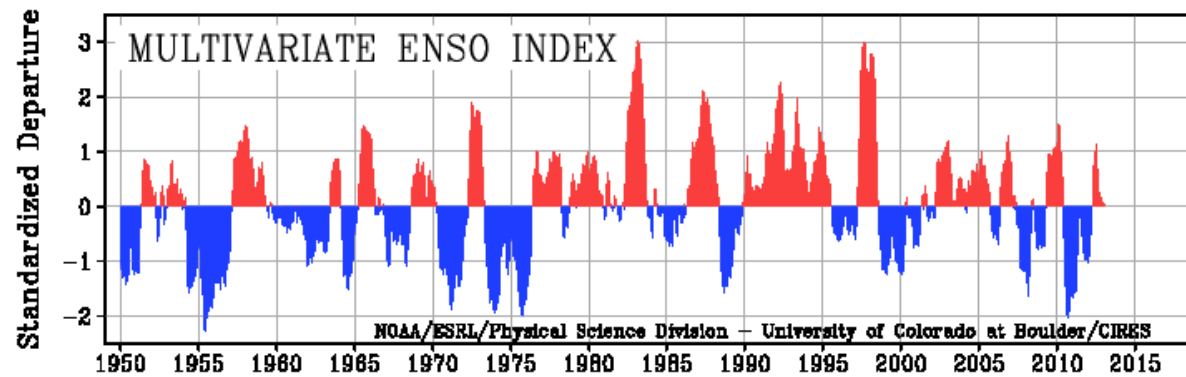
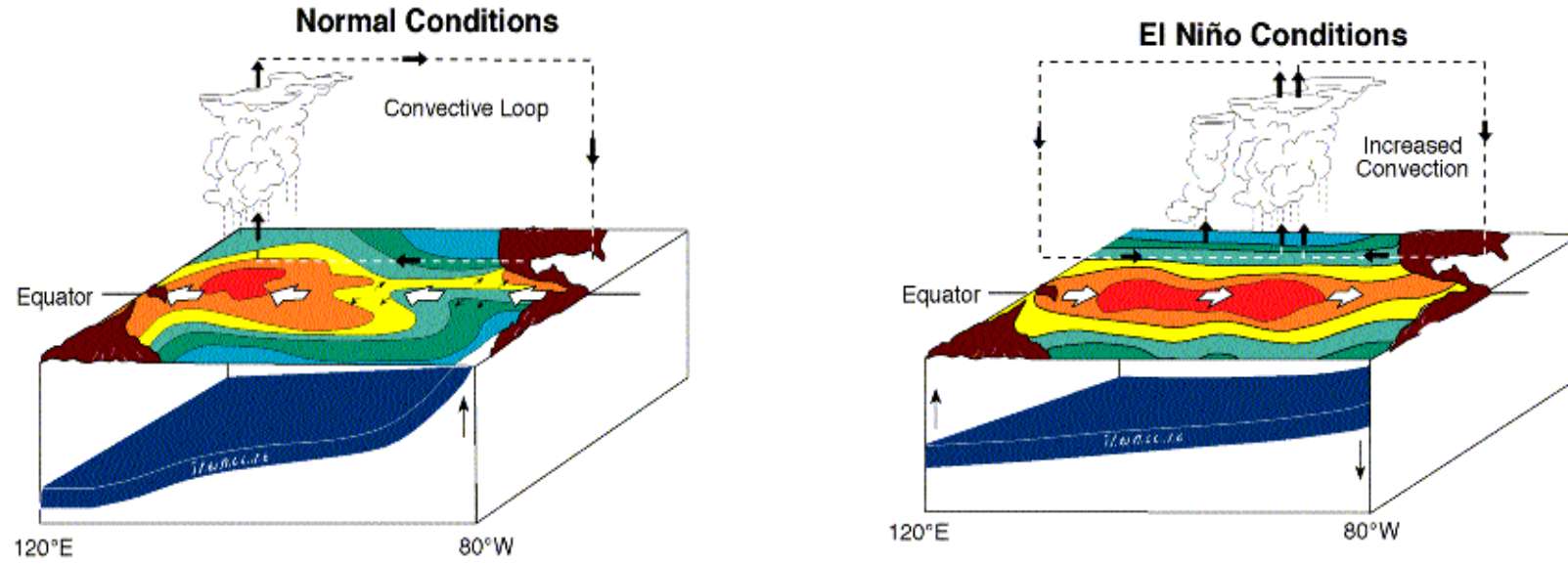


Previsioni a scala stagionale e annuale: progressi e aree di sviluppo

Franco Molteni

ECMWF, Reading, U.K.

ENSO: the main source of seasonal predictability



Prediction of the 1997 El Niño at ECMWF (Newsletter Autumn 1997)

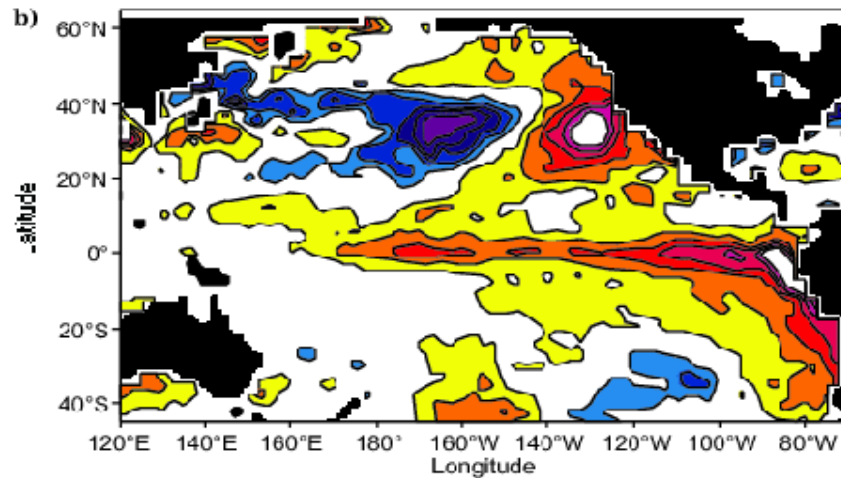
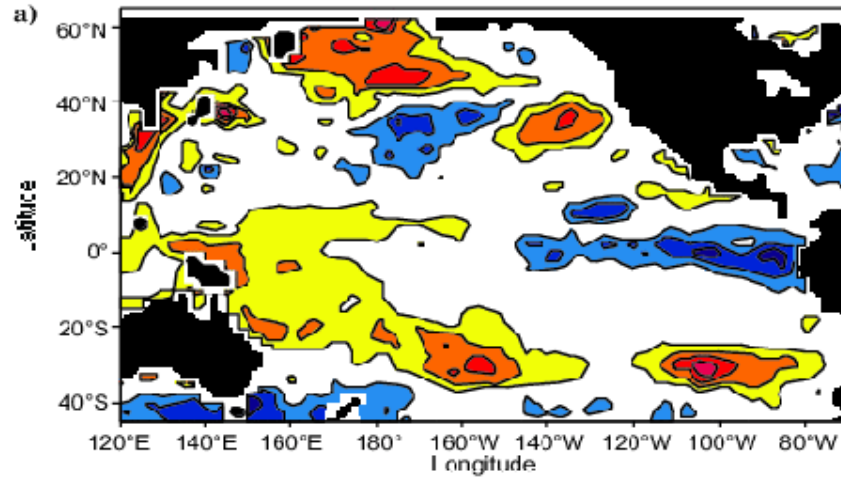
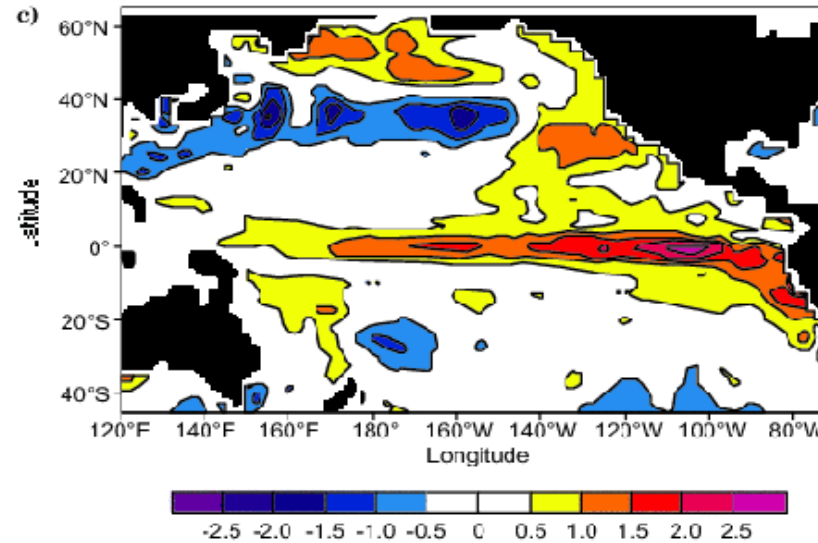


Fig 2: Plot of SST anomalies in the Pacific sector.
 a) Observed anomaly in December 1996;
 b) Observed anomaly in May 1997;
 c) Predicted SST anomaly for May 1997 from forecasts initiated during December 1996.
 Contour interval is 0.5°C. The change in equatorial SST was predicted quite well.

- a) Obs. SST anomaly, December 1996
- b) Obs. SST anomaly, May 1997
- c) Predicted SST anomaly in May 1997 with i.c. in Dec. 1996



Seasonal forecasts in the Copernicus Climate Change Service (C3S)

Implemented by ECMWF as part of The Copernicus Programme

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ABOUT US WHAT WE DO DATA SEARCH

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2001-2010

1951-1960

WHAT WE DO CLIMATE DATASETS

Climate datasets

C3S ensures that users can access the best available climate data free of charge and without restrictions.

Observations

Observations are key to understanding the climate system. C3S users can access a vast variety of instrumental data records, ranging from historic weather observations to the latest measurements from space.

[Read more](#)

Climate reanalyses

Climate reanalyses combine past observations with models to generate consistent time series for a large set of climate variables. Reanalyses are among the most-used datasets in the geophysical sciences.

[Read more](#)

[Reanalysis data on the CDS](#)

Seasonal forecasts

C3S seasonal forecasts combine outputs from several state-of-the-art seasonal prediction systems from providers in Europe and elsewhere. The latest data and products are published monthly on the Climate Data Store.

[Read more](#)

[Seasonal forecast data on the CDS](#)

Climate projections

Projections of future climate change are available for different scenarios for concentrations of greenhouse gases and aerosols, based on outputs from multiple global and regional climate models.

