

Overview

This study by Higgins et al. investigates the Southern Hemisphere (New Zealand, to be specific) tree growth response to volcanic events. In contrast to previous studies that barely found any response, this study presents evidence of clearly identified responses. The authors conducted superposed epoch analysis (SEA) on tree-ring chronologies by species and by sites, and by groups of cedar chronologies as a further analysis. With these analyses, they found that the volcanic response of the New Zealand trees could be positive, negative, and neutral, and site-related factors appear to be more important than species. Then they built temperature reconstructions based on these tree-ring chronologies, on which they conducted SEA, comparing to that of the climate model simulations. The comparison shows agreement between simulations and reconstructions, indicating that the New Zealand trees are reliable volcanism recorders.

In my opinion, these exciting results are of importance and interest to the community, and can stimulate further studies on Southern Hemisphere trees. The manuscript is overall in good quality, with a clear structure, and analyses being thorough and to the point. I have only a few minor suggestions that I list below. Once those have been addressed, I recommend the work be accepted for publication.

Thank you for your review. Please find the responses to your specific comments in blue below.

Specific comments

L28: "the" is a typo.

Yes, thank you.

Figs. 3, S1: We still need the y-axis label for chronologies.

The y-axis label (Average ring-width anomaly) will be added

Fig. 5: Similar to Fig. 3, the y-axis label is missing. The x-axis label ("Years since event year") should be put under the two columns since we have a map at the upper-left corner that does not share such x-axis label.

The y-axis label (Average ring-width anomaly) will be added, and the x-axis label moved.

Figs. 6, S7, S8, S10: The x-axis label is missing.

The x-axis label will be added.

Figs. S2-S6: It seems that the legends are raw codes without any explanation in the caption, and it would be difficult to understand for people who's not familiar with these codes.

We propose that a table with site meta-data for each code is added to Supplementary Information (attached at the end of this document). The legend for Figures S2-S6 would then be updated to link to the table.

L285-287: The readers will wonder why it is the case, and a pointer to the specific discussion section is needed here.

Agreed.

Response by authors to Reviewer Comment 1

Northern Hemisphere high altitude/latitude chronologies predominantly used to determine the climatic effects of volcanic eruptions contain higher biological persistence than the chronologies we have used. In terms of the discussion in this paper, we would classify these trees as extreme stress tolerators. To illustrate, we refer to Table 9 in Cropper & Fritts (1981) which compares the ring width characteristics of arctic trees to more temperate Northern Hemisphere trees. The average first order autocorrelation of the series used to develop our temperature reconstructions is 0.53 (0.149-0.869) with standard deviation 0.15 compared to arctic sites with average 0.62 (0.15 – 0.93) and standard deviation of 0.13.

L382: It seems that Figure 3 is the one to refer to, instead of Figure 2.

Yes, this needs to be updated to Figure 3.

L458-460: A pointer to Figure 7 is needed here.

Agreed.

L478: "MDX" is a typo.

Yes, thank you.

References used in this response

Cropper, J. P., & Fritts, H. C. (1981). Tree-ring width chronologies from the North American Arctic. *Arctic and Alpine Research*, 13(3), 245–260. <https://doi.org/10.2307/1551032>

Supplementary table 1 – Meta data for all chronologies used in this study.

Site	Species	Start	End	Longitude	Latitude	Altitude (m asl)	ITRDB Code	Notes
1CAS	AGAU	1559	1982	-36.88	174.53	180	newz082	Cascades
1HID	AGAU	1679	2002	-36.20	175.43	220	newz083	Hidden Valley
1HUI	AGAU	1720	1981	-36.97	174.57	274	newz085	Huia
1HUP	AGAU	1483	1997	-36.82	174.50	90	newz084	Huapai
1KAT	AGAU	1698	1996	-37.60	175.87	350	newz091	Katikati
1KAW	AGAU	1710	1996	-37.92	174.92	80	newz087	Kawhia
1KON	AGAU	1770	1976	-37.07	175.13	335	newz008	Konini Forks
1LTB	AGAU	1790	1981	-36.20	175.13	274	newz086	Little Barrier Island
1MAS	AGAU	1269	1998	-36.90	175.55	350	newz088	Manaia Sanctuary
1MOE	AGAU	1360	1980	-36.53	175.55	630	newz089	Mount Moehau
1MWL	AGAU	1580	1981	-37.22	175.03	350	newz090	Mount William
1PBL	AGAU	1675	1981	-35.18	173.75	305	newz078	Puketi Bluff
1PKF	AGAU	1504	2002	-35.27	173.73	290	newz079	Puketi Forest
1TRO	AGAU	1408	2002	-35.72	173.65	175	2	Trounson Kauri Park
1WFD	AGAU	1628	1903	-35.65	173.57	180	newz022	Waipoua Forest
1WWF	AGAU	1462	2002	-35.37	173.28	468	newz081	Warawara Plateau
2BON	HABI	1463	1999	-43.08	170.65	850	1	Mount Bonar
2CCP	HABI	1410	1998	-42.72	171.57	970	1	Camp Creek

