APFM

Flood hazard mapping and prediction in poor-gauged basins

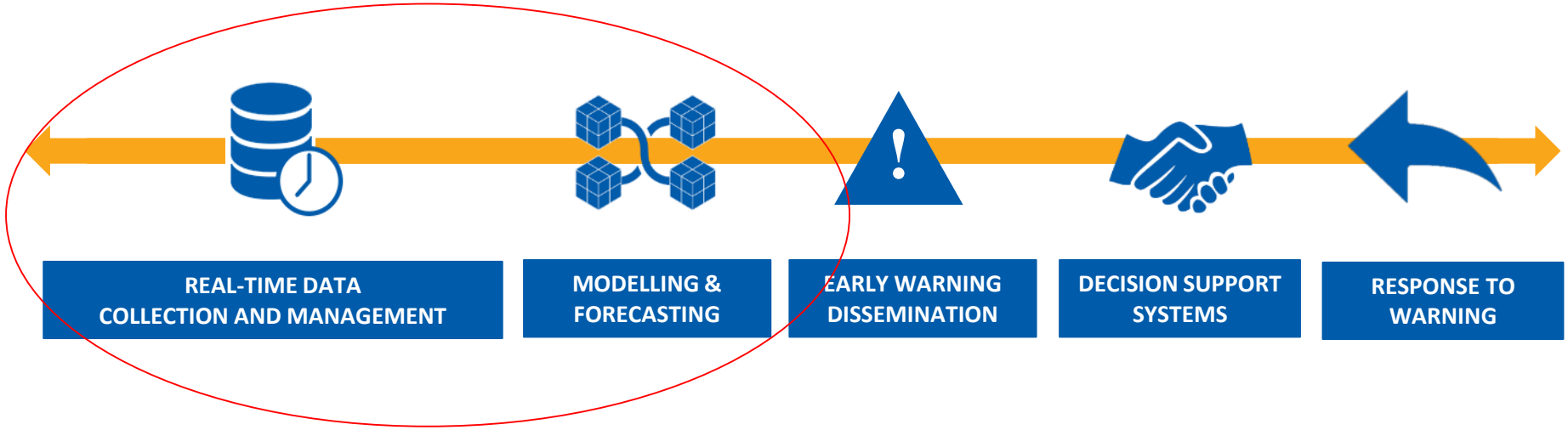
Giacomo Teruggi (WMO) and Valentin Aich (GWP)

World Meteorological Organization
Weather • Climate • Water

20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

Global Water Partnership

End-to-end early warning systems for flood forecasting



20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

…but is flood forecasting all that we need?

20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

Risk Management: Hazards and disasters

"There are two types of levees, those that have been overtopped by floodwaters, and those that will be"

- William Hammon Hall, first State Engineer of California, 1880 circa

Natural hazards are <u>unavoidable</u>

BUT

Disasters are caused by social attitudes and developmental processes that increase vulnerability

APFM

Since 2001, APFM promotes the concept of Integrated Flood Management(IFM)

"Integrated Flood Management is a process that promotes an integrated, as opposed to fragmented, approach to managing floods.

IFM keeps in consideration **environmental preservation**, balancing development needs with flood risk towards a **sustainable development**"

IFM integrates **land use** and **water resources** in a river basin, in accordance with Integrated Water Resources Management, with the objective of **maximizing net benefits** derived from the use of floodplains and **minimizing loss of life** due to flooding. IFM keeps in consideration environmental preservation, balancing development needs with **flood risk** towards **sustainable development**.

