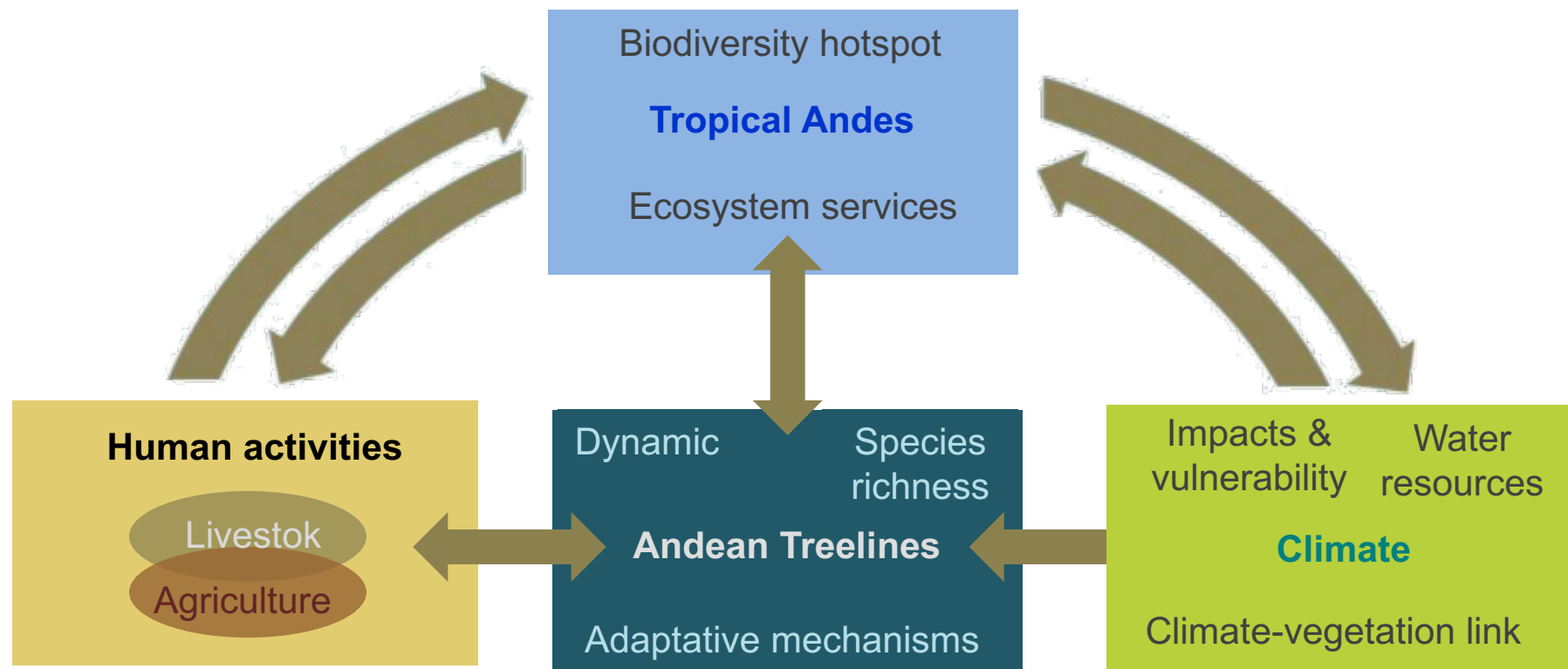


# Modeling the effect of temperature changes on plant life-form distribution along a treeline ecotone in the tropical Andes

