The Added Value of Seasonal Climate Forecasting for Integrated Risk Management

Seasonal climate forecasts multi-model ensembles

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SECLI-FIRM Stakeholder Workshop 15th June

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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.

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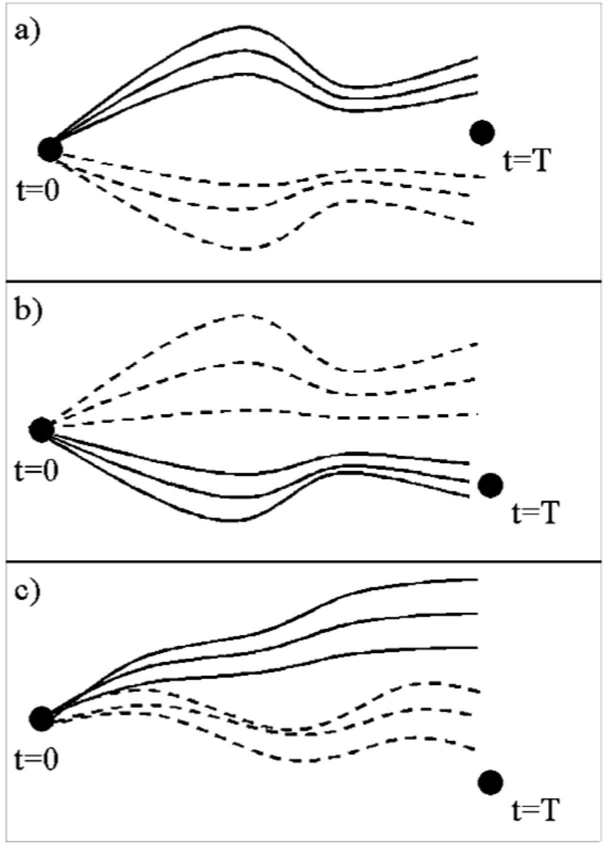
The Added Value of Seasonal Climate Forecasting for Integrated Risk Management

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

Model	Latest System	Horiz. Res.	Temporal Res.	# Ens. members: hindcast/forecasts	Hindcast Period	Ensemble Generation
ECMWF	5	1º x 1º	Daily/Monthly	25/51	1993-2016	Burst
UKMO	14	1º x 1º	Daily/Monthly	28/60	1993-2016	Lagged
MF	6	1º x 1º	Daily/Monthly	25/51	1993-2016	Mixed
DWD	2	1º x 1º	Daily/Monthly	30/50	1993-2016	Burst
CMCC	3	1º x 1º	Daily/Monthly	40/50	1993-2016	Burst
NASA	2	1º x 1º	Monthly	4/10	1981-2016	Lagged
CCMA	2	1º x 1º	Monthly	10/10	1981-2018	Burst
CCSM4	4	1º x 1º	Daily/Monthly	10/10	1982-2016	Burst
GEMNEMO	1	1º x 1º	Monthly	10/10	1993-2016	Burst
NCEP	2	1º x 1º	Daily/Monthly	28/28	1982-2018	Lagged
GFDL	B1	1º x 1º	Monthly	12/12	1980-2018	Burst
JMA	5	1º x 1º	Daily/Monthly	10/10	1993-2016	Burst

Overview of models retrieved for SECLI-FIRM

12 models

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

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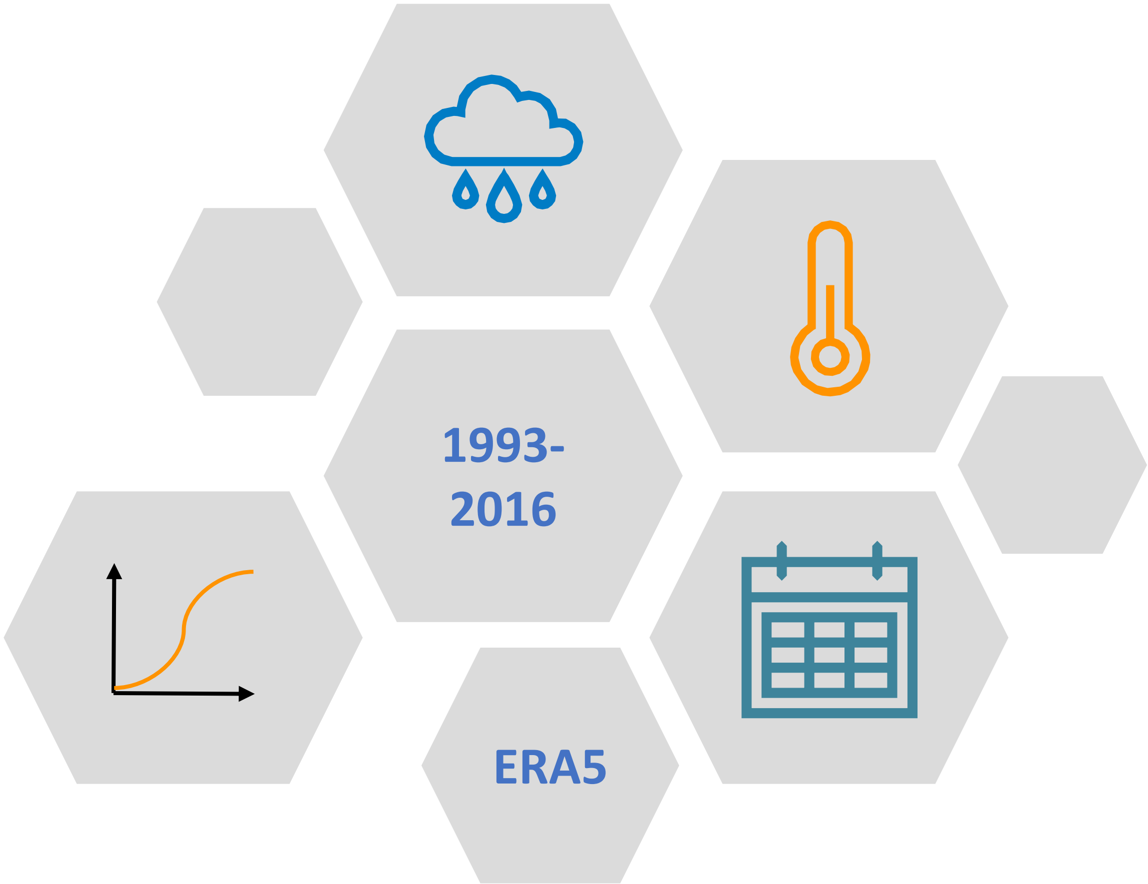
Method for MME combination

