BLACK SEA AND MIDDLE EAST FLASH FLOOD GUIDANCE SYSTEM IMPLEMENTATION

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Black Sea and Middle East Flash Flood Guidance

Flash floods are among the world's deadliest natural disasters with more than 5,000 lives lost annually and result in significant social, economic and environmental impacts. Accounting for approximately 85% of the flooding cases, flash floods also have the highest mortality rate (defined as the number of deaths per number of people affected) among different classes of flooding (e.g., riverine, coastal). Flash floods have a different character than river floods, notably short time scales and occurring in small spatial scales, which make forecasting of flash floods quite a different challenge than traditional flood forecasting approaches. In forecasting of flash floods, we are concerned foremost with the forecast of occurrence, and herein focused on two causative events,

1) intense rain fall and
2) rainfall on saturated soils.

Flash floods occur throughout the world, and the time thresholds vary across regions from minutes to several hours depending on land surface, geomorphological, and hydroclimatological characteristics of the region. However, for the majority of these areas there exists no formal process for flash flood warnings and a lack of capacity to develop effective warnings for these quick response events.

To address the issues associated with flash floods, especially to address the lack of capacity to develop effective flash flood warnings, the Flash Flood Guidance System (FFGS) was designed and developed for use by meteorological and hydrologic forecasters throughout the world. In support of the FFGS program, a Memorandum of Understanding was signed among the World Meteorological Organization, the U.S. Agency for International Development /Office of U.S. Foreign Disaster Assistance, the U.S. National Oceanic and Atmospheric Administration/National Weather Service , and the Hydrologic Research Center (a U.S. non-profit corporation) to work together under a cooperative initiative to implement the FFGS worldwide.
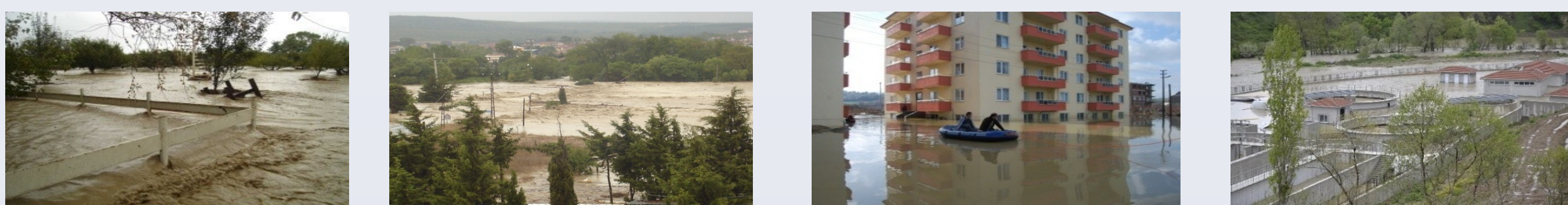

Figure 1: Flash Flood Events in Turkey

The FFGS program is a public benefit effort on behalf of the partners. The Black Sea Middle East FFG system was designed and developed as part of this initiative.
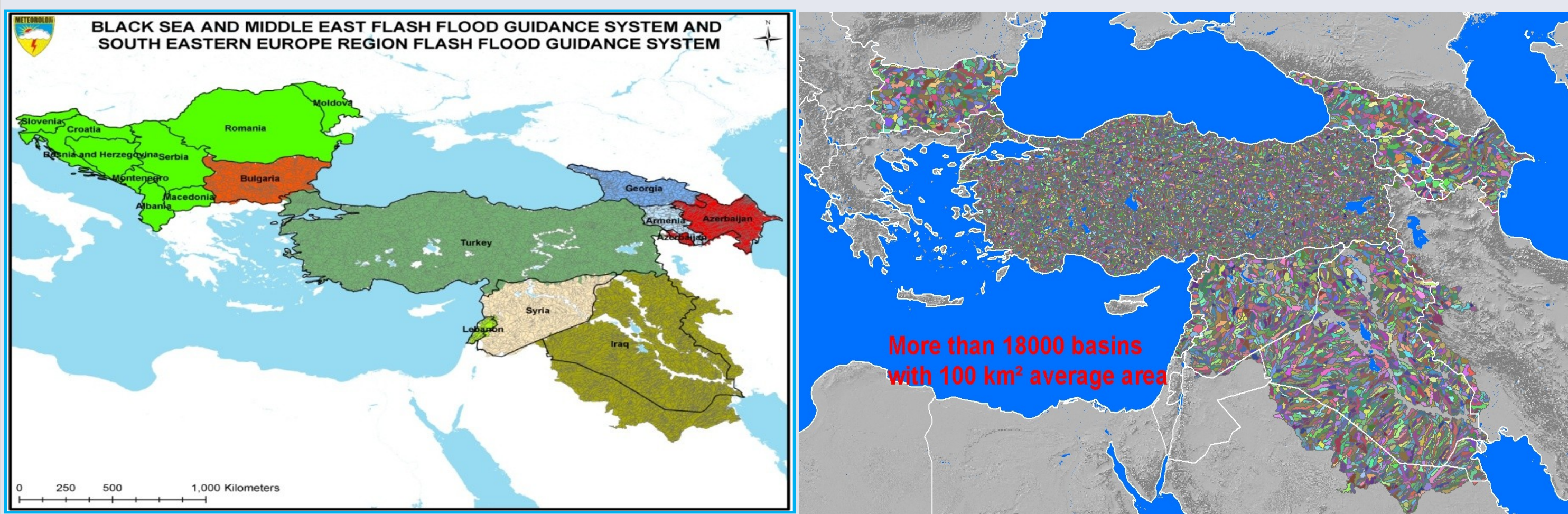

