

# **Minutes of S2S steering group meeting**

**9-12 September at UK Met Office, Exeter, UK**

Were present: Andrew Robertson, Frederic Vitart, Estelle De Coming, Hai Lin, Yuhei Takaya, Arun Kumar, Tongwen Wu, Duane Waliser, Steve Woolnough, Won-Tae Yun, Anca Brookshaw, Richard Graham, Joanne Robbins, Cristiana Stan, Caio Coehlo, Nick Klingaman, Oscar Alves, Yu-Kyung Hyun, Craig McLachlan

Connected remotely: Paul Dirmeyer and Willem Landman

The S2S project which is a 5-year project will expire in November 2018 (Phase 1). An important topic of discussion at this meeting was the proposal for the 5-year renewal (2018-2023) called Phase 2.

## **Monday 9 October 2017**

**13:30-13:45:** Welcome- Adoption of the agenda – Logistics (Co-chairs)

After the adoption of the agenda, the minutes of the previous S2S meeting (Dec. 2016 at Columbia University) were revisited. Most of the actions have been completed (e.g. survey on S2S users, documents for phase 2). The one not completed are mentioned in red in the list of actions at the end of this document.

**13:45-14:15:** Reviewer's comments on the S2S progress report and plans for phase 2 (co-chairs)

The S2S progress report and proposal for Phase 2 have been reviewed by 4 persons selected by WMO. The reviews were generally very positive. A few points raised by the reviewers were discussed:

1) Workshop on GFD for S2S prediction

- The organization of a specific workshop on analytical and simplified model studies would not be necessary, but a session on this topic can be included in the S2S workshop. This would be a good opportunity to link with the community using simple models.

2) Organization of a summer school based on the S2S book

This is a good way to engage early career scientists and could be done in Phase 2.

3) Include users in the S2S membership

This will be considered in phase 2. A survey is currently under way to assess the needs of users.

4) S2S should promote a discussion on the ethical issues in the provision of S2S forecasts

It was agreed that this important issue was much more general than S2S. Therefore these issues should be tackled by a much wider group than S2S; they should be considered in S2S where possible.

- 5) Use of artificial intelligence and machine learning for S2S forecasts

It was agreed that while such methods may be relevant to forecast post-processing, it is beyond the scope of the project to organize any focused activity on the topic.

- 6) Understanding how climate variability modulates S2S phenomena

Current studies (e.g. Belmont project) are looking at this issue

- 7) Revisit the 3-week delay in S2S data provision

This is under consideration with the “real-time pilot” in S2S Phase 2

### **14:30-15:00: S2S database**

ECMWF (Frederic) – So far 951 users from 92 countries have registered to the S2S database, 225 TBs (about 4x the total volume of the S2S database) have been downloaded since May 2015. The number of users per month increases almost regularly. The main model changes over the past year include new versions of the ECMWF model, increased re-forecast size for UKMO, change of start dates for ISAC and HMCR (now all models produced real-time forecasts on Thursdays) and JMA has updated its S2S system in March 2017. A new set of JMA re-forecasts has been included to the database. In the coming months a few additional changes will be introduced: extension of ISAC re-forecasts to 5 members, additional variables from KMA and ECCC.

The RMMS ftp site is online and some initial issues have been fixed. Verification from ERA Interim has been added and a publication on the calculation of indices needs to be written. New indices could be added (tropical storms already calculated, weather regimes? NAO/PNA indices?)

Recently, a tape containing 9TBs of S2S data was down. Work is ongoing to retrieve the lost data. The formation of a S2S-TIGGE data provider panel was suggested to the PDEF working group (in charge of TIGGE) in order to better engage the S2S data provider who are not part of the S2S SG. Work is ongoing at ECMWF to add ocean variables in netcdf. A prototype should be ready by March 2018. Finally, 18 publications on the use of the S2S database have been identified. There may be more since the reference to the S2S database is not always correct. This list of publications should be listed and updated by the ICO.

