Boulder, September 20th, 2018

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

How skilful are the multi-annual forecast of Atlantic hurricanes?

L-P Caron, L Hermanson, A Dobbin, J Imbers, L Lledó, G.A. Vecchi

A success story!

European Climate Prediction system

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

nature geoscience

Letter | Published: 07 November 2010

Skilful multi-year predictions of Atlantic hurricane frequency

Doug M. Smith, Rosie Eade, Nick J. Dunstone, David Fereday, James M. Murphy, Holger Pohlmann & Adam A. Scaife

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Geophysical Research Letters
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But difficult to compare due to variations in the methodology

3 different techniques

Technique	Type	Summary
Cyclone tracking	Dynamical	Hurricane numbers are obtained directly by tracking local minima in surface pressure over the tropical Atlantic
Relative SST (Vecchi et al., 2011)	Hybrid	Hurricane numbers are estimated through a statistical model with 2 predictors: mean June-Nov SST over 1) tropical Atlantic and 2) the entire tropics
AMO index (Klotzbach and Gray, 2008)	Hybrid	Hurricane numbers are estimated using a climate index (AMO) correlated with low-frequency hurricane variability. (Atlantic SST and MSLP)

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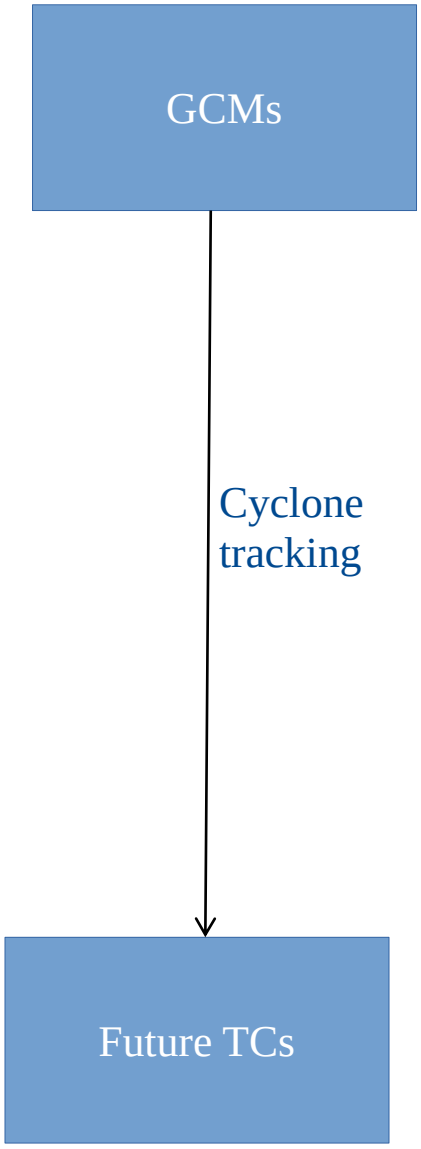
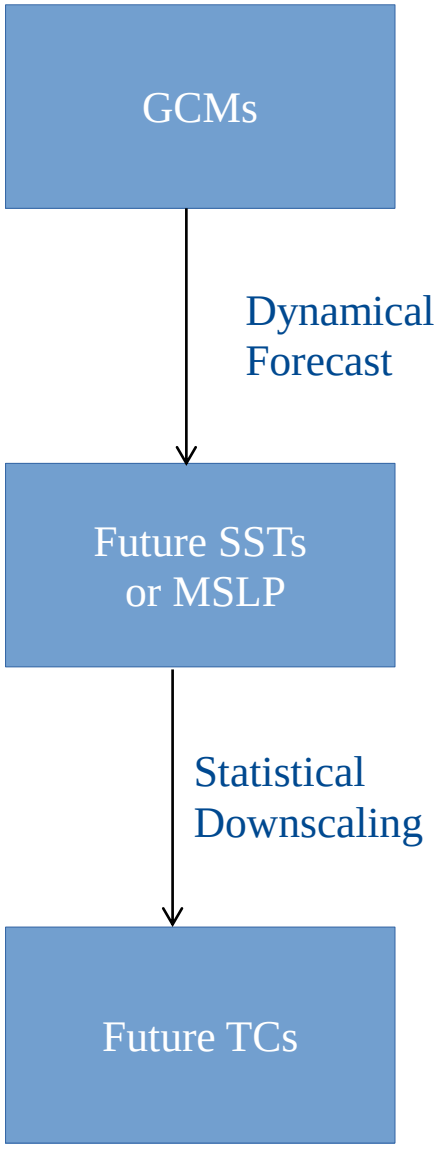
Compare average year 1-5

Dynamical Forecast



Hybrid Forecast (x2)