[Read more](#)

[Climate projection data on the CDS](#)

19

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C3S seasonal charts

42 matching items

No filters applied

Filters

Parameters

- MSLP (6)
- SST (12)
- T2m (6)
- T850 (6)
- geopotential height 500hPa (6)
- precipitation (6)

Plot type

- Maps (36)
- Time series (6)

Centres

- C3S multi-system (7)
- CMCC (7)
- DWD (7)
- ECMWF (7)
- Met Office (7)
- Meteo-France (7)

C3S multi-system MSLP	C3S multi-system NINO plumes	C3S multi-system SST	C3S multi-system T2m	C3S multi-system T850	C3S multi-system geopotential height	C3S multi-system precipitation
CMCC MSLP	CMCC NINO plumes	CMCC SST	CMCC T2m	CMCC T850	CMCC geopotential height 500hPa	CMCC precipitation
DWD MSLP	DWD NINO plumes	DWD SST	DWD T2m	DWD T850	DWD geopotential height 500hPa	DWD precipitation
ECMWF MSLP	ECMWF NINO plumes	ECMWF SST	ECMWF T2m	ECMWF T850	ECMWF geopotential height 500hPa	ECMWF precipitation
Met Office MSLP	Met Office NINO plumes	Met Office SST	Met Office T2m	Met Office T850	Met Office geopotential height	Met Office precipitation
Meteo-France MSLP	Meteo-France NINO plumes	Meteo-France SST	Meteo-France T2m	Meteo-France T850	Meteo-France geopotential height	Meteo-France precipitation

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Multi-model seasonal forecasts in C3S: graphical products

Implemented by ECDFP as part of the Copernicus Programme
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C3S multi-system seasonal forecast
 Prob.(most likely category of 2m temperature)
 Nominal forecast start: 01/05/19
 Unweighted mean

ECMWF/Met Office/Météo-France/CMCC/DWD
 JJA 2019

C3S multi-system T2m

C3S seasonal charts
 From time: May 2019 | Map type: forecast | Area: Global

Results
 42 matching items
 No items applied

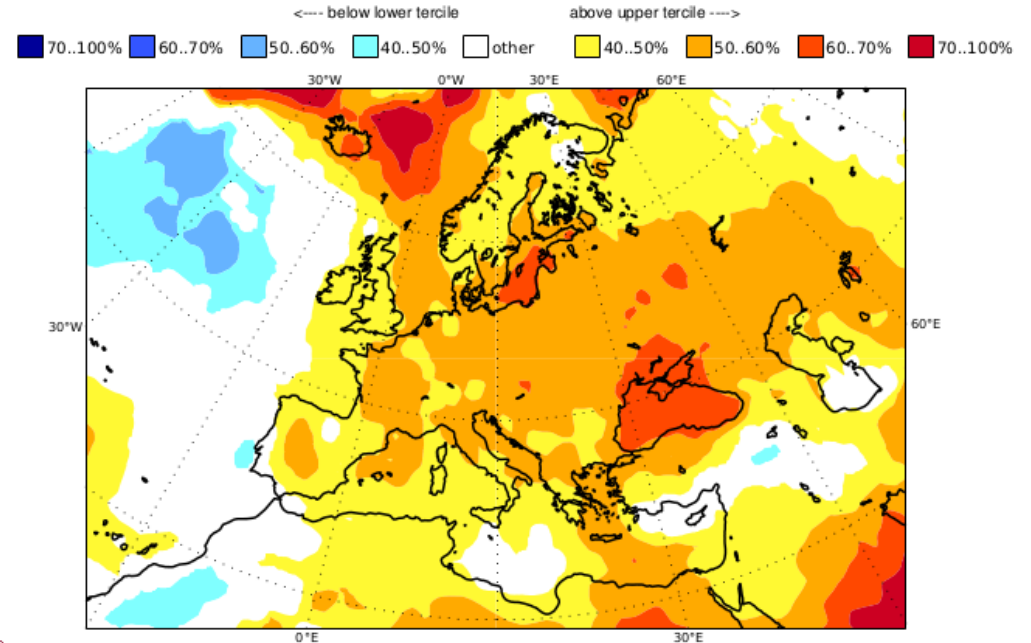
- C3S multi-system MSLP
- C3S multi-system NINO plu...
- C3S multi-system SST
- C3S multi-system T2m
- C3S multi-system TESS
- C3S multi-system geopotent...
- C3S multi-system precipitat...
- CMCC MSLP
- CMCC NINO plumes
- CMCC SST
- CMCC T2m
- CMCC TSS
- CMCC geopotential height S...
- CMCC precipitation
- DWD MSLP
- DWD NINO plumes
- DWD SST

Ensemble mean anomalies
 The charts display the averages of the standardized ensemble mean anomalies. For each component model, ensemble mean anomalies are computed with respect to the corresponding model climate. These are then re-scaled so that the total variance on the monthly time scale of each model is equal to the mean of the variance of all the models contributing to the combination. The variance standardization is based on the hindcast period common to those models.

Probabilities
 Probabilities are defined as the mean of the probabilities from the individual models. Individual model probabilities are estimated by comparing the forecast probability density function (PDF) with the corresponding model climate FDE estimated from the hindcast set. Significance testing is not applied. The probabilities are stratified according to the median, the lower/upper/middle third, and lowest/highest 20% of the model climate distribution. As an overview to the seasonal forecast, a summary plot is presented for tercile categories, which shows in a single figure the areas which have an increased probability (exceeding 40%) of being either below the lower tercile or above the upper tercile.

For products issued from November 2018, the hindcast period for all providers is 1999-2016. (For products issued up to October 2018, the hindcast period is 1993-2016 for ECMWF and Met Office and 1993-2014 for Météo-France) In the case of each provider, data is from the current version of the operational seasonal forecast system.

(Produced by the Copernicus Climate Change Service, using Copernicus data.)



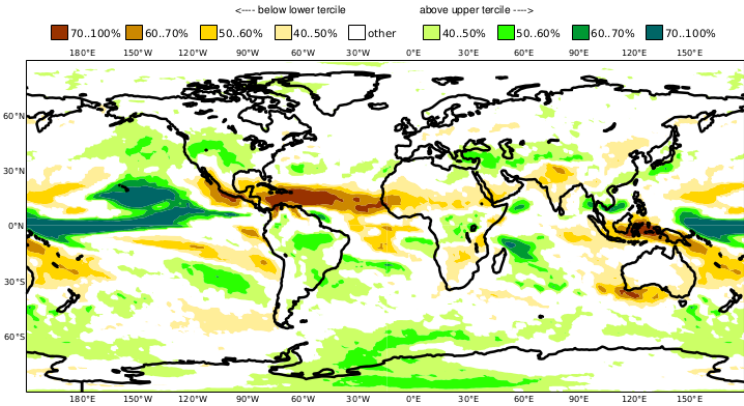
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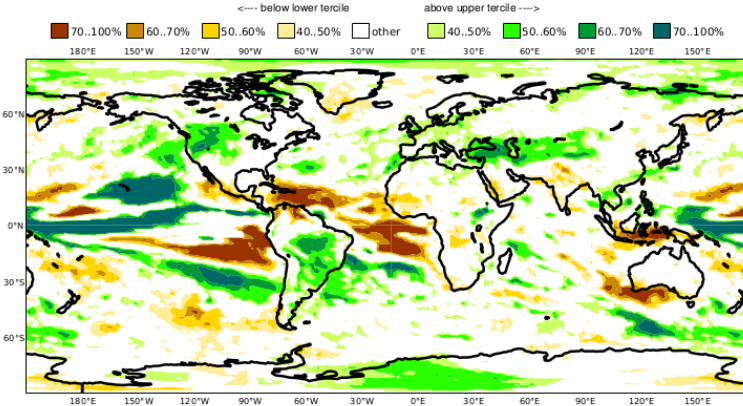
C3S predictions for JJA 2019 from 1 May: multi- and single-model forecasts

C3S multi-system seasonal forecast
 Prob(most likely category of precipitation)
 Nominal forecast start: 01/05/19
 Unweighted mean



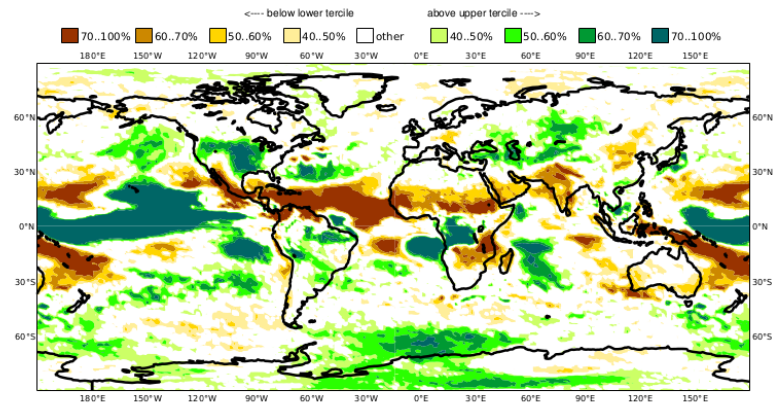
ECMWF/Met Office/Météo-France/CMCC/DWD
 JJA 2019

C3S: CMCC contribution
 Prob(most likely category of precipitation)
 Nominal forecast start: 01/05/19
 Ensemble size = 50, climate size = 960



JJA 2019

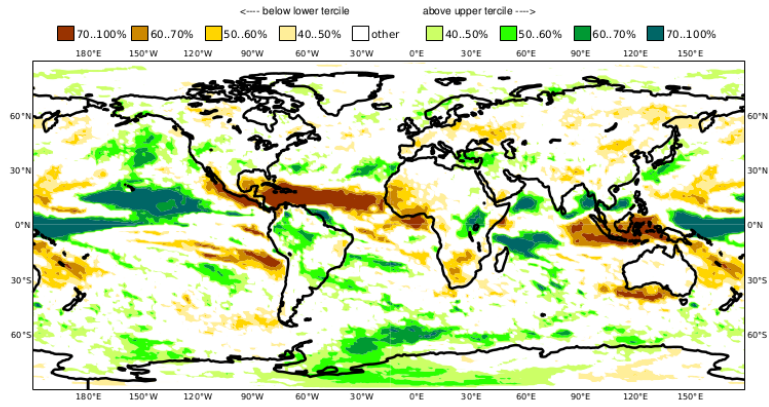
C3S: DWD contribution
 Prob(most likely category of precipitation)
 Nominal forecast start: 01/05/19
 Ensemble size = 50, climate size = 720



JJA 2019



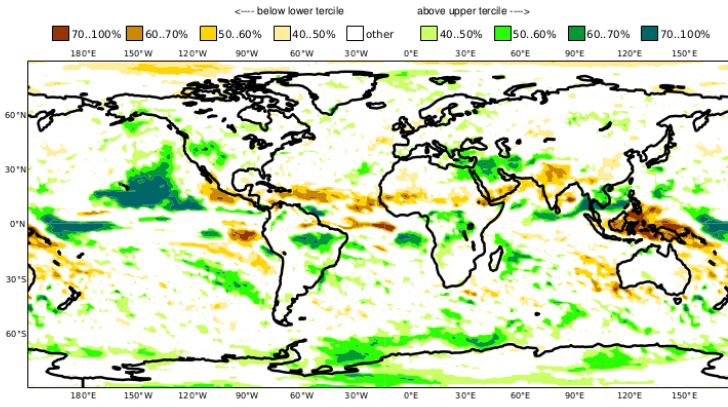
C3S: ECMWF contribution
 Prob(most likely category of precipitation)
 Nominal forecast start: 01/05/19
 Ensemble size = 51, climate size = 600



