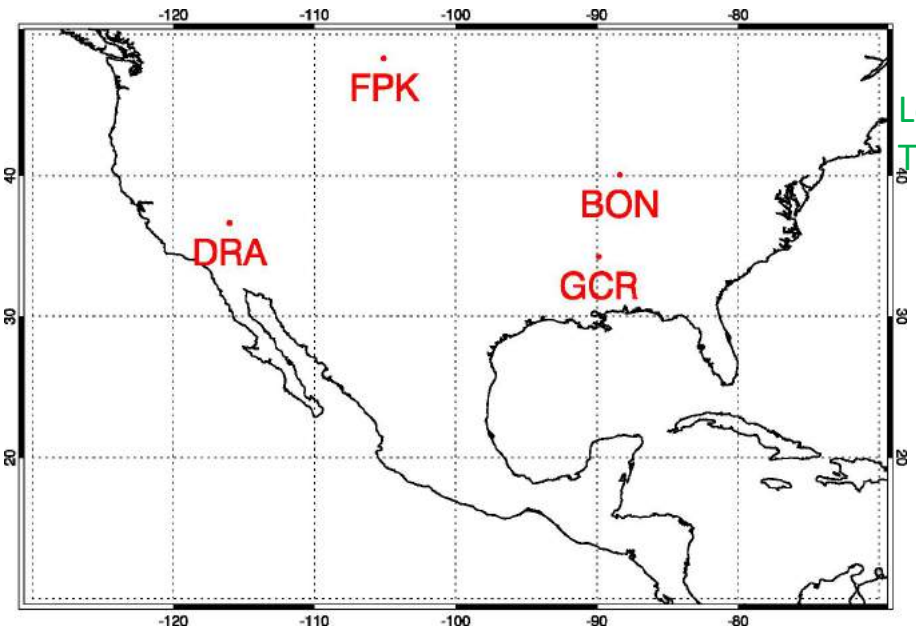
Updates of Clear-Sky Computations using GMAO Profiles

- Surface downward SW flux is included in the comparison.
- For Langley Fu-Liou Simulation, 3-hr-averaged GMAO profiles are used instead of instantaneous 3 hourly profiles since ground observation data are provided as 3-hr-averaged values.
- Comparison between simulation and observation is made over ground sites in US continent and tropical oceans.
- Fluxes from Langley Fu-Liou and GMAO Chou models are compared each other.
- Total aerosol optical depths from MERRA2 and Match are compared.
- The results are for January 2016 period for comparing with ground data.

Ground Sites in United States



FPK (Fort Peck, MT) 48.31N, 105.10W

BON (Bondville, IL) 40.05N, 88.37W

DRA (Desert Rock, NV) 36.63N, 116.02W

GCR (Goodwin Creek, MS) 34.25N, 89.87W

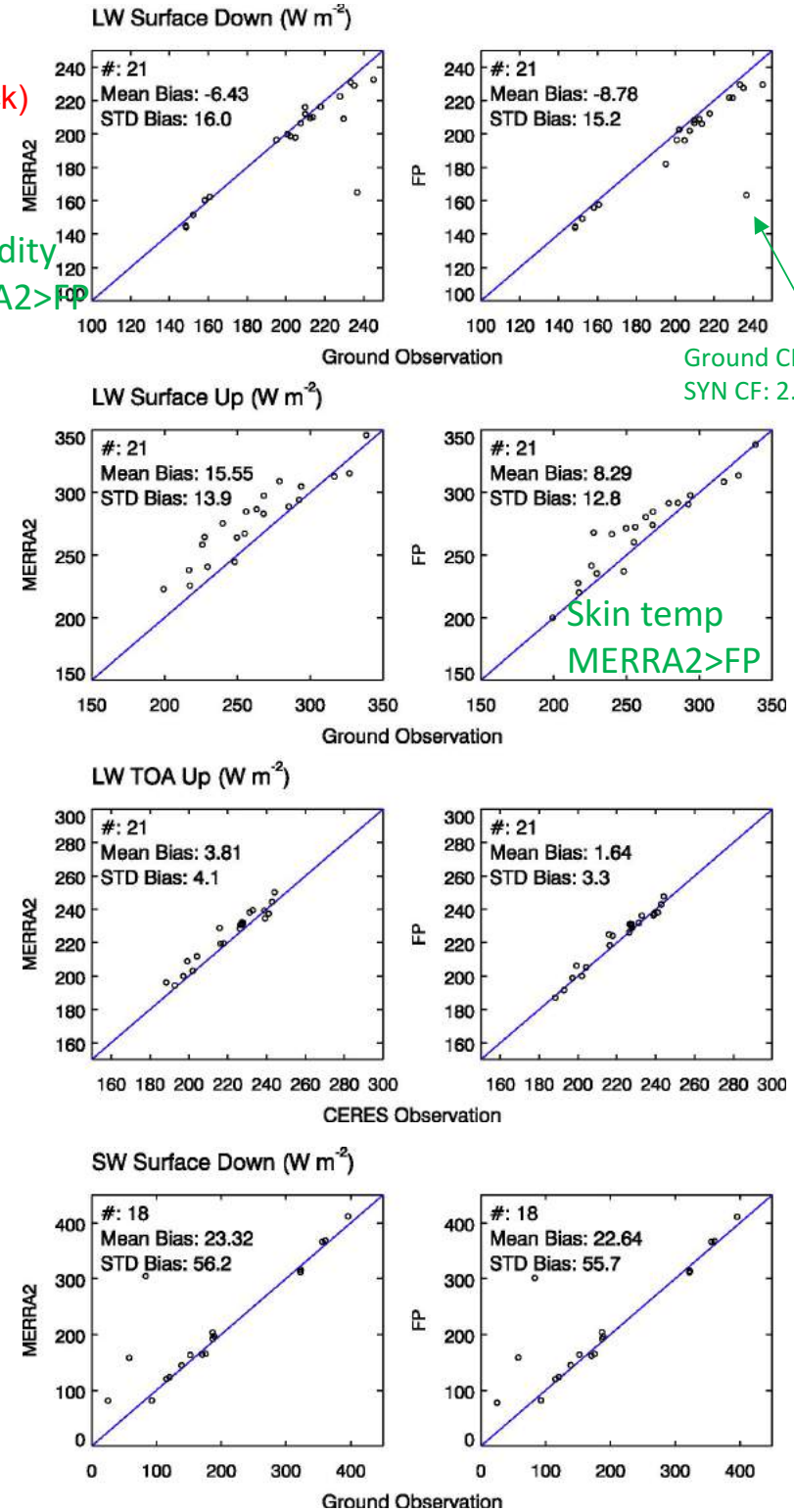
Comparison is made only for clear pixels. Clear pixels are chosen when at least one of SYN or ground cloud fractions < 5%.

