CERES Suomi NPP
ERBE-like Monthly Mean Fluxes

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CERES FM5 Suomi NPP ERBE-like Schedule

- Suomi NPP Spacecraft Launch: 10/28/2011
- CERES FM5 Power On: 11/9/2011
- CERES FM5 Cover Open: 1/26/2012
- CERES FM5 ES8 (Level 2) Edition1-CV* Release: 9/2012
- ***CERES FM5 ES4/ES9 (Level 3) Edition1-CV* Release: 12/2012***
- ***CERES FM5 ES8/ES4/ES9 Edition2** Release: ~ 2013 - 2014***

* *Edition1-CV: Calibration/Validation Edition with static instrument calibration, not suitable for scientific publications*

** *Edition2: Contains dynamic in-orbit instrument calibration correction; suitable for scientific publications*

Objectives

- Provide data quality assessment for Suomi NPP FM5 ERBE-like Edition1-CV* monthly mean TOA fluxes before its official release in 12/2012
- Examine the first month (February 2012) of CERES FM5 ERBE-like TOA fluxes from the Suomi NPP satellite and compare them to CERES FM3 ERBE-like fluxes from EOS Aqua satellite
  - Longwave, shortwave, net (all-sky and clear-sky), solar incoming
  - Regional pattern, zonal profile, tropical and global mean

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Edition2: Contains dynamic in-orbit instrument calibration correction; suitable for scientific publications

Data Sets

- CERES Suomi NPP FM5 ES-4 Edition1-CV* Monthly Mean Data (not yet released to the public; targeted release date: 12/2012)
  - 2.5 degree by 2.5 degree equal angle global grid in EOS-HDF format
  - Obtained from the NASA Langley ASDC
- CERES Aqua FM3 ES-4 Edition3-Test Monthly Mean Data
  - 2.5 degree by 2.5 degree equal angle global grid in EOS-HDF format
  - Generated off-line using the last known Aqua instrument calibration point (12/2011)

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Orbital Information

Suomi NPP Satellite

- *Sun synchronous*
  - *98.7 Inclination angle*
- *1:30 pm ascending node*
- *824 km altitude*
  - ***101.5 minutes/orbit***
  - ***24 km CERES footprint***
- *16-day ground track repeat*
  - *227 revolutions*

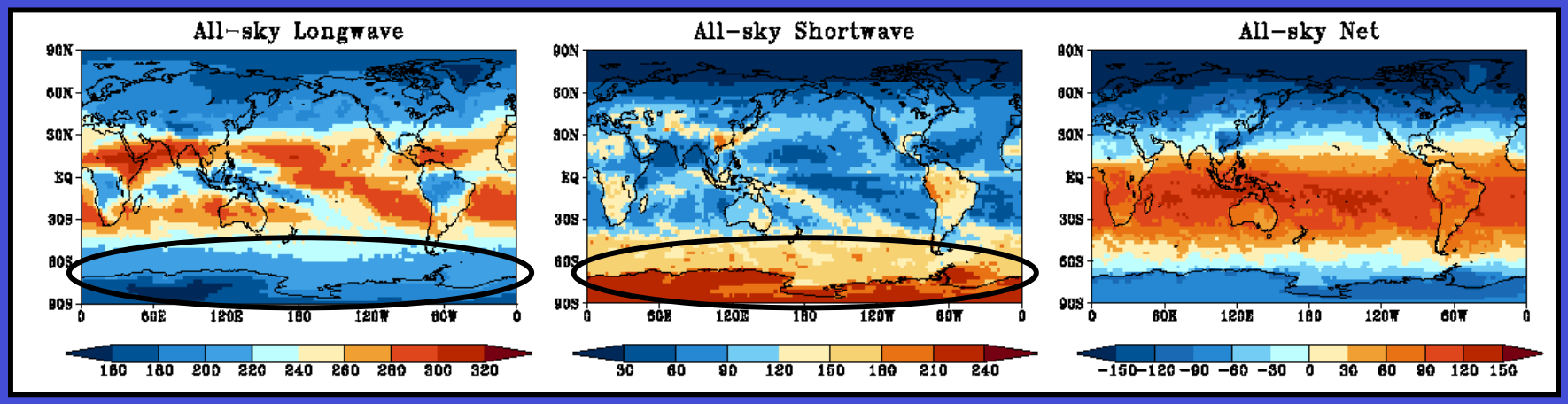
Aqua Satellite

- *Sun synchronous*
  - *98 Inclination angle*
- *1:30 pm ascending node*
- *705 km altitude*
  - ***98.9 minutes/orbit***
  - ***20 km CERES footprint***
- *16-day ground track repeat*
  - *233 revolutions*