JJA 2019



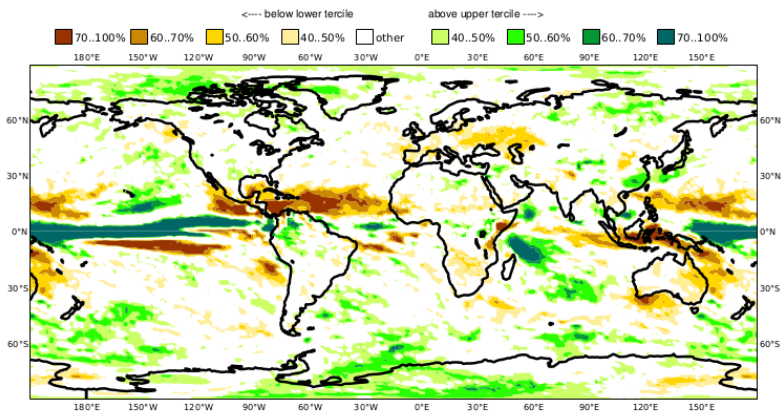
C3S: Met Office contribution
 Prob(most likely category of precipitation)
 Nominal forecast start: 01/05/19
 Ensemble size = 50, climate size = 672



JJA 2019



C3S: Météo-France contribution
 Prob(most likely category of precipitation)
 Nominal forecast start: 01/05/19
 Ensemble size = 51, climate size = 600



JJA 2019



Seasonal forecast data on the C3S Climate Data Store

The screenshot shows the C3S Climate Data Store search results page. At the top, there are logos for the European Union, Copernicus, ECMWF, and Climate Change Service. A navigation bar includes links for Home, Search, Datasets, Applications, Toolbox, and FAQ. A search bar contains the text 'Search dataset' and a magnifying glass icon. Below the search bar, there are tabs for 'All' and 'Datasets'. The search results are sorted by 'Relevancy' and show 1-6 of 6 results for 'Seasonal forecasts'. The results list includes:

- Seasonal forecast anomalies on single levels from 2017 to present
- Seasonal forecast monthly statistics on single levels from 2017 to present
- Seasonal forecast monthly statistics on pressure levels from 2017 to present
- Seasonal forecast daily data on single levels from 2017 to present
- Seasonal forecast daily data on pressure levels from 2017 to present
- Seasonal forecast anomalies on pressure levels from 2017 to present

Each result includes a brief description of the data. On the left side, there are filters for Product type, Spatial coverage, and Temporal coverage. The footer contains links for About C3S, Contact us, Cookies, Disclaimer, and Privacy, along with logos for the European Union, Copernicus, and ECMWF.

WMO Lead Centre for Long-Range Forecasts (KMA/NOAA)

WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble

Home About us News Data & Plot Related Sites WMO Lead Centre for SVSLRF

Introduction | Deterministic MME | Probabilistic MME | References

Latest Forecast data

Offenbach | 2019 JJA
 ECMWF | 2019 JJA
 Moscow | 2019 JJA
 Exeter | 2019 AMJ
 Toulouse | 2019 JJA
 Pretoria | 2019 JJA
 Beijing | 2019 JJA
 Seoul | 2019 JJA
 Tokyo | 2019 JJA
 Melbourne | 2019 JJA
 Montreal | 2019 JJA
 Washington | 2019 JJA
 CPTEC | 2019 JJA

Latest PMME plot [View all](#) Latest Individual Forecast plot [View all](#)

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- Check! System Requirements 2016.08.31
- A new leaflet of LC-LRFMME is published! 2016.08.19
- User guide of the LC-LRFMME website is published! 2019.05.23
- All GPCs(13) for JJA 2019 are uploaded 2019.04.25
- All GPCs(13) for MJJ 2019 are uploaded 2019.04.01
- All GPCs(13) for AMJ 2019 are uploaded 2019.03.04
- All GPCs(12) for MAM 2019 are uploaded 2019.02.13
- All GPCs(12) for FMA 2019 are uploaded

WMO Global Producing Centres

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 Email: lc_lrfmme@korea.kr Tel. 82-2-2181-0486 Fax. 82-2-2181-0489



today : 33 total : 397686

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Graphical products on the WMO Lead Centre web site

The screenshot displays the WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble website. The page is titled "Probabilistic Multi-Model Ensemble" and features a navigation menu with options like Home, About us, News, Data & Plot, and Related Sites. The "Data & Plot" section is active, showing a sidebar with links to Data Exchange Policy, Data Exchange, Plot, and System Configuration Information. The main content area is titled "Probabilistic Multi-Model Ensemble" and includes several configuration sections: Definition, Display, Map Type (with radio buttons for Combined, Below Normal, Near Normal, and Above Normal), Select Period (with a dropdown for 2019, JJA, and Mean), Select Model (with checkboxes for various locations like Melbourne, Montreal, Moscow, etc.), Select Parameters (with radio buttons for Precipitation, 500hPa GPH, Mean Sea Level Pressure, 2m Temperature, and 850hPa Temperature), and Select Region (with a dropdown for Global and input fields for Longitude and Latitude). A "Plot" button is located at the bottom of the configuration area. The footer contains contact information for the Korea Meteorological Administration, including the address 61 16-GIL YEOUIDAEBANG-RO DONGJAK-GU SEOUL 07062 Republic of Korea, email, and phone numbers, along with a copyright notice and a Privacy Handling Policy link.

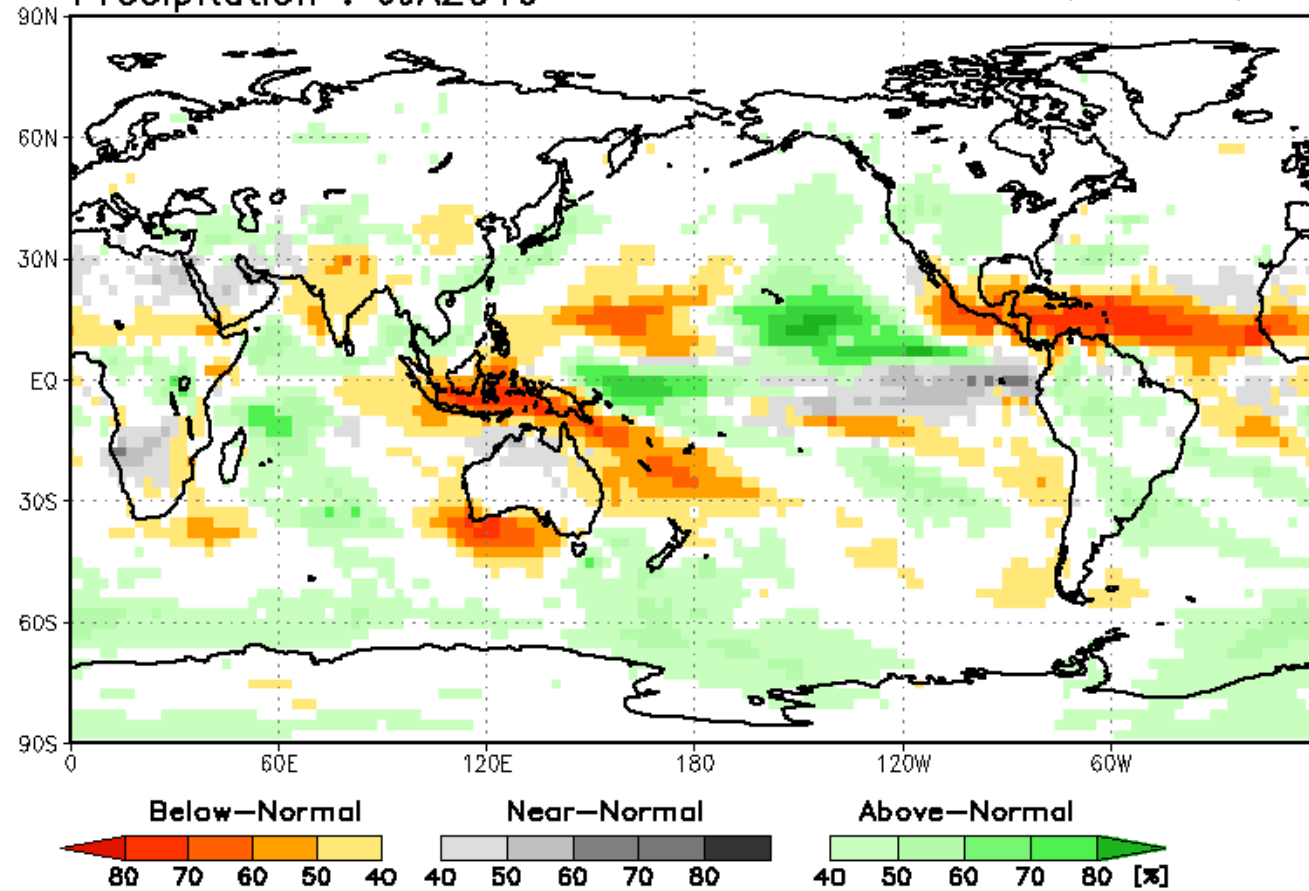
Multi-model ensemble fc. for JJA 2019 from the WMO Lead Centre

