Comparisons of Surface Radiative Fluxes between CERES EBAF and Reanalysis Data

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Objective

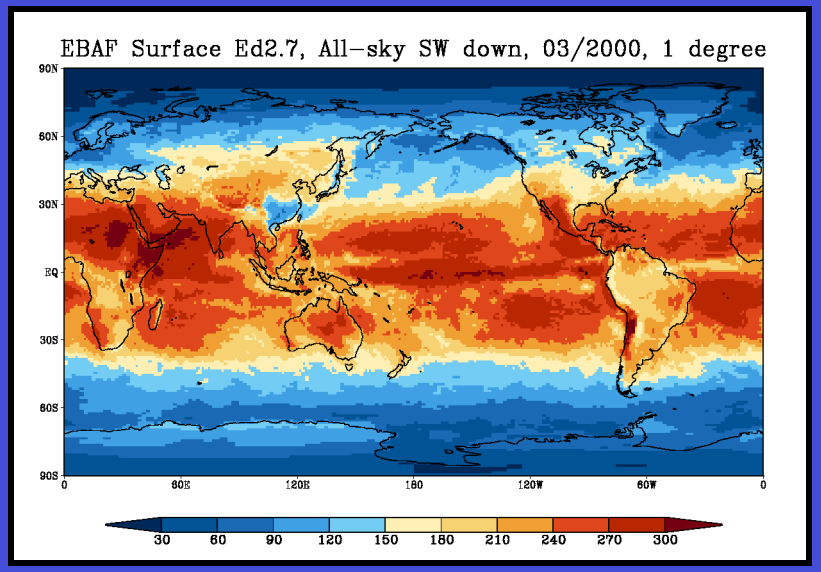
- Compare 12-year of CERES EBAF surface radiation data (March 2000 to February 2012) with ERA Interim Reanalysis Data
  - All-sky Longwave (down, up, net), shortwave (down, up, net), and total net
  - Regional and global (90N to 90S) scale
  - 12-year climatology (average)
  - Interannual variability (2-sigma)
  - Deseasonalized time series (globe and tropics)

Data Sets

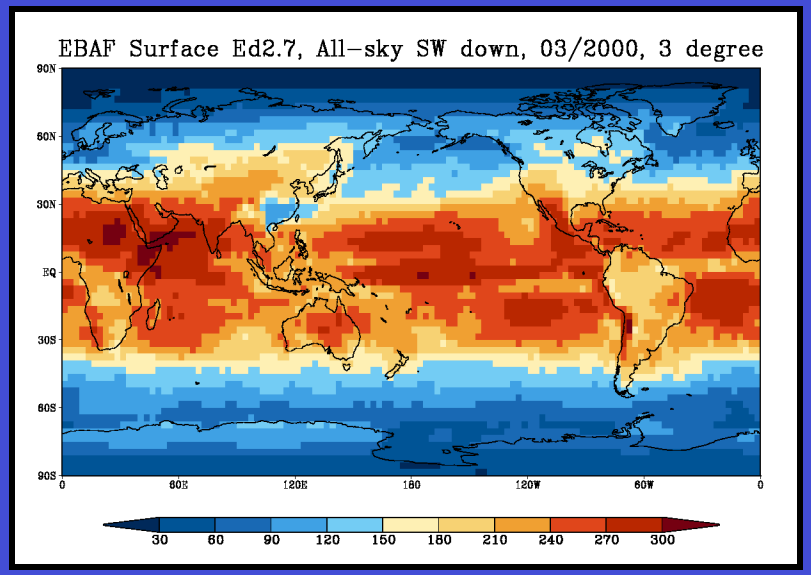
- Pre-release CERES EBAF Surface Edition 2.7 Monthly Mean Data
  - 1 degree by 1 degree equal angle global grid in NetCDF format
  - Obtained from CERES internal data website
- ERA Interim Reanalysis Monthly Mean Data
  - 1.5 degree by 1.5 degree equal angle global grid in NetCDF format
  - Obtained from ECMWF ERA Interim data website http://data-portal.ecmwf.int/data/d/interim_mnth/
  - ERA Interim has an error in TOA solar incoming (~3 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
- Regridding is done using weighted-average procedure to minimize regridding noise (no interpolation) and to preserve the quality of the global mean values



EBAF, Original Data



EBAF, Regridded Data

Data Regridding (Continue)

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

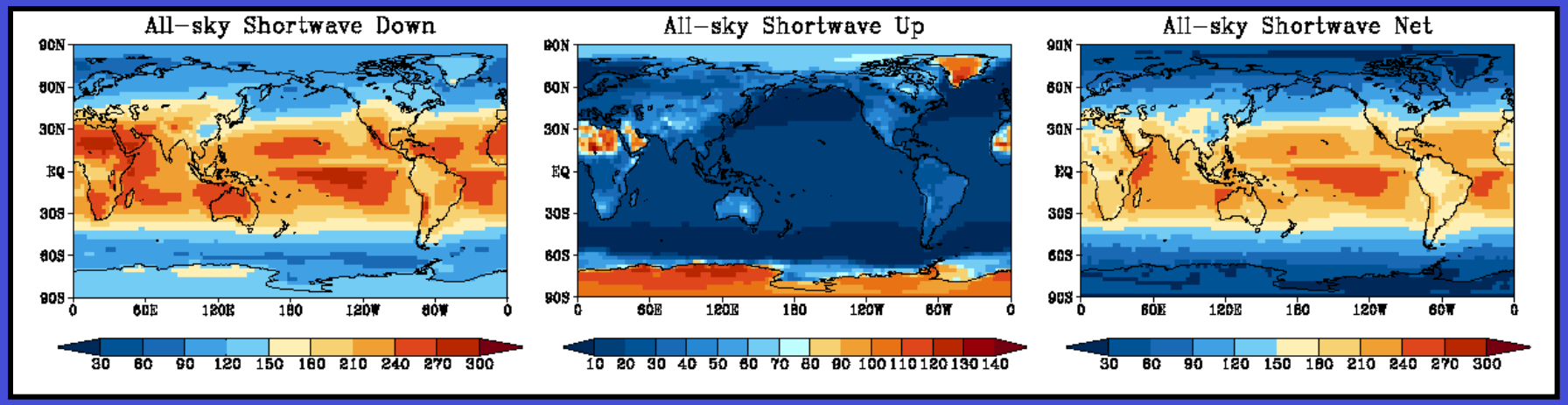
EBAF Surface 12-year Climatology (March 2000 to February 2012)

EBAF Surface	Original Mean*	Original 1-σ**	Regridded Mean*	Regridded 1-σ**
All-sky SW dn	186.6	57.6	186.6	57.4
All-sky SW up	24.1	33.0	24.1	32.6
All-sky SW net	162.5	72.9	162.5	72.7
All-sky LW dn	344.8	84.4	344.8	84.2
All-sky LW up	398.1	94.9	398.1	94.7
All-sky LW Net	-53.3	18.1	-53.3	17.7
All-sky Tot Net	109.2	62.4	109.2	62.2