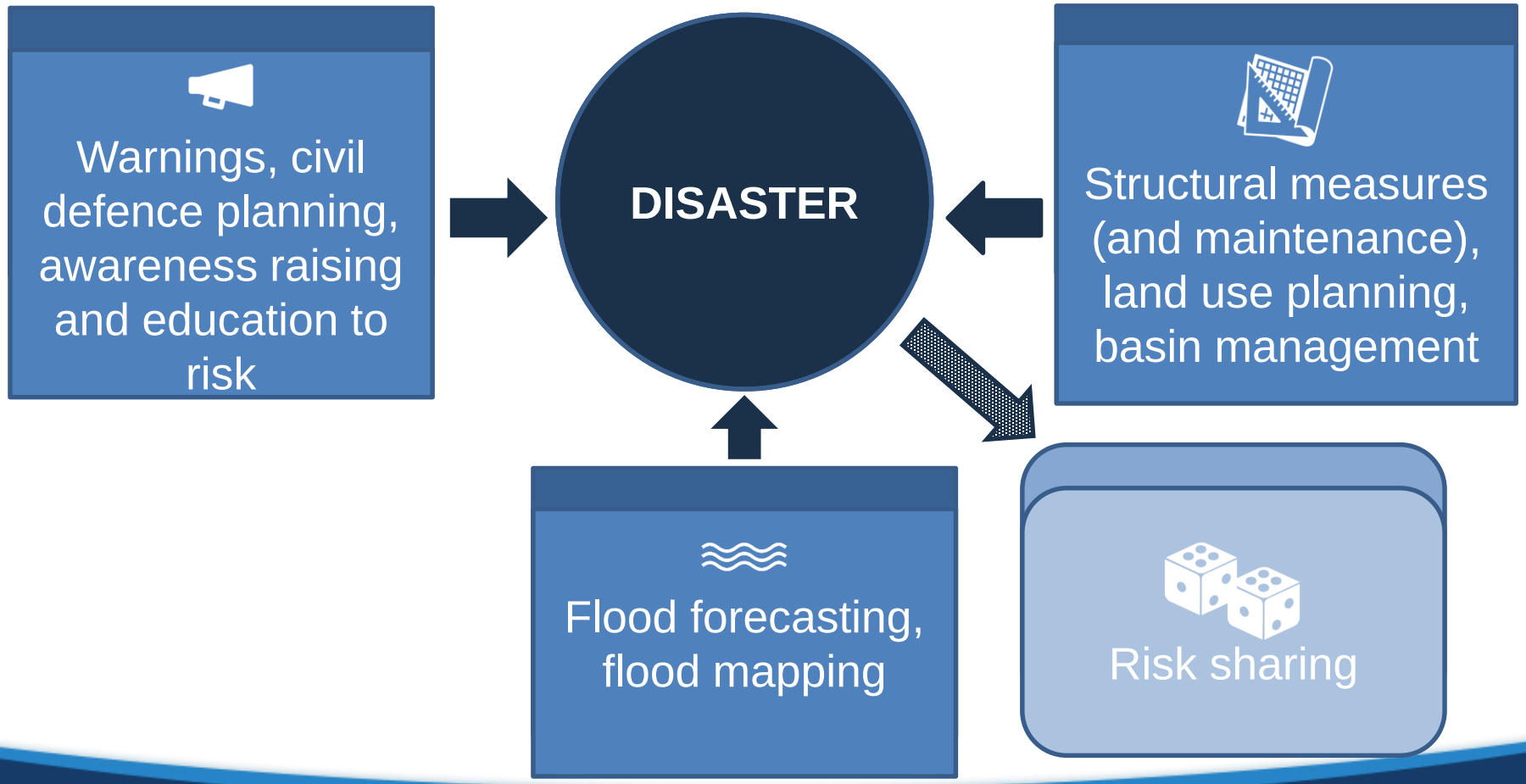
http://www.floodmanagement.info

World Meteorological Organization
Weather • Climate • Water

20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

Global Water Partnership

Flood Risk Mitigation: from theory to practice



IFM Tool Series: guidance documents bridging disciplinary gaps

- Formulating a Basin Flood Management Plan
- Conducting Flood Loss Assessments
- Applying Environmental Assessment for FM
- Organizing Community Participation for FM
- Reservoir Operations and Managed Flows
- Urban Flood Risk Management
- The Role of Land Use Planning in FM
- Risk Sharing in Flood Management
- Flood Management in a Changing Climate
- IFM as an Adaptation Tool for Climate Change: case studies
- Flood Emergency Planning
- Management of Sediment-related Risks
- Conservation and Restoration of Rivers and Floodplains
- Urban Flood Management in a Changing Climate
- Flood Proofing
- Management of Flash Floods
- Coastal and Delta Flood Management
- Transboundary Flood Management
- Flood Forecasting and Early Warnings
- Flood Mapping
- Flood Loss Assessment Case Studies
- Crisis Mapping and Crowdsourcing
- Public Perception of Risk and SIA
- Assistance for the development of an advocacy strategy
- Health and Sanitation aspect of FM
- Role of the Media in FM
- Effectiveness of FM measures

