Climate risk management/early warning information systems

S.H.M. Fakhruddin
Hydrologist
fakhruddin@rimes.int
www.shmfakhruddin.com

Regional Integrated Multi-Hazard Early Warning System
RIMES

Outlines

- Early Warning Systems and climate risk management
- New developments in early warning system-RIMES
- Case Study- CRM & EWS
- Visit the facilities
- Group Discussion

Perceptions of Climate

- Climate as a resource
- Climate as a hazard
- Climate as a constraint

Every society climate has a mix of all three, but the proportions vary from one country to the next and one decade to the next.

RIMES

Climate is a resource most of the time

Hazards of Societal Concern

(whether climate changes or not)

- Droughts
- Floods
- Hurricanes
- Ice storms
- Forest fires
- El Niño & La Niña
- Diseases
- Global warming
- Other

RIMES
Regional Integrated Multi-Hazard Early Warning System

Keep in mind that Climate two faces: a bright side and a dark side

- **Bright side:**
- **People generally have enough water to drink, to grow food, to run factories, water for irrigating dry lands and even deserts**

- **Dark side:**
  - **Droughts, floods, fires, heat waves, hurricanes, tornadoes, etc.**

Regional Integrated Multi-Hazard Early Warning System
RIMES

WHAT GETS YOUR ATTENTION?

- **The sunny side of climate**

Tropical resort

- **or the dark side?**

Flood

RIMES

Rationale for Climate Forecast Applications for Disaster Mitigation

- Impact of recurrent droughts and floods cause widespread damage and loss to assets, infrastructure and crop production

- Climate variability driven by large scale ocean-atmosphere phenomenon like ENSO causes significant number of droughts and floods

- Casualty, livelihood loss and damage are high and a major cause for concern

- Advances in the understanding of the climate system and increased ability in monitoring and forecasting weather events help to solve some of these problems

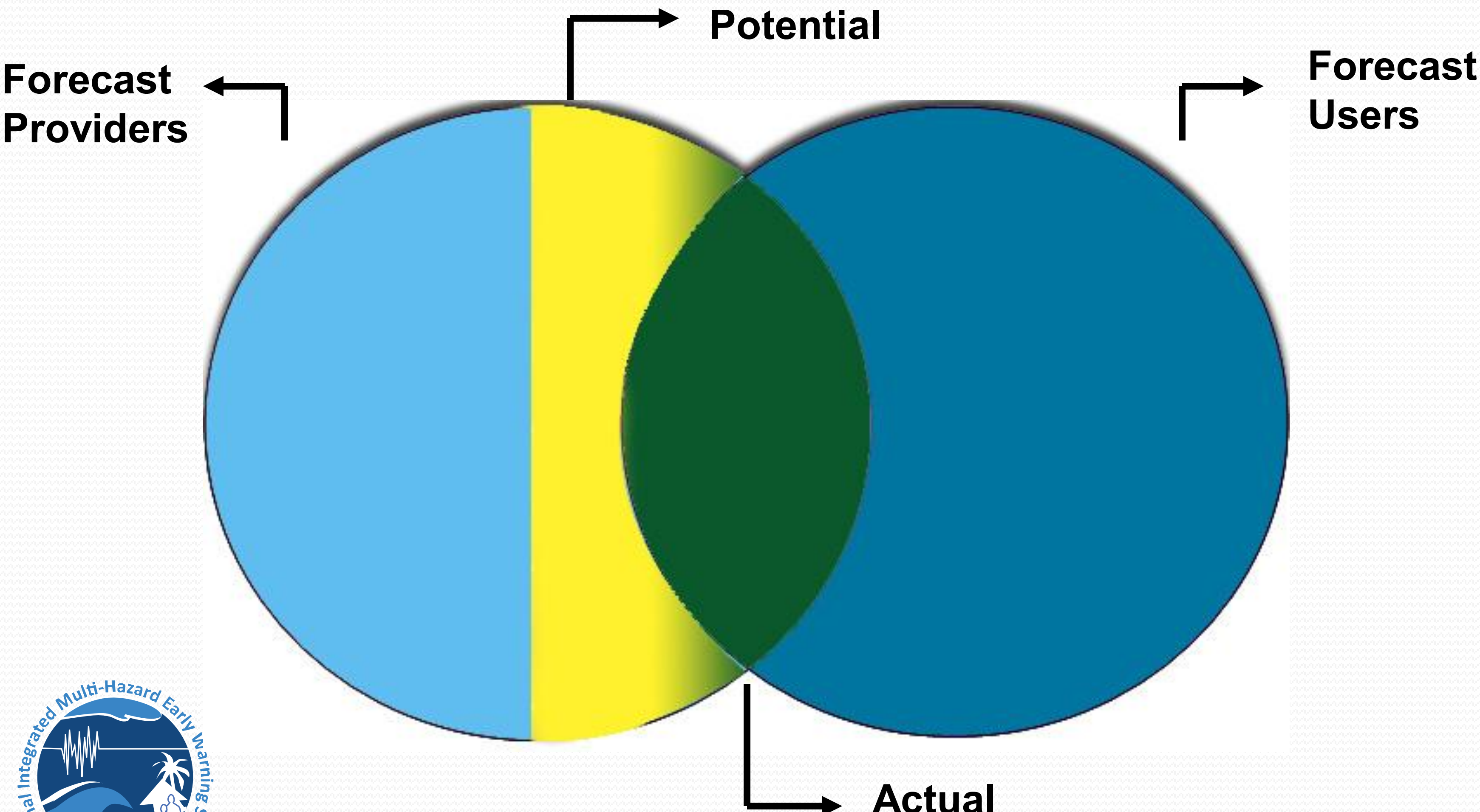
Regional Integrated Multi-Hazard Early Warning System
RIMES

Application of climate information could reduce disaster risks

1. **Past climate information (past)** – high potential, but under-utilized
2. **Climate information monitoring (concurrent)** – moderate potential, satisfactory utilization
3. **Climate forecast information (near future)** – moderate potential, poorly utilized
4. **Climate change scenario information (distant future)** – ???

Regional Integrated Multi-Hazard Early Warning System
RIMES

Potential & Actual Utilization of Climate Information Products

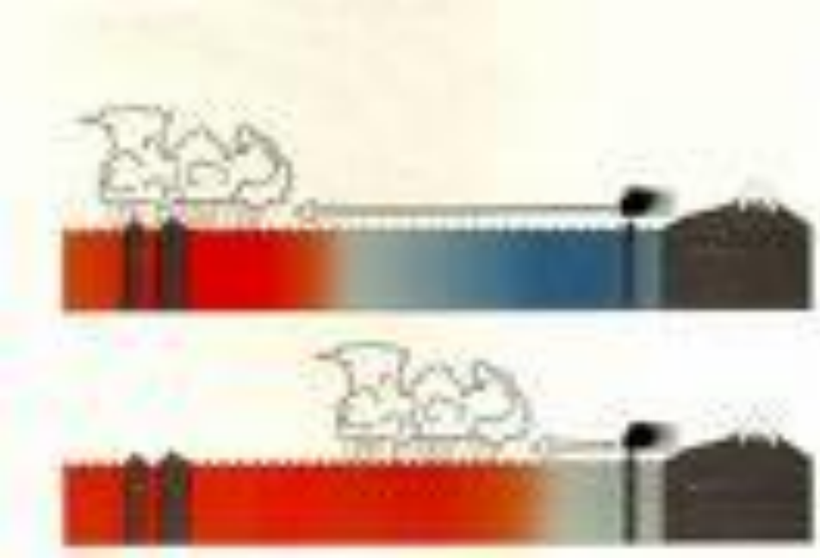


Relevance of climate forecast products depends on:

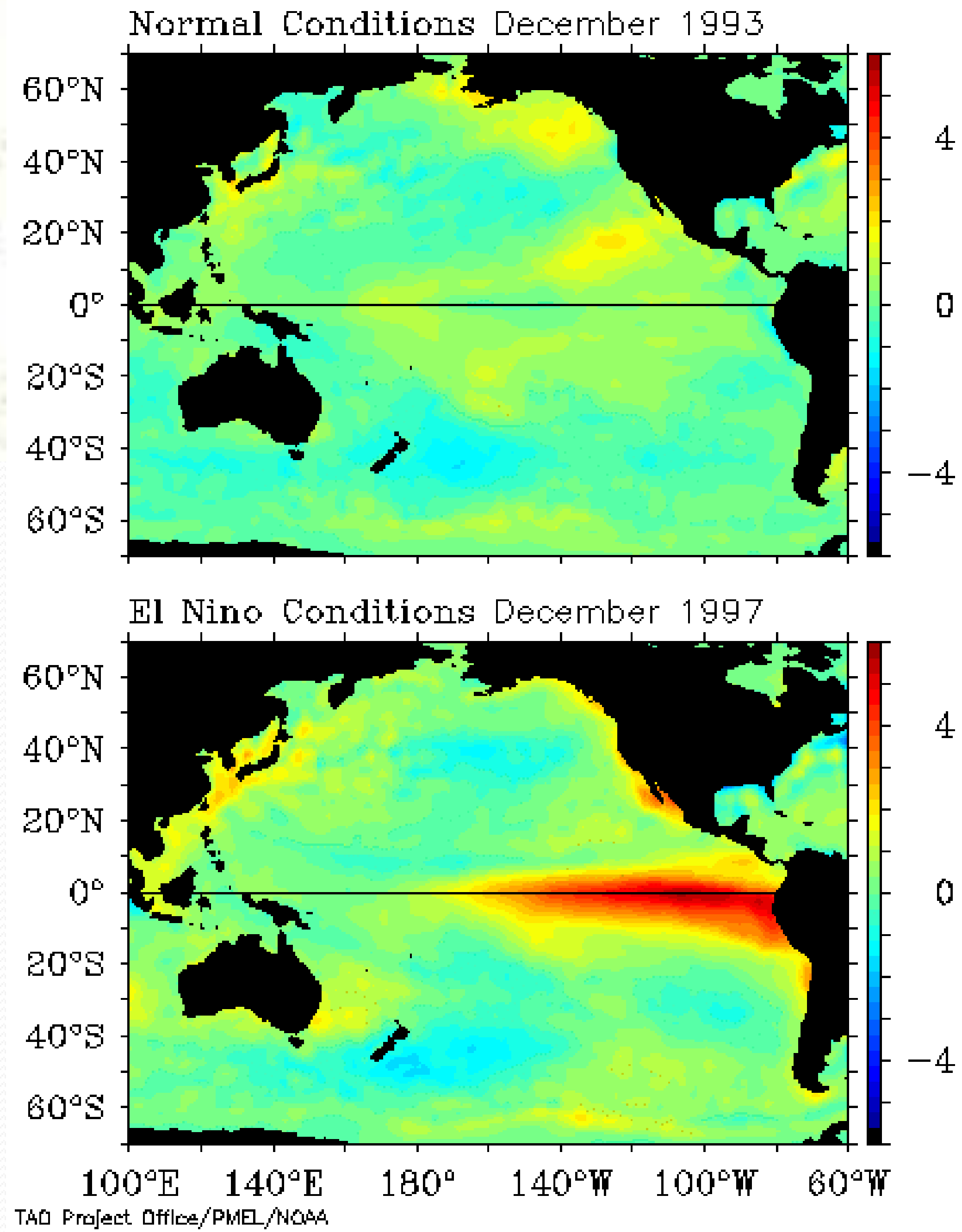
- Timeliness (efficiency of delivery, sufficient lead time)
- Clear, simple language
- Reliability
- Location-specific
- User-need based

Weaknesses in existing systems

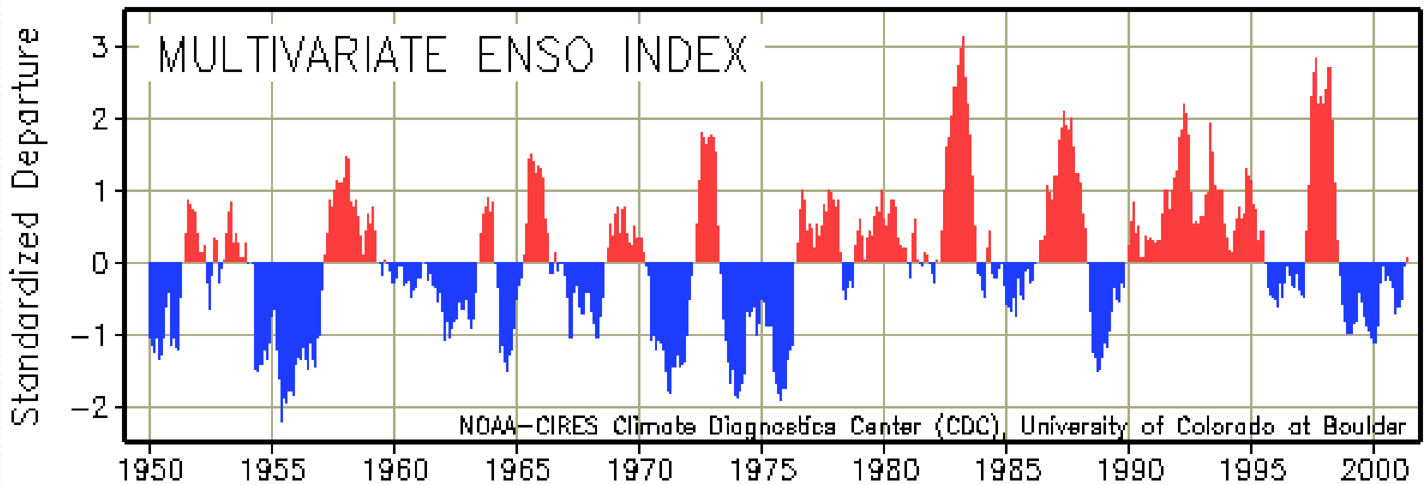
- Absence of participatory mechanism for identifying user forecast requirements
- Available climate information not tailored to users' needs and requirements
- Weak forecast producer-user communication channel
- Users have difficulty understanding forecast language
- Community level dissemination is weak
- Users have no mechanism for processing climate information once it is received
- Feedback channel from forecast user to producer is weak or non-existent in most cases



El Niño
as a
Hazard-Spawned



Time Series for
El Niño (red) and La Niña (blue)

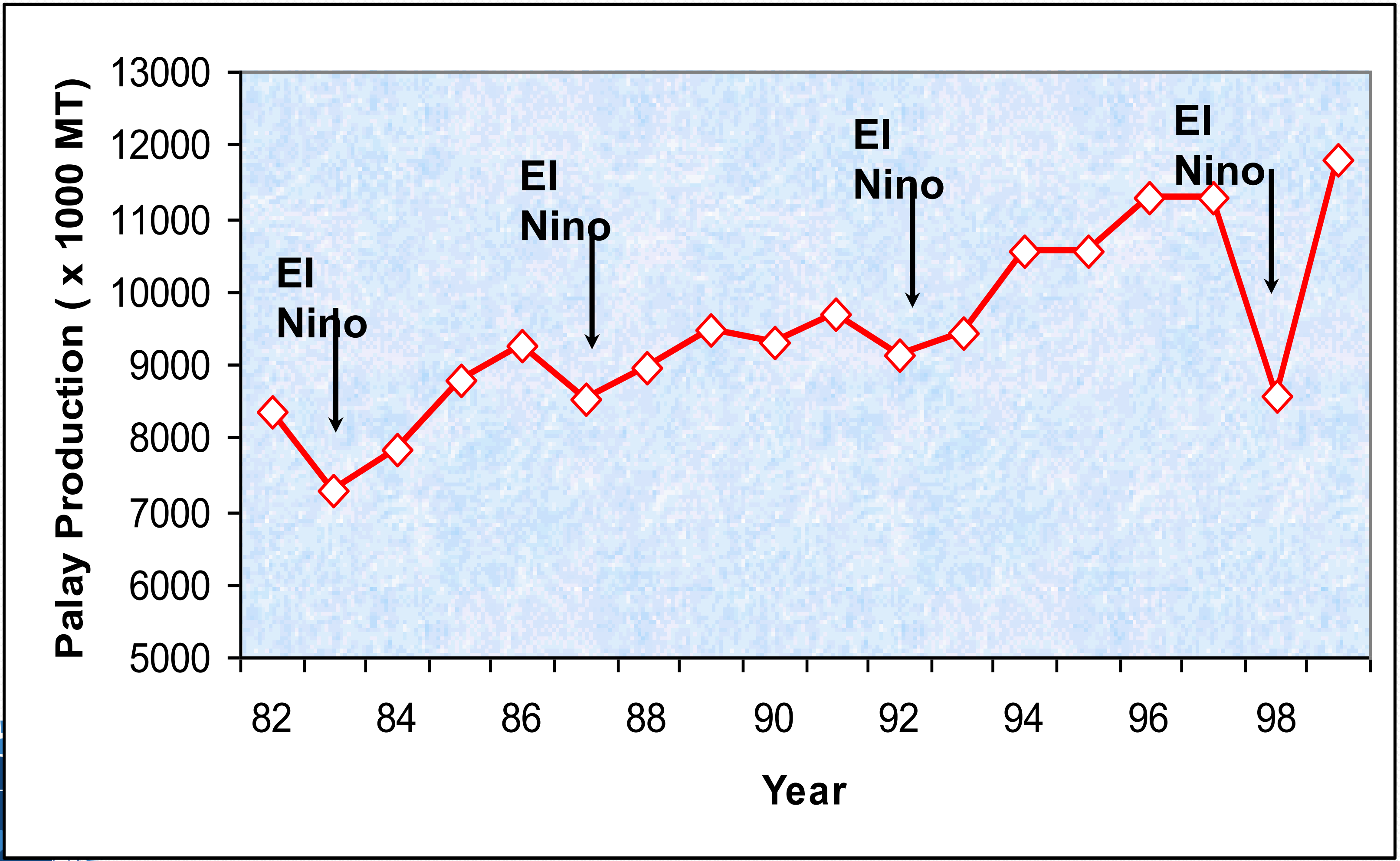


Before 1976 more blue than red; after 1976 more red than blue.