FPK
(Fort Peck)

Lower Humidity
True>MERRA2>FP

Ground CF: NA
SYN CF: 2.8%

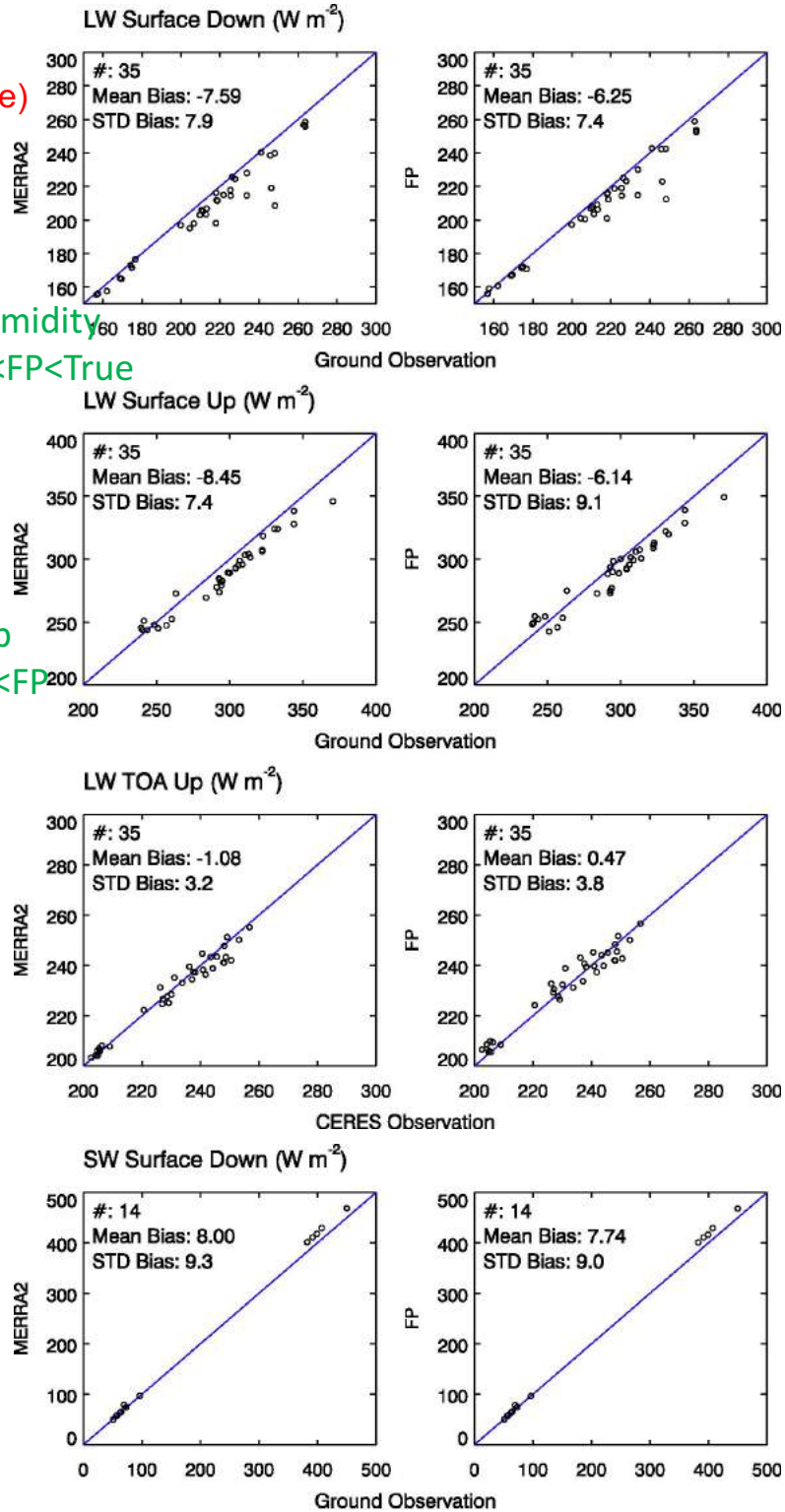
Skin temp
MERRA2>FP



BON
(Bondville)

