

Workshop on SMART Informatics for Sustainability

Global Service on Climate Prediction and Adaptation for Sustainability

Chung Kyu Park

Director, Regional Office for Asia and the South-West Pacific
World Meteorological Organization



WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

Bangkok, Thailand
21 March 2018

WMO structure



**World
Meteorological
Organization**
Weather • Climate • Water

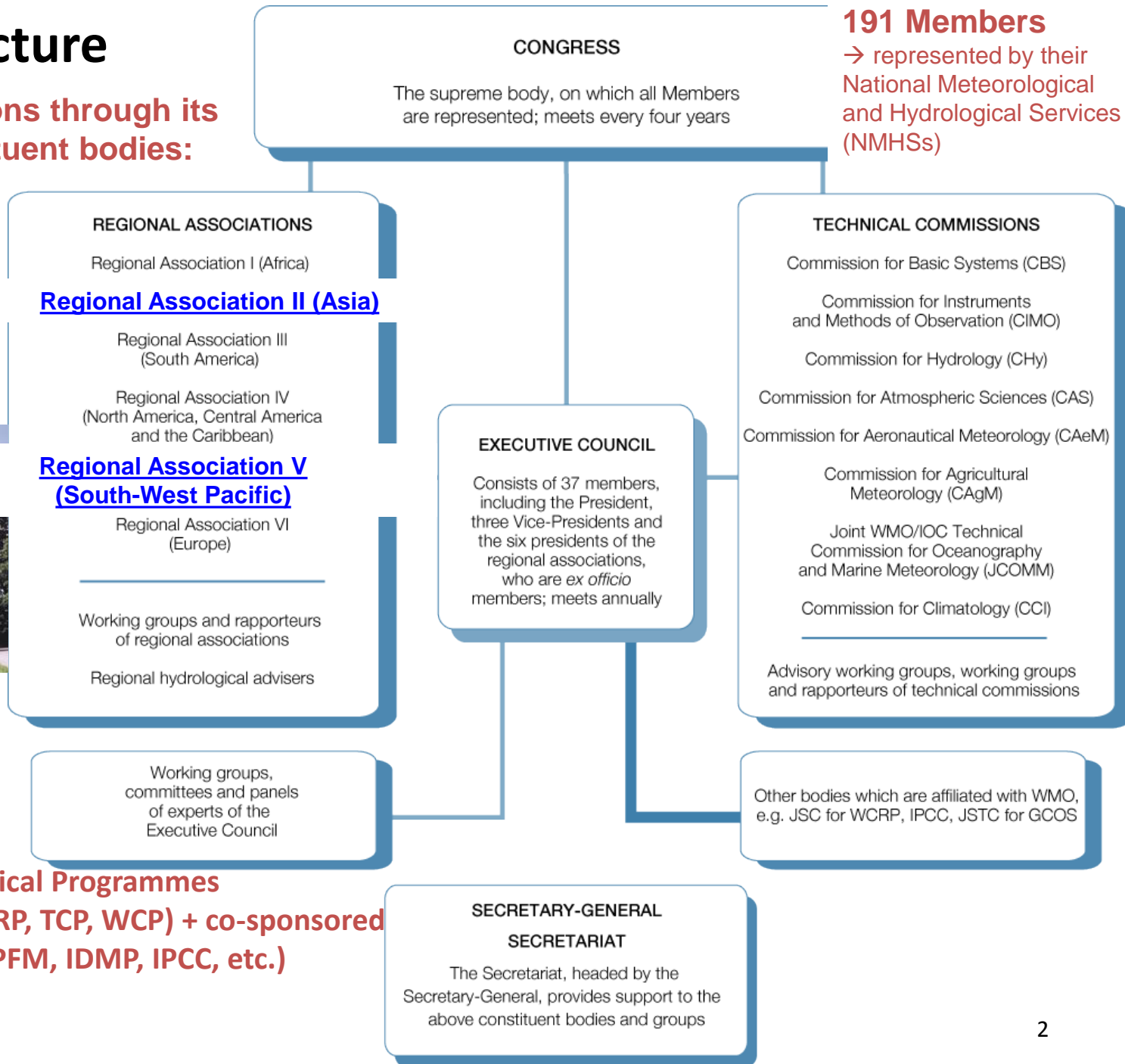


**functions through its
constituent bodies:**

→ Scientific & technical Programmes
(e.g. DRR, PWS, HWRP, TCP, WCP) + co-sponsored
programmes (e.g. APFM, IDMP, IPCC, etc.)



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WMO programmes 2016

Atmospheric Research and Environment

World Weather Watch

Application Meteorology

WIS WIGOS

Space Programme

Public Weather Service

Global Atmosphere Watch

Marine Meteorology and Oceanography

Tropical Meteorology Research

Tropical Cyclone

World Weather Research

Agricultural Meteorology

Hydrology and Water Resources

Aeronautical Meteorology

Integrated Drought Management

Service Delivery Strategy

Associated Programme on Flood Management

Disaster Risk Reduction Programme

World Climate Programme

**Capacity Development
Strategy / Programme**

World Climate Research Programme

Education and Training

Voluntary Cooperation Programme

LDC PROGRAMME

Regional Programme

SIDS and MIT's Programme



Information and Public Affairs

Quality Management Framework

CSIS, UIP, SWFDP, GOS, GDPFS, ISS, S2S, GIPPS, ...

Global Framework for Climate Services

Global Climate Observing System

Polar regions, Marine, Urban



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Before 2003

After 2003 Cg-14

After 2007 Cg-15

After 2011 Cg-16 & Cg-Ext 2012

After 2015 Cg-17

WMO Regional Structure

Regional Offices / Representative Offices / Project Offices



Regional Office – Asia- SW Pacific (RAP)

RAP Office supports 58 members in RA II (35) & RA V (23). Asia-Pacific Region is characterized by:

Dense population with many mega cities and serious casualties and economic losses due to various natural disasters;

Diversity in climate, natural disasters, economics, technology, language and culture (with sub-regional issues and challenges);

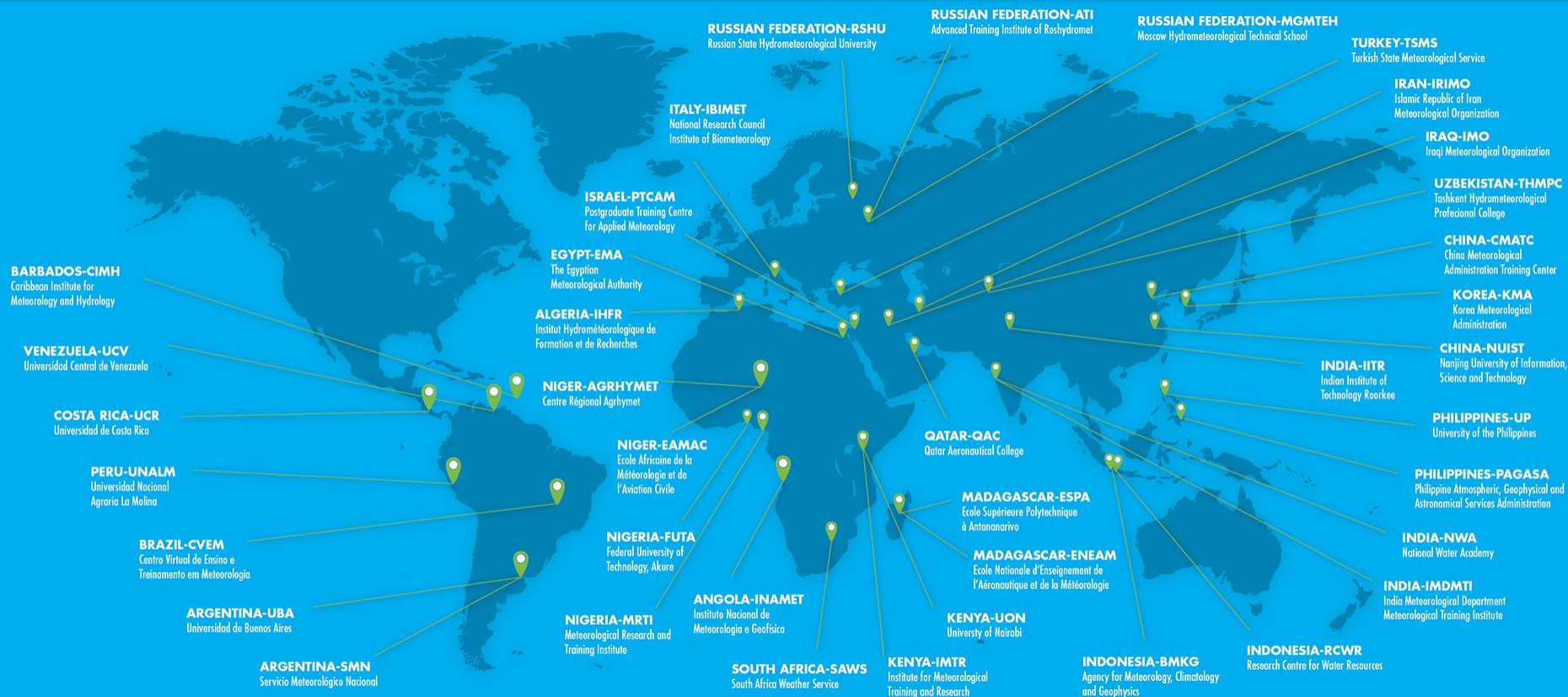
Key players and implementation partners due to high-impact natural disasters and economic losses (opportunity and threat);

Active Regional Centres which provide supports to Members (RSMCs, RCCs, RTCs, RRC, RICs, GISCs, SDS-RNs/RCs, etc.)

