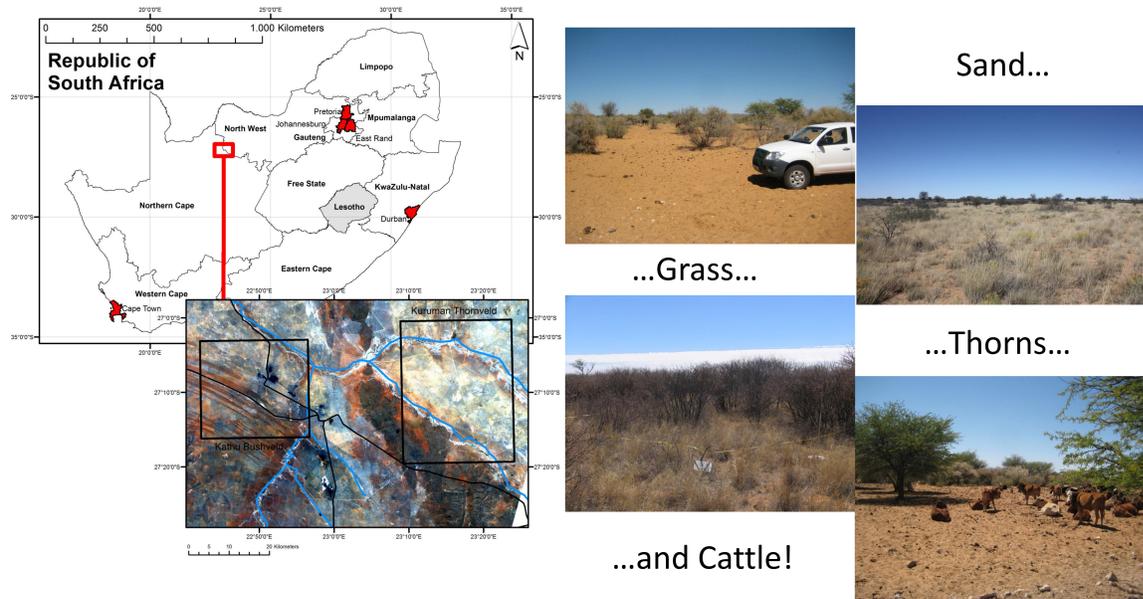


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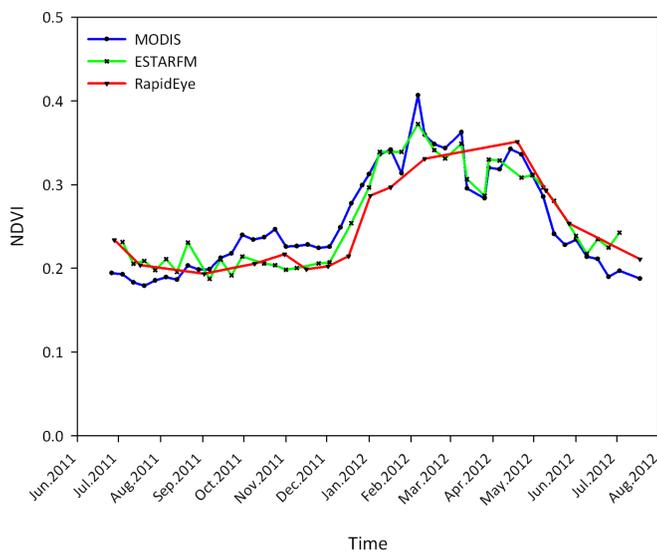
Introduction

- High spatial and high temporal resolution time series from remotely sensed data capture vegetation dynamics and offer the possibility of relating those to measurements collected in the field
- The derivation of temporally dense data at high spatial resolution is still difficult with optical imagery
- Fusion of remotely sensed data from different sensors with different spatial and temporal characteristics is an efficient solution



Study Region: Kalahari Rangelands

Kathu Bushveld Bush Cover $\leq 5\%$



Time series of mean NDVI values calculated for all MODIS pixel size extents classified as containing $\leq 5\%$ bush cover, derived from RapidEye, MODIS and synthetic ESTARFM imagery.

Pixel based regression of the observed RapidEye scenes against the correspondent ESTARFM predicted images for the Kathu Bushveld subset, summarized for bush cover classes. The bias is given as its value relative to the mean value of the observed image.

Bush density	Band	Date							
		2011-10-31	2011-12-02	2012-01-17	2012-05-10				
		R ²	Bias	R ²	Bias	R ²	Bias	R ²	Bias
$\leq 5\%$	Red	0.70	-0.05	0.79	0.07	0.83	-0.12	0.71	-0.04
	NIR	0.75	-0.04	0.87	0.08	0.83	-0.03	0.88	0.00
$> 50\% - \leq 65\%$	Red	0.82	-0.03	0.85	0.07	0.70	-0.09	0.77	-0.06
	NIR	0.86	-0.07	0.90	0.05	0.82	0.01	0.89	0.00
$> 95\%$	Red	0.80	-0.02	0.79	0.08	0.69	-0.08	0.80	-0.04
	NIR	0.86	-0.07	0.90	0.05	0.86	0.03	0.86	0.00

Results

- The fusion method yielded 76 synthetic images (38 images for each subset) at RapidEye resolution
- Correlation between observed and predicted images was generally high (Red: $0.80 < R^2 < 0.92$, NIR: $0.83 < R^2 < 0.93$)
- For all dates, the NIR band yielded better results than the red band
- The data was used to calculate NDVI time series suitable for comparison to NDVI time series derived from RapidEye and MODIS images
- Image fusion is useful for generating a time series for monitoring vegetation dynamics at high spatial and temporal resolution
- Prediction accuracy is good during phases of little vegetation dynamics, but deteriorates during times of quick vegetation growth
- Image fusion shows strong prediction performance at sub-MODIS scale in heterogeneous vegetated areas
- The derived NDVI time series reproduces the characteristic phenological development of different vegetation types well and inherits more information than either MODIS or RapidEye alone

Conclusions

Material and Methods

- Fusion algorithm: ESTARFM (ZHU, X., CHEN, J., GAO, F., CHEN, X., MASEK, J.G., 2010: An enhanced spatial and temporal adaptive reflectance fusion model for complex heterogeneous regions. *Remote Sens. Environ.* 114, 2610 – 2623.)
- Synthetic images were computed using 10 RapidEye scenes as input, combined with the corresponding MODIS images acquired at the closest possible date
- Coarse-resolution information at prediction dates (t_p) was provided by 38 MODIS images
- Accuracy assessment: Nine independent RapidEye scenes were used to compare predicted images to observed ones, on a band by band basis
- We calculated the bush cover within each MODIS pixel to account for mixed signals at coarser resolutions