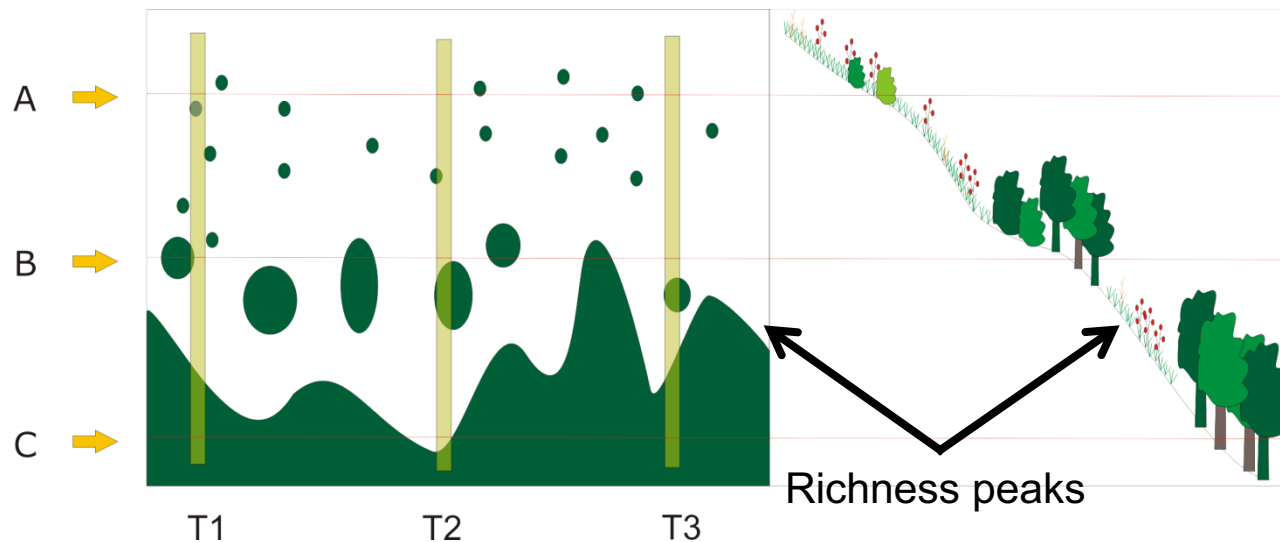
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Previous works have shown that temperature and incident radiation, determined by elevation and slope orientation gradients, can modulate the tropical treeline position.

In the northern Andes, the treeline ecotone corresponds to a complex and species rich transition boundary between continuous high mountain forests and grasslands “páramos”



Trees and tall shrubs are replaced by tussock grasses, small sclerophyllous shrubs and caulescent rosettes with altitude



# Introduction Life-form classification system



Hedberg (1964):  
(1911):

Classification of Afroalpine  
vegetation into 5 categories  
according to morphological  
features, including: fr  
bamboos and non-grass

