Comparisons of CERES EBAF Ed2.8 TOA Fluxes with JRA55 Reanalysis Data

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MERRA and ERA-interim Summary

- 10-yr climatology (MERRA or ERA-Interim Vs. CERES EBAF)
  - MERRA performs slightly better; closer to global net balance
  - ERA-Interim all-sky LW is higher than MERRA and CERES
- Interannual variability (MERRA or ERA-Interim Vs. CERES EBAF)
  - ERA-interim performs better
  - MERRA has excessive interannual variability
- MERRA and ERA-interim use single value of solar irradiance; missing 11-year solar cycle
- Both MERRA and ERA-interim missed clear-sky SW variability over Australia and south Africa

Objective

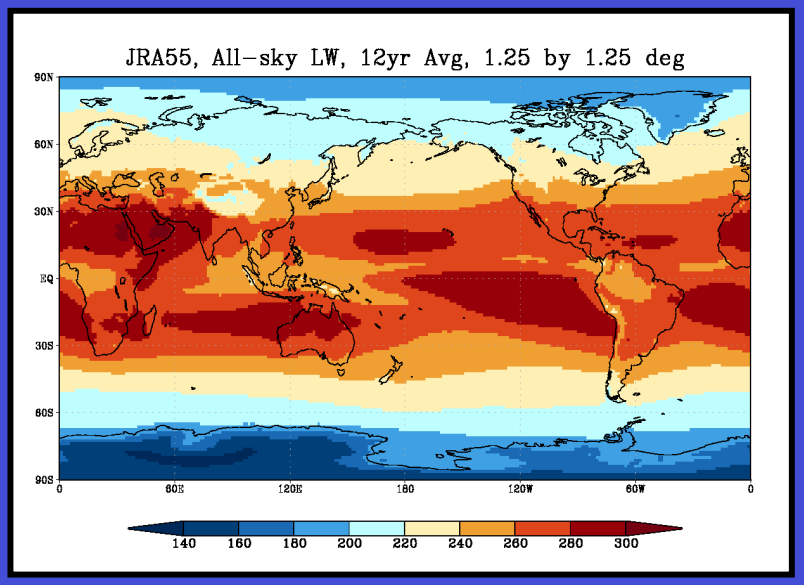
- Compare 12-year of CERES EBAF TOA radiation budget data (January 2001 to December 2012) with JRA55 Reanalysis Data
  - Longwave, shortwave, net (all-sky and clear-sky), solar incoming
  - Regional and global (90N to 90S) scale
  - 12-year climatology (average)
  - Interannual variability (2-sigma)
  - Deseasonalized time series (globe and tropics)

Data Sets

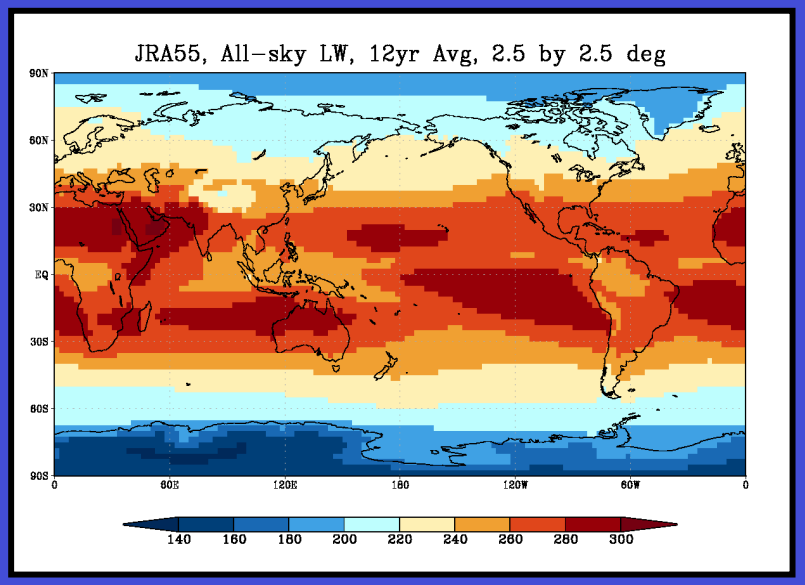
- CERES EBAF TOA Edition 2.8 Monthly Mean Data
  - 1 degree by 1 degree equal angle global grid in NetCDF format
  - Obtained from CERES data website http://ceres.larc.nasa.gov/order_data.php
- JRA55 Reanalysis Monthly Mean Data
  - 1.25 degree by 1.25 degree equal angle global grid in NetCDF format
  - Obtained from NCAR; http://rda.ucar.edu/datasets/ds628.1/

Data Regridding

- CERES and JRA55 data are regridded to a 2.5 degree by 2.5 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



JRA55, Original Data



JRA55, Regridded Data

Data Regridding (Continue)

