



Global Extreme Drought Events

Distribution and Characteristics of Change



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Introduction

Disasters and risks caused by global climate change and social development are closely related to extreme events. In extreme weather events, extreme drought events with long-term lack of rainfall make the water necessary for survival and severely affect people's livelihood, agriculture, and industrial activities.

The previous discussion on droughts is often based on the derived indices, and the analysis of the data is often in fixed grid point or area. Therefore, there is a lack of analysis of individual independent extreme drought events in the perspective of the evolution of drought in time and space.

Drought causation and impact is affected by various weather factors (high temperature, wind speed and relative humidity). drought index based on a single variable may not be insufficient for the reflect the state of drought. Therefore, the multivariate standardized drought index (MSDI) according to the research of Zengchao Hao, Amir AghaKouchak (2013), is used in this study to characterize droughts and was used as the model input variables.

The purpose of the study is to track individual drought events, to know the genesis, termination, duration, impacted area, mean intensity, frequency and the ranking of extreme event.

Method

The Multivariate Standardized Drought Index (MSDI)

MSDI is probabilistically combining results of the Standardized Precipitation Index (SPI) and the Standardized Soil Moisture Index (SSI) for drought characterization.

Time	1980~2020 (month)
Latitude	90° N-90° W (0.5°)
Longitude	180° W-180° E (0.625°)

USDM	Intense Level	MSDI
D0	Abnormally Dry	-0.5~-0.8
D1	Moderate Drought	-0.8~-1.3
D2	Severe Drought	-1.3~-1.6
D3	Extreme Drought	-1.6~-2.0
D4	Exceptional Drought	-2.0~

Event Tracking

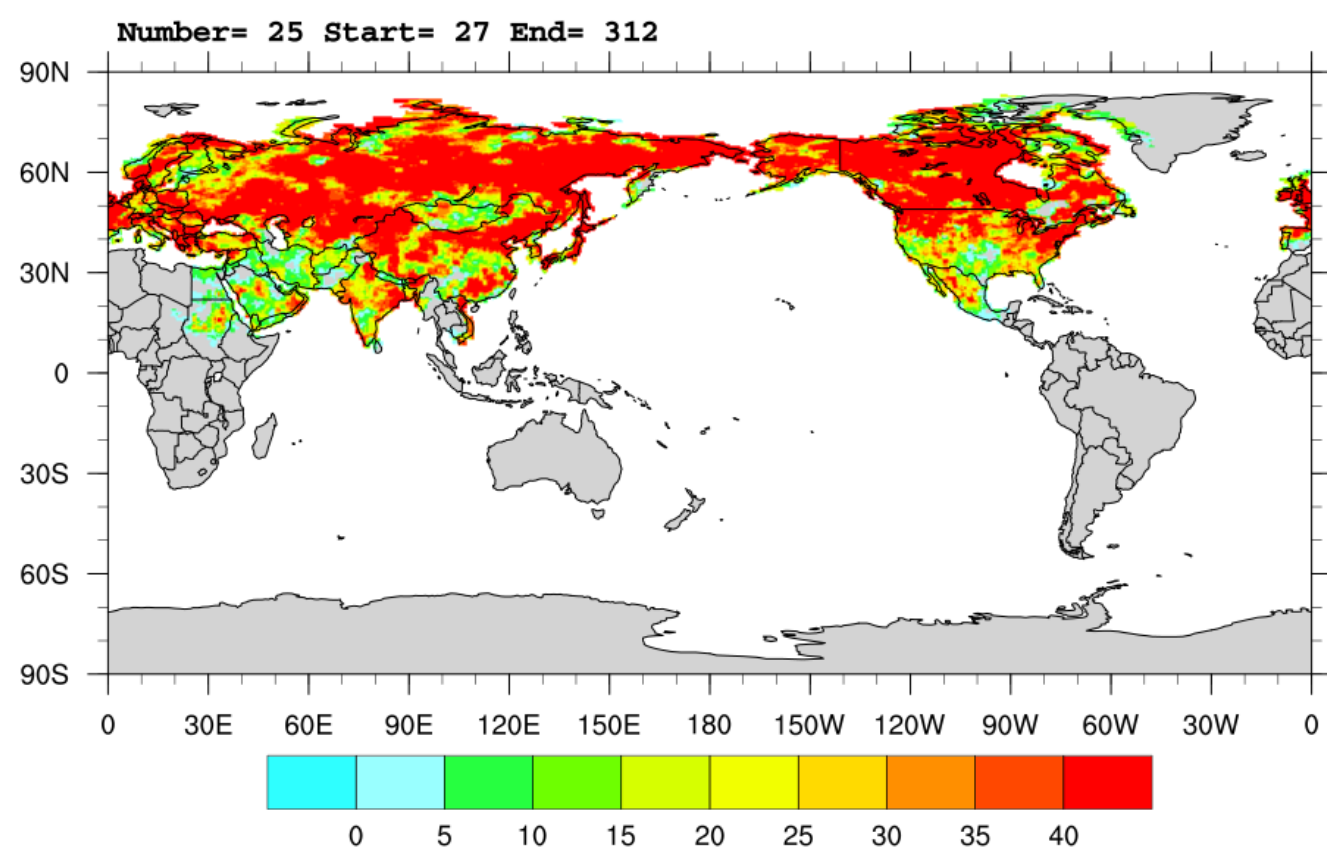
The research refers to Shih-How Lo (2021) and analyzes droughts from an event perspective. Shih-How Lo uses the high-temperature properties of heat to track the trajectory of heatwaves, and distinguish independent heatwave events.

