The World Weather Research Programme

WWRP promotes international and interdisciplinary research for more accurate and reliable forecasts from minutes to seasons, expanding the frontiers of weather science to enhance society's resilience to high-impact weather and the value of weather information for users.

WWRP aims at Seamless Prediction by increasing convergence between weather, climate and environmental approaches. WWRP strengthens academic – operational partnerships and interdisciplinary collaborations, and enhances the role of Early Career Scientists.

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Sarah Jones,
Chair WWRP Scientific
Steering Committee

Paolo Ruti, Chief World
Weather Research Division

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

A seamless approach

WMO's mechanism to foster and progress cooperative research for improved weather and environmental prediction services from minutes to months

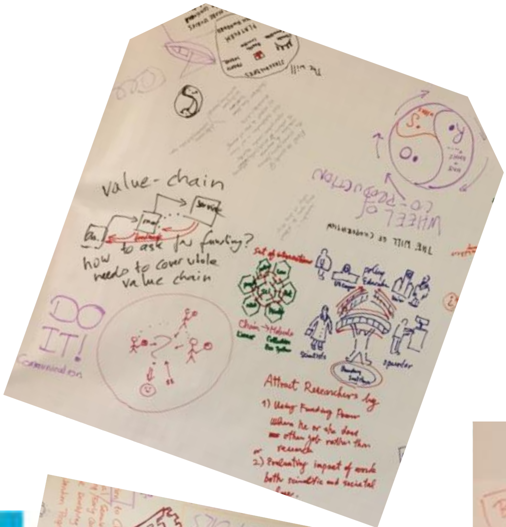
Seamless Definition

In the context of WMO, seamless prediction considers not only all compartments of the Earth system, but also all disciplines of the weather–climate–water–environment value chain (monitoring and observation, models, forecasting, dissemination and communication, perception and interpretation, decision-making, end-user products) to deliver tailor-made weather, climate, water and environmental information covering minutes to centuries and local to global scales.

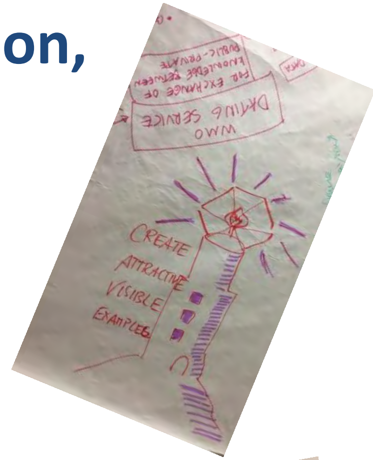
WMO Science Summit

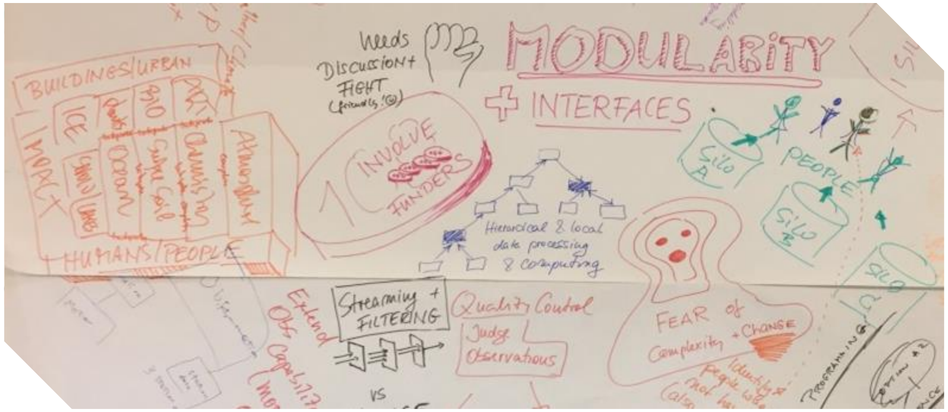
WORLD METEOROLOGICAL ORGANIZATION

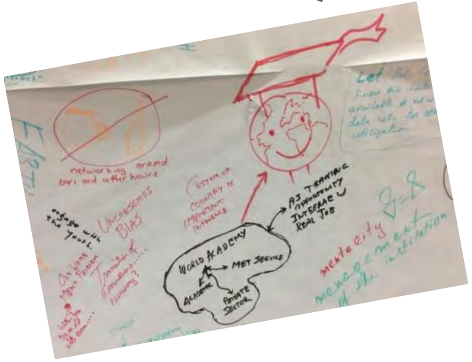
20-22 October 2017 | WMO Headquarters, Geneva, Switzerland



Science for Services, Seamless prediction,
Future infrastructures,
Nurturing scientific talents,
Innovation & Resources







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Five priorities for weather and climate research

Science Summit key outcomes (Nature, vol 552, Dec 2017)

More than 100 experts and more than 50 countries met in Geneva last October, discussing and agreeing on five priorities:

1. **Deliver Science for Services**
2. **Build Seamless Models**
3. **Improve Infrastructure**
4. **Nurture a Diverse Workforce**
5. **Build New Partnerships**

Science Summit gathered together a broad spectrum of expertise, from atmospheric science to hydrology, from social science to science management, from NGOs to private companies, setting a platform for future partnerships.

The Science Summit and CAS session made concrete proposals to the next Congress on Science for Services, Seamless prediction, Future infrastructures, Nurturing scientific talents, Innovation & Resources.

WMO OMM

The Global Data Processing and Forecasting System (GDPFS)

Vision of future seamless DPFS

The proposed vision for the Future GDPFS is:

The GDPFS will be an effective and adaptable monitoring and prediction system enabling Members and partners to make better-informed decisions;

The GDPFS will facilitate the provision of impact-based forecasts and risk-based warnings through partnership and collaboration;

The GDPFS will do so through the sharing of weather, water, climate and related environmental data, products and services in a cost effective, timely and agile way, with the effect of benefitting all WMO Members, while also reducing the gaps between developed and developing Members.

Implementation Plan Components

- Overarching challenges -

- Concrete Activities -

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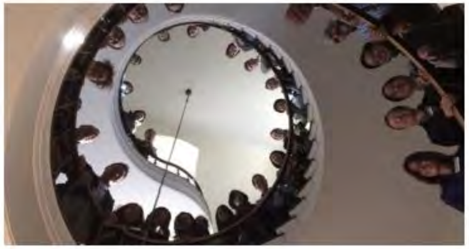
Concrete Activities






Implementation is a 2 stage process:
1) Conduct Benchmarks, Pilot projects, TestBeds
2) Transfer into operational system

Current focus is to identify, prioritise and plan benchmarks and pilot projects to Kick-Start the implementation process

Some key criteria for setting priorities:
- **Information needed in decision making**
- **Ensuring relevance of WMO and ist members**
- **Geographical Dimension**
- **Building on existing and emerging data platforms**

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WWRP Implementation Plan Action Areas

- ➢ are fundamental building blocks for WWRP Implementation
- ➢ articulate WWRP aims for each societal challenge
- ➢ provide mechanism for different WWRP activities to work together towards common goal
- ➢ evolve in response to progress made, needs of stakeholders, ……

High-Impact Weather Project

- **Increasing resilience to Urban Flood, Wildfire, Urban Heat and Air Pollution in Megacities, Localised extreme wind, Disruptive winter weather through improving forecasts for timescales of minutes to two weeks and enhancing their communication and utility in social, economic and environmental applications**
- **Links to WCRP through quantifying vulnerability and risk assessment, and for response to High Impact Weather in a changing climate.**

Co-Chair: Brian Golding, MetOffice, David Johnston Massey Un

International Coordination Office, CMA, China

Met Office

Environment Canada Environnement Canada

Norwegian Meteorological Institute

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

DWD

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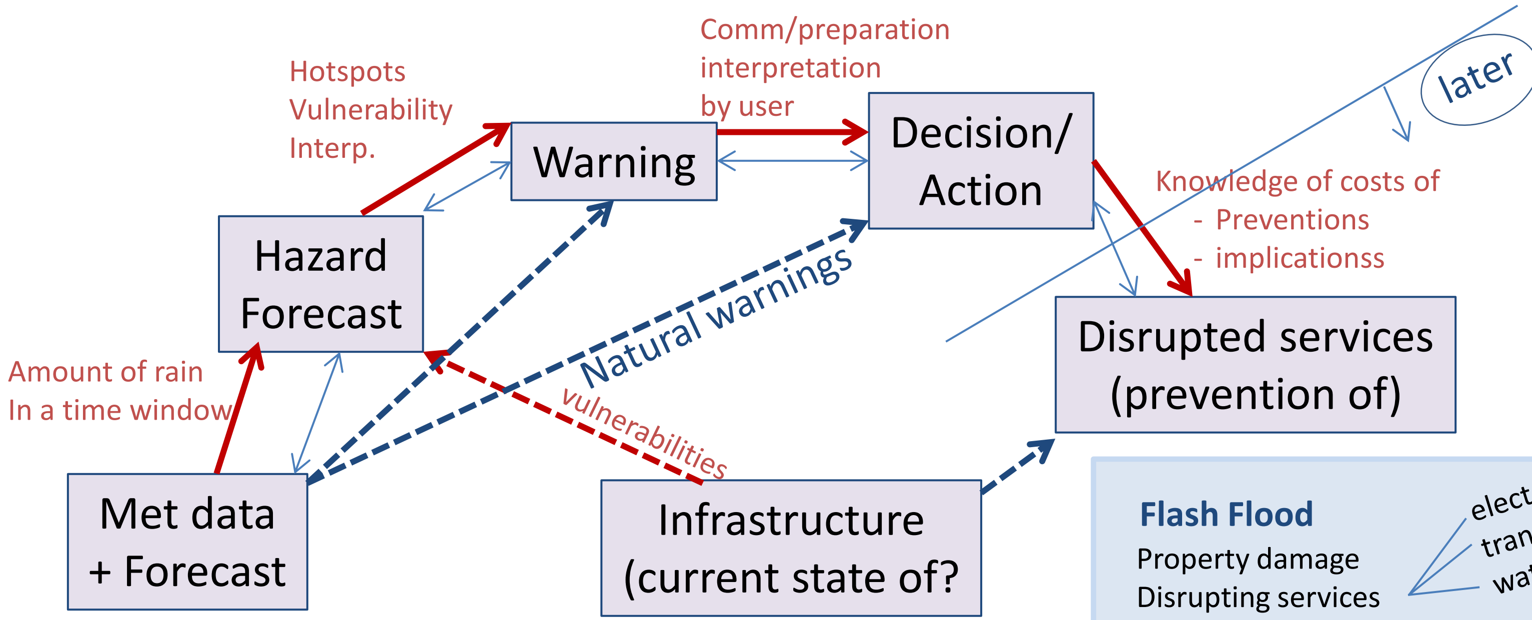
Value Chain Workshop Breakout 2 – Floods



Flash Flood

Property damage
Disrupting services
Poor people with litte lose everything

electricity
transport
water + sewage

Decision / Action

Move out of of harms way /higher ground
Suspension of services
Some action is better than no action (graduated response)

Warning

Official, informal (soc. Media)
'natural' warnings + ' natural' cues
Different levels of warnings (i.t.o. details)
Sufficient to make decisions

Forecast

Surface water important -> no model output
Local knowledge
Bypassing state sector decision making

<u>Ideas for RDP</u>

1. Accuracy of precip fcsts (by lead time) – metric at urban scales (sub-hourly)
2. Link between met + hydr response

→ Can weather fcst improve short-term decision making outcomes (<3h)? -> If yes, in what way?

→ What are the optimal actions?

