Climate Drivers of Equilibrium Line Altitude Changes at Four Low-Latitude Andean Glaciers:

Different Drivers, But Likely Continued Retreat In a Warming World

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Douglas MacAyeal

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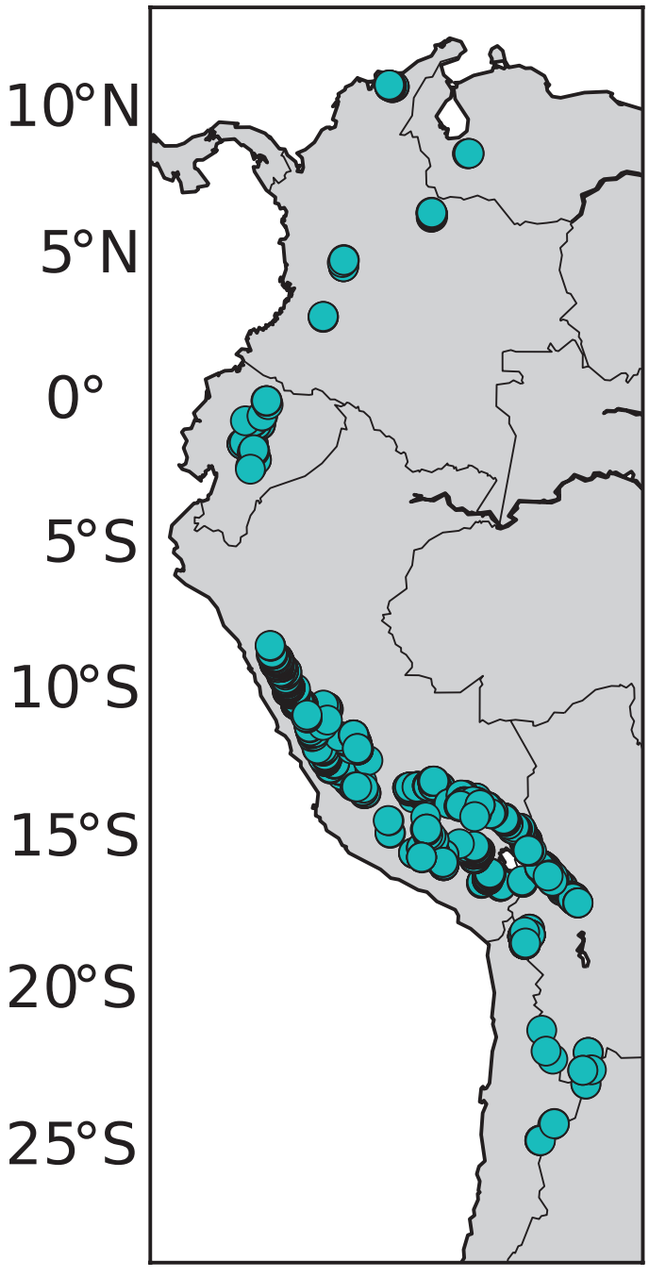
South America Is Ideal For Tropical Glacier Study



2,893 glaciers (~98%)

2,338 km² (>99%)

(Randolph Glacier Inventory)

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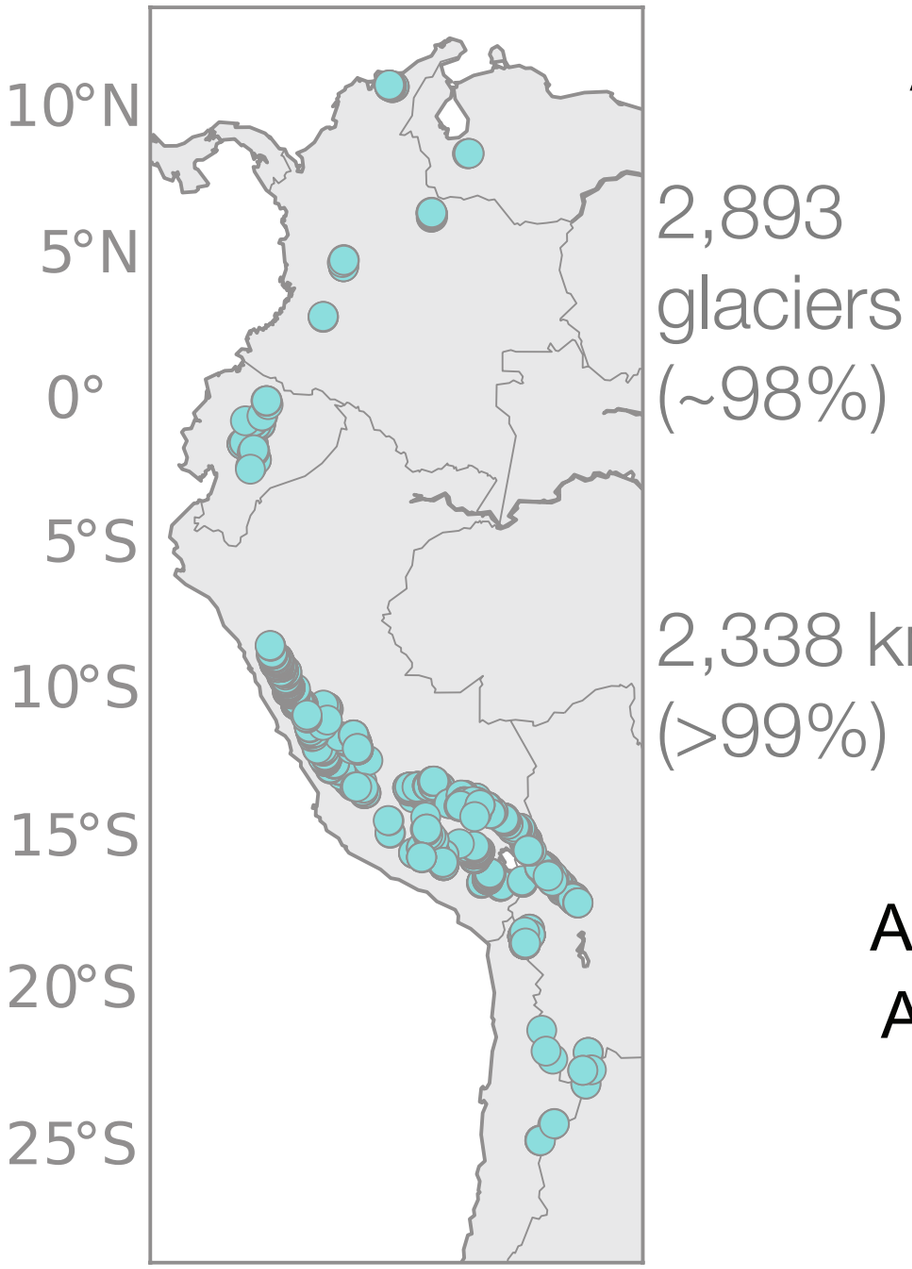

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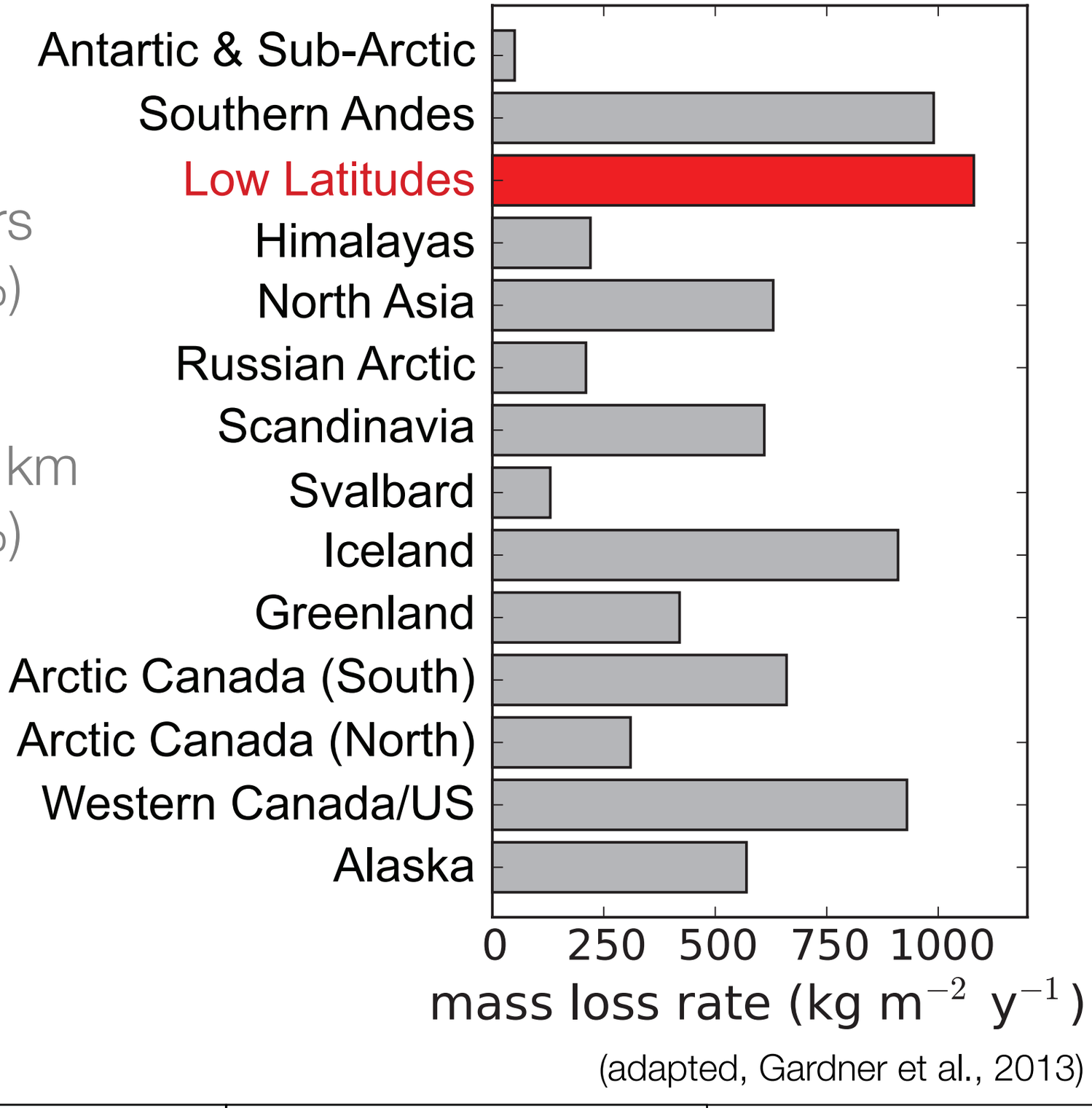

(adapted, Gardner et al., 2013)

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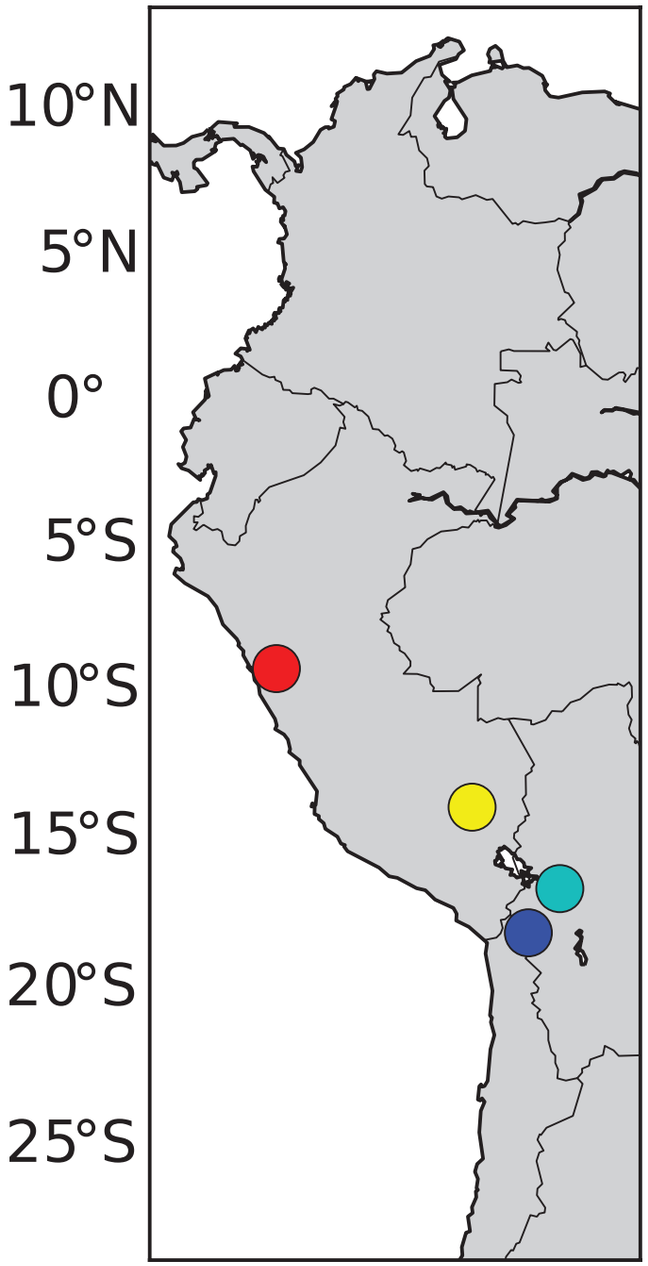

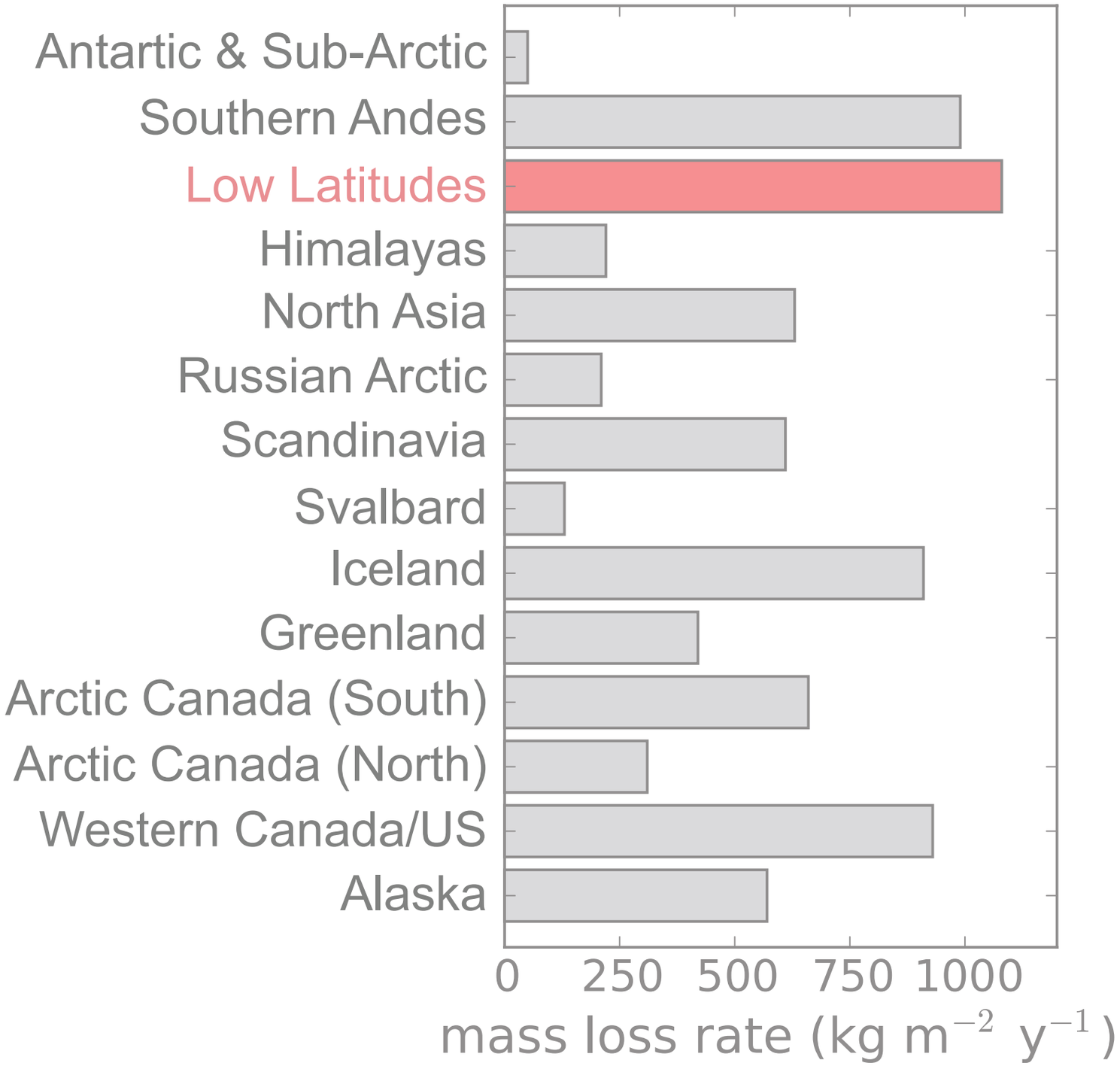

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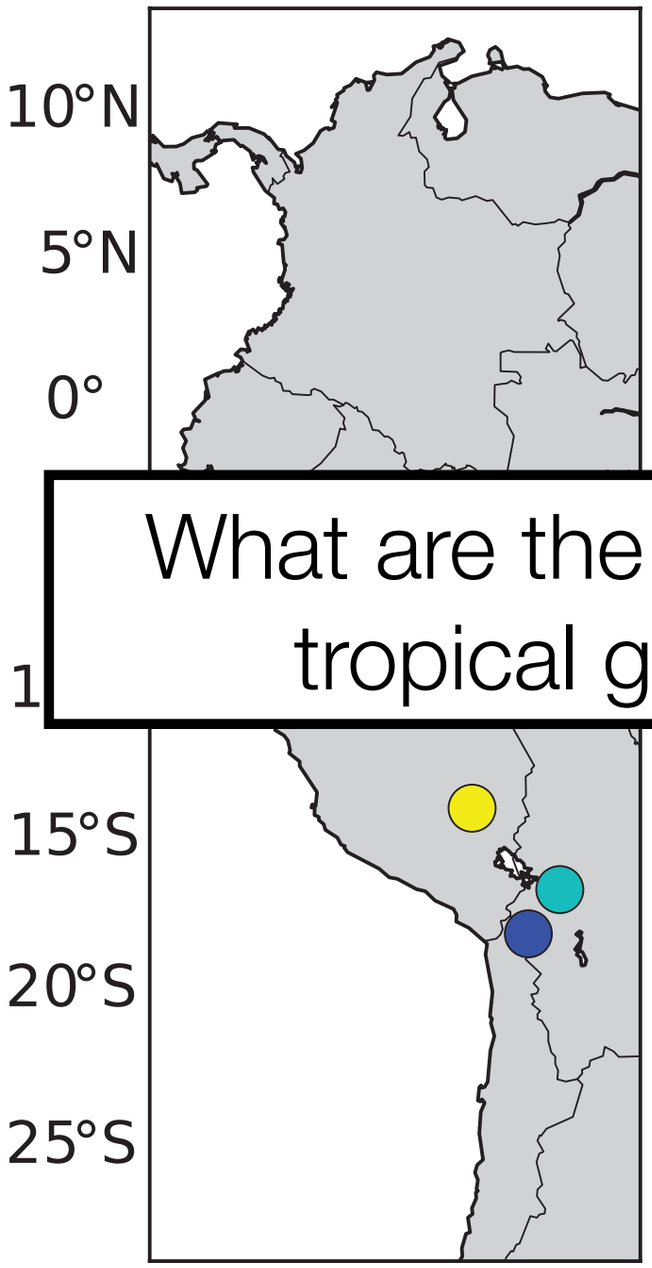
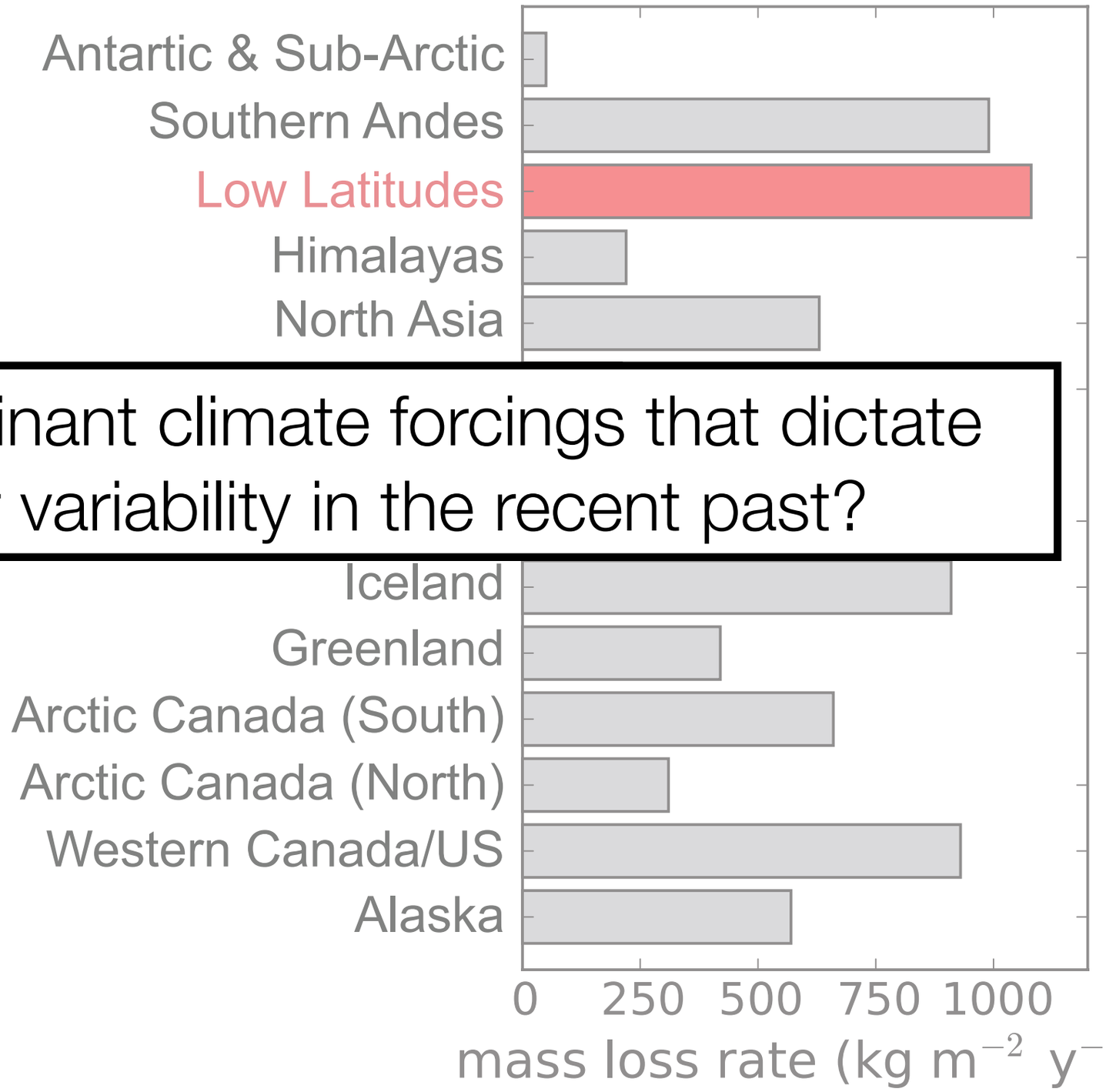
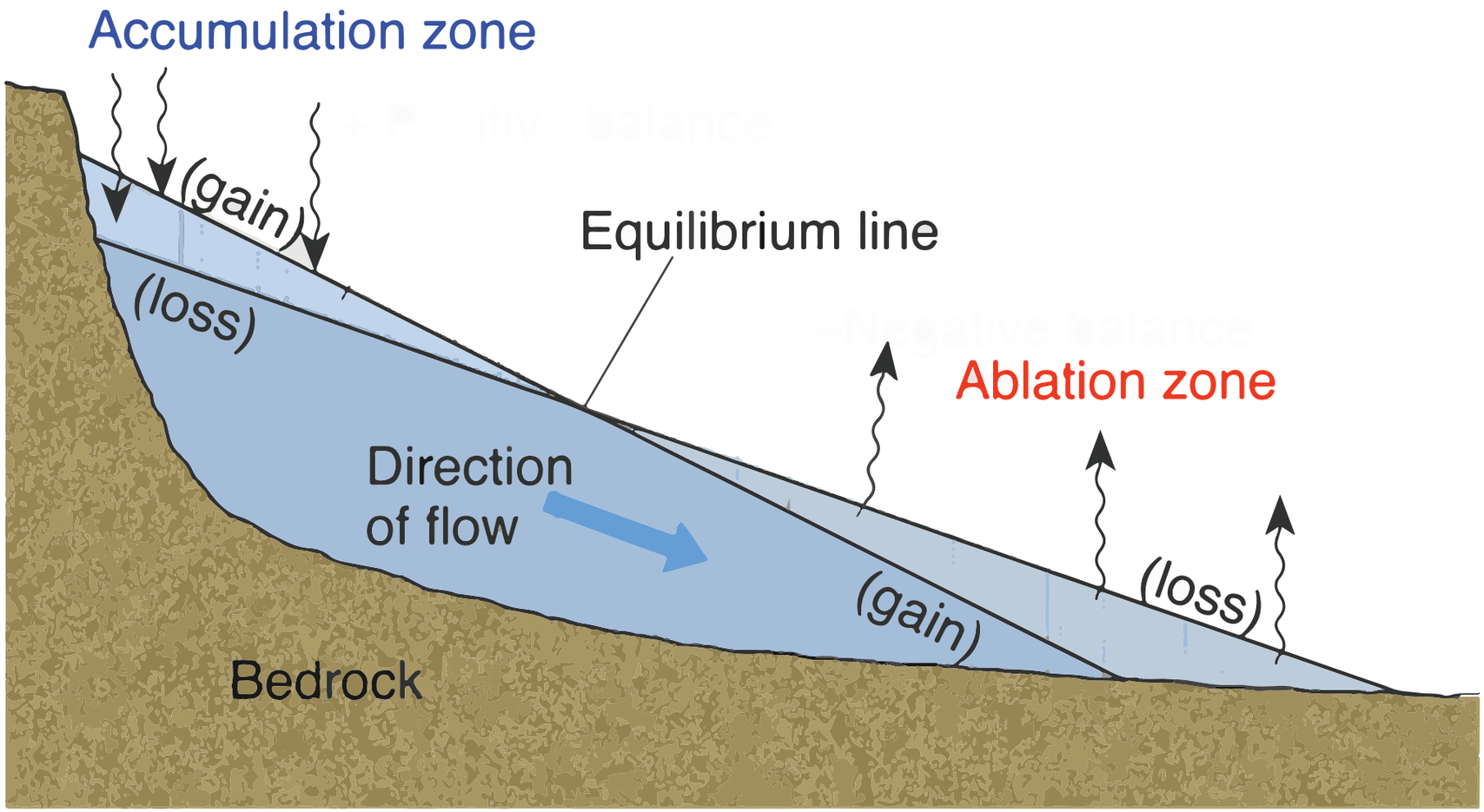




