

WGSIP's Long-Range Forecast Transient Intercomparison Project

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Introduction

- LRFTIP is an initiative of WCRP's Working Group on Subseasonal to Interdecadal Prediction (WGSIP)
- Purpose is to enable **multi-model inter-comparison studies** of the transient behavior of coupled long-range forecast models evolving from observation-based initial conditions. (*WMO defines long-range forecasting as from 30 days up to years.*)

Objectives

- 1) Develop a **multi-model online archive** of hindcast climatologies and related diagnostics including systems contributing to S2S, CHFP, DCPD
- 2) Develop **standard diagnostics** characterizing forecast shock/drift
- 3) Address **science questions**, including
 - influence of different initialization methods on transient behavior of climate model components
 - identification of any impacts (likely negative) on climate forecast quality

Current Status

Models: The LRFTIP archive currently includes

- **4 subseasonal forecast models (S2S) → 6**
- **19 seasonal forecast models (CHFP, ENSEMBLES) → 21**
- **15 decadal forecast models (CMIP5, ENSEMBLES) → 16**

Variables: Number of variables for each model, climate system component, and averaging interval are shown in tables

**Updates
since
WGSIP 21**



Reference



Forecasts

Subseasonal Model	Atmosphere Daily		Ocean Daily	
ECCC-S2S	9	7	1	1
ECMWF-S2S	11	7	1	1
JMA-S2S	2	2	1	1
MeteoFrance-S2S	11	7	1	1
NCEP-S2S	11	7	1	1
UKMO-S2S	6	4	1	1

S2S data processed by Mikhail Tolstykh and Tatiana Krasjuk, INM-RAS

Current Status - Seasonal

Updates since WGSIP 21



Reference



Forecasts

Seasonal Model	Atmosphere Daily			Atmosphere Monthly			Ocean Monthly			Land Monthly			Sea Ice Monthly		
CanCM3	18	22		22	22		12	12			4		1	2	
CanCM4	18	22		22	22		12	12			4		1	2	
CanCM4i	21	26		22	26		11	13		2	3		1	2	
GEM-NEMO				12	12		1	1		1	1		1	1	
ECMWF-S4				18	20						1				
JMAMRI-CGCM1	12	16		20	20		6	7							
JMAMRI-CGCM2				19	21		6	6			13			13	
MIROC5_v1.0	12	18		16	18		6	7							
MPI-ESM-LR				20	22										
POAMA p24a/b/c				12	13										
ARPEGE				7	7										
CFS_SHFP	3	3		8	7										
CMAM	3	5		7	7						10			10	
GloSea4		1		7	7										
GloSea5		1		7	7										
ENSEMBLES (CMCC-INGV, ECMWF-S3, IFM-GEOMAR, MF, <u>DePreSys</u> , HadGEM2)	16	20		20	20						1				

Current Status - Decadal

Analysis /
Initial Conditions

Forecasts

Historical
Simulations

Decadal Model	Atmosphere Daily			Atmosphere Monthly			Atmosphere Yearly			Ocean Monthly			Ocean Yearly			Land Month/yearly			Sealce Month/Yearly		
CCSM4 (i1,i2)				24	24		24	24		8	9		8	9		3	3		2	2	
MF-ENSEMBLES				20			20			11			11			1					
CFSv2(i1,i2)				26			26			7			7			1			2		
CanCM4 (i1,i2)	25	16	6	25	26	17	25	26	17	13	13	13	13	13	13	4	3	2	2	2	2
CNRM-CM5		6	6		26	26		26	26		10	10		10	10		3	3		2	2
ECMWF-ENSEMBLES				20			20			11			11			1					
GFDL-CM2p1				18	18		18	18		11	11		11	11		2	2		2	2	
HadCM3		9	9		25	25		25	25		6	6		6	6		3	3		2	2
IFM-ENSEMBLES				20			20			11			11			1					
MIROC5		20	20		26	26		26	26		7			7			3	3		2	2
MRI-CGCM3		6			26			26			10			10			3			2	
UKMO-DePreSys-ENS				20			20									1					
UKMO-HadGEM2-ENS				20			20									1					
EC-EARTH				19	17		19	17		7	3		7	3					2	2	
BCC-CSM1.1		6	6		26	26		26	26		7	7		7	7				2	2	
CanESM5	21	21	21	26	26	26	26	26	26	11	11	11	11	11	11	3	3	3	2	2	2

