

CMCC Seasonal Outlook

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+ contribution from the ODA Division



NINTH MEDITERRANEAN CLIMATE OUTLOOK FORUM

November 20-23, 2017

Zagreb, Croatia

The new CMCC operational seasonal prediction system

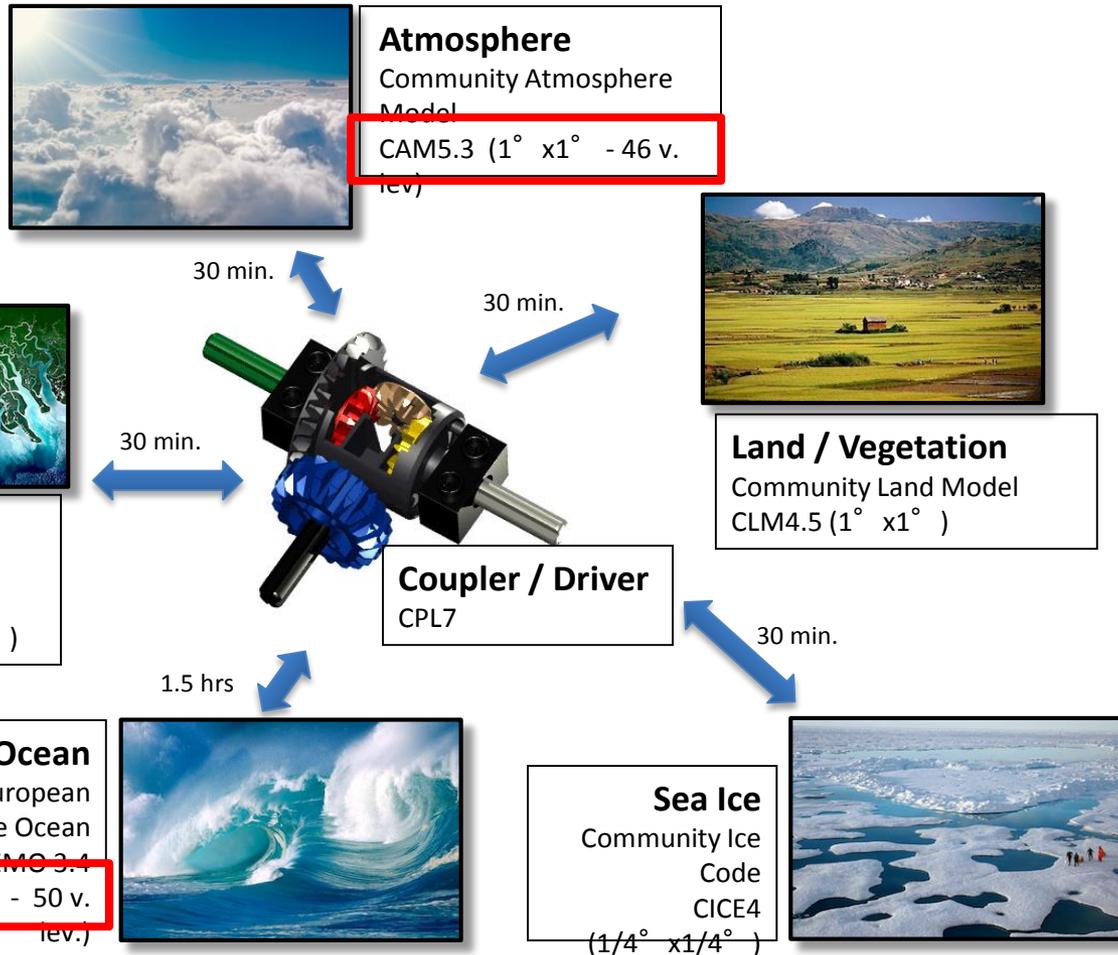
From the CMCC SPSv2 to the SPSv3:

1. Improving the climate model
2. Improving the initialization strategy
3. Increasing the size of the forecast ensembles



The new SPS.v3

The new CMCC-SPSv3: improving the climate model



Main novelties:

- New model components
- Increased atmospheric resolution (both horizontal and vertical)
- Increased oceanic resolution (both horizontal and vertical)



The new SPS.v3

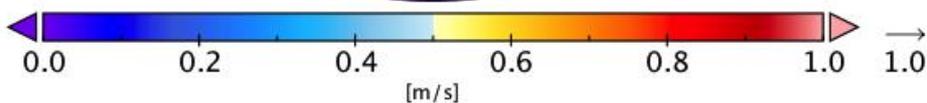
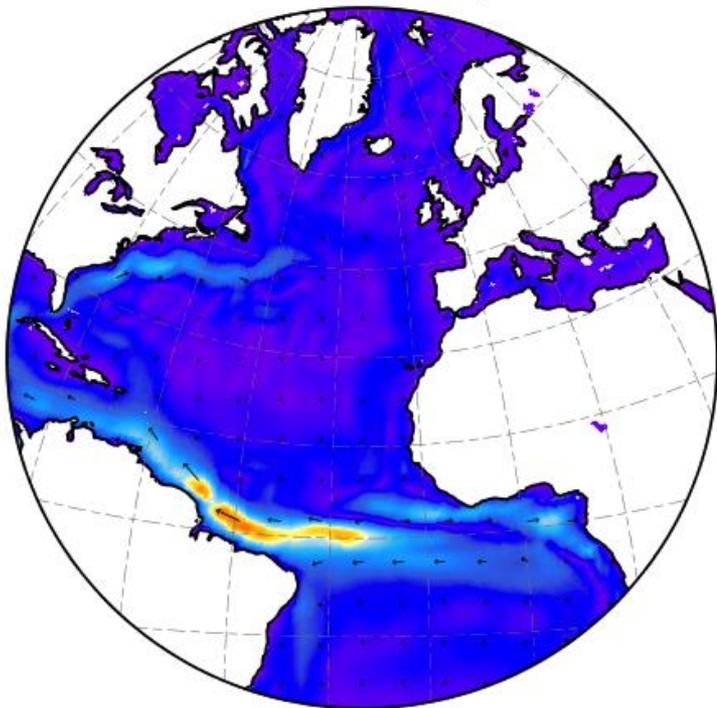
The new CMCC-SPSv3: improving the climate model

Ocean: OPA → NEMO and 2° →

1/4°

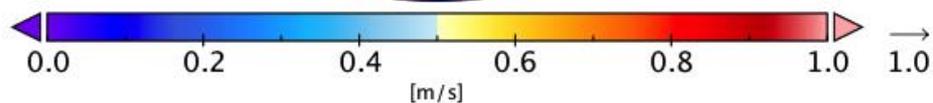
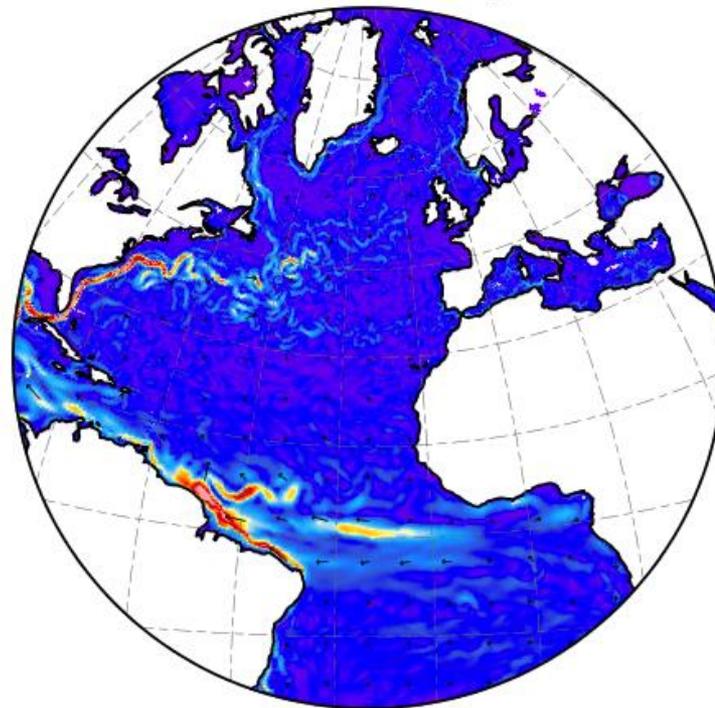
OLD system

Ocean Surface Currents
ORCA2 - 201501 Monthly Mean



New system

Ocean Surface Currents
ORCA025 - 201501 Monthly Mean



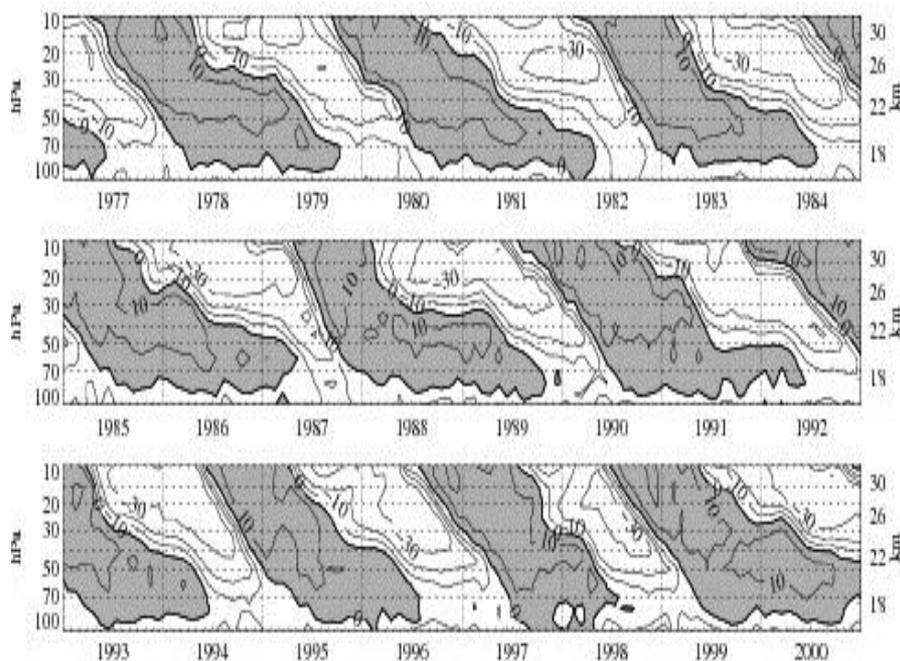
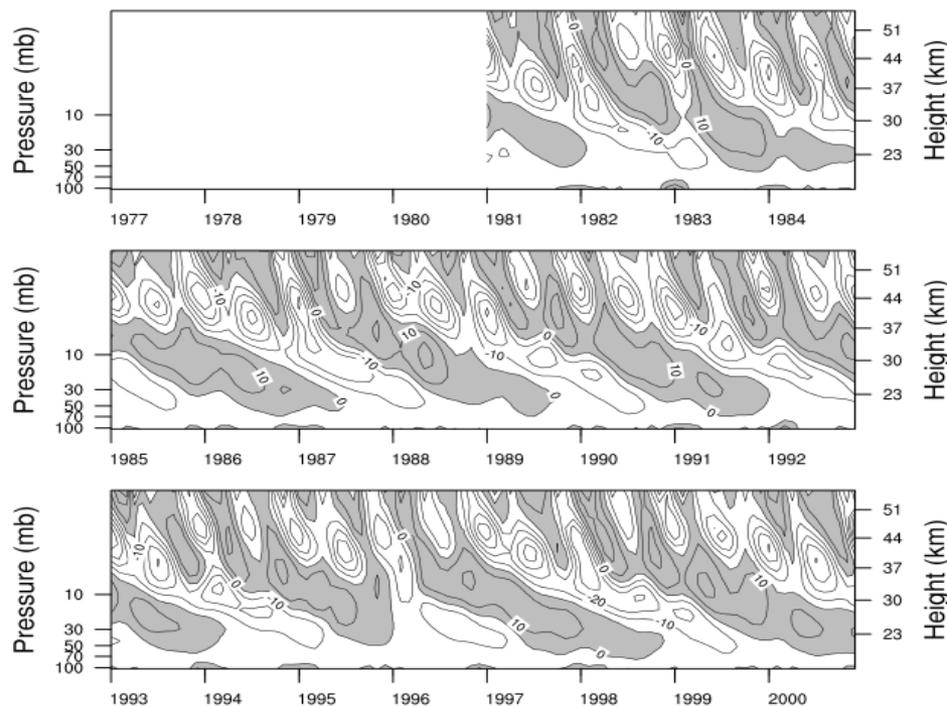
The new SPS.v3

