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Overview of the Global Flash Flood Guidance System

Third meeting of the FFI Advisory Group
5 to 7 December 2017



WMO OMM

World Meteorological Organization

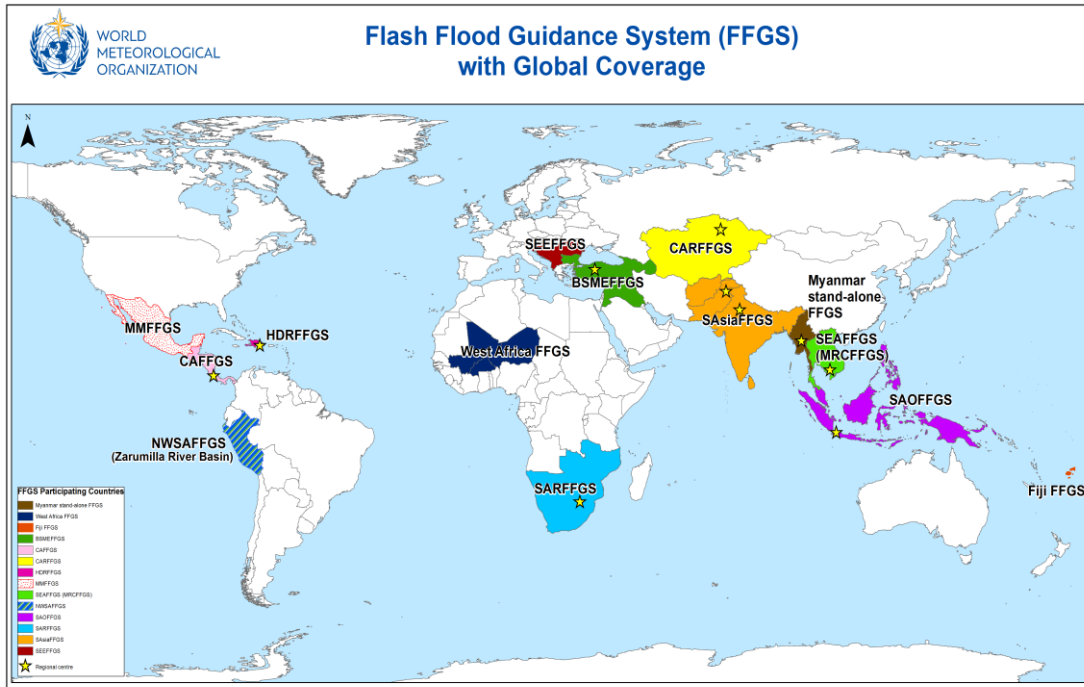
Organisation météorologique mondiale

Flash Floods – The most deadly natural (weather-related) disaster in the world

- “Recent findings of the WMO country-level survey where of the 139 countries, 105 indicated that flash floods were among the top two most important hazards around the world and require special attention”.
- “On the average, these events kill more people worldwide than any other [weather-related] natural disaster; in an average year, flash floods kill over 5,000 unsuspecting people and cause millions of dollars of property damage”(WMO 2008).



Flash Flood Guidance System (FFGS)



Flash Flood Guidance System with global coverage (Resolution 21, World Meteorological Congress-XV) enhances early warning capabilities of the NMHSs, currently **covers more than 60 (sixty) countries** and **more than two billion people** around the world saving lives and decreasing economic losses.

The WMO Commission for Hydrology (CHy) jointly with the WMO Commission for Basic Systems (CBS) and in collaboration with the US National Weather Service, Hydrologic Research Center (HRC), and USAID/OFDA have developed the concept of the Flash Flood Guidance System (FFGS) with global coverage.

The concept has been endorsed by the Fifteenth WMO Congress and is being implemented through a series of regional projects with funding from USAID.

Regional FFGS Projects

The following regional Flash Flood Guidance (FFG) projects have been implemented or under implementation:

- **Central America FFGS** (Operational): Costa Rica (Regional Centre RC), Belize, El Salvador, Guatemala, Honduras, Nicaragua, and Panama;
- **Southern Africa Region FFGS**: (Operational): Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa (RC), Swaziland, Zambia, and Zimbabwe;
- **Mekong River Commission FFGS** (Operational): Cambodia (RC), Lao People's Democratic Republic, Thailand, and Viet Nam;
- **Black Sea and Middle East FFGS** (Operational): Armenia, Azerbaijan, Bulgaria, Georgia, Israel, Jordan, Lebanon, and Turkey (RC);
- **South East Europe FFGS** (Operational): Albania, Bosnia-Herzegovina, Croatia, Moldova, Montenegro, Romania, Serbia, Slovenia, The Former Yugoslav Republic of Macedonia, and Turkey (RC);



Regional FFGS Projects

- **Southeastern Asia-Oceania FFGS** (under implementation): Brunei Darussalam, Indonesia (RC), Malaysia, Papua New Guinea, Philippines, and Timor-Leste;
- **South Asia FFGS** (under implementation): Afghanistan, Bangladesh, Bhutan, India (RC), Nepal, Pakistan (RC), and Sri Lanka;
- **Central Asia Region FFGS** (under implementation): Kazakhstan (RC), Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan;
- **South America Pilot FFGS** (Completed): Zarumilla River Basin (Peru and Ecuador);
- **Haiti and Dominican Republic FFG (HDRFFG)** (under implementation): Dominican Republic and Haiti;
- **Myanmar stand-alone FFG System** (under consideration).

