Non-Gaussian PDFs of TOA SW Flux from MISR and CERES

Jae N. Lee[1,2] and Dong L. Wu[2]

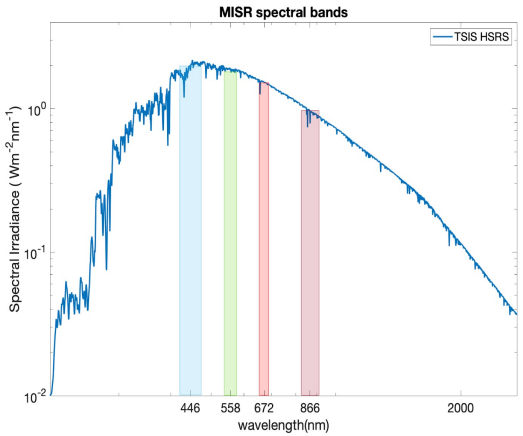
1. Joint Center for Earth Systems Technology, University of Maryland, Baltimore County, Baltimore, Maryland
2. NASA Goddard Space Flight Center, Greenbelt, Maryland

Acknowledgments : NASA Sun Climate Research

MISR and CERES TOA SW Flux Data

MISR (Multi-angle Imaging SpectroRadiometer) (**ATBD**)

- Near-simultaneous multi-angular measurements
- Narrow-to-broad band conversion (Sun et al., 2006)
- broad band albedo => SW Flux by S_0



- 275-m pixel
- Narrow (~400km) swath
- Scene type classification for albedo models (i.e., land, snow, ice, clouds): 1000's

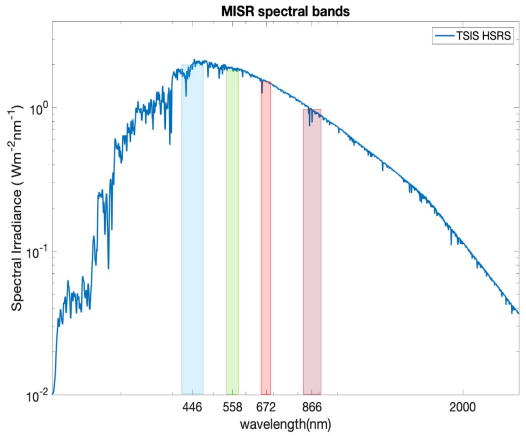
CERES (ATBD) : Single Scanner Footprint (SSF) product

- Climatological angular distribution models (ADMs)
- Direct broad-band SW flux divided
- 10-km pixel
- Wide (~3000km) swath
- Scene type classification for ADMs: 1000's

MISR and CERES TOA SW Flux Data

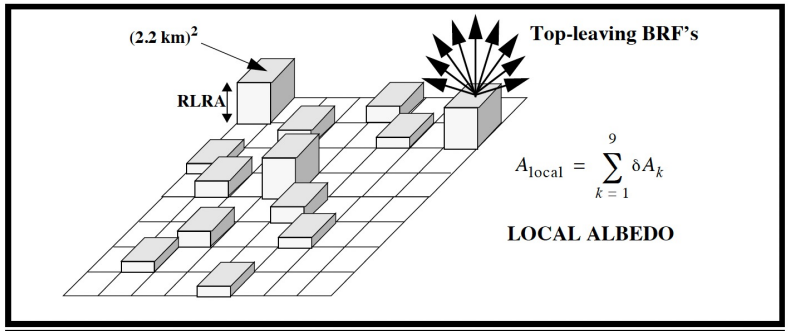
MISR (Multi-angle Imaging SpectroRadiometer) (**ATBD**)

- Near-simultaneous multi-angular measurements
- Narrow-to-broad band conversion (Sun et al., 2006)
- broad band albedo => SW Flux by S_0

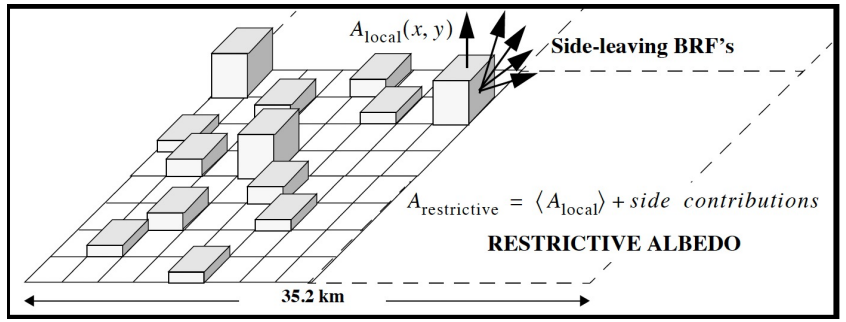


- 275-m pixel
- Narrow (~400km) swath
- Scene type classification for albedo models (i.e., land, snow, ice, clouds): 1000's

