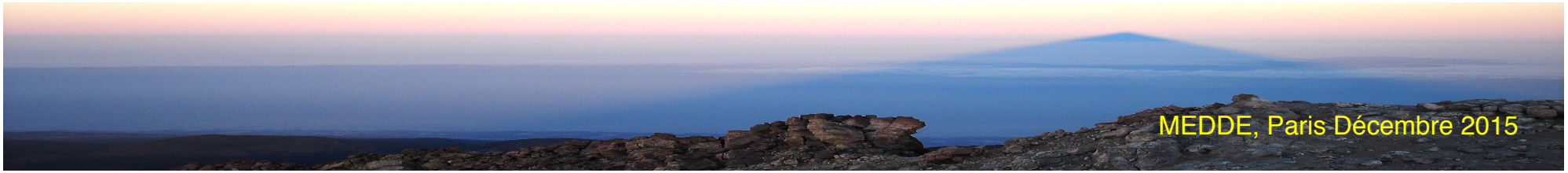
Pistes et réflexions sur le prochain exercice de prévision décennale en cours de discussion dans le cadre de CMIP6

WCRP World Climate Research Programme / WGCM / DCPP

WCRP World Climate Research Programme / WGSIP

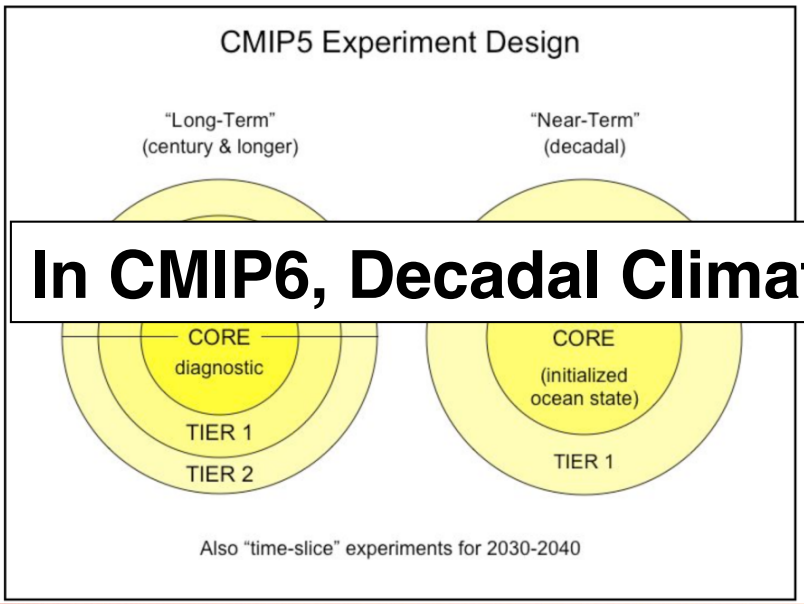


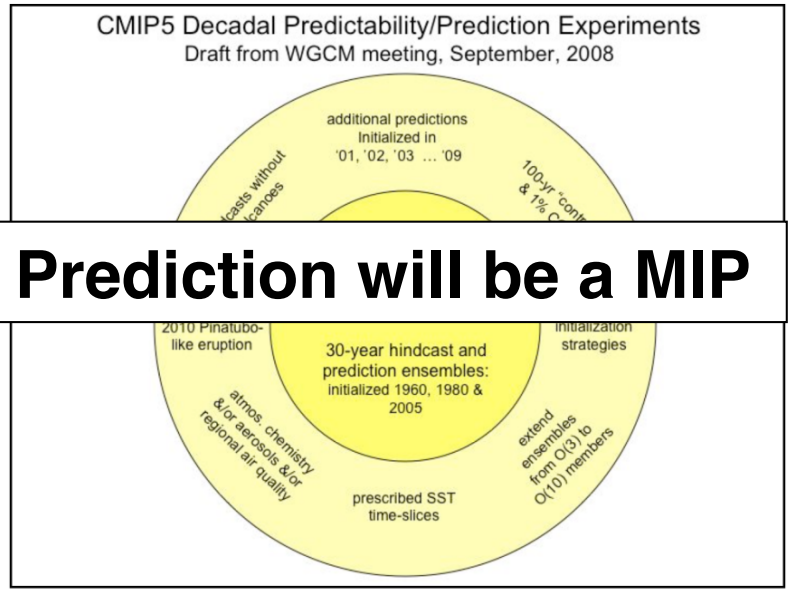
A bit of history : CMIP5

Decadal climate prediction recognized as a new field in climate science in CMIP5:
Decadal climate prediction as a separate set of “near term” CMIP5 experiments

