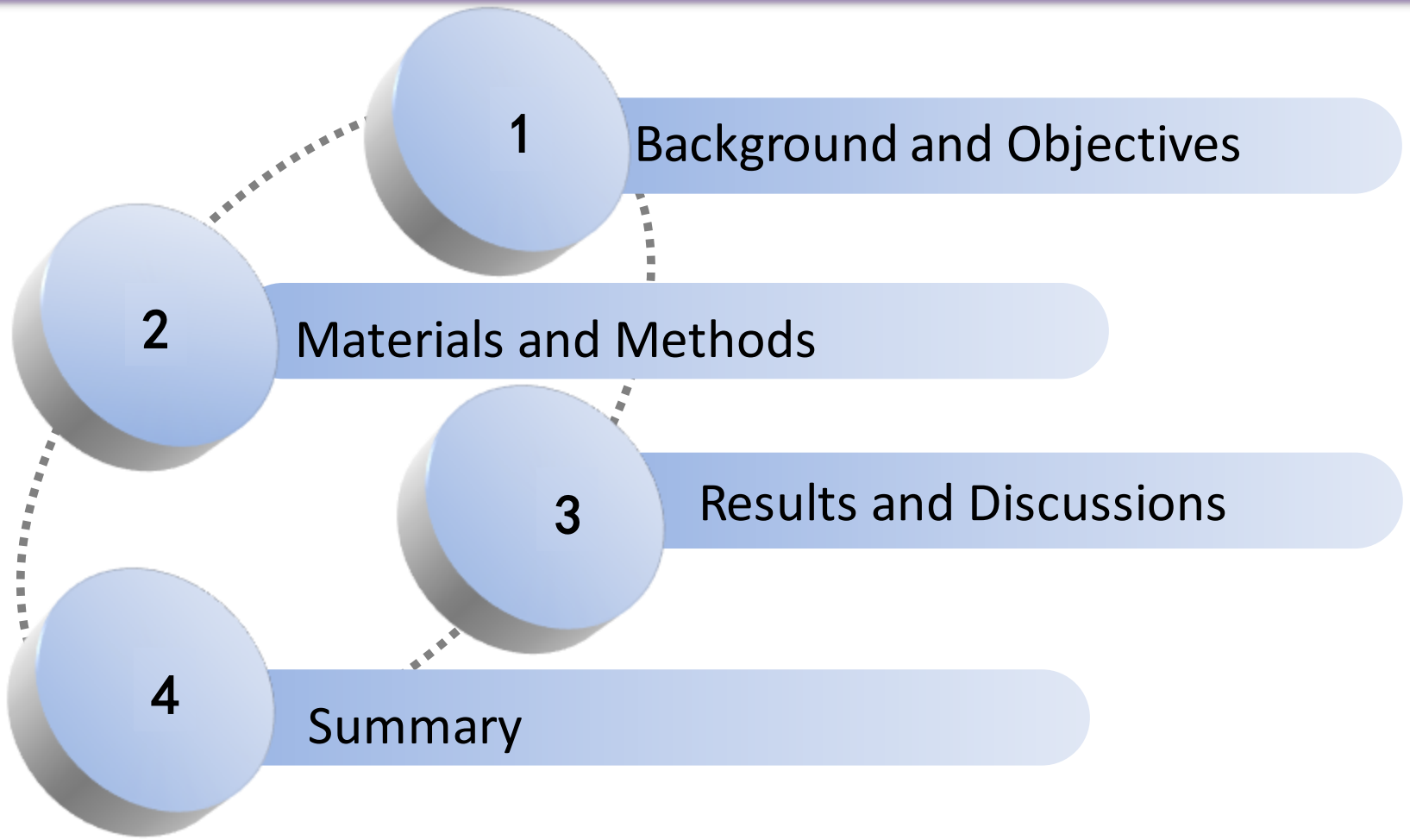
Yale 耶鲁大学-南京信息工程大学大气环境中心
Yale-NUIST Center on Atmospheric Environment

# Comparing MERRA surface global solar radiation and diffuse radiation against field observations in Shanghai

Reporter: Yue Kun

# OUTLINE


1
Background and Objectives
2
Materials and Methods
3
Results and Discussions
4
Summary

# Background and Objectives

- Solar radiation at the Earth's surface (surface solar radiation, SSR) is the ultimate energy source for life on the planet.
- It must rely on reanalysis to get more continuous spatial and temporal radiation data.
- Reanalysis have positive biases with observations, to radiation data, the main causes of biases may be light cloud and aerosol. Reanalysis' bias errors will affect the application. MERRA is one of reanalysis from NASA.
- Objective of this is to evaluation MERRA's global solar radiation and diffuse solar radiation against the observations in Shanghai, and reduce the errors.

# Materials and Methods

- Historical data: global solar radiation and diffuse solar radiation
  Shanghai(121.29° E 31.24° N) 2000.1-2012.9 $10^4$ $J/m^2d$

- MERRA: global solar radiation and diffuse solar radiation $10^4$ $J/m^2d$

- MODIS data:

  The MODerate resolution Imaging Spectrometer (MODIS) instrument is one of the first passive satellite radiometers designed to retrieve aerosols over the land and ocean. The instrument oboard the Terra (EOS-AM) in 1999,and aboard Aqua (EOS-PM) satellites in 2002.

  The daily level-2 AOD data (Collection 005) at 550 nm from the Terra and Aqua MODIS aerosol products (MOD04_L2, MYD04_L2) are applied in this study.

  Aerosol optical depth (AOD) is a measure of the opaqueness of air, and high values of AOD indicate poor visibility.