Lower Humidity
MERRA2<FP<True

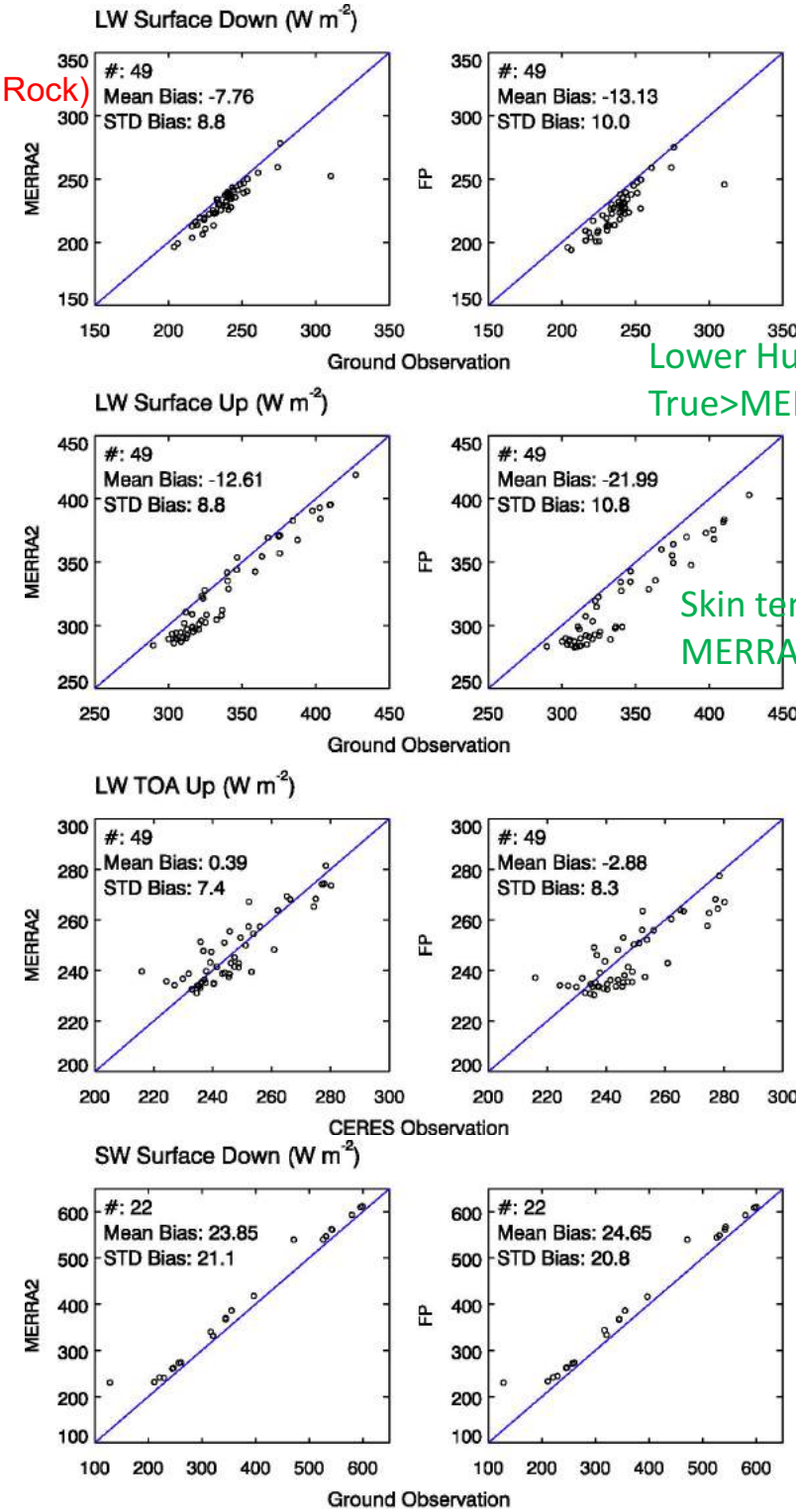
Skin temp
MERRA2<FP



DRA
(Desert Rock)

Lower Humidity
True>MERRA2>FP

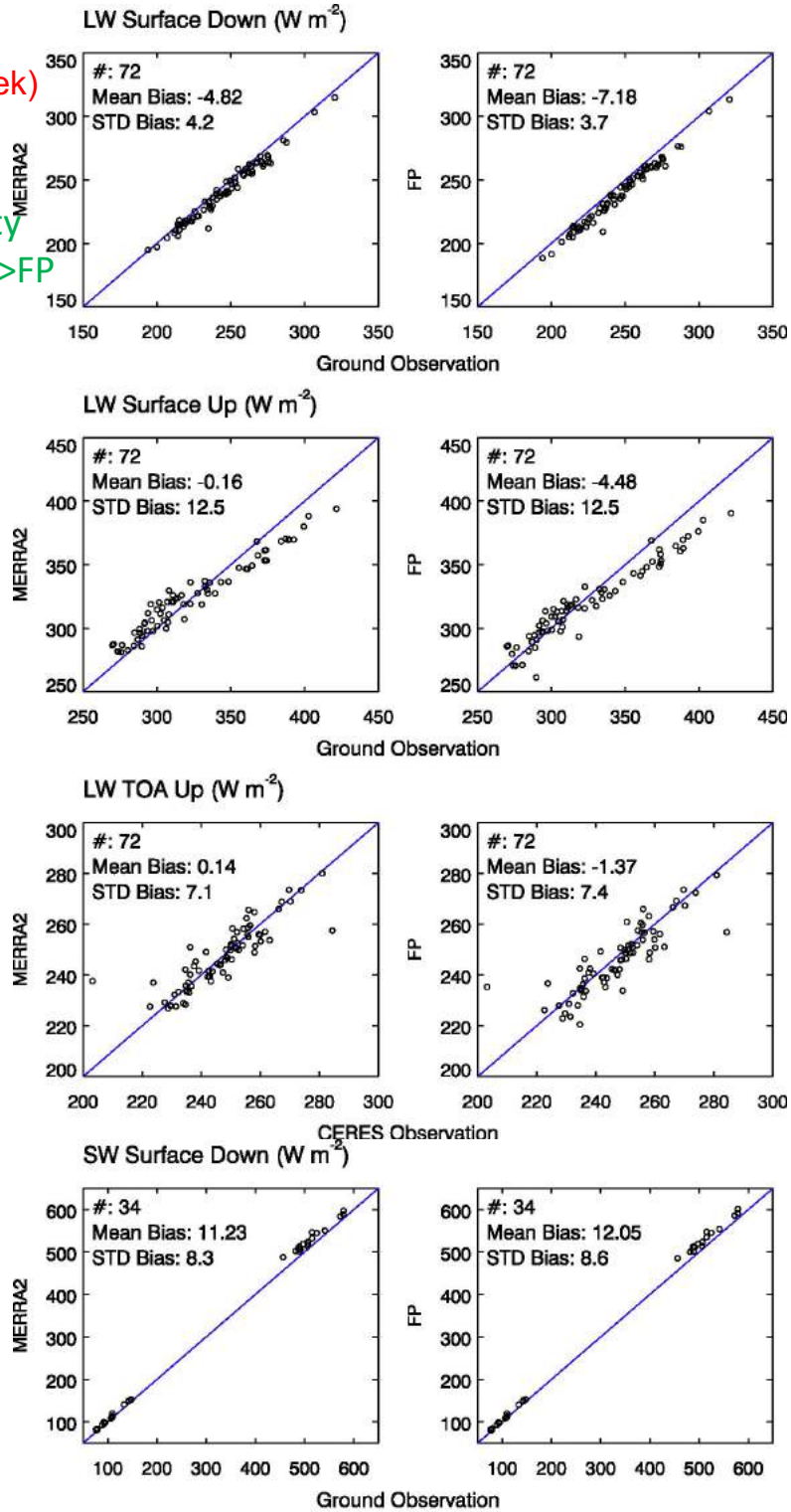
Skin temp
MERRA2>FP



GCR
(Goodwin Creek)

Lower Humidity
True>MERRA2>FP

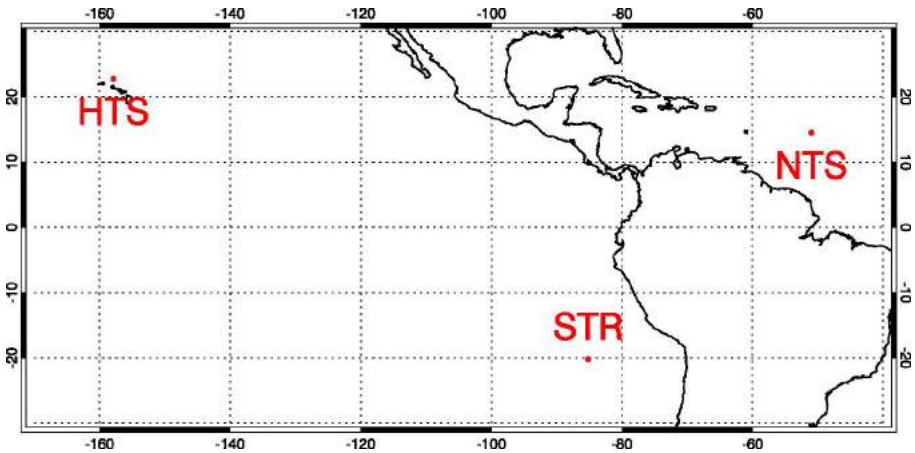
Skin temp
MERRA2>FP



In US ground sites…

- Compared to upward LW fluxes, simulated surface down LW fluxes often show a better agreement with observation since the LW down fluxes are free from the assumption of surface emissivity and skin temperature.
- For all four sites in US, simulated surface downward LW fluxes have negative (–5 to –10 W m^{-2}) biases.
- Surface down SW fluxes show a quite good linear relationship. However, there seems to be a slight positive biases in simulation.
- Both LW and SW surface down fluxes indicate underestimates of near-surface water vapor amounts?

