

# Influence of the Madden-Julian Oscillation on Wintertime Extreme Snowfall and Precipitation in Japan

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The present study found that the Madden-Julian Oscillation (MJO) significantly influences the occurrence probability of extreme snowfall and precipitation in Japan during boreal winter (December–February) based on observational data and the Database for Policy Decision Making for Future Climate Change (d4PDF). By analyzing d4PDF containing 90-member and 50-member ensemble historical simulations by global and high-resolution regional models, respectively, we could quantify and elucidate the geographical distribution of the probability of extreme weather in Japan related to the MJO. The d4PDF global simulations well represent the MJO and its teleconnection over the Pacific-North America region. Our results show that (1) the probability of extreme snowfall on the Sea of Japan side of northwestern Japan (SJA) increases (decreases) by approximately 20 % (30 –40 %) associated with enhanced MJO over the Maritime Continent and western Pacific (western Indian Ocean) relative to that for all winter days; (2) the extreme precipitation on the Pacific Ocean side (PAC) of Japan increases (reduces) by 40 –50 % (approximately 30 %) when the MJO is active over the Indian Ocean (western Pacific); and (3) the extreme snowfall on the Kanto area in PAC increases by 30 –45 % with enhanced MJO over the eastern Indian Ocean and Maritime Continent. Composite analysis reveals that different physical processes associated with the MJO are responsible for extremes in the three regions. The MJO intensifies cold air intrusion from Siberia into Japan associated with a more frequent blocking over East Siberia, causing extreme snowfall in SJA. The MJO stimulates the explosive development of extratropical cyclones due to enhanced moisture flux convergence, leading to extreme precipitation in PAC and extreme snowfall in Kanto. Furthermore, the Kanto snowfall is partly related to a cold air outflow from the blocking induced by the MJO.

Keywords: extreme snowfall and precipitation, large ensemble simulation, MJO teleconnection