# Materials and Methods

$$b_{Sm} = \frac{S_m - S}{S_m}$$

$$b_{Sm} = a \cdot k_t + b$$

$$k_t = \frac{S}{S_e}$$

$$S_e = S_{sc}[1 + 0.033\cos(360t_d / 365)]\sin\beta$$

$$S = \frac{(1-b)S_m S_e}{aS_m + S_e}$$

$$b_{Dm} = \frac{D_m - D}{D_m}$$

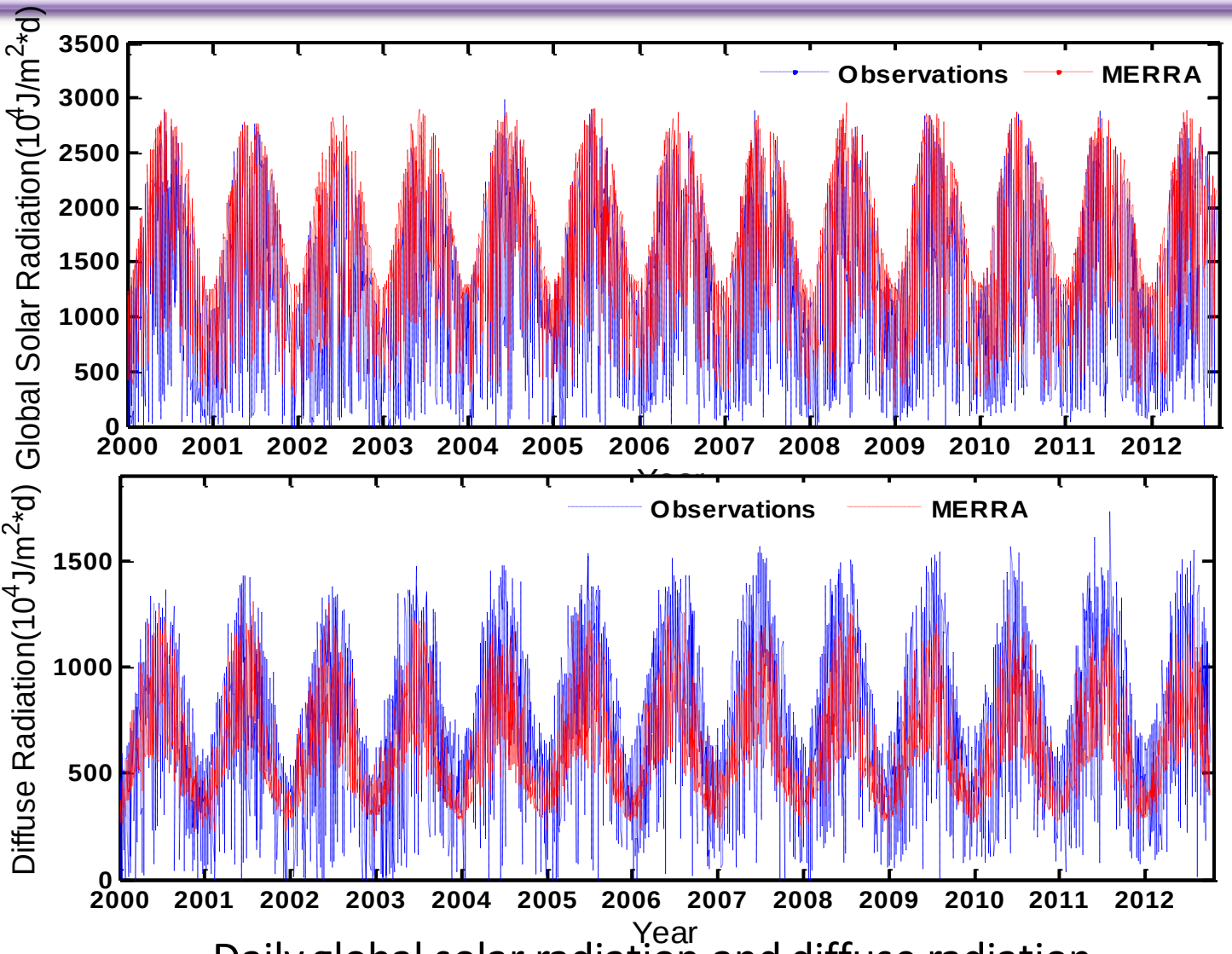
$$b_{Dm} = a \cdot AOD + b$$

$$D = (1 - a \cdot AOD - b) \cdot D_m$$



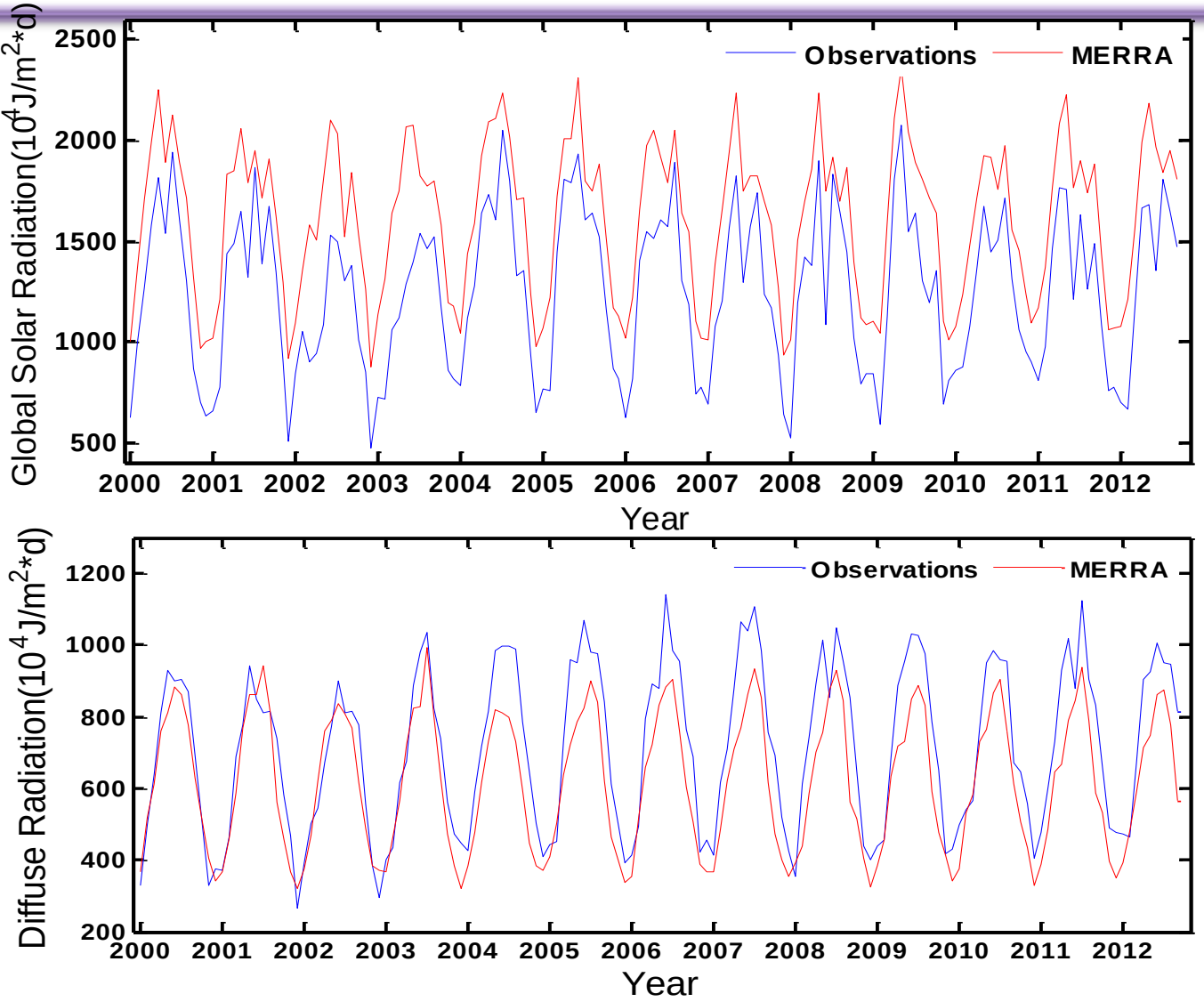
[*Gu et al.*,1999] [*Zhao et al.*,2013]

