Dynamical downscaling of a coarse-resolution large initial-conditions ensemble with a high-resolution Regional Climate Model

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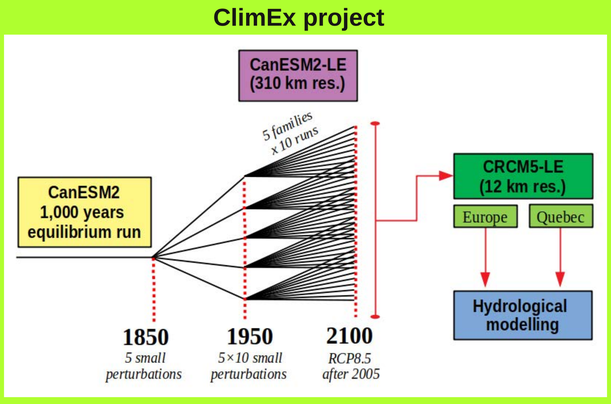
1- Summary

- The ClimEx project of the Bavaria-Québec international collaboration on climate change aims at investigating the effects of natural climate variability and extreme meteorological events on local hydrology.
- A 50-member initial-conditions ensemble was produced, based on three modelling layers:
  - Canadian Earth System Model version 2 (CanESM2; Arora et al. 2011)
  - Canadian Regional Climate Model version 5 (CRCM5; Martynov et al. 2013)
  - Hydrological models applied over Bavaria and Québec.
- Results of the RCM simulations over northeastern North America are presented.

2- Experimental framework

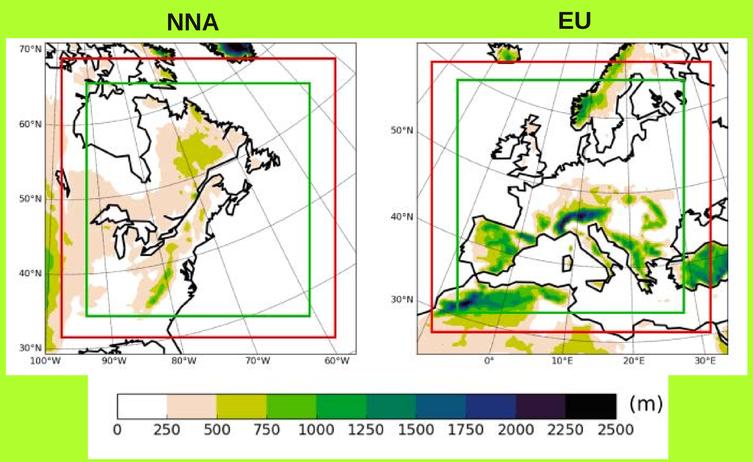
ClimEx project



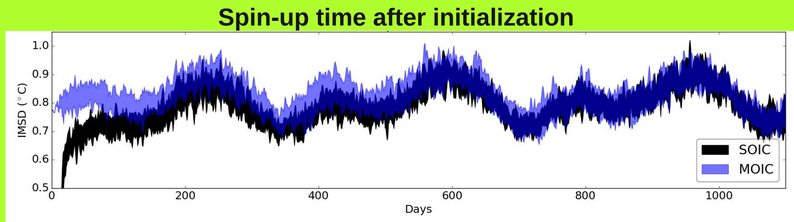
Set-up:

- *The CanESM2 Large Ensemble (CanESM2-LE): 50 members at 2.8° of resolution*
- *Dynamical downscaling to produce the Canadian Regional Climate Model version 5 Large Ensemble (CRCM5-LE) at 0.11° of resolution*
- *Period covered: 1950-2100, following RCP8.5*
- *Two regional domains: northeastern North America (NNA) and Europe (EU)*