Buoy Sites in Tropic Oceans



HTS (Hawaii Time Series Buoy)

22.77N, 157.90W

NTS (North Tropical Atlantic Buoy)

14.50N, 51.0W

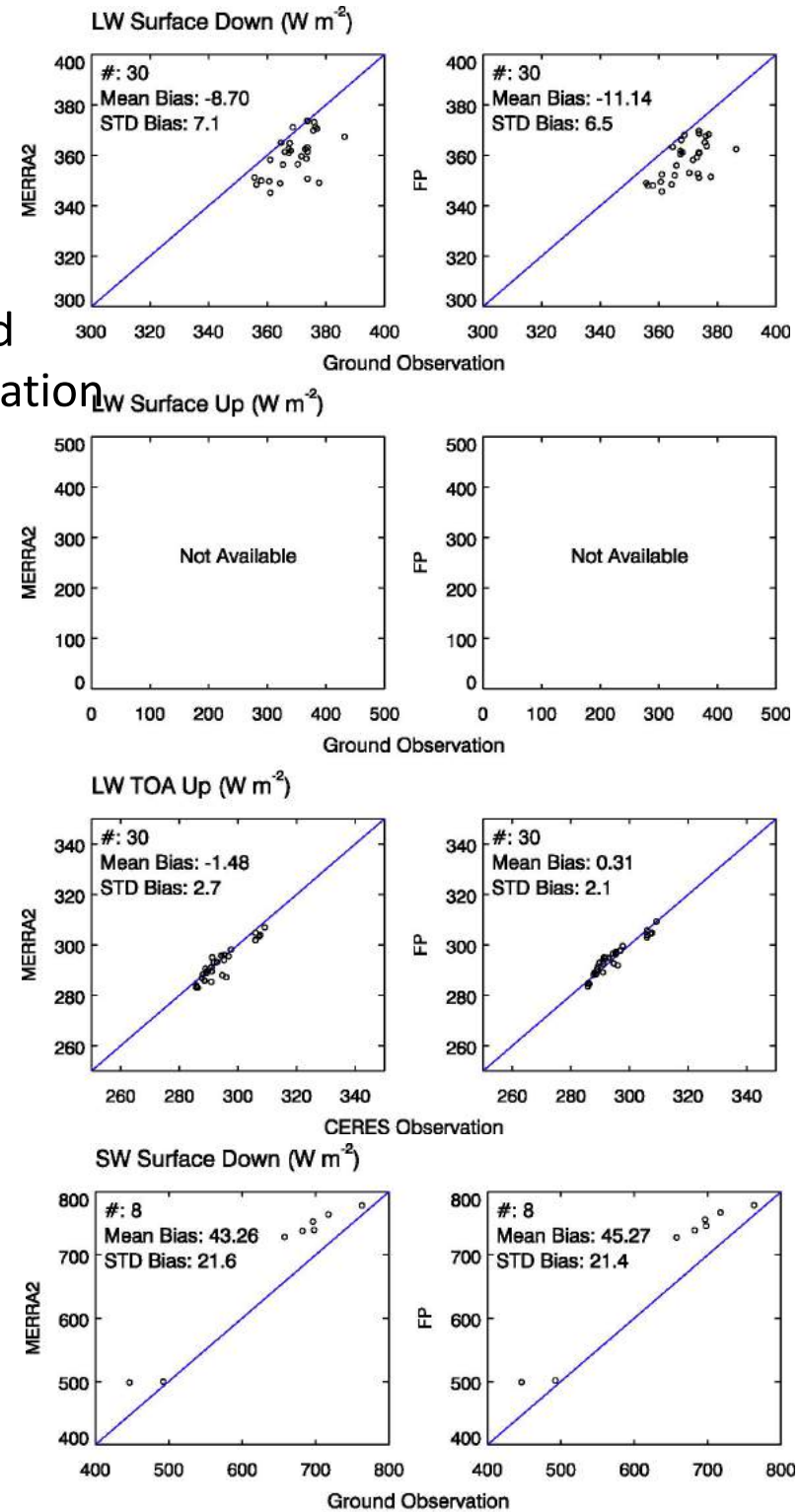
STR (Stratus Buoy)

20.20S, 85.20W

HTS
(Hawaii Time Series Buoy))

Ground CF is NA in HTS.

