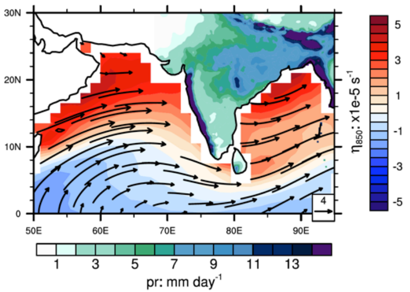
6-P01

On the causes of poleward shift of the Indian summer monsoon low level jetstream

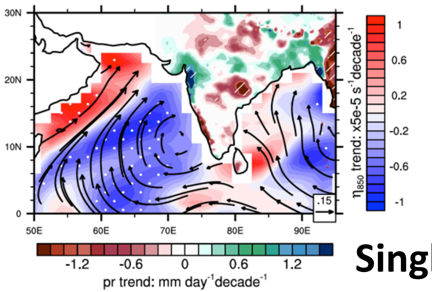
Krishna AchutaRao, S. Sandeep, Dileepkumar R, and Arulalan T
Centre for Atmospheric Sciences, Indian Institute of Technology Delhi

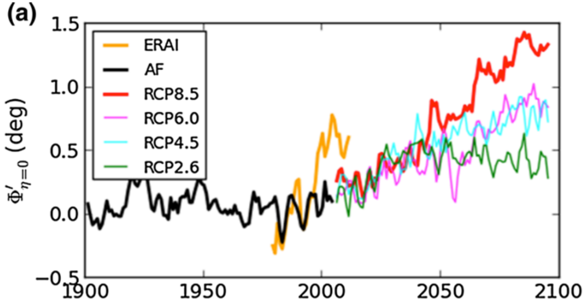
850hPa Absolute vorticity (Oceans) & Precipitation (Land)

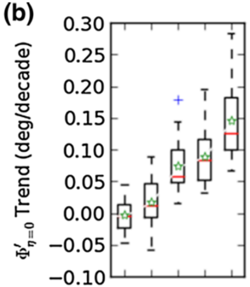
Climatology



Linear Trend







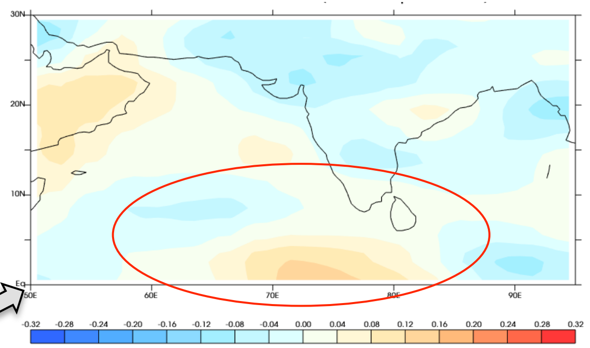
Single forcing experiments:

historicalNat

historicalGHG

historicalMisc

?



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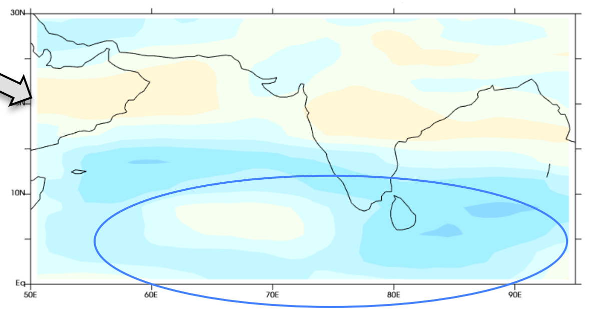


Sandeep and Ajayamohan, Clim Dyn (2015), DOI 10.1007/s00382-014-2261-y

Poster 2

Contrasting methods of detecting and attributing the impact of external forcings

Session 6

Julie Arblaster (julie.arblaster@monash.edu) and Catalyst members

Does the framework of DAMIP experiments matter?

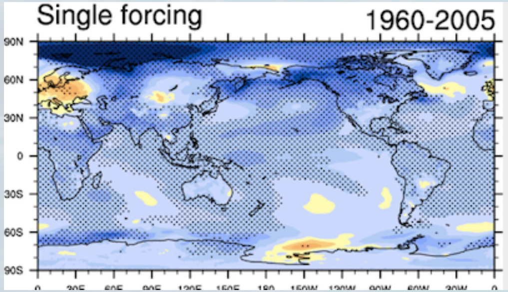
Single: 1850 conditions for all forcings except one

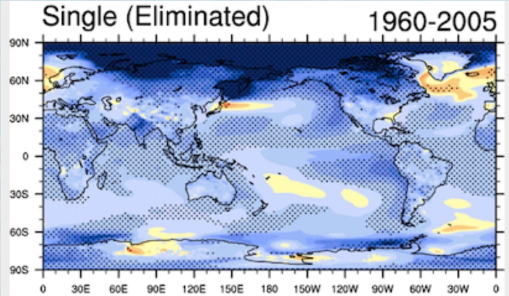
Eliminated: all forcings follow the historical path except for one which is set to1850 conditions

CESM1/CAM5 experiments

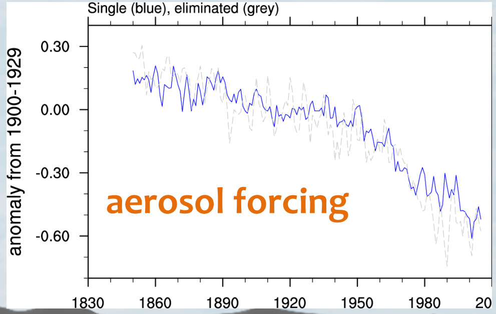
# ensemble members	Volcanic	Solar	GHG	Ozone	Land-use	Aerosols	Sulfate	Black Carbon
Single	5	3	5	3	3	3	3	3
Eliminated	3	3	3	3	3	3		

surface temperature trends in aerosol experiments





global surface temperature



U.S. DEPARTMENT OF ENERGY Office of Science

NCAR

catalyst

P03

Attribution of Ocean Temperature Change to Anthropogenic and Natural Forcings using the Temporal, Vertical and Geographical Structure

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

University of Reading

Met Office

Roberto Bilbao (roberto.bilbao@bsc.es), Jonathan Gregory, Nathaelle Bouttes, Matthew Palmer and Peter Stott

Comparison of Ocean temperature Observations and CMIP5 models (1960-2005):

Observations and CMIP5 models show that the upper 2000m has warmed with a signal that has a well defined geographical pattern and vertical structure.

Greenhouse gas forcing has contributed most to increasing the temperature of the ocean, a warming which has been o set by other anthropogenic forcing (mainly aerosols), and volcanic eruptions which cause episodic cooling.

Detection and attribution analysis:

We carry out multi-model detection and attribution analysis, using optimal fingerprinting, based on the time and depth structure of the temperature together:

- **Two-signal:** anthropogenic and natural forcings.
- **Three-signal:** greenhouse gas, anthropogenic aerosols and natural forcings.

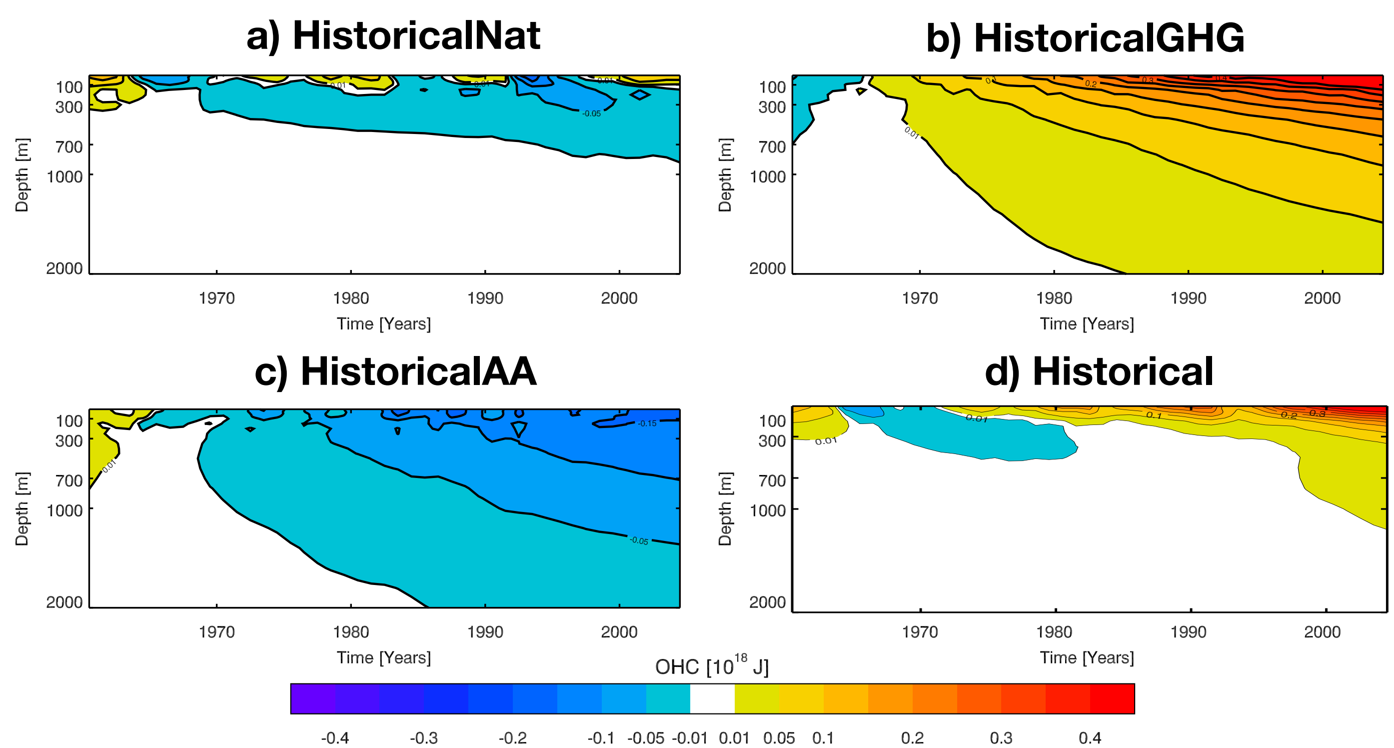


Figure 1. Global mean time-depth ocean heat content change for 1960-2005. a) historicalNat, b) historicalGHG, c) historicalAA and d) historical CMIP5 simulations.

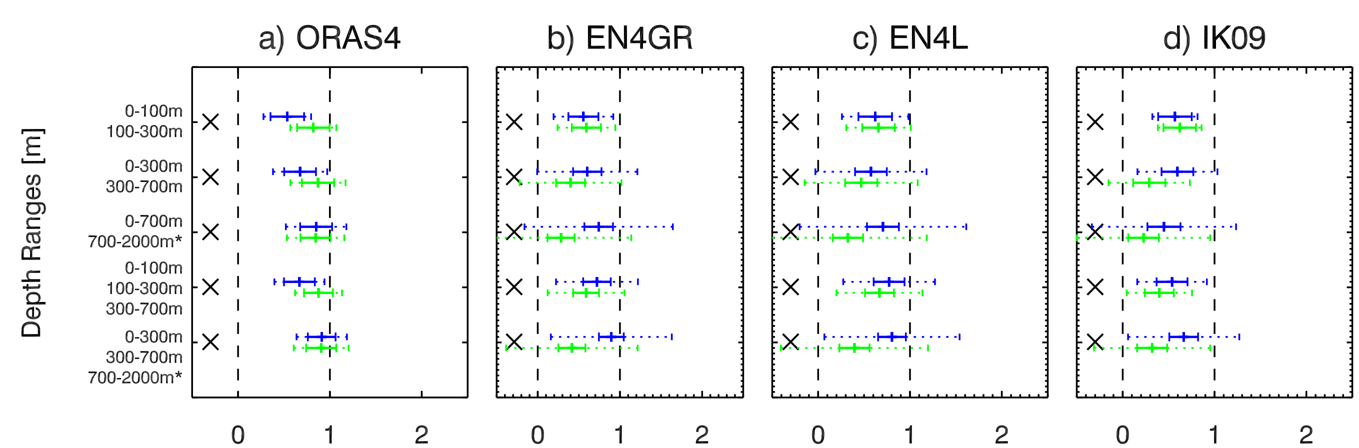
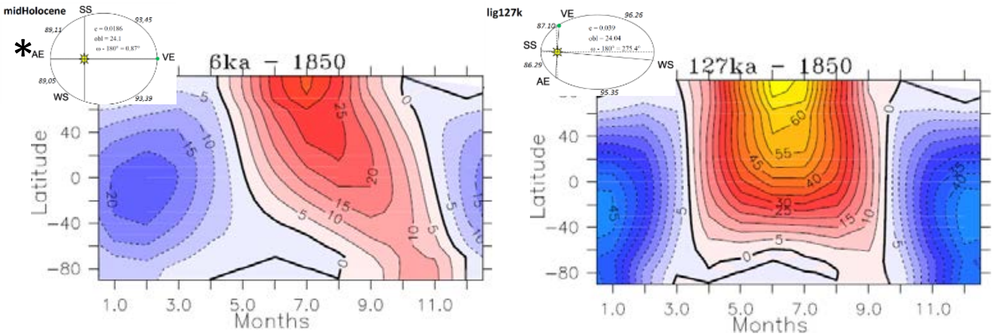


Figure 2. ANT (blue) and NAT (green) signals scaling factors and uncertainty ranges for global mean ocean temperature change between 1960-2005 for multiple depth level fingerprints.

Implication of Mid Holocene and Last Interglacial changes in insolation seasonality on high and mid latitude climate

P. Braconnot, B. Otto-Bliesner and PMIP participants

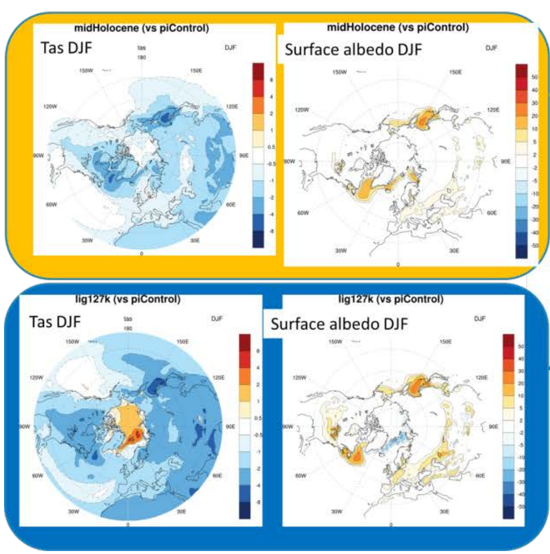
Two interglacial periods : changes with modern conditions driven by insolation

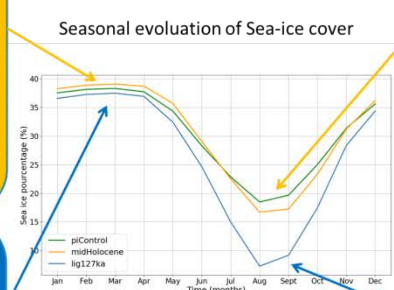


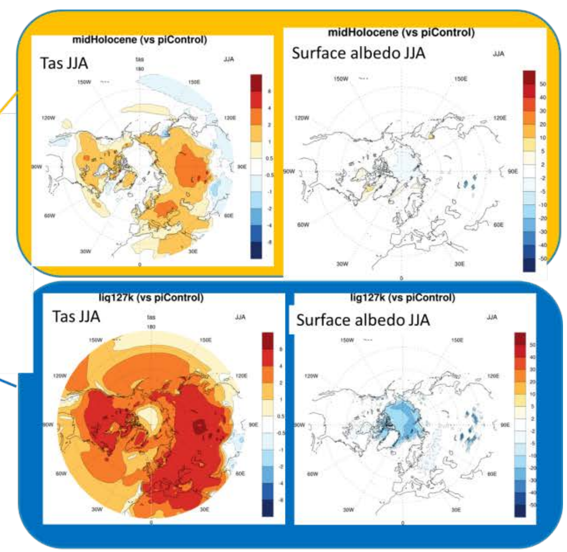
* PMIP4-CMIP6 entry card

- Understand radiative forcing/atmospheric and ocean circulation
- Seasonality and atmosphere, ocean, land-surface and cryosphere feedbacks
- Model benchmarking against paleoclimate reconstructions
- * Test model evolution through time (PMIP1 to PMIP4)

Similarities and differences in the response of the NH high latitude climate

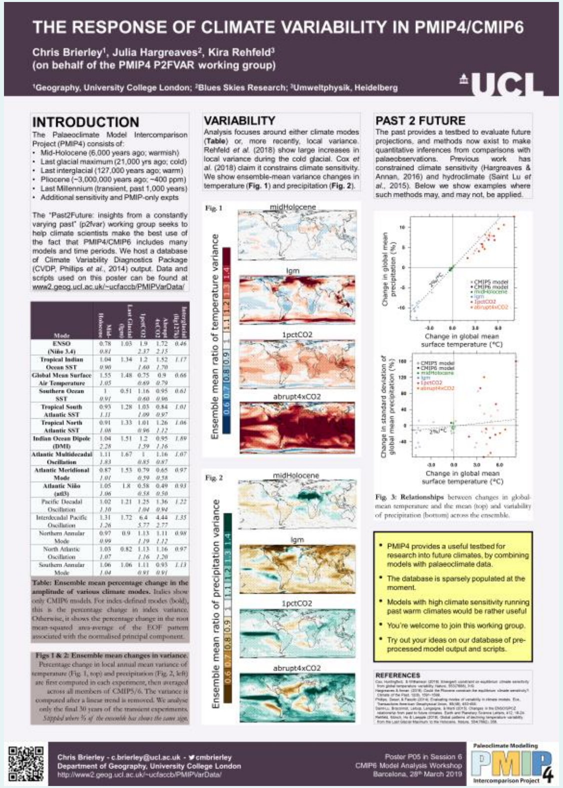






Discuss also hydrology, sensitivity test to vegetation, dust…..