NNA **EU**



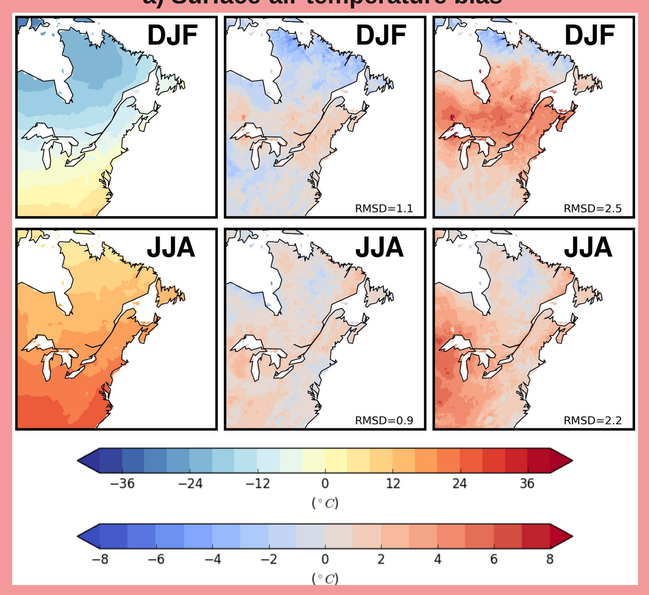
Spin-up time after initialization



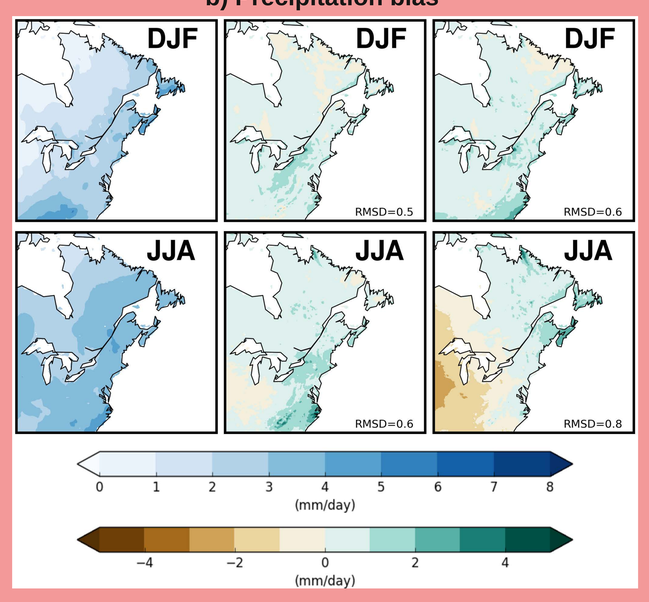
The spin-up time after which the CanESM2-LE provides independent lateral boundary conditions to the CRCM5-LE is estimated using the spatially averaged (over ocean) ensemble standard deviation (STD) as function of time (in days) for surface-air temperature. The STD is calculated between members with same (black) and different (blue) initial conditions of the ocean.

