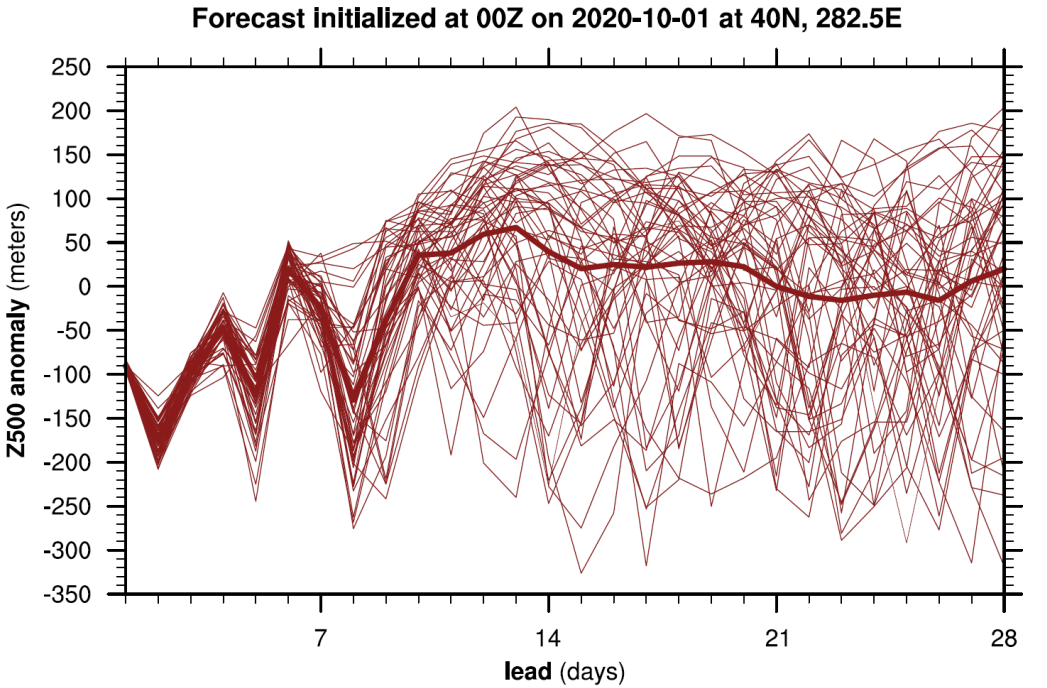
Ensemble Subsampling to Improve Week 3-4 Temperature and Precipitation Forecasts



Can we, like the Borg Queen, "bring order to chaos"?

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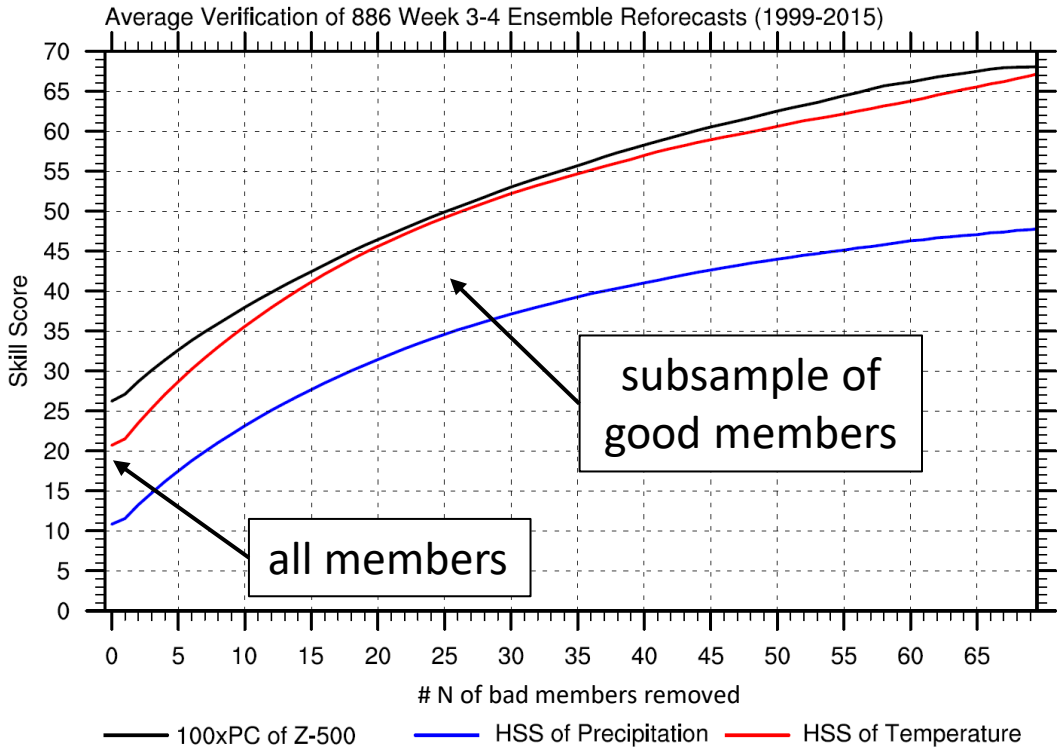
Background: The latest suite of subseasonal dynamical models provides in excess of 200 total ensemble members for use in making real-time Weeks 3-4 forecasts. Models include the ECMWF, JMA, GEFS, CFSv2, and those participating in SubX.

