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Hydrology and Earth System Sciences Discussions

Interactive comment on "Local sensitivity analysis for compositional data with application to soil texture in hydrologic modelling" *by* L. Loosvelt et al.

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General comments

The authors have presented a study of a local sensitivity analysis in the barycentric coordinate system. The proposed methodology is applied to the pedotransfer functions (PTF) developed by Rawls and Brakensiek and further on the TOPLATS model. It provides a coherent methodology for a sensitivity analysis of models based on compositional data. The case study raises awarness of the existence of regions where a model is especially sensitive to data quality.

The study is well addressed and as the proposed methodology is described in detail,

it can be easily implemented in other studies. However, a few issues, concerning i.e. perturbation of a parameter space and limitation of methods used in the presented case study, have to be revised.

The weakest part of the article refers to the choice of "the perturbation factor". The local sensitivity index is computed on the basis of approximated function derivatives. The approximation is done with the use of the finite difference method and the perturbation factor determines its step size. The increment for the finite difference method is computed in the following way (page 8852, line 25): $x \odot (1 \pm \xi)$, where x stands for parameter composition, ξ perturbation factor and $\odot$ denotes scalar multiplication in a simplex domain. Such a formulation is correct (with the restriction in line 4-5, page 8856), if considered in a local scale, i.e. for each point we can find a ξ value that minimizes eq. 9. However, the problem is that authors use one ξ value for a whole parameter space and increment used in a finite difference schema depends on the distance from barycenter p_0 – that is mentioned on page 8853, point 2 and page 8856.

As a result the incremental step is more or less accidental, which might affect the overall analysis (i.e. the author's reference in line 14, page 8845). For smooth, linear problems such an approach might be suitable; however the analysis performed in the section 3.1 suggests that it does not apply to the PTF – fig. 4 shows how the derivative approximation is sensitive to incremental step. The problem is serious, as all sensitivity hot-spots were localized near a simplex border, where the increment is biggest and a reader might be unsure if it is not caused by the applied perturbation technique.

It has to be noted that the problem of perturbation factor covers only a small portion of the proposed methodology; however the impact of the variable increment on the result should be investigated or eliminated.

The second issue concerns the applicability domain of the PTF (Pedotransfer functions) used in a case study. Should the study not be limited to the soil content bands specified in lines 21-24, page 8847? Without an appropriate comment the reader

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might be unsure if high uncertainties observed outside these bands are not caused by methodological limitations.

Specific comments

1. Algorithm 1 and 2 – a model realization in the point $\mathbf{x}$ ($y(\mathbf{x})$) is unnecessary – $y(\mathbf{x})$ is unused (see eq. 7);
2. Section 2.3.2 – it would be sensible to clarify the reason for step 3. (page 8853, line 7);
3. Page: 8861, lines 11-13 – I would appreciate a comment concerning PTF applicability limits;

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 8841, 2012.