Predicted changes in high temperature events over North America within CORDEX simulations

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Introduction

In recent years high temperature events have increased globally leading to additional stress on not only the environment but agriculture, human health and the global economy (Mladjic et al., 2011). These high temperature events have enormous social, political and environmental repercussions, therefore, it is important that there is an increased understanding of how these events will change in the future.

There have only been a handful of studies done with a North American focus despite numerous studies suggesting that the frequency and duration of these extrememe heat events will increase globally (Jeong et al., 2016; Russo et al., 2014). Our study aids in reducing this knowledge gap through producing projections of future heat wave events with the most recent green house gas emmissions scenarios.

Data and Methods

All data was taken from the COordinated Regional Data EXperimental Project. This international interface provides access to high resolution regional climate data. This study used daily temperature data for the years 1950-2100 over the domain of continental North America. The time periods were broken into the following:
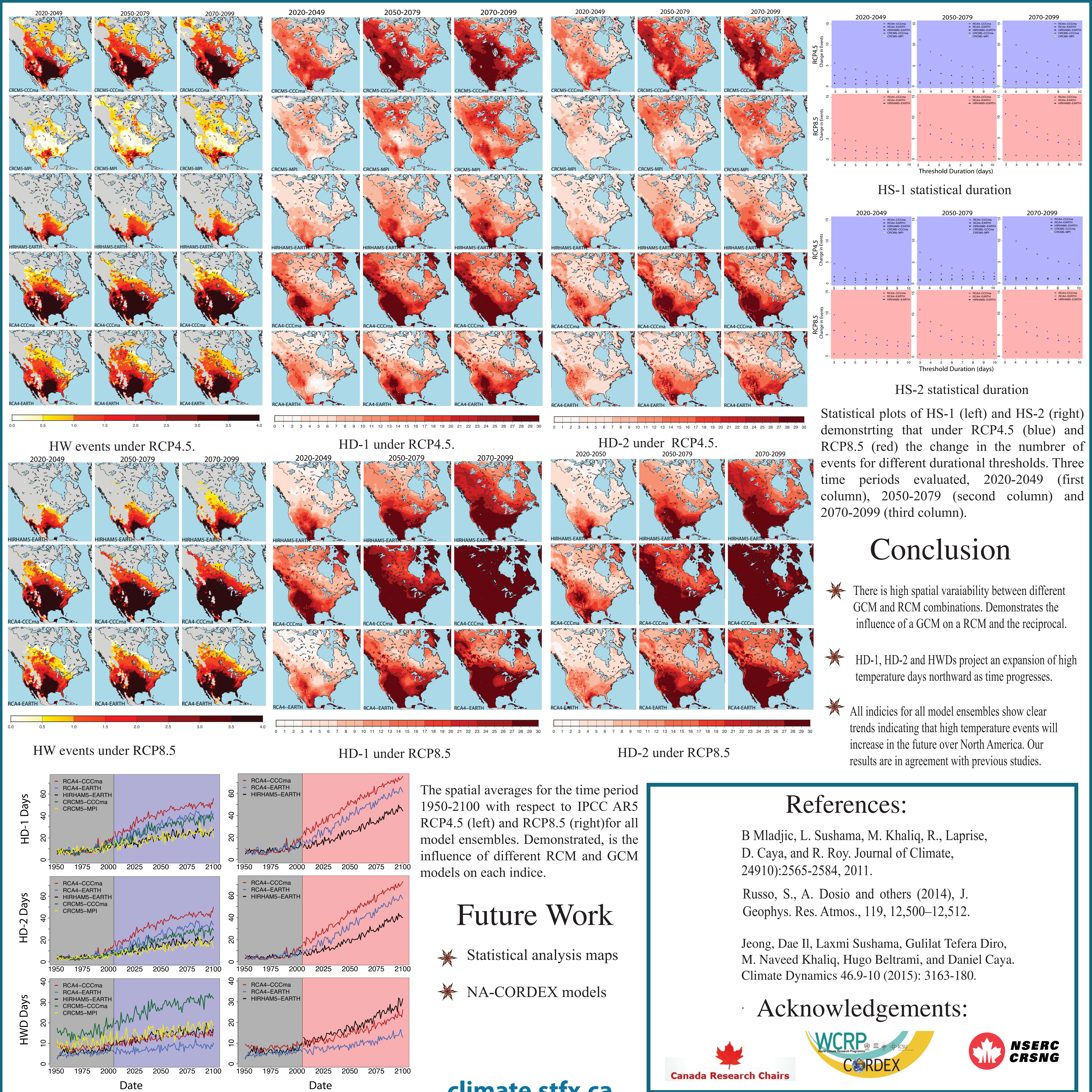
- Historical reference period 1970-1999
- Future periods 2020-2049, 2050-2079 and 2070-2099

Future emissions scenarios were taken from the IPCC AR5. Five model ensembles from three RCMs and three GCMs were used in evaluating three temperature indices, of which were broken down futher as follows:

High Temperature Days → High Temperature Days 1 (HD-1) → Heat Spell Day (HS-1)

High Temperature Days → High Temperature Days 2 (HD-2) → Heat Spell Day (HS-2)

Heat wave Days (HWD) → Heat wave events (HW)

Indice Deffinitions: HD-1, the daily Tmax exceeded the 90th percentile. HD-2, the daily Tmax and Tmin exceeded the 90th percentile. HS-1 and HS-2, 3 to 10 consecutive days of HD-1 or HD-2 respectively. HWD, Tmax exceeded 32 C. HW, 3 to 10 consecutive HWD days. All thresholds calculated for each model ensemble seperately.

RCM	Driving Model		
	EARTH	CCCma	MPI
RCA4	🔵🔴	🔵🔴	
HIRHAM5	🔴		
CRCM5		🔵	🔵

🔴 RCP 8.5   🔵 RCP 4.5

HW events under RCP4.5.

HD-1 under RCP4.5.

HD-2 under RCP4.5.

HS-1 statistical duration

HS-2 statistical duration

Statistical plots of HS-1 (left) and HS-2 (right) demonstrting that under RCP4.5 (blue) and RCP8.5 (red) the change in the numbrer of events for different durational thresholds. Three time periods evaluated, 2020-2049 (first column), 2050-2079 (second column) and 2070-2099 (third column).

HW events under RCP8.5

HD-1 under RCP8.5

HD-2 under RCP8.5

Conclusion

- There is high spatial varaiability between different GCM and RCM combinations. Demonstrates the influence of a GCM on a RCM and the reciprocal.

- HD-1, HD-2 and HWDs project an expansion of high temperature days northward as time progresses.

- All indicies for all model ensembles show clear trends indicating that high temperature events will increase in the future over North America. Our results are in agreement with previous studies.

The spatial averages for the time period 1950-2100 with respect to IPCC AR5 RCP4.5 (left) and RCP8.5 (right)for all model ensembles. Demonstrated, is the influence of different RCM and GCM models on each indice.

Future Work

- Statistical analysis maps
- NA-CORDEX models

References:

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Acknowledgements:

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