CERES Data Management Team Working Group Report

Katie Dejwakh
Fall CERES Science Team Meeting
October 12, 2021
Data Management Team (DMT)

Science research

DMT / ASDC

User community
Data Management Team (DMT)

Science research

DMT / ASDC

User community

Katie Dejwakh (NASA)
Walt Miller (SSAI)
Data Management Team (DMT)

Instrument

Denise Cooper
Thomas Grepiotis
Hunter Winecoff
Dianne Snyder
Dale Walikainen
Data Management Team (DMT)

Instrument

ERBE-like

Dale Walikainen

Jeremie Lande
## Data Management Team (DMT)

<table>
<thead>
<tr>
<th>Instrument</th>
<th>ERBE-like</th>
<th>Clouds</th>
</tr>
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</table>

- Sunny Sun-Mack
- Ricky Brown
- Steve Kohler
- Yan Chen
- Elizabeth Heckert
- Rita Smith
- Walt Miller
# Data Management Team (DMT)

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<tr>
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<tbody>
<tr>
<td>Inversion</td>
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</table>

- Victor Sothcott
- Igor Antropov
Data Management Team (DMT)

- Instrument
- ERBE-like
- Clouds
- Inversion
- SARB
- TISA

Josh Wilkins
Cathy Nguyen
Ed Kizer
Beau Branch
Data Management Team (DMT)

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<td>FLASHFlux</td>
<td>PC Sawaengphokhai</td>
<td>Hunter Winecoff</td>
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<td>Systems &amp; CM</td>
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Nelson Hillyer  
Tammy Ayers  
Dennis Keyes  
Joanne Saunders
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<td>FLASHFlux</td>
<td>Systems &amp; CM</td>
<td>PR Tool</td>
</tr>
</tbody>
</table>

Carla Grune
Elizabeth Heckert
# DMT Adjacent: CERES Ordering Tool

## Parameters

### Observed TOA Fluxes
- Observed TOA Fluxes
- Observed Cloud Parameters
- Number of Observations

### Initial TOA and Surface Fluxes and Meteorological Parameters
- Initial TOA Fluxes
- Initial Surface Fluxes
- Initial Meteorological Parameters

### Number of Computations
- Number of Computations

### Adjusted TOA, Surface, and Profile Fluxes
- Adjusted All-Sky Profile Fluxes
- Adjusted Clear-Sky Profile Fluxes
- Adjusted All-Sky Spectral SW Fluxes
- Adjusted All-Sky Spectral LW Fluxes

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**Pamela Mlynczak**

Churngwei Chu

Babak Samani
Product Availability
<table>
<thead>
<tr>
<th>Product</th>
<th>Platform</th>
<th>Processed Thru</th>
<th>Publicly Available?</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSF1deg-Hour</td>
<td>Terra, Aqua</td>
<td>July ’21</td>
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<tr>
<td>SSF1deg-Day/-Month</td>
<td>Terra, Aqua</td>
<td></td>
<td></td>
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<tr>
<td>SYN1deg-1Hour/MHour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYN1deg-Day/-Month</td>
<td>Terra+Aqua</td>
<td>June ’21</td>
<td>Yes</td>
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</table>
## Edition 4 Terra & Aqua

<table>
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<th>Platform</th>
<th>Processed Thru</th>
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<tr>
<td>CldTypHist</td>
<td>Terra+Aqua</td>
<td>March ’21</td>
<td>Yes</td>
</tr>
<tr>
<td>FluxByCldTyp</td>
<td>Terra+Aqua</td>
<td>July ‘21</td>
<td></td>
</tr>
<tr>
<td>EBAF</td>
<td></td>
<td>June ‘21</td>
<td></td>
</tr>
<tr>
<td>EBAF ToA</td>
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<td>July ‘21</td>
<td></td>
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</table>
## Edition 1 S-NPP

<table>
<thead>
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<th>Platform</th>
<th>Processed Thru</th>
<th>Publicly Available?</th>
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<tr>
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<td>S-NPP</td>
<td>July ‘21</td>
<td></td>
</tr>
<tr>
<td>SSF</td>
<td>S-NPP</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>SSF1deg-Hour</td>
<td></td>
<td>Sep. ‘19*</td>
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<tr>
<td>SSF1deg-Day/-Month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYN1deg-Hour/MHour</td>
<td>Terra+S-NPP</td>
<td>Nov. ‘17*</td>
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</tr>
<tr>
<td>SYN1deg-Day/-Month</td>
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<td></td>
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</tbody>
</table>