# Results and Discussions



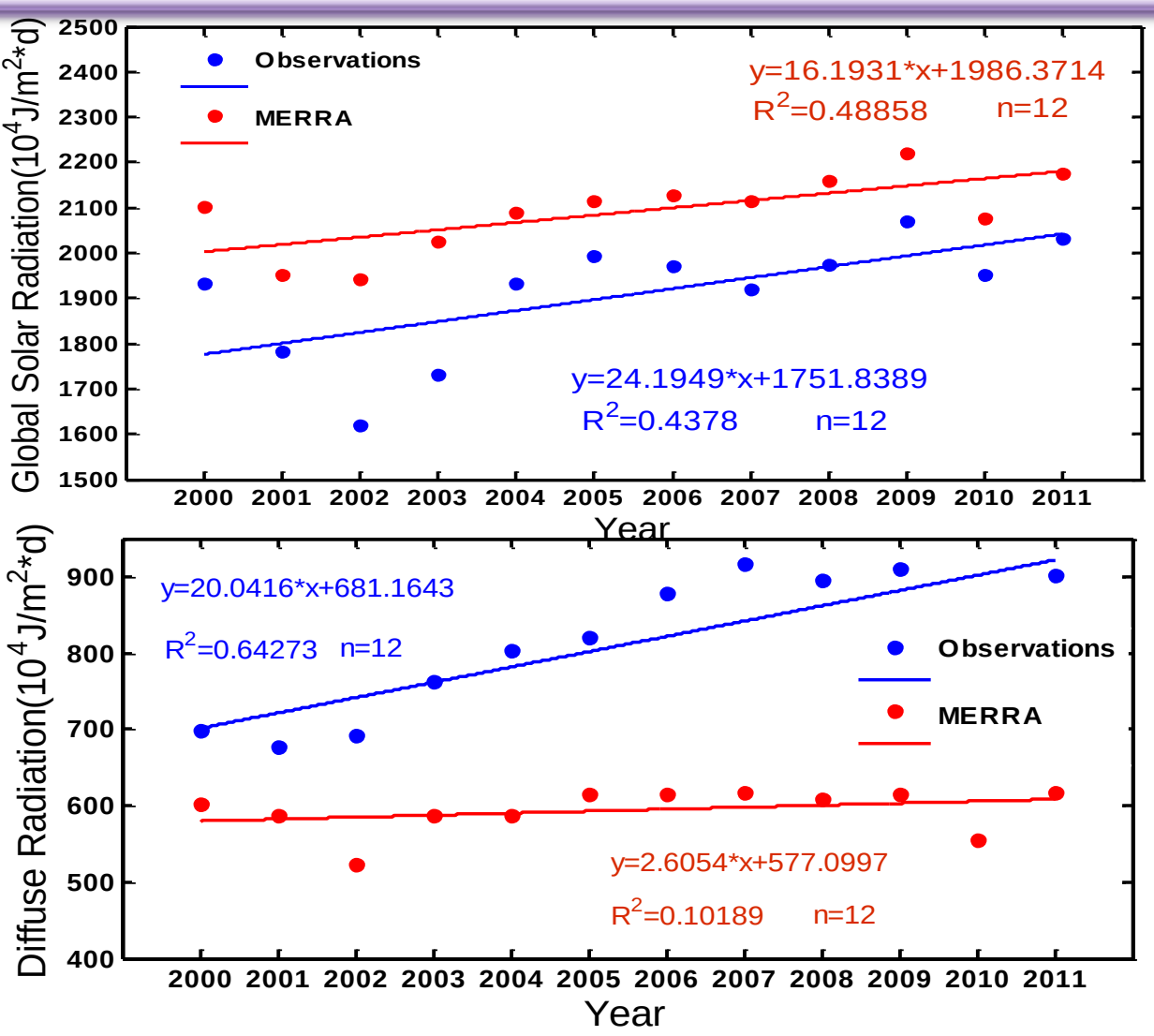

Daily global solar radiation and diffuse radiation

# Results and Discussions



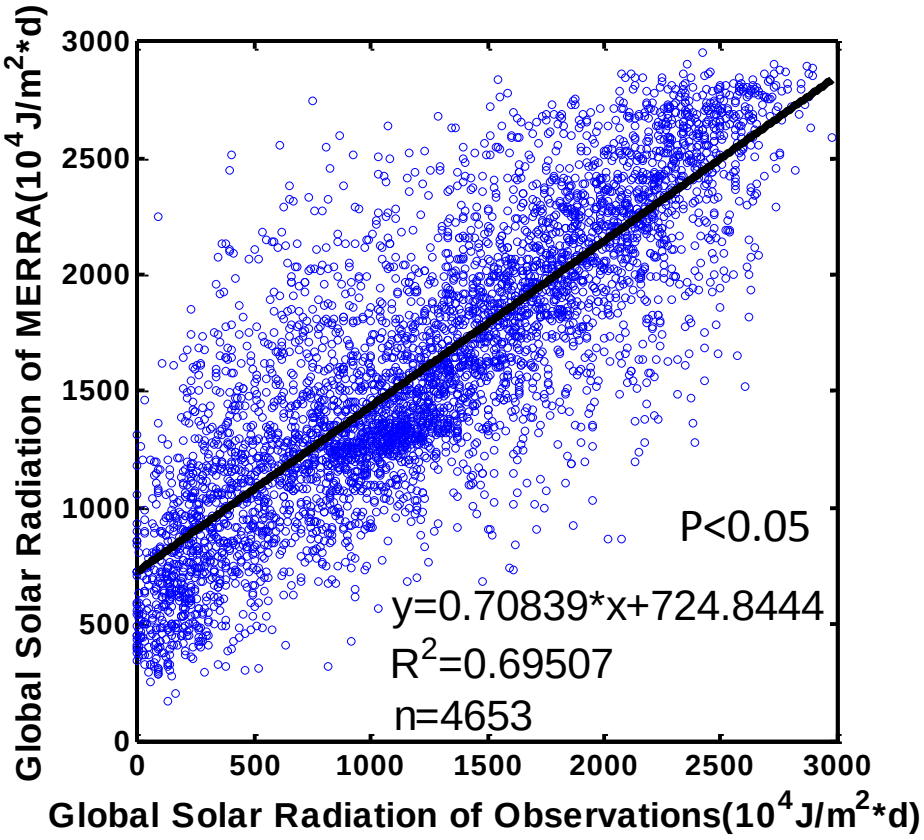

Monthly mean global solar radiation and diffuse radiation

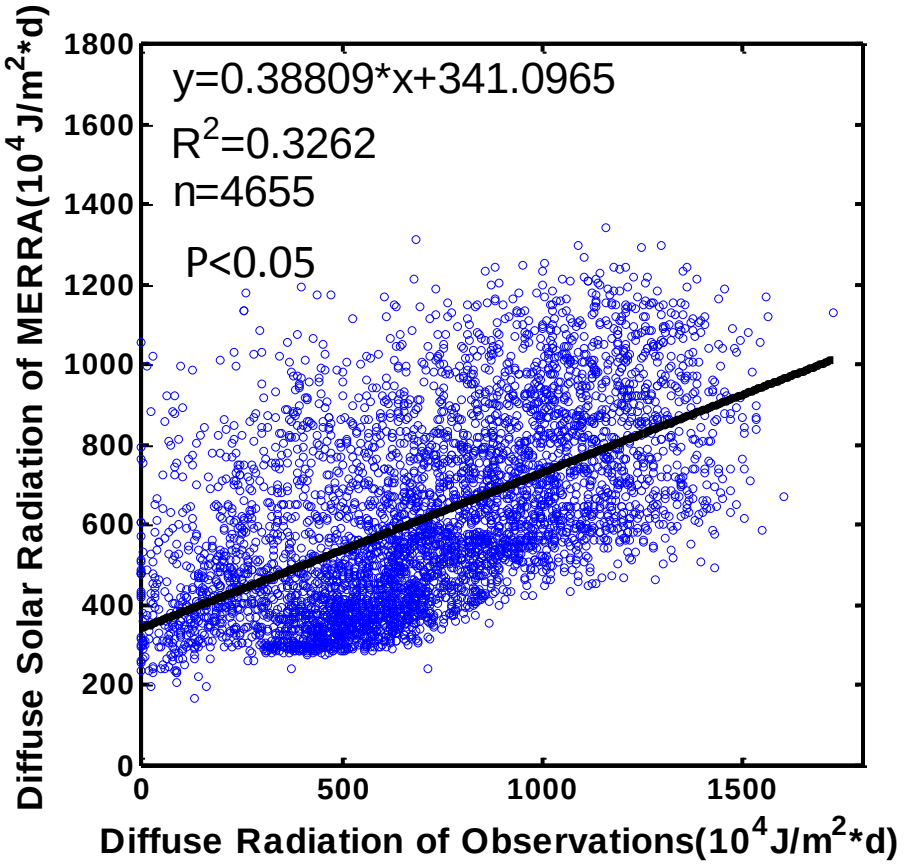
# Results and Discussions




Annual mean global solar radiation and diffuse radiation

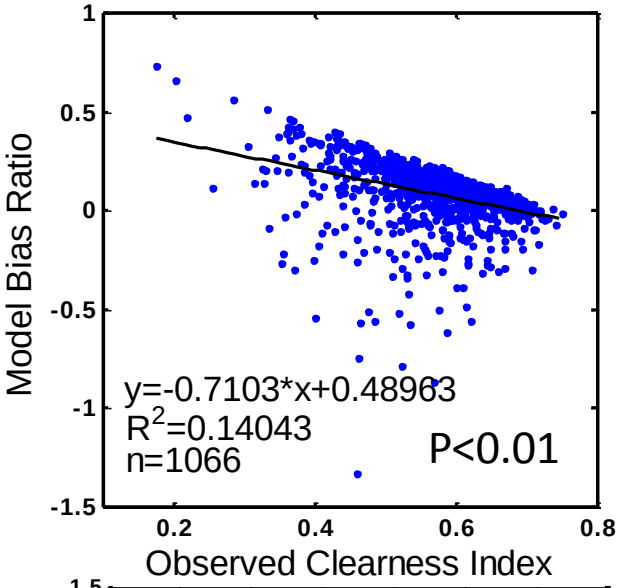
# Results and Discussions

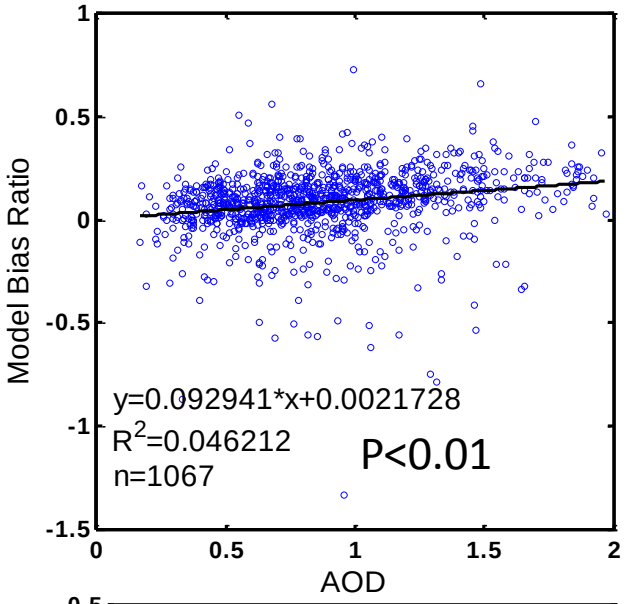


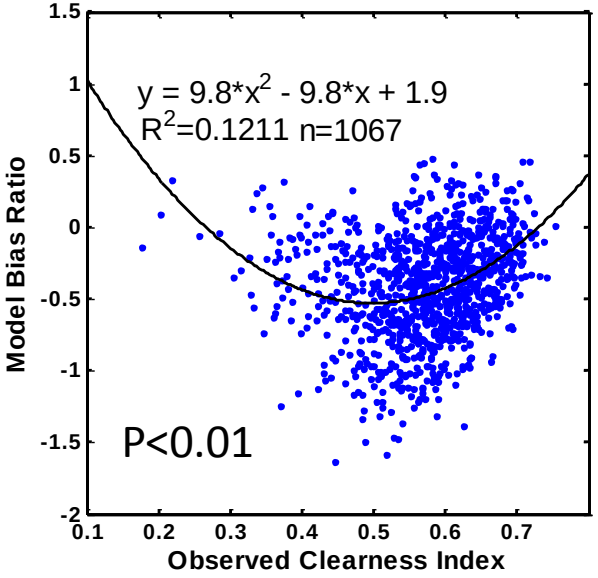



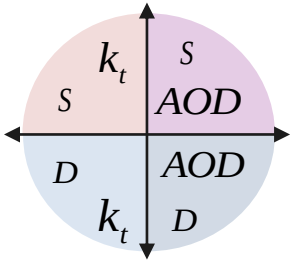

Comparison of the daily global solar radiation and diffuse radiation

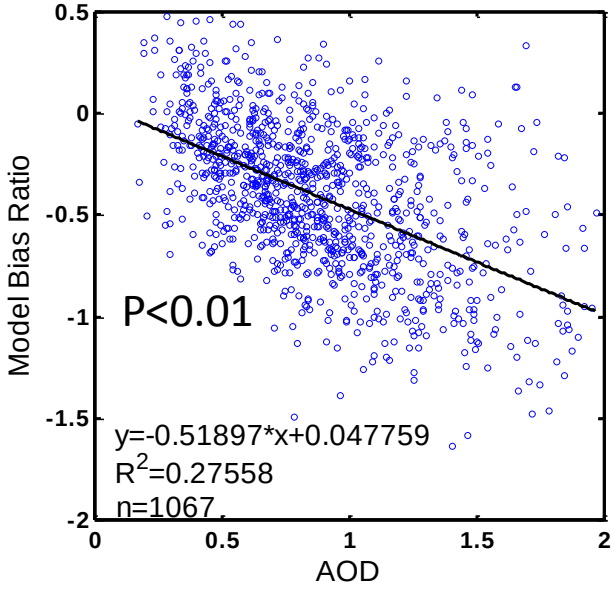
# Relationship between daily clearness index(AOD) and daily global solar radiation's model bias ratio( diffuse radiation's model bias ratio)



