بسم الله الرحمن الرحيم

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تم رفع هذه الرسالة بواسطة / حسام الدين محمد مغربي

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى

مسئولية عن محتوى هذه الرسالة.

ملاحظات:
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AN INTEGRATED FRAMEWORK FOR INVESTIGATING EXTREME RAINFALL EVENTS OVER THE EASTERN MEDITERRANEAN REGION: FOCUSING ON EGYPT AND CYPRUS

By

Doaa Mohamed Fathy Abo El-Yazeed

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
Irrigation and Hydraulics Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

An Integrated Framework for Investigating Extreme Rainfall Events over the Eastern Mediterranean Region: Focusing on Egypt and Cyprus

Key Words:
Extreme rainfall events; eastern Mediterranean; trend analysis; WRF model; synoptic conditions.

Summary:
Extreme rainfall events are one of the devastating natural hazards that have a great impact on different facets of life. This study is initiated to shed light on extreme rainfall events over the eastern Mediterranean region, especially over both Egypt and Cyprus. Investigating research into such events can help mitigate their risks and increase society resilience. An integrated framework is then suggested through this study to analyze those events from different aspects. First, the evolution of extreme rainfall events over the study area during the last few decades is inspected using trend analysis tests such as Mann Kendal trend test and Cox-Stuart test. Second, two heavy rainfall events that affected both Egypt and Cyprus in October 2019 and March 2020 are chosen as case studies, where the anomaly of the rainfall amounts above normal conditions is reviewed during both events. Third, the Weather Research and Forecasting (WRF) model is used as a numerical weather prediction model to reproduce both targeted events. The best combination of parameterization schemes is utilized for revisiting the synoptic conditions accompanying both events and is further validated with a third severe event to examine the potentiality to use the model in future forecasts.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

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Nomenclature

ACM2	Asymmetric Convection Model 2 Scheme
AFWA	Air Force Weather Agency
AMD	Annual Maximum Daily
ARSTs	Active Red Sea Troughs
ARW	Advanced Weather Research
BMJ	Betts-Miller-Janjic Scheme
CAPE	Convective Available Potential Energy
CCI	Commission for Climatology
COR	Correlation Coefficient
CPC	Climate Prediction Center
ECMWF	European Centre for Medium Range Weather Forecast
EMA	Egyptian Meteorological Authority
EMME	Eastern Mediterranean and Middle East
EMR	Eastern Mediterranean Region
ERA	ECMWF Re-analysis Fifth Generation Dataset
ESRL	Earth System Research Laboratory
ETCCDI	Expert Team on Climate Change Detection and Indices
FAA	Federal Aviation Administration
FAR	False Alarm Ratio
FNL	Final Re-analysis Data
GCM	General Circulation Model
GF	Grell-Freitas Scheme
GFS	Global Forecasting System
GMAO	Goddard's Global Modeling and Assimilation Office
GOES	Geostationary Operational Environmental Satellite
GPCP	Global Precipitation Climatology Project
HAD	High Aswan Dam
HPC	High Performance Computer
IGBP	International Geosphere-Biosphere Programme
IOC	Intergovernmental Oceanographic Commission
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter Tropical Convergence Zone
JCOMM	Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
KF	Kain-Fritsch Scheme
LSM	Land Surface Model
MAE	Mean Absolute Error
MB	Mean Bias
ME	Middle Egypt Zone
MED	Mediterranean Zone
MedCLIVAR	Mediterranean Climate Variability and Predictability
MERRA	Modern Era Retrospective-Analysis for Research and Applications
MIA	Modified Index of Agreement

MK	Mann-Kendall Trend Test
MM5	Fifth Generation NCAR/Penn State Mesoscale Model
MNSE	Modified Nash Sutcliff- Efficiency
MODIS	Moderate Resolution Imaging Spectroradiometer
MSLP	Mean Sea Level Pressure
MYJ	Mellor-Yamada-Janjic Scheme
MYNN	Mellor-Yamada Nakanishi and Niino Scheme
NAM	North American Mesoscale Model
NCAR	National Center for Atmospheric Research
NCEP	National Center for Environmental Prediction
NCL	NCAR Command Language
NDE	Nile Delta Zone
NMM	Non-hydrostatic Mesoscale Model
NOAA	National Oceanic Atmospheric Administration
NWP	Numerical Weather Prediction Model
NWRC	National Water Research Center
PBL	Planetary Boundary Layer
PC	Proportion Correct
PERSIANN-CDR	Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks – Climate Data Record
PNNL	Pacific Northwest National Laboratory
POD	Probability of Detection
QNSE	Quasi-Normal Scale Elimination Scheme
Qv	Water Vapor Mixing Ratio
RCM	Regional Climate Model
RD	Red Sea Zone
RFE	Rainfall Estimate
RMSE	Root Mean Square Error
RRTM	Rapid Radiative Transfer Model
RSTs	Red Sea Troughs
SA	Saudi Arabia
SENHAMI	Peruvian Meteorological and Hydrological Service
SN	Sinai Zone
SPI	Standardized Precipitation Index
SRTM	Shuttle Radar Topography Mission
STM	Sign Test Method
TAMSAT	Tropical Applications of Meteorology using SATellite Data
TMPA	Multi Satellite Precipitation Analysis
TRMM	Tropical Rainfall Measuring Mission
TS	Threat Score
UE	Upper Egypt Zone
UGB	Upper Ganga Basin
ULTs	Upper Level Troughs
UN	United Nations
WCDMP	World Climate Data and Monitoring Programme
WCRP	World Climate Research Programme
WDM6	WRF Double-Moment 6-class scheme