# title

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**Abstract**

*Keywords:* hyperspectral imagery, statistical learning, spatial cross-validation

## 1. Introduction

## 2. Data and study area

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### *2.1. Hyperspectral data*

The airborne hyperspectral data was acquired on September 28th and October 5th 2016 around 12 am. The images were taken by an AISAEAGLE-II sensor from the Institut Cartografic i Geologic de Catalunya (ICGC). All preprocessing steps (geometric, radiometric, atmospheric) have been conducted by ICGC.

Additional information is provided in Table 1:

## 3. Methods

### *3.1. Index calculation*

All vegetation indices (90 total) suitable for the wavelength range of the hyperspectral data that are offered by the `hsdar` package have been calculated.

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Additionally, all possible Narrow Band Index (NBI) were calculated from the data using the following formula:

$$NBI_{i,j} = \frac{B_i - B_j}{B_i + B_j} \tag{1}$$

where $i$ and $j$ are the respective band numbers.

To account for geometric offsets, we calculated every index five times using a buffer from 1 - 5 meter around the centroid of the respective tree. The mean value of all pixels touched by the buffer was assigned as the final value for each index. The exact number of contributing pixels of an index cannot be determined as it depends on the location of the tree within the pixel grid. If a tree is located at the border of a pixel, the same buffer (e.g. 3 m) will include more pixels than if the point is located at the center of a pixel. Also, if a tree is located at the border of the image data, some directions of the buffer may not contain values. Missing values were removed from the mean value calculation. However, the bigger the buffer size, the more pixels are represented by the index value. In total, 7875 possible NBIs have been calculated for each buffer size summing up to 39375 indices. The same applies to the vegetation indices which sum up to 450 indices leading to a total number of 39825 indices per tree.

### *3.2. Ridge regression*

## References

Table 1: Specifications of hyperspectral data.

| Characteristic | Value |
|---|---|
| Geometric resolution | 1 m |
| Radiometric resolution | 12 bit |
| Spectral resolution | 126 bands (404.08 nm - 996.31 nm) |
| Correction: | Radiometric, geometric, atmospheric |