Probabilistic Multi-Model Ensemble Forecast

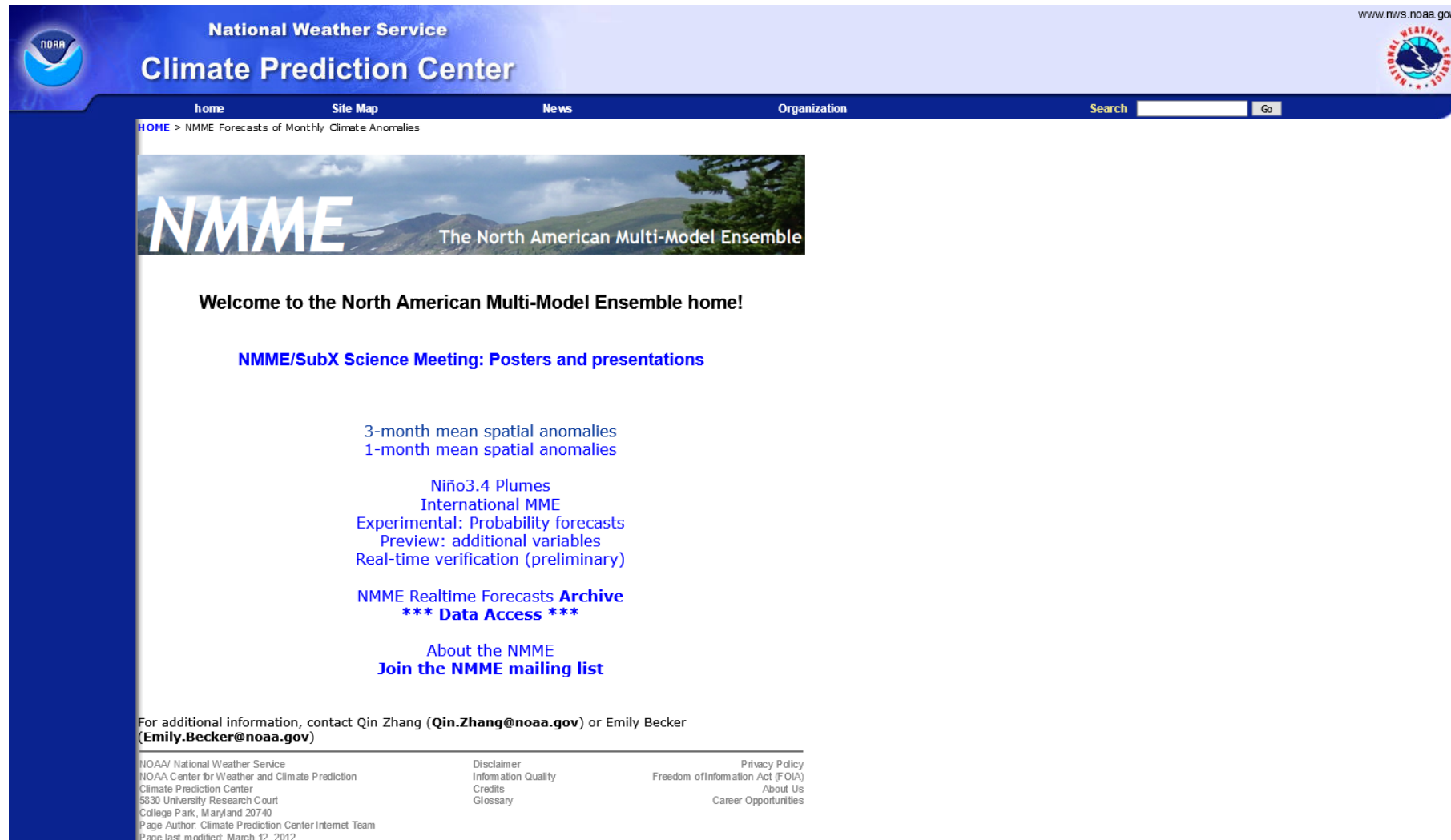
/GPC_seoul/GPC_washington/GPC_tokyo/GPC_exeter/GPC_moscow/GPC_beijing
/GPC_melbourne/GPC_cpctec/GPC_pretoria/GPC_montreal/GPC_ecmwf/GPC_offenbach/GPC_toulouse

Precipitation : JJA2019

(issued on May2019)



The North-American Multi-Model Ensemble (NMME) web site (@ NOAA/CPC)



The screenshot shows the homepage of the National Weather Service Climate Prediction Center's NMME website. The header includes the NOAA logo, the text "National Weather Service Climate Prediction Center", and the URL "www.nws.noaa.gov". A navigation bar contains links for "Home", "Site Map", "News", and "Organization", along with a search box. The main content area features a banner for "NMME The North American Multi-Model Ensemble" with a background image of a mountain range. Below the banner, a welcome message is followed by a link to "NMME/SubX Science Meeting: Posters and presentations". A list of links includes "3-month mean spatial anomalies", "1-month mean spatial anomalies", "Niño3.4 Plumes", "International MME", "Experimental: Probability forecasts", "Preview: additional variables", and "Real-time verification (preliminary)". A prominent link for "NMME Realtime Forecasts Archive" is accompanied by "*** Data Access ***". Other links include "About the NMME" and "Join the NMME mailing list". The footer contains contact information for Qin Zhang and Emily Becker, and a list of site navigation links such as "Disclaimer", "Information Quality", "Credits", "Glossary", "Privacy Policy", "Freedom of Information Act (FOIA)", "About Us", and "Career Opportunities".

National Weather Service
Climate Prediction Center
www.nws.noaa.gov

Home Site Map News Organization Search Go

HOME > NMME Forecasts of Monthly Climate Anomalies

NMME

The North American Multi-Model Ensemble

Welcome to the North American Multi-Model Ensemble home!

[NMME/SubX Science Meeting: Posters and presentations](#)

[3-month mean spatial anomalies](#)
[1-month mean spatial anomalies](#)

[Niño3.4 Plumes](#)
[International MME](#)
[Experimental: Probability forecasts](#)
[Preview: additional variables](#)
[Real-time verification \(preliminary\)](#)

[NMME Realtime Forecasts Archive](#)
***** Data Access *****

[About the NMME](#)
[Join the NMME mailing list](#)

For additional information, contact Qin Zhang (Qin.Zhang@noaa.gov) or Emily Becker (Emily.Becker@noaa.gov)

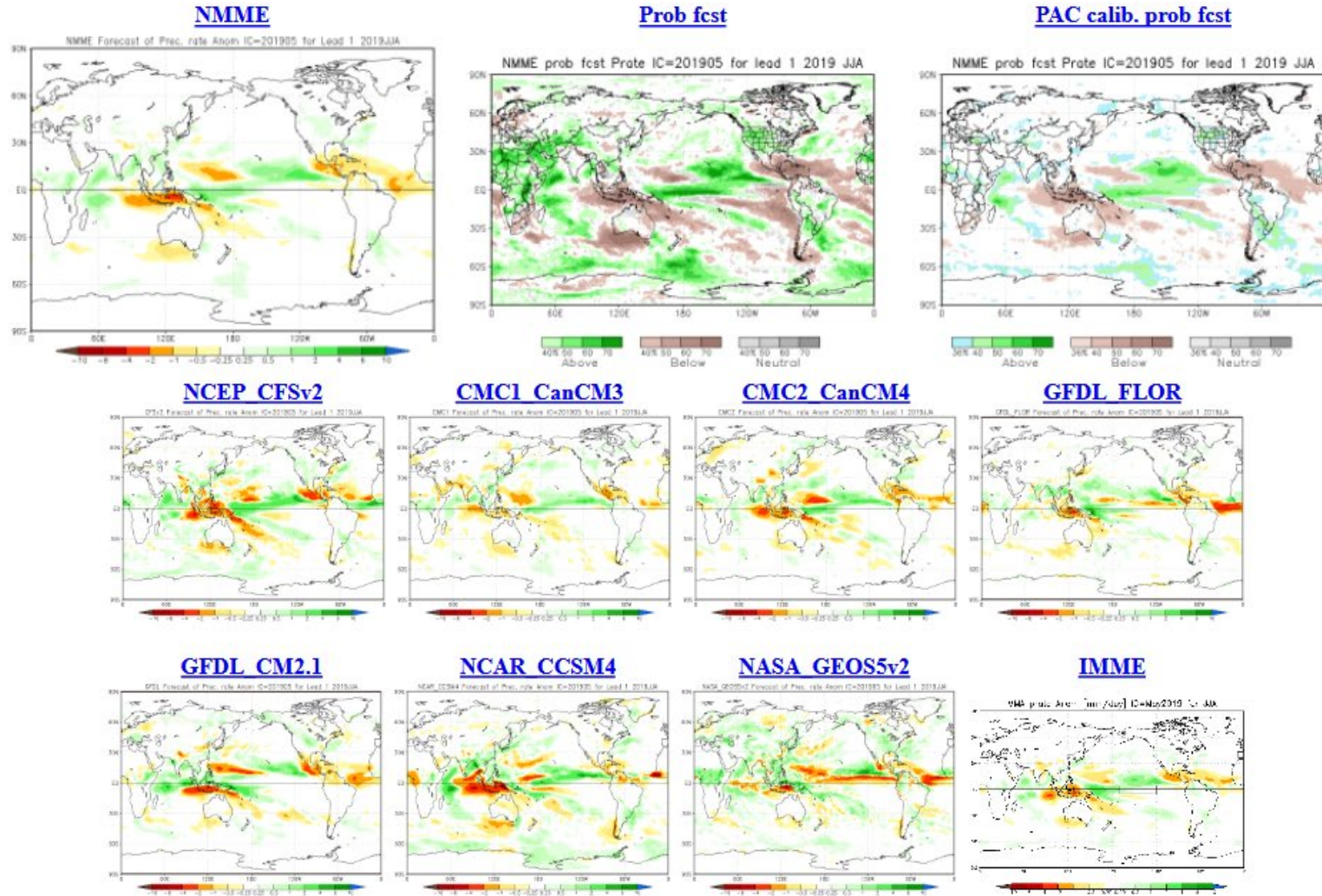
NOAA/ National Weather Service
NOAA Center for Weather and Climate Prediction
Climate Prediction Center
5830 University Research Court
College Park, Maryland 20740
Page Author: Climate Prediction Center Internet Team
Page last modified: March 12, 2012

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The North-American Multi-Model Ensemble (NMME): fc. for JJA 2019

Season 1 prate forecast



Seasonal forecasts at the Asia-Pacific Climate Centre (APCC, S. Korea)



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APCC 소개

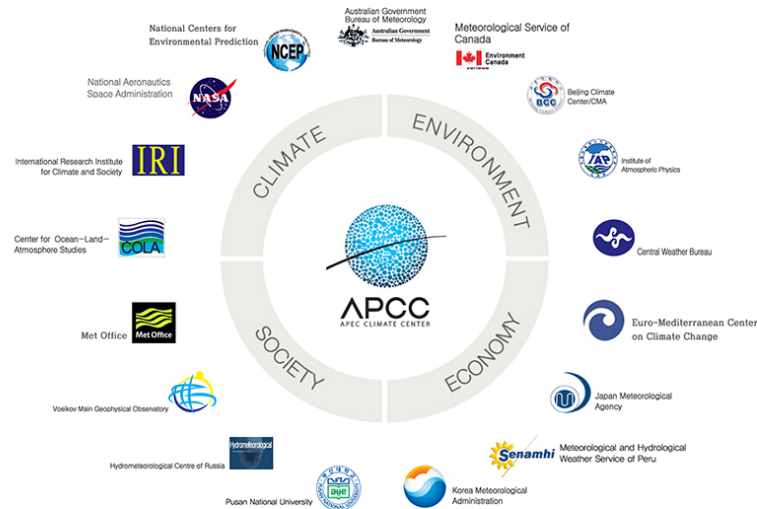
Home > About us > APCC MME Participation Agencies

APCC MME Participation Agencies

- + Introduction
- + Message from the Executive Director
- + History
- + Organization
- + Board of Trustees
- APCC MME Participation Agencies
- + Science Advisory Committee / International Networks
- + Partnerships
- + Location

APCC MME Participation Agencies

The APEC Climate Center collects climate forecast information from 17 leading climate forecasting centers and institutes in 11 countries. These forecasts are combined using the multi-model ensemble (MME) scheme and the high quality climate forecast information is disseminated to APEC member economies and Pacific Islands through APCC's website.



APCC Multi-Model Ensemble forecast for JJA 2019



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Climate Information Services

- Seasonal Forecast
 - Outlook
 - ENSO
 - Verification
 - Forecast
 - Hindcast
- BSISO Forecasts
- Applied Forecast
- Current Climate Conditions
- CLIK
- CLIPs
- ADSS
- OpenWPS

Home > Climate Information Service > Seasonal Forecast > Outlook

Outlook

2019 JJASON search

Our seasonal forecasts are issued on the 25th of each month. In the case that the 25th falls on a weekend or national holiday, they are issued on the closest workday.