3- Results: CRCM5 validation

a) Surface-air temperature bias



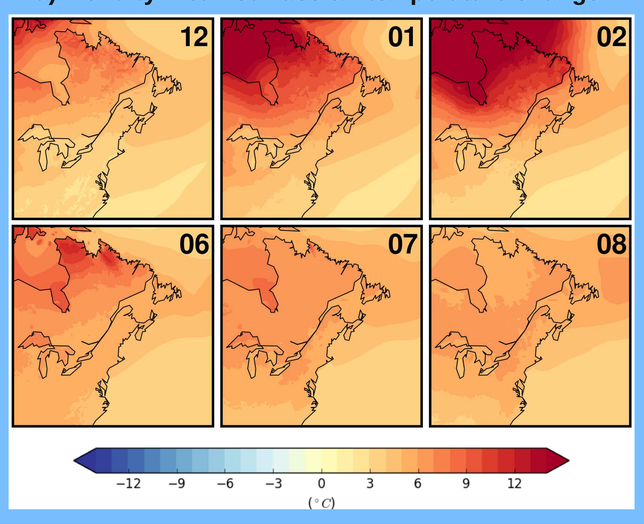
b) Precipitation bias



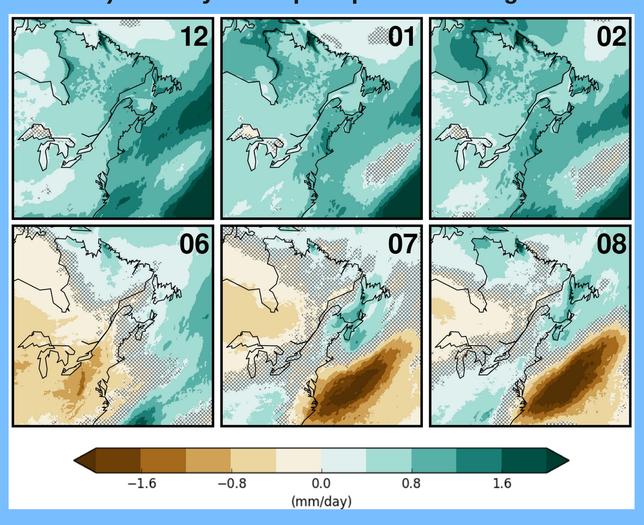
Mean seasonal surface air temperature (a) and precipitation (b) over the 1980–2012 period for CRU (first column), and its difference from a CRCM5 run driven by ERA-Interim reanalysis (second column) and the first member of CRCM5-LE (third column).

4- Results: climate-change projections (2080-2099 vs 2000-2020)

a) Monthly mean surface-air temperature change

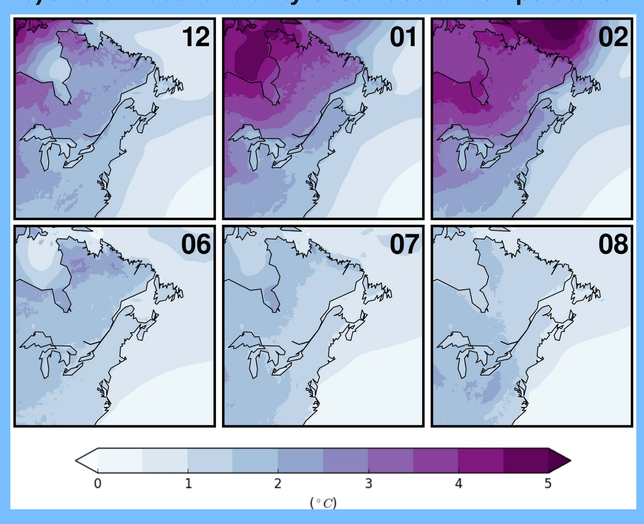


b) Monthly mean precipitation change

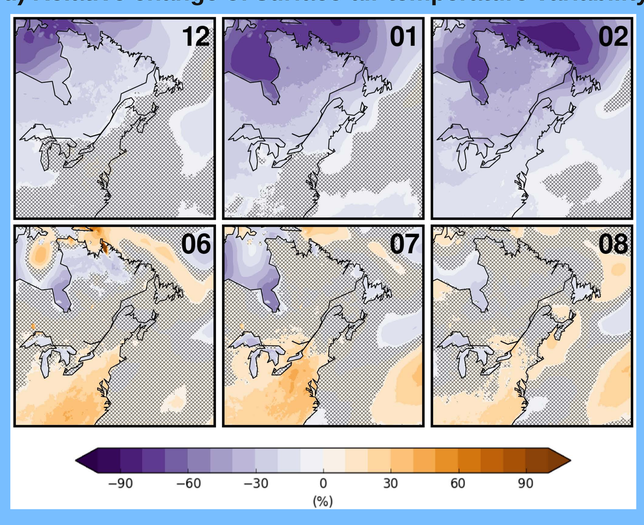


The CRCM5 50-member ensemble-mean climate change signal for surface air temperature (a) and precipitation (b) computed as the difference between the 2080–2099 and 2000–2019 monthly climate means. Hatched regions identify where the signal is not statistically significant at the 99% confidence level (Student's t test with unequal variances). Months are labeled from 1 to 12.

c) Interannual variability of surface-air temperature



d) Relative change of surface-air temperature variability



(c) Interannual variability of monthly mean surface air temperature calculated as the yearly intermember spread averaged during the 2000–2019 period. (d) Relative change in interannual variability for the monthly mean surface air temperature (2080–2099 vs 2000–2019). Hatched regions identify where changes are not statistically significant at the 99% confidence level (F test). Months are labeled from 1 to 12.

Data access

More information on how to access the CRCM5-LE dataset and the list of archived variables can be found at www.climex-project.org.

Acknowledgments

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References

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