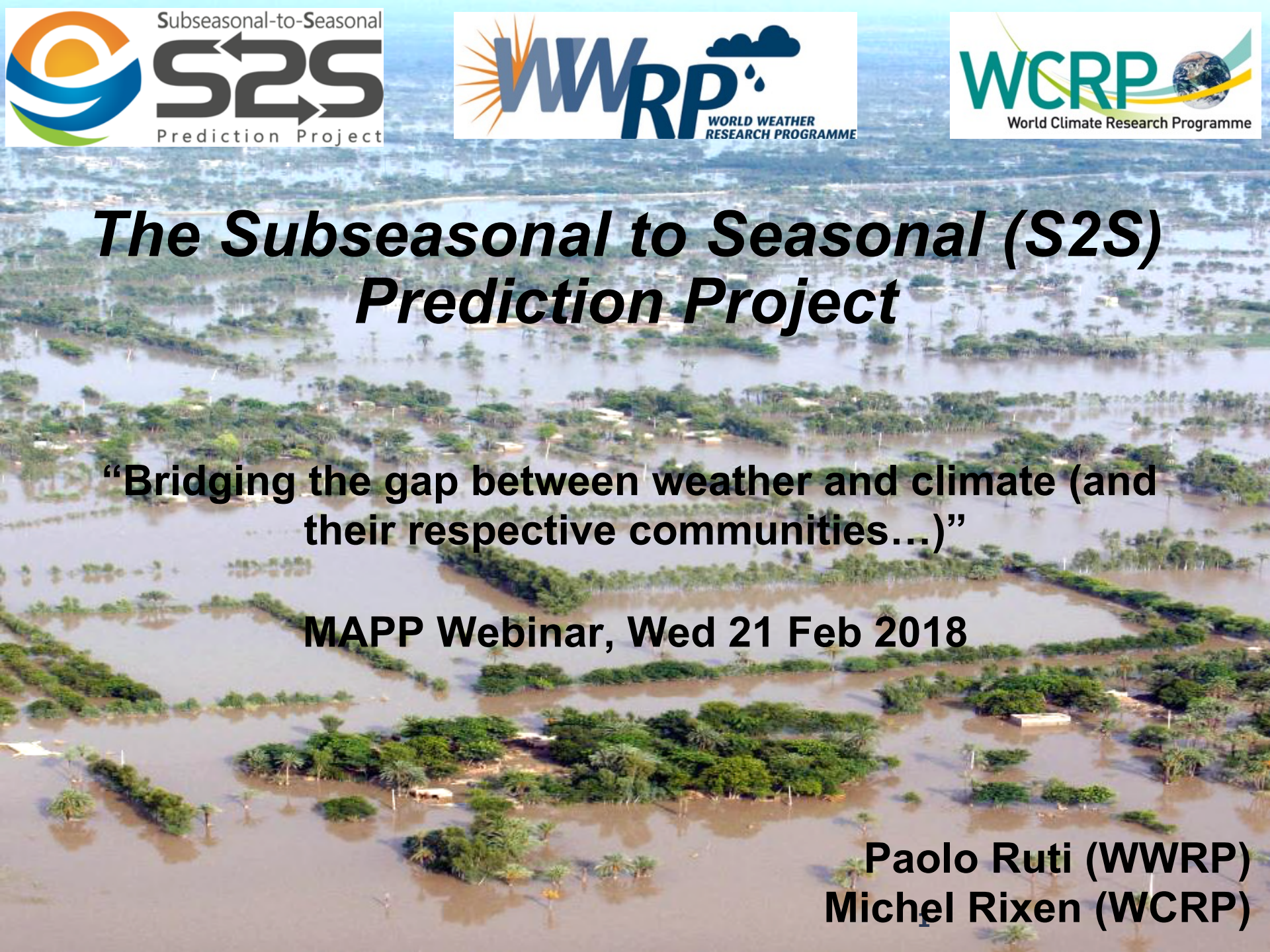


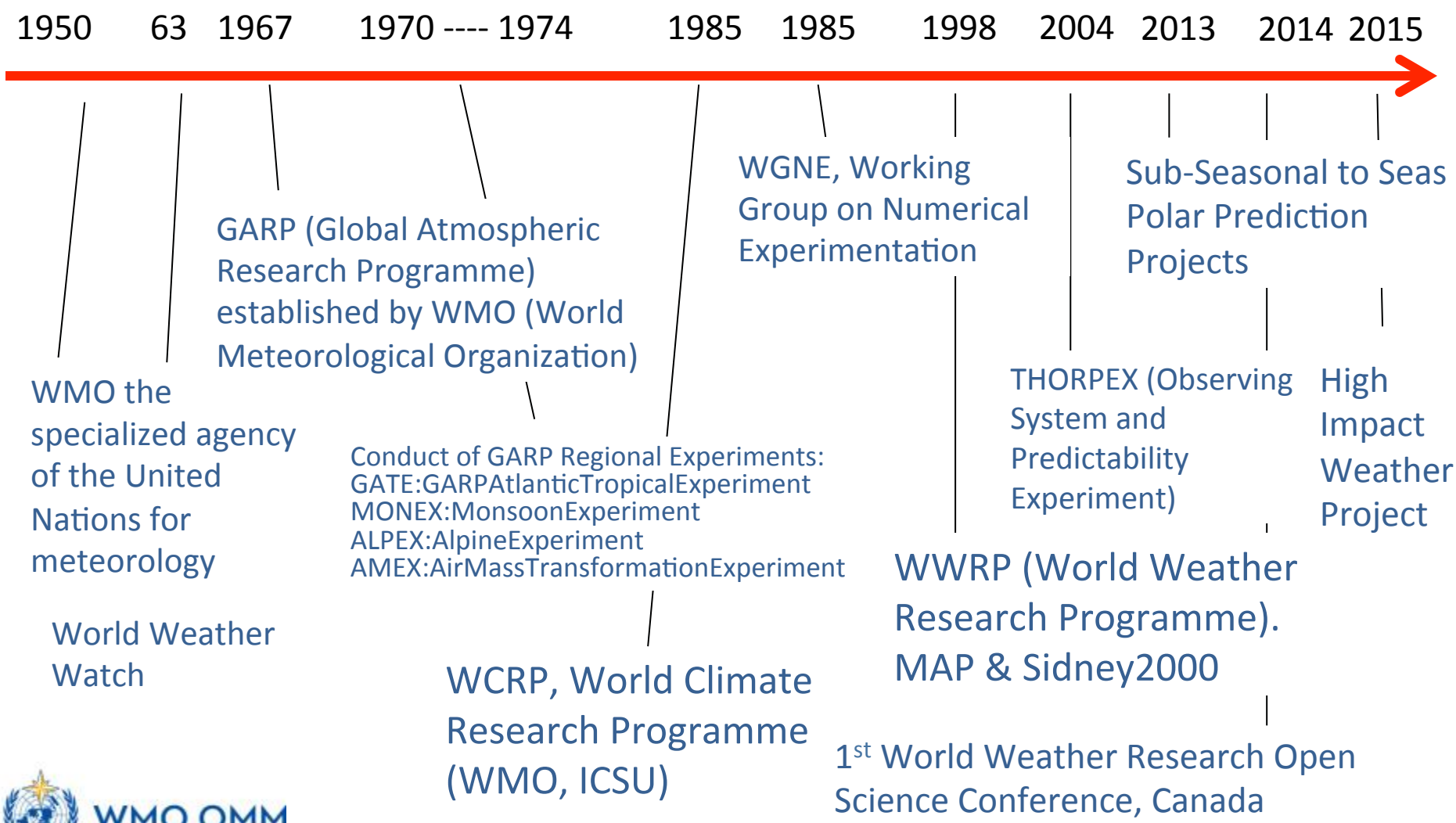
The Subseasonal to Seasonal (S2S) Prediction Project

"Bridging the gap between weather and climate (and their respective communities…)"

MAPP Webinar, Wed 21 Feb 2018

Paolo Ruti (WWRP)
Michel Rixen (WCRP)

Historical background



WMO OMM

The World Weather Research Programme

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

Mission

"The WMO 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**

WMO OMM

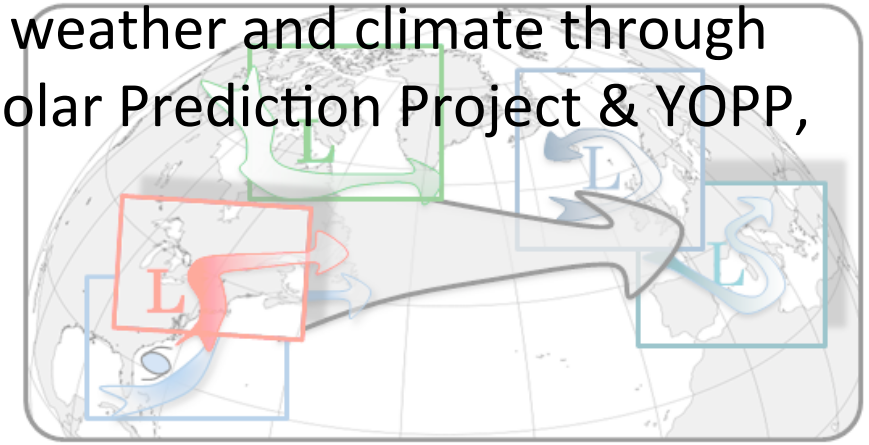
WWRP WORLD WEATHER RESEARCH PROGRAMME

Some Key Achievements

- Advancement in science of predictability, ensemble prediction, data assimilation, and nowcasting - high-resolution NWP
- Major field campaigns: IPY, YOTC, T-PARC, CONCORDIASI
- Data Infrastructure for research: THORPEX Interactive Grand Global Ensemble (TIGGE), forerunner for S2S database
- Quantifying the value/utility of targeting observations (WMO guidelines)
- Dedicated regional projects from research to forecast demonstration (Mesoscale Alpine Programme, Olympic Games)
- Major international workshops & training activities, sharing knowledge across communities and countries

Key topics at intersection of weather, climate and environment

- Understanding the multi-scale interaction between high-impact weather events and the environment in which they develop (HIWeather and GC Extremes; clouds to circulation GC; SPARC-PDEF link)
- Improving forecast skill and understanding on the subseasonal to seasonal timescale (S2S)
- Linking the impact of regional circulation systems to decision making processes both locally and globaly (Monsoons, tropical cyclone variabiltiy and impacts, air-quality)
- Increasing predictive skill for both weather and climate through coupled earth system modeling (Polar Prediction Project & YOPP, coupled data assimilation, …)



