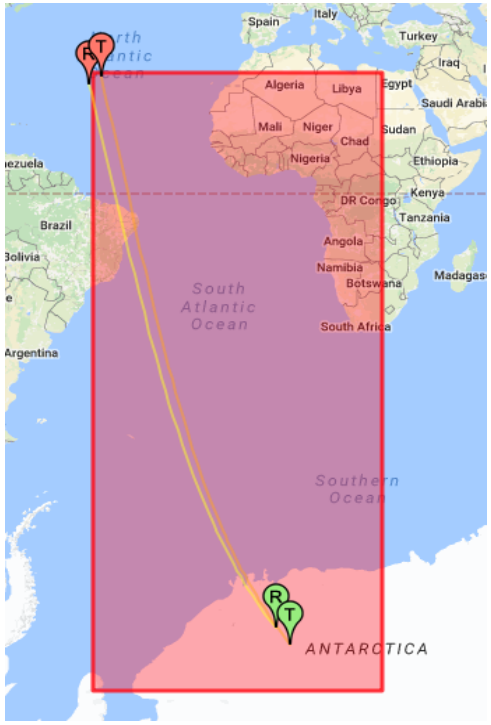
Multi-Instrument Inter-Calibration (MIIC) System

- Distributed system that uses OPeNDAP to access remote data sets
- Event Prediction, Data Acquisition, and Data Analysis web services
- CPF Project to determine how best to leverage the MIIC system
- Lead software architect: Aron Bartle, Mechdyne
- Demo capabilities w/ CERES NPP FM5 vs. Aqua FM3 inter-comparison

Currey, C., Bartle, A., Lukashin, C., Roithmayr, C., Gallagher, J., 2016: "Multi-Instrument Inter-Calibration (MIIC) System," *Remote Sens*. 2016, 8, 902; doi:10.3390/rs8110902.

Multi-Instrument Inter-Calibration (MIIC) software development funded by NASA ROSES ACCESS 2011 and 2013

MIIC Event Prediction



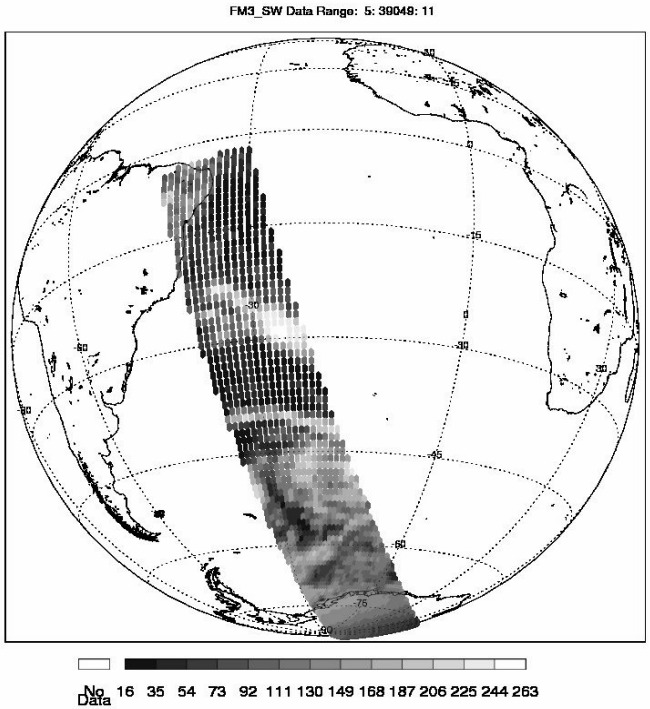


Figure 1. CERES NPP vs. Aqua Event prediction: MIIC (left) vs. SPIE 2014 (right), January 5, 2013; MIIC Event Prediction settings: Δvza=5°, Δraz=180°, Δtime= 24 sec., and 0-75 sza; footprints are averaged within 1°x1° geographic grid cells.