World Meteorological Organization
Weather • Climate • Water

20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

Global Water Partnership

30 Support Base Partners (SBPs)

Specialized institutes in various disciplines relevant for IFM

adpc
WATER FRAMES
Australian Government Bureau of Meteorology
bfg Bundesanstalt für Gewässerkunde
Cap-Net
CEH Centre for Ecology & Hydrology NATURAL ENVIRONMENT RESEARCH COUNCIL
UNIVERSIDAD NACIONAL DEL LITORAL LUX INDEFICIENS
ČHMÚ
RESEARCH FOUNDATION cima
Deltares Enabling Delta Life
DHI The expert in WATER ENVIRONMENTS
EUROAQUAE Euro Hydro-Informatics and Water Management
IAHS AISH
ICHARM
JICE
JWA Japan Water Agency
KOREA WATER FORUM KWF
KOREA WATER RESOURCES ASSOCIATION
PROHIMET
RIVERS WITHOUT BOUNDARIES
SIWI
TUHH Technische Universität Hamburg-Harburg
UNECE United Nations Economic Commission for Europe
UNESCO-IHE Institute for Water Education
UNITED NATIONS UNIVERSITY
UNU-FLORES Institute for Integrated Management of Material Fluxes and of Resources
WWF
zoi environment

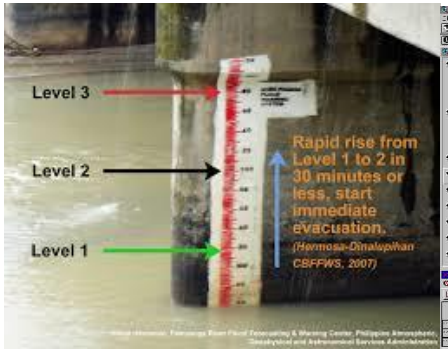
New SBPs

sepia CONSEILS
CARITAS Schweiz Suisse Svizzera Svizra
CAWR Center for Advanced Water Research
WATER YOUTH NETWORK
IUCN

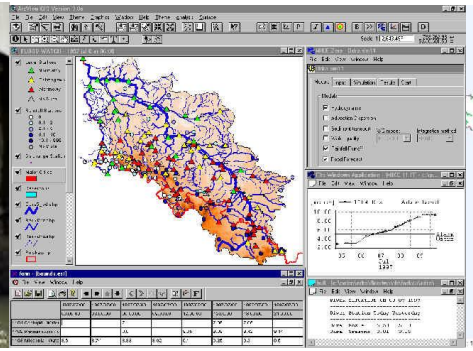
WORLD METEOROLOGICAL ORGANIZATION
20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT
Global Water Partnership

Planning a flood forecasting system: preliminary considerations

- Need to understand:
  - the hydro-morphological characteristics of the basin topography, geology and soils, and the degree of structural development;
  - the main physical processes occurring during hydro meteorological events; and
  - the type of service that is required and that can be achieved technically and economically



Treshold based flood alert (qualitative)



Flood forecasting (quantified and time-based prediction)

Vigilance mapping

Inundation forecasting (hydrodinamic modelling)

