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Vortex identification and interactions across the scales

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Vortex identification is usually based on either geopotential height or vorticity fields. However, methods based on geopotential height fields fail if shear is present and vorticity magnitudes vary depending on the scale of the investigated vortex. In this work, we will present a recently introduced vortex identification method based on the kinematics of the flow field: the W_k method. Defined as the ratio of the tensor norms of vorticity tensor and strain tensor, the dimensionless kinematic vorticity number W_k identifies prevalent rotational motion as simply connected regions of W_k>1. Those regions will be called *vortex structures* since they include one or multiple vorticity extrema. Therefore, the W_k method is able to identify vortices and vortex properties such as circulation and area across multiple scales without the need of adjusting thresholds.

The W_k method will be applied to European derecho cases. Thereby, we will study three data sets with different resolutions: NCEP, CFSR, and COSMO data sets with resolutions of about 250 km, 55 km, and 2.75 km, respectively. These data sets resolve processes on different scales ranging from the synoptic scale to the mesoscale and to the convective scale. The results will be analysed with respect to the interactions and connections of vortex structures on different scales. Moreover, the work will give insight in the interactions between quasi-twodimensional and threedimensional processes that seem to be closely related to the different vortex structures in a large-scale system.