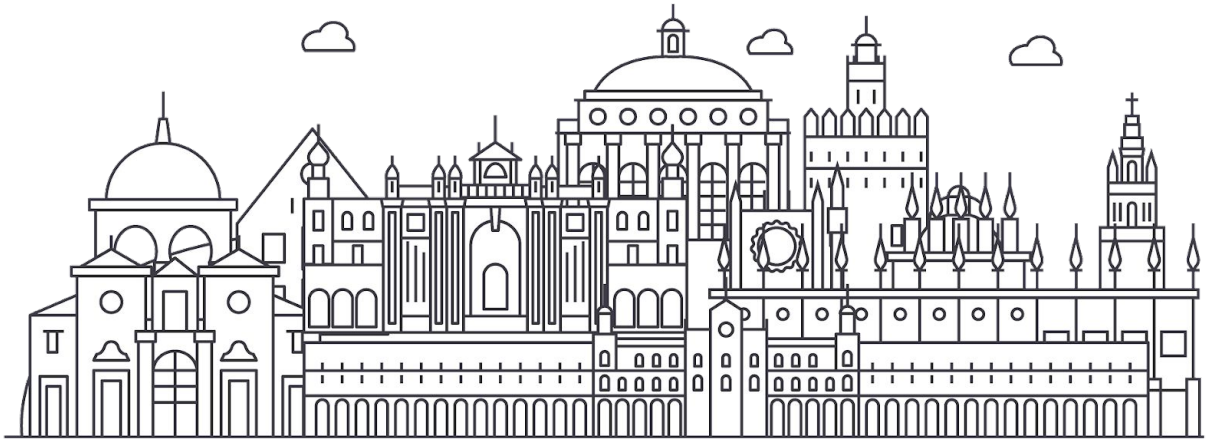
# BEeS

The LifeWatch ERIC Biodiversity & Ecosystem eScience Conference



Seville
22-24/05/23

Threats and challenges to biodiversity and ecosystem conservation from an eScience perspective

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# Essential Ecosystem Service Variables and Models in Mountain Areas: A case study in Sierra Nevada (Spain)

Ecosystem services (ES) are increasingly important for society under the ongoing global and climate change scenarios

**The study and conservation of biodiversity and ecosystem services in mountain areas require tools to monitor their supply and demand**

# Development of several Ecosystem Services models

- Water
- Grazing
- Aboveground carbon storage
- Seed dispersal
- Cultural services
- Land use/land cover (LULC) change

# Models have been developed in the Sierra Nevada Protected Area

## Prototypes for generally applicable models in mountain áreas

### They combine

- Remote sensing data (airborne and satellite sensors)
- Bioclimatic data
- Ancillary data (social media text and images, digital elevation models, etc.)

