

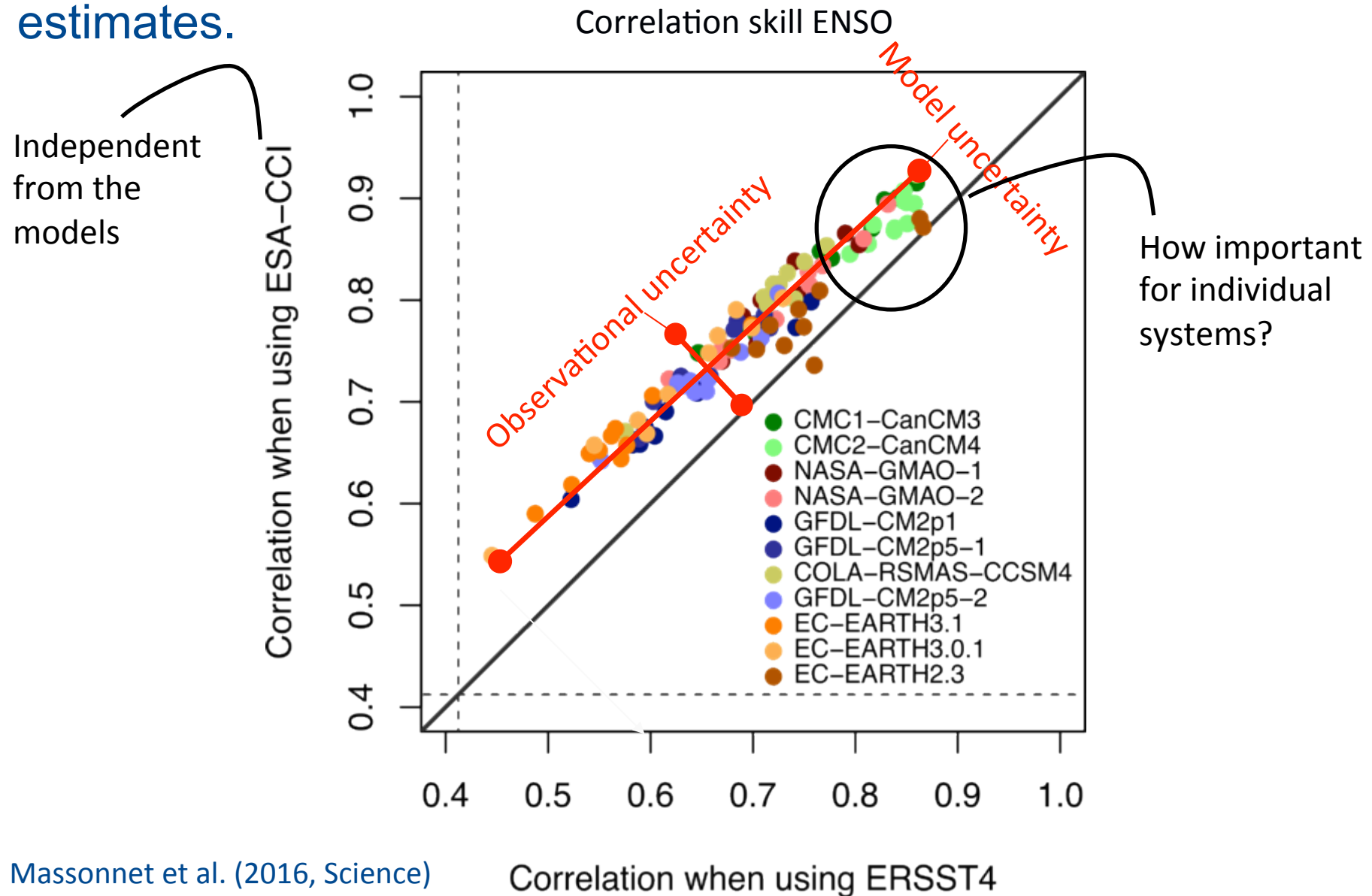


BSC-Earth Sciences Dept.

Francisco J. Doblas-Reyes
BSC Earth Sciences Department

Model and reference uncertainty

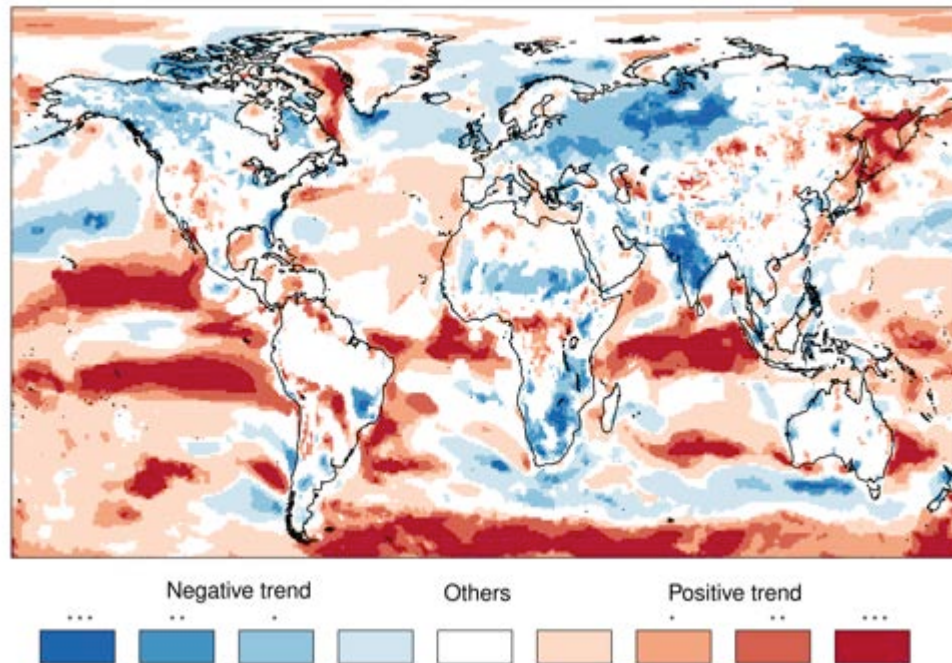
Models can also be used to estimate the quality of observational estimates.



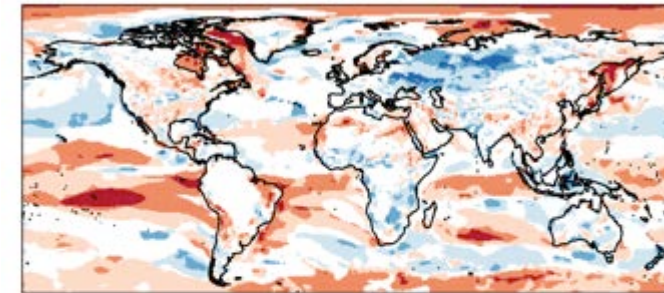
Reference uncertainty: trends

(Bottom) Coherence of the 10-metre wind speed trends in three reanalyses (ERA-Interim, JRA-55 and MERRA) over 1981-2015 during boreal winter.

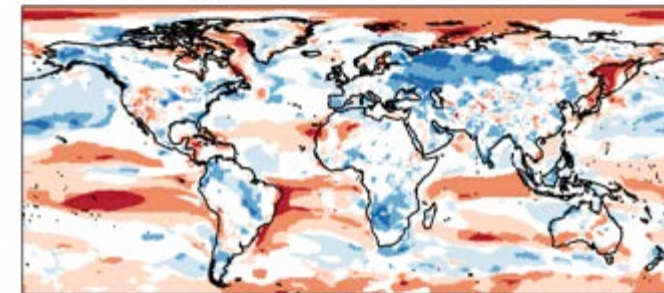
(Right) Coherence of the trends between ECMWF S4 and the three reanalyses.



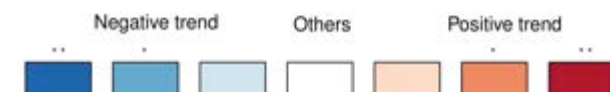
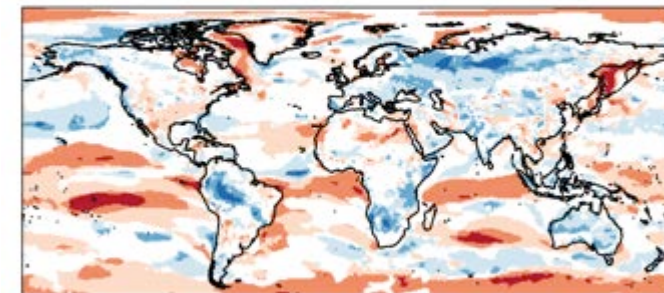
(a)ECMWFS4 – ERA-I



(b)ECMWFS4 – JRA-55



(c)ECMWFS4 – MERRA-2



Predicting tropical storm frequency



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First comprehensive service of predictions of tropical cyclone seasonal frequency

<http://www.bsc.es/ESS/seasonalhurricanepredictions/>



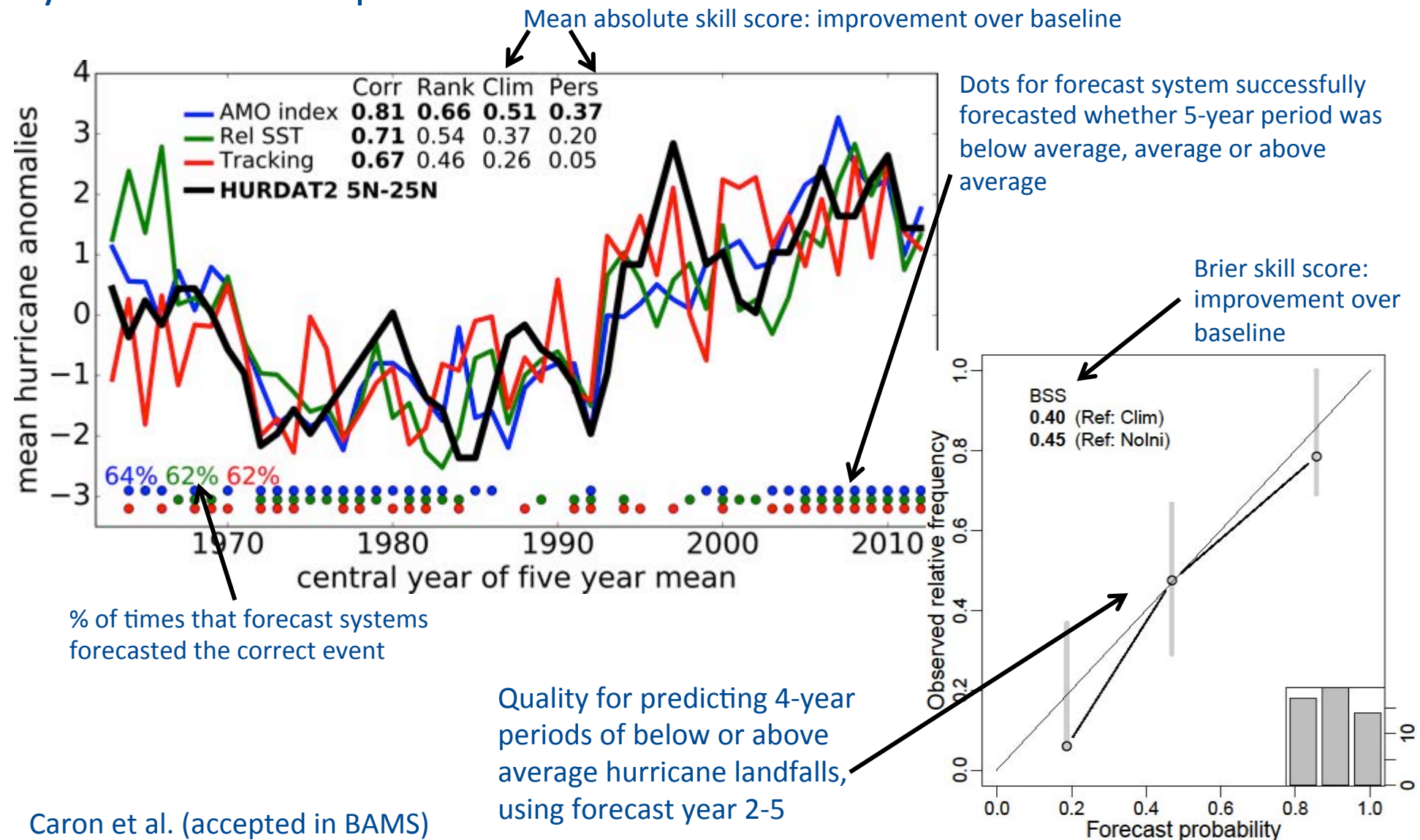
Service-driven predictions



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Soon multi-model decadal predictions of 1-5 year mean number per year will be also provided.