- **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.



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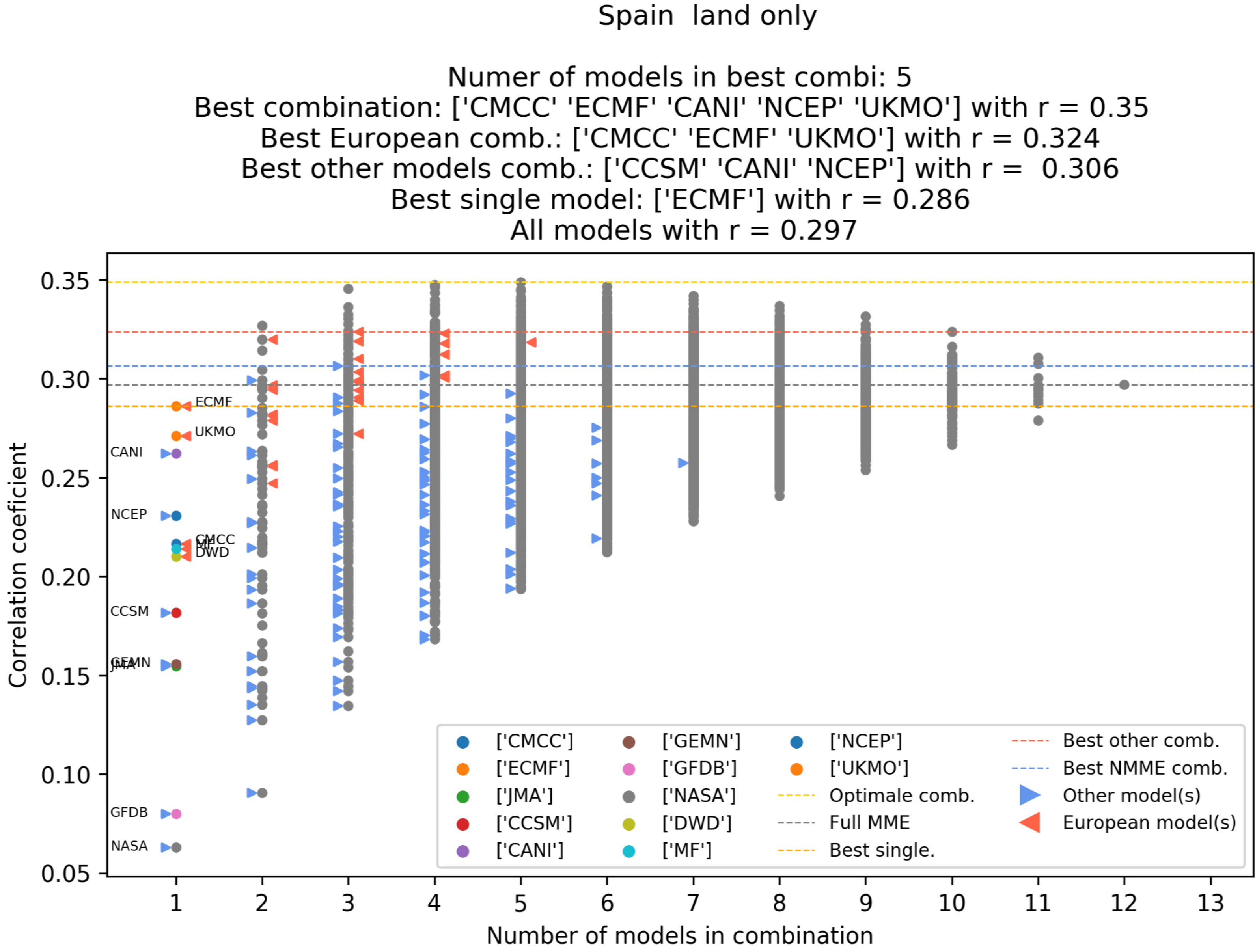
Examples of results for a **deterministic forecast**:

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**.