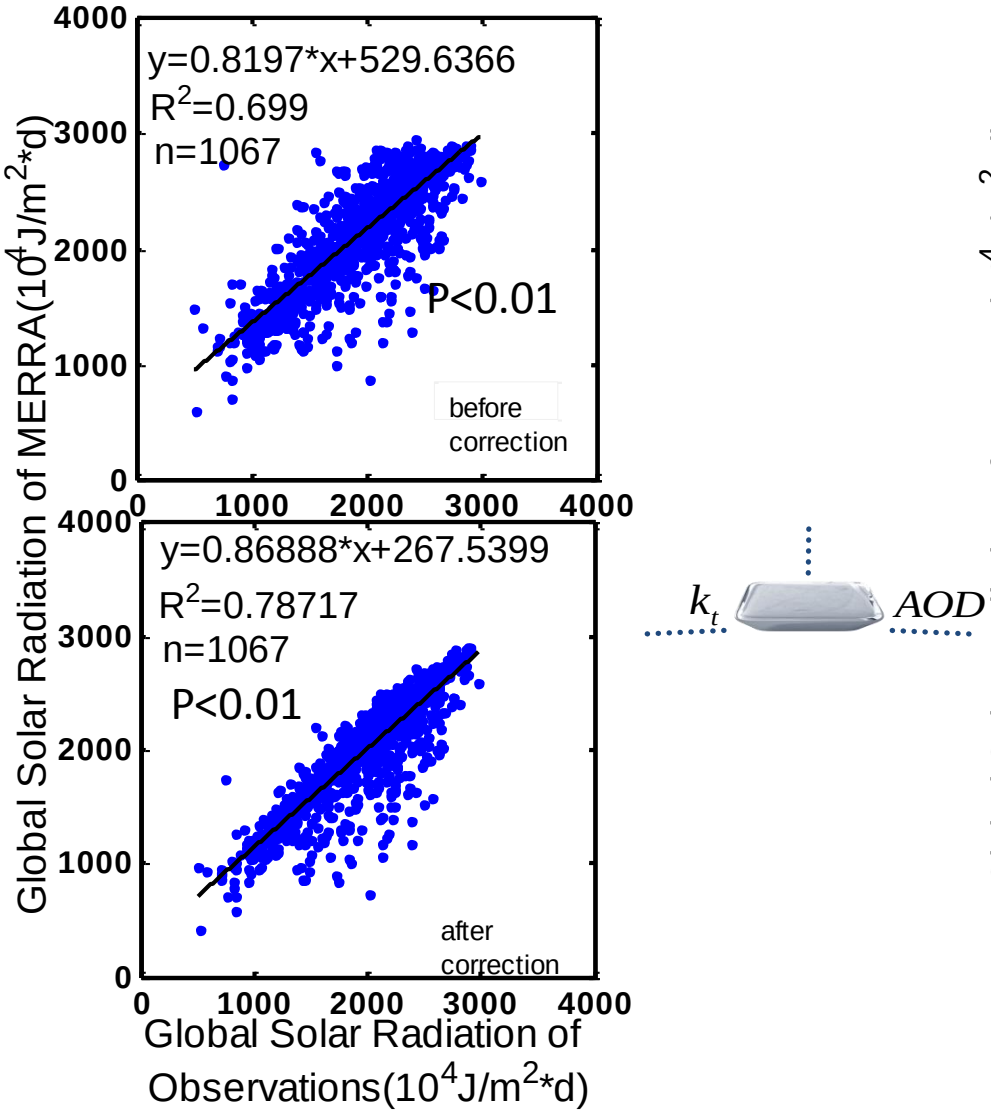



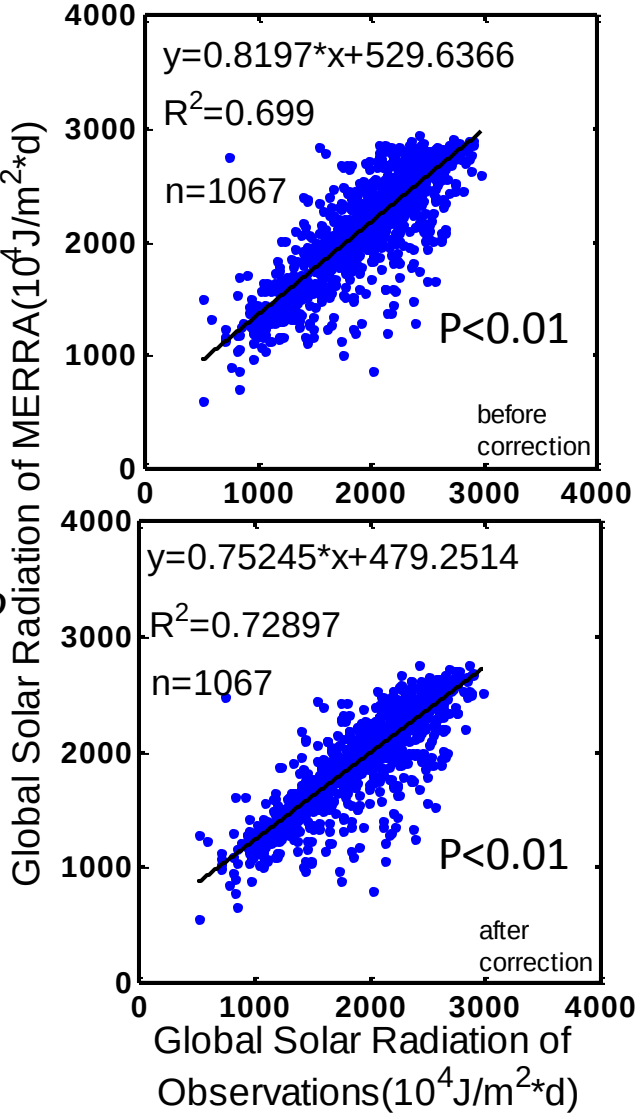



# Comparison of the daily global solar radiation

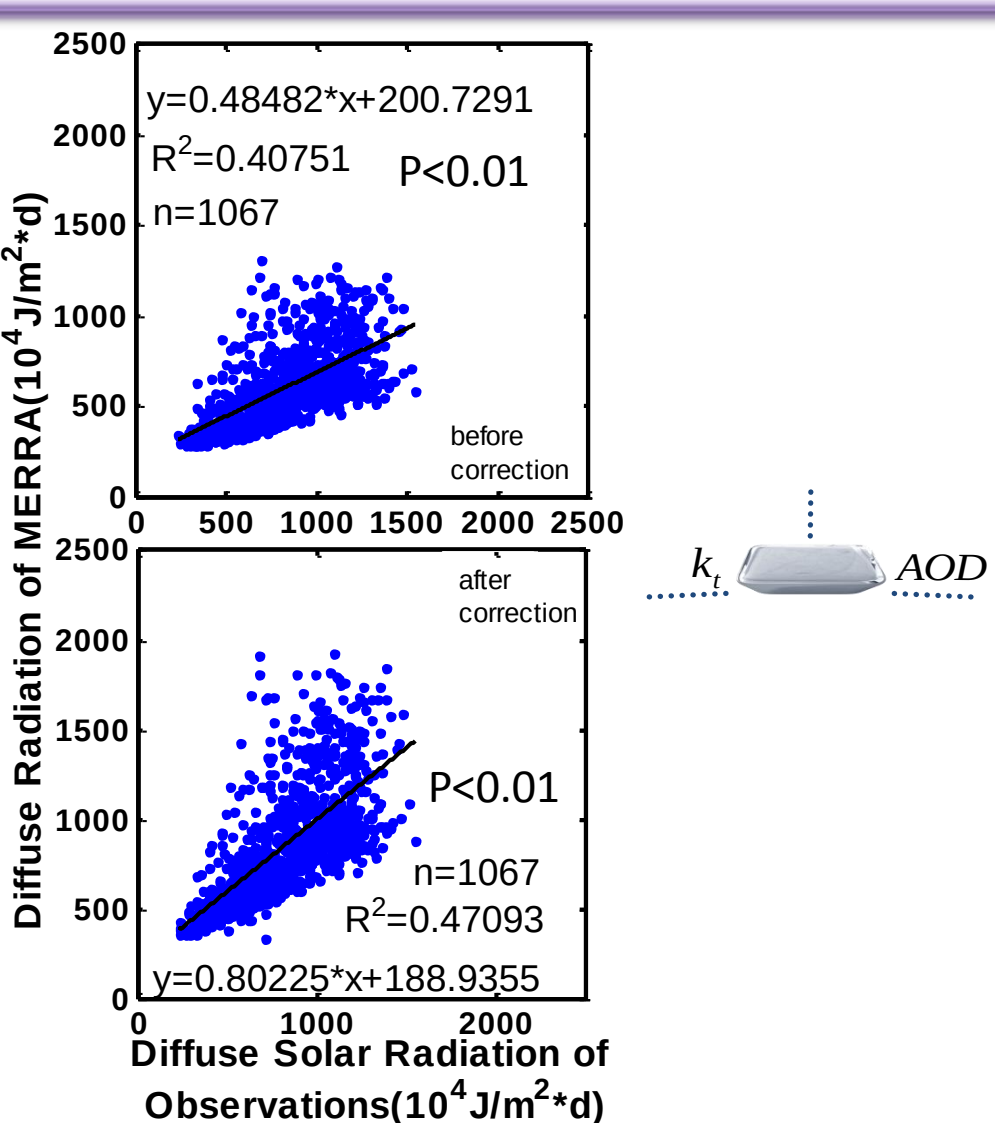


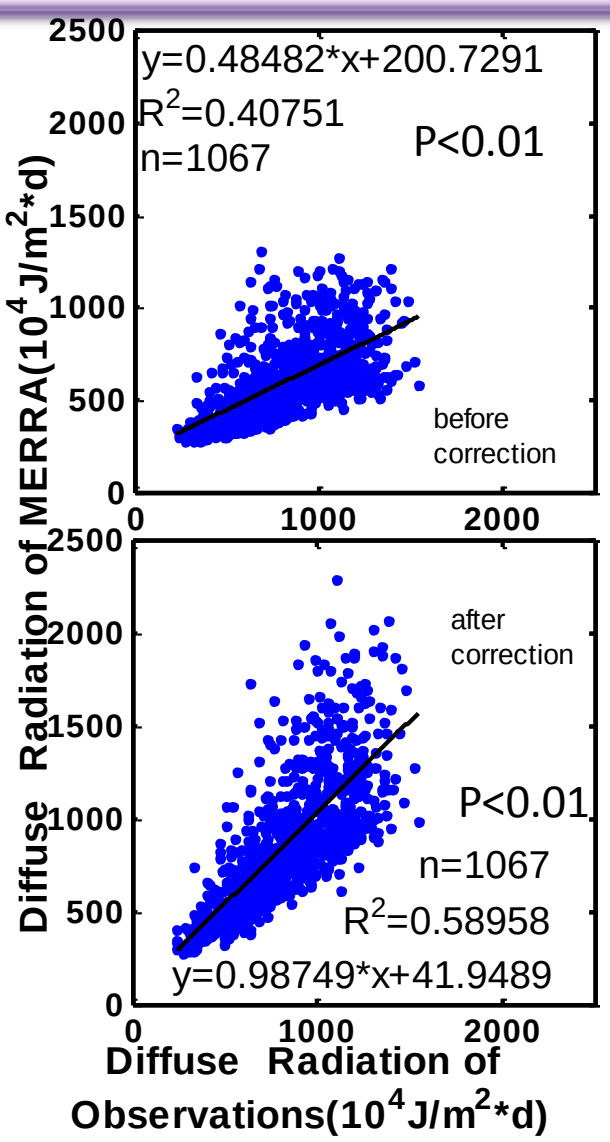