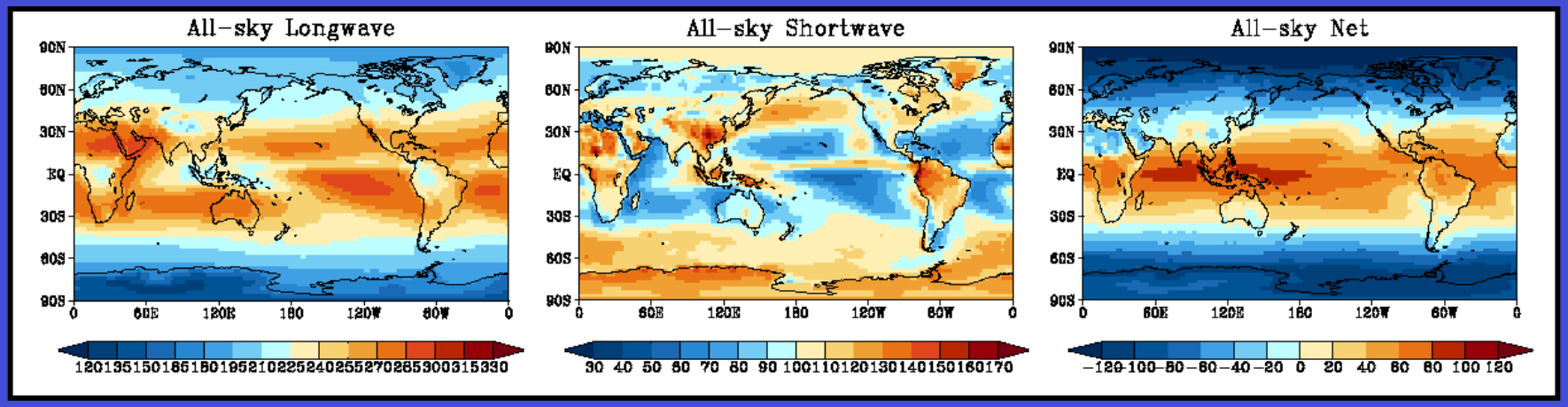
- Regridded data have the exact same global mean values as the original data; very similar but slightly smaller spatial variability

JRA55 12-year Climatology (January 2001 to December 2012)

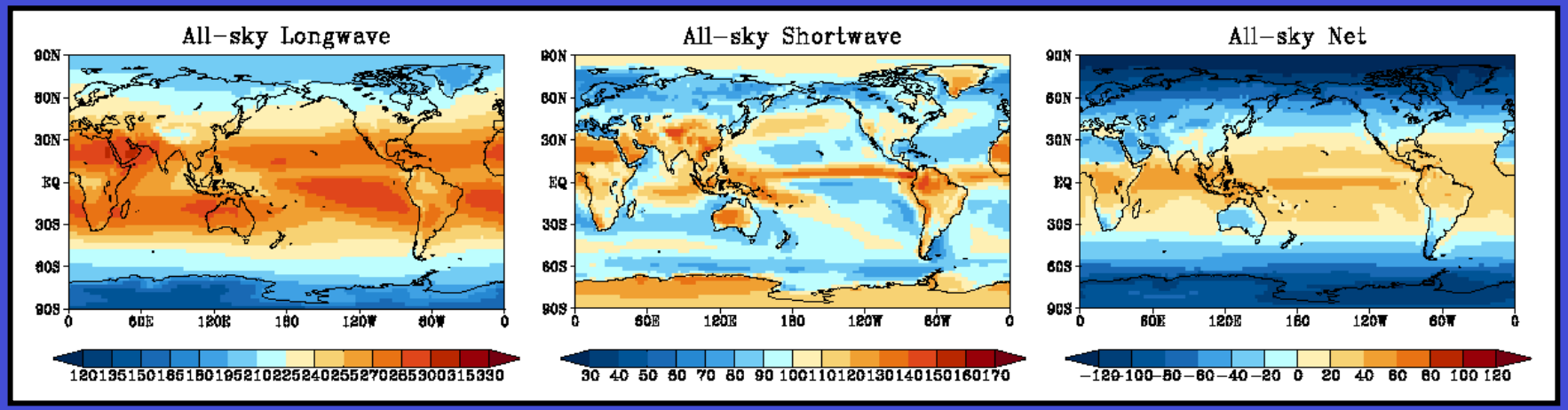
JRA55	Original Mean	Original 1-σ	Regridded Mean	Regridded 1-σ
Solar Inc.	*341.3*	*89.1*	*341.3*	*88.8*
All-sky LW	*251.2*	*37.8*	*251.2*	*37.4*
All-sky SW	*100.2*	*15.6*	*100.2*	*15.0*
All-sky Net	*-10.1*	*54.4*	*-10.1*	*54.0*
Clr-sky LW	*265.8*	*41.3*	*265.8*	*40.7*
Clr-sky SW	*55.2*	*29.2*	*55.2*	*28.6*
Clr-sky Net	*20.3*	*69.5*	*20.3*	*69.1*

All-sky TOA Climatology (1/2001 to 12/2012)