* L3 processing paused. Instrument in RAPS mode.
# Edition 2A S-NPP

<table>
<thead>
<tr>
<th>Product</th>
<th>Platform</th>
<th>Processed Thru</th>
<th>Publicly Available?</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDS</td>
<td>S-NPP</td>
<td>July ’21</td>
<td>No (early Dec.)</td>
</tr>
<tr>
<td>SSF</td>
<td></td>
<td>Dec. ‘12</td>
<td></td>
</tr>
<tr>
<td>SSF1deg-Hour</td>
<td></td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>SSF1deg-Day/-Month</td>
<td></td>
<td>n/a</td>
<td></td>
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</tbody>
</table>
## Edition 1B NOAA-20

<table>
<thead>
<tr>
<th>Product</th>
<th>Platform</th>
<th>Processed Thru</th>
<th>Publicly Available?</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDS</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SSF</td>
<td>NOAA-20</td>
<td>July ’21</td>
<td>No (early Dec.)</td>
</tr>
<tr>
<td>SSF1deg-Hour</td>
<td></td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>SSF1deg-Day/-Month</td>
<td></td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>SYN1deg-Hour/MHour</td>
<td>NOAA-20</td>
<td>n/a</td>
<td></td>
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<tr>
<td>SYN1deg-Day/-Month</td>
<td></td>
<td>n/a</td>
<td>Mid ’22</td>
</tr>
</tbody>
</table>
Available late Fall 2021:

- **Edition 2A S-NPP**
  - Collection 2.0 VIIRS radiances
  - Version 1.0 Deep Blue aerosols
  - No L3 products from 9/2019 onward (S-NPP biaxial mode)

- **Edition 1B NOAA-20**
  - Collection 2.1 VIIRS radiances
  - No aerosols
  - Version 2.0 CrIS Fusion data - water vapor information
DMT Activities
Deliveries Overview

- 64 deliveries to configuration management team
- **CATALYST:**
  - Close/re-open database connection - clear logs
  - Accommodating FLASHFlux MOA, FSNRAD data
- **Inversion:** netCDF-4 SSF product
- **FLASHFlux:**
  - MOA
  - Clouds
- **Clouds:** Incorporating FSNRAD data
CERES WG Website Redesign

**Before**
- Code update
- CERES
- Erbe-Web
- Clouds
- SARB ...
- Dev ➔ Test ➔ Prod

**Now**
- Code update
- CERES
- Erbe-Web
- Clouds
- ...
CERES WG Website Redesign

**Before**

- Maintenance
  - Code update

- Unique Technology Stacks
  - CERES
    - Erbe-Web
    - Clouds
    - SARB...
  - FLASHFlux

**Now**

- Maintenance
  - Code update

- Unique Technology Stacks
  - CERES
    - Erbe-Web
    - Clouds
    - SARB...
  - FLASHFlux
CERES WG Website Redesign

Before

Maintenance

Code update

CERES Erbe-Web Clouds SARB ...

Dev → Test → Prod

Unique Technology Stacks

CERES Erbe-Web Clouds SARB ...

Dev → Test → Prod

FLASHFlux

Security scan/issue

Security scan

CERES Erbe-Web Clouds SARB ...

Dev → Test → Prod

Now

Maintenance

Code update

Clouds

CERES Erbe-Web Dev → Test → Prod

Unique Technology Stacks

CERES Erbe-Web Dev → Test → Prod

FLASHFlux

Security scan/issue

Security scan

CERES Erbe-Web Clouds Dev → Test → Prod

Security scan
Granular CERES Data Availability

• Level 2 SSF, Level 3 SSF1deg: days/hours of data days can be missing

• New table – displays days missing data:

  - 0-5% of the data are missing
  - 5-10% of the data are missing
  - 10% or more of the data are missing
Single Scanner Footprint (SSF)

Individual CERES scanner footprint TOA and parameterized surface fluxes and clouds. For comparison with other same orbit sensors, for example, A-train datasets.

### SSF - Level 2

CERES footprint observed TOA fluxes, MODIS/VIIRS clouds and aerosols, and parameterized surface fluxes by instrument.

