	Ricardo Arevalo Meija (defended Nov., 2018)
	Development of hydro-informatics tool to assess environmental flow in non-gauged basins in Mexico
	Encadrants : C. Diaz-Delgado, C. Mastachi (UAEM CIRA), E. Leblois (Irstea, RiverLy, HyBV)
	Ecole Doctorale: Université Autonome de l'Etat du Mexique (UAEM), Toluca - Mexique

Les débits d'intérêt environnemental sont un repère essentiel pour une exploitation de la ressource en eau qui ne soit pas fatale à la préservation du milieu naturel. Connaître leur valeur partout est aussi une obligation posée par la loi Mexicaine.

Ceci suppose, entre autres, des techniques d'interpolation spatiale compatibles avec la nature des données hydrologiques (quantiles, espérances mathématiques, moyennes de bassin...).

Un séjour d'un an à Irstea RiverLy a permis au doctorant de s'approprier une partie des savoir-faire de géostatistique utiles à son travail, et de les insérer tant dans la réflexion scientifique de sa thèse que dans les outils développés à l'UAEM dans ce cadre.

On a worldwide scale, there has been an increasing desire to settle up environmental flow in national and regional policies and legislation. The aim is to conserve or restore the ecological health and functioning of rivers such that human demands can be met as well as related ecosystem biodiversity. Its benefits have been economically and ecologically seen by those countries that have already established it. In Mexico, that impact has been one of the main causes for the Mexican standard NMX-AA-159-SCFI-2012 that establishes the procedure for environmental flow assessment in hydrological basins.

The aim of the present research is to develop a hydro-informatics tool in order to assess the environmental flow in non-gauged basins. This is feasible due to the integration of interpolated images related to temperature, precipitation and run-off as well as other explicative variables such as: physical basin parameters, database of flow control dams, spatial relationship of endangered species richness or under special protection, land change use, hydrological alteration indices and climate changing indices. Once all the mentioned information has been recovered, a hierarchical cluster regionalization will be carried out in order to identify and classify regions with similar ecosystem-flow responses. In addition to that, several non-linear regressions will be developed for each cluster to assess the environmental flow in regions with lack of hydrological and climatological information. The proposed research methodology is compound by four stages. The first stage is assigned to integration and information processing. During the second stage, a hierarchical cluster analysis will be performed in order to identify areas with similar ecosystem-flow responses. On third stage, non-linear regression models will be calibrated for those regions where there is a considerable lack of information. Finally, a hydro-informatics tool will be developed in order to offer an efficient and friendly tool to water decision makers in Mexico.

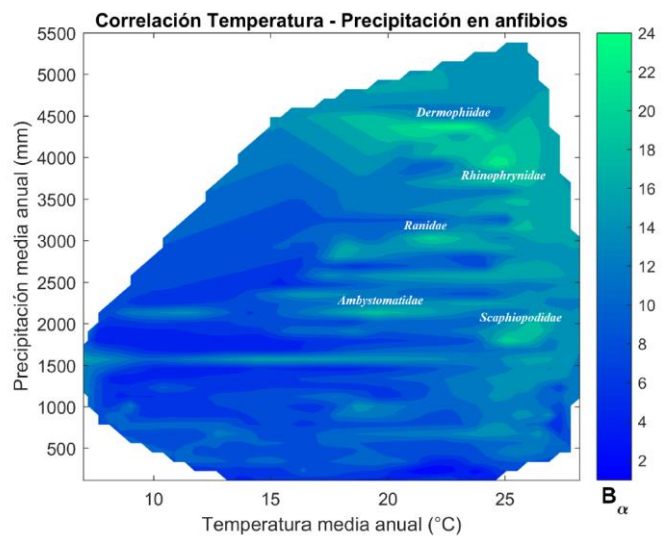
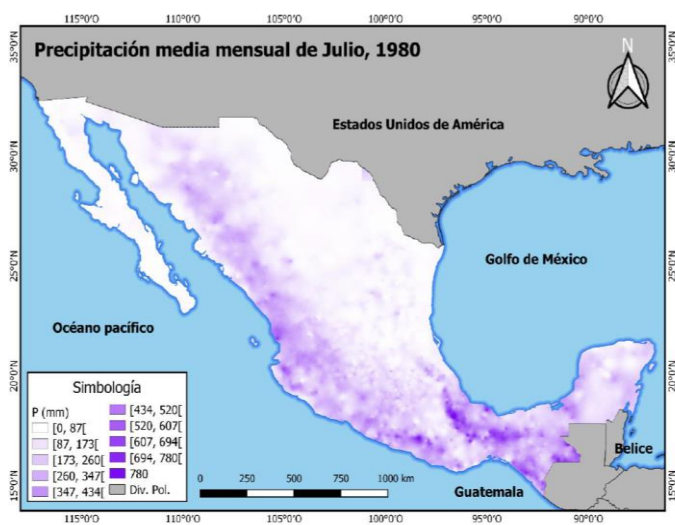
The aim of the present Ph. D. Project is to develop a hydro-informatics tool to assess, in a semi-holistic approach, the environmental flow in non-gauged basins. The objectives are:

1. Integration and databases processing such as: physical basin parameters, run-off, climatological data, flow control dams, spatial relation of endangered species or under special protection and land change use;
2. Interpolation of climatological data such as: maximum temperature, minimum temperature and precipitation to assess climate change indices and check possible trends;
3. Regionalization of basins with similar ecosystem-flow responses;

4. Development of non-linear regressions for areas with noticeable lack of information;
5. Development of hydro-informatics tool to assess the environmental flow in non-gauged basins using the technical computing language MATLAB.

The PhD is based at UAEM. A one year stay at Irstea Lyon (1/8/2016-20/7/2017) was mostly devoted to understand and adapt to the Mexican data conditions the geostatistical tools for hydrological mapping developed over years by E. Leblois, E. Sauquet and co-authors. On 1/3/2017, the geostatistical developments were done.

The defense successfully happened in November 2018 in Toluca, Mex.



Geoestadística a la mexicana ; à gauche la pluie mensuelle de juillet 1990 ; à droite le diagramme ombro-thermique Mexicain et l'attestation d'amphibiens

Financement :

PhD Grant by Conacyt (Mexico) ; some extra fees for stay in Lyon by Irstea international affairs departement

Situation actuel du doctorant (07/2019) :

Présentement en CDD au CIRA, son laboratoire de thèse à l'UAEM. Vient d'être accepté pour un post-doc à l'INRS-EET, Québec, sur le lien entre les techniques de régionalisation géostatistique et d'autres techniques d'interpolation de série chronologiques.