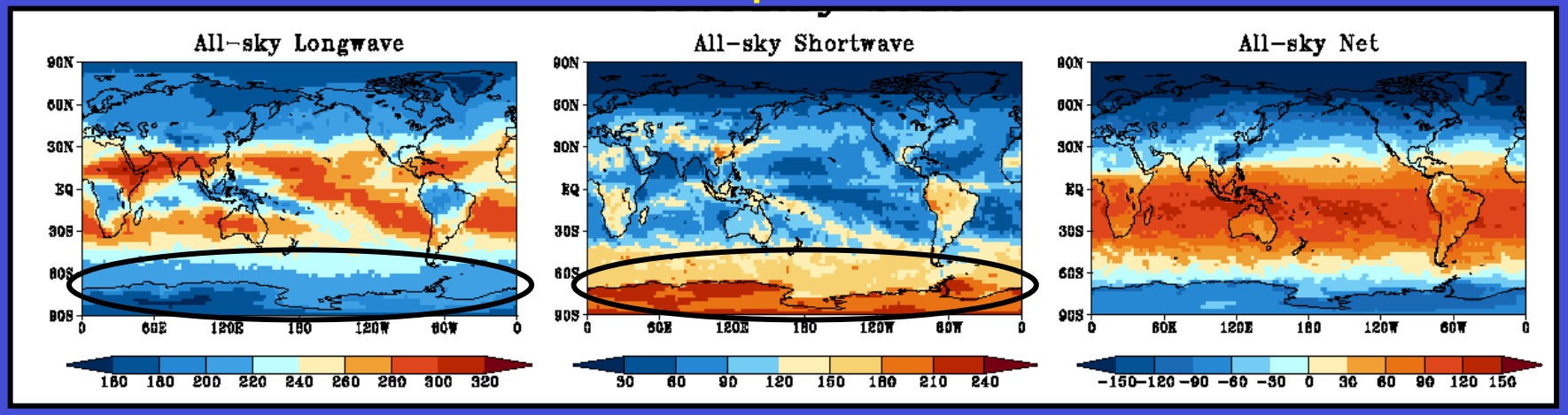
- Suomi NPP is directly over Aqua every 2.667 days
- CERES Suomi NPP and CERES Aqua ES4 regional differences are caused by both calibration and sampling differences

All-sky TOA Fluxes (2/2012)

