Seasonal-to-Decadal Prediction

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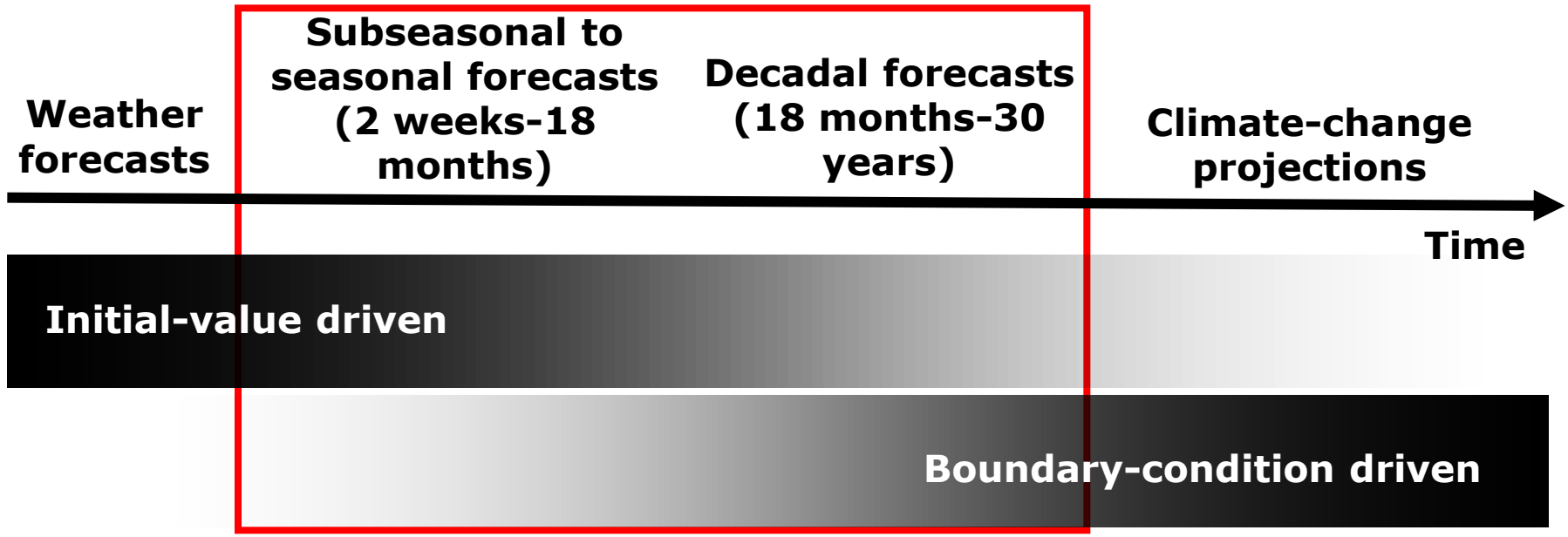
Prediction on climate time scales

