





S2S update

Frédéric Vitart, ECMWF Andrew W. Robertson, IRI, Columbia University

37th session of WGNE – 9 November 2022

The WWRP/WCRP S2S project 2013-2023





- Improve forecast skill and understanding on the sub-seasonal to seasonal timescale with special emphasis on high-impact weather events
- Promote the initiative's uptake by operational centres and exploitation by the applications community
- Capitalize on the expertise of the weather and climate research communities to address issues of importance to the Global Framework for Climate Services
- The S2S project started 2013 and is now in its second phase (2019-2023)
- International Coordination Office hosted by APCC.
- Contribution to S2S trust fund from Australia, Canada, UK and Germany.

The project focuses on the forecast range between 2 weeks and a season.

S2S Prediction Project Phase II: 2019–2023



Research-Operations Applications Dev.

New activities to demonstrate S2S forecast applications value and improve operational infrastructure

Data Infrastructure

Enhance S2S Database Ocean variables, more surface variables 4xdaily, additional models (eg IMD)

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

The S2S Database



ECMWF S2S Server

Summer of active users

S2S Database Models

		Foreca	sts		Hindcasts					
Status on 5th January 2018	Time range	Resolution	Ens. Size	Frequency	Re-forecasts	Rfc length	Rfc frequency	Rfc size		
BoM (ammc)	d 0-62	T47L17	3*11	2/week	fix	1981-2013	6/month	3*11		
CMA (babj)	d 0-60	T106L40	4	daily	fix	1994-2014	daily	4		
CNR-ISAC (isac)	d 0-32	0.75x0.56 L54	41	weekly	fix	1981-2010	every 5 days	5		
CNRM (Ifpw)	d 0-32	T255L91	51	weekly	fix	1993-2014	2/month	15		
ECCC (cwao)	d 0-32	0.45x0.45 L40	21	weekly	on the fly	1995-2014	weekly	4		
ECMWF (ecmf)	d 0-46	Tco639/319 L91	51	2/week	on the fly	past 20 years	2/week	11		
HMCR (rums)	d 0-61	1.1x1.4 L28	coc	Dat	ahaa	o in	ם וסו	ata I	ibrony	
JMA (rjtd)	d 0-33	TI479/TI319L	523	Dai	avas			ala	_ibrary	
KMA (rksi)	d 0-60	N216L85	0.00			200				
NCEP (kwbc)	d 0-44	T126L64	 Over 2/3 databas 	e is archive	dat IRI.			Parate and a second sec		
UKMO (egrr)	d 0-60	N216L85	includin	g MJO indic	es 🛛		ECHIWY SEE			
Fo	recasts avai	lable 3 week bytes	 Kept up Allows s "lazy" ci analyze to user r weekly a of enser) Good fo situation 	to date erver-side a omputation the data aci equests (eq veraged an nble means r low-bandv is	and to cording g avoid the width	WF 935 ************************************	 A second values A s			
			OpenDA	P				Contraction of the	- Augusta and a second	

· Includes RMM indices



Archive size 200 TBs Number of active users 1776 Delivered volume 1.3 PBs Publications: > 270

	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	I
ECCC	D 0-32	~39 km 85 levels	21	weekly	On the fly	2001-2020	weekly	4
ВоМ	D 0-60	T47L17	33	2/weekly	Fix	1981-2013	6/month	33
JMA	D 0-34	40/55km 28 levels	50	weekly	Fix	1991-2020	2/month	13
КМА	D 0-60	N216L85	4	daily	On the fly	1996-2009	4/month	3
СМА	D 0-60	T266L56	4	2/week	On the fly	Past 15y	2/week	4
CNRM	D 0-47	T359L91	25	weekly	Fix	1993-2017	weekly	10
CNR- ISAC	D 0-32	0.75×0.56 L54	40	weekly	Fix	1981-2010	6/month	5
HMCR	D 0-63	I.IxI.4 L28	20	weekly	Fix	1990-2015	weekly	10
IAP-CAS	D0-65	C96L32	16	daily	Fix	1999-2018	daily	4

WWRP/WCRP Sub-seasonal to Seasonal prediction (S2S) database Inclusion of a new model (IPA-CAS) in 2022

S2S database - Ocean variables

9 ocean/sea ice variables are being archived from 4 models (CMA, CNRM, ECCC, ECMWF).





- Air sea-interaction diagnostics
- Diagnosing ocean model systematic errors
- Impact of ocean initialization
 - Assessing S2S predictability of ocean/sea-ice variables. Possible application: prediction of ocean heat waves & coastal flooding

Demott et al., EOS, 2021



EPSG:4326 -180 -60.5 180 80.5 1.0 1.0

Science sub-project activities

Three initiatives have been launched which involve coordination with operational and research centres in order to improve S2S operational prediction:

 Evaluating the Impact (direct and indirect) of Aerosols on NWP and Subseasonal Prediction (WGNE-S2S-GAW Coordinated experiment)

5 centres have run the experiments - evaluation will start soon

- Coordinated experiment to better understand stratosphere-troposphere interaction in NWP and climate models (SNAPSI, Collaboration with SPARC/SNAP)
- Ocean observing system experiments to better understand the impact of ocean observations on sub-seasonal forecasts, with specific focus on the evaluation of the upcoming Tropical Pacific Observing System (TPOS)



Preliminary results – S2S timescale

Bias differences: INT – NOINT

NASA

ECMWF



From Ariane Frassoni

Science sub-project Activities

Community papers published or submitted in 2021/22:

- Representation of MJO teleconnections in S2S models (Stan et al. 2021, BAMS).
- S2S ocean forecasting (DeMott et al. 2021, EOS)
- Advances in the subseasonal prediction of extreme events: Relevant case studies across the globe (Domeisen et al. 2022, BAMS)
- Recent advances in application and utility of S2S forecasts (White et al., 2022, BAMS)



Stan et al. (2021, BAMS)

SSW predictability

Prediction of SSW events



SSW teleconnections



Domeisen et al, 2019

Domeisen et al, 2019

S2S AI/ML Competition

- Challenge: Provide forecasts of near surface temperature and precipitation for weeks 3+4 and 5+6 more skilful than ECMWF operational forecasts for every Thursday of the year 2020.
- Hosted by Swiss Data Science Center at ETH Zürich, with ECMWF support through the new European Weather Cloud for data access to S2S forecasts.
- 49 registered teams ,only 5 succeeded in providing better forecasts than the Benchmark (ECMWF S2S operational forecasts). Top 3 teams got rewarded a prize.



RPSS Score – YEAR 2020

Verification score (RPSS) for the top 3 teams and the ECMWF benchmark. The higher the better. Blue colors indicate scores worse than climatology. Red color indicate better scores than climatology.

S2S Real-Time Pilot Project

Real-time S2S data access for climate services co-development projects



WWRP/WCRP S2S Summit: Advancing Sub-seasonal to Seasonal Predictions and their Applications University of Reading, UK

3rd-7th July 2023

Celebrating 10 years of the Sub-Seasonal to Seasonal Prediction Project and looking to the future

Abstract Submission Opens 15th November 2022

Abstract Submission Deadline 15th January 2023

Abstract Acceptance Notification 28th February 2023





More information soon at www.s2sprediction.net









S2S Legacy

New WWRP core project: Sub-seasonal Applications for aGriculture and Energy (SAGE)

There will also be S2S activities in:

- WWRP Polar Coupled Analysis and Prediction Project
- WWRP/WCRP Monsoon project Office activities

Legacy of the S2S database:

- Establishment of a Lead Centre for sub-seasonal to seasonal Forecast (LC-LSSF)
- Establishment of a new lead centre for databases