Overview of the ClimEx Large Ensemble - basic characteristics and general results

- Martin Leduc, Ouranos -
Possible trajectories of the climate system

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Internal variability in a GCM ensemble

Perturbing the model’s initial conditions to emulate the “butterfly effect”

Standard deviation for day=5

Standard deviation for day=10

Standard deviation for day=15
Natural variability and climate change

50 realizations of “reality”

Natural Variability + CC

Hot extremes

Internal Variability

2000

Cold extremes

Climate Change

mean

1960 1980 2000 2020 2040 2060

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From global climate to local hydrology...

GHG Emissions

Global Climate Model
(CanESM2, $\Delta X \approx 310$ km)

Regional Climate Model
(CRCM5, $\Delta X \approx 12$ km)

Hydrological Models

- CanESM2 is developed by the Canadian Centre for climate modelling and analysis
- CRCM5 is developed by Université du Québec à Montréal (UQAM) and ECCC
Short term climate change

Changes in precipitation for December (2020-2039 vs. 2000-2019)

Leduc et al. (2019)
Signal and “climate noise”

Changes in precipitation for December (2020-2039 vs. 2000-2019)

Individual members

Ensemble mean

Ensemble STD

Leduc et al. (2019)
Ensemble size vs. temporal horizon

Changes in precipitation for December (ref. 2000-2019)

Leduc et al. (2019)
Temperature year-to-year variability

2000-2019

The envelope of uncertainty is evolving in time:

- Inflating in summer
- Compressing in winter

2080-2099

Leduc et al. (2019)
Key messages

- Natural climate variability has two components:
  - **Internally generated variability** at every timescales (from seconds to thousands of years)
  - **Externally forced variability** by natural causes (e.g. volcanoes, solar activity)

- Implications of natural variability:
  - Adds **noise** to CC signal - filtered by averaging over several members
  - May **change over time** as part of the CC signal: difficult to assess in the “single reality paradigm”

- From natural variability emerge **extremes**...

Reference: