

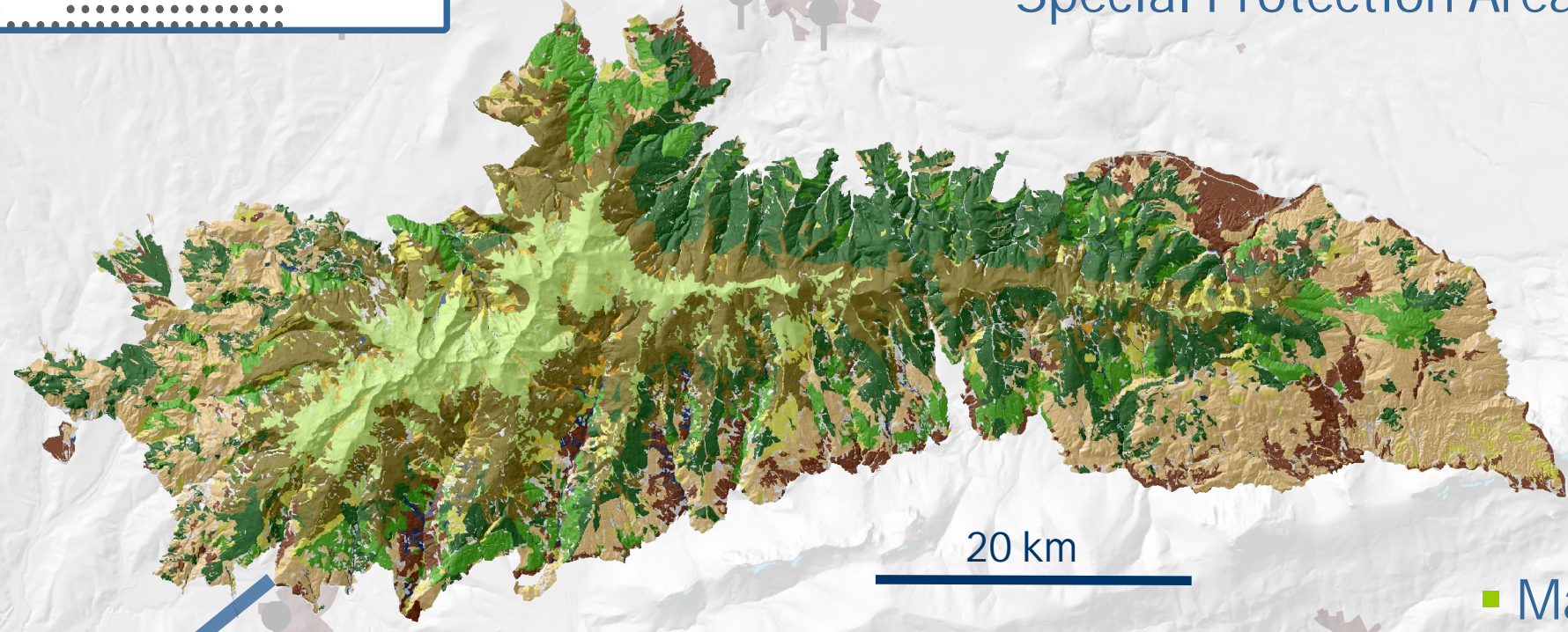
Sierra Nevada (Spain) LTER platform: Towards adaptive management of mediterranean ecosystems