CERES EBAF Ed2.8

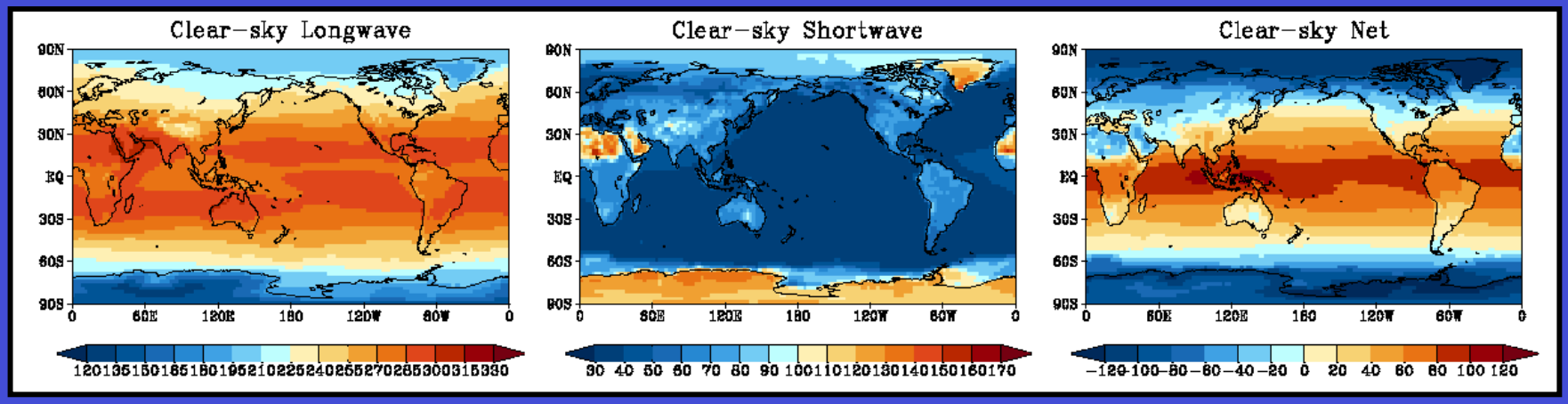


JRA55

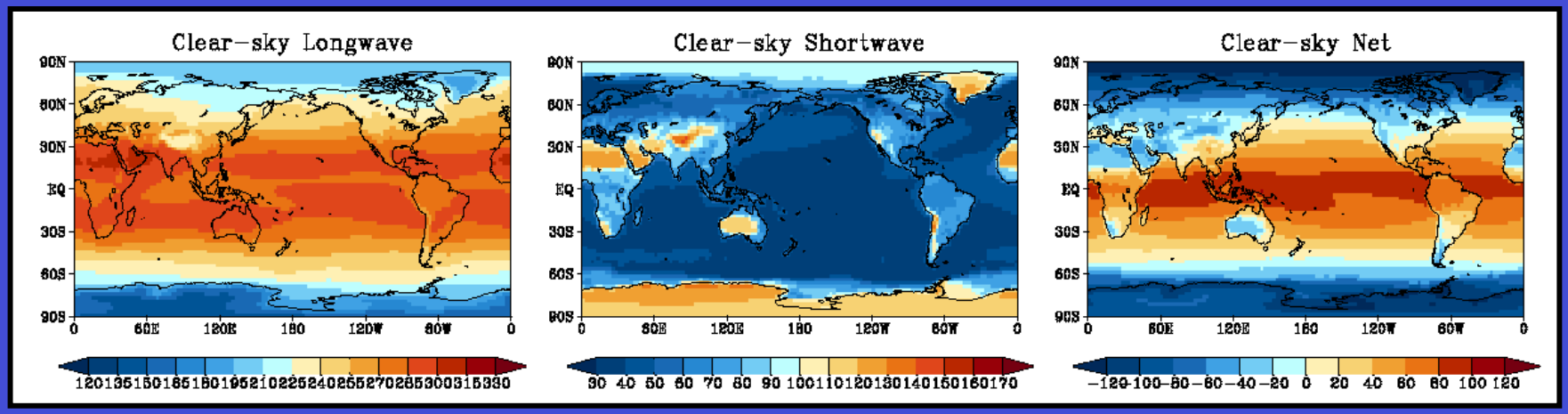


Clear-sky TOA Climatology (1/2001 to 12/2012)