CMA (Tongwen): The CMA S2S database opened on 16 November 2015. 239 users have registered so far, the vast majority of them are from China. The number of visits (about 300,000 in 217) has increased significantly since 2016. The top 5 parameters downloaded are: t, 2t, tp, mx2t6 and mn2t6. Currently all the data is stored on disk. Work is ongoing to also archive the data on tapes. The data is accessed by http at present, but OPeNDAP will be available by the end of 2017. There are also plans to allow the possibility of plotting some S2S variables.

IRI (Andy): A large portion of the S2S database including the RMM indices is now available from the IRIDL on an OPeNDAP server. About 50TB of data was copied from ECMWF, and is being updated regularly. Data from the 11 centers can now be downloaded. About 1000 unique visitors accessed S2S data from the IRIDL in August and September 2017. A news article is available at [iri.columbia.edu](http://iri.columbia.edu), which also describes the archiving of the SubX data at IRI.

The issue of funding the databases at ECMWF and IRI was mentioned. Currently the persons working on the S2S database at IRI and ECMWF are paid from external projects which is not sustainable in the long term. Work is currently ongoing to find more secure sources of financing the S2S database.

### **15:30-17:00 Future developments of the database for Phase 2**

- Additional variables (including ocean)
- Inclusion of new models
- Development of the ftp site
- Product websites to visualize forecasts
- Financing the database
- Near real-time availability

The future of the S2S database for Phase 2 was discussed. Frederic mentioned the results of a survey sent to the users of the S2S ECMWF database. 114 people replied and the vast majority of them were satisfied with the current service. The main complaint was the speed of downloads which ECMWF will work to improve in the future. The users were asked which future development they would like to see in the future, and there was not really a consensus on it. Some would prefer more variables, others more vertical levels in the stratosphere, while others would prefer higher resolution or more frequent (sub-daily) output. For Phase 2, it was argued that it is not clear what the benefit of higher resolution would be. It would increase the volume of data stored and downloaded with little benefit since the sub-seasonal predictability comes mostly from large scale phenomena. The number of variables seems adequate, but the volume of data downloaded per variable will be assessed to check if only a few variables are popular (action for Frederic). It was agreed that we should add new variables only if they have value for some applications or research and cannot be derived from existing variables. It was also agreed that having some surface variables available 6-hourly would be more useful. 10m wind every 6 hours was mentioned as a good candidate to be added in phase 2 and will allow the computation of 10m wind speed for wind energy applications. New models may be added in phase 2. Work is currently ongoing to add the IMD model which is based on CFS integrations. It is not clear which other center could join in the next 5 years (ICTP and South Africa Met Service are unlikely to contribute in the coming years).

Finally a long discussion took place about “near real-time availability” for the real-time pilot (or Year of S2S) which is a main activity of Phase 2. Although a few centers are likely to agree to provide real-time forecasts for a limited period of time, others are very unlikely to accept due to their commercial data policy. So several options could be explored:

1. Have all the S2S data available in real-time to everyone for a limited period of time (about a year) but only from the few centers which will agree (most likely not more than 5).
2. Reduce the behind real-time delay from 3 to 1 weeks.
3. Give access of the data in real-time for a limited period of time and to only a limited number of pre-selected application users (10 to 20).

No decision was taken at this meeting about which option should be chosen, but options 3) and 2) which are not contradictory seemed to be preferred. This topic will be discussed again at the next teleconferences. A final decision will be taken before the start of Phase 2.

## **Tuesday 10 October**

### **9:00-10:30 S2S Phase 2 science plans (20 minutes each)**

- **MJO and teleconnections (Steve)**

This sub-project will promote research to address the following questions on the relationship between the MJO and High impact Weather in the Tropics:

- How well do operational S2S models capture the observed relationship between the MJO and high impact weather events?
- Does the relationship between the MJO and high impact weather events lead to enhanced predictive skill for these events for particular phases of the MJO or whilst there is strong MJO activity?
- Attribution of errors in the representation of the relationship between High Impact Weather and the MJO.

This activity will benefit from links within the international community through e.g. the years of Maritime Continent and the WWRP High impact Weather Project (HIWeather).