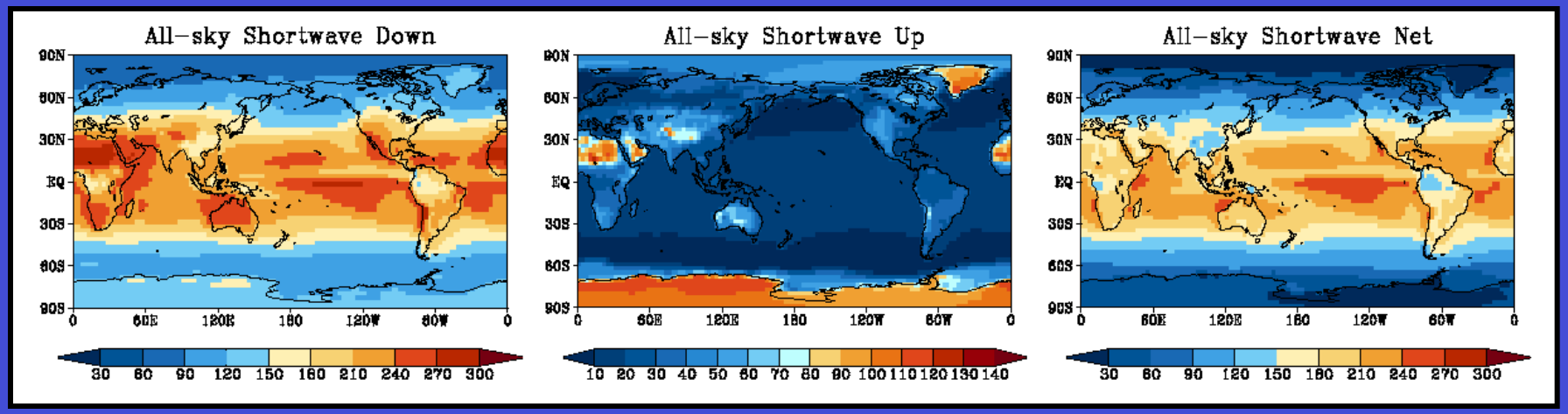
**with geodetic area weighting* ***without geodetic area weighting*

All-sky Surf. SW Climatology (3/2000 to 2/2012)

CERES EBAF Surface Ed2.7

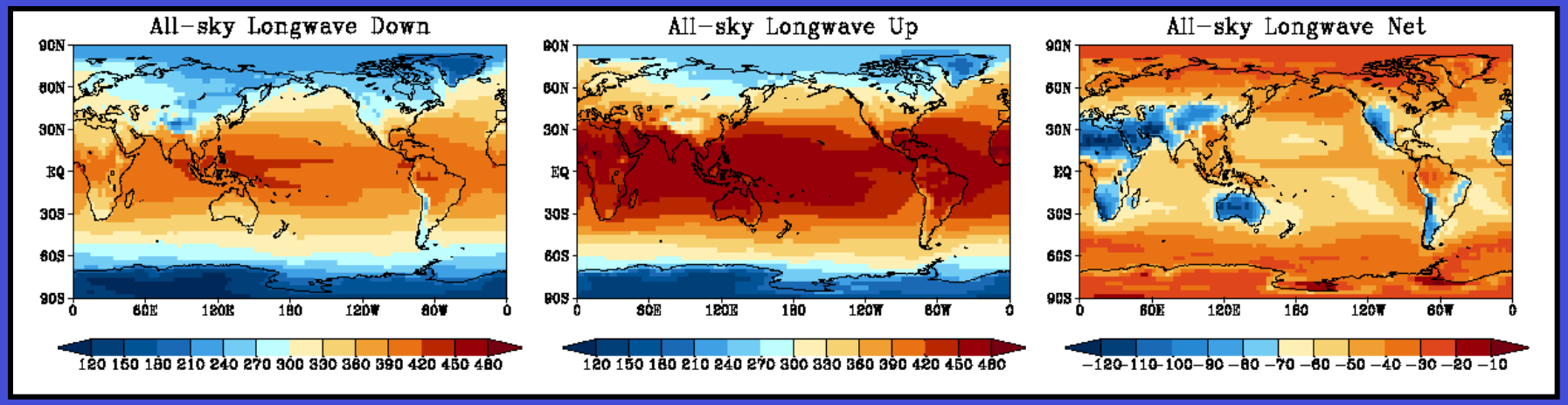


ERA Interim

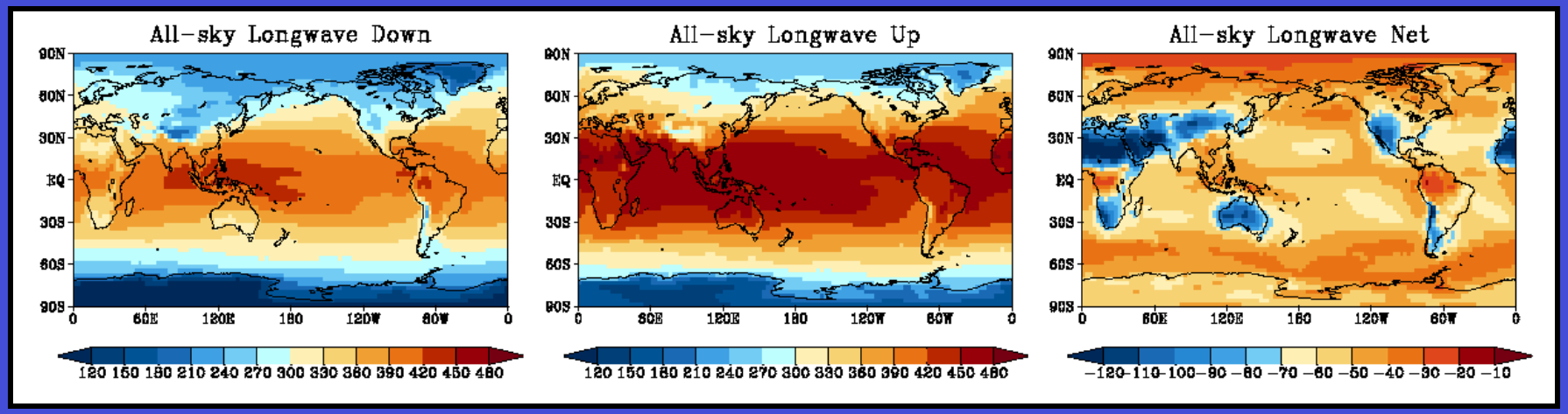


All-sky Surf. LW Climatology (3/2000 to 2/2012)

