Session: B11 Oral presentation

Cryosphere radiative forcing and albedo feedback

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Reductions in boreal snow cover and sea-ice during the past several decades have coincided with surface air warming. Because cryospheric cover decreases the solar power absorbed by Earth, these changes indicate that positive surface albedo feedback is operating. Here, we apply remote sensing observations of snow and sea-ice cover, surface albedo, and cloud cover to quantify cryosphere radiative forcing (CrRF) and albedo feedback during the past 30 years. These observations are used to evaluate simulated albedo feedback from contributions to the WCRP Climate Model Intercomparison Project 3 (CMIP3). We find that mean northern hemisphere CrRF during 1979-2008 was -3.3 ± 1.2 W/m≤, peaking in May at -9.0 ± 2.7 W/m≤. During this time period, cryospheric cooling decreased by 0.45 (0.27 - 0.72) W/m≤, averaged over the northern hemisphere, with nearly equal contributions from changes in land snow cover and sea-ice. In the absence of other feedbacks, this increase in absorbed solar power would augment the current global-mean radiative forcing from anthropogenic activity of ~1.6 W/m≤. The boreal cryosphere albedo feedback currently falls between 0.3 and 1.1 W/m≤/K, with a central estimate of 0.6 W/m≤/K that is stronger than that simulated by all CMIP3 models during 1980-2010 and during both the 20th and 21st centuries. Thirty-year changes in CrRF exerted by land snow are greatest during spring (March-June). Although sea-ice reductions have been largest in September, June ice loss has driven a much larger increase in solar energy absorption because of coincident peak insolation. We will discuss implications of these findings for Earth's climate sensitivity, and will explore experiments that may help identify deficiencies in model physics that lead to under-estimation of the boreal cryosphere albedo feedback.