Catalyzing Innovation in WMO Science

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WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

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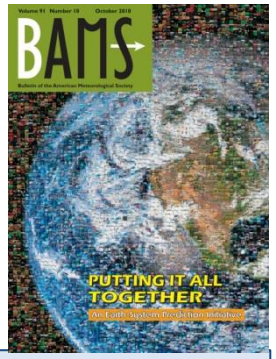
Seamless Prediction

Originally defined at the intersection of weather and climate



Seamless prediction context considers all compartments of the Earth system as well as disciplines of the weather enterprise 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 from minutes to decades and from global to local.

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A turning point: the World Weather Open Science Conference (WWOSC) 2014

Over 1000 participants: experts from over 50 countries in meteorology, application developments, social science as well as users.

An A-list of heads and scientists from National Meteorological and Hydrological Services, Academia, WMO, Stakeholders

Largest international gathering of social and interdisciplinary scientists and application specialists focused on weather-related research

Early Career Scientists developing new ideas and activities

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A tangible synthesis

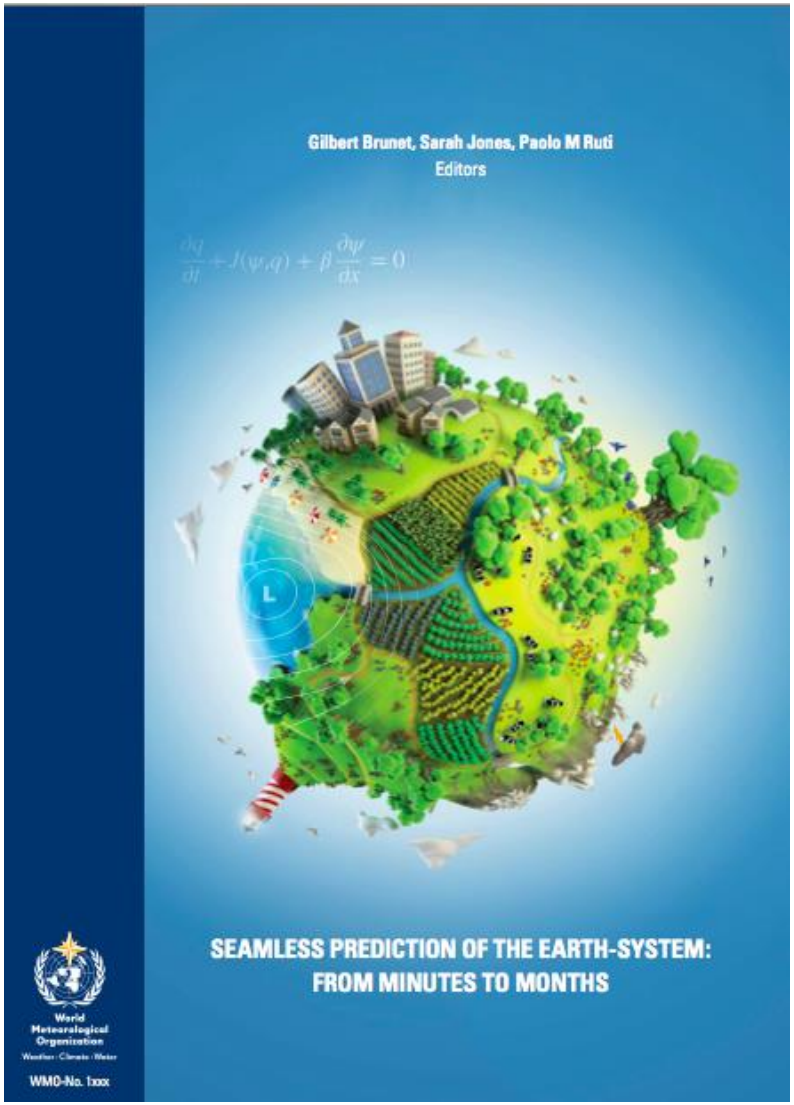
Seamless Prediction of the Earth System: from minutes to months

480 pages

More than 100 authors

Provide a reference of current state of science and future challenges in 25 chapters

Freely available on the WMO website in French, English and Spanish



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COMMENT

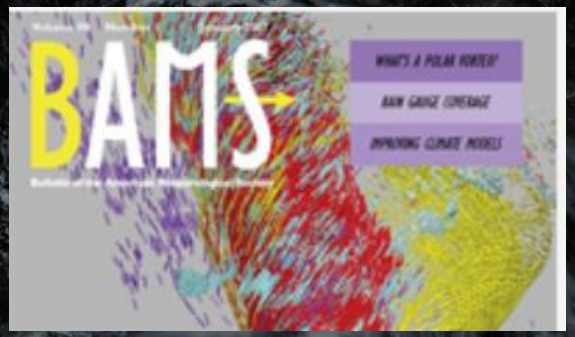
Five priorities for weather and climate research

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.

