The Impact of Tropical Cyclone Rainfall on Drought in Alabama

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Introduction

A drought is an extended period of months or years when a region notes a deficiency in its water supply. Generally, this occurs when a region receives consistently below average precipitation. It can have a substantial impact on the ecosystem and agriculture of the affected region. Although droughts can persist for years, even a short, intense drought can cause significant damage and harm to the local economy.

Consequences of drought in Alabama include, but are not limited to:

- Diminished crop growth or yield productions;
- Diminished carrying capacity for livestock;
- Snake migration and increases in snake bites;
- Reduced electricity production .
- Shortages of water for industrial users;
- Wildfires and erosion;
- Habitat damage;

Alabama precipitation distribution varies seasonally, annually, and geographically. The Gulf of Mexico and the subtropical Atlantic Ocean are the principal sources of moisture for the State, and the Pacific Ocean is a lesser source.

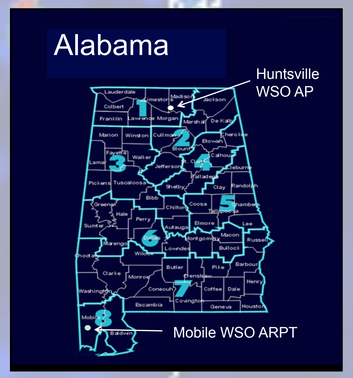
In specific regions of Alabama, tropical cyclones can account for as much as 32 % of the precipitation in a given year. The impacts of tropical cyclones can be devastating, yet the precipitation the cyclones transport can have a positive impact on droughts. My analysis suggests tropical cyclones help mitigate droughts and/or keep regions of Alabama from falling into a drought.

Data

➢ Tropical cyclone yearly rainfall data was found online at the Hydrometeorological Prediction Center.

➢Daily precipitation data was found online at the Global Historical Climatology Network.

➢Palmer Drought Severity Index and Palmer's Z Index monthly data was found online at the National Climatic Data Center.



❖This shows the two sites and two divisions analyzed : (1) Northern Valley; (8) Gulf.

Drought Severity	Description of Possible Impact	Palmer Drought Severity Index
Minor Drought	Going into drought; short-term dryness slowing growth of crops or pastures; fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.	-1.0 to -1.9
Moderate Drought	Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-2.0 to -2.9
Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	-3.0 to -3.9
Extreme Drought	Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions.	-4.0 to -4.9
Exceptional Drought	Exceptional and widespread crop and pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells creating water emergencies.	-5.0 or less

*NDMC - National Drought Mitigation Center

❖This is the monthly value (index) that is generated indicating the severity of a wet or dry spell. This index is based on the principles of a balance between moisture supply and demand. This is most effective in determining long term drought.

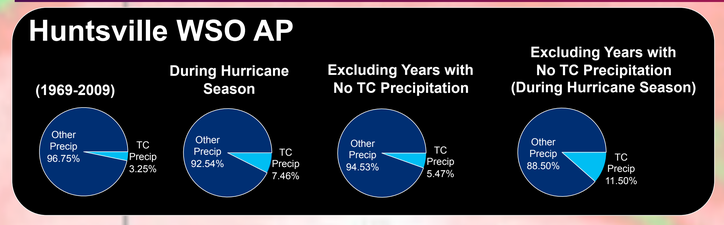
Category	Range Z
Near Normal	0.99 to -1.24
Mild to Moderate Drought	-1.25 to -1.99
Severe Drought	-2.00 to -2.74
Extreme Drought	-2.75 or less

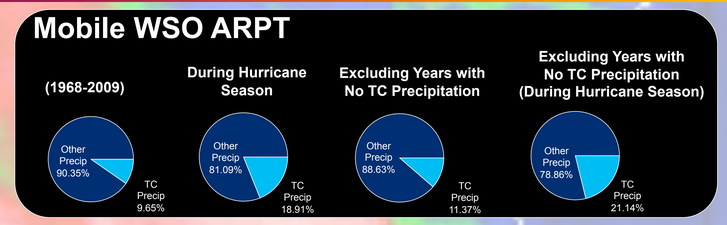
❖This is the generated monthly Palmer Z value, and it can be expressed as the "Moisture Anomaly Index." Each monthly Z value is a measure of the departure from normal of the moisture climate for that month. This index can respond to a month of above-normal precipitation, even during periods of drought.

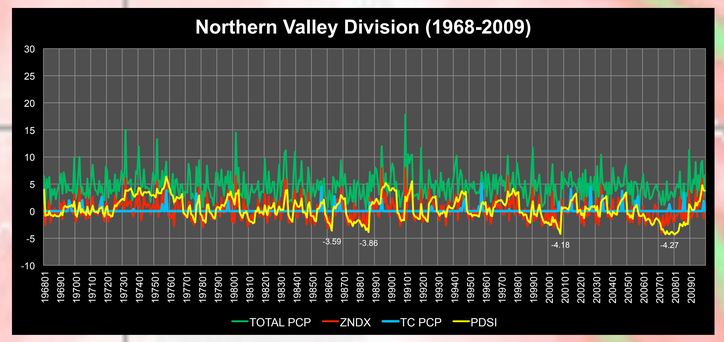
Method

I used two sites in Alabama, one in the north (Huntsville WSO AP) and one in the south (Mobile WSO ARPT). When comparing the rainfall data from tropical cyclones to the daily precipitation data, I established a close approximation of the amount of rainfall from each tropical cyclone at each site. I then used the PDSI and Z Index data from the National Climatic Data Center to compare droughts and tropical cyclone rainfall. I used the drought data from the Northern Valley Division and Gulf Division to be representative of Huntsville and Mobile. The data I used is from 1968 through 2009, focusing on 1999 through 2009.

