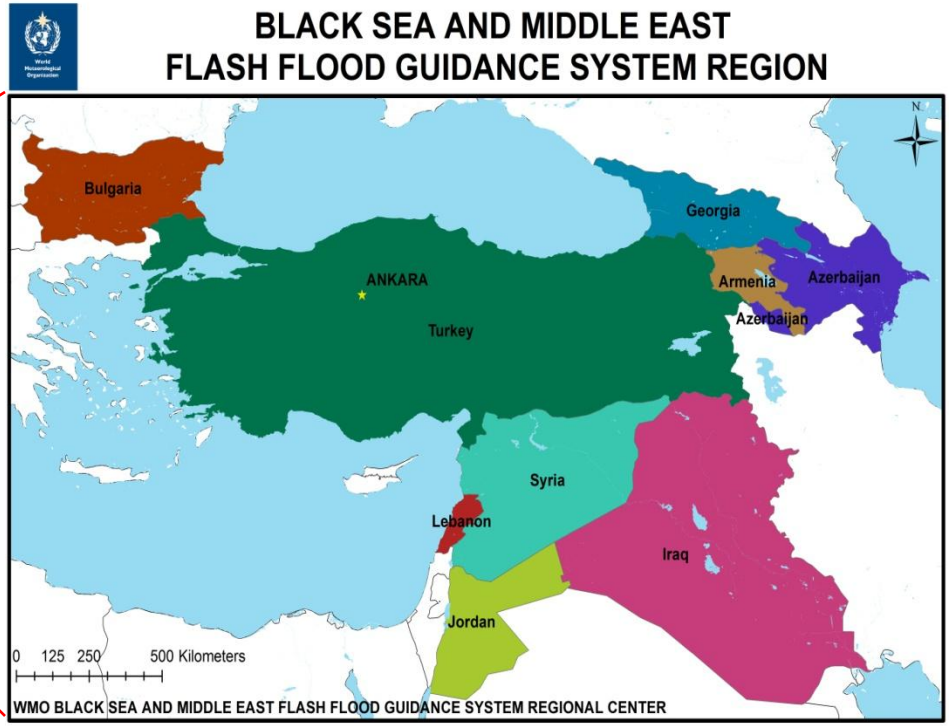
World Meteorological Organization

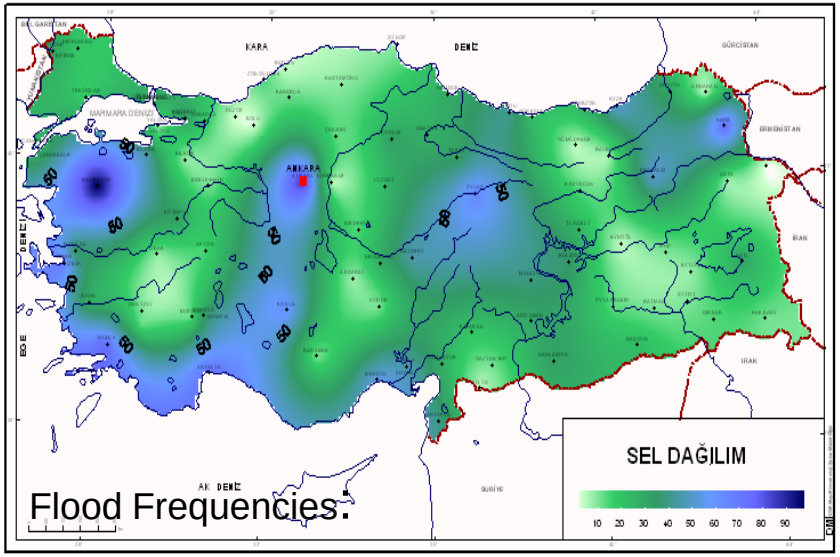
Weather • Climate • Water

An Example of FFGS Implementation: Black Sea and Middle East FFG System

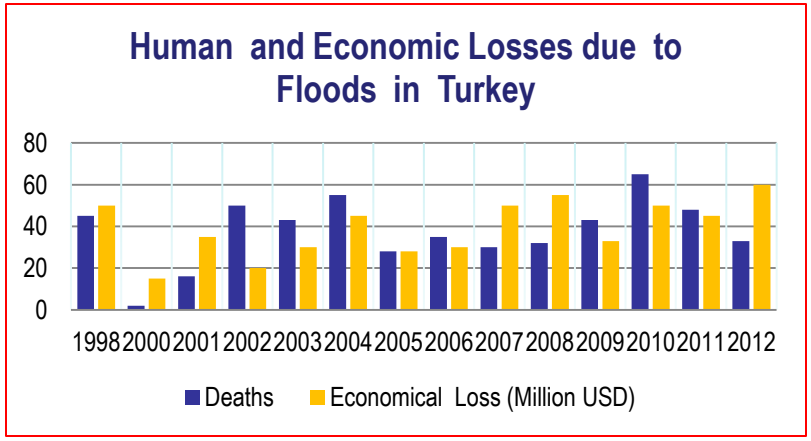
Black Sea and Middle East FFGS



Flash Floods in Turkey



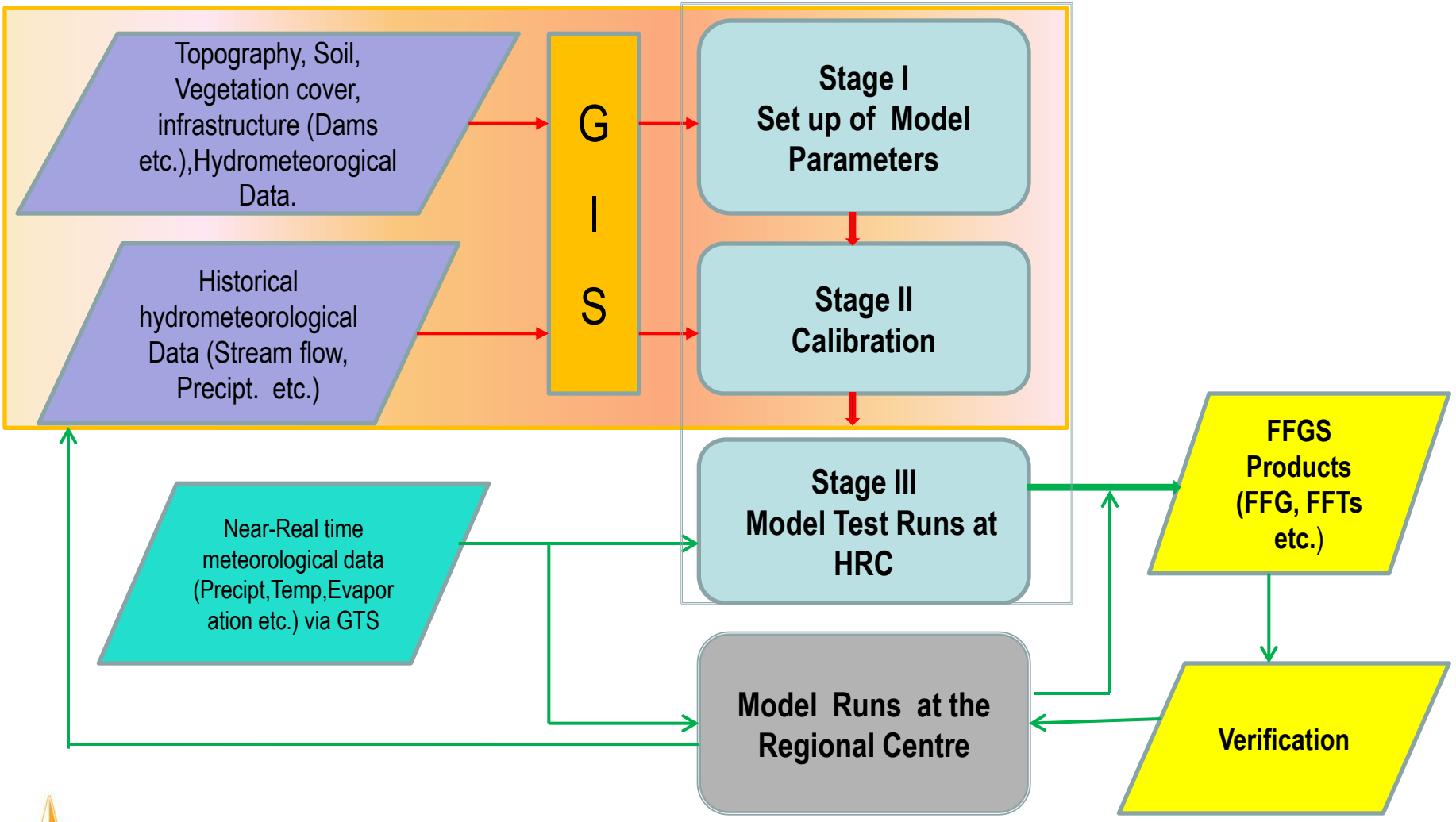
Flood Frequencies.



Black Sea and Middle East FFGS

- Black Sea and Middle East Flash Flood Guidance System initial meeting was held in İstanbul on 29-31 March 2010.
- Turkey was elected as the Regional Centre unanimously.
- *Turkey, Georgia*, *Armenia*, *Azerbaijan*, *Bulgaria,* and *Syria* have submitted Letter of Commitment (LoC) to WMO to declare their commitments to the project. *Lebanon* joined the project in 2015.

