MIT workshop Abstract

# Coupling Climate to Clouds, Land-use, Precipitation and Snow.

Alan Betts
Atmospheric Research, Pittsford, VT
http://alanbetts.com

**Abstract:**
A newly released 60-year hourly dataset for the Canadian Prairies has transformed our understanding of diurnal and season climate over land, because it contains hourly values of opaque/reflective cloud cover, which can be calibrated against $SW_{dn}$ to calculate shortwave cloud forcing (SWCF).

The cloud forcing of the diurnal climate has distinct warm and cold season behavior. In the warm season from April to October, an unstable BL is controlled by SWCF: maximum temperature and the diurnal ranges of temperature and relative humidity increase with decreasing opaque cloud cover; while minimum temperature is almost independent of cloud. During the cold season when snow covers the surface, a stable BL is controlled by LWCF: both maximum and minimum temperature fall with decreasing cloud. The transition between these states occurs in 5 days with snow cover. Snow cover acts as a climate switch, through its impact on surface albedo, reduced evaporation and reduced $LW_{dn}$. There is a fall/rise in temperature of 10K with snowfall/snowmelt; and the mean temperature of the cold season has a tight linear dependence on the fraction of snow days, explaining nearly 80% of the interannual variability. A 10% decrease in days with snow cover increases the mean cold season temperature by 1.4K.

The agricultural land-use conversion in recent decades from summerfallow to annual cropping on 5 MHa on 20% of the land area in Saskatchewan has cooled and moistened the summer climate due to increased transpiration. There has been an increase in summer precipitation.