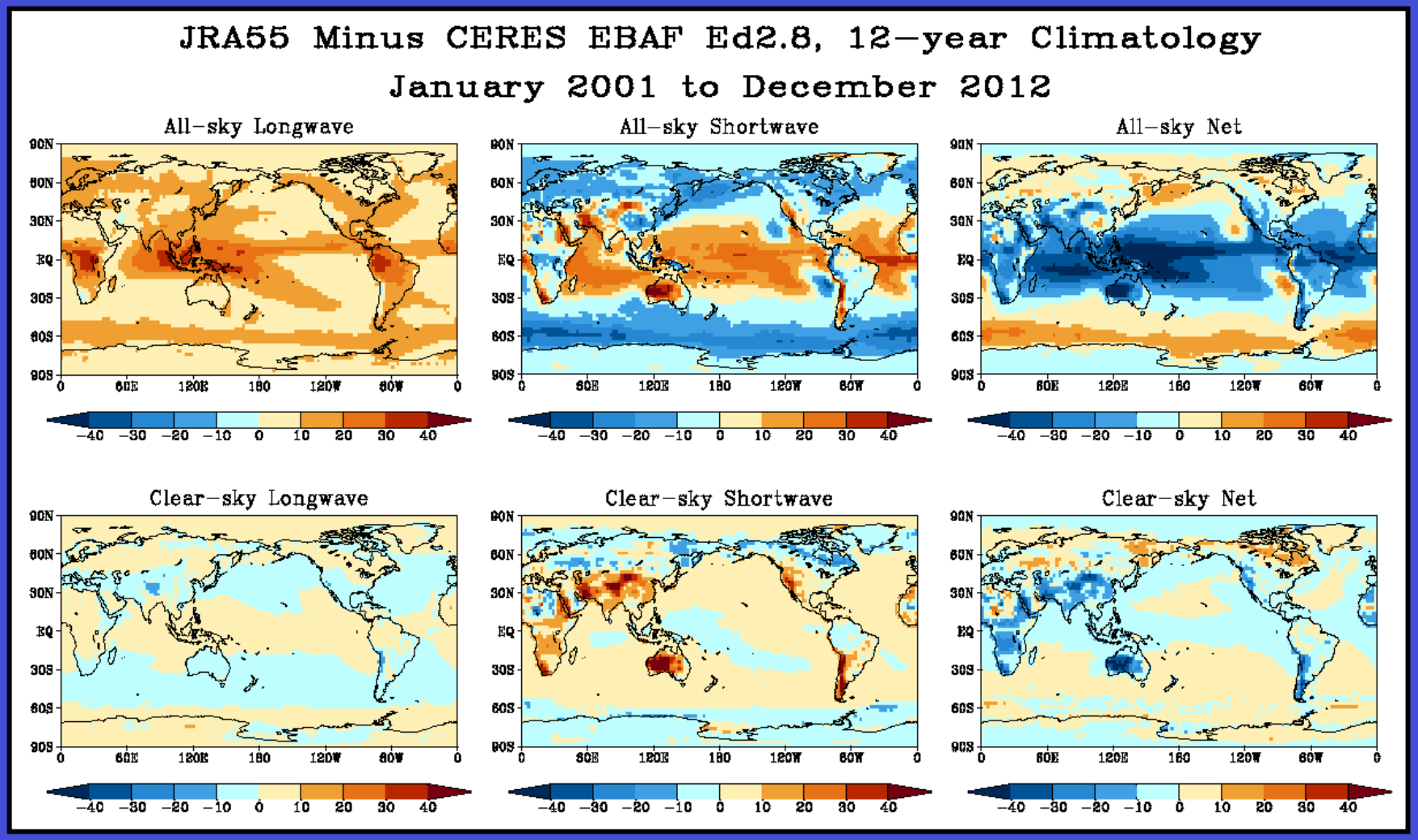
CERES EBAF Ed2.8



JRA55



JRA55 Minus CERES TOA Differences



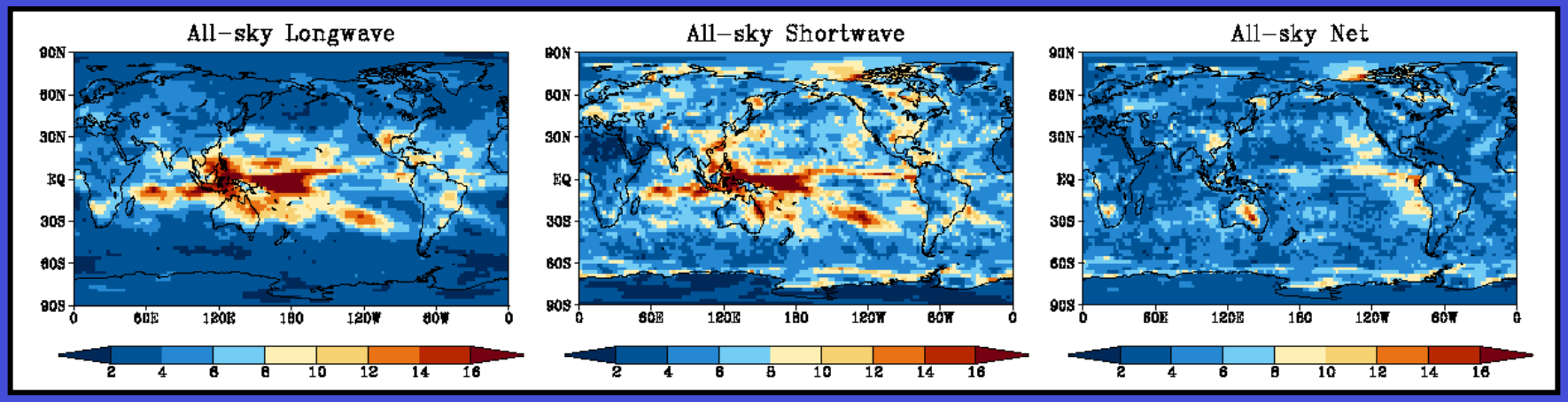
Global (90NS) Mean Comparison

Parameters (Wm^{-2})	JRA55 12y-avg	CERES 12y-avg	Mean Diff. JRA55-Ceres
Solar Incoming	*341.3*	*339.8*	*1.5 (0.4%)*
Longwave	*251.2*	*239.6*	*11.6 (4.8%)*
Shortwave	*100.2*	*99.6*	*0.6 (0.6%)*
Net	*-10.1*	*0.6*	*-10.7 (1783%)*
