

# Algorithm development for CERES-like TISA radiative flux data product

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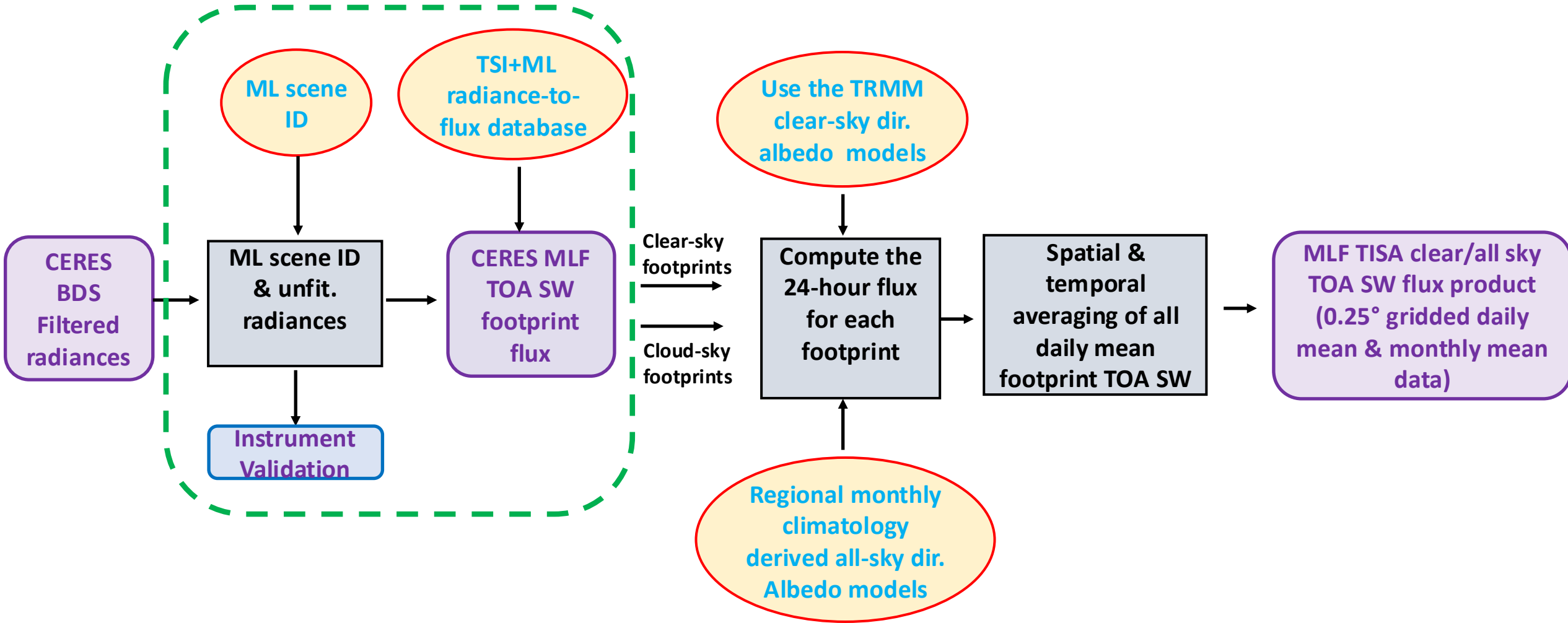
<sup>2</sup>Analytical Mechanics Associates (AMA), Hampton, Virginia

44<sup>th</sup> CERES Science Team Meeting  
NASA Langley Research Center, Hampton, Virginia  
May 14, 2026

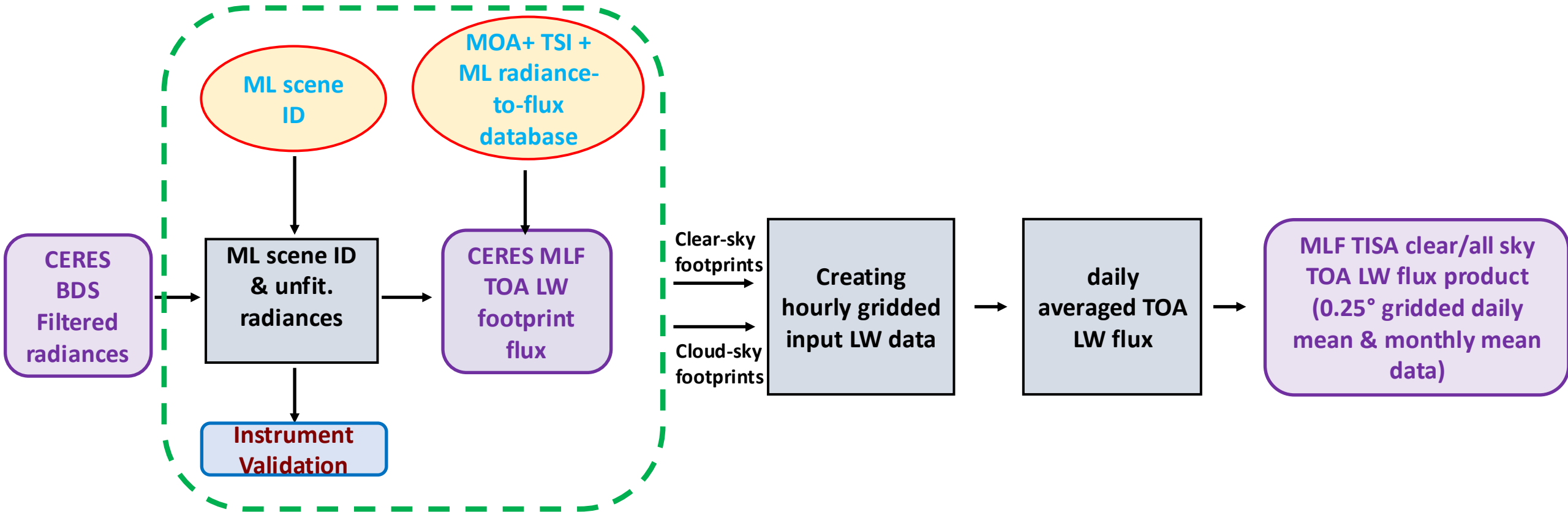
# Introduction

- **CERES EBAF, SSF1deg product SW, LW and Net fluxes rely on sophisticated algorithms based on the instantaneous broadband measurements of CERES instruments**
  - The broadband fluxes use imager cloud information, various ancillary data such as atmospheric profiles and surface properties, and the crucial angular distribution models for radiance to flux conversion.
  - These inputs may not be stable over time, for example imager calibration drifts, atmospheric inputs
  - These inputs may have data gaps thus preventing CERES SSF1deg flux observations
- **A CERES-like TISA product potentially can be used to independently assess CERES instrument calibration/validation and performance, long-term flux variations, and impacts of ancillary data.**
  - The CERES-like product will rely on only the CERES instrument footprint radiances
  - Use Artificial Intelligence and Machine Learning (AI/ML) and climatology to derive ADMs, directional models, and scene ID.
  - The CERES-like product can easily be processed on fine scales such as 0.25° grid

