Earth System Approach to resilience

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WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

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World Meteorological Organization
Organisation météorologique mondiale

Expected outcomes

global platform for disaster risk reduction
Geneva, Switzerland, 13-17 May 2019

- The first stock take on progress made in implementing the Sendai Framework by Member States and stakeholders, and achievement of disaster risk-related targets of the 2030 Agenda for Sustainable Development.

- Understanding of the state of global risk, and launch of the Global Risk Assessment Framework (GRAF).

- Recommendations and actionable suggestions for key policy makers in charge of sustainable development, finance & economic planning and disaster risk reduction.

- Increased awareness on good practices in implementing the Sendai Framework, including innovative approaches, tools and methodologies.

- A contribution to the discussions of the High-Level Political Forum on Sustainable Development to be held in New York in July 2019, as well as the UN Climate Summit in September 2019.

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Outline

WMO fosters and progresses cooperative international research and operations for improved weather and environmental prediction services from minutes to seasons strengthening academic-operational partnerships around the world

more accurate and reliable forecasts from minutes to seasons

enhance society's resilience to extreme weather and the value of weather information for users

KEY OUTCOMES AND ON-GOING PROJECTS

BOOSTING RESILIENCE EVERYWHERE IN THE WORLD

A VALUE CHAIN APPROACH BRIDGING GEOPHYSICAL SPHERE AND SOCIAL SPHERE

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Key Outcomes & On-going projects

- **Advancement in science to improve predictions and use of weather/climate information in society**
- **Strengthening observational capabilities for Disaster Risk Reduction**
- **Major improvements in predicting extreme weather events**

more accurate and reliable forecasts from minutes to seasons

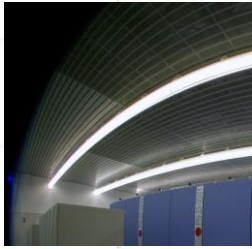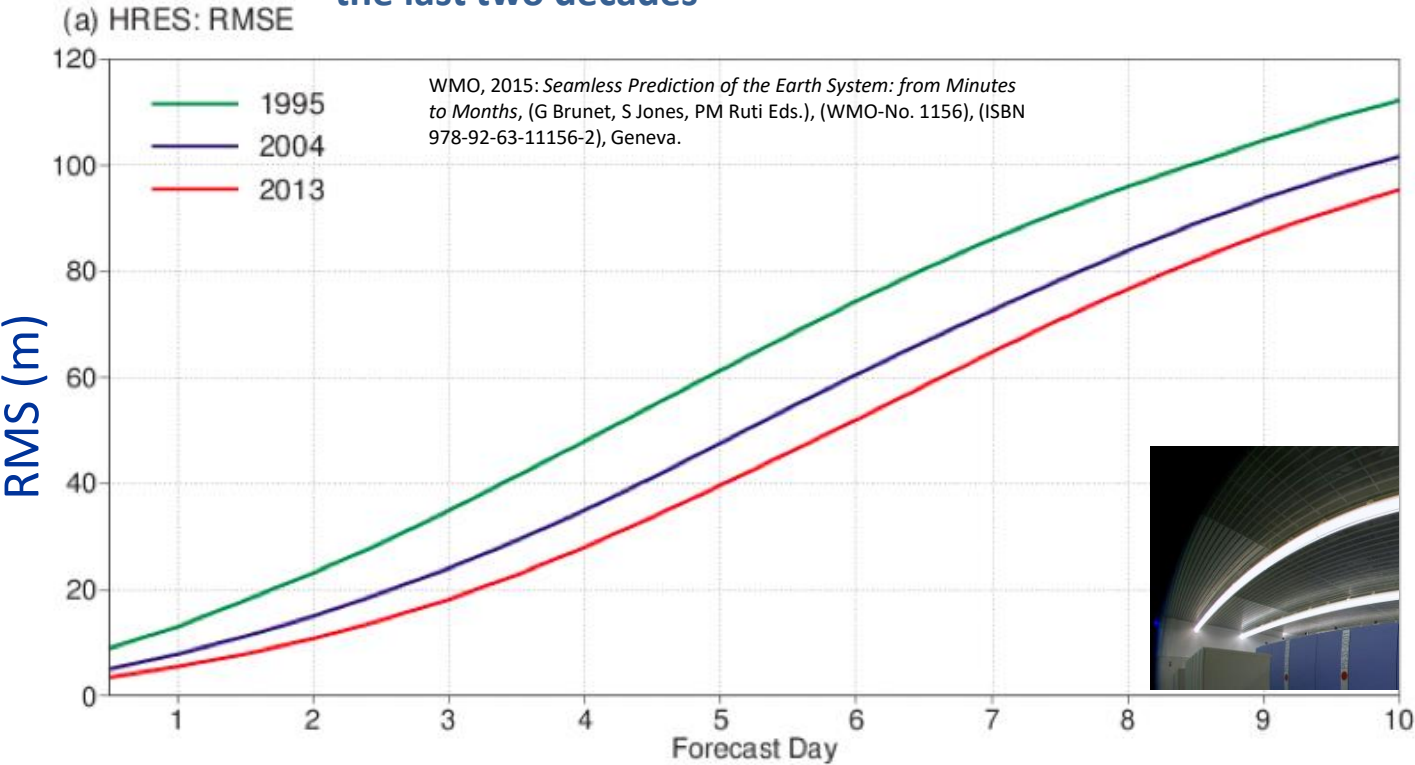enhance society's resilience to extreme weather and the value of weather information for users

