APEC Climate Center (APCC)

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APCC APEC CLIMATE CENTER

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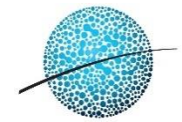
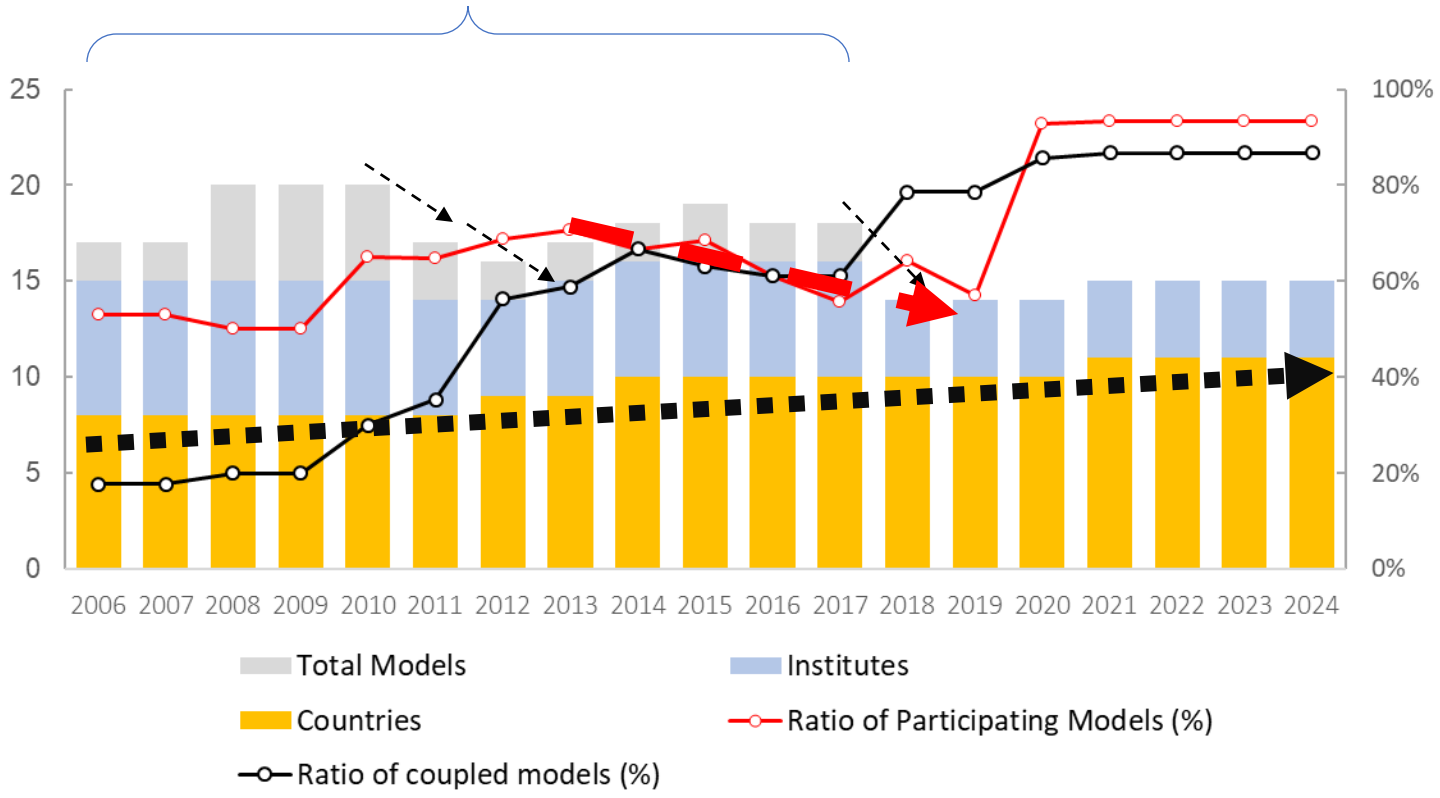
- MME development

