

## NASA GEWEX SRB Release 4.0

### Baseline Processing Plan

#### 1. Introduction

The NASA Global Energy and Water Cycle Experiment (GEWEX) Surface Radiation Budget (SRB) project is a major component of the GEWEX radiation research. The objective of the NASA/GEWEX SRB project is to determine surface, top-of-atmosphere (TOA), and atmospheric shortwave (SW) and longwave (LW) radiative fluxes with the precision needed to predict transient climate variations and decadal-to-centennial climate trends.

The current SRB Release 3.0 data set includes top-of-atmosphere and surface radiative fluxes at a  $1^{\circ} \times 1^{\circ}$  spatial scale for both shortwave (0.28 – 4 mm) and longwave ( $4 - \infty$  mm) wavelengths. All products are computed at a base 3-hourly temporal resolution. These are subsequently used to produce daily, monthly-averaged 3-hourly, and monthly averages.

In Release 4.0 Baseline the GEWEX SRB products will be processed at a  $0.5^{\circ} \times 0.5^{\circ}$  spatial resolution for a 30-year period using the reprocessed ISCCP DX and GMAO GEOS data as input.

#### 2. Scope

This document will describe the Release 4.0 Baseline SRB processing system and algorithms developed at the NASA Langley Research Center.

#### 3. Project Development Requirements

The SRB Release 4.0 Baseline processing system will be designed, tested and implemented per the following specified requirements:

##### a. Input Data

Several ancillary data products will be used as input to the science algorithms. The following table lists the input data, the organizations that will provide the data, and the subsystem which requires the data. Some of these input products are large and dynamic and will be archived at the Atmospheric Science Data Center (ASDC). Other products are smaller and will be placed on local disk.

Input Data	Source	Subsystem
GEOS 4.0.3/5.2.0	GMAO <a href="http://www.gmao.gsfc.nasa.gov">http://www.gmao.gsfc.nasa.gov</a>	MOA
ISCCP DX	GISS/NCDC <a href="http://www.ncdc.noaa.gov">http://www.ncdc.noaa.gov</a>	ISCCP DX Stage 1/2
		GSW
Blended Ozone	TOMS/TOVS/SMOBA (GES DISC) <a href="http://disc.gsfc.nasa.gov">http://disc.gsfc.nasa.gov</a>	GLW

Vegetation Map	IGBP <a href="http://igbp.net">http://igbp.net</a>	GLW
CO2 Global Marine Ave.	NOAA ESRL <a href="http://www.esrl.noaa.gov/gmd/ccgg/trends/">http://www.esrl.noaa.gov/gmd/ccgg/trends/</a>	GLW
MATCH Aerosol	NCAR <a href="http://www.ncar.ucar.edu">http://www.ncar.ucar.edu</a>	GSW
		LPSA/LPLA
5 Band Surface Albedoes		GSW
Column Ozone	GISS <a href="http://isccp.giss.nasa.gov">http://isccp.giss.nasa.gov</a>	LPSA
Surface Emissivities		LPSA

b. System Requirements

The SRB Release 4.0 Baseline processing system will be operated at NASA LaRC. The hardware resources will be located at the ASDC. The Total SRB 4.0 IT requirements for 30 years of reprocessing are included in Appendix B. Specifications for the computer resource requirements are included in the following table:

System Component	Requirement	Requirement
Machine Type/Environment	x86_64 (IDL)	Powerpc (Fortran)
Operating System	Linux Release2.6.16.60-0.42.8-smp	Linux Release 2.6.16.60-0.21-ppc64
Processors	8	8
Processor Speed	3000 MHz	4005 MHz
Memory	16441368 KB	15792300.000 KB
Swap Space	2104472 KB	8393952.000 KB
Disk/File System Space		
Network		

c. Software Requirements

The satellite algorithms prepared for operational processing will follow these software requirements.

i. Language

All science algorithms will be written in Fortran and IDL. Processing and wrapper scripts will be written in Perl (?)

- ii. Tools  
<Any tools required?>
  - iii. Databases  
<Any databases required?>
  - iv. Comments  
All software files must contain descriptive comments and header information.
  - v. Source Control  
All code will be maintained in a source control system such as Subversion.
- d. Data Products  
The science products listed are selected to address the requirements of the Surface Radiation Budget project.
- i. Format  
Output products will be generated in NetCDF (binary too?)
  - ii. Spatial Resolution  
0.5 x 0.5 deg
  - iii. Temporal Resolution  
Monthly, Daily, 3-hourly and 3-hourly/monthly
  - iv. Availability/Latency  
Data products will be available within *x* hours/days
  - v. Internal Data Products  
The internal products are intermediate data files that pass from one subsystem to another in the data processing system.

