

# Comparisons of CERES and ERA Interim TOA Radiative Fluxes

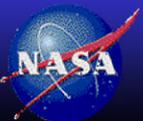
Takmeng Wong

NASA Langley Research Center, Hampton, Virginia

CERES Science Team Meeting

Newport News, Virginia

1-3 May, 2012

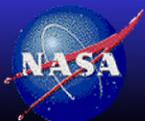


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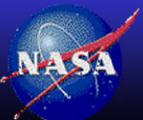
## Objective

- Compare the first decade of CERES EBAF TOA radiation budget data (March 2000 to February 2010) with ERA Interim Reanalysis Data
  - Longwave, shortwave, net (all-sky and clear-sky), solar incoming
  - Regional and global (90N to 90S) scale
  - 10-year climatology (average)
  - Interannual variability (2-sigma)
  - Deseasonalized time series (globe and tropics)



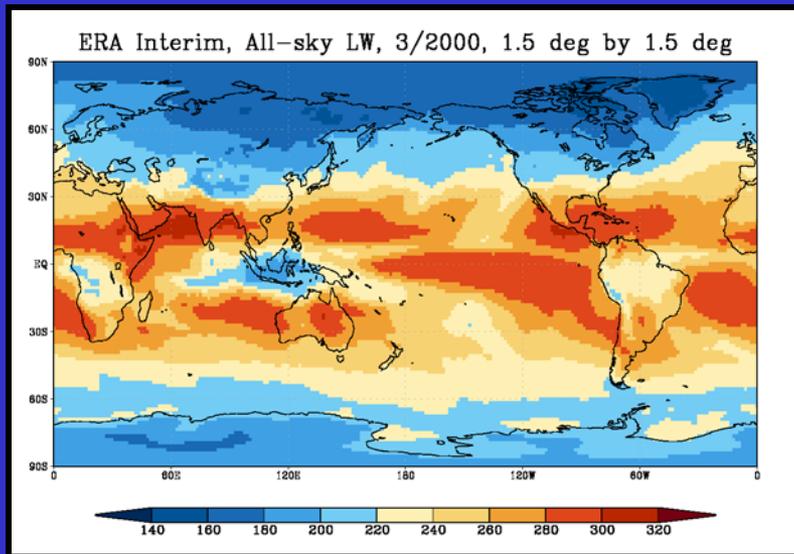
# Data Sets

- CERES EBAF Edition 2.6r Monthly Mean Data
  - 1 degree by 1 degree equal angle global grid in NetCDF format
  - Obtained from CERES data website  
[http://ceres.larc.nasa.gov/order\\_data.php](http://ceres.larc.nasa.gov/order_data.php)
- ERA Interim Reanalysis Monthly Mean Data
  - 1.5 degree by 1.5 degree equal angle global grid in NetCDF format
  - Obtained from ECMWF ERA Interim data website  
[http://data-portal.ecmwf.int/data/d/interim\\_mnth/](http://data-portal.ecmwf.int/data/d/interim_mnth/)
  - ERA Interim has an error in solar incoming ( $\sim 3 \text{ Wm}^{-2}$  too high)  
<http://www.ecmwf.int/research/era/do/get/index/QualityIssues>

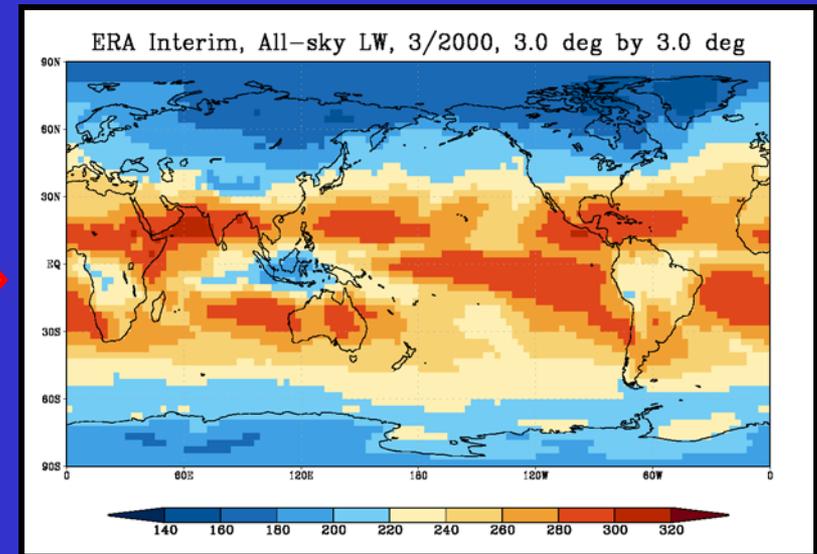
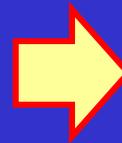


# Data Regridding

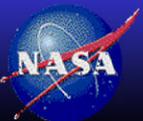
- CERES and ERA Interim data are regridded to a 3 degree by 3 degree grid to facilitate comparison of these data sets
- Re-gridding is done using weighted-average procedure to minimize re-gridding noise and to preserve the quality of the global mean values



ERA Interim, Original Data



ERA Interim, Regridded Data



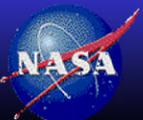
## Data Regridding (Continue)

- Regridded data have the exact same global mean values as the original data; very similar but slightly smaller spatial variability

