Environment and Climate Change Canada | Environnement et Changement climatique Canada

Seasonal forecasting developments at ECCC

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Topics covered

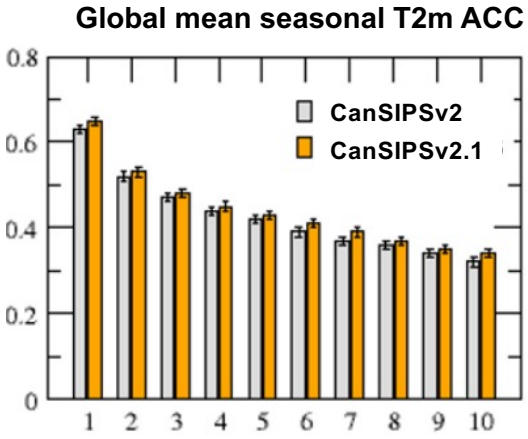
- ECCC is contributing to C3S seasonal forecast ensemble as of May 2021 (high-frequency hind/forecast data for ~35 single & multi-level variables)
- CanSIPSv2.1 upgraded multi-model ensemble
- Seasonal forecasting experiments with CanESM5 (CCCma's CMIP6 ESM)
- Experimental online ocean bias correction in CanESM5

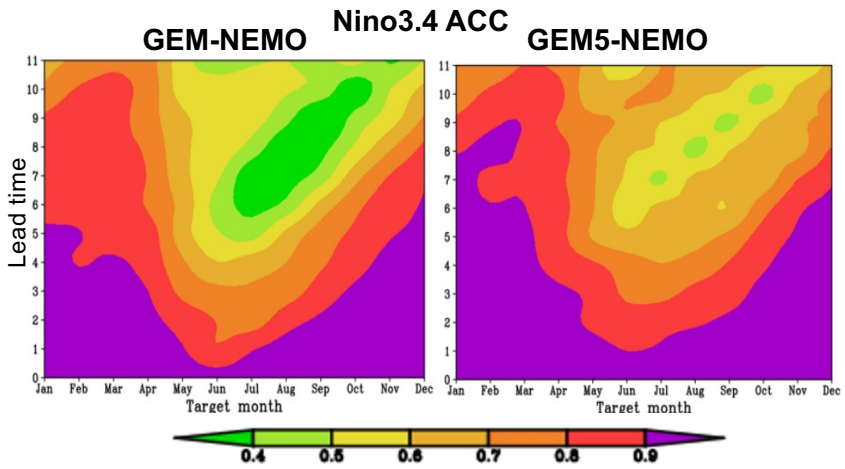
CanSIPSv2.1 upgraded MME

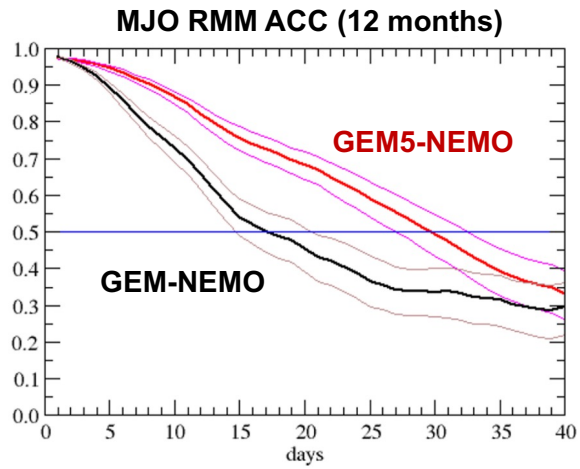
	System	Debut	Climate models	NWP models	Coupled?	Range
	HFP	1996	GCM2	SEF	N	3 mon
	HFP2	2008	GCM2, GCM3	SEF, GEM	N	4 mon
Coupled	CanSIPS	2011	CanCM3,CanCM4	-	Y	12 mon
Coupled	CanSIPSv2	2019	CanCM4i	GEM-NEMO	Y	12 mon
Coupled	CanSIPSv2.1	2021 Dec	CanCM4i	GEM5-NEMO	Y	12 mon

HFP = Historical Forecasting Project CanSIPS = Canadian Seasonal to Interannual Prediction System

- GEM5-NEMO uses 1° Yin-Yang atmospheric grid (vs 1.4° lat-lon before), 85 vertical levels, 0.1hPa top
- Bechtold (2001) shallow convection scheme, stochastic perturbation of parameters (SPP), modified land init

