The SECLI-FIRM project has received funding from European Union’s Horizon 2020 Research and Innovation Program under Grant Agreement 776868.

Seasonal climate forecasts multi-model ensembles

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The SECLI-FIRM project has received funding from European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 776868.

Brief *introduction* to the concept of Multi Model Ensembles

*Results* from methods of model selection from SECLI-FIRM

*Discussion* on the use of and potential advantages and limitations of using a weighted mean when combining models.
Why use more than one skillful model?

a) The two systems lie above and below the verification leading to improvement from error cancelation

b) One wrong one right leading to a multi model better/worse than the individually models, respectively.

c) Both models wrong leading to same conclusion as in b)

Source: R. Hagedorn et al., 2005
https://doi.org/10.3402/tellusa.v57i3.14657
Overview of models retrieved for SECLI-FIRM

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12 models
Can the skill be improved by obtaining the optimal combination of models compared with including all models?
Method for MME combination

- **Tp** and **Ta** for the hindcast period 1993-2016.
- **Deterministic**, anomaly correlation using mean of ensemble members.
- **Probabilistic**, brier score for a binary event (colder/warmer...drier/wetter)
- **Monthly** forecast with 1 month lead.
- **ERA5** reanalysis as observational data.
Examples of results for a deterministic forecast:

A monthly forecast with a lead of 1-month of 2m temperature anomalies over the domain of Spain (35,44 ; -10,3) for land only.
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Examples of results for a deterministic forecast:

A monthly forecast with a lead of 1-month of 2m temperature anomalies over the domain of Spain (35,44 ; -10,3) for land only.

Numer of models in best combi: 5
Best combination: ['CMCC' 'ECMF' 'CANI' 'NCEP' 'UKMO'] with $r = 0.35$
Best European comb.: ['CMCC' 'ECMF' 'UKMO'] with $r = 0.324$
Best other models comb.: ['CCSM' 'CANI' 'NCEP'] with $r = 0.306$
Best single model: ['ECMF'] with $r = 0.286$
All models with $r = 0.297$
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**Examples** of results for a deterministic forecast:

A monthly forecast with a lead of 1-month of 2m temperature anomalies over the domain of Colombia (0,10N ; -80,-70) for land only.

Num of models in best combi: 3
Best combination: ['ECMF' 'NASA' 'MF'] with r = 0.82
Best European comb.: ['ECMF' 'MF'] with r = 0.816
Best other models comb.: ['JMA' 'NASA'] with r = 0.801
Best single model: ['MF'] with r = 0.807
All models with r = 0.789
Examples of results for a deterministic forecast:

A monthly forecast with a lead of 1-month of total precipitation over the domain of interest for CS5 in Colombia (2,3N ; 78,77W) for land only.
Examples of results for a probabilistic forecast:

A monthly forecast with a lead of 1-month of 2m temperature anomalies over the domain of Mediterranean (30,50 ; -10,50) for land only.
Summary

• Often **best combination** is involving **more than one model**.

• **Best combination often does not include all models.**

• Often best combination involves a "**mix**" of **independent models**.

• **All models are useful** as the best combination depends on: variable, season, domain..
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Questions and Discussion
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Is there a strong argument for favouring a simple mean versus a weighted approach when combining multi-models?

Is there a clear advantage in adopting an adaptive choice of models depending on variable, region, season as opposed to a ‘global’ choice?
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