

CanRCM

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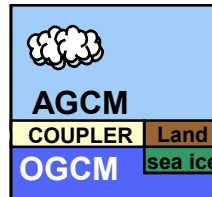


Environment and
Climate Change Canada

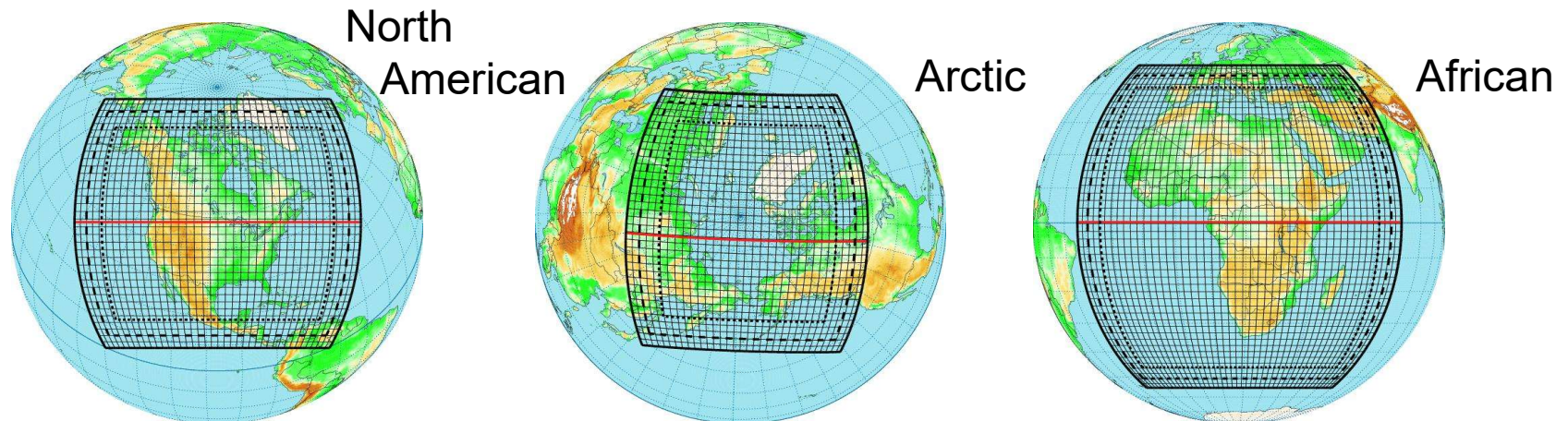
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CCCma Regional Climate Model

- **Primary Goal:** Downscale climate predictions/projections made with the CanESM over “regional/local” domains