→ Answering the «joint» question? (physical + societal sciences)

→ Asking questions across the entire value chain

→ Look from multiple perspectives and more specifically

→ Value chain purpose to integrate

DFID/WISER Project Highway
(HIGH impact Weather lAke sYstem)

Outcome: Increased access to and use of co-designed and sustainable early warning systems to inform regional, national, sub-national and community level planning and decision-making in the East African region

Output 2: Improved access to all operational data sources to support the generation and maintenance of Early Warning Services for the East African Region

Activity 2.3 – Mini field campaign to exploit and improve all existing data sources and products

Partners: NCAR, UK MetOffice, Met services of Kenya Tanzania Uganda Rwanda Burundi East Africa commission

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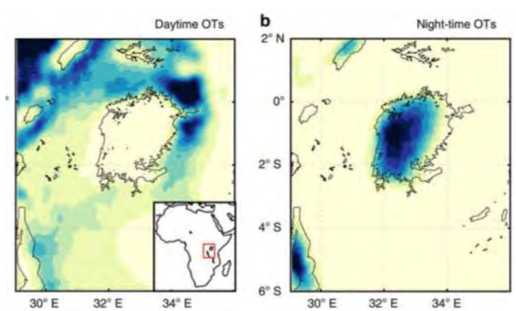
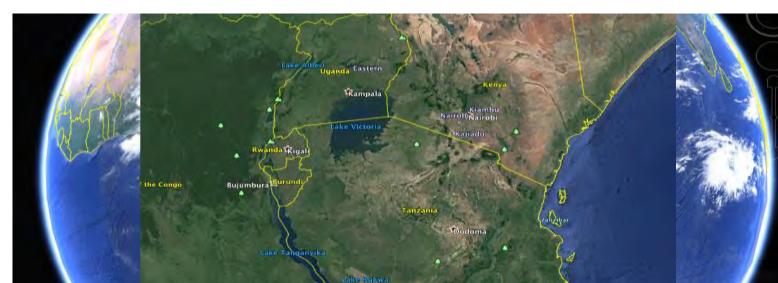
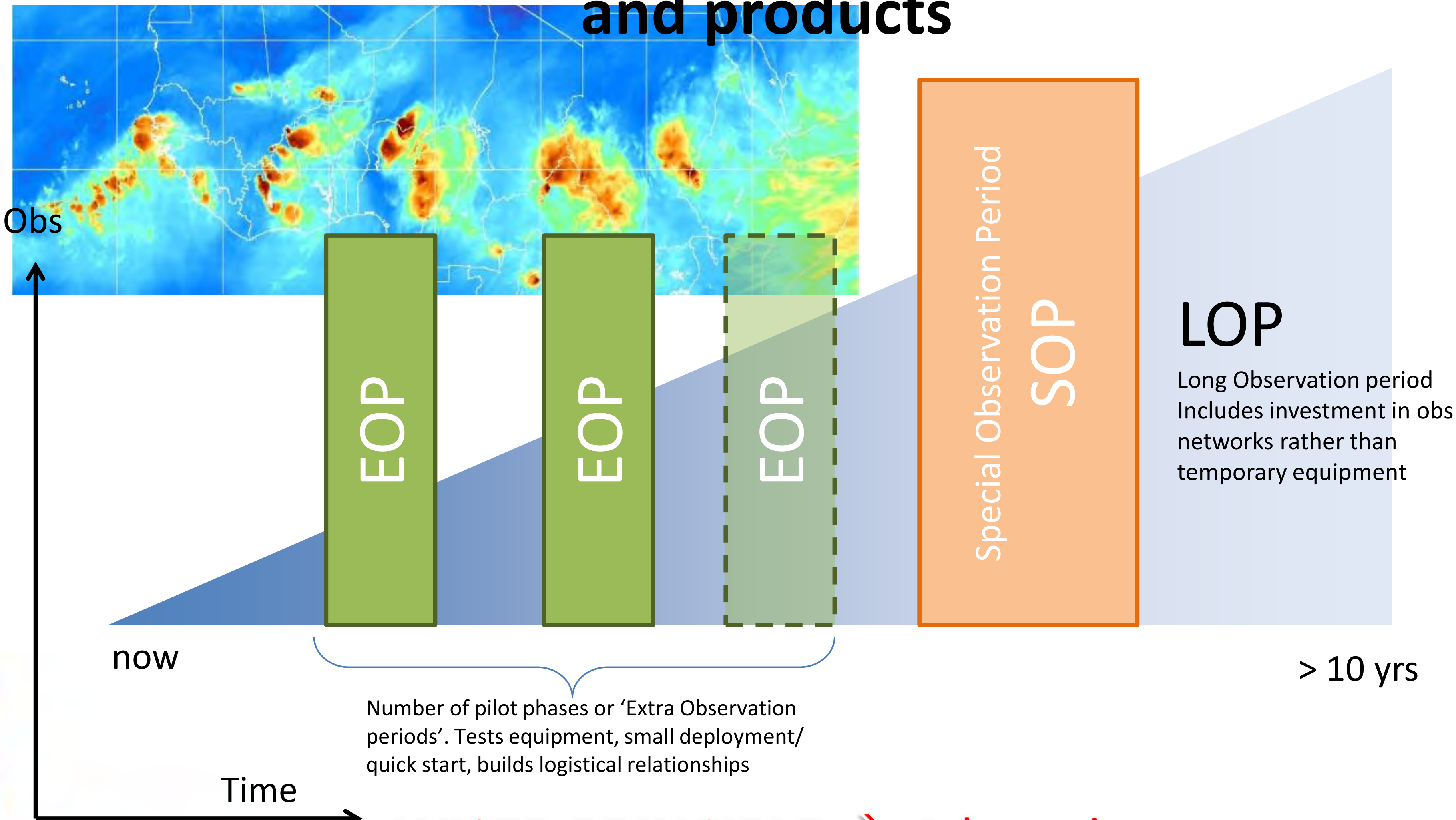




Mini field campaign planned for Spring 2019 to exploit and improve all existing data sources and products



WISER PRINCIPLE → A learning programme

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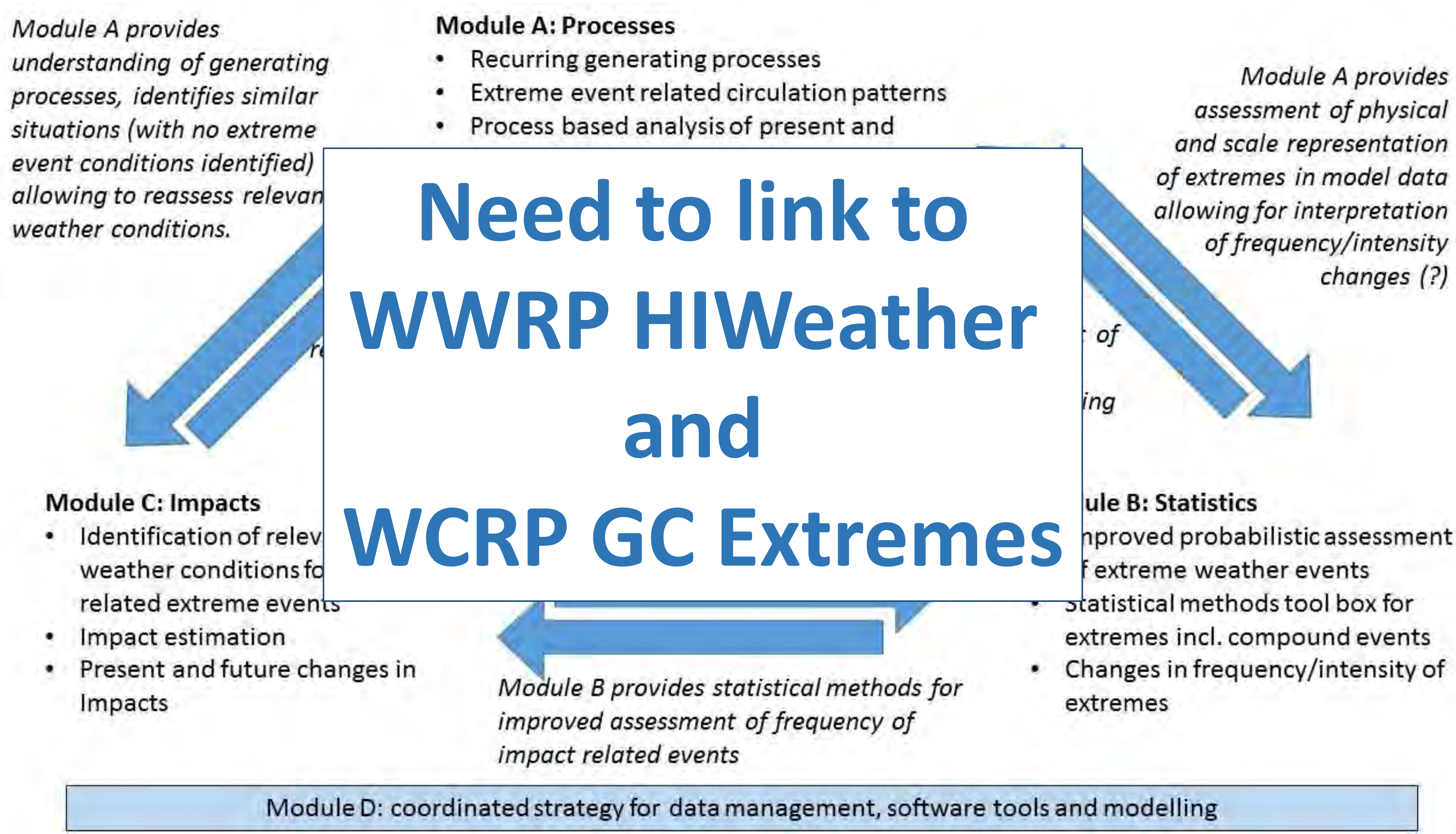
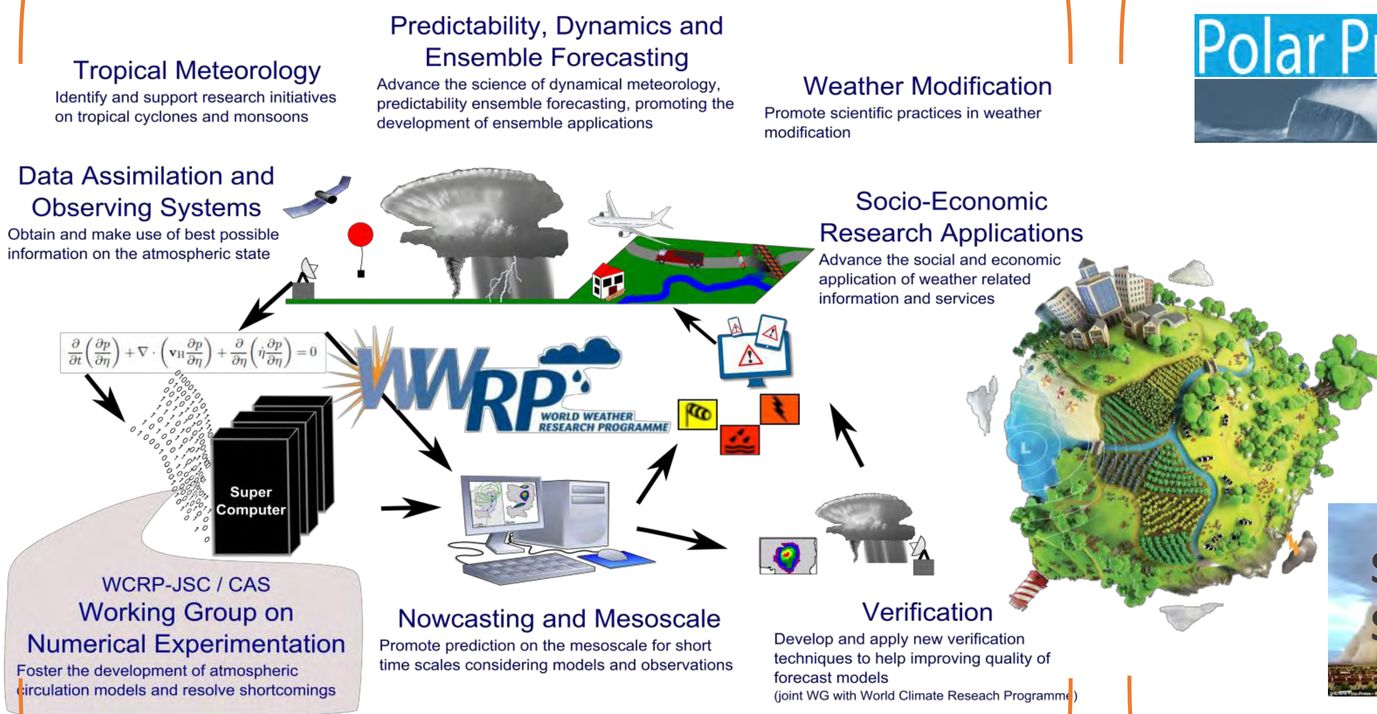
ClimXtreme

