



**Hashemite Kingdom of Jordan**  
**Ministry of Transport**  
**Jordan Meteorological Department**

**BSMEFFGS**

**Georgia 28-30 June 2016**

**Case Study**

*For the period from 26-28/3/2016*

**Prepared by: Eng. Dafi Elryalat**



World Meteorological Organization  
(WMO)



Hydrologic Research Center  
(HRC)



National Oceanic and Atmospheric  
Administration (NOAA)



U.S. Agency for International  
Development (USAID)

**26/03/2016**

# Synoptic Analysis

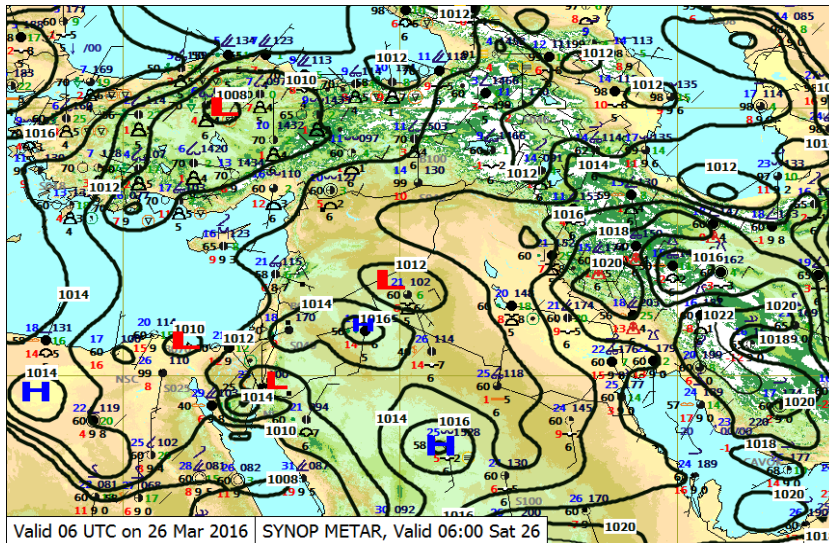


Figure (1)

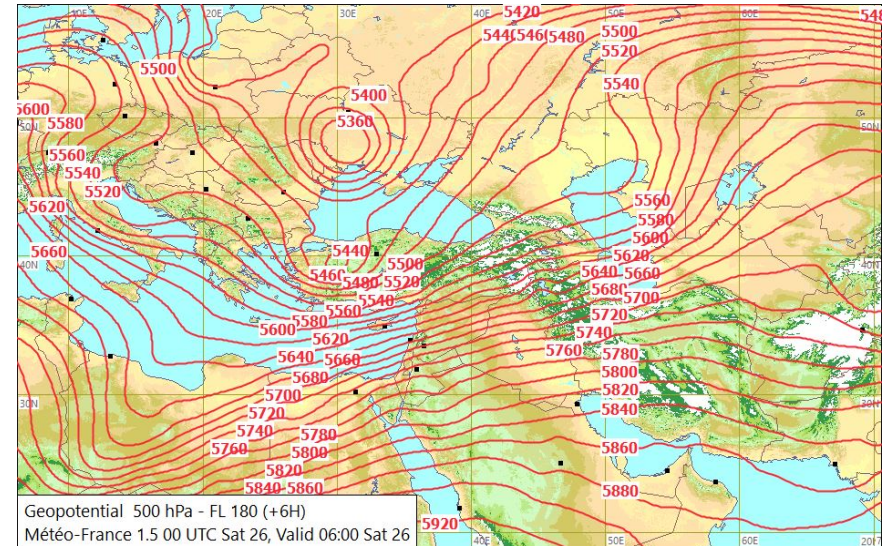


Figure (2)

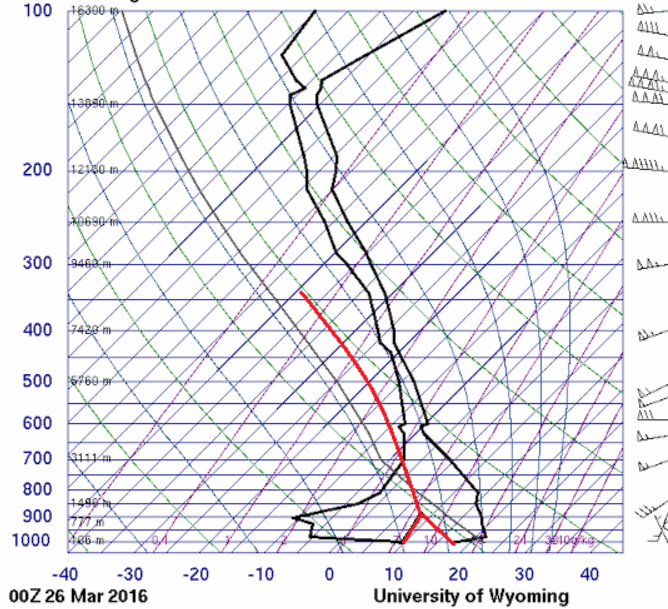
Figure (1) shows Plotted Surface Chart on 26, March 2016 at 0600 utc.

- High Pressure center with 1016 hpa was located over Northern and eastern parts of Jordan.
- Low Pressure center with 1012 hpa over southern parts of Jordan.
- Surface Pressure Tendencies had negative values in north and east of surface trough indicating that the surface trough will extend to north and east parts.

Figure (2) shows geopotential height at 500 hpa on 26, March 2016 at 0600 utc.

- Deep Upper Low depression with 5360m over Ukraine extend to east Mediterranean and Jordan as well .
- high pressure over Red Sea Ridging to southern parts of Jordan.
- \* Surface low (trough) associated with upper low (trough) form instability condition.

**40179 Bet Dagan**



**40265 Mafrqa Station**

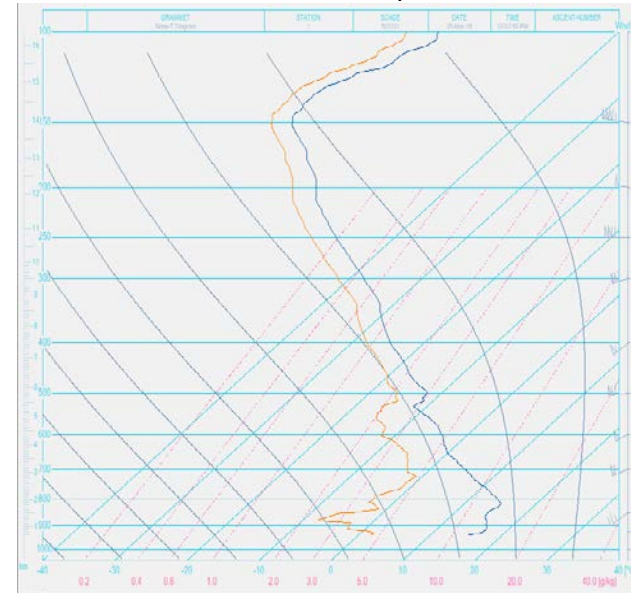


Figure (4)

**Instability Analysis:**

Skew-T Diagram (Figure (3) & (4) shows high relative humidity in upper levels (700 hpa and above) and low humidity in lower levels ( below 700 hpa)

Stability indices:

K-index: 18 (15-20 <20% Prability)

SWET: 187 (<300 non-sever thunderstorm)

S-index: 7.33 (> +3 No convective activity)

Jl: 20 (weak)

**All indices show weak or no instability**

Skew-T Diagram (Figure (5) shows high RH from SFC to upper levels .

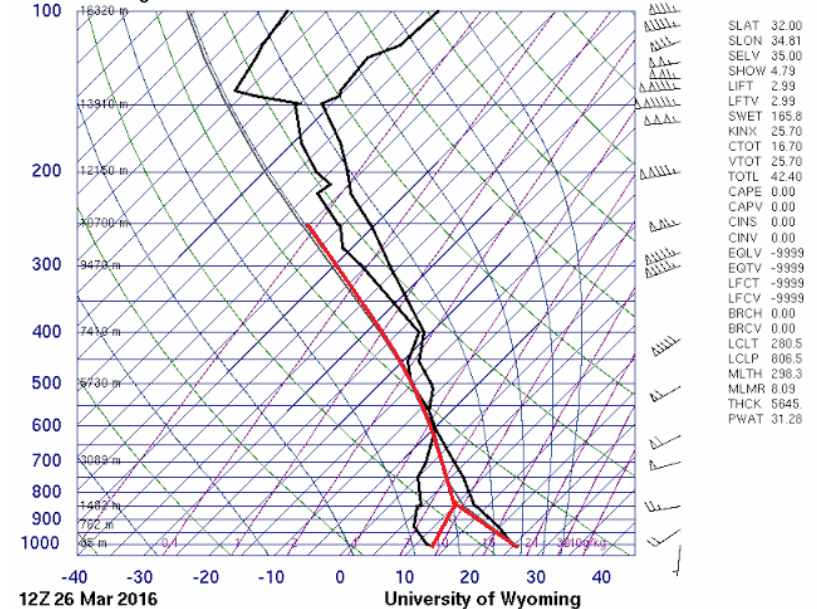
K-index: 25 (20-40 <20% Prability)

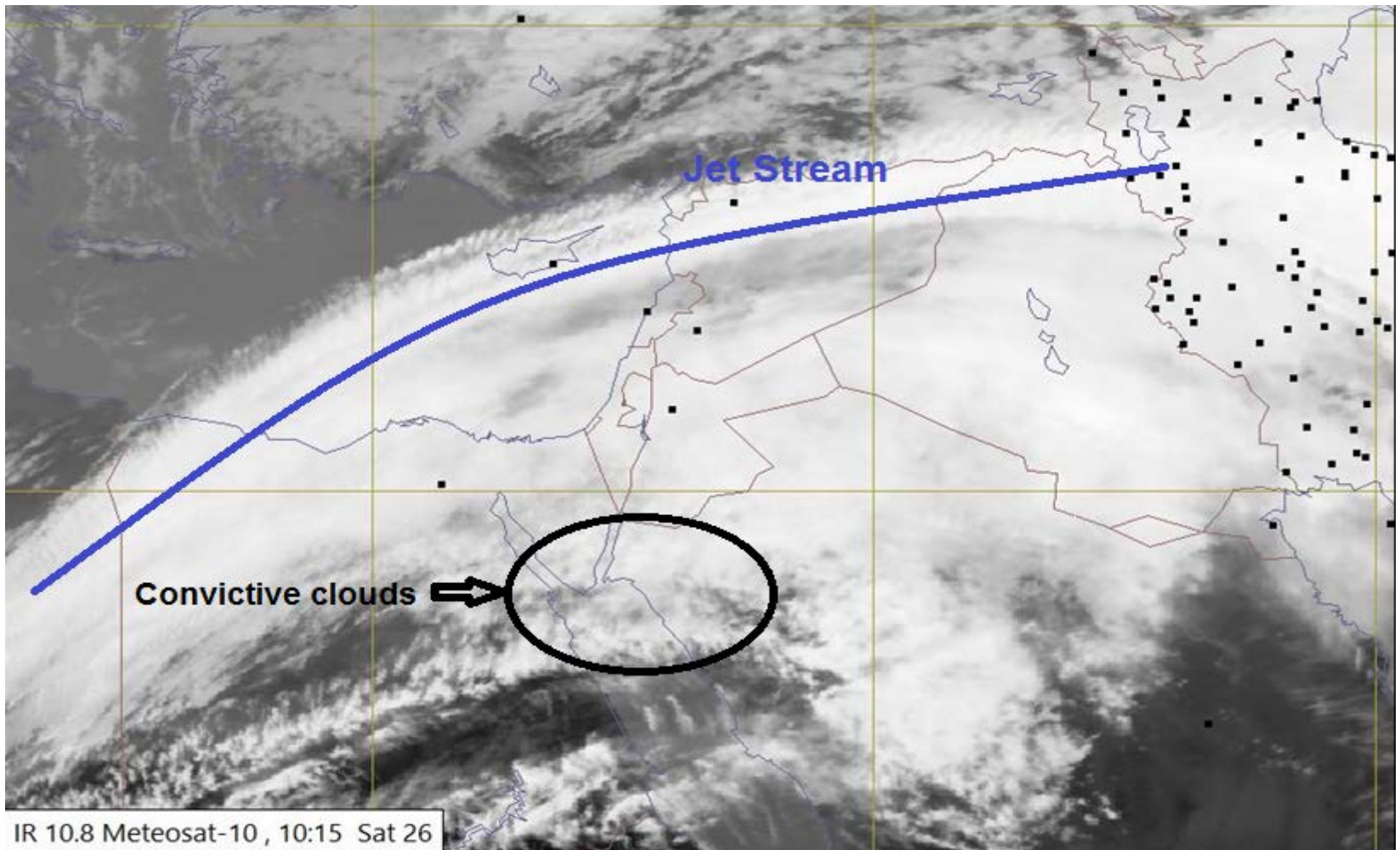
SWET: 165 (<300 non-sever thunderstorm)

S-index: 4.79 (> +3 No convective activity)

**All indices show weak or no instability**

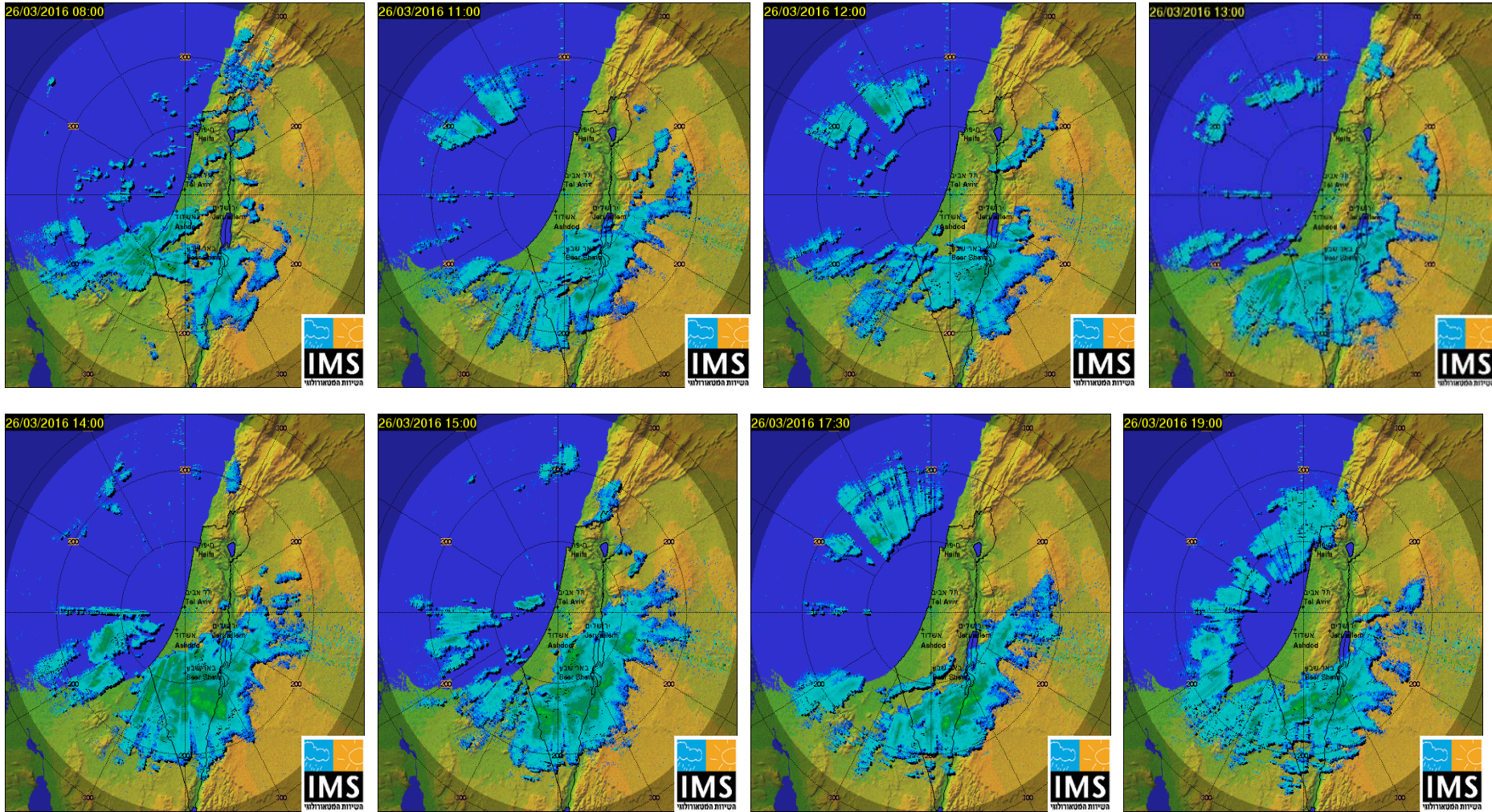
**40179 Bet Dagan**





IR satellite image shows band of Medium and High clouds cover east Mediterranean, convective clouds appear over Egypt, Saudi Arabia and southern parts of Jordan as well.

