Costliest U.S. Hailstorms Dataset Documentation

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Known Issues

- Radar data is missing for the following cases: **23.** Omaha, NE, **29.** Bismarck, ND, **36.** Amarillo, TX, **55.** Lubbock, TX. Radar products are not available for these cases.
- Radar data is incomplete for the following cases: **17.** Dallas/Ft. Worth TX, **25.** Dallas/Ft. Worth, TX, **30.** Temple, TX, **33.** Omaha, NE, **53.** San Antonio, TX. Caution should be used when using radar products for these cases.

- *How are the events chosen?*

The events are chosen primarily from National Centers for Environmental Information (NCEI 2017) property loss data for storm events occurring between 1995 and 2017. Property loss data is adjusted to 2017 dollars using an inflation factor given by the Consumer Price Index. We have also incorporated information from journal articles and regional/state insurance organizations where the NCEI data was incomplete.

The loss data does not carefully distinguish between different types of severe weather damage (e.g. wind versus hail), and loss data may be incomplete, so the rankings should not be taken as absolutely certain.

- *How do I read in the NetCDF4 files?*

The NetCDF4 files adhere to Climate-Forecast (CF) v1.6 metadata conventions and are compatible with ArcGIS[1] or other GIS-based software supporting CF-compliant NetCDF files. Any program or language that has an available NetCDF library (e.g., Python) can read in these files as well.

CF-compliant NetCDF4 files are self-describing, meaning that all the information about the variables (dimensions, units, etc.) is contained within the file itself. This information can be accessed via NetCDF utilities (e.g., ncdump).

- *What is in the radar data files?*

Each event file contains gridded reflectivity, hail kinetic energy (HKE, Waldvogel et al. 1978), and maximum estimated size of hail (MESH, Witt et al. 1998) over the duration of

[1] http://desktop.arcgis.com/en/arcmap/10.3/manage-data/netcdf/what-is-netcdf-data.htm

the event. Additionally, the integrated HKE and time-maximum MESH is provided after interpolating the fields. The interpolation is done between successive radar scans using the Farneback (2003) optical flow algorithm to determine the velocity of radar objects and a semi-Lagrangian scheme to advect the radar objects. The interpolation achieves much smoother integrated HKE and time-maximum MESH swaths, especially for quickly moving storms.

The integrated HKE and time-maximum MESH are useful metrics for assessing potential losses and damage claim severity, respectively (Hohl et al. 2002a,b; Brown et al. 2015). When combined with other geospatial insurance data, the combined data may be used to assess risk by 1) evaluating expected losses if an identical hailstorm would occur today and 2) evaluating possible maximum losses, where swaths are moved over different insured assets with varying exposure and vulnerability.

Keep in mind that the due to the nature of the radar scanning technique, storms far from the radar (> 100 km or 62 mi) are not sampled lower down in the atmosphere, and storms very near the radar (< 20 km or 12 mi) are not sampled higher up in the atmosphere. In either case, the integrated HKE and time-maximum MESH are lower quality due to the incomplete sampling.

- *What is in the storm report files?*

Separate files contain Storm Prediction Center (SPC 2017) storm reports of hail and wind for each event (available for events that occurred through 2016). The file format is .CSV, which can imported into ArcGIS[2], other GIS-based software, or a spreadsheet. Each row is a separate storm report. The fields are latitude, longitude, time, and hail size/wind speed (if available). When severe wind reports are collocated with hail reports, it may indicate the exacerbation of hail damage and losses due to windblown hail.

While the storm reports are the best ground truth we have over the full period of the dataset, keep in mind that storm reports are usually very sparse compared to the area that experiences the hail fall and/or high winds. Furthermore, there can be uncertainties/errors in hail size/wind speed and exact location.

- *Who may I contact if I have comments or questions?*

Comments and questions about this dataset may be directed to Dr. Brian Tang (btang@albany.edu).

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[2] https://doc.arcgis.com/en/arcgis-online/reference/csv-gpx.htm

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