WATER AUTHORITY

Hydrological Service

Modeling floods and drought in Israel: current situation and future possibilities

Amir Givati, Israeli Hydrological Service-Water Authority

Outline

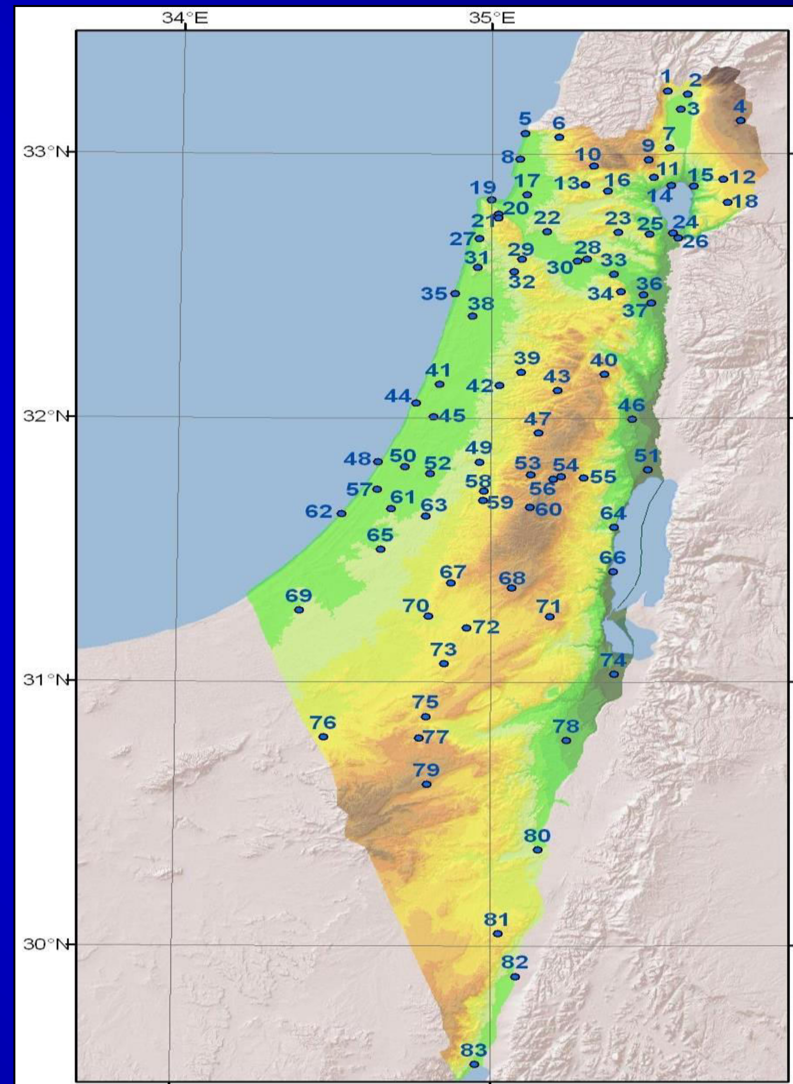
- Surface water monitoring at the IHS: stream flow, wells, lakes
- Flood forecasting
- Seasonal Forecasting
- Climate change and water resources:

  Long term Hydro-Climate simulations

IMS Meteorological Network:

