Enhancing Community Based Early Warning Systems in Nepal with Flood Forecasting Using Local and Global Models

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Department of Hydrology and Meteorology
Government of Nepal

PRACTICAL ACTION
Technology challenging poverty

Community Based Flood EWS in Nepal

Background

- Operationalizing effective Flood Early Warning Systems (EWS) in developing countries like Nepal poses numerous challenges

- Despite these challenges, simple real-time monitoring based Flood EWSs have been in place for the past decade

- Piloted in major river basins of Nepal by Practical Action and Nepal Department of Hydrology and Meteorology (DHM)
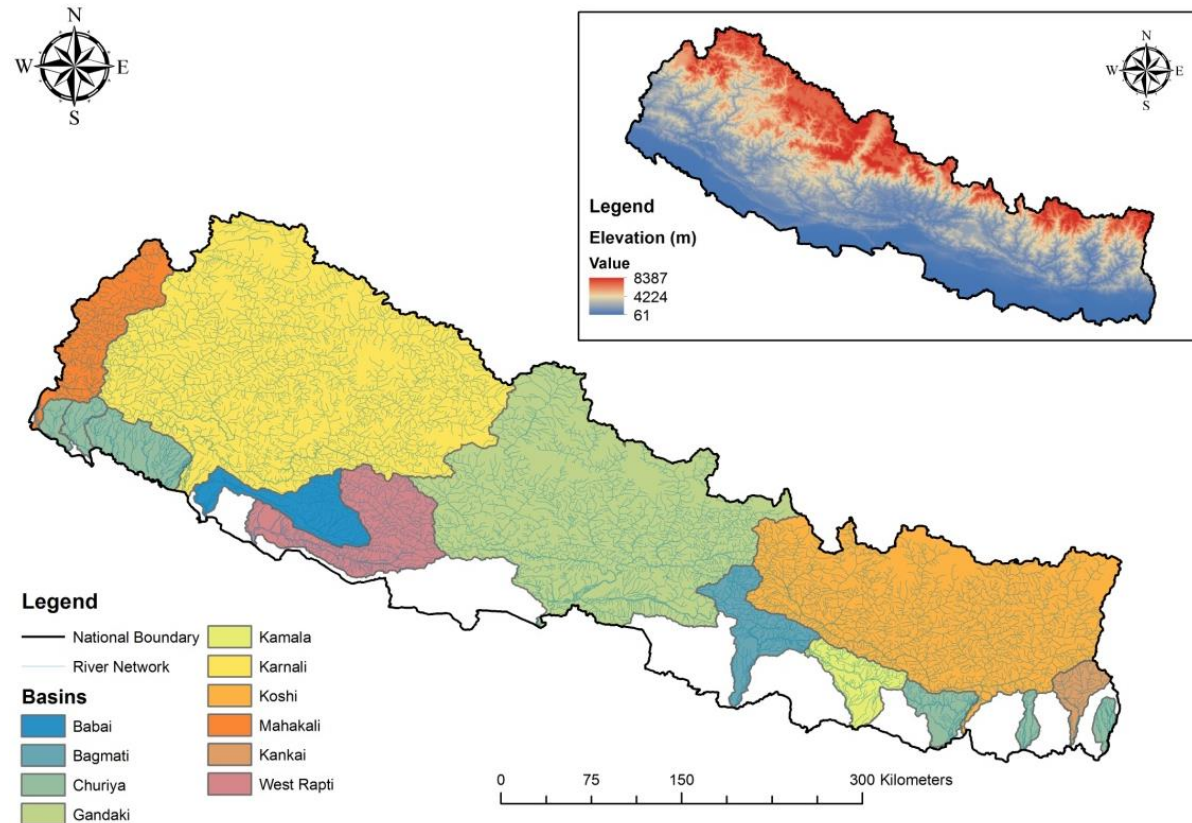
Major River Basins of Nepal. Source: Practical Action (2016)

Community Based Flood EWS in Nepal
Challenges and Constraints

- Complex topography and geology, sparse network of river and rainfall gauging stations and diverse socio-economic conditions