The new CMCC-SPSv3: improving the climate model

Atmosphere: CAM5 version used has a modified vertical grid with 46 levels and a model top at 0.3 hPa, producing a **QBO period similar to observations in the lower stratosphere.**

Model

Observations



The new SPS.v3

The new CMCC-SPSv3: improving the initialization strategy

Atmosphere:

- initialized with **ECMWF operational analyses**, whereas in the re-forecasts (1993-2016) atmospheric initial conditions are generated using the ERA-Interim re-analyses → **9 atmospheric I.C.**

Land surface:

- **initialization from land analyses performed with the land-surface model forced with meteorological fields** (four times a day) from NCEP/NCAR and ECMWF analyses. Restart of the first day of the month used as initial condition for the forecast. Both for the forecasts and for the re-forecasts (1993-2016) → **3 land I.C.**

Ocean (sea-ice)

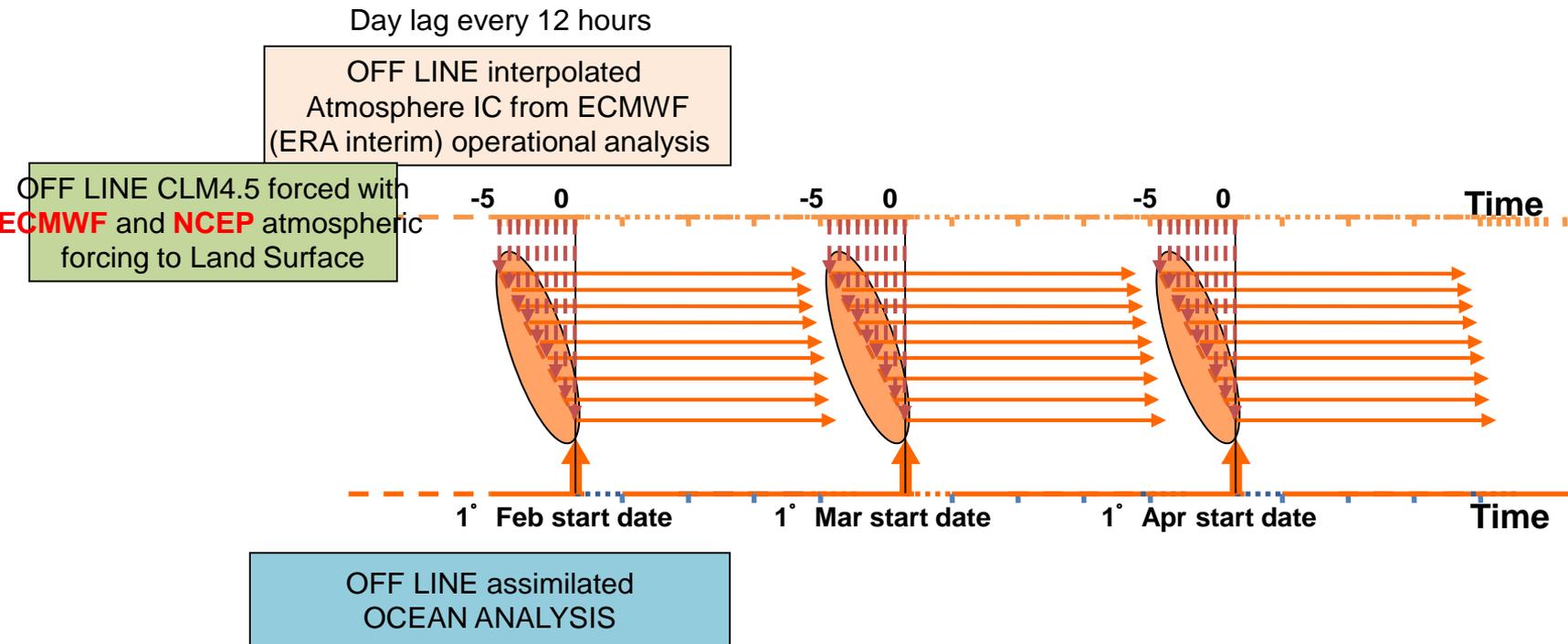
- eddy-permitting **global ocean analyses system developed and produced at CMCC**, C-GLORS (Storto et al. 2015), with NEMO at ¼ degree resolution, with 50 vertical levels with partial steps and coupled to the LIM2 sea-ice model → **8 oceanic I.C.**

A set of 216 (= 8*9*3) initial states generated and **50 ICs randomly selected from this set**



The new SPS.v3

The new CMCC-SPSv3: increasing the forecast ensemble size



- 3 perturbations for the **land surface**
- 9 perturbations for the **atmosphere**
- 8 perturbations for the **ocean**

216 ICs



50 forecast members

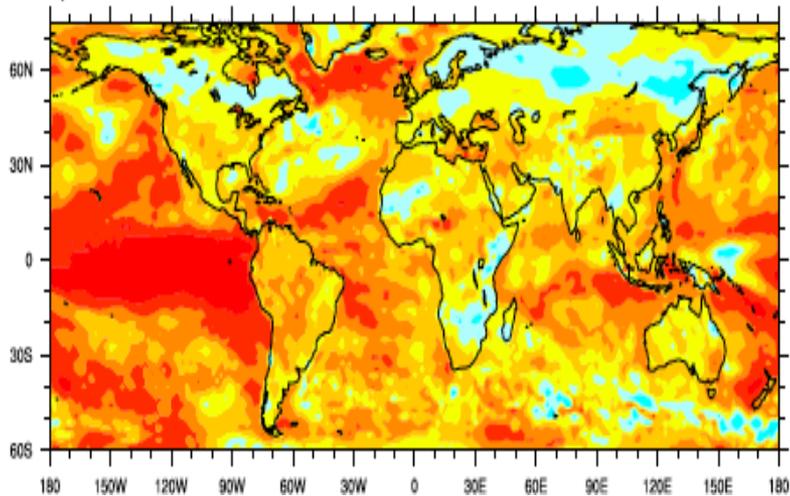
40 re-forecast members

The new SPS.v3

Tsurf (ACC) - lead time 1

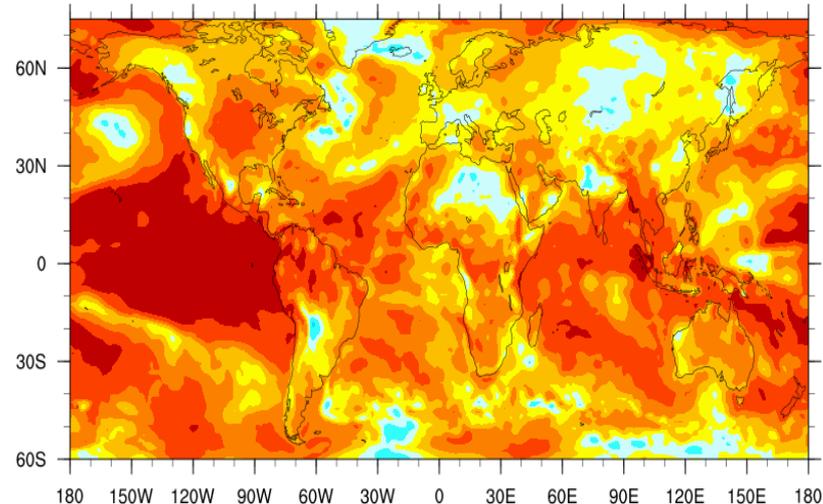
SPS.v2

August start date – lead season 1

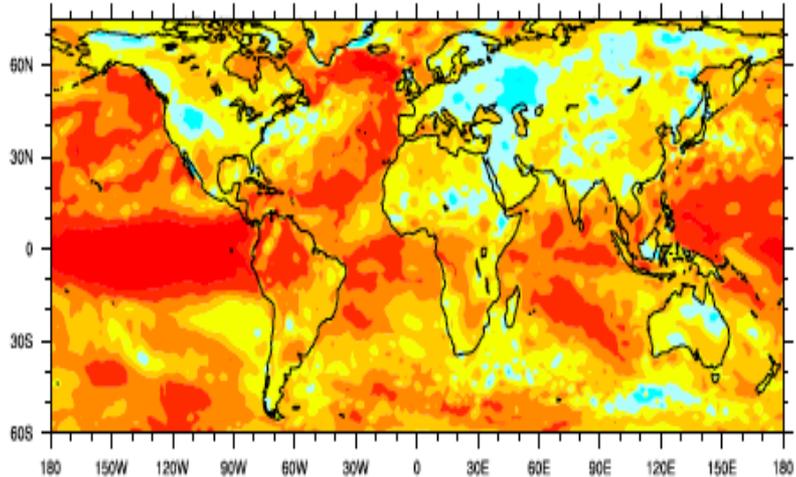


SPS.v3

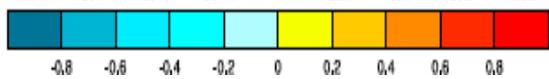
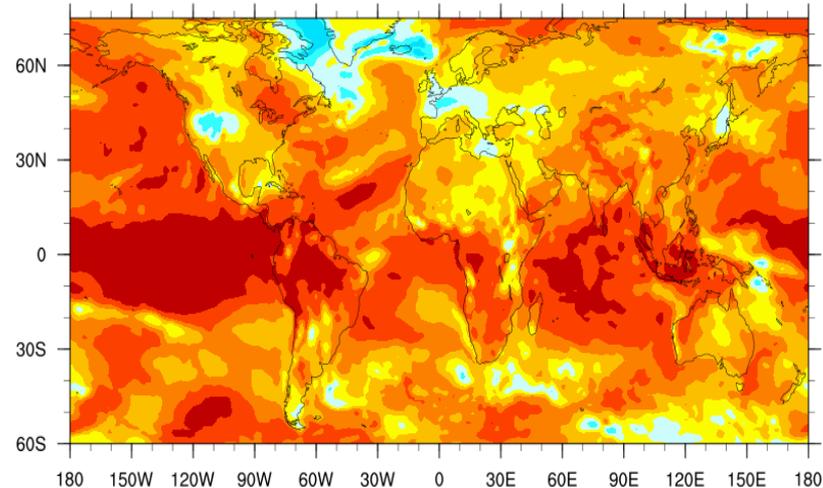
August start-date - lead seson 1



November start date – lead season 1



November start-date - lead seson 1



The new SPS.v3

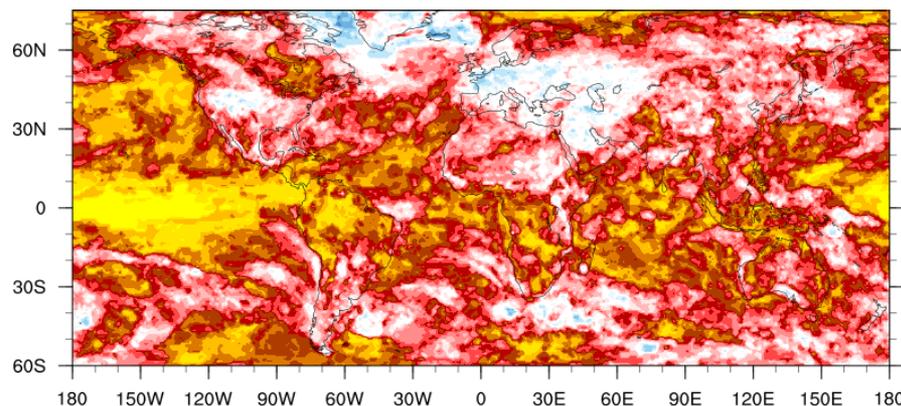
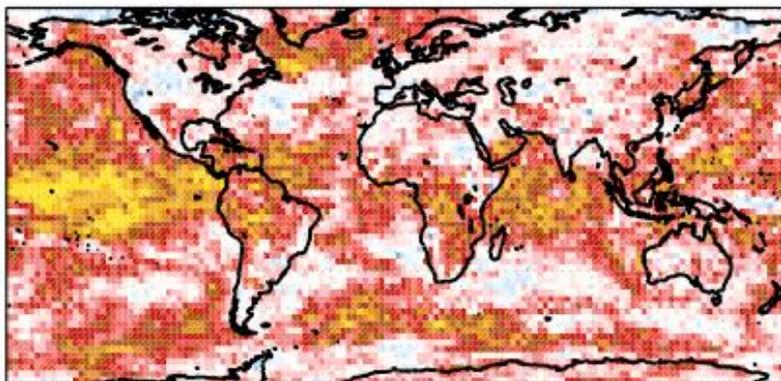
Tsurf ROC score - Nov start date, lead time 1