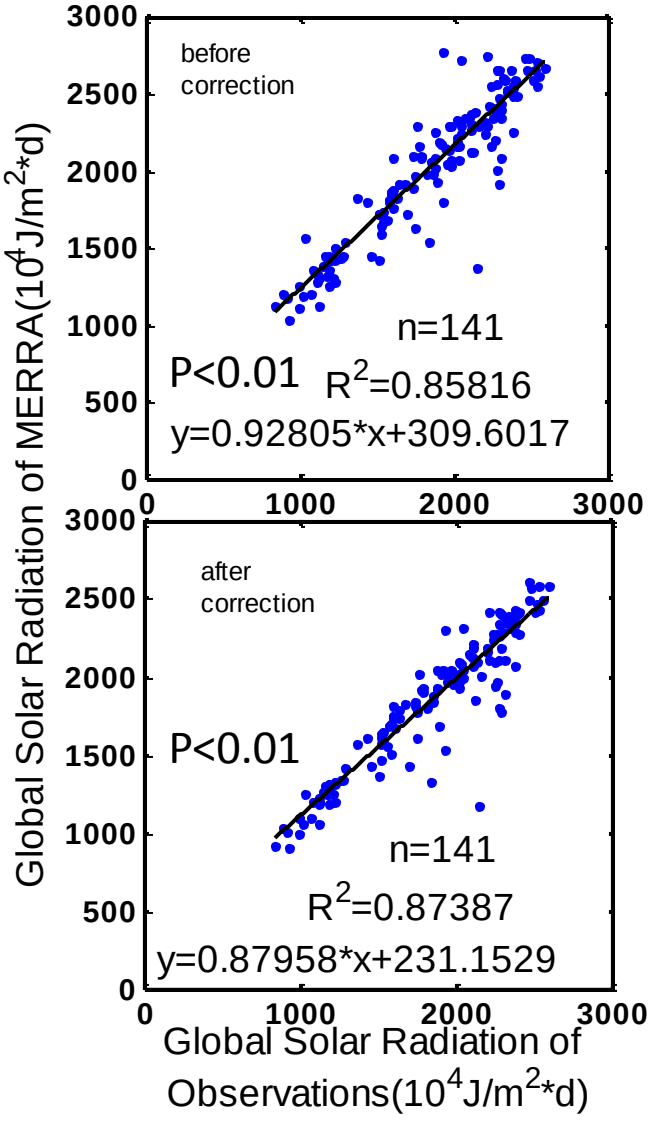


# Comparison of the daily diffuse radiation

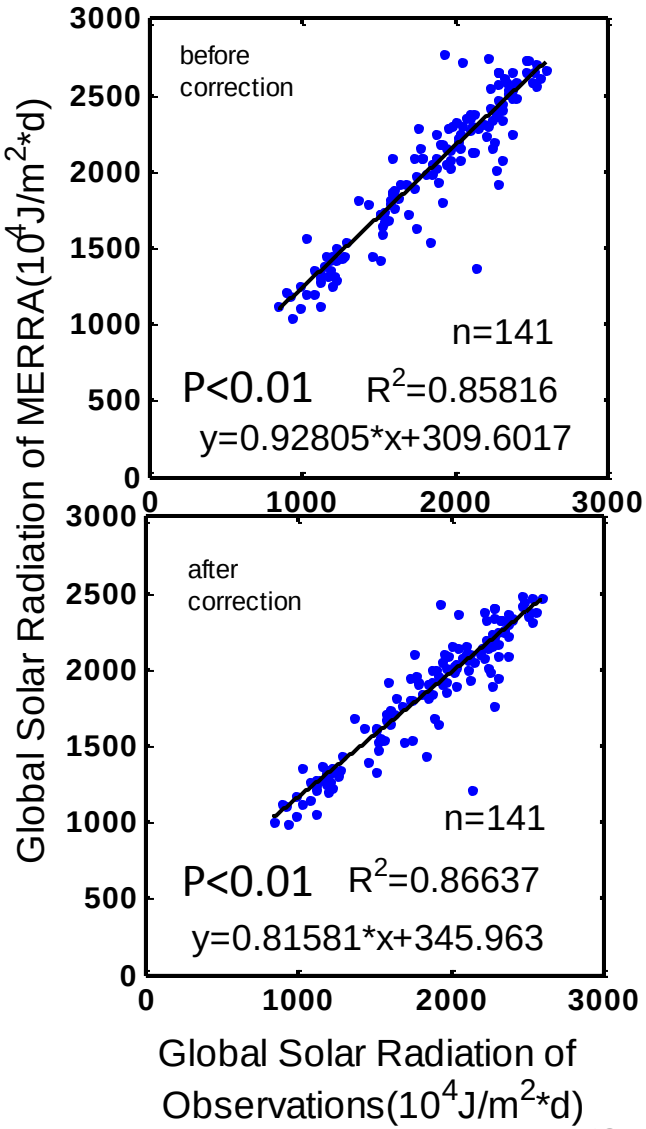


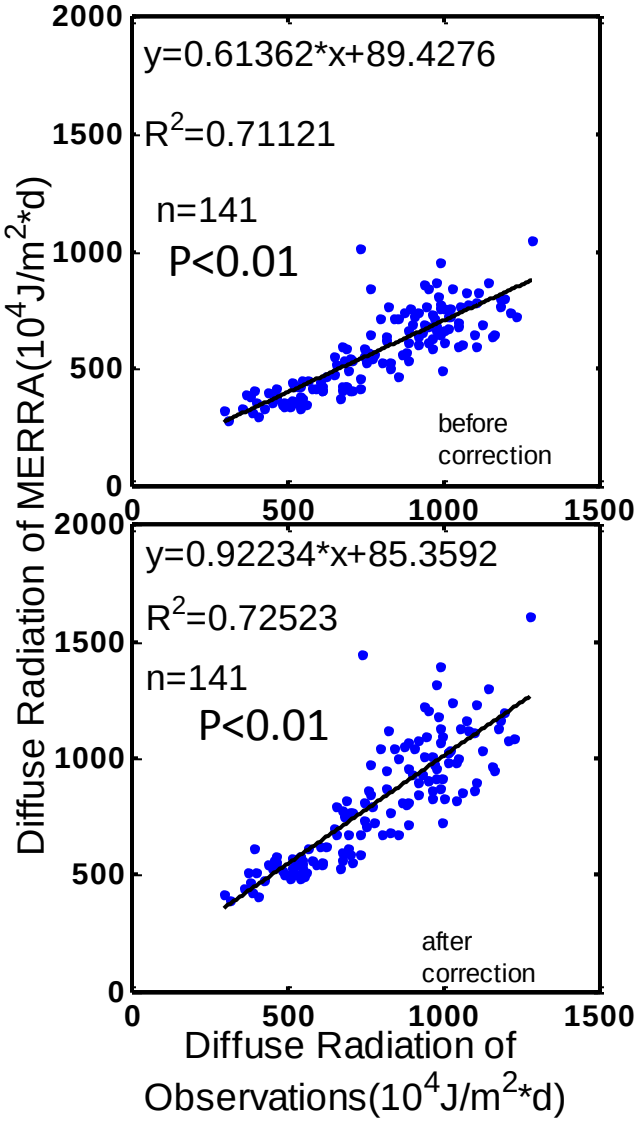
# Comparison of the monthly mean global solar radiation



