

# **OVERVIEW OF THE FLASH FLOOD GUIDANCE SYSTEM FOR SOUTHEAST ASIA**

**HYDROLOGIC RESEARCH CENTER**

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# FLASH FLOODS

- World Meteorological Organization - A flood of short duration with a relatively high peak discharge
- American Meteorological Society – A flood that rises and falls quite rapidly with little or no advance warning, usually as the result of intense rainfall over a relatively small area
- Response time is 6 hours or less
- A local hydrometeorological phenomenon that requires:
  - BOTH Hydrological and Meteorological expertise for real time forecasting/warning
  - Knowledge of local up to the hour information for effective warning (24 - 7 operation)

# FLASH FLOOD GUIDANCE SYSTEMS

- The implementation of Flash Flood Guidance (**FFG**) systems is a program to provide a tool for National Meteorological and Hydrologic Services to develop flash flood warnings.
- Addresses the need to provide early warnings for flash floods in the development of **regional or country-wide** approaches to flash flood issues.

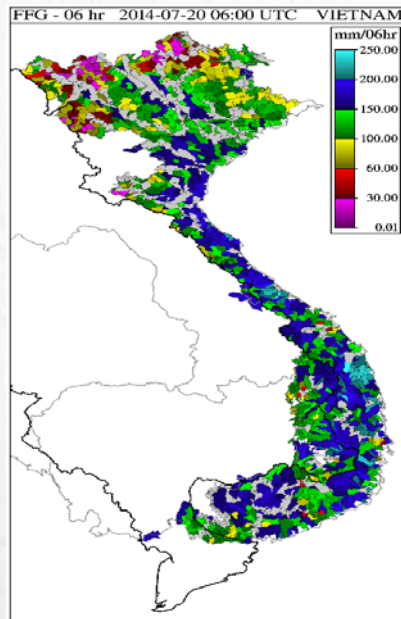
## FFG SYSTEM BENEFITS

- Addresses all flash flood prone basins over the area of interest
- Provides information on rainfall and hydrologic response of the basin
- Early awareness of impending local flash flood threats for all potentially vulnerable areas
  - Provide rapid assessments of the **occurrence** (not the magnitude) of a flash flood
  - Only analyzing the occurrence allows for more rapid mobilization, reduces uncertainty and complexity
- **System designed to provide a balance between quality (accuracy) and value (timely)**

# DEFINITION OF KEY FFG PRODUCTS

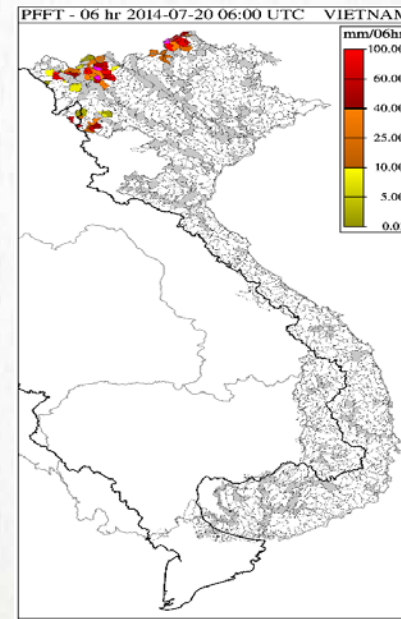
**Flash Flood Guidance** – volume of rainfall of a given duration (1-6 hours) over a given small catchment that is just enough to cause minor flooding at the outlet (bank full flow)