SPS.v2

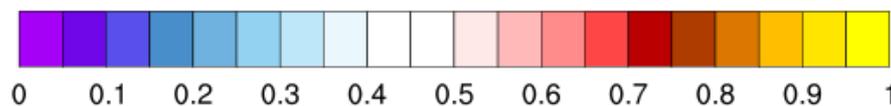
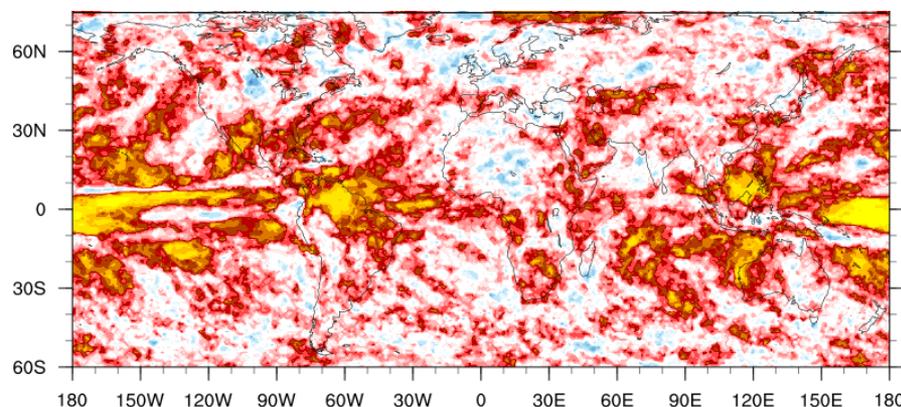
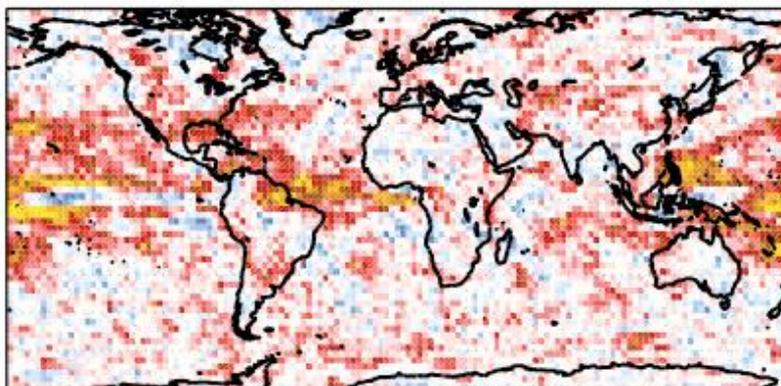
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SPS.v3

2m temperature



Precipitation



The new SPS.v3

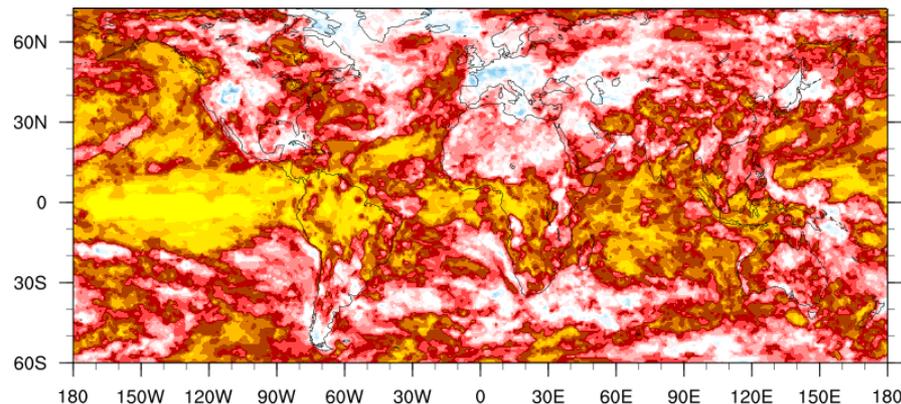
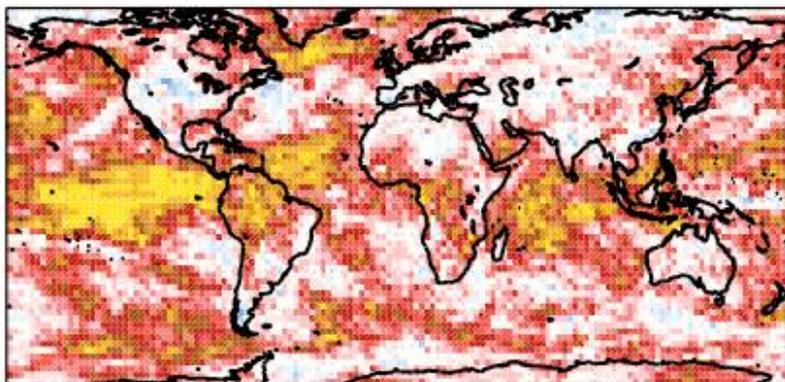
Tsurf ROC score - Nov start date, lead time 1

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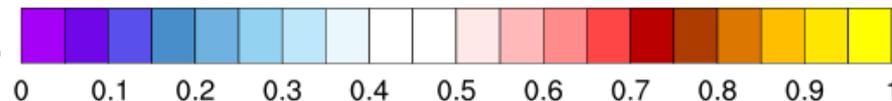
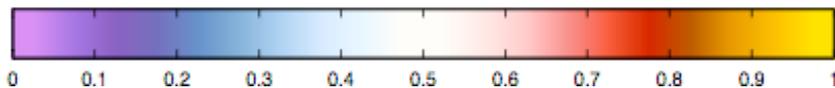
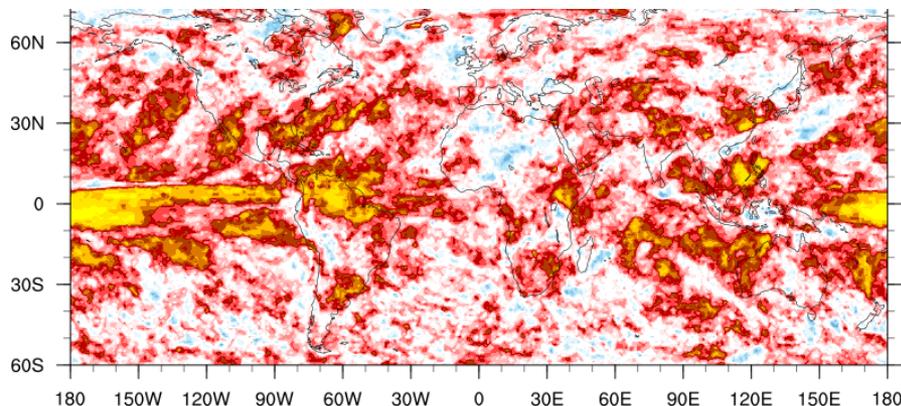
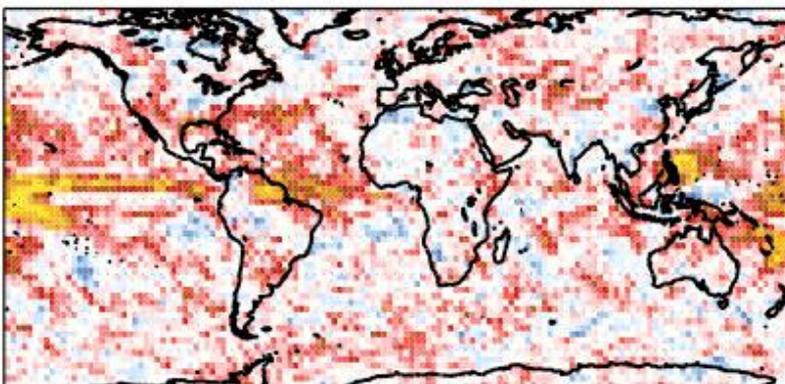
SPS.v2

SPS.v3

2m temperature



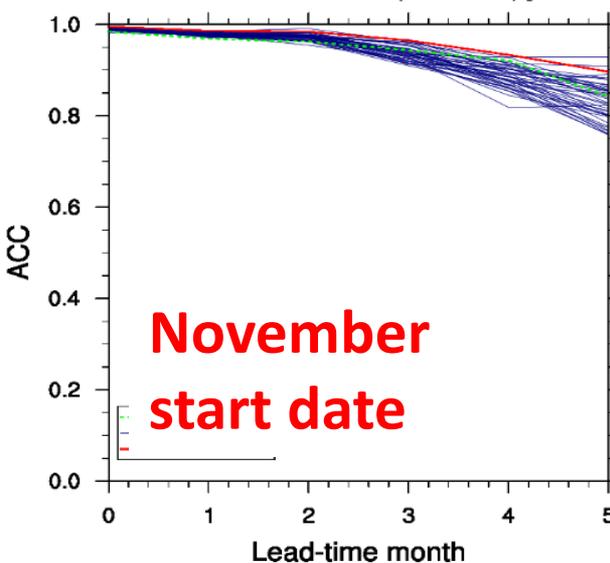
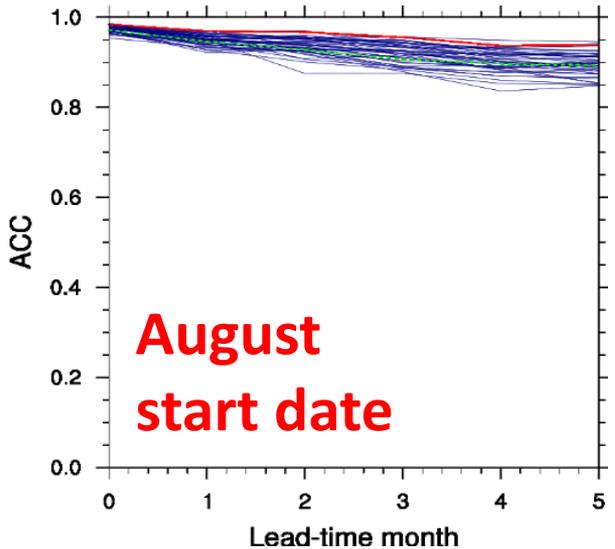
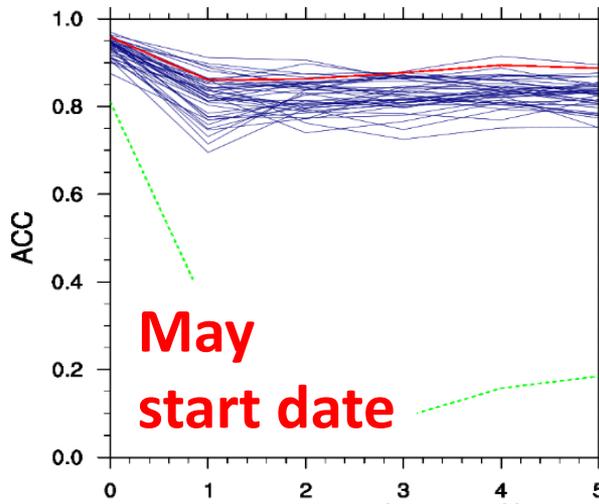
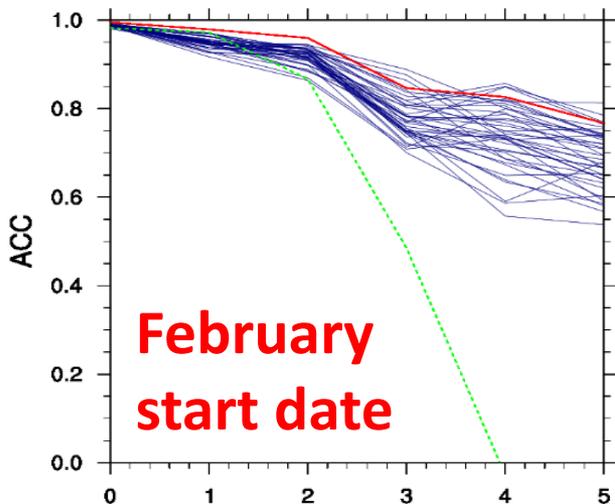
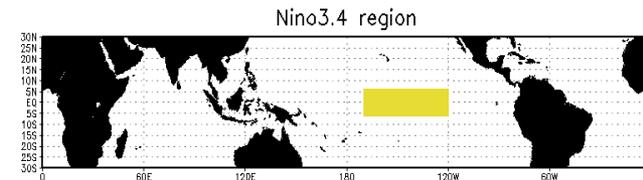
Precipitation



The new SPS.v3

Hindcasts (1993–2016) of the **SST – NINO3.4** index against the respective observed index (ERA-Interim).