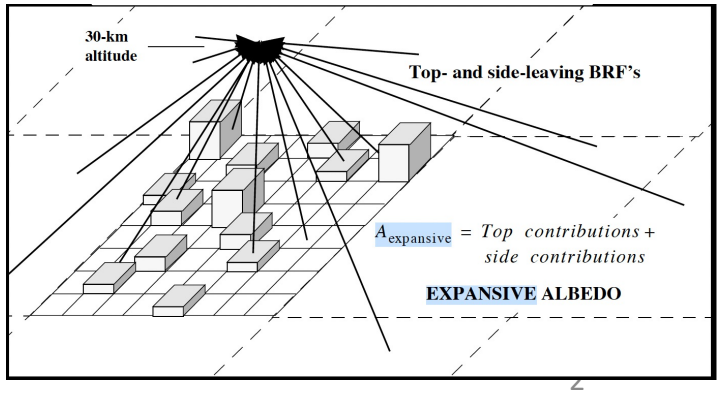
Local Albedo



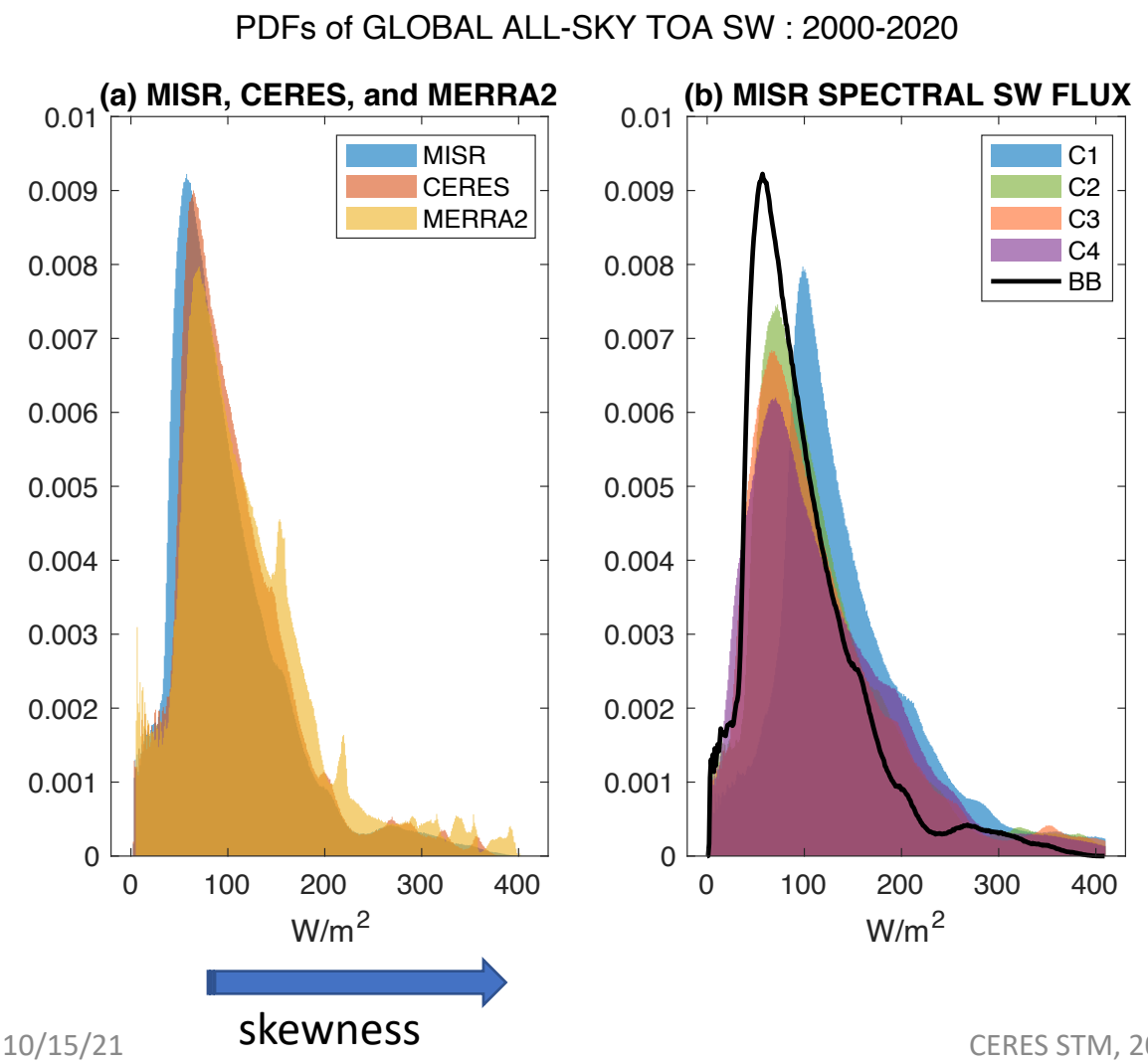
Restrictive Albedo



Expansive Albedo

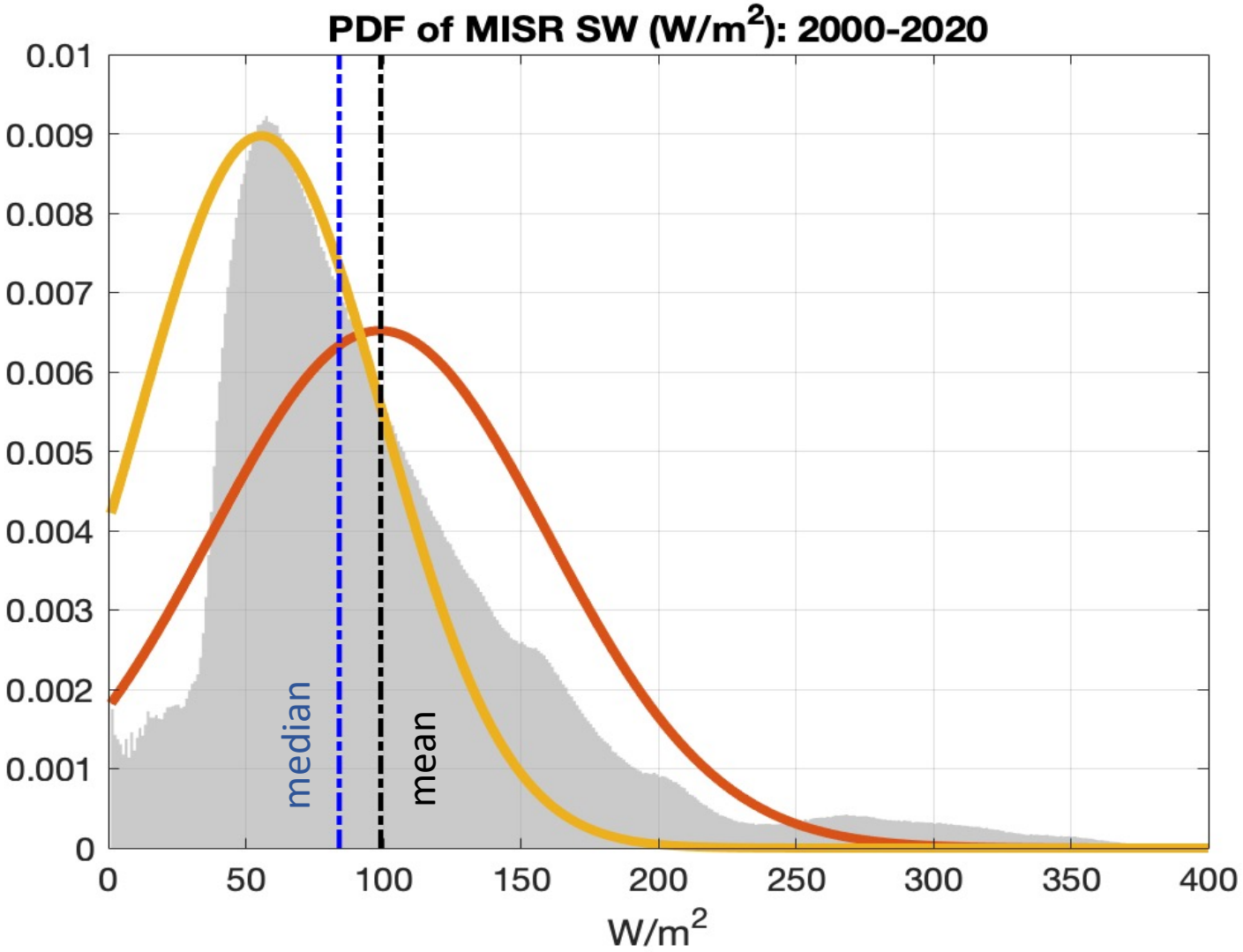


Skewness in the TOA SW distribution

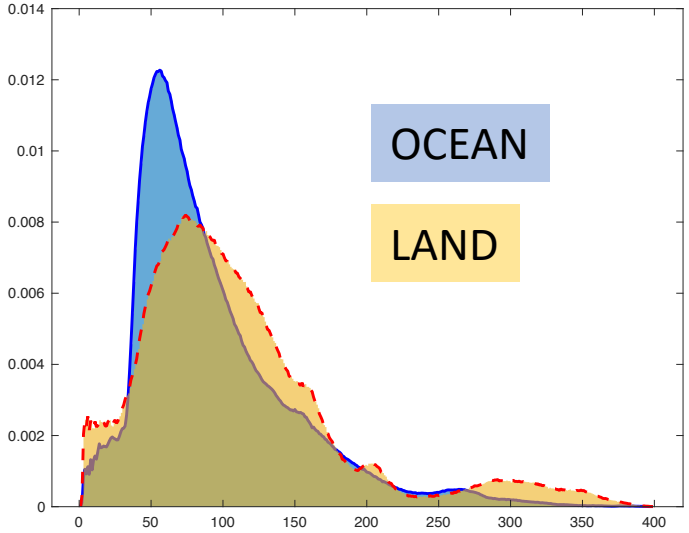


- Deviation from normal distribution
- Asymmetric from the maximum population
