

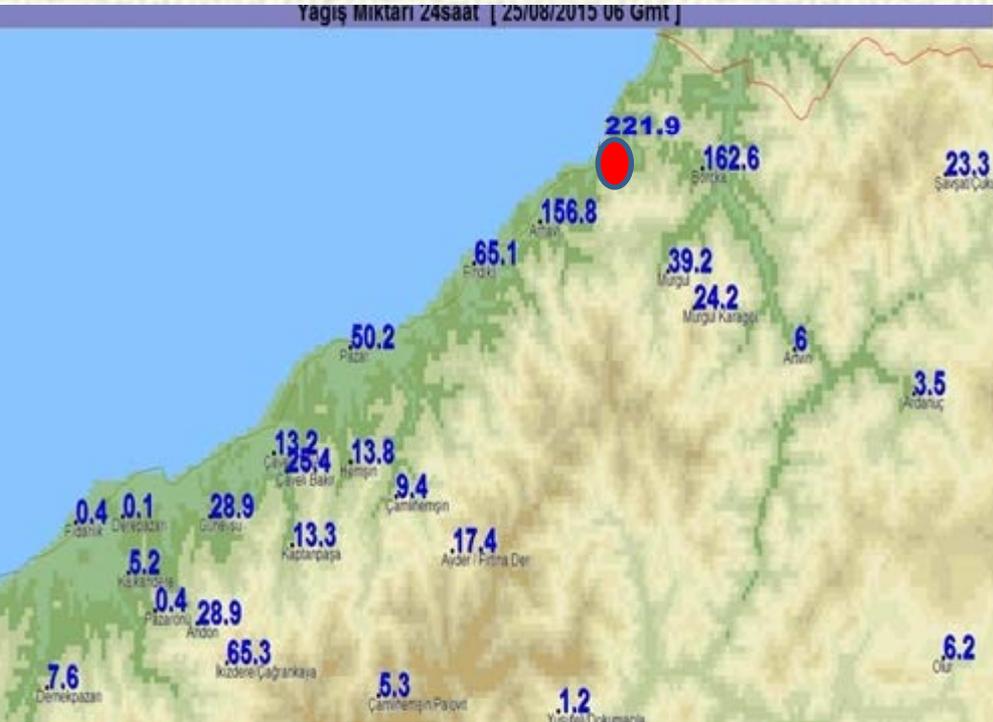


# **Hopa Flash Flood Event**

## **24 August 2015**

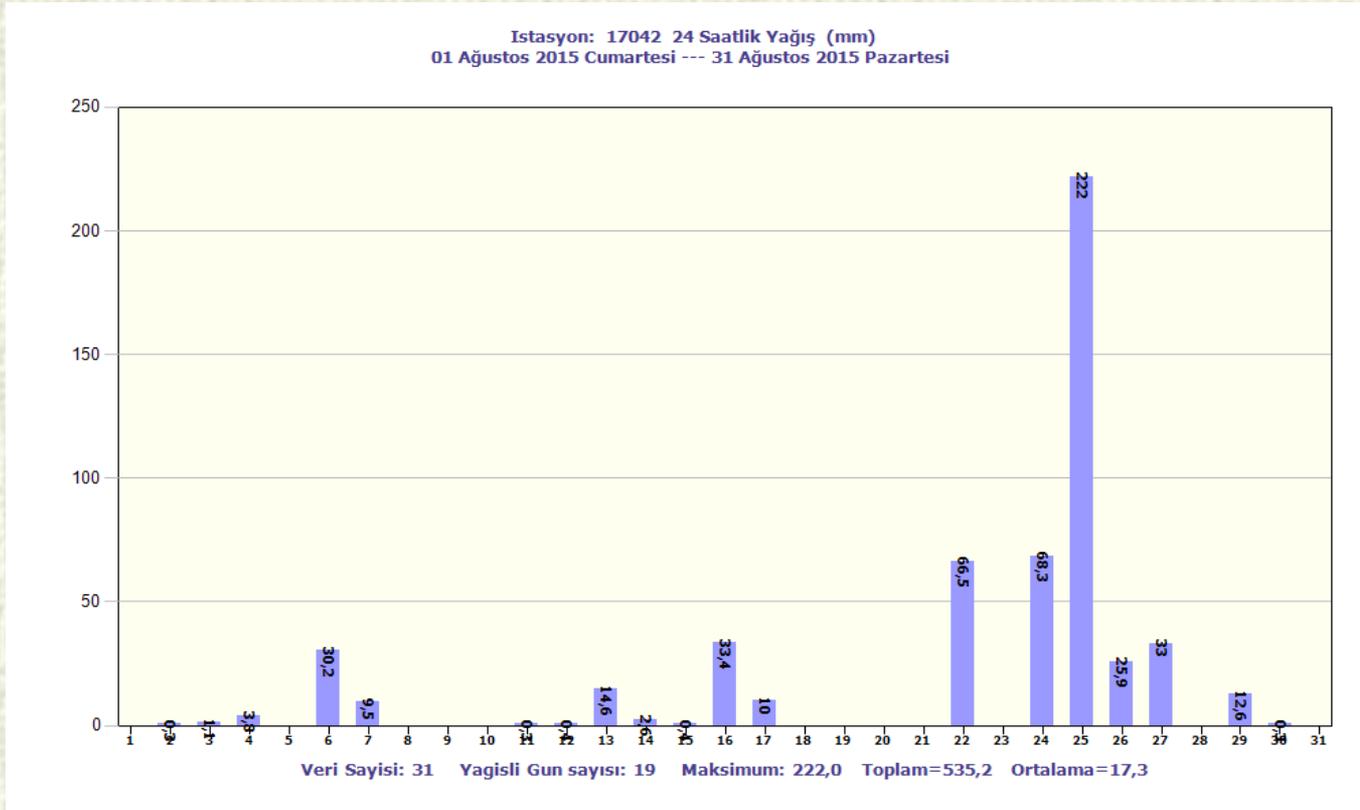
**Yusuf ULUPINAR**  
**Turkish State Meteorological Service**  
**[yulupinar@mgm.gov.tr](mailto:yulupinar@mgm.gov.tr)**

# Hopa Flash Flood Event



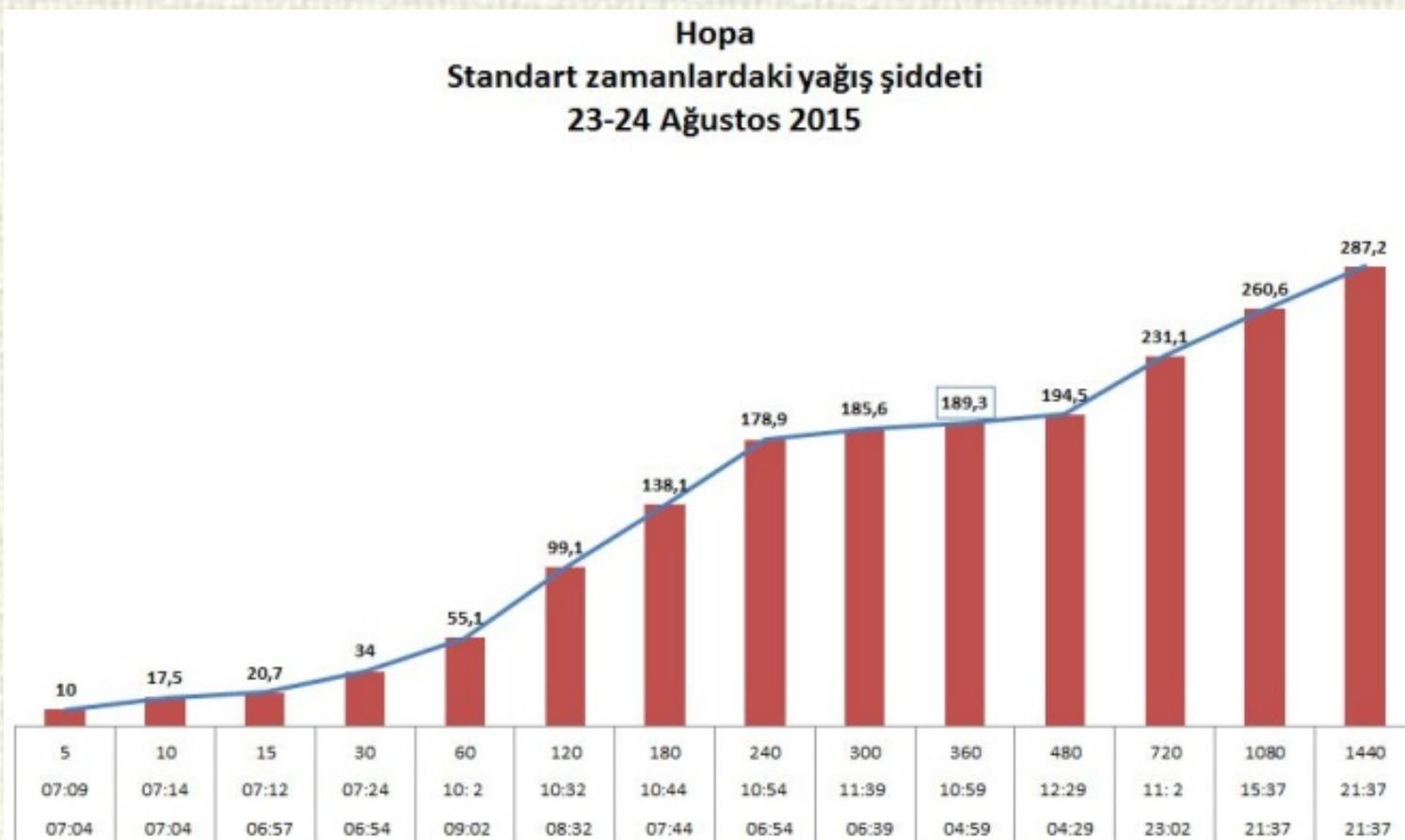
- Hopa town is located in northeast of Turkey on the Black Sea Coast.
- Eastern Black Sea region has the highest annual rainfall accumulation Turkey. It is over 2000 mm.
- 24 h precipitation accumulation 25 .08.2015 at 06 UTC is shown on the image.

# Daily Precipitation Accumulation



- Daily precipitation accumulation is shown in the above Figure that, on August 25th, it was of 222 mm.