- Form the data into a 4-D object including longitude, latitude, time, and intensity.
- Using a depth-first search algorithm to confirm similar 4-D objects connectivity.
- According to requirements, set thresholds and analyze them.

Result and Discussion

Different thresholds

Voxel	MSDI	Num of event	Voxel	MSDI	Num of event
3000	-2.0 (D4)	79	10000	-0.8 (D1)	10
5000	-2.0 (D4)	55	10000	-1.3 (D2)	22
10000	-2.0 (D4)	32	10000	-1.6 (D3)	38
30000	-2.0 (D4)	6	10000	-2.0 (D4)	32

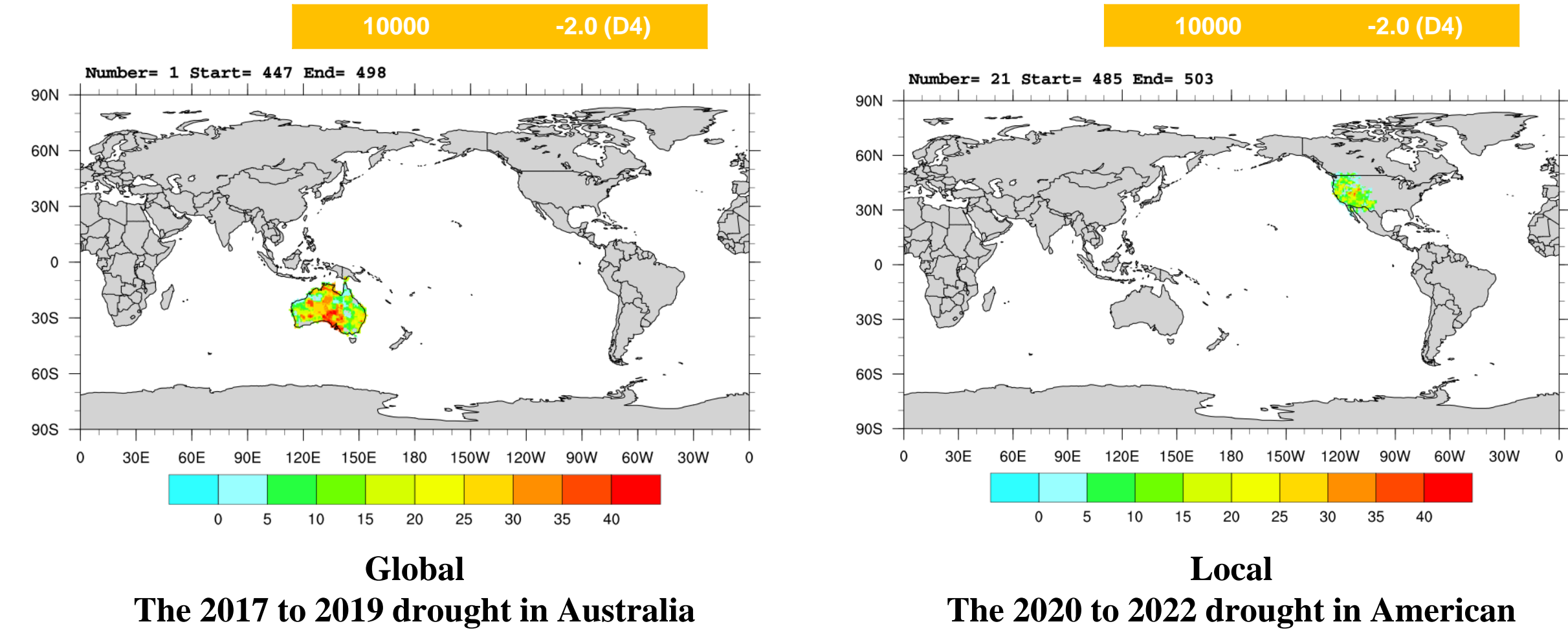


5000 -1.6 (D3)

When the thresholds of intensity change, it might may allow the two events to be linked and further considered as one event.

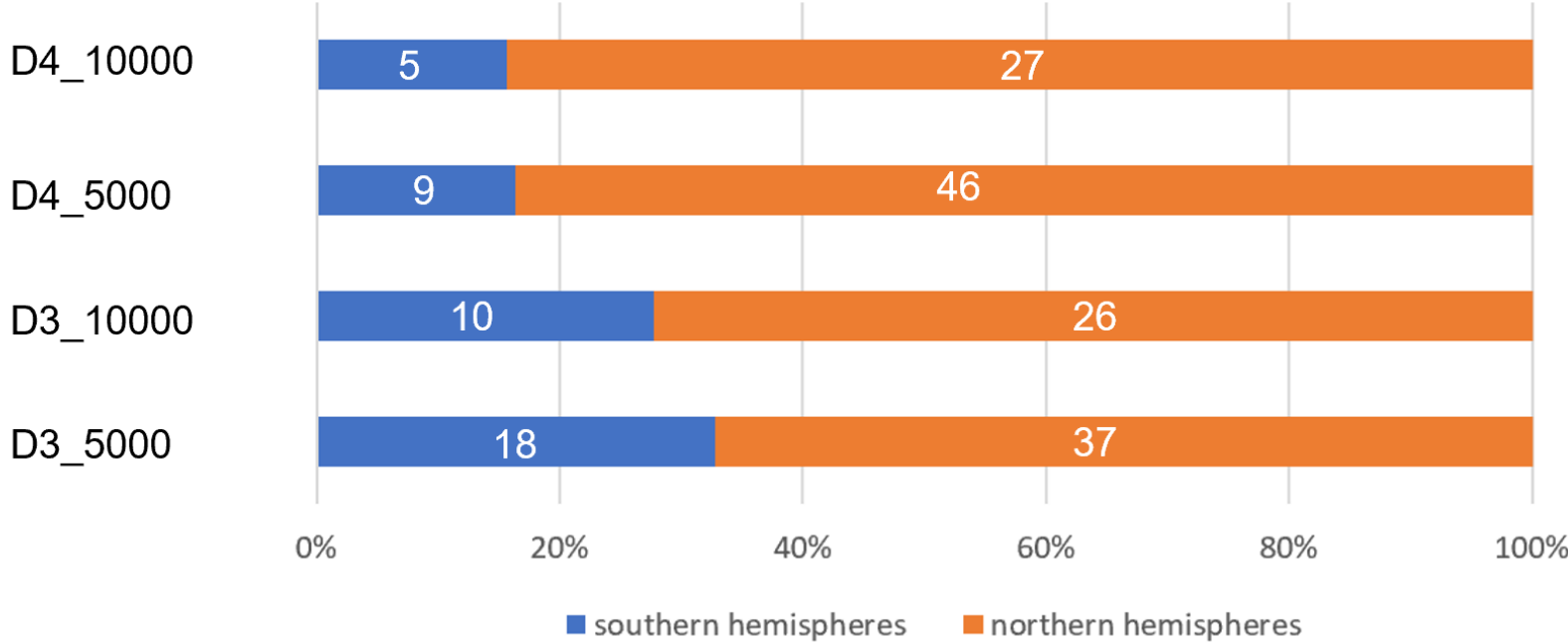
In the data, some marine areas are treated as continental areas, causing events to be tracked incorrectly.