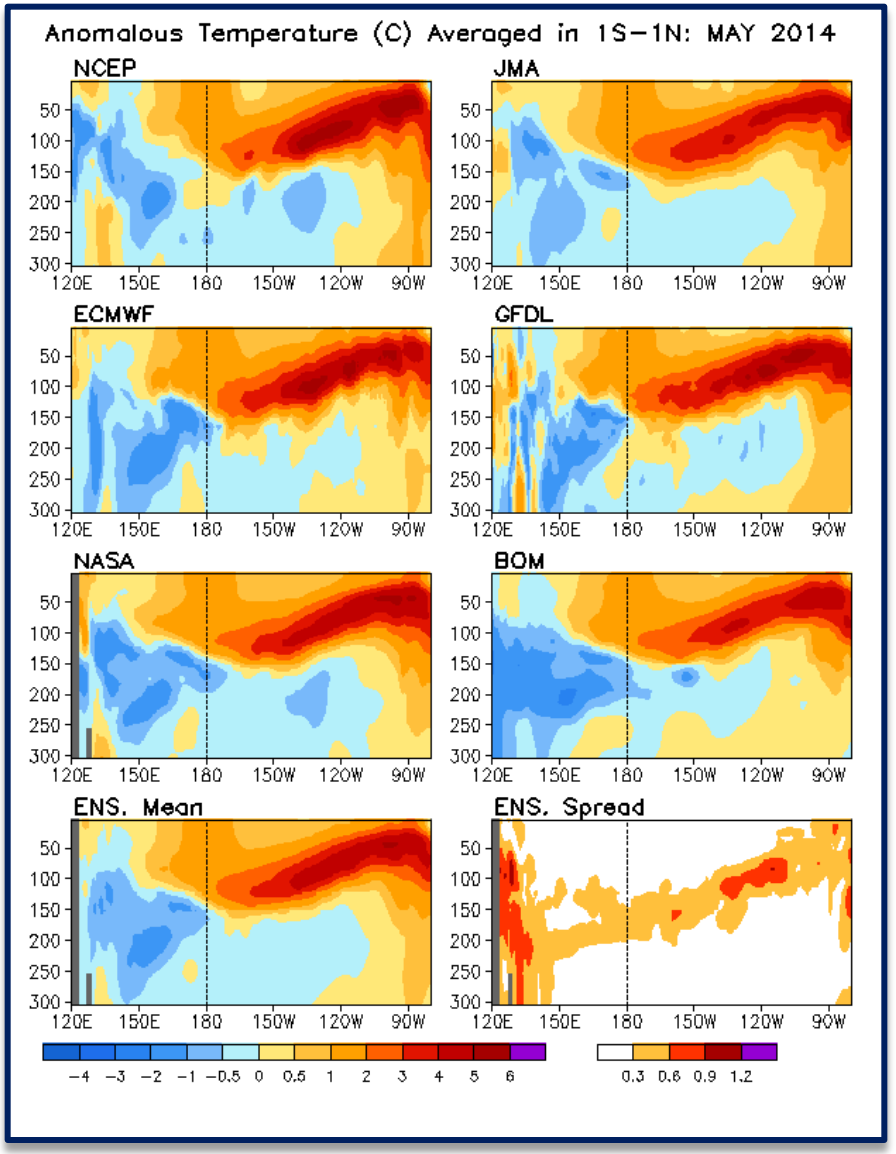
Progression from initial-value problems with weather forecasting at one end and multi-decadal to century projections as a forced boundary condition problem at the other, with climate prediction (sub-seasonal, seasonal and decadal) in the middle. Prediction involves initialization and systematic comparison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

