

Summary of the A2 Session at the ICRC-CORDEX 2016 Conference

Wednesday May 18, 2016

Models of the coupled regional climate system

Chairs Anne Frigon and Silvina Solman

INTRODUCTION

Session A2 on models of the coupled regional climate system took place on Wednesday May 18, 2016. Results between uncoupled and coupled simulations were presented over many domains and showed that the coupling generally improved the simulated climate because it incorporates processes and feedbacks not taken into account in the non coupled RCM. More importantly, a few presentations also examined the climate change and showed that the coupling also influences the signal, which can even change sign.

FIRST PART BEFORE THE BREAK

Anne Frigon

Dr Samuel Somot of Meteo-France was the invited speaker and presented sensitivity results from fully coupled runs of regional seas and aerosols performed over the Mediterranean region with RCM. Better representation of the Mediterranean Sea through coupling lead to different SST evolution and different regional climate change results. The coupling of aerosols affects the climate change signal importantly through radiation feedbacks (sign change in surface shortwave radiation, giving a reduced or enhanced warming) and provided insight on the importance of desert dust transport from Northern Africa, and its effect on the climate over long distances northward.

Ole Christensen, from DMI in Denmark, presented a regional coupled model system based on HIRHAM that can include modules for hydrology, ocean and ice sheet. Simulations over Denmark show that the two-way coupling of HIRHAM with a hydrological model improves the simulated precipitation and ground water. Over Greenland, coupling with the ice sheet model also produces improved simulations, as is the case over the North Atlantic ocean with the ocean and sea ice coupling.

Armelle Reza Remedio from GERICs in Germany, discussed the influence of ocean coupling over the CORDEX Southeast Asia domain using the REMO regional climate model coupled with Max Planck Institute's ROM ocean model. Results show that the coupling reduces the warm and wet bias found in the non-coupled run, and that it decreases typhoon occurrences, which becomes more comparable to observations.

François Engelbrecht from the Council for Scientific and Industrial Research in South Africa presented results from climate projections produced with a coupled regional southern African ocean-atmosphere system in development, which is based on the Variable-resolution Earth System Model (VRESM) and used in stretched-grid mode. The 8-km resolution coupled downscaling simulations show a southward shift in the prevailing south-easterly winds along the southern African west coast that may lead to a weakening of upwelling zones along the Namibian coast. Such an effect may have important implications on the distribution and abundance of fish species relying on the nutrient-rich water of the upwelling zones.

SECOND PART AFTER THE BREAK - Silvina Solman

After the break 4 presentations devoted to coupled ocean-atmosphere regional model results (two of them focused on the Caribbean region, one of them focused on the Arctic region and one focused on the Indian Monsoon) and one presentation focused on a coupled vegetation-climate

regional ESM were discussed.

Experiments using a Regional Climate Earth System Model (RegESM) over the CORDEX Central America domain were evaluated in order to identify the benefits of using coupled models in reproducing the observed climatology. The RegESM is composed by RegCM4 using CLM4.5 as land model, MITgcm ocean model and the Hydrological Discharge (HD) model, as atmospheric, land, ocean and river models respectively. The authors showed that the coupled simulation improved the representation of the mean precipitation over the Pacific Ocean, the spatial density of tropical cyclones, the location and intensity of the ITCZ and the mid-summer drought over Central America and southern Mexico compared with the uncoupled model. However, some deficiencies such as biases in the SST were found, probably associated with deficiencies in the representation of clouds and/or boundary layer mechanisms.

The sensitivity of the Caribbean climate simulation to the location of the coupled domain and resolution was explored using a global ocean model with regionally high resolution coupled to an atmospheric regional model and a global terrestrial hydrology model. The authors showed that the simulated climate is sensitive to the location of the coupled domain. Coupled mechanisms were found to be important to control the Caribbean Low Level Jet characteristics. It was concluded that the coupled model simulation allows for more realistic ocean-atmosphere fluxes.

The ESM focused on the Arctic region was used to explore the sensitivity of the simulated climate to atmospheric processes in a coupled system. A suite of multi-decadal simulations using different schemes for the representation of the boundary layer and cumulus were presented. The authors showed that the coupled model simulation is strongly sensitive to the atmospheric model parameterizations due to complex interactions among the different components of the coupled system, mainly those associated with cloud cover and radiative fluxes.

The importance of using regional ocean-atmosphere coupled models in reproducing the Indian-monsoon system, a typically coupled system, was demonstrated through a series of simulations using coupled and uncoupled regional models. The ocean rectification effect on the monsoon simulation from downscaling was highlighted, otherwise missing in uncoupled simulations.

Results from a regional Earth system model incorporating interactive vegetation-atmosphere coupling was presented to investigate the potential role of vegetation-mediated biophysical feedbacks on climate dynamics in Africa in an RCP8.5 future climate scenario. Changes in vegetation patterns associated with increasing CO₂ were shown to impose important local effects on regional climate by altering surface energy fluxes, but also resulted in meso-scale remote effects over central Africa by modulating the land-ocean thermogradient, near-surface circulation and moisture inflow via the Atlantic Walker circulation feeding the central African tropical rainforest region with precipitation. Moreover, the vegetation feedbacks were found to damp the warming temperature trend and enhanced the precipitation reduction over rainforests areas, emphasising the importance of including vegetation-atmosphere interactions in climate model projections.