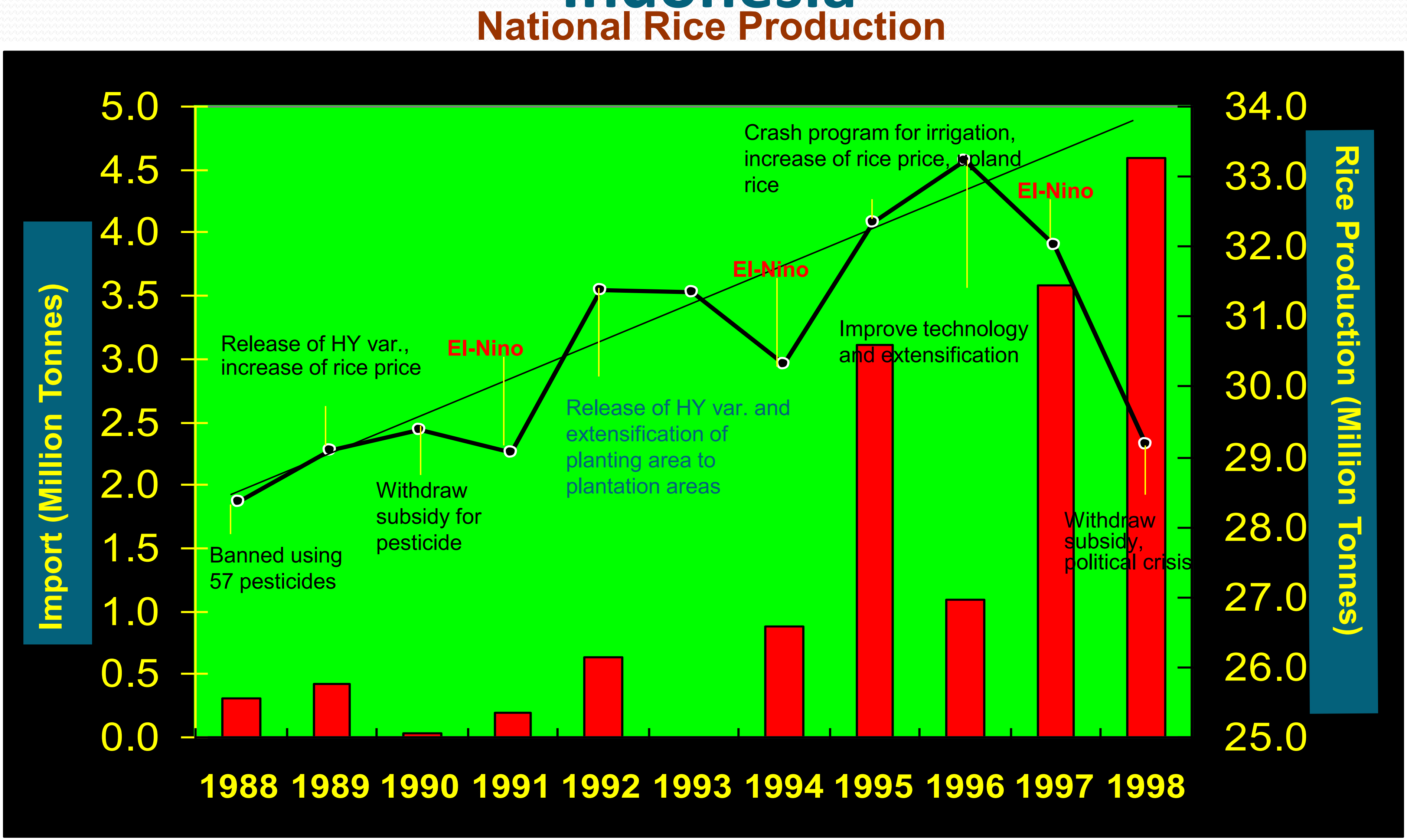
Red : El Nino

Blue: La Nina

El Niño impact on rice production, Philippines

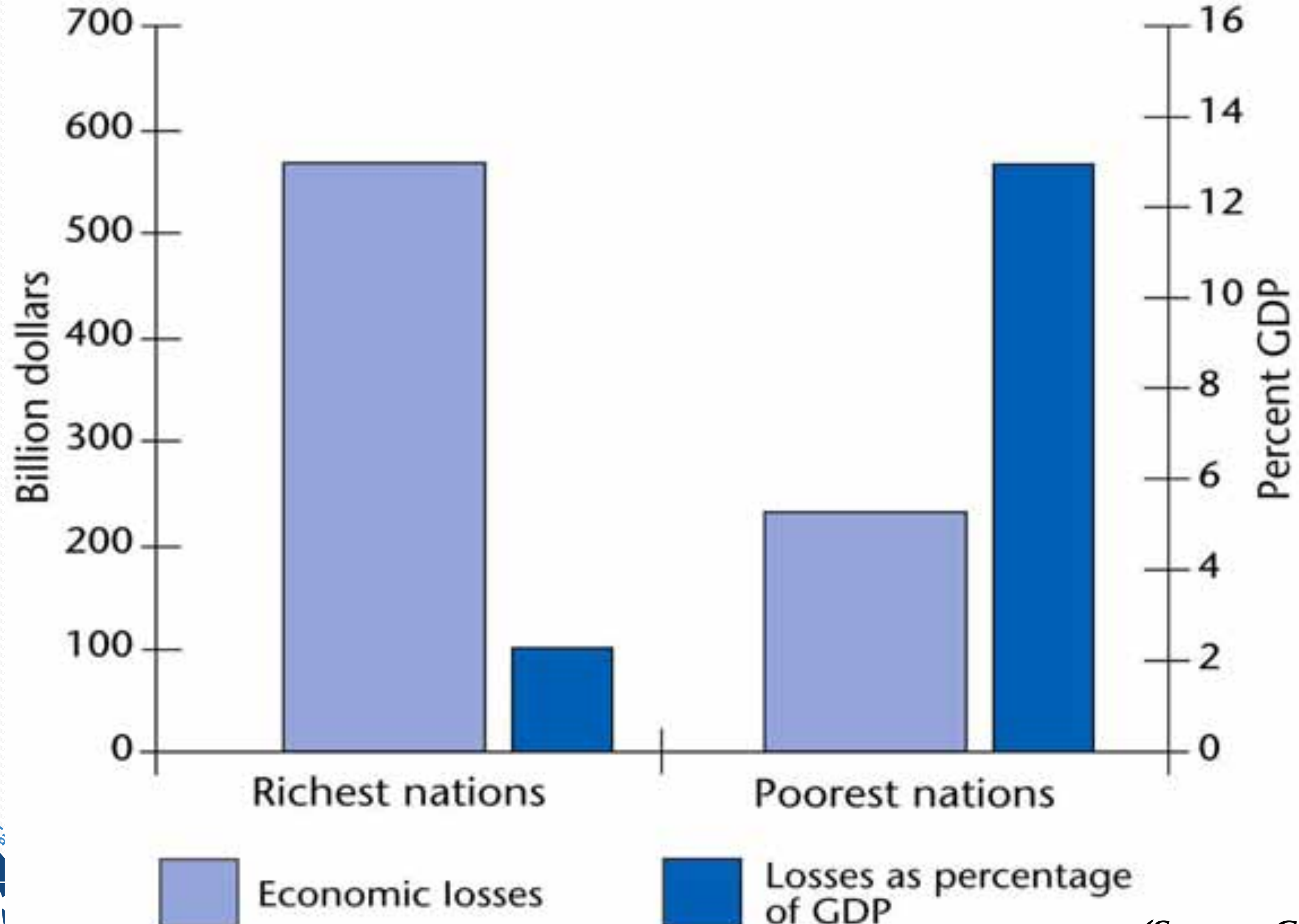


El Niño impact on rice production, Indonesia



RIMES

Developing Countries are Hit the Hardest…



(Source: CRED)

RIMES

Climate Risk Management- Challenges

- Risk Communication
  - Dealing with uncertainties
  - Decision research and stakeholder involvement
  - Integrating climate information into decision making process

- RIMES experience in risk communication will be shared

Regional Integrated Multi-Hazard Early Warning System
RIMES

The need:

Climate forecast information that:

- **is localized**
- **timely**
- **in easily understandable language**
- **meets end user needs**

The issues:

- **Capacity to generate the localized information**
- **Experience in communicating probabilistic scientific information for practical use by end users**

Regional Integrated Multi-Hazard Early Warning System
RIMES

End-to-end climate information and application system

Providing climate outlook

Interpreting global climate outlook into local outlook

Translating local climate outlook into impact scenarios

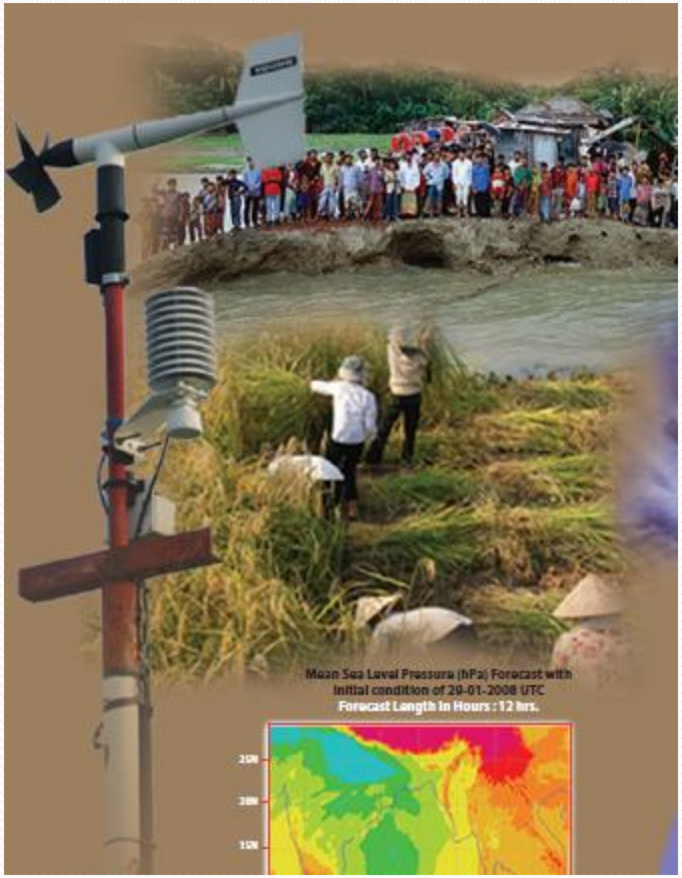
Communication on farmers responses/ feedback

Regional Integrated Multi-Hazard Early Warning System

RIMES

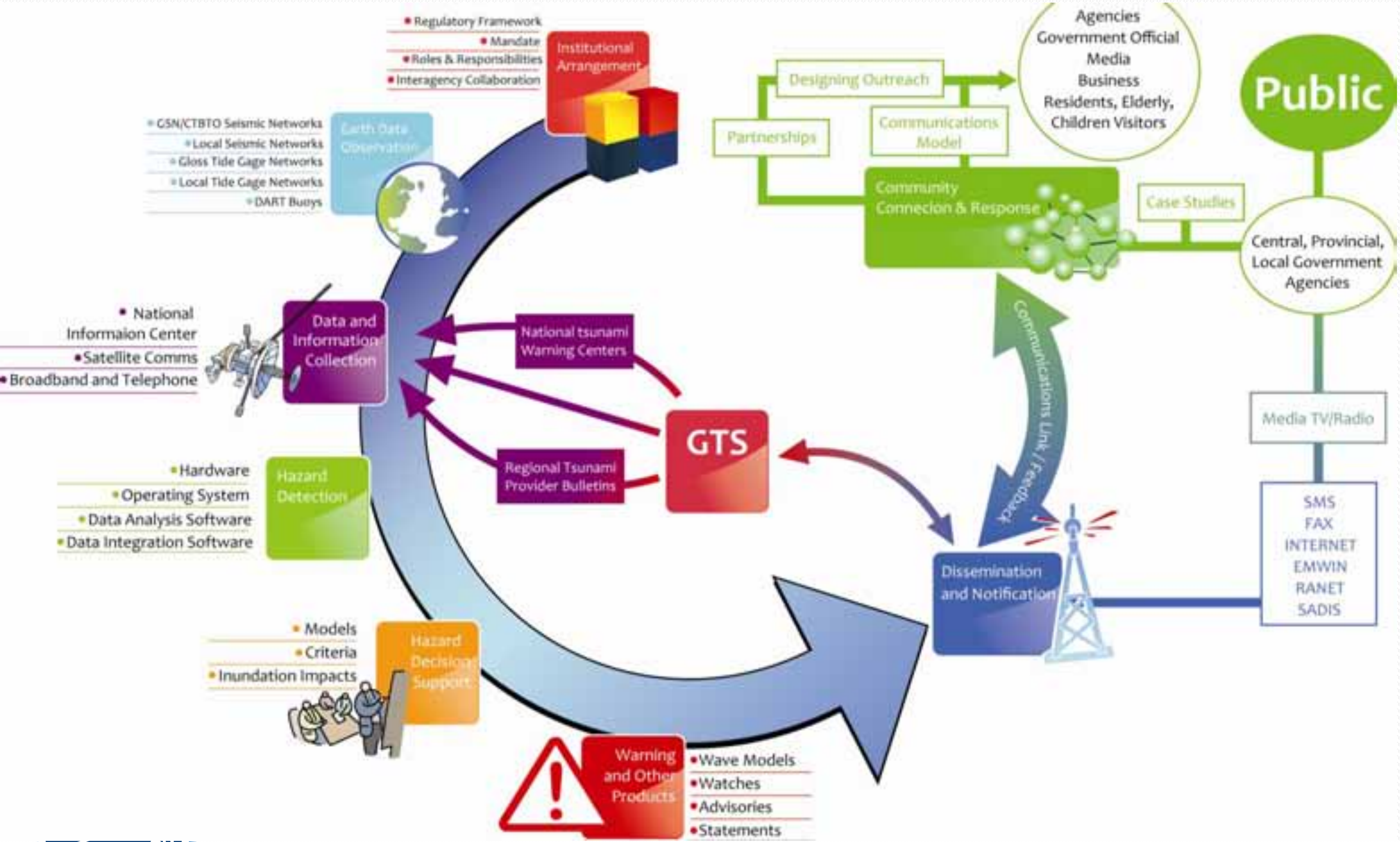
Early Warning Systems (EWS)

- ***Till 1980's:*** EWS focused on saving lives
- ***1990's on:*** Focus on saving lives + livelihood systems
- ***Currently:*** Opportunities through new, emerging forecast technologies



Regional Integrated Multi-Hazard Early Warning System
RIMES

Key Component of EWS



RIMES

EW System Structure

Detection Subsystem

Monitoring, detection, data Assessment, data analysis, prediction

Management Subsystem

Risk Assessment, interpretation, communication

Response Subsystem

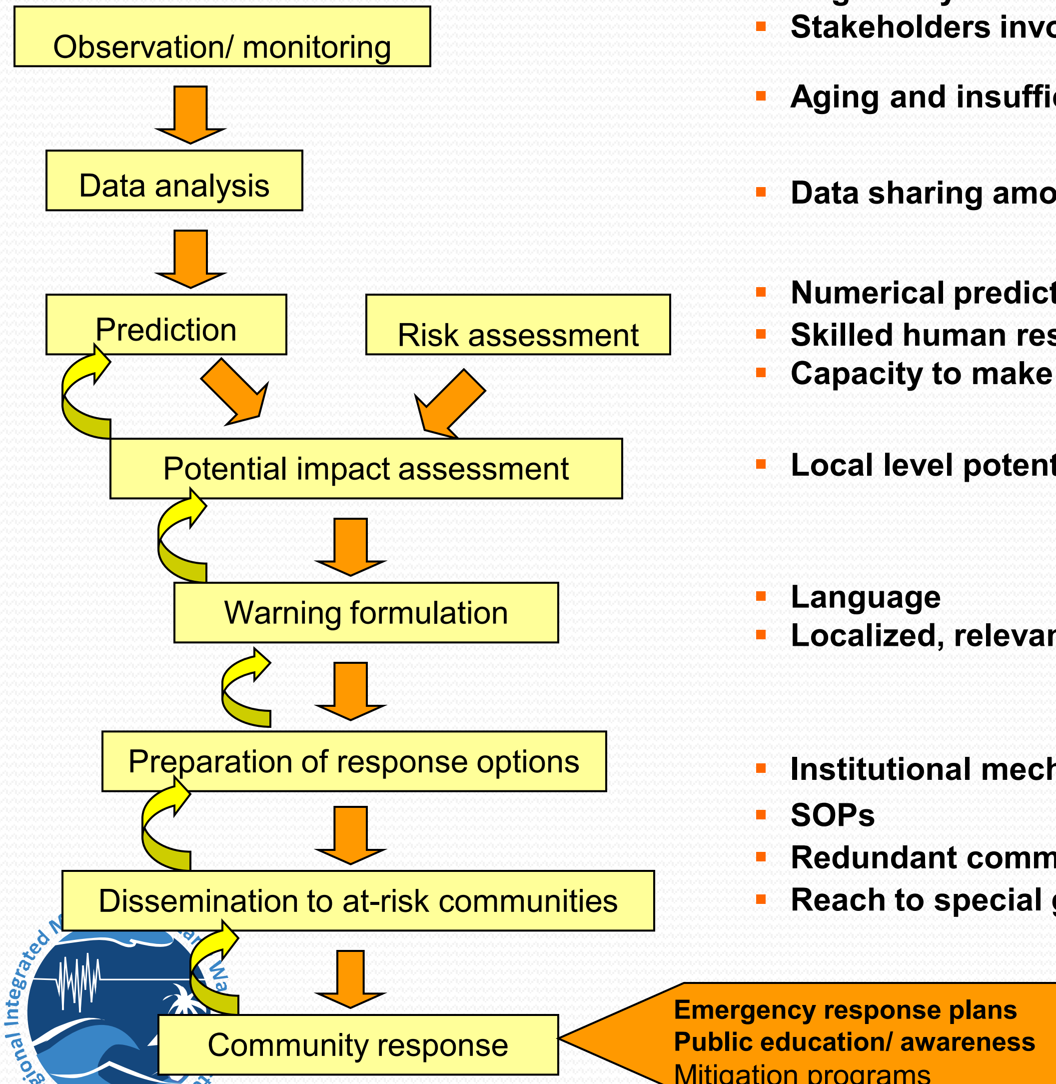
Interpretation, confirmation and response

Reasons for Warning Failure

?

RIMES

Gaps



- **Regulatory framework for warning**
- **Stakeholders involvement and roles**
- **Aging and insufficient observation and data communication facilities**
- **Data sharing among agencies**
- **Numerical prediction capability**
- **Skilled human resource**
- **Capacity to make use of new generation forecasts**
- **Local level potential impact assessment not done**
- **Language**
- **Localized, relevant**
- **Institutional mechanism, linkages**
- **SOPs**
- **Redundant communication systems**
- **Reach to special groups**
- **Public awareness**
- **Communication of forecast limitations**
- **Lack of trainers/ facilitators**
- **Resources to respond to warning**

RIMES

A regional cooperation of 26 countries in Africa and Asia on multi-hazard early warning.
RIMES aims to cater to differential needs and demands of member states in addressing gaps in the end-to-end multi-hazard early warning system.

