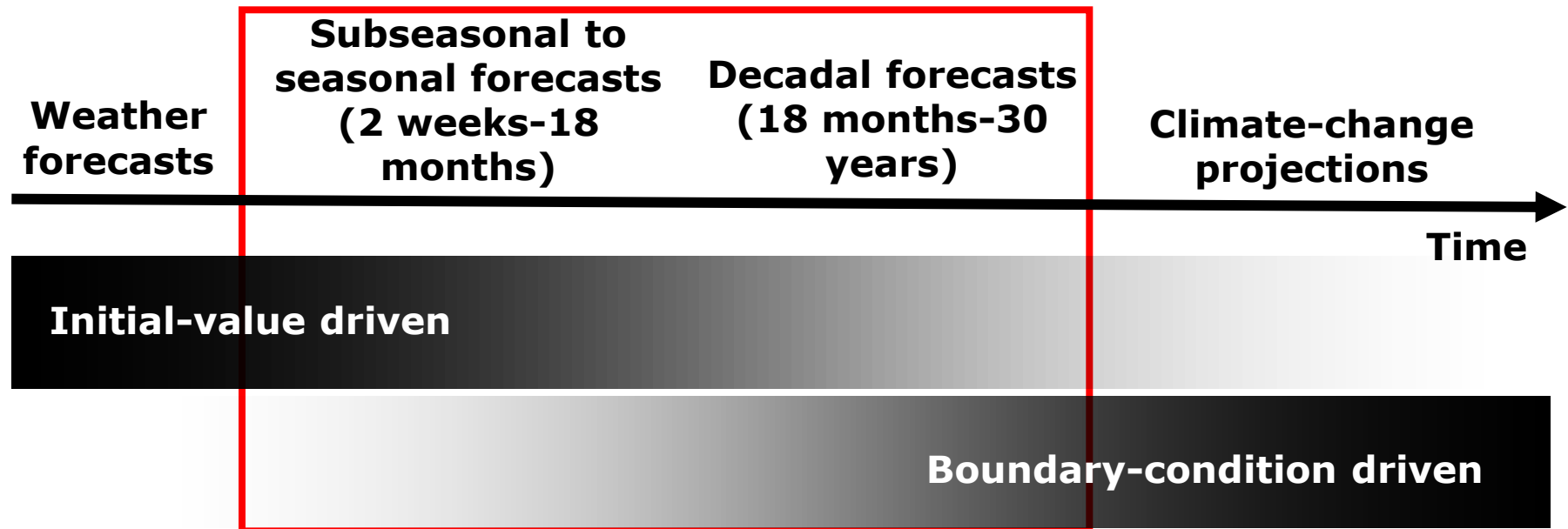

Seasonal-to-Decadal Prediction

F. J. Doblas-Reyes, ICREA & CFU-IC3
Barcelona, Spain

Prediction on climate time scales

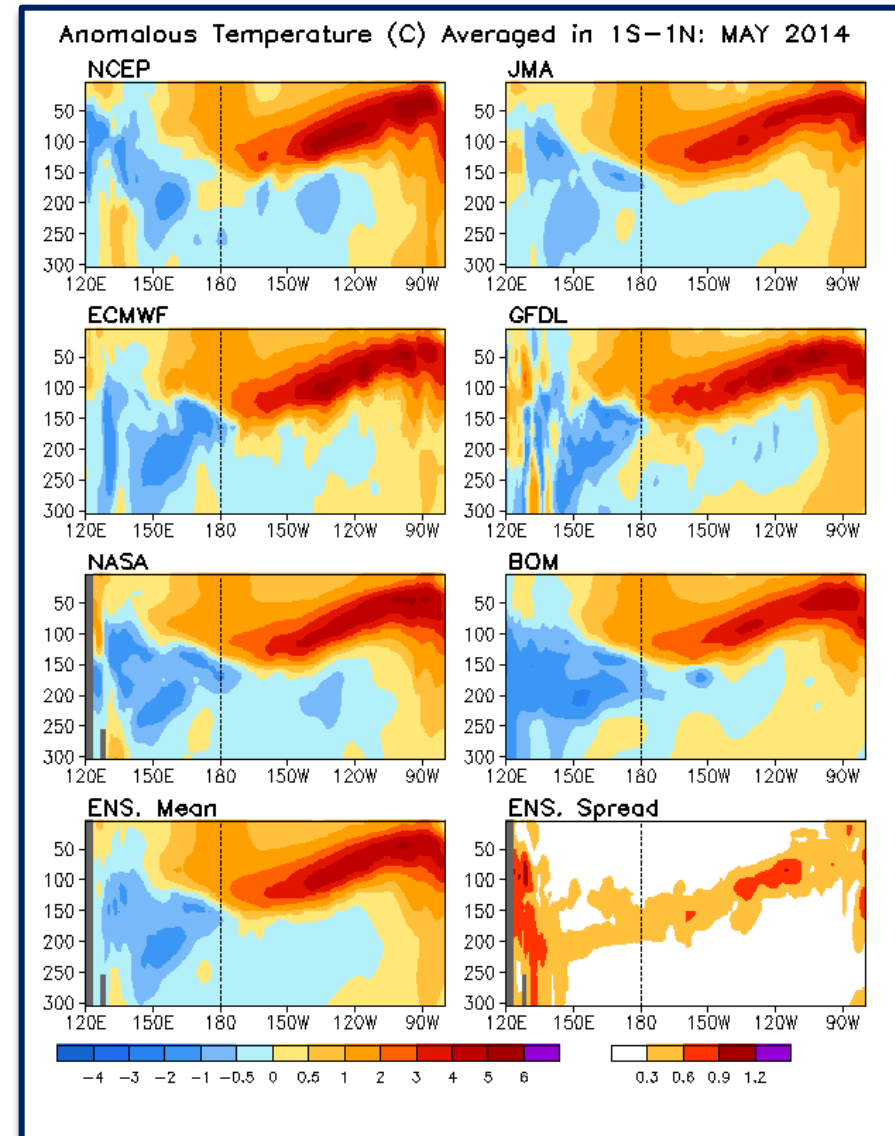
Progression from initial-value problems with weather forecasting at one end and multi-decadal to century projections as a forced boundary condition problem at the other, with climate prediction (**sub-seasonal, seasonal and decadal**) in the middle. Prediction involves initialization and systematic comparison with a **simultaneous** reference.