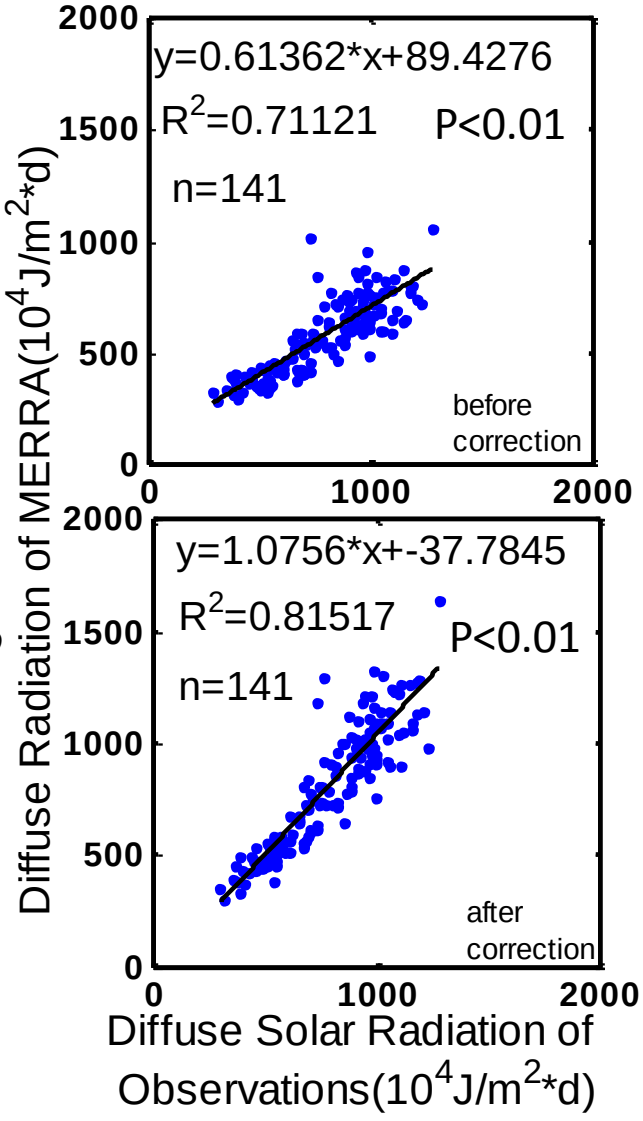




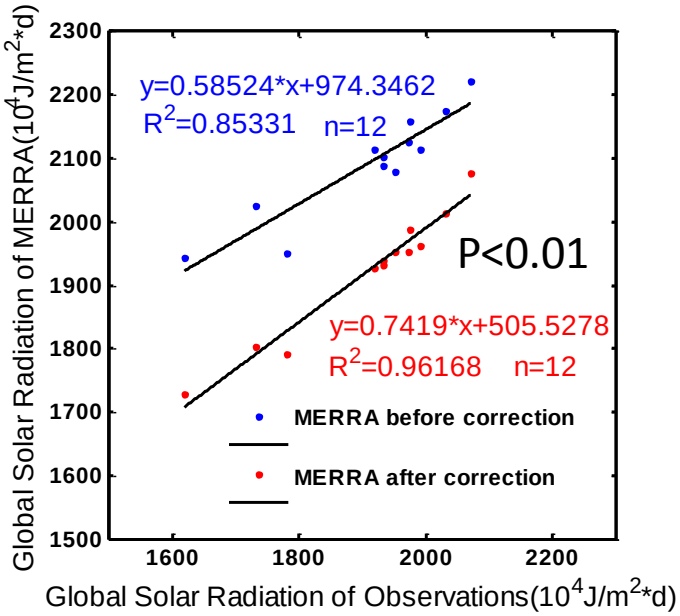
# Comparison of the monthly mean diffuse radiation

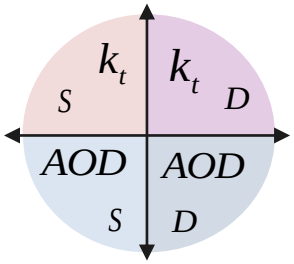


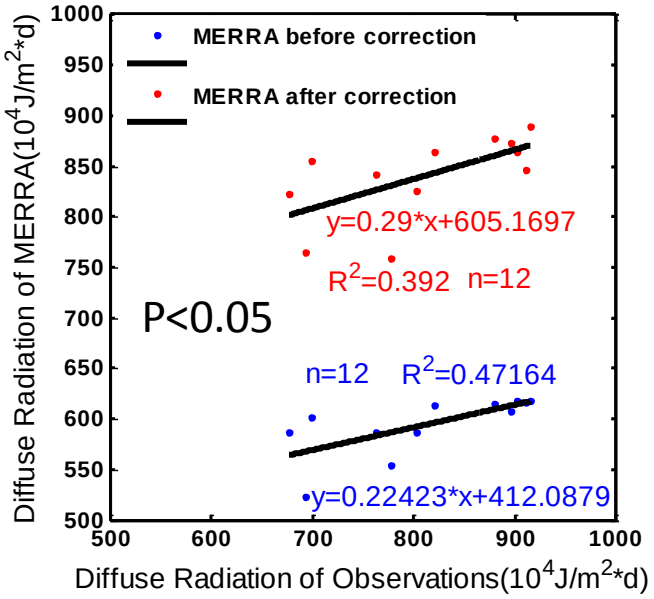


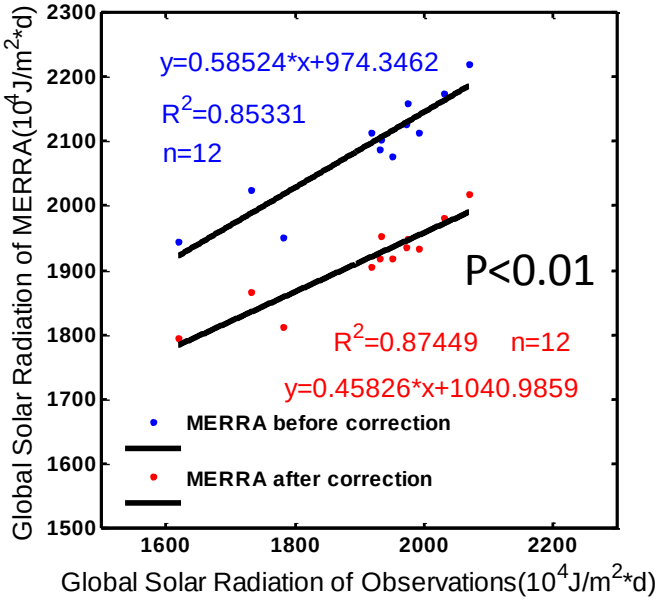


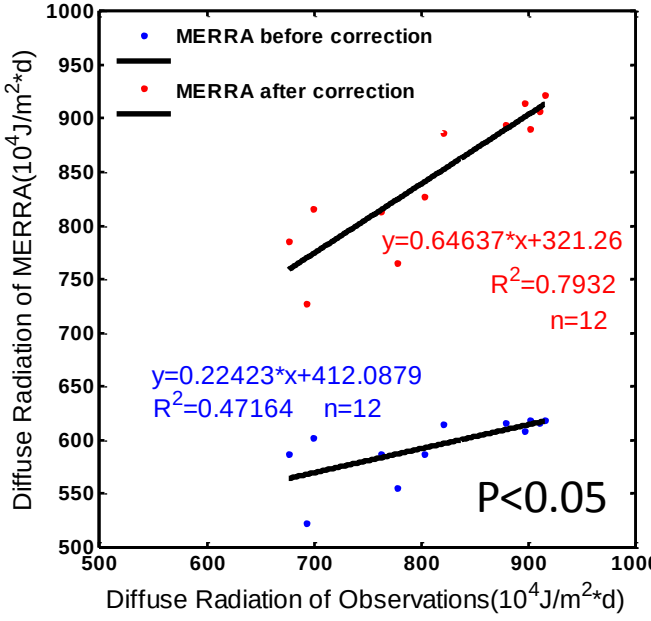
# Comparison of the annual mean global solar radiation



