

The GEWEX Surface Radiation Budget Project: Release 4 Integrated Product Progress and Plans

GEWEX Data and Assessments

Panel Meeting

Lisbon, Portugal

25-27 November 2018

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GEWEX SRB Overview

SRB Objectives:

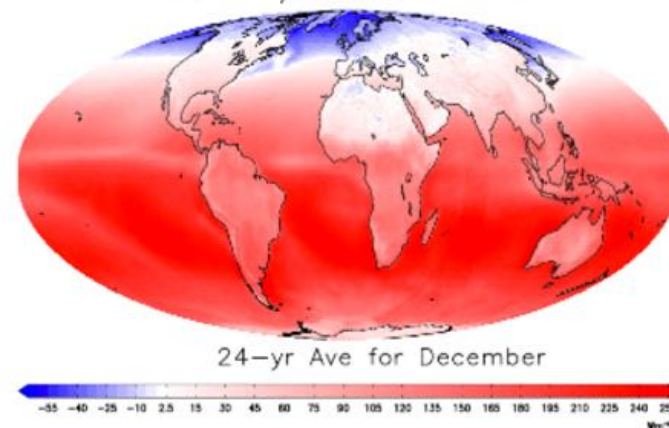
- **Fuse observations** of clouds, aerosols, atmospheric constituents, and surface properties consistently in time and space to estimate the key components of the surface and TOA radiative fluxes for long-time periods (exceeding 30 years)
- **Explore** these data sets to describe the long-term mean & variability of the surface and TOA radiative budgets and their dependencies
- **Provide** these data products to scientific and applied science users
- **Collaborate** with other global GEWEX projects to improve integration and promote the understanding of these energy components in the context global heat and water budgets

NASA GEWEX Surface Radiation Budget

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NASA GEWEX Surface Radiation Budget

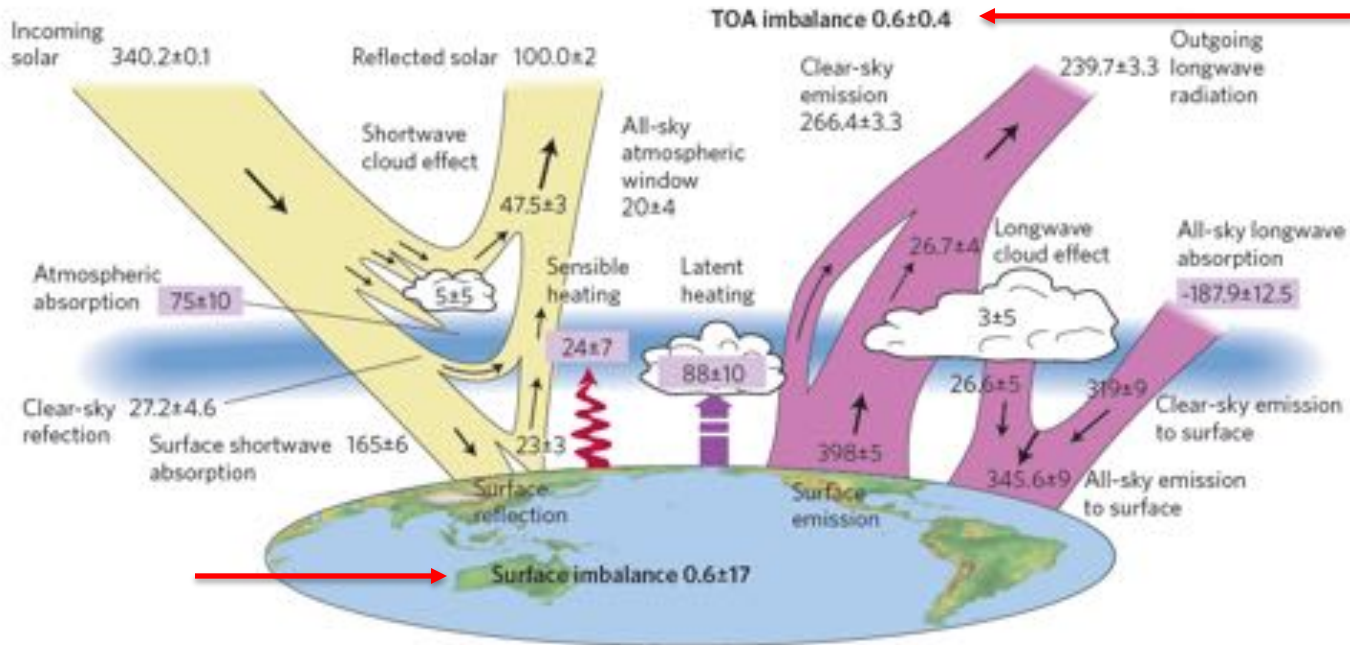
SRB Rel. 3/3.1 Sfc Total Net Flux



<http://gewex-srb.larc.nasa.gov>

Global Energy Budget Closure

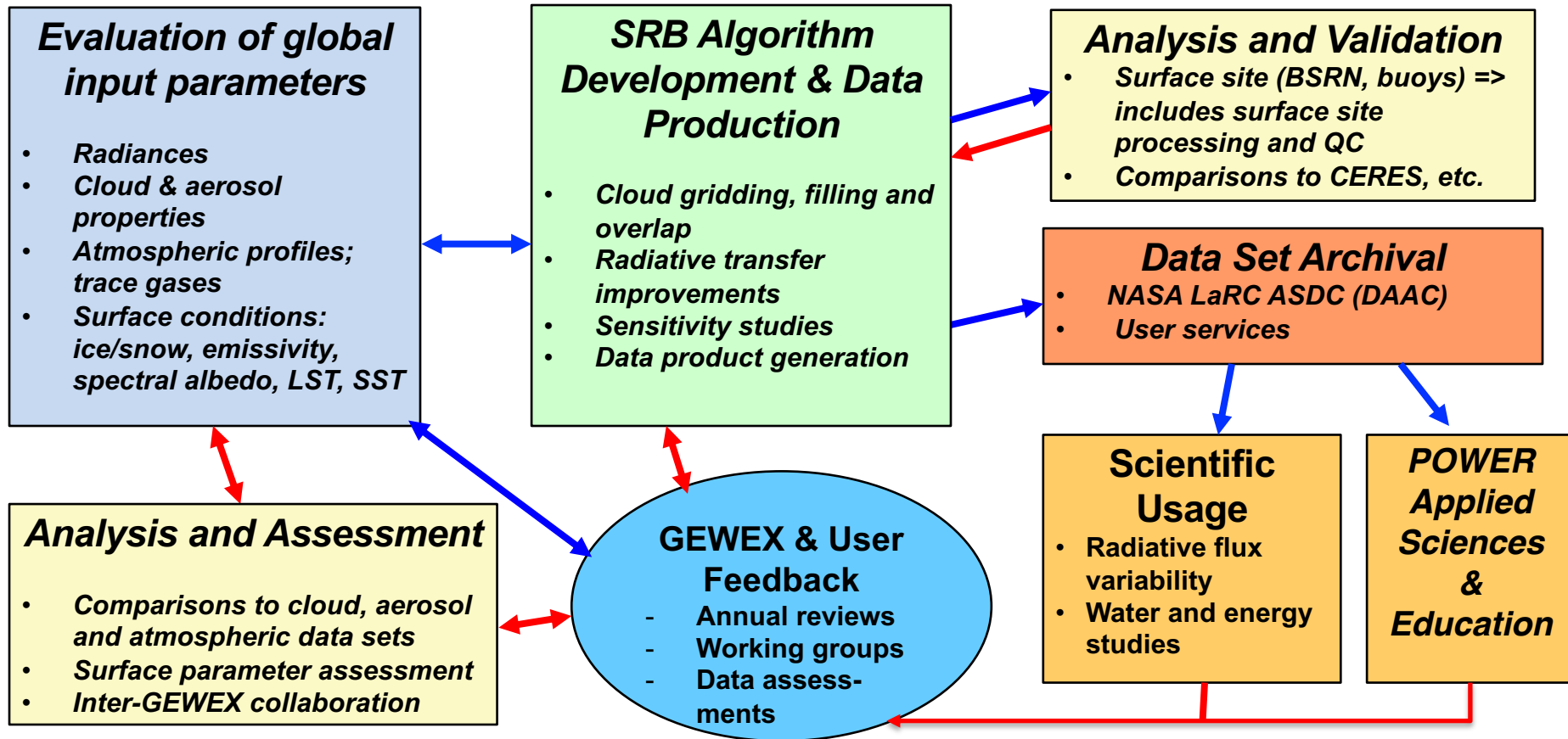
- Global energy balanced with uncertainties
- EBAF assumed to adjust TOA net
- Precipitation assumed to be higher than GPCP
- Surface imbalance $\pm 17 \text{ W m}^{-2}$



Stephens et al (2012, Nature GeoScience, 23 September 2012)



NASA/GEWEX Surface Radiation Budget Activities





Current SRB Release 3 Data Products

(Spatial Resolution: $1^\circ \times 1^\circ$; 7/83 – 12/07)

Data Types	Model Name	Temporal Resolution	Parameters
SW	GEWEX SW (Pinker/Laszlo) (v3.0)	3-hourly, Monthly Averaged 3-hourly, Daily and Monthly Averaged (UTC and local sun time)	All-sky: Surface down, up, PAR down; TOA Down, Up
			Clear-Sky: Surface Down, Up; TOA Up
	LPSA (Staylor/Gupta) (v3.0)	Daily, Monthly	All-sky: Surface Down, Net, and Albedo
			Clear-sky: Surface Down
LW	GEWEX LW (Fu/Liou/Stackhouse) (v3.1)	3-hourly, Monthly Averaged 3-hourly, Daily and Monthly Averaged	All-sky and clear-sky: TOA up; Surface Up and Down
	LPLA (Gupta) (v3.0)	3-hourly, Monthly Averaged 3-hourly, Daily and Monthly Averaged	All-sky Surface Downward, Net; Cloud Radiative Forcing
Input Property	CLDPROPS	3-Hourly	Surface emissivity, skin temperature, atmospheric profile; cloud phase, fraction, optical depth and LWC

