Extreme temperature and precipitation: -- Past changes and future projections

Adaptation to Climate Change: Tools for Decision Making

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Outline

- Global-scale assessment of observed changes and future projection
  - Confidence and uncertainty differ for different extremes
- Regional-scale assessment of observed changes and future projection
  - Increase in the hottest and coldest temperature
  - Increase in extreme precipitation
  - Larger uncertainty at regional/local scales

Global-scale assessment

Past Changes

Phenomenon	Assessment that changes occurred (typically since 1950 unless otherwise indicated)	Assessment of a human contribution to observed changes
Warmer/fewer cold days, nights	*Very likely* {2.6} *Very likely* *Very likely*	***Very likely*** {10.6} *Likely* *Likely*
Warmer/more hot days, nights	*Very likely* {2.6} *Very likely* *Very likely*	***Very likely*** {10.6} *Likely* *Likely* (nights only)
More frequent/longer hot spells and heat waves	***Medium confidence*** on a global scale *Likely* in large parts of Europe, Asia and Australia {2.6} *Medium confidence* in many (but not all) regions *Likely*	***Likely***[a] {10.6} Not formally assessed *More likely than not*
More frequent/ intense heavy precipitation	*Likely* more land areas with increases than decreases[c] {2.6} *Likely* more land areas with increases than decreases *Likely* over most land areas	***Medium confidence*** {7.6, 10.6} *Medium confidence* *More likely than not*
More intense/ longer droughts	***Low confidence*** on a global scale *Likely* changes in some regions[d] {2.6} *Medium confidence* in some regions *Likely* in many regions, since 1970[e]	***Low confidence*** {10.6} *Medium confidence*[f] *More likely than not*
Increased intense tropical cyclone activity	***Low confidence*** in long term (centennial) changes *Virtually certain* in North Atlantic since 1970 {2.6} *Low confidence* *Likely* in some regions, since 1970	***Low confidence***[i] {10.6} *Low confidence* *More likely than not*
More frequent/higher extreme sea levels	*Likely* (since 1970) {3.7} *Likely* (late 20th century) *Likely*	***Likely***[k] {3.7} *Likely*[k] *More likely than not*[k]

Likelihood of Future Changes

Phenomenon	Early 21st Century	Late 21st Century
Warmer/fewer cold days, nights	*Likely* {11.3} *Virtually certain* *Virtually certain*	*Virtually certain* {12.4} *Virtually certain* *Virtually certain*
Warmer/more hot days, nights	*Likely* {11.3} *Virtually certain* *Virtually certain*	*Virtually certain* {12.4} *Virtually certain* *Virtually certain*
More frequent/longer hot spells and heat waves	Not formally assessed[b] {11.3} *Very likely* *Very likely*	*Very likely* {12.4} *Very likely* *Very likely*
More frequent/ intense heavy precipitation	*Likely* over many land areas {11.3} *Likely* over many areas *Very likely* over most land areas	***Very likely*** over most of the mid-latitude land masses and over wet tropical regions {12.4} *Likely* over many areas *Very likely* over most land areas
More intense/ longer droughts	*Low confidence*[g] {11.3} *Medium confidence* in some regions *Likely*[e]	***Likely*** *(medium confidence)* on a regional to global scale[h] {12.4} *Medium confidence* in some regions *Likely*[e]
Increased intense tropical cyclone activity	*Low confidence* {11.3} *More likely than not* in some basins *Likely*	***More likely than not*** in the Western North Pacific and North Atlantic[i] {14.6} *More likely than not* in some basins *Likely*
More frequent/higher extreme sea levels	*Likely*[l] {13.7} *Very likely*[m] *Likely*	***Very likely***[l] {13.7} *Very likely*[m] *Likely*