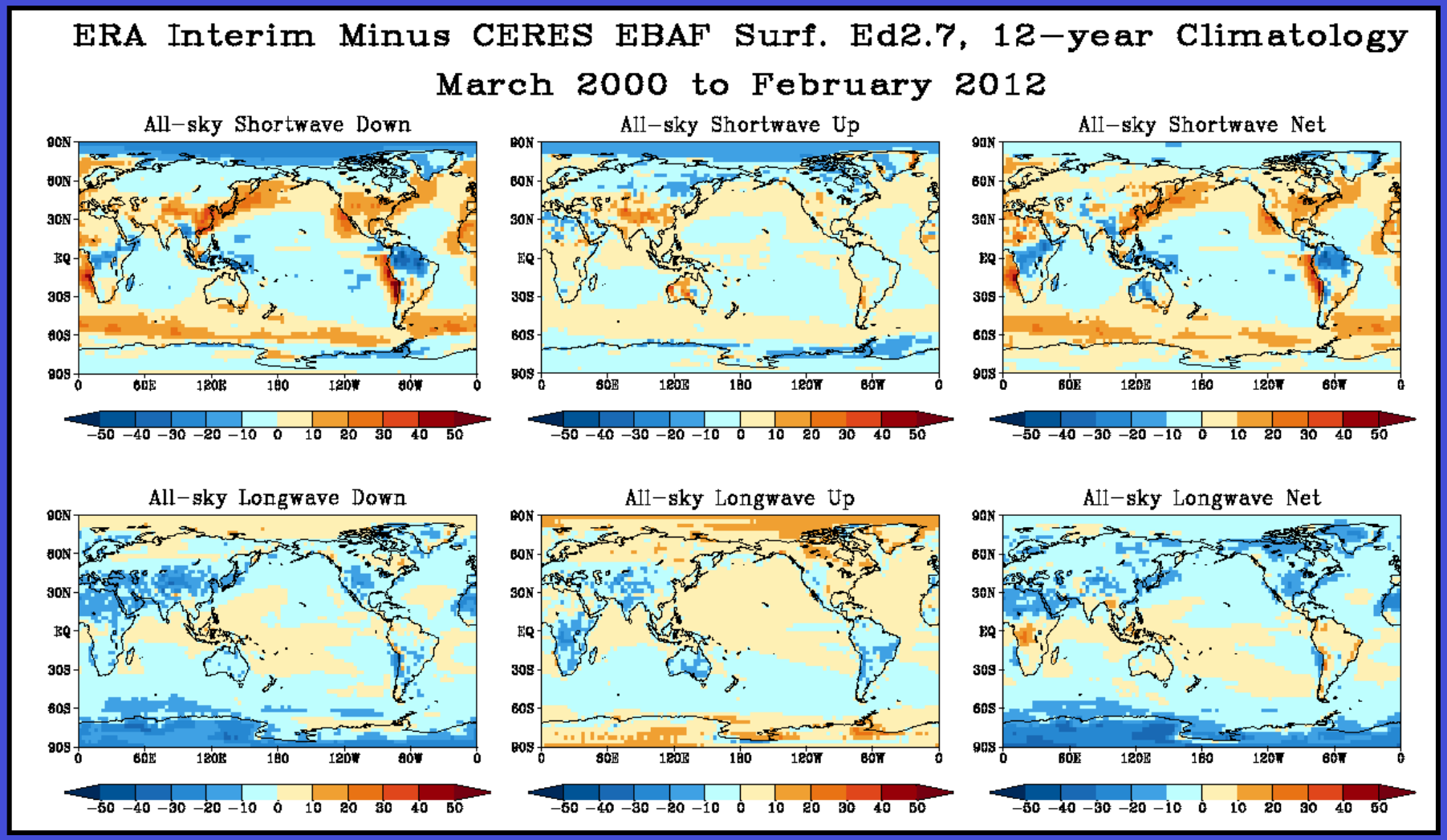
CERES EBAF Surface Ed2.7



ERA Interim



ERA Interim Minus CERES TOA Differences



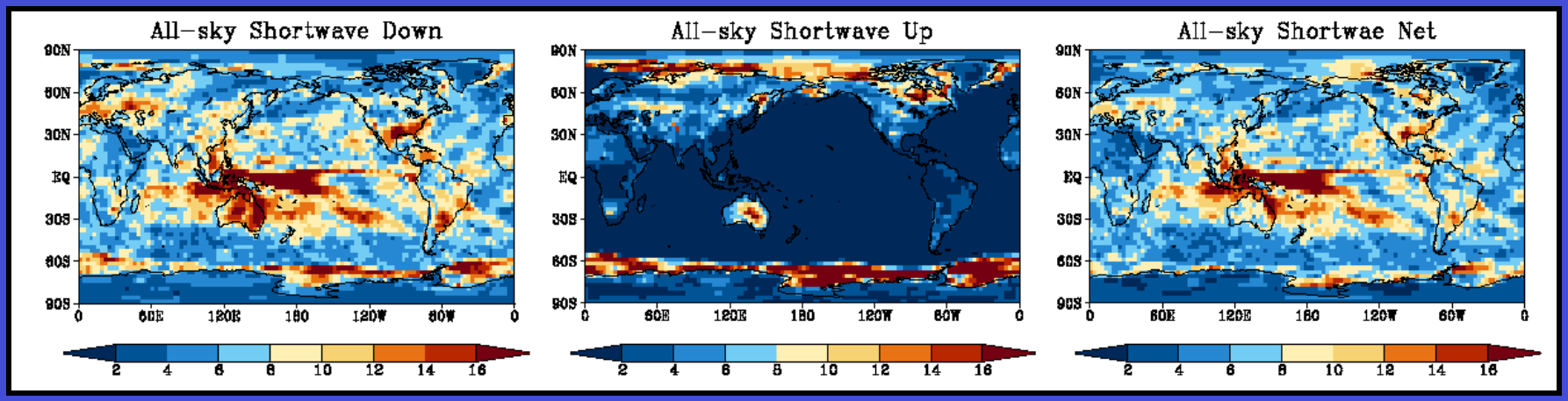
Global (90NS) Mean Comparison

Parameters (Wm^{-2})	ERA Int. 12y-avg	CERES 12y-avg	Mean Diff. ERA-CERES
All-sky SW dn	187.8	186.6	1.2 (0.6%)
All-sky SW up	23.8	24.1	-0.3 (-1.2%)
All-sky SW Net	164.0	162.5	1.5 (0.9%)
All-sky LW dn	341.7	344.8	-3.1 (-0.9%)
All-sky LW up	398.1	398.1	0.0 (0.0%)
All-sky LW Net	-56.4	-53.3	-3.1 (-5.8%)
All-sky Tot Net	107.6	109.2	-1.6 (-1.5%)