**FFG = INDEX**



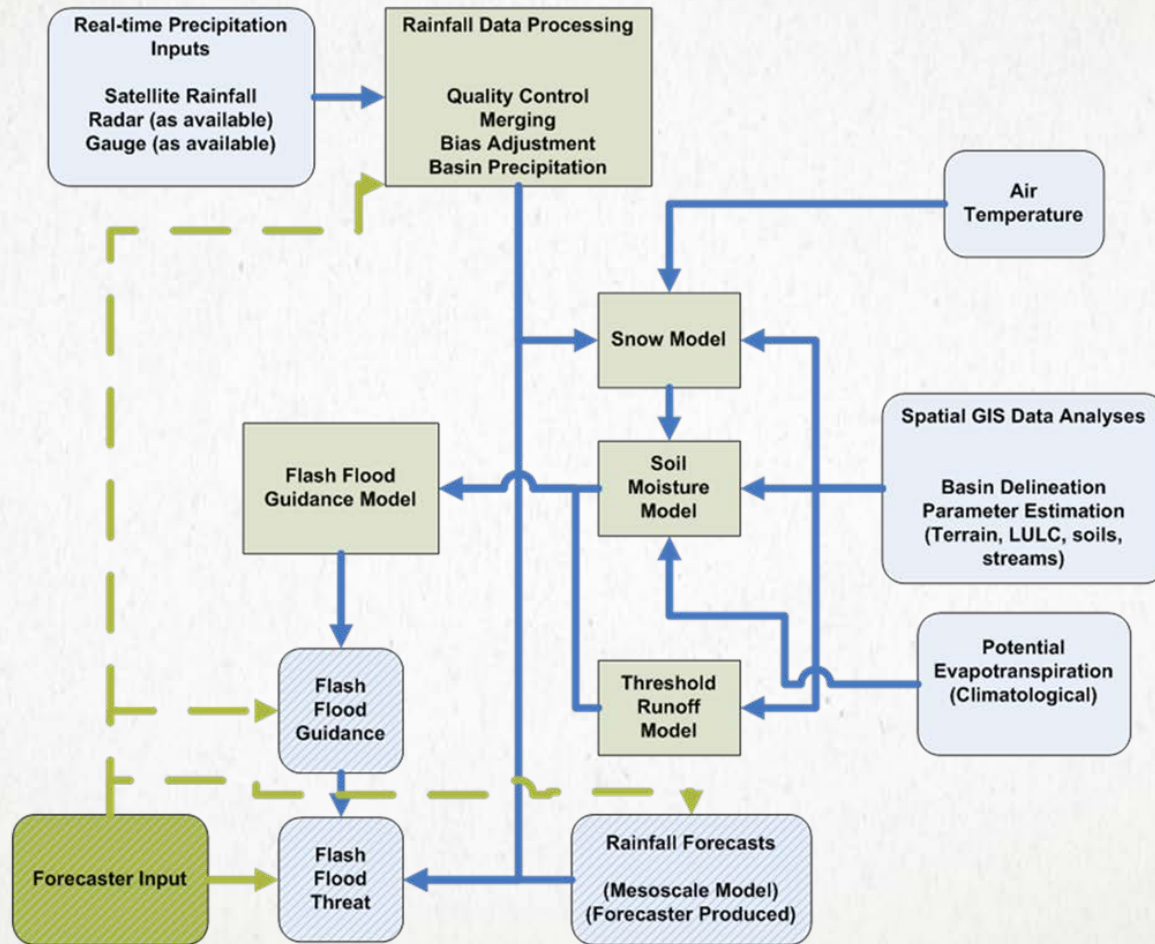
**Flash Flood Threat** – rainfall of a given duration in excess of the corresponding Flash Flood Guidance value (**existing/past or “forecast” rainfall**)

**FFT = INDEX**





# KEY TECHNICAL COMPONENTS FOR THE STANDARD FFG SYSTEM



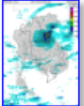
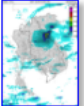
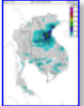
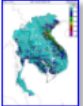
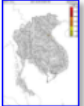
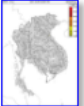
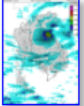
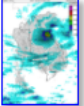
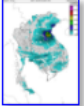
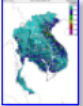
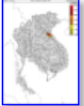
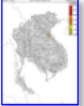
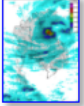
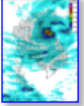
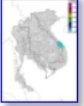
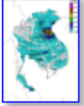

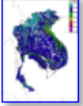
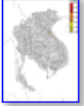
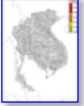
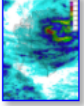
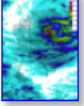
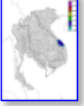
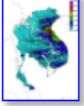
## STANDARDIZED FFG SYSTEM

- Real-time Satellite Precipitation Inputs
  - Global HydroEstimator (NOAA/NESDIS) – short latency (<30 minutes), IR-based
  - CMORPH (NOAA/CPC) for Adjustments to the Global HydroEstimator, microwave-based
- Snow Model and Snow Cover
  - SNOW-17 (NOAA/NWS)
- Soil Moisture Model
  - Sacramento Soil Moisture Accounting Model
- Rainfall Forecast Model
  - Mesoscale Models – examples WRF, ALADIN, UNIFIED, HRM

# STANDARDIZED FFG SYSTEM FORECASTER USER INTERFACE

Current Date: 2017-11-13 19:51 UTC      Product Date: 2017-10-09 22:00 UTC  
 Year: 2017    Month: 10    Day: 09    Hour: 22    REGION: REGIONAL    OPTION: MEDIAN    Submit  
 -1 Month   -1 Day   -6 Hours   -1 Hour   +1 Hour   +6 Hours   +1 Day   +1 Month  
 Prev 6-hr Interval (18 UTC)    Reset to Current    Next 6-hr Interval (00 UTC)

