Forum Article / Obituary

The Holocene

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In Memoriam:

Keith R. Briffa, 1952-2017

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Abstract

Keith R. Briffa was one of the most influential palaeoclimatologists of the last thirty years. His primary research interests lay in late Holocene climate change with a geographical emphasis on northern Eurasia. His greatest impact was in the field of dendroclimatology, a field that he helped to shape. His contributions have been seminal to the development of sound methods for tree-ring analysis and in their proper application to allow the interpretation of climate variability from tree rings. This led to the development of many important records that allow us to understand natural climate variability on timescales from years to millennia and to set recent climatic trends in their historical context.

Keywords

Dendrochronology, Tree-rings, Holocene, Climate Change, Palaeoclimate

Keith R. Briffa (Plate 1), who helped to shape the field of dendroclimatology, died peacefully on 29 October 2017 at the age of 64. Keith studied Biological Sciences at the University of East Anglia, graduating in 1974. His scientific career began when he joined the Climatic Research Unit (CRU) at the University of East Anglia (UEA) in 1977 and ended with his death as Emeritus Professor 40 years later. His work ranged across such topics as European droughts, glacier fluctuations, cooling by volcanic eruptions, beetle fossils, and temperatures in ice age Britain. His greatest and most sustained contribution was to unravel the complex climatic signals encrypted in annual tree rings, and to set their interpretation on a sound and rigorously tested footing.

Keith made outstanding achievements in the reconstruction, interpretation and understanding of climate variability and change. His greatest impact has been in the field of dendroclimatology, where he led many methodological developments that have become widely used in this field (and in other palaeoclimate disciplines). He applied these methods to develop many highly-cited tree-ring chronologies, interpreting their climatic information on timescales from centuries to millennia.

His first major research area was methodological advances in dendroclimatology. A key methodological advance was the introduction of widely-used measures of chronology confidence (such as the Expressed Population Signal, EPS and the sub-sample signal strength, SSS), based on the average inter-core correlation value (r-bar). Keith identified these relationships empirically and Tom Wigley undertook a more formal mathematical derivation. Their article (Wigley et al., 1984) is among the most widely cited in dendroclimatology, with over 2,100 citations in Google Scholar in May 2018 (and related methodological work – Briffa and Jones, 1990 – has almost 500 citations). It is notable that, more than three decades after it was first published, this work is being cited almost 200 times each year. The approach was recently extended to measure the reliability of chronologies on longer timescales, such as their centennial tree-growth variability (Briffa et al., 2013).

Another major methodological focus, with improvements and advances continuing every few years, was on approaches to objectively remove non-climatic variability from tree-ring chronologies while retaining long-timescale climatic information. This challenge was later referred to as the “segment length curse” (Cook et al., 1995). Keith first experimented with Gaussian filters (Briffa et al., 1983, 1988a; Briffa, 1984) and splines, but realized that more fundamental approaches were needed, particularly if long tree-ring chronologies were to be developed combining samples from living trees, archaeological and sub-fossil material. His first approach was “Regional Curve Standardization” (RCS), realigning all the samples to their tree age instead of their calendrical age (Briffa et al., 1992a). Although this worked well there were issues with samples coming from different populations, such as modern samples growing on relatively dry ground whereas those preserved as sub-fossil trees had grown close to, and fell into, small lakes (Plate 1). The most recent approaches use “Signal-Free” methods to minimise modern sample bias (Melvin and Briffa, 2008; Briffa and Melvin, 2011) and multiple RCS curves to represent different populations (Briffa et al., 2013). These innovations in tree-ring standardisation methods will continue to influence the future development of the field for many years and are implemented in freely available software (CRUST – Melvin and Briffa, 2014). Keith’s methodological advances pervade the dendroclimatic literature such that most studies cite one or more of his papers.

His second major research area was the development of long (multi-century to multi-millennial) tree-ring chronologies from Fennoscandia, North America, northern Russia and most recently the Tibetan Plateau (Briffa et al., 1992ab, 1995, 2008 and 2013; Yang et al., 2014). They provide annually-resolved information about growth-rate changes on interannual to millennial timescales in these regions, from which summer temperatures or annual precipitation can be inferred. None of these would have been possible without the methodological advances that address the segment length curse.

His third major research area was the combination of chronologies to infer the spatial patterns of past climate variability (Cook et al., 1994; Briffa et al., 2002b) or to reconstruct climate variability of large area averages, such as the northern extratropics (Briffa et al., 2001). Using extensive tree-ring networks compiled by Fritz Schweingruber (Plate 2), Keith demonstrated that maximum latewood density (MXD) measurements have a more sensitive response than ring widths to summer temperatures in high northern latitudes (Briffa et al., 1992b, 2002a). MXD reconstructions led to better isolation of the effects of explosive volcanic eruptions (Briffa et al., 1998a) and with exact dating the realization that these events could be used to improve ice core dating (Vinther et al., 2010). Keith was also the first to demonstrate that a widespread divergence between some MXD data and instrumental summer temperatures in northern high latitude had apparently occurred since about 1960 (Briffa et al., 1998bc). This provided a challenge to the interpretation of long tree-ring reconstructions and a new urgency to more fully understand the impacts of standardization and modern sampling bias, and that many more samples are needed to evaluate the low-frequency climate signal in the presence of multiple climatic and non-climatic influences.