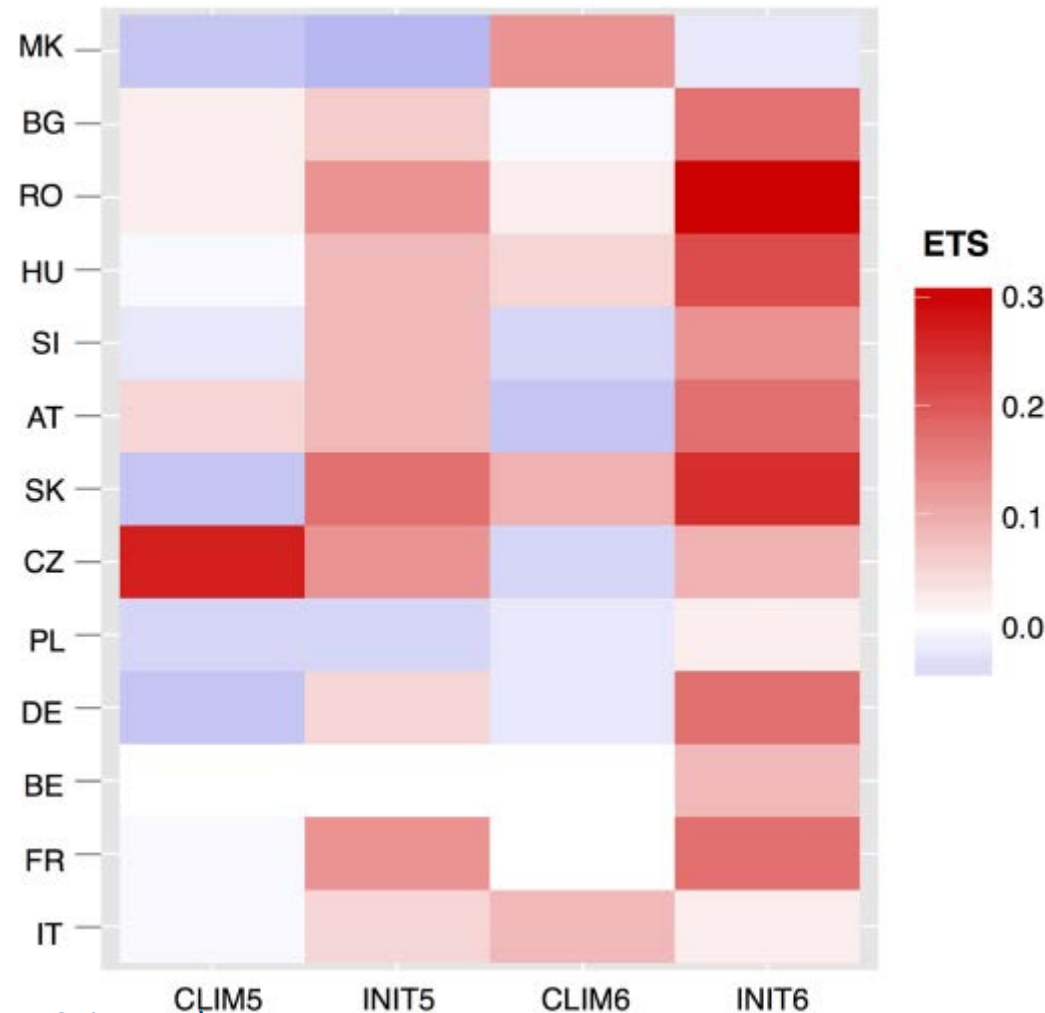
Climate information: agriculture



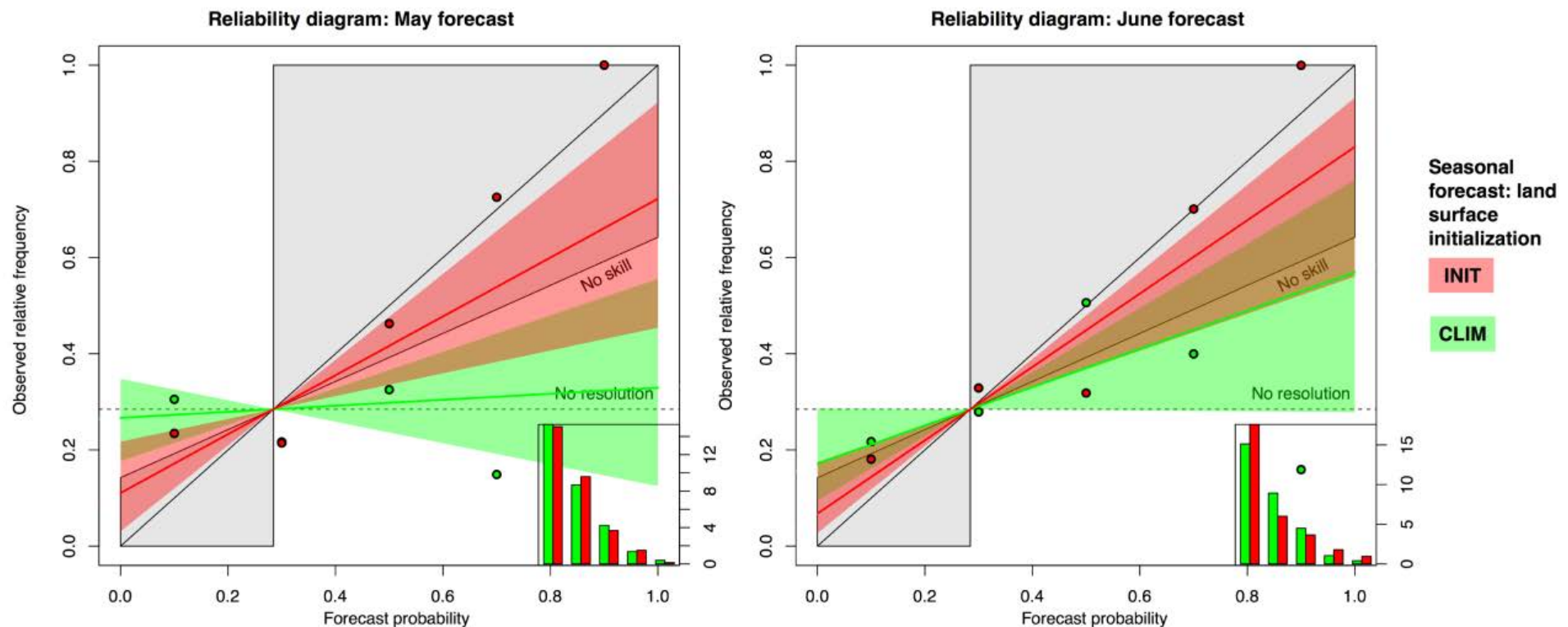
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Equitable threat score (ETS) of predictions of poor maize yield (lower quartile) from EC-Earth seasonal predictions when land-surface is initialised with realistic initial conditions (INIT) wrt no information (CLIM).