### ERA Interim 10-year Climatology (March 2000 to February 2010)

ERA Interim	Original Mean	Original 1- $\sigma$	Regridded Mean	Regridded 1- $\sigma$
Solar Inc.	<b>344.2*</b>	<b>88.8</b>	<b>344.2*</b>	<b>88.4</b>
All-sky LW	<b>245.7</b>	<b>37.1</b>	<b>245.7</b>	<b>36.7</b>
All-sky SW	<b>99.8</b>	<b>16.5</b>	<b>99.8</b>	<b>15.8</b>
All-sky Net	<b>-1.3</b>	<b>61.5</b>	<b>-1.3</b>	<b>61.1</b>
Clr-sky LW	<b>264.0</b>	<b>40.9</b>	<b>264.0</b>	<b>40.4</b>
Clr-sky SW	<b>53.7</b>	<b>28.0</b>	<b>53.7</b>	<b>27.4</b>
Clr-sky Net	<b>26.5</b>	<b>70.4</b>	<b>26.5</b>	<b>70.0</b>

\* *ERA Interim has an error in the solar incoming ( $\sim 3 \text{ Wm}^{-2}$  too high)*  
(<http://www.ecmwf.int/research/era/do/get/index/QualityIssues>)



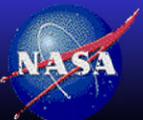
## ERA Interim Solar Correction

- Apply simple solar correction factor (1365/1377) to solar incoming and reflected SW; recalculate Net using these two new values

### ERA Interim 10-year Climatology (March 2000 to February 2010)

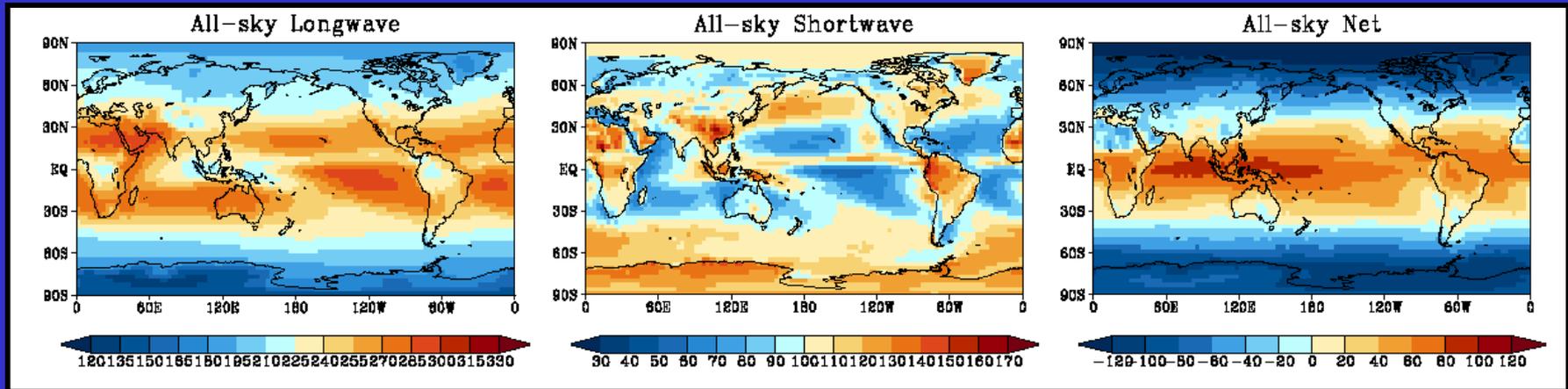
ERA-Interim	Uncorrected Mean	Uncorrected 1- $\sigma$	Corrected Mean	Corrected 1- $\sigma$
Solar Inc.	<b>344.2*</b>	<b>88.4</b>	<b>341.2</b>	<b>87.6</b>
All-sky LW	<b>245.7</b>	<b>36.7</b>	<b>245.7</b>	<b>36.7</b>
All-sky SW	<b>99.8</b>	<b>15.8</b>	<b>98.9</b>	<b>15.7</b>
All-sky Net	<b>-1.3</b>	<b>61.1</b>	<b>-3.4</b>	<b>60.3</b>
Clr-sky LW	<b>264.0</b>	<b>40.4</b>	<b>264.0</b>	<b>40.4</b>
Clr-sky SW	<b>53.7</b>	<b>27.4</b>	<b>53.2</b>	<b>27.2</b>
Clr-sky Net	<b>26.5</b>	<b>70.0</b>	<b>24.0</b>	<b>69.1</b>

\* *ERA Interim has an error in the solar incoming ( $\sim 3 \text{ Wm}^{-2}$  too high)*  
(<http://www.ecmwf.int/research/era/do/get/index/QualityIssues>)

