NEW YORK CITY COLLEGE OF TECHNOLOGY
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# Drought Climatology and Impacts in the Northeast: Case Studies for New Jersey and Delaware


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# Purpose

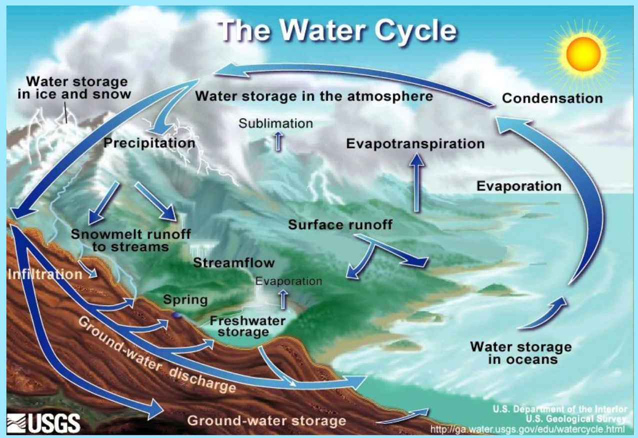
**A temporal analysis of the frequency and severity of drought reporting in the Northeast climate region.**

**Analysis of pertinent data should highlight drought trends and variance in drought monitoring methodology. In order to better predict droughts and improve management & remediation in the Northeast, effective drought monitoring is crucial.**

# Introduction

Hydrological drought:

- Causes:
  - Precipitation deficiency
  - Climate variability
  - Complete or partial failure of monsoon
- Effects:
  - Low levels of groundwater, reservoirs, lakes
  - Decreased groundwater discharge
  - Slowed down drying process of aquifer
  - Decreased streamflow




Weather

**N.J. faces worst drought conditions in 14 years**

Updated Jan 16, 2019; Posted Oct 20, 2016

# Storm Event Database

## (SED)

- Administrator: NOAA’s National Centers for Environmental Information (NCEI)
- Parameters:
  - Date
  - Magnitude
  - Deaths
  - Injuries
  - Property damage, and
  - Crop damage

(includes episode narrative)

| | |
|---|---|
| Episode Narrative | October 2000 was one of the driest Octobers on record in New Jersey and in a few locations, the driest month ever on record. On a county weighted average monthly precipitation totals ranged from 0.1 inches in Atlantic and Cape May Counties to 1.2 inches in Gloucester County. Normal monthly precipitation is around 3.4 inches. At the Atlantic City Marina, the monthly precipitation total of 0.01 inches was not only the driest October on record, but also tied September 1941 as the driest month on record. Records within Atlantic City go back to 1874. At the Atlantic City International Airport, the monthly precipitation total of 0.06 inches was not only the driest October on record, but also the driest month on record ever. Records at the airport go back to 1943. In Cape May City, the monthly precipitation total of 0.34 inches was the third driest October on record. Records have been kept since 1888. While the dry weather did not cause any appreciable agricultural damage, the falling leaves left the state susceptible to forest and brush fires. |

$$\text{SED Data} = \frac{\text{Yearly Total \# of Droughts Reported}}{\text{Number of Climate Zones}} \times \frac{1}{10}$$

# United States Drought Monitor

## (USDM)

- Collaboration: National Drought Mitigation Center, NOAA, USDA
- Used for:
  - Triggering disaster declarations
  - Eligibility for livestock forage program, and tax deferral
- Drought Monitor report released every thursday
- Measure of drought severity
  - Per cumulative percent area of region/state
- Composed of 5 prominent climate indexes and percentiles
  - PDSI, CPC Soil Moisture Model, USGS Streamflow, SPI, Objective Blends Drought Indicator