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Improving the skill – big resources

ECMWF's forecast Z500hPa extra-tropical error growth over the last two decades

(a) HRES: RMSE

RMS (m)

1995
2004
2013

WMO, 2015: *Seamless Prediction of the Earth System: from Minutes to Months*, (G Brunet, S Jones, PM Ruti Eds.), (WMO-No. 1156), (ISBN 978-92-63-11156-2), Geneva.

Forecast Day

ECMWF

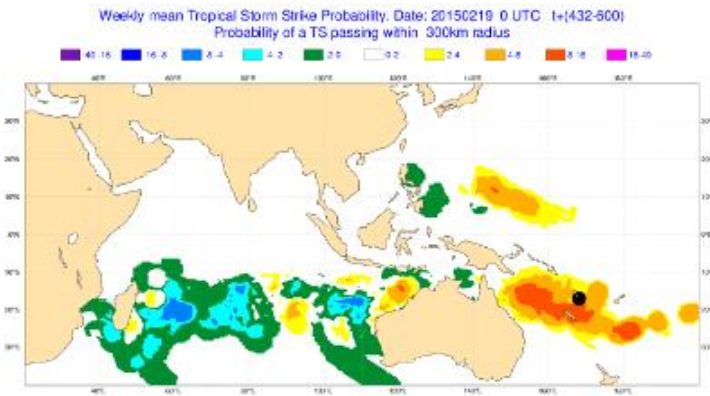WMO OMM

Tropical Cyclones

The WMO Sub-seasonal to Seasonal project develop new products for DRR

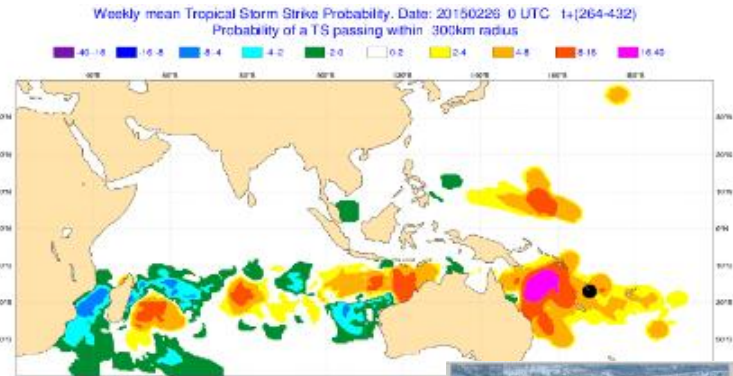Multi-model prediction of TC strike probability anomalies 9–15 March 2015