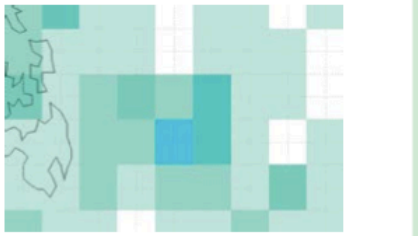
WMO OMM

Key topics at intersection of weather, climate and environment

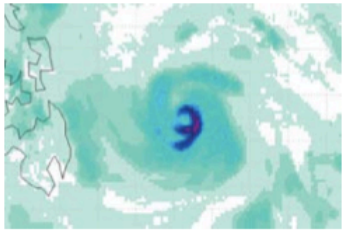
Advancing modelling and observations:

- Research to define the future observing system must consider needs for weather, climate and environment
- Distinction between weather and climate models is becoming less meaningful (WGNE, WWRP/ GEWEX-GASS-GLASS)
- HPC and data handling represent major future challenges
- Innovation in ensemble prediction, data assimilation, verification, post-processing has applications at all scales (Reanalysis, CMIP, …)
- Modelling and observing impacts needs shared expertise on vulnerability and risk

Improved forecasts



1981: Global models run at ~200 km resolution. Example: Total precipitation of Typhoon Haiyan (2013) in DWD ICON shown at 200 km resolution



2016: Global models run at ~12 km resolution. Example: Total precipitation of Typhoon Haiyan (2013) in DWD ICON, shown at 12 km resolution

WMO OMM

Key topics at intersection of weather, climate and environment

Strengthening regional activities:

- Societal impacts depend crucially on regional characteristics => joint regional projects e.g. WWRP & WCRP involvement in HyMEX
- Sustainable development requires working in partnership to enhance regional capacity

Preparing for the future:

- Research expertise must contribute to capacity development, e.g. Joint WG Verification training courses
- The long term success of research programmes depends on the involvement of Early Career Scientists - YESS

WMO OMM

WCRP's mission….

… is to facilitate analysis and prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society.

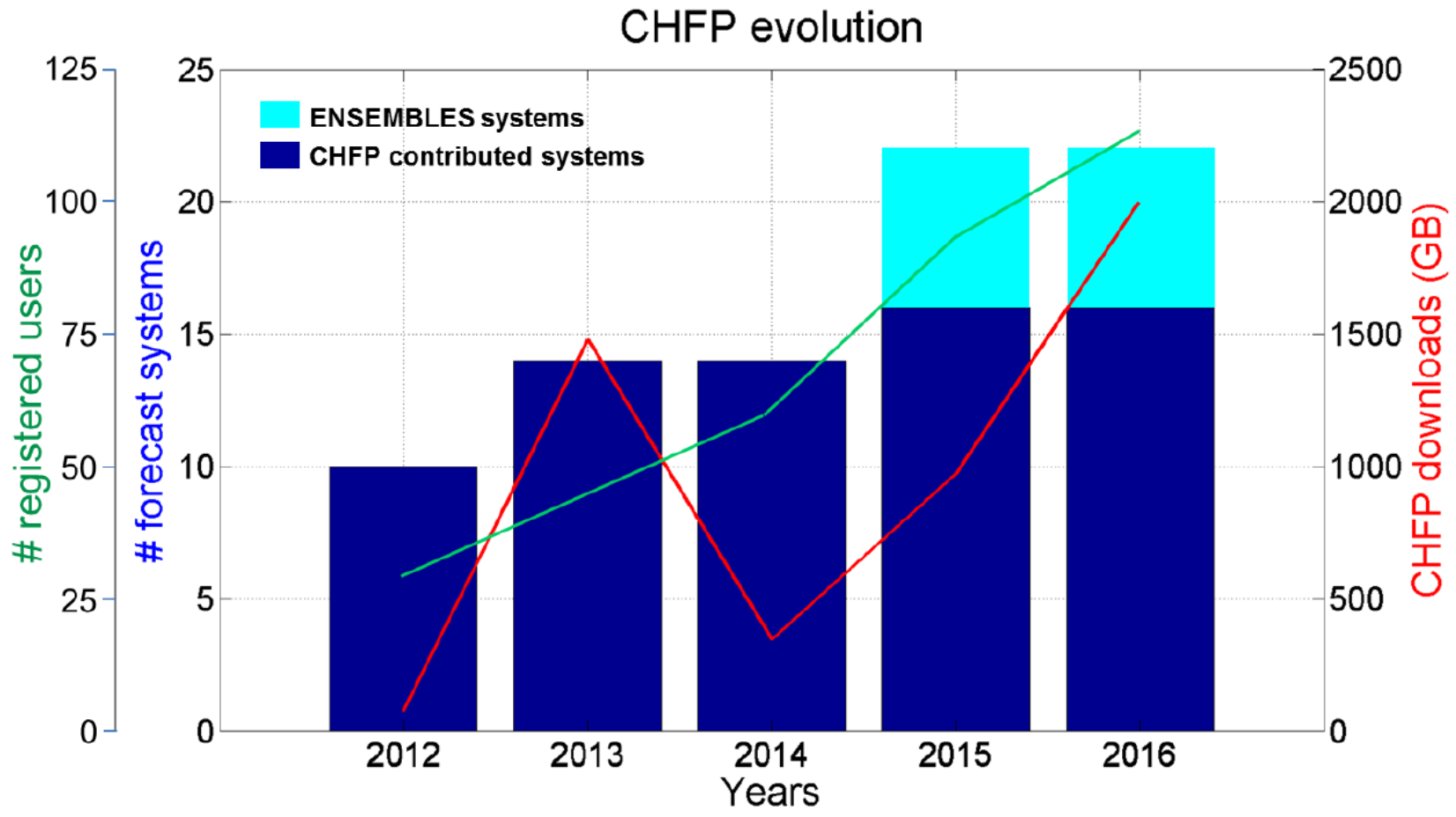
The two overarching objectives of WCRP are:

to determine the predictability of climate

to determine the effect of human activities on climate

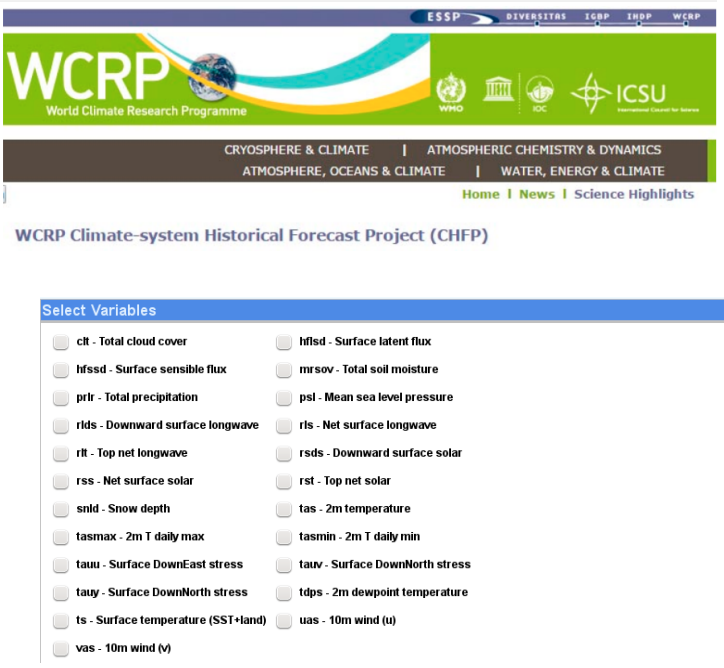
Current WGSIP Projects – CHFP

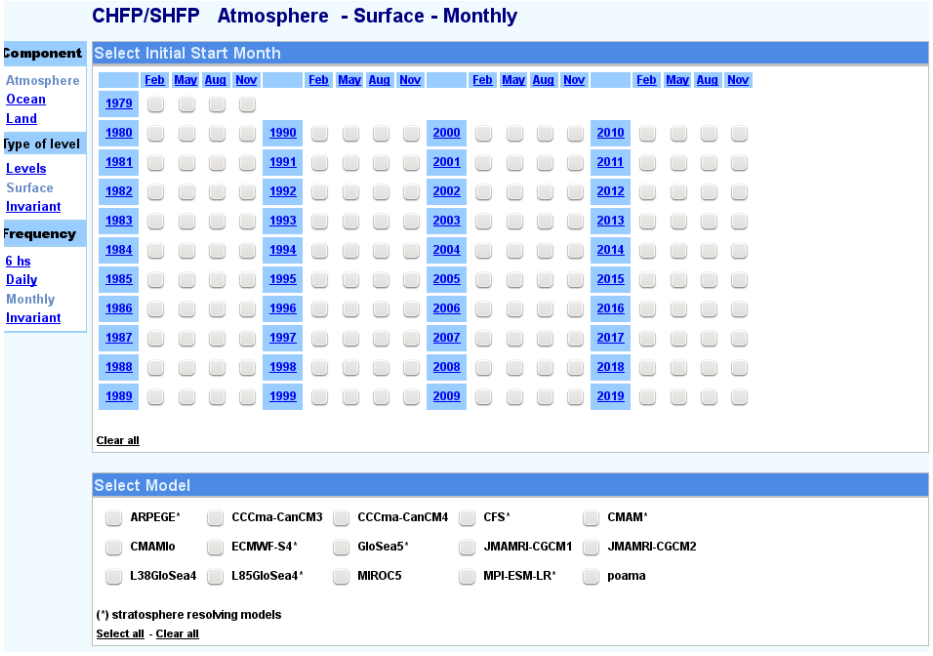
- Climate-system Historical Forecast Project (CHFP) is an extensive multi-model archive of seasonal hindcasts
- Supports investigations into seasonal predictability of the climate system and multi-model ensemble forecasting



Current WGSIP Projects – CHFP

- CHFP data served at CIMA:





Current WGSIP Projects – SNOWGLACE

WMO WGSIP INITIATIVE:

"SNOWGLACE":

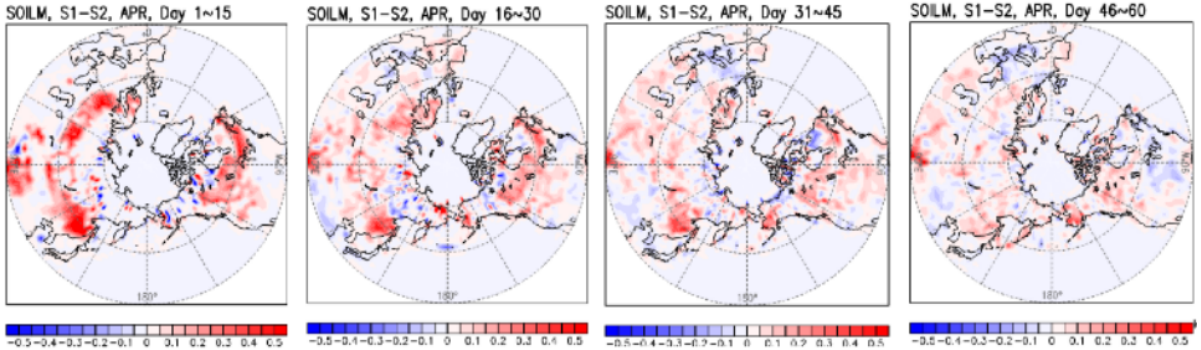
An international project aimed at quantifying snow initialisation impact on subseasonal-to-seasonal forecasts