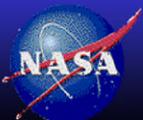
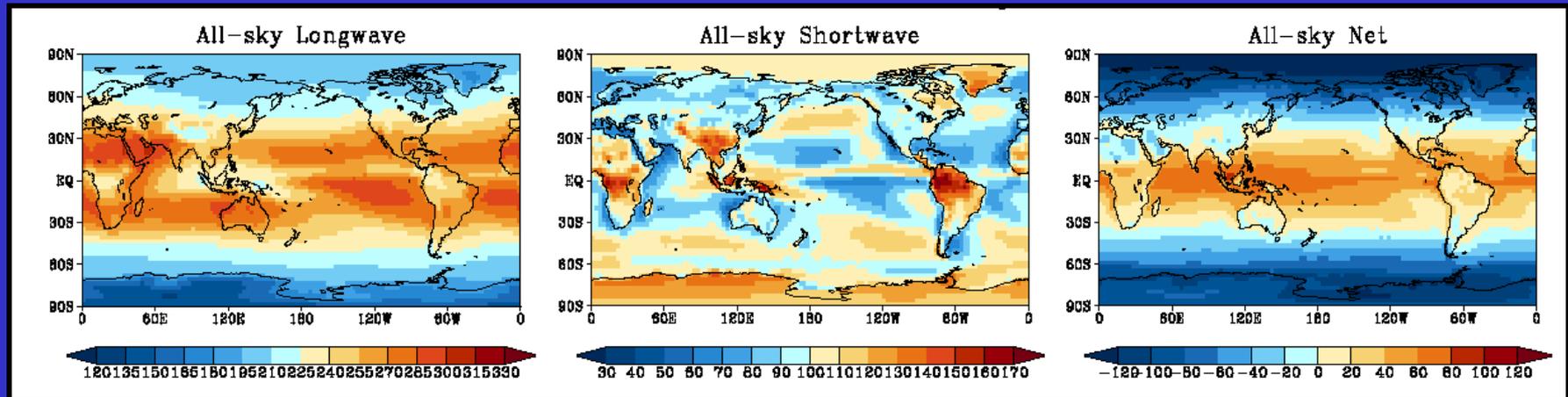


# All-sky TOA Climatology (3/2000 to 2/2010)

CERES EBAF Ed2.6r



ERA Interim

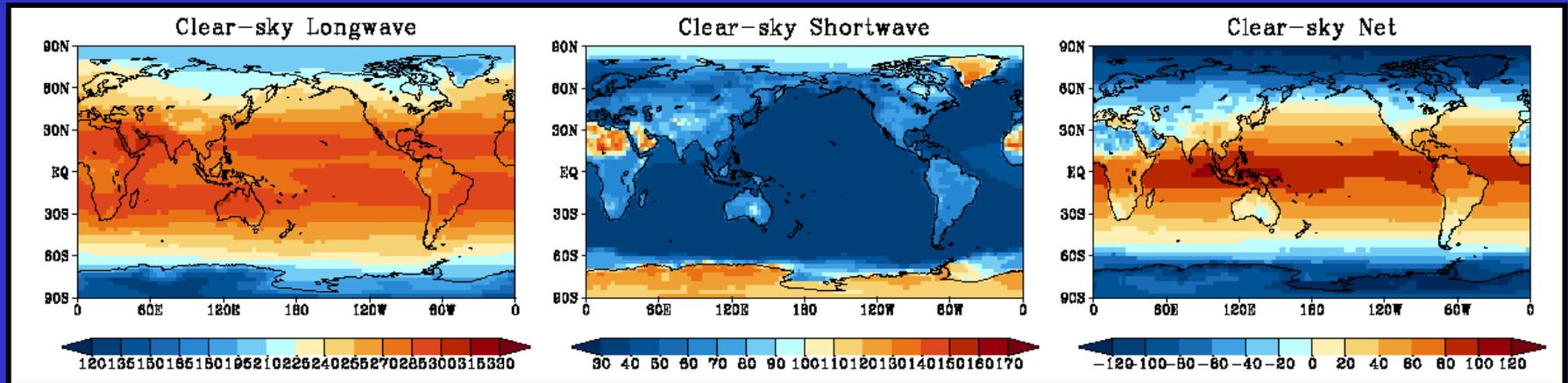


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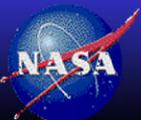
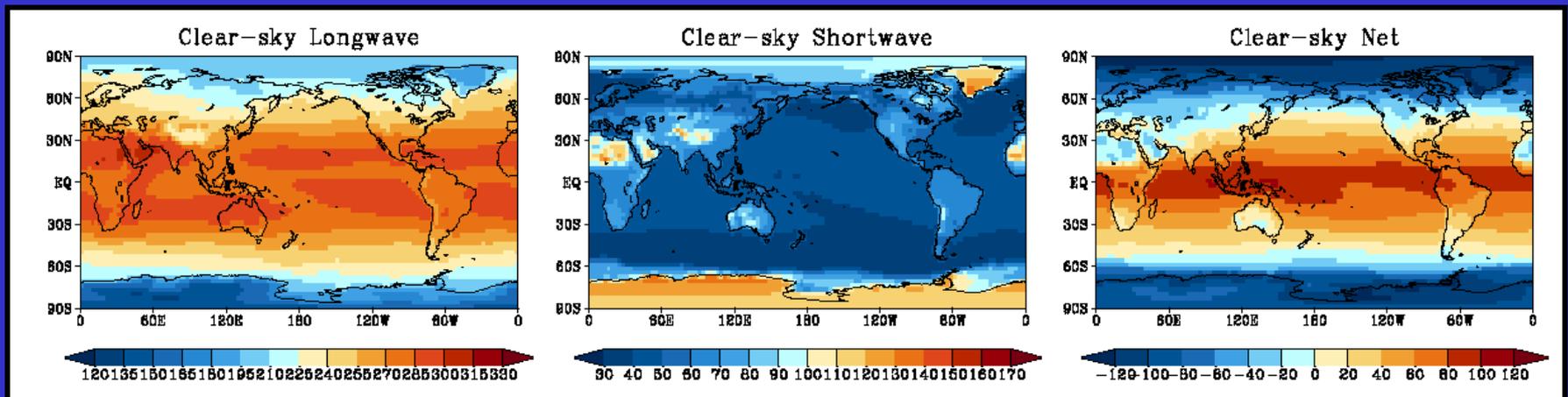