Modelling protocol formulated at Aspen Global Change Institute session (Aug,2008) and approved at WGCM Paris (Oct,2008)

- formation of a “Joint WGCM-WGSIP Contact Group on Decadal Predictability/Prediction” (now the “Decadal Climate Prediction Panel”

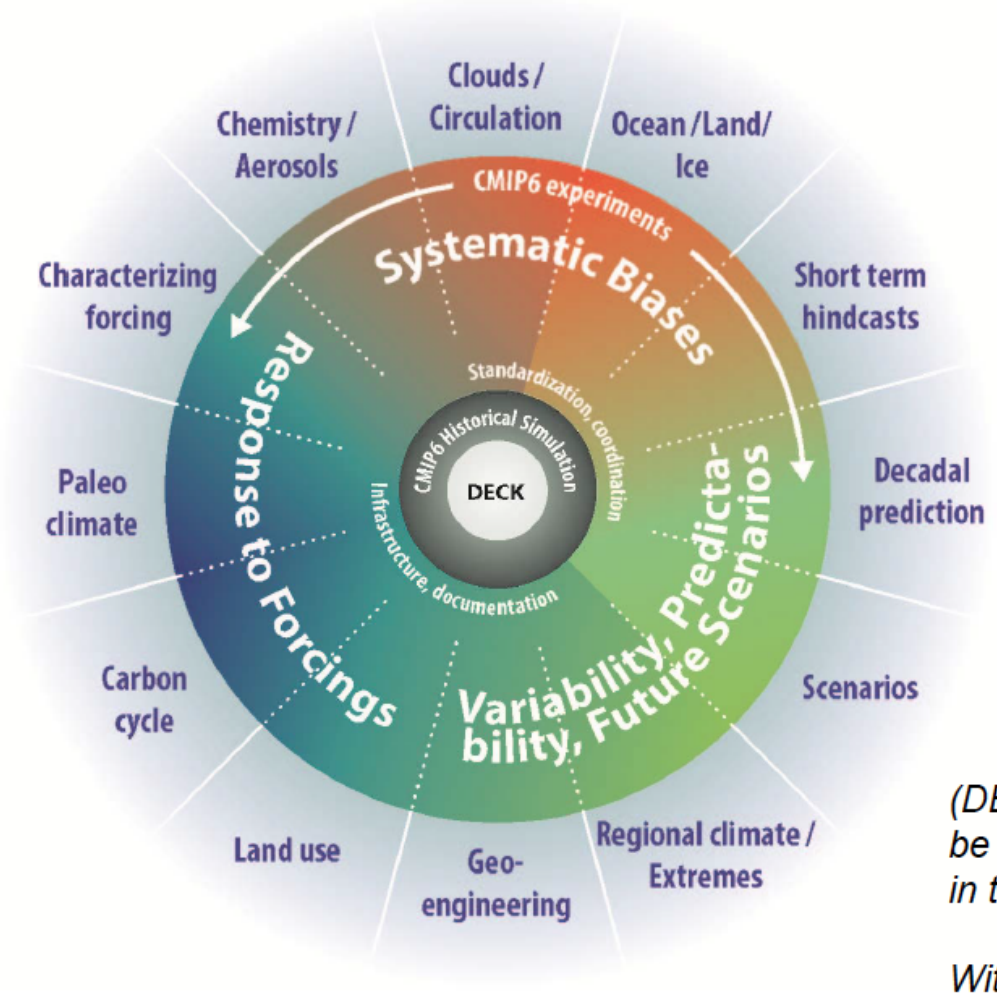




In CMIP6, Decadal Climate Prediction will be a MIP

A bit of future : CMIP6

WCRP Grand Challenges: (1) Clouds, circulation and climate sensitivity, (2) Changes in cryosphere, (3) Climate extremes, (4) Regional climate information, (5) Regional sea-level rise, and (6) Water availability, plus an additional theme on "Biogeochemical forcings and feedbacks"



Note: *The themes in the outer circle of the figure might be slightly revised at the end of the MIP endorsement process*

