

High-Resolution Global Datasets of Climate Extreme and Sectoral Impact Indicators

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Empirical approaches applied in sectoral impacts assessment represent one of the key tools for assessing risks emanating from climate change and variability. The models built on functional relationships between response variable(s) and a vector of climate/non-climatic predictor variable(s) often rely heavily on long time-series of observed climate indicators recorded at multiple spatial units. Empirical frameworks in sectoral impacts assessment more often than not employ predictor variables accounting for extremes in weather events (e.g. number of days in a year with temperature or rainfall exceeding 95th percentile at the location). Such indicators, more commonly referred to as Climate Extreme Indices (CEIs) are important metrics that not only assist in the analysis of regional and global extremes in meteorological events, but also have potential wide-ranging applications in assessment of impacts in sectors such as agriculture, health and energy.

Global high-spatial-resolution datasets of CEIs, as well as sector specific impact indicators derived from quality-controlled historical observations are scarce. This study introduces recently released three unique high spatiotemporal resolution global datasets of climate indices applicable for a broad range of impacts and risk assessments. The 3 datasets referred to as: (i) '*CEI_0p25_1970_2018*' (Mistry, 2019a); (ii) '*DegDays_0p25_1970_2018*' (Mistry, 2019b); and (iii) '*HDI_0p25_1970_2018*' (Mistry, 2019c), are a collection of three different sets of indicators assembled utilizing sub-daily meteorological variables such as temperature, precipitation, humidity and wind, from a climate reanalysis data [Global Land Data Assimilation System (GLDAS) (Rodell et al., 2004)].

The datasets include an exhaustive set of ~120 indices at daily, monthly and annual timescales, covering 49 years over the period 1970–2018 at 0.25° x 0.25° global gridded resolution¹; offering the research community a ready-to-use set of potential indicators for assessing not only climate sectoral impacts, but also for potential application as climate-stress tests² in financial system.

¹ ~27 km x 27 km at the equator.

² While existing climate stress-tests cater to policy induced shocks (reference), the shocks to financial systems emanating from climate events (especially extremes) at various spatiotemporal scales are yet to be developed and tested.

The datasets include: (i) set of 71 CEIs defined and recommended by the World Meteorological Organization (WMO) Expert Teams on Climate Change Detection and Indices (ETCCDI) and Sector-specific Climate Indices (ET-SCI)³; (ii) Cooling and Heating degree days (CDD/HDD) applicable in energy sector; and (iii) indices based on human discomfort measures (such as Humidex, Heat Index, Apparent Temperature, Discomfort Index and Wet Bulb Globe Temperature) , applicable to the health sector. The indices can be coupled to multi-sectoral impact models, integrated assessment models (IAMs), and models designed to assess financial shocks propagating through a network of borrowing and lending institutions, either directly or through reduced form response functions.

The data of individual indices are publicly available for download in the commonly used Network Common Data Form 4 (NetCDF4) and GeoTIFF formats. The presented datasets fill gaps in existing climate extremes and sectoral impact indicators, by encompassing not only more indices, but also by being the only comprehensive global historical datasets available at high spatiotemporal resolution. The current effort is a preliminary framework of an ongoing cumbersome exercise of assembling similar datasets for future period, using the output of high-resolution Global Climate Models (GCMs).

References

- Mistry Malcolm Noshir (2019a) A High-Resolution (0.25 degree) Historical Global Gridded Dataset of Climate Extreme Indices (1970-2016). *PANGAEA*. DOI: <https://doi.pangaea.de/10.1594/PANGAEA.898014>.
- Mistry Malcolm Noshir (2019b) A high-resolution (0.25 degree) historical global gridded dataset of monthly and annual cooling and heating degree-days (1970-2018) based on GLDAS data. *PANGAEA*. DOI: 10.1594/PANGAEA.903123.
- Mistry Malcolm Noshir (2019c) A high spatiotemporal resolution global gridded dataset of historical (1970-2018) human discomfort Indices based on GLDAS data. *PANGAEA*. DOI: 10.1594/PANGAEA.904282.
- Rodell M, Houser PR, Jambor U, et al. (2004) The Global Land Data Assimilation System. *Bulletin of the American Meteorological Society* 85(3): 381–394. DOI: 10.1175/BAMS-85-3-381.

³ <https://www.wcrp-climate.org/data-etccdi>.