Grazing Resource Information for Sahel

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Background and aim

Grasslands, mainly in drier areas cover extensive parts of the globe and are the home of the majority of the 1 billion people, many of them poor, depending on livestock for their livelihoods . In Africa are 40 % of the land dedicated to pastoralism, a majority of this in semi-arid areas as grassland and savannas. In the Sahel region, pastoral and agro-pastoral systems are very important parts of the economy and a crucial activity in local and regional food production (protein).

Additionally, drylands, grasslands and rangelands deserve greater attention, not only for their large extent, severe degradation and limited resilience to drought, but also for their potential for carbon sequestration and hence support mitigation of and adaptation to climate change while simultaneously supporting sustainable pastoral and agropastoral livelihoods. Sustainable management of rangelands should be based on scientific assessments and mapping of productivity in order to provide reliable management information.

The **overall aim** of this project is to develop a monitoring system quantifying supply and demand of grazing resources in semiarid Africa (initially in Sudan) including data assimilation, processing and information distribution to the end user (i.e. the pastoralist and regional managers).

Specific aims;

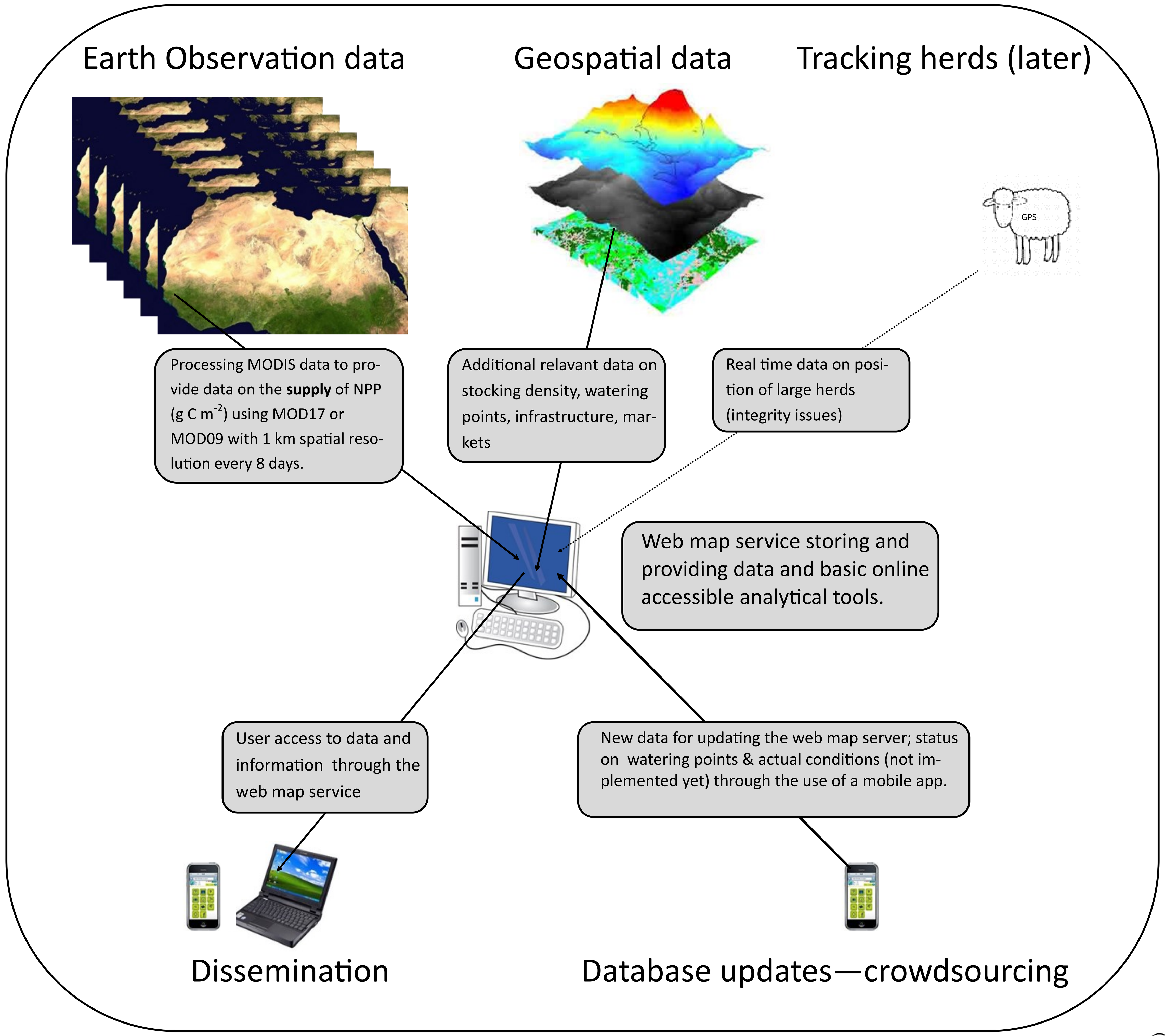
- Quantification of available **supply** of grazing resources with an 8-day temporal resolution and 1x1 km spatial resolution for the study area.
- Quantification of current **demand** for grazing resources based on national and regional animal statistics and by mapping spatial patterns of seasonal grazing demand through tracking of animal herd movement using GPS collars.
- **Dissemination** of grazing resource information via webserver and mobile phones.

