

Spatial dynamic Bayesian network to model deforestation in the Brazilian Legal Amazon

Deforestation and forest degradation are one of the major drivers of the global climate changes. According to the PRODES, a Brazilian program that monitors the Brazilian Legal Amazonia, the rate of deforestation has increased in recent years. Hence, it is important to monitor it in order to anticipate preventive actions and establish public policies. Methods of Bayesian Network have been increasingly used to model environmental systems. Here, we present a computer-aided Spatial Dynamic Bayesian Network (SDBN) method capable to incorporate experts' knowledge and makes predictions about areas more susceptible to deforestation over time based on spatial and temporal data observation. The study area is located in the Pará state, which is the one with the highest rate of deforestation. The SDBN method takes into account random variables related to the deforestation, for example, land use and land cover (proximity to livestock and agricultural areas can influence deforestation), available infrastructure (roads and rivers that can give accessibility to the forests) and others spatial data. This method is intended as a snapshot, modeling what happens at a certain time in a spatial area. The time line is divided into a finite number of time instants. An initial instance of the Bayesian Network is designed, which contains the formulation of the problem at time $t=0$, that is, the set of random variables and their dependency relationships. The structure of this initial Bayesian Network is replicated for each instant and sequentially chained. In this way, each network models the annual deforestation of the study area. As results, we expect to obtain a spatialization of the areas most susceptible to deforestation over the time. For each studied year (2010-2015), one Probability Image is computed, in which each pixel value represents the probability of such area be deforested. These resulted images can help stakeholders to control or even reducing deforestation for a beneficial action against global warming, which contributes to save biodiversity and to support a sustainable development.

Keywords: Spatial Dynamic Bayesian Network; Probability; Spatio-temporal data; Deforestation