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Synoptic Analysis of a Rare Convective Storm Over Alexandria, Egypt in May 2025

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INTRODUCTION & AIM

Extreme weather events can severely impact urban areas, causing infrastructure damage and casualties. Although the Mediterranean basin typically experiences major weather systems during winter, an unusual convective storm affected Alexandria on 31 May 2025, producing intense rainfall and hail within a short period, overwhelming the city's inadequate drainage systems.

This study investigates the synoptic conditions that triggered this rare event through analysis of pressure patterns and wind fields up to 200 hPa, alongside the role of elevated SST in promoting cumulonimbus development over Alexandria.

METHOD

Study Area: This study focuses on Alexandria; a major coastal city located on the northern Mediterranean shore of Egypt. Alexandria extends approximately 70km along the coastline and is characterized by a Mediterranean climate.

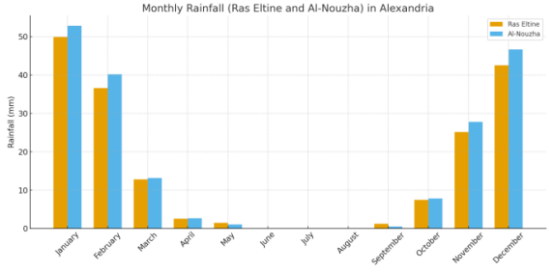
Due to its geographical position, Alexandria is highly influenced by weather systems moving across the Mediterranean Basin, making it susceptible to rapid atmospheric changes, particularly during the autumn and spring seasons.

Data:

Reanalysis Data: Surface pressure, geopotential height, wind, temperature, humidity from ERA5 , precipitation from ERA5land
Satellite Imagery: Cloud cover, convective development (IR) from Eumetsat
Rainfall Records: Rain gauges in weather stations of Egyptian Meteorological Authority in Alexandria.

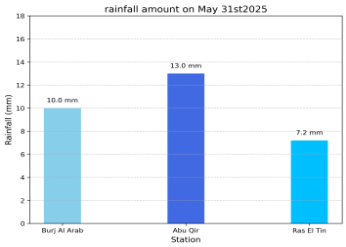
Climatology: The rainfall distribution across two stations in Alexandria (1981-2010) shows a distinct seasonal pattern, with the highest precipitation recorded during the winter months, particularly from December to February.

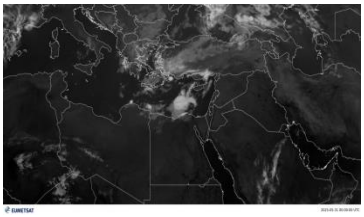
In contrast, rainfall decreases sharply from March onward and reaches its minimum during the summer months. The gradual increase beginning in October indicates the onset of the wet season, highlighting the strong seasonality that characterizes Alexandria's rainfall regime.



RESULTS & DISCUSSION

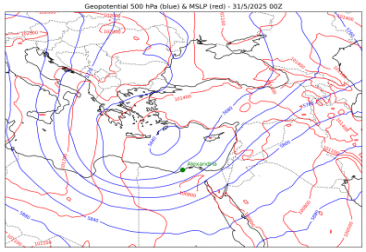
This event is considered a strong rainfall case, as the recorded precipitation amounts are high compared to the climatology for Alexandria at the same time. Moreover, this rainfall occurred in a short period during the early hours of the morning on 31/5/2025.



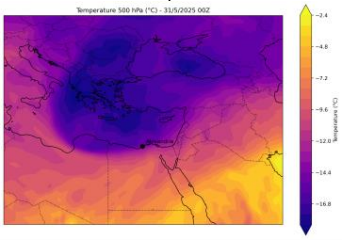


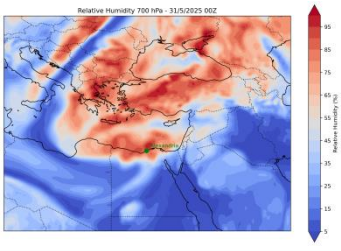
Satellite imagery revealed rapidly developing convective cloud tops and enhanced cold cloud signatures, indicating strong vertical motion and vigorous thunderstorm activity over Alexandria.

Combined chart of mean sea-level pressure and geopotential height at 500hpa illustrated the interaction between a surface low-pressure system and an upper-level trough, a synoptic setup that played a crucial role in initiating and sustaining the convective storm.



Upper-air observations indicated a marked drop in temperature along with exceptionally high moisture levels, reaching their maximum directly above the Alexandria region, thereby creating a highly favorable environment for deep convective development.





CONCLUSION

A rare convective storm struck Alexandria on 31 May 2025, caused by an upper-level trough interacting with warm, moisture-rich Mediterranean air intensified. This combination produced rapid thunderstorm development and brief but intense rainfall, revealing the susceptibility of coastal cities like Alexandria to unexpected severe weather.

FUTURE WORK/REFERENCE

Future research will investigate extreme rainfall events across Egypt from 1990 to 2025, aiming to identify unusual cases and analyze their spatial and temporal patterns to better understand their national impacts.

[1] Baldi, M., Amin, D., Al Zayed, I. S., & Dalu, G. (2022). Climatology and dynamical evolution of extreme rainfall events in the Sinai Peninsula—Egypt. Journal of Climate Studies, 45(3), 123–145.