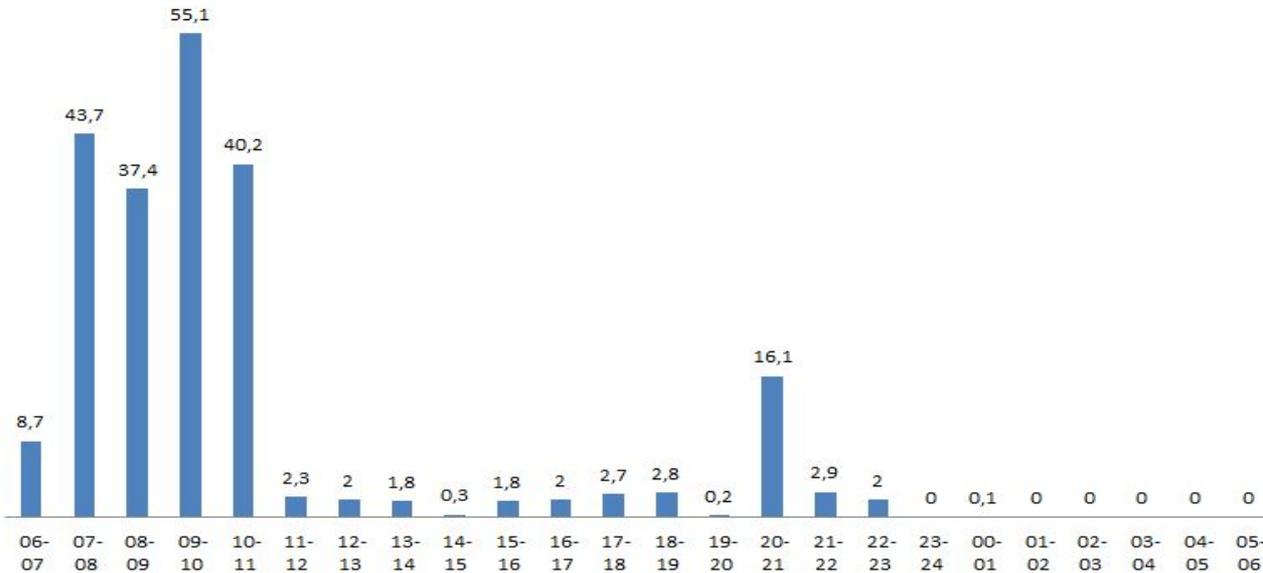
# Daily Precipitation Accumulation



➤ The measured precipitation data were the extrem values for the period of 1965-2015.

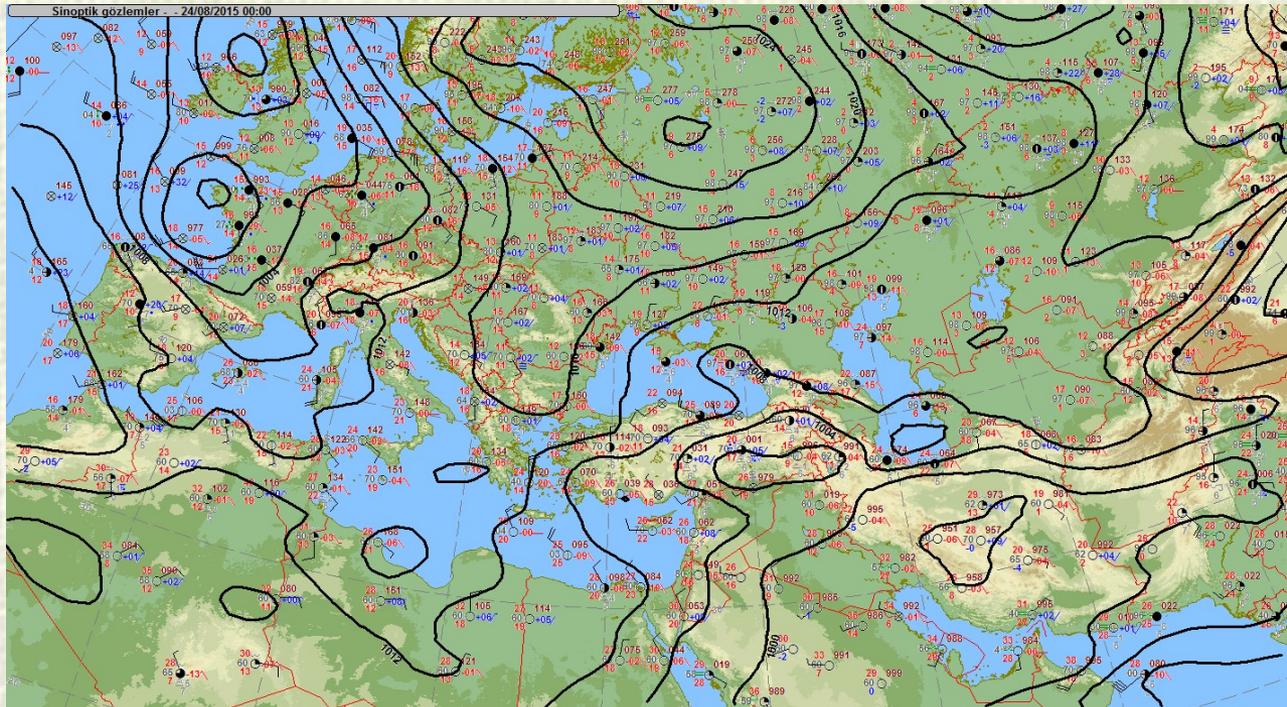
# Rainfall Intensity

Hopa  
saatlik yağış miktarı (mm)  
24 Ağustos 2015



➤ Rainfall intensity graph shows that heavy precipitation lasted for 4 hours from 07-11 UTC with the values of 43.7, 37.4, 55.1 and 40.2 mm.

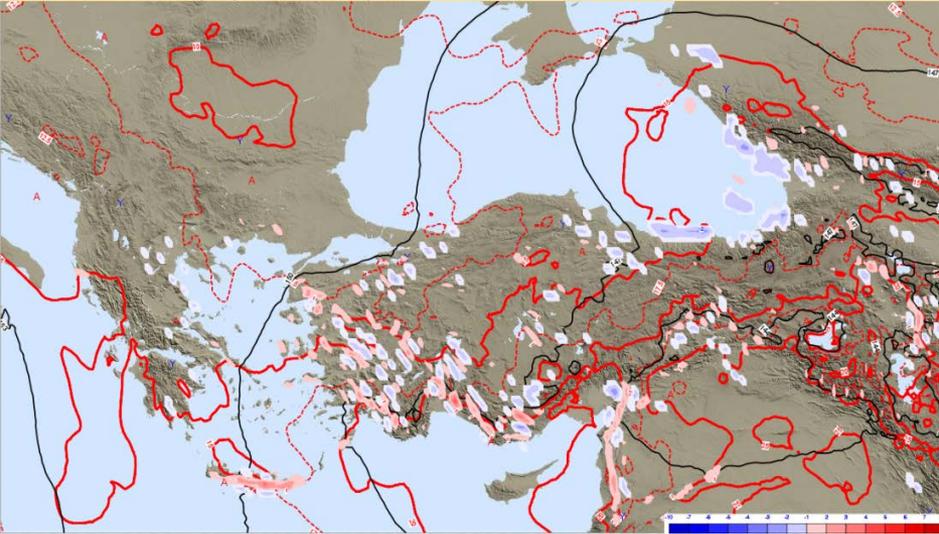
# Synoptic Analysis-Surface Chart on August 24, 2015 00 UTC



- A low pressure center with a value 1000 hPa was located in the southeast region of the Turkey and ground pressure varies between 1000-1012 hPa. There is no significant pressure changes. Pressure has continuously rising trend during rains.

# Synoptic Analysis - 850 hPa on August 24, 2015

Run : 24-08-2015 00:00GMT (T+000) Valid : 24-08-2015 00:00GMT (PAZARTESI) Model : IFS  
Parametre : 850mb-Sicaklik / 850mb-Geopotansiyel Yukseklik / 850mb-Dusey Hiz /

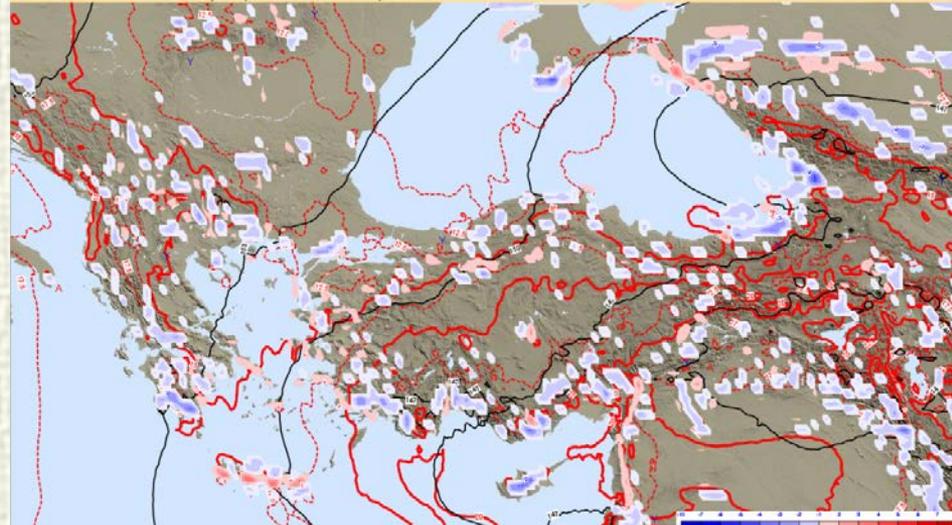


➤ 850 hPa geopotential height, vertical velocity and temperature values are shown on the 24<sup>th</sup>, August, at 00:00 UTC (left) and 12:00 UTC (bottom).

