Climate Change at Swift Current, SK: Bright Sunshine and Incoming Solar Energy

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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).
- The sun's activity cycles. For example, sunspots exhibit a prominent 11-year cycle, and also shorter (27-day) and longer (22-year) cycles. Other cycles of various durations are thought to exist (Francis and Hengeveld 1998; Lean and Rind 1998).
- 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).

Objective

- To analyze long-term meteorological records at Swift Current for evidence of annual and seasonal change in bright sunshine and incoming solar energy.

Methods

- Sunshine hours were measured with the same Campbell Stokes Sunshine recorder at Swift Current SRL (near the main building) and, from 1959, at Swift Current CDA.
- Site inhomogeneities with regards to sunshine data were assummed to be minor (interference from growing trees and buildings was not a problem at either site).
- From 1995 to 1998, sunshine hours were recorded automatically at the CDA site. The automated readings were correlated to the Campbell Stokes recorder using regression analysis.
- From 1962, a pyranometer had been installed at Swift Current CDA (South Farm) to measure incoming solar energy.

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

Results

- Note: These results are preliminary. Analyses are ongoing.
- Total hours of bright sunshine annually (Fig. 1 - top left) and for MJJA (Fig. 1 - top right) have increased from 1924 to about the mid-1960's and have decreased thereafter.
- Contrarily, hours of bright sunshine for JFMA have decreased from 1924 to the late-1950's and increased thereafter. Sunshine hours for SOND have not changed (data not shown).
- Contrary to the observed increase in solar activity, annual and seasonal - JFMA and MJJA - incoming solar energy measured at Swift Current have decreased linearily since 1962 (Fig. 2). Incoming solar energy for SOND has tended to decrease (but not significantly) since 1962 (Fig. 2 - bottom right).
- The cyclical nature of incoming solar energy is clearly visible in the data (Fig. 2).
- The decrease in bright sunshine and solar energy may, in part, be due to increased cloud cover associated with increased precipitation events.
- For example, concurrent to the decrease in both bright sunshine hours and incoming solar energy, events with < 0.5 mm precipitation have increased dramatically (Fig. 1 - bottom left and right).

Conclusions

- Bright sunshine (annually and for MJJA) and incoming solar energy (annually and seasonally) have decreased since the early 1960's. However, bright sunshine for JFMA has increased since about 1960.
- The reasons for these patterns of change need further research.

References

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Lean, J. and Rind, D. 1998. Climate forcing by changing solar radiation. J. Clim. 11:3069-3094.