- Cooperative mechanism for model improvement in Korea



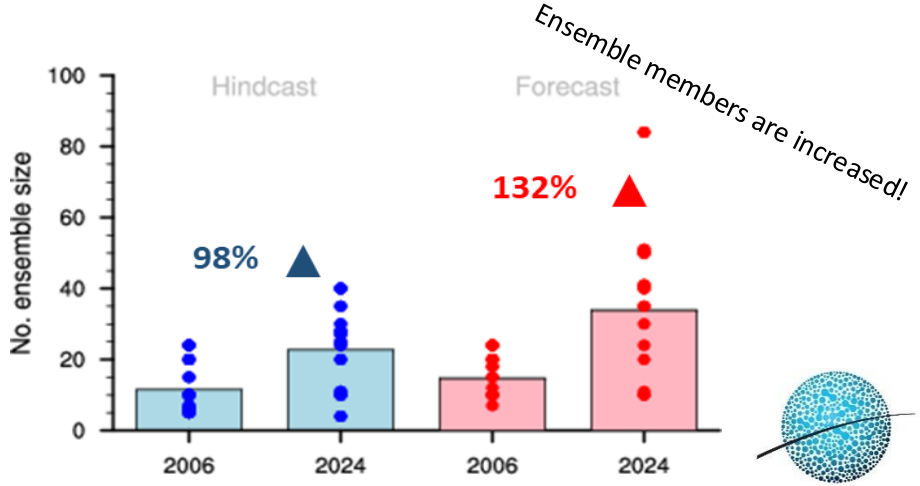
Evolution of APCC MME (reflecting evolution of model ecosystem)

- **multiple models from single insitutute** (IRI, KMA, MSC)

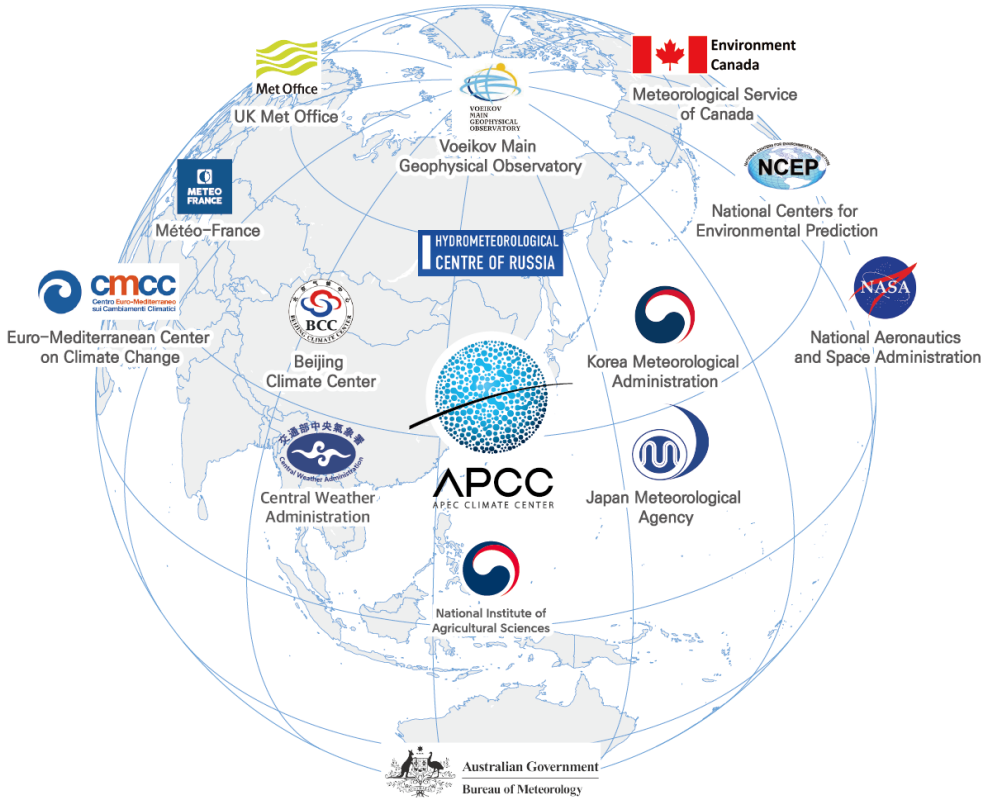


- Actual Participating models were decreased due to hindcast period mismatch between old and new models.
- Hindcast change : 1983~2010 → 1991-2010 (from 2020) → 1993-2016 (from 2025)