Over 400 daily rain gauges

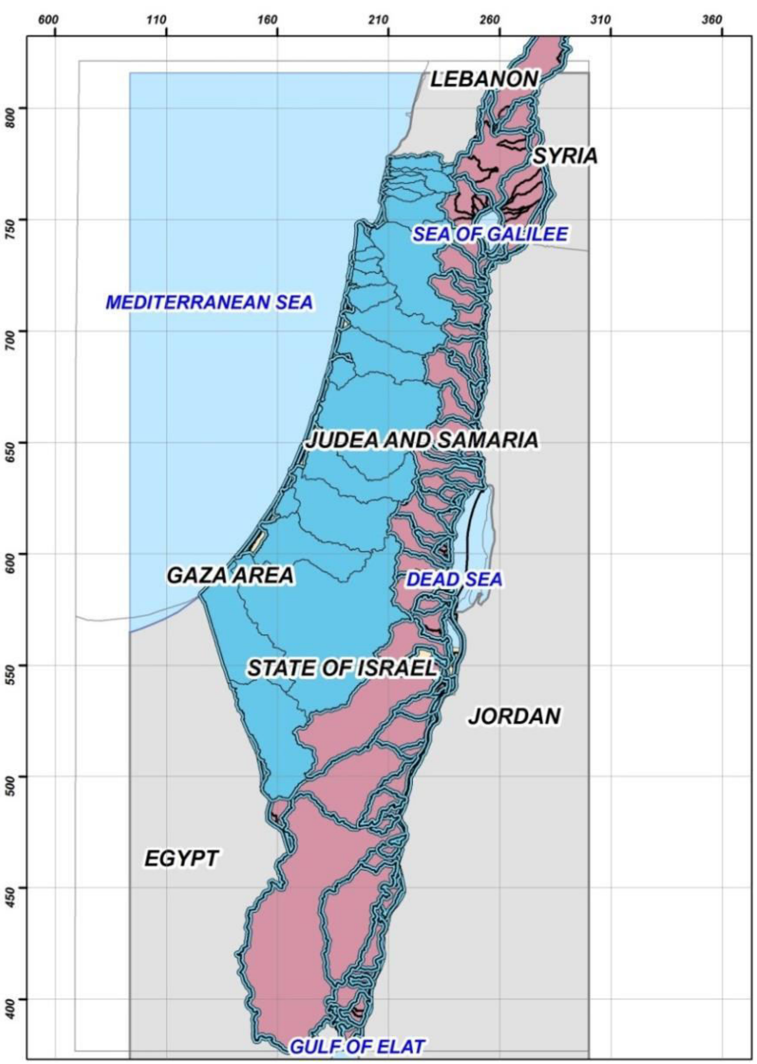
Telemetric meteorological stations

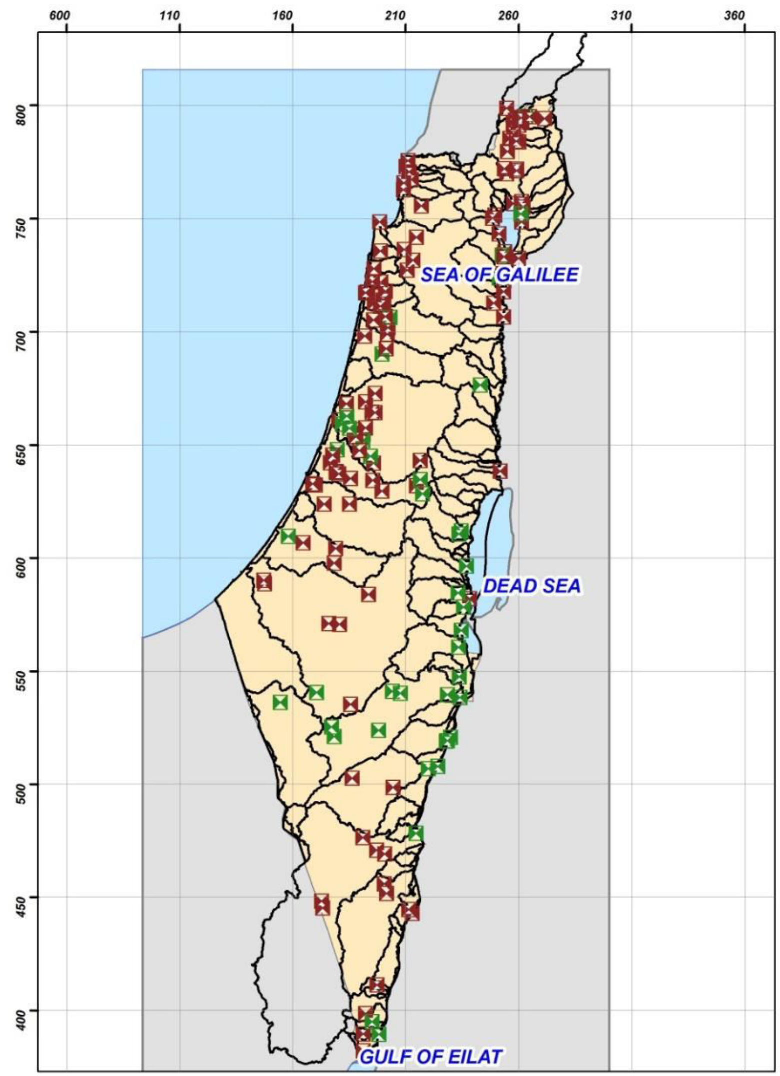


Different types of hydrometric station:

1. Cable station (discharge)
2. Recording station (level gauge)

The national network of hydrometric stations in Israel: Transmitting level gauges (red) and non-transmitting level gauges (green)

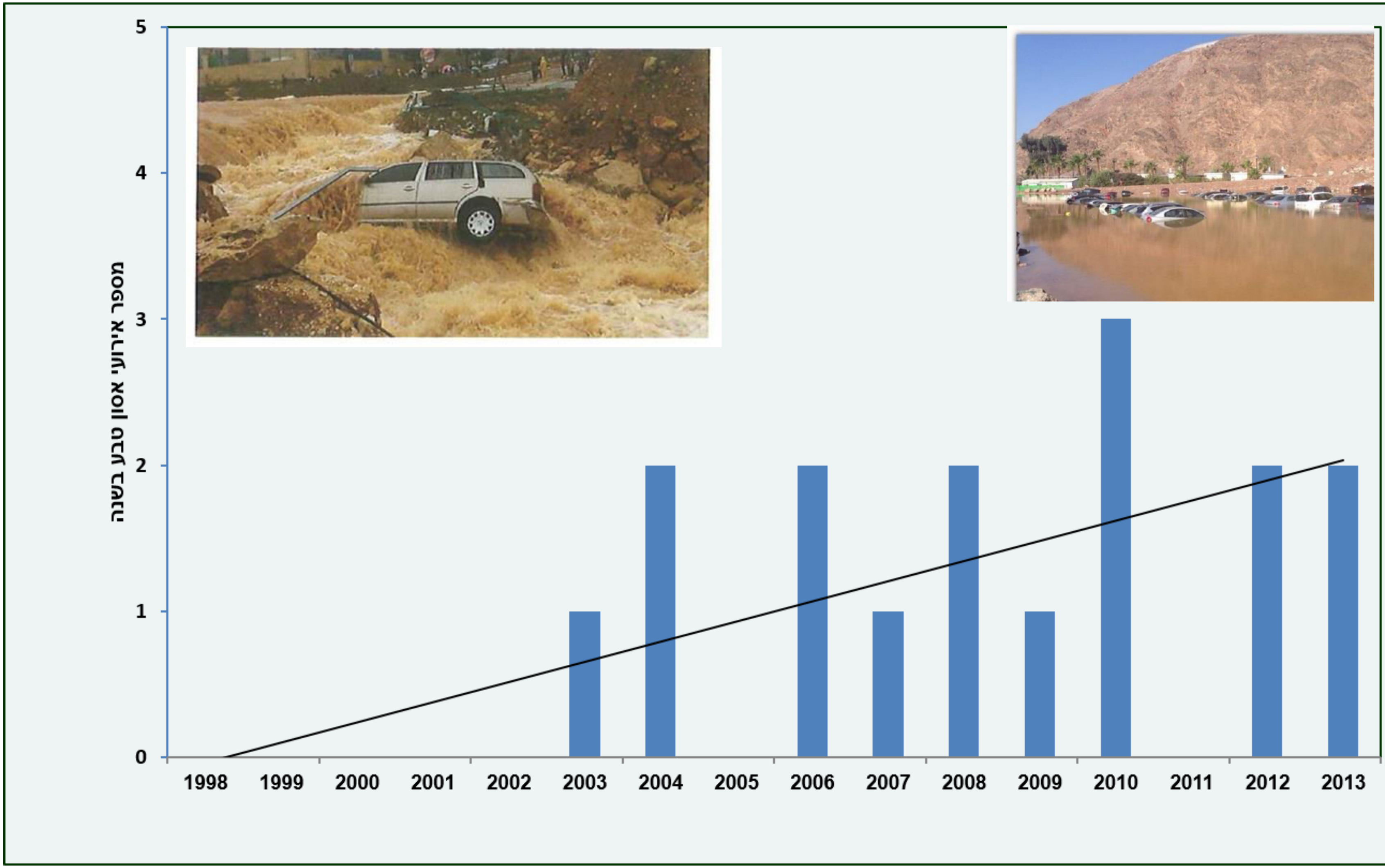






flood forecasting modeling

Increase in “Natural Disaster” Events



Surface Water Modeling

1. Real time flood forecasting models
2. Seasonal precipitation/Hydrological models
3. Down scaling of climate models to evaluate the effect of climate change and land use changes on water resources and the hydrological cycle

