Upcoming Changes in EBAF Ed4.1

N.G. Loeb, F.G. Rose, W. Su, H. Wang, S. Kato, D.R. Doelling, W.L. Smith, A. Gettelman

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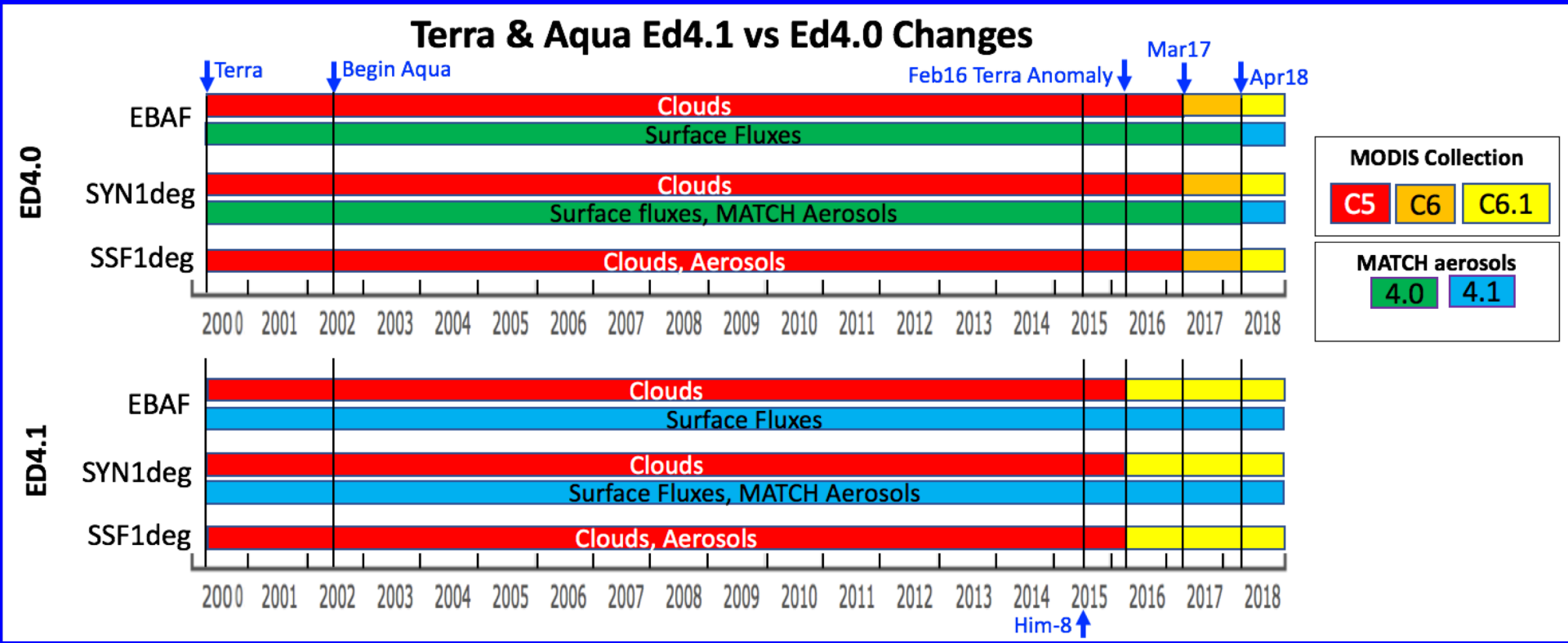
Upcoming Changes in EBAF Ed4.1

1) Introducing new clear-sky fluxes & associated CREs

2) Entire surface flux record reprocessed using consistent aerosols (C6.1) throughout

3) Reprocessed cloud properties from 03/2016 onwards (C6.1)

Note: No change to TOA fluxes

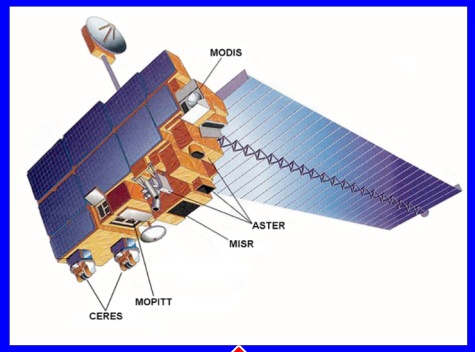


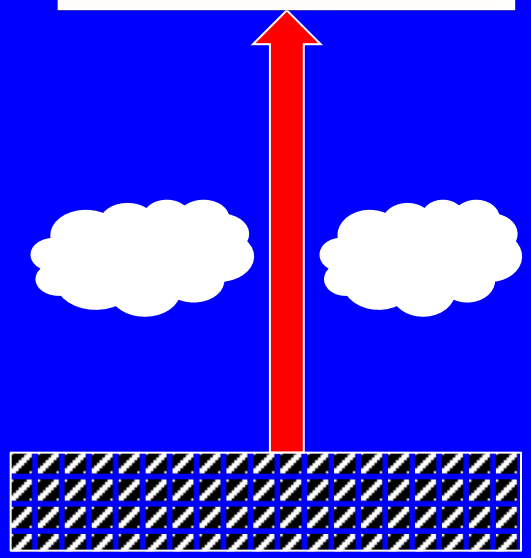
"Clear-Sky" Definitions in Models & Observations

Historical Name	Source	Description	Symbol
Method 1 (Potter et al., 1992)	Observation	Observed clear-sky flux for cloud-free regions within gridbox	F_{cs}^{O}
Method 1b (Potter et al., 1992)	Model	Model clear-sky flux over gridbox weighted by model clear-sky fraction	$F_{cs}^{M}(ModWgt)$
Method 1c	Hybrid	Calculated clear-sky flux over gridbox weighted by observed clear-sky fraction	$F_{cs}^{C}(ObsWgt)$
Method 2	Model	Model or calculated clear-sky flux over gridbox determined by ignoring clouds in the atmospheric column	$F_{cs}^{M}(CldRem)$ $F_{cs}^{C}(CldRem)$