## Product Console - Main Table

DT	MWGHE Precipitation	GHE Precipitation	Gauge MAP	Merged MAP	ASM	FFG	IFFT	PFFT
01-hr	 2017-10-09 22:00 UTC Text: <a href="#">view</a>	 2017-10-09 22:00 UTC Text: <a href="#">view</a>		 2017-10-09 22:00 UTC Text: <a href="#">view</a>		 2017-10-09 18:00 UTC Text: <a href="#">view</a>	 2017-10-09 19:00 UTC Text: <a href="#">view</a>	 2017-10-09 18:00 UTC Text: <a href="#">view</a>
03-hr	 2017-10-09 22:00 UTC Text: <a href="#">view</a>	 2017-10-09 22:00 UTC Text: <a href="#">view</a>		 2017-10-09 22:00 UTC Text: <a href="#">view</a>		 2017-10-09 18:00 UTC Text: <a href="#">view</a>	 2017-10-09 21:00 UTC Text: <a href="#">view</a>	 2017-10-09 18:00 UTC Text: <a href="#">view</a>
06-hr	 2017-10-09 22:00 UTC Text: <a href="#">view</a>	 2017-10-09 22:00 UTC Text: <a href="#">view</a>	 2017-10-09 18:00 UTC Text: <a href="#">view</a>	 2017-10-09 22:00 UTC Text: <a href="#">view</a>	 2017-10-09 18:00 UTC Text: <a href="#">view</a>	 2017-10-09 18:00 UTC Text: <a href="#">view</a>	 2017-10-09 18:00 UTC Text: <a href="#">view</a>	 2017-10-09 18:00 UTC Text: <a href="#">view</a>
24-hr	 2017-10-09 22:00 UTC Text: <a href="#">view</a>	 2017-10-09 22:00 UTC Text: <a href="#">view</a>	 2017-10-09 18:00 UTC Text: <a href="#">view</a>	 2017-10-09 22:00 UTC Text: <a href="#">view</a>				

Composite Product: [text](#) , [CSV](#) , [CSVT](#)

SFTP data transfer (requires SFTP Client): [EXPORTS/REGIONAL/2017/10/09](#)

### Surfmet Gauge Observations at 2017-10-09 22:00 UTC

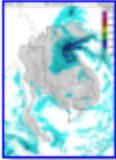
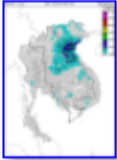
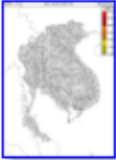
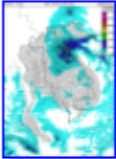
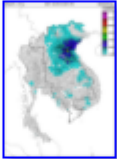
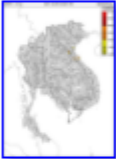
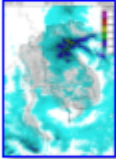
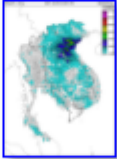

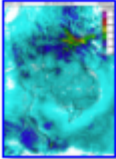
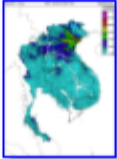
Station Identifier	Station Name	Accumulated Precipitation (mm/01hr)	Average Temperature (C)	Region	Latitude	Longitude	Elevation	Enable Precipitation Flag
No reports for region	No reports for region	No reports for region	No reports for region	No reports for region	No reports for region	No reports for region	No reports for region	No reports for region

Thumbnails to access a Map Server Interface

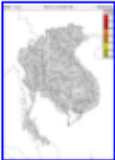
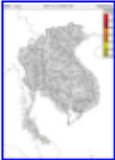
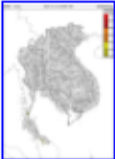


# STANDARDIZED FFG SYSTEM FORECASTER USER INTERFACE

## Product Console - Model Forecast Products

DT	WRF Forecast	FMAP	FFFT
01-hr	 2017-10-09 22:00 UTC <a href="#">Text: view</a>	 2017-10-09 22:00 UTC <a href="#">Text: view</a>	 2017-10-09 18:00 UTC <a href="#">Text: view</a>
03-hr	 2017-10-09 22:00 UTC <a href="#">Text: view</a>	 2017-10-09 22:00 UTC <a href="#">Text: view</a>	 2017-10-09 18:00 UTC <a href="#">Text: view</a>
06-hr	 2017-10-09 22:00 UTC <a href="#">Text: view</a>	 2017-10-09 22:00 UTC <a href="#">Text: view</a>	 2017-10-09 18:00 UTC <a href="#">Text: view</a>
24-hr	 2017-10-09 22:00 UTC <a href="#">Text: view</a>	 2017-10-09 22:00 UTC <a href="#">Text: view</a>	

## Product Console Baseline Threat Products

DT	Flash Flood Risk
12-hr	 2017-11-13 18:00 UTC <a href="#">Text: view</a>
24-hr	 2017-11-13 18:00 UTC <a href="#">Text: view</a>
36-hr	 2017-11-13 18:00 UTC <a href="#">Text: view</a>

