An Analysis of the Extreme Dry Spells in Taiwan and Its Variations during the Recent One Hundred and Ten Years

Mong-Ming Lu (盧孟明) and Yin-Min Cho (卓盈旻) Central Weather Bureau, Taiwan

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 The increasing contrast between dry and wet seasons is a major concern about climate change in Taiwan.

• The past 100 years showed a clear decreasing trend of the annual rainy days (r>0.1mm/day).



Q: Has the extremely prolonged dry spells become more frequent in the warming climate?

Data

6 CWB station
Taipei, Taichung, Tainan,
Hengchun, Hualien, Taitung

daily precipitation; 1901-2010

Dry day definition

Daily rainfall amount < 1mm/day. (WMO ETCCDI/CRD Climate Change indices)



Definition of the Extremely Prolonged Dry Spells

- Apply a sliding 90-day window to the daily precipitation data of 1951-2010 (N=60) and count the lengths of the dry spells within the 90-day window.
- Establish the 60-year dry-spell database with the date representing the last day of the 90-day window. ($day_i = day_{i-90+1} \sim day_i$)
- The probability distribution of the dry spells with the length (DS) from 1 to 90 days can be plotted.
- A dry-spell threshold (DS99) of the extremely prolonged dry spells are defined as the exceedance probability of the threshold is less than 1%.



Precipitation Climatology Daily mean precipitation day (1901-2010)





• The overall dry extremes in Taiwan is represented by the index **DSidx**, which is the total number of stations that show extremely prolonged dry spells.



The Sums of DSidx during Every (Sliding) 11 Years



• Scale the extremely prolonged dry spells to 5 levels according to the 11-year sums of DSidx



Moderate Severe Very Severe Extreme Very Extreme

1231

DS99 in Taichung, a station at the west side of the Central Mountain Range



DS99 in Hualien, a station at the east side

of the Central Mountain Range

Contribution of each station to the 11-year sums of DSidx



Before 1930: major contribution from stations in the south 1961-1991: major contribution from the stations in the west After 1991: major contribution from the stations in the east • The typhoon activity around Taiwan is relatively low during the period of 1967-1990 compared with the period after 1991.



Wang, Wu, and Wang (J Climate, 2011)



The East Asian winter monsoon weakened in late 1980's and remained weak until late 2000's.



Fig. 1. The time series of the 18 existing EAWM indices and their decadal components expressed by a 9-year running mean for the winters 1957–2001.

Citation: Wang, L., and W. Chen, 2010: How well do existing indices measure the strength of the East Asian winter monsoon? Adv. Atmos. Sci., 27(4), 855–870, doi: 10.1007/s00376-009-9094-3.

Conclusions

• The extremely prolonged dry spells became more severe after 1960.

• During the period of 1961-1990, the extremely prolonged dry spells mainly appeared during the wet seasons. After 1991, the extremely prolonged dry spells mainly appeared during the dry seasons. The findings are supported by the analysis results of 21 stations (not shown).

• It is speculated that the dry conditions during 1961-1990 is caused by less active typhoon activity around Taiwan and the dry conditions after 1991 is caused by the weakened East Asian winter monsoon.

• The decadal-scale variability of typhoon and monsoons will be further investigated using model data.

Thank you !

Dry Spell Index Frequency Precentage