Israeli Early Warning System for Floods

- Prediction time scale: From hours to days
  - Water levels, peak discharge
  - Total water volume
  - Return periods and exceedance probabilities
- Fast delivery of alerts to emergency agencies/civil protection and decision makers in the most convenient form

The Methodology for Early Warning System

- Run model with both atmospheric and land-use input
- Run model in real time
- Upload results to a website
- Send alerts by email/sms
- Include animated maps and targeted alerts based on severity level of forecasted flood

IHS Hydro-Meteorological Modeling Tools:

Meteorological input:

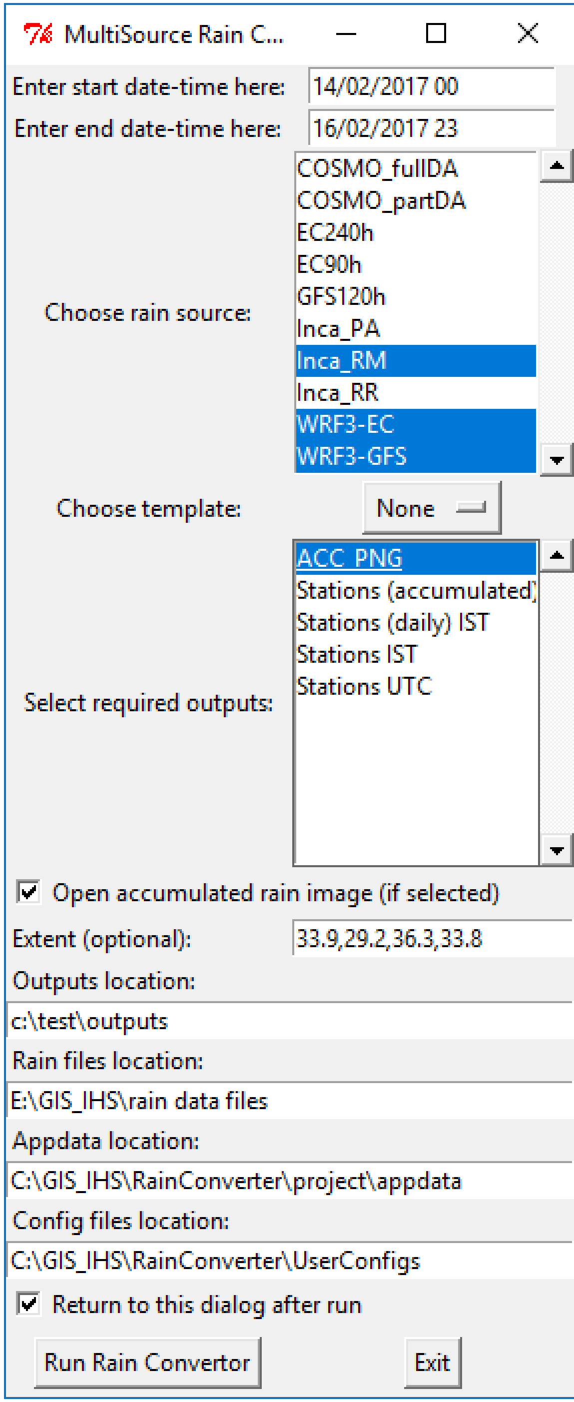
- Radar (Corrected): RM
- Interpolated rain gauges: PM
- NWP: GFS 0.25 degrees
- NWP: ECMWF 0.1 degrees
- High resolution NWP:
- WRF 3km (based on GFS, ECMWF)
- Cosmo (2.8km): part and full DA

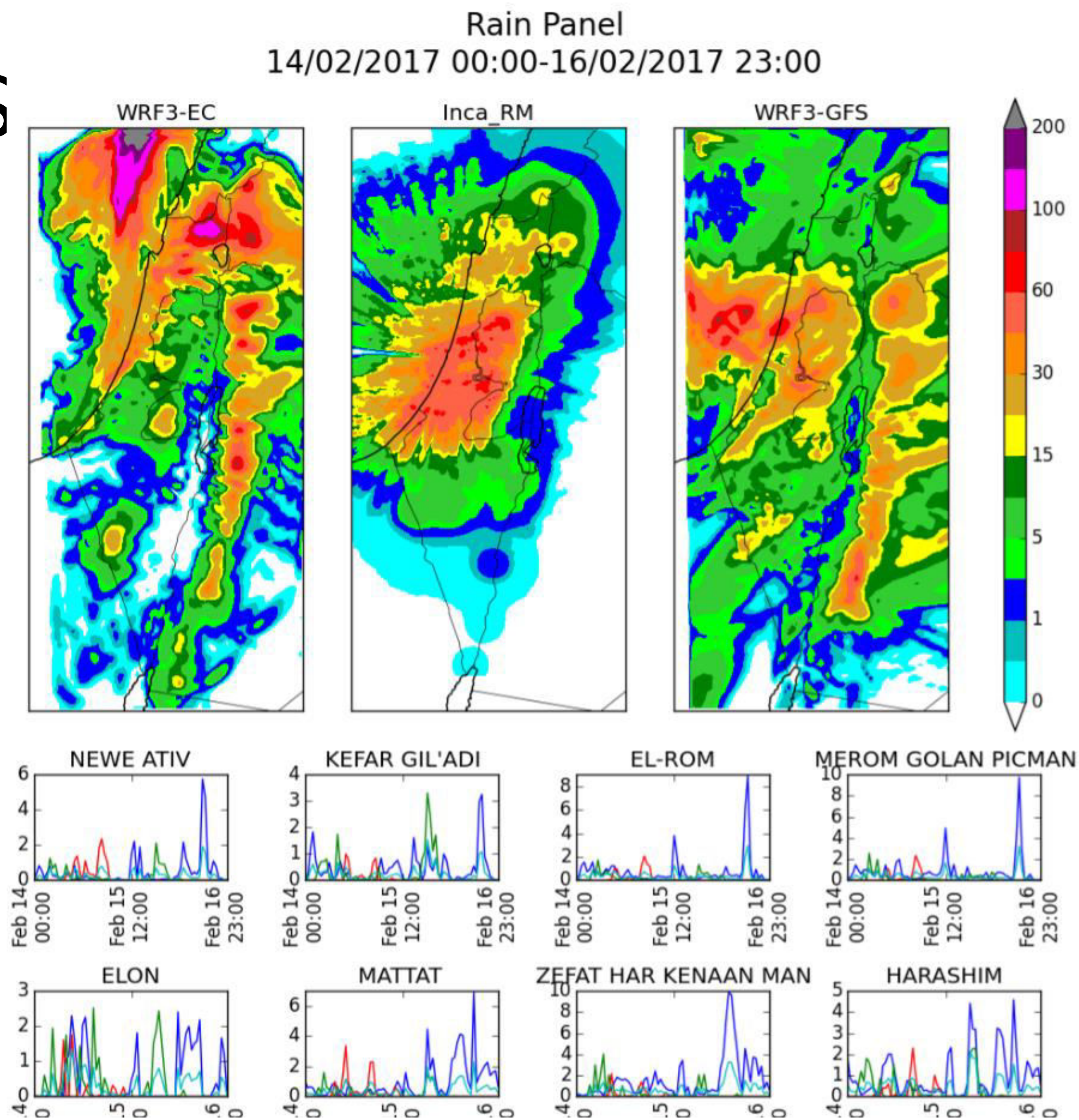
Hydrological models:

- Fully coupled WRF - hydro (hourly time steps)
- HEC-HMS (15 min.)
- AirGR (daily time steps)
- Wflow_SBM (under development)

Integration tools:

- RainConcverter (developed at IHS)
- Delft-FEWS


MultiSource Rain C...
Enter start date-time here:
14/02/2017 00
Enter end date-time here:
16/02/2017 23
Choose rain source:
COSMO_fullDA
COSMO_partDA
EC240h
EC90h
GFS120h
Inca_PA
Inca_RM
Inca_RR
WRF3-EC
WRF3-GFS
Choose template:
None
Select required outputs:
ACC PNG
Stations (accumulated)
Stations (daily) IST
Stations IST
Stations UTC
Open accumulated rain image (if selected)
Extent (optional):
33.9,29.2,36.3,33.8
Outputs location:
c:\test\outputs
Rain files location:
E:\GIS_IHS\rain data files
Appdata location:
C:\GIS_IHS\RainConverter\project\appdata
Config files location:
C:\GIS_IHS\RainConverter\UserConfigs
Return to this dialog after run
Run Rain Convertor
Exit


Rain Panel
14/02/2017 00:00-16/02/2017 23:00
WRF3-EC
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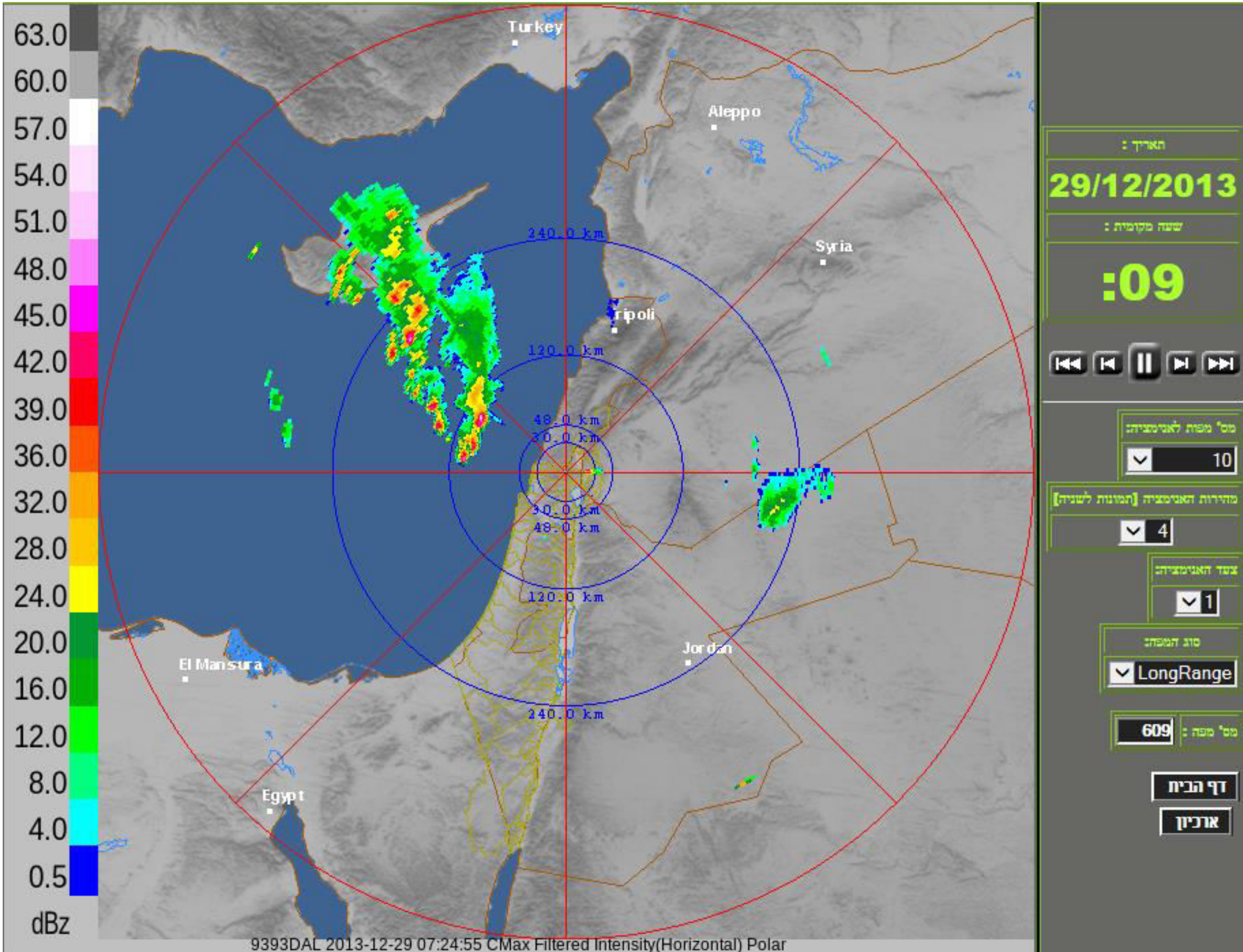
ZEFAT HAR KENAAN MAN
HARASHIM
Feb 14 00:00
Feb 15 12:00
Feb 16 23:00