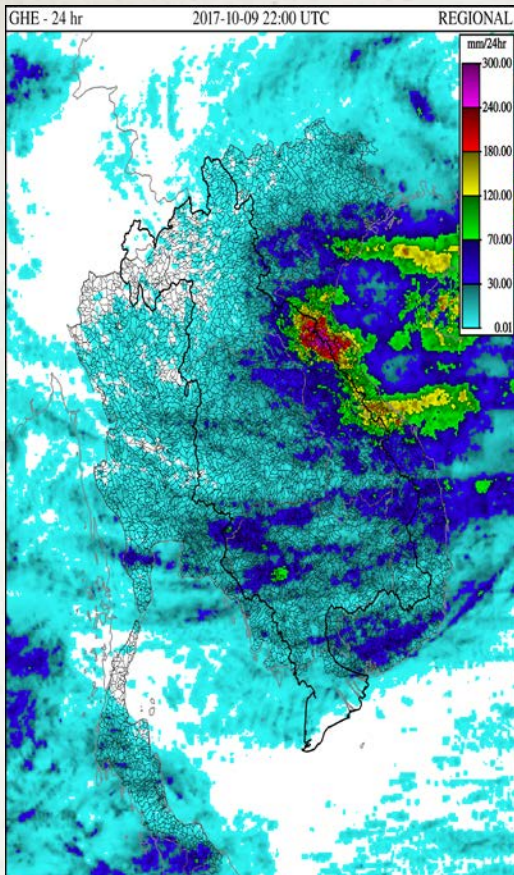
# BASIN DELINEATIONS



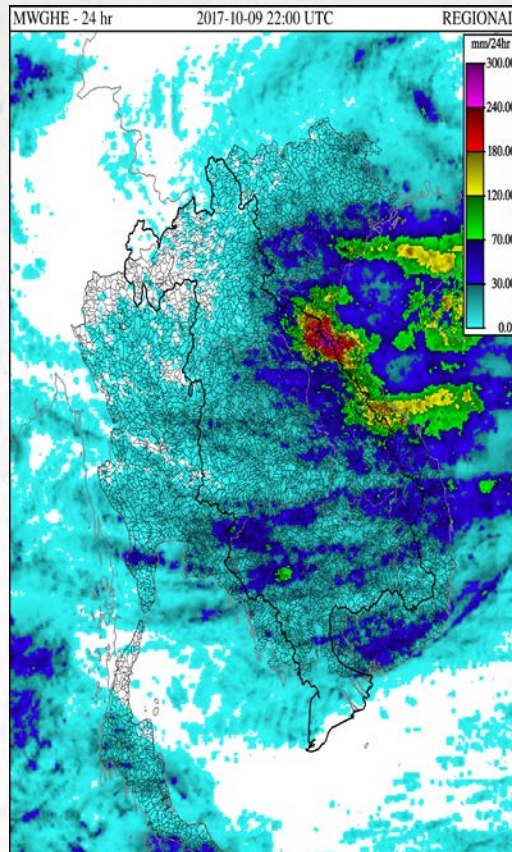
6372 sub-basins

Mean area  $\sim 180 \text{ km}^2$

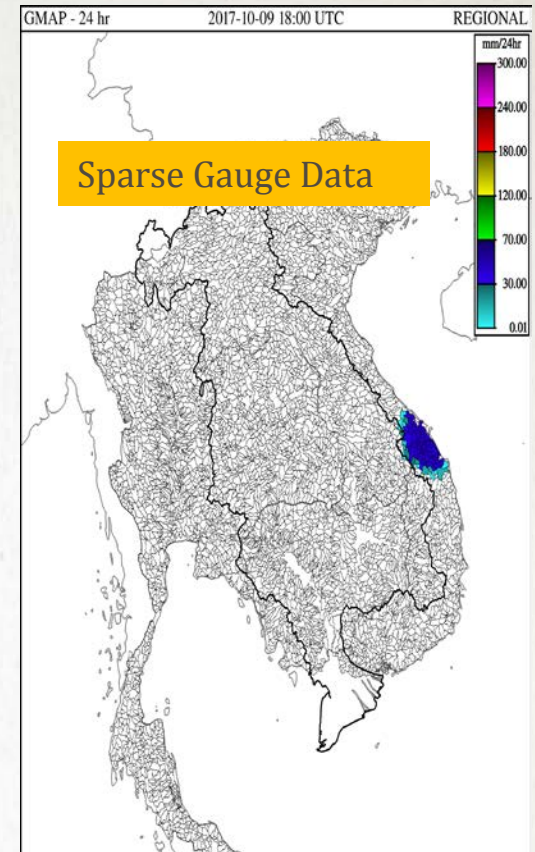
For Radars  $\sim 30\text{-}70 \text{ km}^2$