SST anomalies in the NINO 3.4 region



Persistence

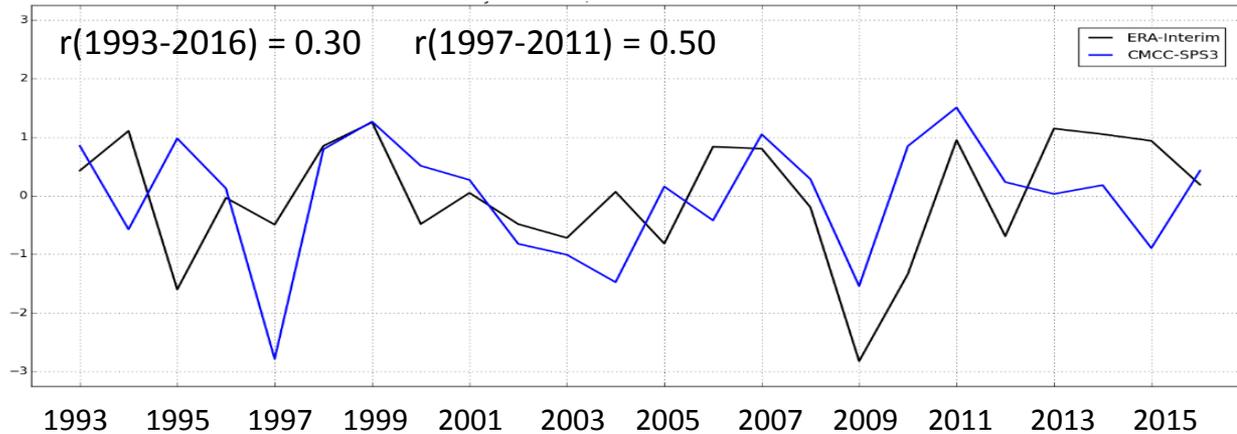
SPS3

SPS3 ens. mean



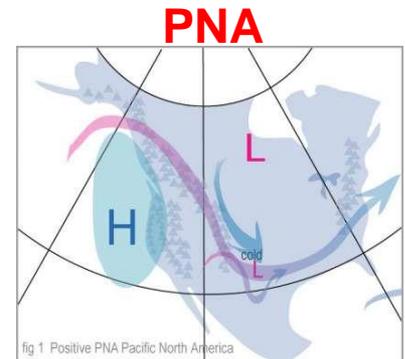
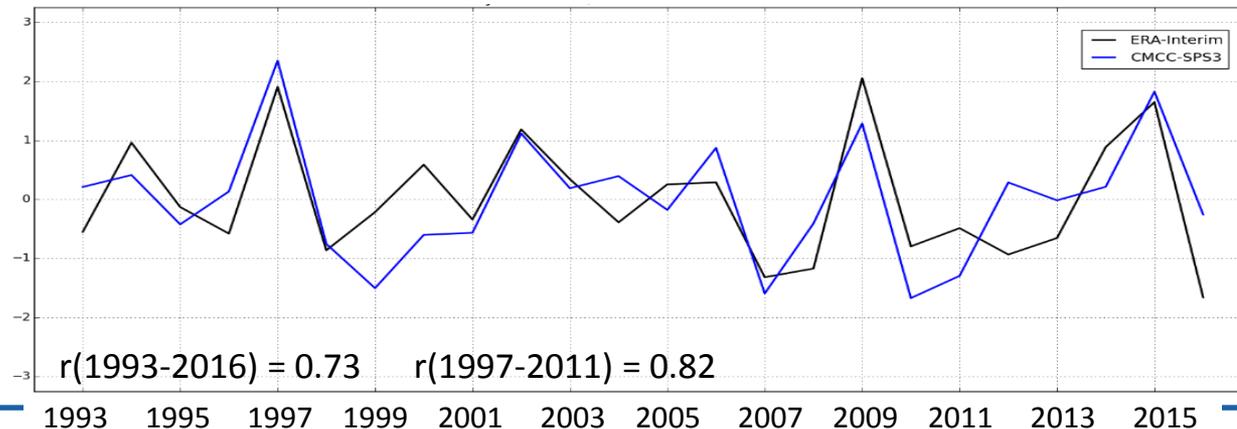
The new SPS.v3

Hindcasts (1993–2016) of the **DJF NAO** index (**Nov.** start date) against the respective observed index (ERA-Interim).



ERA – Interim
CMCC – SPS3

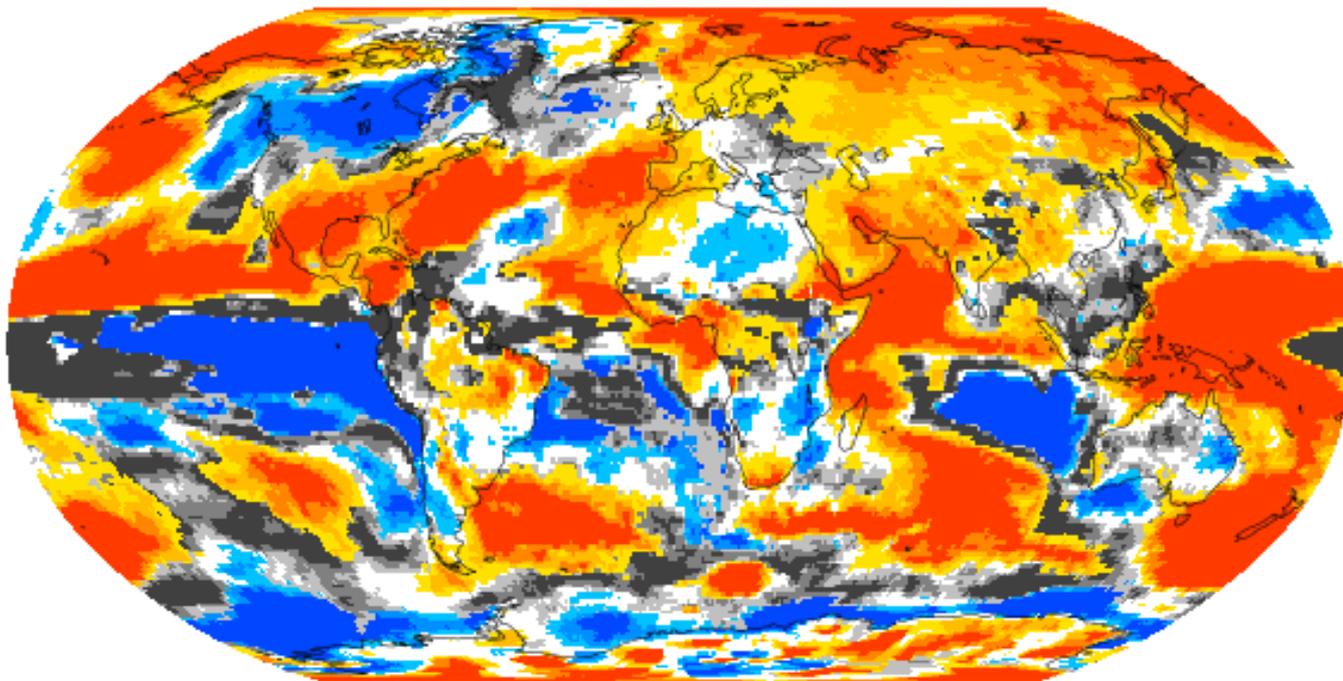
Hindcasts (1993–2016) of the **DJF PNA** index (**Nov.** start date) against the respective observed index (ERA-Interim).



DJF T2m

November – Lead 1

Probability Forecast



Below lower tercile



Normal range



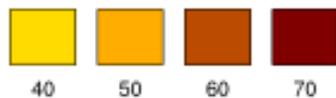
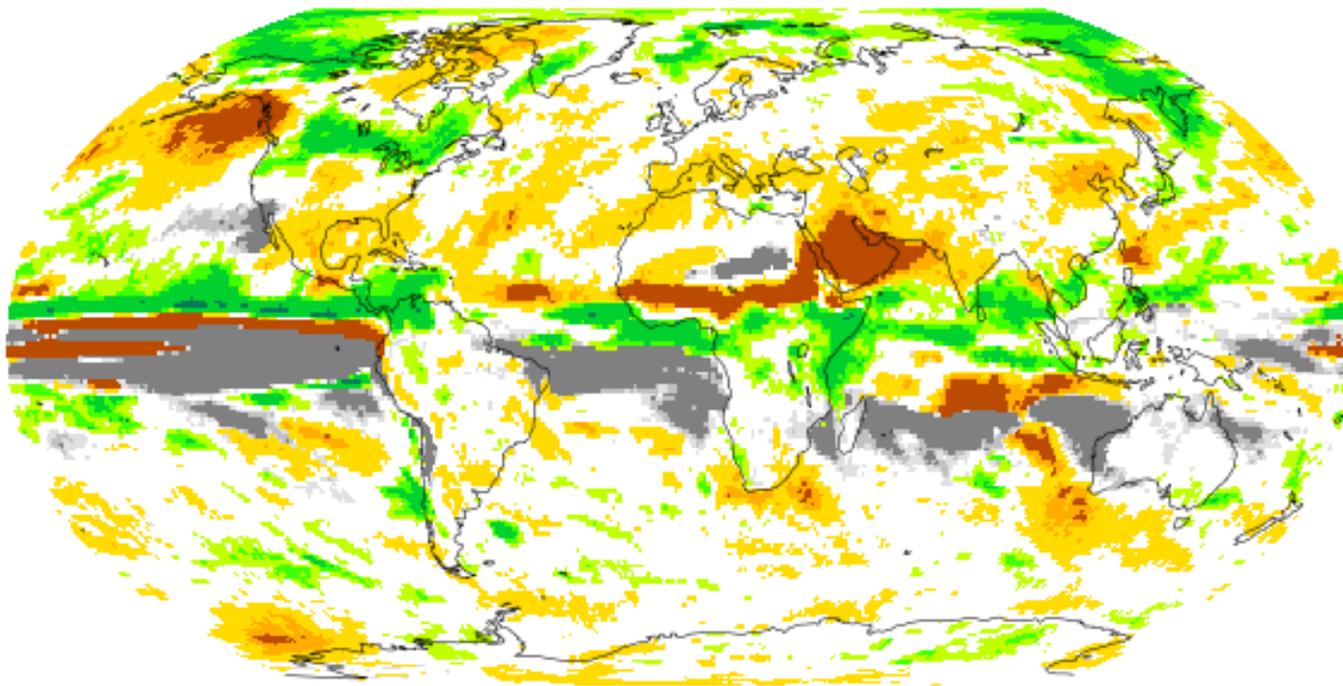
Above upper tercile



