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Second-order and Third-order structure functions calculated from 10 years of QuikSCAT winds over the Pacific Ocean

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Second- and third-order velocity structure functions are calculated using the two-dimensional surface wind fields over the Pacific Ocean measured by the SeaWinds scatterometer on board the QuikSCAT satellite. The global coverage of the satellite and the ten-year data set are used to extract information about the scaling of mesoscale atmospheric kinetic energy and the direction of the energy cascade as a function of time and geographical region.

According to turbulence theory the sign of the longitudinal third-order structure function S_{LLL} can be used to infer the direction of the energy cascade, with $S_{LLL} < 0$ indicating a downscale energy cascade and $S_{LLL} > 0$ indicating an upscale energy cascade — analogous to how S_{LLL} would behave in three- and two-dimensional turbulence respectively. We find regions where the sign of S_{LLL} is negative, regions where it is positive, and regions where the sign varies with the month of the year.