Note: The LPSA and LPLA algorithms are also used in CERES Surface-Only



Examples of Recent GEWEX SRB Usage

Regional SRB Projects and Climatology

- Southern Ocean (Luo et al., '15)
- Specific geostationary satellites (Albarelo et al., '15, Müller et al., '15, Posselt et al., '14, Zhang et al., '14)
- Specific continental-scale areas (Cattiaux et al. '15, Gianotti and Eltahir '14, Pessacg et al., '14, Gao et al., '15, Wang et al., '14, Zhang & Liang, '14)
- US (Slater, '16)
- China (Yang et al '18)
- Mediterranean basin study (Pyrina et al., '15 Nabat et al, '14)
- Alaska (Ueyama et al., '14)
- Arctic (Christensen et al., '16; Riihelä et al., '17; Sun et al., '18)

Global Earth Radiative Budget, Clouds & Aerosols

- Atmospheric energy budgets and variability (Ma et al., '15, Stephens et al., '15, Zhang et al., '15)
- CERES comparisons (Kato et al., '13, Rutan et al., '15, Pan et al., '15)
- Global surface albedo estimations (Qu et al., '15, He et al., '14)
- Ocean heat budget (Wong et al., '14)
- Global/Hemispheric (Hakuba et al., '16)
- Aerosol radiative effects (Qin et al., '18)

Water and Energy Cycle

- GEWEX LandFlux (McCabe et al., '16)
- Global evapotranspiration (Long et al. '14, Yao et al. '14, Liou et al 2016)

Water and Energy Cycle (cont'd)

- Global soil moisture/precipitation: Guillod et al., '15)
- Closure studies (Robertson et al., '14)
- Monsoon (Hu and Duan, '15, Kothe et al., '14, Halder et al., '18)
- /energy balance of snow (Lapo et al. '15)
- River basin water and energy balance (Tatsumi and Yamashiki '15; Yang et al. '15)
- North China drought (Zhang et al. '15)
- Tibetan energy/water (Jiang et al. '16, Duan et al. '17, '18)
- Tanzania (Armanios and Fisher '14)

Model Evaluation

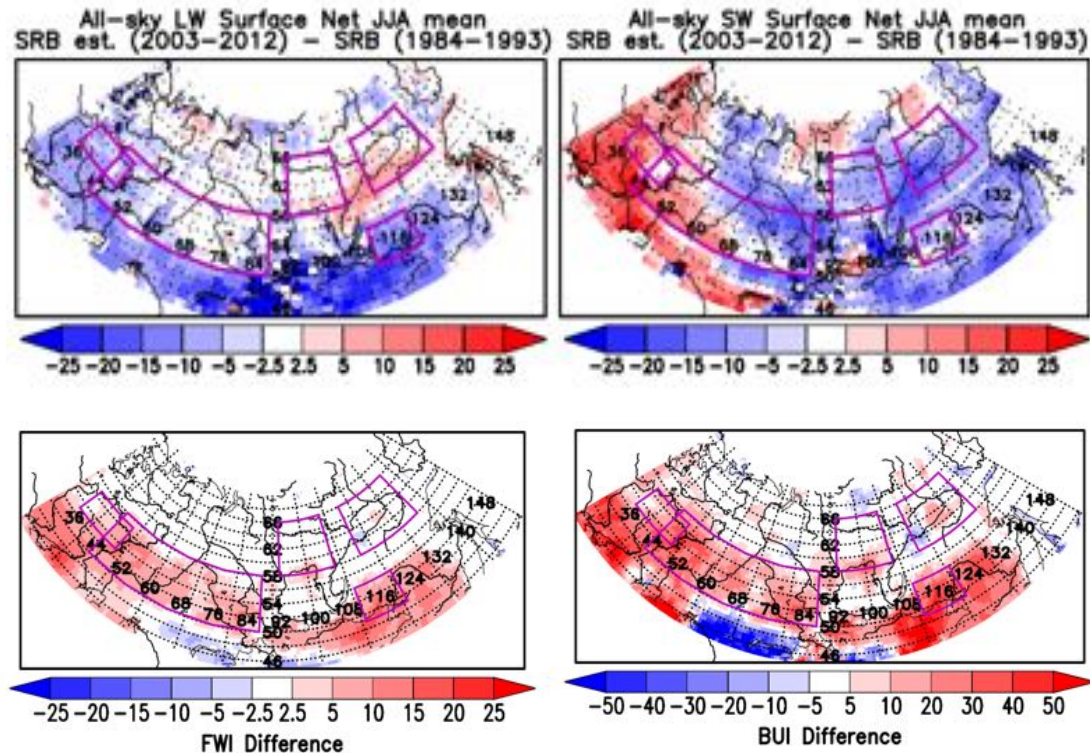
- GLDAS Validation (Wong et al., '16, Xia et al., '16, Ma et al., '18)
- Weather predictability (Orth et al., '16)
- Seasonal Forecasting (Goswami et al., '17)
- CMIP & Climate Models (Loew et al., '16; Levine & Boos, '17)

Interdisciplinary Research Projects

- Solar cooking in Sahel (Newton et al., '14)
- Solar energy (Mazurek '14)
- Global gross primary production (Cai et al., '14, Yao et al., '17, '18)
- Forrest productivity and climate (Tei et al, '17)
- Global lake surface temperatures (Sharma et al., '15)
- Agricultural modeling (Ruane et al., '15)

Current Science Highlights: Northern Eurasia

- Decade average relationships between radiation and fire weather for Northern Eurasia
- Used SRB, CERES and MERRA to assess '84 – '93 vs. '03 – '12
- Used regional analysis and surface sites to assess variability, correction sampling
- Found Net LW reduction (warmer/drier) corresponded with FWI and BUI
- Found Net SW intensified Western region



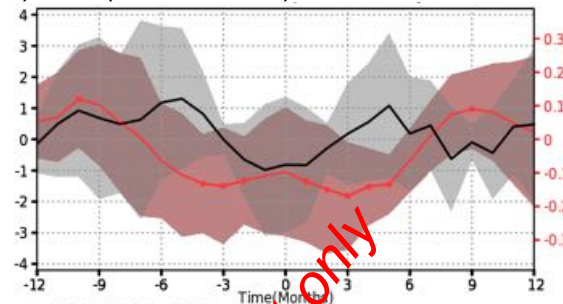
Stackhouse, Soja et al (tbs 2018)

Current Science Highlights: El Nino Compositing

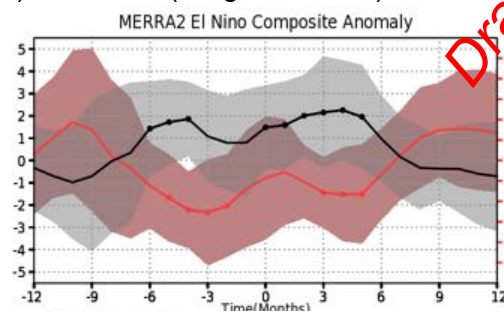
- Assessment of MERRA-2 and M2AMIP runs vis observations from SRB, CERES, GPCP, etc.
- Using a compositing technique assessing lag/lead relationships between El Nino onset and tropical land response over a 35 year period.
- Finding lag/lead patterns more similar between MERRA-2 and obs than with M2-AMIP
- Still assessing implications of and significance of the findings

Tropical Land SWgCRE, Prec Anomal

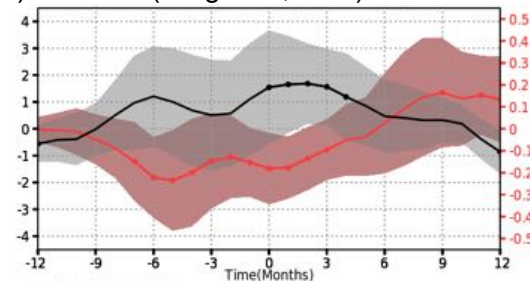
a) Obs (SRB, **GPCP**)



b) MERRA-2 (SWgCRE, **Prec**)



c) M2AMIP (SWgCRE, **Prec**)

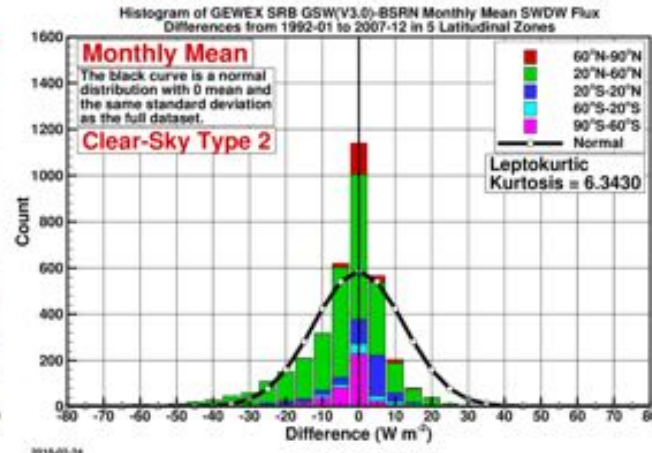
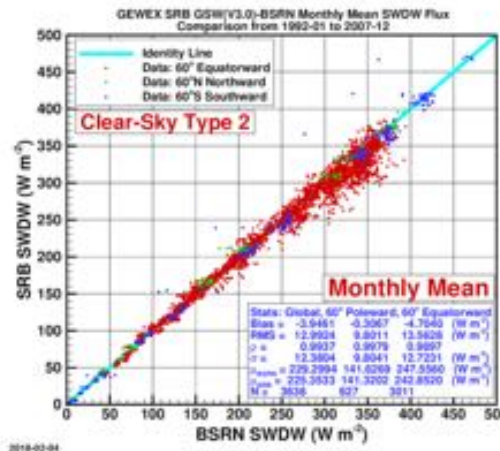


*Bosilovich, Robinson, Stackhouse et al
(in preparation 2018)*



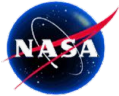
Current Science Highlights: Clear-sky Flux Assessment

