



# Analysis of Solar Radiation Measurements at BSRN Lulin Candidate Station

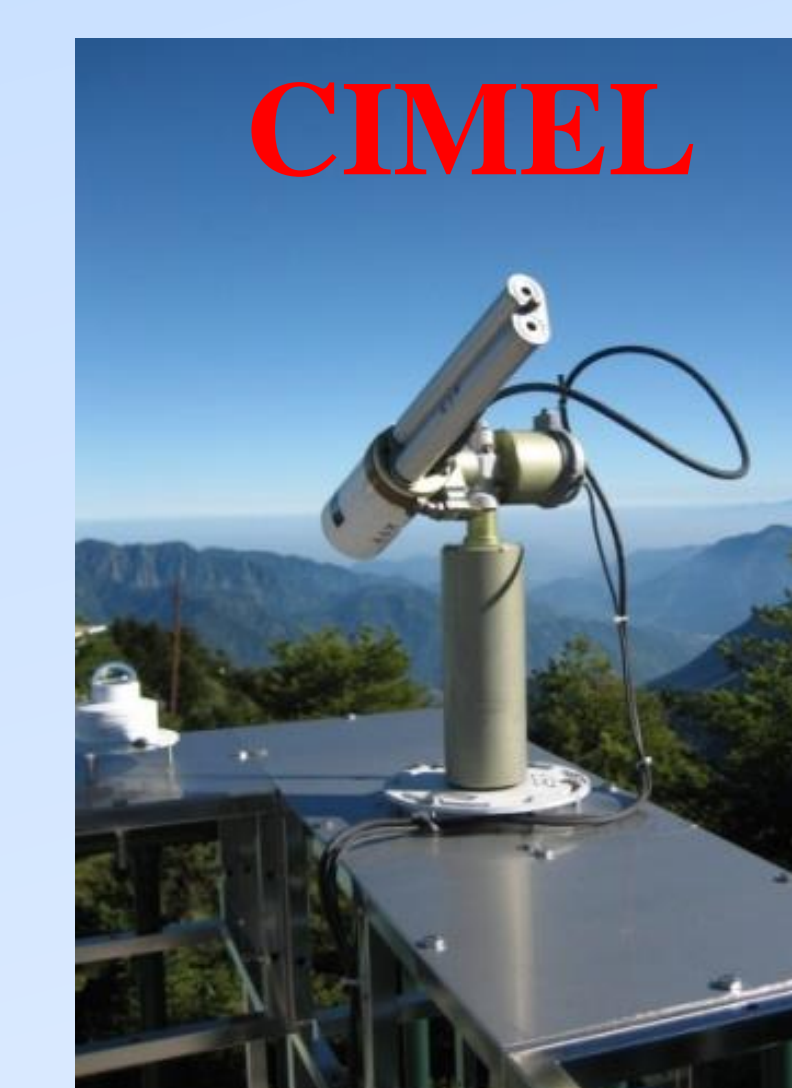
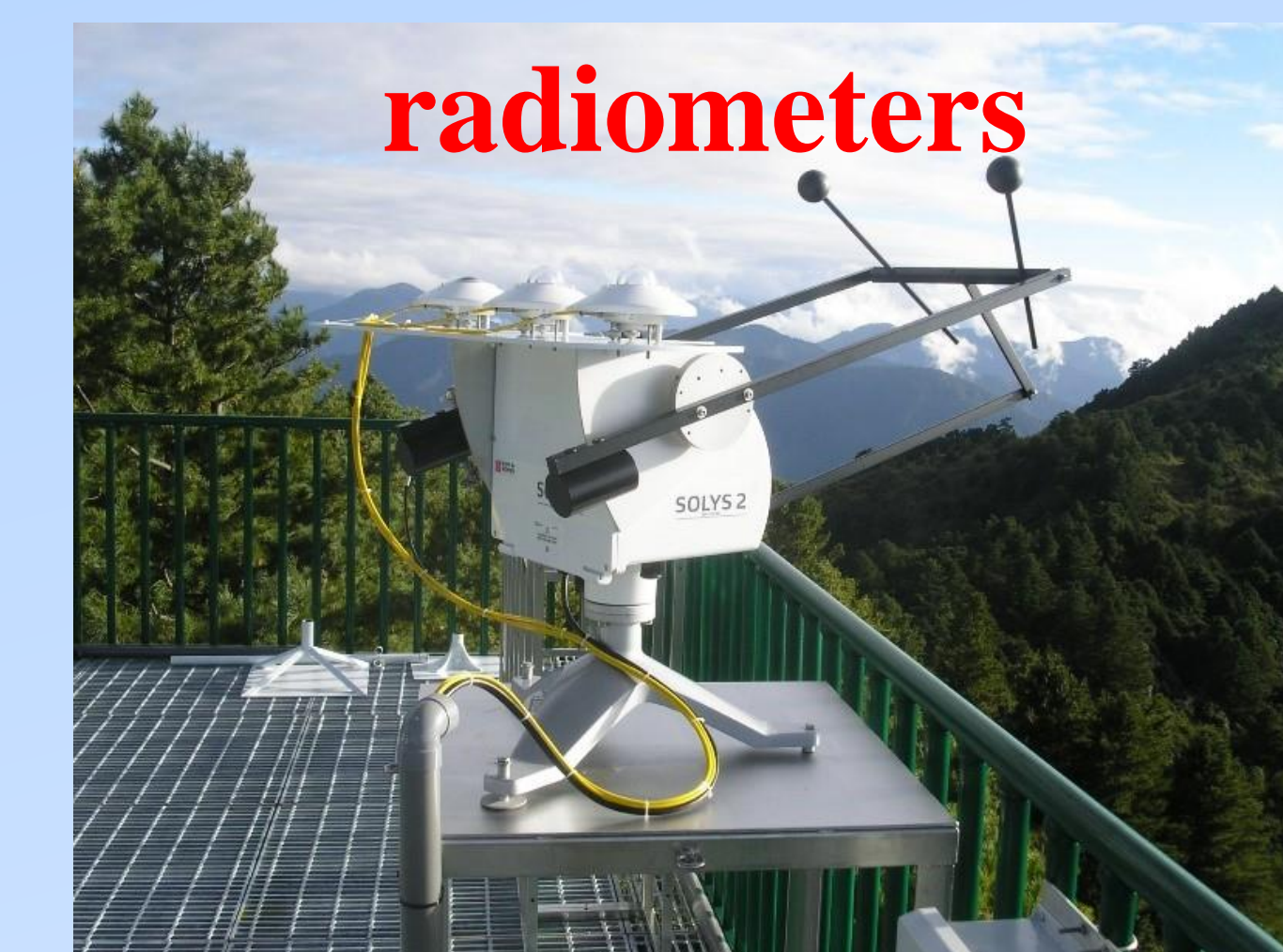


