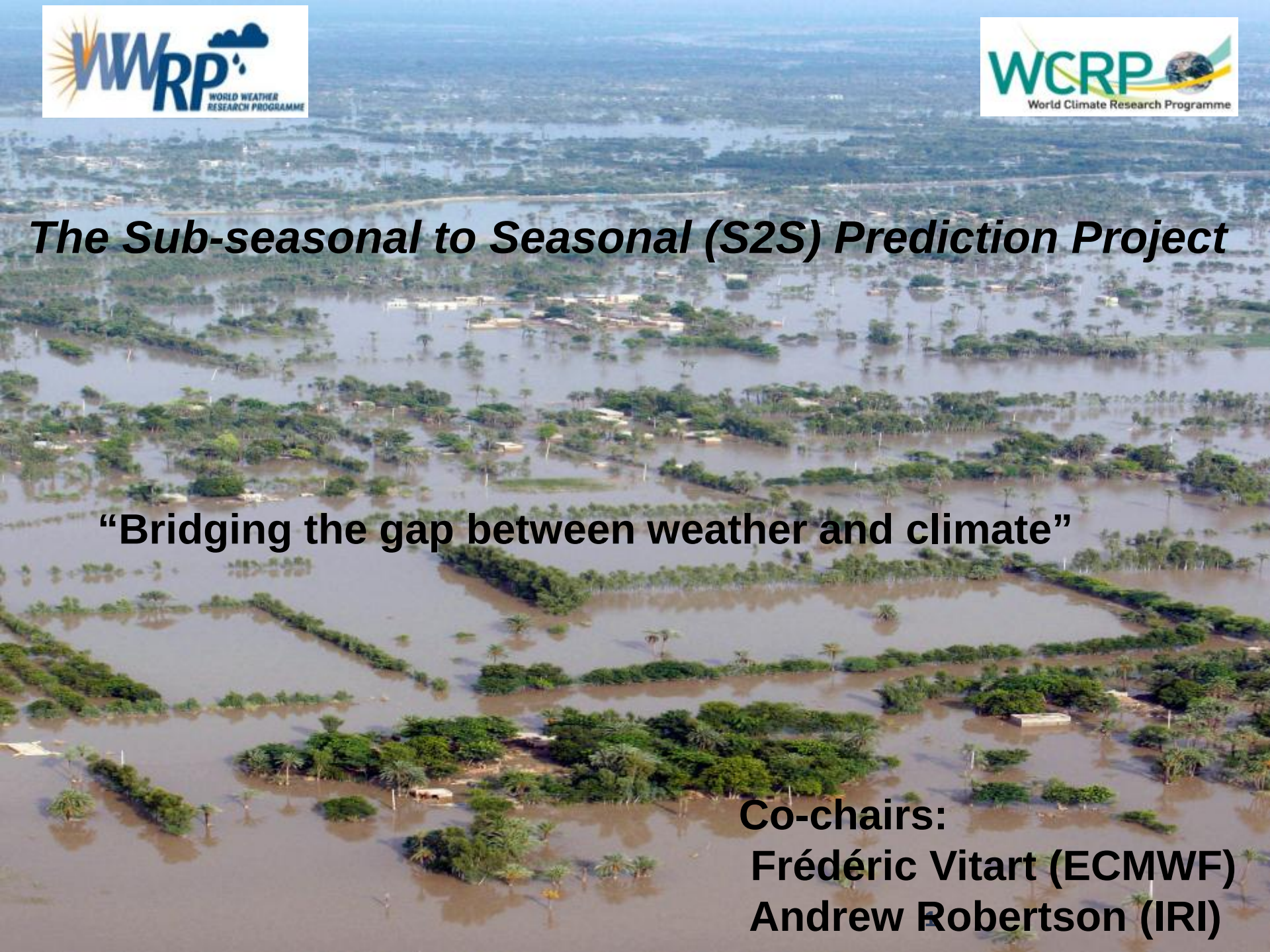


The Sub-seasonal to Seasonal (S2S) Prediction Project

“Bridging the gap between weather and climate”

Co-chairs:
Frédéric Vitart (ECMWF)
Andrew Robertson (IRI)

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

- Implementation plan finalized & printed
- Terms of references have been drafted
- 5-year project, started in Nov 2013.
- Project office: KMA/NIMR hosts the project office in Jeju island.
- Trust Fund: Contributions from Australia, USA and UK

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

Conferences/Education outreach

- *Nov 2013: S2S workshop organized by the S2S ICO (Jeju, Republic of Korea)*
- *Dec. 2013: S2S session at AGU conference*
- *Feb 2014: International conference on sub-seasonal to seasonal prediction – NCEP –*
- *Aug. 2014: WWRP Open Science Conference –Montreal, Canada:*

  S2S sessions (26 oral presentations in 6 sessions) + white paper
- **June 2015: 3-day workshop organized by the ICO (Jeju, Republic of Korea) on Sub-seasonal to seasonal predictability of monsoons.**

- *Oct 2014: Training course was co-organized with APCC in Busan (Republic of Korea)- It was attended by 18 participants from national meteorological services in 16 developing countries working on climate and weather forecasting, with funding from APCC.*
- **Nov, 2015: 2 week training course at ICTP (Trieste, Italy) for young scientists from developing countries**

International Conference on Sub-seasonal to Seasonal Prediction

(NCEP- 10–13 February 2014)

- Over 150 participants from 16 countries. 60 oral presentations and 80 posters
- This conference gave a clear indication of the growing interest that sub-seasonal predictions are getting. Week 3 and 4 is seen as the new frontier for predictability research
- Several presentations emphasized the importance of the weather-climate linkage, addressing the challenge of “end-to-end” forecasts for operations, applications and climate services.
- Conference abstract to appear soon in the Bulletin of The American Meteorological Society

S2S sub-projects

MJO Subproject

MJO and Maritime Continent (MC) Interactions: Evaluating State of the Art & Characterizing Shortcomings

In collaboration with the WGNE MJO Task Force

Major Objectives:

- Assess current model simulation fidelity and prediction forecast skill over the MC across time scales, with emphasis on the MJO, and identify and rectify model biases.
- What roles do: 1) multi-scale interactions, 2) topography and land-sea contrast, and 3) ocean/land-atmosphere coupling play in the MC-MJO interaction and how do they influence predictability over the MC.

Modeling Resources to Exploit

- 1) S2S Database, 2) MJOTF-GASS Multi-Model Exp and 3) ISVHE

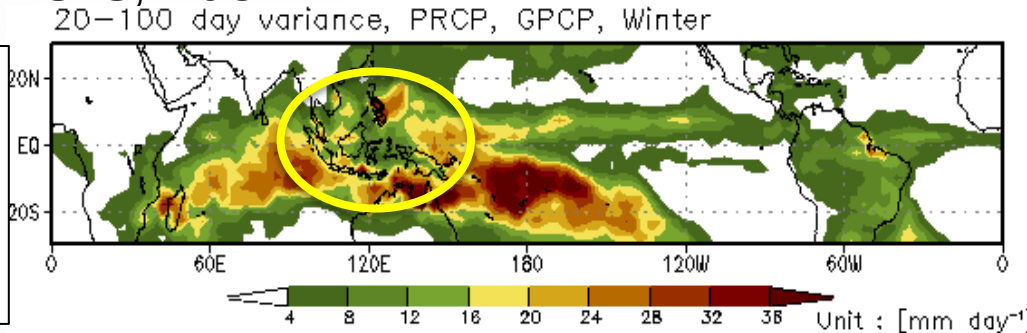
Potential Future Field Campaign

- Year of Maritime Continent (YMC) is a growing multi-nation effort to carry out a field campaign over the MC in 2017 to address objectives such as those above.

