Climate changes and its ef ects on the hydrophysical approach to quant tat ve morphology in catchments.

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Introduct on

The proposal establishes as a hypothesis how the changes in the morphological order of the rivers have been verif ed and are percept ble over the last decades and, in morphometric terms, the total length of the drainage networks are being reduced in the caudal volume of the rivers evidenced in the satellites analyzed.

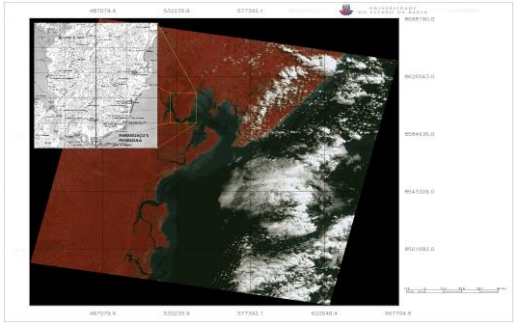

Figure 1. Composit on of a 1973 Landsat image in false color bands 4B, 5R and 6G.
Source: DGSA/INPE -2012

Materials and Methods

The elements of the theoret cal analysis proposed by Horton (1945) was the main methodology used for the development of this research. The morphometric analysis was applied in the coastal hydrographic basins of Recôncavo Baiano region, state of Bahia, Brazil. (Figure 1).

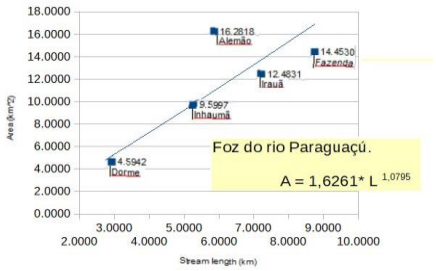

Figure 2. Correlat on between main river length and area for f ve Lithuanian basins.

Morphometric factors were studied the drainage density, the overland f ow length, the stream frequency and, the drainage net composit on. Figure 2 shows the correlat on results obtained for the studied of these parameters. With the parametric determinat ons, evaluat ons using Horton's (1945) surface f ow inf ltrat on theory were studied for the morphophysiographic development of the region's rivers, considering the expected responses to crit cal and extreme events of rainfall observed in the last two decades

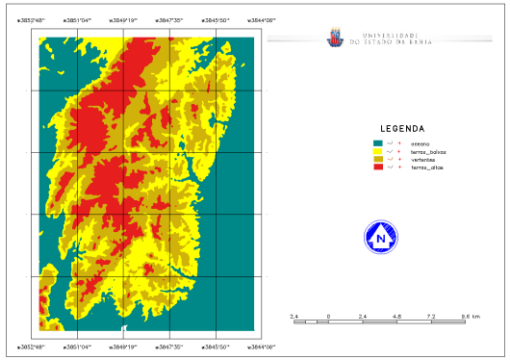

Figure 3. It shows elements of the digit zed cartographic analysis: main rivers, water dividers and contour lines.

The Georeferenced Informat on Processing Sof ware - SPRING (Câmara et al., 1996) allowed a satellite image crit cal evaluat on of the photointerpretat on stage. In addit on, the SPRING allowed an evaluat on of the vector parameters, essent al for the determinat on of the morphometric parameters.

Results and Discussion

In red at Figure 3 shows the preliminary drainage analysis to dangerous area that need a f rst order river protect on. The correlat on between the area and length parameters of the main river involves an approximat on to the equat on obtained by Hack (1954). Figure 2 shows the spreadsheet model used in the development of the regression parameter analysis.

Table 1: A f rst approximat on of the morphological parameters of the f ve basin.

Order of main stream	Area (km²)	Numebr of streams	Numebr of 1st order streams	Stream frequency	drainage density	average length 1st order streams	bifurcation ratio	length ratio	Σ Li	ρ stream length ratio / bifurcation ratio	s
4	16.2818	17	14	1.0441	1.4616	0.7468	2.7983	1.6325	23.7979	0.5834	3
3	4.5942	6	4	1.3069	1.7345	0.8864	2.4496	1.1588	7.9685	0.4731	2
4	9.5997	19	14	1.9792	2.1794	0.7029	2.4803	1.3753	20.9218	0.5545	3
3	12.4831	16	13	1.2817	1.5252	0.7127	1.9999	0.8120	19.0389	0.3060	4
3	14.4530	18	12	1.2454	1.6809	0.6087	3.4642	4.0759	24.2935	1.1766	2

Conclusions

Table 1 shows a f rst approximat on of the morphological parameters of the f ve basin. Given the recent responses of extreme climat c events, visible in the intensity of rainfall over the last two decades, the erosive and deposit onal processes, as a result of the surface rainfall-def ut on relat onship, increased their signif cance for river siltat on.

