

21st Century climate change in the European Alps and its elevation dependency

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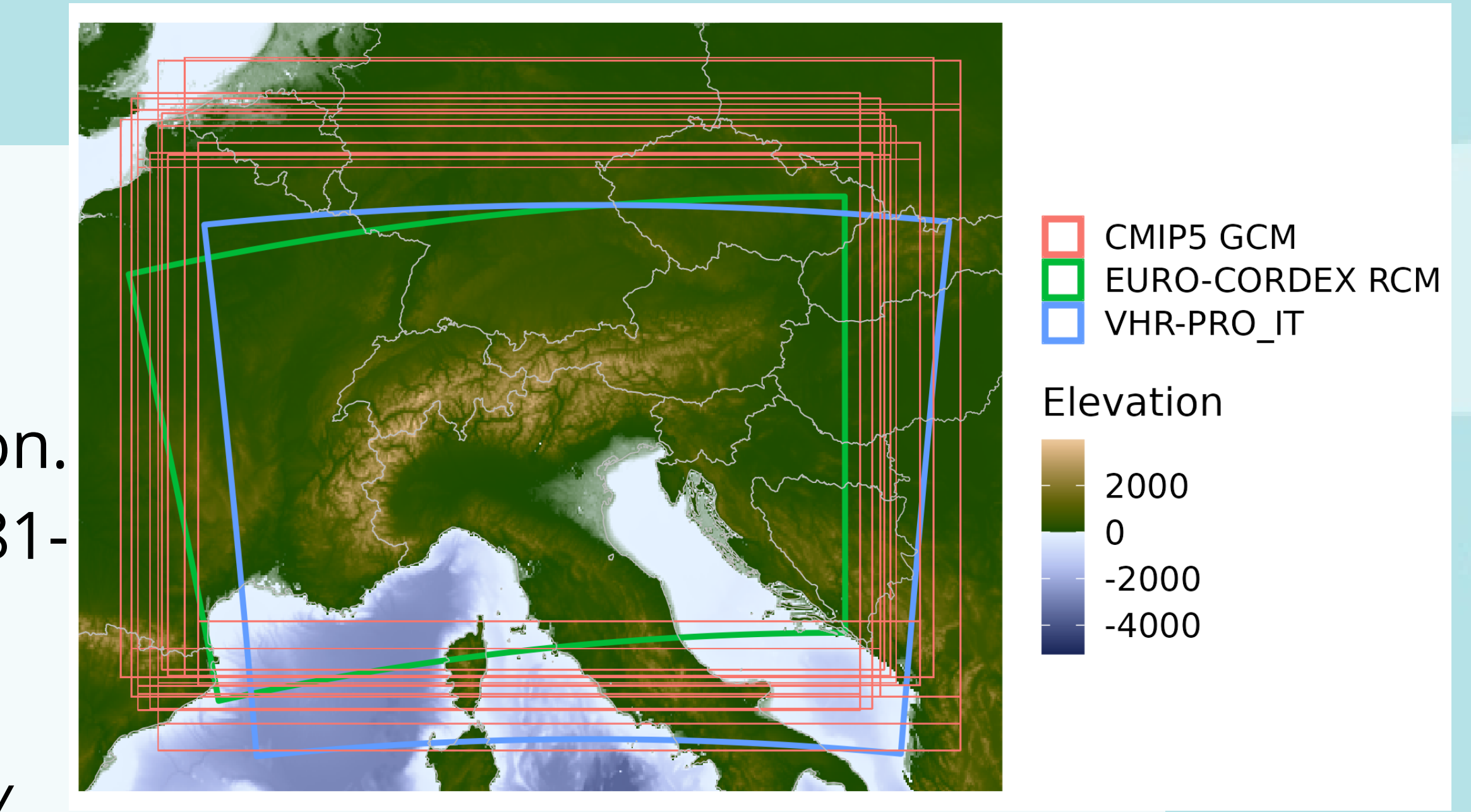


Introduction

Elevation Dependent Climate Change (EDCC) [1,2] has been observed worldwide: to understand the dependencies of future trends over the European Alps, in this study future trends of climate indices and statistics are explored across spatial scales and RCPs using different models.