Tentative Development

- Spring 2016 Workshop for Subproject – S2S, MJOTF

Nexus of 1) land, atmosphere & ocean interactions and 2) multi-scale interactions: diurnal, mesoscale, synoptic, subseasonal, seasonal & interannual.



Africa sub-project

Main Goal

To develop skilful forecasts on the S2S time scale over Africa and to encourage their uptake by national meteorological services and other stakeholder groups.

Objectives:

- Assess the performance of forecasts for 5-40 days ahead using the S2S forecast archive, with focus on rain-day frequency, heavy rainfall events, dry spells and monsoon onset/cessation dates, with relevance to agriculture, water resources and public health.

- Develop metrics for measuring the success of forecasts in ways that are useful for farmers and other stakeholder communities.

- Improve understanding of the climate modes that drive sub-seasonal variability in Africa and their representations in models.

- The Africa sub-project will work with post-Africa Climate Conference 2013 framework (recently named “Climate Research for Development CR4D)” to connect international with African climate communities. An S2S activity is envisaged to be one of the first CR4D pilot activities, through a joint CR4D-S2S proposal to Future Earth program funding.

Monsoon sub-project

In collaboration with with GEWEX/CLIVAR monsoon panel

Major Objectives:

- Development of a set of scientifically and societally relevant intra-seasonal forecast products and metrics that are applicable to all the major monsoon systems which can be monitored with operational real-time forecast systems.

- Case studies of monsoon onsets

The S2S and ISVHE databases can be used to assess the skill of the forecasting systems to predict the onset of the various monsoons.

A compilation of the observed monsoon onsets has been produced and is available from the S2S website.

Extreme weather sub-project

Major Objectives:

- Evaluate the predictive skill and predictability of weather regimes and extreme events (droughts, floodings, head and cold waves)
- Assess the benefit of multi-model forecasting for extreme events
- Improve understanding of the modulation of extreme weather events by climate modes.
- Sub-seasonal prediction of tropical storms (link with TIGGE-GIFS and SWFDP)
- Case studies selected for the strong societal impact

A case study already completed: March 2013 cold wave over Europe. Results published in Meteoworld.

This sub-project will have links with HIW. A member of HIW (Brian Golding) will be part of this subproject.

Verification sub-project

Major objectives:

- Recommend verification metrics and datasets for assessing the forecast quality of S2S forecasts

- Provide guidance for a potential centralized effort for comparing forecast

Quality of different S2S forecast systems, including the comparison of multi-model and individual forecast systems and consider linkages with users and applications.

Issues to be addressed:

- Identification of current practises in sub-seasonal to seasonal forecasts
- Identification of user-relevant variables and quantities to be verified
- Provision of guidance on minimum hindcast standards (hindcast length and ensemble size)
- Promotion of subseasonal forecasting intercomparison efforts and evaluation of benefit of multi-model approach.

Teleconnections Mid-latitudes-tropics (Cristiana Stan and Hai Lin)

Major objectives:

- Better understand sub-seasonal tropical-extratropical interaction pathways.
- Identify periods and regions of increased predictability ("forecasts of opportunity")
- Improve sub-seasonal to seasonal forecasts of weather and climate for applications.

Issues to be addressed:

- Understand physical mechanisms of tropical-extratropical interaction
- Develop new comprehensive estimates of tropical diabatic heating
- Identify main errors associated with teleconnections.

S2S sub-projects

- The science plans of the 6 sub-projects have been discussed and finalized in the S2S steering group meetings. Updates to these plans are anticipated on an ongoing basis (www.s2sprediction.net)

- It is planned to open the membership of the sub-projects to persons outside the S2S steering group, to have a total membership for each sub-project of around 5-6 members.

- Cross-cutting activities which are relevant to all the sub-projects (predictability, teleconnections, role of ocean-atmosphere coupling..) will also take place.

- Sub-project activities are strongly dependent on the development and availability of the S2S database.

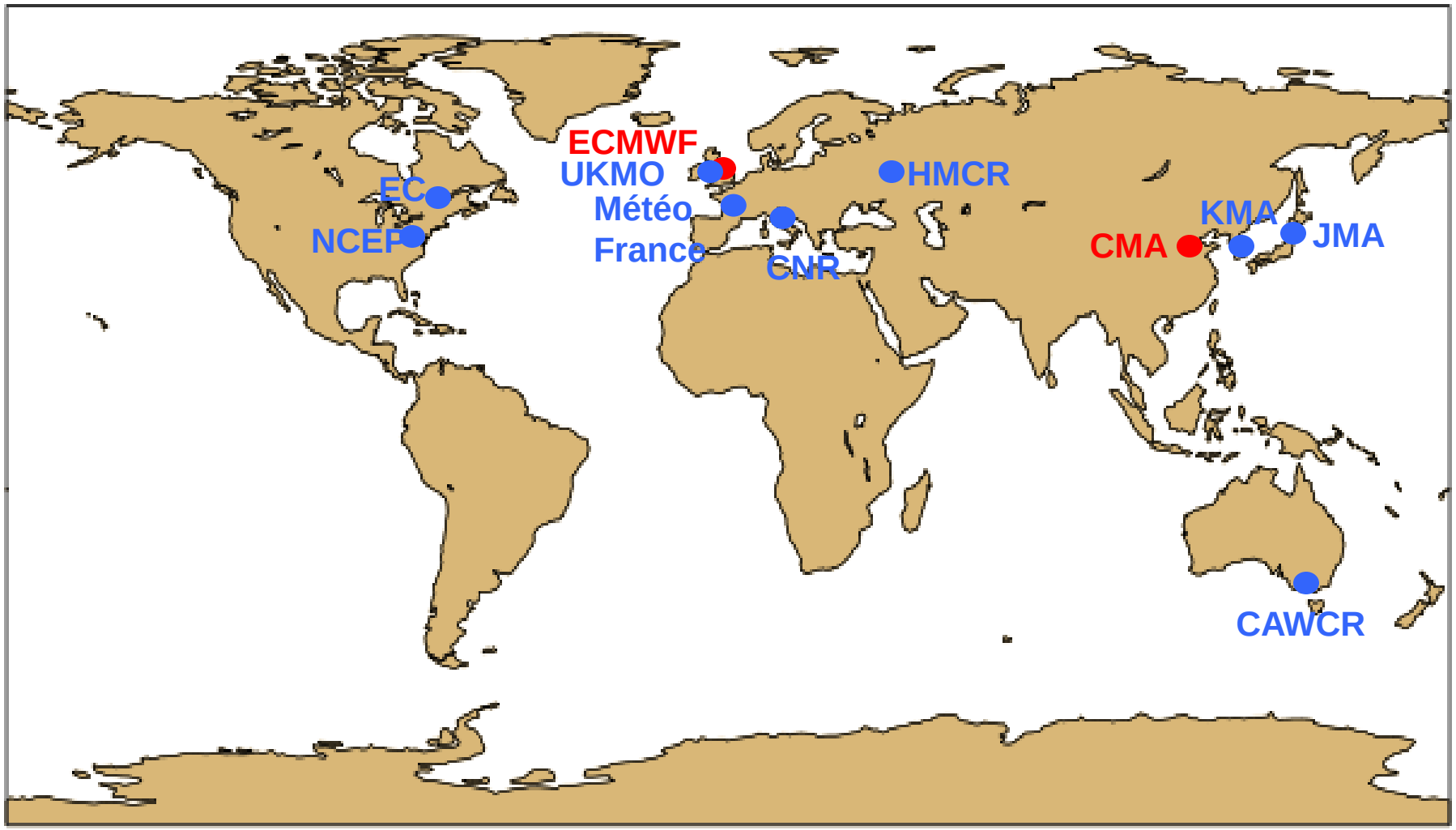
Database

Database Description

- 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/temperature
- Archived in GRIB2 – NETCDF conversion available
- Database to open in 2015, initially with 3 models (ECMWF, NCEP and JMA)