Specific thanks to Paolo Scussolini, Marie Sicard, Jérôme Servonnat and Jean-Yves Peterschmitt

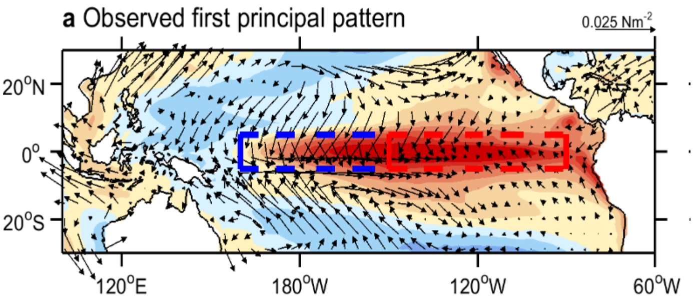


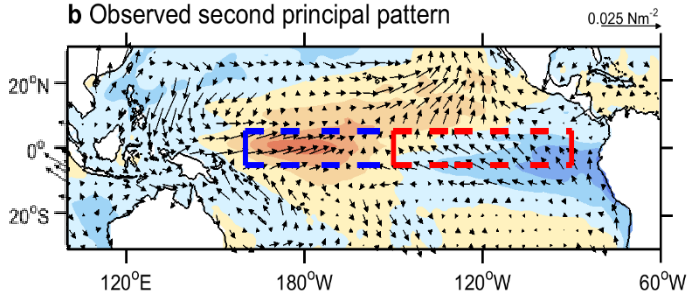
PMIP4 P2FVAR wg

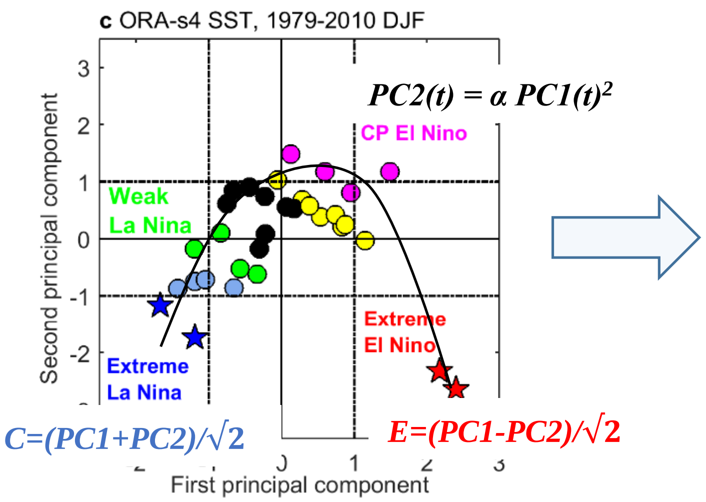
- PMIP4 provides a useful testbed for research into future climates, by combining models with palaeoclimate data.
- Working group exists to help scientists make the best use of the fact that PMIP4/CMIP6 includes many models and time periods.
- We host a database of pre-processed simulation output & some scripts to analyse it.
- Models with high climate sensitivity running past warm climates would be rather useful

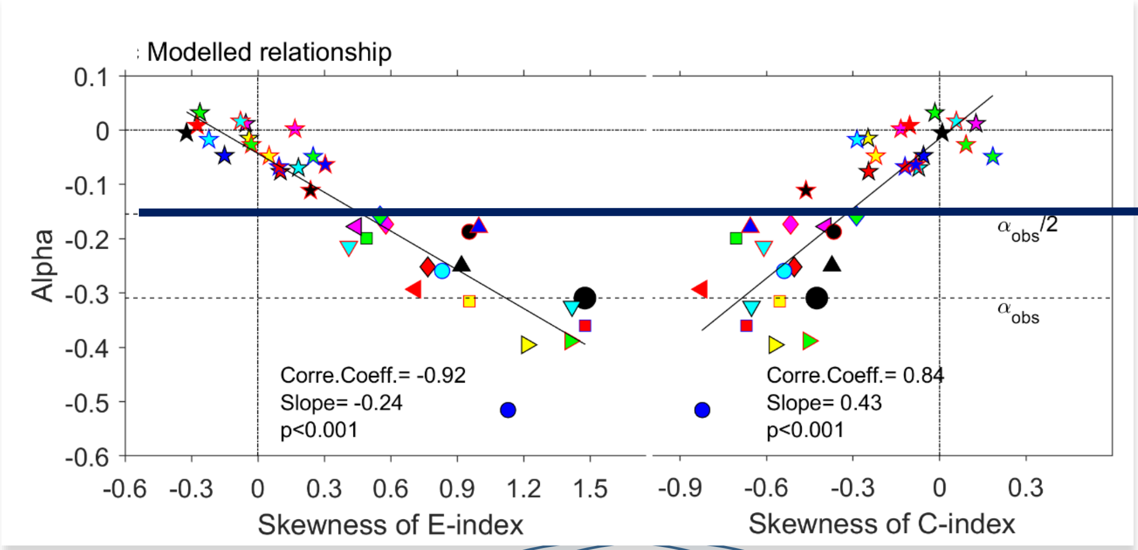
Increased variability of eastern Pacific El Niño under greenhouse warming

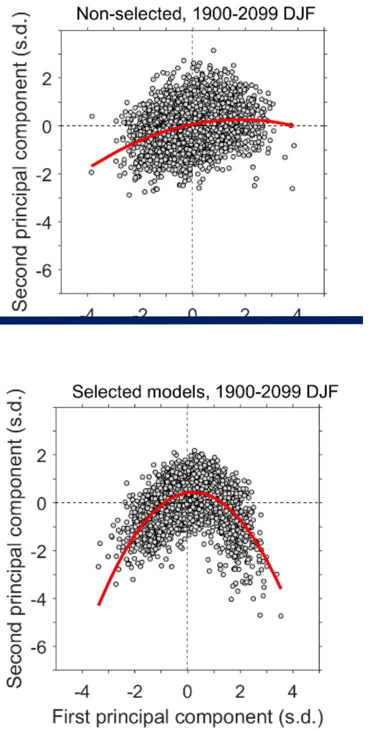
Cai *et al.* (2018)

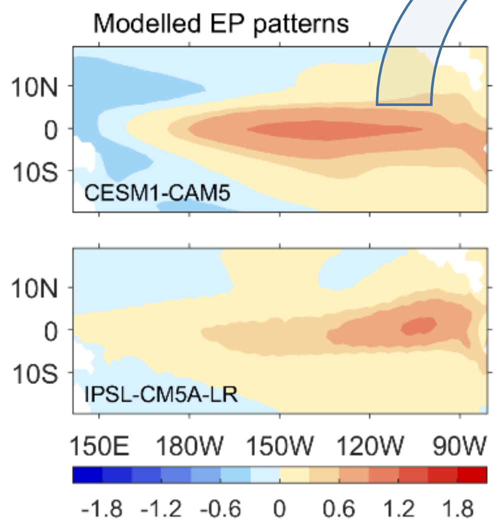


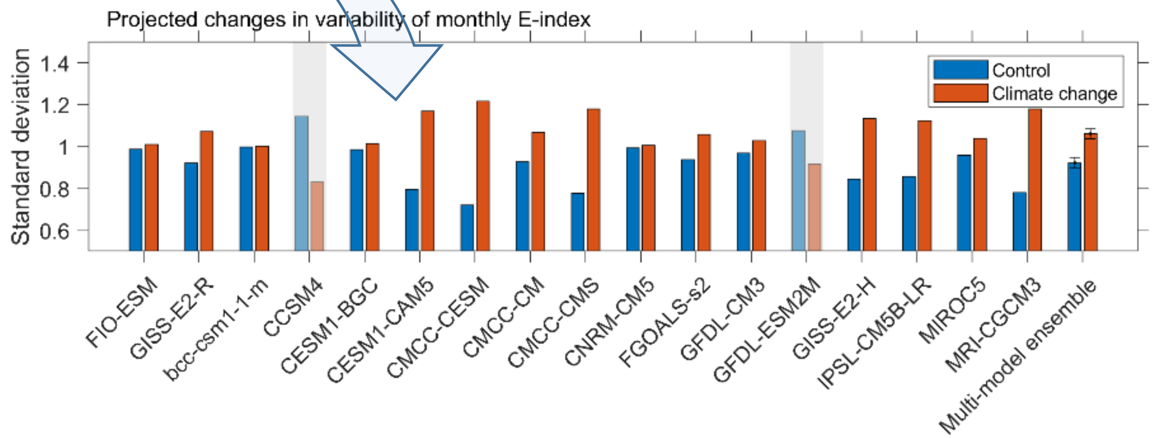












Cai *et al*. Increased variability of eastern Pacific El Niño under greenhouse warming. *Nature* **564**, 201-206 (2018)

Climate Scenarios for the Fifth United States National Climate Assessment

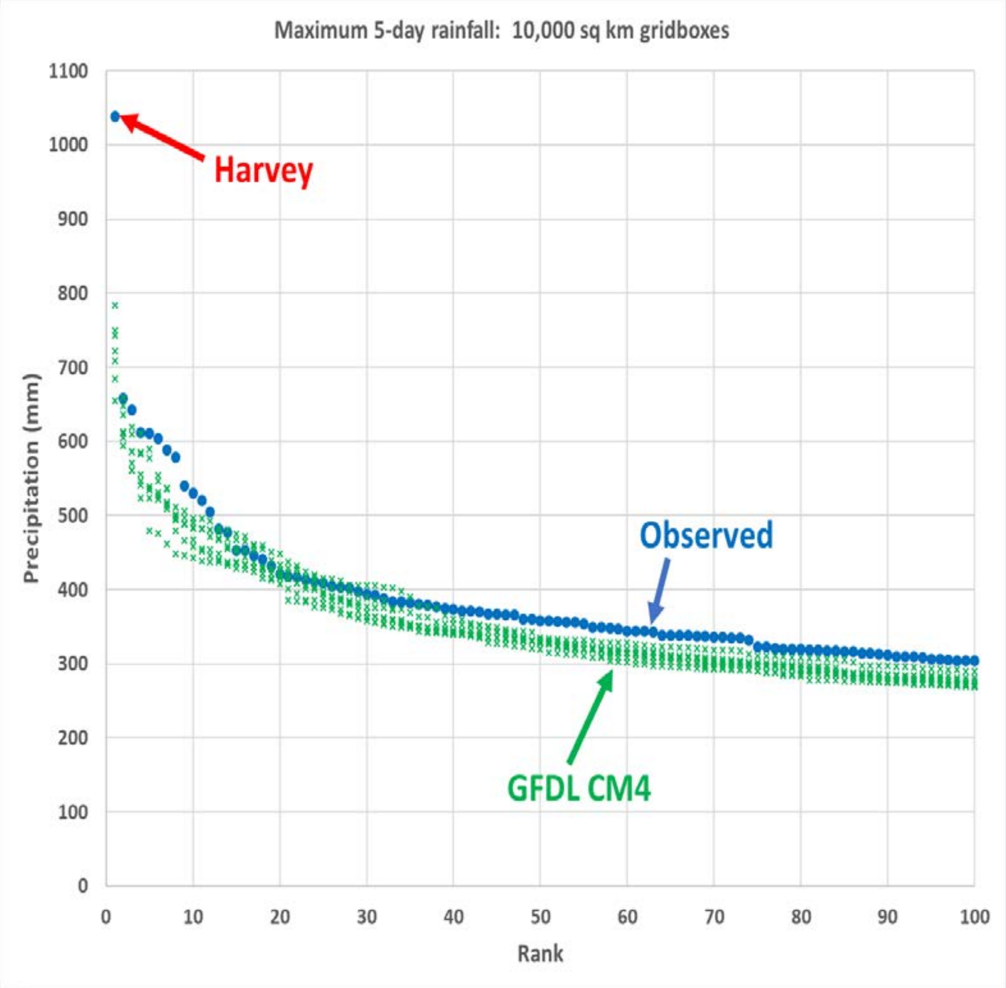
David R. Easterling[1], Kenneth E. Kunkel[2], and Xungang Yin[3]

- Hurricane Harvey (2017) dropped more than 1200mm of precipitation on the Houston, Texas area over a 5 day period.
- How well do climate models produce these kinds of multi-day heavy precipitation events compared to obs?
- Model Simulations.

CMIP6: NOAA GFDL CM4 model, PiCtrl

CMIP6: IPSL model, PiCtrl and Doubled CO2

CMIP5: NOAA GFDL CM3, Historical and PiCtrl



Results:

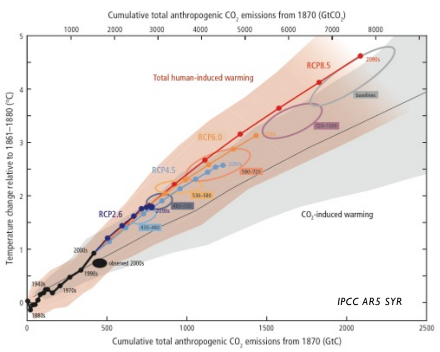
- The GFDL CM4 models results are superior to GFDL CM3 model results in event magnitude, although the seasonal distribution is biased and events are too large at the 100,000 km2 scale
- The IPSL model events are a little higher than observed when comparing similar box sizes
- At their native resolutions, none of the model simulations produce an event of the size of Harvey

Transient Climate Response to Cumulative Emissions in CMIP6 models

Preliminary results from the C4MIP experiments

Pierre Friedlingstein, Chris Jones, Vivek Arora, Tatiana Ilyina
and the C4MIP community

1) Background



TCRE is a metric that measure the global average surface temperature change for a given cumulative CO_2 emissions. IPCC AR5 assessed that TCRE range is 0.8 to 2.5˚C/10^{3}GtC. TCRE gained a large interest in the policy arena as it allows to quantify the remaining carbon budget for a given climate target, with a large TCRE implying a low remaining carbon budget.

CMIP6 provides an opportunity to reassess TCRE with state of the art Earth System Models (ESMs). The deck 1% simulation allows to quantify TCRE providing ESMs simulate land and ocean carbon sinks, anthropogenic CO_2 emissions being diagnosed as:

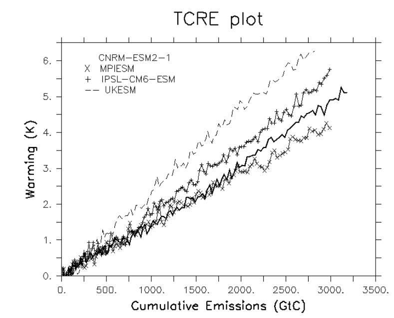
$$E(t) = \frac{dC_A}{dt} + F_{land} + F_{ocean} \qquad (1)$$

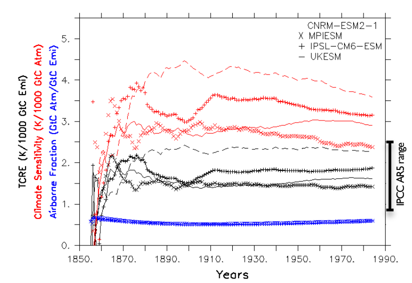
Formally, TCRE can be expressed as the product of a measure of the climate sensitivity by the atmospheric CO_2 airborne fraction:

$$TCRE = \frac{dT}{dE_{cum}} = \frac{dT}{dC_A} \times \frac{dC_A}{dE_{cum}} \qquad (2)$$

In addition the C^{4}MIP 1%_BGC and 1%_RAD simulations allow to quantify the strength of the carbon cycle feedbacks (β and γ) and their contribution to the TCRE uncertainty.