Looked at individually (e.g. for Fennoscandia and locations in northern Russia) the timing of cooler and warmer periods differed (Briffa, 2000). In terms of past temperature variability, local response functions indicated that the trees were responding to variability during high summer (for ring widths) and an extended summer season (for MXD) from May to September. One issue was whether reconstructions for different seasons could be combined and how they would relate to our understanding of the centennial variability over the Northern Hemisphere, where there was then believed to have been a Medieval Warm Period (MWP from ~900 to 1250) and a Little Ice Age (LIA from ~1550 to 1850). Concepts of both the MWP and LIA have evolved since their initial use in their modern form in the 1970s (see discussions in Matthews and Briffa, 2005; Jones et al., 2009), especially as the amount of available information from an expanding array of proxies had multiplied from a handful of reconstructions in the early 1970s to the several hundred available today. Keith was involved in a number of studies that looked at the sensitivity of using only certain proxies (e.g. trees only) or the effects of only using a limited number of series that all extended back for the whole millennium (Jones et al., 1998; Rutherford et al., 2005; Osborn and Briffa, 2006; Juckes et al., 2007; Kaufman et al., 2009), as well as reconstructions of precipitation and drought patterns in mid-latitude regions (Cooper et al., 2013; Yang et al., 2014; Cook et al., 2015).

Keith's scientific contributions extend far beyond dendroclimatology. Examples include other palaeoclimatic areas, such as the use of beetle remains for reconstructions since the last glacial maximum (Atkinson et al., 1987) and combining tree-ring reconstructions with glacier snout reconstructions from Scandinavia and Canada (Raper et al., 1996; Luckman et al., 1997). He investigated the evidence for recent climate change based on instrumental records, encompassing surface air temperature (Jones and Briffa, 1992, 1995; Briffa and Jones, 1993), drought (Briffa et al., 1994, 2009; Trenberth et al., 2014) and atmospheric circulation variability (Briffa et al., 1990a; Cornes et al., 2013).

In all, Keith published more than 140 articles in journals and chapters in books. These have amassed more than 16,000 citations, illustrating his influence on the field (with an *average* of more than 100 citations per article). Beyond his personal research, he was an associate editor of *The Holocene* (of which he was a founding member) for more than two decades, and held similar editorial roles for the journals *Dendrochronologia* (for 21 years) and *Boreas* (for 12 years). Keith saw at an early stage the importance of bringing together communities working with palaeoclimate data and those studying climate variability from a dynamical and numerical modelling perspective. He used his international roles within the International Geosphere-Biosphere Programme Past Global Changes (IGBP PAGES) programme (as a member of its scientific steering committee, 1994–2000 and its executive committee, 1998–2000) and within the World Climate Research Programme (WRCP) CLIVAR / PAGES Intersection Working Group (2005–2011) to foster closer ties between these communities.

Keith's amenable, friendly personality, combined with enthusiasm for his science and a searching and constructively critical mind led to building contacts with many people in the field of palaeoclimatology (e.g., Plates 1 to 3). The fruits of these long-lasting and successful collaborations have been felt across climate science, with Keith leading the development of many important records allowing us to understand natural climate variability on timescales from years to millennia and to set recent climatic trends in their historical context. This spirit of collaboration is apparent in the Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC), to which Keith made important contributions over four of its cycles. In particular, he was a lead author of the *Palaeoclimate* chapter (Jansen et al., 2007) for the IPCC's Fourth Assessment Report, with a focus on the, at times controversial, topic of climate variations during the last 2000 years. With his characteristic objectivity and openness about the strengths and limitations of palaeoclimate data, he led the careful assessment of scientific understanding about this topic.

Keith Briffa was a great friend to many colleagues throughout his 40 years in the Climatic Research Unit and the School of Environmental Sciences at UEA, and was an admired lecturer among students, especially for his never-ending enthusiasm for his subject. Despite his great achievements, Keith remained remarkably modest and self-effacing. He helped many colleagues and particularly early stage researchers to achieve their potential, and he provided enduring support for the development of dendroclimatology communities in many regions of the world.

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Selected publications by Keith R. Briffa (in chronological order)

Briffa KR, Jones PD, Wigley TML, Pilcher JR and Baillie MGL (1983) Climate reconstruction from tree rings: part 1, basic methodology and preliminary results for England. *Journal of Climatology* **3**, 233-242.

Briffa KR (1984) *Tree-climate Relationships and Dendroclimatological Reconstruction in the British Isles*. Unpublished Ph.D. dissertation. University of East Anglia, U.K.

Wigley TML, **Briffa KR** and Jones PD (1984) On the average value of correlated time series, with applications in dendroclimatology and hydrometeorology. *Journal of Climate and Applied Meteorology* **23**, 201-213.