Political sensitivity and conflicts with neighbouring countries in sub-regions (cross-boundary issues);

Gaps among Members for capacity development and implementation of projects in sub-regions;

WMO Regional Training Centres



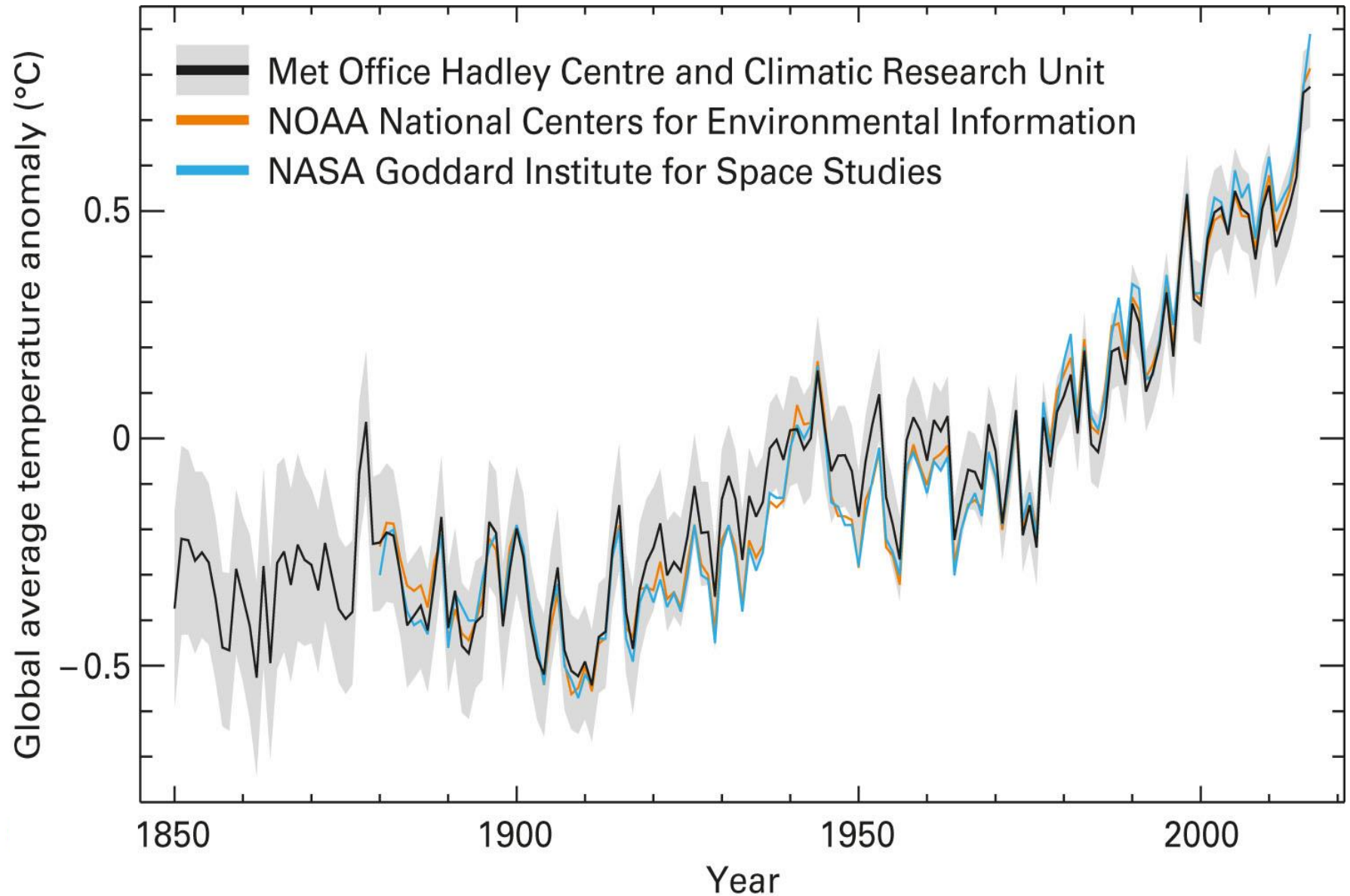
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The world is increasingly exposed to severe weather and extreme climate events amid rising global temperatures!



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Global temperature 1850-2016



Arctic sea ice volume 1979-2016: -74 %

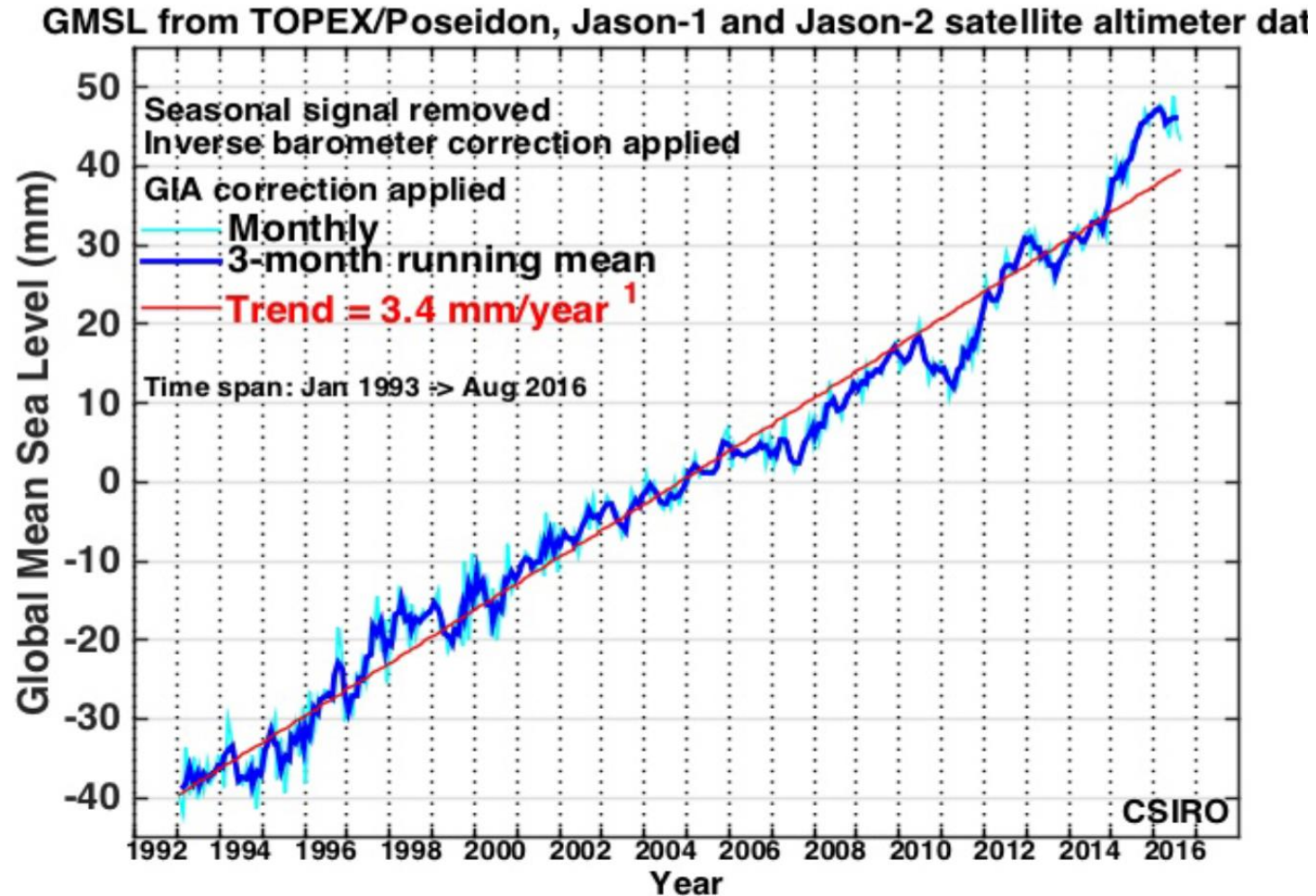


Source: <http://psc.apl.washington.edu/wordpress/research/projects/arctic-sea-ice-volume-anomaly/>
Created by: Andy Lee Robinson <http://youtube.com/ahaveland> Oct 2016



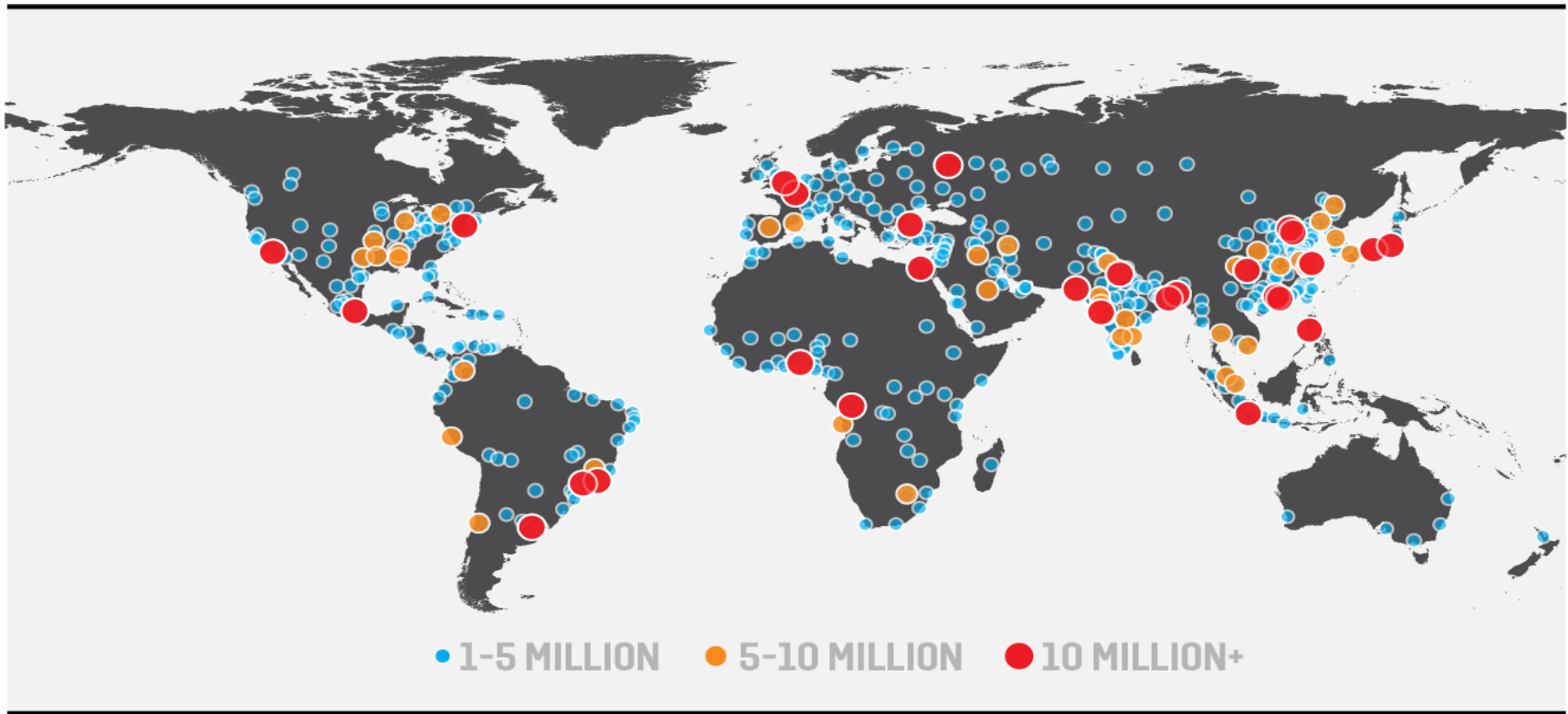
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Sea level rise is accelerating



