Long-term NDVI series analysis for water management in irrigated areas

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We analyze NDVI time series of an irrigated area of 25 ha that was launched in 1984 in a sylvo-agro-pastoral mountainous of Northern Tunisia. The study area is under anthropic changes consisting in an increasing of pumping volumes for irrigation and spreading of arboriculture practices. The main occupation now is apple trees but earliest (unsuccessful) trials were within vineyards and pears. A series of Landsat 30 m resolution images for a 34-year period from the starting of the irrigation facilities in 1984 to 2017 is analyzed. The NDVI of June is considered. Sample statistics of every June map are identified to help monitoring the evolution of NDVI over the study area. In interpreting NDVI observations NDVI=0.2 and NDVI =0.5 are usually adopted as descriptors of respectively soil and full vegetation conditions. Results show that while the non-exceedance probability of the value NDVI equal 0.2 decreased through time, that corresponding to NDVI equal to 0.5 increased, well reflecting the growth of arboriculture through time. Furthermore, a log-normal probability distribution is adjusted to every NDVI map from 1984 to 2017. It is found a rising time trend in position and scale distribution parameters, signifying non stationary log normal distributions for NDVI. The position parameter of the log-normal distribution is found statistically related to the growing season rainfall with different regressions corresponding to two periods the one before and the one after 2010. The changing year 2010 represents phenological growth (10 years old for most trees) but also corresponds to a changing year with respect to the increase in irrigated volumes. Finally, homogeneity tests (Mann-Kendall, Pettit, Sen) were applied to test the time series of a subsample of pixels against temporal change in NDVI. They result in rejecting homogeneity hypothesis at the confidence level of 5%. The most probable date of change was found 2005. This year corresponds to 5 years old for apple plantations. The study outlines the worth of NDVI information for monitoring anthropic changes in arboriculture systems. The next challenge is using this no stationary variable for sustainable water management in this case of a shared groundwater resource under pressure.