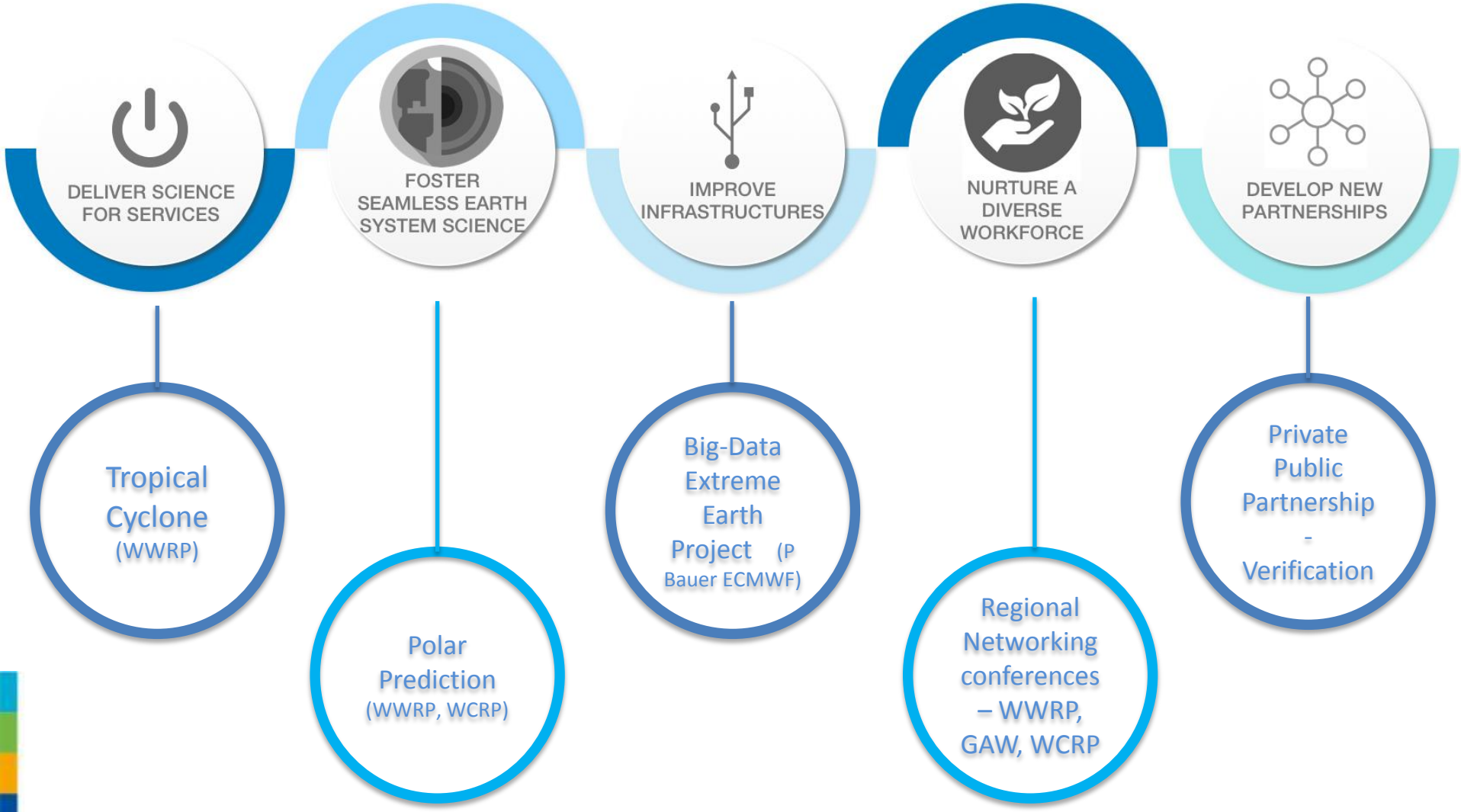


Modes of collecting and delivering weather and climate information are evolving.

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.

Seamless Science Challenges and Opportunities



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COMMENT

Five priorities for weather and climate research

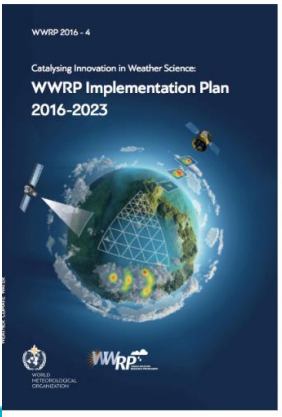
Science Summit key outcomes (Nature, vol 552, Dec 2017)

Integrated Science Approach

1. Advance knowledge of the Earth System (fundamental knowledge development)
2. Advance policy relevant science (where some interaction with TCs happens)
3. Enhance connections between the science and the services through the value chain approach (where most of the interaction with other TCs will happen)

Key WMO and co-sponsored Programmes

WWRP World Weather Research Programme

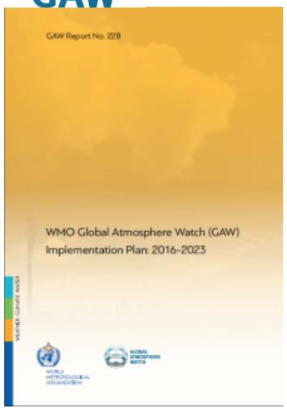


IP Action Areas address societal challenges

Core Projects

Working Groups / Expert Teams

GAW



IP focuses on Science for Services

Expert Groups,

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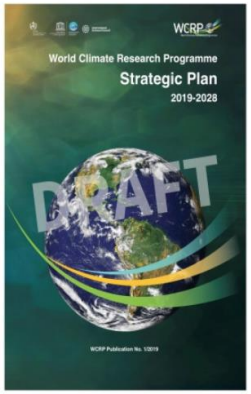
WCRP World Climate Research Programme



New Programmes

Overarching objectives

Advisory Councils

Working Groups

Projects

Grand Challenges

Seamlessness

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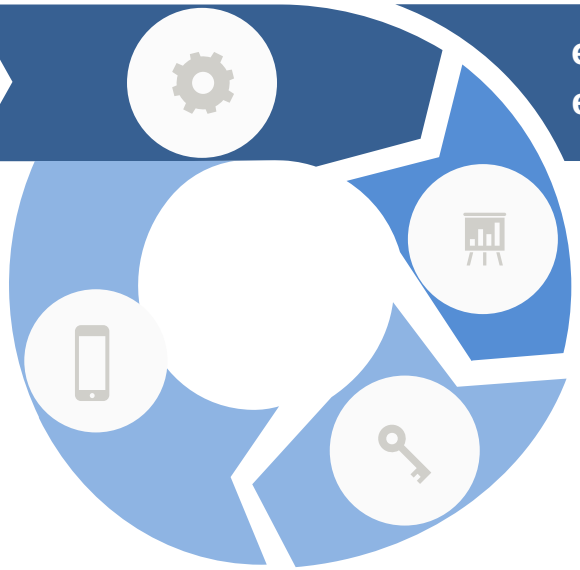
Science for Services