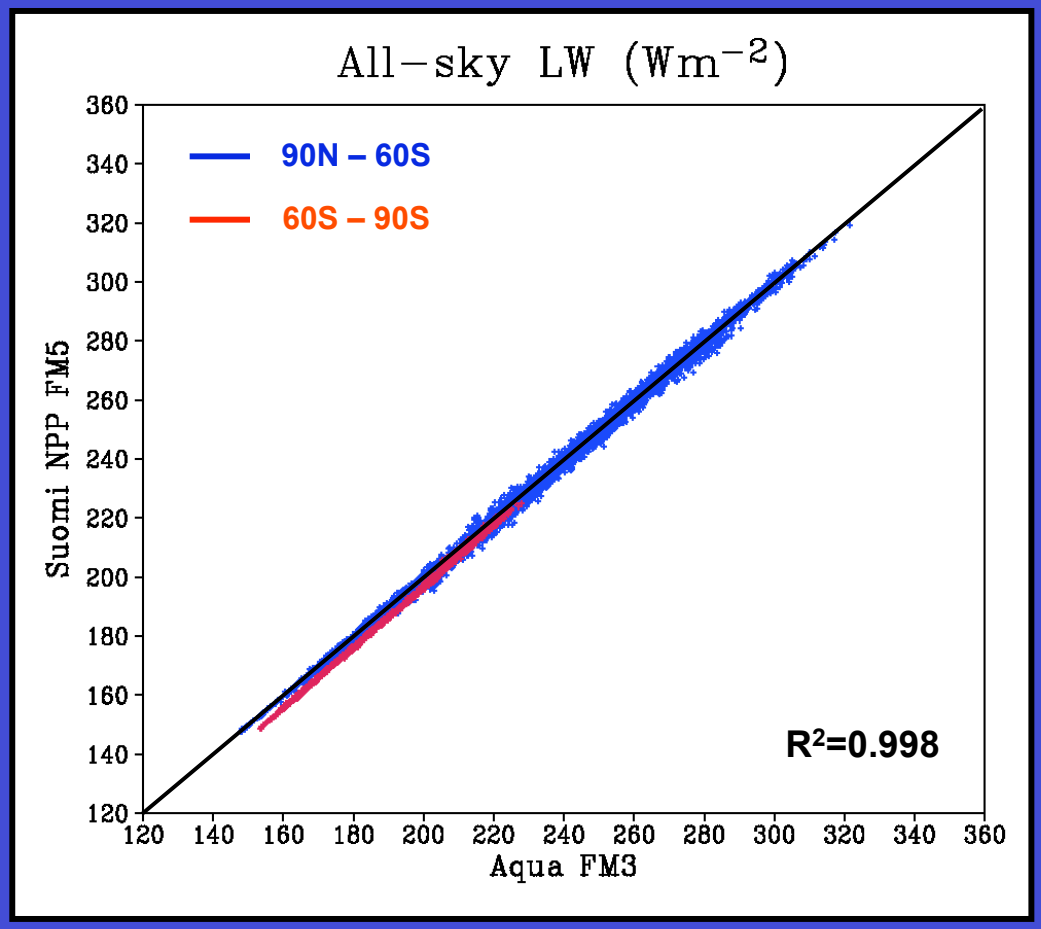
CERES FM5 Suomi NPP ES4 Ed1-CV



CERES FM3 Aqua ES4 Ed3-Test

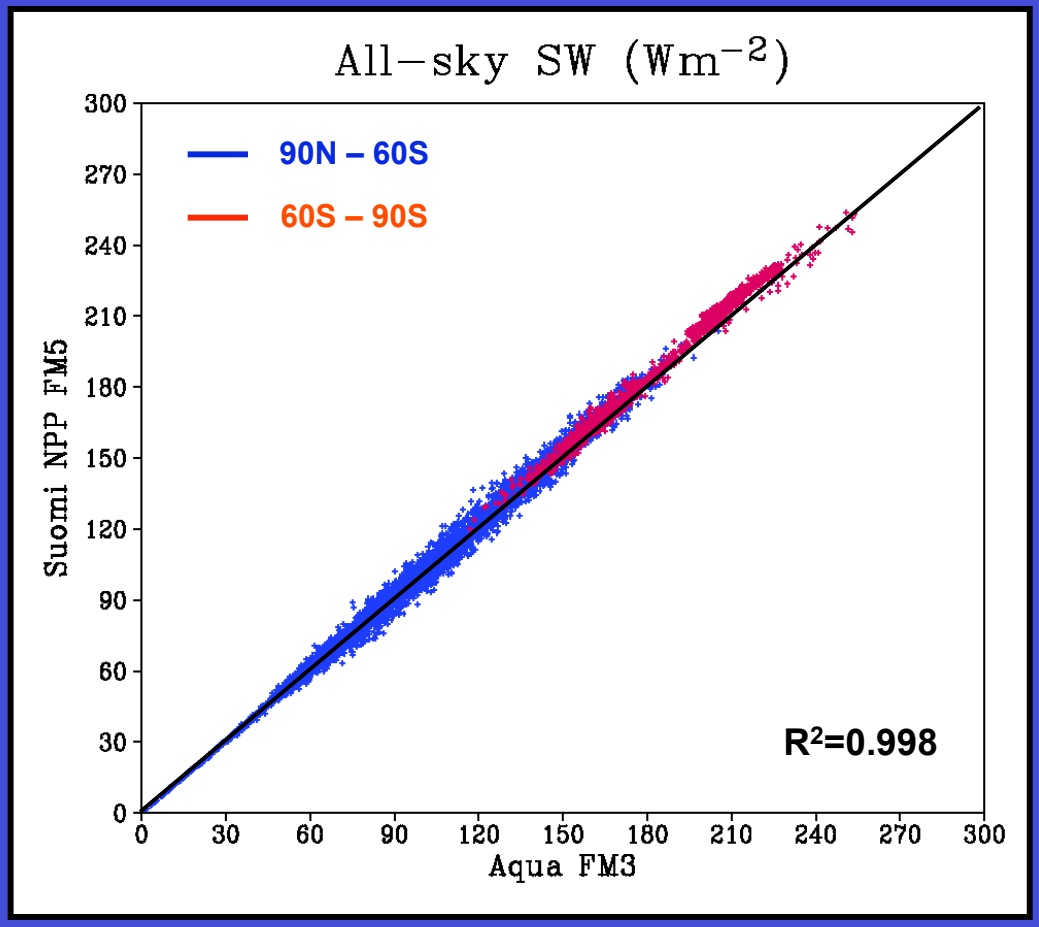


All-sky LW Mean Comparison



- NPP LW is lower than Aqua LW for regions south of 60S (i.e., regions with high reflected SW)

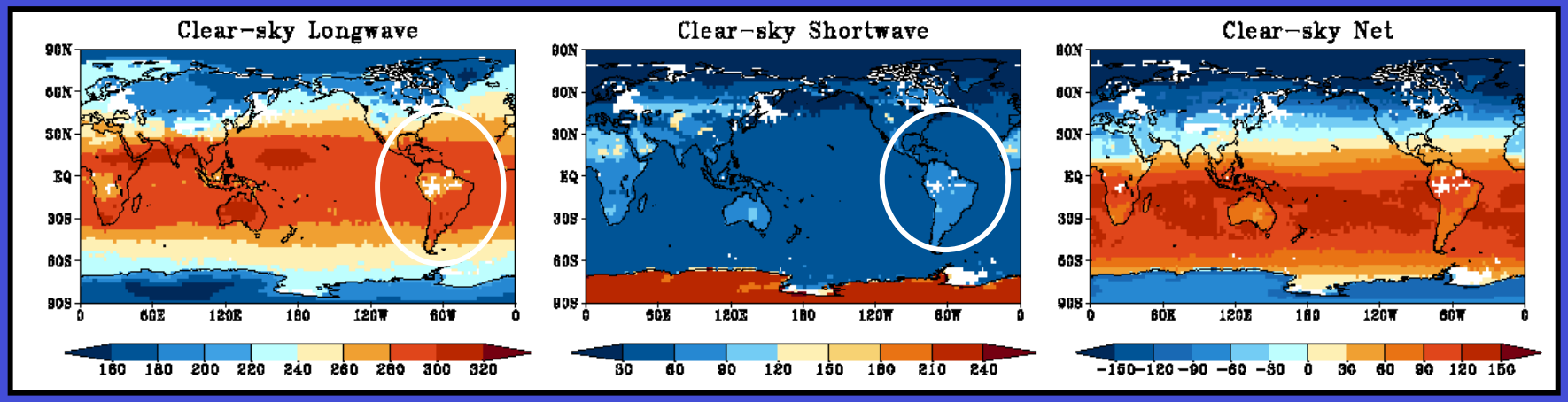
All-sky SW Mean Comparison



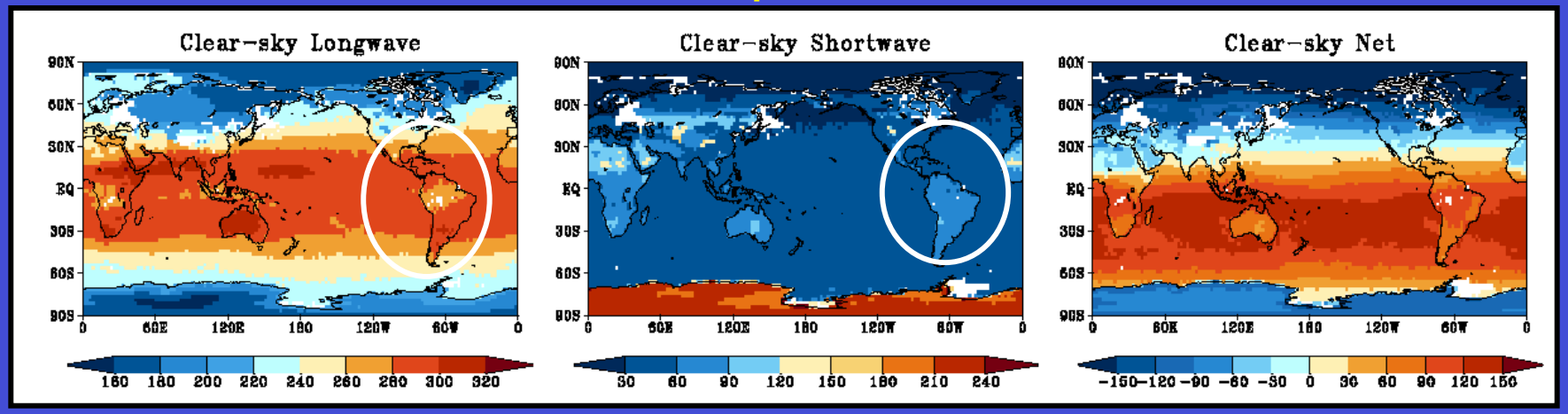
- NPP SW is higher than Aqua SW in regions with high TOA SW flux (i.e., 60S – 90S).

