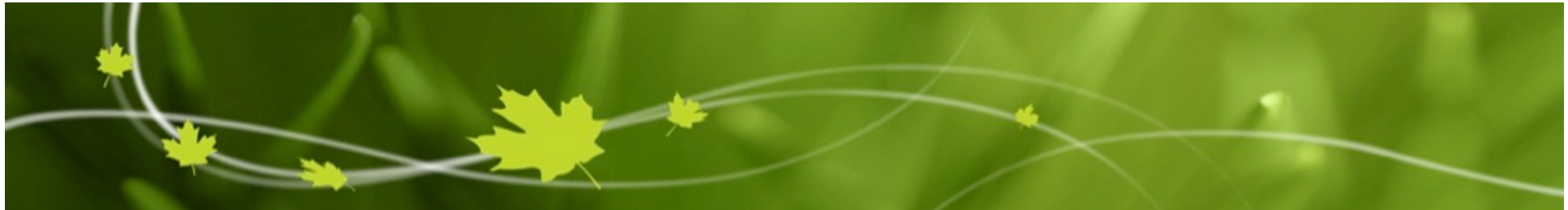




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GEM-NEMO global coupled model for seasonal predictions

Hai Lin
RPN, ECCC

Acknowledgements: contributions of many
RPN/CMC and CCCma colleagues

Outline

- Motivation
- Coupled GEM
- Hindcast
- Verification and comparison with CanSIPS
- Summary



Why coupled GEM?

- NWP based model for S2S prediction
- Multimodel ensemble (MME): benefit of a 3rd model or replacement of a weaker model in CanSIPS



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Atmospheric Model

- Global Environmental Multiscale (GEM)
- Horizontal resolution: 256 x 128 ($\sim 1.4^\circ \times 1.4^\circ$)
- 79 levels, top at 0.075 hPa
- Time step: 1 hour
- Land surface scheme: ISBA
- Deep convection scheme: Kain-Fritsch (KFC)



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Ocean + Sea ice

- NEMO
- Horizontal resolution: $1^\circ \times 1^\circ$, 1/3 degree meridionally near the equator
- 50 levels
- Time step: 30 minutes
- coupled with sea ice --- CICE



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Hindcast: initial conditions

- Atmosphere: ERA-interim
10 members (random isotropic perturbations)
- Ocean: **ORAP5** from ECMWF: ocean T, S, H, U, V
- Land: off-line SPS forced by ERA-interim atmosphere
- Sea ice concentration: **ORAP5**
- Sea ice thickness: **ORAP5**



Hindcast

- 12 month integrations
- 10 members
- 31 years of 1980-2010



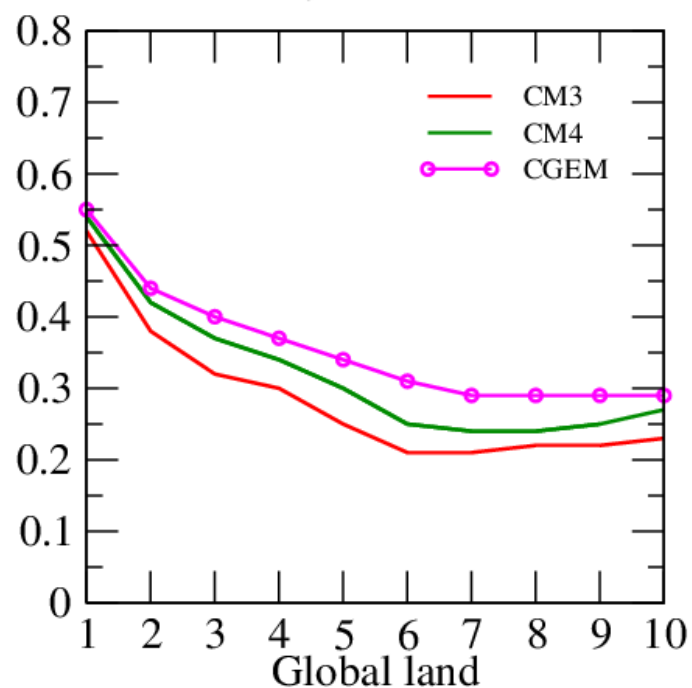
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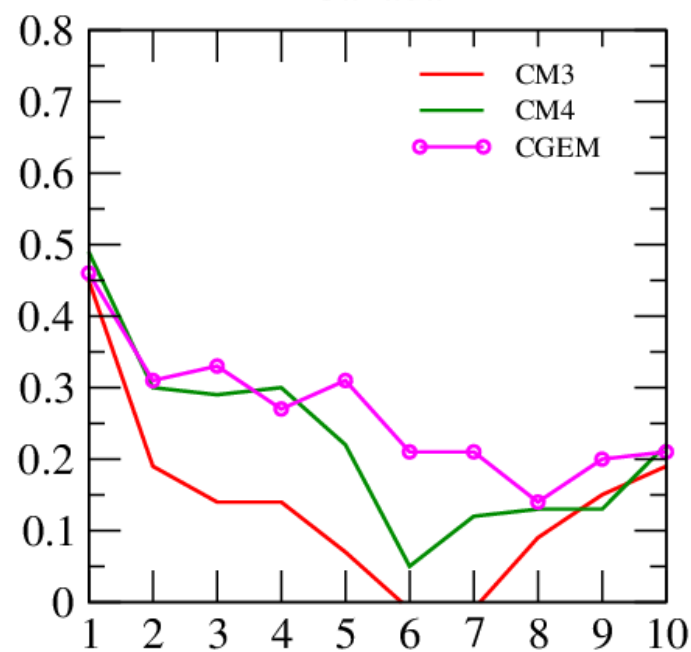
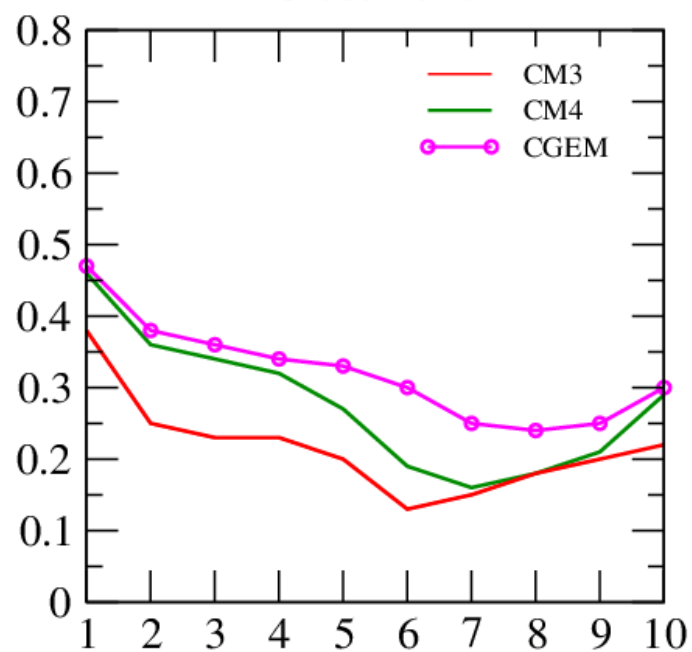
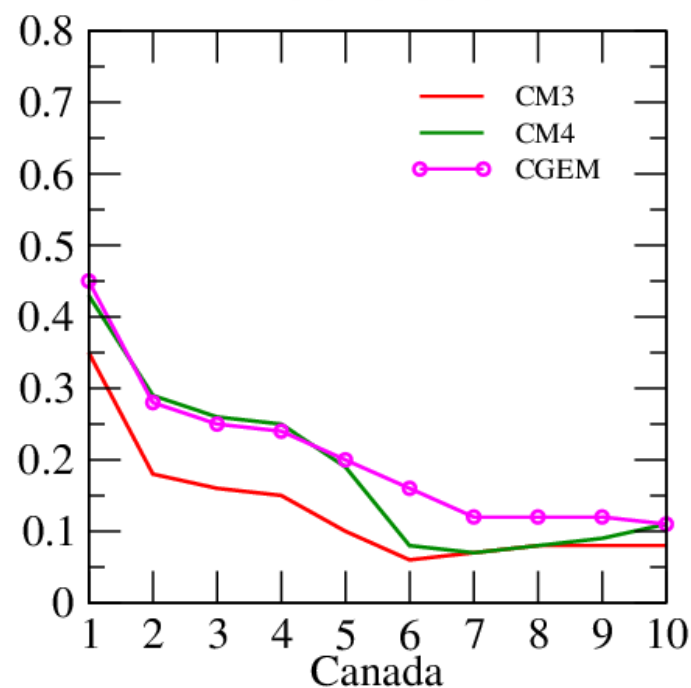
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May 1
Start