ROC diagram of predictions of poor maize yield (lower quartile) from EC-Earth seasonal predictions when land-surface is initialised with realistic (INIT) and climatological (CLIM) initial conditions with May and June start dates.



From the Copernicus regulation (EU) 377/2014:
"the Climate Change service (C3S) shall provide information to increase the knowledge base to support **adaptation and mitigation policies**. It shall in particular contribute to the provision of **Essential Climate Variables (ECVs)**, **climate analyses, projections and indicators** at temporal and spatial scales relevant to adaptation and mitigation strategies for various Union's sectoral and societal benefit areas."

Climate
Data Store

Sectoral
Information
System

Evaluation and
Quality Control

Outreach and
Dissemination



QA4Seas aims at developing a strategy for the evaluation and quality control (EQC) of the multi-model seasonal forecasts provided by the Copernicus Climate Change Service (C3S) to respond to the needs identified among a wide range of stakeholders.

To achieve the objective the consortium:

- Considers the evaluation of multi-faceted quality aspects
- Is user driven with a two-stage consultation process (coordinated with other lots)
- Formulates requirements to the CDS to address user requirements
- Performs a gap analysis of the current information available to users
- Develops a framework and a prototype of the EQC system

What do the users want?

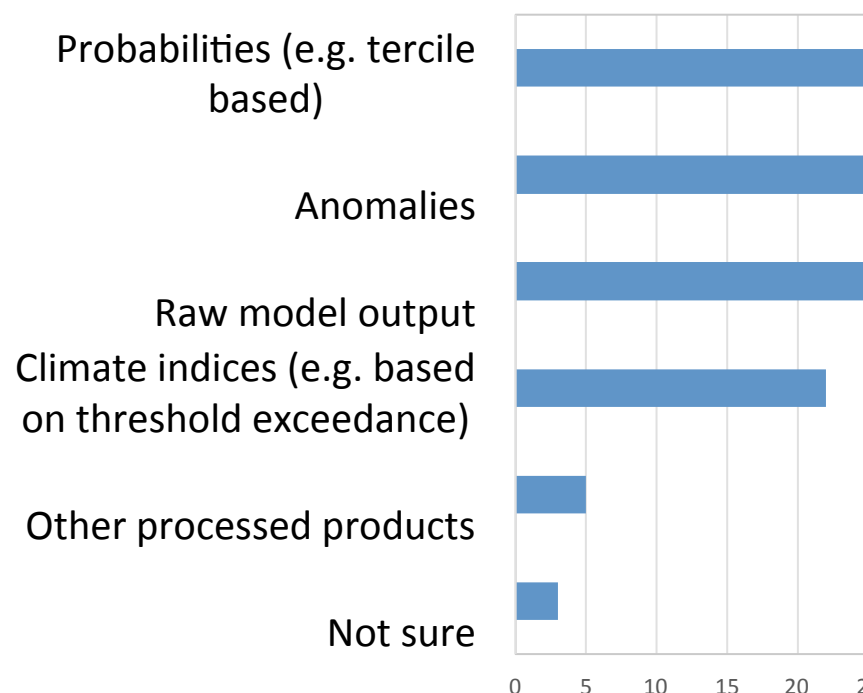


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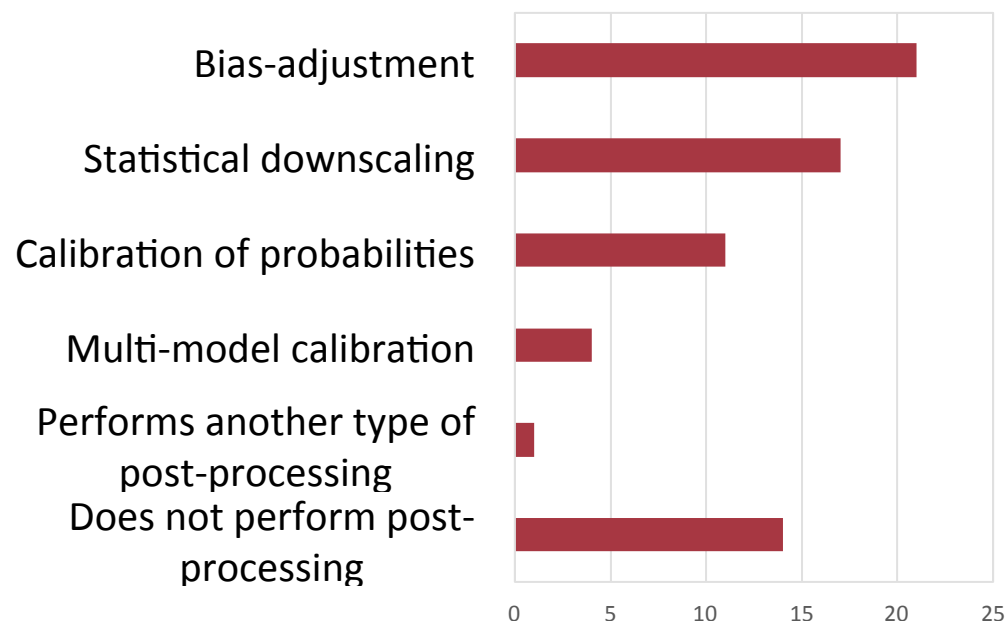


Results from a user survey.

