Litter decomposition in alpine ecosystems across 9 zonobiome

Aim: To investigate the long-term litter decomposition initiative across 9 zonobiomes in alpine ecosystems and its key drivers under present and future climate scenarios.

Approach:

Along a climatic gradient (pronounce climate and associated change in vegetation) 3 sites will be selected (Fig.1). The sites should have the same parent material (silicate), should be exposed to south (SW-SE is OK), should have the same soil type and should be semi-natural (less-no human impacts) ecosystems. Please avoid transition zones between the vegetation types and select one site above the tree line.

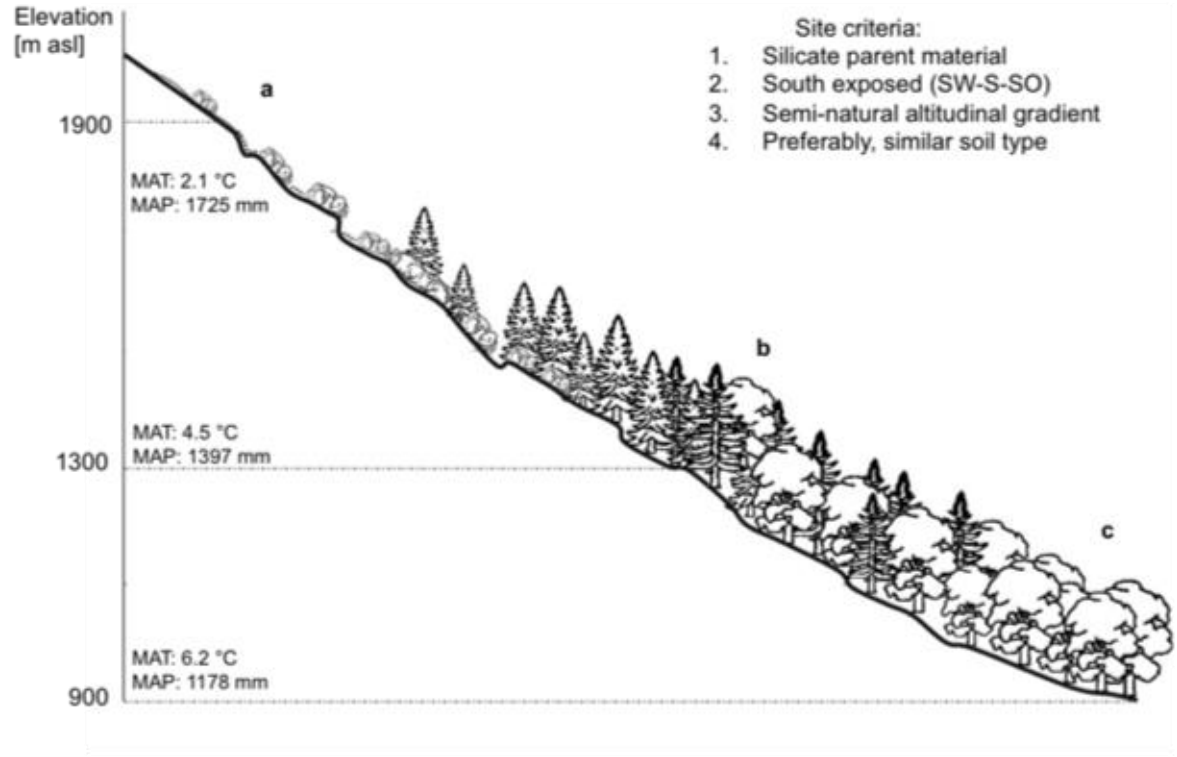

Fig.1 An example for site selection along a climosequence.

We will use standard material = tea to analyze the litter decomposition.
Amount of tea needed: 3 sites * 2 tea types * 2 sampling points*5 replicates per sampling point); in total this would be 30 if green tea and 30 of rooibos tea.

In the lab:

- Label them on the white side of tag using a permanent marker with a “unique identifier" (e.g. IL31 = IL stays for Israel, 31 is the 31st sample and you can add G = green tea or R for Rooibos). Additional marking can be used if desirable.

- Boiled it for 2-3 min (Green tea) and 4-5 min (Rooibos tea), respectively.
- Dry tea bags at 70°C fro 48 hours
- Before weighing, make sure that the digital bubble on the scale is accurately placed (red circle - Fig.2.3). Weigh them preferably on 4 decimal places (0,000) and note the weight.
- Store the weighed tea bags in a zip-lock bag until the burial

Installation in the field:

- Start the incubation in August/September 2017
- Select 2 homogeneous replicate areas (min. 1m2) at each site where tea bags are going to be installed. Take a photo (JPEG files; .jpg) of the entire area/site as well as of the plots. The photo should have at least 2000 x 1500 pixel resolutions.

- The site should have a uniform vegetation type of the dominant species and the vegetation type should be similar at both replicate areas.

- Select a flat spot or if not avoidable a spot with a gentle slope (avoid steep and flat sites along the slope) and describe the topography

- Note the coordinates (WGS), elevation above sea level. Selected replicate areas shall have similar exposition; in the Northern Hemisphere the exposition shall be south (south-west/south-east).