Recent activities

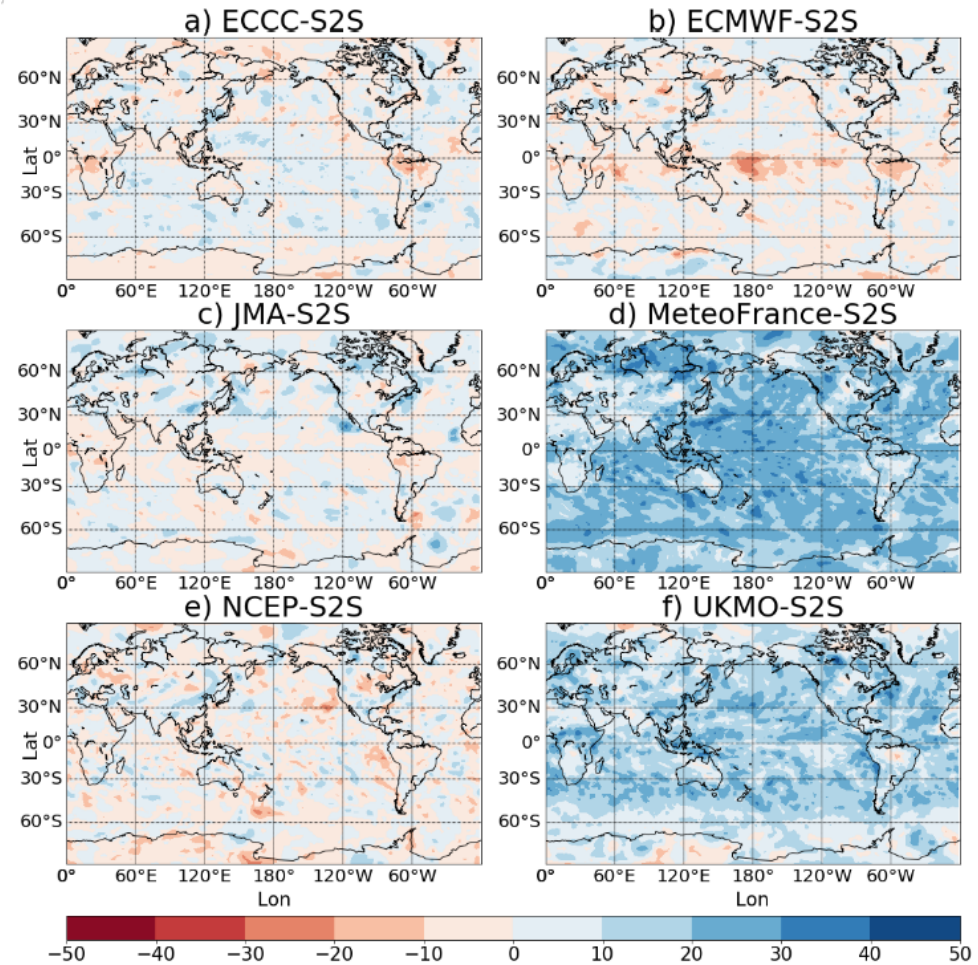
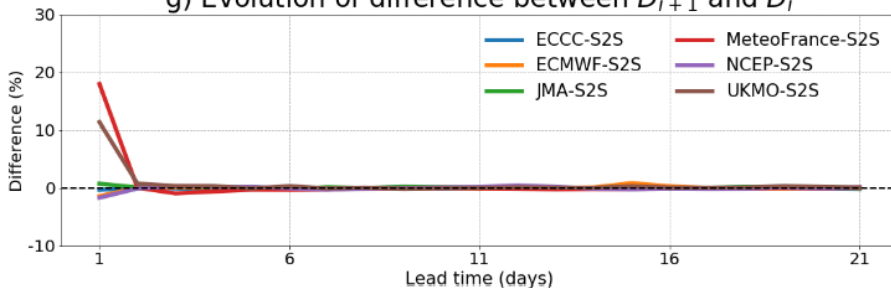
- EU H2020 project APPLICATE is using LRFTIP data to inform work package on the growth of systematic model error across time scales
→ has brought to light inconsistencies in daily forecast vs reference data (instantaneous vs 24h mean)
- FTP data access updated to
<ftp://crd-data-donnees-rdc.ec.gc.ca/pub/CCCMA/bmerryfield/goapp/goapp/LRFTIP/>
(links to <https://www.wcrp-climate.org/wgsip-projects>)
- Saurral et al. overview paper in preparation