Regional FFGS Projects

- **Southeast Asia FFGS** (under Consideration): Lao PDR, Cambodia, Thailand, and Vietnam;
- **Fiji FFGS** (under consideration): Fiji; and
- **West Africa FFGS** (under considiration): Burkina Faso, Mali, and Niger;

Objectives of the FFGS with Global Coverage

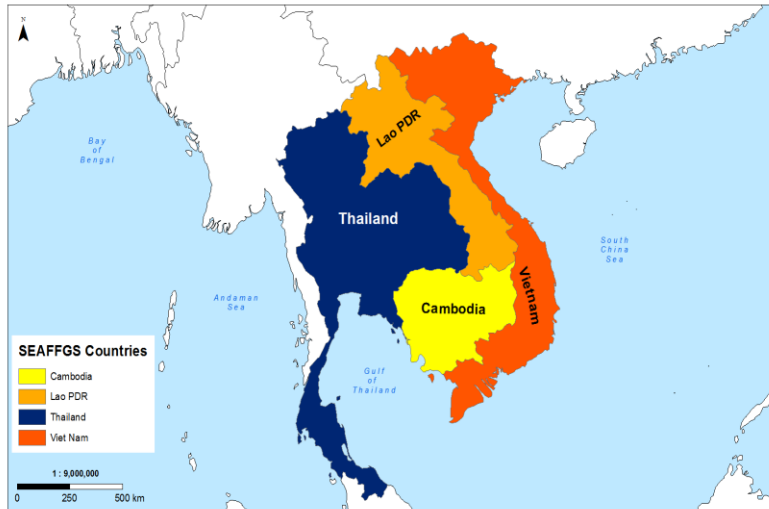
The main objectives of the Flash Flood Guidance System with global coverage are to:

- enhance NMHSs capacity to issue flash flood warnings and alerts;
- mitigate adverse impacts of hydrometeorological hazards;
- enhance collaborations between NMHSs and Emergency Management Agencies;
- generate flash flood early warning products by using state-of-the-art hydrometeorological forecasting models;
- provide extensive training including on-line training to the hydrometeorological forecasters;
- foster regional developments and collaborations; and
- Support WMO Flood Forecasting Initiative.

The Regional Centre is to:



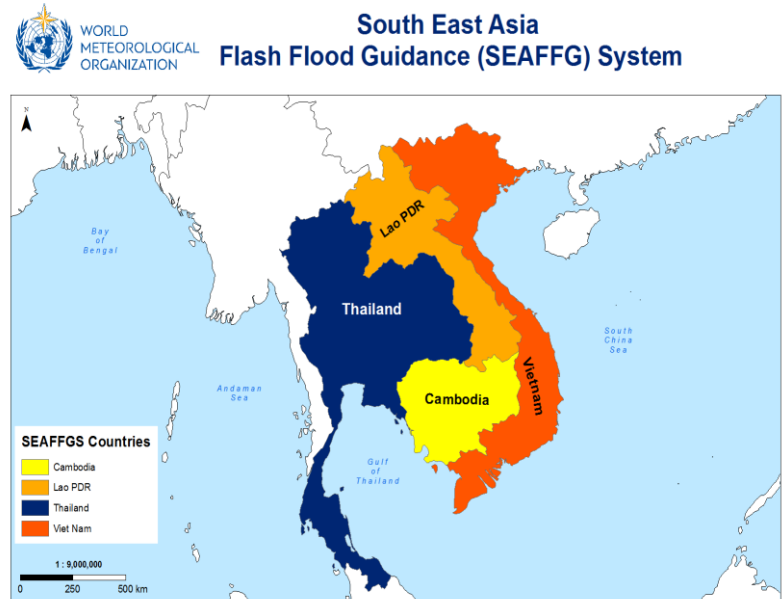
South East Asia Flash Flood Guidance (SEAFFG) System



- host the FFGS servers to provide products and data to the participating countries,
- collaborate with WMO and its project partners to implement the flash flood hydrometeorologist training programme,
- evaluate FFG products from the regional perspective and conduct verification studies in collaboration with the participating NMHSs, and
- have good IT infrastructure for data exchange and internet connectivity.

The Participating NMHSs are to:

- prepare and issue flash flood warnings and alerts to the public and national agencies including DMA,
- provide historical and in-situ local data to the FFG system developer through the RC,
- participate in the Flash Flood Hydrometeorologist Training Programme (Steps 1-5), and
- conduct verification studies.



FFGS User Interface

BSMEFFG - Black Sea Middle East Flash Flood Guidance System

Year: 2011 Month: 06 Day: 24 Hour: 00 Language: English (UK) (Admin)