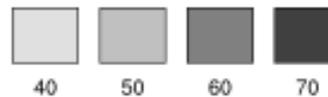
DJF Precip

November – Lead 1

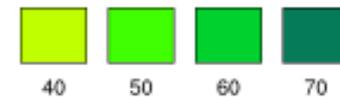
Probability Forecast



Below lower tercile



Normal range

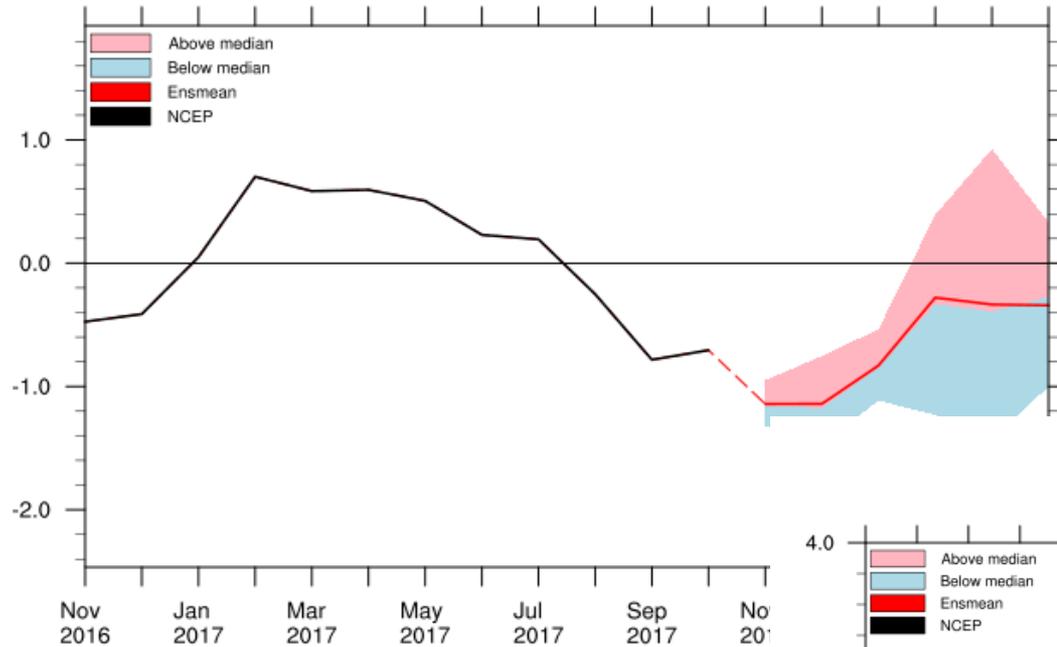


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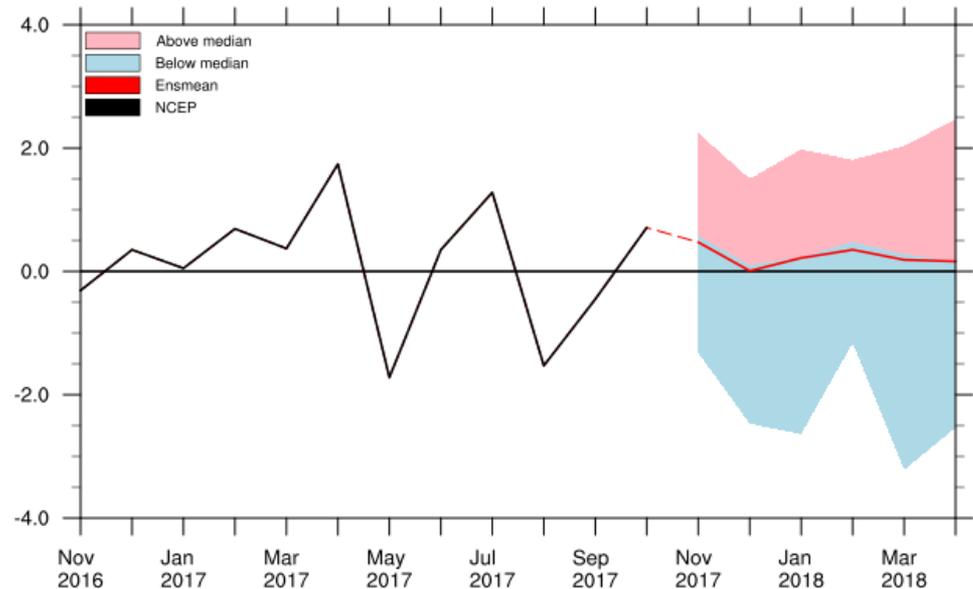


CMCC Seasonal Outlook – winter 2017-18

Nino3 Index



NAO Index



CMCC Seasonal Outlook – winter 2017-18

start date
November
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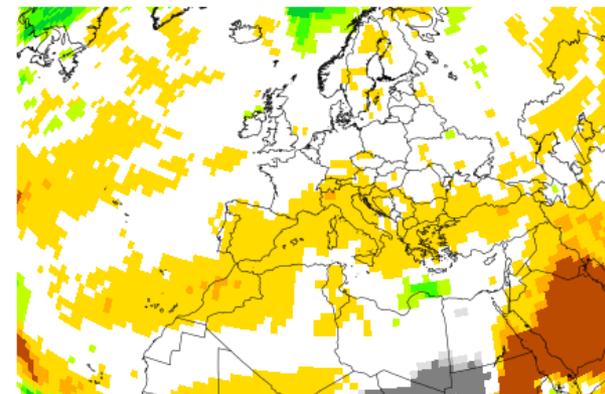
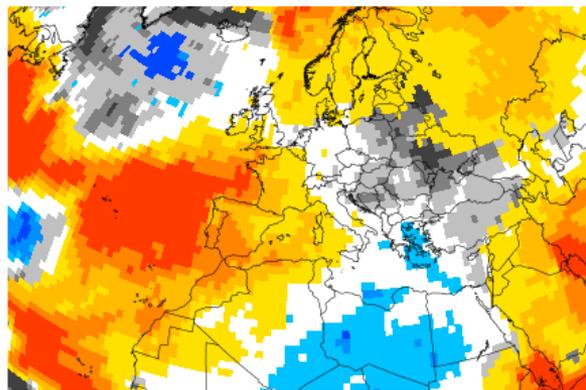
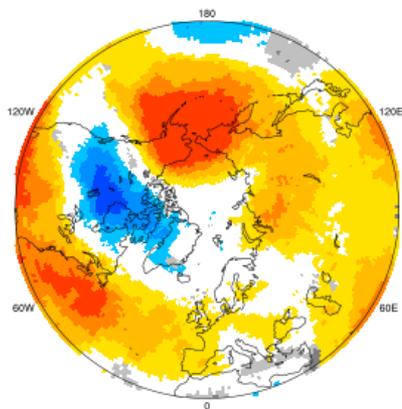
Z500

T2m

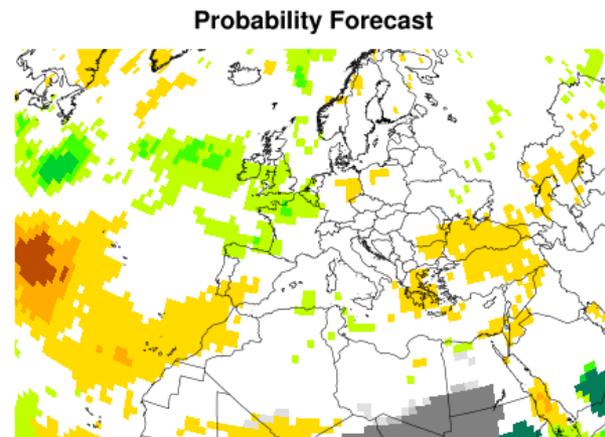
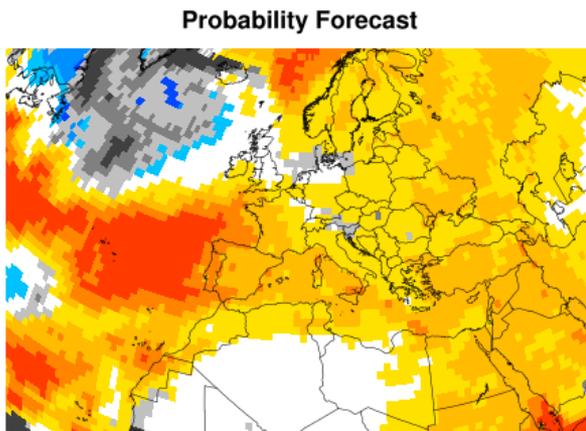
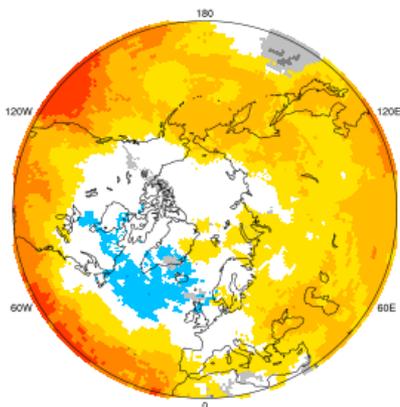
Precip

Probability Forecast

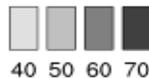
Probability Forecast



DJF
Lead 1



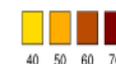
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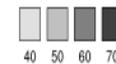
Normal range



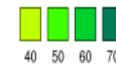
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Below lower tercile



Normal range



Above upper tercile

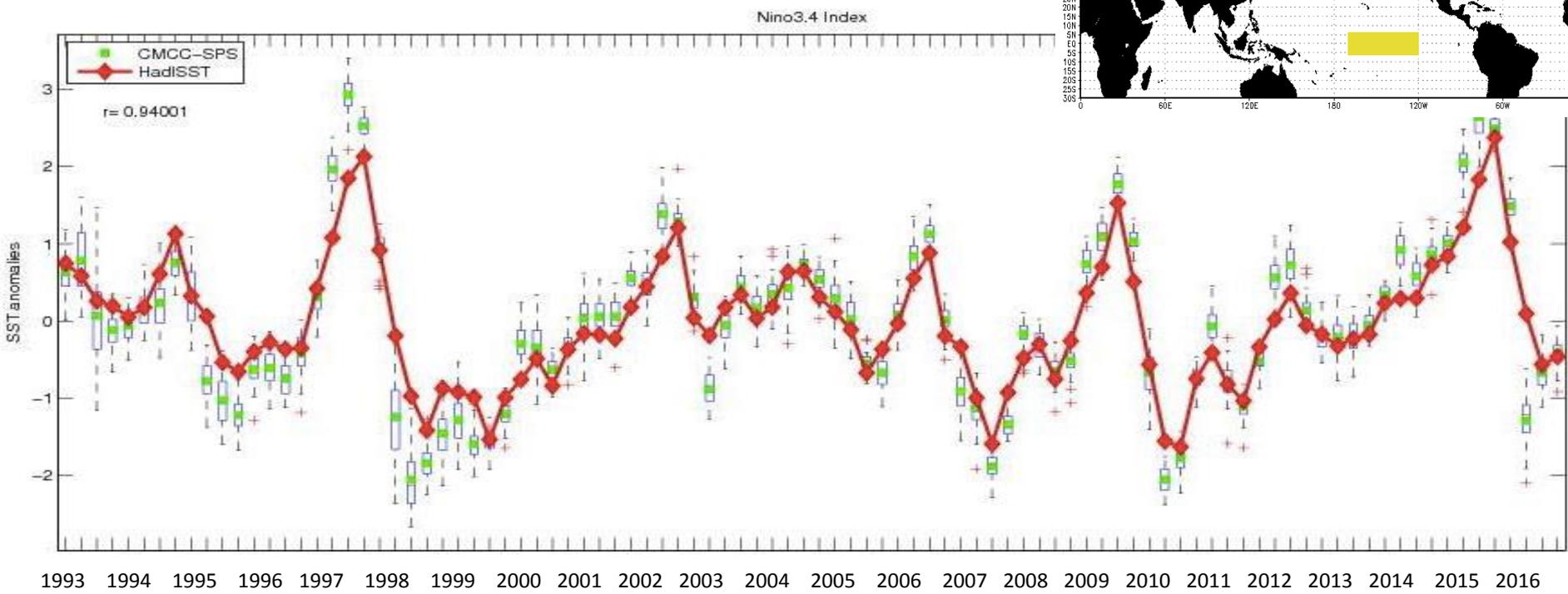
Thanks



The new SPS.v3

Hindcasts (1993–2016) of the **SST – NINO3.4** index against the respective observed index (ERA-Interim).