Figure 2: BSMEFFG System Area and Basin Delineations

More than 18000 basins with 100 km² average area

Global Design Concept & Coverage

Global FFGS Development Center (HRC)

	Completed	In Progress	Under Planning	Total
Counties	30	15	6	51
Population (Million)	754	184	65	1.003

Objectives of BSMEFFG System

A system such as the FFGS is an important tool necessary to provide operational forecasters and disaster management agencies with real-time informational guidance products pertaining to the threat of small-scale flash flooding. The FFGS is a robust system designed to provide the necessary products to support the development of warnings for flash floods from rainfall events through the use of remote-sensed precipitation (e.g., radar and satellite-based rainfall estimates) and hydrologic models. To assess the threat of a local flash flood, the FFGS is designed to allow product adjustments based on the forecaster's experience with local conditions, incorporation of other information (e.g., Numerical Weather Prediction output) and any last minute local observations (e.g., non-traditional rain gauge data) or local observer reports.
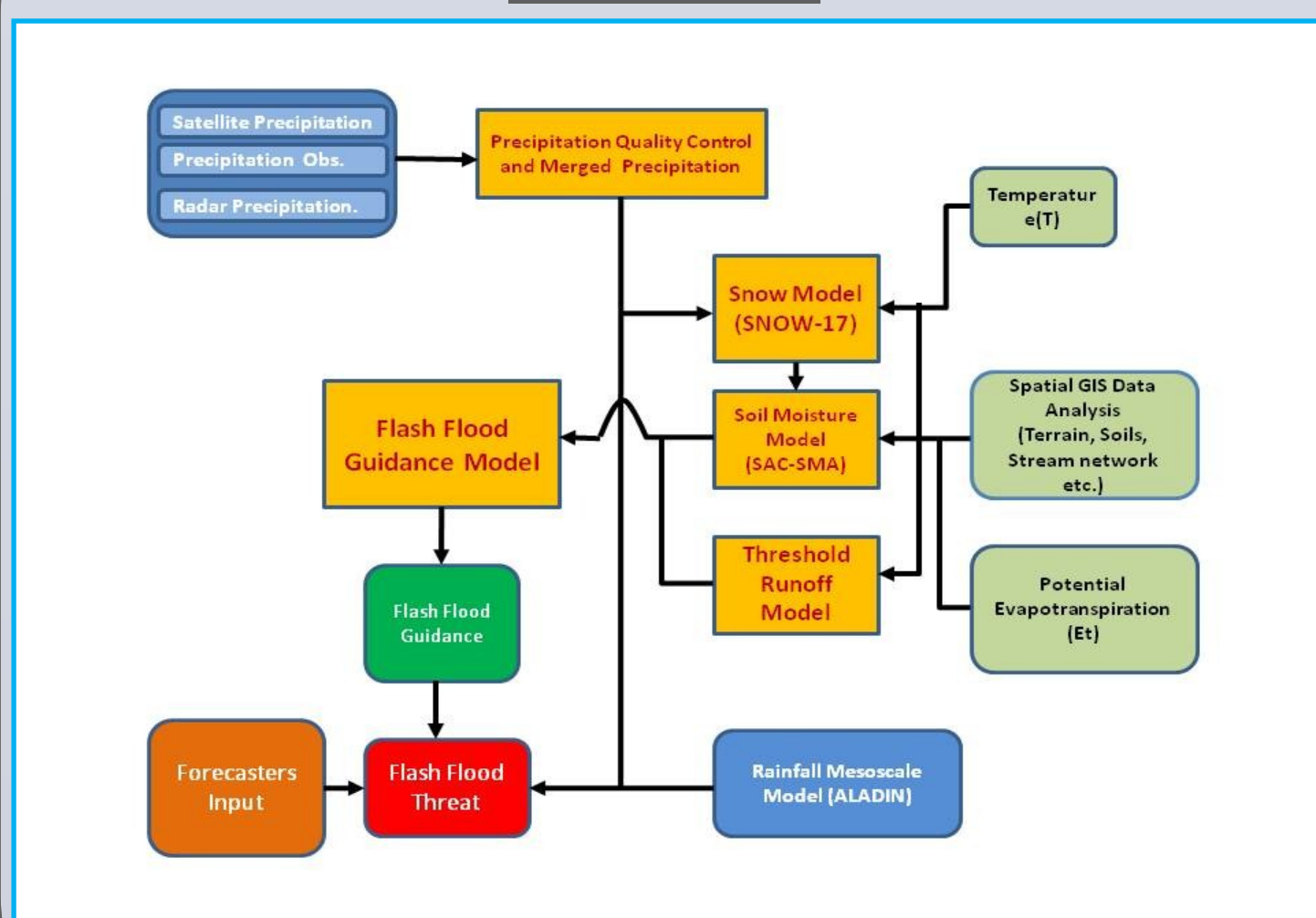
Flash Flood Guidance Model Consept