(NCEP/ECMWF/BoM/JMA/CMA)

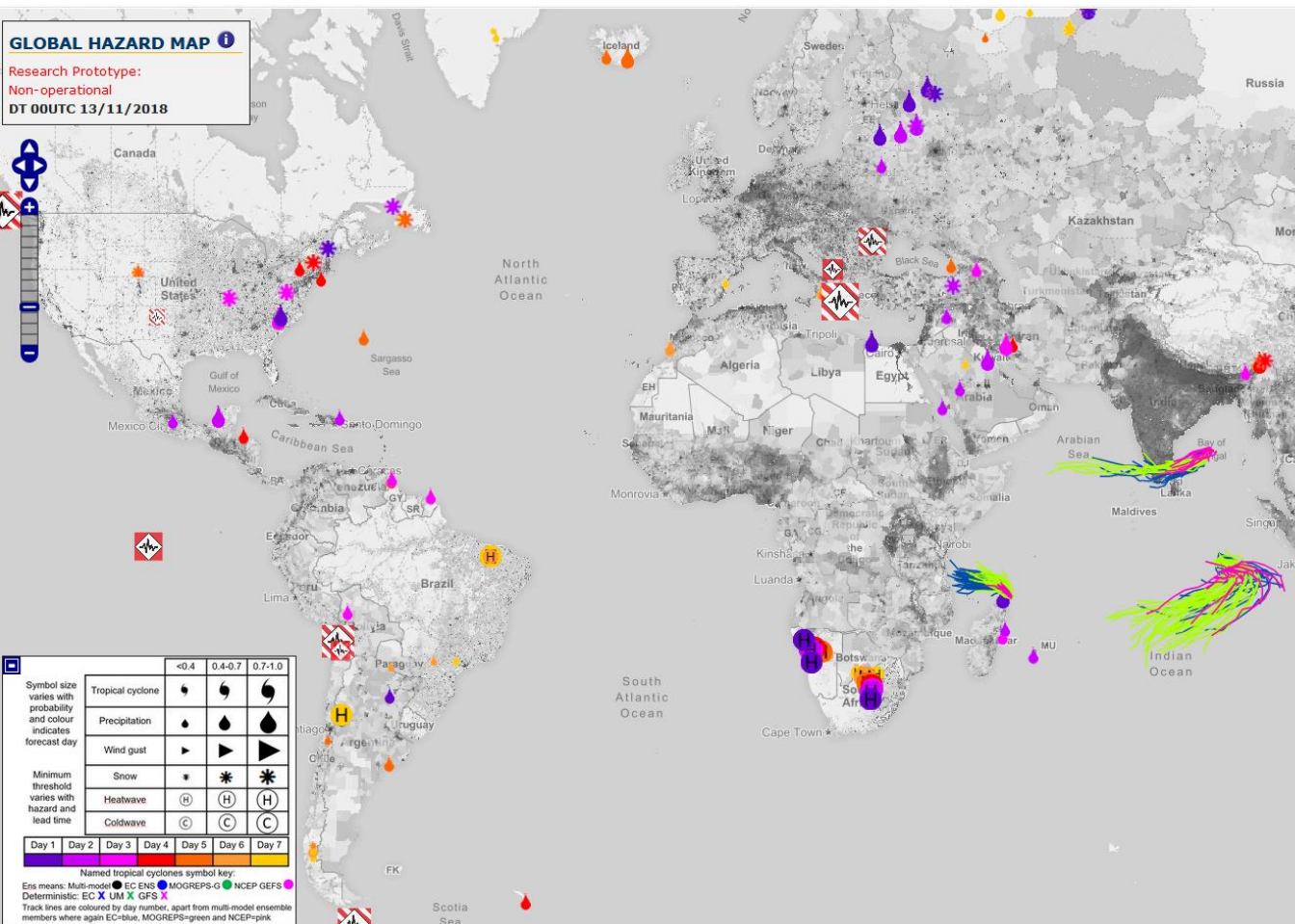By courtesy of F Vitart

2015/02/19 day 19–25

2015/02/26 day 12–18