## Radar Images 26-03-2016

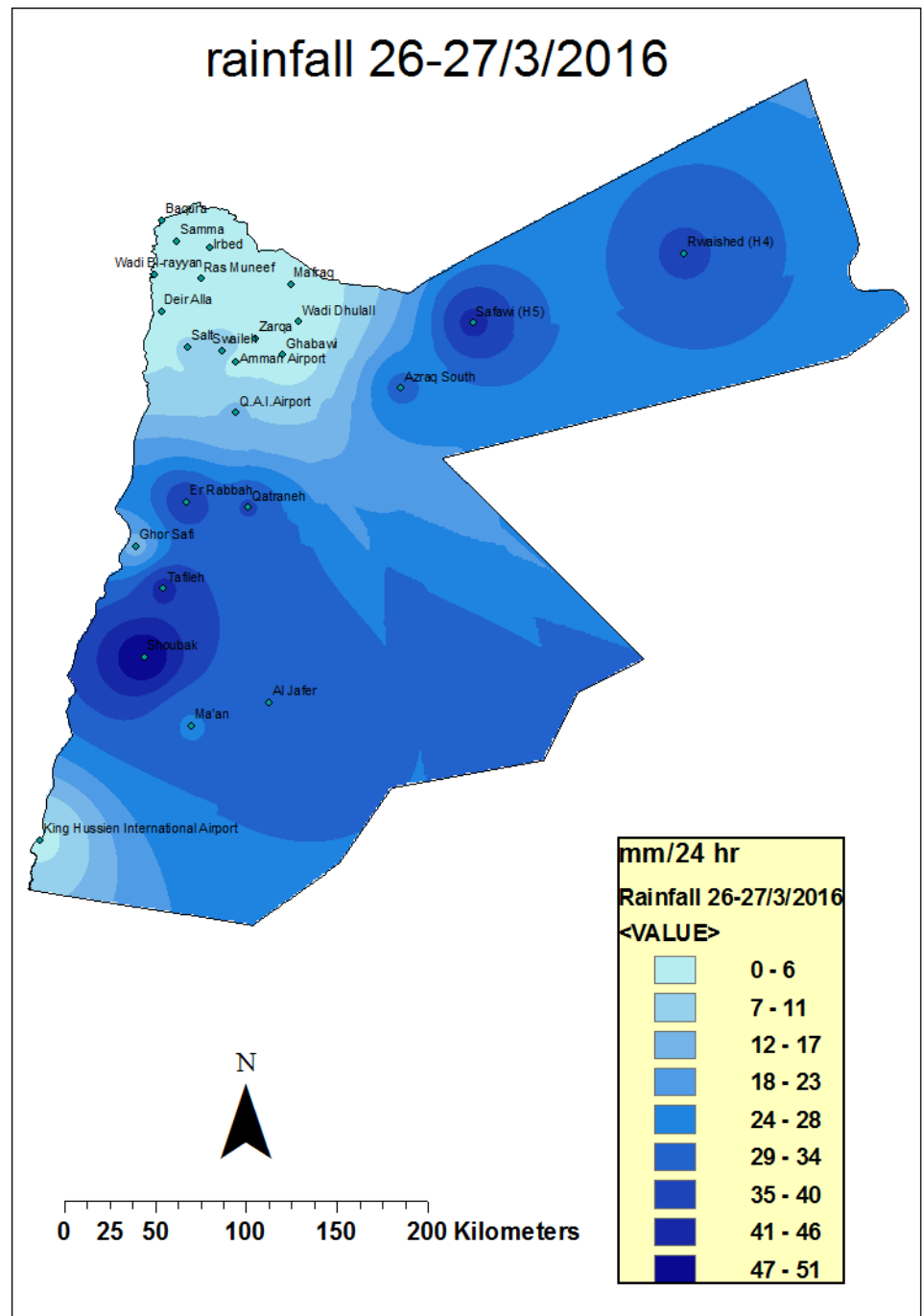


Radar Images show light to moderate rain over southern and central parts of Jordan in the morning while moderate to heavy rain after midday over southern, central and some eastern parts of Jordan

Actual Rainfall distribution using GIS .

Heavy rainfall over southern and eastern parts of Jordan.

Light to moderate rainfall over northern and central regions.



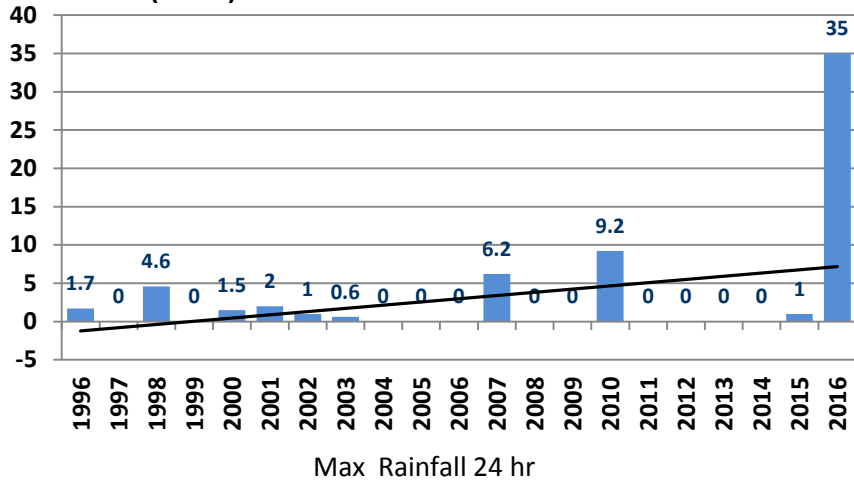
**26-27/3/2016**  
**24 hr precipitations**

<b>Station</b>	<b>Elevation_</b>	<b>mm/24hr</b>
Baqura	-170	0.4
Deir Alla	-224	0
Ghor Safi	-380	14.9
Irbed	616	0.6
Er Rabbah	942	39
<b>Shoubak</b>	<b>1365</b>	<b>51.2</b>
Wadi Dhulall	580	1
Samma	332	0
Wadi El-rayyan	-200	0
Swaileh	1086	9.2
<b>Qatraneh</b>	<b>768</b>	<b>34.7</b>
<b>Tafileh</b>	<b>1266</b>	<b>41.4</b>
Zarqa	644	5
<b>Ramtha</b>	<b>590</b>	<b>48.5</b>
Salt	935	6.3
King Hussien International Airport	55	4.4
Ras Muneef	1150	0
Amman Airport	781	4.2
Mafraq	686	0.5
<b>Safawi (H5)</b>	<b>674.2</b>	<b>41.3</b>
<b>Azraq South</b>	<b>521</b>	<b>30.1</b>
Q.A.I.Airport	722	12.2
Ma'an	1069	28
Al Jafer	865	30.5
Ghabawi	725	2.5
<b>Rwaished (H4)</b>	<b>750</b>	<b>35.0</b>

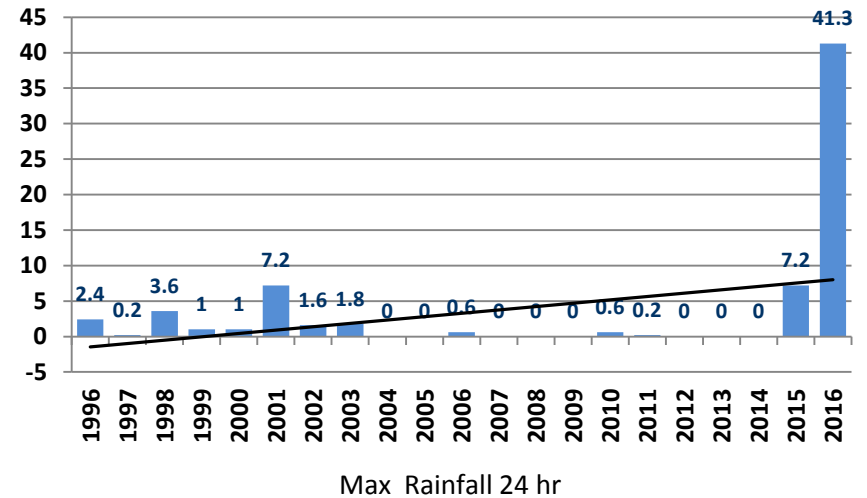


# Statistics of Historical Data

(26-28)MAR 1996-2016 for Alrwaished Station

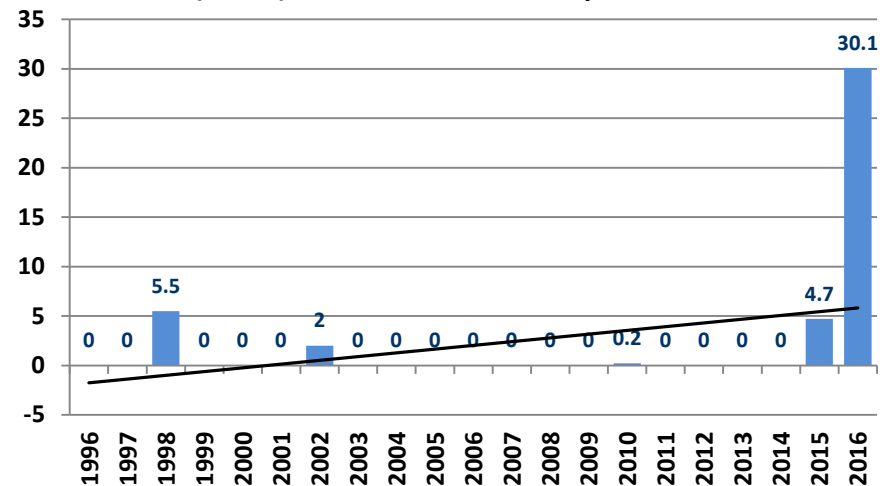


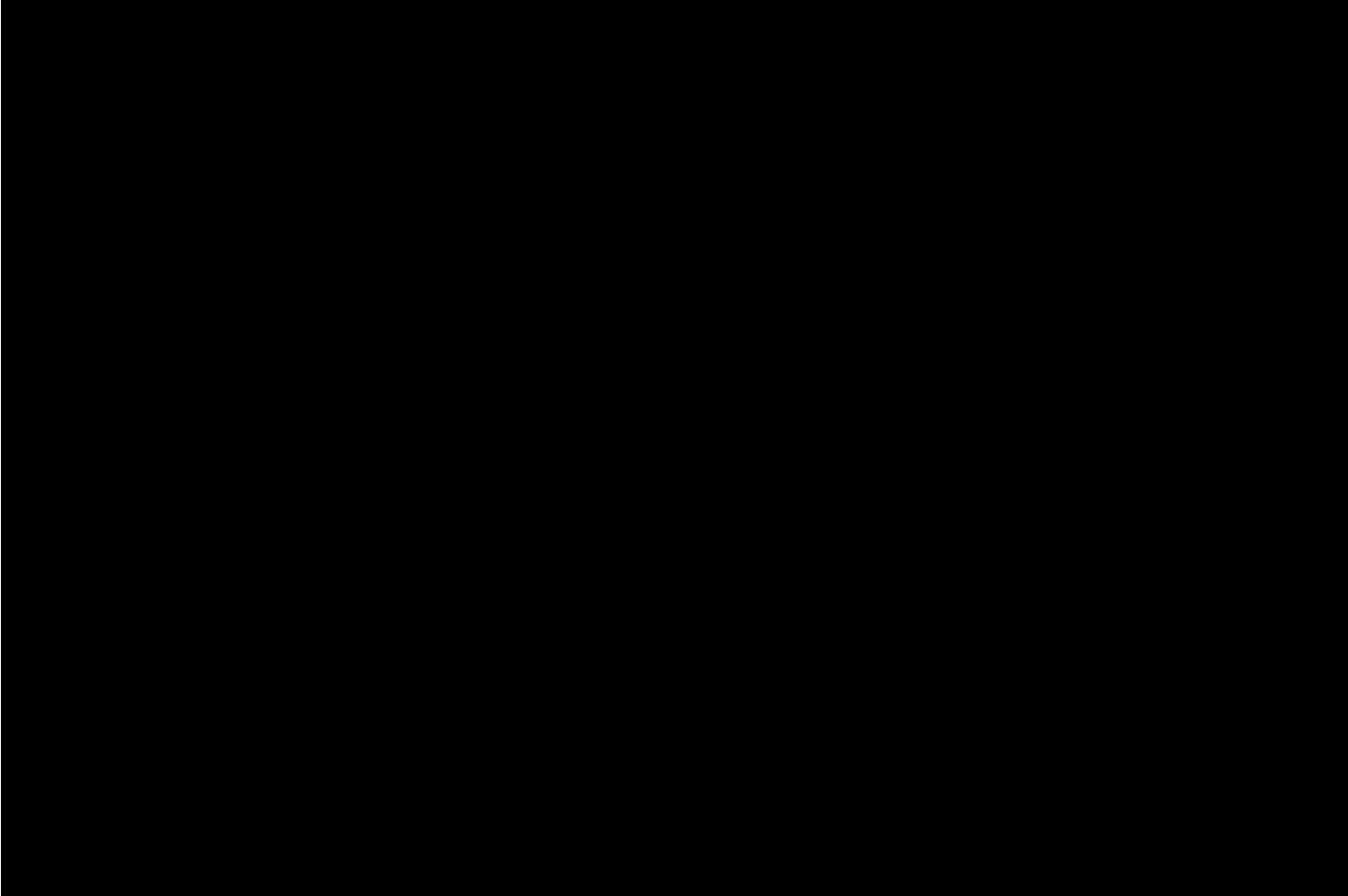
(26-28) MAR 1996-2016 for Safawai Station



All graphs show up normal rainfall for a long time historical data during this time for north east stations. These amount of rainfall causes flash flooding in these cities.