- RADFlux is an analysis packaged that estimates clear-sky fluxes from surface measurements (based on Long & Ackerman, 2002)
- GEWEX SRB GSW(V3.0)-BSRN Monthly Mean Clear-Sky SW Downward Flux Comparison for the Period 1992-2007
- RADFlux estimates a clearer/drier sky than SRB and CERES
- Estimates of cloud radiative effect possible



Dataset	Bias	RMS	ρ	σ	μ_{DATA}	N
GSW(V3.0)	-5.29	12.59	0.9941	11.42	232.96	2347
SYN1deg(Ed4A)	-9.43	13.27	0.9966	9.33	228.82	2347
EBAF(Ed4.0)	-7.61	12.23	0.9963	9.57	230.65	2347

(Zhang et al., 2018, accepted)



SRB v4-Integrated Product (3-hourly, 1x1)

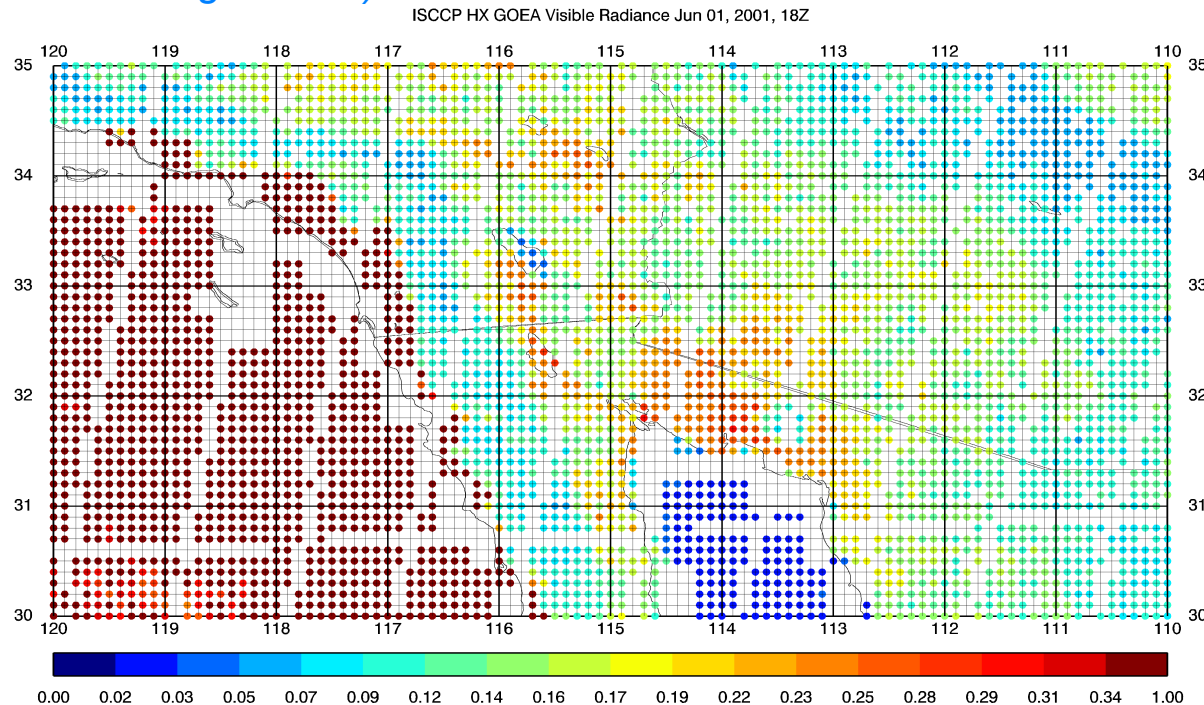
Purpose: Integrated GEWEX global data sets for water/energy balance

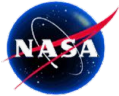
ISCCP HX (production based at NCEI through 12/12)

- Uses all 10 km pixels with no subsampling, 3-hourly by satellite
- Revised calibration and cloud retrieval algorithms
- nnHIRS: Gridded & filled data set using T, q retrieval (Shi et al.)
- New surface vegetation type maps
- Revised & extended snow/ice
- Extended O3

Ancillary inputs such as:

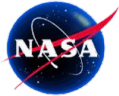
- Max Planck aerosol climatology (AEROCOM)
- LandFlux/SeaFlux LST/SST
- Other trace gases



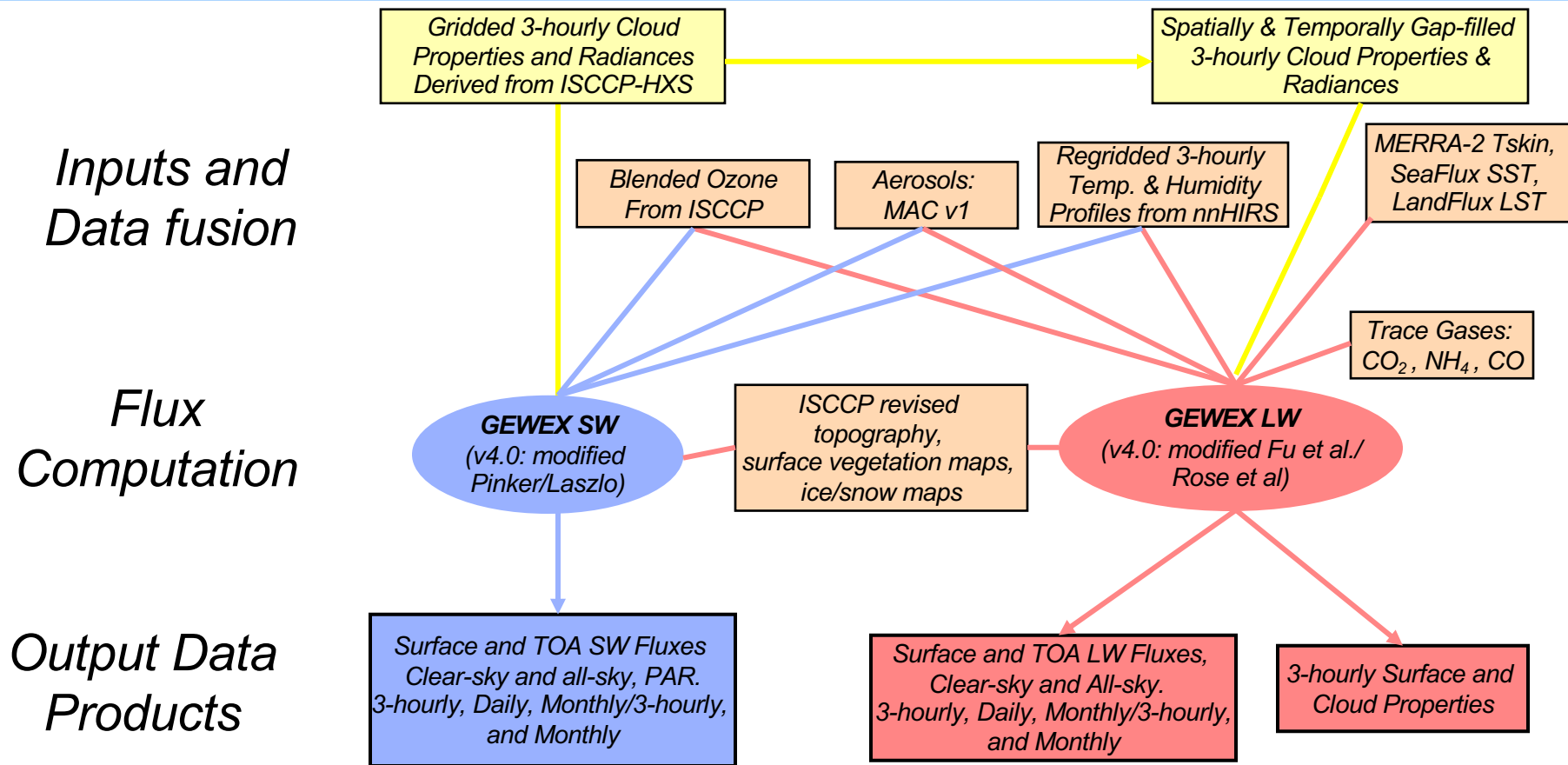


SRB (Rel 4) Main Inputs

General Inputs	Release 3	Integrated Product
Total Solar Irradiance	Constant mean full ephemeris for annual variability	Daily SORCE normalized time series with full ephemeris (Coddington et al., 2016)
Trace Gases – O ₃	TOMS, TOVS, SMOBA blend	TOMS, TOVS, OMI blend from ISCCP; with vertical profiles from GOZCARDS
Other Gases	Single values	GISS GCM; NOAA
Surface elevation	GTOPO30 remapped	GTOPO30 remapped
Land Vegetation Cover Map	IGBP remapped to 1x1	Revised IGBP (w/ GISS)
Snow/ice cover	ISCCP snow/ice	ISCCP snow/ice
Surface albedo/emissivity	VIS radiance w/ aerosol; IGBP surface types for spectral albedo/spectral emissivity	VIS radiance w/ aerosol; IGBP surface types for spectral albedo; Huang et al (2016, JAS) monthly spectral emissivity
Aerosols	SW – MATCH climatology	GEWEX MAC v1 (Kinne et al., 2013)
Skin Temperature/Near Surface T/q	Blended ISCCP & GEOS-4	ISCCP retrieved (TSCOMP); MERRA 2, Princeton HIRS LST, and SeaFlux CDR (v2)
Meteorological Profiles	GEOS-4 reanalysis	nnHIRS (ISCCP produced data that fills, grids and adds diurnal cycle to HIRS retrievals)
Radiance & Cloud Retrieval	ISCCP DX	ISCCP HXS



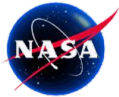
SRB (Rel 4) Integrated Product Data Flow