2) TCRE in CMIP6

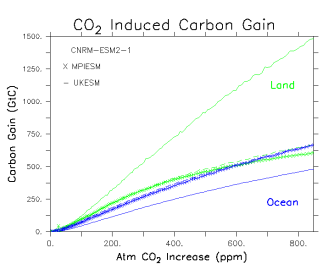


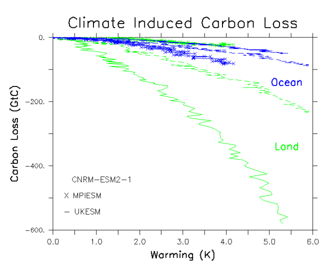


A preliminary analysis based on four ESMs available to date, CNRM-ESM2-1, MPIESM, IPSL-CM6-ESM, and UKESM is presented here. The spread in TCRE is already quite large, with diagnosed TCRE of 1.4˚ (CNRM-ESM2-1), 1.6 MPIESM), 1.9 (IPSL-CM6-ESM), and 2.3 ˚C/10^{3}GtC (UKESM)., although still within the IPCC AR5 assessed range (0.8-2.5 ˚C/10^{3}GtC).

From the models available so far, the spread in TCRE largely comes from the spread in climate sensitivity, (CS), CNRM-ESM2-1, MPIESM, IPSL-CM6-ESM and UKESM having respectively a Transient Climate Response (TCR) of 2.8, 2.8, 3.5˚C and 4.2 ˚C.
However, the uncertainty in the airborne fraction (AF) is not negligible, CNRM-ESM2-1 lower TCRE than MPIESM being primarily due to its slightly lower airborne fraction.

3) Carbon Cycle Feedbacks





Further analysis of the carbon cycle role in controlling TCRE via the airborne fraction could be done using the simple linear climate-carbon feedback framework. TCRE can be expressed as:

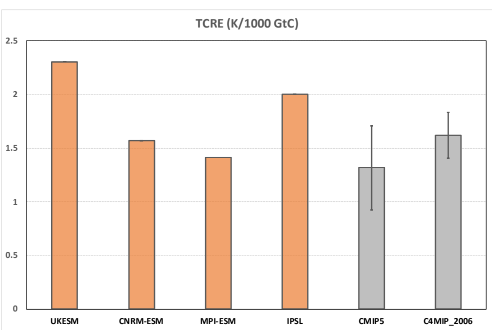
$$TCRE = \alpha/(1+\beta+\alpha\gamma) \qquad (3)$$

with α being a measure of the climate sensitivity, β being the carbon cycle sensitivity to atmospheric CO_2 increase, and γ being the carbon cycle sensitivity to climate change.

As in CMIP5, models show a large spread in land carbon cycle response to both atmospheric CO_2 and climate, while the ocean carbon cycle response is more robust across the models available here.

Spread in land response could be due to presence/absence of nitrogen cycle.

4) (very preliminary) Conclusions



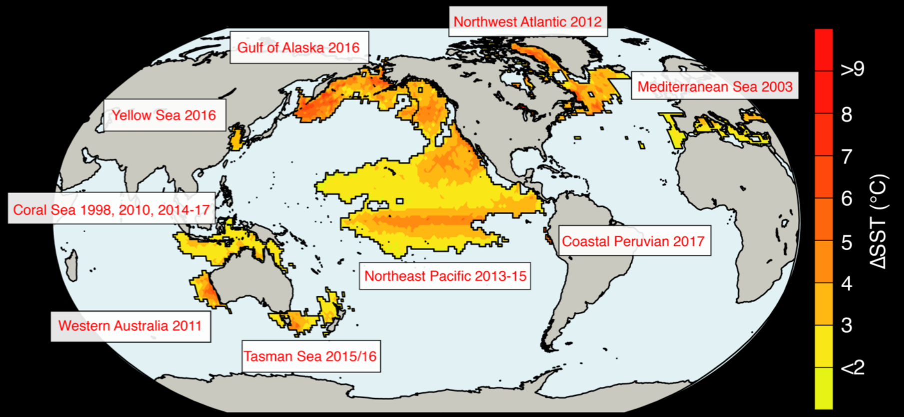
- TCRE can be diagnosed from 1%CO2 runs performed by CMIP6 ESMs.
- From the models available now, all have a TCRE above the CMIP5 multi-model mean, with 2 models being above the 1-σ range of the CMIP5 ESMs.
- Nevertheless, all models are still within the AR5 assessed range (0.8-2.5 ˚C/10^{3}GtC).
- Preliminary analysis indicate that the large TCRE simulated by IPSL-CM6-ESM and UKESM is primarily due to the large climate sensitivity of these models.
- Spread in land carbon cycle response to CO_2 and climate is quite large, potentially due to nitrogen cycle being only included in some ESMs.

UNIVERSITY OF EXETER

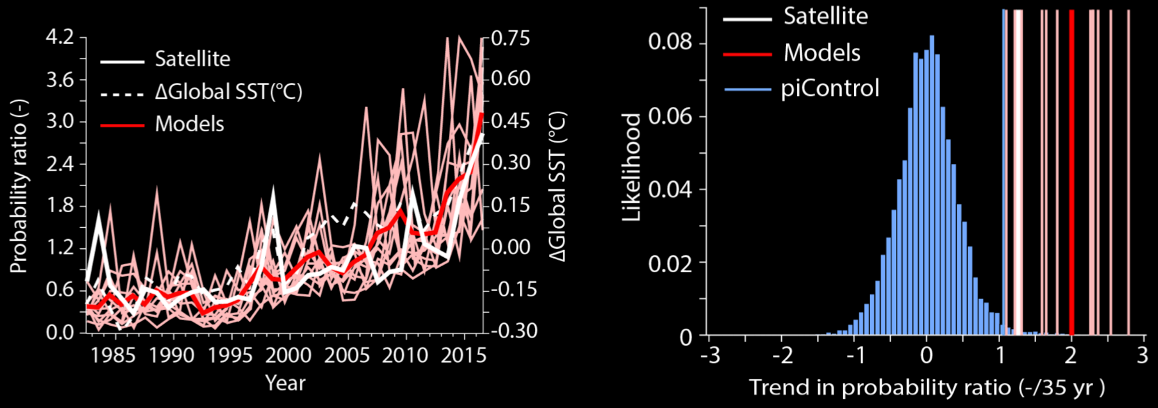
Assessing the robustness of marine heatwave projections

Thomas Frölicher (froelicher@climate.unibe.ch), Mathias Aschwanden, Stephen Griffies

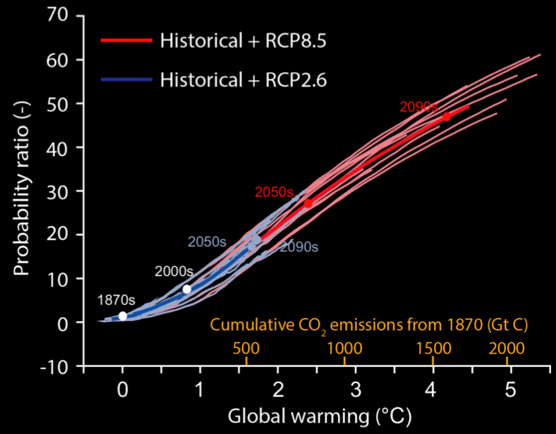
UNIVERSITÄT BERN



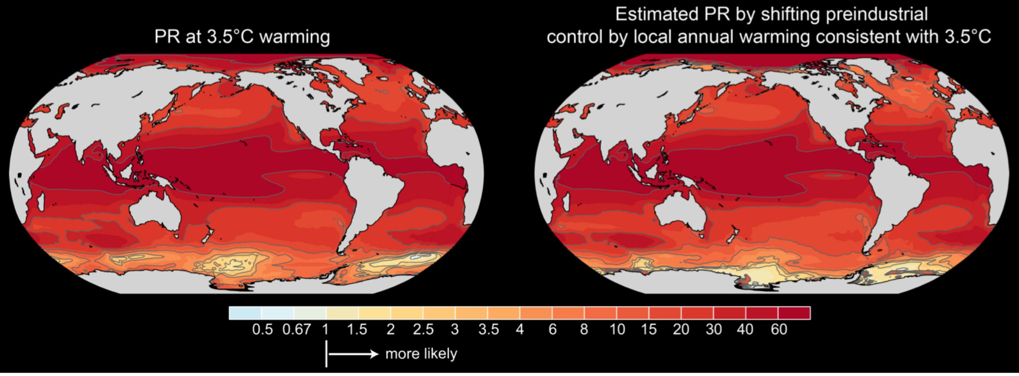
MHWs have occurred in all ocean basins over the last decades.



The number of MHW days have doubled since 1982.
87 % of today's MHWs have an anthropogenic component.



MHWs will increase in frequency under future global warming.



Largest changes are projected for tropics and Arctic Ocean.
Changes are mainly driven by global-scale shift in mean SST.

References: Frölicher et al. (2018, Nature), Frölicher and Laufkötter (2018, Nature Communications)

6-P10: Sensitivity of precipitation and its future changes to model resolution

Ying Na and Qiang Fu
Dept. of Atmos. Sciences, University of Washington, Seattle, WA, USA

Motivation: Examining how the precipitation probability density functions, extreme precipitations, and clear-sky fractions, and their future changes depend on the model resolutions

Data: IPSL-CM6A-LR (1950-2014) and the high resolution cloud resolving model NICAM (1979-2008) and 4 scenarios of IPSL-CM6A-LR (2015-2100) and NICAM based on A1B scenario (2075-2104)

Main Conclusion: For a given model, the frequency of extreme precipitation and clear sky fraction tend to decrease but their future changes tend to increase when the model data are re-gridded to coarser resolution

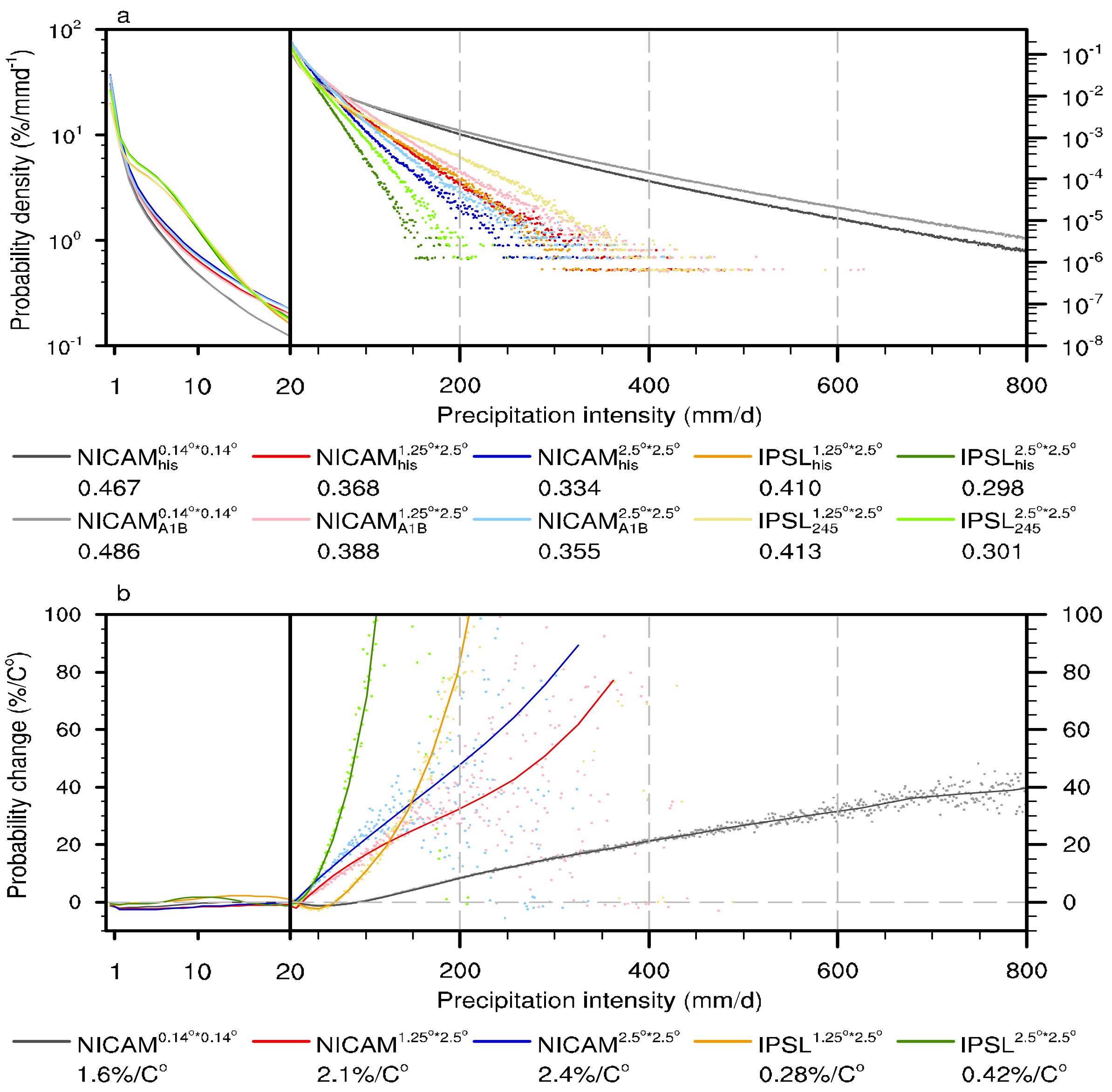
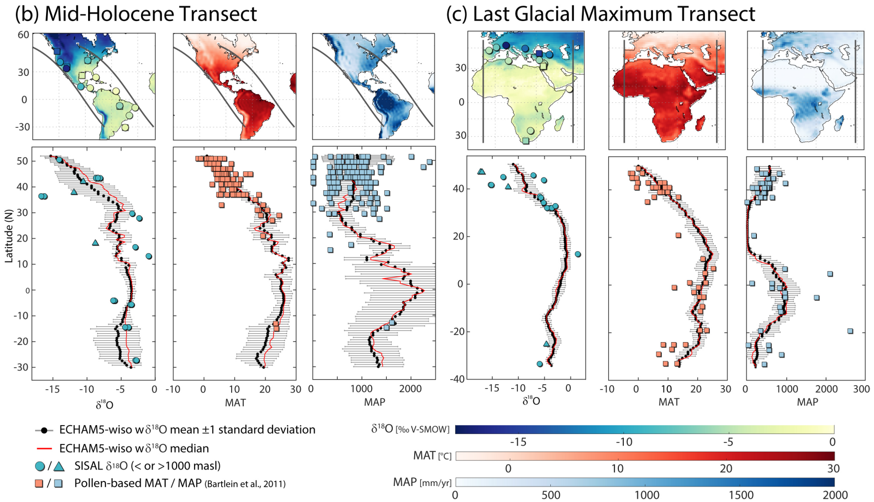
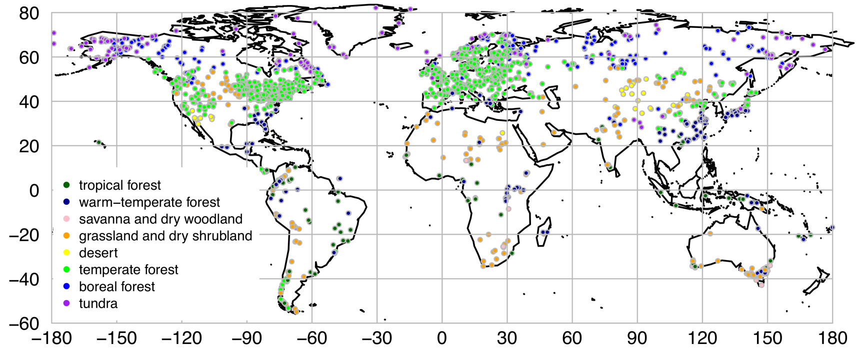


Fig. (a) Precipitation probability density of IPSL and NICAM with native resolution and coarser resolution for historical (1979-2008) and future (2071-2100 for IPSL, 2075-2104 for NICAM). (b) Percentage change of precipitation probability scaled by temperature change. The values under the labels are clear sky fractions and their percentage changes in the future scaled by temperature change.