What are the dominant climate forcings that dictate tropical glacier variability in the recent past?

(adapted, Gardner et al., 2013)

Equilibrium Line Altitude As a Metric of Glacier Change



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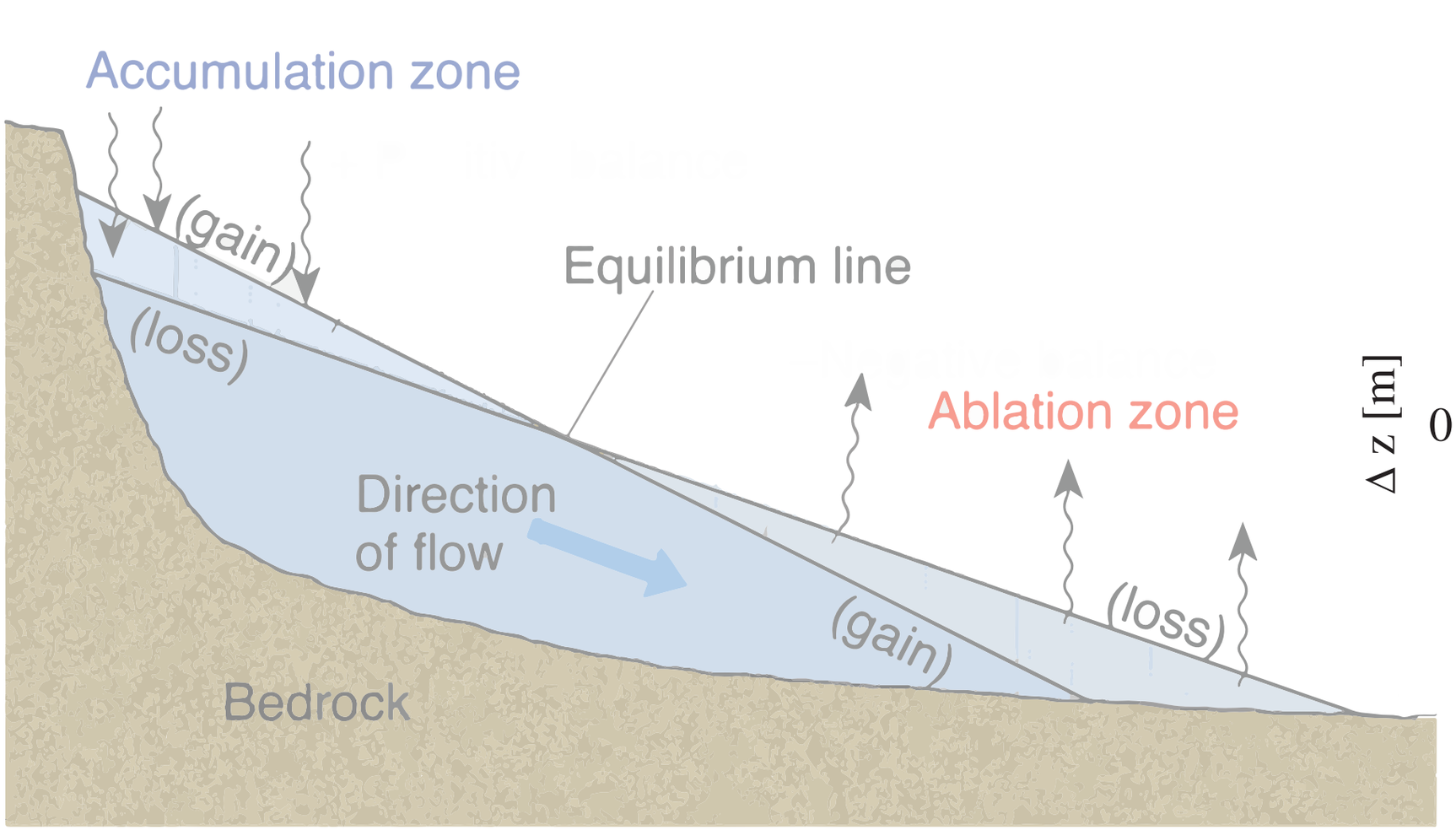

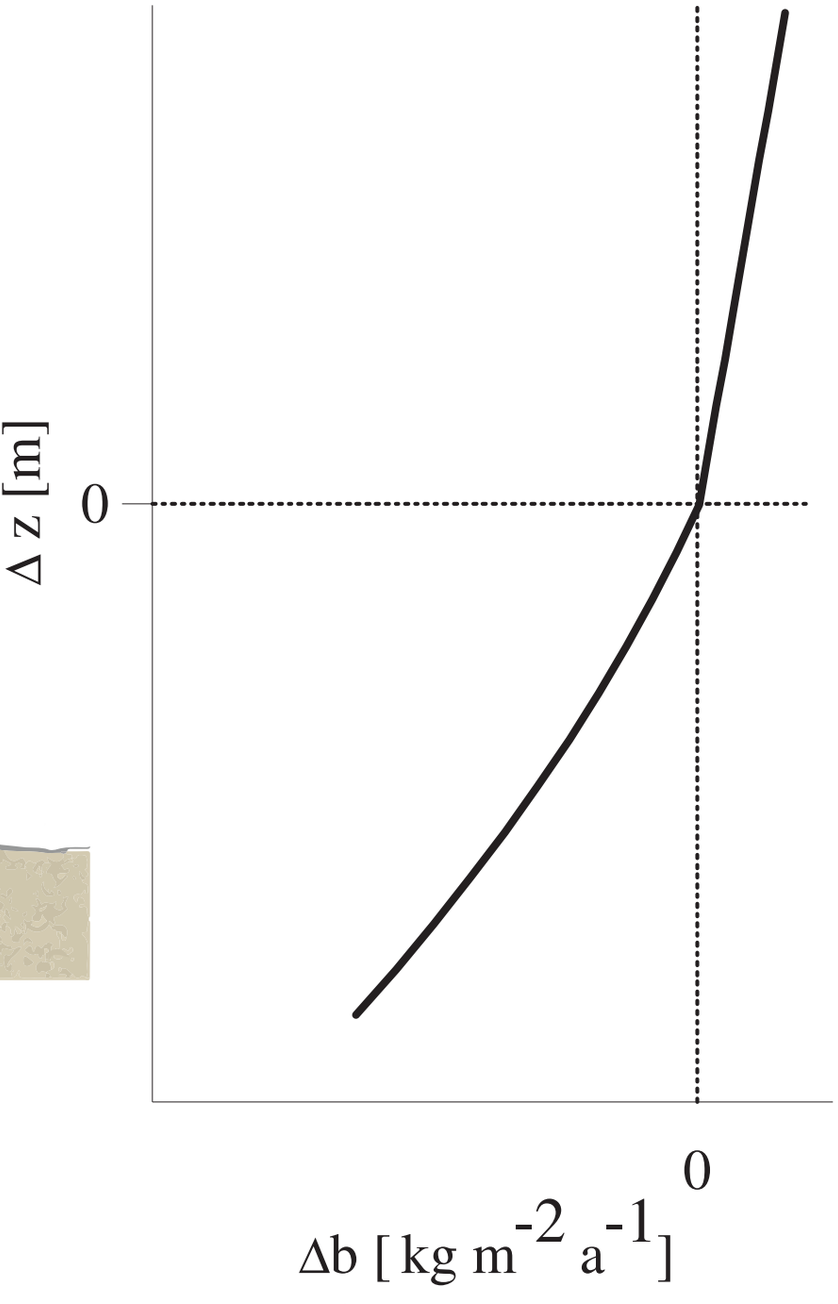

(modified, Kaser, 2001)

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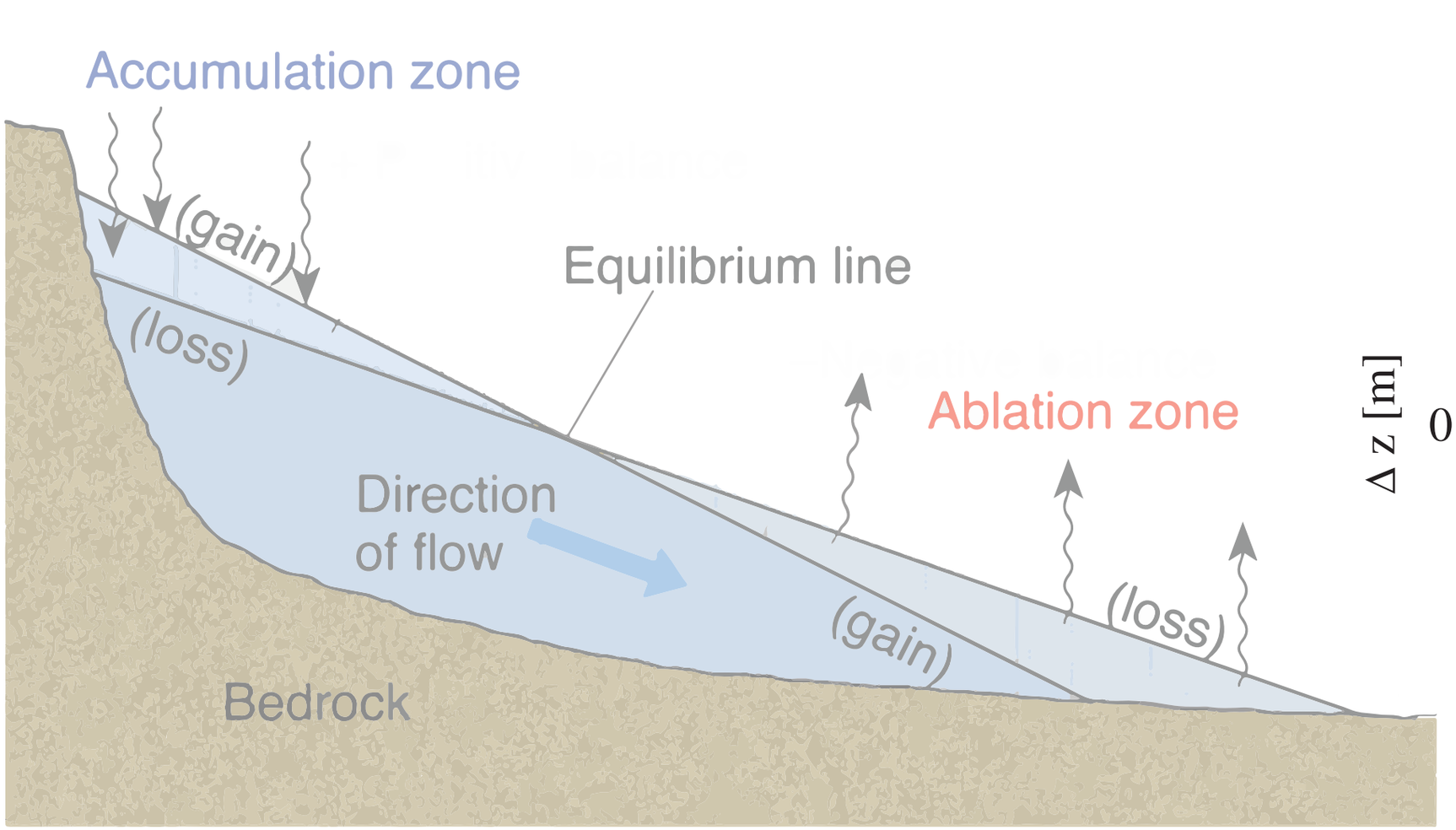

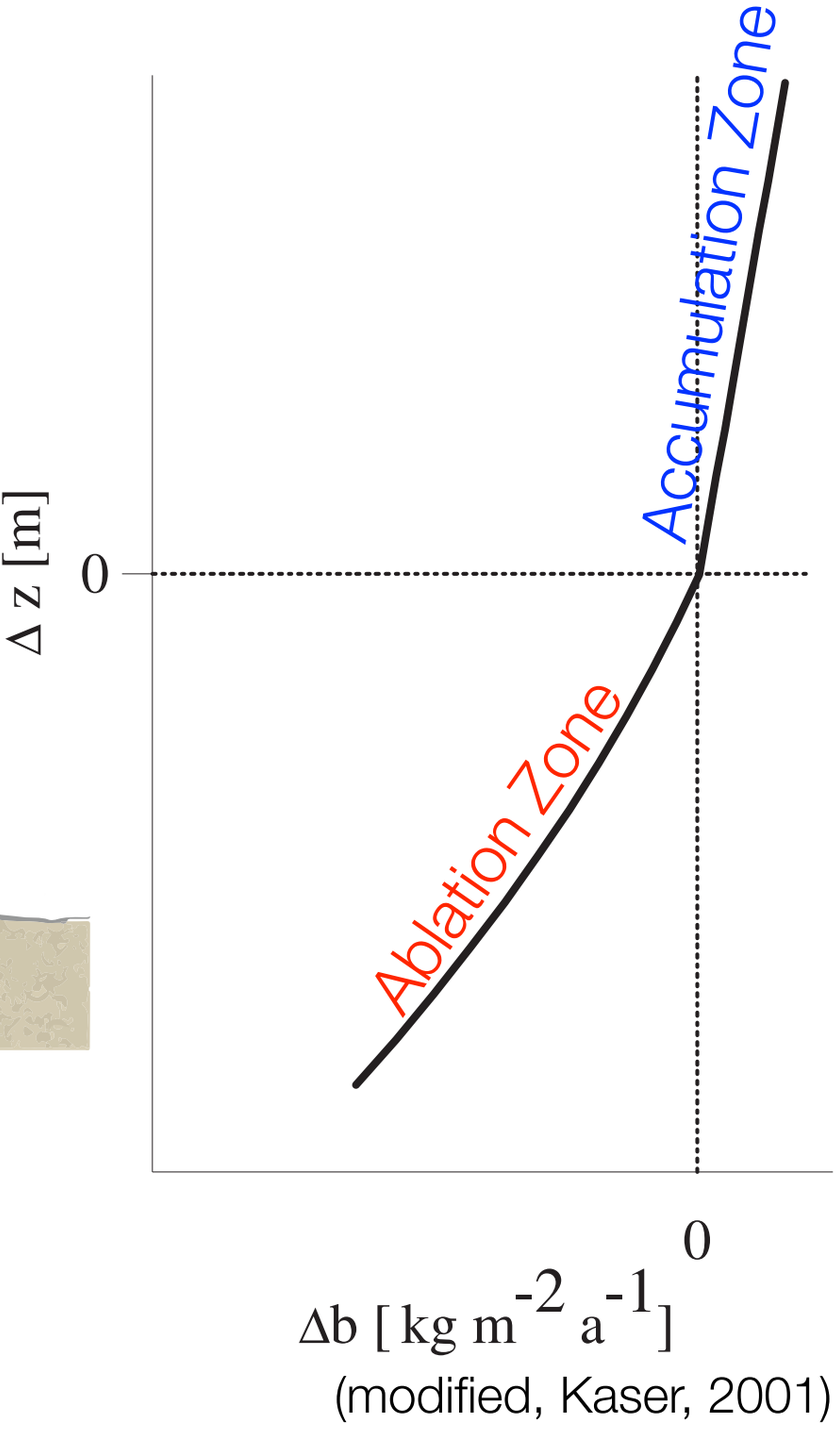

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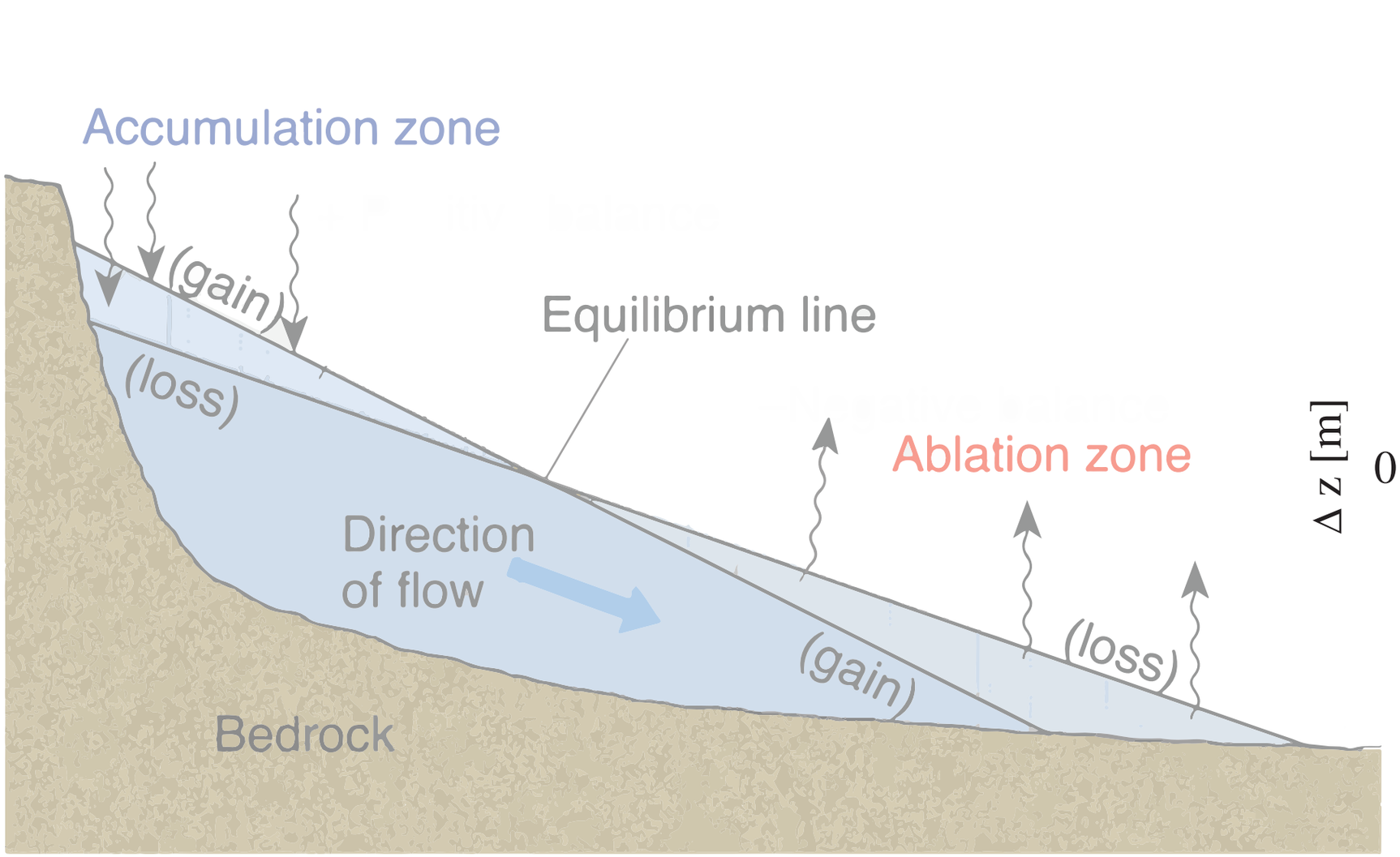