- **How do we build up the effective interaction between Research and Operations to ensure the implementation of the full value chain?**
- **How do we guarantee Members continue to provide their feedbacks and co-design WMO research activities?**

more accurate and reliable forecasts from minutes to decades

enhance society's resilience to extreme



BOOSTING CO-DESIGN AND CO-PRODUCTION I AT GLOBAL AND REGIONAL LEVEL

BUILDING ON ON-GOING IMPLEMENTATION OF THE GLOBAL DATA & PROCESSING FORECASTING SYSTEM ACROSS OPERATION AND SCIENCE

INVOLVING TECHNICAL COMMISSIONS AND MEMBERS IN PLANNING PILOT FRAMEWORKS/PROJECTS AT ANY FOUR YEAR CYCLE (INCUBATOR ROLE)

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Value Chain Example: Polar Prediction

1 DESIGNING NEW OBS NETWORK

Key questions from operational centers and society have inspired the development of the Polar Prediction Project

2 PREDICTIVE CAPABILITIES

Polar Prediction Project planned research activities with a strong connection to operational aspects (ECMWF, NCEP)

3 ENGAGING COMMUNNITIES

Climate Community strongly engaged on process studies

4 PROVIDING INPUTS TO DECISION MAKERS

YOPP provided key inputs in high level meetings (Arctic Science Ministerial, …)

YOPP YEAR OF POLAR PREDICTION

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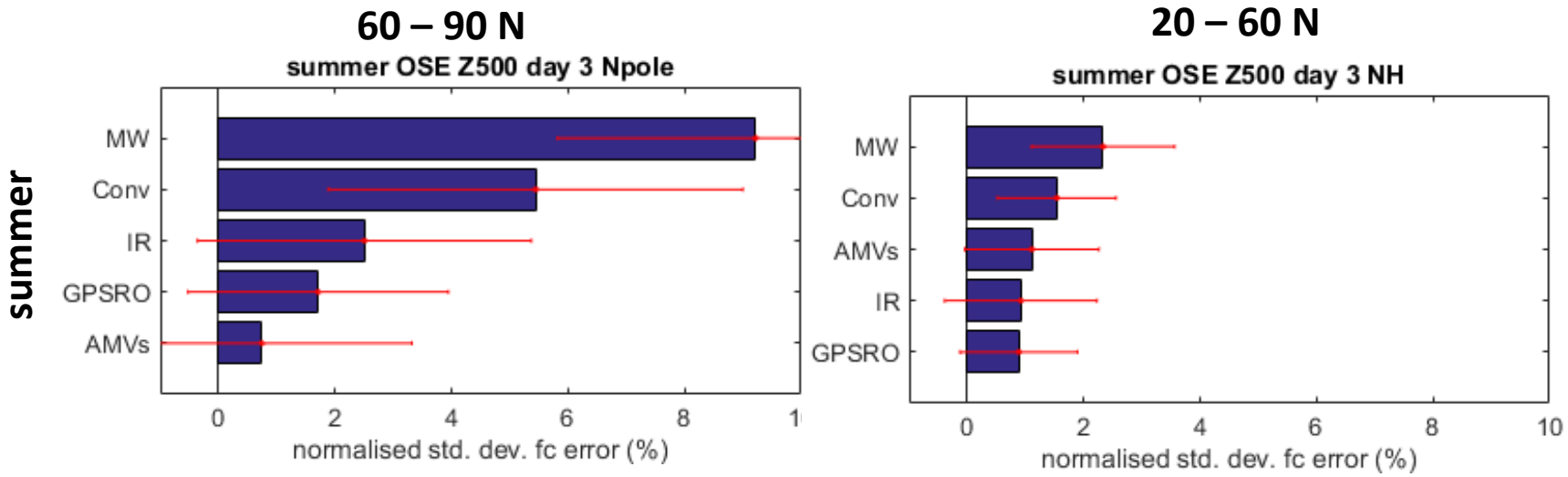
Future observing systems in polar regions



Summer:

- Microwave
- Conventional
- Infrared
- GPSRO, AMVs

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By courtesy of Irina Sandu (ECMWF)

APPLICATE.eu
Advanced prediction in polar regions and beyond

International Workshop on Tropical Cyclones

Forecasters and researchers meet every four years to review the state of the art in science and operations and make recommendations on future needs