Adapted from Meehl et al. (2009)

Initialisation

- Real-time ocean analysis comparison. Temperature anomalies along the Equator based on 1981-2010 climatology.
- Large spread in real-time initial conditions (similar message from CLIVAR-GSOP).
- **Good observations of the whole system are absolutely fundamental for accurate predictions.**



Y. Xue (CPC)

Seasonal predictions

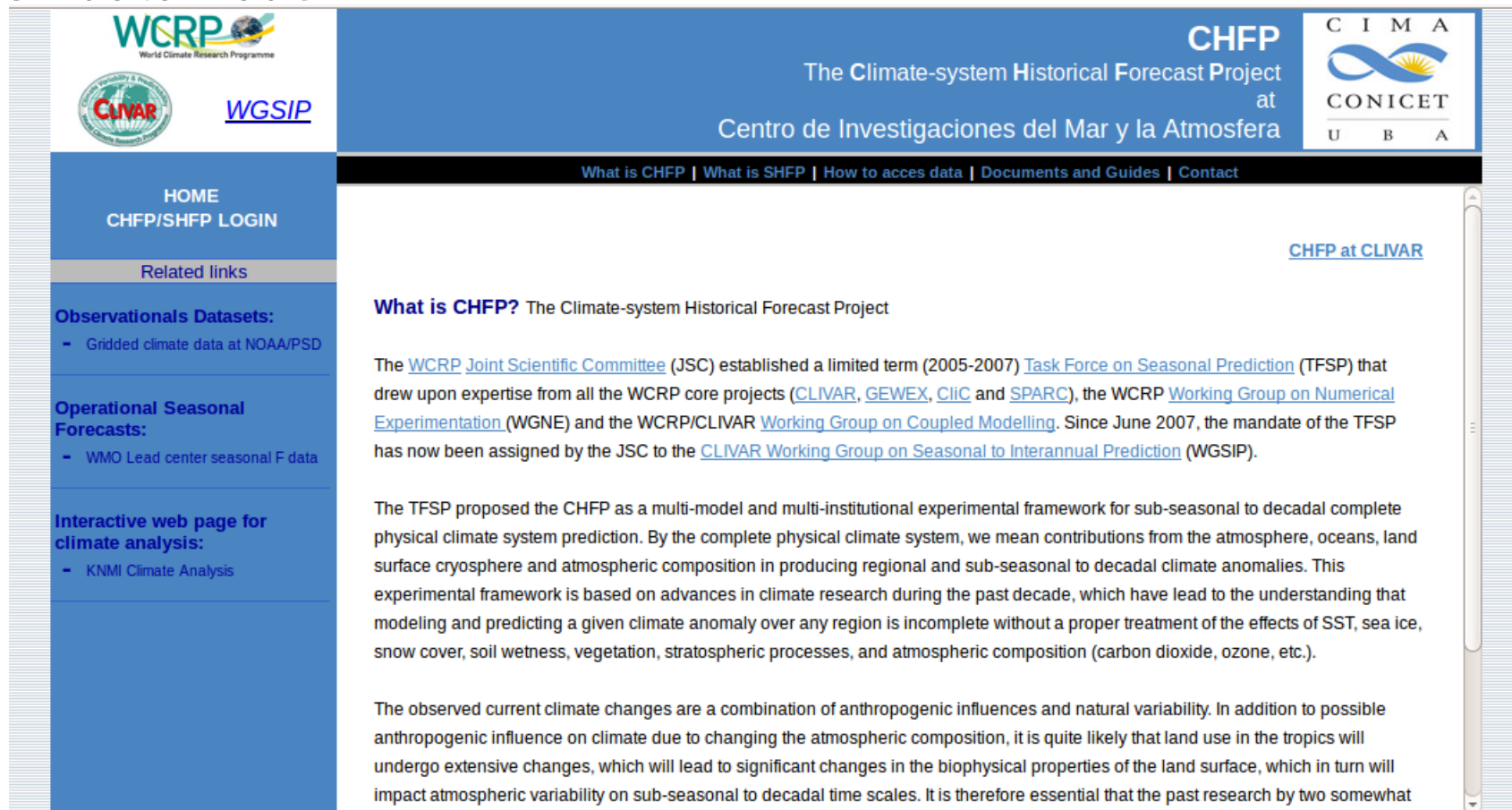
Dynamical seasonal (and in many cases also sub-seasonal) predictions are regularly made by the global producing centres (GPCs).