We should expect over the next decades a signif cant proport on of the reduct on of the depth of the f rst order rivers and consequently their shortening, which can be translated into smaller length rat os, mainly for the f rst order rivers.

Agricultural pract ces of a low technological level and, mainly, by the subst tut on of forests for pasture, without ef ect ve control of surface erosion, must also be expected to increase erosion processes and deposit on. This will also increase the reduct on of the river lengths.

References

Câmara, Gilberto, Ricardo Cartacho Modesto Souza, Ubirajara Moura Freitas, Juan Garrido. 1996. "SPRING: Integrat ng remote sensing and GIS by object-oriented data modeling" *Computers & Graphics*, 20: (3) 395-403, May-Jun.

DSA. 2012 . Divisão de Satélites Ambientais. Centro de Previsão do Tempo e Estudos Climát cos - CPTEC. Inst tuto Nacional de Pesquisas Espaciais - INPE. Accesed May 30, 2012. ht p://sigma.cptec.inpe.br/prec_sat/.

HACK, John T.1957. Studies of longitudinal stream prof les in Virginia and Maryland.*U. S. Geol. Surv. Prof. Paper* (294-B).

Horton, Robert E. 1945. Erosional development of streams and their drainage basins; hydrophisical approach to quant tat ve morphlogy. Geological Survey of American Bullet n; 56: 275-370.

Acknowledgments

In deference to my mother that f ghted during all your life.

DYNAMICS OF THE GLOBAL ATMOSPHERIC CIRCULATION AND THE CLIMATE CHANGE

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Fluctuat ons in the global atmospheric circulat on in 1899-2017, in the classif cat on by BL Dzerdzeevskii considered. Three circulat on epochs ident f ed. Frequency elementary circulat on mechanisms (ECM) in each epoch analyzed.

Long-term f uctuat ons in mean annual air temperature in Northern and Southern hemispheres and the global and also the annual amplitude of air temperature due to changes in the nature of atmospheric circulat on are analyzed.

Part cular at ent on is paid to the last period (1998-2017). During this period, in the lower troposphere maximum meridional transport of air masses is observed (on average 335 days per year). In 93 days on average per year macroprocesses with cyclones at the poles, without blocking processes, with three or four cyclones outputs from low to high lat tudes in each hemisphere observed (type 13). On other days macroprocesses with ant cyclones at the poles, the outputs of the cyclone from low to high lat tudes in two-four quadrants of each hemisphere and the Arct c/Antarct c invasions in their rear, forming a blocking process (types 8 to 12) are marked. As a result, the average annual air temperature in the Northern, Southern Hemispheres and the global ceased to rise each year as in 1981-1997. Although 2016 proved to be the warmest on Earth since 1850.

Due to the growth of the length of the high pressure in winter and summer annual amplitude of air temperature for the present t me is growing. Because of the high pressure over Eurasia winter Atlant c cyclones go to the Arct c, ice in the Kara and Barents Seas decreases. Simultaneous outputs cyclones in dif erent sectors cause the occurrence of natural hazards in dif erent regions.

From a comparison of the variat ons in air temperature with the variat ons in the atmospheric circulat on, it can be seen that the air temperature follows a change in the nature of the circulat on of the atmosphere. The f rst epoch (1899 - 1915), the epoch of blocking processes, was the epoch of cooling: the average global air temperature, as well as the average air temperature of the Northern Hemisphere, decreased. The second epoch (1916 - 1956) is zonal, it became the epoch of the f rst global warming in the XX century, which went down in history as the warming of the Arct c. The third epoch (1957-present t me), the epoch of cyclone out lows from low lat tudes to high, in contrast to the f rst two, breaks up into periods. 1957 - 1969 characterized by an increase in the durat on of blocking processes, which led to a decrease in air temperature.