Nai-Ju Hsueh<sup>1</sup>, Sheng-Hsiang Wang<sup>1,\*</sup>, Neng-Huei Lin<sup>1</sup>, Yu-Chi Lee<sup>2</sup>,  
Shuenn-Chin Chang<sup>3</sup>, Hsiang-Yu Huang<sup>1</sup>, Cheng-Min Yao<sup>1</sup>

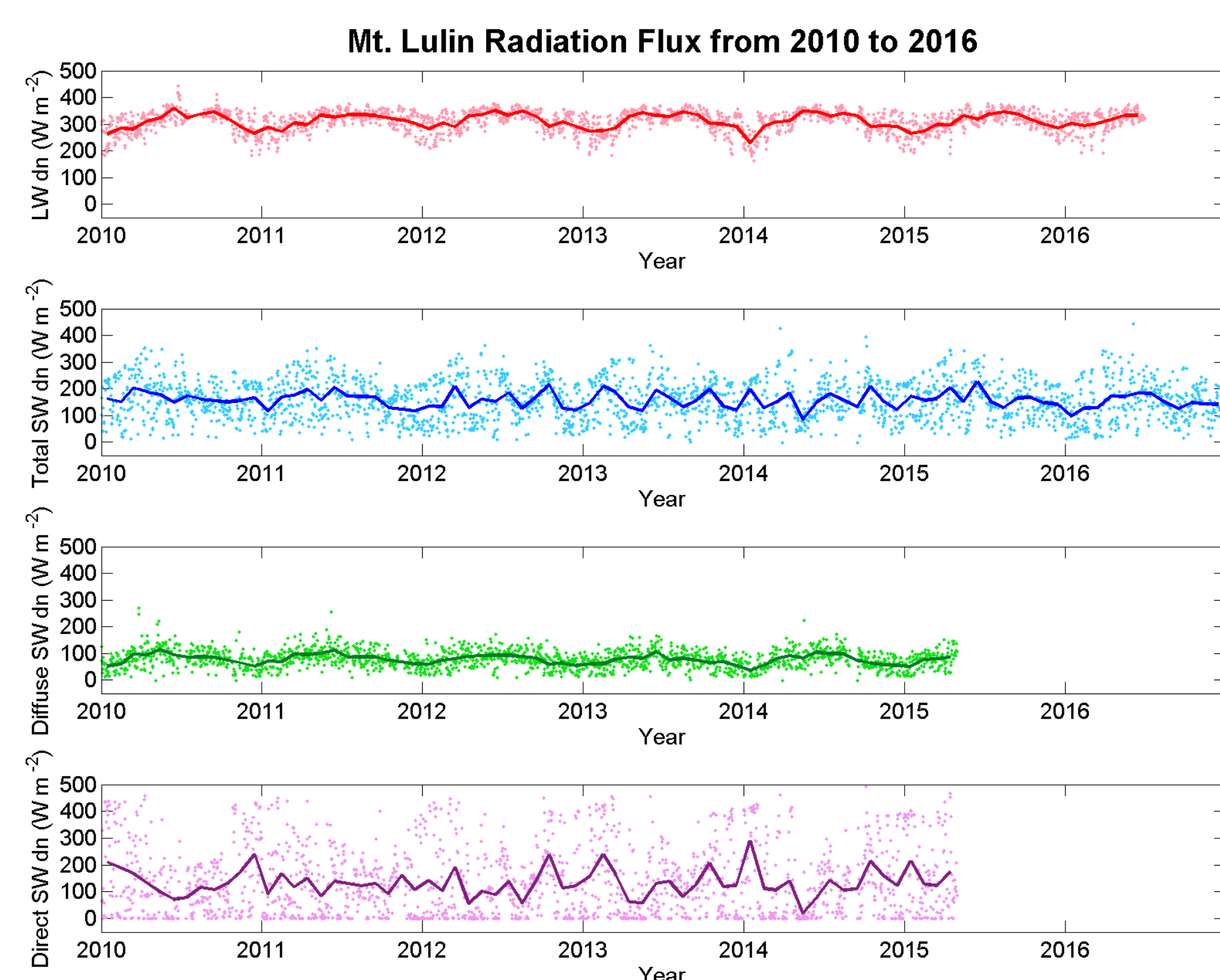
<sup>1</sup>National Central University, Taiwan; <sup>2</sup>Central Weather Bureau, Taiwan; <sup>3</sup>Environmental Protection Administration, Taipei, Taiwan