WMO Lead Centre for long range forecast multi-model ensembles: www.wmolc.org

| WMO Global Producing Centres | | | |
|--|---|--|--|
|  Canada Montreal |  Beijing |  ECMWF |  Moscow |
|  Seoul |  Tokyo |  Toulouse |  Washington |
|  Exeter |  Melbourne |  Pretoria |  CPTEC |

Climate Historical Forecast Project

- WGSIP's CHFP is the largest public repository of multi-model seasonal hindcasts.
- Data server at CIMA <http://chfps.cima.fcen.uba.ar> being transferred to ESGF data node.



The screenshot shows the CHFP website interface. At the top, there are logos for WCRP (World Climate Research Programme), CLIVAR, and WGSIP on the left. On the right, the CHFP logo is displayed above the text 'The Climate-system Historical Forecast Project at Centro de Investigaciones del Mar y la Atmosfera', along with the CIMA and CONICET logos. A navigation bar contains links: 'What is CHFP | What is SHFP | How to access data | Documents and Guides | Contact'. The main content area is titled 'CHFP at CLIVAR' and includes a section 'What is CHFP?' with a detailed description of the project's origins and goals. A sidebar on the left contains navigation links like 'HOME', 'CHFP/SHFP LOGIN', 'Related links', 'Observational Datasets', 'Operational Seasonal Forecasts', and 'Interactive web page for climate analysis'.

CHFP
The Climate-system Historical Forecast Project
at
Centro de Investigaciones del Mar y la Atmosfera

What is CHFP | What is SHFP | How to access data | Documents and Guides | Contact

[CHFP at CLIVAR](#)

What is CHFP? The Climate-system Historical Forecast Project

The [WCRP Joint Scientific Committee](#) (JSC) established a limited term (2005-2007) [Task Force on Seasonal Prediction](#) (TFSP) that drew upon expertise from all the WCRP core projects ([CLIVAR](#), [GEWEX](#), [CliC](#) and [SPARC](#)), the WCRP [Working Group on Numerical Experimentation](#) (WGNE) and the WCRP/CLIVAR [Working Group on Coupled Modelling](#). Since June 2007, the mandate of the TFSP has now been assigned by the JSC to the [CLIVAR Working Group on Seasonal to Interannual Prediction](#) (WGSIP).

The TFSP proposed the CHFP as a multi-model and multi-institutional experimental framework for sub-seasonal to decadal complete physical climate system prediction. By the complete physical climate system, we mean contributions from the atmosphere, oceans, land surface cryosphere and atmospheric composition in producing regional and sub-seasonal to decadal climate anomalies. This experimental framework is based on advances in climate research during the past decade, which have led to the understanding that modeling and predicting a given climate anomaly over any region is incomplete without a proper treatment of the effects of SST, sea ice, snow cover, soil wetness, vegetation, stratospheric processes, and atmospheric composition (carbon dioxide, ozone, etc.).

The observed current climate changes are a combination of anthropogenic influences and natural variability. In addition to possible anthropogenic influence on climate due to changing the atmospheric composition, it is quite likely that land use in the tropics will undergo extensive changes, which will lead to significant changes in the biophysical properties of the land surface, which in turn will impact atmospheric variability on sub-seasonal to decadal time scales. It is therefore essential that the past research by two somewhat

Climate Historical Forecast Project

- To include the ENSEMBLES and NMME hindcasts this year.
- To be linked to the IRI data library for use with the CPT in capacity building events; proposal submitted to FE Fast Track Initiative/Cluster Activity call, but not fully accepted.