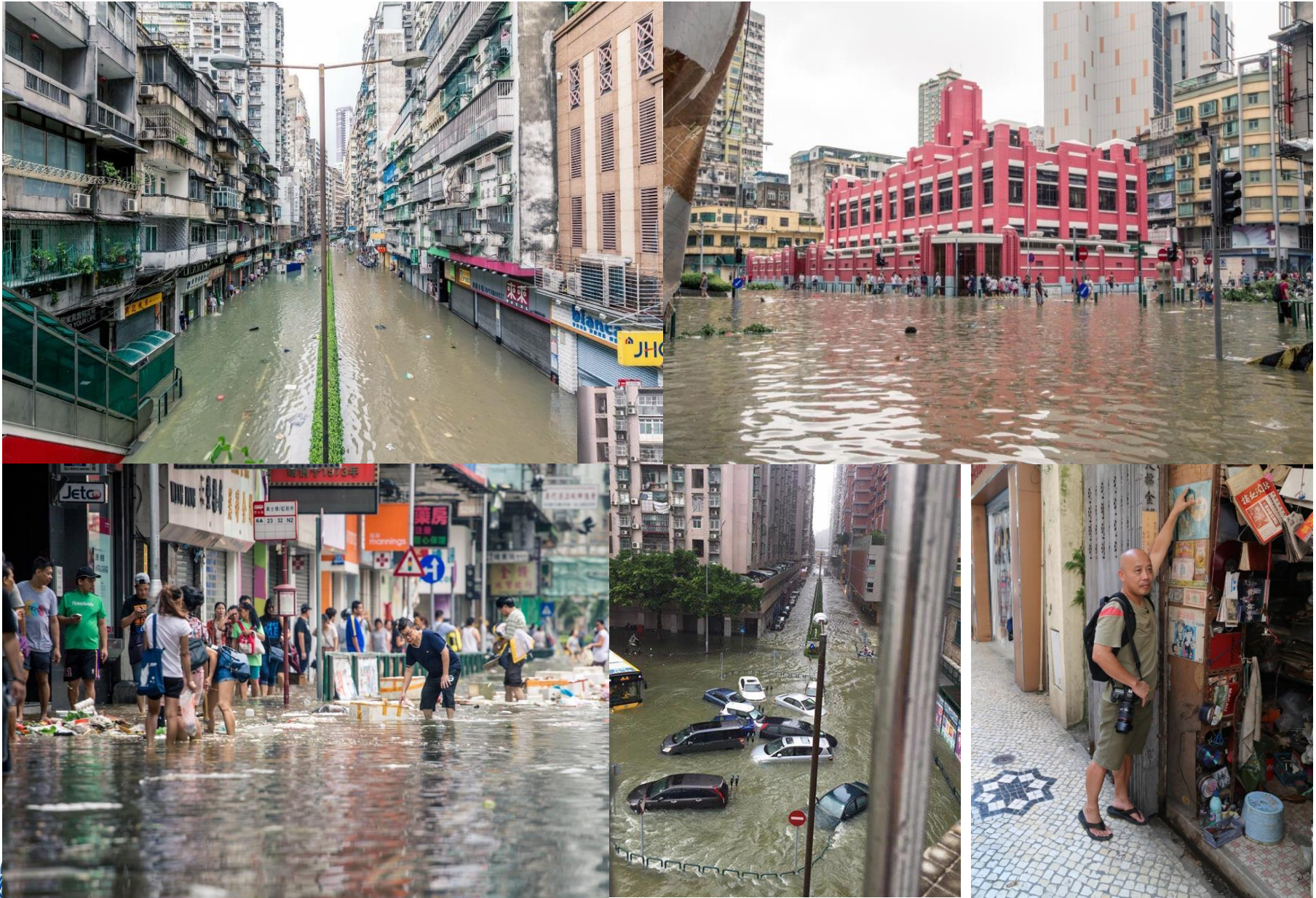
Climate change impact to costal Megacities !!!!

FP Distribution of Cities 2014



FOREIGN POLICY / DATA VIA THE UNITED NATIONS

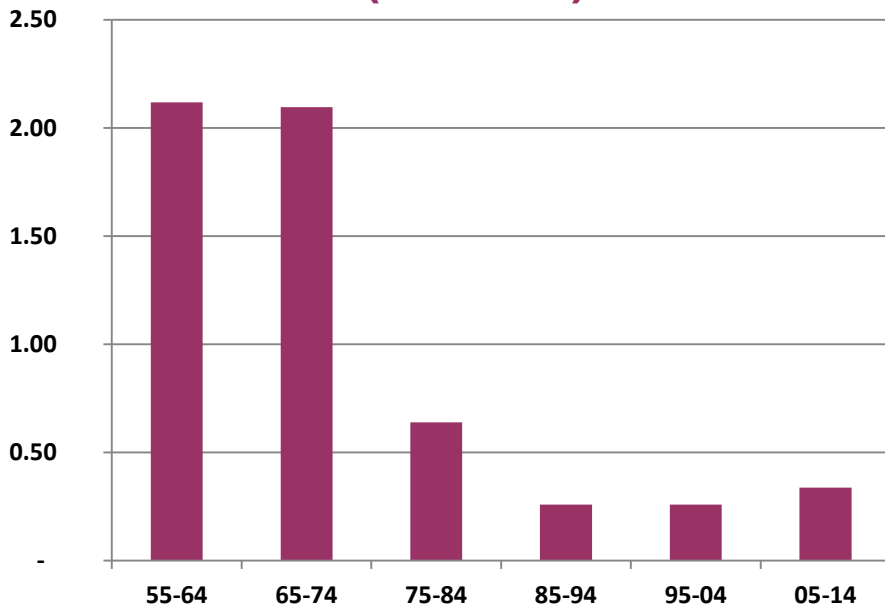
Flooding in Macao during the approach of Hato (23 AUG 2017)



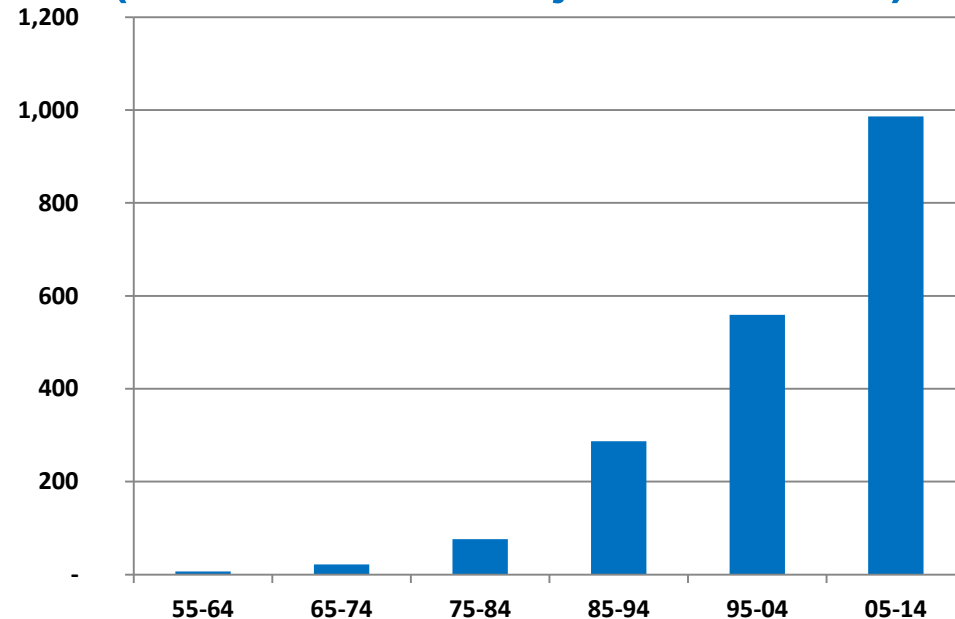
(Photo courtesy : Tomas Choi and Denise Lau)

Impacts of hydrometeorological and climatological hazards (1955–2014)

Human losses by decade
(millions)



Economic losses by decade
(billions of US\$ adjusted to 2013)