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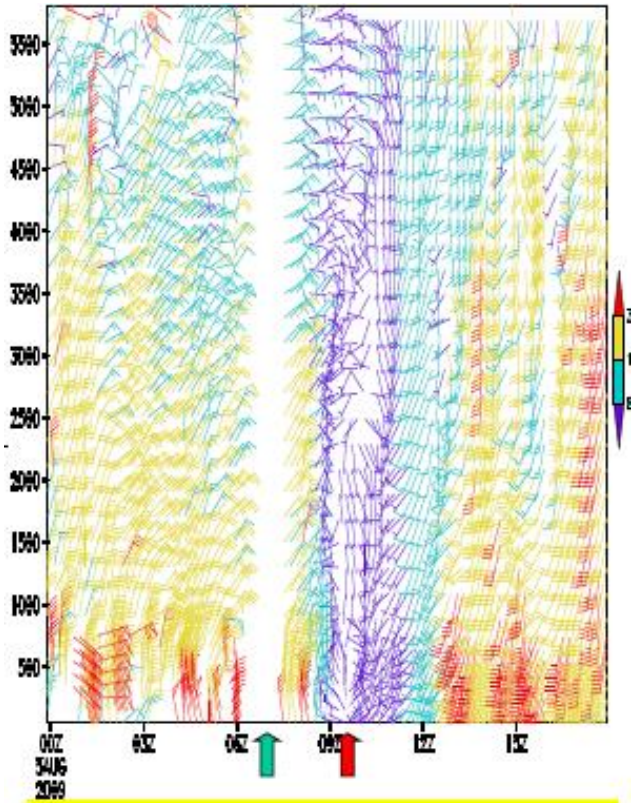
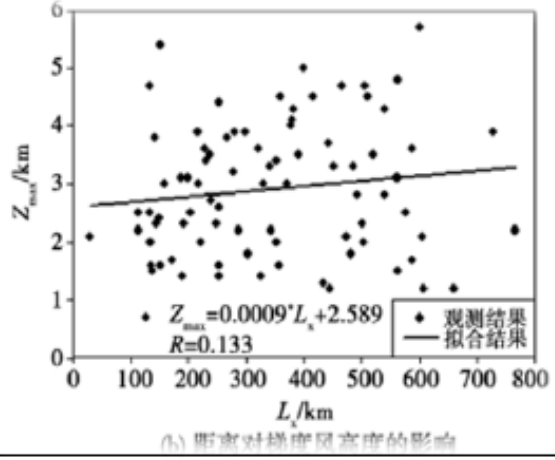
WWRP WORLD WEATHER RESEARCH PROGRAMME

Tropical Cyclone Research: Boundary Layer Structure

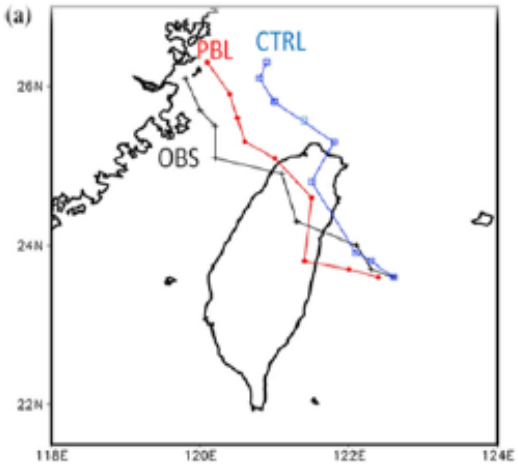
EXOTICCA Observations lead to better representation of Tropical Cyclone PBL in NWP model

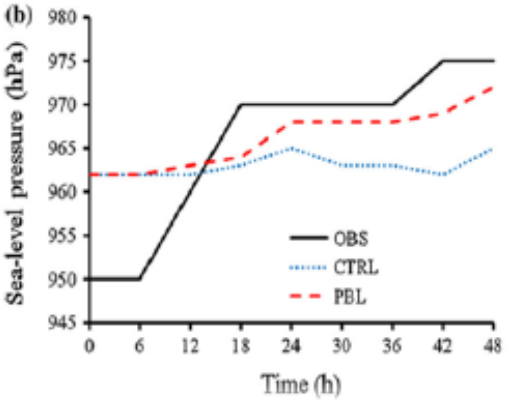


PBL more than 5km (during landfalling)



Modify the definition of PBL in HWRFV3.3 (YSU) based on field campaign data





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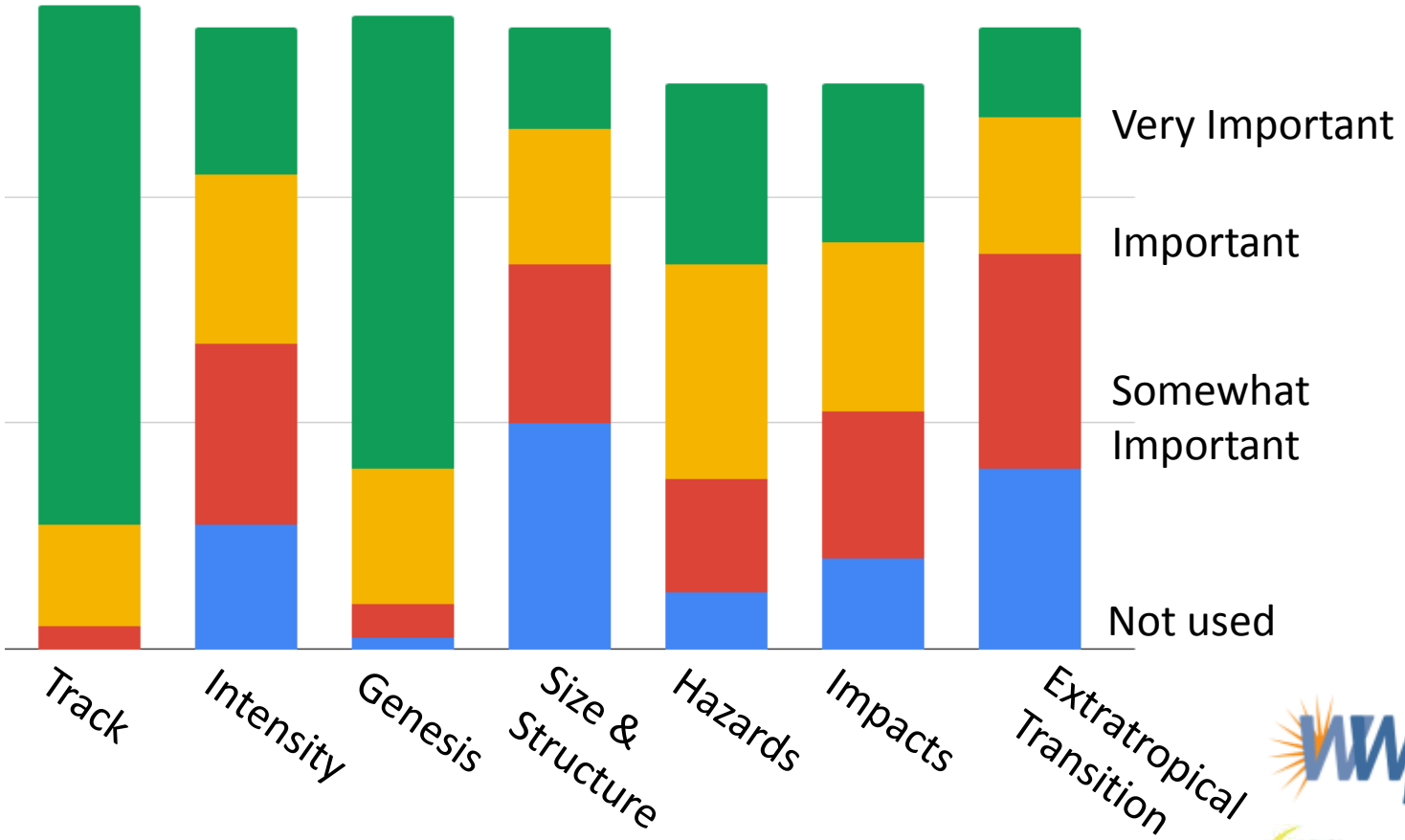
Tropical Cyclone Research: Using Ensemble Products