## Introduction

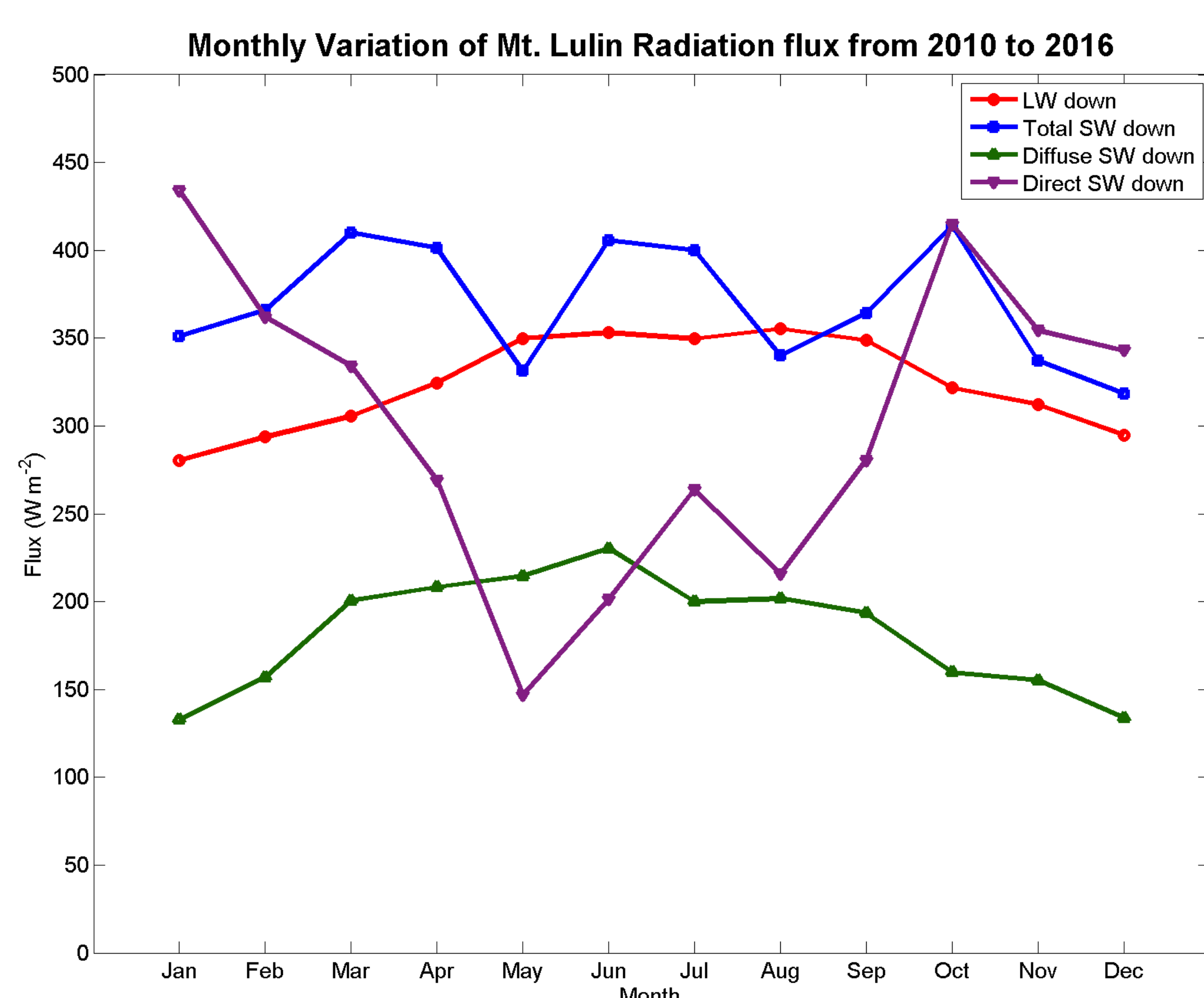
Solar radiation plays an important role in the global energy balance, and largely determines the climatic conditions of the Earth. In order to better understand the solar radiation reaching Earth's surface, ground-based observations were established at Lulin Atmospheric Background Station (LABS; 23.47°N, 120.87°E; 2,862 m a.s.l.), which is now a BSRN (Baseline Surface Radiation Network) candidate station. In this research, we focus on the solar radiation at LABS during the period of 2010 to 2016. Previous study showed that from 1980s to nowadays, global brightening, which refers to a decadal increase in surface shortwave radiation, had been observed in many regions of the world. Equipped with broad-band shortwave and longwave radiometers (Kipp & Zonen CMP21 and CGR4, respectively) at LABS, it allows us to analyze the seasonal variations and long-term trends of solar radiation from 2010 to 2016 and detect the global brightening phenomenon. In addition, comparisons with the solar radiation measurements at Mt. Jade (23.29°N, 120.57°E; 3,850 m a.s.l.) are included, enhancing the knowledge of radiation characteristics for the mountain area in central Taiwan. The long-term changes in aerosol optical depth (AOD) at LABS will also be analyzed, showing whether it accounts for the increasing and decreasing of surface solar radiation.



