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Re-interpreting thermodynamic Arctic sea ice feedbacks

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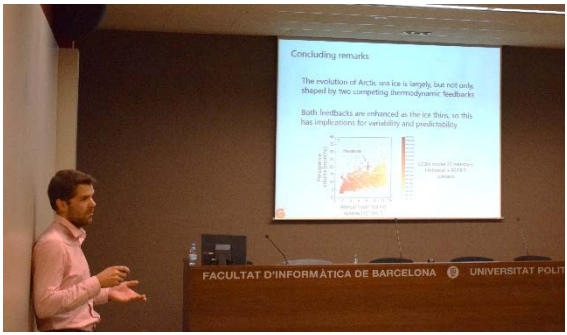
Abstract

One of the clearest manifestations of ongoing global climate change is the dramatic retreat and thinning of the Arctic sea-ice cover. All state-of-the-art climate models reproduce consistently the sign of these changes but largely disagree on their magnitude. The very deep causes remain contentious and consensual methods to reduce uncertainty in projections are lacking. Here we propose a process-oriented approach to revisit this question. We show that inter-model differences in sea-ice loss and, more generally in simulated sea-ice variability at all time scales, can be traced back to differences in the simulation of two competing thermodynamic sea-ice feedbacks. In turn, we show that both feedbacks are closely tied to the average ice thickness simulated by each model, regardless of the complexity of its sea-ice component. The results prompt modelling groups to focus their priorities on the reduction of sea-ice thickness biases, as we provide physical evidence that Arctic sea-ice projections from models with unrealistic current thickness can robustly be distrusted. We finally show that because of the enhancement of the feedbacks as sea ice thins, the recent and future changes in sea-ice thickness induce a transition of the Arctic towards a state with increased seasonal-to-interannual variability and less persistence, in other words less predictability.



Short bio

Dr Massonnet obtained his PhD in Sciences in 2014 from the Université catholique de Louvain (UCL) under the supervision of Profs. Thierry Fichefet and Hugues Goosse. During his PhD, he developed various metrics to evaluate sea ice models used in the framework of climate reconstructions, predictions and projections. He participated as a contributing author to the IPCC WG1 AR5 and was involved in several national and international research projects about climate prediction and predictability. He also implemented ensemble data assimilation methods in large-scale sea ice models for state and parameter estimation.
Immediately after his thesis, he joined the Climate Prediction Group of the Barcelona Supercomputing Center Earth Sciences Department (BSC-ES) and worked under the guidance of Dr Virginie Guemas and Prof. Francisco Doblas-Reyes. There, he explored various aspects of seasonal-to-decadal polar and extra-polar prediction, including attribution of extreme events, improved initialization techniques, novel aspects of forecast verification and linkages of the Arctic system with lower latitudes. In particular, he implemented an ensemble coupled sea ice data assimilation method in the General Circulation Model EC-Earth for initialization of near-term predictions in both the Arctic and Antarctic regions.
Since December 2016, Dr Massonnet is a F.R.S.-FNRS Postdoctoral Researcher at the Université catholique de Louvain. His work is focused on the use and assessment of climate general circulation models for prediction at time scales from the month to the decade.
Dr Massonnet is author or co-author of 27 paper published in international peer-reviewed journals. He is strongly involved in international projects or initiatives like the Southern Ocean Region Panel (SORP), the Year of Polar Prediction (YOPP) and the Sea Ice Prediction Network.