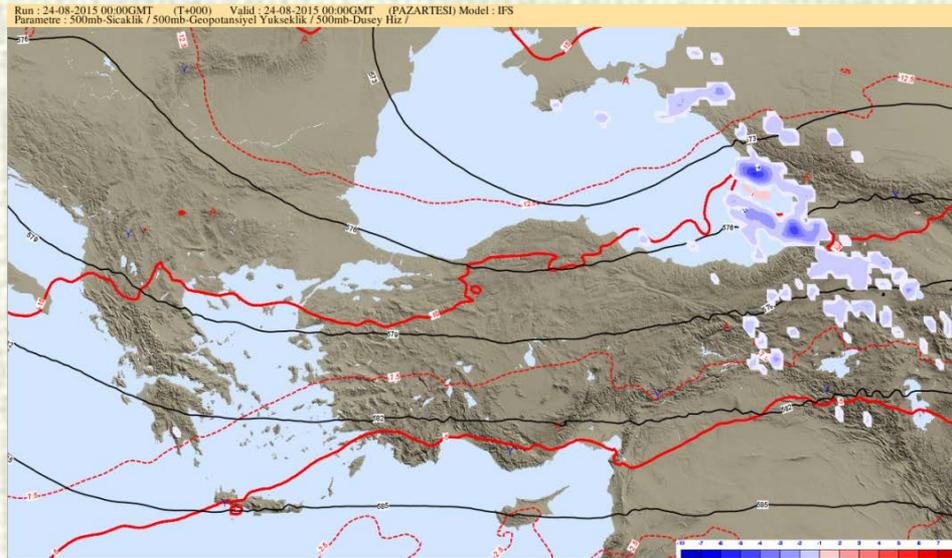
➤ There is a cyclonic circulation over the East Black Sea Region and cold advections behind of the cyclonic rotation.

➤ Low pressure center geopotential height is of 147 hPa. Isotherm value is of 15 ° C over the East Black Sea Coast.

Run : 24-08-2015 00:00GMT (T+012) Valid : 24-08-2015 12:00GMT (PAZARTESI) Model : IFS  
Parametre : 850mb-Sicaklik / 850mb-Geopotansiyel Yukseklik / 850mb-Dusey Hiz /



# Synoptic Analysis- 500 hPa on August 24, 2015

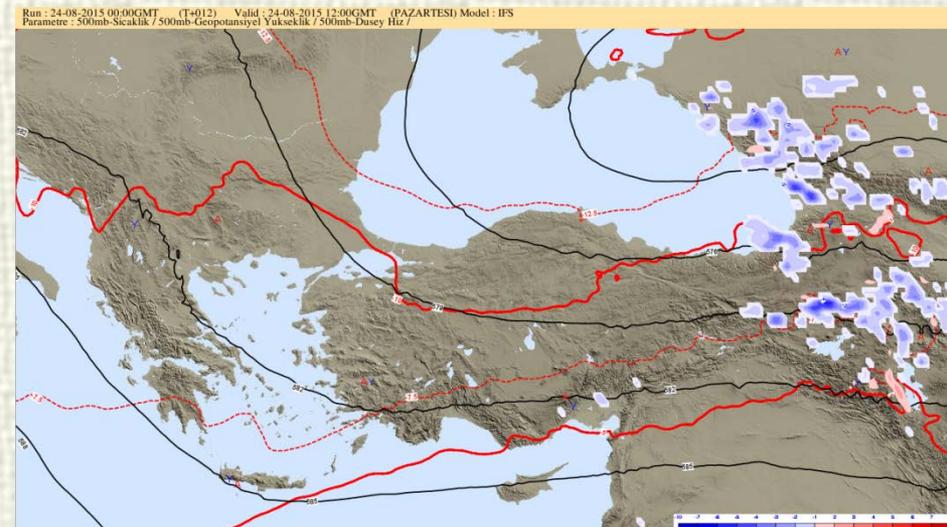


➤ 500 hPa geopotential height and temperature values were shown on the 24<sup>th</sup>, August, at 00:00 UTC (left) and 12:00 UTC (bottom).

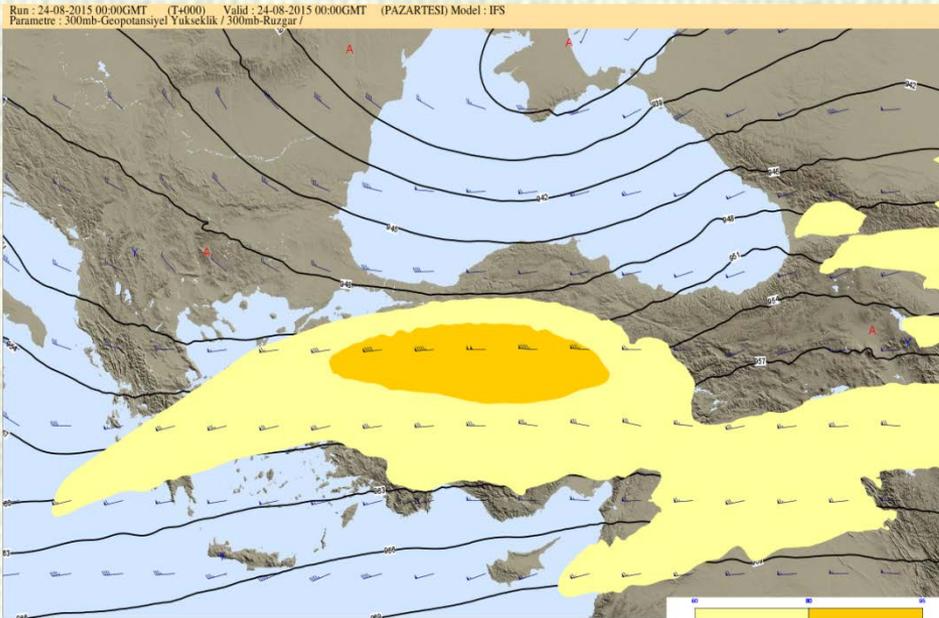
➤ There is south-western flow with cold trough in the north of the region at the 500 hPa level.

➤ Isotherm value is around  $-10^{\circ}\text{C}$  over east Black Sea Coast and  $-17^{\circ}\text{C}$  in the further north at the 500 hPa level.

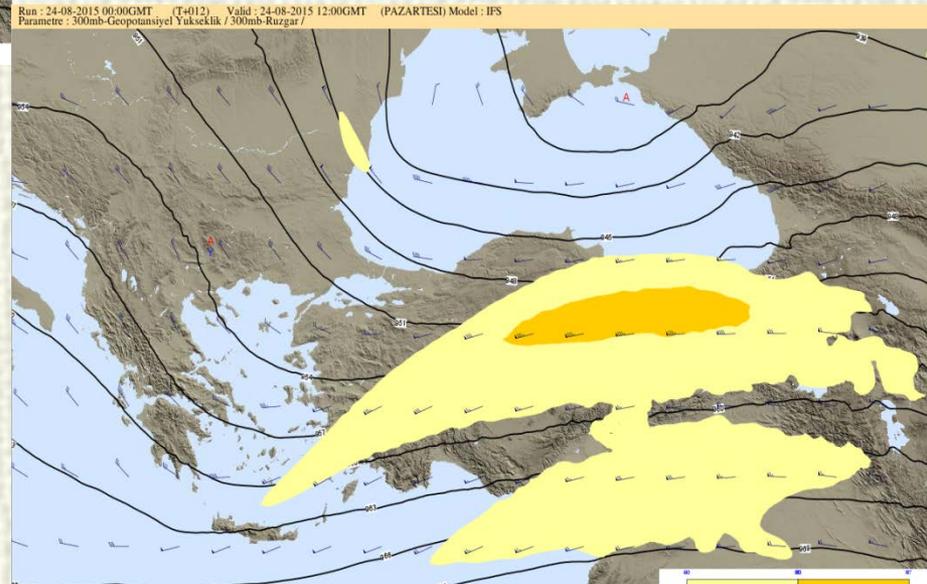
➤ Slow movement of the low center here has provided continuity of heavy precipitation.



# Jet Stream on August 24, 2015



➤ At 06:00 UTC (upper) and 12:00 UTC (bottom) 300 hPa maps show that jet core moved to the northeast and bringing warm air to East Black Sea region and make system of heavy rain move in the northeast direction.

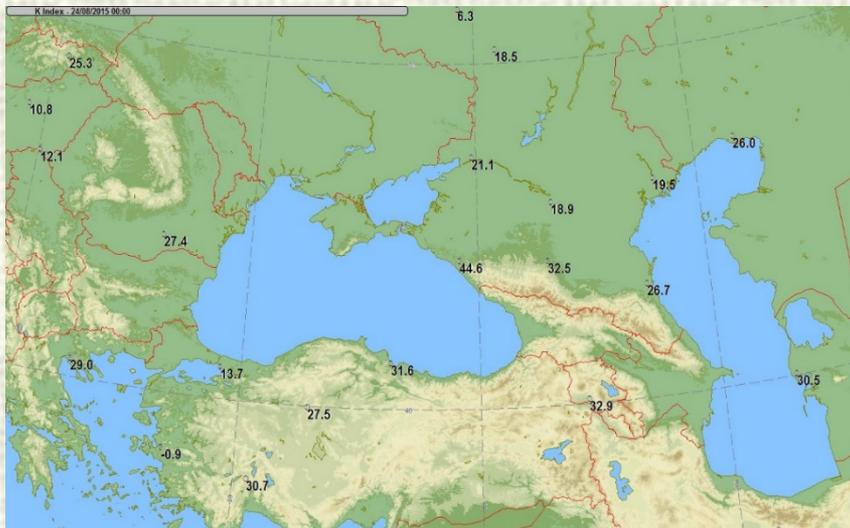


➤ Jet stream exist in the middle Anatolia from Ege region to East Black Sea region having jet core wind speed of 100 knots (yellow).

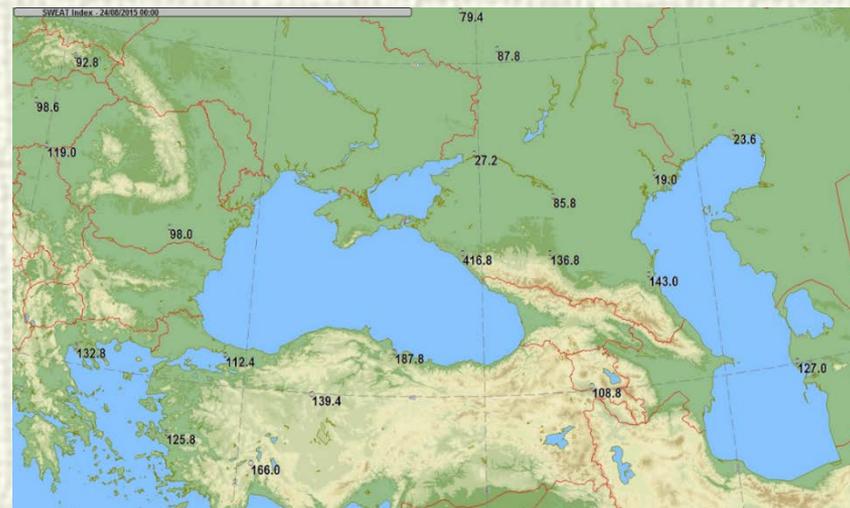


# K, TT and Sweat Index on August 24, 2015 at 00 UTC

## K Indeks



## TT Indeks



## Sweat Indeks

➤ All index values are close to the extrem values.