# MLF TISA SW Flux Processing Flow Chart

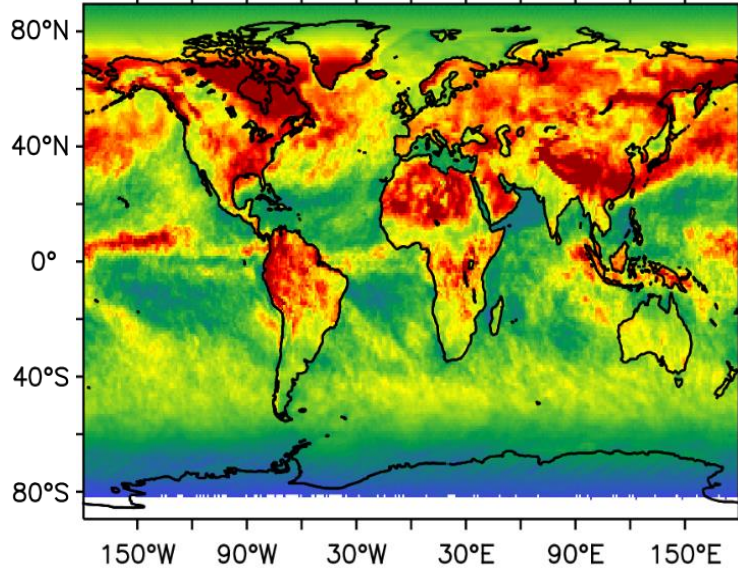


# MLF TISA LW Flux Processing Flow Chart

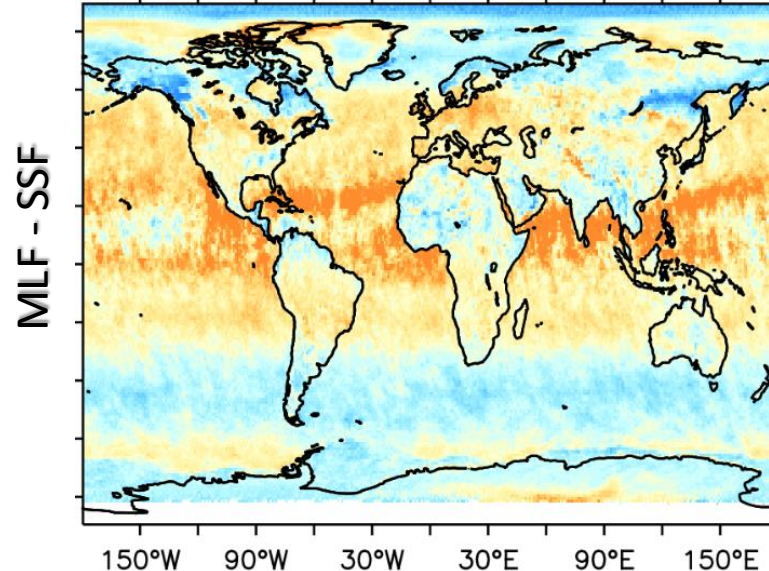


# CERES-like instantaneous footprint ML SW flux ( $\text{Wm}^{-2}$ ), April 2010

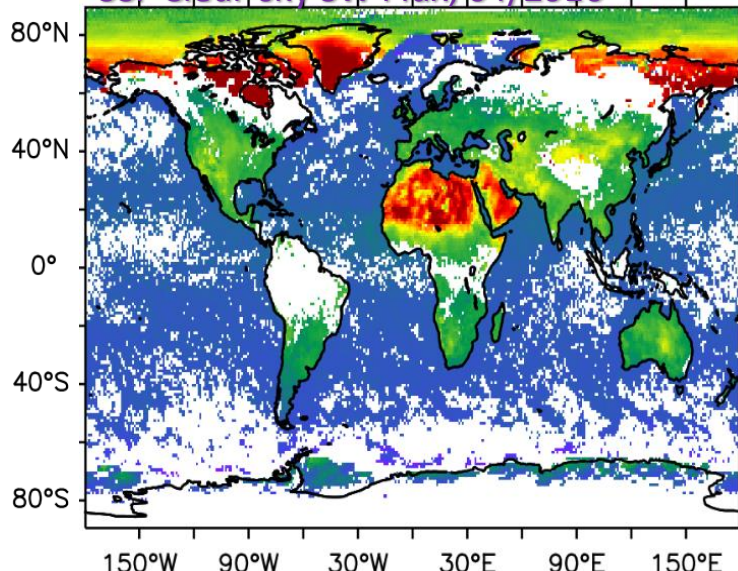
SSF All-sky SW Flux, 04/2010



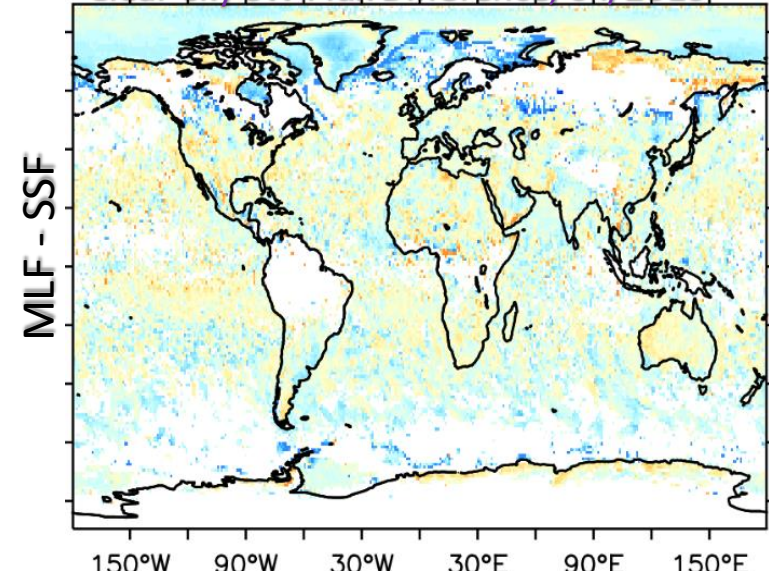
All-sky SW Flux Difference, 04/2010



SSF Clear-sky SW Flux, 04/2010