Outlook	Deterministic MME Forecast	Probabilistic MME Forecast	Deterministic Forecast
---------	----------------------------	----------------------------	------------------------

Outlook

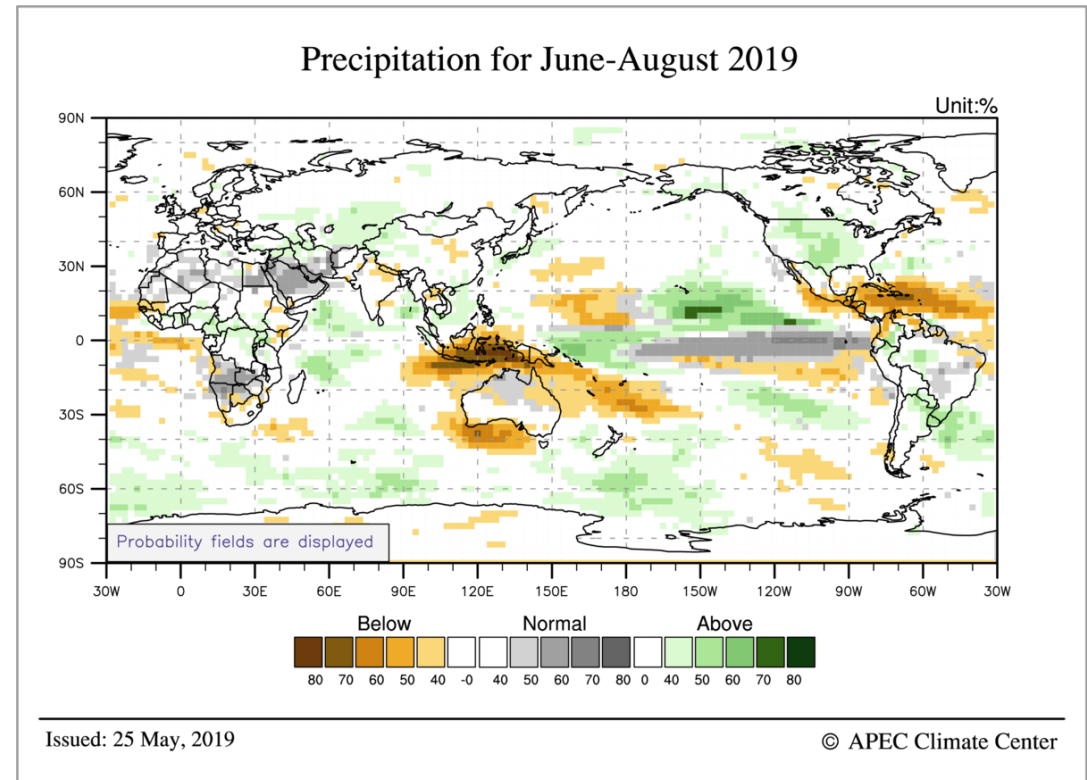
Climate Outlook for June - November 2019

(Issued: 25 May, 2019)

- o During April 2019, El Niño conditions persisted with positive sea surface temperature anomalies across the equatorial Pacific Ocean.
- o The latest APCC ENSO outlook suggests about a 35% probability for weak El Niño conditions during June – August 2019 and the conditions are likely to persist through September – November 2019.
- o Positive temperature anomalies are likely to prevail over the Arctic, Eurasia (excluding Central Asia), the tropical Pacific, southwestern South Pacific, maritime continent, tropical Atlantic, Indian Ocean except the eastern part, and Africa for June – November 2019.
- o Below normal precipitation anomalies are expected for the maritime continent, Great Australian Bight, and the Caribbean Sea, whereas near normal precipitation anomalies are predicted for the central equatorial Pacific for June – November 2019.

Temperature and Precipitation Outlook:

1. Forecast for June – August 2019



Seasonal forecasts and multi-decadal historical simulations at ECMWF

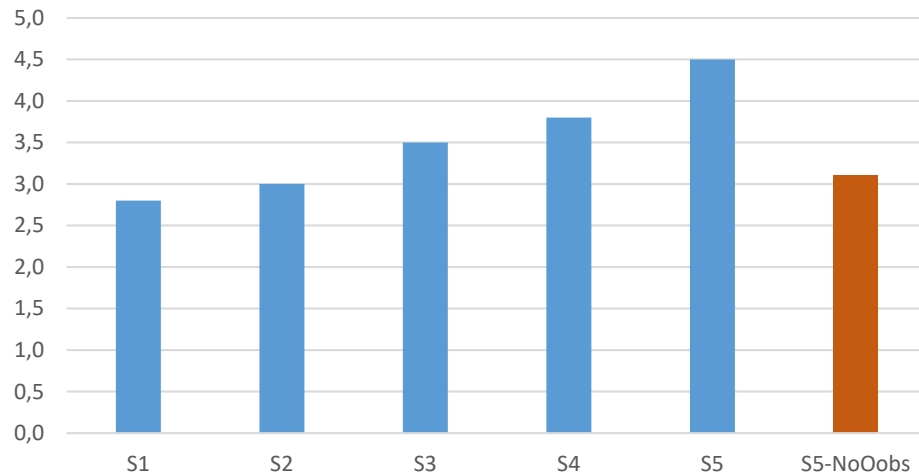
- **a) Seasonal fc. System 5 (Seas5)**
 - IFS cy43r1 Tco 319 (~32 km grid) L91 + NEMO v3.4 ORCA 0.25 deg. Z75+ LIM2 sea-ice
 - 7-month forecasts, 13-month fc. From Feb/May/Aug/Nov
 - Ensemble size: operational fc.: 51 members, re-forecasts: 25 members
 - Re-forecast period: Jan 1981 – Dec 2016 (36 years), IC from ERA-interim + ORA-S5

- **b) Multi-decadal historical simulations for the EU PRIMAVERA project, following HighResMIP (ECM-hist)**
 - **High res.:** IFS cy43r1 Tco 399 (~25 km grid) L91 + NEMO v3.4 ORCA 0.25 deg. Z75 + LIM2 sea-ice
 - **Low res.:** IFS cy43r1 Tco 199 (~50 km grid) L91 + NEMO v3.4 ORCA 1.0 deg. Z75 + LIM2 sea-ice
 - CMIP6 forcing fields (GHG, aerosol, ozone, ...)
 - 1950-2014 started from 50-yr spin-up (1950 forcings)
 - Additional runs: AMIP integrations using HadISST2 data (SST + sea-ice conc.), 1950-forcing control

Good news: ENSO forecasts, surface temperature trend

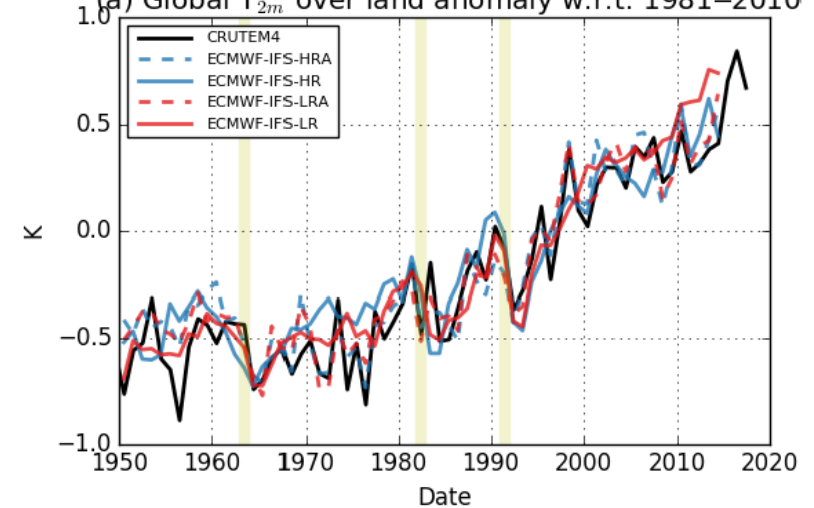
Seas5 ENSO predictions

Forecast lead for NINO3.4 correlation > 0.9

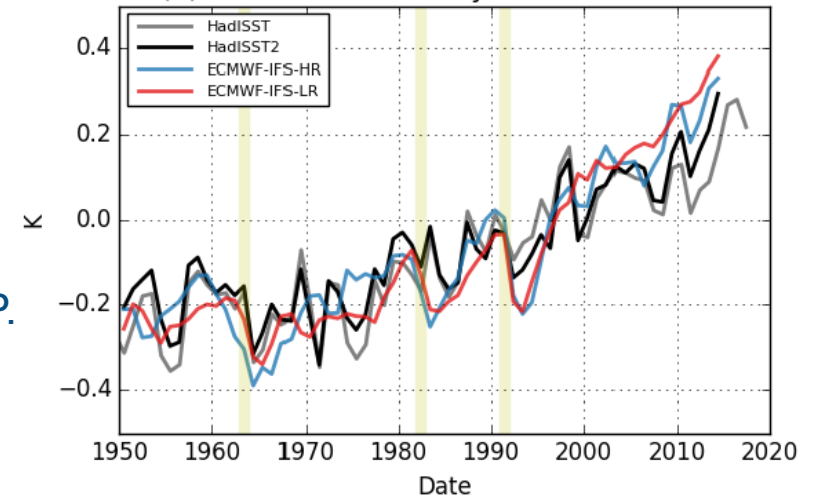


Sfc. T anomaly in PRIMAVERA hist. simulations

(a) Global T_{2m} over land anomaly w.r.t. 1981–2010



(b) Global SST anomaly w.r.t. 1981–2010

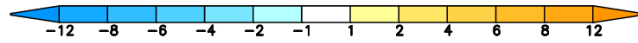
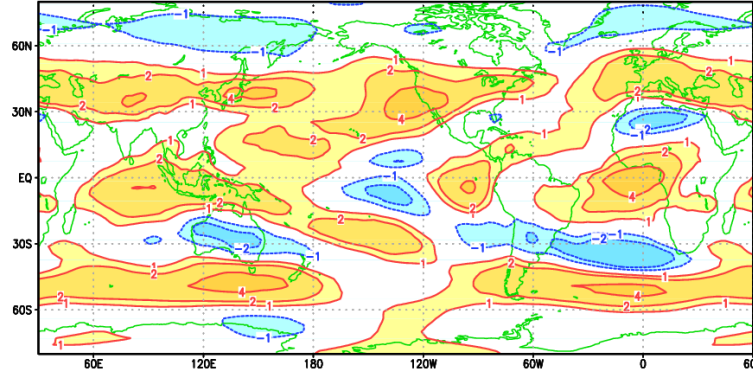


More info in:

- Johnson S. et al.: SEAS5: The new ECMWF seasonal forecast system. *Geosci. Model Dev.*, 12, 1087-1117, 2019, doi:10.5194/gmd-12-1087-2019
- Roberts C. et al.: Climate model configurations of the ECMWF Integrated Forecast System (ECMWF-IFS cycle 43r1) for HighResMIP. *Geosci. Model Dev.* 2018, doi:10.5194/gmd-11-3681-2018