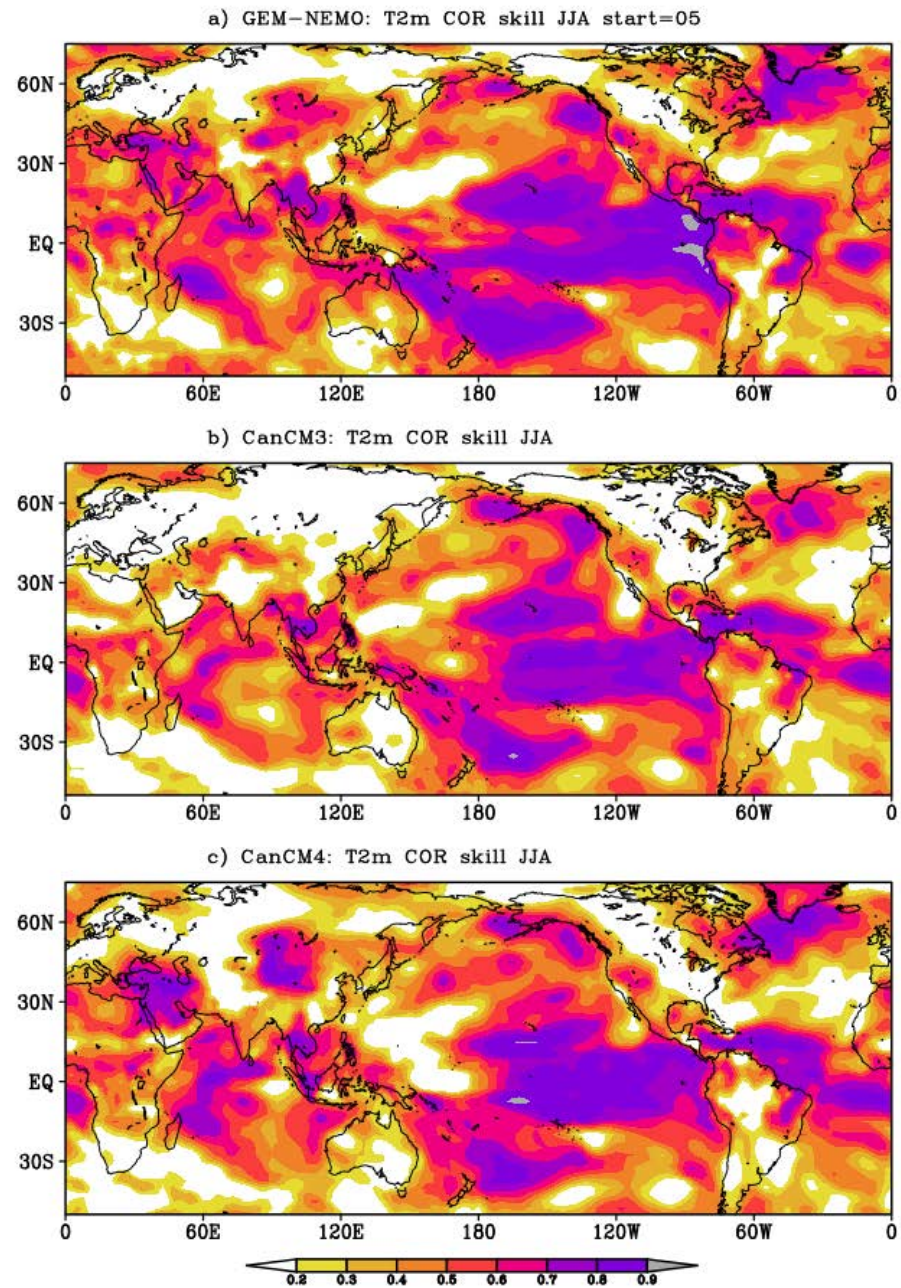
T2m May 1 start: Global



north of 30N

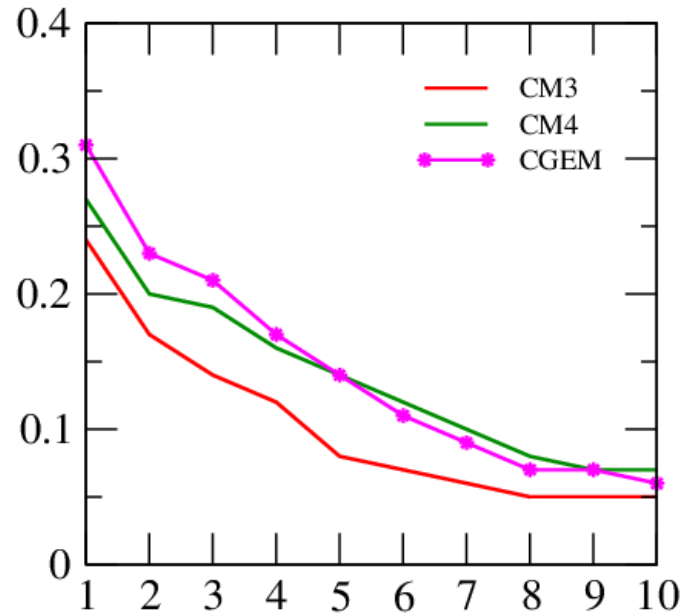


JJA T2m
lead=1 month

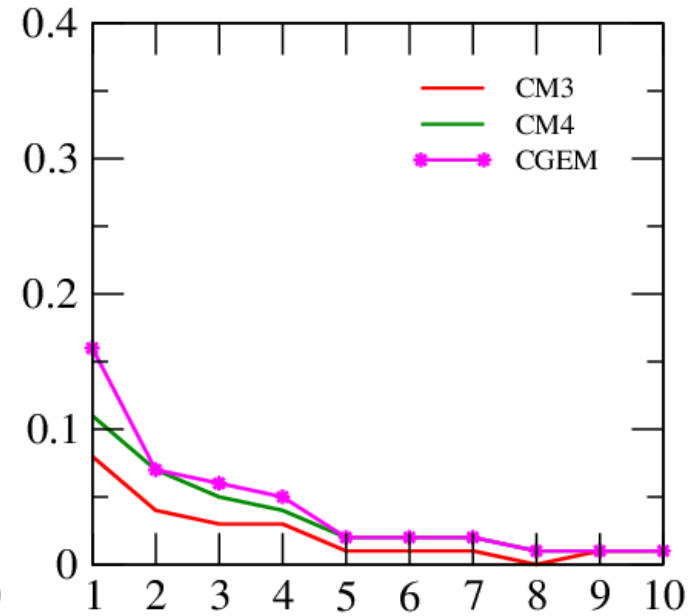


Nov 1
Start

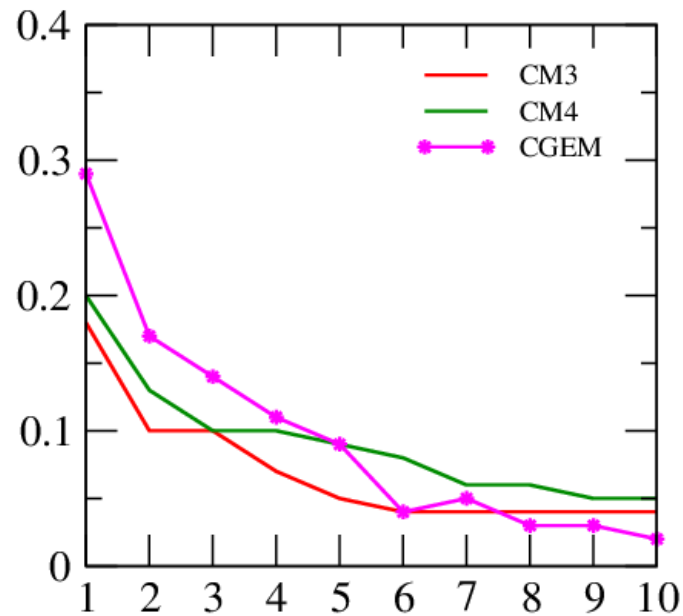