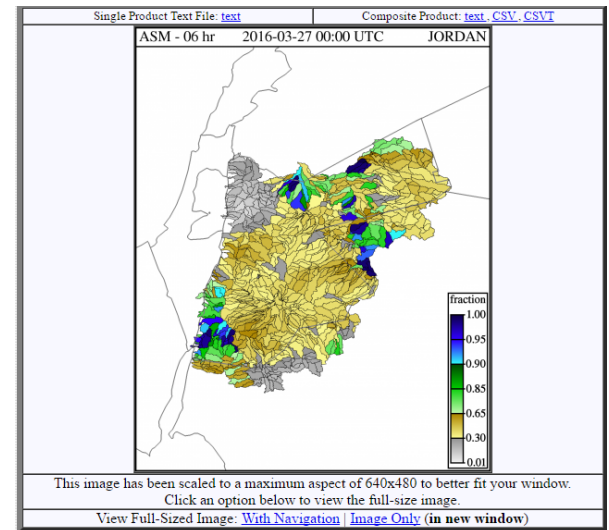
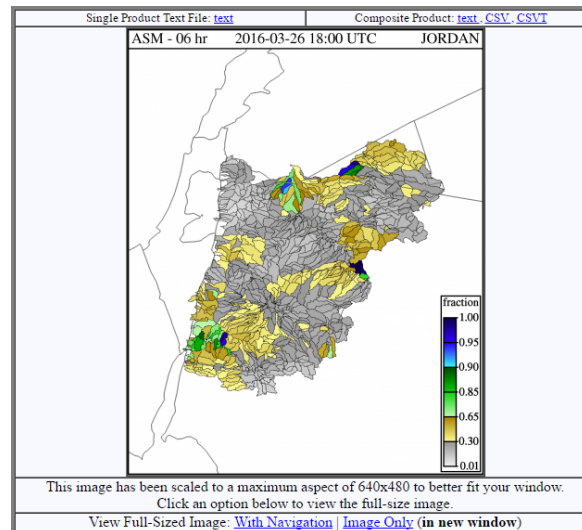
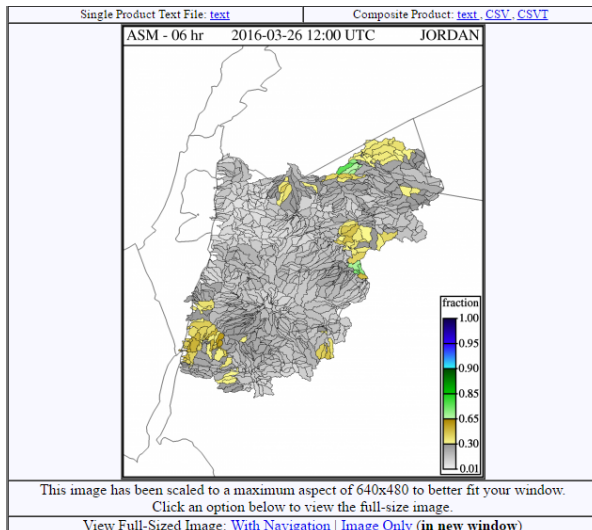
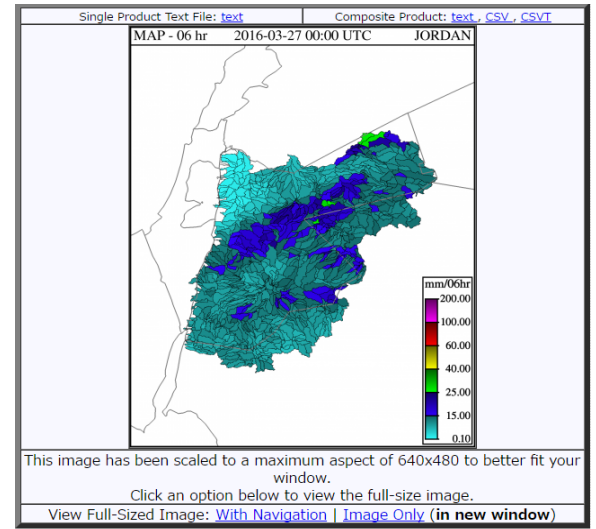
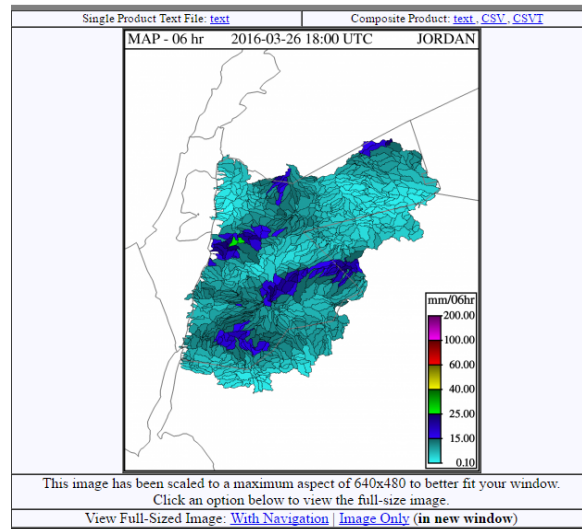
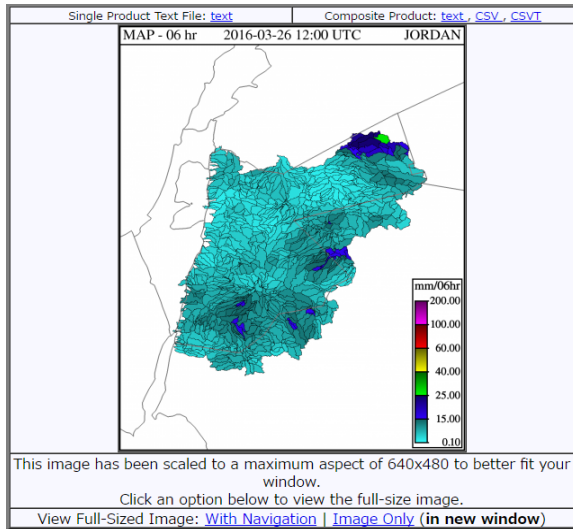
(26-28) MAR 1996-2016 Azraq Station





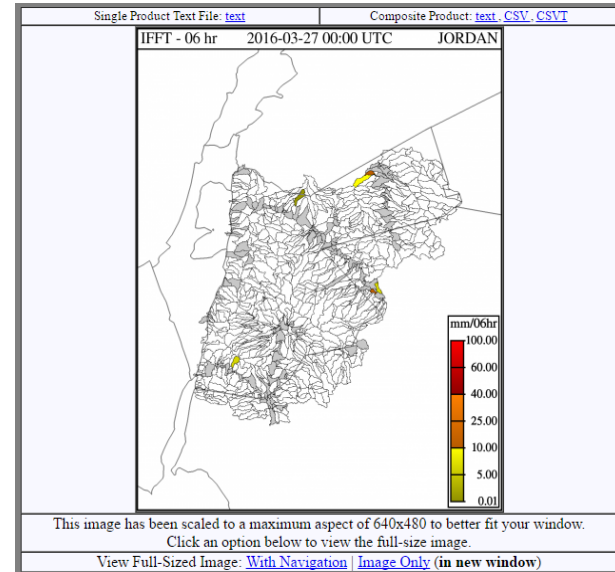
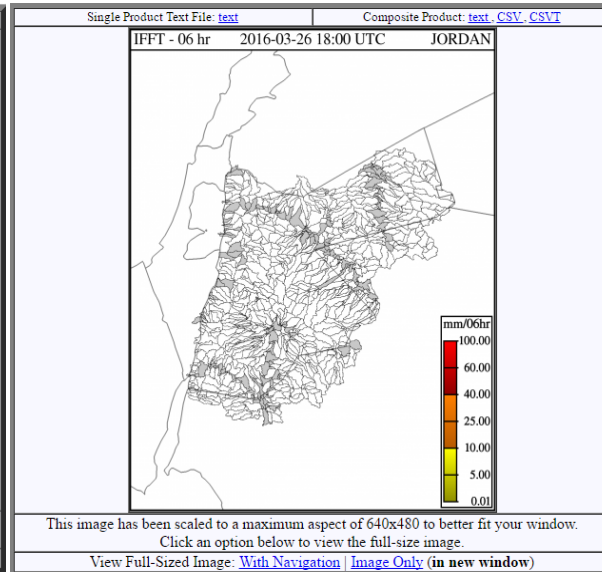
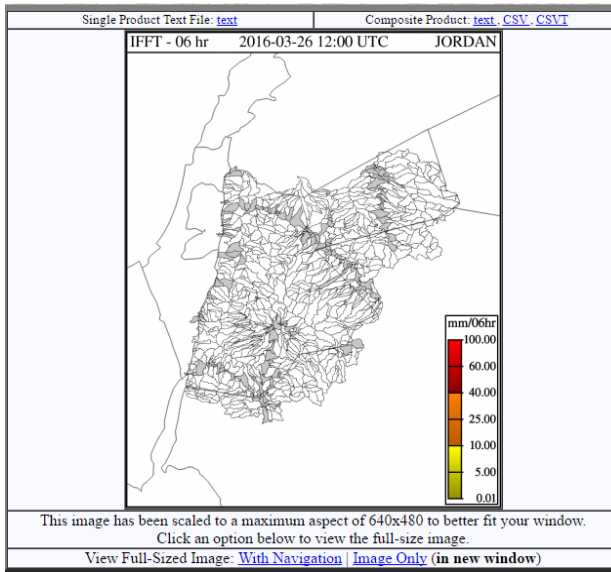
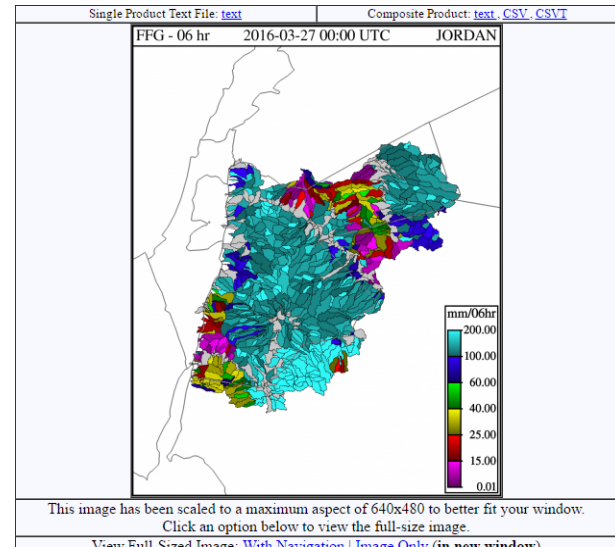
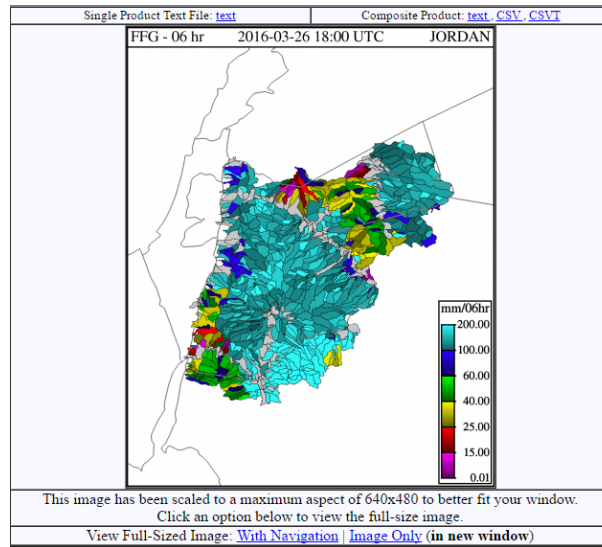
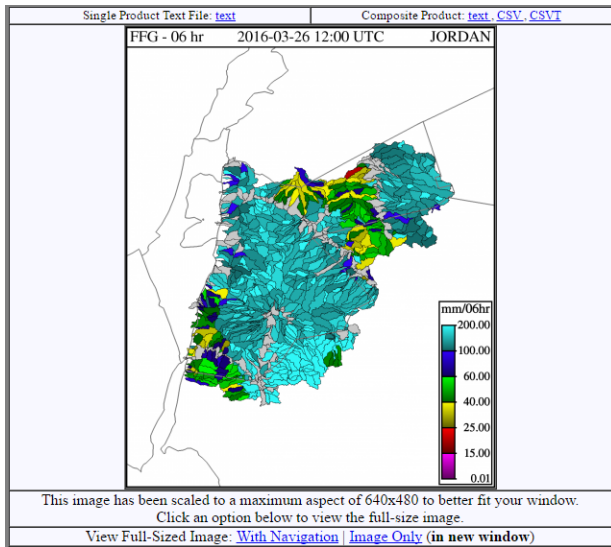
**Flash flooding in Azraq city in 26/3/2016**

# FFG Products (26/3/2016)



MAP shows moderate to heavy precipitation during evening over southern and some eastern regions.

ASM shows high soil moisture in southern, central and eastern regions.

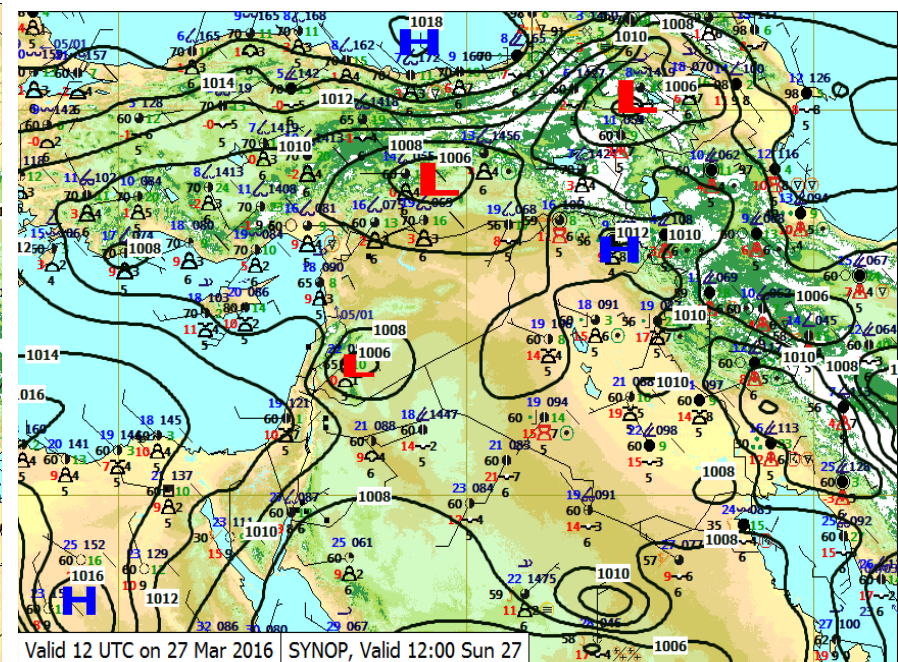
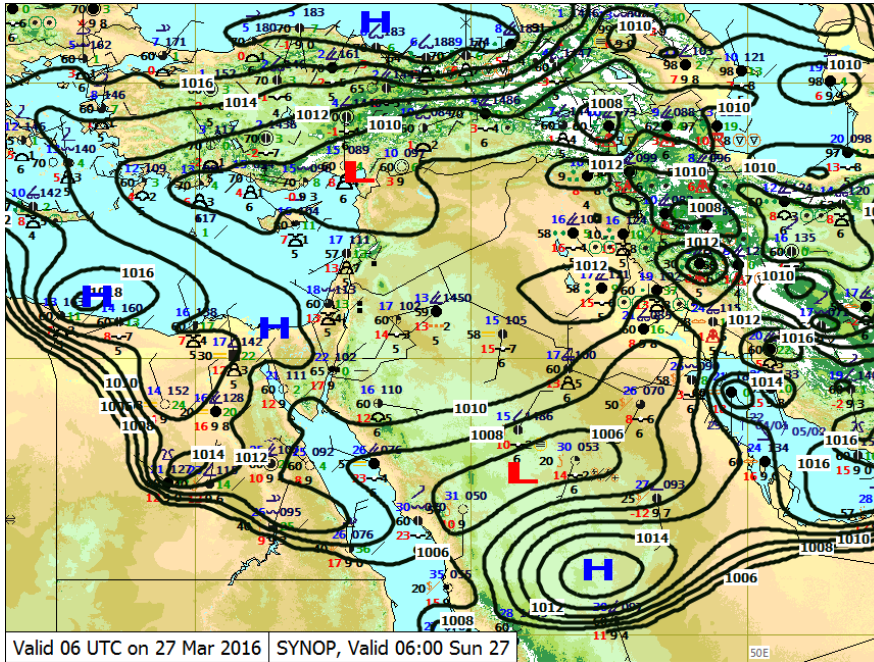


FFG shows prone areas for flash flooding during evening time in eastern and southern regions where 0-15mm/6hr may cause FF.

IFFT shows some east and south regions where imminent flash flood may occur soon.