## 1. Climatology of solar radiation at Mt. Lulin

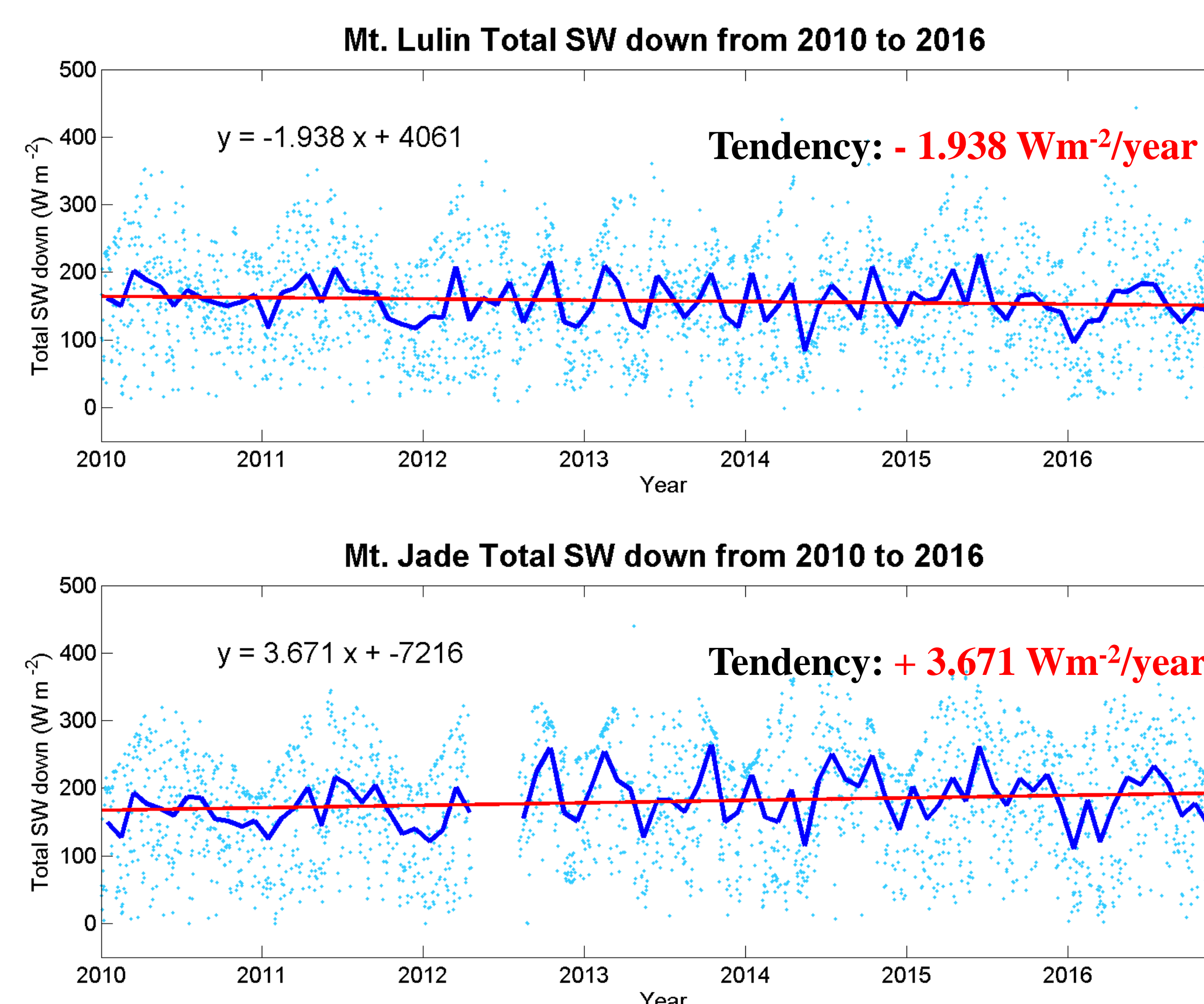


**Figure 1.** Daily (points) and monthly (bold lines) mean radiation flux (longwave down, total shortwave down, diffuse shortwave down, direct shortwave down) at Mt. Lulin (2010-2016).