MARCH 2005 (7) JULY 2006 (10) DEC 2006 (13) APRIL-JUNE 07 (22) JUN 08(26)

RIMES

RIMES: on 30 April 2009

- Formally established on 30 April 2009, with the signing of RIMES International Cooperation Agreement, by five countries:
  - Cambodia
  - Comoros
  - Lao PDR
  - Maldives, and
  - Seychelles

Regional Integrated Multi-Hazard Early Warning System
RIMES

RIMES Framework

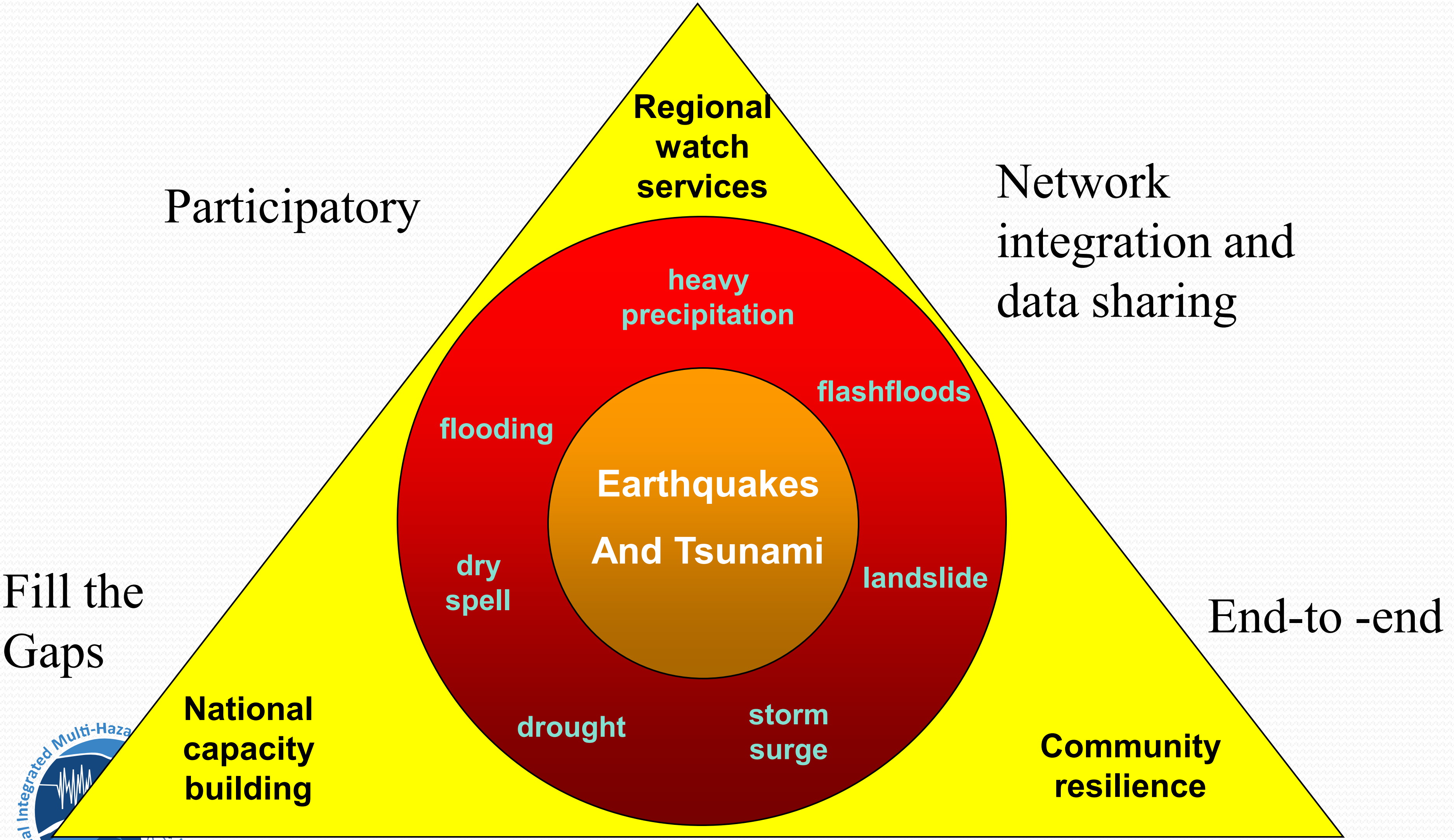
Regional Integrated Multi-Hazard Early Warning System

RIMES

Provision of 4 integrated services

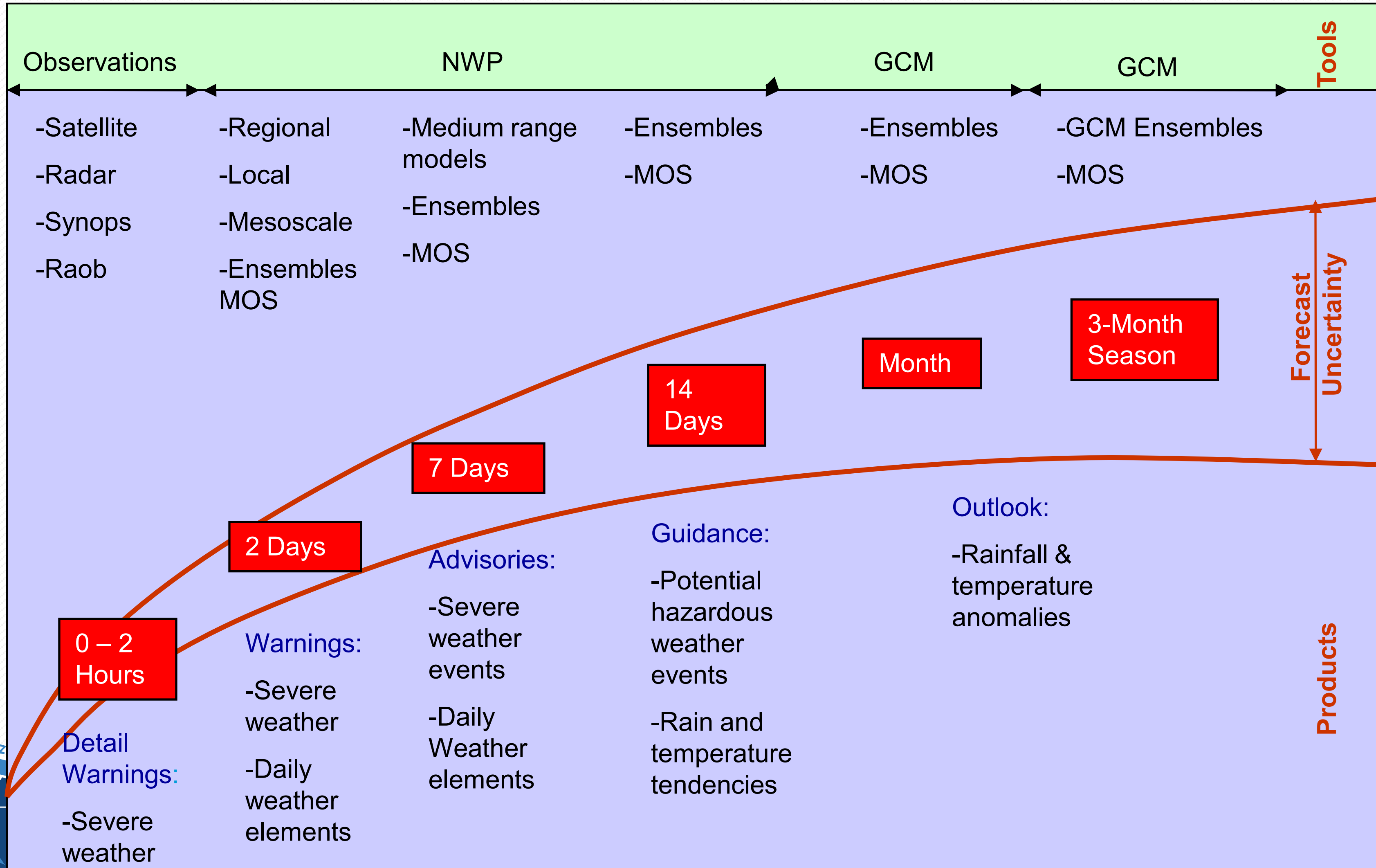
- Establishment of Regional core observation networks
- Provision of Regional tsunami watch
- Research and development support to NHMS for providing localized hydro-meteorological disaster risk information
- Enhancing capacities to respond to early warning information at national and local levels for disaster preparedness and management

Regional Multi-hazards Early-Warning System (RIMES)



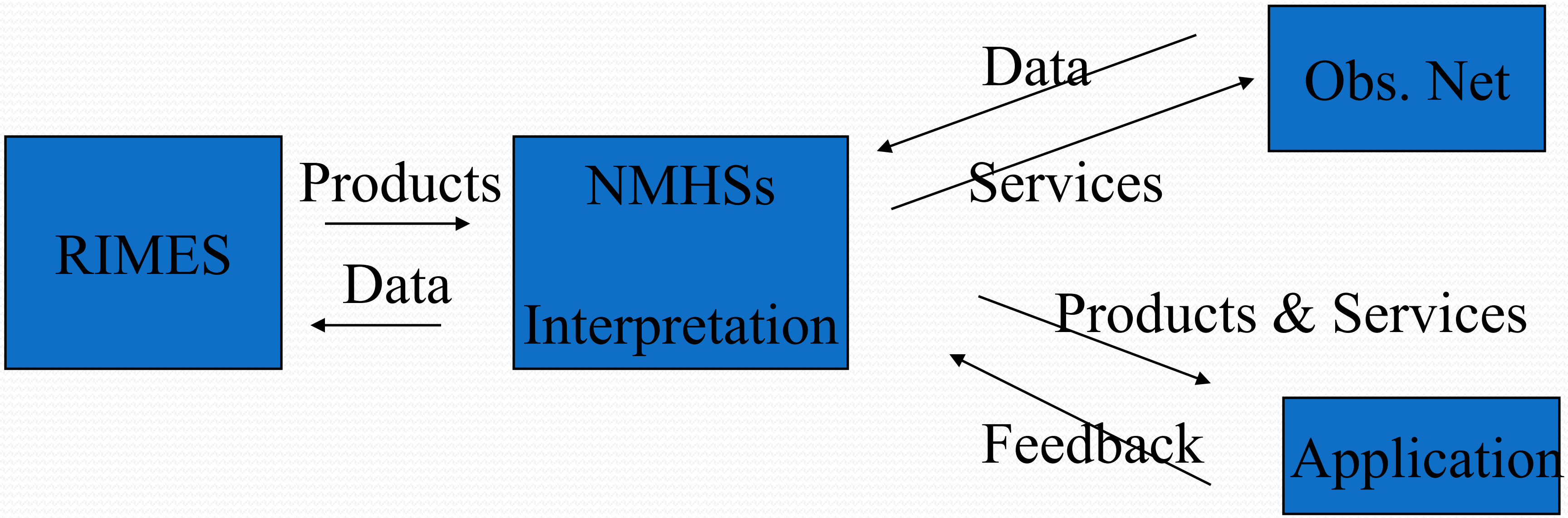
RIMES

The Seamless Integration of Hazard Risk Information



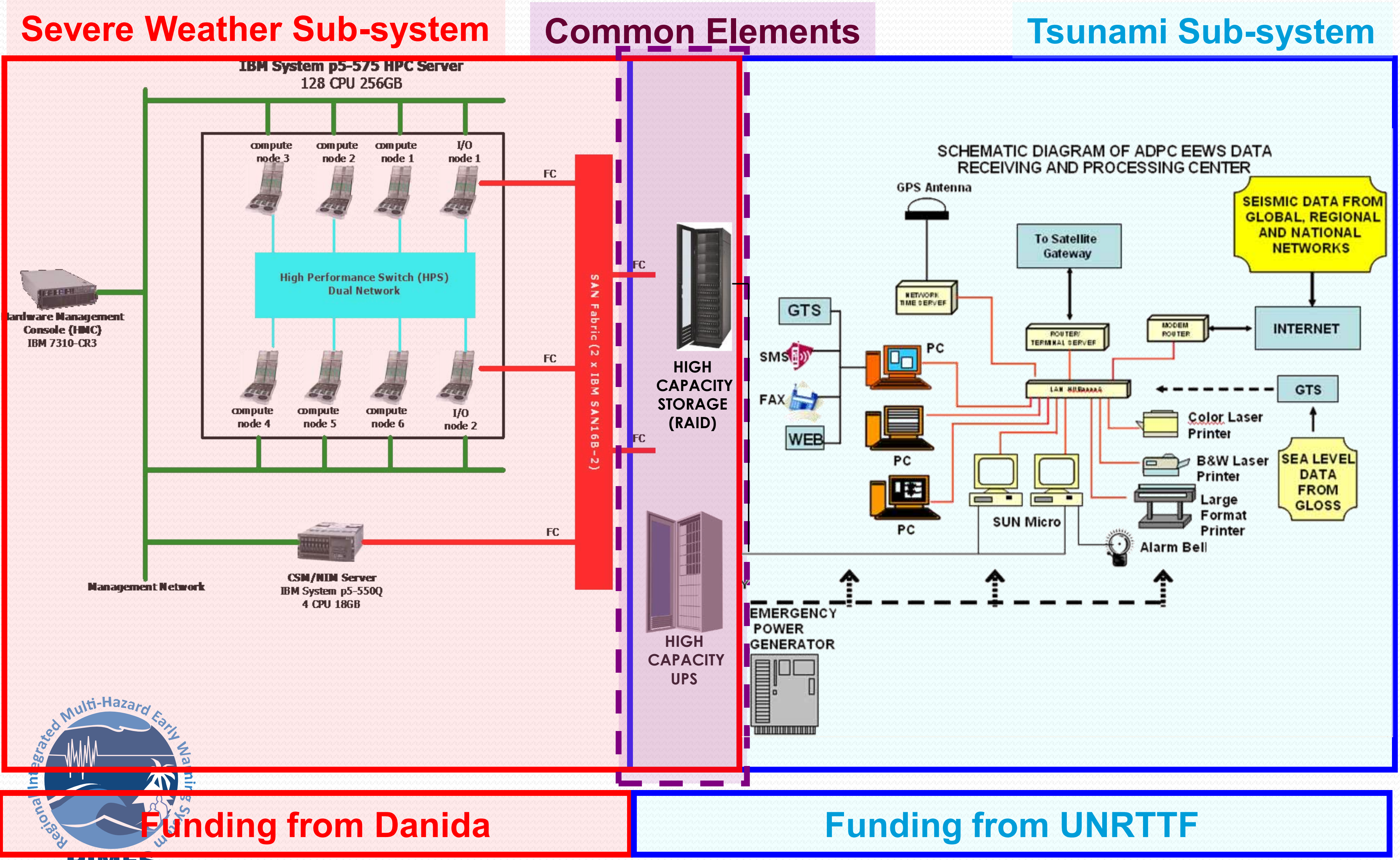
Regional Integrated Multi-Hazard Early Warning System
RIMES

RIMES, NMHS and Societal Application linkages



- Advantages
  - Greater cost effectiveness in the use of scarse resources
  - Continuous support in addressing common problems of NMHSs;
  - Connecting Global research to NHMS needs.

System Configuration



RIMES Governance

RIMES Governance

- **Presidential Task Force**
  - Chaired by His Excellency Vice President of the Republic of Maldives and comprising of Minister of Foreign Affairs, Minister of Housing, Transport and Environment
  - To provide highest level guidance and advice, facilitate institutional establishment and consolidation

- **Council**
  - Composed of heads of National Hydro-Meteorological Services and national scientific and technical agencies generating multi-hazard early warning information
  - Empowered to make policy decisions concerning regional early warning arrangements

RIMES Governance cont.

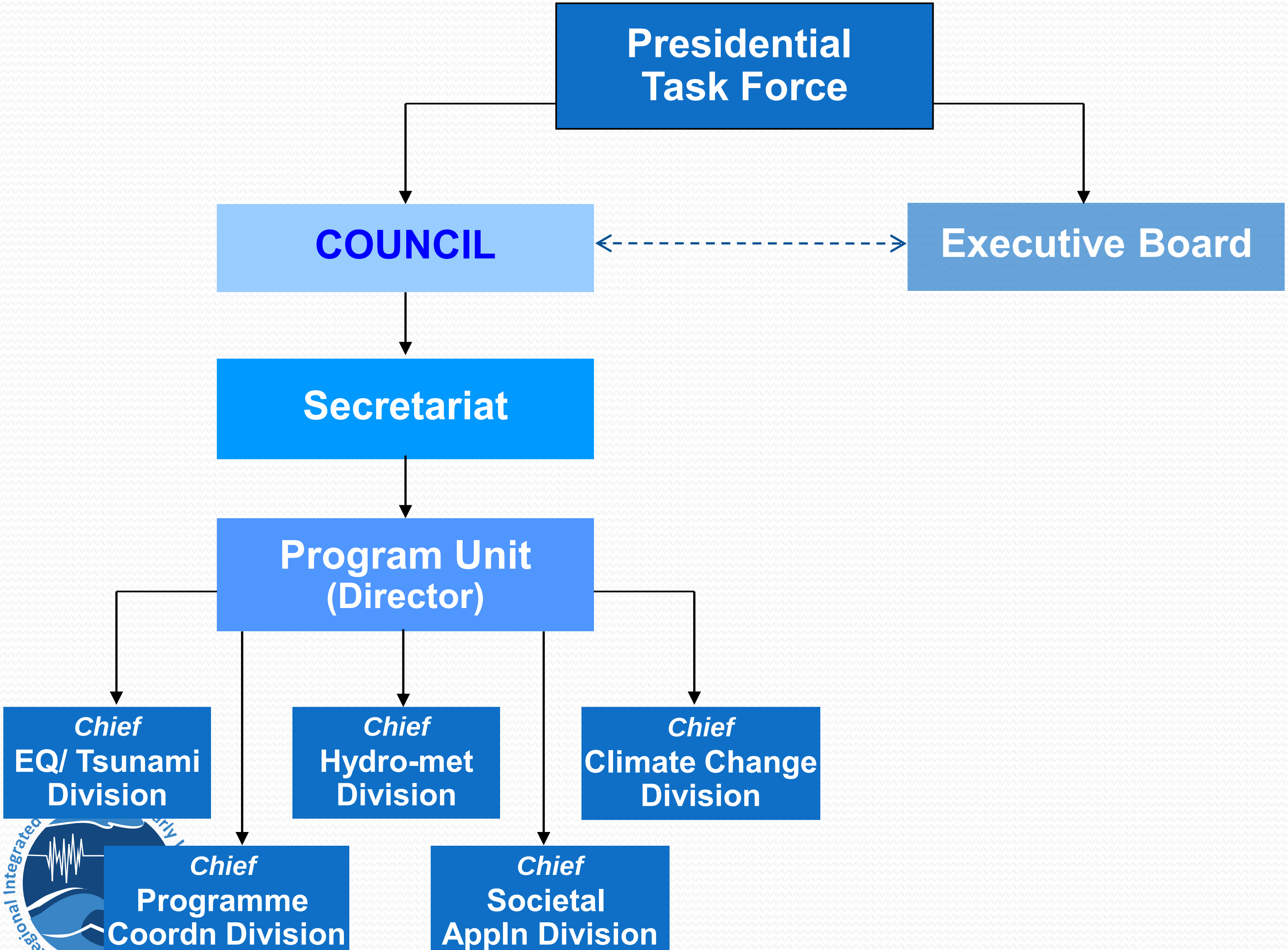
- ## Executive Board
  - Implement policies and decisions of the Council for resource mobilization
  - Formulate an action plan to provide cost-effective services to each Member State
  - India as Chair; China as Vice-Chair
- ## Secretariat
  - Carries out the decisions and tasks assigned by the Council
  - Supports the Program Unit in the management of the regional early warning facility
  - Maldives is the RIMES Secretariat

Regional Integrated Multi-Hazard Early Warning System
RIMES

RIMES Governance cont.

- **Program Unit**
  - Responsible for the day-to-day operation and management of the regional early warning facility
  - Has financial and administrative autonomy through delegated powers and the financial and staff regulations approved by the Council
  - Is co-located with the regional EW facility at the campus of the Asian Institute of Technology, Thailand

RIMES Governance



RIMES Endorsement by UN

- RIMES has been registered with United Nations Treaty Office of Legal Affairs, as per Article 102 of the Charter of United Nations, on 14 September 2009, effective from 01 July 2009

No. 58230

Certificate of registration

The Secretary-General of the United Nations

hereby certifies that the following international agreement has been registered with the Secretariat, in accordance with Article 102 of the Charter of the United Nations:

No. 46327. **Comoros, Maldives and Seychelles**

Agreement on the cooperation on Regional Integrated Multi-hazard Early Warning System for Afro-Asian Region. Male, 30 April 2009

Registration with the Secretariat of the United Nations: Regional Integrated Multi-hazard Early Warning System for Africa and Asia, 1 July 2009

Done at New York on 14 September 2009

For the Secretary-General

Certificat d'enregistrement

Le Secrétaire Général de l'Organisation des Nations Unies

certifie par la présente que l'accord international indiqué ci-après a été enregistré au Secrétariat, conformément à l'Article 102 de la Charte des Nations Unies :

No. 46327. **Comores, Maldives et Seychelles**

Accord relatif à la coopération sur le Dispositif régional intégré d'alerte rapide multirisque pour la région afro-asiatique. Malé, 30 avril 2009

Enregistrement auprès du Secrétariat des Nations Unies : Dispositif régional intégré d'alerte rapide multiriisque pour l'Afrique et l'Asie, 1er juillet 2009

Fait à New York le 14 septembre 2009

Pour le Secrétaire Général

UNITED NATIONS

Le Conseiller juridique

The Legal Counsel

ORGANISATION DES NATIONS UNIES

Regional Integrated Multi-Hazard Early Warning System

RIMES

Integration of RIMES with IOC IOTWS Framework

- RIMES Integration with IOC IOTWS approved in principle by IGC IOTWS Steering Group in its meeting in Perth Australia on 3-4 December 2009
- As per this decision RIMES will invite ICG/IOTWS to join the RIMES Council.
- 2. RIMES is invited to send a representative to ICG/IOTWS

Regional Integrated Multi-Hazard Early Warning System
RIMES

Integration of RIMES with WMO

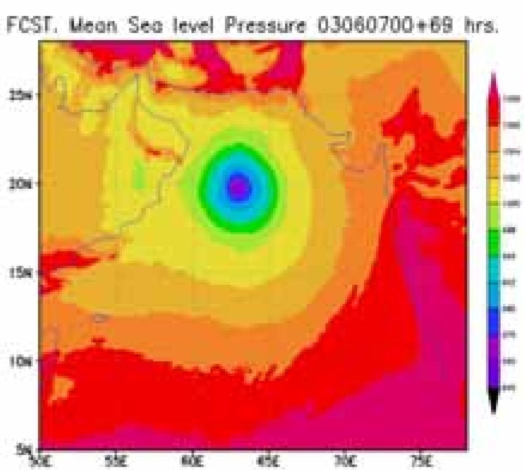
- An MoU between RIMES and WMO under finalization
- RIMES Will translate WMO Mandate into Operational Program
- RIMES and WMO Will develop Join Projects to build capacity of NHMS
- WMO will facilitate GTS direct connection to RIMES through one of the Member States
- RIMES will provide Research and Development support to NHMS .