SST anomalies in the NINO 3.4 region



Summary 1

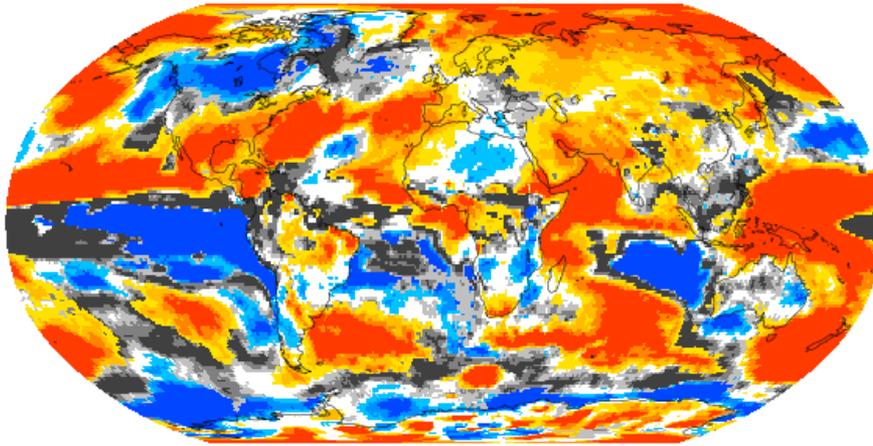
- The **new CMCC seasonal prediction system** (SPS) has been illustrated.
- The new CMCC seasonal prediction system is part of the **Copernicus C3S pre-operational multi – model system** and it will become **operational very soon** (next few weeks).
- An extensive **analysis of the performance of the new SPS is on going.**
- Very preliminary results indicate that **improving** the model components and their **resolution, the initialization and the ensemble size lead to better predictions.**
- There is **room for improvement, especially for the land–surface model and its initialization**
- We are designing sensitivity experiments and targeted analysis aimed at improving understanding of sources of predictability and how to provide better information and data on climate variability at seasonal to multiannual timescales.



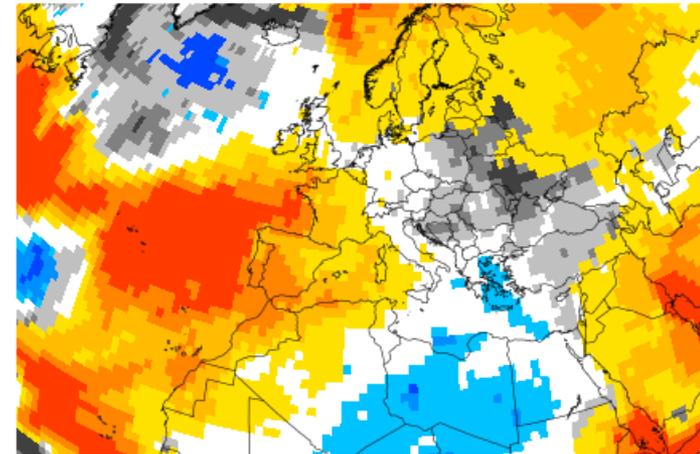
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T2m – start date November

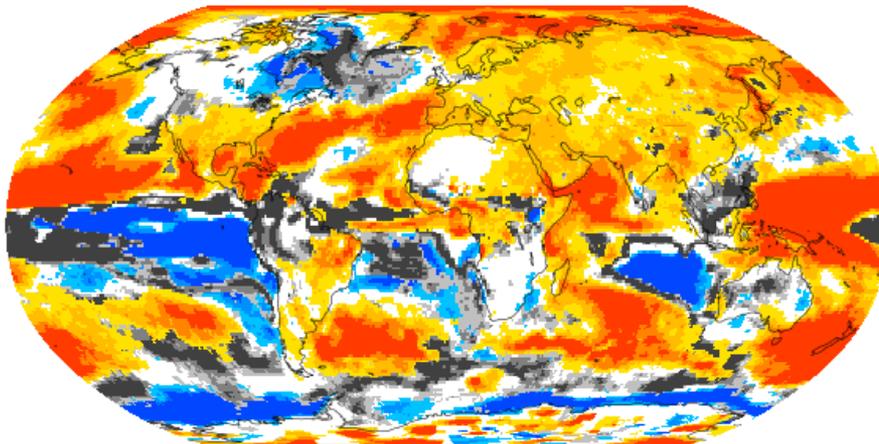
Probability Forecast



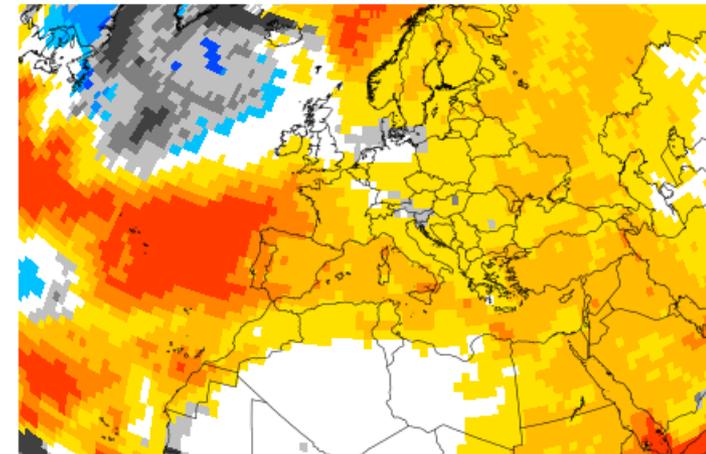
Probability Forecast



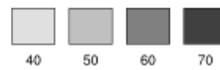
Probability Forecast



Probability Forecast



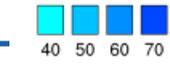
Below lower tercile



Normal range



Above upper terci



Below lower tercile



Normal range



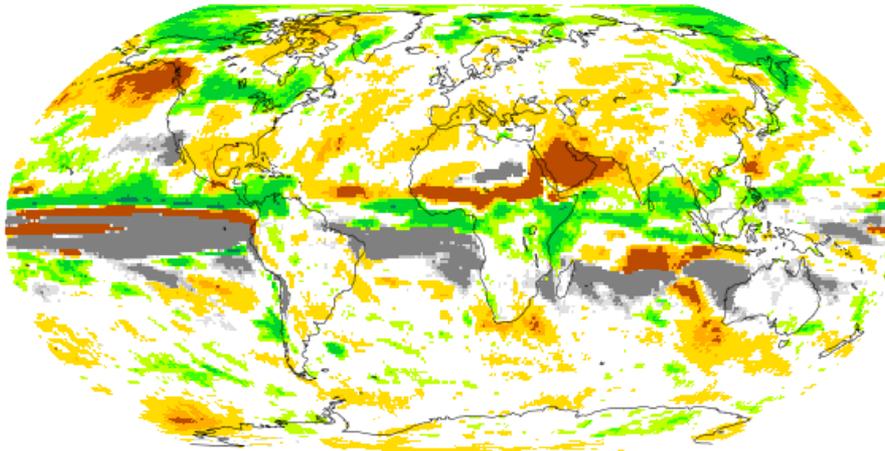
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CMCC Seasonal Outlook – winter 2017-18

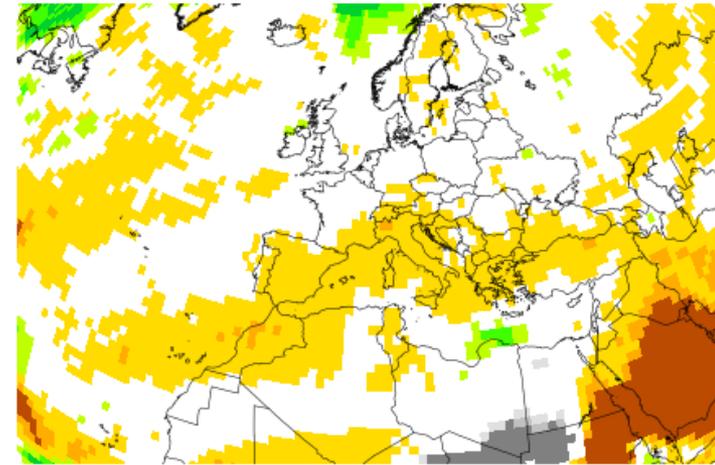
Precip – start date November

DJF
Lead 1

Probability Forecast

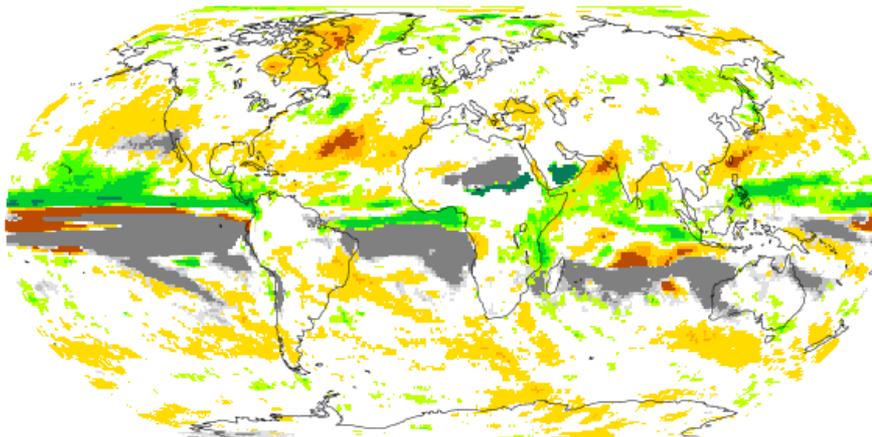


Probability Forecast

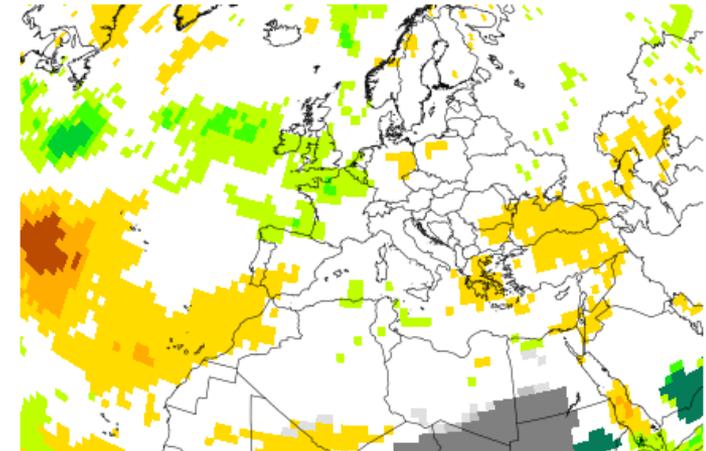


JFM
Lead 2

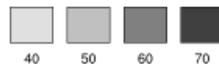
Probability Forecast



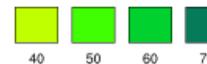
Probability Forecast



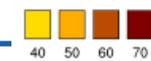
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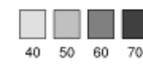
Normal range