Dynamical Forecast

GCMs

33 members from 3 versions of the Met Office model

Cyclone tracking

Future TCs

Hybrid Forecast

GCMs

Dynamical Forecast

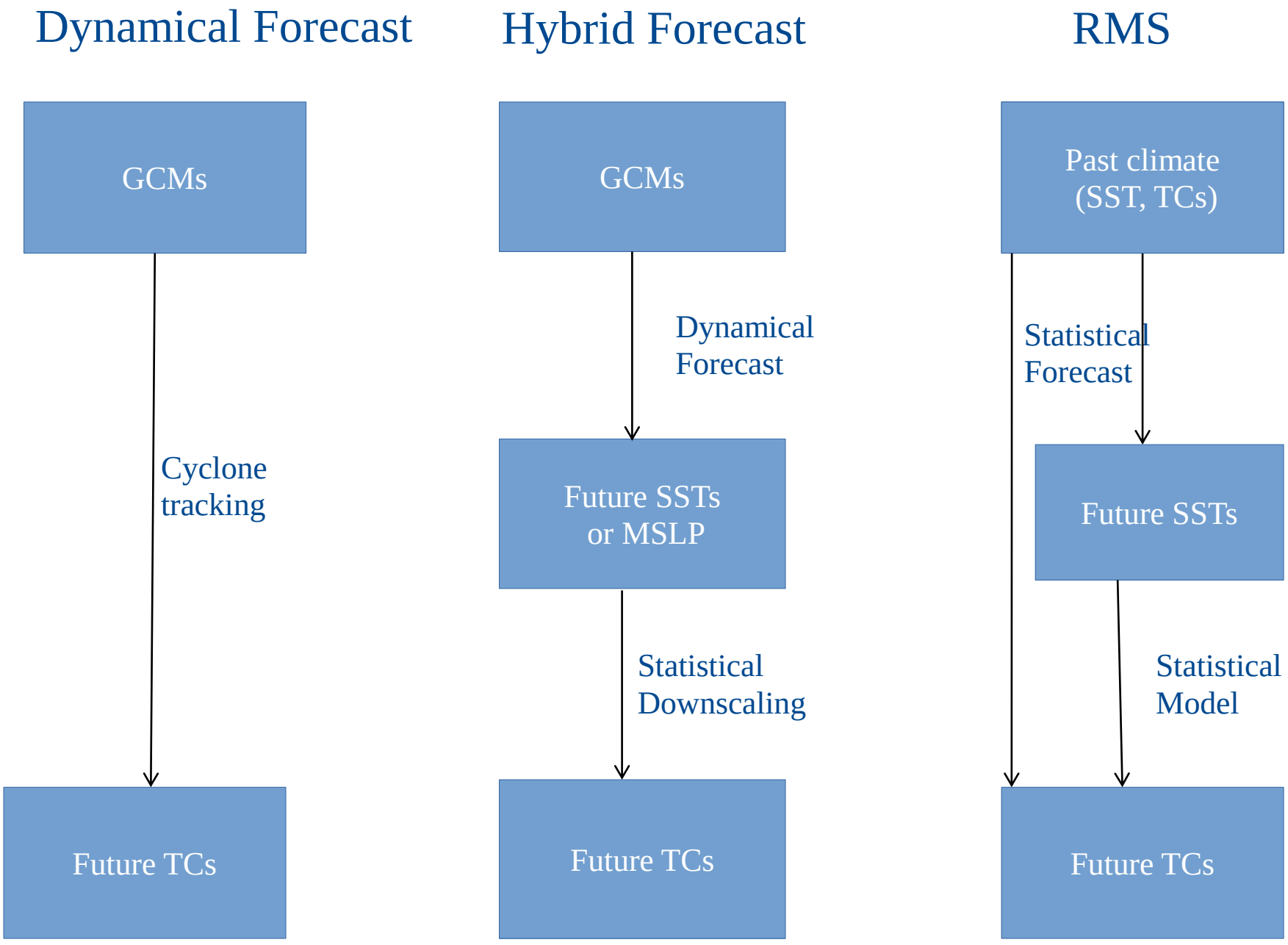
Future SSTs or MSLP

Statistical Downscaling

Future TCs

46 members from 4 CGCMs:

