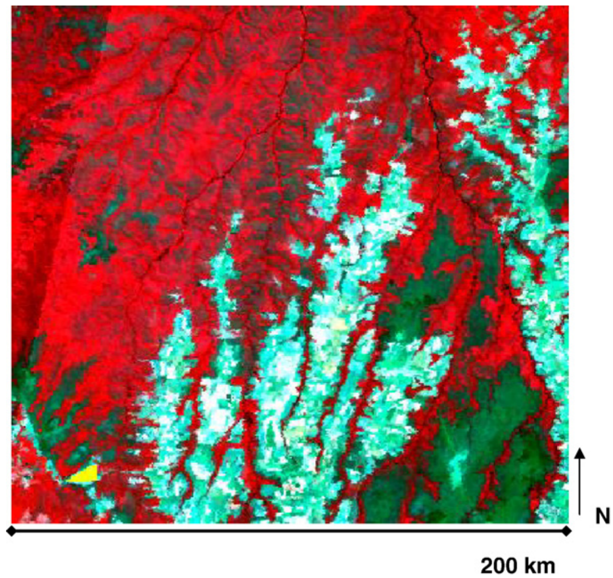

Fig. 3. False-color infrared MODIS image (Red = 859 nm, Green = 645 nm, Blue = 555 nm) for the study area on 28 July 2005 (Upper left corner: 12° 15′ 23.61″ S, 59° 45′ 18.23″ W; Lower right corner: 13° 59′ 27.86″ S, 57°57′ 30.8″ W). Bright red areas represent dense *cerradão* woodland savanna native vegetation. Lighter reds to dark greens show the extent of *cerrado* native vegetation. Bright turquoise blues show row-crop agriculture, and very bright white areas are (bare) agricultural fields. Fazenda Santa Lordes is highlighted with a yellow polygon. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

We first separate croplands from other land covers. Lands managed in croplands display a distinctly higher annual standard deviation compared to natural vegetation due to high vegetation density during the growing season and extremely low vegetation density following harvest. Woody *cerrado* land cover has very little phenological variation and maintains a mean value of 0.6 EVI, rarely exceeding 0.8 EVI (Fig. 4). The open *cerrado* phenology shows some seasonal variation as it decreases in greenness through the dry season and increases during the rainy season, with an annual mean of 0.25 EVI and a maximum around 0.6 EVI (Fig. 4). Both woody and open *cerrado* remain above 0.2 EVI through the year. Pasture phenology is similar to the *cerrado* with a slightly larger dynamic range and a mean of 0.5 EVI (Fig. 4). Croplands have maximum EVI values exceeding 0.8 and EVI minimums often reaching 0.1 or lower (Fig. 4).

Because these differences in amplitude of seasonal phenology in EVI we can use the standard deviation of an annual EVI time series to distinguish lands in croplands from native vegetation (Fig. 5). There is a bimodal distribution in the histogram of standard deviations for all pixels in the study area, separating croplands on the right tail (Fig. 5). There is a biomodal distribution of the standard deviation for each pixel. For each year, we used the standard deviation value that separated the two modes (the histogram minimum) as the detection point for croplands—all pixels with a standard deviation higher than this point were classes as croplands. The value of the detection point, or histogram minimum between modes, is included in Fig. 5 for each year of analysis. The mean detection point for all years was at the standard deviation of 0.149.

2.5. Creating a wavelet-smoothed EVI time series

Here we use a discrete wavelet transform. A wavelet function $\phi(t)$ is an oscillating function with a finite energy and null mean:

$$\int_{-\infty}^{+\infty} \phi(t)\mathrm{d}t = 0. \tag{1}$$

The wavelet transform $W(a,b)$ is defined by Eq. (2):

$$W(a,b)_i = \frac{1}{\sqrt{a}} \int \phi^*\left(\frac{t-b}{a}\right) s(t)\mathrm{d}t \tag{2}$$

where $s(t)$ is the analyzed input signal and ϕ^* is a mother wavelet, or a wavelet basis function. A number of different mother wavelets exist, including Daubechies, Derivative of a Gaussian (DOG) and Coiflet (Torrence & Compo, 1998). In this equation, the wavelet width is determined by the scaling parameter a while its center is determined by the parameter b. The variable t represents the time-step in the one-dimensional time series over which the integration is performed. The wavelet transform has the advantage of retaining information related to the width (scale) and the location (time) of the features present

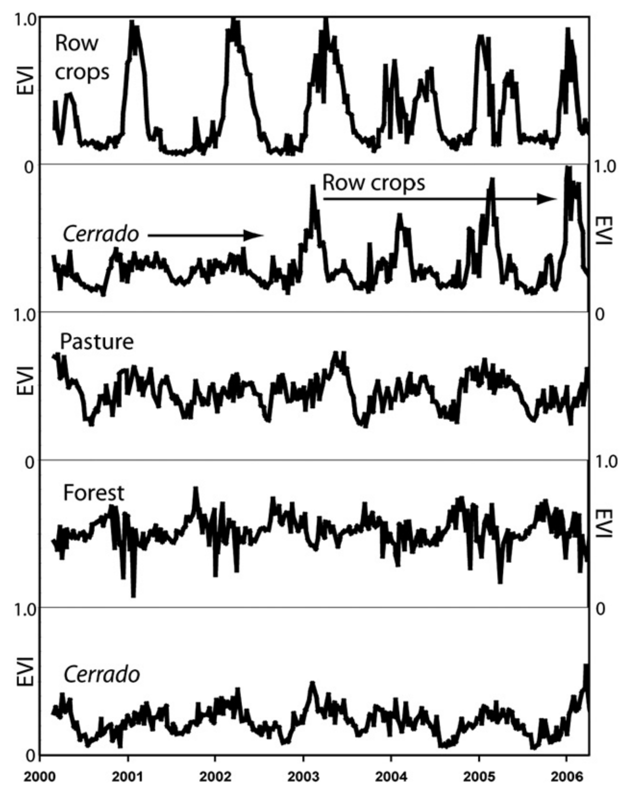

Fig. 4. EVI time series of representative land cover for 2000–2006 with cloud-contaminated points removed and filled by linear interpolation. Open c*errado* phenology has a low annual mean EVI and exhibits only minor seasonal fluctuations. Rainforest phenology has only slight changes in greenness between the wet and dry seasons. A pasture has higher annual mean and variance than *cerrado*, but a lower mean and higher standard deviation than forest. The time series second from the top shows an area in *cerrado* from 2000 to mid 2002, followed by a conversion prior to 2003 to cropland phenology. The top time series shows an area that exhibits single crop phenology in 2001, 2002, and 2003 and double crop patterns in 2004 and 2005.