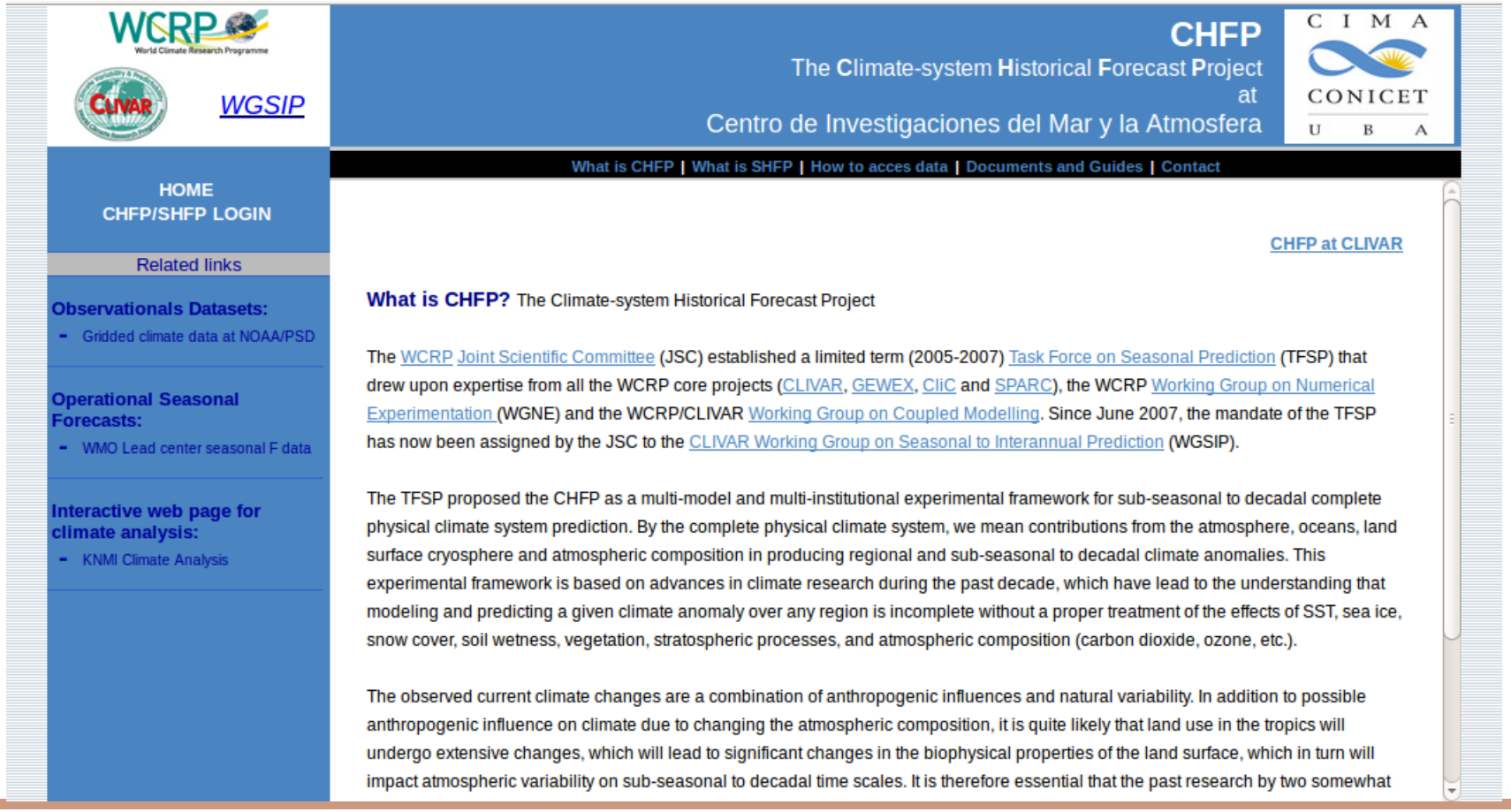
Seasonal predictions

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

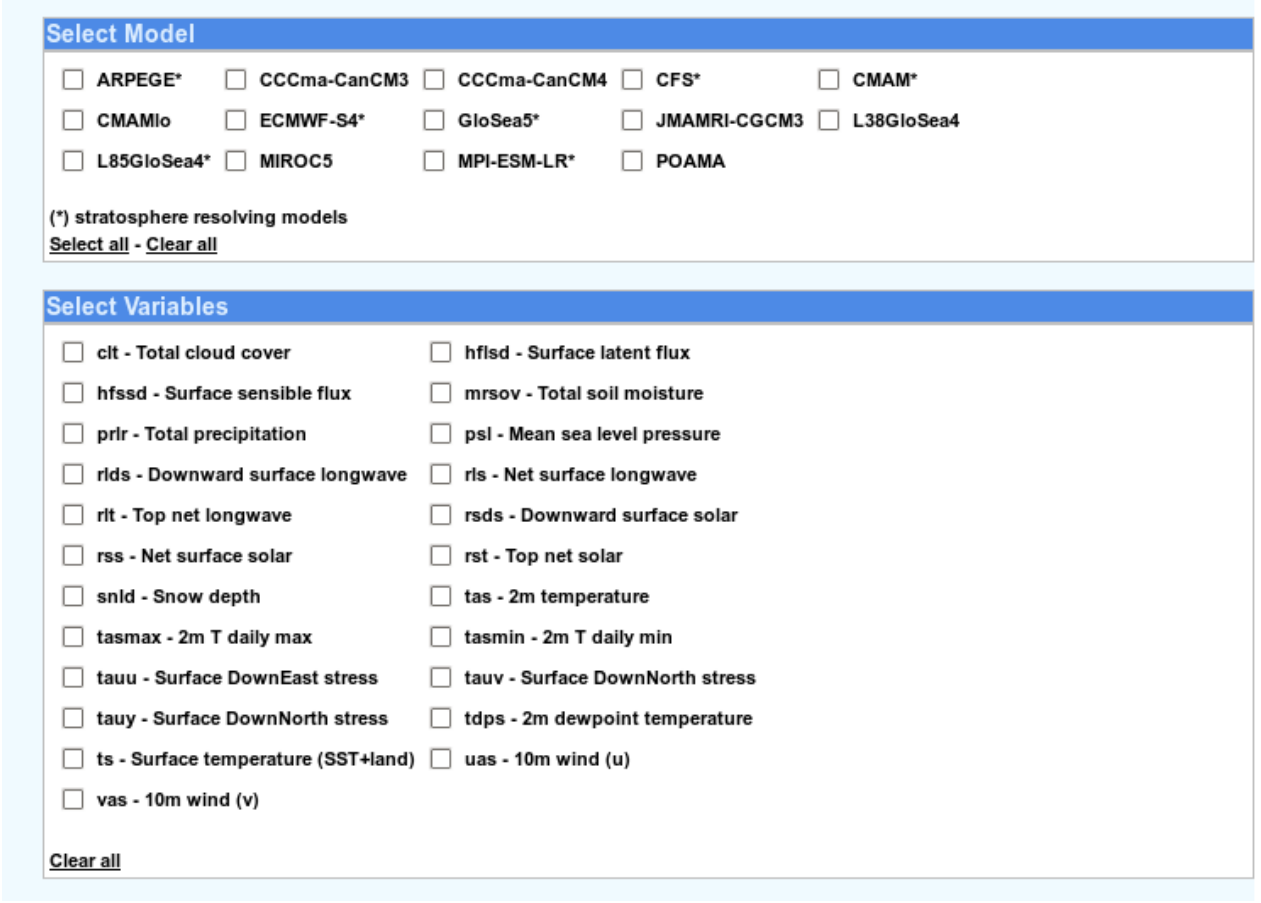
Climate Historical Forecast Project