<b>Data Product</b>	<b>Size</b>	<b>Format</b>
SRB_REL4.0_CLDPROPS_3HRLY (this file is per day)	253 MB	Binary
SRB_REL4.0_BASELINE_GSW_3HRLY	916 MB	Binary
SRB_REL4.0_BASELINE_GSW_3HRLY_NC	1349 MB	NetCDF
SRB_REL4.0_BASELINE_GSW_3HRLY_MONTHLY	59 MB	Binary
SRB_REL4.0_BASELINE_GSW_3HRLY_MONTHLY_LOCAL_NC	87 MB	NetCDF
SRB_REL4.0_BASELINE_GSW_3HRLY_MONTHLY_UTC_NC	87 MB	NetCDF
SRB_REL4.0_BASELINE_GSW_DAILY_LOCAL	229 MB	Binary
SRB_REL4.0_BASELINE_GSW_DAILY_LOCAL_NC	169 MB	NetCDF
SRB_REL4.0_BASELINE_GSW_DAILY_UTC	229 MB	Binary
SRB_REL4.0_BASELINE_GSW_DAILY_UTC_NC	169 MB	NetCDF
SRB_REL4.0_BASELINE_GSW_MONTHLY_LOCAL	7 MB	Binary

SRB_REL4.0_BASELINE_GSW_MONTHLY_LOCAL_NC	11 MB	NetCDF
SRB_REL4.0_BASELINE_GSW_MONTLY_UTC	7 MB	Binary
SRB_REL4.0_BASELINE_GSW_MONTLY_UTC_NC	11 MB	NetCDF
SRB_REL4.0_BASELINE_GLW_3HRLY	1166 MB	Binary
SRB_REL4.0_BASELINE_GLW_3HRLY_NC	858 MB	NetCDF
SRB_REL4.0_BASELINE_GLW_3HRLY_MONTHLY	32.2 MB	Binary
SRB_REL4.0_BASELINE_GLW_3HRLY_MONTHLY_NC	47.5 MB	NetCDF
SRB_REL4.0_BASELINE_GLW_DAILY	125 MB	Binary
SRB_REL4.0_BASELINE_GLW_DAILY_NC	184 MB	NetCDF
SRB_REL4.0_BASELINE_GLW_MONTHLY	4 MB	Binary
SRB_REL4.0_BASELINE_GLW_MONTHLY_NC	6 MB	NetCDF
SRB_REL4.0_BASELINE_LPSA_DAILY	125 MB	Binary
SRB_REL4.0_BASELINE_LPSA_DAILY_NC	184 MB	NetCDF
SRB_REL4.0_BASELINE_LPSA_MONTHLY	4 MB	Binary
SRB_REL4.0_BASELINE_LPSA_MONTHLY_NC	6 MB	NetCDF
SRB_REL4.0_BASELINE_LPLA_DAILY	62 MB	Binary
SRB_REL4.0_BASELINE_LPLA_DAILY_NC	92 MB	NetCDF
SRB_REL4.0_BASELINE_LPLA_MONTHLY	4 MB	Binary
SRB_REL4.0_BASELINE_LPLA_MONTHLY_NC	6 MB	NetCDF
SRB_REL4.0_BASELINE_LPLA_3HRLY	500 MB	Binary
SRB_REL4.0_BASELINE_LPLA_3HRLY_NC	368 MB	NetCDF
SRB_REL4.0_BASELINE_LPLA_3HRLY_MONTHLY	16 MB	Binary
SRB_REL4.0_BASELINE_LPLA_3HRLY_MONTHLY_NC	24 MB	NetCDF
SRB_REL4.0_BASELINE_G4TskinOnly_GLW_3HRLY	Will this data set be reprocessed to 4.0?	Binary
SRB_REL4.0_BASELINE_G4TskinOnly_GLW_DAILY	"	Binary
SRB_REL4.0_BASELINE_G4TskinOnly_GLW_MONTHLY	"	Binary
SRB_REL4.0_BASELINE_G4TskinOnly_GLW_3HRLY_MONTHLY	"	Binary

#### e. Metadata

SRB Release 4.0 data products will adhere to Global Climate Observing System (GCOS) guidelines for the generation of climate data records (CDR) and be ISO 19115 compliant. All metadata files, required for data distribution from the ASDC, will be created and tagged using Extensible Markup Language (XML) and will include the data set-specific Digital Object Identifier (DOI).