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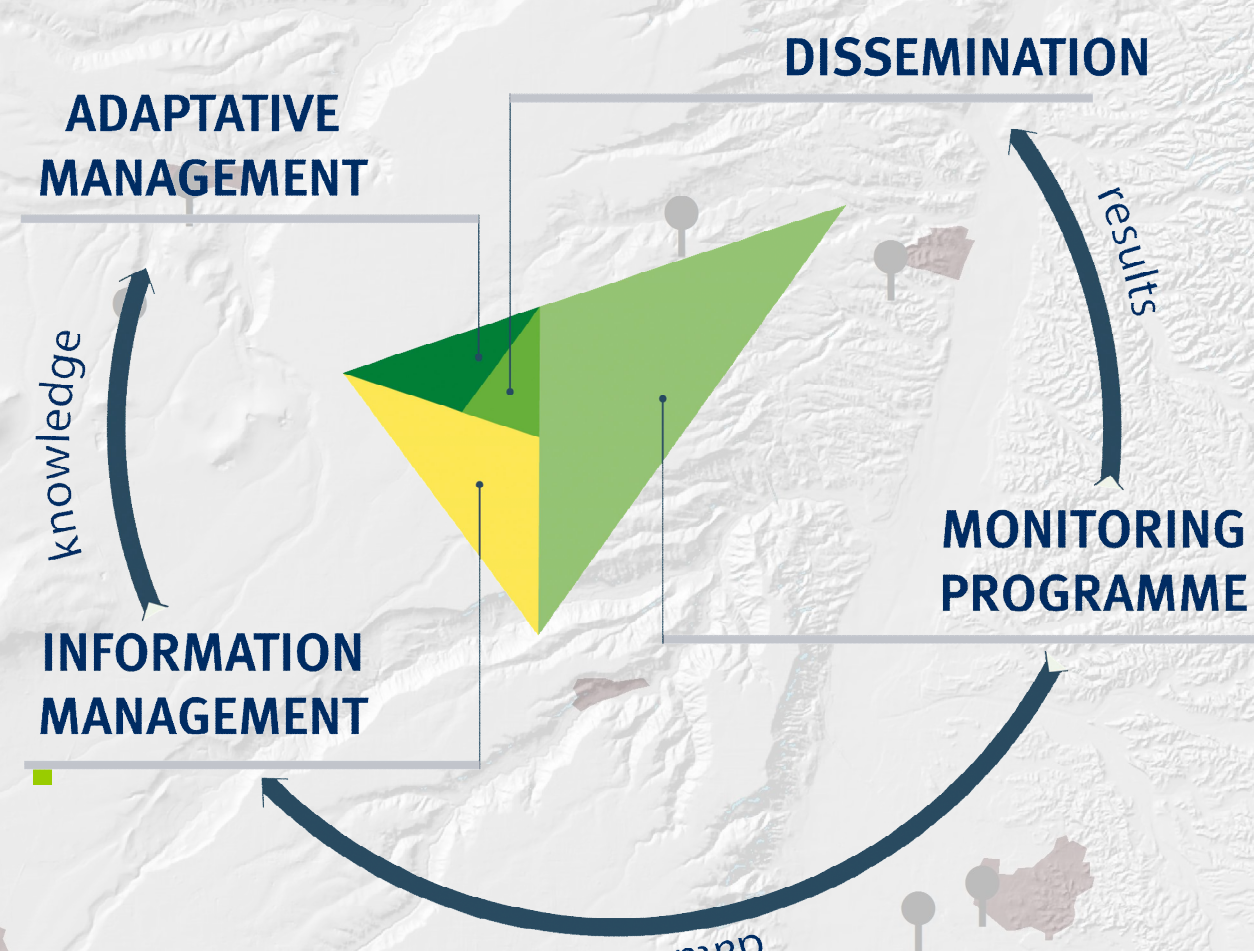
Sierra Nevada LTER site

Sierra Nevada is a high mountain range (reaching 3482 m. a. s. l.) located in Southern Spain. It's considered one of the most important biodiversity hotspot in the Mediterranean region.

- Natural Biosphere Reserve (MaB, UNESCO)
- Special Protection Area and Site of Community Importance
- National Park and Nature Reserve
- LTER-site (LTER-Spain network)
- 2100 vascular plant species
- 80 vegetal endemic species
- 2000 km² surface
- 61 municipalities
- 90.000 inhabitants
- Main economic activities: agriculture, tourism, beekeeping, mining and skiing.