Regional scale assessment

Extreme temperatures

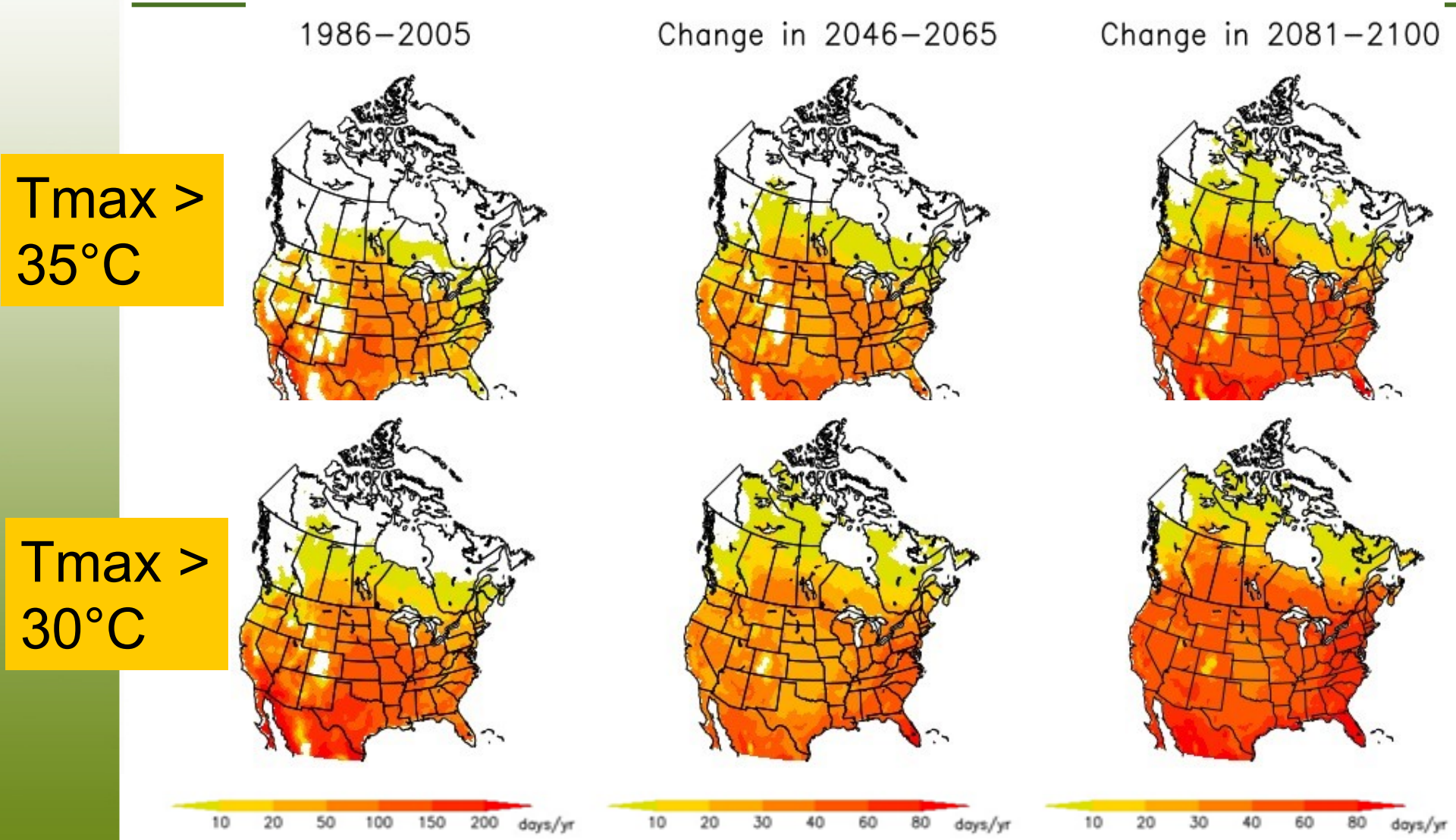
For Canada

- Increase observed almost everywhere
- Observed changes attributed to human influence even at regional scale
- High confidence in projection even at relatively small scale

For the US

- Increase in extremely cold days since early 1900s
- Mean temperature increase by at least 1.4C over the next few decades and 2.8 to 4.8C increase by late century depending on the level of future emissions
- Extreme temperatures are projected to increase even more than average temperatures