- i. GCOS
  - 1.
- ii. ISO 19115
  - 1.
- iii. Other

See Appendix C for a table of collection-level and granule-level metadata attributes.

#### 4. Operational Requirements

##### a. Subsystems

This section will describe the processing system. The Release 4.0 Baseline processing system encompasses six components or subsystems: the SRB Meteorological Ozone and Aerosol (MOA), ISCCP DX Stage 1/Stage2/Cloud Properties, GEWEX Longwave (GLW), GEWEX Shortwave (GSW), Langley Parameterized Longwave Algorithm (LPLA), and the Langley Parameterized Shortwave Algorithm (LPSA). Flow charts illustrating each component are included in Appendix A. The functional requirements of each subsystem are described here:

##### b. MOA

- i. Processing meteorology files typically requires the CERESLIB environment to be in place for ease of usage of compiling the fortran code. In the past, this code has made use of routines available within that environment. If the atmospheric profile data is not available at all time periods, then for time interpolation, the previous day's data file will need to be present.

##### c. ISCCP DX Stage D1/D2/Cloud Properties

##### d. GLW

##### e. GSW

##### f. LPLA

##### g. LPSA

-SRB personnel will operate the system. (GUI and/or Command Line)

##### i.

#### 5. Implementation and Deployment Approach

- a. Establish a successful implementation of the processing system
- b. Begin deployment of the processing system module by module
- c. Compile and run test data sets
- d. Run a specified period of time; benchmark the processing time.
- e. Repeat this procedure until the module is working properly; move to the next module and repeat.
- f. Once all modules have been deployed designate a period of NASA LaRC production to verify integrity of the data products (6 months to 1 year.)
- g. Define & refine science algorithms

#### 6. Documentation

Unless otherwise noted, all project documentation must be written using Microsoft Word. The following documentation will be produced as part of the project deliverables.

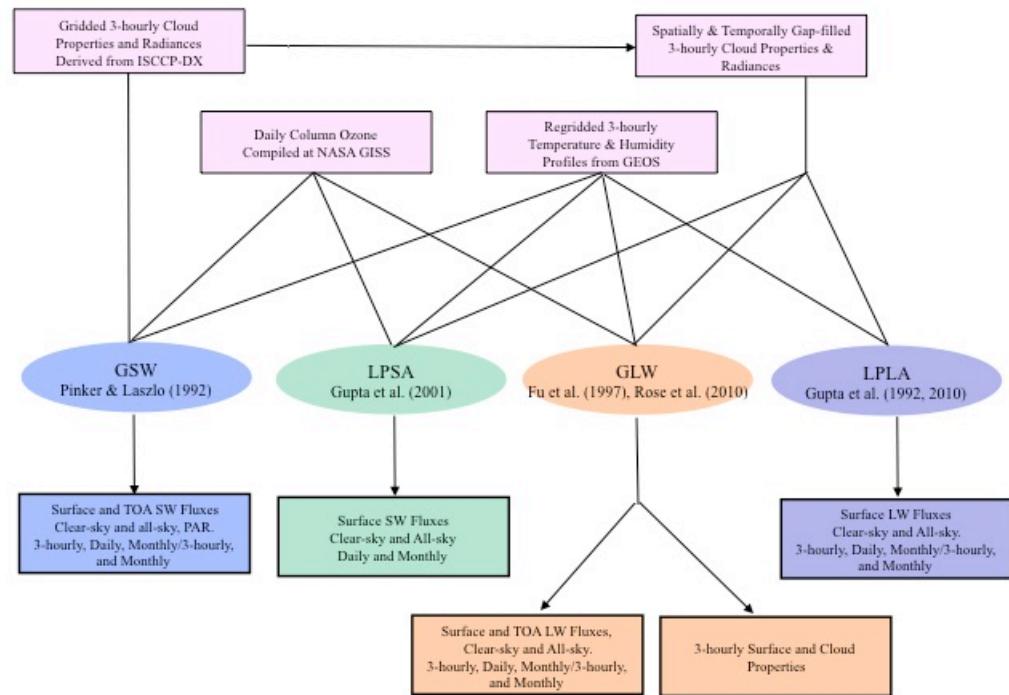
- a. Design Document – A document that presents the system design details must be produced. This document will be kept under configuration management.
- b. Data Flow Diagrams – for each subsystem as well as the overall SRB processing system were produced using Microsoft Project. They were imported as JPG images for inclusion in this document and are available in Appendix A.

