National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

UKRI Natural Environment Research Council

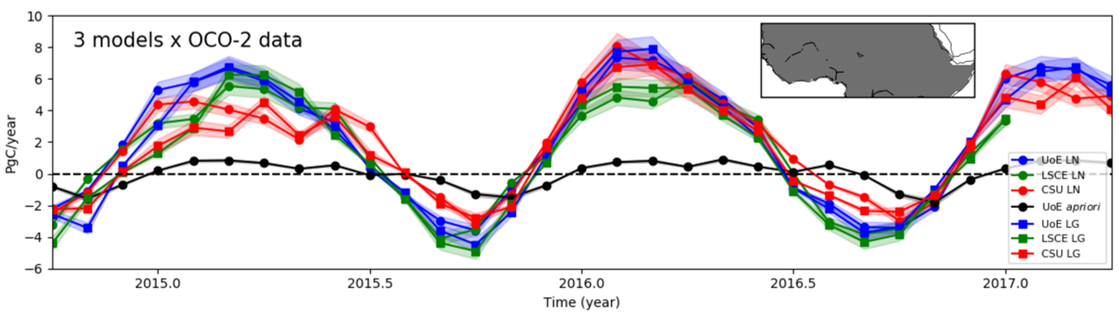
UK NCEO support for regional climate information: recent findings

Net carbon emissions from observing the atmospheric

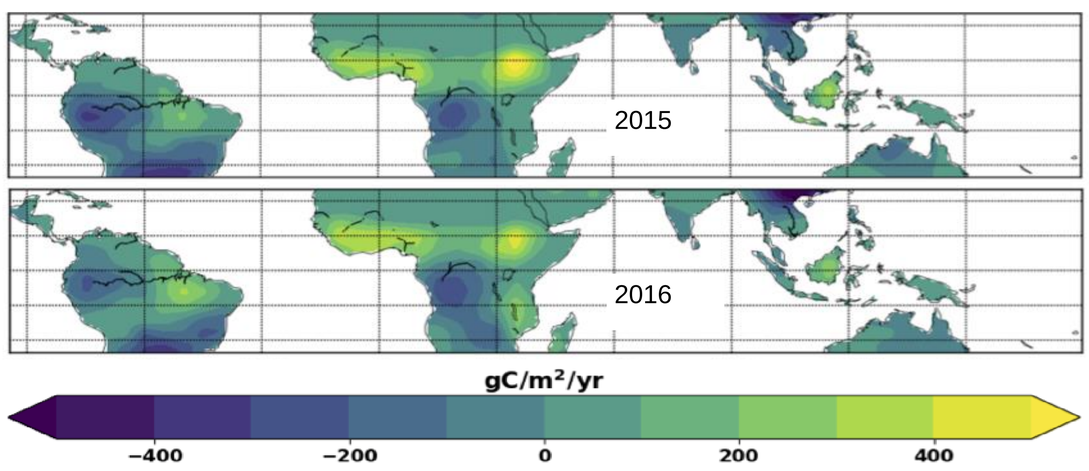
Significance

- Spaceborne spectrometers are sufficiently accurate to determine carbon emissions into the atmosphere
- To examine emissions, UK scientists also use atmospheric chemistry transport models
- For methane, scientific results are interrogating net emissions at the country-scale and verifying their consistency
- For carbon dioxide, there is more confidence at the regional-scale.
- New inter-agency satellite constellations will deliver trusted information globally at regional-to-country scale and for large urban centres

Defining net carbon emissions of tropical Africa



Top panel: tropical northern African CO_2 fluxes (PgC/yr) 2015-2016 inferred from satellite data, using a variety of models, have a larger seasonal cycle than *a priori* fluxes. They also represent a net annual flux to the atmosphere

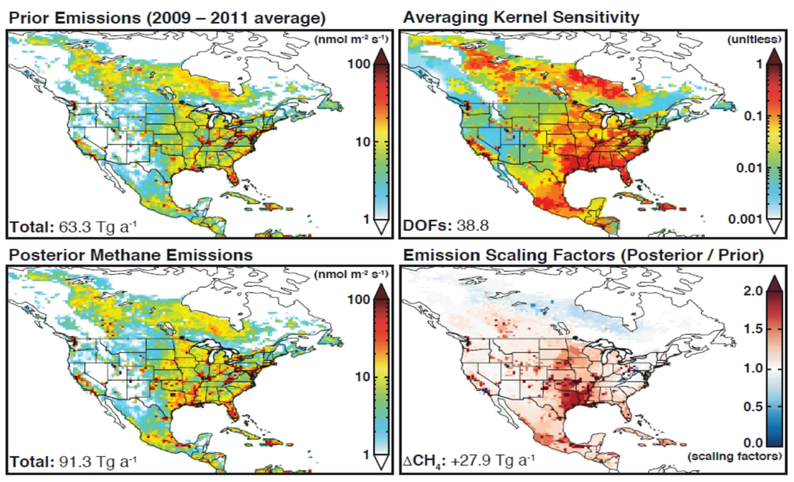


Middle panel: annual mean pan-tropical CO_2 fluxes (gC/m^2/yr) for 2015 and 2016 clearly show the regions of positive fluxes to the atmosphere.

Palmer et al, Nature Comms., 2019

Top-down evaluation of country-scale - CH_4 emissions

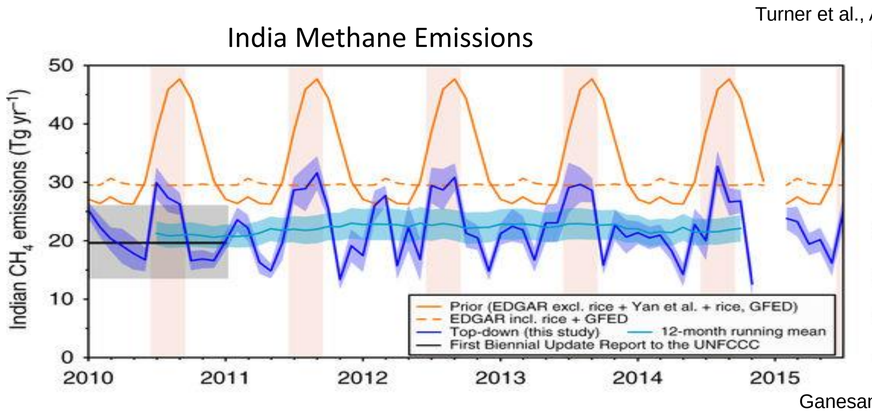
Demonstration for capability of satellites to monitor and assess national methane emission inventories and the scientific inventories such as the Emission Database for Global Atmospheric Research (EDGAR)



Left panel: Country-scale emission from GOSAT CH_4 in conjunction with in-situ data and high-res. inverse modelling

USA: Large underestimate in US EPA (and EDGAR) methane inventory attributable to oil/gas and livestock emissions

Turner et al., Atmos. Chem. Phys., 2015



India: National emissions (UNFCCC) consistent with GOSAT, but 30% overestimate in EDGAR. No detectable trend between 2010 and 2015

