



Soil geography and diversity of the European biogeographical regions

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ABSTRACT

For decades, soil geography has been mainly a qualitative and descriptive discipline. There are now technologies and mathematical tools available that allow formalizing soil geography in more quantitative terms. In this paper, the distribution and diversity of the soils of Europe are analyzed using GIS tools and pedodiversity algorithms. Soil data were taken from the European Soil Database (V2.0) and computed within the spatial framework of the Biogeographical Regions of Europe (BGRE) as defined by the European Environmental Agency (EEA) on the basis of climate and vegetation. The results obtained show the soil assemblages, including dominant soils and endemic and non-endemic soil minorities, and their respective soil diversity for each BGRE. Most BGRE have dominant soils that mainly reflect the influence of the climatic conditions prevailing in each regional context. Although the definition of the BGRE lacks relevant information on geology, relief and paleogeographic evolution, soil assemblages of most biogeographical regions are idiosyncratic and characterize quite well the European soils. Northern BGRE (i.e. Arctic and Boreal) have low pedotaxa diversity in contrast to the other BGRE. The mountain biome has the highest pederichness at European as well as at global level. The Atlantic and Mediterranean regions and, to some extent, the Alpine region are mutually related. Most continental soils constitute a mix of typical steppe and forest soils. The Black Sea region, the smallest one of all, has no idiosyncratic soil type, suggesting that it could be considered as an important biodiversity hotspot rather than a genuine biogeographical region. These results are relevant as baseline information for a full inventory of pedodiversity and as an important part of the European natural heritage.

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1. Introduction

The European soil geography has been studied for decades from different points of view, at different scales, and making use of different national classification schemes (Jones et al., 2005) as well as the FAO Keys (1974, 1990) and, more recently, the WRB framework (FAO, 1998, 2006). However, a comprehensive, quantitative analysis of the spatial distribution of the soil types (pedotaxa) across the continent is still lacking, whereas a digitized georeferenced soil database at European level permits now to undertake such an analysis. A first initiative was carried out for the European Communities (CEC, 1985), resulting in the publication of a soil map in paper format for most of the western countries. This map was subsequently digitized, improved, and expanded several times until the latest 2004 version on CD-ROM (EC, 2004). Likewise, a Soil Atlas of Europe (ESBN-EC, 2005) together with a monograph on “Soils of European Union” (Tóth et al., 2008) has been published recently. This is mainly descriptive information. Several papers provide a more elaborate vision on the spatial distribution of the soil types across Europe, showing fractal structures at least

for the most abundant pedotaxa (Ibáñez et al., 2009). Pedodiversity analysis has been considered to be an interesting mathematical tool in soil geography (e.g. Ibáñez and Efland, 2011), and soil geography is increasingly formalized in quantitative terms (Gray et al., 2011; Ibáñez et al., 1998). Pedodiversity analysis has been used at worldwide level (Ibáñez et al., 1998; Minasny et al., 2010) and in the United States of America (Amundson et al., 2003; Guo et al., 2003), but it was not yet applied to the European continent. The objective of this paper is to show the soil assemblages of most European countries and analyze their pedodiversities in a quantitative way. The paper intends to match the primary data contained in two complementary documents, the “Soil Atlas of Europe” (European Soil Database) and the “Map of the Biogeographical Regions of Europe,” to generate integrated information describing the soil geography and soils of the European continent and analyzing the factors that explain the pedodiversity in the frame of the biogeographical regions.

2. Material and methods

2.1. Material

To analyze soil geography and pedodiversity of Europe, the continent can be fragmented using different geometric supports such as

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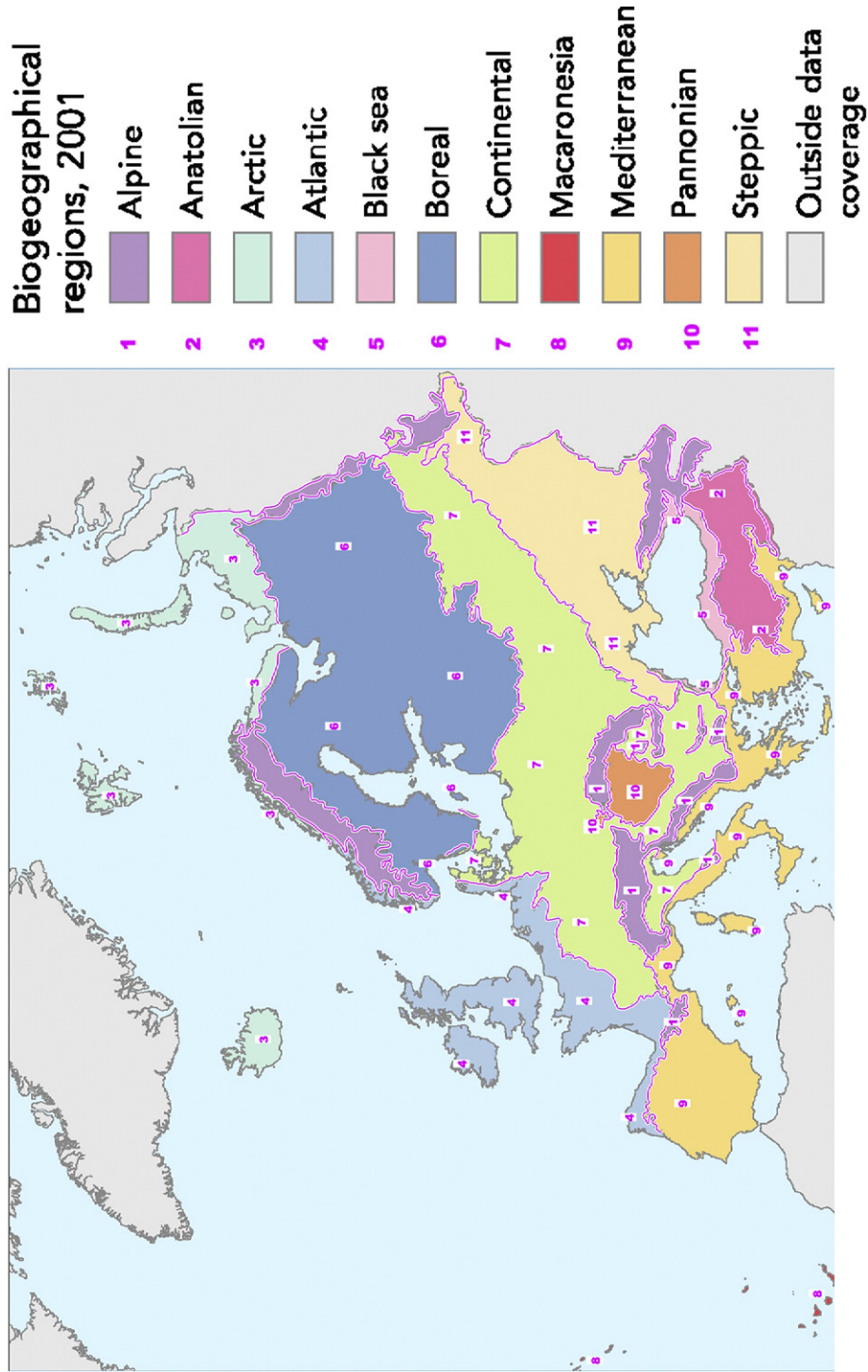


Fig. 1. Biogeographical Regions of Europe.

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