TREND DATA

What are the EVI trend layers and how were they calculated?

Each of the three trends represents a different aspect of the photosynthetic behaviour of the vegetation within that pixel over a year. The trend data was calculated as the slope of the line for a linear regression of the annual minimum EVI values (lowest 3 EVI values for each year) (Figure 1), annual maximum EVI values (highest 3 EVI values for each year) (Figure 2) and annual mean EVI values (average of all EVI values for that year) Figure 3

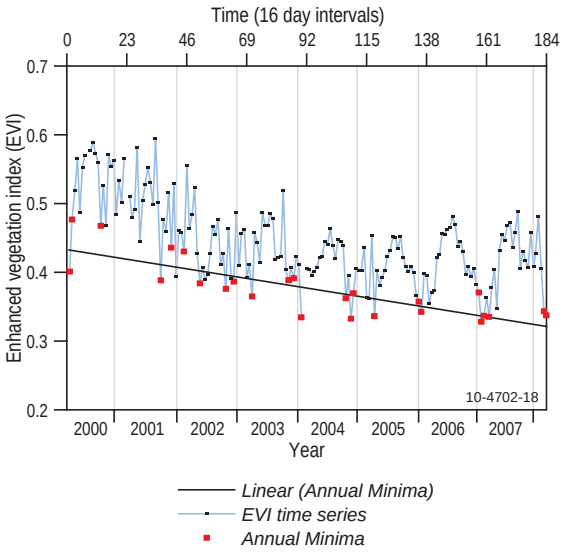

Figure 1 A sample time series that shows how the trend in the annual minimum EVI values was calculated

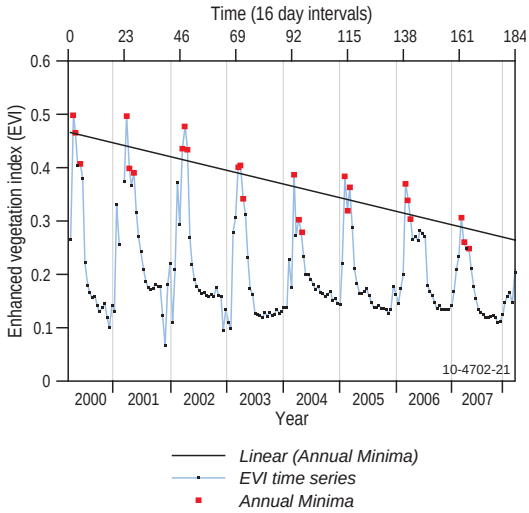

Figure 2 A sample time series that shows how the trend in the annual maximum EVI values was calculated

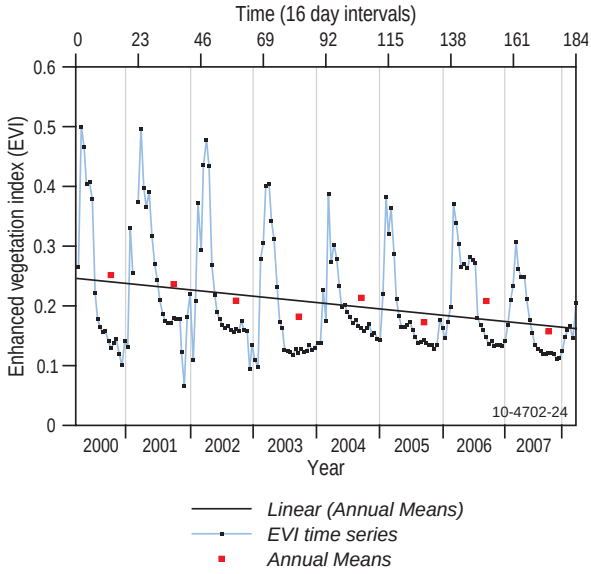

Figure 3 A sample time series that shows how the trend in the annual mean EVI values was calculated

What can the trend data be used for?

