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KM-SCALE REGIONAL SYSTEMS COUPLED AT HIGH FREQUENCY FOR METEOTSUNAMIS PREDICTION

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Meteotsunamis are anomalous tidal waves triggered by atmospheric disturbances like thunderstorms, gravity waves, squalls, and cyclones. These events occur at frequencies similar to tsunamis and are driven by rapid sea-level pressure changes, where even a 1 mbar fluctuation can alter sea height by ~1 cm. When the speed of the atmospheric disturbance matches the wave's phase speed ($\sqrt{gh}$), Proudman resonance can amplify the wave significantly.

While meteotsunamis have been studied extensively in the U.S. and Mediterranean, they remain under-researched in the UK, where they're seen as rare and low-risk. However, new evidence, including reports from the UK Environment Agency, suggests that meteotsunamis may be more frequent and damaging than previously assumed. This raise concerns that many events have likely gone undetected – missed due to the limited temporal resolution of standard tide gauge data and the lack of dedicated forecasting or early warning systems.

This study explores the role of atmospheric forcing in meteotsunami formation using high-resolution atmosphere-ocean-wave coupled models: the UK Met Office (UM–NEMO–WaveWatchIII) and Météo France AROME–NEMO FRA36. We analyse two events: one linked to a slow-moving front causing coastal flooding, and another—the strongest meteotsunami recorded in Ireland—driven by frontal and gravity wave activity.

Findings show the Met Office model more accurately captures UK and Irish events, while the French model performs better near France. The most significant cases involve Arctic and warm continental air masses forming a stable surface layer, allowing gravity waves to propagate. High-resolution ensemble forecasts show strong potential for early meteotsunami warning systems.