# Sierra Nevada Protected Area

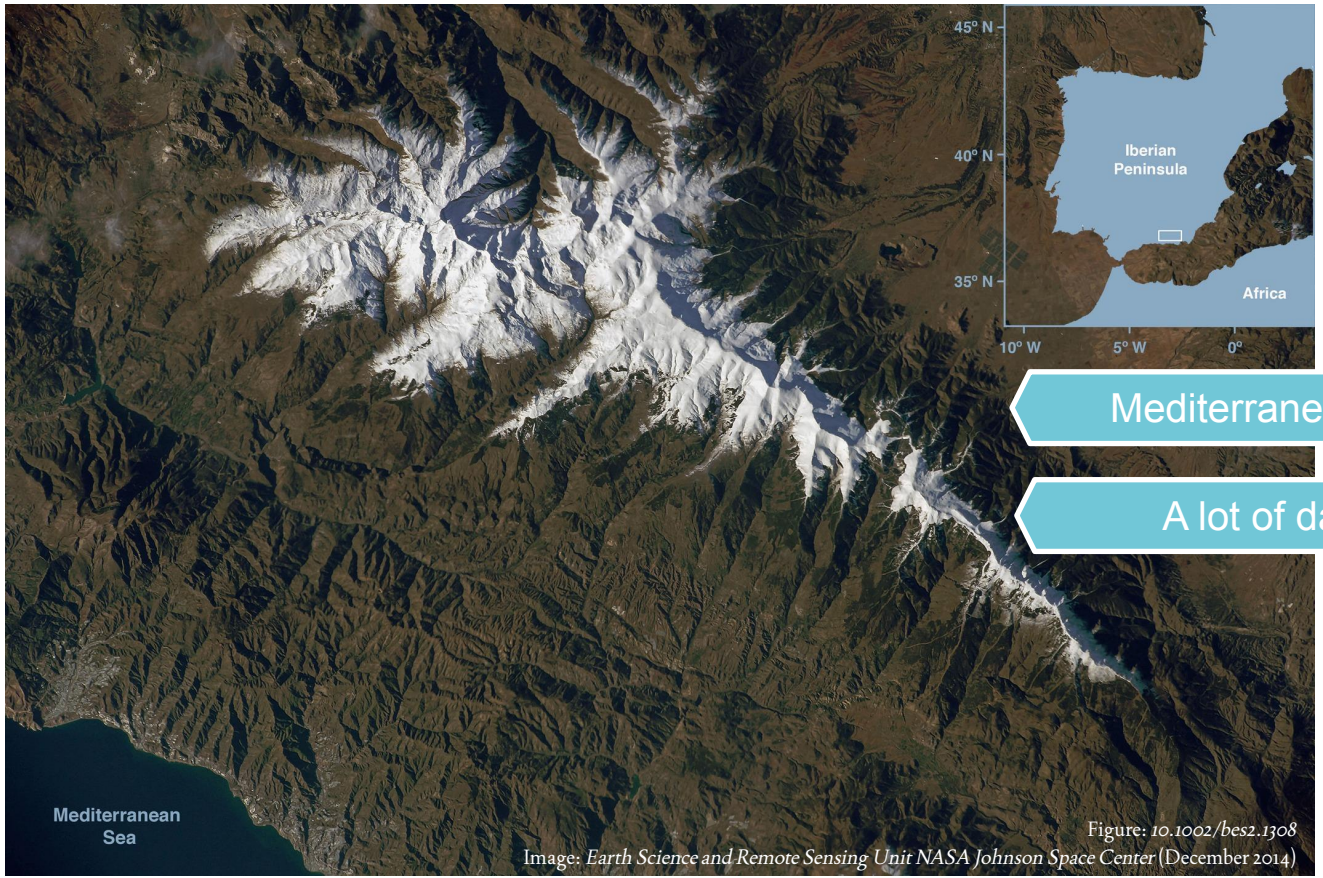


Figure: *10.1002/bes2.1308*
Image: *Earth Science and Remote Sensing Unit NASA Johnson Space Center* (December 2014)

Mediterranean biodiversity hotspot

A lot of data on this mountain

- Centuries
- Legally declared as Global-Change Observatory
- Focus of many scientists

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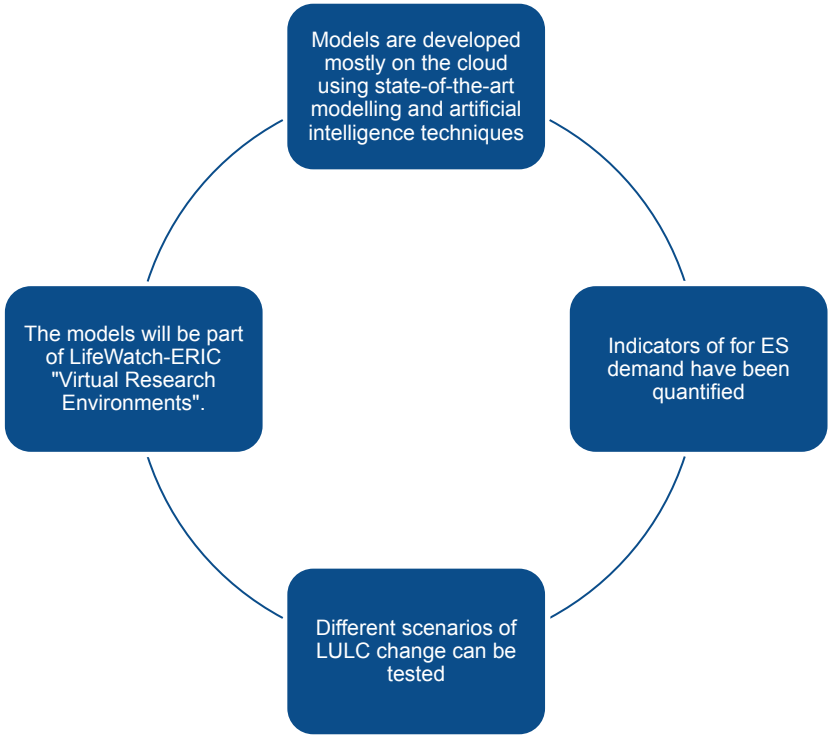
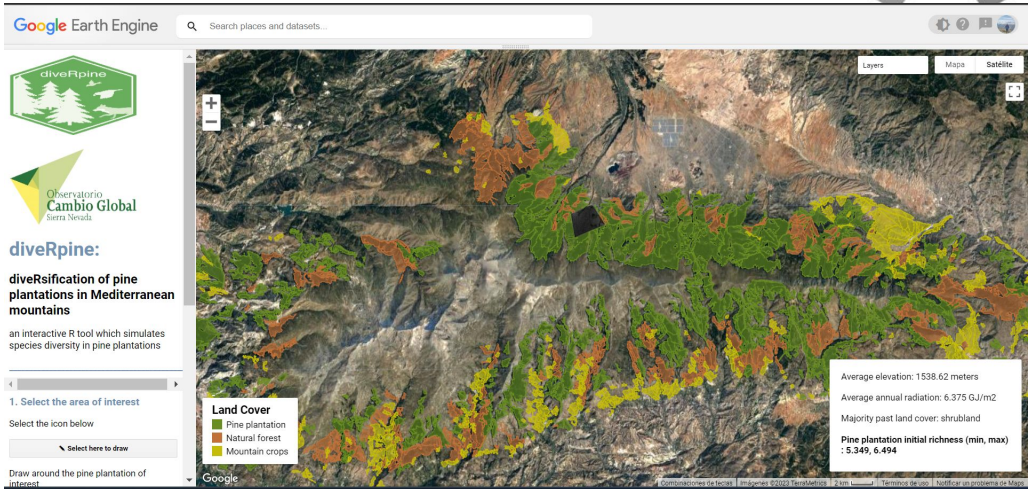