TIGGE-S2S Database

11 data providers and 2 archiving centres



S2S partners

	Time-range	Resol.	Ens. Size	Freq.	Hcsts	Hcst length	Hcst Freq	Hcst Size
ECMWF	D 0-32	T639/319L91	51	2/week	On the fly	Past 18y	2/weekly	11
UKMO	D 0-60	N96L85	4	daily	On the fly	1989-2003	4/month	3
NCEP	D 0-45	N126L64	4	4/daily	Fix	1999-2010	4/daily	1
EC	D 0-35	0.6x0.6L40	21	weekly	On the fly	Past 15y	weekly	4
CAWCR	D 0-60	T47L17	33	weekly	Fix	1981-2013	6/month	33
JMA	D 0-34	T159L60	50	weekly	Fix	1979-2009	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	1992-now	daily	4
Met.Fr	D 0-60	T127L31	51	monthly	Fix	1981-2005	monthly	11
CNR	D 0-32	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

Development of the S2S database

1) Define S2S data in GRIB2 (re-forecasts, daily means, new parameters…)

All the changes have been submitted to WMO and have been officialised in May 2014,

2) ECMWF software has been updated to include these changes.

3) Web page documentation on how to code and handle S2S data has been set up

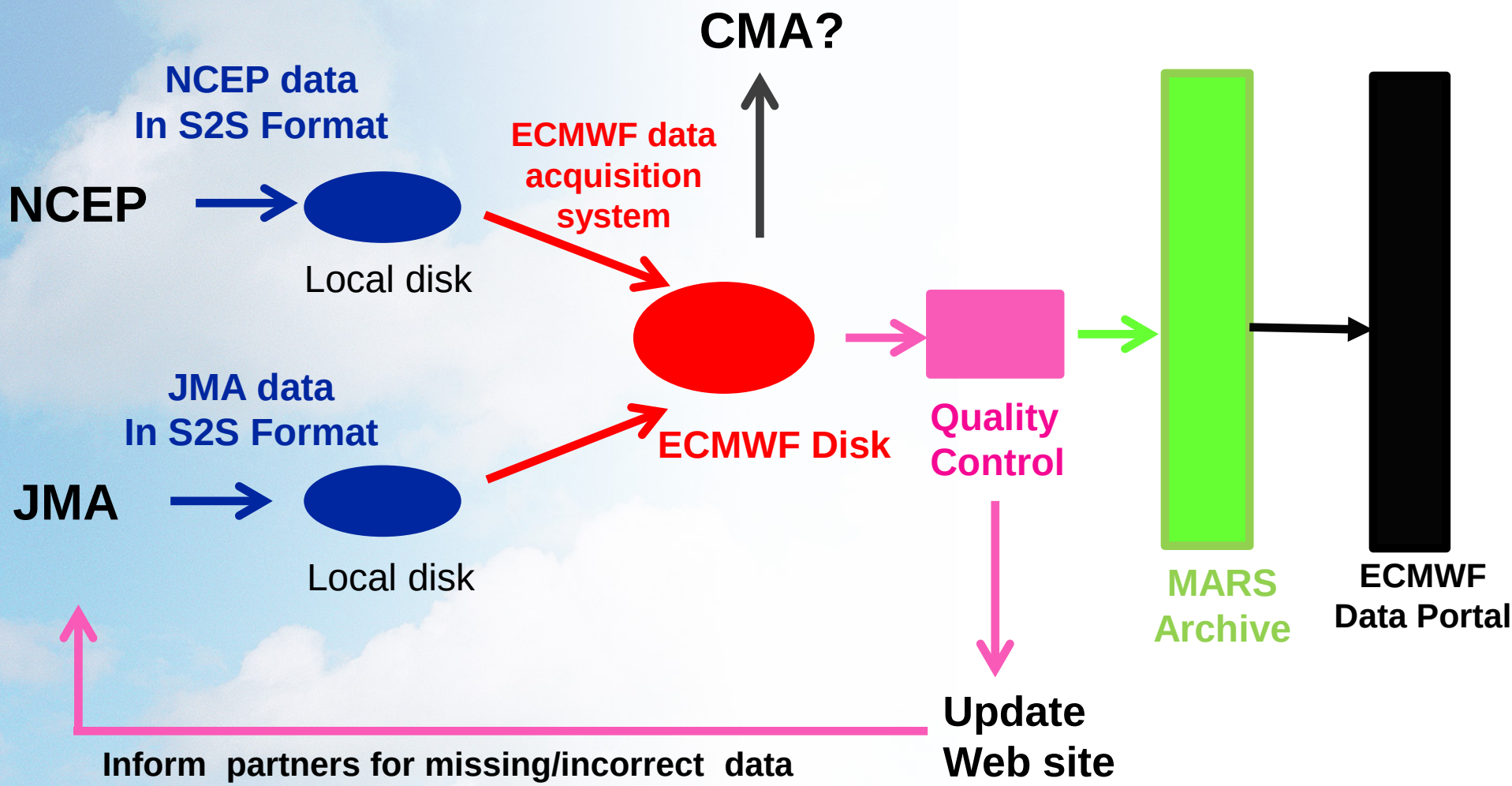
4) Test data: All partners have provided S2S test data. 7 partners are now ready for data exchange: CAWCR, ECMWF, NCEP, JMA, CMA, HMCR and Météo-France.