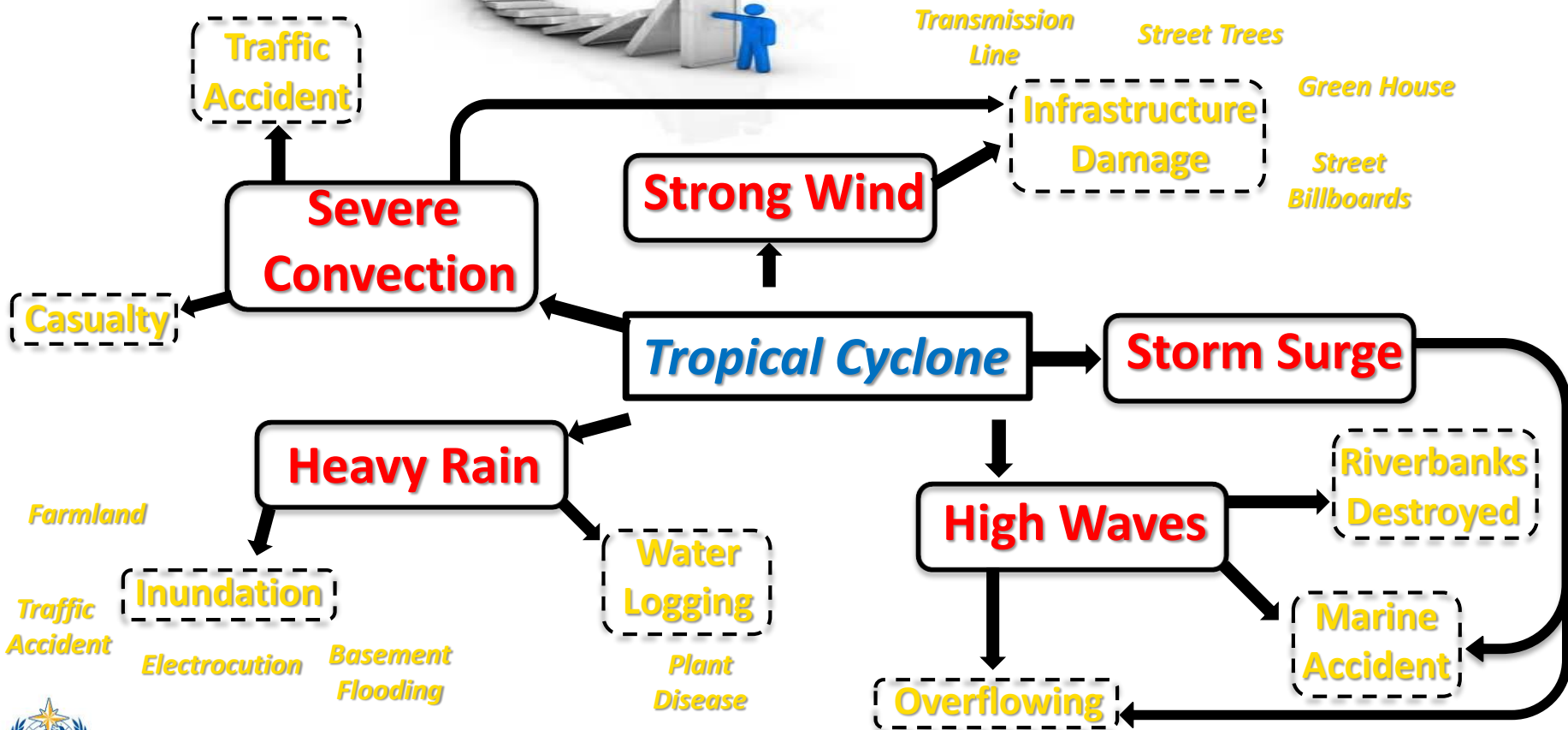
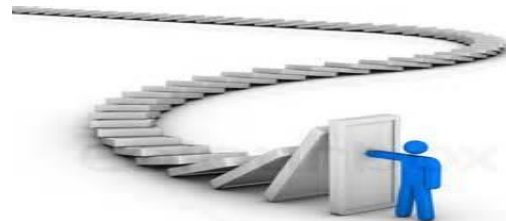
Reduction of the number of victims thanks to greater effectiveness of early warning systems and prevention measures!



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Through a domino effect, a single extreme event can lead to a broad breakdown of a city's infrastructure:

Impact-based Forecasting!!!



Climate Risk and Early Warning Systems (CREWS) Initiative



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Climate Risk and Early Warning Systems (CREWS) Initiative

- ❑ Launched during COP 21 (Paris, 2015) by France in collaboration with WMO, UNISDR and WB/GFDRR.
- ❑ **Significantly increase access to EWSs and risk information to protect lives, livelihoods in LDCs & SIDS**

CREWS contributes to the SDGs, the Paris Climate Change Agreement & the Sendai Framework

« Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030. »



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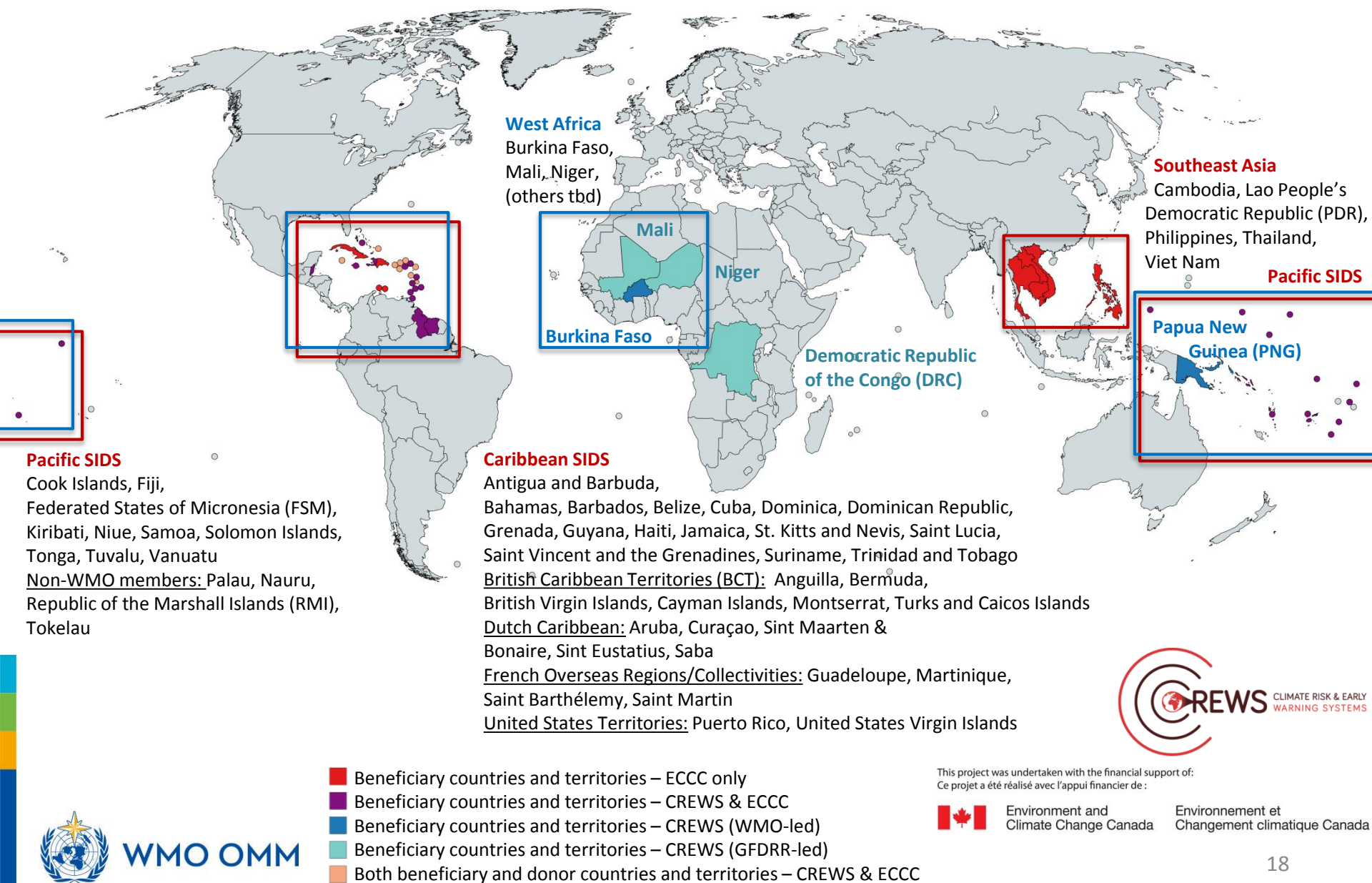


Climate Risk and Early Warning Systems (CREWS)

- Australia, Belgium, Canada, **France**, Germany, Japan, Luxembourg & Netherlands
- By 2020, moderate early warning system and risk information capacities in SIDS and LDCs (~80 countries)
- Mobilize US \$100 million by 2020 to fill gaps
- Around US\$ 80 million already pledged by 8 countries
- **WMO, UNISDR and World Bank's Global Facility for Disaster Reduction and Recovery act as technical implementation agencies**



CREWS beneficiary countries and territories (Feb 2018)

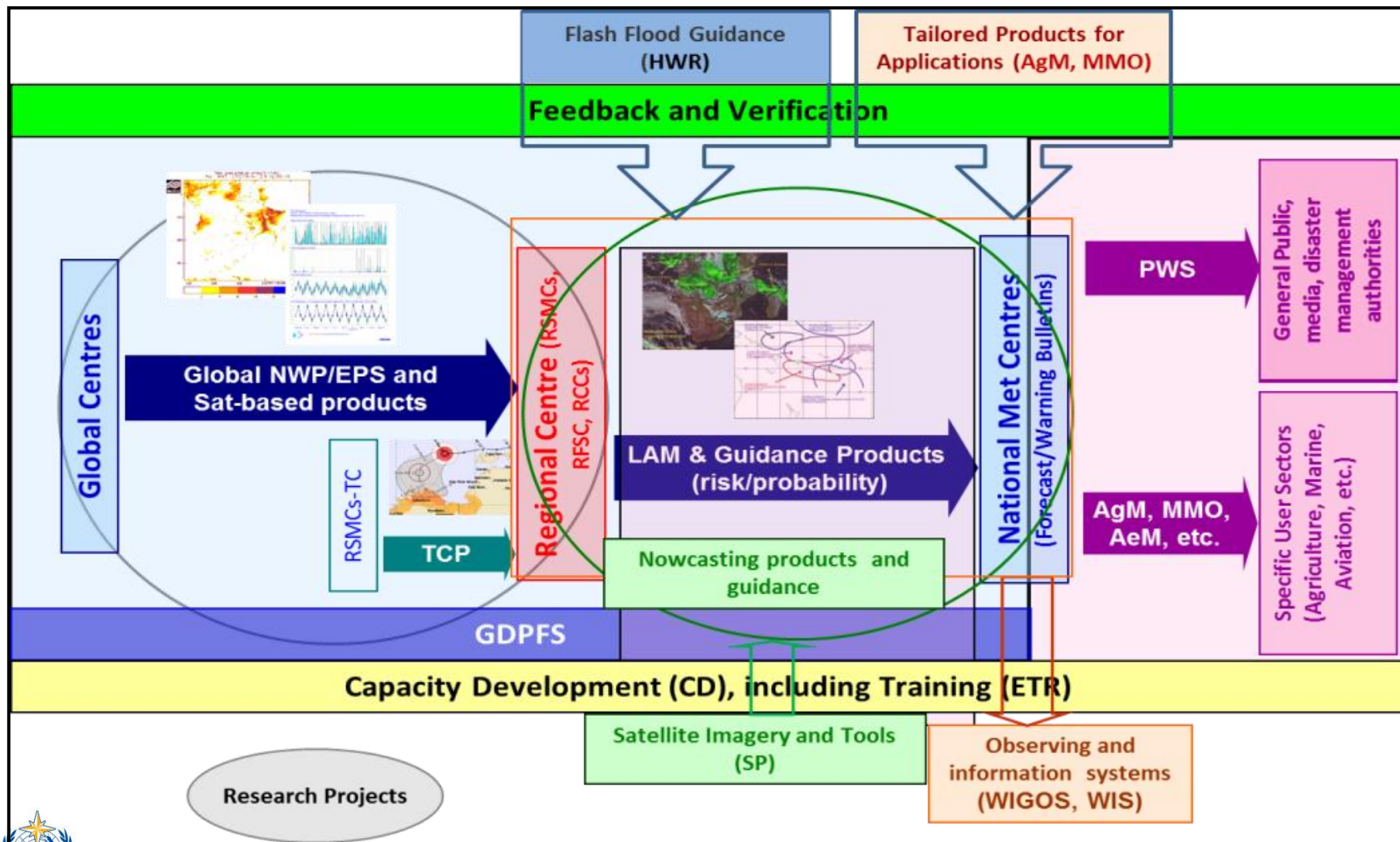


Severe Weather Forecasting Demonstration Project (SWFDP)