Study area and Data

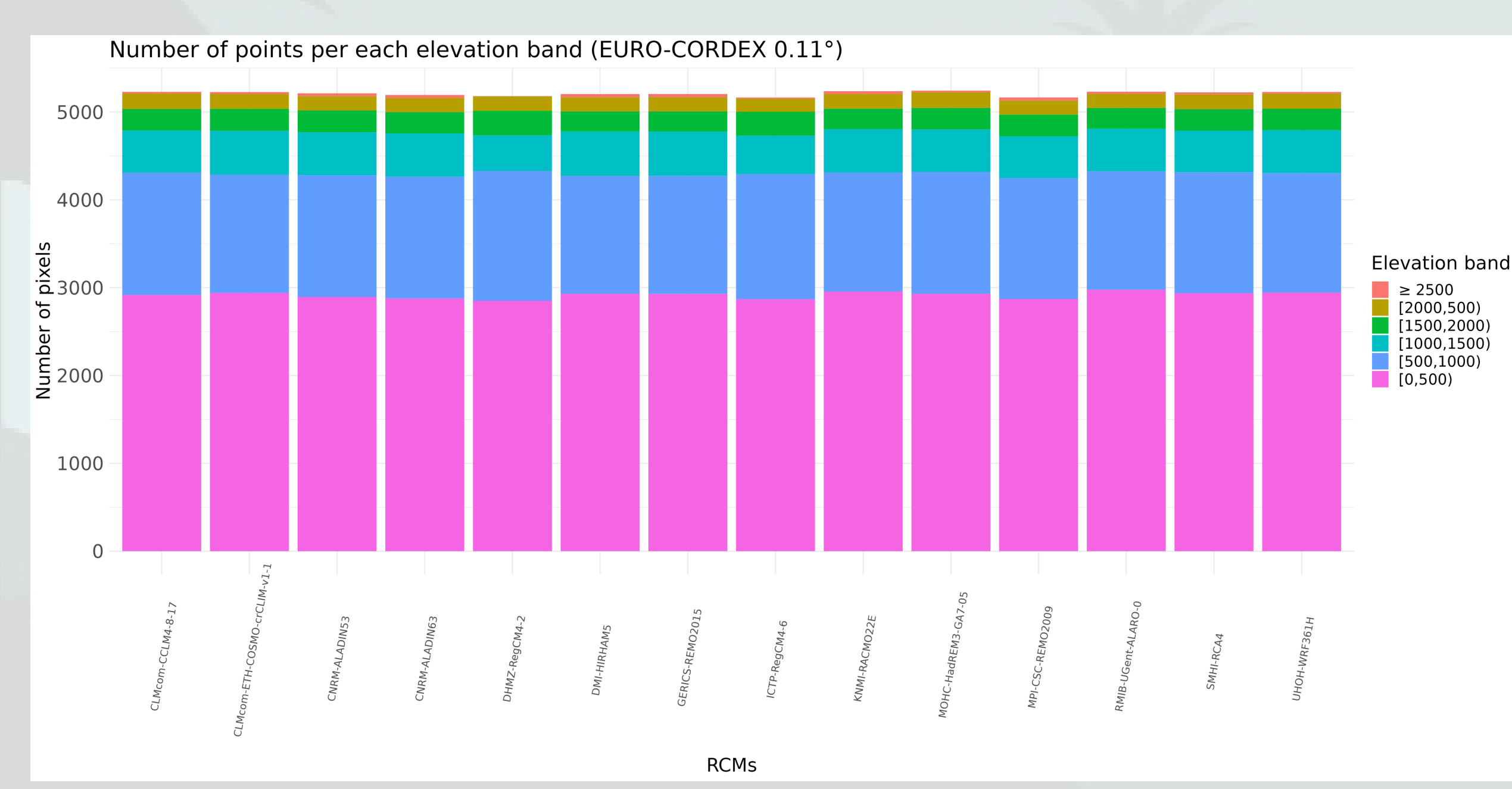
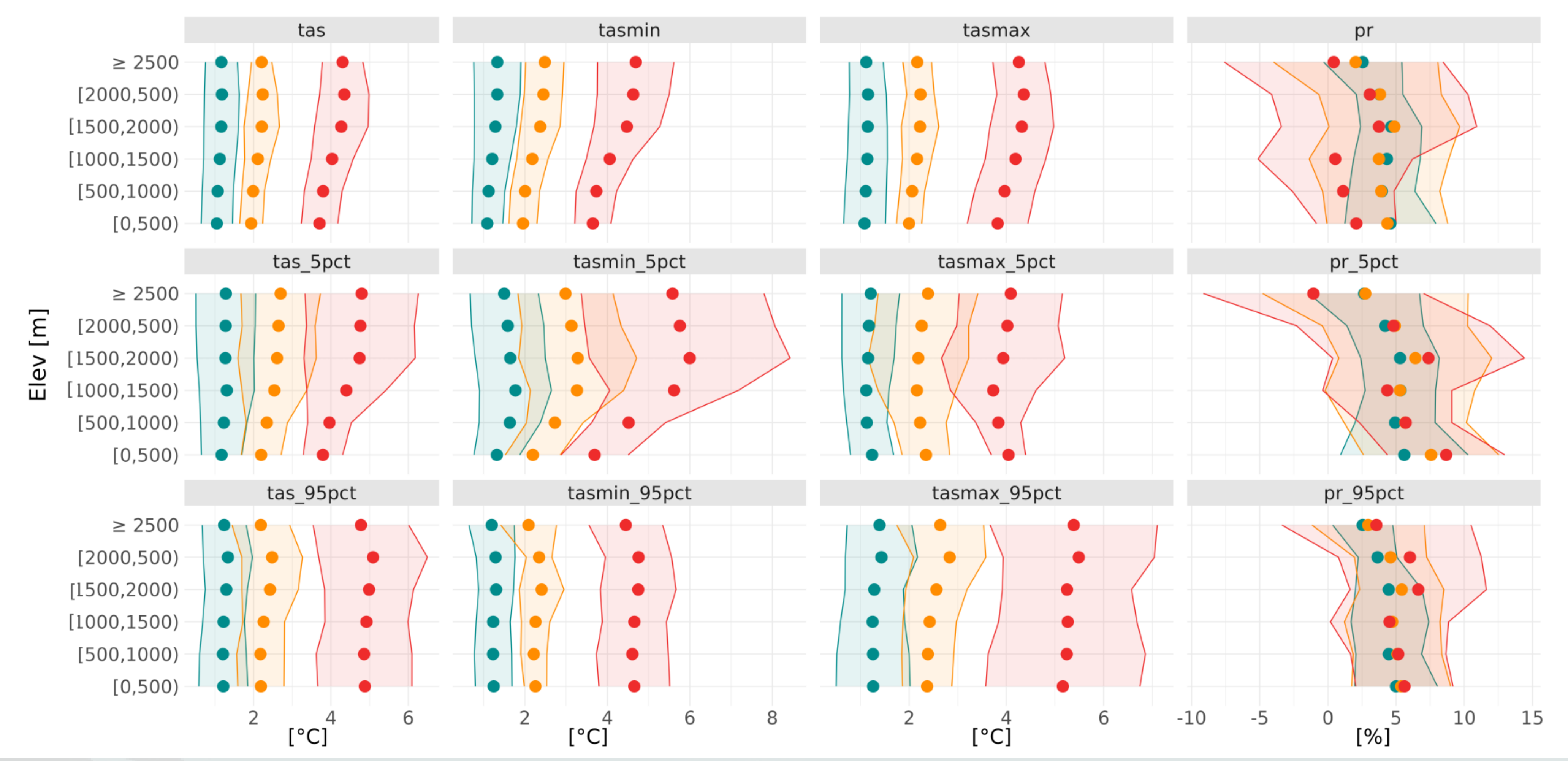
- **EURO-CORDEX** ensemble of regional climate models at 0.11° resolution [3]
- **CMIP5** (Coupled Model Intercomparison Project Phase 5) [4]
- **VHR-PRO_IT**: climate projections at convection-permitting resolution. Dynamical downscaling with CMCC-CM global model over the period 1981-2070, adopting the RCP8.5 and RCP4.5 future scenario [5]