Development of the System

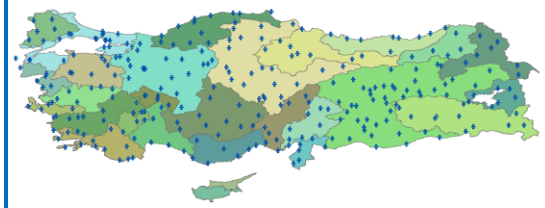


Historical Data

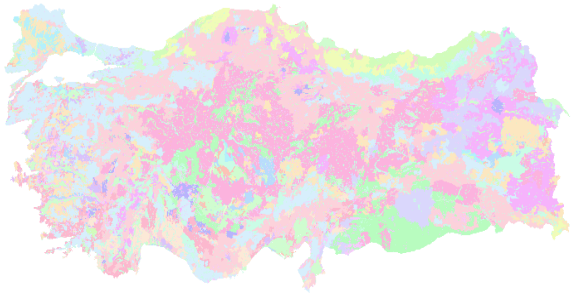
In order to set up the model parameters, more than *30 geophysical and hydro-meteorological parameters* were prepared by GIS and put on TSMS *ftp server to be delivered to Hydrologic Research Center (HRC)*. Some of them are:

- Historical Precipitation, Temperature, Evaporation, Radiation;
- Soil and Vegetation Cover,
- Stream flow, Dams, Lakes and Rivers.