Yvan J. Orsolini[1,2] and Jee-Hoon Jeong[3]

[1] NILU - Norwegian Institute for Air Research, [2] BCCR - Bjerknes Centre for Climate Research,
[3] Faculty of Earth Systems & Env. Sciences, Chonnam National Univ., South Korea

- Modeling strategy follows that of GLACE2 initiative (compare forecast sets having realistic vs climatological land initializations)
- Participants: ECMWF, BSC (Spain), NILU (Norway), Chonnam National University - UNIST (South Korea), KOPRI (South Korea), IAP (China), Gøteborg University (Sweden)

Increase in soil moisture potential predictability attributable to realistic snow initialization as a function of lead time, 1 Apr initialization



Current WGSIP Projects – Teleconnections

WMO WGSIP INITIATIVE:

"Interaction/teleconnection between tropics and extra-tropics":

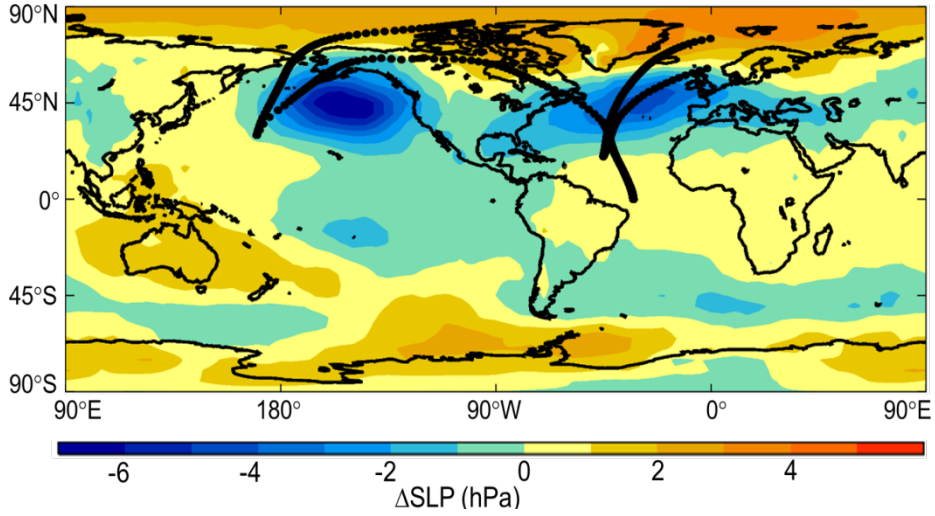
An international project aimed at diagnosing tropical-extratropical interactions at seasonal and sub-seasonal time scales

Laura Ferranti[1] Adam Scaife[2] Herve Douville[3]

[1] European Center for Medium Range weather Forecast, [2] Met Office Hadley Centre, [3] Meteo France

- Aim is to evaluate ability of current dynamical forecasting systems in representing tropical-extratropical teleconnections, using tropical rainfall to anomalous tropical atmospheric heat sources

Atmospheric teleconnections arising from El Niño in boreal winter. Dots represent approximate pathways of barotropic planetary waves having azimuthal wave numbers 1 and 2, propagating on the observed climatological background wind (after Scaife et al [2017]). Colors show associated changes in sea level pressure in hPa, indicative of atmospheric circulation changes.



Current WGSIP Projects– Shock/Drift

WMO WGSIP INITIATIVE:

Long-Range Forecast Transient Intercomparison Project (LRFTIP)

