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The Influence of Severe Storm Tracks on High Impact Weather in North America

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The behavior of Northern Hemisphere (NH) severe storm tracks and their influence on high impact winter weather are diagnostically studied using data from the Climate Forecast System Reanalysis (CFSR) and the Global Precipitation Climatology Project (GPCP). In this study high impact weather is represented by strong low-level winds and intense precipitation. Storm tracks are described by isentropic potential vorticity (IPV) maxima within a Lagrangian framework and are found to correspond with those described in previous studies: three storm tracks are identified over the North Pacific and North Atlantic Oceans as well as over the Mediterranean Sea. The cyclogenesis pattern shows that severe storms (the top 14% of all storms) generally develop along the tracks. The cyclolysis pattern reveals that most cyclones dissipate in the eastern North Pacific and western North Atlantic Oceans. Across the NH, the diabatic heating increases where the storm tracks are present, with the larger heating gradients corresponding to high track density regions, i.e., where the majority of storms tend to propagate.

Precipitation intensity related to the severe storm tracks is largest where they are strongest, e.g., over the oceans, and along the west coast of North America. Over North America, it is found that severe storms contribute 40-60% of the precipitation produced by all winter storms. The largest increases in low-level wind speeds are found in the storm track regions which are collocated poleward and eastward of the jet stream maxima over the oceans. The winds in the severe storm track regions almost double in speed from the background wind, particularly in the northeastern North Pacific, the northeastern North Atlantic, and leeward of the Rocky Mountains. Leeward of high orography, the winds intensify and flow southeastward across North America toward the North Atlantic Ocean.