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Extreme vertical drafts in the polar summer mesosphere: A super mesospheric bore?

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The polar summer mesosphere is the Earth's coldest region, allowing the formation of mesospheric ice clouds, potentially linked to climate change. These clouds produce strong radar echoes that are used as tracers of mesospheric dynamics. Here we report the first observations of extreme vertical drafts in the mesosphere, characterized by velocities larger than 40 m/s, i.e., more than five standard deviations larger than the observed wind variability. The morphology seems to resemble mesospheric bores, however the scales observed are much larger. Powerful vertical drafts, intermittent in space and time, emerge also in direct numerical simulations of stratified flows, predicting non-Gaussian statistics of vertical velocities. This evidence suggests that mesospheric bores might result from the interplay of gravity waves and turbulent motions. Our extreme event is interpreted as a mesospheric "super-bore", impacting mesospheric mixing and ice-formation, and would potentially impact planning of sub-orbital flights, and the investigation of biological material in the near space.