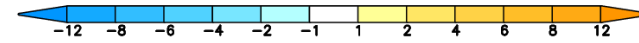
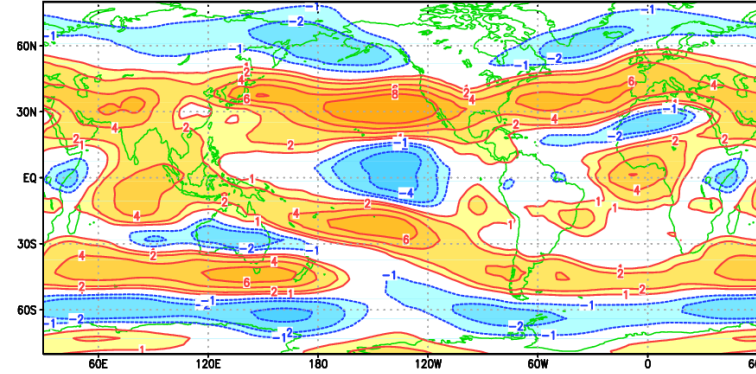
DJF model biases in U 200-hPa and precipitation

Seas5 bias u 200 DJF 1982-2014



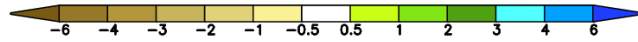
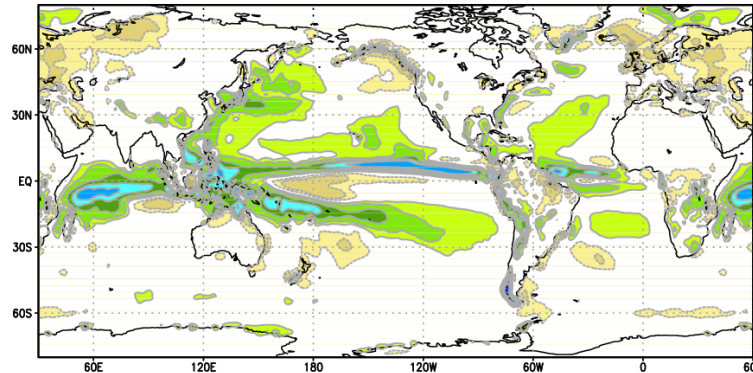
Seas5

ECM-hist bias u 200 DJF 1982-2014

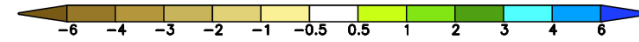
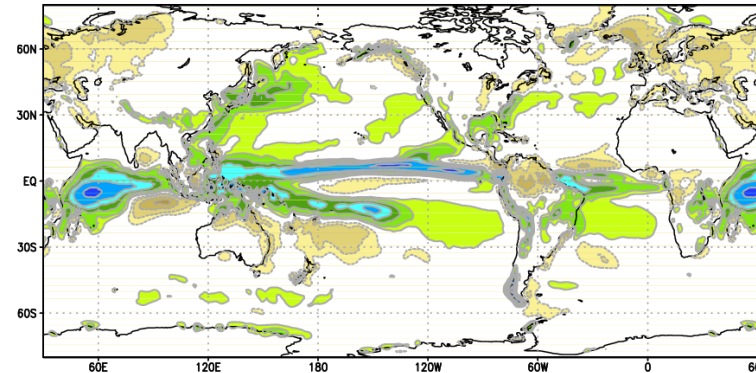


ECM-hist

Seas5 bias prec DJF 1982-2014

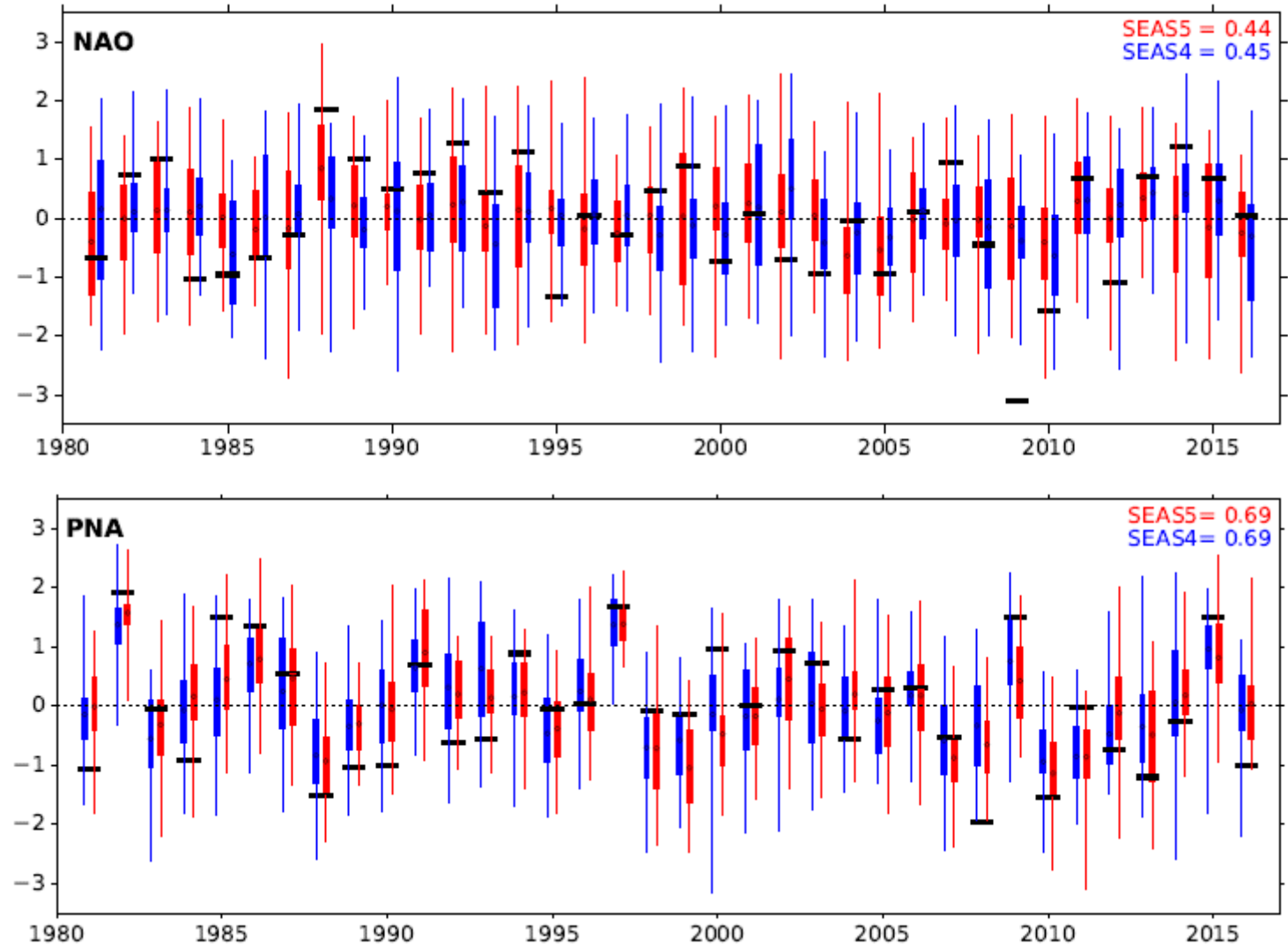


ECM-hist bias prec DJF 1982-2014



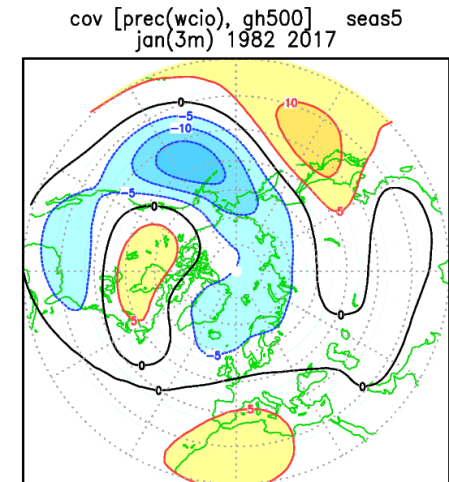
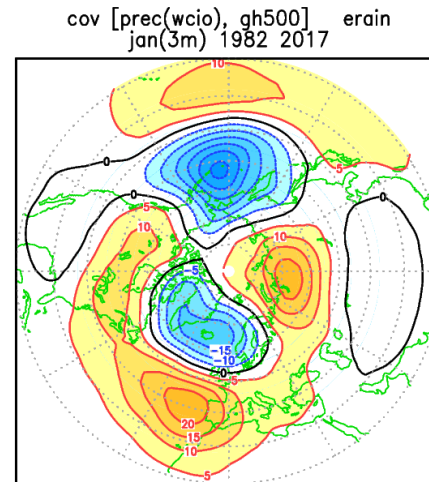
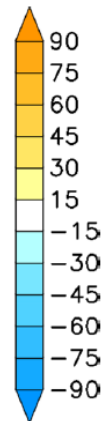
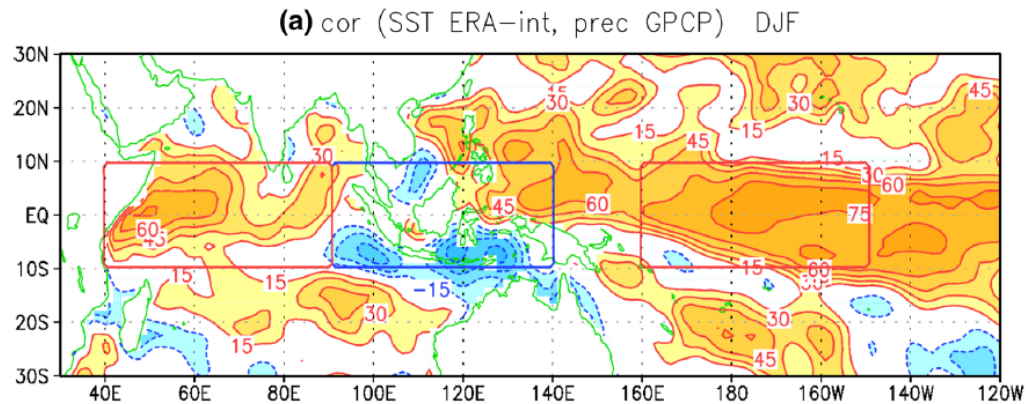
Anomaly correlation of ensemble-mean NAO and PNA indices

Predictive skill for NHem teleconnection patterns is almost identical in System-4 and System-5