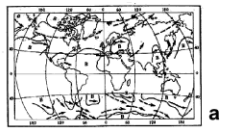

Fig. 1. Comparison of standard schemes of atmospheric circulation over the Northern and Southern hemispheres (Northern - by BL Dzerdzeevskii [1], Southern – by PD Astapenko): a - zonal circulation, b - two meridional blocking processes in each hemisphere, c – three meridional blocking processes in each hemisphere. Dotted arrows - generalized path of cyclones, solid — anticyclones.

Fig. 2. Dynamic schemes of ECM 13w (for the Northern Hemisphere winter): a - Northern Hemisphere (by BL Dzerdzeevskii [1]), b - the Southern Hemisphere.

Fig. 3. Dynamic schemes of ECM 13s (summer in the Northern Hemisphere): a - Northern Hemisphere (by BL Dzerdzeevskii) b - the Southern Hemisphere.

Fig. 4. Dynamic schemes of ECM 1a (zonal circulation, for the Northern Hemisphere winter): a - Northern Hemisphere (by BL Dzerdzeevskii [1]), b - the Southern Hemisphere.

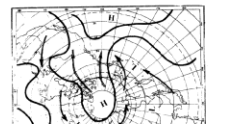

Fig. 5. Dynamic schemes of ECM 7bs (disturbance of zonal circulation, summer in the Northern Hemisphere): a - Northern Hemisphere (by BL Dzerdzeevskii) b - the Southern Hemisphere.

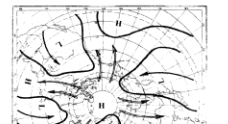

Fig. 6. Dynamic schemes of ECM 12a (group blocking processes, transitional seasons): a - Northern Hemisphere (by BL Dzerdzeevskii [1]), b - the Southern Hemisphere.

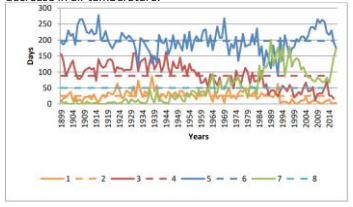

Fig. 7. Durat on of circulat on groups for 1899-2017 : 1 - zonal, 2 - zonal average, 3 - disturbance of zonal, 4 - - disturbance of zonal average, 5 - blocking processes, 6 - - blocking processes average, 7 – cyclones on the poles and cyclone outlets from low to high lat tudes, 8 - cyclones on the poles and cyclone outlets from low to high lat tudes average.

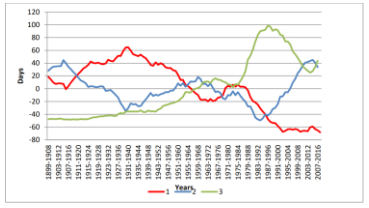

Fig. 8. 10-year smoothed average deviat ons in the durat on of circulat on groups from their average for 1899-2017. 1 - zonal + Disturbance of Zonal, 2 - group of blocking processes, 3 - group of cyclone outlets from low lat tudes to high ones

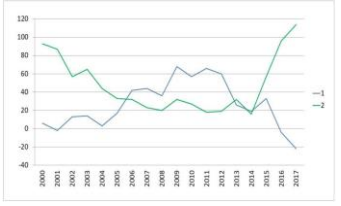

Fig. 9. Deviat ons of the group of blocking processes (1) and cyclone outlets from low lat tudes to high (2) in the 21st century. from their average for 1899-2017.

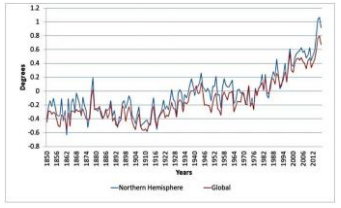

Fig. 10. Deviat ons of the average annual air temperature for the years 1850 - 2017 from the average for 1961-1990.

