J13.1 **NOAA ECONOMICS V2.0:**
DERIVING SOCIETAL ECONOMIC LOSS, RISK, AND BENEFIT CLIMATOLOGIES FROM NOAA EXTREME EVENT AND WARNING CLIMATOLOGIES ACROSS THE UNITED STATES

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Our research seeks to provide newly integrated and analyzed economic loss, risk, and benefit climatologies for U.S. states and counties for several extreme event categories: hurricanes, winter storms, tornadoes, hail, high winds, and drought. This is performed by using NOAA geophysical data sets, insurance loss datasets, NWS warning data, and county-level socioeconomic data from the Bureau of Economic Analysis (BEA) and U.S. Census using normalization algorithms in a spatial database. This will allow for dynamic (time/space) analysis in deriving economic loss, risk, and benefit climatologies for U.S. states and counties for user-defined time intervals of interest (from 1998-present). This work will be completed in three phases.

The first phase builds upon contemporary research that have defined the frequency, intensity (where applicable), duration, and return period of different types of extreme events for U.S. states and counties. This data includes U.S. hurricanes (NHC), winter storms (NESIS/RESIS), tornadoes (SPC; SWDI), hail (SPC; SWDI), high winds (SPC), and drought (USDM/NIDIS). It is understood that the underlying extreme event data collection methods differ between the extreme event types. In this initial research each event type is analyzed separately to avoid any discrepancy.

The extreme event data sets are first augmented by merging sources of extreme loss data (e.g., FEMA, USDA-RMA, NOAA storm data, and several insurance loss datasets) into a spatial database using common data fields including (i.e., event type, state, county, time/duration, and economic loss totals). This creates dynamic '**loss climatologies**' across space and time at the county level. This information is further transformed by algorithms that normalize for inflation, wealth, population and average housing value indices over space and time at the county-level, as performed in other research (e.g., Schmidt et al., 2009; Pielke Jr. et al., 2008, Collins and Lowe, 2001).

The second phase involves joining the 'economic loss' climatologies from phase 1, with NOAA / National Weather Service (NWS) '**warning climatologies**.' This blending process is performed using NWS warning data (e.g., TOR, SVR, FFW, WSW, NPW) to analyze all county or polygon-based warnings issued for specific extreme events using common data fields (i.e., warning event type, state, county, and time/duration) . The 'warning climatologies' are superimposed with annual Bureau of Economic Analysis (BEA) and U.S. Census county-level socioeconomic data (e.g., gridded (~1 km^2) population/density, average housing value, per capita income, production (wealth), etc.) for specific storm events creating socioeconomic '**risk climatologies.**' This allows contrast between current and past extreme events with historically normalized economic loss and risk climatologies by state or county for varying time horizons.

The third phase involves extrapolating 'economic benefit' metrics using geographically homogenous NOAA data products with predefined economic value (e.g., Centrec, 2007; Lazo et al., 2009) and corresponding BEA and Census socioeconomic statistics for county-level storm events to create economic (potential) '**benefit climatologies**.' For example, NOAA radar and satellite data are used in many distinct data products to produce a variety of storm warnings regularly across the U.S. We are only concerned with potential economic valuation of a data product/forecast and therefore account for the total sum of socioeconomic variables at risk (e.g., population, wealth) within a warning area for simplicity.

These economic (potential) 'benefit climatologies' can then be developed for user-defined spatial (state, county) and temporal (1998-present) areas of interest for specific extreme events, which can also be contrasted with the spatio-temporal equivalent risk and loss climatologies. There are of course numerous data caveats to be explored more fully, as the project becomes more developed.

References:

Centrec Consulting Group, LLC., 2007: *An Investigation of the Economic and Social Value of Selected NOAA Data and Products for Geostationary Operational Environmental Satellites (GOES)*. A report submitted to NOAA's National Climatic Data Center. Centrec Consulting Group, Savoy, IL

Collins D.J., Lowe S.P., 2001: *A macro validation dataset for U.S. hurricane models*. Casualty actuarial society forum; p. 217–51. Arlington VA, <http://www.casact.org/pubs/formu/01wforum/01wf217.pdf>.

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Lazo, J. K., Morss, R. E., and J. L. Demuth, 2009: *300 Billion Served Sources, Perceptions, Uses, and Values of Weather Forecasts*. Bulletin of the American Meteorological Society, **90(6)**, 785-798.

Pielke R.A. Jr., Gratz J., Landsea C.W., Collins D., Saunders M., Musulin R., 2008: *Normalized hurricane damages in the United States*: 1900–2005. Natural Hazards Review; 9:29–42.

Schmidt, S., C. Kemfert, and P. Höppe, 2009. *Tropical cyclone losses in the USA and the impact of climate change — A trend analysis based on data from a new approach to adjusting storm losses*, Environmental Impact Assessment Review. Volume 29, Issue 6, Pages 359-369.

Acronyms:

FFW: Flash flood warning

NESIS: Northeast Snowfall Impact Scale

NHC: (NOAA) National Hurricane Center

NIDIS: National Integrated Drought Information System

NPW: Non-precipitation events (e.g., high wind, excessive heat, freeze warnings, etc.)

RESIS: Regional Snowfall Impact Scale

SPC: (NOAA) Storm Prediction Center

SWDI: (NOAA) Severe Weather Data Inventory

TOR: Tornado warning

SVR: Severe thunderstorm warning

USDM: U.S. Drought Monitor

WSW: Winter storm warning