Initial shock in subseasonal predictions

Day 2 – Day 1 Total cloud cover in S2S hindcasts initialized in May →

Successive differences in global mean Total cloud cover ↓

g) Evolution of difference between D_{i+1} and D_i



Thank you for attention!

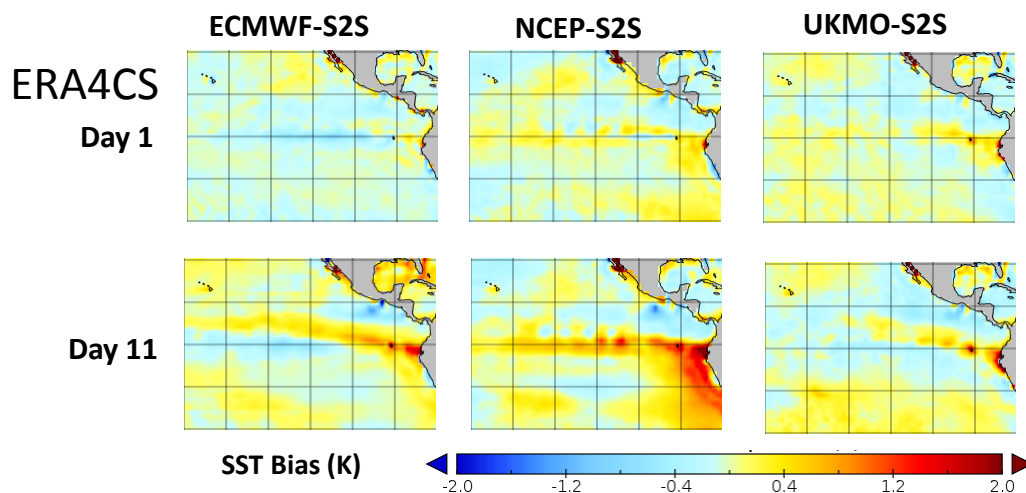
Additional slides

(material presented for previous meetings)

This material was presented by Bill to recent JSC and S2S meetings:

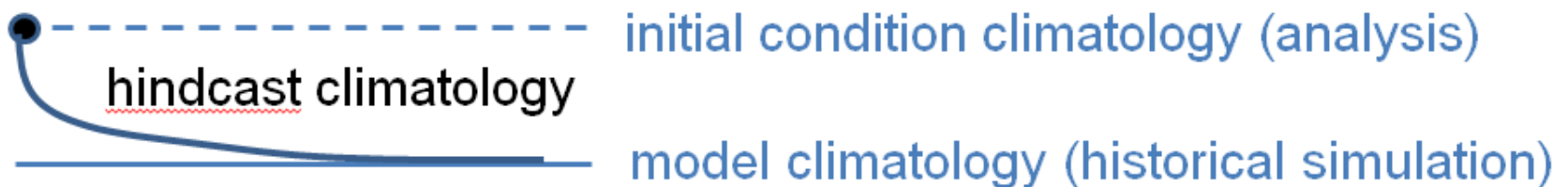
- **LRFTIP** (shock and drift intercomparison) *W. Merryfield, M. Tolstykh, R. Saurral*
 - evaluating development of model systematic errors in >40 subseasonal, seasonal and decadal systems
 - database of hindcast & reference climatologies (linked to url below)
 - overview paper in preparation