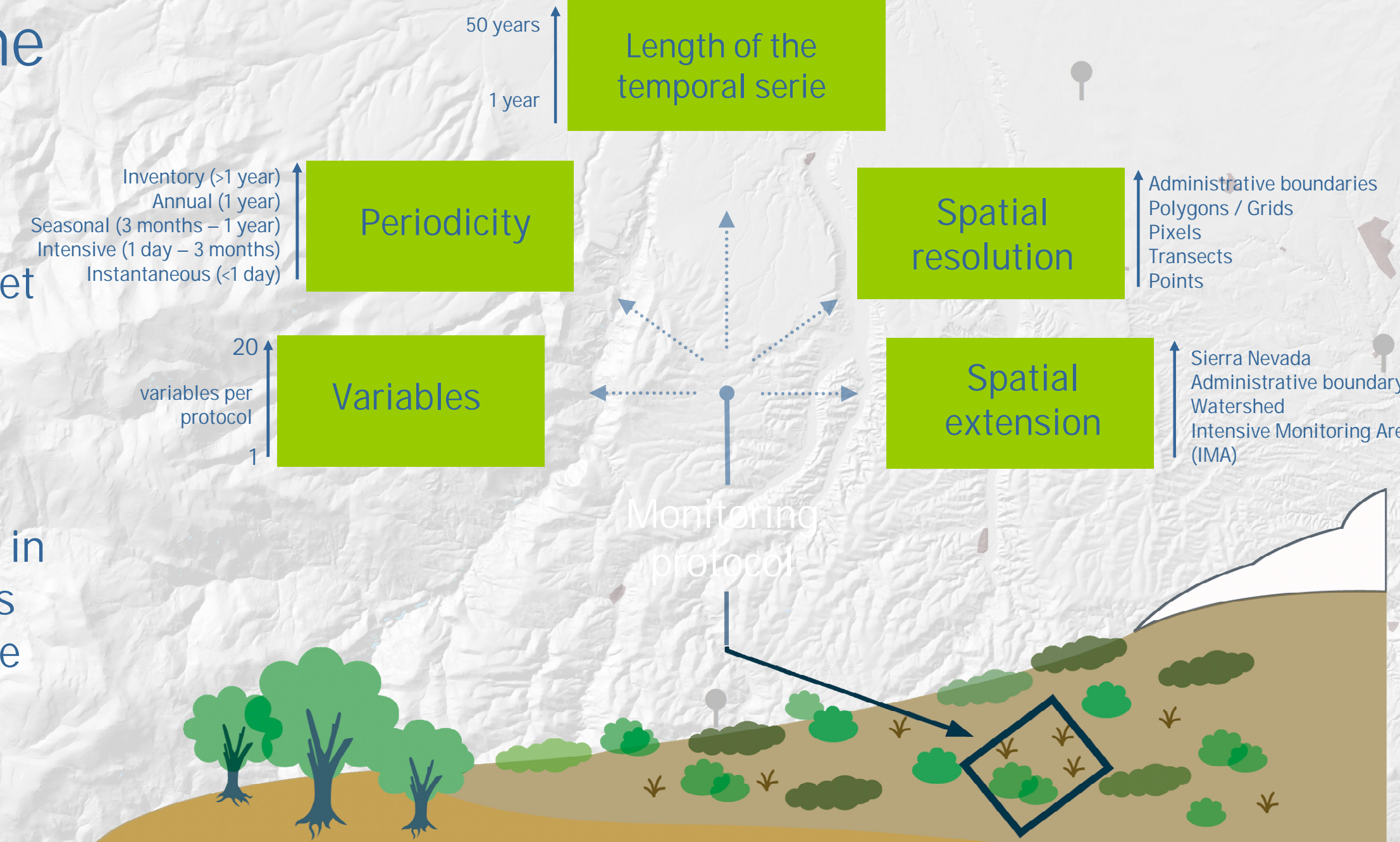
Sierra Nevada Global Change Observatory: the project



Sierra Nevada Global Change Observatory is a *long term monitoring programme* to assess the effects of global change in this LTER site. The basic objective to gather information to identify the impacts of global change in order to design management actions that minimize them. The data generated by the monitoring programme must be transformed into useful knowledge to be useful for managers. The key issues are the *integration and analysis* of monitoring data by an information management system, and the *transfer of current scientific knowledge* to society and the natural resource managers through effective *outreach*.