Clear Longwave	*265.8*	*265.6*	*0.2 (0.1%)*
Clear Shortwave	*55.2*	*52.5*	*2.7 (5.1%)*
Clear Net	*20.3*	*21.7*	*-1.4 (-6.4%)*

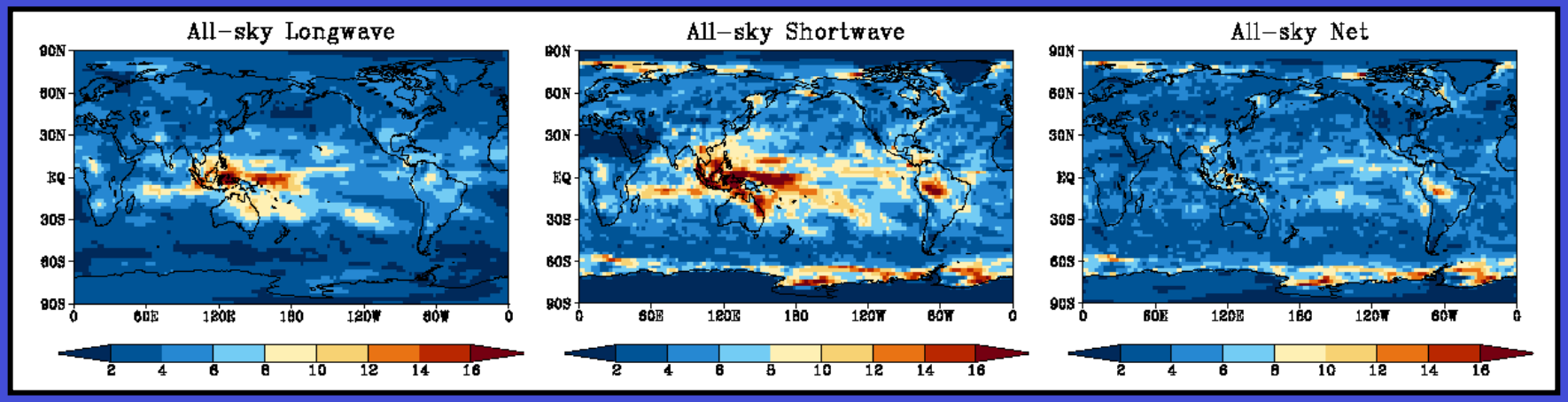
- All-sky: JRA55 has higher global mean values of solar incoming outgoing LW, reflected SW; but lower value of Net
- Clear-sky: JRA55 has lower global mean value of Net ; higher value of SW; almost identical value in LW

