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## **Air-traffic restrictions at the Madeira International Airport due to adverse winds: links to synoptic-scale patterns and mountain wave phenomena**

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The Madeira International Airport (MIA) lies on the island south-eastern coast and it is known to be exposed to wind hazards. A link between these adverse winds at MIA and the synoptic-scale circulation is established using a weather type (WT) classification. From April to September (summer period), five WTs prevail, cumulatively representing nearly 70% of days. These WTs reflect the presence of well-established Azores high, with some variations on location and strength. Although with a low frequency of occurrence (<5%), this anticyclone occasionally strengthens and extends towards Iberia, inducing anomalously strong NNE/NE up to 3-5 km over Madeira. The most severe and longer-lasting wind conditions at the MIA, with a higher frequency of gusts above 35 kt, are driven by this synoptic-scale pattern and are more common in summer. An episode of adverse winds at the MIA is analyzed, illustrating the occurrence of upstream stagnation, flow splitting, and lee wake formation. The upstream conditions include a low-level inversion, strong NNE/NE winds near and above the inversion and a Froude number less than 1. AROME model predicted the occurrence of downslope winds, in association with a large-amplitude mountain wave. At this time, the strongest wind gusts were registered and a missed approach occurred. The wind regime in different places of the island suggests that these conditions are relatively frequent, mostly in summer. Lastly, this study provides an objective verification of the AROME wind forecasts, for a 3-year period and from June to August.