"What kind of data from global SF do you use?"



"What type of adjustment post-processing do you perform on the SF data before using it?"



The building blocks



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Existing R packages are used for both the preliminary assessment and the prototype. New elements (inference assessment, metadata propagation, etc.) are built in to address the C3S needs.



SpecsVerification

- Probabilistic and deterministic scores
- Works on [time x members] arrays

easyVerification

- Applies SpecsVerification scores to arrays of any dimensions, multi-core
- Probabilistic and deterministic scores

S
C
O
R
E
S



F
R
A
M
E
W
O
R
K
S

downscaleR + loaderR

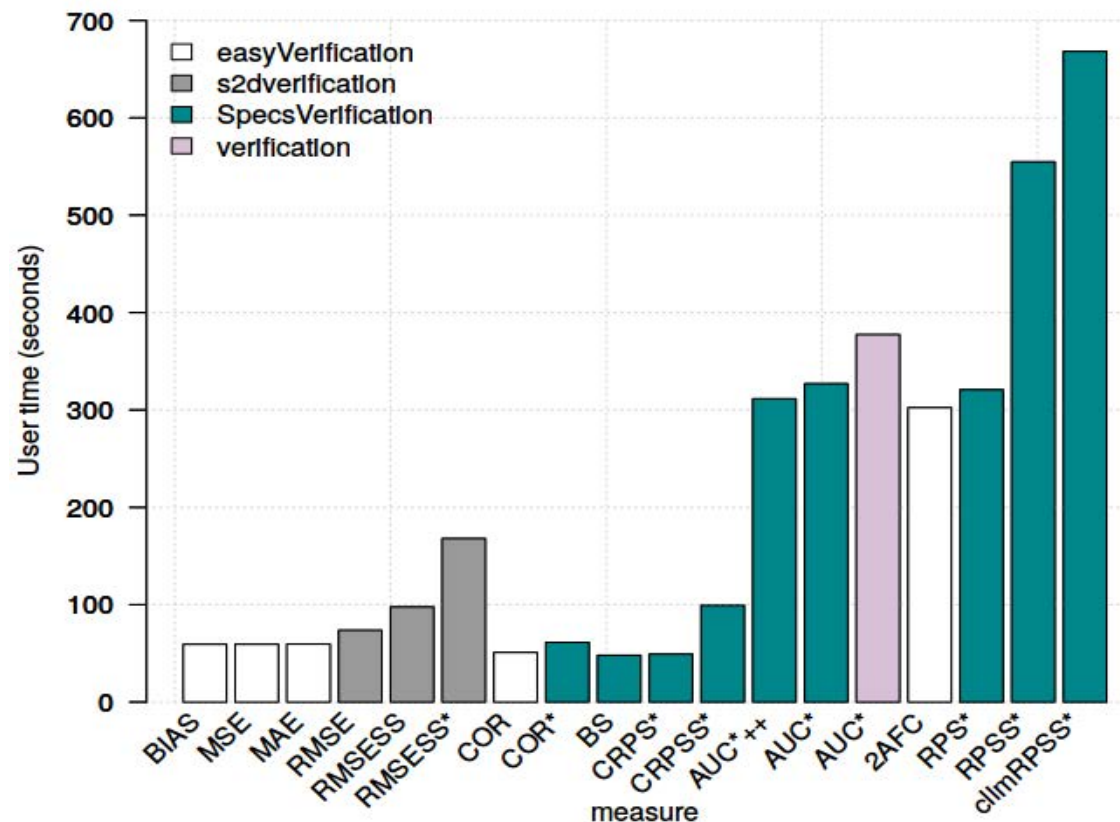
- Data retrieval and homogenization
- Bias adjustment, modes, downscaling
- Probabilistic and deterministic scores
- Visualisation of data and results

s2dverification

- Data retrieval and homogenization
- Bias adjustment, filtering, modes
- Probabilistic and deterministic scores
- Visualisation of data and results



Computing performance is key: performance and efficiency (parallel scalability), which are evaluated in controlled environments, are part of the contract KPIs.