| Category | Description | Possible Impacts | Palmer Drought Severity Index (PDSI) | CPC Soil Moisture Model (Percentiles) | USGS Weekly Streamflow (Percentiles) | Standardized Precipitation Index (SPI) | Objective Drought Indicator Blends (Percentiles) |
|---|---|---|---|---|---|---|---|
| D0 | Abnormally Dry | Going into drought: ▪ short-term dryness slowing planting, growth of crops or pastures Coming out of drought: ▪ some lingering water deficits ▪ pastures or crops not fully recovered | -1.0 to -1.9 | 21 to 30 | 21 to 30 | -0.5 to -0.7 | 21 to 30 |
| D1 | Moderate Drought | ▪ Some damage to crops, pastures ▪ Streams, reservoirs, or wells low, some water shortages developing or imminent ▪ Voluntary water-use restrictions requested | -2.0 to -2.9 | 11 to 20 | 11 to 20 | -0.8 to -1.2 | 11 to 20 |
| D2 | Severe Drought | ▪ Crop or pasture losses likely ▪ Water shortages common ▪ Water restrictions imposed | -3.0 to -3.9 | 6 to 10 | 6 to 10 | -1.3 to -1.5 | 6 to 10 |
| D3 | Extreme Drought | ▪ Major crop/pasture losses ▪ Widespread water shortages or restrictions | -4.0 to -4.9 | 3 to 5 | 3 to 5 | -1.6 to -1.9 | 3 to 5 |
| D4 | Exceptional Drought | ▪ Exceptional and widespread crop/pasture losses ▪ Shortages of water in reservoirs, streams, and wells creating water emergencies | -5.0 or less | 0 to 2 | 0 to 2 | -2.0 or less | 0 to 2 |

$$\text{USDM Index} = 1\left(\frac{D0-D1}{100}\right) + 2\left(\frac{D1-D2}{100}\right) + 3\left(\frac{D2-D3}{100}\right) + 4\left(\frac{D3-D4}{100}\right) + 5\left(\frac{D4}{100}\right)$$

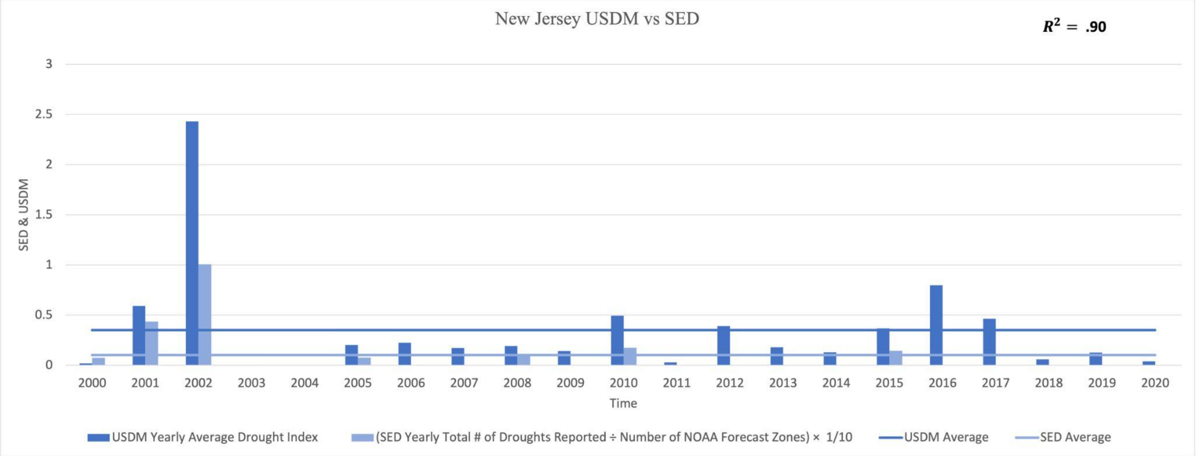
# Scope of Study

- Yearly and Monthly Analysis 2000-2020
- Isolated Study of New Jersey & Delaware
- Compare, Correlate and Analyze USDM and SED data
- Utilize NOAA Climate data (NCEI) and seasonality to add context