DECK (entry card for CMIP)

i. AMIP simulation (~1979-2014)
ii. Pre-industrial control simulation
iii. 1%/yr CO_2 increase
iv. Abrupt 4xCO_2 run

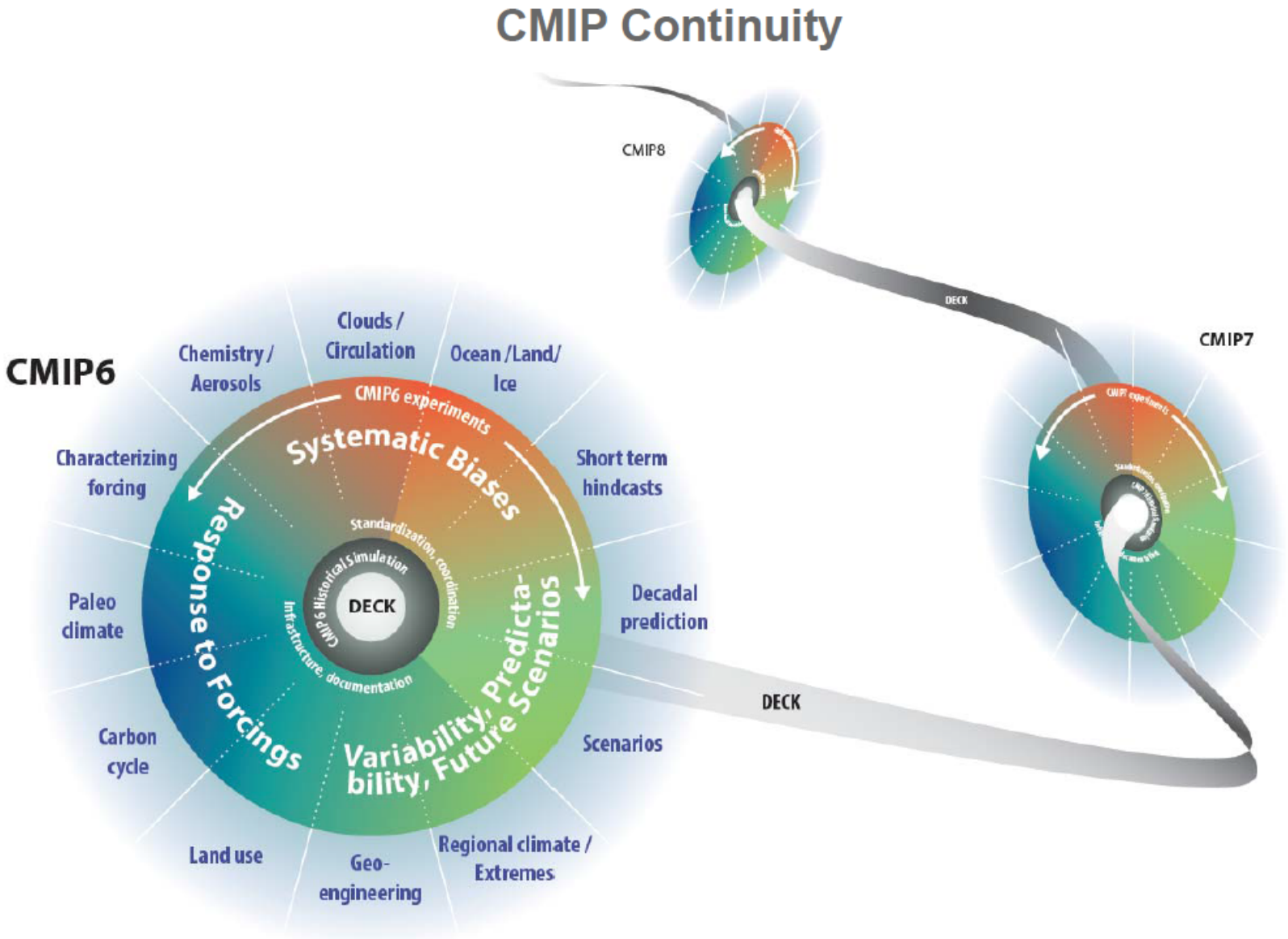
CMIP6 Historical Simulation (entry card for CMIP6)

v. Historical simulation using CMIP6 forcings (1850-2014)