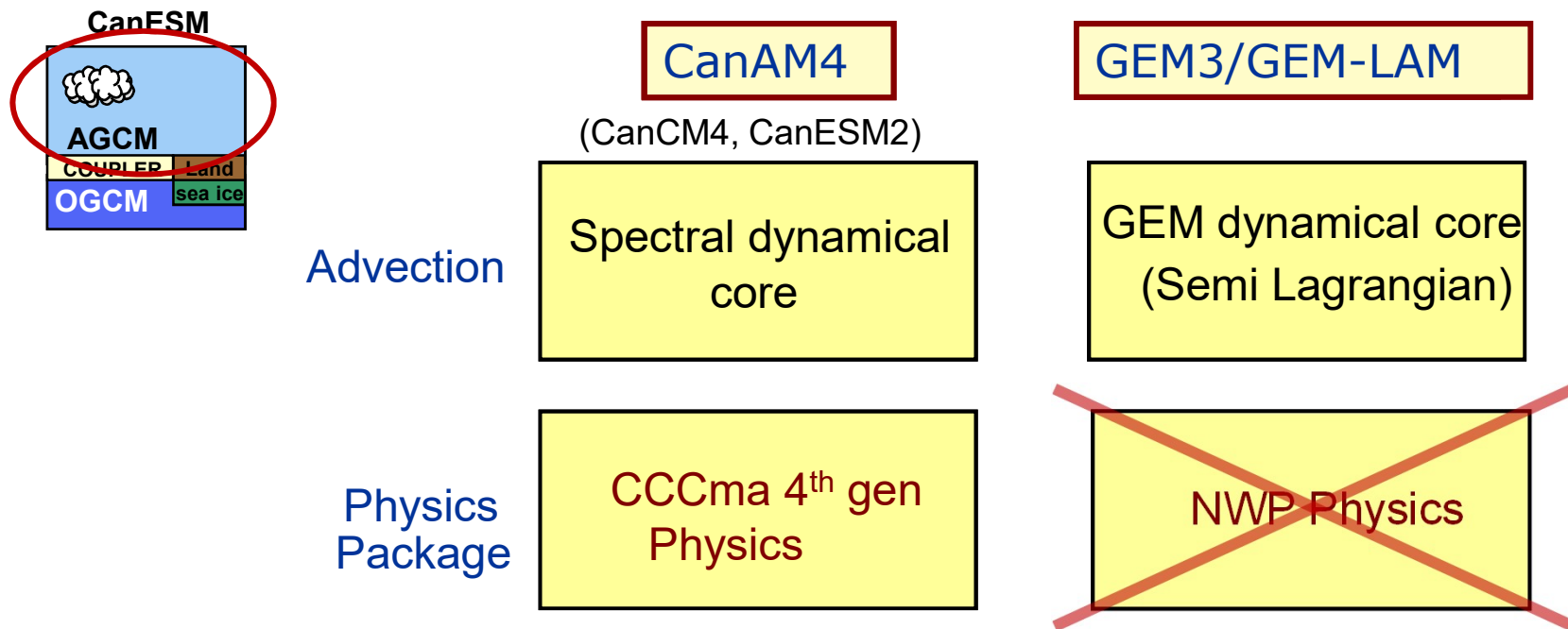


- **Dynamical Downscaling:** one-way driving of a limited-area/regional climate model (RCM) by a global climate model



