Megacity projekt: LiWa, climate and water balance modelling

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Motivation

The population growth, the very scarce precipitation in Lima, wich reach only arround 10 mm/year in average, and the occurence of some singular events such as el Nino/Nina as well as drought periods, among others, make it neccesary to know as exact as possible, the behaviour of the hydrological cycle, the importance and impact of the singular events that could lead to undesirable extrem situations, and the extra water which is posible to be obtained from new sources.

LiWa Project description

The LiWa project is a large scale project which involves several disciplines. Some importans tasks are the climate and water balance modelling, and Macro-modelling and simulation for Lima. An important issue is the consideration of the climate change by selecting diferent scenarios which wil be downscaled and modelled to obtain an assesment for the glacial melt, river discharge and groundwater recharge. New water sources will be also considered and the modelled outcome, under climate change, will be the input for the future water-resource system.

Hydrological modelling

An hydrological modelling based on HBV concept (Bergström, 1995) will be adapted to the project requirement. The calibration will be done by using available discharge and meteorological data. Precipitation data series were completed and interpolated in the whole area. The area was divided in grids of 1000*1000 m². Schematic it can be seen in figure 1.

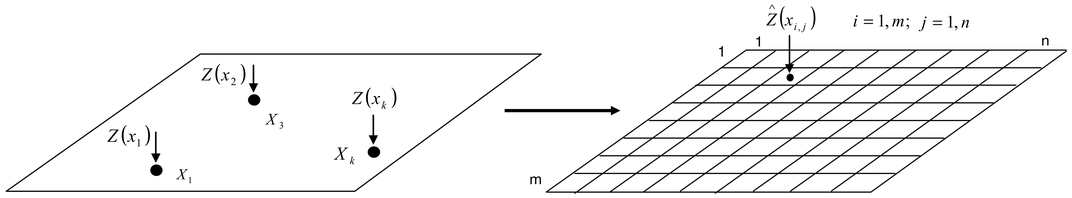


Figure 1: discretization of the area (random field)

The method of interpolation was External-drift-kriging (Ec. 1)

Ec 1

$$\sum_{j=1}^{n} \lambda_j \gamma(u_i - u_j) + \mu_1 + \mu_2 Y(u_i) = \gamma(u_i - u) \qquad i = 1,\ldots,n$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\sum_{j=1}^{n} \gamma_j Y(u_j) = Y(u)$$

With *uk* vectors position, *μ1*, *μ2* lagrange parameter, Y variable linearly related to the regionalized variables and λ_k parameters to be be found. An example of the interpolated data can be seen in figure 2. In this example is it shown the annually precipitation for 2 consecutive years, namely 2005 and 2006. The interpolation was carried out with monthly precipitation data and averaged in the years.

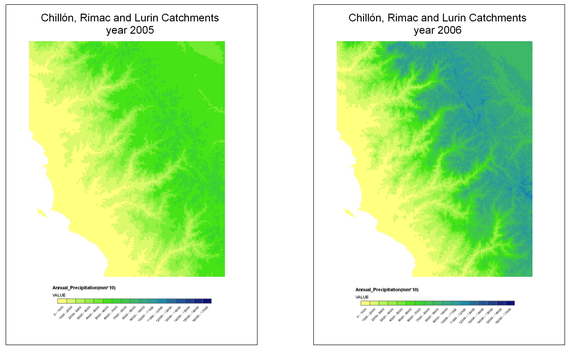


Figure 2: maps of annually interpolation

It can be seen in these figures the diferences in precipitation amount for the years 2005 and 2006. Daily interpolation will be the basis for the input in hidrological moddelling.

Alternative sources

The catchments of Mantaro, on the other side of the andes, have been analyzed and for all the new projects in this catchment the maximum extra water which is possible to be obtained was calculated. Figure 3a show the calculated sub catchments in Mantaro and figure 3b show the percentage of rainfall for the catchments Chillón, Rimac and Lurín, and the percentage of rainfall in the catchments in Mantaro.

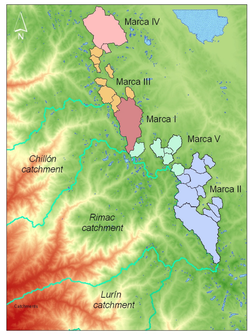


Fig. 3a: Sub catchments in Mantaro

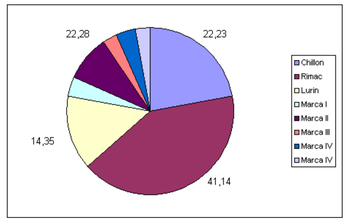
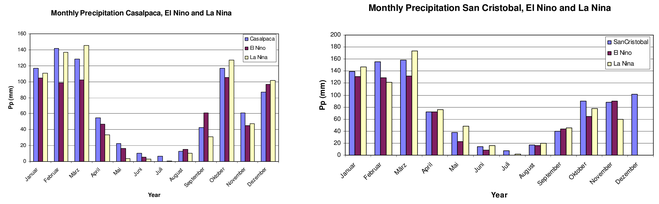


Fig. 3b: Percentage of rainfall of each catchmnet and sub catchment.

El Nino/La Nina phenomenon:

El Nino and La Nina phenomenon are strongly present in Perú. Studies that have been done in this context show that there are serious impacts of these phenomenon in Perú. For instance, it can be seen the impact of these phenomenon in two stations in in the catchment of Rimac:



Casapalca has an elevation of 4150 m and San Cristobal an elevation of 4600 m

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