Above upper terci



Below lower tercile



Normal range

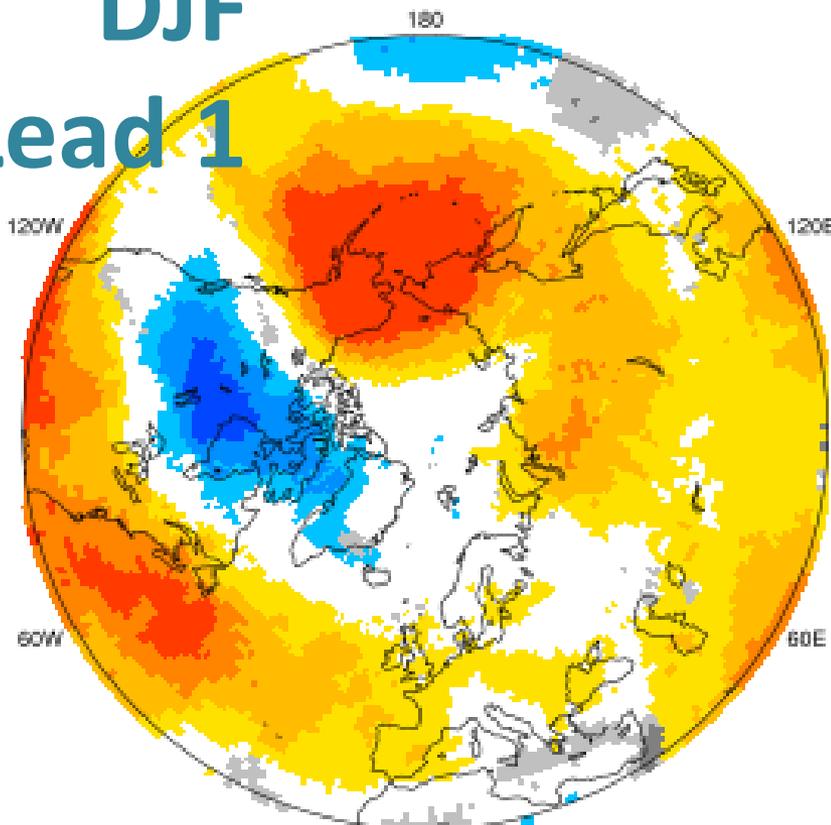


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CMCC Seasonal Outlook – winter 2017-18

Z500 (start date November)

DJF Lead 1



40 50 60 70

Below lower tercile



40 50 60 70

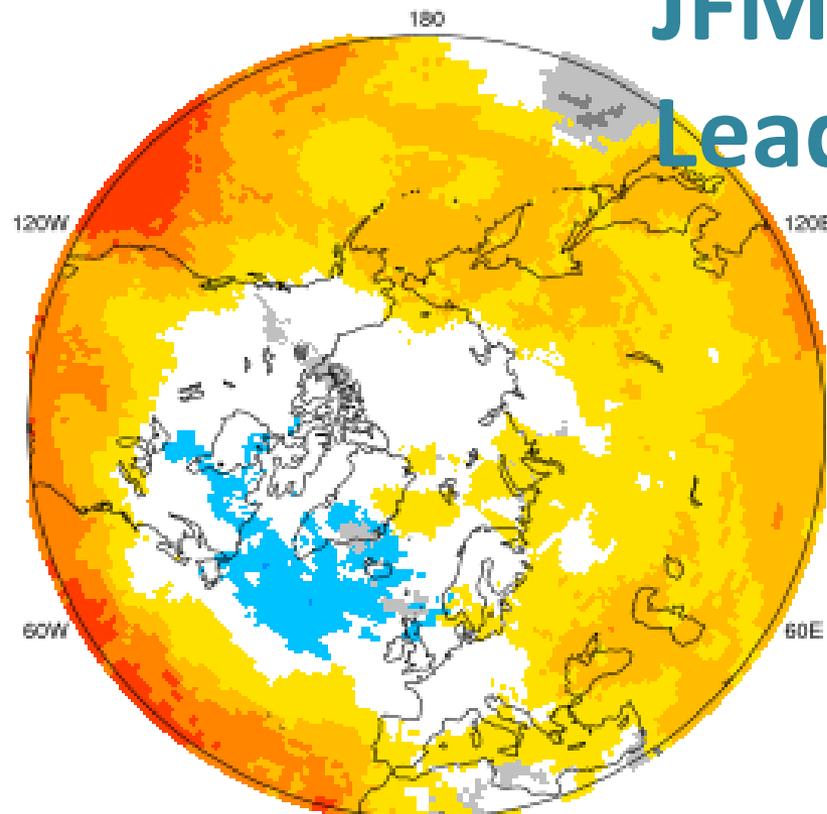
Normal range



40 50 60 70

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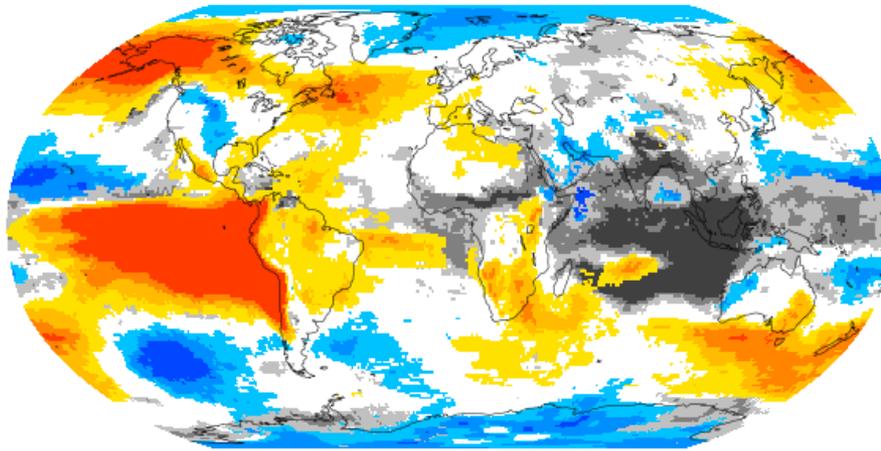
JFM Lead 2



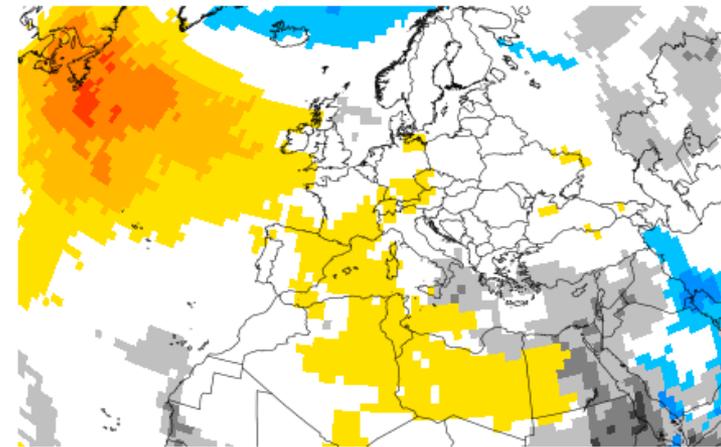
CMCC Seasonal Outlook – winter 2017-18

SLP – start date November

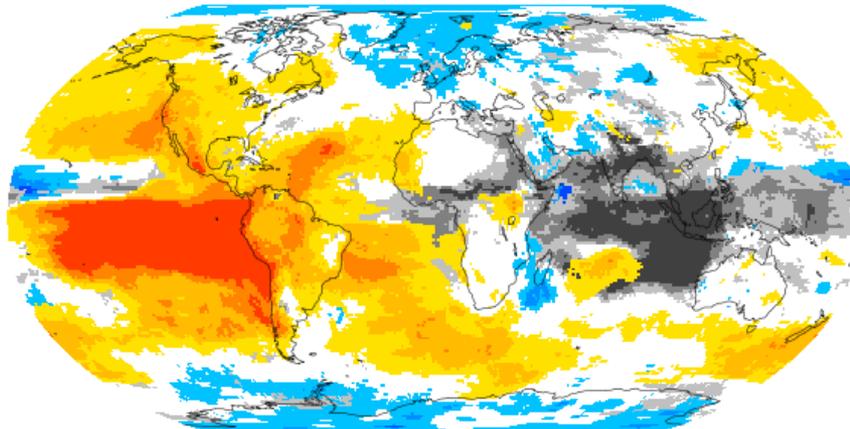
Probability Forecast



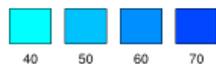
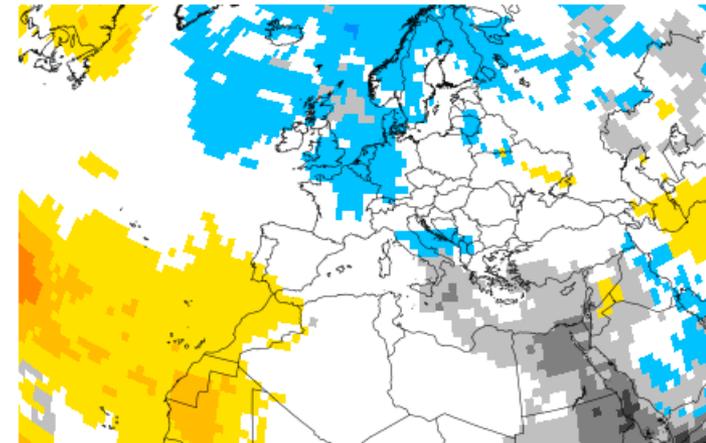
Probability Forecast



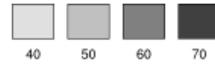
Probability Forecast



Probability Forecast



Below lower tercile



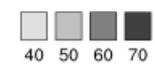
Normal range



Above upper tercile



Below lower tercile



Normal range



Above upper tercile

DJF
Lead 1

JFM
Lead 2

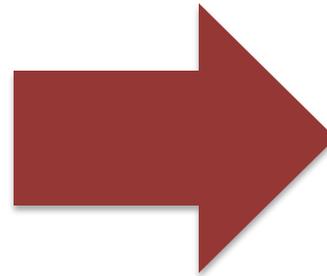
1. Introduction

Evolution of the CMCC-SPS

Currently
operational system

New operational system
(next few weeks)

	SPS.v2 2012 (CLIMAFIRCA)
Ocean	OPA-ORCA2 2°x2° – 30 levs
Atmosph.	ECHAM-5 2°x2° – 19 levs no stratosph.
Land	SILVA model
Ensemble size	9
Initial Conditions	Ocean Analyses Atmosphere Analyses



SPS.v3 2016 (Copernicus)
NEMO 1/4° x 1/4° – 50 levs
CAM5 1°x1° – 46 levs with stratosph.
CLM + River routing scheme
50
Ocean Analyses Atmosphere Analyses



