Implications for Arctic Amplification of Changes in the Strength of the Water Vapor Feedback

Debjani Ghatak (Institute of Marine and Coastal Sciences) and James Miller (Institute of Marine and Coastal Sciences)

Abstract

Amplified warming relative to the global mean is one of the major climatic changes apparent over the Arctic Ocean. There are multiple factors which play roles in this amplification, including changes in sea ice/albedo, atmospheric circulation, clouds, and water vapor. We investigate the positive feedback on temperature caused by increasing downward longwave radiation flux (DLF) associated with increasing atmospheric precipitable water vapor (PWV). The Japanese Reanalysis (JRA 25) is used to examine the role of the DLF/PWV component of the water vapor feedback loop on the enhanced warming in the Arctic during the last three decades. We find a non-linear relationship between DLF and PWV, which suggests that the sensitivity of DLF to changes in PWV varies by season, with the highest sensitivities in winter and the lowest in summer. The relative importance of PWV on changes in DLF varies both spatially and seasonally over the Arctic. The positive trends in DLF and PWV are widespread over the Arctic during autumn and spring, but are centered mainly over the Atlantic sector in winter. The strength of the PWV feedback loop depends on both the sensitivity of DLF to changes in PWV as well as the change in PWV during the last three decades. Although the DLF/PWV sensitivity is high in winter, there is little change in PWV throughout much of the Pacific sector of the Arctic. If in the future PWV were to increase significantly during winter in the central and Pacific sectors of the Arctic, there could be an expansion of Arctic amplification during winter.