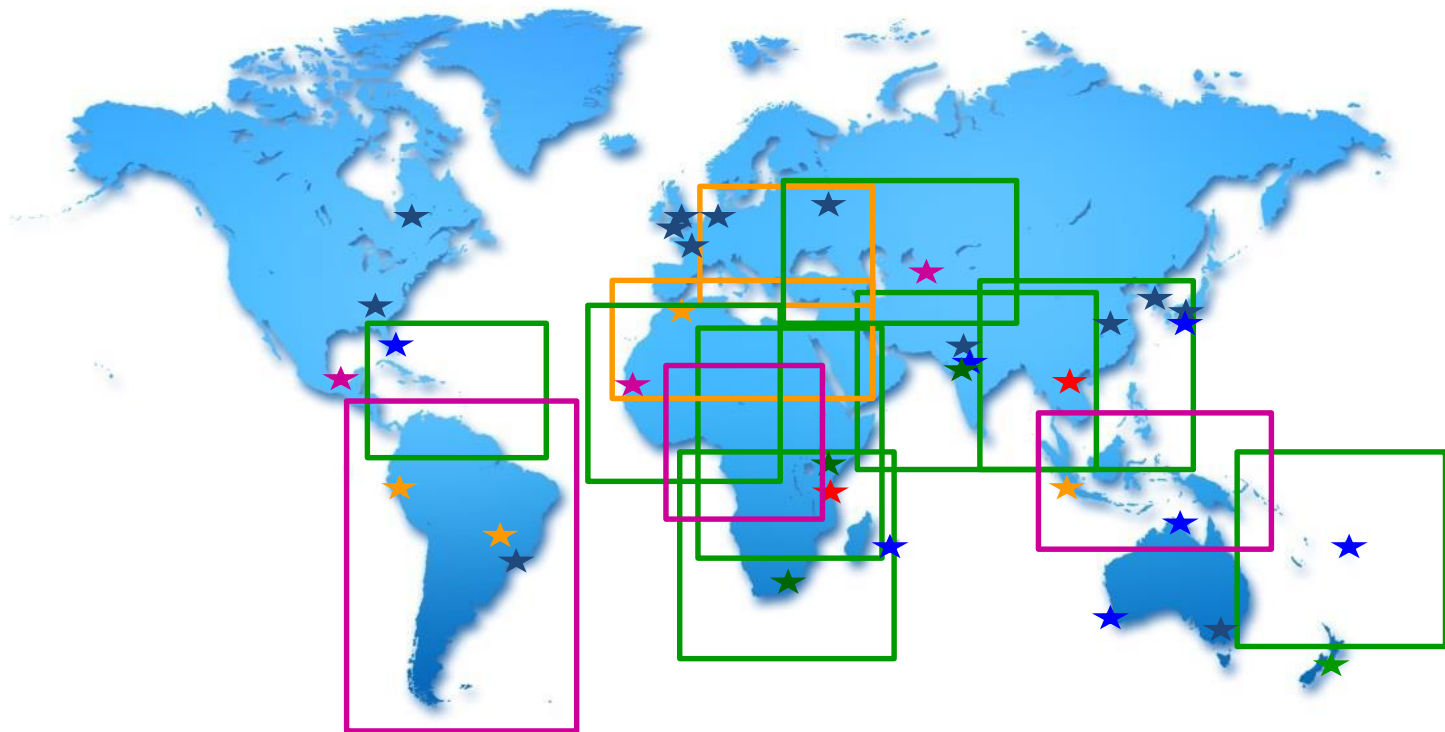
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SWFDP – The ‘Cascading Forecasting Process’



SWFDP – Ongoing regional subprojects and future directions

Currently, SWFDP involves over 75 countries including around 45 LDCs and SIDS in 8 sub-regions. Subject to availability of resources, number of benefitting countries may grow to over 100 in next 2-3 years.



Green color boxes - shows the existing on-going SWFDP regional subprojects.

Pink color boxes – the regional subprojects in discussion (next 1-2 years)

Orange color boxes – future SWFDP subprojects (next 3-5 years?)



SWFDP – Southeast Asia

(RFSC Ha Noi web portal since 2011)

5 countries:

Cambodia

Lao PDR

Viet Nam

Philippines

Thailand

Regional Centres:

RFSC Ha Noi (Lead centre)

RSMC Tokyo (typhoon forecast support)

RSMC New Delhi (TC forecast support)

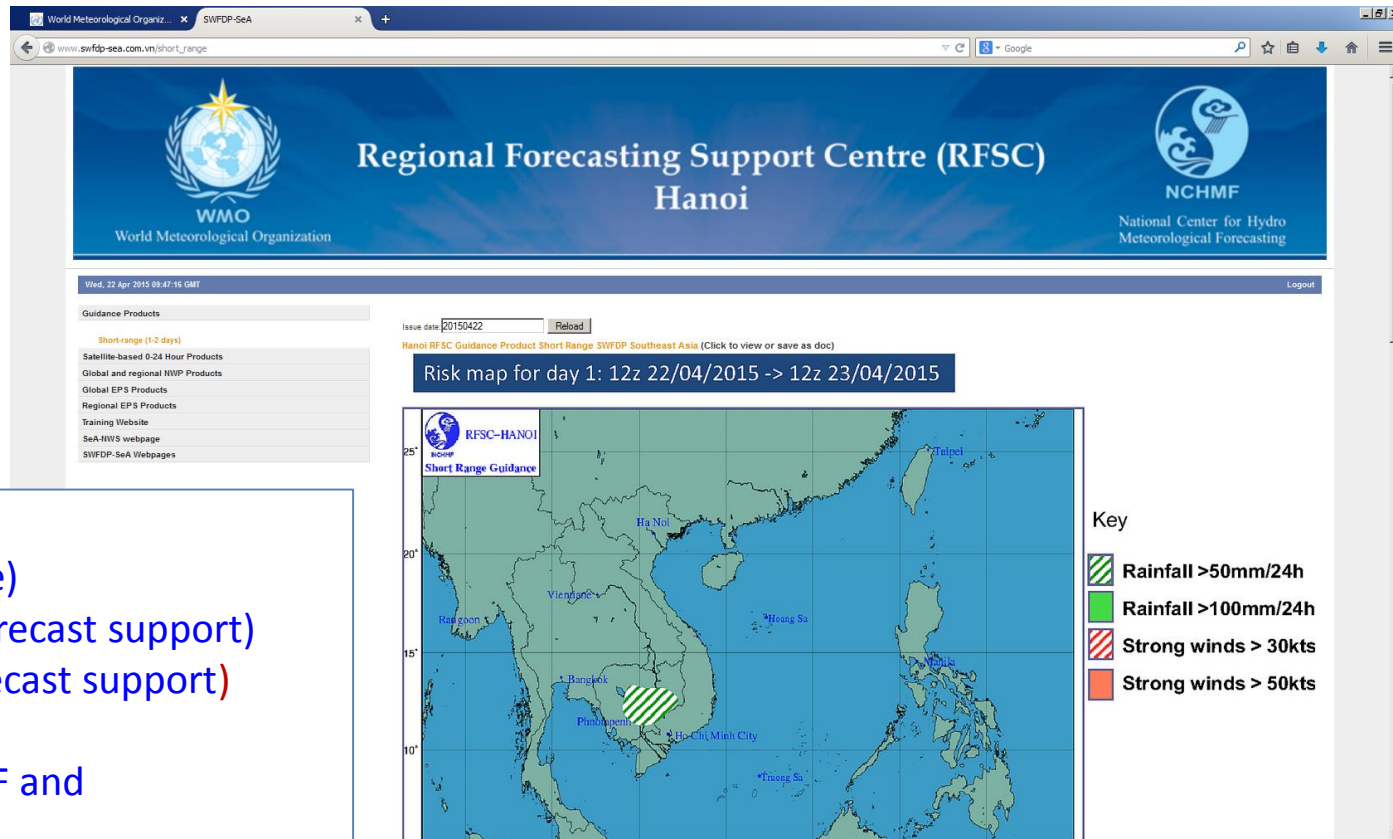
Global Centres:

CMA, JMA, KMA, ECMWF and

DWD (for LAM support)

Hazards:

Heavy rain, strong wind, high seas and swell

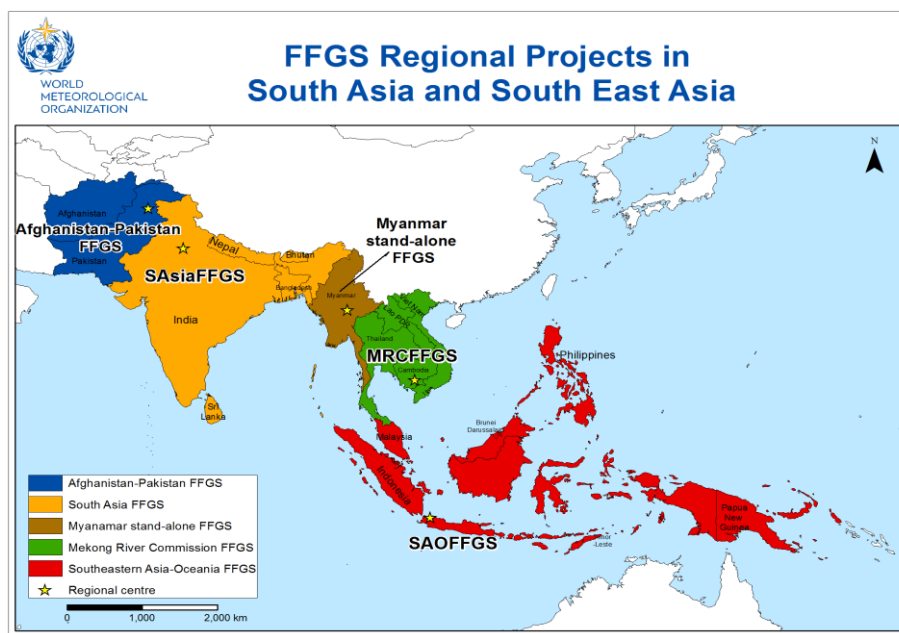


Flash Flood Guidance System



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FFGS Projects in SA, SEA and SAO