(DECK & CMIP6 Historical Simulation to be run for each model configuration used in the subsequent CMIP6-Endorsed MIPs)

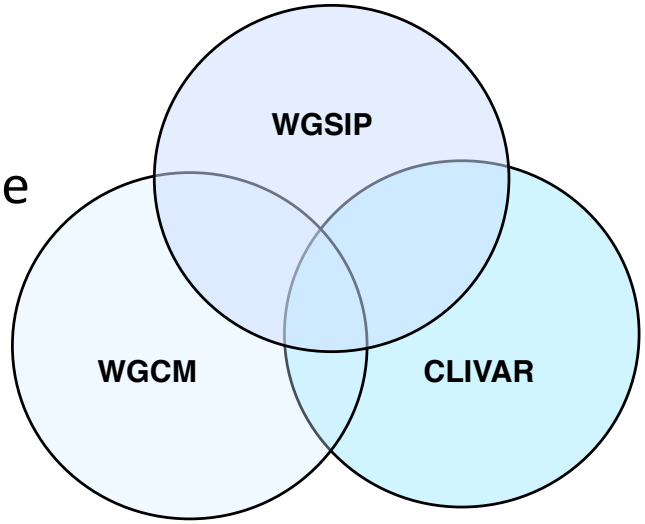
With proto-DECK experiments (LMIP,OMIP etc.) in CMIP6 Tier1

Why not thinking about CMIP7 and beyond?



Decadal Climate Prediction Panel (DCPP)

- Origin
  - Membership from WGCM and WGSIP and the CLIVAR decadal variability and predictability focus (George Boer, chair, Doug Smith , co-chair)



- Focus
  - the development and support of both the science and practice of decadal prediction
  - the provision of an archive of decadal prediction information for research and applications
  - advise on CMIP5 practicalities
  - Propose new generation of coordinated experiments for CMIP6

Things we've learned so far from the CMIP5 decadal prediction experiments

- need long sequence of historical forecasts initialized every year
  - for statistical stability of results
  - to provide historical skill assessment
  - allow drift adjustment
- considerable annual, multi-annual skill for temperature, not so much for precipitation
  - initial condition skill dominates for several years then dies away leaving skill from forced component
  - skill varies a great deal geographically
    - skill higher over N. Atlantic than N. Pacific
    - skill for predicting large decadal shifts in Pacific and Atlantic
    - disconnect between potential and actual skill over land
    - low skill over Southern Ocean
- *model error is a major issue*, requiring bias adjustments to evaluate hindcasts and predictions
- single and multi-model assessments of CMIP5 results still underway

Decadal Climate Prediction in CMIP6

Science framework in CMIP6:

WCRP Grand Challenge #1

regional climate information: ***Can we provide skilful regional climate predictions at seasonal to decadal time scales*** and reliable and actionable long term regional climate change projections?

CMIP6 science questions:

"The specific experimental design should be focused on three broad scientific questions in CMIP6:

1. **How does the Earth System respond to forcing?**
2. **What are the origins and consequences of systematic model biases?**
3. **How can we assess future climate changes given climate variability, predictability and uncertainties in scenarios?"**