# Clear-sky TOA Climatology (3/2000 to 2/2010)

CERES EBAF Ed2.6r



ERA Interim

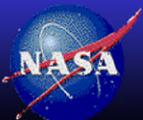
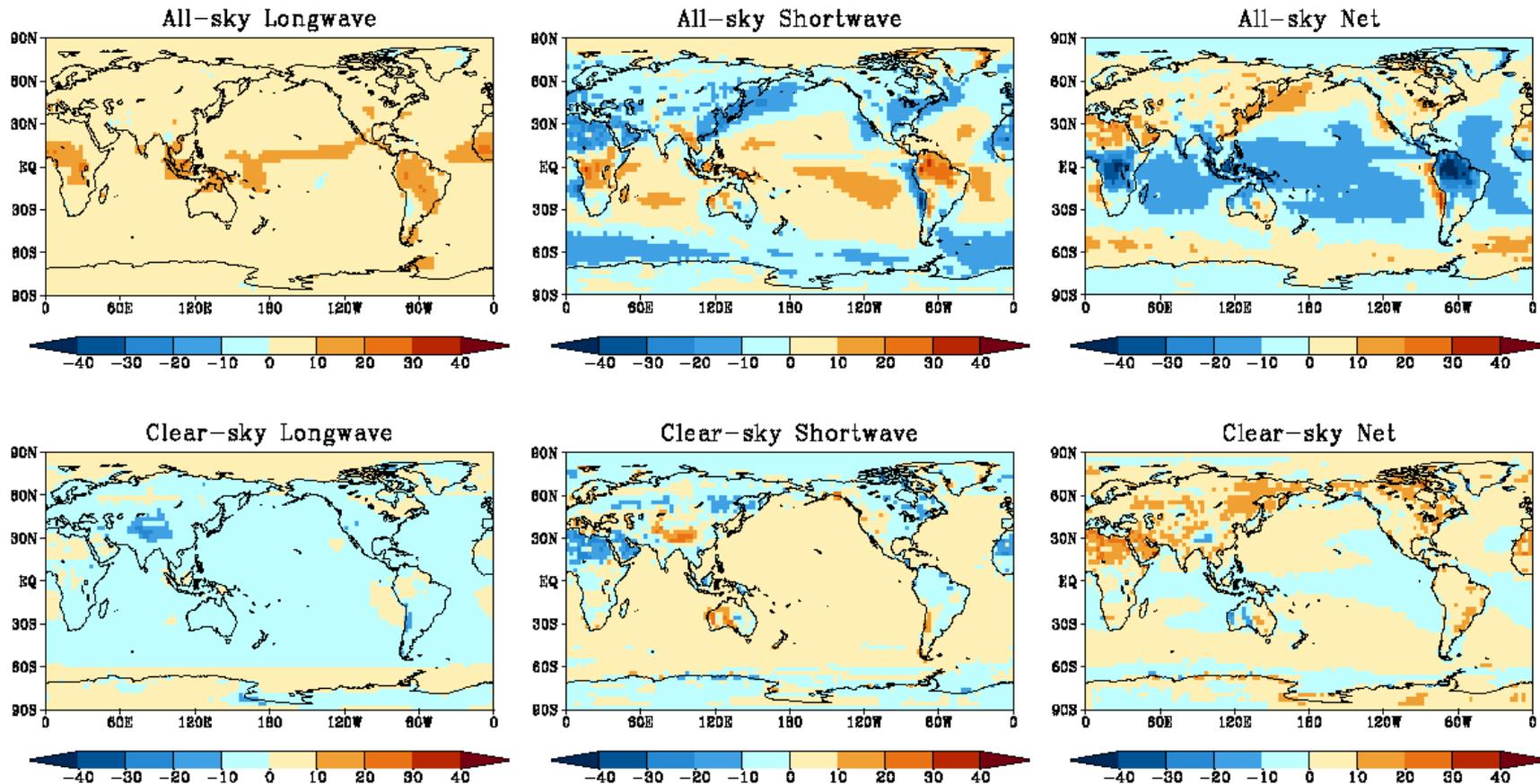


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# ERA Interim Minus CERES TOA Differences

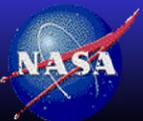
ERA Interim Minus CERES EBAF Ed2.6r, 10-year Climatology  
March 2000 to February 2010