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Site	Species	Start	End	Longitude	Latitude	Altitude (m asl)	ITRDB Code	Notes
2CRS	HABI	1483	1999	-42.28	171.38	900	1	Croesus Track
2DBY	HABI	1457	2010	-47.03	167.72	100	newz118	Doughboy - Adams Hill
2ELD	HABI	1338	1999	-45.75	167.47	750	1	Eldrig Peak
2GLS	HABI	1461	1999	-41.62	172.03	950	1	Mount Glasgow
2HEL	HABI	1407	2013	-46.98	167.75	100	newz119	Hellfire Ruggedy Mt
2MAP	HABI	1567	1976	-45.53	167.30	305	newz010	Manapouri Dam
2MAT	HABI	1508	1999	-41.57	172.32	1060	1	Matiri Range
2MEL	HABI	1440	1999	-42.50	171.83	1050	1	Mount Elliot
2MGR	HABI	1400	1999	-42.95	170.82	865	1	Mount Greenland
2MTF	HABI	1367	1999	-42.67	171.33	750	1	Mount French
2OMO	HABI	1578	1999	-43.40	170.10	320	1	Omoeroa Saddle
2PEG	HABI	1667	1991	-46.92	167.73	450	2	Pegasus Stewart Island
2PUT	HABI	1646	1993	-40.67	175.52	650	newz010	Putara
2SPD	HABI	1447	1999	-46.37	169.05	560	1	Slopedown Hill
2TKG	HABI	1450	1999	-42.65	171.50	950	1	Mount Tekinga
2TKP	HABI	1708	1995	-40.08	176.00	800	NEWZ076	Takapari
2TOS	HABI	1590	1998	-42.98	170.85	210	1	Totara Saddle
3AHA	LACO	1209	2000	-42.38	171.80	244	newz005	Ahaura
3FLG	LACO	1230	2003	-42.50	171.72	200	newz120	Flagstaff Creek
3MWO	LACO	1464	1976	-39.35	175.48	1000	newz011	Mangawhero River Bridge
3ORO	LACO	470	1999	-43.23	170.28	110	newz121	Oroko Swamp
3SWF	LACO	1130	1969	-43.13	170.40	200	newz122	Saltwater Forest
4AHA	LIBI	1303	2009	-42.38	171.80	244	newz127	Ahaura
4ARM	LIBI	1446	1958	-43.83	173.00	731	newz007	Armstrong Reserve
4CCC	LIBI	1064	2010	-42.72	171.57	965	newz124	Camp Creek
4CLW	LIBI	1450	1991	-39.63	176.10	1220	newz064	Clearwater
4CRG	LIBI	1492	2010	-45.83	170.53	576	newz128	Mount Cargill
4CRK	LIBI	1460	1978	-43.08	170.98	800	newz039	Cream Creek
4EMT	LIBI	1616	1990	-39.25	174.08	1050	newz003	Mount Egmont
4FLG	LIBI	1464	2004	-42.50	171.72	200	newz125	Flagstaff Creek
4FLH	LIBI	1683	1991	-41.27	172.60	950	newz065	Flanagans Hut
4HIT	LIBI	1431	1991	-39.53	175.73	976	newz066	Hihitahi
4MOA	LIBI	1490	1991	-40.93	172.93	1036	newz067	Moa Park
4MTF	LIBI	1330	1999	-42.67	171.33	855	newz126	Mount French
4MWO	LIBI	1662	1976	-39.35	175.48	1000	newz012	Mangawhero River Bridge
4NET	LIBI	1625	1990	-39.28	174.10	991	newz014	North Egmont
4OHT	LIBI	1585	1991	-39.62	176.12	1140	newz068	Ohutu Ridge
4OKA	LIBI	1732	1976	-46.38	169.45	305	newz016	Owaka
4RAH	LIBI	1480	2012	-42.32	172.12	672	newz129	Rahu Saddle
4RUC	LIBI	1473	1991	-39.63	176.18	1200	newz069	Ruahine Corner
4STR	LIBI	1626	1990	-39.32	174.12	860	newz071	Stratford side - East Egmont