- HadCM3
- MIROC5
- MPI-ESM
- GFDL-CM2.1


Dynamical Forecast
GCMs
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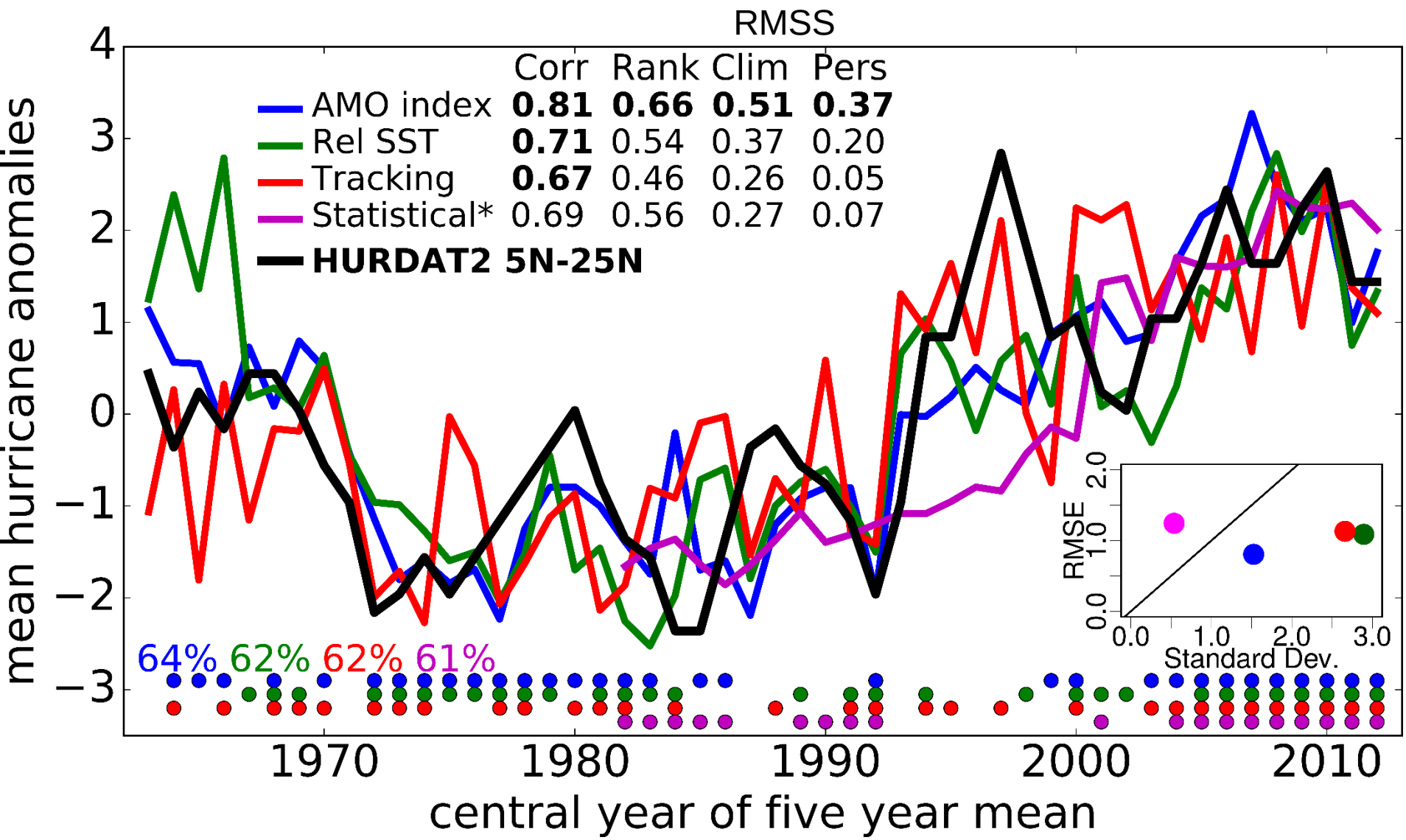
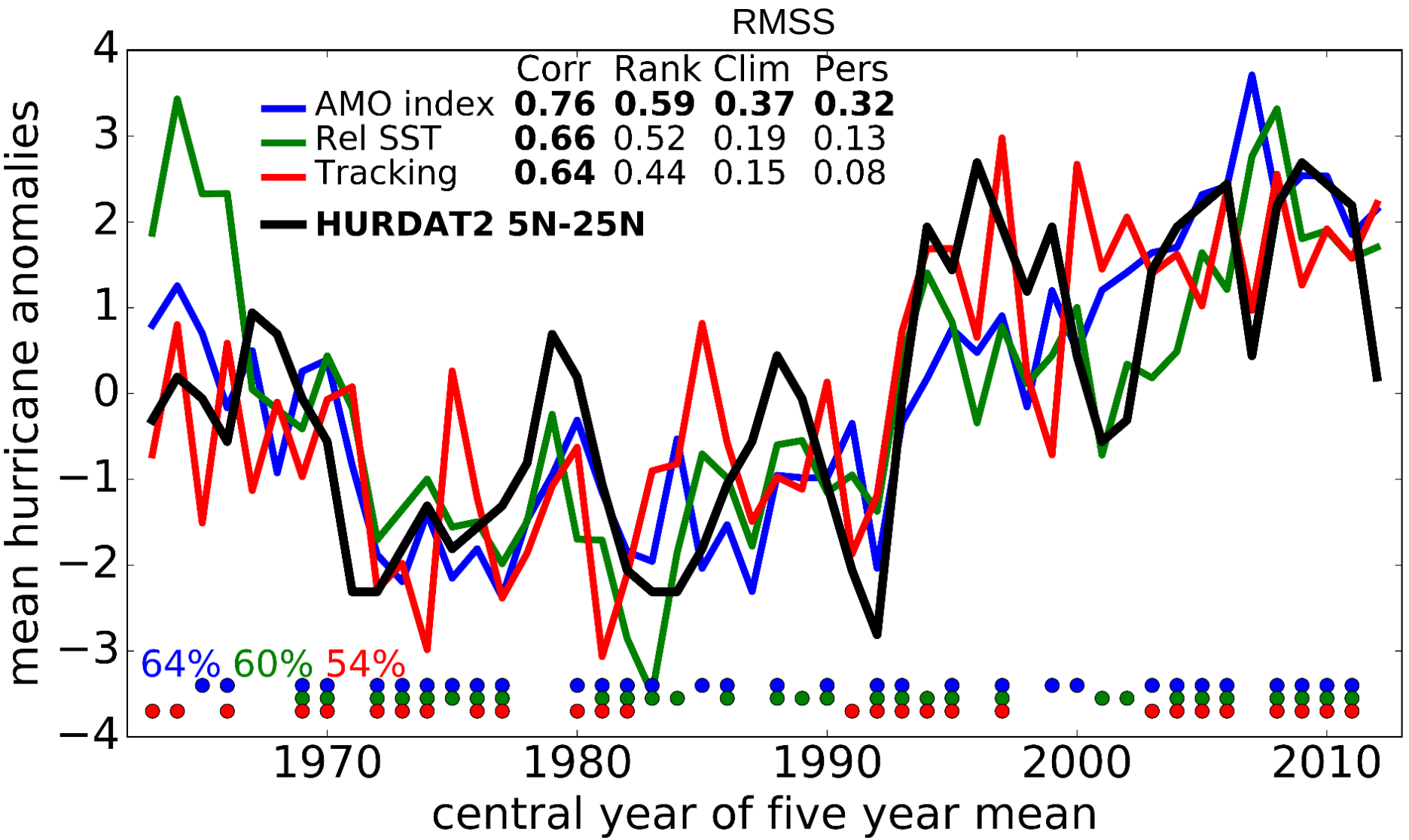
Future SSTs or MSLP
Statistical Downscaling
Future TCs
RMS
Past climate (SST, TCs)
Statistical Forecast
Future SSTs
Statistical Model
Future TCs

Skill, average year 1-5



Skill, average year 2-5



Weather roulette

- Hagedorn and Smith (2009)
- Competition between 2 forecasts:
  - Player (your forecast system)
  - The house (reference forecast)
- Both compete in providing the best forecast

Weather roulette

- Player starts with an initial amount of (e.g. 10€)

Weather roulette

- Player starts with an initial amount of (e.g. 10€)

- The player bets according to the odds given by his/her forecast, for each category:

How active will the next 5 hurricane seasons be?