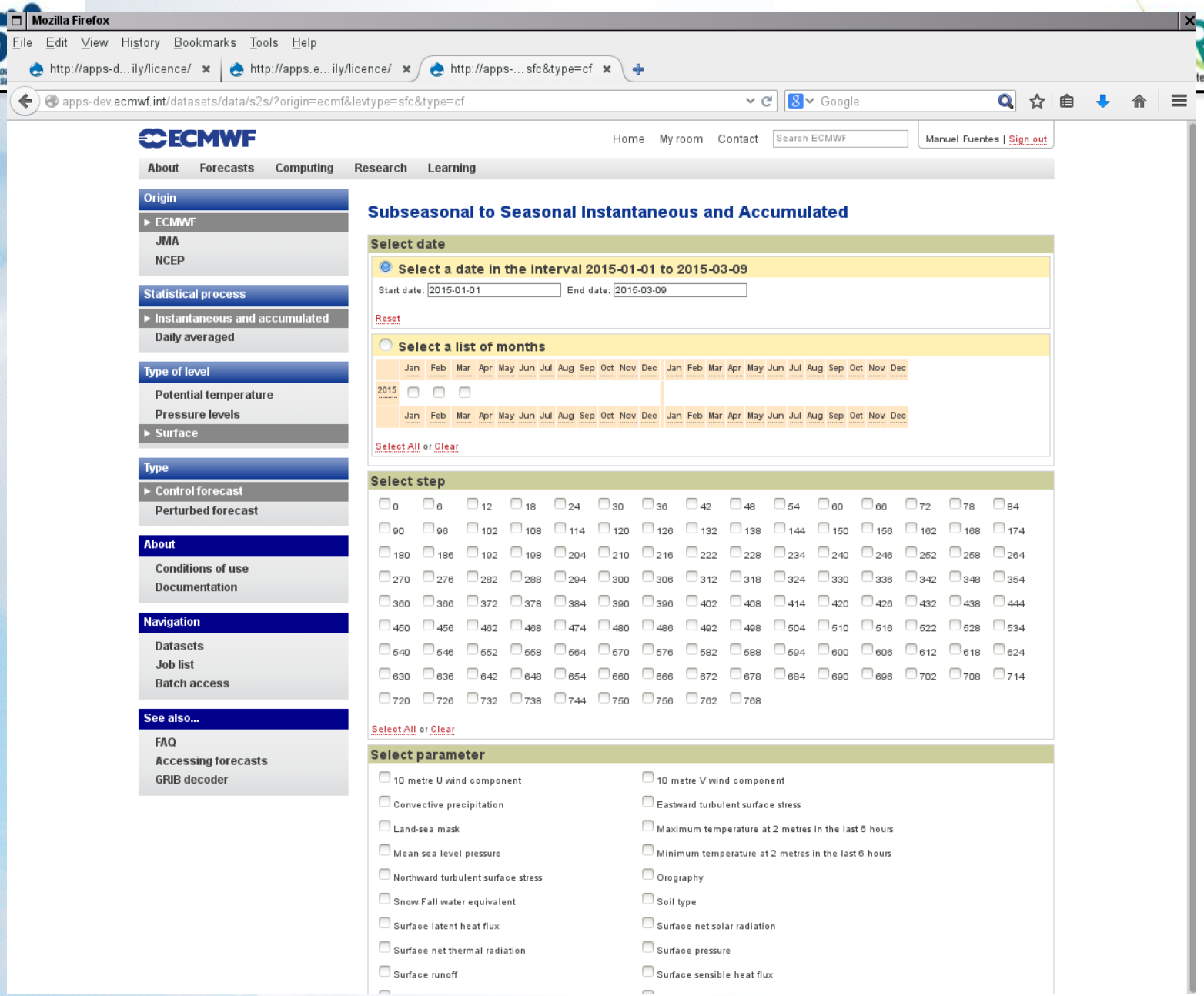
5) Data exchange started:

- Re-forecasts from JMA, CAWCR, NCEP and ECMWF archived in S2S database
- Real-time forecasts from ECMWF, NCEP, JMA and CAWCR routinely archived in S2S database.
- CMA and Meteo-France re-forecasts acquisition is in progress

S2S Data exchange

- Partners have been asked to provide data as close as possible to real-time
- Access from data portal restricted to 3-weeks behind real-time

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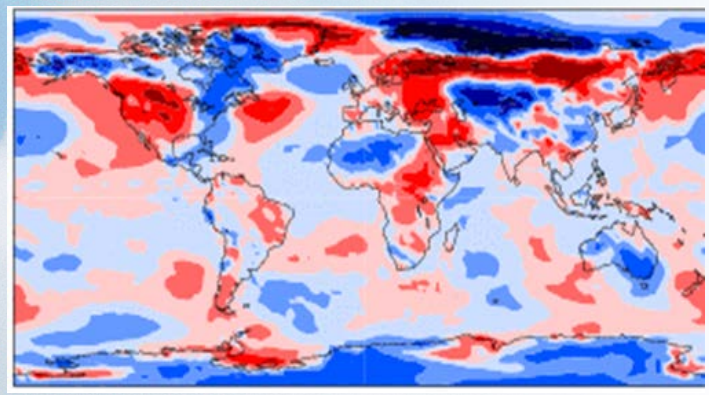
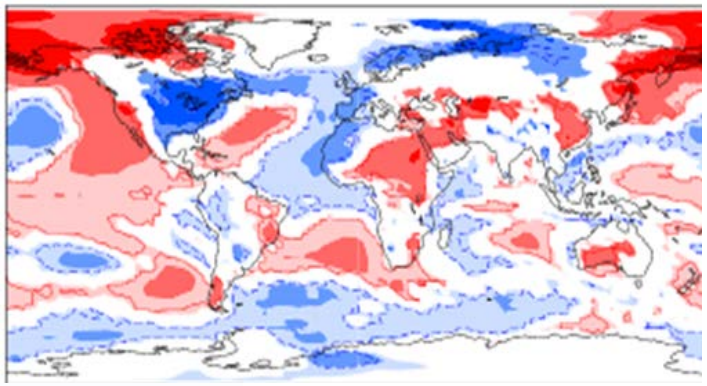
Google
ECMWF
Home My room Contact Search ECMWF Manuel Fuentes | Sign out
About Forecasts Computing Research Learning
Origin
ECMWF
JMA
NCEP
Statistical process
Instantaneous and accumulated
Daily averaged
Type of level
Potential temperature
Pressure levels
Surface
Type
Control forecast
Perturbed forecast
About
Conditions of use
Documentation
Navigation
Datasets
Job list
Batch access
See also...
FAQ
Accessing forecasts
GRIB decoder
Subseasonal to Seasonal Instantaneous and Accumulated
Select date
Select a date in the interval 2015-01-01 to 2015-03-09
Start date: 2015-01-01 End date: 2015-03-09
Reset
Select a list of months
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2015
Select All or Clear
Select step
0 6 12 18 24 30 36 42 48 54 60 66 72 78 84
90 96 102 108 114 120 126 132 138 144 150 156 162 168 174
180 186 192 198 204 210 216 222 228 234 240 246 252 258 264
270 276 282 288 294 300 306 312 318 324 330 336 342 348 354
360 366 372 378 384 390 396 402 408 414 420 426 432 438 444
450 456 462 468 474 480 486 492 498 504 510 516 522 528 534
540 546 552 558 564 570 576 582 588 594 600 606 612 618 624
630 636 642 648 654 660 666 672 678 684 690 696 702 708 714
720 726 732 738 744 750 756 762 768
Select All or Clear
Select parameter
10 metre U wind component
10 metre V wind component
Convective precipitation
Eastward turbulent surface stress
Land-sea mask
Maximum temperature at 2 metres in the last 6 hours
Mean sea level pressure
Minimum temperature at 2 metres in the last 6 hours
Northward turbulent surface stress
Orography
Snow Fall water equivalent
Soil type
Surface latent heat flux
Surface net solar radiation
Surface net thermal radiation
Surface pressure
Surface runoff
Surface sensible heat flux