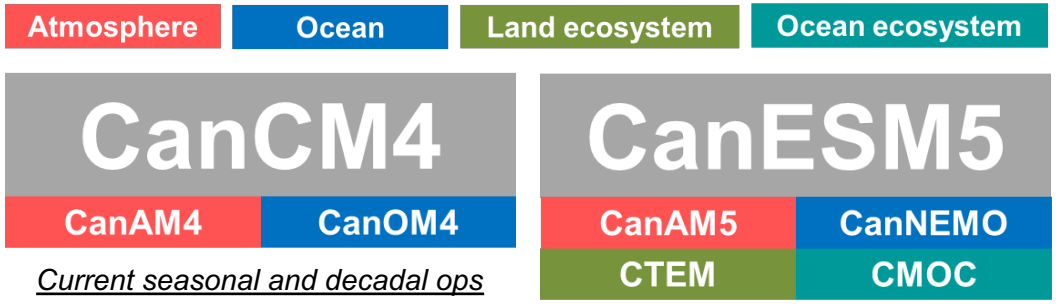




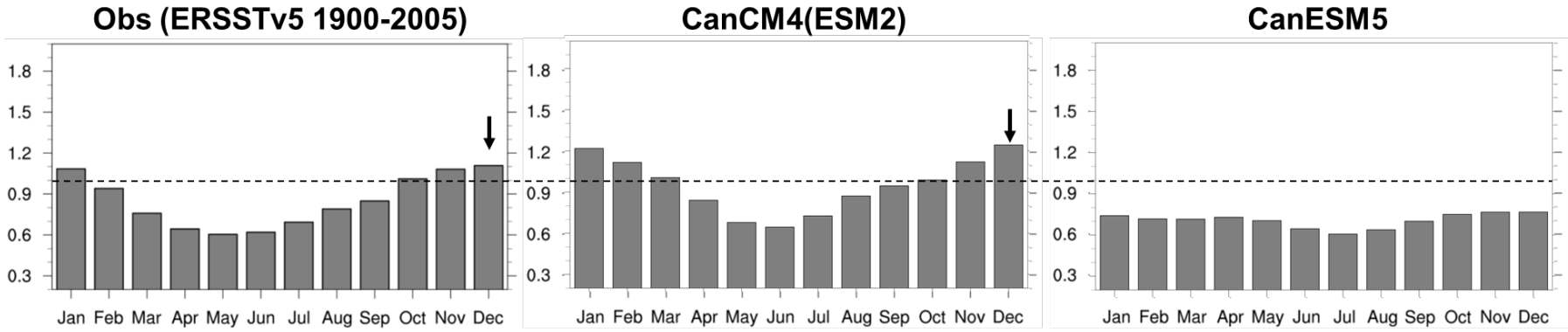


Seasonal forecasting experiments with CanESM5

- CanESM5 = CCCma CMIP6 ESM
- Equilibrium climate sensitivity:
  - 3.7K CanESM2 (proxy for CanCM4)
  - 5.6K CanESM5
- Nino3.4 std dev vs month (freely running):



Current seasonal and decadal ops



- CanESM5 seasonal skills nonetheless competitive with CanCM4

Global mean ACC averaged over all lead times, target months/seasons →

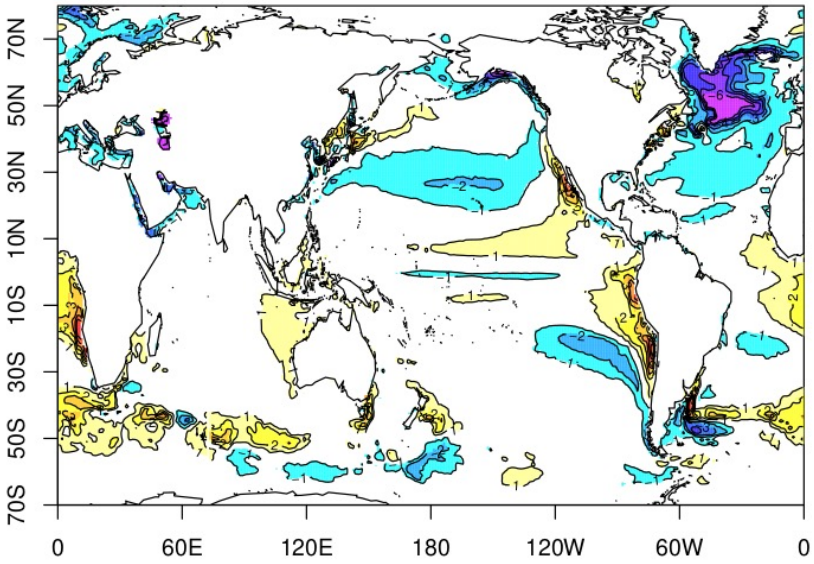
	CanCM4i	CanESM5
Nino3.4 (mon)	**0.81**	0.75
T2m land (seas)	0.30	**0.32**
Sea ice area (mon)	0.76	**0.79**

