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Applying citizen weather data and AI for developing a high-resolution wind speed monitor in the Valencia region (Spain)

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Reliable near-surface wind speed (NSWS; ~10 m above ground level) data is crucial for assessing the impact of wind changes on various socio-economic and environmental sectors, such as wind energy production or risk assessment. Meteorological stations provide local and realistic observations, but their spatial coverage is limited. Although this limitation can be overcome by using classical geostatistical interpolation methods, the reliability of their results is questionable, especially in regions with complex topography. This has motivated the use of reanalyses or dynamical downscaling of simulations as gridded NSWS products that contain local to regional wind data. However, their uncertainties in reproducing observed trends and their coarse resolutions raise doubts about their reliability for reproducing local NSWS. The use of classical interpolation products is even riskier in regions such as the Valencian Community (Eastern Iberian Peninsula, Spain), a region where both local winds (sea breezes) and extreme winds (westerlies "*ponientes*" or convective wind gusts "downbursts") occur at local scales (~3km), impacting the tourism activities and wildfires propagation fatalities, among others.

Here, we propose a deep neural network based on partial convolutions as a more reliable spatial interpolation method, capable of learning the wind speed pattern across the Valencian Community observed in a dense observational network. Observed NSWS from a citizen weather network of up to ~600 stations from the Valencian Association of Meteorology (AVAMET) were used after homogenization, resulting in a high-resolution (3-km) wind speed product. This offers a new tool for both climate and marine research in the framework of the ThinkInAzul project.

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