Climate Forecasting Unit:
Structure, objectives and strategic goals

Global mean surface air temperature

Historical simulations (dashed curves)

Initialized forecasts (solid curves)

Forecast year 2-5

Init RMSSS

Ratio RMSSS Init/Noinit

Doblas-Reyes et al. (2013), Nature Communications
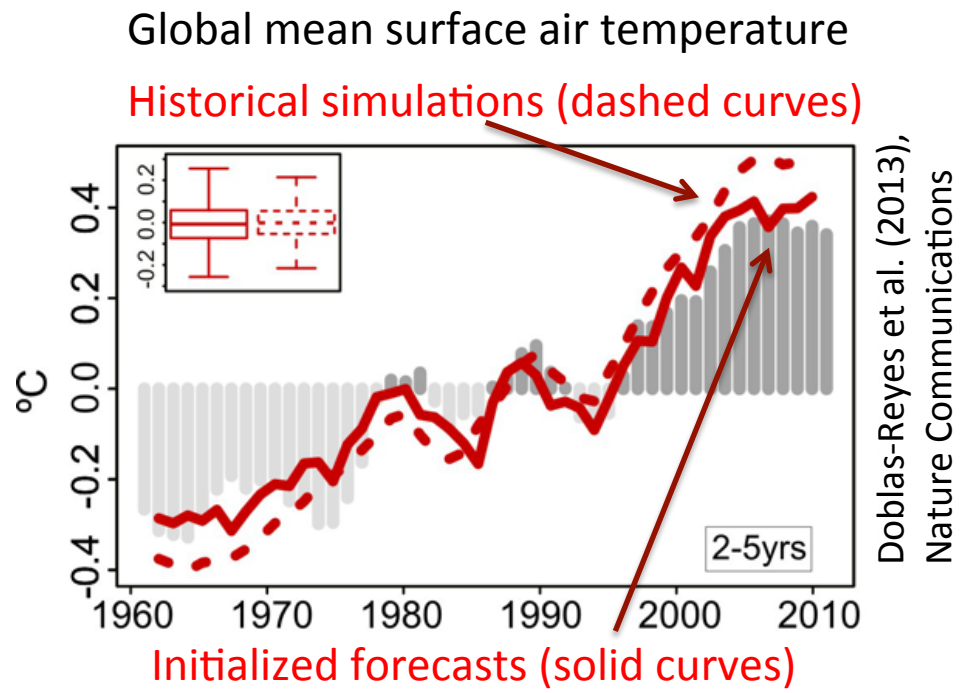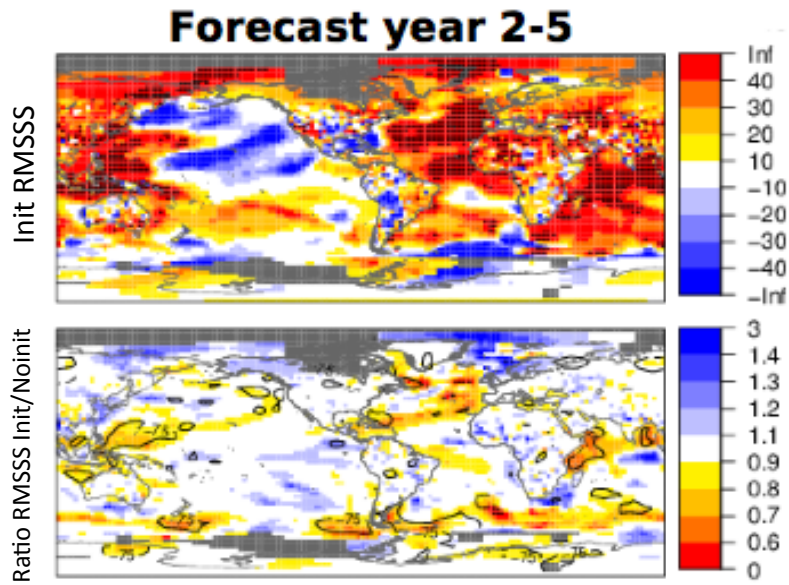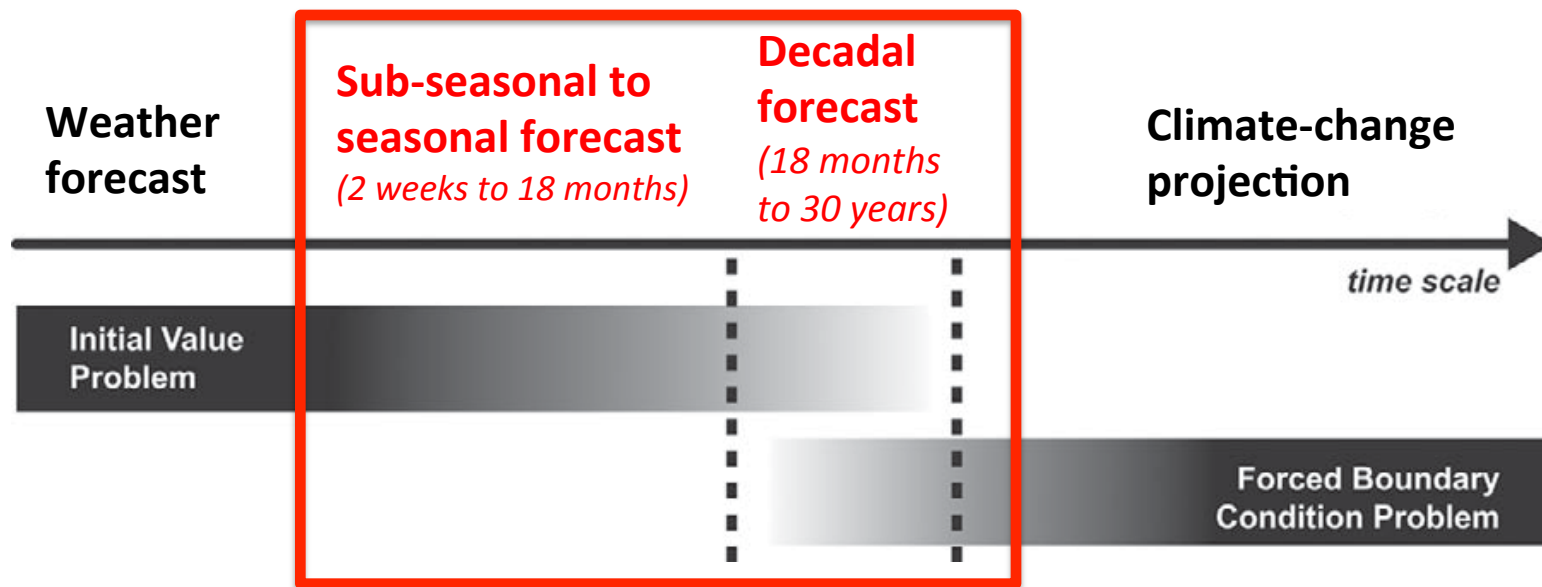
Barcelona Supercomputing Center, UPC, Barcelona, December 1st, 2014

