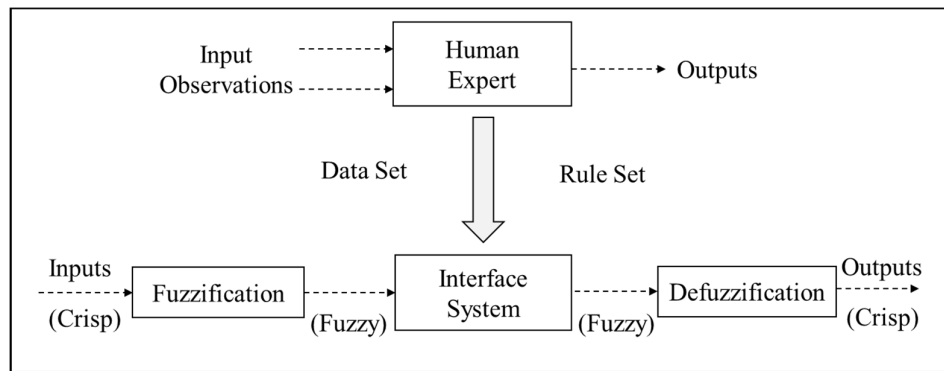


SM1. Supplementary material - FUZZY logic approach

The theory and concept of fuzzy logic were first introduced by Zadeh in 1965 [76] for the purpose to handle complex problems. After that fuzzy concept has been widely accepted and used for many scientific studies in different disciplines such as geomorphology, environment, hydrology, etc. In a very simple word, fuzzy simulates the way that people make inferences and decisions based on observations. The observation or information that propagates into the fuzzy model requires that the input variables go through three major transformations before the final output are known as fuzzification: fuzzy inference, and defuzzification. These three processes were shown below and briefly summarized:



The process of fuzzification: fuzzy inference, and defuzzification compiles the total Fuzzy logic system is similar to the mechanism with the human expert system and decision making.

1. *Fuzzification*: In this process, the input variables of the system are decomposed into one or more than one fuzzy set, and therefore a number of fuzzified input variables are produced.
2. *Fuzzy inference*: In this stage, the fuzzified input variables have been further decomposed into fuzzy sets. The fuzzy set involves if-then-else rules are applied to process the inputs and produce fuzzy output. Each rule is characterized with one condition and one action and the condition/action is defined by the input fuzzy set.
3. *Defuzzification*: In this final step, the fuzzy output has been estimated based on the defined output fuzzy set. The final fuzzy output is the outcome of the weighted mean from all the individual fuzzy rules in the fuzzy logic model.

Two types of fuzzy modelling approaches can be implemented in the fuzzy logic toolbox: (1) Mamdani-type, and (2) Sugeno-type. In our study, we have applied the Mamdani-type fuzzy modelling approach which is the most commonly used and widely accepted. The detailed description of fuzzy logic and the algorithms have been extensively discussed by Zadeh (1965).

The implementation of fuzzy logic is a very new and unique concept of SIF approximation based on the combination of different SVIs using airborne acquired imaging spectroscopic data. The fuzzy approach allowed us to develop more flexible combinations of weighted maps and could be readily implemented using spatial modelling language.