

## **Previous experiences on observatory networks and discussion about the creation of the socio-ecological observatories network for the Andes (ROSA)**

Proposal: Participatory Land Observatories for a Sustainable Andes: Leveraging the tools of Earth observation and land system science to build a network of socio-ecological observatories for the Andes (ROSA).

This workshop was held virtually in Zoom on 14<sup>th</sup> April, 2023 for three hours (10:30-13:30 GMT-3). It aimed to present different experiences of socio-ecological monitoring in the mountains, particularly in the Andes. This is the second workshop of a proposal for establishing a socio-ecological observatories network for the Andes (ROSA), and corresponded to module 1 in the program (which consisted of two virtual workshops before the face-to face meeting to be held in May in Tucuman, Argentina; [Concept](#)). The workshop was organized by researchers from Instituto de Ecología Regional (IER) and Instituto de Investigaciones Territoriales y Tecnológicas para la Producción del Hábitat (INTEPH) from Universidad Nacional de Tucumán - CONICET (Argentina), Freie Universität Berlin (FUB - Germany), Universidad de Los Andes (Venezuela) and the Global Land Program (GLP). The proposal was funded by Future Earth and ESA, and facilitated by CONDESAN.

The workshop included six speakers who presented their previous and current studies on socio-ecological observatories (Table 1, Figure 1). The workshop was moderated by Julieta Carilla, Ricardo Grau and Luis Daniel Llambí. Twenty-two participants attended to the workshop (Appendix 1). Agustina Malizia was in charge of the first presentation, which consisted of an introduction to this workshop. Malizia showed the main goals of ROSA, the structure of the three modules planned for the creation of the network, and the moderators and speakers of this virtual meeting.

Time (GMT-3)	Content	Speaker
10:30-10:45	Welcome and introduction to the workshop	Agustina Malizia IER (UNT-CONICET), Argentina
10:45-11:05	Proposal for the creation of the socio-ecological observatories for the Andes (ROSA) network	María Piquer-Rodríguez, Institute of Geography - Freie Universität Berlin, Alemania
11:05-11:25	Current situation of the socio-ecological monitoring in the Andes	Ezequiel Aráoz, IER (UNT-CONICET), Argentina
11:25-11:40	Mountain observatories	James Thornton, GEO Mountains, Suiza
11:40-11:55	Long-term Social Ecological Research Programmes	Laszlo Nagy, Campinas University
11:55-12:10	Experiences of monitoring networks and participatory systems	Camilo Rodríguez, Facultad de Ingeniería, Universidad del Desarrollo, Chile
12:10-12:20	Survey of potential sites for ROSA and variables monitored	Saskia Flores, CONDESAN, Ecuador
12:20-13:20	Discussion	Luis Daniel Llambí (CONDESAN), Venezuela
13:20-13:30	Conclusions	Ricardo Grau, IER (UNT-CONICET), Argentina



Figure 1. Program and flyer of speakers of the second ROSA workshop .

In the second presentation, María Piquer-Rodríguez showed results of a compilation of existing environmental and social monitoring efforts in the Andes (sources: Carilla, Araoz et al in press, and a recent survey responded by the participants). Piquer-Rodríguez also, presented a map of the geographical distribution of these monitoring projects superimposed on a map of SELS (land typologies of South America based on biophysical and socioeconomic) from Zarbá et al. 2022 (<https://doi.org/10.5751/ES-13066-270227>). This map will be the basis for rescaling Andean SELS (under preparation). Particularly, in the Andes there are monitoring projects of climate/hydrology, fauna, wetlands, biotic interactions, socio-environmental features, vegetation, and disturbances. A table of monitoring variables versus number of projects in the Andes was presented. Vegetation and disturbances in the first place, and climate/hidrology in the second place were the most monitored variables. The SELS with the most number of monitoring projects were 1. Intensive, connected hilly agropastoral systems with a long colonization history, and 2. Arid and semi-arid highlands and adjacent coasts, with a long history of agriculture and mining. This presentation was useful to understand the lack of integration of social and environmental variables in the socio-ecological systems of the Andes, and that monitoring projects are not equally distributed in this region.