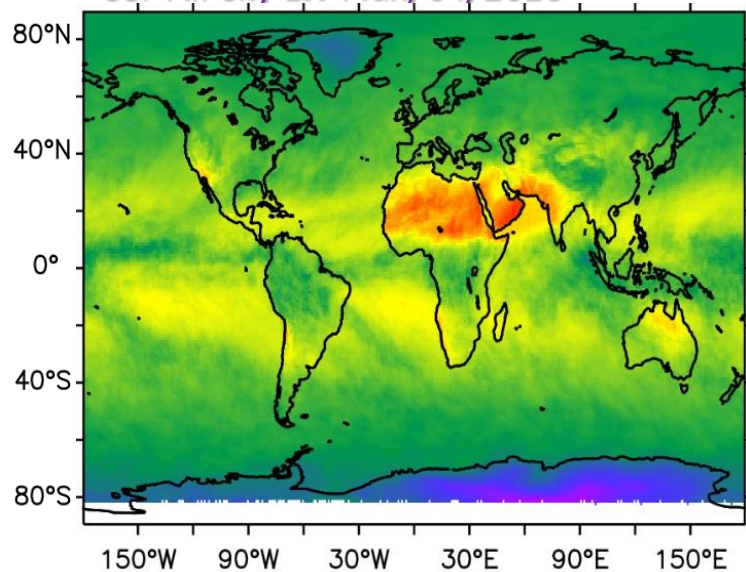


Clear-sky SW Flux Difference, 04/2010

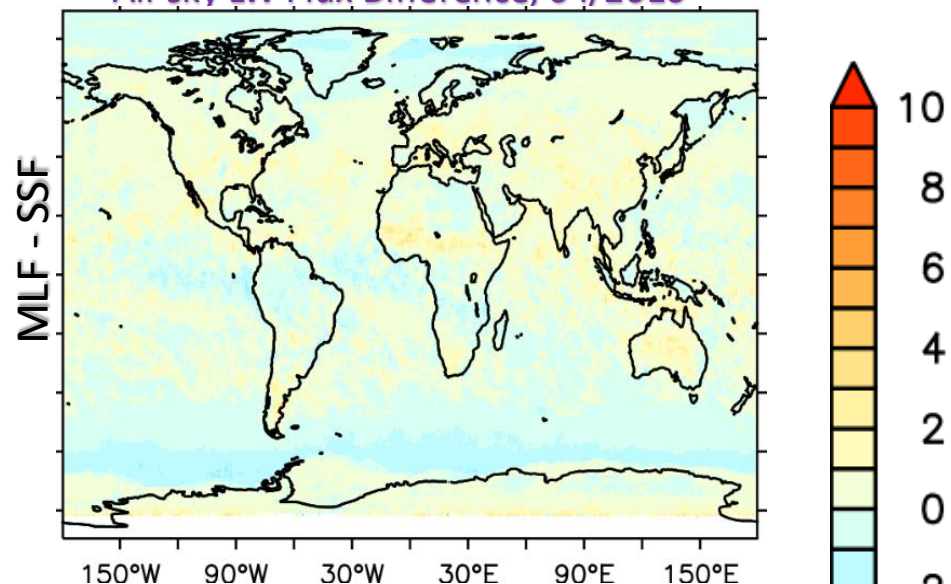


# CERES-like instantaneous footprint ML LW flux ( $Wm^{-2}$ ), April 2010

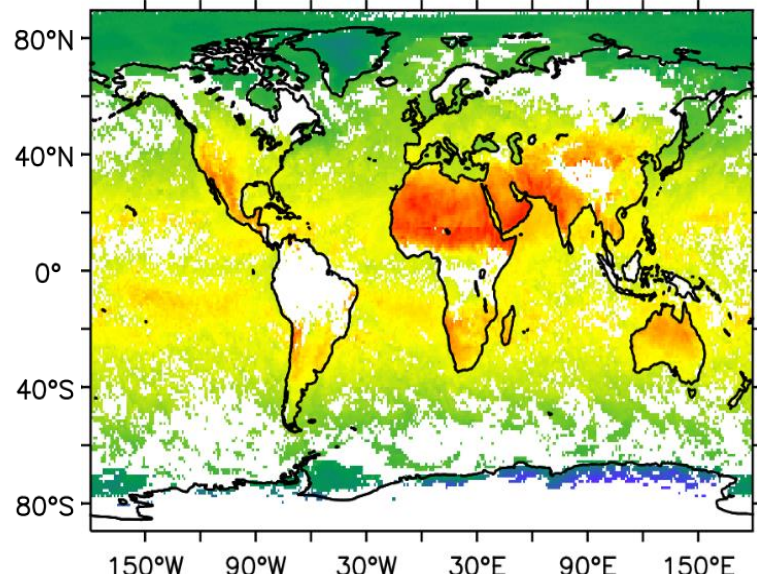
SSF All-sky LW Flux, 04/2010



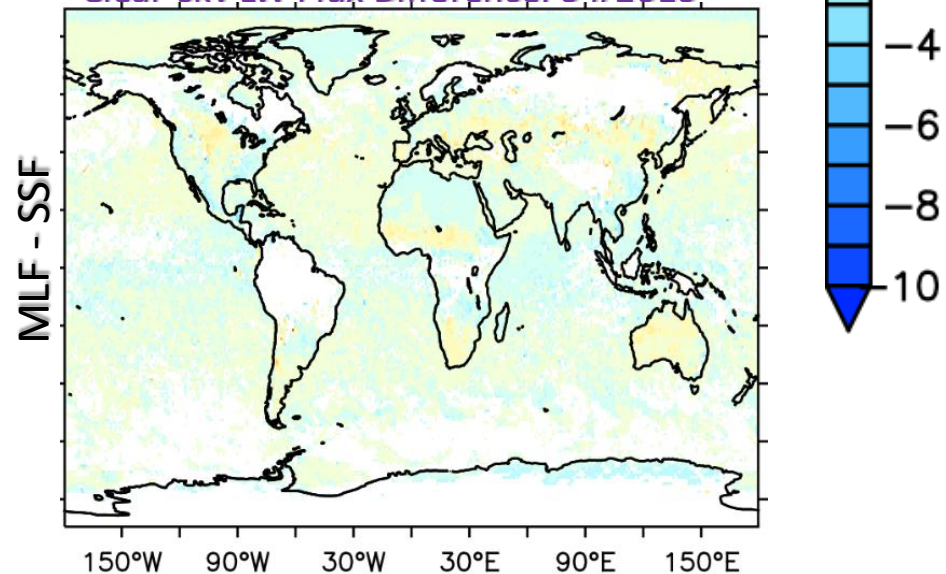
All-sky LW Flux Difference, 04/2010



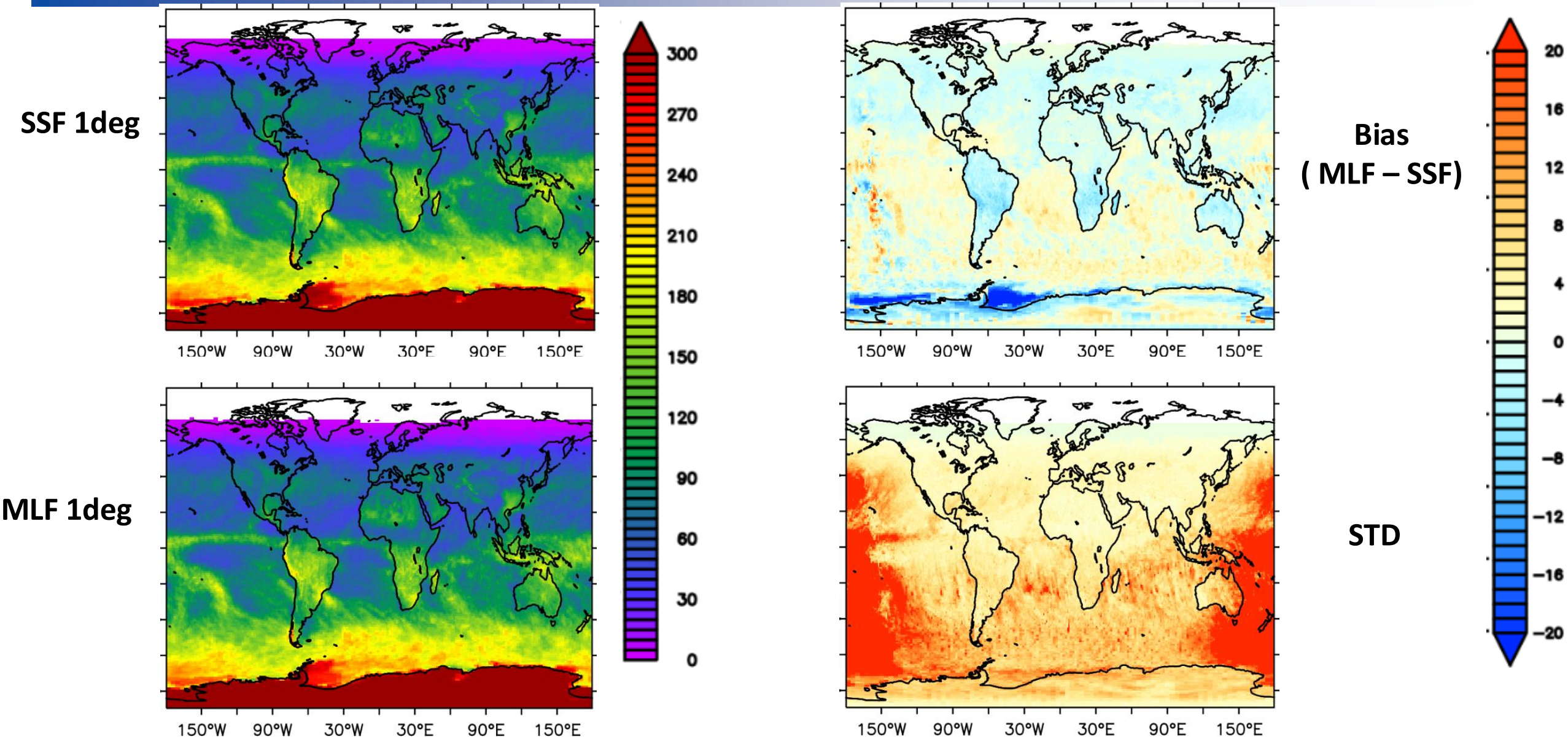
SSF Clear-sky LW Flux. 04/2010