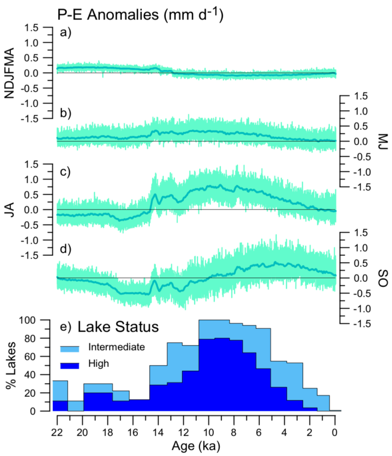
Evaluation of the PMIP4/CMIP6 palaeosimulations: P11

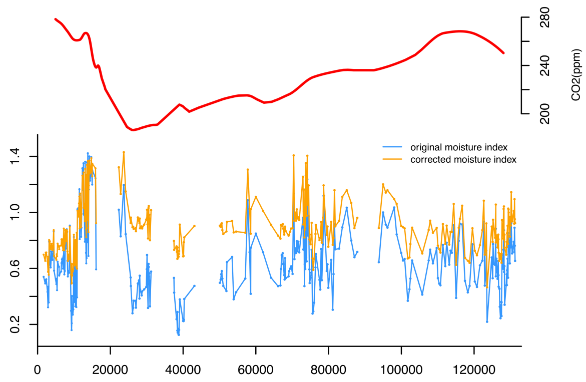


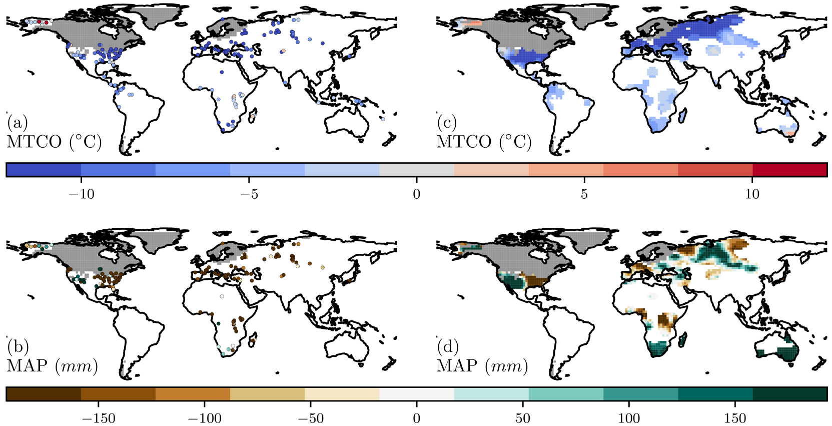


New data syntheses,
Improved theoretical basis,
Forward models,
Better evaluation tools

Sandy's Palaeo Environments and Climate Analysis group







Session 6 / P12

Monsoon precipitation responses to global warming and their regional differences simulated by CMIP models

***Hirokazu ENDO and Akio KITOH**

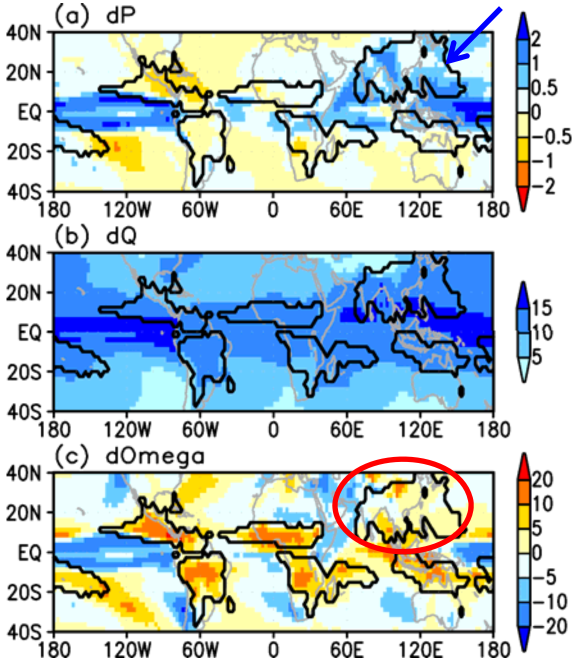
*** Meteorological Research Institute/JMA, JAPAN, hendo@mri-jma.go.jp**

Summer season **CMIP5/RCP8.5** Monsoon domain

Precipitation [mm/d]

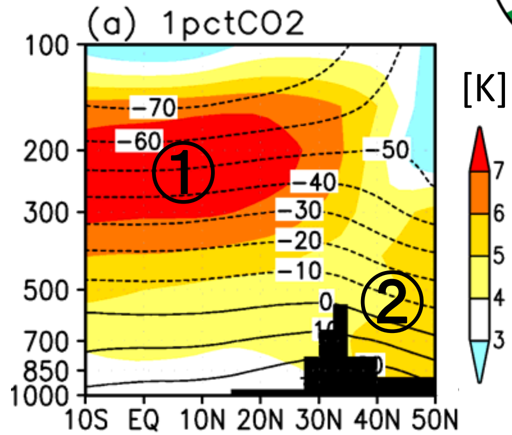
Atmospheric moisture [10^{-3} kg/m^2]

500-hPa vertical velocity [10^{-3} Pa/s]



- **Precipitation increase is clear over Asia.**
- **Atmospheric moisture is increased everywhere, while the atmospheric mean upward motion is weakened over the monsoon regions, with a less weakening over Asia.**

60E-100E ave temperature anomaly in JJA

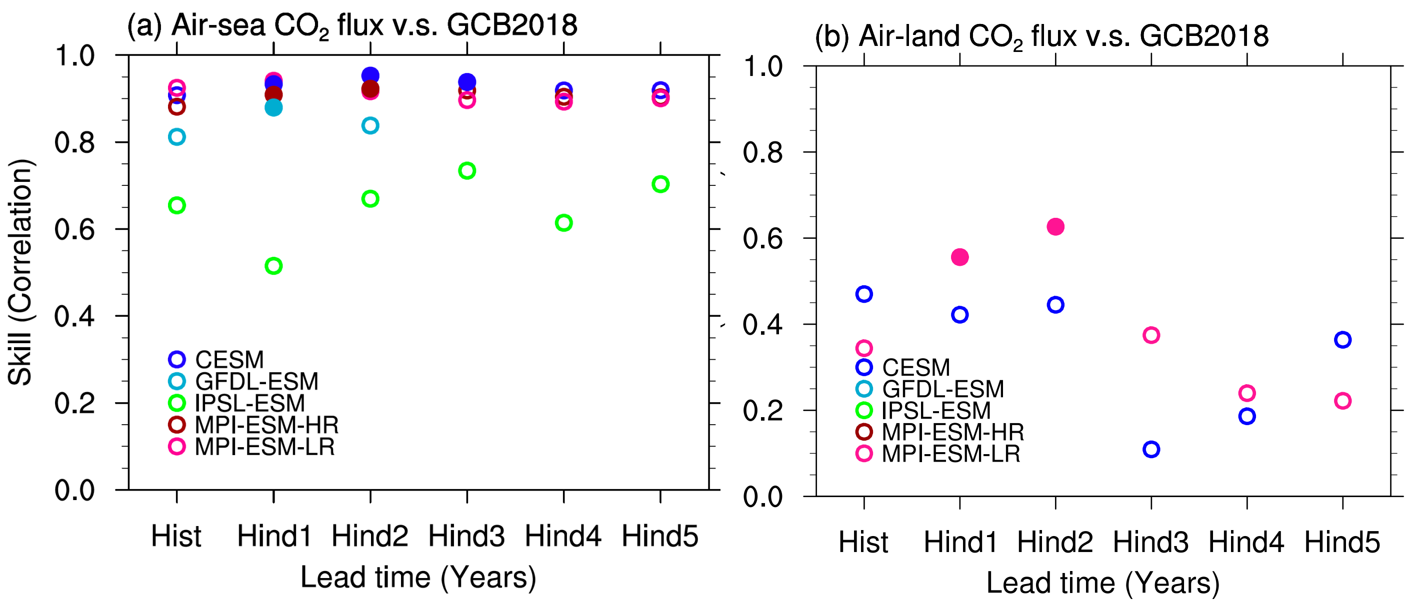


- **① Tropical upper-tropospheric warming stabilizes troposphere and decreases land-sea thermal contrast in the upper troposphere**
  → **Weaken monsoon circulation**
- **② Tropospheric warming over land increases the land-sea thermal contrast in the lower-troposphere**
  → **Intensify monsoon circulation**
- **The second factor is the most influential in the South Asian monsoon, resulting in the largest increase in precipitation, suggesting an important role of the land warming on the Asian monsoon response.**

How far is the carbon sink predictable in a multi-model framework?

Ocean C sink: predictable up to 2-3 years globally and up to 6 years regionally

Land C sink: predictable up to 2 years primarily in the tropics and extra-tropics



29 March – 9:30-15:00 Carbon Cycle Predictability Meeting
Venue: Aula de Teleensenyament – B3 Building, 1st floor

Tatiana Ilyina, H. Li, A. Spring, R. Bernardello, L. Bopp, J. Dunne,
P. Friedlingstein, N. Lovenduski, M. Chikamoto, J. Park, R. Séférian, S. Yeager

Max-Planck-Institut für Meteorologie

Preliminary results from the Global Carbon Cycle emissions driven simulations in the NASA-GISS climate model

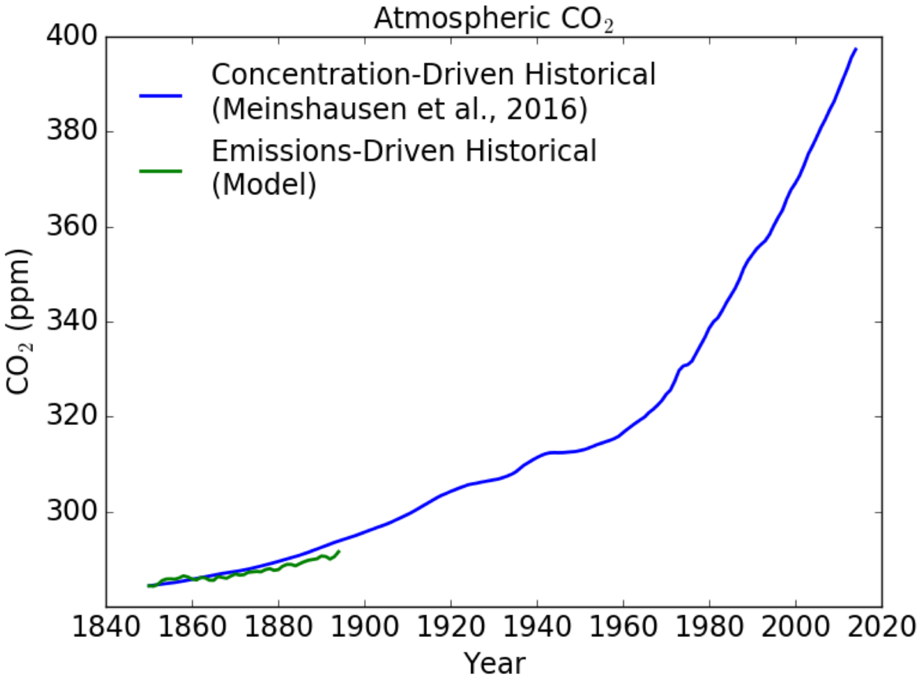
CMIP6 Workshop
Session #6 Poster P14

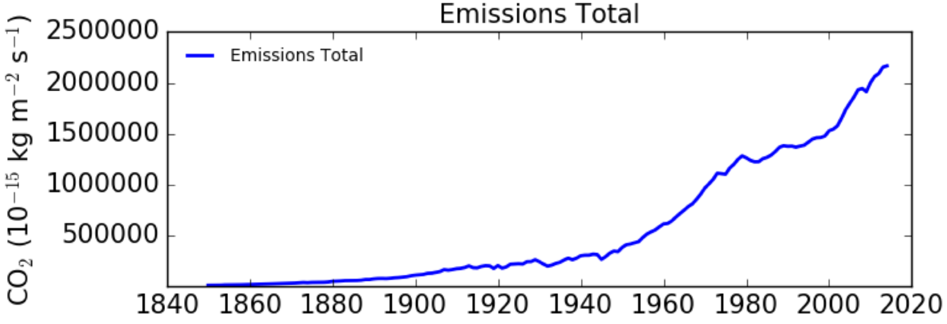
Gen Ito, Anastasia Romanou, Nancy Kiang, Igor Aleinov, Gregory Faluvegi, Maxwell Kelley, and Reto Ruedy

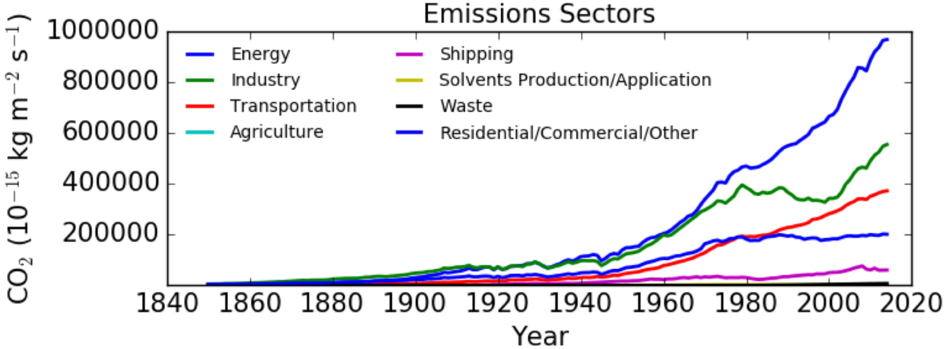
NASA Goddard Institute for Space Studies, New York, NY, USA (contact gen.ito@nasa.gov)

NASA GISS ModelE 2.1 coupled land-ocean-atmosphere global simulation run in:

1. concentration-driven historical simulation for 1850-2015 forced by prescribed CO_2
2. emissions-driven simulation forced by anthropogenic CO_2 emissions interacting with the atmosphere and coupled to the model's radiation







Fully coupled emissions-driven simulation consistent with the concentration-driven case:

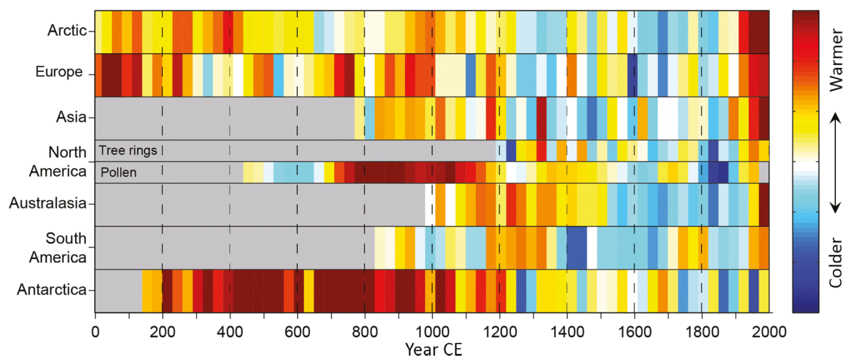
- atmospheric CO_2
- land/ocean fluxes

Perform all tier 1 experiments described in C4MIP protocol

Transient simulations over the Common Era as part of PMIP4/CMIP6

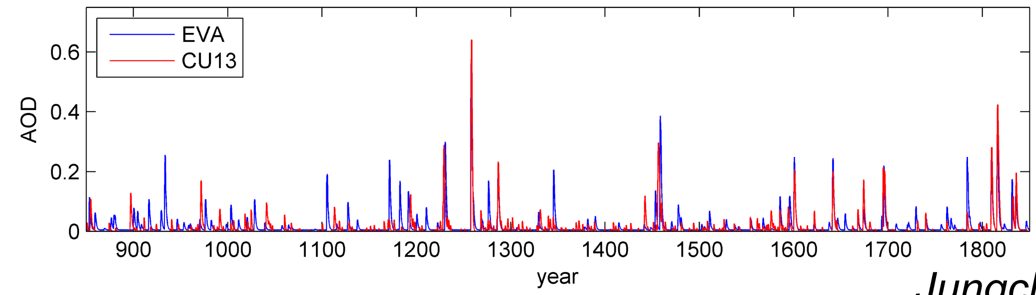
Johann Jungclaus[1], Alexandra Jahn[2], Matthew Toohey[3], Sebastian Wagner[4], and Stephan Lorenz[1]

