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Volcanic ash and meteorological clouds detection by neural networks

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The recent eruptions of the Icelandic Eyjafjallajokull and Grímsvötn volcanoes occurred in 2010 and 2011 respectively have been highlighted the necessity to increase the accuracy of the ash detection and retrieval.
Follow the evolution of the ash plume is crucial for aviation security. Indeed from the accuracy of the algorithms applied to identify the ash presence may depend the safety of the passengers. The difference between the brightness temperatures (BTD) of thermal infrared channels, centered around 11 μm and 12 μm, is suitable to distinguish the ash plume from the meteorological clouds [Prata, 1989] on satellite images.
Anyway in some condition an accurate interpretation is essential to avoid false alarms. In particular Corradini et al. (2008) have developed a correction procedure aimed to avoid the atmospheric water vapour effect that tends to mask, or cancel-out, the ash plume effects on the BTD. Another relevant issue is due to the height of the meteorological clouds since their brightness temperatures is affected by this parameter. Moreover the overlapping of ash plume and meteorological clouds may affects the retrieval result since this latter is dependent by the physical temperature of the surface below the ash cloud. For this reason the correct identification of such condition, that can require a proper interpretation by the analyst, is crucial to address properly the inversion of ash parameters. In this work a fast and automatic procedure based on multispectral data from MODIS and a neural network algorithm is applied to the recent eruptions of Eyjafjallajokull and Grímsvötn volcanoes.
A similar approach has been already tested with encouraging results in a previous work [Picchiani et al., 2011]. The algorithm is now improved in order to distinguish the meteorological clouds from the ash plume, dividing the latter between ash above sea and ash overlapped to meteorological clouds. The results have been compared to the BTD ones, properly interpreted considering the information of the visible and infrared channels. The comparison shows that the proposed methodology achieves very promising performances, indeed an overall accuracy greater than 87% can be iteratively obtained classifying new images without human interactions.

References:

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