Will Outer Tropical Cyclone Size Change due to Anthropogenic Warming?

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THE UNIVERSITY OF OKLAHOMA SCHOOL OF METEOROLOGY

CIMMS

Cooperative Institute for Mesoscale Meteorological Studies

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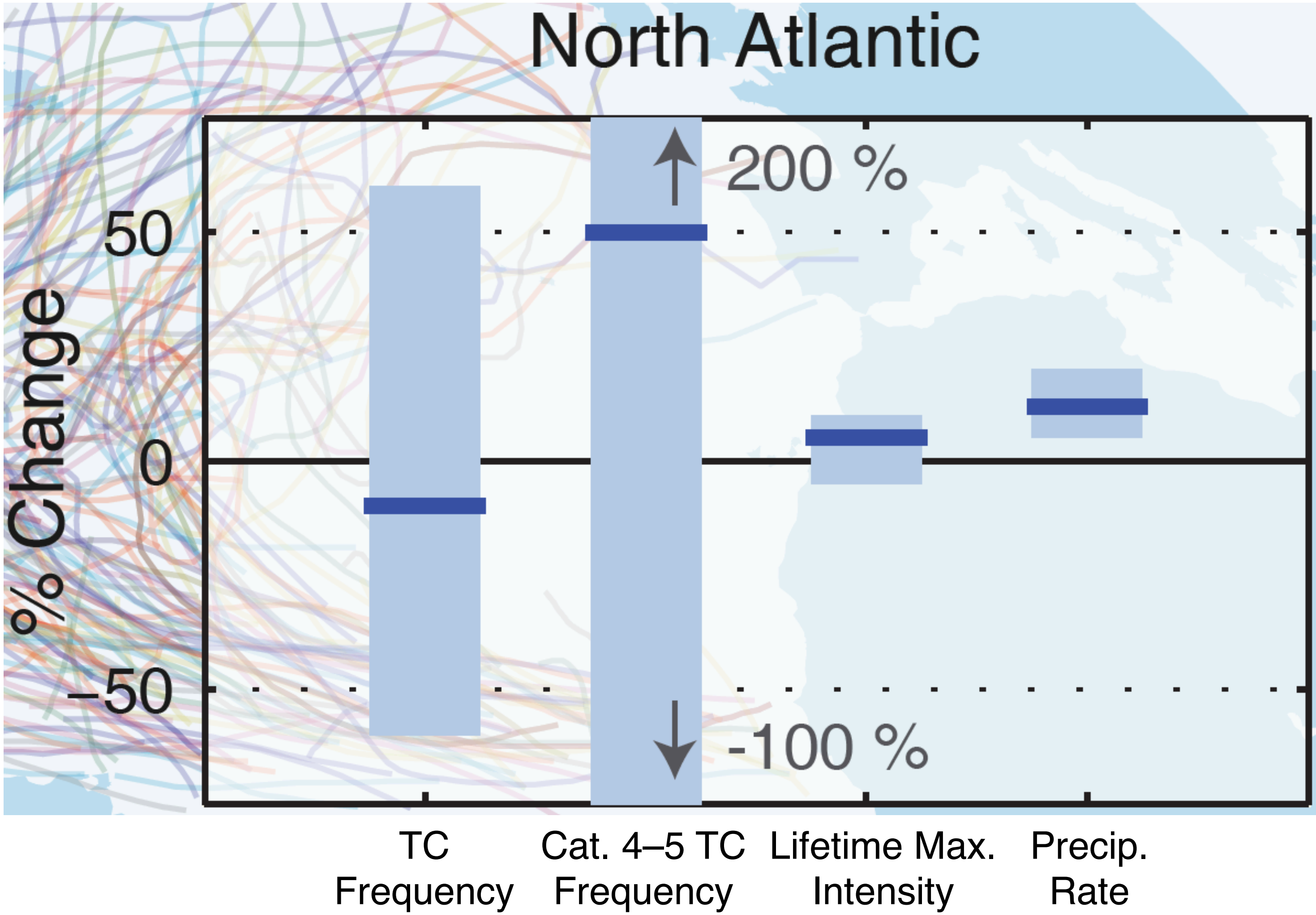
How will TC Activity Change in Future Climates?



Christensen et al. (2013)

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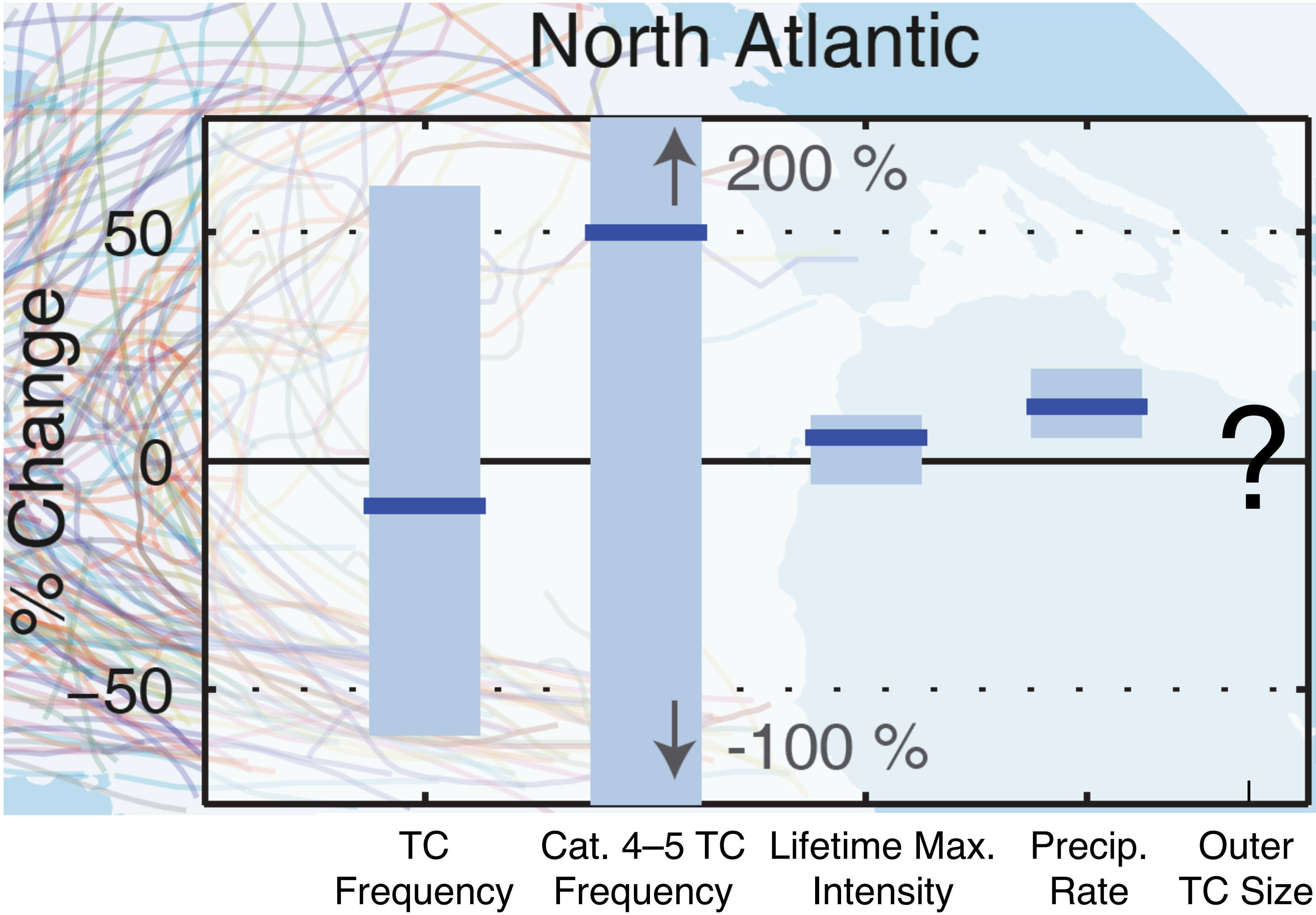
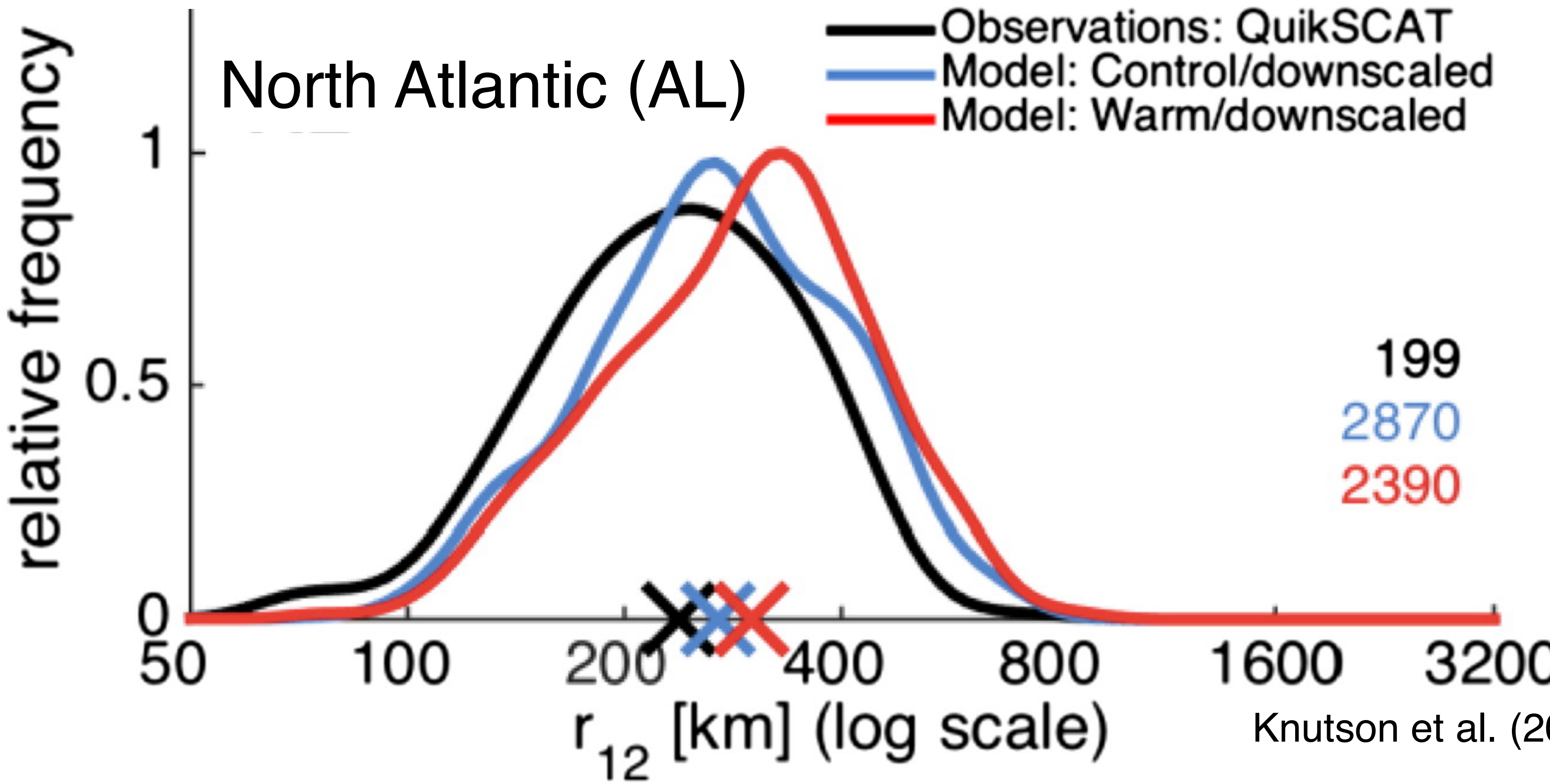


Can we add a fifth category to this figure for outer TC size given its importance to accurately estimating TC hazards and risk?

