Title: Measuring dune velocity and sand flux with COSI-Corr

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Abstract:

Roads and pipelines in desert areas can be buried by migrating sand dunes. The cost of removing this sand is directly proportional to the sand flux of the moving dunes. Traditionally, sand flux measurements have been carried out by costly geodetic field surveys and/or long term monitoring of stakes set out in the (inter)dunes. We have developed an alternative approach for measuring sand flux from pairs of high resolution optical satellite images with a change detection algorithm called COSI-Corr. Using pairs of optical satellite images, we detected dune migration over time intervals of months to years. We then used the resulting displacement map to automatically distinguish dunes from interdunes. We interpolated a surface between the interdune areas and subtracted it from a digital elevation model, thus obtaining dune heights and volumes. Multiplying height with celerity yielded a pixel-by-pixel estimate of the sand flux, which was used to assess the annual volume of sand that needs to be removed from artifacts such as roads in dune areas.

We then set out to extend the COSI-Corr algorithm in order to extract time series of dune mobility from the co-registered satellite images without further human intervention. This was achieved by 'warping' sequential displacement fields onto a common reference frame, and then tracking individual dune pixels through time. We applied this algorithm to a sequence of Landsat, SPOT and ASTER from the central Sahara, discovering that little or no change has occurred in the dune velocity (and therefore windiness) of this area over the past 26 years.