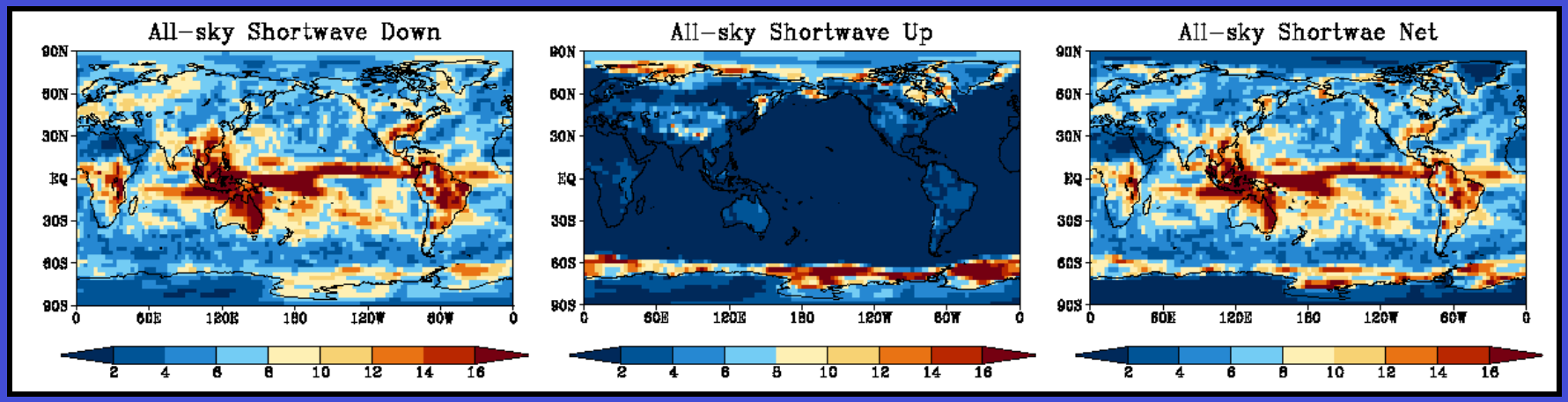
- All-sky: ERA Interim has higher global mean values of SW dn and SW Net; but lower values of LW dn, LW Net and Tot Net; SW up and LW up are nearly identical to CERES EBAF Surface data.