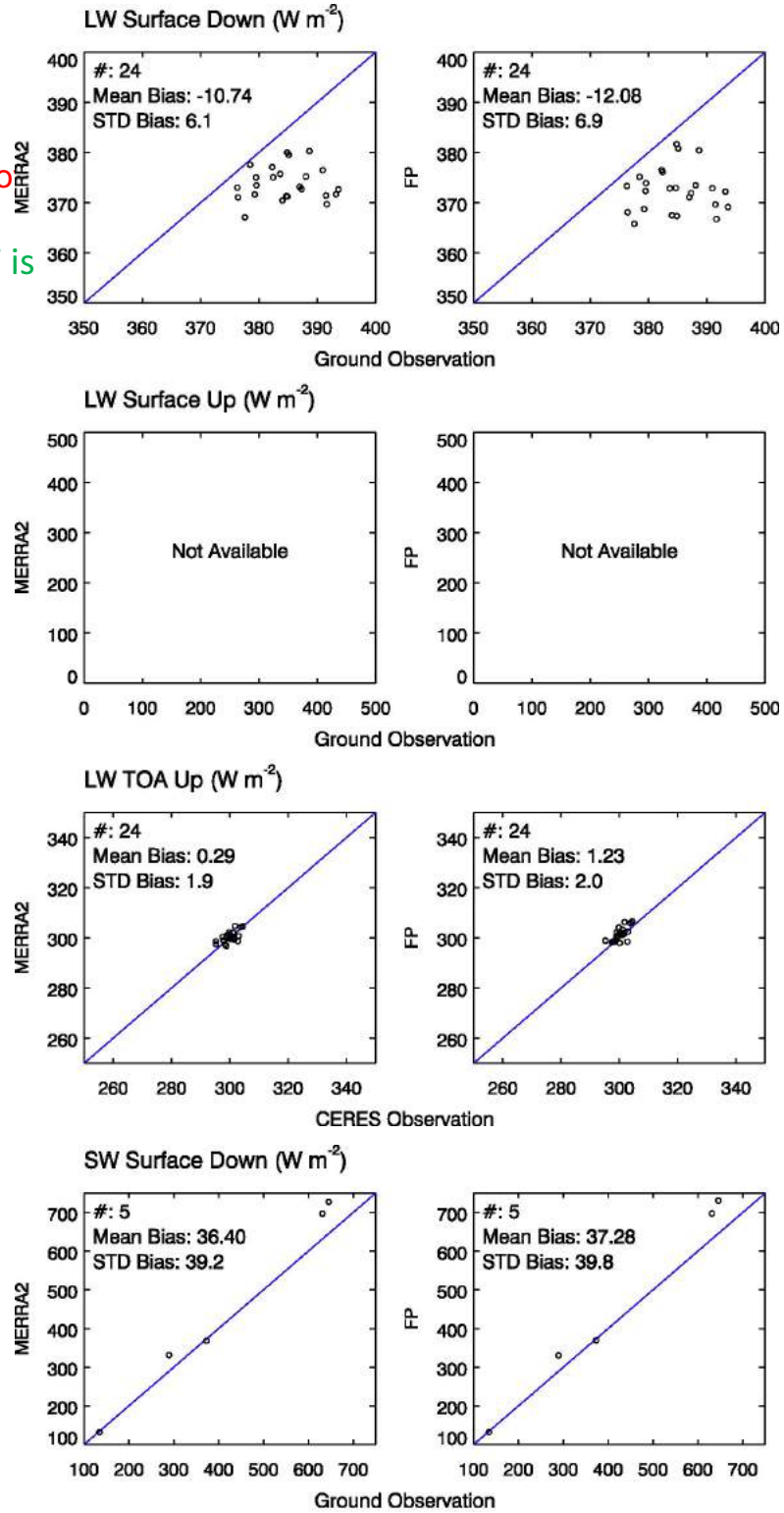
Low cloud contamination



NTS

North Tropical Atlantic Buoy

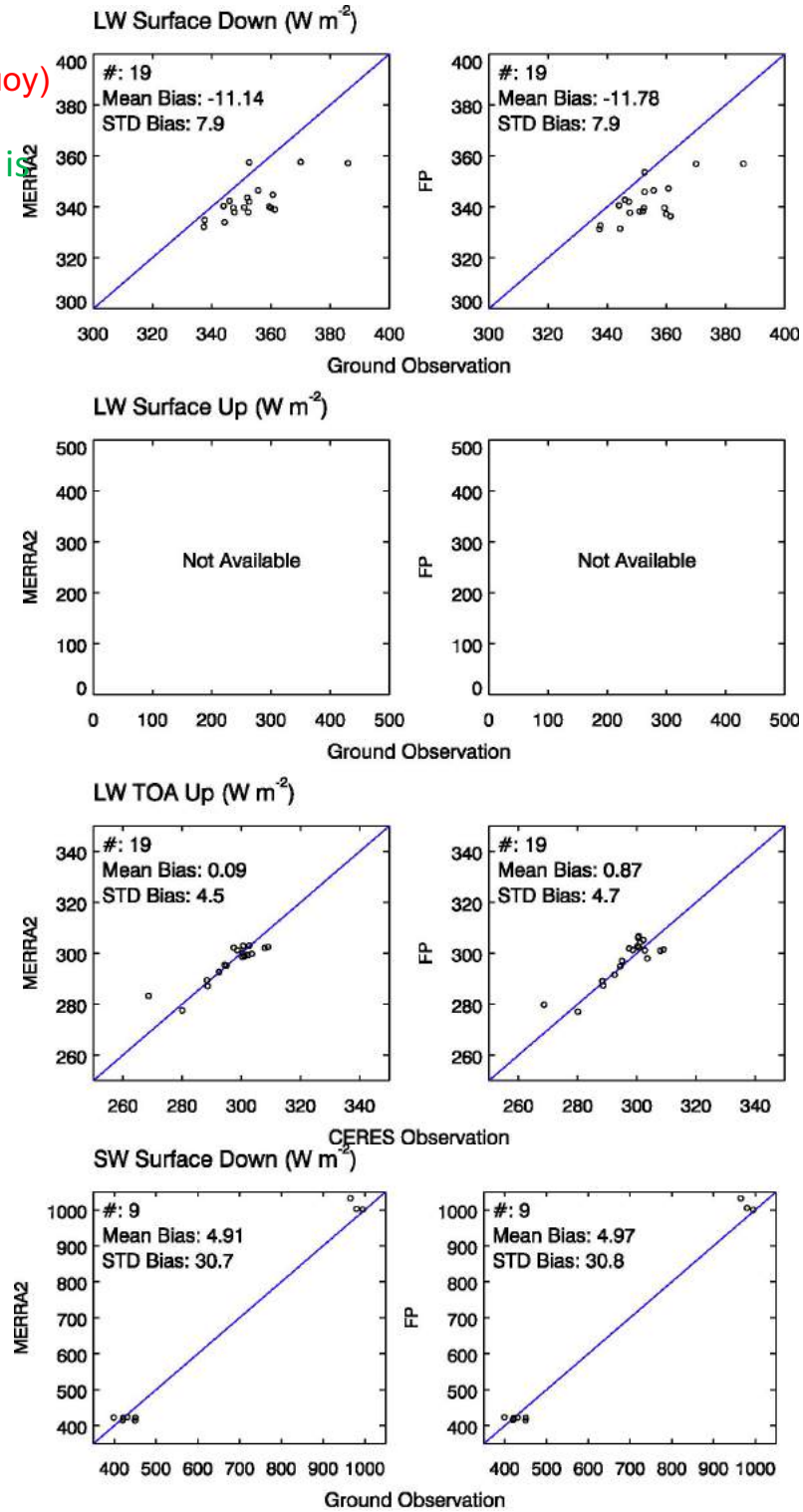
Ground CF is NA in NTS.



STR

(Stratus Buoy)

Ground CF is NA in STR.



In tropical buoys…

- Clouds are frequently occur and the number of clear pixels is much smaller compared to US continent.