All-sky TOA Interannual Variability

CERES EBAF Ed2.8

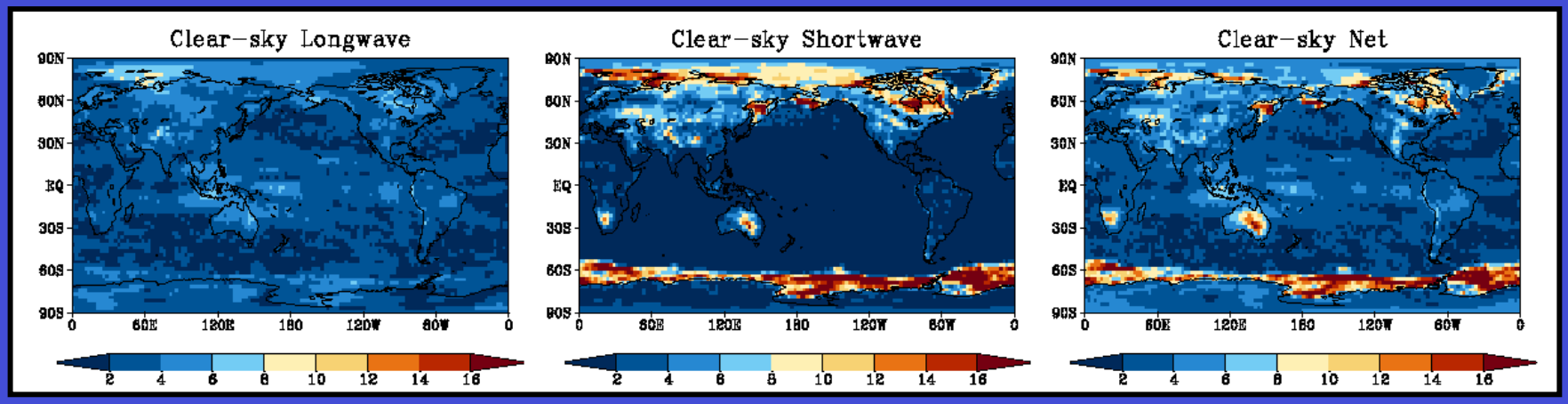


JRA55

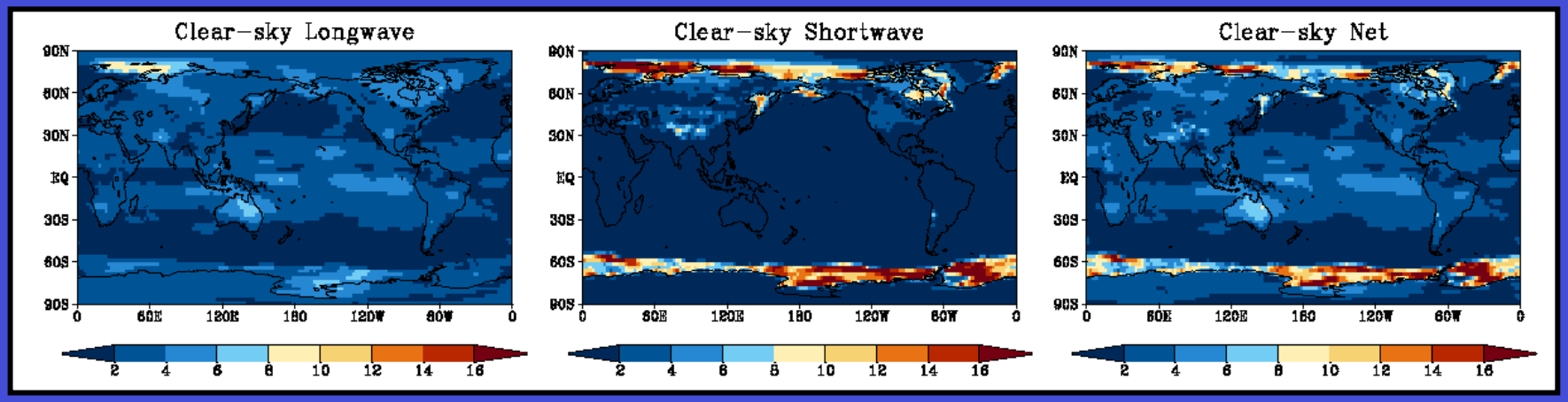


Clear-sky TOA Interannual Variability

CERES EBAF Ed2.8



JRA55

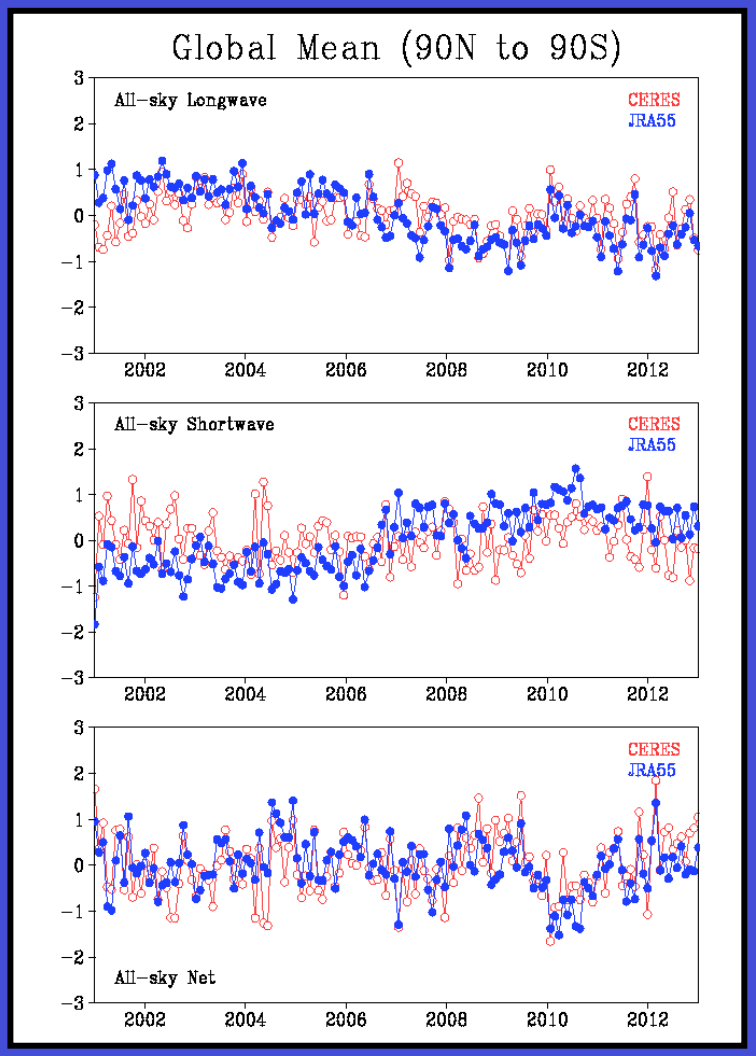


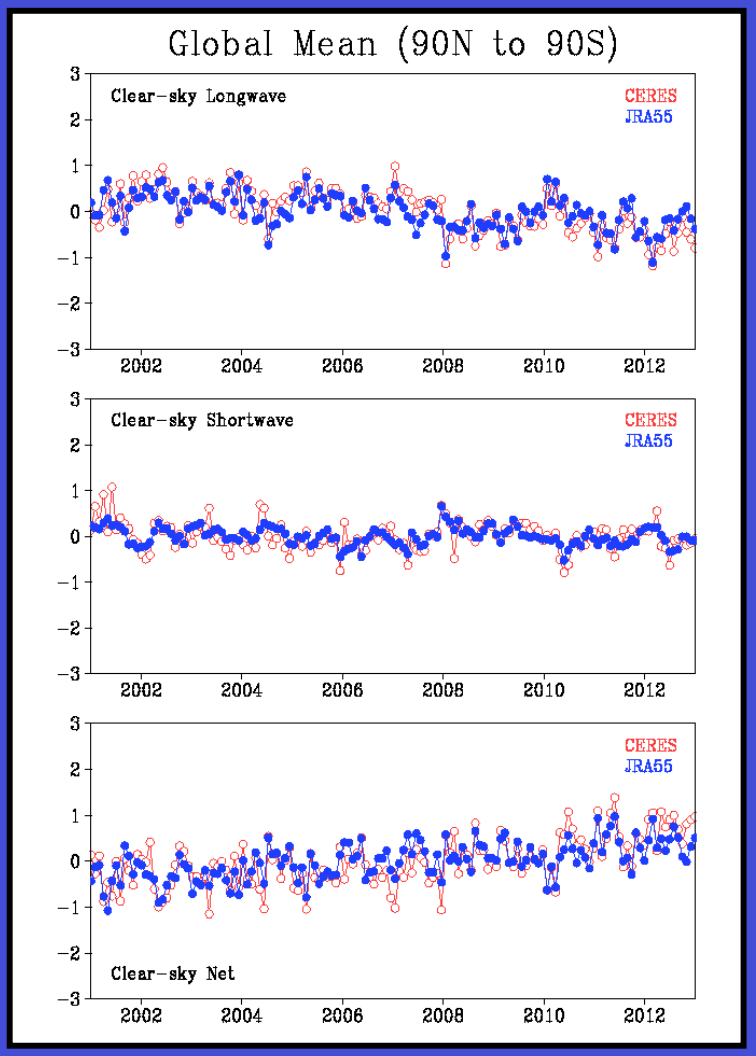
Global (90NS) Mean and Interannual Variability

Parameters (Wm^{-2})	JRA55 12y-avg	CERES 12y-avg	Mean Diff. JRA-Ceres	JRA55 2-σ	CERES 2-σ
Solar Incoming	341.3	339.8	1.5(0.5%)	0.01	0.19
Longwave	251.2	239.6	11.6 (4.8%)	1.00	0.54