Drought event



The color red means that the area is dry for a long time. The drought events I have tracked are consistent with other reported findings.

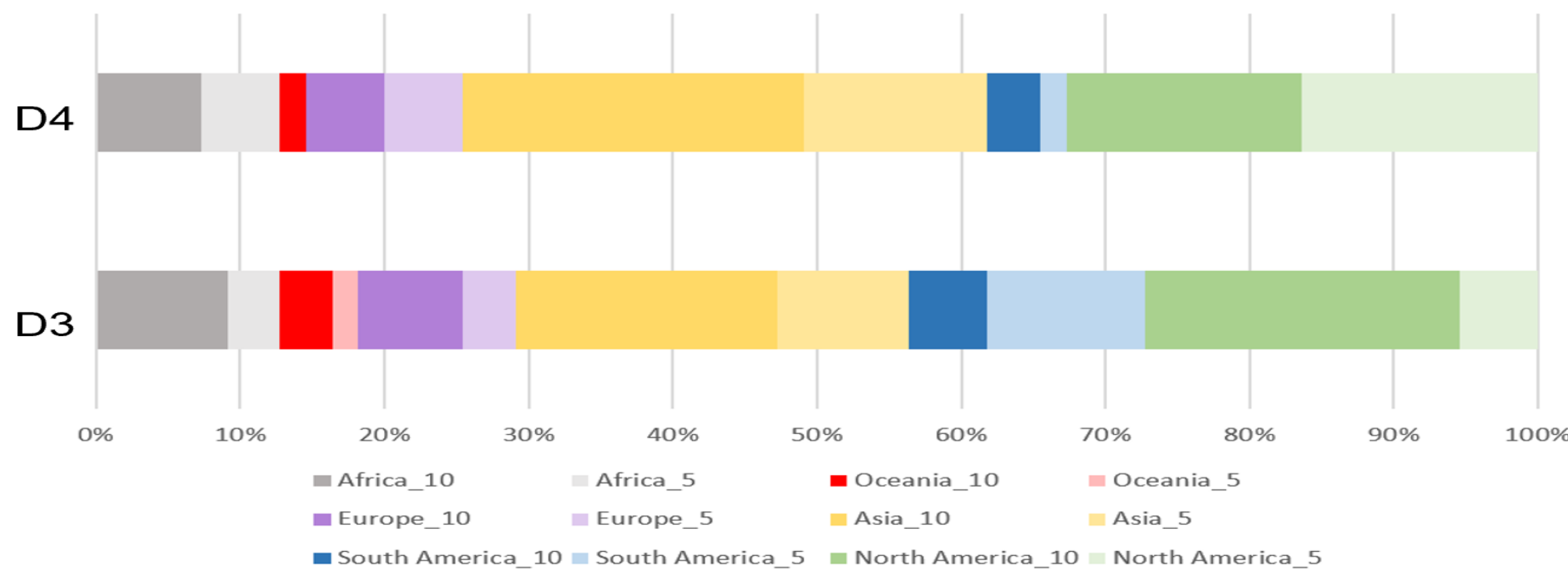
The northern and southern hemispheres



Different thresholds

- The size of an area
- Dry season length
- Soil moisture
- Specific areas
- Mask

Six continents



Whichever thresholds is used, Asia and North America has a lot of extreme drought events. Choose thresholds to better track extreme events.

Future Research Direction

- Analyze for specific areas and time.
- Use other drought index to track drought events before 1980.
- Compound events include heat waves(e.g. Universal Thermal Comfort Index) and wild fires(e.g. Fire Weather Index).
- Provide information to Risk assessment of drought damage and Drought monitoring and prediction system
- Discuss the impact of droughts on crop yields, general ecosystem function, water resources and electricity generation.

Reference

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