

Analysis of Spatial Patterns and Modeling of Landscape Dynamics in South-Central Chile: The Impact of Forest Plantation

Cristián Vergara-Fernández¹, Francisco Aguilera-Benavente², Fabián Argandoña-Castro³*, Fernando Peña-Cortés⁴

1. Doctorado en Tecnologías de la Información Geográfica. Universidad de Alcalá, Alcalá de Henares, España.
2. Departamento de Geología, Geografía, y Medio Ambiente. Universidad de Alcalá, Alcalá de Henares, España.
3. Doctorado en Ciencias Agropecuarias, Universidad Católica de Temuco, Temuco, Chile.
4. Laboratorio de Planificación Territorial, Universidad Católica de Temuco, Temuco, Chile.

* cristian.vergara@uah.es

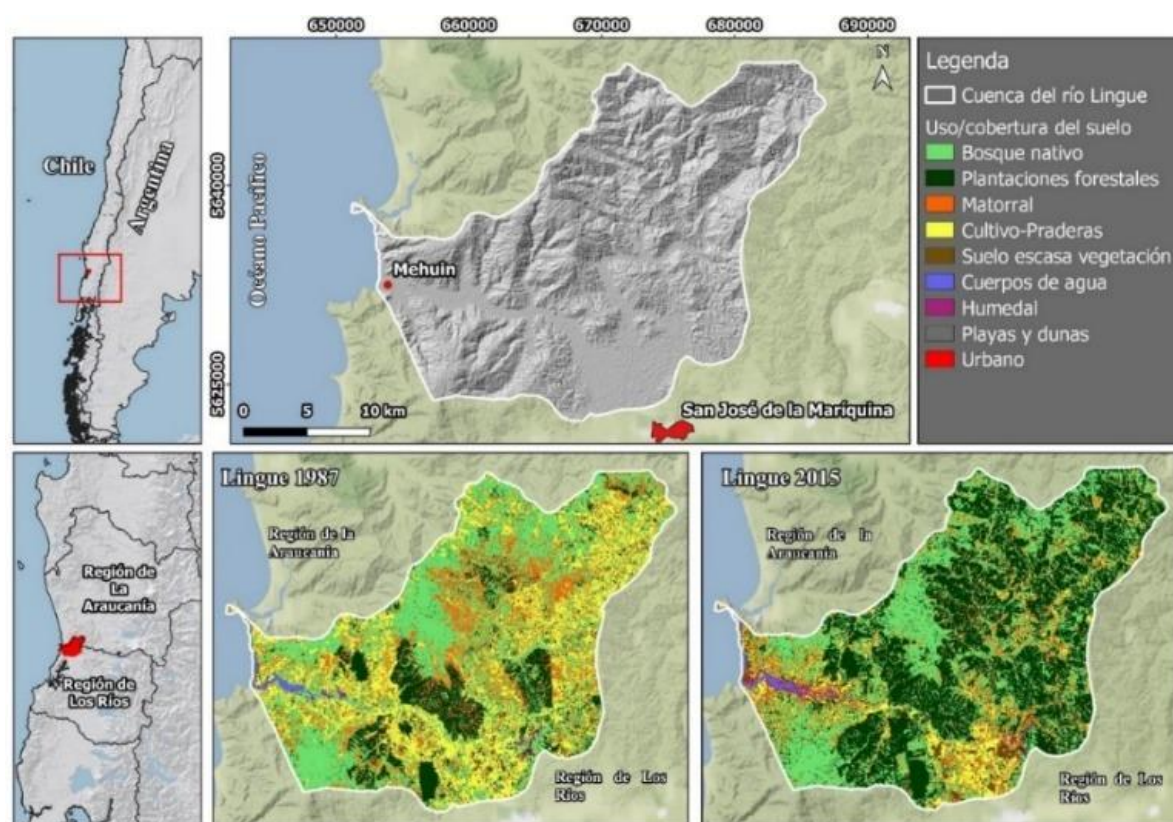
Introduction:

The expansion of planted forests is a major global land-use change, with significant growth in South America, mainly from exotic species. This study analyzes the factors driving forest plantation expansion in a coastal basin of south-central Chile (1987–2015), evaluating model performance using spatial pattern reproduction criteria and comparing global and geographically weighted regression approaches.