Clear-sky LW Flux Difference. 04/2010



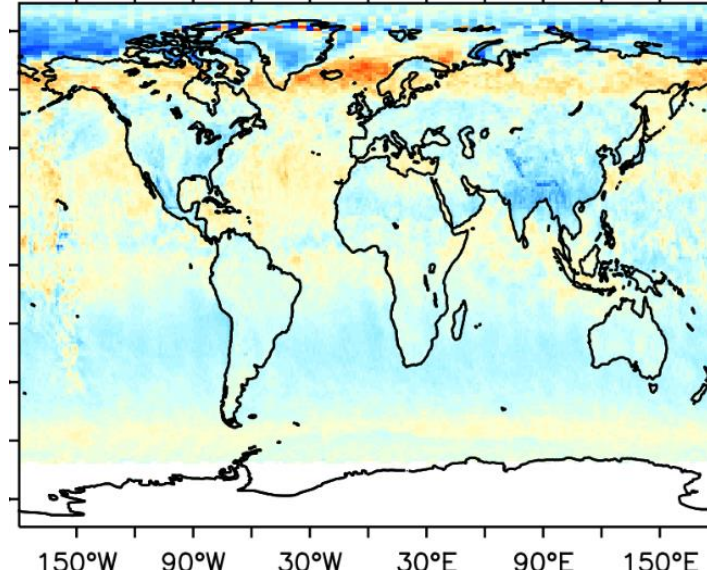
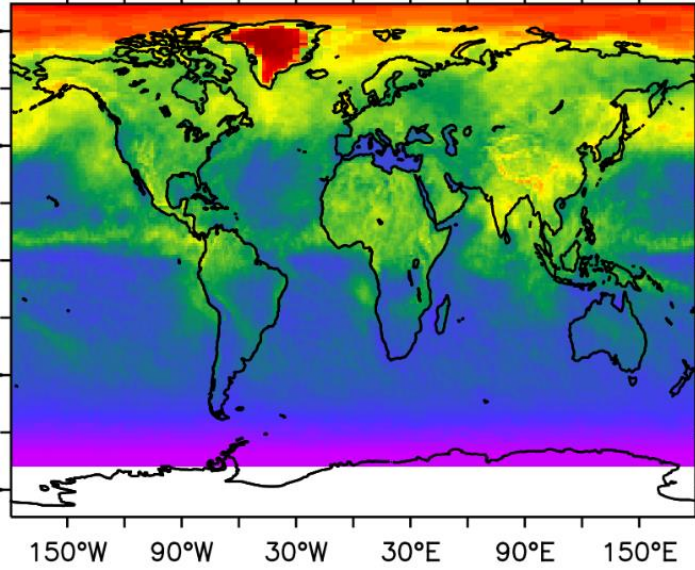
# CERES-like TISA All-sky SW flux : SSF vs MLF (January 2010)



MLF- use Monthly Mean albedo model for cloud-sky footprint

# CERES-like TISA All-sky SW flux : SSF vs MLF (July 2010)

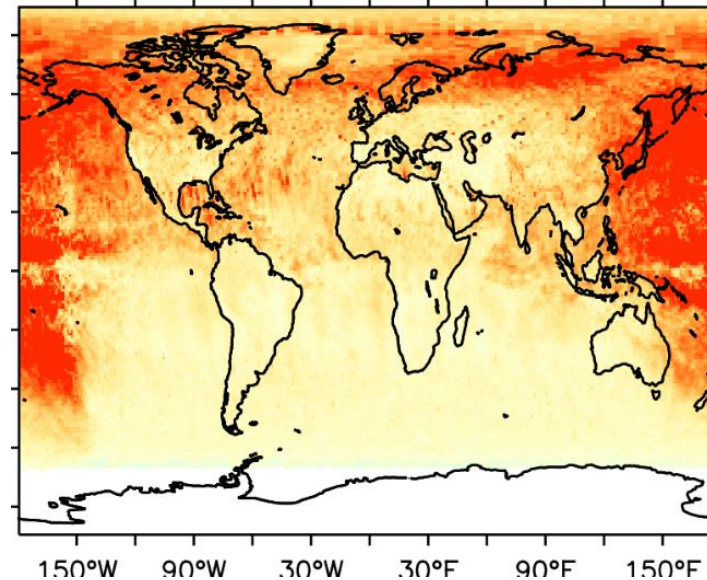
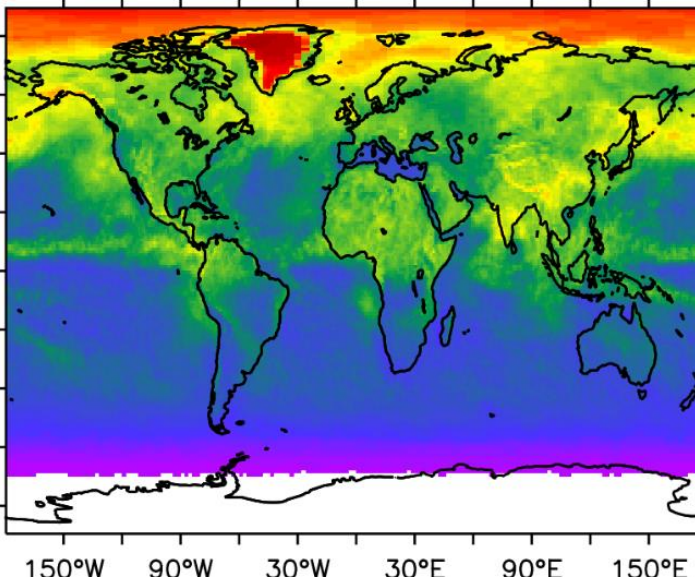
SSF 1deg



Bias  
( MLF - SSF )