- Positive skewness → more data on right side of the maximum population
- One major peak near 60W/m2, MISR peak value is ~7W/m2 less than that of CERES
- All four of MISR spectral SW flux are showing similar positive skewness

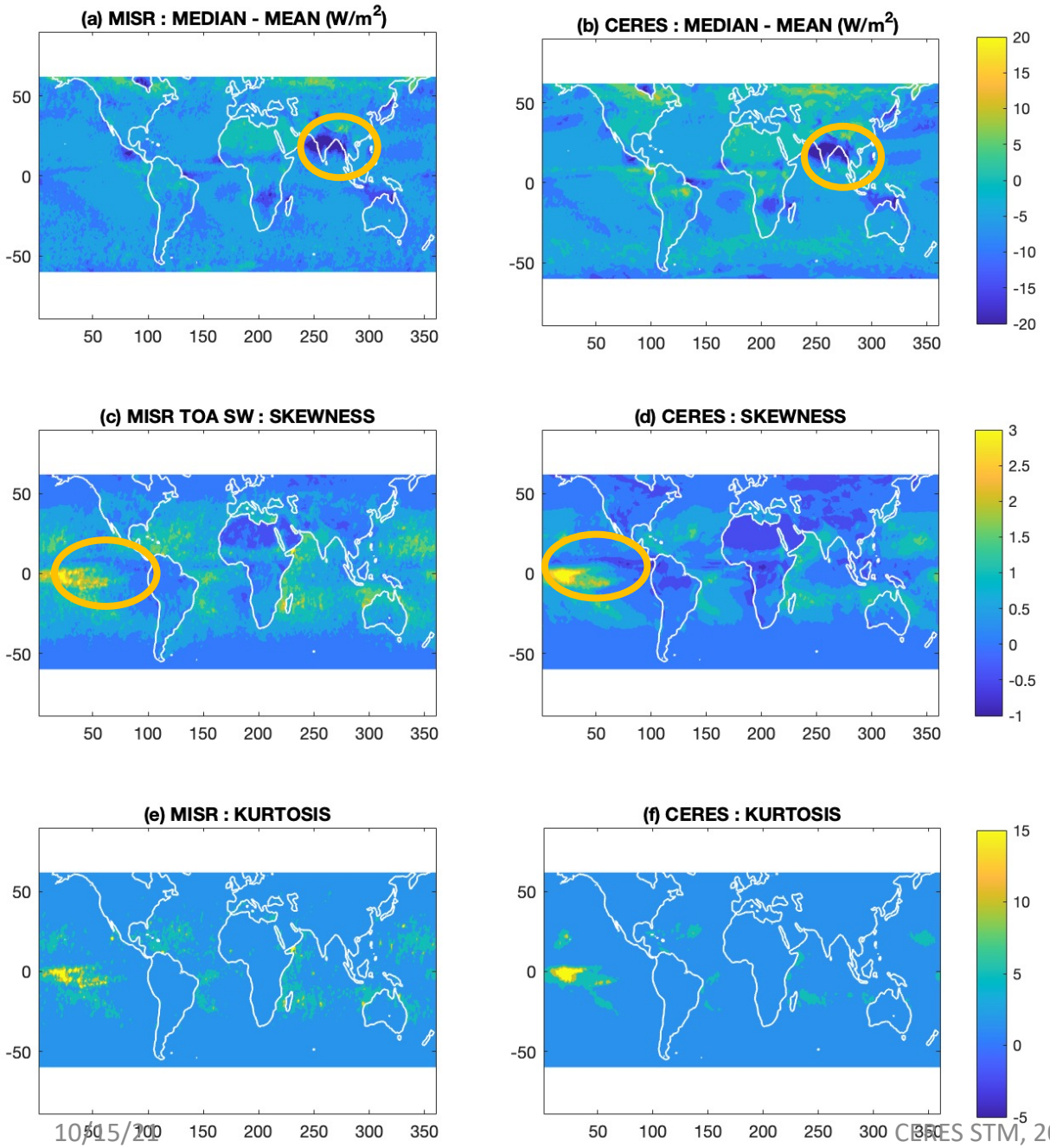
Implications of Non- Gaussian distribution?