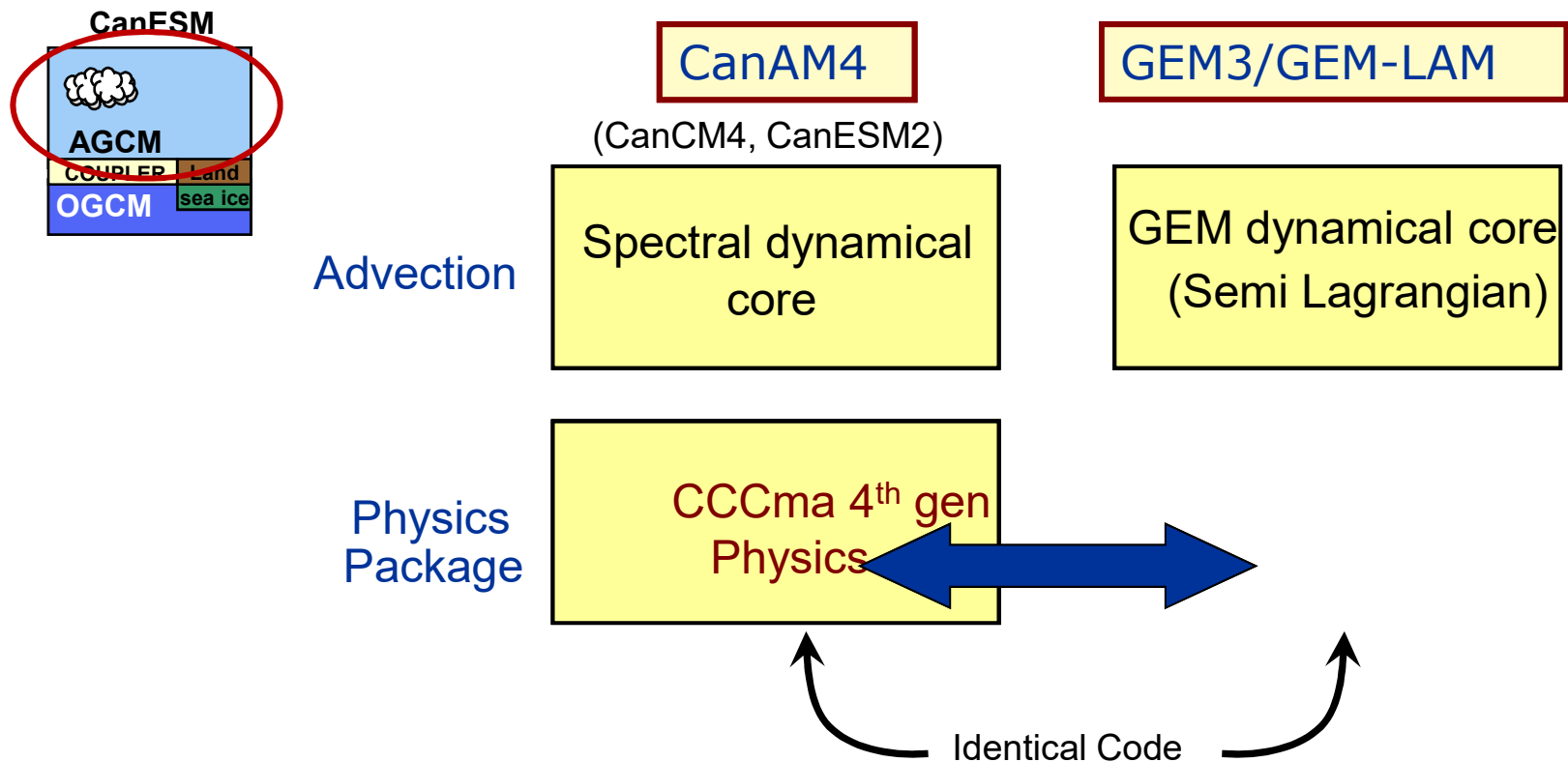
CanRCM4 Construct

- Employ “one-way nesting” of atmospheric component of CanESM
- Retain CanAM4 physics package to exploit its multi-decadal development
- Employ NWP limited-area dynamical core to drive AM4 physics



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Coordinated Global and Regional Climate Modelling