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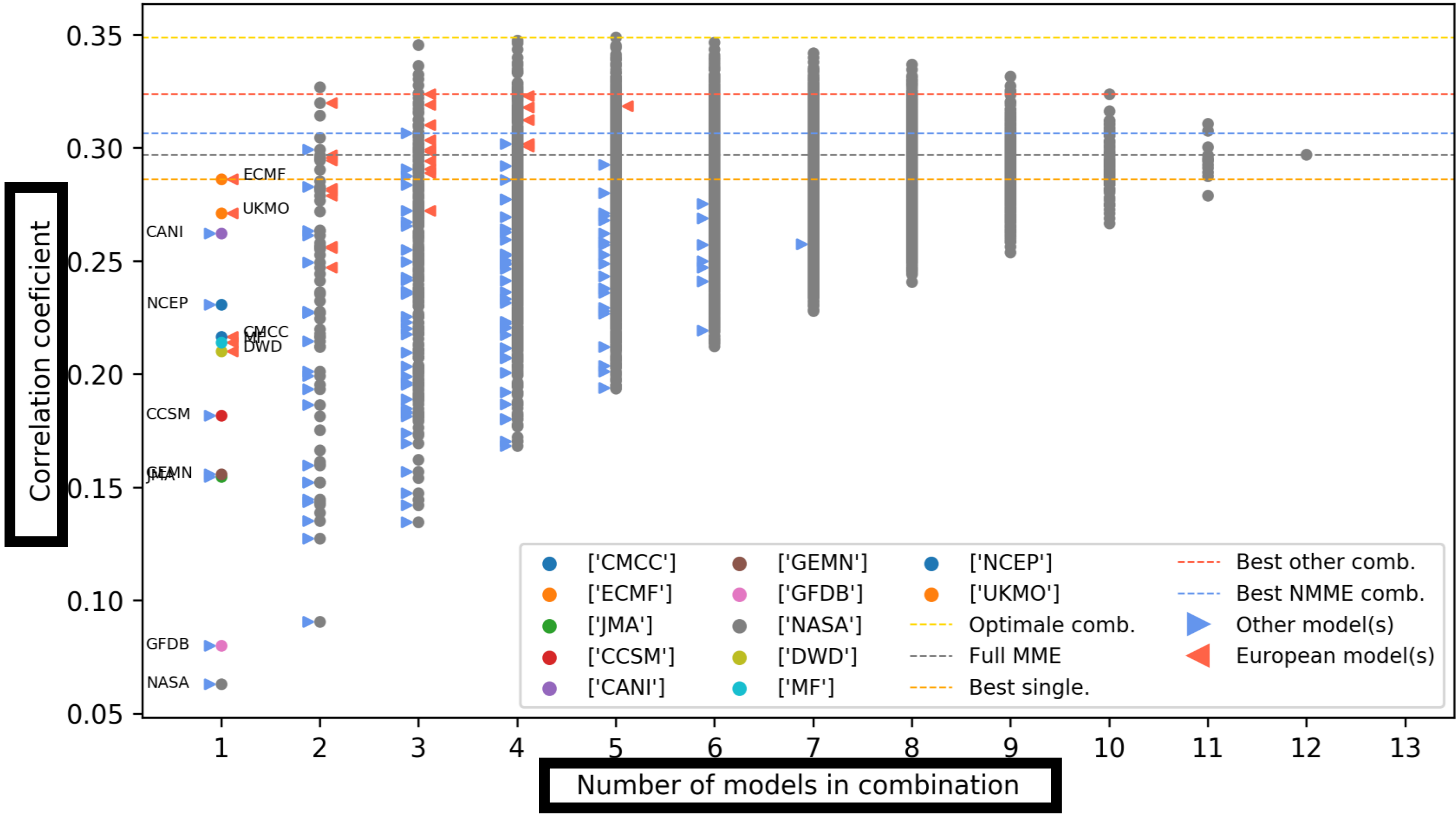
Spain land only

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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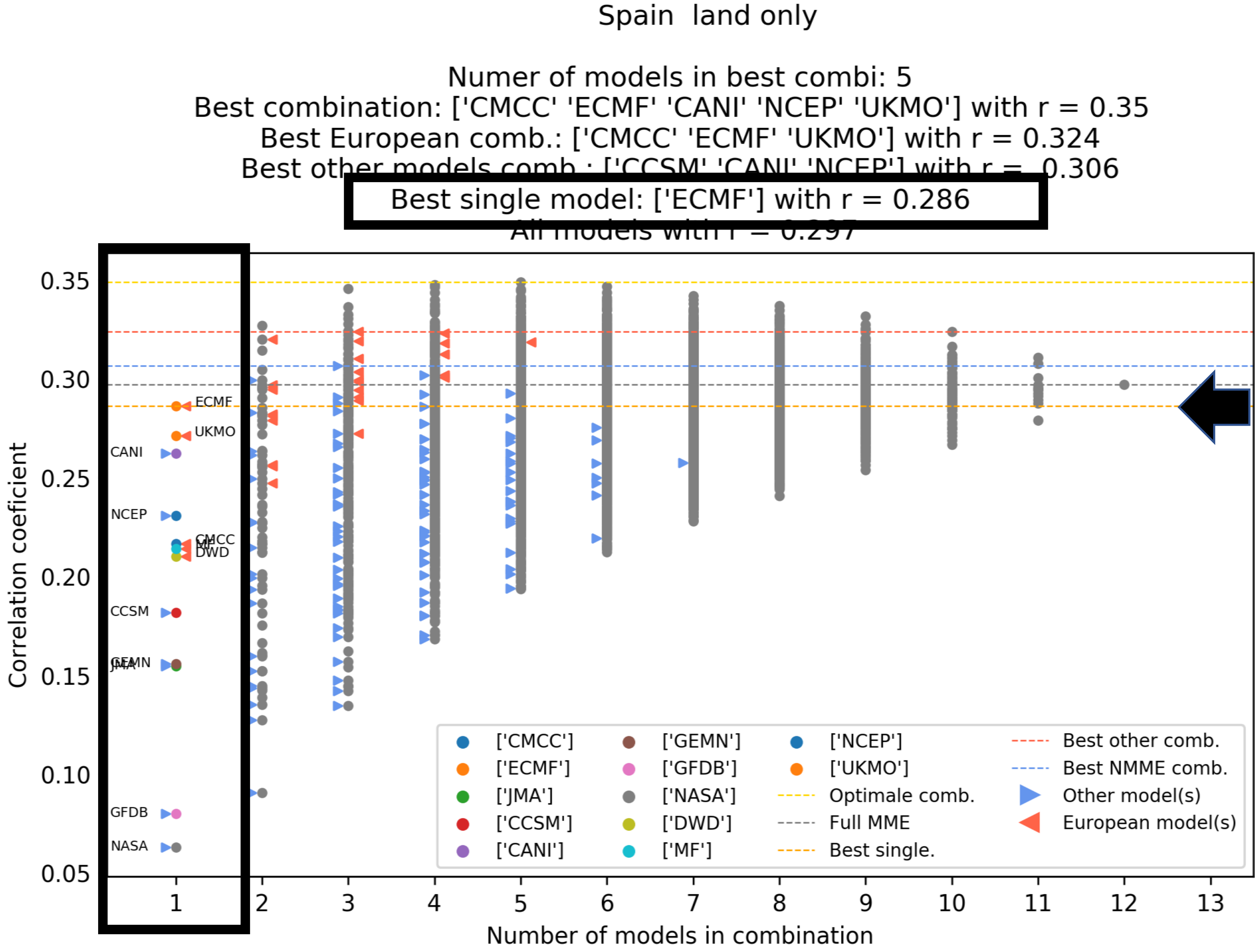

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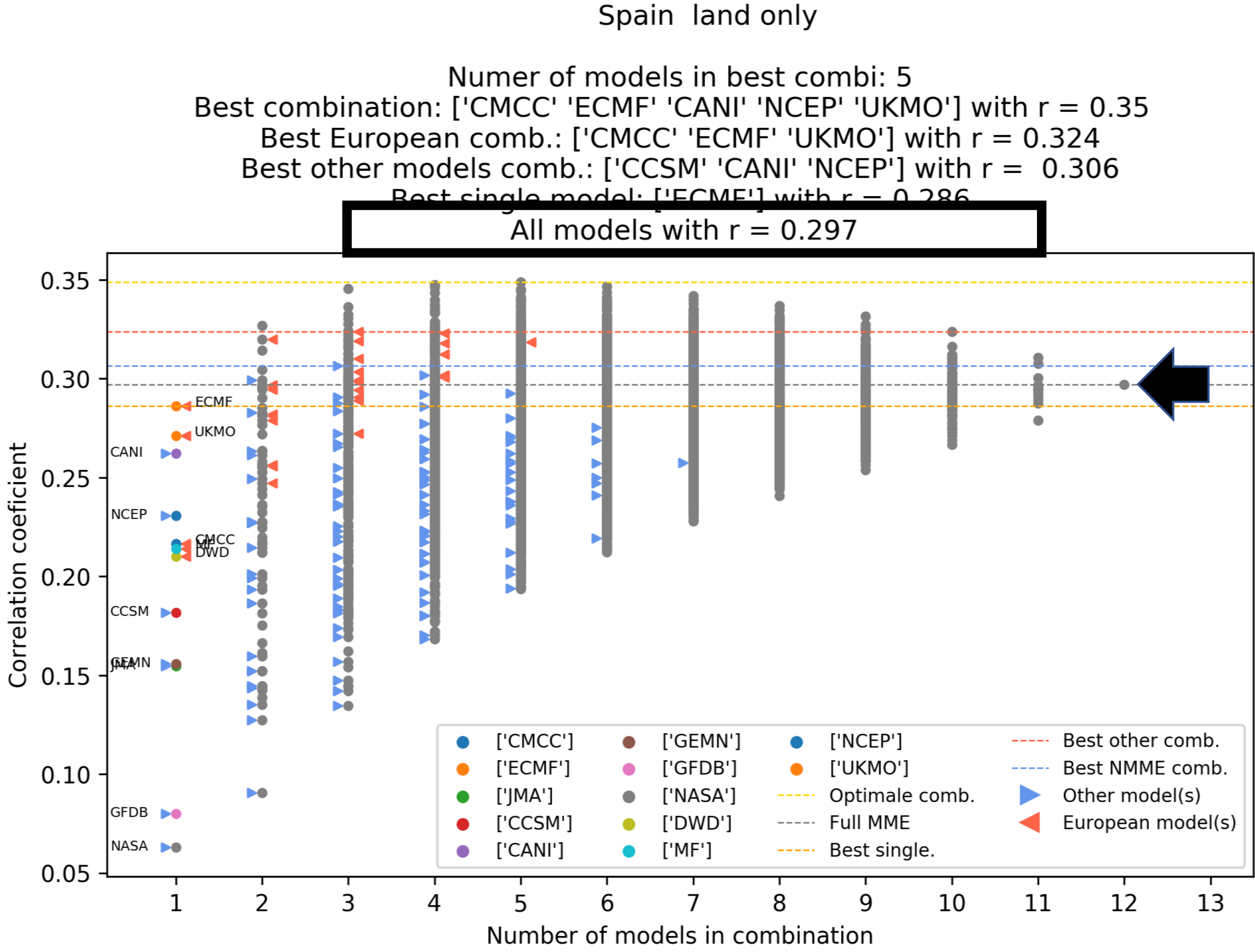

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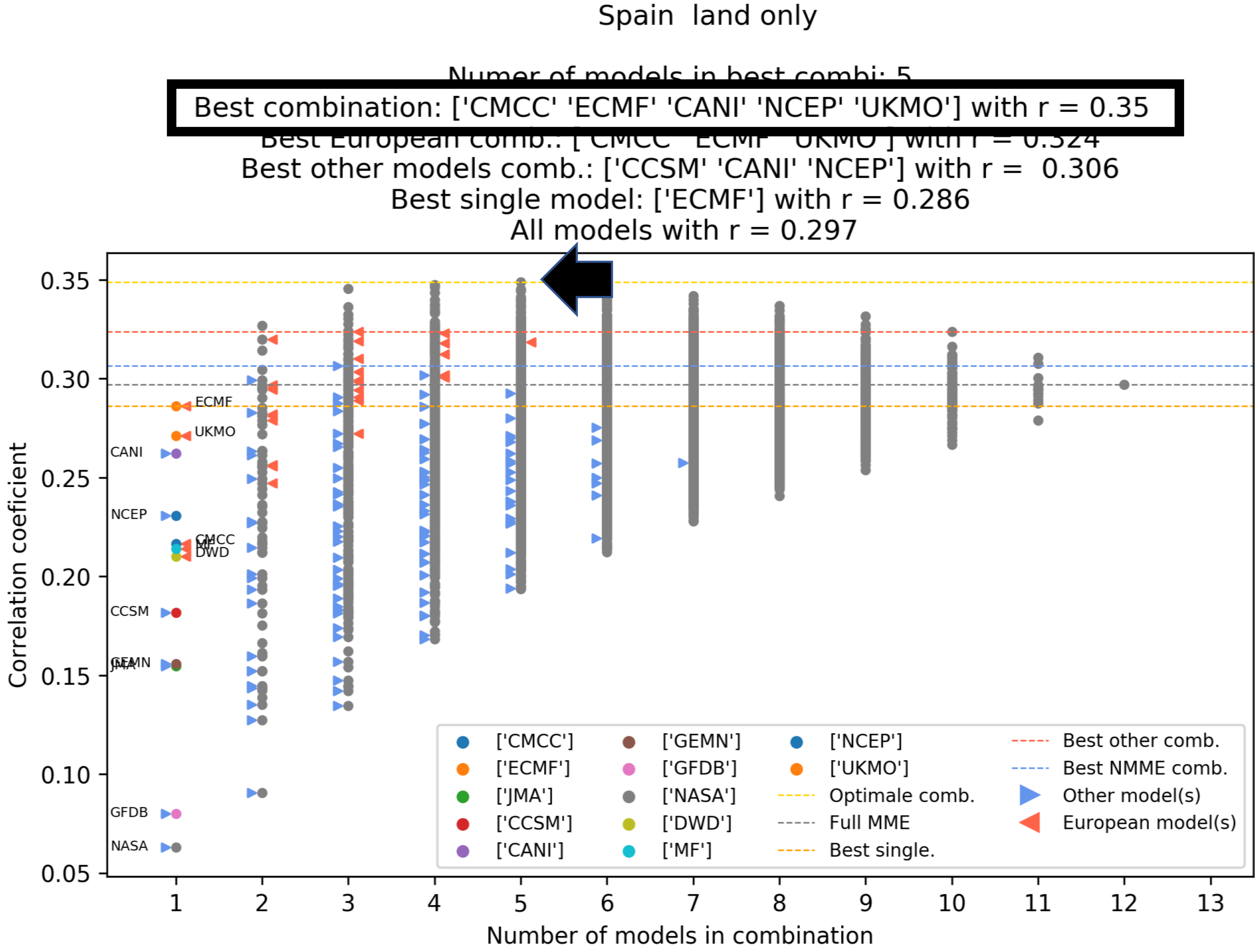