This sub-project will also address questions regarding the tropical extratropical teleconnections associated with the MJO and the potential for extratropical predictive skill associated with the MJO:

- How does the teleconnection depend on the horizontal, vertical and temporal structure of the diabatic heating anomalies associated with the MJO.
- How do variations in the slowly varying background state affect the Rossby-wave propagation from the source region?
- How does the extratropical circulation respond to the Rossby wave forcing from the Extratropics?

This activity will benefit from links developed with the Year of tropical-Mid latitude interactions and teleconnections project.

The possibility to include teleconnections from the Extra-tropics to the tropics was discussed. It was recommended to include this as topic of interest to this sub-project even if no concrete work is planned on this topic.

- **Ocean (Oscar Alves)**

This sub-project will include the following activities:

- Diagnose and understand ocean-atmosphere feedbacks that directly drive/influence sub-seasonal variability.
- Identify and quantify S2S predictability arising from ocean mean state
- Understand how low frequency variations of ocean mean state impact S2S variability
- Quantify and understand impacts on sub-seasonal predictability arising from ocean mean state drift in models

- Understand mechanisms and predictability of sub-seasonal extreme weather events
- Look at case studies (e.g. ocean heat waves)

The data needed for these studies was discussed. Most of the sub-project activities will rely on the availability of ocean data from the S2S database. As mentioned above, we expect the netcdf ocean data to be available in 2018, before the start of Phase 2. Frederic will recirculate the list of ocean variables to make sure that no important ocean variable is missing. The current list includes about 10 ocean variables, but no 3D fields (too costly). It is planned to archive the ocean fields in a regular longitude/latitude grid as for the atmosphere. However, it was mentioned that a database of ocean re-analyses has been set up with ocean data available on a 1 degree grid. It was proposed to do the same for the S2S data and archive the ocean fields at a 1 degree resolution rather than on the 1.5 degree grid used for the S2S atmospheric variables. Some of the activities proposed (e.g. eddies prediction) would need a much finer resolution and therefore may need to access higher resolution output data directly from operational centers. Oscar also suggested to extend the database to 3 months instead of the current 60 days to cover a complete season. However, very few S2S models currently cover more than 60 days (e.g. ECMWF forecasts in the S2S database stop at day 46).

- Aerosols (Duane)

Currently all operational S2S systems make use of climatological aerosols. However, previous studies (e.g. Tian et al. 2008) have demonstrated that the MJO can represent an important source of modulation and predictability for aerosols at the S2S time scale which is not represented in current operational systems. This impact of the MJO is likely to feed back on the atmospheric circulation via the radiative impacts of aerosols. Exploring this gap and quantifying the potential impacts relative to S2S forecast skill is the objective of this atmospheric composition element of the S2S proposal. The proposed studies will address the following questions:

- What is the impact of prognostic aerosol loading in the atmosphere on S2S forecasts?
- What is the level of complexity needed?
- What is the predictability of aerosols?

The sub-project will explore the possibility of performing coordinated experiments to address these questions. A first step would be to contact the operational centers which could produce such simulations with active aerosols (ECMWF, maybe GMAO, JMA, UKMO).

In the following discussion, it was suggested to also include off-line aerosol models in this study.

### **15:30-17:00 S2S phase 2 (continuation)**

- Ensemble generation (Arun )

Operational centers need to provide reliable predictions. Under or over confident forecasts undermine the decision making process. Currently, S2S models tend to be overconfident with a spread which is too small. This could be due to issues with the specification of uncertainty

in initial conditions or model errors. Efforts are underway to improve the representation of uncertainty in initial conditions (e.g. stochastically perturbed parameterization tendencies). Possible research for the 2<sup>nd</sup> phase of S2S will include:

- Quantify ensemble spread for different prediction systems
  - Explore dependency in model resolution, initialization techniques, etc...
  - Explore dependency on different versions of the same model
  - Explore the possibility of sensitivity experiments in collaboration with the Predictability Dynamics, Ensemble Forecasting (PDEF) working group.
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- Land surface (Paul, remotely)

The sub-project will work in collaboration with GEWEX/GLASS, DAOS and WGSIP SNOWGLACE to both investigate the fidelity of model representations of land-atmosphere interactions and how S2S forecasts may be improved by taking better advantage of the information contained in land surface states. Several questions will be addressed in this sub-project:

- What is the impact of the observing system on land initialization and S2S forecasts
- How well are the coupled land/atmosphere processes represented in S2S models
- How might anomalies in land surface states contribute to extremes.