Ganesan et al., Nature Com., 2017

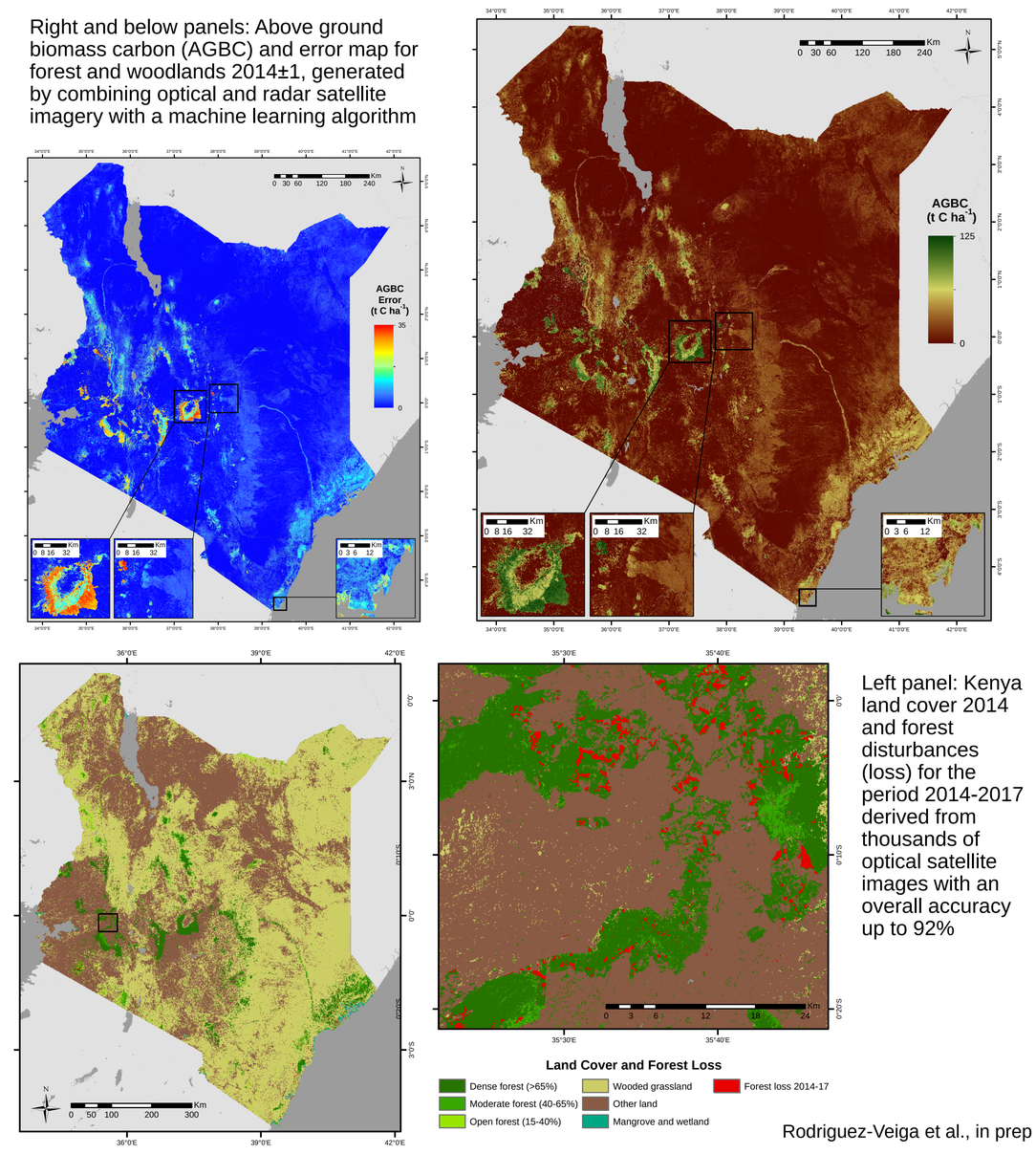
Estimating carbon stocks in forests

Significance:

- New methods of aboveground biomass carbon estimation and forest disturbance mapping have allowed more precise country-scale maps
- UK scientists run powerful carbon models which can interpret the data to show in-country “hotspots” of carbon
- Mapping can be performed at country-scale with some confidence working alongside local organisations

Estimating country-stocks of forest biomass carbon

Right and below panels: Above ground biomass carbon (AGBC) and error map for forest and woodlands 2014±1, generated by combining optical and radar satellite imagery with a machine learning algorithm

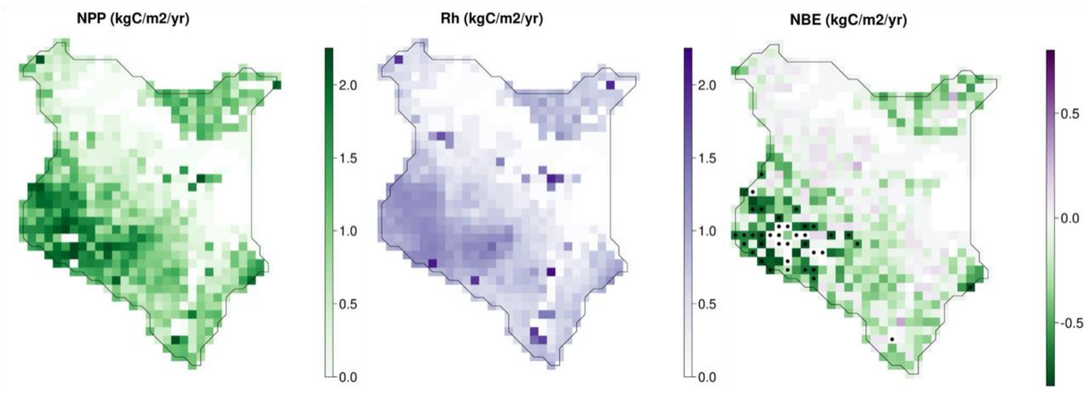


Left panel: Kenya land cover 2014 and forest disturbances (loss) for the period 2014-2017 derived from thousands of optical satellite images with an overall accuracy up to 92%

Rodriguez-Veiga et al., in prep

Quantifying forest sinks of carbon

A model-data fusion analysis (CARDAMOM) combes information on Earth Observation estimated above ground biomass, leaf area and databased soil carbon stocks within a terrestrial carbon cycle model
The model can be used to provide insights into carbon processes, their interactions, and to make probabilistic forecasts of future carbon stocks



Top panel: Carbon cycle analysis of Kenyan Forests at 0.25 x 0.25 degree resolution for 2014-2017. Maps show Net primary productivity (NPP), heterotrophic respiration (Rh) and Net Biome Exchange (NBE = -NPP + Rh + Fire). The stippling in the NBE figure indicate areas where our analysis is greater than 95 % confidence in the forests being a net sink of carbon.

Rodriguez-Veiga et al., in prep

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