Development of SST biases in days 1-11 of S2S forecasts initialized in November →



Approach

- For a particular model and start date, hindcasts are averaged over available years and ensemble members to form a *hindcast climatology*
- When available, climatologies are also constructed for
 - Freely running model (e.g. CMIP **historical** simulations, averaging over multiple ensemble members)
 - Hindcast initial conditions = assimilating model run or **analysis** used for initialization, alternatively use observational **reference** dataset
- These represent “endpoints” of hindcast drifts, with differences from hindcast climatology indicating evolution away from initial conditions, toward model’s own climate:



- Community input is invited and indeed sought, including
 - Suggestions for shock/drift diagnostics
 - Data contributions for models and/or initialization methods not in archive

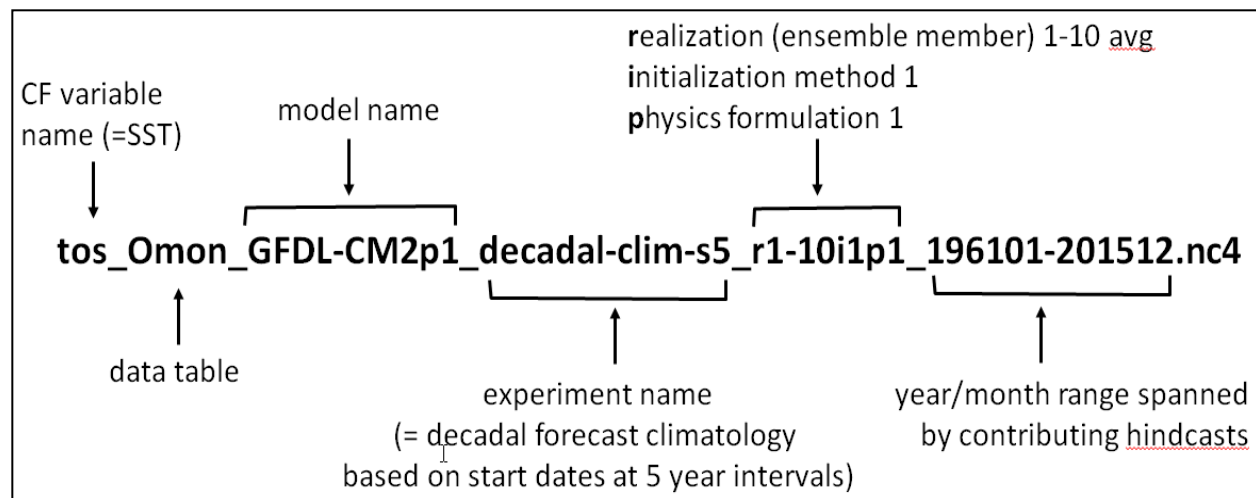
Data Archive

Time scales represented for different forecast types

- **Subseasonal**: daily to 30/60 days
- **Seasonal**: daily to 30/60 days + monthly through forecast range
- **Decadal**: daily to 30/60 days + monthly/annual through forecast range

Data format

- CF-compliant **NetCDF4**
- Time variable=**leadtime**
- File names, directory tree guided by **CMIP/ESGF conventions** →



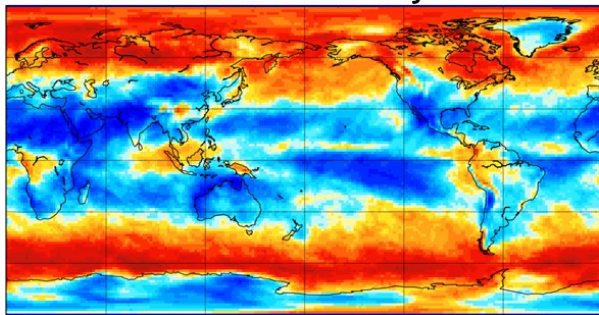
Data location: <ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP/>

- Can be accessed from <https://www.wcrp-climate.org/wgsip-projects/lrftip> (web search “LRFTIP”), includes data specification document

