Supporting Information for

Does ERA5 mark a new era for resolving the tropical cyclone environment?

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Descriptions of the tropical-cyclone-centric output and derived quantities calculated from the ECMWF fifth-generation reanalysis (ERA5; Hersbach et al. 2020) product single- (Hersbach et al. 2018b) and pressure-level (Hersbach et al. 2018a) output. The information is included in the diagnostic group of the environmental files of the Tropical Cyclone Precipitation, Infrared, Microwave, and Environmental Dataset (TC PRIMED; Razin et al. 2022). The descriptions include ERA5 model storm center information (Table S1), single-level output diagnostics (Table S2), pressure-level diagnostics (Table S3), and derived diagnostics (Table S4) based on calculations in the manuscript.

TABLE S1. Information related to the tropical cyclone center in ERA5 that is used for calculating diagnostic quantities. The columns provide the netCDF variable name (first column), units (second column), description (third column).

Variable Name	Units	Description
center_latitude	°	Diagnostics center latitude
center_longitude	°	Diagnostics center longitude
center_qc	–	Diagnostics center quality; ERA5 used to calculate center unless flag nonzero then best-track center use
center_offset	km	Diagnostic calculation center offset from best-track storm center
distance_to_land	km	Distance to nearest major land mass; Negative values overland

TABLE S2. Area-averaged diagnostic values from the ERA5 product single-level output. The columns provide the netCDF variable name (first column), units (second column), description (third column), and averaging areas (fourth column). For the averaging areas, 'X' denotes the radial extent in km of the azimuthal average.

Variable Name	Units	Description	Averaging Areas			
			0–500	200–800	0–1000	Other
central_min_pressure	hPa	Minimum central mean sea level pressure	–	–	–	–
pressure_msl	hPa	Mean sea level pressure	X	X	–	–
sst	K	0 to 50 km sea surface temperature	–	–	–	X
temperature_2m	K	Temperature at 2 meters	X	X	–	–
dewpoint_2m	K	Dew point temperature at 2 meters	X	X	–	–
u_wind_10m	m s^{-1}	Zonal wind at 10 meters	X	X	–	–
v_wind_10m	m s^{-1}	Meridional wind at 10 meters	X	X	–	–
precipitable_water	Kg m^{-2}	Total column water vapor; precipitable water; 200-km wide bins every 200 km out to 800 km	–	–	–	X

TABLE S3. Area-averaged diagnostic profiles from the ERA5 product pressure-level output for pressure surfaces between 100 and 1000 hPa at 50 hPa intervals with the addition of 925 and 975 hPa. The columns provide the netCDF variable name (first column), units (second column), description (third column), and averaging areas (fourth column). For the averaging areas, 'X' denotes the radial in km extent of the azimuthal average. Note that ERA5 outputs geopotential and that we have converted it to geopotential height.

Variable Name	Units	Description	Averaging Areas			
			0–500	200–800	0–1000	Other
temperature	K	Temperature	X	X	–	–
relative_humidity	%	Relative humidity	X	X	–	–
specific_humidity	kg kg^{-1}	Specific humidity	X	X	–	–
u_wind	m s^{-1}	Zonal wind	X	X	–	–
v_wind	m s^{-1}	Meridional wind	X	X	–	–
geopotential_height	m	Geopotential height profile; the geopotential divided by the standard acceleration due to gravity (9.80665 m s^{-2})	–	–	X	–
vorticity	s^{-1}	Relative vorticity	–	–	X	–
divergence	s^{-1}	Divergence	–	–	X	–

TABLE S4. Area-averaged derived diagnostic quantities from the ERA5 product pressure-level. The columns provide the netCDF variable name (first column), units (second column), description (third column), and averaging areas (fourth column). For the averaging areas, 'X' denotes the radial extent in km of the azimuthal average.

Variable Name	Units	Description	Averaging Areas			
			0–500	200–800	0–1000	Other
temperature_mean	K	Average temperature at 1500 km	–	–	–	X
temperature_anomaly	K	Warm-core temperature anomaly defined as the difference from the temperature at 1500 km to the average temperature between 0 and 15 km	–	–	–	X
temperature_advection	$^\circ$ C s^{-1}	700- to 850-hPa temperature advection from the geostrophic thermal wind equation	X	X	–	–
temperature_gradient	$^\circ$ C m^{-1}	700- to 850-hPa temperature gradient from the geostrophic thermal wind equation	X	X	–	–
convective_mass_flux	m s^{-1}	Density-weighted convective mass flux from an entrained plume model with ice and water condensate weight (DeMaria 2009)	X	X	–	–
t_wind	m s^{-1}	Tangential wind component at 500 km	–	–	–	X
shear_magnitude	m s^{-1}	Magnitude of the 850 to 200 hPa deep-layer shear vector	X	X	–	–
shear_direction	$^\circ$	Direction of the 850 to 200 hPa deep-layer shear vector averaged; Westerly shear has a value of 90 $^\circ$	X	X	–	–
shear_generalized	m s^{-1}	Magnitude of the 1000 to 100 hPa generalized shear vector averaged (Knaff et al. 2005)	X	X	–	–

References

DeMaria, M., 2009: A simplified dynamical system for tropical cyclone intensity prediction. *Mon. Wea. Rev.*, **137**, 68–82, https://doi.org/10.1175/2008MWR2513.1.

Hersbach, H., and Coauthors, 2018a: ERA5 hourly data on pressure levels from 1979 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS), https://doi.org/10.24381/cds.bd0915c6.

Hersbach, H., and Coauthors, 2018b: ERA5 hourly data on single levels from 1979 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS), https://doi.org/10.24381/cds.adbb2d47.

Hersbach, H., and Coauthors, 2020: The ERA5 global reanalysis. *Quart. J. Roy. Meteor. Soc.*, **146**, 1999–2049, https://doi.org/10.1002/qj.3803.

Knaff, J. A., C. R. Sampson, and M. DeMaria, 2005: An operational statistical typhoon intensity prediction scheme for the western North Pacific. *Wea. Forecasting*, **20**, 688–699, https://doi.org/10.1175/WAF863.1.

Razin, M. N., C. J. Slocum, J. A. Knaff, P. J. Brown, and M. M. Bell, 2022: Tropical cyclone precipitation, infrared, microwave, and environmental database. *Bull. Amer. Meteor. Soc.*, **Accepted**.