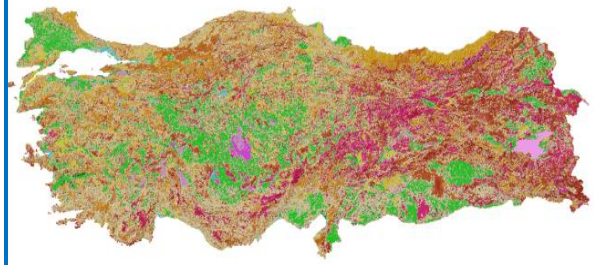
AWS Stations



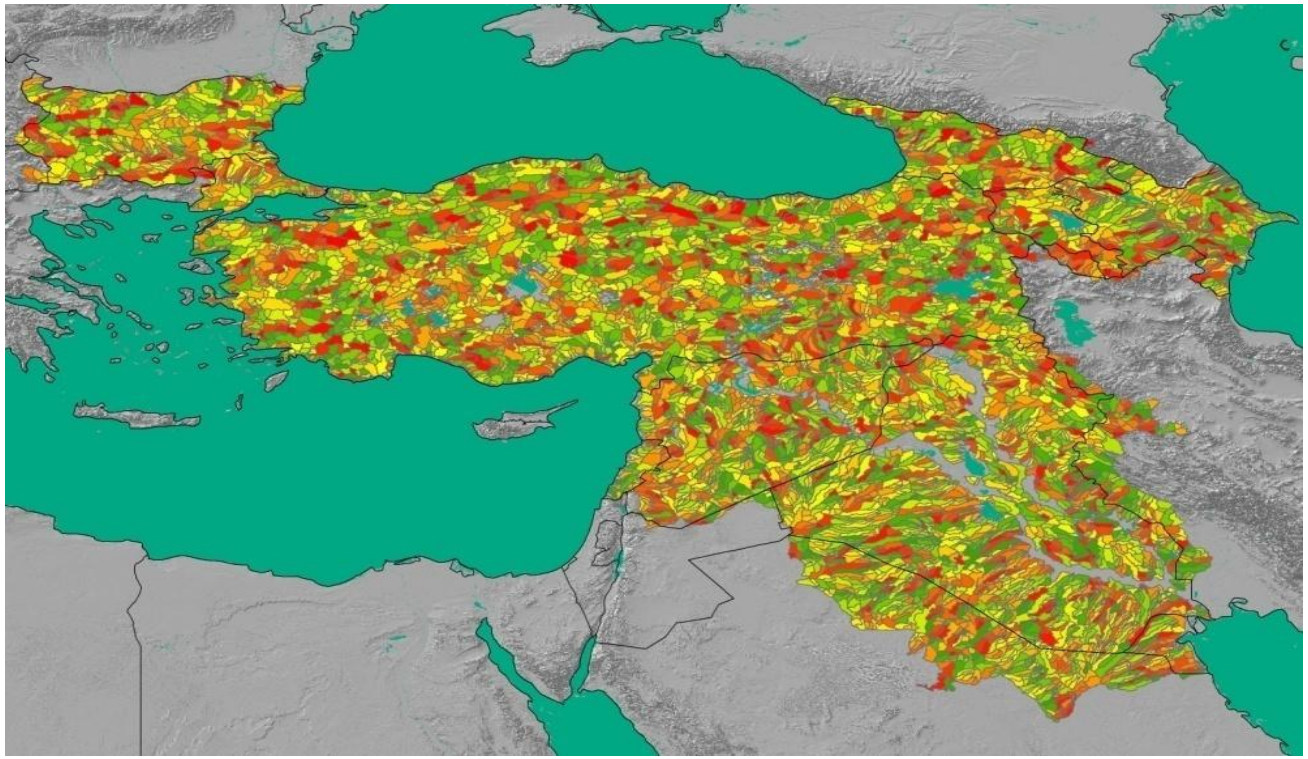
Soil Data



Vegetation Cover

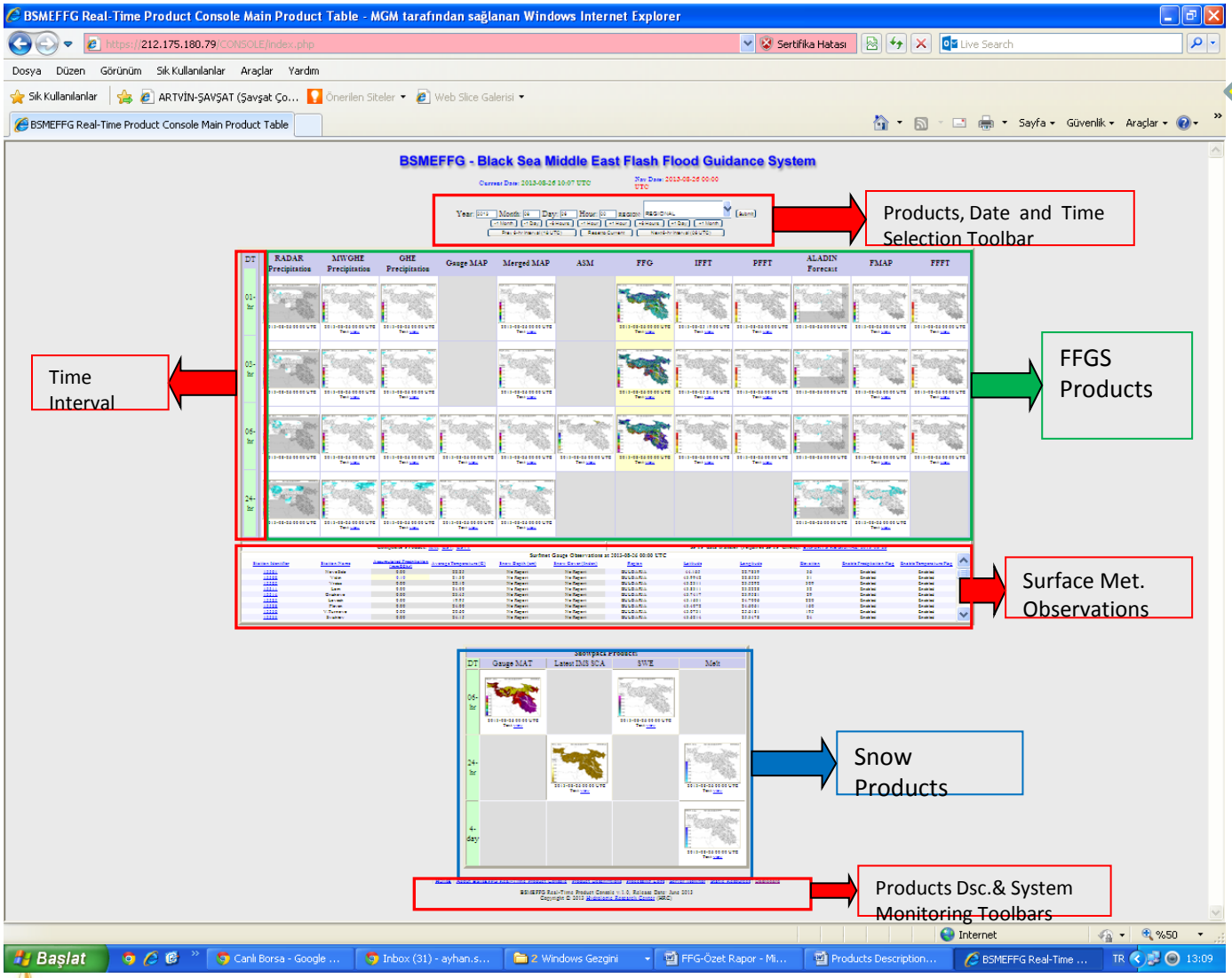


Basin Delineation

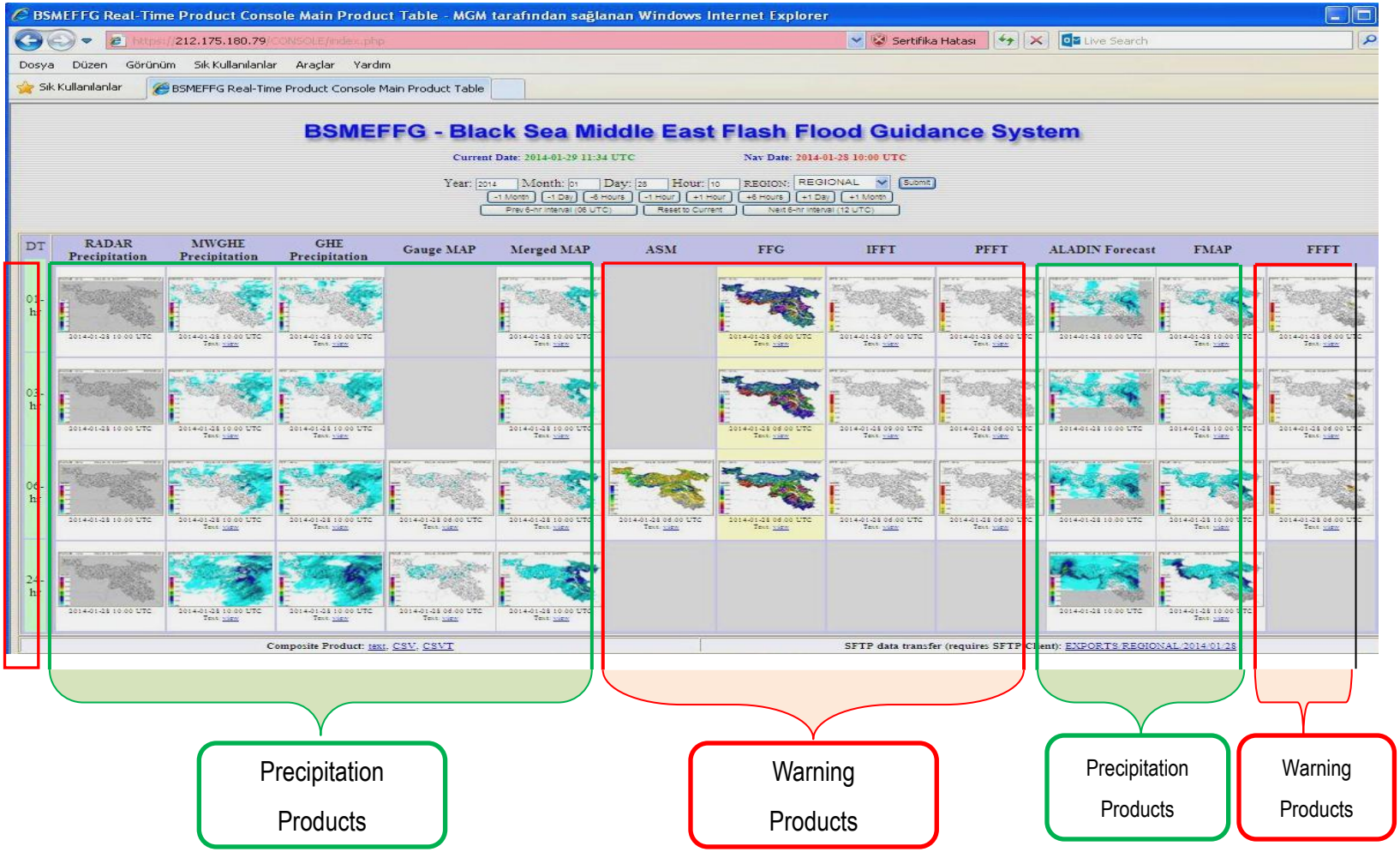


- More than 6.900 sub-basins with average area of 100-150 square kilometer were generated by HRC and sent to the participating counties for checking.