- **Most model evaluation is between Method 2 (Model) & Method 1 (CERES)**

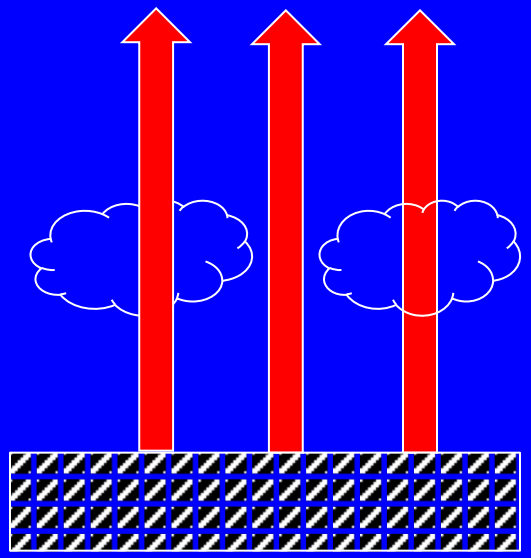
“Clear-Sky” in Models & Observations





Method 1
(Observation)

Climate Model



Method 2
(Climate Models)

- Cloudy columns generally moister than clear columns => Impact on OLR comparisons
- AODs typically larger in cloudy columns => Impact on SW comparisons

New EBAF Ed4.1 Clear-Sky Flux

- We derive an adjustment (Δ^C) to the EBAF observed monthly mean clear-sky flux that enables direct comparisons with model clear-sky fluxes determined by ignoring ("removing") clouds:

$$F_{cs}^{o}(CldRem) = F_{cs}^{o} + \Delta^{C}$$

$$\Delta^{C} = F_{cs}^{C}(CldRem) - F_{cs}^{c}(ObsWgt)$$

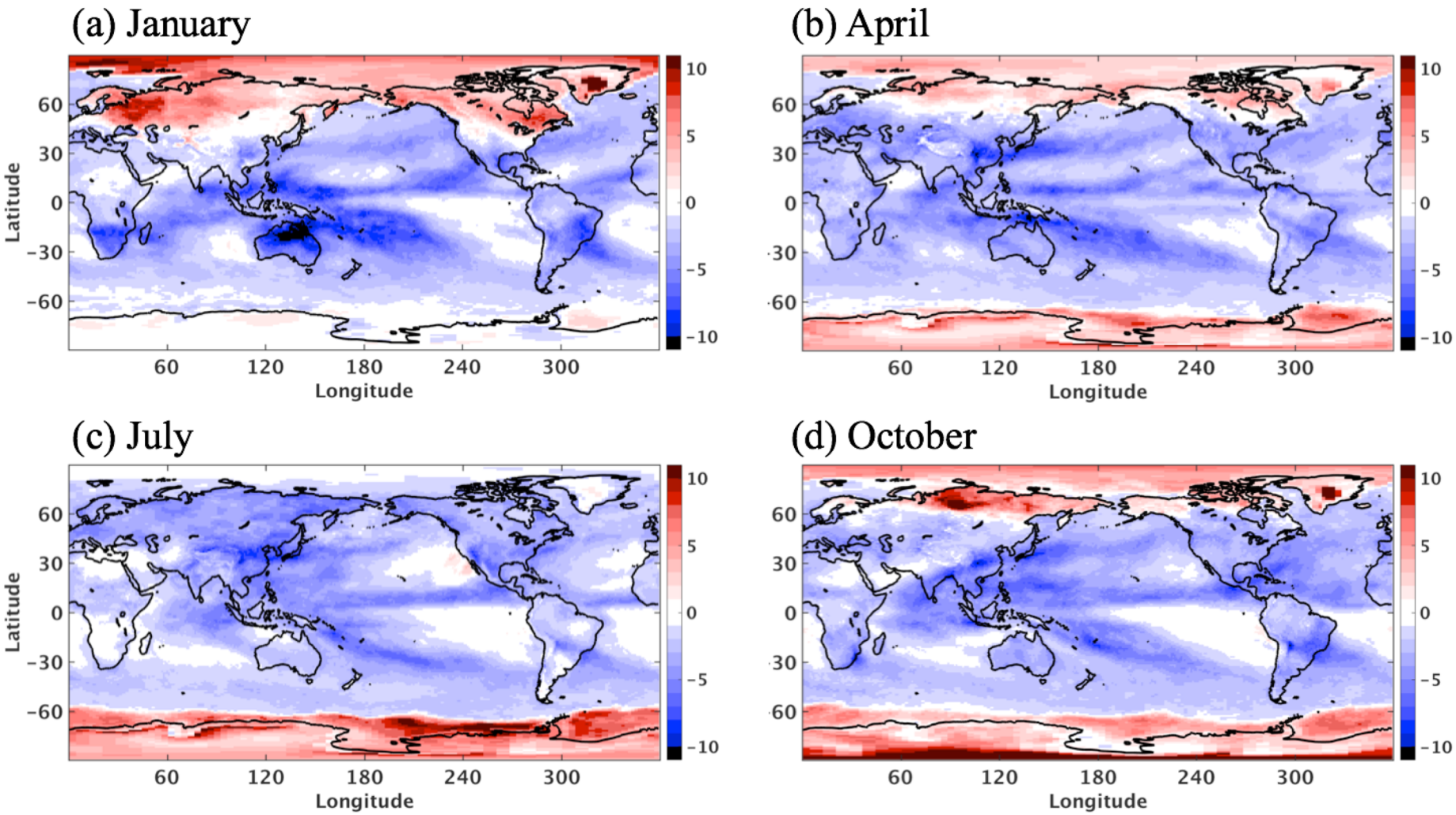
F_{cs}^{o} = Observed clear-sky flux for cloud-free regions within gridbox (original EBAF)

$F_{cs}^{C}(CldRem)$ = Computed clear-sky flux over entire gridbox determined by ignoring clouds in the atmospheric column (from CERES SYN1deg product)

$F_{cs}^{c}(ObsWgt)$ = Computed clear-sky flux over entire gridbox weighted by MODIS clear-sky fraction (analogous to F_{cs}^{o}).