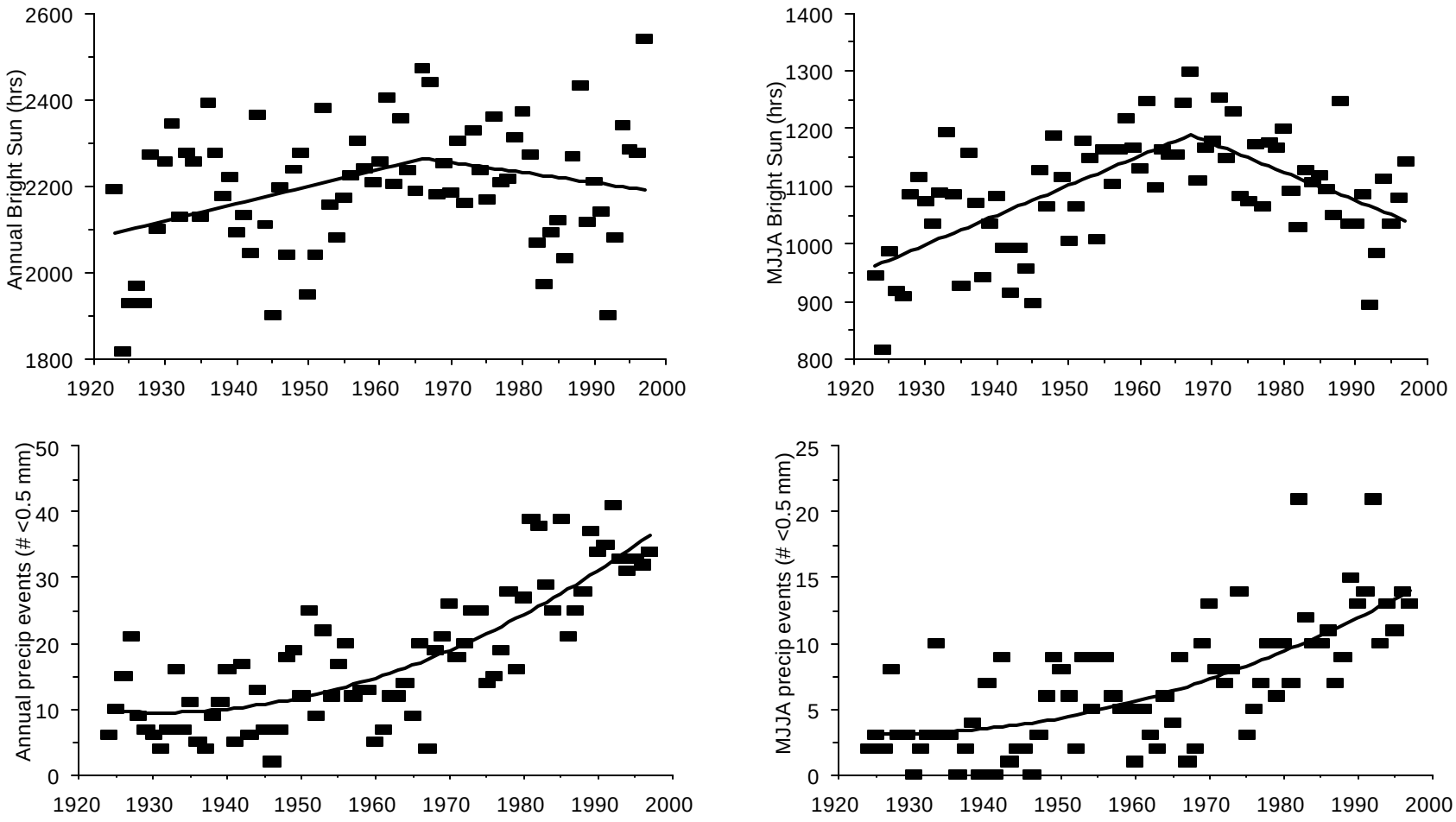

Figure 1: From 1924 to 1998, total hours of bright sun annually (top left) and for May through August (MJJA - top right), and the number of precipitation events with less than 0.5 mm of precipitation annually (bottom left) and for MJJA (bottom right).

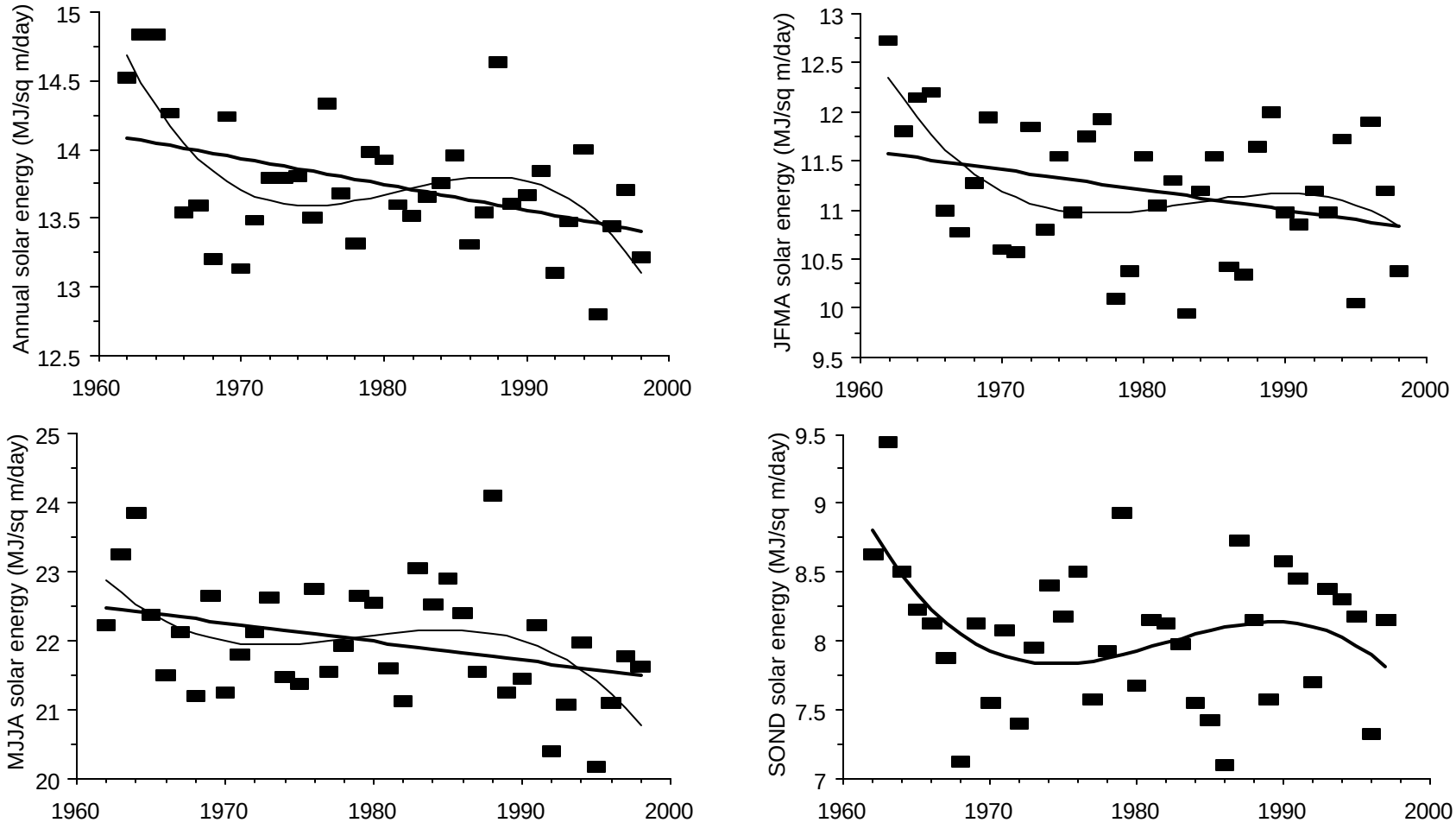

Figure 2: From 1962 to 1998, average annual (top left), January through April (JFMA - top right), May through August (MJJA - bottom left), and September through December (SOND - bottom right) incoming solar energy (MJ m^{-2} day^{-1}) at Swift Current.