All-sky Surface SW Interannual Variability

CERES EBAF Surface Ed2.7

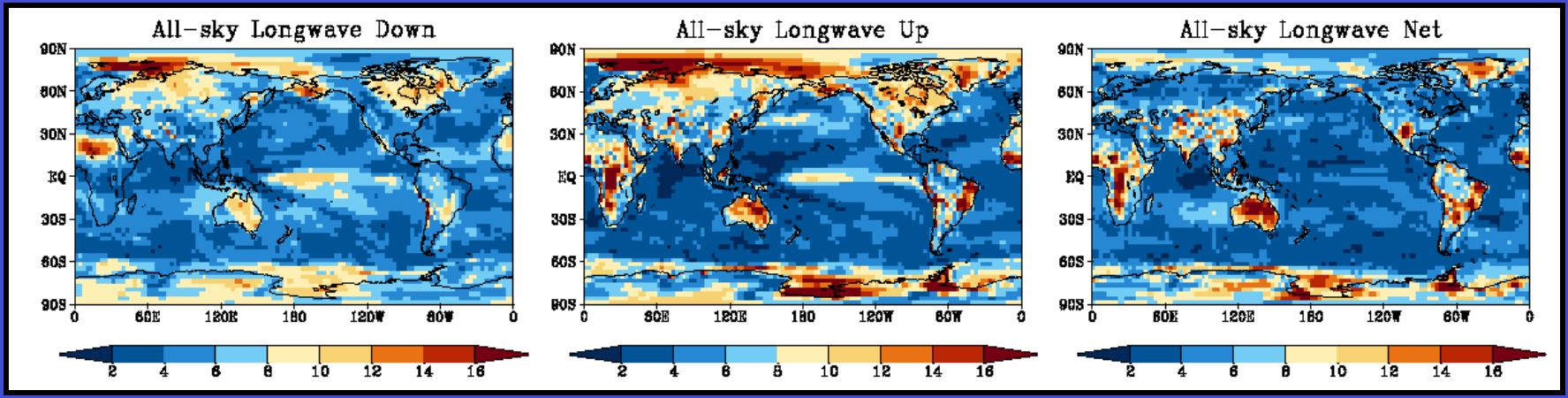


ERA Interim

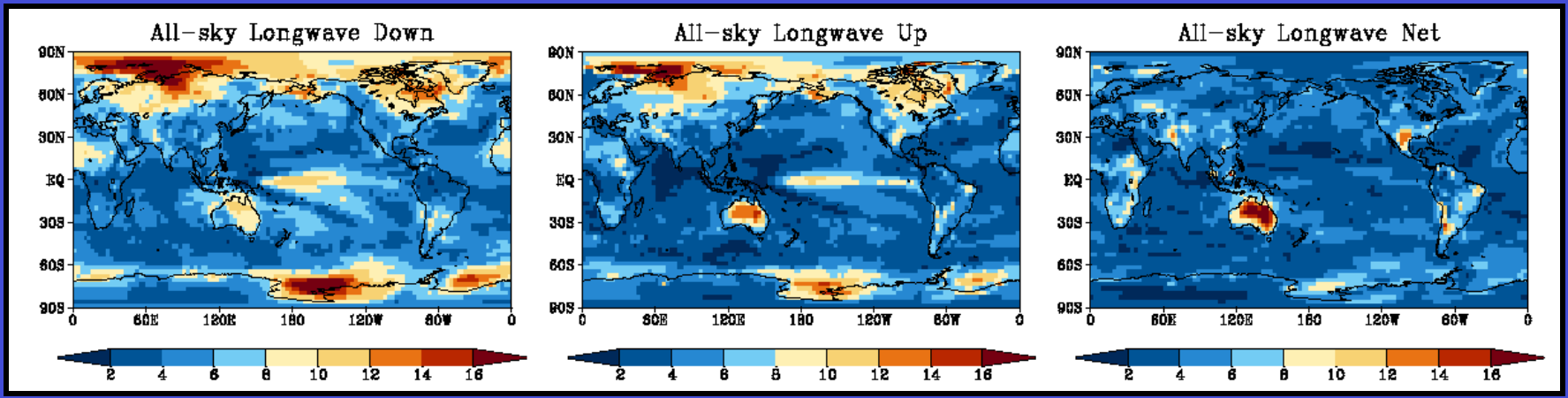


All-sky Surface LW Interannual Variability

CERES EBAF Surface Ed2.7



ERA Interim

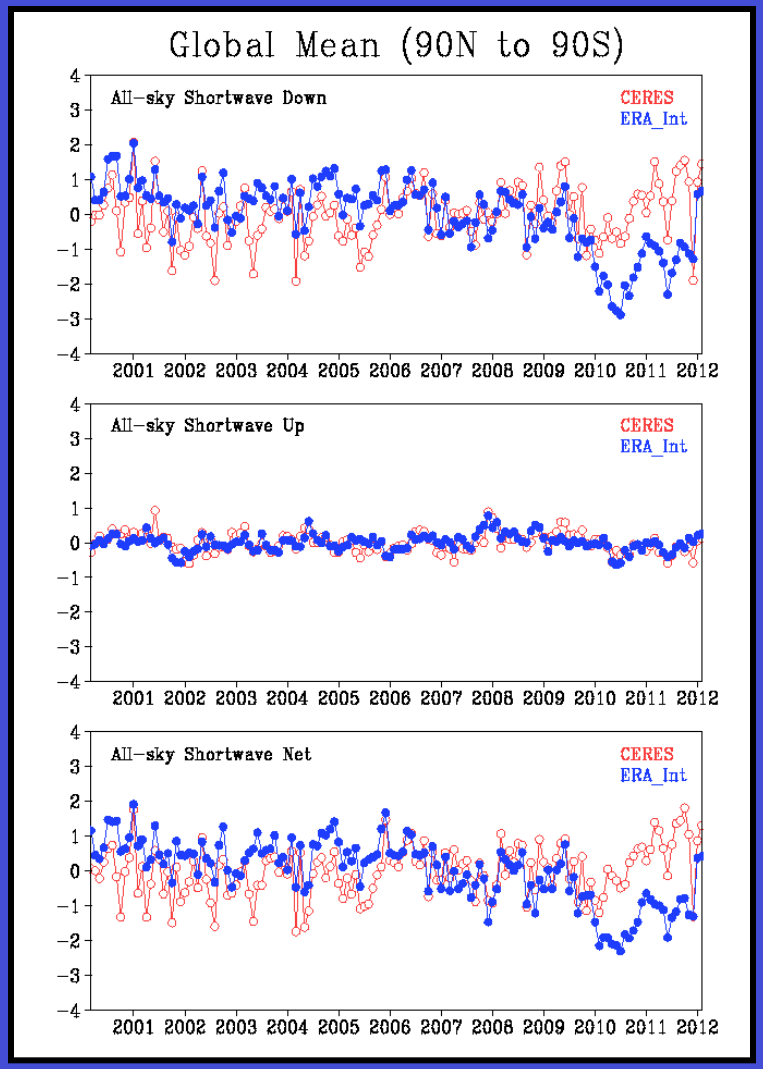


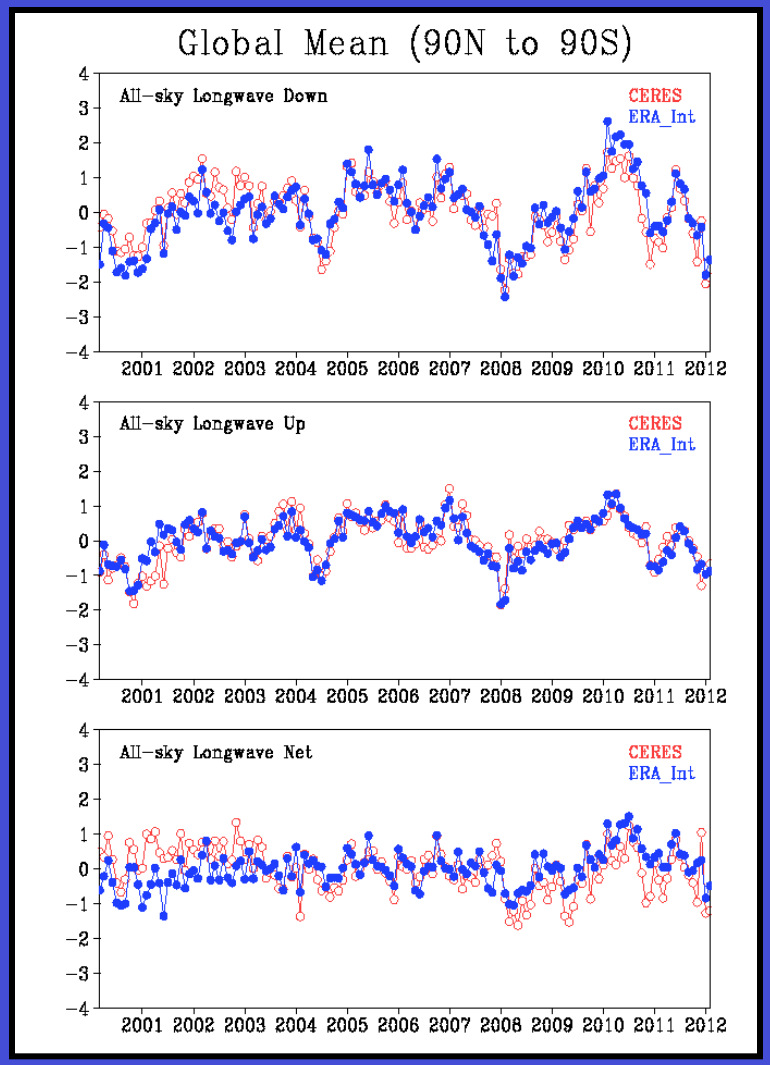
Global (90NS) Mean and Interannual Variability

Parameters (Wm^{-2})	ERA Int. 12y-avg	CERES 12y-avg	Mean Diff. ERA-CERES	ERA Int 2-σ	CERES 2-σ
All-sky SW dn	187.8	186.6	1.2 (0.6%)	1.60	0.66
All-sky SW up	23.8	24.1	-0.3 (-1.2%)	0.25	0.27
All-sky SW Net	164.0	162.5	1.5 (0.9%)	1.52	0.71
All-sky LW dn	341.7	344.8	-3.1 (-0.9%)	1.33	0.96
All-sky LW up	398.1	398.1	0.0 (0.0%)	0.88	0.83
All-sky LW Net	-56.4	-53.3	-3.1 (-5.8%)	0.65	0.65
All-sky Tot Net	107.6	109.2	-1.6 (-1.5%)	1.15	0.84

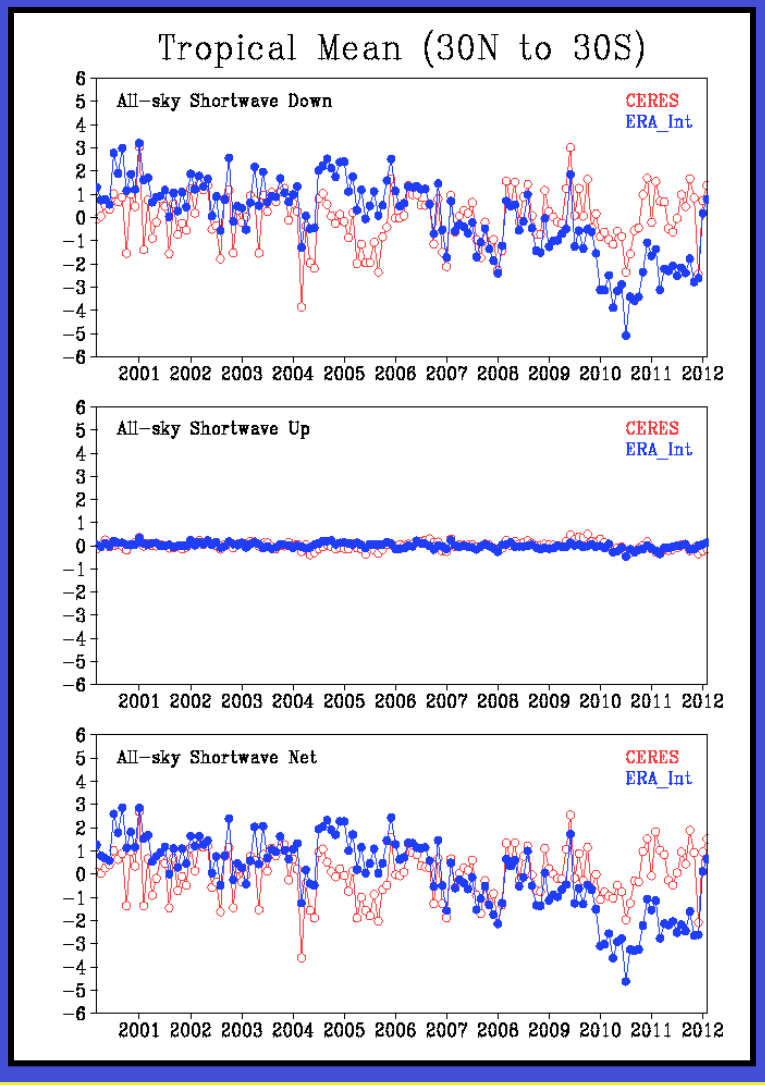
- ERA Interim has higher interannual variability of all-sky SW dn, SW Net, LW dn, Tot Net
- ERA Interim has lower interannual variability of all-sky LW Net

