The impact of topography on the dynamics of sting-jet storm "Egon" over continental Europe

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Intense Shapiro-Keyser cyclones are often accompanied by a sting jet (SJ), an airstream that descends from the cloud head into the frontal-fracture region and can cause extreme surface wind gusts. Previous work has concentrated on cases over the North Atlantic and the British Isles. Here we present the first-ever detailed analysis of a SJ over continental Europe and investigate the influence of topography on its dynamical evolution based on observations and high-resolution simulations using the ICOsahedral Nonhydrostatic model (ICON). Windstorm Egon intensified over the English Channel and then tracked from northern France to Poland on 12–13 January 2017, causing wind gusts of almost 150 km h\(^{-1}\) and significant damages. ICON reproduces the storm evolution realistically but delays the explosive deepening, shifts the track southward over Belgium and Germany and underestimates wind gusts over land. Storm characteristics show weak sensitivity to varying grid spacing between 1.6 and 6.5 km, while switching off the convection parametrisation at 3.3 km grid spacing improves correlations with surface observations but deteriorates the mean error. Trajectories reveal typical SJ characteristics such as mid-level descent, strong acceleration and conditional symmetric and other mesoscale instabilities, while evaporative cooling is stronger than in previous cases, preventing drying during descent. The SJ identification and the analysis of mesoscale instabilities depend considerably on model resolution, convective parametrisation, output frequency and employed thresholds for trajectory selection. Sensitivity experiments with modified surface characteristics show that the combined effects of warm air blocking by the Alps, higher roughness over land and reduced surface fluxes cause Egon to fill more quickly and to move on a faster, more northern track across Germany. While the SJ response is complex showing some compensating effects, surface gusts strongly increase when roughness is reduced. Weather forecasters in continental Europe should be more aware of the potential risks associated with SJs.