Caulescent  
rosettes

- Leaf morphological  
ch  
pu  
an



Acaulescent  
rosettes



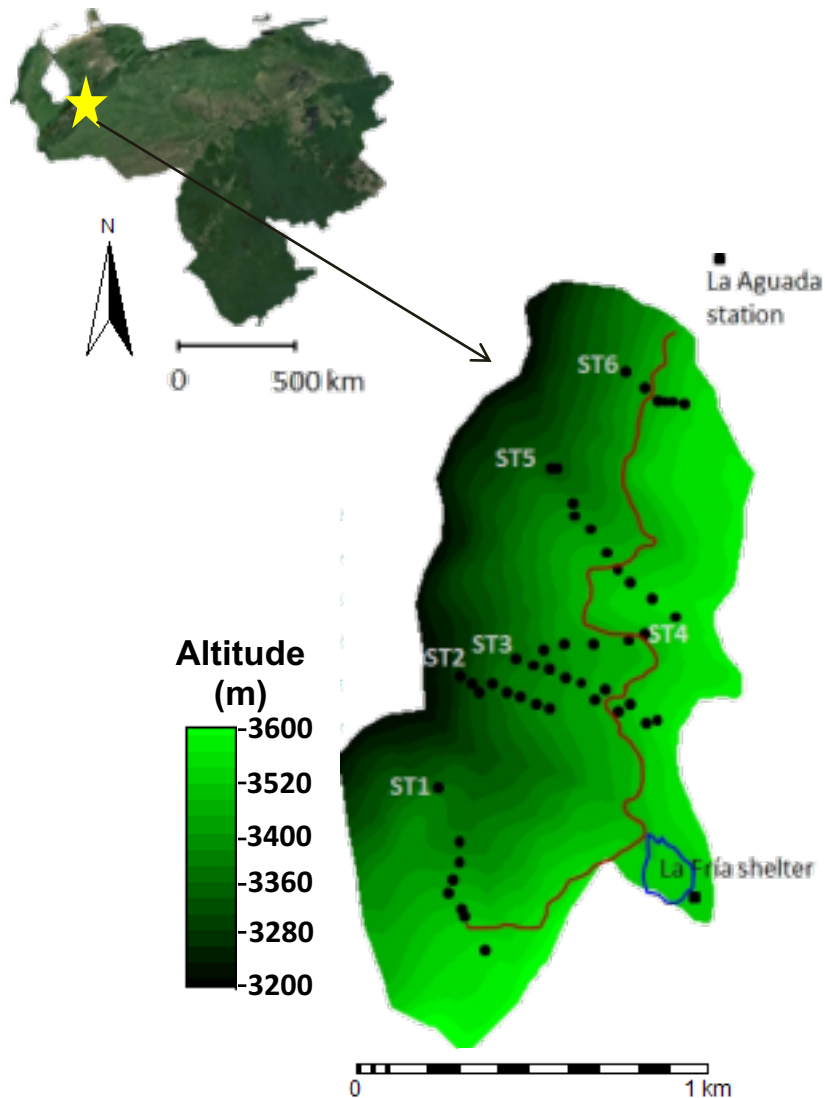
Sclerophyllous  
shrubs

Cushion plants

## Two main questions:

- Dominant plant life-forms will respond differently to altitude and slope orientation, influencing treeline vegetation structure and the spatial distribution of vegetation belts
- Plant life-forms will respond differently under temperature increase scenarios, modifying vegetation physiognomy across the treeline ecotone.





### Study area:

- Altitudinal gradient (3300-3550 masl)
- Forest-páramo ecotone
- Mérida cable car system (Venezuela)

### Climate:

- Mean Temperature: 7.1 °C
- Annual precipitation: 1811 mm
- Bimodal precipitation pattern

### Morphology:

- Slope between 15 – 40°
- Slope orientation varied between North, North-West and West