From a Questionnaire to operational Tropical Cyclone Forecast Centres: “How important would you say ensemble forecasts are in each area of tropical cyclone forecasting?”



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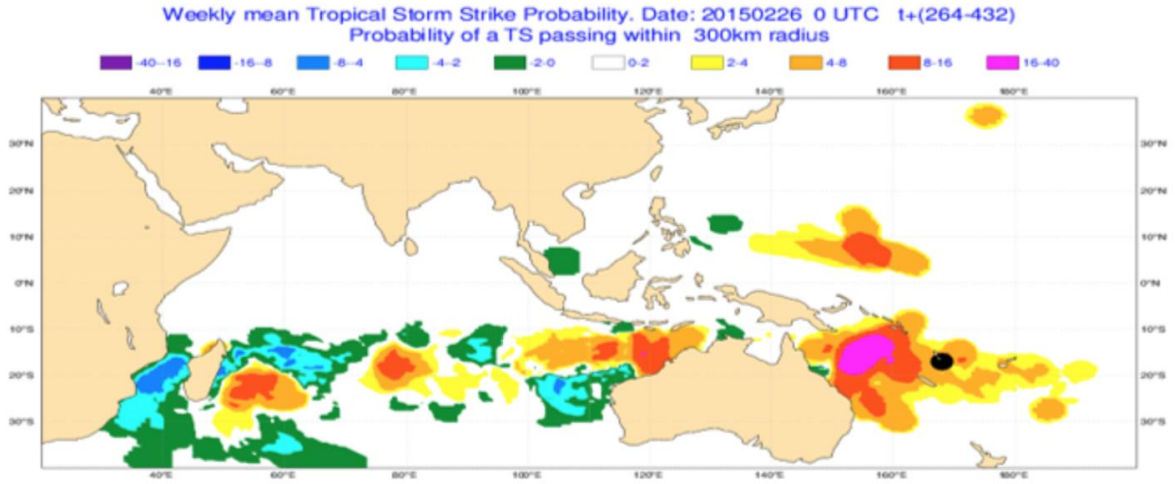
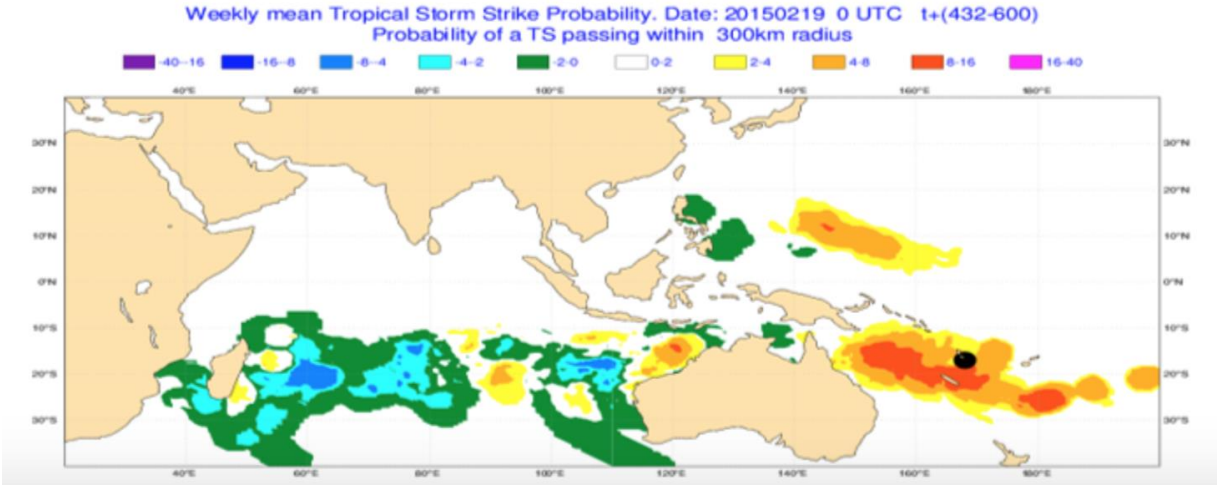
Helen Titley, Munehiko Yamaguchi, Linus Magnusson
WWRP WORLD WEATHER RESEARCH PROGRAMME
HIWeather