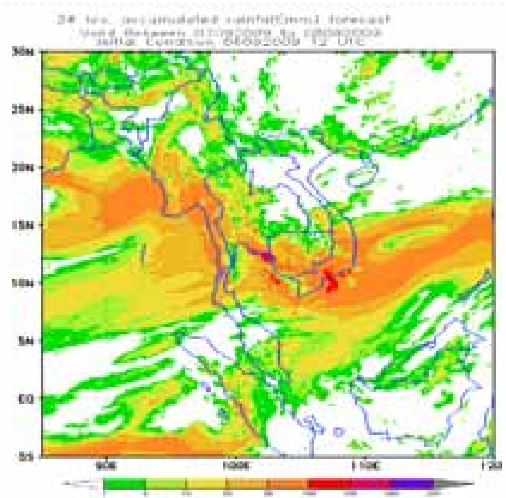
RIMES Products

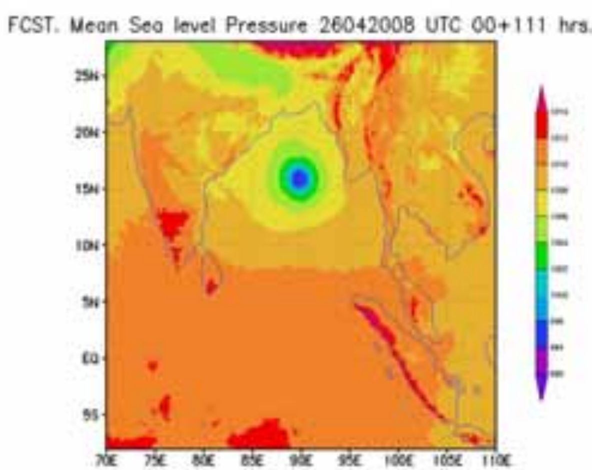
Regional Integrated Multi-Hazard Early Warning System
RIMES

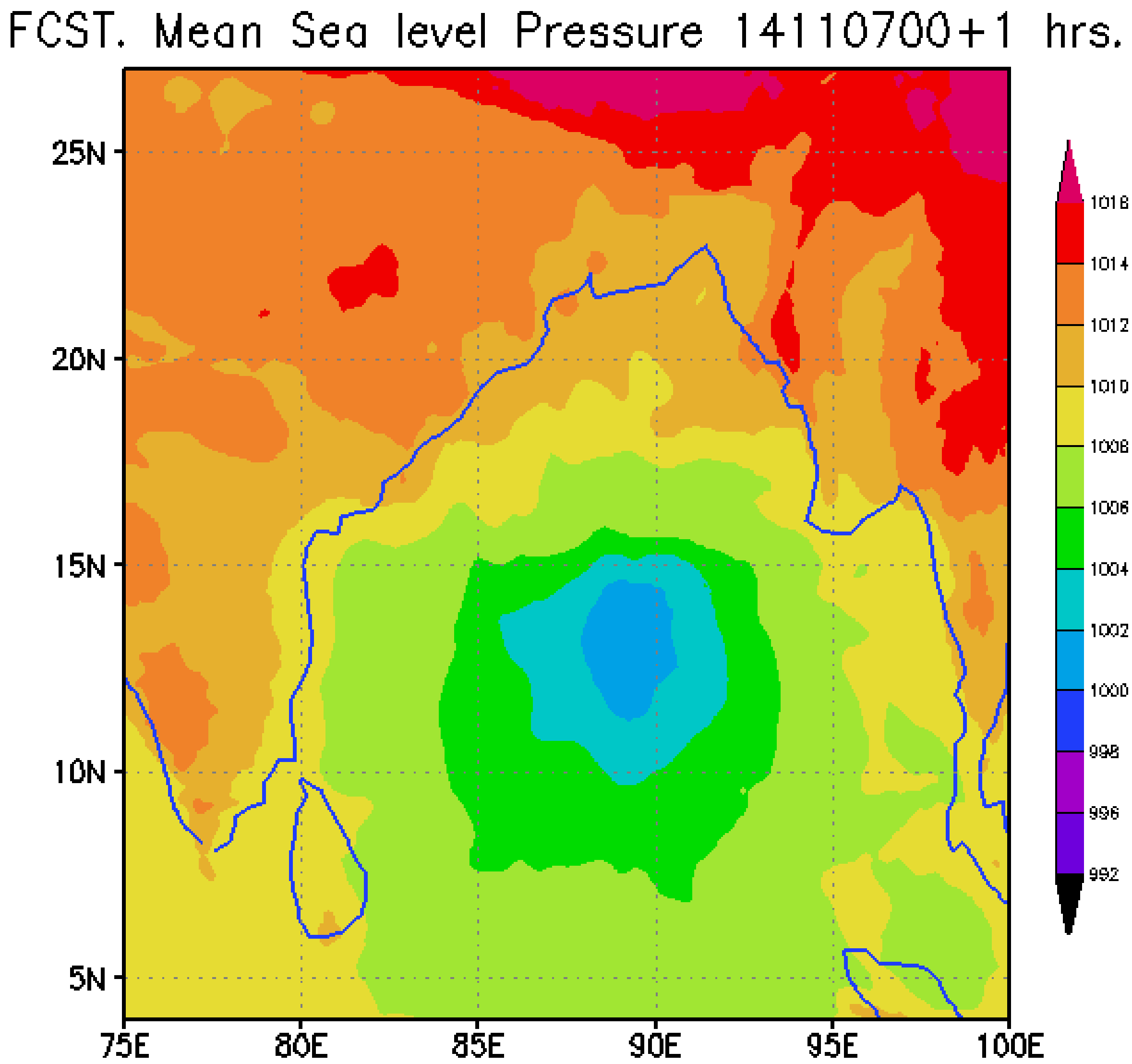
Providing Localized severe weather information

- Track, intensity and time of land fall of Cyclones/Typhones
- Heavy rainfall, Strong winds
- Riverine and Flash floods

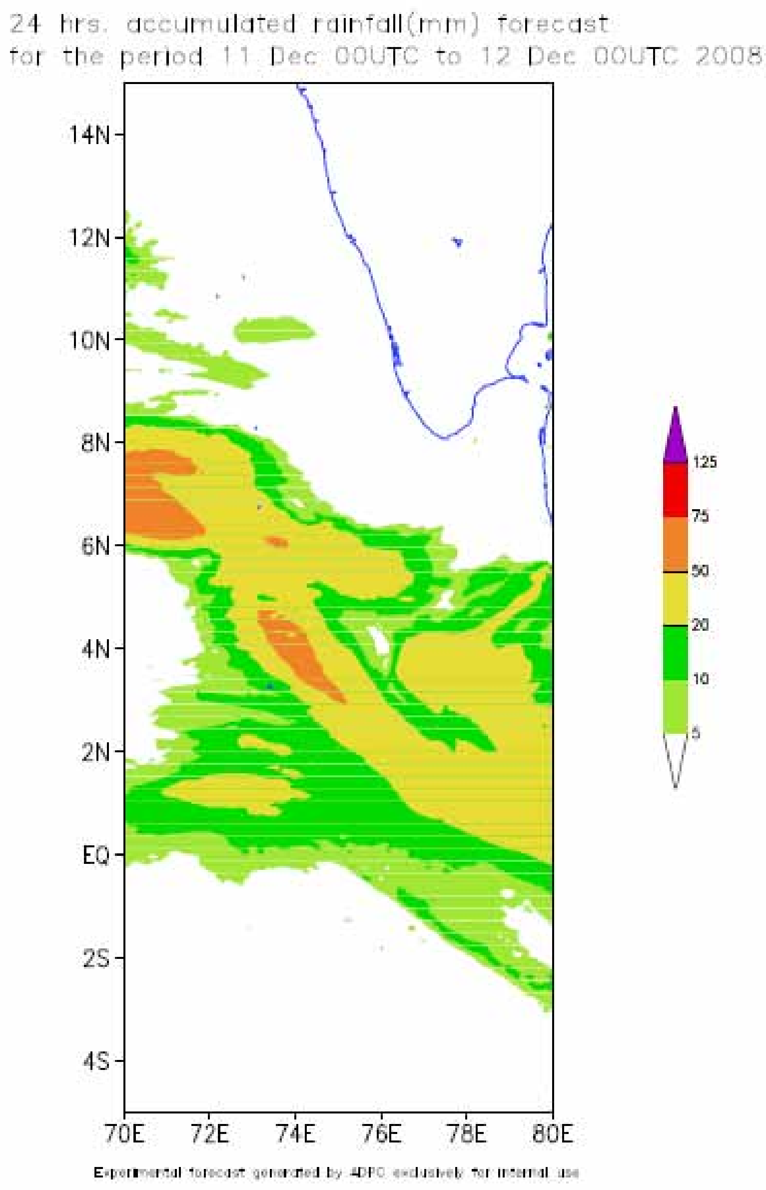


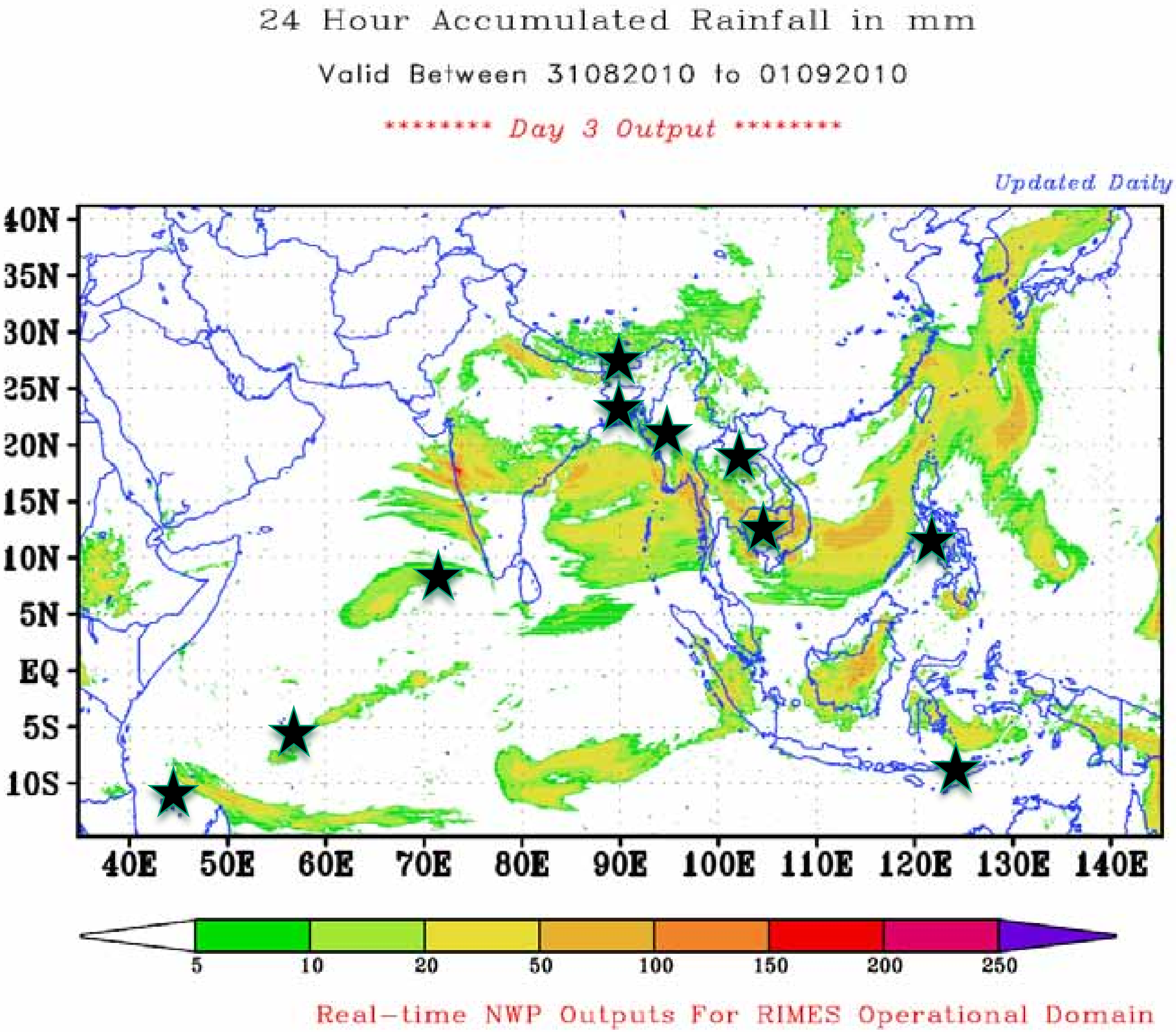





FCST. Mean Sea level Pressure 14110700+1 hrs.
25N
20N
15N
10N
5N
75E
80E
85E
90E
95E
100E
1018
1014
1012
1010
1008
1006
1004
1002
1000
998
996
992