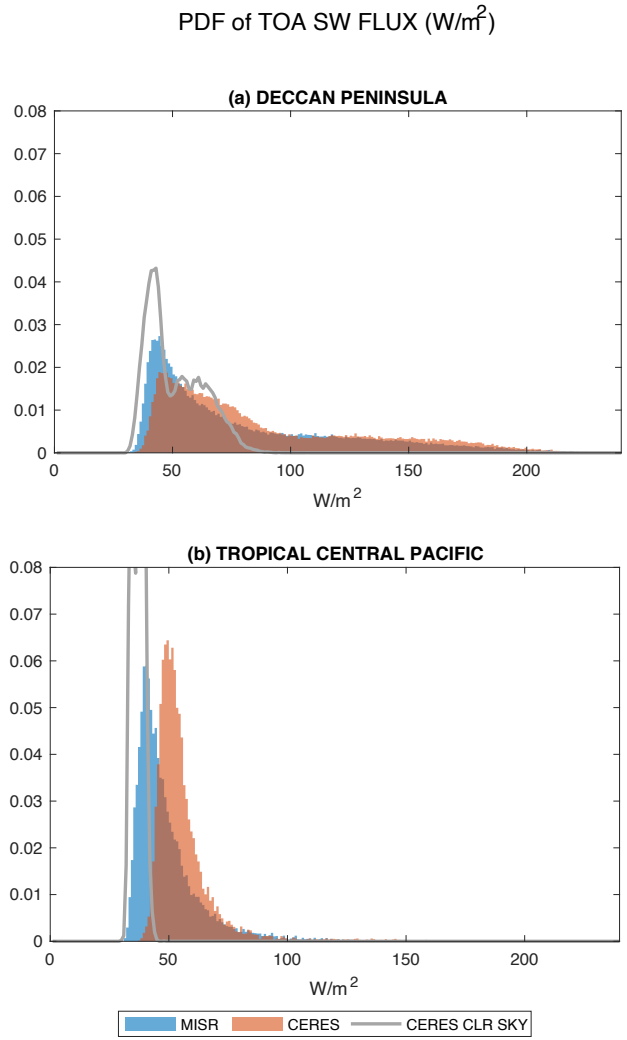


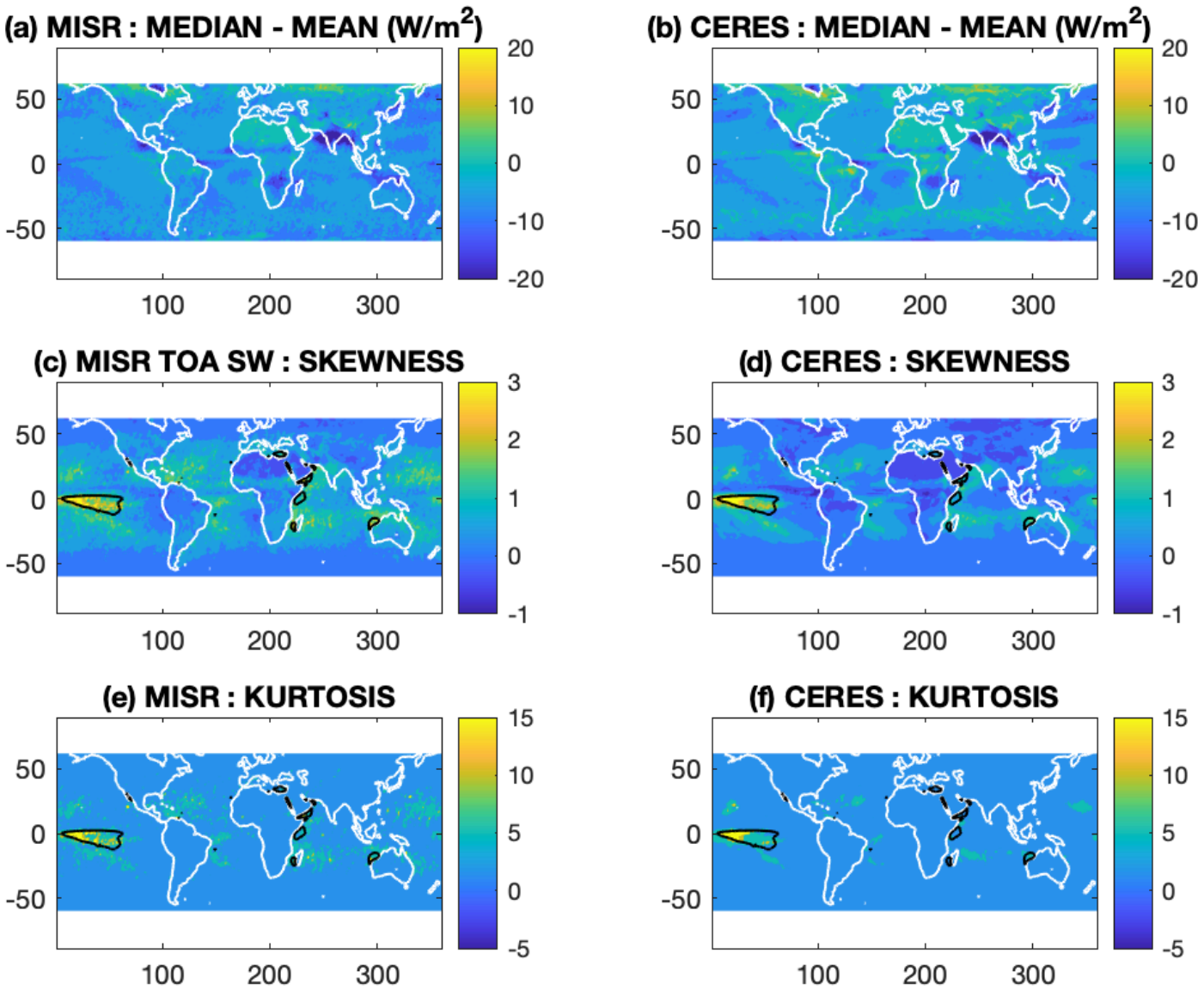
1. Deviations from mean
2. Outliers in high flux values above 300 W/m2?



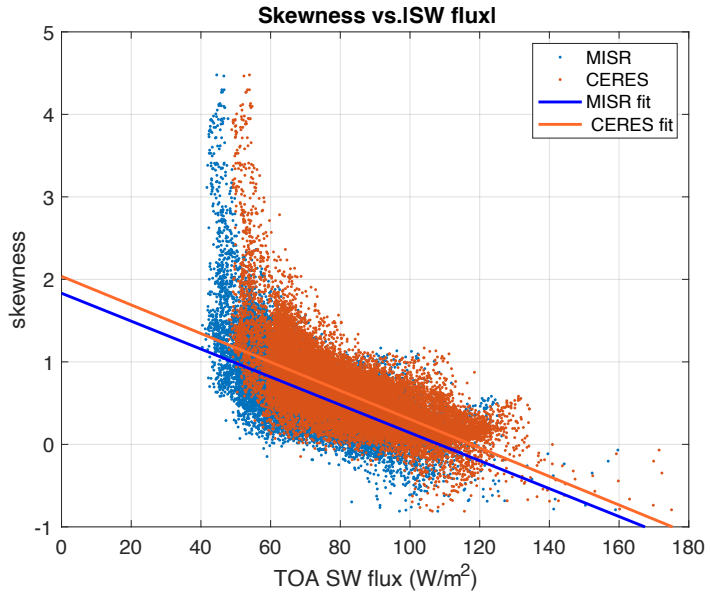
Where are the most skewed regions?



