Landscape - Riverscape Evolution Modelling: LAPSUS

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LAPSUS has been used for erosion and landscape evolution studies in many landscapes in many countries in recent years. The development of LAPSUS started in 2000 with the programming, calibration and validation of the LAPSUS model and applications concerning land use in Spain and Ecuador (Schoorl et al., 2000, 2002, 2004, 2006; Schoorl and Veldkamp, 2001, 2006). Later, the model has been extended in order to include soil redistribution by landsliding in New Zealand and Taiwan (Claessens et al., 2005, 2006a, 2006b, 2007a, 2007b). In addition, issues of DEM resolution and the treatment of sinks and pits in the landscape have been investigated (Temme et al., 2006, 2009a) as well as stretching the models time scale to landscape evolution time spans, for example in South Africa (Temme and Veldkamp, 2009; Temme et.al., 2009b). Different applications with individual processes have been developed, for example, the model has been used in regional nutrient balance studies in Africa (Haileslassie et al., 2005, 2006, 2007; Roy et al., 2004; Lesschen et al., 2005). The model has also been applied in desert environments in Israel (Buis and Veldkamp, 2008) as well as being used in combination with geostatistical tools and tillage in Canada (Heuvelink et al, 2006), and to investigate the fate of phosphor in the landscapes of the Netherlands (Sonneveld et al., 2006). Recent developments and research directions with the LAPSUS model are:

- Connectivity, agricultural terraces and land abandonment (Lesschen et al., 2007, 2009).
- Interactions and feedback mechanisms between land use and soil redistribution (Claessens et al., 2009).
- Effects of hydrological engineering on soil redistribution in large fluvial systems (Viveen et al., 2009)
- Erosion in a landscape evolution context, comparing event based and long term based models: LISEM and LAPSUS (Baartman et al., 2009).
- Refining the LAPSUS temporal resolution. Modelling daily sediment yield from a meso-scale catchment, a case study in SW Poland. (Coevert-Keesstra et al., 2009)
- Land sliding in mountainous areas. Landscape Dynamics: Calibrating landscape process modelling with Caesium-137 data, separating water driven erosion from landslides (Schoorl et al., 2009).
- 3D river gradient modelling. Quaternary tectonics, sea level and climate change: the case of the river Miño (Viveen, W. et al., 2009).
- Coupling and interaction with TOA modelling. A novel site-specific methodology to assess the supply curve of environmental services (Stoorvogel, J.J. et al., 2009; Claessens et al., in prep).

Landscape evolution modelling allows for confirmation, falsification or improvement of landscape evolution hypotheses and can make the consequences temporally and spatially explicit. Ideally, landscape evolution models (LEMs) combine the results of all relevant landscape forming processes into an ever-adapting digital landscape model These processes may act and interact on different spatial and temporal scales. The LAPSUS modelling framework is an example of a LEM that has embedded multiple landscape forming processes and their interactions in a generic tool that can be used to study many landscapes of the world at multiple temporal and spatial scales.

Claessens, L., Heuvelink, G.B.M., Schoorl, J.M., and Veldkamp, A., 2005, DEM resolution effects on shallow landslide hazard and soil redistribution modelling. Earth Surface Processes and Landforms 30, 461-477
Claessens, L., Schoorl, J.M., and Veldkamp, A., 2007. Modelling the location of shallow landslides and their effects on landscape dynamics in large watersheds: an application for Northern New Zealand: Geomorphology 87 (1-2) 16-27
Claessens, L., J.M. Schoorl, P.H. Verburg, L. Geraedts and A. Veldkamp 2009. Modelling interactions and feedback mechanisms between land use change and landscape processes. Agriculture, Ecosystems and Environment 129 (1-3) 157-170
Schoorl, J.M., Sonneveld, M.P.W., and Veldkamp, A., 2000, Three-dimensional landscape process modelling: the effect of DEM resolution: Earth Surf.Proc.Landforms 25, 1025-1034
Schoorl, J.M., Veldkamp, A., and Bouma, J., 2002, Modeling water and soil redistribution in a dynamic landscape context: Soil Science Society of America Journal 66, 1610-1619
Temme, A.J.A.M., Schoorl, J.M., and Veldkamp, A., 2006, Algorithm for dealing with depressions in dynamic landscape evolution models: Computers and Geosciences 32, 452 - 461
Temme, A.J.A.M., Baartman, J.E.M., Schoorl, J.M. 2009. Can uncertain landscape evolution models discriminate between landscape responses to stable and changing future climate? A millennial-scale test. Global and Planetary Change 69 (1-2), 48-58

See other references at www.lad.wur.nl or www.lapsusmodel.nl