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Promoting Interest in Soil Sustainability Issues Using Interactive Virtual Environments

Jenny Gilford (1), Ruth Falconer (1), Rebecca Wade (1), and Kenneth Scott-Brown (2)

(1) School of Contemporary Sciences, University of Abertay, Dundee, United Kingdom (j.gilford@abertay.ac.uk; r.falconer@abertay.ac.uk; r.wade@abertay.ac.uk), (2) School of Health and Social Sciences, University of Abertay, Dundee, United Kingdom (k.scott-brown@abertay.ac.uk)

How do we best promote interest in soil science and related sustainability issues, using interactive visualisation software?

Soil virtual environments could be used to help address the drop in the number of students studying soil science, as the interest has shifted more to other environmental sciences, which often lack a soil science component, despite being a key factor in many environmental issues today (Hopmans, 2007, Baveye & Jacobson, 2008). For example, soil stores approximately 99% of terrestrial UK carbon, and there is evidence (both direct and indirect) that UK soils are losing carbon at a net rate, particularly in the highest-carbon soils, most of which are in upland Scottish areas (Towers et al, 2006). Soil virtual environments could be used to stimulate interest in soil and related issues. What is proposed in this project is an important first step towards evaluating alternative methodologies to textbook-based, non-interactive, and flat-colour 2D illustrations, for communicating soil science.

Crucial to these new methodologies are the use of 3D graphics to allow for greater depth, texturing, lighting, realism, and the rotation and manipulation of objects in ways that are not possible with traditional paper or 2D graphics. A greater sense of user-engagement is possible using 3D graphics in an interactive virtual environment, especially where temporal aspects are also shown.

To start this exploration, two common soil viability indicators have been selected for representation: drainage-capacity and carbon-density. These were chosen due to data availability, and the latter is linked to climate-change issues. Two terrain-level indicators (land-cover and elevations) are also rendered to provide a geographical context, within an interactive 3D soil atlas. The terrain is rendered in two different ways - one colour blended according to elevation data, the other textured according to land-cover data, for a 10km2 area in Scotland. The soil indicators are viewable as both 2D and 3D representations. The former are represented as flat colour/transparency coded maps, while the latter are represented as microscopic views of underground structures. We wish to assess the viability for extending this remit to not only depicting more soil indicators but also for teaching students or the general public about the structures/functions of soil (e.g. in schools/universities/museums).

Scenes created and rendered using a 3D artistic program (Blender) are used to represent the soil-drainage capacity (dominant category for each 1km2), serving as subterranean views. The 3D soil-carbon indicator is represented by different densities of carbon atoms. These atoms are procedurally-generated within the soil atlas, rather than generated by a 3D artistic program. Additionally, for the soil-drainage indicator computer artists are being invited to submit alternative visual interpretations of soil-drainage categories for the below-ground visualisations.

Future work includes a perception study, which will evaluate user preferences (based on comprehension and interest, e.g. aesthetic appeal) for the different 3D representations of soil-drainage, as well as comparing the 3D representation(s) of both soil indicators with their 2D equivalents.

We also wish to explore whether touch-screen surfaces may promote greater engagement and/or be more user-friendly for interaction with the virtual environments than standard keyboard/mouse interfaces, in a second user evaluation study.

References:

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