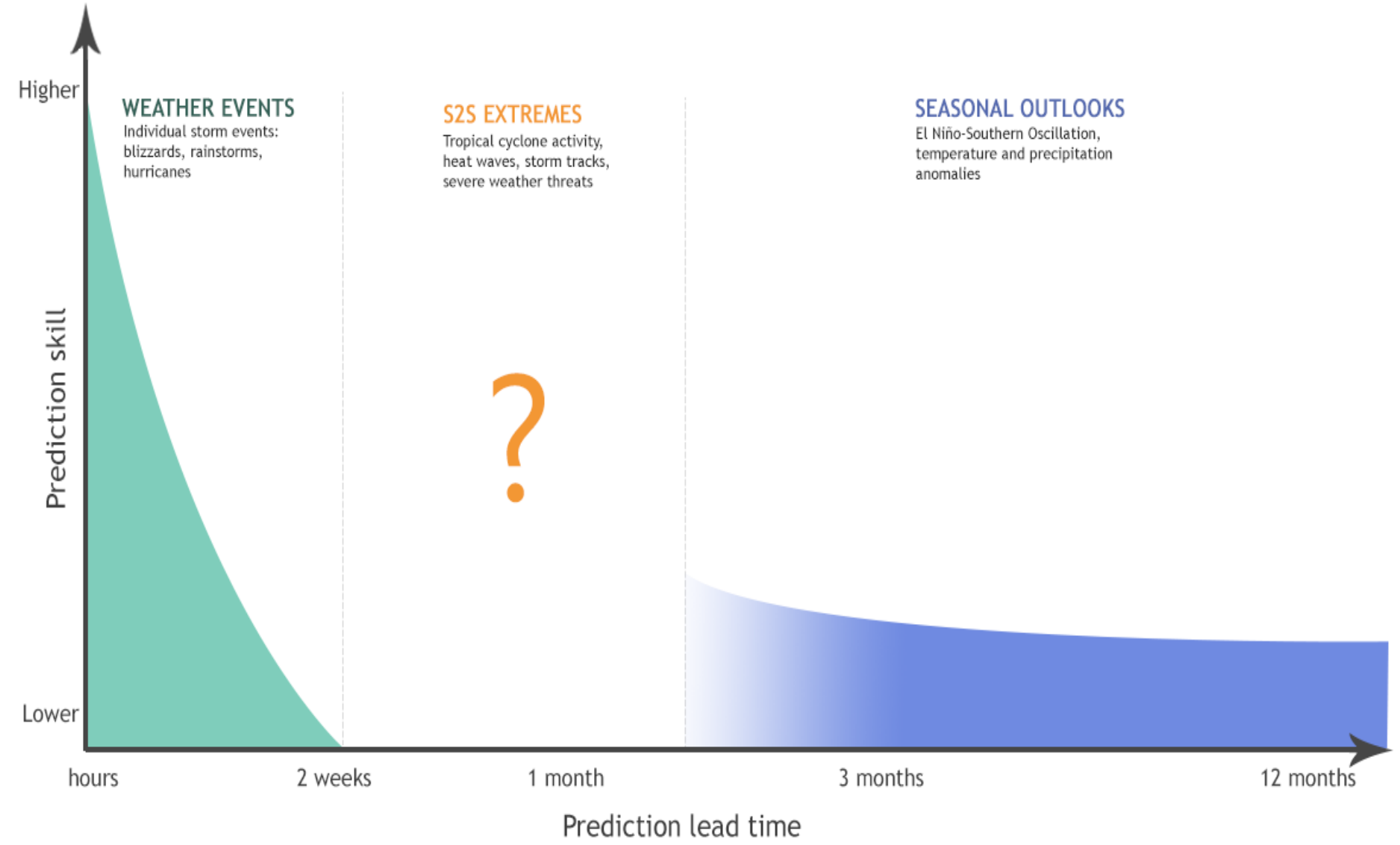
An international project aimed at characterizing transient behaviour of initialized forecasts on subseasonal to decadal time scales

William Merryfield[1] (lead, S2D component), Mikhail Tolstykh[2,3] (lead, S2S component), Francisco Doblas-Reyes[4], Tamaki Yasuda[5], Woo-Sung Lee[1]

[1] Canadian Centre for Climate Modelling and Analysis, Environment and Climate Change Canada, [2] Institute of Numerical Mathematics, Russian Academy of Sciences (INM RAS), [3] Hydrometcentre of Russia (HMCR), [4] Catalan Institute of Climate Sciences (IC3), [5] Japan Meteorological Agency (JMA)

- Purpose is to enable multi-model intercomparison studies of the transient behavior of coupled long-range forecast models evolving from observation based initial conditions
- **Models:** Archive of hindcast and ancillary climatologies so far includes
  - **4 subseasonal** forecast models (S2S)
  - **19 seasonal** forecast models (CHFP, ENSEMBLES)
  - **15 decadal** forecast models (CMIP5, ENSEMBLES)

The S2S Prediction Gap



Adapted from: iri.columbia.edu/news/qa-subseasonal-prediction-project

atmosphere
(weather)

land

ocean

Predictability

~7 days

~30 days

Time

courtesy of Paul Dirmeyer (GMU/COLA)

WWRP-WCRP S2S Project
Mission Statement

"To improve forecast skill and understanding on the sub-seasonal to seasonal timescale with special emphasis on high-impact weather events"

"To promote the initiative's uptake by operational centres and exploitation by the applications community"

"To capitalize on the expertise of the weather and climate research communities to address issues of importance to the Global Framework for Climate Services"

S2S Project

5-year project, started in Nov 2013

Project office: KMA/NIMR hosts the project office in Jeju island

Trust Fund: Contributions from Australia, Canada and UK

http://s2sprediction.net/

Sub-seasonal to Seasonal (S2S) Prediction Project

Sub-Projects

- Interactions and teleconnections between midlatitudes and tropics
- Madden-Julian Oscillation
- Monsoons
- Africa
- Extremes
- Verification

Research Issues	Modelling Issues	Needs & Applications
• Predictability • Teleconnection • O-A Coupling • Scale interactions • Physical processes	• Initialisation • Ensemble generation • Resolution • O-A Coupling • Systematic errors • Multi-model combination	Liaison with SERA (Working Group on Societal and Economic Research Applications)

S2S Database

S2S Database

- Daily real-time forecasts + re-forecasts
- 3 weeks behind real-time
- Common grid (1.5x1.5 degree)
- Variables archived: about 80 variables including ocean variables, stratospheric levels and soil moisture and temperature