In the period 1970 - 1980, the durat on of zonal circulat on increased. In addit on, during this period the durat on of all groups was close to the average. It can be assumed that the dynamic schemes built between 1970 and 1978, best ref ect the average posit on of cyclones and ant cyclones at each ECM. Between 1981 and 1997, the durat on of the cyclone out lows from low lat tudes to high was rapidly increased. The air temperature also increased rapidly, reaching a maximum in 1998. Since this year, the durat on of the cyclonic circulat on group has begun to decrease, and the groups of blocking processes have increased. However, now the group of blocking processes is growing mainly due to the ECM with four blocking processes and four cyclone outlets from low lat tudes, so that the number of cyclone outlets, especially in summer, has not changed, so the temperature did not decrease, but f uctuated at the highest level up to 2015, when due to the increase in the durat on of cyclone outcrops from low lat tudes, it again increased.

Meteorological extremes and natural disasters

The most terrible natural disasters in Russia are droughts, natural f res, severe frosts and f oods. The decade of 1931-1940. dif ered from the subsequent by almost annual strong and extensive droughts and minimum average humidif cat on of the territory. By the nature of the circulat on of the atmosphere, this was the peak of the zonal epoch, when on the Eurasian cont nent there were ant cyclones in winter and summer, and Atlant c cyclones were forced to bypass them along the northern coast of Eurasia, facilitat ng navigat on along the Northern Sea Route. The air temperature in the central regions of European Russia and in the Lower Volga region in the winter of 1938-1942. fell below -40ºC. Def ciency of rainfall is also ref ected in the life of glaciers.

In the 21st century, the change in the nature of the circulat on of the atmosphere generates outstanding extremes: an unprecedented drought and natural f res in European Russia in 2010, a severe f ood in the Novorossiysk area in 2002, a catastrophic f ood in the city of Krymsk in 2012, a catastrophic f ood in Primorye in 2013. In May 2014, in the Altai Territory due to heavy precipitat on and melt ng of glaciers, the Ob f owed with tributaries, 33,000 inhabitants, 4,000 houses, bridges, roads were damaged.

With the current nature of atmospheric circulat on (4 simultaneous cyclone outputs from low lat tudes with the most common ECMs 12a and 13s), simultaneous extreme events associated with severe precipitat on in dif erent parts of the hemispheres are not uncommon. So, on May 28, 2014, rains in the Stavropol region, because of which the emergency regime was introduced, took place simultaneously with downpours in the Altai and in China.

Conclusion

Create dynamic diagrams ECM Southern Hemisphere allows us to analyze the global circulat on of the atmosphere.

In the development of the global atmospheric circulat on in the 1899-2014 marked three circulat on epoch: blocking processes, zonal and outputs cyclones from low to high lat tudes dif ering prevalence of certain macro-processes. Fluctuat ons in global average surface air temperature correspond to f uctuat ons of the global atmospheric circulat on.

The modern character of the atmospheric circulat on caused the increases frequency meteorologically due by natural hazards in dif erent regions of the Earth, including the occurrence of simultaneous disasters ice in the Arct c and Antarct c.

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References

1. Dzerdzeevskii BL, Kurganskaya VM and Vitvitskaya ZM 1946. Classif cat on of circulat on mechanisms in the Northern Hemisphere and the characterist cs of synopt c seasons. *Proceedings of research inst tut ons Hydrometeor. Service under the Council of Ministers of the USSR. Ser.* ***2****. Synopt c meteorology; Issue.* ***21****. Central Inst tute of Forecasts. M., L., Hydromet zdat, 80 p.*
2. Dzerdzeevskii BL 1967. Comparison of the main regularit es of atmospheric circulat on over the Northern and Southern hemispheres. *Informat on Bullet n of the Soviet Antarct c Expedit on, No.* ***65****, p.58-68. (BL Dzerdzeevskii, Selected Works, edited by Nauka, 1975, pp. 149-158).*
3. Dzerdzeevskii, B 1962. Fluctuat ons of Climate and of General Circulat on of the Atmosphere in extra-tropical lat tudes of the Northern Hemisphere and some problems of dynamic climatology. *TELLUS, XIV, No* ***3*** *pp. 328-336*
4. Climat c Research Unit Data URL: ht p://www.cru.uea.ac.uk/cru/data/temperature/
5. Weather news, URL: www.meteonovost .ru
6. Kononova NK 2009. Classif cat on of the circulat on mechanisms of the Northern Hemisphere according to BL Dzerdzeevskii. Ed. AB Shmakin; Russian Acad. Sciences, Inst tute of Geography. - Moscow: Voyentekhinizdat, 372 p.
7. Fluctuat ons in the atmospheric circulat on of the Northern Hemisphere in the XX - early XXI century. URL: ht p:www.atmospheric-circulat on.ru
8. Dzerdzeevskii BL 1956. The problem of f uctuat ons in the general circulat on of the atmosphere and the climate. *Al Voeikov and modern problems of climatology. L .: Gidrometeoizdat, p. 109-122.*