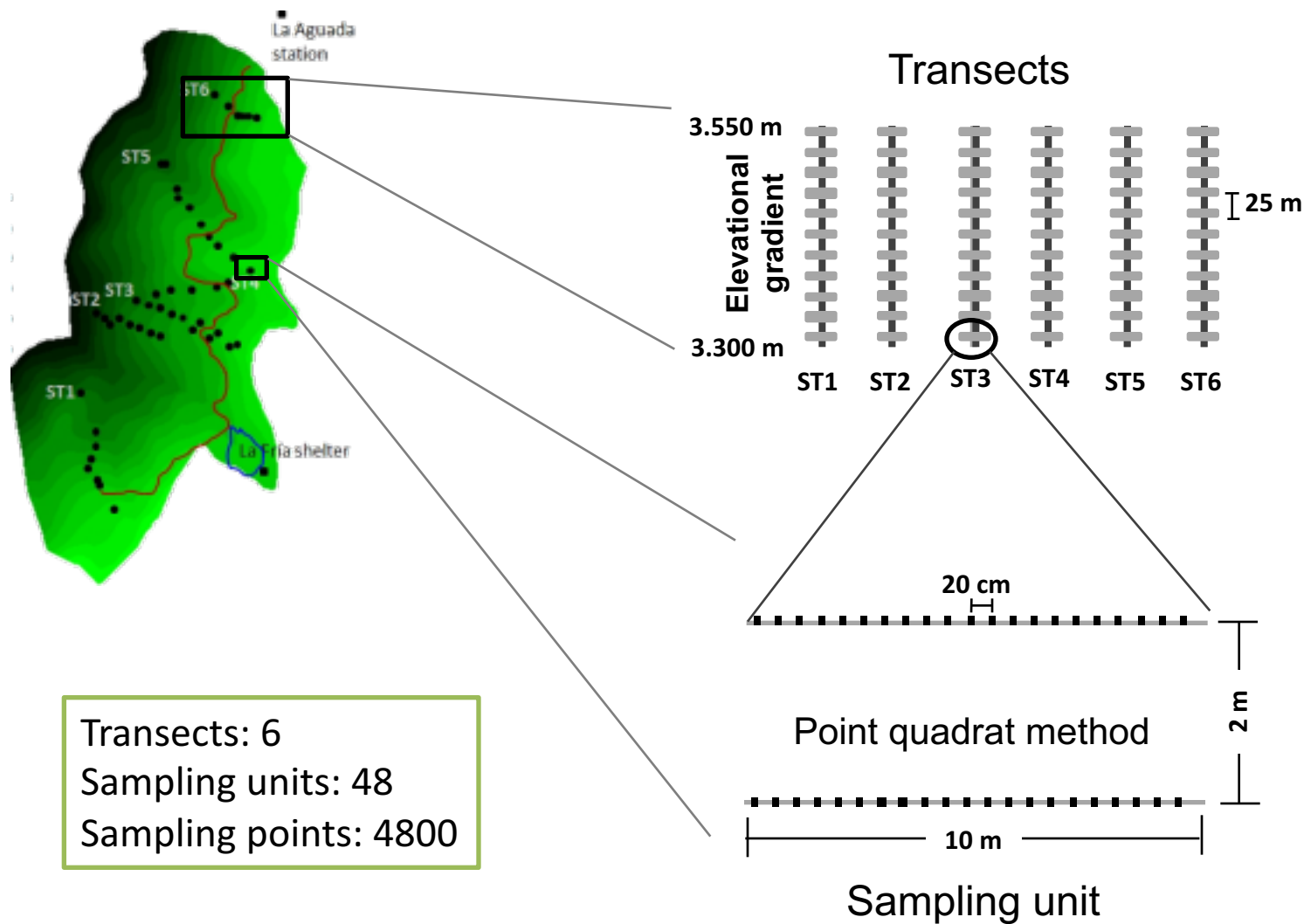


*Grassland-páramo at the top of gradient*

*Mountain forest at the bottom of gradient*







Five plant life-forms were chosen for further analysis based on their relative abundance and structural importance (defining the major vegetation physiognomic types across the treeline ecotone).

### **Plant life-form along the gradient**

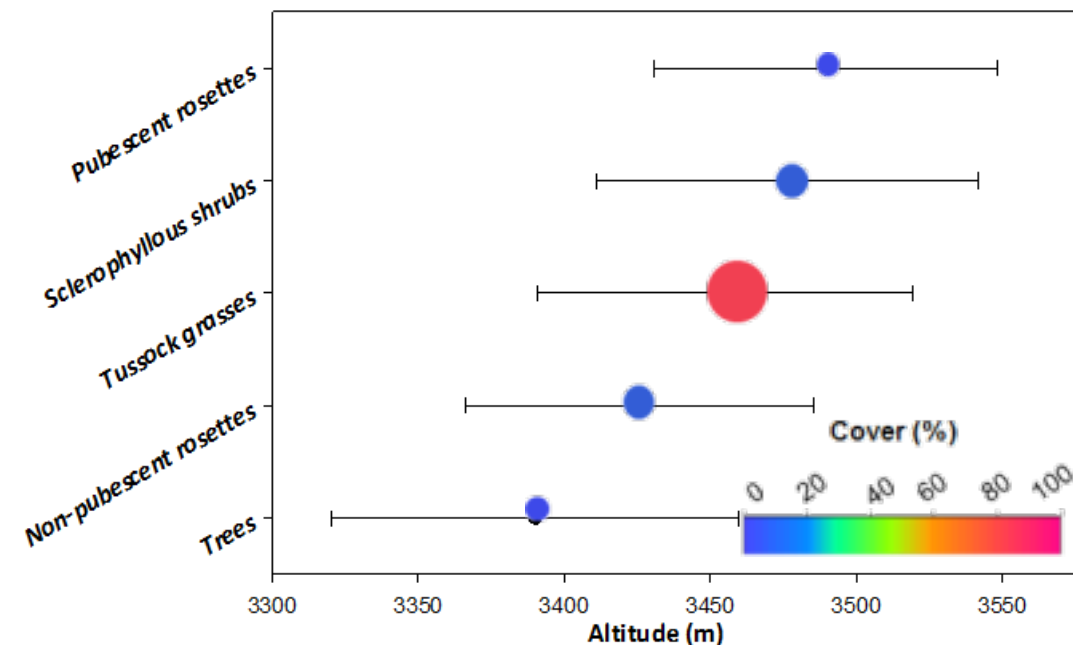
Multiple regression models were performed to analyze the response of cover for each plant life-form as a function of altitude and slope orientation