- Key constraint of these simple early warning systems is the limited lead time for response - as little as 2-3 hours, especially for rivers originating from steep mountainous catchments
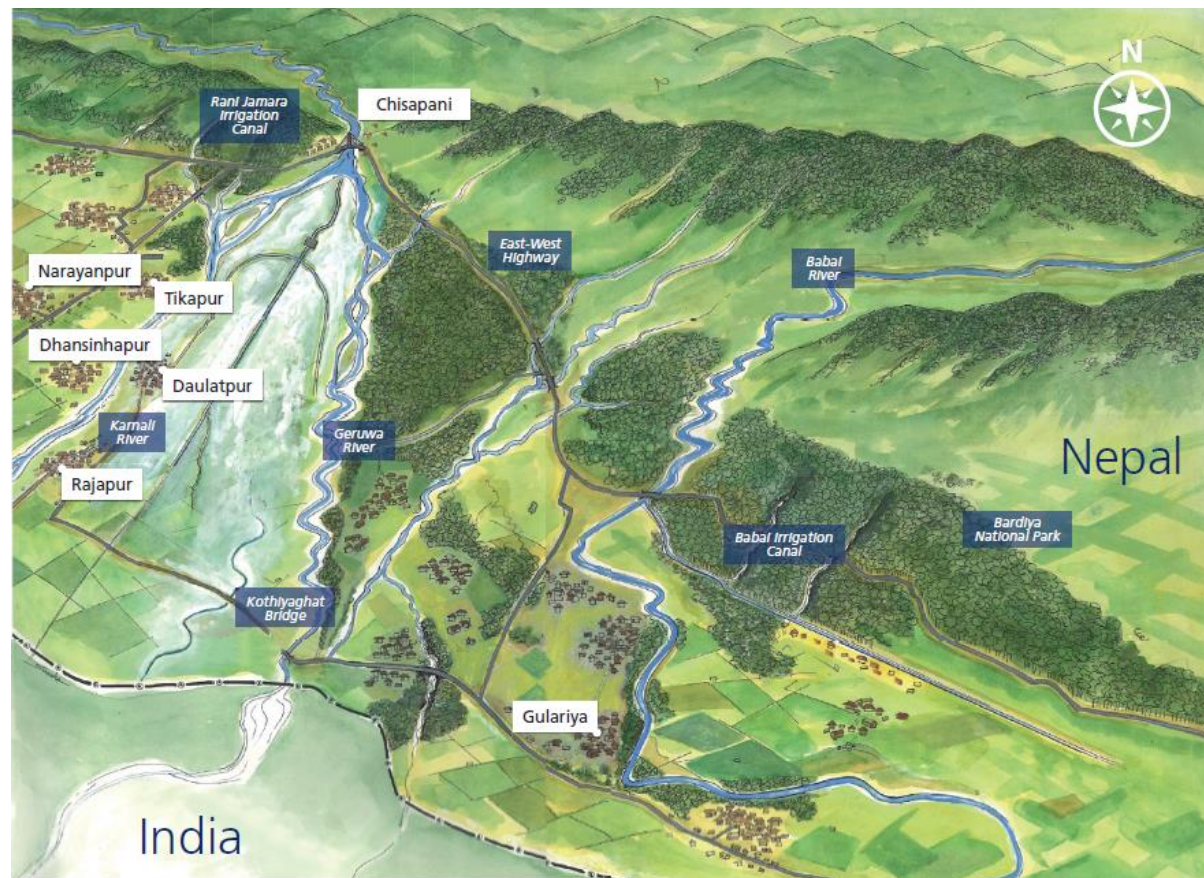
Schematic of Karnali Basin, West Nepal. Source: Zurich (2015)

Components of Community Based Flood EWS

Nepal Experience

- Risk Knowledge

- Monitoring and Warning Service

- Response Capabilities

- Dissemination and Communication

Mobile phones and web services are key to exchange and disseminate information on EWS in Nepal


Elements of Community Based EWS. Source: Practical Action (2008)

Global Models

Global Flood Awareness System (GLoFAS)

- **Streamflow prediction having a temporal resolution of 14 days for major reporting points of Nepal**

- **Based upon distributed hydrological simulations using numerical ensemble weather forecasts from the ECMWF (European Centre for Medium-Range Weather Forecasts)**