With the support

Predictive models of functional connectivity of threatened populations in Special Areas of Conservation of the Natura 2000 network

A project supported by the Biodiversity Foundation of the Ministry for the Ecological Transition (Spain)

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Abstract: In order to increase survival probability of the most valuable threatened species and habitats, the European Community (EC) defined a series of strategies to improve management of sites within Natura 2000, the largest coordinated network of protected areas in the world, so that citizens become involved in their maintenance and new tools are implemented to facilitate joint efforts addressed to biodiversity conservation. The general objective of this project, whose final results are due on May 31, 2019, is to develop a predictive tool that helps to orientate conservation efforts in Special Areas of Conservation (SAC) within Natura 2000 in response to ongoing climate change, so that its impact on reducing the loss of biodiversity can be maximized. Specific objectives include: determining habitat preferences and dispersal patterns of two indicator species of small land vertebrates, particularly sensitive to environmental changes, in the SAC Betanzos-Mandeo, NW Spain; estimating gene flow levels between different parts of the SAC through whole-genome molecular markers obtained by next-generation sequencing; fine-scale mapping of suitable habitats; modelling landscape connectivity with the aid of GIS tools; predicting consequences of landscape modification categorised by key elements on population conservation; assessing social attitudes toward environmental conservation in the SAC; and setting territory management priorities assisted by high-resolution species distribution models. Our contribution will provide a general outline of the global warming scenario in this SAC and describe actions so far implemented under each specific objective of the project.

Background: Because of their generally low dispersal abilities, amphibians and reptiles are among the most vulnerable groups to environmental changes. Here we assess the impact of future climate and land use changes on the distribution of two indicator species (an amphibian and a reptile) within a Special Area of Conservation, where their populations are already considerably fragmented. Both species, endemic to the NW quadrant of the Iberian Peninsula, are considered climatic relics, and listed as "Vulnerable" in the IUCN Red List of Threatened Species.

Chioglossa lusitanica

Iberolacerta monticola

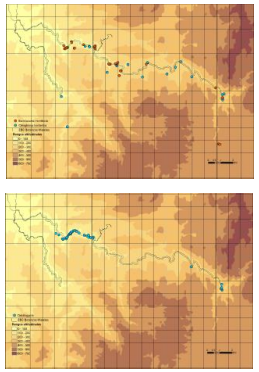
The vulnerability of *Chioglossa lusitanica* is associated to its specialized habitat requirements (wetlands near clear, well-oxygenated streams, with dense surrounding vegetation, or caves and abandoned flooded mines).

As for *Iberolacerta monticola*, it merits this consideration according to its severely fragmented distribution and the continuing decline of its natural environment (mainly rocky habitats, in subalpine and forest zones, although its Western populations, such as those studied here, are also associated to lowland patches of Atlantic forests in shady fluvial gorges).

Climatic change models predict important reductions of the ranges of both species, with the dissapearance of most of their present populations in horizon 2050-2080.

Determining habitat preferences and dispersal patterns of indicator species:

Individuals of *Iberolacerta monticola* and *Chioglossa lusitanica* in the study area were collected, processed (recording of biometric traits, obtention of small tissue sample, photography of diagnostic body patterns) and released.



Dataloggers, each with 2 temperature sensors, were deployed in the study area to obtain comparative measures of temperature among different types of habitat.

Null hypothesis 1: The indicator species continue to be present in the habitat patches where they were recorded years ago (records available from visits to the same sites for the last 25 years).
Null hypothesis 2: The indicator species are present in all patches of "a priori" suitable habitat, according to substrate and average environmental conditions.

- Galán (2014). Basic and Applied Herpetology 28: 113-136.
- Remón, Galán & Naveira (2012). Conservation Genetics 13: 131-142.
- Remón et al. (2013). PLoS ONE 8, 6: 1-15.