Objectives:

This study analyzes the factors driving forest plantation expansion in a coastal basin of south-central Chile (1987–2015), evaluating model performance using spatial pattern reproduction and metrics as the AIC, FOM, SPATIAL AUC, AND TOC to assess model performance among all possible models defined by using a multi-model inference approach.

Study Area:



Calculations and parameters used:

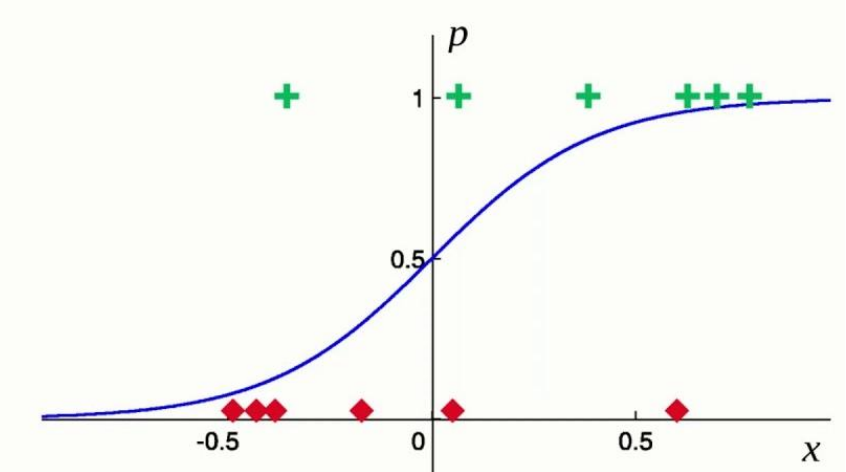
Relative importance of location factors:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_n X_n + \varepsilon$$

Logistics regression model:

$$\log\frac{p}{1-p} = \beta_0 + \beta_1 x$$

$$p = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x)}}$$

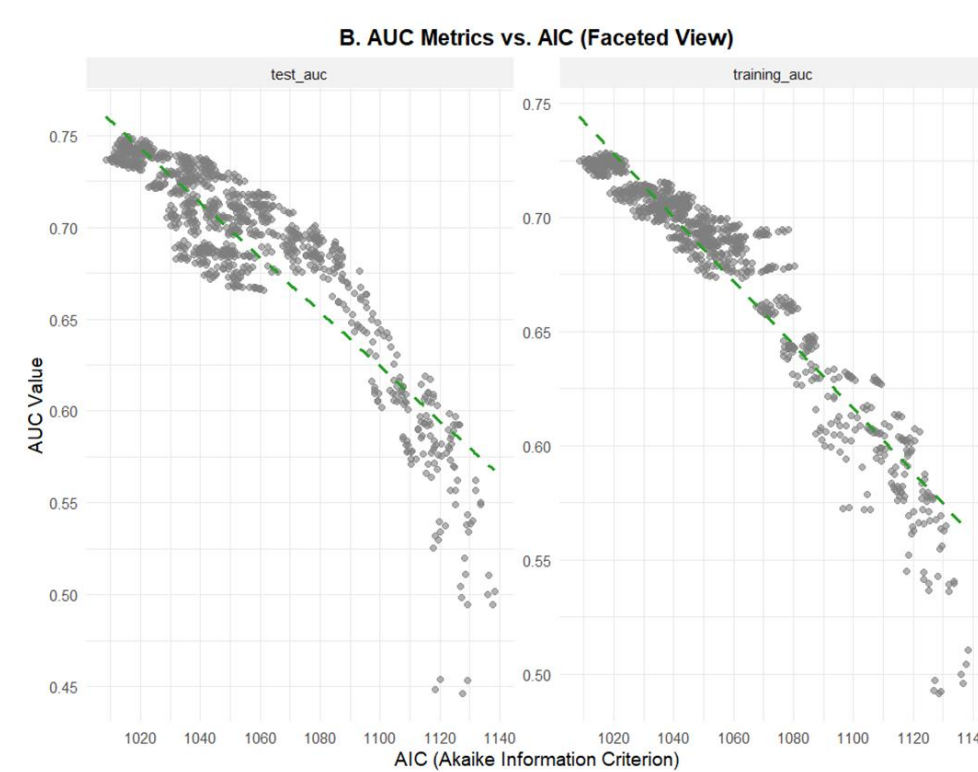


Results:

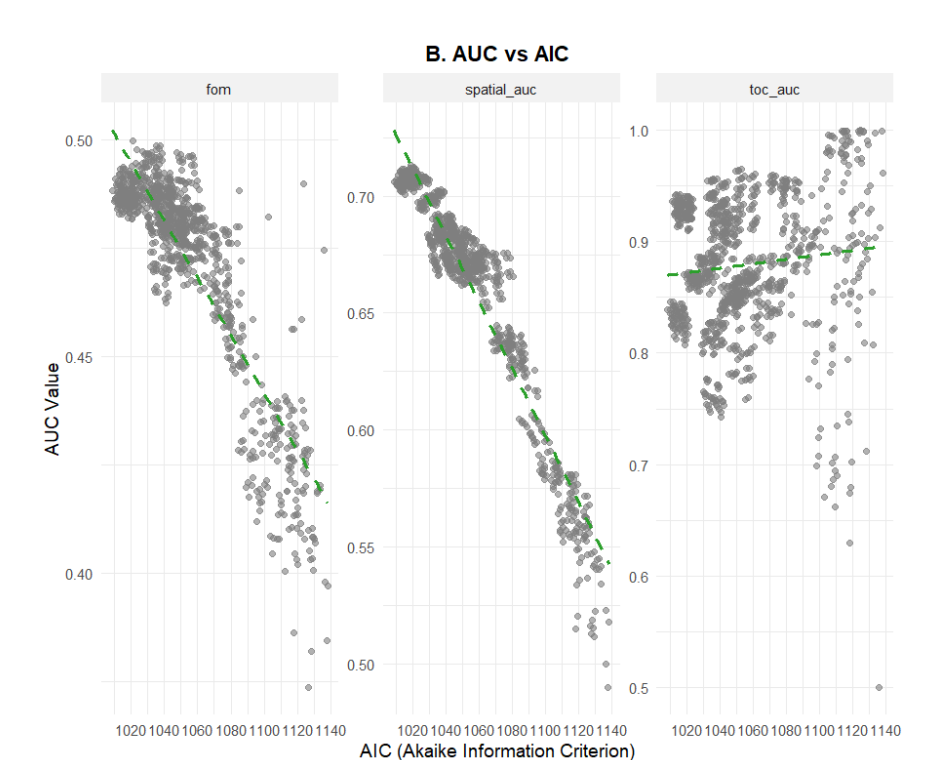
Descriptive statistics of models for forest expansion prediction

Statistic	fom	aic	spatial auc	training auc	test auc	toc
Min	0.3737	1009	0.4899	0.4917	0.4463	0.5
1st Qu.	0.4674	1033	0.6502	0.6713	0.6828	0.843
Median	0.4807	1047	0.6749	0.6953	0.7038	0.8797
Mean	0.4717	1054	0.6624	0.68	0.692	0.8791
3rd Qu.	0.4868	1072	0.6928	0.7085	0.7295	0.9264
Max	0.4997	1138	0.7131	0.7283	0.7502	0.9999