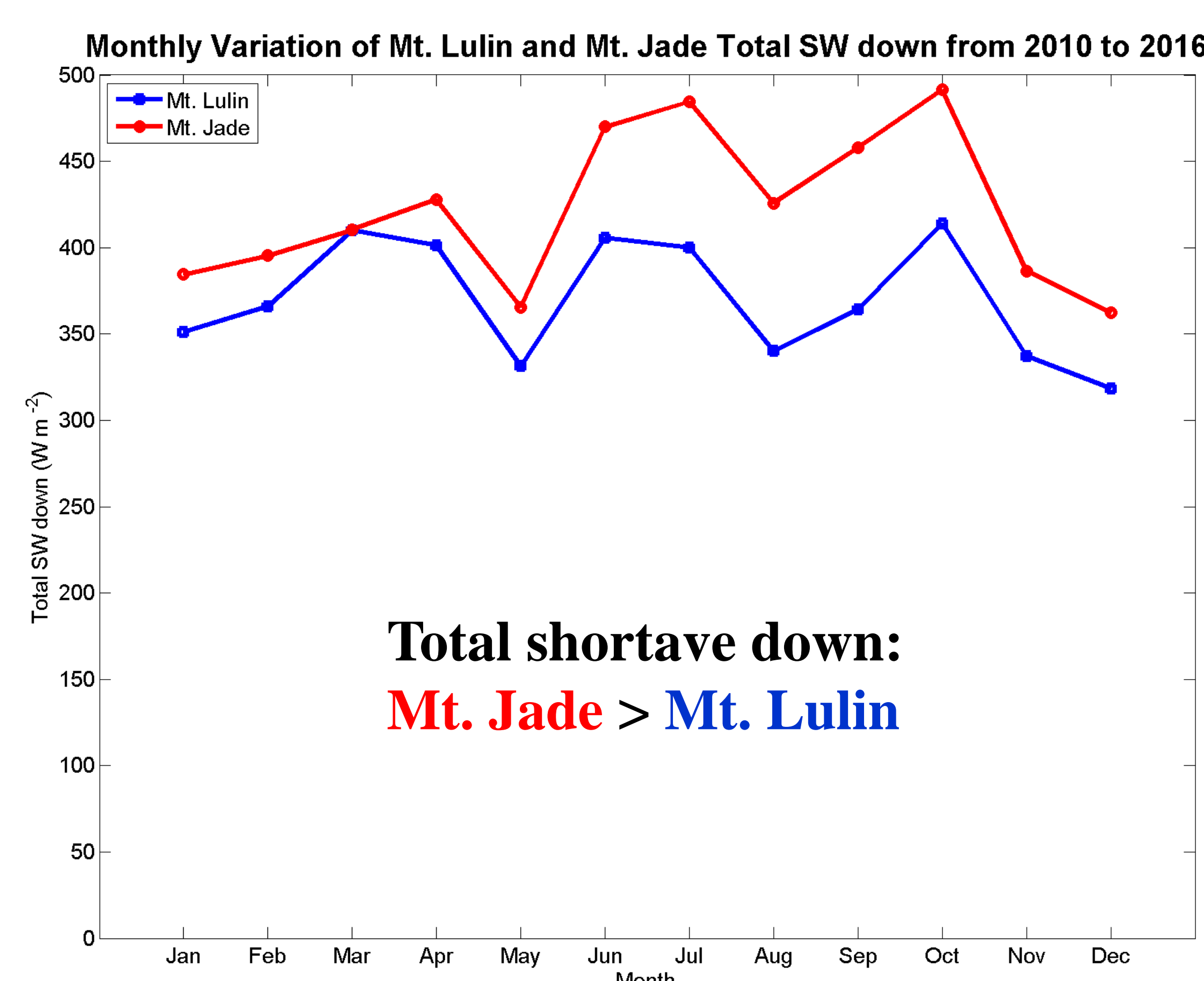


**Figure 2.** Monthly variations of radiation flux (LW down, total SW down, diffuse SW down, direct SW down) at Mt. Lulin (2010-2016).