The trend data can be used to identify areas where vegetation is showing inter-annual changes over the 8 year period of observation. The factors that may be driving that change are listed in Table 1. In some instances the trend data will identify vegetation that has been impacted by specific events such as bushfires and tropical cyclones. In other instances the trend data will identify vegetation response to more gradual processes such as drought or changes in ground water availability. It is important to note that the trend data play a valuable role in *detecting* change, however additional data is required to *identify* which driver(s) is leading to the changes in greenness. In instances such as severe tropical cyclones and major bushfires, identifying the drivers of change is straightforward, however there are many instances where the trend data is detecting changes at the large paddock, regional and national scale where additional information is needed to characterise the processes that are driving the change.

What are the drivers that can influence trend in EVI values?

Table 1 Factors that drive inter and intra annual changes in greenness dynamics

Broad scale driver	Specific Driver	Human system, Natural system
Plant available water		
	Timing of rainfall	Natural
	Amount of rainfall	Natural
	Floodplain inundation	Both
	Groundwater expression	Both
	Irrigation	Human
Soil fertility		
	Soil organic C content	Both
	Soil N,P,K content	Both
Grazing pressure		
	Stocking rate	Both
	Stock type	Both
Fire		
	Fire frequency	Both
	Fire severity	Both
Cyclone		
	Canopy loss or tree mortality	Natural
Salinity		
	Salt water intrusion	Both
	Dry land salinity	Both
Drought		
	Curing rate	Natural
Phenology		
	Leaf bud	Natural
	Leaf drop	Natural
Disease/Plague		Both
Removal of woody vegetation		
	Land clearing	Human
	Forestry	Human
Vegetation Type		Both

Caveats for interpreting the EVI trends

- Caveat 1 Extreme caution should be applied in linking any value judgement to the trend data. If there has been a large green flush on a central Australian floodplain river near the start of the time series and all three trends have been in decline since then, it doesn't necessarily mean that the river is in 'bad' condition, it may simply mean that there hasn't been a significant flood event since then. Likewise, an increase in greenness may represent an increase in the presence of invasive weeds rather than any improvement in productivity or condition
- Caveat 2. Trend data are easily skewed by extreme values, which is particularly problematic for the minimum and maximum trends that are by definition based on extreme values. This means that if an event that causes a major increase (for example a flood pulse on central Australian floodplain rivers) or major decrease (a severe bushfire) occurs at the start or end of the time series it will have a strong influence on the trend in the maximum or minimum. Trend data are of limited use when analysing episodic rather than seasonal systems
- Caveat 3. Interpretation of greenness dynamics needs to be done within the conceptual framework that acknowledges all factors that may be influencing greenness in that vegetation community and climatic/landscape setting. This means that the trend data is a very useful tool for flagging areas that are trending upwards or downwards more strongly than similar vegetation types in the same climate and landscape setting. Once these areas are flagged more detailed analysis is required to identify which factors (anthropogenic or otherwise) are driving the observed change.
- Caveat 4. In areas where pixels contain little or no vegetative cover *i.e.* salt lakes and permanent water bodies, the EVI is very noisy and all trend data are meaningless.
- Caveat 5. The trend data for an individual pixel has limited statistical significance, however if many pixels of the same class show the same trend, particularly if they are collocated, the statistical significance increases rapidly.

How to interpret the trend in the annual maximum EVI values,

The annual maximum EVI value is related to the maximum leaf area[1] (including both canopy cover and ground cover) observed at any point during a year. Irrigated summer crops may reach EVI values in excess of 8000, whereas the maximum EVI over the Nullarbor plain is around 2000.
The trend in the maximum EVI value is very sensitive to individual 'good' years, so it can be misleading when applied to systems that are episodic rather than seasonal in nature. The data can potentially be used assess whether maximum leaf area for a specific area is increasing or decreasing. This is a qualitative rather than quantitative measure *i.e* the maximum EVI is observed to drop from year to year, but the necessary ancillary data may not be available to link that to a absolute value for change in leaf area index.