PAGES2K reconstructions



PAGES2K, 2013

New PMIP4/CMIP6 forcing data

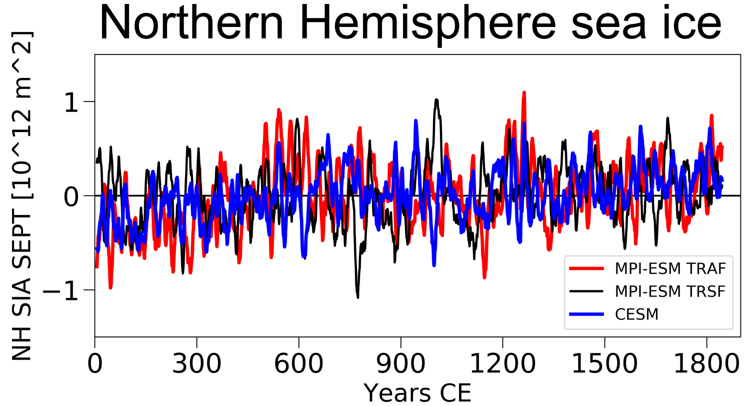


Jungclaus et al;., 2017

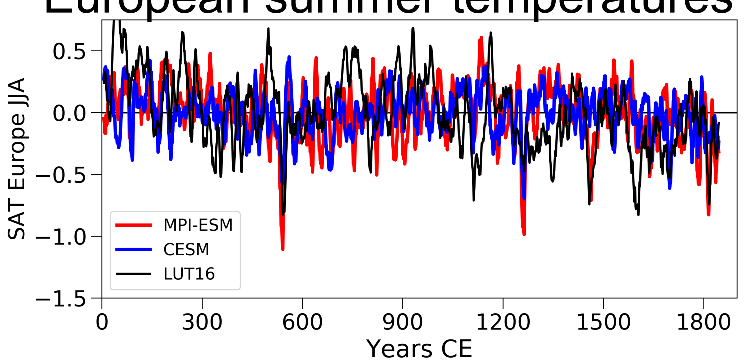
CESM* and MPI-ESM+ "past2k"simulations

Climate evolution over the CE

Northern Hemisphere sea ice



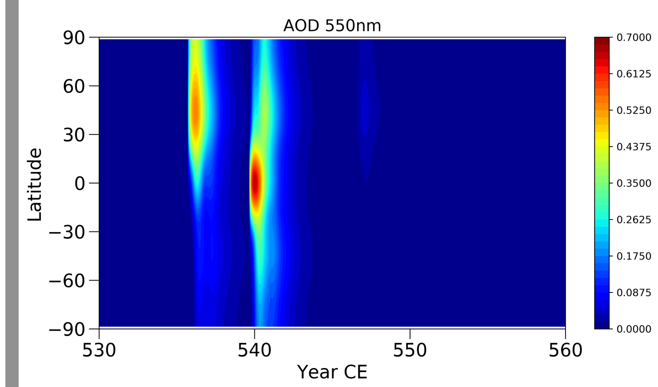
European summer temperatures



"past2k" simulations offer:

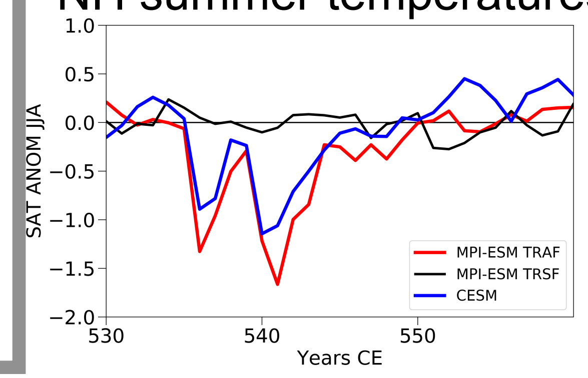
- **new perspectives for combined studies on models/ reconstructions (PAGES2K)**
- **new insights in origins and effects of 6th century cool phase (aka "Late Antique Little Ice Age")**

The 6th century volcanic double event

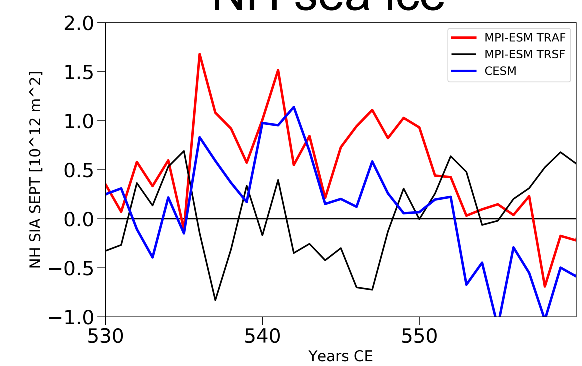


Aerosol optical depth @ 550 nm

NH summer temperatures



NH sea ice



[1]Max Planck Institute for Meteorology, Hamburg, Germany, [2]University of Colorado, Boulder, Co, USA
[3]GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany, [4]Helmholtz Zentrum Geesthacht, Germany

*Zhong, Y. et al., GRL, 2018
+Bader, J., et al. under review

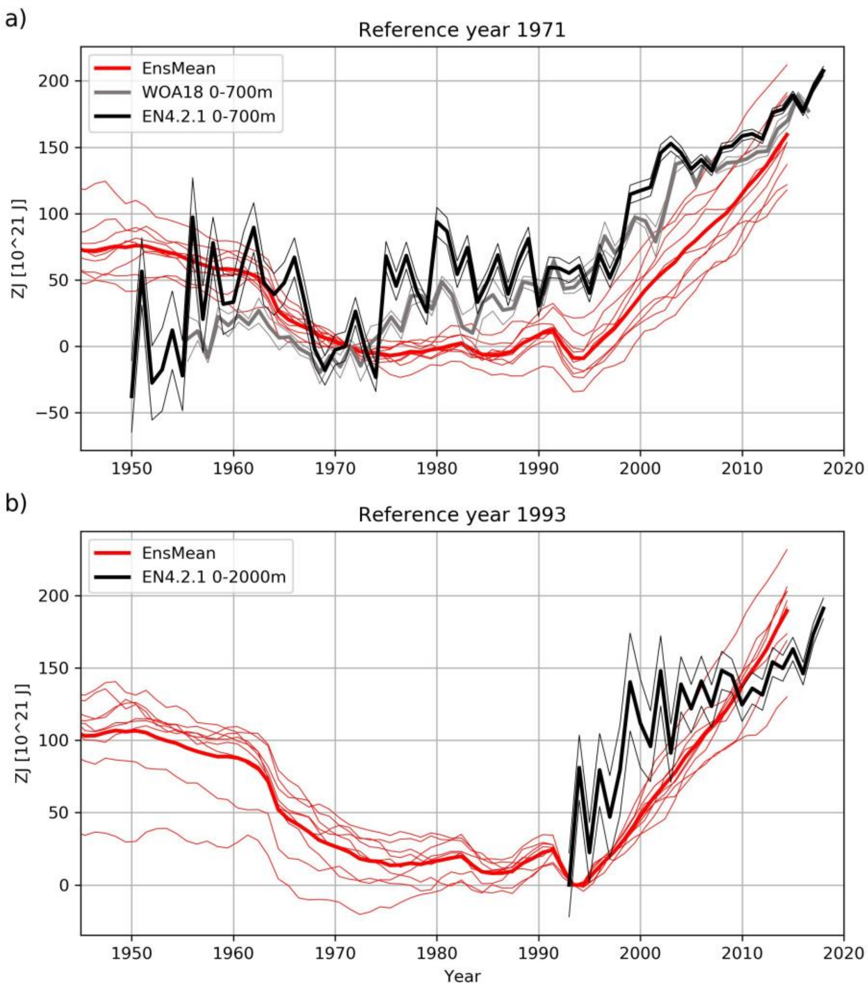
Max-Planck-Institut für Meteorologie

Ocean heat uptake in the UKESM1 CMIP6 simulations of the historical climate

Till Kuhlbrodt, Colin Jones, Lee de Mora, Julien Palmieri, Andrew Yool

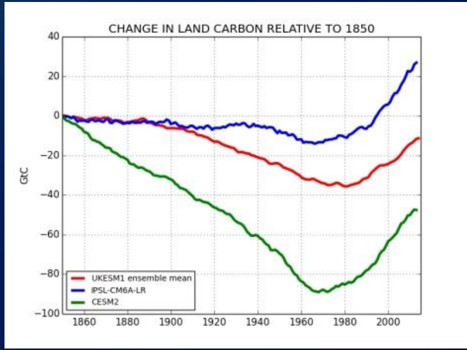
- First analysis of ocean heat content (OHC) anomalies in the CMIP6 historical simulations with the UK Earth System Model UKESM1.
- The EN4.2.1 observational data set shows a ~150 ZJ OHC increase from 1993 to 2015, between 0-2000 m. In the UKESM1 historical simulations the ocean heat uptake is similar (lower panel).
- Both observational data sets show an OHC increase of about ~50 ZJ from 1971 to 1993, between 0-700 m. The UKESM1 historical simulations do not show this (upper panel).
- Reasons for the absence of ocean heat uptake in the simulated 1970s and 1980s are under investigation.

P16



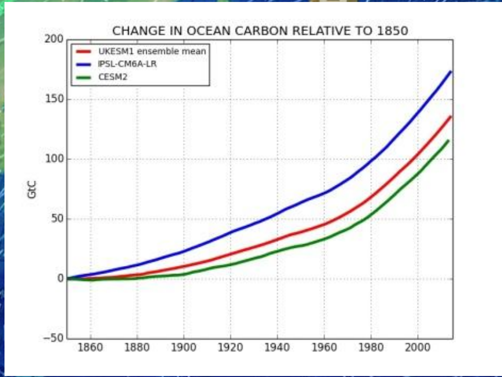
Compatible fossil fuel emissions in three CMIP6 Models

Spencer Liddicoat, Chris Jones, Andy Wiltshire

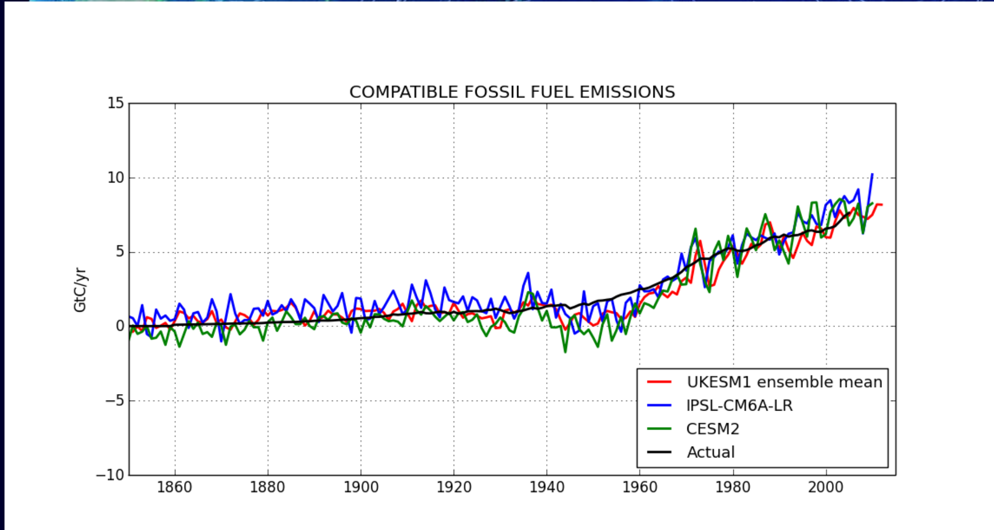


CMIP6 Historical simulation: results from 3 Earth System Models: UKESM1, IPSL-CM6A-LR, CESM2

- **Driven by prescribed historical atmospheric CO_2**
- **Models simulate carbon uptake by land and by the oceans**



- **Therefore we can calculate how much fossil fuel CO_2 can be emitted to be consistent with the concentration pathway driving the model.**
- **These compare well with the observed CO_2 Fossil Fuel emissions.**
- **This gives us confidence in the ESMs' future carbon budgets.**

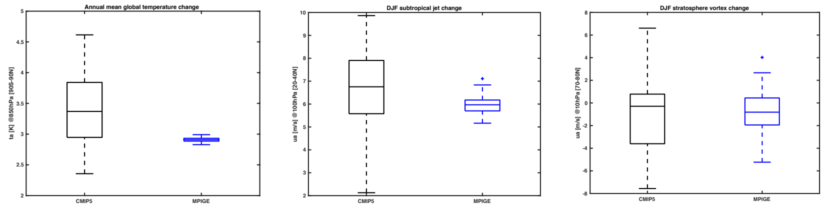


Stratosphere-Troposphere Circulation Changes

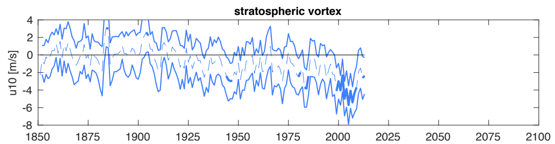
Manzini, E. (Max Planck Institute for Meteorology, Hamburg, Germany)
A. Yu. Karpechko (Finnish Meteorological Institute, Helsinki, Finland)

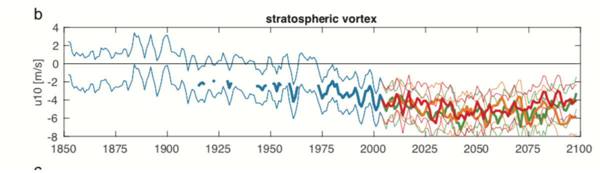
Motivation: analyze *DynVarMIP/CMIP6* and *single-model large ensembles* to assess, understand and better quantify previously found dynamical uncertainties and their links, with a focus on the stratosphere-surface climate links.
(Manzini et al 2014; Simpson et al 2018)

- CMIP models and MPIGE ranges

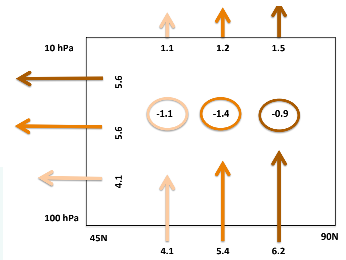


- Inter-comparison of single-model large ensembles (CMIP6/IPSL and MPIGE)





- DynVar/CMIP6 EP flux budgets



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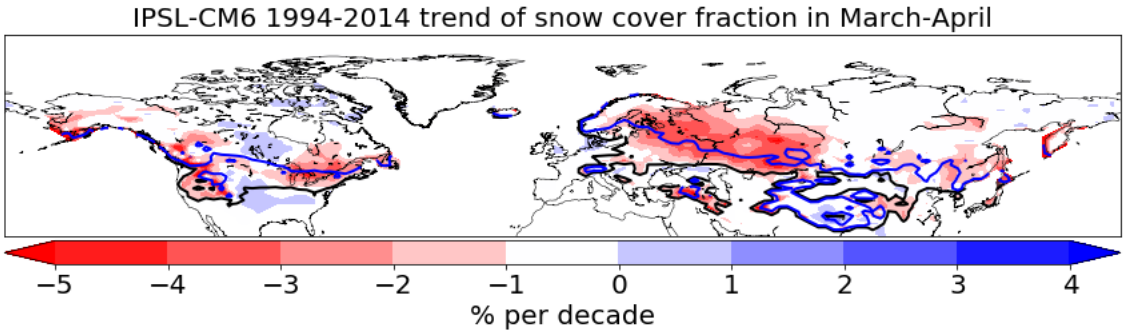
Present and future seasonal land snow cover simulated by CMIP coupled climate models

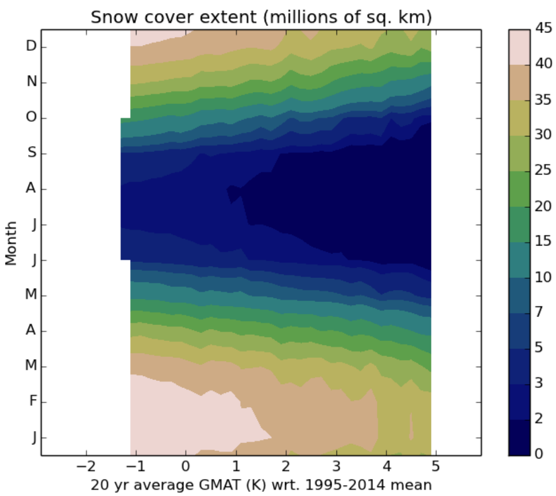
Ménégoz M.[1], Krinner G. [1], Brutel-Vuilmet C.[1], Santolaria-Otín M. [1], Derksen C. [2], Mudryk L.[2]
1 Institut des Géosciences de l'Environnement (France); 2 Environment and Climate Change Canada

Motivations:

- 45 million km^2 of the Northern Hemisphere snow-covered in winter.
- Snow albedo feedback, atmospheric circulation, carbon storage in permafrost.