Christensen et al. (2013)

Prior Work on Outer TC Size Changes due to Anthropogenic Warming



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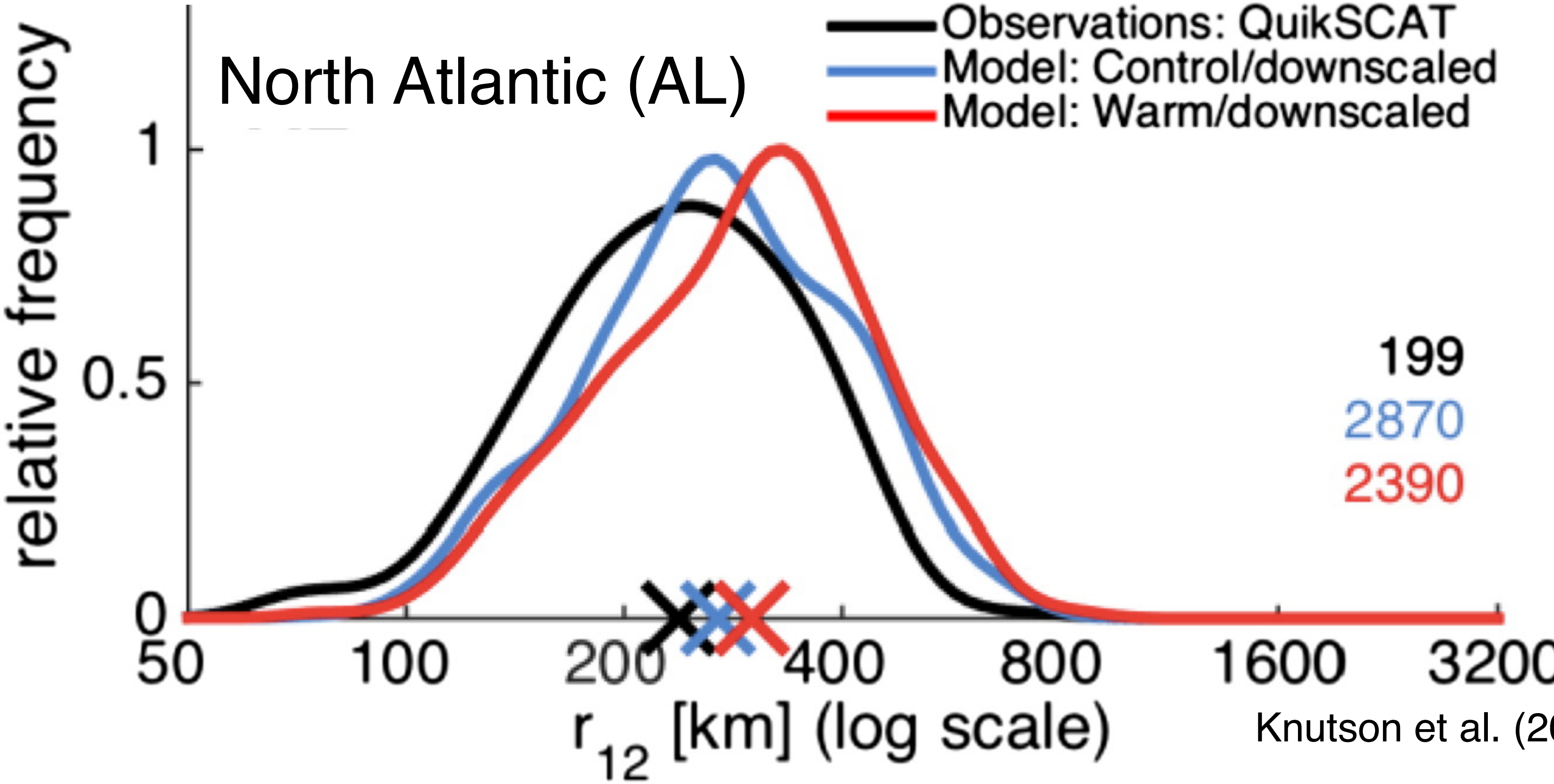

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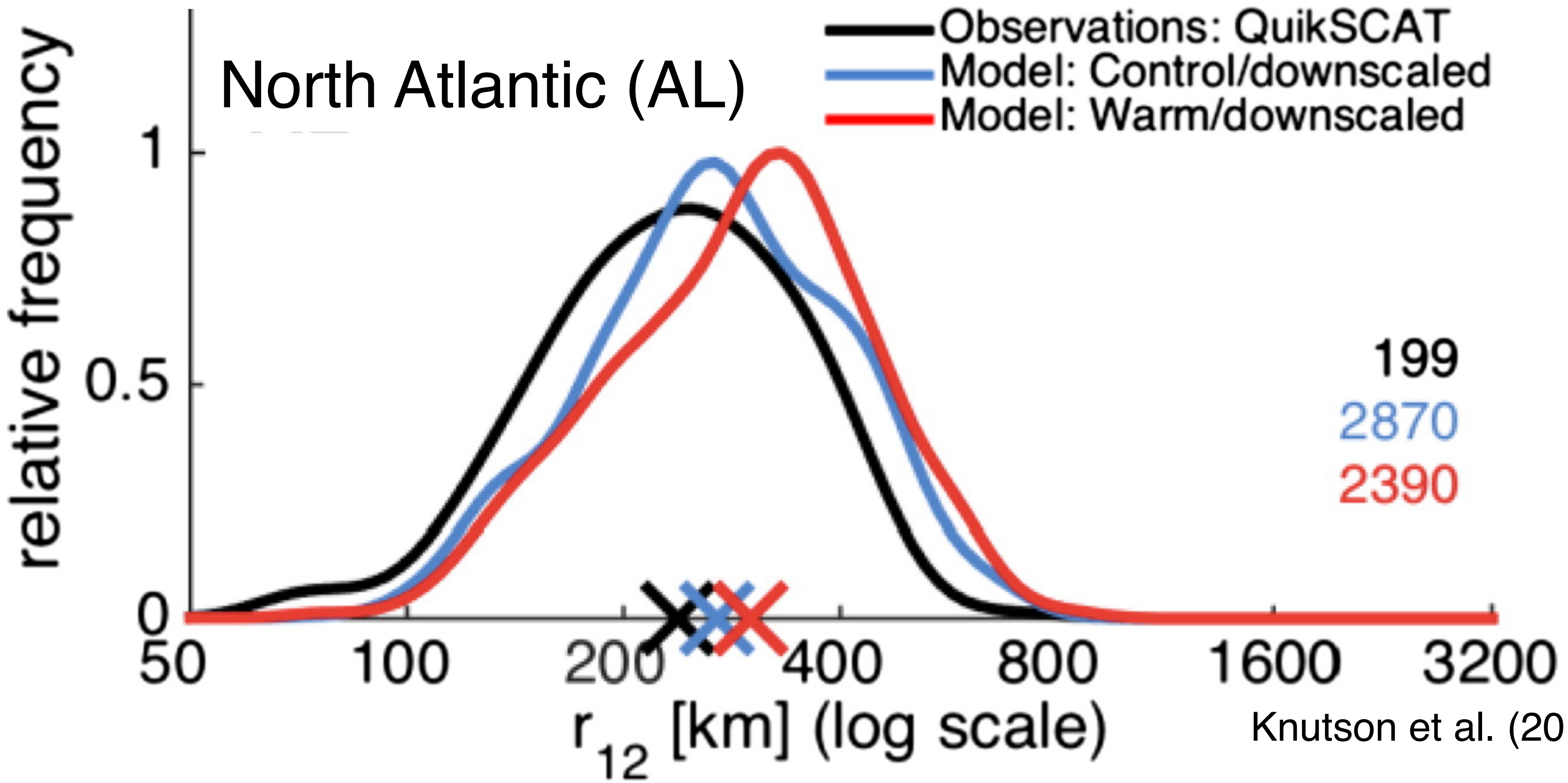

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- Used high-resolution GFDL hurricane model for simulations of current climate (blue) and late 21st century conditions (CMIP5 RCP4.5; red)
- North Atlantic outer TC size shifts towards larger values in late 21st century conditions

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2. Are the differences in outer TC size between current climate and late 21st century conditions statistically significant?

3. Are changes in outer TC size uniform across the entire TC lifecycle (e.g., genesis versus end of lifetime)?

Data and Methods

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- Each model simulation has two experiments: 1) **current climate** and 2) **late 21st century conditions** (CMIP5 RCP4.5 ensemble mean)

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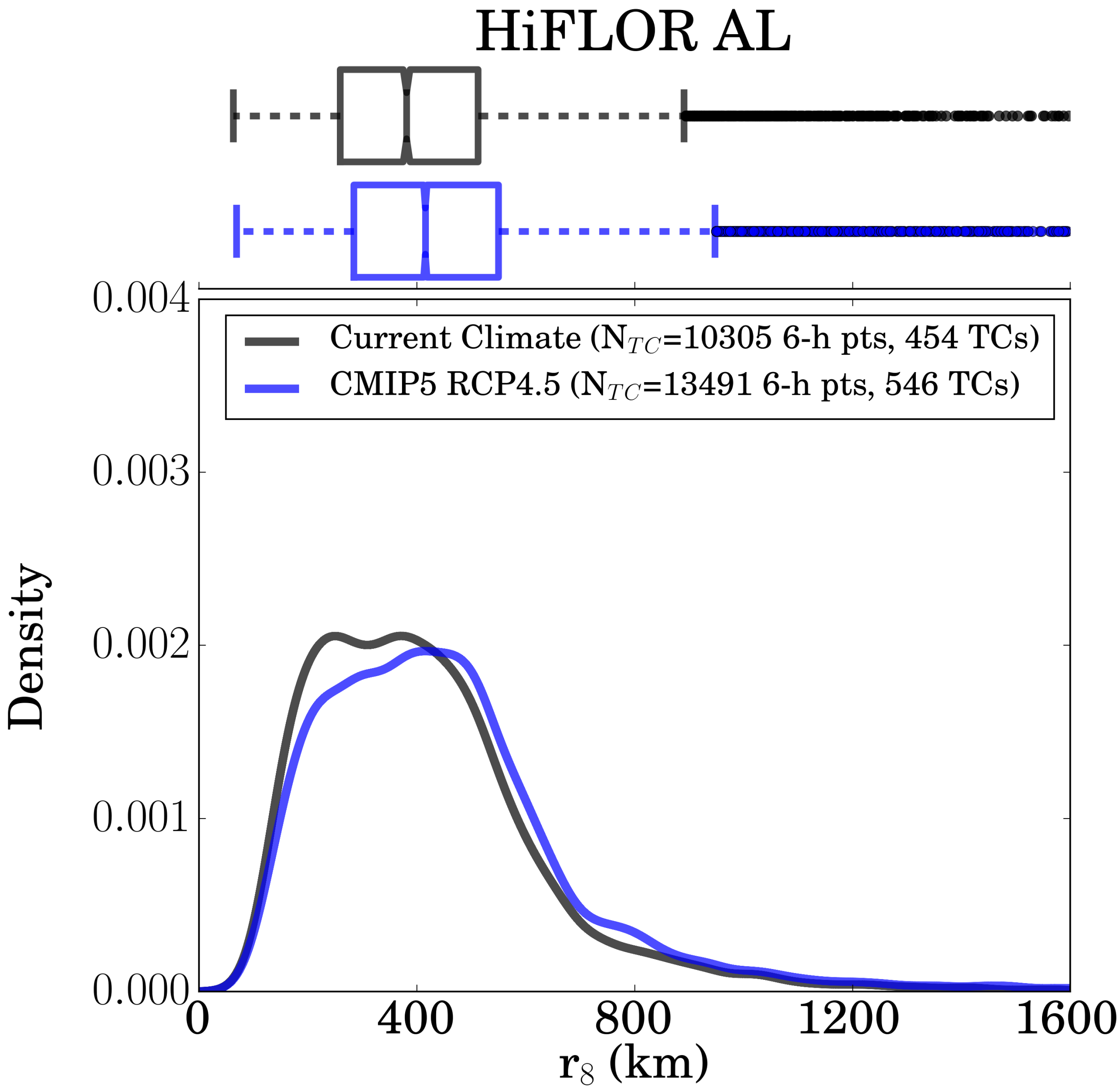
  2. r_8 distributions taken from different parent distribution as shown by **two-sample Kolmogorov-Smirnov testing at 5% level.**

Changes in Outer TC Size Throughout TC Lifetime



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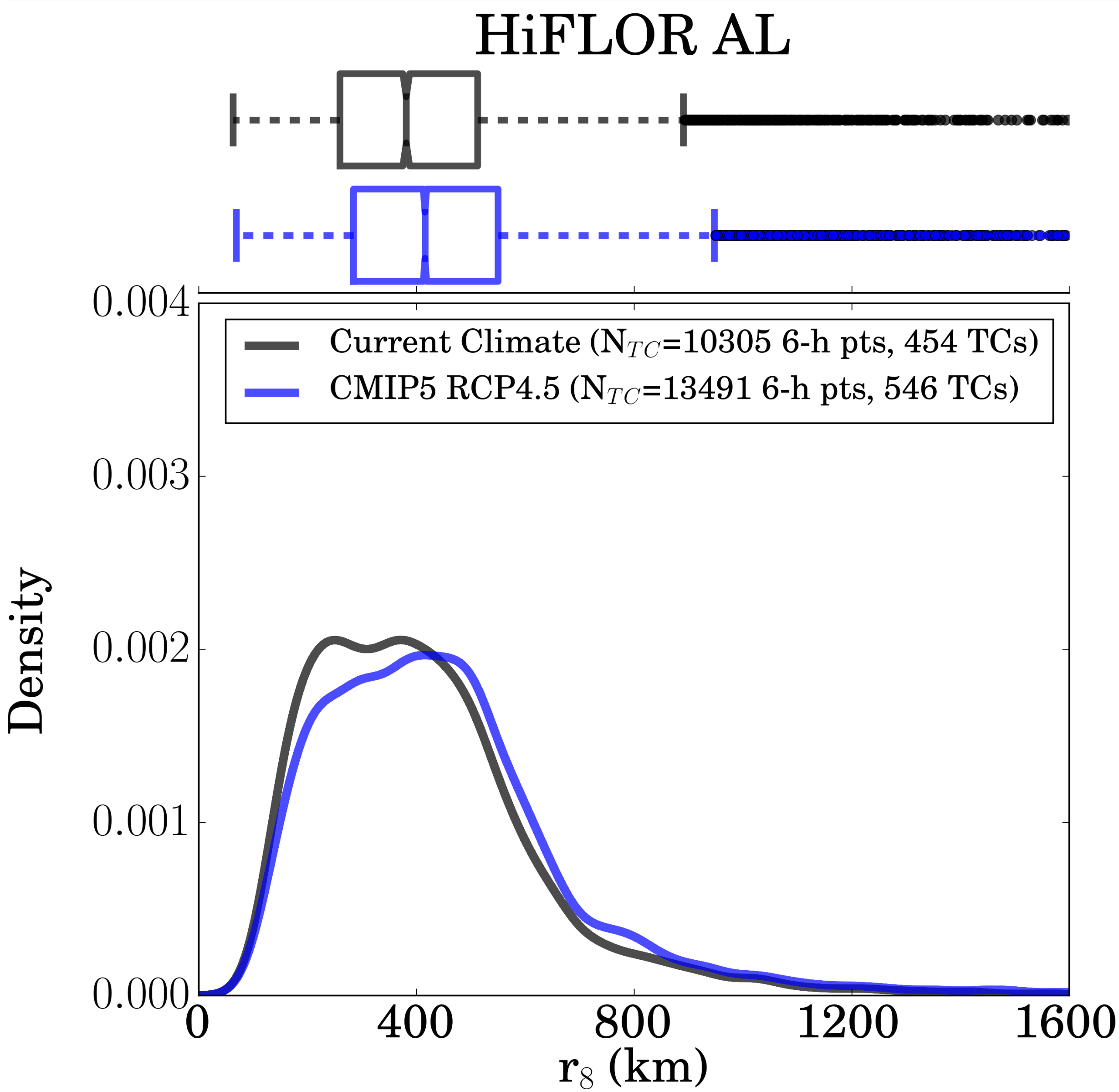