Day 12-18 2-m temp anomalies - Forecasts starting on 15/01

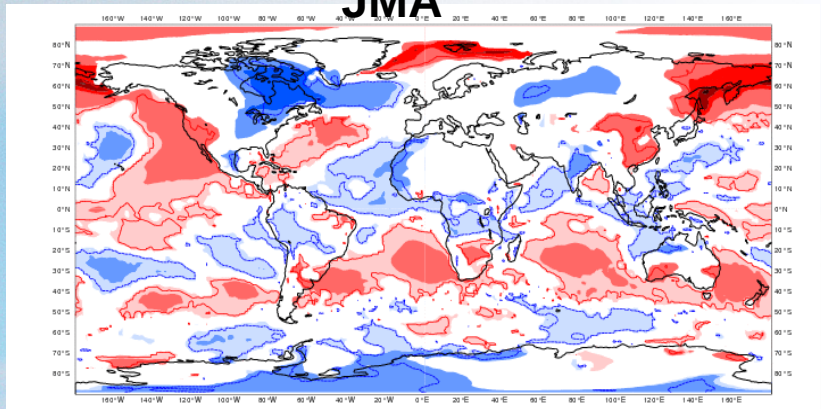
Verification



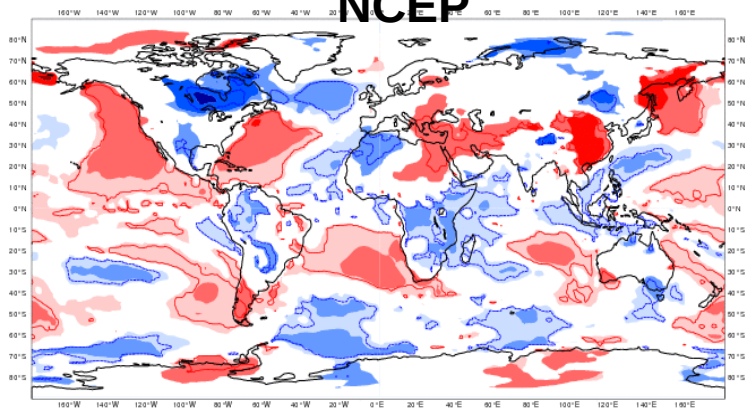
ECMWF



JMA

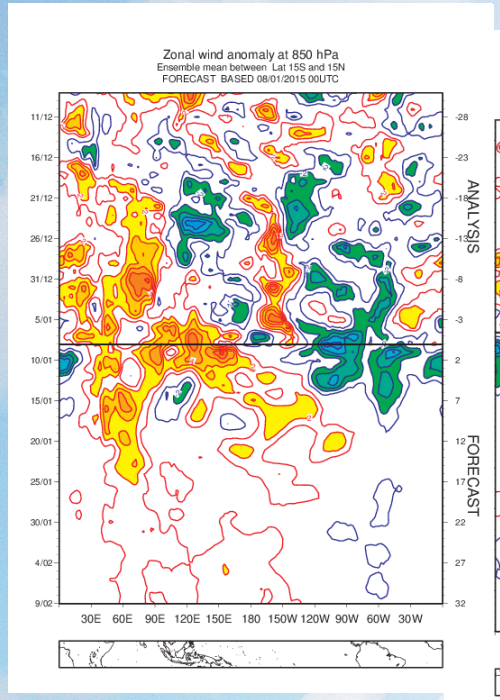


NCEP



S2S : MJO

ECMWF



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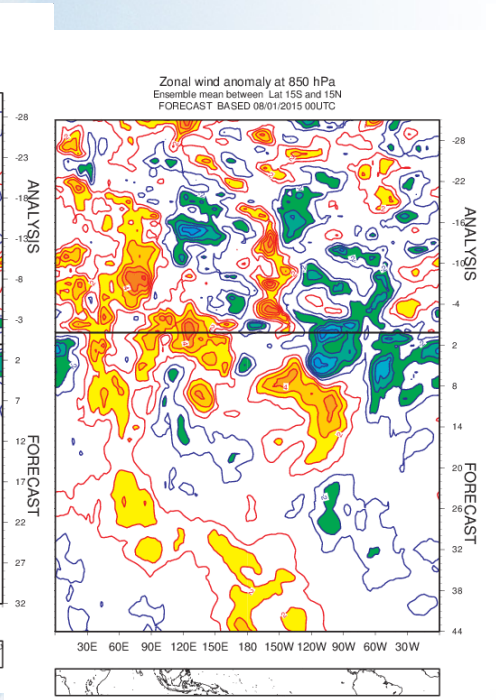

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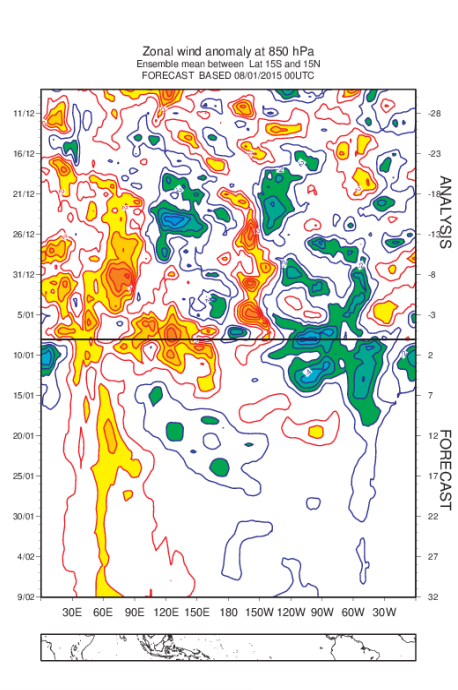
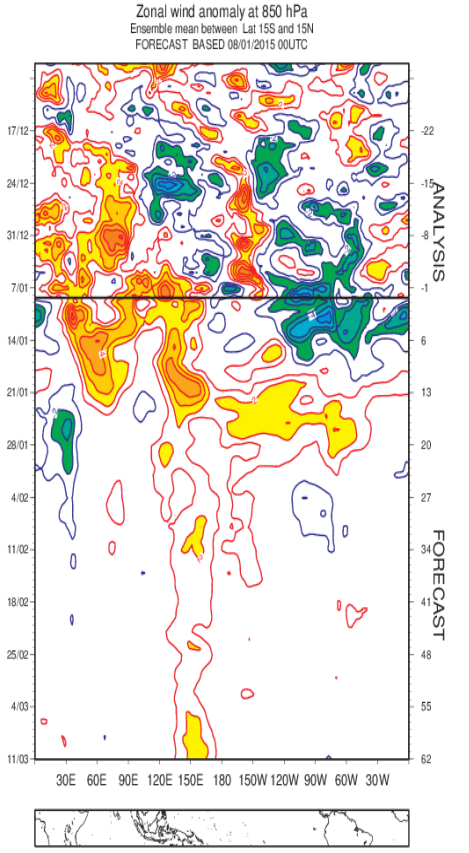
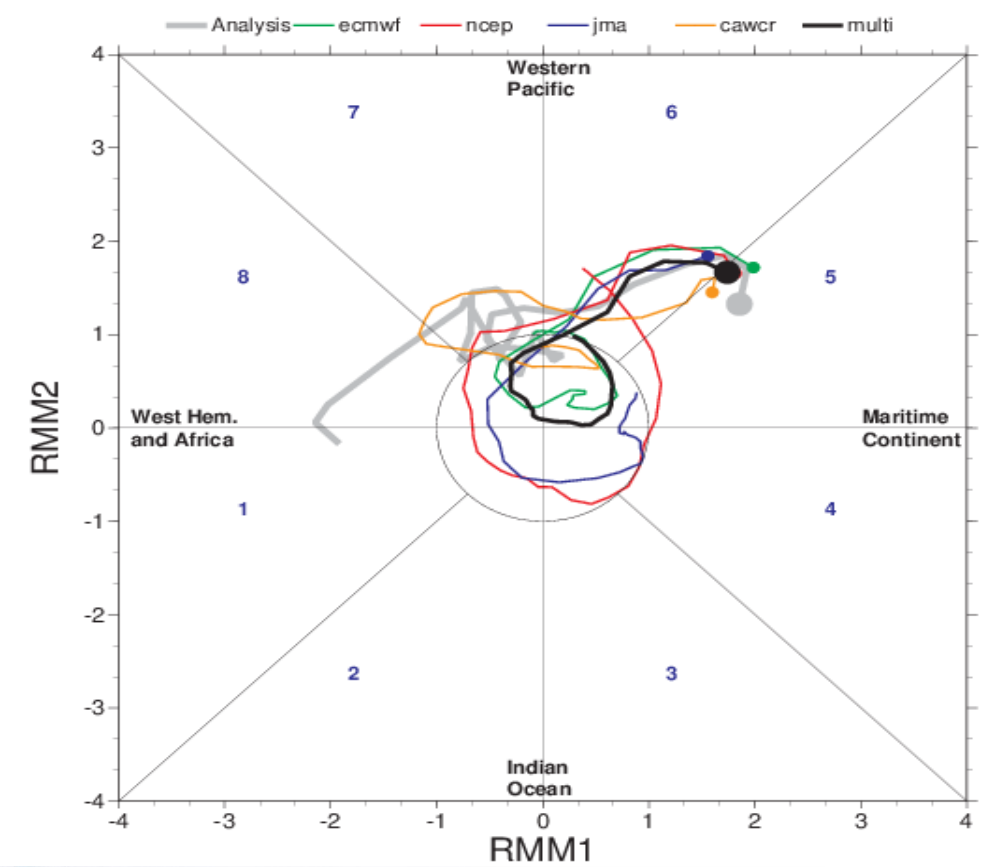


