Climate Services
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I reviewed the use of FaIR for the New Zealand Climate Change Commission, to evaluate the contribution of New Zealand's emissions to global mean surface temperature change. FaIR v2.1.3 was used with calibration v1.2.0.

There are 9 emissions scenarios, plus a base scenario (SSP1-2.6) which the New Zealand emissions are evaluated against. For each scenario, different combinations of emissions are removed, and some historical- and future-only warming scenarios are investigated using 1990 and 2023 cut-off years. By varying the name of the scenario and cut-off year, all combinations can be run in the supplied Jupyter Notebook.

I was able to reproduce a sample of results from the supplied calculations. I get slightly different SSP1-2.6 base projections since the configuration includes statistical internal variability. The differences are likely due to differing machine architecture in the random sampling that generates the internal variability. The New Zealand warming contributions differ between the supplied results and my calculation by at most 0.000002°C but are in most cases zero. If the scenarios were to be re-run, stochastic internal variability could be turned off, but the differences are so small as to be immaterial.

FaIR does not currently separate the effects of fossil fuel and biogenic source methane. Separation would correctly account for the oxidation of fossil methane to carbon dioxide since the carbon atom in the fossil-fuel source methane molecule was not part of the ocean-biosphere-atmosphere system prior to emission. However, the climate impacts of neglecting this additional carbon dioxide source are small compared to, for example, the uncertainty in the GWP value for methane or uncertainties and the uncertainty in historical carbon dioxide emissions (estimated at ±5%), given fossil methane emissions are of the order of 1% of those of carbon dioxide. This omission is therefore not expected to make a material difference to results, especially considering New Zealand's small total emissions of fossil methane. On this point, the New Zealand methane contribution scenario is from biogenic methane rather than all methane sources. This point should be clarified in any reporting.

It is assumed that all supplied New Zealand emissions are in units of kilotons. The conversion to FaIR's preferred units ($GtCO_2$ for carbon dioxide, $MtCH_4$ for methane, MtN_2O for N_2O, all others in kilotons) appears to be done correctly, using IPCC AR5 GWP100 values to convert from CO_2-eq units to each respective gas.

No additional emissions aside from CO_2, CH_4, N_2O, HFCs (in HFC-134a-eq), PFCs (in CF_4-eq) and SF_6 are considered. While different PFCs and HFCs have different lifetimes and their varying emissions rates would affect climate differently than assuming equivalent emissions of the representative gas, these gases do not contribute substantially to New Zealand's emissions inventory, and so any approximation in this regard is not material.

The calibration version 1.2.0 has been superseded by version 1.4.0 for emissions scenarios based on those prepared for the IPCC Sixth Assessment Report (supplied

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through the Reduced Complexity Model Intercomparison Project) but remains valid for this task.

The output CSV files report combinations of New Zealand's contribution to global mean warming under different gas assumptions for each scenario, calculated as the medians (or medians of differences) of the 1001-member parameter set comprising calibration v1.2.0. One point to note is that the timestamp reported in the output files are on the year boundaries rather than mid-year values, therefore for example in the 2023 cut-off scenarios, the 2024 year-start temperatures are unaffected. This is expected.

From my review, I conclude that FaIR is an appropriate tool for the analysis which has been conducted correctly.

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