Geophysical Research Abstracts
Vol. 21, EGU2019-4527-1, 2019
EGU General Assembly 2019

National scale carbon dioxide inverse modelling: a New Zealand case study

Sara Mikaloff Fletcher (1), Kay Steinkamp (1), Gordon Brailsford (1), Dan Smale (1), Zoe Buxton (1), Peter Sperlich (1), Elizabeth Keller (2), Troy Baisden (3), Benedict Spaan (1,4), Briton Stephens (5), and Stuart Moore (1)

(1) National Institute of Water and Atmospheric Research, Wellington, New Zealand (sara.mikaloff-fletcher@niwa.co.nz), (2) Geological and Nuclear Sciences, Wellington, New Zealand, (3) University of Waikato, Hamilton, New Zealand, (4) University of Augsberg, Augsberg, Germany, (5) National Centre for Atmospheric Research, Boulder, Colorado

Atmospheric observations of CO_2 and other greenhouse gases have the potential to constrain estimates of terrestrial and oceanic CO_2 fluxes through atmospheric inverse modelling. Yet, applying these methods at national scale to verify and improve the National Inventory Report (NIR) and support the Paris agreement remains at the frontier of CO_2 science. We will present results from CarbonWatch-NZ, a national atmospheric inverse model developed for New Zealand.

Our inverse approach infers net air–sea and air–land CO_2 fluxes from measurement records, using back-trajectory simulations from the Numerical Atmospheric dispersion Modelling Environment (NAME) Lagrangian dispersion model, driven by meteorology from the New Zealand Limited Area Model (NZLAM) weather prediction model, which is run at 1.5 and 12km resolutions. Our first results are based on in situ measurements from two fixed sites, Baring Head on the southern tip of New Zealand's North Island (41.41°S, 174.87°E) and Lauder from the central South Island (45.034°S, 169.68°E), and ship board data from monthly cruises between Japan, New Zealand, and Australia. We also show results that include our newest site, Maunga Kākaramea in the central North Island (38.33°S, 176.38°E) for the period when data is available for all three in situ sites (2012-2017). A range of scenarios is used to assess the sensitivity of the inversion method to underlying assumptions and to ensure robustness of the results.

We find that the National Inventory Report may under-estimate New Zealand's land carbon uptake by 30-60%, when differences between the total uptake observed by the atmosphere and accounting rules of the NIR are considered. Much of this additional uptake occurs in the southwest of New Zealand's South Island, an unihabited region dominated by indigenous forests. First analysis of 13C isotope ratios in CO_2 confirms the presence of a vigorous land-based carbon sink in this region. This carbon sink is characterised by strong interannual variability, and suggests an unexpectedly strong response of New Zealand's land carbon sink to drought stress. Observations from our newest observing site in the central North Island shed new light on carbon fluxes in this subtropical region.