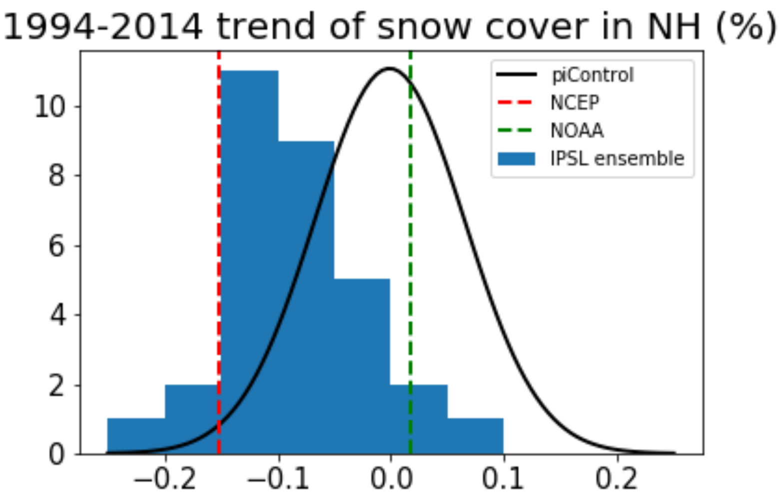


The IPSL-CM6 31 member historical experiment shows a **pronounced retreat of the snow cover extent** (50% climatological level in blue)



Monthly snow cover decrease as a function of global temperature (historical+projection, left)

Internal variability: 31-member distribution of 20 year trends in the historical experiment (right)



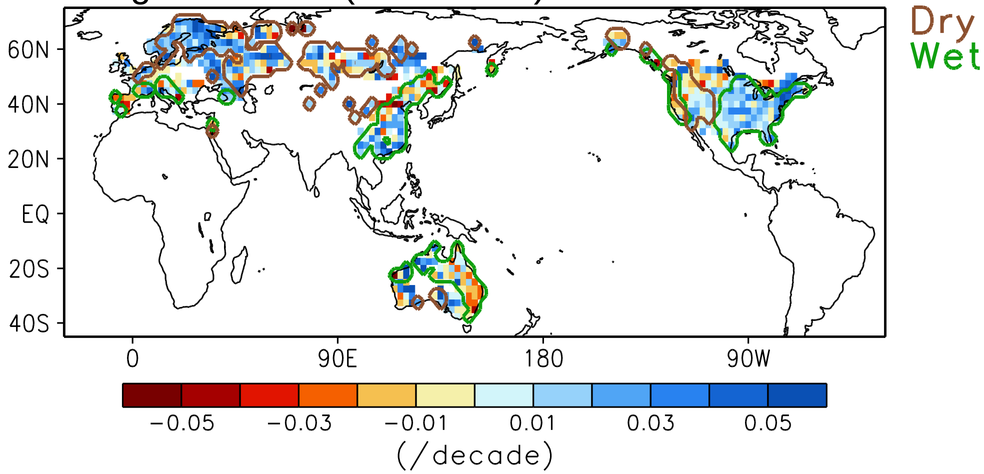
Attribution of the observed intensification of extreme precipitation over dry and wet regions

Seungmok Paik and Seung-Ki Min
Pohang University of Science and Technology (POSTECH)

Session 6 / P20

OBS

Annual maximum precipitation
Long-term trend (1953-2012)

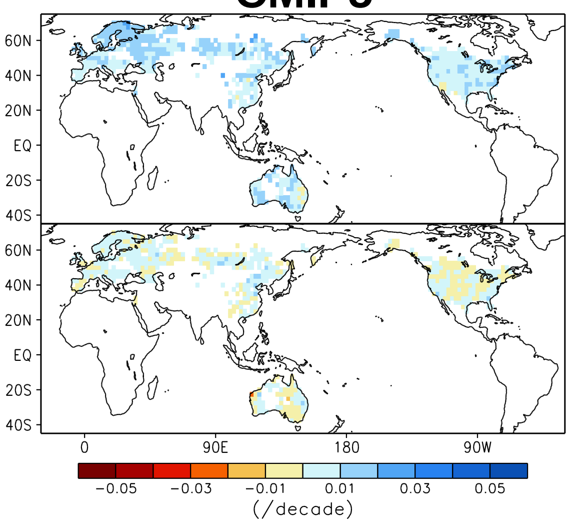


- Anthropogenic influences on extreme precipitation increase is robustly detected from optimal detection analysis, especially over dry regions

CMIP5

ALL [36]

NAT [9]



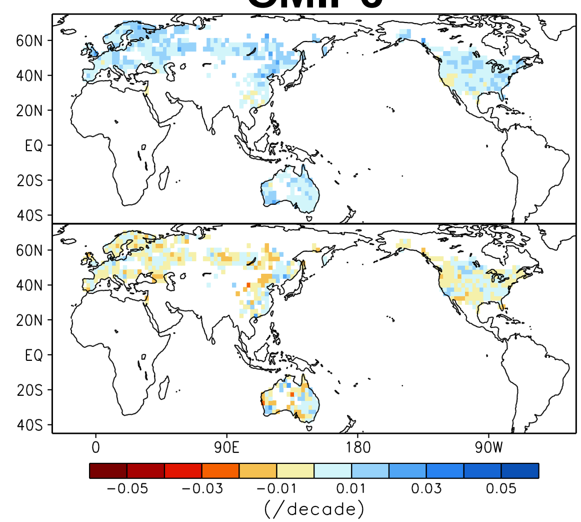
CMIP6

ALL [5]

BCC-CSM2-MR
BCC-ESM1
CNRM-CM6-1
CNRM-ESM2-1
IPSL-CM6A-LR

NAT [1]

IPSL-CM6A-LR



CONTRIBUTION OF THE GREENLAND ICE SHEET TO EUSTATIC SEA LEVEL RISE: PROJECTIONS WITH CMIP6 CESM2.1 – CISM2.1

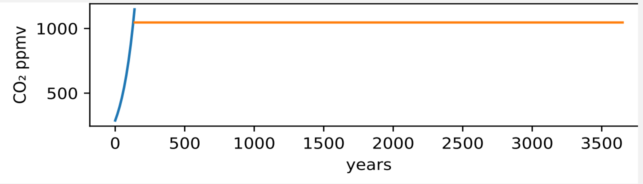
L. Muntjewerf[1], W.H. Lipscomb[2], W.J. Sacks[2], M. Löfverstrom[3], J.G. Fyke[4,5], R. Sellevold[1], C. Ernani da Silva[1], S.L. Bradley[1], M. Petrini[1], M.Vizcaino[1]

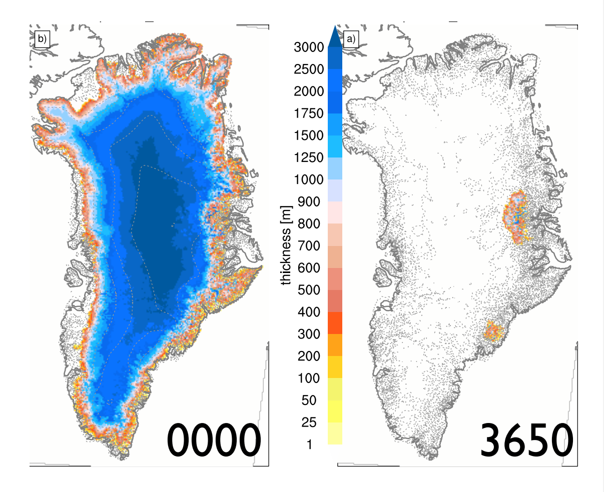
- Community Ice Sheet Model simulations with CESM2.1 CMIP6 forcing
- Results in preparation for AOGCM-ISM runs

Session 6
#P21

Ice sheet model only

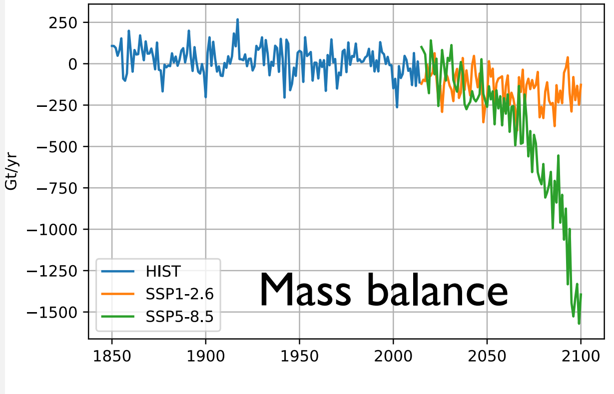
1% till 4xCO_2
+ extension to deglaciation





Ice sheet model only

SSP1-2.6 and SSP5-8.5
scenario projections



	Historical	*SSP1-2.6*	*SSP5-8.5*
GrIS eustatic SLR (mm)	-6.18	35.80	100.29
Mass Balance (Gt/yr)	15.50	-138.06	-855.38
- Surface mass balance	486.71	271.23	-526.59
- Basal mass balance	-22.98	-22.21	-20.45
- Ice Discharge	-448.22	-387.09	-308.33

Table 1: Greenland cumulative contribution to eustatic sea level rise (mm) for the historical simulation (1850-2014), the SSP1-2.6 scenario (2015-2100), and the SSP5-8.5 scenario (2015-2100). Mass balance (Gt/yr) and

TU Delft

European Research Council
Established by the European Commission

CoupledIceClim
June 2016-May 2021

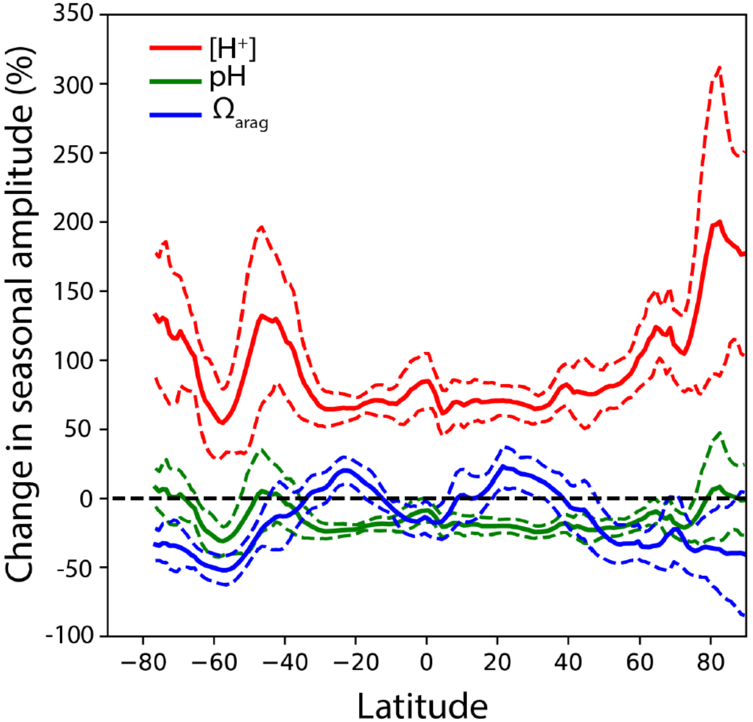
[1] Department of Geoscience and Remote Sensing, Technical University Delft, Delft, The Netherlands. [2] Climate and Global Dynamics Laboratory, NCAR, Boulder, USA. [3] Department of Geosciences, University of Arizona, Tucson, USA. [4] Associated Engineering Group, Ltd., Edmonton, Alberta, Canada. [5] Los Alamos National Laboratory, Los Alamos, NM, USA.

l.muntjewerf@tudelft.nl

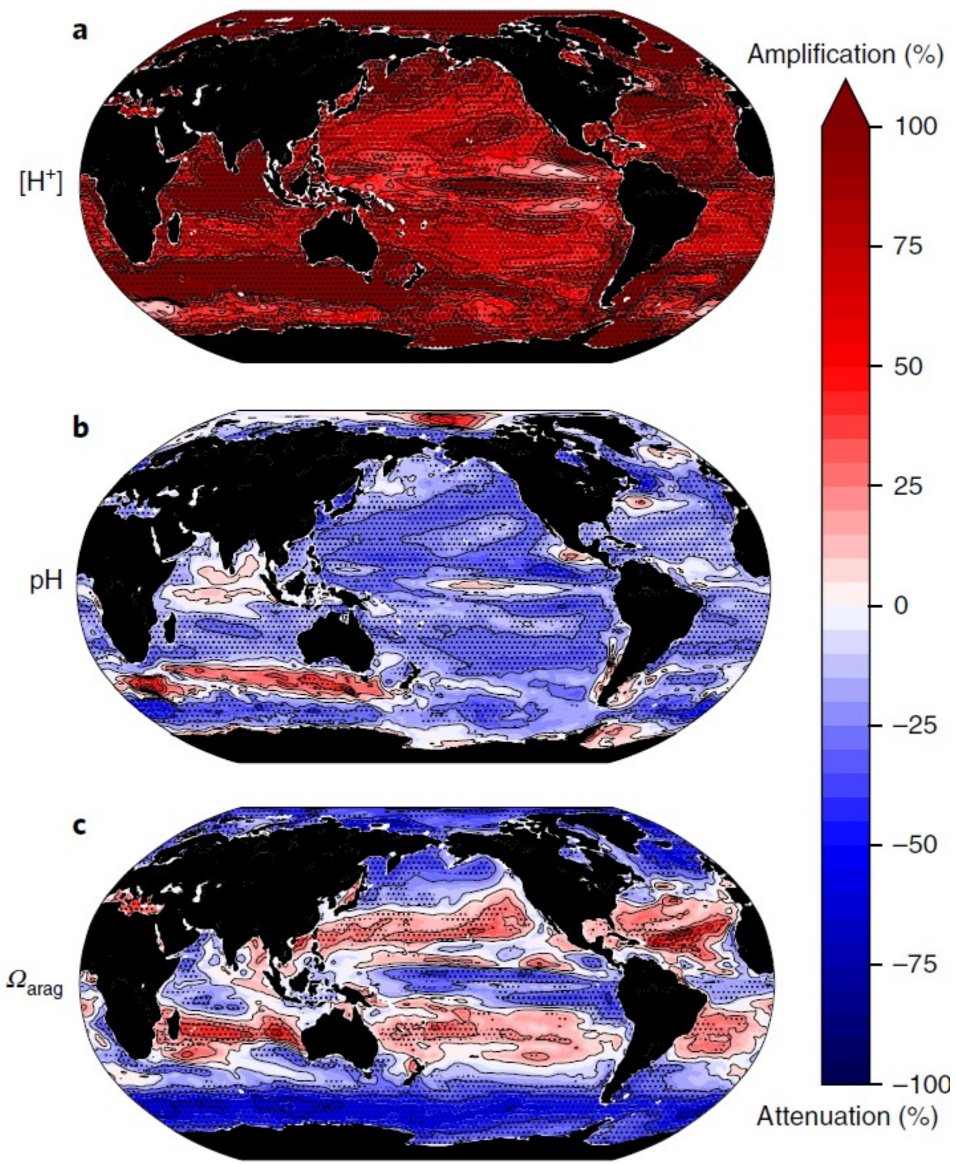
Seasonal amplification, phase shift, & uncertainties for ocean acidity during the 21st century *(poster 6-P22)*