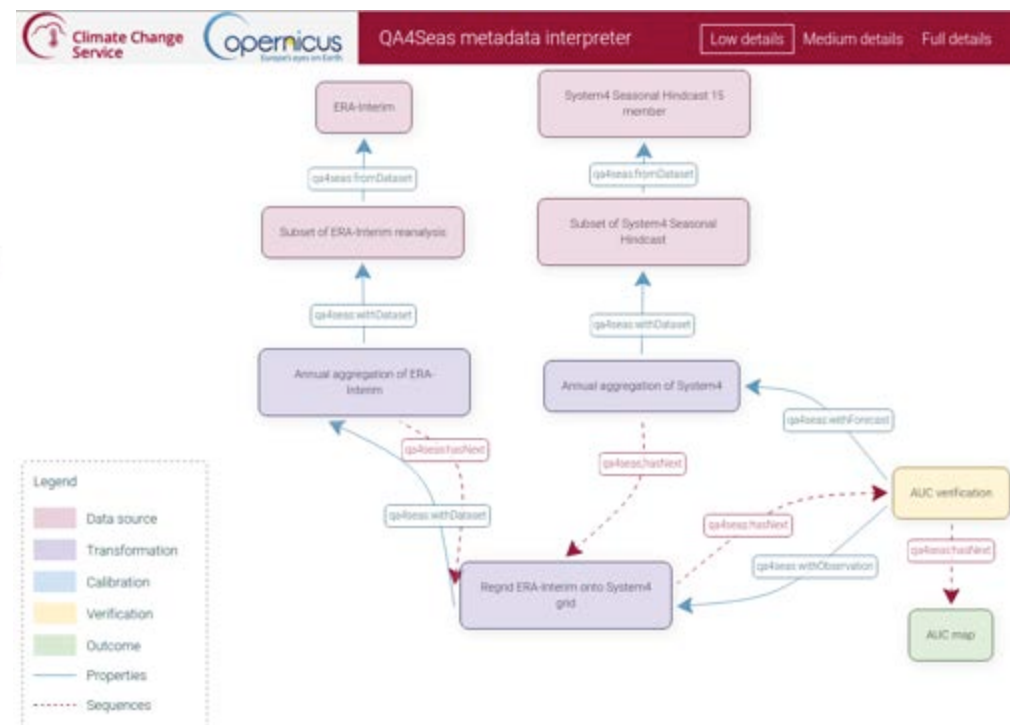
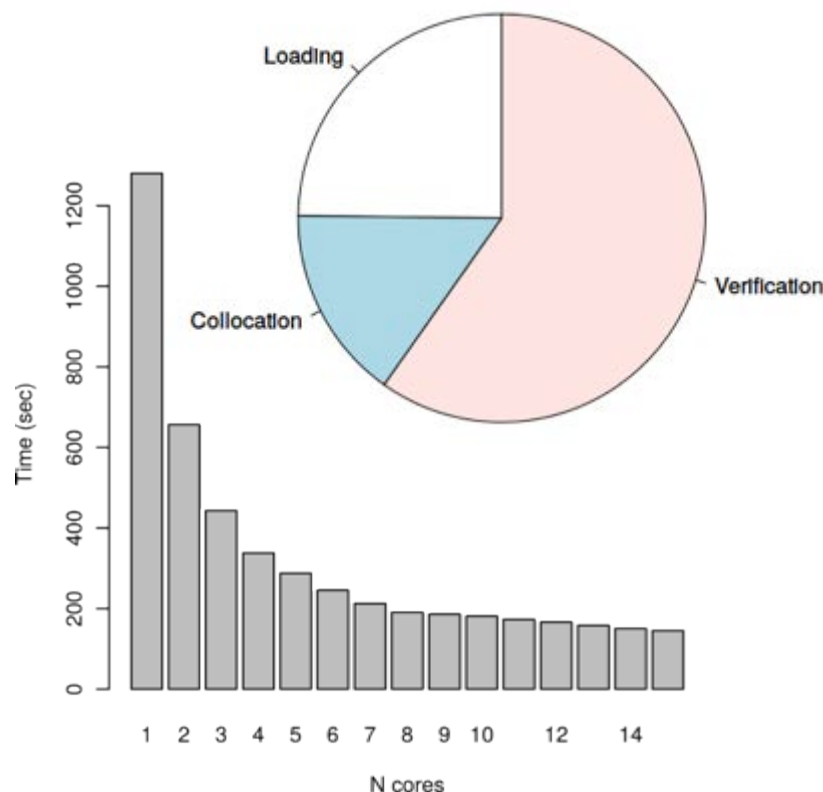
Improving diagnostics efficiency



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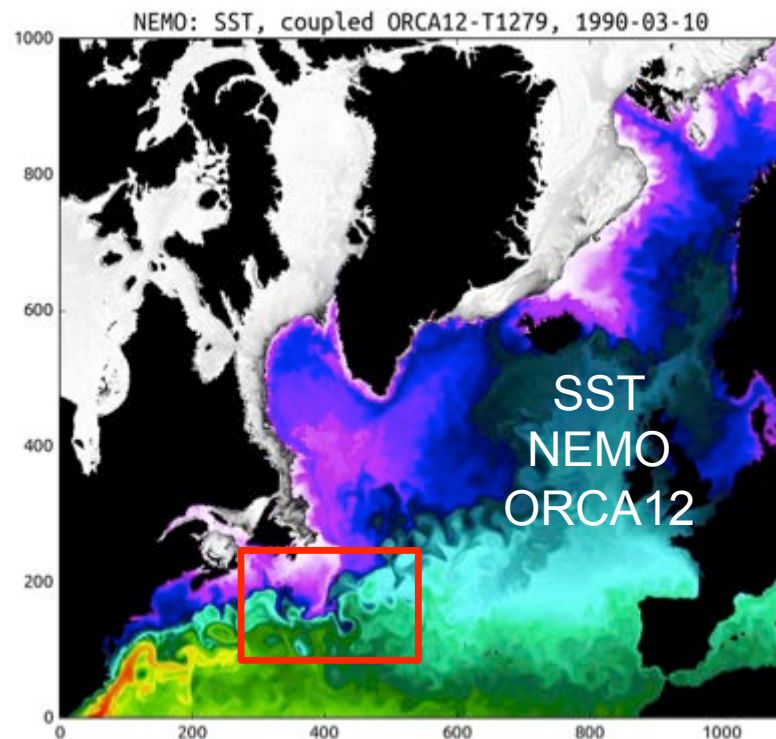
- **Computing performance is key:** (left) scalability of a ROC area estimate using loadR, SpecsVerification and easyVerification.
- An RDF-based approach aiming at the reproducibility of objects (NetCDF file, image) with human and machine-readable solution using a semantic metadata model has been created in QA4Seas.