# Yearly Analysis

## New Jersey

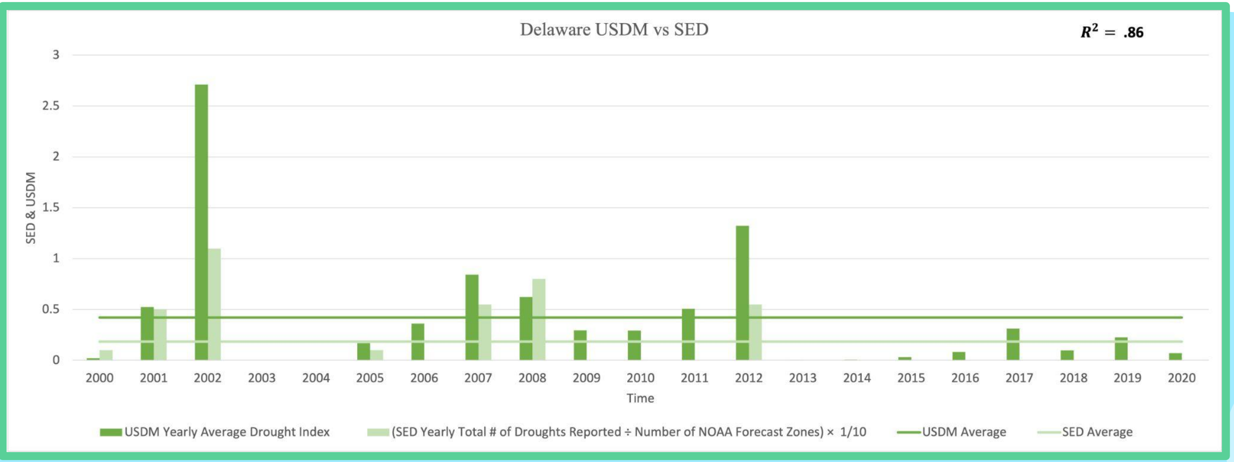
- 2001, 2002, and 2010 displayed higher than average USDM and SED values
- 2016 exhibited a huge discrepancy
  - High USDM, but considerably low SED value
- Compared to USDM, SED fell short in reporting drought
- Hypothesis: USDM is sensitive to all droughts, while SED is sensitive to severe or notable droughts