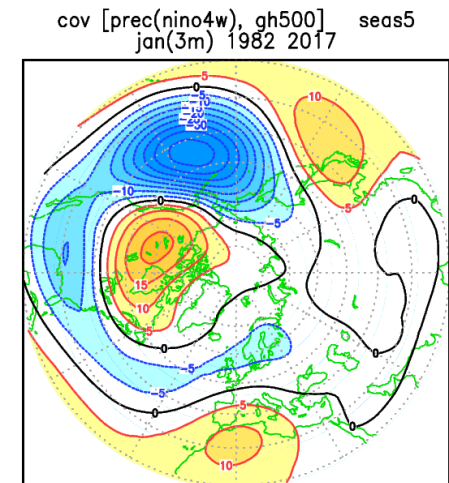
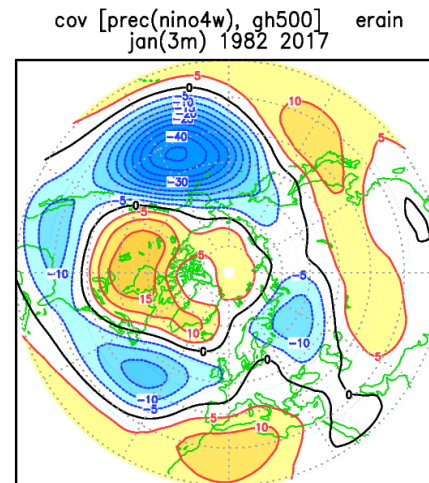


Seas5: teleconnections from DJF tropical rainfall in Pacific and Indian Oceans

Local correlation between rainfall and SST
(Molteni et al., Climate Dyn 2015)



WCIO
40E-90E
10S-10N



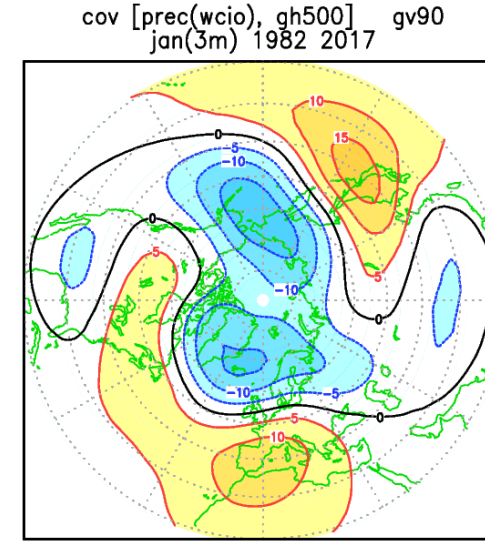
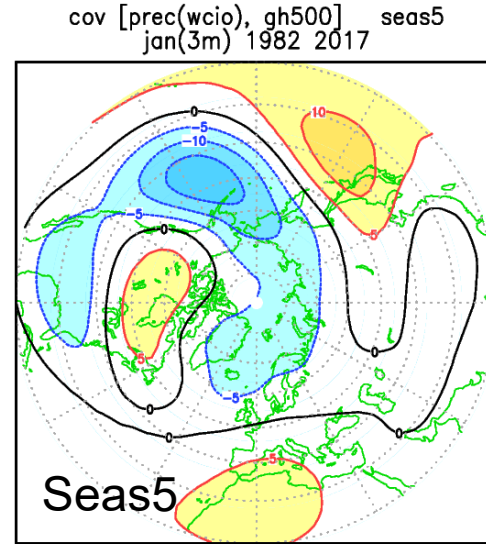
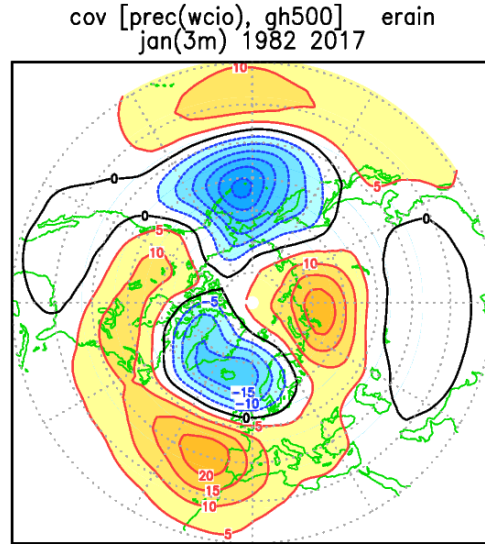
Nino4w
160E-150W
10S-10N

ERA-Int

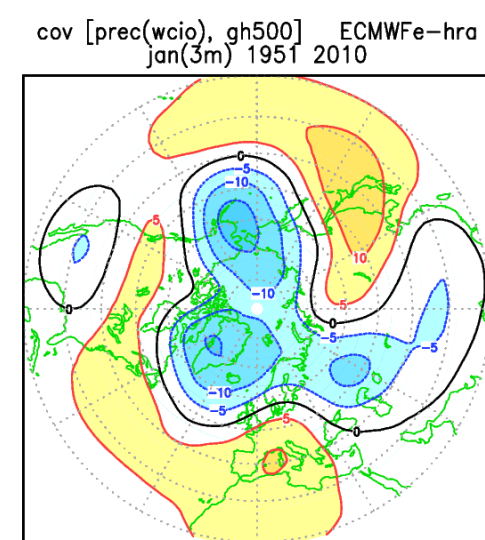
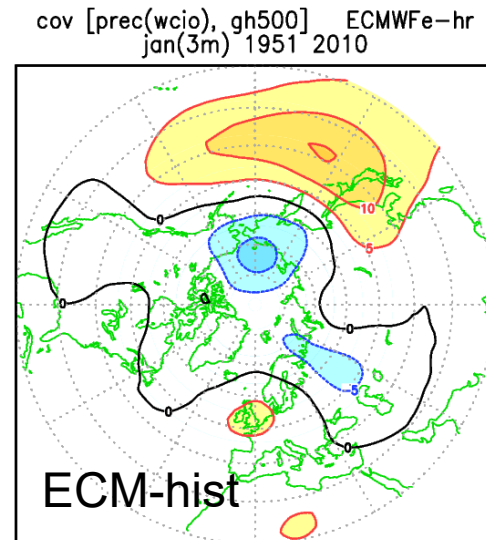
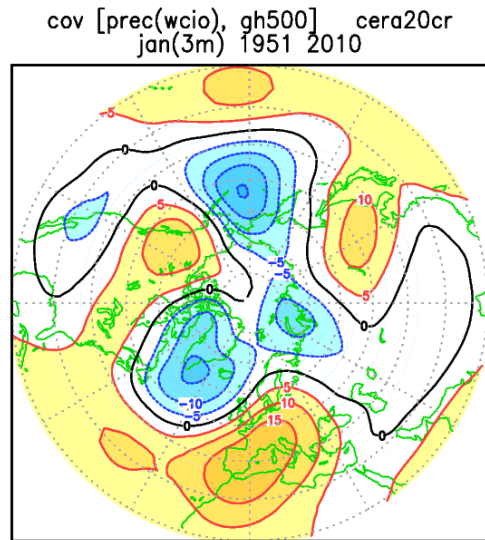
Seas5

Indian Ocean teleconnections: coupled vs. obs SST experiments

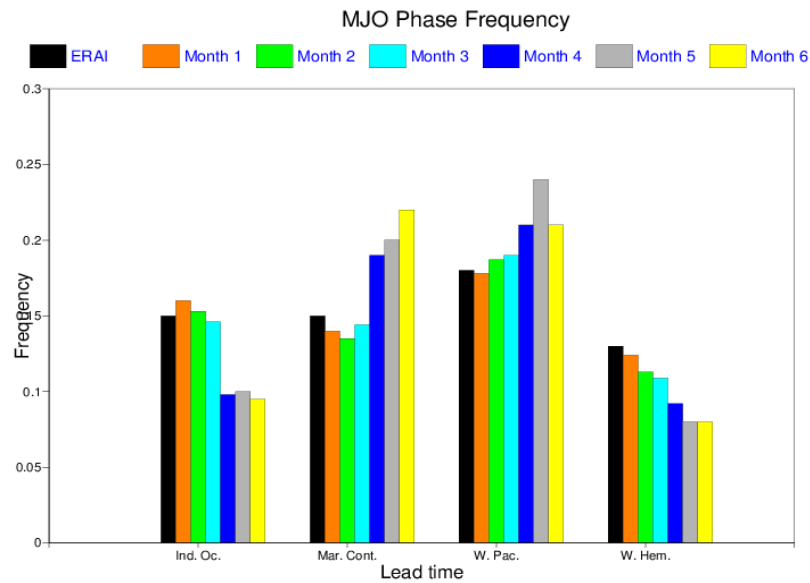
ERA Int



CERA20C

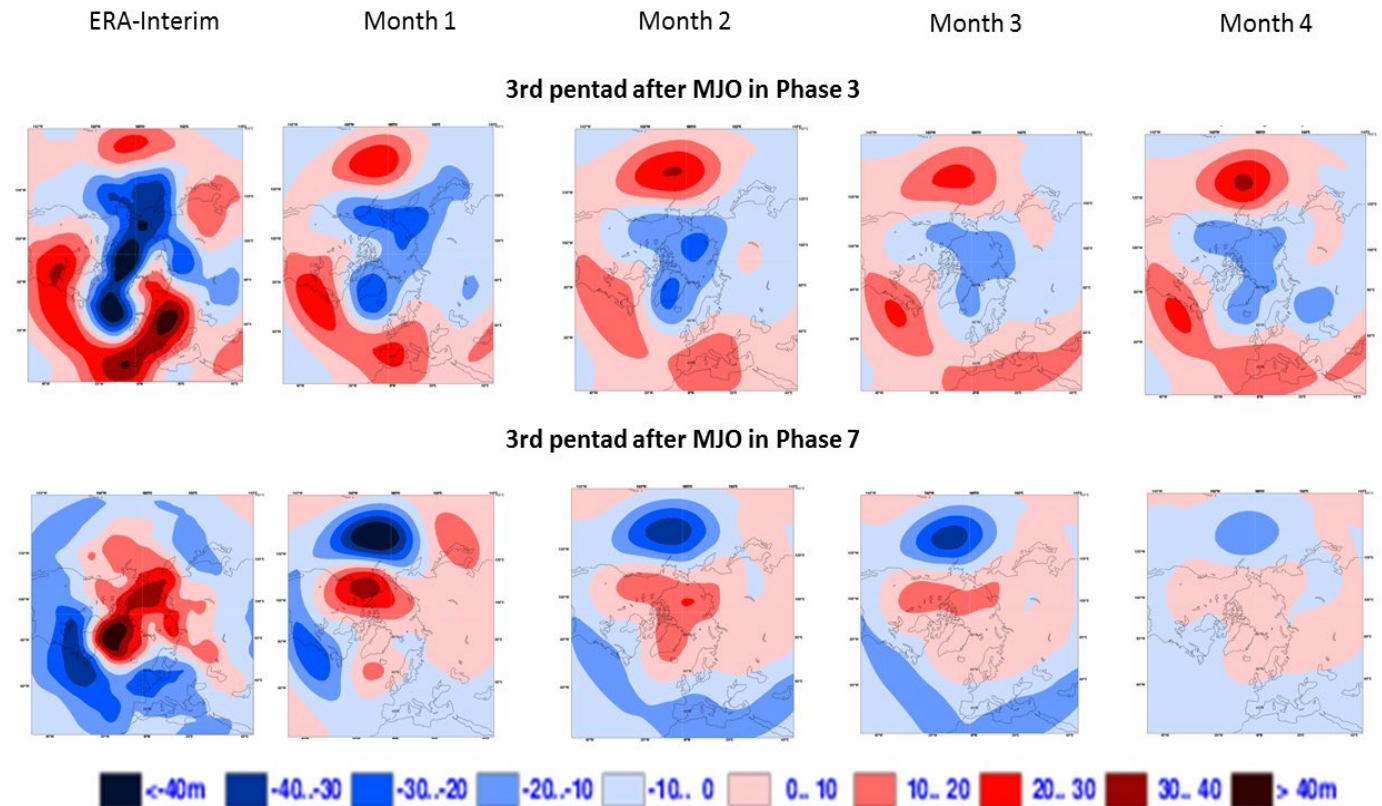


Errors in MJO phase frequency and Z500 teleconnections in SEAS5



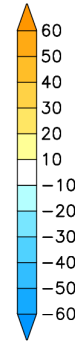
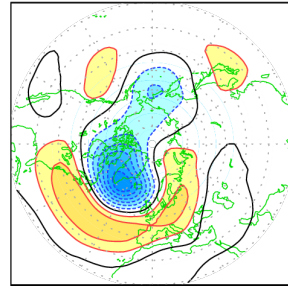
From F. Vitart (SAC 2018
Special Topic paper on SEAS5)