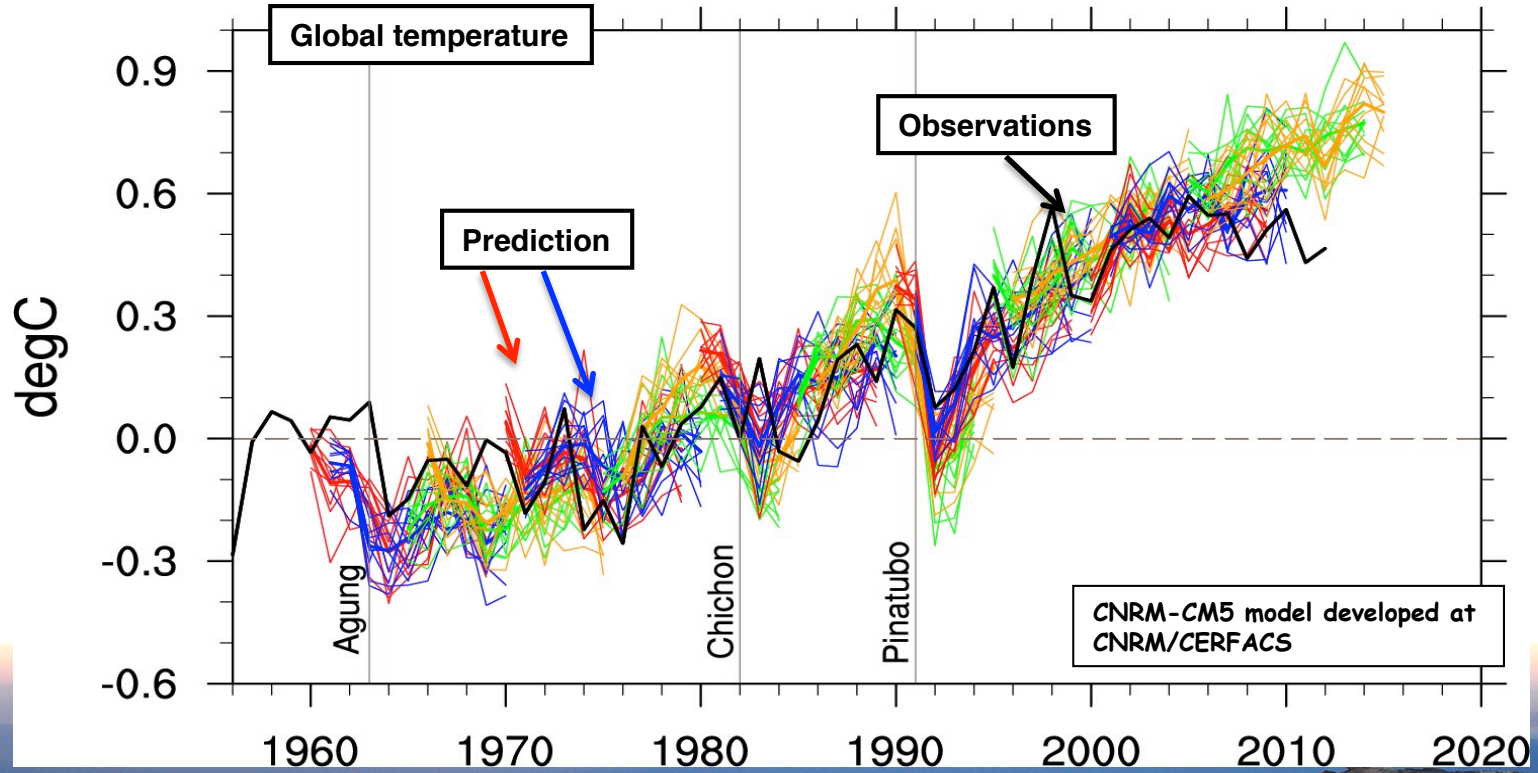
DCPP-MIP meets all of them

DCPP_MIP in CMIP6

- Three components
  - A. CMIP-decadal hindcasts
  - B. Experimental multi-model forecasting
  - C. Mechanisms, predictability and case studies
    - Hiatus+
    - Volcanoes and prediction

Component A: CMIP6-decadal

- Ensembles of multi-model multi-member hindcasts (*retrospective forecasts)* made each year from 1960 to the present (~2014).
- 5-10 year predictions for each start year, recommend 10 ensemble members (3000-6000 years)
- Volcanoes included