German (BMBF) funded 3 year project, Starting early 2019
~ 13 PostDocs, 36 Ph.D. positions



WWRP Structure

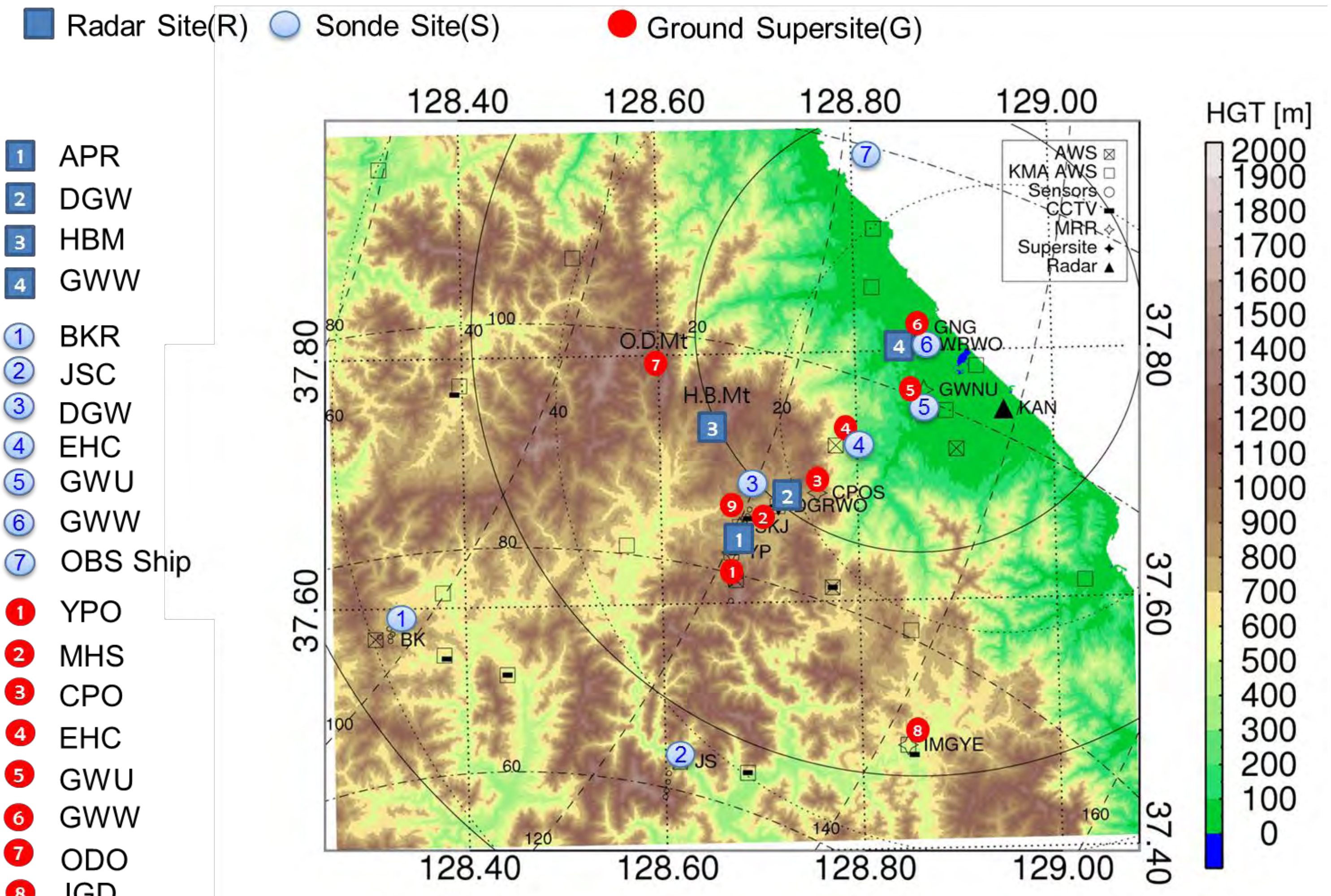
WWRP Working Groups



WWRP Core Projects

Subseasonal-to-Seasonal
S2S
Prediction Project

RDP: Intensive Observation for ICE-POP2018

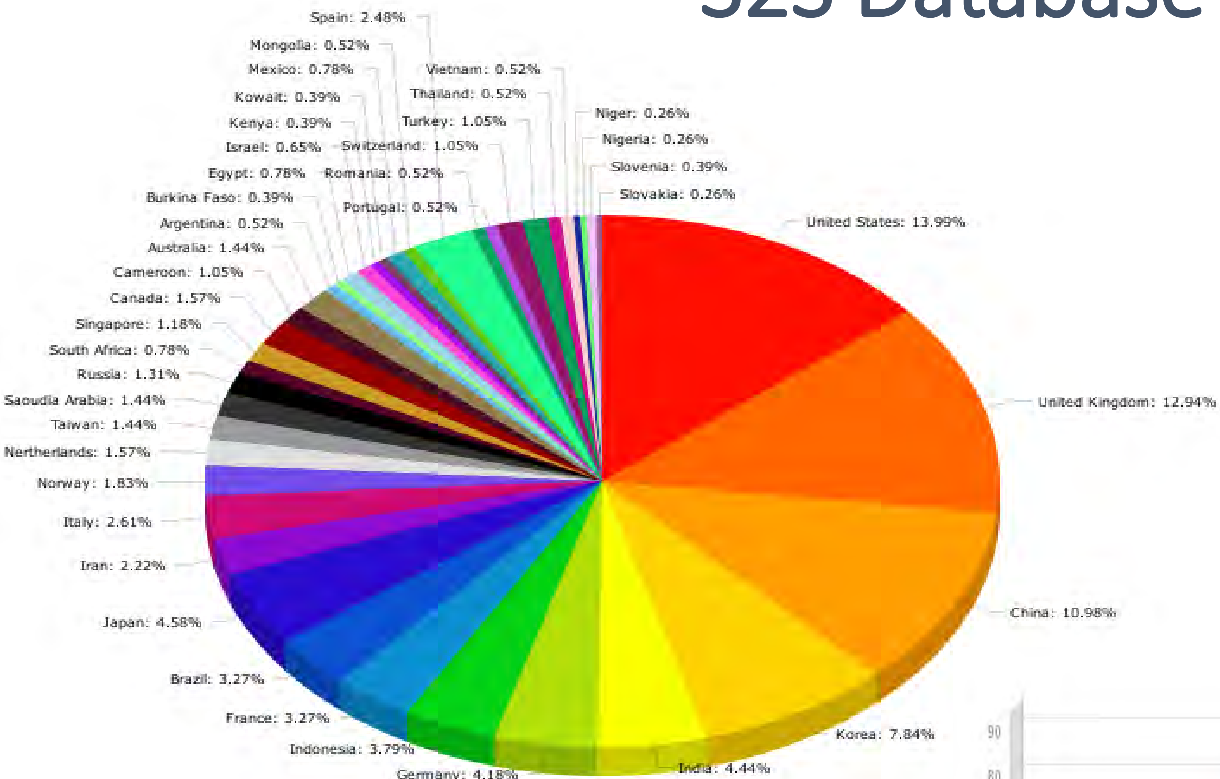


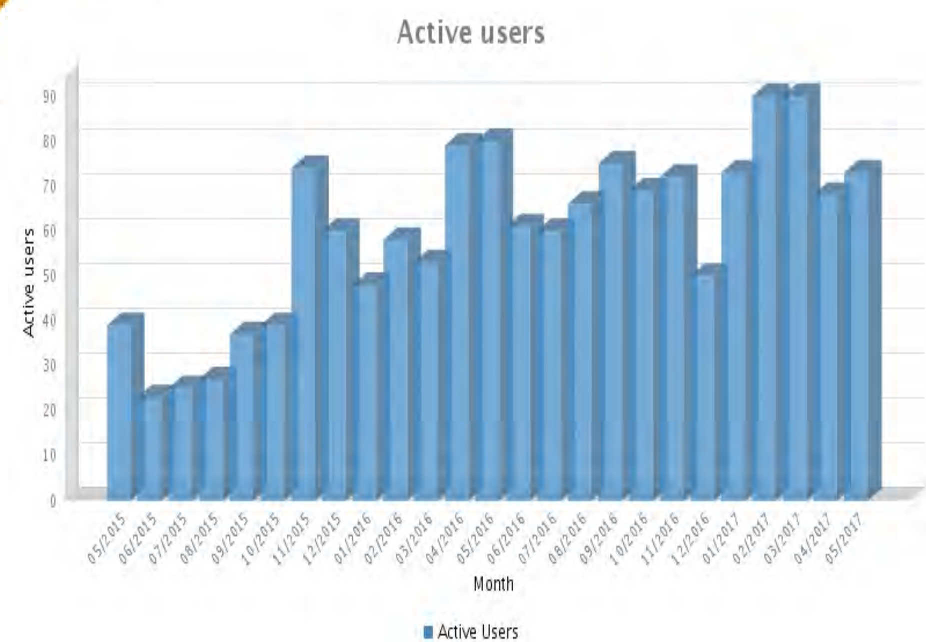
GNG: Gangneung radar(S-band, Operational radar/KMA)

KAN: Airforces Radar(C-band)

