Annual report 2022 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. Implementation of the annual program with the activities, functions and mechanisms of communication in the Hydrology and Climatology groups.
2. The web page of the project is available at: http://cordex.imta.mx/
3. José Antonio Salinas was awarded as a Senior Associate of the ICTP (International Centre for Theoretical Physics, Trieste, Italy) from 01 January 2023 until 31 December 2028.

Activities 2022.

- ✓ Selection of global models according to: the best correlation, closest STD to the observations, the best annual cycle reproduction (midsummer drought), the highest spatial resolution containing all the necessary variables to carry out regional numerical simulations.
- ✓ Analysis and evaluation of the numerical simulations (atmosphere) at high resolutions: 3, 4, 5 and 10 km in a nested grid structure, detecting the best parameterizations and the convection permitting option for the highest resolution.
- ✓ Diagnosis of the reproduction of relevant atmospheric processes in the tropics and extra-tropics applying atmospheric models at different spatial resolutions: 25, 5, 4, and 3 Km, analyzing their intra-seasonal and seasonal cycles in precipitation and temperature and the midsummer drought.
- ✓ State-of-the-art application of the statistical and dynamical downscaling methods.
- ✓ Selection of the models with the best performance for the regions of interest.
- ✓ The proposal submitted to BUAP (University of Puebla, Mexico) was accepted and developed during 2022. The main results are focused on the dynamical downscaling tests.
- ✓ Bias correction was selected as one of the first methods for the statistical downscaling tests in Mexico.
- ✓ A first paper draft was elaborated related to statistical downscaling tests.
- ✓ Climate4r was identified as one potential tool for the statistical downscaling methods.
- ✓ Setup of Mexican and Quebec River basins in the distributed hydrological model is completed.
- ✓ Start of calibrations of the hydrological models.
- ✓ Start of Maedeh Khalili's PhD at ETS, in March 2022. Maedeh is in the process of her doctoral exam, now undertaking the second step out of three.
- ✓ Starting in January 2023, involvement of an undergraduate student from Universidad Veracruzana (Ximena Anell Parra). She will help with hydrological modelling tasks, focusing on lumped hydrological models.
- ✓ Pr. Romero-Lopez's academic stay at ETS, from March to August 2022, was completed.
- ✓ Involvement of a newly appointed faculty member at UQAM in Montreal, Professor Philippe-Lucas Picher, who specializes in convection permitting regional climate modelling.

Summary of each workshop/activity held during the year

Name of the activity.	Responsible person/-s	Funder
First Workshop on May 19 2022. Description: To develop a synthesis of the current status of the project, providing information to identify the activities to complete the project. Each participant made 'flash talks' (15 minutes duration) on topics of their expertise to identify the progress of the project, the state-of-the-art, and the challenges and difficulties in achieving results. Dr. Ruth Cerezo, from the IPCC, gave a presentation about the expectations of downscaling methods, highlighting relevant processes in the hydrological cycle. After the presentations, A session with open discussions was held followed by a dialogue focused on the internal communication, project milestones and how to achieve them. Location: Remote meeting. Link used: https://us02web.zoom.us/j/83310850405?pwd=aWFUGClhpkZZatZRq0KxUQGv6EQ-gl.1	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

At least, one researcher will attend the 5th CORDEX conference, ICRC-CORDEX 2023, in Trieste, Italy, 25-29 September.

Continue applying 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.

One potential PhD student, registered at IMTA, will join the team (in February 2023) and work on the statistical downscaling experiments.

Publication of the paper related to bias correction in the statistical downscaling tests in Mexico.

A paper related to state-of-the-art methods in statistical downscaling will be prepared and possibly submitted during 2023.

More statistical downscaling tests will be applied considering other techniques.

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

With two students now involved in the project's hydrological modelling tasks, we will definitely be able to complete the hydrological model's calibrations and the hydrological simulations using outputs from CMIP6 simulations.

Hydrological simulations using outputs from convection permitting simulations should also start.

Additional relevant information

As Senior Associate of the ICTP, José Antonio Salinas will visit one month ICTP, in Trieste, Italy (September 2023), to analyze regional numerical simulations of the atmosphere.

During 2022, this project had access to supercomputing equipment. 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.

Some participants in this project belong to REDESClim (https://www.redesclim.org.mx/) that is a scientific network related to disasters associated with hydrometeorological and climatic phenomena.

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