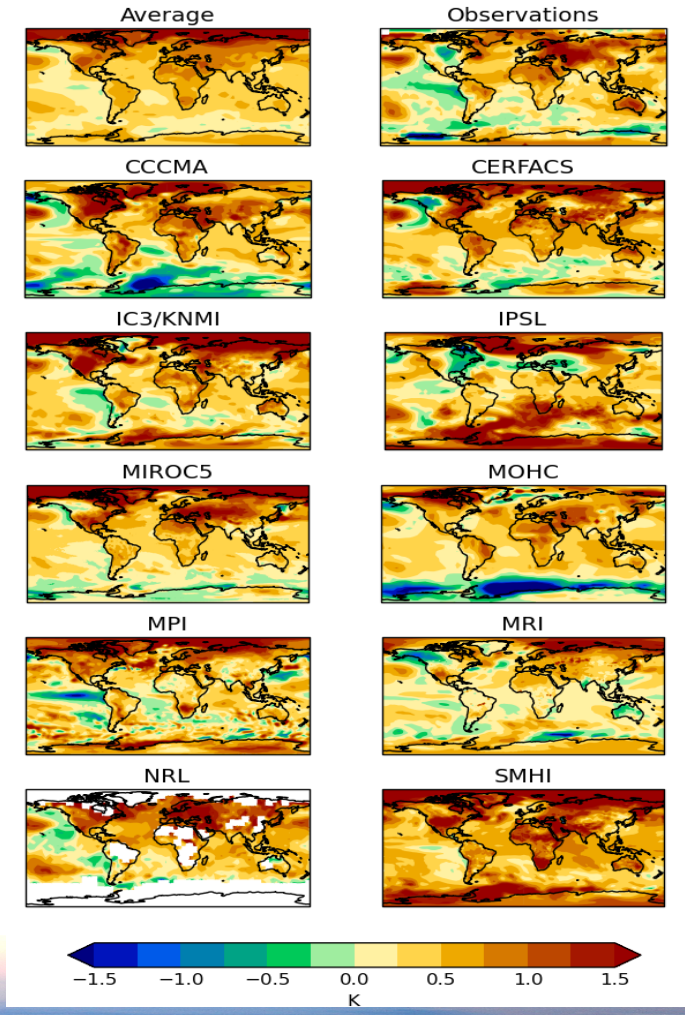
DCPP_MIP in CMIP6

- Three components
  - A. CMIP-decadal hindcasts
  - B. Experimental multi-model forecasting
  - C. Mechanisms, predictability and case studies
    - Hiatus+
    - Volcanoes and prediction

Component B: Experimental decadal forecasts

- Decadal predictions (not hindcasts) currently being made by a number of groups
- Collection, calibration and combination of forecasts
- Forecasts and data made available in support of research and applications
- To evolve as a CMIP6 activity (need guidance as to which scenario to use from ScenarioMIP); 10 year prediction, 10 ensemble members (100 years)

2013 temperature prediction



DCPP_MIP in CMIP6

- Three components
  - A. CMIP-decadal hindcasts
  - B. Experimental multi-model forecasting
  - C. Mechanisms, predictability and case studies
    - Hiatus+
    - Volcanoes and prediction

Component C: Mechanisms, predictability and case studies

- **What are the mechanisms and processes determining decadal predictability and permitting (or making difficult) decadal prediction skill?**
  - *Predictability*: a feature of the climate system reflecting its "ability to be predicted"
  - *Skill*: the "ability to predict" aspects of the system

- ***Component C:* proposals being developed for coordinated multi-models experiments include:**
  - Hiatus+: the nature and predictability of both positive and negative long timescale variations in temperature and other quantities as exemplified by the current hiatus; connection between Pacific and Atlantic
  - Volcanoes: the actual and potential consequences of volcanic activity on predictions of the forced and internally generated components of temperature and other variables
  - Modeling groups running prototype experiments 2014-mid-2015; workshop in mid-2015 to review results and formulate one or two coordinated experiments for Component C

MORDICUS

Mechanisms for climate Oscillations and Retroactions at Decadal tImesCale : Uncertainties and Sensitivity

AGENCE NATIONALE DE LA RECHERCHE
ANR

cnrs
www.cnrs.fr

CERFACS

Institut Pierre Simon Laplace

METEO FRANCE

IC3R

MORDICUS Objectives

- **process-oriented project** in line with some key lessons drawn from CMIP5
- **modeling-oriented project** built upon CMIP5 outcomes

• Objective 1: Understand the physical/dynamical coupled ocean-atmosphere mechanisms leading to internal variability at decadal timescale (processes connecting subsurface ocean, to surface temperature anomalies possibly associated with large-scale atmospheric changes when interactions occur, focus on IPV and AMV decadal modes as well as their interconnections.

• Objective 2: Extract, characterize the fingerprint of the various external forcings (GHG, stratospheric ozone depletion, solar+volcanoes and aerosols) on regional climate and explore the physical/dynamical processes (direct radiative effect, ocean-atmosphere coupling etc.) by which the external forcings may contribute to the decadal spectral band of variability. A special attention will be devoted to the interactions between those forcings and the IPV and AMV internal modes (phase reversal or lock etc.).

• Objective 3: Isolate the respective role of decadal ocean modes of variability and anthropogenic factors upon atmospheric and continental changes with a special attention to the hydrological cycle (focus on droughts) and extreme events such as midlatitude storms and tropical cyclones.

SPECS