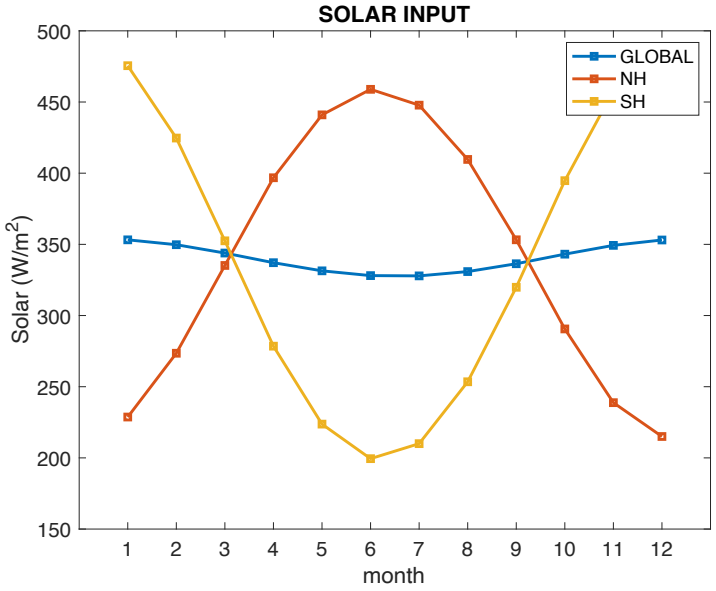


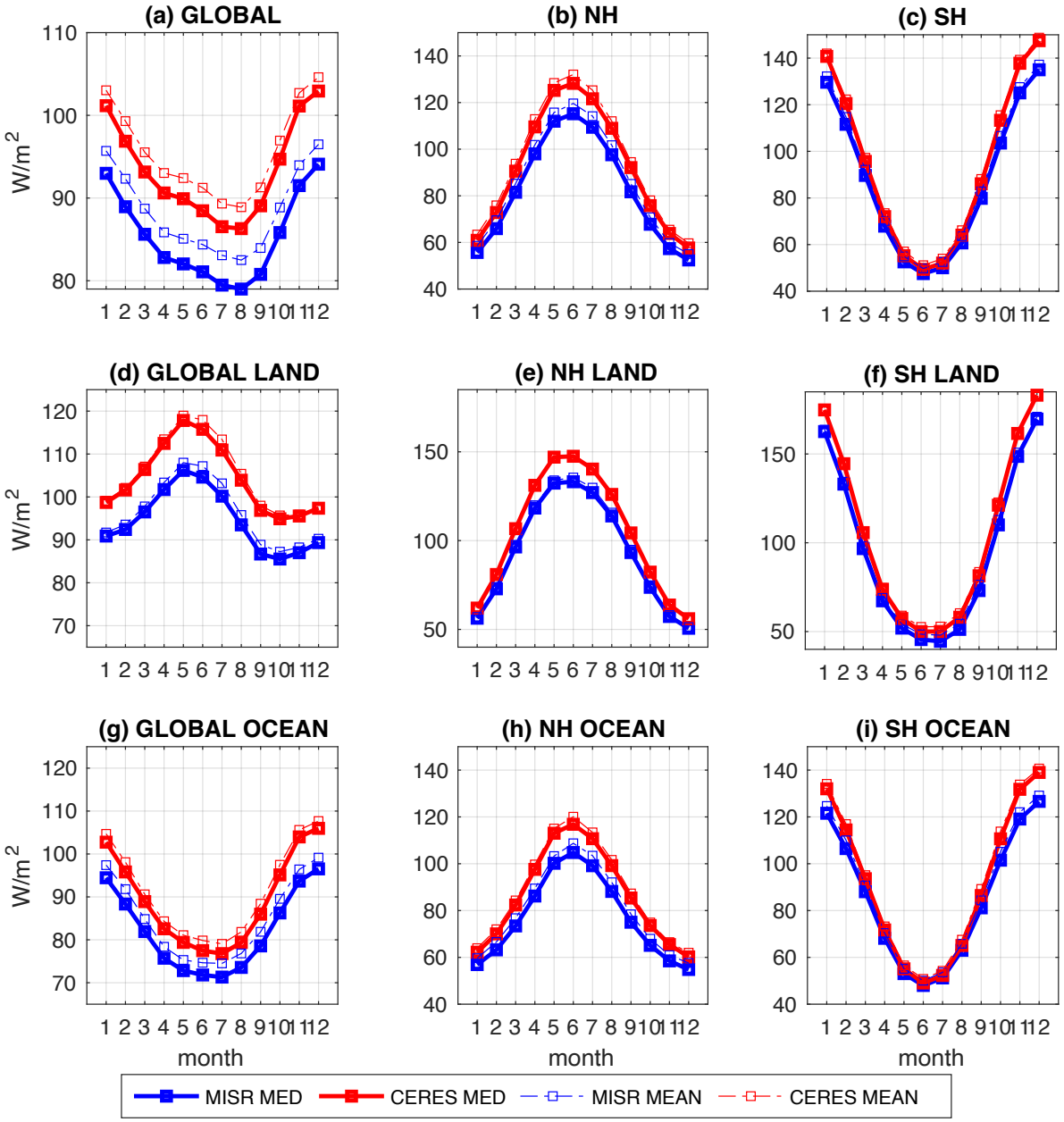


Where are the most skewed regions?

