The Sub-seasonal to Seasonal (S2S) Prediction Project

“Bridging the gap between weather and climate”

Co-chairs:
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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”
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
- 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)

S2S Database
Sub-seasonal to Seasonal (S2S) Prediction Project

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S2S Database

Sub-Projects
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

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<th>Resol.</th>
<th>Ens. Size</th>
<th>Freq.</th>
<th>Hcsts</th>
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* since April 2016
Better understand and predict sub-seasonal tropical-extratropical interaction pathways.

US National Academy of Science has just published a book on S2S


Updated: 2016-03-30 01:43

International Workshop on MJO, 6-9 August, Chengdu, China

There is the International Workshop on MJO from 6 to 9 August 2016 in Chengdu, China. The workshop webpage is available at http://www.lesg.ac.cn/mjo-workshop/. There are several important dates you remember as follows.

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 promoting 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 panel.
S2S Database current status

- Open access to researchers from ECMWF (since May 2015) and CMA (since Nov 2015). Subset of data also available from IRI. Data from nine data providers:
  - ECMWF, NCEP, JMA, BoM, CMA, Météo-France, HMCR, ISAC and UKMO
- Total size of the database: 37 Tbytes:
  - real-time: 5 Tbytes
  - re-forecast: 32 TBytes

- Plans
  - End of 2016: all 11 Data Providers
  - Add new ocean sub-surface and sea-ice variables
  - Compute and archive indices such as MJO RMMs, SSW index, Weather regimes, Tropical storm tracks, Monsoon indices to be available for the research community from ECMWF and IRI Data Library.
A major goal of S2S is to support CBS operational sub-seasonal activities

- Research into sub-seasonal predictability under S2S will be conducted in close liaison with developing infrastructure and procedure for operational sub-seasonal prediction as they develop under CBS.
- It has been proposed to use the S2S database to exchange real-time data for a prototype subseasonal service to be developed by the WMO Lead Centre for Long-Range Forecasts (LC-LRFMME)
S2S sub-projects
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.
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.
Modulation of tropical cyclone density anomaly by MJO 1999-2010

MJO Phase 2-3

MJO Phase 4-5

MJO Phase 6-7

MJO Phase 8-1

OBS

ECMWF

NCEP

JMA

BoM

Multi
Objectives:

- Recommend verification metrics and datasets for assessing 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

Links with WMO Joint Working Group on Forecast Verification Research (JWGFVR), WMO CBS/CCI ET-OPSLS, WMO LC-LRFMME and other S2S sub-projects
S2S sub-project on verification (and products)

Website: [http://www.s2sprediction.net/xwiki/bin/view/Main/Verification](http://www.s2sprediction.net/xwiki/bin/view/Main/Verification)

Science plan developed with inputs from JWGFVR, SERA and S2S: [http://www.s2sprediction.net/resources/documents/sub-projects/Verification.pdf](http://www.s2sprediction.net/resources/documents/sub-projects/Verification.pdf)

Current activities and plans:

- Questionnaire on subseasonal verification practices in operational centers prepared and sent to Global Operational Centers, with the purpose sharing current practices used to verify subseasonal forecasts (both for operations and research) and also help identify gaps and guide novel developments. Results discussed with WMO CBS/CCI ET-OPSLS
- Literature survey on S2S verification posted on the sub-project webpage
- S2S is now included in the JWGFVR user-oriented verification challenge [https://www.wmo.int/pages/prog/arep/wwrp/new/FcstVerChallenge.html](https://www.wmo.int/pages/prog/arep/wwrp/new/FcstVerChallenge.html)
- Plans for establishing verification of sub-seasonal and longer range forecasts as a theme for the 7th International Verification Methods Workshop (IVMW) organized by the JWGFVR, Berlin in May 2017, and promote a S2S verification and climate metrics session in this workshop.
Teleconnections (Cristiana Stan and Hai Lin)

**Year of Tropics-Midlatitude Interactions and Teleconnections**

**Description**
- Intense coordinated effort involving existing observational data, forecasts and applications, diagnostics, theory and modeling experiments

**Mission**
- Foster relationships between research, forecasting, and stakeholder communities, and facilitate the sharing of common interests to explore the links between the tropics and midlatitudes for a better prediction skill at intraseasonal time scales

**Research Questions**
- Are mid-latitude teleconnections from the fluctuating tropical heating fundamentally just time-lagged stationary wave responses to heating, or does time-dependent wave interference play a role?
- Why are the North Atlantic weather regimes so influenced by MJO-related heating in the distant Indian and Pacific Oceans?
- What is the role of synoptic-scale transients?
- Is the impact of extra-tropical forcing associated primarily with the initiation of tropical convection, or can it organize tropical convection of intraseasonal time scale?
- What is the role of PV streamers?
Ongoing Activities

- Review paper to be submitted to Review of Geophysics

- Workshops:
  Title: Large-Scale Intra-Seasonal Diabatic Heating Variability in the Tropics and Monsoon Regions: Multi-Scale Interactions and Teleconnections
  Date: June 6-7, 2016
  Venue: George Mason University
  Sponsor: ONR

  Title: Systematic Error
  Date: June 19-23, 2017
  Venue: Montreal, Canada
  Sponsor: WGNE

- AGU Fall Meeting 2016 Session (proposed)

- ICTP School (proposed)
  Date: 2017
  Sponsors: ICTP, WWRP/WCRP/S2S
Another example of drift (air temperature)
MJO Diagnostics
MJO Skill – Ensemble Mean
1999-2010 re-forecasts - ALL YEAR

MJO Bivariate Correlation
S2S REFORECASTS 1999-2010

MJO Skill – Ensemble Mean
1999-2010 re-forecasts - ALL YEAR
Amplitude error relative to ERA Interim
Spread/RMS error relationship - 2015

ECMWF

BoM

NCEP
Spread/RMS Error relationship – PC1 and PC2 - RT

ECMWF 51 members

WEEK1

WEEK2

WEEK3

WEEK4

BoM 33 members
MJO impacts

MJO-NAO teleconnection: modulates significant wave height in NE Atlantic

Marshall et al. 2015