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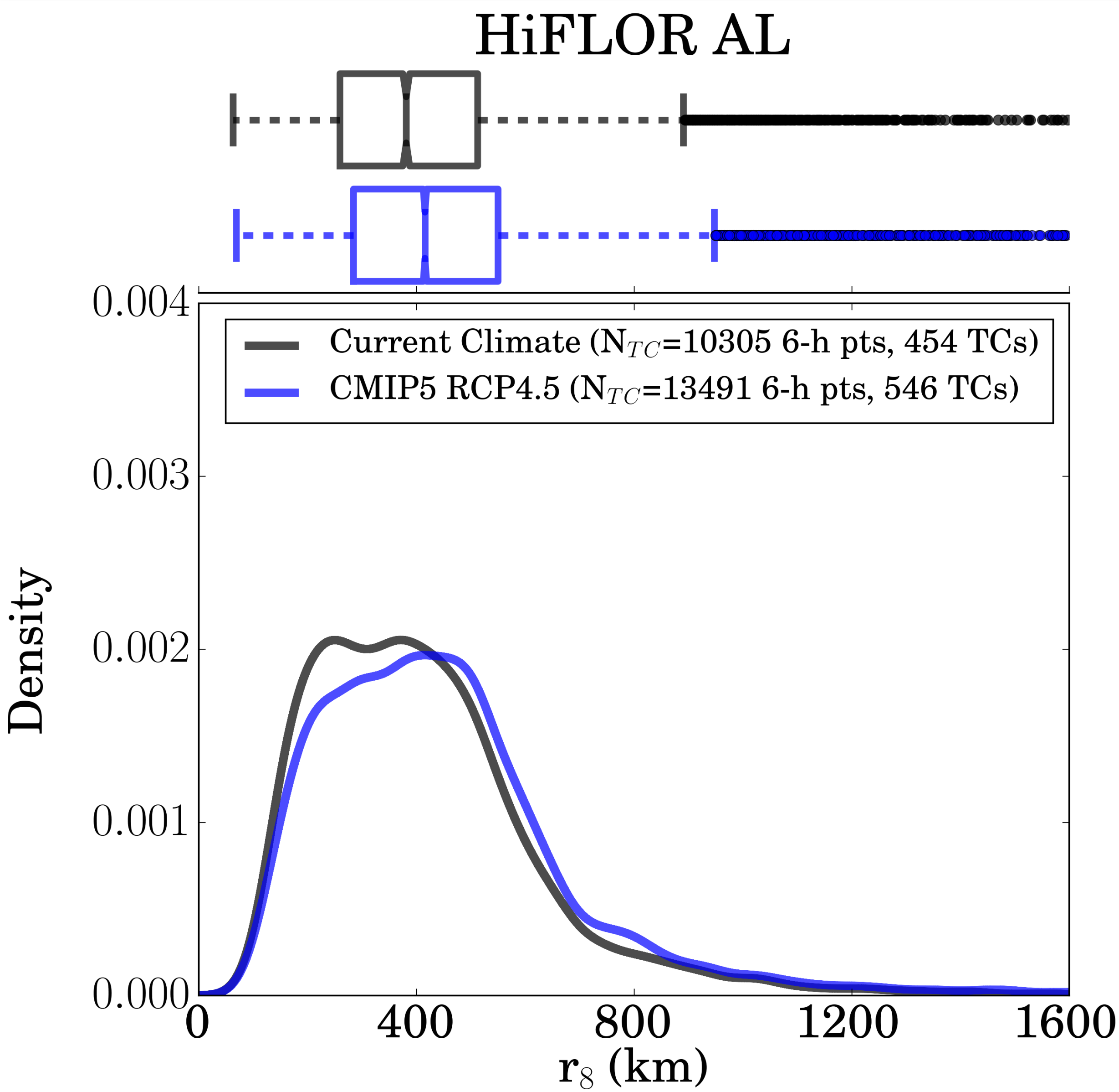

- r_8 distribution in late 21st century is shifted towards statistically significantly larger values
- Median r_8 is 35 km (9%) larger in late 21st century

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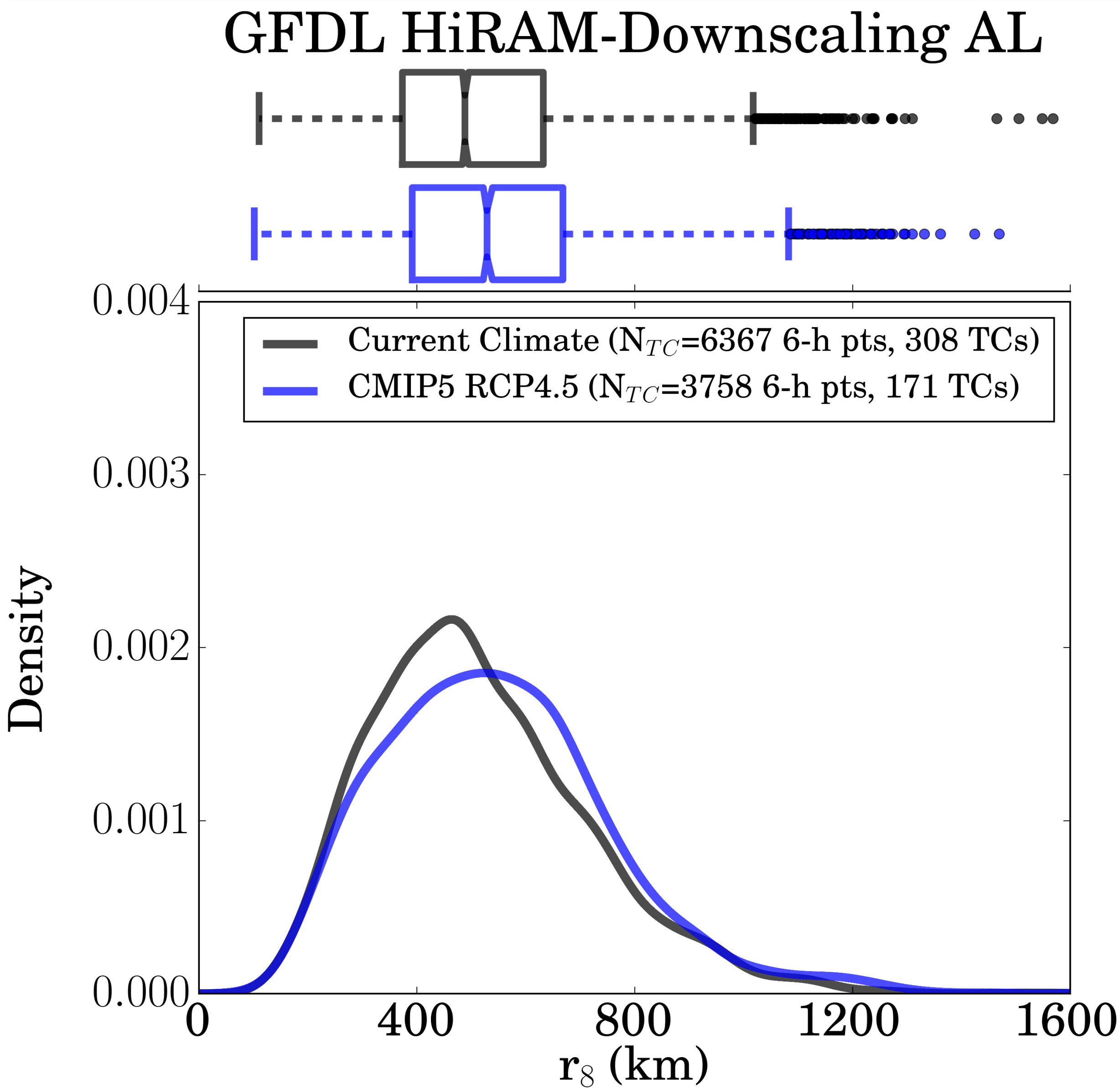

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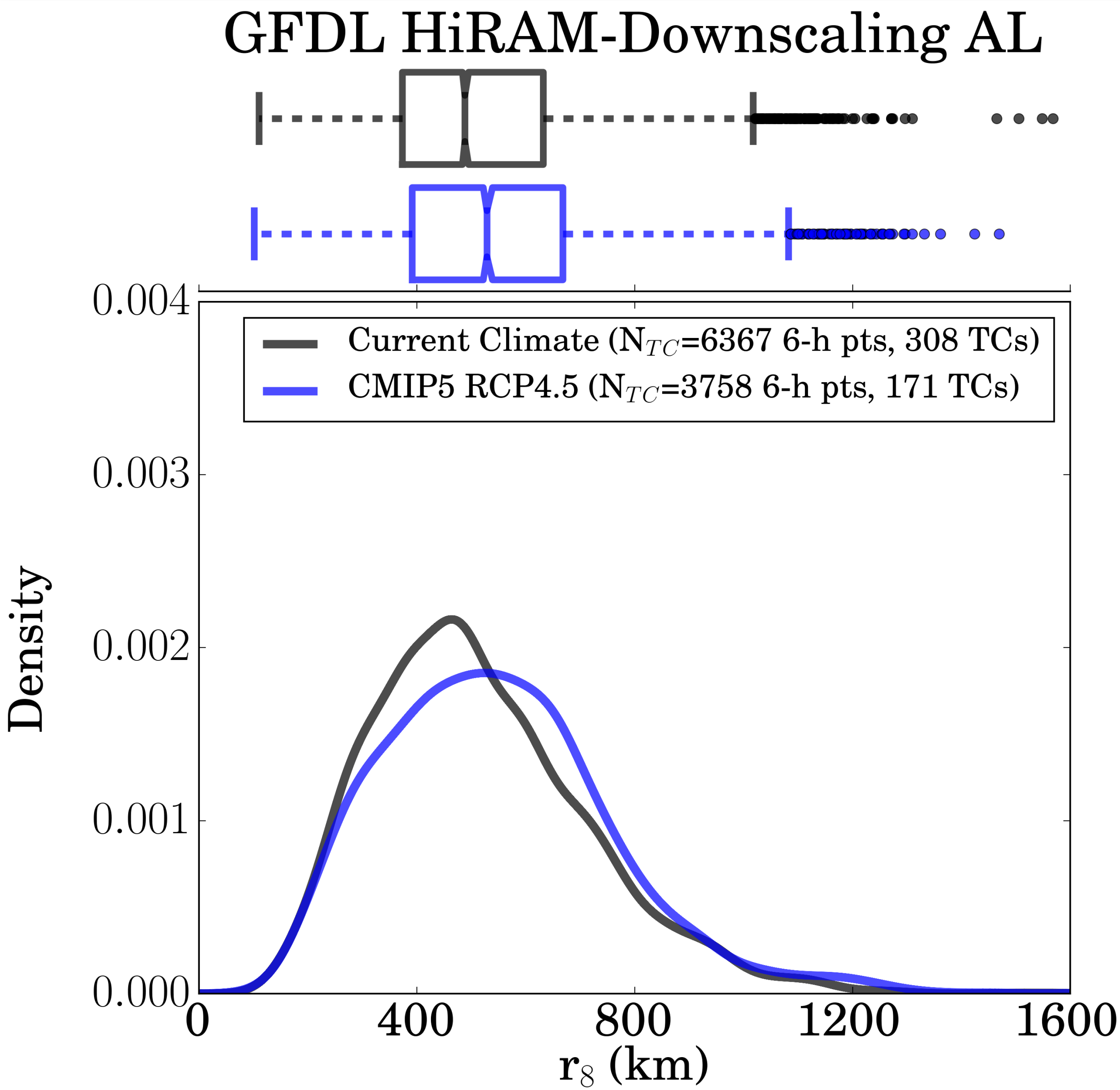

