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Unprecedented observations of Mediane precipitation structure from the GPM Core Observatory

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Mediterranean hurricanes (Medicanes) are meso-scale cyclones typical of the Mediterranean area which during their lifetime may show some dynamical features with tropical cyclones: the presence of a quasi-cloud-free calm eye, spiral-like cloud bands elongated from the center, strong winds close to the vortex center and a deep warm core. They are often associated to heavy rainfall and flooding, intense wind, and high waves and storm surge, and can be serious threats to human life and infrastructure. Recent studies highlighted that extra-tropical and tropical-like cyclone characteristics can alternate or even coexist in the same cyclonic system, and that only in some cases strong diabatic forcing leads to tropical-like transition (i.e., purely barotropic structure). In this study the satellite measurements from the NASA/JAXA Global Precipitation Measurement Core Observatory (GPM-CO) active and passive microwave (MW) sensors are used to analyze the precipitation structure of the most intense Mediterranean Hurricane (Mediane) on record, named Ianos, which swept across the Ionian Sea between 14 and 18 September 2020. Two GPM-CO overpasses, available during Ianos development and tropical-like cyclone (mature) phase, are analyzed in detail. GPM Microwave Imager (GMI) measurements are used to carry out a comparative analysis of the mediane precipitation structure and microphysics processes between the two phases. The GPM-CO Dual-frequency Precipitation Radar (DPR) overpass, available for the first time during a mediane mature phase, provides key measurements and products to analyze the 3D precipitation structure in the rainbands, offering further evidence of the main precipitation microphysics processes inferred from the passive MW measurement analysis. Substantial difference in the rainband precipitation structure is observed, with deeper convection and stronger updraft features during development than at the mature phase, when also shallow precipitation/warm rain processes are observed in the inner region around the mediane eye. These features play a key role to explain the substantial drop in lightning activity during Ianos mature phase. Graupel-ice electrification process is inhibited due to the combined effect of strong horizontal wind and the observed limited growth of graupel. Starting from the detailed analysis of Ianos, a comparative study among the medicanes occurred during the GPM era is carried out. The goal is to extract common features from PMW measurements characterizing the different stage of medicanes' evolution. The study demonstrates the value of the GPM-CO not only to characterize mediane precipitation structure and microphysics processes and convection strength with

unprecedented detail, but also to provide evidence of tropical-like characteristics and of similarities with tropical cyclones for those medicanes undergoing tropical-like transition during their mature phase.