Heavy rainfall, Strong winds





Bangladesh

Bhutan

Cambodia

Comoros

Lao PDR

Maldives

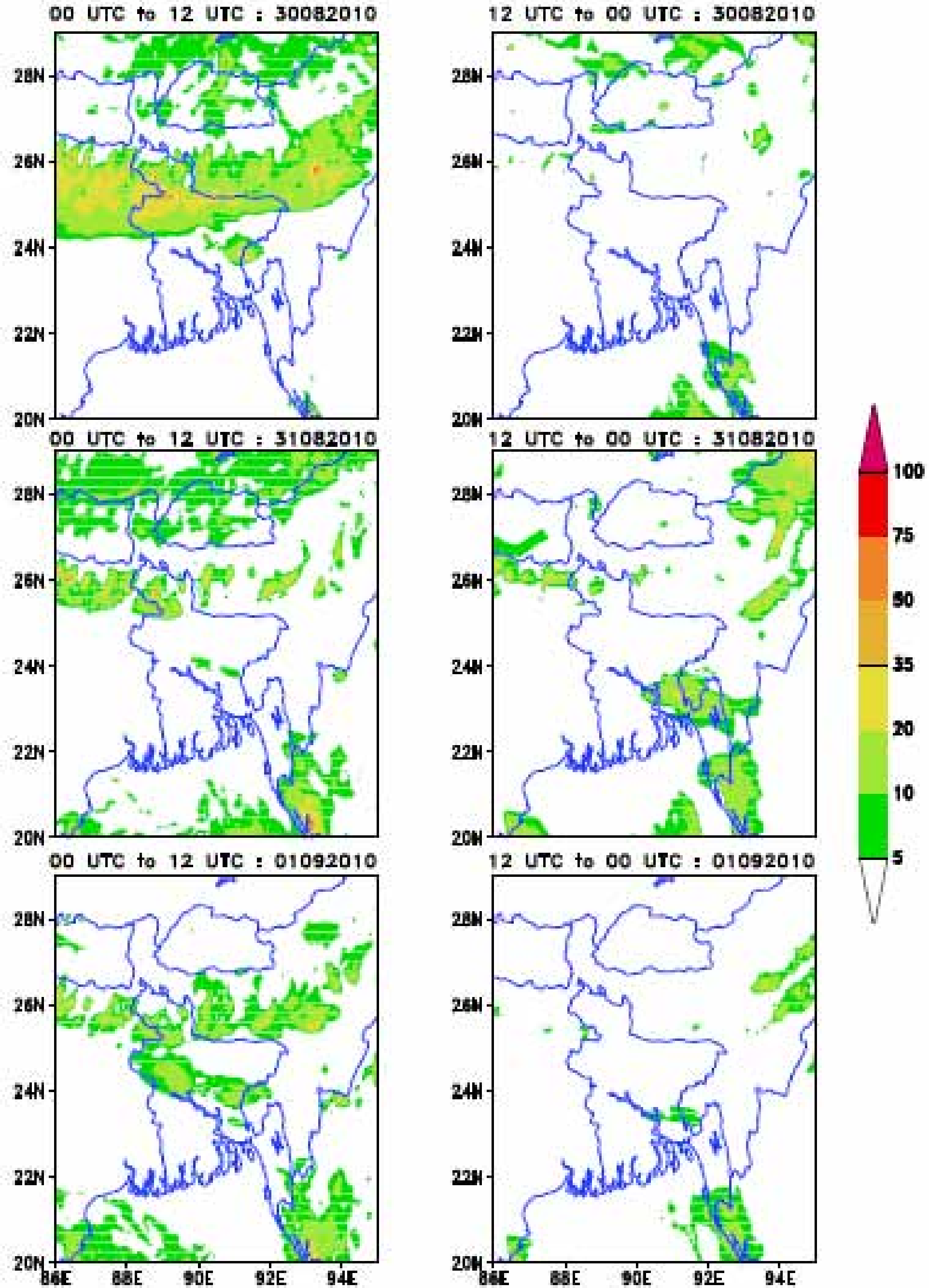
Myanmar

Philippines

Seychelles &

Timor Leste

12 Hour Accumulated Rainfall (mm) Forecast Valid Between

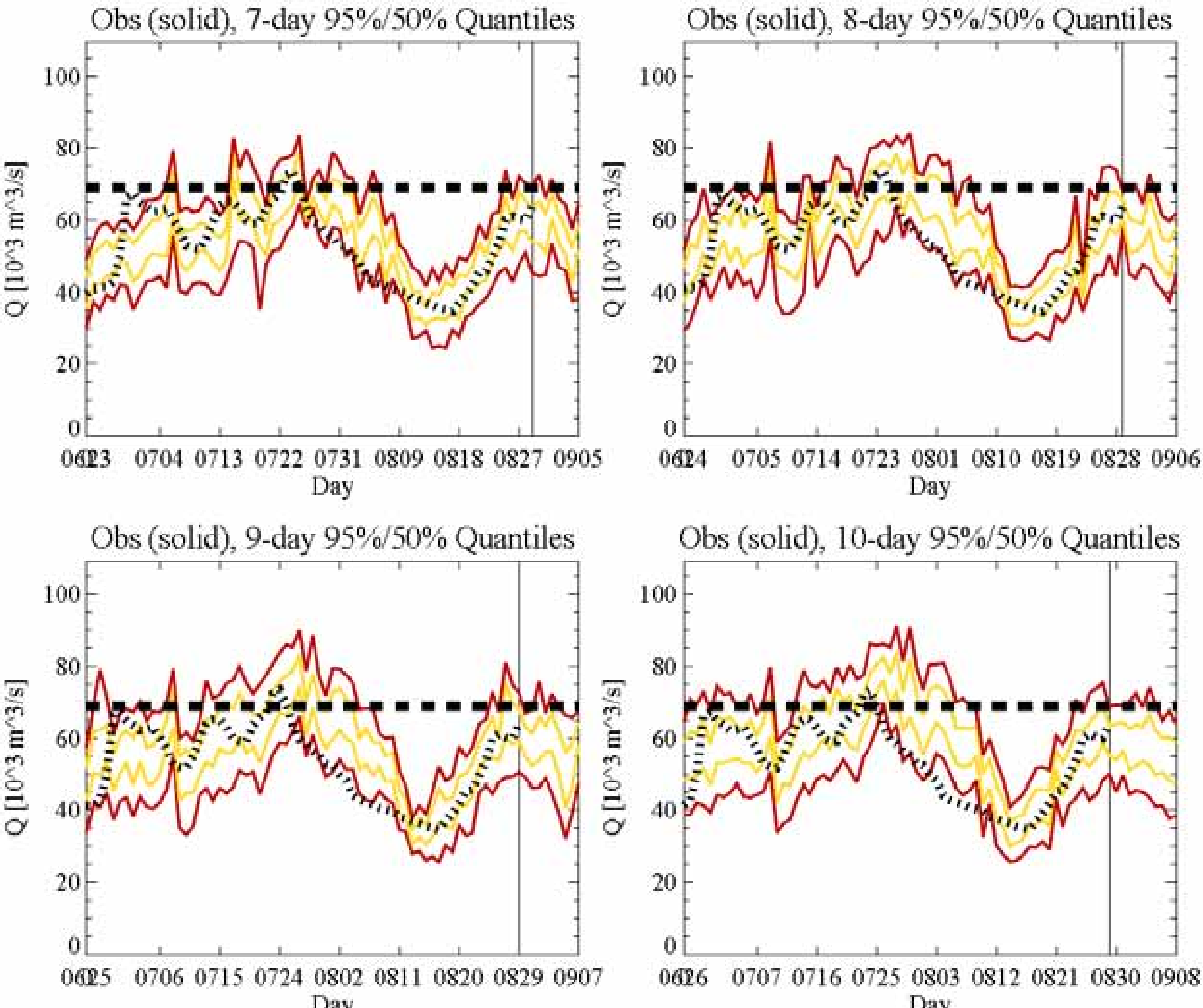


RIMES Meso-scale Weather Advisory

Multi-Model Brahmaputra Discharge Quantile Forecasts

7-10 day using ECMWF Precipitation Forecasts

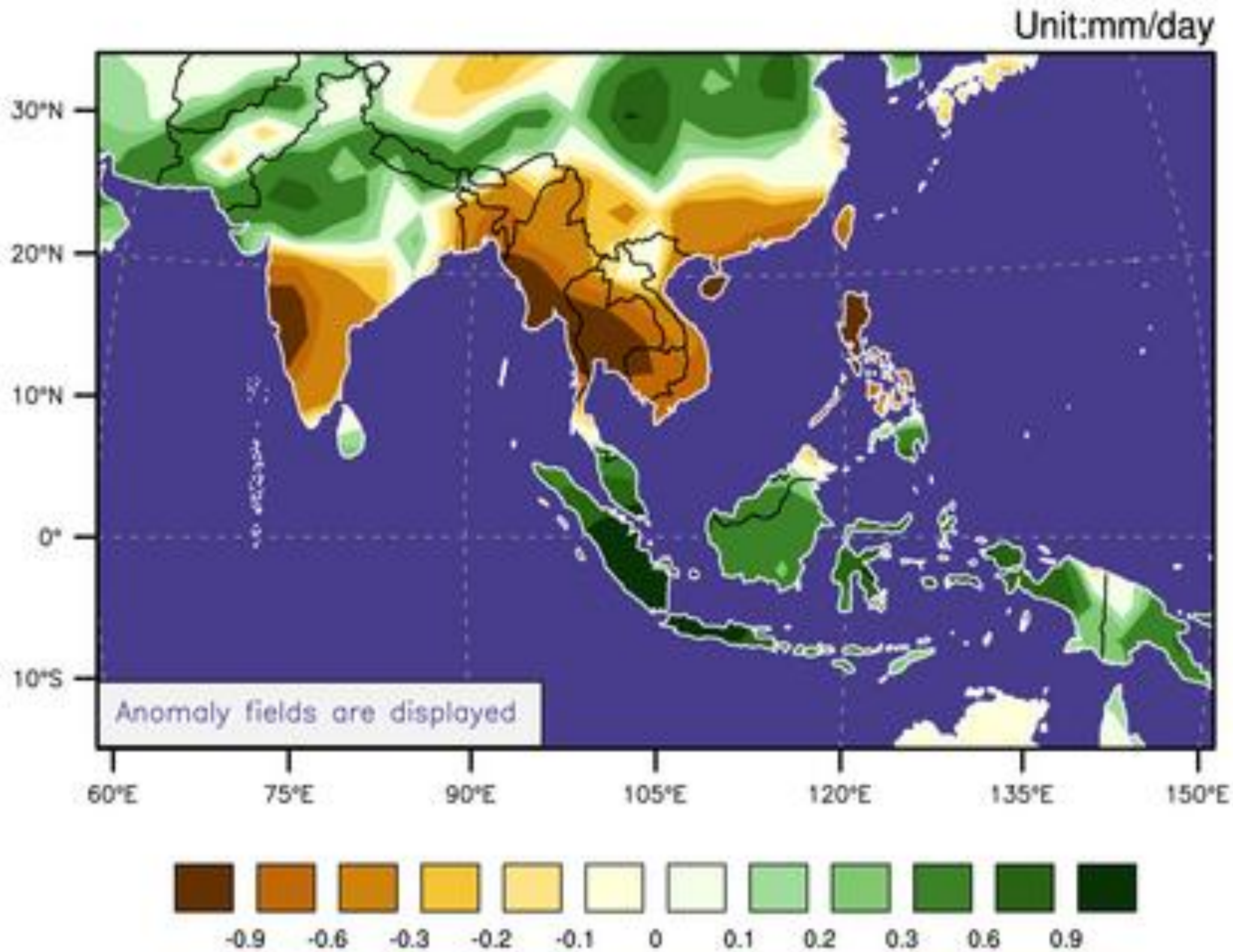
Forecasts Initialized June 16 - August 29, 2010



Climate Change Impact Analyses

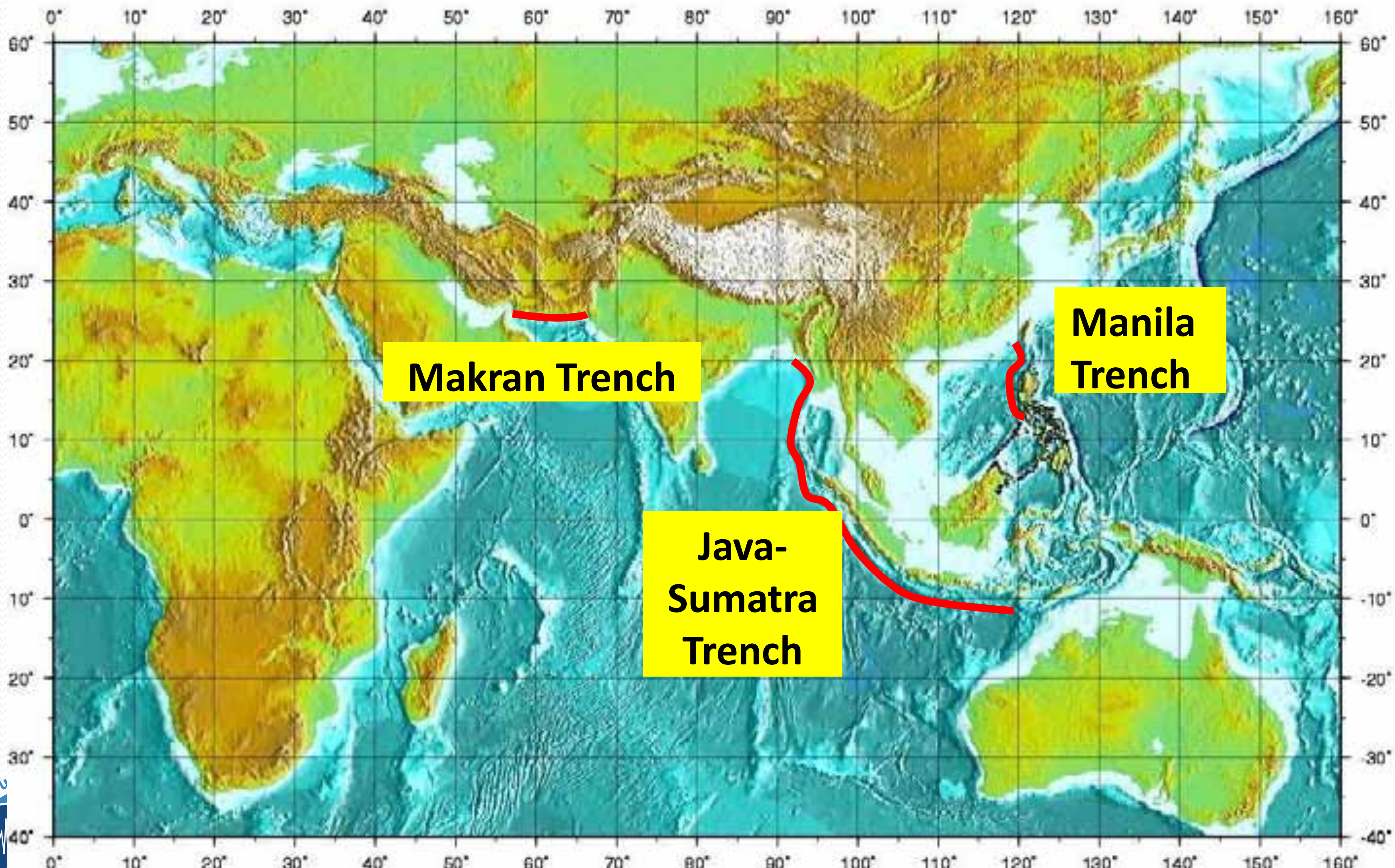
- Analyses of IPCC Scenarios
- Statistical Downscaling
- Analyses of observed Climate trend and future projections
- Development of Regional Climate Models

Precipitation for AUG 2010



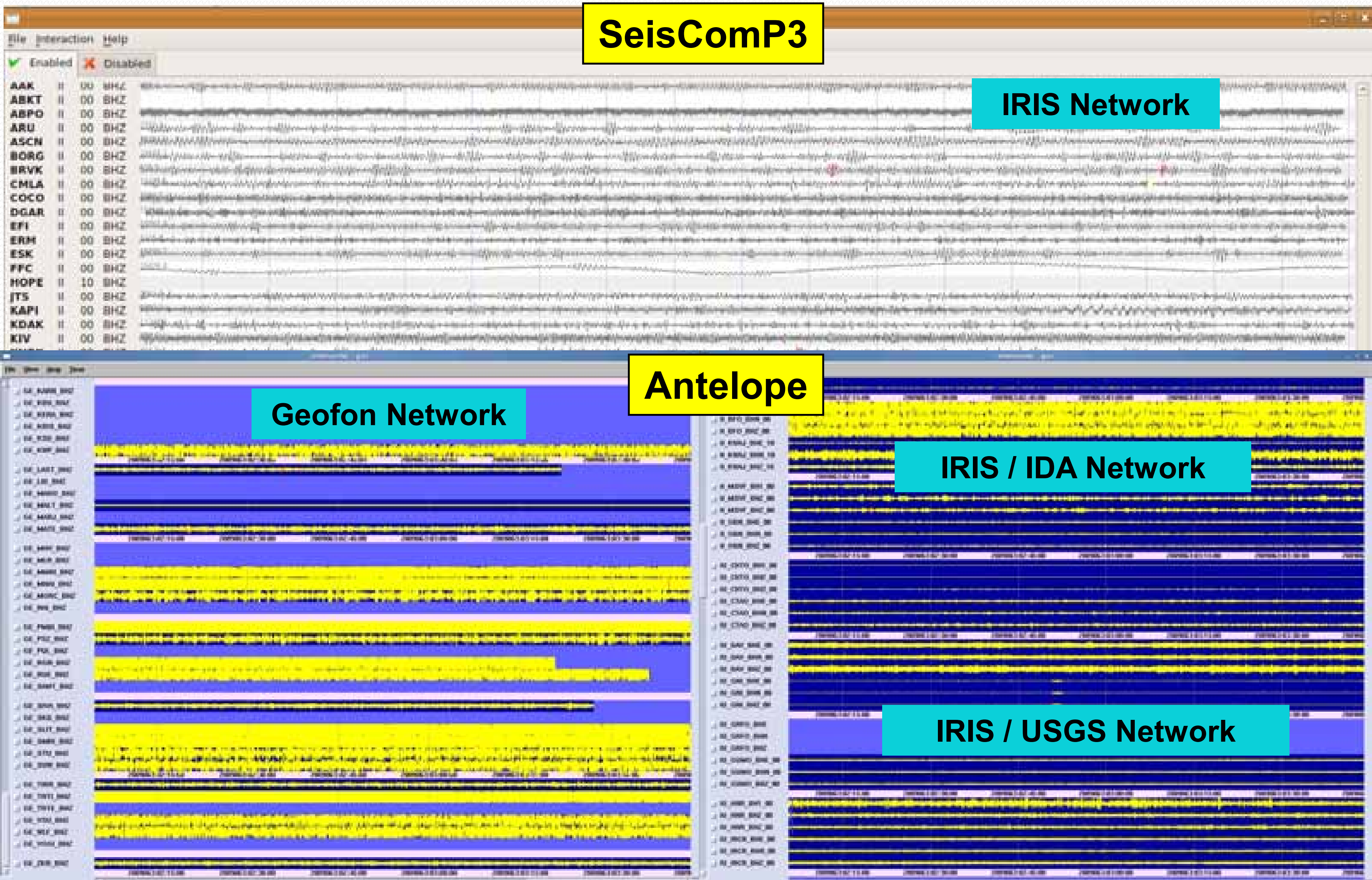
10 cm less in North , North East;Central and South

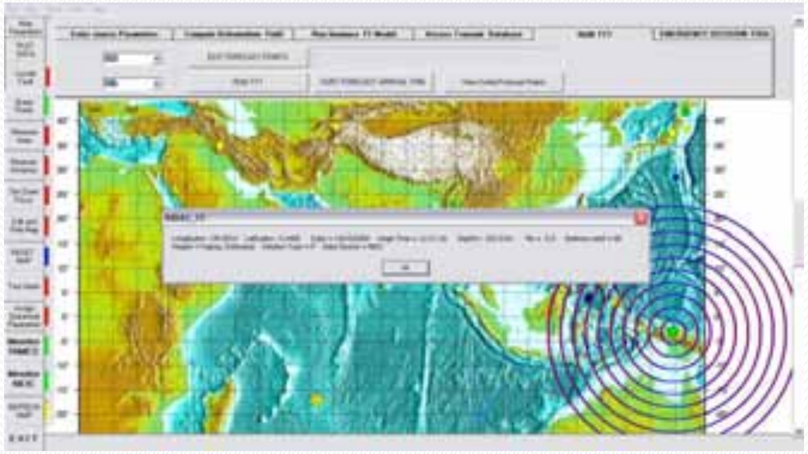
RIMES Seismic Monitoring



RIMES

Seismic waveforms from virtual networks

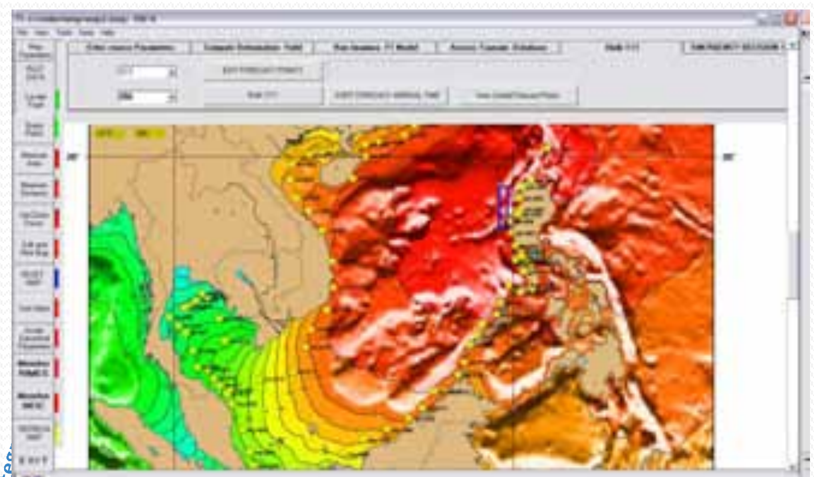




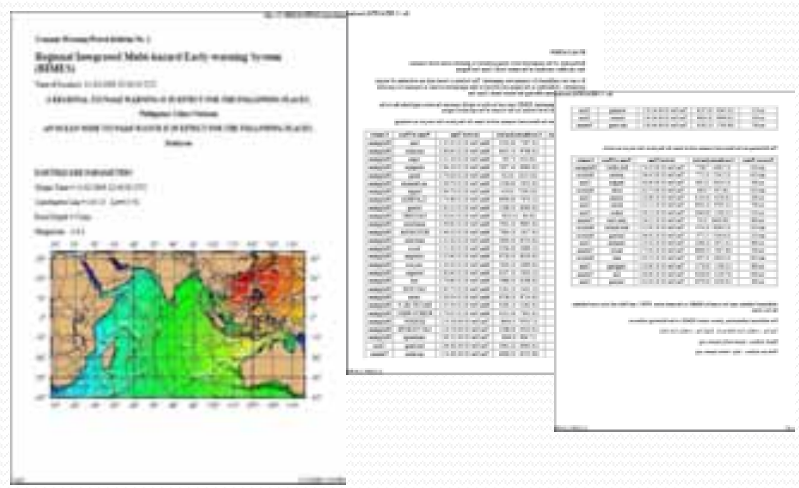
Real-time Seismicity Monitoring

Email and SMS Alert Applications

Decision-support Tools

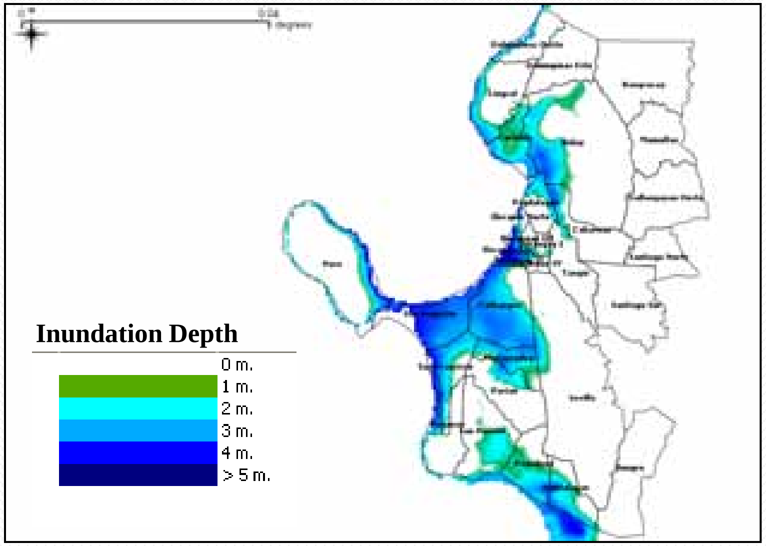


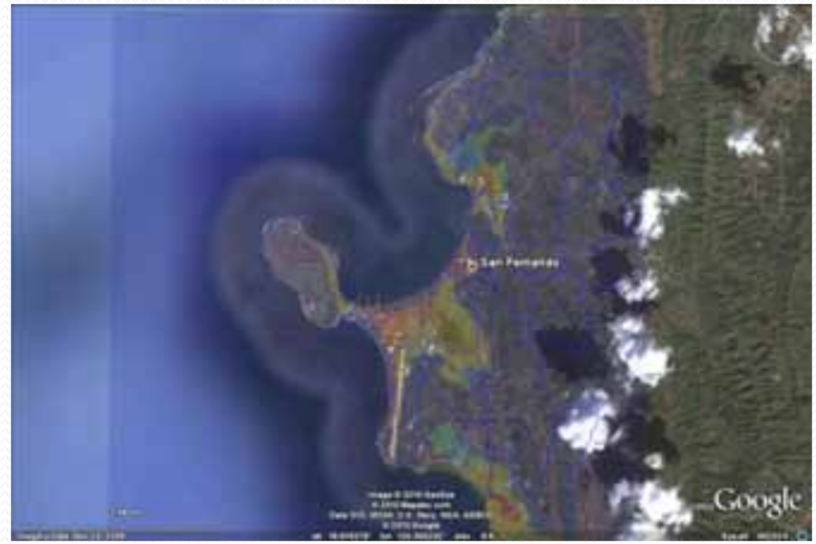
Tsunami Travel Time Calculation (TTT)

