The Sub-seasonal to Seasonal (S2S) Prediction Project

“Bridging the gap between weather and climate”

Co-chairs:
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Andrew Robertson (IRI)
WMO/WWRP International Legacy Projects

From S. Majumdar
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, USA and UK
The document outlines the Sub-seasonal to Seasonal (S2S) Prediction Project, which includes several sub-projects and focuses on different aspects such as Madden-Julian Oscillation, Monsoons, Africa, and Extremes. The project addresses various research issues, modeling issues, and needs and applications. Key points include:

**Research Issues**
- Predictability
- Teleconnection
- O-A Coupling
- Scale interactions
- Physical processes

**Modelling Issues**
- Initialisation
- Ensemble generation
- Resolution
- O-A Coupling
- Systematic errors
- Multi-model combination

**Needs & Applications**
Liaison with SERA (Working Group on Societal and Economic Research Applications)
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.
- 11-14 April 2016 Workshop for Subproject in Singapore– S2S, MJOTF

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

Major Objectives:

• Evaluate the predictive skill and predictability of weather regimes and extreme events (droughts, floodings, heat 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

• Case studies selected for the strong societal impact

A case study already completed: March 2013 cold wave over Europe. Next cases will include intense tropical cyclone Pam and intra-seasonal variability of precipitation over the US west coast during the 2015 El-Niño event.
Why was the start to spring 2013 so cold?

April 2013

Professor Julia Slingo, Met Office Chief Scientist

Extreme Weather – case studies

Summary

March 2013 was the second coldest March in the UK record since 1910, and was associated with a negative phase of the North Atlantic Oscillation. A number of potential drivers may predispose the climate system to a state which accounts for these conditions.

- The cold temperatures were part of a larger-scale weather pattern in the Northern Hemisphere.
- This pattern was associated with the negative phase of the North Atlantic Oscillation, which leads to the prevalence of easterly winds and cold conditions over the UK.
- There are a number of similarities between the climatological context of the March 2013 cold weather and that observed in 1962 (the coldest March on record).
- A number of potential drivers may predispose the climate system to negative NAO states in early spring. These include:
  - weather in the Tropics
  - the Stratosphere
  - conditions in the North Atlantic
  - the state of the Arctic
- These drivers are not necessarily independent, and no single explanation can account for the cold conditions observed.
2mtm anomalies  14 Feb day 26-32

ERA Interim  11 -17 March
Cold March 2013 – 14 Feb 2013 -Day 26-32

[Diagrams and maps related to RMM indices and sea-ice cover]
Cold March 2013 – 14 Feb 2013 - Day 26-32
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)
- Nov/Dec, 2015: 2 week training course at ICTP (Trieste, Italy) for young scientists from developing countries
- Dec 2015: S2S session at AGU conference
- 11-14 April 2016: S2S/MJO-TF Maritime Continent workshop - Singapore
http://s2sprediction.net/

*** News ***

Reforecast data are now available at the ECMWF S2S Data Portal
http://apps.ecmwf.int/datasets/data/s2s/

Mission

The main goal of the proposed WWRP/THORPEX/ WCRP joint research project is to improve forecast skill and understanding on the subseasonal to seasonal timescale, and promote its uptake by operational centres and exploitation by the applications community. Specific attention will be paid to the risk of extreme weather, including tropical cyclones, droughts, floods, heat waves and the waxing and waning of monsoon precipitation. Work will be guided by a steering group that will work in conjunction with appropriate WMO bodies and other relevant structures.

Reports & Publications

- Subseasonal to Seasonal Prediction Research Implementation Plan
- WMO Publication, 2015: Seamless Prediction of the Earth System: from minutes to months
- WMO, 2012, WMO Bulletin, 61 (2), 48pp
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
- Archived in GRIB2 – NETCDF conversion planned
- Database opened in May 2015, currently data of 7 models available
Contributing Centres to S2S database

- Data provider (11)
- Archiving centre (2)
## S2S contributions

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<tr>
<th>Institution</th>
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<tr>
<td>BoM</td>
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<td>T. Wu and L. Zhang</td>
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<td>CNR-ISAC</td>
<td>P. Malguazzi, D. Mastrangelo</td>
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Data archiving at EMCWF: M. Fuentes, F. Vitart, R. Mladek, I. Mallas, M. Manoussakis, S. Najm, A. Bonet, L. Ferranti, E. Fucile, C. Codorean, F. Venuti, C. Sun (CMA)
S2S Data Portal at ECMWF
http://apps.ecmwf.int/datasets/data/s2s/
S2S Database current status

- Open access to researchers on 6\textsuperscript{th} May
  - Data from seven data providers:
    - ECMWF, NCEP, JMA, BoM, CMA, Météo-France, HMCR
    - Near real-time data from 1\textsuperscript{st} January 2015
    - Re-forecast available

- Usage (end of October): about 200 users, 130 000 requests, 25 TBs downloaded

- Plans
  - End of 2015: all 11 Data Providers
  - Add new ocean and sea-ice variables
## S2S partners

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2-m temperature anomalies - Day 19-25
Forecast start date is 11 June 2015

VERIFICATION

NCEP

BoM

JMA

ECMWF

CMA

<10deg -10..-6 -6..-3 -3..-1 -1..0 0..1 1..3 3..6 6..10 >10deg
MJO prediction
Tropical Cyclone Pam case study

Multi-model prediction of TC strike probability anomalies - 9-15 March 2015
(NCEP/ECMWF/BoM/JMA/CMA)

2015/02/19 day 19-25

2015/02/26 day 12-18
MJO skill scores

36 start dates

MJO Bivariate Correlation Jan-Sept 2015

- JMA
- BoM
- ECMWF
- NCEP
- CMA
- Multi

Correlation vs. Forecast day
MJO Amplitude

36 start dates

MJO Amplitude error Jan-Sept 2015

- JMA
- BoM
- ECMWF
- NCEP
- CMA
- Multi

Amplitude Error

Forecast day
SSW skill scores

SSW Correlation Jan-May 2015

- JMA
- BoM
- ECMWF
- NCEP
- CMA

Correlation vs Forecast day
MJO Teleconnections (S2S re-forecasts)

Analysis

ECMWF

JMA

NCEP

CAWCR

Z500 anomalies 10 days after an MJO in Phase 3
Tropical Cyclone Density Anomaly

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Slide 28  ECMWF sub-seasonal workshop – Reading, 2-5 November 2015
Summary

- Sub-seasonal to seasonal is a very important time range which links weather and climate communities

- S2S is one of the three post THORPEX legacy project

- What can S2S do for us?
  - It provides a framework to facilitate international collaboration (S2S database, workshops, coordinated experiments..)
  - It can influence funding agencies
  - Training and promotion of early career scientists
MJO Teleconnections (S2S re-forecasts)

Analysis

ECMWF

JMA

NCEP

CAWCR

MJO Teleconnections (re-forecasts)

Z50 anomalies 10 days after an MJO in Phase 3
## S2S models

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<th>Time-range</th>
<th>Resol.</th>
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