Tropical Cyclone Research: S2S

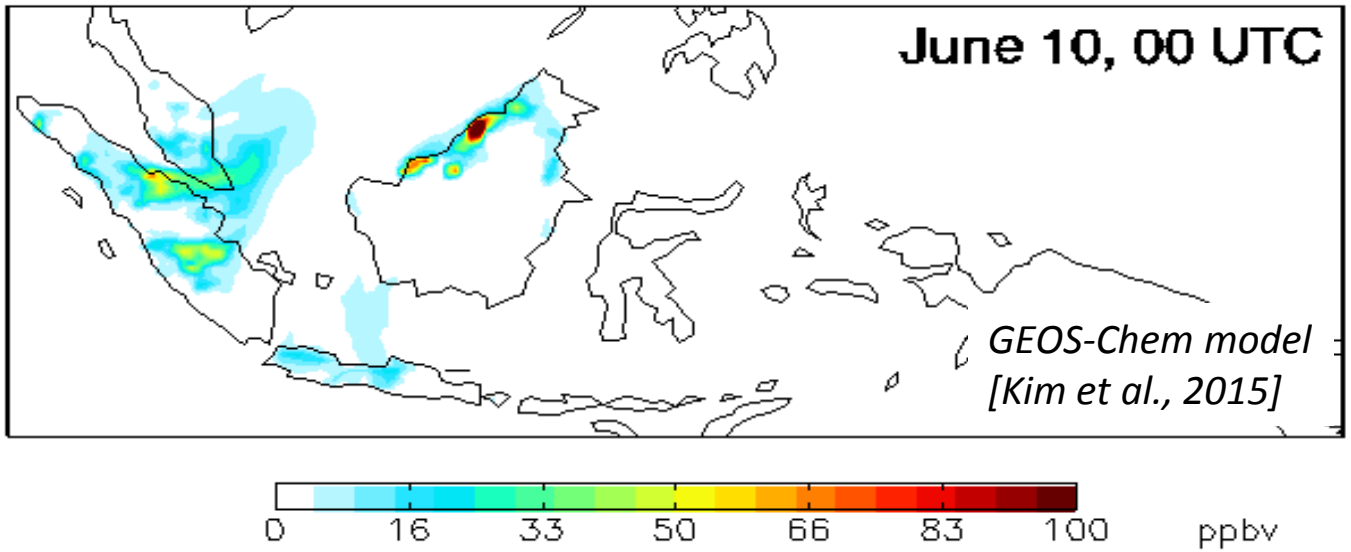


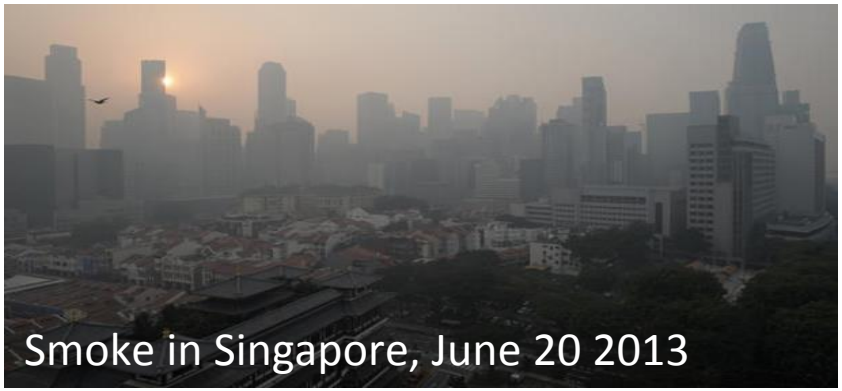
2015/02/19 day 19-25



Predicting Air Quality

Smoke from agricultural fires in Sumatra





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GAW

WGNE – Working Group on Numerical Experimentation

fostering the **development of atmospheric circulation models** for use in weather prediction and climate studies on **all time scales**, and **diagnosing and resolving shortcomings**.

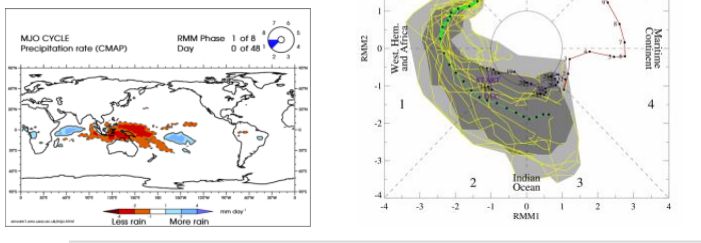
Objectives are achieved through

- Identification of **systematic errors** common to many models.
- Sharing **diagnostic tools and techniques** to get to the root of the error.
- Sharing knowledge around **sensitivity of errors to model formulation** (parametrizations, dynamical core, etc.).
- Work with other groups (e.g. GASS & GLASS) to **develop solutions**.

Cases of strong or persistent events of aerosol pollution studied by the WGNE Aerosols project

1) Dust over Egypt: 4/2012 2) Pollution in China: 1/2013 3) Smoke in Brazil: 9/2012