# Temp Analysis on August 24, 2015 at 00 UTC

➤ The nearest sounding station to the region Dzugba, No: 37011, in Russia .

➤ All index values are close to the eksrem values.

➤ K index, TT index and Sweat index shows values 45, 62 and 425 respectively.

➤ Temperature, humidity and wind is very suitable for precipitation.

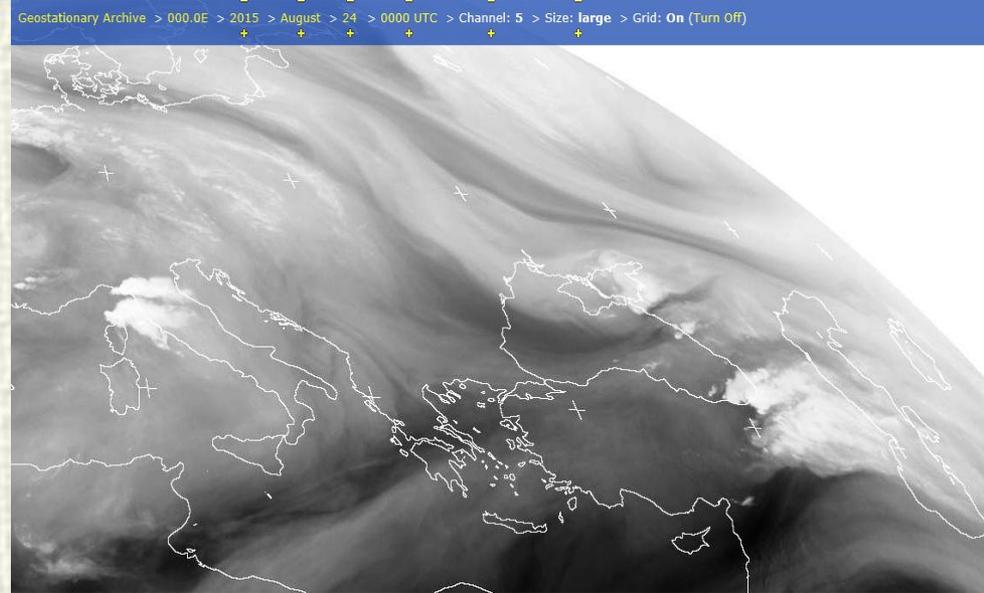
Analizler	İndeksler	Enverziyon	Sıcaklık/S.R	Değişimler	Analizler	İndeksler	Enverziyon	Sıcaklık/S.R	Değişimler
<b>DZUGBA RUSYA</b> <b>Boy:39.2 D En:44.3 K Yük:25 m</b>					<b>Kararsızlık İndeksleri</b>				
YER : 995hPa 22.2/16.2 090/ 8Kt					Showalter : -7.9				
TROP: 237hPa -49.9/51.5 260/60Kt					Lifted : -5.2				
AZAMI RÜZGAR : 158hPa 265/ 84Kt					Cross Total : 29.6				
LCL: 911 hPa 14.8 °C 844m					Vert. Total : 32.1				
OCL: 787 hPa 10.2 °C 2111m					Total Total : 61.7				
LFC: 748 hPa 7.1 °C 2530					Sweat : 424.8				
Lfc EL: 384 hPa -26.0 °C 7691m					K İndeksi : 44.6				
CAPE : 293 J/Kg					Thompson İndeksi : 49.8				
CAPE(-20°C - -30°C): 11 J/Kg					Boyden : 98.5				
CAPE (0-3000m): 7 J/Kg					KO İndeks : -9.6				
NCAPE : 195 J/Kg					Rackliff : 36.8				
Yağabilir su miktarı (PW): 41.1 mm					Bradbury : -4.3				
Yer - 500hPa Ortalama RH % 82.6					Modified Jeff.İndeks : 40.6				
Kısa Süreli Motor izi : 50300 Ft - 51000 Ft					S{TT} İndeks : 61.3				
Uzun Süreli Motor İzi: 51000 Ft den itibaren					L57 (700-500 dT/dZ): 7.5 °C				
Buz: Kirağı (Hafif) 11500 - Buz: Kirağı (Hafif)					CAP : 5.8				
Buz: Kirağı (Orta) 16350 - 18610Ft					Energy Index: -4.3				
Buz: Kirağı (Hafif) 18610 - 23420Ft					Sıcak Bulut Derinliği (m) : 2664				
Seviye Ortalama					Sis İhtimali (FSI) : 29.6 (Yüksek)				
(Km) Yön Hız(Kt)					Sis Noktası : 12.6 °C				
0 - 1 180 004					Fog Threat Index: 7.5				
0 - 2 198 004					Sis dağılma sıcaklığı: 27.9 °C				
0 - 3 180 005									
0 - 4 180 005									
0 - 5 180 006									
0 - 6 194 006									



# Satellite Images between 00:00-06:00 UTC on August 24, 2015

➤ Satellite images on 24.08.2015 at 00:00UTC (top) and at 06:00 UTC (bottom) show cloudiness over East Black Sea Coast in grey scale.

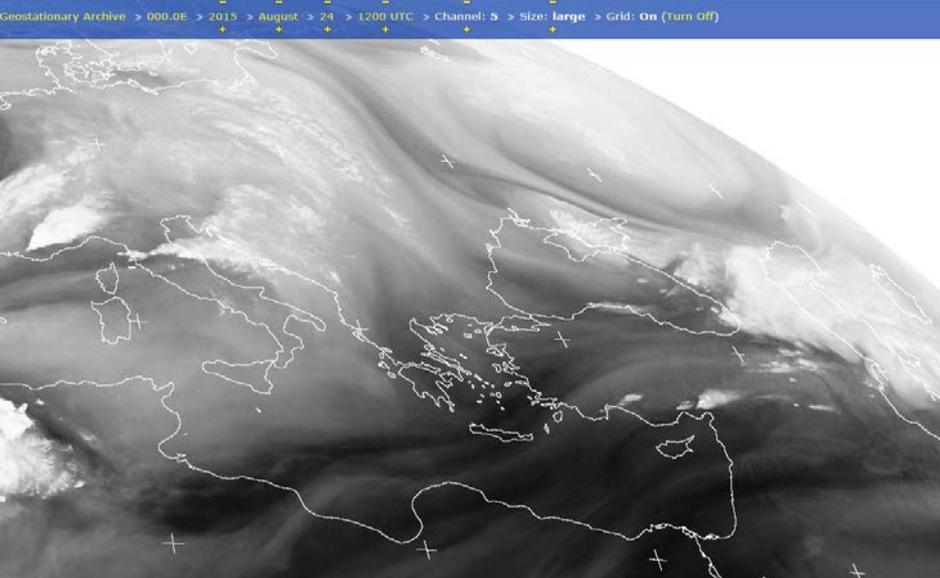
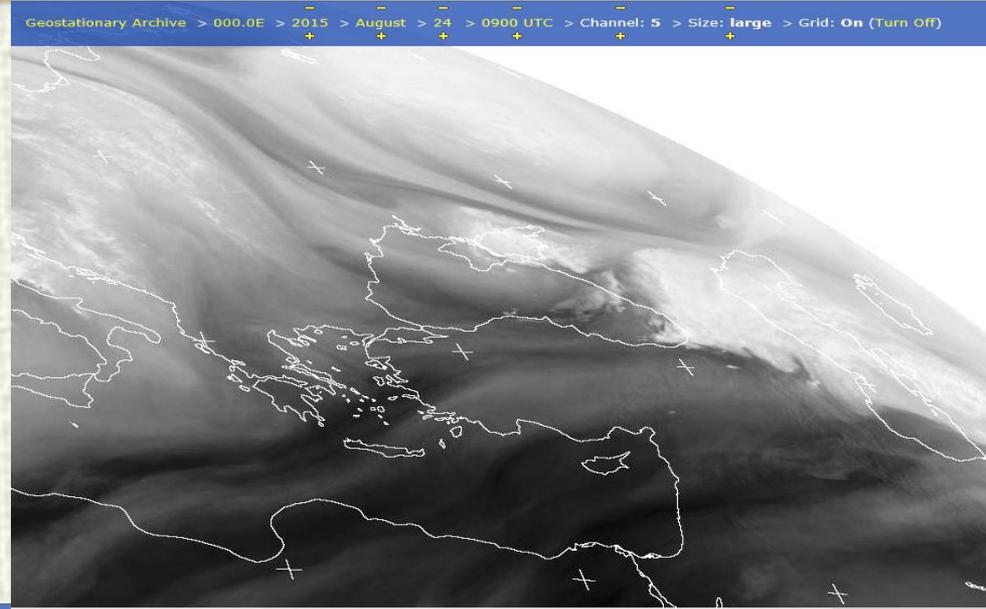
➤ It should be noted that Cb (Cumulonimbus) clouds that are associated with convection exist along the East Black Sea Coast that could be due to both frontal and orographical lifting.





# Satellite Images between 09:00-12:00 UTC on August 24, 2015

- Satellite images on 24.08.2015 at 09:00UTC (top) and at 12:00 UTC (bottom) show cloudiness over East Black Sea Coast in grey scale.
- It is clearly seen that cloudiness is moving in the direction of north east when compare with previous time.





# Radar Images at 03:00 and at 06:00 UTC on August 24, 2015

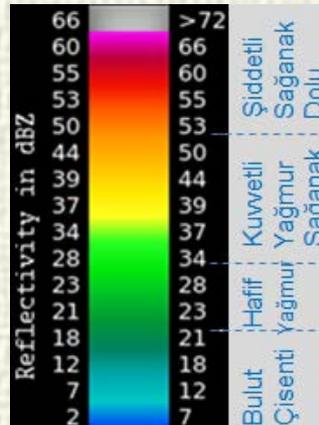
➤ PPI Radar images on 24.08.2015 at 03:00UTC (upper-right) and at 12:00 UTC (bottom-left) show density of the precipitation over East Black Sea Coast in colour scale at the bottom right.

➤ As seen in the 03:00 UTC and 06:00 UTC map, There is mostly yellow color along the region. That means, based on the scale, heavy rain shower.