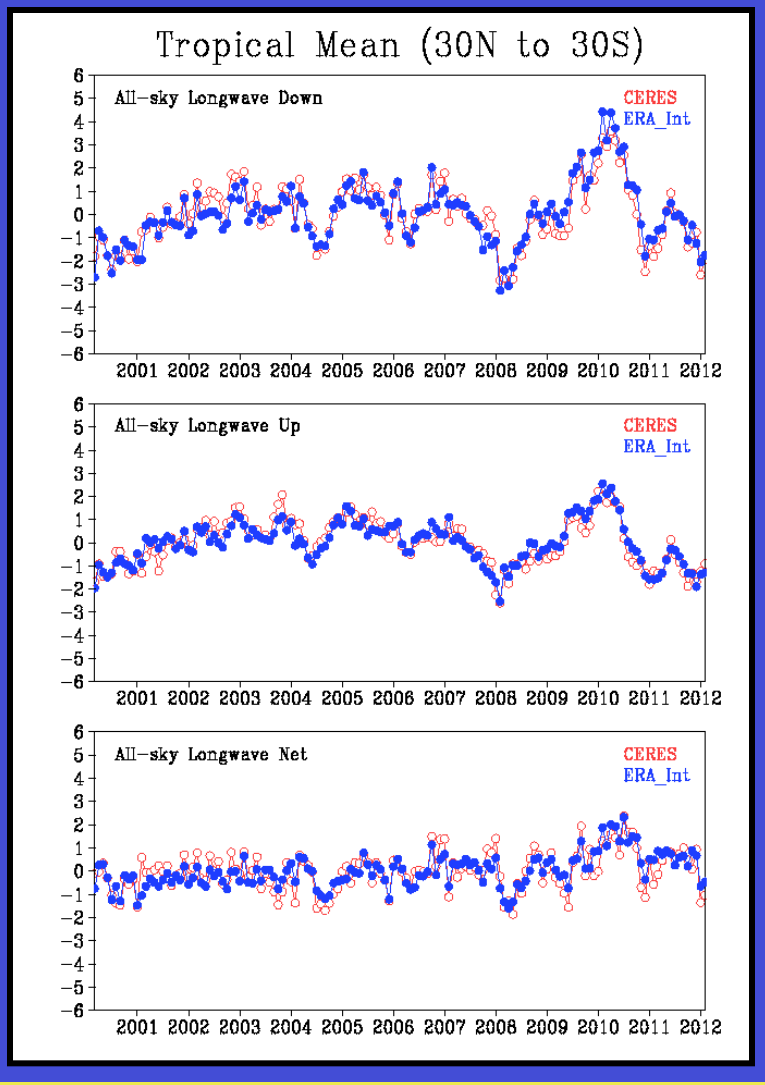
Global Mean Deseasonalized Time Series



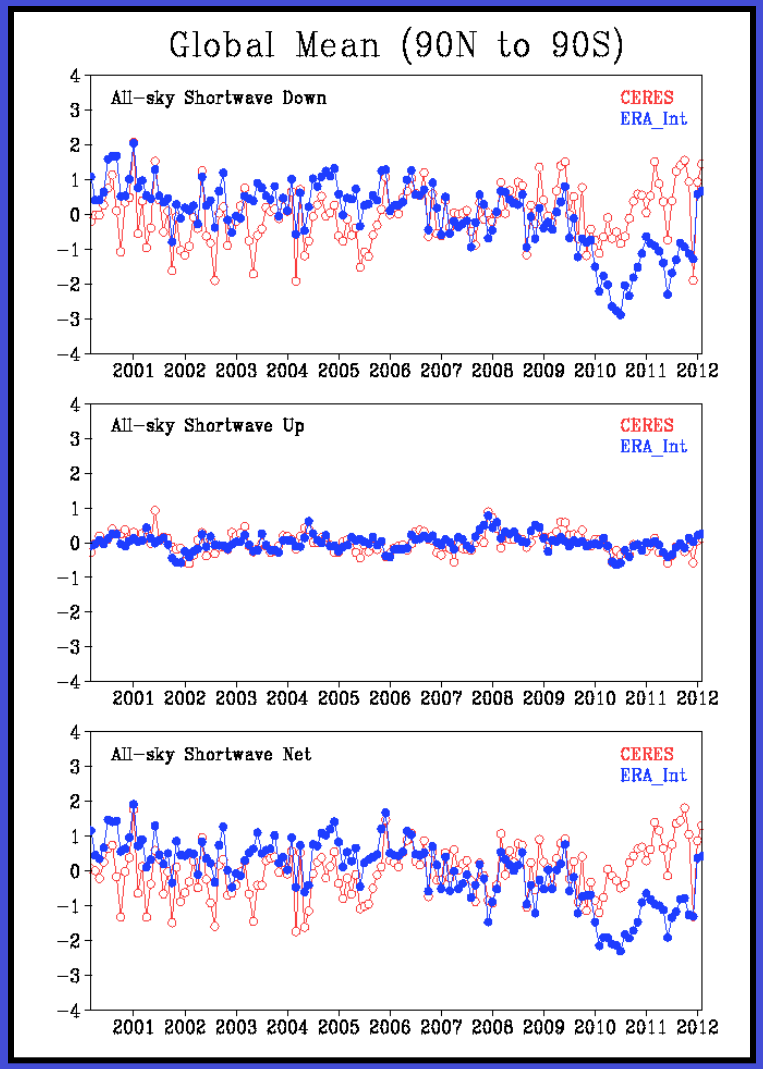


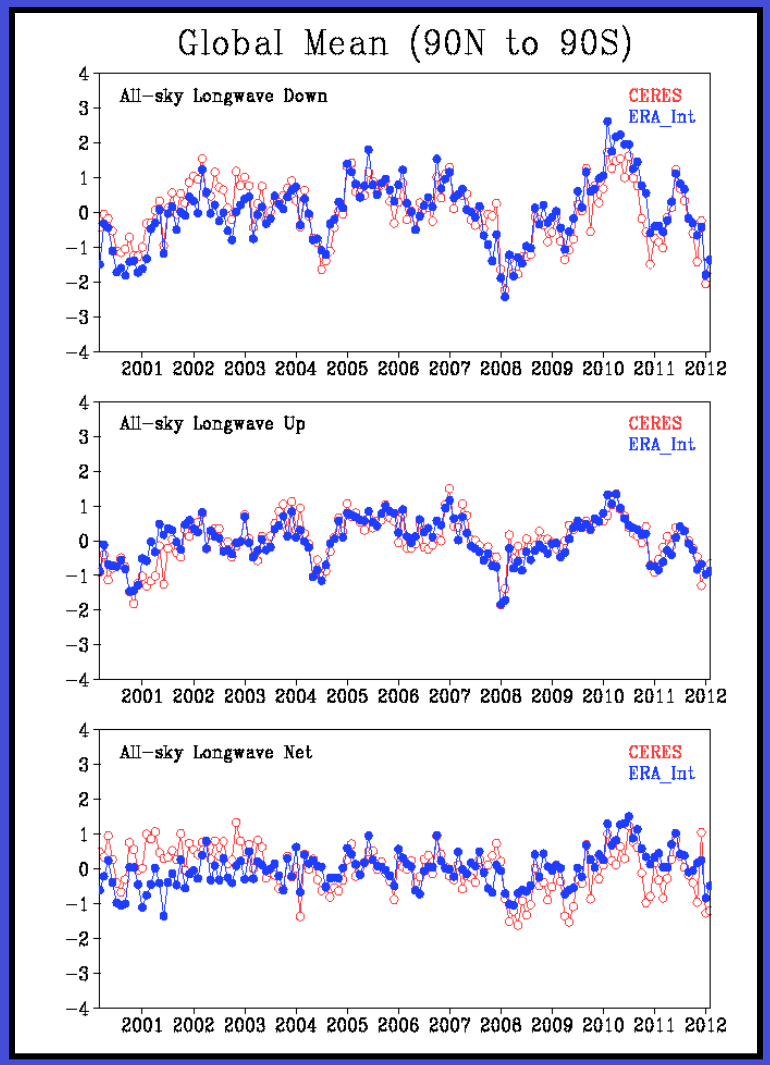