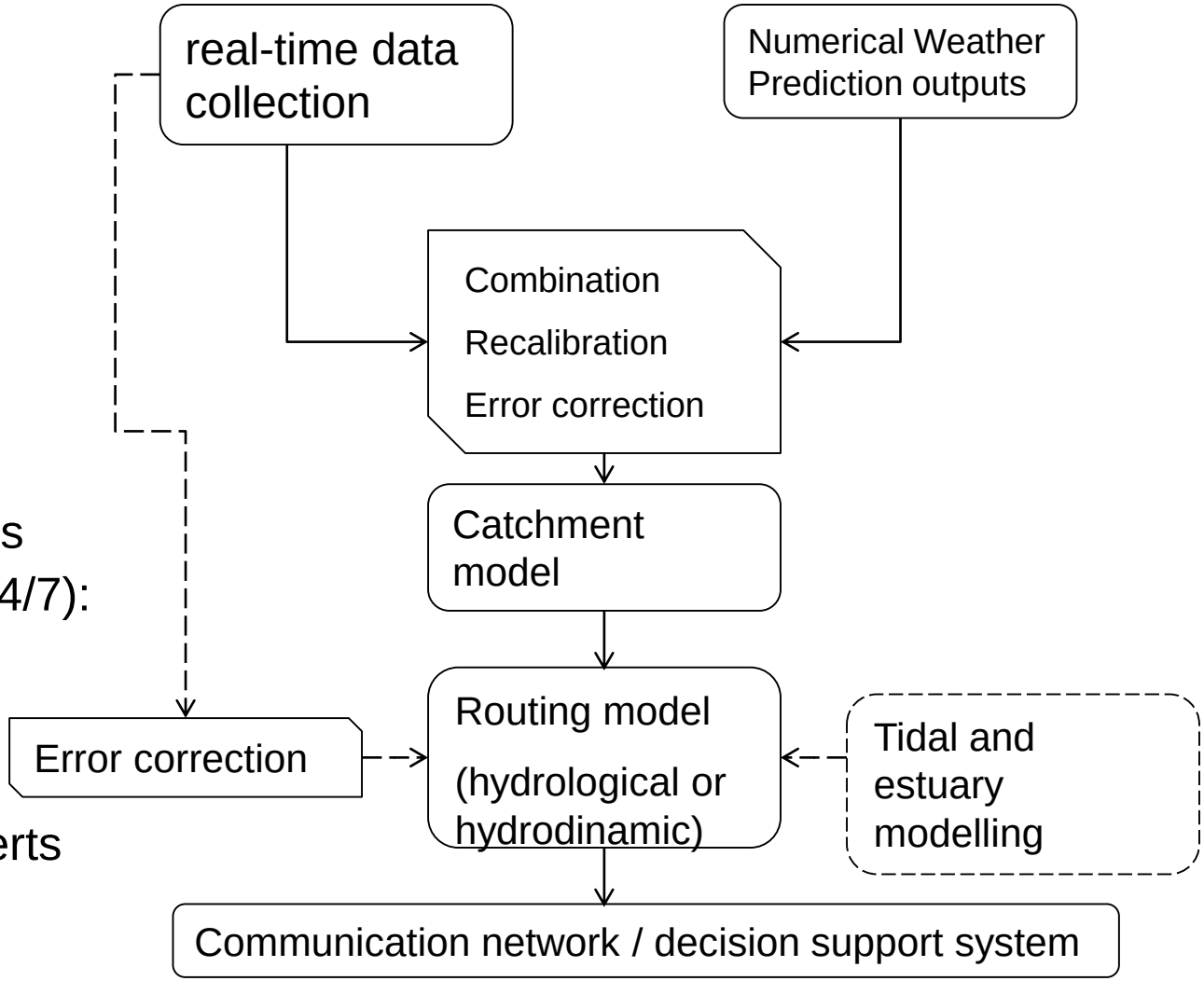
20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

Requirements for a flood forecasting and early warning system

Data:
- Meteorological
- Hydrological
- Topographic
- Socio-economic

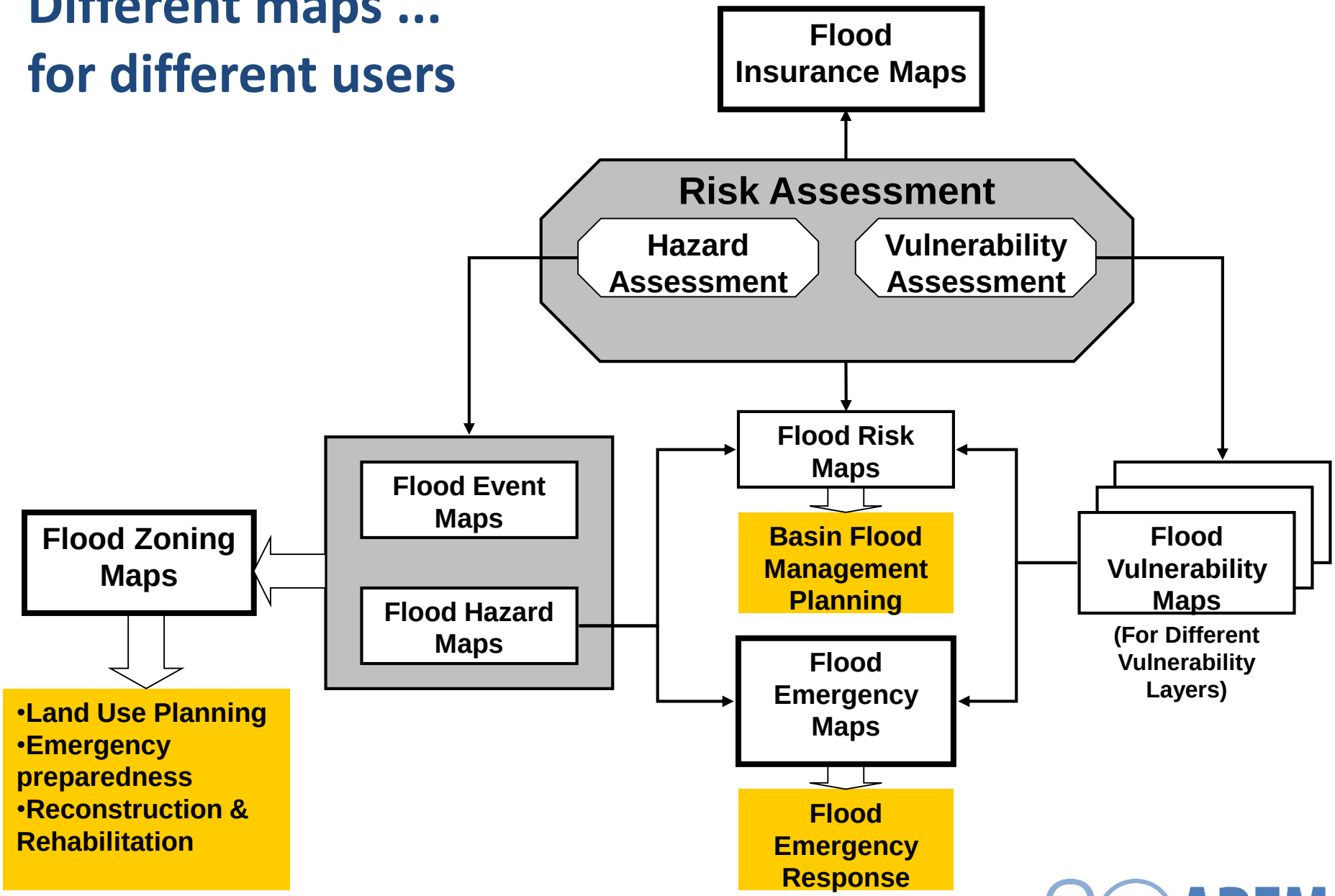
Infrastructure:
- Safe place
- Availability of calculus