- 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.



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.



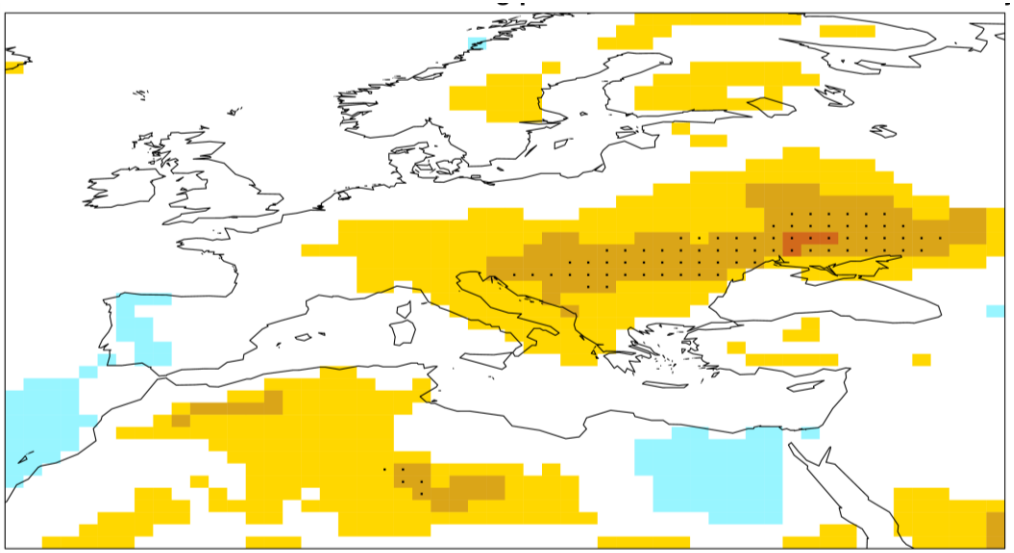
CHFP sub-projects

- 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.