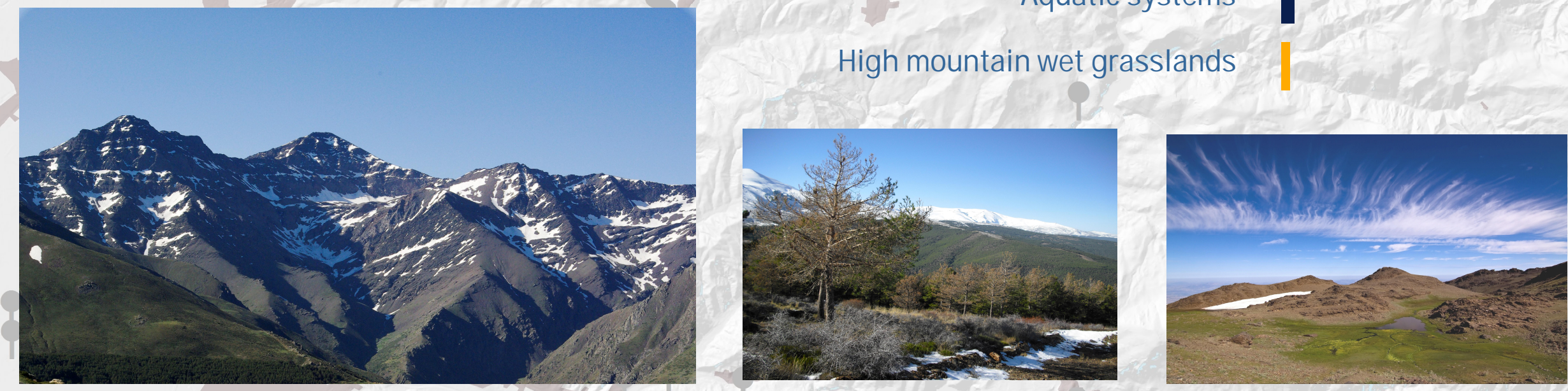
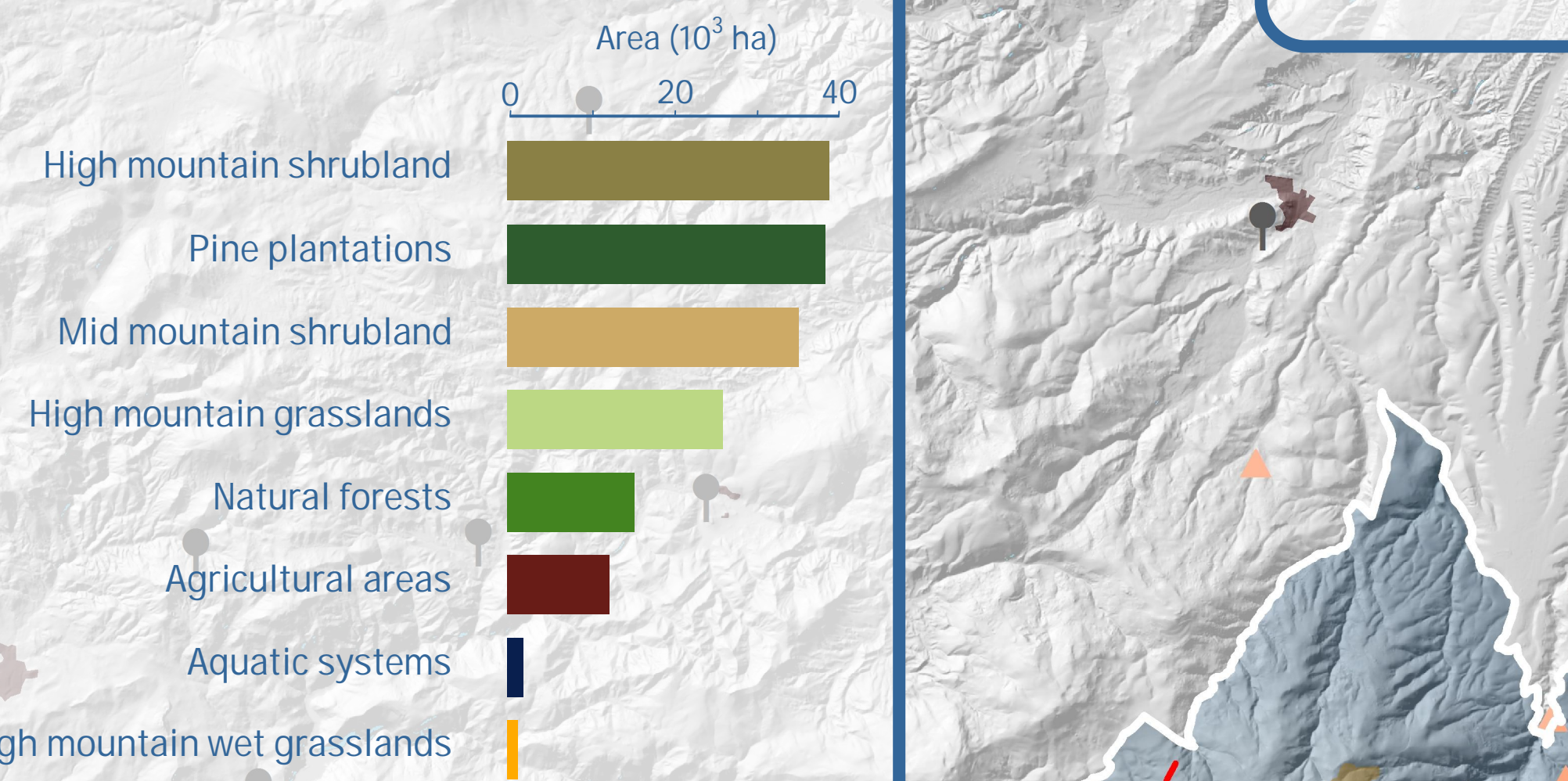
Monitoring Programme