## 2. Mt. Lulin vs. Mt. Jade solar SW radiation



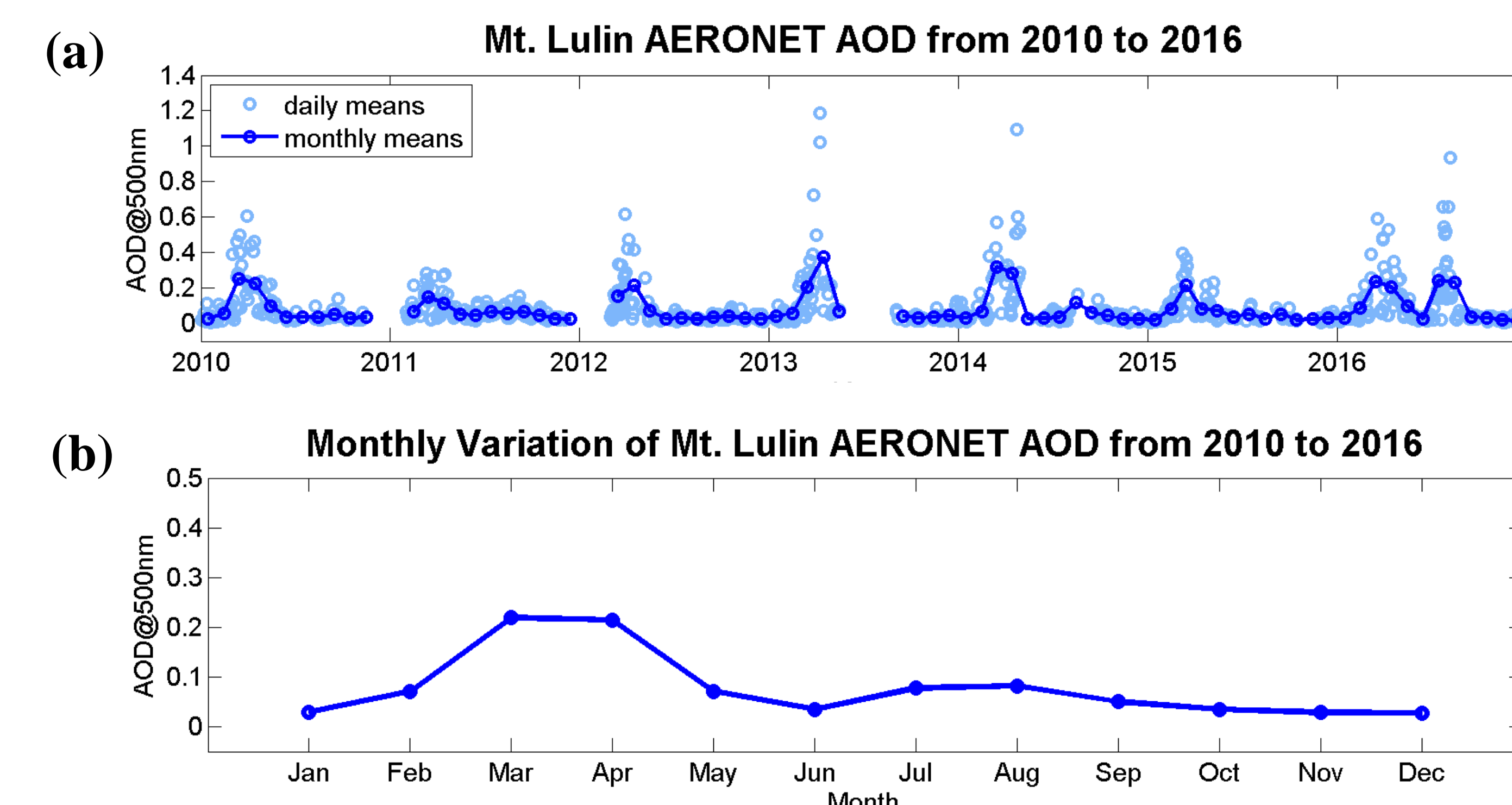
**Figure 3.** Trend analysis of total SW down at Mt. Lulin and Mt. Jade (2010-2016).