Clear-sky TOA Fluxes (2/2012)

CERES FM5 Suomi NPP ES4 Ed1-CV



CERES FM3 Aqua ES4 Ed3-Test

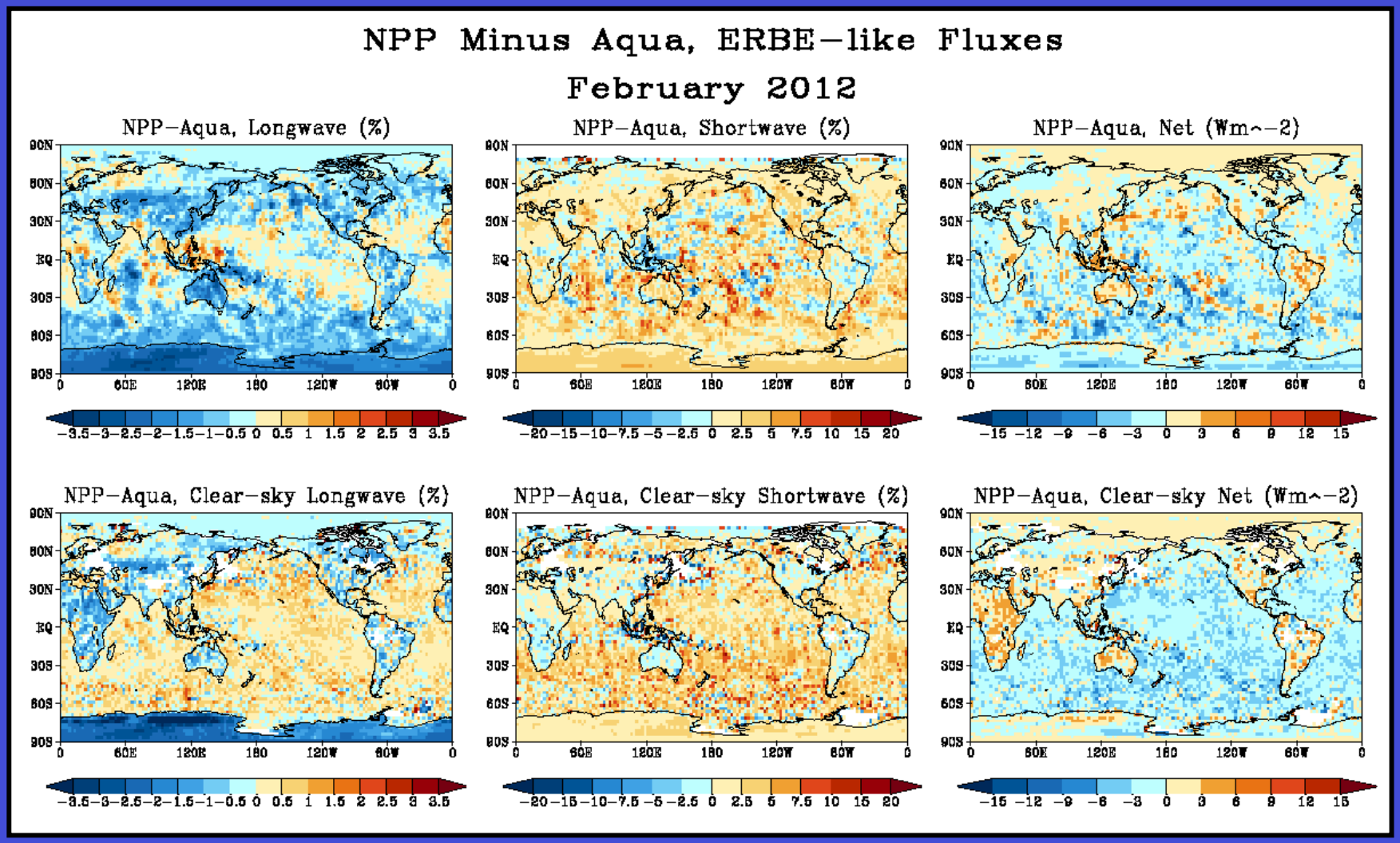


Regional Summary (All Regions)

Parameters (Wm^{-2})	NPP Mean	NPP 1-σ	Aqua Mean	Aqua 1-σ	R^2
Solar Incoming	300.4	149.9	300.4	149.9	1.000
Longwave	221.5	37.6	222.7	37.0	0.998
Shortwave	103.8	61.6	101.8	60.1	0.998
Net	-24.9	96.7	-24.1	97.1	0.999
Clear Longwave	245.8	44.6	246.0	43.5	0.998
Clear Shortwave	61.6	57.7	60.4	56.6	0.999
Clear Net	2.2	107.8	2.9	108.7	0.999

- NPP and Aqua ES4 TOA fluxes are very similar to each others for both mean and spatial standard deviation
- R^2 between NPP and Aqua is better than 0.998 for all variables