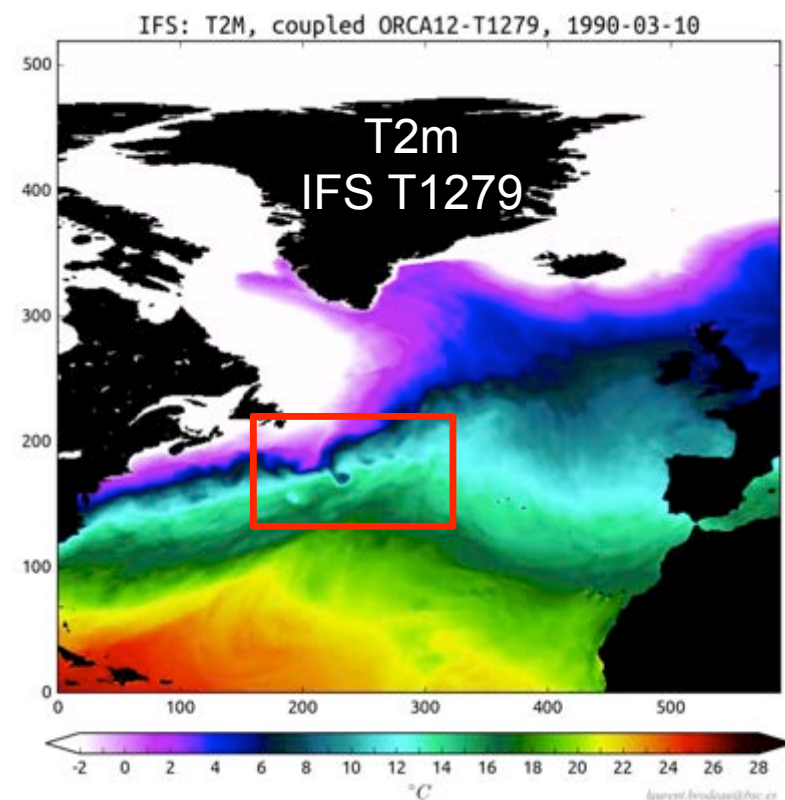
Global high resolution matters



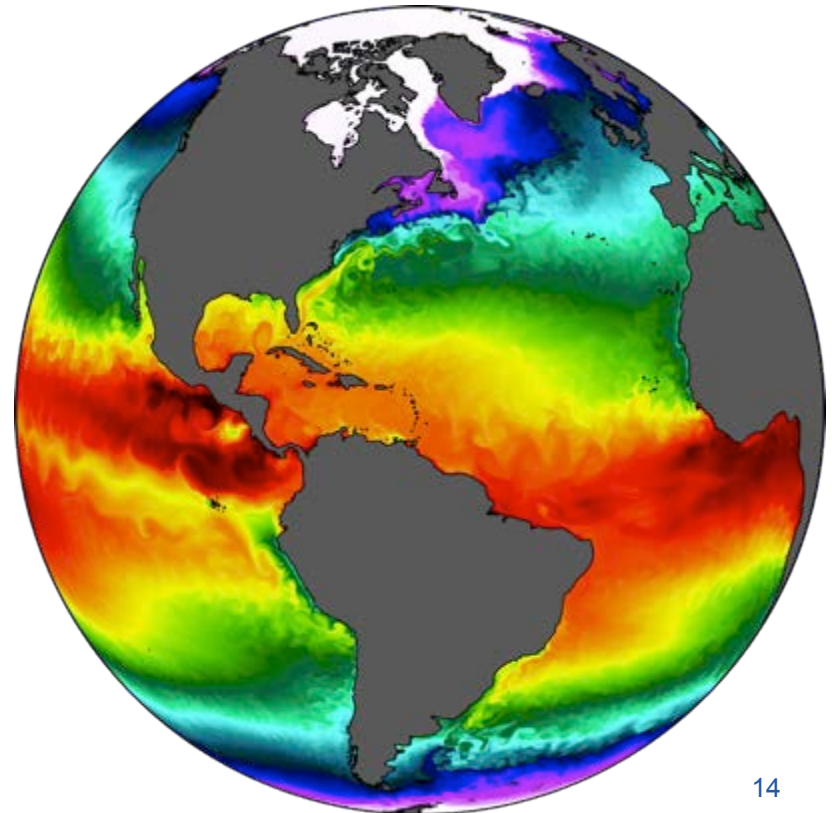
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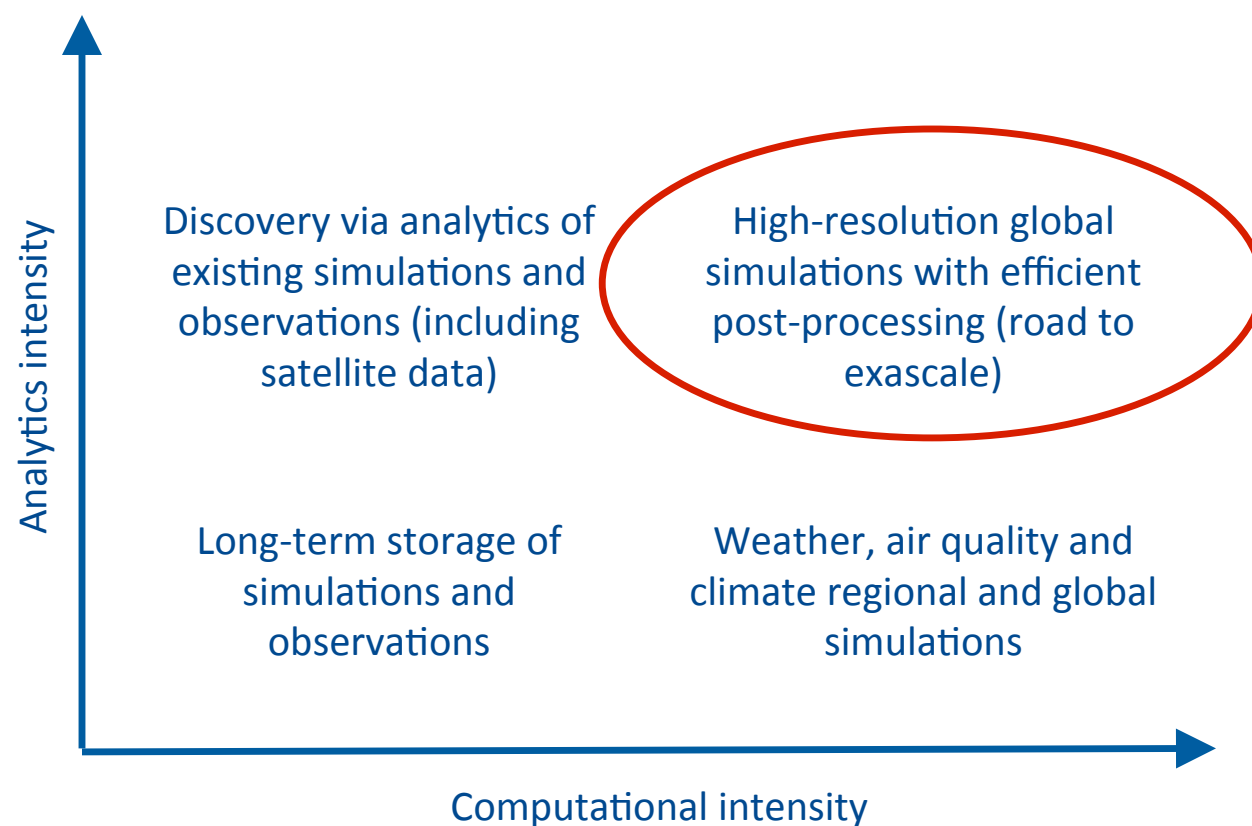


