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Sea Ice Reduction on Northern Hemisphere and its Impact on Climate of South America

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The cryosphere plays an important role on the Earth's climate system because it affects the surface energy balance, the hydrological cycle, the primary productivity and the sea level. It exerts control over the physical and biological environment in an extensive portion of the Earth's surface. The cryosphere is a natural integrator of climate variability and has provided some of the most visible signatures of climate change. IPCC 5th Assessment Report shows continuous ice loss in the cryosphere although it points out significant differences on loss rates among different cryosphere components (sea ice, glaciers, etc.) and among the various places where it is observed (Artic, Antarctica and other continents). In this context, the purpose of this study was to evaluate possible impacts on climate caused by the decline of the sea ice sheet, in some areas of the Northern Hemisphere. We conducted three experiments, using SPEEDY global atmospheric model with T30L8 resolution to localize and quantify climate changes caused by a possible reduction of the ice existent now. The first experiment, called control, used as lower boundary condition the current ice sheet on the Arctic region. The other two experiments were carried out reducing by 50% the ice sheet over the Barents Sea and around Greenland, respectively. The SPEEDY model was integrated by 110 years in each experiment. By establishing the mean values obtained over the last 100 years of each integration, it was possible to determine differences in the performance of the meteorological variables of interest, such as rainfall, specific humidity and temperature, when comparing the control experiment with the simulations of ice decline. In the simulation of ice decline over the Barents Sea, there was rainfall increase in January in the region of the Gulf of Mexico and in the region of SACZ acting in Brazil as well as a decrease over the northern region of the Northeast. A rainfall decrease in October, when the rainy season begins, was observed throughout the interior of Brazil. These differences were statistically significant at the 95% level. In the experiment where an ice reduction was promoted on the sea around Greenland, we observed smaller differences, but rainfall decrease over Brazilian northern region and temperature increase in the South and Southeast in summer time could be highlighted. This simulation also showed a statistically significant rainfall decrease in the central part of the country, at the time of the onset of the rainy season in the region. These experiments allowed concluding that, in the event of a warmer planet, where a reduction of the ice sheet over the Northern Hemisphere is expected, there will be changes in humidity and temperature distribution even on the Southern Hemisphere leading to changes in rainfall regime on various regions.