

# A global data set of tropical cyclone exposure (TCE-DAT)

## IMPORTANT NOTE

This data set is part of a data collection of tropical cyclone exposure data sets assembled under the roof of following DOI:

Geiger, T.; Frieler, K.; Bresch, D.N. (2017) A data collection of tropical cyclone exposure data sets (TCE-DAT). GFZ Data Services, <http://doi.org/10.5880/pik.2017.011>

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## Use of the data set and full description

Before using the data set, please read the article describing the methodology, especially about the uncertainties and the limitations of the method and use of the data set.

Geiger, T., Frieler, K., and Bresch, D. N.: A global historical data set of tropical cyclone exposure (TCE-DAT), Earth Syst. Sci. Data Discuss., in review, 2017 <https://doi.org/10.5194/essd-2017-78>

Please notify us ([geiger@pik-potsdam.de](mailto:geiger@pik-potsdam.de)) if you use the data set so that we can keep track of how it is used and take that into consideration when updating and improving the data set.

When using this data set or one of its updates, please cite the DOI of the precise version of the data set used and also the data description article which this data set is supplement to (see above). Please consider also citing the relevant original sources when using the data set. See the full citations in the References section further below.

## Support

If you need support in using the data set or have any other questions regarding the data set, please contact Tobias Geiger ([geiger@pik-potsdam.de](mailto:geiger@pik-potsdam.de)).

## Abstract

Tropical cyclones (TCs) pose a major risk to societies worldwide. While data on observed cyclones tracks (location of the center) and wind speeds is publicly available these data sets do not contain information about the spatial extent of the storm and people or assets exposed. Here, we apply a simplified wind field model to estimate the areas exposed to wind speeds above 34, 64, and 96 knots. Based on available spatially-explicit data on population densities and Gross Domestic Product (GDP) we estimate 1) the number of people and 2) the sum of assets exposed to wind speeds above these thresholds accounting for temporal changes in historical distribution of population and assets (TCE-hist) and assuming fixed 2015 patterns (TCE-2015). The associated country-event level exposure data (TCE-DAT) covers the period 1950 to 2015. It is considered key information to 1) assess the contribution of climatological versus socio-economic drivers of changes in exposure to tropical cyclones, 2) estimate changes in vulnerability from the difference in exposure and reported damages and calibrate associated damage functions, and 3) build improved exposure-based predictors to estimate higher-level societal impacts such as long-term effects on GDP, employment, or migration. We validate the adequateness of our methodology by comparing our exposure estimate to estimated exposure obtained from reported wind fields available since 1988 for the United States. We expect that the free availability of the underlying model and TCE-DAT will make research on tropical cyclone risks more accessible to non-experts and stakeholders.

## Sources

**The International Best Track Archive for Climate Stewardship (IBTrACS):** Knapp et al. (2010)

**Atlantic Hurricane Data (HURDAT2):** Demuth et al. (2006)

**HYDE population data version 3.2:** Klein Goldewijk et al. (2010), Klein Goldewijk et al. (2011)

**Global dataset of gridded population and GDP scenarios:** Murakami and Yamagata (2017), Geiger et al. (2017)

**Global Wealth Databook 2016:** <https://www.credit-suisse.com>

**climada module ISIMIP v1.0:** Bresch (2017)

**Hurricane pressure-wind model:** Holland (2008)

## Files included in the data set

**TCE-DAT\_historic-exposure\_1950-2015.csv:** Exposed population and assets by event and country using historical socio-economic exposure estimates.

**TCE-DAT\_2015-exposure\_1950-2015.csv:** Exposed population and assets by event and country using fixed socio-economic exposure at 2015 values.

### note on the file size

The two files differ in size. “TCE-DAT\_2015-exposure\_1950-2015.csv” contains 23 entries more than “TCE-DAT\_historic-exposure\_1950-2015.csv”. This is due to the fact that population and assets distributions have advanced over time and would have been exposed if all historical TCs were

to make landfall in 2015, while they were not exposed historically. In particular, TCs with IBTrACS\_ID=['1954259N20253', '1970198N16257', '1974198N14244', '1974224N21111', '1993345S08083', '1997143N17111', '2008251N15256'] do only appear in “TCE-DAT\_2015-exposure\_1950-2015.csv”.

## Data format description (columns)

Table 1: Data structure in files.

Column	Description
year	year of event
IBTrACS_ID	unique event ID assigned by IBTrACS data archive
TC_name	name as given to event by regional meteorological centers
NatCatSERVICE_ID	unique event ID assigned by Munich Re’s NatCatSERVICE (Munich Re, 2017)
genesis_basin	ocean basin of event genesis as reported by IBTrACS data archive
countries_affected	number of countries affected by event (single / multi)
ISO3	ISO 3166 country codes
v_land_SI	wind speed at landfall by country in SI units (meters per second)
v_land_kn	wind speed at landfall by country in knots
34kn_pop	exposed population by event and country with minimum windspeed of 34 knots
34kn_assets	exposed assets by event and country with minimum windspeed of 34 knots
64kn_pop	exposed population by event and country with minimum windspeed of 64 knots
64kn_assets	exposed assets by event and country with minimum windspeed of 64 knots
96kn_pop	exposed population by event and country with minimum windspeed of 96 knots
96kn_assets	exposed assets by event and country with minimum windspeed of 96 knots

### unit

Exposed population is given in number of people, exposed assets are given in U.S. dollars in 2005 purchasing power parity (PPP).