MJO - Task Force: Real time MJO Index forecast activity using 20 forecast models



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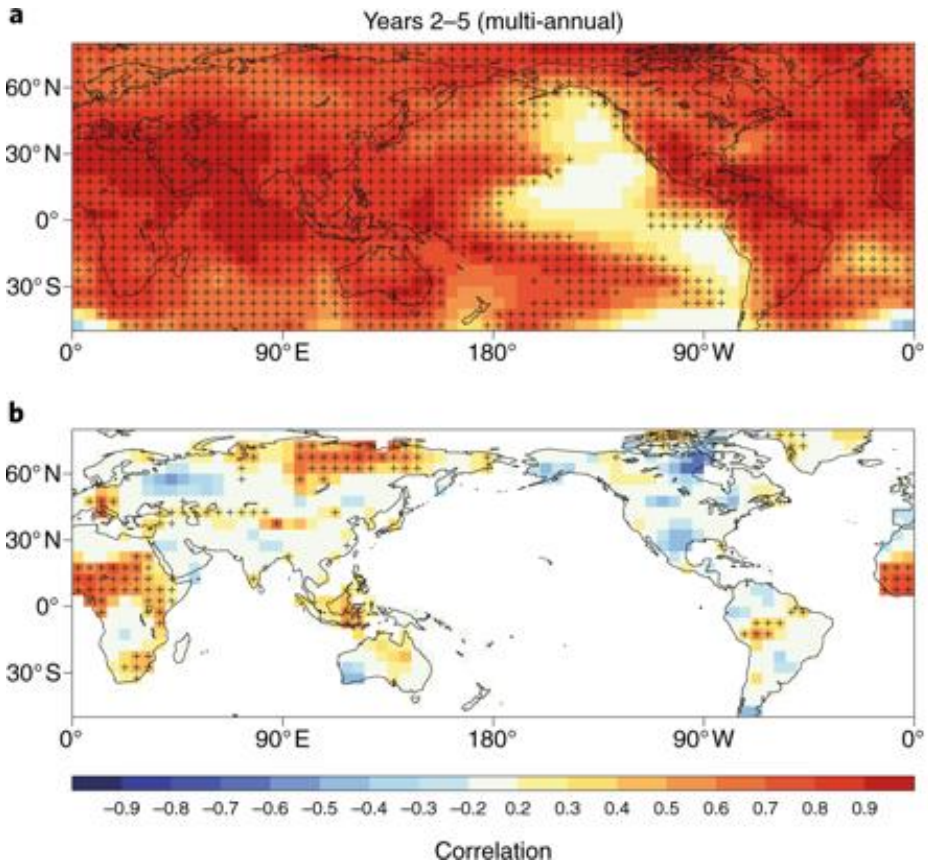
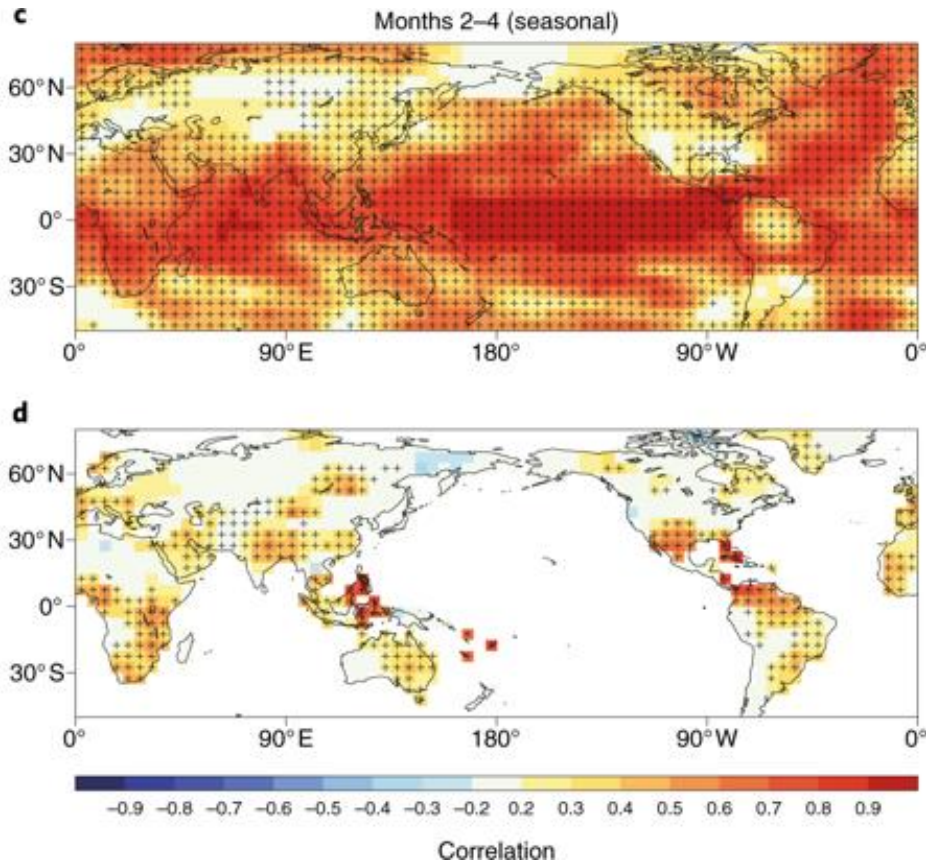
Decadal Prediction





Kushnir et al, Nature Climate Change
volume 9, pages94–101 (2019)

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Regional Innovation

FORECAST DEMONSTRATION PROJECTS

REGIONAL DEVELOPMENT AND INNOVATION PROJECTS

REGIONAL SCIENCE AND TECH TRANINGS

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

20 More than 20 global and regional research projects

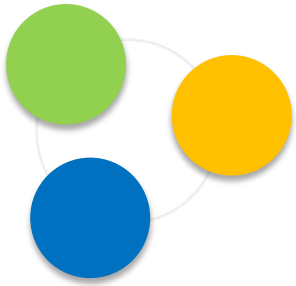
50 More than 50 countries engaged

100 More than 100 Mil Dollars mobilized

OLYMPIC GAMES

POLAR OBSERVING SYSTEM

FUTURE EWS IN EAST AFRICA



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Thank you
Merci

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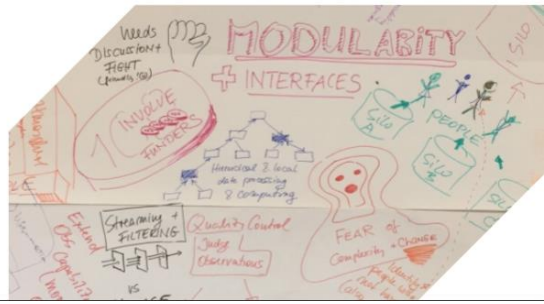
How to engage with Research