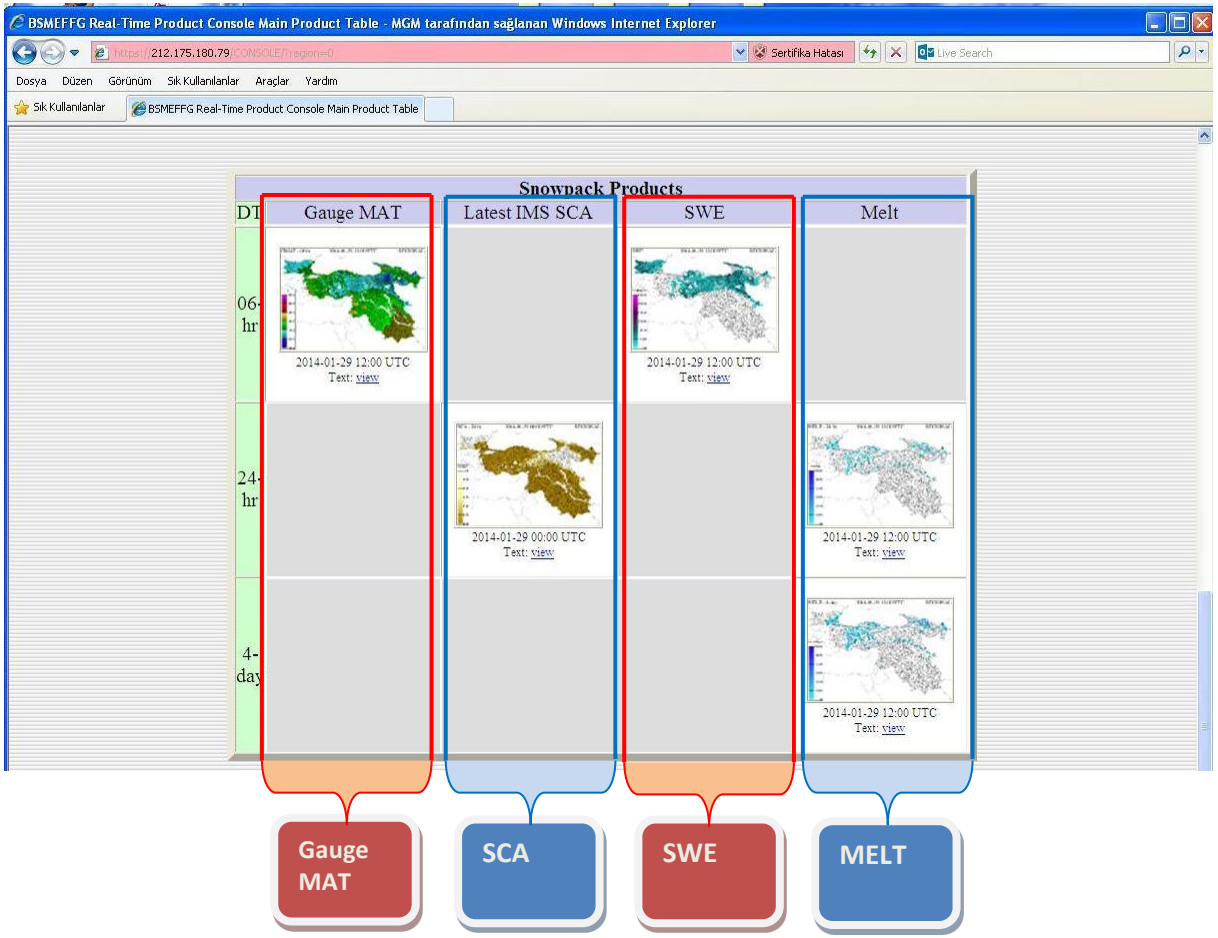
BSMEFFG User Console



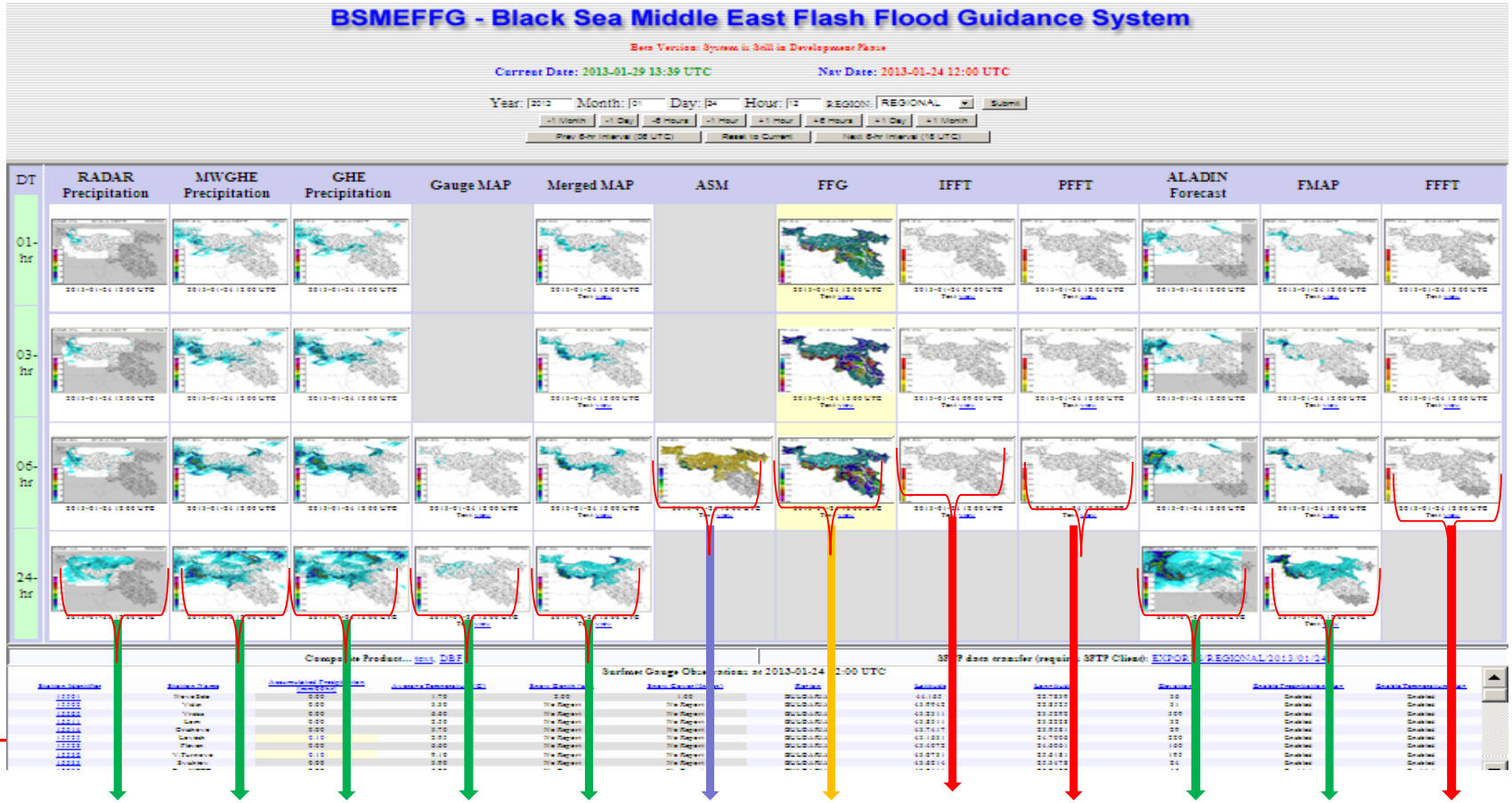
Products


BSMEFFG Real-Time Product Console Main Product Table - MGM tarafından sağlanan Windows Internet Explorer
BSMEFFG - Black Sea Middle East Flash Flood Guidance System
DT
RADAR Precipitation
MWGHE Precipitation
GHE Precipitation
Gauge MAP
Merged MAP
ASM
FFG
IFFT
PFFT
ALADIN Forecast
FMAP
FFFT
Precipitation Products
Warning Products
Precipitation Products
Warning Products

Snow Products



BSMEFFG Products



Surface obs.

Radar Precipt .

Sat. MW Precipt..

Satellite IR precipt.

Gauge MAP

Merged MAP

Soil moisture

FFG

Imminent FFT

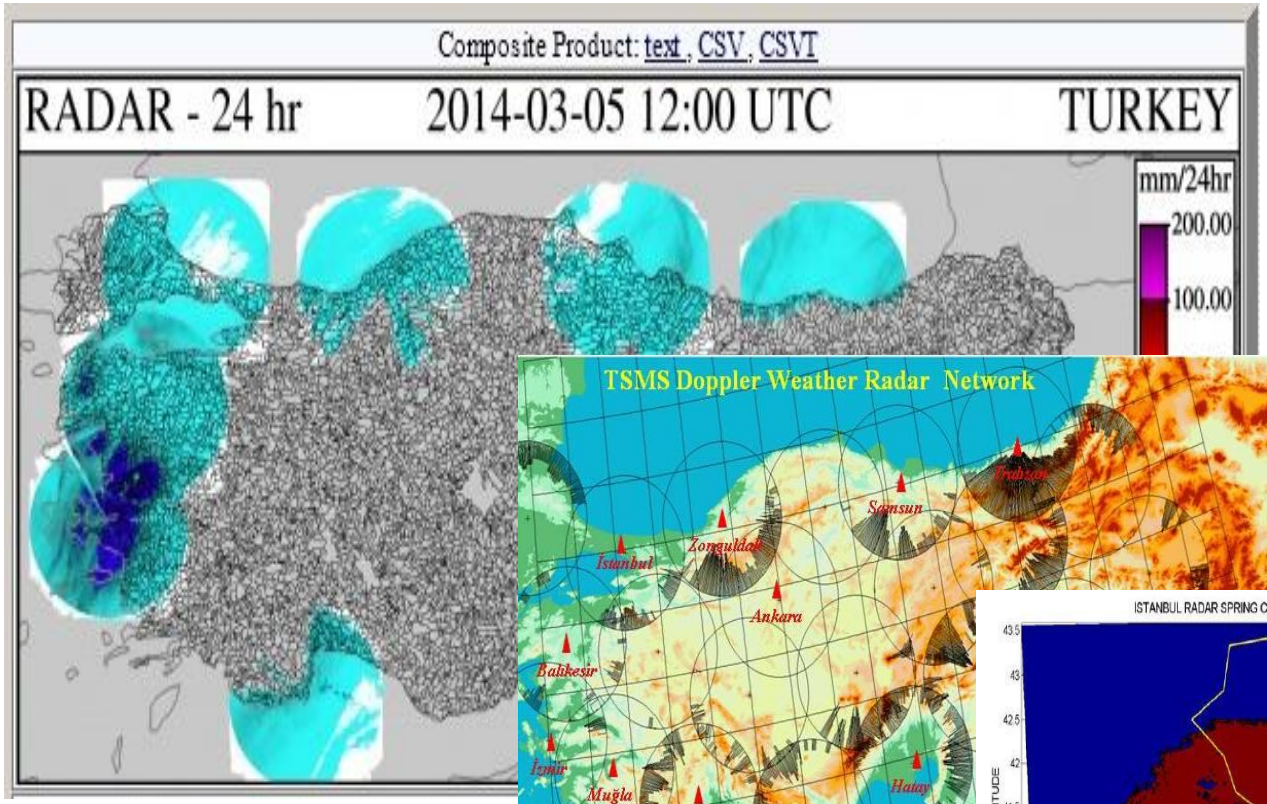
Persistence FFT

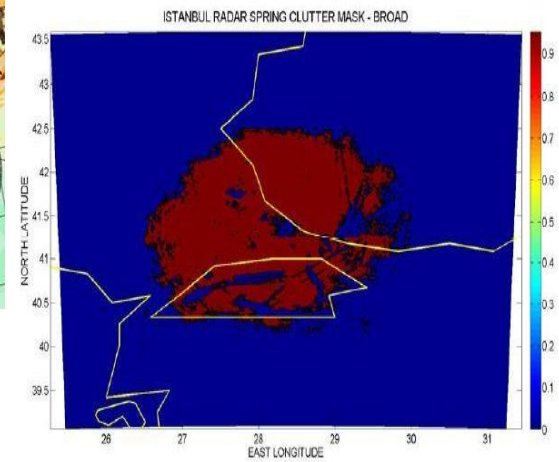
ALADIN Precipt.