TOA LW Adjustment Factor (Δ^C)

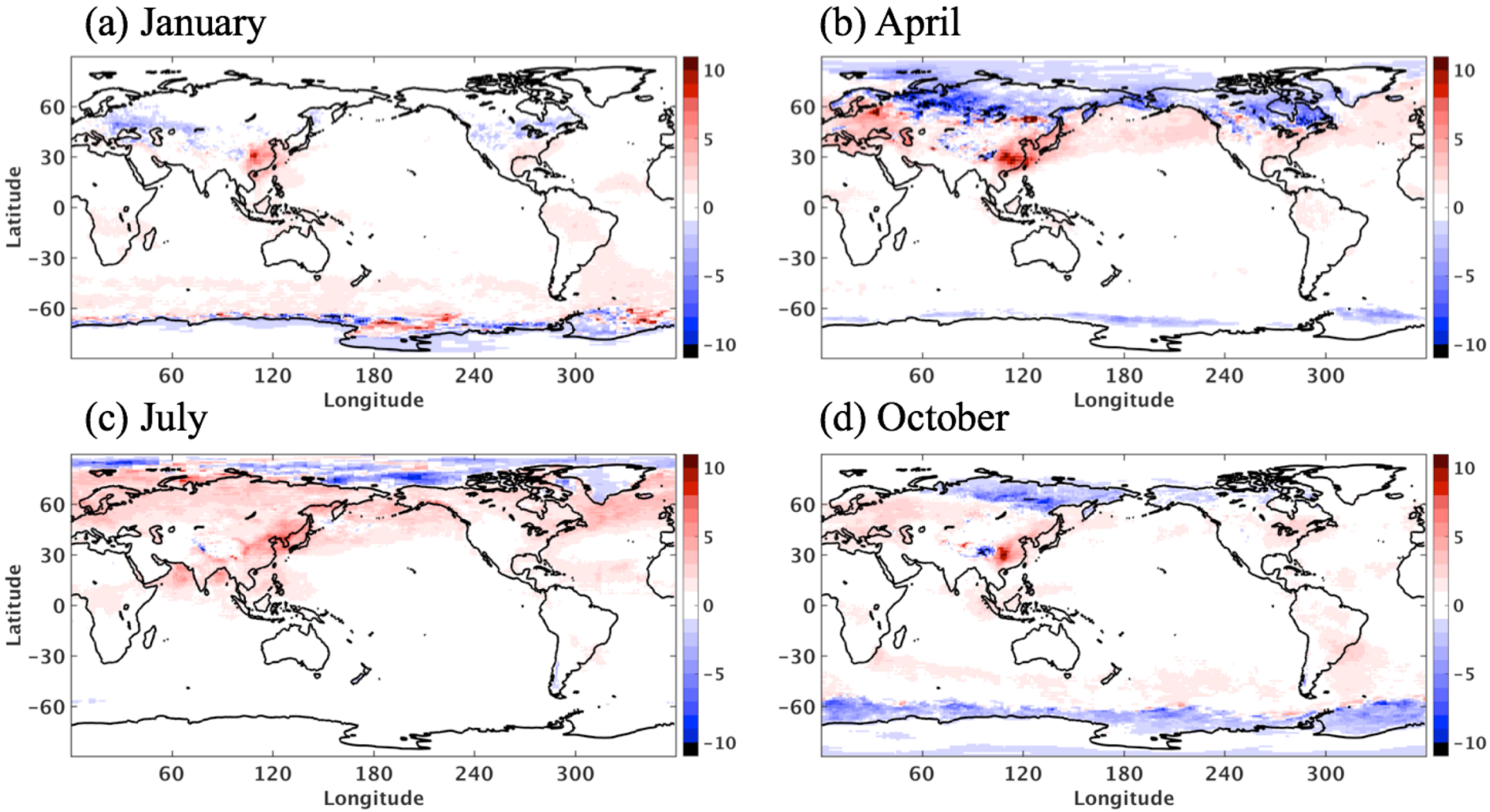
(Climatological Monthly Mean for 07/2005-06/2015; Units: Wm^{-2})



- The overall global mean LW Δ^C for the entire 07/2005-06/2015 period is –2.2 Wm^{-2}

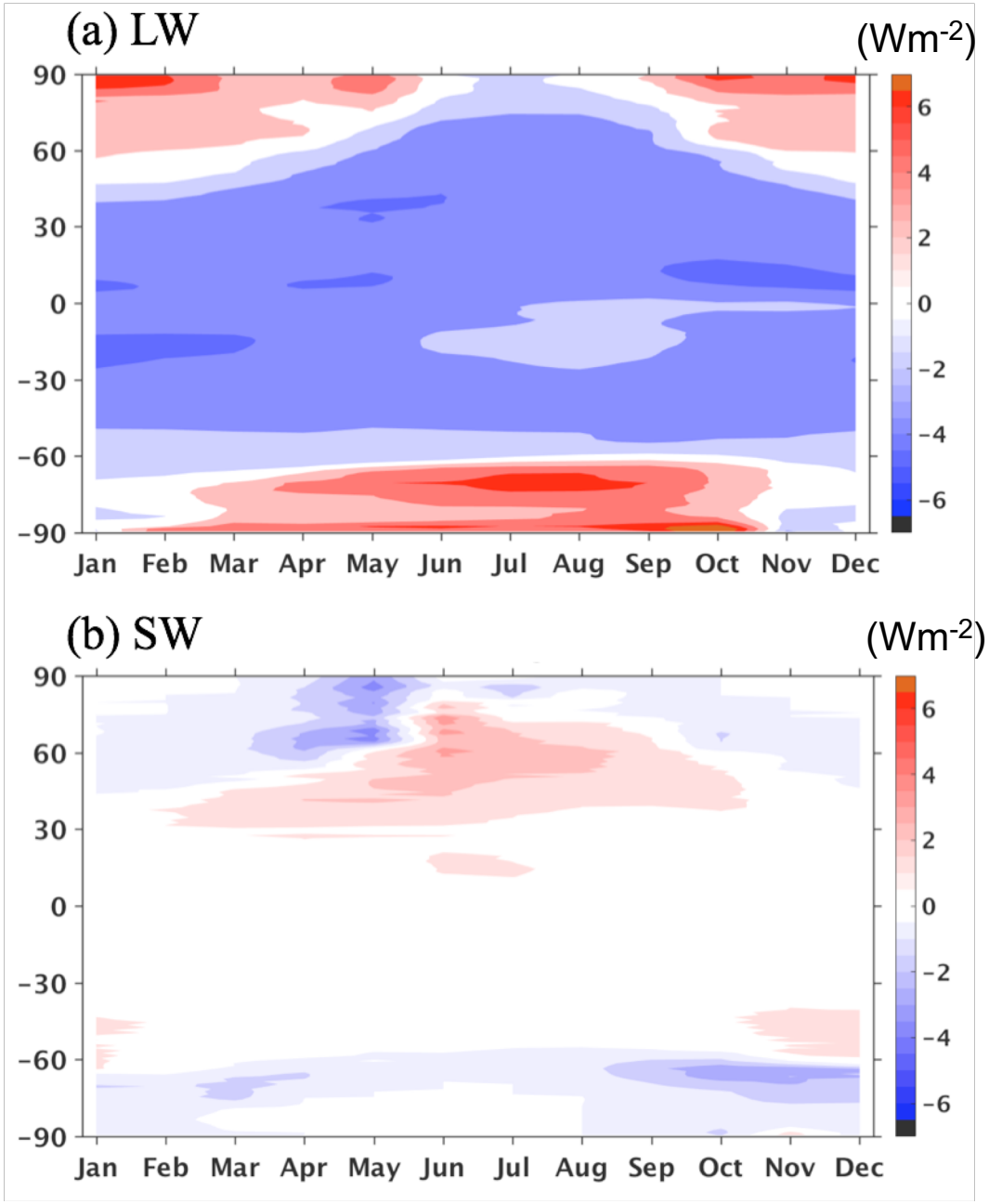
TOA SW Adjustment Factor (Δ^C)