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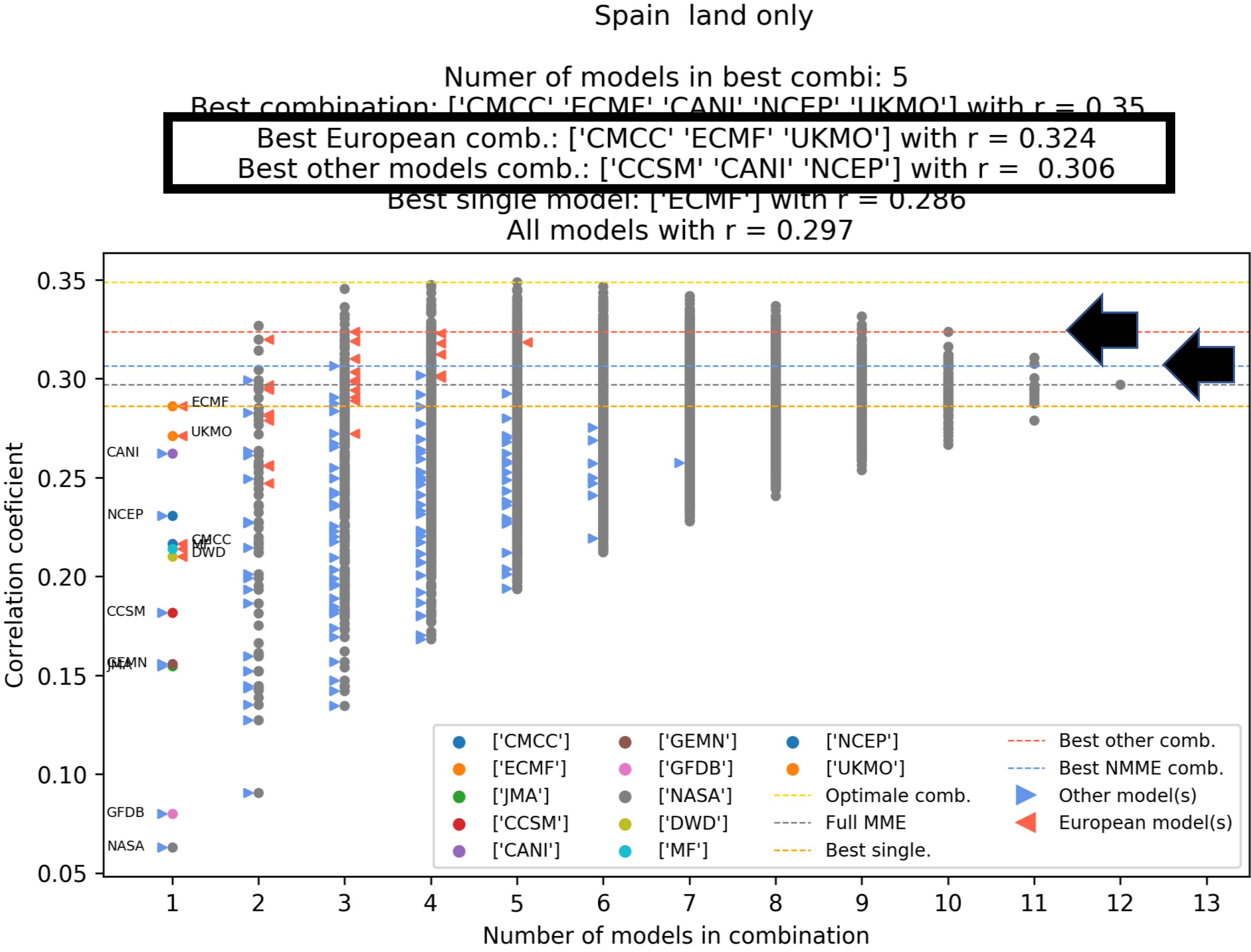