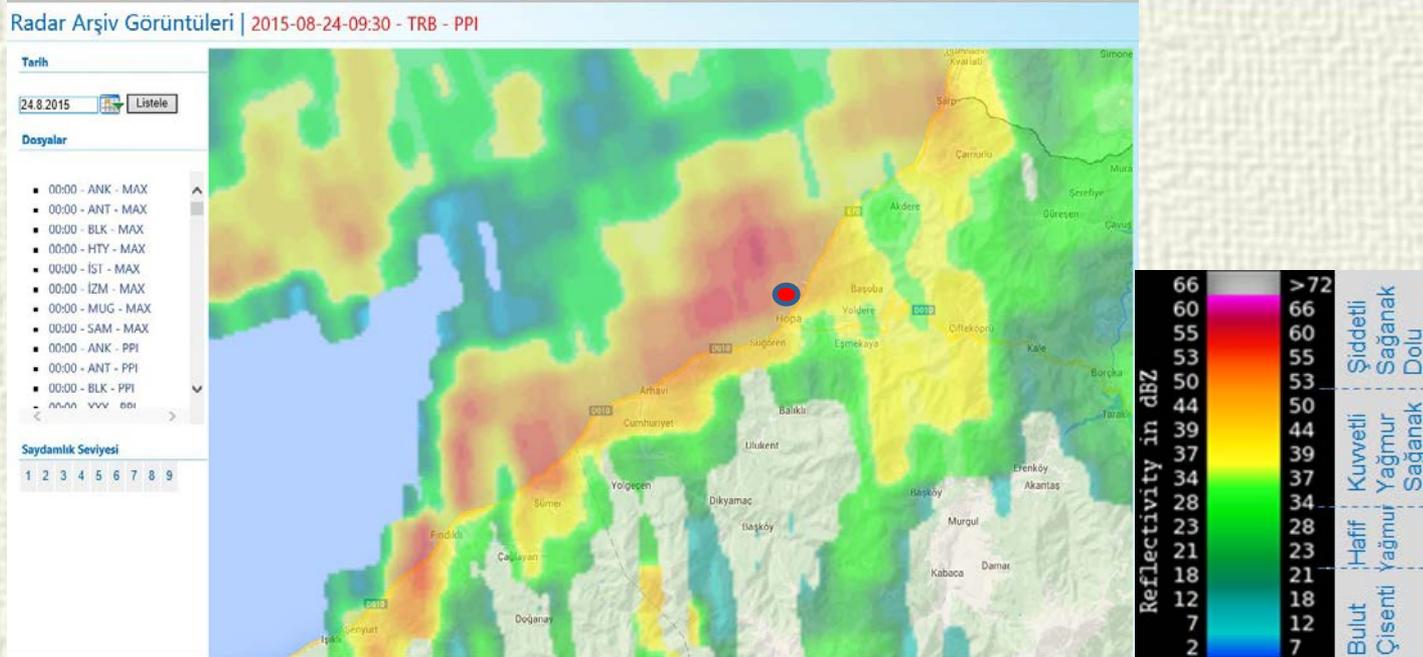
Radar Arşiv Görüntüleri | 2015-08-24-03:00 - TRB - PPI



Radar Arşiv Görüntüleri | 2015-08-24-06:00 - TRB - PPI

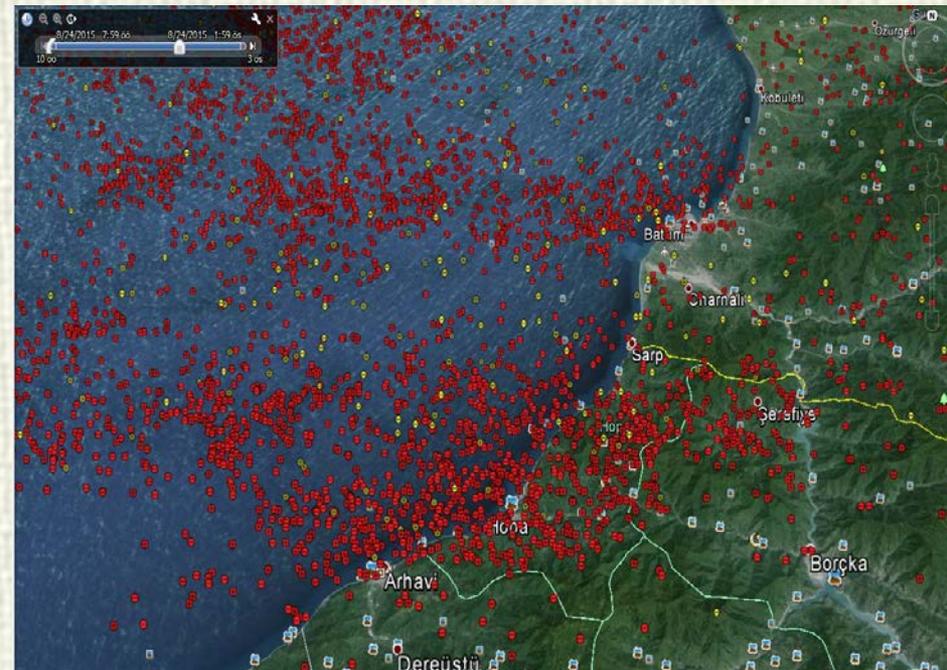
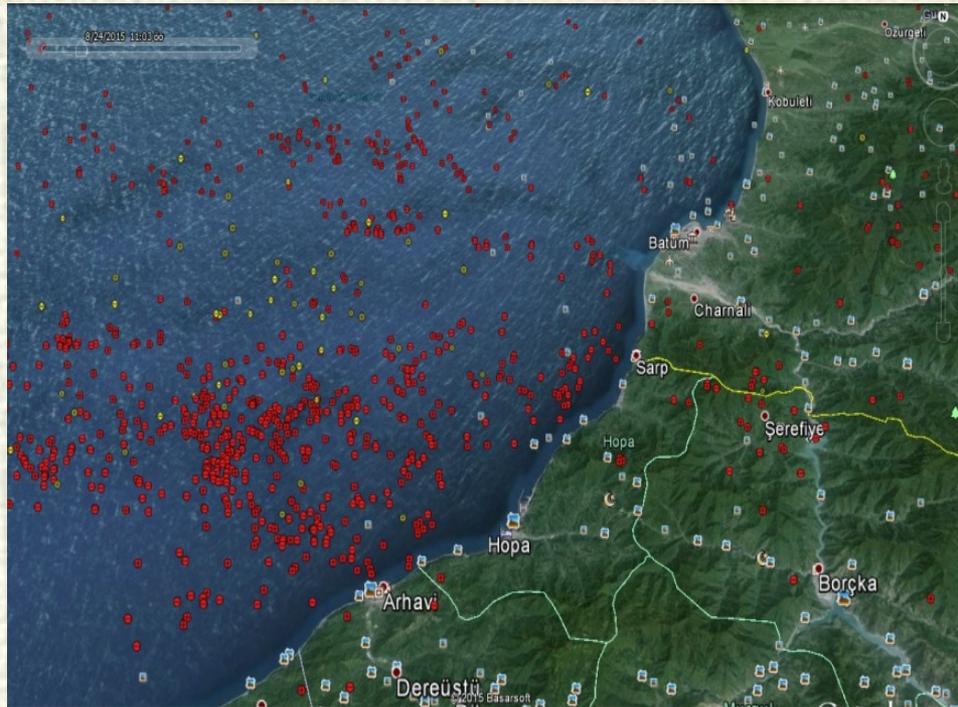


# Radar Images at 09:30 UTC on August 24, 2015

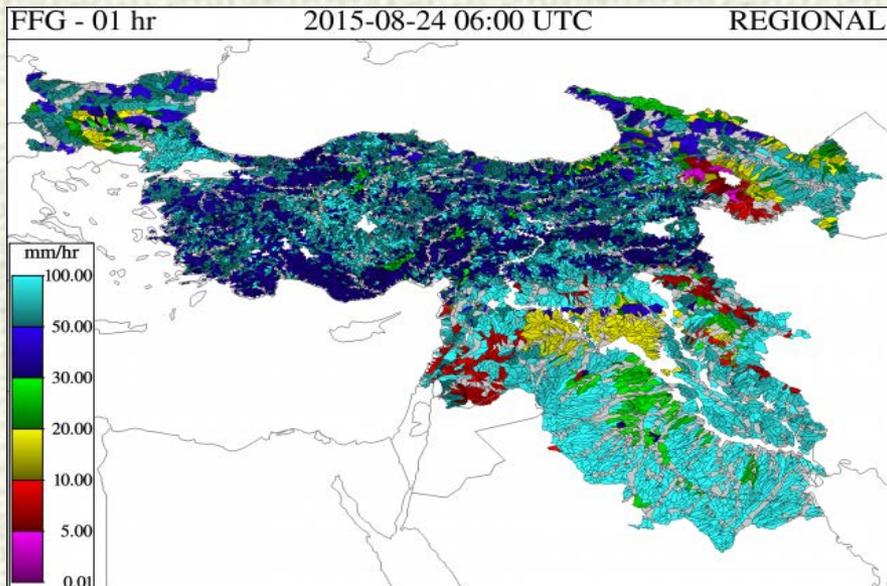
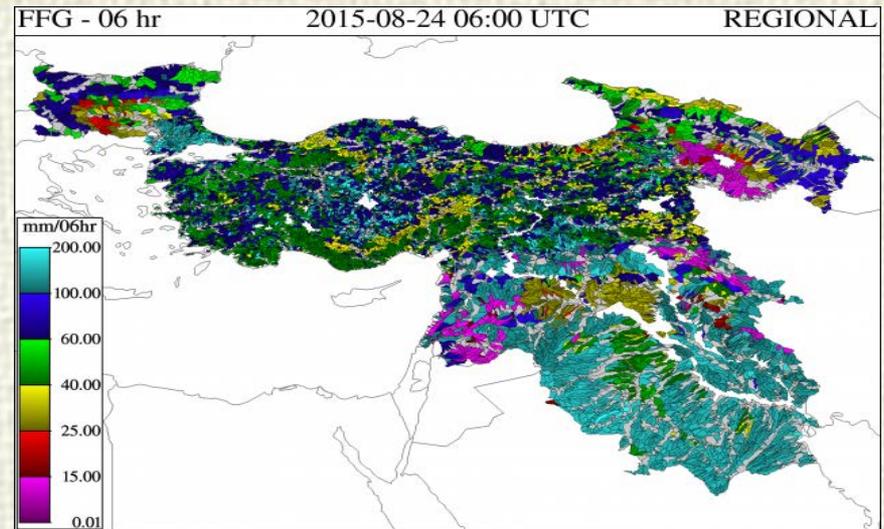
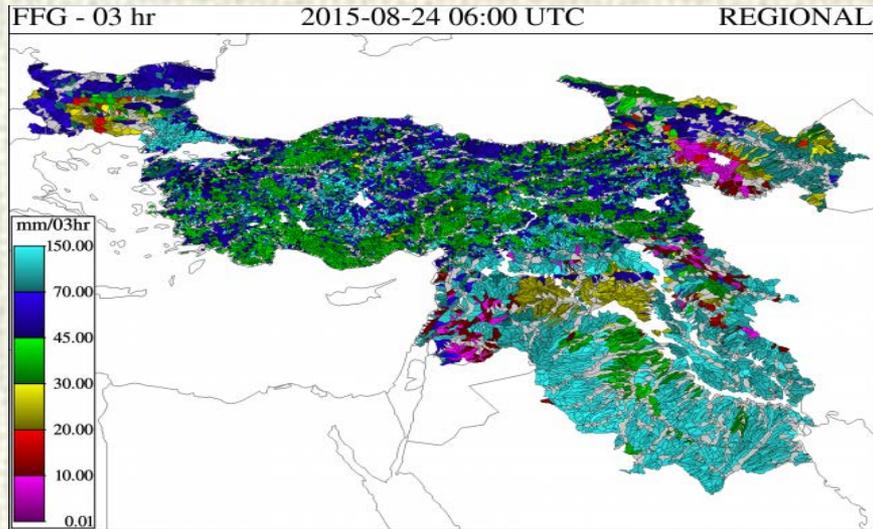