Korea Meteorological Administration

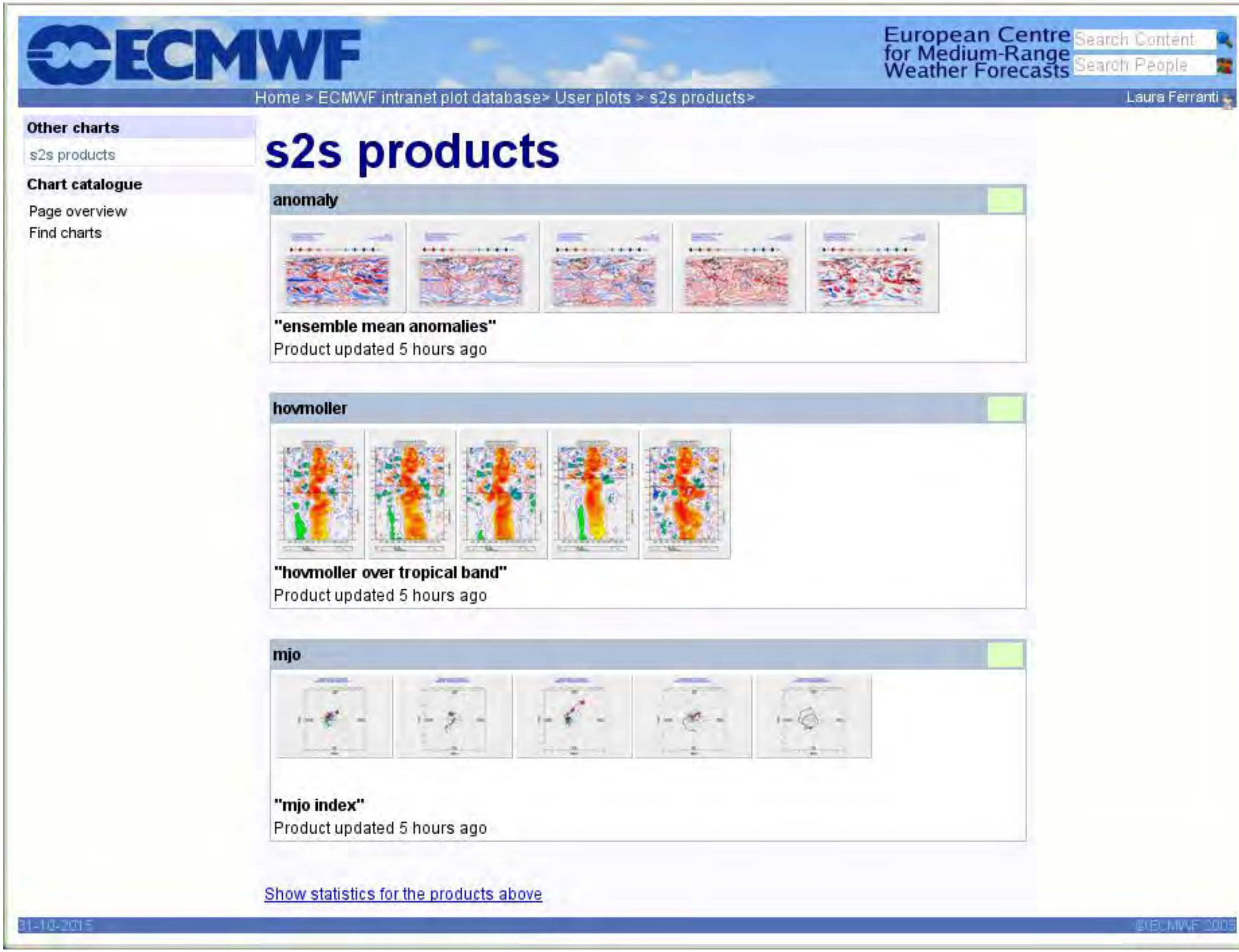
S2S Database



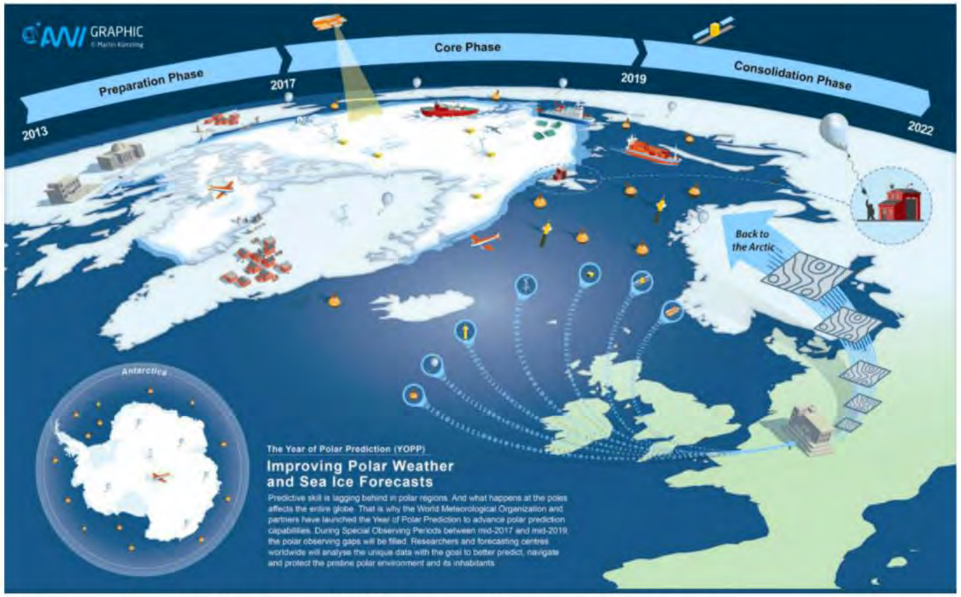


Seventh International WMO Symposium on Data Assimilation in Brazil

Monitoring S2S Products



Year of Polar Prediction - YOPP



YOPP Infographic available at polarprediction.net

Coordinated by the World Meteorological Organization (WMO)

Period:
mid 2017– mid 2019
(Launch: 15th May 2017)

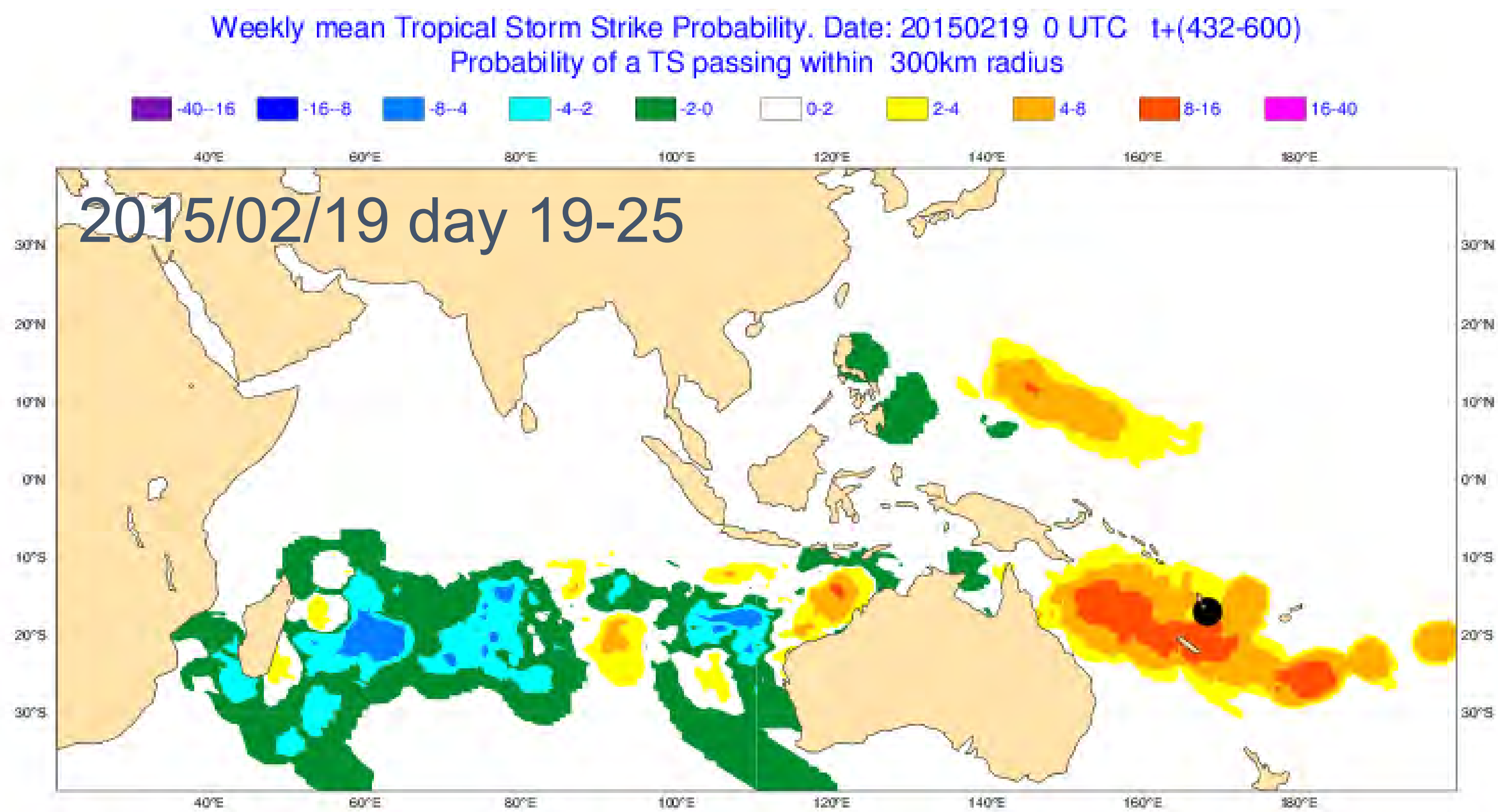
- **Goal: Improving predictions of weather and environmental conditions in polar regions and beyond**
- International collaboration between academia, operational forecasting centres, and stakeholders
- Improving the polar observing system, as well as weather and climate prediction models in polar regions

Tropical Meteorology Research WG

Joint workshop on UPDRAFT, TLFDP & EXOTICCA
(Oct. 2016, Shanghai, China)

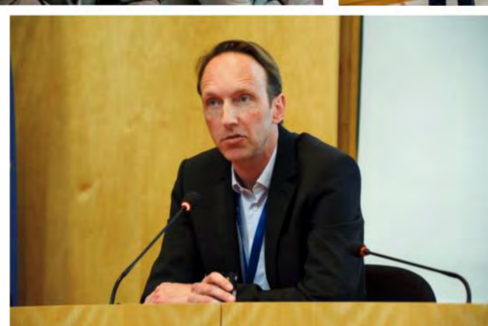
Workshop on Frontiers of Tropical Meteorology
(Sep. 2017, Hong Kong, China)

S2S Multi-model prediction of TC Pam Strike Probability Anomalies 9-15 March 2015

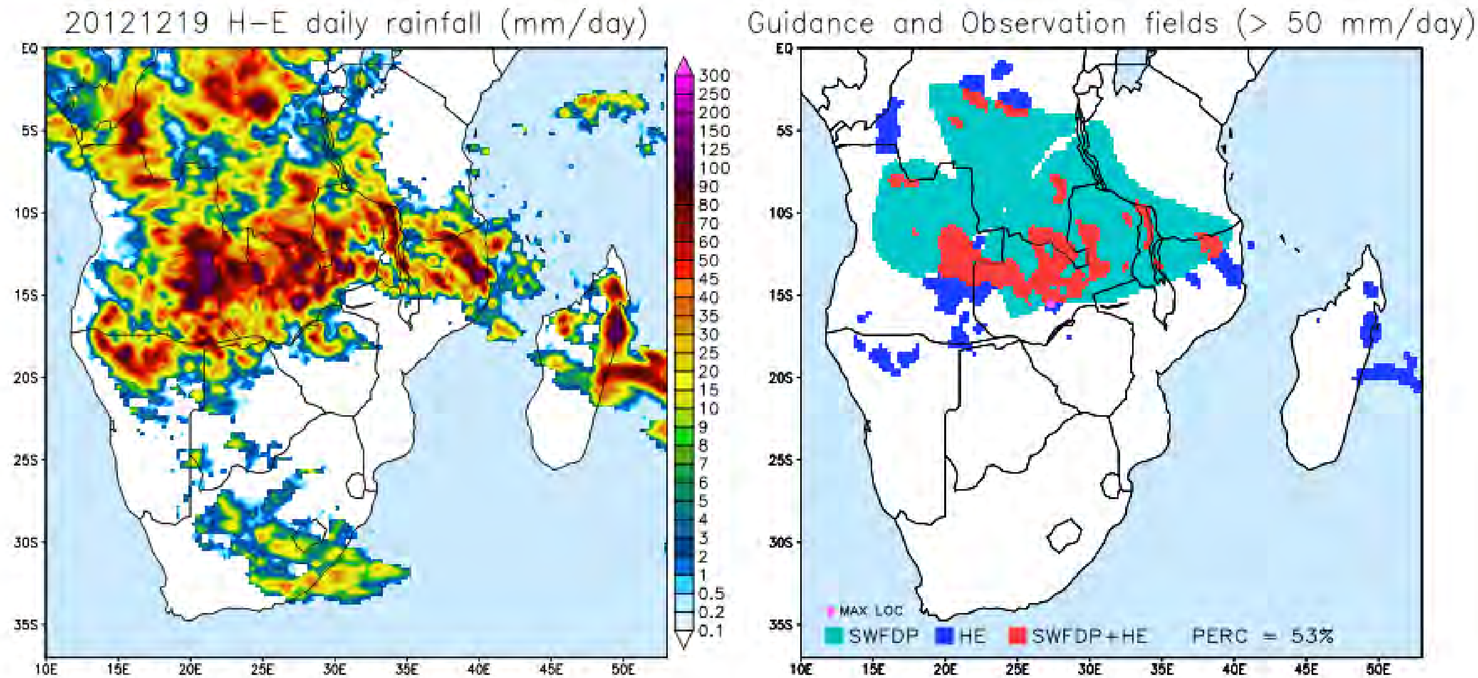


(NCEP/ECMWF/BoM/JMA/CMA)