Above average

Average

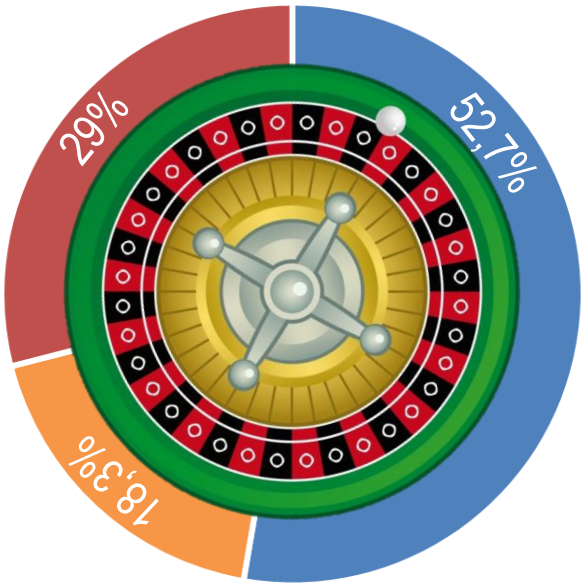
Below average

Weather roulette

- Player starts with an initial amount of (e.g. 10€)

- The player bets according to the odds given by his/her forecast, for each category:

- For example:



Above average

Average

Below average

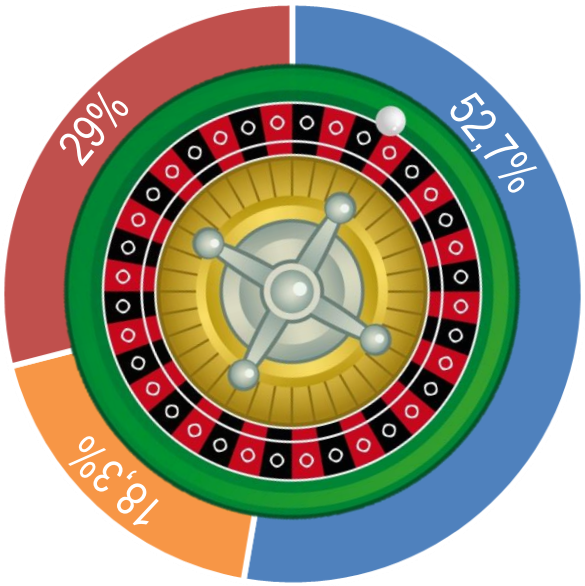
For our hurricane forecast system, the odds are given by the number of ensemble members.

Weather roulette

- Player starts with an initial amount of (e.g. 10€)

- The player bets according to the odds given by his/her forecast, for each category:

- For example:



Above average

Average

Below average

5,27€

1,83€

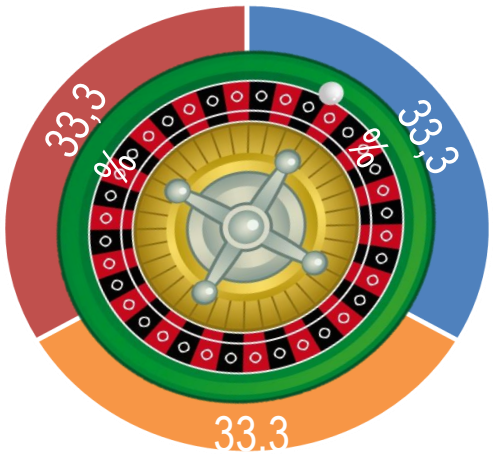
2,9€

Weather roulette

- After the first round, the money bet on the wrong terciles is lost.
- The player's return is given by

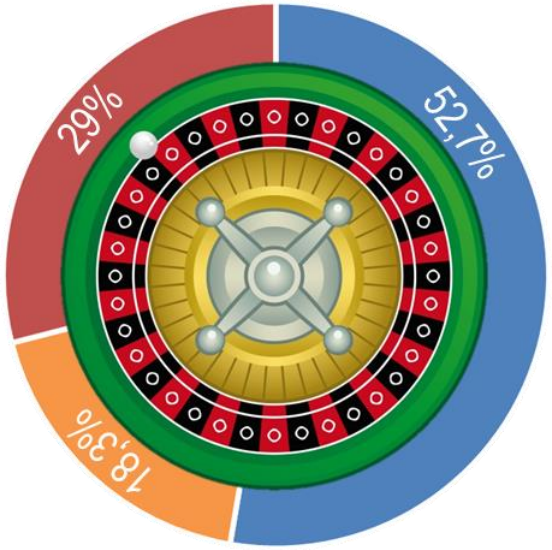
$$\frac{1}{p_{baseline}(v)}$$

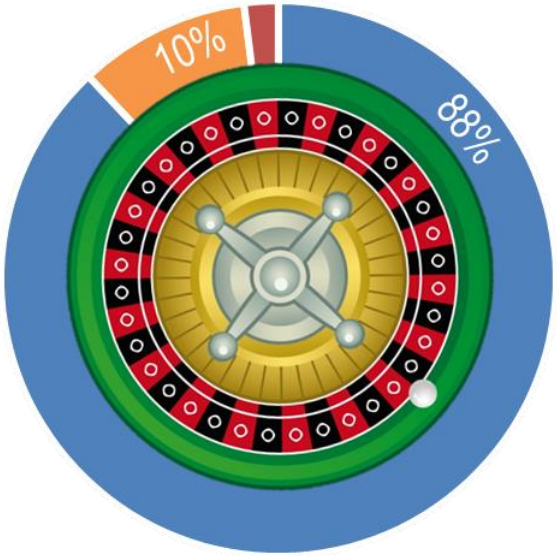
$p_{baseline}(v)$: probability of verifying tercile



(e.g. clim 1/0.33 -> x3)

- All the player's money is invested in the next round





10€

2,9€	1,83€	5,27€

2,9€ x 3= 8,7€

0,17€	0,87€	7,65€

7,65€ x 3= 22,97€

…

1 round per start date: 50 rounds.