Climate time scales of interest

Progression from *initial-value problem* with **weather forecasting** at one end and multi-decadal to century **climate-change projections** as a *forced boundary condition problem* at the other, with climate forecast (**sub-seasonal, seasonal and decadal**) in between

CFU structure and main objectives

Groups	Main objectives
1. Climate forecast	1.1 Development of climate forecast systems 1.2 Utilization of climate forecasts to understand predictability mechanisms and forecast systems limitations
2. Climate services	2.1 Downscaling, calibration and verification of multi-model climate predictions for selected regions and locations 2.2 Development of climate prediction tools and communications for the energy sector and other stakeholders
3. Software development for climate forecast and services	3.1 Development of HPC user-friendly software framework for climate modeling and optimization of climate models 3.2 Development of local and distributed software for pre-processing and post-processing of modeled and observed data

1. Climate Forecast: Strategic goals

(1.a) Development of climate forecast systems:
   toward more realistic model processes

● Incorporation and testing of new model components and sub-grid cell parameterizations to account for additional potential predictability sources

● Tuning of parameterizations to reduce the climate forecast drift and improve skill

● Development of the next generation high-resolution global climate forecast system and assessment of the added-value of such resolution increase (0.25°-0.12°, 40-25km)
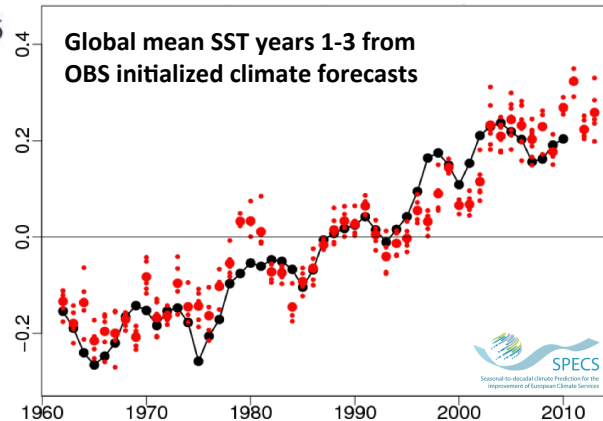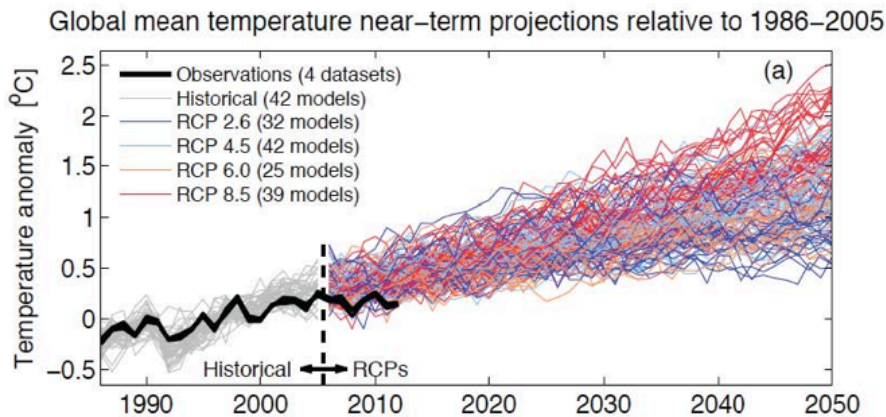
(1.b) Development of climate forecast systems:
   data assimilation and initialization

● Utilization of various oceanic and atmospheric reanalyses and production of ensemble sea ice reconstructions to obtain a large set of initial conditions (IC) for climate forecast

● Comparison of the performance of various initialization techniques

● Assessment of the benefits of weakly coupled data assimilation in obtaining IC

(1.c) **Forecast quality assessment:**
**attribution and sources of predictability**

● Assessment of the state-of-the-art climate forecast quality in terms of prediction drift and skill (tropical cyclones, heat waves, ocean circulation, sea ice conditions, etc.)

● Production of sensitivity experiments to highlight sources of skill

● Utilization of successful climate forecasts for attribution purposes (extreme events, *hiatus*) through analysis and sensitivity experiments to highlight the causes for success

Global mean temperature near–term projections relative to 1986–2005 (a)

Observations (4 datasets)
Historical (42 models)
RCP 2.6 (32 models)
RCP 4.5 (42 models)
RCP 6.0 (25 models)
RCP 8.5 (39 models)

Global mean SST years 1-3 from OBS initialized climate forecasts

Guemas et al. (2013), Nature Climate Change

1. Climate Forecast: Strategic goals

(1.d) Forecast quality assessment: diagnosis of climate forecast errors

● Investigation of the mechanisms leading to climate prediction drift and the relations between the drift and the prediction skill