Models are developed mostly on the cloud using state-of-the-art modelling and artificial intelligence techniques
Indicators of for ES demand have been quantified
Different scenarios of LULC change can be tested
The models will be part of LifeWatch-ERIC "Virtual Research Environments".

# Seed dispersal

*Pérez-Luque and Zamora, 2023. diveRpine: Diversification of pine plantations in Mediterranean mountains. An interactive R tool to help decision makers. Ecological Indicators. doi:10.1016/j.ecolind.2023.110021*

- Elevation (DEM)
- Annual Radiation (Global Solar Atlas)
- Tree Density (LiDAR )
- Pine plantation patches
- Natural Forest patches
- Cropland patches
- Past Land Cover
- Abundance of dispersers (based on literature)
  - •Small Birds
  - •Medium Birds
  - •Mammals

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# Grazing

*Passera 1999 (EEZ-CSIC)*

Grassland/shrubland cover

Experimental regression equations

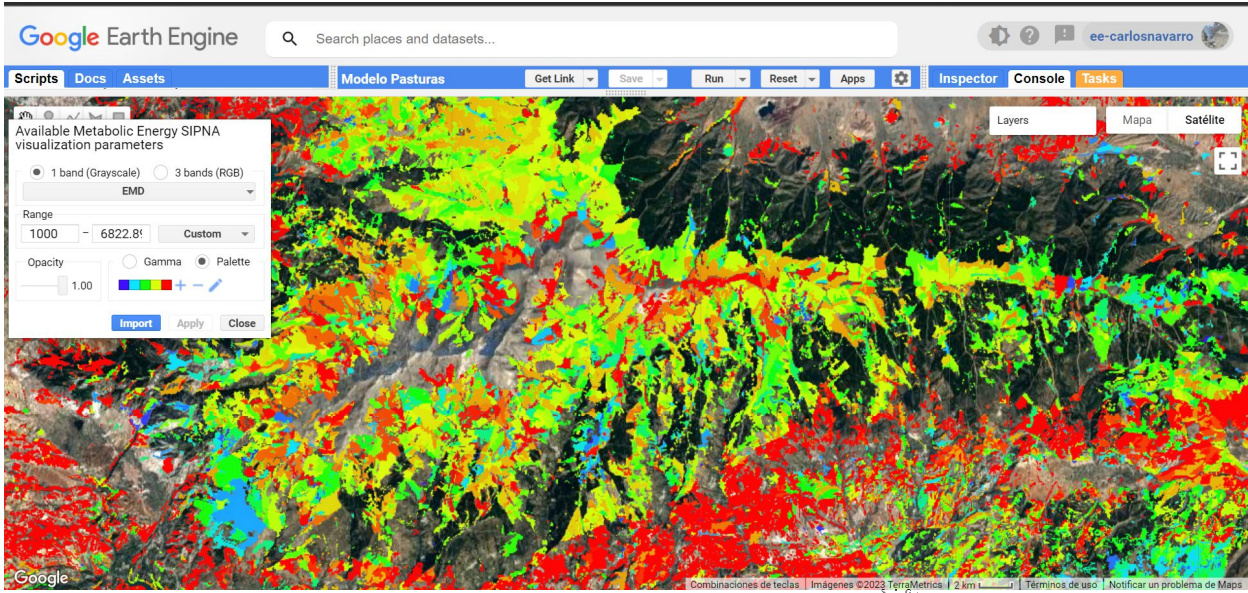
- Annual precipitation

Different bioclimatic zones

- Monthly temperature

Uncertainty assessment (*Mahalanobis* distance)

## Available metabolic energy (Megajoules/ha/year)

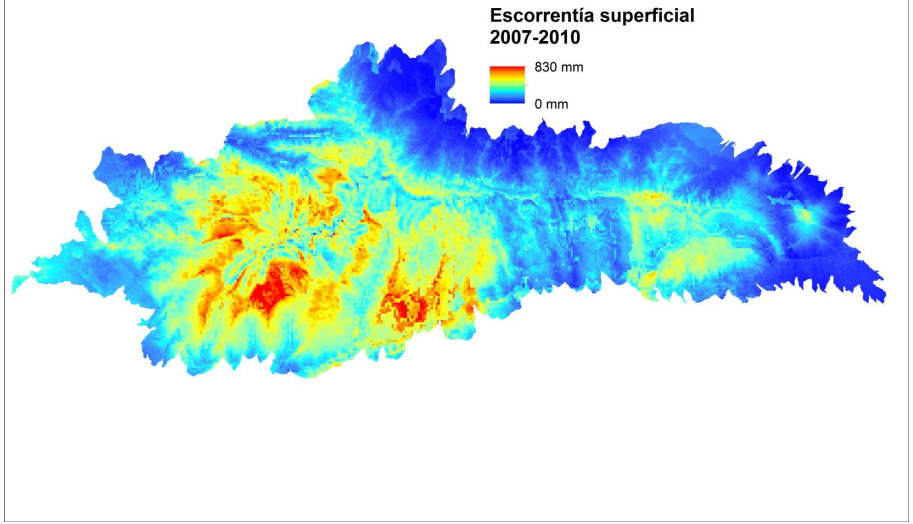


WiMMed®

*Herrero et al., 2014. Coupling spatial and time scales in the hydrological modelling of Mediterranean regions: WiMMed, in: Informatics and the Environment: Data and Model Integration in a Heterogeneous Hydro World.*

- Flood prevention
- Surface water supply
- Surface runoff
- Aquifer recharge
- Evapotranspiration
- Erosion prevention

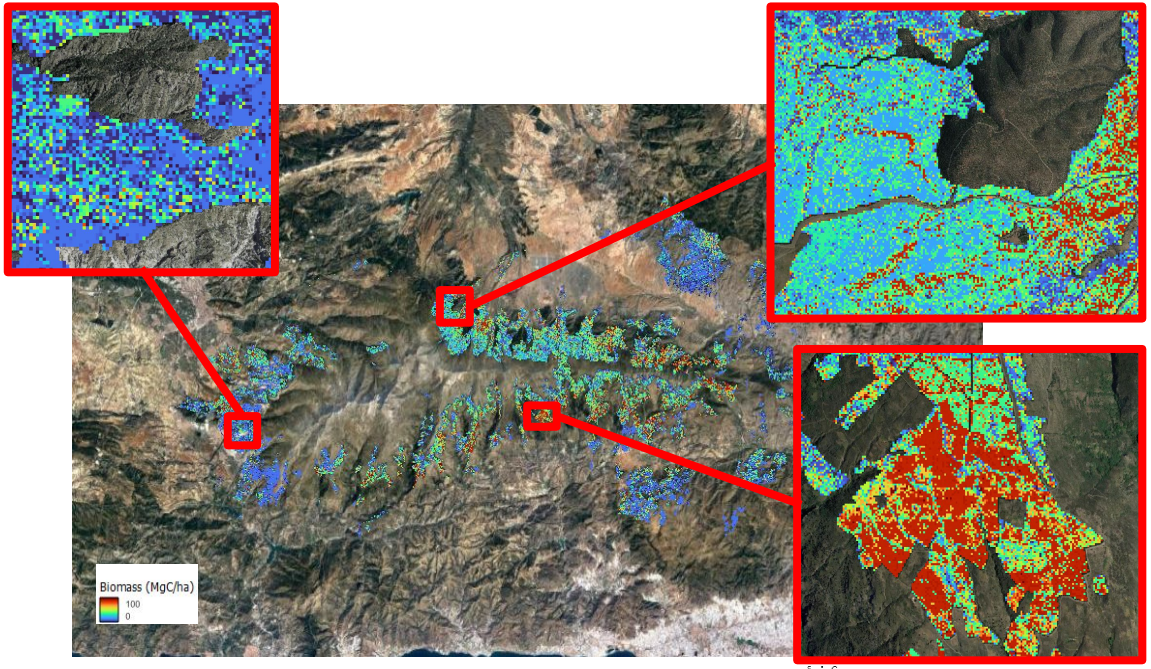
## Surface runoff (mm/period)