How to interpret the trend in the annual minimum EVI values,

In areas that are subject to more than 16 consecutive days inundation, the trend in the annual minimum may be skewed by flood events. Aside from these areas, annual minimum EVI relates to the minimum observed levels of photosynthetic activity for that location in the landscape throughout the year. In environments where the ground cover senesces completely the minimum EVI is related to the woody vegetation canopy component. The relationship between dry season EVI and the woody vegetation canopy component (foliage projective cover (FPC)) as measured by the Queensland Statewide Land and Tree Survey (SLATS) team is shown in Figure 4. This means that

[1] The relationship between EVI and leaf area index (LAI) or foliage projective cover (FPC) can vary between vegetation types

the trend in the annual minimum can be used to estimate the trend in dry season leaf area in environments that experience a 'dry season' when the ground cover component of the vegetation is not photosynthetically active. In less water limited environments the minimum EVI can be determined by the green fraction during the driest periods, although the green fraction in these areas may still include a ground cover component, making interpretation of the trend data more difficult. One of the key ways of using the trend data is to compare the trend in the minimum EVI values within one woody vegetation class. The trend in the minimum EVI values can also be very strongly influenced by fire events (particularly hot fires that burn the complete canopy (both under story and over story).

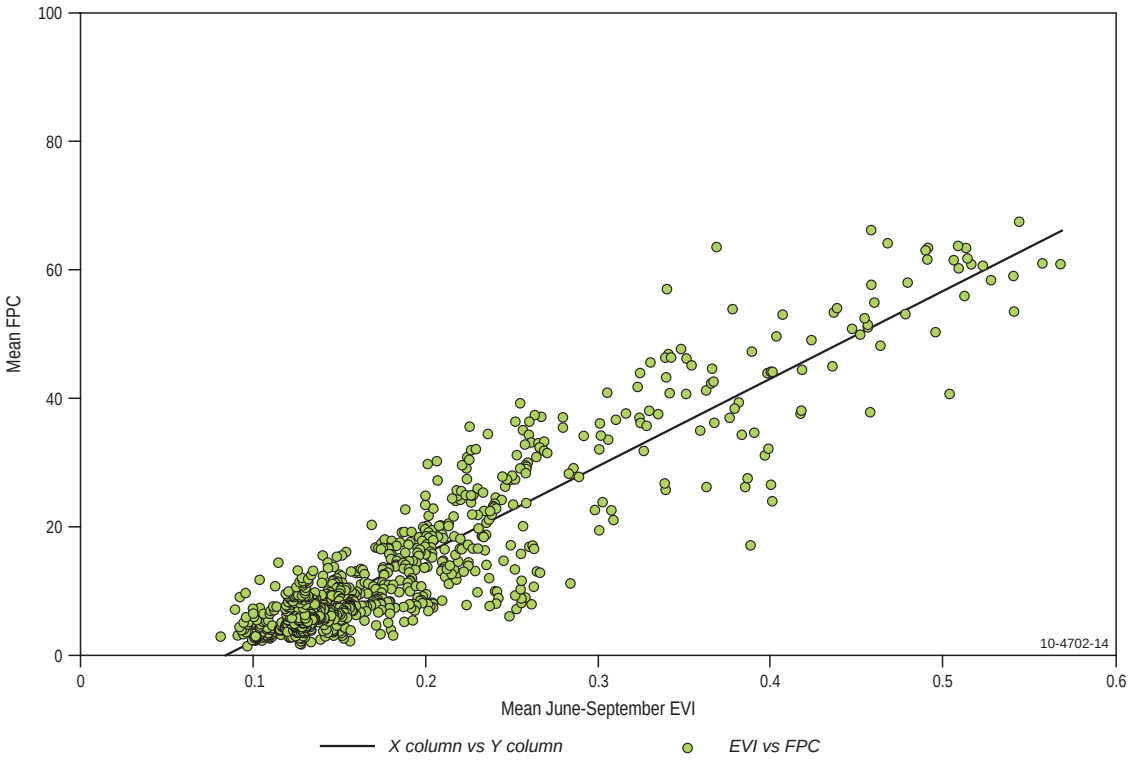

Figure 4 The correlation between dry season (minimum) EVI values and foliage projective cover in Queensland for land cover classes that contain a woody component (all tree and shrub classes)

How to interpret the trend in the annual mean EVI values

For areas that support vegetation (*i.e.* not salt lakes and open water bodies) the trend in the mean provides an estimate of how total photosynthetic activity is changing from year to year. The trend in the annual mean is the most robust of all three trend data analyses because it incorporates all 23 points in the time series for each year *i.e.* every point in the time series. This also makes it a less sensitive tool than the other two trends, but also more robust as an indicator of change.