## Global (90NS) Mean Comparison

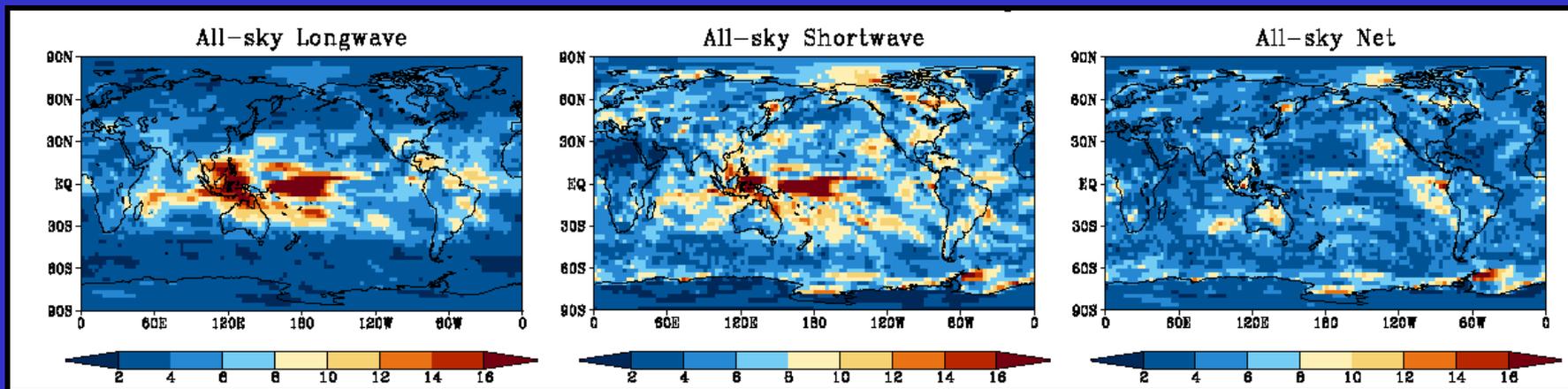
Parameters (Wm <sup>-2</sup> )	ERA Int. 10y-avg	CERES 10y-avg	Mean Diff. ERA-Ceres	ERA Int 2-σ	CERES 2-σ
Solar Incoming	<b>341.2</b>	<b>339.9</b>	1.3 (0.4%)	0.01	0.23
Longwave	<b>245.7</b>	<b>239.6</b>	6.1 (2.5%)	0.80	0.52
Shortwave	<b>98.9</b>	<b>99.7</b>	-0.8 (-0.8%)	0.74	0.46
Net	<b>-3.4</b>	<b>0.6</b>	-4.0 (-667%)	0.62	0.54
Clear Longwave	<b>264.0</b>	<b>265.8</b>	-1.8 (-0.7%)	0.48	0.53
Clear Shortwave	<b>53.2</b>	<b>52.5</b>	0.7 (1.3%)	0.23	0.24
Clear Net	<b>24.0</b>	<b>21.6</b>	2.4 (11.1%)	0.40	0.34

- All-sky: ERA Interim has higher global mean values of Solar incoming and outgoing LW; but lower values of SW and Net
- Clear-sky: ERA Interim has lower global mean values of outgoing LW ; but higher values of SW and Net

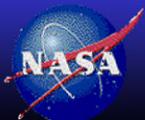
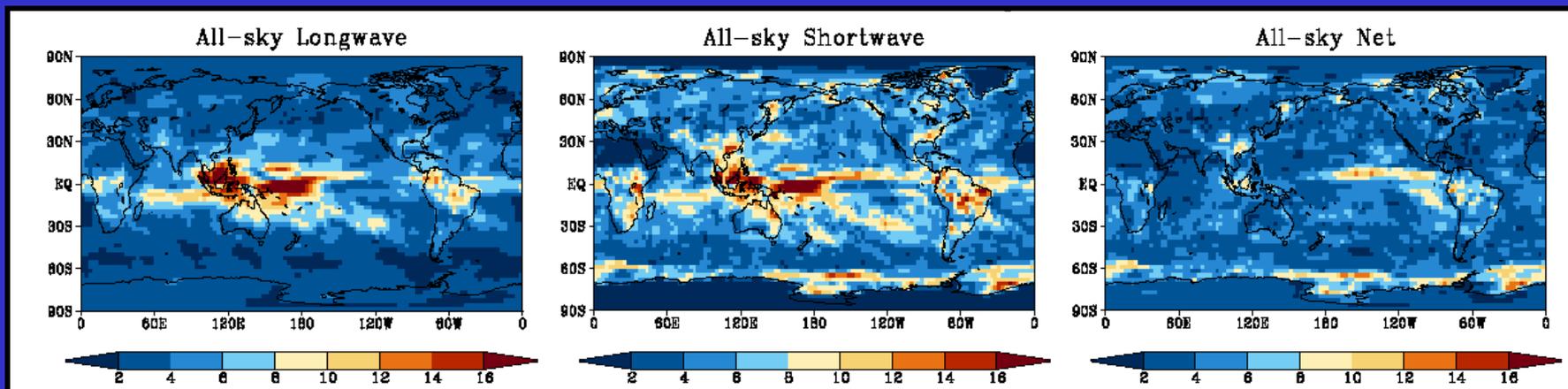


