Impact of Groundwater in Earth system Models (ANR-MoST project)

Groundwater (GW) constitutes 30% of the fresh water resources, which are subjected to increasing withdrawals. When shallow enough, it can also sustain soil moisture, thus increase evapotranspiration, with potential impact on the climate system (in particular temperatures and precipitation). Its large residence time can also increase the Earth system's memory, with consequences on the persistence of extreme events, hydro-climatic predictability, and anthropogenic climate change, particularly the magnitude of regional warming.

Our main goal is to explore the impacts of GW on regional and global climate, and its links to water resources availability, through model analyses. To this end, our Franco-Taiwanese consortium offers a unique opportunity to compare the sensitivity of simulated climate to different GW parametrizations within 3 different climate models: the French IPSL and CNRM-GAME climate models, and the American NCAR climate model (CESM), modified and used here by the Taiwanese team.

The project includes two transversal tasks: T0. Coordination; T5. International workshops; and the research program is organized into 4 successive scientific tasks:
T1. Sensitivity to fixed water table depths (WTD), to identify the patterns of "active WTD", below which GW do not impact regional climate
T2. Dynamic WTD over the recent period, to assess the potential of realistic GW parametrizations to improve the simulated climate, with a focus on land/atmosphere feedback and persistence/ memory in the Earth system
T3. Dynamic WTD and climate change, with two complementary questions: (*1)* What is the influence of GW on the climate change trajectory? (2) What is the impact of climate change on water resources (including GW)?
T4. Dynamic WTD with withdrawals, which artificially increase soil moisture via irrigation, with potential impacts on climate until water resources get exhausted.

I-GEM is also intended to consolidate the potential of France and Taiwan in the interdisciplinary research field of the global water cycle, by tightening the links between these two countries, and by federating the French community (IPSL and CNRM-GAME). We also aim at enhancing the visibility of French and Taiwanese teams, by developing closer links with European and North-American leaders in large-scale modeling of GW. To this end, we want to organize two international workshops on the role of GW in climate models, one in Taiwan and one in France, with a broad audience (T5).