Weather roulette

- For each round, the return ratio r is given by

$$r = \frac{p(v)}{p_{baseline}(v)}$$

- Where $p(v)$: probability verifying tercile for each round

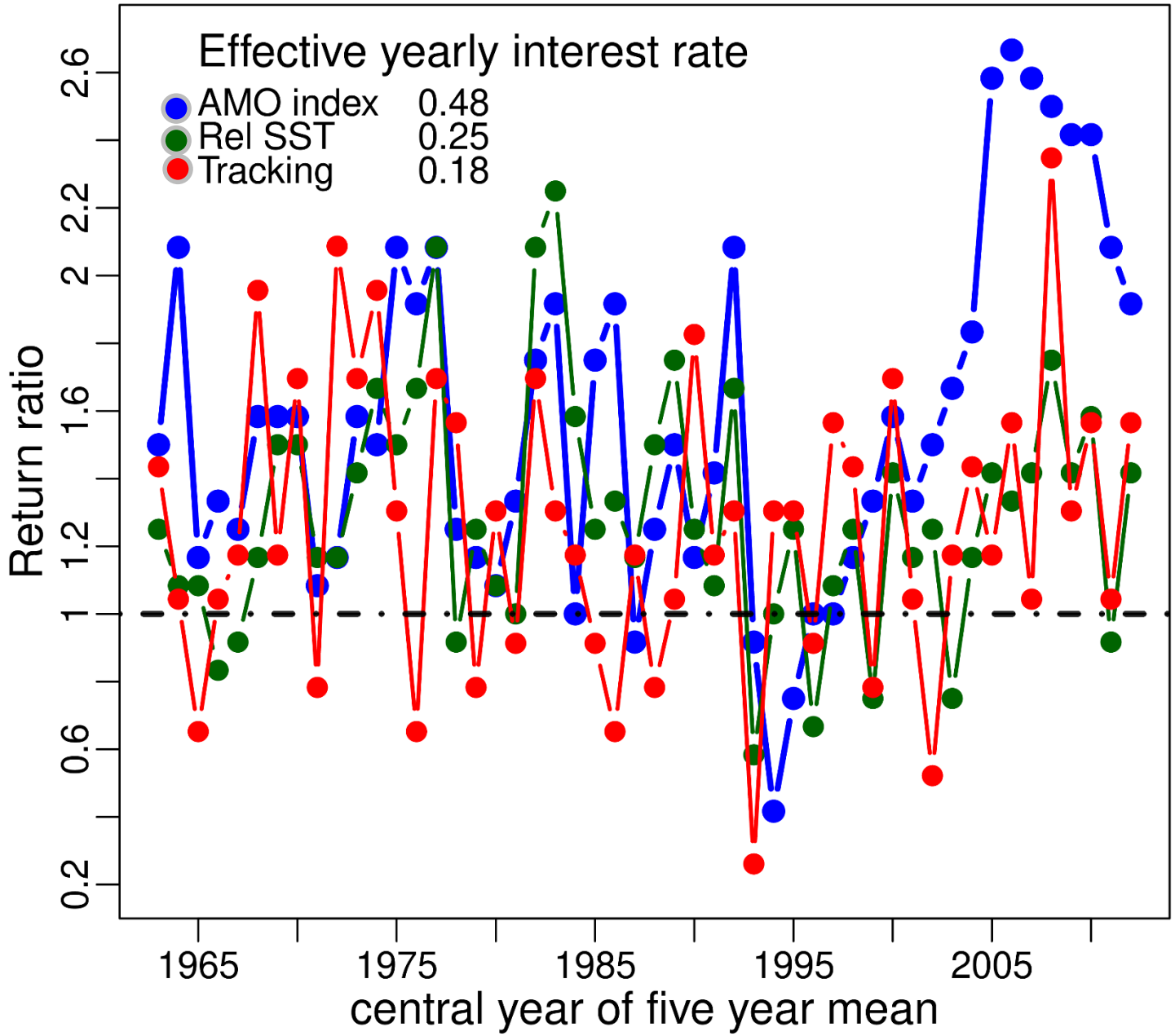
- The skill R of the forecast system is given by the geometric average of the return ratios r:

$$R = \sqrt[n]{\prod_{i=1}^{n} r_i}$$

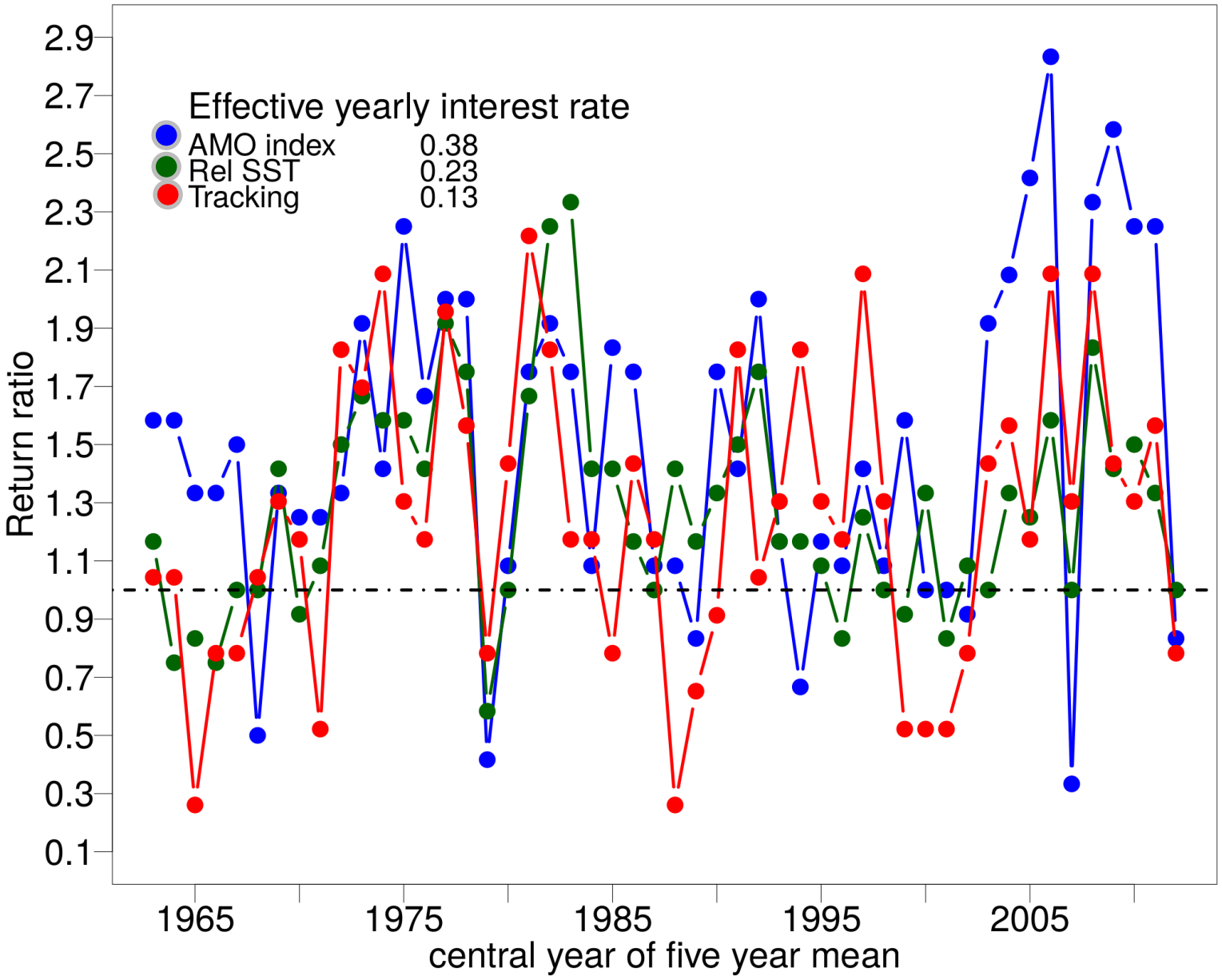
- A forecast more skillful than a baseline will return R>1