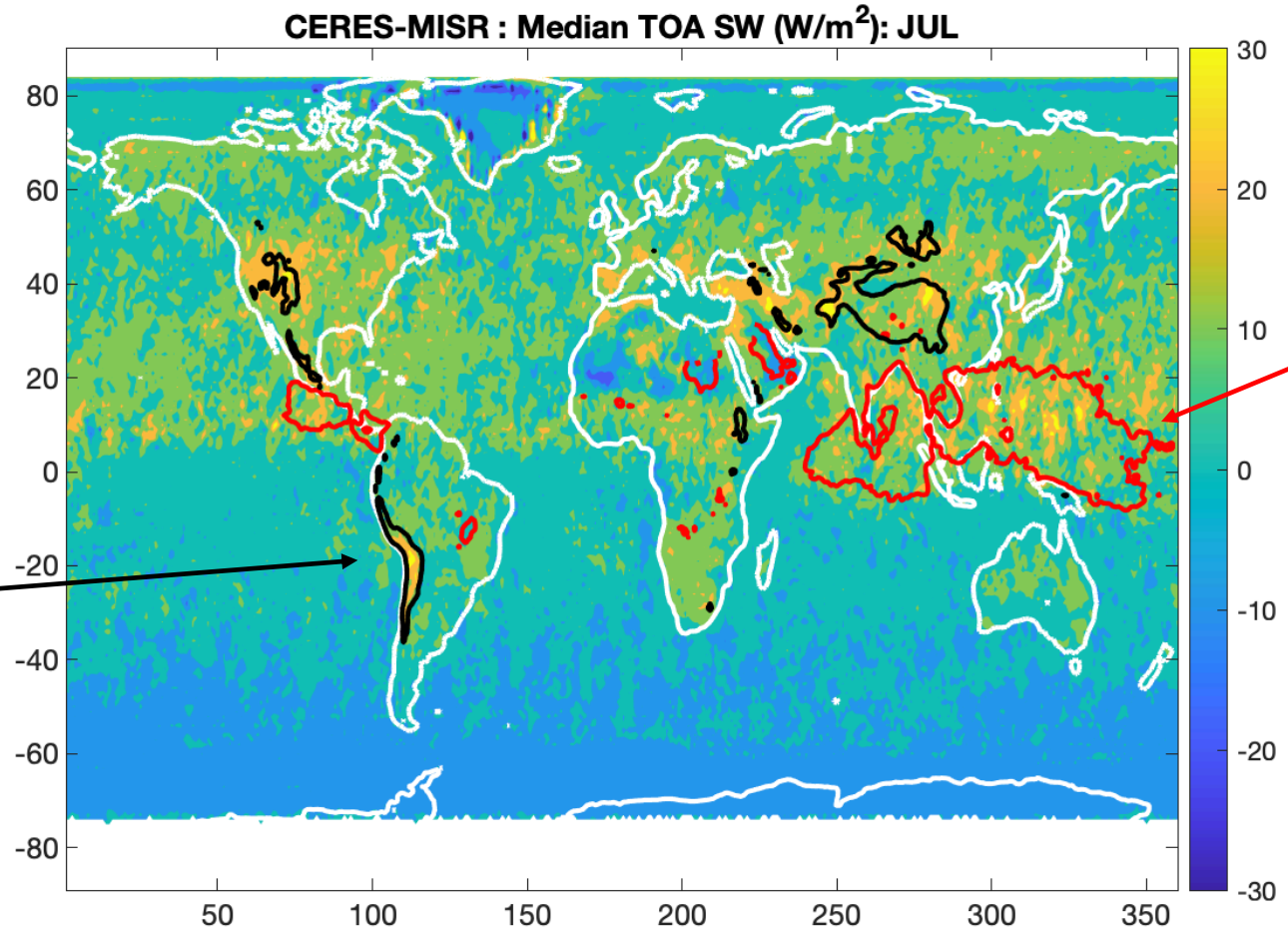


Seasonal variation of TOA SW (2000-2020)