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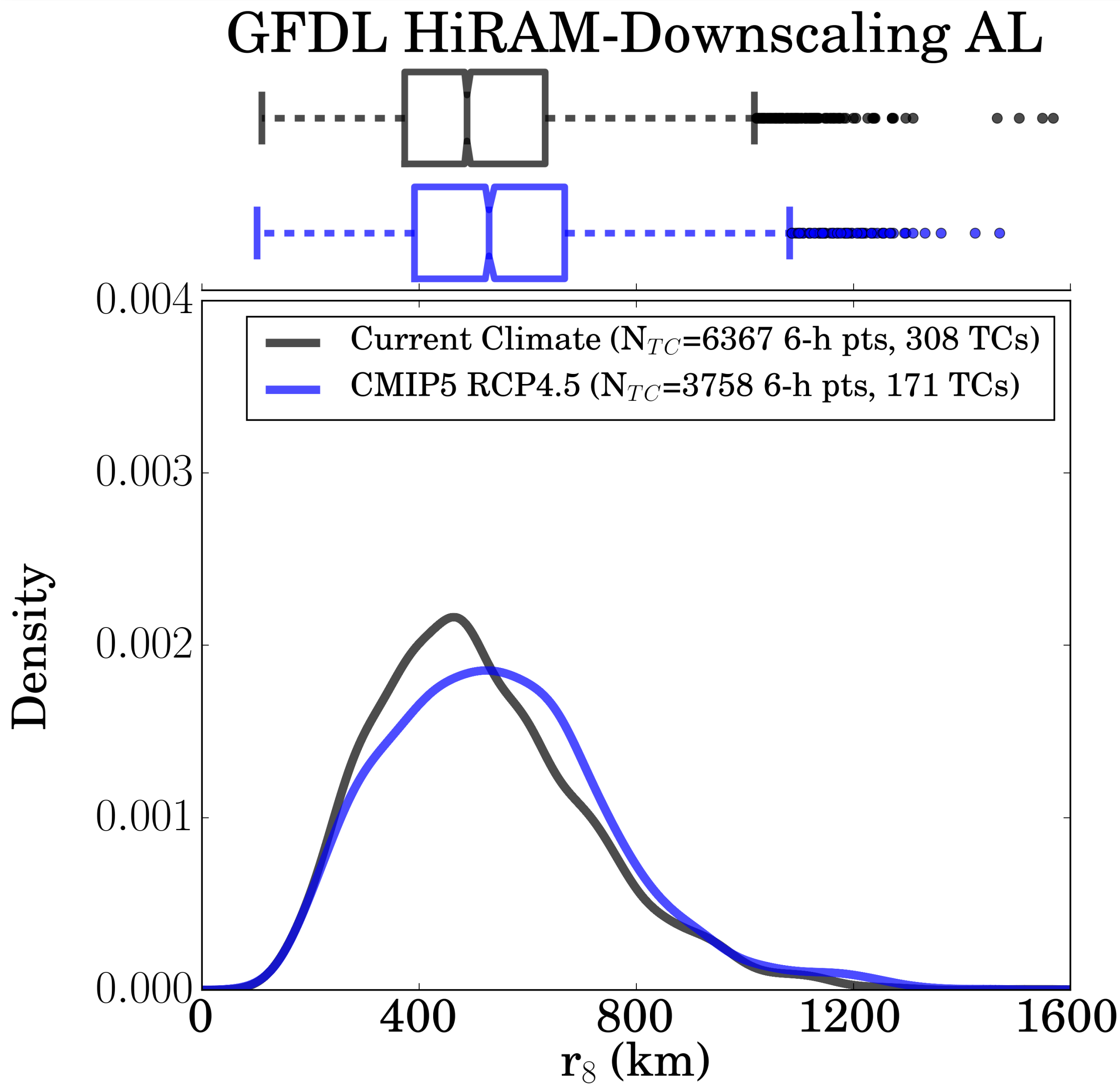
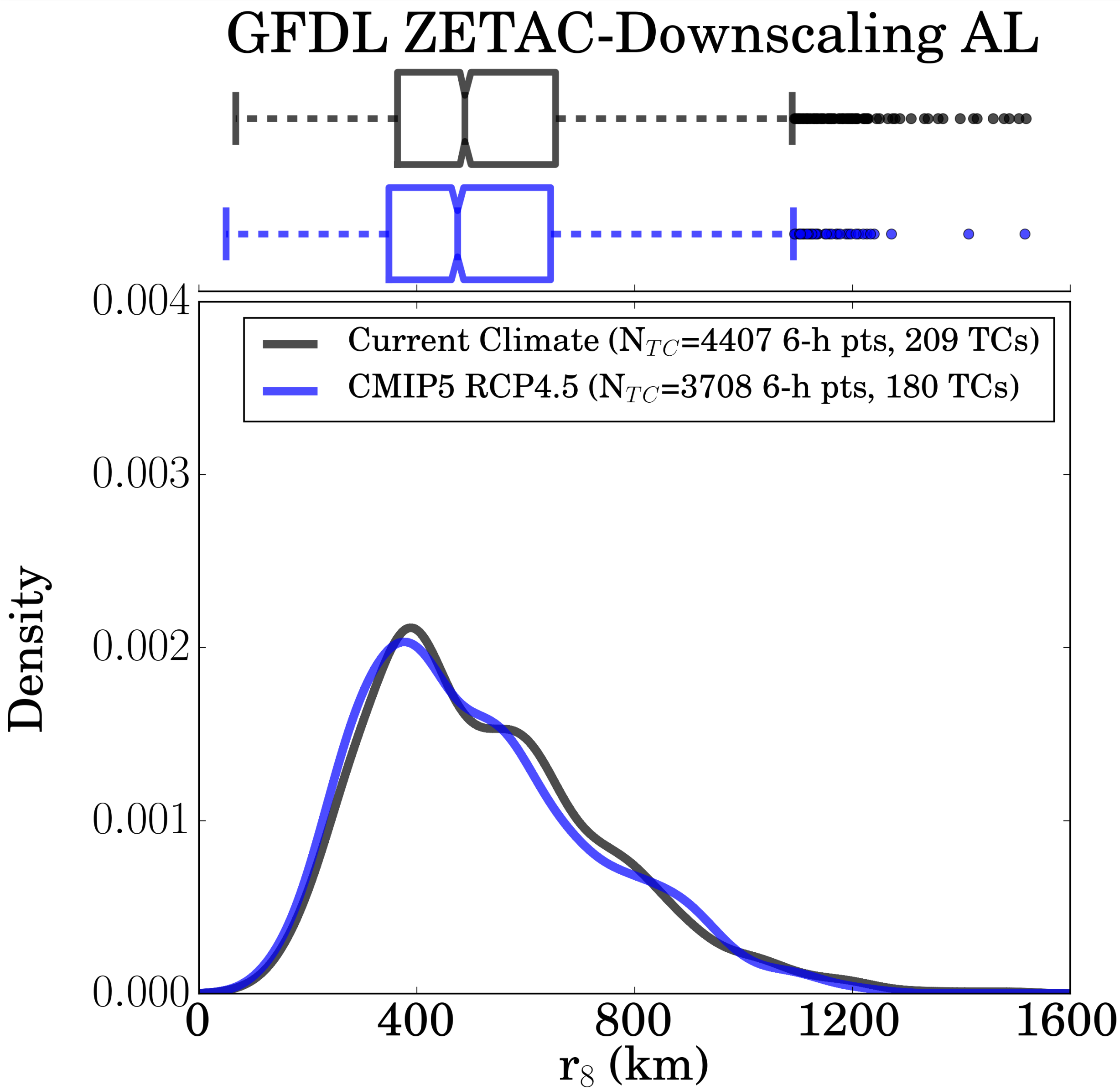


- r_8 distribution in late 21st century is shifted towards statistically significantly larger values
- Median r_8 is 40 km (8%) larger in late 21st century

Changes in Outer TC Size Throughout TC Lifetime



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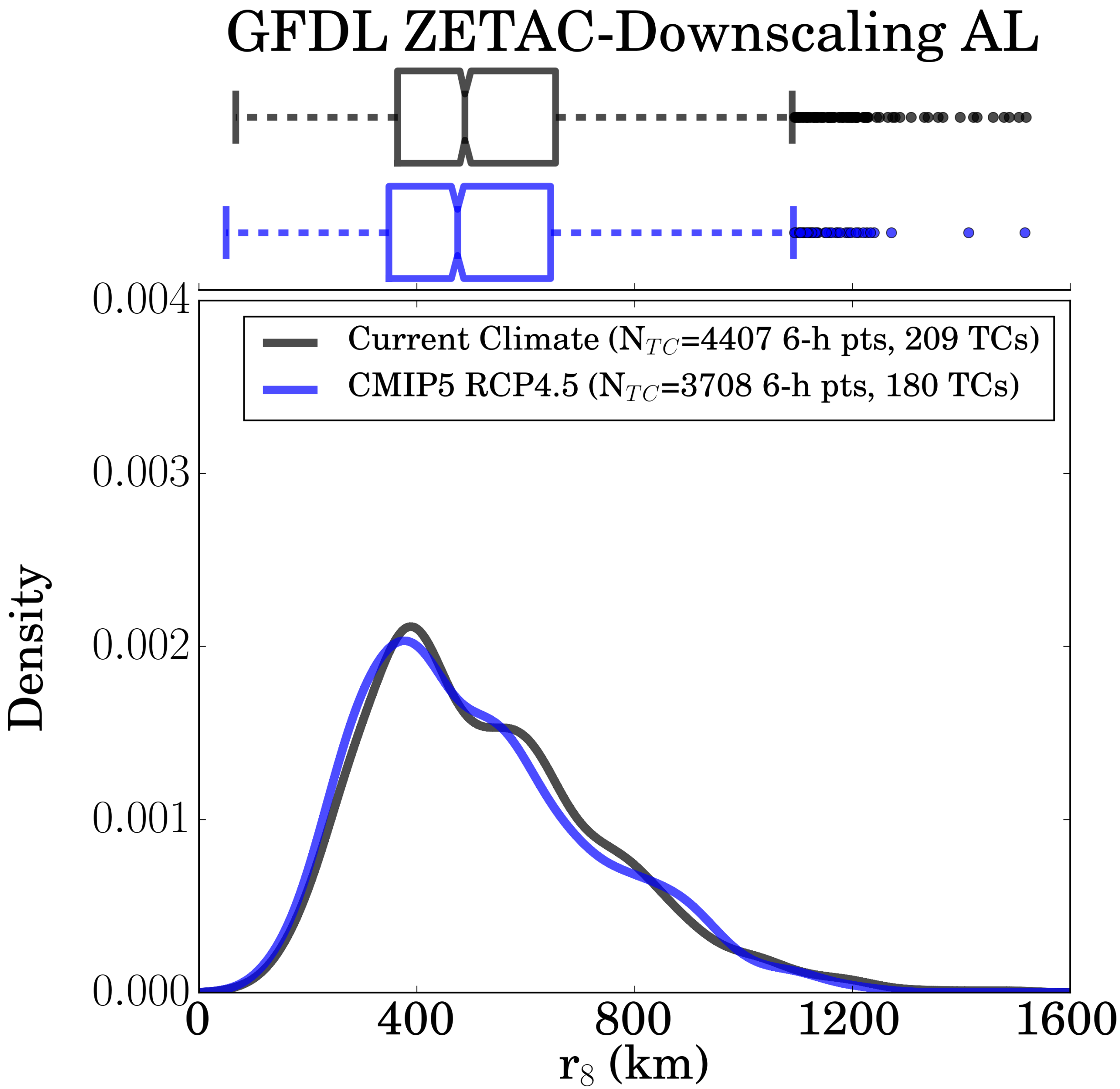

- r_8 distribution remains unchanged in late 21st century

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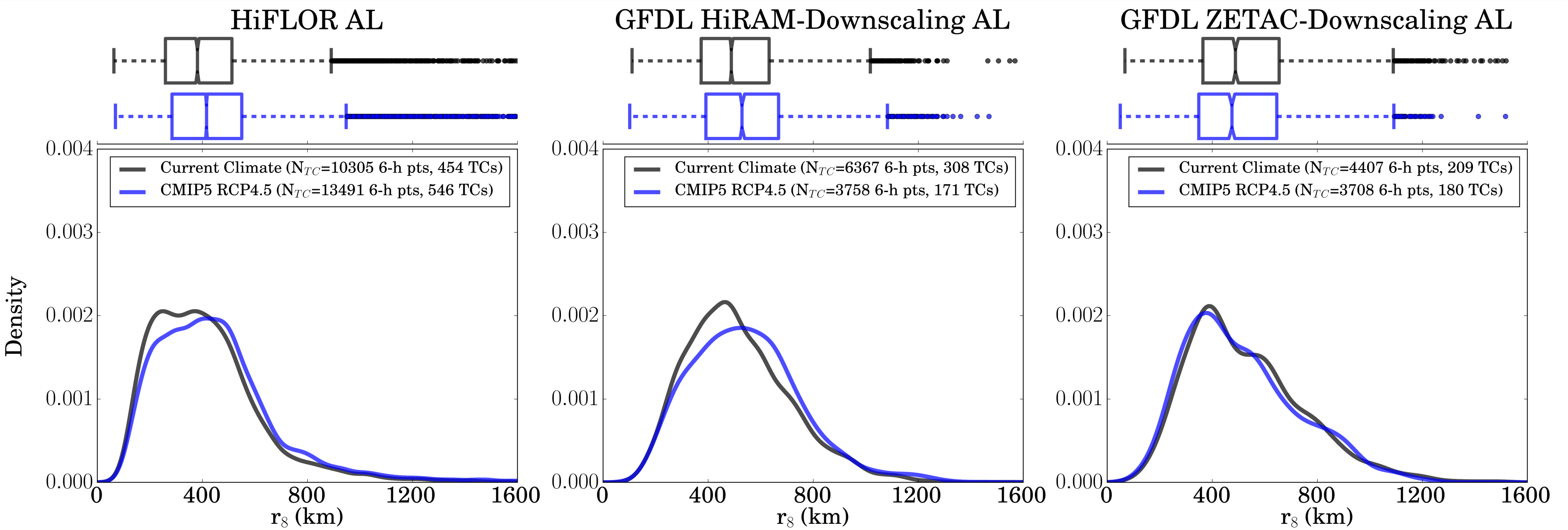