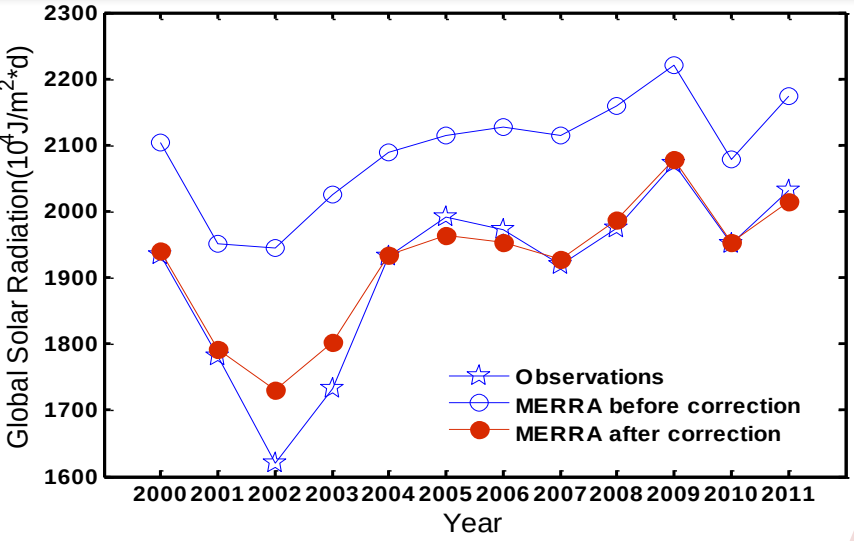



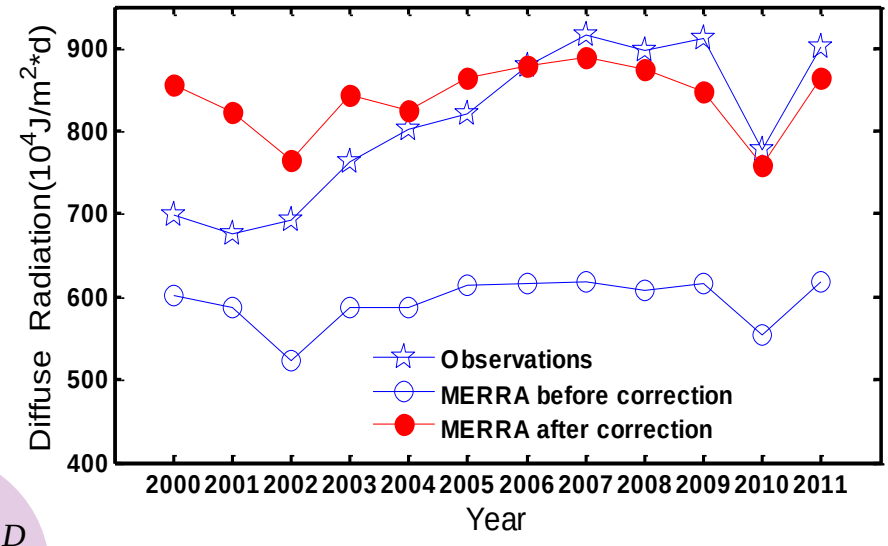



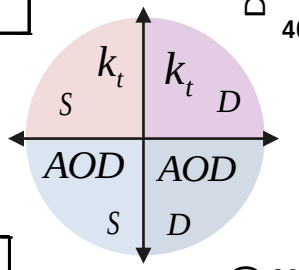



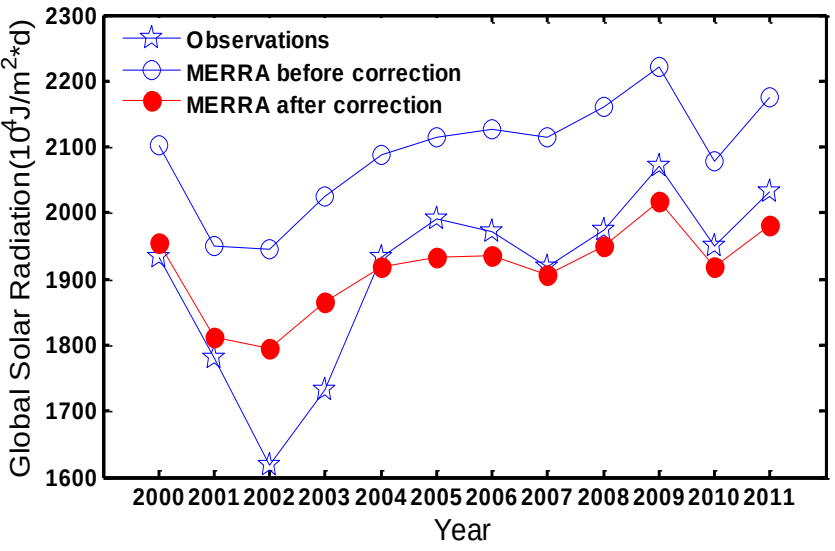



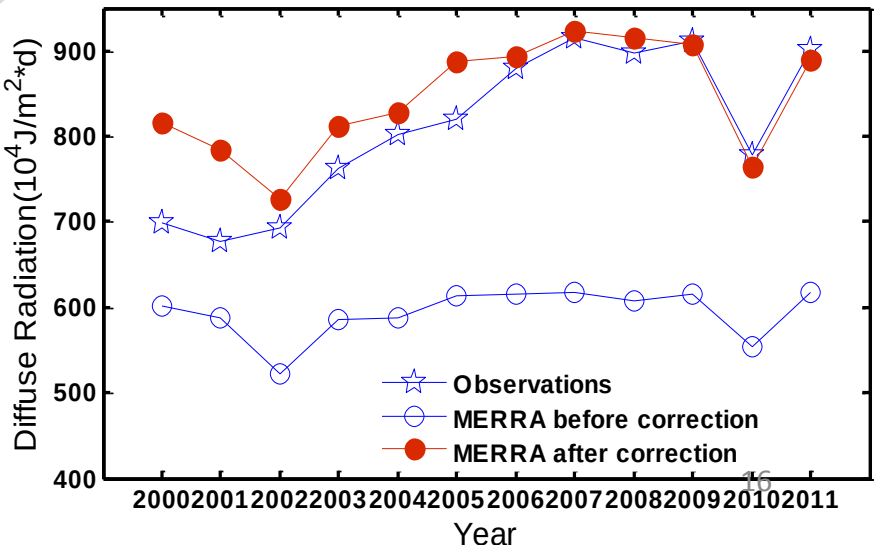
# Annual mean global solar radiation and diffuse radiation