### additional information

Table 2: Definition of ocean basins.

Column	Description
EP	East Pacific Ocean
NA	North Atlantic Ocean
NI	North Indian Ocean
SA	South Atlantic Ocean
SI	South Indian Ocean
SP	South Pacific Ocean
WP	West Pacific Ocean

### information on column “TC\_name”

The column “TC\_name” reports the commonly-used name for the TC event of interest (e.g. Hurricane Katrina in 2005). It is only provided for additional guidance and coverage might be incomplete or faulty. The IBTrACS\_ID should always be the primary reference! Also note that the naming is not unique, very many (small) events are not named, i.e. reported as “UNNAMED”, and events might have controversial namings from different regional meteorological centers. Please consult IBTrACS’ cross referencing table cross referencing table which maps IBTrACS serial numbers to WMO storm names and other storm identification for further details ([ftp://eclipse.ncdc.noaa.gov/pub/ibtracs/v03r09/archive/ibtracs\\_v03r09\\_serial-name-](ftp://eclipse.ncdc.noaa.gov/pub/ibtracs/v03r09/archive/ibtracs_v03r09_serial-name-)

mapping.txt).

### information on column “NatCatSERVICE\_ID”

The column “NatCatSERVICE\_ID” reports the ID used by Munich Re’s NatCatSERVICE to identify TC loss events (Munich Re, 2017). As many researchers use Munich Re’s proprietary NatCatSERVICE loss archive this column is added to facilitate the interaction between the IBTrACS data and NatCatSERVICE data. The matching of both data sets was conducted using great care but it might still be incomplete or faulty. Also note that NatCatSERVICE data is only available starting in 1980 and the year 2015 was unavailable at the time of matching.

## References

- Bresch, D. N.: climada – the open-source economics of climate adaptation (ECA) tool, [online] Available from: <https://github.com/davidnbresch/climada> (Accessed 17 June 2017), 2017.
- Demuth, J. L., DeMaria, M. and Knaff, J. A.: Improvement of advanced microwave sounding unit tropical cyclone intensity and size estimation algorithms, *Journal of Applied Meteorology and Climatology*, 45(11), 1573–1581 [online] Available from: [http://doi.org/10.1175/1520-0450\(2004\)043<0282:EOAMSU>2.0.CO;2](http://doi.org/10.1175/1520-0450(2004)043<0282:EOAMSU>2.0.CO;2), 2006.
- Geiger, T., Murakami, D., Frieler, K. and Yamagata, Y.: Spatially-explicit Gross Cell Product (GCP) time series: past observations (1850-2000) harmonized with future projections according the Shared Socioeconomic Pathways (2010-2100), doi:[10.5880/PIK.2017.007](https://doi.org/10.5880/PIK.2017.007), 2017.
- Holland, G.: A Revised Hurricane Pressure–Wind Model, *Monthly Weather Review*, 136(9), 3432–3445, doi:[10.1175/2008MWR2395.1](https://doi.org/10.1175/2008MWR2395.1), 2008.
- Klein Goldewijk, K., Beusen, A. and Janssen, P.: Long-term dynamic modeling of global population and built-up area in a spatially explicit way: HYDE 3.1, *The Holocene*, 20(4), 565–573, doi:[10.1177/0959683609356587](https://doi.org/10.1177/0959683609356587), 2010.
- Klein Goldewijk, K., Beusen, A., Van Drecht, G. and De Vos, M.: The HYDE 3.1 spatially explicit database of human-induced global land-use change over the past 12,000 years, *Global Ecology and Biogeography*, 20(1), 73–86, doi:[10.1111/j.1466-8238.2010.00587.x](https://doi.org/10.1111/j.1466-8238.2010.00587.x), 2011.
- Knapp, K. R., Kruk, M. C., Levinson, D. H., Diamond, H. J. and Neumann, C. J.: The International Best Track Archive for Climate Stewardship (IBTrACS): Unifying tropical cyclone best track data., *Bulletin of the American Meteorological Society*, (91), 363–376 [online] Available from: <http://journals.ametsoc.org/doi/abs/10.1175/2009BAMS2755.1>, 2010.
- Munich Re: Munich Re NatCatSERVICE, [online] Available from: <http://www.munichre.com/natcatservice> (Accessed 17 July 2017), 2017.
- Murakami, D. and Yamagata, Y.: Estimation of gridded population and GDP scenarios with spatially explicit statistical downscaling., *Environmental Research Letters*, (in review) [online] Available from: <https://arxiv.org/abs/1610.09041>, 2017.