Domains and datasets used in the study

Results

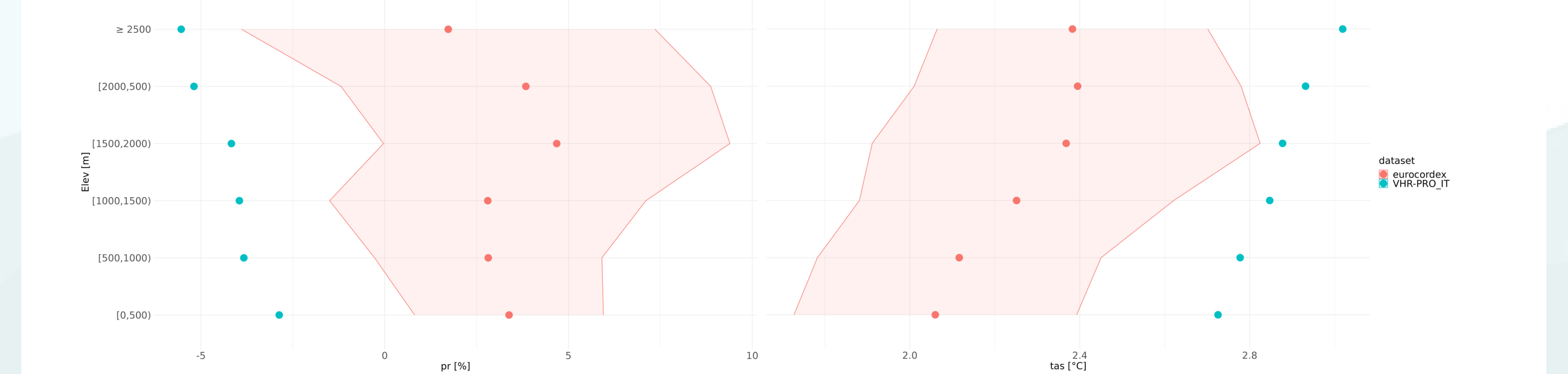
Absolute change, relative change and percentiles in annual mean (tas), minimum (tasmin) and maximum (tasmax) daily temperature and in annual mean daily precipitation (pr) between the climatological periods 2071-2100 and 1981-2010 using different RCP scenarios: RCP8.5 (red), RCP4.5 (yellow), RCP2.6 (teal)
(Raw EURO-CORDEX ensemble, the error bars show the models variability within the 10th and the 90th percentiles)