Old System:	Installed before FFGS Phase II
Basic System:	GHE, MWGHE, Gauge MAP, Merged MAP, ASM, FFG, FFTs, NWP QPF, FMAP, Snow Products, Dashboard
Advanced System:	Basic System plus: RADAR, Multiple NWP QPF ingestions and/or Landslide and/or Urban FFGS and/or Riverine Forecasting

Regional Project	Status
MRCFFGS	Old System, Operational
SAsiaFFGS	Under implementation
Pakistan-Afghanistan FFGS	Under implementation
SAOFFGS	Under implementation
Myanmar stand-alone FFGS	Under implementation

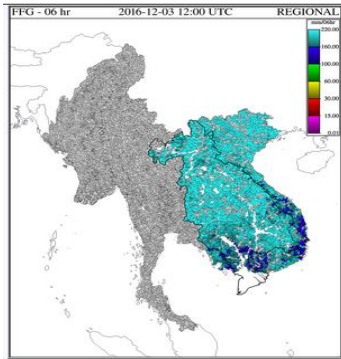
Southeast Asia FFG (SEAFFG) (under implementation): Cambodia, Lao PDR, Thailand, Vietnam

Mekong River Commission FFG (MRCFFG) (operational): Cambodia, Lao PDR Thailand, Vietnam

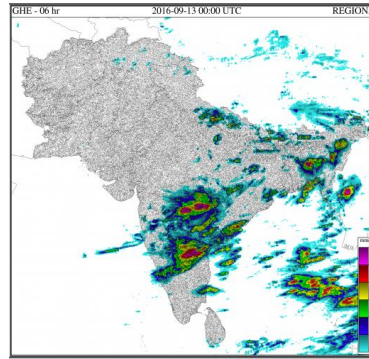
Southeastern Asia–Oceania FFG (SAOFFG) (under implementation): Brunei Darussalam, Indonesia, Malaysia, Papua New Guinea, Philippines, and Timor-Leste.

Myanmar stand-alone FFG (under implementation): Myanmar.

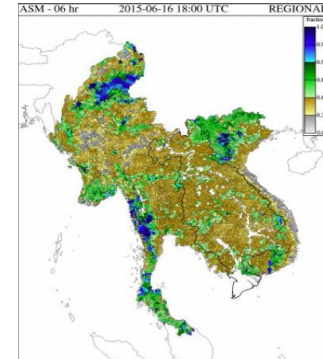
FFGS Products



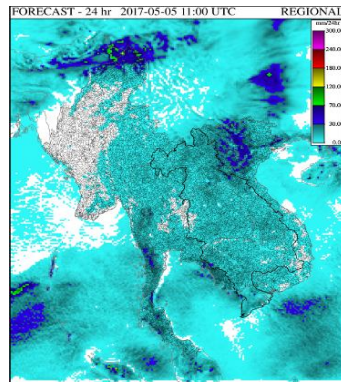
Flash Flood Guidance (FFG)



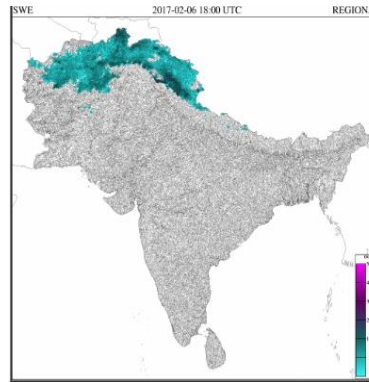
GHE Satellite precipitation



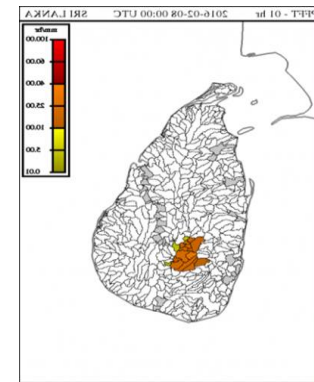
Average Soil Moisture (ASM)



WRF Precipitation

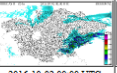
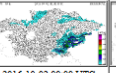
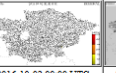
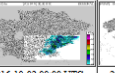
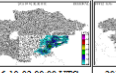

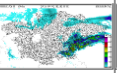
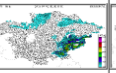
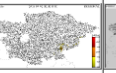
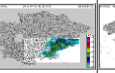
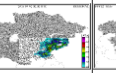

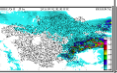
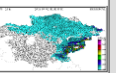
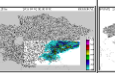
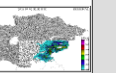


Snow Water Equivalent (SWE)



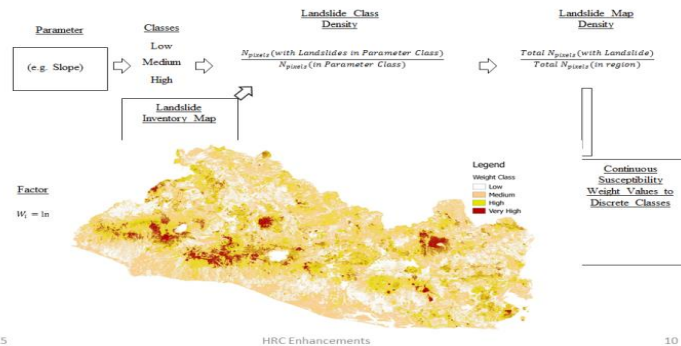
Flash Flood Threat (PFFT)

Advances

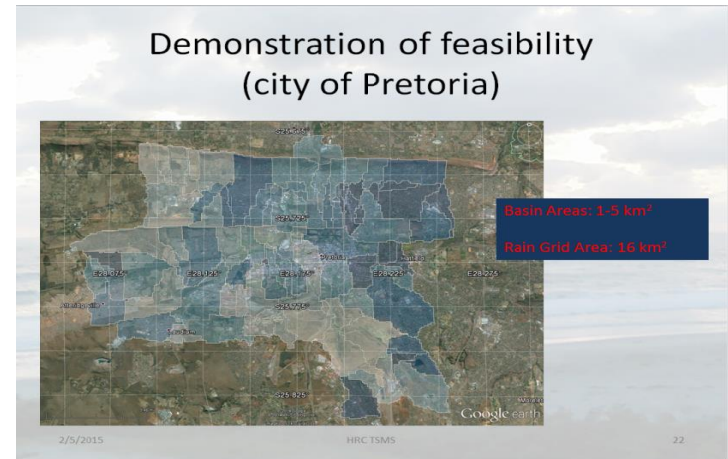
Forecast Products						
DT	WRF D01 Forecast	WRF D01 FMAP	WRF D01 FFT	WRF D02 Forecast	WRF D02 FMAP	WRF D02 FFT
01-hr						
03-hr						
	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view
06-hr						
	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view
24-hr						
	2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view		2016-10-02 00:00 UTC Test view	2016-10-02 00:00 UTC Test view	