- Along almost all East Black Sea is in colour that varying from yellow to dark red at 09:00 UTC Radar image. It means that severe thunderstorm and heavy rain shower continues along the coast based on the scale.
- Red dot on the map shows place in East Black Coast where rain shower is the most severe. That place is the Hopa district of the Artvin.

# Thunderstorm Areas for 3 hours between August 24, at 08:00 UTC – August 24, at 11:00 UTC



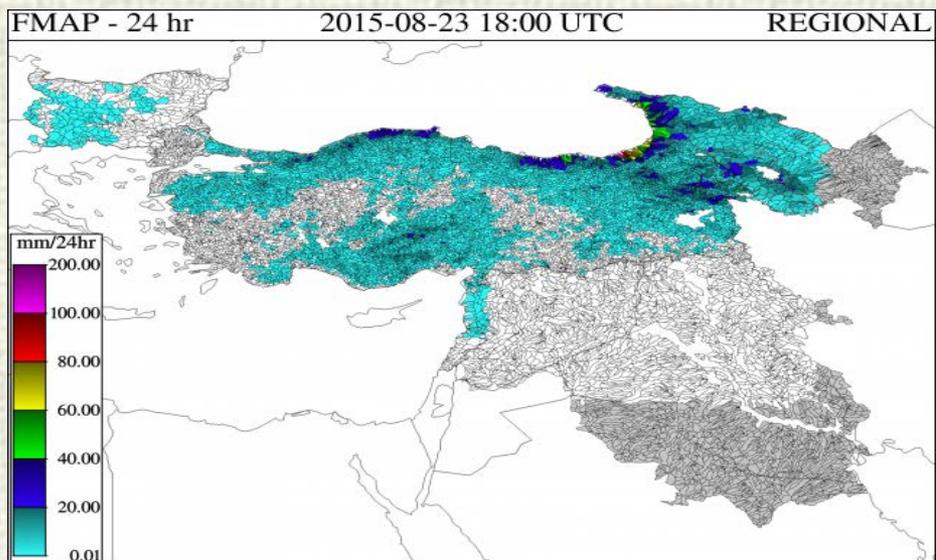
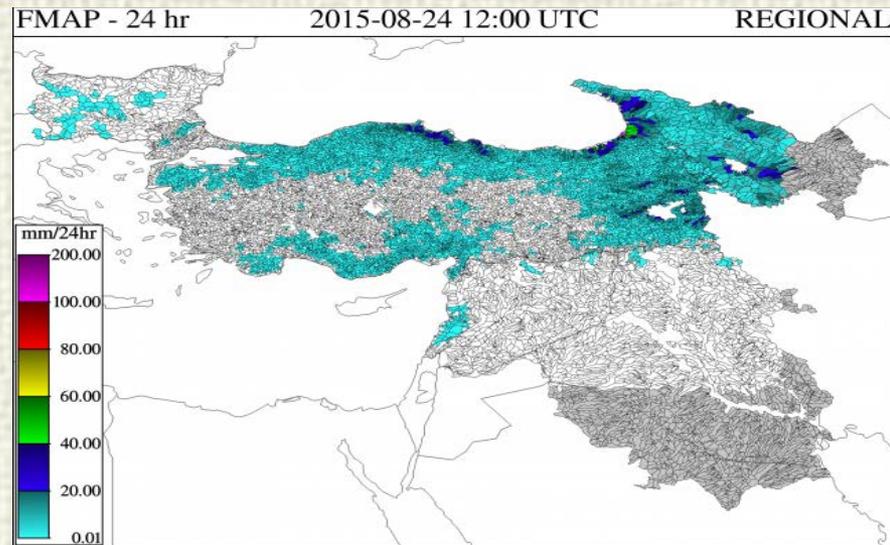
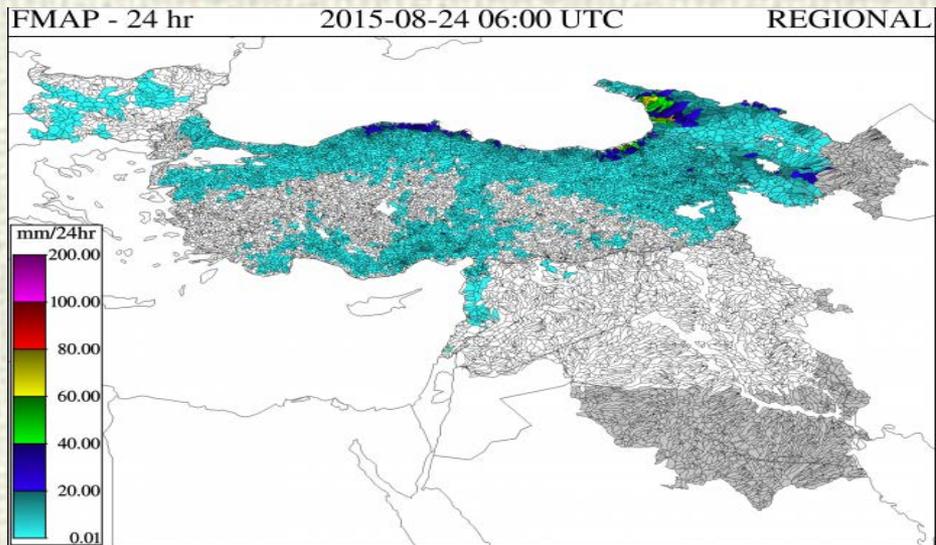
# Flash Flood Guidance



Flash Flood Guidance (FFG) is the actual rainfall that may cause just bankfull at the outlet of a sub-basin for a given duration. 1-hr, 3-hr and 6-hr FFG values are estimated at model runtimes 00, 06, 12 and 18 UTC. It is a function of threshold runoff, and soil moisture deficit. The lower FFG, the higher the occurrences of flash floods.

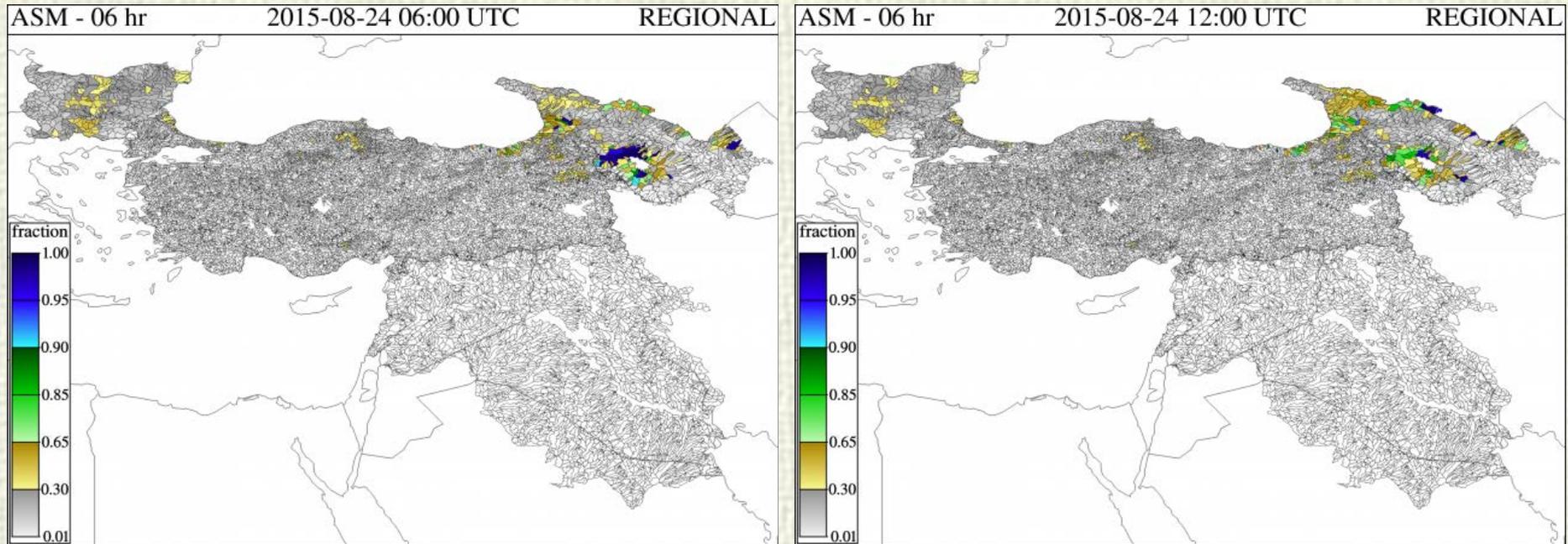
6-hr FFG product (upper-right) shows shows predominantly 25-40 mm (yellow colour) for areas around Hopa and even 15-25 mm (red colour) for some certain small place on 24.08.2015 at 06 UTC.