● Investigation of the causes for climate forecast errors of particular events

● Feedbacks toward climate forecast system development
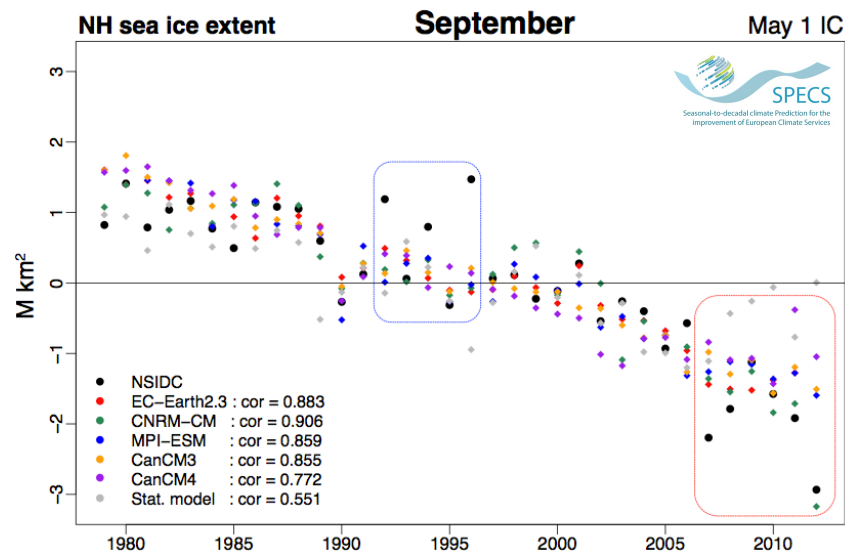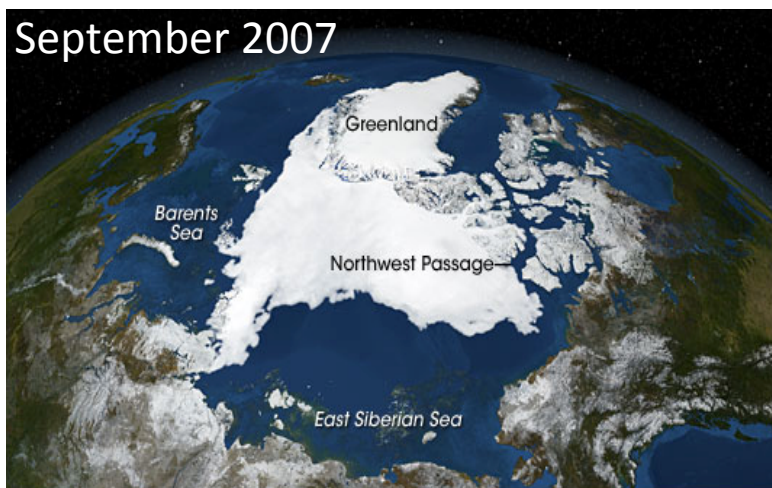
2. Climate Services: Strategic goals

(2.a) Development of user-defined climate forecasts and an assessment of their skill: Using a multi-model approach (EU and USA) climate forecasts can be created and post-processed for variables, timescales and resolutions requested by the user

Main research topics: Evaluation of wind power via wind and temperature forecasts

→ Extend research to solar and hydro power using several models
→ Expand use of forecasts to risk and vulnerabilities management
→ Translate knowledge into the wine and other agricultural sectors

(2.b) Application of climate predictions in user-tailored decision support tools: Usable visualization and communication techniques can be employed to facilitate the application of climate predictions within specific decision making process

Main research topics: Collaboration with end users whose decisions are influenced by wind power supply to develop a decision support tool

(2.c) Assessment of the impact of climate prediction tools on the decision of various stakeholders: An evaluation of climate forecasts within specific decision making processes will be explored through feedback mechanisms between the users and the provider

→ Extend user groups and develop more advanced feedback mechanisms, such as online tools, co-designed projects/initiatives etc.