Tropical Mean Deseasonalized Time Series



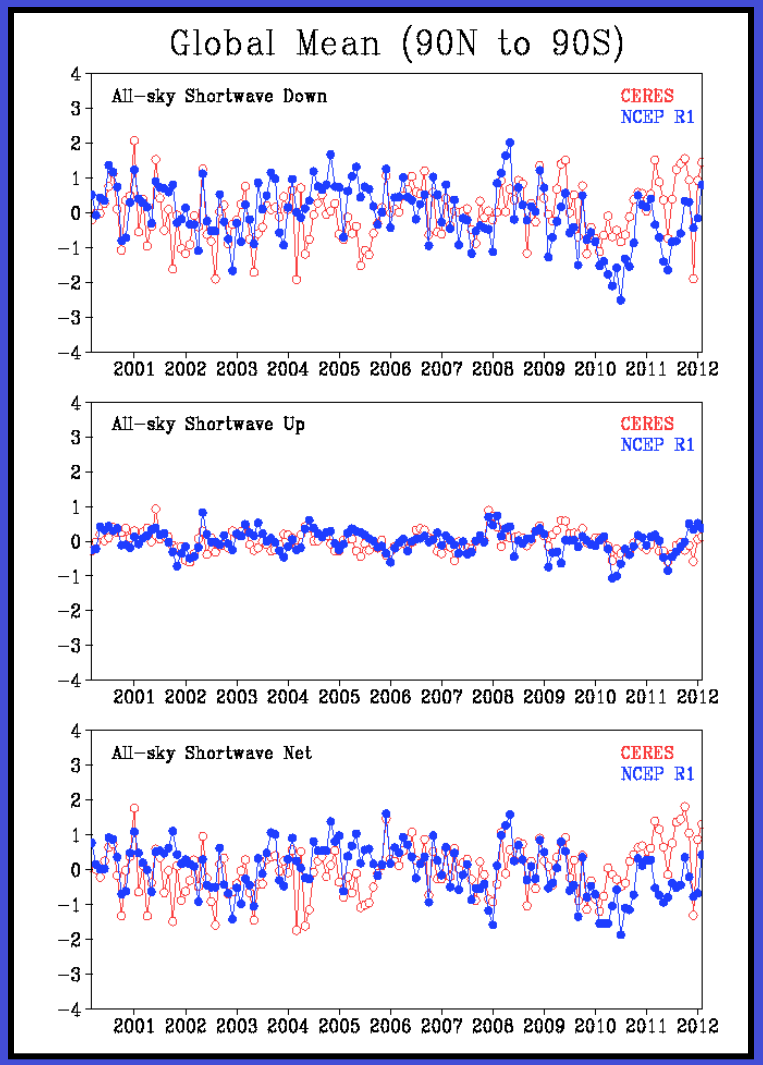


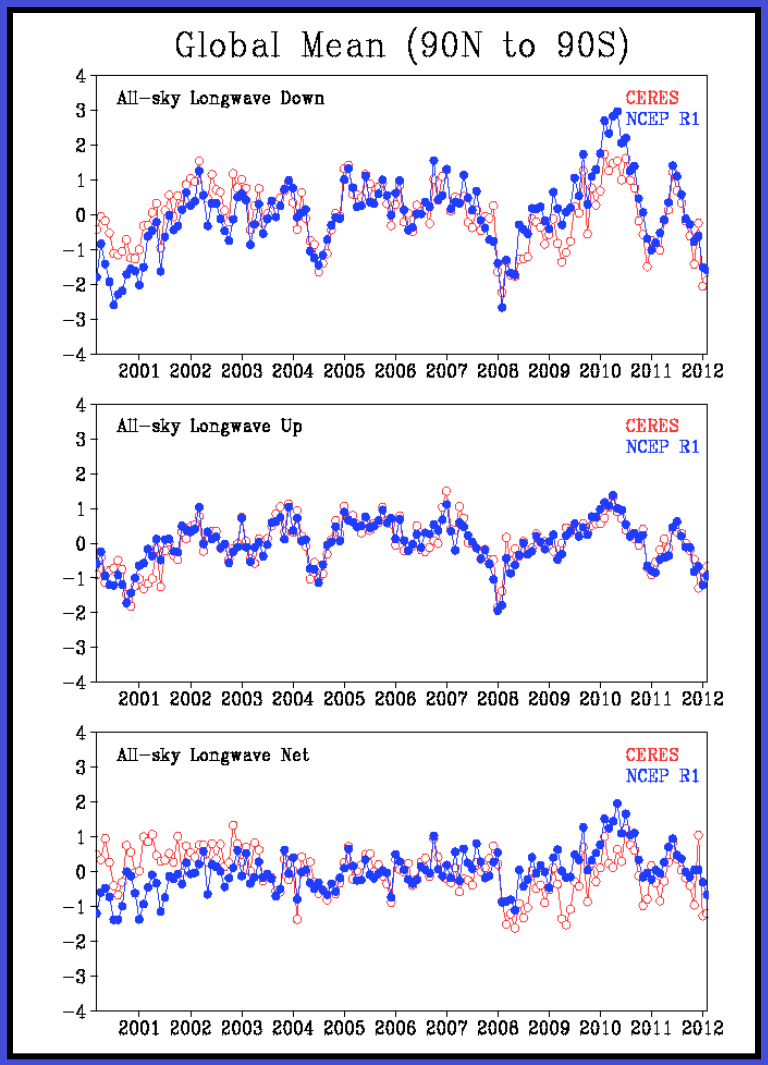
Deseasonalized Time Series (ERA-I vs. CERES)