Precipitation estimates from the Global HydroEstimator, NOAA



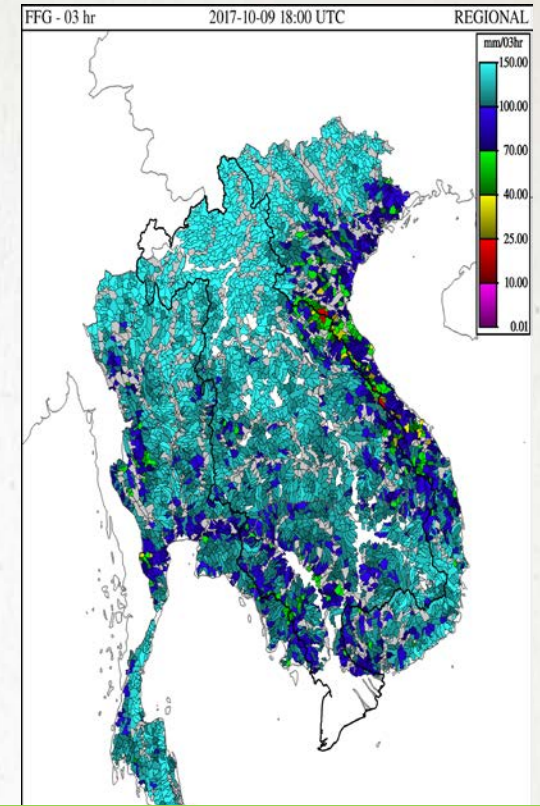
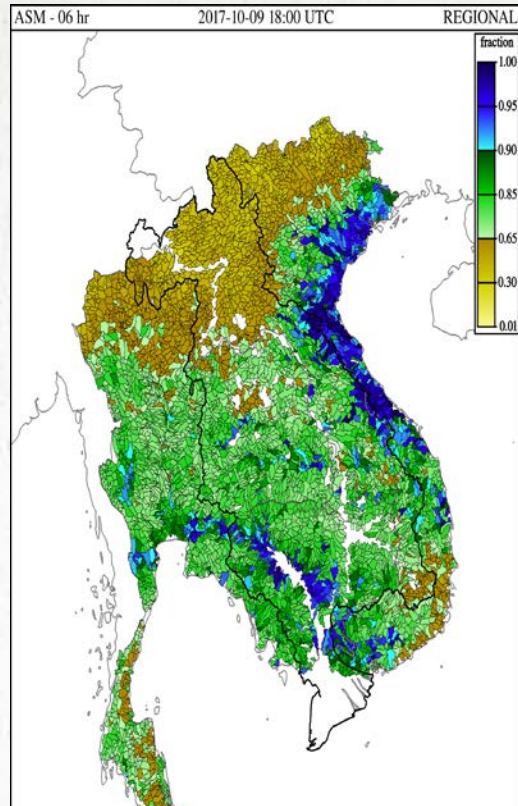
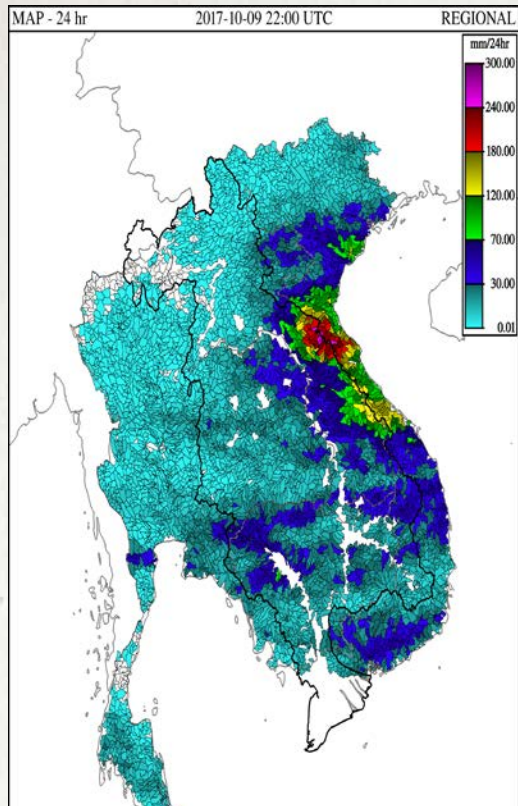
Precipitation estimates from the CMORPH (micro-wave) adjusted Global HydroEstimator, NOAA