- Multi-NWP Model ingestion

C.1 Susceptibility Mapping

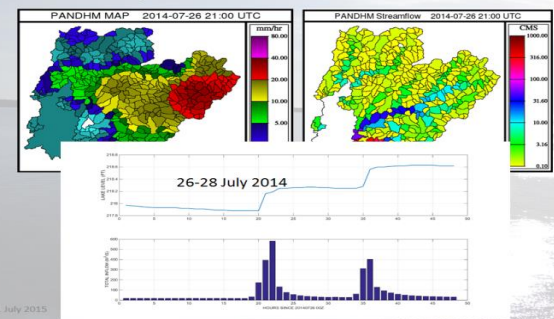


- Landslide Susceptibility Mapping



- Urban Flash Flood Early Warning

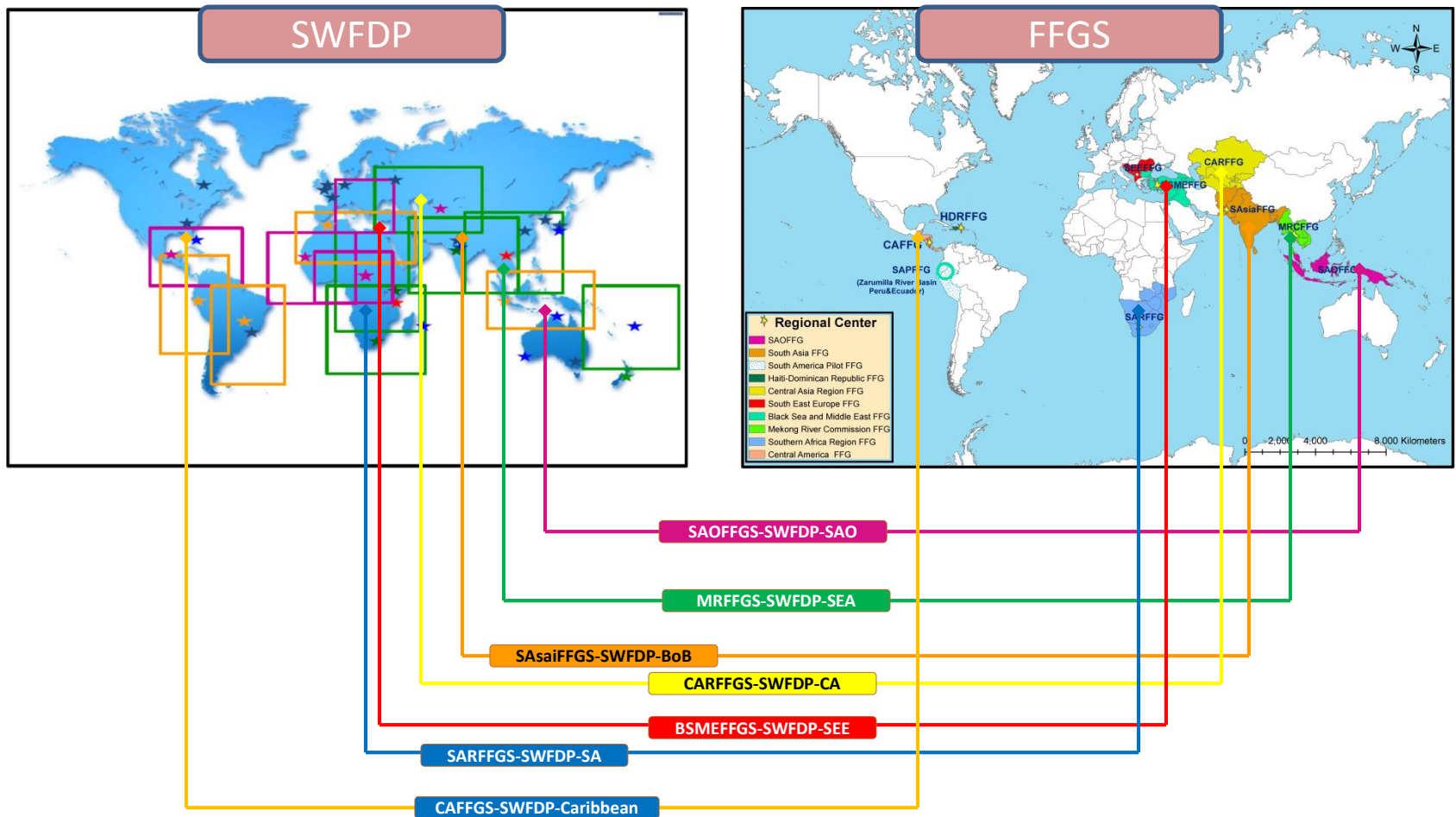
Example Simulation Products



- Expandable and Scalable Riverine Routing (Riverine Forecasting)

Linkages between SWFDP and regional FFG Systems

Synergies for the severe weather forecasts and flash flood warnings



SIGMET Coordination Pilot Project in Southeast Asia (ASEAN)



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SIGMET Coordination Pilot Project (2016/17)

Objective

- To establish and test SIGMET coordination procedures among target Meteorological Watch Offices (MWOs) with a view to improving the **quality of SIGMET information*** over a large portion of the SE Asia airspace

Origin of pilot project

- Regional Forum on Meteorological Services for Aviation Safety in Southeast Asia (29 to 30 April 2015)

Target countries

- **Indonesia (BMKG)**
 - Jakarta Meteorological Watch Office (MWO)
 - Ujung Pandang MWO
- **Malaysia (MalaysiaMet)**
 - Kuala Lumpur MWO
 - Kota Kinabalu MWO
- **Singapore (MSS)**
 - Singapore MWO

Assisting countries (web tools)

- Hong Kong, China (HKO)
- Japan (JMA)

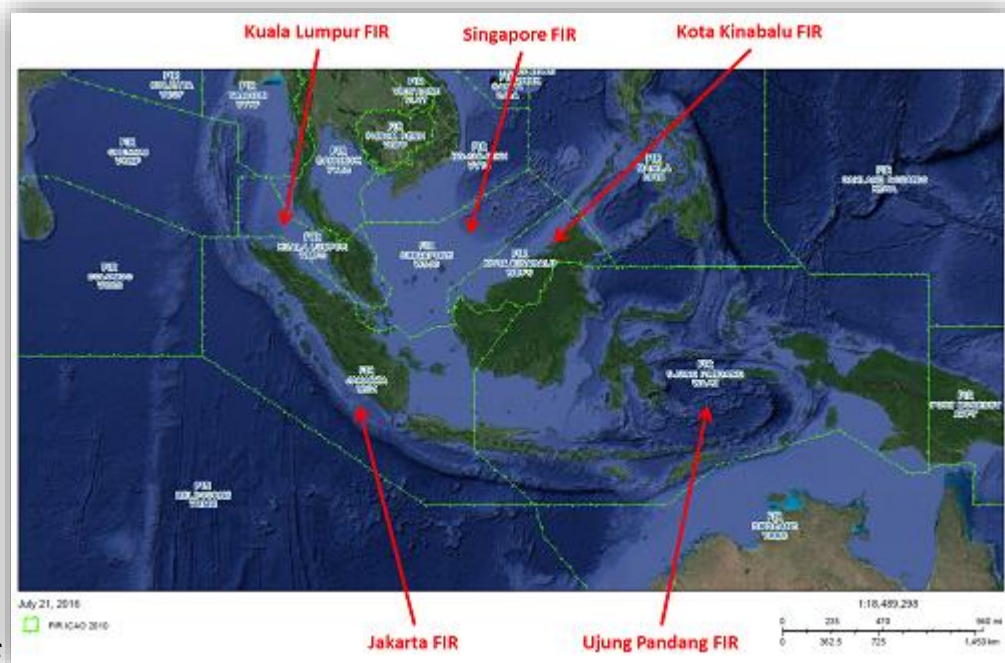
Plus, **WMO Secretariat support**

SIGMET Coordination Pilot Project

(2016/17)

Pilot project phase

- ✓ **May 2016:** Preparatory meeting
- ✓ **July/August 2016:** Coordination procedures and guiding principles developed
- ✓ **August 2016:** Online training of HKO and JMA web-based platforms/tools
- ✓ **September 2016:** MWO local training activities
- ✓ **October 2016:** Commencement of 6-month operational phase of pilot project
- ✓ **March 2017:** Wrap-up/evaluation meeting held including steps to transition to full 24/7 operations



Operational phase

- ✓ **1 August 2017:** MWOs commenced full, 24/7 SIGMET coordination activities

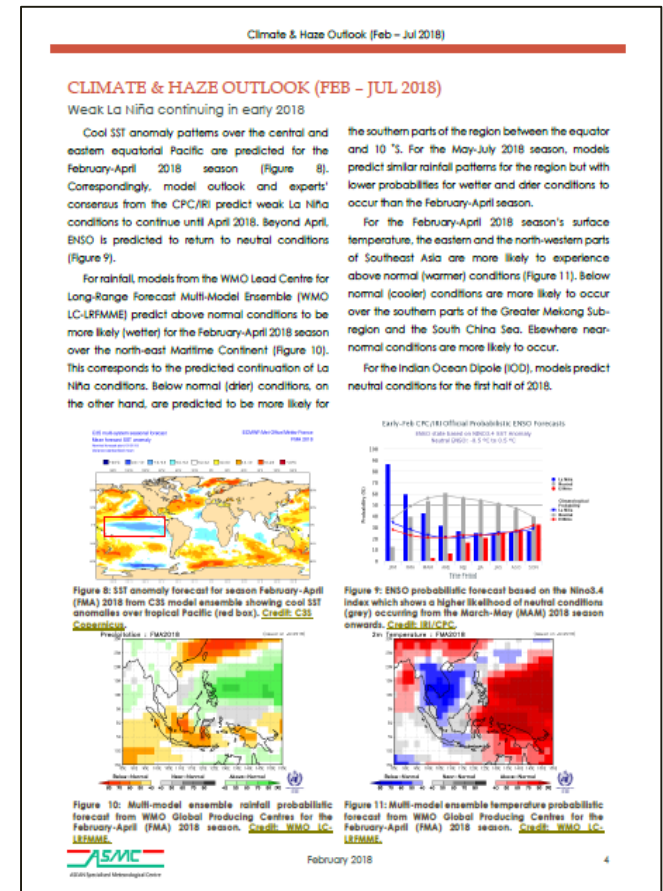
Climate Services in Southeast Asia



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ASEAN Climate Outlook Forum (ASEANCOF)

- July 2013: Endorsed by ASEAN SCM3G-35
- December 2013: Inaugural session of the ASEAN Climate Outlook Forum (ASEANCOF) in Singapore
- ASEAN member countries: Brunei, Cambodia, Lao PDR, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam
- Two sessions a year (one face-to-face, one online)
 - in May (for summer season outlook)
 - In November (for winter season outlook)
- Previous ASEANCOF sessions supported by USAID through WMO



ASEAN Climate Outlook Forum (ASEANCOF)

- RCOFs provide platforms for climate **experts/information users** to discuss
 - Climate status
 - Scientific developments
 - End-user requirements
- 9th ASEANCOF, Hanoi, 15 – 17 Nov 2017 coordinated by host & ASMC
- **Aim: Regional consensus outlook for upcoming boreal Winter Monsoon season (Dec 2017 – Feb 2018)**
- A 2-day Pre-COF: “Applications to the agricultural community – impacts, user requirements and forecast communications”

http://asmc.asean.org/asmc_asean_cof_about/

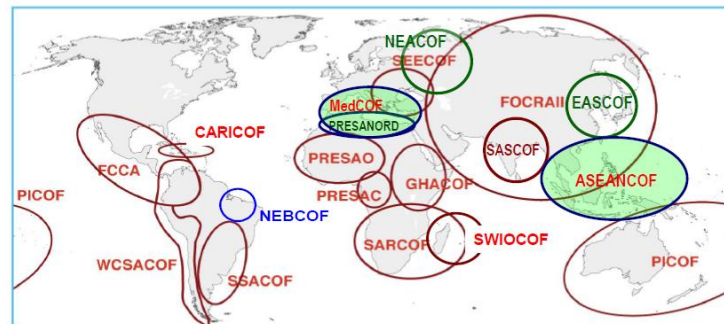
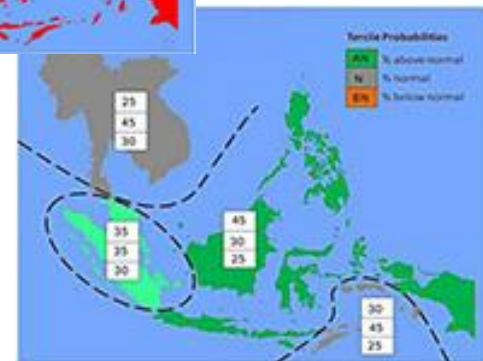
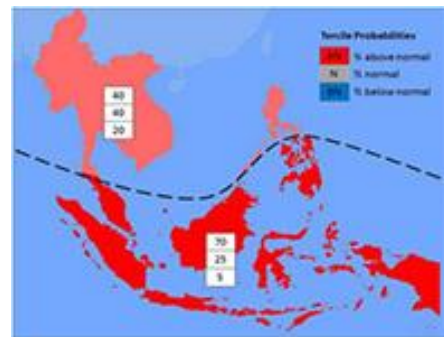