At least 6-hourly data would be needed to assess the diurnal cycle.

- Research to operations (Caio and Arun)

This sub-project aims to enhance the operational infrastructure and will work in coordination with joint CBS-CCI IPET-OPSLs and the verification working group JWGFVR. The R2O transition will require efforts in research for testing new methods for calibration, generation and verification of forecast products and collaboration with the relevant WMO technical commissions to define the standards and protocols for operational implementation and exchange of S2S forecasts. Therefore, the sub-project will:

- Promote the development and inter-comparison of different methodologies for forecast calibration, multi-model combination, verification and forecast formats.
- Make recommendations for operational centers to harmonize their real-time and re-forecast set-ups.
- Develop S2S training resources
- Work with IPET-OPSLs to develop standards for data exchange and delivery of S2S re-forecasts

- Real-time Pilot for S2S Applications research & demonstrations (Andy)

Goal is to catalyze research on demonstrating S2S forecast value to GFCS priority areas by making near-real time forecasts available for a limited period of time, eg 2019-2020. Coordinated activities (eg competition) could be organized. It could be designed to overlap with other “Years of” programs.

It was agreed that it will be very important to have a sustained interaction with potential users sufficiently before the RT pilot, including use of the S2S database, to develop and demonstrate the potential forecast use, before the real-time pilot trial period. For this to take place, some groups/institutions/agencies that are serious about the pilot need to be identified, and the number of groups could be of the order of 5-10 (though the number of end users they might serve could be much larger). It was mentioned that these groups could be identified via the interviews that the SERA group is currently undertaking, and that they should span the GFCS priority user areas. Limiting the real-time access only to groups with a demonstrated interest (rather than publically), may be attractive to the S2S forecast providers. A mechanism for RT pilot is needed and could be managed by a proposed S2S-SERA sub-project. Some retrospective evaluation of the RT pilot should be undertaken to assess its value, and this will need to be carefully planned ahead of the pilot itself, and the outcomes published in a high-visibility journal such as in BAMS.

### **Next steps for Phase 2 proposal**

Each sub-project should send their final version (about 2 pages with 1 or 2 figures) following the same template by December. The co-chairs will integrate the reviewer comments to finalize the proposal by end of December.

## **Thursday 12 October**

### **9:00-9:30: S2S stakeholder survey (Andy)**

A survey of stakeholders is currently ongoing with SERA. This survey is performed by phone interviews of a few selected application users who are already familiar with seasonal forecasting. So far only few applications and sectors have been targeted. These interviews should be wrapped up by end of November to be included in the Phase 2 proposal. Additional interviews could continue as part of Phase 2 and could lead to a publication. The possibility of forming a SERA-S2S group has been considered. Hai and Cristina suggested to contact some application users for possible interviews (agriculture in Canada, science of disaster at GMU). Duane has a contact a water resource manager in the western US, who also provides leadership to a broader organization called the Western States Water Council and thus has a great feel for water forecast needs for entire western US. He volunteered to contact her.

### **10:00-10:30: Planned workshops/training courses:**

- Teleconnection training course and workshop (Cristiana)

This 2-week training course is taking place at ICTP (<http://indico.ictp.it/event/7998>), with 38 accepted participants (out of 145 applicants).

- AGU (Duane)

About 25 abstracts and 8 oral presentations. This session is organized with NOAA MAPP.

- EGU (Frederic)

A proposal for an EGU session has been submitted. This is a merge of 2 proposals: one on S2S applications and one on S2S dynamics, most especially stratospheric processes.

