Ocean warming patterns and heavy rainfall over East Asia associated with atmospheric rivers

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Atmospheric rivers (ARs), narrow moisture transport bands developed over the mid-latitude oceans, have attracted much attention because they often cause natural disasters (flash flood, extreme wind) when they make landfall. Over East Asia, ARs explains 20-90% of heavy rainfall events occurred during warm seasons. On an interannual timescale, substantial fraction of East Asian AR frequency is explained by the Pacific and Indian Ocean SST variability, suggesting the potential predictability of seasonal AR-disaster risk. Recent studies suggested that the global SST rise under the global warming results in more occurrence of ARs due to increased water vapor content. In addition to the thermodynamic effect, change in atmospheric circulation associated with SST warming patterns may also increase AR-disaster risk over specific regions. We examine spatial patterns of change in AR-disaster risk under global warming using ensemble simulations assuming different ocean warming patterns. When we assume warm Indian Ocean during summer, an anomalous subtropical anticyclone over the western North Pacific results in an enhanced moist southwesterly over East Asia and more occurrence of ARs. In addition to the dynamic effect, warm condition over the East China Sea and the western North Pacific are also related to the enhanced AR activity over the western North Pacific. We further evaluate AR-related heavy rainfall using hourly model outputs and effects of ocean warming patterns.

Keywords: Atmospheric river, Global warming, Heavy rainfall