Winter (DJF) forecast skill
Nov 1st start date
**10m wind speed**
ECMWF S4 vs ERA-Interim
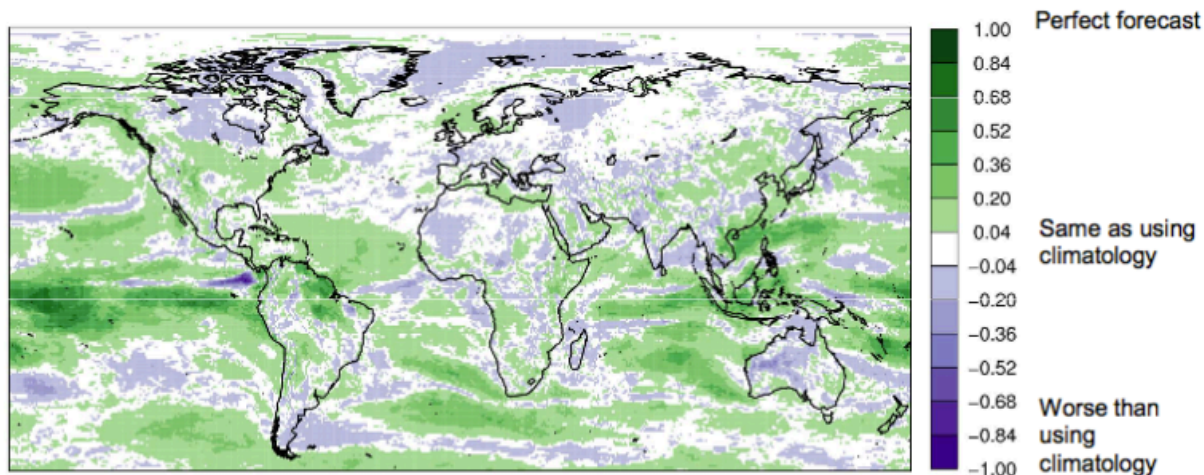
3. Software development: Strategic goals

(3.a) Development of AUTOSUBMIT: http://ic3.cat/wikicfu/index.php/Tools/Autosubmit

user-friendly framework for climate modeling

● Autosubmit is a software designed to configure, submit and run climate simulations on a wide range of platforms in a uniform, highly automatized and absolutely transparent way for the users

● Continuous development and regular releases of new versions ensure its distribution to a wider community by extending its options and functionalities
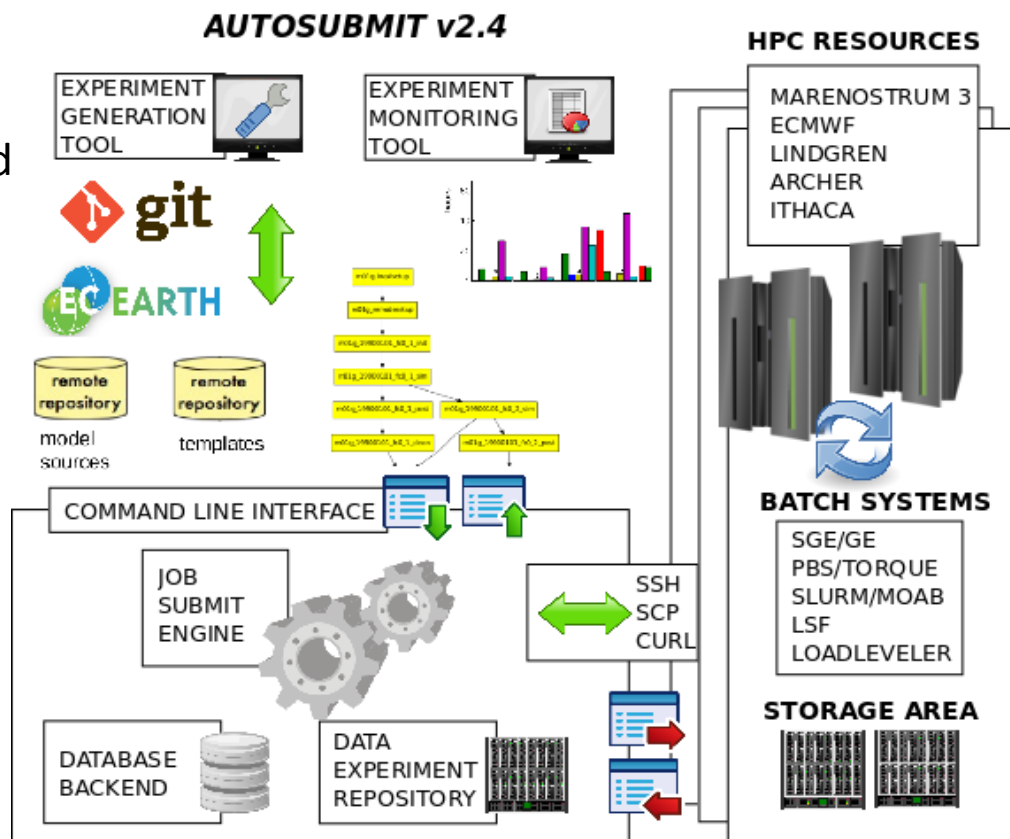
3. Software development: Strategic goals