Figure 3: Flash Flood Guidance System technical components
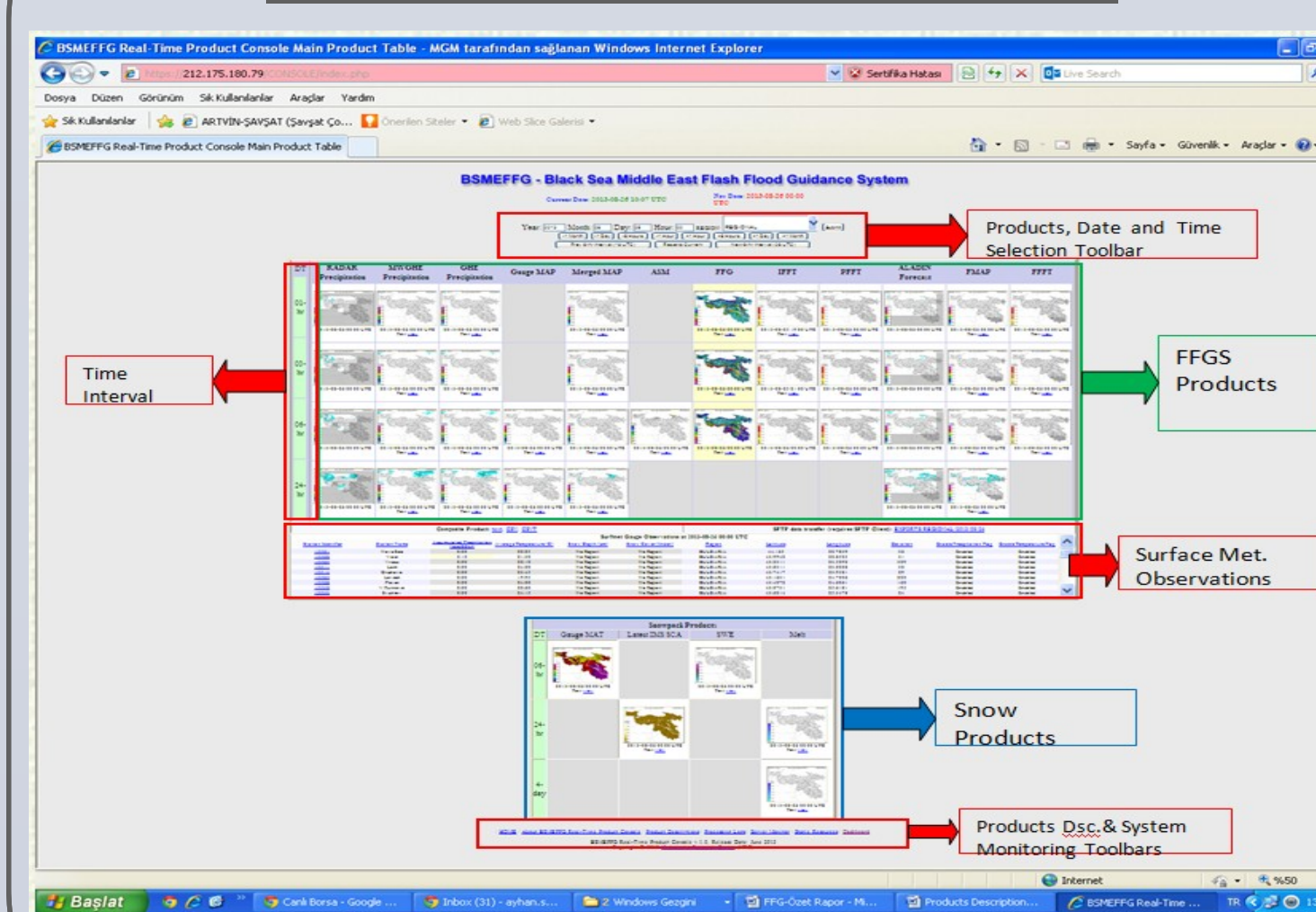
Main Products Console