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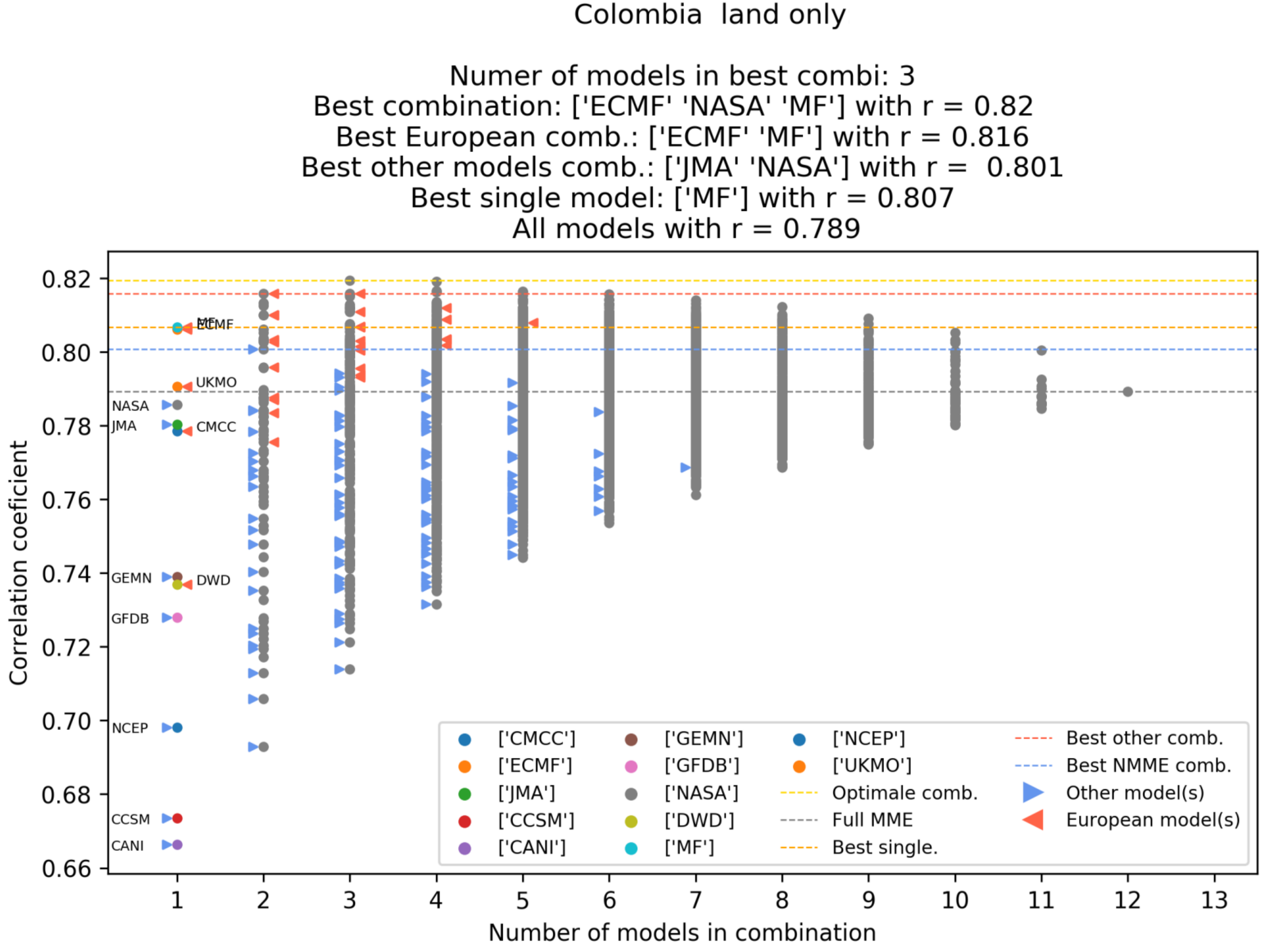
Examples of results for a **deterministic forecast**:

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**.



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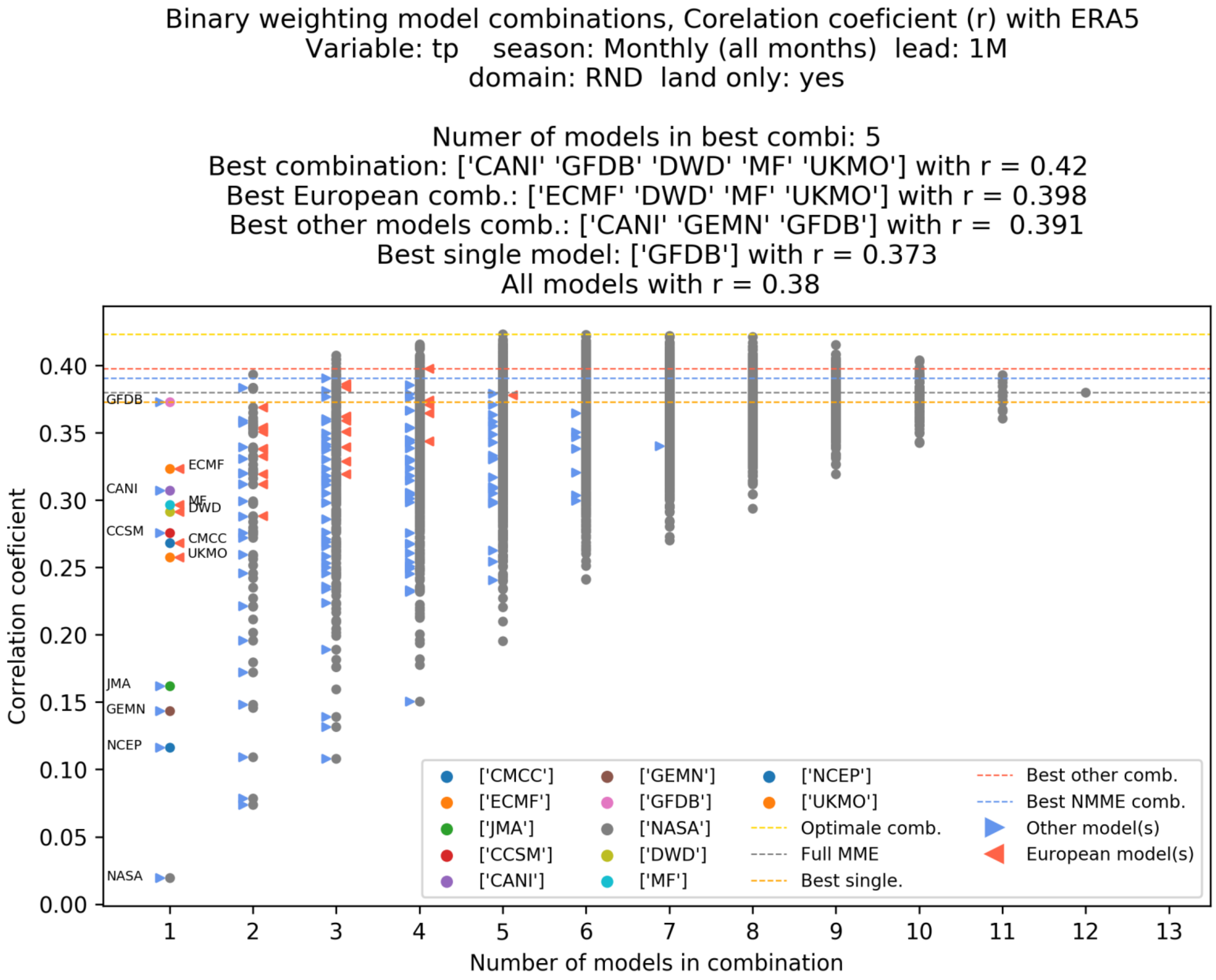
Examples of results for a **deterministic forecast**:

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**.



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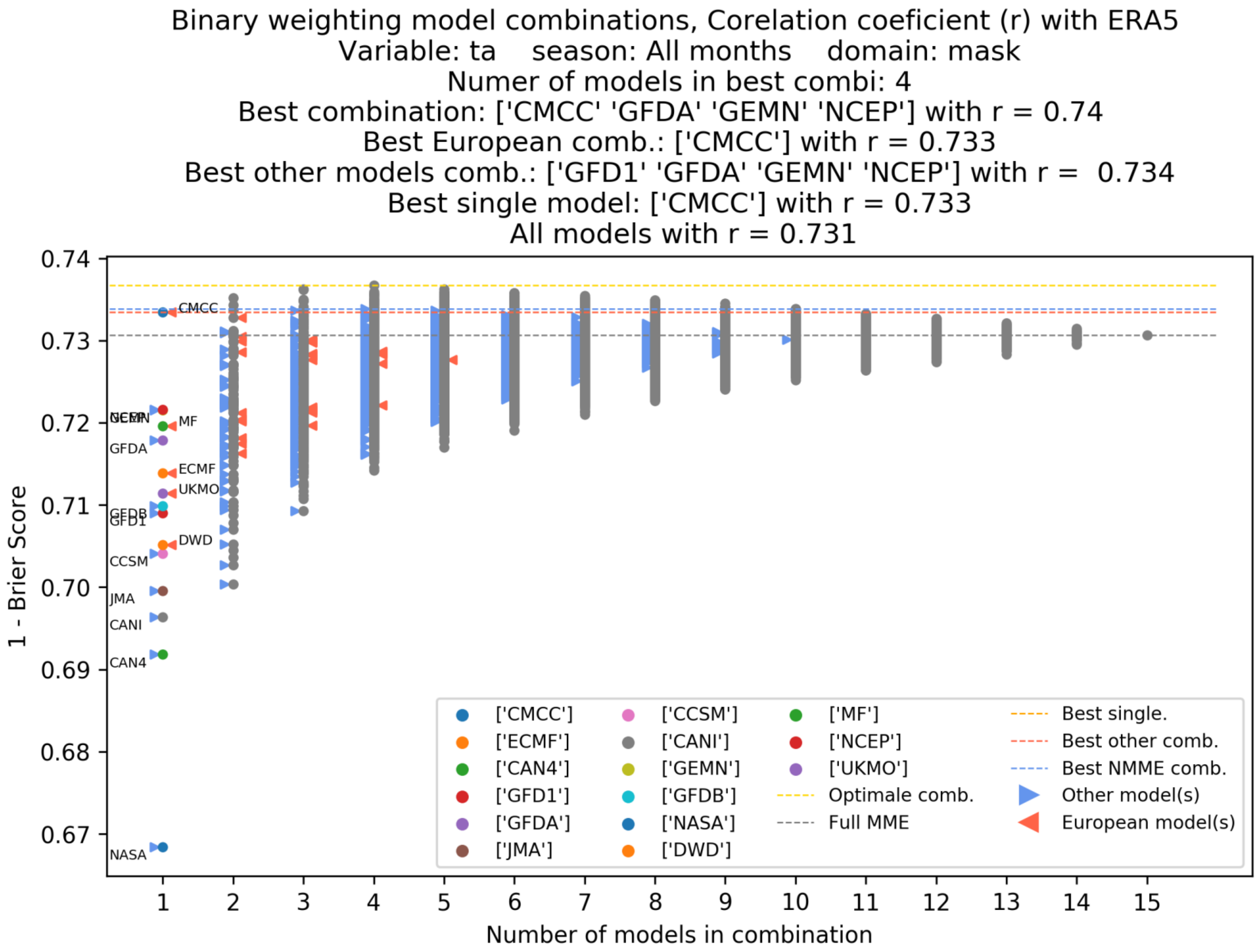
Examples of results for a **probabilistic forecast**:

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**.



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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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