## Acronyms

ASDC	Atmospheric Science Data Center
CDR	Climate Data Record
CEOS	Committee on Earth Observation Satellites
DOI	Digital Object Identifier
ESRL	Earth System Research Laboratory
GCOS	Global Climate Observation System
GES DISC	Goddard Earth Sciences Data and Information Center
GEWEX	Global Energy and Water Cycle Experiment
GISS	Goddard Institute for Space Studies
GMAO	Global Modeling and Assimilation Office
GSW	GEWEX Shortwave
GLW	GEWEX Longwave
IDL	Interactive Data Language
IGBP	International Geosphere-Biosphere Programme
ISCCP	International Satellite Cloud Climatology Project
IT	Internet Technology
LaRC	Langley Research Center
LPLA	Langley Parameterization Longwave Algorithm
LPSA	Langley Parameterization Shortwave Algorithm
LW	longwave
MATCH	Model of Atmospheric Transport and Chemistry
MOA	Meteorological Ozone and Aerosols
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCDC	National Climatic Data Center
NetCDF	Network Common Data Format
NOAA	National Oceanic and Atmospheric Administration
SMOBA	Stratospheric Monitoring Ozone Blended Analyses
SRB	Surface Radiation Budget
SW	shortwave
TOA	Top of Atmosphere
TOMS	Total Ozone Mapping Spectrometer
TOVS	TIROS Operational Vertical Sounder
XML	Extensible Markup Language

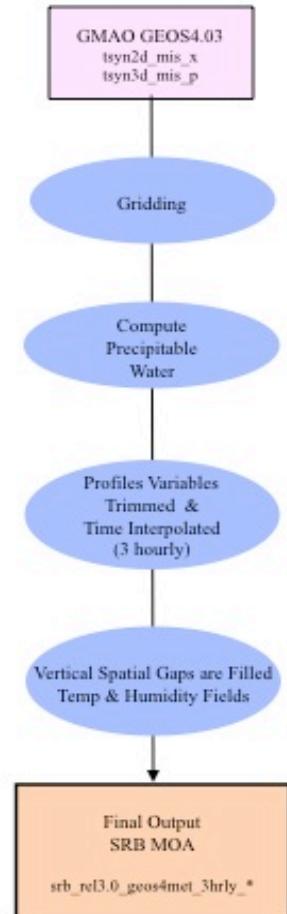
## Appendix A.