Figure 4: BSMEFFG forcaster interface console

Products of BSMEFFG System

The BSMEFFG System products can be classified into three groups; precipitation products, warning products, and snow products.

Precipitation Products

• **RADAR Precipitation** – from the Turkish State Meteorological Service Radar Network,
• **MWGHE Precipitation** – Satellite-based Microwave-adjusted Global Hydro Estimator Precipitation (from U.S. NOAA),
• **GHE Precipitation** – Satellite-based Global Hydro Estimator Precipitation (from U.S. NOAA),
• **Gauge MAP** – Basin Mean Areal Precipitation based on available gauge data only,
• **Merged MAP** – Basin Mean Areal Precipitation based on radar, MWGHE or GHE precipitation,
• **ALADIN Forecast** – ALADIN LAM forecast precipitation,
• **FMAP** – Forecast Basin Mean Areal Precipitation based on ALADIN LAM quantitative precipitation forecasts.

Warning Products

• **ASM** – Average Soil Moisture,
• **FFG** – Flash Flood Guidance,
• **IFFT** – Imminent Flash Flood Threat,
• **PFFT** – Persistence Flash Flood Threat,
• **FFFT** – Forecast Flash Flood Threat.

Snow Products

• **Gauge MAT** – Basin Mean Areal Temperature based on available temperature gauges,
• **Latest IMS SCA** – Fraction of basin area with snow cover,
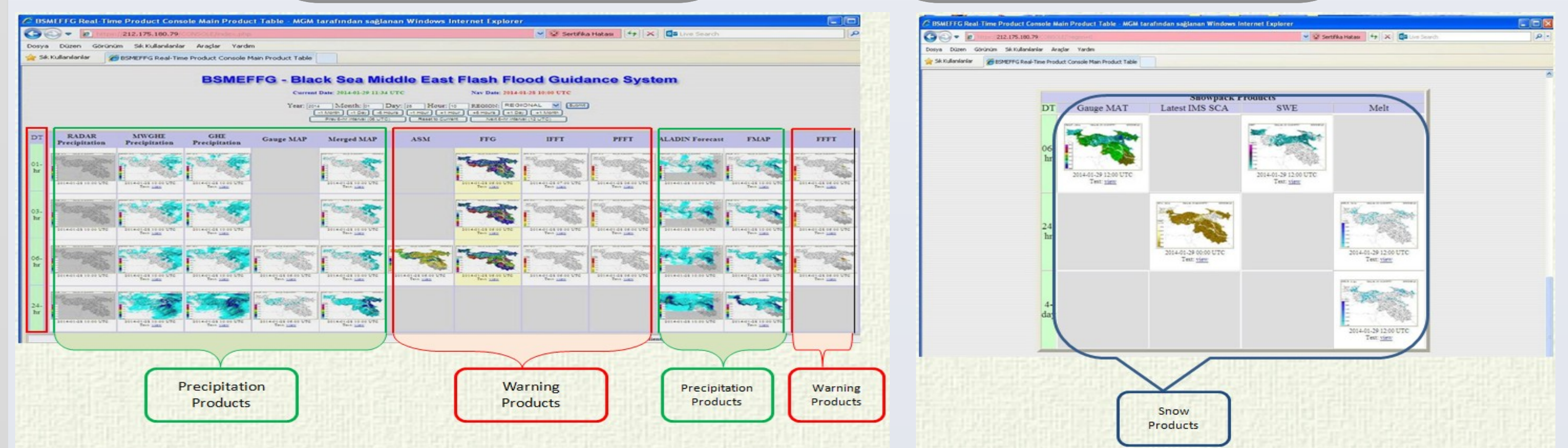• **SWE** – Snow Water Equivalent,
• **MELT** – Snow Melt.