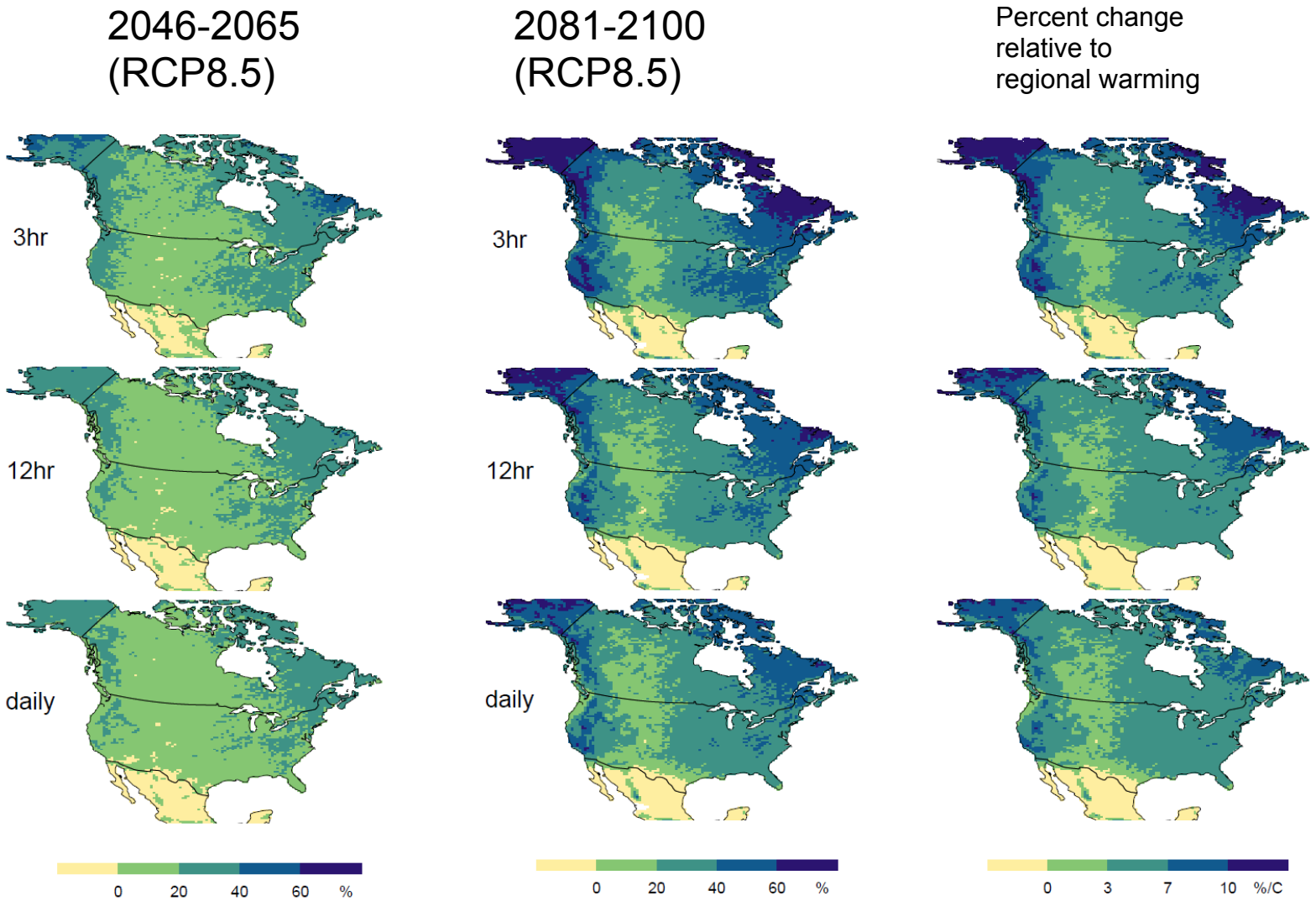
Projected changes in number of hot days by CanRCM4 large ensemble



Extreme precipitation

- Heavy precipitation events across the US have increased in both intensity and frequency since 1901.
- Changes in extreme precipitation over Canada is less clear..
- The frequency and intensity of heavy precipitation events are projected to increase over the 21st century in the US and Canada.
- Small process such as convection not well represented even in regional models, making it difficult to estimate future precipitation at small scale.

Projected changes in annual maximum precipitation by CanRCM4 large ensemble



Conclusions

- There is clear evidence of increase in extreme temperature, there is high confidence in projected increase for the future.
- There is evidence of increase in extreme precipitation, a large increase (about 6-7%/°C temperature increase) is projected for the future.
- Exact info for specific application may not be readily available. However, existing information may be useful enough for planning.

Thank you