Human Resources (24/7):
- Hydrologists
- Meteorologists
- IT experts
- Communication experts



20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

Different maps ... for different users



20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

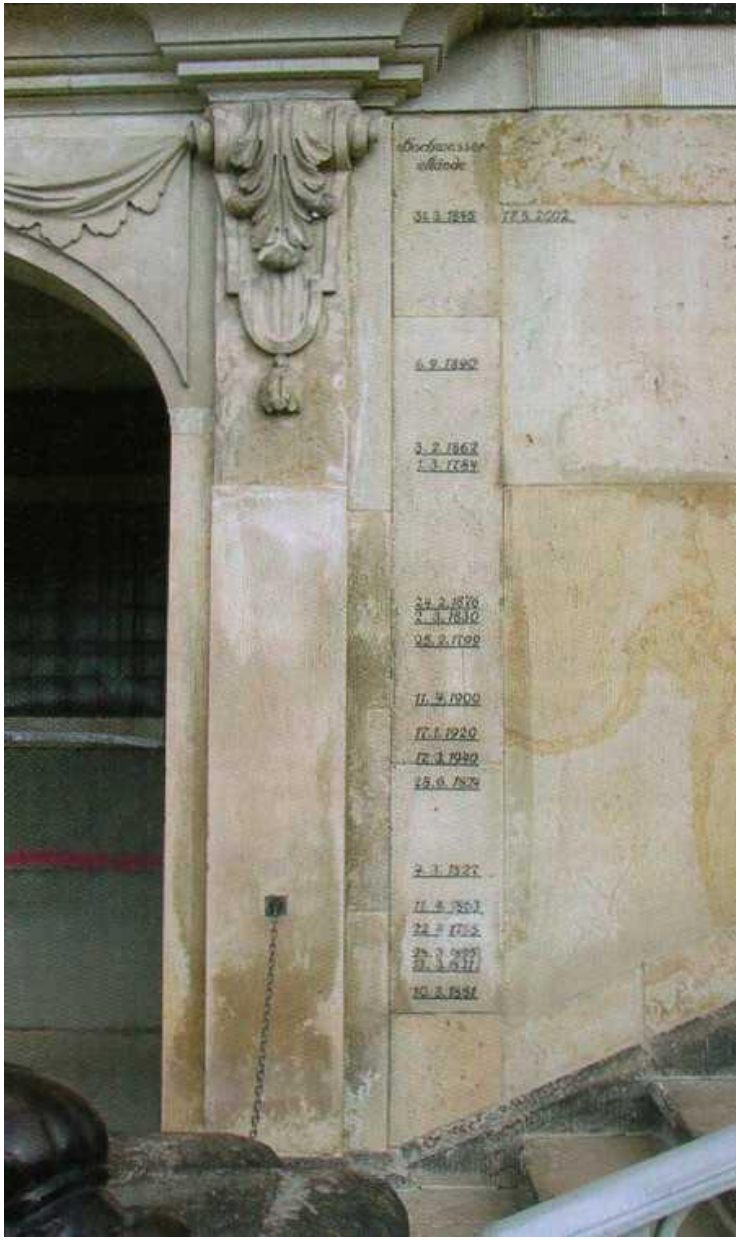
Flood Mapping: Hazard analysis

1. Historic events

2. Geomorphologic analysis

3. Hydro-dynamic (Hydrological studies and mathematical modeling)

Keep in mind the **vulnerability** of affected areas.
If there are no consequences, no details are necessary



Dresden, Germany

20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

Hydrometric data collection – the challenges

- Elevated costs of:
  - Installation
  - **Operation**
  - Data transmission
  - **Maintenance**
- Difficult to couple the technology to the social and environmental conditions
- Prone to vandalism and depredation
- Difficult to get the data in real-time without a considerable investment

3D PAWS station

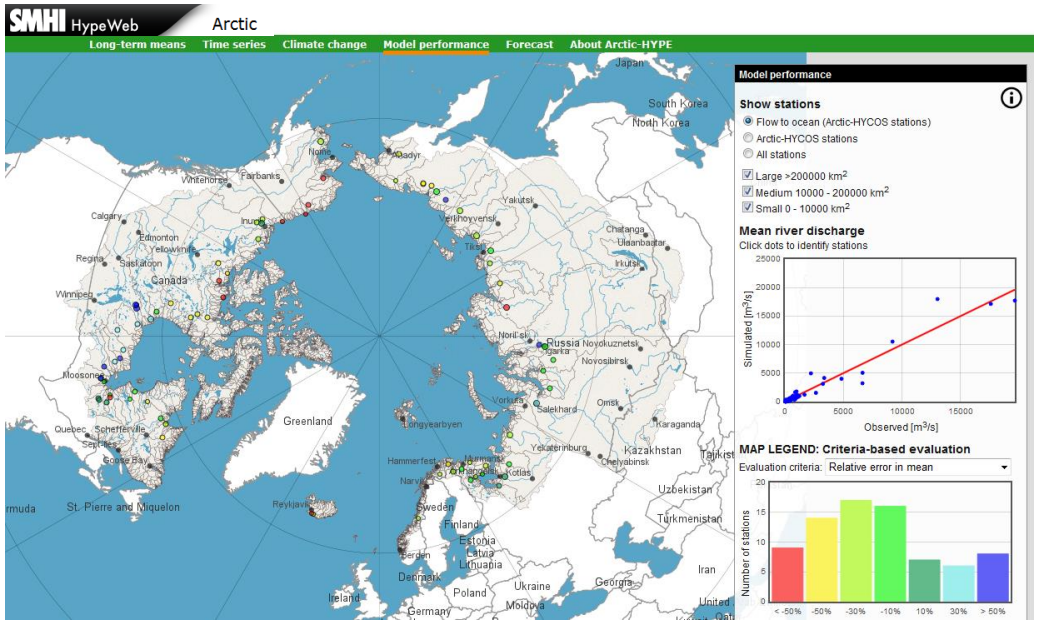
ACRONET by CIMA Foundation

How to cope with data scarcity? «Virtual» stations

Arctic-HYPE Model

A pan-arctic application of the **Hydrological Predictions for the Environment model (Arctic-HYPE)**, developed as a contribution to the Arctic-HYCOS project, to run hydrological forecasts of flow to the Arctic Ocean

- Developed by SMHI (Sweden, Gustafsson *et al*) in collaboration with U Manitoba (Canada; Stadnyk *et al*) and Melnikov Permafrost Institute (Russia; Lebedeva *et al*)
- Semi-distributed catchment based multi-basin hydrological model
- Forcing hydrological and meteorological data for 1961 – present, assimilating Arctic-HYCOS station discharge data
- Model key water storages and fluxes in the Arctic Ocean drainage basin:
  - explain observed trends in river flow (hydrological regimes)
  - estimate flow in non-gauged basins (flow-to-ocean)
- Daily hindcasts and 10-day forecasts have running since June 2017



http://hypeweb.smhi.se/

20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

How to cope with data scarcity?

Community Based Flood Management: pilots in India, Bangladesh, Thailand and Laos PDR

Bottom-up approach to flood management, increasing awareness and preparedness of local populations to flood risk.