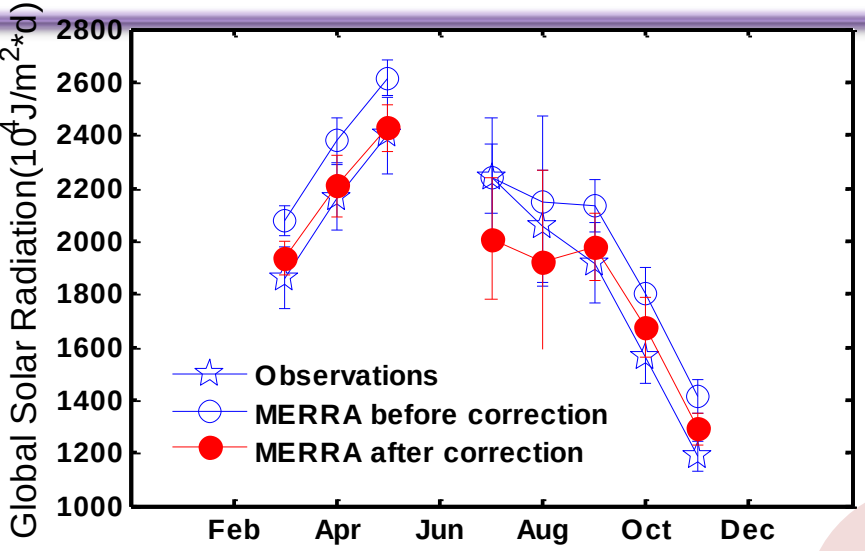



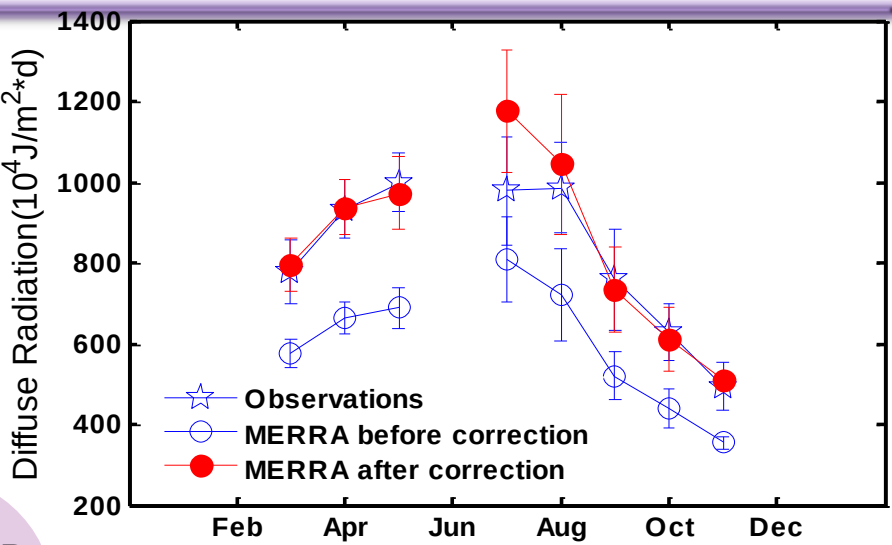



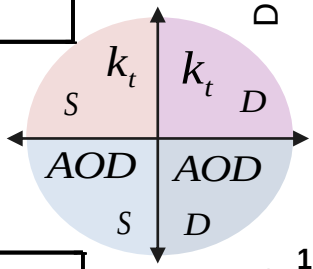



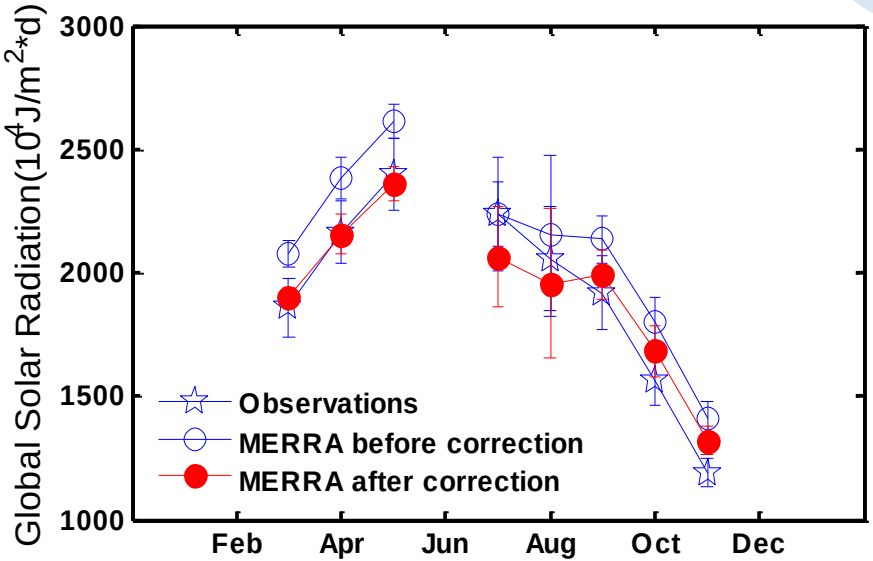



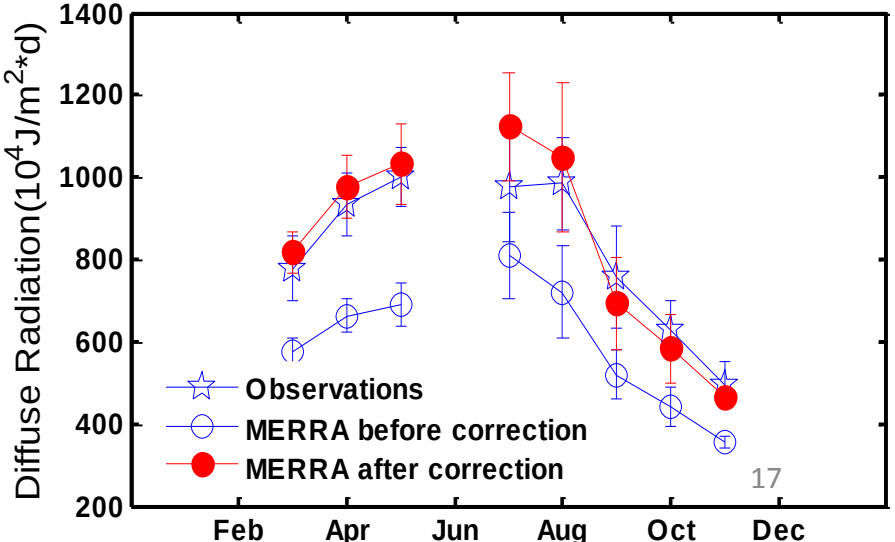
# Monthly composite global solar radiation and diffuse radiation



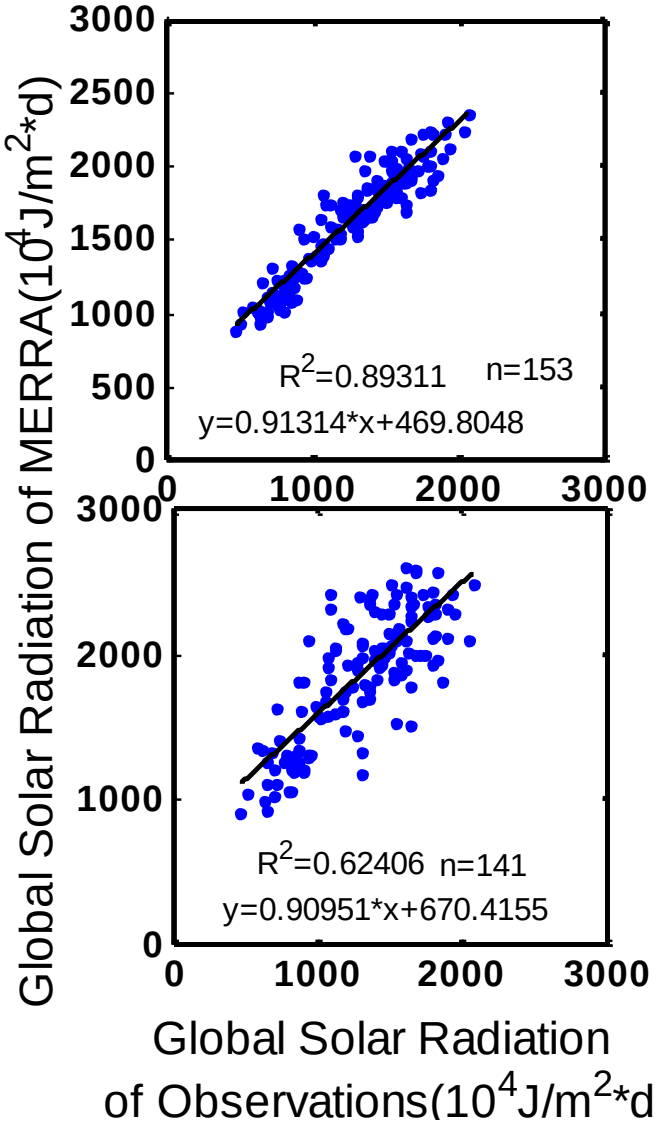



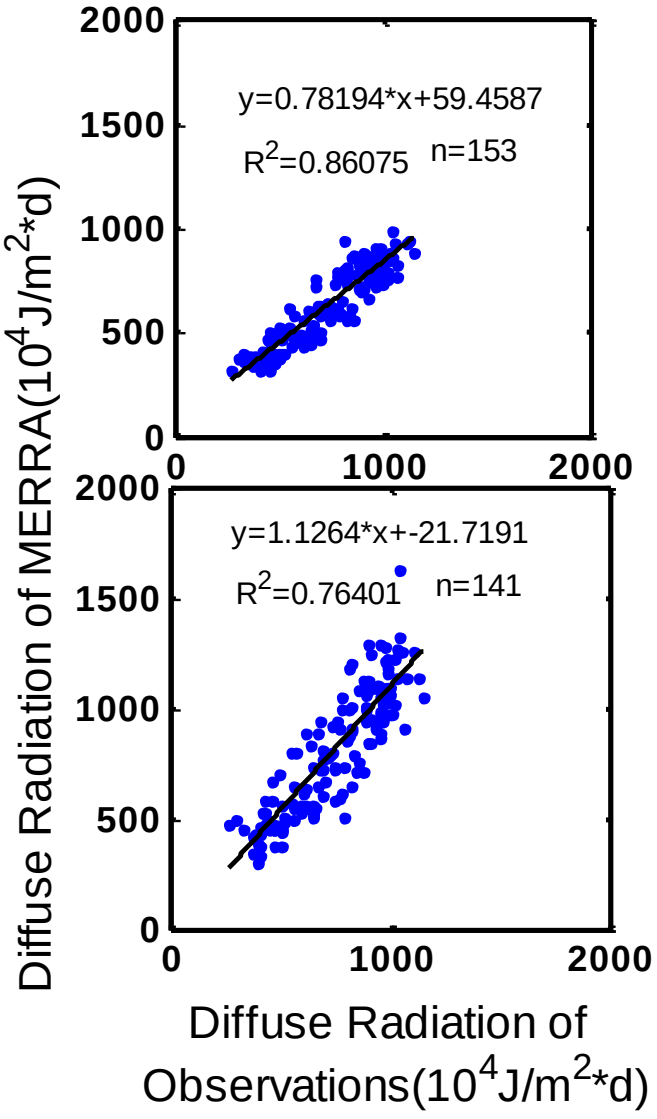
# Results and Discussions

| | | MERRA | | | Corrected MERRA | | |
|---|---|---|---|---|---|---|---|
| | | ME | RMSE | $R^2$ | ME | RMSE | $R^2$ |
| Kt | Daily S | 184.02 | 341.77 | 0.7 | 15.11 | 239.54 | 0.79 |
| | Monthly S | 178.07 | 252.62 | 0.86 | 10.23 | 165.9 | 0.87 |
| | Annual S | 182.52 | 192.34 | 0.85 | 12.79 | 39.68 | 0.96 |
| | Daily D | -217.36 | 303.54 | 0.41 | 27.43 | 239.05 | 0.47 |
| | Monthly D | -213.92 | 250.37 | 0.71 | 23.69 | 137.75 | 0.72 |
| | Annual D | -217.4 | 228.39 | 0.47 | 29.05 | 74.63 | 0.39 |
| AOD | Daily S | 184.02 | 341.77 | 0.7 | 9.12 | 264.45 | 0.73 |
| | Monthly S | 178.07 | 252.62 | 0.86 | 13.93 | 173.47 | 0.87 |
| | Annual S | 182.52 | 192.34 | 0.85 | 6.74 | 72.13 | 0.87 |
| | Daily D | -217.36 | 303.54 | 0.41 | 31.8 | 226.3 | 0.59 |
| | Monthly D | -213.92 | 250.39 | 0.71 | 21.57 | 124.44 | 0.82 |
| | Annual D | -217.4 | 228.39 | 0.47 | 34.32 | 54.04 | 0.79 |

# Comparison of the monthly mean global solar radiation( diffuse radiation) without eliminating







# Summary

- The results showed that the global solar radiation better correction with clearness index, and correction of the diffuse radiation with AOD . Correction effect in longer time scale is better than shorter time scale. But AOD data have more default, which will affect the correction.


Thank You !