PR Nov start: Global



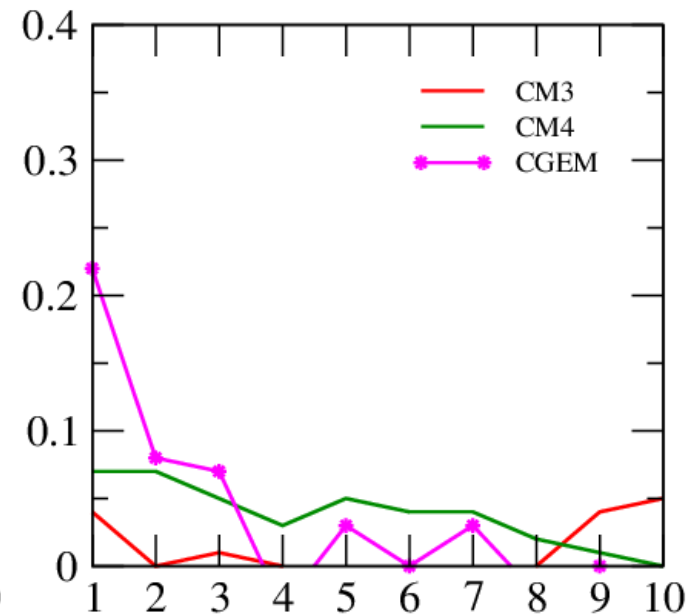
North of 30N



Global Land

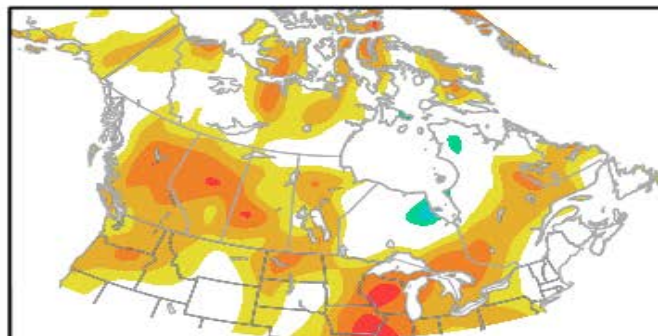


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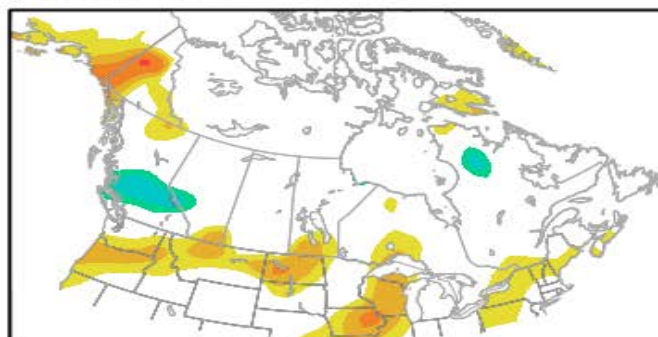


