Subseasonal Skill Sensitivity in the Global FIM-iHYCOM Coupled Model

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Introduction

- The Flow-following Icosahedral Model (FIM) is coupled to an icosahedral-grid version of the Hybrid Coordinate Ocean Model (HYCOM)
- FIM-iHYCOM ("FIMr1.1") is a participant model in the SubX project
- Thorough evaluation of FIM-iHYCOM in terms of both deterministic and probabilistic skill is necessary to identify the model's strengths and weaknesses, and to show its potential to be competitive at subseasonal timescales.

Montreal Biosphere, an example of an icosahedral grid

Experiments

- FIM uses the 2015 GFS physics package
- FIM has an optional GF (Grell and Freitas 2014) convective parameterization to replace SAS
- The ocean component shares the horizontal grid with the atmosphere. Both use an adaptive (isentropic) vert. coordinate
- Hindcasts are carried out with 4 time-lagged ensemble members centered on Wednesdays during 1999-2014
- Initial conditions are from CFSR/CFSv2

	Horiz. Resolution	Conv. Scheme	w. Ocean Model
FIM-iHYCOM GF7	60 km	GF	Yes
FIM-iHYCOM GF8	30 km	GF	Yes
FIM-iHYCOM SAS7	60 km	SAS	Yes
FIM w. obs SST AGF7	60 km	GF	No
CFSv2	~100 km	SAS	Yes

MJO Skill and Blocking Frequency

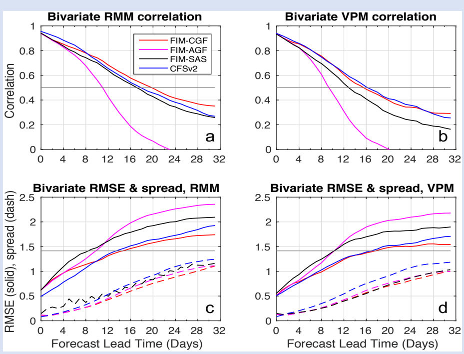

Fig.1: Model performance as a function of lead time for FIM-iHYCOM (GF7, AGF7, SAS7) and CFSv2 ensemble mean forecasts of the RMM index. Top: Bivariate RMM/VPM correlation; Bottom: Bivariate rms error (solid) and 4-member ensemble spread (dashed). GF7 and CFSv2 have similar skill, RSME and spread, and are better than SAS7. The uncoupled AGF7 fares worst.

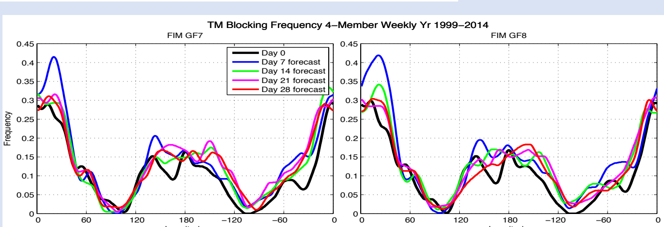

Fig.2: Tibaldi-Molteni blocking frequency at different lead times from FIM-iHYCOM at 60km (GF7, left) and 30km (GF8, right) horizontal resolution. The blocking frequency appears to be insensitive to these two different horizontal resolutions.

Deterministic and Probabilistic Skills

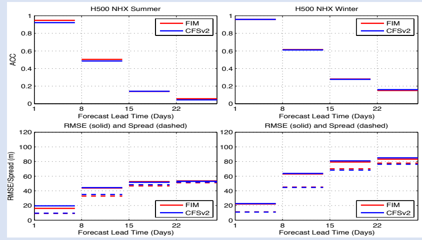

Fig.3: Anomaly correlation coefficient (ACC, upper) and RMSE/spread (lower) for 500 hPa height over 20-80N at lead weeks 1 to 4 from FIM-iHYCOM GF7 (red) and CFSv2 (blue), from weekly 4-member time-lagged ensembles during 16 year hindcasts. Left: May-Oct ; right: Nov-Apr. The two models have similar ACC and RMSE/spread.

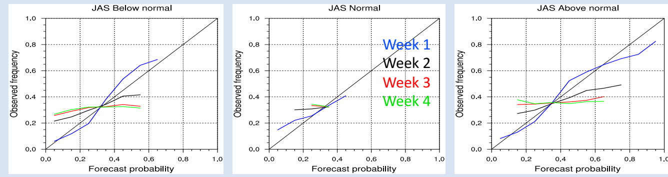

Fig.4: Reliability diagrams of FIM-iHYCOM GF7 precip over North American land points (20-50N) starting in JAS 1999-2010 for below-normal/normal/above-normal (left to right).

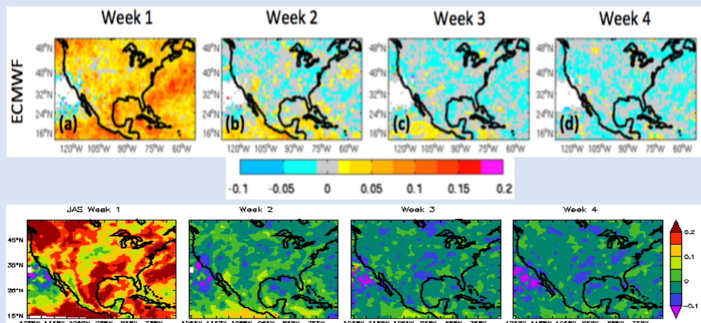

Fig.5: Ranked Probability Skill Scores (RPSS) for precipitation forecasts starting in JAS 1999-2010. Upper: ECMWF (Vigaud et al. 2017); lower: FIM-iHYCOM. The scores from these two models appear to be comparable.

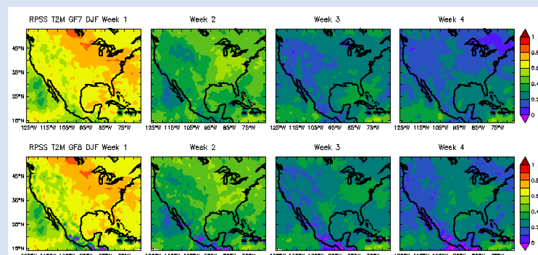

Fig.6: RPSS for 2m temperature from FIM-iHYCOM GF7 (upper) and GF8 (lower) at lead weeks 1 to 4 for DJF. The scores are very similar to each other.

Summary

- Finding potential sources of predictability on sub-seasonal time scales is crucial; candidate processes include the Madden Julian Oscillation, atmospheric blocking, etc.
- Preliminary evaluation of 16 year FIM-iHYCOM retrospective sub-seasonal experiments suggests that the skill of their predictions is comparable to CFSv2
- In addition, RPSS for precipitation in JAS from FIM-iHYCOM are similar to those from ECMWF
- No significant skill improvement is seen when horizontal resolution increases from 60km to 30km in FIM-iHYCOM, suggesting that adding ensemble members may be more beneficial than increasing horizontal resolution when the model is already at 60 km.