Products, Date and Time Selection Toolbar

Time Interval

FFGS Products

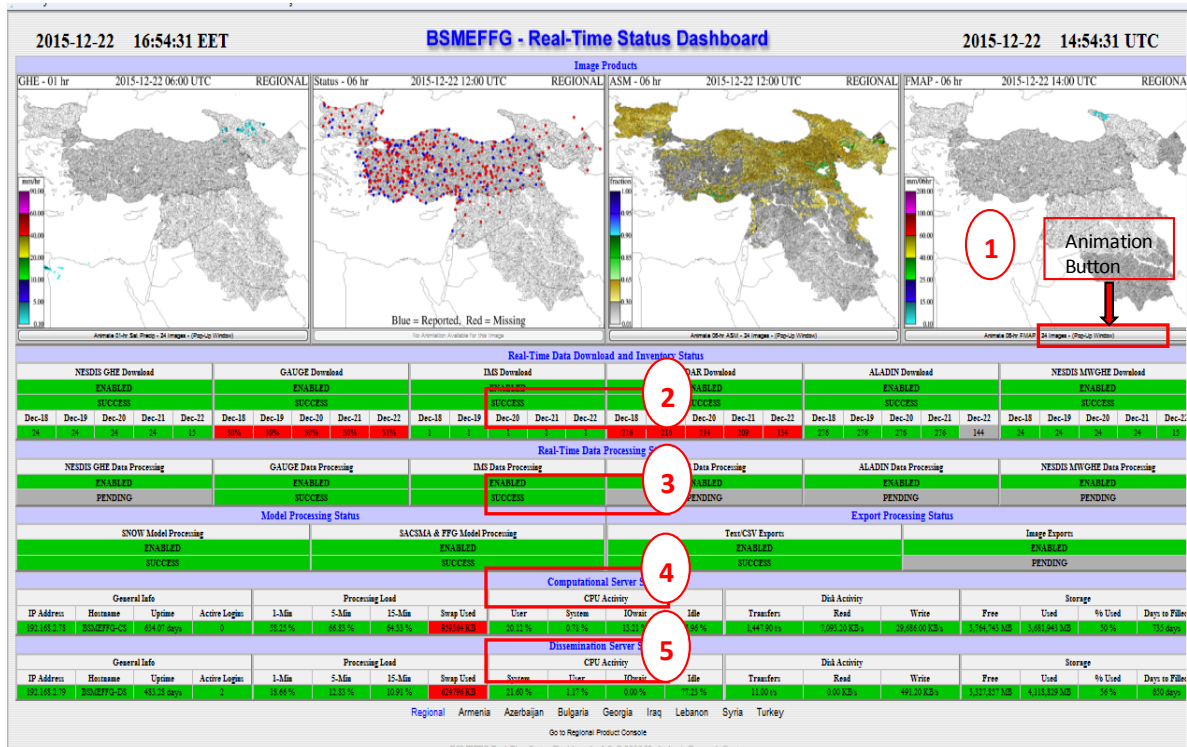
Station Name	Station Code	Latitude	Longitude	Station Type	Station Status	Station Category	Station Sub-Category	Station Group	Station Group Code	Station Group Name	Station Group Code	Station Group Name
Adana	14001	37.00	35.50	Stn	Open	Surface	Surface	Surface	14001	Adana	14001	Adana
Antalya	14002	37.00	30.50	Stn	Open	Surface	Surface	Surface	14002	Antalya	14002	Antalya
Erzurum	14003	39.90	41.00	Stn	Open	Surface	Surface	Surface	14003	Erzurum	14003	Erzurum
Van	14004	38.50	42.00	Stn	Open	Surface	Surface	Surface	14004	Van	14004	Van
Diyarbakir	14005	37.00	38.00	Stn	Open	Surface	Surface	Surface	14005	Diyarbakir	14005	Diyarbakir
Malazgirt	14006	38.00	41.00	Stn	Open	Surface	Surface	Surface	14006	Malazgirt	14006	Malazgirt
Harput	14007	38.00	38.00	Stn	Open	Surface	Surface	Surface	14007	Harput	14007	Harput
Van	14008	38.50	42.00	Stn	Open	Surface	Surface	Surface	14008	Van	14008	Van
Van	14009	38.50	42.00	Stn	Open	Surface	Surface	Surface	14009	Van	14009	Van
Van	14010	38.50	42.00	Stn	Open	Surface	Surface	Surface	14010	Van	14010	Van
Van	14011	38.50	42.00	Stn	Open	Surface	Surface	Surface	14011	Van	14011	Van
Van	14012	38.50	42.00	Stn	Open	Surface	Surface	Surface	14012	Van	14012	Van
Van	14013	38.50	42.00	Stn	Open	Surface	Surface	Surface	14013	Van	14013	Van
Van	14014	38.50	42.00	Stn	Open	Surface	Surface	Surface	14014	Van	14014	Van
Van	14015	38.50	42.00	Stn	Open	Surface	Surface	Surface	14015	Van	14015	Van
Van	14016	38.50	42.00	Stn	Open	Surface	Surface	Surface	14016	Van	14016	Van
Van	14017	38.50	42.00	Stn	Open	Surface	Surface	Surface	14017	Van	14017	Van
Van	14018	38.50	42.00	Stn	Open	Surface	Surface	Surface	14018	Van	14018	Van
Van	14019	38.50	42.00	Stn	Open	Surface	Surface	Surface	14019	Van	14019	Van
Van	14020	38.50	42.00	Stn	Open	Surface	Surface	Surface	14020	Van	14020	Van

Surface Met. Observations

Snow Products

Products Desc. & System Monitoring Toolbars

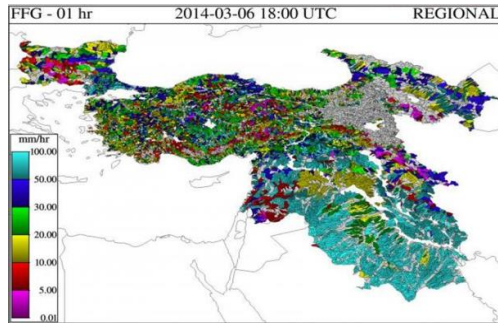
FFGS Dashboard



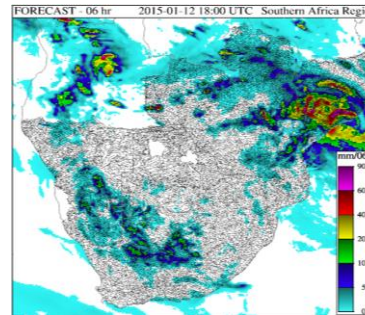
Dashboard is designed to monitor server processes:

- (1) Quick-look;
- (2) Real-Time data downloads and inventory status;
- (3) Real-Time Data processing status;
- (4) Computational server status; and
- (5) Dissemination server status.

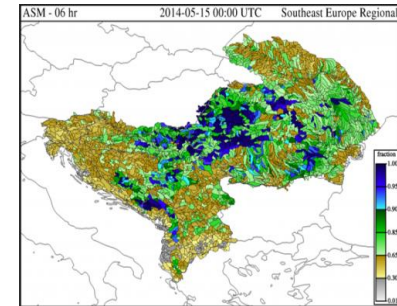
FFGS Products



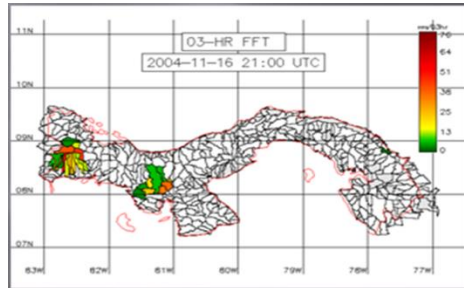
- Flash Flood Guidance for Black Sea and Middle East FFGS.



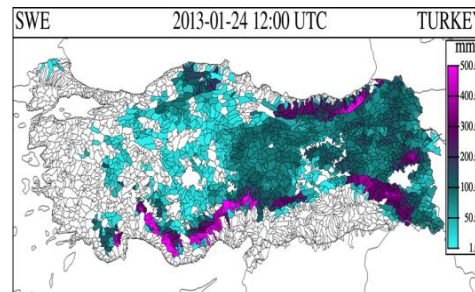
- GHE Satellite precipitation for Southern Africa Region FFGS.