# Yearly Analysis

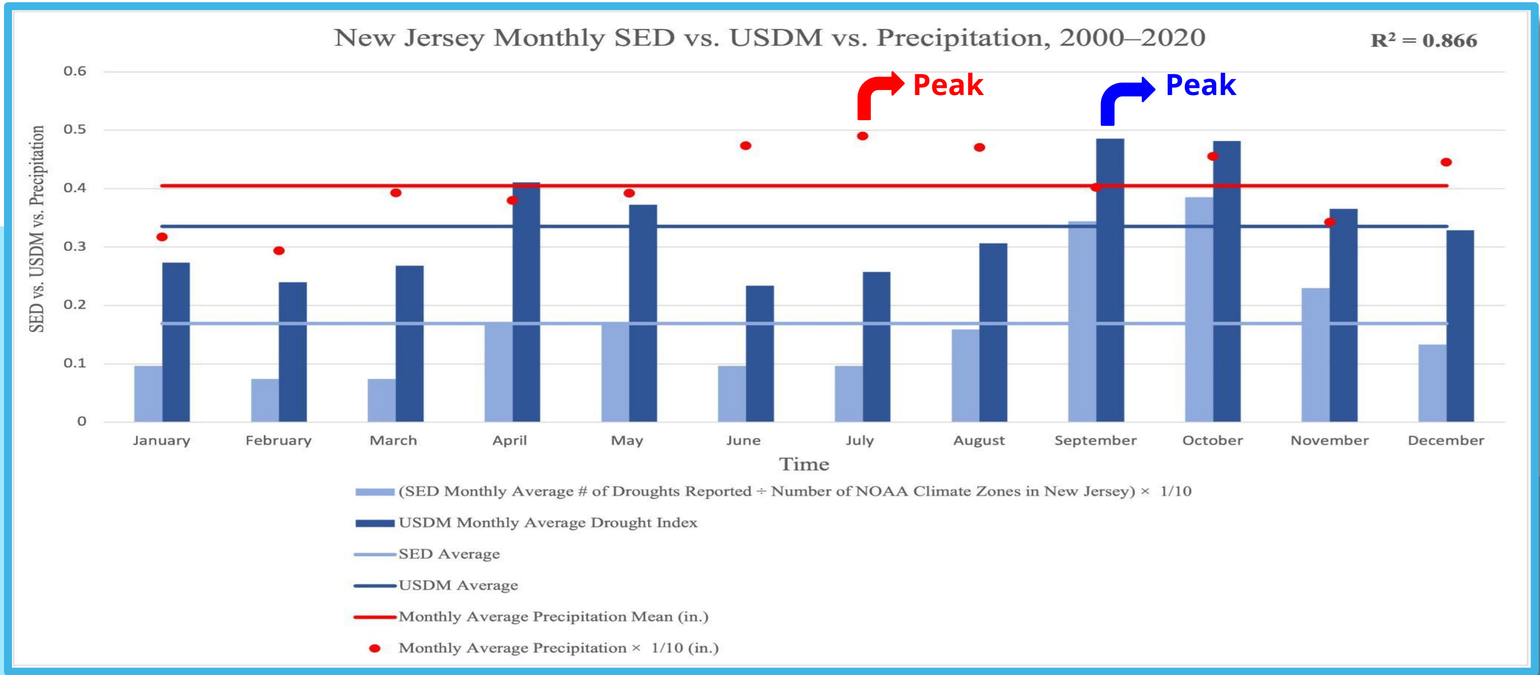
## Delaware

- Use both data sets for confirmation of severe drought
- 2002, 2007, 2012 were home to higher than average USDM and SED values
- 2008 exhibited a slight disparity; High SED and near average USDM; impending drought that subsided without severity?
- SED data was reinforced by USDM
    - First signaling existence then illustrating severity