EC-Earth GLOBAL ORCA12-T1279
(ocean and atmosphere at ~10 km)



- The very high resolution configuration runs at ~ 10 kms
- The physical interaction between ocean and atmosphere is far more realistic at these resolutions
- 220 kCPUhours per simulated year (typical simulation is 150 years times several members)
- 5 TB I/O per simulated year
- Post-processing can reduce it to 350 GB per simulated year
- Data reduction requires analytics on the node (or on an accelerator)
- A handful of institutions are currently able to address the issue

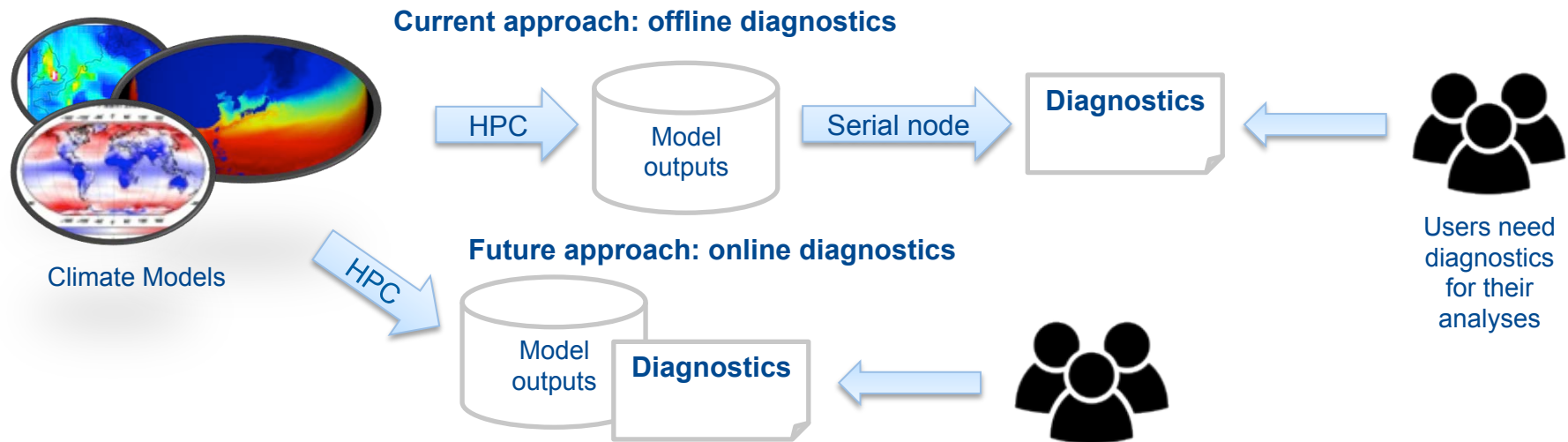




Improving diagnostics efficiency



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- Diagnostics computed as Analytics as a Service
 - Diagnostics online (during model run)
 - Reduced data traffic
 - Diagnostics possible on the computing nodes (using GPUs)
 - New diagnostics (data mining of extremes) possible
 - The user gets the results faster → crucial to adapt to climate change and to develop climate services (public and private)

Improving model efficiency



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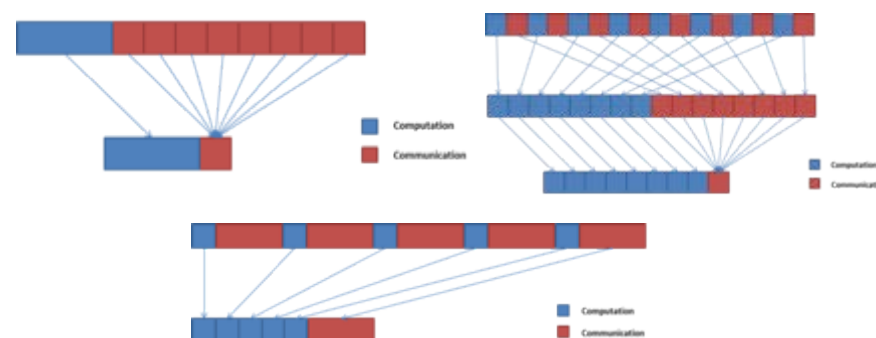
Collaboration with computer sciences department

BSC performance tools



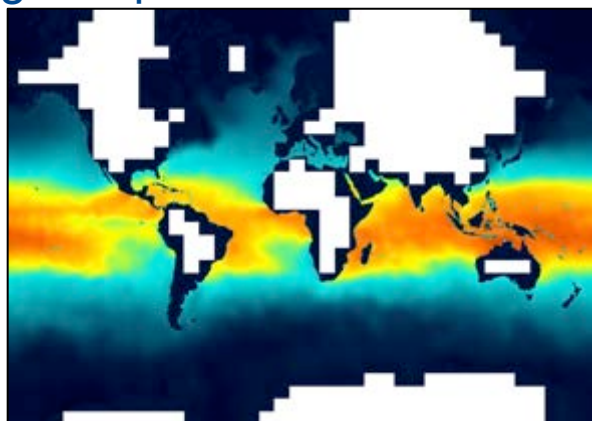
MPI communications optimizations

Reducing p2p and collective communications overhead



Exclude land processes in NEMO

Finding an optimal domain decomposition



Explore mixed precision

Which precision is needed in NEMO?