### **Distribution models**

Regression models were carried out to obtain the predictive models to be integrated into the geographical information system.

### **Temperature change scenarios**

Projections based on climate change models used in the Fifth Assessment Report of the Intergovernmental Panel of Climate Change (AR5)



## Distribution

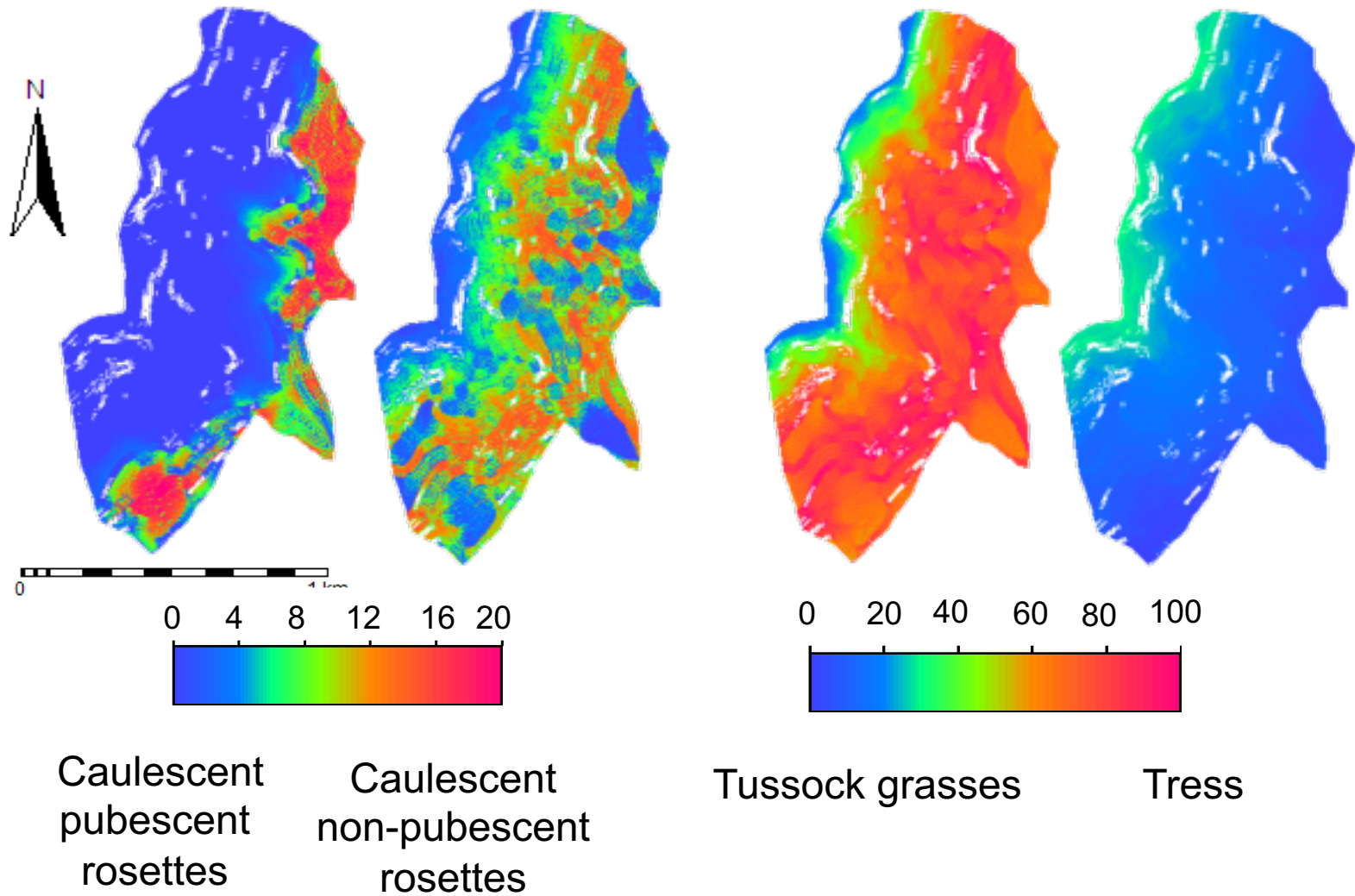
CPR and SS at the top (3489 & 3476 masl).