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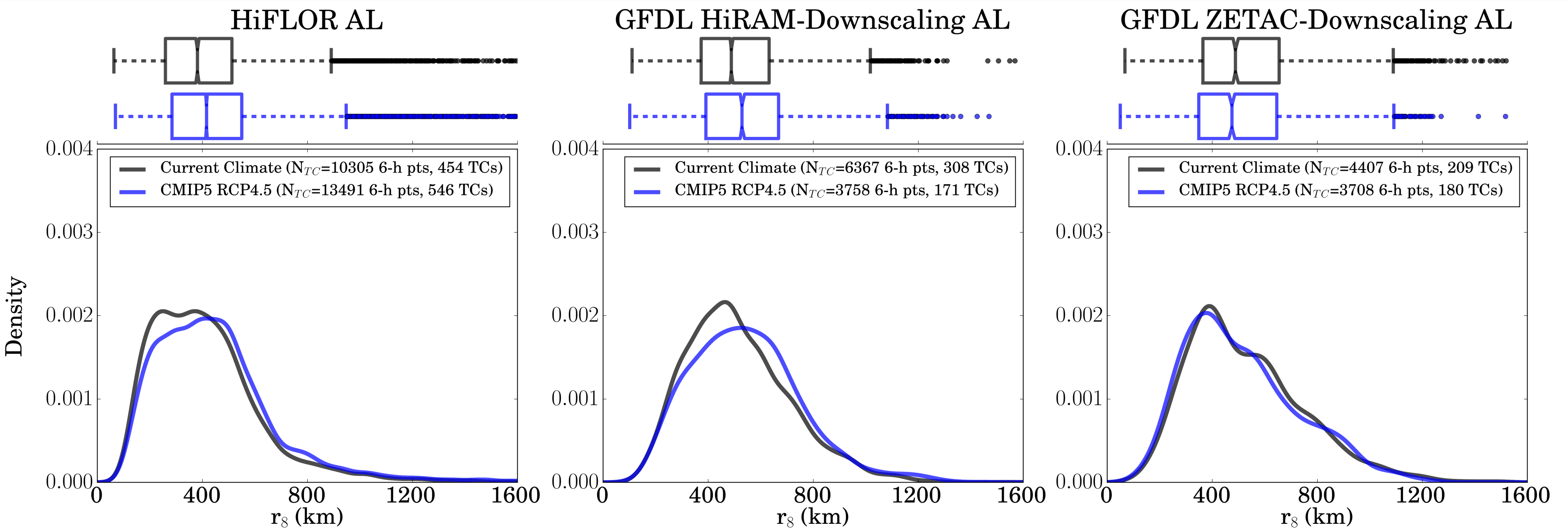

Shift towards larger r_8

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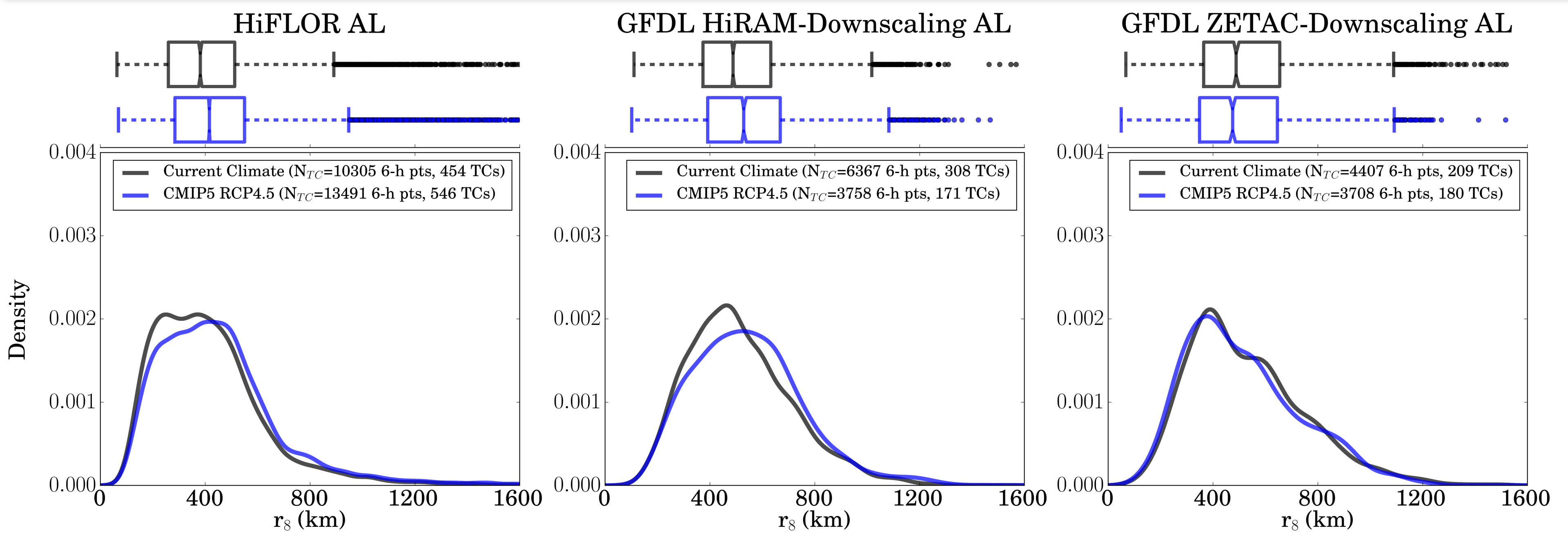

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No change in future climate

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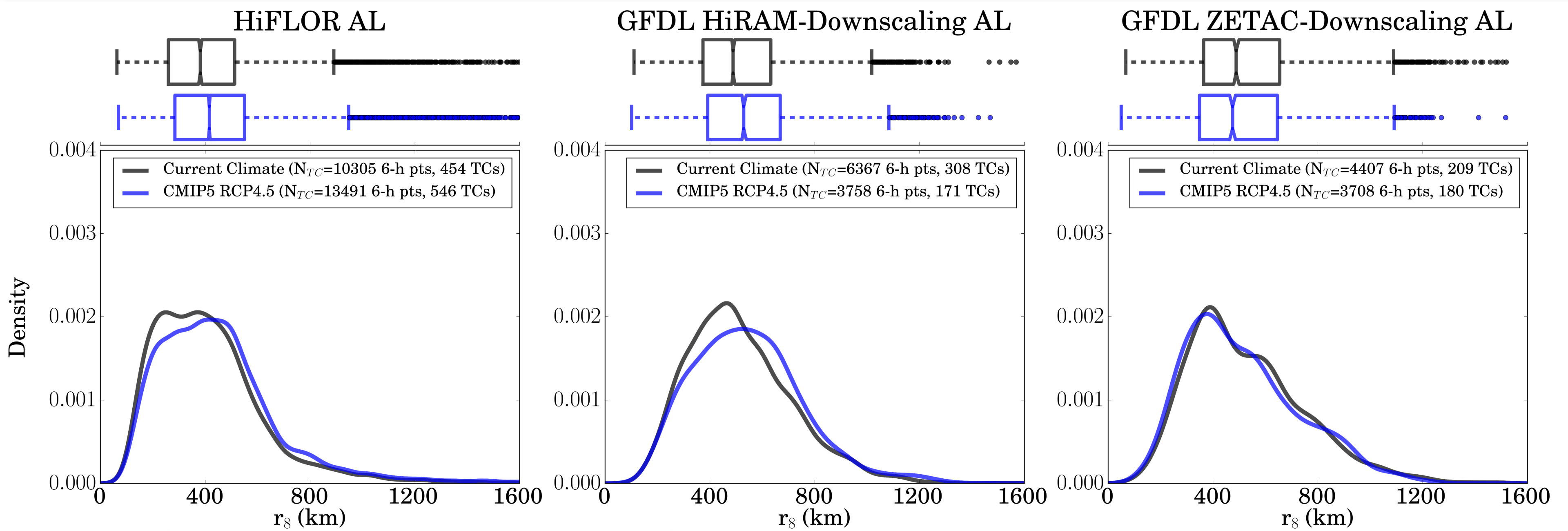

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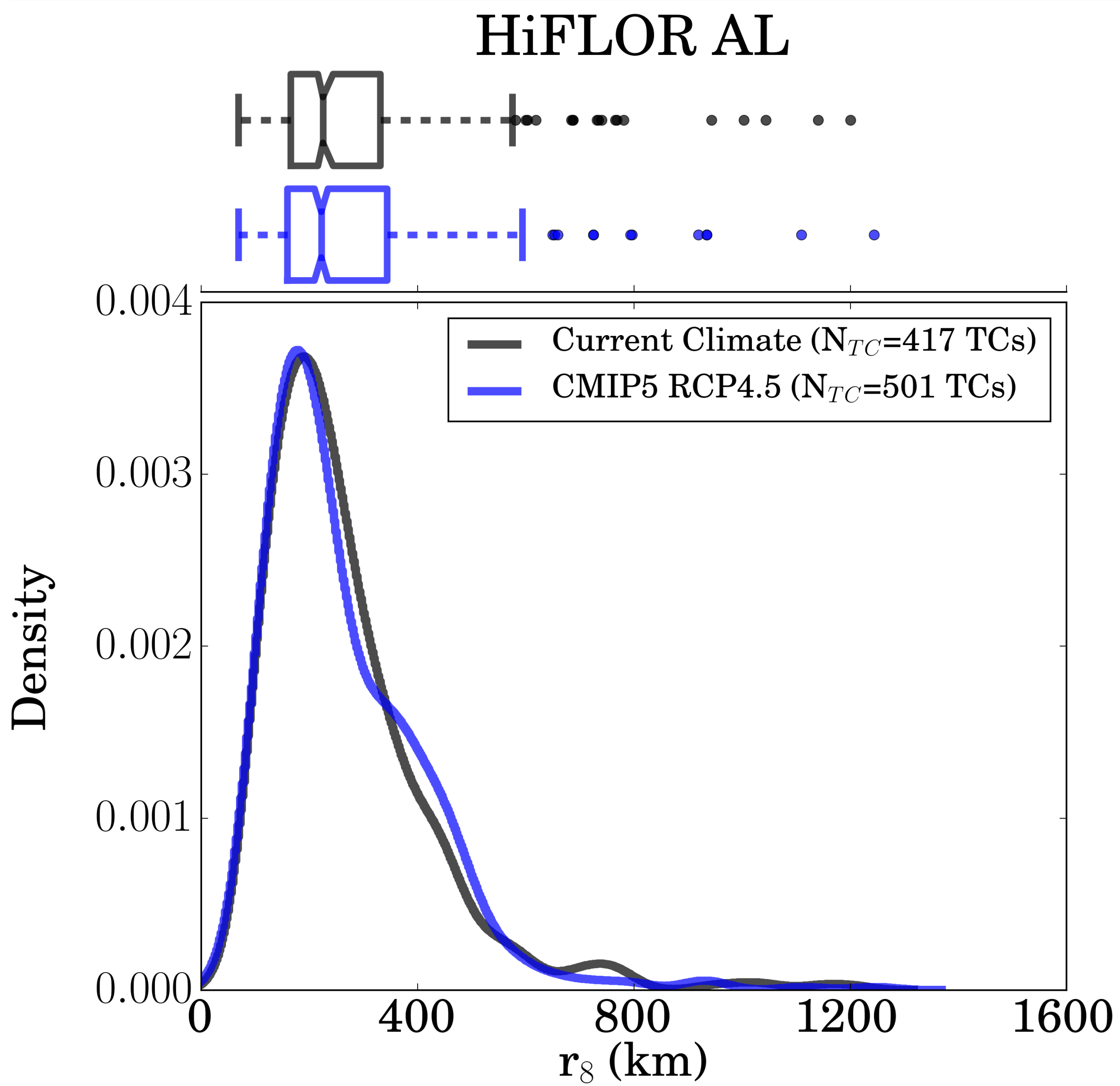
Does this change in outer TC size begin at TC genesis?

Changes in Outer TC Size at Genesis



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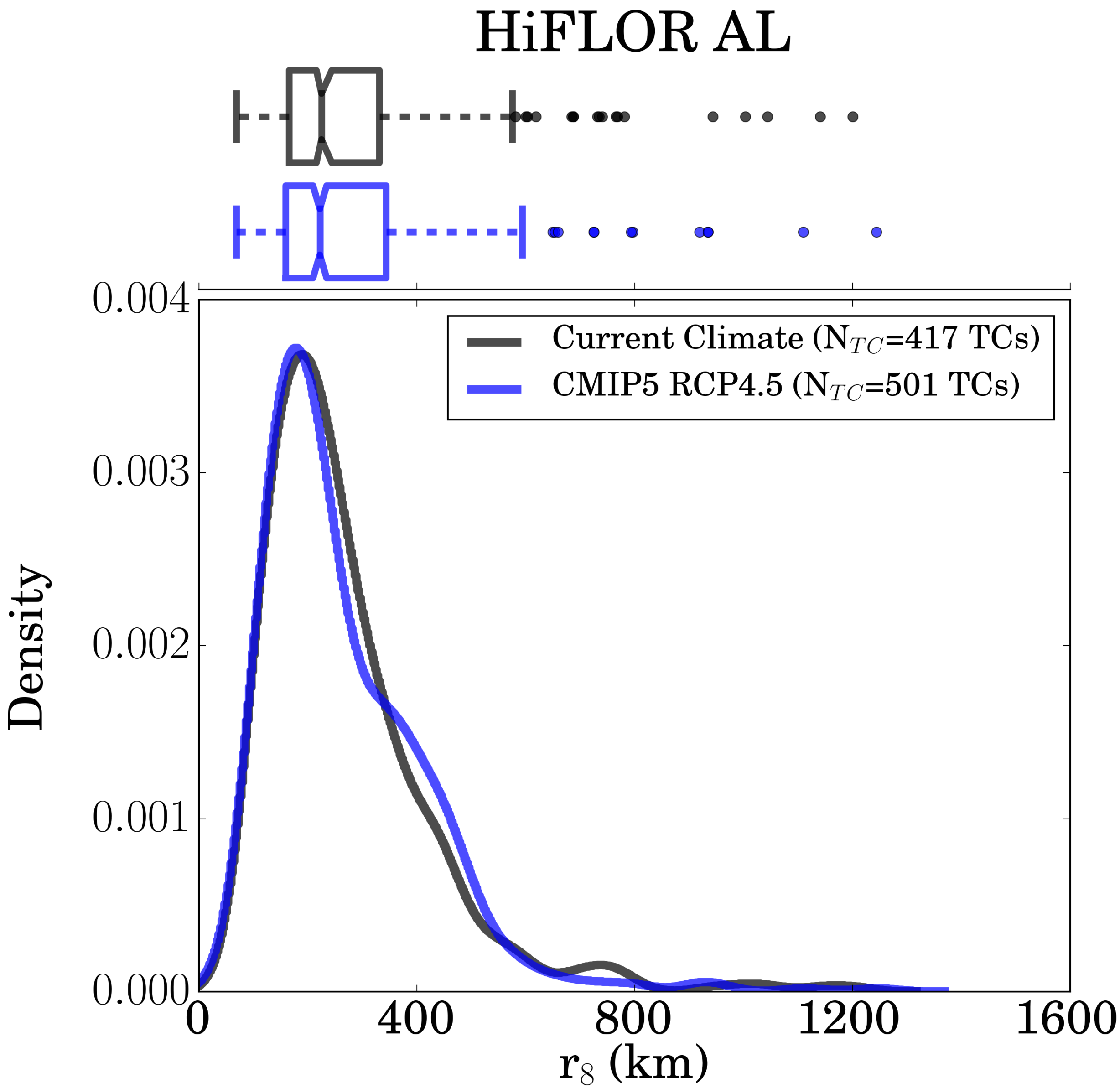