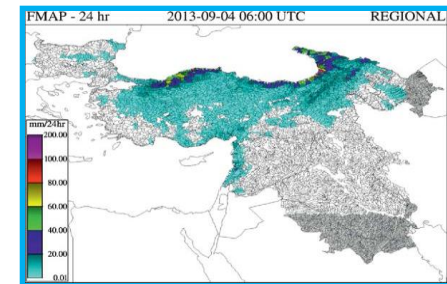
- Average Soil Moisture for South East Europe FFGS.



- Flash Flood Threat for Central America FFGS

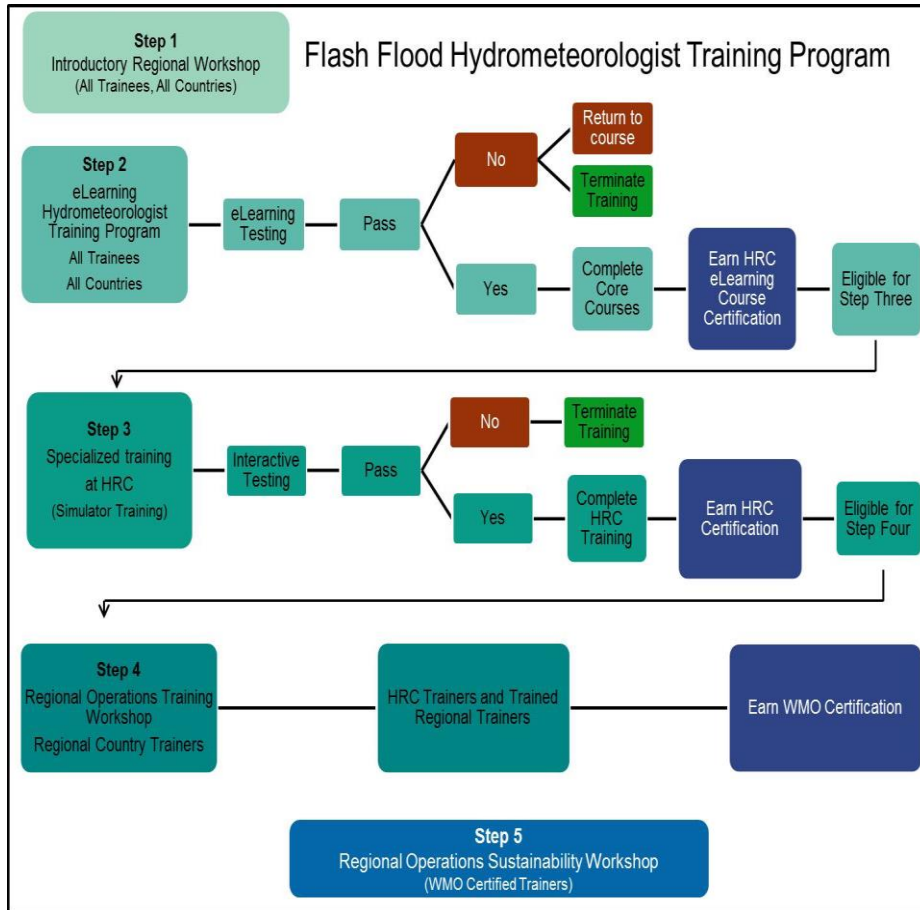


- Snow Water Equivalent (SWE) for Turkey.



- Forecast Mean Areal Precipitation for Black Sea and Middle East FFGS.

Training Programme



Training is an integral part of regional FFG Systems and consists of five steps:

Step-1: Introductory in-country workshops and meetings such as Steering Committee Meetings;

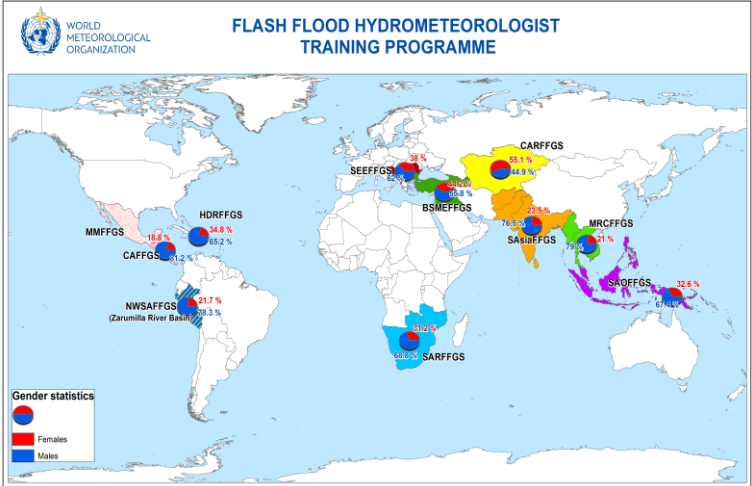
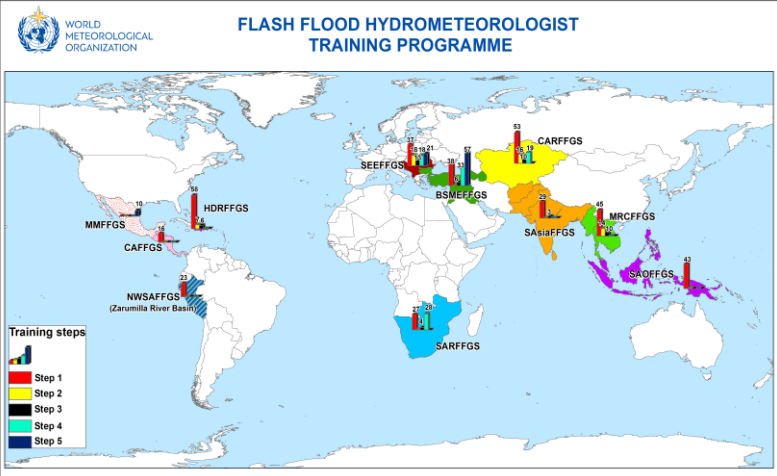
Step-2: On-line eLearning comprises elements of Meteorology, Hydrology, Flash Flood Guidance, GIS, and remote sensing;