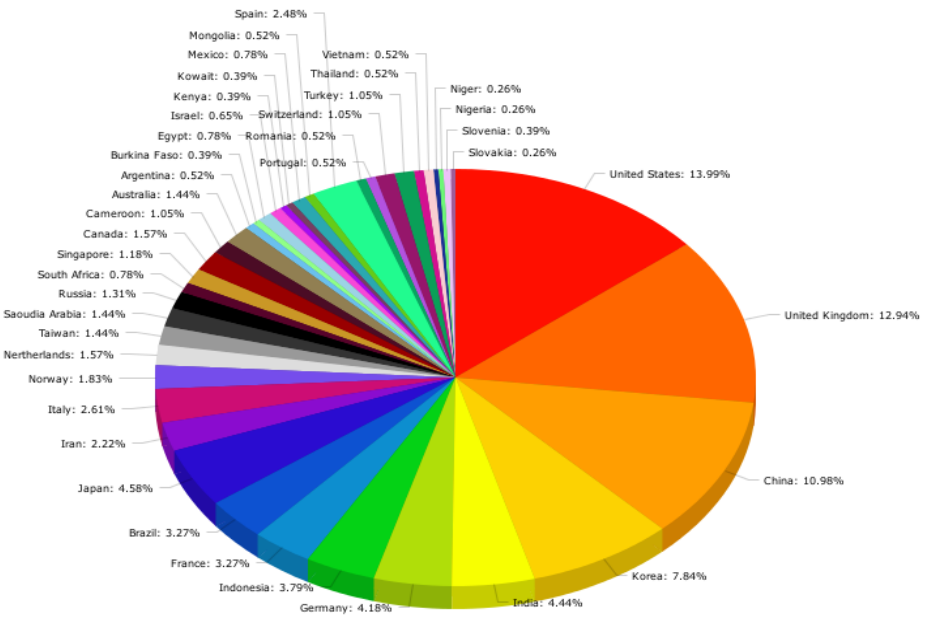
S2S partners

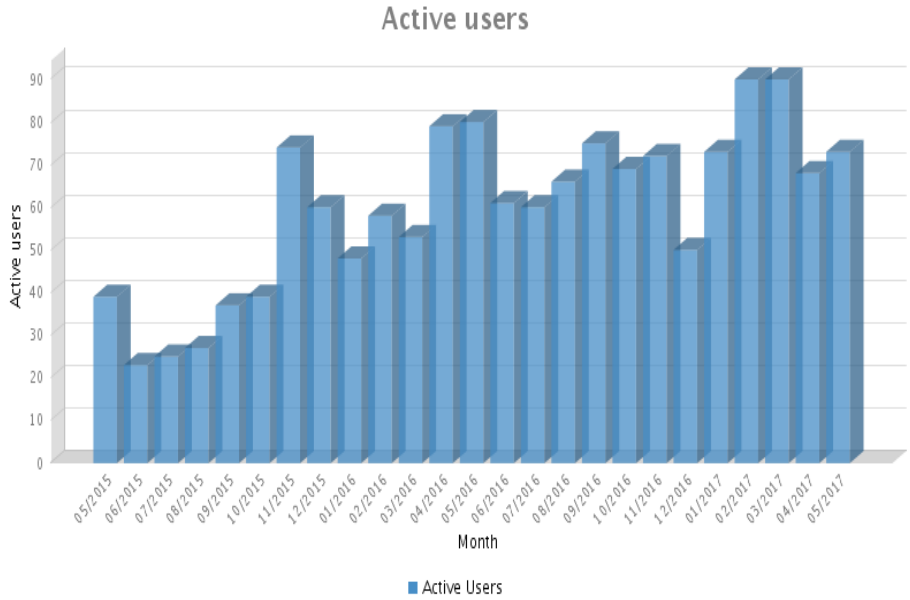
	Time-range	Resol.	Ens. Size	Freq.	Hcsts	Hcst length	Hcst Freq	Hcst Size
ECMWF	D 0-46	Tco639/319L91	51	2/week	On the fly	Past 20y	2/weekly	11
UKMO	D 0-60	N216L85	4	daily	On the fly	1993-2015	4/month	7
NCEP	D 0-44	N126L64	4	4/daily	Fix	1999-2010	4/daily	1
EC	D 0-32	0.6x0.6L40	21	weekly	On the fly	1995-2014	weekly	4
CAWCR	D 0-60	T47L17	33	weekly	Fix	1981-2013	6/month	33
JMA	D 0-33	TI479/TI319L100	50	weekly	Fix	1981-2010	3/month	5
KMA	D 0-60	N216L85	4	daily	On the fly	1996-2009	4/month	3
CMA	D 0-45	T106L40	4	daily	Fix	1886-2014	daily	4
CNRM	D 0-32	T255L91	51	Weekly	Fix	1993-2014	2/monthly	15
CNR-ISAC	D 0-31	0.75x0.56 L54	40	weekly	Fix	1981-2010	6/month	1
HMCR	D 0-63	1.1x1.4 L28	20	weekly	Fix	1981-2010	weekly	10