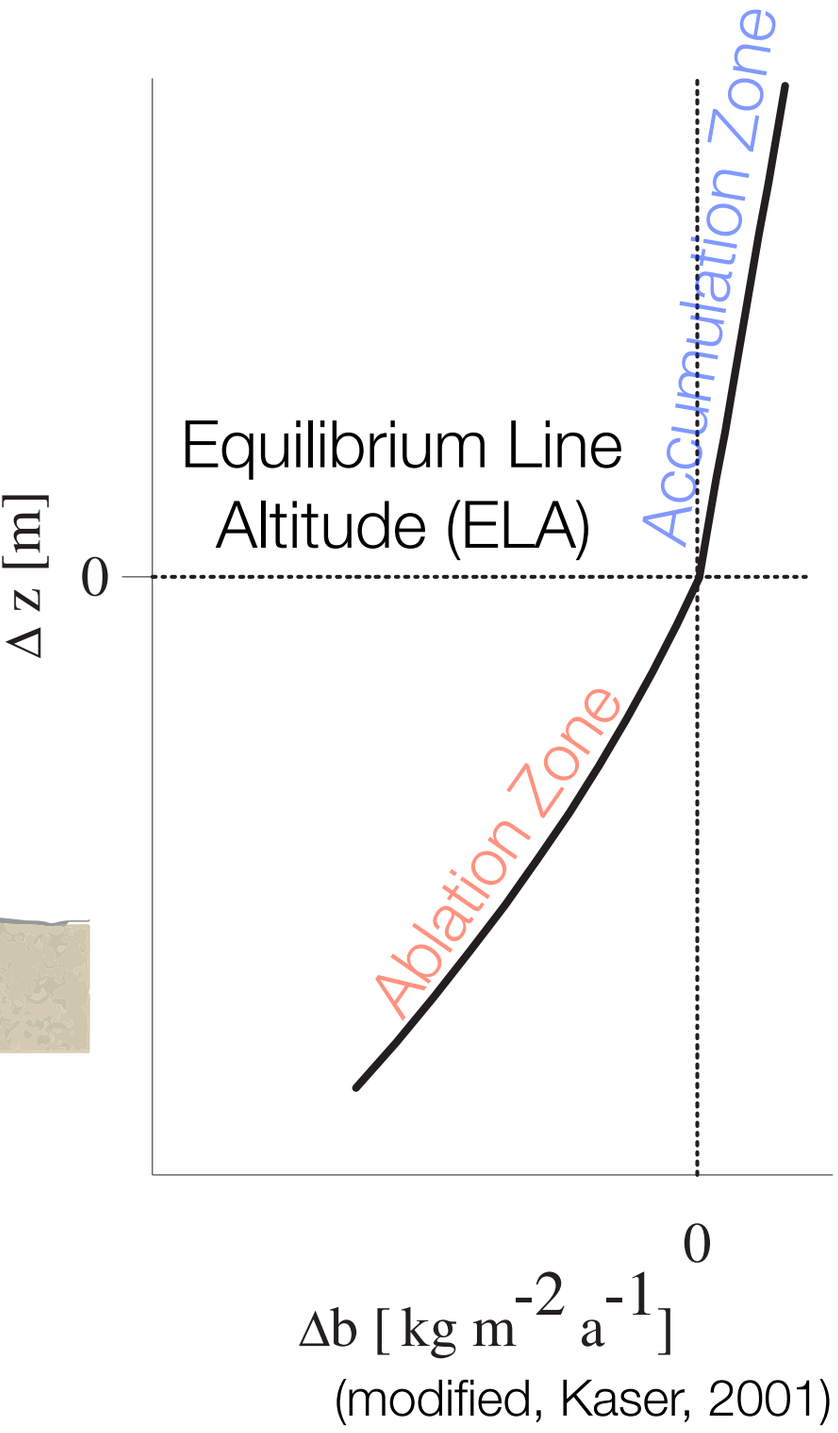

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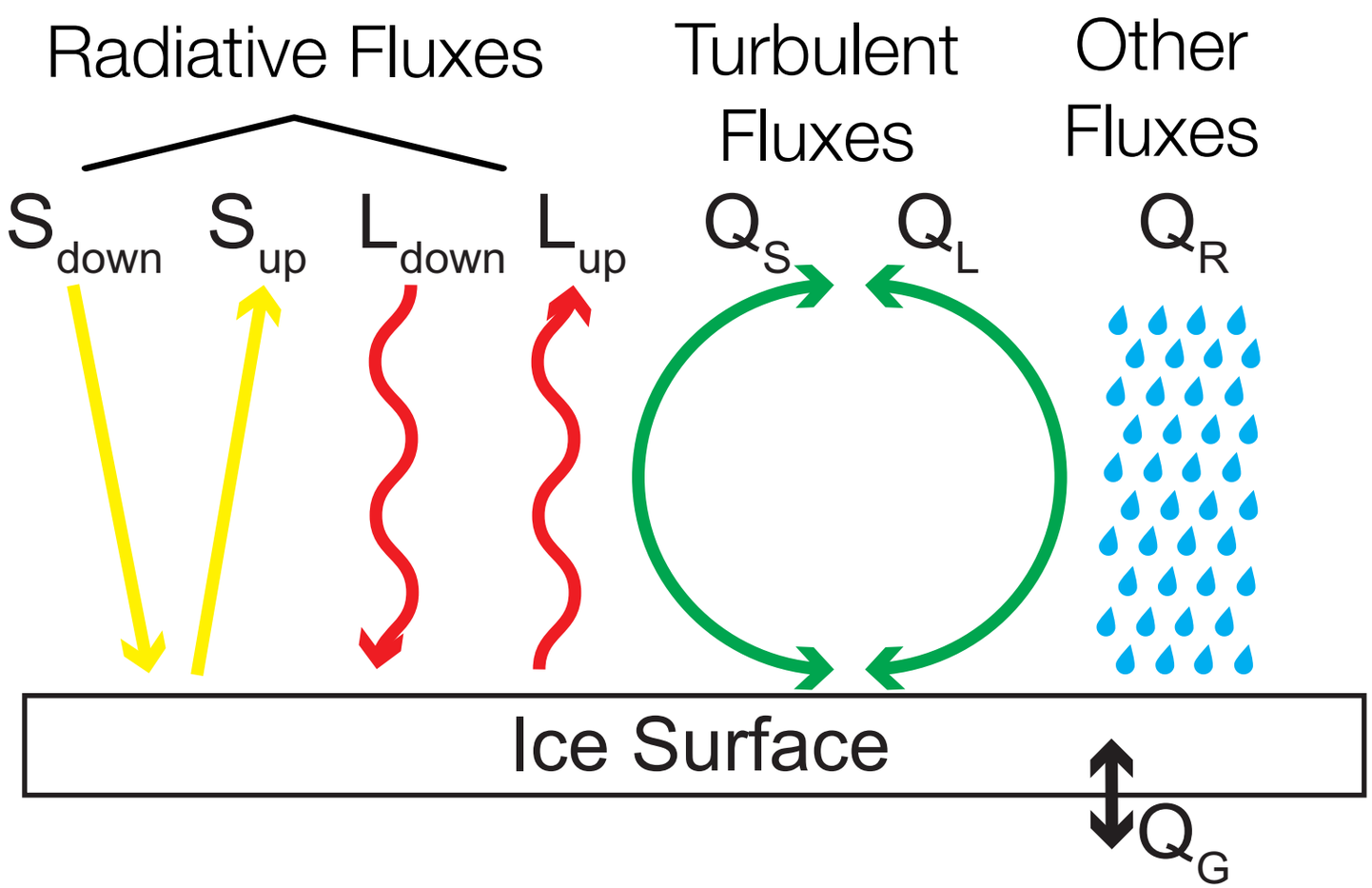
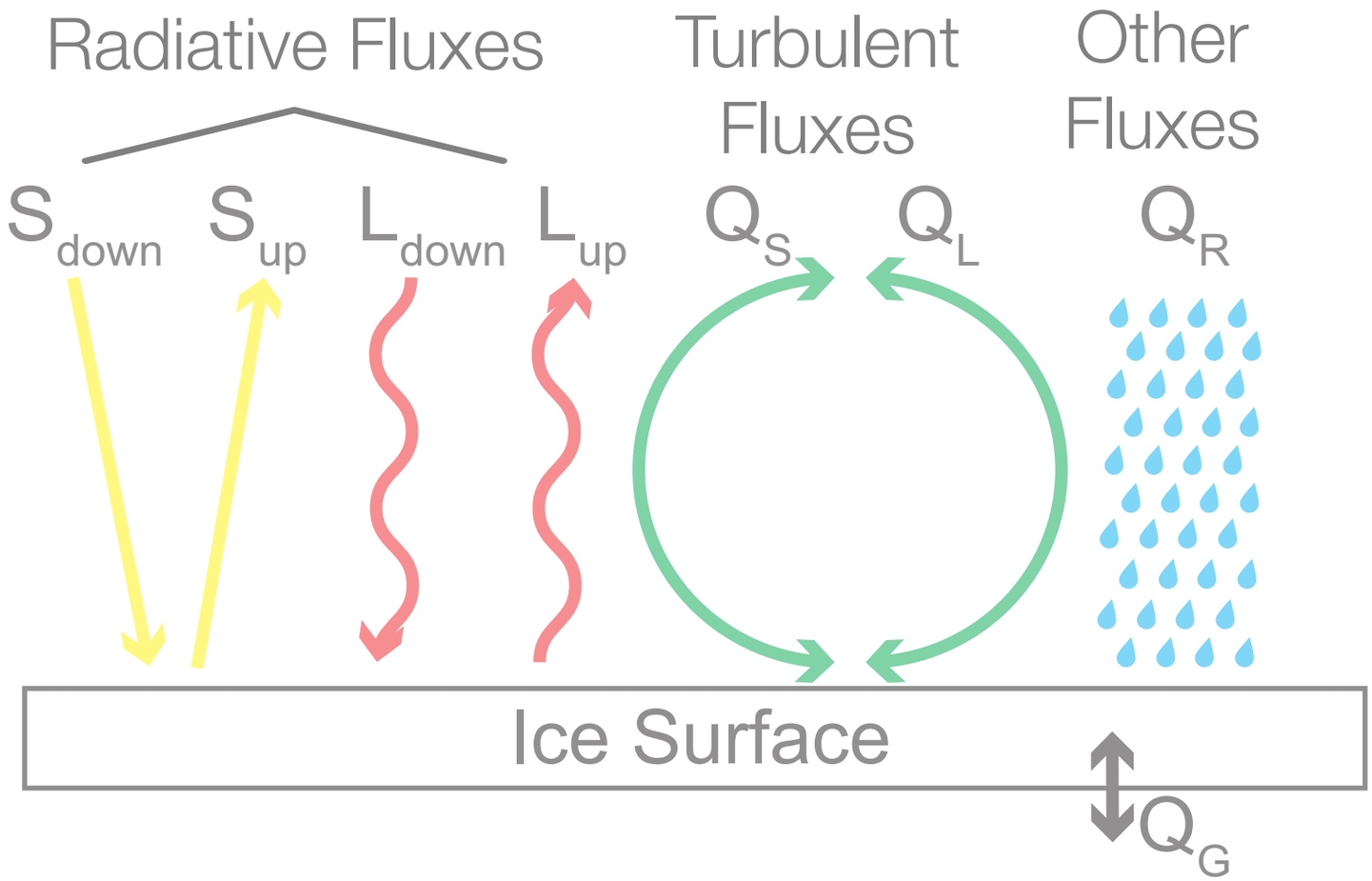
Quantify Glacier Change Using an Energy Balance Model



Quantify Glacier Change Using an Energy Balance Model

Inputs

Climate Signal



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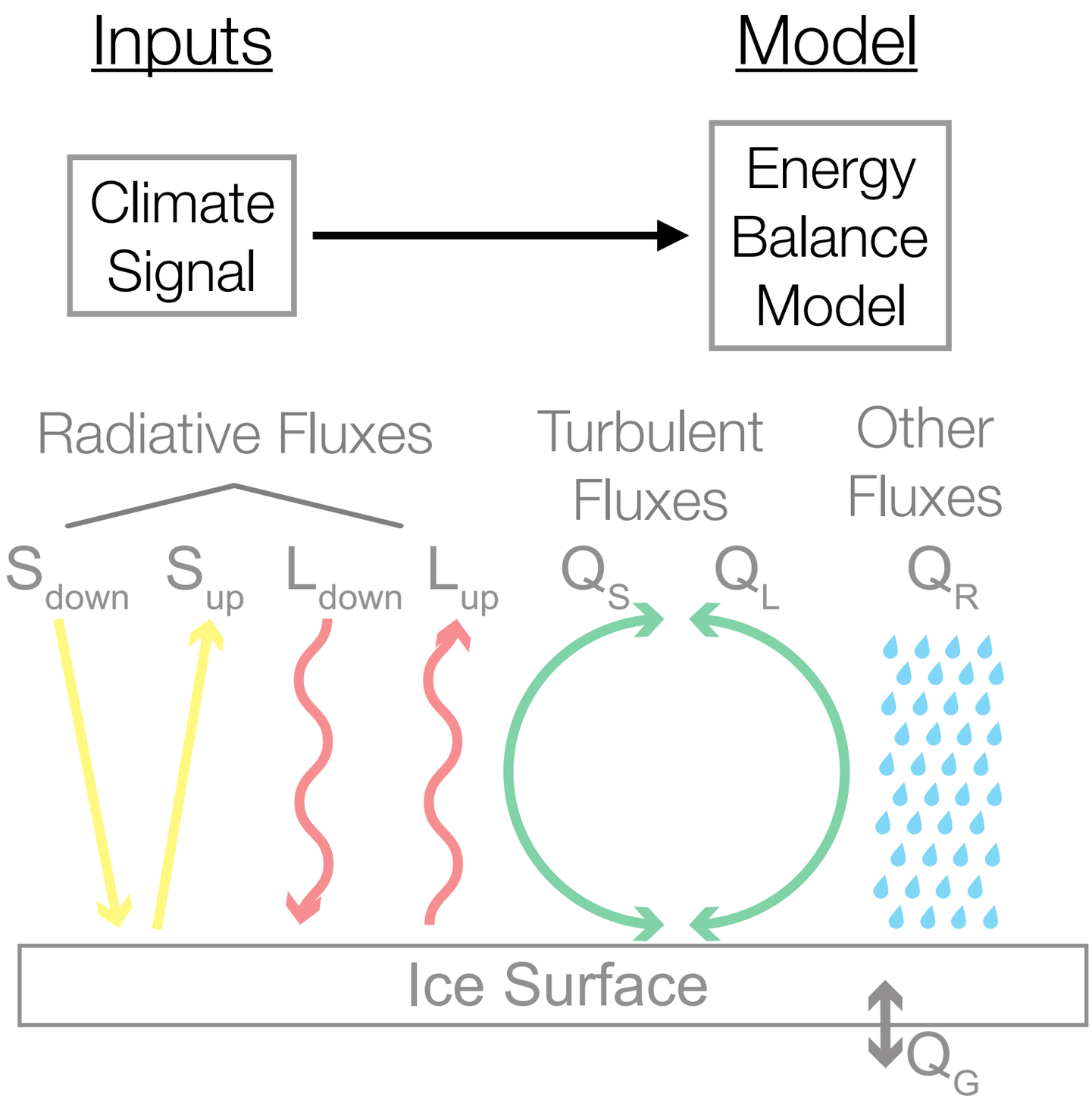

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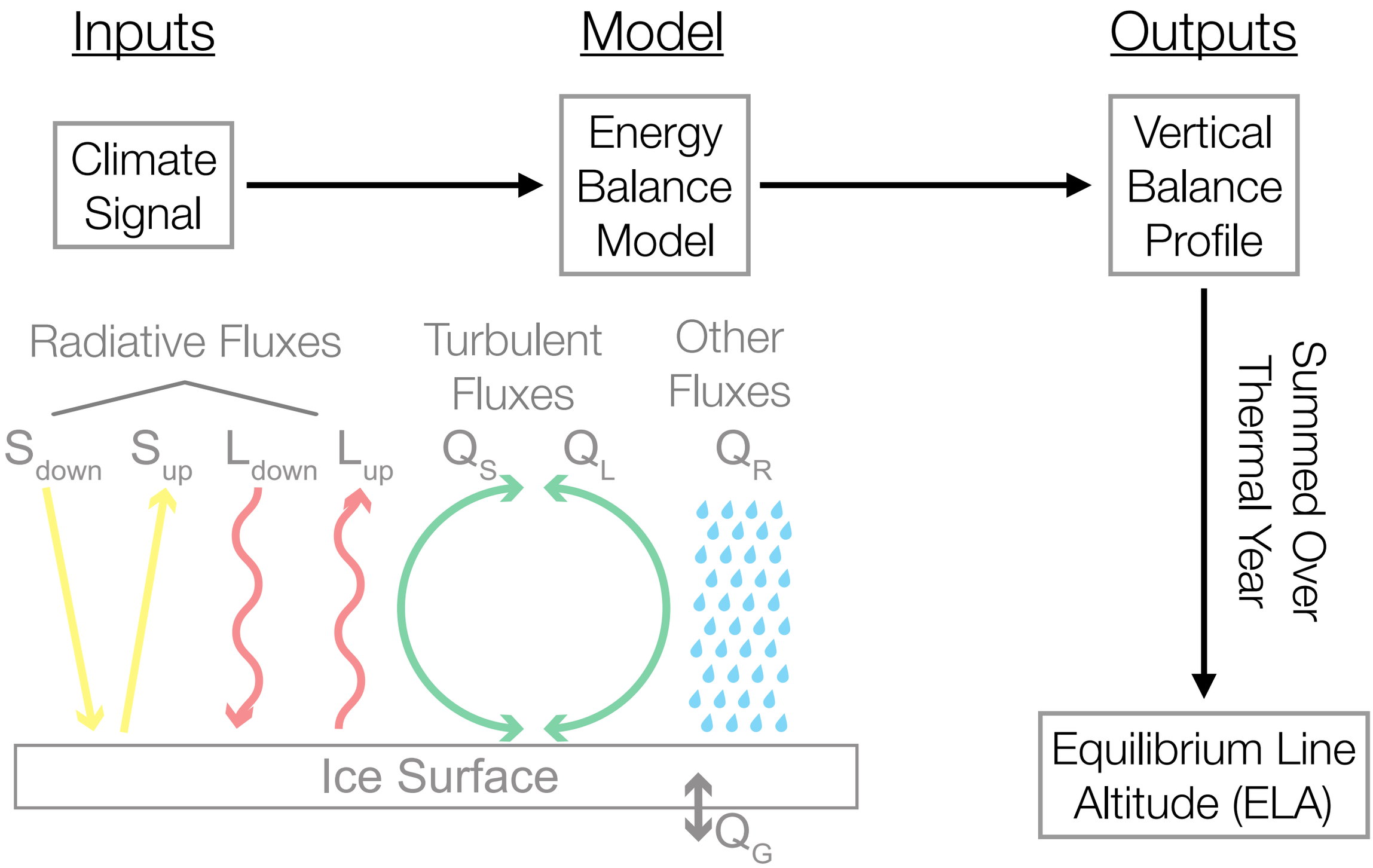
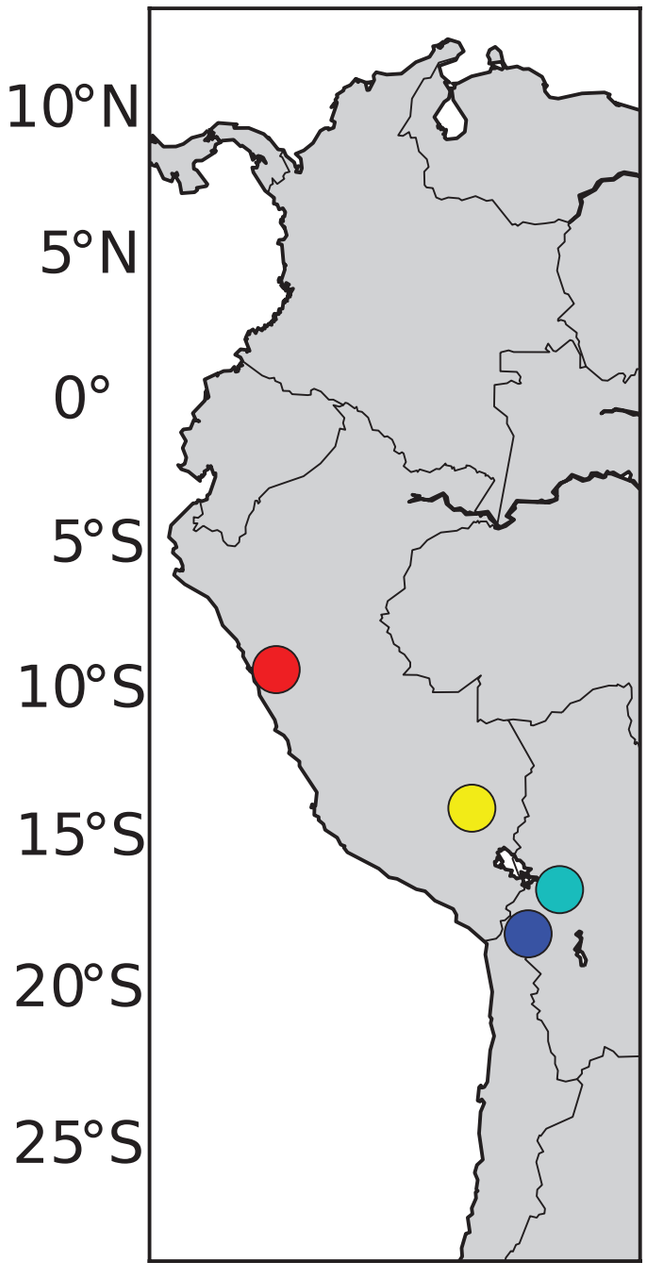