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Site	Species	Start	End	Longitude	Latitude	Altitude (m asl)	ITRDB Code	Notes
4TKP	LIBI	1256	1992	-40.07	175.98	838	newz062	Takapari Road
4TOA	LIBI	1511	1992	-39.23	175.43	1160	newz072	Hauhangatahi Site A
4TOB	LIBI	1332	1992	-39.23	175.43	1100	newz073	Hauhangatahi Site B
4TOC	LIBI	1213	1992	-39.23	175.43	1000	newz074	Hauhangatahi Site C
4TRK	LIBI	1526	1978	-43.08	170.97	925	newz055	Tarkus Knob
4UWR	LIBI	1140	1992	-38.68	177.20	854	newz063	Urewera
4WBF	LIBI	1674	1992	-43.07	171.28	780	newz075	Wilberforce
5BOR	NOME	1389	2007	-45.78	167.37	200	2	Borland
5KEA	NOME	1580	1980	-43.87	169.78	1150	newz036	Kea Flat
5LKE	NOME	1676	1980	-45.25	167.48	950	newz048	Lake Eyles
5LKO	NOME	1584	1980	-45.30	167.68	1000	newz051	Lake Orbell
5UHV	NOME	1710	1980	-44.77	168.00	950	newz033	Upper Hollyford Valley
5UTV	NOME	1622	1979	-45.20	167.65	1000	newz054	Upper Takahe Valley
6GHC	NOSO	1795	2006	-43.25	171.75	870	newz046	Ghost Creek
6HDC	NOSO	1730	1979	-43.13	171.60	1350	newz037	Hidden Creek
6LCV	NOSO	1730	1979	-43.08	171.72	1350	newz035	Lower Cass Valley
6LGH	NOSO	1740	1979	-43.08	171.70	1400	newz031	Logos Hill
6LGS	NOSO	1760	1979	-43.05	171.60	1300	newz024	Lagoon Saddle
6LKP	NOSO	1713	2006	-43.12	171.78	970	newz049	Lake Pearson
6MKW	NOME	1730	1979	-43.05	171.68	1275	newz023	Mirkwood
6RTC	NOSO	1787	2006	-43.15	171.80	950	newz052	Rata Creek
6SSS	NOSO	1760	1979	-43.05	171.72	1250	newz030	Snowslide Stream
6TKV	NOSO	1630	1979	-45.30	167.68	1100	newz031	Takahe Valley
6TST	NOSO	1840	1979	-45.28	167.65	1000	newz032	Takahe Stream
6WND	NOSO	1760	2006	-43.08	171.58	1350	newz053	Windy Creek
7PLC	PHAL	1717	2015	-42.90	171.57	915	newz130	Pegleg Creek
8WER	PHGL	1740	1976	-38.57	175.70	518	newz020	Waimanoa Ecological Reserve
8WHS	PHGL	1550	1986	-38.65	175.63	780	newz056	Waihora Stream
8WKT	PHGL	1535	1976	-38.70	177.20	853	newz009	Lake Waikareiti
8WPA	PHGL	1585	1976	-35.68	173.55	244	newz022	Waipoua Forest
9OWI	PHTR	1709	1976	-41.12	173.67	15	newz015	Okiwi
9PAP	PHTR	1779	1975	-36.12	174.25	160	newz001	Paparoa
9WHH	PHTR	1613	1986	-38.70	175.60	575	newz058	Waihaha Terrace
9WHL	PHTR	1650	1985	-38.65	175.67	640	newz057	Waihora Lagoon
9WMU	PHTR	1664	1976	-37.03	175.53	61	newz021	Waiomu
1Kauri	AGAU	0	2002	-36.20	175.43	na	2	Kauri network
2Pink	HABI	1400	1999	-43.23	170.28	na	2	Pink pine network
3Silver	LACO	0	2003	-43.23	170.28	na	2	South Island silver pine

1 <https://researcharchive.lincoln.ac.nz/handle/10182/2141>

2 Private collection