(Climatological Monthly Mean for 07/2005-06/2015; Units: Wm^{-2})



- The overall global mean SW Δ^C for the entire 07/2005-06/2015 period is 0.5 Wm^{-2}

Hovmoller Plots of Climatological Monthly Zonal Mean

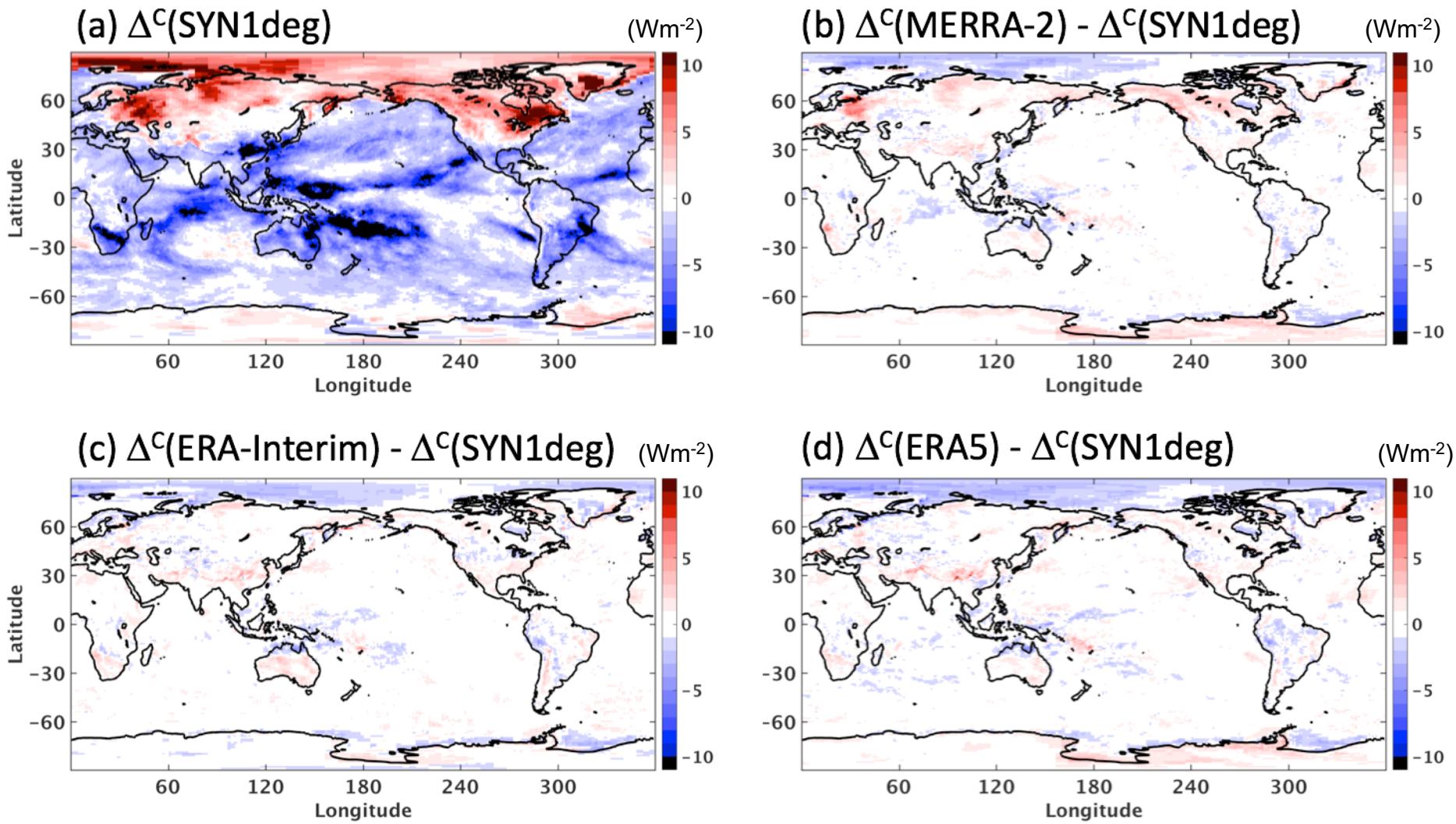


- LW Δ^C is positive during winter at high latitudes because surface and boundary layer temps are warmer in cloudy conditions.