In the third presentation, Ezequiel Aráoz presented a diagnosis of socio-ecological monitoring in the Andes. Aráoz showed a conceptual model of a socio-ecological system that includes the actors that are part of it (biophysical and social scientists, community, governments / states) and the internal and external factors that influence the system (e.g. climate change, international legislation and telecouplings). In addition, Aráoz showed different methodologies to understand changes in socio-ecological systems (corresponding to priorities in research in monitoring, from Carilla, Araoz et al. in press) such as: 1. Fire maps as an indicator of processes of land-use de-intensification in rural systems. 2. Nightlights as an indicator of the densification and growth of urban systems, which are the main users of natural resources. 3. The use of data from permanent plots whose information can be extrapolated to larger scales. 4. Biological databases such as GBIF, BIEN, GLORIA, RBA that are useful to study the influence of cities on exotic species invasion. The main conclusions of the diagnosis were related to the need of 1. advancing in the conceptualization of what a socio-ecological system, which is more complex than the sum of biophysical and social variables. 2. defining the methodology to study a social-ecological system, because the information recorded is not always extrapolated to different scales. 3. finding a way to evaluate which questions are of interest to the community, which do not always agree with the interests or work topics of scientists.

The last three presentations showed different experiences on social-ecological monitoring in mountains at global, regional and local scales. James Thornton

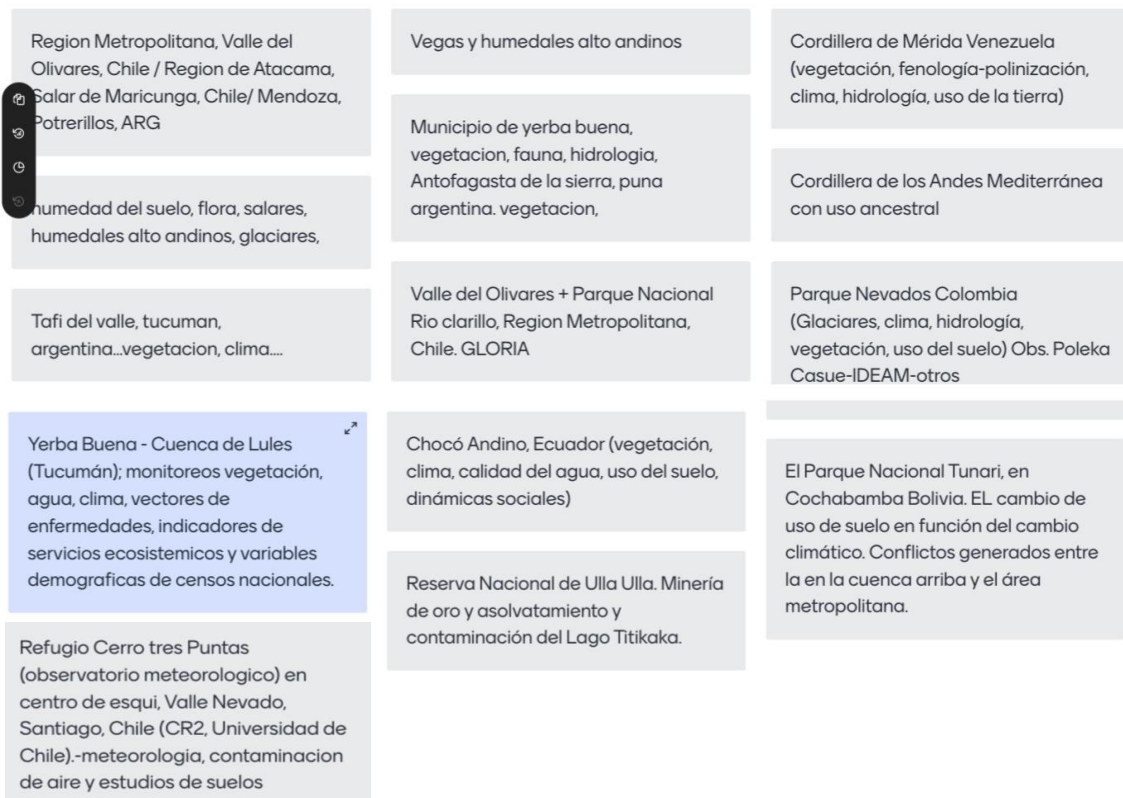
presented the network of mountain observatories of MRI (Mountain Research Initiative). This network was established in 2015 and consists of "super sites" that function as regional monitoring centers, where several variables, such as climate and hydrology, land use, governance are monitored. Next, Laszlo Nagy presented long-term socio-ecological research programs, with special emphasis on the monitoring carried out in Campos do Jordão (Brazil), where different variables, such as deforestation, tourism, invasion of exotic species, fragmentation and urbanization are studied. Finally, Camilo Rodríguez Beltrán presented his experience in monitoring networks and participatory systems at the local scale in Chile. It consists of systems co-designed between scientists and the local community to monitor air and water quality, soil health and biodiversity, among others.

