A101

Large-Scale Teleconnection Association with Extreme Flood Events in Coastal Wadis

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The extreme variability of climate in the coastal cities of the Middle East and North Africa is becoming increasingly impactful, such as in Jeddah, which recently experienced devastating flooding that significantly affected the community, as shown in **Figure 1**. Oceanic-atmospheric teleconnection patterns greatly influence global hydroclimatic events, affecting hydroclimate events such as precipitation and temperature (Alizadeh-Choobari & Adibi 2019). Also, their intensity and frequency have become altered due to the impact of climate change, which significantly amplifies extreme weather events and shifts climate dynamics globally. These patterns are crucial for comprehending their association with the complex climate, especially in the MENA area.

Figure 1 Major Flash Flood inventory in Jeddah City

This study aims to disclose the most effective large-scale teleconnection and Sea Surface Temperature (SST) for further prediction analysis. In addition, understands the association between several teleconnections and the extreme precipitation events over Jeddah city. Hence, a hybrid data mining approach is used to unravel the hidden relationships between large-scale oceanic atmospheric teleconnections (ONI and SOI) and the detrended SSTs of the surrounding sea teleconnections and extreme precipitation events in Jeddah city.

Firstly, the monthly precipitation data was classified into two groups, high and low, based on the thresholds of monthly precipitation (T = 35% or the 65th percentile) (Najafi et al., 2022), as displayed in **Figure 2**. Then, the teleconnection data (SOI and ONI) and the detrend of all SSTs are also categorized into five classes based on the boundaries of $\mu \pm i\sigma$ (where μ and σ are the mean and standard deviation of the data, respectively, and i = 1, 1.5), as shown in **Figure 3**. The association rule approach was applied to extract the non-linear association between the selected parameters and extreme precipitation events based on long-term data from 1970 to 2024.

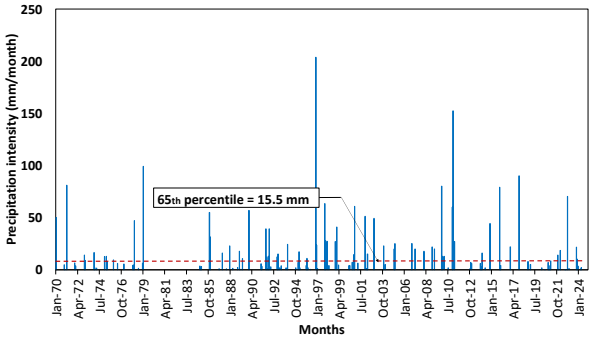

Figure 2 The monthly rainfall at Jeddah station and its 65th percentile.

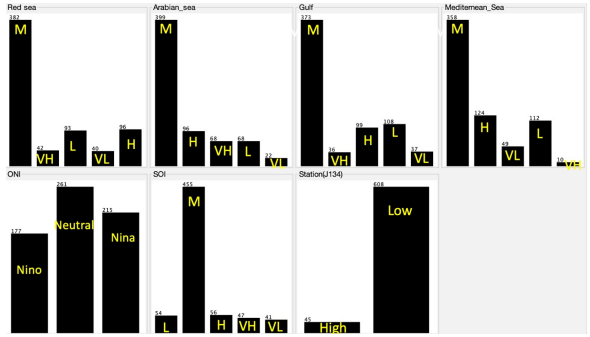

Figure 3 Classification of teleconnections, SSTs, and monthly precipitation data.

The results show that several extracted rules (among more than 4000 rules) explore the association between the detrend of SSTs, SOI, ONI, and the extreme precipitation in Jeddah. For example, an extracted rule discloses the low detrending of the SSTs of the Red and Arabian Seas, the present of the NINA phenomena and the very low detrending of the Gulf SST, simultaneously resulting in extreme precipitation, with a confidence of 75%. The implication is that this rule occurred four times (in November 2000, 2008, 2017, and 2021), corresponding to three times of extreme precipitation (in November 2000, 2008, and 2017), see **Figure 4**. It is also worth mentioning that this phenomenon's occurrence frequency decreases from approximately nine years to 5 years.

Figure 4 The extracted rules and their association with the extreme precipitation event of November 2017.

Another extracted rule unravels that the association of the very low detrend of the Red Sea and Gulf, the low detrend of Arabian and Mediterranean seas, the presence of NINO and the SOI class is M together, and the extreme precipitation event that happened in November 2015 caused the death of two people (**Figure 5**). This rule was repeated four times, among them three times resulting in extreme precipitation. Overall, the results reveal that the SST of surrounding seas is an important driver of extreme flood events in Jeddah.

Figure 5 The extracted rules and their association with extreme precipitation of November 2015

This proposed approach unravels the hidden associations between detrended SSTs and major extreme precipitation events, such as flood events in January 2011, November 2015, and 2017. This approach could serve as a valuable tool for decision-makers, providing them with knowledge-driven insights to mitigate the impacts of flood risk proactively.

References:

Alizadeh-Choobari, O., Adibi, P., 2019. Impacts of large-scale teleconnections on climate variability over Southwest Asia. Dyn. Atmos. Ocean. 86, 41–51. https://doi.org/https://doi.org/10.1016/j.dynatmoce.2019.02.001

Najafi, H., Nourani, V., Sharghi, E., Roushangar, K., Dąbrowska, D., 2022. Application of Z-numbers to teleconnection modeling between monthly precipitation and large scale sea surface temperature. Hydrol. Res. 53, 1–13. https://doi.org/10.2166/NH.2021.025