SW Algorithm Improvements for Release 4.0

	Release 3.0	Release 4.0 Baseline	Release 4.0 Gamma	Release 4.0 IP (GSW v-nu with HXS v1)
Radiative bands	5	5	18 (from CERES LFL05 model; Fu/Liou based)	18 (from CERES LFL05 model; Fu/Liou based)
Spectral Albedo	Original	Original	New expanded albedo from MODIS and ASTER	New expanded albedo from MODIS and ASTER, Jin (2004) ocean, ice, and snow albedos
Aerosol Radiative Properties	One land aerosol, one ocean	One land aerosol, one ocean	Variable asymmetry parameter and single scatter albedo permitted with expanded LUT	Variable asymmetry parameter and single scatter albedo permitted with expanded LUT
Input aerosol	MATCH modal optical depth, monthly climatology	MATCH modal optical depth, monthly climatology	Max-Planck Aerosol Climatology, with variable optical depth and composition through product time period (1983-present)	Max-Planck Aerosol Climatology, with variable optical depth and composition through product time period (1983-present)
Clouds	ISCCP DX; Liquid clouds assumed	ISCCP HXS; Liquid clouds assumed	ISCCP DX; Liquid clouds assumed	ISCCP HXS; Liquid and ice clouds supported, use Water/Ice temperature threshold.
TSI	1367	1367	1367	Coddington et al., (2016)
Run Period	1983-2007	2007	1998-2007	2000 - 2009



SRB (R4) Annual Averages Fluxes for 2007

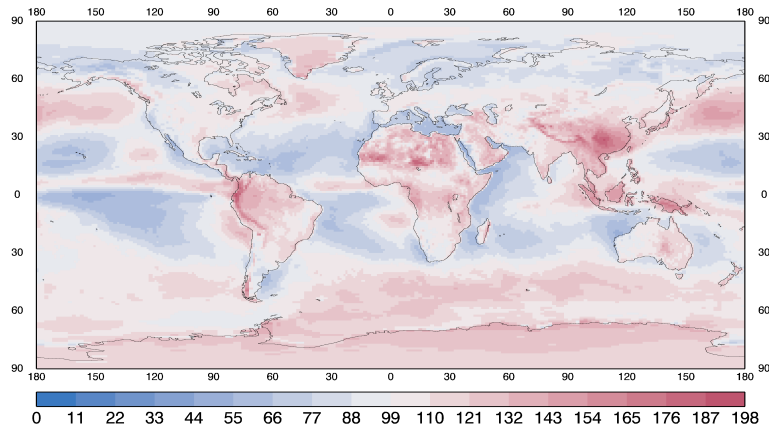
*Global
annual
averaged
fluxes for
2007*

Flux Component	Rel 3.0	Rel 4_xi (NEW algorithm, NEW inputs – HXS V01)	CERES Syn1Deg (Ed. 4A)	CERES EBAF (Ed 4.0)
Surface total down	186.1	184.7	187.8	186.5
Surface down diffuse	104.1	100.0	105.7	--
Surface clear-sky down	247.6	239.8	242.5	244.1
Surface pristine-sky down	258.5	252.1	253.0	--
Surface albedo	0.131	0.133	0.136	0.143
Surface net	163.5	161.8	166.9	164.6
Surface Cloud Radiative Effect	-61.5	-55.1	-54.6	-57.6
TOA Up	104.4	100.6	99.6	99.0

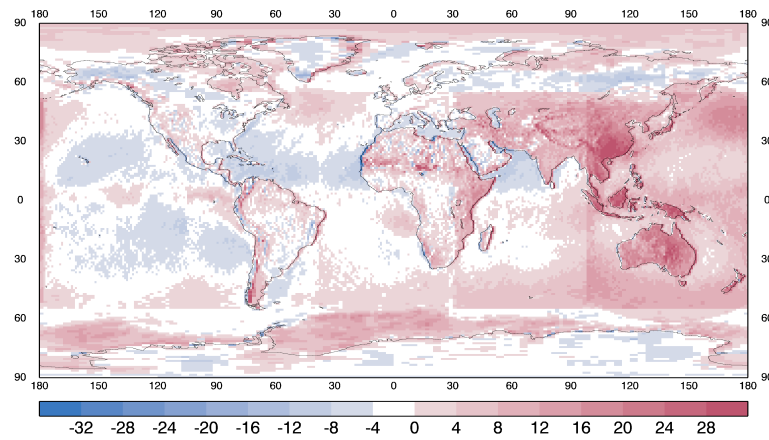


SW TOA Up Global Annual Fluxes for 2007

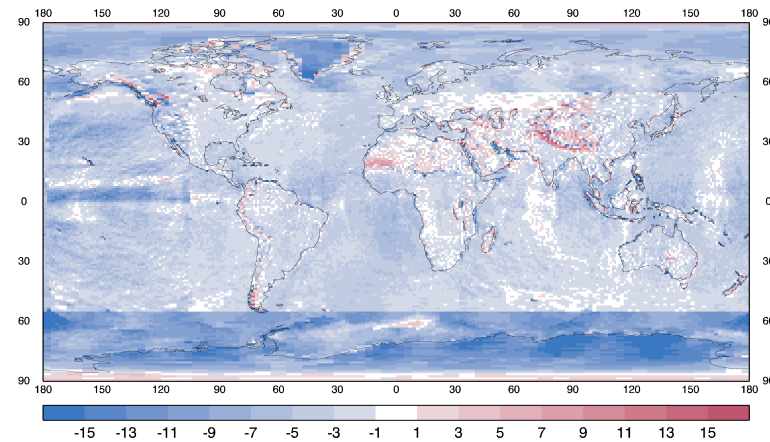
SRB Release 4_nu All Sky TOA Upward Flux, Wm-2, 2007, Local Day Average



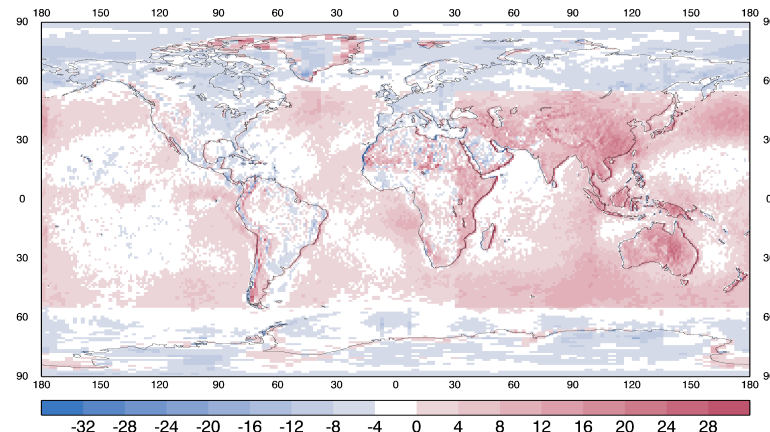
SRB Rel4_nu - SYN1DEG All Sky TOA Upward Flux, Wm-2, 2007 Annual



All Sky TOA Upward Flux, Wm-2, Annual 2007, 4_nu - 3.00



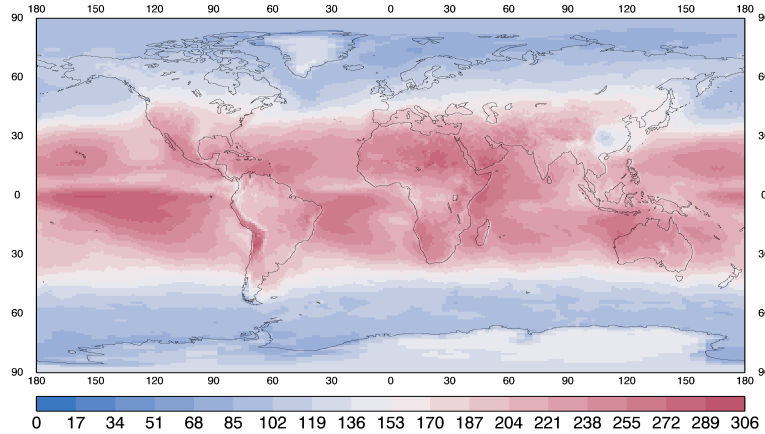
SRB Rel4_nu - EBAF All Sky TOA Upward Flux, Wm-2, 2007 Annual



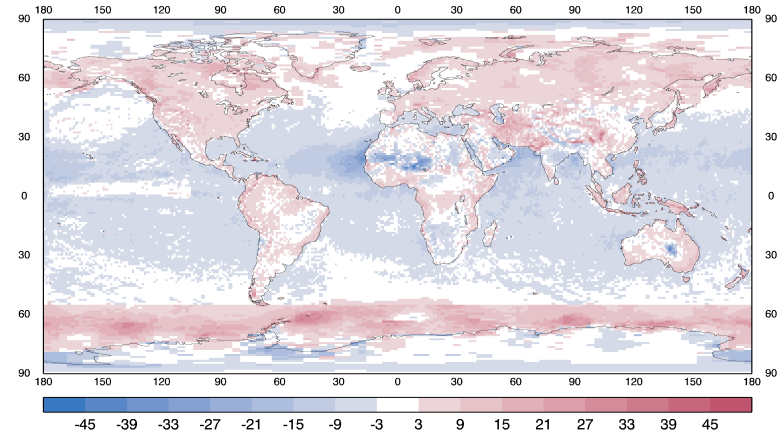


Surf SW Down Global Annual Fluxes for 2007

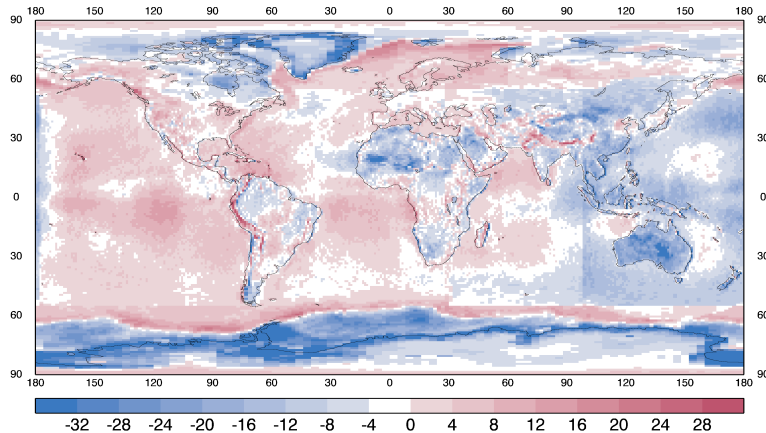
SRB Release 4_nu All Sky Surface Downward Flux, Wm-2, 2007, Local Day Average