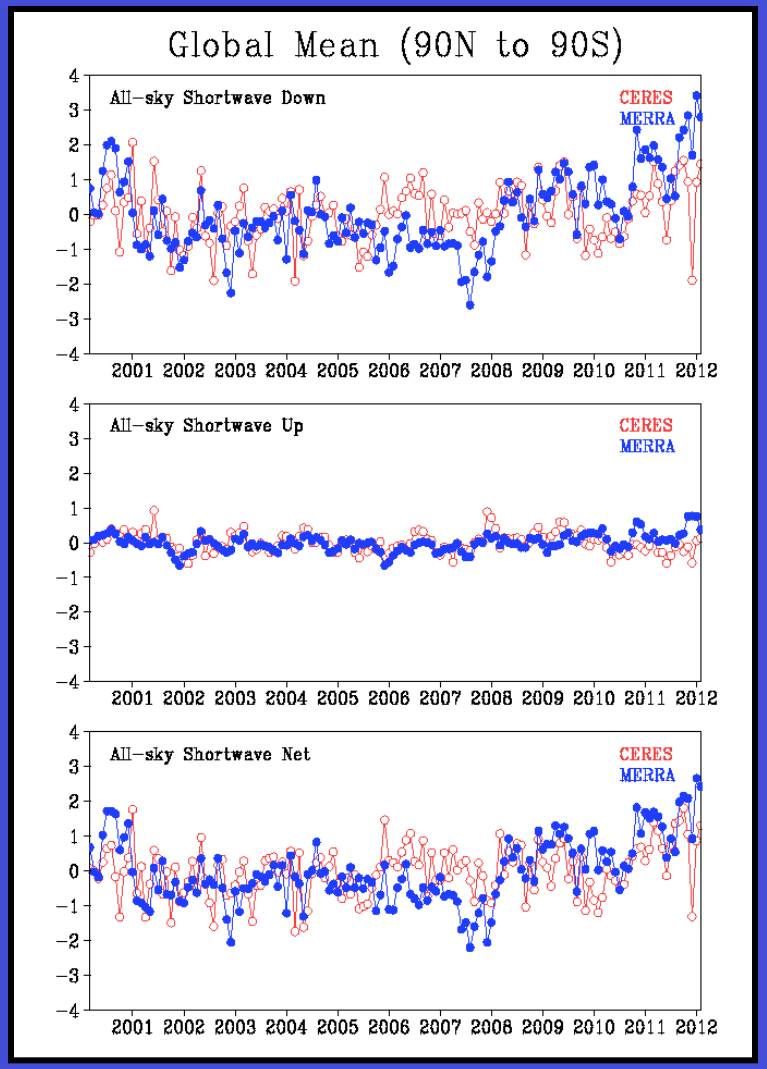


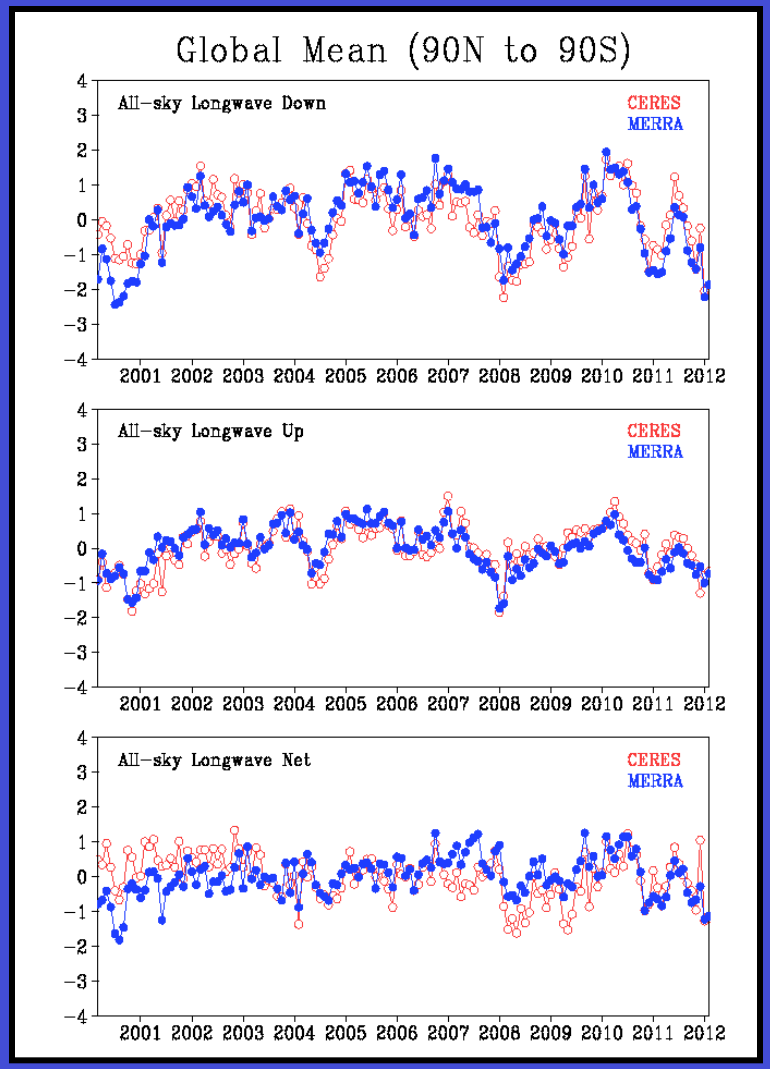
Deseasonalized Time Series (NCEP vs. CERES)





Deseasonalized Time Series (MERRA vs. CERES)





Summary

- 12-year averaged global mean ERA Interim Reanalysis surface radiative fluxes are very similar to CERES EBAF observations
- Large regional differences are found in areas of deep convections, stratus, and mid-latitude frontal zone for all-sky SW down, and SW Net
- Both ERA Interim and CERES EBAF Surface 12-year global mean all-sky surface Total Net is positive indicating radiative energy gain at the surface. ERA's value is smaller than CERES's by 1.6 Wm^{-2} or ~1.5%
- ERA Interim has higher global mean interannual variability of all-sky fluxes SW down, SW Net, LW down, and Total Net; but interannual variability for SW up LW up, and LW Net are very similar
- Deseasonalized time series of longwave (up, down, and Net) are remarkably similar among CERES, ERA Interim, NCEP-R1, and MERRA
- There are some large differences in deseasonalized time series among CERES, ERA Interim, NCEP-R1, and MERRA for shortwave down and shortwave Net after 2010 that need further study