NPP Minus Aqua CERES ES4 Differences

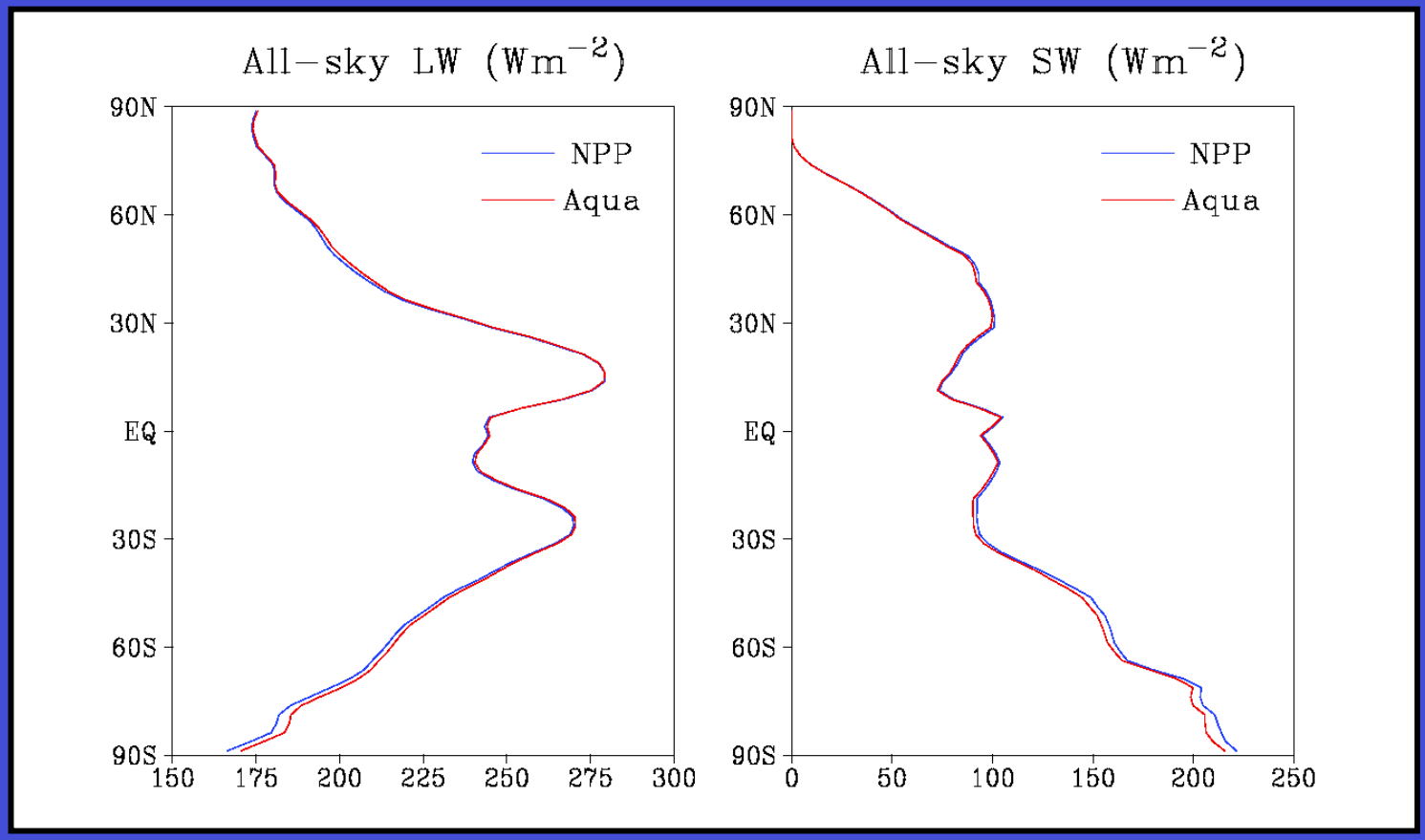


Regional Difference Summary

Parameters (Wm^{-2})	FM5 NPP	FM3 Aqua	Mean Diff. (NPP-Aqua)	Std Dev Diff.	RMS Diff.
Solar Incoming	300.4	300.4	0.00 (0.0%)	0.00	0.00
Longwave	221.5	222.7	-1.21 (-0.5%)	1.68	2.07
Shortwave	103.8	101.8	1.97 (1.9%)	2.97	3.56
Net	-24.9	-24.1	-0.76 (-3.1%)	2.44	2.56