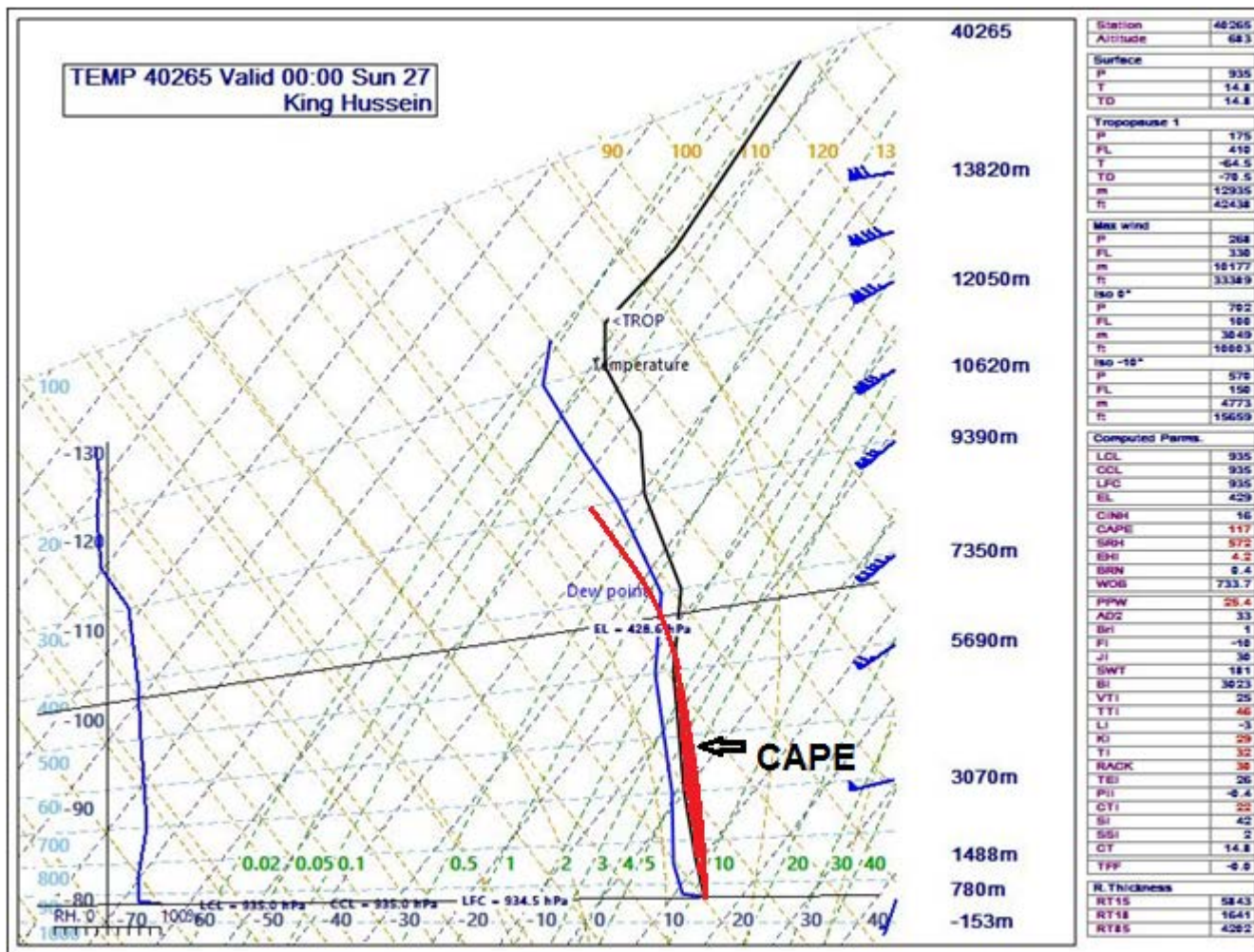
27/03/2016

## Synoptic 27/3/2016



SFC charts (0600 utc) shows low pressure over Turkey and Syria, High pressure over Egypt Jordan was affected by ridge of high pressure, (stable weather).

1200 utc shows low pressure over southern parts of Syria, ridge of high pressure extend to central regions of Jordan.



Skew-T Diagram shows high relative humidity from SFC to Upper levels.

### Stability Indices:

K-index: 29.4 (40-60% Probability)

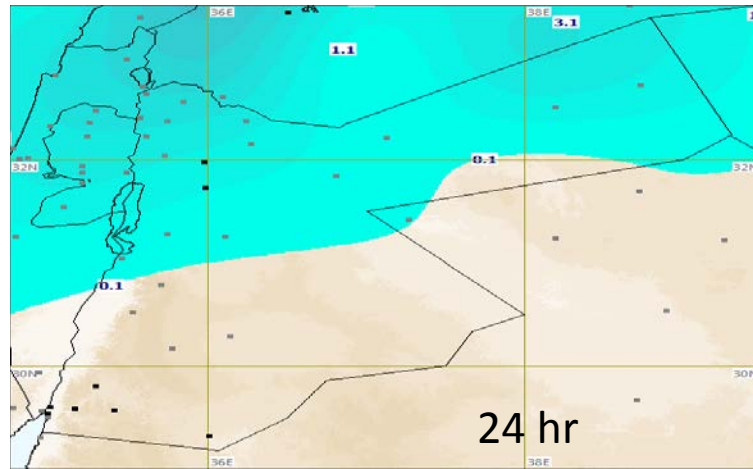
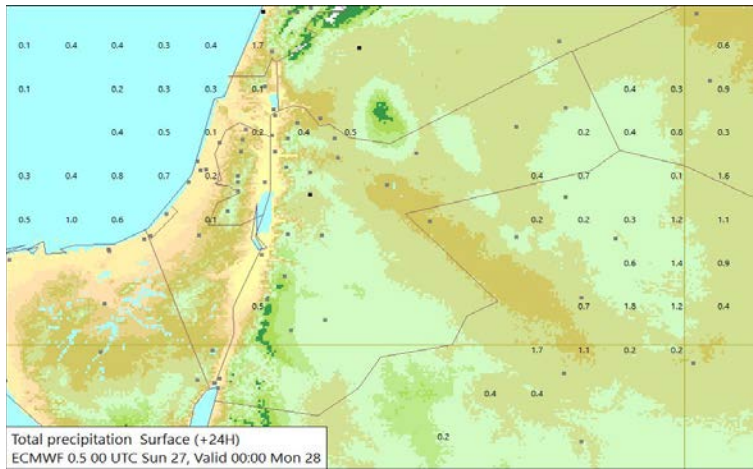
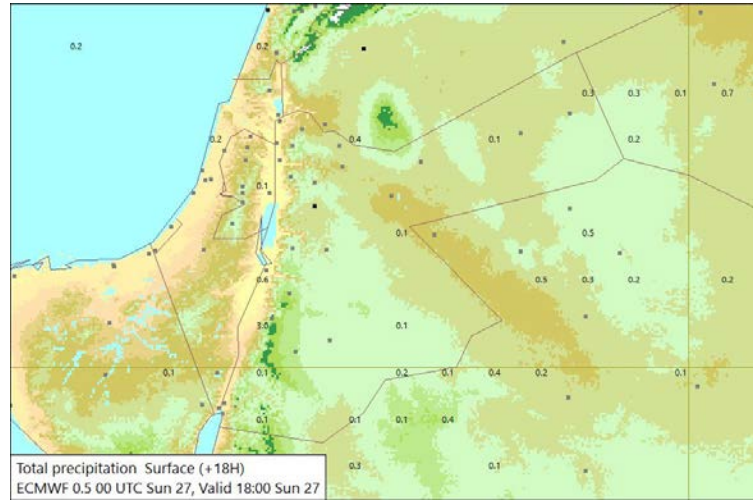
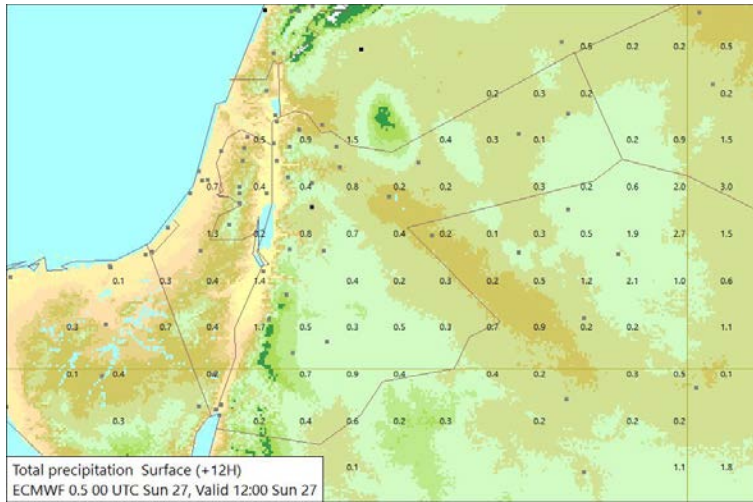
SWET: 181 (<300 non-sever thunderstorm)

S-index: 2.89 (1 to 3 : Showers probable, isolated thunderstorms possible)

CAPE: 117

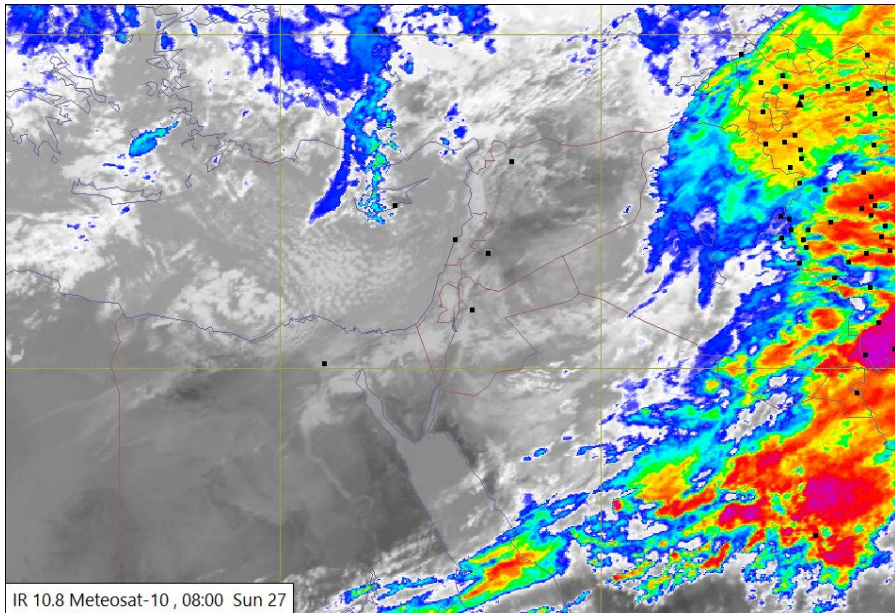
**All indices show light to moderate instability**

# ECMWF NWP Model

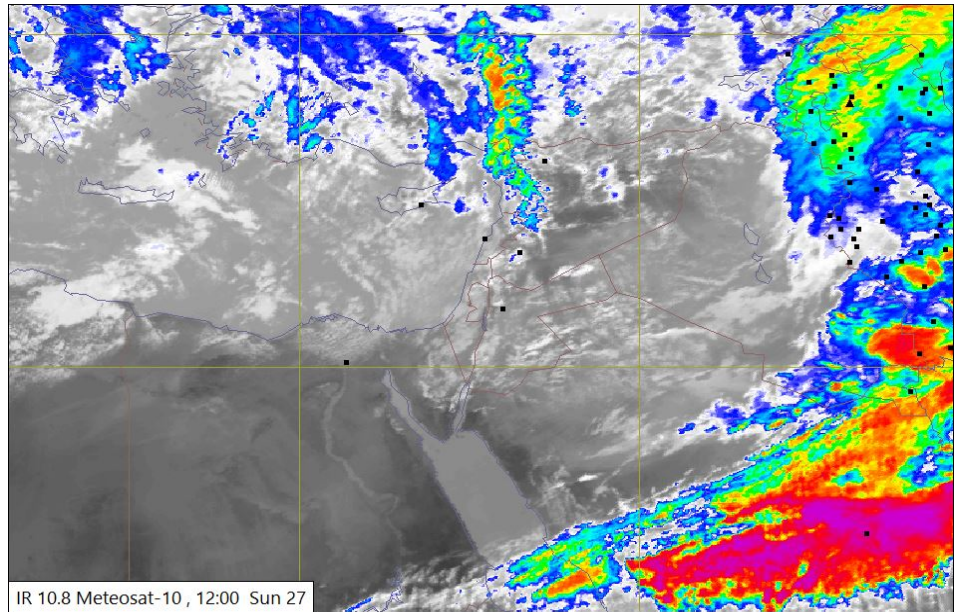


Light rain was expected over different regions by ECMWF Model.



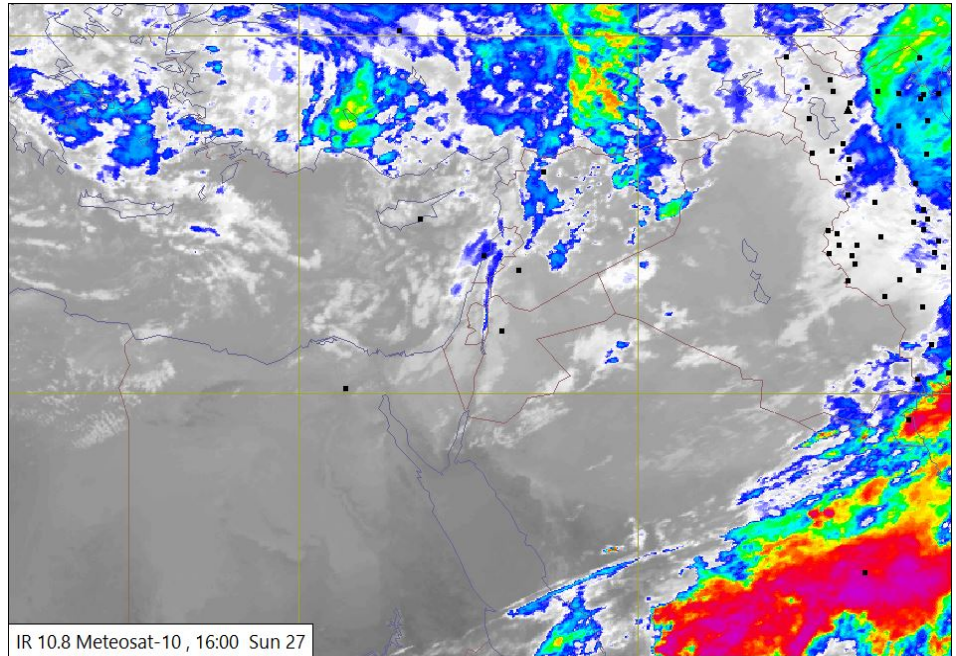


IR 10.8 Meteosat-10 , 08:00 Sun 27

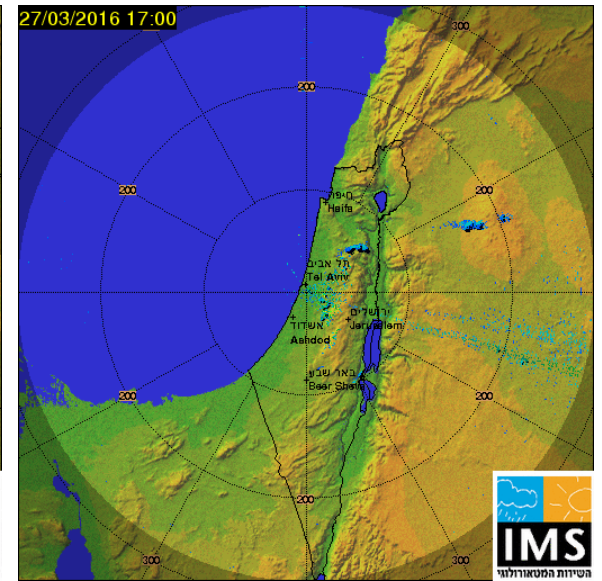
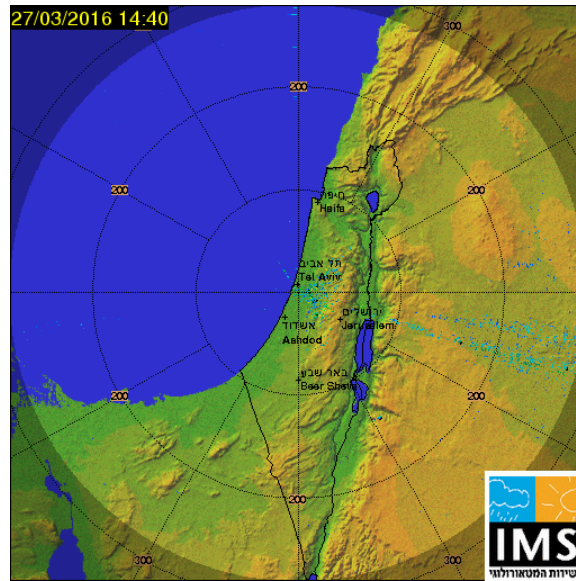
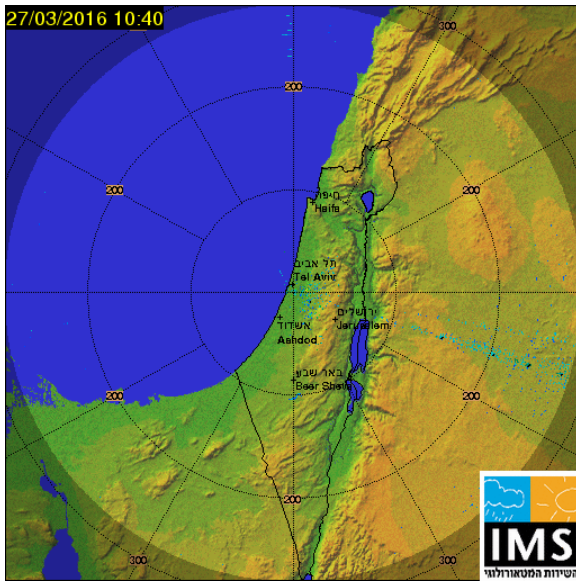