CAWCR



S2S : MJO


Analysis
ecmwf
ncep
jma
cawcr
multi
Western Pacific
Maritime Continent
West Hem. and Africa
Indian Ocean
7
6
8
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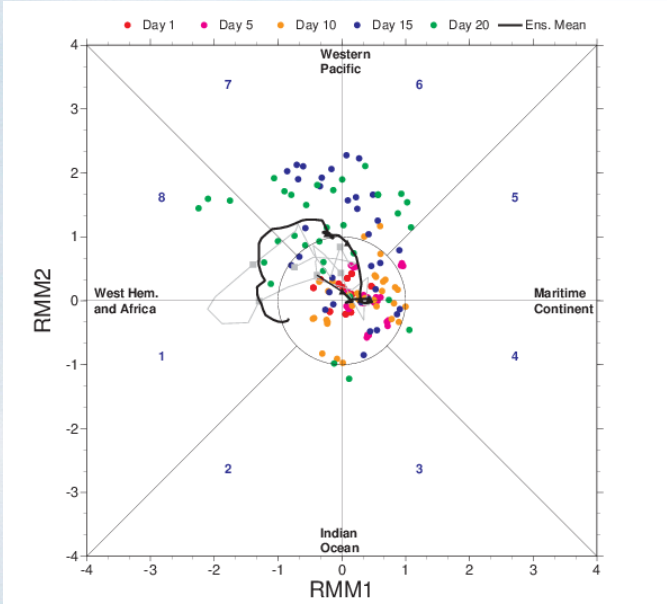
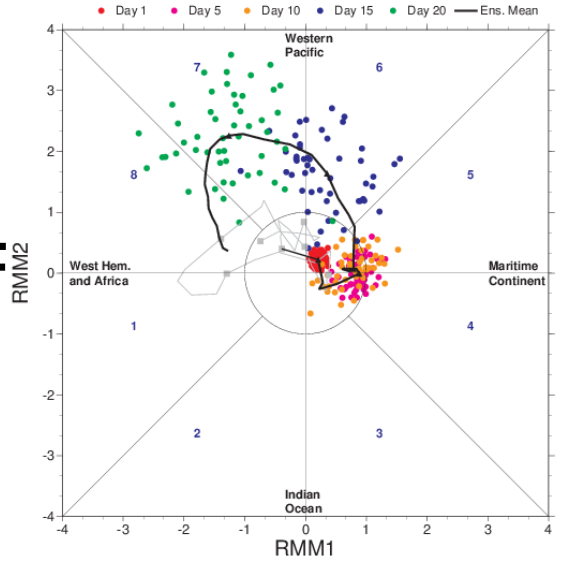
RMM1
RMM2

MJO forecast – 26/02/2015
S2S Database

CAWCR



ECMWF



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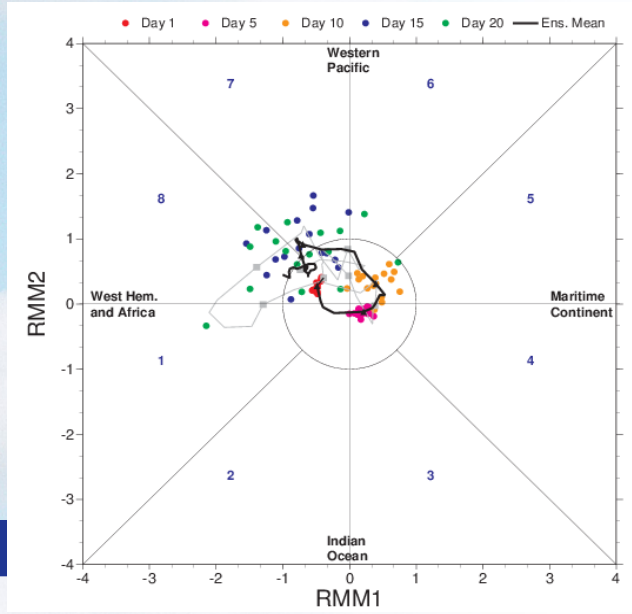