YOPP Launch and YOPP Summit



Verification of regional forecast



Verification statistics for 20121219 : Grid Size = 0.25° : Units = mm/day : n = 25777

	Guidance	H–E
Number of gridpoints >= 50 mm	3294	1243
Average Rain over domain	~	19.7012
>= 50 mm Rain Area (km²*10⁶)	2.05875	0.776875
Maximum Rainfall Observed (mm)	~	151.124

	Categorical Forecasts
Frequency Bias	2.65004
Probability of Detection	0.526146
False Alarm Ratio	0.801457
Hansen & Kuipers Score	0.418541
Equitable threat score	0.132959
Spatial Correlation	0.264835

GUIDANCE	OBSERVATION >=50	OBSERVATION <50
>=50	654	2640
<50	589	21894

Extreme Events Verification	
Extreme Dependency Score	0.650434
Symmetric Extreme Dependency Score	0.385181
Extremal Dependency Index	0.552717
Symmetric Extremal Dependency Index	0.59486
(**Ferro and Stephenson, 2011***)	

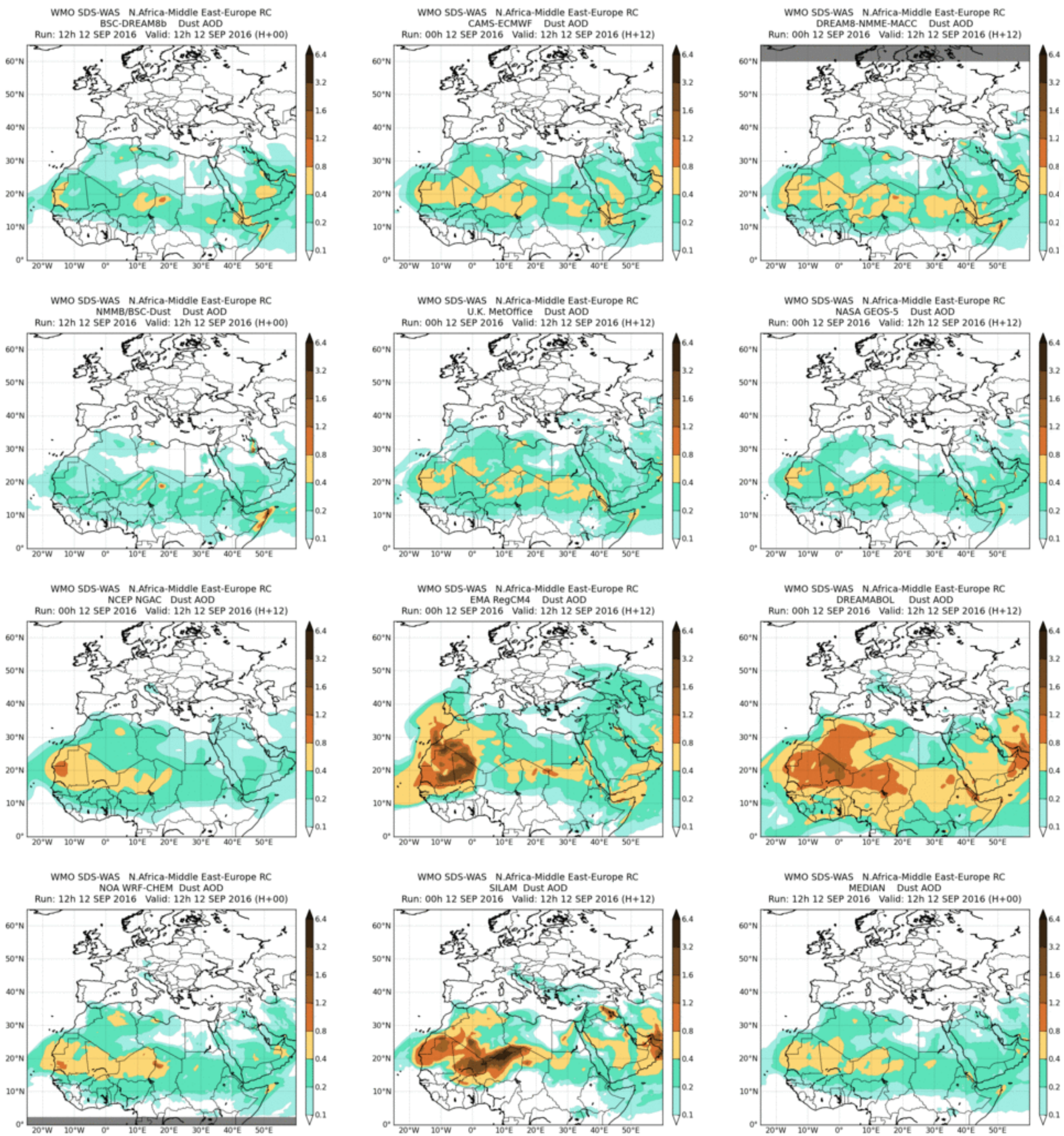
http://rsmc.weathersa.co.za/RSMC/index.php
Format based on IPWG verification output

WMO

South African Weather Service

HIWeather International Coordination Office at CMA

SDS-WAS Dust forecasts



WRF-Chem-NOA
(Dec 2015)

FINNISH METEOROLOGICAL INSTITUTE

SILAM-FMI
(May 2016)

LOTO/EUROS-TNO
(Oct 2016)

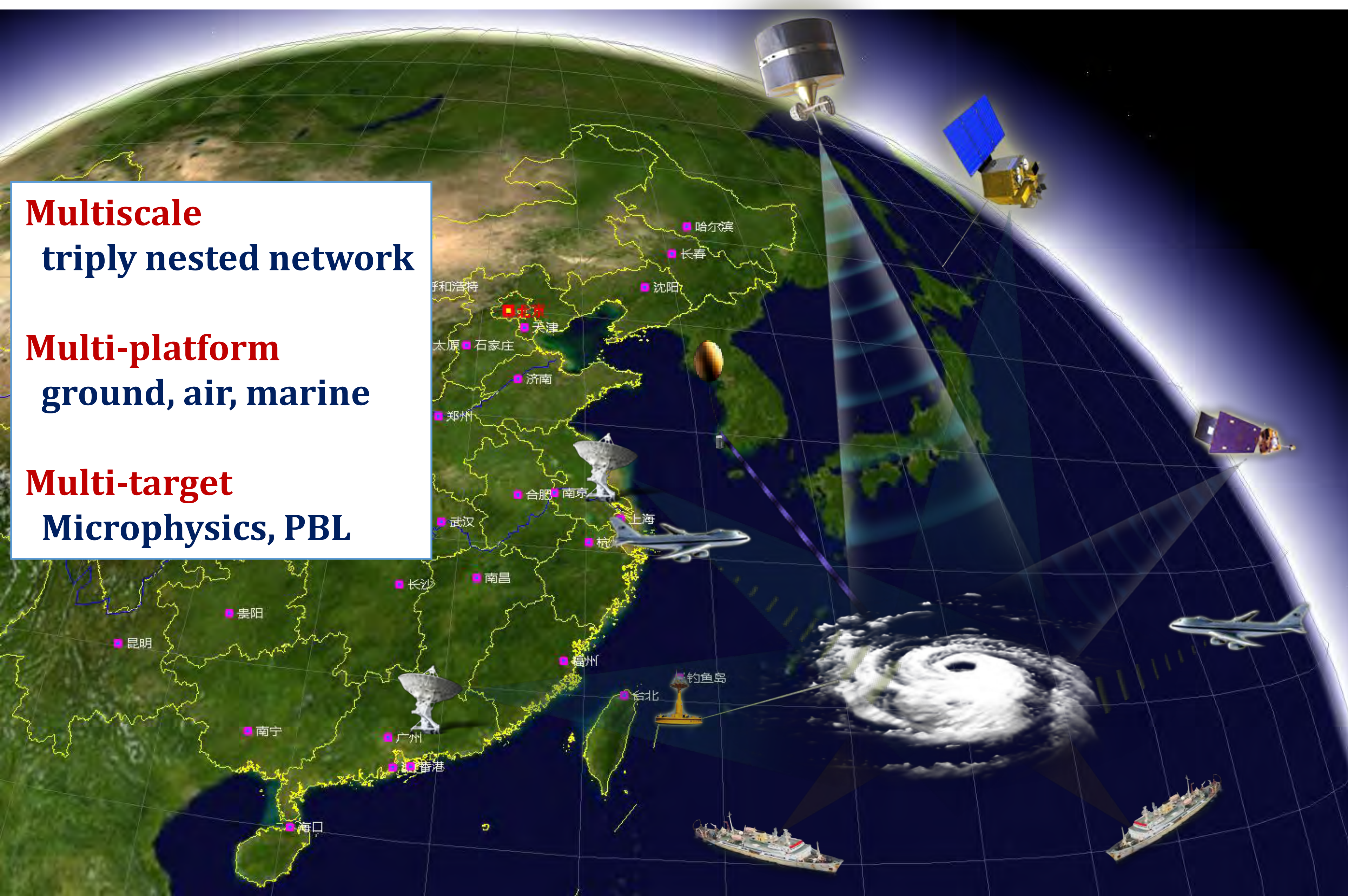
11 models + 1 “ensemble”

TMR: UPDRAFT Field Observations

Multiscale
triply nested network

Multi-platform
ground, air, marine

Multi-target
Microphysics, PBL



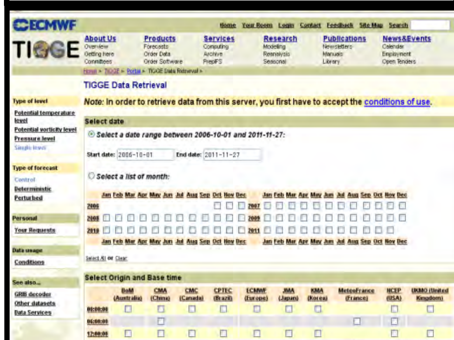
PDEF: TIGGE and SWFDP

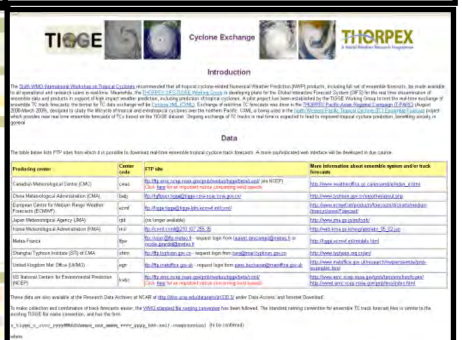
Successful transfer of research outcomes into operations