- **Effective yearly interest rate** is given by R-1

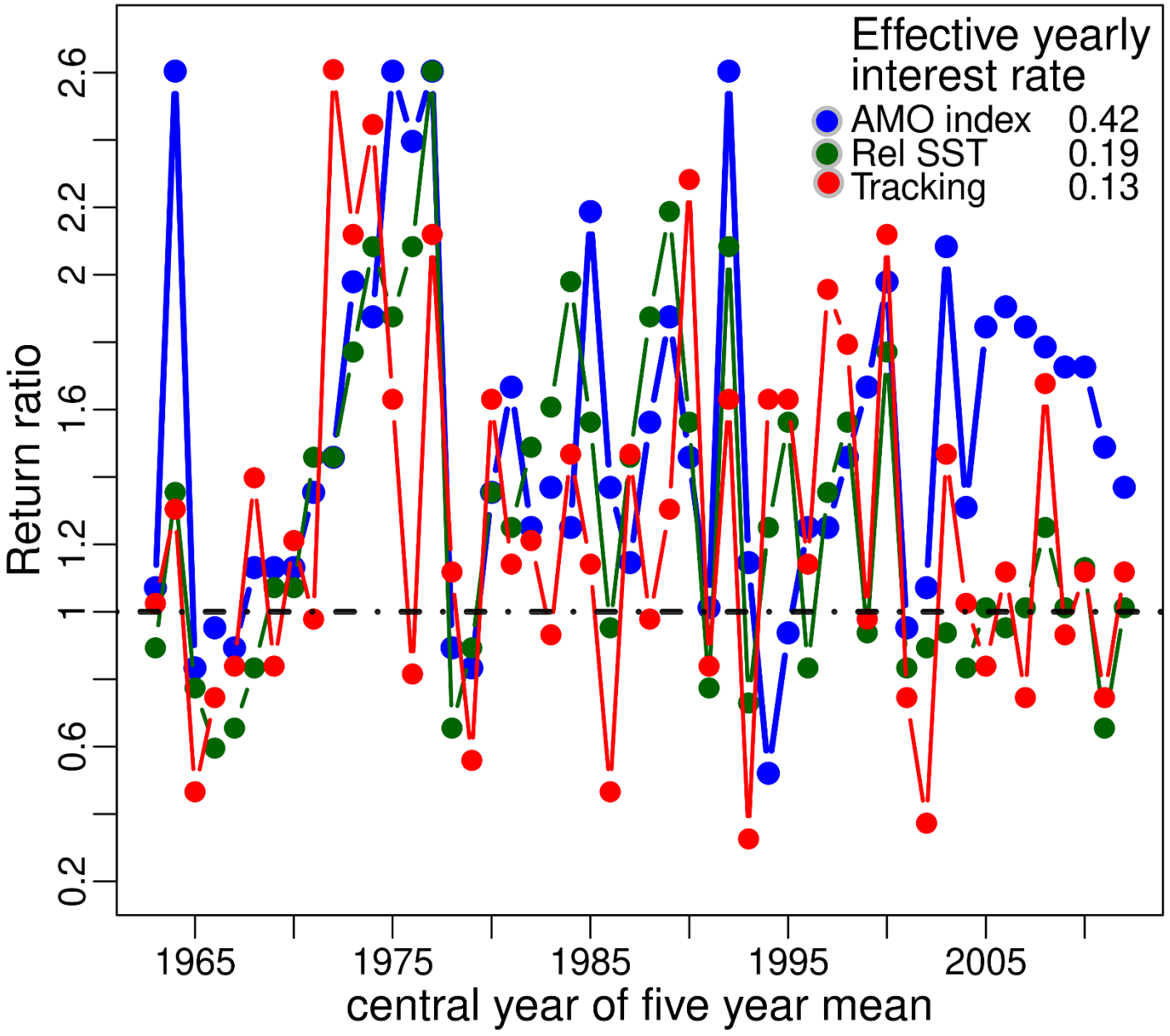
Performance against climatology



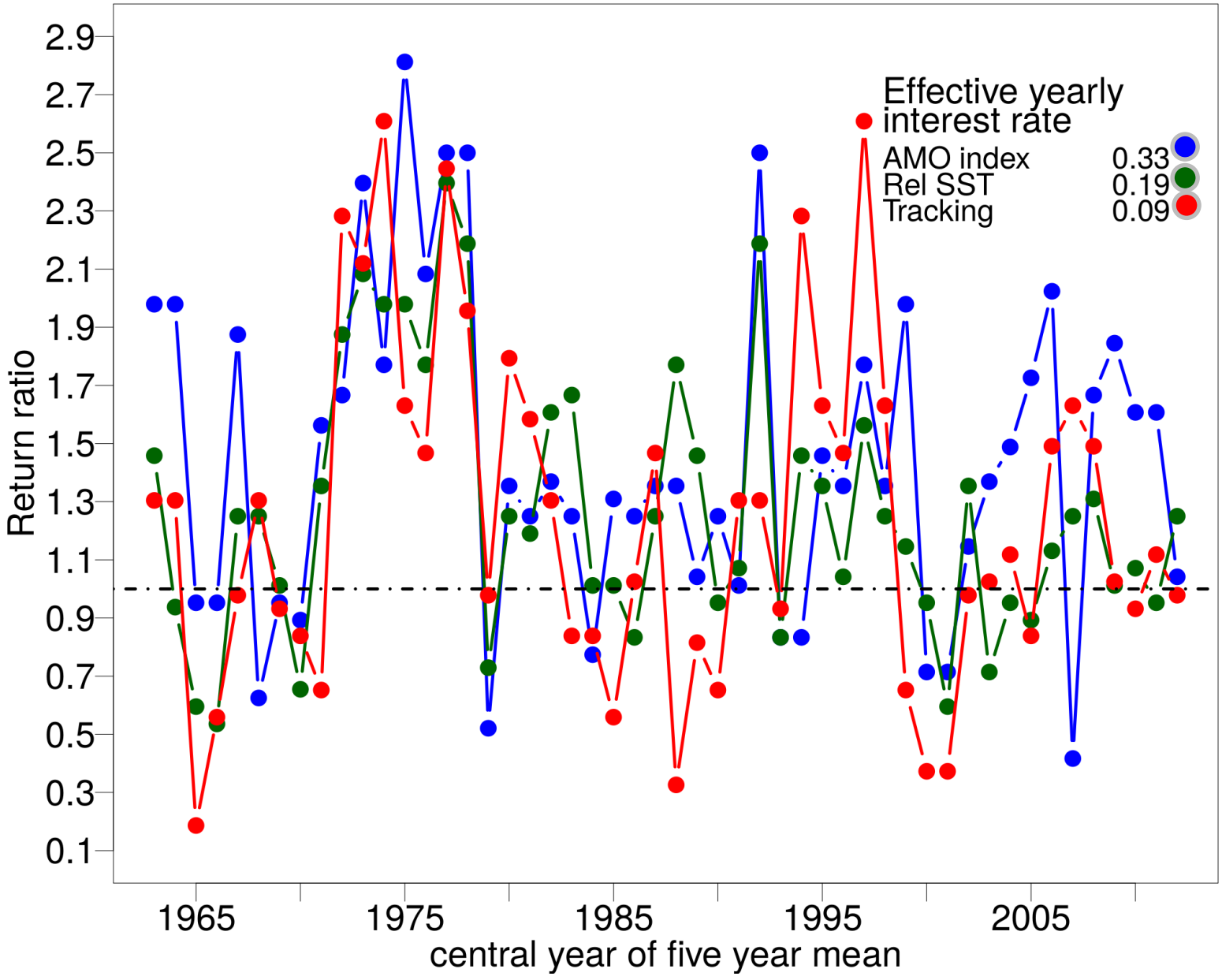
Performance against climatology (2-5)