- **Provides 10 day accumulated rainfall and probability (%) of exceeding 50, 150 and 300 mm of accumulated rainfall over forecast range of 10 days for the ensemble ECMWF forecasts**
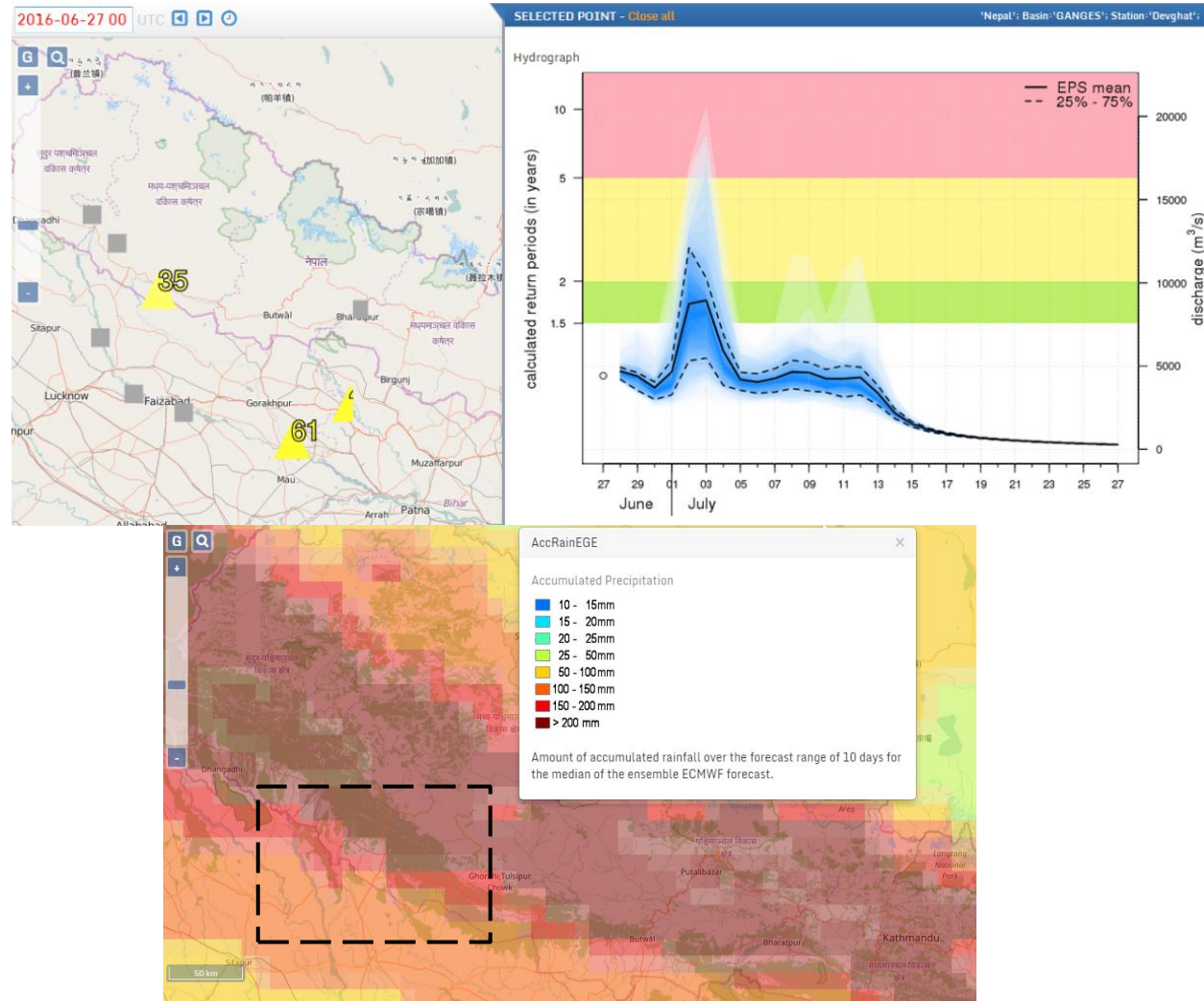
Forecast Products from Global Flood Awareness System (GLoFAS). Source: GLoFAS (2016)

Local Models

Operational Probabilistic Flood Forecasting Model

- Low data approach to forecast water levels, developed jointly through a research/practitioner partnership with Lancaster University, WaterNumbers (UK) and the International NGO Practical Action