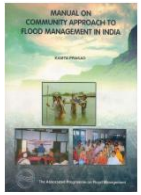
Integrating local knowledge, gender issues, and disaster risk reduction disciplines.

Elevated Cost-Benefit ratio for saving lives

Sustainability limited by the need of periodic drills and rehearsals

Led to the formulation of guidelines allowing replication of the approach at the national level

More info: "Voices from the field"



20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

Better coordination and collaboration between the hydrometeorological department and the local community

Early warning information dissemination through LINE

Likit: ***"Water level at Kabinburi (in front of Kabinburi HydroMet Station) at 6:00 am is 4.72 m. Rain water is 26.6 mm."***

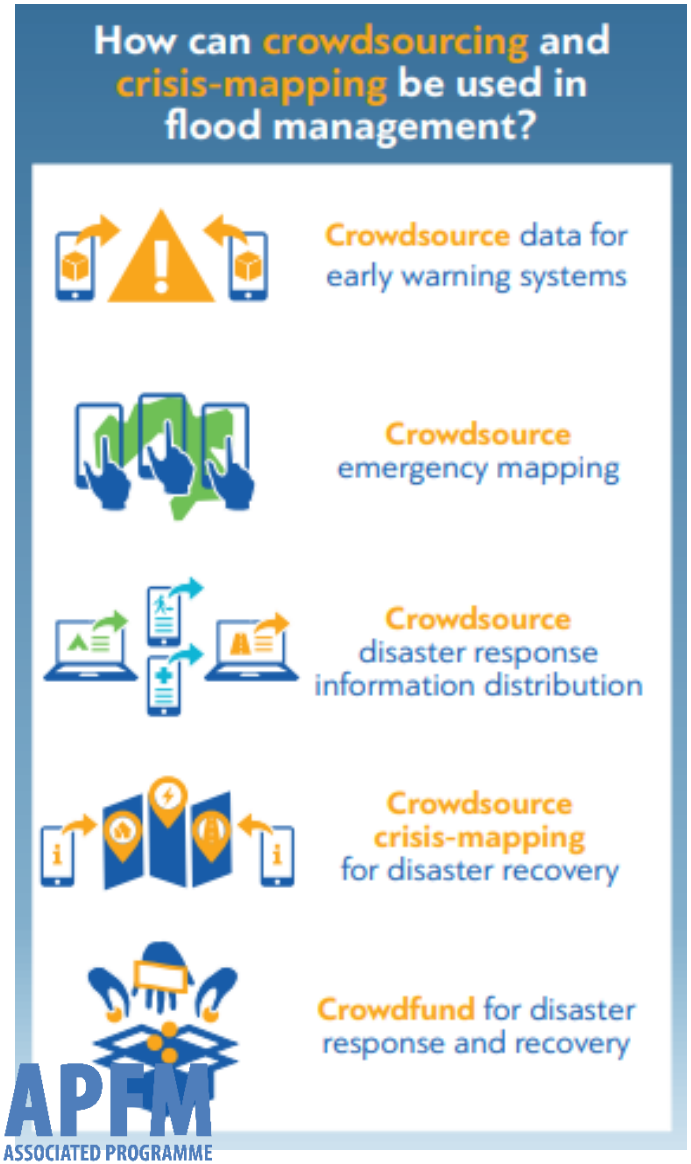
20 APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT YEARS

Communities that come up with their own ideas and work programmes to address their needs tend to have better chances of finding long-term solutions to their problems.