Performance against persistence



Performance against persistence (2-5)



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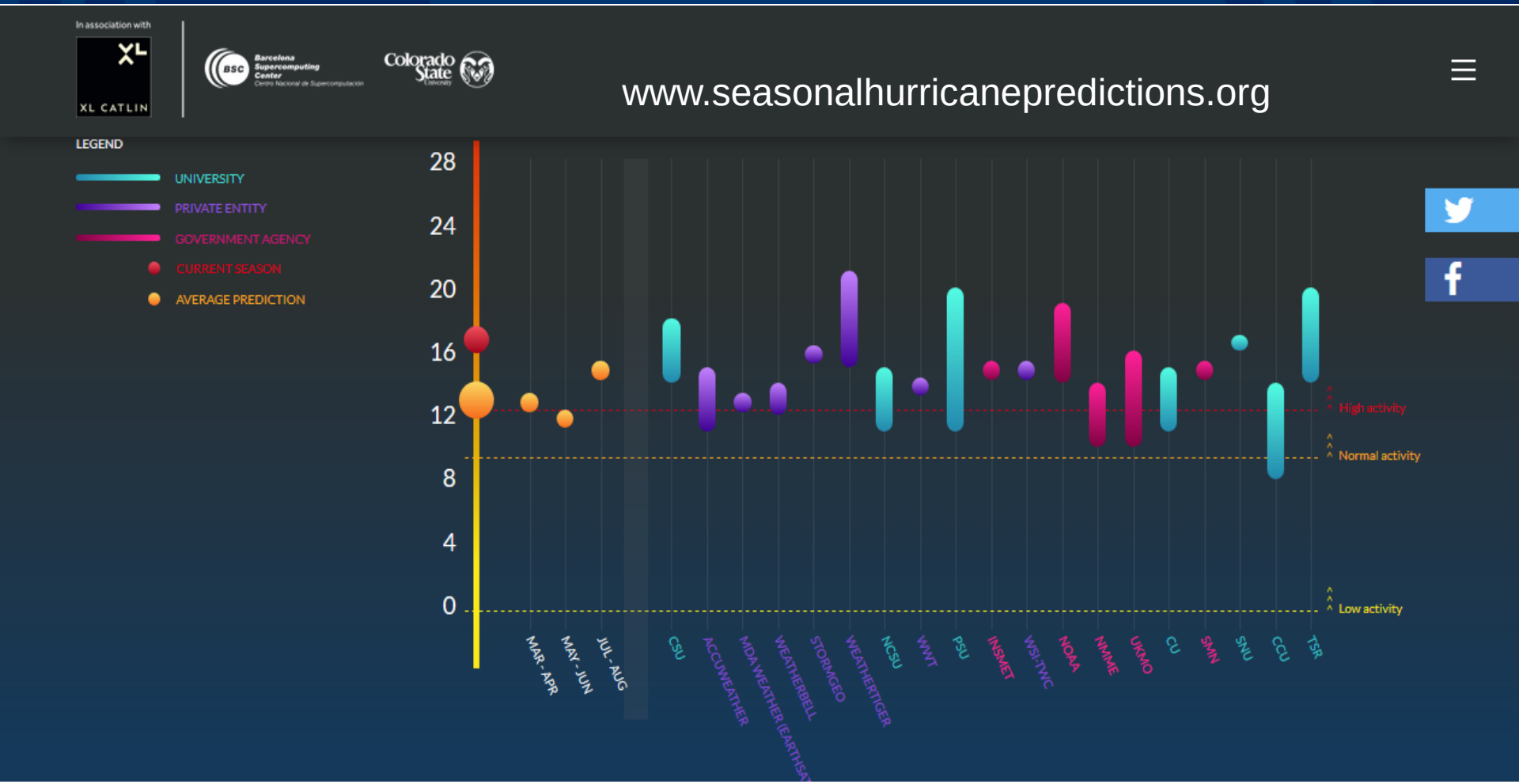
How skilful are the multi-annual forecast of Atlantic hurricanes?