- Data-Based Mechanistic Modelling (DBM) techniques, the model assimilates rainfall and water levels to generate localized hourly flood predictions, which are presented as probabilistic forecasts, increasing lead times from 2-3 hours to 7-8 hours
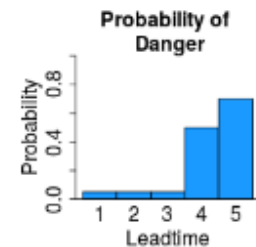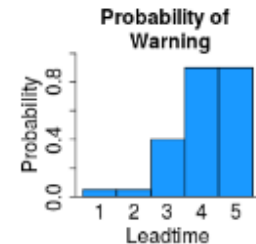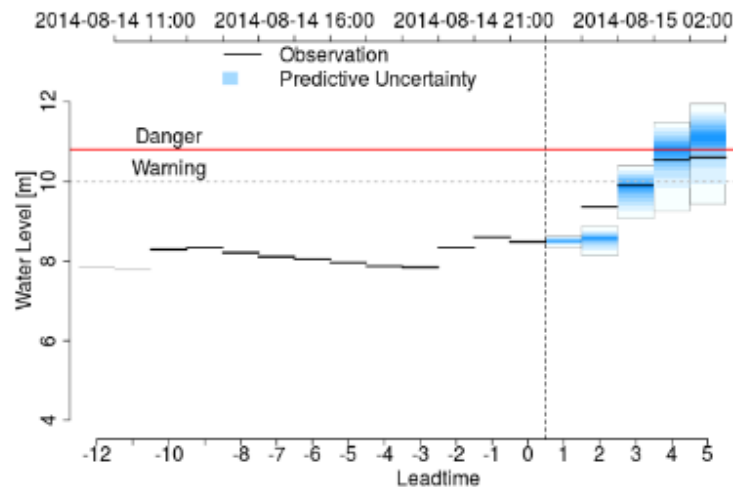

Probabilistic Flood Forecasts. Source: Smith et al., (2017)

