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## Soil quality — Guidance on soil temperature measurement

*Qualité du sol — Recommandations relatives au mesurage de la  
température du sol*





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## Foreword

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This document was prepared by Technical Committee ISO/190, *Soil quality*.

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## Introduction

Soil temperature varies continuously in response to climate and meteorological changes and the interaction of soil and atmosphere. Some of the factors that affect soil temperature include diurnal and annual cycles, and irregular episodic changes in weather (i.e. radiation, cloudiness, drought, humidity, atmospheric temperature, rainfall, cold events). Landscape formation, regional differences, vegetation and soil management practices by humans also affect soil temperature. The other major influence on soil temperature variation is depth below the ground surface, with the soil temperature shifting in peaks moving deeper in the soil profile<sup>[2]</sup>.

Soil temperature variations across day and year can be quite important. In boreal conditions within the year, soil temperature can pass from  $-15\text{ }^{\circ}\text{C}$  to more than  $15\text{ }^{\circ}\text{C}$  at 5 cm depth. If in drylands in Mediterranean areas, the temperature can reach  $40\text{ }^{\circ}\text{C}$  at depth and more than  $50\text{ }^{\circ}\text{C}$  at the ground surface. With global warming, soil temperature tends also to increase in the same order as atmospheric temperature as demonstrated in various studies<sup>[3],[4]</sup>.

Soil temperature needs to be measured being crucial for biogeochemical processes such as length of growing season, decomposition of soil organic matter, rates of mineralization and nutrient assimilation by plants as well as plant productivity. Soil temperature changes with depth influence many soil characteristics, such as microbial activity, chemical reactions, nutrient cycling, and many other processes.<sup>[2]</sup> It is known that soil organic matter is more easily decomposed by microbes activated when the temperature is raised if appropriate water content is available and temperature stays in a range favourable for microbes. Soil temperature can then be used as a proxy for the risk of carbon dioxide emission from target land.

Soil temperature is, as mentioned earlier, also a basic parameter in agricultural sciences and industries since it directly affects plant growth. Soil temperature has a strong influence on the microbial mineralization such as ammonification of nitrogen contained in organic forms to ammonium and nitrification thereof to nitrite and nitrate in agricultural soil. This contributes to growth, especially during sprouting. In agricultural businesses, using greenhouses, controlling soil temperature is a key to successfully growing vegetables for a good harvest by optimizing the growth speed and depressing the activities of worms and other soil organisms that eat vegetables. In golf courses, soil temperature is continuously monitored for proper maintenance of greens to condition the grass growth, leaf colour and green density.

In the civil engineering field for ground disaster prevention, soil temperature is used as a useful indicator suggesting groundwater flow routes. By carefully measuring soil temperature at many points in sloping ground to map the values 3-dimensionally, water streams underground can be tracked. As groundwater can be a trigger for the start of massive soil blocks sliding on a slope and an accelerator of the movement, draining groundwater therefrom reduces the risk of landslides. Thus, soil temperature is helpful in efficiently managing landslide prevention work.

The procedure for soil temperature measurement depends on the accuracy required for the given purpose for which the data are required. To know a soil temperature range in target land for climate change studies, the measurement can be done in a simple and quick way which indicates soil temperature as an approximate value. In contrast, to precisely map soil temperature distributions in the ground for slope disaster prevention, the temperature should be carefully measured to obtain not approximate but exact values. Selection of appropriate measurement methods for soil temperature should be discussed prior to site investigation.