Shortwave	100.2	99.6	0.6 (0.6%)	1.21	0.40
Net	-10.1	0.6	-10.7	0.72	0.72
Clear Longwave	265.8	265.6	0.2 (0.1%)	0.53	0.77
Clear Shortwave	55.2	52.5	2.7 (5.1%)	0.20	0.29
Clear Net	20.3	21.7	-1.4 (-6.4%)	0.55	0.75

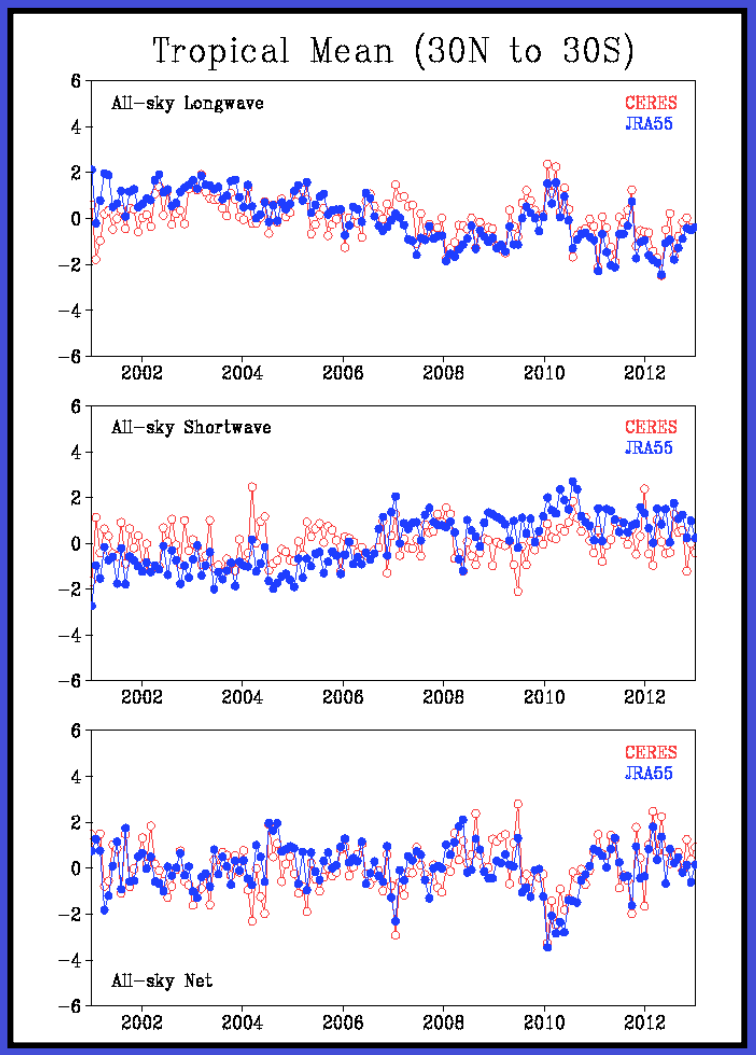
- JRA55 has higher interannual variability of all-sky LW, SW fluxes; but slightly lower interannual variability of clear-sky fluxes
- JRA55 uses a constant solar irradiance value while CERES uses a time varying solar irradiance observations from SORCE