- Reduction of number of model in 2010s
  : Some AGCMs stopped Operation
- Increasing Numbers of model
  : New participants from Europe=more diversity
- In 2020s, every year, a couple of models were improved (except 2023)



APCC MME model status



Collecting prediction data from 15 institutes in 11 economies

2024~

ECCC (CanSIPSv3)

Upgrade of component models
- CanAM4 → CanESM5.1p1
- CanOM4 → CanNEMO3.4
- CLASS2.7 → CLASS3.6.3 and CTEM
- CICE4 → CICE6
- Ensemble size up (20/20 → 40/40)

MGO (MGOAM2.4)
- Resolution up (T42L14 → T63L25)
- Ensemble size up (F/H: 10/6 → 10/10)
- Hindcast period expand (1979-2004 → 1991-2020)

In progress:

CMCC (SPS4)

NASA (GEOS-S2S-2.1)

CWA (CWACFSv2)

PKNU (CGCMv1.0)
Pukyong National Univ.

ECMWF (SEAS5)

* Under consideration for New Members

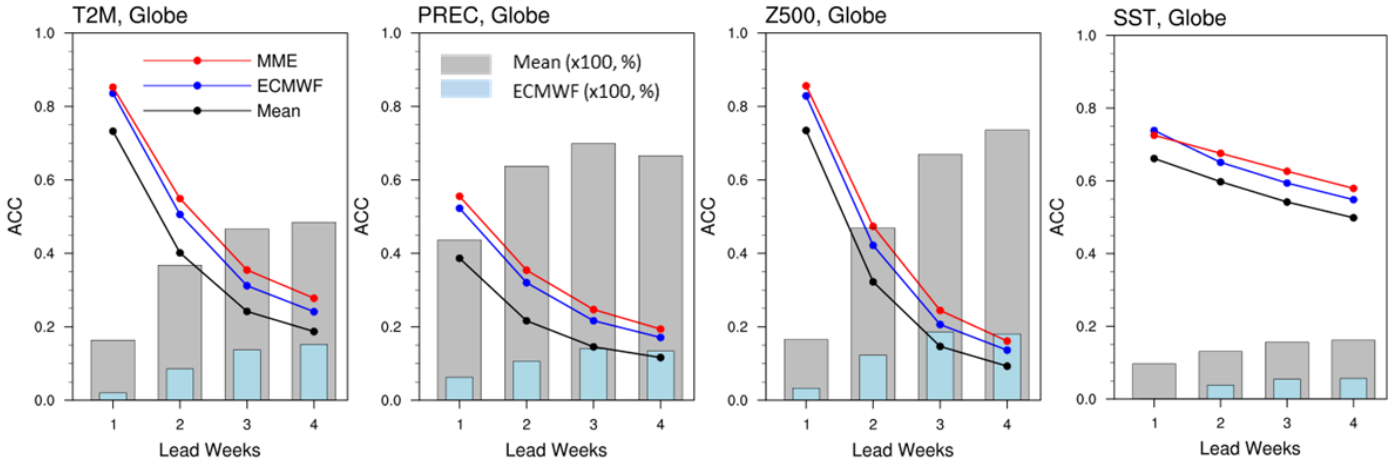
Towards Seamless MME

- **MME Efficiency** (%) $= \frac{\mathrm{ACC}_{MME} - \mathrm{ACC}_{Mean}}{\mathrm{ACC}_{Mean}} \times 100$