<table>
<thead>
<tr>
<th>Product</th>
<th>Sat</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSF</td>
<td>Terra</td>
<td>N</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>Aqua</td>
<td>N</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>S-NPP</td>
<td>N</td>
<td>D</td>
</tr>
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</table>

**Legend**
- Terra Available
- Aqua Available
- S-NPP Available
- NOAA20 Available

### SSF1deg - Level 3

Gridded daily and monthly averages of the SSF product by instrument.
Libera Data Processing

- Developing modern pipeline:
  - Genericized process control files
  - Executables: container images

- Data Management Working Group meetings
- Level 1B data processing handoff
Code Re-architecture
TISA Code

Object-Oriented Gridding

C++

Gridding containers, zones, regions

Code re-architecture

"like" Interpolation & Averaging

Fortran

JSON property configuration files

Property containers
TISA Code - C++ Gridding

- JSON configuration extended: accept known property format \( \rightarrow \) translate for TISA

```json
    Cloud_Optical_Depth_Log" : {
        "alternate_name" : "Cloud_Optical_Depth",
        "alternate_property" : "Cloud_Optical_Depth_Exp"
    },
```

- I/O library - handle GEOstationalry satellites

- GEO-cloud-specific algorithm implementations:
  GEO \( \rightarrow \) GGEAO output
TISA Code - C++ Gridding

- Modular C++ code easily enabled extension to GEOs
- Product-specific driver routines leverage library calls
New cloud properties infrastructure:

- JSON configuration file - Edition 4 vs. 5 processing
- Unified “container” (Modern Fortran data structure)

Possible inputs:

- netCDF4 hourly cloud properties (MODIS or GEO)
- HDF4 (legacy) hourly cloud layer properties
- 1° x 1° hourly obs., binned, SSF zonal data

Output: daily, monthly-hourly, monthly averaged
TISA Code - LW Flux Computation

Longwave (LW) look-up table (LUT)
- Basis for LW flux computation
- Narrowband-to-broadband coefficients → fluxes

LW_nb2bb_lut: (3 coeff, 7 surf. types, 2 SZA, 16 VZA, 4 PW, 6 radiance)
TISA Code - SW Flux Computation

Shortwave (SW) look-up table
  - Basis for SW flux computation
  - Narrowband-to-broadband coefficients → fluxes
  - netCDF-4 library to read TRMM ADM coefficients

Binary: Ocean cloudy, land clear, wind speed, ...

... → netCDF-4
TISA Code

- Remaining Fortran:
  - De-duplicated subroutines
  - Removed unused:
    - Variables
    - Functions
    - Files

Over 20% code reduction!

- Decreased stove-piping
- Increased institutional knowledge sharing
Cloude Code

- Current code containerized
- CI/CD pipeline incorporated

Diagram:
- Jenkins
- Docker
- Code
- Libraries
Clouds Code

- Team working in parallel
- Gradual, “swap-in” approach
- Started with cloud mask:
  - de-duplicated, removed code (retired sensor I/O)
  - “growing” C++ outwards
Clouds Code - Cloud Mask Unit Testing

- Global variables
- Pass by reference, pointers
Clouds Code - Cloud Mask Unit Testing

1. Create expected results from existing code run
2. De-coupled CERESmask.c
3. Execute standalone CERESmask.c
4. Input static test data files (CloudPixel struct current values)
5. Compare to expected Edition 4 run
Clouds Code - Cloud Mask Unit Testing

• De-coupling the code:
  • Shorter, targeted test runs
  • Easier to troubleshoot anomalies
  • Easier to incorporate debuggers (GDB), CI/CD tool (Jenkins)

• Standalone test data & creation thereof:
  • Keep test data and outputs in version control
  • Generate test data wherever needed, tie to builds
Open-Source Science

• Earth System Observatory (ESO)-driven

• CERES Goal: alignment

• Objectives:
  • Transparency
  • Inclusivity
  • Accessibility
  • Reproducibility
SMCE Engagement

- “Science Managed Cloud Environment” - AIST
- Managed Amazon Web Services (AWS) infrastructure
Data in the Cloud

ESDIS populating data into Earthdata Cloud:
- First CERES product: SYN1deg
- Next: SSF
- Subsetting -
  - upgrading on-premise capability
  - ASDC developing EOSDIS’ Harmony services
- TEMPO becoming priority, setting expectations
Systems

• ANGe configuration for CrIS Fusion - V2
• 1.5 PB HPE Scale-Out NAS storage w/ Qumulo

and

1.5 PB Spectra-Scale tape library:
• Enable low-latency data for research
• De-couple project and DAAC hardware
• Efficient data back-up
Systems

• ANGe ingest replacement, “Dark Horse”:
  • Testing with ASDC development team ongoing
  • Metadata backward-compatibility with ANGe
  • Testing with “RabbitMQ” messaging

• Level-2 subsetting:
  • Tuning virtual machine settings, hosts for load
  • Accommodating netCDF4 CERES SSF
Summary

- Fall 2021 release:
  - Ed1B NOAA-20
  - Ed2A NPP

- Code and infrastructure modernization continue

- Aligning with Earth Science data directives