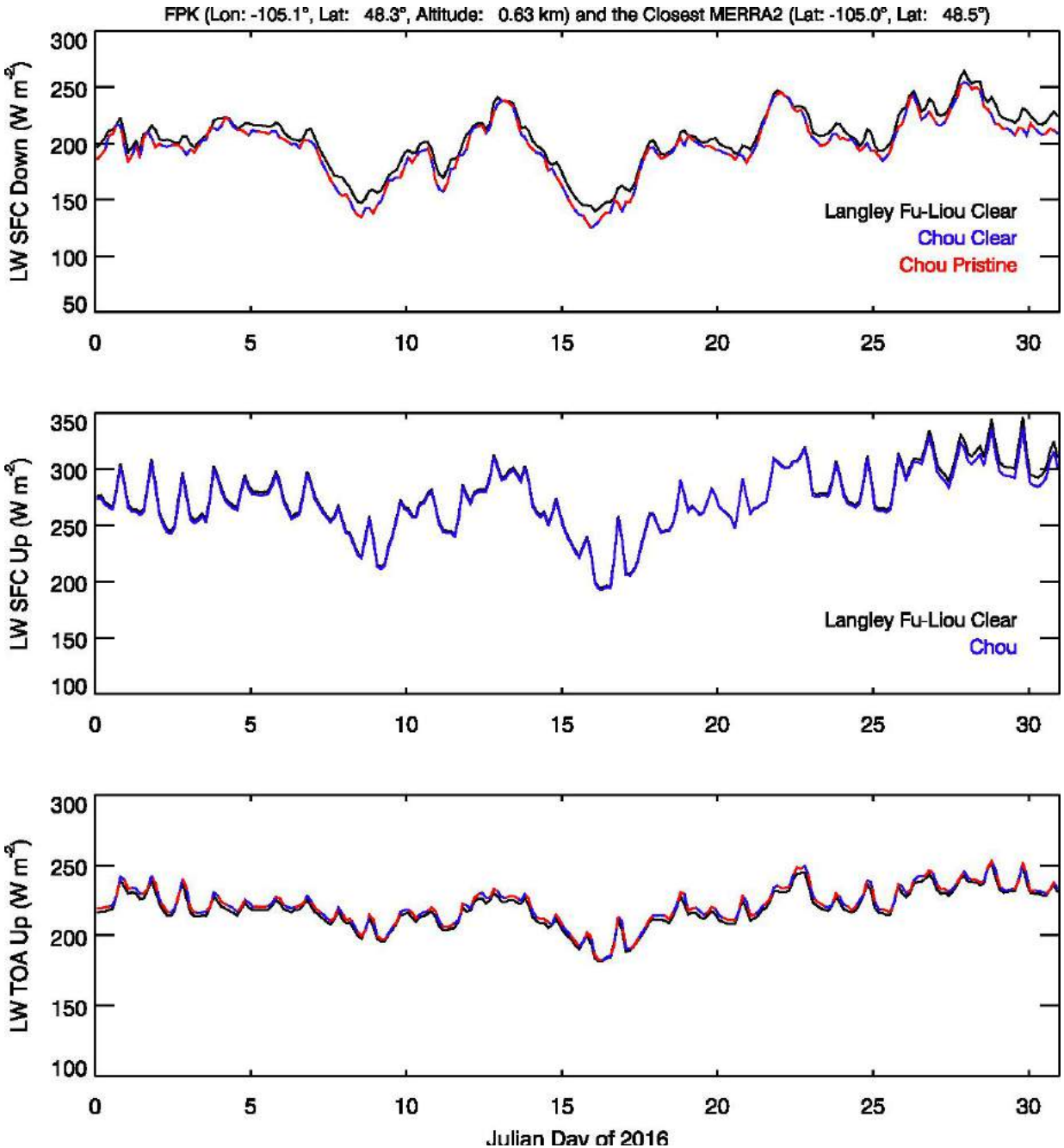
- Surface downward LW fluxes show more scatterend patterns from observations, while TOA upward LW fluxes show a good agreement with CERES observations.

- Surface downward SW fluxes are positively biased to ground observations.

- One of reasons of scattered patterns in LW comparison is due to low cloud contamination since ground-based cloud fraction is not availble in these ocean sites. Impact of the low cloud contamination can be small in TOA upward LW flux.

Comparison of Clear-Sky Fluxes from Langley Fu-Liou and Chou Models

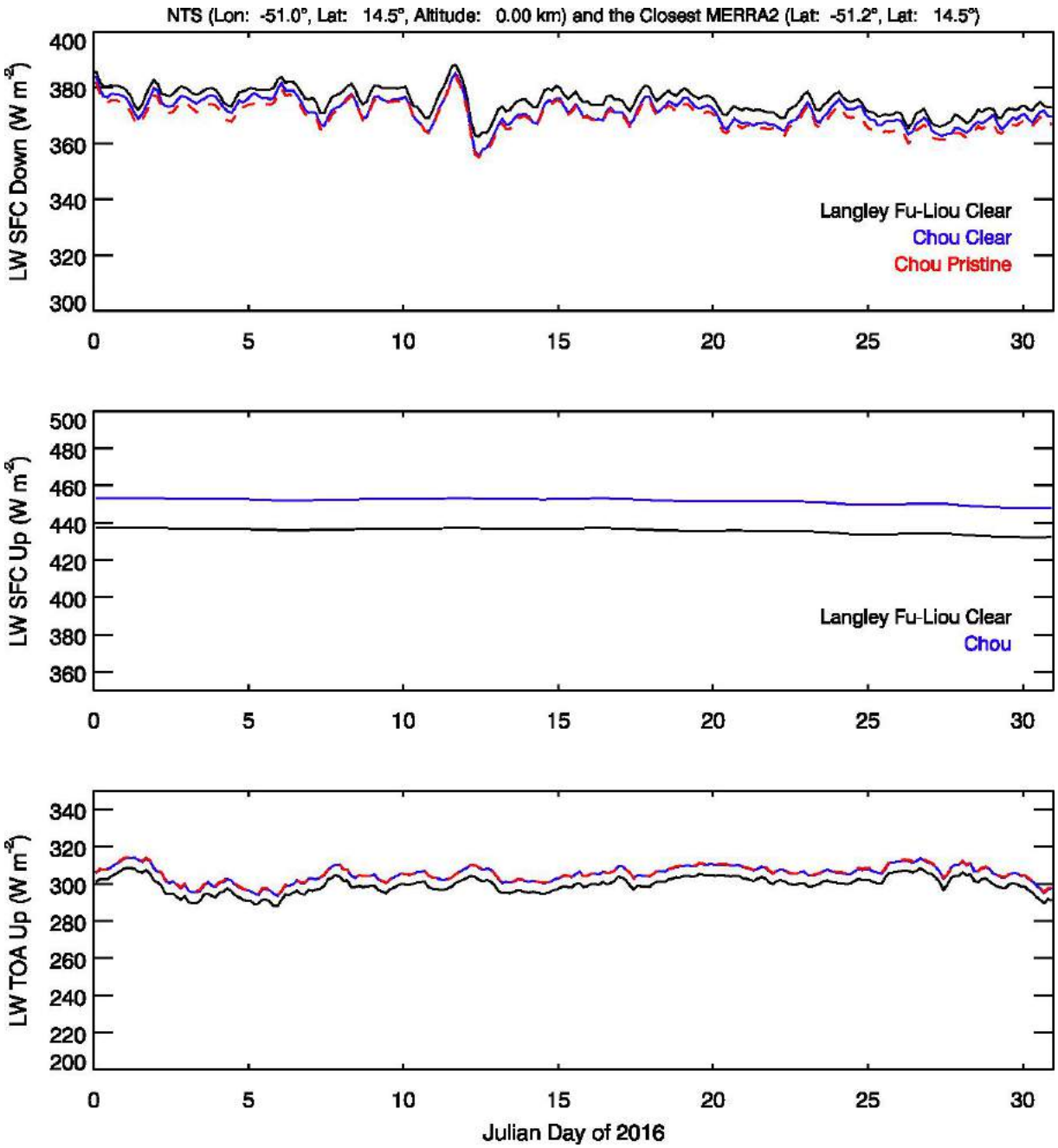
US Site, FPK (Fort Peck, MT) 48.31N, 105.10W



- Same profiles from MERRA2 are used to compute clear-sky fluxes.
- LW downward surface flux from Langley Fu-Liou model is greater than the flux from Chou Model (Chou LW surface flux has a larger negative bias in comparison to ground-observation).
- For US sites, both models seem to be use similar surface emissivity.
- At TOA, Chou LW upward flux is slightly larger because it is more transmissive.