Demand

The demand of NPP is estimated as a function of the stocking rate (Tropical Livestock Units per km^2) [5], this data is often uncertain and will vary due to seasonality, migration etc. In addition to existing estimates of spatial distribution of grazing animals [5] can herds be tracked using GPS-collars sending their position in real time.

Dissemination

ARCGIS online (ESRI) is currently used make the information available as a web map application displaying the supply of grazing recourses in terms of Net Primary Production (NPP), either for the last 8 days from MOD17 data or as an accumulation for the year. A very preliminary test-version can be seen at http://www.nateko.lu.se/personal/jonas.ardo/GRIS/GRIS.html



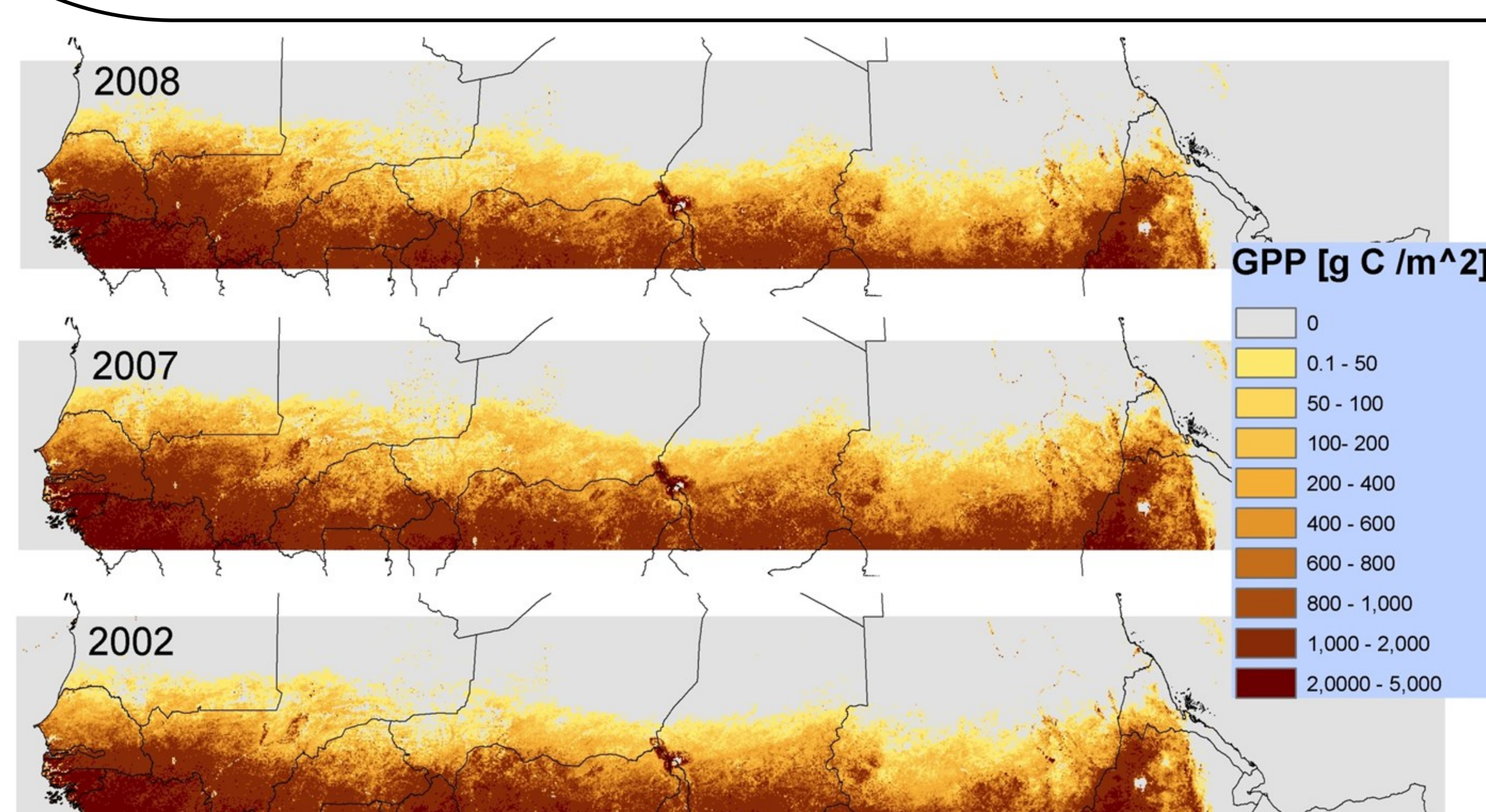


Fig 3. GPP in Sahel estimated using linear regression (from Fig. 2). Large spatial and temporal variability.

Supply

We have used and tested two methods, MOD17 and regressions using EVI or NDVI in order to estimate the supply of NPP (grazing resource).

MOD17 [2] provides operational gross & net primary production (GPP, NPP) data globally at 1 km spatial resolution and 8-day temporal resolution using MODIS data. MOD17 estimates GPP according to the light use efficiency (LUE) concept assuming a fixed maximum rate of carbon assimilation per unit photosynthetically active radiation (PAR, [MJ]) absorbed by the vegetation (i.e. the light use efficiency, εmax, [g C MJ^{-1}]). Minimum temperature and vapour pressure deficit (VPD) derived from meteorological data down-regulate εmax and constrain carbon assimilation. This data is useful for regional studies of the terrestrial carbon budget, climate change and natural resources. Recent studies, based on eddy covariance (EC) flux data, suggest that current εmax may be too low, especially for drier sites in Africa, hence resulting in underestimations of MOD17 GPP [1] (Fig 1).

Regression based models is an simple alternative using EVI or NDVI to estimate GPP as $GPP = a + b \times EVI$ [1,3,4] (Fig 2, 3).

To **decrease the dependence** on climatic data sets (NCEP and similar) as input in the estimation of GPP & NPP, can land surface temperature and VPD be estimated using earth observation data [6]. Incoming PAR can be estimated using existing products based on METEOSAT/SEVIRI down-wellling surface shortwave radiation (DSSF). For drier areas can also soil moisture data be usefull as an additional regulator of LUE.