Select Model

| | | | | |
|--------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|-------------------------------------|
| <input type="checkbox"/> ARPEGE* | <input type="checkbox"/> CCCma-CanCM3 | <input type="checkbox"/> CCCma-CanCM4 | <input type="checkbox"/> CFS* | <input type="checkbox"/> CMAM* |
| <input type="checkbox"/> CMAMlo | <input type="checkbox"/> ECMWF-S4* | <input type="checkbox"/> GloSea5* | <input type="checkbox"/> JMAMRI-CGCM3 | <input type="checkbox"/> L38GloSea4 |
| <input type="checkbox"/> L85GloSea4* | <input type="checkbox"/> MIROC5 | <input type="checkbox"/> MPI-ESM-LR* | <input type="checkbox"/> POAMA | |

(*) stratosphere resolving models
[Select all](#) - [Clear all](#)

Select Variables

| | |
|--|--|
| <input type="checkbox"/> clt - Total cloud cover | <input type="checkbox"/> hflsd - Surface latent flux |
| <input type="checkbox"/> hfssd - Surface sensible flux | <input type="checkbox"/> mrsov - Total soil moisture |
| <input type="checkbox"/> prfr - Total precipitation | <input type="checkbox"/> psl - Mean sea level pressure |
| <input type="checkbox"/> rlds - Downward surface longwave | <input type="checkbox"/> rls - Net surface longwave |
| <input type="checkbox"/> rit - Top net longwave | <input type="checkbox"/> rsds - Downward surface solar |
| <input type="checkbox"/> rss - Net surface solar | <input type="checkbox"/> rst - Top net solar |
| <input type="checkbox"/> snld - Snow depth | <input type="checkbox"/> tas - 2m temperature |
| <input type="checkbox"/> tasmax - 2m T daily max | <input type="checkbox"/> tasmin - 2m T daily min |
| <input type="checkbox"/> tauu - Surface DownEast stress | <input type="checkbox"/> tauv - Surface DownNorth stress |
| <input type="checkbox"/> tauy - Surface DownNorth stress | <input type="checkbox"/> tdps - 2m dewpoint temperature |
| <input type="checkbox"/> ts - Surface temperature (SST+land) | <input type="checkbox"/> uas - 10m wind (u) |
| <input type="checkbox"/> vas - 10m wind (v) | |

[Clear all](#)

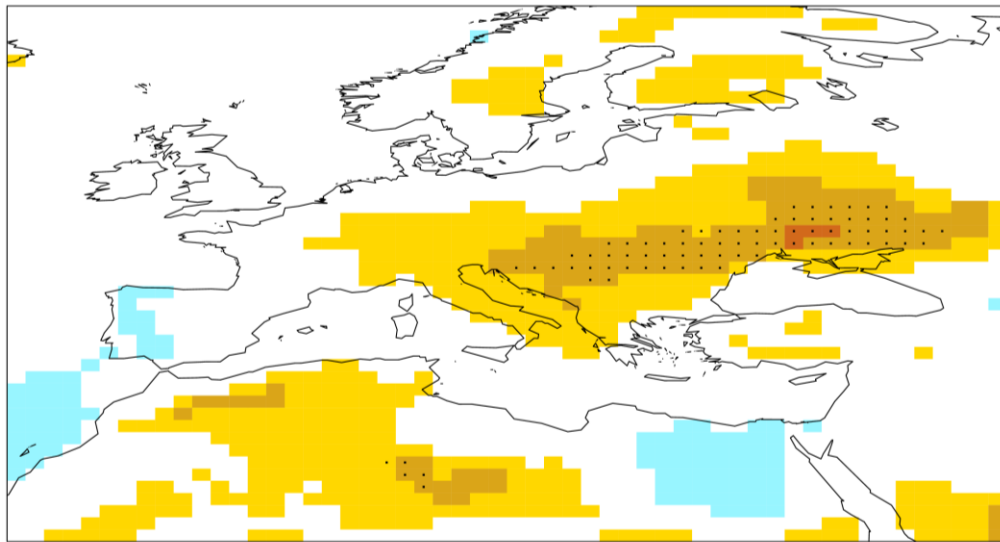
CHFP sub-projects

- Areas of untapped skill were identified at the WCRP 2007 workshop on seasonal prediction.
- Lead to three additional experiments:
 - Land surface, the **GLACE2** experiment (started by R. Koster): Soil moisture experiments in seasonal mode. Data for ten different systems available from R. Koster upon request. Transposed to assess impact of snow initial conditions (snowGLACE).
 - Stratosphere, **Stratospheric Historical Forecast Project** (A. Scaife): High top-Low top four-month hindcasts from 1989 starting in May and November.
 - Sea ice, **Sea Ice Historical Forecast Project** (D. Peterson): Six-month predictions starting in May, August and November for case studies with observed and climatological initial sea-ice data (2007/1996). Leading to contributions to the SEARCH Sea Ice Outlook.
- Recently revised with new experiments.