NDJ PR
lead=0

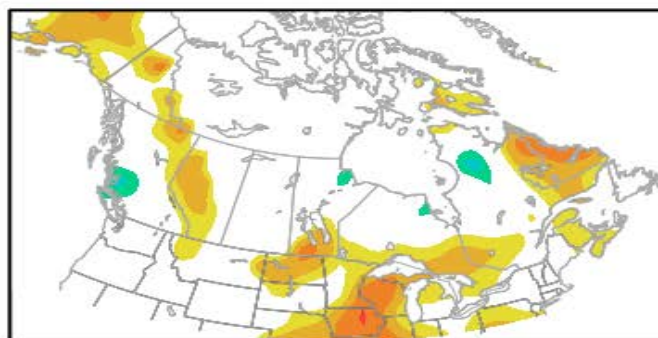
a) GEM-NEMO: PR COR skill NDJ, start=11



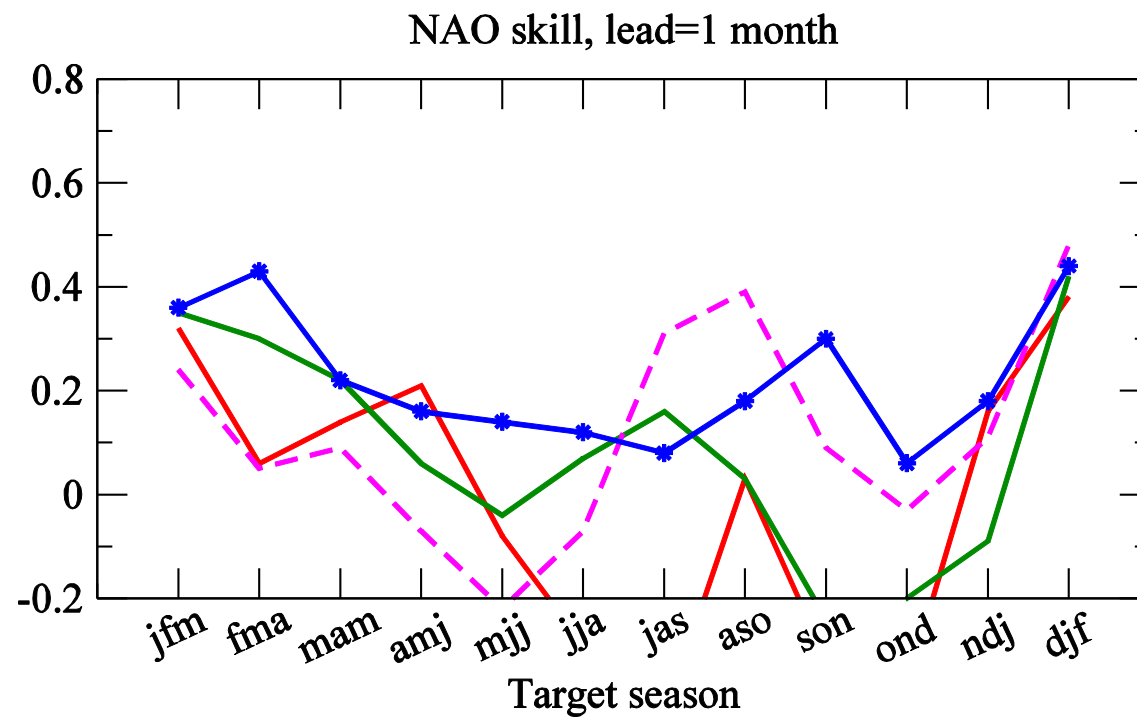
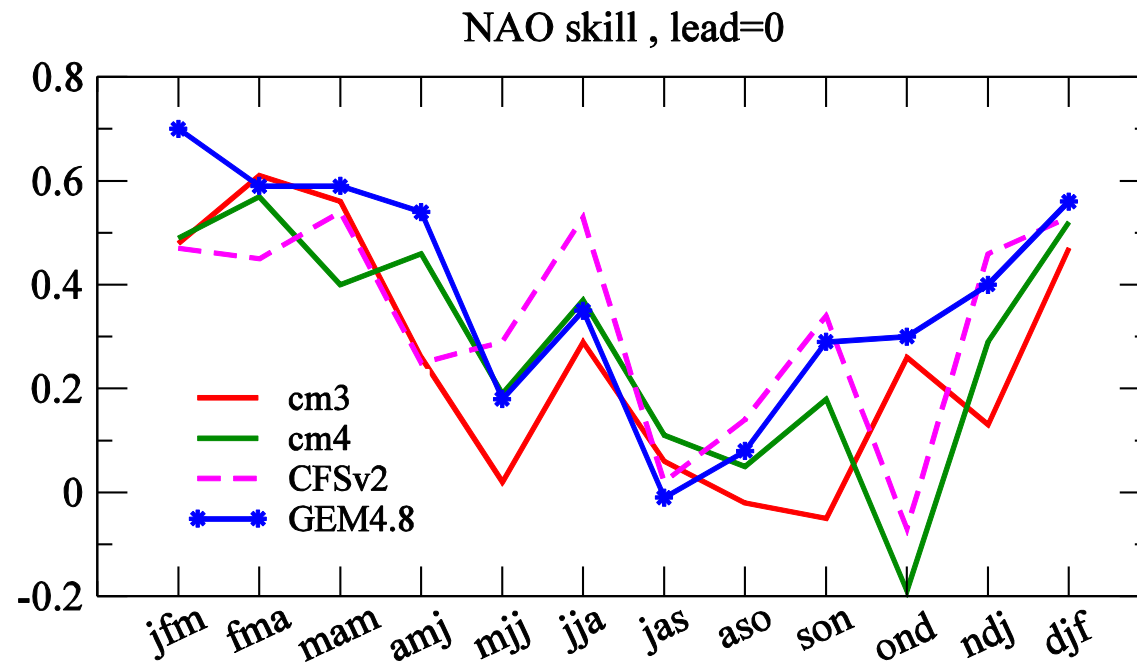
b) CanCM3: PR COR skill NDJ