Long-term ELA Tracks Climate Setting of Glacier



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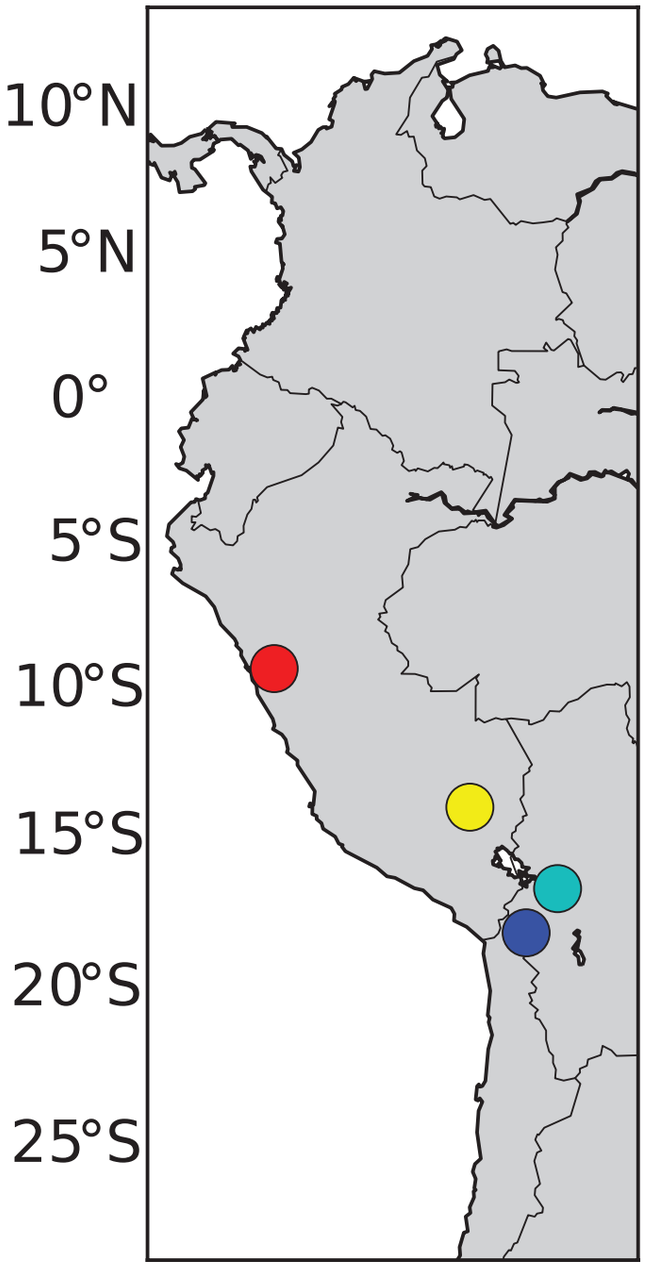

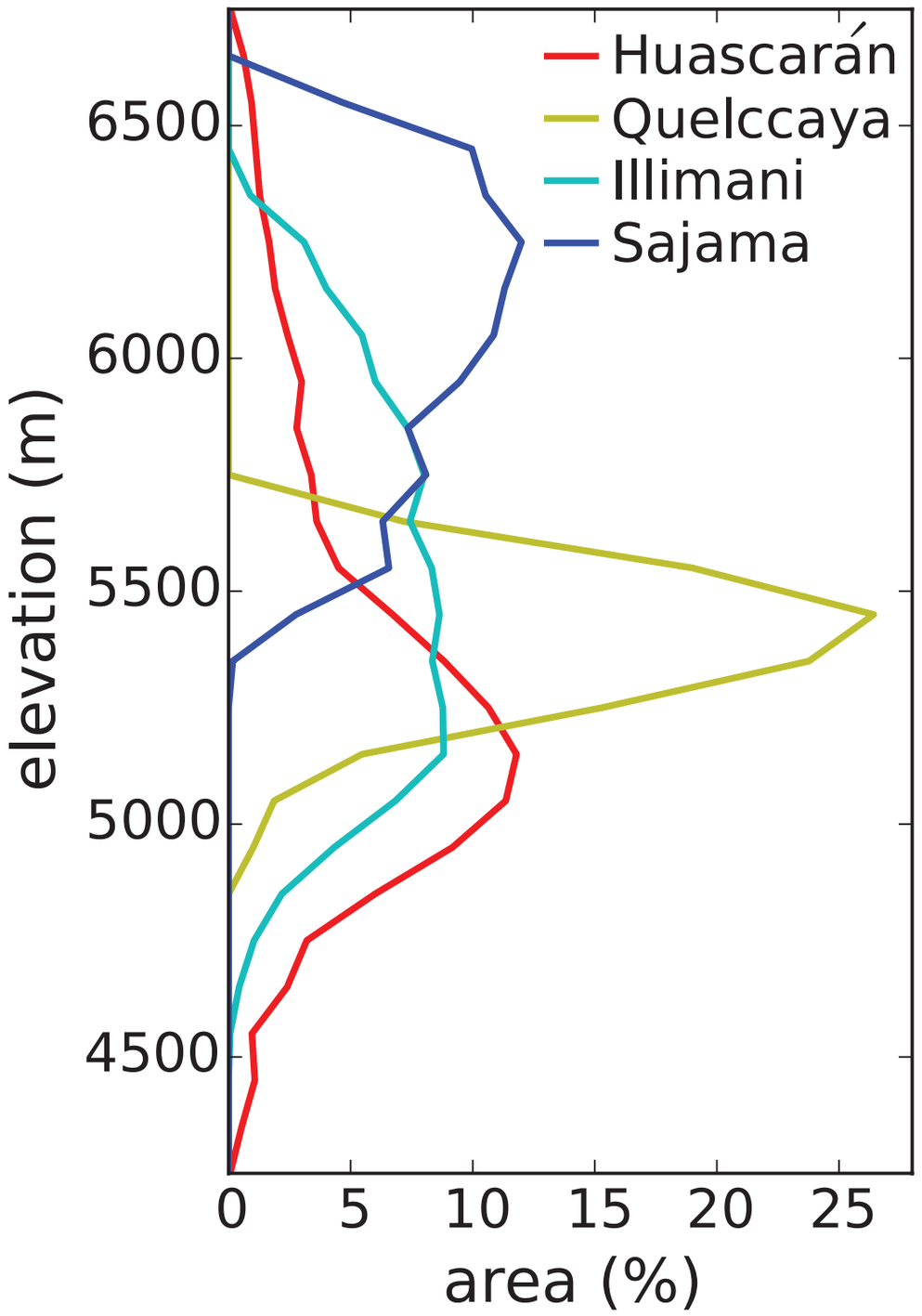

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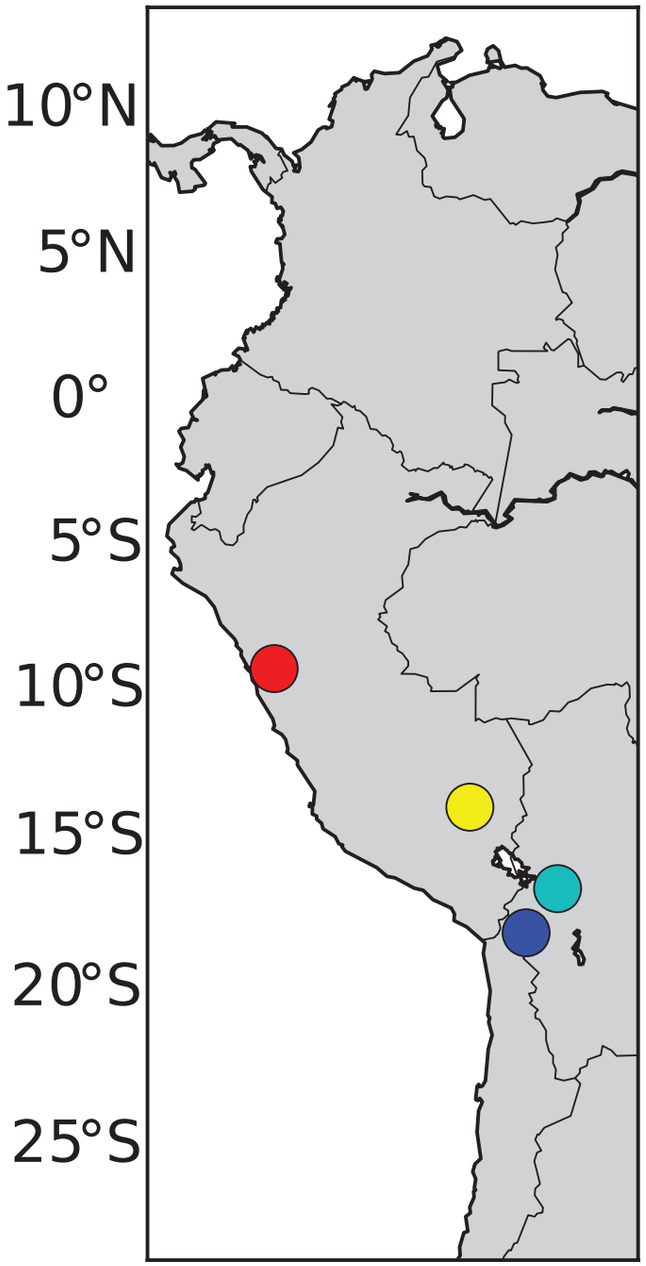

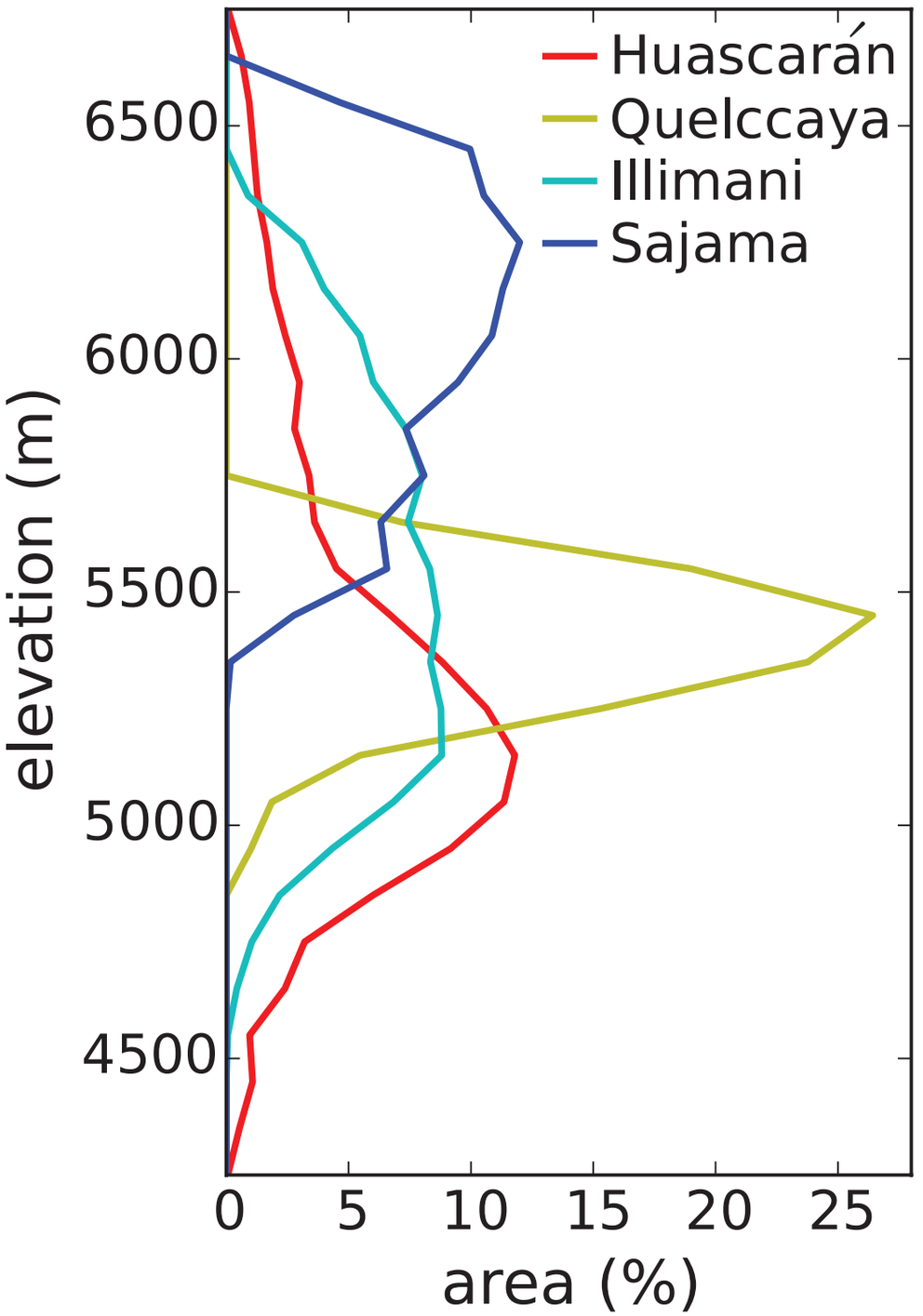

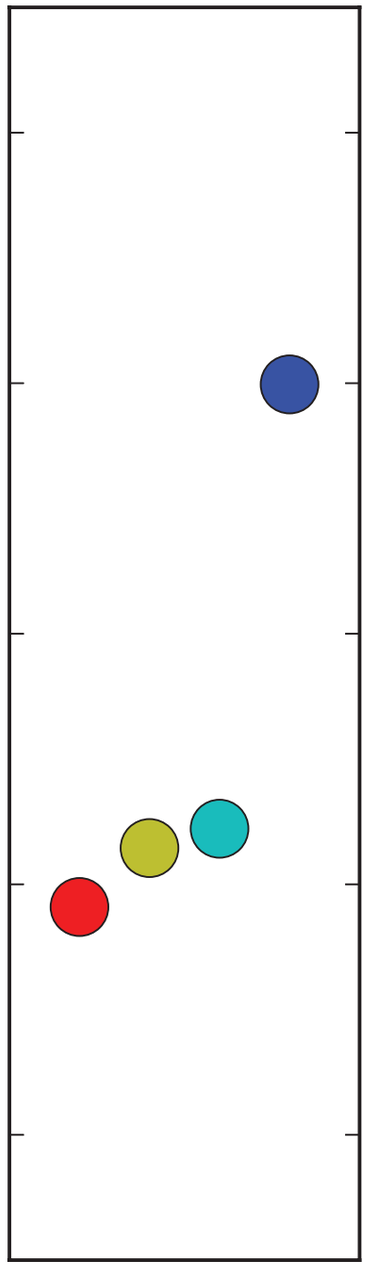

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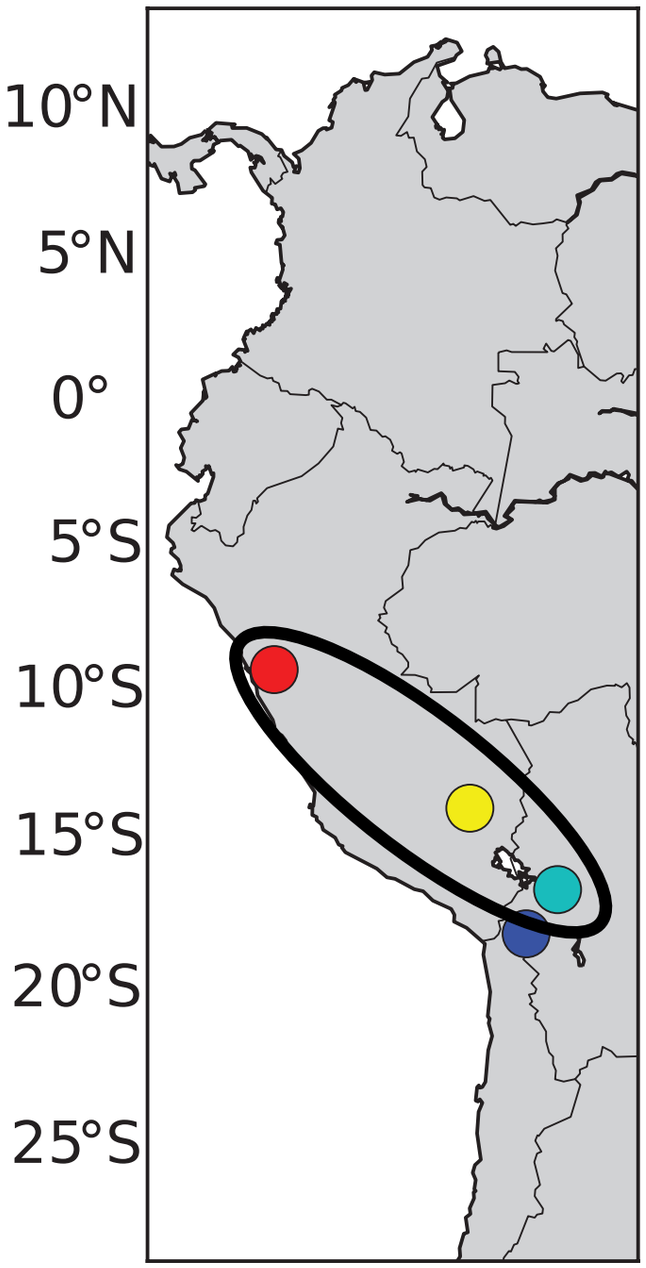
Wet Tropical Glacier ELAs Track Freezing Level Heights



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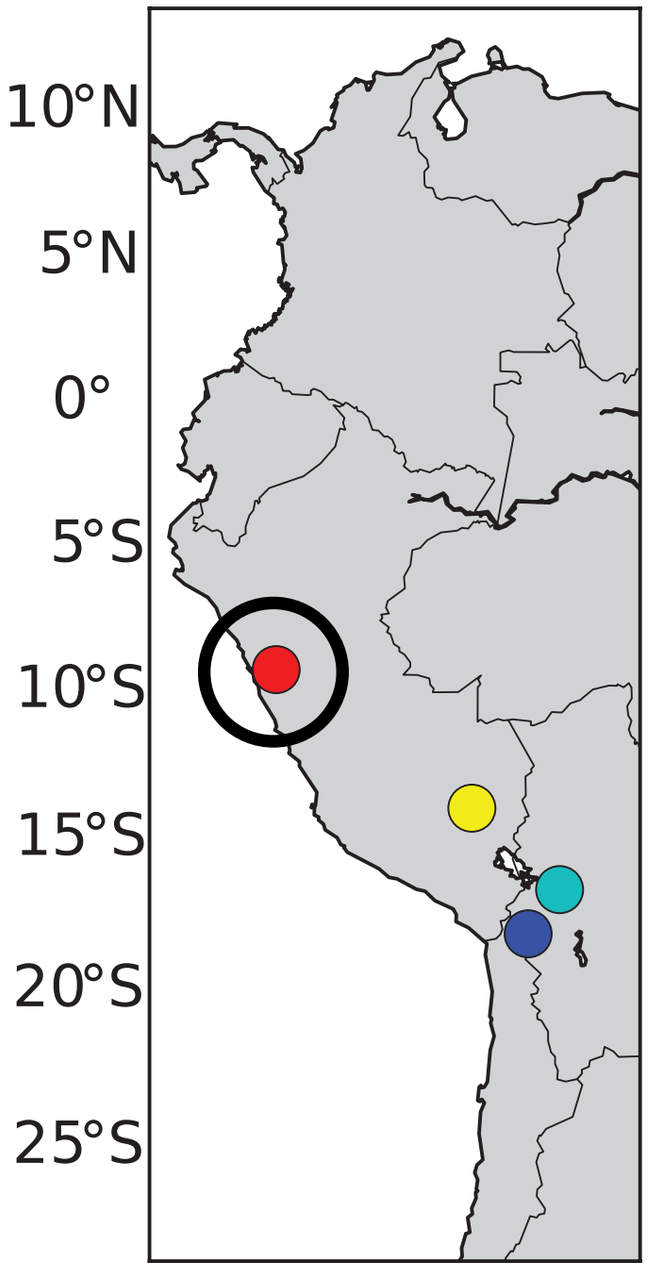

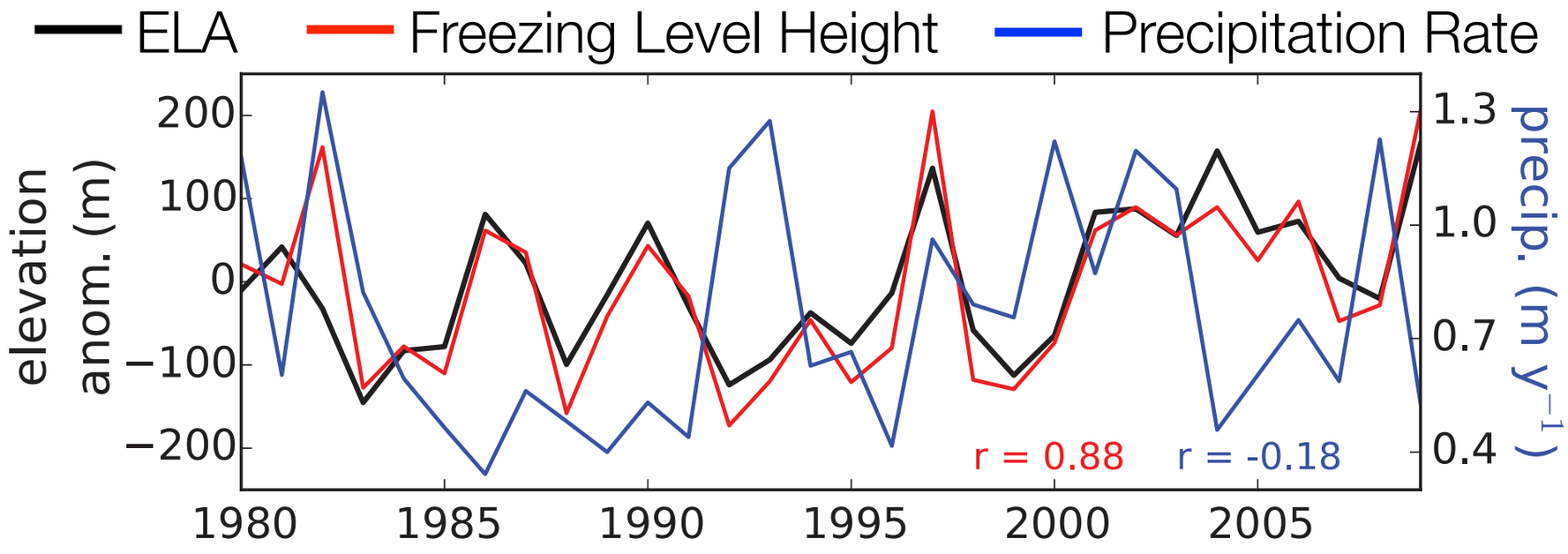

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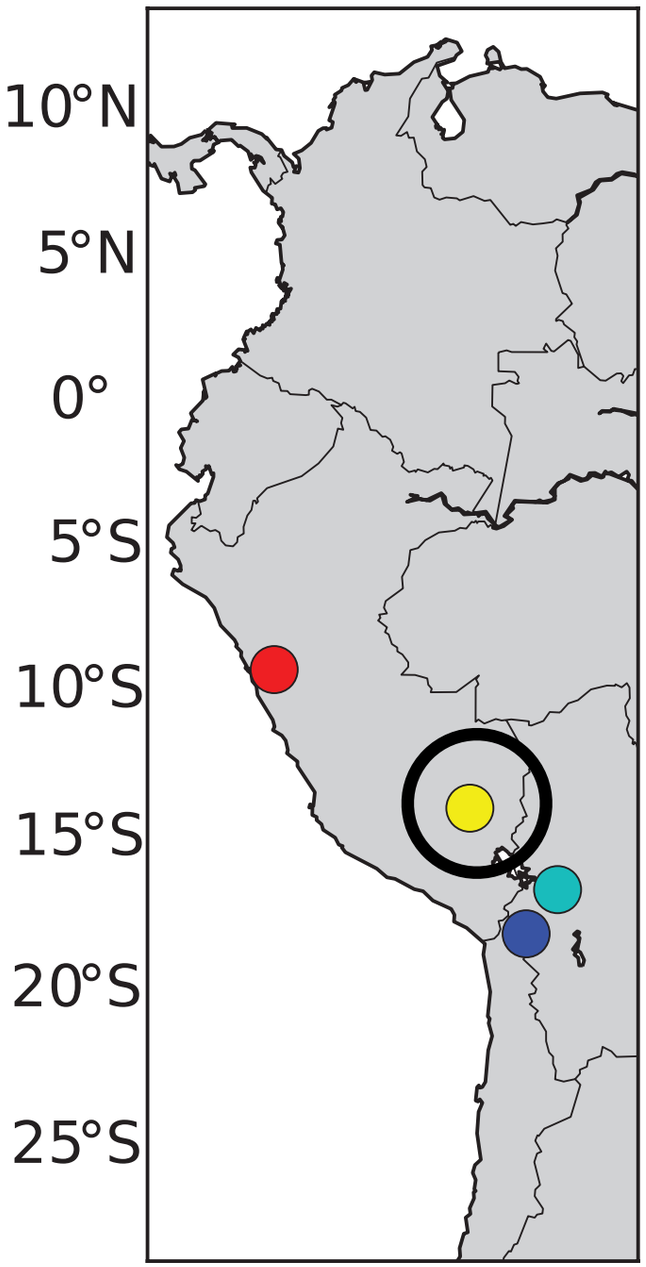