# All-sky TOA Interannual Variability

CERES EBAF Ed2.6r



ERA Interim

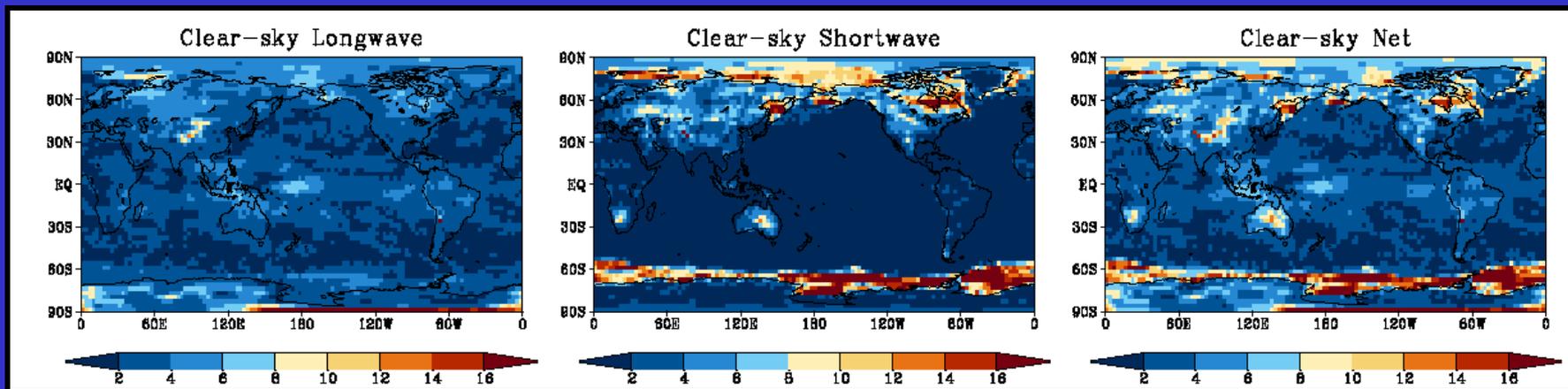


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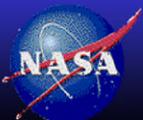
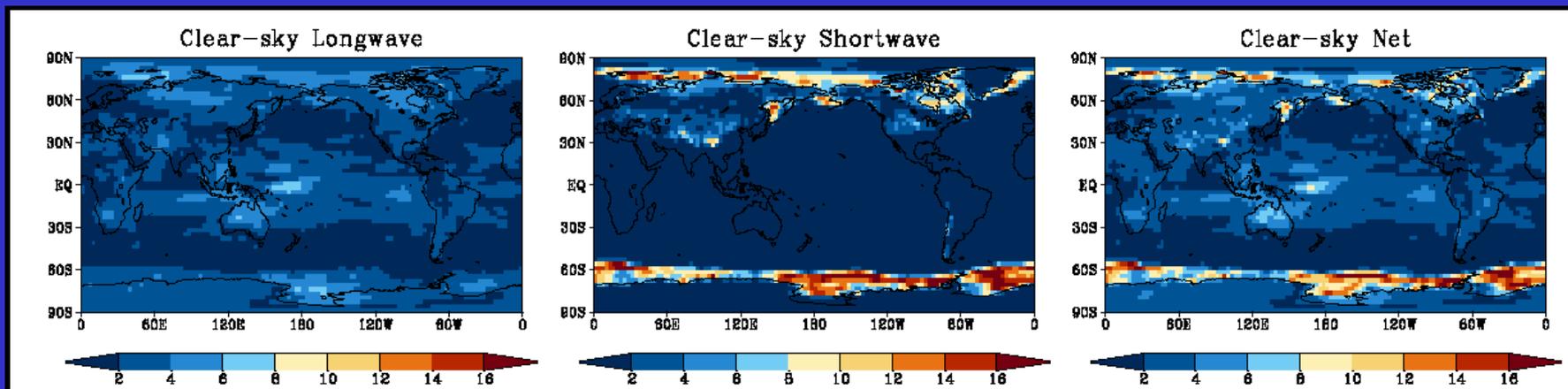