MJO phases as in
Wheeler & Hendon 2004

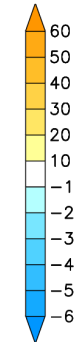
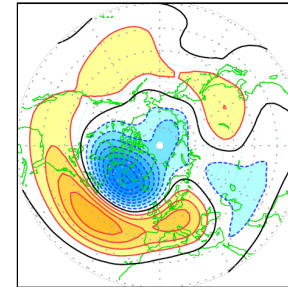


Covariance with NAO index based on 500 hPa height in Nov-Dec and Jan-Feb

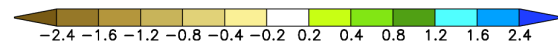
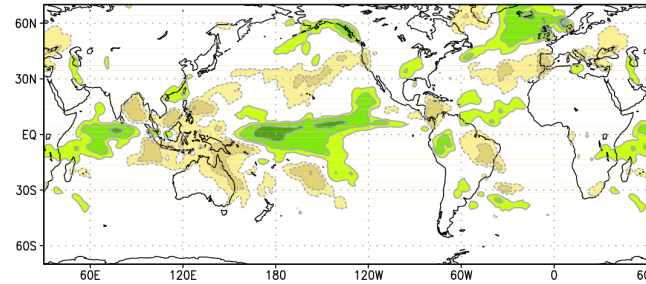
cov [gh500(ena0), gh500] cera20cr
nov(2m) 1951 2010



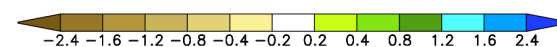
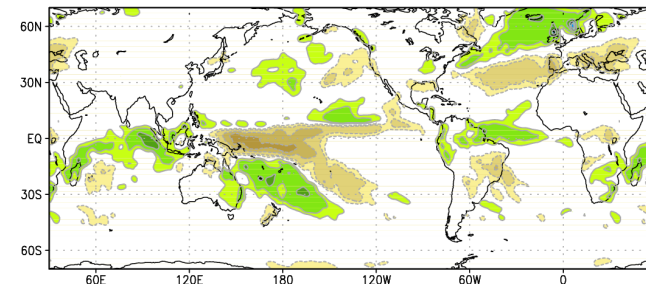
cov [gh500(ena0), gh500] cera20cr
jan(2m) 1951 2010



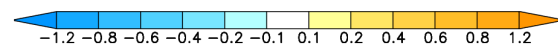
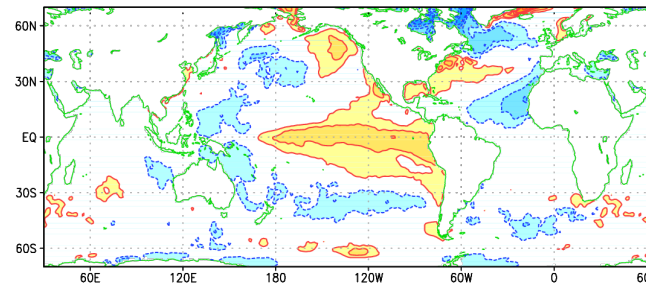
cov [gh500(ena0), prec] cera20cr
nov(2m) 1951 2010



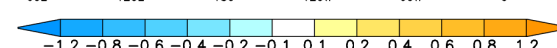
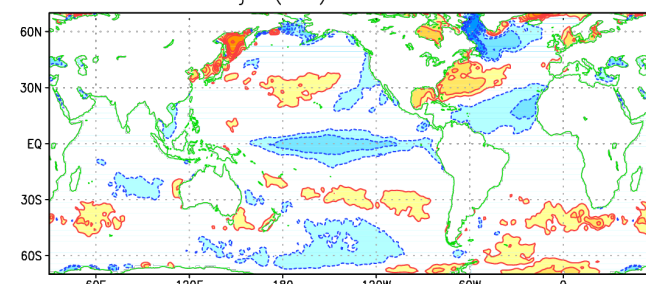
cov [gh500(ena0), prec] cera20cr
jan(2m) 1951 2010



cov [gh500(ena0), sst] cera20cr
nov(2m) 1951 2010



cov [gh500(ena0), sst] cera20cr
jan(2m) 1951 2010



Norm. error of teleconnections in AMIP/coupled PRIMAVERA runs 1950-2010

Models:

1. CMCC-CM2
2. CNRM-CM6
3. EC-Earth 3
4. HadGEM3 GC3.1
5. MPI-ESM 1-2
6. ECMWF-IFS
7. ECMWF ens.
6 members low res.
4 members high res.

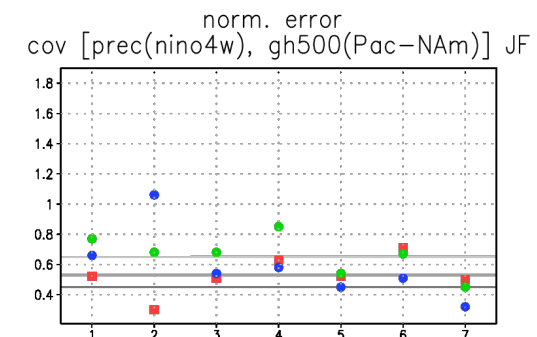
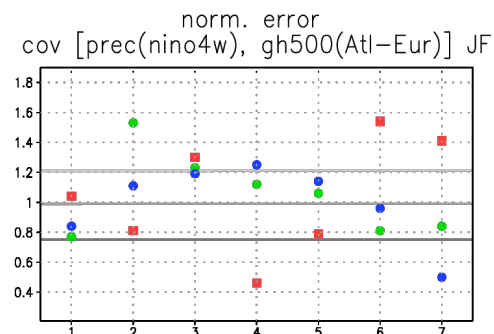
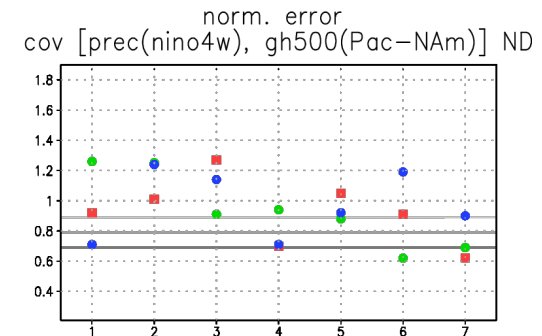
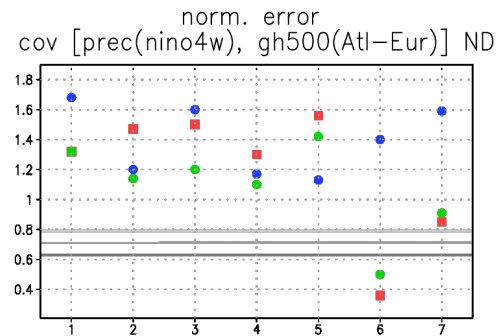
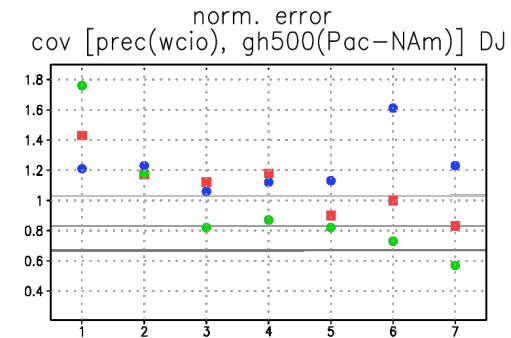
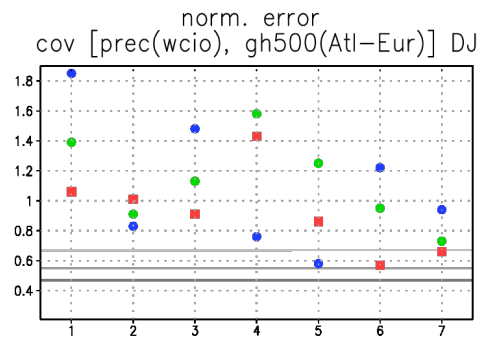
AMIP Low resol. \approx 100 km

AMIP High resol: 20 - 40km

Coupled High-res:

atmos: 20-40km,

ocean: \sim 1/4 degree



Conclusioni e commenti

- Prodotti di previsioni stagionali basate su multi-model ensembles sono oggi disponibili sui siti di diversi centri in Europa, Nord America e Asia.
- Il contributo di C3S ha permesso di uniformare le procedure di produzione e rendere pubbliche le previsioni stagionali di 5 centri/servizi europei, in forma sia grafica che numerica.
- Il numero di prodotti grafici presenti sul sito di C3S e' ancora limitato, e non sono ancora presenti indici dello skill delle previsioni basati sui re-forecasts.
- Negli ultimi 10 anni c'e stata una convergenza nella qualita' dei modelli usati per previsioni stagionali; in generale, i maggiori progressi sono visibili ai tropici.
- L'Europa e il Nord Atlantico rimangono regioni critiche per le previsioni stagionali, sia per ragioni "intrinseche" (basso rapporto segnale/rumore), ma anche per la difficoltà dei modelli a riprodurre correttamente teleconnessioni tra tropici ed extratropici (con l'eccezione della classica risposta a ENSO nel tardo inverno).
- Esistono chiare sinergie tra lo studio di errori sistematici (nello stato medio e nella variabilità) dei modelli climatici in previsioni stagionali e in simulazioni "storiche" multidecadali.
- Un approccio "seamless" alle previsioni stagionali puo' essere un'arma a doppio taglio: gli errori nelle previsioni a breve/medio termine sono dominate da processi diversi da quelli rilevanti a scala inter-annuale e decadale.