European Centre for Medium-Range Weather Forecasts
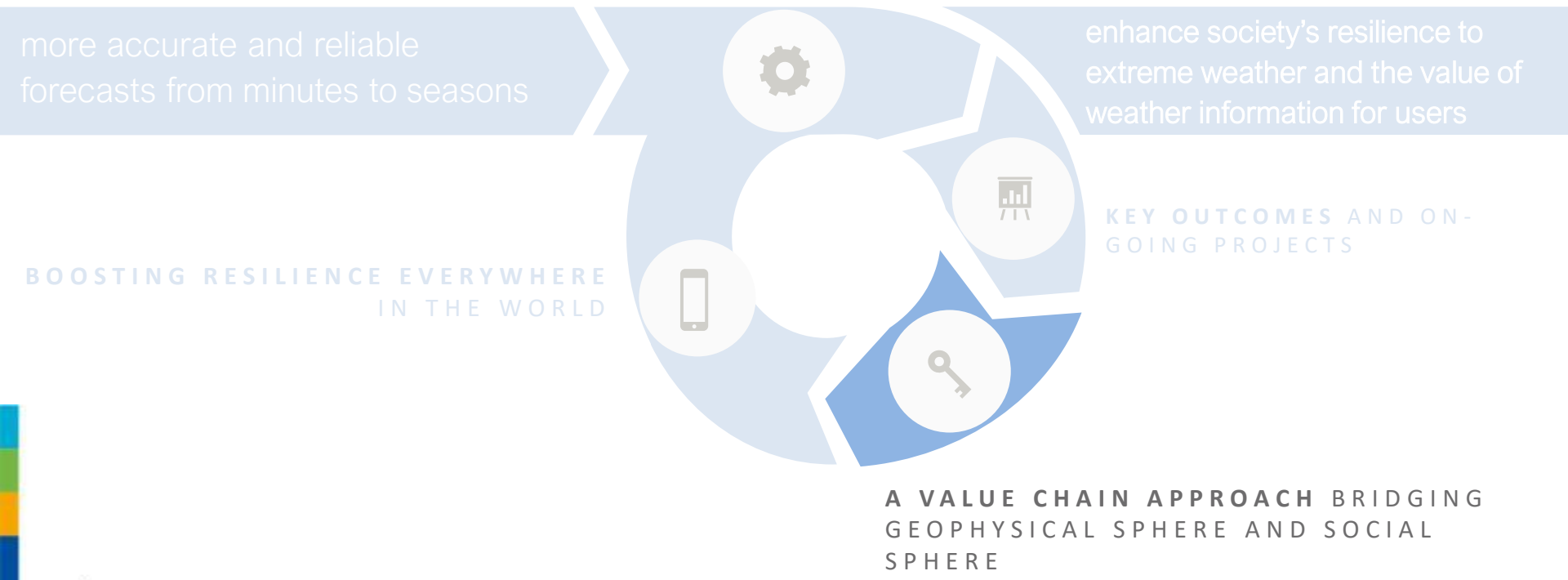
Integrated information
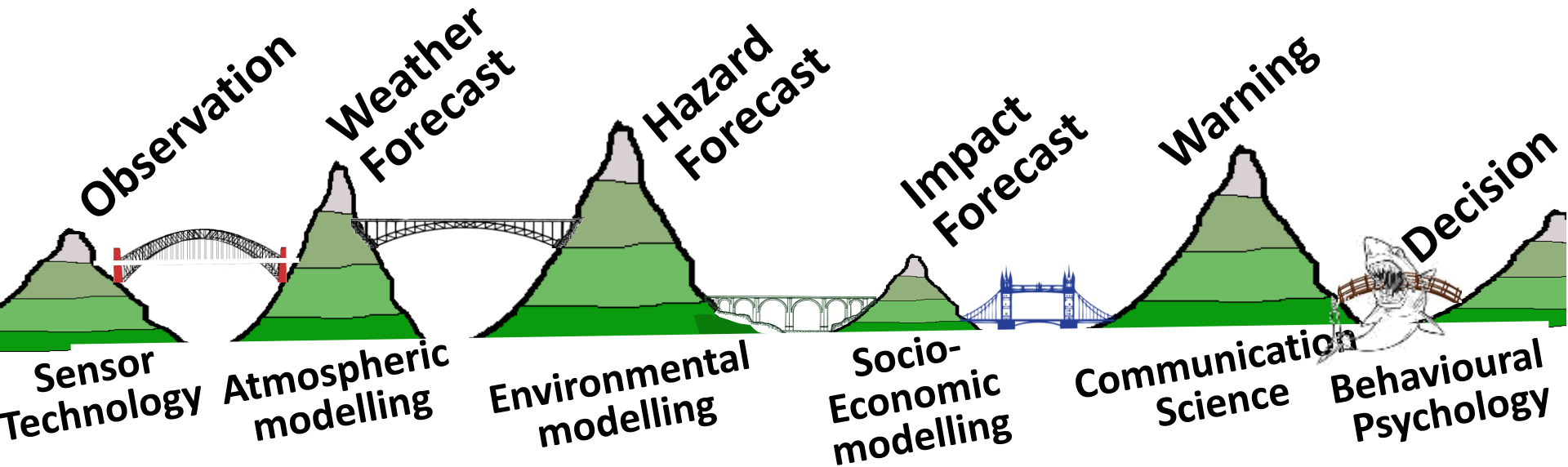