63.0
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dBz
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Aleppo
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El Mansura
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240.0 km
9393DAL 2013-12-29 07:24:55 CMax Filtered Intensity(Horizontal) Polar
תאריך :
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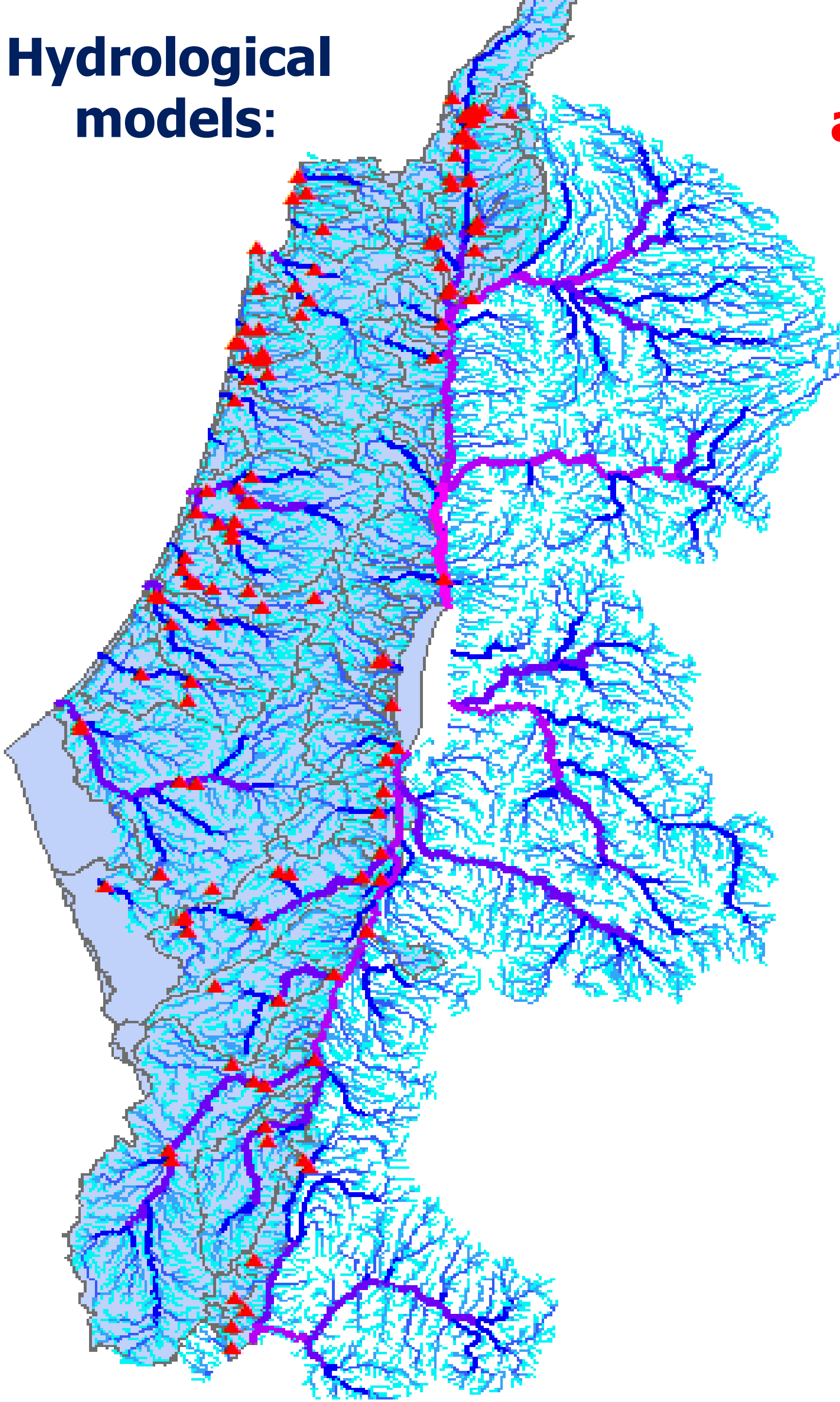
מס' מפות לאנימציה:
10
מהירות האנימציה [תמונות לשניה]
4
צעד האנימציה:
1
סוג המפה:
LongRange
מס' מפה :
609
דף הבית
ארכיון

Hydrological models:



WRF-Hydro domain and forecasting points

1. WRF-Hydro

WRF-Hydro at the IHS runs at hourly time steps for 72h in advance.
The model runs 6 times a day: 4 times based on initial conditions from the 0.25 degrees GFS model (00,06,12,18) and twice a day based on ECMWCF 0.1 initial conditions (00,12).
The model provides hourly forecasts for each grid cell in the domain.
The model is a physical, fully distributed, fully coupled hydrological model.
The precipitation input to WRF (in 3 km resolution) is based on GFS and ECMWCF.
Flood warnings are issued only when both models run (GFS and ECMWCF) have exceeded the flood threshold for a specific location.

IHS WRF-Hydro domain

hydrology

MDPI

Article

Comparing One-Way and Two-Way Coupled Hydrometeorological Forecasting Systems for Flood Forecasting in the Mediterranean Region

