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A comprehensive overview on the use of satellite remote sensing to characterize and map fuel types

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Prevention measures, together with early warning and fast suppression, are the only methods available that can support fire fighting and limit damages caused by fires, especially in regions with high ecological value or dense populations. In order to limit fire damage, fire agencies need to have effective decision support tools that are able to provide timely information for quantifying fire risk. In particular, fire managers need information concerning the distribution, amount, and condition of fuels in order to improve fire prevention and to model fire spread and intensity.
In the past, fuel were generally typed in the field s thought long and expensive field reconnaissance campaigns Today, it is recognized that remote sensing can provide valuable data on type (namely distribution and amount of fuels) and status of vegetation in a consistent way at different spatial and temporal scales.
Obviously, field surveys are still indispensable for fuel type mapping either as the basic source of data or for assessment of products generated at a lower level of detail or to parameterise each fuel type. Field surveys are also recommended to create field reference datasets (i.e. groundtruth) to validate maps created from remotely sensed data products
Aerial photos have been the most common remote sensing data source traditionally used for mapping fuel types distribution.
Satellite multispectral data can be an effective data source for building up fuel type maps from global, regional down to a local scale.
Direct fuel mapping using remote sensing refers to the direct assignment of fuel characteristics to the results of image classification. The main advantage of the direct approach is its simplicity: by classifying fuels directly from imagery, compounding errors from biomass calculations, translation errors from vegetation classifications and image processing steps are minimized. Also the ground references are simplified. However, the main disadvantage is that it is difficult to classify all fuel characteristics in a way useful to fire management in many forested ecosystems. Passive sensors cannot get information about understory, therefore it is not possible to discriminate understory in forest areas. Moreover, a direct remote sensing mapping often distinguishes vegetation types rather than fuel attributes. An approach based on a direct fuel mapping (using remote sensing) provides high performances in grasslands and shrub-land, but meets serious difficulties when used in forested ecosystems because of passive sensors are usually unable to detect understory under close canopies.
Indirect fuel mapping based on remote sensing uses ecosystem characteristics as surrogates for fuels to overcome the limitations of imagery to directly map fuel characteristics. This approach assumes that biophysical or biological properties can be accurately classified from remotely sensed imagery.
These properties are often related to the vegetation and well correlate with fuel characteristics or fuel models. The indirect approach is the most commonly used for mapping fuels. At coarse scale AVHRR images have been often used to discriminate broad vegetation types or land cover classes