Global Hazard Map

- Aims to summarise the likelihood of high-impact weather across the globe in the next 7 days using global multi-model ensemble forecasts
  - Precip / Wind / Snow
  - Tropical Cyclones
  - Heatwave and Coldwaves

- Symbol-based summary map, coloured by lead time, gives 'at a glance' view of all hazards

- Web Map Service – easy to overlay info, zoom/pan, flexible format for data layers

- Can then drill down to particular variables / days / models / areas of interest

- Can overlay vulnerability and exposure layers to give information on likely impact
  - Population density
  - Fragile State Index
  - Soil moisture
  - Recent earthquakes

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Value Chain Approach

In the WMO context the weather enterprise value chain (monitoring and observation, models, forecasting, dissemination and communication, perception and interpretation, decision- making, end-user products) ensures the delivery of tailor made weather information from minutes to months and from global to local.

more accurate and reliable forecasts from minutes to seasons

enhance society's resilience to extreme weather and the value of weather information for users

BOOSTING RESILIENCE EVERYWHERE IN THE WORLD

KEY OUTCOMES AND ON-GOING PROJECTS

A VALUE CHAIN APPROACH BRIDGING GEOPHYSICAL SPHERE AND SOCIAL SPHERE

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What makes successful a warning?
Solving **the 5 valleys of death problem**

Observation — Sensor Technology

Weather Forecast — Atmospheric modelling

Hazard Forecast — Environmental modelling

Impact Forecast — Socio-Economic modelling

Warning — Communication Science

Decision — Behavioural Psychology

Bridges represent inter-disciplinary &/or inter-agency communication

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What makes successful a warning?
Considering User Needs first

Forecasters know well about the forecast errors, the skill of transfer forecast to service is consider the needs of warning users.

Improve the utility and operability of warning

- ✓ **TC's long-range forecasts could help and contribute to an early voyage planning decision.**
- ✓ **The information of TC forecast uncertainty should be included in the maritime broadcast thus benefit the decision-making.**
- ✓ **Advance gale warning related to the extension of TC forecast has potential value in further discussion of enriching the products.**