(3.b) Development of s2dverification: http://ic3.cat/wikicfu/index.php/Tools/s2dverification
**R package tailored for climate forecast skill assessment**

● s2dverification is an R package in continuous development and is publically distributed through the Comprehensive R Archive Network (CRAN) and designed for climate prediction skill assessment over large multi-model and multi-observational database

(3.c) Model profiling and optimization

● Expertise has been developed on the profiling of climate models, analysis of their bottlenecks and design of new algorithms and methods to overcome these bottlenecks

(3.d) Development of tools for data formatting and diagnostics

● A precise data formatting policy is applied to ensure the efficiency of data analysis and comparison

● Pre-processing and post-processing scripts are being continuously developed to extend the common database and to compute advanced climate diagnostics for model validation and forecast quality assessment.

Climate Forecasting Unit

Climate Forecast

synergy

Climate Services

Software Development
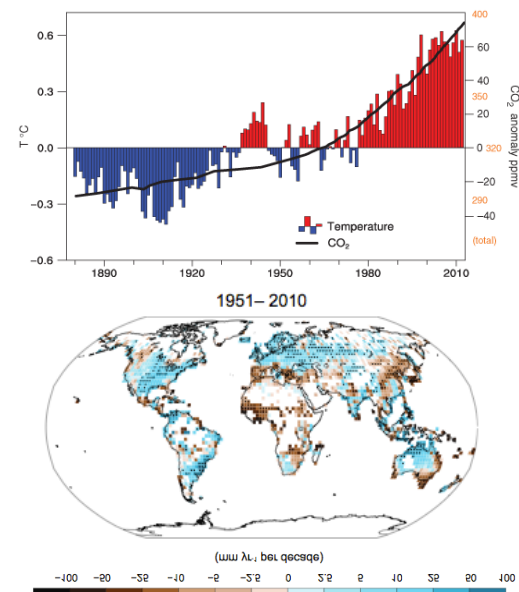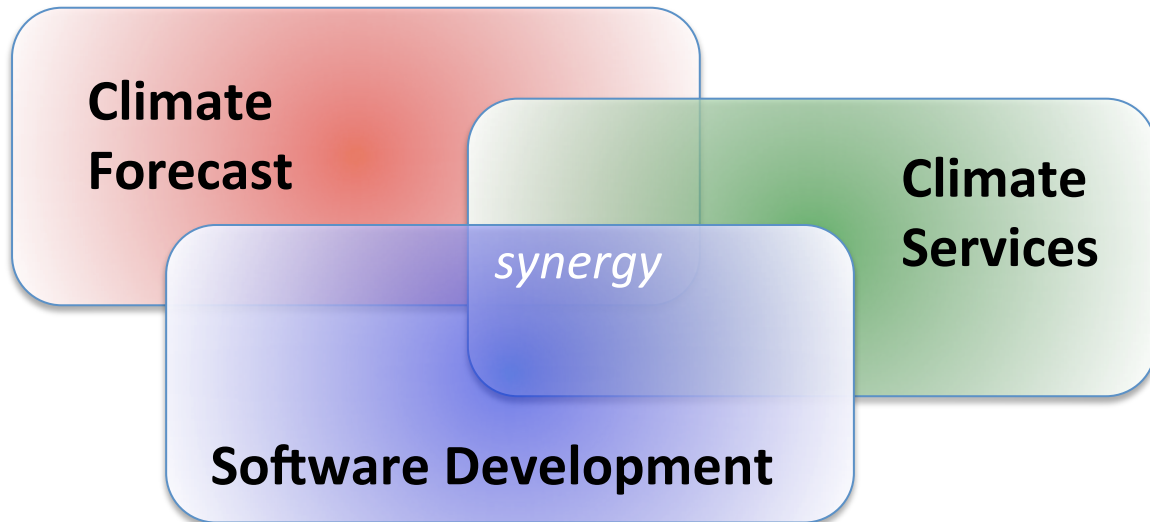
Gracias / Gràcies / Merci / Grazie / Obrigado / Hvala vam
σας ευχαριστώ / اَپ کا شکریہ / Thank you for your attention

Questions, comments, …