=> $F_{cs}^{C}(CldRem)$ > $F_{cs}^{c}(ObsWgt)$

SYN1deg LW Δ^C vs MERRA-2, ERA-Interim and ERA5

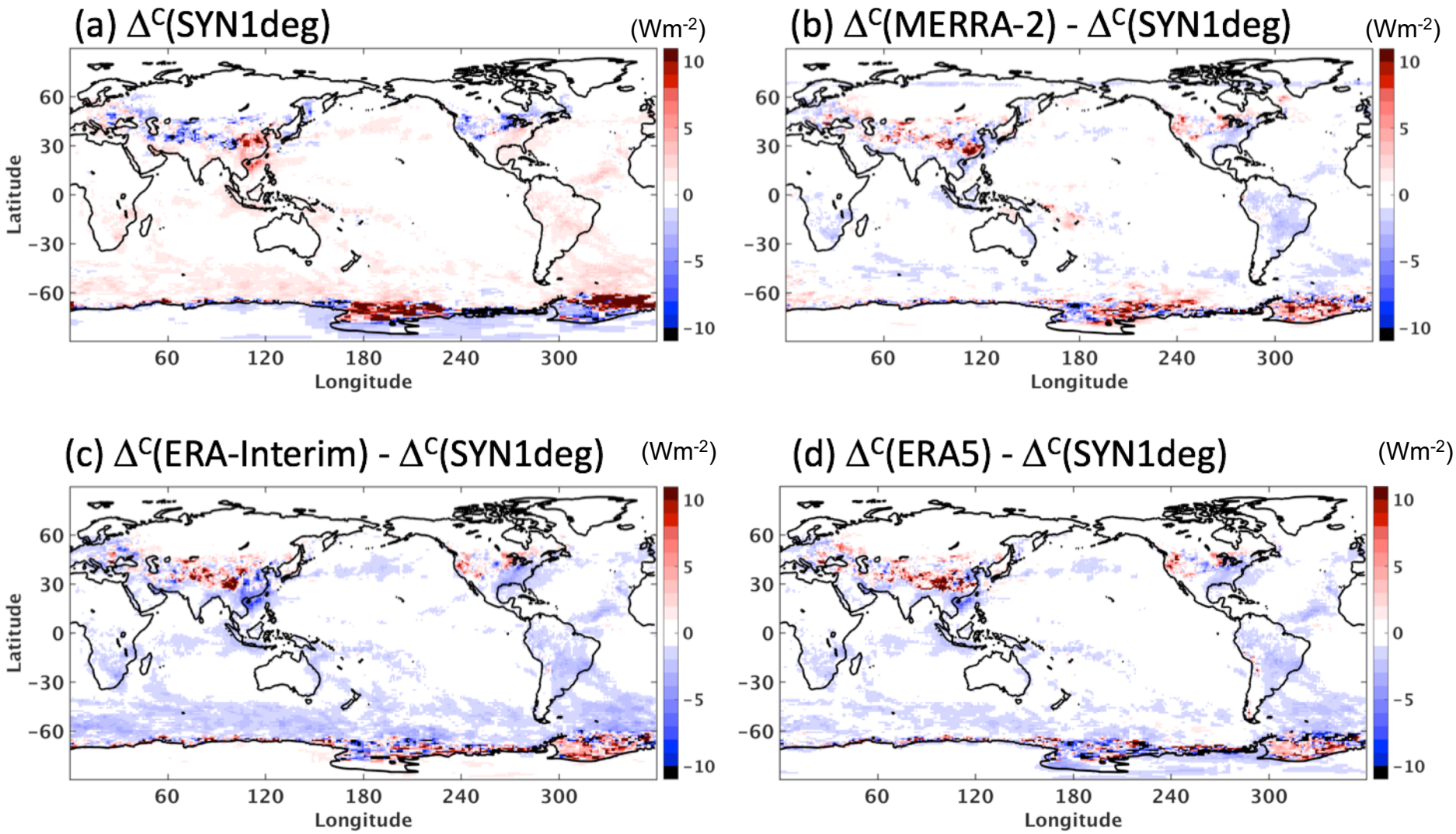
(January 2008; For same MODIS-observed clear-sky weights)



- Regional RMS difference < 1 Wm^{-2}.

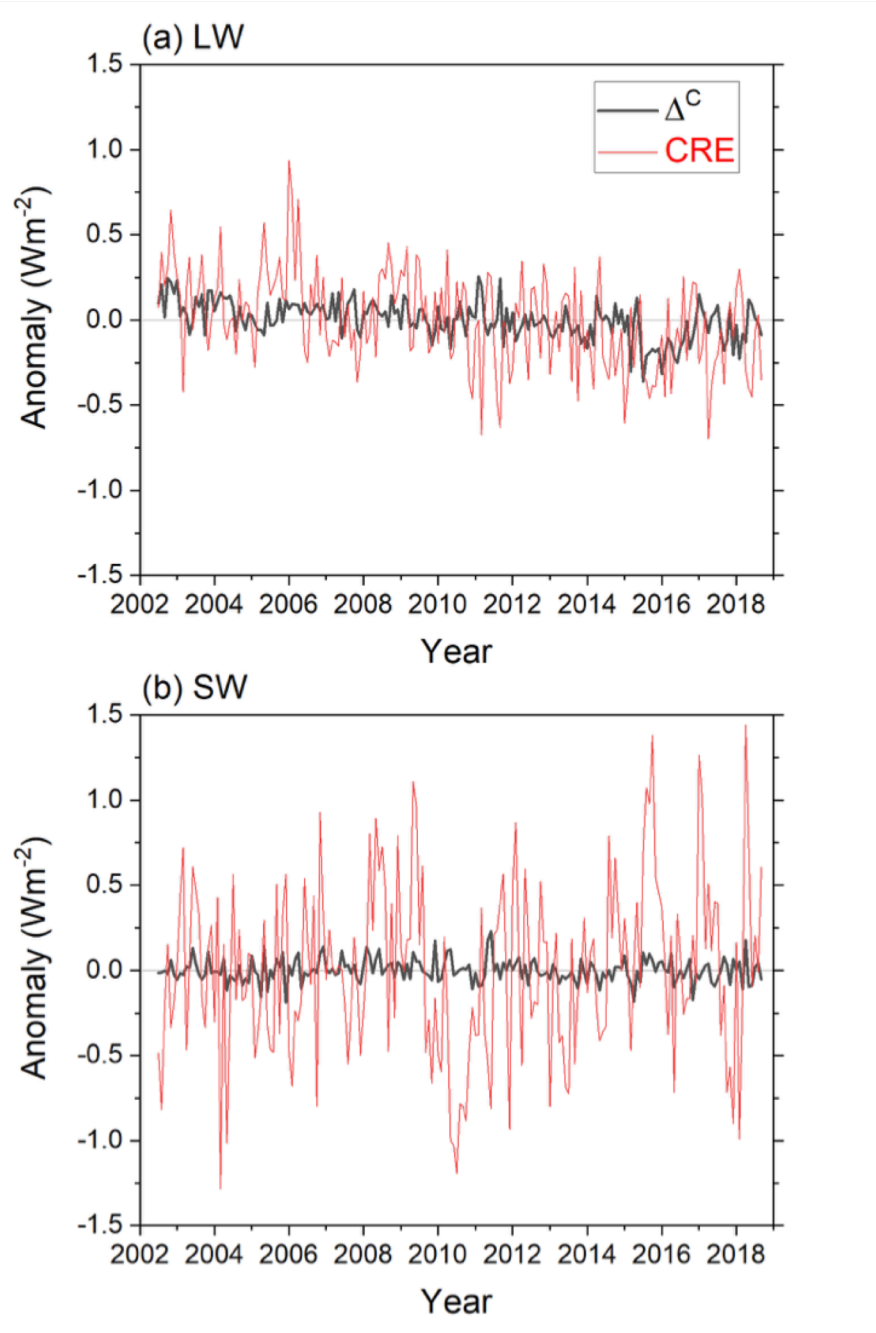
SYN1deg SW Δ^C vs MERRA-2, ERA-Interim and ERA5

