
Long-term Changes in Incoming Solar Radiation on the Canadian Prairie

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Introduction

- Variability in the sun's activity is one potential cause of natural climate change (Lean and Rind 1998).
- The output of energy from the sun has been increasing since about 1850 (Foukal and Lean 1990).
- About half of the warming of the earth's surface over the past century and a third of the warming since 1970 may be due to increased solar energy output (Lean and Rind 1998).
- Many regions of the earth have experienced a steady decline in solar radiation since the late 1950's (Stanhill and Cohen 2001).

Objective

- To analyze long-term (1960 to 1997) meteorological records at several locations on the Canadian Prairies for evidence of annual and seasonal trends in incoming solar energy (Table 1).

Methods

- We analyzed annual and seasonal - January through April (JFMA), May through August (MJJA), September through December (SOND) - incoming solar energy ($\text{MJ m}^{-2} \text{ day}^{-1}$).

Results

- Contrary to the observed increase in solar activity, annual and seasonal - JFMA and MJJA - incoming solar energy averaged across 6 locations (Table 1) on the Canadian Prairies have decreased linearly between 1960 and 1997 (Fig. 1). Over the same period, incoming solar energy for SOND has tended to decrease (but not significantly) (Fig. 1 - bottom right).

Conclusions

- Averaged across 6 locations across the Canadian Prairie, incoming solar energy (annually and seasonally) has decreased since about 1960.
- The reasons for these patterns of change need further research.

References

- Foukal, P. and Lean, J. 1990. An empirical model of total irradiance variation between 1874 and 1988. *Science* 247: 556-558.
- Lean, J. and Rind, D. 1998. Climate forcing by changing solar radiation. *J. Clim.* 11: 3069-3094.
- Stanhill, G. and Cohen, S. 2001. Global dimming: a review of the evidence for a widespread and significant reduction in global radiation with discussion of its probable causes and possible agricultural consequences. *Agric. Forest Meteorol.* 107: 255-278.

Table 1: Locations on the Canadian Prairies where the majority of the values for daily incoming global solar radiation were observed rather than estimated over a period with continuous records of at least 30 years (except Bad Lake-Outlook with 27 years). Solar radiation data were obtained by Agriculture and Agri-Food Canada from Meteorological Services of Canada. Also included are trend (linear slope) and significance ($P < 0.1$) for the relationship of annual average daily global solar radiation with year at each location.

Climatological Station	Prov	Lat. ($^{\circ}$ N)	Long. ($^{\circ}$ W)	Duration		Linear slope ($P < 0.1$)
				From	To	
Beaverlodge	AB	55.2	119.4	1960	1995	0.0063
Edmonton	AB	53.3	114.1	1960	1997	0.012 (0.054)
Suffield	AB	50.3	111.2	1960	1997	0.0125 (0.022)
Bad Lake-Outlook	SK	51.5	107.1	1972	1995	0.058 (0.001)
Swift Current	SK	50.3	107.7	1960	1994	0.0165 (0.038)
Winnipeg	MB	49.9	97.2	1960	1995	0.0196 (0.012)