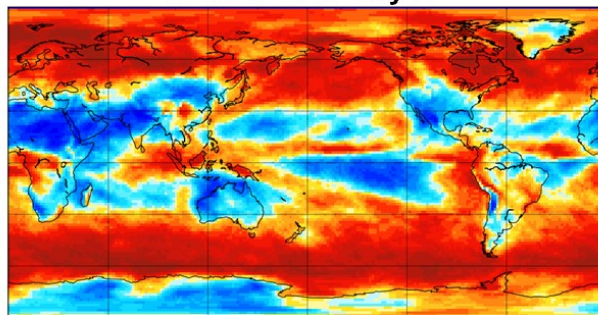
Sample Diagnostics - Subseasonal

- **Total cloud cover** in first days of hindcasts initialized near **1 Nov**

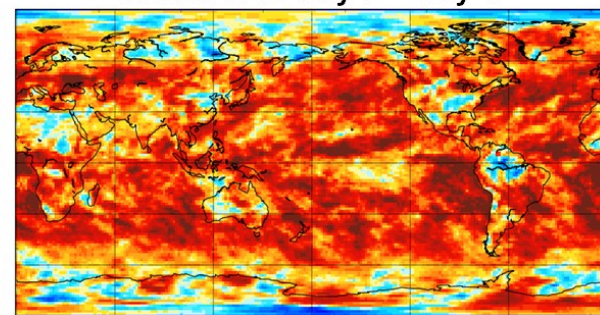
UKMO-S2S day 1



UKMO-S2S day 2



UKMO-S2S day 2 – day 1