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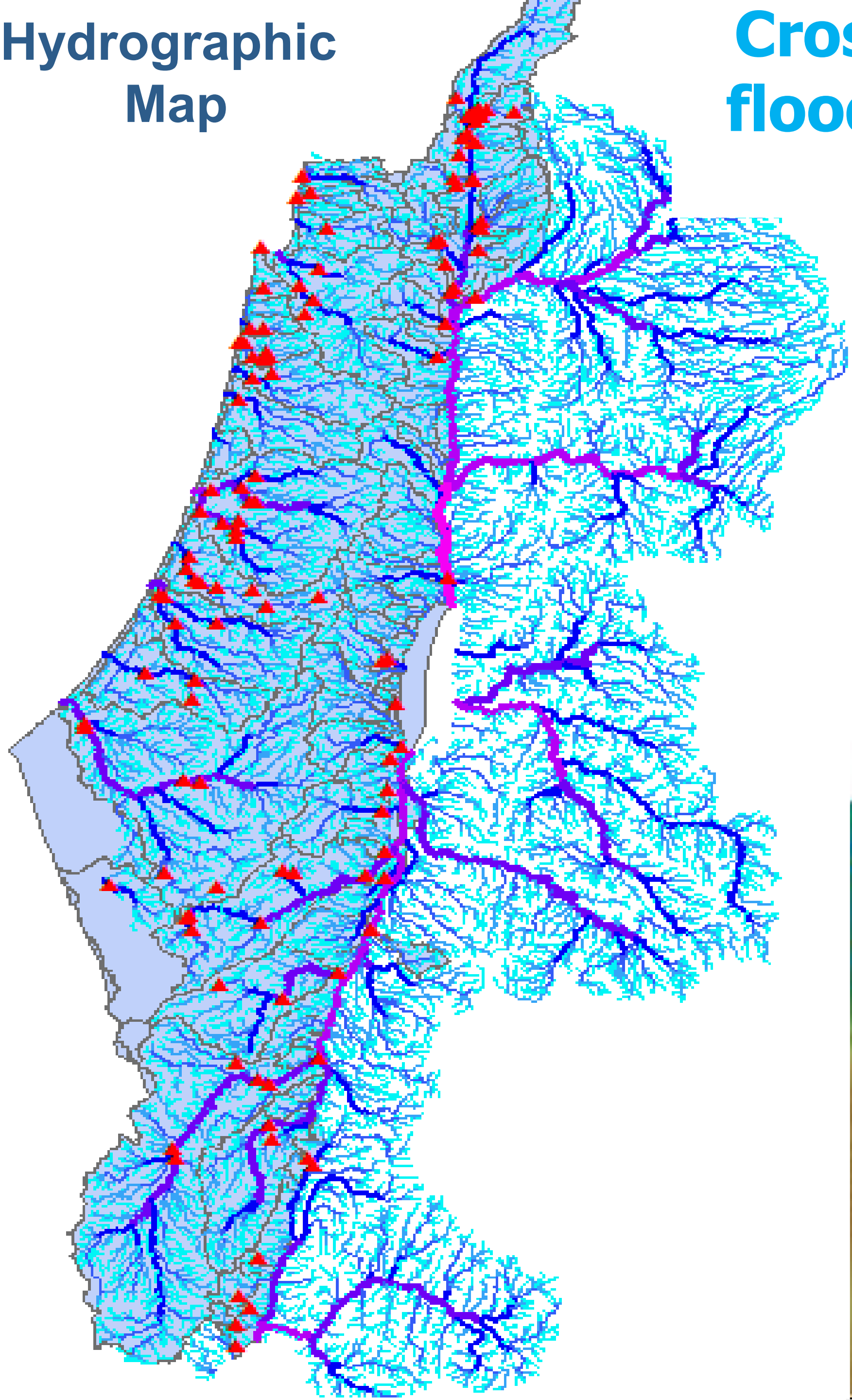
Abstract: A pair of hydro-meteorological modeling systems were calibrated and evaluated for the Ayalon basin in central Israel to assess the advantages and limitations of one-way *versus* two-way coupled modeling systems for flood prediction. The models used included the Hydrological Engineering Center-Hydrological Modeling System (HEC-HMS) model and the Weather Research and Forecasting (WRF) Hydro modeling system. The models were forced by observed, interpolated precipitation from rain-gauges within the basin, and with modeled precipitation from the WRF atmospheric model. Detailed calibration and evaluation was carried out for two major winter storms in January and December 2013. Then, both modeling systems were executed and evaluated in an operational mode for the full 2014/2015 rainy season. Outputs from these simulations were compared to observed measurements from the hydrometric station at the Ayalon basin outlet. Various statistical metrics were employed to quantify and analyze the results: correlation, Root Mean Square Error (RMSE) and the Nash–Sutcliffe (NS) efficiency coefficient. Foremost, the results presented in this study highlight the sensitivity of hydrological responses to different sources of simulated and observed precipitation data, and demonstrate improvement, although not significant, at the Hydrological response, like simulated hydrographs. With observed precipitation data both calibrated models closely simulated the observed hydrographs. The two-way coupled WRF/WRF-Hydro modeling system produced improved both the precipitation and hydrological simulations as compared to the one-way WRF simulations. Findings from this study, as well as previous studies, suggest that the use of two-way atmospheric-hydrological coupling has the potential to improve precipitation and, therefore, hydrological forecasts for early flood warning applications. However, more research needed in order to better understand the land-atmosphere coupling mechanisms driving hydrometeorological processes on a wider variety precipitation and terrestrial hydrologic systems.

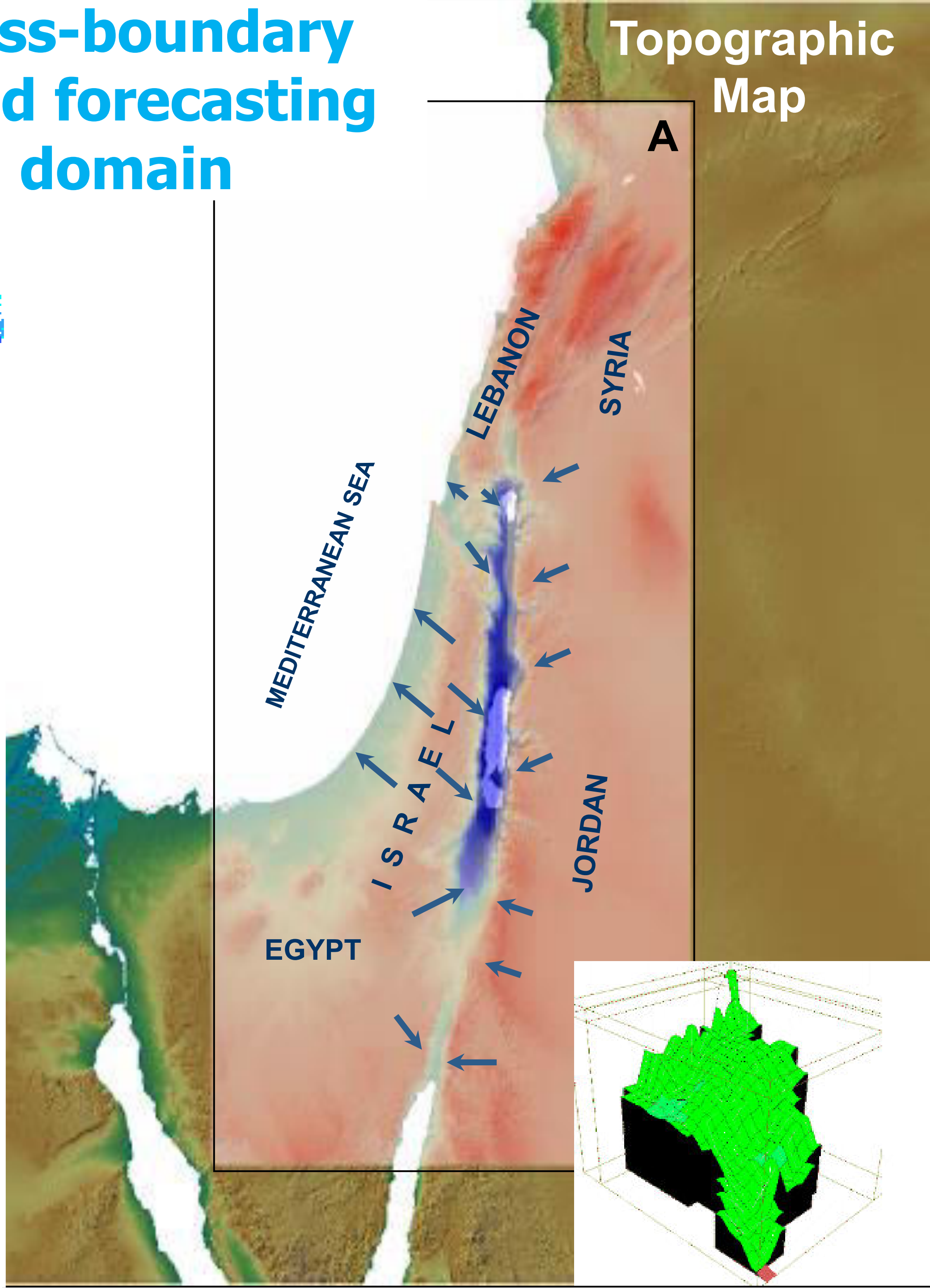
Keywords: floods; atmospheric-land surface coupling; WRF-Hydro

