Identification of vineyard water status from VNIR-SWIR hyperspectral measurements

Eve Laroche-Pinel[1,2,3], Mohanad Albughdadi[1], Sylvie Duthoit[1], Véronique Cheret[2,3], Jacques Rousseau[4] and Harold Clenet[2,3]

[1] TerraNIS, 12 Avenue de l'Europe, F-31520 Ramonville Saint-Agne, France
[2] Ecole d'Ingénieurs de PURPAN, 75 voie du TOEC, F-31076 Toulouse, France
[3] UMR 1201 DYNAFOR, INRA / Toulouse INP, 24 chemin de Borderouge F-31326 Castanet Tolosan Cedex
[4] Groupe - Institut Coopératif du vin, La Jasse de Maurin, F-34970 Montpellier, France

Keywords : leaves reflectance, water status, precision viticulture

To optimize both yield, quality and vigour of vineyards, a moderate hydric constraint is essential to restrict vegetative development and foster berries growth. However, water stress, defined as an exceeding lack of water, leads to lower yields and decrease the harvest quality. Climate change in the south of Europe resulted in a temperature increase and rainfall decrease during summer (Saurin et al., 2014). Since 2017, French AOC vineyards irrigation approvals are delivered exclusively under certain conditions and if an important water stress is stated. In this context it seems crucial to provide objective and practical information on the water status of vineyards and estimate accurately and swiftly a field or region's level of water stress. Presently water stress measurements are mainly based on field analysis in vineyards which is especially burdensome. Remote sensing is an advantageous tool because it decreases the need for fields measurements and both intra and inter-plots information. Remote sensing could especially be useful to demonstrate efficiently that plots suffer from significant water stress, allowing winegrowers to ask for irrigation approvals and to manage irrigation according to the needs.

This study aims at identifying the most relevant spectral domains to estimate the water content of vines' leaves. To carry out this study, four plots located in the south of France were monitored from bunch closure (July 2019) to harvest (end of August 2019): two experimental plots with three distinct water management scheme and two plots without any irrigation. Water status was measured using the stem water potential (SWP) and hyperspectral measurements from 0.35 to 2.5µm were acquired on leaves from the same roots thanks to an ASD FieldSpec 4 Hi-Res NG Spectroradiometer. The relation between SWP and VNIR-SWIR reflectance was evaluated by means of three methods: a simple correlation matrix testing every single wavelengths, a feature importance selection using an Extra Tree machine learning algorithm and a normalize difference spectral index (NDSI).

The first results of our study not only confirm the relevance of the main water absorptions near 1.4 and 1.9µm but also highlight the significance of the red-edge and NIR domains to assess the water content level of vineyard using remote sensing data.