Comparison of Clear-Sky Fluxes from Langley Fu-Liou and Chou Models

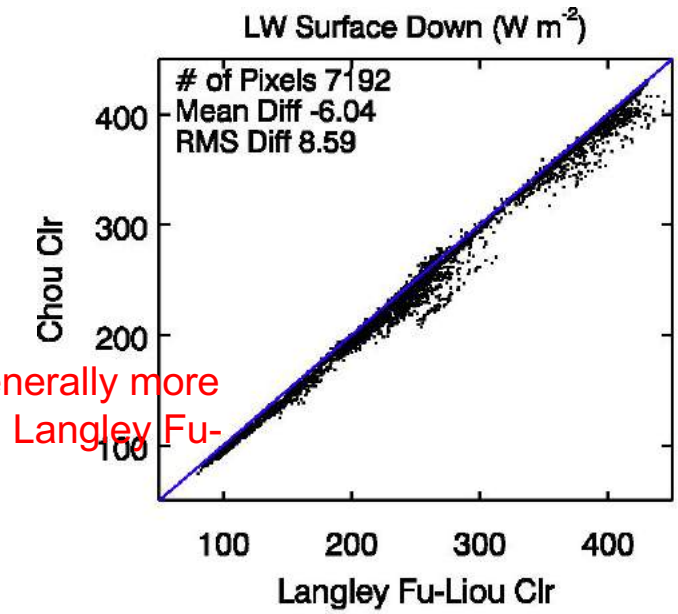
NTS (North Tropical Atlantic Buoy) 14.50N, 51.0W

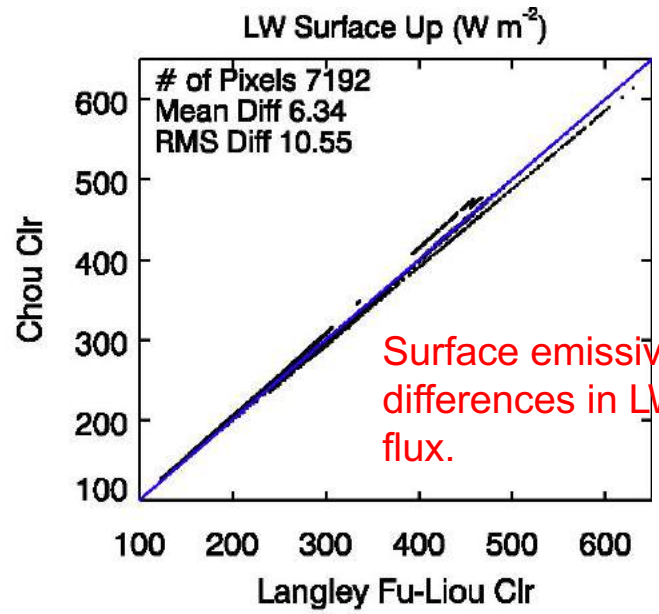


- As in US ground sites, Chou model is more transmissive than Langley Fu-Liou model, showing smaller LW surface down flux.
- Surface emissivity used in Chou model is larger than that used in Langley Fu-Liou model (Xianglei Huang's emissivity) over ocean. The difference propagates to TOA LW flux.

Comparison of Clear-Sky Fluxes from Langley Fu-Liou and Chou Models

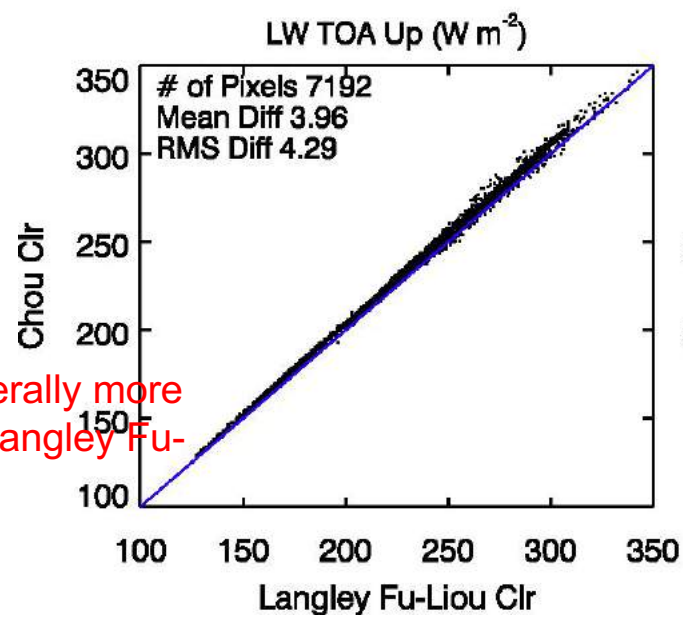
For all ground sites..

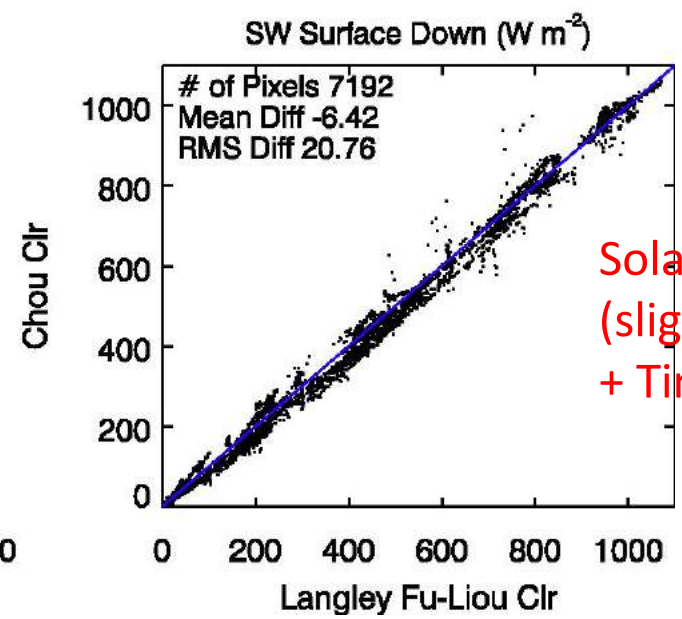




Chou model is generally more transmissive than Langley Fu-Liou.

Surface emissivity causes differences in LW surface upward flux.