Step-3: Advanced operations training at the Hydrologic Research Center (HRC), USA;

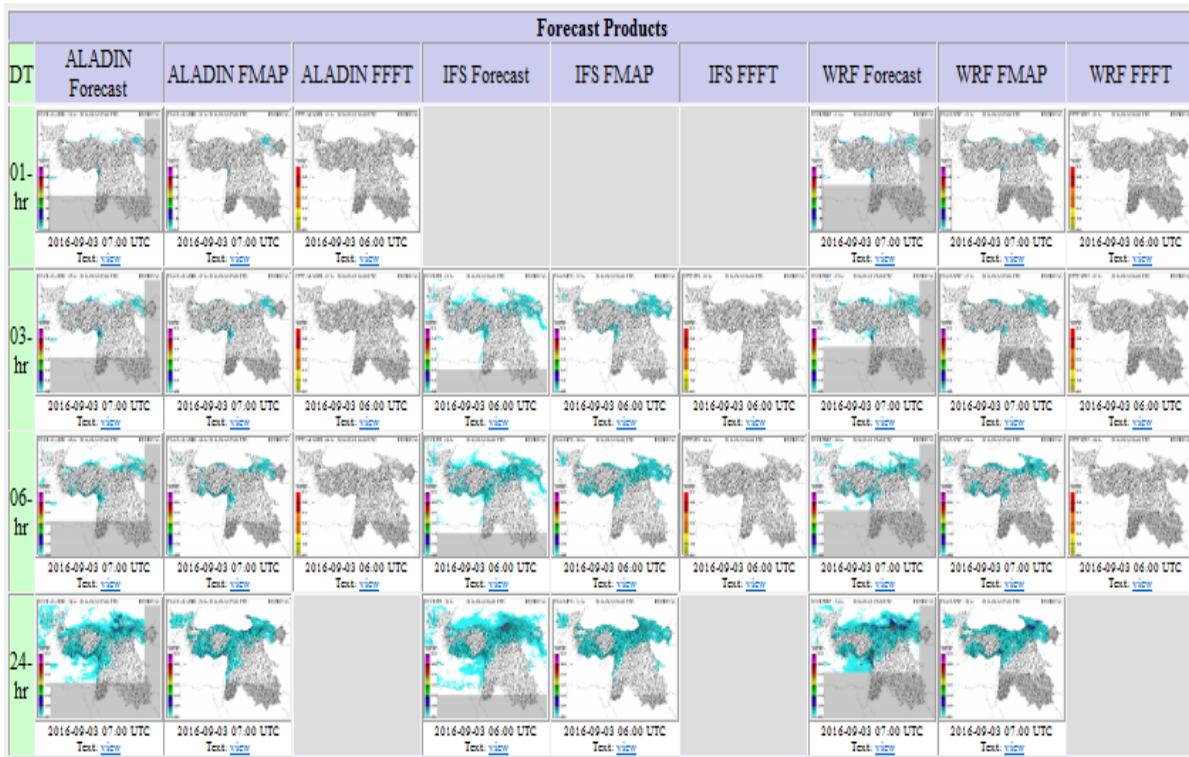
Step-4: Regional operations training workshop toward qualification of WMO flash flood trainer certificate; and

Step-5: Regional operation sustainability workshop provided by the WMO certified trainer.

Training Statistics



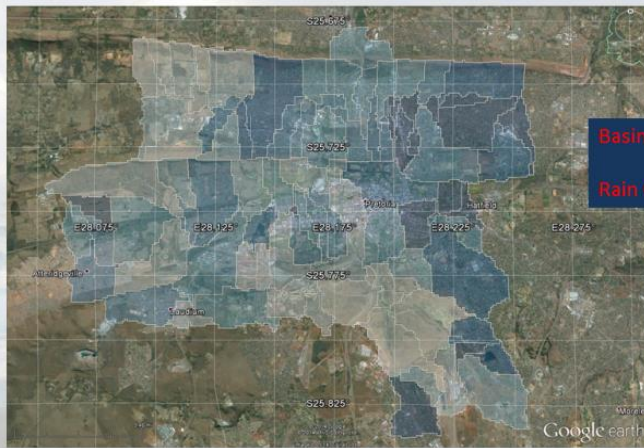
FFGS Advances: Multi-NWP Ingestion



Date & Time 06032016 00 +6 hr interval	ECMWF Precipitation Forecast (mm)	WRF Precipitation Forecast (mm)
00 UCC	32.7	36.9
06UTC	46.4	68.3
12 UTC	44.1	92.3
18 UTC	39.9	90.6
00 UTC	53.4	54.4
06 UTC	41.1	34.4
12 UTC	29.8	49.4
18 UTC	16.1	33.1

FFGS Advances: Urban FFEWS

Demonstration of feasibility
(city of Pretoria)



2/5/2015

HRC TSMS

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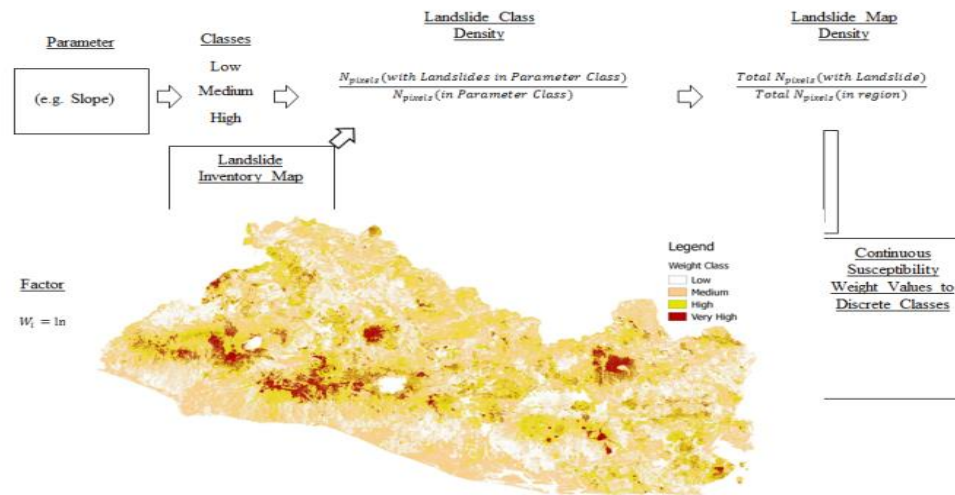