Clear Longwave	245.8	246.0	-0.12 (-0.1%)	2.11	2.11
Clear Shortwave	61.6	60.4	1.08 (1.8%)	2.00	2.28
Clear Net	2.2	2.9	-0.95 (-33%)	2.59	2.76

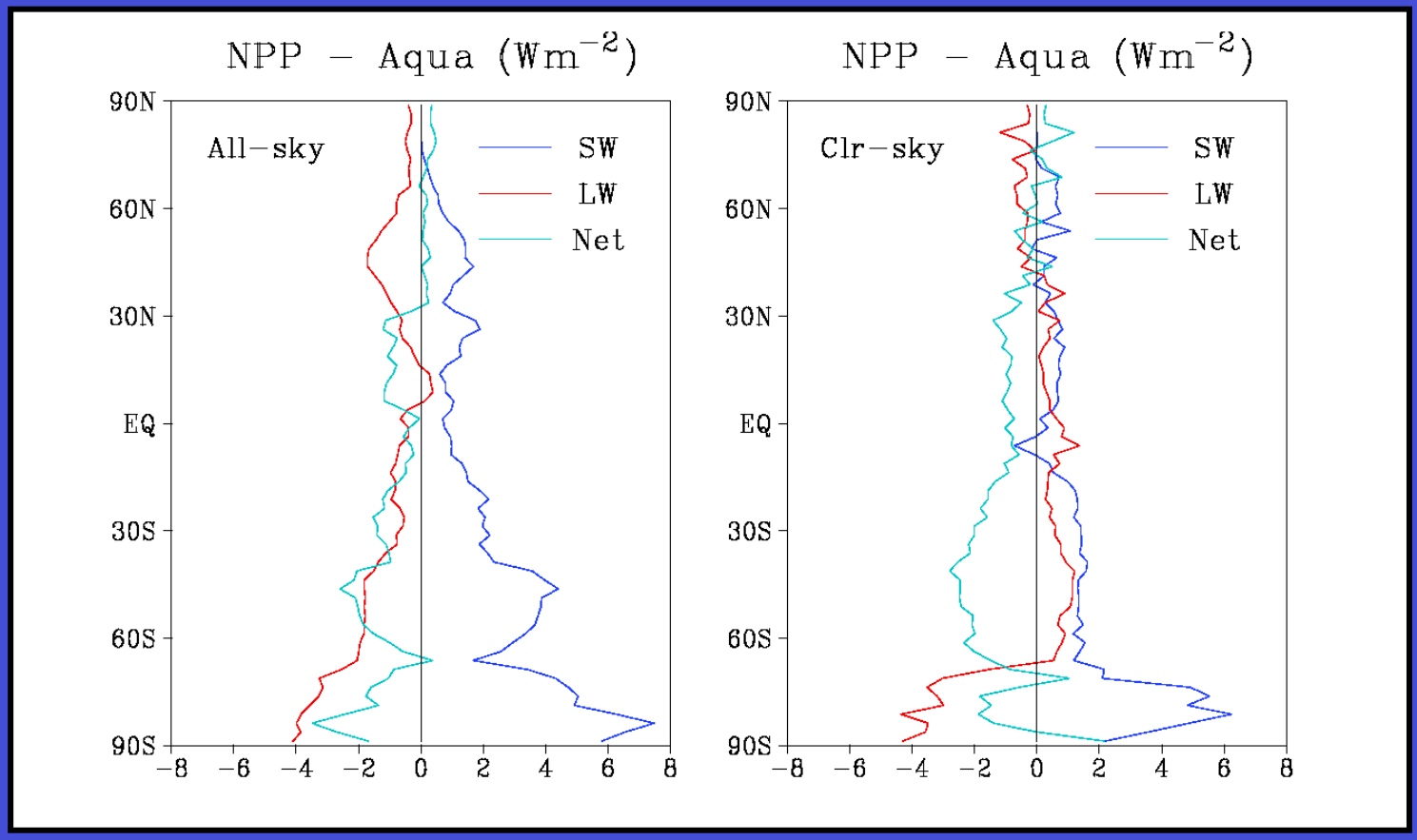
- NPP reads higher in SW (2%), lower in LW (-0.5%); similar to CERES instrument team finding.
- Sampling differences play a large role in explaining the regional RMS differences between NPP and Aqua ES4 fluxes