MIIC Data Acquisition

MIIC Multi Instrument Inter-Calibration

Current User: Jon Logout

Home > Plans > Copy Of Copy Of Copy Of EP-DAY-TEST [Events , Analysis]

Current State: ANALYSIS_COMPLETED

Intercalibration Plan | Event Prediction Options | Data Collection Options

No Data Collection | PROFILE_2D (Averaged data values) | N_TUPLE (1D list of observations) | COMPACT (array with filtered indices removed) | Spatial/Spectral Convolution

Target Variables: Clear_Footprint_Area_Clear_area_percent_coverage_at_subpixel_resolution, MIIC_standard_latitude, MIIC_standard_longitude, Surface_Map_Surface_type_index, Time_and_Position_Time_of_observation, Unfiltered_Radiances_CERES_LW_radiance___upwards, Unfiltered_Radiances_CERES_SW_radiance___upwards, Viewing_Angles_CERES_solar_zenith_at_surface, Viewing_Angles_CERES_viewing_zenith_at_surface, Viewing_Angles_CERES_relative_azimuth_at_surface — Target dimensions

Reference Variables: Clear_Footprint_Area_Clear_area_percent_coverage_at_subpixel_resolution, MIIC_standard_latitude, MIIC_standard_longitude, Surface_Map_Surface_type_index, Time_and_Position_Time_of_observation, Unfiltered_Radiances_CERES_LW_radiance___upwards, Unfiltered_Radiances_CERES_SW_radiance___upwards, Viewing_Angles_CERES_solar_zenith_at_surface, Viewing_Angles_CERES_viewing_zenith_at_surface, Viewing_Angles_CERES_relative_azimuth_at_surface — Reference dimensions

Advanced Options

Save Plan

Home | View Logs | Admin Console | NASA ECE Website

MIIC Data Analysis (App tier) Setup

Home > Plans > Terra-NPP-15mos [Events , Analysis]

Current State: ANALYSIS_COMPLETED

- MatchedObservations => tuple
- Fit => SW_fit2
- Fit => LW_fit2

New | Edit | Delete

Analyze | Cancel

Available Objects

data:
- /CER_SSF_Terra-FM1-MODIS
- /CER_SSF_NPP-FM5-VIIRS

result:
- /tuple
- /SW_fit2
- /LW_fit2

Edit Analysis

Analysis Type: MatchedObservations 1.0

Version 1.0: Creates a new Tuple using profiled variables as columns and matched bins as rows. Matches occur where all profile bins have count > 0 and pass an optional filter expression. Profiles provided as input must have identical axis definitions.

Usage:

```
-allColumns          Include all available profiled variables (and count & stderr) as columns in
                     the output Tuple.
-columns <arg>       Profiled variables to include as columns in the output Tuple. Each variable
                     creates three columns: var, var_count & var_stderr.
-filter <arg>        Filter expression (in quotes) to use when matching profile cells.
                     Expressions are evaluated by JEL library and may reference columns inside
                     the tuple.
-out <arg>           Where in results tree to store the the output tuple (e.g. /mystuff/matchy)
```