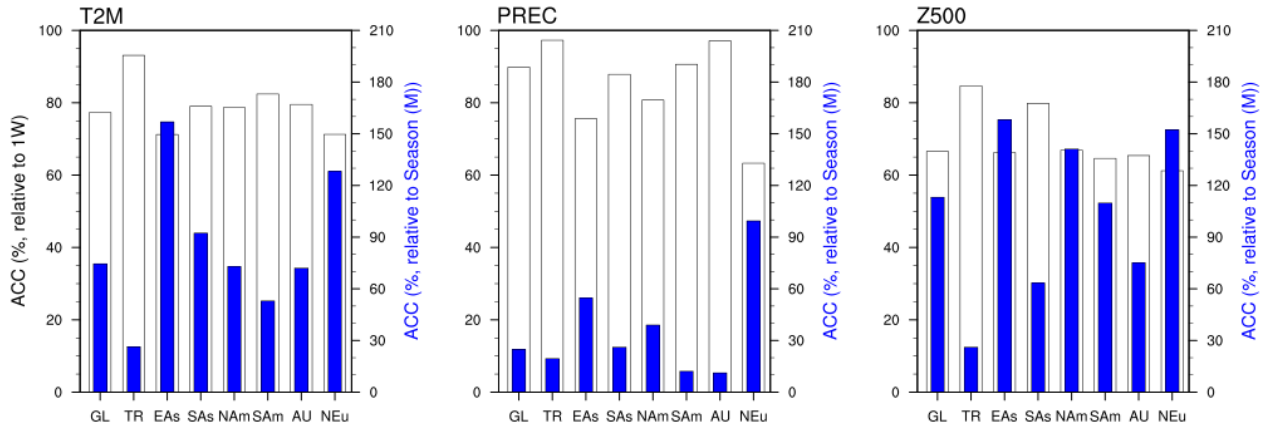
Subseasonal MME

- ✓ 8 S2S Models with a common hindcast period of **2003-2015**
- ✓ "**Monday-Sunday**" average (target-based)
- ✓ the closest reforecast based on the MME forecast date (Monday)
- ✓ **simple average** of 8 models with equal weighting

Multi-Model Ensemble Efficiency (relative to Mean/ECMWF)