# Clear-sky TOA Interannual Variability

CERES EBAF Ed2.6r



ERA Interim



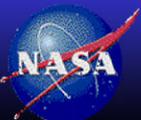
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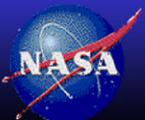
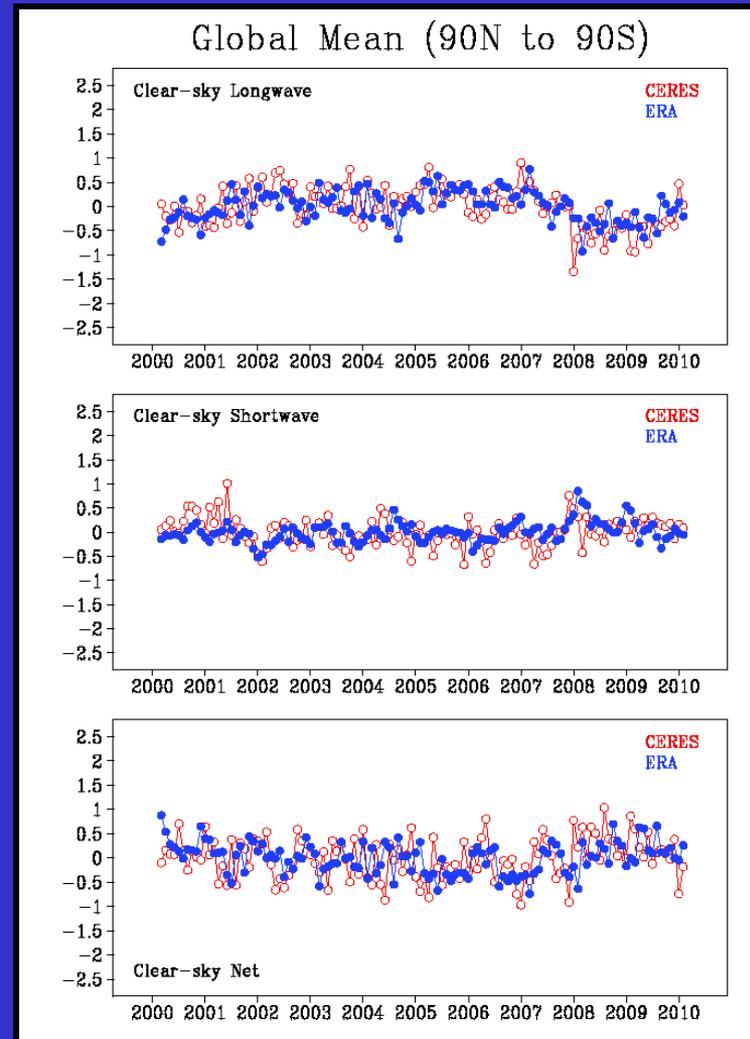
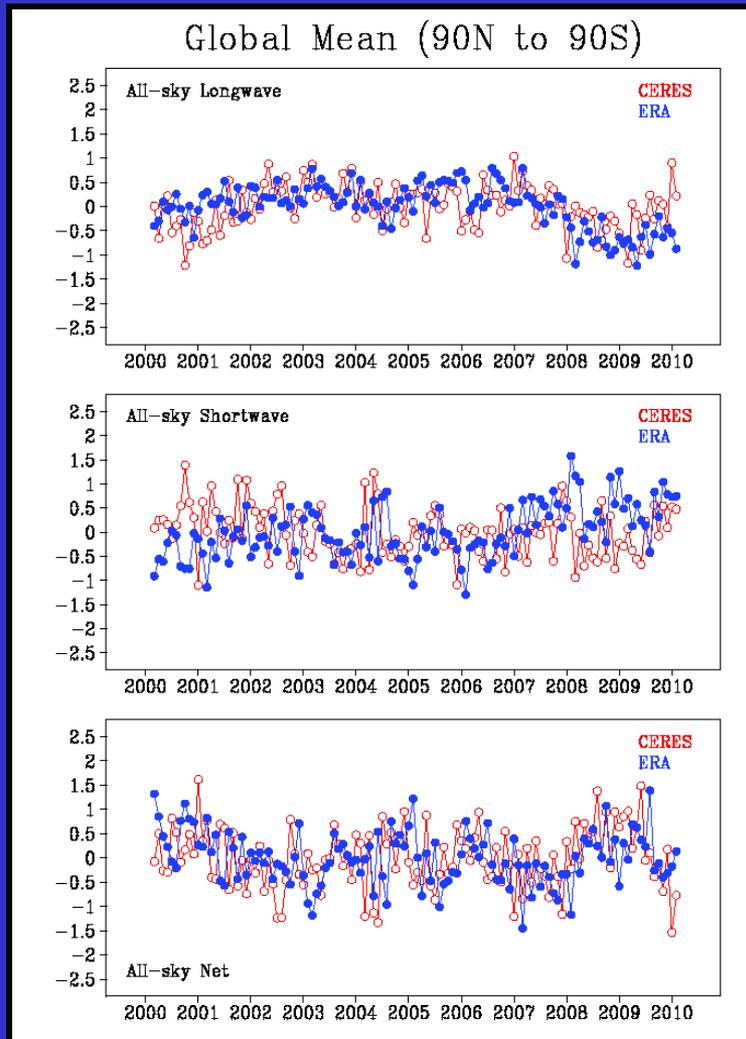
## Global (90NS) Mean and Interannual Variability

Parameters (Wm <sup>-2</sup> )	ERA Int. 10y-avg	CERES 10y-avg	Mean Diff. ERA-Ceres	ERA Int 2-σ	CERES 2-σ
Solar Incoming	<b>341.2</b>	<b>339.9</b>	1.3 (0.4%)	<b>0.01</b>	<b>0.23</b>
Longwave	<b>245.7</b>	<b>239.6</b>	6.1 (2.5%)	<b>0.80</b>	<b>0.52</b>
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Net	<b>-3.4</b>	<b>0.6</b>	-4.0 (-667%)	<b>0.62</b>	<b>0.54</b>
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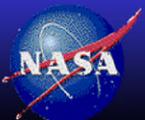
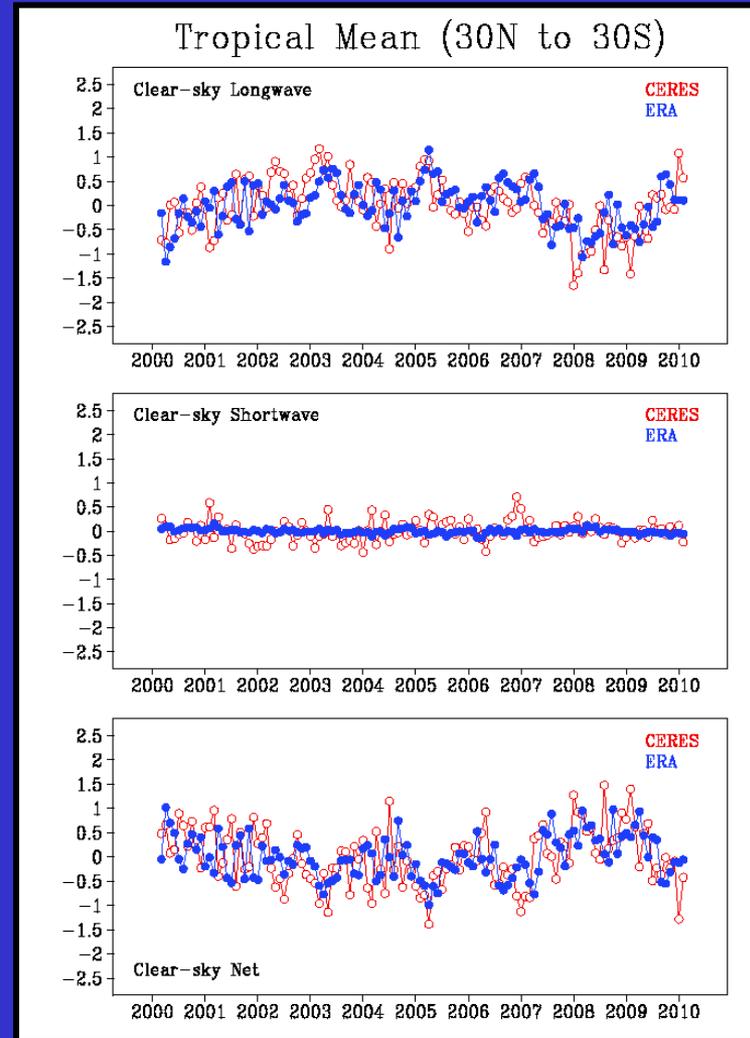
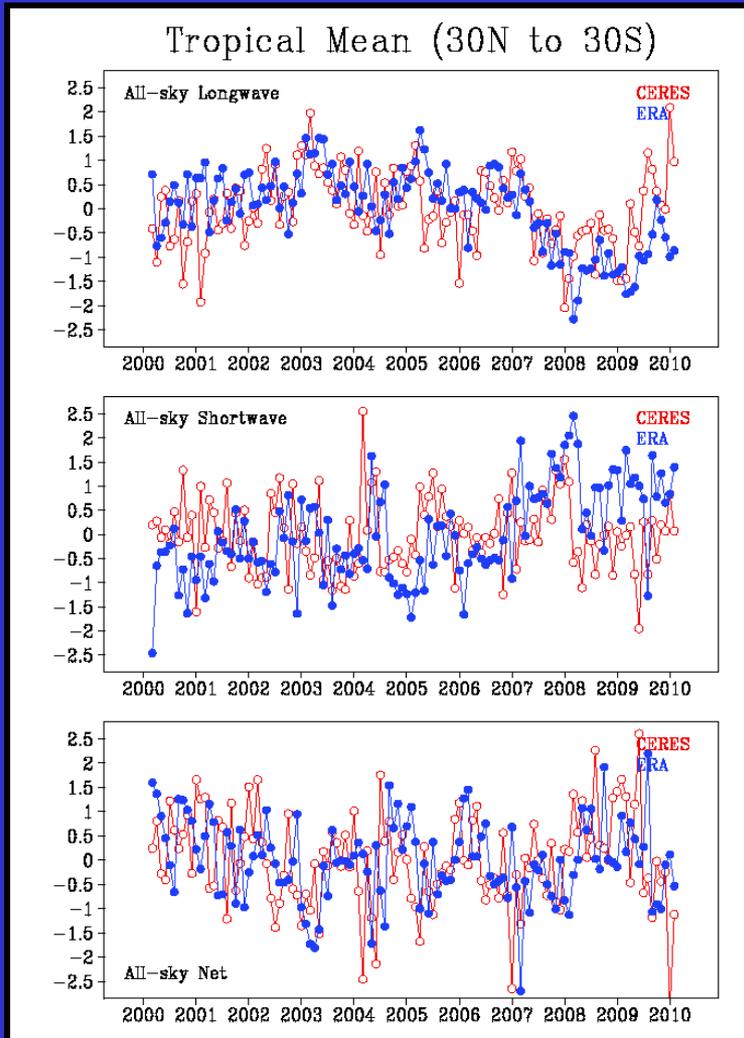
- ERA Interim has slightly higher interannual variability of all-sky fluxes; but slightly lower interannual variability of clear-sky fluxes
- ERA Interim uses a constant solar irradiance value while CERES uses a time varying solar irradiance observations from SORCE



# Global Mean Deseasonalized Time Series



# Tropical Mean Deseasonalized Time Series



## Summary

- ERA Interim has an error in the solar incoming; simple correction is developed to remove this error; which also affected SW and Net
- ERA Interim uses a constant solar irradiance value. CERES EBAF uses a time varying solar irradiance from SORCE with a solar constant  $\sim 1361$ . This leads to differences in solar incoming fluxes for both mean and interannual variability
- ERA Interim global mean all-sky longwave are much higher than CERES values (global mean by  $6 \text{ Wm}^{-2}$ ). This contributed to the large difference in global mean Net when compared to CERES
- ERA Interim 10-year global mean all-sky Net is negative (losing energy) while the corresponding CERES value is positive (gaining energy)
- ERA Interim has slightly higher interannual variability of all-sky fluxes; but slightly lower interannual variability of clear-sky fluxes than CERES
- Global mean time series are very similar; There are some differences in times series in the beginning and the ending of the 10-year period