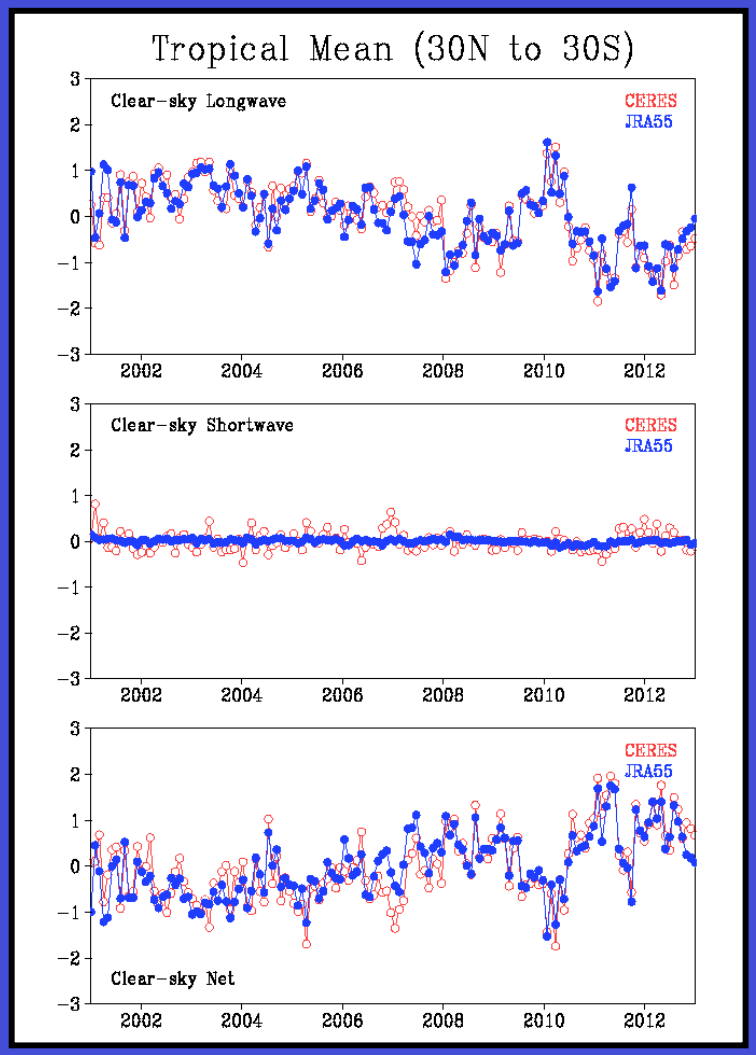
Global Mean Deseasonalized Time Series





Tropical Mean Deseasonalized Time Series





Summary

- JRA55 uses a constant solar irradiance value (~1365); missing 11-year solar cycle. CERES EBAF uses a time varying solar irradiance from SORCE (~1361)
- JRA55 global mean all-sky LW are much higher than CERES values (by 11 Wm^{-2}, worst than ERA-Interim); leads to larger global mean Net imbalance
- Larger regional differences are found in all-sky LW, SW, and Net, all-sky; especially in the tropics
- Globally, JRA55 has higher interannual variability of all-sky LW and SW fluxes; but slightly lower interannual variability of clear-sky fluxes LW and SW than CERES. Net fluxes variability are similar to CERES
- Global mean time series are very similar to CERES. JRA55 clear-sky SW fluxes in the tropics have very little variability compares to CERES

Next

- Look at the comparisons with NCEP CFSR Product (available from NCAR)
- Summarize comparison results of all four modern reanalysis products (ERA-Interim, MERRA, JRA55, and CFSR) with CERES EBAF Ed2.8
- Will have a poster on these comparisons at the AMS Radiation Conference in Boston this July