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Land-Surface Variability Detected by Long-Term AVHRR Data Series

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The AVHRR data form one of the longest available remote sensing data set and are therefore predestinated for global change research. For land-surface applications, however, a homogenisation and calibration of the series obtained with different instruments is necessary. Methods have been developed to use these data world-wide for ecological research. Because of its topographic diversity the Mediterranean and central European area is ideally suited to test the accuracy and applicability of the products derived from these data. For this purpose the MEDOKADS archive was generated at the Free University of Berlin. It is a long-term, re-calibrated, homogenized, full resolution set of daily AVHRR data starting in1989 and covering the area of 27° - 55°N, 10° W - 42° E for each day and the northern part of Europe up to 72° N from March to October. Originally developed to study desertification in the Mediterranean it has a range of other applications as well of which examples are presented. Basic or primary products are spectral reflectances averaged over a decade to remove cloud contamination and effects of variable observation conditions. The long-term data set allows to determine the variability, trends and regional synergies of surface temperature and reflectance related quantities.
Combination of spectral reflectances leads to broad band reflectances and to vegetation indices. These are related to vegetation density, vegetation period, and changes of land use. Further data aggregation eventually under inclusion of higher (Landsat, SPOT) and lower (Meteosat) resolution satellite data as well as of supplemental ground observations leads to higher order data products. The combination of shortwave and long-wave infrared data allows to determine the extent of droughts, heat waves, and fires. More elaborate evaluation of the data leads to albedo and the energy budget at the surface. Part of this is the latent heat flux from the surface, a component of the hydrological cycle. Combination with models finally allows to study changes of ecosystem and hydrological processes.
Discussed are also limitations for the application of the data. Aerosol effects play a major role in the Mediterranean: Frequent desert dust outbreaks, industrial pollution and burning and volcanic eruptions cause a high variability of atmospheric turbidity. The local time difference between the eastern and western edge of the swath results in different illumination geometries and surface temperatures. This requires an in principle pixel-wise correction according to the bidirectional reflection function of the surface in the shortwave AVHRR channels and a normalization of the radiometric surface temperature to the daily maximum. Notwithstanding a careful re- and inter-calibration there remain irregularities in the data base probably caused by variations of the sensor sensitivity. To correct for such effects, inter-comparisons with other satellite data from shorter term missions and with surface measurements at anchor stations are necessary. Validation studies have been carried out in a number of places in the Mediterranean area.