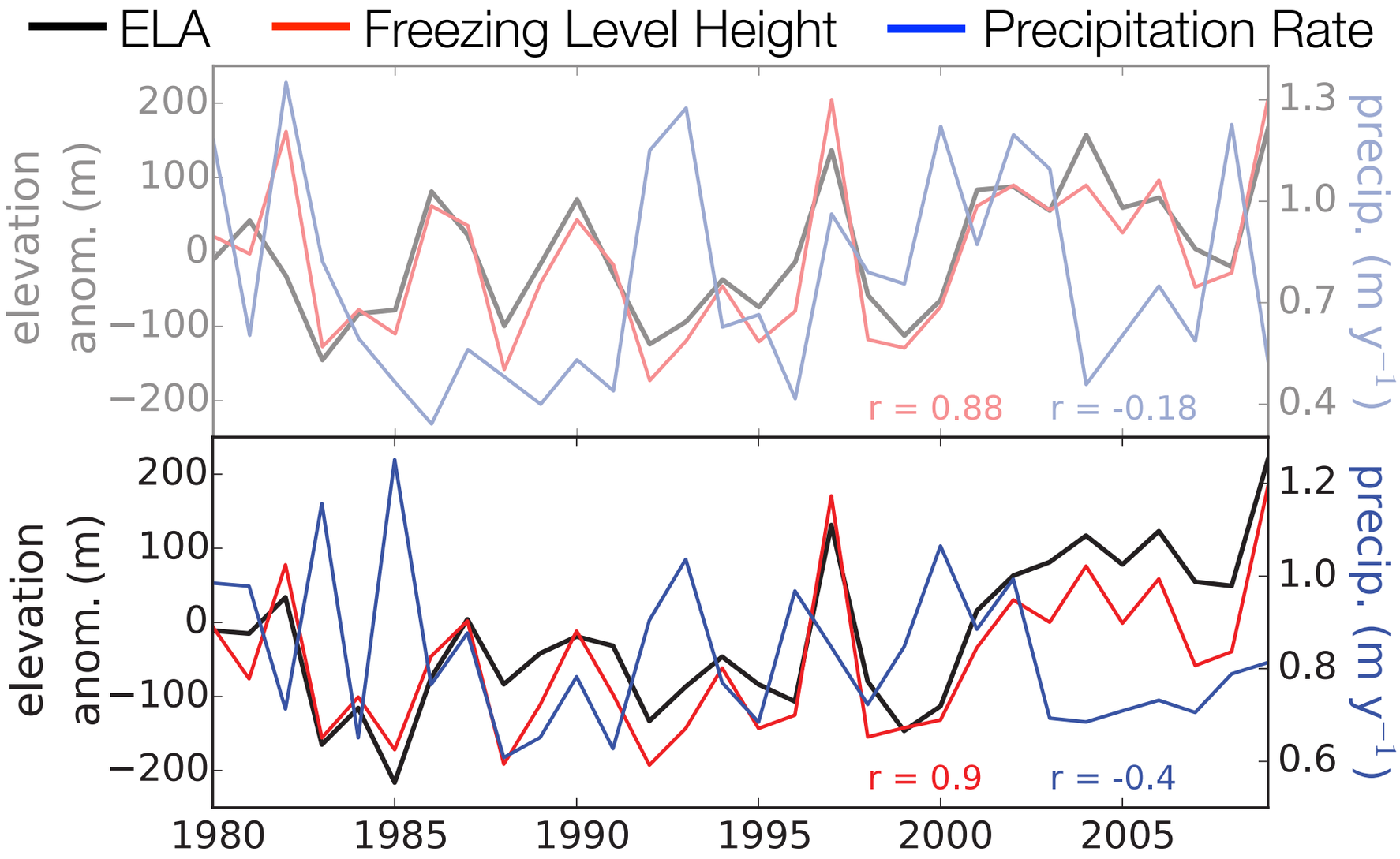

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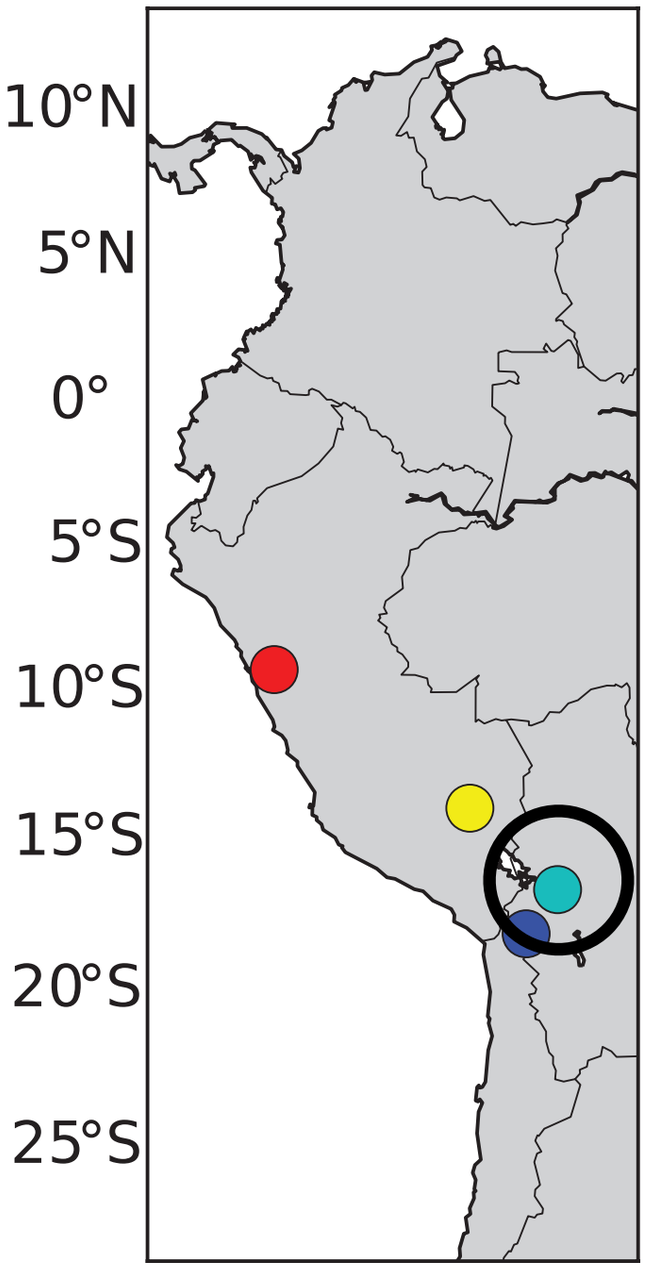

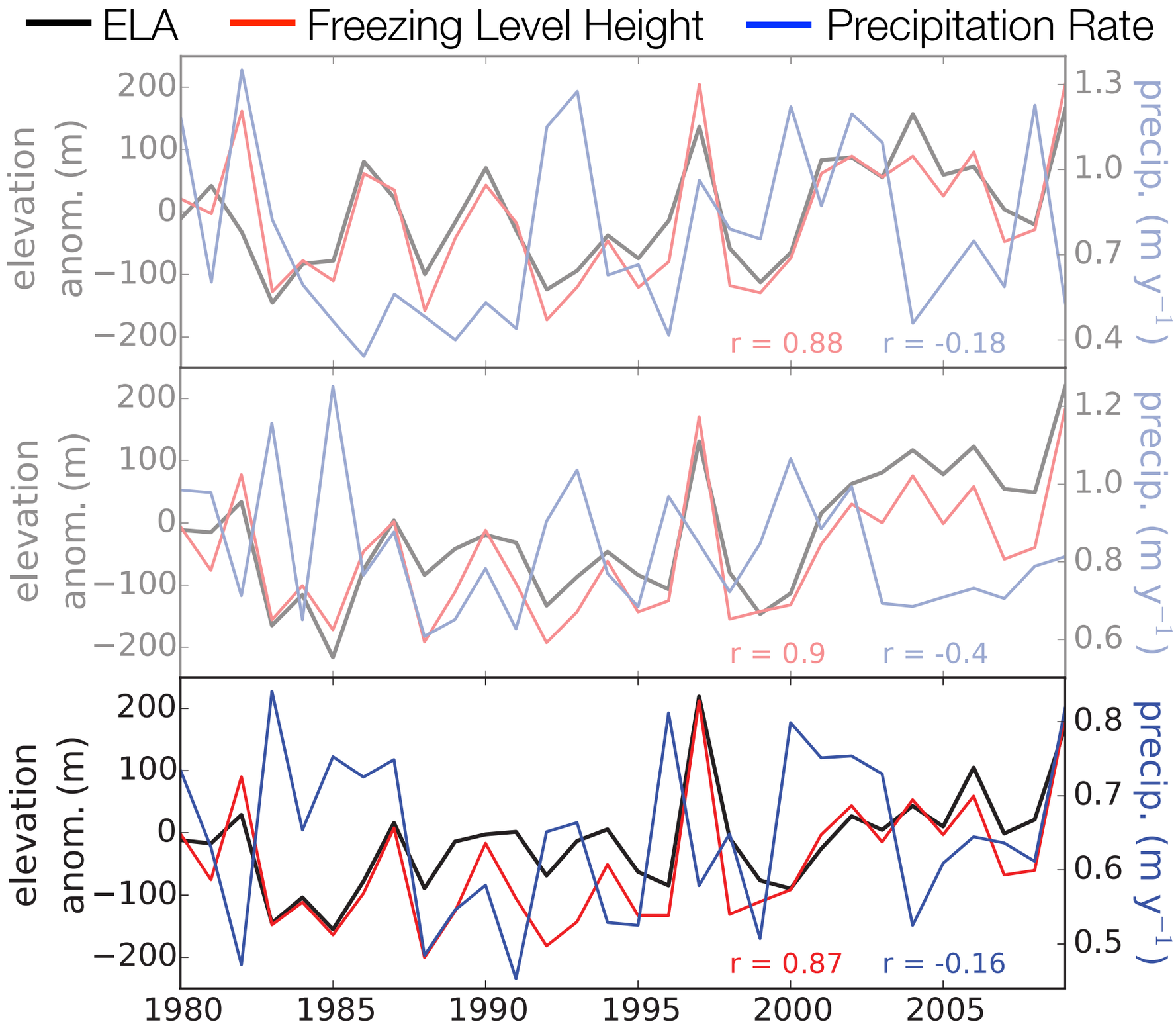

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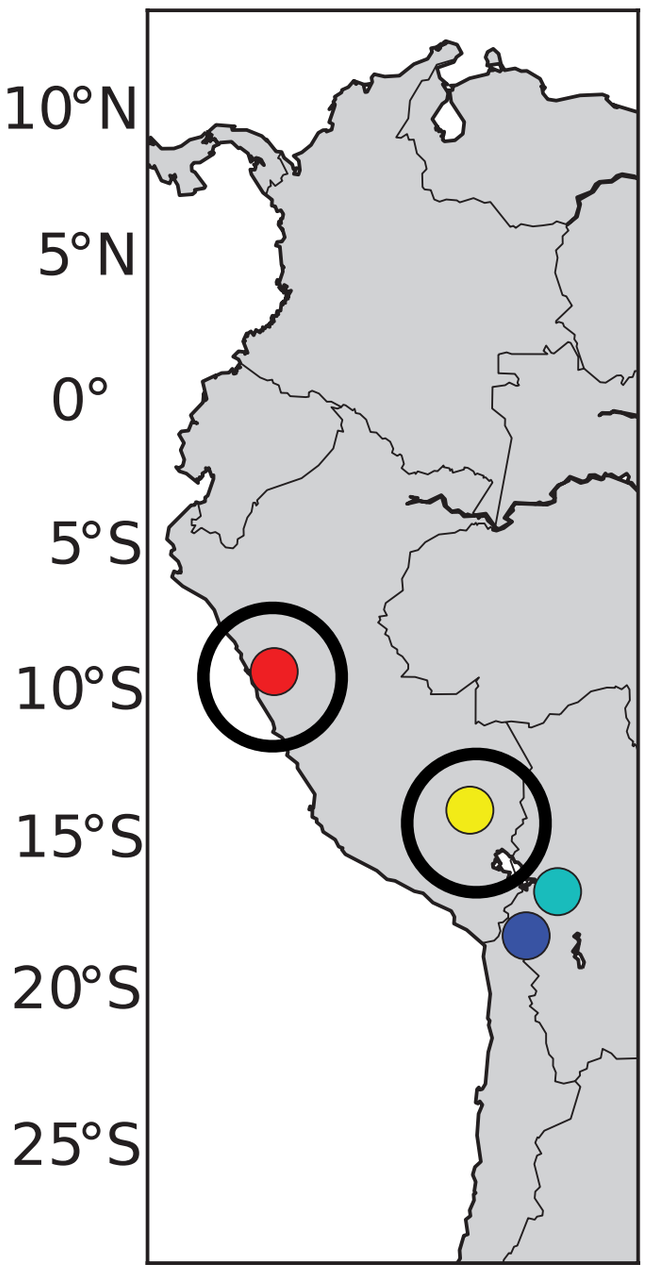
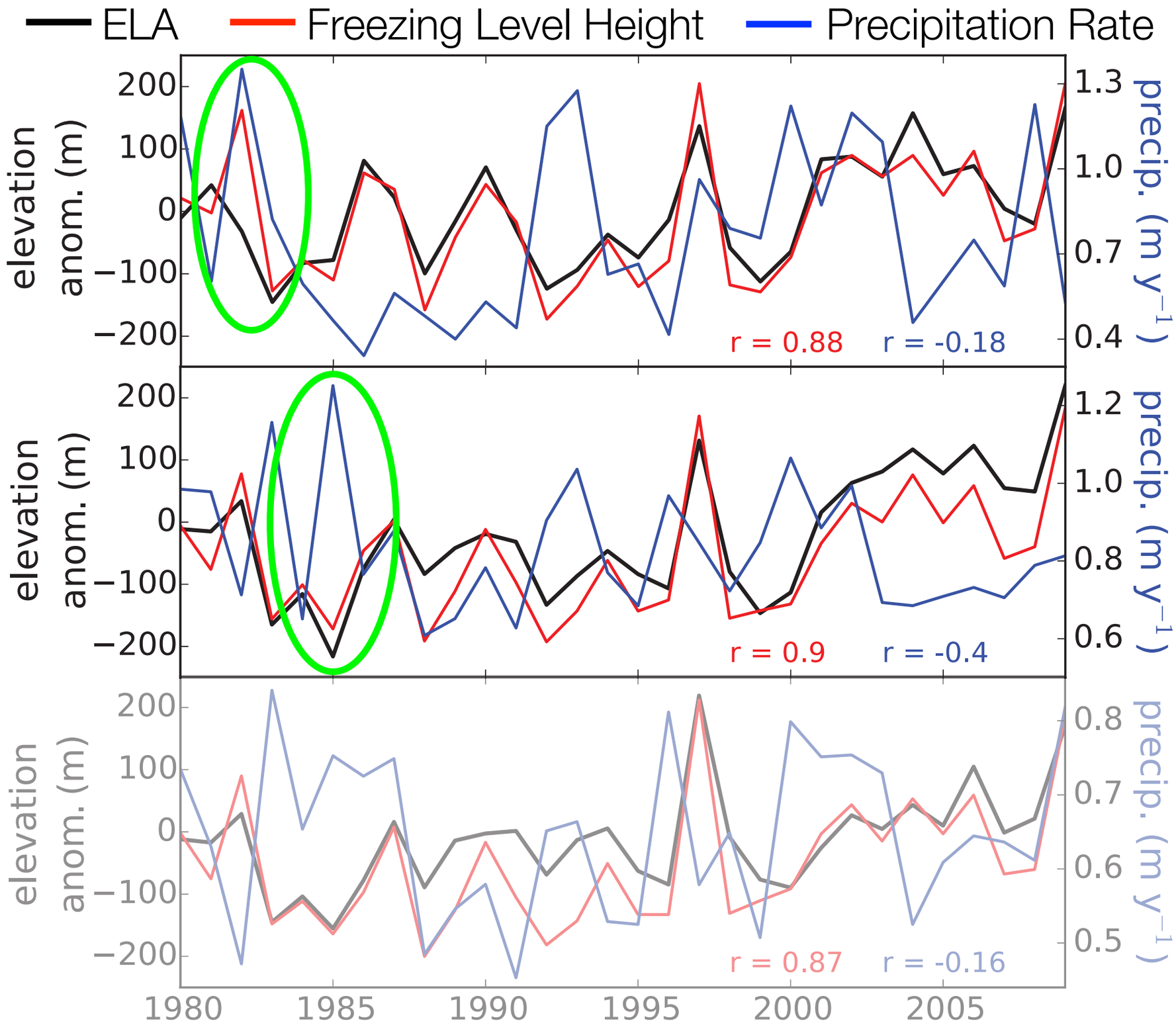
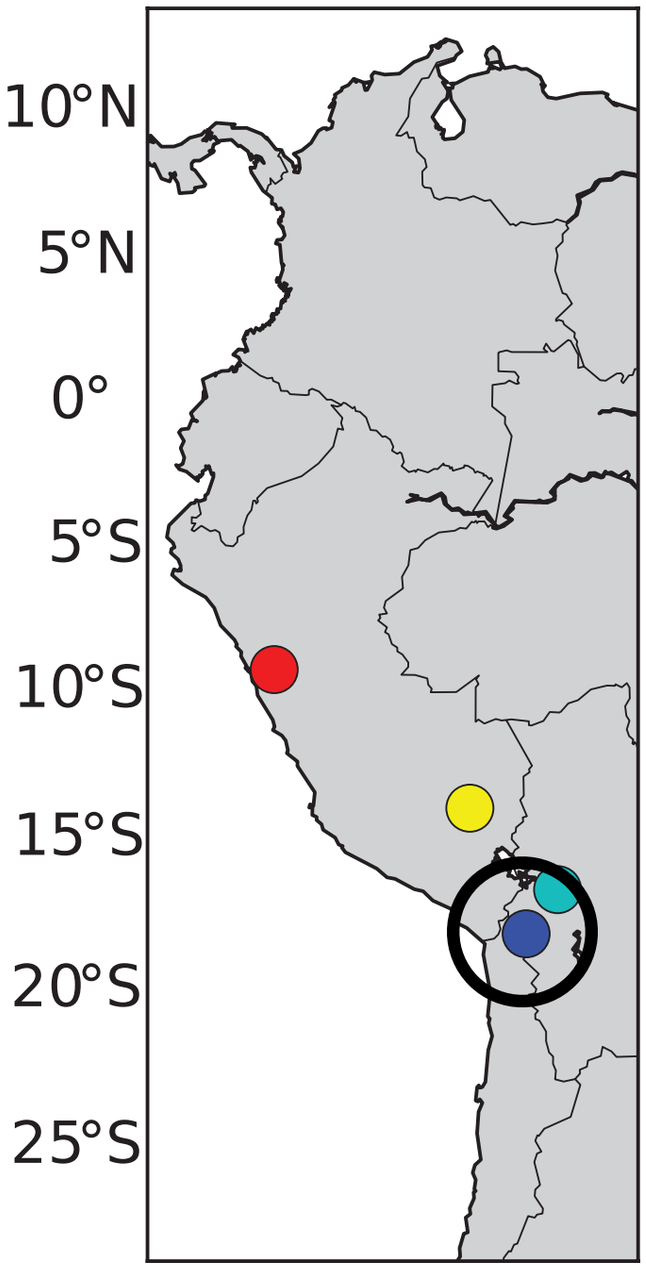