TG and CNR in the middle (3455 & 3425 masl)

Trees at the bottom (3390 masl)



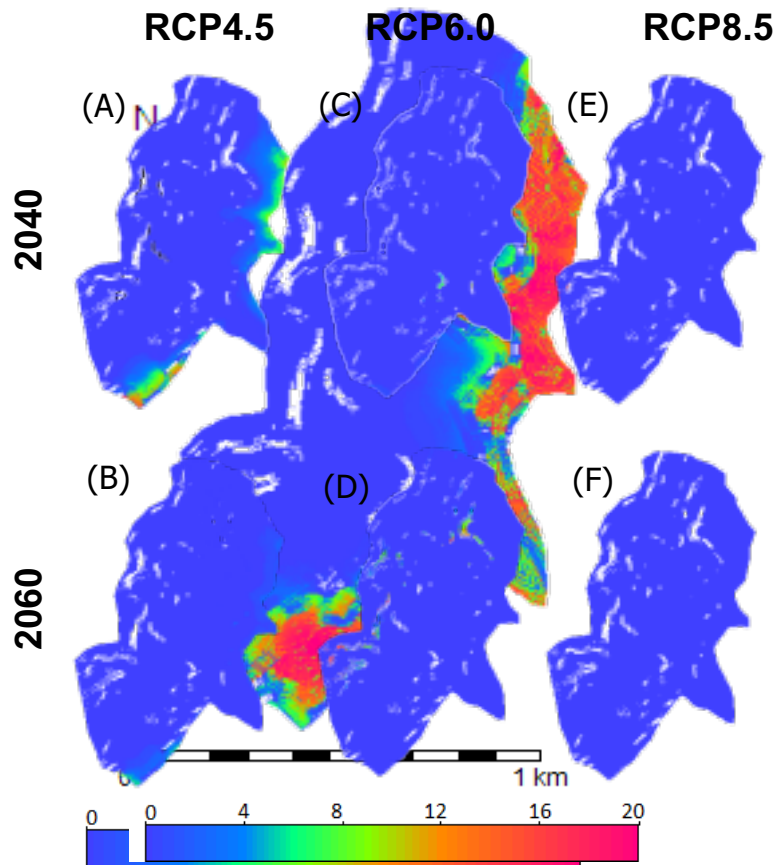
**Results:** Distribution models (current climate conditions)



