PROGRESS REPORT

INSTITUT CATALÀ DE CIÈNCIES DEL CLIMA

Climate Forecasting Unit

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Introduction

This progress report aims at providing an overview of the progress made during the first six months of my PhD at the Catalan Institute for Climate Sciences (IC3) within the Climate Forecasting Unit (CFU). This progress report covers the six month period between November 2009 and April 2010. It is also intended to describe the work in progress and the tasks to be done, stressing both the short and long-term objectives of my PhD thesis.

PhD Overview

Seasonal climate prediction has several impacts on the society. Predict temperature and precipitation from few weeks to one year ahead could help decision makers to better mitigate damages caused by floods and wave heats, and also alert society about the risks of influenza and/or other weather related illnesses. Agriculture and climate-sensitive energy resources, such as, hydroelectric, wind and solar energies, also have a very large dependency on this type of information.

Considerably effort has been made to improve climate prediction at this time scale, and much improvement has been achieved. Currently, several methods on seasonal climate prediction are available and used operationally to predict seasonal climate by several national and international weather services around the world. These methods go from simple statistical prediction, that is, assuming the climate in the next months will behave like it did in the past, through dynamically-based forecast systems to the forecast assimilation method, a method to combine dynamical seasonal climate predictions carried out by multi-model Global Climate Models (GCMs) and simple statistical models (Coelho, 2005).

The Mediterranean region, including Southern Europe and Northern Africa, is one of the most vulnerably regions affected by climate change with emerging trends in both temperature and precipitation. Besides, it is well known that the observational sample available for performing probabilistic prediction using a statistical model is relatively small, and additionally, the predictability at this lead time outside the tropics is low (e.g., George and Sutton, 2006). Therefore, the final objective of this PhD thesis is to apply the forecast assimilation method in the Mediterranean region to obtain probabilistic forecasts of seasonal-mean temperature and precipitation. It will be studied whether this combination could lead to a better probabilistic prediction than the ones derived from the several available GCMs prediction within the ENSEMBLES project and from a simple statistical model that will be developed in this thesis, when assessed independently.

Training

As I completed an M.Sc. degree in Meteorology in the Brazilian National Institute for Space Research, which was recognized by the Department of Astronomy and Meteorology in the University of Barcelona, no additional courses were required to start the research phase of the PhD.

To achieve the main objective of my thesis I, under guidance of my advisor, followed several paths, which are described below.

1) *Study basic statistics:* I am mainly following the online course "Data analysis methods in weather and climate research"[1]. In addition, I am studying several other online tutorial (e.g., statistics.com[2] and gardenersown.co.uk[3]) and courses (e.g., Applied Statistics at MIT OpenCourseWare[4]) on statistics, books (e.g., Wilks, 2006), as well as papers.
2) *Learn and practice several data analysis and visualization software packages*: the list includes R, GrADS, NCO and CDO. In addition, I am improving my knowledge in bash scripting to better handle the tools provided by the software mentioned above. This task implied reading the available information about these software (i.e., online tutorials, books, man online, etc).
3) *Start reading the literature about the climate of the Mediterranean region.*
4) *Datasets*: I invested time in preparing and getting acquainted with different types of global climate data available, such as the ERA-Interim reanalysis data and GPCC and GPCP precipitation data.

In addition, I have applied to several summer courses on climate prediction as a complementary training. I have been admitted in the course "Predictability, diagnostics and extended-range forecasting" at ECMWF on 19-28 April 2010. I have also been admitted and granted full funding to attend the joint ASP/NCAR summer colloquium "Forecast Verification in the Atmospheric Sciences and Beyond" at NCAR on 6-18 June 2010. I will also apply to at least one more summer school on Mediterranean climate and a workshop on Seasonal prediction to be held at ICTP, Italy. Besides, I have attended several talks on climate and related sciences of the regular informal seminars held at IC3 and elsewhere.

Completed and ongoing work

In collaboration with other CFU members, I have been helping in the build up process of the CFU data repository. This data repository will consist of datasets from different types and origins, such as NCEP/NCAR and ERA-Interim Reanalysis, GPCP and GPCC precipitation data, hindcasts from the ENSEMBLES project, CFU seasonal and decadal hindcasts performed with the EC-Earth model, etc. Specifically, I have been dealing with the ERA-Interim as I already have some experience using NCEP/NCAR reanalysis.

Among the tasks I have performed there is to download the ERA-Interim reanalysis data and manipulate it. The original files have been modified into the CFU standard, which is based on the Program for Climate Model Diagnosis and Intercomparison (PCMDI) and NetCDF Climate and

[1] http://www1.secam.ex.ac.uk/data-analysis-(postgraduate).dhtml
[2] http://courses.statistics.com/software/R/Rhome.htm
[3] http://www.gardenersown.co.uk/Education/Lectures/R/graphs.htm
[4] http://ocw.mit.edu/OcwWeb/Sloan-School-of-Management/15-075Applied-StatisticsSpring2003/CourseHome/

Forecast (CF) standards. For example, regardless of the format of the original file, it will firstly be converted into NetCDF format and a set of headers (e.g., variable long and short names, units, units name, dimension information, etc) will be modified and/or added in order to make it as self-described as possible. The same procedure has been performed by other colleagues for other datasets.

Simple statistics of different climate variables, using ERA-Interim and GPCP datasets, have been computed for the Mediterranean region. The aim is to make a simple analysis of the previous season. This kind of analysis will be done for every season of the year as new data set become available for download. I started with data from the previous summer. A shell script has been created to do these plots automatically with a generalized procedure so that it can be used to plot variables from different datasets.

Work to be done

By the end of October 2010, I am expect to finish the course "Data analysis methods in weather and climate research" and be able to build a simple statistical model for predicting El Niño/Southern Oscillation (ENSO) 3.4 index using the software R. This simple model will be based on the linear regression between December and the preceding July ENSO 3.4 index values as in Coelho et al. (2004). I am also expected to get acquainted with the ENSEMBLES project multi-model hindcasts.

References

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