# Forecast Mean Areal Precipitation



- FMAP provide 1-hour, 3-hour, 6-hour and 24-hour accumulations of mean areal precipitation (mm) for each sub-basin produced by using numerical forecasts from the Aladin model.
- 24-hour FMAP maps shows possible heavy rainfall around the East Black Sea Coast.
- Especially, it is clearly seen that heavy precipitation area around the East Black Sea Coast is having the maximum values 100-200 mm over the province of the Artvin in the 24-hour FMAP at 18:00 UTC on August 23, 2015. (Bottom-left)

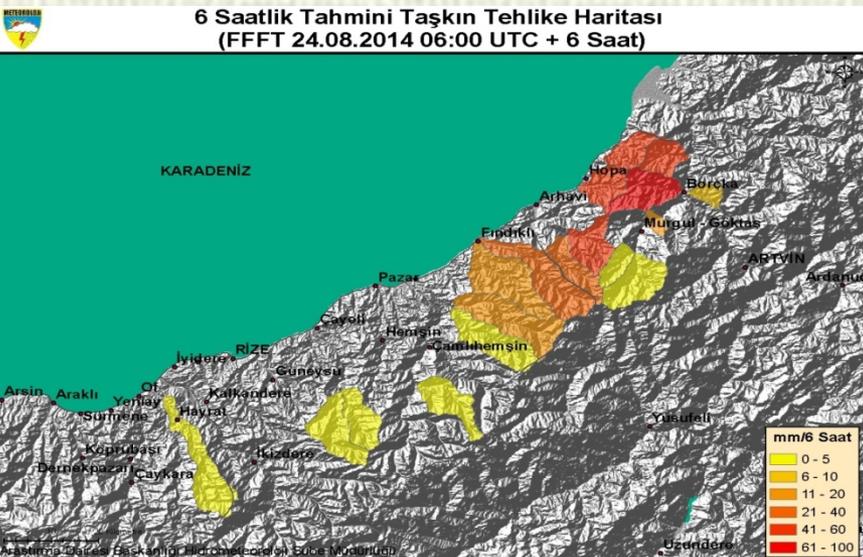
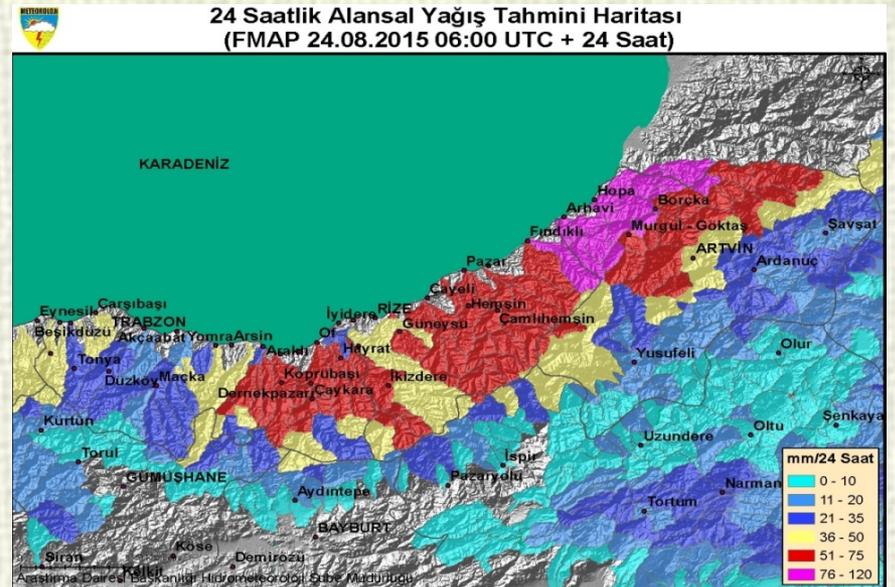
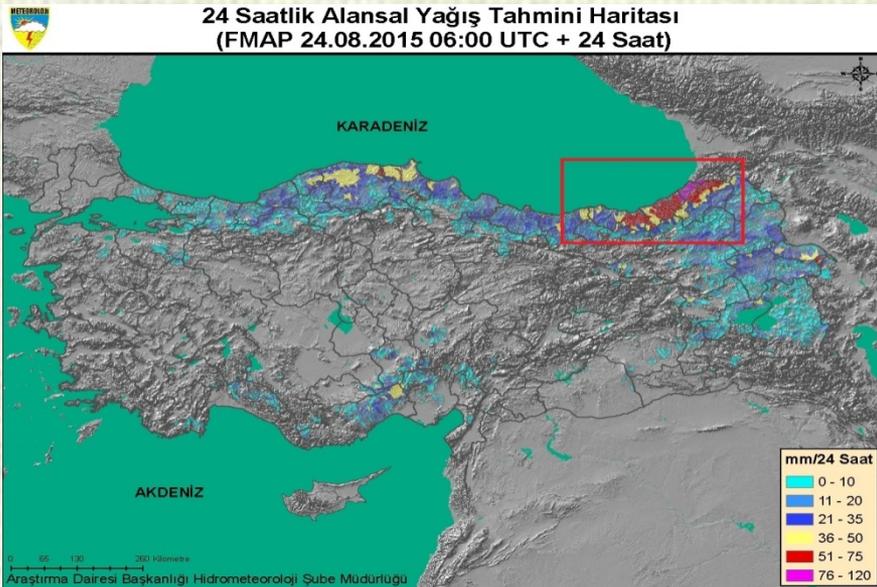
# Average Soil Moisture (ASM)



➤ On 24.08.2015 at 06:00 UTC (left) and 12:00 UTC (right), ASM images show that more sub-basin upper soil saturated associated with continues rainfall in the region. Particularly, sub-basins in the province of ARTVİN were remained saturated up to 24 hours making the region very vulnerable to flash flood occurrences.

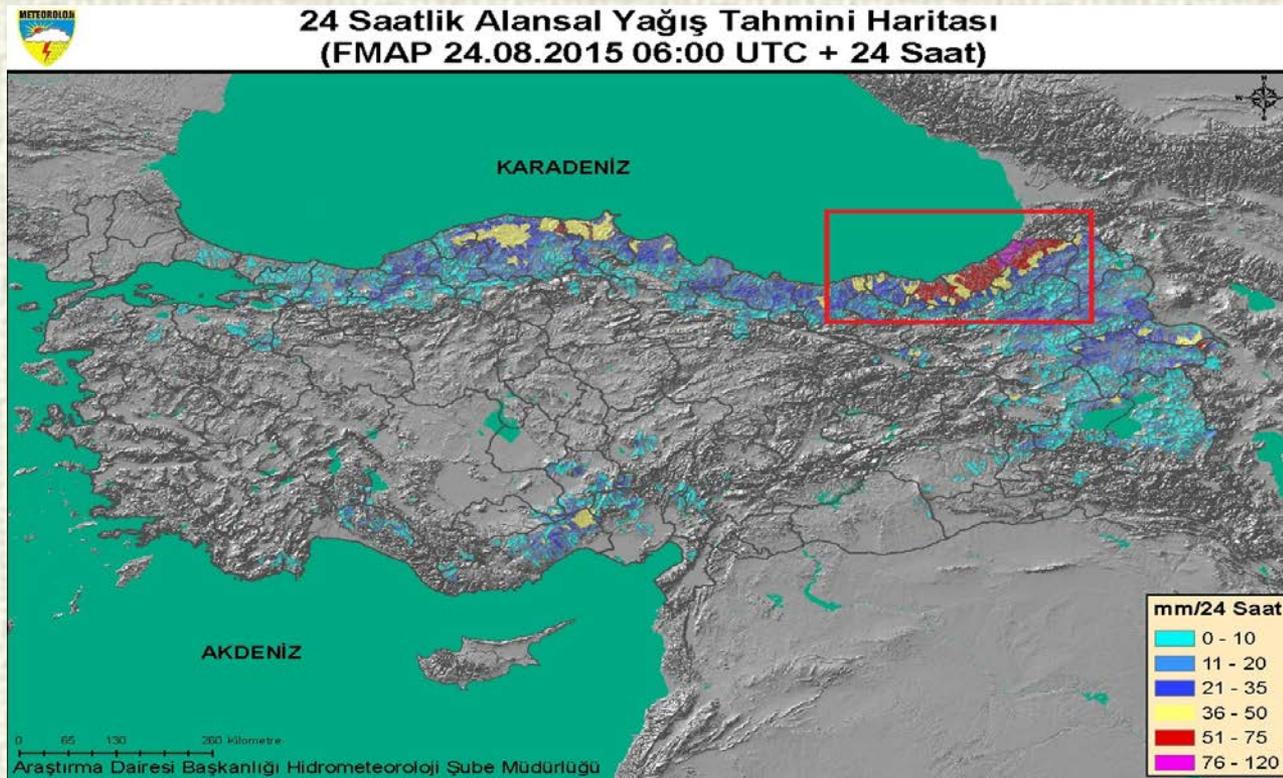
➤ ASM map shows %90 soil moisture for some sub-basins around the East Black Sea Coast.