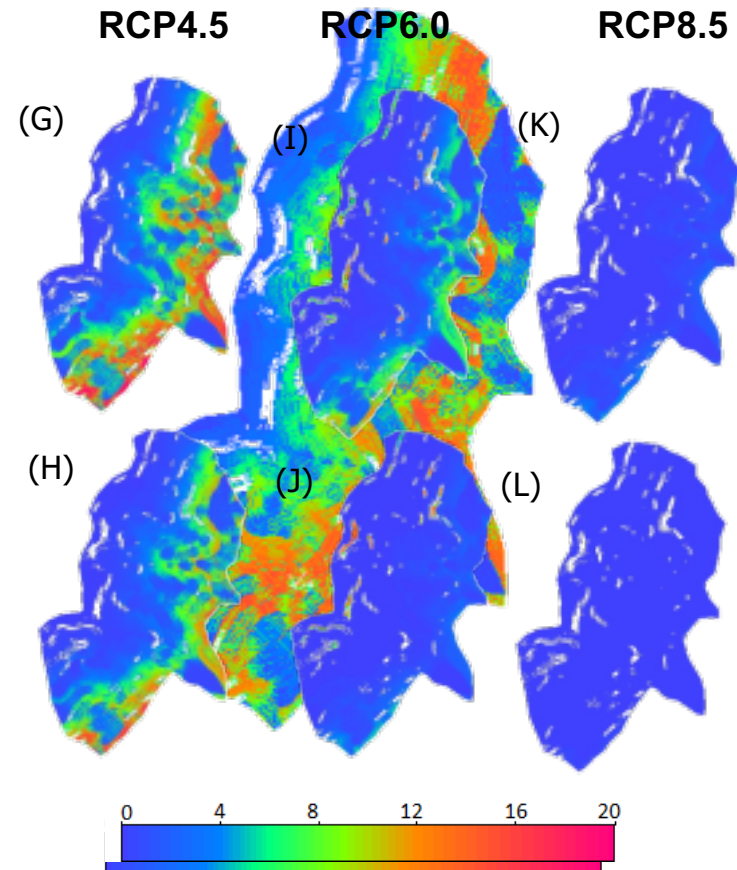
- Hierarchy of climate models: Coupled Model Intercomparison Project Phase 5 (CMIP5) of the World Climate Research Program
- Four Representative Concentration Pathways (RCPs) scenarios were used: RCP2.6, RCP4.5, RCP6.0 and RCP8.5.
- Predictions focused for years 2040 & 2060

	Temperature difference in relation with period 1986-2005 (°C)	
	2025-2055 (2040)	2045-2075 (2060)
RCP 4.5	0.7	0.9
RCP 6.0	1.3	1.9
RCP 8.5	1.8	2.6