FMAP

Forecast FFT

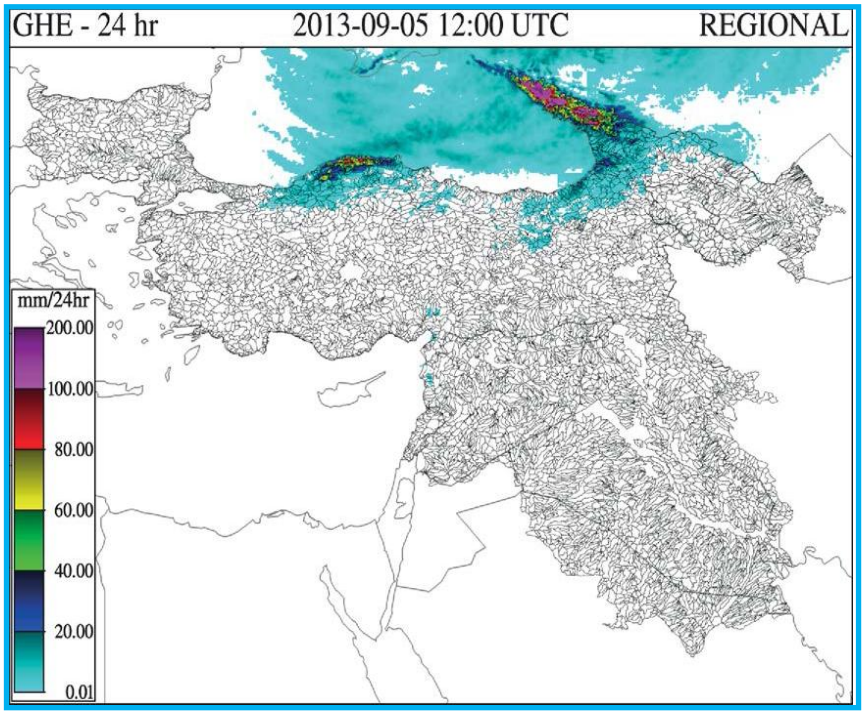
RADAR Precipitation

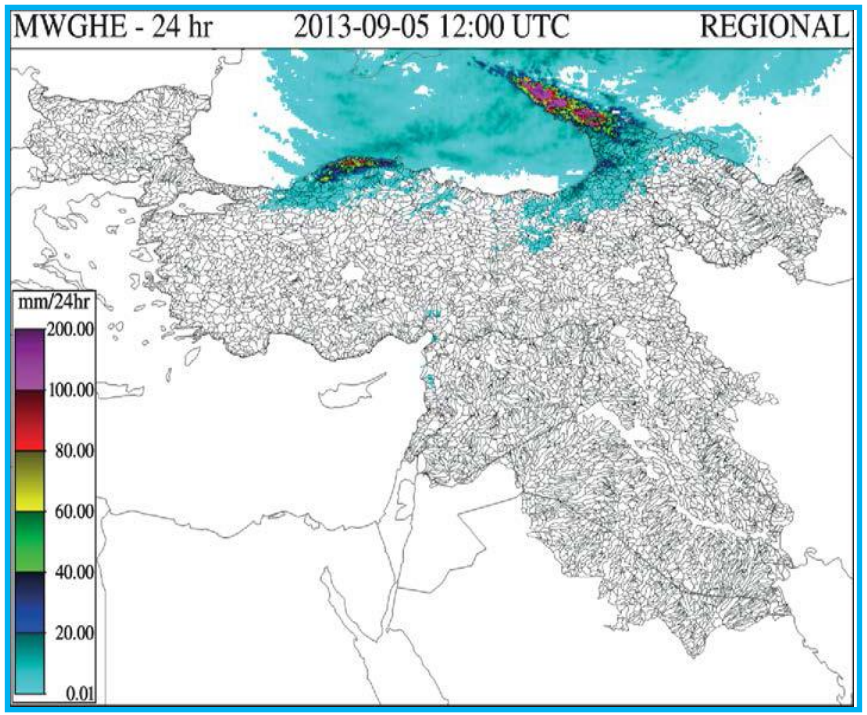




- TSMS has 10 C band Doppler Radar network, covering mostly coastal regions where most flash floods occur.
- HRC created a mask for each Radar to eliminate clutters.

Satellite Precipitation

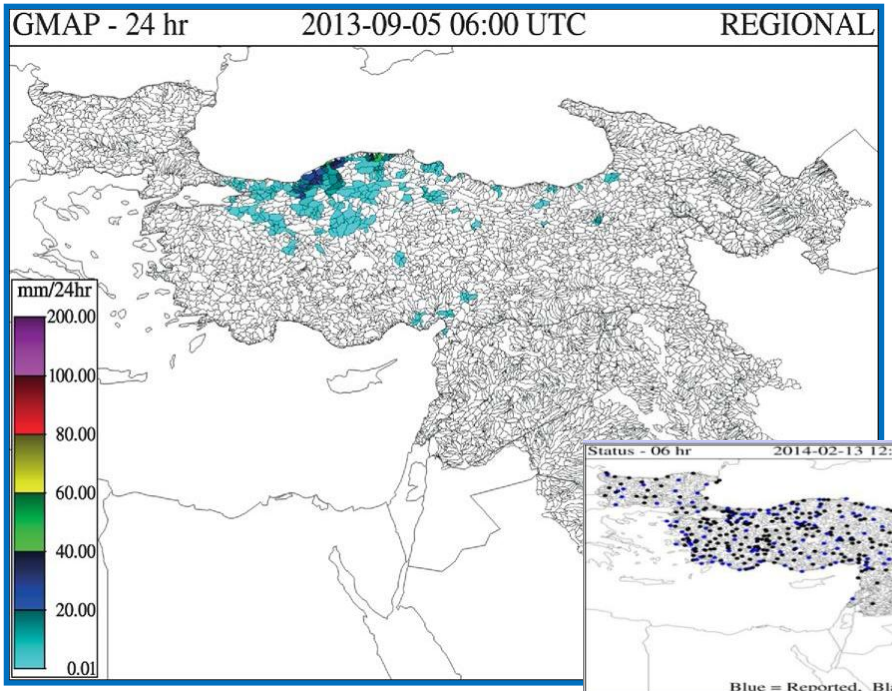


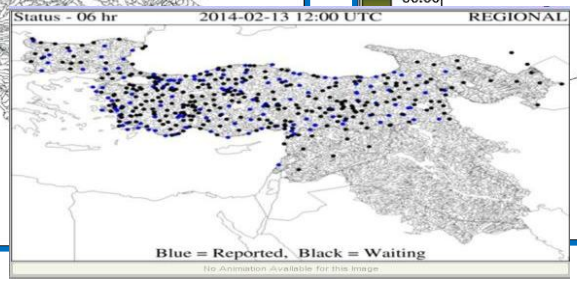


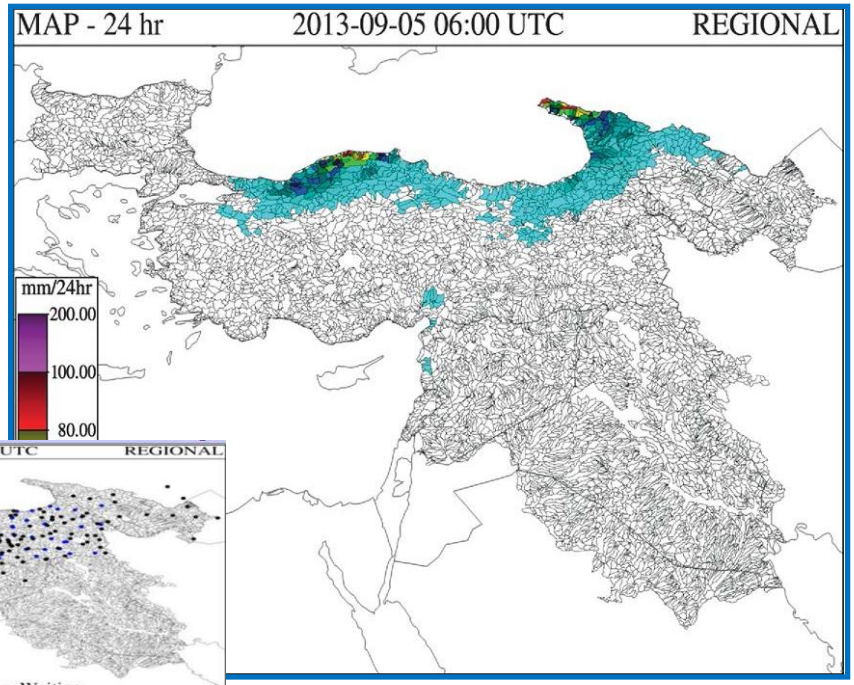
- Global Hydro Estimator (GHE) is generated by NOAA-NESDIS using IR window channels of meteorological geostationary satellites.

- Microwave bias adjusted Global Hydro Estimator (MWGHE) is generated by NOAA-NESDIS by adjusting GHE precipitation with microwave precipitation retrievals from polar orbiting satellites.

Gauge and Merged Mean Areal Precipitation



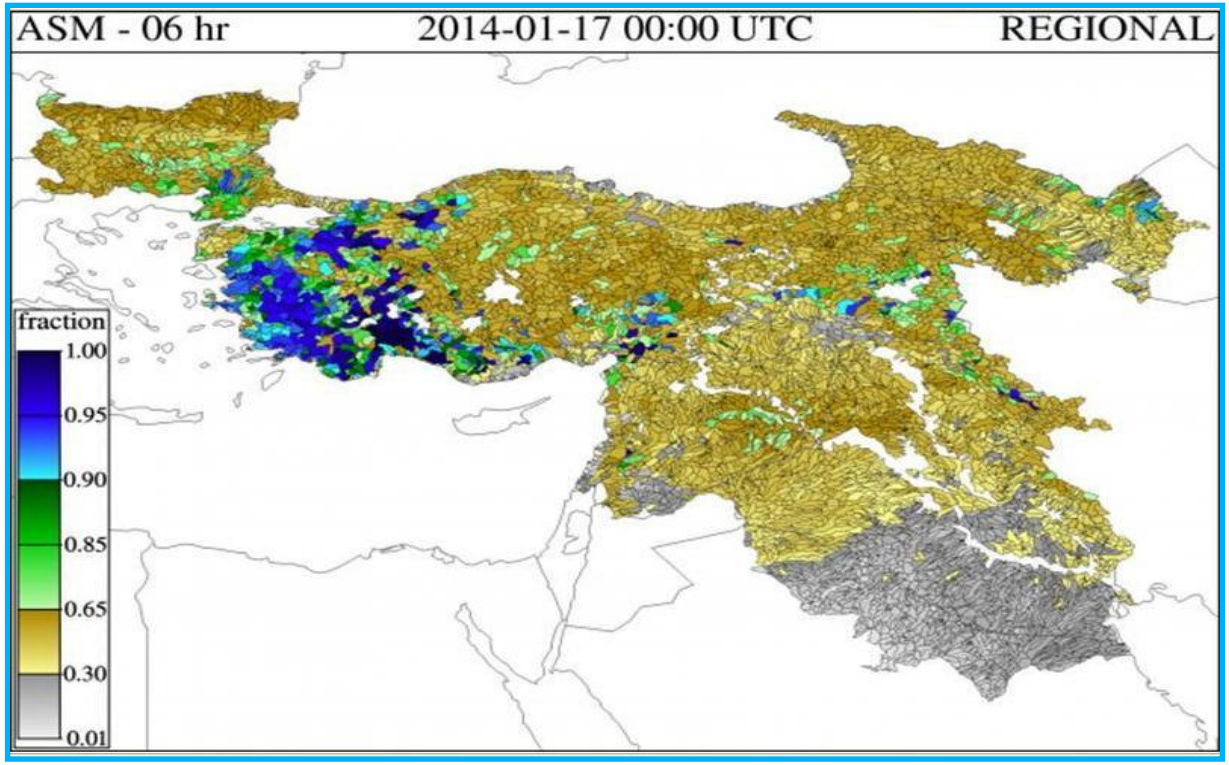




- Gauge Mean Areal Precipitation (GMAP) is created by using surface meteorological observations that are disseminated via WMO GTS communication line. Member states reporting std. are given in the middle picture.