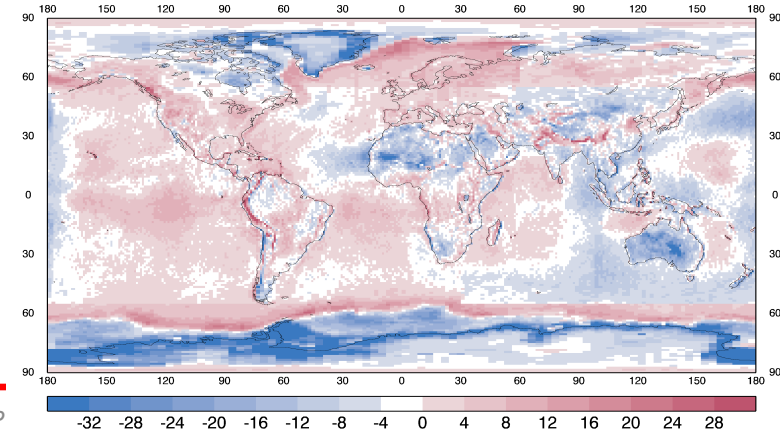
All Sky Surface Downward Flux, Wm-2, Annual 2007, 4_nu - 3.00

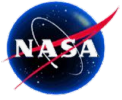


SRB Rel4_nu - SYN1DEG All Sky Surface Downward Flux, Wm-2, 2007 Annual

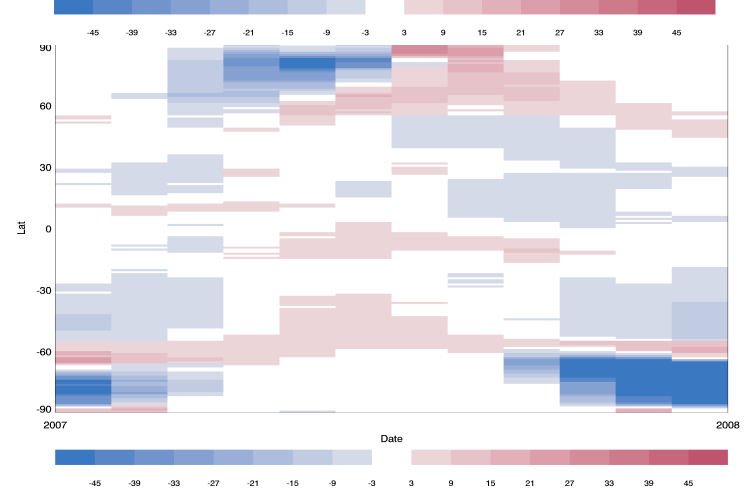
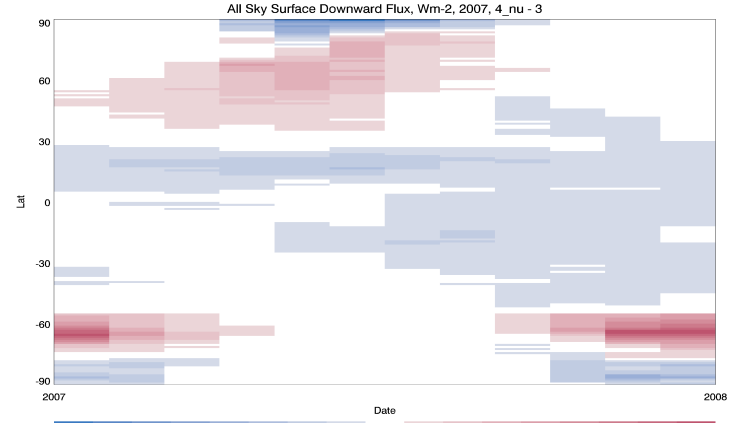
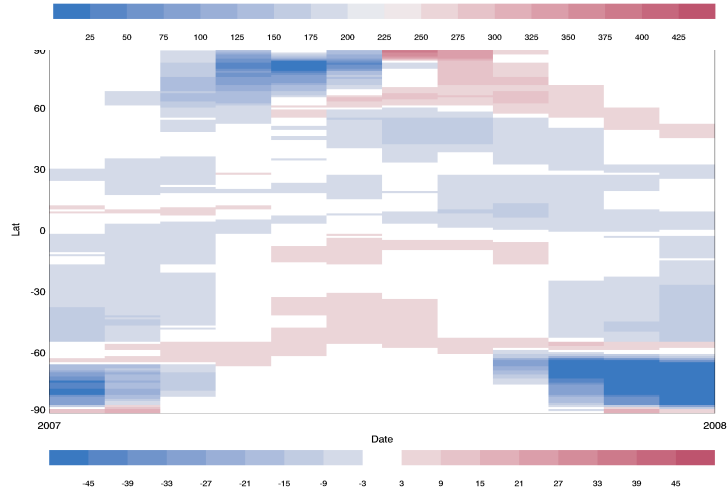
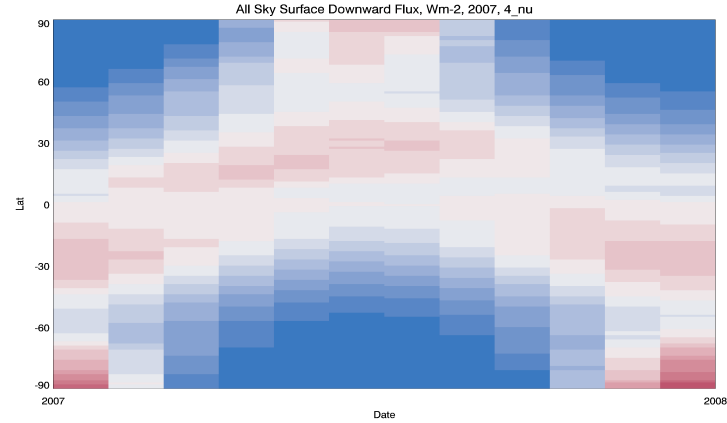


SRB Rel4_nu - EBAF All Sky Surface Downward Flux, Wm-2, 2007 Annual





Surface SW Flux Down Zonal Annual Cycle

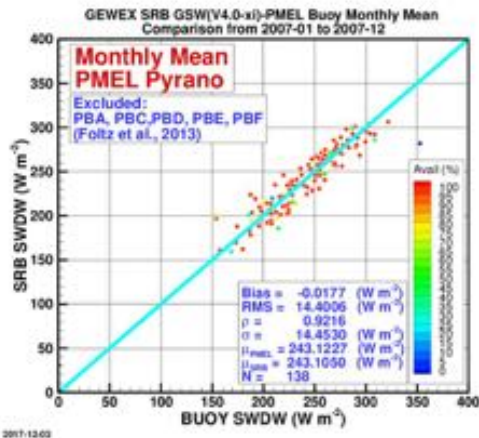




SRB v4-IP SW BSRN & Buoy Validation for 2007

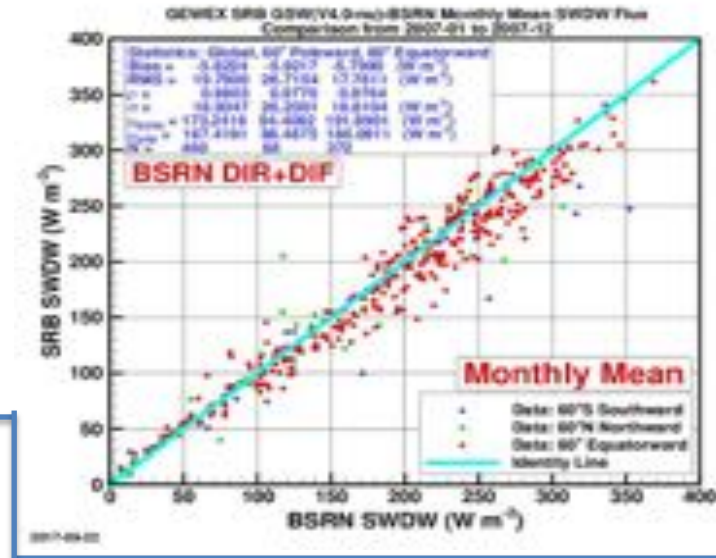
Monthly SW-BSRN for 2007-01 to 2007-12.

Version	Bias	RMS	ρ	σ	μ_{GSW}^*	N
GSW(V3.0)	-8.45	24.05	0.9717	22.54	164.78	460
GSW(R4.0 iota)	-6.28	20.38	0.9793	19.41	166.95	460
GSW(V4.0_nu)	-5.82	19.79	0.9803	18.93	167.41	460
GSW(V4.0_omnicron)	-4.95	18.63	0.9822	17.98	167.57	467
CERES SYN1deg(V4A)	-5.27	15.97	0.9875	15.09	167.25	467



Ocean Buoy SW Validation (PMEL)

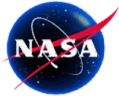
Version	Bias	RMS	ρ	σ	μ	N
GSW (V3.0)	7.76	17.02	0.9132	15.20	250.88	138
GSW(V4.0_nu)	0.47	14.29	0.9225	14.34	243.60	138
GSW (V4.0-xi)	-0.02	14.40	0.9216	14.45	243.11	138
GSW(V4.0_omnicron)	-0.52	15.32	0.9114	15.37	242.59	138
CERES EBAF(E4.0)	1.97	12.34	0.9451	12.23	245.10	138
CERES SYN1deg(V4A)	-0.86	11.80	0.9506	11.81	242.26	138





LW Algorithm/Input Updates for Release 4.0

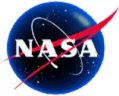
	Release 3.0	Rel. 4.0
Aerosol Inputs	None	MAC v1 Aerosols (Kinne et al., 2013)
Cloud Ice Properties	Original ice cloud radiative properties	Updated ice cloud radiative properties (Rose et al. 2015)
High Water Cloud Type	Assumed no water clouds above 440 mb	Modified cloud overlap to treat high water clouds
T, q profile	GEOS-4	ISCCP nnHIRS (Shi et al)
Tskin	GEOS-4/ISCCP Ts blend	Blend SeaFlux SST (CDR R2) / LandFlux Ts (Coccia et al) /ISCCP HX Ts
Data Product Changes	TOA and surface flux only; UT; Clear and all-sky	Pristine-sky (no aerosols), local time, atmospheric levels.
Years Run	1983-2007	2007