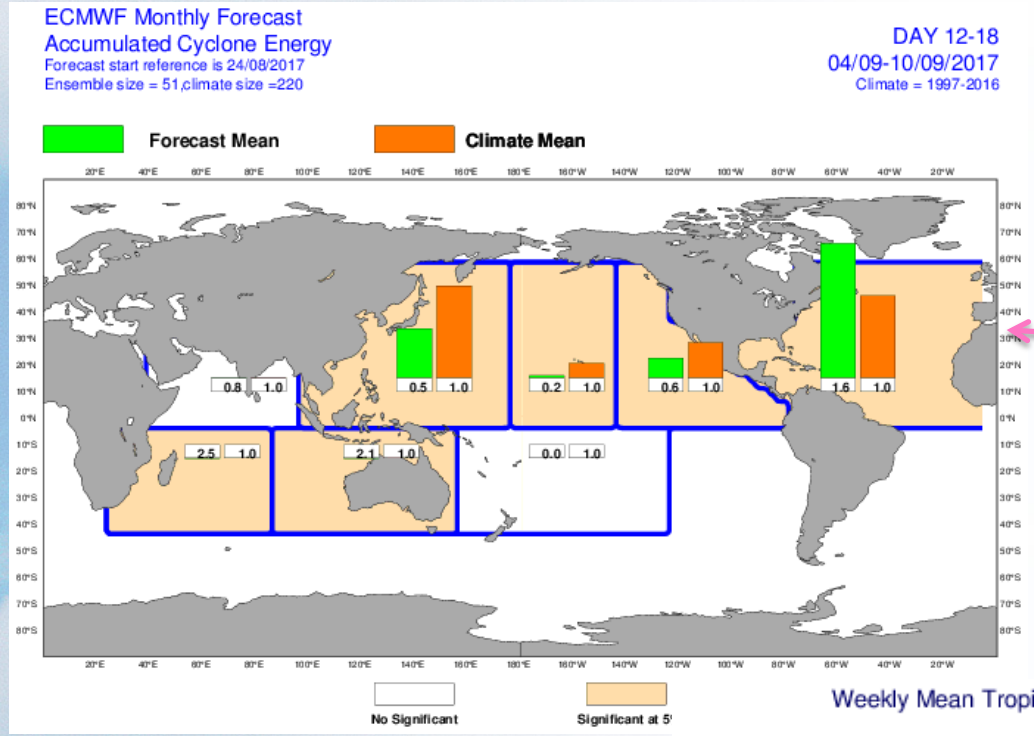
Use of the S2S database Since May 2015

- 848 registered users from 88 countries at ECMWF
- 222 register users mostly from China at CMA

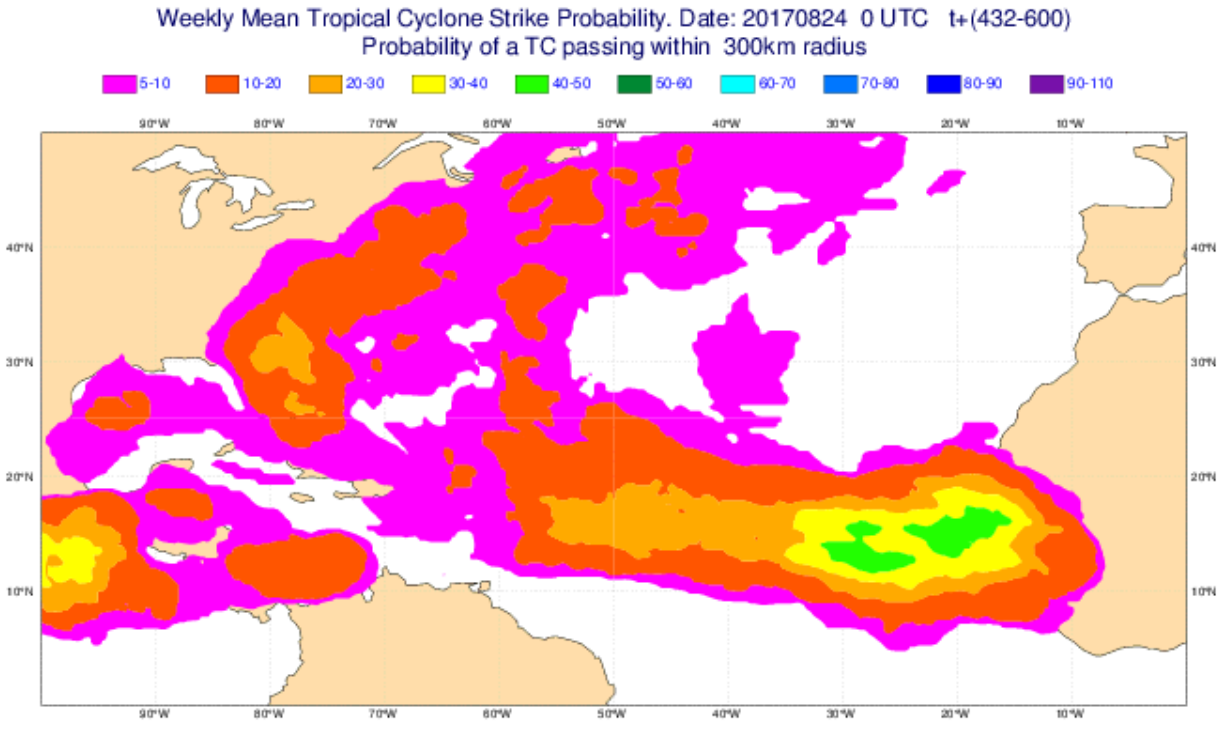
ECMWF Server







Third week prediction
Starting date: 24th August 2017
- Cyclone Energy
- Strike Probability



S2S Phase I - some key findings

- The skill of MJO forecasts in 7 of 10 S2S models exceeds a bivariate correlation skill of 0.5 at 20-day lead, while only one model reaches that level after 30 days;
- MJO teleconnections over the North Atlantic are of realistic sign, but too weak in all the models;
- MJO skill is enhanced by up to a week during the easterly phase of the stratospheric QBO in several S2S models;
- Evidence from the S2S database forecast ensembles suggests that the severe cold spell that affected Western Europe in March 2013 was at least in part attributable to a strong MJO event propagating into the western Pacific.
- The skill of the S2S models to predict Euro-Atlantic weather regimes and their transitions has been assessed. Results indicate predictive skill up to about 3 weeks for the positive and negative NAO phases, and up to about 16 days for the other weather regimes. The S2S models display skill to predict weather regime transitions up to about 16 days.

https://www.wcrp-climate.org/s2s-s2d-2018-home

16 March 2018: Deadline for submissions and applications for financial support

WCRP World Climate Research Programme

WWRP WORLD WEATHER RESEARCH PROGRAMME