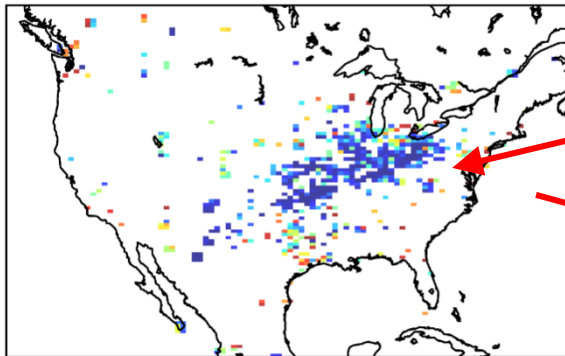Development of tropical cyclone intensity during re-curving process
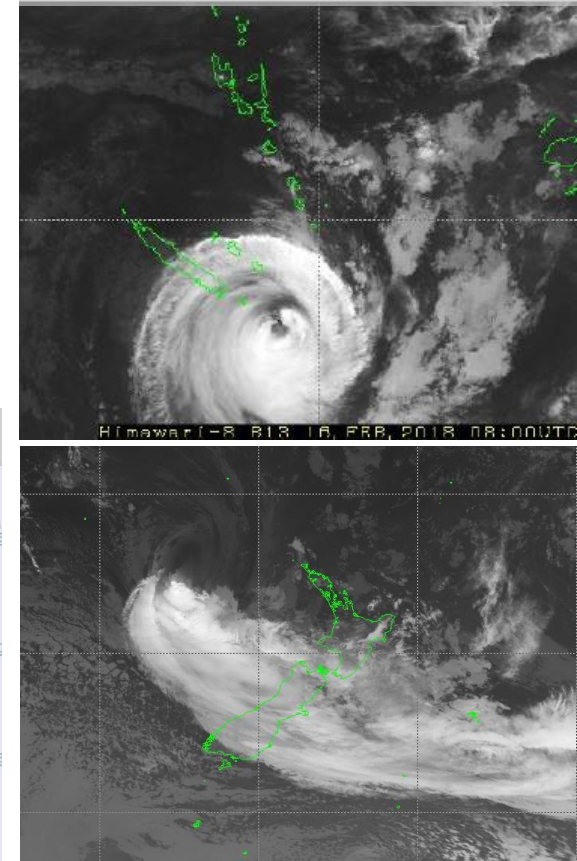
Large track forecast error may existence during re-curving process in numerical models.
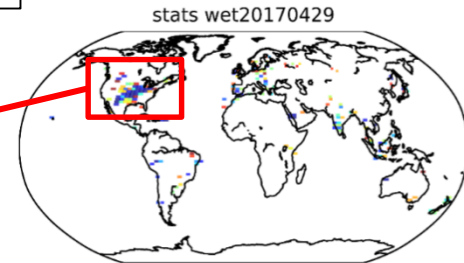

WMO OMM
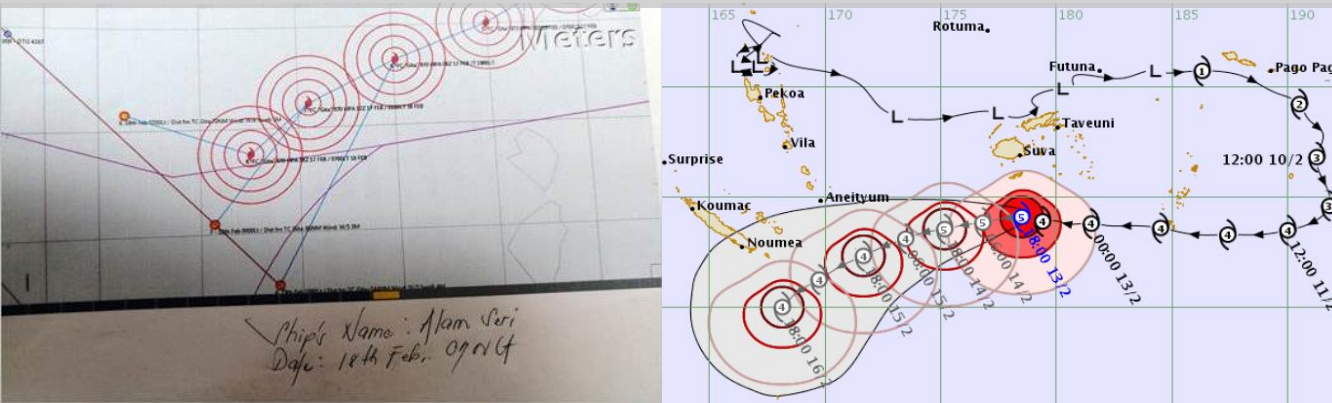
Exploring new warning's frontiers