Better than climatological forecasts

Probably better, or at least equivalent to, 10-year persistence forecasts

Caron et al. (2018) Bull. Amer. Meteor. Soc., 99 (2), 403-413.



Number of tropical cyclones
Number of hurricanes
Number of major hurricanes (cat 3-5)
Accumulated Cyclone Energy

Forecasts are issued from late March to early August

http://www.seasonalhurricanepredictions.org

Contributing Forecast Groups

21 groups in 2017

26 groups in 2018

Mix of

- Private vendors
- Universities
- Government Agencies

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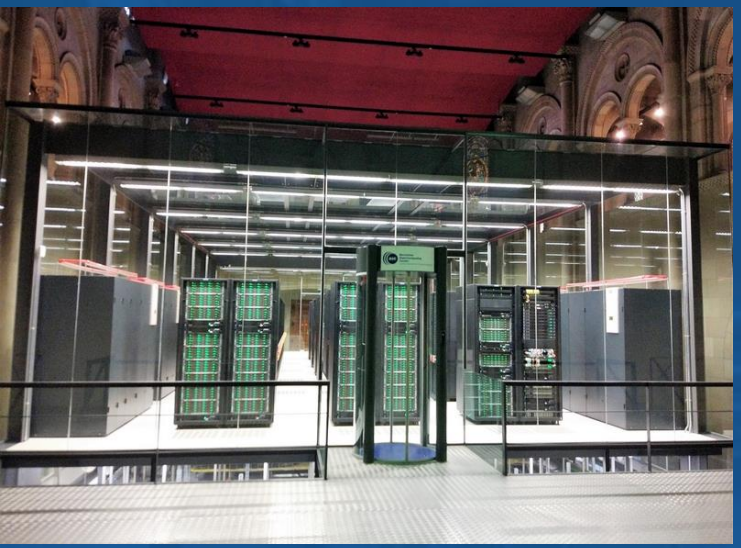

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We're hiring
https://www.bsc.es/join-us/job-opportunities
Deadline: October 1st

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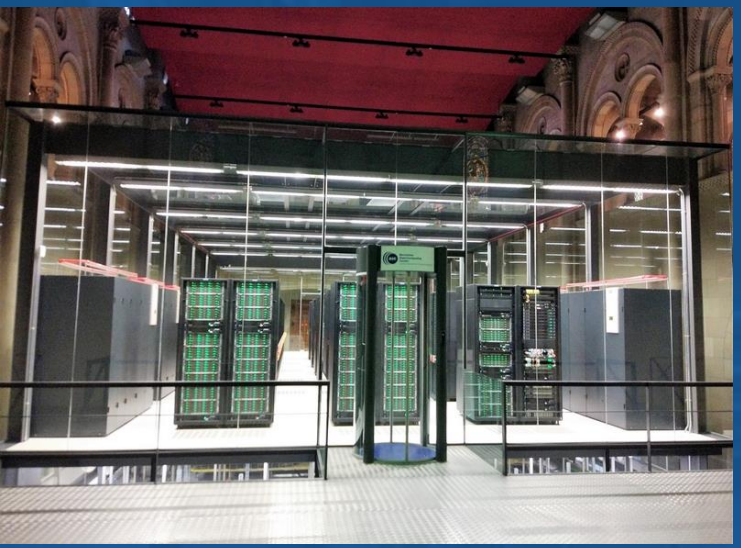

You get to play with it

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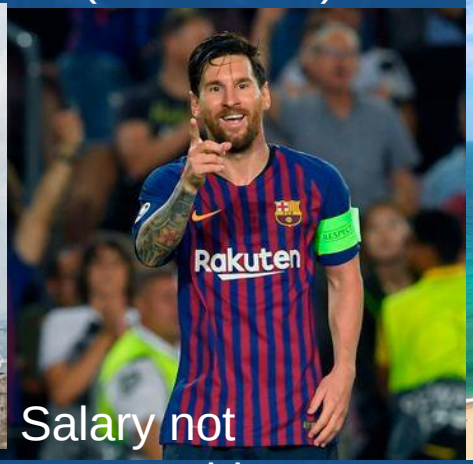
Thank you!

Won't be finished for another 10 years (at least)

(Disclosure)



Salary not comparable

Never so empty

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Thank you!

For further information please contact
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