MLF 1deg

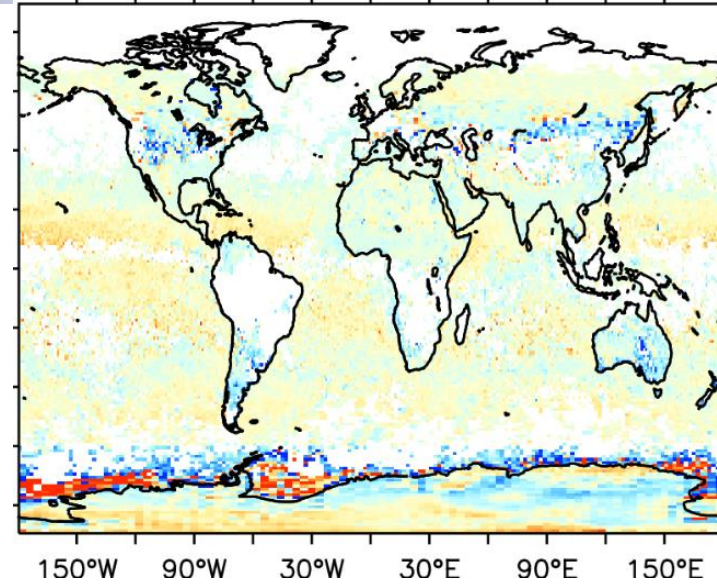
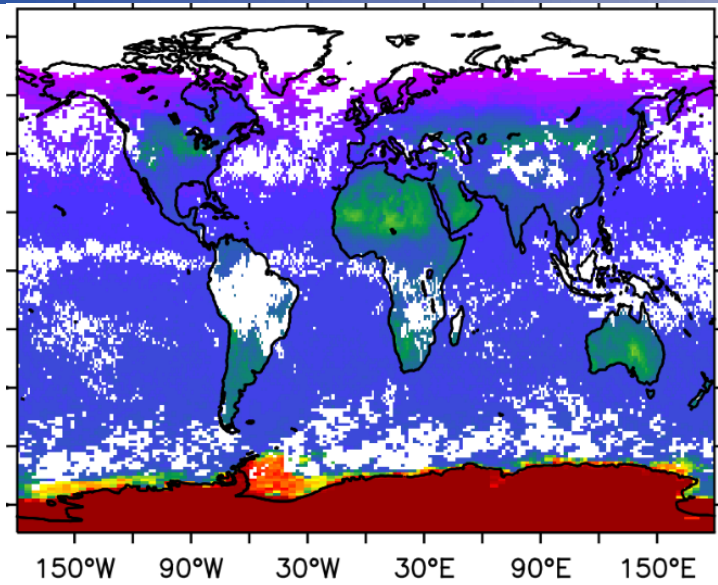


STD

MLF- use Monthly Mean albedo model for cloud-sky footprints

# CERES-like TISA Clear-sky SW flux : SSF vs MLF (January 2010)

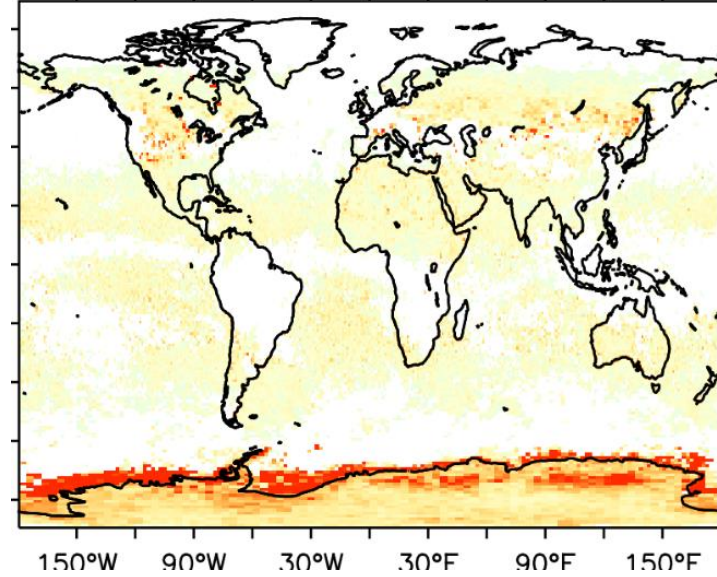
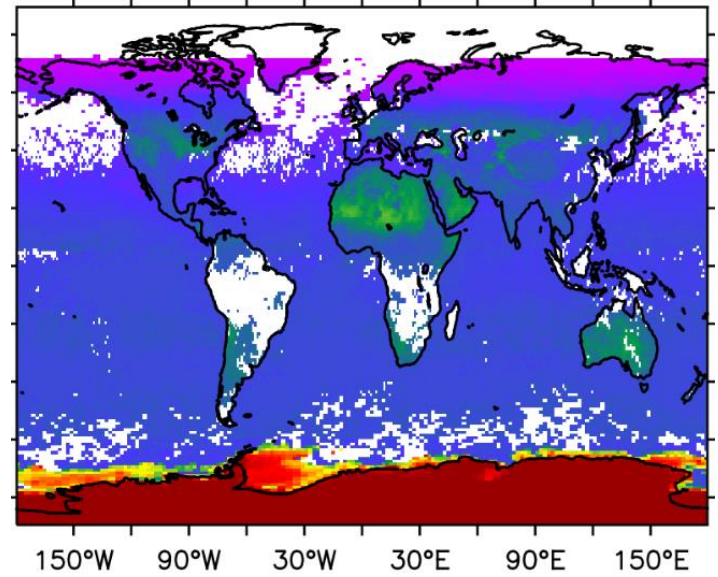
SSF 1deg



Bias  
( MLF - SSF )



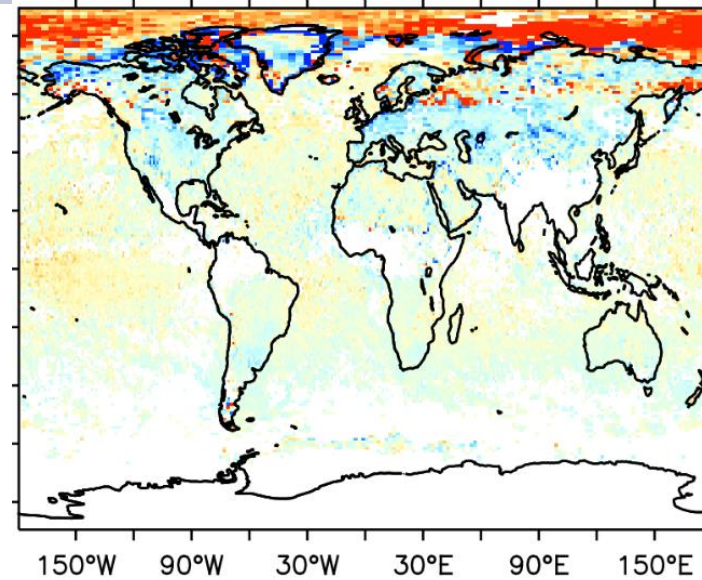
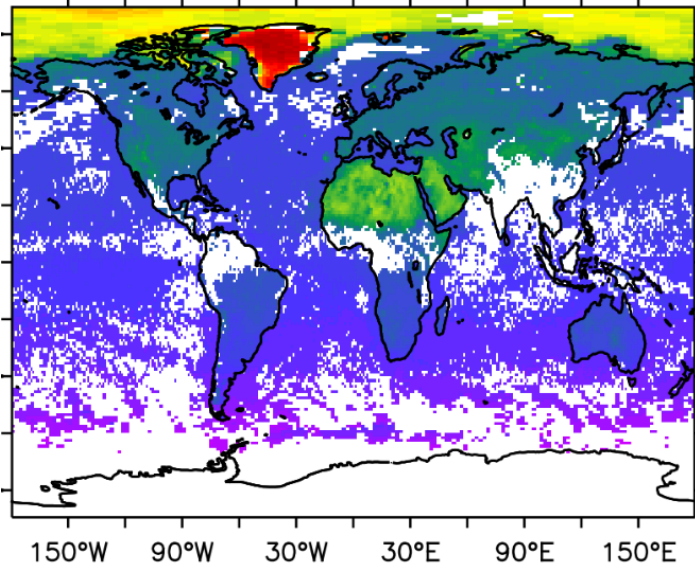
MLF 1deg