IR 10.8 Meteosat-10 , 12:00 Sun 27

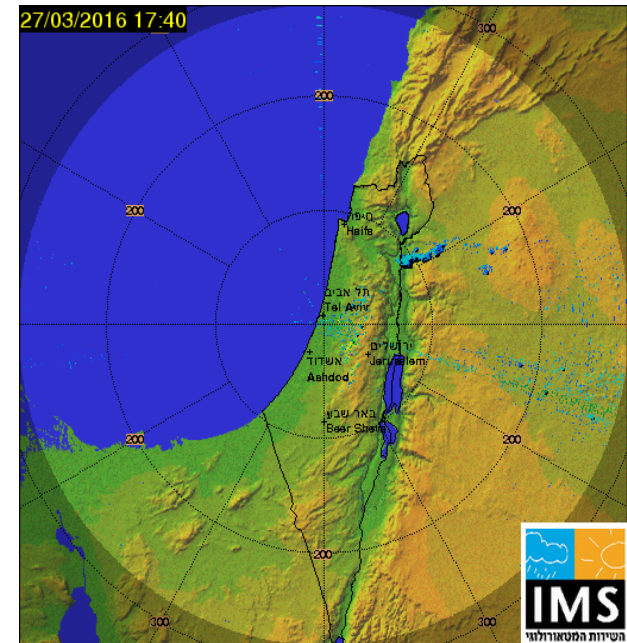
Satellite images show low clouds over Mediterranean moving eastward passing Jordan during day time .



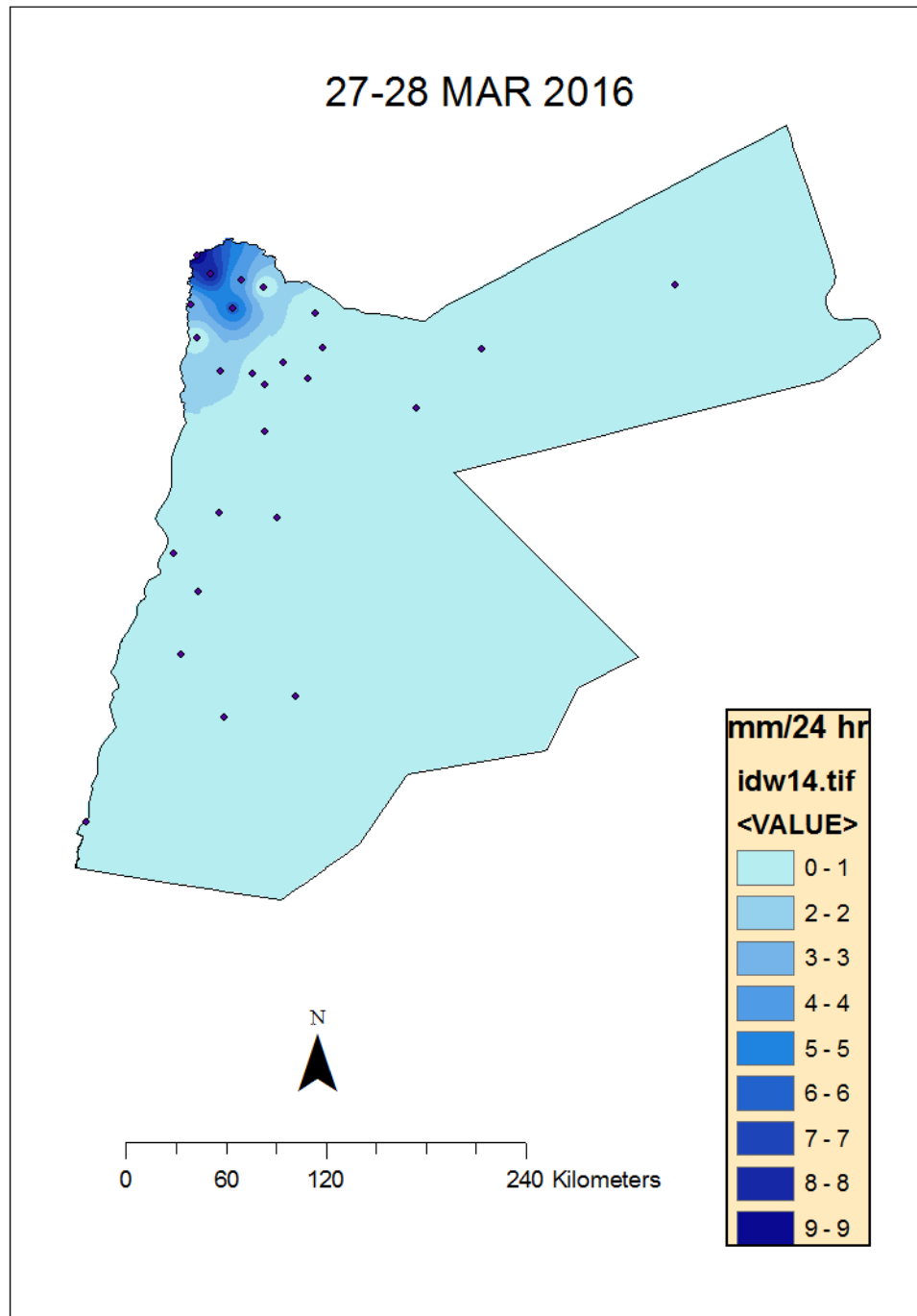
IR 10.8 Meteosat-10 , 16:00 Sun 27



Radar Images show light rain over the far north.



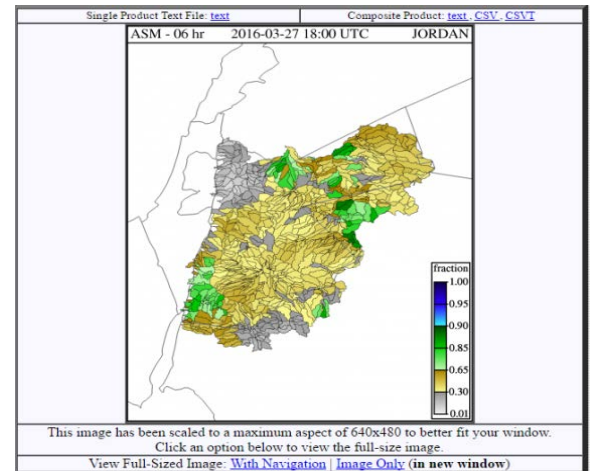
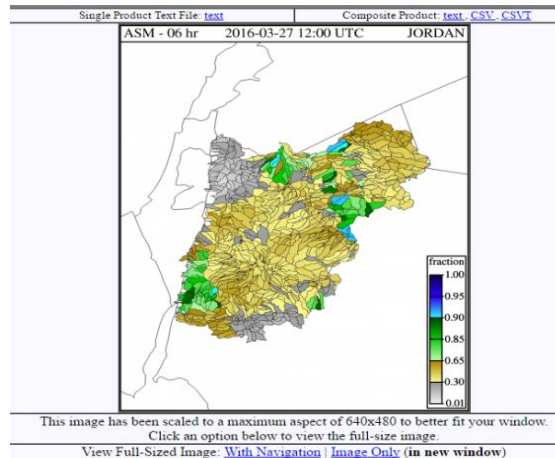
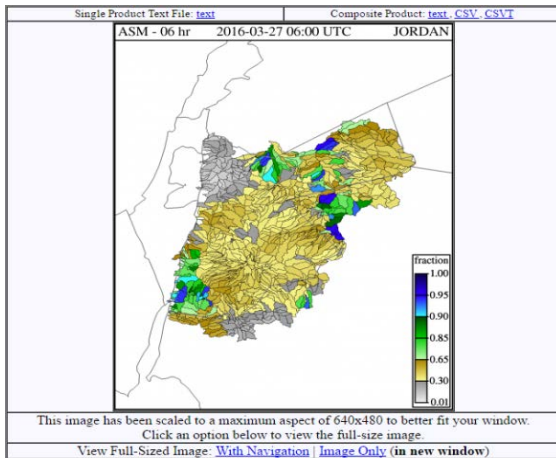
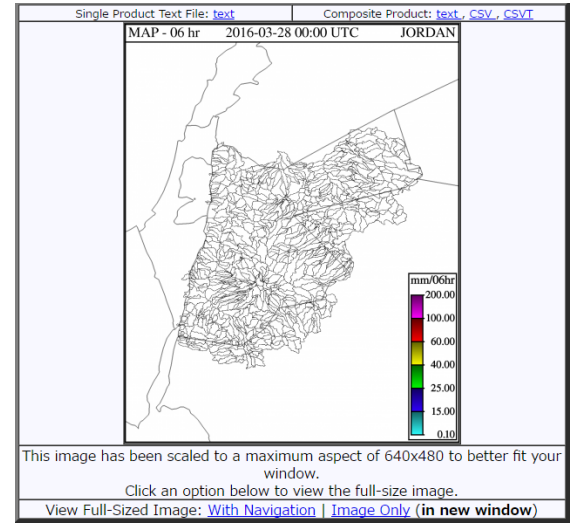
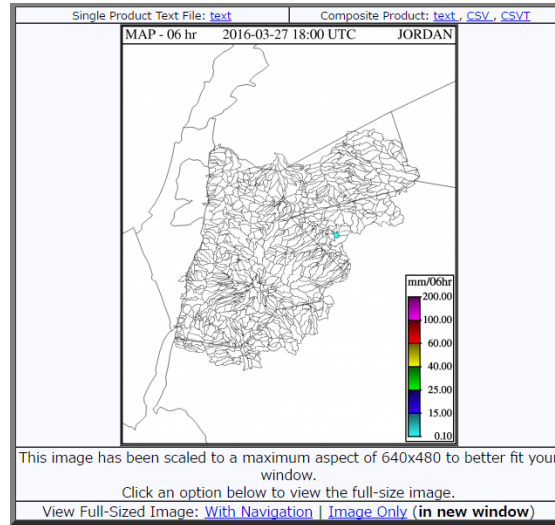
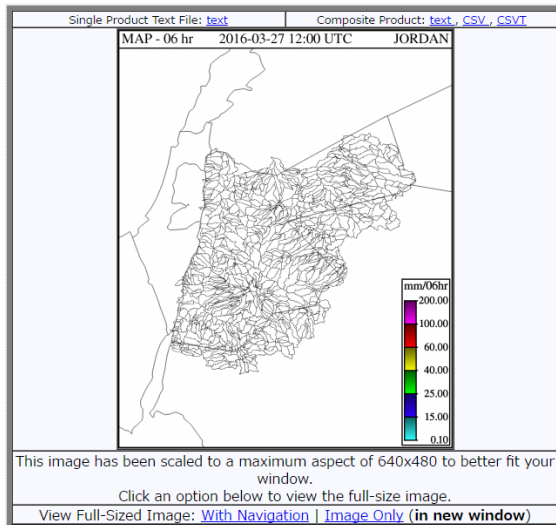
Actual Rainfall distribution  
using GIS.  
Light to moderate rain over  
northern parts of Jordan.  
Light rain in rest regions



27-28/3/2016 24hr precipitation

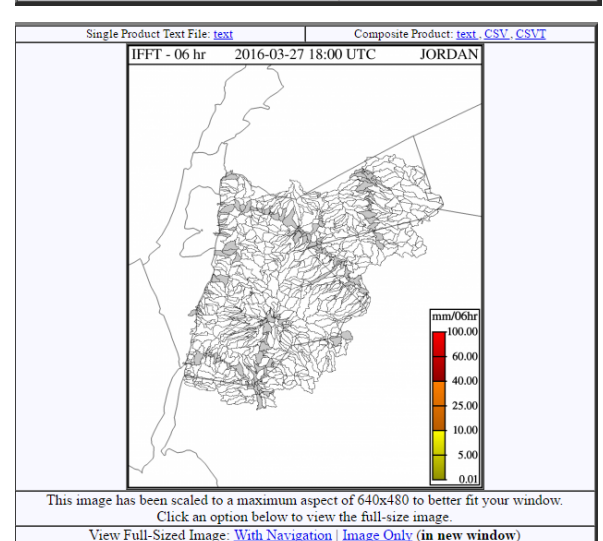
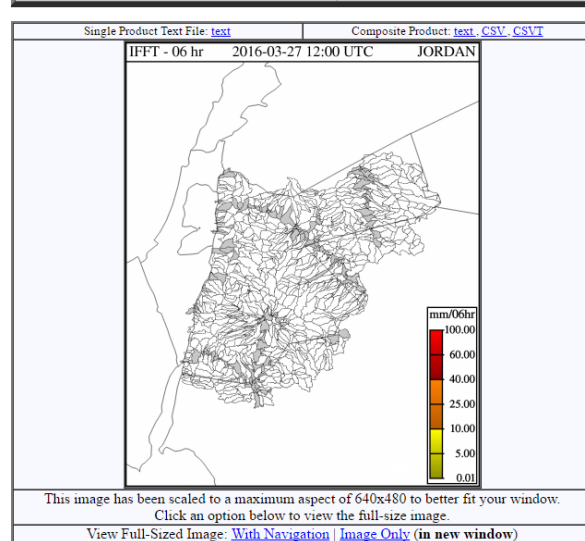
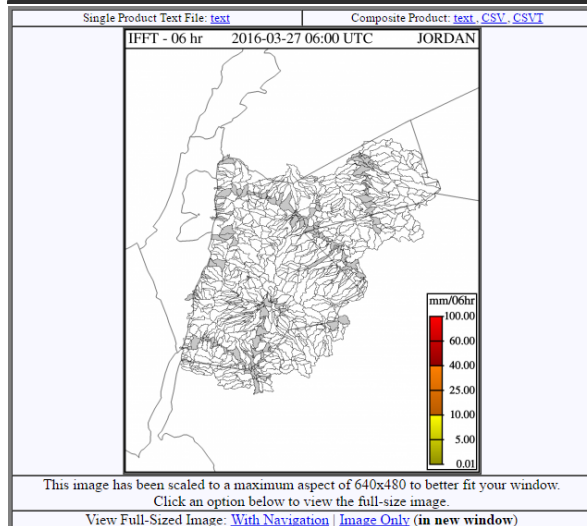
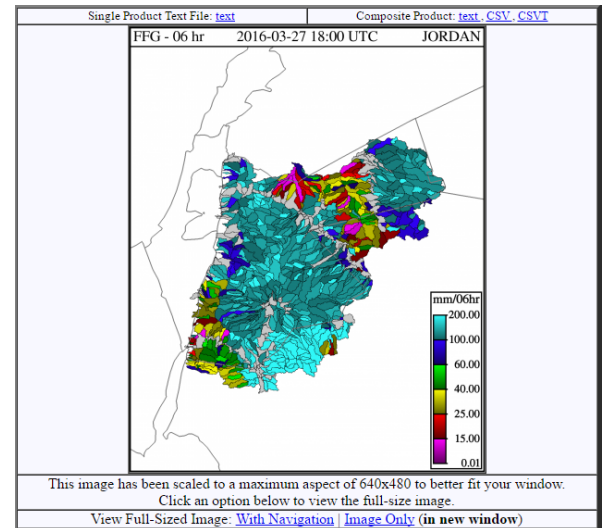
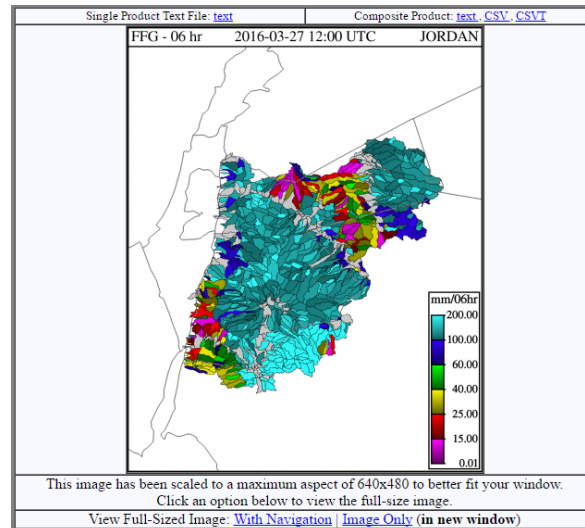
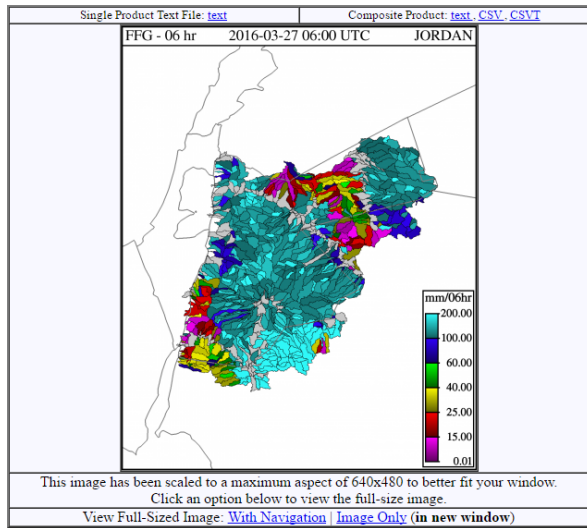
Station	Elevation_	mm/24hr
Baqura	-170	8.6
Deir Alla	-224	0
Ghor Safi	-380	0
Irbed	616	3
Er Rabbah	942	0
Shoubak	1365	0
Wadi Dhulall	580	0
Samma	332	7.6
Wadi El-rayyan	-200	2
Swaileh	1086	0.8
Qatraneh	768	0
Tafileh	1266	0.4
Zarqa	644	0
Ramtha	590	0
Salt	935	1.8
King Hussien International Airport	55	0
Ras Muneef	1150	5.2
Amman Airport	781	0
Rwaished (H4)	683	0
Mafrag	686	0.1
Safawi (H5)	674.2	0
Azraq South	521	0
Q.A.I.Airport	722	0
Ma'an	1069	0
Al Jafer	865	0
Ghabawi	725	0