Dry Tropical Glacier ELAs Mainly Track Precipitation



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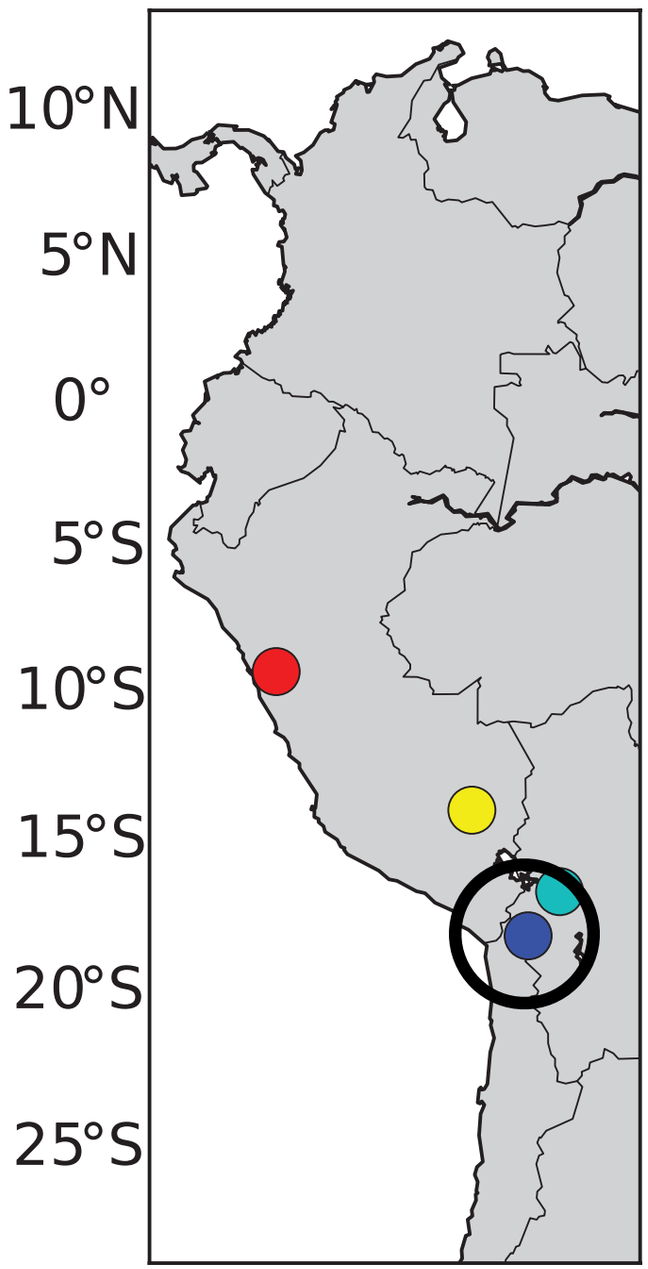

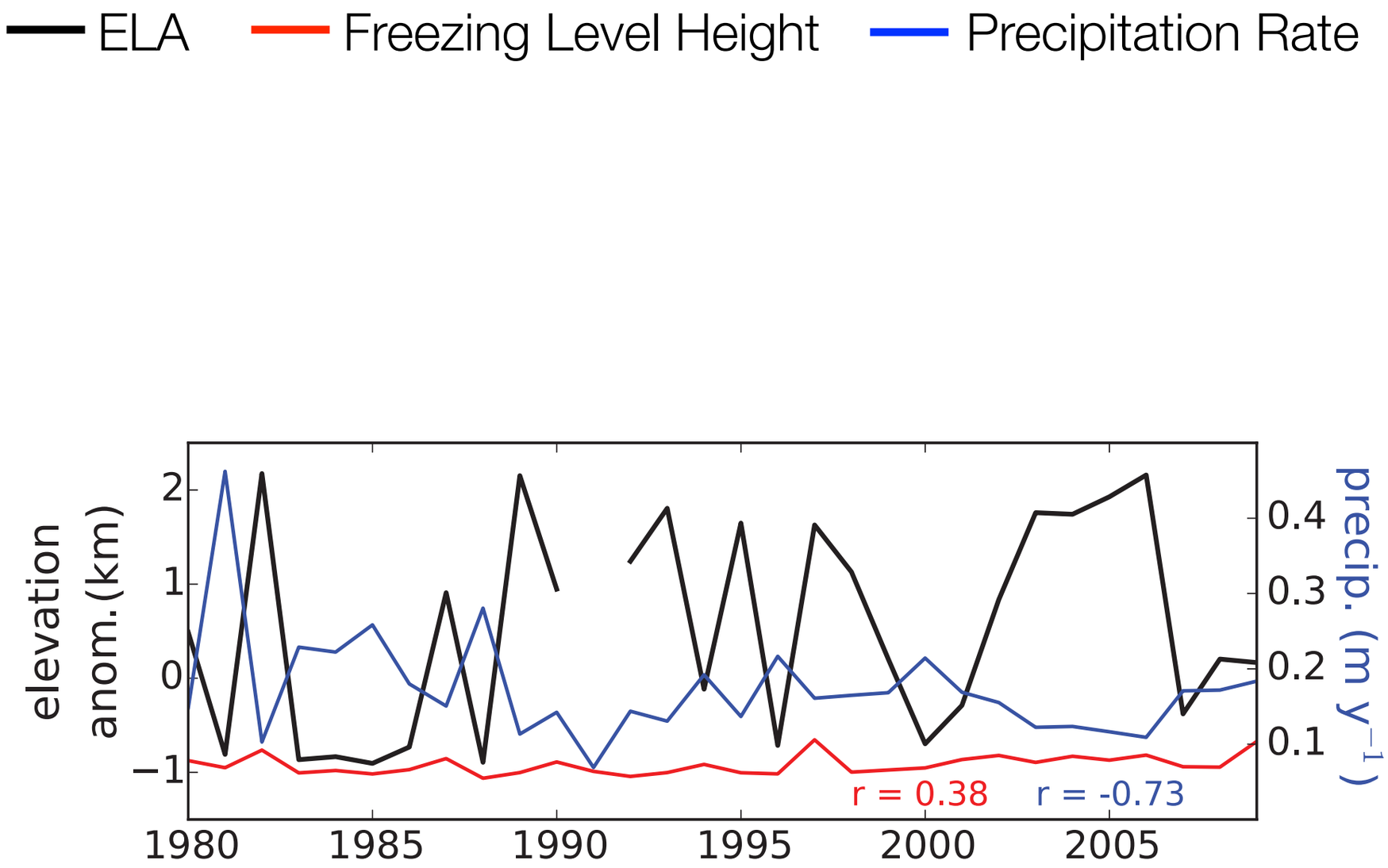

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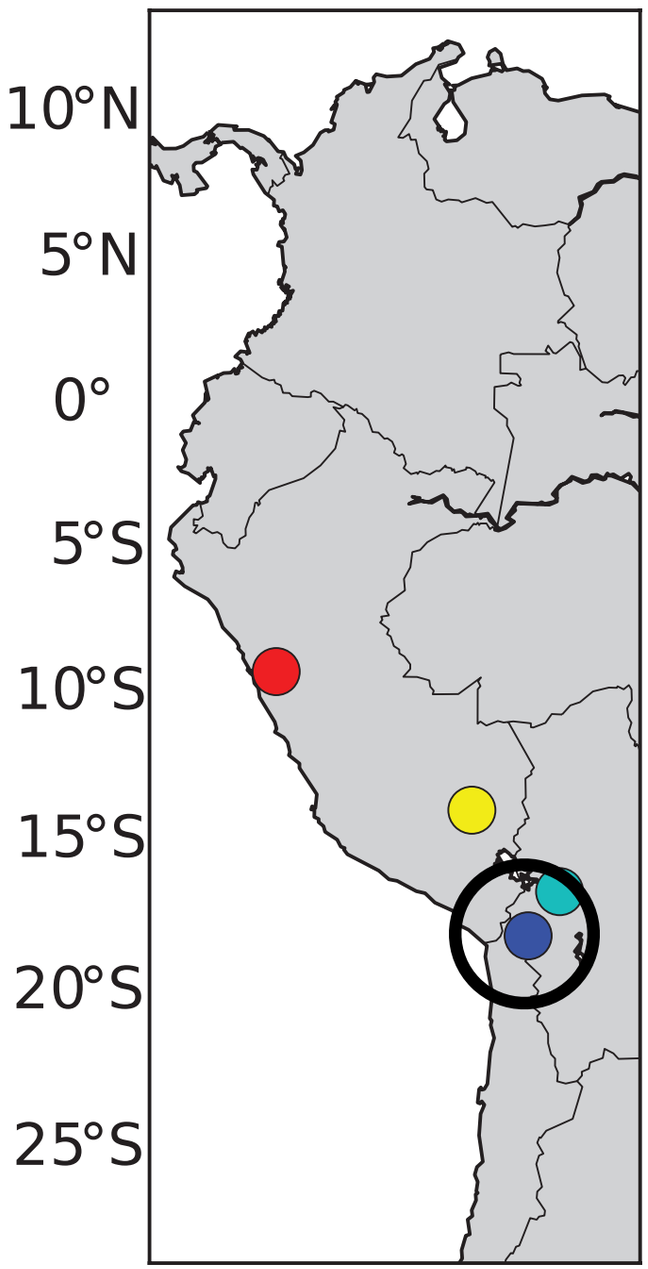

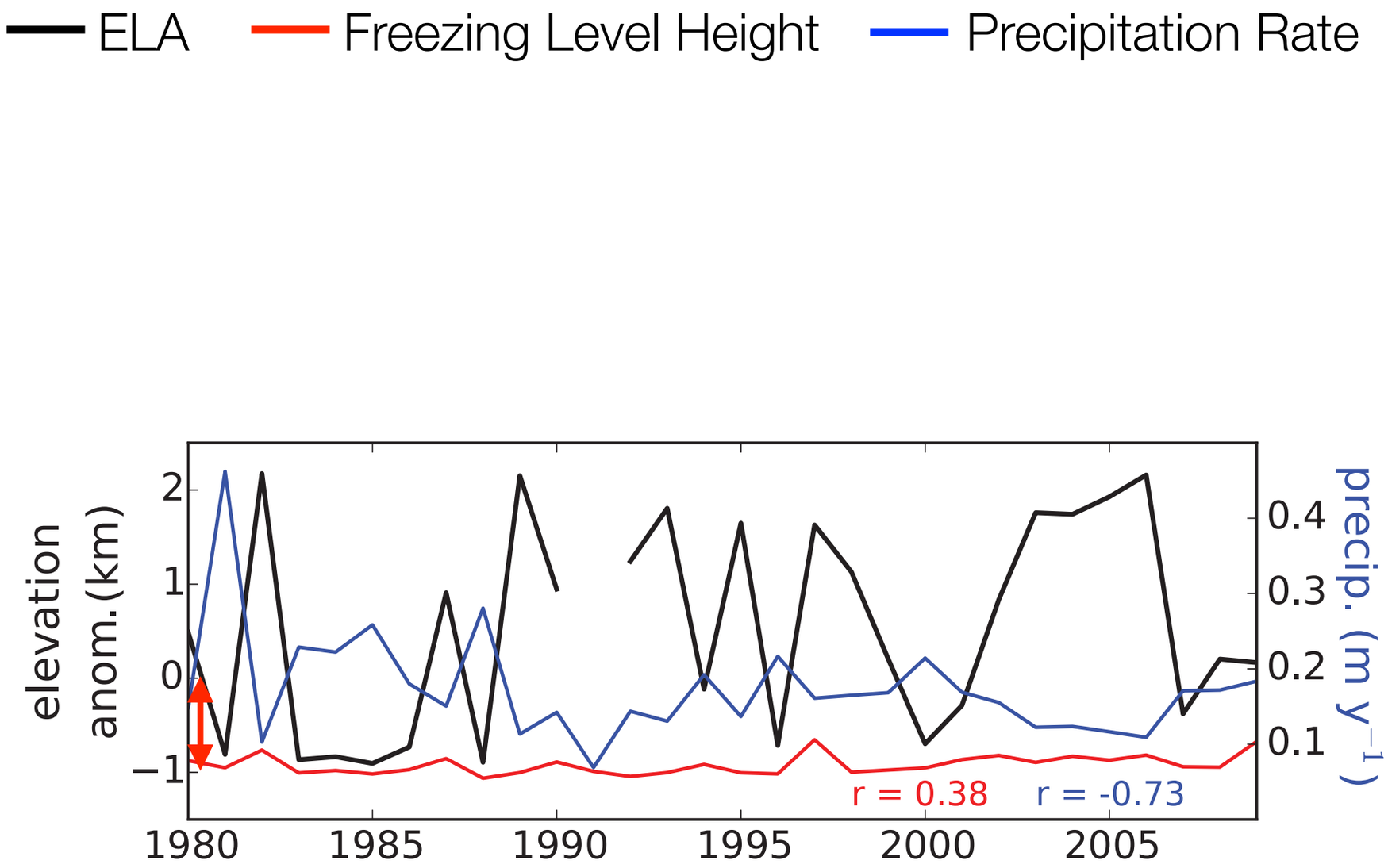

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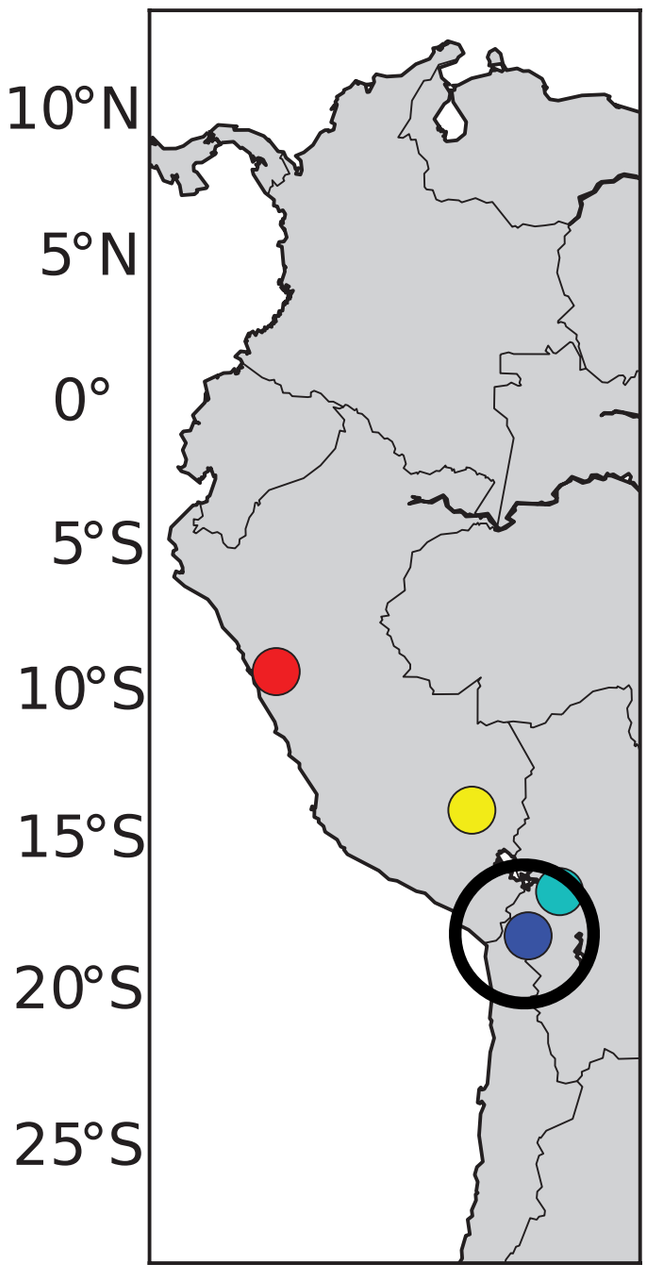

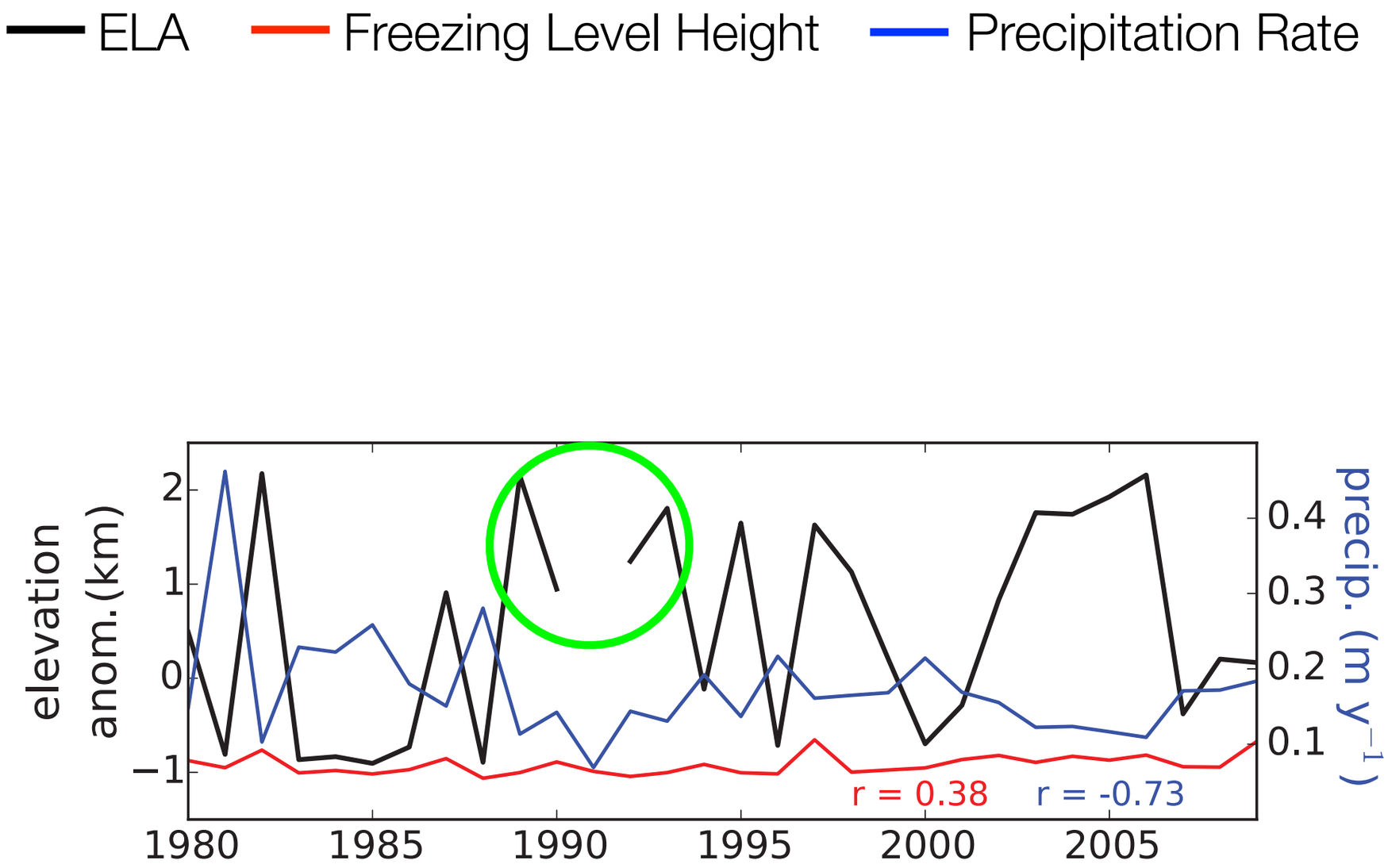

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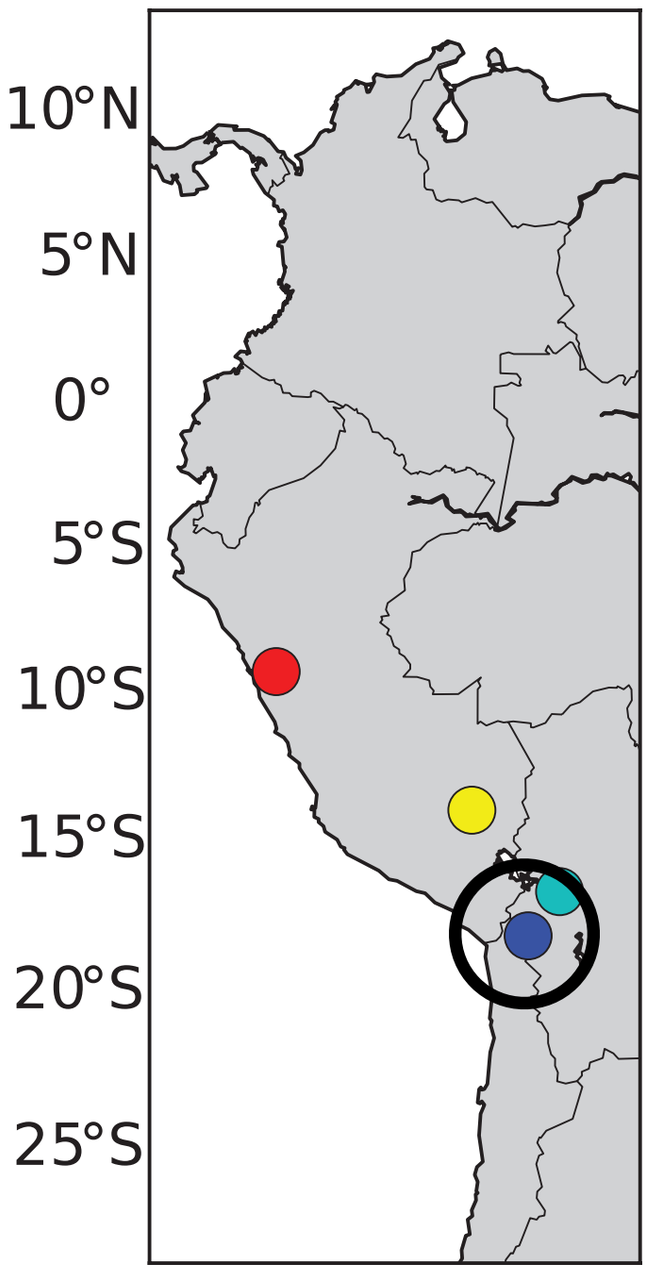