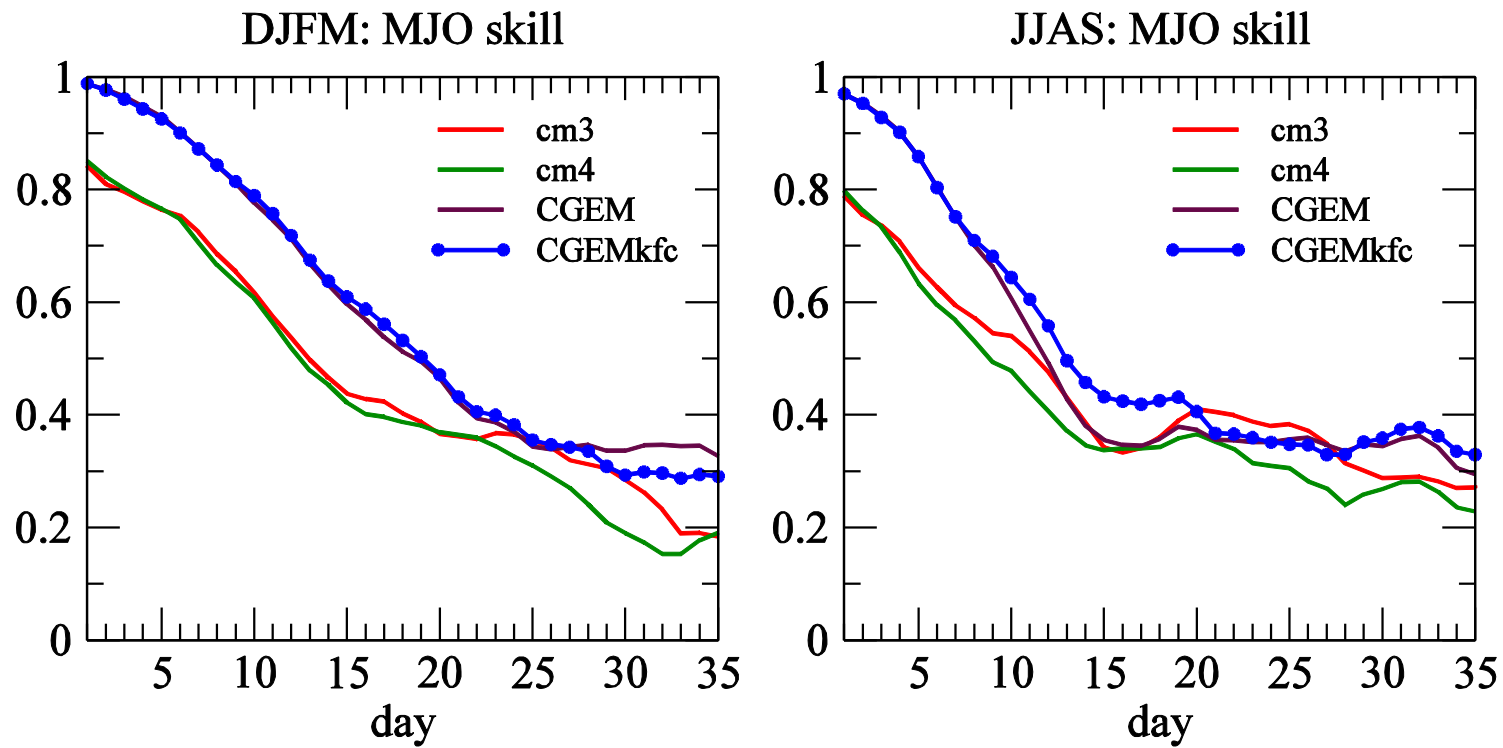
c) CanCM4: PR COR skill NDJ



NAO skill



MJO skill



Multi-model ensemble

- Current operational system (CanSIPS):
CM3+CM4
- Possible next system
 - option 1: GEM+CM4
 - option 2: GEM+CM3+CM4