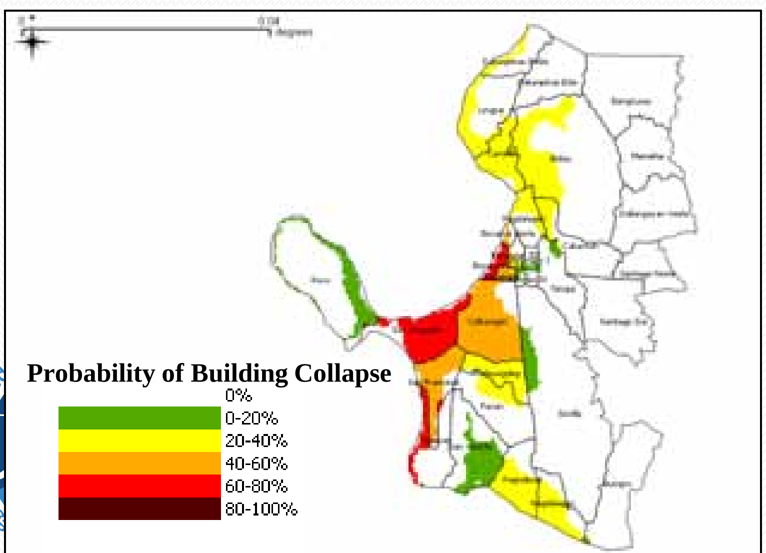


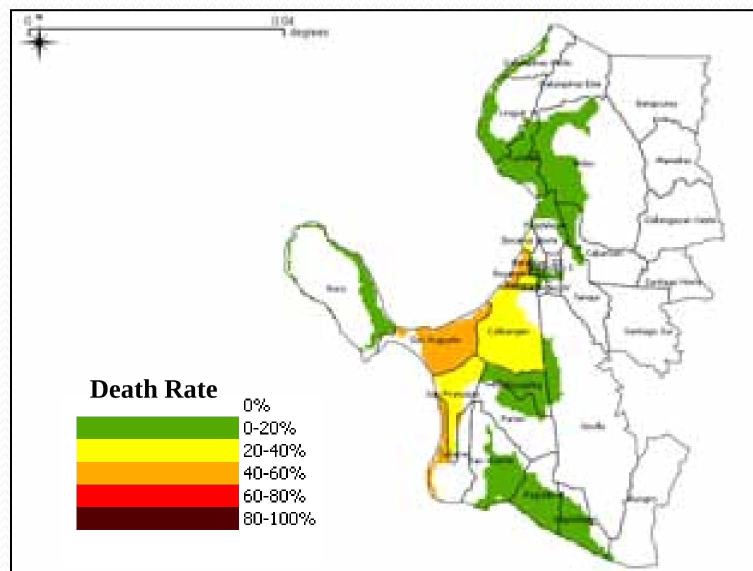
Generation of bulletins and warning updates

RIMES


Inundation Depth
0 m.
1 m.
2 m.
3 m.
4 m.
> 5 m.


San Fernando
Google


Probability of Building Collapse
0%
0-20%
20-40%
40-60%
60-80%
80-100%


Death Rate
0%
0-20%
20-40%
40-60%
60-80%
80-100%

Group Discussions- establishing what exist and what is needed

- What do people already know and believe about climate risk?
- What information is being used and who/where is the source of information?
- What has been the past experience/outcomes of information use?
- What kind of "new" information is needed to reduce climate risk (current and near future)

Case Study: Climate Information System

Countries needed timely, usable climate information to manage resources effectively & reduce disaster risks. However, localized & usable climate information was not available to resource managers

RIMES

Reasons why climate information was not available

- Absence of participatory mechanism for identifying user forecast requirements
- Available climate information not tailored to users' needs and requirements
- Weak forecast producer-user communication channel
- Users have difficulty understanding forecast language
- Community-level dissemination is weak
- Users have no mechanism for processing climate information once it is received
- Feedback channel from forecast user to producer is weak or nonexistent in most cases

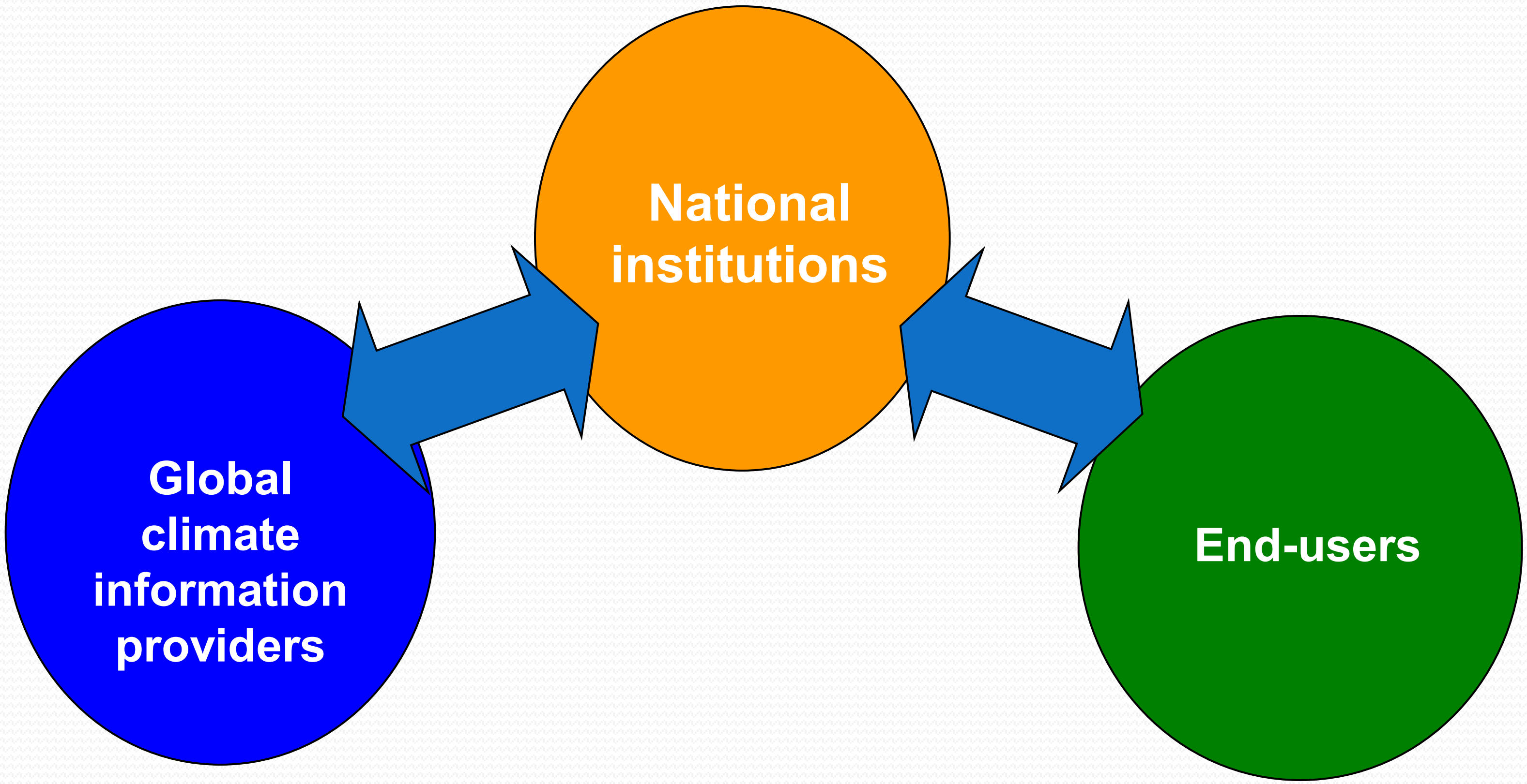
Regional Integrated Multi-Hazard Early Warning System
RIMES

CFA Methodology: Six step process

1. Need/ capacity assessments
2. Assessment of available technology
3. Capacity building through partnerships
4. Institutionalization of end-to-end system: pilot demonstrations, replication
5. Apply information to enable pro-active decision making
6. Monitor and evaluate applicability of information

RIMES

Focused Intervention:



End-to-end climate information generation and application system

Providing climate outlook

Interpreting global climate outlook into local outlook

Translating local climate outlook into impact scenarios

Communication of response options/ feedback

Regional Integrated Multi-Hazard Early Warning System

RIMES

Major Achievements of CFA

Indonesia & Philippines

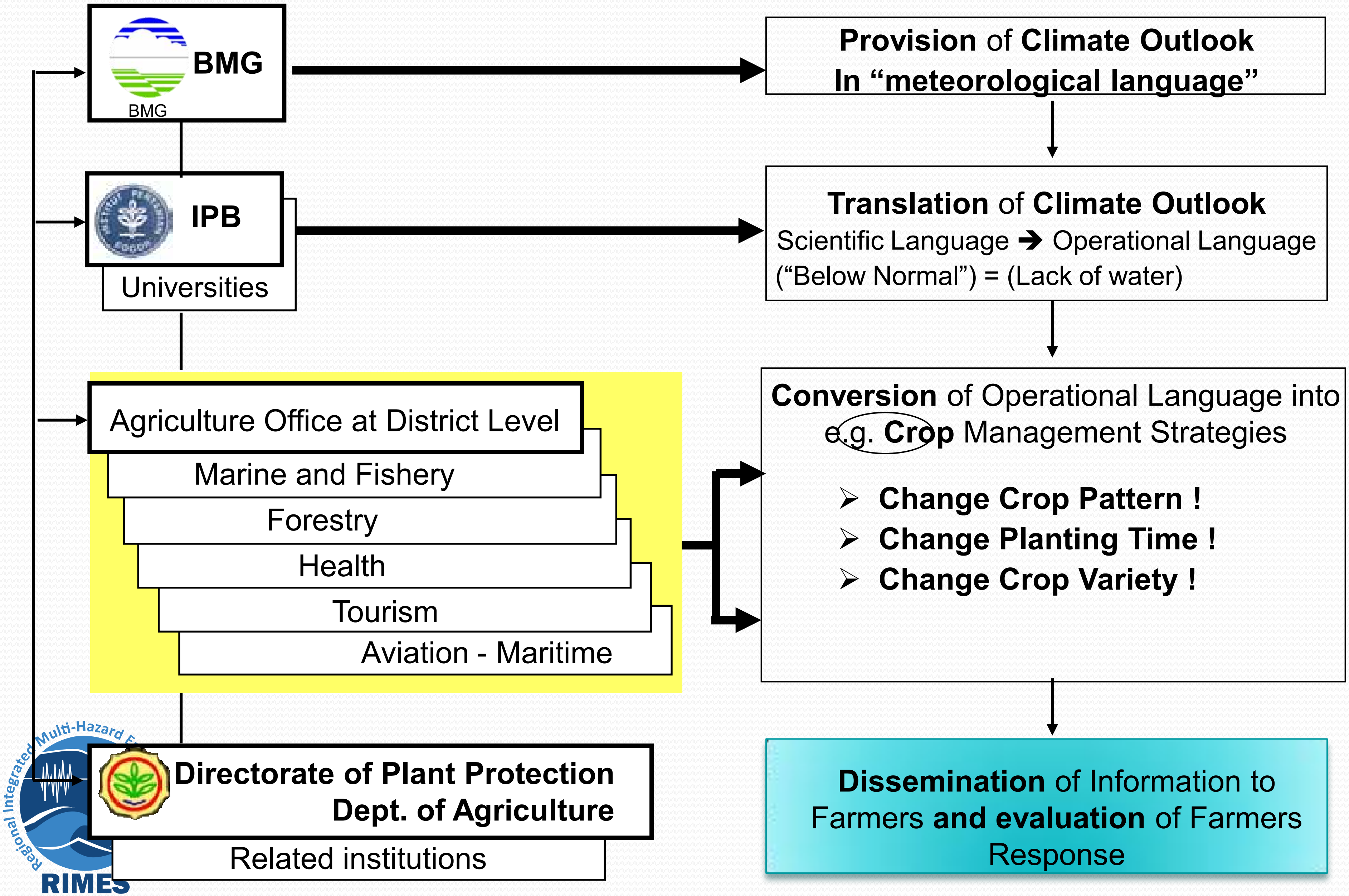
The CFA program is instrumental in establishing institutional mechanisms that connect hydro-meteorological communities, risk management institutions, & societies.

Farmers in Liquiça district learning basic rainfall observation at the Climate Field School for Farmers.

RIMES

Regional Integrated Multi-Hazard Early Warning System

Institutional Framework for Climate Forecast Application



Institutional innovation at Indonesian Ministry of Agriculture

DIREKTUR PERLINDUNGAN TANAMAN
Ir. Ati Wasiati

SUB BAGIAN TATA USAHA
Drs. Agung Wradsongko, MP

SUB DIT PENGELOLAHAN DATA OPT
Ir. Fatra Widjaya, M Si

SEKSI MONITORING
Drs. Tigor Sagala

SEKSI INFORMASI & DOKUMENTASI
Ir. Yarmiati Munaf

SUBDIT ANALISIS & MITIGASI DAMPAK IKLIM
Ir. Jatmiko

SEKSI ANALISI IKLIM
Ir. Irwan Kamal

SEKSI MITIGASI DAMPAK IKLIM
Ir. Endang Titi P. MM

SUBDIT PENGELOLAAN PHT
Ir. Sarsito WGS, MM

SEKSI KELEMBAGAAN
Ir. B. Indriastuti K

SEKSI PEMASYARAKATAN
Ir. Dyah Mutiawari

SUBDIT PENGENDALIAN OPT
Ir. Hari Utomo

SEKSI OPT SEREALIA
Drs. Ruswandi, MM

SEKSI OPT KACANG-2AN DAN UMBI-2AN
Ir. Ety Purwanti

BALAI PENGUJI MUTU PRODUK TANAMAN
Ir. Yayah Roliyah, M Si

SUB BAGAIN TAT USAHA
Suparjo

SEKSI PELAYANAN TEKNIK
Drs. Oscar Rulli

SEKSI PENGELOLAA SAMPLE
Dra. Tantri Indrianti

KELOMPOK JABATAN FUNGSIONAL

*Subdivision on Climate Analysis and Mitigation

RIMES
Regional Integrated Multi-Hazard Early Warning System

A pool of meteorologists has been formed & trained to provide tailored climate information for risk management in program countries. Through their interactions with institutions & communities under the Program, they understand that meteorologists should not just produce information but have to relate the information to the user context.

Dumangas Climate Field School

A farmer shows his revised cropping calendar

Institutional and community-level dissemination channels in demonstration sites have been strengthened. Community capacity to use climate information have been built primarily through Climate Field Schools, climate forum, & community-level workshops

Indramayu Climate Field School

Women farmers participating in the Climate Field School work with extension workers in understanding rainfall graphs

Farmers in Losarang subdistrict Indramayu
showing rainfall
graphs

Regional Integrated Multi-Hazard Early Warning System
RIMES

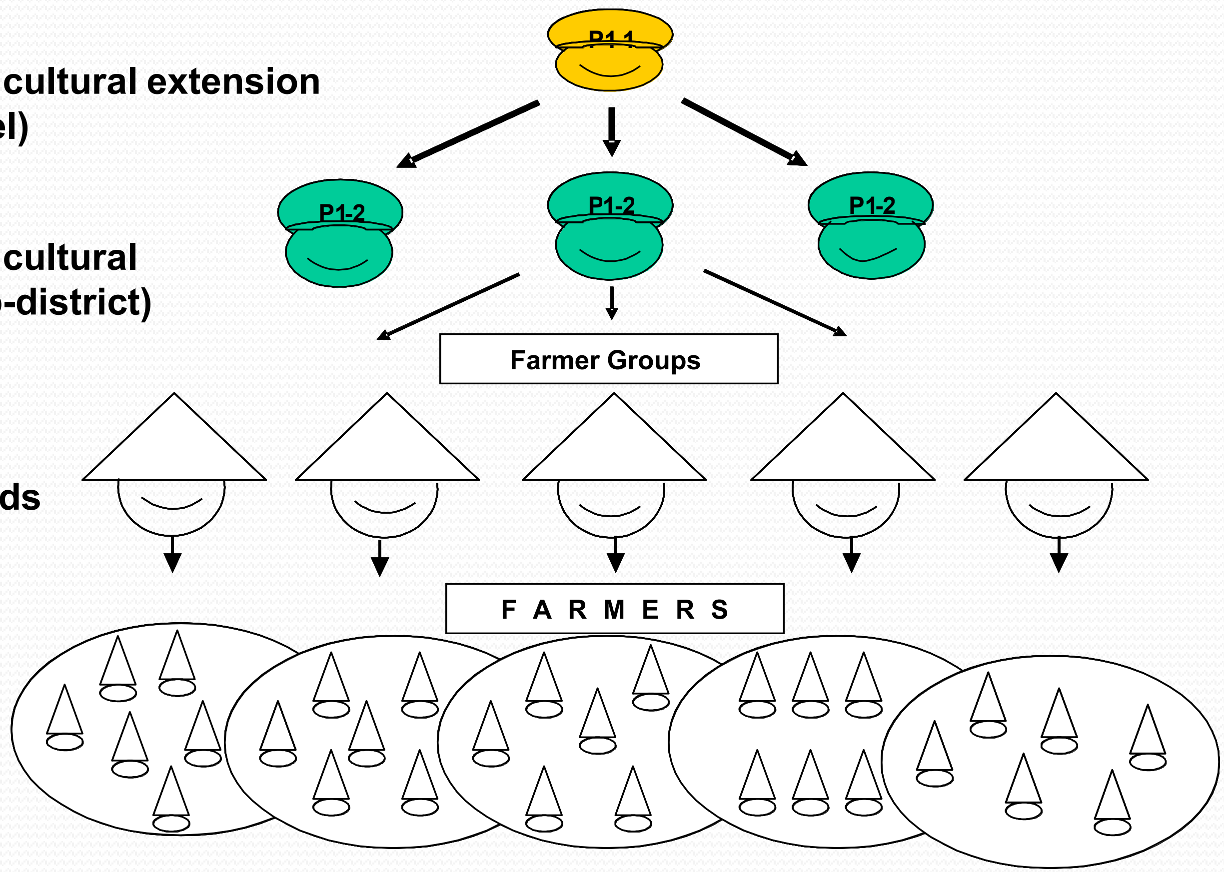
Climate field school: implementation process

Stage 1: training of agricultural extension specialists (district level)

Stage 2: training of agricultural extension workers (sub-district)

Stage 3: training of heads of farmers groups

Stage 4: dialogue with farmers



Key coping strategy: crop substitution

El Nino 2002-2003

As reported by the Iloilo Provincial Agriculturist, due to early dissemination of the El Niño forecast, farmers in the province were able to mitigate its adverse impacts by switching to alternative crops (e.g. rice to watermelon)