Cross-boundary flood forecasting domain

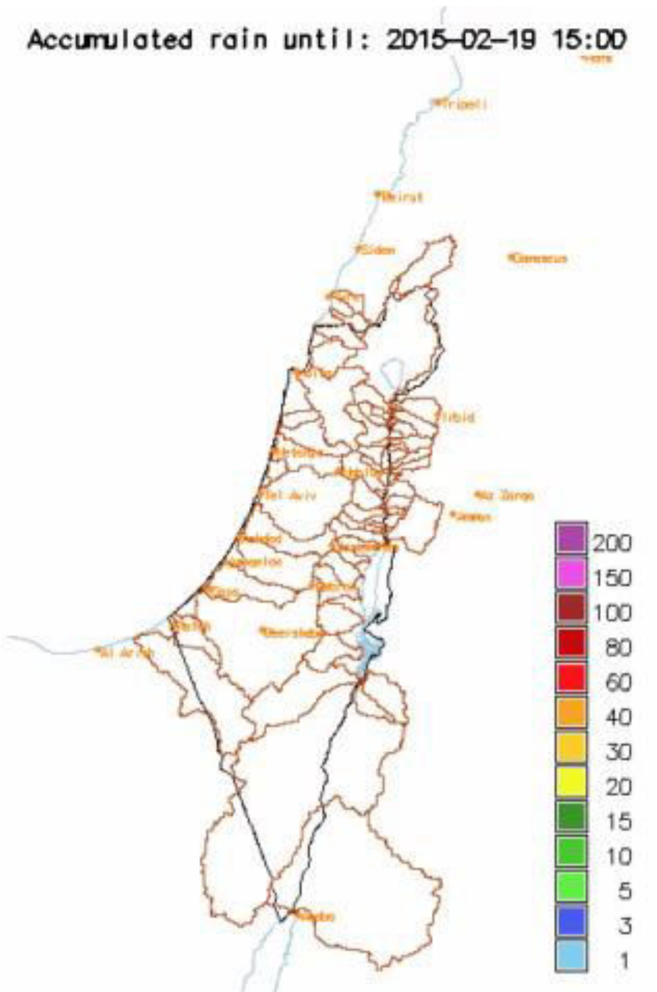
Hydrographic Map



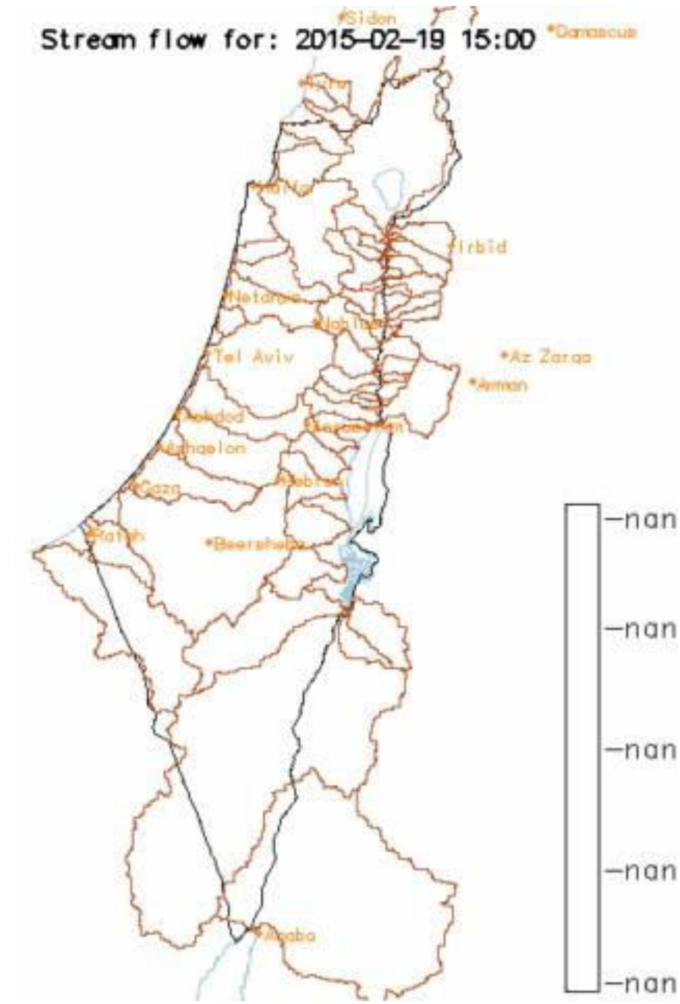
Topographic Map



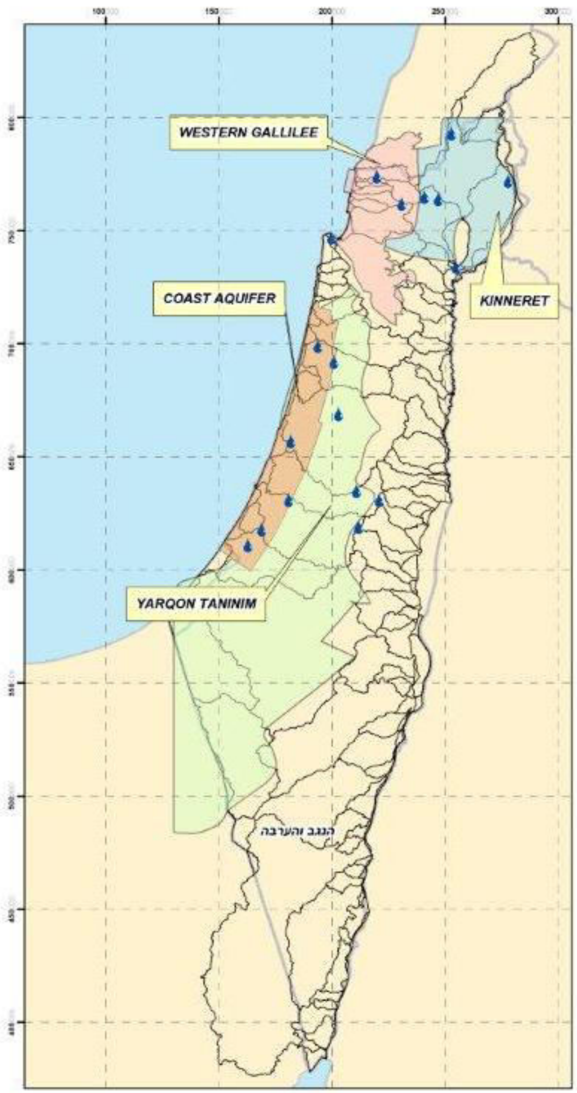
Expected precipitation animation



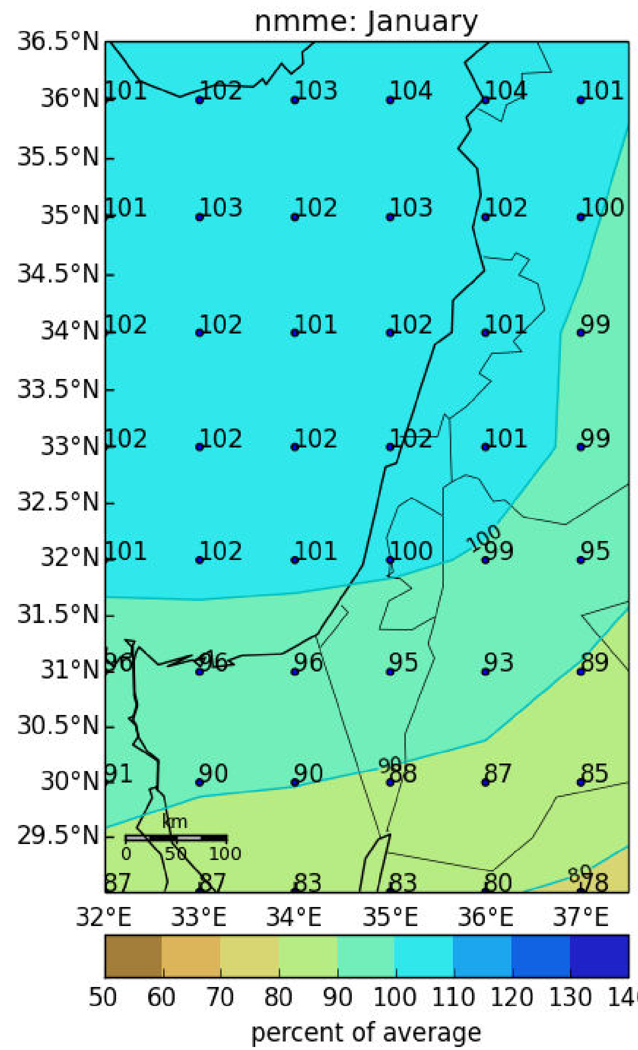
Expected flood animation



Seasonal precipitation in the in the Eastern Mediterranean Region



NMME forecast for Jan. 2016 issued at Dec 2015



Hindawi
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https://doi.org/10.1155/2017/9204081

Research Article

The Advantage of Using International Multimodel Ensemble for Seasonal Precipitation Forecast over Israel

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This study analyzes the results of monthly and seasonal precipitation forecasting from seven different global climate forecast models for major basins in Israel within October–April 1982–2010. The six National Multimodel Ensemble (NMME) models and the ECMWF seasonal model were used to calculate an International Multimodel Ensemble (IMME). The study presents the performance of both monthly and seasonal predictions of precipitation accumulated over three months, with respect to different lead times for the ensemble mean values, one per individual model. Additionally, we analyzed the performance of different combinations of models. We present verification of seasonal forecasting using real forecasts, focusing on a small domain characterized by complex terrain, high annual precipitation variability, and a sharp precipitation gradient from west to east as well as from south to north. The results in this study show that, in general, the monthly analysis does not provide very accurate results, even when using the IMME for one-month lead time. We found that the IMME outperformed any single model prediction. Our analysis indicates that the optimal combinations with the high correlation values contain at least three models. Moreover, prediction with larger number of models in the ensemble produces more robust predictions. The results obtained in this study highlight the advantages of using an ensemble of global models over single models for small domain.

1. Introduction

