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Integrating uncertainty information into the process of visual change analysis based on remotely sensed scenes

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Remotely sensed scenes have a continuously increasing impact on describing, modeling and simulating landscape structures and processes. Nowadays new applications like urban monitoring or classical applications at larger scales can be addressed due to technical developments of satellite or airborne sensing systems concerning their spatial, spectral and radiometric resolutions. With this increased potential a stronger integration of the derived geo data in binding decision and evaluation processes takes place.

On the other hand it has to be stated that automatic and time saving approaches for a thematic interpretation of remotely sensed scenes and series of scenes is by far not operational yet. This status is caused by several reasons (like the variance and complexity of topographic knowledge representation), and will probably be valid for the next ten years or so. From that we draw the conclusion also to go "back" to a **visual approach**, i.e. to improve the visual interpretation process through the adaption of interactive methods and tools that are known from disciplines like Visual Analytics or Geovisualization.

Focusing on the task of **change detection and analysis** based on remotely sensed and classified scenes of different dates, the mentioned complexity can be further described by several aspects. The various spatio-temporal questions, even the combination of the "simple" questions of what, when and where changes occur, need a structured approach, that cannot be handled, for example, by a simple side by side display in two views without any further user support. Even more complex are higher level analyses for exploring distributions and reasons of changes which can be hardly formalized for automatic procedures. For example, it is crucial to know whether a change is of existential character (i.e., an object has completely appeared or disappeared) or whether it just shows only changes in size or form. Answering those questions needs a human interpreter who is well-guided and equipped with efficient and effective multiple representations of the underlying data.

While these aspects have already been discussed in our earlier publications, we now extend this concept for another very important aspect during change analysis based on remotely sensed and classified scenes, the **integration of uncertainty information**. Like in other change analysis applications the key problem is to differentiate between underlying acquisition and classification errors on one hand and actual changes on the other hand. The problem becomes clearly evident if one compares typical classification errors in the order of 15% and land cover changes which are usually in the same order.

Goal of this contribution is to present our ongoing work on an **extended conceptual design** that enables the additional visualization of different uncertainty information. This includes both the further development of an user interface, and the presentation of various options for displaying uncertainty data. Here different non-interactive options (e.g., showing uncertainty through hachures or overlaid transparent layers with different grades of brightness or saturation) and interactive approaches (e.g., mouse-over or sound effects) in a single view layout will be considered.