Youths of community involved in developing hazard and vulnerabilities maps

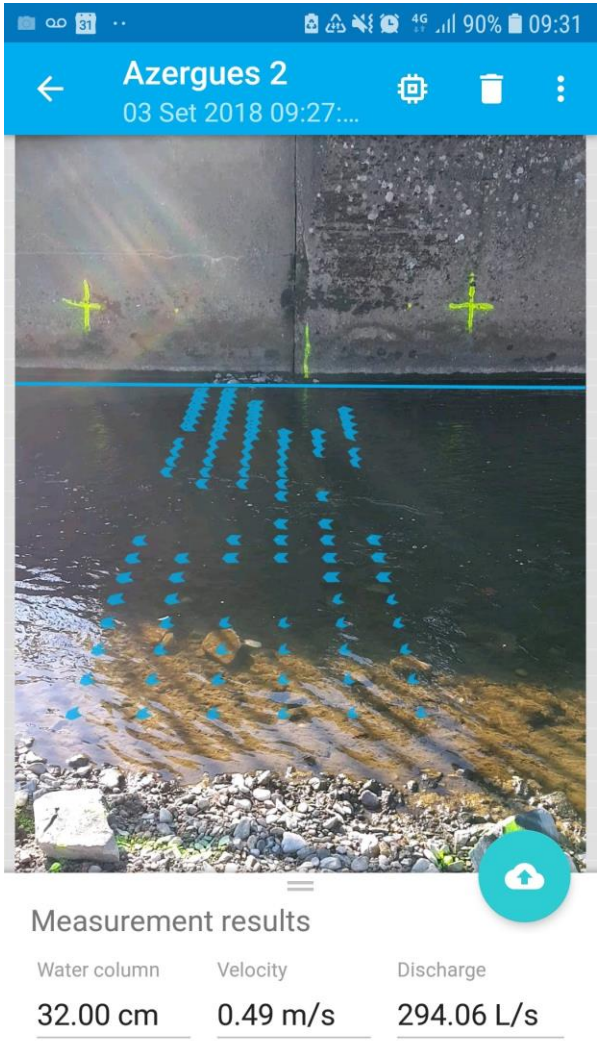
20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

How to cope with data scarcity? Crowdsourcing



20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

How to cope with data scarcity? New technologies

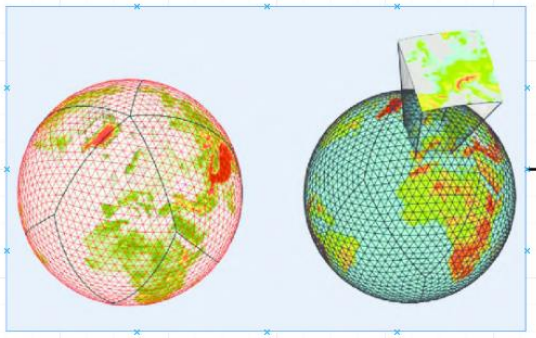


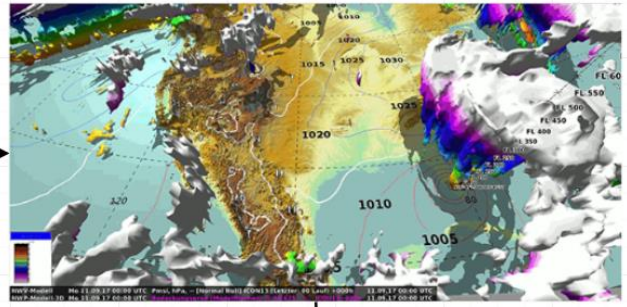
20 APFM
YEARS
ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

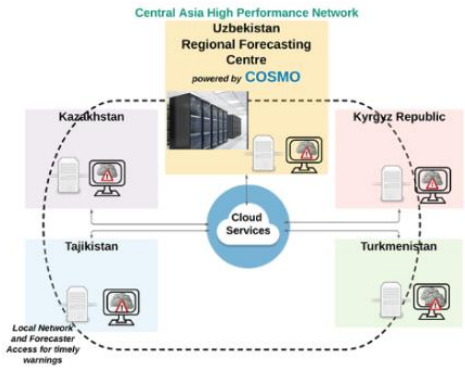
CAFEWS: Central Asia Flood Early Warning System

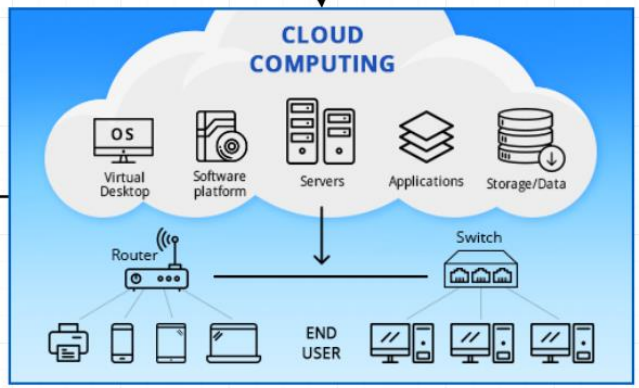
A Flow Forecasting and Flood Warning Advisory System for the Amu Darya and Syr Darya Basins

- **River Flow Forecast**
- **Landslide Occurance Warning**
- **Wide Area Network (WAN) installation in Central Asia**
- **Forecaster Workstation Equipment purchase for each NHMS**









WORLD BANK GROUP

WORLD METEOROLOGICAL ORGANIZATION

With financial support from:

CAWEP GFDRR REWS USAID

20 YEARS APFM ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT