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Development of Multi-temporal Model for Frost Prediction on Agricultural Land exploiting MODIS satellite observations

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ABSTRACT:

Extreme climatic conditions, such as frost, play a critical role in agricultural productivity resulting to significant economic impacts. With the support of technological developments in Earth Observation (EO), the ability to map and analyse the spatial patterns of frost distribution over a given area has improved significantly, which can assist significantly in the evaluation and mitigation of the frost impacts on economy and society.

In this study, a dynamic model for the estimation of frost risk over agricultural land has been developed which aims at providing information on frost conditions at three temporal resolutions: 8-day, monthly and yearly. The model is developed in a Geographical Information Systems (GIS) environment and is based primarily on freely available EO Earth data from MODIS sensor series of operational products. The main model inputs include descriptors of the topographical characteristics of a given study region, yearly updated land use/cover data, inputs concerning vegetation density and vigor as well as vegetation health and productivity parameters, all represented by operationally distributed products at no cost provided from MODIS sensor.

Herein, the ability of our model to provide frost risk maps is evaluated for a typical Mediterranean setting, situated in Northwestern Greece using ground observations of frost conditions obtained by the Greek Agricultural Insurance Organization (ELGA) over a period of 10-years (i.e. 2000-2010). Our analysis showed that our model proved capable in mapping the extend of agricultural land at risk from frost damage rapidly and cost-effectively. With the necessary adjustments for each study site, the model has the ability to map reasonably the spatio-temporal distribution of frost conditions in a Mediterranean area. Our model can be a tool which could be of key value in planning of early prevention measures and agricultural insurance policies.