Geophysical Research Abstracts
Vol. 16, EGU2014-12948, 2014
EGU General Assembly 2014

An overview of the recent approaches for terroir functional modelling, footprinting and zoning

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Notions of terroir and their conceptualization through agri-environmental sciences have become popular in many parts of world. Originally developed for wine, terroir is now investigated for fruits, vegetables, cheese, olive oil, coffee, cacao and other crops, linking the uniqueness and quality of both beverages and foods to the environment where they are produced, giving the consumer a sense of place. Climate, geology, geomorphology, and soil are the main environmental factors which compose the terroir effect at different scales. Often considered immutable at the cultural scale, the natural components of terroir are actually a set of processes, which together create a delicate equilibrium and regulation of its effect on products in both space and time. Due to both a greater need to better understand regional to site variations in crop production and the growth in spatial analytic technologies, the study of terroir has shifted from a largely descriptive regional science to a more applied, technical research field. Furthermore, the explosion of spatial data availability and elaboration technologies have made the scale of study more valuable to the individual grower, resulting in greater adoption and application. Moreover, as soil microbial communities are known to be of vital importance for terrestrial processes by driving the major soil geochemical cycles and supporting healthy plant growth, an intensive investigation of the microbial organization and their function is also required. Our objective is to present an overview of existing data and modeling approaches for terroir functional modeling, footprinting and zoning at local and regional scales. This review will focus on four main areas of recent terroir research: 1) quantifying the influences of terroir components on plant growth, fruit composition and quality, mostly examining climate-soil-water relationships; 2) the metagenomic approach as new tool to unravel the biogeochemical cycles of both macro- and micronutrients, and the functional diversity of terroirs; 3) regional fingerprinting (examining the chemical signature of products for authentification); 4) terroir zoning (mapping terroirs) and precision agriculture (using remote and proxy sensing technologies to lower costs and manage the crop system for a better food quality and environmental sustainability).