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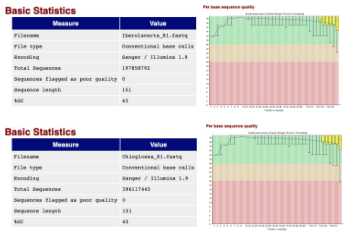
Development of SNP markers using MobiSeq:



We sequenced the whole genome of a single female from each species using a HiSeq X PE150 platform (Illumina).
Genome sizes: *Iberolacerta*, 1.4 Gb; *Chioglossa*, 25 Gb
Coverage: *Iberolacerta*, 26x; *Chioglossa*, 3x.
Then we carried out a "de novo" SNP discovery using flanking regions of transposable elements (MobiSeq).
Number of SNP candidate markers developed:
Iberolacerta, ≈ 33,000 loci adjacent to SINE/MIR;
Chioglossa, ≈ 3,000 loci adjacent to LINE/RTE-X.
Next steps: to obtain the multi-locus genotypes for 48 individuals of each species, and carry out genetic analyses of population structure.

Null hypothesis 1: There is no genetic variation among individuals within species for the candidate loci.
Null hypothesis 2: The individuals of each species were sampled from a single panmictic population.

- Remón et al. (2013). PLoS ONE 8, 6: 1-15.
- Rey-Iglesia et al. (2019). Molecular Ecology 19: 512-525.

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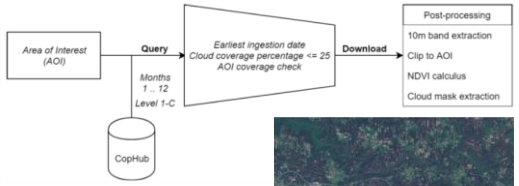
Automatic land-cover classification using remote sensing satellite images:



The Sentinel-2 satellite constellation is an Earth observation mission developed by the European Spatial Agency (ESA) under the Copernicus programme. Two satellites provide high-resolution multispectral images across 13 different spectral bands (413–2190 nm) with spatial resolutions of 10 m (visible light spectrum and near-infrared bands), 20 m (6 red-edge and shortwave-infrared bands) and 60 m (3 atmospheric correction bands), with a high revisit frequency of 5 days at the Equator.
In this project we develop an automatic classification procedure to predict land cover uses from multi-temporal Sentinel-2 satellite image data.

Original Sentinel-2 image product

Prediction result

Null hypothesis: land cover uses and landscape features do not leave characteristic high-resolution spatial and temporal footprints in Sentinel-2 satellite image data.

- Foody (2002). Remote Sensing of Environment 80, 185–201.
- Griffiths, Nendel & Hostert (2019). Remote Sensing of Environment 220, 135–151.
- Immitzer, Vuolo & Atzberger (2016). Remote Sensing 8, 166.

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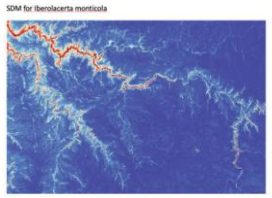
Modelling the distribution of the indicator species:

The distribution of each indicator species is being modelled by applying a máximum entropy (MaxEnt) approach, given presence records and environmental variables. The relative quality of species distribution models (SDMs) is assessed by comparing their areas under receiver operating characteristic curves.



Next steps: to combine gene flow levels and landscape connectivity (using least-cost path analysis) with SDMs to assess the capability of the indicator species to track spatial shifts in suitable habitat as climate changes.

Null hypothesis 1: species are at equilibrium with the environment.
Null hypothesis 2: presence records adequately reflect habitat suitability.

- Ofori et al. (2017). PLoS ONE 12, 9: e0184193
- Teixeira & Arntzen (2002). Biodiversity & Conservation 11: 2167-2176.
- Phillips et al. (2017). Ecography 40:887-893.

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Assessing the social impact of current policies to protect biodiversity:

Through interviews with policy makers, coordinators of non-profit associations involved in the conservation of biodiversity, and small meetings with land owners and people developing economic activities in the neighborhood of the studied SAC, our research team is gathering data to assess how current efforts to combat the loss of biodiversity are perceived by the the human communities on-site, and to detect possible conflicts of interest.

Null hypothesis: current actions to protect biodiversity in the studied SAC are irrelevant for the resident human community.

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