Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2019-478-AC3, 2020

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "Linking climatic-driven iron toxicity and water stress to a massive mangrove dieback" *by* James Z. Sippo et al.

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Received and published: 19 May 2020

Comment from Reviewer 2: Although the scientific aspect of the paper by Sippo et al is quite novel, the reasoning of mangrove dieback due to Fe toxicity, drought period and strong ENSO is quite speculative that requires more careful handling before being conclusive.

Response: We thank the reviewer for this comment. We will make changes throughout the manuscript to avoid excessive speculation. We will clarify that the evidence is strongly suggesting differences in water availability between sites and not necessarily Fe toxicity. We will modify the manuscript to use Fe in wood and sediments as an indicator of water availability and the possibility of Fe toxicity will be presented as one

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possible stressor. For example we will change the title of the paper to: “Evidence of climate extremes during a massive mangrove dieback event from wood and sediment chronologies”. We will also remove any overly conclusive text from the abstract and manuscript about the relationships between ENSO and Fe concentrations in wood.

Comment from Reviewer 2: Since 1985, drought condition during the occurrence of 7 El Nino events affected dead mangroves (34 $\pm$ 1 years old), in contrast to the living mangroves which are younger (21 $\pm$ 4 years old) are survived to 4 El Nino events in Gulf of Carpentaria. It was seen that Fe peak in the dead mangrove area at the time of tree mortality were 30 to 90 fold higher than baseline in contrast to the living mangrove which showed an Fe peak 25 fold higher than baseline. Authors argued that low sea level and low rainfall/ groundwater reduced soil water content, leading to oxidation of Fe sulphide minerals and release of Fe2+. Fe was observed in the upper intertidal zone. Even in absence of El Nino event, these Fe bearing-phases dissolution can occur in suboxic conditions in mangrove ecosystems.

Response: We will include discussion of how Fe dissolution can occur in suboxic conditions. Importantly we will modify the tone of the manuscript to be less conclusive about the role of Fe toxicity in the forest mortality and instead discuss Fe trends as a reflection of changes in sediment geochemistry over time. Our results of Fe concentrations in wood over time do suggest that a significant change in sediment redox conditions occurred during the period of forest mortality.

Comment from Reviewer 2: On the one hand, crab burrow and root system may induce these conditions allowing the renewal of electron acceptors with tides; and on the other hand, physiological activities of mangrove root system can lead to increased O2 concentrations in the sediment (Aquat. Bot. 89 (2), 210–219, 2008). Generally, roots absorb Fe+2 and is highly affected by several plant and environmental factors and their toxicity is often associated with salinity and a low phosphorus or base status of soils. Furthermore, injured leaves or necrotic spots on leaves indicate an accumulation of Fe above 1000 ppm (3 to 6 times as high as the Fe content of healthy leaves). However,

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the most pronounced symptom is the ratio of Fe to other elements and to heavy metals in particular. The proper Fe:Mn ratio seems to be the most obligatory factor in the tolerance of plants to Fe toxicity. The world average Fe (_g g-1) conc in Avicennia marina is estimated to be 54000 (Lewis et al. 2011, Bayen 2012), and 120000 in New Caledonia, the South-West Pacific Ocean (Marchand et al. 2016). The increased uptake of Fe+2 in toxic level by the mangrove root system may reduce growth, DNA damage as evident by morphological or structural damage. Authors could highlight above aspects in their paper by comparing a possible impact of iron and substrate factors on mangrove that would be very relevant in this specific context.

Response: In response to this constructive comment, we will reduce overstatement of Fe being the cause of mangrove mortality. We will also clarify that the Fe chronologies in wood and sediment are evidence of geochemical changes in the sediments, which also suggest that changes in water availability occurred during the dieback period. We have looked at sediment Fe:Mn ratios in ITRAX data and found no clear differences between living and dead mangrove areas. We assume that this may be because the sediment cores were taken after the dieback period when sediment geochemistry conditions returned to normal. We also looked at Fe:Mn ratios in the wood ITRAX data, these trends overwhelmingly reflect the Fe concentrations. Because we have re-shifted the focus of the manuscript away from Fe toxicity, further exploration of this data may be beyond the scope of this study

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