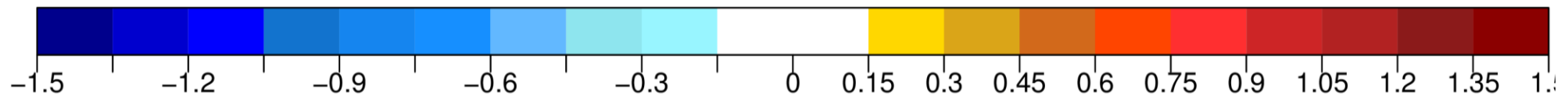
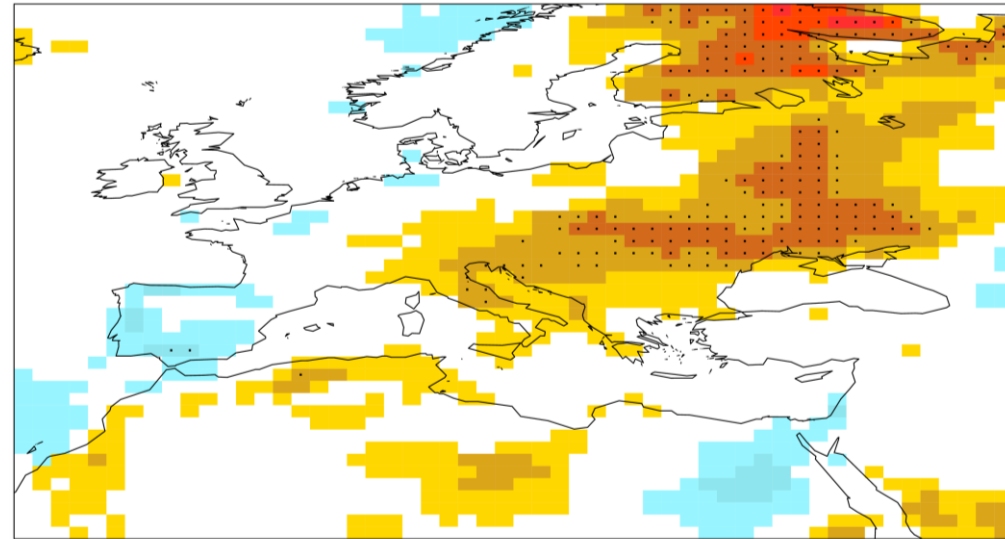
CHFP sub-projects: GLACE2

Difference in the correlation of the ensemble-mean near-surface temperature from two experiments, one using a realistic and another a climatological land-surface initialisation. Results for EC-Earth2.3 started every May over 1979-2010 with ERAInt and ORAS4 initial conditions and a sea-ice reconstruction.