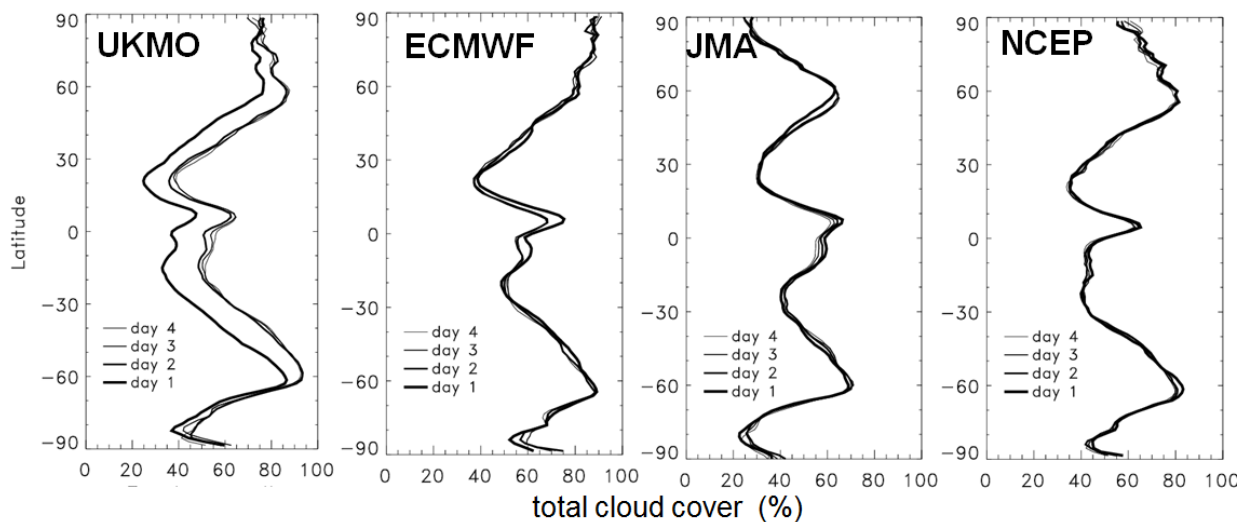
0 20 40 % 60 80 100

-25 0 25

- UKMO model shows large transient relative to other models ↓

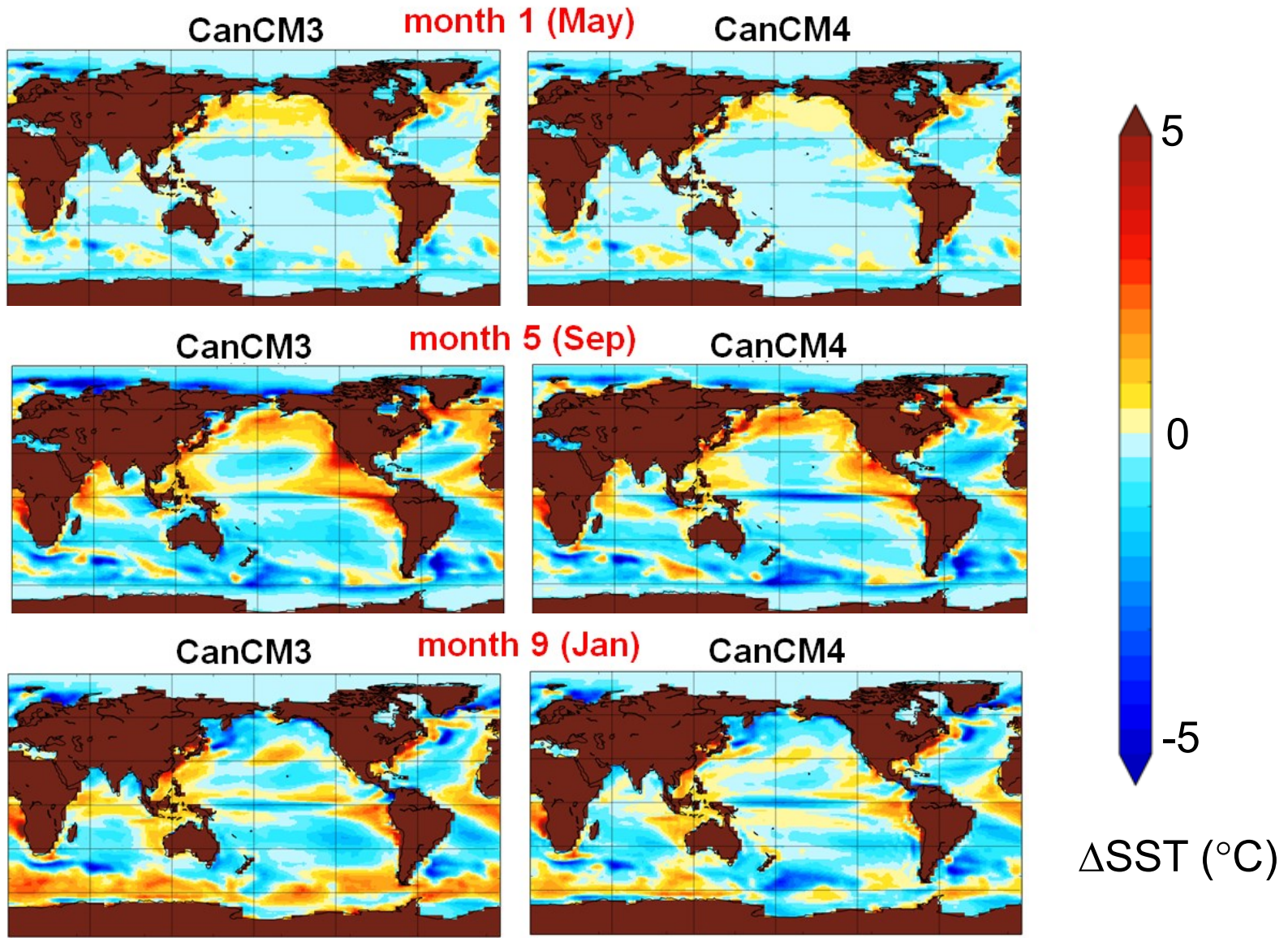
- Low initial cloud cover is a result of initializing UKMO model with ERA-Interim fields

