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Comparative analysis of spatially explicit models to simulate Land use/cover changes for future wildfire occurrence analysis at regional scale

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Wildfire occurrence is reported to be substantially affected by recent land use/cover changes (LUCC) driven by natural (climate) and socio-economic factors. The contact areas between the forest and other land covers (interfaces) have been used to explain fire occurrence as they are associated with human activities that can lead to fire ignitions. This work aims to compare two dynamic explicit models for LUCC analysis, DINAMICA EGO and Land Change Modeler (LCM) to establish Land use/cover (LUC) scenarios for 2025 and 2050 in Madrid region (central Spain) with a spatial resolution of 300m. From these future LUC scenarios the Wildland Urban Interface (WUI), Agricultural-Forest interface (AFI) and Grassland-Forest interface (GFI) has been obtained and they could be used as inputs in the development of future wildfire occurrence scenarios. DINAMICA EGO and LCM are both two models widely applied in LUCC analysis. DINAMICA is a cellular automaton model that uses Weights of Evidence and two mechanisms (patcher and expander) to obtain potential change maps and new LUC scenarios. LCM can calculate the transition susceptibility maps by training learning machines as neural networks. Markov chain matrices are used to determine the quantity of change in both models.
The calibration of these models was based on the study of observed LUCC in the Madrid region between 1998 and 2008 from ESA-CCI Land Cover maps reclassified in eight classes. The obtained calibration rates of change and transition potentials were used to simulate LUC maps by 2015. Coincidence between simulated and real maps from 2015 was checked to assess models′ accuracy.
In order to calculate the business as usual scenarios for 2025 and 2050, drivers and restrictions were considered. Drivers were compiled according to suitability (e.g. slope or aspect) and accessibility (e.g. distance or accessibility to roads or urban areas). Restrictions were related to natural protected areas and zones with legal restrictions to urban growth.
For both models overall agreement in the assessment process was >90%. Larger commission and omission errors (>12 %) were obtained for the settlements class for both DINAMICA and LCM models. Regarding the spatial distribution of the LUC classes, the largest differences were found between models for settlement growth, while the results for forest were very similar. LUC interfaces were calculated for the 2025 and 2050 maps. For DINAMICA maps the area occupied by WUI and GFI increased in 4518 ha and 2682 ha, respectively from 2015 to 2025 while AFI decreased in 6066 ha. Between 2025 and 2050 the same increasing trend was observed in WUI (9558 ha) and both AFI and GFI decreased (3240 and 6579 ha respectively). For LCM maps a similar increasing trend in WUI and GFI was observed compared with DINAMICA (4077 ha and 1233 ha respectively) while the AFI decreased was larger (11988 ha). Between 2025 and 2050 WUI and GFI increased while AFI decreased following the trend of the previous simulation. Consequently, this work provides information related to LUC and derived variables that could be used in the development of future wildfire occurrence scenarios.