STD

# CERES-like TISA Clear-sky SW flux : SSF vs MLF (July 2010)

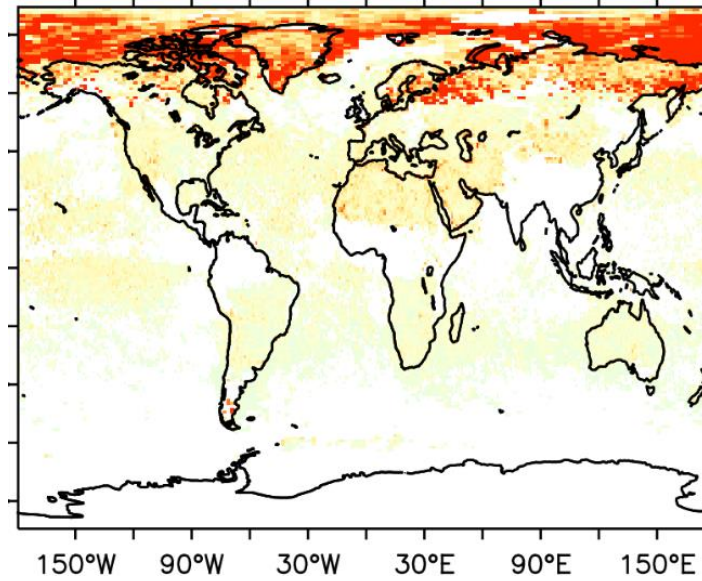
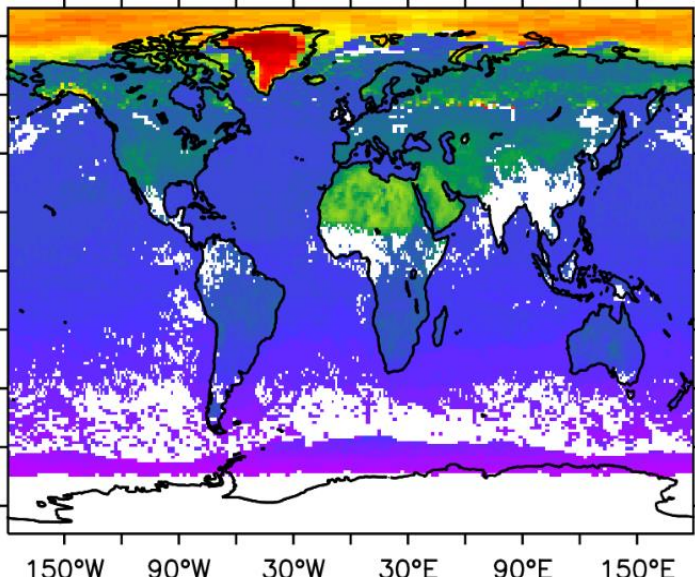
SSF 1deg



Bias  
( MLF - SSF )



MLF 1deg



STD

# CERES-like TISA Global Mean SW Flux: SSF1deg vs MLF1deg (2010)

**All-sky**

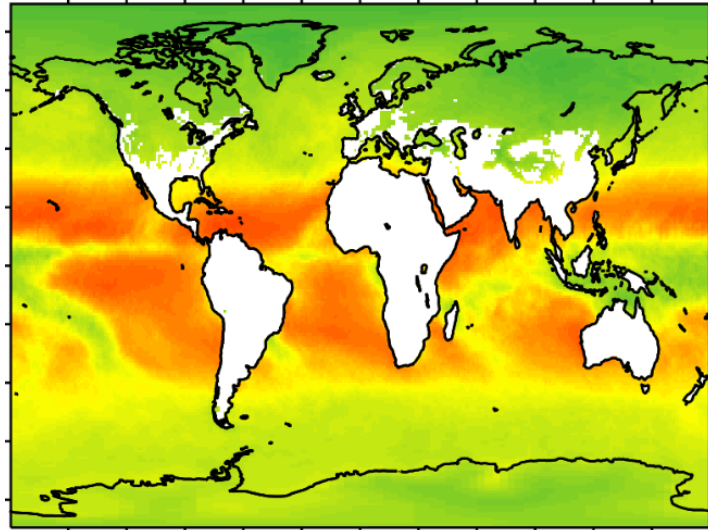
Month	BIAS (MLF1deg - SSF1deg)	STDEV.	RMSD
Jan	<b>-0.09</b>	3.70	3.70
Apr	<b>-0.06</b>	2.82	2.82
Jul	<b>-0.63</b>	4.04	4.08
Oct	<b>0.20</b>	2.90	2.96

**Clear-sky**

Month	BIAS (MLF1deg - SSF1deg)	STDEV.	RMSD
Jan	<b>3.58</b>	13.48	13.94
Apr	<b>2.71</b>	9.08	9.48
Jul	<b>3.85</b>	18.63	19.03
Oct	<b>2.54</b>	7.35	7.78

