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Atmospheric Measurement Techniques Discussions

Interactive comment on "On the performance of satellite-based observations of CO_2 in capturing the NOAA Carbon Tracker model and ground-based flask observations over Africa land mass" *by* Anteneh Getachew Mengistu and Gizaw Mengistu Tsidu

Anonymous Referee #1

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General comments This is a very timely and very useful study of a much neglected problem – I strongly recommend publication. Scientific observation of CO2 over Africa is extremely limited. Satellites watch the continent, but much of tropical Africa is under heavy cloud in the crucially important high-growth periods in the rainy season. On the ground in situ observation is minimal, and the few sites that are measured are mainly located on remote islands or around the continental periphery. Mengistu and Tsidu tackle this problem by examining the sensitivity and trustworthiness of GOSAT and

OCO satellite measurements, tested against both the NOAA Carbon Tracker model and directly in comparison with the few available flask data sets.

The paper is well thought out, detailed, and careful. There are some problems with the language but these are minor and there is full clarity of meaning.

I strongly recommend publication after minor revision.

Specific Comments Page 1. Line 20 – all over Southern Africa? Does this mean south of the equator? Or south of the Zambesi? Page 2 L4 – space after networks. Page 2 L14 – maybe give more mention to the TCCON station on Ascension Island. Contact D. Feist. https://data.caltech.edu/records/210 I note that ASC is mentioned in table 1. Page 2 L35 onto P3 last sentence doesn't really mean anything. Also note that total column over many places includes very different air masses. For example over Ascension the air under the Trade wind Inversion is from the Southern Ocean and further, while the air above it is from the Congo, and ultimately further away. Page 3 L 1 – say where Kuwalik found this, geographically. Page 3 L13 – African aerosol loading is very seasonal – very bad in biomass burning seasons. Page 3 L 30 – TM5 transport modelling – good. Explain in more detail. Page 4 L23 – maybe explain in more detail about the systematic error Page 4 L25 – I think this means world's second, not 'second world' (i.e. Russia & China). Page 5 Table 1 – Maybe mention the TCCON instrument Leicester have set up at Jinja Uganda (though it will be too late for this paper). Page 7 L8 – southern part of Congo (does this mean Congo Brazzavile???The southern Brazzaville Congo is similar to Kinshasa so I'm puzzled by that comment.) and then the text mentions Southern DRC. . ..note the southern DRC is savanna, not forest, and has intense biomass burning in winter. Page 7 L10 – I am very puzzled by the comment on "weak anthropogenic emissions" from South Africa, which has bigger CO2 emissions than either the UK or France. South Africa has some of the world's biggest CO2 point sources including the enormous SASOL synthetic oil-form-coal plant and many >4GW coal-fired power stations. The ITCZ is critical of course, in two ways – it marks the effective boundary between the two meteorlogical hemispheres, and it

also controls the vegetation uptake, as the plants grow under it, while the fires occur when it is in the opposite end of its range. Page 7 L18 – year-round rainfall only near the coast in West Africa. Inland northern Nigeria is highly seasonal. The forest is only at the southern equatorial frings of this band of countries. Page 7 L29 – note NOAA calibrated measurements are ppm, NOT ppmV. Best to stick to ppm, even through there is only a tiny difference between ppm and ppmv. Page 8 L10 – annual mean position of the ITCZ – this is the meteorological hemisphere boundary. Might be worth expanding this remark. Page 8 L17 – model weakness? Or terrible satellite visibility when the ITCZ is present and clouds are extremely thick and widely present. Page 9 L5 – "satellite own" ?? Typo?? Page 10 L2 – Africa is one of the largest – rewrite as terrible English! I think this means it has more land on both sides of the equator than South America, but I'm not sure! Page 10 L4-13 – maybe move this entire paragraph to a place much earlier in the manuscript, to explain the focus on Africa? Page 12 L15 – "simulation respond" - ??? does this mean response?? Page 13 L14 – sahara – it's a desert! I have flown over it many times. Not a weak source/sink – the vegetation is a nearly zero source/sink but there are very large flaring operations in the Algerian and Libyan oil and gas fields. Those must be big emitters. Page 14 L13 – these are the winter & summer months for the Northern Hemisphere. Opposite in SH. Page 14 L18 – winter (DJF) in Southern Africa???!!!! – last time I heard it was high summer!!! Winter in the Southern Hemisphere is JJA. More to the point, the key factor for vegetation is the distinction between the rainy season (ITCZ present - growth) and the dry season (No ITCZ – fires). Page 16 L2 and L3 – maybe discuss this CT/GOSAT discrepancy in a little more detail? ITCZ cloud blocking observation?? Page 17 L6 CT underestimation – interesting. Page 17 L18 – note Northern Africa includes two very different biomes. North Africa (Morocco, Algerian coast, Tunisia) has a wet Mediterranean winter. The Sahara is desert but has big oil and gasfields, (including supplying Europe with winter gas). Page 19 L3 – note that at the start of an El Nino there is often intense biomass burning. Later, the grass fires are smaller because there is no fuel. Page 23 L2 – Question mark in text??? Which region is the text talking about? – North Africa??

– if so, it is wet in the Algerian mountains in MAM. Fires are in summer. See also Line 4 in same paragraph. Page 23 L5 – "my cause"?? Page 23 L9 – plantation – well, maybe, but I flew over this a while ago and didn't see much! Note that Nigeria is very very different form Egypt, and both are very different from Algeria!!! I think this paragraph needs substantial revision. Page 25 L13 – note that grass fires dominate in the dry savanna, while leaf litter fires are common in the wetter wooded savanna. Page 27 Section 3.8 and Figure 18 – maybe it is worth expanding this section 3.8 very significantly – it has real data!! Also note that these are boundary layer measurements. For example the Trade Wind Inversion (about 1500m in the Atlantic) is really important – ASC is below it, while IZO is well above it, so they sample completely different types of air mass (as noted in the last sentence of the section). General comment on the text Through the text there are many minor language problems. Some sentences are especially challenged grammatically. However, in contrast, many long sections read fluently and clearly. The language infelicities are many but small and not significant – the overall message gets through. The problems could easily be cleared up to make the work easier to read.

Conclusion This is a valuable and very interesting study. The paper should certainly be published, but it needs minor revision.

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