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Use of advanced earth observation tools for the analyses of recent surface changes in Kalahari pans and Namibian coastal lagoons

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The remote sensing analyses in the BMBF-SPACES collaborative project Geoarchives - Signals of Climate and Landscape Change preserved in Southern African Geoarchives - focuses on the use of recent and upcoming Earth Observation Tools for the study of climate and land use changes and its impact on the ecosystem. It aims at demonstrating the potential of recently available advanced optical remote sensing imagery with its extended spectral coverage and temporal resolution for the identification and mapping of sediment features associated with paleo-environmental archives as well as their recent dynamic. In this study we focus on the analyses of two ecosystems of major interest, the Kalahari salt pans as well as the lagoons at Namibia's west coast, that present high dynamic caused by combined hydrological and surface processes linked to climatic events. Multitemporal remote sensing techniques allow us to derive the recent surface dynamic of the salt pans and also provide opportunities to get a detailed understanding of the spatiotemporal development of the coastal lagoons. Furthermore spaceborne hyperspectral analysis can give insight to the current surface mineralogy of the salt pans on a physical basis and provide the intra pan distribution of evaporites.

The soils and sediments of the Kalahari salt pans such as the Omongwa pan are a potentially significant storage of global carbon and also function as an important terrestrial climate archive. Thus far the surface distribution of evaporites have been only assessed mono-temporally and on a coarse regional scale, but the dynamic of the salt pans, especially the formation of evaporites, is still uncertain and poorly understood. For the salt pan analyses a change detection is applied using the Iterative-reweighted Multivariate Alteration Detection (IR-MAD) method to identify and investigate surface changes based on a Landsat time-series covering the period 1984-2015. Furthermore the current spatial distribution of evaporites is obtained using of EO-1 Hyperion hyperspectral imagery linked with geochemical field data. Results reveal a highly heterogeneous dynamic of the pan surface, which seems to be associated with varying surface crust types, halite or gypsum dominated.

The lagoons at Namibia's west coast such as of Sandwich Harbour and Walvis Bay, are important habitats and also serve as a natural barrier to protect shipping and ports on an otherwise inhospitable coastline. Several studies have shown that these lagoons are highly dynamic and are known to have altered their shape in historical time. These changes occur due to sediment transport forced by aeolian processes or either by longshore or cross-shore drifts. A profound understanding of the spatiotemporal variations in the sand spits is of high relevance. In the lagoon environment the Landsat time-series is used to separate sand spits from open water. This way, changes in morphology of the sand spit are identified over time. The results reveal the presence of long-term and short-term changes as well as the presence of stable parts in the sand spits. These findings are linked to temporal patterns of forcing processes such as wind, tidal and ocean current data.