# FFG Products



MAP (27 MAR 06) shows no rain over Jordan

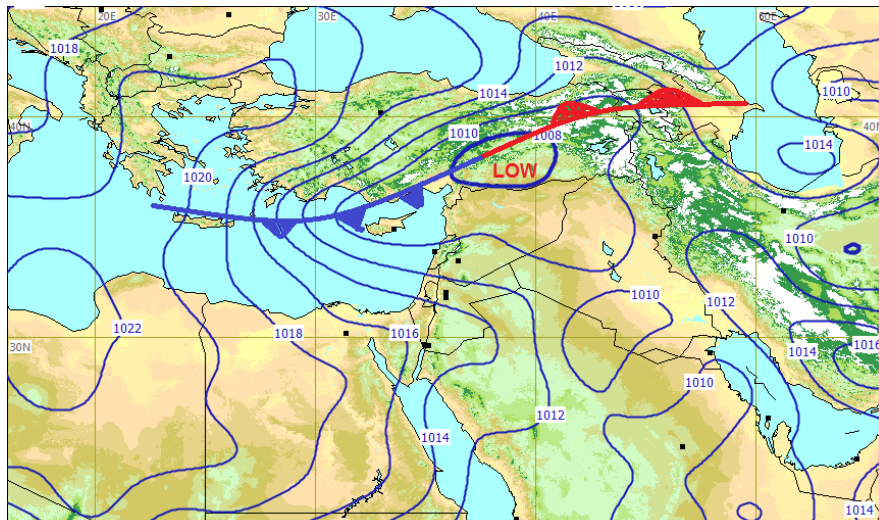
ASM shows high soil moisture in some southern and eastern parts of Jordan.



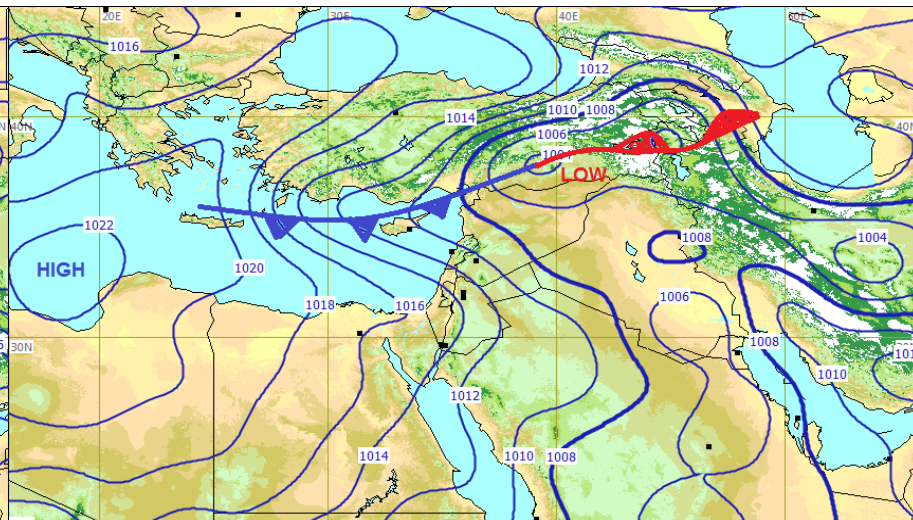
FFG shows prone areas for FF during the next 6 hr at different time (06,12,18), less than 15mm/06 is sufficient to cause FF in eastern and some southern regions. IFFT shows nothing.

28/03/2016

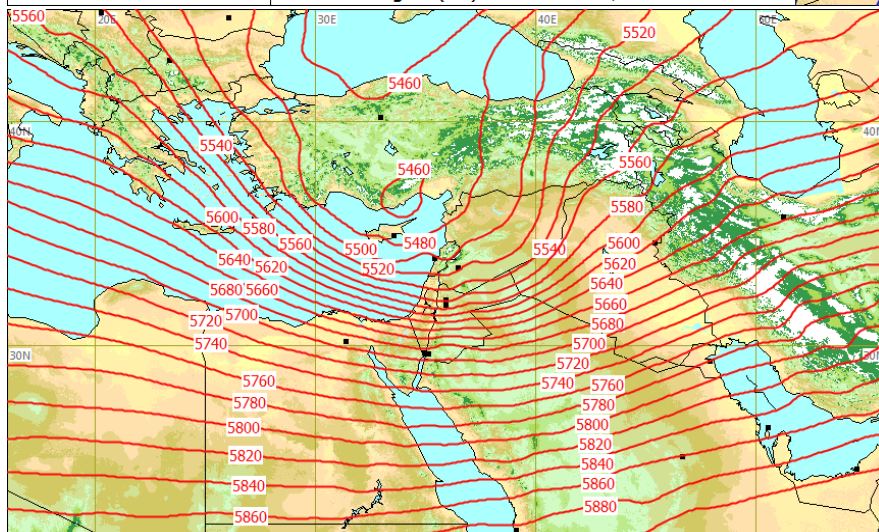
# SFC & 500 hpa charts



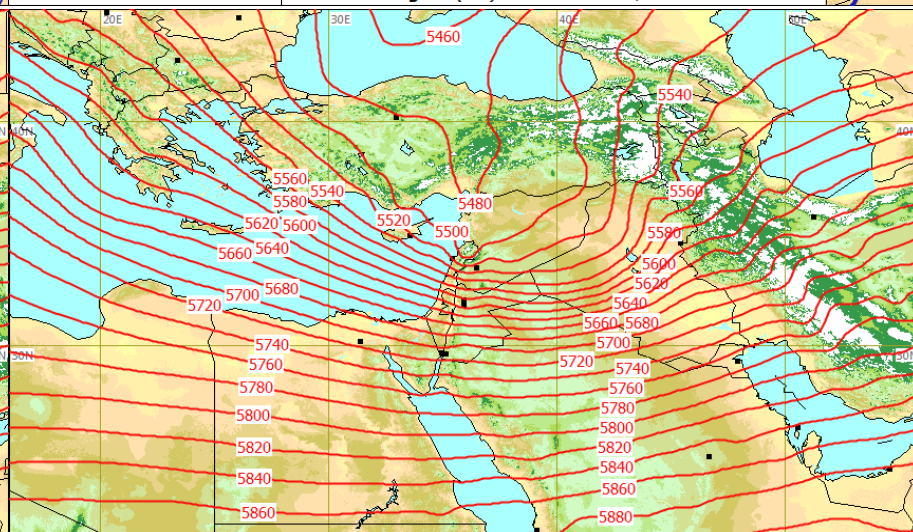
Valid 06 UTC on 28 Mar 2016 Pressure MSL MSL (+18H)  
E.T.A.Washington (0.5) 12 UTC Sun 27, Valid 06:00 Mon 28



Valid 12 UTC on 28 Mar 2016 Pressure MSL MSL (+24H)  
E.T.A.Washington (0.5) 12 UTC Sun 27, Valid 12:00 Mon 28



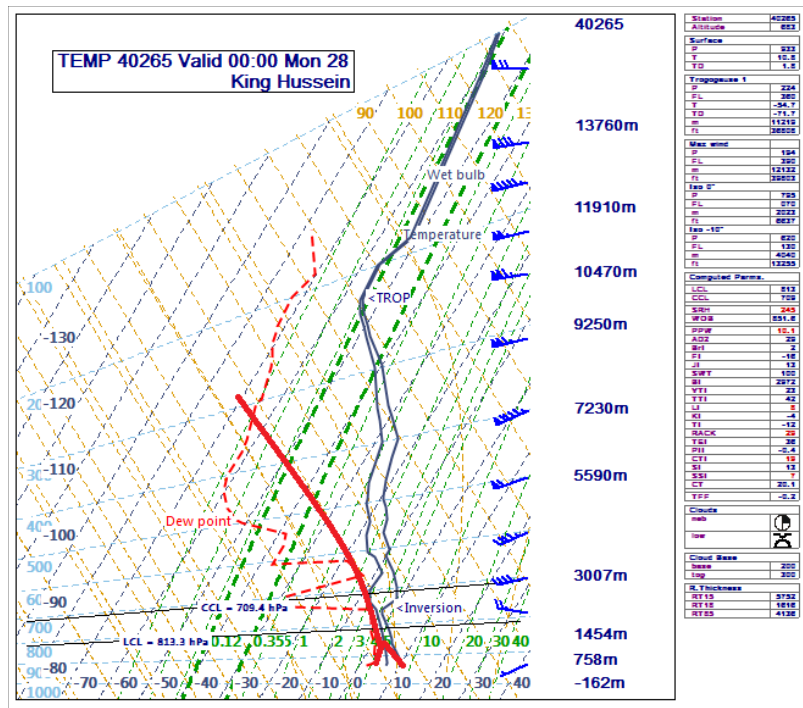
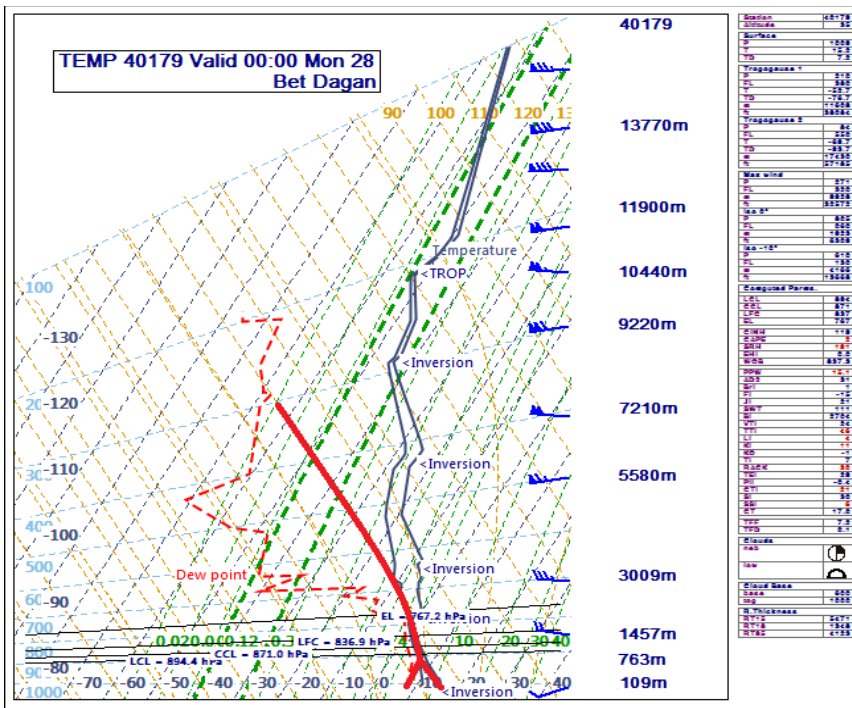
Valid 06 UTC on 28 Mar 2016 Geopotential height 500 hPa - FL 180 (+18H)  
WAFC Washington (1) 12 UTC Sun 27, Valid 06:00 Mon 28



Valid 12 UTC on 28 Mar 2016 Geopotential height 500 hPa - FL 180 (+24H)  
WAFC Washington (1) 12 UTC Sun 27, Valid 12:00 Mon 28

Frontal depression, low over east of Turkey with cold and moist north westerly flow, associated with upper low





Skew-T Diagram shows high relative humidity from SFC to upper levels in both stations (west and north of Jordan)

### Stability indices:

K-index: 10.8 (<15< 00% Probability)

SWET: 111 (<300 non-sever thunderstorm)