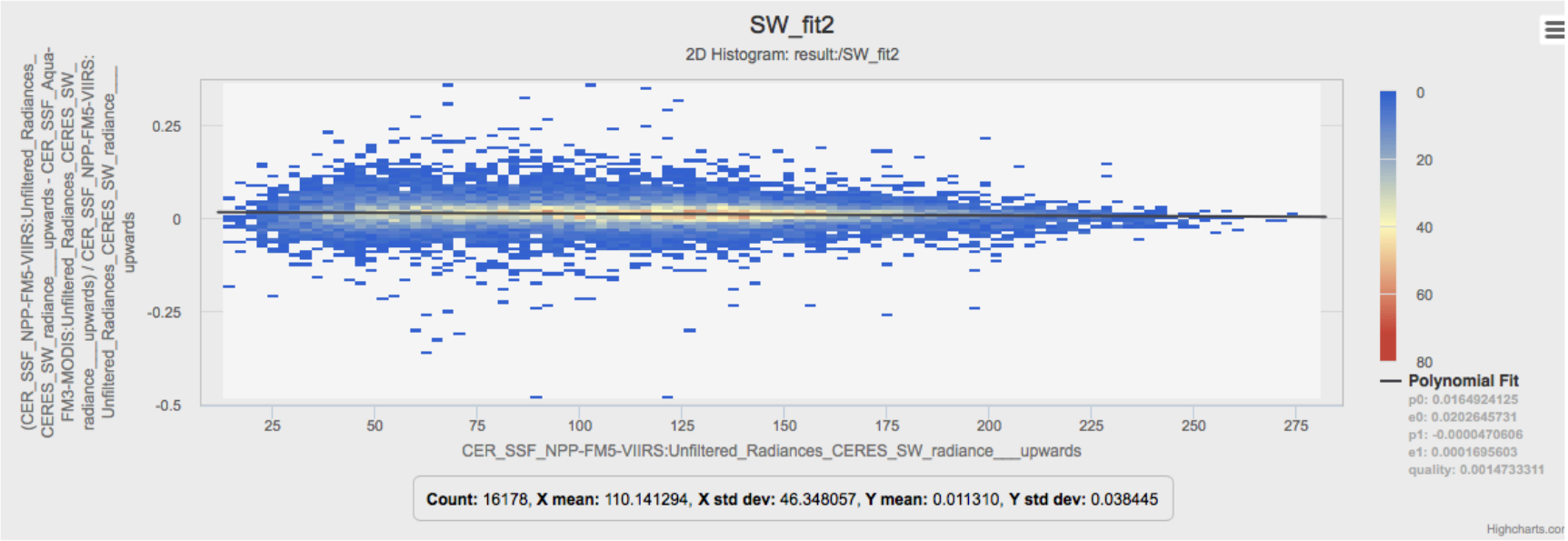
Args:

```
-allColumns -out tuple -filter "(abs(CER_SSF_Terra-FM1-MODIS:Viewing_Angles_CERES_viewing_zenith_at_surface -
CER_SSF_NPP-FM5-VIIRS:Viewing_Angles_CERES_viewing_zenith_at_surface) < 5) && (abs(CER_SSF_Terra-FM1-
MODIS:Viewing_Angles_CERES_relative_azimuth_at_surface - CER_SSF_NPP-FM5-
VIIRS:Viewing_Angles_CERES_relative_azimuth_at_surface) < 5) && CER_SSF_NPP-FM5-
VIIRS:Unfiltered_Radiances_CERES_SW_radiance___upwards_count > 7 && (CER_SSF_NPP-FM5-
VIIRS:Unfiltered_Radiances_CERES_SW_radiance___upwards_stderr / CER_SSF_NPP-FM5-
VIIRS:Unfiltered_Radiances_CERES_SW_radiance___upwards) < .25"
```

Filter merged $1°x1°$ grid cells on server:

$\Delta raz \leq 5°$,
$\Delta vza \leq 5°$,
count > 7,
$\sigma_{SW}/\overline{SW} < .25$

MIIC Data Analysis Visualization



Search:

_LW_radiance___upwards_count	CER_SSF_NPP-FM5-VIIRS Unfiltered_Radiances_CERES_LW_radiance___upwards_stderr	CER_SSF_NPP-FM5-VIIRS Unfiltered_Radiances_CERES_SW_radiance___upwards	CER_SSF_NPP-FM5-VIIRS Unfiltered_Radiances_CERES_SW_radiance___upwards_count
	2.508541273764263	143.33327969637784	11
	2.348462902195875	130.43747874668668	14
	1.6295947580794823	145.20375442504886	12
	1.6877708154677407	165.11226947490985	13
	1.4276253252981312	152.83859888712564	12
	0.9560710849147996	108.38558912277222	16
	1.2464282271977545	179.53932495117186	10