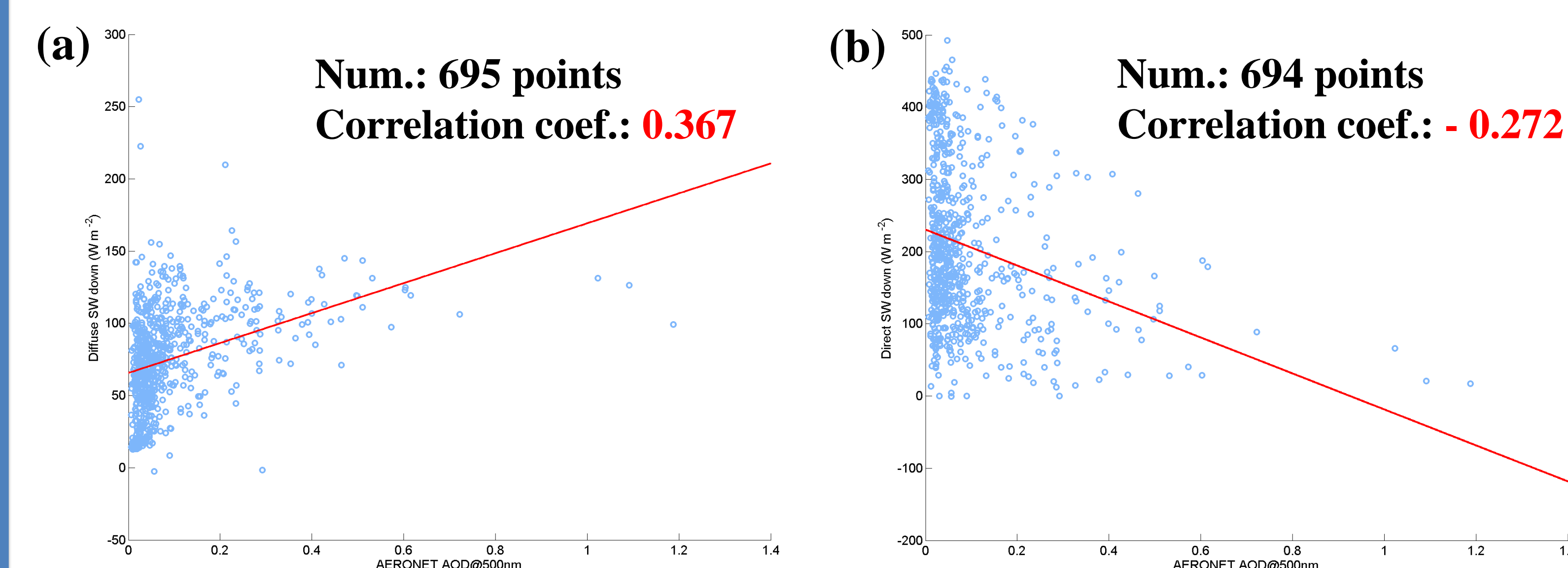
**Figure 4.** Comparison of monthly variations of total SW down at Mt. Lulin and Mt. Jade (2010-2016).

## 3. AOD vs. diffuse and direct SW down at Mt. Lulin

AERONET Level 3 data (2010-2016) was used in the analysis.



**Figure 5.** (a) Aerosol optical depth (AOD) at Mt. Lulin (2010-2016). (b) Monthly variations of AOD at Mt. Lulin (2010-2016).



**Figure 6.** (a) Correlation of AOD and diffuse SW down. (b) Correlation of AOD and direct SW down at Mt. Lulin (2010-2016).

## Conclusions

- The trend of total SW down is  $-1.938 \text{ Wm}^{-2}/\text{year}$  (dimming) at Mt. Lulin and  $+3.671 \text{ Wm}^{-2}/\text{year}$  (brightening) at Mt. Jade.
- The total SW down values are usually higher at Mt. Jade than at Mt. Lulin.
- The highest AOD monthly mean at Mt. Lulin occurs in March, with the value of 0.219.
- The variations of AOD at Mt. Lulin may be associated with the diffuse SW down and direct SW down. The correlation coefficients are 0.367 and  $-0.272$ , respectively.

## Acknowledgments

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