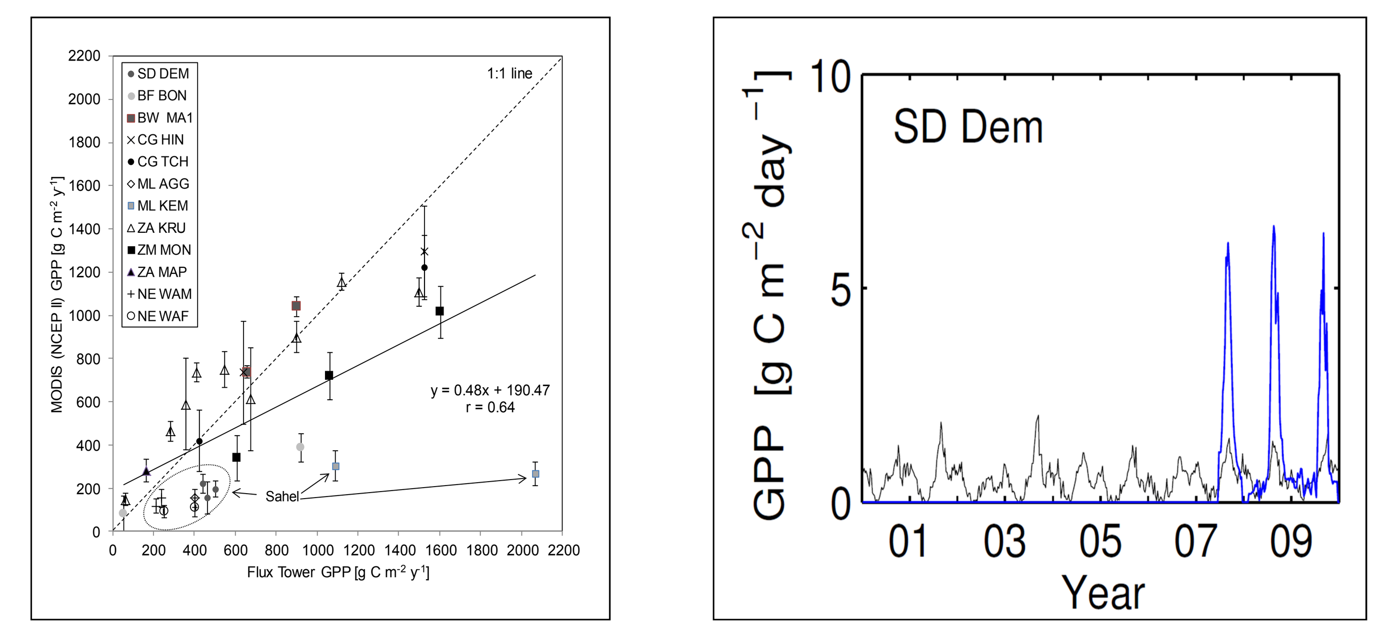


Fig 1. GPP from African flux towers vs GPP from MOD17A (left).
GPP from MODIS (black) and from a eddy covariance flux tower in Sudan (blue).

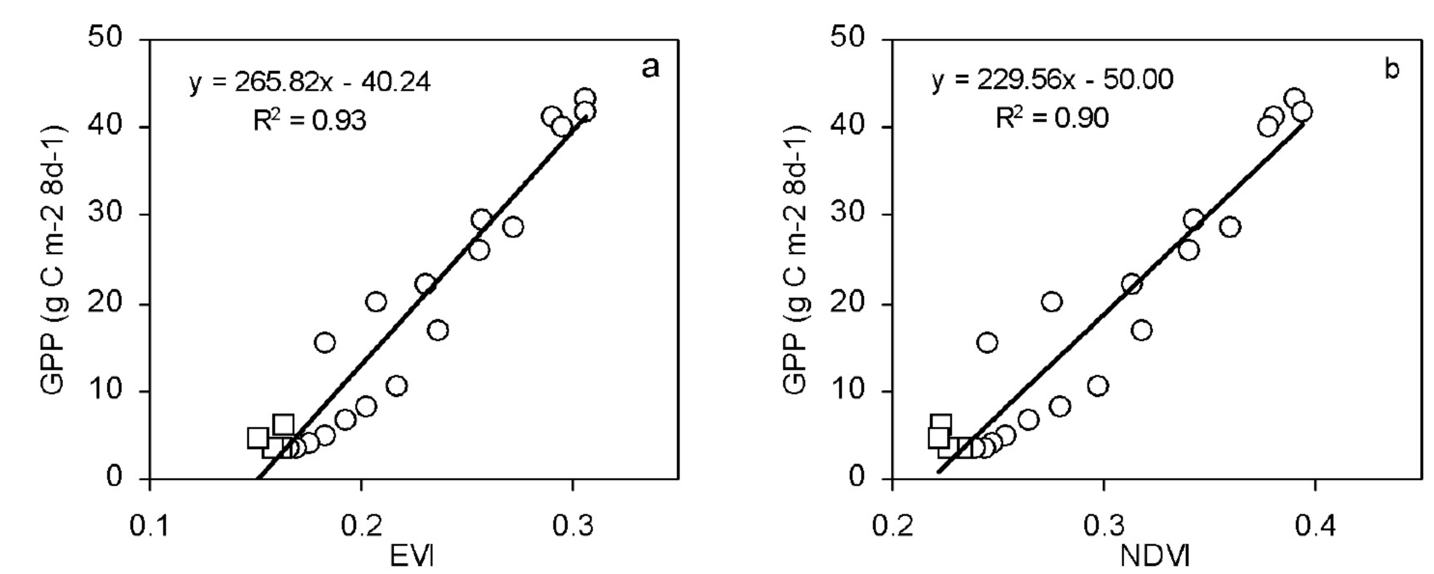
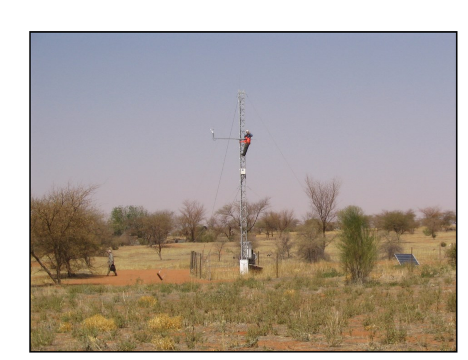


Fig. 2 Linear regression analysis between 8-day sums of eddy covariance GPP and **(a)** MODIS EVI and **(b)** MODIS NDVI for the Demokeya site 2007, July–December (squares denote points outside the growing season).



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