### SRB Processing System



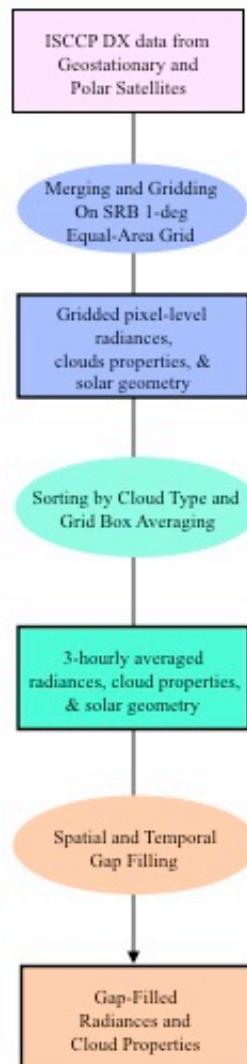
6/27/12

## MOA Subsystem



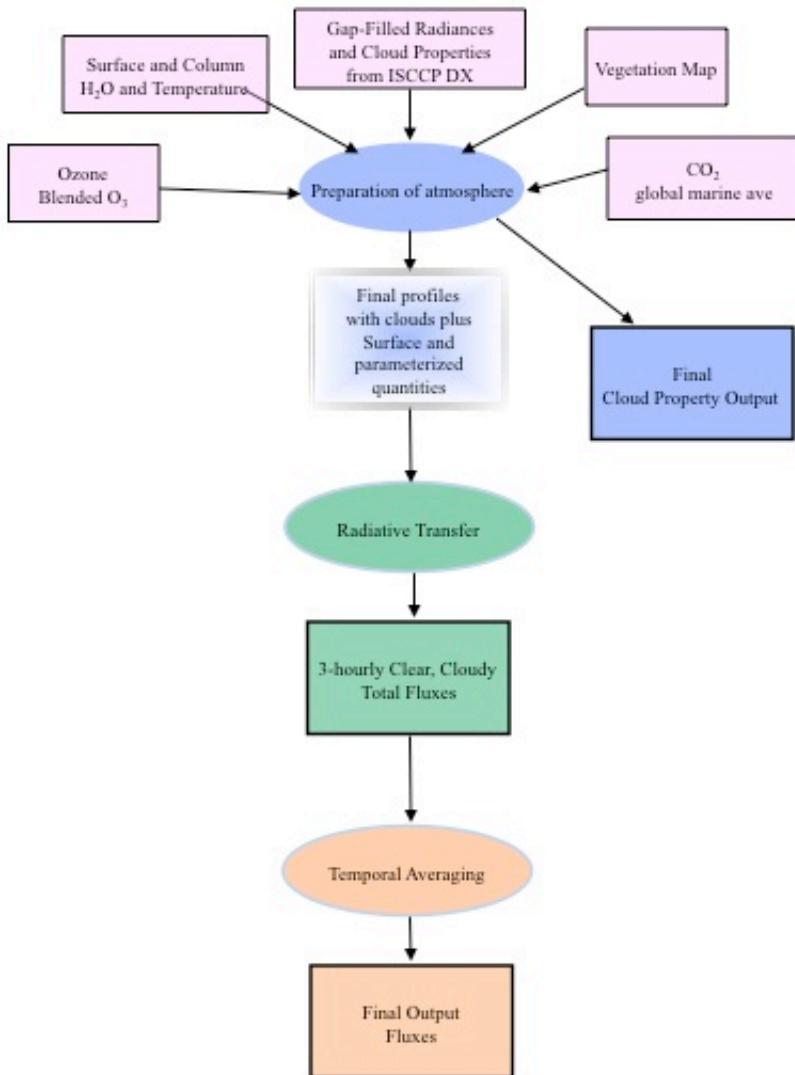
6/8/12

## ISCCP DX Stage 1/Stage 2/Cloud Properties Subsystems



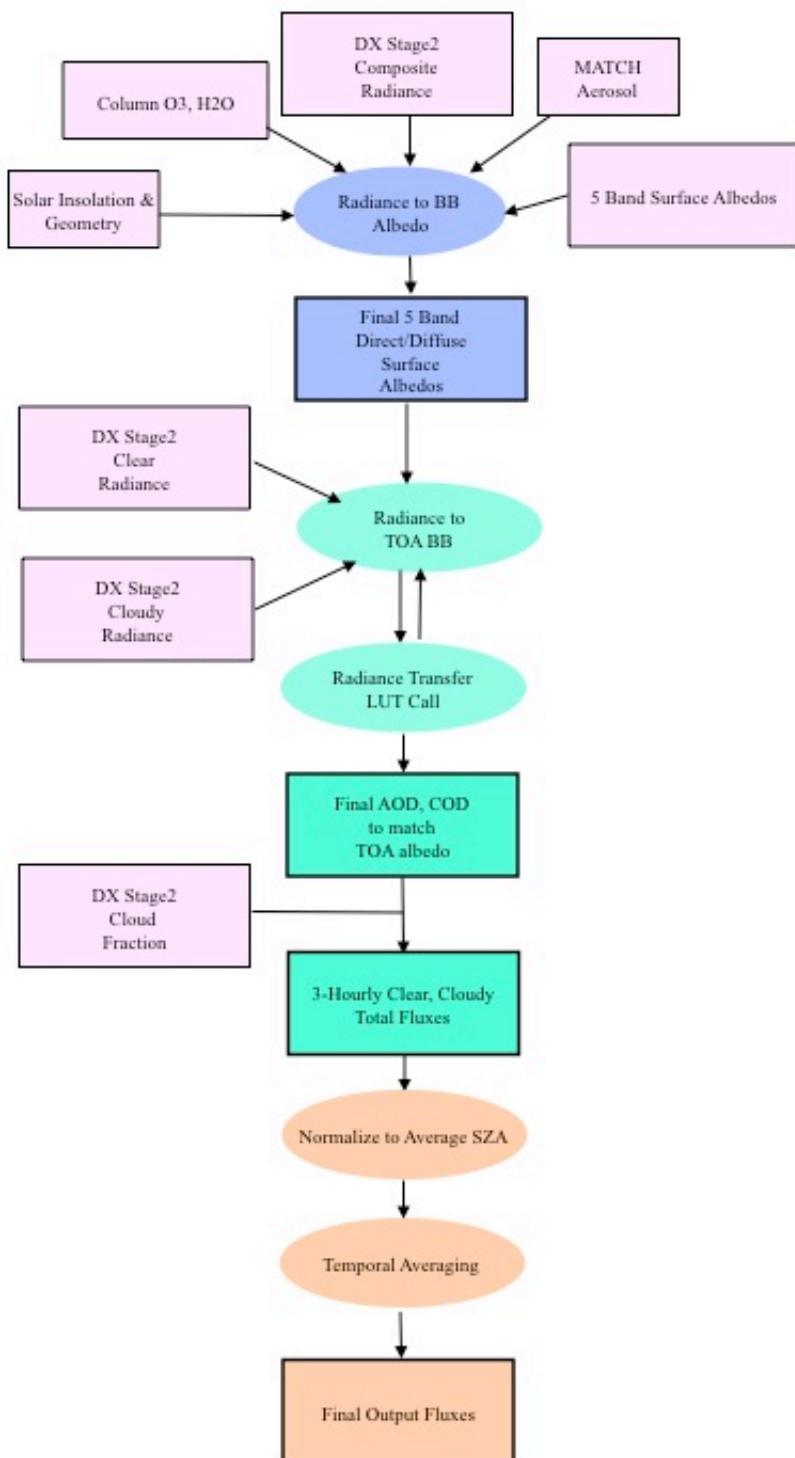
6/8/12

## GEWEX Longwave (GLW) Subsystem



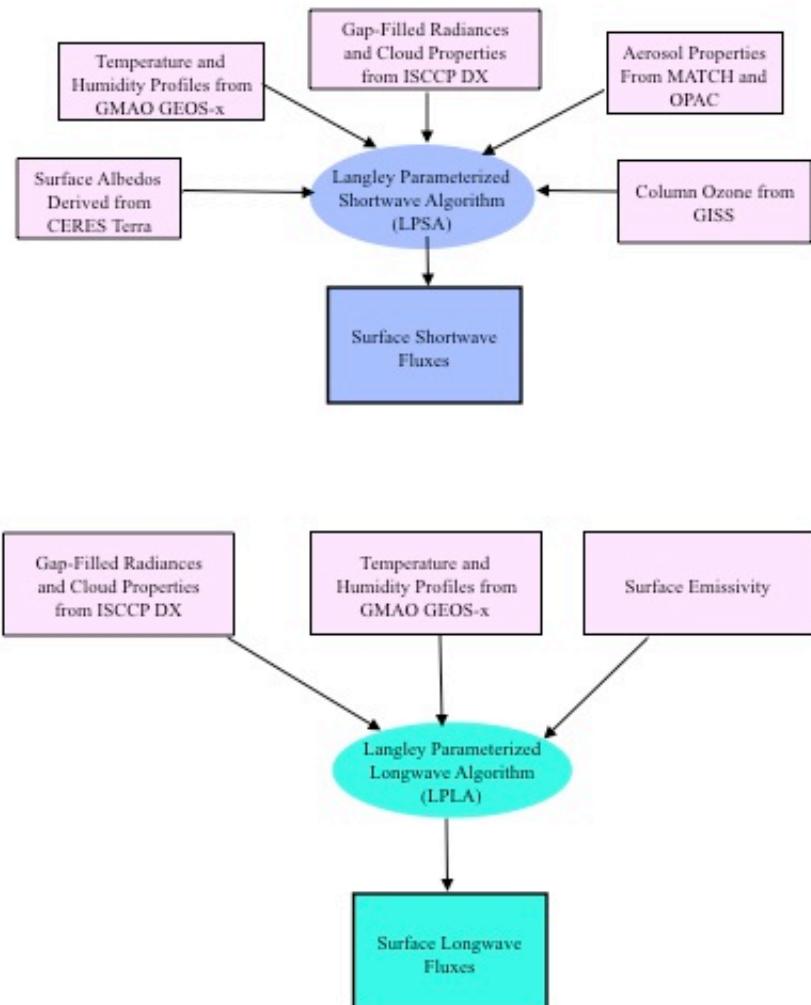
6/8/12

## GEWEX Shortwave (GSW) Subsystem



6/8/12

## LPLA and LPSA Subsystems



6/8/12

## Appendix B

Total SRB 4.0 IT Requirements for 30 years of reprocessing										
Input	Data Set	Monthly Size (GB)	Monthly size (GB)		30 year size (GB)		Node-hours of processing/month		Total node-hours	
			Current	1.0 Deg	0.5 Deg	1.0 Deg	0.5 Deg	1.0 Deg	0.5 Deg	1.0 Deg
	Raw DX	5.69	40.00	0.00	14400.00	0.00	0	0	0	0
	DX Stage 1	0.63	270.00	350.00	97200.00	126000.00	8	11	2400	3100
	DX Stage 2	0.01	2.40	9.00	864.00	3240.00	2	6	600	1800
	GEOS 4.0.3	6.16	21.00	0.00	7560.00	0.00	0	0	0	0
	GEOS 5.2.7 1/2 deg x 2.3 deg	576.60			207576.00					
	GISS Ozone		0.003	0.01	0.09	0.30				
	TOMS Ozone			0.01	0.00	2.11	0.00	small	small	small
Output	GEOS (Met)	2.56	2.70	10.00	972.00	3600.00	1	3.75	300	1125
	Filled Cloud	2.28	2.50	10.00	900.00	3600.00	0.2	0.4	60	120