Annual Average LW Fluxes for 2007

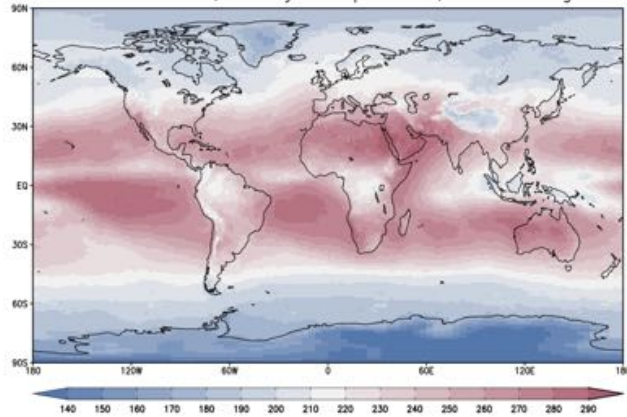
*Global
(tropical)
annual
averaged
fluxes for
2007*

Parameter	Rel 3.1 GEOS-4/DX	Rel. 4 nnHIRS/HX	CERES SYN 1-deg Ed. 4A	CERES EBAF Ed. 4
All-sky Sfc Down	344.8 (404.5)	347.6 (411.0)	346.9 (406.3)	344.8 (405.9)
Clear-sky Sfc Down	311.4 (383.4)*	316.3 (392.0)	318.1 (390.5)	314.2 (388.3)
Pristine-sky Sfc Dn	--	314.9 (390.6)	315.9 (389.0)	--
All-sky Sfc Up	398.3 (459.1)	400.4 (461.0)	397.8 (457.8)	398.6 (458.1)
All-sky Sfc Net	-53.5 (-54.6)	-52.7 (-50.0)	-50.8 (-51.7)	-53.8 (-52.2)
Sfc CRE	33.4 (21.1)	31.3 (19.0)	28.8 (15.7)	30.6 (17.5)
OLR	238.3 (256.6)	235.1 (254.5)	238.6 (255.7)	240.56 (257.4)
Clear OLR	265.3 (285.9)*	263.8 (285.7)	262.5 (282.8)	268.4 (290.6)
Pristine-sky OLR	--	265.1 (287.0)	263.2 (284.1)	--
TOA CRE	-27.0 (-29.3)	-28.7 (-31.2)	-23.8 (-27.1)	-27.8 (-33.2)

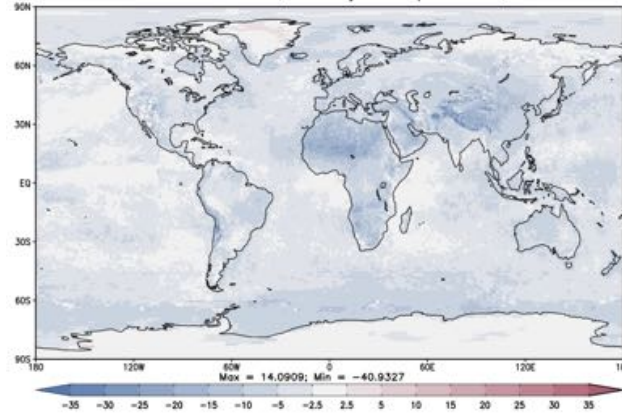


TOA LW Up Global Annual Fluxes for 2007

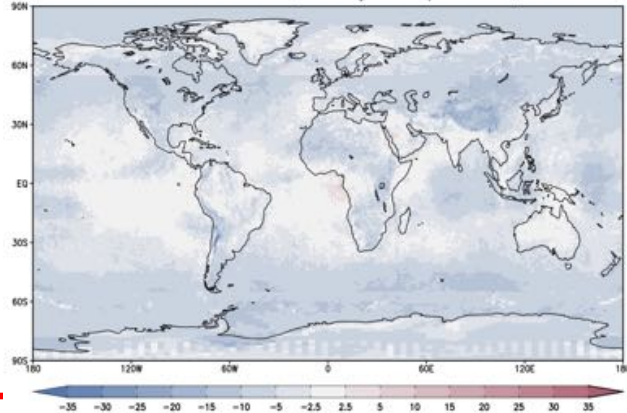
SRB Release 4, All-sky LW Up at TOA, 2007 Average



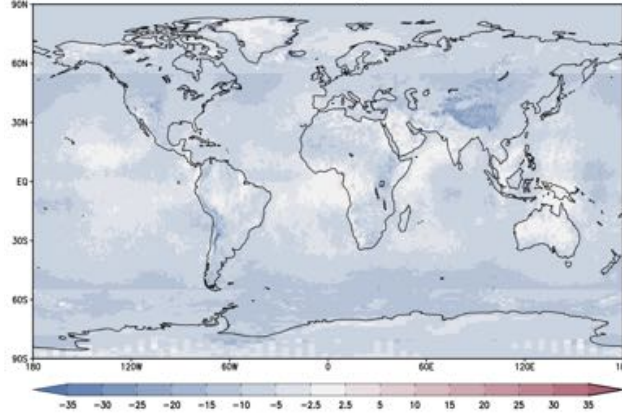
SRB Rel. 4 - Rel. 3.1, All-sky LW Up at TOA, 2007 Ave

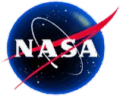


SRB Rel. 4 - SYN Ed. 4A, All-sky LW Up at TOA, 2007 Ave



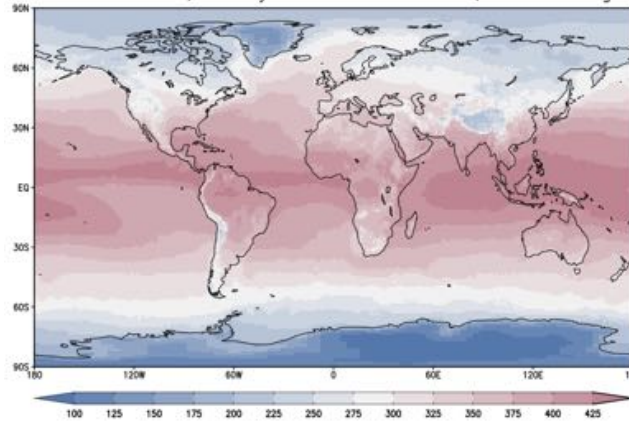
SRB Rel. 4 - EBAF Ed. 4, All-sky LW Up at TOA, 2007 Ave



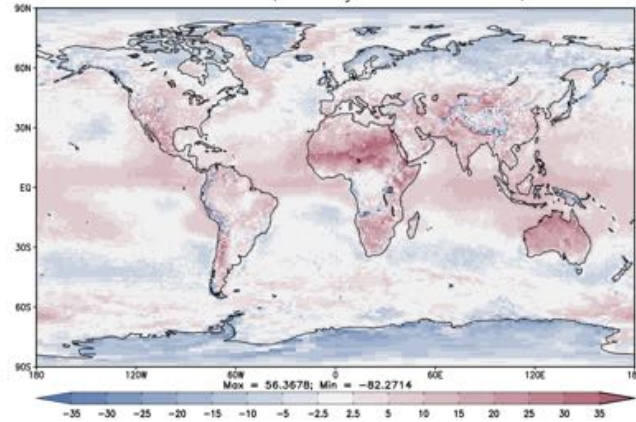


Surf LW Down Annual Fluxes for 2007

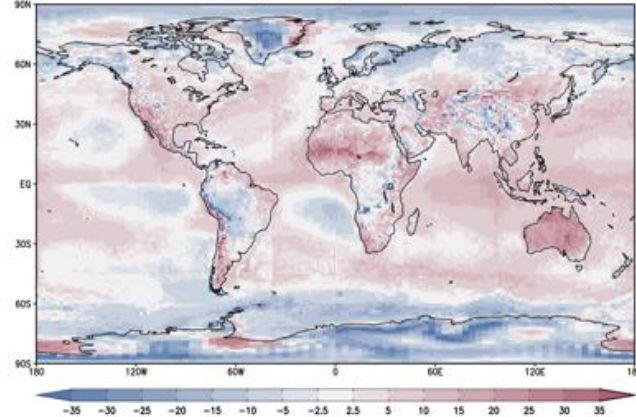
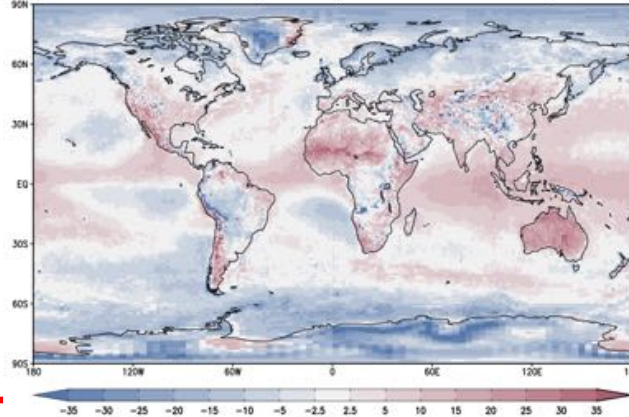
SRB Release 4, All-sky LW Down at Surface, 2007 Average



