



## **Geothermal power plants and forest decline: remote-sensing techniques for impact evaluation of effects of human activity impact in forestal environment**

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As observed elsewhere in Tuscany, one of the components of the M.Amiata forest decline appears to be traceable to the activity of the local geothermal power plants. The presence of acid and heavy metals in the rain has been measured in several sampling site with different distances around the gas emission points.

Aimed to the phenomenon evolutionary trend definition a set of multitemporal Landsat Thematic Mapper images has been acquired (one before and two after the beginning of the power plant activity - 1984, 1995 and 2000), analysed and interpreted confronting the extracted vegetation optical indexes.

Even though the TM sensor (1984 and 1995 images) have instrumental characteristics compatible with its successor ETM+ (image 2000), the stability (i.e. the radiometric calibration) of his measurement progressively worsened making practically impossible comparison among the absolute values recorded

To dismiss the effects of the different illumination conditions, due to the sun position, a comparison methodology between the images taken in 1984 and 1995 relatively to that taken in 2000 needs to be adopted; this is equivalent to an empirical data calibration of the first two respect to the third one (multitemporal normalisation).

We observe a distribution of vegetation damage that increases in proximity and downwind from the geothermal power stations. We propose two mechanisms to explain such influence:

- The emissions from the geothermal power stations bring into the atmosphere elements that can have a phytotoxic effect, particularly boric and sulfidric acids, arsenic and mercury.
- The geothermal fluid extraction drastically lowers the water table of the superficial aquifer, stressing the forest particularly during dry summers.