{rokbox title=| Spatial distribution of γ computed from (a) the high-resolution SST field (γ) and (b–d) progressively smoothed SST fields (γ) using Gaussian filter length scales of σ = 0.125°, 0.25°, and 0.5°, respectively, for 21 August 2014 :: Image: Authors|images/stories/ieo/imagenespublicaciones/centro-oceanografico-baleares-ieo-csic-importance-kilometre-scale-sst-jorda-2026-thumb-et-al.jpg|}images/stories/ieo/imagenespublicaciones/centro-oceanografico-baleares-ieo-csic-importance-kilometre-scale-sst-jorda-2026-et-al.jpg{/rokbox}

Camilo Melo-Aguilar and **Gabriel Jordà**, 2026. **The importance of kilometre-scale SST variability for SST-gradient-driven air–sea coupling in the western Mediterranean.** Scientific Reports volume 16, Article number: 34714 (2026). https://doi.org/10.1038/s41598-026-71837-z

Abstract:Submesoscale sea surface temperature (SST) variability can modulate near-surface winds through the downward momentum mixing mechanism, whose strength depends on the intensity and orientation of SST gradients relative to the wind. In regional climate modelling, this coupling may be limited by both atmospheric resolution and the spatial resolution of the SST forcing. Here we assess the spatiotemporal variability of the downwind SST-gradient diagnostic (γ), a proxy for the potential of SST-gradient-driven coupling, in the western Mediterranean using high-resolution winds and multiple high-resolution SST datasets. The influence of fine-scale SST variability is quantified through spatial filtering experiments, showing that coarsening the SST field substantially reduces the amplitude and extremes of γ and weakens its distribution tails. These results indicate that kilometre-scale SST gradients make the largest contribution to the strongest γ conditions and suggest that coarse-resolution SST fields substantially underrepresent the occurrence of diagnostically favourable conditions for SST-gradient-driven coupling. Furthermore, the results reveal a robust climatological imprint of fine-scale SST variability on the γ diagnostic. A sensitivity analysis across SST products reveals notable variability in γ magnitude, particularly in frontal regions. Nevertheless, all datasets consistently identify coherent coupling hotspots associated with persistent mesoscale and submesoscale fronts.

Keywords:submesoscale SST variability,air-sea interactions,mediterranean climate,high-resolution SST.