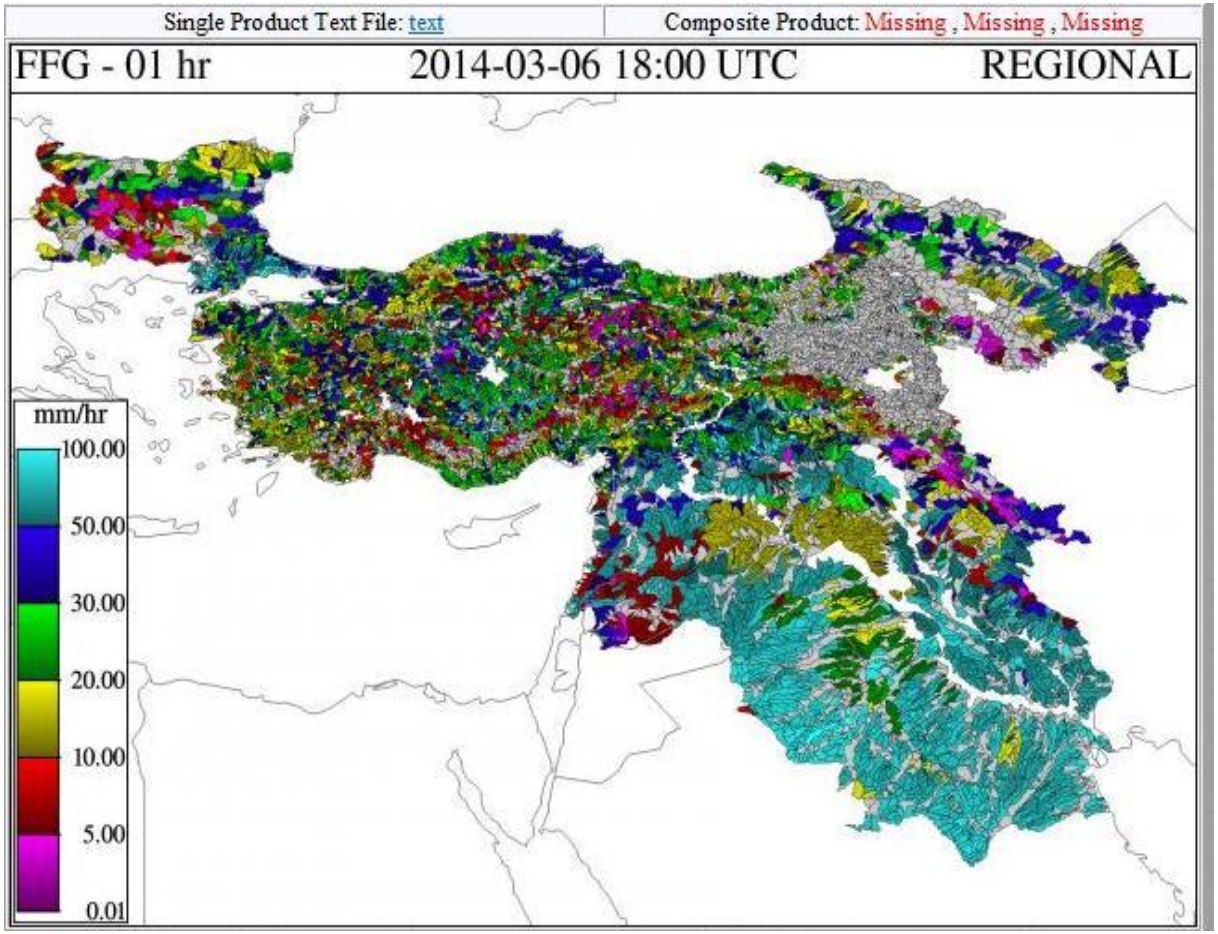
- Merged Mean Areal Precipitation (MAP) is created by merging Radar or satellite or Gauge precipitation.

Average Soil Moisture (ASM)



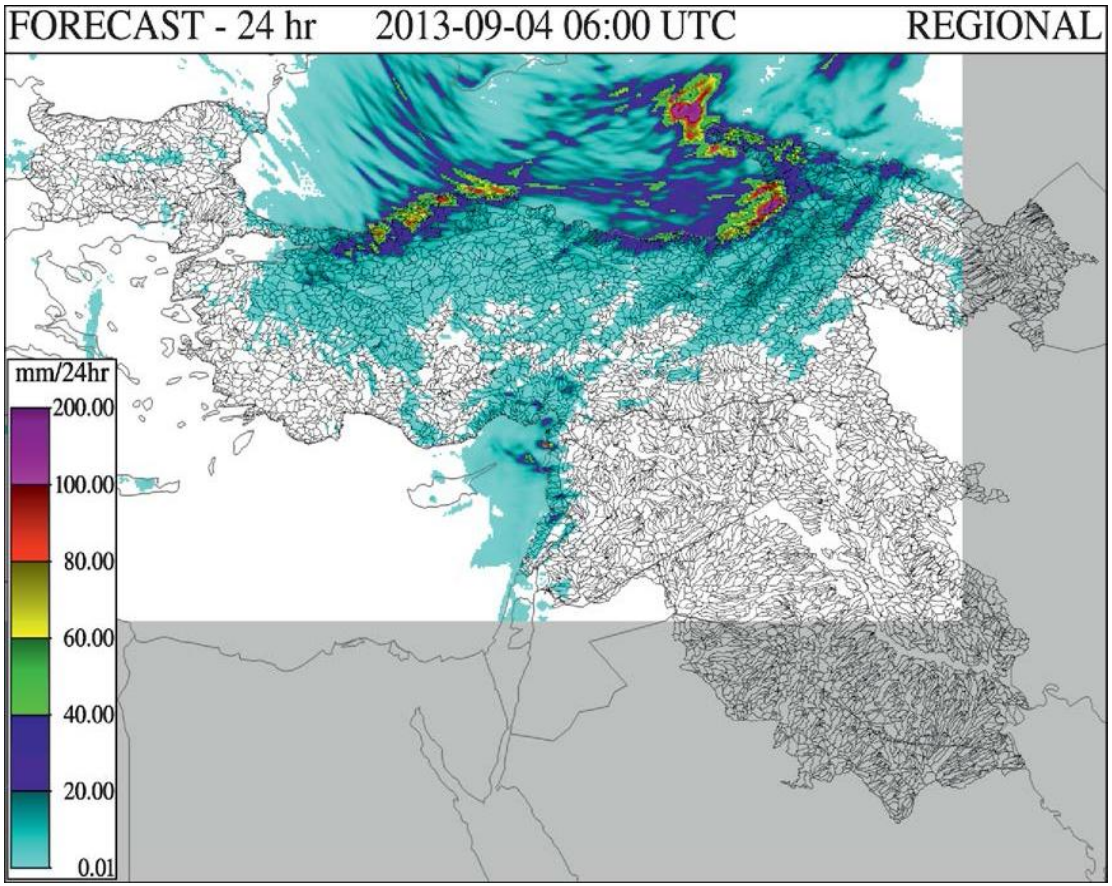
- Average Soil Moisture (ASM) product shows fraction of soil moisture deficit of the upper soil (20-30 cm) for which upper zone tension and free water contents are estimated by using Sacramento Soil Moisture Accounting Model (SC-SMA).

Flash Flood Guidance (FFG)



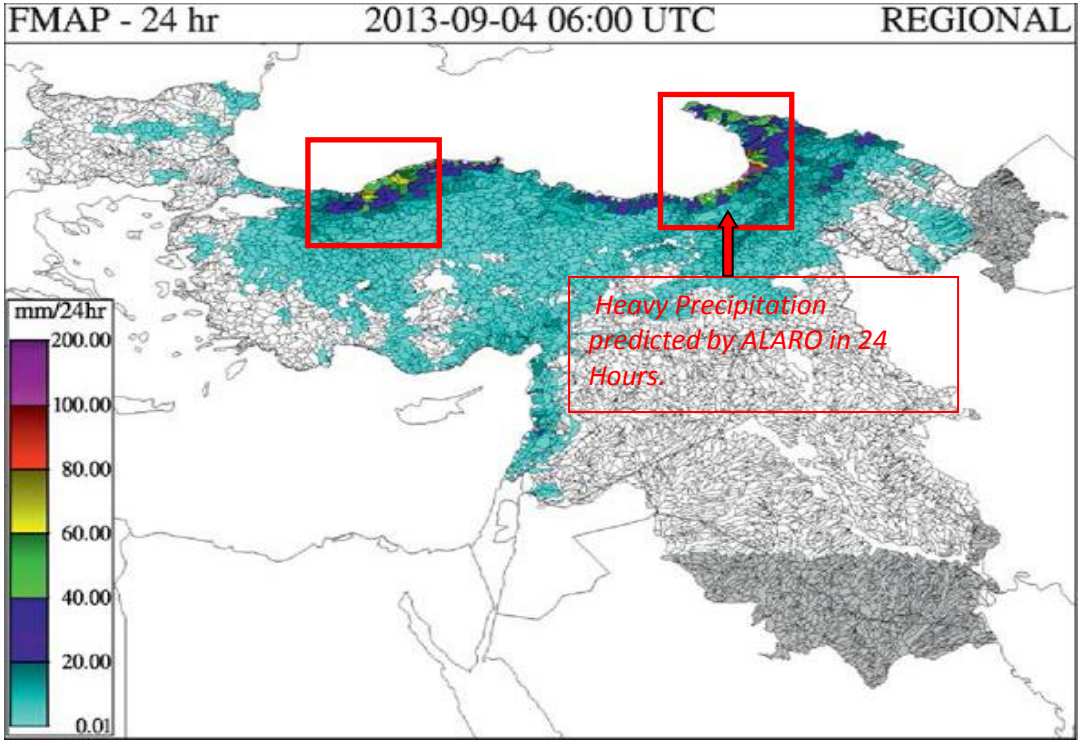
- Flash Flood Guidance, which is defined as the amount of actual rainfall that causes bankfull flow at the end of catchment for a given duration e.g. 1,3 and 6 hours.

