CLIMATE UPDATE FROM THE MCMURDO DRY VALLEYS LONG TERM ECOLOGICAL RESEARCH PROJECT: SURFACE AIR TEMPERATURE AND SOLAR RADIATION TRENDS

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1. OVERVIEW

The McMurdo Dry Valleys is the largest and the most extensively studied ice-free region in Antarctica. Owing to the McMurdo Long Term Ecological Research (LTER) project established in 1993, the project is currently operating 14 meteorological stations throughout the valleys located on valley bottoms, glaciers, and limited high altitude sites, which collect data at 15-minute intervals year-round. The longest continuous meteorological record spans over three decades (includes some pre-LTER data) at a station located at Lake Hoare, Taylor Valley. Here I provide an update on current air temperature and solar radiation trends with a focus on the longest record.

2. MCMURDO DRY VALLEYS

Mean annual air temperature in the McMurdo Dry Valleys varies between -14.8°C to 30.0°C (Doran et al., 2002a) and precipitation is < 50 mm water equivalent (Fountain et al., 2010). Surface air temperature and solar radiation are critical in controlling water availability in this polar desert and the knowledge of climate trends has important implications to the prediction of future desert processes. Surface summer air temperatures in the McMurdo Dry Valleys cooled at a rate of 0.7°C decade^{-1} and solar radiation increased at a rate of +2 W m^{-2} since the 1987 to late 1990s (Fountain et al., 2015). Up-to-date surface air temperature and solar radiation trends are presented in this work.

3. LAKE HOARE AWS – SURFACE AIR TEMPERATURE

The focus of this study is Lake Hoare AWS record because of its longest continuous record (see Figure 1). Measurements from this station are highly correlated with other stations in the MDV and are therefore considered representative of the region. Initial analysis of surface air temperature at Lake Hoare AWS showed a statistically significant cooling at a rate of 0.67°C decade^{-1} from the beginning of the record (late 1987) up to 2006 (similar rates to Doran et al., 2002b). Thereafter, surface air temperatures were warming at a rate of 0.52°C decade^{-1} but this rate is not statistically significant.

The trend shift in surface air temperature from cooling to warming occurs in 2006 and was determined based on modified Mann-Kendall and Pettitt statistics. The 2006 trend shift also occurs across most stations (depending on the length of the record).

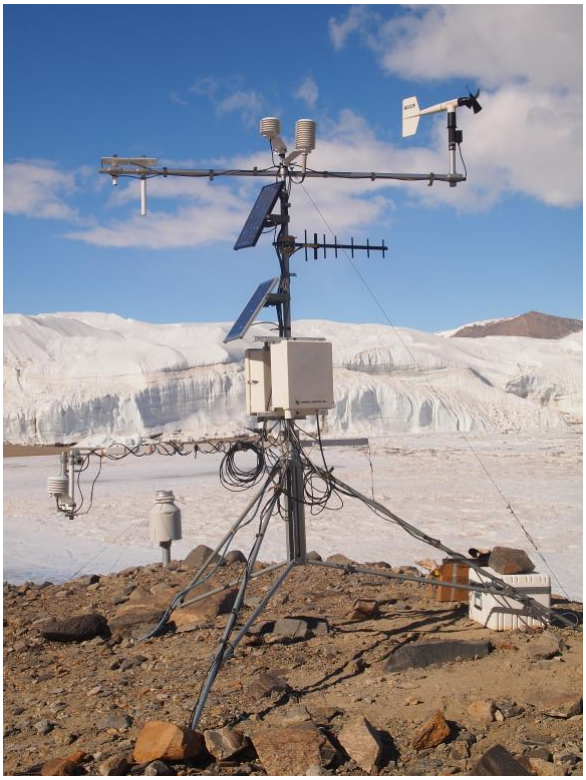

Figure 1. The longest operational AWS located at Lake Hoare, Taylor Valley.

4. LAKE HOARE AWS – SOLAR RADIATION

Annual solar radiation exhibits large variability over the past three decades (by up to 25 W m^{-2}). Annual solar radiation increased from the beginning of the record (1987 – 78 W m^{-2}) to a peak in 2001 (103 W m^{-2}) and showed variability thereafter but at elevated values (Obryk et al., 2018). These large variations have been attributed to changes in optical depth in the lower stratosphere due to sulfur

dioxide emissions from volcanic eruptions (Mount Pinatubo), anthropogenic sources, and perhaps large tropical wildfires (Obryk et al., 2018). Sulfur dioxide evolves into sulfate aerosols, which have a profound effect on atmospheric optical depth.

5. ACKNOWLEDGEMENTS

This research was supported by the National Science Foundation Office of Polar Programs, under grants 1246342, 1637708, and 1115245.

6. REFERENCES

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