# CERES-like TISA All-sky LW flux : SSF vs MLF (January 2010)

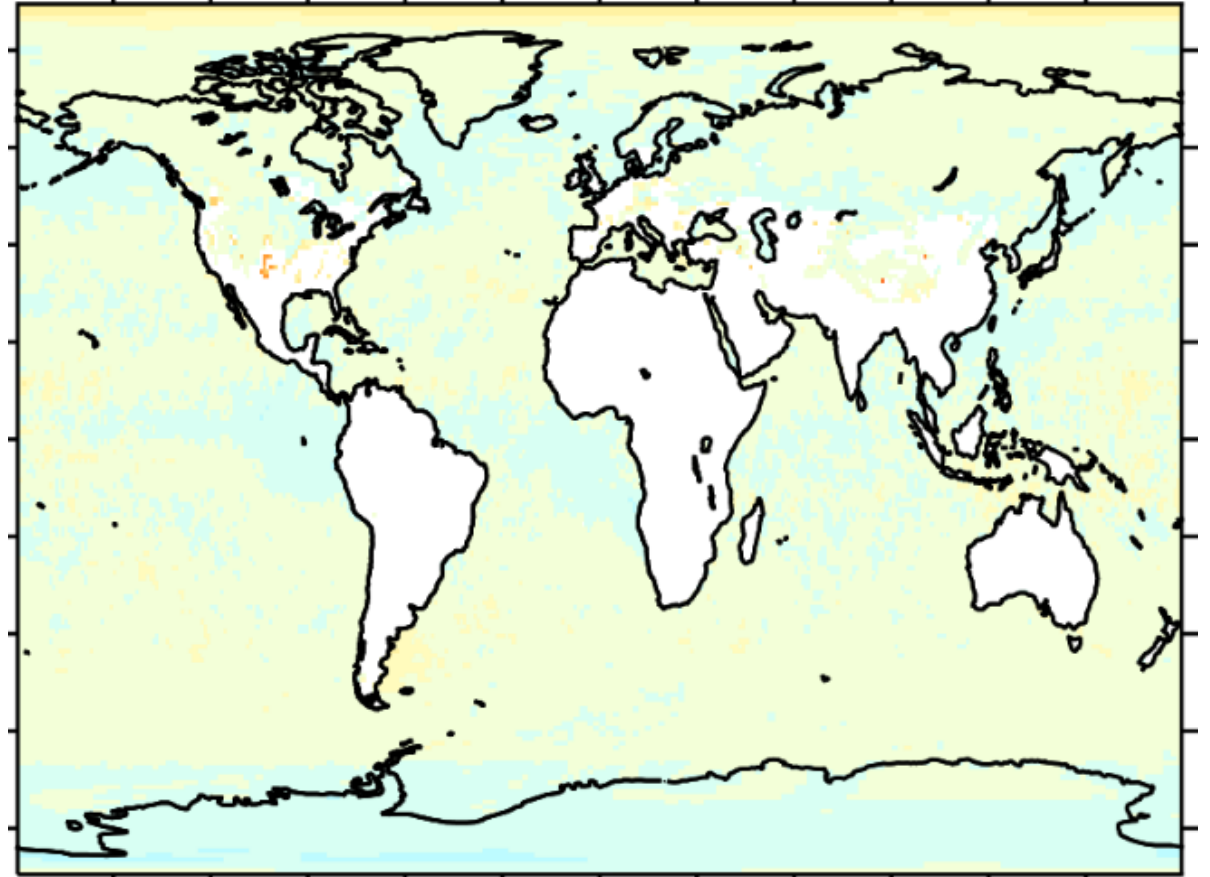
SSF 1deg



150°W 90°W 30°W 30°E 90°E 150°E



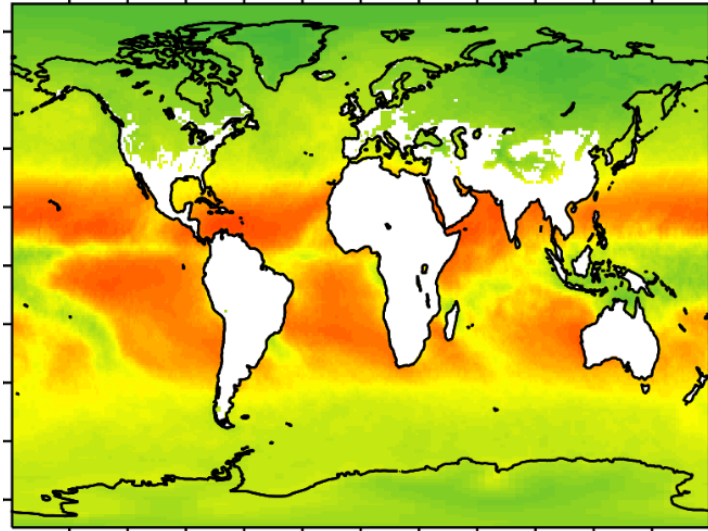
Diff (MLF – SSF)



150°W 90°W 30°W 30°E 90°E 150°E



MLF 1deg

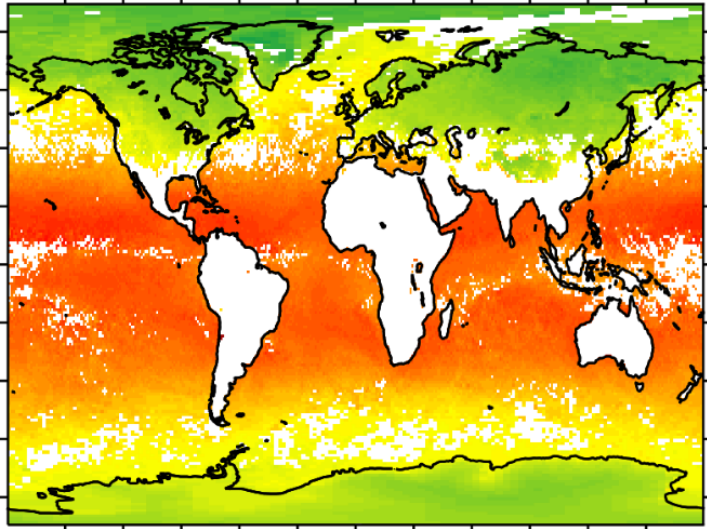


150°W 90°W 30°W 30°E 90°E 150°E

BIAS	STDEV.	RMSD
0.16	3.39	3.39

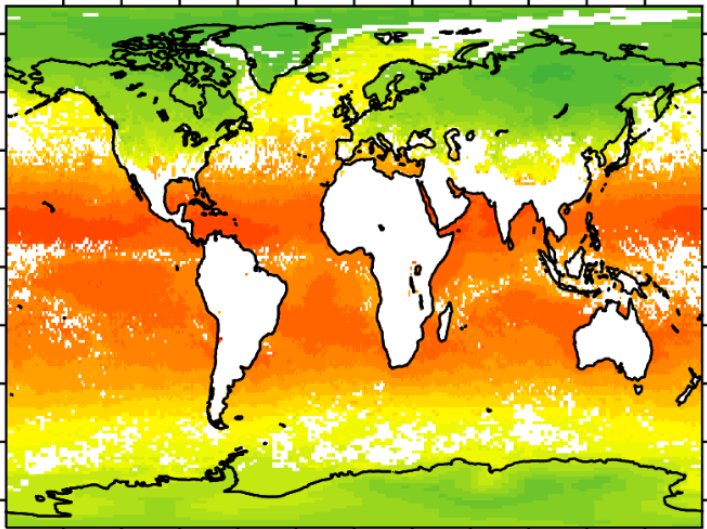
# CERES-like TISA Clear-sky LW flux : SSF vs MLF (January 2010)

SSF 1deg



150°W 90°W 30°W 30°E 90°E 150°E

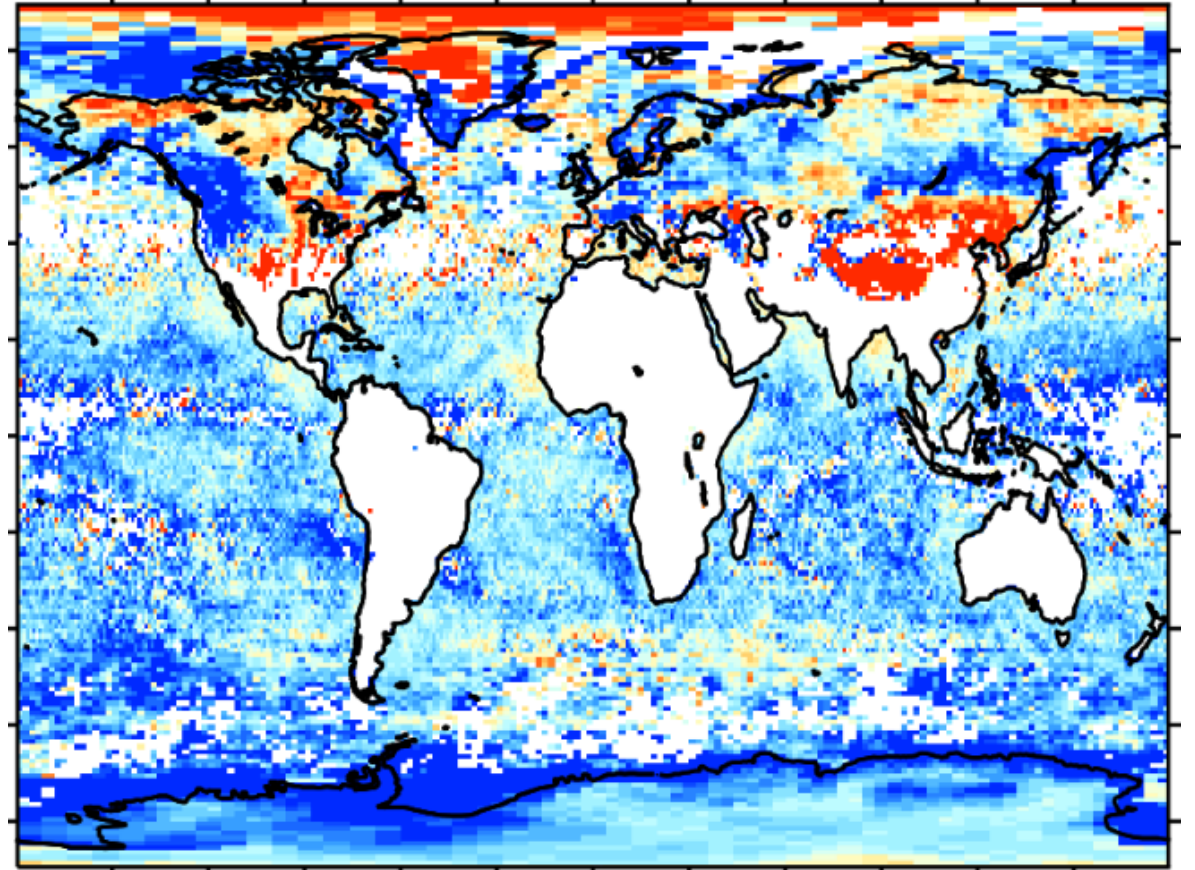
MLF 1deg



150°W 90°W 30°W 30°E 90°E 150°E



Diff (MLF - SSF)