Monsoon 2016 Nepal

Global and Local Models Operationalized in West Rapti Basin

- On 25 July 2016, GLoFAS hydrological forecasts for the West Rapti indicated a sharp rise in river discharge above 1500 m3/sec (equivalent to the river warning level at 5 meters) with 57% probability of exceeding the Medium Level Alert in two days
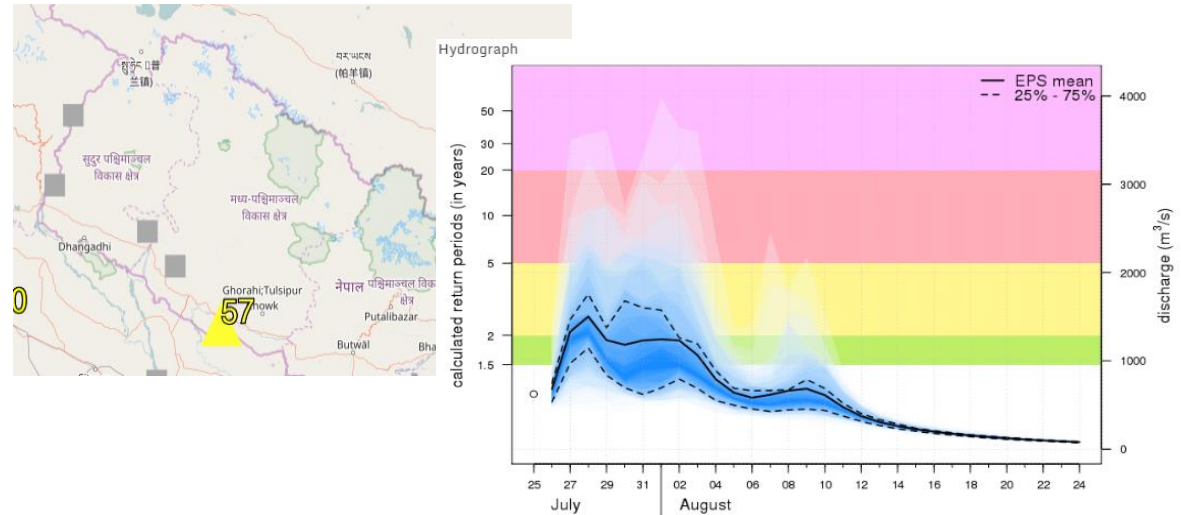
- Rainfall stations upstream of the West Rapti catchment recorded heavy rainfall on 26 July, and localized forecasts from the probabilistic model at 8 am suggested that the water level would cross a pre-determined warning level in the next 3 hours
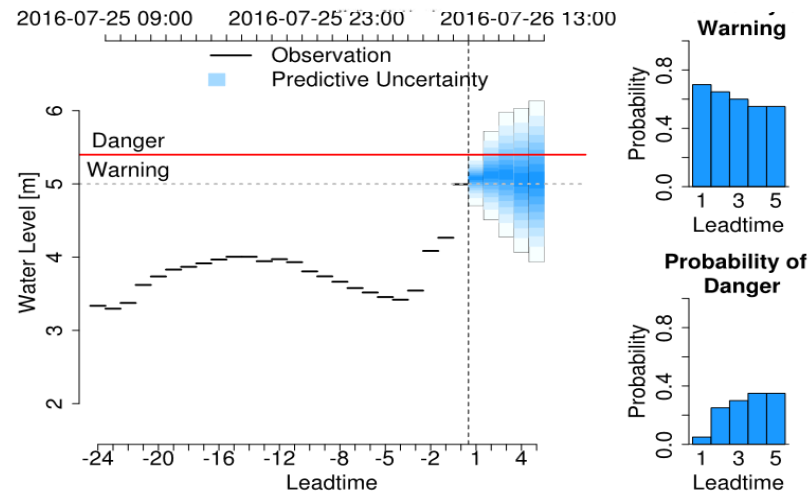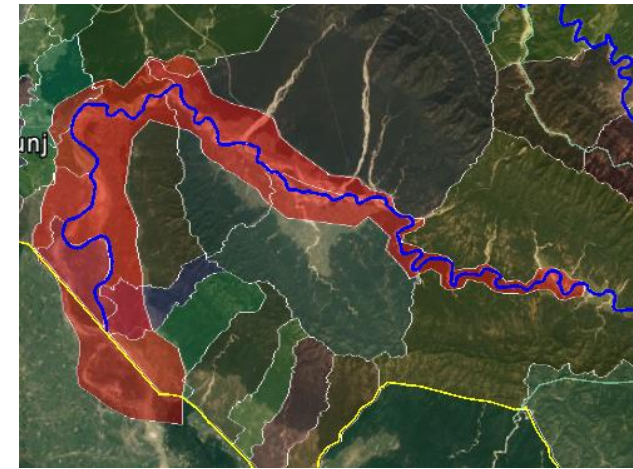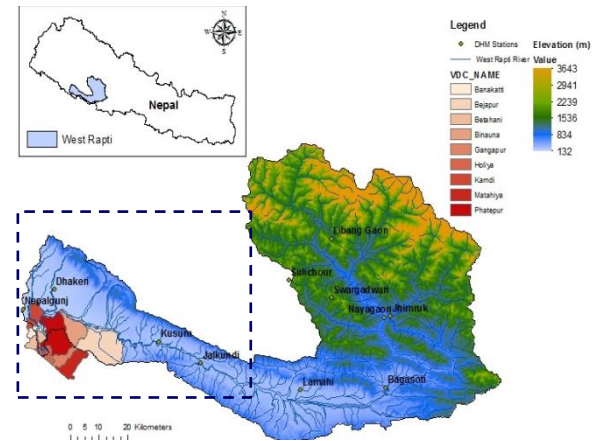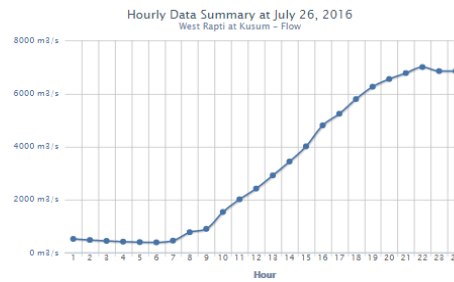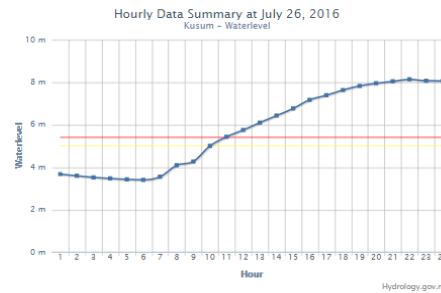
Research Into Use
West Rapti Basin