- Describe the vegetation for each area at least at biotope level. Take a photo of each site.

- Describe soil type (e.g. cambisol, tschernosem), soil depth (form surface to the parent material; Fig.2) and parent material (sites should have the same bedrock type). Take a photo of a soil profile.

Fig.2 An example for soil profile

- Take 3 soil samples (approx. 100g) from the Ah mineral soil layer (~0-5 cm after removing the litter layer; see Fig. 3b) at each site for the analysis of the main soil properties- this is only needed if no soil data are available (see point 5). The collected soil shall be air dried and 2 mm sieved for the further analyses. The soil collection

can be performed at any sampling point during the 3 years of incubation.

- Note the date for the start of the incubation. This is important for the retrieval time, which you shall plan accordingly and remember.
- Install 5 teabags of Green tea and 5 tea bags of Rooibos tea in each replicate area into the 0-5 cm depth (Fig.3). At all 3 sites along the climosequence the soil layer shall be the same.

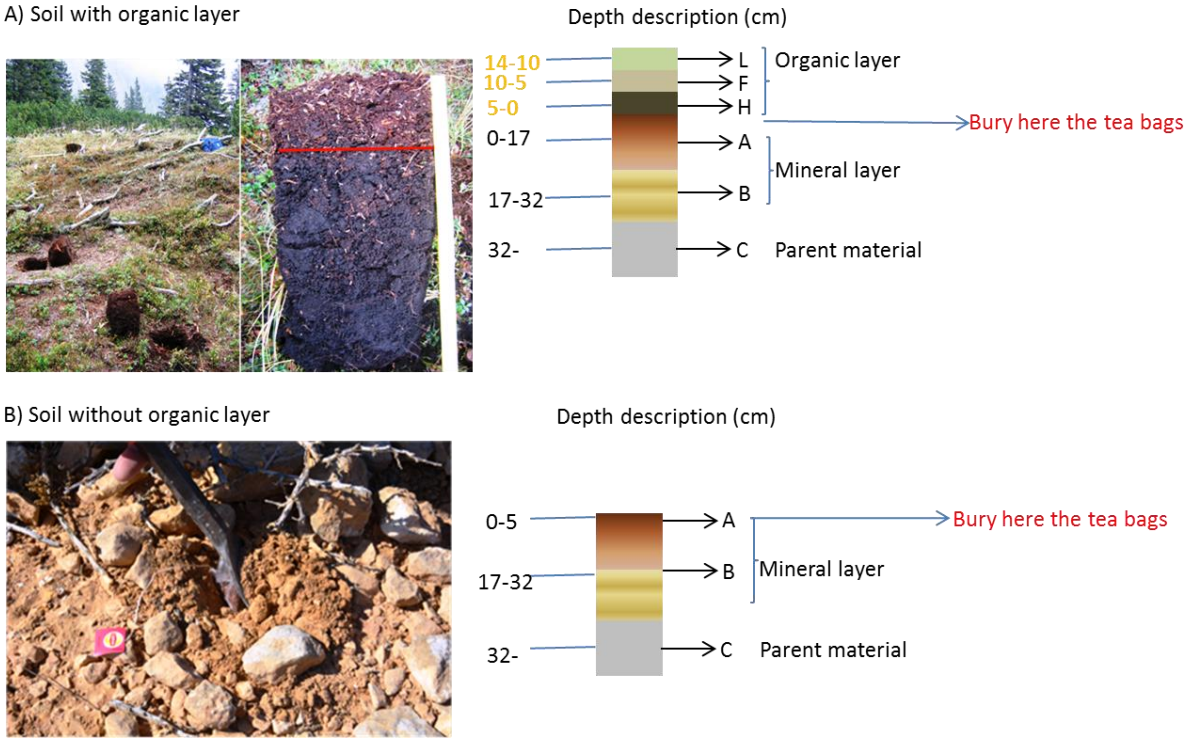

Fig.3: Positioning of tea bags in the soil (organic vs mineral soil layer)

- At each replicate are install 5 green and 5 rooibos tea bags in 2 “installation lines”. Each line should be 50 cm long allowing 5 teabags to be placed on the line with approximate 10 cm between neighboring bags (Fig. 4). For each “installation line”, make a 5cm deep slot vertical into the soil, then cut horizontal into the soil, lift gently and place the teabag into the upper soil (~0-5cm) the tag shall be visible on the surface. Place every additional bag in a distance of approx. 10cm. Place the bags in ascending serial number in a row, so that in case a labeling is missing you can “reconstruct” the missing label number from the numbers of the previous and subsequent bags. Optionally, label the beginning and end of 5 bags with metal sticks and number plate so that in case labeling is missing you can assign the bag number when they are placed in ascending seria. Metal sticks are also suitable to be detected with metal detector, if the spot is covered with thick litter layer. In case the string with tag is falling apart from the bag, take a tacker with you to attach them again.