Accurate prediction of precipitation amounts and its spatial distribution is vital for regional and local-scale hydrological applications. This is especially true for arid and semiarid regions such as the Middle East, where estimations and predictions of the highly variable precipitation amounts during the rainy season are critical for water resources planning and management. Therefore, weekly, monthly, and seasonal forecasting are highly desired by regional policy-makers, water authorities, and climate-sensitive businesses. It is especially crucial in the early detection of oncoming droughts [1]. Seasonal forecasting has made progress in recent years [2], and the climate models provide increasingly accurate and reliable seasonal forecasting with up to 6–9 months' lead time [2, 3]. The accuracy of such forecasts over land surfaces, however, is still not too favorable [4–6].

Previous studies have applied statistical downscaling methods for seasonal forecasting in the Middle East ([7, 8]). The analysis, however, was based only on the Climate Forecast System (CFS) model reanalysis data and not on real reforecasts, so they did not examine the skill of the seasonal forecasts for the various meteorological variables and for different lead times. Global dynamical climate models are providing forecasts for 6–9 months in advance at 80–100 km grid resolution. Due to the chaotic nature of the atmosphere and a limited physical understanding of it, the accuracy of seasonal precipitation forecasting on land is not so favorable unless performed during a period with strong oceanic anomalies, such as El Niño [4–6]. An intermediate solution is the ensemble forecasting technique. This includes the ensembles of different initial conditions by perturbing sea surface temperature (SST) and wind stress [9], as well

Conclusions and future research

- The radar INCA RM products is very useful for hydrological applications: Flood forecasting as well as for water resources management.
- Data assimilation is adding value for now casting: 6 hours lead time.
- Ensemble of high resolution models (COSMO, WRF-GFS,
- WRF-ECMWF) performed better then each single models for hydrological forecasting.
- Products from remount sensing tools may improve the lead hydrological simulations: Precipitation, land use, soil types, soil moister.