The design of the monitoring programme is based on the thematic areas of GLOCHAMORE Research Initiative (UNESCO). A set of 48 different monitoring methodologies were defined to assess both the state of key ecological functions and the structure of the main ecosystems in the Sierra Nevada. It also includes methodologies to characterize the socioeconomic activities. Each protocol is characterized by 5 attributes (see right figure).



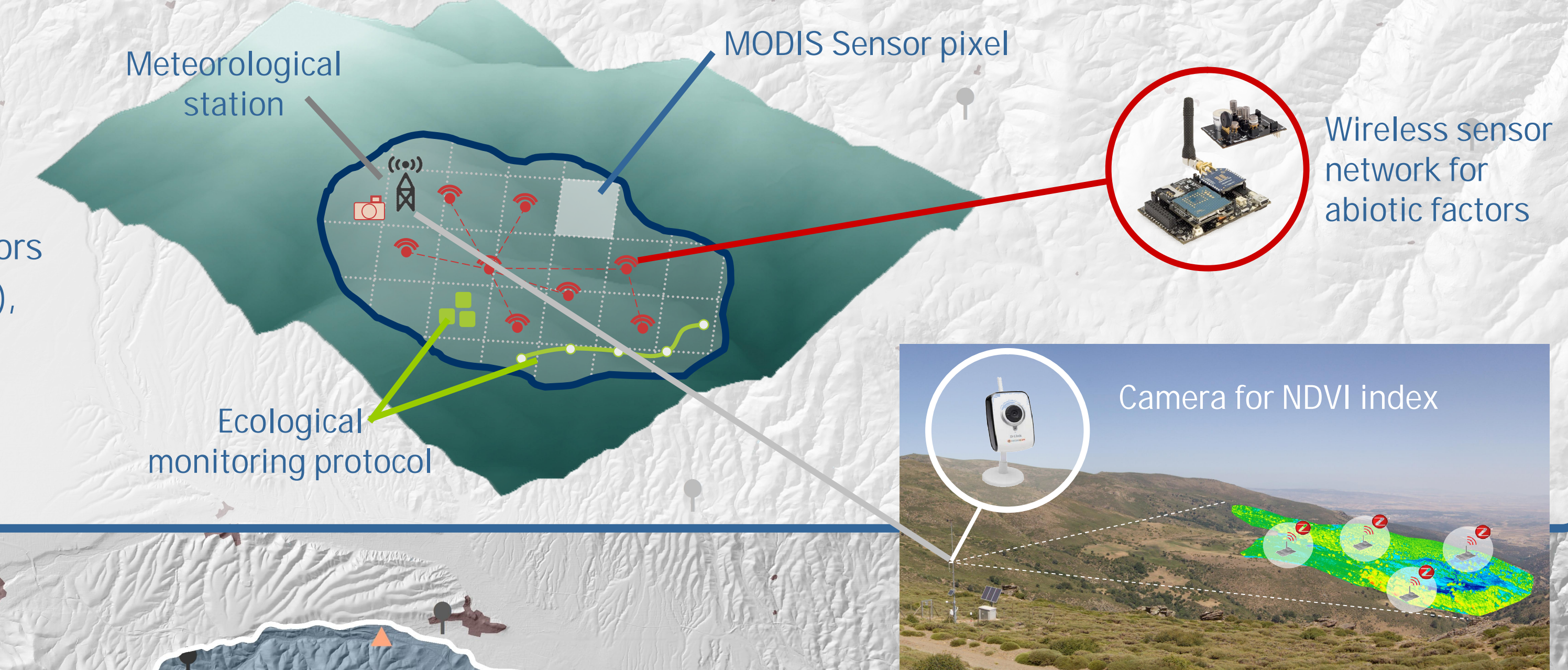
Types of ecosystems

The map shows the spatial distribution of ecosystems that have been identified in Sierra Nevada. Vegetation is predominantly high mountain shrublands and pine plantations. We also have natural forests (oaks, Pyrenean oaks, maples, etc.) that are regenerating after decades of overexploitation.