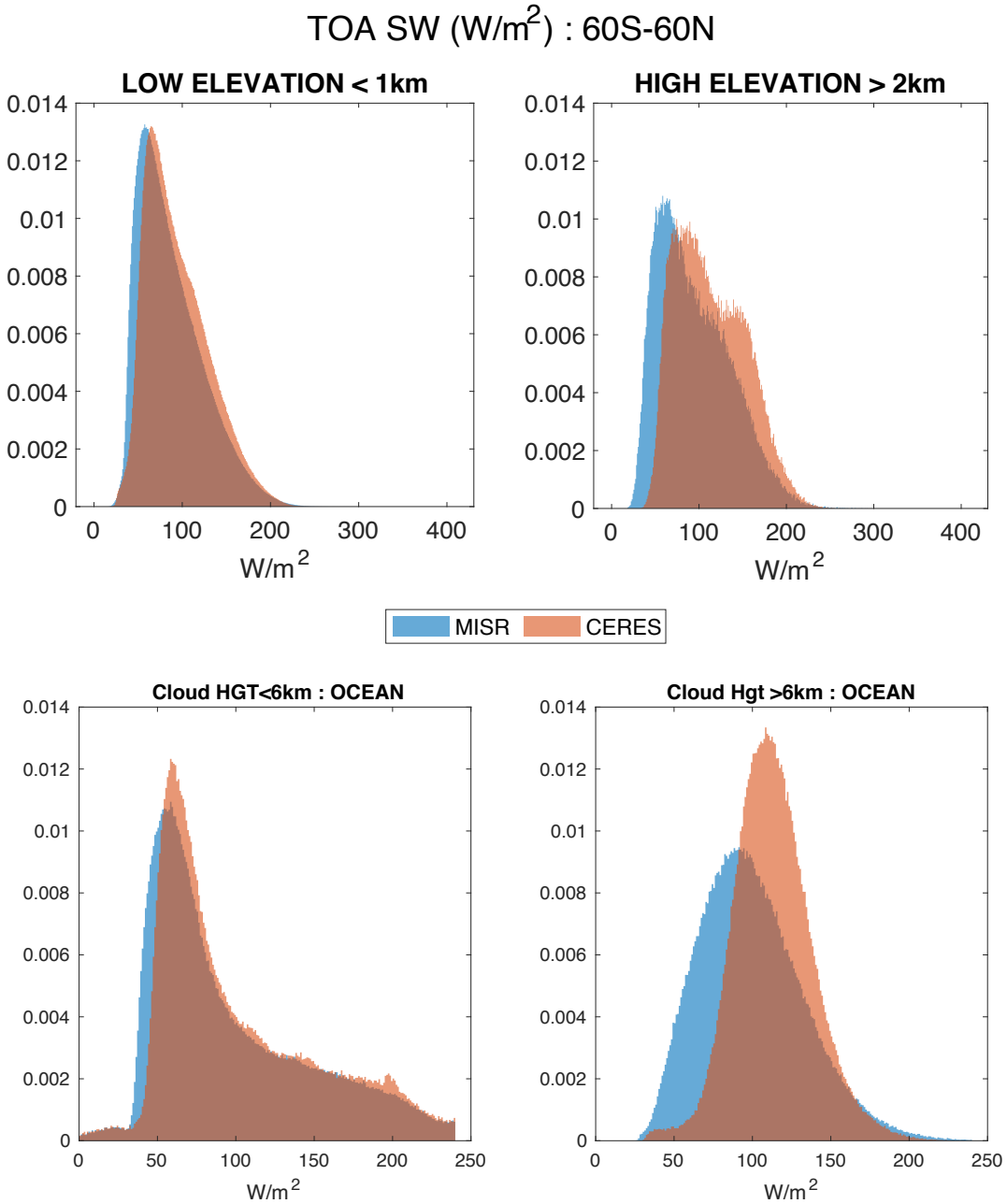
Difference between CERES - MISR



High Elevation
Z>2km

HIgh Cloud region
Cloud HGT > 9km

High vs. Low

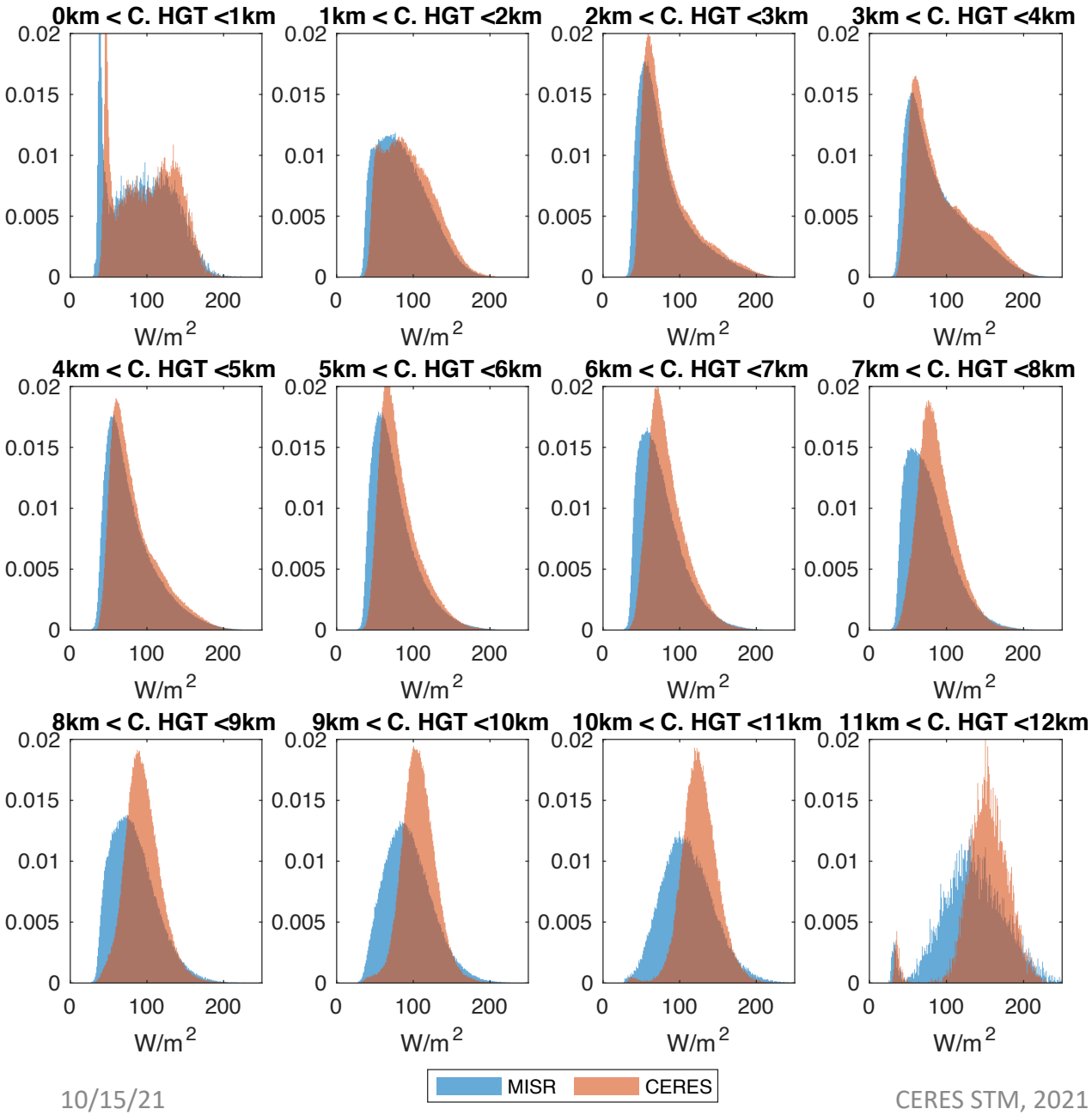


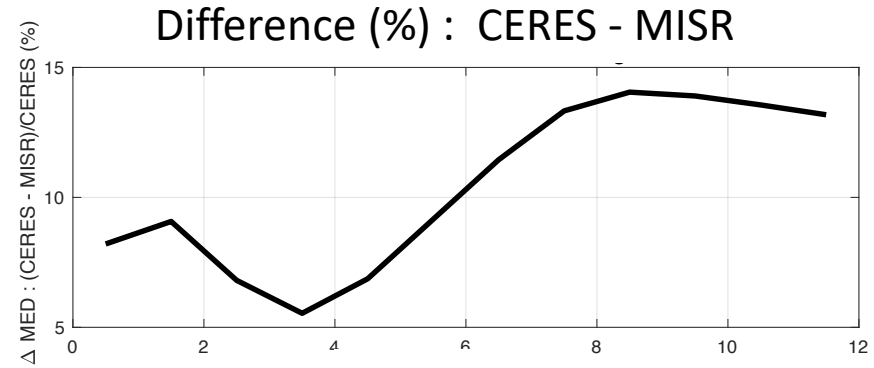
High Elevation

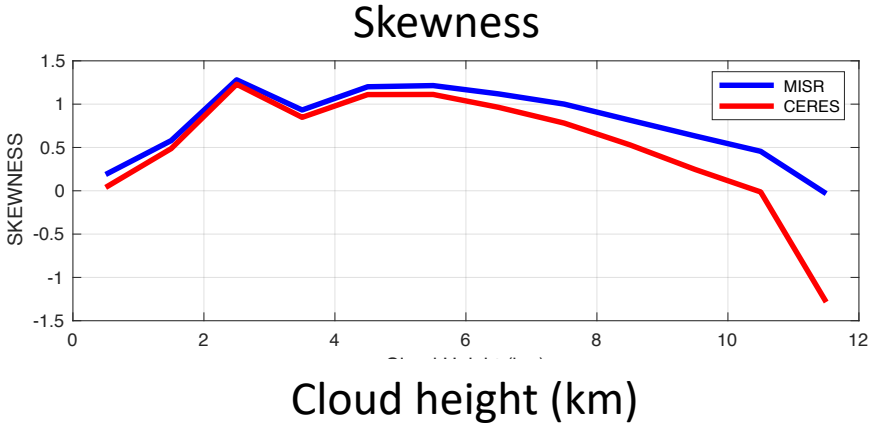
High Clouds

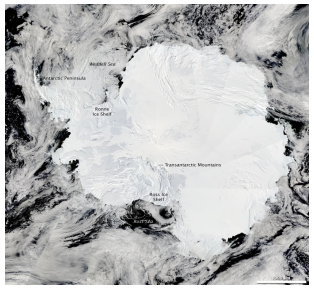
- Different anisotropy?
- 3D effects (Ham et al., 2017)?