Heavy Rainfall – 29/04/2017

'Heavy Rainfall' USA Tweet Activity 29/04/17
stats wetUSA20170429

stats wet20170429

Actual Precipitation 29/04/17

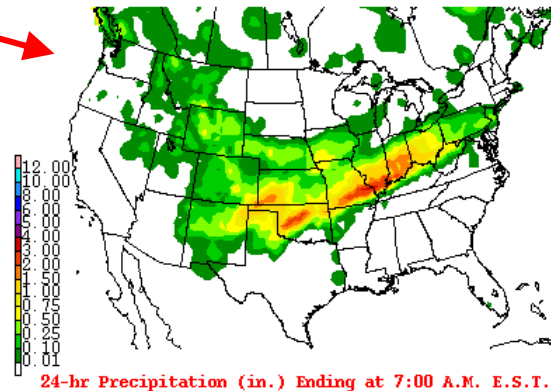24-hr Precipitation (in.) Ending at 7:00 A.M. E.S.T.

- Locations with number of 'heavy rainfall' tweets above the 70th percentile on 29th April 2017
- Blue shading indicates unusually high number of tweets about rainfall/flooding

- Rainfall radar for the USA on 29th April 2017
- Red shading indicates areas which were most affected by heavy rainfall

http://www.wpc.ncep.noaa.gov

Examples of Twitter activity vs weather event

≋Met Office

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Boosting Resilience Everywhere

Leading End-to-End Research and Development Projects at regional level to greatly improve resilience to high-impact weather events and to facilitate the transfer of research results into operational practise to the benefit of WMO Members.

more accurate and reliable forecasts from minutes to seasons

enhance society's resilience to extreme weather and the value of weather information for users

BOOSTING RESILIENCE EVERYWHERE
IN THE WORLD

KEY OUTCOMES AND ON-GOING PROJECTS OF THE WORLD WEATHER RESEARCH PROGRAMME

A SEAMLESS EARTH SYSTEM SCIENCE BRIDGING GEOPHYSICAL SPHERE AND SOCIAL SPHERE

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Regional Innovation

| INVOLVING ACADEMIA AND PRIVATE SECTOR | OPEN INNOVATION AND TECHNOLOGY SCOUTING | NURTURING FUTURE TALENTS |

Integrating regional and national needs into iinternational science plans through a continuous interactions with WMO members

FORECAST DEMONSTRATION PROJECTS

REGIONAL DEVELOPMENT AND INNOVATION PROJECTS

REGIONAL SCIENCE AND TECH TRANINGS

20 More than 20 global and regional research projects

50 More than 50 countries engaged

100 More than 100 Mil Dollars mobilized

OLYMPIC GAMES

POLAR OBSERVING SYSTEM

FUTURE EWS IN EAST AFRICA

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COMMENT
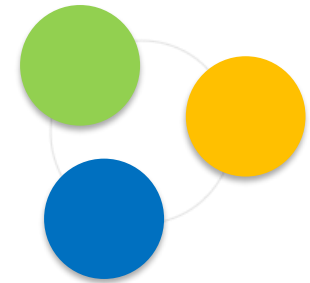
Five priorities for weather and climate research
Science Summit key outcomes (Nature, vol 552, Dec 2017)

More than 100 experts and more than 50 countries met in Geneva last October for the Science Summit and CAS-17 session, 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**

becoming a landmark in moving Earth System science forwards.

Modes of collecting and delivering weather and climate information are evolving.

Business and non-profit organizations are increasingly supplying weather and climate services.

Data now stem from a broader range of sources, such as mobile-phone apps and smart devices.