J.C Orr (LSCE/IPSL) & L. Kwiatkowski (LMD/IPSL), France

CMIP5 assessment (9 models):
21st century increase
in $[H^+]$ seasonal amplitude



$$d\ pH = \frac{-1}{2.303}\frac{d[H^+]}{[H^+]}$$

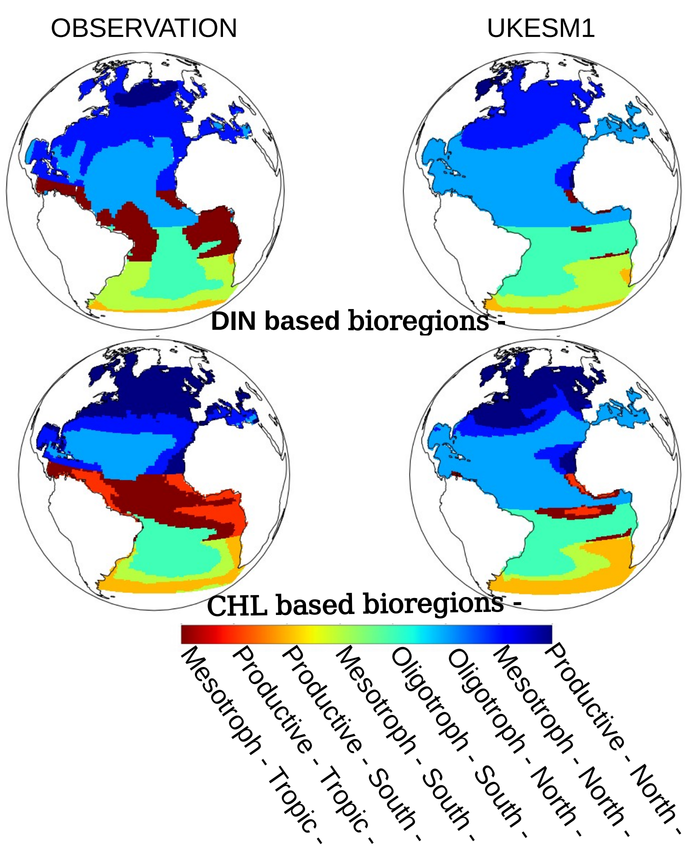


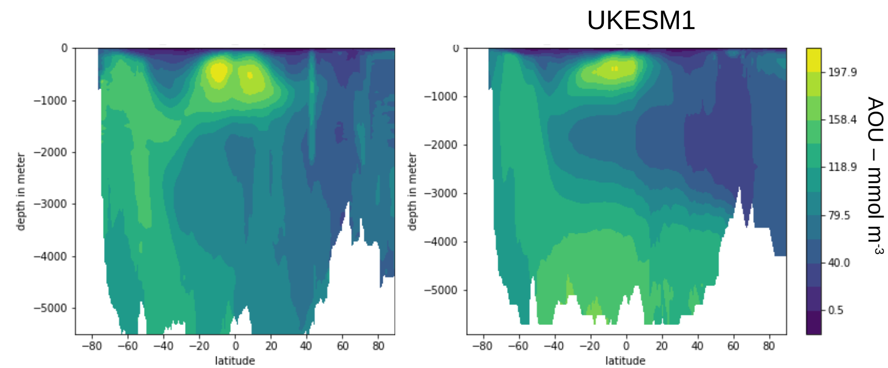
Kwiatkowski & Orr (2018)

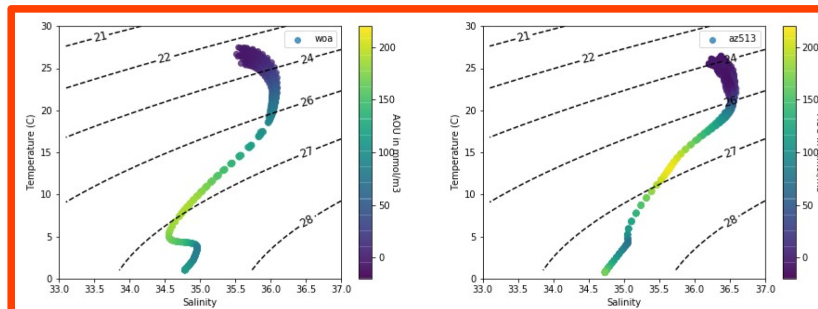
Regional analysis of present day marine productivity in UKESM1

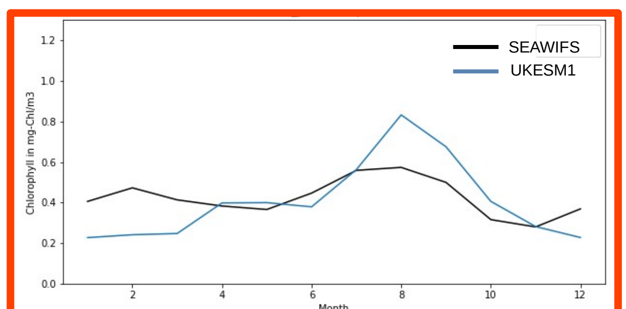
J. Palmiéri, A. Yool, E.E. Popova, UKESM1 core group
(National Oceanography Centre, Southampton, United Kingdom)

Evaluate UKESM1 bioregions and associated biogeochemistry









Poster : P23 !!

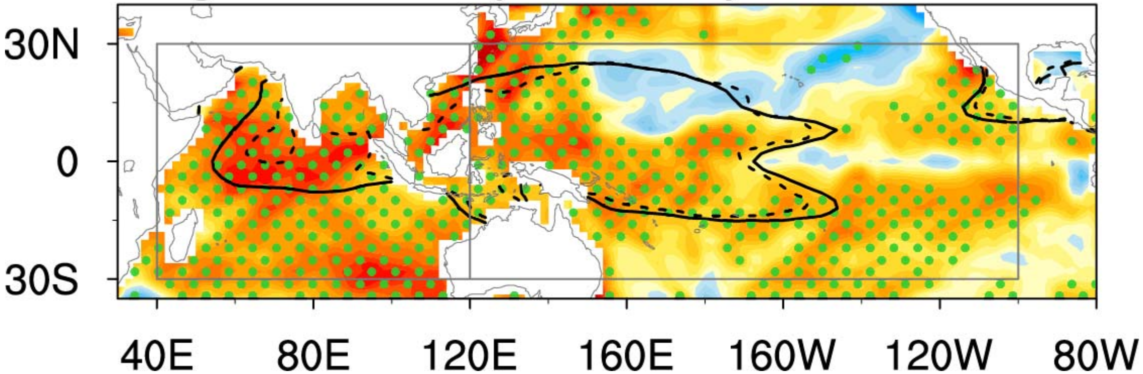
Session 6
P-24

Attributing the Indo-Pacific warm pool expansion : seasonal changes and its impacts on precipitation

In-Hong Park and Seung-Ki Min (POSTECH)

OBS

Boreal Autumn SST and warm pool
Long-term trends (1953-2012)

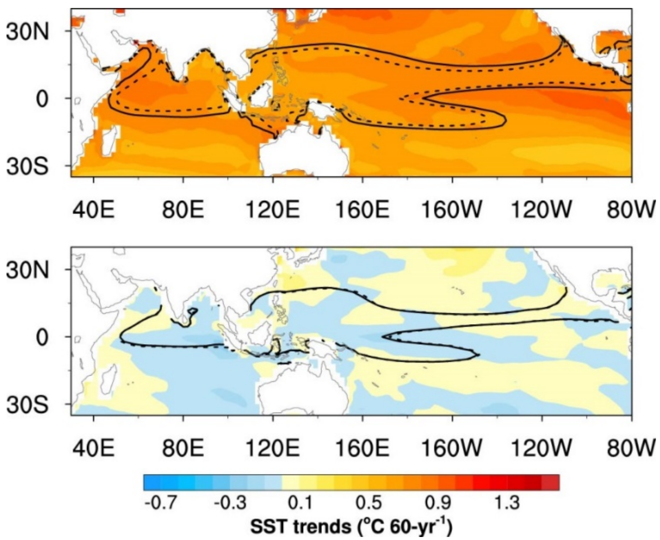


- **IPWP expansion dominant in Indian Ocean during SON/DJF**
- Robustly attributed to **anthropogenic forcing**
- Similar results between CMIP5 and CMIP6 models

CMIP5

ALL [22]

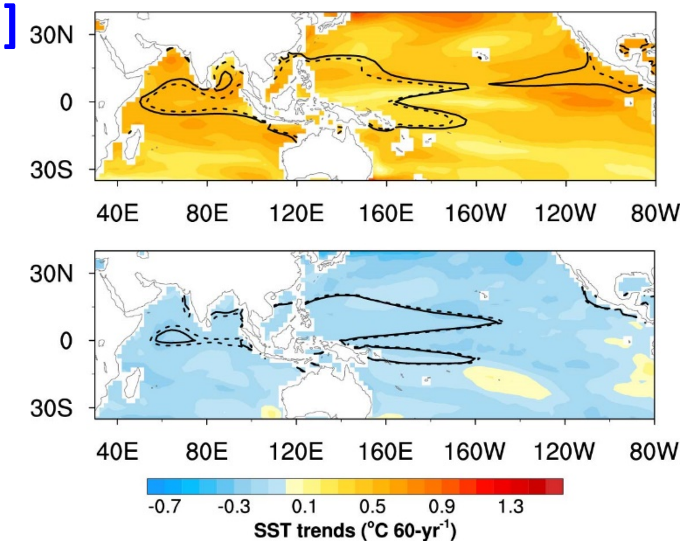
NAT [5]



ALL [8] NAT [2]

- BCC-ESM1
- BCC-CSM2-MR
- CESM2
- CNRM-CM6-1
- CNRM-ESM2-1
- GISS-E2-1-G
- IPSL-CM6A-LR
- MIROC6

CMIP6

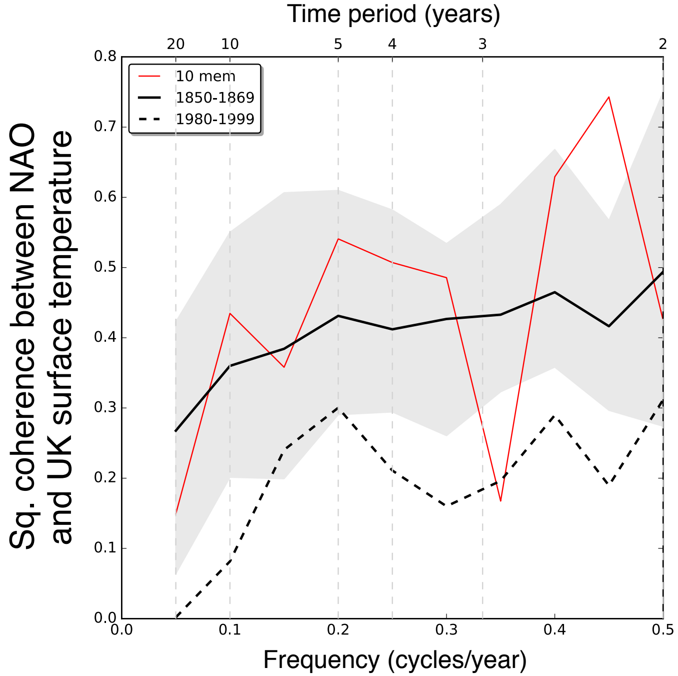


6-P25: Detecting changes in North Atlantic variability under global warming

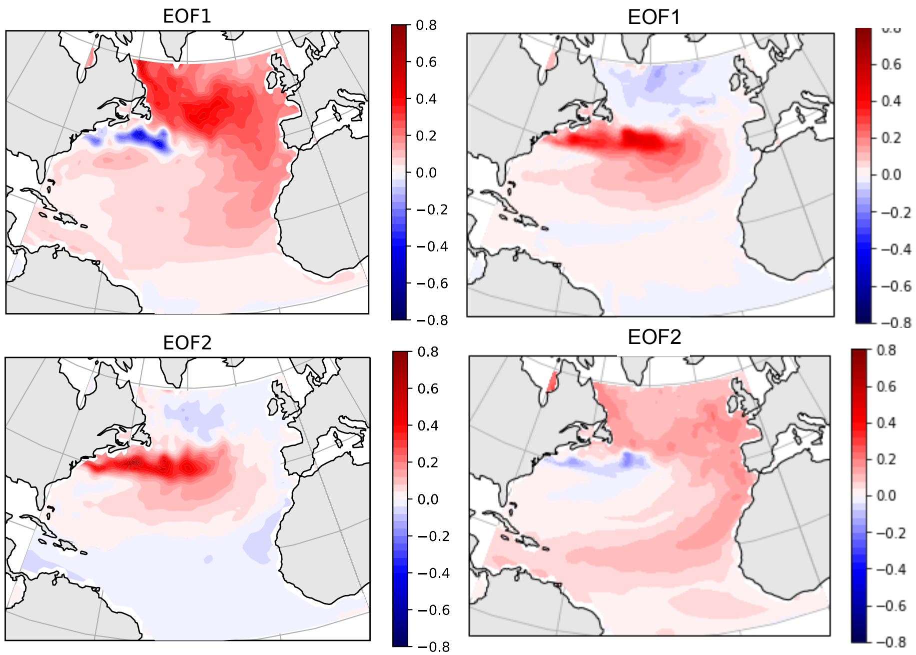
Putrasahan, D. A., Jungclaus, J. H., von Storch, J.-S., Ghosh, R.
Max Planck Institute for Meteorology, Hamburg, Germany

The Max Planck Institute - Grand Ensemble (MPI-GE) gives us the opportunity to assess changes in internal variability in a transient climate. This is done by extending 2 classical techniques (simple EOFs and cross spectral analysis) to:

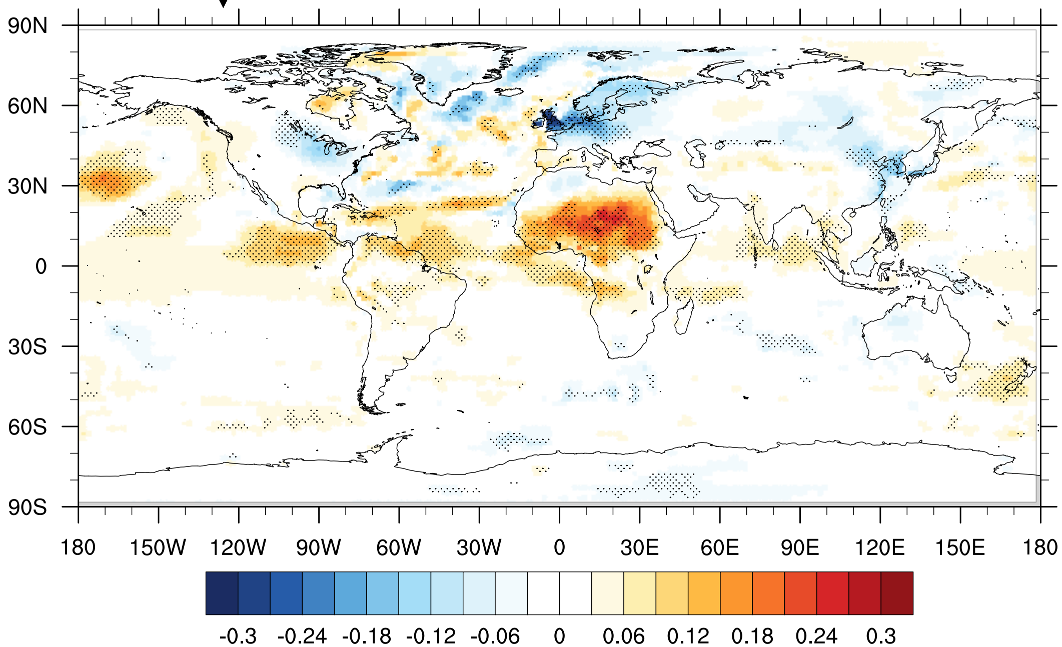
1) EOFs in ensemble space to primarily detect changes in spatial patterns of dominant modes (e.g. North Atlantic SST)
2) squared coherence between a climate index (e.g. NAO) and a climate variable (e.g. DJF surface temperature) all over the world to evaluate changes in the pattern of their relationship at different timescales



Historical, year 1851 **RCP8.5, year 2077**



Difference in sq. coherence between NAO and surface temperatures on decadal scale (130 years apart) for 1%CO_2 scenario



Max-Planck-Institut für Meteorologie

contact: dian.putrasahan@mpimet.mpg.de

PRIMAVERA

MAX-PLANCK-GESELLSCHAFT

Assessing co-behavior of climate processes over southern Africa using CMIP5 models [S6 P26]

[1]Kwesi A. Quagraine*, [1]Bruce Hewitson, [1]Chris Jack, [1]Izidine Pinto, [1]Chris Lennard [1]Piotr Wolski

[1]Climate Systems Analysis Group, University of Cape Town, South Africa

(contact: **kwesi@csag.uct.ac.za**)

Background

- Regional climates → a no. of climate processes operating in multiple spatial and temporal scales.
- Evaluating the regional response to the collective co-behavior of these processes is central to understanding the region's climate, more so with regions with no dominant large-scale driver, this is important.
- Co-behavior is a concept used here and is interpreted as an interaction between at least two or more climate features leading to their influence on the weather and climate for any given region.