Istanbul Urban Flash Flood Early Warning System
Cendere River Basin



FFGS Advances: Landslide Susceptibility Mapping

C.1 Susceptibility Mapping

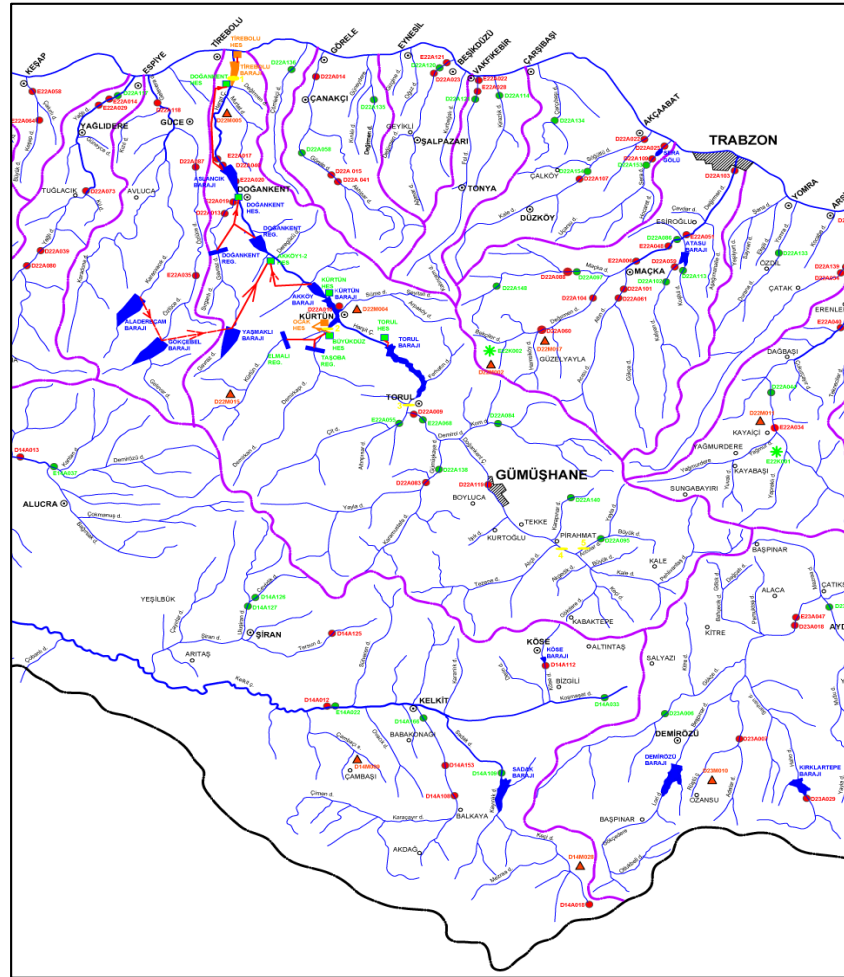


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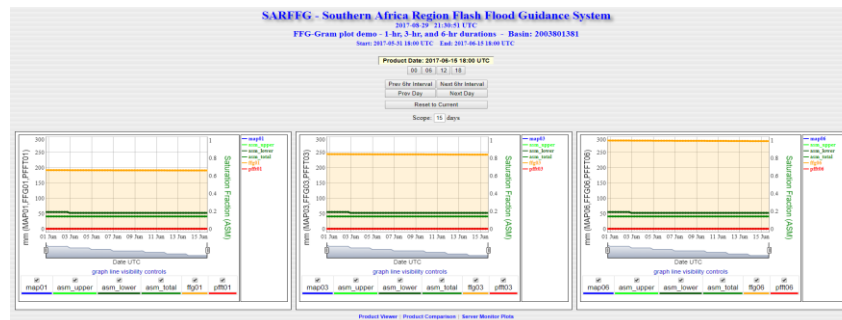
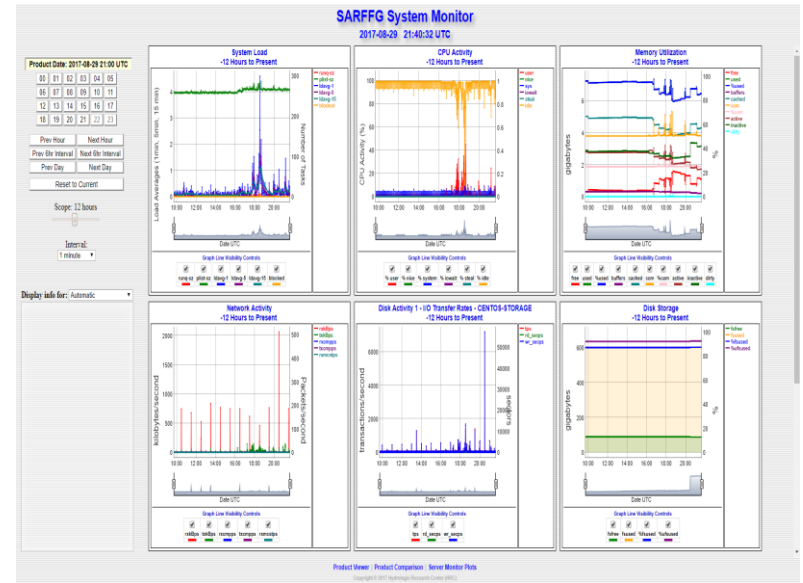
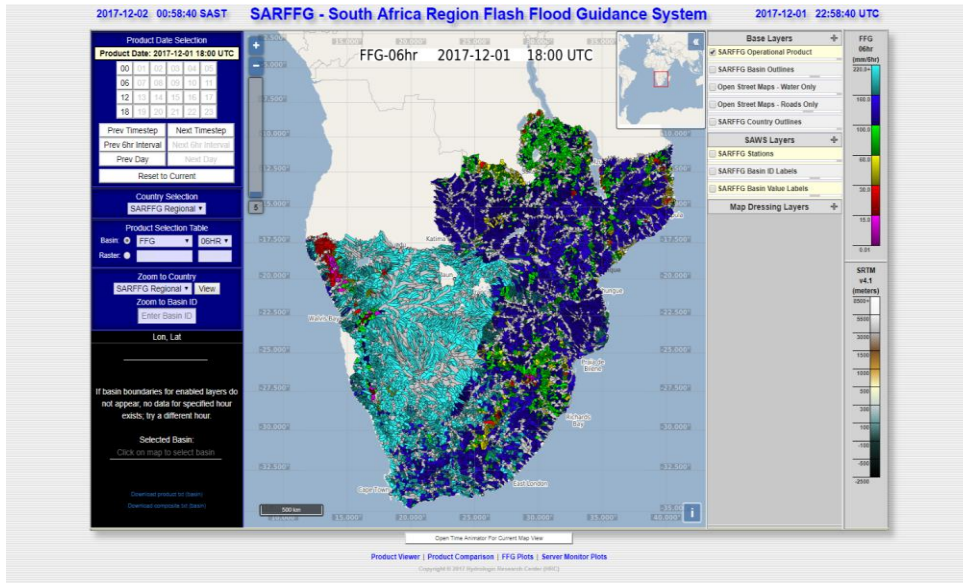
HRC Enhancements