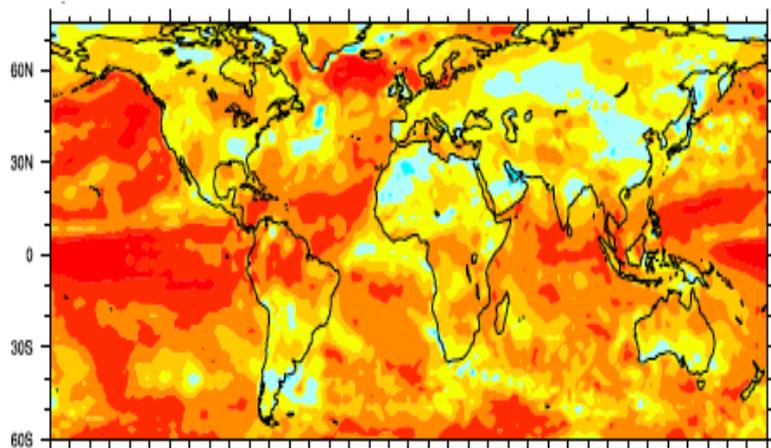
The new SPS.v3

Tsurf (ACC) - lead time 1

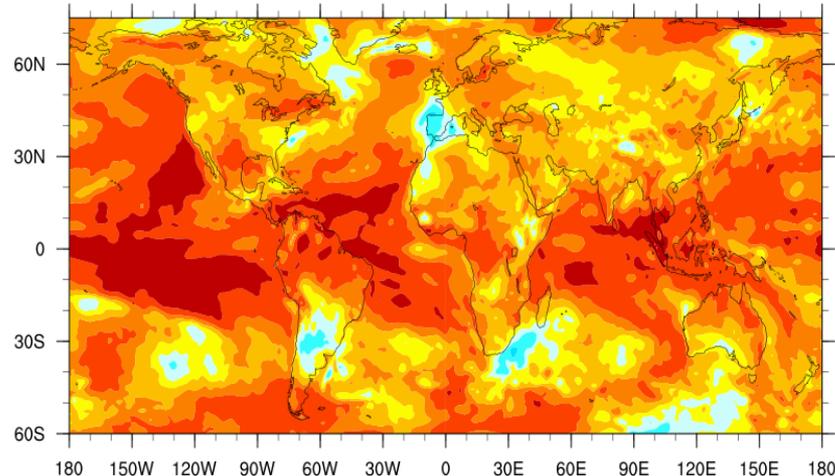
SPS.v2

SPS.v3

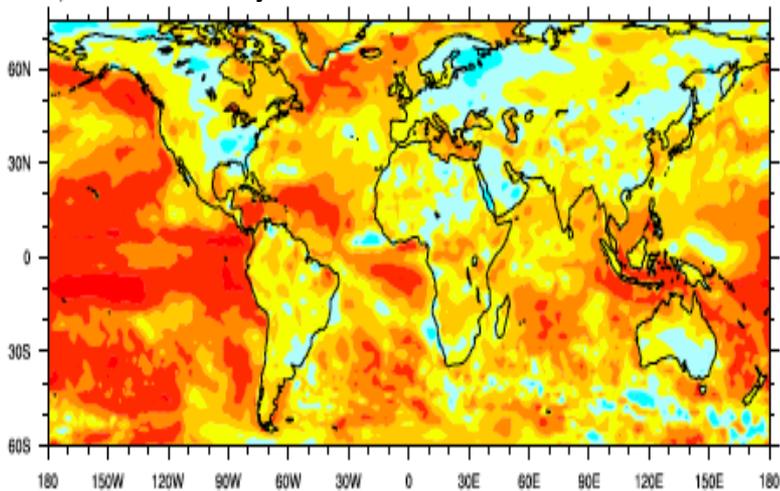
February start date – lead season 1



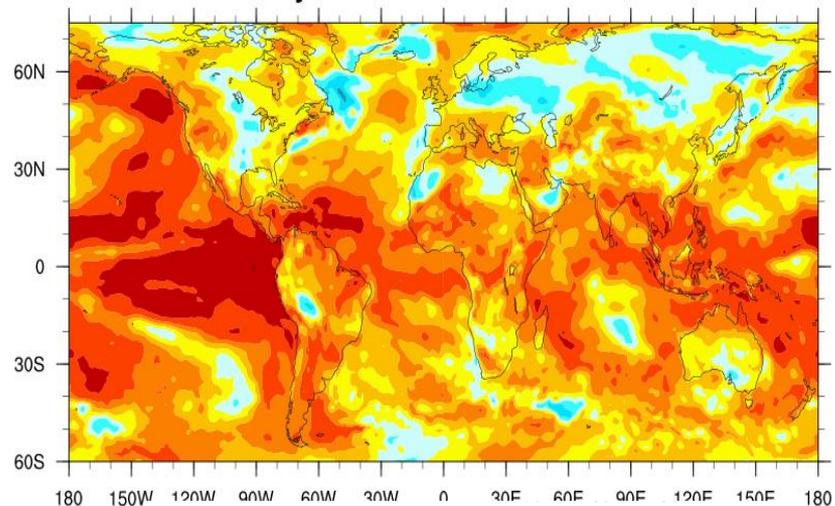
February start-date - lead seson 1



May start date – lead season 1



May start-date - lead seson 1



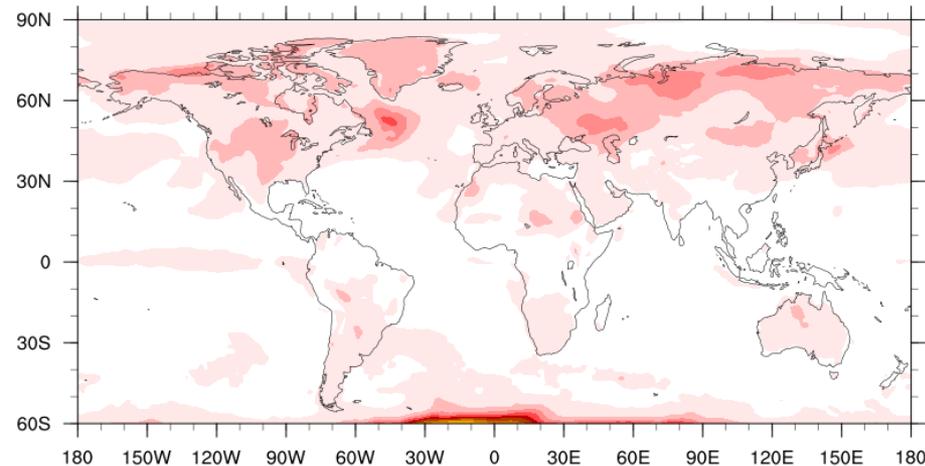
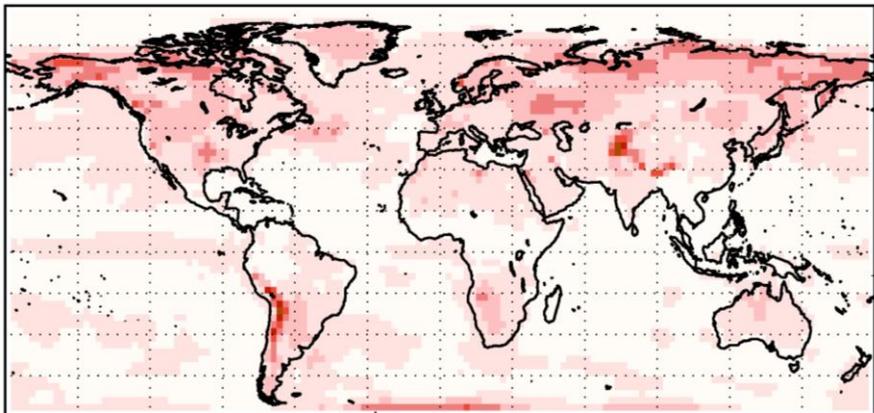
The new SPS.v3

RMSE T2m [K] (1993-2016) Forecasts vs ERA-Interim

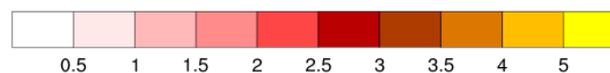
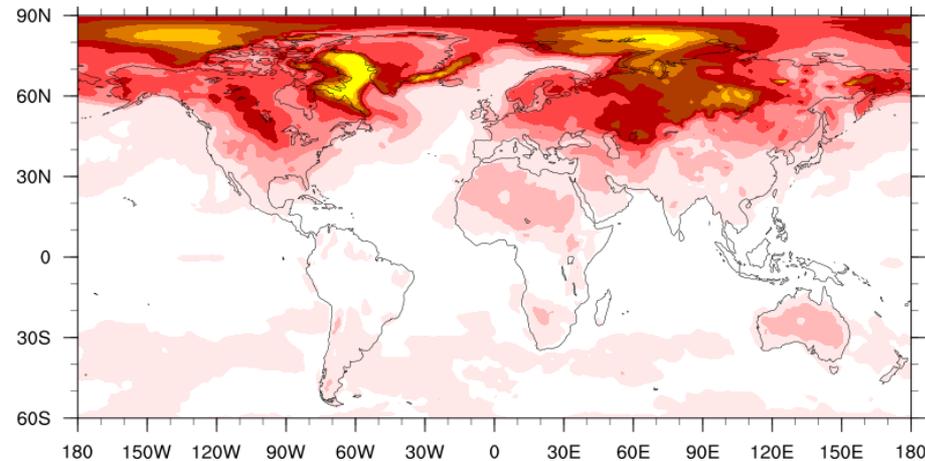
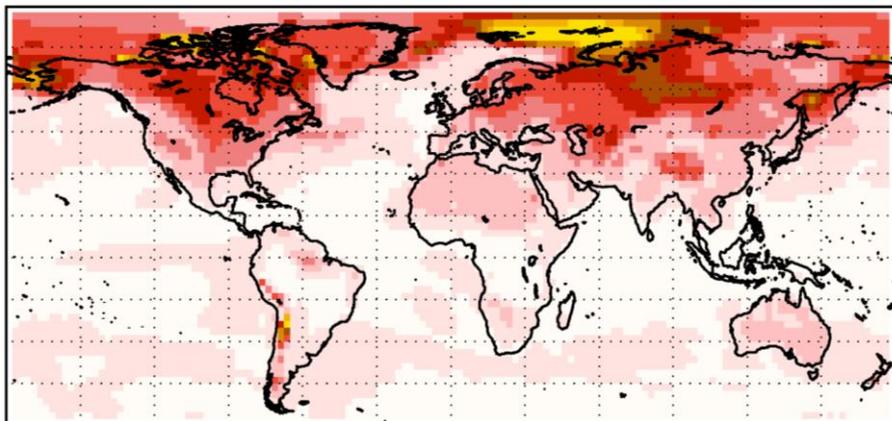
SPS.v2

May start date – lead season 1

SPS.v3



November start date – lead season 1



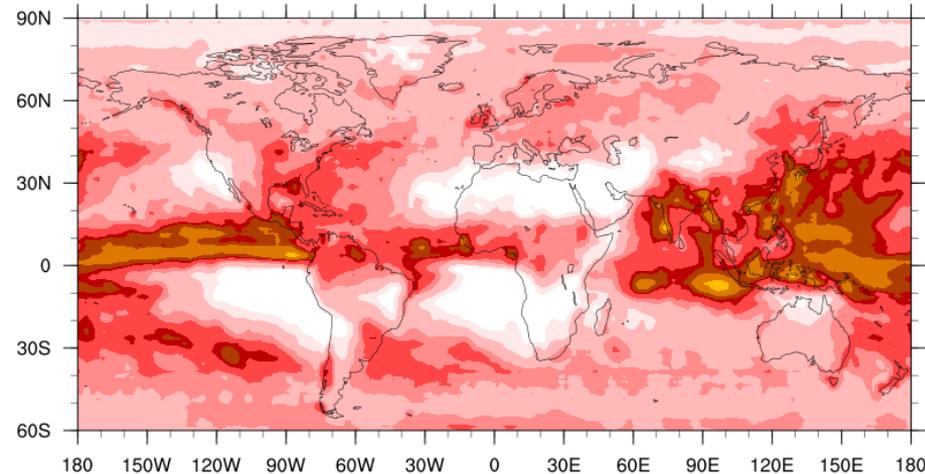
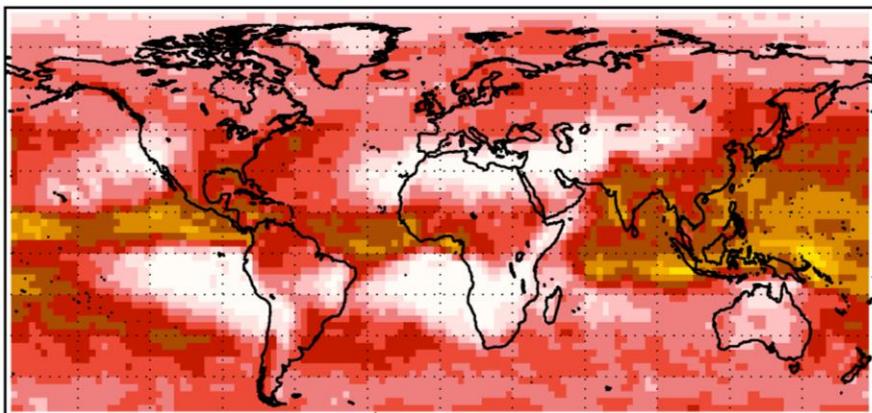
The new SPS.v3

RMSE Precip. (mm/day) (1993-2016) Forecasts vs GPCP

SPS.v2

May start date – lead season 1

SPS.v3



November start date – lead season 1