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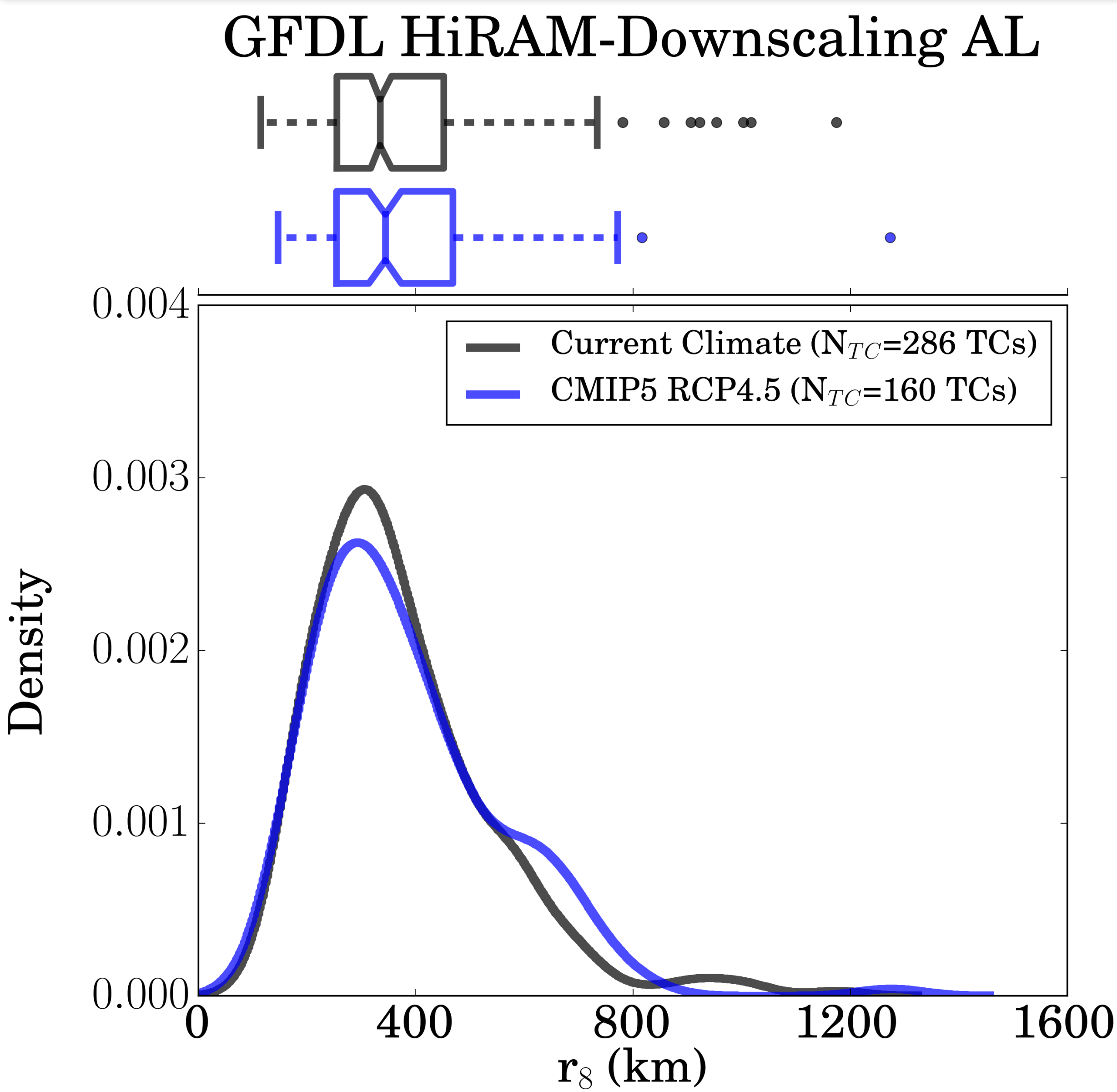

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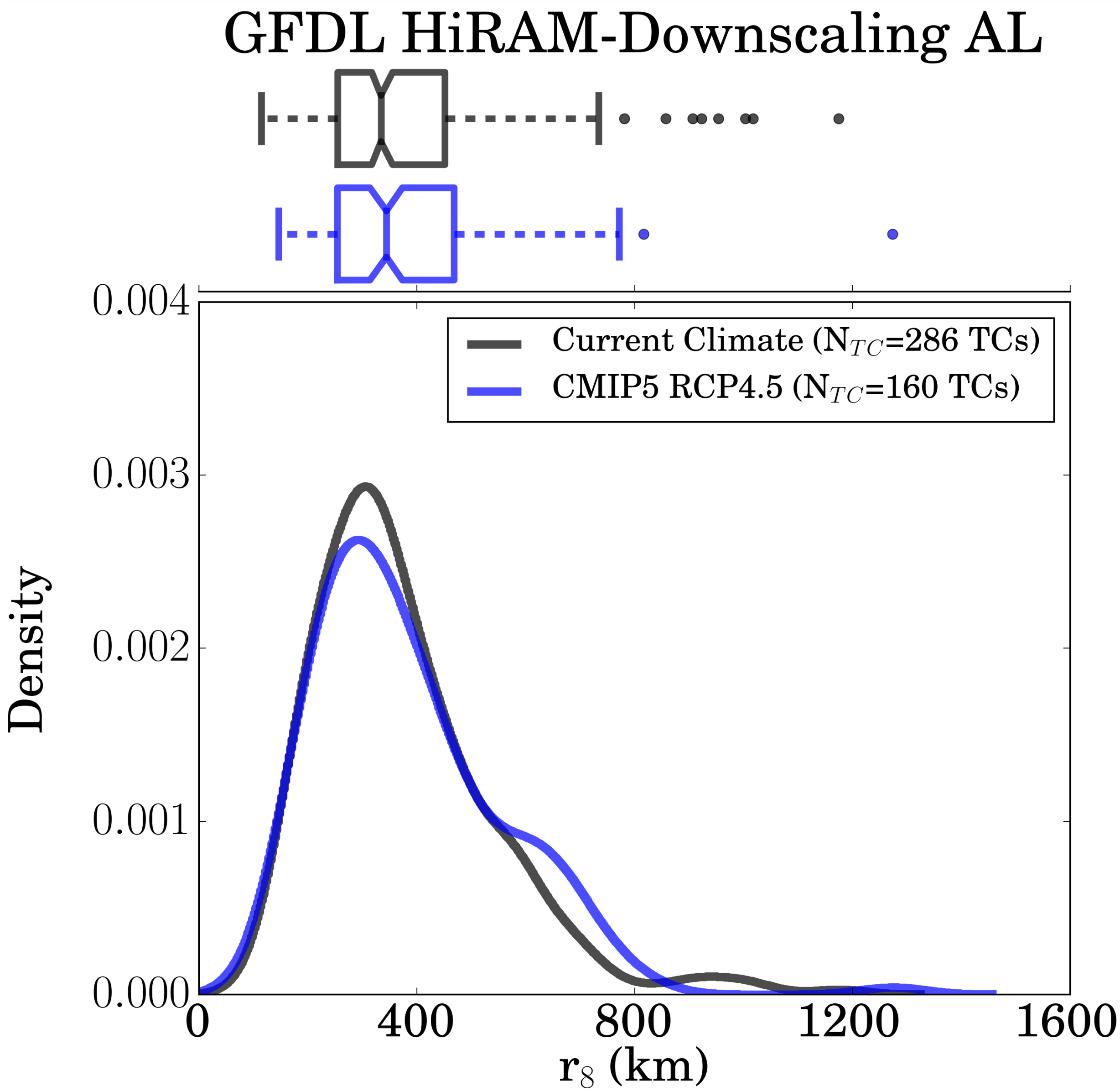

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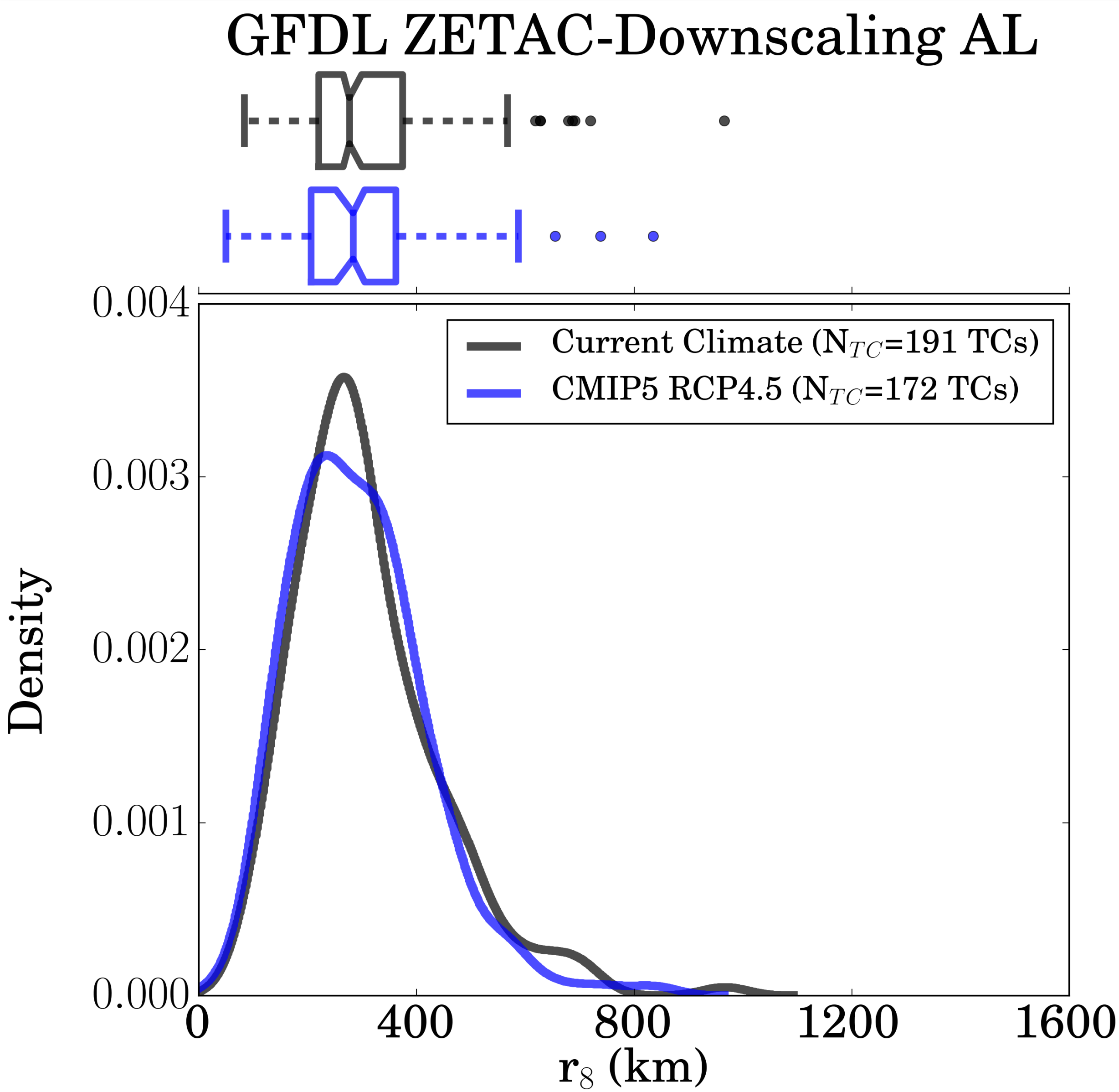