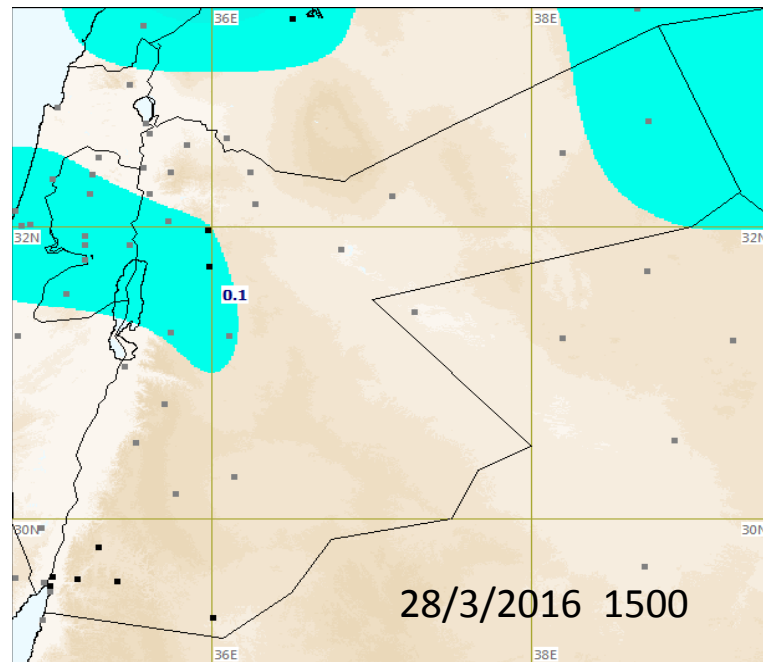
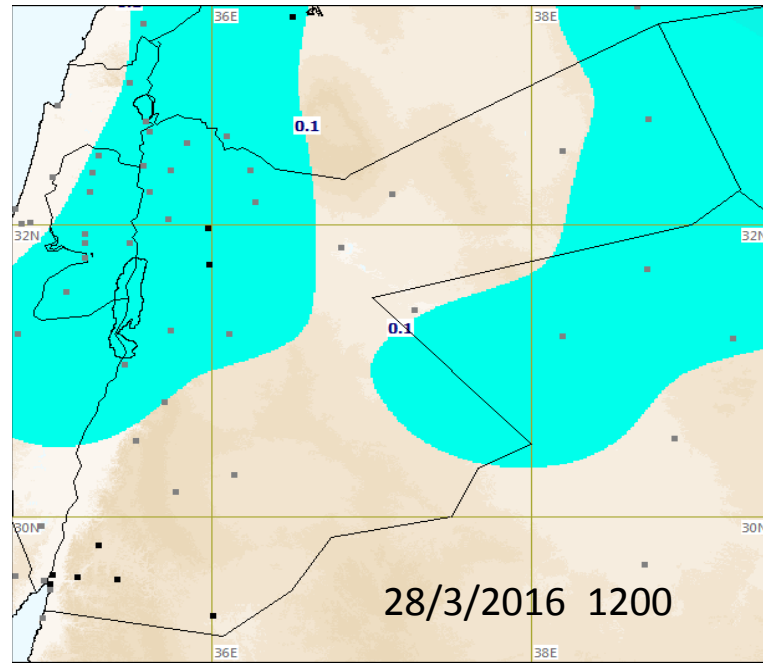
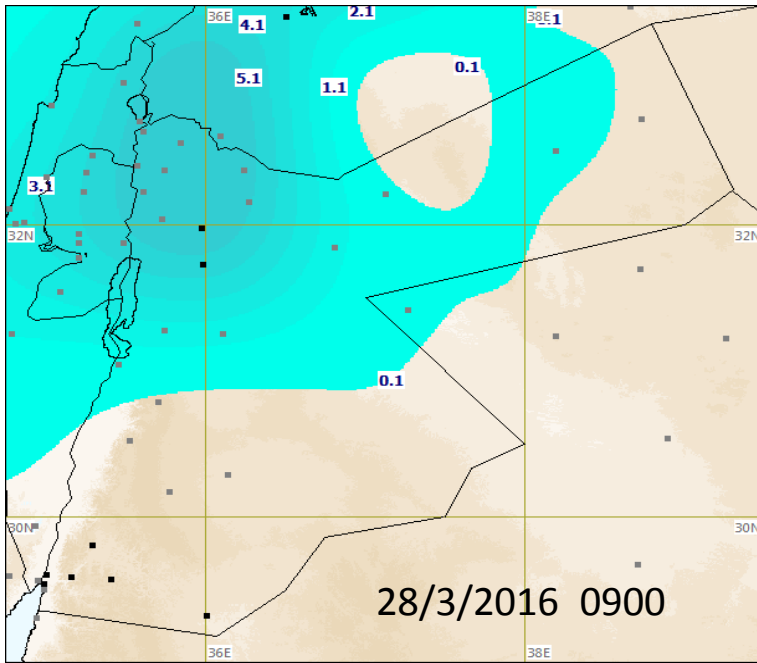
S-index: 5.83 (> +3 No convective activity)

JI: 21 (weak)

CAPE : 26.36

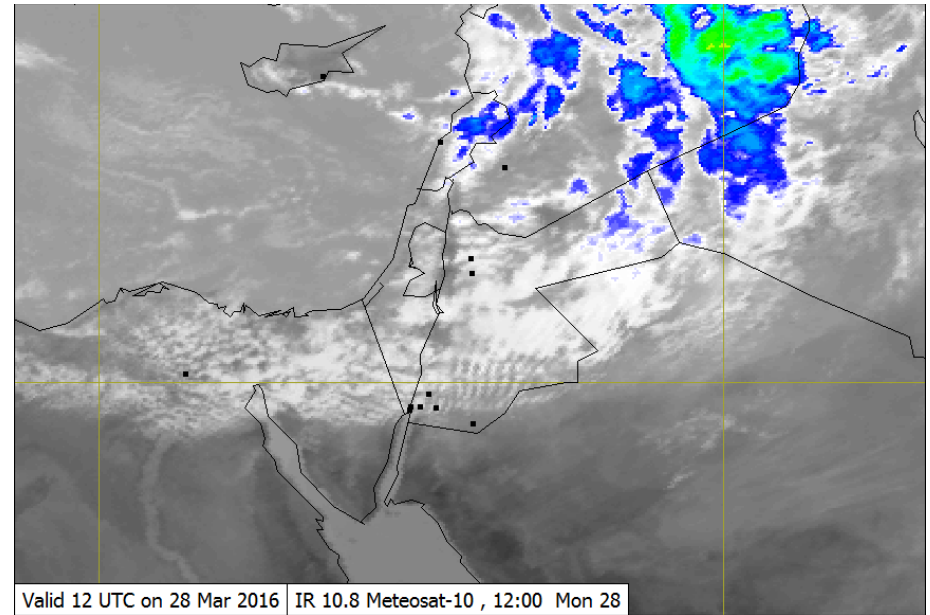
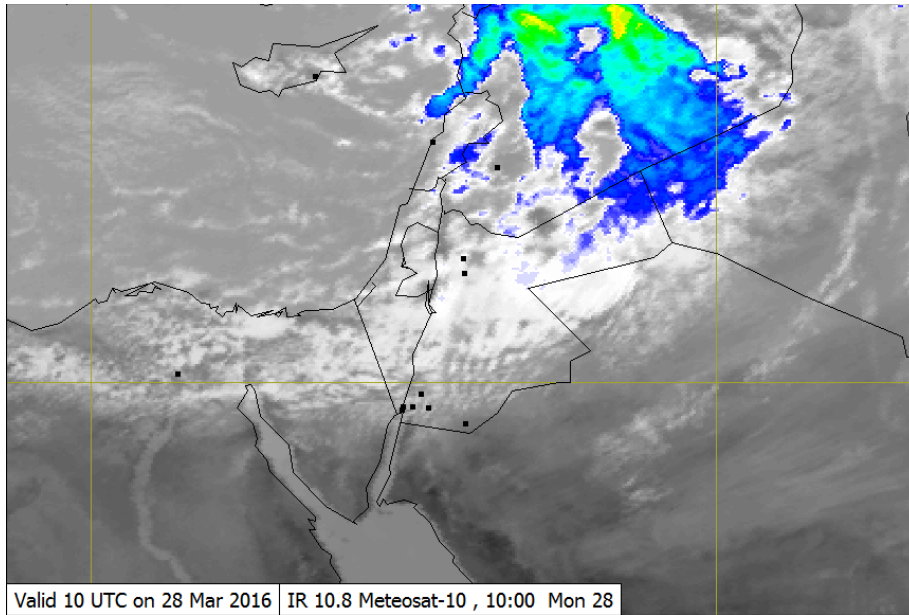
All indices show no instability

# ECMWF Rain map

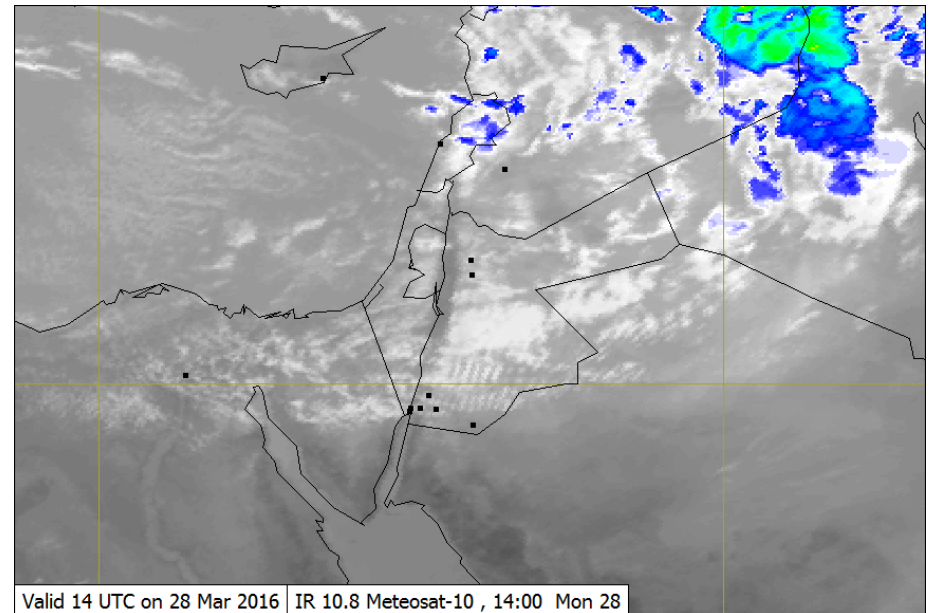


Moderate rain was expected in morning over north and central regions. Very light rain (drizzle) over north , central and far east of Jordan after midday.

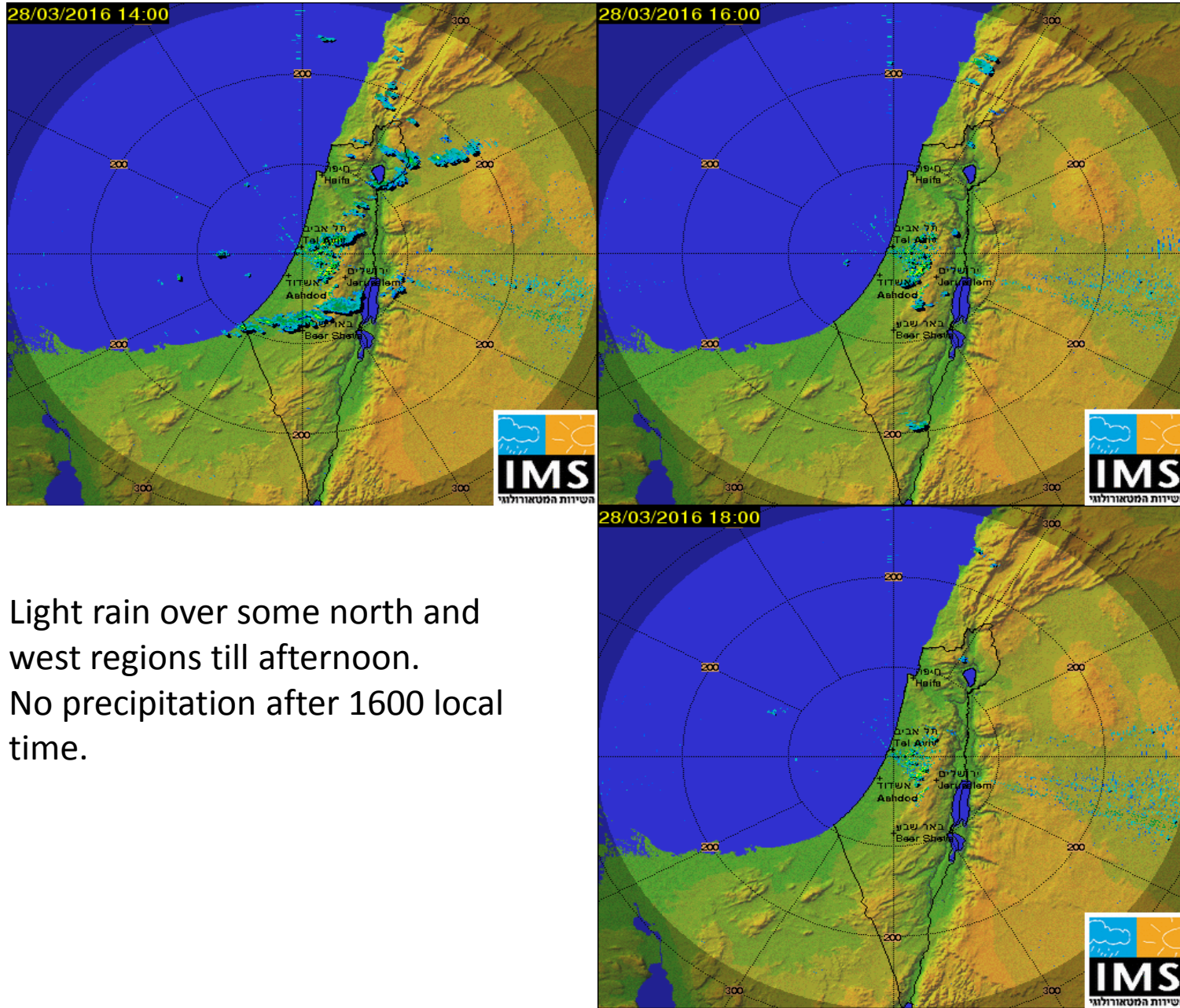
# Satellite Images 28/3/2016



IR channel 10.8 shows different types of clouds over Jordan (Cu,Ac,Ci)



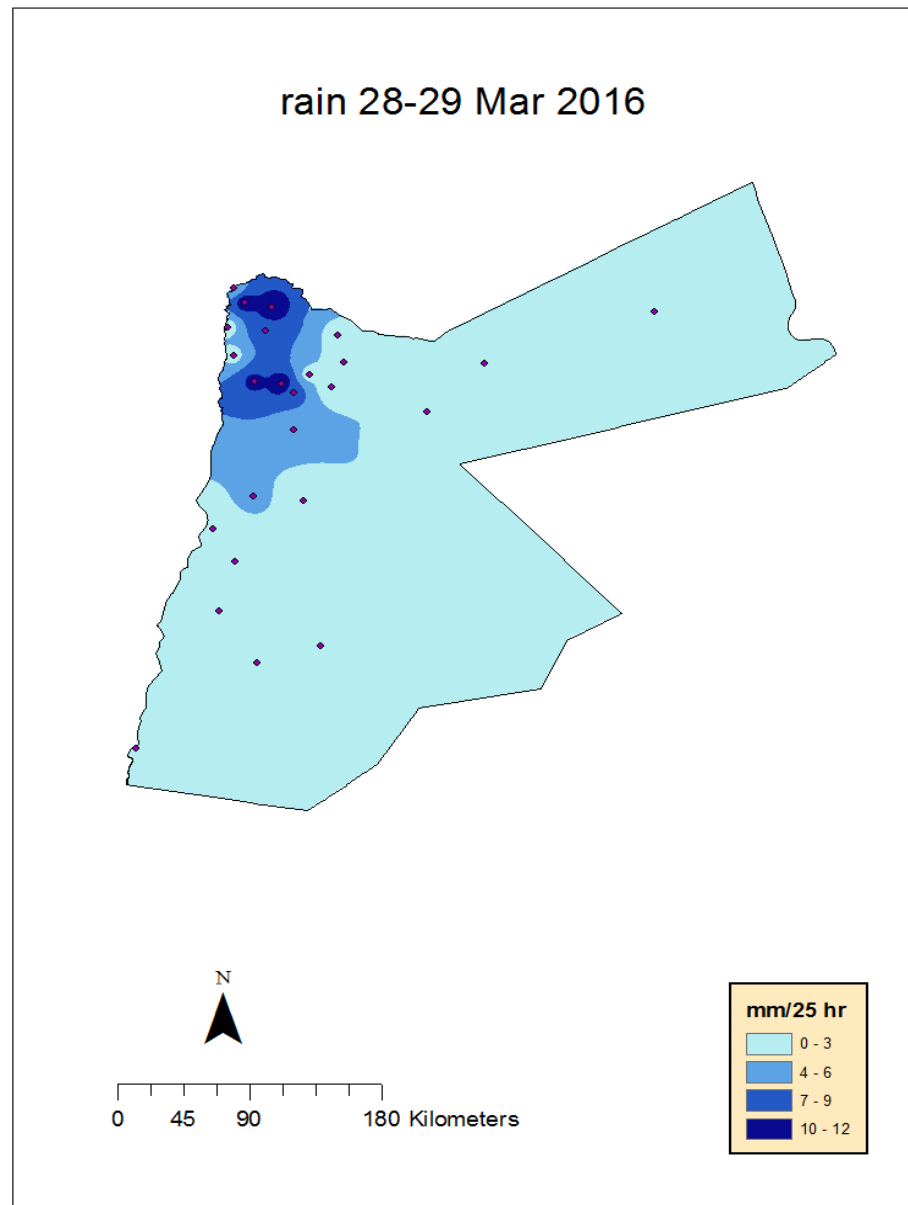
# Radar Images 28/3/2016



Light rain over some north and west regions till afternoon.  
No precipitation after 1600 local time.

## Rain distribution 24hr using GIS.

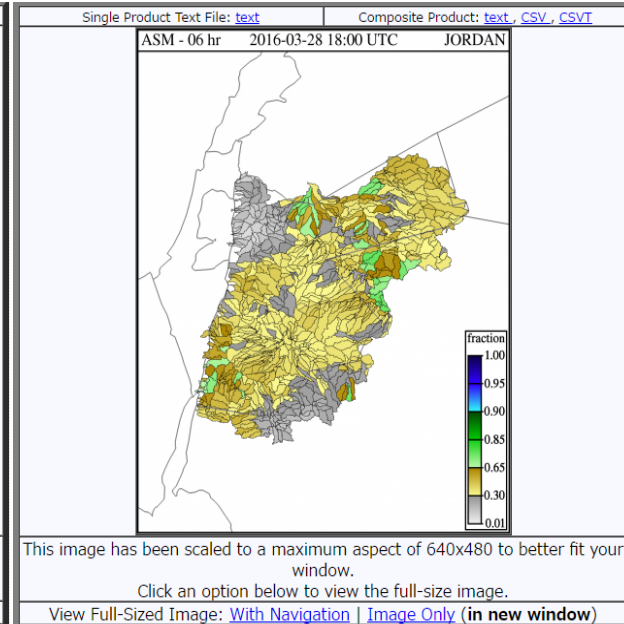
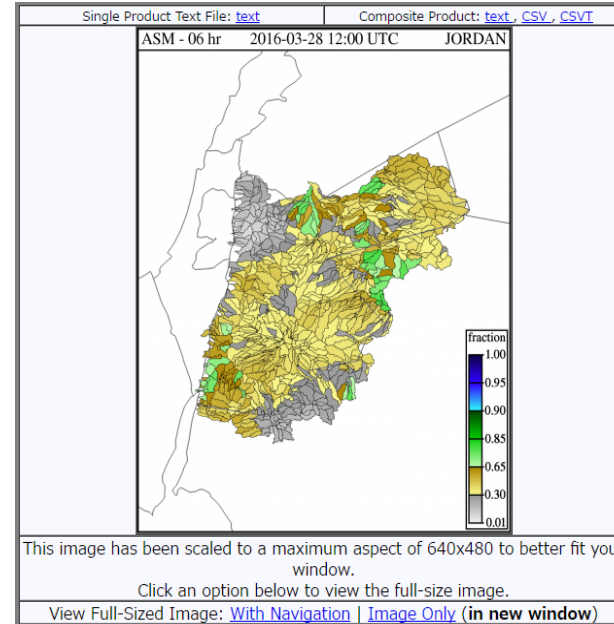
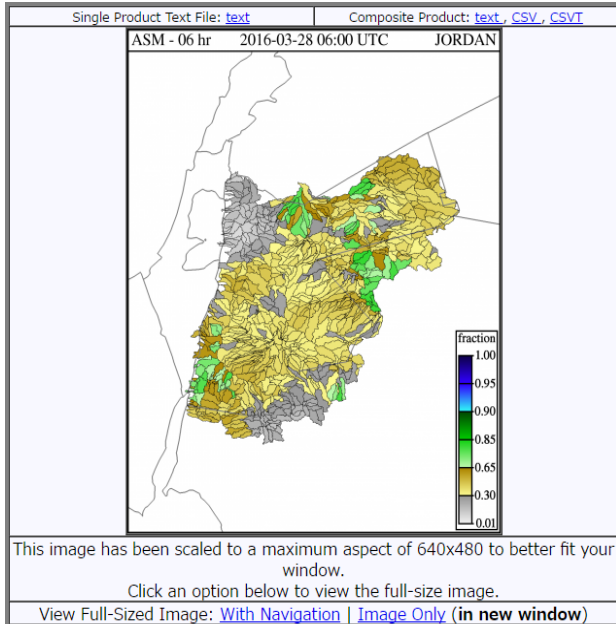
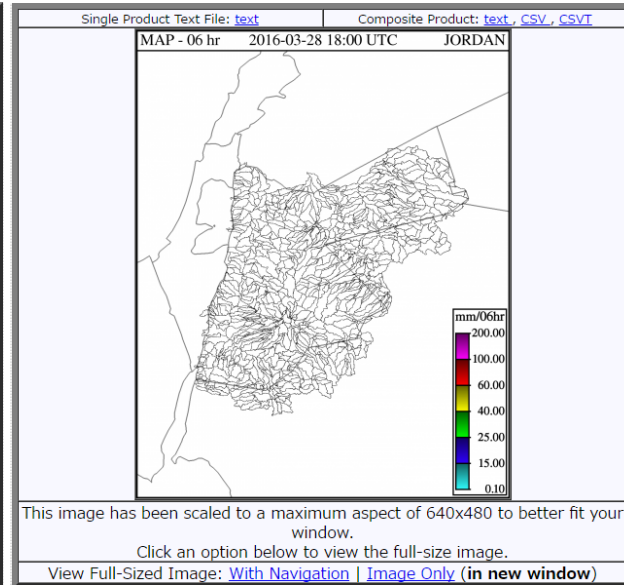
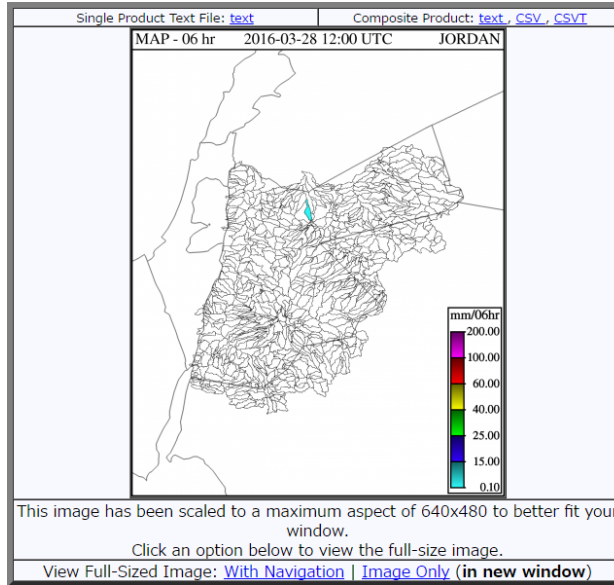
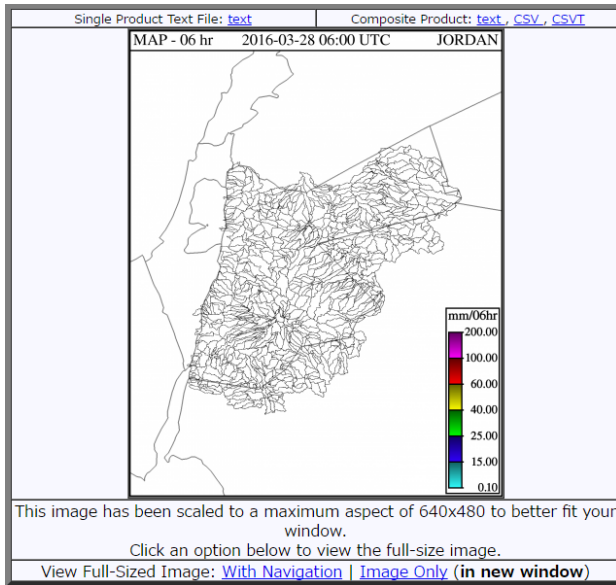
- Light to moderate rain over north and central regions.
- very light rain in rest regions



## 28-29/3/2016 24hr precipitations

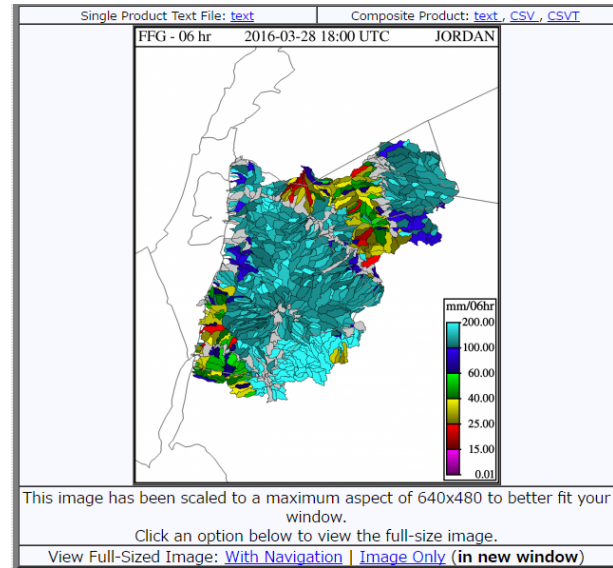
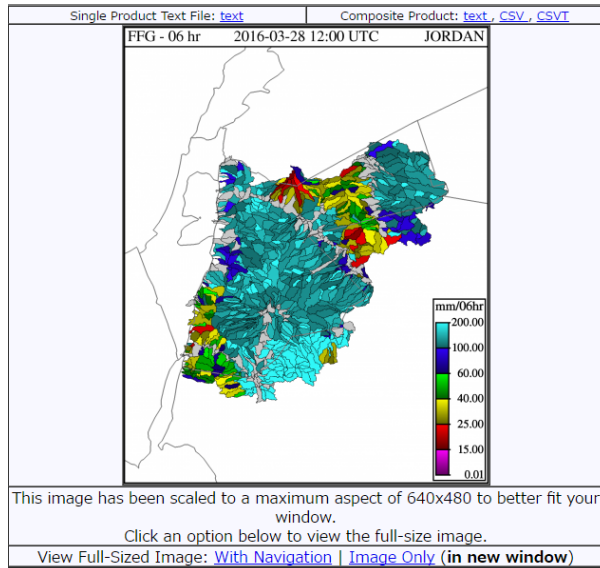
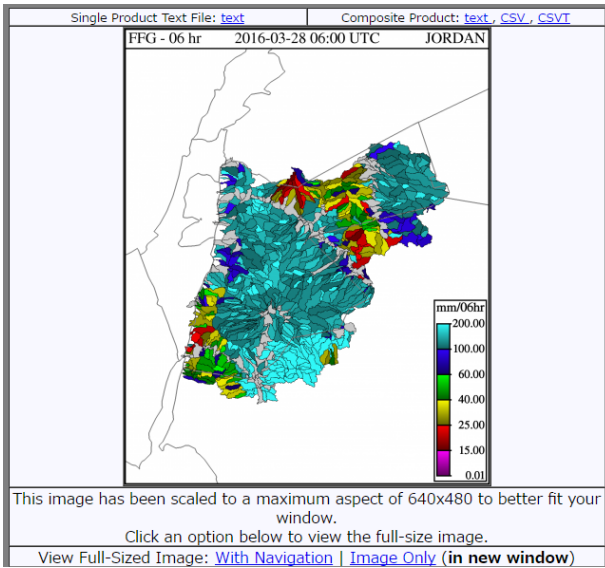
Station	mm/24hr
Baqura	2.4
Deir Alla	1.6
Ghor Safi	0.6
Irbed	11.9
Er Rabbah	4
Shoubak	0
Wadi Dhulall	0
Samma	11.1
Wadi El-rayyan	1.4
Swaileh	12.2
Qatraneh	0.6
Tafileh	0
Zarqa	1.8
Salt	10
King Hussien International Airport	0
Ras Muneef	8.5
Amman Airport	8
Rwaished (H4)	1.2
Mafrag	1.7
Safawi (H5)	0.4
Azraq South	0.9
Q.A.I.Airport	3
Ma'an	0
Al Jafer	0
Ghabawi	0.3

# FFG Products



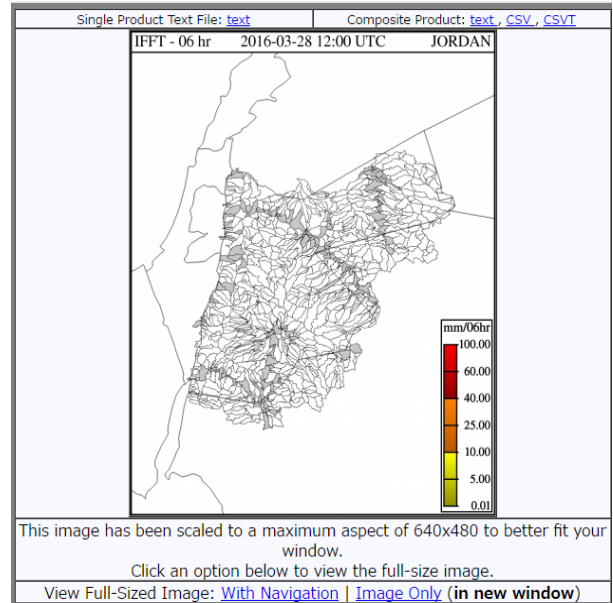
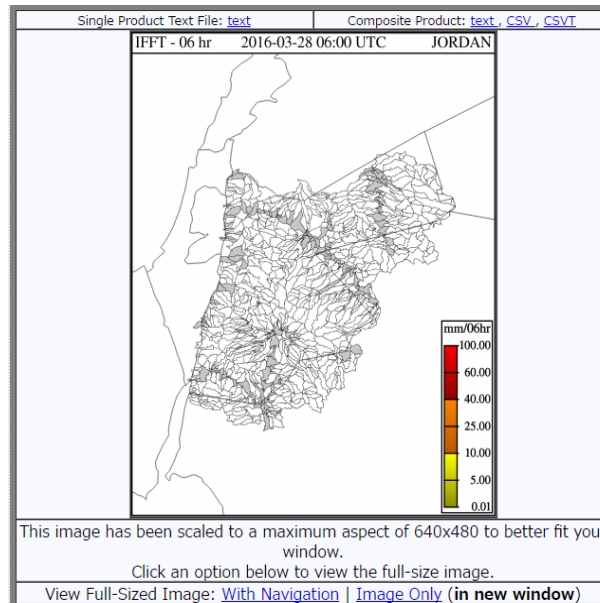
Small amount of precipitation was expected at 1200 over small basin.

Soil moisture is still high in some east and south regions



FFG is still showing prone areas for FF (east and south).

No Imminent FF.





## Summary & Conclusion

**26/3/2016:**

- Instability (Surface low was associated with upper low).
- Heavy precipitation was expected (ECMWF) over south and east regions.
- High amount of rain was measured in south and east stations ( unprecedented).
- **FFG Products:**
  - MAP shows high precipitations in south and some east regions.
  - FFG shows prone areas for FF (south and east).
  - IFFT shows east and south regions where IFFT may occur soon.
- **Performance (effectiveness) was very good.**

**27/3/2016:**

- North westerly flow affected north and central regions.
- light to moderate rain was expected over north and central regions.
- small amount of precipitation (< 10mm) was measured in some north and center regions.
- **FFG Products:**
  - MAP shows no precipitations over Jordan (underestimation).
  - FFG shows prone areas for FF (south and east).
  - IFFT shows nothing.
- **Performance (effectiveness) was good .**

**28/3/2016:**

- Frontal Depression with cold front feeding cold north westerly flow..
- light to moderate rain was expected over north, central and some eastern regions.
- small amount of precipitation (< 12mm) was measured in some north and center regions.
- **FFG Products:**
  - MAP shows light rain over small basin in eastern region .
  - FFG shows prone areas for FF (south and east).
  - IFFT shows nothing.
  - Performance (effectiveness) was moderate.

**Thank you for patience**