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Monitoring morphological changes in an arid zone by spaceborne images and aerial photography between 1945 – 2009; the Yamin Plateau, Israel

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This research focuses on a geomorphic mapping of the Yamin Plateau in southern Israel which is part of the Yamin-Rotem Syncline and covers about 200 km^2. This area has been restricted since the 1950s and therefore, provides a unique opportunity to study undisturbed geomorphic processes. Nowadays, the national nuclear waste depository is located in this area accepting waste from industrial factories, research institutes and hospitals. This is the main reason why environmental processes are of major interest in terms of landform changes in space and time.

The exposed geology section of the Yamin Plateau mostly consists of the Miocene Hazeva Group where sedimentary processes started 20 million years ago and continued for 12-14 million years. Two formations of the Miocene Hazeva Group appear in the study area Zefa and Rotem. The compositions of these two formations are similar and sometimes defined as "the main sand body" in the Hazeva Group. The restriction of the area stopped the grazing and let the development of a biological soil crust on the surface. The research objective was to document and characterize landform changes from 1945 until 2009 within the Yamin Plateau based on spaceborne images and aerial photography. All the parameters we extracted in the laboratory were validated with field measurements. A combination of the spaceborne images, aerial photography and field measurements leads us to the following conclusions:

1. The research results show that soil stabilization processes took place earlier than the area closure. Inspite of decreasing precipitation tendencies as measured during the last 50 years in Yamin Plateau, the vegetation cover increased from 55% in 1945 to 67% in 2009. The main reason for this is the area closure and reduction in grazing along with developing of vegetation and biological soil crusts.

2. Field studies and image processing of aerial photographs and recent QuickBird images alongside grain-size distribution show that in the past there were active zibar morphologies in the region. The most frequent grain-size of 350 μm supports this.

3. Although the current geology map of the Yamin Plateau is characterized by sand soil texture, nowadays the study area surface contains 50% of clay minerals, which were probably trapped by soil crusts during dust storms.

4. A grain size analysis shows the dominance of medium-coarse sand (350 μm) that partially mantle the Yamin Plateau surface. Aeolian activity that took place in the past and was concentrated in the southern and eastern parts of the plateau and included linear zibars.

We also present a new index, the Clay Crust Index (CCI) that includes the combination of the Crust Index and the 7-th band of the Landsat TM that covers the clay absorption range. The idea behind this combination is based on trapping of clays by biological soil crusts which deepens the absorption feature in the spectrum of 7-th band of the Landsat TM. From 1945 to 2004 there were no evidence that indicate aeolian nor fluvial activities. Yet, a single extreme rain event that took place in 29 October 2004 caused the largest landform changes in the past 60 years. The runoff widened in the eastern channel streams.

To summarize, the study area's closure in the late 1950's had contributed to the decrease of aeolian processes.

The fluvial processes are very limited, yet, when there is an unusually large rainstorm event there is a risk of undermining and extreme erosion processes, especially when the surface is covered by soil crusts and clay.