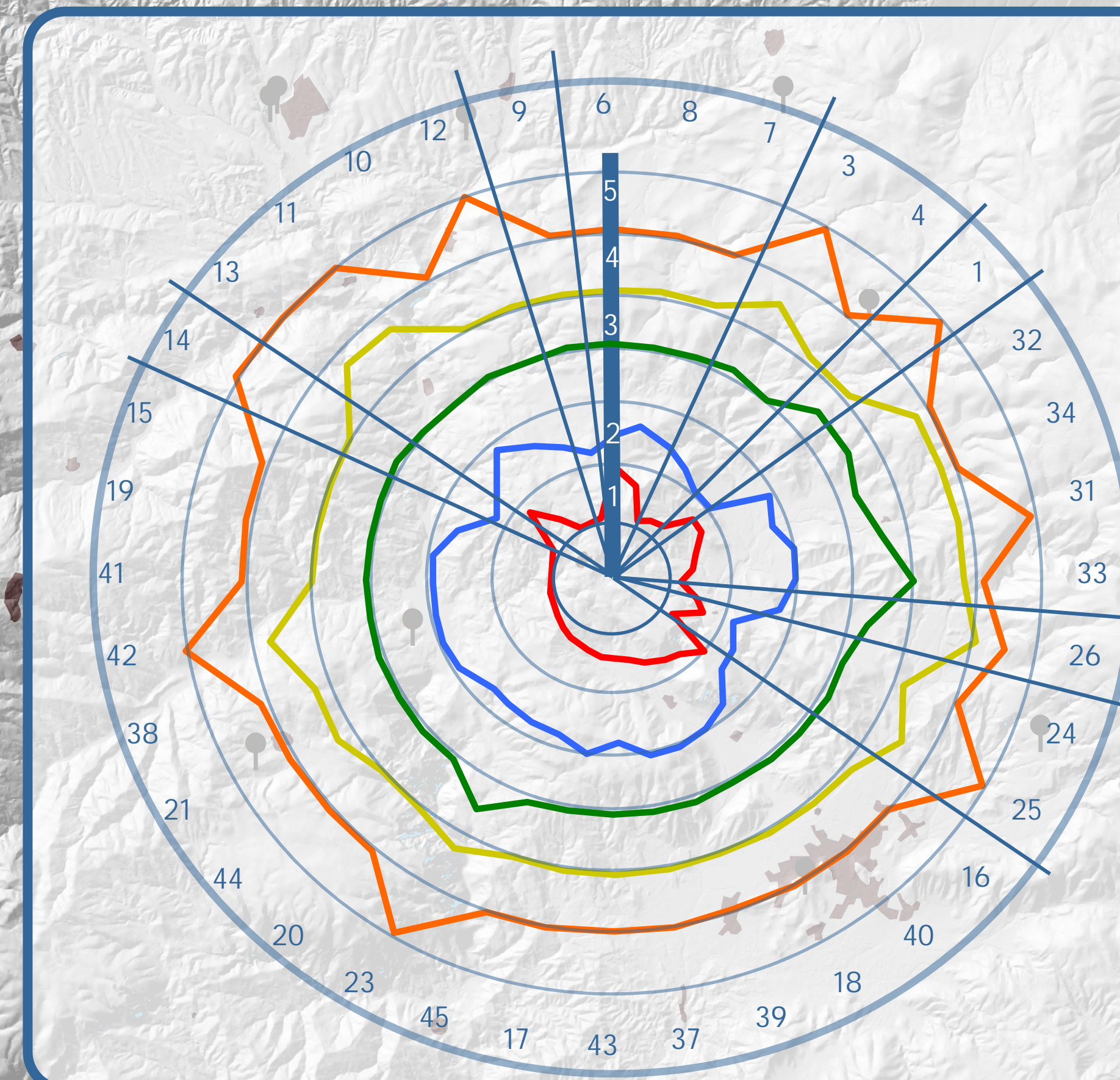
Highly instrumented areas

These are areas with high density of ecological monitoring protocols located around a meteorological station. They also include a wireless sensor network to measure abiotic factors (temperature, moisture, CO₂ concentration, etc.), as well as a camera obtain vegetation indexes.



Monitoring methodologies - legends

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|--|--|--|
| 1. Meteorological stations | 16. Population trends of threatened flora | 40. Passerine bird monitoring |
| 4. Snow monitoring stations | 17. GLORIA's project plots | 41. Amphibians |
| 6. Streams and Lakes Physicochemical | 18. Juniper-genista thickets along an altitudinal gradient | 42. Reptiles |
| 7. Macroinvertebrate sampling | 19. Natural forest and high mountain shrubland | 43. Monitoring butterflies |
| 8. Monitoring brown trout | 20. High mountain wet grasslands | 44. High mountain terrestrial arthropods |
| 9. Air pollution | 21. Riparian forests | 45. Pine processionary caterpillar |
| 10. Monitoring forest restoration treatments on post-fire vegetation | 23. Iberian ibex monitoring | 3. Monitoring the snowfall profile by MODIS sensor |
| 11. Evaluation of forest management in oak-forest | 25. Eddy-covariance stations | 24. NDVI index from satellite images |
| 12. Evaluation of forest management in pine plantations | 32. Detailed characterization of vegetation changes 1956-present | 26. Socioeconomic characterization |
| 13. Evaluation of forest management in Juniper-genista thickets | 37. Micromammals monitoring | 31. Historic vegetation map from orthophotography |
| 14. Emerging infectious diseases on Spanish ibex | 38. Monitoring of mammals carnivores | 32. Reconstructing landscape history by compiling historical documents |
| 15. Phenology | 39. Raptors | 33. Retrospective analysis of forest management |



This graph shows in a very synthetic way most of the monitoring protocols that we are carrying out in Sierra Nevada. Each protocol is represented as a number (see legend at the left). Its characteristics are represented as parts of the radial graph. Each color line shows one of the 5 properties used to classify the protocols (see sector legend at the right).