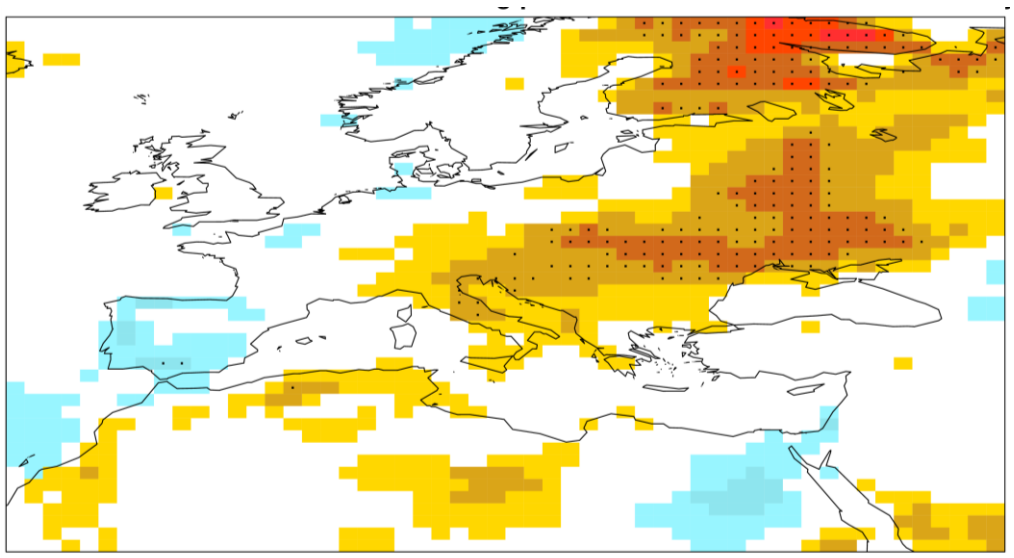
CHFP sub-projects: GLACE2

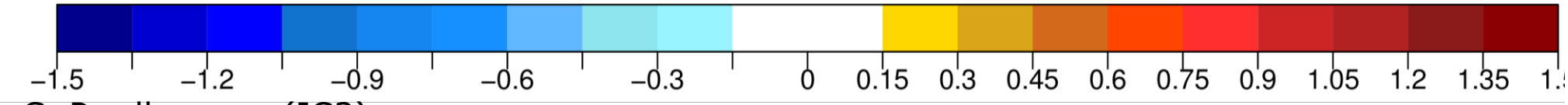
Difference in the correlation of the ensemble-mean near-surface temperature from two experiments, one using a realistic and another a climatological land-surface initialisation. Results for EC-Earth2.3 started every May over 1979-2010 with ERAInt and ORAS4 initial conditions and a sea-ice reconstruction.

Skill difference for mean T



Skill difference for T max

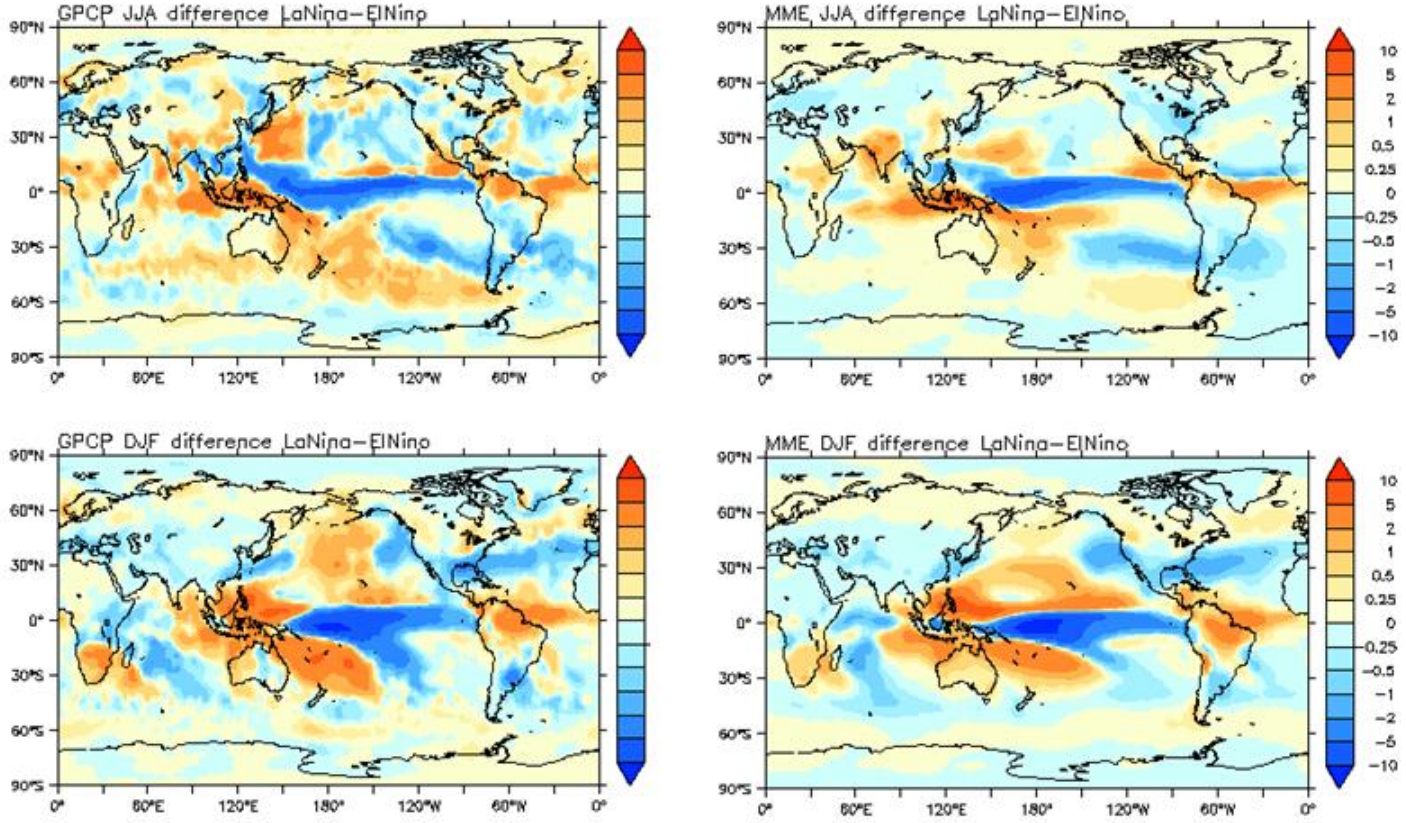




C. Prodhomme (IC3)

Tropical/extra-tropical links

Composite precipitation differences (La Niña minus El Niño) based on years which observed seasonal mean Nino3.4 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.)