Question: Can we identify, in real-time, a subsample from the suite of ensemble members that can improve Week 3-4 temperature and precipitation forecasts beyond using the entire ensemble suite?



Ideal Setup: 1) Verify each member at Week 3-4 and remove the bad members one by one. This is not possible in real-time! 2) Verify the ensemble forecast of the remaining subsample of good members.

Ideal Result: Removal of the bad members quickly doubles the skill score of the ensemble forecast of the subsample of good members.

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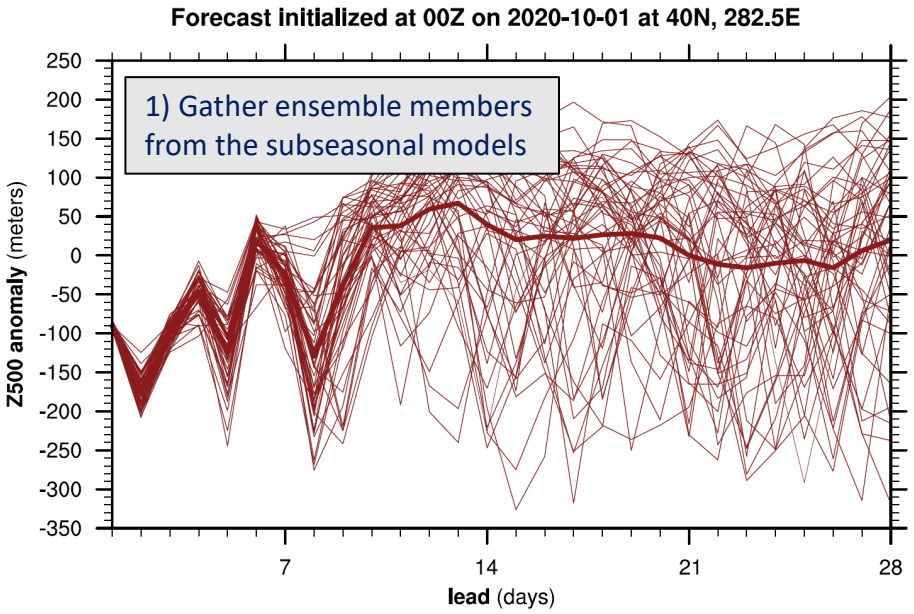