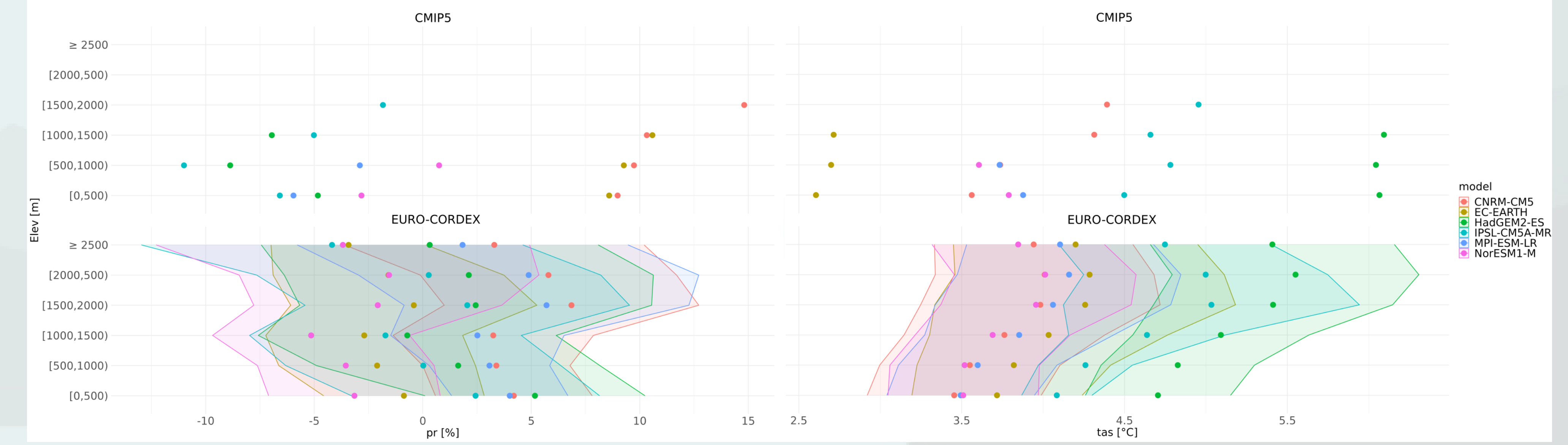
TEMPERATURE	PRECIPITATION
ICE DAYS (ID)	CONSECUTIVE DRY DAYS (CDD)
FROST DAYS (FD)	TOTAL DAILY PRECIPITATION EXCEEDING 90TH PERCENTILE (R90PTOT)
TROPICAL NIGHTS (TN)	SIMPLE DAILY INTENSITY INDEX (SDII)
SUMMER NIGHTS (SU)	NUMBER OF WET DAYS (RR)

Additional climate indices (ETCCDI) used in the study to better understand trends in extreme events in mountain regions

Relative change in annual mean daily precipitation and absolute change in annual mean daily temperature between the climatological periods 2041-2070 (RCP8.5) and 1981-2010 (RCM in common COSMO-CLM, the error bars show the models variability within the 10th and 90th percentiles)



Relative change in annual mean daily precipitation and absolute change in annual mean daily temperature between the climatological periods 2071-2100 (RCP8.5) and 1981-2010 (GCMs in common between CMIP5 and EURO-CORDEX ensembles, the error bars show the models variability within the 10th and 90th percentiles)



While the GCM impacts mainly the area's average conditions, the emission scenario impacts the change and the variability as a function of the elevation. Thus, **what are the different mechanisms at play at different elevations?** Further regional, seasonal, and model analyses are necessary!

[1] Pepin, N. C., et al. "Climate changes and their elevational patterns in the mountains of the world." Reviews of Geophysics 60.1 (2022): e2020RG000730.
 [2] Napoli, Anna, et al. "A workshop on advances in our understanding of Elevation Dependent Climate Change." Bulletin of the American Meteorological Society 104.4 (2023): E928-E934.
 [3] Jacob, Daniela, et al. "EURO-CORDEX: new high-resolution climate change projections for European impact research." Regional environmental change 14 (2014): 563-578
 [4] Taylor, Karl E., Ronald J. Stouffer, and Gerald A. Meehl. "An overview of CMIP5 and the experiment design." Bulletin of the American meteorological Society 93.4 (2012): 485-498.
 [5] Raffa, Mario, et al. "Very high resolution projections over Italy under different CMIP5 IPCC scenarios." Scientific Data 10.1 (2023): 238.