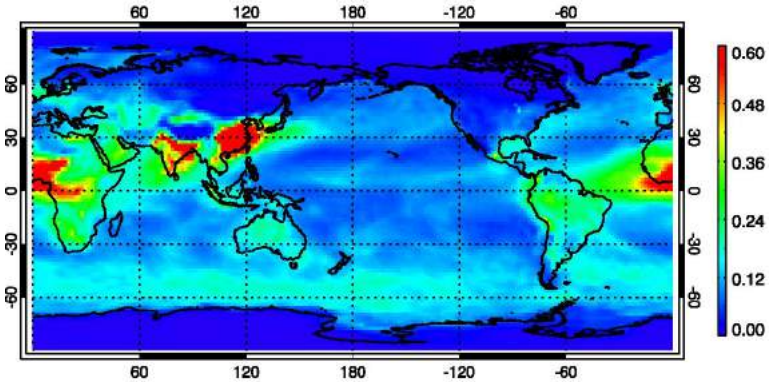
Chou model is generally more transmissive than Langley Fu-Liou.

Solar insolation diff (slight location diff + Time integration)

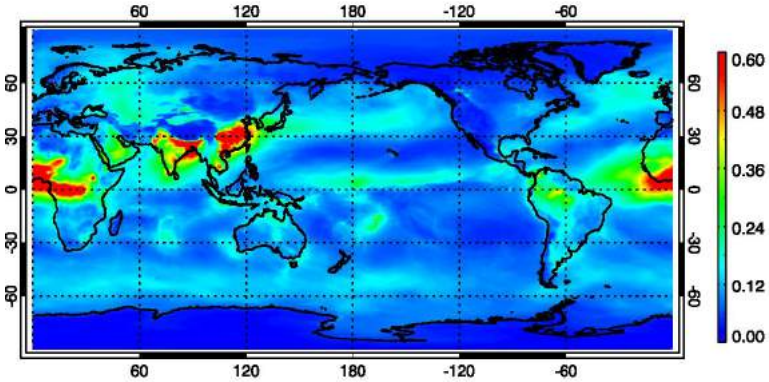
MATCH vs MERRA2 Aerosol Optical Thickness

January 2016

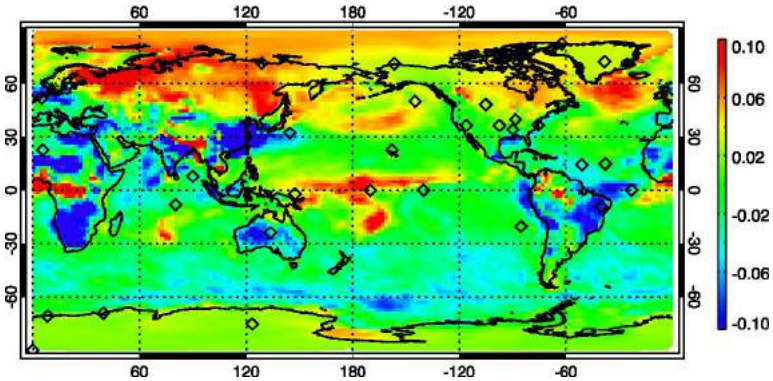
MATCH Aerosol Optical Depth (Mean: 0.1082)



MERRA2 Aerosol Optical Depth (Mean: 0.1084)



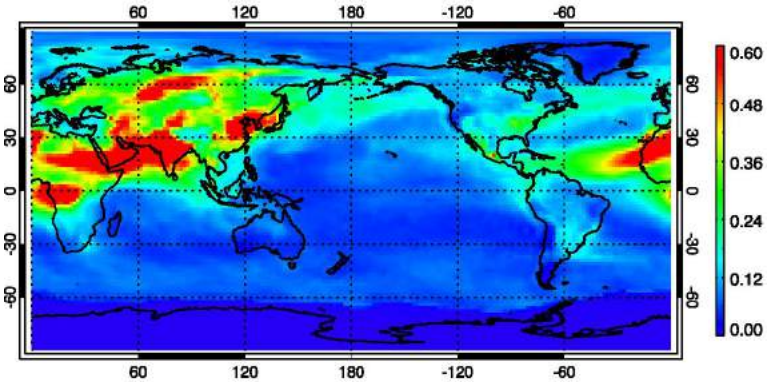
MERRA2 minus MATCH (Mean Diff: 0.0013)



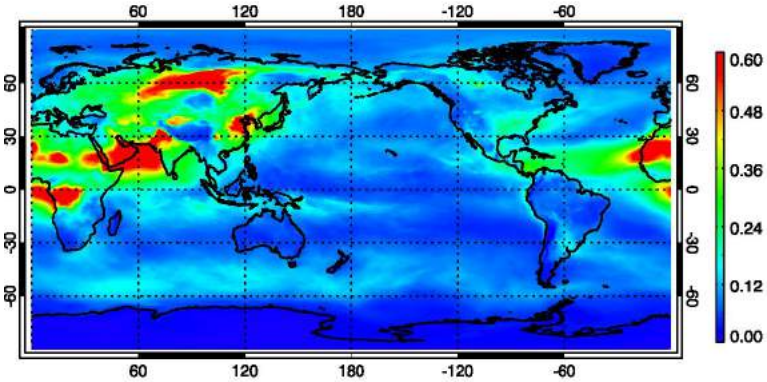
Over desert area, Merra2 is smaller

July 2016

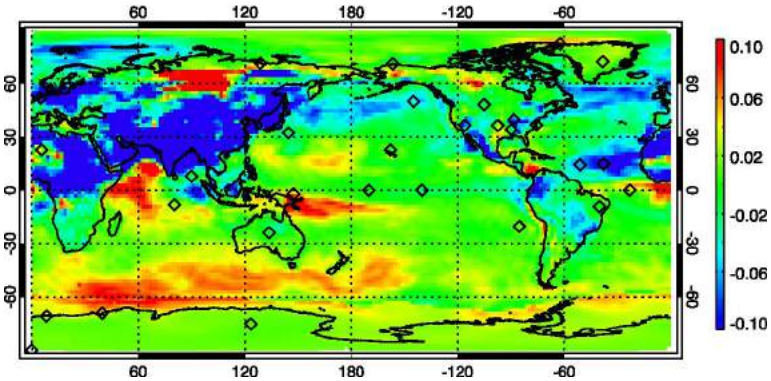
MATCH Aerosol Optical Depth (Mean: 0.1315)



MERRA2 Aerosol Optical Depth (Mean: 0.1221)



MERRA2 minus MATCH (Mean Diff: -0.0074)



Future Plans

- Use Match Aerosol instead of fixing aerosol optical depth as 0.001.
- Diurnal variation will be compared among different datasets (ground obs vs Langley Fu-Liou vs Chou).
- Use new version of FP (v5.16) using February 2017 data. In this case, surface validation data are not available for February 2017 and thus we can simply compare simulated clear-sky fluxes from MERRA2 and FP v5.16. The simulation can be extend to global domain.