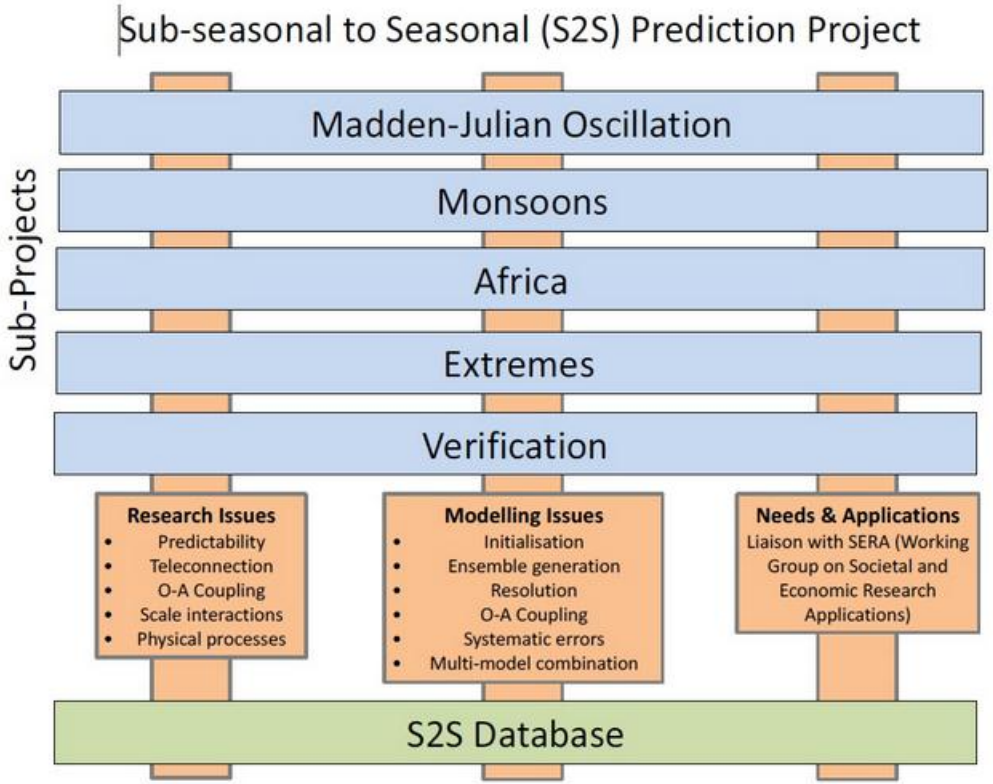
WGSIP science projects

- 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:

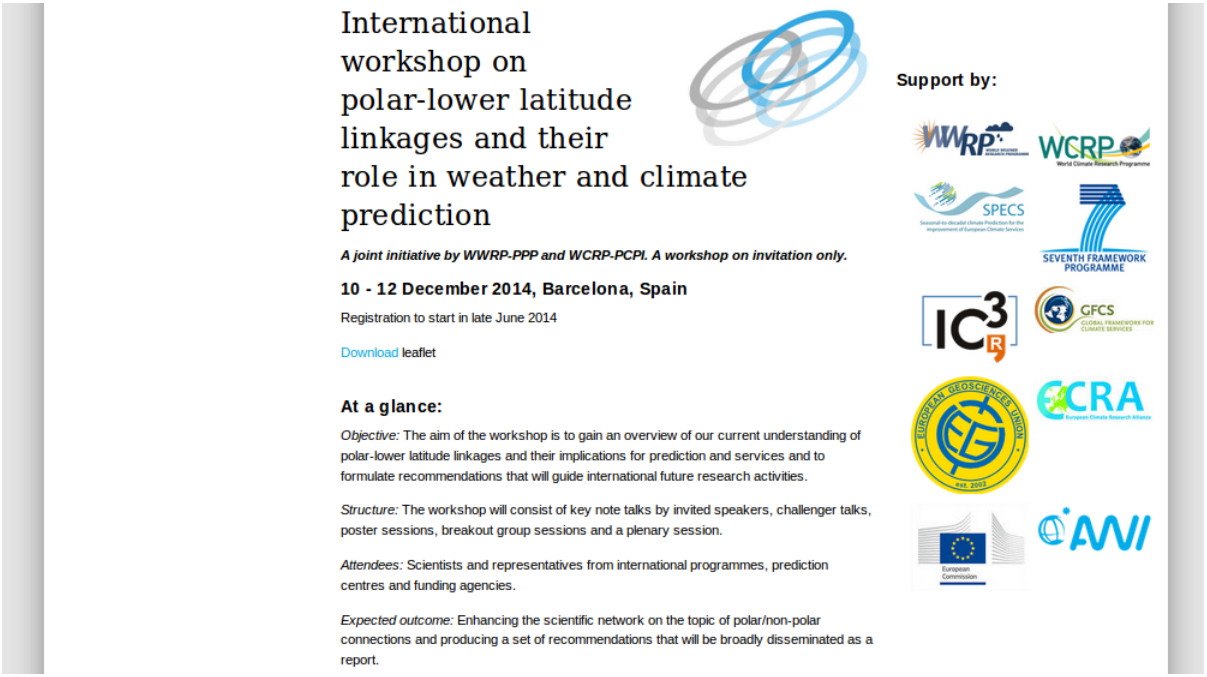
- To improve forecast skill and understanding on the sub-seasonal to seasonal timescale with special emphasis on high-impact weather events
- To promote the initiative's uptake by operational centres and exploitation by the applications community
- To capitalize on the expertise of the weather and climate 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

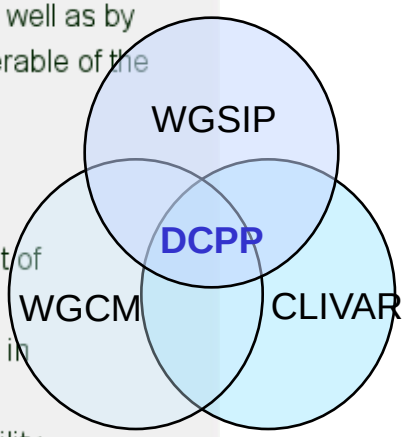
The Decadal Climate Prediction Panel (DCPP) promotes coordinated decadal prediction experimental set ups and informal near-real time exchange of multi-model forecasts. It also organises the decadal MIP towards CMIP6 (with four components, and including consideration of a transpose CMIP).

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.

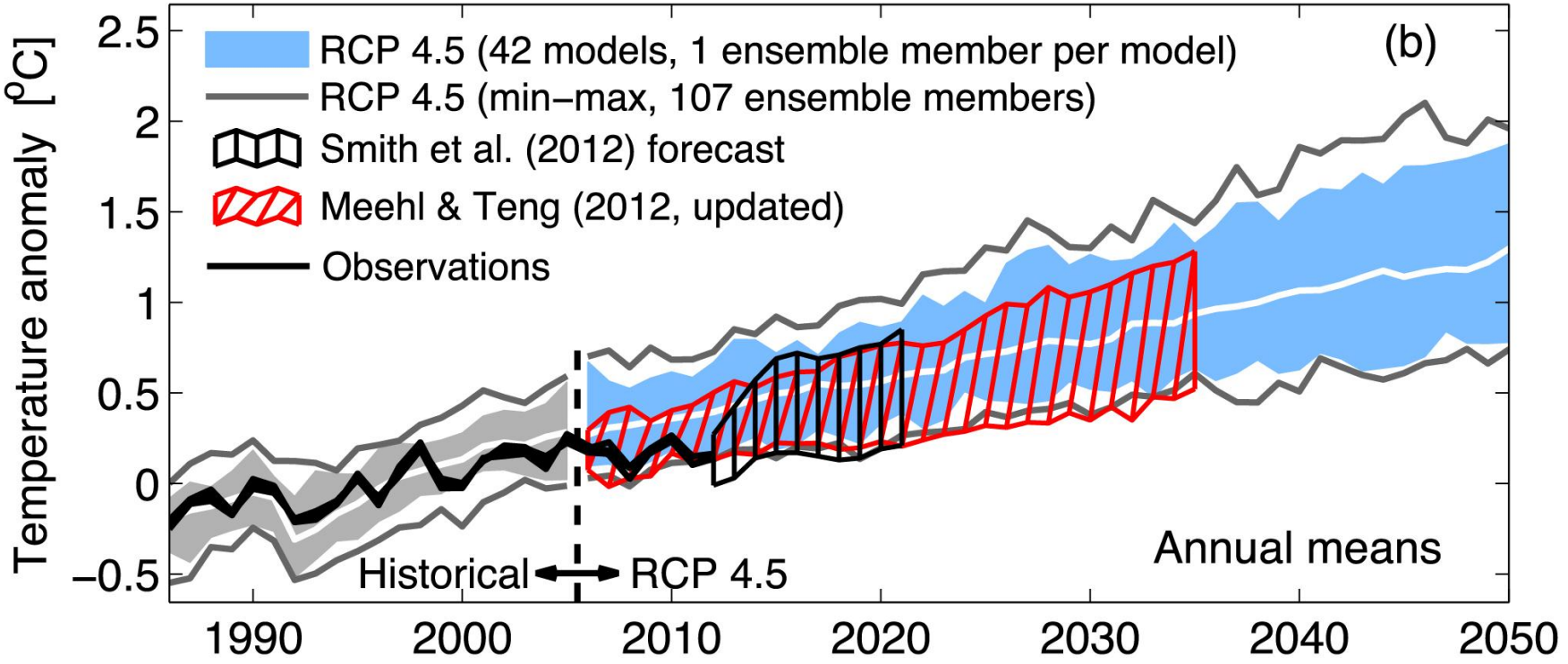
The DCPP envisions four components:

- ***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)

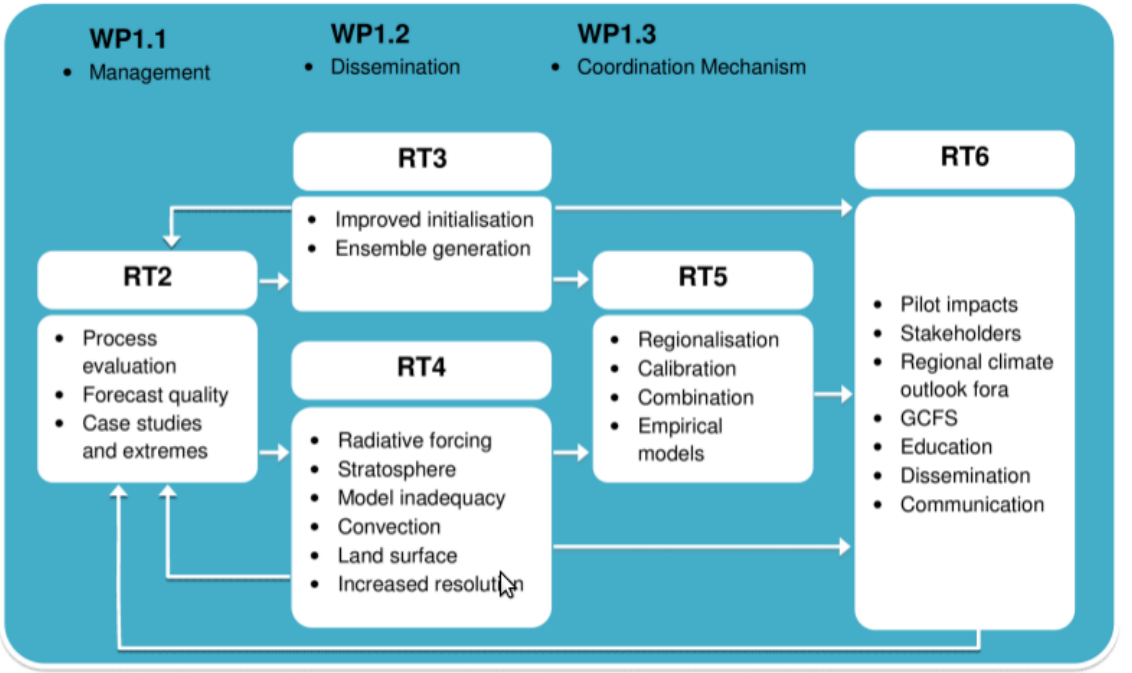
Some open fronts

- 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



WP1.1: Management
WP1.2: Dissemination
WP1.3: Coordination across EUPORIAS, NACLIM & SPECS
RT2: Evaluation of current s2d forecast systems
RT3: Forecast strategies
RT4: Improved systems
RT5: Calibrated predictions at the local scale

SPECS
Seasonal-to-decadal climate Prediction for the improvement of European Climate Services