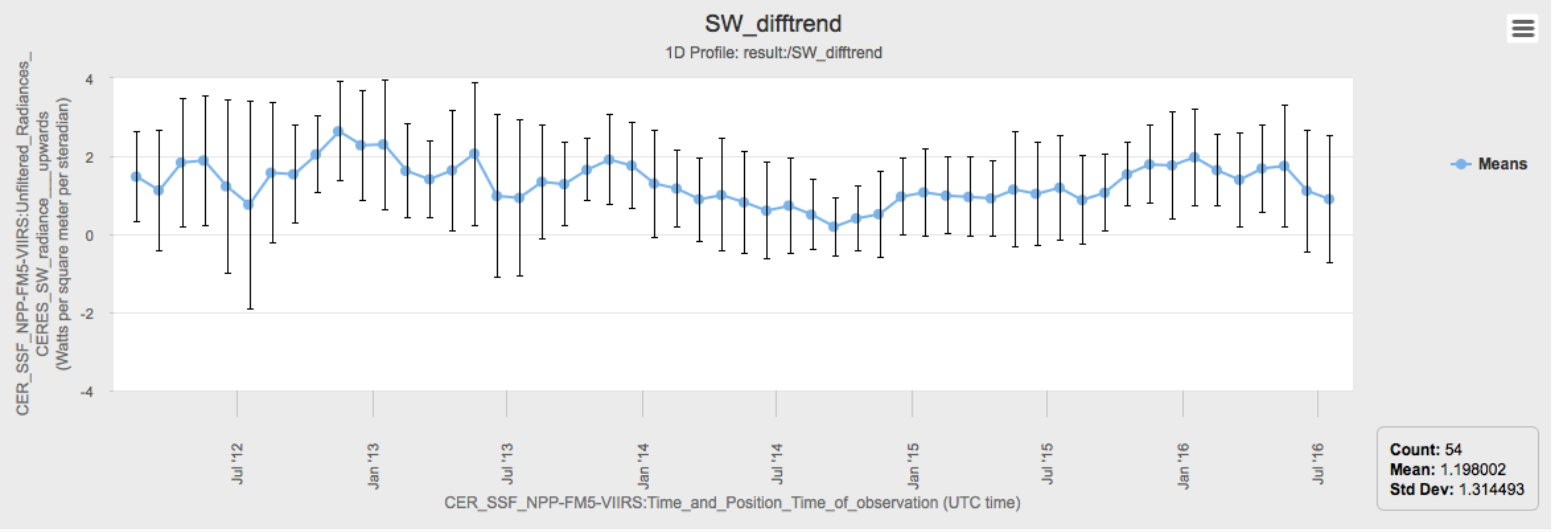
Showing 1 to 8 of 16,179 entries

Working w/ CERES Cal-Val Team to Validate MIIC
(NPP FM5 vs. Aqua FM3 Inter-comparison)

Relative Difference:
(FM5-FM3)/FM5

Date	IC Events	SW Relative Difference All-Sky [%]	SW Relative Difference Overcast [%]	LW Relative Difference All-Sky [%]	LW Relative Difference Overcast [%]
Feb. 1, 2012 – April 30, 2013 (15 mos.)	127	2.97	1.34	-2.01	-2.43
May 1, 2013 – July 31, 2014 (15 mos.)	123	1.74	1.13	-1.61	-2.21
Aug. 1, 2014 – Oct. 31, 2015 (15 mos.)	120	0.98	0.77	-1.10	-1.76
Nov. 1, 2015 – July 31, 2016 (9 mos.)	72	2.41	1.46	-1.80	-2.29

SW Difference Monthly Trend: FM5-FM3



CPF IC Data System Issues and Challenges

- **Work with science working groups for requirements**
  - *ATBDs - define algorithms to implement*
  - *Data Product Catalog – define data products to produce*
- **DM software effort – run IC science jobs (PGEs) -> framework**
- **Select file format (HDF5, netCDF4)**
- **Define Interfaces**
  - *Ingest and Archive interface to be defined by DAAC*
  - *IC Command interface to be defined by LASP*
  - *Controller interface to science jobs (PGEs) via Univa Grid Engine*
- **Determine how to best leverage the MIIC system**
  - *Currently access CERES L2 data from ASDC DPO*
  - *Deploy MIIC OPeNDAP server at LAADS to access VIIRS data (**TBD**)*
- **Plan Build 1**
- **Plan CPF Data Management Workshop w/ LASP (*Feb., '17 TBC*)**
- **Prepare for SRR**