Experimental online ocean bias correction in CanESM5

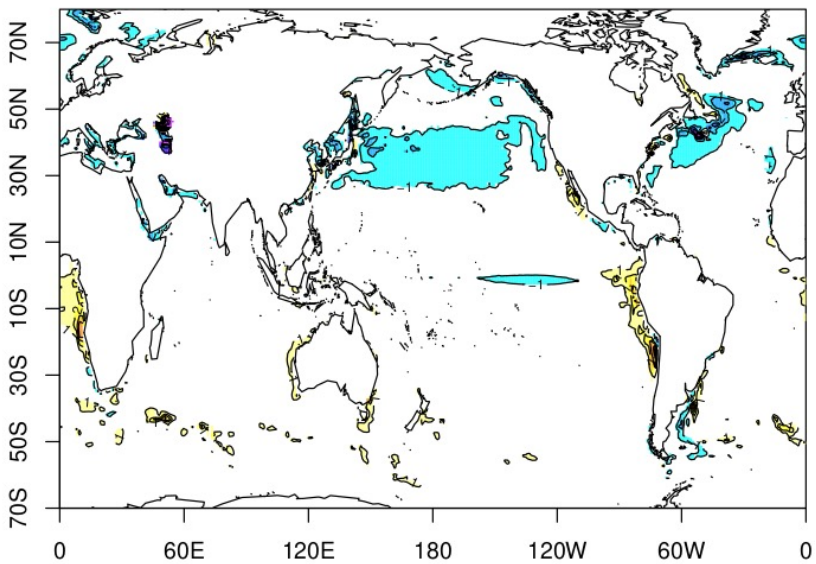
- Methodology:
  - Nudge ocean T/S to ORAS5, letting atmosphere evolve freely (30d upper / 360d deep, including equator)
  - Calculate 1981-2010 monthly climatology of nudging terms
  - Apply as non-interactive correction to T/S tendencies

1981-2010 annual mean SST biases

CanESM5 historical run



Ocean bias correction



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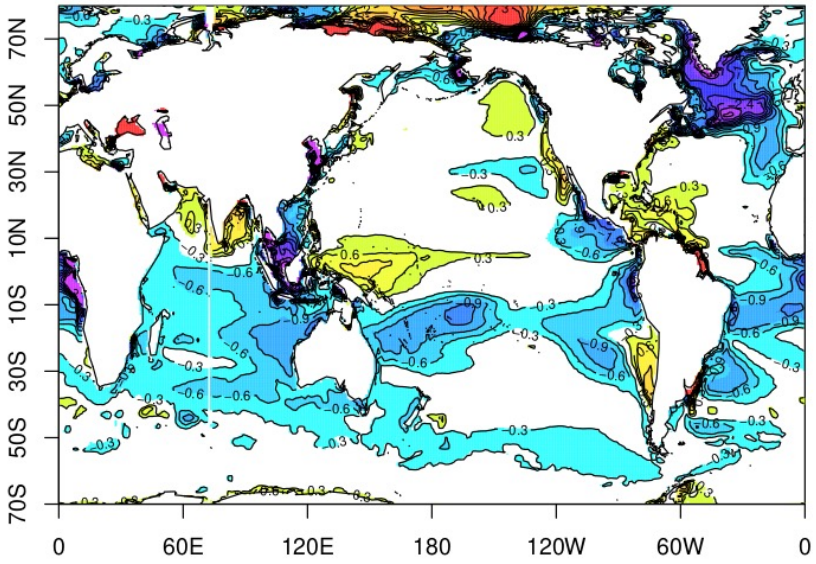

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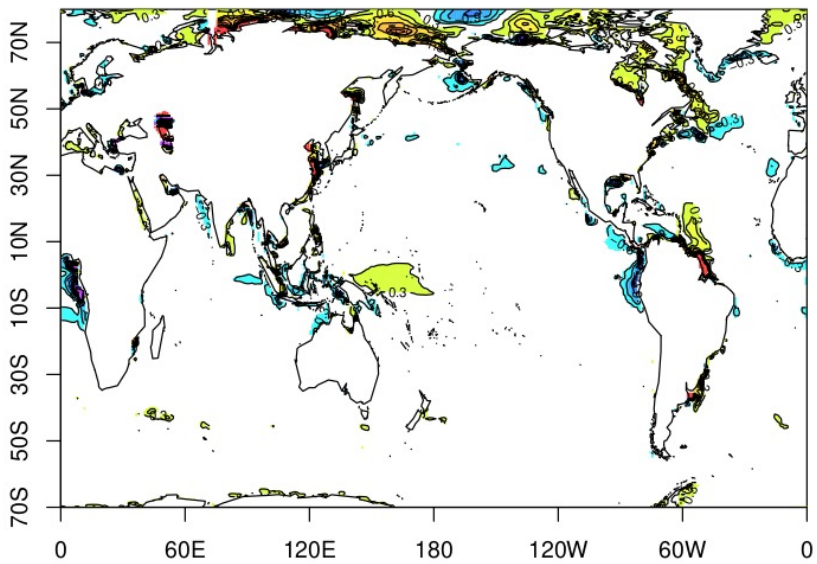