# Aboveground carbon storage

*Navarrete-Poyatos et al., 2018*

- Based on 2020 LiDAR data (0.5 points / $m^2$)
- For pine plantations we use a pre-trained RF model based on allometric equations
- New models for other dominant species



# Estimation of cultural ecosystem services from social media comments and images

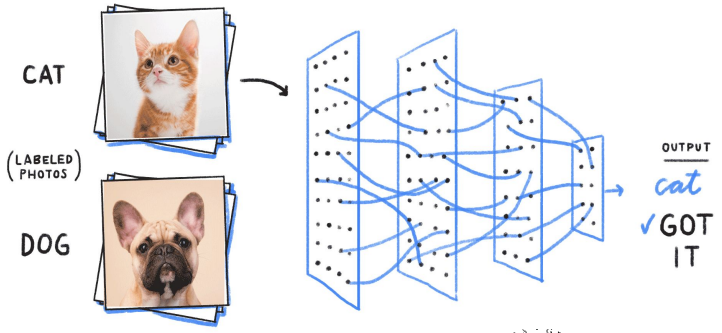
**Objective:**

Estimation of cultural ecosystem services using Twitter and Flickr images and comments shared in social media

**Methods:**

- **Deep Learning** based approach that uses public image databases (e.g. ImageNet) to infer the motivations and interests of visitors and inhabitants of national parks

- Model the spatial and temporal patterns of people interests on national parks by applying **ecological niche models** to the DL outputs

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# Land use/land cover change

