On the climate change implications to water supply In the city of Lima, Perú

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Motivation

Water supply is one of the mayor problems that faces the city of Lima in Perú. This problem is critic in periods of drought and extreme drought. Moreover, the hydrological cycle vulnerability to climate change, especially the impact on the availability of water resources requires, among others factors, the study and prediction of the consequences in water resources.

LiWa Project

Climate change is expected to have a number of serious impacts. Although predictions of climate change are varying and are characterized by some uncertainty, almost all experts agree that our globe will be seriously affected. The LiWa project is a large-scale project which take into account the climate change. It involves several disciplines addressing the problem of water supply in different perspectives in order to know the different and relevant parameters, their interactions, the present and future implications, and at the end try to give an assessment and proposal for the development and the optimal use of the water resource, with particularly adverse boundary conditions.

Problem

One of the most dramatic consequences of climate change is the alteration of the hydrological cycle. For instance we can mention the melting of glaciers, rising sea-levels and important changes in temperature and precipitation patterns. Figure 1 shows the assessment of the change in precipitation from 4 different global climate models in the catchments under study, for the period 2010-2039:

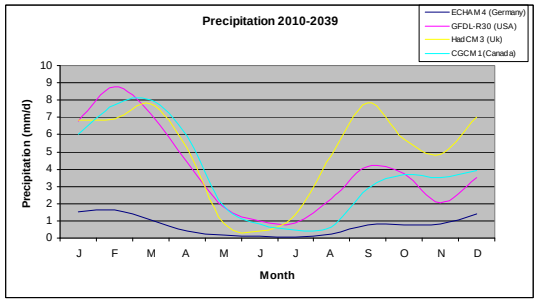

Fig. 1:Precipitation prediction 2010-2039

ECHAM4: Max Plank Institut fuer Meteorologie, Deutschland
GFDL-30 : Geophysical Fluid Dynamics Laboratory, USA
HadCM3 : Hadley Centre for Climate Prediction and Research, UK
CGCM1 : Canadian Centre for Climate Modeling and Analysis

As showed in figure 1, the predictions of the future behaviour of the precipitation is uncertain. But these uncertain behaviour is unfortunately expected since in this complex dynamical processes uncertainty (from quantum theory) is always present. It is not possible simultaneously measure both, the position and the momentum of a particle in a micro-scale, or equivalently its energy at an accurate time. Here, the definitions of particle position, momentum, energy and time are all **PROBABILISTIC**.

Consequences

It is not possible to know with certainty the characteristics of one variable until we measure it. It is important to mention that the **future behaviour** of a variable (or particle) **can not be predicted** either. Because of these deep and conceptual uncertainties, the future outcome is also unpredictable. So, since then, in a micro-scale only a deterministic view is meaningless and one could only talk about **PROBABILITIES** of outcomes instead.

Task

The most important task is to provide a simulation of the water and energy resources under changing climate and different development scenarios. Different scenarios will be downscaled using a mixed classification-regression based on downscaling scheme to generate local time-series of temperature and precipitation for the project area and selected time period. A hydrological model, based on the HBV concept (Bergström, 1995), will be adapted to the project requirements and calibrated using the available discharge and meteorological data.

Region under study

The three catchments which feed the city of Lima with water are Chillón, Rimac and Lurín. Some of the characteristic of them are:
Precipitation: from 9 mm/year in the city to approximately 990 mm/year in the Andean regions.
Area: 7000 km^2
Longitude of the main catchment: 160 km
Temperature: relatively constant, 15°C in average

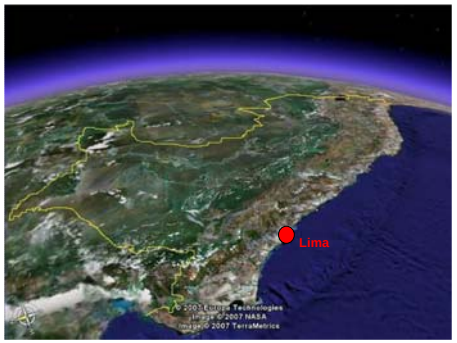

Fig. 3: City of Lima

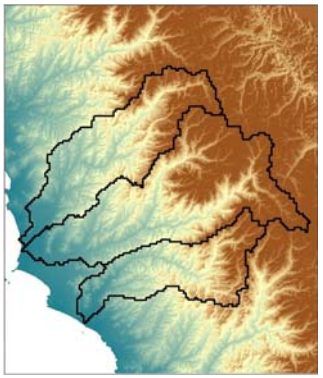

Fig. 2: Catchment of Chillón, Rimac und Lurín