SRB Rel. 4 - Rel. 3.1, All-sky LW Down at Sfc, 2007 Ave

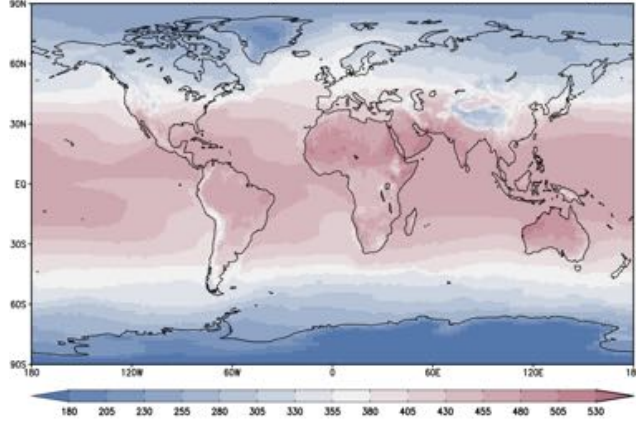


SRB Rel. 4 - SYN Ed. 4A, All-sky LW Down at Surface, 2007 Ave

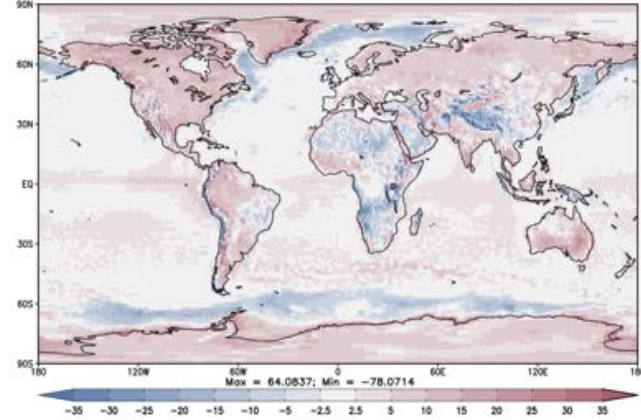


Surf LW Up Annual Fluxes for 2007

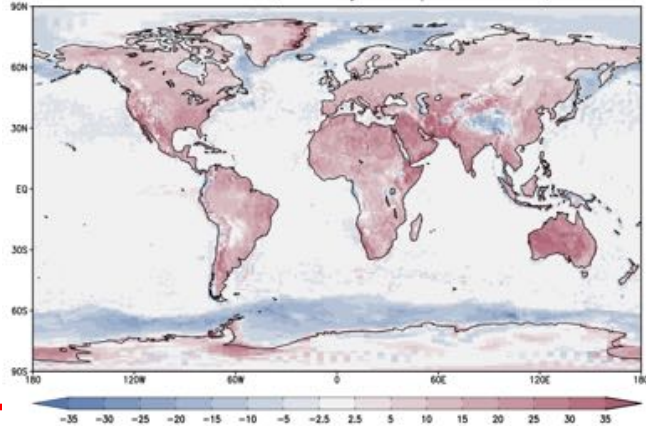
SRB Release 4, All-sky LW Up at Surface, 2007 Average



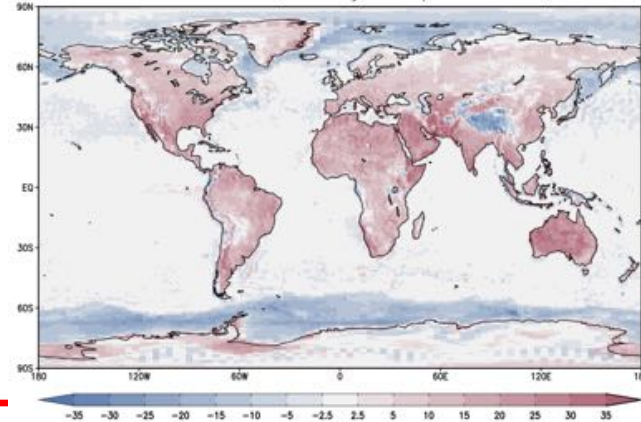
SRB Rel. 4 - Rel. 3.1, All-sky LW Up at Sfc, 2007 Ave

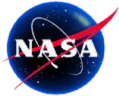


SRB Rel. 4 - SYN Ed. 4A, All-sky LW Up at Surface, 2007 Ave



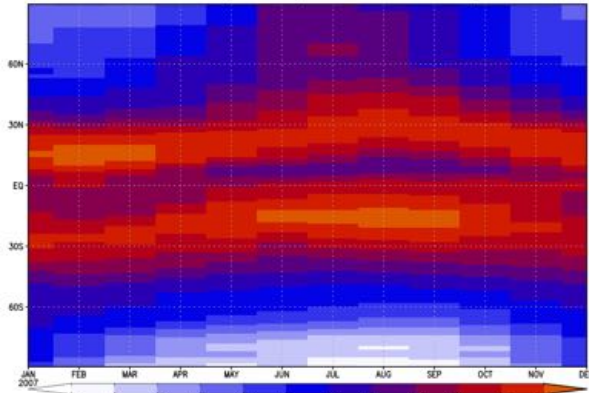
SRB Rel. 4 - EBAF Ed. 4, All-sky LW Up at Surface, 2007 Ave



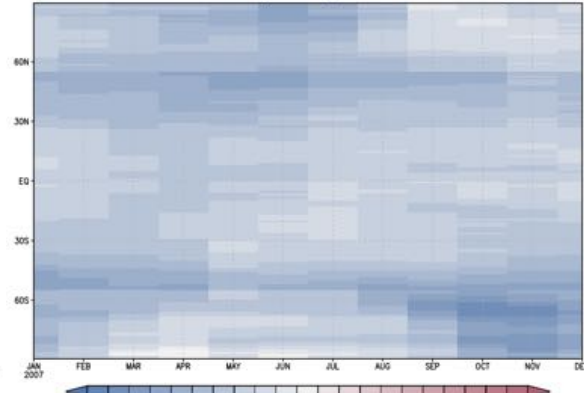


LW Annual Cycle Fluxes for 2007

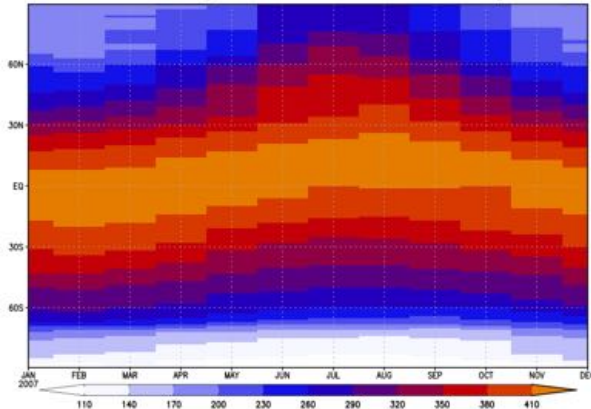
SRB Rel. 4 All-sky LW Up TOA: Month Average 2007



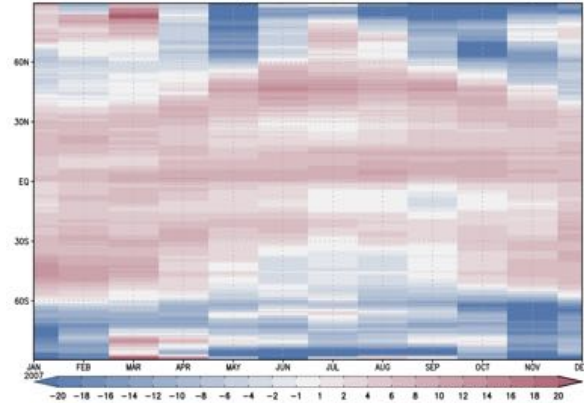
SRB - EBAF Ed. 4 All-sky LW Up TOA: Month Average 2007

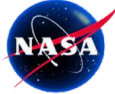


SRB Rel. 4 All-sky LW Down at Sfc: Month Average 2007



SRB - EBAF Ed. 4 All-sky LW Down at Sfc: Month Average 2007

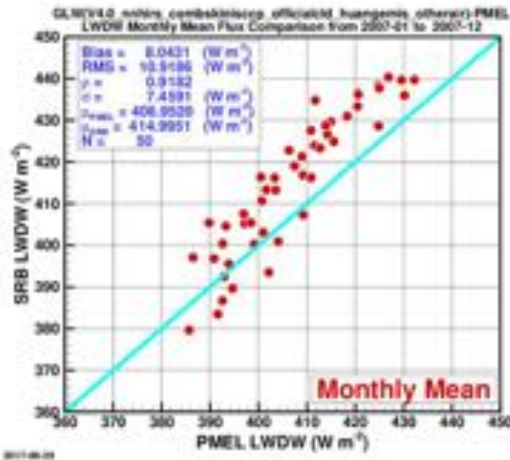
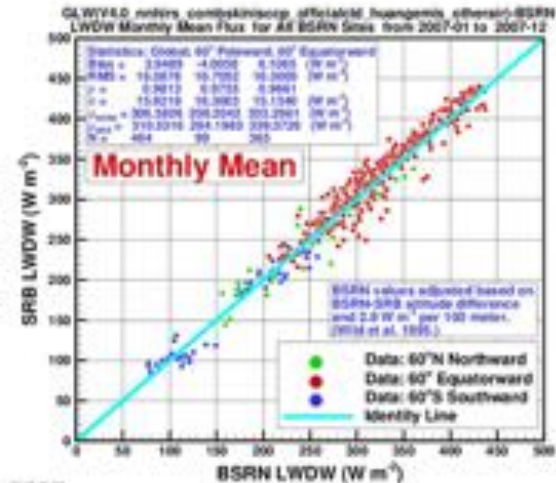




SRB v4-IP LW BSRN & Buoy Validation for 2007

Monthly LW-BSRN for 2007-01 to 2007-12.