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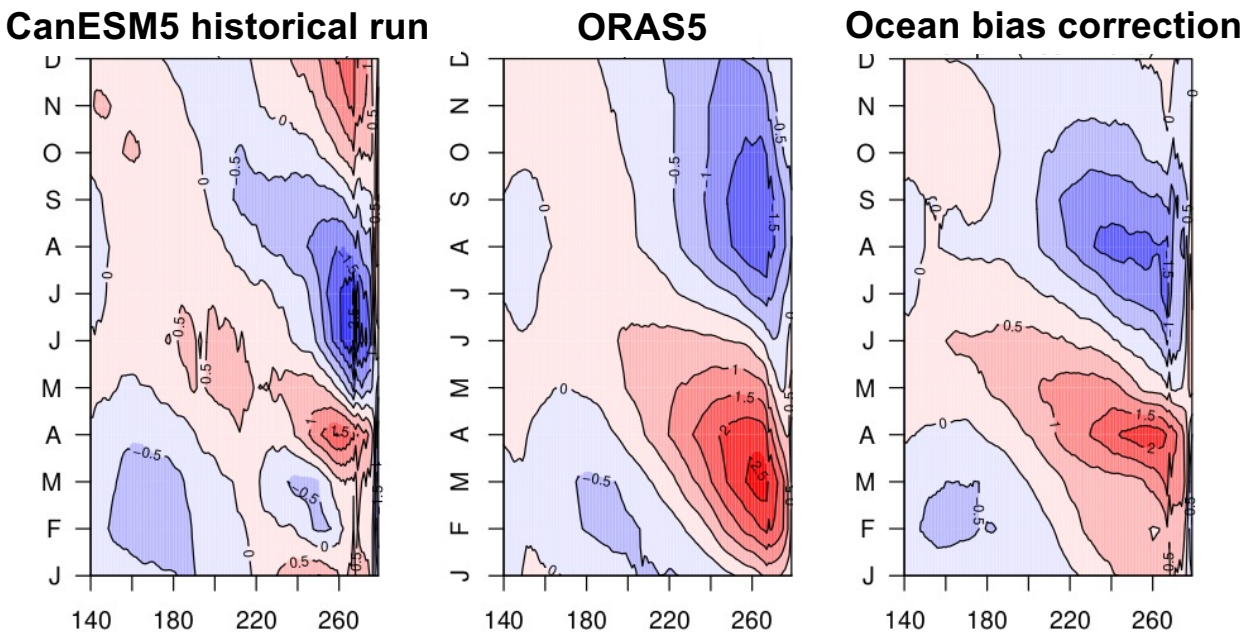
1981-2010 equatorial Pacific SST seasonal cycle



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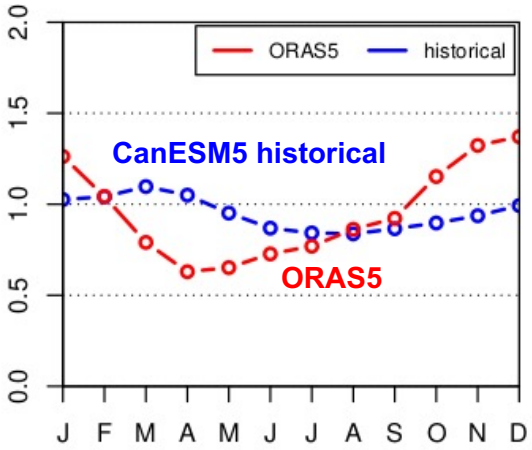
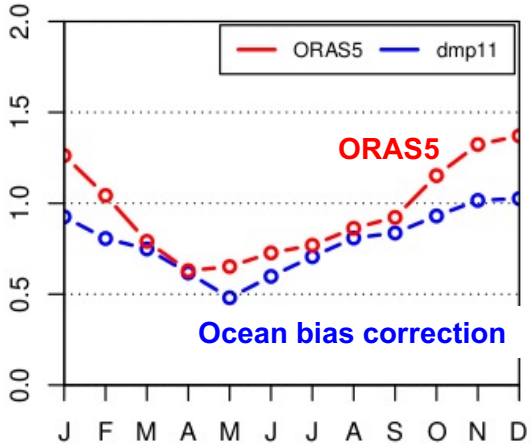
1981-2010 Nino3.4 monthly std dev





- Next steps:
  - Atmospheric model parameter adjustments → promising early results
  - Experiment with atmospheric online bias correction after Kharin and Scinocca (GRL 2012, https://doi.org/10.1029/2012GL052815)