(January 2008; For same MODIS-observed clear-sky weights)



- Regional RMS difference ~2 Wm^{-2}. (1 Wm^{-2} for non-Polar Oceans).
- Largest discrepancies over sea-ice and in heavily polluted land regions (e.g., China).

Anomalies in Global Mean Δ^C and CRE (07/2002-09/2018)



Standard Dev (Wm^{-2})

$\Delta^{c.}$: 0.11
CRE: 0.28

Δ^c : 0.069
CRE: 0.51

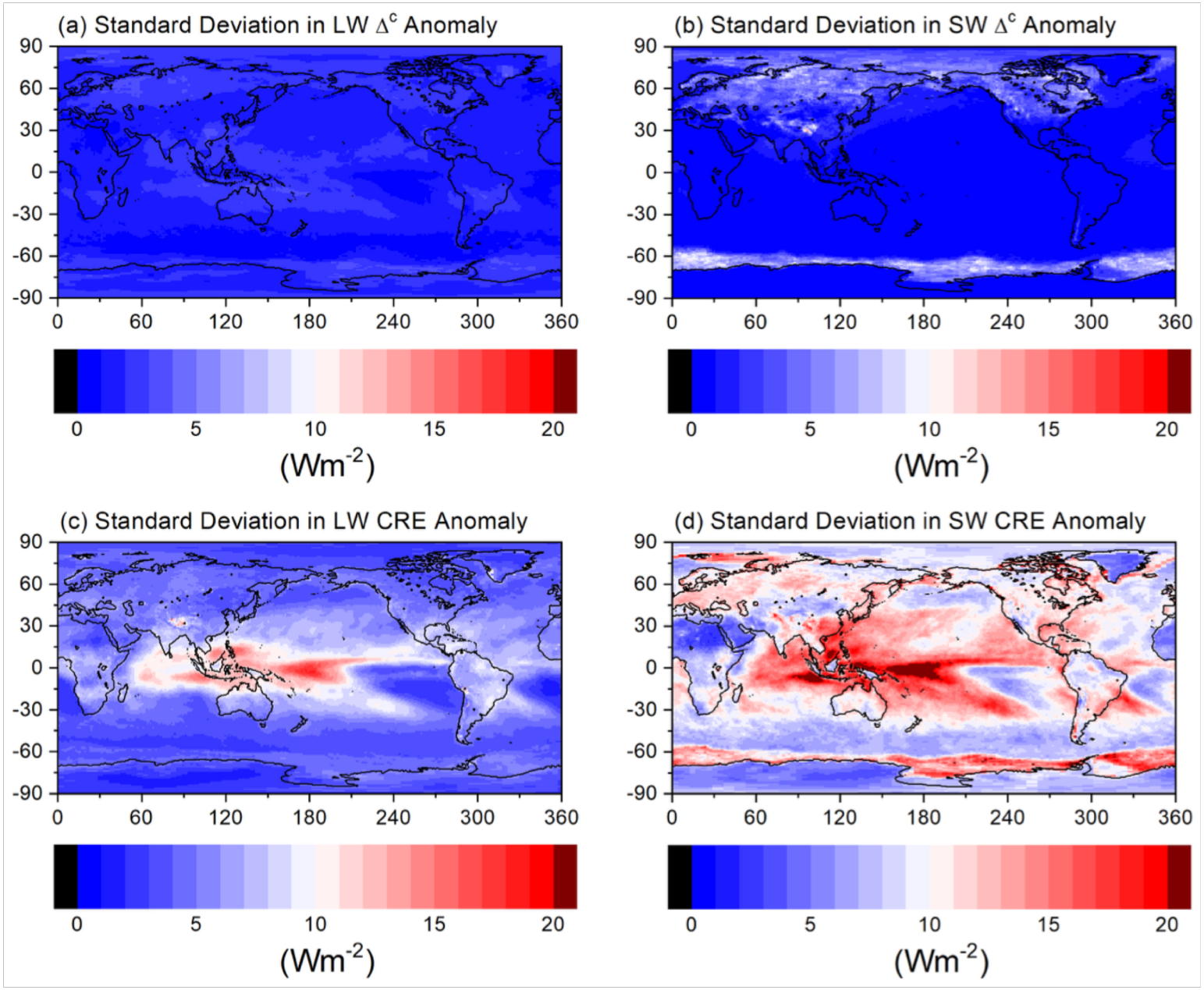
Standard Deviation in Regional Anomalies of Δ^C and CRE