- AOGS2018

Yuhei, Hai and Hyun-Suk and Mio Matsueda have submitted a proposal for this conference in Hawaii. More than 10 speakers are needed. The deadline for submission is 20 October.

- 2<sup>nd</sup> S2S International Workshop

This will be the major S2S activity in 2018. The 2<sup>nd</sup> international S2S conference will take place in Boulder (17-19 Sept 2018) in parallel with the S2D workshop (18-21 Sept 2018). There will be a common S2S-S2D day on 19 Sept 2018. The Scientific committee of the S2S conference will be formed soon.

Future strategy for training courses.

Lots of training course have been organized in 2017. The SWIFT project will include two training activities: forecast test bed and training activity as the one at ICTP. This project is about capacity building. It was found that a lot of people who come to training course do not continue working on S2S. A better way to select candidates and organize the training courses needs to be found. It was suggested to reach more COFs for encouraging them to explore the use of S2S forecasts. A good sustained S2S series of trainings is underway with the ASEANCOF (with ASMC, Singapore). S2S was advertised at the East African COF (GHACOF) in August, and a training course on S2S has been proposed for 2019 at ICPAC (FORPAC). Arun will advertise S2S at the Russian COF and Anca at the Mediterranean COF.

**11:00-11:30:** Project office activities (Newsletter, video, website, plans for phase 2 ...)  
(Won-Tae)

The Project Office website needs to include the login and password for the RMMs ftp site. The list of publications on the S2S database should also be included and maintained in the ICO website. It was suggested to ask all the authors to send a short description/summary of their paper which could be uploaded in the website. A new issue of the Newsletter is in preparation. This new issue should contain a summary of one of the papers on S2S database. The S2S mailing list is increasing nicely and contains now 358 names compared to 252 once year ago. There is a delay between the time of sending a message and its publication for security reasons.



Promotional video: The ICO is currently working on a 4 minutes promotional video on S2S. A script has been written and presented at the SG meeting. It was suggested to send it to Paolo and to the whole SG for comments, but the video needs be done by end of November.

Won-Tae also announced that KMA is planning to organize a meeting on S2S regional activities in April/May 2018.

**11:45-12:00: Meeting actions**

**Actions from last meeting**

1. Duane expressed willingness to help set up a hydrology themed workshop in next year – to contact Janine in CA
2. Andrew to contact Kathy about Github that she is setting up for SubX
3. Andrew to check on ERA-I RMMs in IRIDL - done
4. S2S Newsletter item on S2S/WGSIP - Andrew to liaise with Bill M
5. Michel to contact WCRP Extreme Grand Challenge to facilitate collaboration with S2S
6. Publication on RMMS (Frederic)

**New Actions:**

1. Andrew to contact Angel regarding the status of weather regime analysis
2. Andrew will circulate an example for calculating vert integrated moisture flux, as an example of IRIDL capabilities
3. Hai to provide NAO & PNA structures, for computation of indices
4. Andrew to contact Raizan and/or Carlos Perez (BSC) about the data requirements for running offline Aerosol models. May not be feasible without 3D 6-hr fields.
5. Frederic to rank most popular variables in DB
6. Frederic to circulate list of ocean variables to the ocean group
7. s2s database: consider adding 10m wind speed and make suggestions for 6 hourly output for some surface variables (to be discussed at later stage) (co-chairs)
8. Identify list of possible application/met services users of the Year of S2S (co-chairs)
9. Finalize the S2S project plan by end of the year (everyone)
10. Project Office to publish and maintain list of S2S references (ICO)
11. Add password RMMs ftp site (ICO)
12. Share movie script with SG/LC group and for all to feedback comments (ICO, all)
13. Revise “Real-time Pilot for S2S Applications research & demonstrations” part of proposal (Andy)
14. Contact application users (Duane, Hai, Andy, Cristiana)

15. Follow up on SERA survey (Joanne)

16. Include SERA-S2S project in Phase 2 proposal (co-chairs)