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Monitoring soil moisture over crop fields in the Argentine Pampas using multi-temporal Sentinel-1 data

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Accurate monitoring of the variability of soil moisture within agricultural field during the crop growing season can provide valuable insight to implement site-specific crop management. The aim of this study was to develop an approach to improve the estimation of surface soil moisture at field scale based on multi-temporal Sentinel-1 data. Two agricultural fields located in the Argentine Pampas (Long 60º 14,264′W; Lat 38º 19,178′S) were used for this study. Wheat and oat were sown in field 1 and 2, respectively. ECa and elevation were previously determined using VERIS 3100 soil sensor and DGPS. Based on this information, two standard digital soil mapping (DSM) techniques were applied. First, a coupled spatial Principal Components and Fuzzy K-means (sPCA-FK) was used to delimitate three homogeneous zones per field. Second, 11-sampling points were determined per field using conditioned Latin Hypercube (cLHS). Ten Sentinel-1 images were acquired during the period August-December 2017 through crop growing season. All images were in dual-polarization modes (VH and VV) and were calibrated. Also, VH/VV rate was calculated. The coefficient of variation (CV) and the mean of radar backscatter within each field were calculated for all polarization modes along time serie. Volumetric soil moisture (VSM) content at 0-5, 5-10 and 10-15 cm depth was measured for each sampling point, simultaneously with Sentinel-1 image acquisition. All measurements were coupled with zone delimitation within field. A lineal model per zone between polarization modes and VSM was adjusted and validated. The results suggest that the zone delimitation was efficient to define the differences in the CV and mean radar backscatter for both fields. Also, cLHS was efficient to establsih representative sampling points. Lineal regression model results suggest that previous zone delimitation and the use of cHLS could improve the prediction of VSM. We demonstrated that the use of DSM techniques can predict VSM satisfactorily based on Sentinel-1 data.