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# Variability and extremes of meridional atmospheric heat transport

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Meridional atmospheric heat transport is a fundamentally sporadic process. Here, we analyse the spatial and temporal variability of such transport, and show that transient motions – diagnosed in terms of deviations from a long term climatology – drive large local transport values. This implies that, at any given location in the extra-tropics, the net seasonal heat transport by the transients is heavily affected by a few extreme days every season. A large variability with notable extreme events also emerges when considering zonally integrated meridional transport values. We next perform a scale decomposition of the total, zonally integrated transport to separate the roles of the mean meridional flow, the planetary (zonal wavenumber 1 to 5) and the synoptic (zonal wavenumber 6 to 10) waves. In both the winter and summer months, poleward transport extremes result from a constructive interference of transport performed by planetary and synoptic motions, while the contribution of the mean meridional circulation is close to climatology (and predominantly equatorward). Instances of this constructive interference have been previously associated with extreme heat and moisture transports to the high latitudes. The pattern is different for extreme equatorward transport anomalies. In winter, the mean meridional flow mostly drives a net equatorward transport (thus acting counter-gradient), while the planetary and synoptic modes chiefly (but not always) transport energy poleward. In summer, the transport by mean meridional circulation is weak and close to climatological values, the planetary modes mostly transport energy equatorward and the synoptic modes again drive a poleward transport. This translates into a systematic destructive interference between the transport by planetary waves and by synoptic motions. The existence of such pronounced variability in the meridional heat transport, associated with complex scale interactions, has important consequences for the interplay between mid-latitude dynamics and the energy balance of the high latitudes.