RMS 1.74

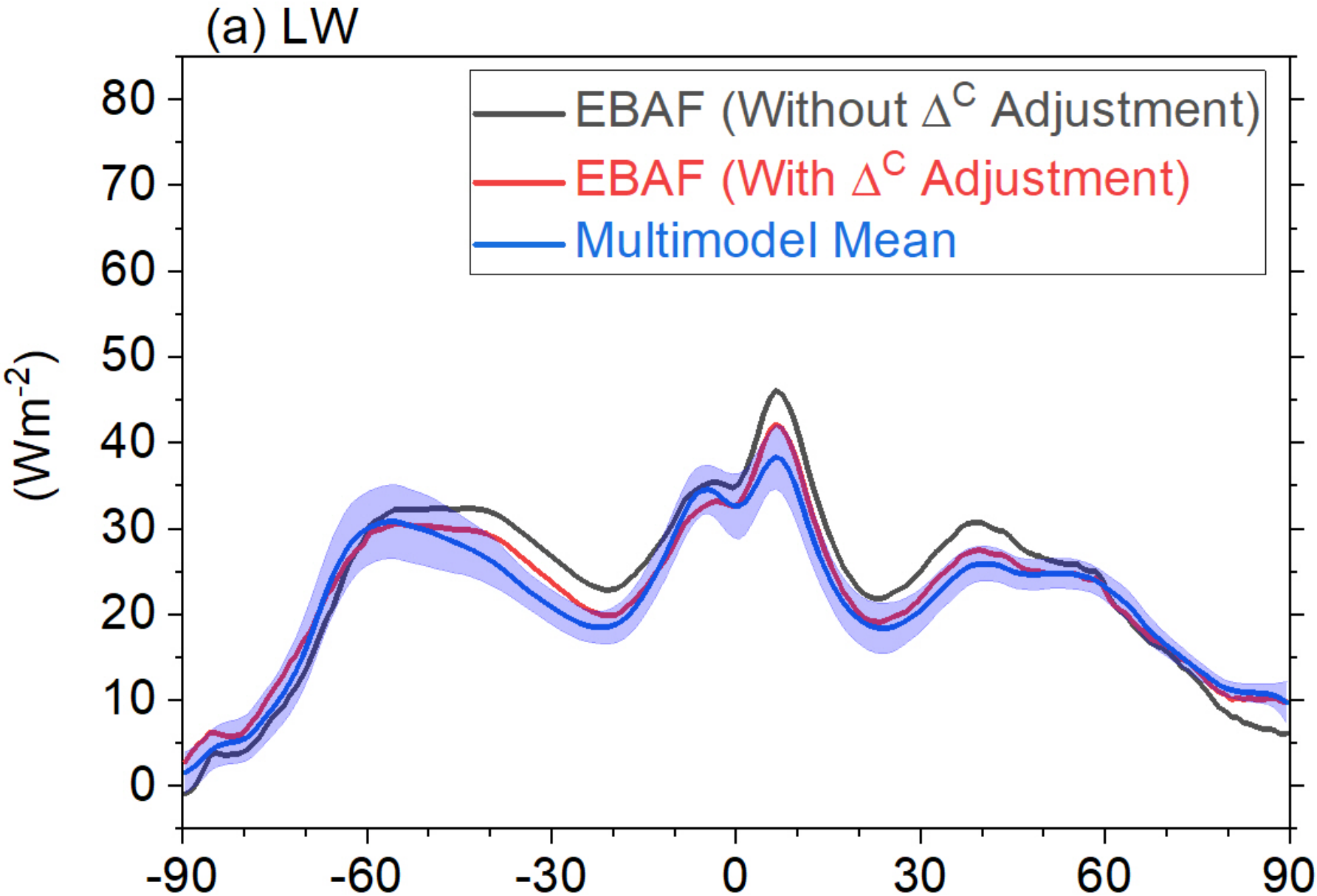
RMS 1.96

RMS 6.64

RMS 11.3



TOA Cloud Radiative Effect: CERES EBAF vs Multimodel Mean of 7 CMIP6 Models
(2003-2014; Shading: ±1 Standard Deviation from the Multimodel Mean)