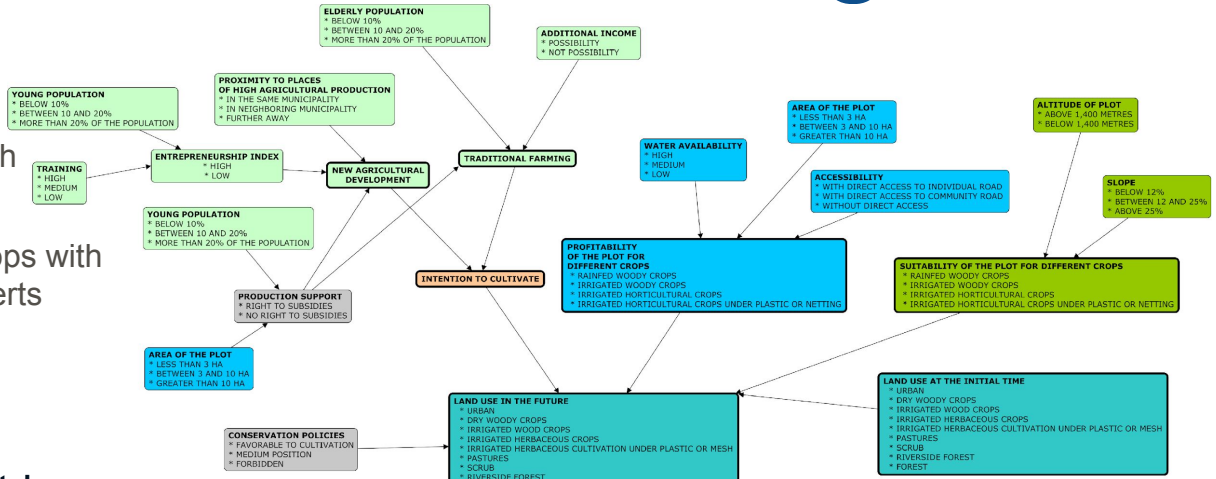
Literature

Workshops with stakeholders

Experts and stakeholders consultations

Workshops with experts

**Development of Bayesian Belief Network**




Bayesian Network

**Agricultural management decisions**

**Environmental management decisions**

**Create future land use scenarios**

# Socio-ecological implications

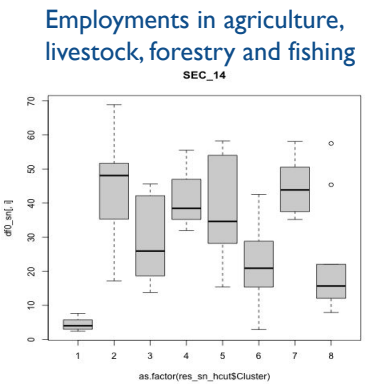
**Clustering analysis**

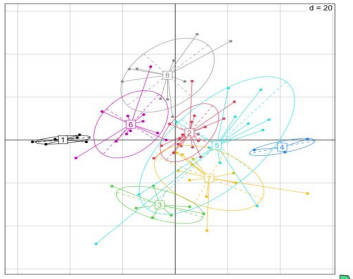
**> 80 socio-economic variables**

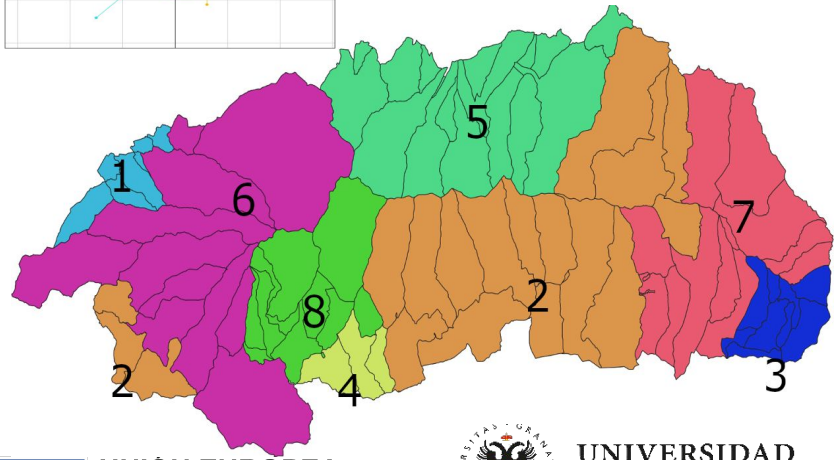
**Characterize green and red loops**

**Framework including wellbeing dimensions:**

- Security and sovereignty
- Health
- Equity and justice
- Heritage, identity and stewardship
- Economic development
- Sustainability





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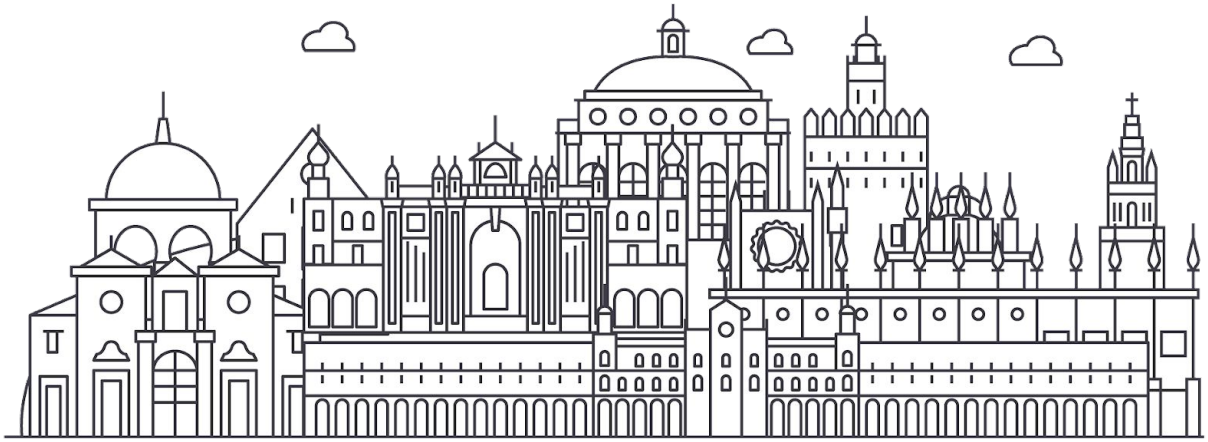

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Thank you! | www.lifewatch.eu/bees-2023