- Flood Forecasting Section at DHM issued a flood advisory, and disseminated SMS flood alerts to more than 13,000 at-risk people residing along the floodplains. Water levels crossed the danger threshold (5.4 meters) at 11 am, peaking at 8.15 meters at 10 pm on 26 July

- Extension of the warning lead time from probabilistic forecasts was significant in minimizing the risk to lives and livelihoods as communities gained extra time to prepare, evacuate and respond

Government of Nepal
Ministry of Population and Environment
Department of Hydrology and Meteorology
Flood Forecasting Project

Choose Your Option

Select Date 2016-07-26   View Type Hourly ▼   View

Hour	Value (m)	Flow (m³/s)
1	3.67	516.40
2	3.59	475.10
3	3.52	440.80
4	3.46	413.00
5	3.42	395.00
6	3.40	386.00
7	3.54	450.60
8	4.09	767.40
9	4.27	894.10
10	5.00	1531.00
11	5.43	2008.00
12	5.75	2414.00
13	6.10	2911.00
14	6.43	3433.10
15	6.76	4007.20
16	7.17	4797.40
17	7.38	5235.60
18	7.63	5788.70
19	7.83	6255.00
20	7.95	6545.50
21	8.04	6768.40
22	8.13	6996.10
23	8.07	6843.70
24	8.07	6843.70

Hourly Data Summary at July 26, 2016
Kusum – Waterlevel

Hydrology.gov.np

Hourly Data Summary at July 26, 2016
West Rapti at Kusum – Flow

Rising water level: near warning level	above warning level	above danger level	falling water level: below warning
Westrapti Kusumko jalamapan kendrama jalsataha chetawani taha najik pugekole sajag rahanuhuna anurodh chha	jalamapan kendrama jalsataha le chetawani taha par garekole sajag rahanuhuna anurodh chha	Westrapti Kusumko jalamapan kendrama jalsataha le khatara ko taha par garekole surakchhit sthan ma rahanuhuna anurodh chha	Westrapti Kusumko jalamapan kendrama jalsataha samanya awasthama farkiyekole tatkal kunai khatara chhaina

Total Number of Message Sent: 13205
Total Number of Successful Message: 9064
Total Number of Failed Message: 4141

Mobile SMS Interface. Source: Nepal Department of Hydrology and Meteorology (2016)
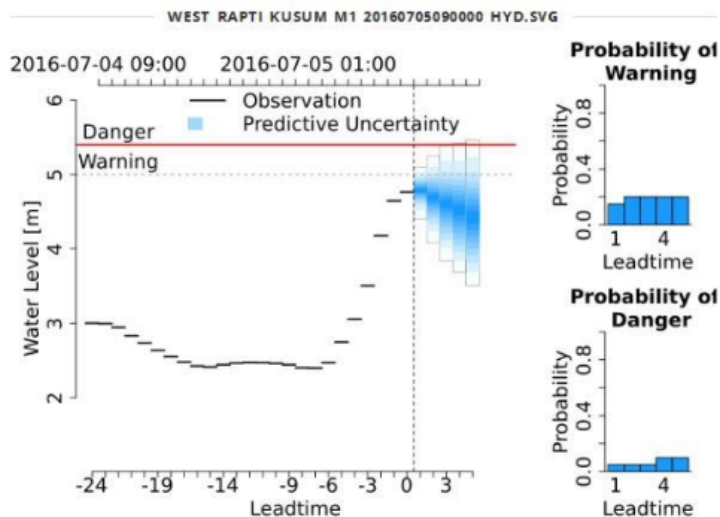
Science Policy Interface

DHM utilized forecasts from Local and Global Models enabling them to produce flood advisories and make decisions on sending mobile SMS to vulnerable communities residing along the Narayani and West Rapti river basins during the 2016 Monsoon

Flood Advisories for Nepal. Source: Nepal Department of Hydrology and Meteorology (2016)

Challenges and Uncertainties

Way Forward

- Forecasting tools have contributed to enhance the effectiveness and efficiency of existing community based systems, increasing the lead time for response

- Extensive research is required on appropriate ways to interpret and disseminate probabilistic forecasts having longer (2-14 days) and shorter (3-5 hours) time horizon for operational deployment as there are numerous uncertainties associated with predictions

Natural Hazards and Earth System Sciences

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Community-based early warning systems for flood risk mitigation in Nepal

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Thank You

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