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Using atmospheric data to understand carbon uptake by forestry in New Zealand

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We analyze four years of in-situ atmospheric CO_2 from New Zealand's most recent atmospheric greenhouse gas observing site Maunga Kakaramea (-38.319376 S, 176.388220 E), in the central North Island. This new site fills a gap in our previous network, in that it is able to observe CO_2 from air that has travelled across both indigenous and exotic forests of the central North Island.

The seasonal and trend decomposition by Loess shows a stronger summertime CO_2 draw-down, than any other station in our network, but a comparable wintertime signal to our other terrestrial site, suggesting vigorous photosynthetic uptake from the surrounding forests. The observations also suggest suppression in uptake, as well respiration, in the summer of 2017/2018 and following autumn.

This year was marked by a record breaking drought across the Region. Simulations from the NAME III Lagrangian atmospheric dispersion model are used to determine the pathway air took prior to arriving at the station, and cluster analysis was employed to evaluate differences in the CO_2 anomalies in air along different pathways of travel. Climate data and terrestrial model simulations were used to explore the influence of climate on CO_2anomalies observed at the site.

Previous work that did not include data from Maunga Kakaramea found, that mature indigenous forests on New Zealand's South Island have a much greater carbon uptake than expected from inventory methods or terrestrial models predict.

Our analysis of the Maunga Kakaramea data suggests that this result may extend to the exotic and indigenous forests of the North Island. We will explore the policy implications for our findings.

These results will be important for precise national CO_2 budgeting and an improvement in understanding exchanges processes as sources and sinks of the greenhouse gas CO_2.

Keywords: CO_2, *Seasonal Decompostion, New Zealand, inverse modelling, neural networks*