Image credit: WMO



E.g. tercile probabilistic forecasts for rainfall and temperature

Activity: S2S-SEA

Multi-year S2S Capability Building Programme

- Led and funded by ASMC in collaboration with S2S Prediction Project (2 wks–2 mths timescale)
- First of four workshops held in Mar 2017, with participation from all ten ASEAN countries and S2S international experts.
- Assess ECMWF model skill for **temperature** and **rainfall** at different **lead times** (+1 week, +2 week, +3 week, +4 week)

Product Development

Research

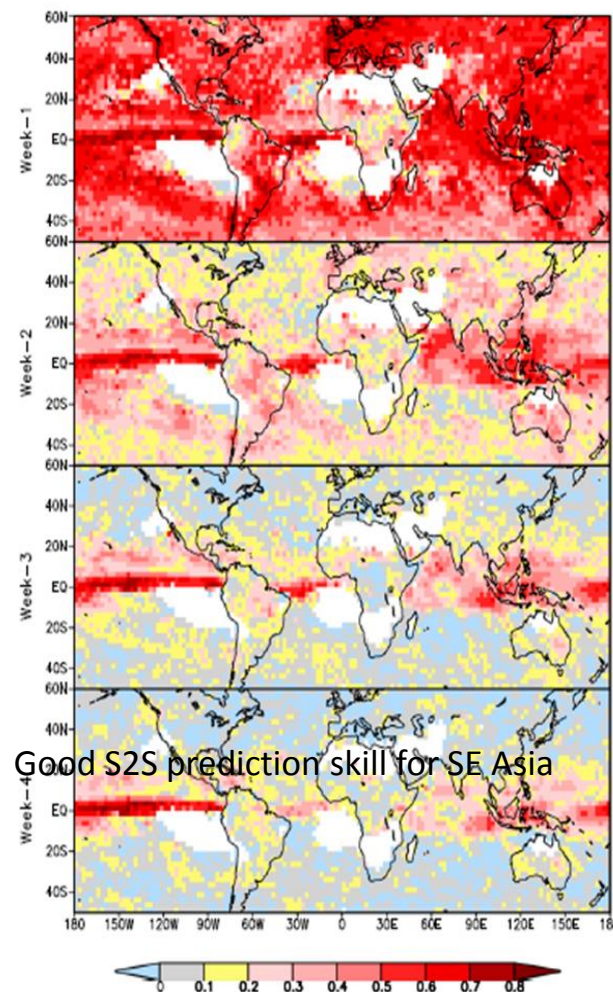
S2S-SEA II (Tentatively Aug 2018)

S2S-SEA I (Mar 2017)



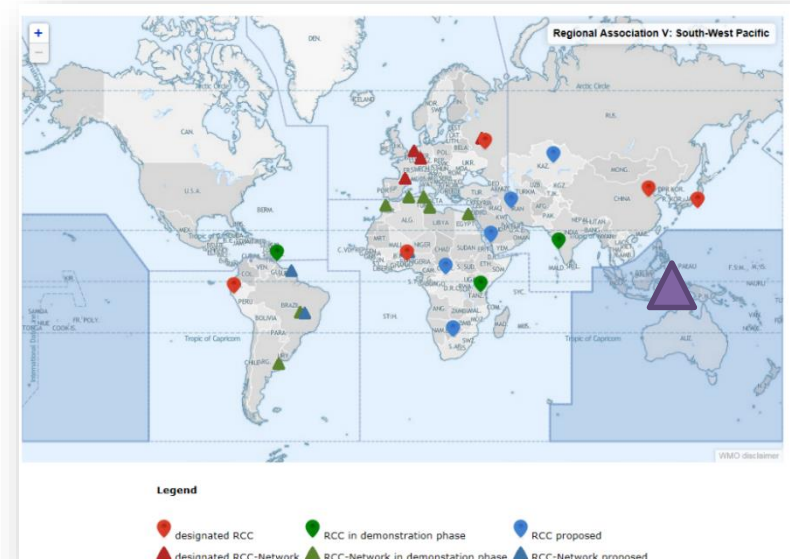
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ECMWF Precip Fcst vs CMAP: 1992–2008



SE Asia RCC-Network

- Regional Climate Centre (RCC): a WMO-designated Centre of Excellence providing climate services to the region it serves. *RCC Network*: the functions are shared by members of the Network.
- SE Asia RCC-Network: [Indonesia \(Climate Data Services\)](#), [Philippines \(Climate Monitoring\)](#) and [Singapore \(Long-range forecasting & coordinating node\)](#). Training function to be shared.
- Demonstration phase: Nov 2017
- Going forward: *tighter integration with ASMC to streamline and enhance delivery of services and capability-building programme.*



Global Multi-Hazard Alert System (GMAS)



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Global Multi-Hazard Alert System (GMAS)

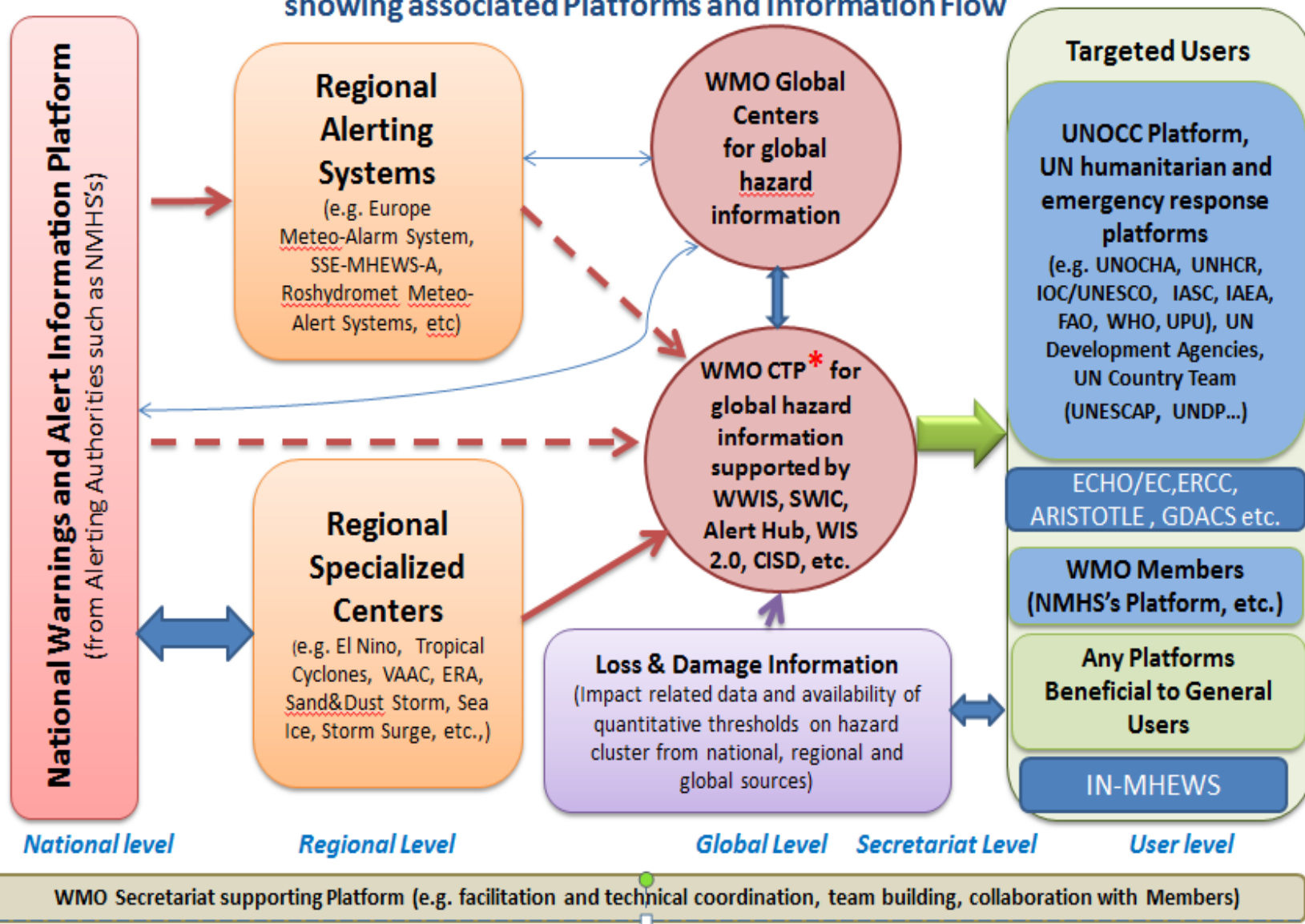
*New concept by WMO Members to develop a system
To be recognized globally by decision makers as a resource of
authoritative warnings and information related to high-
impact weather, water, ocean and climate events.*

Weather Warnings Information



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Schematic of WMO Global Multi-Hazard Alert System (GMAS) showing associated Platforms and Information Flow



* CTP - Common Technical Platform- is a framework with relevant protocols, standards, open systems, etc. which have been agreed by all relevant stakeholders to show all the authorized warnings and associated impact-related information that have been made available by WMO Members to be accessible to the decision makers and others.

National and Sub-Regional Projects in the Asia-Pacific Region



SUMMARY

1. **Data sharing:** Encourage ASEAN Members to follow WMO's Open Data Policy.
2. **Enhancing data-processing and forecasting capabilities** to cope with the requirements of EWS.
3. **Build infrastructure** and improve weather and climate modelling capabilities to enhance forecast products.
4. **Implementation of RCC-Network Southeast Asia** and use its services for regional climate early warning, especially for Disaster Risk Reduction initiatives of ASEAN.
5. Active participation and engagement in the **ASEAN SIGMET project** and other sub-regional activities.
6. **Commitment of the Governments** on the development of projects in coordination with WMO and sustainable operation of the EWS.
7. **Legal basis for the private sector engagement** in meteorological services.



Thank you
Gracias
Merci

