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Classifying Volcanic Ash using Decision Theory

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Volcanic ash poses a risk to infrastructure, aviation and health. Economic losses can result from both false positive and false negative classification of airspace contaminated with volcanic ash, however the overall risk associated with a false negative classification of ash-contaminated airspace is less severe than that of a false positive classification. The identification of volcanic ash using infrared remote sensing is a textbook example of where decision theory, a Bayesian framework for rational decision making, should be applied when interpreting a signal with associated risk. This paper demonstrates the use of decision theory to classify pixels as containing volcanic ash, desert dust (a common false positive for volcanic ash) or free from both volcanic ash and desert dust. The example uses the SEVIRI instrument and the 'reverse absorption' effect of silicate particles to demonstrate the strengths of decision theory in the classification of hazards under uncertainty and their associated risk. The implications of decision theory stretch beyond volcanic hazards and can be applied to the classification of any atmospheric or meteorological hazard.