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Using remote sensing and spatial analysis of trees characteristics for long-term monitoring in arid environments

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Trees play a significant role in the desert ecosystem by moderating the extreme environmental conditions including radiation, temperature, low humidity and small amount of precipitation. Trees In arid environments such an Acacia are considered to be 'keystone species', because they have major influence over both plants and animal species. Long term monitoring of acacia tree population in those areas is thus essential tool to estimate the overall ecosystem condition. We suggest a new remote sensing data analysis technique that can be integrated with field long term monitoring of trees in arid environments and improve our understanding of the spatial and temporal changes of these populations.

In this work we have studied the contribution of remote sensing methods to long term monitoring of acacia trees in hyper arid environments. In order to expand the time scope of the acacia population field survey, we implemented two different approaches: (1) Trees individual based change detection using Corona satellite images and (2) Spatial analysis of trees population, converting spatial data into temporal data.

A map of individual acacia trees that was extracted from a color infra-red (CIR) aerial photographs taken at 2010 allowed us to examine the distribution pattern of the trees size and foliage health status (NDVI). Comparison of the tree sizes distribution and NDVI values distribution enabled us to differentiate between long-term (decades) and short-term (months to few years) processes that brought the population to its present state.
The spatial analysis revealed that both tree size and NDVI distribution patterns were significantly clustered, suggesting that the processes responsible for tree size and tree health status (i.e. flash-floods spatial spreading) have a spatial expression. The distribution of the trees in the Wadi (ephemeral river) was divided into three distinct parts: large trees with high NDVI values, large trees with low NDVI values and small trees with medium NDVI values. Using these results, we divided the Wadi into three sections, each representing a unique combination of long and short-term geo-hydrologic processes affecting the acacia trees.

The next phase of the temporal data extraction procedure was to implement change detection regarding each of the Wadi sections defined by the spatial analysis result. For this purpose we used a corona image from 1968 and applied individual based change detection. The result of the change detection supported our findings of changes in the geo-hydrology regime from long to short term scale.