Zonal means vs forecast day



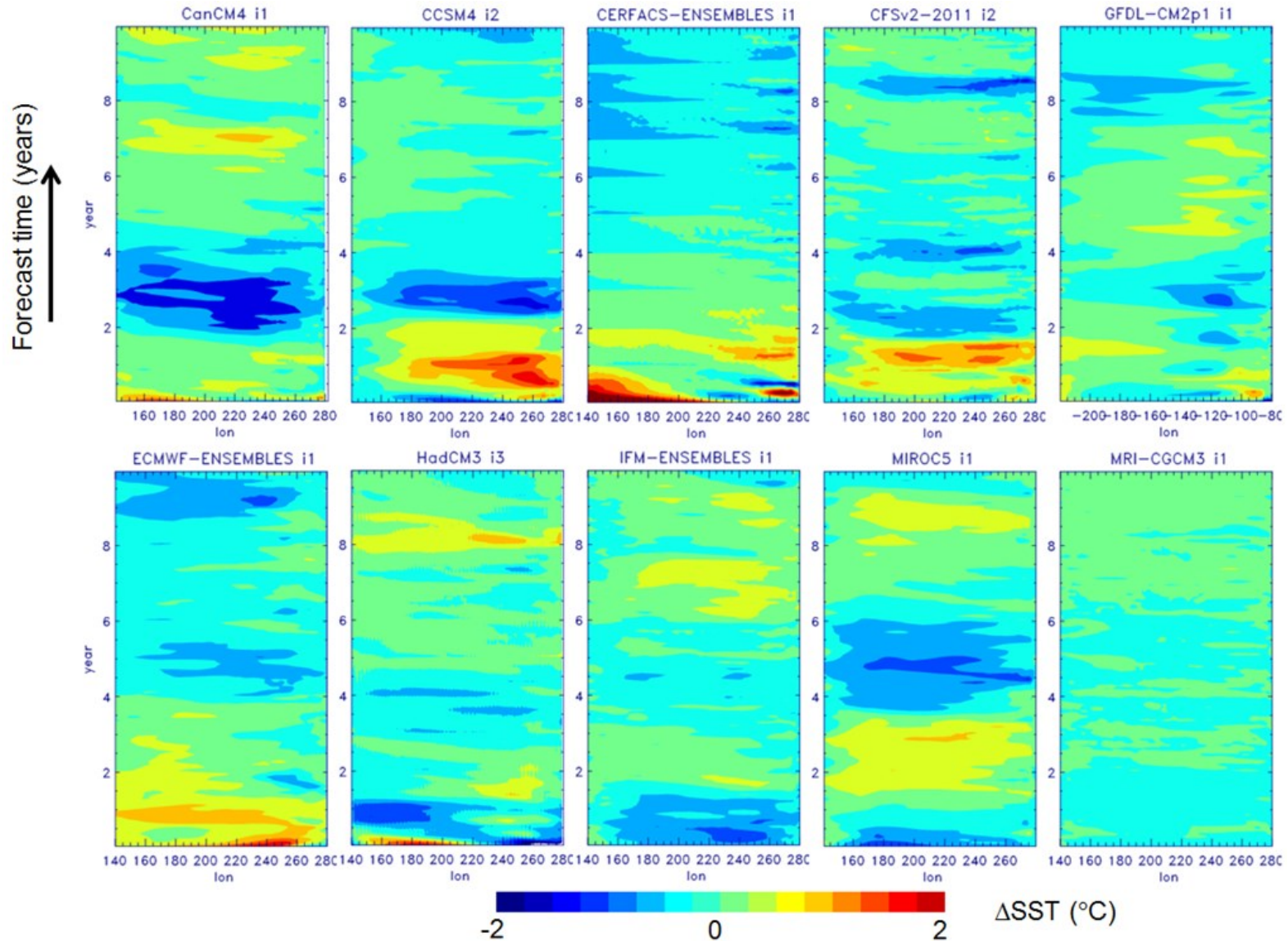
Sample Diagnostics - Seasonal

- SST biases** developing in hindcasts initialized **1 May** in two models having same ocean, different atmospheric components (vs OISST reference)