Comparison between S2S MME and Seasonal MME for same target month

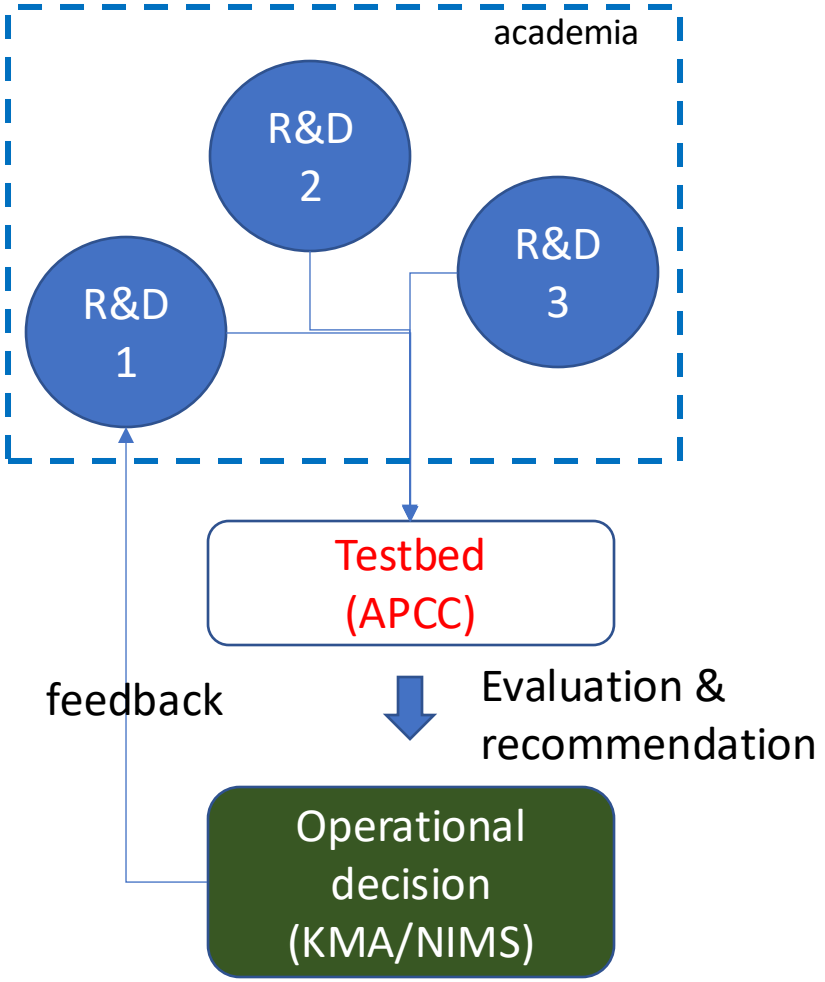


- 1-4 weeks avg (1mon) ~ 80% of skill of 1st week forecast
- 75% (Temp), 25%(Prec) better than 1month forecast from seasonal MME (due to shorter lead-time)

- Merging two MMEs may be useful for users
  - Frequently updated (better) monthly mean forecast

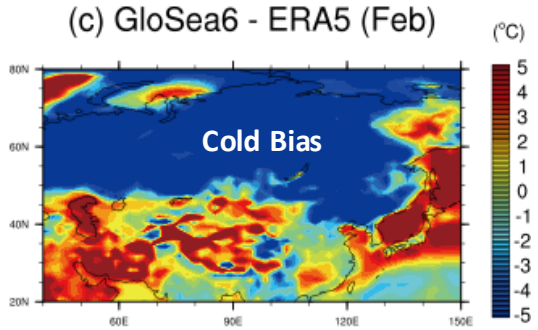
Cooperative Model Development (R2O)

- Researches to improve climate forecast system in KMA by various groups
- No clear R2O process
  - Different evaluations under diverse experiment configurations
- Testbed
  - Same computing environment with operation
  - Comprehensive evaluation processes and metrics
  - Recommendations on the impacts, computational efficiencies for adoption on the operational system