10

FFGS Advances: Riverine Routing

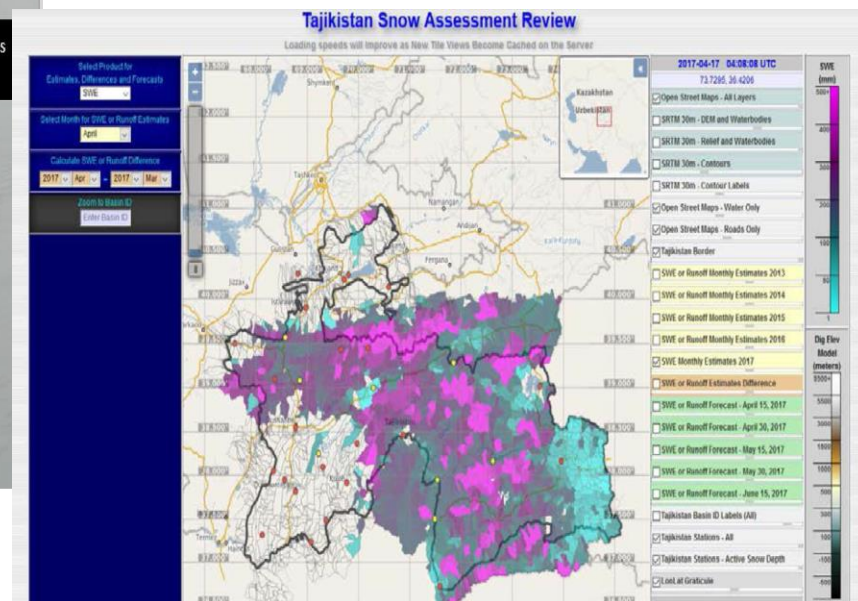
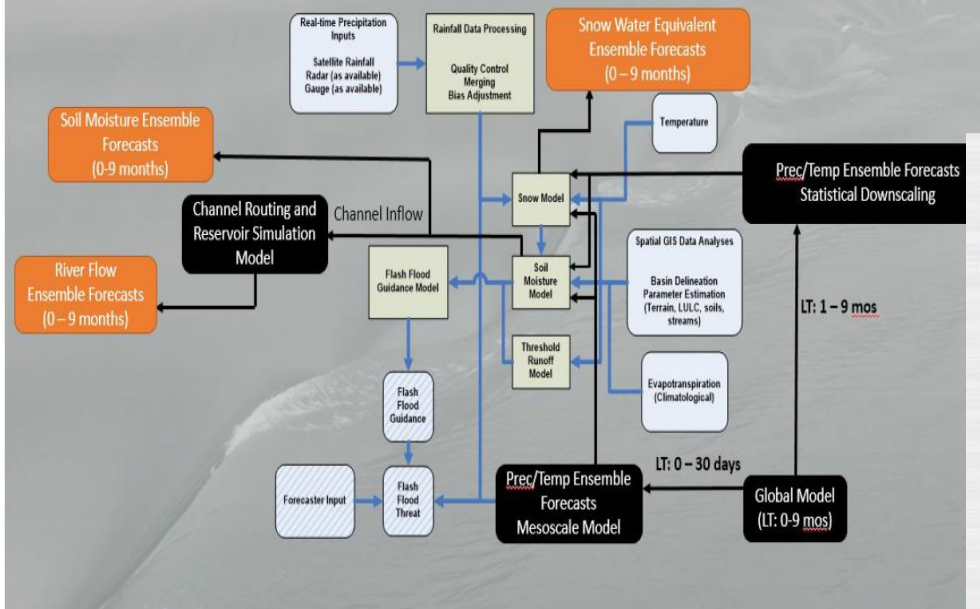


FFGS Advances: MapServer



FFGS Advances: Seasonal and Sub-seasonal Data Ingestion

FFGS Enhanced for Seasonal to Sub-seasonal Prediction



Verification Guideline

a = Hits
b = False alarms
c = Misses
d = Correct negatives

		EVENT OBSERVED		
		Yes	No	Total
EVENT FORECASTED	Yes	21 (a)	7 (b)	28
	No	1 (c)	113 (d)	114
Total		22	120	142

a = Hits
b = False alarms
c = Misses
d = Correct negatives

		EVENT OBSERVED		
		Yes	No	Total
EVENT FORECASTED	Yes	43 (a)	25 (b)	68
	No	18 (c)	306 (d)	324
Total		61	331	392

a

a = Hits
b = False alarms
c = Misses
d = Correct negatives

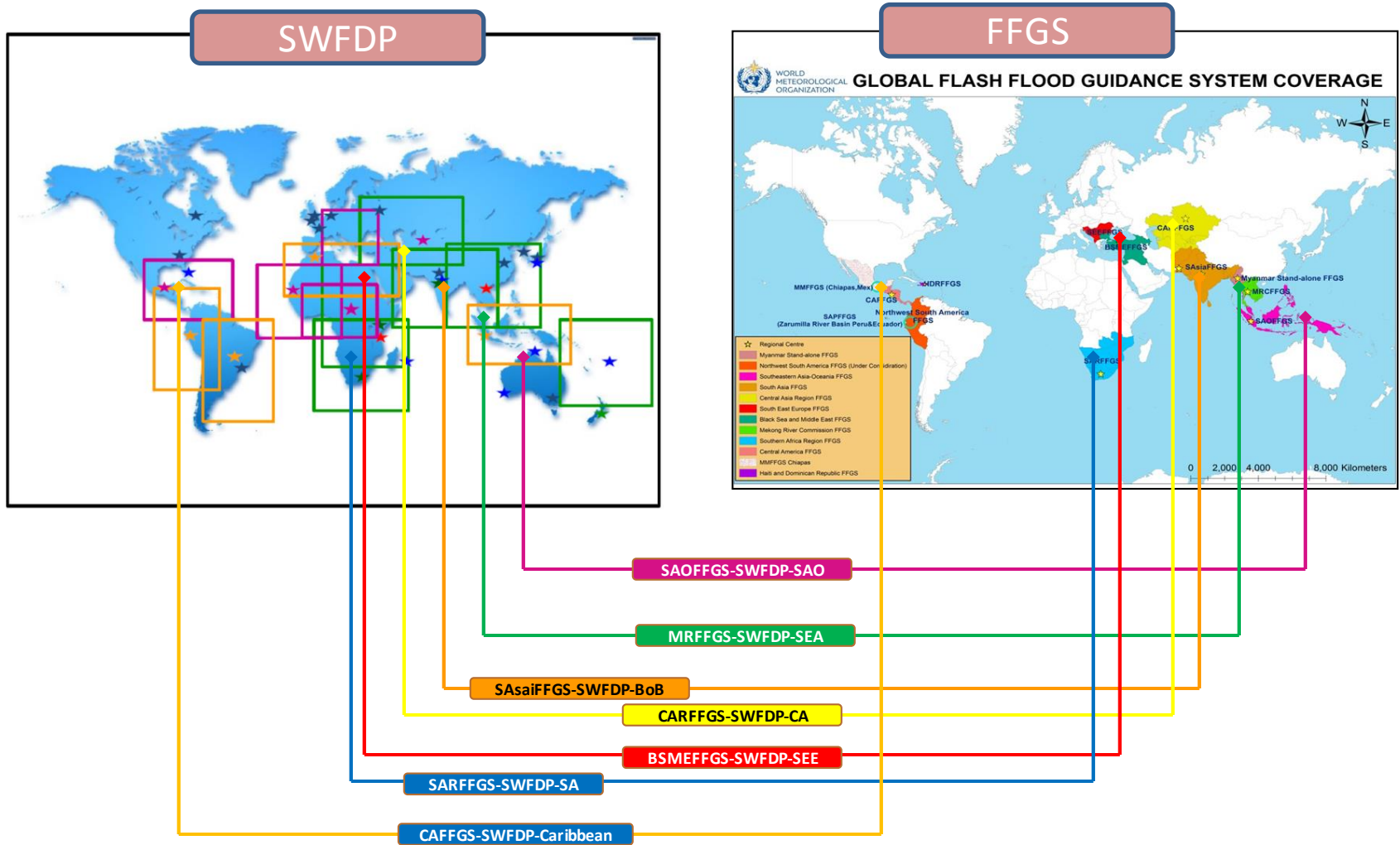
		EVENT OBSERVED		
		Yes	No	Total
EVENT FORECASTED	Yes	58 (a)	10 (b)	68
	No	48 (c)	249 (d)	297
Total		106	259	365

b

VERIFICATION SCORE	Value
Hit rate (HR) or Probability of detection (PoD):	0.95
False Alarm Ratio (FAR):	0.25
Frequency bias (FBI) or Bias (B):	1.27
False Alarm Rate (POFD):	0.06
Threat score (TS) or Critical success index (CSI):	0.72
Heidke skill score (HSS):	0.58
Hanssen-Kuipers skill score (KSS), True Skill Statistics (TSS), or Pierce skill score:	0.6
Stable extreme dependency score (SEDS):	0.8
Extremal dependency index (EDI):	0.85
Symmetric extremal dependency index (SEDI):	0.97

VERIFICATION SCORE	Value
Hit rate (HR) or Probability of detection (PoD):	0.7
False Alarm Ratio (FAR):	0.36
Frequency bias (FBI) or Bias (B):	1.11
False Alarm Rate (POFD):	0.07
Threat score (TS) or Critical success index (CSI):	0.5
Heidke skill score (HSS):	0.6
Hanssen-Kuipers skill score (KSS), True Skill Statistics (TSS), or Pierce skill score:	0.63
Stable extreme dependency score (SEDS):	0.64
Extremal dependency index (EDI):	0.76
Symmetric extremal dependency index (SEDI):	0.82

Linkages between SWFDP and Regional FFGS



Linkages between SWFDP and Regional FFGS: Benefits

- Provision of high resolution mesoascale NWP QPF products by the SWFDPs;
- Provision of Nowcasting products by the SWFDPs;
- Generating synergies for the severe weather forecasts and warnings, including flash floods;
- Enhancing user interfaces and expand the suite of products available to forecasters; and
- Developing products and information that addresses needs of users to reduce loss of lives and livelihoods due to extreme hydrometeorological events.

Thank you

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For more information please visit:

<http://www.wmo.int/ffgs>

<http://www.hrcwater.org>