Geophysical Research Abstracts
Vol. 20, EGU2018-12783, 2018
EGU General Assembly 2018

Influence of morphodynamics and earth surface processes on alpine vegetation in the Western Swiss Alps

Elisa Giaccone (1), Luoto Miska (2), Grégoire Mariéthoz (1), and Christophe Lambiel (1)

(1) University of Lausanne, Institute of Earth Surface Dynamics, Lausanne, Switzerland, (2) University of Helsinki, Department of Geosciences and Geography, Helsinki, Finland

Landforms movements and earth surface processes can modify the microhabitat conditions and the species richness, composition and distribution patterns of plant communities. Given the high vulnerability of the alpine environment to climate change, deciphering the weight of the landforms processes on plant species and how they can influence the plant communities appears to be of high importance.

To reach these objectives, we applied a multi-methodological approach on three sites in the Western Swiss Alps (elevation between 2000 and 2500 m). The sites are characterized by a high geomorphological diversity, such as multi-age moraine deposits, rock glaciers, talus slopes and stabilized area, which allow the presence of different plant communities (from pioneer species to grassland species).

Monitoring of the ground surface temperatures, geomorphological mapping, interpretation of earth surface processes (ESPs - solifluction, erosion, nivation, frost weathering) and vegetation surveys were carried out. During the summers 2016 and 2017, we realized 73 surveys of vegetation in a plot of 2 x 2 m, on different geomorphological features, following the abundance-dominance scale of Braun-Blanquet. For every vegetation plot, we calculated species cover, species richness and evenness and we assigned a value for each ESPs and for the morphodynamics of landforms. Topographic variables (elevation, orientation and slope) were also computed. For each plot, the ground surface temperature was recorded during one year (October 2016 – September 2017) with miniature temperature loggers iButton® DS1922L. Mean, maximum and minimum temperatures, freezing degree days (FDD), growing degree days (GDS) and growing season length (GSL) were calculated from raw temperature data.

In according to achieved results, ESPs influence significantly and negatively species cover (Spearman's rank correlation = -0.45; $p < 0.01$) and species richness (-0.37; $p < 0.01$), but positively evenness (0.35; $p < 0.01$). Species richness is strongly correlated with species cover (0.81; $p < 0.01$).

Based on results of non-metric multi-dimensional scaling (NMDS) applied with a permutation approach, GSL, morphodynamics, GDD, erosion, FDD, solifluction, frost weathering and nivation seem to be the most explicative variables of vegetation communities (ordination stress = 22%). All values are significant (p < 0.0o1, except for the last three, $p = 0.01$). In particular, the GSL has the highest value of linear fit (R2 = 50%), followed by morphodynamics (R2 = 49%) and GDD (R2 = 43%).

Furthermore, species cover and species richness predictions are significantly improved by the addition of environmental factors, overall the morphodynamics variable. For the species cover, the explained deviance is 67.1% and 67.6% respectively using Generalized Linear Model and Generalized Additive Model. For the species richness, it is 42.4% and 46.7%.