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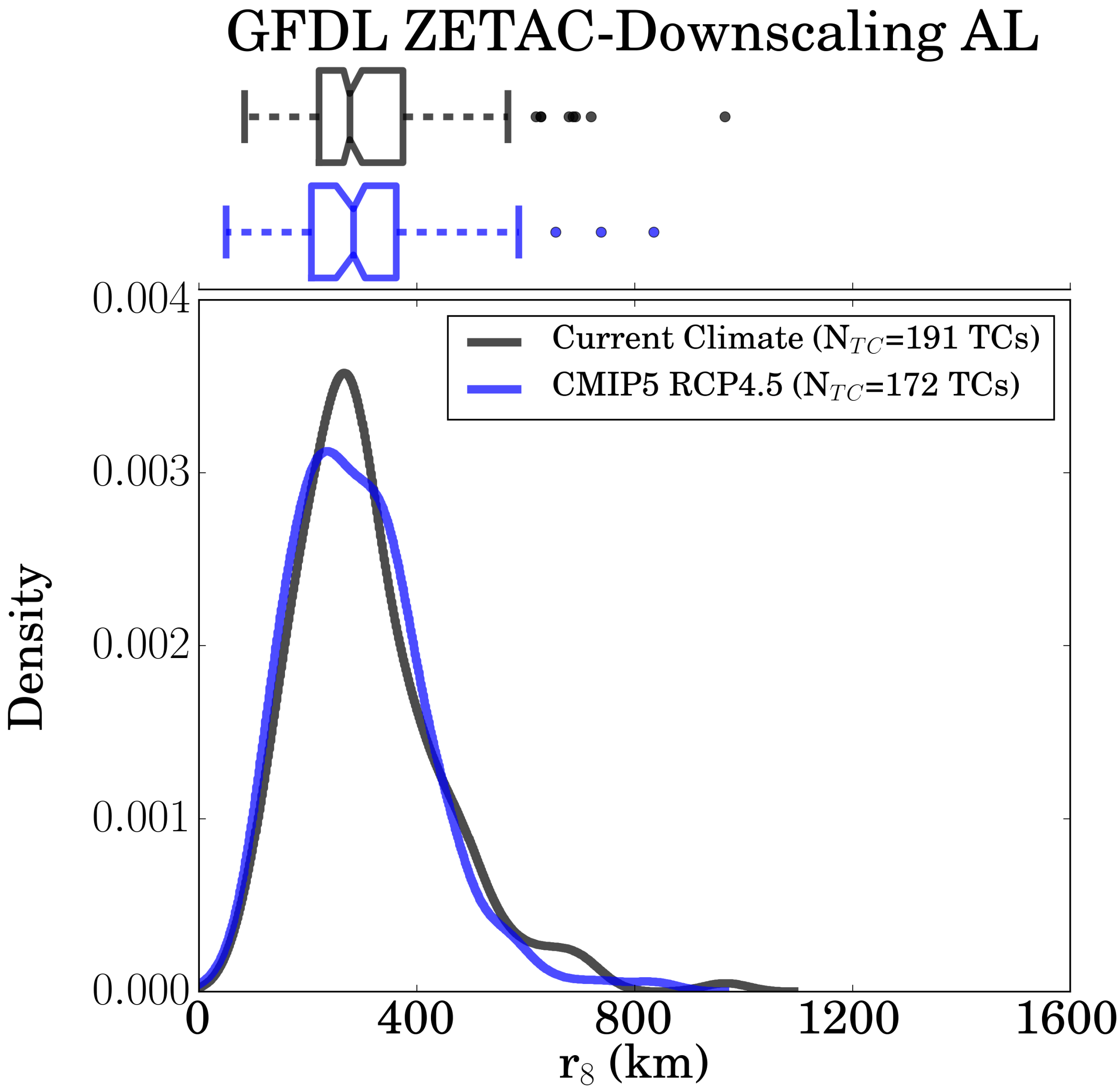

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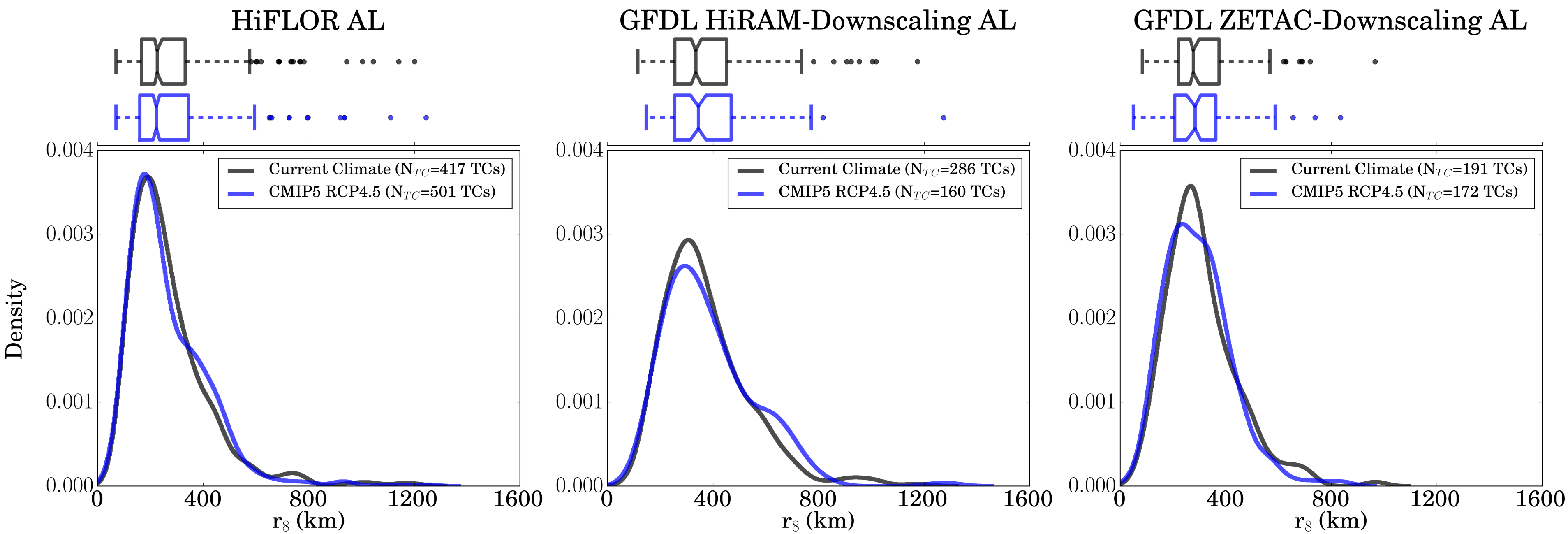

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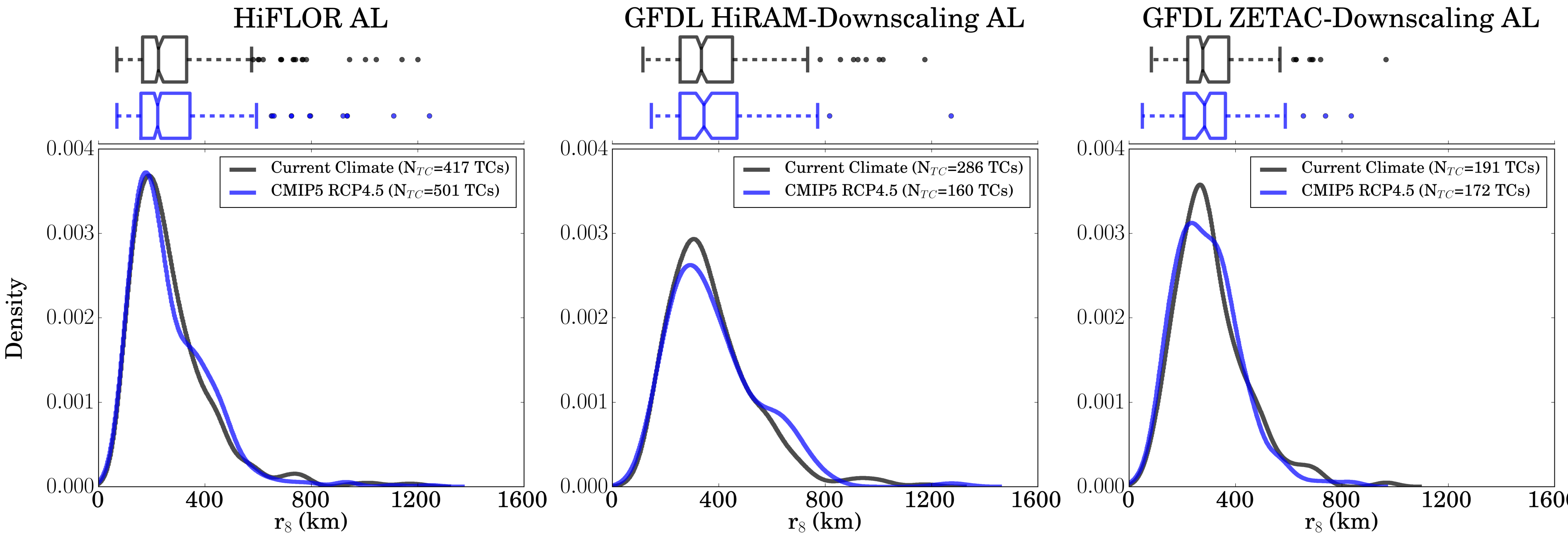

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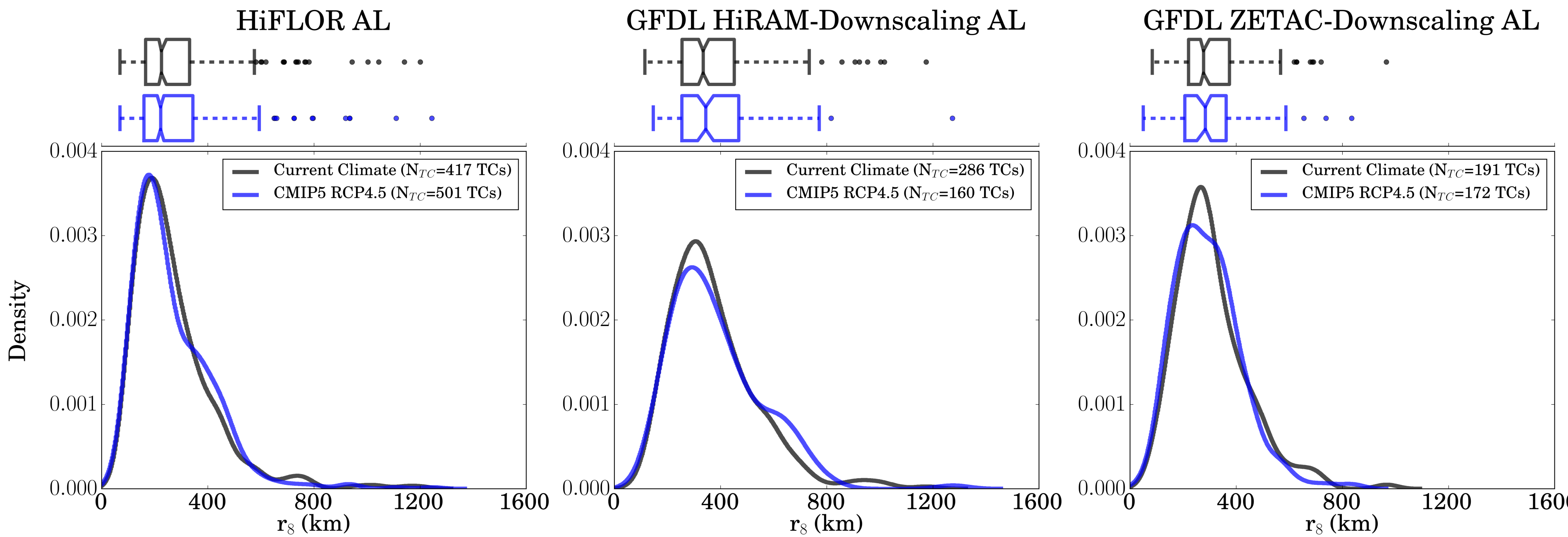