# BSMEFFG Flash Flood Bulletin



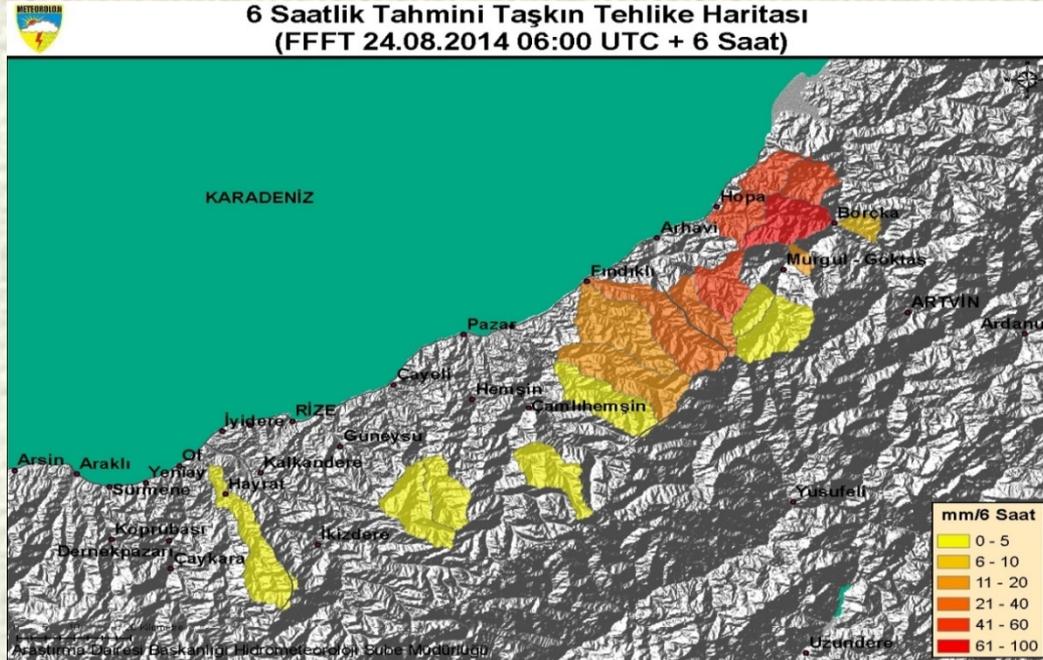
- It was advised to issue flash flood warning so that a BSMEFFG flash flood Bulletin was to be prepared by using one of GIS tools and available raw data on the user interface page.
- For the 24.08.2015 flood events in BSMEFFG, partial content of BSMEFFG flash flood bulletin are shown. Then, Bulletin must be distributed to responsible organizations e.g., emergency management, municipality.

# BSMEFFG Flash Flood Bulletin



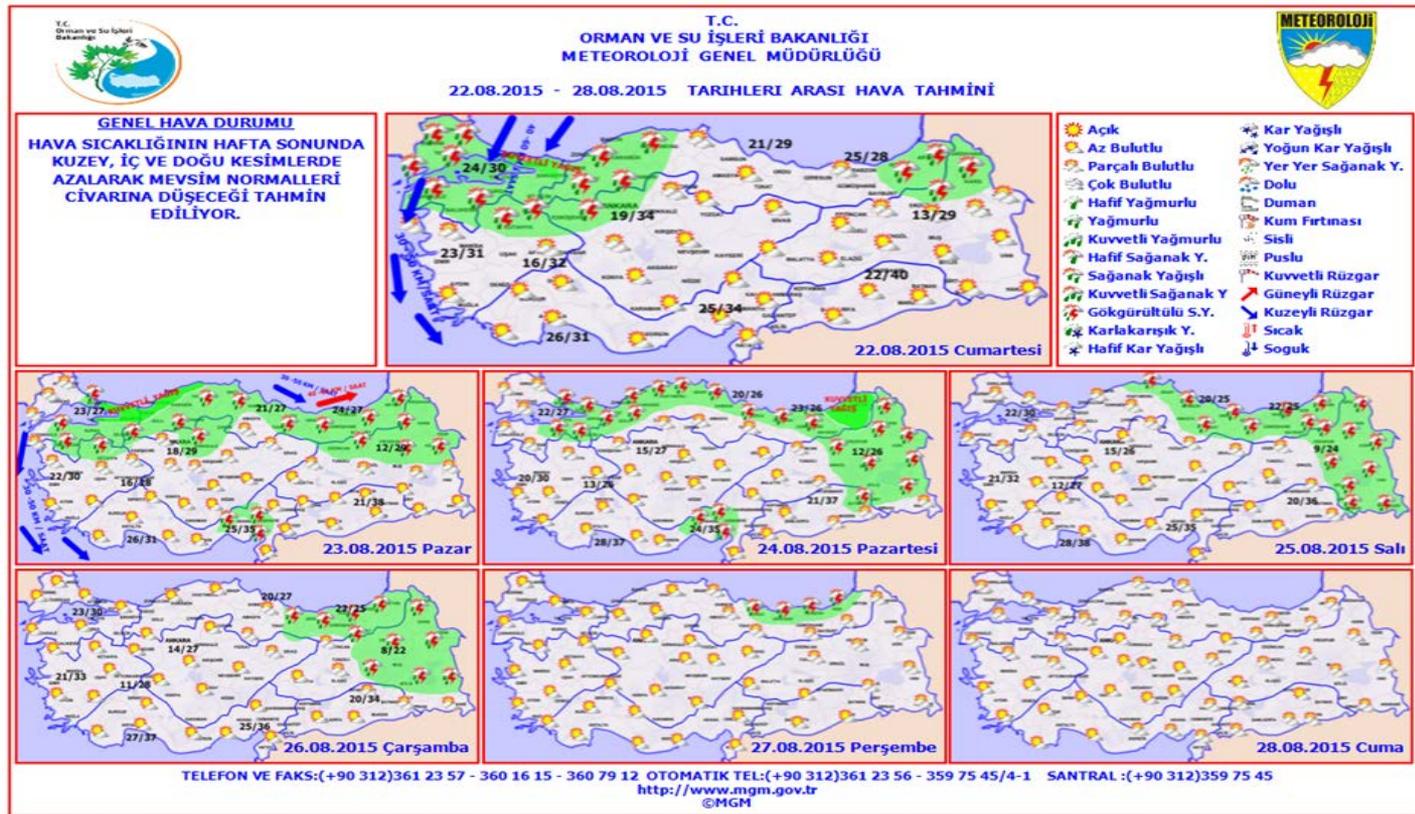
- Forecast Mean Areal Precipitation Map at 06:00 UTC on August 24, 2015.
- This map is formed by hydrometeorology division of TSMS by using the GIS tools and raw data on the user interface page.
- FMAP shows possible heavy rainfall along the East Black Sea Coast.
- 24-hr FMAP on 24.08.2015 at 06:00 UTC depicts that over the next 24 hours precipitation accumulation changed from 21-35 mm to 120 mm over the East Black Sea Coast.

# BSMEFFG Flash Flood Bulletin



- Forecast Flash Flood Threat (FFFT) Map at 06:00 UTC on August 24, 2015.
- This map provide 6-hour Forecast Flash Flood Threat (mm) for each sub-basin. The values indicate the difference of the FMAP of the given duration and the corresponding current FFG of the same duration.
- FFFT map shows possible heavy rainfall around the East Black Sea Coast especially Hopa, Murgul and Borçka districts of the Artvin.
- 6hr FFFT on 24.08.2015 at 06:00 UTC depicts that over the next 6 hours precipitation accumulation that exceeds the threshold level changed from 5 mm to 100 mm over the East Black Sea Coast.

# Forecasts and Warnings



➤ Weekly Weather Forecast for dates between 22 – 28/08/2015 published by Analysis Division of the TSMS.

➤ It was expressed that there would be heavy rainfall on the Eastern Black Sea Coast since August 21, 2015. **Watch out!!**



# Forecasts and Warnings

SIM Yok 12:18 %88  
mgm.gov.tr

## Meteorolojik Uyarılar veya Değerlendirmeler

### Meteorolojik Uyarı

Tarih: 23 Ağustos 2015 Pazar Saat: 12:00 Uyarı No: 238 Uyarı Kodu: Normal

#### Doğu Karadeniz Kıyıları ve Artvin'de Kuvvetli Yağış Bekleniyor!

Beklenen Hadise	Sağanak Yağış
Beklendiği Yer	Bu gece ve yarın (24.08.2015 Pazartesi Günü), Doğu Karadeniz'de görülecek olan sağanak ve gök gürültülü sağanak yağışların; Giresun ve Trabzon'un batı ilçelerinde kuvvetli (21-50 kg/m2), Trabzon'un doğusu, Rize ve Artvin çevrelerinde çok kuvvetli ve şiddetli (51-100 kg/m2) olması beklendiğinden meydana gelebilecek olumsuzluklara (ani sel, su baskını, yıldırım, heyelan riski v.b.) karşı vatandaşların ve ilgililerin dikkatli ve tedbirli olmaları gerekmektedir.
Başlama-Bitiş Zamanı	24.08.2015 00.00 - 23.59 TSİ
Hadisenin Şiddeti	Kuvvetli Yağış
Oluşması Muhtemel Riskler	Ani Sel - Su Baskını - Yıldırım - Heyelan
Alınabilir Önlemler	Sellerden Korunma Yöntemleri   Yıldırımdan Korunma Yöntemleri
Uyarı Yapan Merkez	Analiz ve Tahminler Şube Müdürlüğü

#### Yağış Şiddeti Sınıflandırması

Hafif Yağış	1 - 5 mm
Orta Kuvvette Yağış	6 - 20 mm
Kuvvetli Yağış	21 - 50 mm
Çok Kuvvetli Yağış	51 - 75 mm
Şiddetli Yağış	76 - 100 mm
Aşırı yağış	100 mm üzeri

Not: 12 Saatlik periyotta miktara bağlı değerlendirme yapılmış ve bölgeler arası topografik farklılıklar dikkate alınmadan sınıflandırılmıştır.

➤ Meteorological warnings and evaluations for heavy and severe rain around the Eastern Black Sea coast, particularly for the province of the Artvin, Rize, Trabzon and Giresun, for 24th day between 00.00-23.59 lokal and 23/08/2015 at 12:00 UTC published by Analysis Division of the TSMS.

➤ According to the warning, 100 mm rainfall was expected around the province of Rize and Artvin.

➤ **Expected to flash flood event and landslide**

# Press Reports



- 8 people lost their lives in the flood disaster, three citizens lost and 27 people were injured.
- 6 buildings were destroyed. There are 17 heavy and 11 moderately damaged buildings and also evacuation demand was conducted for 24 buildings.
- There are 1208 victims in Hopa, 216 in Arhavi and 10 in Borçka.



# Conclusion

- 535 mm rainfall was measured monthly in Hopa district of the Artvin in August, 2015. This rainfall is the second highest value after the rainfall measured monthly as 588.9 mm in August, 1988.
- While 100 mm rainfall fell in Hopa between 1-20 August 2015 , 66.5 mm rainfall was recorded on August 21, 2015.
- Precipitation occurred over the sea as mass in the direction of western, as well as convective precipitation in the direction of southwestern.
- Turkey's northeast region is always more affected by the western flow. When orographic conditions of the Eastern Black Sea basin is considered, it is the highest potential rainfall place.
- Effective precipitation in the Hopa basin with an area of 71 square kilometers failed to reach the sea at one point and so flooding has caused landslides.
- Timely meteorological forecasts and warnings and also the occurrence of flooding during daylight hours reduced to a minimum loss of life and property.



**Thank you for your kind attention...**