Attendants and speakers discussed and commented several points throughout the presentations, which are clarified in the defining bases for ROSA, currently under preparation for the face-to-face meeting:

1. Regarding the diagnosis of the social-ecological systems of the Andes, on the one hand A. monitoring currently carried out in the SELS is not necessarily related to the predominant uses that define them, because scientists have traditionally been more focused on monitoring vegetation in areas with relatively low human influence; on the other hand, B. the social component is underrepresented.
2. It is necessary to advance in defining what a socio-ecological system is, whose conceptualization encompasses more than the sum of social and ecological variables.
3. ROSA's work approach could focus not only on seeking answers (data, quantifiable results) but also on monitoring what questions society is asking about the socio-ecological systems they inhabit. These questions change over time and we can look for ways to obtain them using new technological tools such as artificial intelligence or web scraping.
4. It is important to define what we want to monitor, because the socio-ecological systems in the Andes are very heterogeneous and it is difficult and ambitious to study all their components and functioning. In this sense, we must take into account our common interests, work topics and existing monitoring to define a common ground.
5. We must select one of the two ways of approaching socio-ecological systems: bottom up approach (starting from the integration of existing monitoring) or top down approach (implementing a new monitoring protocol common to all network participants).

**The main conclusions of the workshop** were: 1. Advancing on the conceptualization of what socio-ecological system is and which variables or components of the system we want to monitor in the Andes (i.e., selecting priorities). 2. Selecting either a bottom-up or top-down approach to start working as a network to integrate our existing data. 3. Finding ways to incorporate the social component in monitoring, since socio-ecological variables are understudied in this region. 4. Considering how to organize data (e.g. sites, municipalities or other scales (data structure). 5. Advancing in the incorporation and integration of ROSA in one the global networks (GLP, GNOMO?) and how to get funding (LT(S)ER, GMBA, MRI, CONDESAN). 6. Planning ROSA as an evolutive network that can start from simplicity (based on the integration of existing data) to complexity in the long term (protocols, experiments, education; understand how the system works and moving from only biophysical variables monitored to the incorporation of more social components).

At the end of the workshop, we shared with the participants an **open-answer survey** (using the mentimeter tool) to ask which sites can be selected as socio-ecological observatories in the Andes and which variables are monitored in those sites. The answers highlighted about seven potential learning sites: Tafi del Valle and Yerba Buena, in Tucumán. Chocó Andino in Ecuador, Cordillera de Merida in Venezuela, Valle de Olivares, Cerro tres Puntas, and other areas from Chile, Tunari National Park in Bolivia (Figure 2).



**Figure 2.** Results from Mentimeter developed during the workshop.

Other files derived from the workshop:

File with [useful links](#) shared during the workshop

[Folder](#) with speaker's presentations and the recording of the workshop

Appendix 1. List of attendants

	Name	Afiliation	Country
1	Andrea Arias	UCC	Bolivia
2	Agustina Malizia	IER, UNT-CONICET	Argentina
3	Camilo Rodríguez Beltrán	UDD	Chile
4	Ezequiel Araoz	IER, UNT-CONICET	Argentina
5	Ferran Gascon	ESA	Italy
6	Julieta Carilla	IER, UNT-CONICET	Argentina
7	Laszlo Nagy	Universidad de Campinas	Brasil
8	Lucía Zarbá	INTEPH	Argentina
9	Luis Daniel Llambí	A@A	Venezuela
10	Luis Phillips	UCC	Bolivia
11	Manuel Peralvo	CONDESAN	Ecuador
12	María Piquer-Rodríguez	FUB	Germany
13	James Thornton	Geo Mountain	Switzerland
14	Nicolás Cuvi	Flasco	Ecuador
15	Oriana Osinaga Acosta	IER, UNT-CONICET	Argentina
16	Patricia Breuer	Universidad del Desarrollo	Chile
17	Petra Wallem		Chile
18	Ricardo Grau	IER, UNT-CONICET	Argentina
19	Saskia Flores	CONDESAN	Ecuador



20	Sergio Ceballos	IER, UNT-CONICET	Argentina
21	Wanderley Ferreira	UCC	Bolivia
22	Zöe Fleming	Universidad del Desarrollo	Chile