	GSW intermediate		0.52	0.00	186.33	0.00	0	0	0	0
	GSW		6.00	23.00	2160.00	8280.00	0.7	3	210	800
	GLW		2.30	9.00	828.00	3240.00	31	116	9300	34800
	QCSW daily		0.04	0.16	14.06	56.25	0.1	0.2	30	60
	QCSW 3hrly		0.29	1.17	105.47	421.88	0.2	0.4	60	120
	QCLW		0.29	1.17	105.47	421.88	0.2	0.4	60	120
	BSRN		0.52	0.00	186.33	0.00	0	0	0	0
Total			348.57	413.51	333059.85 56	148860.3	43.4	141.15	13020	42045
					325.25	145.37			18.08	58.40

## **Appendix C**

### Metadata Requirements

#### **Parameter Example:**

Parameter =Barometric Altitude, Geopotential Height, Absolute Humidity, Cloud Ice, Dew/Frost Point Temperature, Infrared Radiation, Mixing Ratio, Potential Temperature, Relative Humidity, Shortwave Radiation, Specific Humidity, Static Pressure, Temperature, Vertical Wind Speed, Wind Direction, Wind Speed, Altitude, Cloud Amount, Cloud Top Pressure, Cloud Top Temperature, Precipitable Water Profiles, Radiance, Skin Temperature, Surface Pressure, Surface Temperature, Temperature Profiles, Tropopause Pressure, Tropopause Temperature, Water Vapor Mixing Profiles, Infrared Radiance, Visible Radiance, Aerosol