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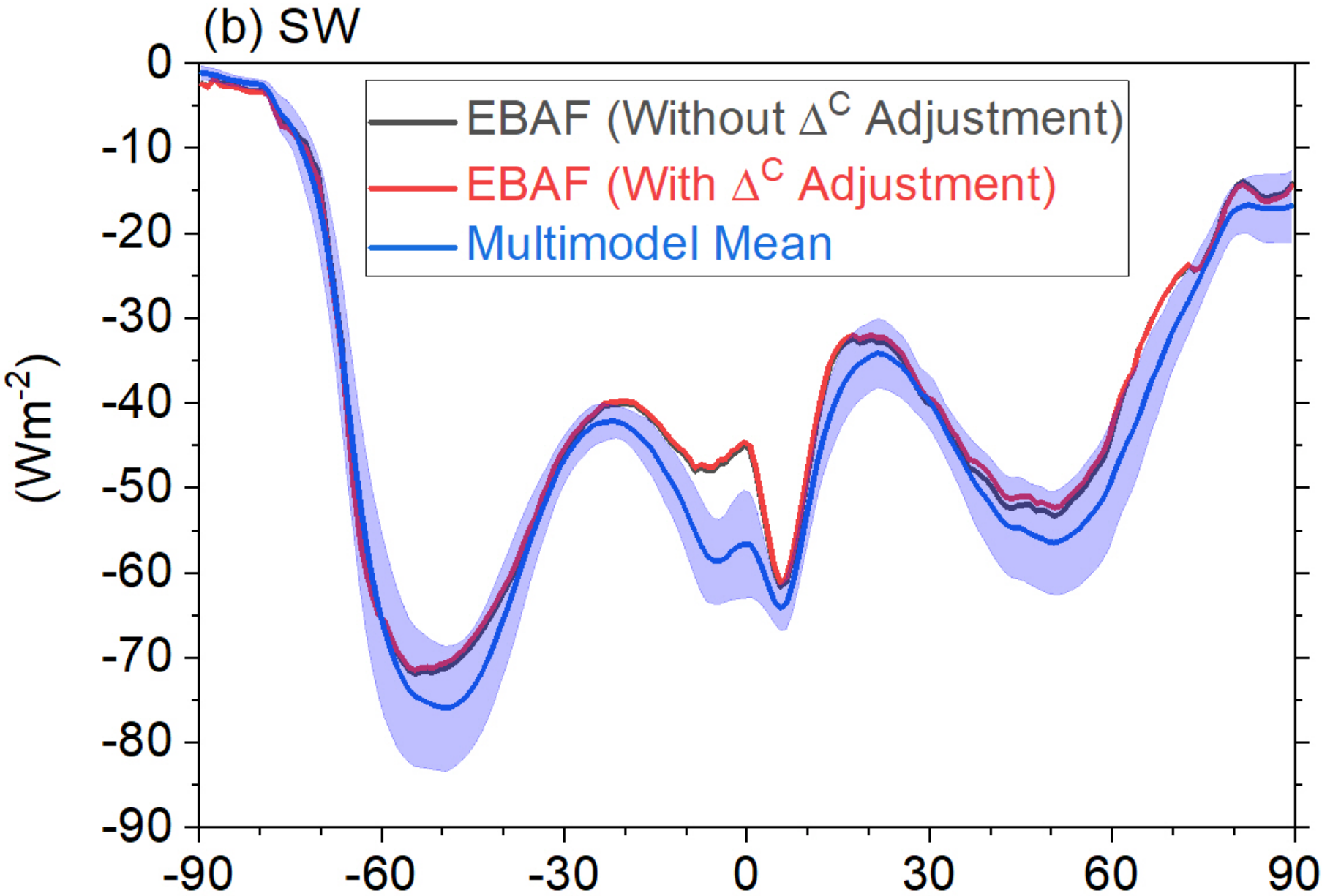
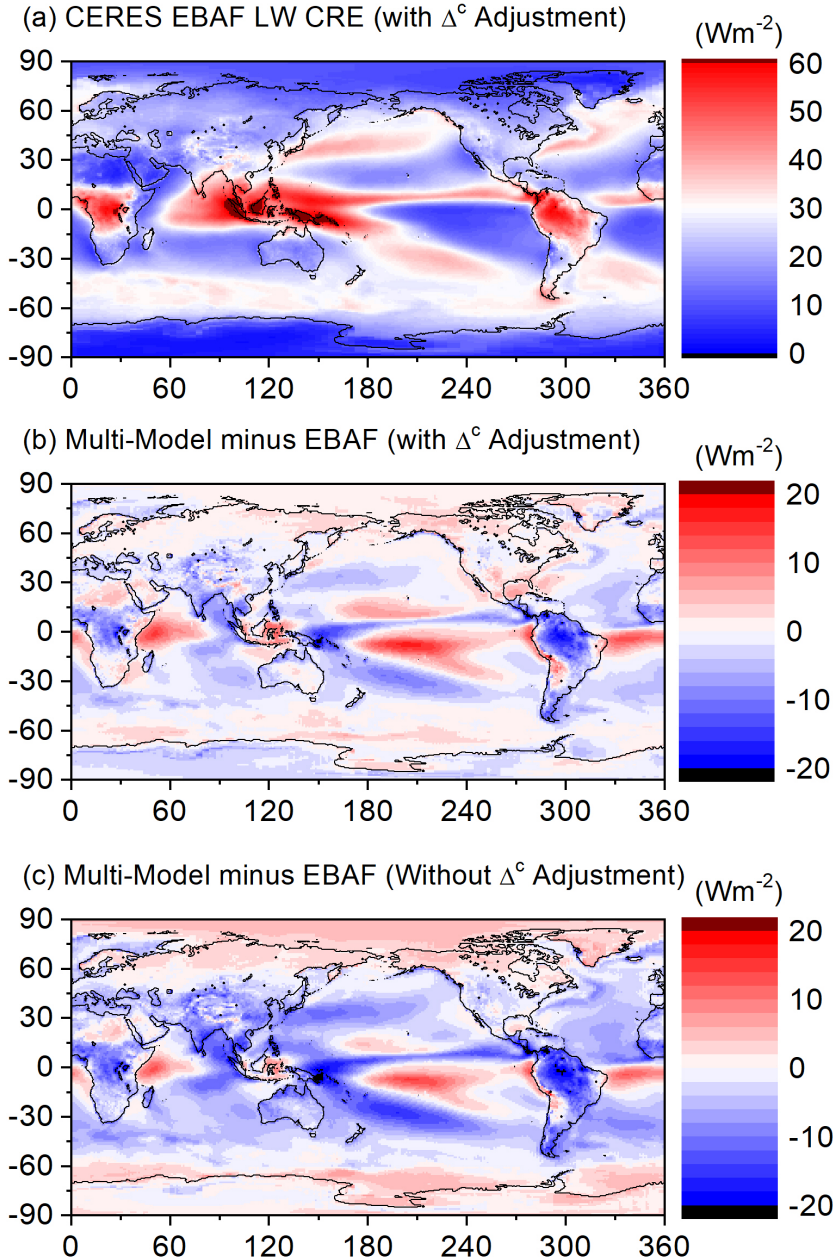


LW TOA Cloud Radiative Effect: CERES EBAF vs Multimodel Mean of 7 CMIP6 Models

(2003-2014; Shading: ±1 Standard Deviation from the Multimodel Mean)



RMS: 4.5 Wm^{-2}

RMS: 6.1 Wm^{-2}

Uncertainty in 1°×1° Regional Monthly TOA Fluxes and CREs

	TOA (Wm^{-2})		
	All-Sky	Clear-Sky	CRE
SW	2.5	5.4	5.9
LW	2.5	4.6	4.5
NET	3.5	7.1	7.4

Changes to CERES EBAF Ordering Page

Clouds and the Earth's Radiant Energy System

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Edition 4.1

EBAF Product	Parameters	Data Availability	Order Data
TOA Fluxes, Clouds	Observed TOA all-sky and clear-sky fluxes; CERES-MODIS cloud properties *(Clear-sky for cloud free areas of $1^o x 1^o$ region)*	03/2000 - 12/2018	Browse & Subset
TOA & Surface Fluxes, Clouds	Observed TOA and computed surface all-sky and clear-sky fluxes; CERES-MODIS cloud properties *(Clear-sky for total area of $1^o x 1^o$ region)*	03/2000 - 03/2018	Browse & Subset

Changes to CERES EBAF Ordering Page

Parameters

		All Sky	Clear Sky (for cloud-free areas of region)	Clear Sky (for total region)
TOA Fluxes	Shortwave Flux			
	Longwave Flux			
	Net Flux			
TOA CRE Fluxes (clear-sky cloud removed)	Click to select individual parameters			
Solar Flux	Click to select individual parameters			
Cloud Parameters	Click to select individual parameters			
Surface Fluxes	Click to select individual parameters			
Surface CRE Fluxes (clear-sky cloud removed)	Click to select individual parameters			

Summary

- Ed4.1 changes include:
  - New clear-sky fluxes & associated CREs. Clear-sky definition is more consistent with that used in climate models.
  - Reprocessed surface fluxes using consistent aerosols throughout (No changes made to TOA fluxes).
  - Reprocessed cloud properties from 03/2016 onwards (C6.1)
- Clear-sky adjustment reduces global mean clear-sky LW flux by 2.2 Wm^{-2} and increases SW flux by 0.5 Wm^{-2}. Larger regional changes.
- Global mean TOA CRE changes:

	EBAF Ed4.0	EBAF Ed4.1
LW	27.9	25.7
SW	-45.8	-45.3
Net	-17.9	-19.6