# Monitor crop disease and stress

## Applications

### Early Warning

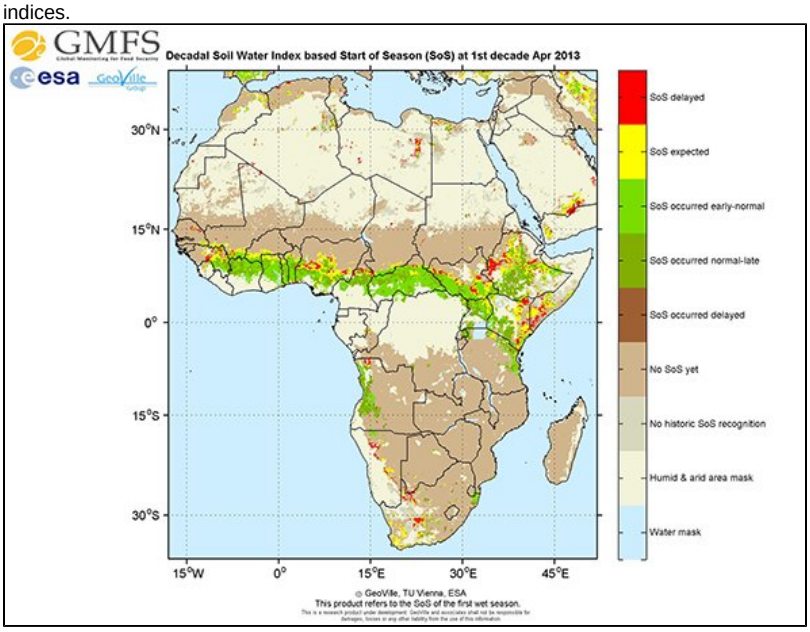
The service provides vegetation health early warning. It makes use of a set of qualitative indicators and biophysical variables providing information on the status of vegetation with high temporal frequency over wide areas (country/ continental level) at medium spatial resolution. The indicators described represent the state-of-the-art, exploiting most advanced algorithms and taking advantage of the performance and characteristics of recent optical satellite sensors.

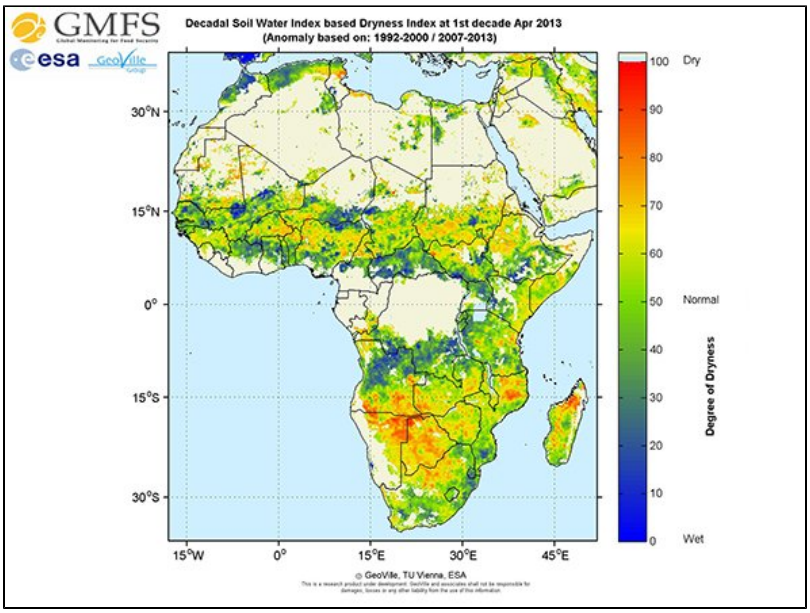
1. VPI (Vegetation Productivity Indicator) Its purpose is to identify drought affected areas. The VPI is used to qualitatively identify areas with potentially low agricultural productivity as
compared to what can be expected based on the historical range. It's derived from a statistical analysis and gives probability ranges (categories) and can be calculated on the basis of either NDVI, fAPAR or DMP (see description below).

2. NDVI (Normalized Difference Vegetation Index) NDVI measures the relative presence (or absence) of healthy, green vegetation, exploiting spectral features in optical data. Over the
course of a growing season, we first see a steady increase in the 'vegetation health and density' values as the young, green vegetation grows (the growth makes the surface appear more and more green). This increase reaches a maximum value just before it drops suddenly at harvest time or when the plants die naturally.

3. fAPAR (fraction of Absorbed Photosynthetically Active Radiation) The solar radiation reaching the surface in the 0.4-0.7 m spectral region is known as the Photosynthetically Active radiation (PAR). fAPAR refers to the fraction of PAR that is absorbed by a vegetation canopy: it is a primary variable controlling the photosynthetic activity of plants, and therefore constitutes an indicator of the presence and productivity of agricultural, forest and natural ecosystems, as well as of the intensity of the terrestrial carbon sink.

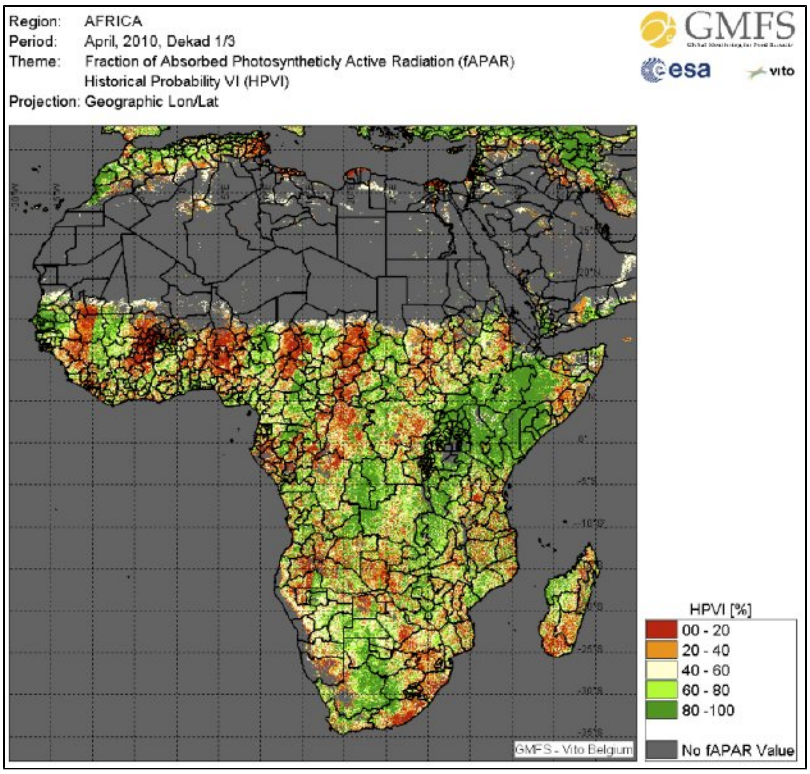
fAPAR estimates result from the analysis of multiple measurements with the help of a radiation transfer model in plant canopies using remote sensing observations as constraints. In parallel to the optical indicators, the service provides soil moisture indicators for the start of the growing season (showing water availability to vegetation) as well as for monitoring drought and/or wet spells. These indicators are completely independent from the optical ones and as such work as a cross-validation source. Information on the start date and progress of the growing season can be derived from these indicators, as well as derived products such as early estimates of crop yields and drought indices.






Sample Near Real Time products derived from the Soil Water Index (SWI) (soil moisture content in the first meter of the soil profile in relative units (0 – 100%) ranging between wilting level and field capacity). Both products are based on a time series of a decade up until April 2013. (1) Start of Season - to steer agricultural practices and hint at potential production shortages. (2) Dryness Index (relative to past values) - to support water management and drought monitoring - values higher than 50% indicate increasingly dryer conditions. Credits: Geoville, TU Vienna.

Optical indicators calculation is based on mostly medium resolution (300-500 metre to 1 km) multispectral data, with a very high temporal frequency (usually 10-days composites are used for a country/continental area map). Soil moisture indicators are based on a long time series of soil moisture measurements (1991-present) derived from the ERS scatterometer and ASCAT sensors.



Sample VPI based on fAPAR. The VPI percentages indicate the probability of getting a lower or higher fAPARvalue based on a historical analysis of the fAPAR values. Credits: VITO Belgium.

The service provides early warning indications which are timely, frequent and spatially consistent over wide areas. Validation is obtained by comparing the results from the two completely independent data sources (optical and radar scatterometer). For early crop yield forecasts, one significant constraint is the reliability of historical yield values which are used to calibrate the service.

This service can support early warning for food security in relation to the effects of climate variability and change, or extreme events on agriculture productivity to adjust food-aid measures; it can qualitatively indicate crop areas affected by damages related to water stress/drought.

Forthcoming PROBA V, Sentinel-3 and meteorological satellites will provide continuity to the optical component of the service. Data availability for soil moisture will also improve in the future. As a replacement for ASCAT, a Scatterometer Mission (SCA) on board the Post-EUMETSAT Polar System (Post-EPS) is planned, with a spatial resolution improved by a factor of 2. Furthermore, the Soil Moisture and Ocean Salinity (SMOS) satellite on orbit allows the establishment of more high-quality validation sites in different environments.

**References:**

ESA 2013, Earth Observation for Green Growth: An overview of European and Canadian Industrial Capability