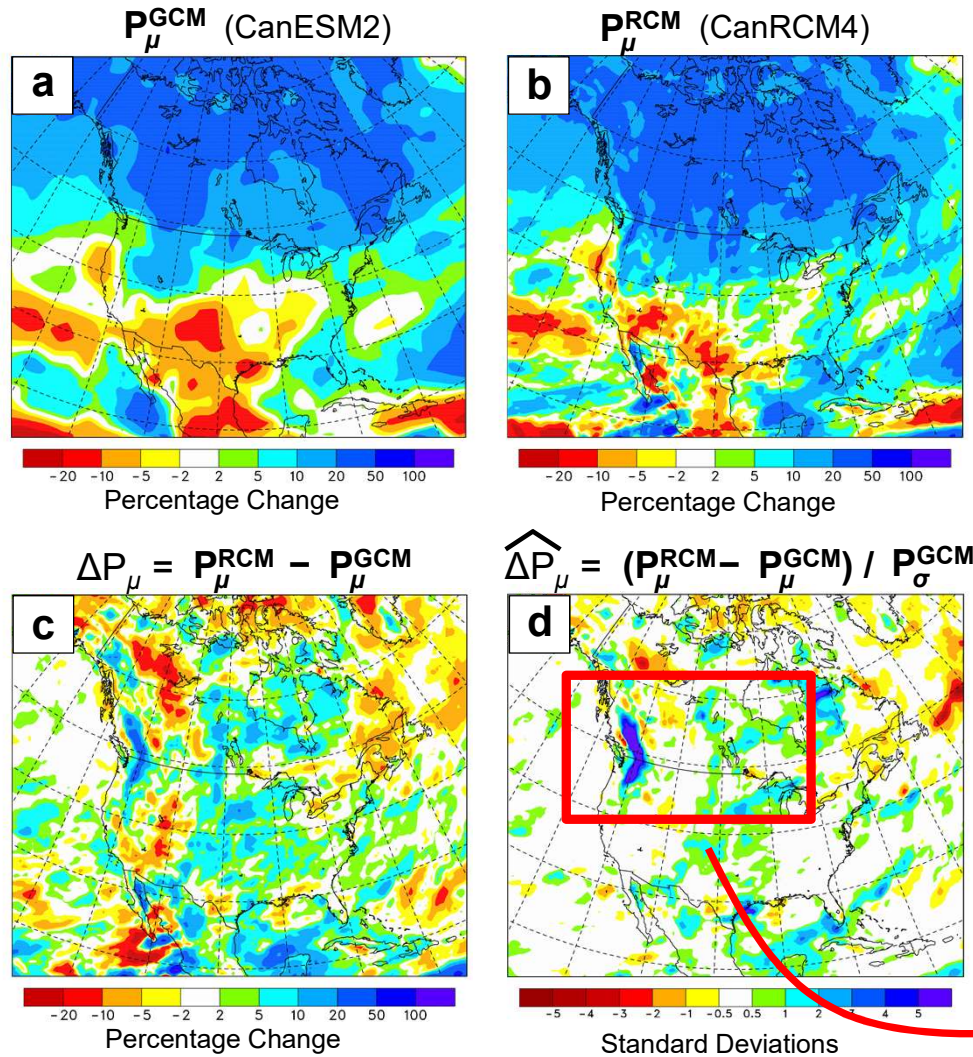
- Coordination and strict physics compatibility between global and regional model offers a number of advantages not available to independent regional climate modelling centres

Advantages:

- 1) Physics Development and Scalability
- 2) RCM domain transferability issues are absent
 - understanding of global physics biases from CanAM global properties
- 3) Improved RCM driving (all field)
 - in addition to U,V,T,q, CanRCM has boundary driving data for all tracers from CanAM
- 4) Concept of value added more clearly defined
 - CanESM projections must exist before CanRCM downscaled projections are made. What, if any, additional value is associated with CanAM

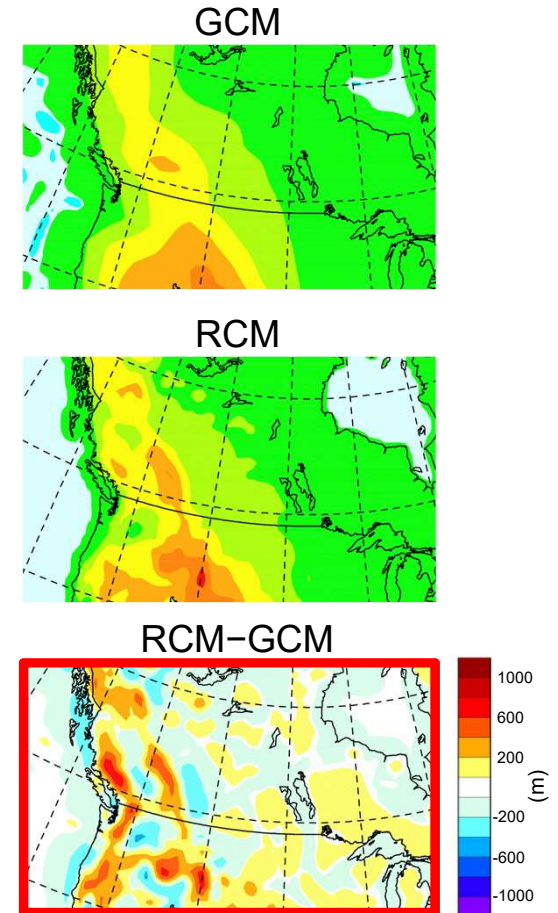


Precipitation Response



- Mar-Apr-May
- (2100-2081) - (2005-1986)
- RCP4.5
- 5 ensemble members

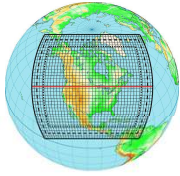
Topography



Scinocca et al. JCLIM (2015)