Skill difference for mean T



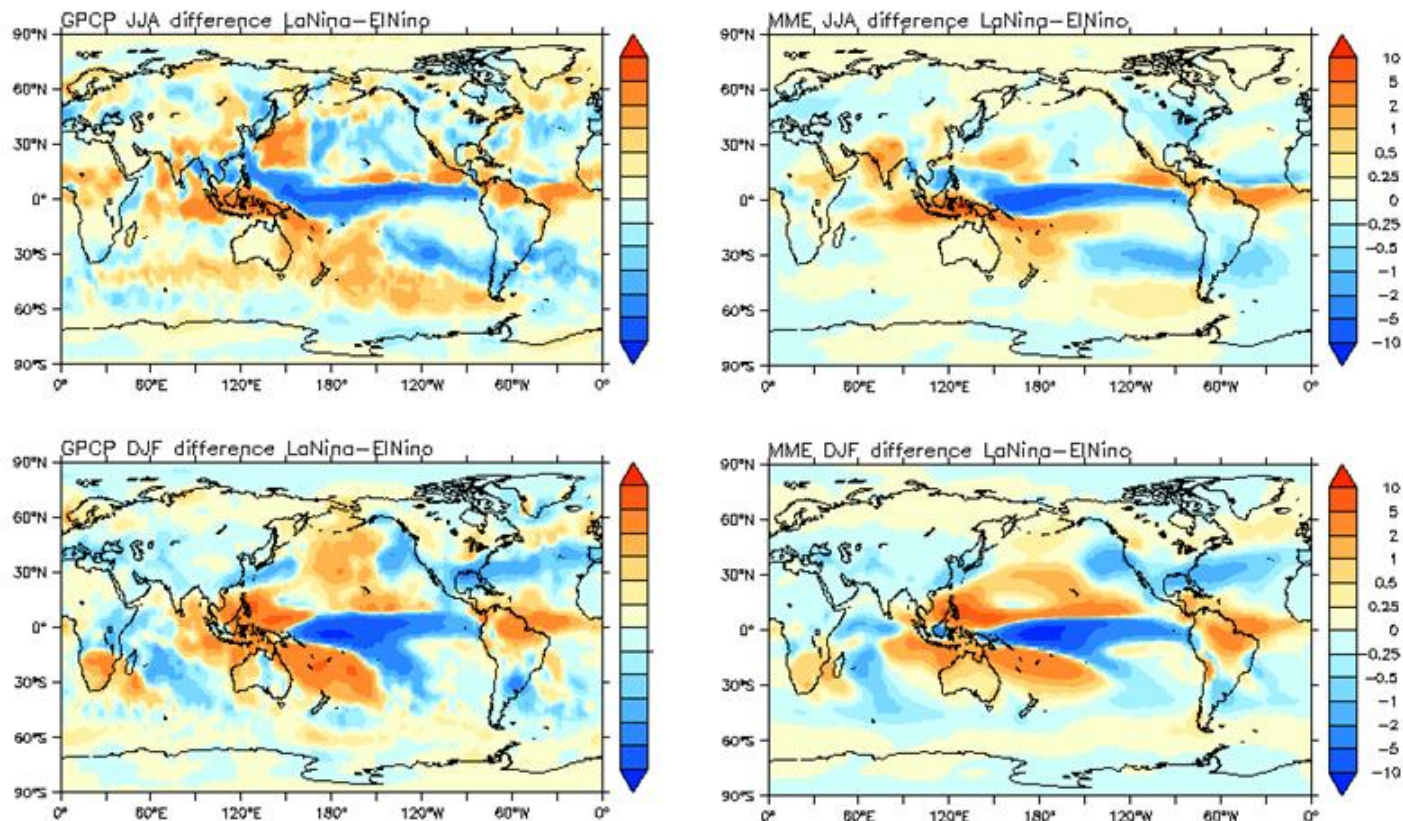
Skill difference for T max



C. Prodhomme (IC3)

Tropical/extra-tropical links

Composite precipitation differences (La Niña minus El Niño) based on years which observed seasonal mean Niño3.4 exceeds ± 1 standard deviation over 1982-2009, from GPCP observations (left) and the CHFP ensemble at 1-month lead time (right), for JJA (top) and DJF (bottom).



Kirtman et al. (in prep.)

