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Remote sensing based soil water balance for the benchmarking analysis of sprinkler and furrow irrigation in Nebraska.

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Nebraska-US harvested nearly 3.8 million hectares of corn for grain with a yield of 12 Mg.ha-1 in 2017. Almost 60% of the cultivated area is irrigated making it the most irrigated State in the United States. Most of the irrigation water in the State comes from groundwater. To supply this water demand, Nebraska has more 100 thousand active irrigations wells, and on average ten thousand wells are added every decade, increasing the pressure on the groundwater resources.
In this work, we propose the benchmarking analysis of irrigation management at the scale of the commercial field and Natural Resources District (NRD), comparing the actual irrigation records and the estimates of net irrigation requirements using the reflectance-based crop coefficient approach. This analysis allowed us to compare pumping records and identify fields where significant over and under irrigation has occurred. Additionally, we examined the impact of soil types, local weather and irrigation system (center pivot and furrow irrigation).
The study was carried out in three NRDs, namely Tri-Basin, Central Platte and Lower Niobrara for the period 2004-2012 in over 2000 irrigated fields per year. Annual crop choice and field data are reported for each well through cropland data layer by National Agricultural Statistics Service of USDA. Daily weather data for the study period was obtained from two hundred stations and interpolated using inverse distance weighing to achieve the required spatial coverage. The soil properties were derived from SSURGO 2.2 database, and the soil moisture data at planting was obtained from the High Plains Regional Climate Center at the University of Nebraska-Lincoln.
The difference between modeled irrigation water requirement and field level irrigation records was significant ($p<0.001$). We also observed a significant difference in field level irrigation application between pivot and furrow irrigation systems. According to results, both irrigation system shows a wide standard deviation for observed irrigation at field-level, which means that water management of each irrigator has not considered the soil type and weather for all NRDs. In both wet and dry years, fields with furrow irrigation over-irrigate in all NRDs reaching up to three times more water applied compared to the required amount. On the other hand, when we consider center pivot irrigation system there was under-irrigation for the three NRDs in the drought year and in general less scattered data when compared to furrow irrigation.