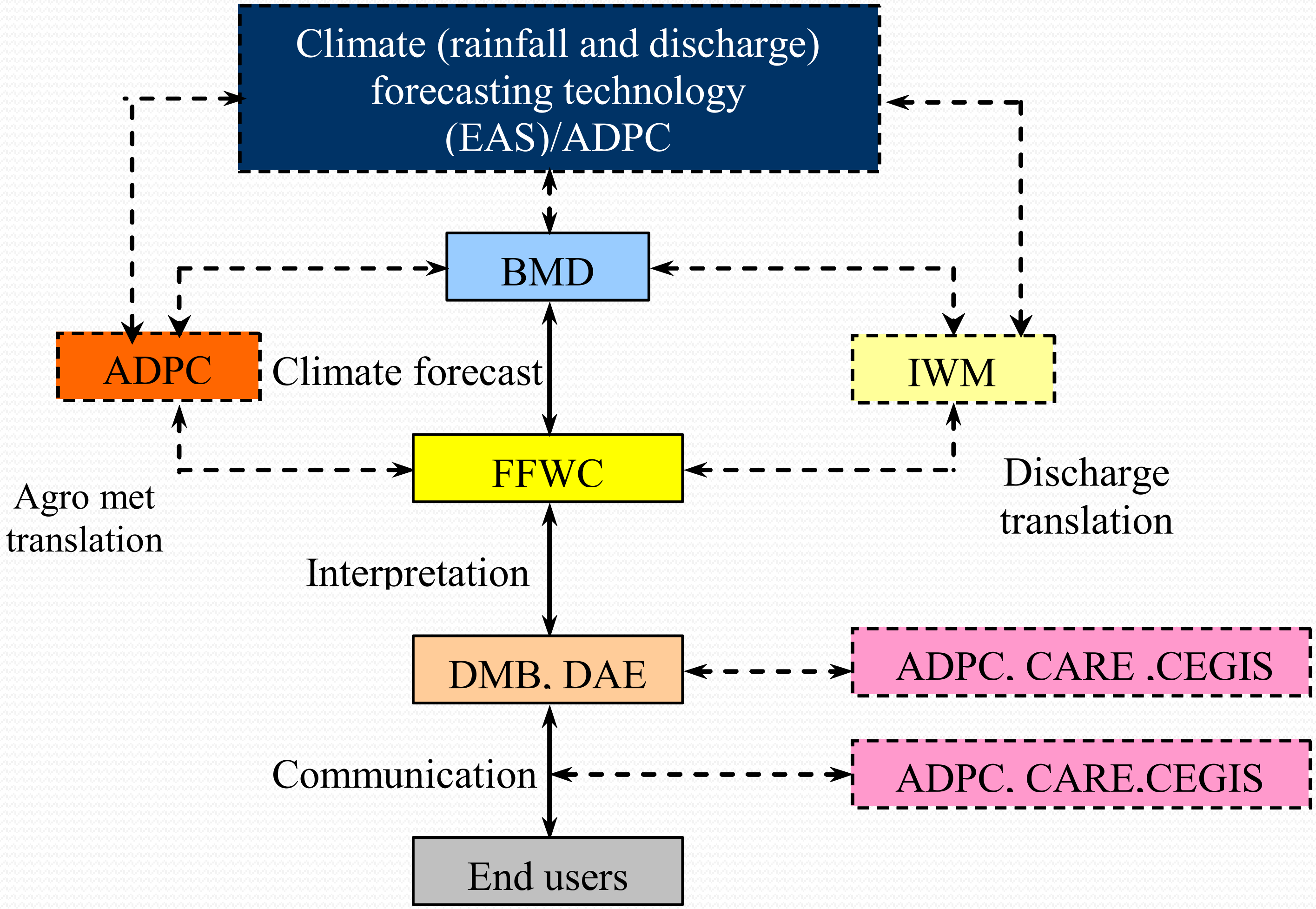
El Niño damage	-	64.00 M
Production of other crops -		732.02 M
Difference	Php	688.02 M

Regional Integrated Multi-Hazard Early Warning System
RIMES

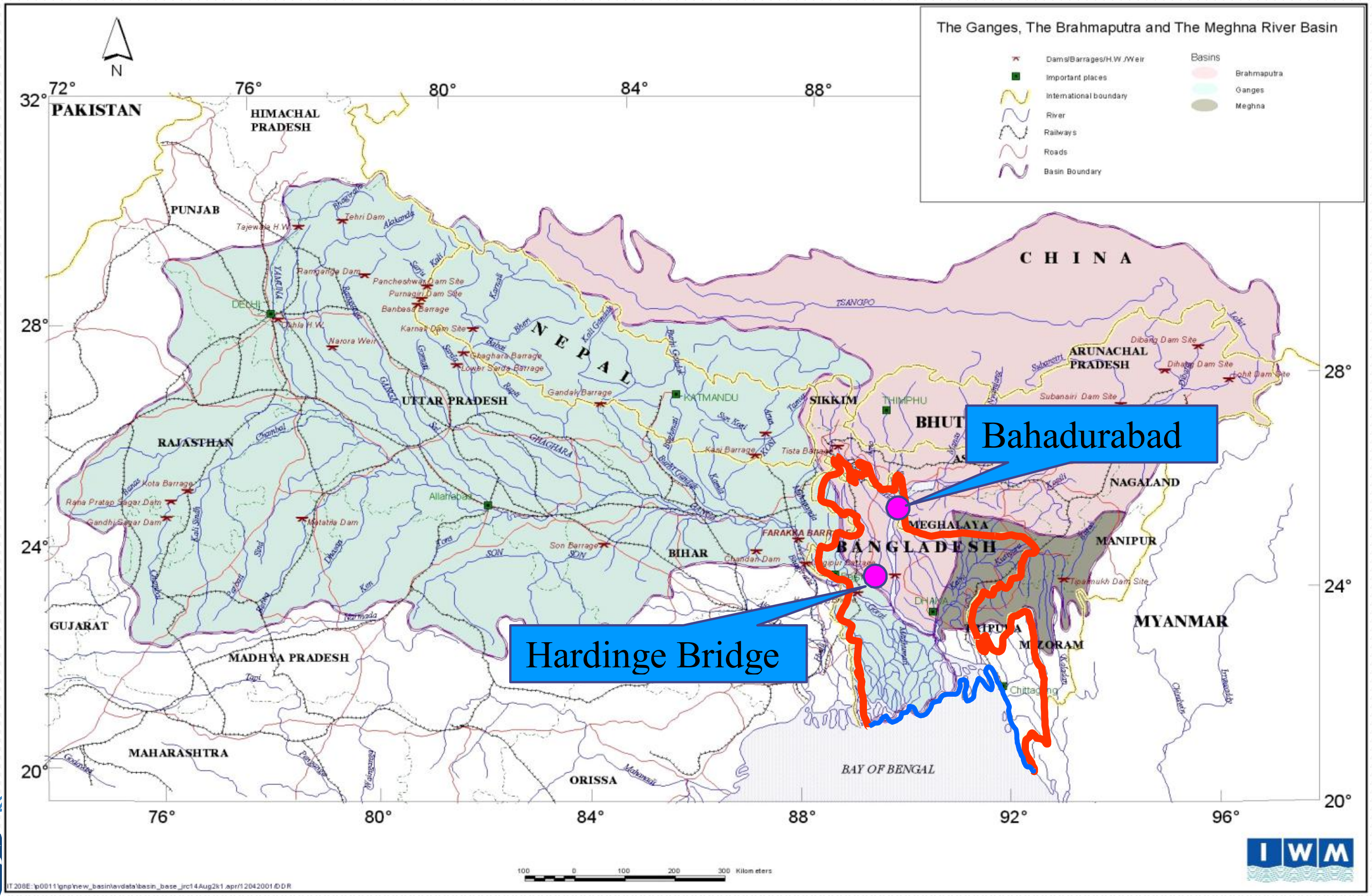
Case Study: Long Lead Flood Forecast Application

Regional Integrated Multi-Hazard Early Warning System
RIMES

Institutional Collaboration For Sustainable End-to-end Flood Forecasts System



CFAB Model Area



Discharge Forecast Schemes

(I). Initial Data Input

(II). Statistical Rendering

(III). Hydrological Modeling

(IV). Generation of Probabilistic Q

(V). Forecast Product

Discharge data

Hydrologic model parameters

NOAA and NASA (i.e.CMORPH and GPCP) satellite precipitation & GTS rain gauge data

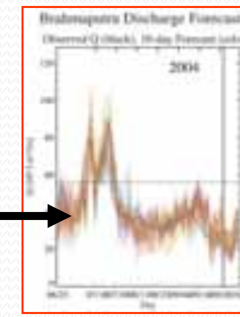
ECMWF Operational ensemble forecast

Downscaling of forecasts
Statistical correction

Hydrological Model

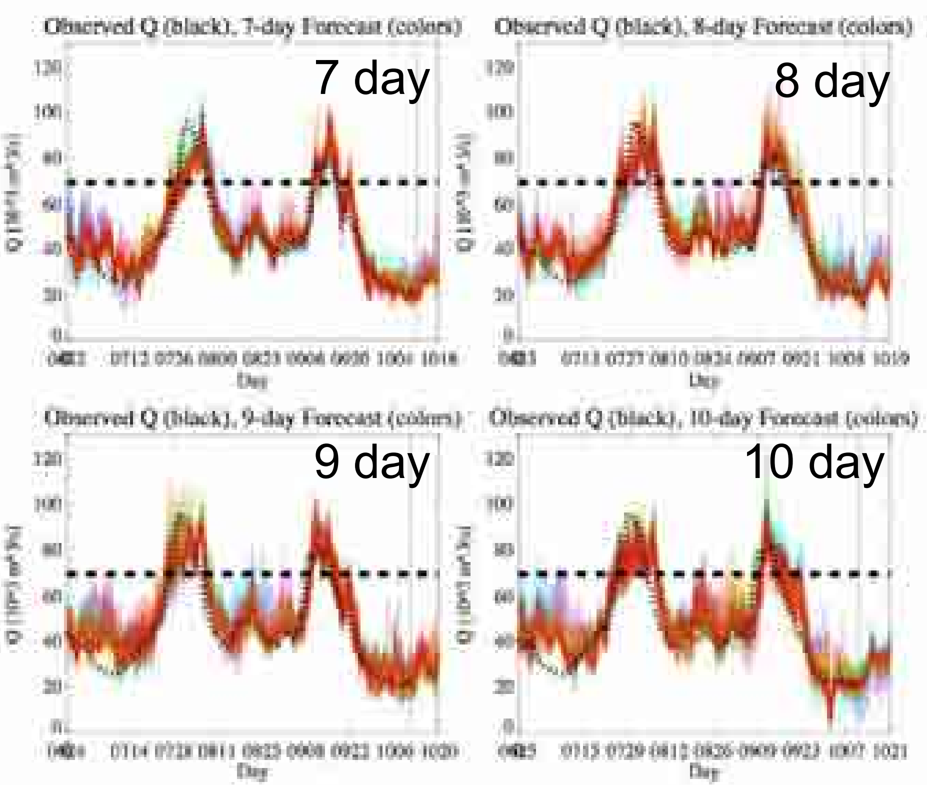
- Lumped
- Distributed
- Multi-Model Discharge Forecasting

- Accounting for uncertainties
- Final error correction
- Generation of discharge forecast PDF
- Critical level probability forecast

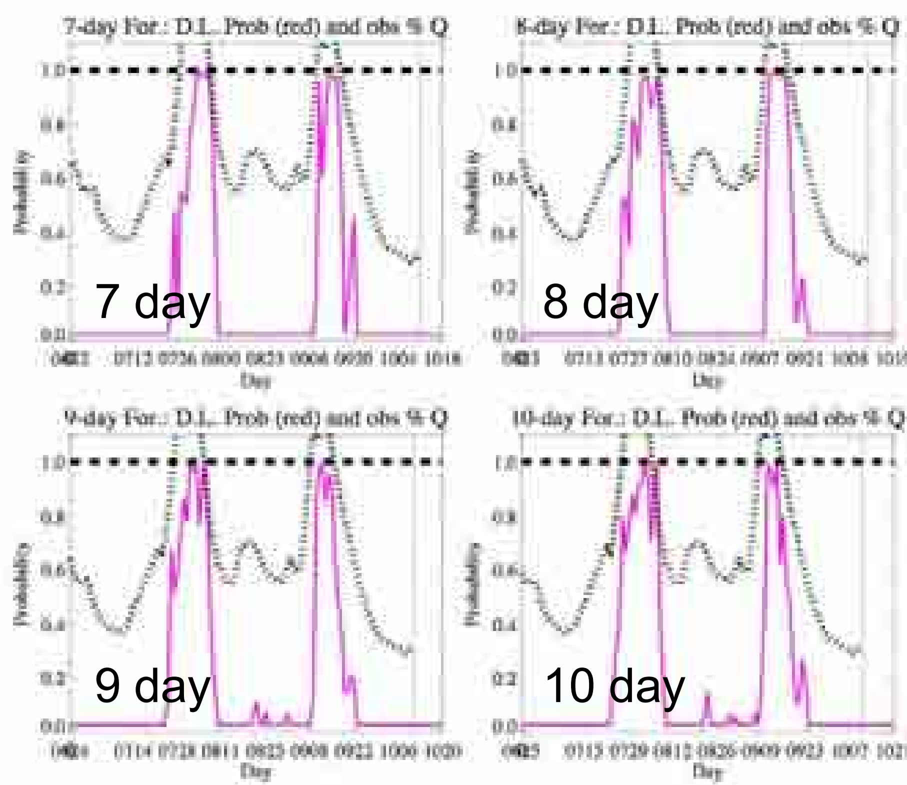


2007 Brahmaputra Ensemble Forecasts and Danger Level Probabilities

7-10 day Ensemble Forecasts

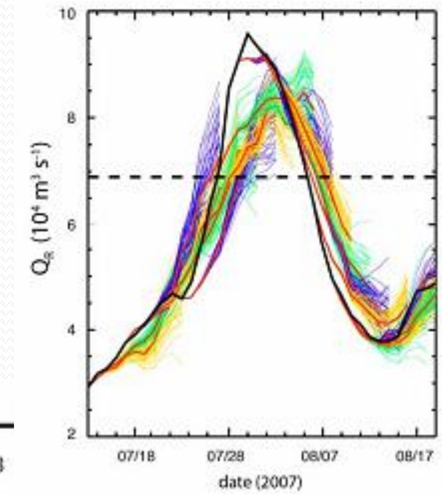


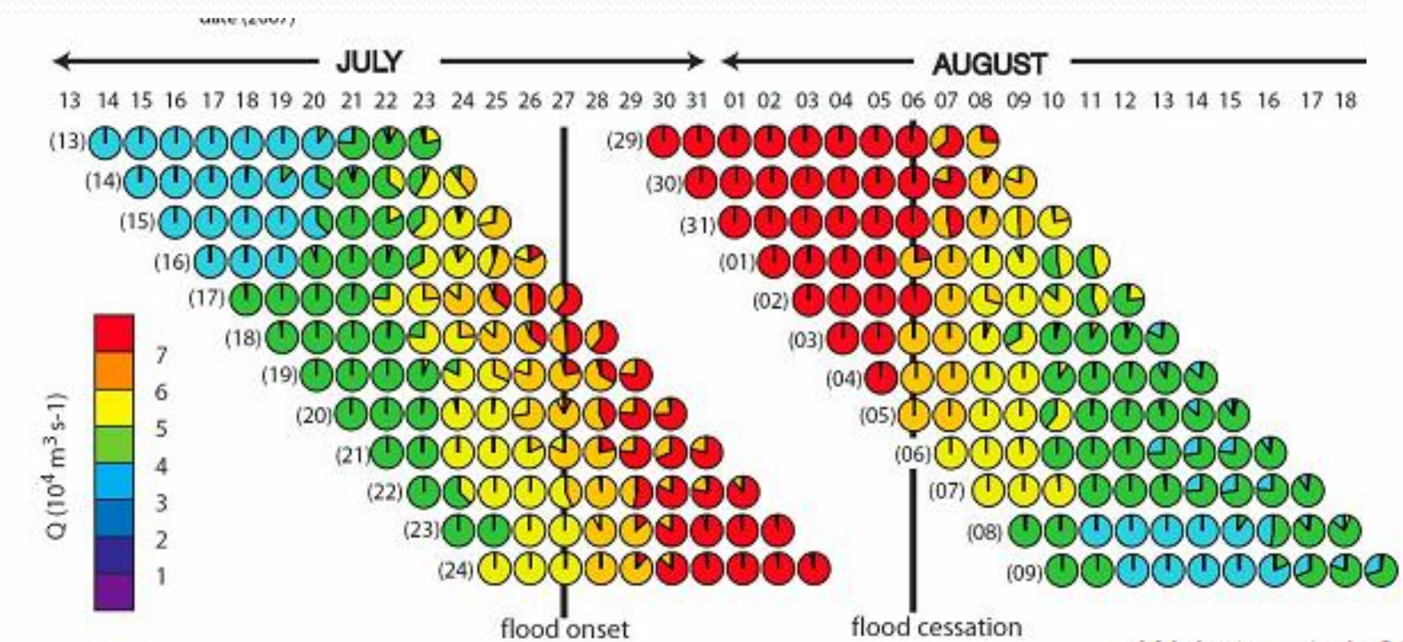
7-10 day Danger Levels



Plumes and probability pies for the first Brahmaputra flood July 28-August 6, 2007

High probabilities of exceedance of the danger level by the Brahmaputra at the India-Bangladesh border

