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Behaviors of synoptic eddies around the Tibetan Plateau

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The Tibetan Plateau (TP), as the highest and largest obstacle embedded in the westerly jet stream, can influence the development of synoptic eddies that are steered by the westerly jet stream. Since the synoptic eddies can significantly affect weather and climate over the plateau and further downstream, this study explores their behaviors at different altitudes (850, 500, and 250 hPa) around the TP using an objective feature tracking algorithm and 41-years of hourly data from the ERA5. All synoptic eddies that occur over the TP region (25-45°N, 60-110°E) for at least a part of their lifecycle are considered in this study.

Analysis shows that these eddies mainly enter the TP region from the western and northern boundaries or form locally. Regardless of altitude, more than half of the eddies coming from outside die out when they encounter the TP, suggesting a suppression effect of the TP on external eddies. About one in ten eddies will turn north and fewer turn south. Eddies do not generally directly pass the TP region from west to east, except for a few cases at the upper level (250 hPa). Additionally, some 500-hPa and 250-hPa eddies can reach East Asia travelling around the TP on its northern side, which tends to happen in transitional seasons, and few winter eddies can pass through on the southern side. The number of synoptic eddies moving in from outside increases with altitude, while the number of locally generated eddies is largest at the 500-hPa level, which is the surface height of the TP. These eddies tend to occur over the central and southeastern parts of the TP, indicating the orographic perturbation effect of the TP. Nearly half of the locally generated eddies die out over the TP region, and more than a third move to East Asia. These results pave the way for future dynamical investigation of the interactions between the TP and the synoptic eddies, and of the impacts associated with the different categories of eddies.