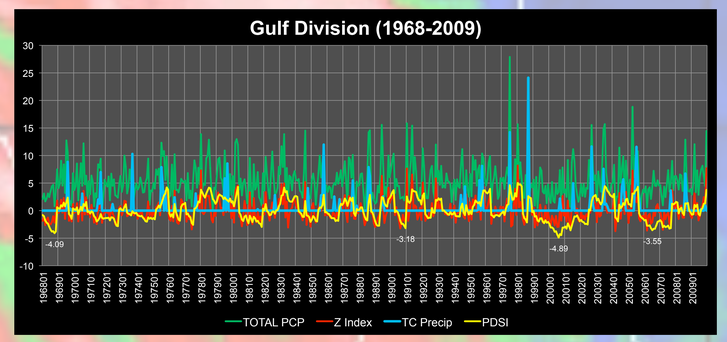
Results



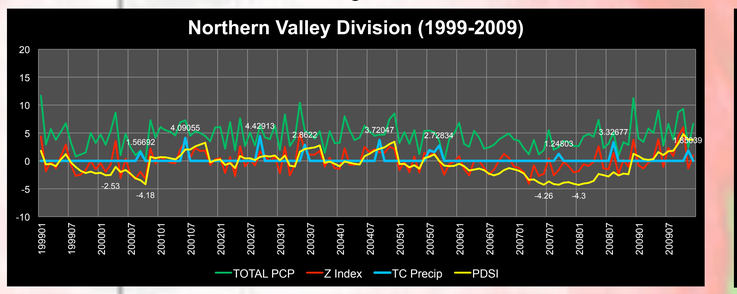




Northern Valley Division rainfall is more dependent on Atlantic and Pacific moisture than on Gulf moisture and tropical cyclones. There were four severe or extreme droughts from 1968 to 2009.



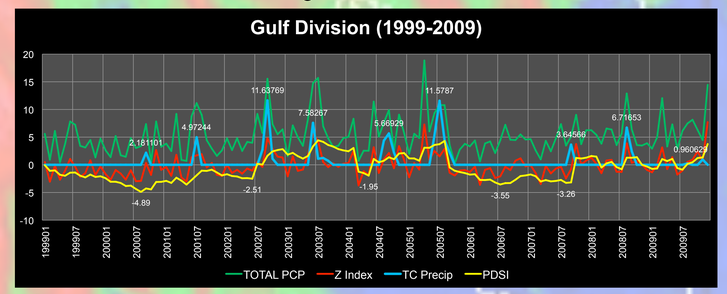
Gulf Division rainfall is more dependent on Gulf moisture and tropical cyclones, compared to the Northern Division. There were four severe or extreme droughts from 1968 to 2009.



•Two extreme droughts occurred in the Northern Valley Division from 1999 to 2009. Tropical cyclones have less of an impact on northern Alabama than near the gulf. The first drought started in Aug 1999, became an extreme drought in Oct 2000, and ended in Nov 2000. The combination of Tropical Storm Helene in Sept 2000 and increased rainfall lead to the mitigation of the drought.

•The tropical storms from 2001 to 2005 helped keep the Northern Valley Division out of drought by dropping approximately 6.4%, 8.8%, 5.3%, 6.3%, and 16%, of the annual rainfall for those years.

•2006 had no tropical cyclone rainfall in Alabama. 2007 had only 1.25" of tropical cyclone rainfall, entirely from Hurricane Humberto. Compared to the annual 55.24" of precipitation, 2007 also was an extremely dry year, having only 28.65" of total precipitation. This induced a drought from March 2006 to Nov 2008. The drought ended because of an increase in rainfall and an increase in tropical cyclone rainfall. Two tropical cyclones in Aug and Sept of 2008 dropped a total of 9.15" of rainfall.



•One extreme and one severe drought occurred in the Gulf Division from 1999 to 2009. The first drought started in Feb 1990, became an extreme drought in July 2000, and ended on July 2002. The PDSI continued to drop from Jan 1999 through Aug 2000. There were two tropical cyclones in Sept 2000 that dropped 2.18" of rain. After this rainfall, the PDSI gradually began to rise. In June 2001 Tropical Storm Allison dropped 4.97" of rain raising the PDSI number by 0.84 in one month. The PDSI in June 2002 was at -2.51. After four tropical storms that dropped 15.45" of rain, the PDSI was 2.67 by Nov 2002.

•The tropical storms from 2003 to 2005 helped keep the gulf out of drought by dropping approximately 15%, 16%, and 32%, of the annual rainfall for those years.

•2006 was a dry year with zero tropical cyclone rainfall. Without the help from tropical cyclone rainfall, the Gulf Division fell into a drought. The division almost came out of the drought in Oct 2007 without any tropical cyclone rainfall, but fell back into drought again. It took the 3.65" of rain from tropical cyclones in Sept 2007 to help mitigate the drought.

Conclusions

Tropical cyclones help mitigate droughts and keep regions of Alabama out of droughts. Without tropical cyclone rainfall, regions of Alabama are more prone to stay or fall into a drought.

Acknowledgements

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