## Service summary and potential applications

Land degradation may ultimately result in severe loss of vegetation cover and biological productivity over prolonged periods of time and vast areas. Satellite remote sensing presents a viable option to monitor such losses. The Normalized Difference Vegetation Index (NDVI) has been the predominant tool in large-scale vegetation monitoring for desertification studies. Advanced Earth Observation (EO)-derived indices such as FAPAR (Fraction of Absorbed Photosynthetically Active Radiation) move beyond NDVI and assess land productivity dynamics and vegetative land cover structure quantitatively at high spatial and temporal scale. Vegetation cover trends obtained over the years can indicate land degradation processes, and such analyses can be conducted with (and without) controlling for water availability. This helps to pin-point areas of change, assess the land degradation directly, and target areas for further investigation and possible intervention. The same tools allow monitoring the impact of conservation and rehabilitation of degraded land, and the effectiveness of the mitigation and rehabilitation efforts. The European Space Agency's fleet of Sentinel satellites provides a substantial boost to this domain as it substantially improves some of the fundamental data acquisition parameters, especially in revisit time, and spatial and spectral resolution of available data.

The advantage of satellites is that they provide spatially continuous, replicable and homogenhous information on the condition, distribution and dynamics of the environment in a cost-effective manner and over large areas. Some satellite time series have become long enough to identify significant vegetation changes over time. From a historical analysis of the variability of climate variables and vegetation indices, a drought indicator can be derived to determine arable lands that are suffering under climatic change pressures.

At the same time agriculture-driven land degradation also affects the future productivity of landscapes. The soils are being routinely degraded by misuse of fertilizers causing loss of soil microbiological health. Agriculture expansion drives forest/woodland clearings. Short or no fallow, overgrazing, poor irrigation and drainage lead to pollution, erosion, salinization, acidification/alkalinization or loss of biomass. EO data can provide a range of indicators related to mapping of the land use and soil properties. For example, mapping of the rural population proximity to permanent or seasonal water bodies may identify potential livestock grazing pressures, and predict (or explain) observed land degradation trends. In a similar way, the Revised Universal Soil Loss Equation (RUSLE) fed with EO-derived inputs can predict the average annual soil loss caused by water erosion from data that characterizes rainfall, soil type, topography, cropping system and land management practice. Such a model helps to identify and trace hotspot areas with high erosion potential, and informs the planning of restoration activities.

The integration of multiple satellite-based products allows for a comprehensive assessment of land degradation and environmental conditions, by considering land use and productivity, soil degradation as well as climatic factors. Satellite data and derived information can be spatially analyzed to improve understanding of causal impact chains.
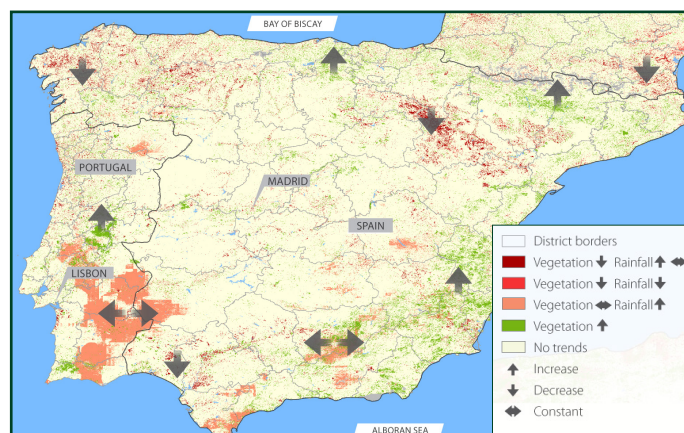
Satellite-based rainfall and vegetation trends observed from 2003 to 2010. Areas prone to degradation (red) or with positive vegetation (green) trends are clearly visible. Copyright: GeoVille for ESA/CBD/UNCCD.
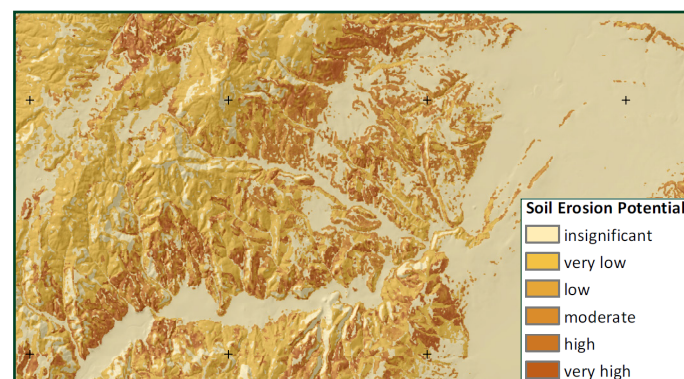
The map shows the soil erosion potential based on the Universal Soil Loss Equation with EO-derived inputs on land cover, terrain and precipitation and with soil type information from a database. Copyright: GeoVille for ESA/World Bank.

EO information services

Information service	Content / Products
Land degradation assessment	» Long-term, large-area assessment of land degradation processes » Assessment of vegetation trends » Development of indicators to determine hotspot locations
High-resolution monitoring of land degradation investments	» Recent land cover and land use maps of areas that undergo restoration » Distribution of major land cover categories relevant for land degradation monitoring » Assessment of the major land cover changes within the area of interest
Supporting land status indicators	» Comprehensive assessment of land degradation and environmental conditions by integrating multiple EO-based products considering land use and land productivity, soil and climate. Supporting products encompass evapotranspiration, land surface temperature, fraction of absorbed photosynthetically active radiation (fAPAR), soil moisture, rainfall, digital elevation model, soil erosion potential.

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