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Sand Dunes of Khenifiss National Park of Morocco

Amelia Carolina Sparavigna *(Department of Applied Science and Technology, Politecnico di Torino)*

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Abstract
Drifted by winds, the dunes move and change their shape. We can observe the evolution of them in the time series of satellite images, such as those provided by Google Earth. Here we consider the dune field of the Khenifiss National Park of Morocco. We see that these dunes, which spent several years having, more or less, the same shape, are now remarkably changing, as evidenced by the recent satellite images of 2016. The origin of this strong deformation is in the change of the wind direction.

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Sand Dunes of Khenifiss National Park of Morocco

Amelia Carolina Sparavigna

Politecnico di Torino, Italy

Abstract: Drifted by winds, the dunes move and change their shape. We can observe the evolution of them in the time series of satellite images, such as those provided by Google Earth. Here we consider the dune field of the Khenifiss National Park of Morocco. We see that these dunes, which spent several years having, more or less, the same shape, are now remarkably changing, as evidenced by the recent satellite images of 2016. The origin of this strong deformation is in the change of the wind direction.

Keywords: Sand dunes, Satellite images, Time series, Google Earth.

The Khenifiss National Park is a national park in the southwest of Morocco. This park, established in 2006, is located near the Atlantic coast in the region of Laayoune - Sakia El Hamra. It was created to protect the desert, the coastal wetlands and the sand dunes [1]. In fact, the Khenifiss National Park is including the biggest lagoon at the Moroccan coast, an important bird nesting ground and the place where a large number of species migrate during the winter [1,2].

The inland part of this park includes sand dunes and limestone plateaus. The evolution of these dunes can be observed by means of the satellite images collected in the time series of Google Earth. Remarkably, the sand dunes of the Park are changing their shape. Let us remember that the shape of dunes is determined by the quantity of sand and by the interaction of it with the local wind and soil surface. By this complex interaction, the variety of shapes displayed by the dunes arise [4-13]. In the case that wind is blowing from a prevailing direction, the dunes migrate; this

migration can be easily studied by using the abovementioned time series of satellite images (examples are given in [14,15] and references therein).

As discussed in [3], Google Earth evidences that, recently, the dunes of the Laayoune - Sakia El Hamra region have been subjected to strong changes. For instance, dunes that for years were barchans drifted by NNE wind, in the satellite images of 2016 appear distorted by ESE wind [3].

Let us consider here the dunes in the Khenifiss National Park. We have Google Earth images from 2010 to 2016 for the northern part of the park and from 2003 to 2016 for the southern part. As for the dunes shown in [3], the dunes of this Park, which slightly altered their shape for several years, appear as definitely changed in the last images of 2016. An example is given in the Figure 1 (the satellite images have been enhanced using GIMP Retinex).

We can suppose that the dunes are changing their shape because of a change of the direction of the winds. For example (see Figure 2), in the images of 2013, according to the shape of the barchans, the direction of the wind was NNE, but in the images of 2016 the barchans appear deformed by ESE wind. In the Figure 3, we can see a sequence of four images (2003, 2010, 2013 and 2016). In the images 2003/2010/2013, the barchans slightly changed their shape, but in 2016 the deformation is prominent.

We can conclude as we did in [3], stressing that the satellite images from the time series of Google Earth are showing a quite interesting phenomenon, which requires further detailed researches, in particular concerning the direction of the wind. From the deformation of the barchans, it seems that this region is undergoing a climate change.

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Figure 1: Dunes of the Khenifiss National Park in the time series of Google Earth.

Figure 2: Two barchans in the Khenifiss National Park (coordinates 28.005560, -12.328146). On the left, we see the dunes in 2013, and, on the right, the same dunes in 2016. They have drastically changed their shape.

Figure 3: A sequence of Google Earth satellite images (up/left 2003, up/right 2010, down/left 2012, and down/right 2016; location 27°53’48.02’’N 12°24’36.68’’W). In the images 2003/2010/2013, the barchans (for instance, dune A) slightly changed their shape, but in 2016, the deformation is prominent.

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