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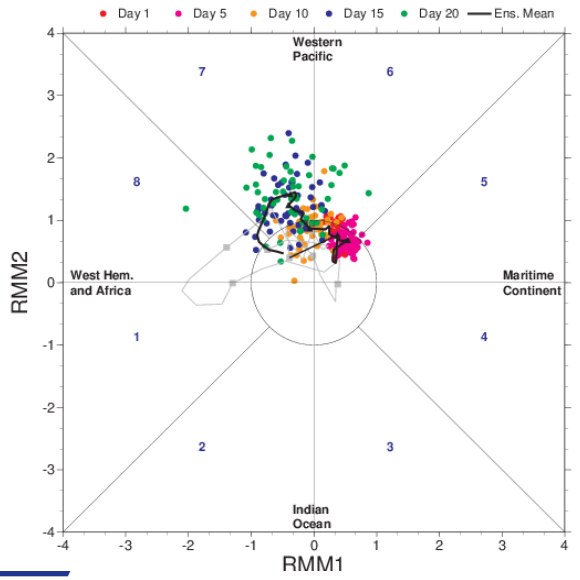
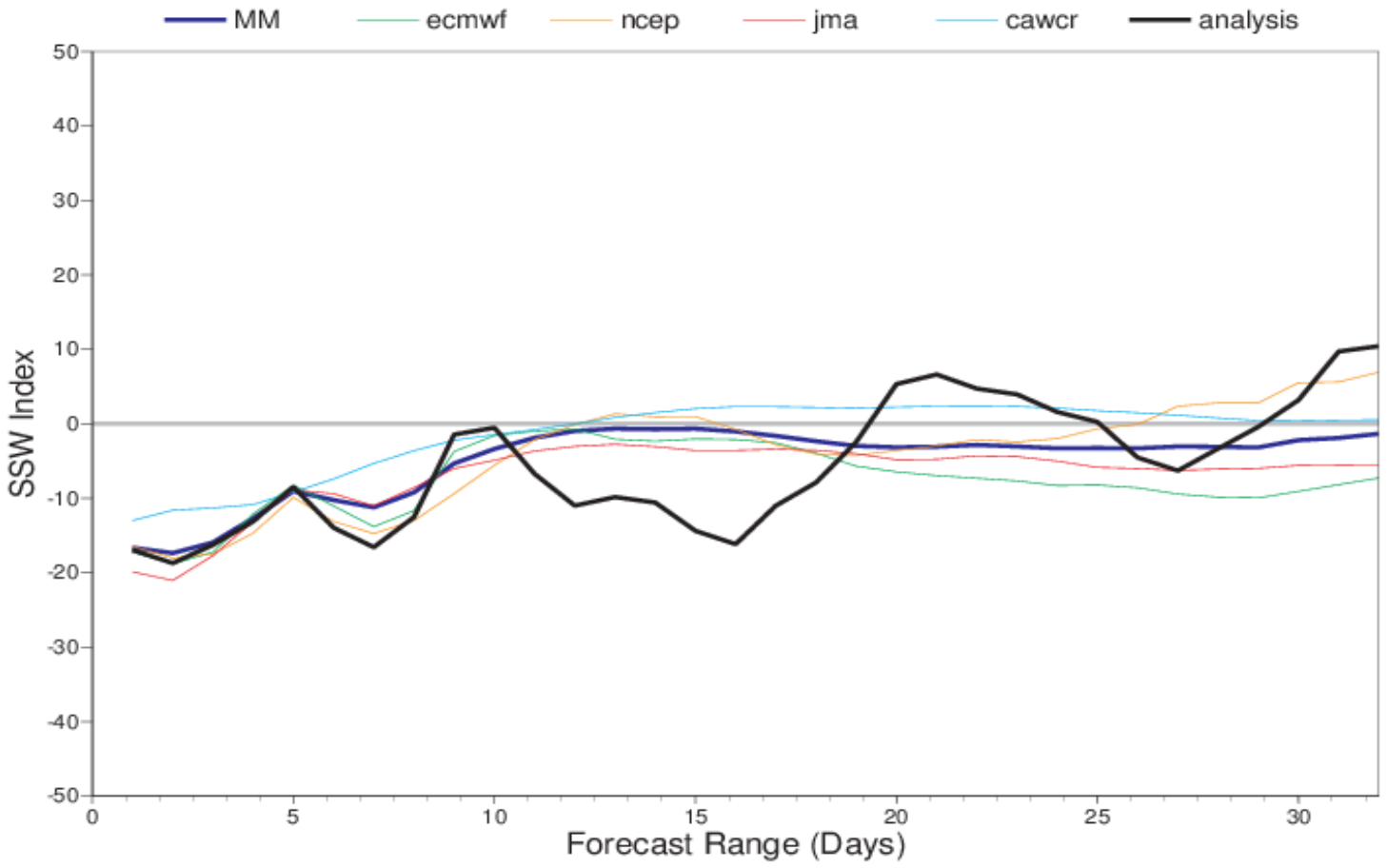


S2S : SSWs


MM
ecmwf
ncep
jma
cawcr
analysis
SSW Index
50
40
30
20
10
0
-10
-20
-30
-40
-50
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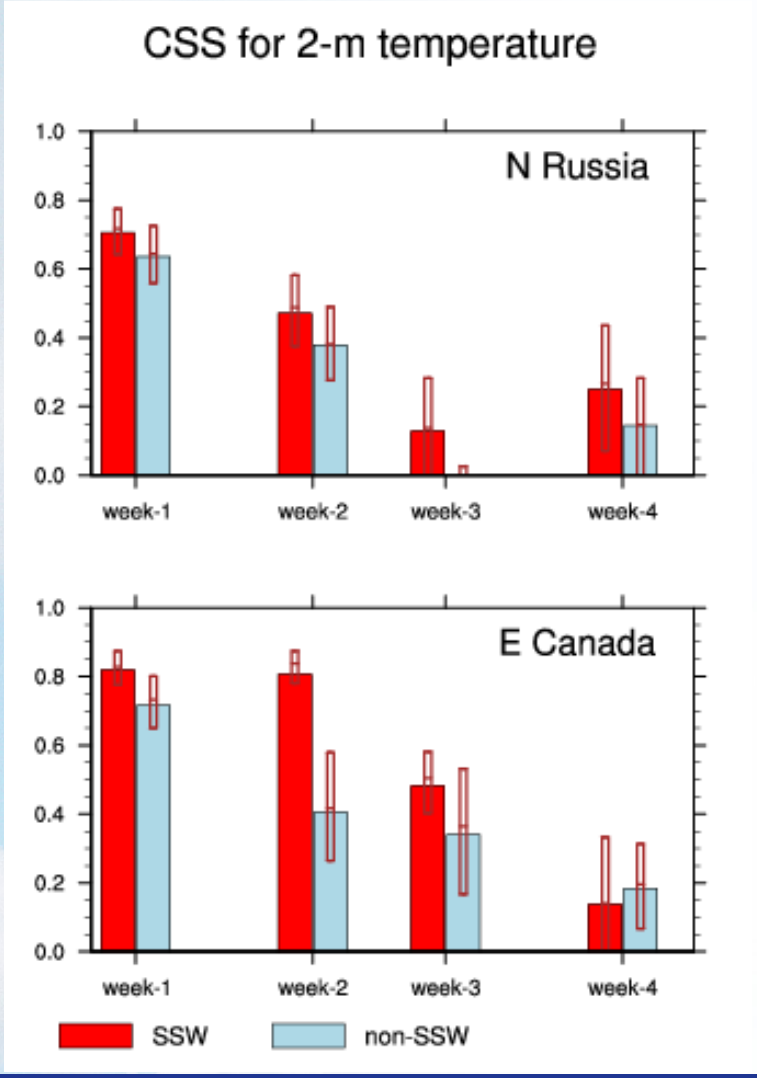
15
20
25
30
Forecast Range (Days)

Linkage with SNAP

Impact of SSWs on forecast skill scores



From Om Tripathi

Linkage with WGNE

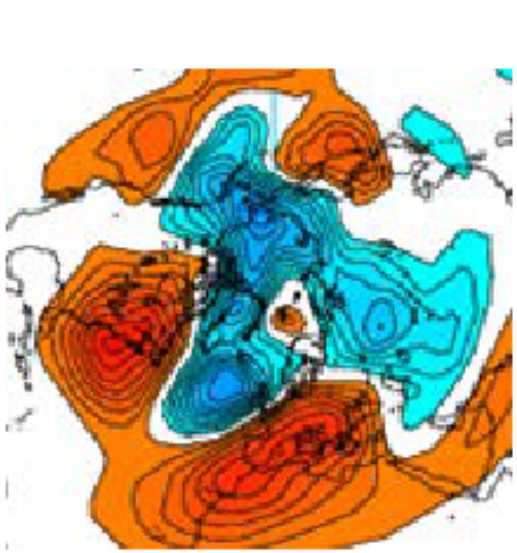
A strong link is already established with the WGNE MJO task Force.