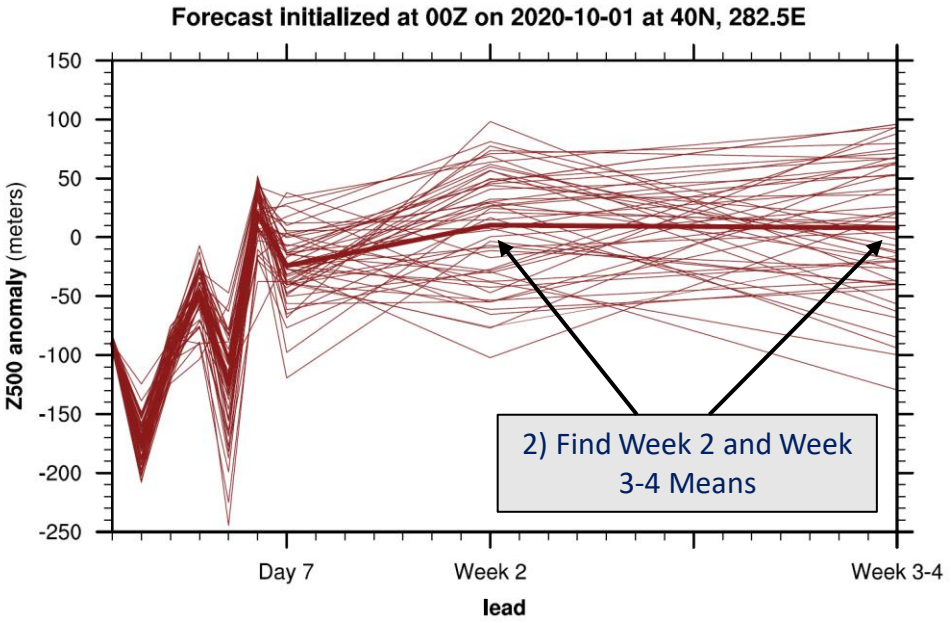

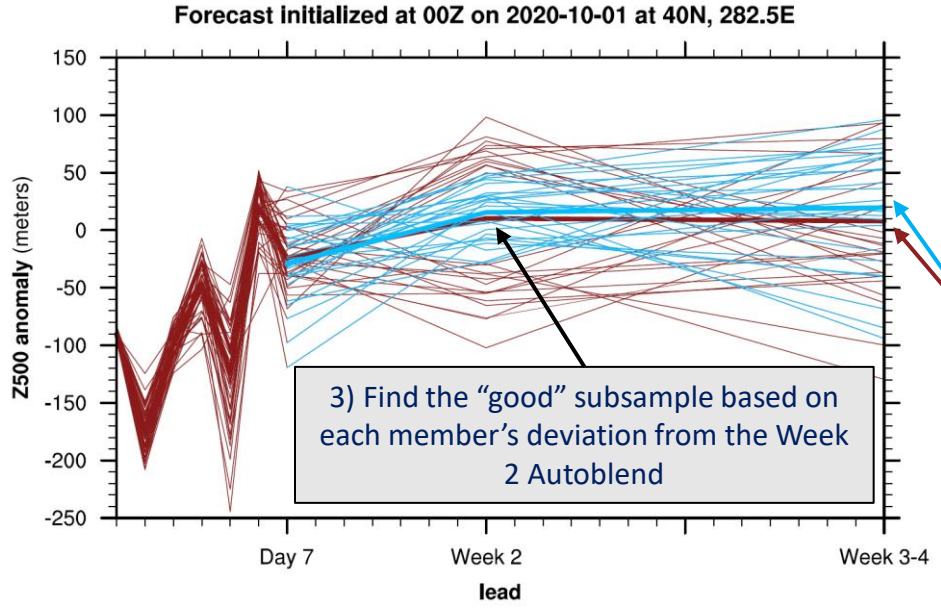

Week 2 Autoblend Subsampling Method: Follow steps 1), 2) and 3).

As a basis for subsampling, use the Week 2 Autoblend, which is the weighted average of the 00Z Friday ensemble suites of ECCC (25%), GEFS (25%), and ECMWF (50%).

Use the Week 3-4 forecast derived from the "good" subsample rather than the forecast derived from all members.

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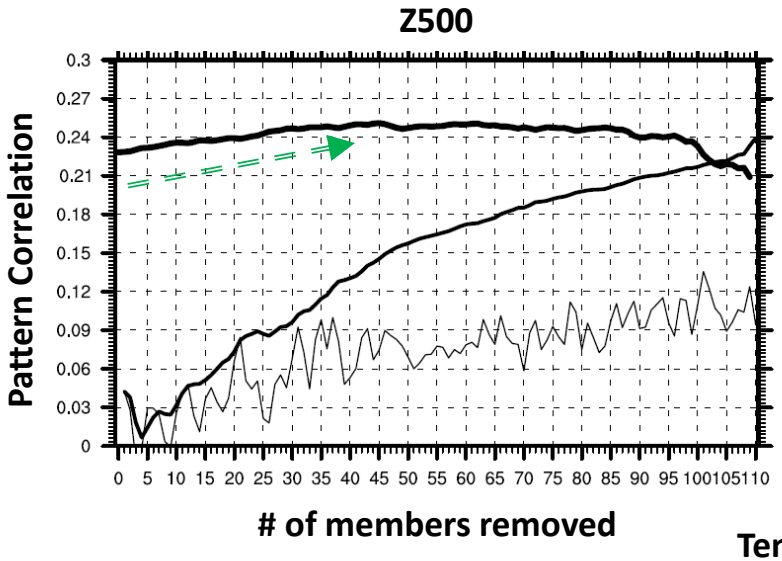