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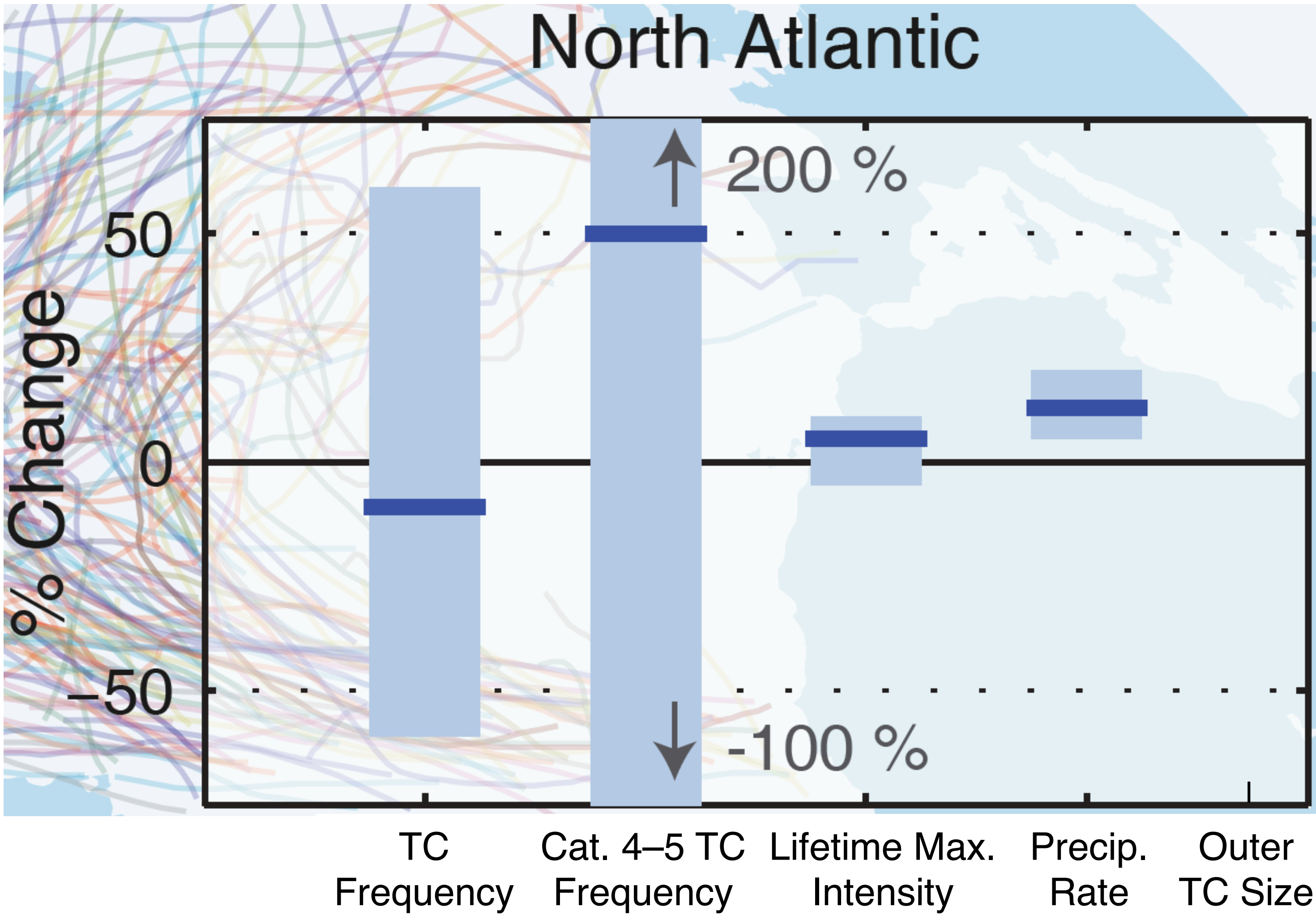
Changes in r_8 in late 21st century conditions are primarily confined to later stages of TC lifecycle

Summary and Discussion



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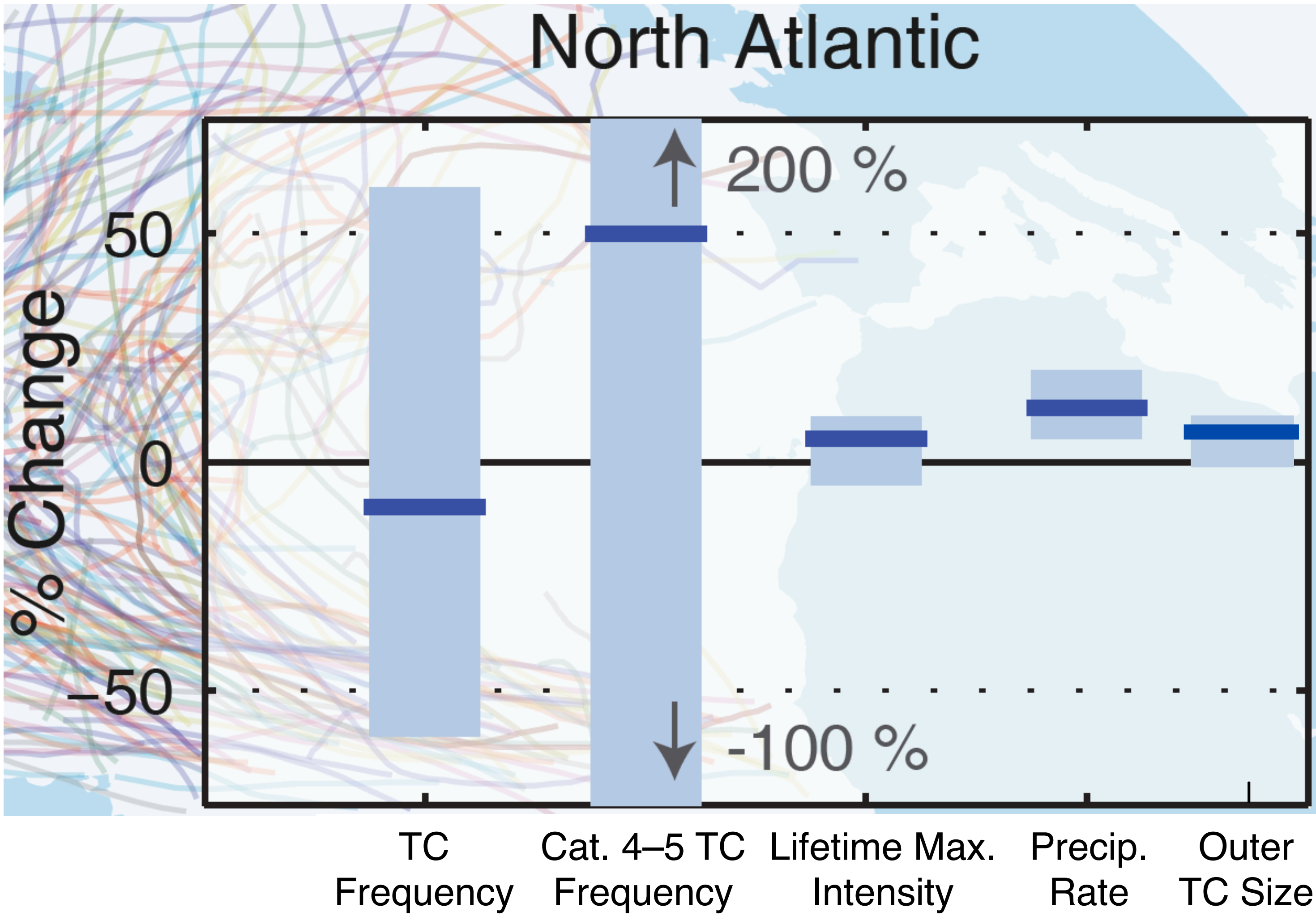

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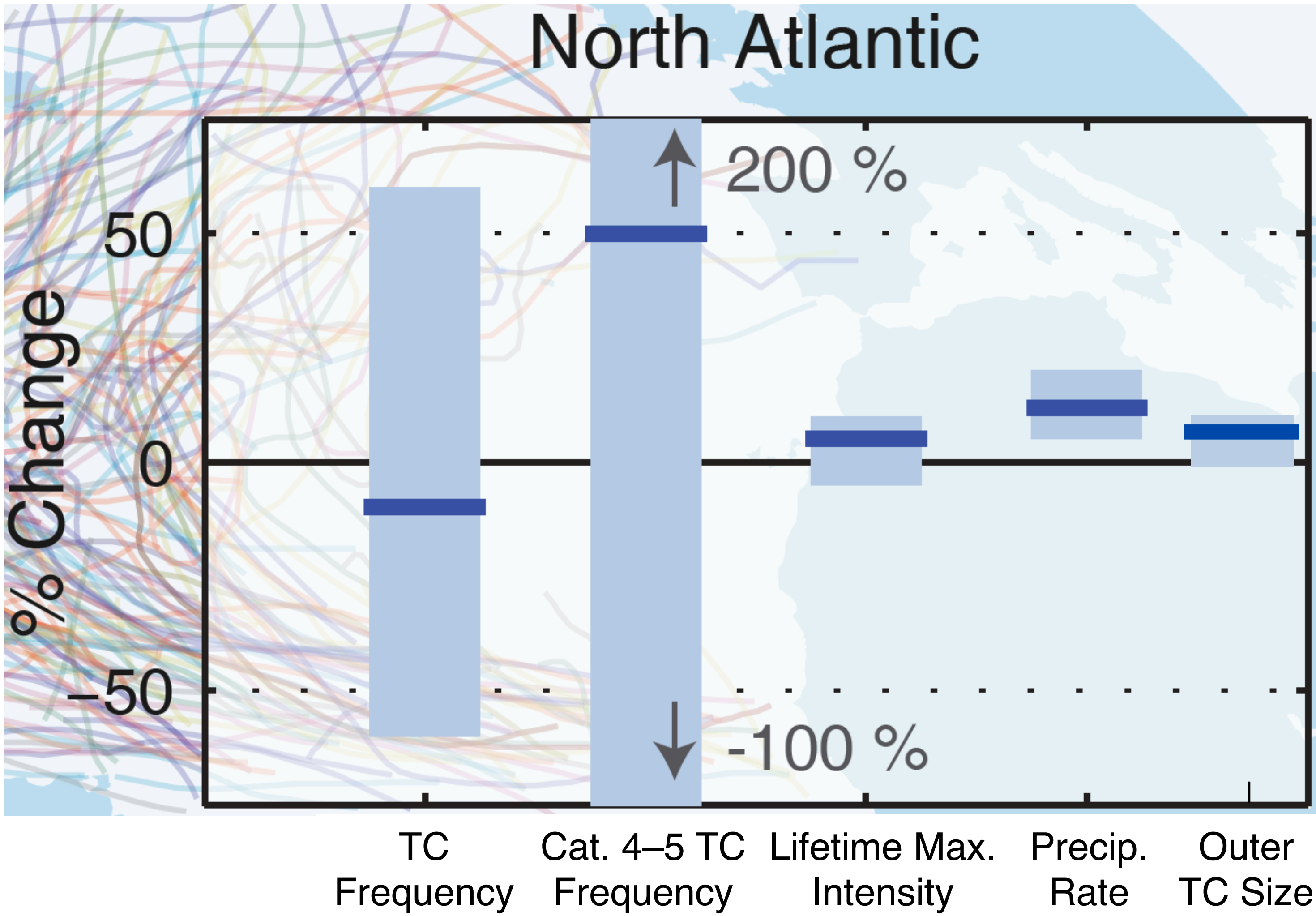

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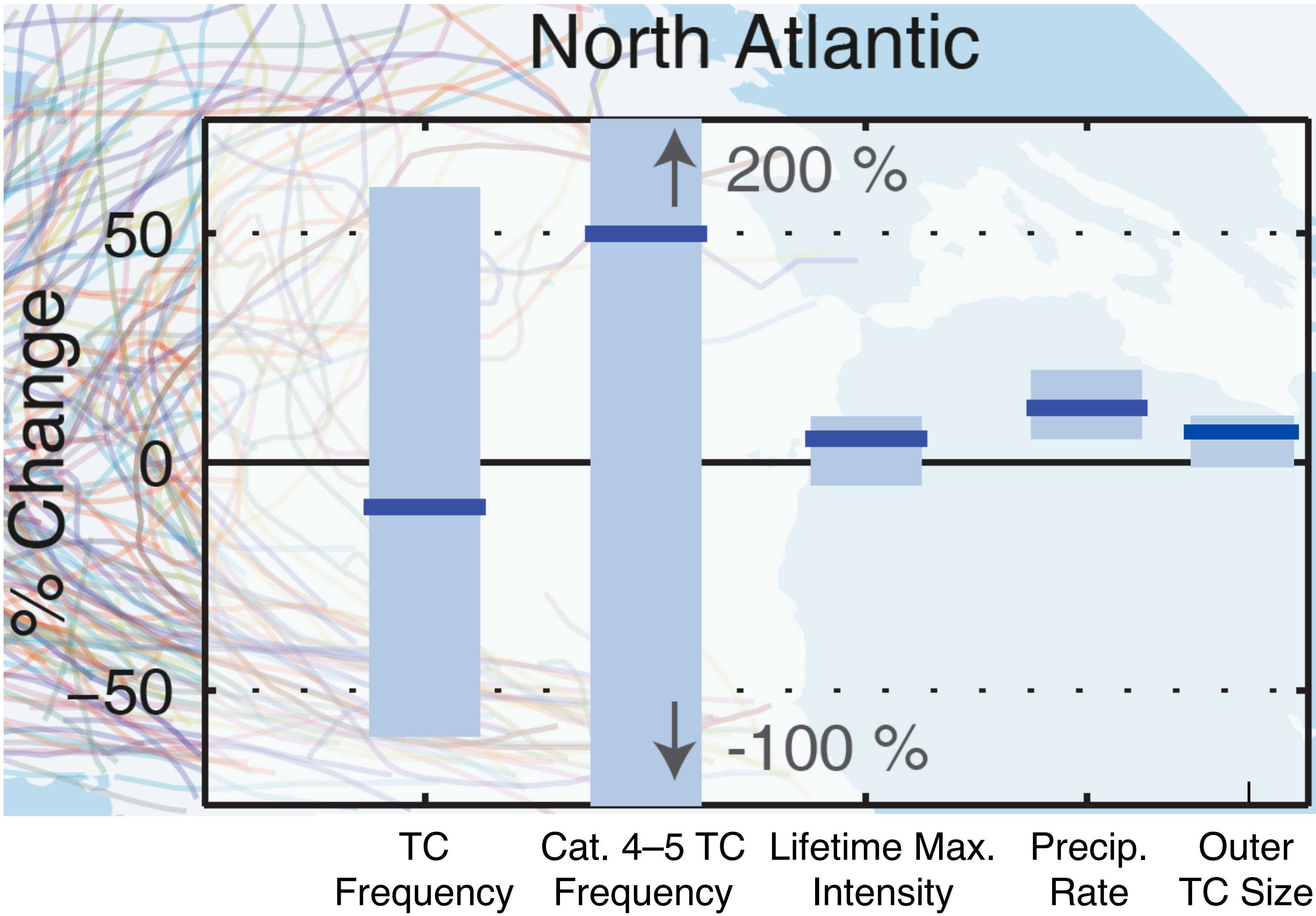

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Results suggest that changes in full r_8 distribution are primarily due to r_8 changes in later part of TC lifecycle