Research Phase

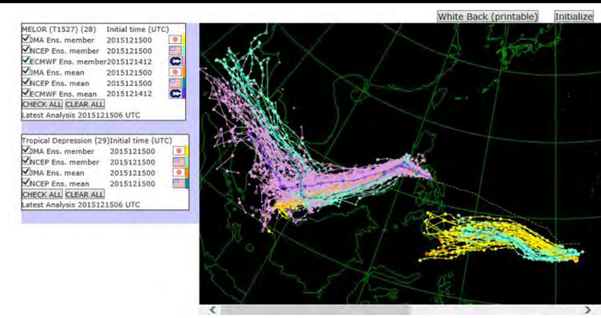
TIGGE
(started 2006)

TIGGE CXML
(started 2008)





Operational Phase



RSMC Tokyo – Typhoon Center started providing multi-centre ensemble products of TCs to the Typhoon Committee Members

WWRP RDP

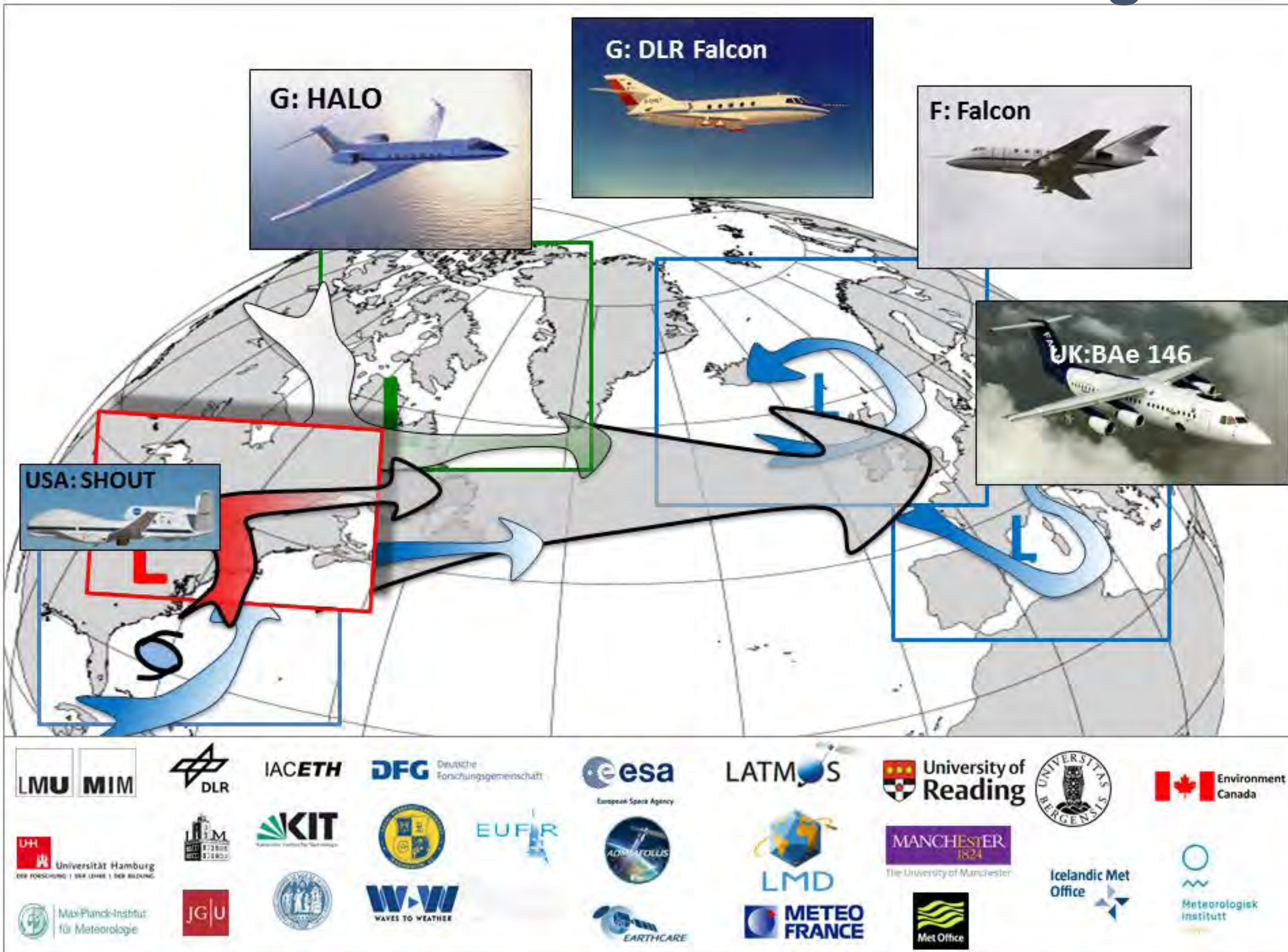
North Western Pacific Tropical Cyclone (TC) Ensemble Forecast Project (NWP-TCEFP)

International Workshop on Monsoons IWM-6

Singapore, November 2017

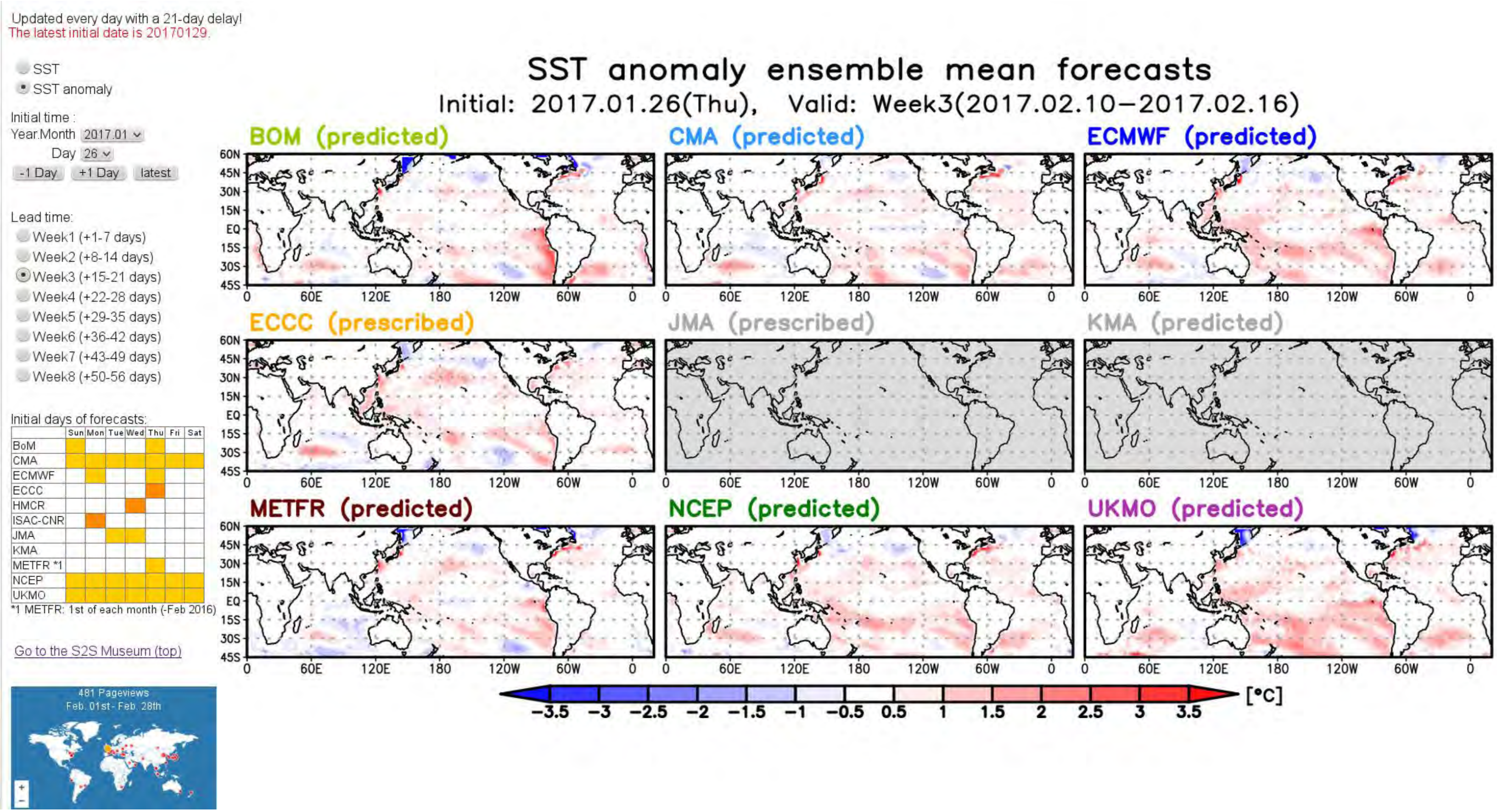
Researchers and forecasters discuss recent advances and current issues covering all time scales relevant to the forecasts of high-impact weather in the monsoon regions around the world.

PDEF: NAWDEX 49 research aircraft flights



HIWeather / Waves to Weather
Conference on Predictability and Multi-Scale Prediction of High Impact Weather