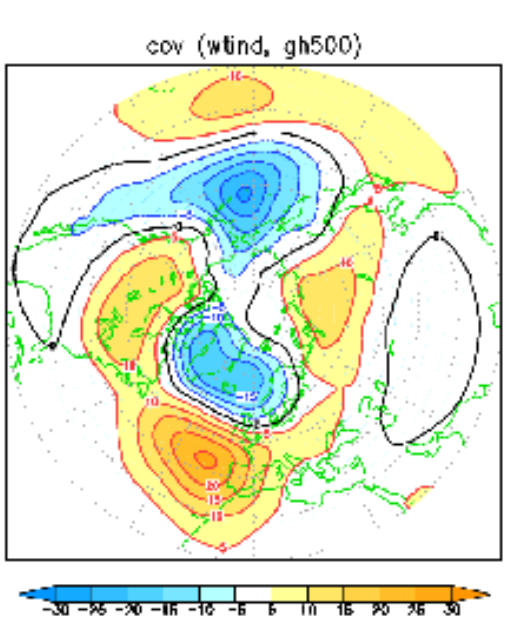
Other possible joint projects include:

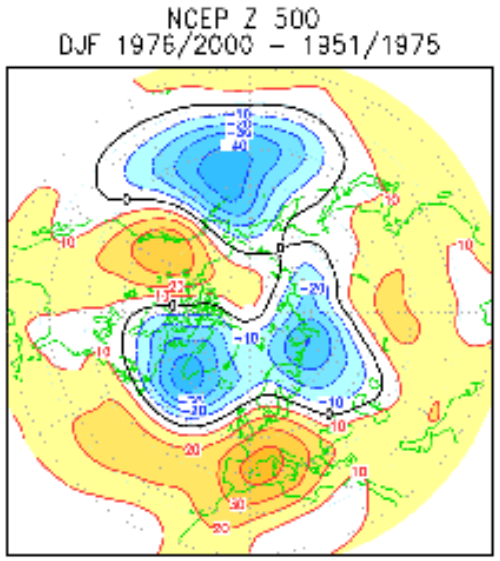
- **Representation of teleconnections in dynamical models (tropics- extratropics, tropics-monsoons, high latitudes-mid latitudes..)**
- Systematic errors in the monsoon regions, with a particular focus on variability, not only mean biases.
- Impact on initialization on S2S (coupled data assimilation, ensemble perturbations, lag vs burst sampling..)

Joint session at the next Systematic Errors Workshop (2016).

A planetary-wave signal common to different time scales?







Z 500hPa anomaly

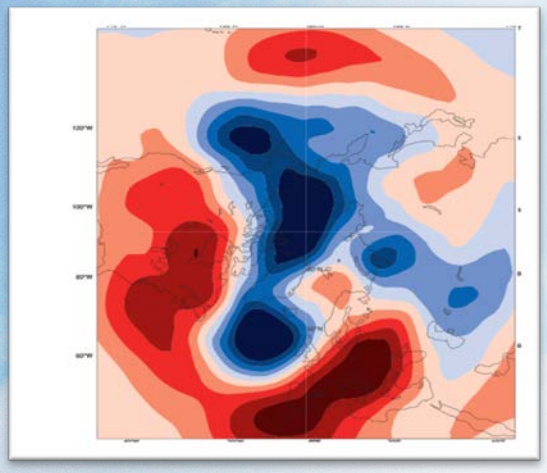
MJO phase3 + 10d

DJF W. Indian Oc. Rain

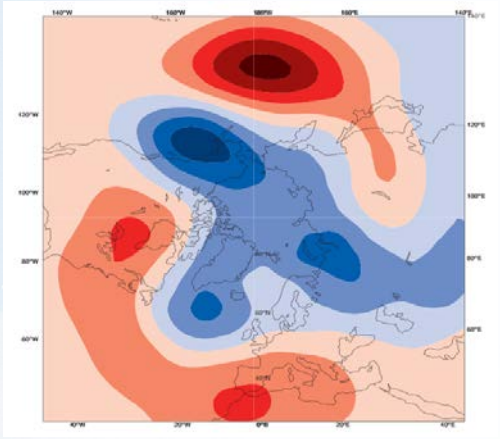
20th C. decadal variability

Molteni et al, 2014

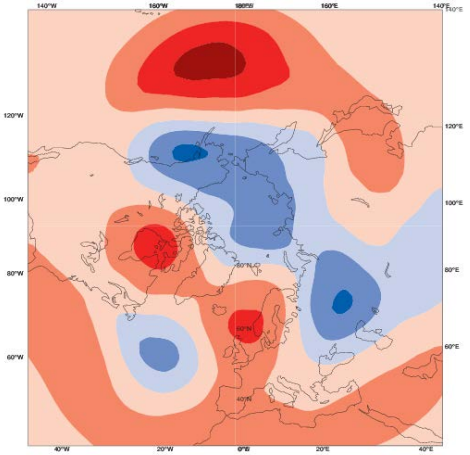
Analysis



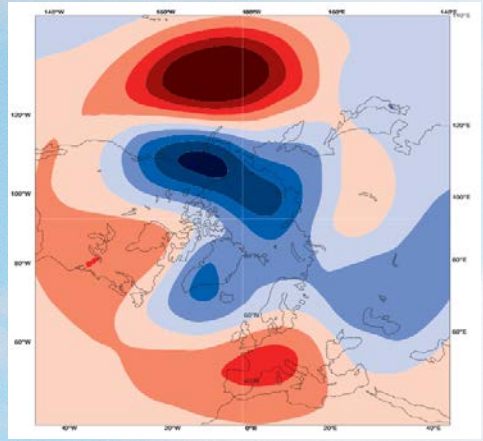
ECMWF



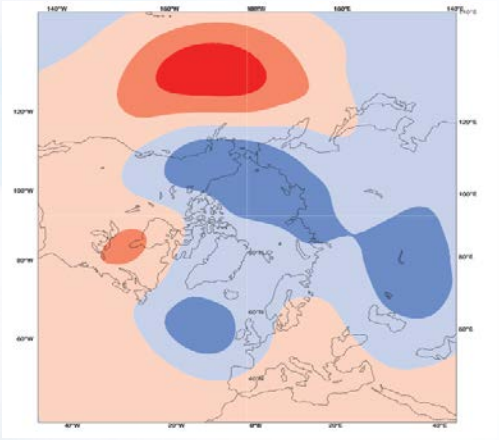
JMA



NCEP



CAWCR



MJO Teleconnections (re-forecasts)

Z500 anomalies 10 days after an MJO in Phase 3