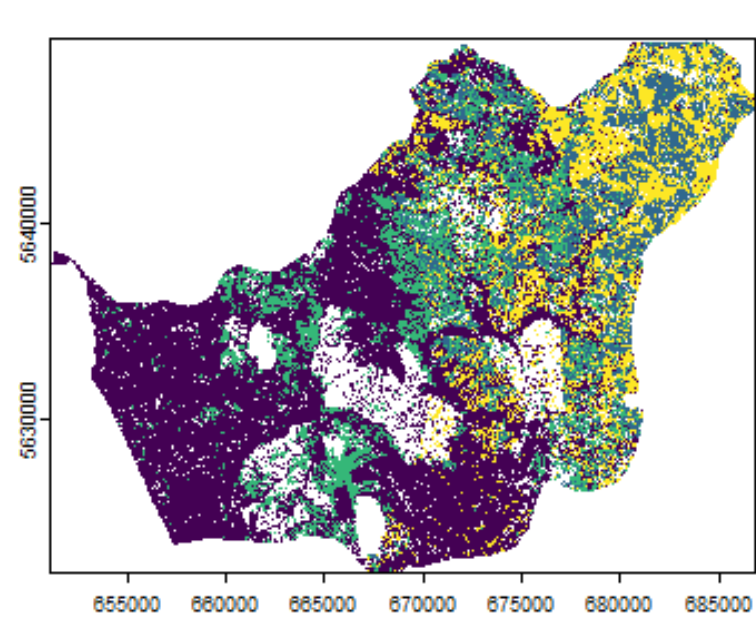
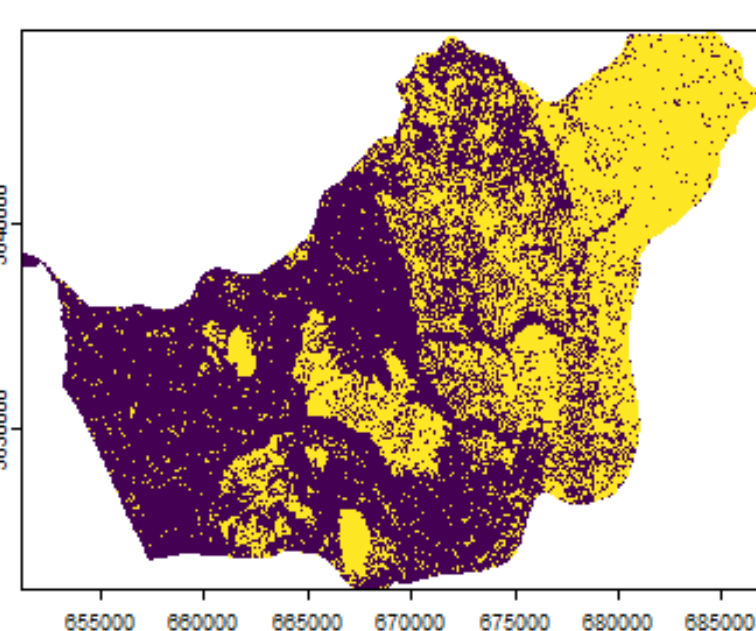
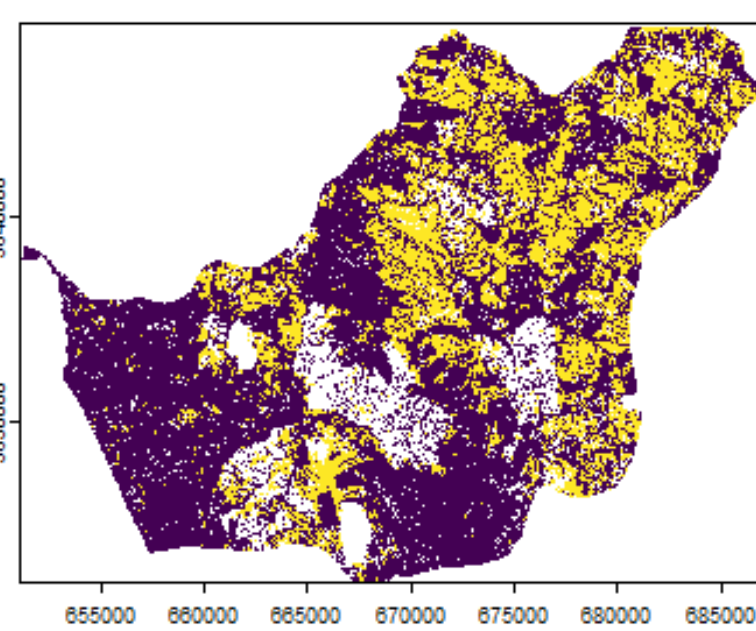
Models Assessment



