A hypothetical framework for testing phytodiversity in mountainous regions: the influence of airstreams and hygrothermic conditions

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with 12 figures

Abstract. High mountain ranges are considered “hot spots” of phytodiversity due to their geomorphological, petrographical and climatic complexity in relation to the surrounding climate and vegetation zones. The degree of species numbers in high mountains depends on different factors: mass elevation, orographic heterogeneity, location within a floristic region and climate zone, frequency and amount of natural disturbances, as well as the position of the mountain chain against advective airstreams. While these factors are considered as the main triggers driving γ-diversity at a general macro-level, additional stand conditions and processes play an important role for the degree of β-turnover, considering the change of species number in altitude at a meso-level (Fig. 1 and 3) and of α-diversity at a micro-level. After analysing different effects caused by mass elevation (Fig. 7), the second part of the paper focuses attention on the importance of different directions and types of airstreams. A main distinction is presented by the comparison of a species-poor type, given by convective currents and a species-rich type given by obvious climatic differences between windward and leeward exposures (Fig. 8 and 9). Intermediate types result in transitional numbers of species (Fig. 10 to 12). It must be emphasized that the extent of advective airstreams form an important, but only one of the decisive triggers concerning the degree of γ-diversity of a high mountain range.

Keywords: α-, β-, γ-diversity, advective and convective airflows, mass elevation effects; homogeneous, intermediate and heterogeneous exposure types.

1. Mountain ranges as “hot spots” of phytodiversity: criteria for consideration

According to Barthlott et al. (1996), high mountain ranges are regarded as biodiversity “hot spots” (for details of the term see Myers (1988)). This concept must first of all be seen as relative to particular climatic or vegetation zones and biogeographic regions, in which mountain ranges occur and rise up to their different altitudinal levels. Global maximum values are reached in tropical mountain ranges, where conditions of tropical species richness in the wake of evolution meet a maximum number of altitudinal belts (comprising montane, cloud, and elfin forest, altotropical shrub- and grassland up to subnival habitats).

Relief formation as a result of mass elevation and dissection controls the extent of the γ-diversity, which, in the sense of Whittaker (1972), ex-