

Annual report 2021 for Flagship Pilot Study: Dynamical downscaling experiments and hydrological modelling for Canada and Mexico.

Status and progress during the year including scientific highlights, end to end perspective, and participants engaged in the project.

Progress.

1. Generate a program for 2021-2022 to identify the activities of each group. (Hydrology group and Climatology group).
2. Identify the team structure.
3. Analyze individual functions.
4. Analyze efficient mechanisms of communication.
5. Design of the project's Web page.
6. Addition of new collaborators. Centro del Cambio Global y la Sustentabilidad, A.C., Mexico (CCGS), Centro de Investigación Científica y de Educación Superior de Ensenada, Mexico (CICESE) and Institute for Atmospheric and Climate Science., ETH Zurich, Switzerland.

Activities 2021.

- ✓ Numerical experiments design.
- ✓ The project's WEB page design and contents.
- ✓ State-of-the-art of the different statistical methods in use nowadays.
- ✓ Review of the available CMIP6 model's performance for Mexico.
- ✓ Test the performance of simple hydrological models with CMIP6 simulations as inputs, for experimentation in the Quebec and Mexican watersheds.
- ✓ Submit to CONACYT (Mexican National Science and Technology Council) a project proposal for funding.
- ✓ Submit to BUAP (University of Puebla, Mexico) a project proposal for using a supercomputer without any cost.
- ✓ Identify ways to track project progress.
- ✓ Identify future work.
- ✓ Analysis in geographic information systems of the basins in Mexico and Quebec, required for setting up the distributed model on the studied river basins.
- ✓ Treatment of climatological and hydrometric data.

Generate Milestones.

1. State-of-the-art diagnostics for the whole project
2. Final configuration of the climate & hydrological numerical models
3. Hydrometeorological modelling for Mexico and Canada (using the full modelling chain, from CMIP6 climate models output to streamflow simulation)
3. Results of the experiments (climate & hydrological simulations)
4. Diagnosis of the reproduction of relevant atmospheric processes in the tropics and extratropics.

Summary of each workshop/activity held during the year

Name of the activity.	Responsible person/-s	Funder
First meeting. Date: 14 April 2021. Description: To generate a program for 2021 to identify the activities of each group. To identify the team	José Antonio Salinas. All participants in the project.	

structure. To analyze efficient mechanisms of communication. Location: Remote meeting. Link used: meet.google.com/wua-ybow-mvt		
Second meeting. Date: 12 July 2021. Description: To evaluate 2021 goals. To analyze individual functions. To identify future work. Location: Remote meeting. Link used: meet.google.com/kgg-xncc-ojd	José Antonio Salinas. All participants in the project.	
Third meeting. Date: 29 September 2021. Description: To analyze the progress of the project. To identify ways to track project progress. To identify future work. Location: Remote meeting. Link used: meet.google.com/kkg-bkug-nie	José Antonio Salinas. All participants in the project.	

Related publications during the year

Title, journal, and link to publication	Author/-s	Date

Planned activities for next year

Universidad Veracruzana will accept some students to work on the project (thesis).

Define better the experiments before we add more information to the website.

Apply multiple dynamical downscaling experiments with two of the ESMs from CMIP6 with the best performance for Mexico and Canada using nested grids with WRF and RegCM models.

Apply multiple statistical downscaling techniques to the new set of ESMs from CMIP6 to define a small set to be used for the whole project.

Develop and apply multiple statistical downscaling techniques to the new set of ESMs from CMIP6 to define a small set to be used for the whole project as a) Based on bias correction (such as Bias Correction/Constructed Analogues. b) Bias-Correction Spatial Disaggregation.

Get some intermediate meetings among different groups (climatology and hydrology) to better define the line of work in the project.

A contributor of Working Group I (Sixth Assessment Report. IPCC) will be invited to give a talk in March 2022, she will talk about the limitations of Earth System Models (ESM's) and what is expected of both dynamic and statistical downscaling for the two study areas (southern Quebec and central Veracruz).

In terms of hydrological modelling more specifically:

In addition to the distributed Hydrotel model, lumped conceptual models will be used to carry hydrological modelling. Those models are simpler to implement (due to their lumped nature) and can add relevant information while contributing to a higher diversity of model structures.

One PhD student, registered at ETS, will join the team (in March 2022) and work on the hydrological modelling experiments, both under current and future climates. Those experiments will involve working with outputs from climate modelling, i.e. bias-corrected CMIP6 ESM simulations and dynamically downscaled CMIP6 simulations using WRF and RegCM regional models.

What is planned for the next project year is as follows:

Calibrate and validate all hydrological models for studied rivers basins in Mexico and Canada.

Proceed to simulations using outputs (precipitation, temperature) from the bias-corrected CMIP6 ESM simulations to force hydrological models.

A six-month academic stay of Professor Rabindranath Romero at the École de Technologie Supérieure with the professor Annie Poulin, to specifically work on the hydrological modelling experiments together with the PhD student that will be involved in this part of the project. It is planned that the student be cosupervised by both professors Poulin and Romero.

Additional relevant information

In February 2022, this project was selected to be supported with access to supercomputing equipment for one year (March 2022 to February 2023). This equipment belongs to "National Supercomputing Laboratory of Southeast Mexico" managed by BUAP (Autonomous University of Puebla), strengthening capacities to achieve project objectives. This hardware adds to the supercomputing capabilities of IMTA.

Contact person/-s

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The report is due the 15th of February each year and should be sent to ipoc@cordex.org.