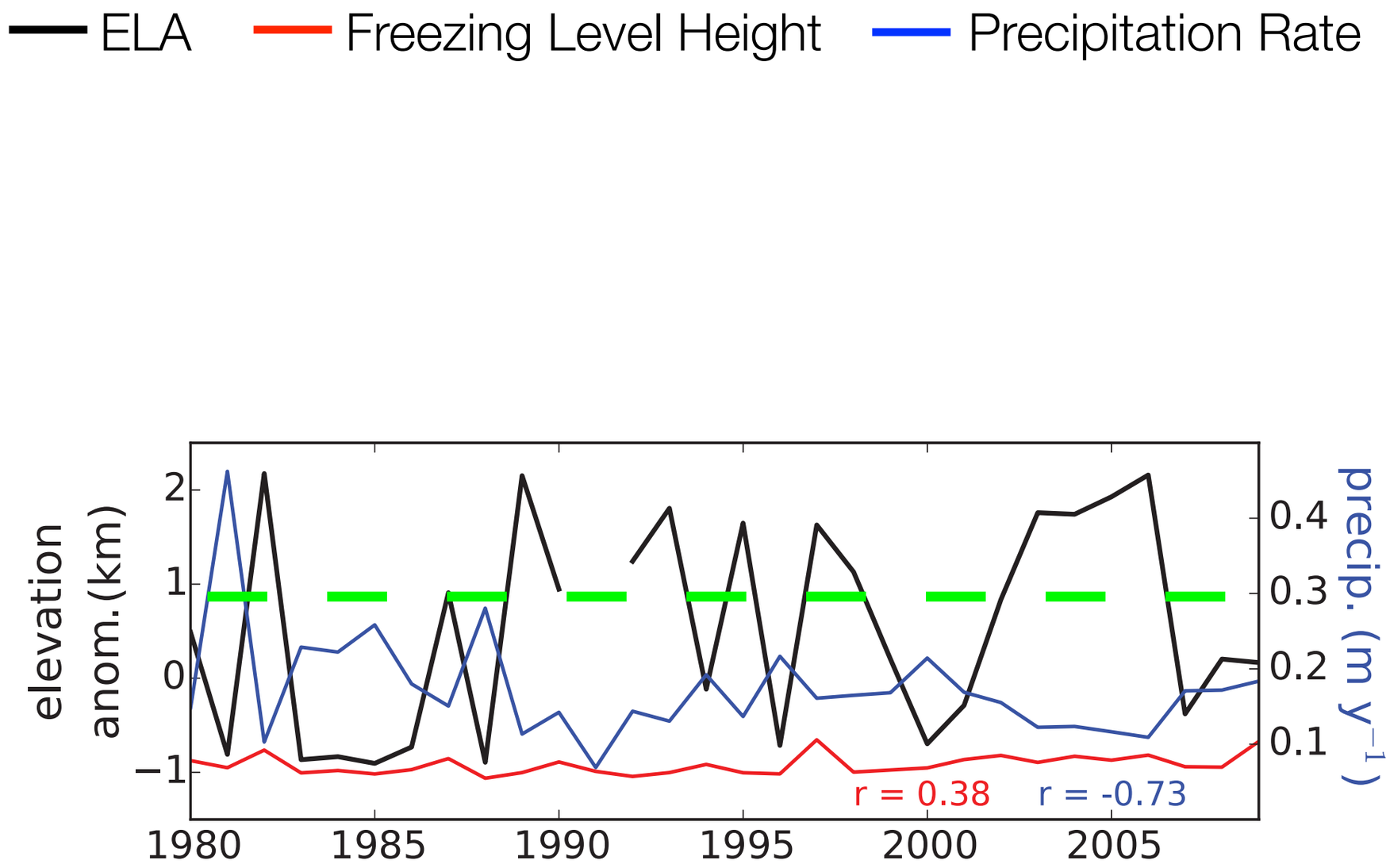

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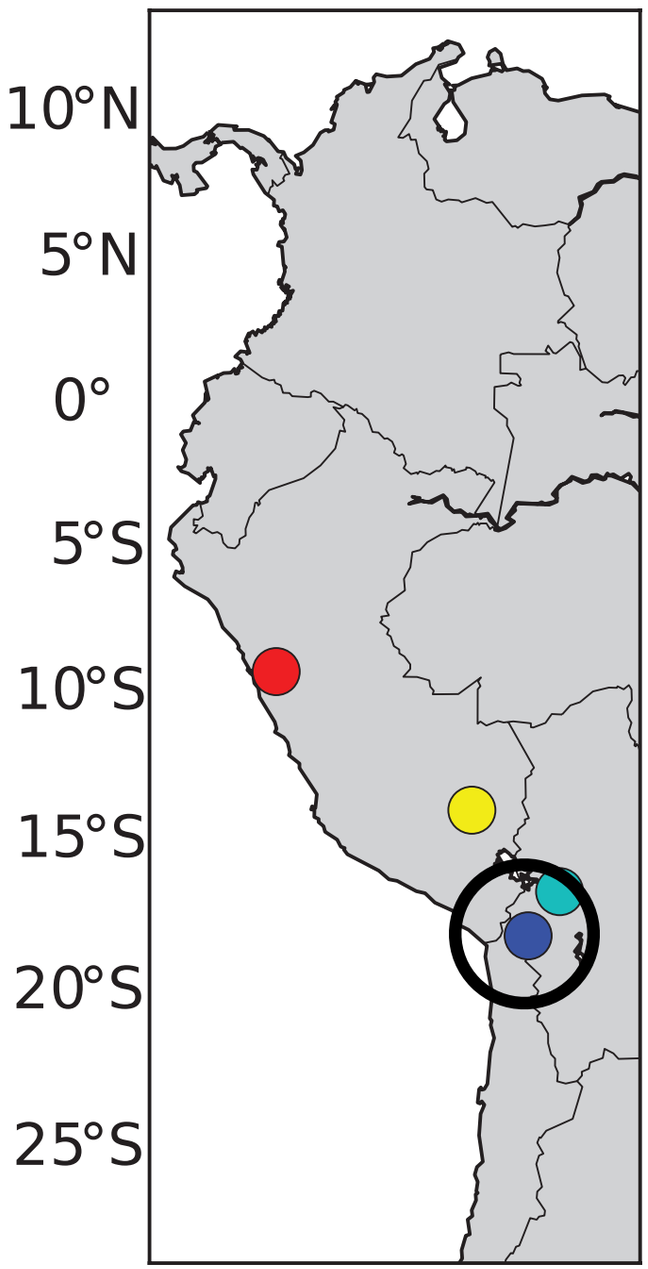
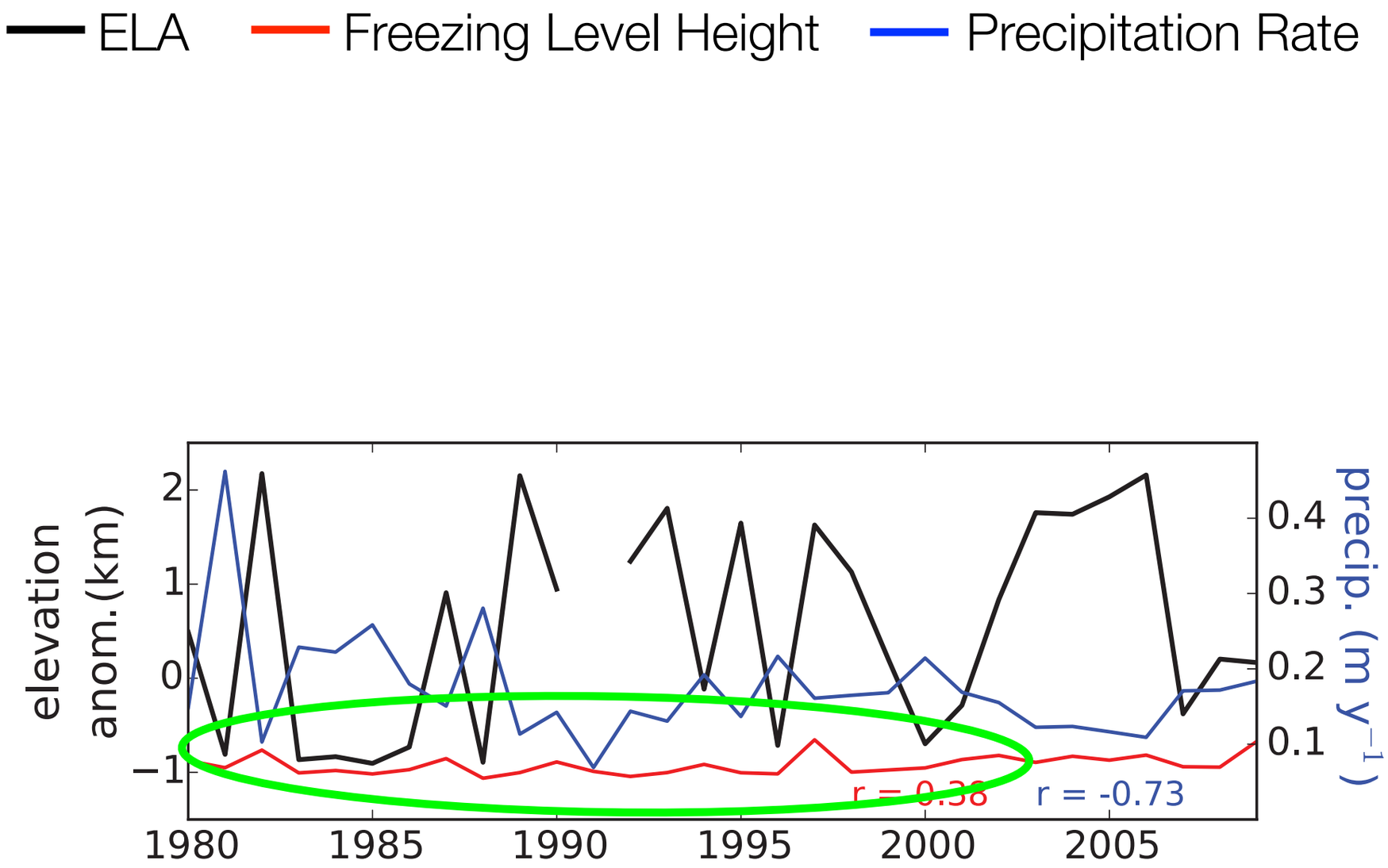
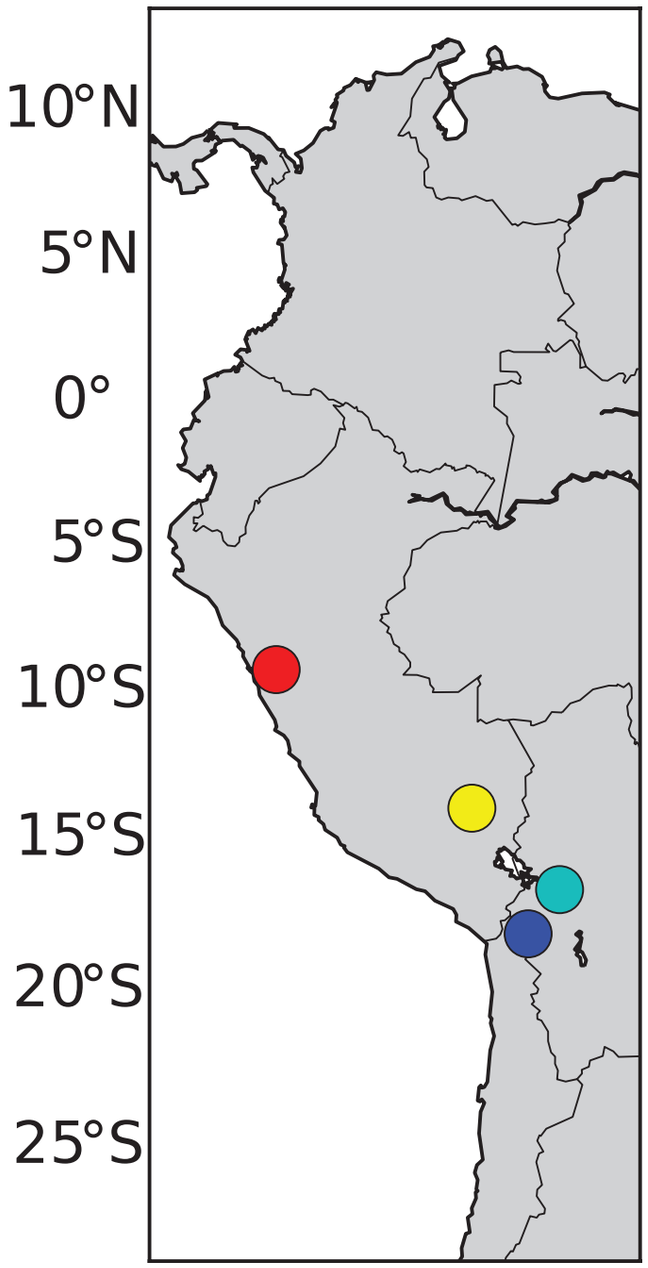
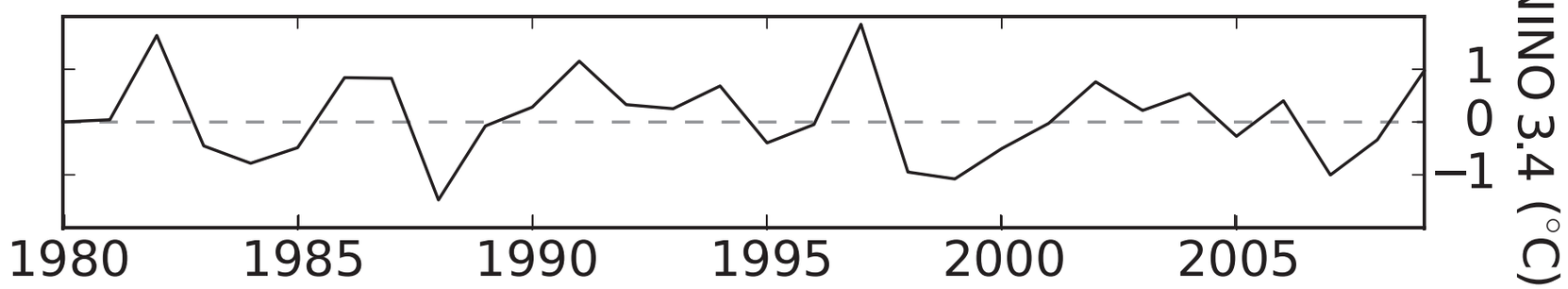




ENSO Trends Partially Explain ELA Variability





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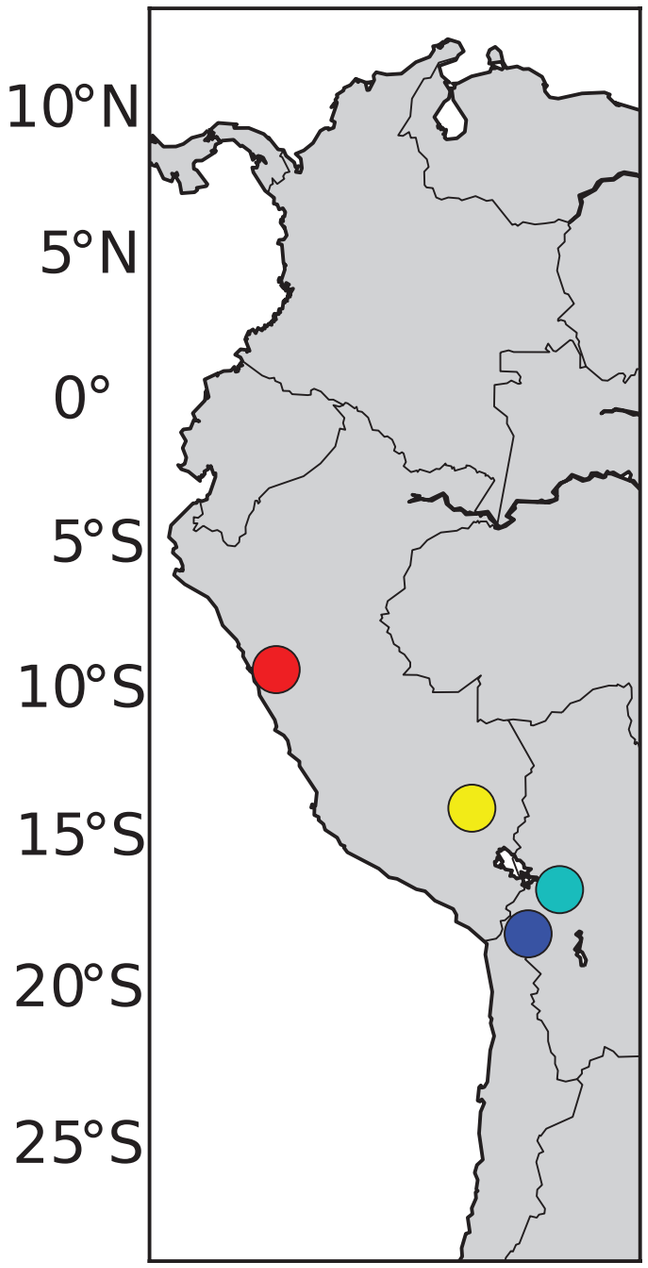

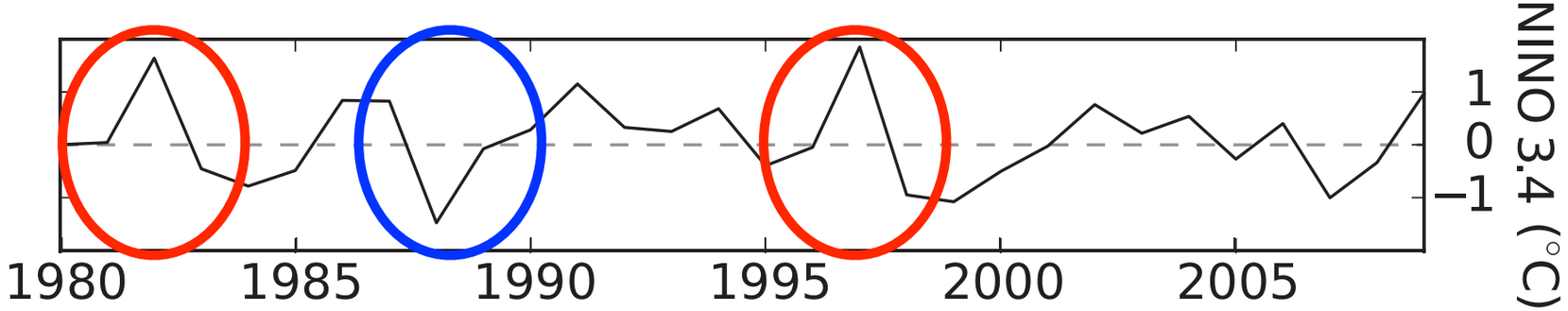

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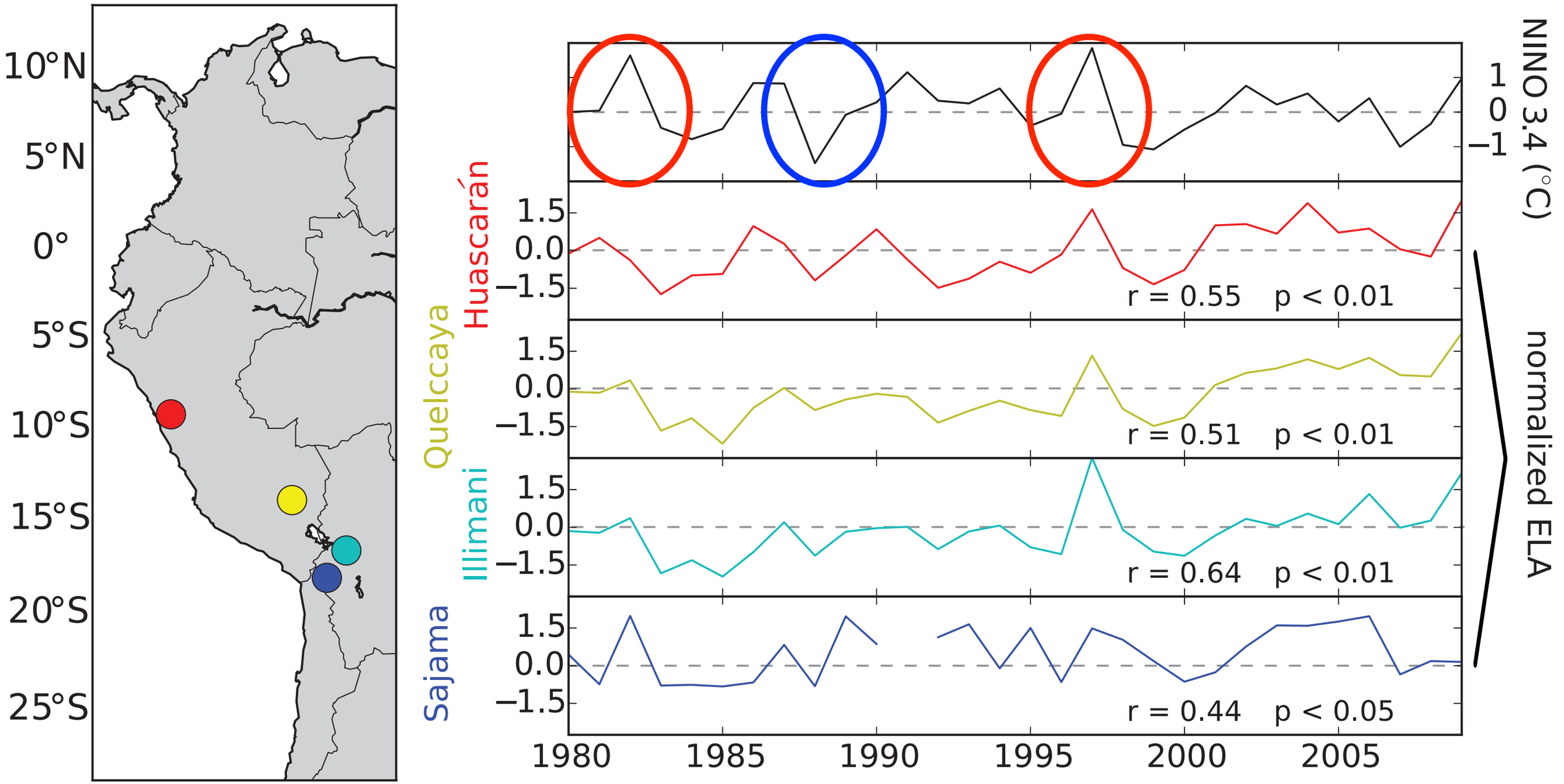