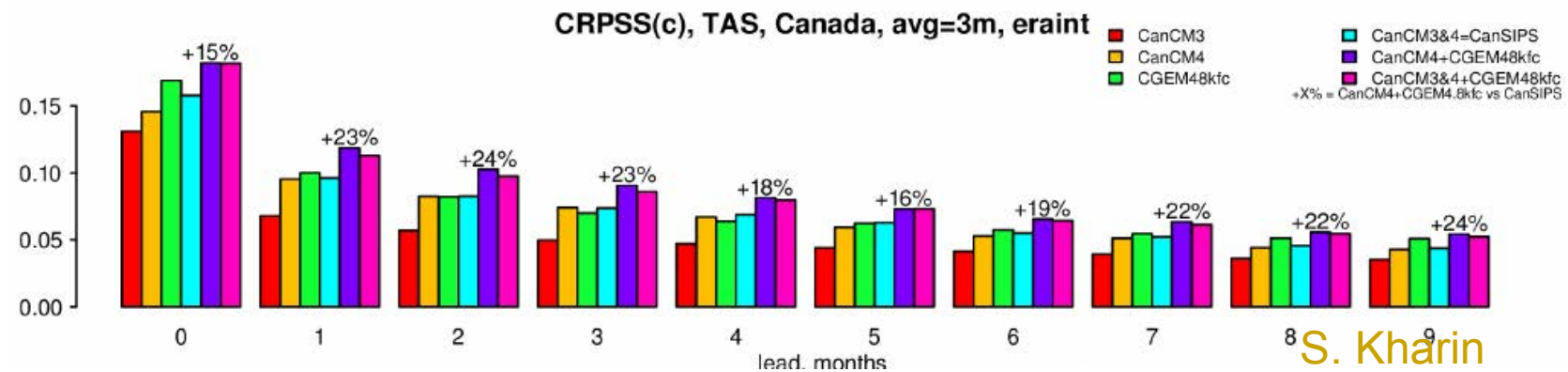
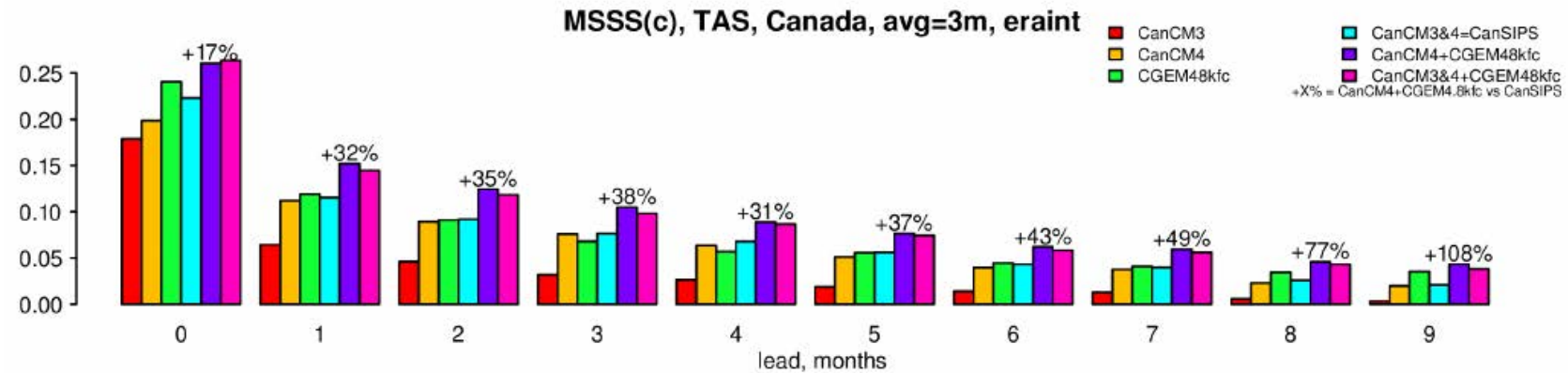
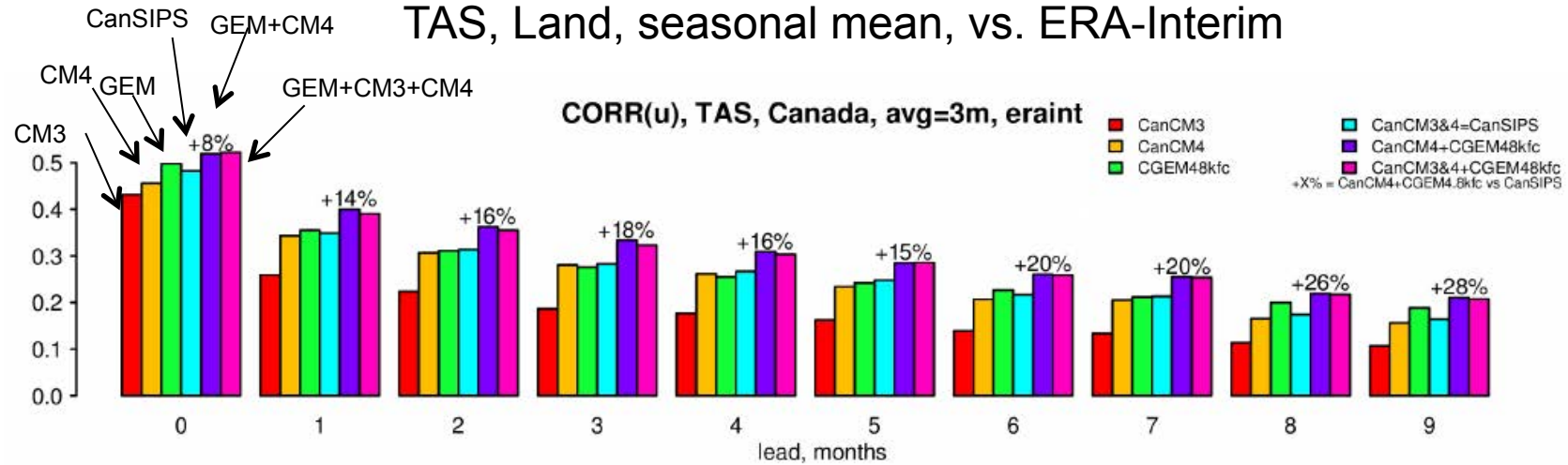
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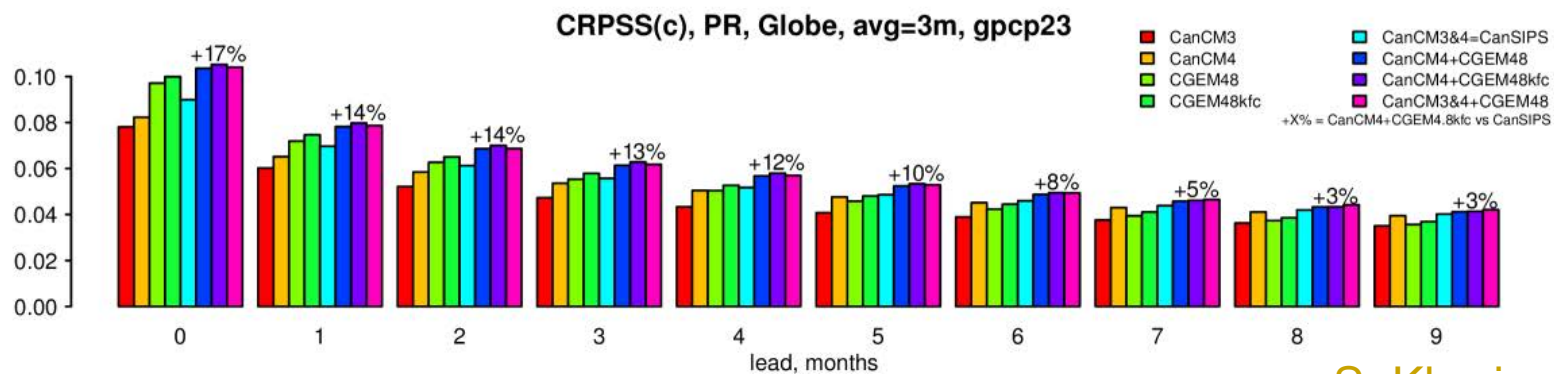
