A global data set of spatially-explicit 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

Recommended citation

> 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
>
> Geiger, T.; Frieler, K.; Bresch, D.N. (2017) A global data set of spatially-explicit tropical cyclone exposure (TCE-DAT). GFZ Data Services, http://doi.org/10.5880/pik.2017.008

Content

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) 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).

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 all areas (grid cells) exposed to wind speeds above 34 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 above tropical storm force wind speeds for temporal changes in historical distribution of population and assets (TCE-hist) and assuming fixed 2015 patterns (TCE-2015). The associated spatially-explicit 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)

Credit Suisse Global Wealth Databook 2016: CreditSuisse (2016)

climada module ISIMIP v1.0: Bresch (2017)

Hurricane pressure-wind model: Holland (2008)

Files included in the data set

TCE-DAT_single_events_historical.zip: Zipped archive containing 2707 files with exposed population and assets by grid cell using historical socio-economic exposure estimates.

TCE-DAT_single_events_2015.zip: Zipped archive containing 2713 files with exposed population and assets by grid cell using fixed socio-economic exposure at 2015 values.

note on additional data sources

Additional information on each TC event in the zipped archive (e.g. TC name, NatCatSERVICE_ID, genesis_basin, aggregated exposure estimates by country) are available in the exposure data sets aggregated on country-event level, see http://doi.org/10.5880/pik.2017.005 for details.

note on the file size

The two zipped archives differ in size. "TCE-DAT_single_events_2015.zip" contains 6 entries more than "TCE-DAT_single_events_historical.zip". 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. More specifically, TCs with IB-TrACS_ID=['1954259N20253', '1970198N16257', '1974198N14244', '1974224N21111', '1993345S08083', '1997143N17111', '2008251N15256'] do only appear in "TCE-DAT_single_events_2015.zip".

Data format description (columns)

Table 1: Data structure in spatially-explicit event level files named by IBTrACS_ID.

Column	Description
ISO	ISO 3166 country codes
LAT	latitude of grid cell
LON	longitude of grid cell
exposed_pop	exposed population by event and grid cell
exposed_assets	exposed assets by event and grid cell
windspeed	maximum wind speed at grid cell in knots

naming convention

Naming convention for files in the zipped archive:

'[IBTrACS_ID]_hist.csv' for historical distribution of population and assets

'[IBTrACS_ID]_fix2015.csv' for fixed distribution of population and assets according to 2015 values

unit

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

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.

CreditSuisse: Global Wealth Databook 2016, [online] Available from: http://publications.credit-suisse.com/tasks/render/file/index.cfm?fileid=AD6F2B43-B17B-345E-E20A1A254A3E24A5, 2016.

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, 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, 2017.

Holland, G.: A Revised Hurricane Pressure–Wind Model, Monthly Weather Review, 136(9), 3432–3445, doi:10.1175/2008MWR2395.1, 2008.

Klein Goldewijk, K., Beusen, A. and Janssen, P.: Long-term dynamic modeling of global popu-

lation and built-up area in a spatially explicit way: HYDE 3.1, The Holocene, 20(4), 565–573, doi: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, 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.

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.