

---

## 12. Validation procedure based on sensitivity analysis and uncertainty analysis

---

In the development and application of any model, one of the most important—and less customary than might be desired—phases is that of validation. This project intends to use a general validation method for the models and data employed during its different phases (especially for the urban growth simulation models) on the basis of sensibility and uncertainty, as well as other qualitative methods.

So far we have performed an exhaustive sensibility analysis of the normative models developed to simulate future urban growth in the Madrid region.

In addition to analyzing the impact on the variability of the results caused by the factors that form part of the normative model, we also plan in principle to develop specific methods which will allow an AS to be performed which is spatially explicit and related to other parts of interest of the normative model. Thus we hope to explore the scope and influence of varying the restrictions used in the model, the influence of the correlations that exist between some of the factors, the variation in the results that might be caused by a different modelling of the same factor, and the use of different multi-criteria assessment methods.

As is well known, it is very common for only a few factors and parameters to be really relevant and decisive when obtaining results from a particular model. This principle has been tested by a sensibility analysis using the Fast and E-Fast method implemented in the SimLab Software of the *Institute for Systems, Informatics, and Safety of the Joint Research Centre* of the European Union. To this end the value of the different factors (in the strict sense of the word and the weights assigned to them) in the model were varied between  $\pm 20\%$  and  $\pm 50\%$ . The results show that the factor 'land uses' was adjudicated the greatest measure of variability in the results for any of the simulated uses (residential, commercial and industrial). This means that any small variation to this factor will entail more or less significant modifications in the results of the model. At the same time, we observed how two other factors also acquired some percentage variability: accessibility to urban zones and accessibility to roads. Nevertheless, the proportion they amount to together is relatively slight compared with what is habitual in other models. From this we may deduce that in reality no group of factors may, on its own, have any truly significant impact on the variation of results and that therefore it would be ill-advised to simplify the model by retaining only the three or four factors that seem to achieve greatest influence.

An alternative has also been put forward which permits a truly spatial analysis to be performed in line with the principles of the sensitivity analysis used in the numerical modelling (Fast method, etc.) and with the aid of a GIS raster. On the whole we may say that the model's results are fairly robust, confirming that it cannot be simplified since all the factors prove to be important and decisive to the final outcome of urban land assignation.

Meanwhile, some tests have already been made which focus on the variations which the different modelling of some of the variables included in the model may cause to the results.

More information in:

[Orán Cáceres, P.; Gómez Delgado, M. y Bosque Sendra, J. \(2010\). "Una propuesta complementaria de análisis de sensibilidad de un modelo basado en técnicas SIG y evaluación multicriterio", en Ojeda, J.; Pita, M.F. y Vallejo, I. \(Eds\). \*Tecnologías de la Información Geográfica: la Información Geográfica al servicio de los ciudadanos\*. Secretariado de Publicaciones de la Universidad de Sevilla. Sevilla, pp. 971-987. ISBN: 978-84-472-1294-1.](#)