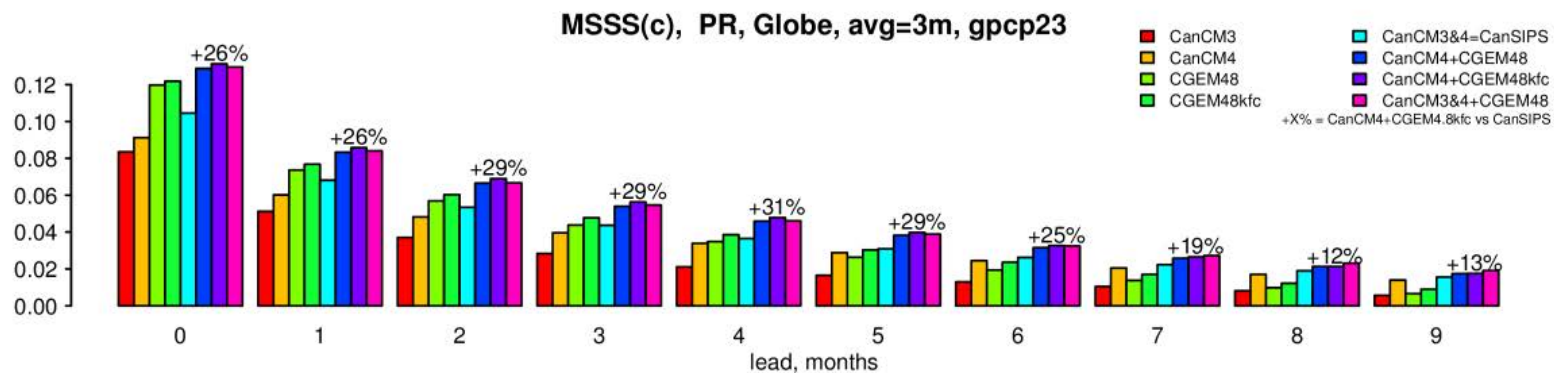
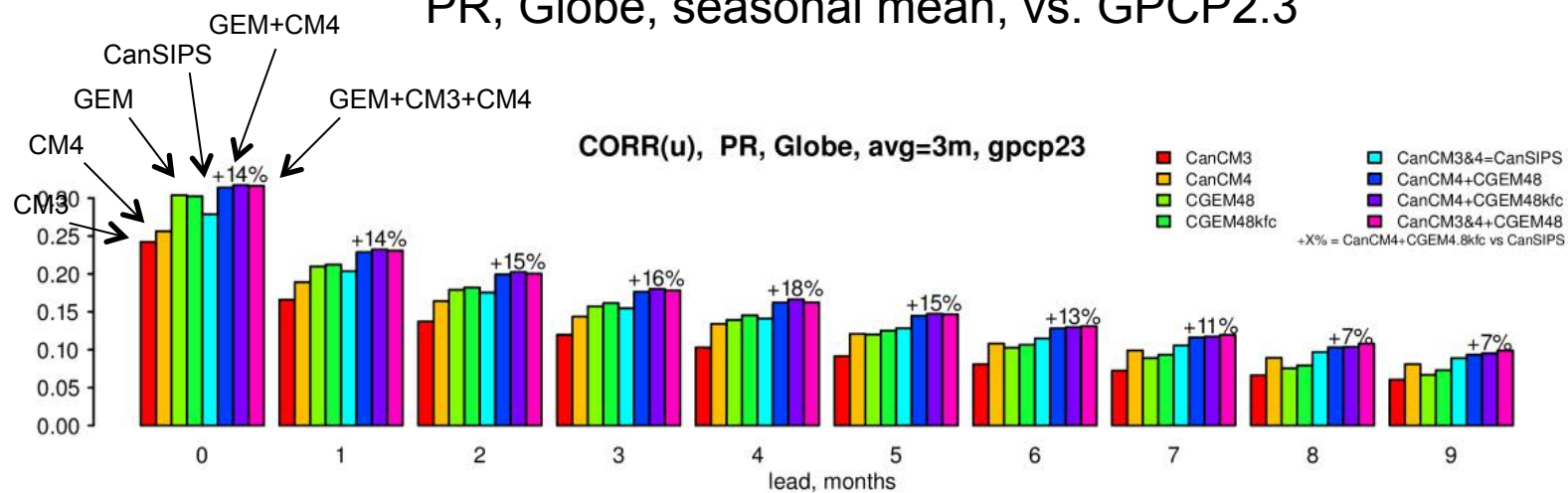
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TAS, Canada, seasonal mean, vs. ERA-Interim

