Session: B11 Oral presentation

Snow-atmosphere coupling strength

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This study investigated the snow-atmosphere coupling strength (the degree to which atmosphere responds to anomalies in the snow cover and their subsequently interaction) and its potential contribution to short range climate predictability, based on the realistic snow information from the MODIS snow retrieval from NASA satellites and GLDAS land "reanalysis" data. A complex land surface model (CLM 3.5) with an advanced snow scheme coupled to the Community Atmospheric Model (CAM) was employed to quantify continental snow-atmosphere coupling strength. A series of ensemble experiments were designed to investigate the snow albedo effect and hydrological effect separately. A recently derived index Ω was used to quantify the coupling strength and predictability estimated separately by the phase and shape characteristics of a forecast ensemble. In addition, the climate predictability represented by Signal-to-Total Ratio (STR) due to realistic snow information, including Snow Water Equivalent (SWE) and Snow Cover Fraction (SCF), are also investigated. During spring to early summer, the snow regions over the Northern Hemisphere (NH) demonstrate strong snow-atmosphere coupling. Climate model experiments reveal the spatial and temporal distribution of coupling strength during the snow depletion phase (March to June) over the Northern Hemisphere. The snow coupling strength was found to evolve in three distinct stages (before snowmelt, during snowmelt and after snowmelt) that are also evaluated and compared. The coupling strength is strongest during snowmelt. After snowmelt, the coupling strength due to hydrological effect (soil moisture impact) is stronger than coupling strength due to albedo effect (radiative impact) before snowmelt. A conceptual model is proposed to explain the mechanism behind the spatial distribution of coupling strength. This study improved our understanding of the interaction between snow cover and atmosphere. Determining the seasonal forecast skill attributed by snow information also increased our knowledge of climate predictability. These experiments would also offer a prototype for testing snow-atmosphere coupling strength that could be implemented in other weather and climate models in the future.