Mean areal precipitation for each flash flood basin based on gauges

## Precipitation Products Updated Hourly



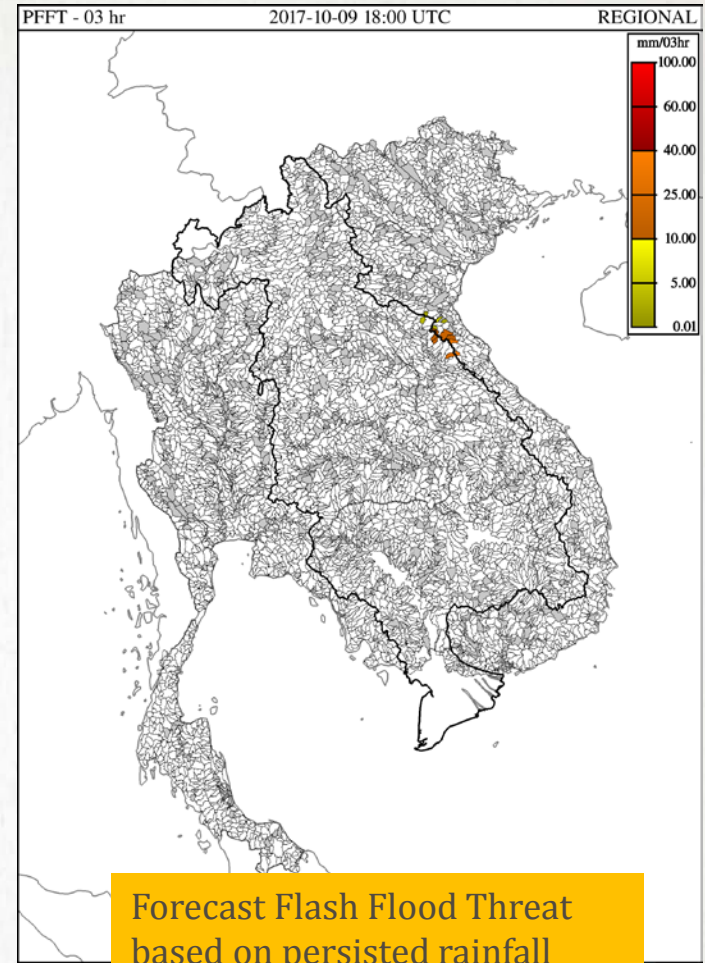
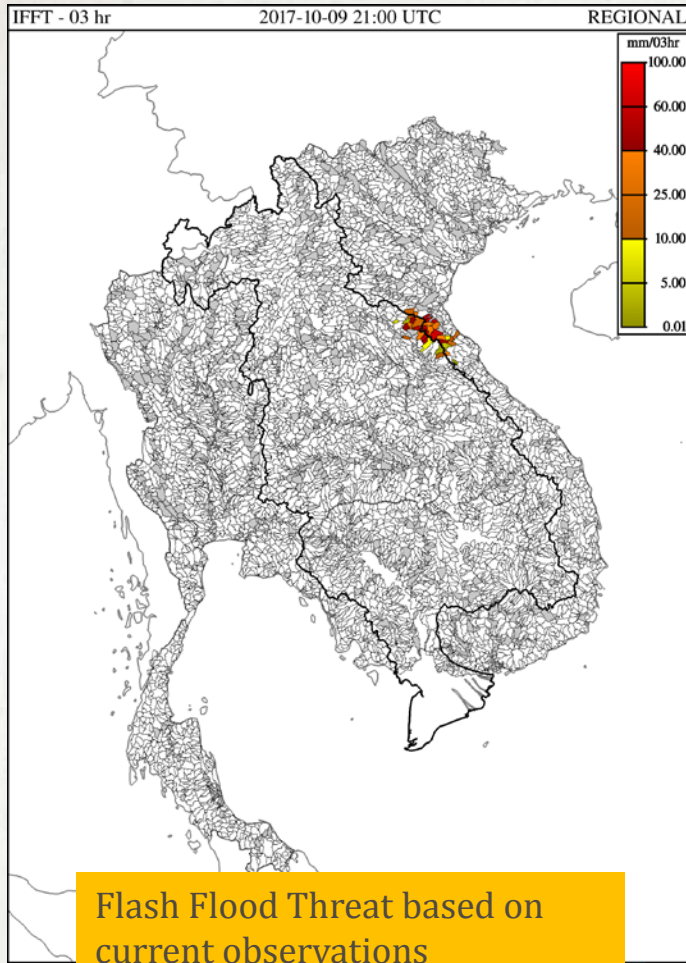


Mean areal precipitation for each flash flood basin based on bias-corrected satellite, radar, or gauge estimates