150°W 90°W 30°W 30°E 90°E 150°E

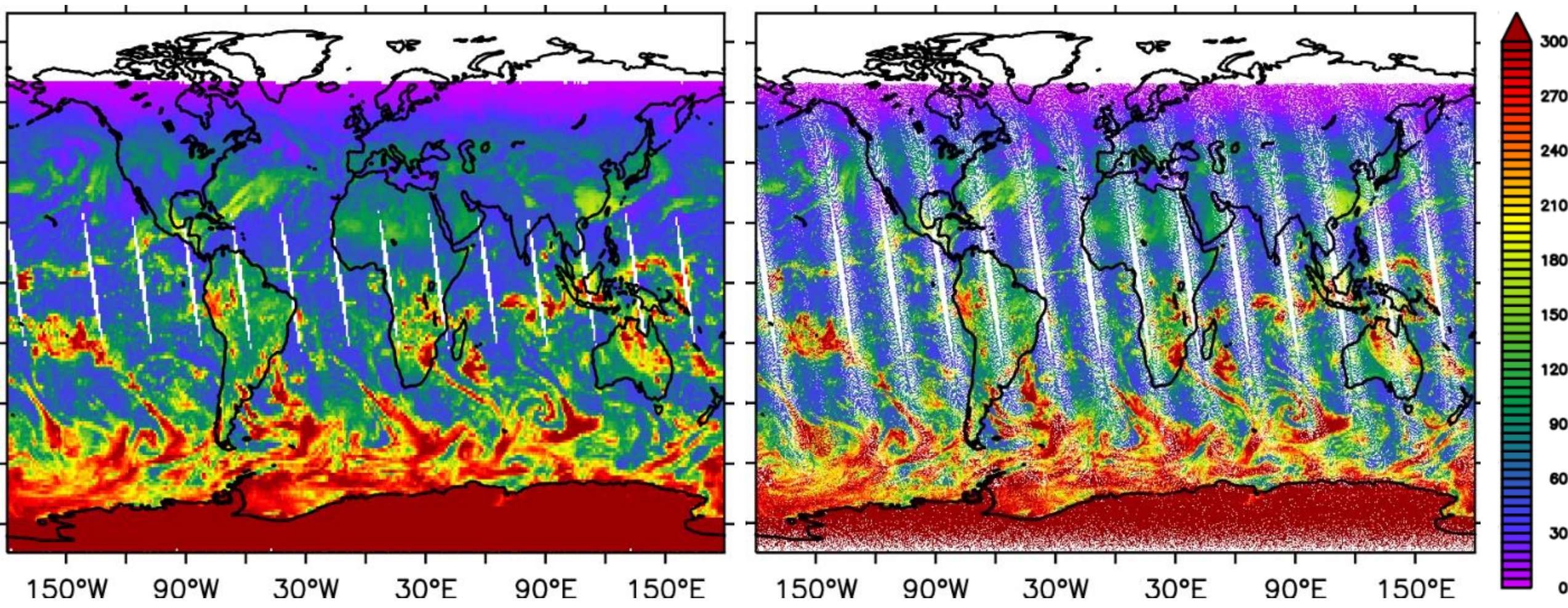


BIAS	STDEV.	RMSD
-3.84	10.54	11.22

# SW MLF (5 January 2010) : 1 deg vs 0.25 deg

MLF all-sky 1deg

MLF all-sky 0.25deg



# Summary

- A new methodology was developed to estimate the CERES-like MLF TISA daily and monthly mean fluxes from MLF instantaneous dataset
- The fluxes estimated from Monthly mean climatological directional albedo (CERES-like model) are close to those from CERES direct albedo models at the grid and for the month as expected.
- Daily mean all sky fluxes derived from the CERES-like monthly mean direct albedo model on instantaneous footprints are generally similar to those of SSF1deg despite some data processing procedure differences. Monthly mean and standard differences are about  $\pm 0.5$  W/m<sup>2</sup> and  $< 4$  W/m<sup>2</sup>, respectively.
- The standard differences for clear sky SW flux estimates between CERES-like and SSF1deg are larger ( $\sim 19$  W/m<sup>2</sup>) due to different approaches.
- **Future work:**
  - Process 20-years of CERES-like MLF TISA data and compare to the SSF1deg monthly global means to verify the stability of the MLR product
  - Prepare the MLF TISA algorithm for production software by the CERES DMT.
  - Add finer spatial resolution data such as 0.25° gridded fluxes into CERES production family

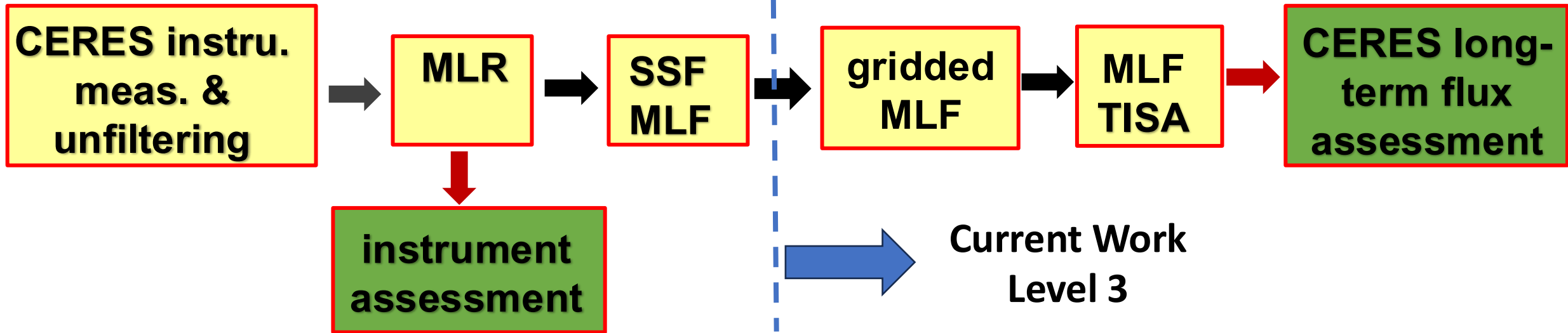
# Backup slides

# CERES-like ML Data product: Level 2 & 3 data

## Machine Learning algorithm, data products and objective

### ML radiance & flux

### MLF TISA



- MLR software, data processing and documentation were completed previously
- MLF software, data processing and testing have been completed during this period
- TISA from MLF for gridded daily, monthly, yearly meand: tested, and ongoing for massive data production
- Final production at ASDC (TBD)