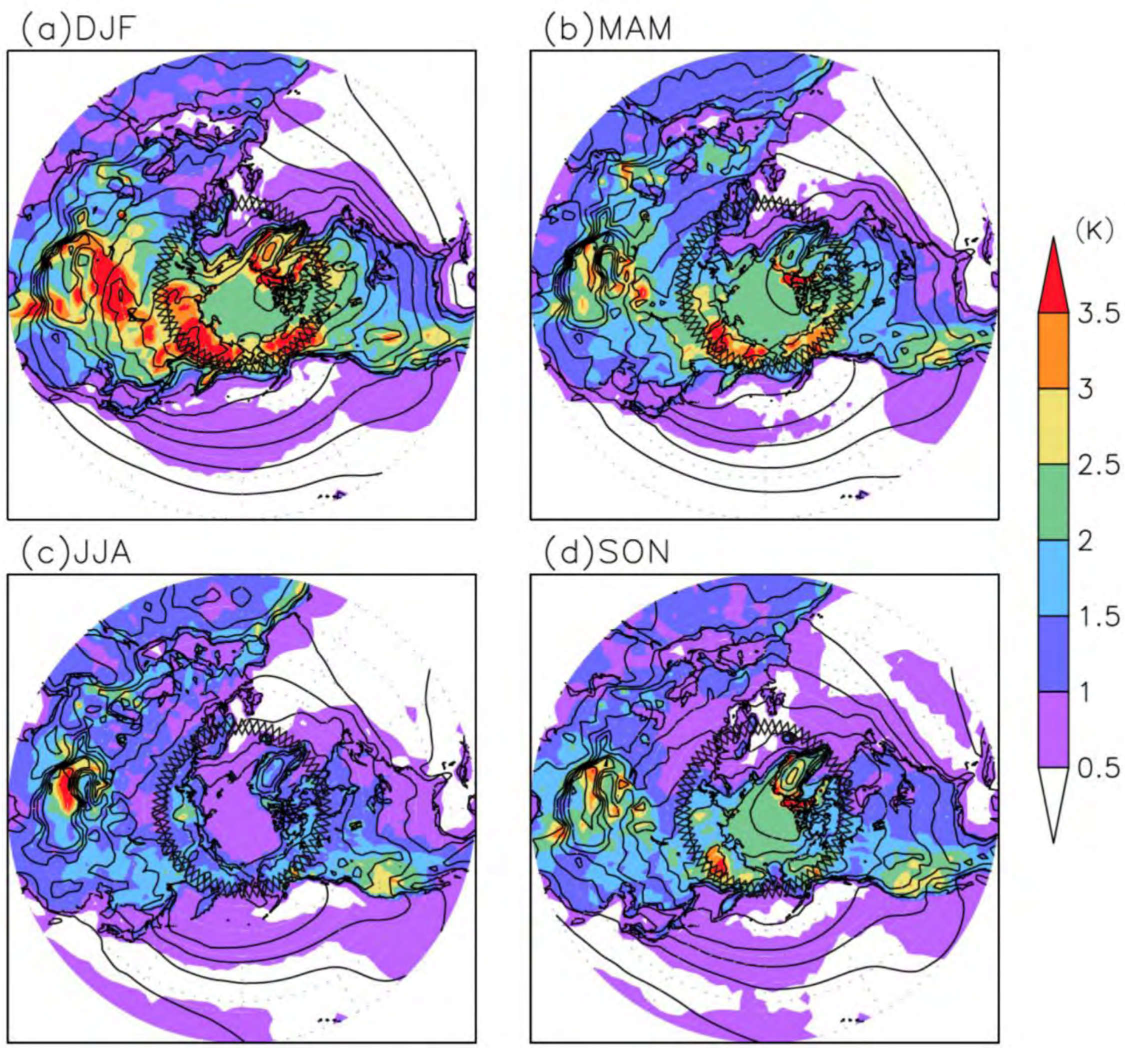
S2S SST anomaly forecasts



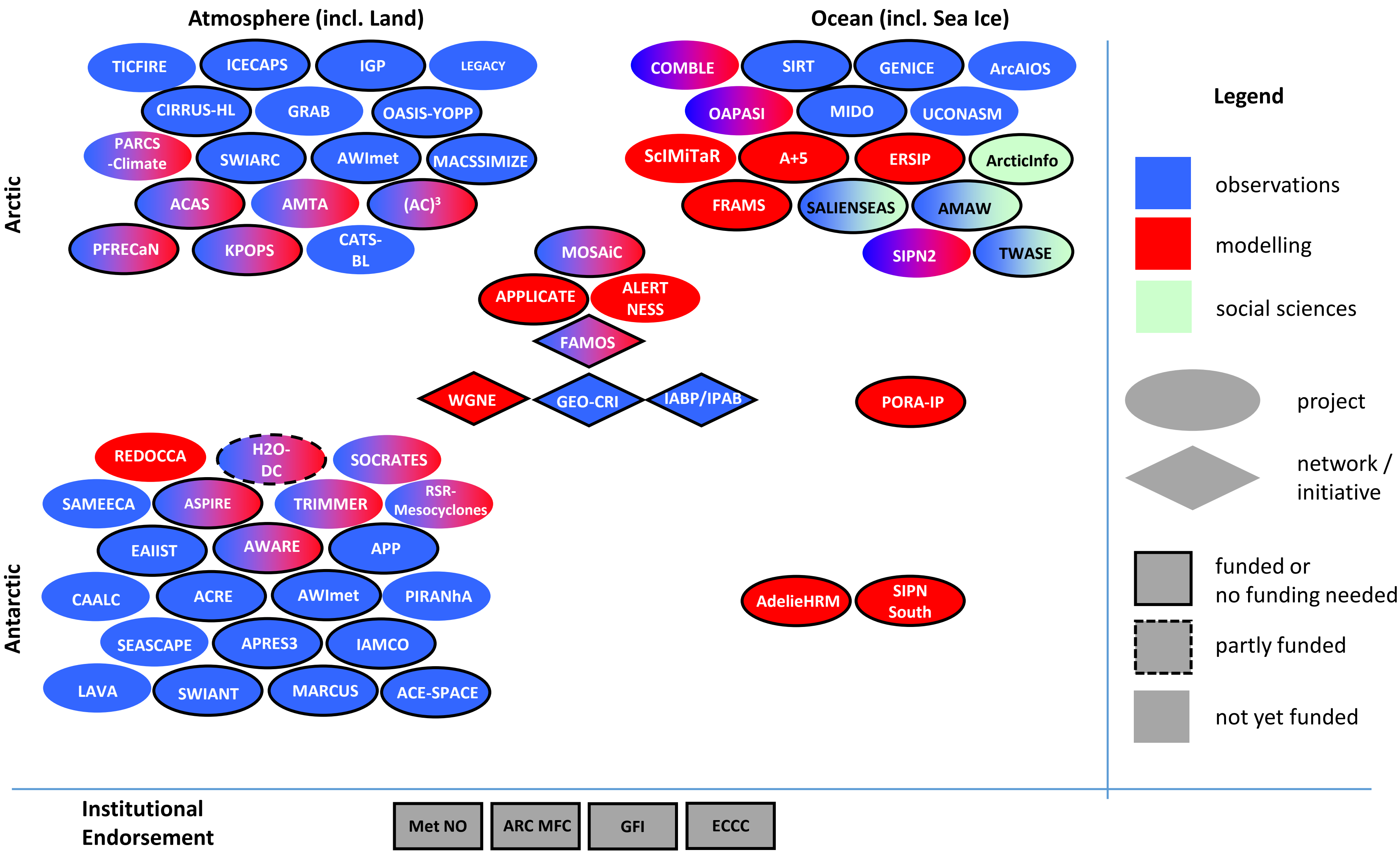
"S2S Museum" at University of Tsukuba, Japan (Mio Matsueda)