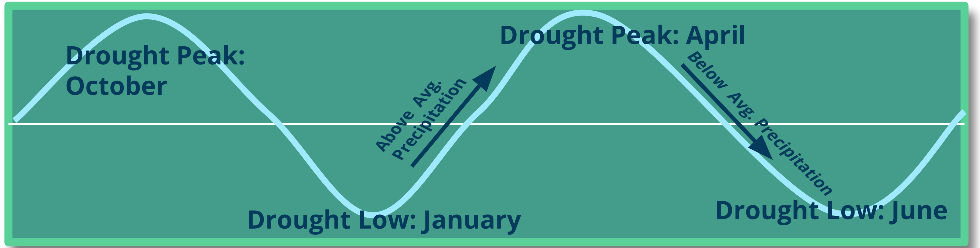
# Monthly Analysis

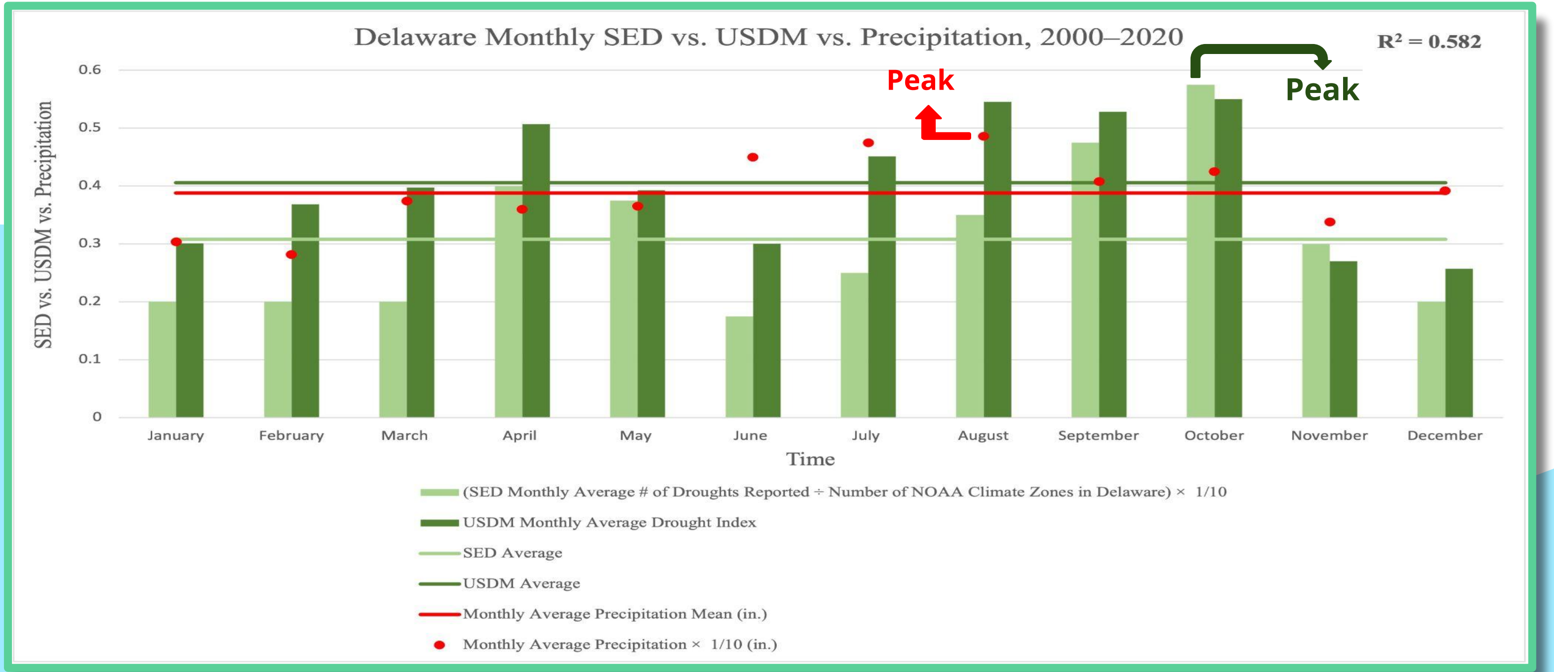
## New Jersey



# Monthly Analysis

## Delaware



# Cost of Natural Hazards

| Disaster Type | Number of Events | Percent Frequency | CPI-Adjusted Losses (billions of dollars) | Percent of Total Losses | Average Event Cost (billions of dollars) | Death |
|---|---|---|---|---|---|---|
| Drought | 25 | 11.4% | $236.6 | 15.4% | $9.5 | 2.993† |
| Flooding | 28 | 12.8% | $119.9 | 7.8% | $4.3 | 540 |
| Freeze | 8 | 3.7% | $27.6 | 1.8% | $3.5 | 162 |
| Severe Storm | 91 | 41.6% | $206.1 | 13.4% | $2.3 | 1,578 |
| Tropical Cyclone | 38 | 17.4% | $850.5 | 55.3% | $22.4 | 3,461 |
| Wildfire | 15 | 6.8% | $53.6 | 3.5% | $3.6 | 238 |
| Winter Storm | 14 | 6.4% | $43.1 | 2.8% | $3.1 | 1,013 |
| **All Disasters** | **219** | **100.0%** | **$1,537.4** | **100.0%** | **$7.0** | **9,985** |

# Conclusion

- Analysis of temporal drought trends in New Jersey and Delaware
  - interconnectivity of severity, number of droughts reported, and precipitation.
- Amplify drought patterns through visualization of drought reporting data
- Examination of methodology and sensitivity of each drought monitoring system
  - USDM is more sensitive to droughts signals; leading indicator
  - SED validates the existence of notable drought
- Inspection of drought patterns is crucial for:
  - Prevention and preparation
  - Protection of economic systems
  - Adaptive control of public water supply
  - Constructive and effective government policy formation
- Preventive rather than reactionary.

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# Thank You!