Primary value-added in CanRCM4 comes from better resolved topography





NA
domain

CanRCM4 (CanESM2) Utilization

CORDEX

	<u>Resolution</u>	<u>Ensemble Members</u>	<u>Years</u>
<u>Evaluation</u>	0.44° (50km)	1	1989-2009
	0.22° (25km)	1	1989-2009
<u>Historical</u>	0.44° (50km)	5	1950-2005
	0.22° (25km)	5	1950-2005
<u>RCP4.5</u>	0.44° (50km)	5	2005-2100
	0.22° (25km)	5	2005-2100
<u>RCP8.5</u>	0.44° (50km)	5	2005-2100
	0.22° (25km)	5	2005-2100

CanSISE large ensemble

<u>Historical</u>	0.44° (50km)	50	1950-2005
	0.22° (25km)	1	1950-2005
<u>RCP8.5</u>	0.44° (50km)	50	2005-2100
	0.22° (25km)	1	2005-2100

CanSIPS hindcast downscaling (proof of concept)

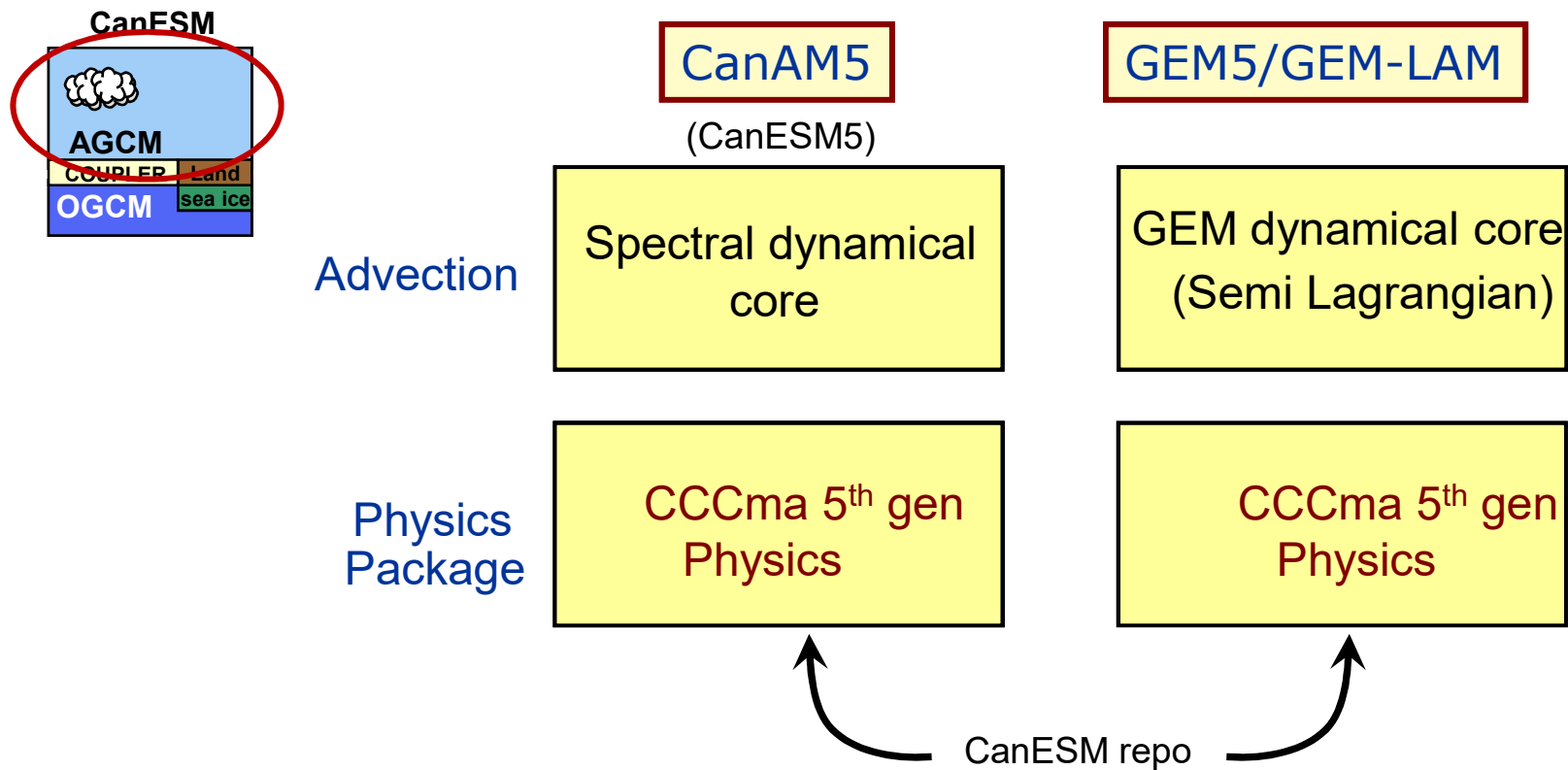
0.44° (50km)	JFM, JAS	1981-2010
0.22° (25km)	JFM, JAS	1981-2010