http://gpvjma.ccs.hpcc.jp/S2S/S2S_SICmap.html

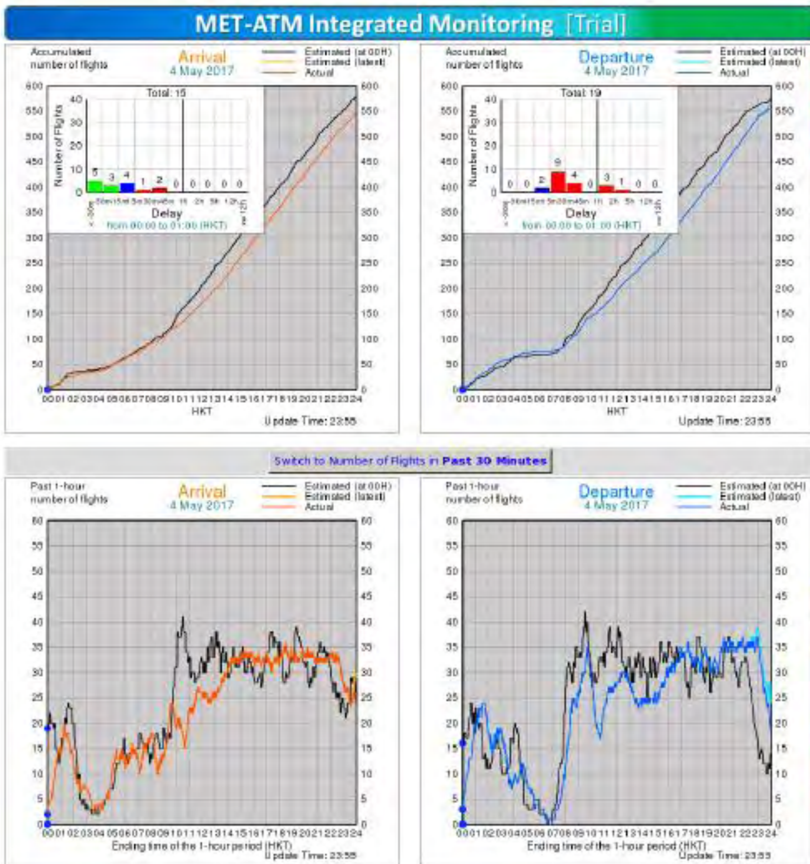
PPP Weather forecast uncertainties

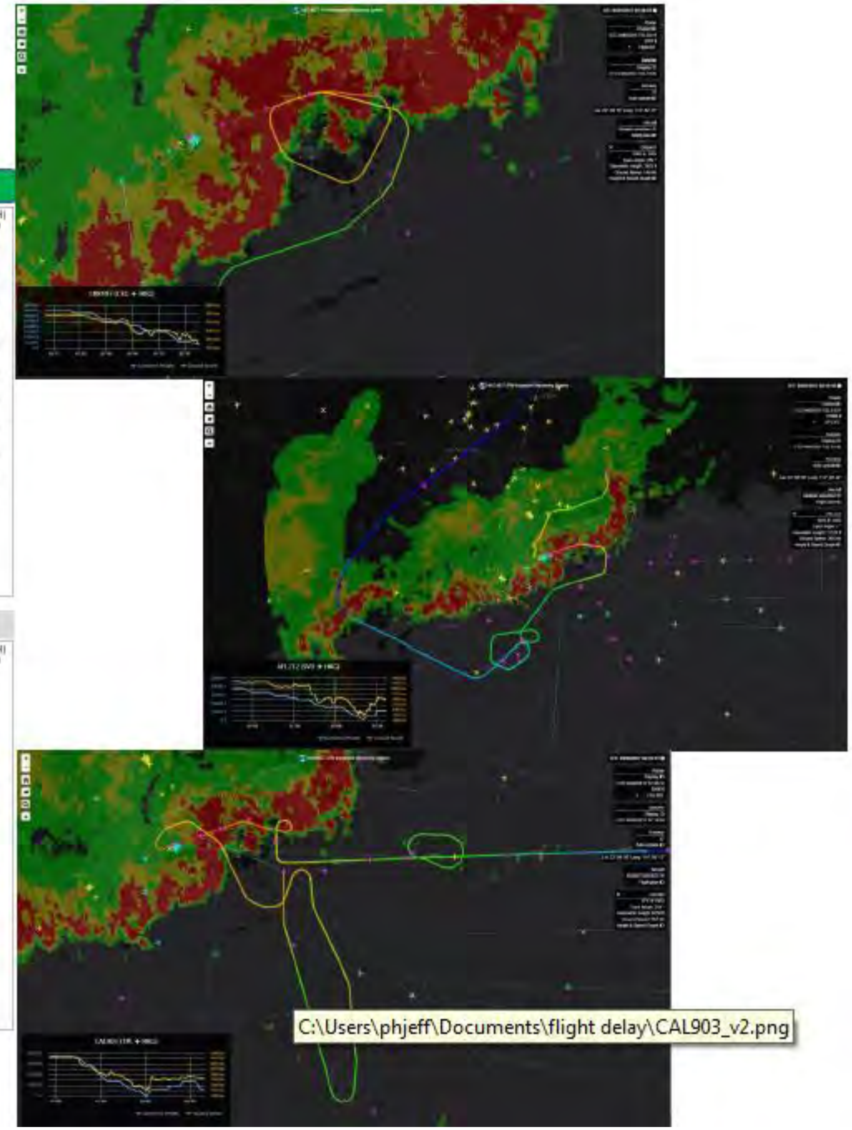


YOPP Endorsed Projects

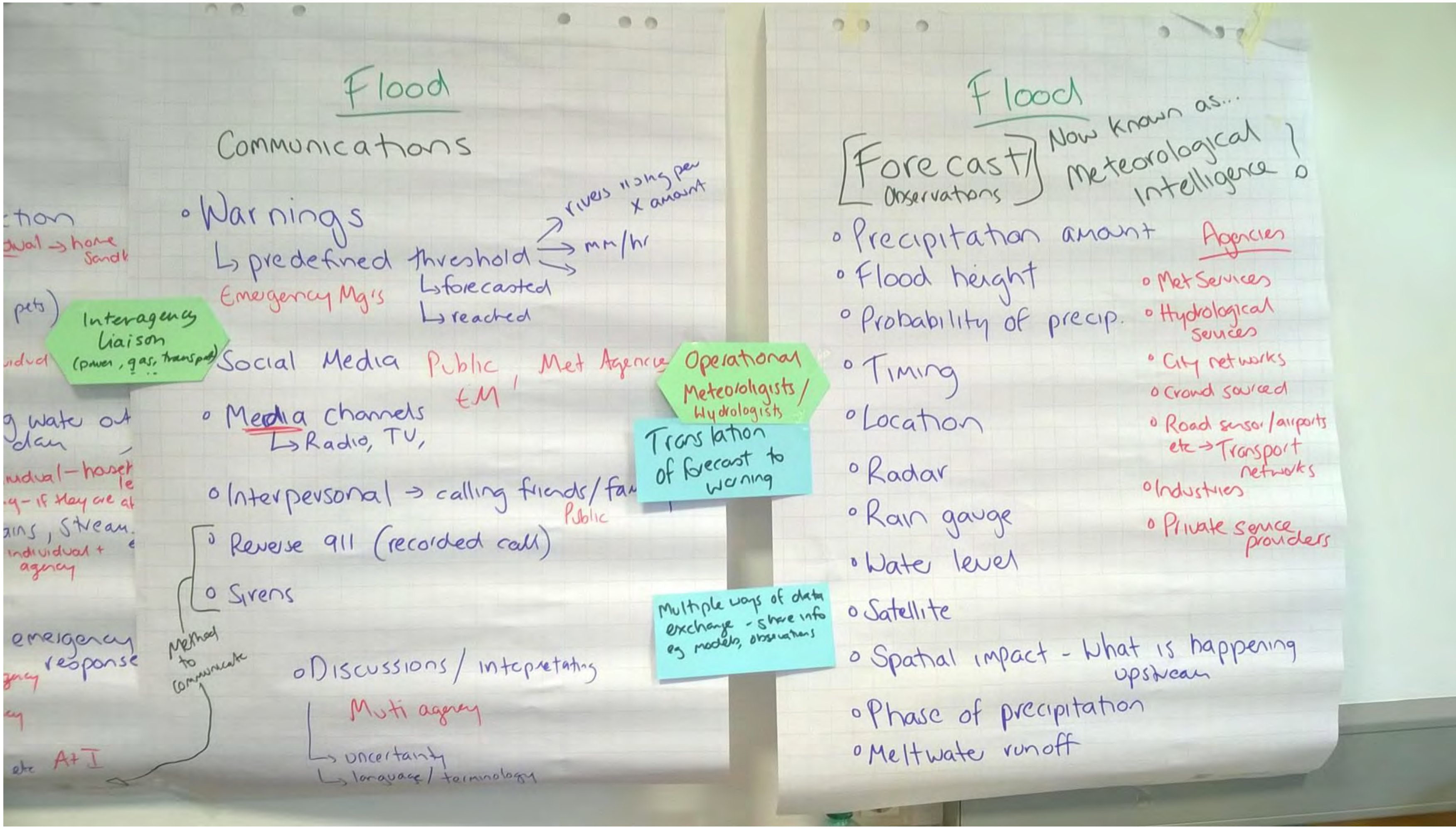


Aviation RDP: flight avoidance study





HIWeather Value Chain Workshop



HIWeather: enhancing communication and utility of forecasts

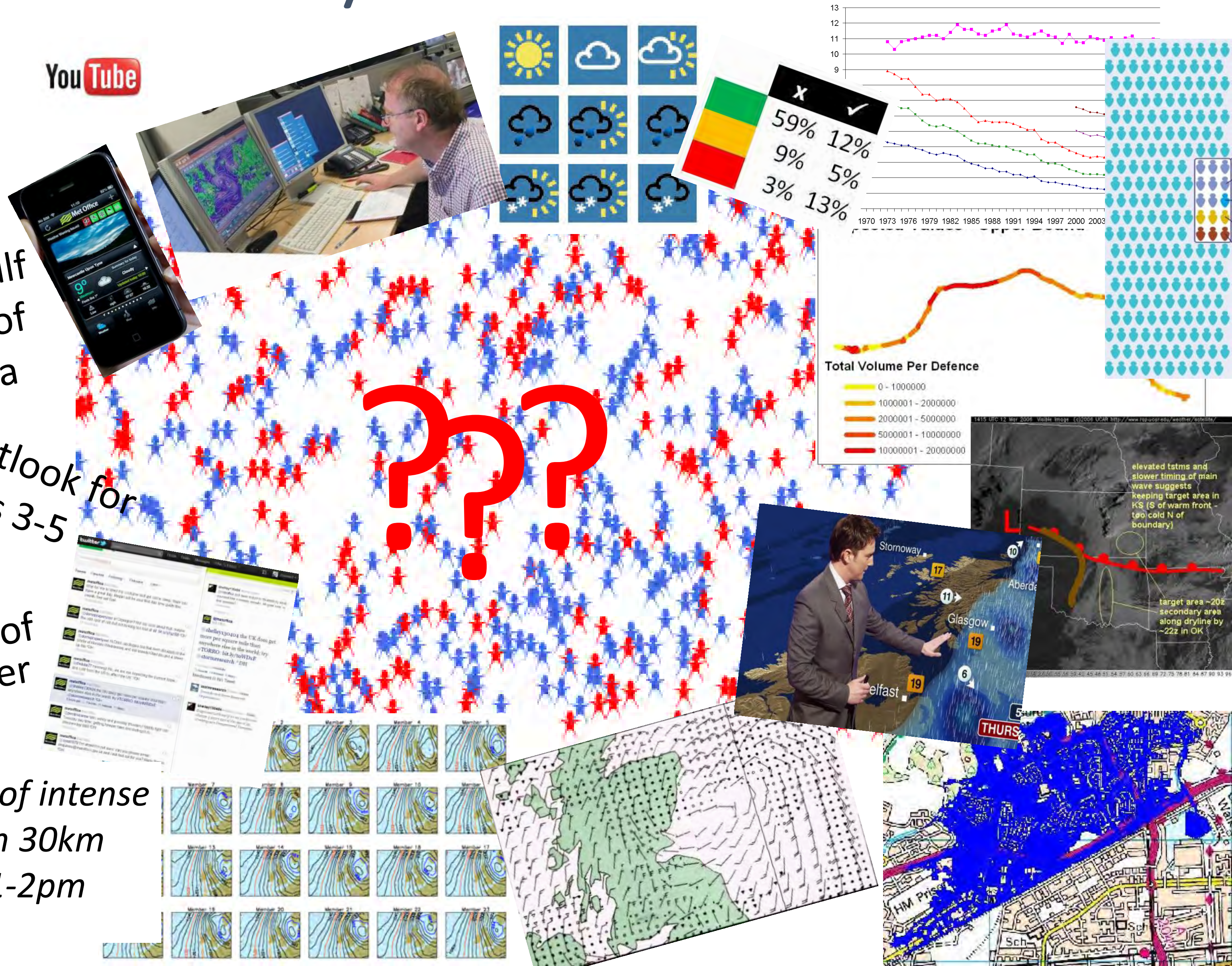
P_{msl}
H_{500}

The Gulf coast of Florida

Outlook for days 3-5

A 10% chance of a shower

20% prob of intense rain within 30km between 1-2pm tomorrow



Resource Mobilization for WWRP

Global strategy:

- large international projects have provided research outcomes with the potential for developing new services (THORPEX, AMMA)
- Strengthening the relationship with organizations planning and funding large-scale initiatives with worldwide positive outcomes (EU Research → Polar Prediction Project)

Regional to local strategy:

- Important players are international funds that are working to improve local developments.
- A co-designed approach could promote innovation and support research activities.
- Example Lake Victoria Project linking together Research and development projects (RDPs) and Severe Weather Forecast Demonstration Projects (FDPs)

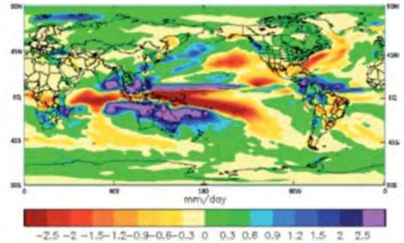
Research infrastructure:

- TIGGE and S2S databases give the research community access to operational predictions, with the potential to develop operational products.
- Securing the long-term maintenance of these databases remains a challenge.

WWRP working with key partners

YESS community
YOUNG EARTH SYSTEM SCIENTISTS community

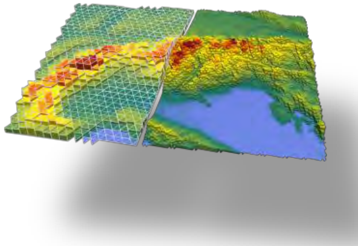
WCRP
World Climate Research Programme

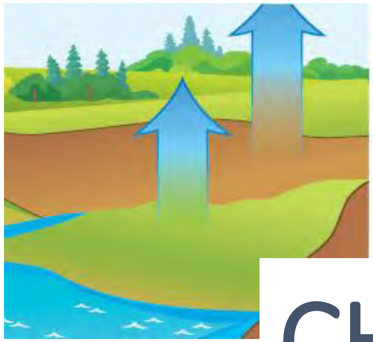


CAeM

WWRP
WORLD WEATHER RESEARCH PROGRAMME

WGNE

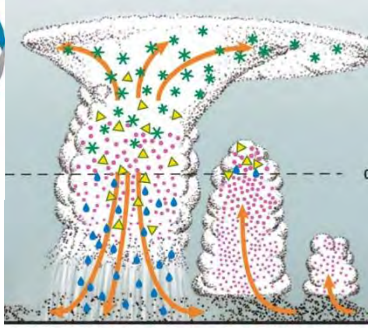




CHy

CBS

GAW



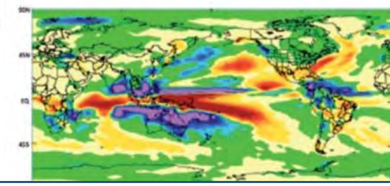
Rosenfeld et al. Science 2008;321:1309-1313

WWRP working with key partners

YESS community

YOUNG EARTH SYSTEM SCIENTISTS community

WCRP World Climate Research Programme



Enhancing collaboration with WWRP:

- Key science challenges at the intersection of weather and climate
- Advancing modelling and observations
- Strengthening regional activities
- Preparing for the future

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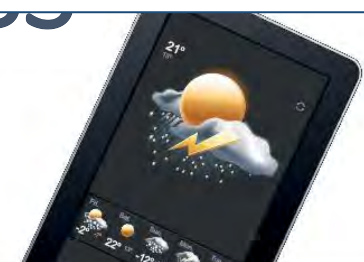

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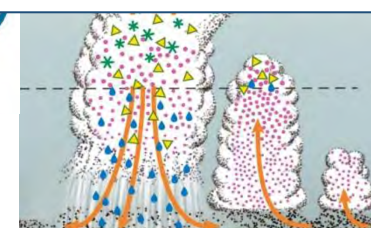

Rosenfeld et al. Science 2008;321:1309-1313

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Thank you
Merci

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

CAS Management Group 2017-2020

Øystein Hov, Norway, president
Jae-Cheol Nam, Republic of Korea, vice-president
Gregory Carmichael, United States of America, chairperson of EPAC SSC
Sarah Jones, Germany, chairperson of WWRP SSC
Amanda Lynch, United States of America, invited expert representing the academic research community
Keith Williams, United Kingdom of Great Britain and Northern Ireland, co-chairperson of the Working Group on Numerical Experimentation
Pascal Waniha, United Republic of Tanzania (Regional Association I – Africa)
Yi-Hong Duan, China (Regional Association II – Asia)
Carolina Vera, Argentina (Regional Association III – South America)
John Cortinas, United States of America (Regional Association IV – North America, Central America and the Caribbean)
Peter May, Australia (Regional Association V – South-West Pacific)
Jörg Klausen, Switzerland (Regional Association VI – Europe)
A representative of the European Commission, Directorate General: Research, invited expert