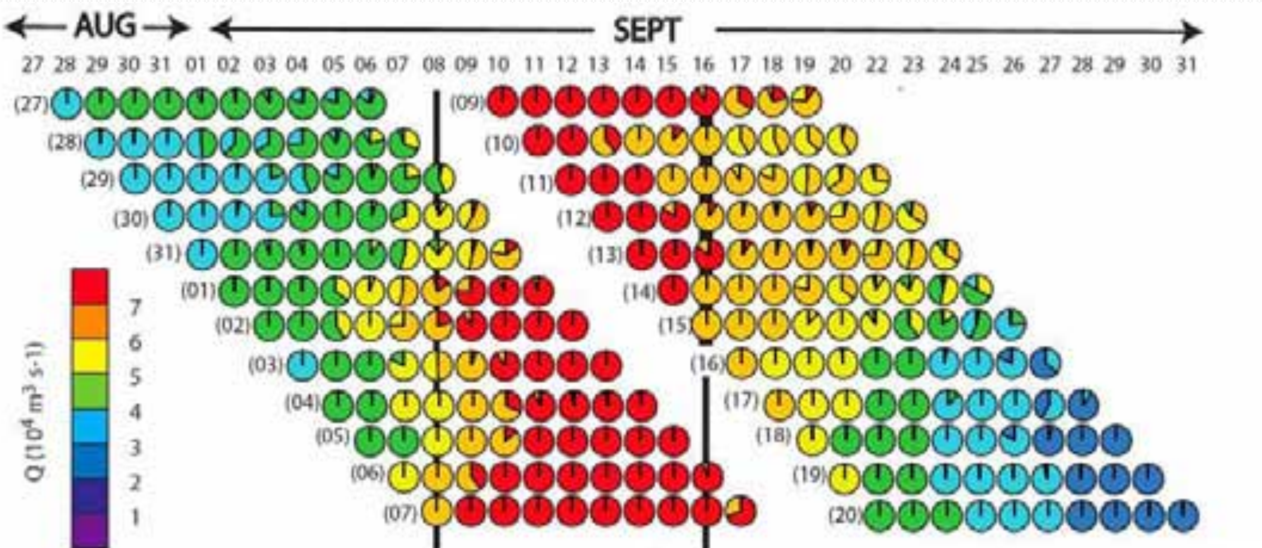


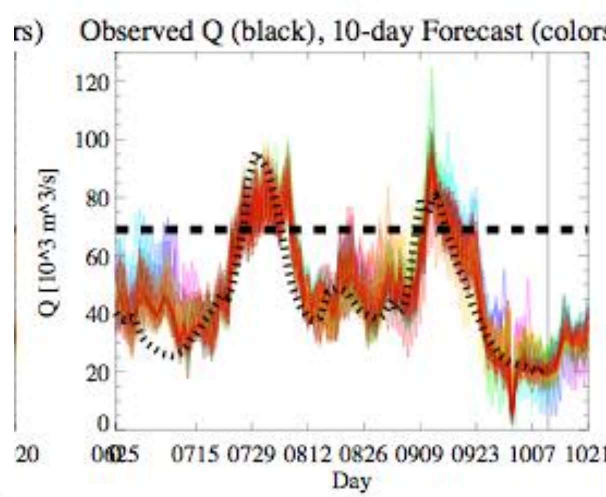


Webster et al. 2007

Accomplishments

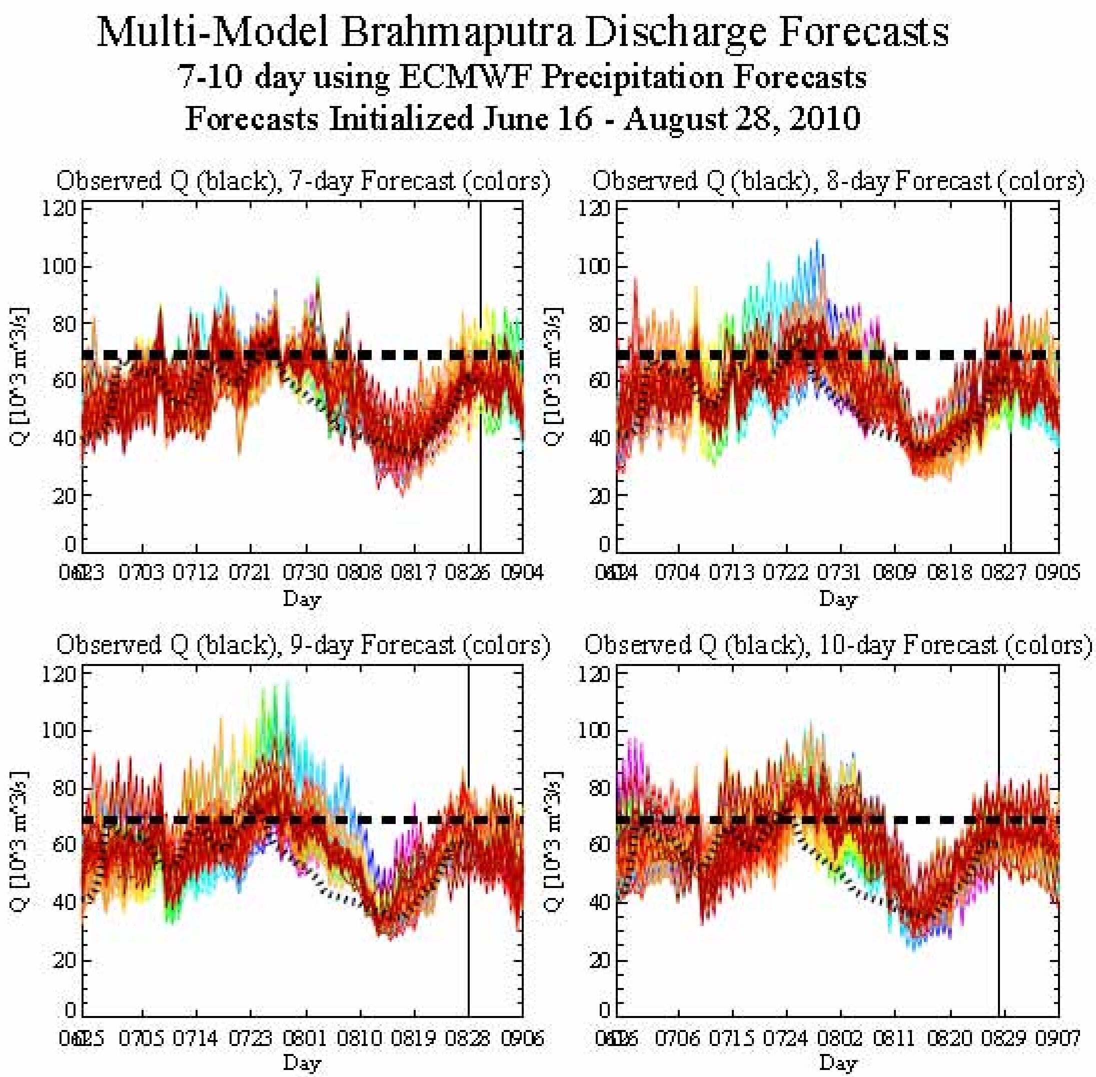
- The model performs consistently well and correctly predicted all floods from 2004 on ward (2004, 2007 and 2008)
- The flood forecasts provides onset of flood, duration and dates of receding of floods





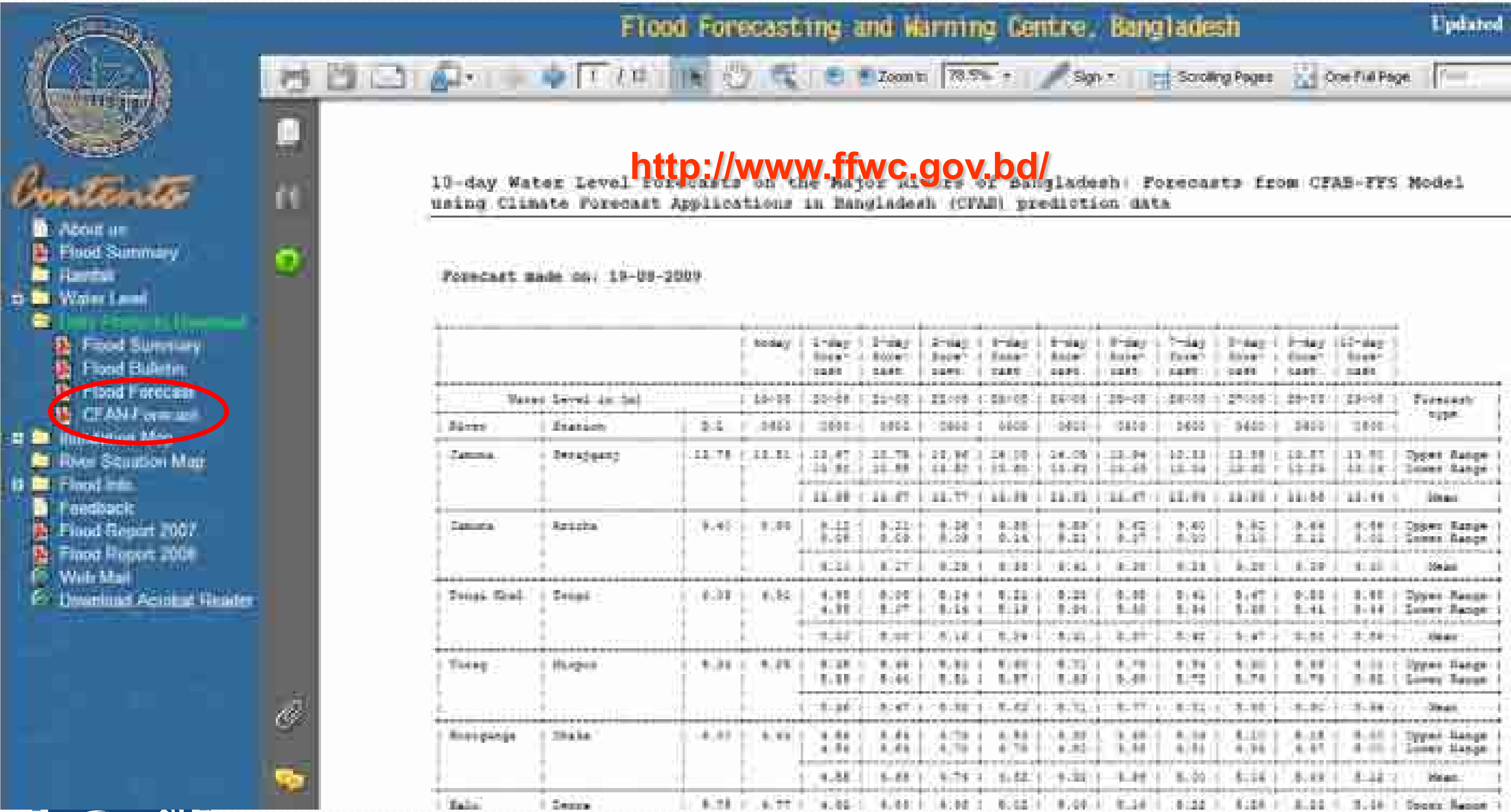
Webster et al. 2007

1-10 Days Forecasts at Bahadurabad 2010

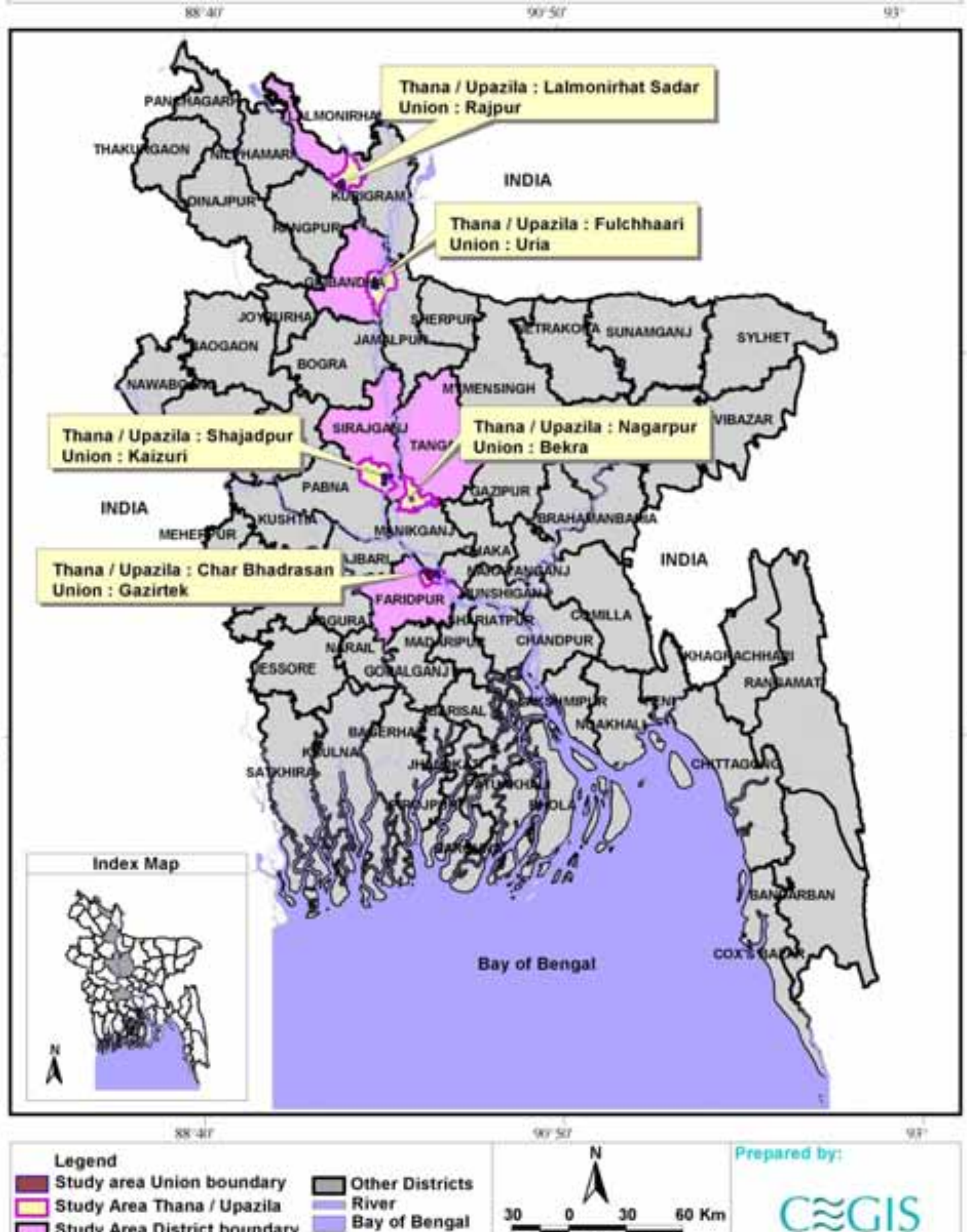


RIMES

1-10 Days Forecasts in the FFWC Website



Pilot Areas



Thana / Upazila : Lalmonirhat Sadar
Union : Rajpur
Thana / Upazila : Fulchhaari
Union : Uria
Thana / Upazila : Shajadpur
Union : Kaizuri
Thana / Upazila : Nagarpur
Union : Bekra
Thana / Upazila : Char Bhadrasan
Union : Gazirtek
INDIA
INDIA
INDIA
PANCHAGARH
THAKURGAON
NILPHAMARI
DINAJPUR
KURIGRAM
RANGPUR
GAIBANDHA
JOYPURHAT
NAOGAON
BOGRA
JAMALPUR
SHERPUR
NETRAKONA
SUNAMGANJ
SYLHET
MYMENSINGH
SIRAJGANJ
PABNA
GAZIPUR
KUSHTIA
MEHERPUR
MANIKGANJ
BRAHAMANBARIA
FARIDPUR
COMILLA
CHANDPUR
JESSORE
GOPALGANJ
BARISAL
NOAKHALI
KHULNA
SATKHIRA
CHITTAGONG
KHAGRACHHARI
RANGAMATI
BANDARBAN
Bay of Bengal
Index Map
Legend
Study area Union boundary
Study Area Thana / Upazila
Study Area District boundary
Other Districts
River
Bay of Bengal
N
30 0 30 60 Km
Prepared by:
CEGIS

Flood risk management at community level decisions and forecast lead time requirement (Eg. Rajpur Union, Lalmunirhat district)

Target groups	Decisions	Forecast lead time requirement
Farmers	Early harvesting of B.Aman, delayed planting of T.Aman	10 days
	Crop systems selection, area of T. Aman and subsequent crops	Seasonal
	Selling cattle, goats and poultry (extreme)	Seasonal
Household	Storage of dry food, safe drinking water, food grains, fire wood	10 days
	Collecting vegetables, banana	1 week
	With draw money from micro-financing institutions	1 week
Fisherman	Protecting fishing nets	1 week
	Harvesting fresh water fish from small ponds	10 days
DMCs	Planning evacuation routs and boats	20 – 25 days
	Arrangements for women and children	20 – 25 days
	Distribution of water purification tablets	1 week
Char households	Storage of dry food, drinking water, deciding on temporary accommodation	1 week

USER MATRIX on Disasters, Impacts and Management Plan for Crop, Livestock and Fisheries sector

Disasters	Crop	Stages	Season/ month	Impacts	Time of flood forecast	Alternative management plans
Early flood	T.Aman	Seedling and Vegetative stage	Kharif II Jun – Jul	Damage seedlings Damage early planted T.Aman Delay planting Soil erosion	Early June	Delayed seedling raising, Gapfilling, skipping early fertilizer application
	T.Aus	Harvesting	Kharif I Jun – Jul	Damage to the matured crop	Early June	Advance harvest
	Jute	Near maturity	June-July	Yield loss Poor quality	May end	Early harvest
	S.Vegetables	Harvesting	June-July	Damage yield loss Poor quality	Mar - Apr	Pot culture (homestead) Use resistant variety
High flood	T. Aman	Tillering	Kharif - II July-Aug	Total crop damage	Early June	Late varieties Direct seeding Late planting
Late flood	T. Aman	Booting	Kharif II Aug-Sep	Yield loss and crop damage	Early July	Use of late varieties Direct seeding Early winter vegetables Mustard or pulses

Risk Communication of flood forecasts 2007- 2008

RIMES

Risk Communication for Flood Forecasts

Mobile phone

Flag hoisting

Risk Communications

- 1-10 days forecasts shared with the decision makers at national and district level through fax and e-mail
- 1-4 days forecasts information communicated to the pilot communities through SMS and flag network. If danger level probability exceed 85%, 10 days forecast communicate to the pilot areas and appropriate actions take place



Institutional and community responses on 2007 flood forecast: ADPC Field Team

Discussion of options with local communities, CBOs, local working group members, networks

21 Jul	22 Jul	23 Jul	24 Jul	25 Jul	26 Jul			30 Jul	2 Aug
Flood forecast issued for two boundary locations	Incorporated into customized local model	Communication to project partners	Communication to stakeholders and local DMC members	Communication to Disaster Emergency Group	Information to relief agencies about the extent of flooding				
				Local institutions prepared response and relief plans	Community in low lands reserved their food, drinking water, fodder requirements	Local Disaster Management Committee and Volunteers prepared for rescue		Aid agencies arranged logistics and begin dialogue with district administration	Relief distribution started in affected locations

Flood water exceeded danger level on 28th July

Low lying areas are flooded on 29th July

RIMES

Community responses to flood forecasts

(a) Shelter for human and livestock on road

(b) Collection of drinking water

(c) Raising net around pond to protect fish

(d) People living on *macha* (bamboo made structure) during flood

RIMES

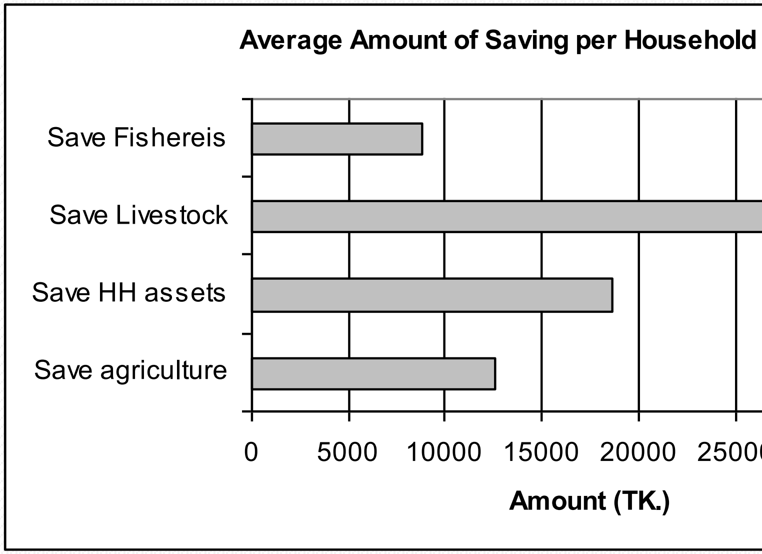
Regional Integrated Multi-Hazard Early Warning System

Community responses to flood forecasts

RIMES

Economic- Benefits

- In 2008 Flood, Economic Benefits on average per household at pilot areas
  - Livestock's = TK. 33,000 ($485) per household
  - HH assets = TK. 18,500 ($270) per household
  - Agriculture = TK 12,500 ($180) per household
  - Fisheries = TK. 8,800 ($120) per households



- Experiment showed that every USD 1 invested, a return of USD 40.85 in benefits over a ten-year period may be realized (WB).

Regional Integrated Multi-Hazard Early Warning System
RIMES

Group Work: Establishing the relevance and usefulness of EWS

- Is the new information *relevant* for decisions in your sector? Why?
- Are the sources/providers of information *credible* to the intended user? Why and How?
- Are practitioners (or users of information) *receptive* to the information? What factors hinder or enable?
- Is the information *accessible* to the decision maker? Describe gaps if any
- Is the information *compatible* with existing decision models e.g. for agriculture, water management practice? Describe gaps if any.
- Does the community (or users) have the *capacity* to use information? Describe gaps if any.

Regional Integrated Multi-Hazard Early Warning System
RIMES