Ex) Sea Ice parameters

Exp: 1993~2016, Nov, May 12 members,

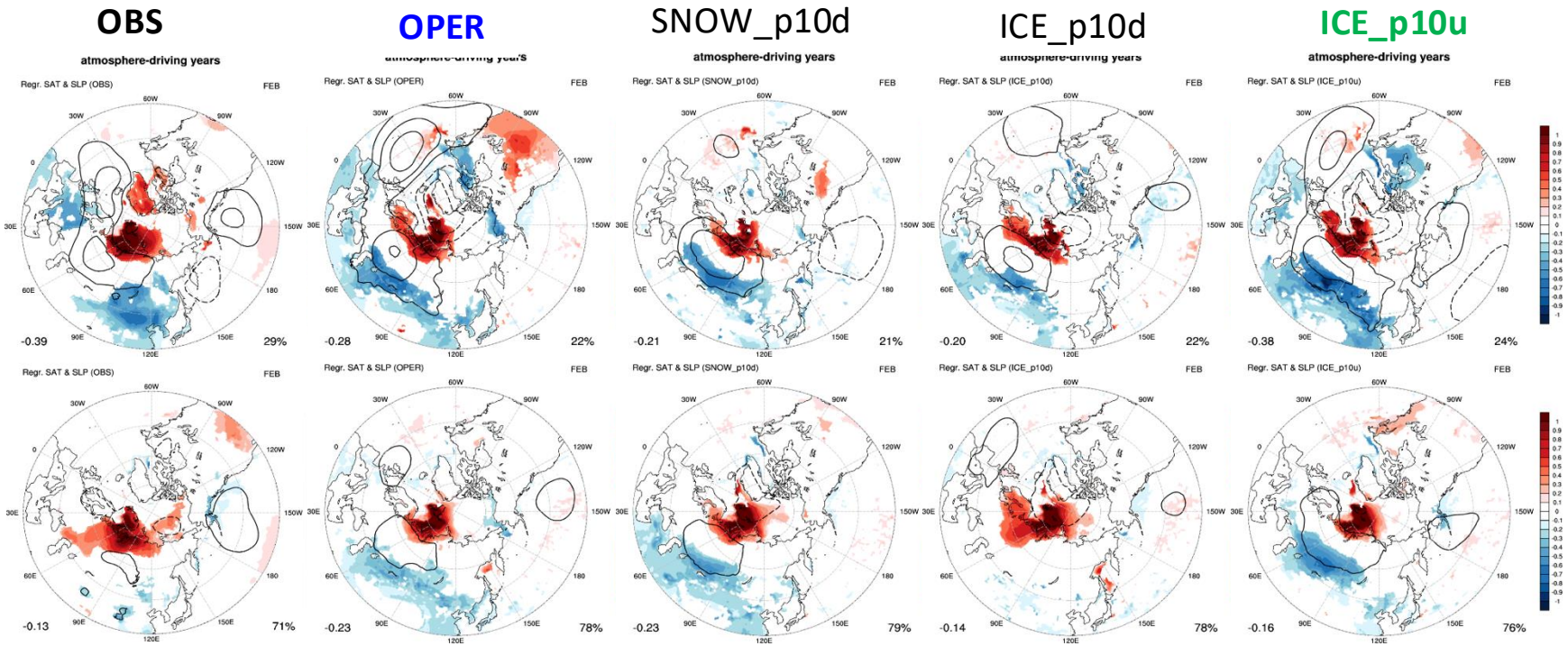


Parameter Sensitivity analysis by academia

experiment	Ice albedo (albicei)
ICE_p10u	10% increase (0.36 → 0.396)
ICE_p10d	10% decrease (0.36 → 0.324)

experiment	Snow albedo (albsnowv)
SNOW_p10d	10% 감소 (0.98 → 0.88)

Regression of SAT on ARTI



Evaluation

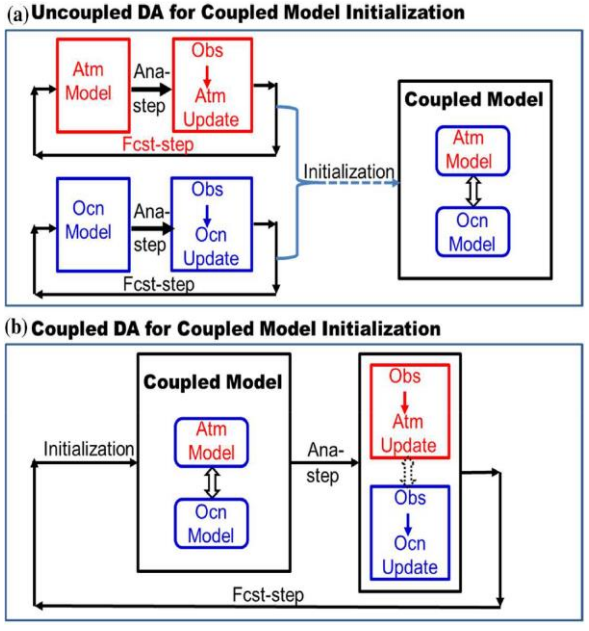
- Simulated climate characteristics : No big change
- Improved teleconnection by Ice albedo increase
- Computational efficiency and stability : No change

