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Vegetation phenology to partition groundwater from surface water-irrigated areas using MODIS 250-m time series data for the Krishna River basin, India

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Abstract This paper describes a remote sensing based vegetation-phenology approach to accurately separate out and quantify groundwater irrigated areas from surface-water irrigated areas in the Krishna River basin (265 752 km^2), India, using MODIS 250-m every 8-day near continuous time series for 2000–2001. Temporal variations in the Normalized Difference Vegetation Index (NDVI) pattern, depicting phenology, obtained for the irrigated classes enabled demarcation between: (a) irrigated surface-water double crop, (b) irrigated surface-water continuous crop, and (c) irrigated groundwater mixed crops. The NDVI patterns were found to be more consistent in areas irrigated with groundwater due to the continuity of water supply. Surface water availability, however, was dependent on canal water release that affected time of crop sowing and growth stages, which was in turn reflected in the NDVI pattern. Double-cropped (IDBL) and light irrigation (IL) have relatively late onset of greenness, because they use canal water from reservoirs that drain large catchments and take weeks to fill. Minor irrigation and groundwater-irrigated areas have early onset of greenness because they drain smaller catchments where aquifers and reservoirs fill more quickly. Vegetation phonologies of nine distinct classes consisting of irrigated, rainfed, and other land-use classes were derived using MODIS 250-m near continuous time-series data that were tested and verified using groundtruth data, Google Earth very high resolution (sub-metre to 4 m) imagery, and state-level census data. Fuzzy classification accuracies for most classes were around 80% with class mixing mainly between various irrigated classes. The areas estimated from MODIS were highly correlated with census data (R-squared value of 0.86).

Key words groundwater irrigated areas; surface-water irrigated areas; phenology; MODIS; NDVI; irrigated areas; Krishna basin, India