Data

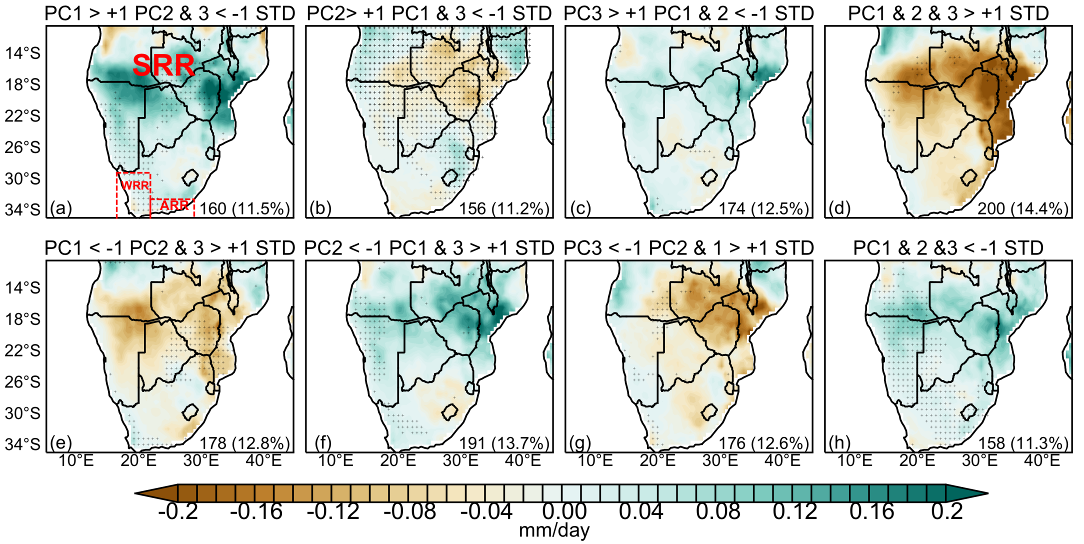
- Observational datasets (Precipitation → CHIRPS and temperature →CRU)
- Climate indices for Antarctic Oscillation (AAO), El Niño Southern Oscillation (ENSO) and Inter-Tropical Convergence Zone (ITCZ)
- 8 CMIP5 GCMs

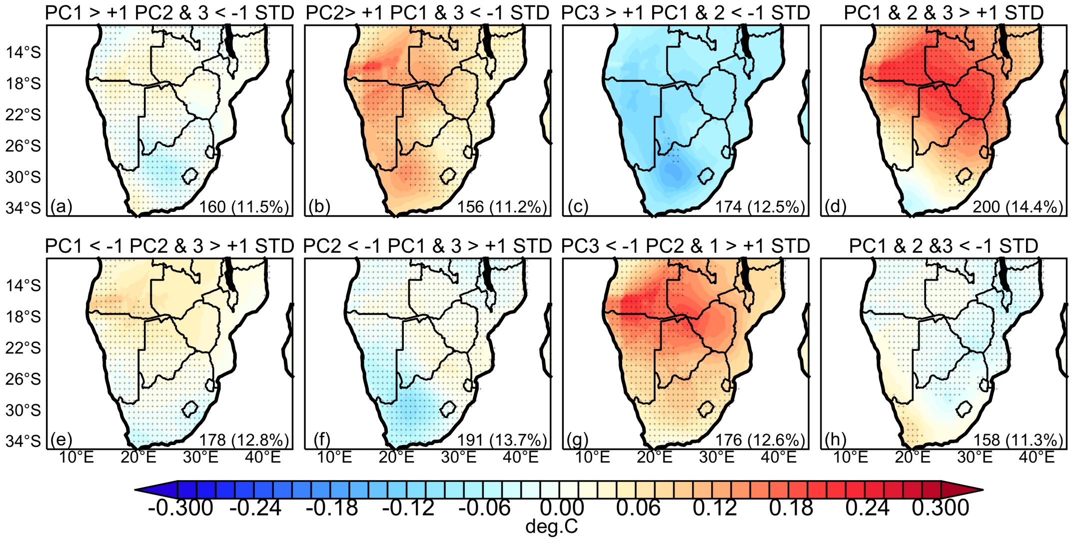
Methods

- Self-Organising Map (SOM), PCA and composite analysis

Summary

- AAO) moderates the regional precipitation and temperature response to EL Niño when co-behaving
- CMIP5 models largely agree with the sign of change of identified co-behavior modes in observational datasets.



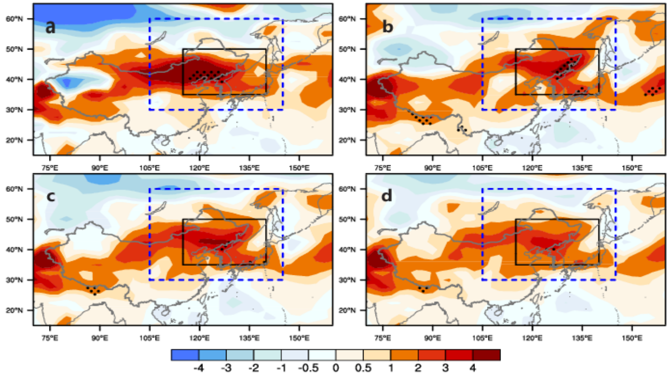


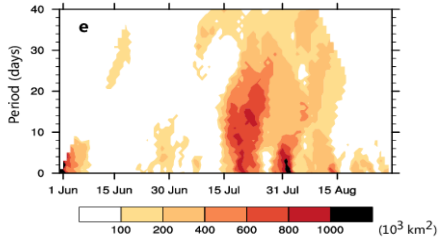
Attribution of record-breaking hot summer over Northeast Asia in July-August 2018: the contribution of circulation

Liwen Ren, Tianjun Zhou

Institute of Atmospheric Physics, Chinese Academy of Sciences, China

1 Observed characteristic



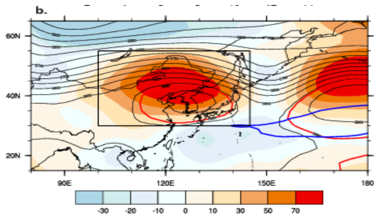


An extraordinary heat wave hit Northeast Asia in summer 2018.

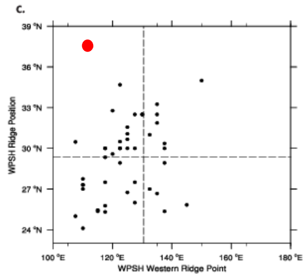
Northeast China, Korea and Japan were the most affected area, from daily to monthly timescales.

2 Circulation feature

Z500



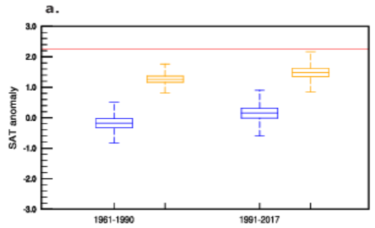
WPSH ridge line index

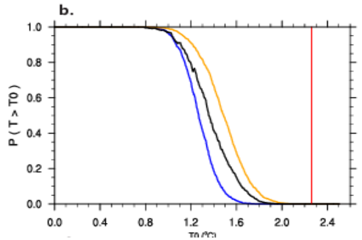


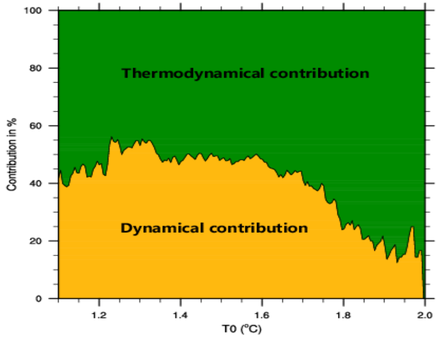
WPSH ridge west-extending point

Anticyclonic anomaly over Northeast Asia, as well as record-breaking northward shift of Western Pacific Subtropical High (WPSH)

3 Circulation contribution







1. The persistent anomalous anticyclone explain two-thirds of the temperature anomalies.

2. The change in dynamical flow explain a fraction between 20% and 50% of the temperature anomalies.

3. The contribution of thermodynamical changes to temperature anomalies generally increased with the rarity of extreme event.

Tracking the impact of climate model complexity in future climate projections using CNRM-ESM2-1 and CNRM-CM6-1

Poster session 6 P28

Roland Séférian, Pierre Nabat, Martine Michou, David Saint-Martin, Aurore Voldoire, Jeanne Colin, Bertrand Decharme, Christine Delire, Sarah Berthet and the CNRM-CERFACS Modelling group

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Contributions of CNRM-CERFACS modelling group to CMIP6:

This poster

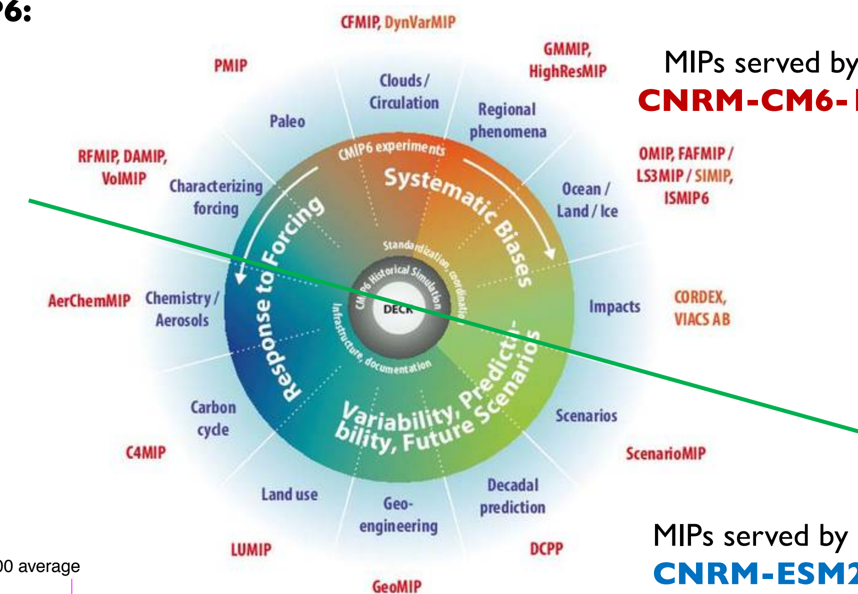
Rising complexity

Low/Standard resolution Atmosphere-Ocean GCM **CNRM-CM6-1**

Low/standard resolution Earth system model **CNRM-ESM2-1**

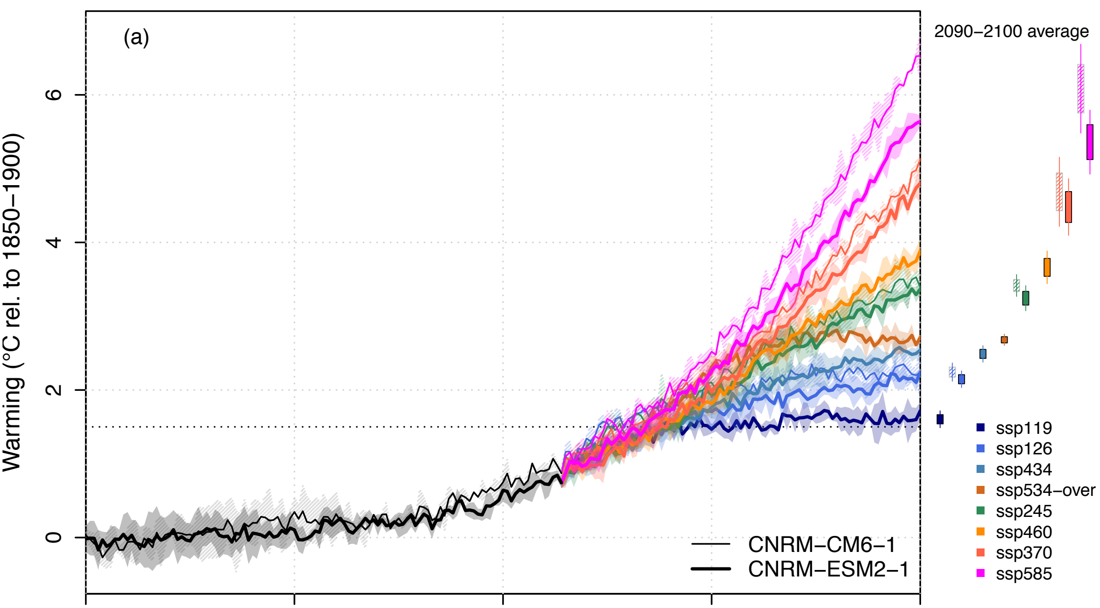
Rising resolution

High-resolution Atmosphere-Ocean GCM **CNRM-CM6-1-HR**



MIPs served by **CNRM-CM6-1**

MIPs served by **CNRM-ESM2-1**

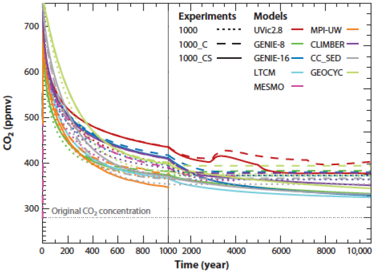


Two models fully traceable to address CMIP6 overarching questions**:**

- What are the impacts of model complexity on model skill (model-data comparison) ?
- What are the impacts of model complexity on climate sensitivity ?
- What are the impacts of model complexity on future projections ?

The lifetime of fossil-fuel derived carbon

Atmospheric lifetimes from impulse-response experiments

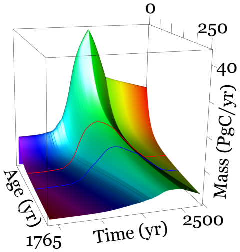


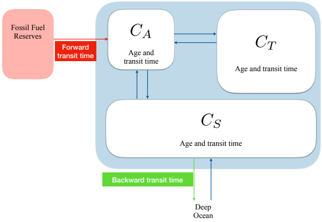
Archer et al (2009)

Assumptions:

- Linearity
- Steady-state
- Non-transient simulations

New approach based on model reconstructions from numerical output





Objectives

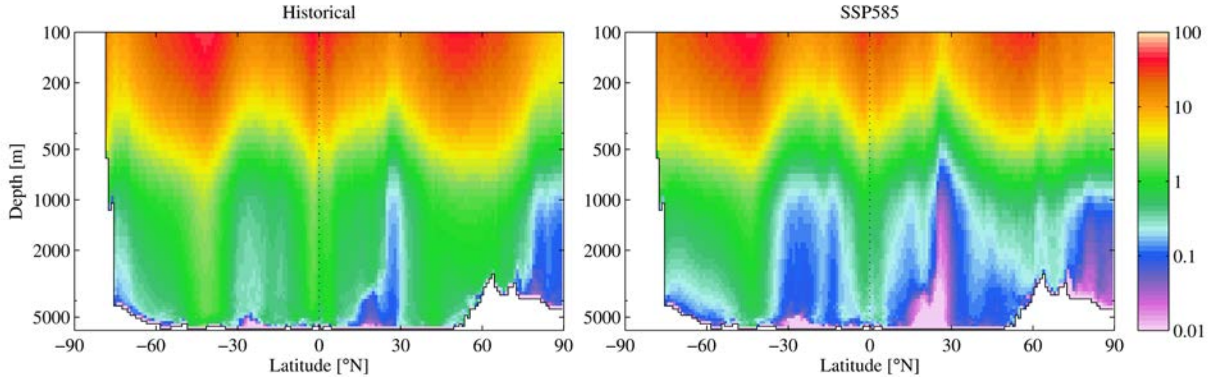
- Quantify time to remove fossil-fuel carbon
- Compare among models and scenarios
- Quantify forward and transit times

Max Planck Institute for Biogeochemistry

What's up with what's going down? Trends in primary and export production

Andrew Yool, Julien Palmiéri, Katya Popova, Lee de Mora, Alistair Sellar, Colin Jones, the UKESM1 Core Group, Roland Séférian, Sarah Berthet, Yohei Takano

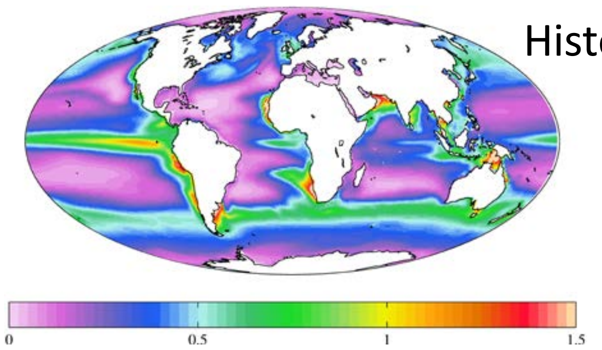
- Climate change is coming (it's here); the biological pump is threatened
- Carbon flux plays a role in both ocean carbon storage and in the supply of food to deep seafloor communities

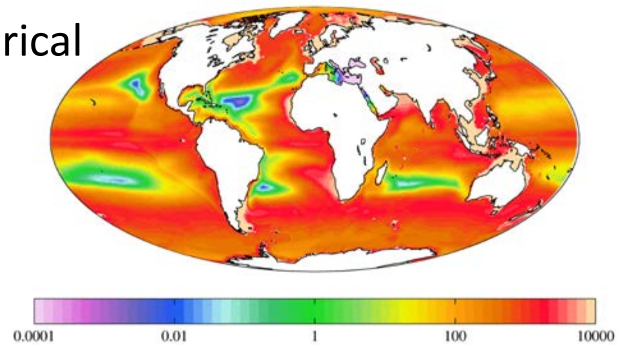


Primary production

Seafloor POC

Historical





SSP585