Mobilising the research community:

- Open Science Conferences
- Science Summits
- International Workshops including researchers and stakeholders
- Targeted smaller workshops focusing on specific topics
- Building regional activities
- Early Career Scientist activities

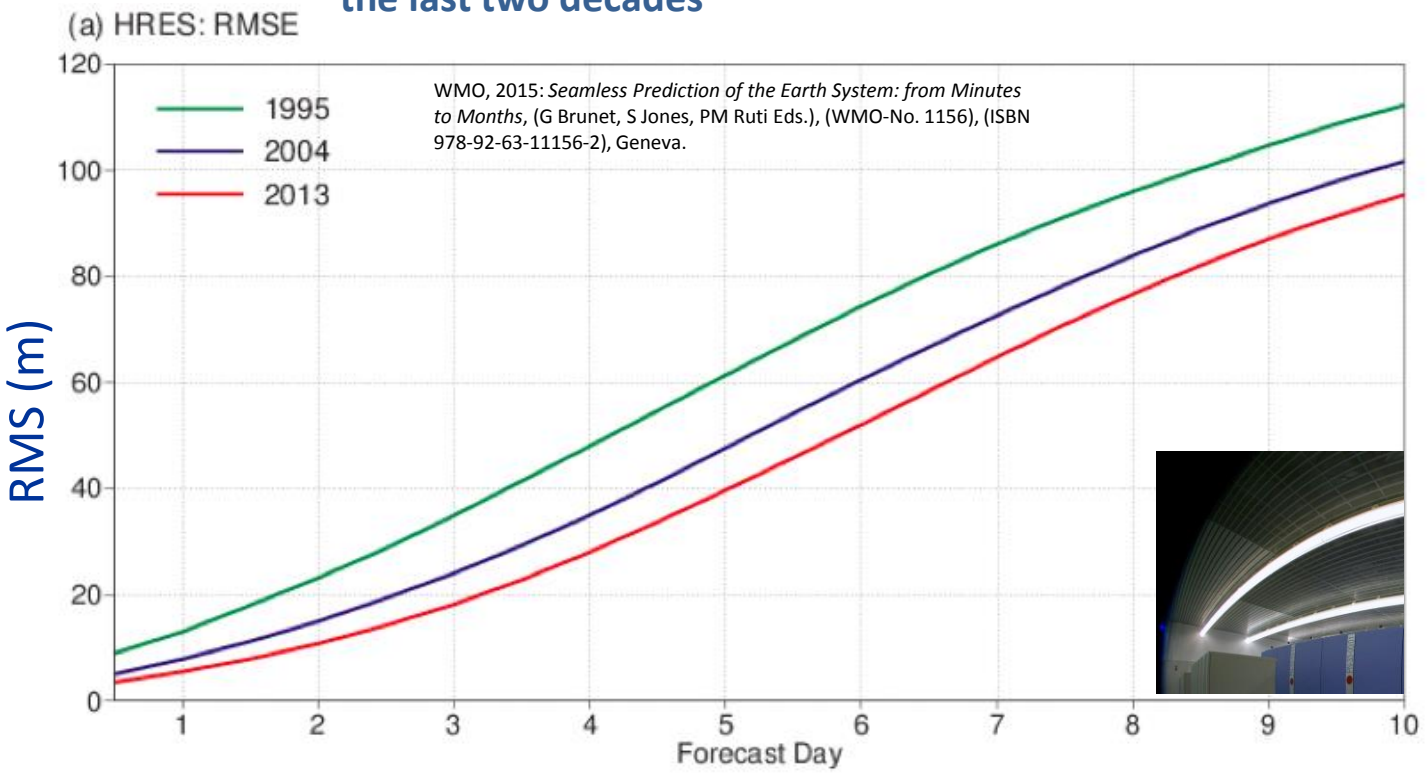
Mobilising research resources:

- Engaging with stakeholders and funding agencies



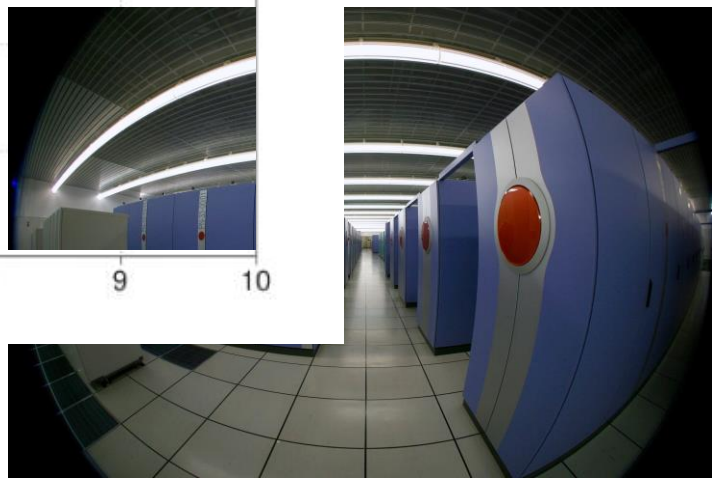
Improving the skill – big resources

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



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.

ECMWF



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Regional Forward thinking

- Regional Science – Social and Economic approaches: Increase the link between WWRP social and economic WG and Regions
- Fostering national and regional-level research-to-operation initiatives: regional science officer
- Based on on-going projects (HighWay) promote regional science donors-stakeholders conference

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