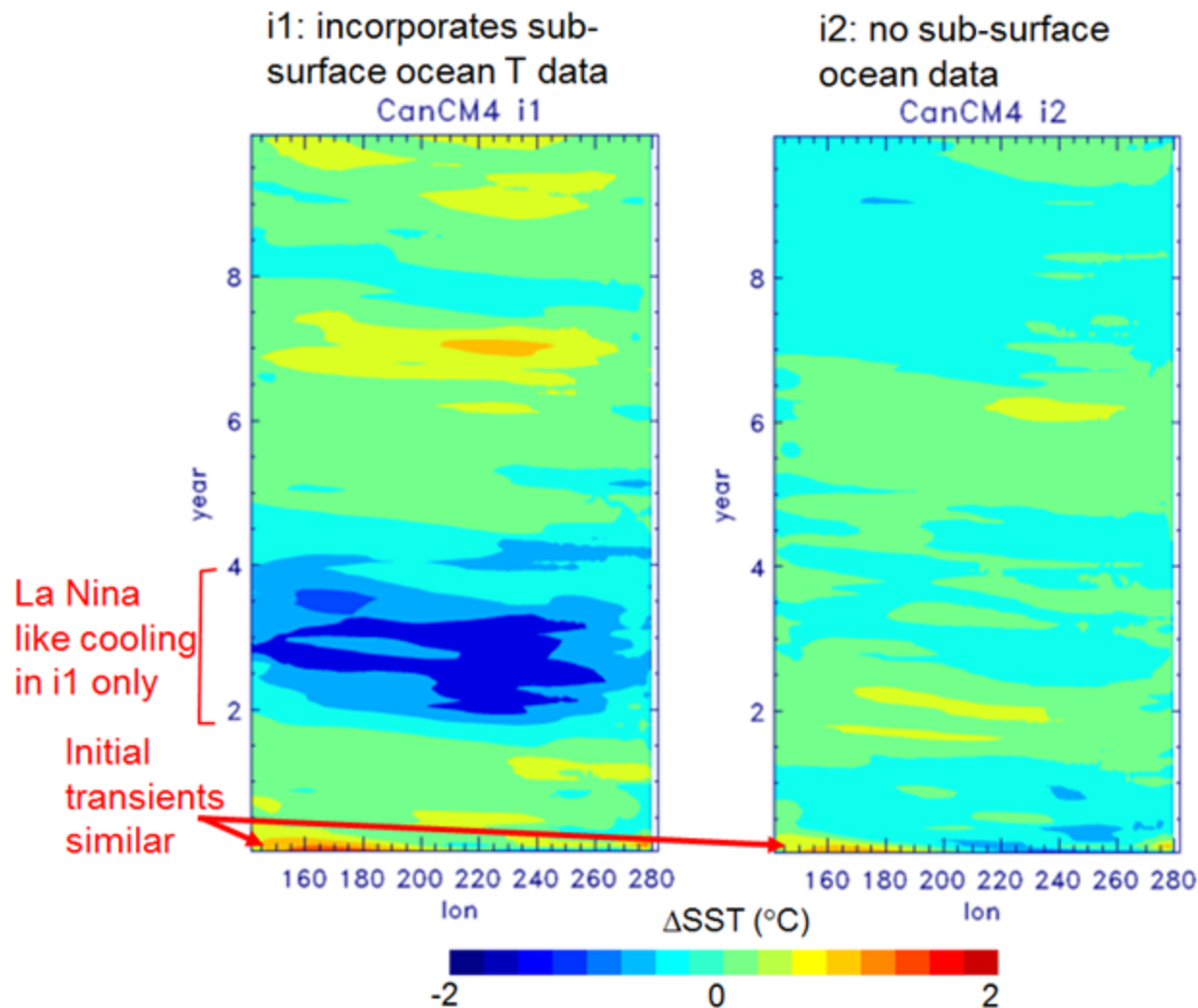
Sample Diagnostics - Decadal

- Drift evolution of SST across equatorial Pacific in 10 decadal prediction models, showing El Niño and La Niña-like transients



Sample Diagnostics - Decadal

- Same except for CanCM4 using two different ocean initialization methods:
i1 includes subsurface data, i2 = surface initialization only



Sample Diagnostics - Decadal

- differences* (i1–i2) in 20°C isotherm depth (left) and SST (right), showing La Niña-like transient excitation by anomalous upwelling Kelvin waves in years 2-6