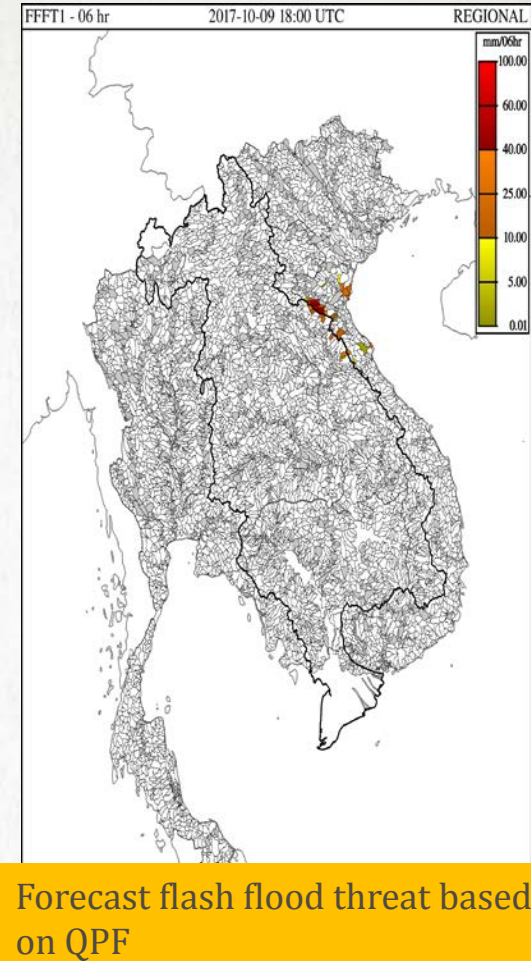
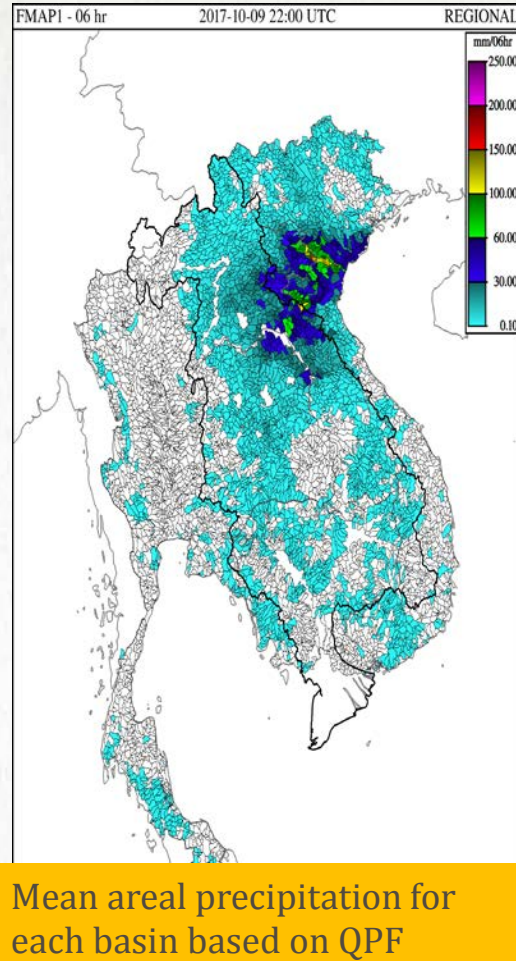
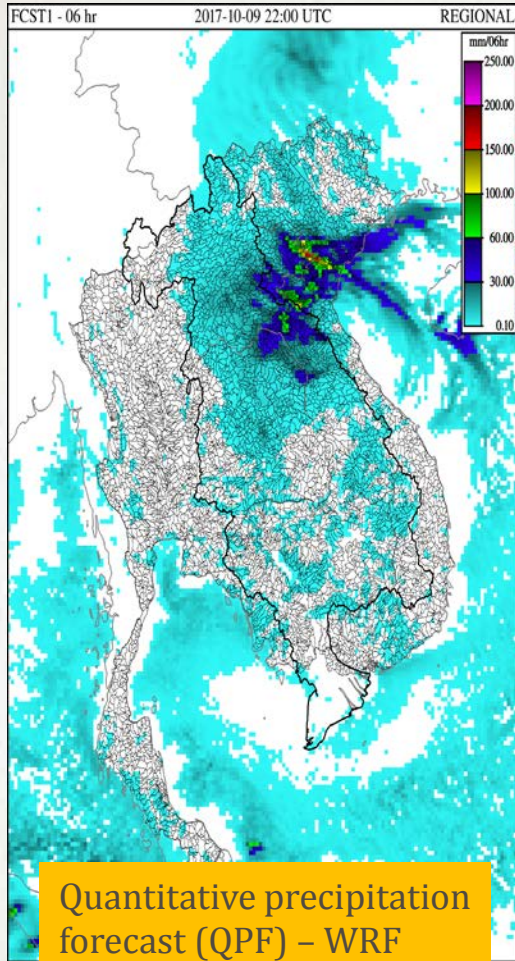
Model-based soil moisture for each basin presented as fraction of saturation (top 20 cm)

Flash Flood Guidance values for each basin. The lower the FFG, the more likely flooding will occur during a rainfall event