Cloud Height





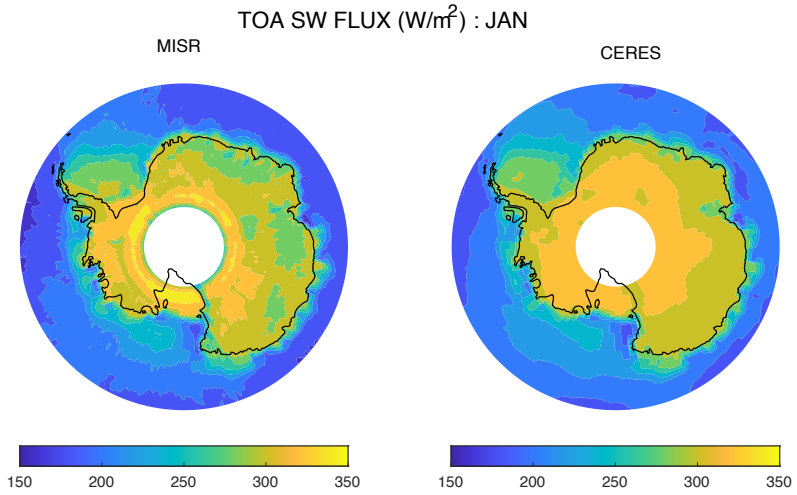




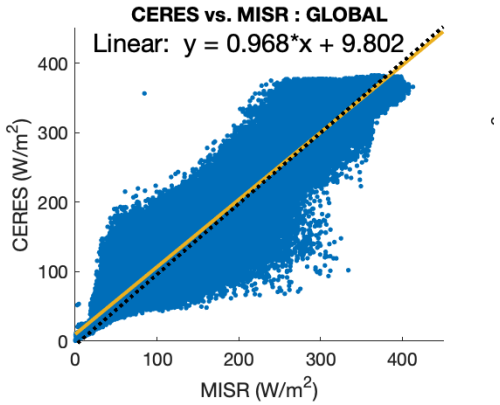
MODIS, Jan 30, 2009

Antarctic

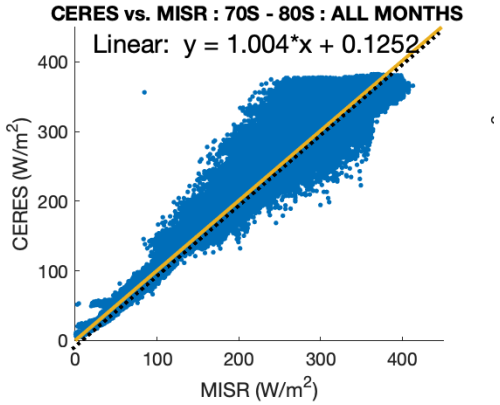
- Difference between two measurements are outstanding in Antarctica.
- CERES Flux shows saturated near 350 W/m^2 over Antarctica.



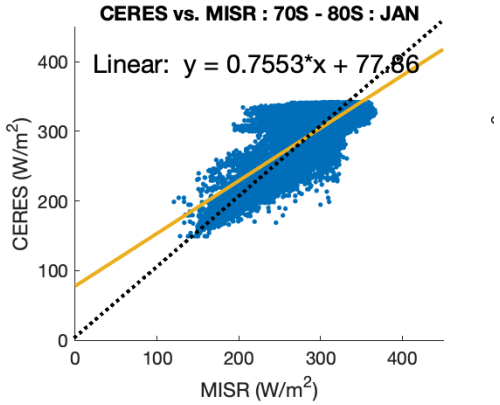
Global : all months



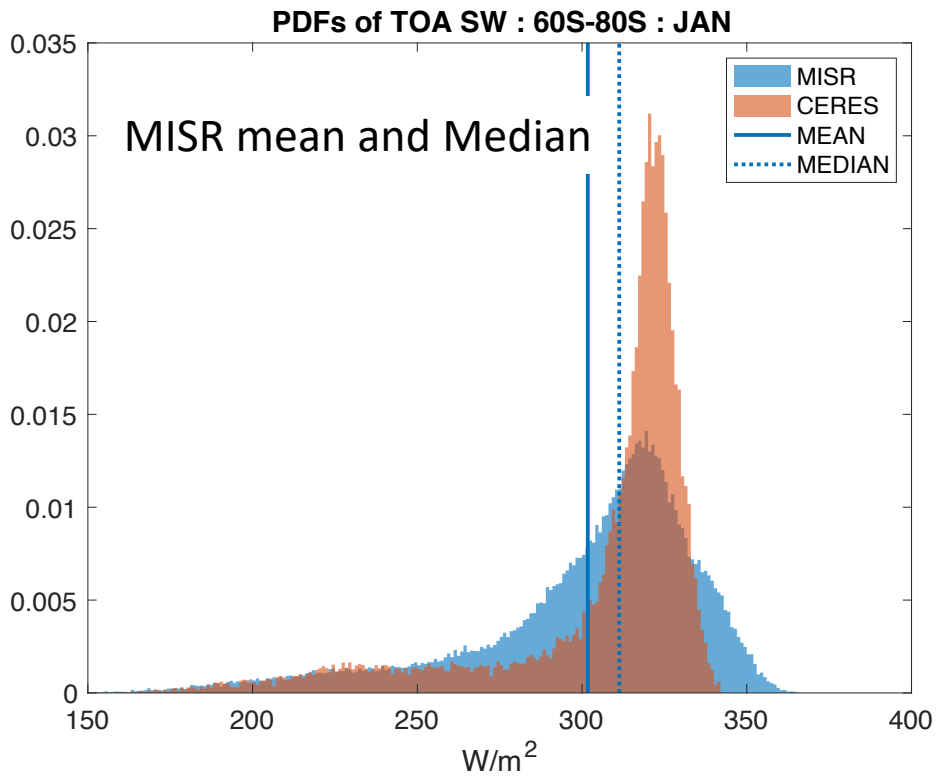
70S-80S : all months

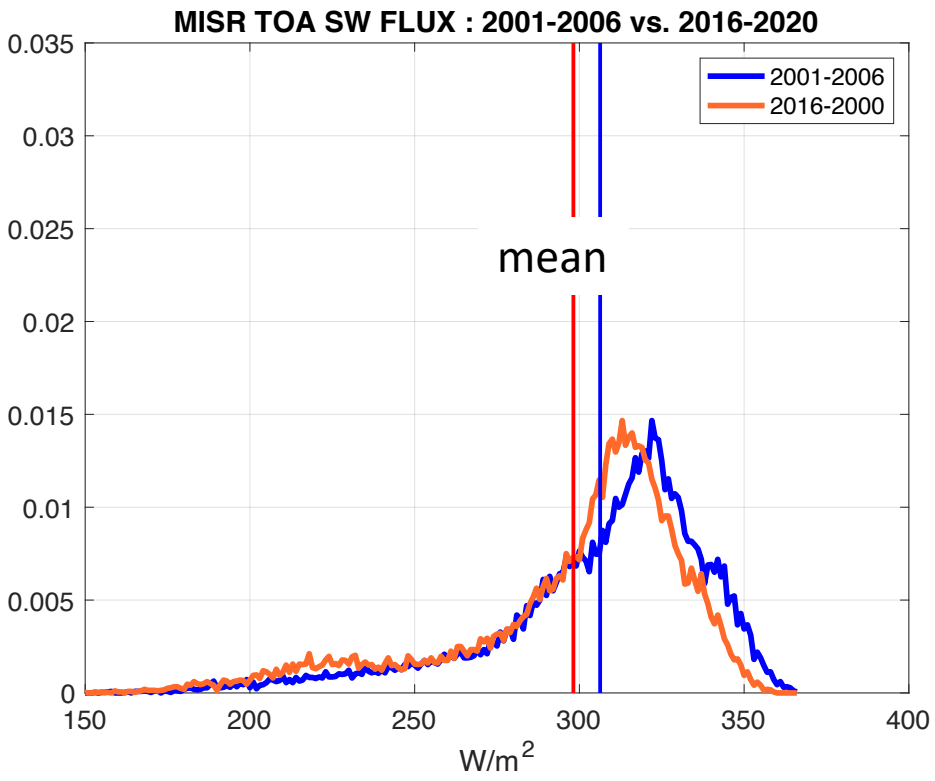


70S-80S : January



Antarctic : 70S-80S : JAN





summary

- Difference between MISR and CERES SW flux is large at high elevation and high cloud region.
- Should the PDFs be considered with caution in averaging TOA SW flux? Which value can well represent TOA SW flux?
- The PDFs may not be preserved but can change with time and location.
- Potential in MISR spectral albedo retrieval over Arctic and Antarctic, beyond 80S and 80N?