Greenhouse Gas Parameter= Carbon Dioxide, Methane, Nitrous Oxide, CFC12, Ozone

Trace Gas Parameter= Sulfur Dioxide, Nitrogen Oxide, halocarbons, chlorofluorocarbons, Water Vapor, Amonium, Calcium , Nitrate, Nitric Acid Sulfur Dioxide, formaldehyde, methylsulfinylmethane, Volatile Organic Compounds, nitrogen trioxide, chlorine dioxide, Carbon Monoxide, Nitrogen Dioxide

#### **Browse Image Examples:**

Brows hdf=b\_scarb\_mas\_950813.002.hdf(example...don't include tags if there are no hdf files)  
hdfsiz e=1507262

Brows gif=xxxxx(example...don't include tags if there are no gif images)  
gifsize=xxxxx

Brows jpeg=xxxxx(example...don't include tags if there are no jpeg images)  
jpegsize=xxxxx

Brows png=xxxxx(example...don't include tags if there are no png images)  
pngsize=xxxxx

Brows pdf=xxxxx(example...don't include tags if there are no pdf images)  
pdfsize=xxxxx

#### **Geodetic Examples:**

NOTE: Here are the formats for the various geodetic data:

GeoBox=(-55,-179.90),(55,180.0) (This example is for NONglobal data)

GeoBox=(-90,-180),(90,180) (This example is for GLOBAL data)

GeoPoint=(35.33,-24.88)

GeoString=((31.62,-98.60),(32.17,-98.13))