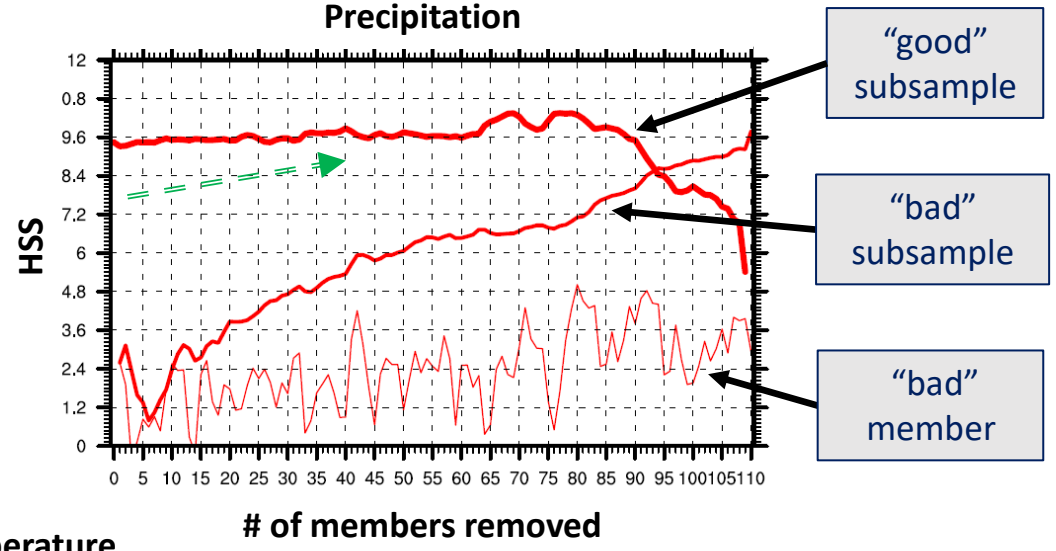

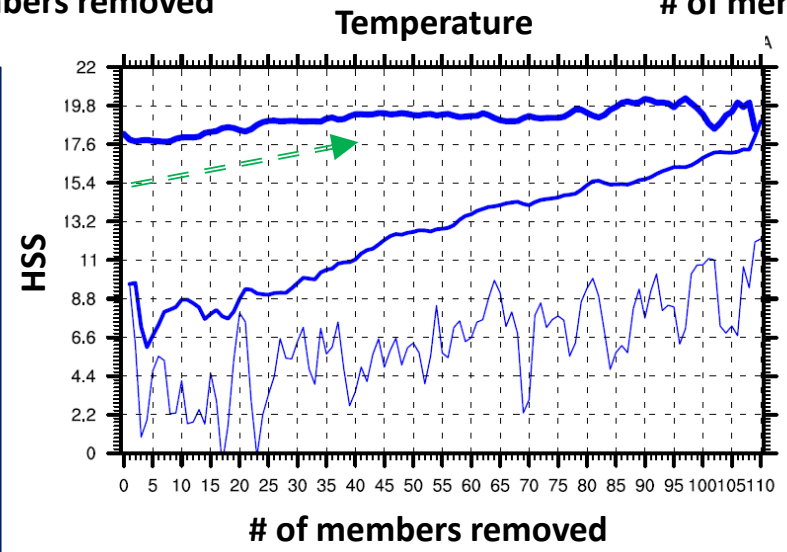

- Quasi real-time results from September 2017 to August 2020
- 156 Forecasts, issued on Friday
- Z500: extended-PNA region
- Temperature & Precipitation: USA

Removal of the "bad" members leads to an improvement in skill scores in the remaining "good" subsample, compared to using all members.

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Z500 (PC)			
Year (August to July)	All Members	"Good" Subsample	"Bad" Subsample
2017-2018	23.7	27.2 (+14.8%)	9.0
2018-2019	27.1	29.6 (+9.2%)	15.3
2019-2020	17.3	18.3 (+5.8%)	13.8

Temperature (HSS)			
Year (August to July)	All Members	"Good" Subsample	"Bad" Subsample
2017-2018	19.3	19.8 (+2.5%)	15.8
2018-2019	24.1	26.1 (+8.2%)	15.4
2019-2020	10.8	12.8 (+18.5%)	2.3

Precipitation (HSS)			
Year (August to July)	All Members	"Good" Subsample	"Bad" Subsample
2017-2018	5.8	7.0 (+20.6%)	1.2
2018-2019	13.6	13.1 (-3.7%)	9.6
2019-2020	9.1	9.9 (+8.8%)	6.5

Yearly Results: ~33% of the members are removed. The remaining "good" subsample provides, overall, better forecasts than using either all members or the "bad" subsample.

Conjecture: This method seemingly works because the 200 members are not a true ensemble suite. It is a multi-model, multi-start date ensemble being subsampled by a semi-independent, very good Week 2 autoblend.

Moving Forward: This subsampling-based forecast will be provided as an experimental tool to the Week 3-4 forecaster. Its success or failure will be monitored.