Projected Extreme Rainfall Intensity Duration Frequency (IDF) Curves for NY

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Anatomy of an IDF Curve

- **Observed Data Values (Specific Recurrence Period, e.g. 100-yr)**
- **Confidence Interval Bounds**

**Diagram Details:**
- **Y-Axis:** Intensity (Inches/hr)
- **X-Axis:** Duration (Hours)
- **Legend:** Blue line for Intensity Estimates, Red line for Confidence Interval Limits

**Note:** The diagram illustrates how intensity values change over duration and the associated confidence intervals.
IDF Curves 101

- **Partial Duration Series (PDS)**
  - $n$ highest independent daily rainfalls in $n$ year period

- **Fit Statistical Distribution to Data**
  - **Smooth** sampling variations in observed period
  - **Extrapolate** beyond period of record… 100-yr storm from 50-yr record
  - Tested **Beta-P** (Wilks approach) and **L-moments GEV** (NOAA Atlas 14)
  - Adopted L-moments GEV fits

- **Monte Carlo Resampling Provides Confidence Intervals**
  - Randomly **Draw** 1,000 $n$-year samples from PDS.
  - **Refit** distribution to random samples.
  - Retain $5^{th}$ and $95^{th}$ percentiles confidence interval (90%).
Extreme Precip in a Changing Climate

Change in heaviest 1% of all daily events 1958-2012

from Karl et al. 2009
The 100-year storm has become the 66 year storm!

The 50-year storm has become the 33 year storm!

The 2-year storm has become the 1.4 year storm!

New York Climate Risk and Resiliency Act CCRA

• Advances NY's policies toward climate change adaptation
• Applies to permitting, funding and regulatory decisions
  For example
  Smart growth assessments
  Wastewater treatment plant funding
  Hazardous waste facilities siting
  Design and construction of petroleum and chemical storage facilities
  Oil and gas drilling
  State acquisition of open space

• Applicants must demonstrate that they have taken into account future physical climate risks caused by storm surges, sea-level rise or flooding.
Downscaling Approaches

1) Dynamical Downscaling (CORDEX) (also NARCCAP)
   → Regional climate models (RCMs) run at 50-km resolution and driven by atmosphere–ocean general circulation (AOGCM) models

2) Statistical Downscaling – Delta Method (CMIP5)
   → Compares model-simulated precipitation extremes between historical and future periods (at GCM resolution)

3) Statistical Downscaling – Analog Method (CMIP5)
   → Uses historical weather map analogues to predict the occurrence of extreme precipitation on a given day
REALITY CHECK AHEAD
Bias: 1-day 100-year Rainfall Amounts
CORDEX vs. Observed

Beta-P (left) vs. L-moments (right)
CORDEX vs Observed Ensemble Mean Bias: 1-day 100-year Rainfall
Bias for 1-day Extreme Rainfall Amounts 
Analog Method (Reanalysis) vs. Observed
Analog vs Observed Ensemble Mean Bias: 1-day 100-year Rainfall
What Does the Future Hold?

Schematic for Global Atmospheric Model

- Horizontal Grid (Latitude-Longitude)
- Vertical Grid (Height or Pressure)
Projected Changes in 1-day Extreme Rainfall Amounts Relative to 1970–1999

Graphs showing the percent change in rainfall amounts for different time periods and emission scenarios (rcp45, rcp85) with data from CORDEX, Delta, and Analog models.
Projected Changes in 1-day 100-year Rainfall Amounts

Percent Change (%)
Projected Changes in 1-day 100-year Rainfall Amounts
2040–2069 vs. 1970–1999

10th Percentile
Mean
90th Percentile

RCP4.5
RCP8.5

Percent Change (%)
-15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60

Cornell University
Projected Changes in 1-day 100-year Rainfall Amounts
2070–2099 vs. 1970–1999

Percent Change (%)
Intensity Duration Frequency Curves for New York State

Future Projections for a Changing Climate

Select a Station Location by Clicking Map

About this Project Numerous studies have documented significant increases in both the frequency and magnitude of extreme precipitation in the northeastern U.S. since the mid-to-late 20th century. The most recent assessment from the Intergovernmental Panel on Climate Change (IPCC) suggests that the frequency and magnitude of extreme precipitation in this region will likely continue to increase throughout the 21st century. Such changes could greatly exacerbate the societal impacts of extreme precipitation in the future. In consideration of these impacts, the Northeast Regional Climate Center (NRCC) has partnered with the New York State Energy Research and Development Authority (NYSERDA) to downscale global climate model output and create extreme precipitation projections that will ultimately be incorporated into climate change adaptation planning for New York State. Read more...

http://ny-idf-projections.nrcc.cornell.edu