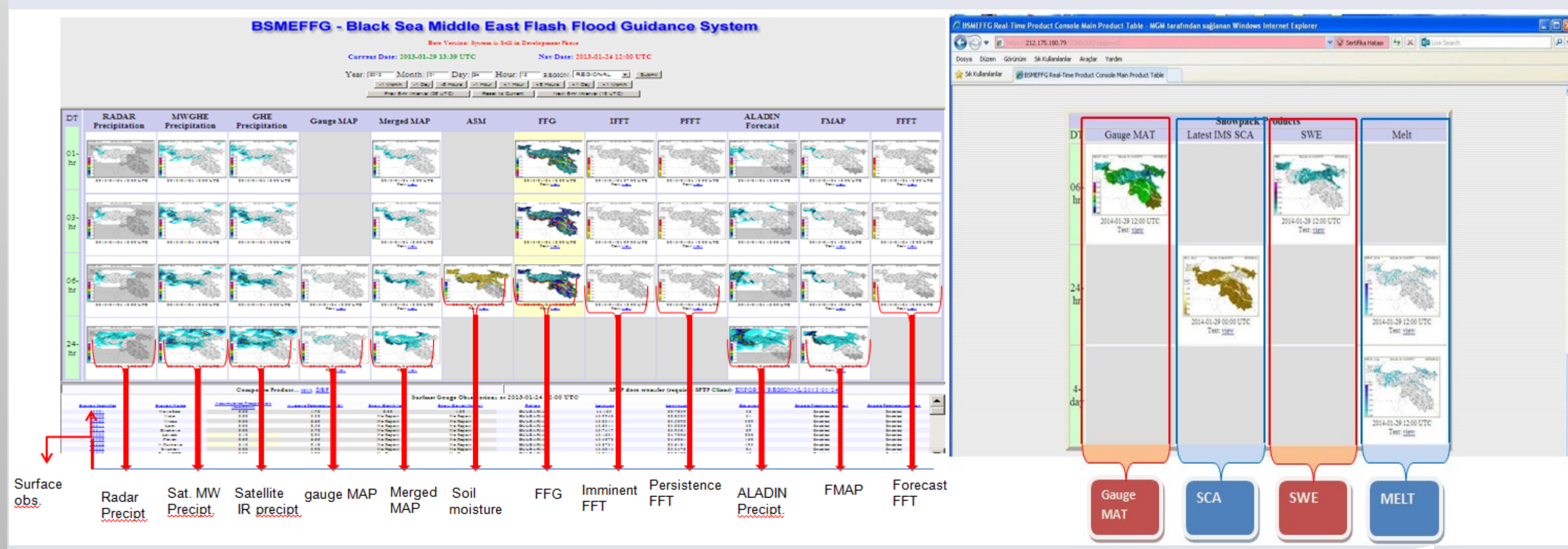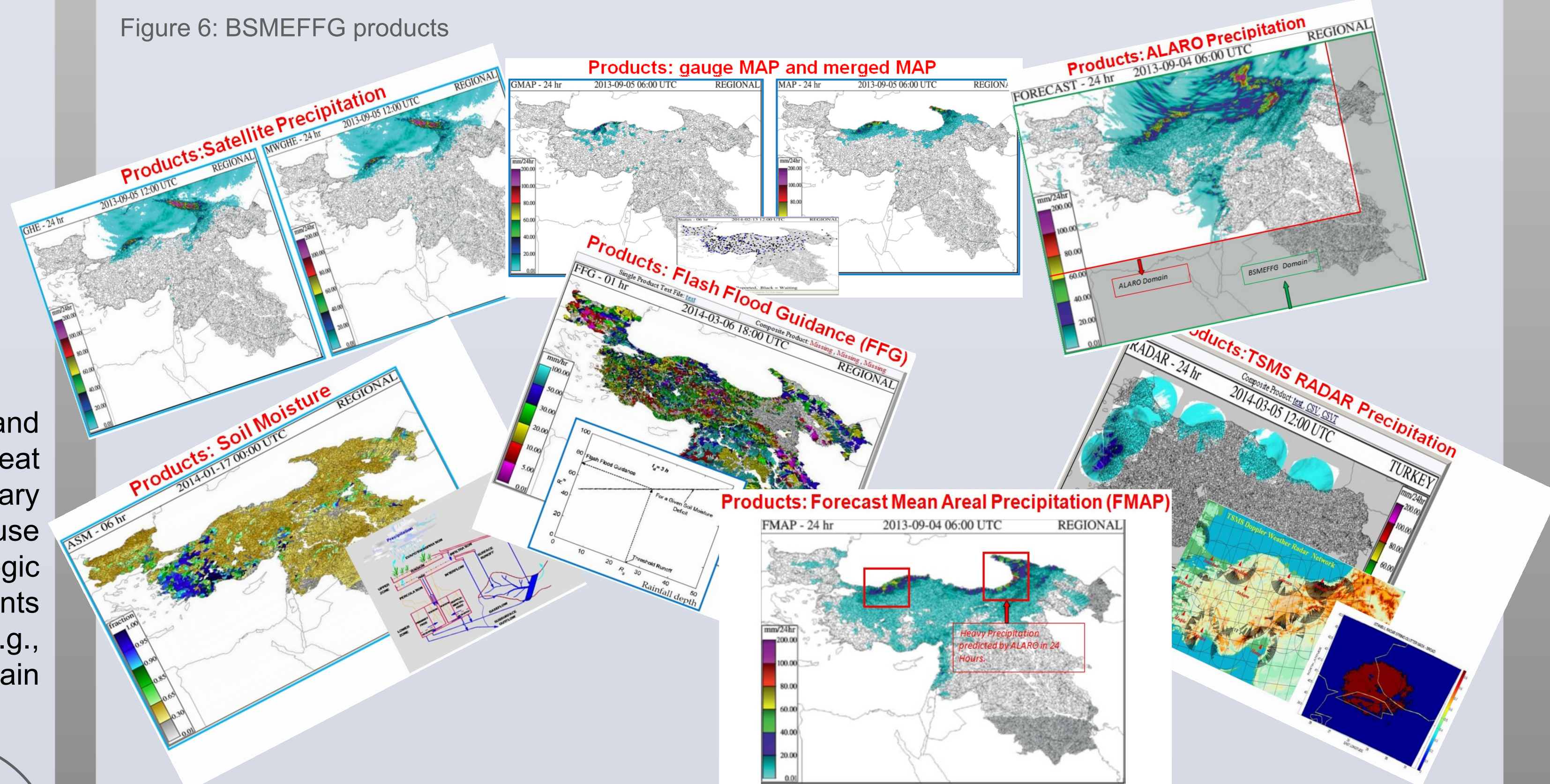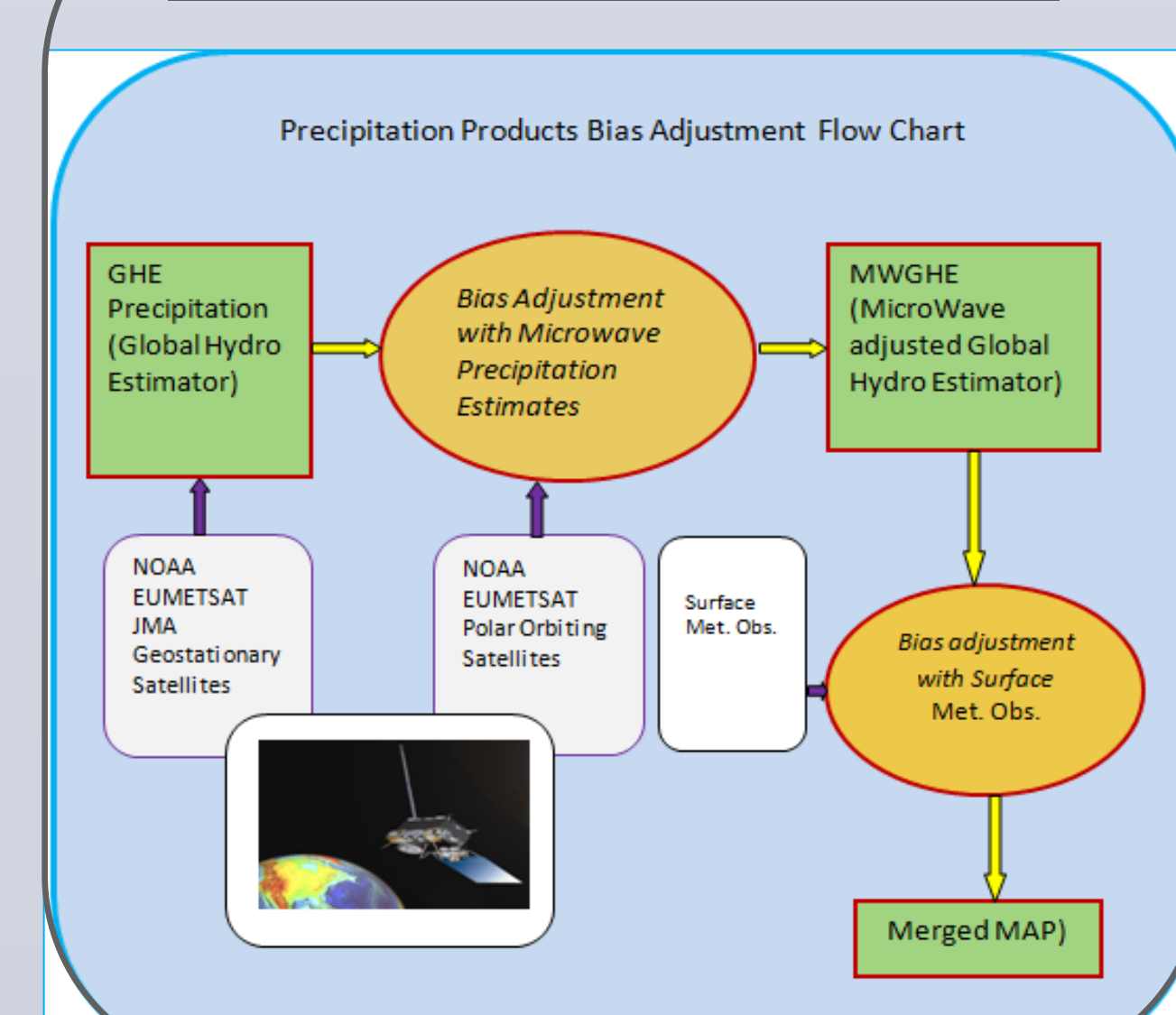Figure 5: BSMEFFG precipitation, snow and warning products

Figure 6: BSMEFFG products

Products: gauge MAP and merged MAP
Products: ALARO Precipitation
Products: Satellite Precipitation
Products: Flash Flood Guidance (FFG)
Products: TSMS RADAR Precipitation
Products: Soil Moisture
Products: Forecast Mean Areal Precipitation (FMAP)

Precipation Summary

Precipitation Products Bias Adjustment Flow Chart

Verification

		Y	N	
Bulletin (21 May-17 June 2013)	Y	43 (a)	25(b)	68
	N	18 (DSI) (c)	306(d)	324
		61	331	392

Observations (Flash Flood Reports: TSMS+DSI+Press)

Figure 7: Contingency table of FF bulletins for Turkey

Hit Rate: (a / (a+b))	0.70
Threat Score: (a / (a+b+c))	0.50
False Alarm Ratio(FAR): (b / (a+b))	0.41

During verification period, 26 people were killed due to FF. FF bulletins were not prepared for the events in which 3 people were killed.