Recommendations

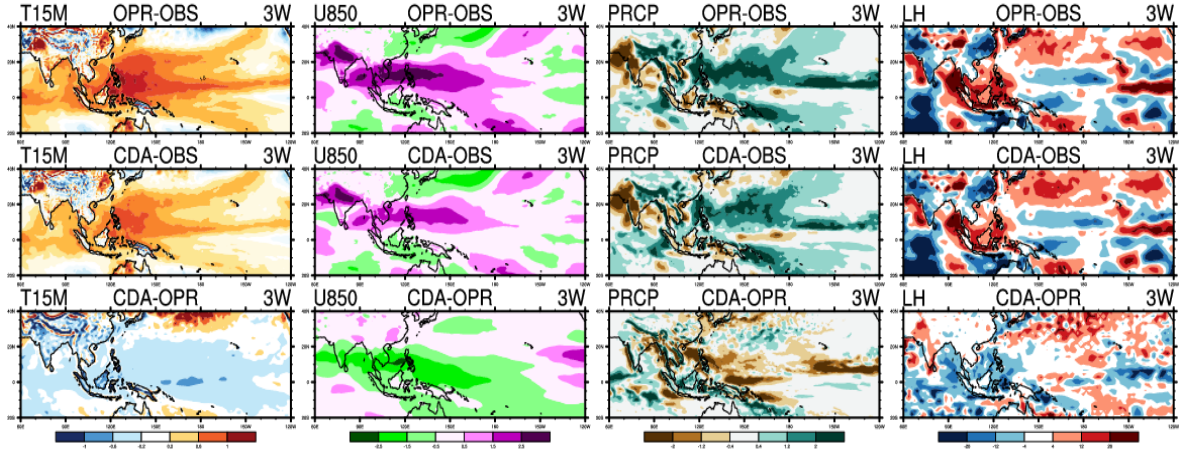
- Increasing Ice albedo can be applied
- Decreasing snow albedo may be considerable

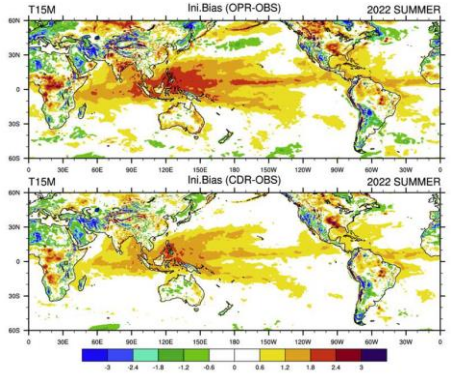
Ex) Coupled Initialization for S2S forecast

Experiments : 72 cases in summer (56) and winter (16) under full operational setting

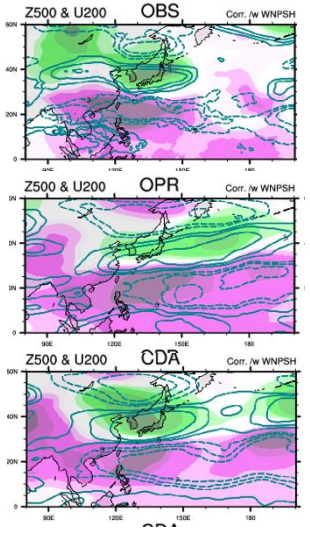


Wk3 error reduction : excessive wind, heat flux, Precip biases



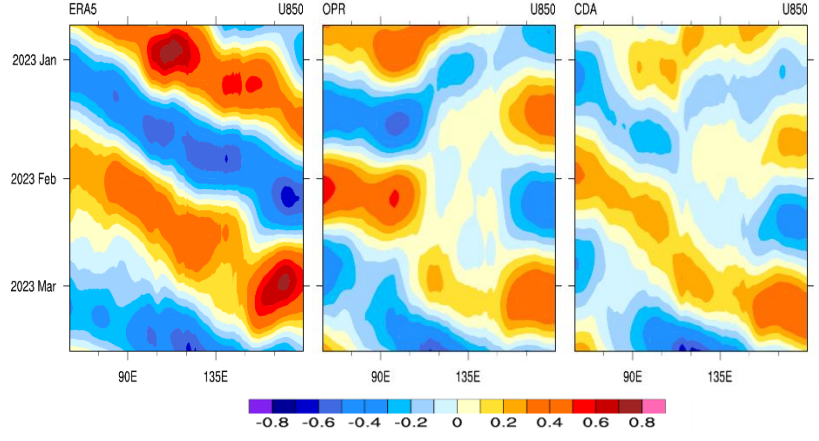


Initial error reduction (T)



EA summer monsoon circulation (Wk3)

MJO propagation improved (Wk3)



Evaluation

- Improvement in the physical processes related with EA subseasonal forecast & Tropical ISO
- Computational efficiency and stability : needs additional 80 min (+6hr), stable to run