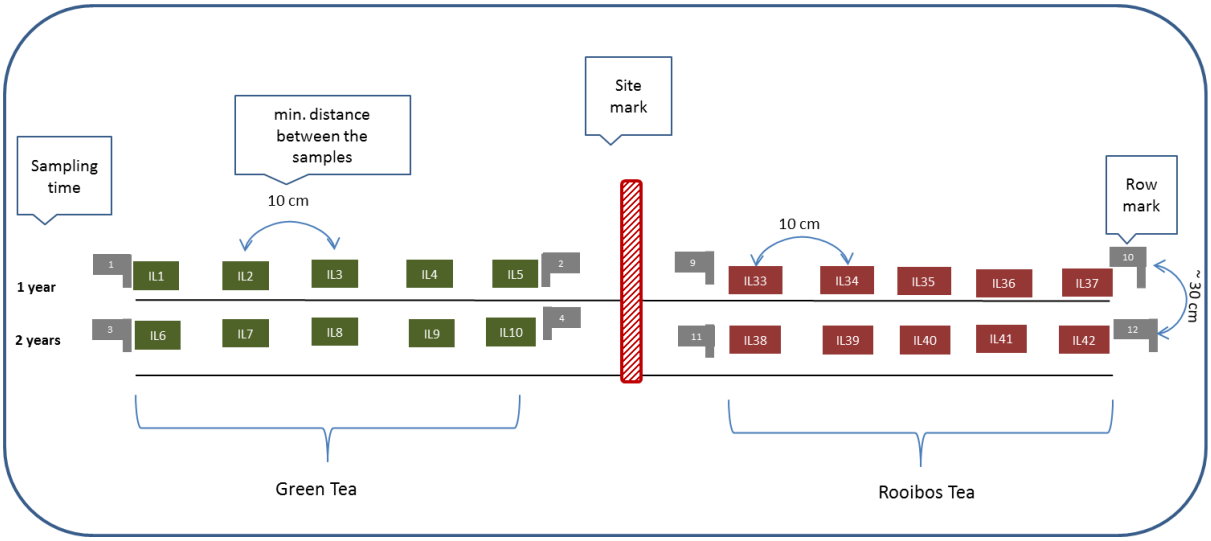

Figure 4: Sketch of the study set up.

- Mark the replicate areas, so that you can find them easily. Draw a sketch of the teabag set up.

Reprocessing of the tea in the lab:

Figure 5: Work steps 4.1. – 4.7 – Reprocessing of the collected tea.

4.1. Start reprocessing of the tea bag in the lab as soon as possible (preferably within 1 week after collection of the sample)
4.2. Clean the tea bags manually from roots, soil etc. (be careful not to lose any tea, and make sure all soil and plant debris are removed to avoid errors in the weighing).
4.3. Dry the bags at 70°C for 48 hours. If necessary, remove remaining soil.
4.4. Before weighing make sure that the digital bubble on the scale is accurately placed. Label the glassine paper bag (county/site/ sample ID/tea type, incubation length, date) and tare weight them. Open the tea bag and transfer the tea into the glassine paper bag. Weigh the glassine paper bag with tea preferably on 4 decimal places (0,000) and note the weight. Close the glassine bag with a stripe of the sellotape.
4.5. Note if the bag was damaged or found at the surface.

4.6. Use default value (0.248 g) for the empty tea bag

4.7. In case soil has entered the bags and cannot be easily removed by external cleaning and the measured incubation litter weight is higher than the initial one, then the samples have to be analyzed for the organic matter content and carbon content of the soil by using muffle oven (at 500°C overnight (16h)).
Mineral content [%] = (RW/ODW) x 100; where: RW = Residue weight after ignition
ODW = Oven-dry soil weight. Organic matter percent [%] =100-Mineral content [%]

Required additional data:
In order to be able to interpret and to link decomposition data to the potential driver of the litter decomposition additional data are needed. The minimum required data over the incubation period (i.e. June 2016-June 2019) are:

- Annual average air temperature (°C)
- Annual precipitation (mm)
- Annual average temperature amplitude (mean temp. of the warmest month - mean temp of the coldest month)/2)

Note: If climatic data are not available at site, please provide the most reasonable meteorological data from the area.

Further desirable data:

- If possible-soil temperature (5 cm depth; recorded daily)
- If possible -soil moisture (5 cm depth; recorded daily)
- If possible, basic soil properties (pH, OC, Ntot); soil nutrients (P, S, K, Ca, Mg, Mn) and heavy metals (Cu, Zn, Pb, Cd); Ah mineral layer; ~0-5 cm; only ones during the 3 year of incubation.
- Optional: For each sampling time, at least one composite sample per control plot and per treatment shall be made for the following analyses: litter OC, Ntot, P, S, K, Ca, Mg, Mn, tannins, cellulose, hemicellulose, lignin, heavy metals (Cu, Zn, Pb, Cd). If they are more resources, then one sample per replicate shall be measured.

Add-On:
Litter bags with native litter

- Collect the intact (whole) shed leaves from two dominant species (with different litter quality) and dry them at 70°C to a constant mass.
- Make the triangular litter bags of polyethylene net (10x10 cm, with a mesh size of 0.25mm).

- Fill each bag with approximately 2 g of single (grind) leave type. Notice the weight and label the bags with an ID.
- Proceed further similar as for the tea bags.