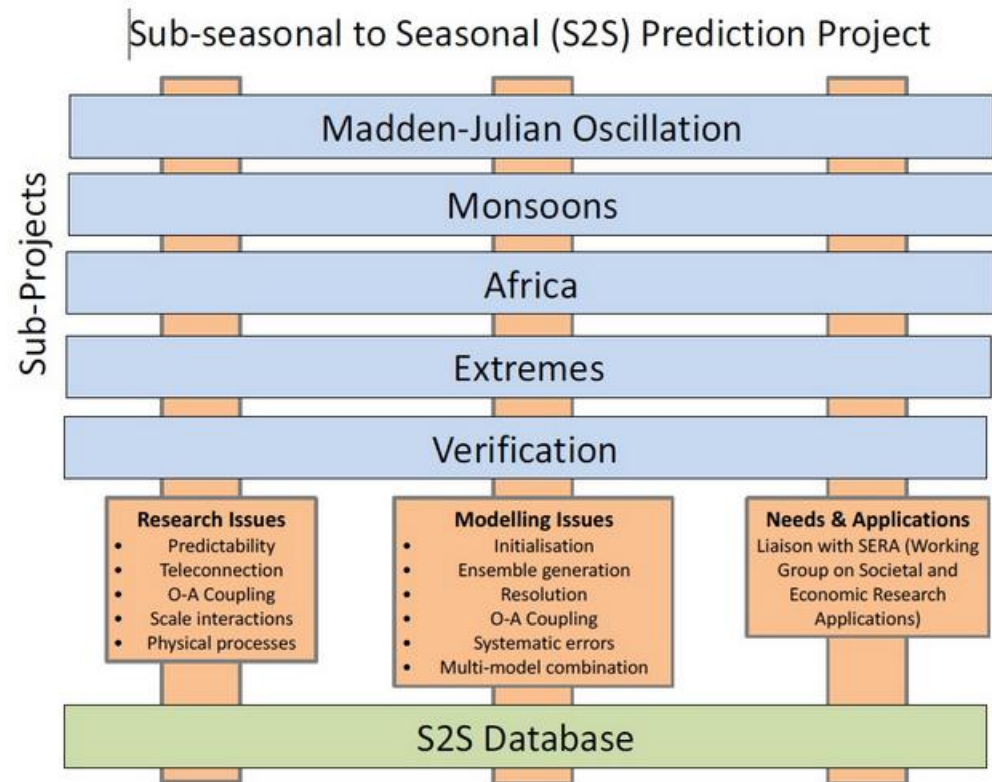
WGSIP science projects

- Leverage resources from the community to analyse the huge amount of experiments already available. Identify key problems that hamper progress in climate prediction. Design new experiments. Link to S2S and other initiatives.
 - Lead to three science projects:
 - **Model drift/initial shock and model validation within the first month:** Mikhail Tolstykh (lead atmosphere), Bill Merryfield (lead ocean) => links to coupled initialisation (note that initialisation is not data assimilation)
 - **Interaction/teleconnection between tropics and extratropics:** Laura Ferranti, Hervé Douville (co-lead)
 - **SNOW Glace:** Jee-Hoon Jeong, Yvan Orsolini (co-lead) -> **ACTION: Build links with GEWEX and CliC (SnowMIP)**
 - Inspiring instead of prescribing. Gain visibility among those not familiar with climate prediction.
 - Work plans available this autumn.
-

THORPEX legacy projects

The subseasonal-to-seasonal (S2S) prediction initiative is a WWRP/WCRP joint initiative with objectives:

- To improve forecast skill and understanding on the sub-seasonal to seasonal timescale with special emphasis on high-impact weather events
- To promote the initiative's uptake by operational centres and exploitation by the applications community
- To capitalize on the expertise of the weather and climate research communities to address issues of importance to the GFCS
- Open data access



THORPEX legacy projects

The WWRP/WCRP Polar Prediction Project (PPP) promotes cooperative research enabling improved prediction services for the polar regions, on time scales from hourly to seasonal. **This is the hourly to seasonal research component of the WMO Global Integrated Polar Prediction System (GIPPS)**, and complementary to WCRP-PCPI.

WGSIP contributes to the links between polar and non-polar regions (workshop in December) and the organisation of YOPP.

International workshop on polar-lower latitude linkages and their role in weather and climate prediction



A joint initiative by WWRP-PPP and WCRP-PCPI. A workshop on invitation only.

10 - 12 December 2014, Barcelona, Spain

Registration to start in late June 2014

[Download leaflet](#)

At a glance:

Objective: The aim of the workshop is to gain an overview of our current understanding of polar-lower latitude linkages and their implications for prediction and services and to formulate recommendations that will guide international future research activities.

Structure: The workshop will consist of key note talks by invited speakers, challenger talks, poster sessions, breakout group sessions and a plenary session.

Attendees: Scientists and representatives from international programmes, prediction centres and funding agencies.

Expected outcome: Enhancing the scientific network on the topic of polar/non-polar connections and producing a set of recommendations that will be broadly disseminated as a report.

Support by:



Decadal prediction

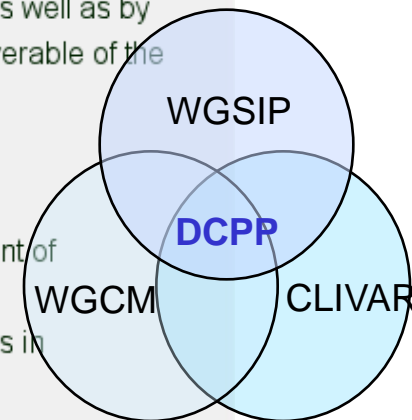
The Decadal Climate Prediction Panel (DCPP) promotes coordinated decadal prediction experimental set ups and informal near-real time exchange of multi-model forecasts. It also organises the decadal MIP towards CMIP6 (with four components, and including consideration of a transpose CMIP).

The DCPP is managed by WGSIP, WGCM and CLIVAR; chair George Boer.

The term "decadal prediction" encompasses predictions on annual, multi-annual to decadal timescales. The possibility of making skilful forecasts on these timescales, and the ability to do so, is investigated by means of predictability studies and retrospective predictions (hindcasts) made using the current generation of climate models as well as by means of statistical approaches. Skilful decadal prediction of relevant climate parameters is a Key Deliverable of the WCRP's Grand Challenge of providing [Regional Climate Information](#).