### Caulescent pubescent rosettes

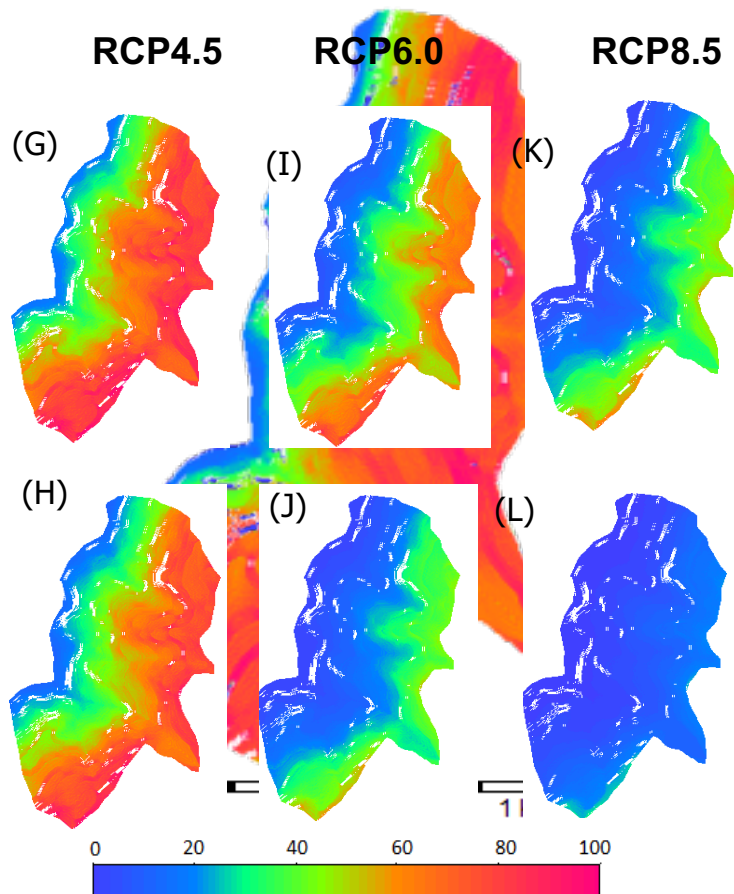


### Caulescent non- pubescent rosettes

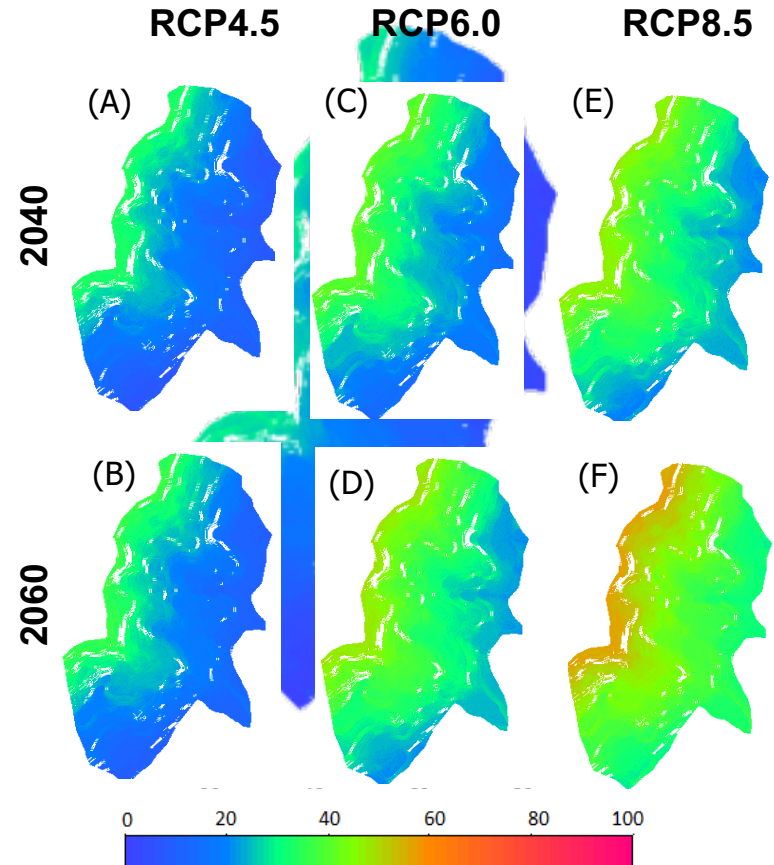




## Tussock grasses



## Trees



- The analysis of plant life-forms distribution facilitates the characterization of changes in the vegetation composition in the tropical treeline, allowing the assessment of abundance of dominant elements of forest (such as trees) on the continuous treeline in relation to other plant life-forms.
- Temperature increments seems to be a driver factor of life-forms upslope shift within the study area,



The background image shows a vast field of small, spiky, yellowish-green plants, possibly a species of bromeliad or similar tropical flora, growing densely on a rocky, brownish ground. The plants are arranged in a somewhat regular pattern, with many small clumps visible across the entire frame. The lighting is bright, casting shadows that emphasize the texture of the plants and the ground.

Thank you very much for your attention!

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