The European Space Agency (ESA) Marine Atmosphere eXtreme Satellite Synergy (MAXSS) project

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In this talk, we will present the main outcome of the European Space Agency (ESA) Marine Atmosphere eXtreme Satellite Synergy (MAXSS) project (https://www.maxss.org/, 2020-2023) in term of new products and scientific analysis. The primary objective of the project was to provide guidance and innovative methodologies to maximize the synergetic use of available Earth Observation (EO) data (satellite, in situ, models) to improve understanding about the multi-scale dynamical characteristics of extreme air-sea interaction, such as during Tropical Cyclones (TC), Extra-Tropical Cyclones (ETC), and, Polar Lows (PL). Extreme wind events occupy an increasing place in the mass media as they have direct societal and economic implications (human loss, material destructions...), and are expected to become more destructive in the future as a consequence of global warming. Over the last several years an increasing number of satellite observations (e.g., scatterometers, radiometers, synthetic aperture radars, altimeters) have become available that are able to estimate, either directly or indirectly, surface winds and wave characteristics under extreme marine wind. These available observations are known to be largely heterogeneous, in both space and time resolutions, but also in terms of sensor physics. In that context, a number of activities has been performed to generate six important databases, covering for now the period 2010-2020. These databases include:

(1) intercalibrated satellite surface winds (scatterometers, radiometers and altime-

ters) in extreme wind conditions, using as a reference co-localized Step Frequency Microwave Radiometer aircraft flight data,

(2) a global 10-year long hourly Multi-Missions surface extreme Wind vector product provided on a quarter degree grid. This product is derived from the merging of intercalibrated sensors, and ERA5 surface winds using an optical flow morphing technique,

(3) a 10-year long Storm Atlas of Earth Observation data collected around TC, ETC and PL,

(4) a 10-year Atlas of pre-storm upper ocean conditions, atmospheric forcing during TC, and, TC-induced oceanic wakes,

(5) a database of high resolution TC vortex and wind structure derived from SAR and radiometer data, and, finally,

(6) a database of ocean swell characteristics that were generated by TCs, as measured by different sensors, including satellite and in-situ sources.

The developed products and available databases will be presented and we will illustrate how these products were first used in some science case studies, including decadal extreme wind changes, turbulent air-sea fluxes under extreme wind conditions, oceanic wake analyses, and Storm Impact on Biogeochemistry.