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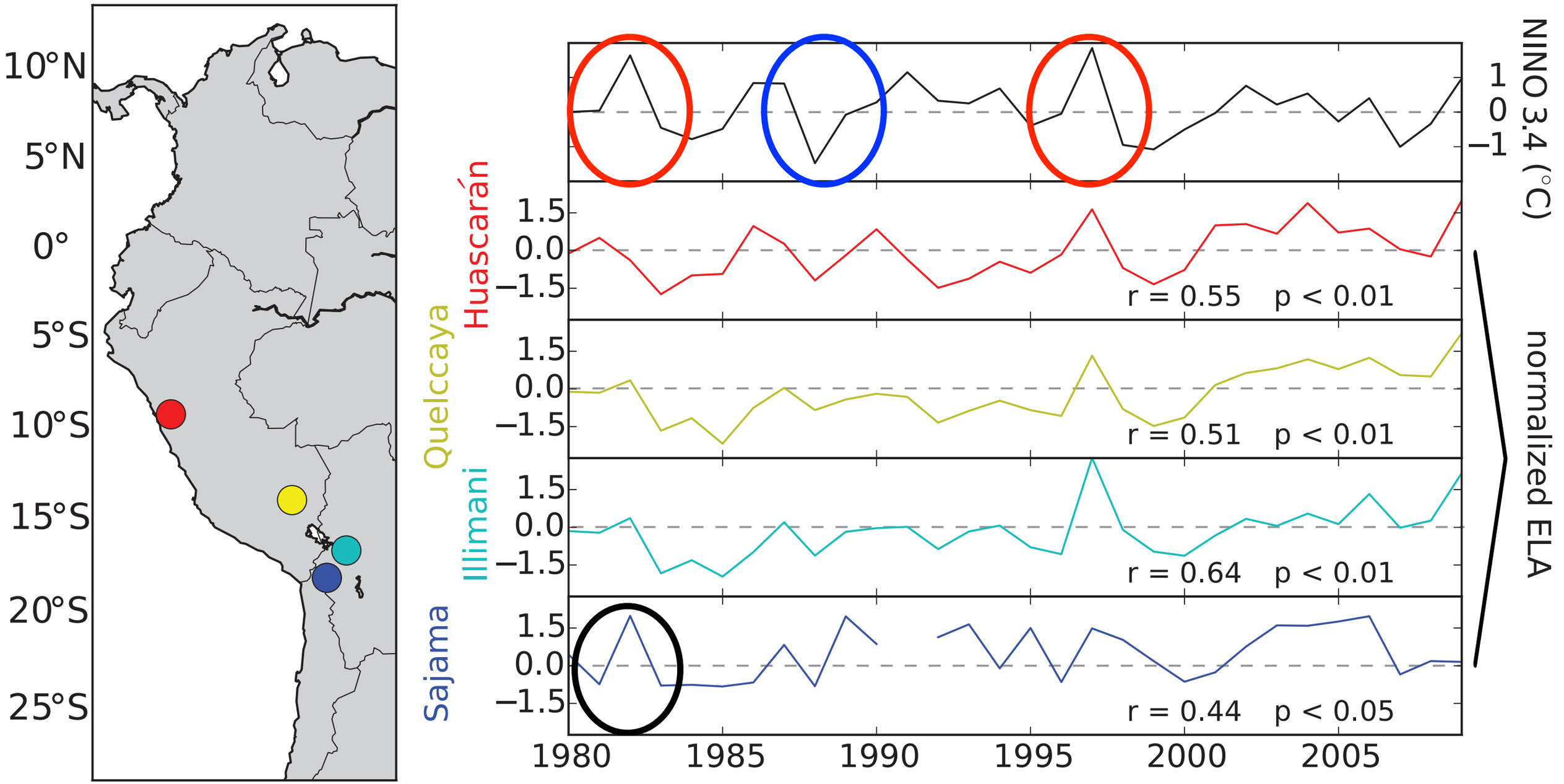

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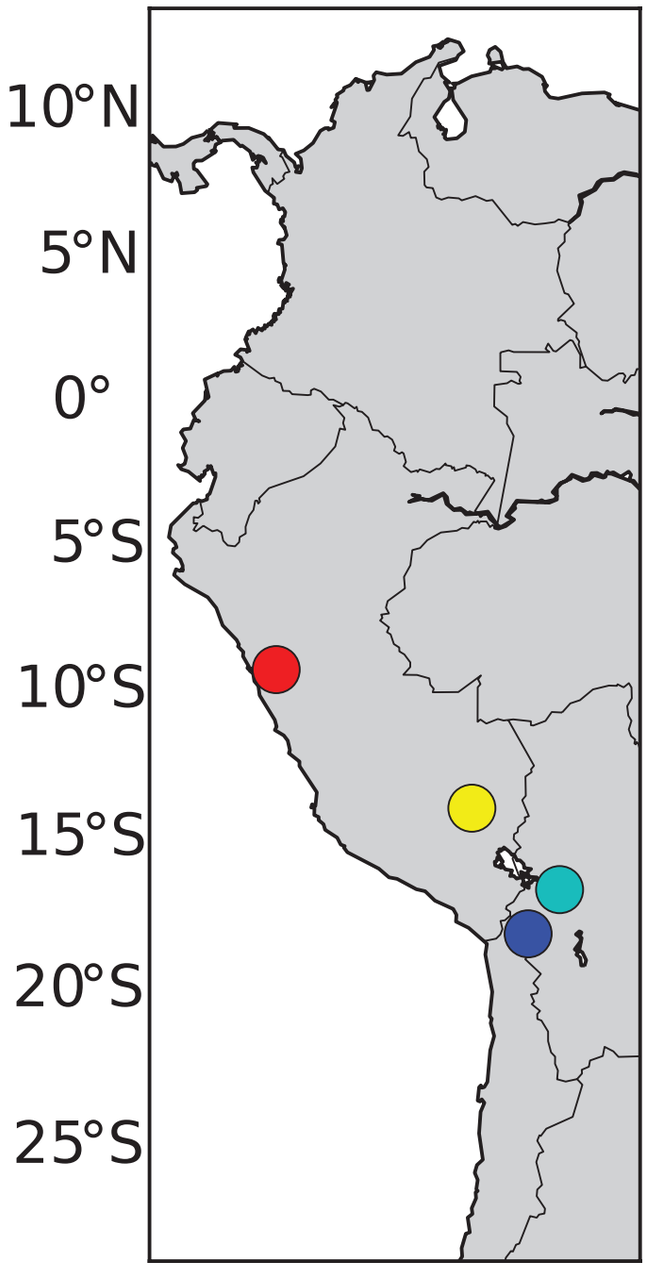

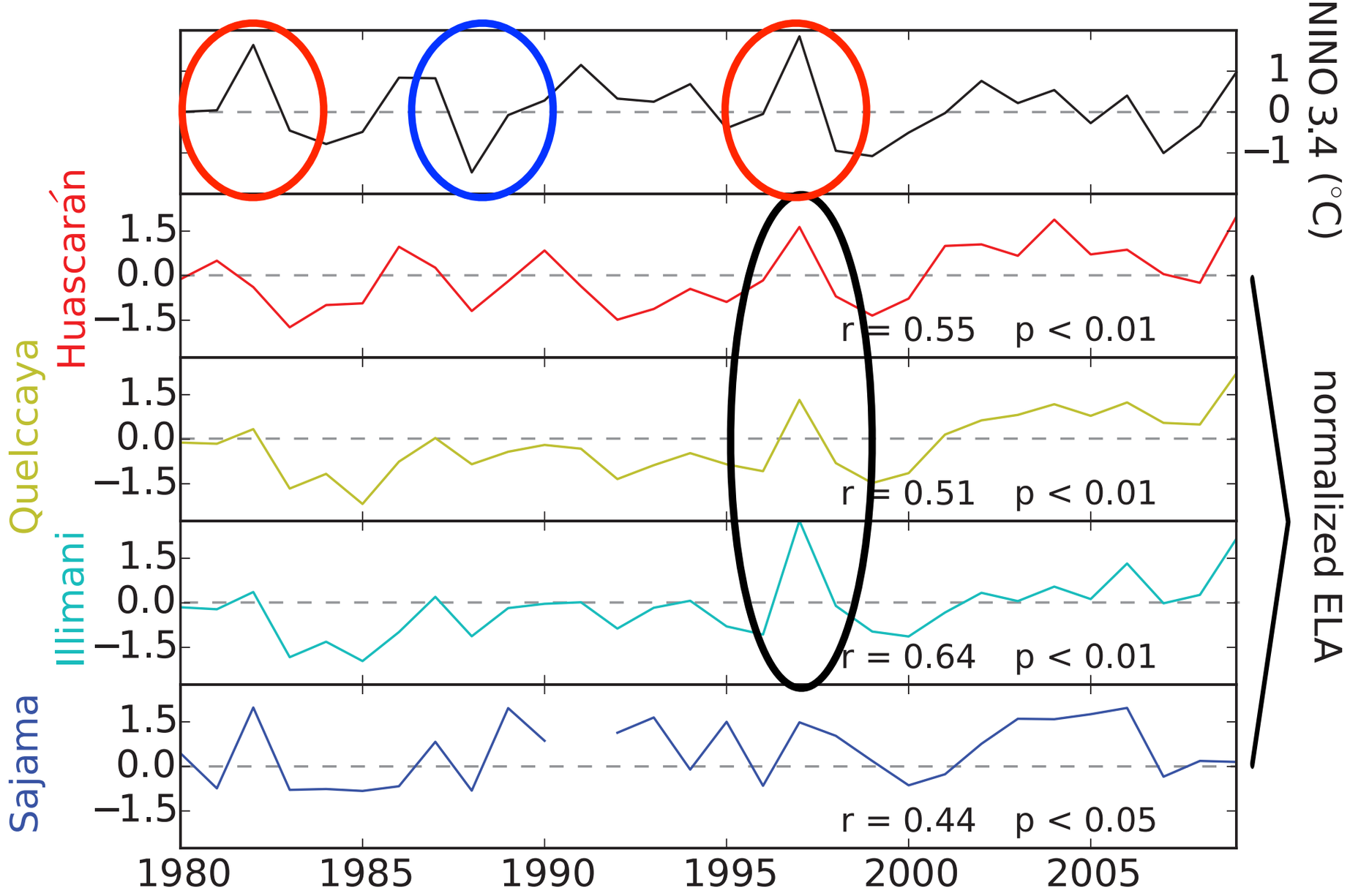

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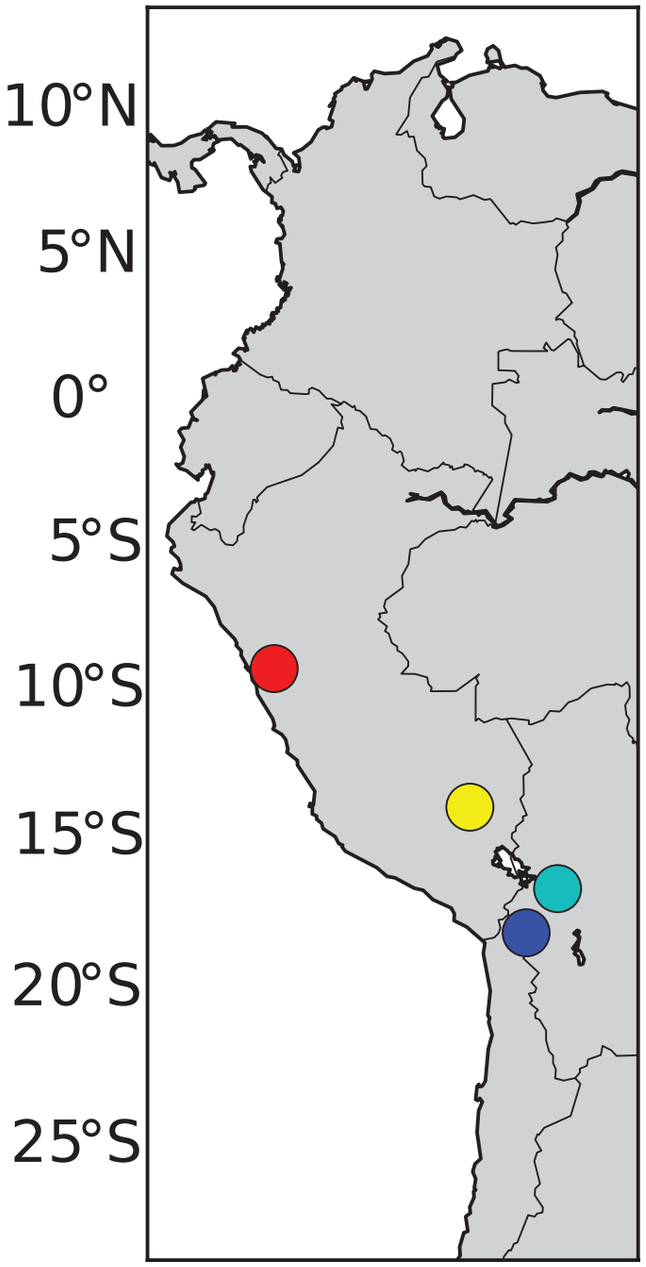

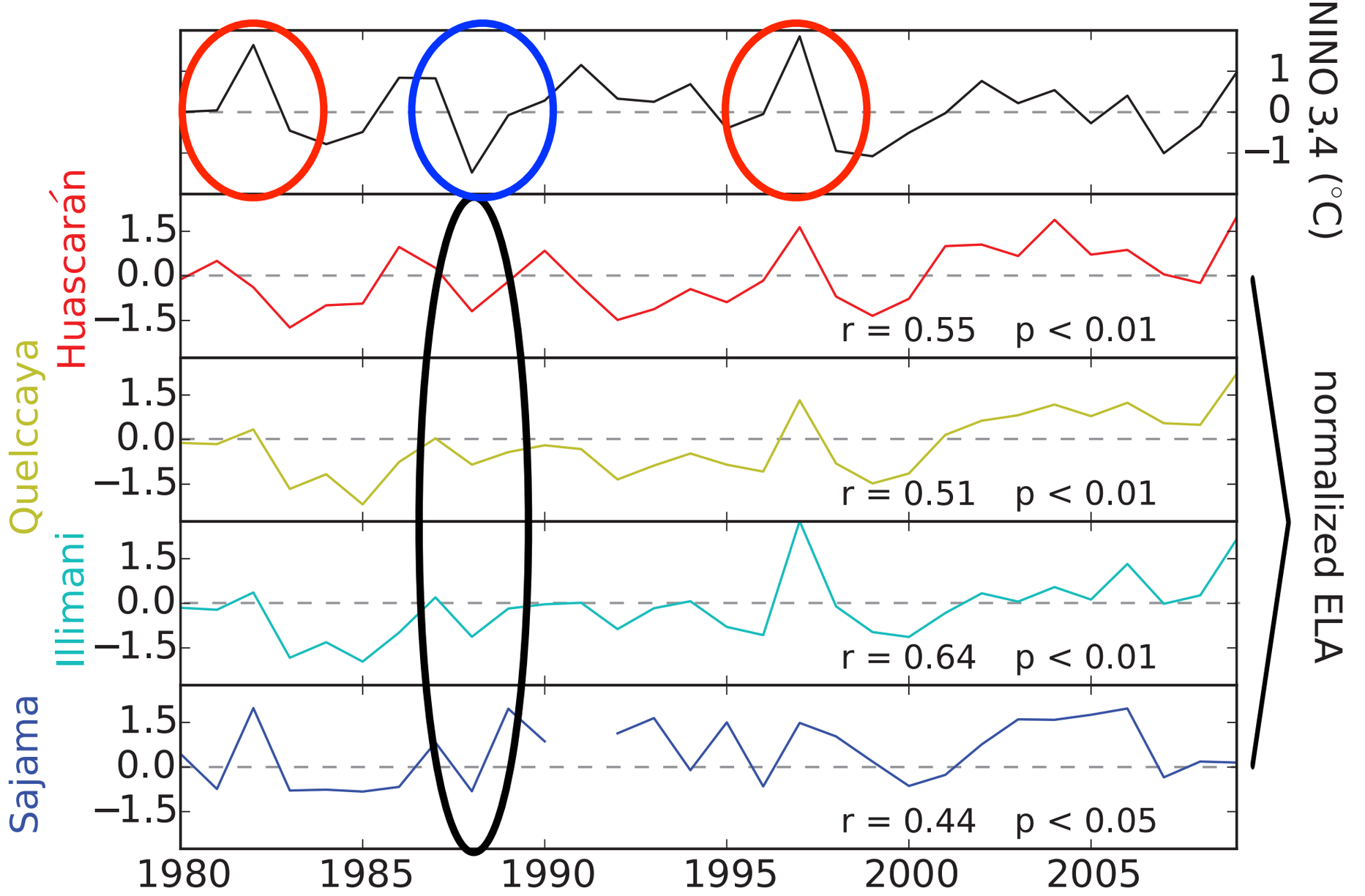

Tropical Glaciers Repsond to Regional Climate Trends

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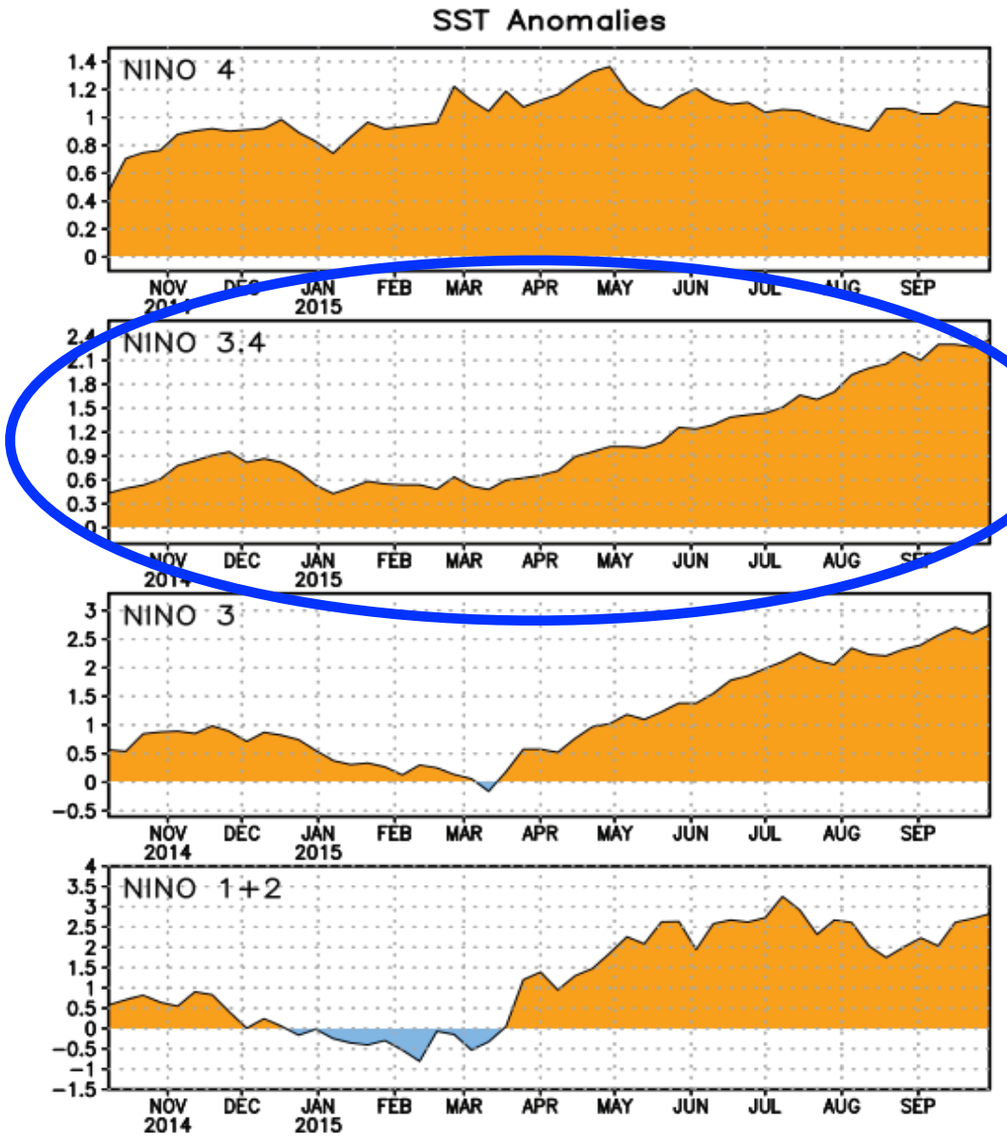


(NOAA)

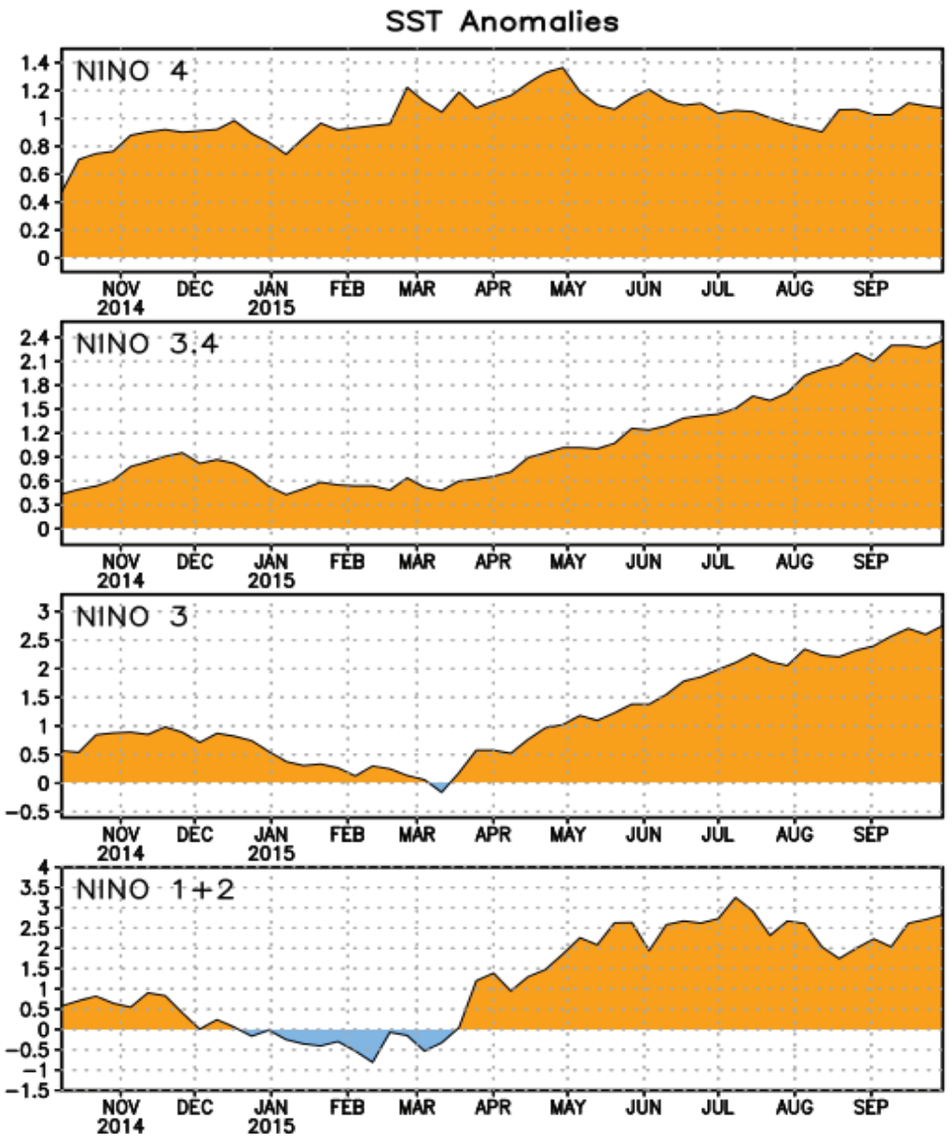
Tropical Glaciers Repsond to Regional Climate Trends

Tropical glacier ELAs reflect trends noticeable at annual and interannual timescales

Temperature changes dictate wet tropical glacier ELA changes through effects on the summertime freezing level height

ELAs of sublimation-dominated glaciers strongly respond to precipitation rate changes but the freezing level height dictates the lowest ELAs

ENSO plays partial role in ELAs variations



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