NWP Precipitation Forecast



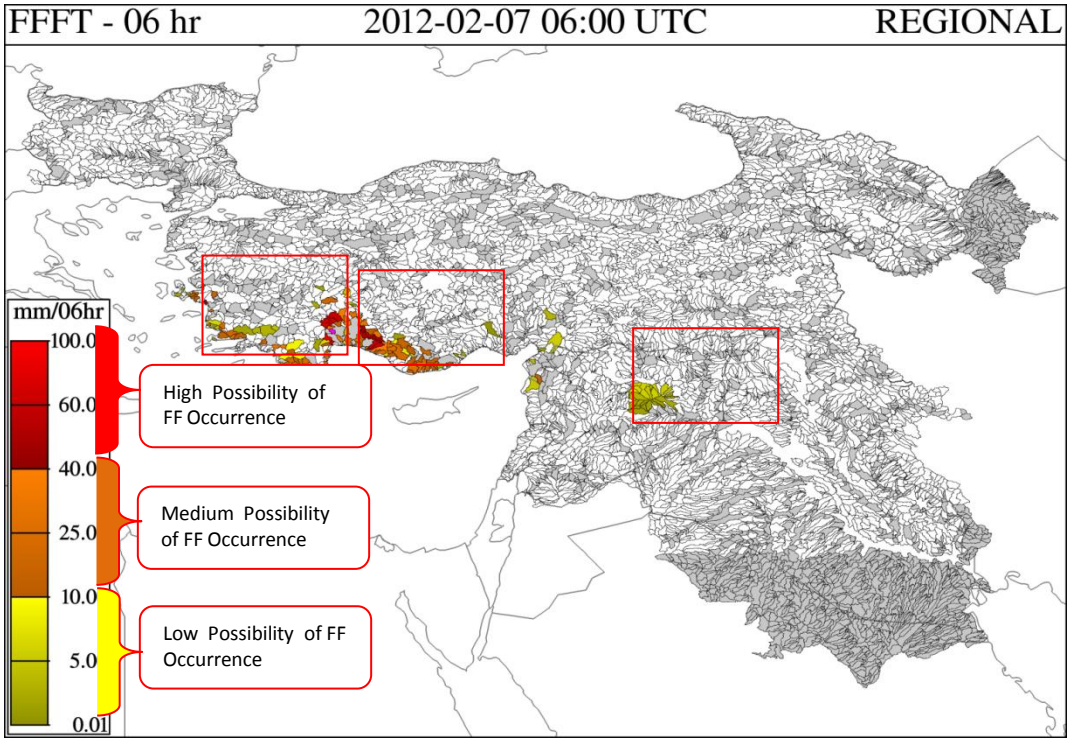
- ALADIN, which was commenced in the early 1990s and led by Metéo France and has 15 member Meteorological Services mostly eastern Europe and Turkey, is a high resolution Limited Area Model for short range forecasting.
- Currently TSMS is running non-hydrostatic version of ALADIN called ALARO with 4.5 km horizontal resolution.
- It runs four times a day at 00 UTC, 06 UTC, 12 UTC and 18 UTC producing precipitation forecast up to 72 hours.

Forecast Mean Areal Precipitation (FMAP)



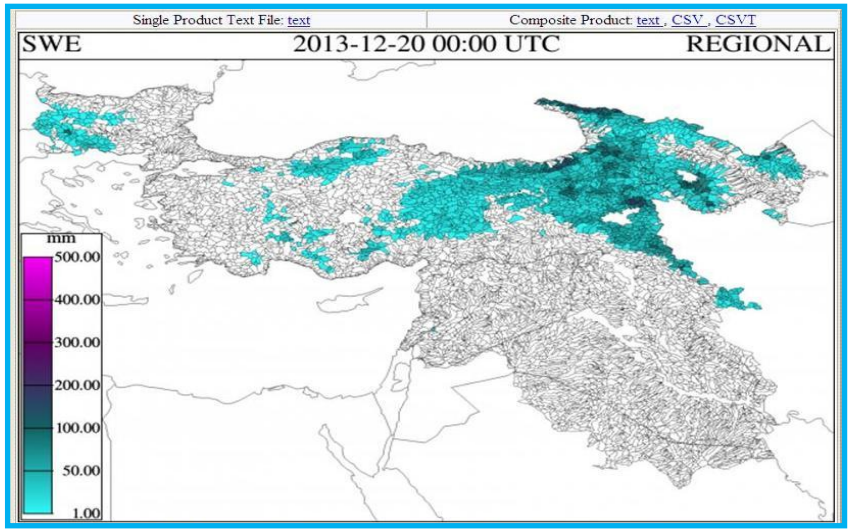
- 1-Hour, 3-Hour, 6-Hour and 24-Hour Forecast Mean Areal Precipitation are generated from ALARO precipitation forecast for each catchment.
- Forecasters should analysis the catchments where intense precipitation occur for a given period and watch these regions for next 24 hours.

Forecast Flash Flood Threat (FFFT)

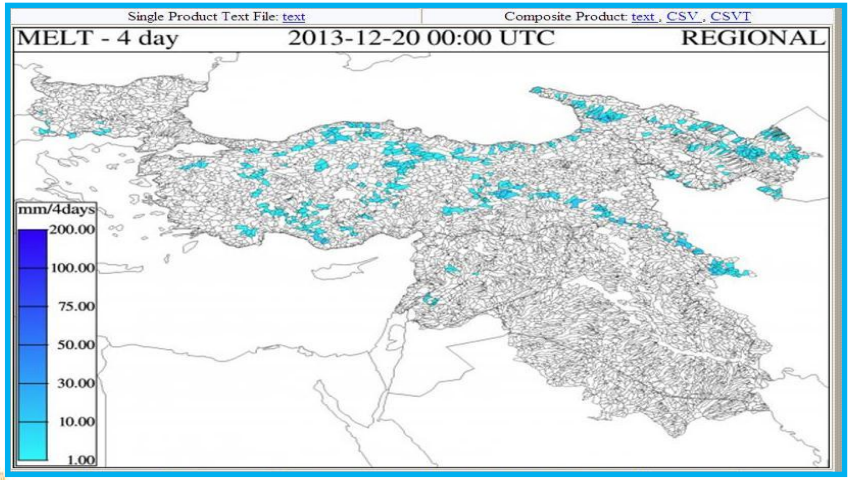


- . FFFT is the differences between forecast mean areal precipitation (FMAP) and FFG.

Snow Products: SWE and MELT

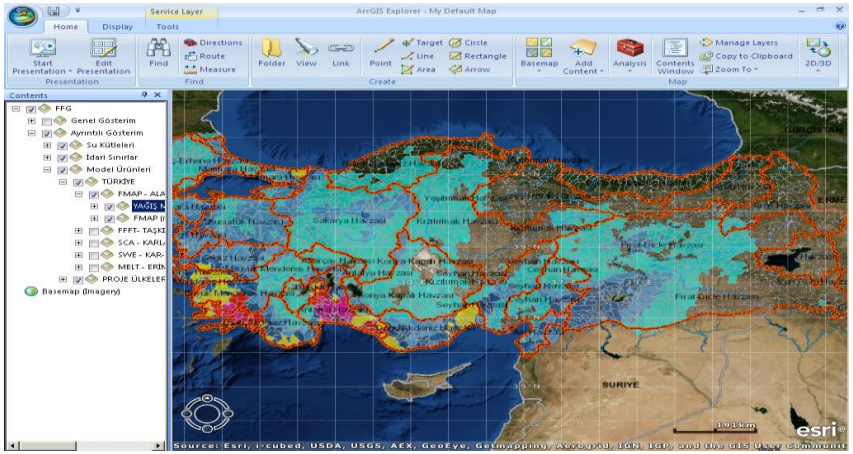


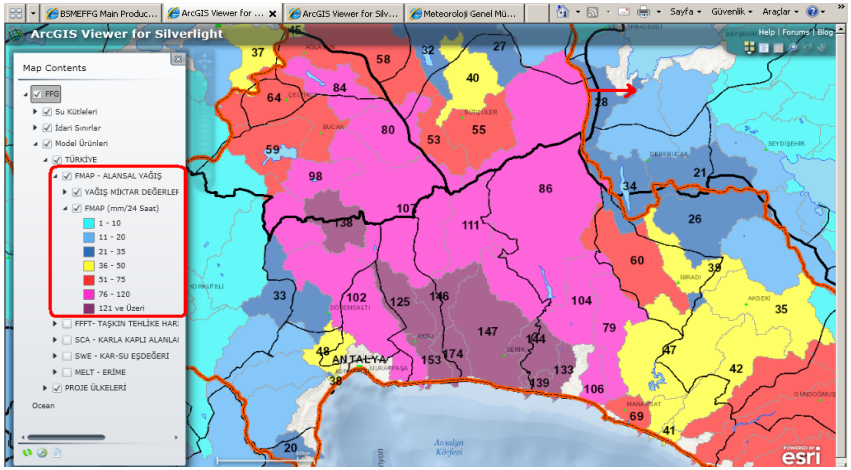
- Snow Water Equivalent (SWE) product is a direct output of SNOW-17 accumulation and ablation model and estimated at 00, 06,12 and 18 UTC. SNOW-17 model gets two parameters namely GMAT and merged MAP and produces a number of products including SWE and MELT by using thermodynamic equations.



