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Using the photochemical reflectance index (PRI) to detect the water stress of winter wheat in semi-arid regions

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Of all human activities, agriculture is by far the largest user of water. However, this activity consumes the majority of the water mobilized by humans with large losses to groundwater and/or the atmosphere. In order to optimize irrigation and to participate in the rational management of our heritage, the monitoring of rapid changes in plant physiology is necessary. The remotely sensed photochemical reflectance index (PRI) can provide us with information on the dynamics of xanthophyll pigments. To better understand the temporal dynamics of the PRI, two experiments were carried out over winter wheat during two agricultural seasons in the Marrakech (semi-arid) region of Morocco. In situ PRI and soil moisture measurements were collected every 30 minutes at a station located in a winter wheat field . The PRI is normalized for (plant) structural effects by defining the PRI0 as the morning measurements extrapolated to a global radiation (Rg) of 0 W/m2. By assuming that the structural effects of the vegetation are all included in PRI0, a daily stress index (dPRI) can be derived as the solar noon PRI (PRIt) subtracted by the morning PRI (PRI0). In this study, PRI0 shows a good correlation with the leaf area index (LAI), indicating that it is possible to isolate the structural effects of the plant. During the weeks when vegetation is well developed, the correlation between the 5-cm (25-cm) soil moisture and dPRI is 0.57 (0.52), respectively. Finally, the PRI has potential for monitoring the status of plants and their responses to changes in environmental conditions.