Zonal Mean Comparison



- Zonal profiles between NPP and Aqua diverge in the Southern Hemisphere where there is maximum solar insolation

Zonal Mean Differences



- Relative to Aqua, NPP SW is too high and this can lead to lower value of NPP LW when compared to Aqua; (LW_day=Total–SW)

Area-weighted Global and Tropical Mean

Parameters (Wm^{-2})	NPP (90NS)	Aqua (90NS)	NPP-Aqua (90NS)	NPP (30NS)	Aqua (30NS)	NPP-Aqua (30NS)
Solar Inc.	349.7	349.7	0.0 (0.0%)	416.2	416.2	0.0 (0.0%)
LW	236.4	237.3	-0.9 (-0.4%)	258.2	258.6	-0.4 (-0.2%)
SW	101.3	99.6	1.7 (1.7%)	92.5	91.2	1.3 (1.4%)
Net	12.0	12.8	-0.8 (-6.0%)	65.5	66.4	-0.9 (-1.4%)
Clear LW	264.2	263.9	0.3 (0.1%)	288.6	288.2	0.4 (0.1%)
Clear SW	52.1	51.2	0.9 (1.8%)	50.6	49.9	0.7 (1.4%)
Clear Net	33.4	34.6	-1.2 (-3.2%)	77.0	78.2	-1.2 (-1.5%)

- SW and Clear SW: NPP is higher than Aqua
- LW: NPP is lower; Clear LW: NPP is higher (larger footprint)
- Net and Clear Net: NPP is lower than Aqua

Summary

- NPP and Aqua ES4 TOA fluxes are very similar due to similarity in satellite orbit. $R^2 > 0.998$ for all ES4 TOA variables
- Relative to Aqua, NPP SW fluxes are higher (2%) and NPP LW fluxes are lower (-0.5%); similar to instrument team findings
- The larger NPP CERES footprint (24 km vs 20 km) also causes more missing clear-sky regions in NPP ES4 data
- There may be some possible scene dependent spectral issue (land vs. ocean differences)
- NPP and Aqua zonal mean profiles diverge in the Southern Hemisphere where there is maximum solar insolation
- The larger NPP SW can lead to lower NPP LW; LW_{day} = Total – SW
- Regional RMS differences between NPP and Aqua are driven in large part by sampling differences