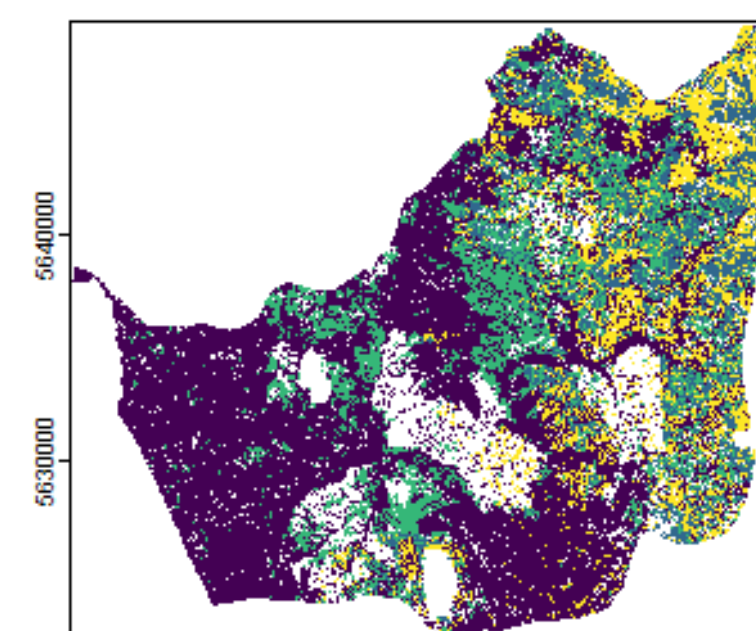
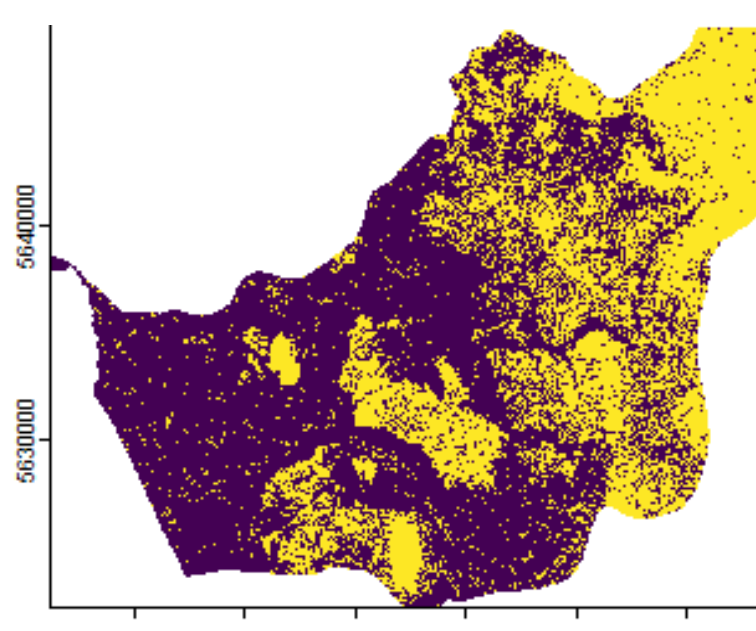
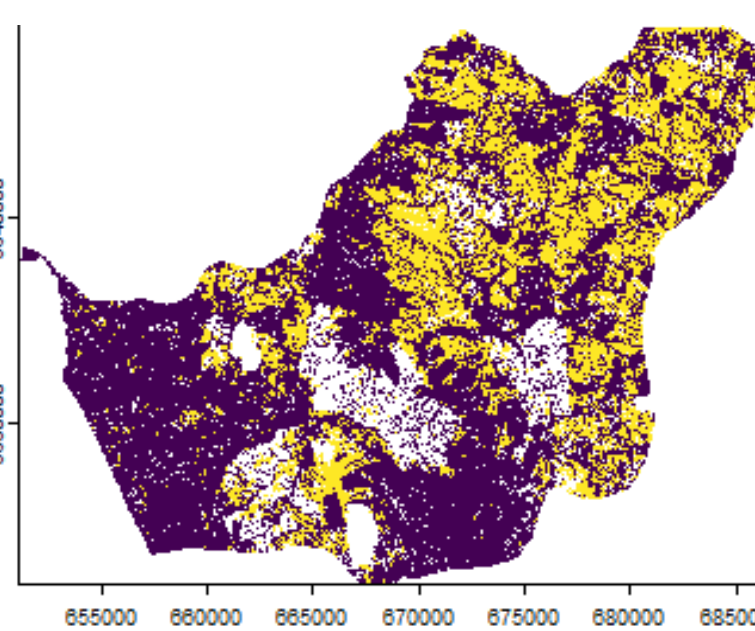
Spatial Model Assessment



Model 99:



Model 01:



Conclusions:

- The variables with the greatest impact on the expansion of forest plantations were slope, distance from urban areas, confirming patterns observed in other studies conducted in Chile.
- The use of the AIC criterion alone does not adequately reflect the ability of models to reproduce spatial patterns, so metrics such as FOM, SPATIAL AUC, AND TOC may be useful for appropriate choose a set of best models to assess relative importance of location factors.