GeoPolygon=((-20.514999, 62.858002), (-20.514999, 69.999001), (-26.431000, 79.998001), (-30.737000, 90.000000), (-33.889999, 99.999001), (-36.264999, 109.998001), (-37.574997, 120.000000), (-38.158005, 129.934006), (-38.328003, 139.998001), (-37.869003, 150.000000), (-36.402000, 160.000000), (-34.077003, 170.000000), (-30.772003, 180.000000), (-26.652000, -170.001007), (-21.134003, -160.001007), (-14.278000, -150.000000), (-7.050003, -140.000000), (0.602997, -130.000000), (7.953003, -120.001007), (14.660004, -110.000000), (20.185997, -100.000000), (24.818001, -90.002014), (28.021999, -80.001007), (30.544998, -72.440002), (37.383999, -72.440002), (36.667000, -80.001007), (34.346001, -90.002014), (31.365002, -100.000000), (26.472000, -110.000000), (21.288002, -120.001007), (14.922997, -130.000000), (7.771004, -140.000000), (0.455002, -150.000000), (-7.279999, -160.001007), (-14.026001, -170.001007), (-19.777000, 180.000000), (-24.329002, 170.000000), (-28.171997, 160.000000), (-30.330002, 150.000000), (-31.740997, 139.998001), (-31.490997, 129.934006), (-30.202003, 120.000000), (-27.742996, 109.998001), (-24.194000, 99.999001), (-19.303001, 90.000000), (-13.745003, 79.998001), (-11.096001, 69.999001), (-11.096001, 62.858002))

GeoCircle=(90,0),111700\*DD (where DD is the edge of the circle from the pole; i.e. if 80 degrees, DD=90-80=10)

### **Processing Level:**

Level 0 Raw Radiance Data

Level 1 Both 1A and 1B

Level 1A Data unprocessed to sensor units

Level 1B Data processed to sensor units

Level 2 Derived geophysical parameters

Level 3 Geolocated geophysical parameters

Level 4 Data from multiple measurements

### **Collection Level Metadata Example:**

```
dataset =CER_SSF_TRMM-PFM-VIRS_ValidationR2
shortname =CER_SSF_TRMM-PFM-VIRS_ValidationR2
description =CERES Single Satellite Footprint, TOA and Surface Fluxes, Clouds (SSF) data in HDF.
longname =CERES Single Satellite Footprint, TOA and Surface Fluxes, Clouds (SSF) data in HDF.
Daynite = B
visible =Science Team
project =CERES
product= CERES-SSF
level= 2
timeres =Hourly
spatialres =Satellite Swath
global= N
fmt= HDF
source =TRMM
sensor =CERES-PFM, CERES SCANNER
parameter =CLOUDS, RADIANCE, TOA FLUX, SURFACE FLUX
maxlat =55
minlat =-55
maxlon =180
minlon= -180
```

```
strdate= 01/01/1998  
enddate= 01/31/1998  
spatialrep = Cartesian
```

### **Granule Level Metadata Example:**

```
DatasetName=SCAR_B_ER2_MAS  
GranuleName=scarb_mas_950813.002  
GranuleSize uncompressed=452566468  
Processing Date-Time=1997-07-01T00:00:00  
VERSIONID=1  
Browse=Y  
Minlon=-114.62  
Maxlat=34.62  
Maxlon=-112.75  
Minlat=33.82  
Start Time=00:00:00  
End Time=00:00:00  
ingestdate=1995-08-13  
Start Date=1995-08-13  
End Date=1995-08-13  
GeoBox=(33.82,-114.62),(34.62,-112.75)  
Brows hdf=b_scarb_mas_950813.002.hdf  
hdfsiz e=1507262
```

Table: datasetnames

Columns:

- dataset
- shortname
- description
- longname

Table: dataset

Columns:

- inv\_id
- daynite
- visible\_id
- gracount
- datafld
- granuinfo
- project\_id
- product\_id
- level\_id
- time\_id
- spatial\_id
- global
- read\_prg
- md\_id
- fmt
- gring\_no

```
param_subset
spatial_subset
crit_subset
temp_subset
browse_desc
browse_fmt
url
qs_url
world_date
population_date
update_date
spatialrep
twodname
orbitmin
orbitmax
pathmin
pathmax
timezone
larcset_update_date
```

Table: datafld

Columns:

```
inv_id
source_id
sensor_id
maxlat
minlat
maxlon
minlon
strttime
endtime
minaltitude
maxaltitude
```

Table: software

Columns:

```
inv_id
software
size
```

Table: dataset\_textfiles

Columns:

```
inv_id
text_id
```

Table: textfiles

Columns:

text\_id  
filename  
size

Table: source  
Columns:  
inv\_id  
source\_id  
Table: sourcenames  
Columns:  
source\_id  
source  
description

Table: sensor  
Columns:  
inv\_id  
sensor\_id  
Table: sensornames  
Columns:  
sensor\_id  
sensor  
description

Table: parameter  
Columns:  
inv\_id  
parameter\_id  
Table: parameternames  
Columns:  
parameter\_id  
parameter  
description