- MELT is an estimate of ablation due to melt processes and is a direct output of SNOW-17 model. MELT is estimated every six hours at the model runtimes. 24-Hours and 96-Hour cumulative melt products are created from 6 hourly estimations.

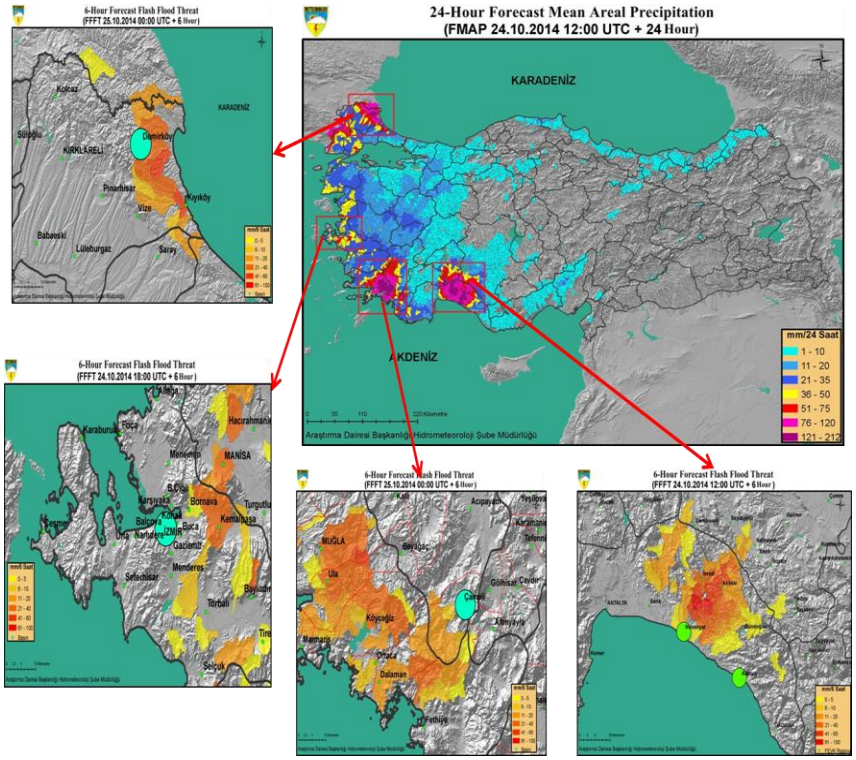
Post-processing with GIS





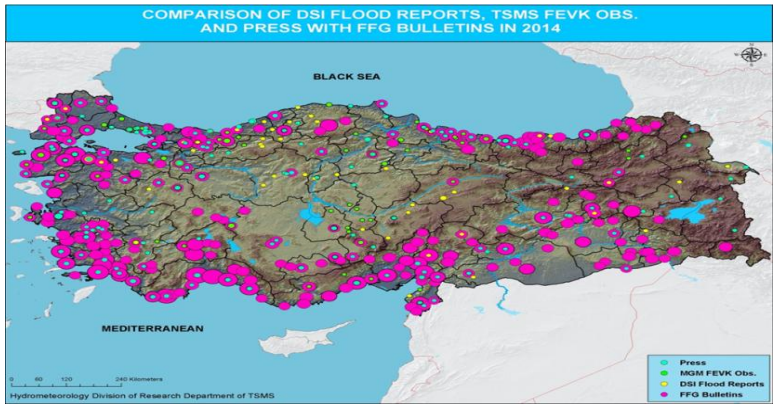
- BSMEEFFG main console displays products for each sub-basin which does not contain any geographical information like topography, cities, towns, borders etc. Forecasters would like to see not only products but also additional layers that are displayed with the products so that precise event locations would be known to them. Thus, Turkish Meteorological Service uses ArcGIS Silverlight product from ESRI to display two and three dimensional display of products with additional layers.

Flash Flood Bulletins and Warnings



Products	Date: 14.05.2014		Time: 00 UTC	
	Status			
	1-hr	3-hr	6-hr	24-hr
GHE (Max , mm)	10-20	20-30	40-60	50-75
Merged MAP (Max, mm)	5-10	10-20	10-20	20-35
FMAP	0-5	10-20	20-40	75-120
ASM (compare last several periods)			Increasing (+)	
FFG (Region and amount (mm))	Adriatic Coast, Central Romania: 10-25 North and southern Romania : 40-60	Adriatic Coast, Central Romania: 10-25 North and southern Romania : 40-70	Adriatic Coast, Central Romania: 15-30 North and southern Romania : 30-60	
I/PFFT (mm)			+ (Romania) 0-10	
FFFT (mm)			+ (Bosnia and Herzegovina) 10-40	
Forecasters Opinion	FF watch/warning is adviced for next 6 hours. In the next 24 hours heavy to very heavy precipitation is expected in the region.			

Verification



		Observations (TSMS, DSİ, Press)		
Bulletins (21 May 2012-17 June 2013)		YES	NO	Σ
	YES	43 (a)	25 (b)	68
	NO	18 (c)	306 (d)	324
	Σ	61	331	392

Hit Rate (POD): (a/(a+c))	0.70
False Alarm Rate (FAR): (b/(a+b))	0.36
False Alarm Rate (POFD): b/(b+d)	0.07
Threat Score: (a/(a+b+c))	0.5

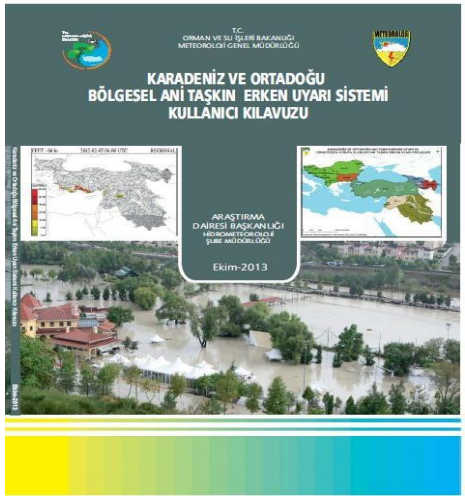
		Observations (TSMS, DSİ, Press)		
Bulletins 2014		YES	NO	Σ
	YES	58(a)	10 (b)	68
	NO	48 (c) (DSİ+MGM+Basın)	249 (d)	297
	Σ	106	259	365

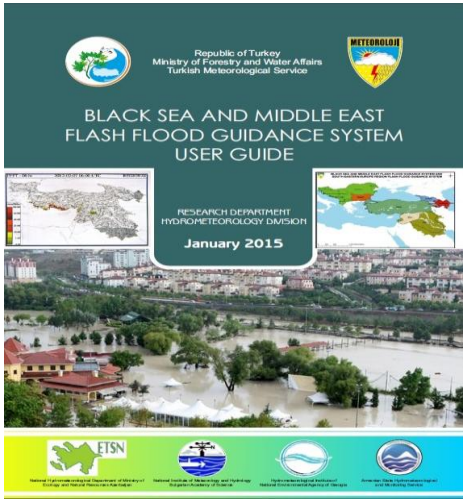
Hit Rate (POD): (a/(a+c))	0.55
False Alarm Rate (FAR): (b/(a+b))	0.15
False Alarm Rate (POFD): b/(b+d)	0.04
Threat Score: (a/(a+b+c))	0.5

Operational Training at HRC

- BSMEFFG operational training took place in San Diego on 8 April-3 May 2013.
- Trainees from Turkey, Bulgaria, and Georgia participated.
- Scientific, technical, and operational aspects were presented and case studies were conducted.

Forecasters Training of TSMS





- 55 forecasters from 15 regional forecasting offices were trained about BSMEFFG products and how to use them in daily forecasting held in Ankara at WMO RTC on 30 October-1 November 2013.
- BSMEFFG user guides were prepared in Turkish & English.
- Similar training is planned to be given in each member state.

Forecaster Training of Participating NMHSs

- BSMEFFG forecasters training took place at the NMHSs of Armenian, Azerbaijan, and Georgia on 19-23 May, 26-29 May, and 21-25 July 2014 respectively.
- Moreover, Meteorological Data Processing and Visualization Software of TSMS called METCAP+ was installed and training was provided to NMHSs of Georgian and Azerbaijan.

Cooperation with Universities

- Prof.Dr. Zekai Şen of İstanbul Technical University was the hydrological consultant to TSMS. He gave training on the principles of hydrology, hydrological forecasting, routing, Kalman Filter, numerical analysis, QPE. Pictures show him giving lectures to hydrometerology division employees on ,among others, ensemble prediction on 4-8 November 2013 in Ankara.

World Meteorological Organization

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Thank you for your attention

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