



The characteristic of radiation balance and its effect in the Tibetan Plateau lakes during the frozen period

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The Tibetan Plateau (TP) lakes are sensitive to climate change due to ice-albedo feedback, but almost no study has paid attention to the ice albedo of TP lakes and its potential impacts. Here we present a recent field experiment for observing the lake ice albedo in the TP, and evaluate the applicability of the Moderate Resolution Imaging Spectroradiometer (MODIS) products as well as ice albedo parameterizations. Most of the observed lake ice albedos on TP are less than 0.12, and the clear blue ice albedo is only 0.075, much lower than reported in previous studies. Even that of ice covered with snow patches is only 0.212. MOD10A1 albedo product has the best agreement with observations, followed by those of MYD10A1. MCD43A3 product is consistently higher than the observations. Due to an error of snow flag and inconsistent time windows in MCD43A2 and MCD43A3, at certain times, the albedo of the ice without snow is even higher than that covered with snow. When the solar zenith angle is not considered, there is no significant correlation between the albedo and the ice surface temperature. None of the existing ice-albedo parameterizations can reproduce well the observed relationship of the albedo and surface temperature. In order to study the effect of lake ice albedo, a group of numerical simulations with different ice albedos using a lake model are carried out. The forcing data come from the observation in Ngoring Lake. Although the simulated water temperature is underestimated systematically, the bias and the root mean square error all decrease with the decrease of the ice surface albedo. This means that, for Ngoring Lake, the low ice albedo is more appropriate for the lake temperature simulation.