Version	Bias	RMS	ρ	σ	μ_{GLW}	N
V3.1	1.49	12.30	0.9882	12.23	308.08	464
V4.0_g4_g4tsclrskin_dxclld	4.88	13.75	0.9870	12.86	311.46	464
V4.0_merra2_comskin_betaclld	5.21	13.78	0.9871	12.77	311.79	464
GLW 4 IP (nnHIRS, HXS v1, PLST, SSST)	3.94	16.38	0.9813	15.92	310.53	464
CERES EBAF(E4.0)	0.76	10.00	0.9922	9.98	307.87	464
CERES SYN1deg(V4A)	2.85	10.28	0.9923	9.89	309.96	464



Monthly Averaged GLW vs. Buoy Measurements

Version	Bias	RMS	ρ	σ	μ_{DATA}	N
V3.1	-0.07	6.17	0.9342	6.23	406.88	50
GLW 4 IP (nnHIRS, HXS v1, PLST, SSST)	8.04	10.91	0.9182	7.45	414.99	50
CERES EBAF(E4.0)	0.99	3.80	0.9581	3.70	407.94	50
CERES SYN1deg(V4A)	0.85	3.70	0.9567	3.64	407.80	50

Beyond SRB v4-IP: Higher Spatial Resolution

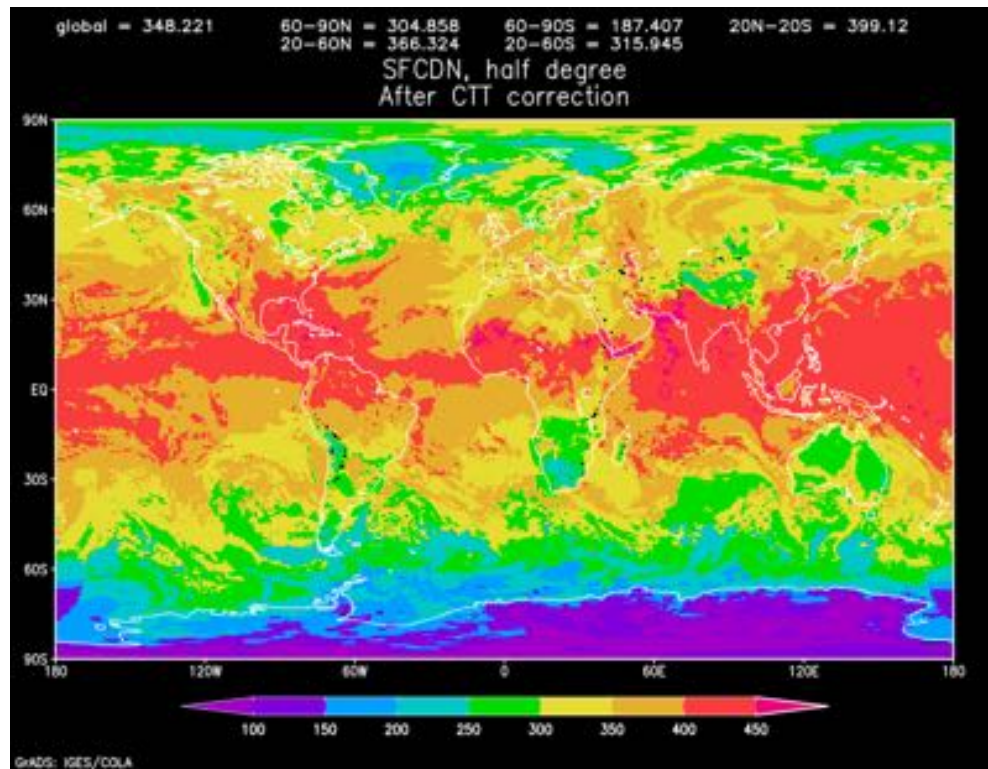
Better resolve physical processes related to surface properties:

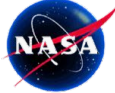
- Topography, vegetative state, snow/ice
- Atmospheric rivers, stationary features, oceanic eddies
- Homogeneity of atmospheric state & PBL

Improved integration/comparison with into Other Energy and Water Parameters

- Latent and Sensible flux mapping (up to $\frac{1}{4} \times \frac{1}{4}$ degree)
- Precipitation/Evaporation

Increased Applicability to Applied Sciences





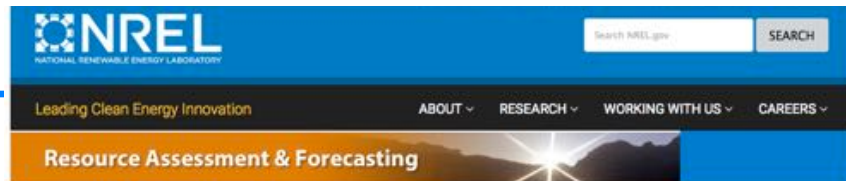
POWER Overview

- **Objectives:** Improve the Nation's public/private capability for integrating environmental data from NASA Earth observations and research to support increased renewable energy development, building energy efficiency and agricultural modeling.

- **Goals:** Through partnerships, derive/validate/provide parameters relevant to industry needs, link to decision support, and transition capabilities when possible.

- **Website:**

<http://power.larc.nasa.gov>



SEE YALL IN ATLANTA





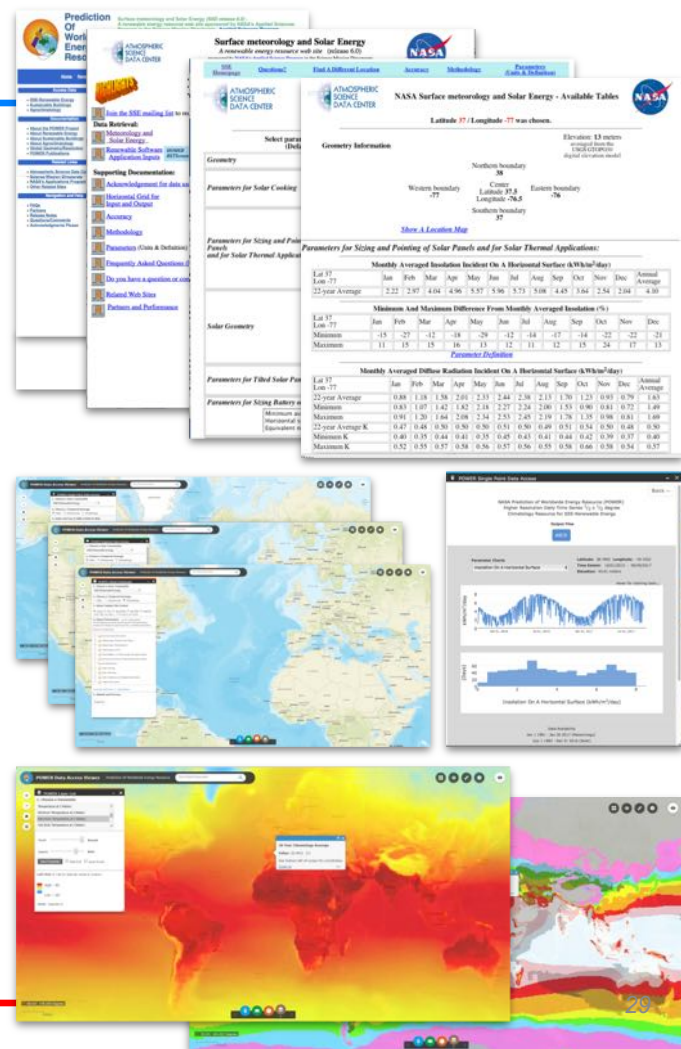
POWER – Modernization

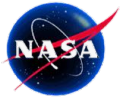
Old POWER (SSE v6):

- Over 200 parameters
- HTML and ASCII tables only formats only
- Data backend production was not scalable; required a complete rewrite to reprocess a parameter
- Original graphics not supportable due to unsupported software and security issues

New POWER (v1.0.9):

- Over 200 parameters; from latest NASA science version such as SRB, CERES and MERRA-2
- ASCII, CSV, geoJSON, NetCDF₄, ICASA, GeoTiff formats available with user Community based unit conversions
- Increased spatial/temporal resolutions: from 1x1 to 1/2 x 1/2 Spatial resolution and NRT Daily Time Series available
- API service (data order using URL) – allows for data to be repeatedly requested using a script or form within our Data Access Viewer.





POWER Applied Science Benefits the World Renewable Energy

- USA:
 - “I ... calculate solar arrays and battery banks needed in a given location for our solar powered chemical injection pump.” CheckPoint Pumps & Systems®, LA
 - Solar data for remote locations. SunWize Power & Battery (HQ, Albany, multiple US locations)
 - Data ... for sizing Battery & PV systems. Scott Rayment, Voltmaster Electrical Contracting, Houston, Texas
 - Universities using for courses in renewable energies (U. of Wisc, Purdue using RETScreen)
- Spain: *Solar App (SOLARPE) for cell phone with 30,000 worldwide users. Pedro García Martín, IES Universidad Laboral of Toledo, Toledo*
- Canada: Assess solar generation system performance and report to site owners. *Peter Mason, Radiant Technical Services, Ottawa.*
- Argentina: Sizing and Pointing of Solar Panels in the new POWER data portal. *Área Técnica , Goodenergy, Buenos Aires*
- Belgium: “We’ve been using the NASA database for Nokia’s Renewable Energy solutions dimensioning.” *Nokia, Antwerpen*
- Peru: Provider of solar systems in Peru and uses the POWER data to check amount of sun at a specific point. *Chavier E. Solano Isaya, Product Manager, Energía Solar y Automatización*



FINALIST IN GESS EDUCATION AWARDS 2017 (DUBAI).

MIT (Massachusetts Institute of Technology) has declared SOLARPE as most innovate app in the last June 2016.



GEWEX SRB: Summary Status

- **FY2018 Accomplishments GEWEX SRB Rel 4-IP**
 - HXS cloud rendering testing/assessment; cloud base biases, cloud detection over ice surfaces assess
 - Re-assess new sources of land/ocean PBL temp/hum; contrast with nnHIRS
 - Produced 15 year 1x1 data set SW 1998-2012 to maximize overlap with CERES and NASA NEWS data sets for error and uncertainty assessment
- **FY2019 Plans GEWEX SRB Rel 4 and 4+**
 - Complete review LW cloud overlap and assess LW algorithm changes
 - Complete 15 yr LW 1x1 run to finalized SRB v4-IP
 - Deliver, Document, Archive and Distribute and Publish
 - Plans for SRB 4+
 - Complete sampling assessment to prepare $\frac{1}{2} \times \frac{1}{2}$ degree production
 - Evaluate resolution dependence of cloud overlap fusion
 - Process at least test period (up to 10 years) at $\frac{1}{2} \times \frac{1}{2}$ resolution
 - Use BSRN and other measurements to provide data quality information
 - Assess against old SRB, CERES and other data sets