- generally, we have made **CanRCM4** output data freely available to the community or performed a few special runs with additional output

- **CanRCM4** model output has been used for more than 90 national and international peer-reviewed scientific studies and assessments. Canadian users include, 12 Canadian Universities; two regional climate impacts Consortia (the Pacific Climate Impacts Consortium and the Consortium on Regional Climatology and Adaptation to Climate Change); multiple federal departments of Agriculture and Agri-Food Canada, Environment and Climate Change Canada, Fisheries and Oceans Canada; the Public Health Agency of Canada; and the provincial ministry of Natural Resources and Forestry (Ontario).

CanRCM5 Construct

- GEM5: interface developed to switch between physics packages (NWP/Climate)
- CanESM repository is now the single source of physics code for both spectral and S/L
- Testing and evaluation of global GEM configuration with CanAM5 physics



CanRCM5 Properties

- Coordinated global/regional modelling with physics compatibility
- updated physics package from CanAM4 (CMIP5) to CanAM5 (CMIP6)

Application of run-time bias corrections:

- 1) Runtime bias corrected large-scale driving
 - bias corrected CanAM5 based on CanESM5 projections following *Kharin and Scinocca (2012)*, *Krinner et al. (2020)*
- 2) Runtime bias corrections within CanRCM5
 - currently under development
- 3) Runtime bias corrected lake-surface water temperature and lake ice of large-scale lakes.
 - improve lower boundary forcing from parameterized thermodynamic lake model (CSLM *MacKay 2012*, *MacKay et al. 2017*) when representing lakes that become resolved in the RCM



CanRCM5 Applications

- **Cordex-CMIP6**
- **Deeper integration with CanSIPS for predictions and CanESM5 for projections**
- **Flood Hazard Identification and Mapping Initiative:** Large 3-year proposal with climate-change component (NRCan, ECCC, PSC)
 - G&C support: Ouranos; PCIC; U. of Calgary; U. Saskatchewan; U. Laval; McMaster
- **Climate Change Impacts on the Security of the Electricity Transmission and Distribution System of Portland General Electric**
 - Oregon State University
- **Great Lakes Water Levels:** Improved estimates of Net Basin Supply from historical and future projections of CanRCM5.
 - Frank Seglenieks Water Resources Eng. MSC
- **Climate Impacts on Salish Sea:** Driving data for further downscaling (WRF)
 - A. Holdsworth, IOS ; R. Stull, UBC