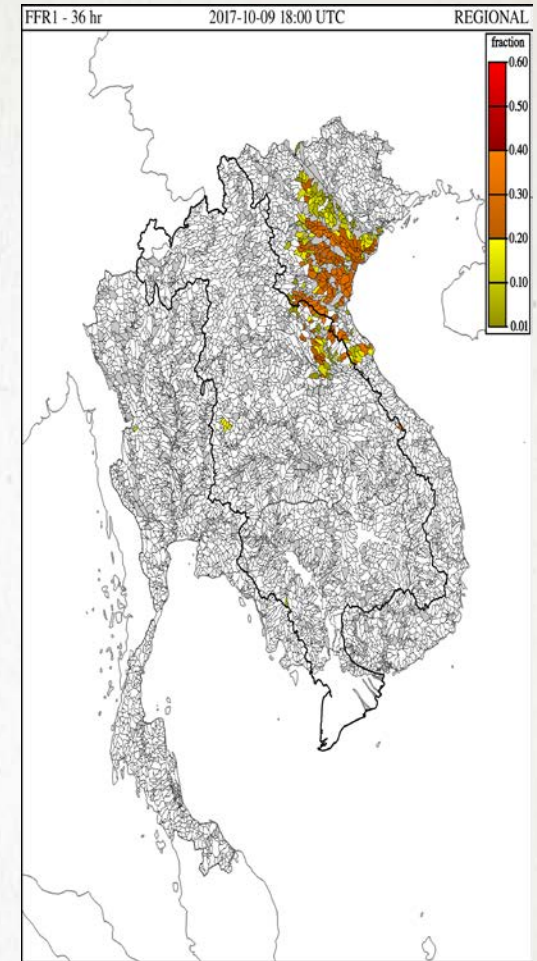
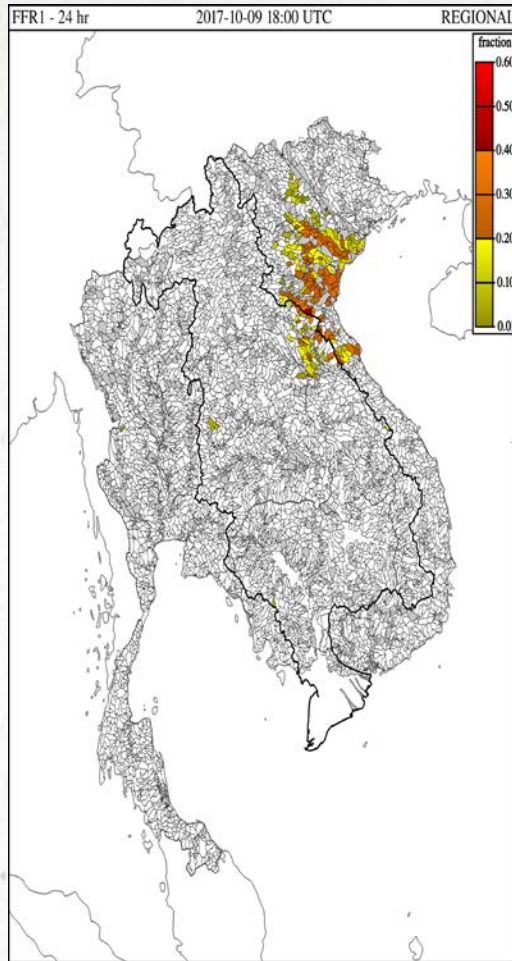
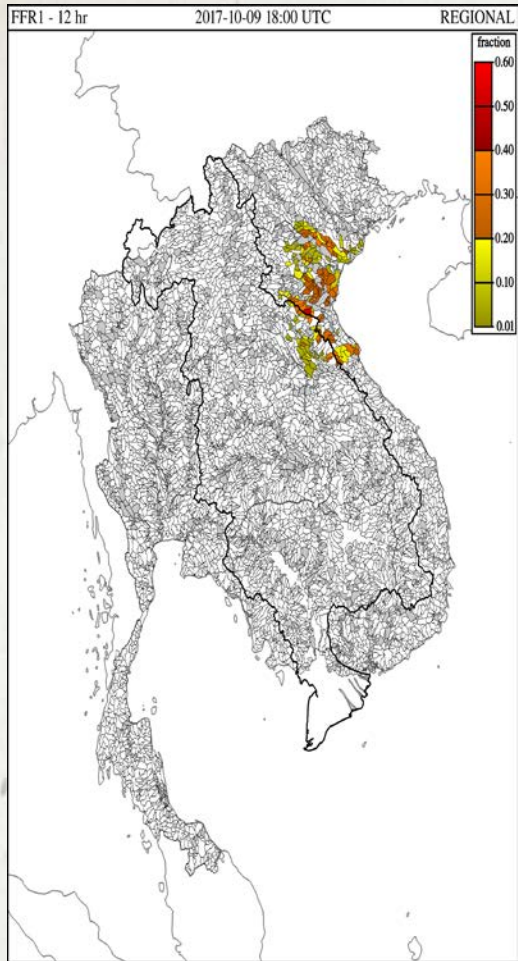
## Radars







## Model Information



## 12, 24, and 36-hour Flash Flood Risk

## POTENTIAL FUTURE ENHANCEMENTS

- Multi-NWP QPF Ingestion
- Implement a rainfall-induced landslide hazard threat product
  - Using soil moisture and rainfall thresholds from FFG systems
- Evaluate urban flooding issues
- Riverine Routing
- Seasonal and sub-seasonal discharge prediction



Landslide Susceptibility Map





THANK YOU

## MESOSCALE MODEL INGESTION

- Up to five (5) different models can be run through the FFG
- Allows forecaster decision on the most appropriate model for the situation
- Ingest hourly forecasts out to 48 hours
  - Output of 1, 3,6 and 24 hour precipitation accumulations (for FFG)
  - Produce Forecast Mean Areal Precipitation (FMAP) products
- Can ingest nowcasting products from SWFDP if available – just another model product

## RETURN