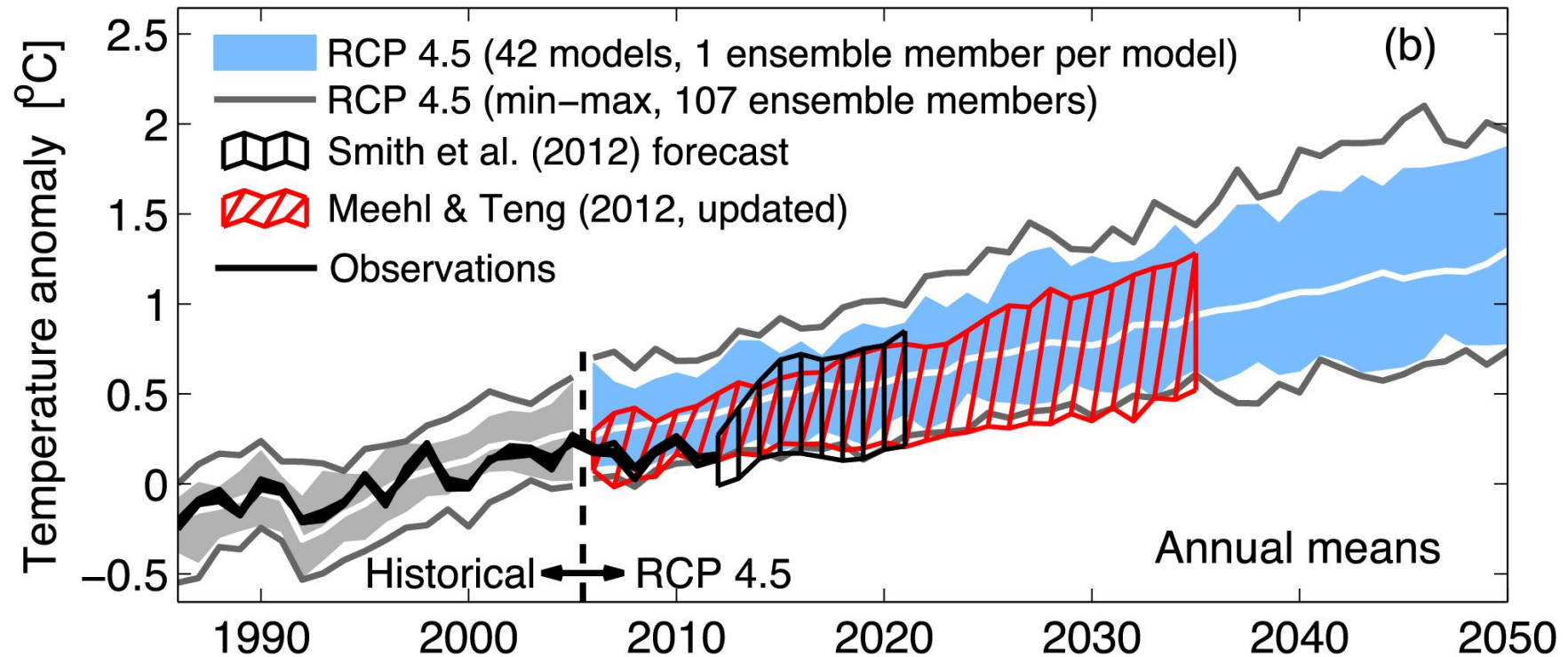
The DCPP envisions four components:

- **Hindcasts**: the design and organization of a coordinated decadal prediction (hindcast) component of CMIP6 in conjunction with the seasonal prediction and climate modelling communities
- **Forecasts**: the ongoing production of experimental quasi-operational decadal climate predictions in support of multi-model annual to decadal forecasting and the application of the forecasts
- **Predictability and mechanisms**: the organization and coordination of decadal climate predictability studies including the study of the mechanisms that determine predictability
- **Case studies**: the organization and coordination of case studies to investigate the ability to predict particular climate shifts and variations that have occurred and to identify the processes determining these behaviours



Predictions and projections

Annual-mean global-mean temperature predictions and projections from CMIP5.



IPCC AR5 WGI (2013)

Some open fronts

- **Work on initialisation**: initial conditions for all components (including better ocean), better ensemble generation, etc. Link to observational and reanalysis efforts.
 - **Model improvement**: leverage knowledge and resources from modelling at other time scales (improve sea ice, treatment of volcanic and anthropogenic aerosols, vegetation and land, etc); drift reduction; more efficient codes and adequate computing resources.
 - **Calibration and combination**: empirical prediction (better use of current benchmarks), local knowledge.
 - **Forecast quality assessment**: scores closer to the user, reliability as a main target, process-based verification.
 - **More sensitivity to the users' needs**: going beyond downscaling, better documentation (e.g. use the IPCC language), demonstration of value and outreach.
-

SPECS FP7

SPECS will deliver *a new generation of European climate forecast systems, including initialised Earth System Models (ESMs) and efficient regionalisation tools to produce quasi-operational and actionable local climate information over land at seasonal-to-decadal time scales with improved forecast quality and a focus on extreme climate events, and provide an enhanced communication protocol and services to satisfy the climate information needs of a wide range of public and private stakeholders.*

| Forecast System | Project Partners |
|-----------------|-----------------------|
| CNRM-CM5 | CNRM, CERFACS |
| EC-Earth | KNMI, SMHI, IC3, ENEA |
| IFS/NEMO | ECMWF, UOXF |
| IPSL-CM5 | CNRS |
| MPI-ESM | MPG, UniHH |
| UM | UKMET |