TAS, Land, seasonal mean, vs. ERA-Interim



PR, Globe, seasonal mean, vs. GPCP2.3



Real-time forecast

- Start at beginning of each month, 10 members
- 12 month integrations
- Atmosphere: 10 members from ENKF of GEPS
- Land: SPS forced by CMC analysis
- Ocean: CMC **GIOPS**
- Sea ice concentration: CMC **GIOPS**
- Sea ice thickness: CMC **GIOPS**



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Summary

- ECCCC continues to develop MME in seasonal forecasting
- GEM has a higher skill for T2m and PR than CM3 and CM4. CM3 has the least skill.
- Better MJO and NAO skill in GEM
- Combining GEM with CM4 gives better skill than CanSIPS. Adding CM3 provides limited benefit.

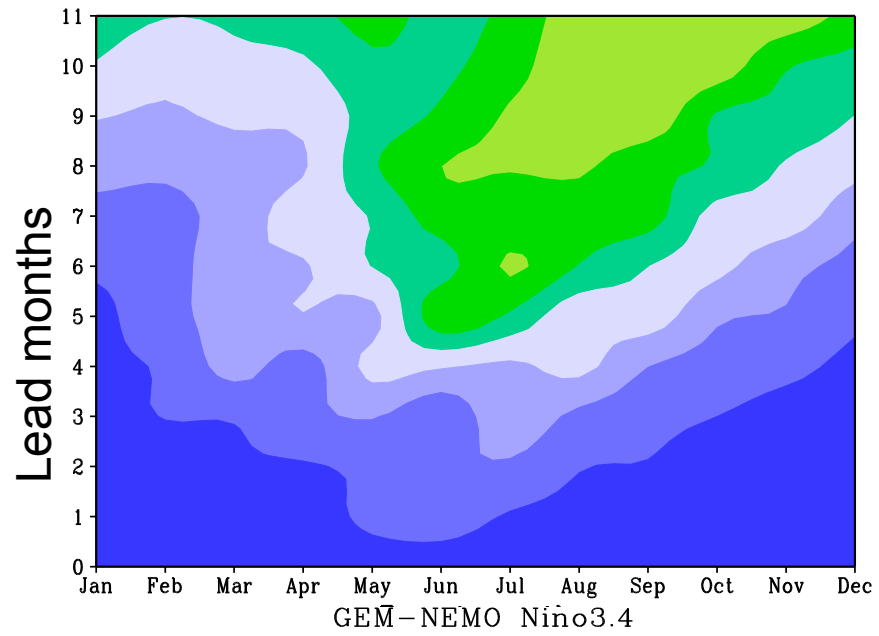


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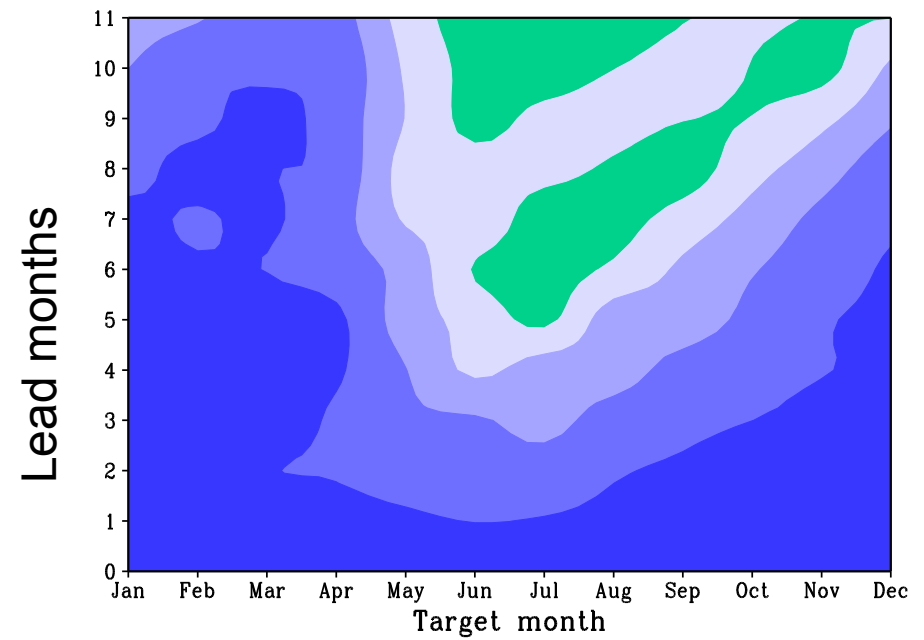
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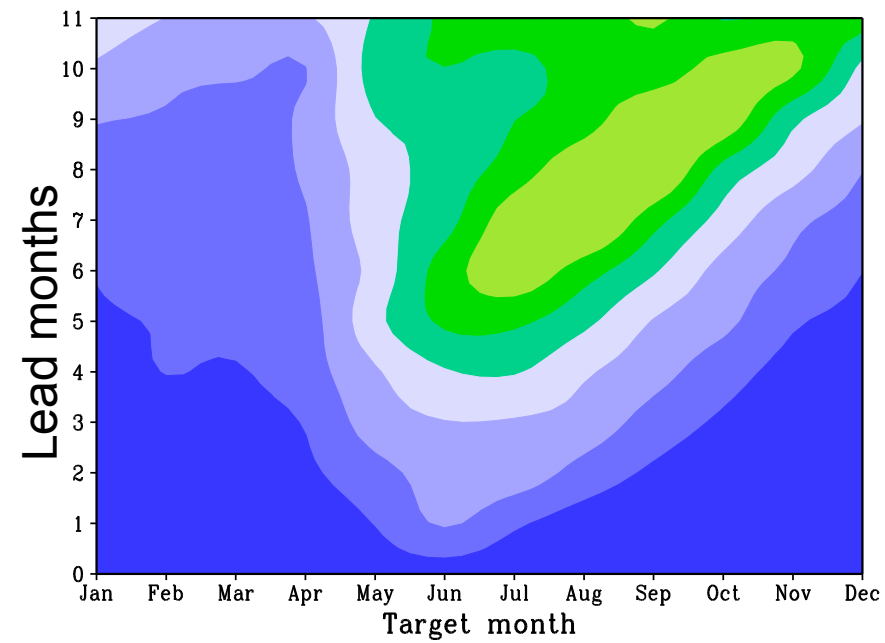
CanCM3 Nino3.4



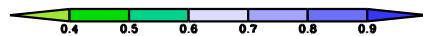
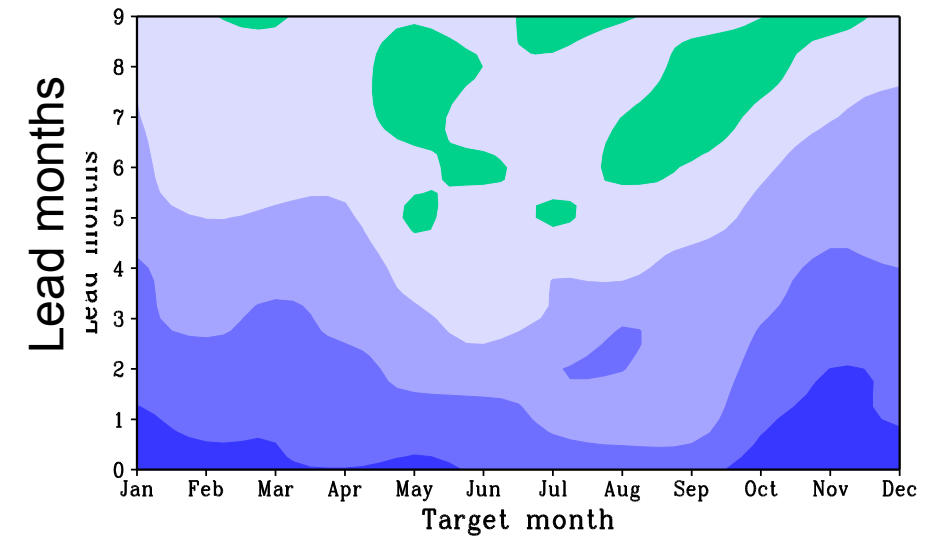
CanCM4 Nino3.4



GEM-NEMO Niño3.4



CFSv2 Nino3.4



TAS, Land, seasonal mean, vs. ERA-Interim