Recommendations

- Application of coupled Initialization in operation

CrEMA

Provide comprehensive picture of model's performance for improvement and development of model under the cooperative development framework

Climate fo**R**ecast model **E**valuation & **M**anagement system by **A**PCC (**CrEMA**)

Data processing
- Sorting / filtering
  - Observation
  - Model data (Hindcast)
- Transformation into the desired form

Forecast skill
- **Deterministic**
  - Climatology (Mean field)
  - Y2Y variability (Anomaly field)
- **Probabilistic**
  - Quantile probability
  - Ensemble characteristics

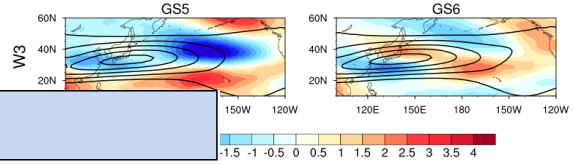
Diagnostics ENSO/ISO/EAM/AO
- **Performance**: evaluate predictive skill and basic characteristics of each climate mode
- **Process**: assess the model's ability to reproduce the core processes essential to each climate variability
- **Teleconnection**: evaluate how the influence of each climate mode propagates to remote regions

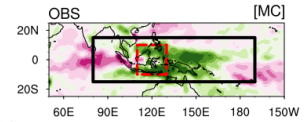
Scorecard
- Selection of essential metric component
- standardization

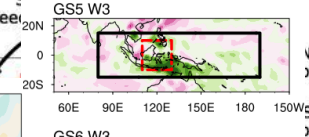
Comprehensive evaluation information
- Monitoring forecasts quality and Identifying model flaws
- Understanding the causes of model flaws

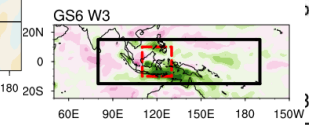
Diagnostics

2023			2024		
ENSO	MJO	EASM	Arctic	BSISO	EAWM





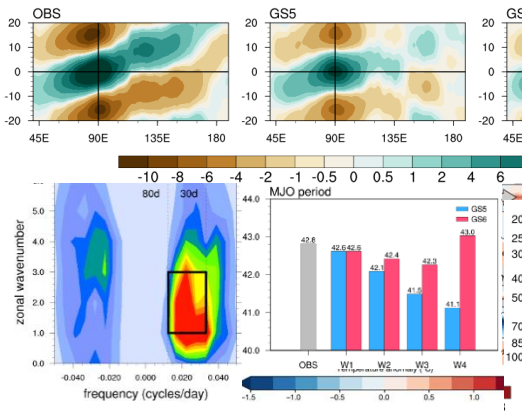


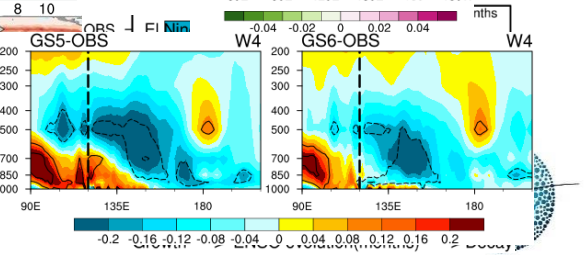


MJO Diagnostic Scorecard

GS6 -GS5	Prediction skill							Basic characteristics											Teleconnection								Processes					
	East. Prop.			Pattern		Occur. Freq.		PD	Coh.	Int.Pha. Cons.		Baroclinic							Subtropical Jet				PNA				EPT			APE		
												LLMC			ULD								RMSE		EW.Pos.							
	IO	MC	WP	P2-3	P6-7	P2-3	P6-7			P2-3	P6-7	IO	MC	WP	IO	MC	WP	RMSE	Amp.	ZE	MS	P2-3	P6-7	P2-3	P6-7	IO	MC	WP	IO	MC	WP
W1																															
W2																															
W3																															
W4																															

better 30 25 20 15 10 5 0 5 10 15 20 25 30 worse





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