Baillie MGL, Hillam J, **Briffa KR** and Brown DM (1985) Re-dating the English art-historical tree-ring chronologies. *Nature* **315**, 317-319.

Briffa KR, Jones PD, Wigley TML, Pilcher JR and Baillie MGL (1986) Climate reconstruction from tree rings: part 2, spatial reconstruction of summer mean sea level pressure patterns over Great Britain. *Journal of Climatology* **6**, 1-15.

Atkinson TC, **Briffa KR** and Coope GR (1987) Seasonal temperatures in Britain during the last 22,000 years, reconstructed using beetle remains. *Nature* **325**, 587-592.

Briffa KR, Jones PD, Pilcher JR and Hughes MK (1988a) Reconstructing summer temperatures in northern Fennoscandinavia back to A.D. 1700 using tree-ring data from Scots Pine. *Arctic and Alpine Research* **20**, 385-394.

Briffa KR, Jones PD and Schweingruber FH (1988b) Summer temperature patterns in Europe: a reconstruction to 1750 based on maximum latewood density indices of conifers. *Quaternary Research* **30**, 36-52.

Briffa KR and Jones PD (1990) Basic chronology statistics and assessment. (In) *Methods of Dendrochronology*: *Applications in the Environmental Sciences* (ER Cook and LA Kairiukstis, Eds.) 137-152. Kluwer, Dordrecht.

Briffa KR, Jones PD and Kelly PM (1990a) Principal component analysis of the Lamb catalogue of daily weather types: Part 2, Seasonal frequencies and update to 1987. *International Journal of Climatology* **10**, 549-563.

Briffa KR, Bartholin T, Eckstein D, Jones PD, Karlén W, Schweingruber FH and Zetterberg P (1990b) A 1,400-year tree-ring record of summer temperatures in Fennoscandia. *Nature* **346**, 434-439.

Schweingruber FH, **Briffa KR** and Jones PD (1991) Yearly maps of summer temperature in western Europe from A.D. 1750 to 1975 and western North America from 1600 to 1982: Results of a radiodensitometrical study on tree rings. *Vegetatio* **92**, 5-71.

Briffa KR, Jones PD, Bartholin TS, Eckstein D, Schweingruber FH, Karlén W, Zetterberg P and Eronen M (1992a) Fennoscandian summers from A.D. 500: Temperature changes on short and long timescales. *Climate Dynamics* **7**, 111-119.

Briffa KR, Jones PD and Schweingruber FH (1992b) Tree-ring density reconstructions of summer temperature patterns across western North America since A.D. 1600. *Journal of Climate* **5**, 735-754.

Jones PD and **Briffa KR** (1992) Global surface air temperature variations over the twentieth century: Part 1, Spatial, Temporal and seasonal details. *The Holocene* **2**, 165-179.

Briffa KR and Jones PD (1993) Global surface air temperature variations during the Twentieth Century. Part 2, Implications for large-scale high-frequency palaeoclimatic studies. *The Holocene* **3**, 82-93.

Schweingruber FH, **Briffa KR** and Nogler P (1993) A tree-ring densitometric transect from Alaska to Labrador: comparison of ring-width and maximum-latewood-density chronologies in the conifer belt of northern North America. *International Journal of Biometeorology* **37**, 151-169.

Briffa KR, Jones PD and Hulme, M (1994) Summer moisture variability across Europe, 1892-1991: an analysis based on the Palmer Drought Severity Index. *International Journal of Climatology* **14**, 475-506.

Cook ER, **Briffa KR** and Jones PD (1994) Spatial regression methods in dendroclimatology: a review and comparison of two techniques. *International Journal of Climatology* **14**, 379-402.

Briffa KR, Jones PD, Schweingruber FH, Shiyatov SG and Cook ER (1995) Unusual twentieth-century warmth in a 1000-year temperature record from Siberia. *Nature* **376**, 156-159.

Briffa KR (1995) Interpreting high-resolution proxy climate data: the example of dendroclimatology. (In) *Analysis of Climate Variability*: *Applications of Statistical Techniques* (H von Storch and A Navarra, Eds.) 77-94. Springer, Berlin.

Cook ER, **Briffa KR**, Meko DM, Graybill DA and Funkhouser G (1995) The “Segment Length Curse” in long tree-ring chronology development for palaeoclimatic studies. *The Holocene* **5**, 229-237.

Jones PD and **Briffa KR** (1995) Growing season temperatures over the former Soviet Union. *International Journal of Climatology* **15**, 943-959.

Raper SCB, **Briffa KR** and Wigley TML (1996) Glacier change in northern Sweden from A.D. 500: a simple geometric model of Storglaciären. *Journal of Glaciology* **42**, 341-351.

Shiyatov SG, Hantemirov RM, Schweingruber FH, **Briffa KR** and Moell M (1996) Potential long-chronology development on the northwest Siberian Plain: early results. *Dendrochronologia* **14**, 13-29.

Vaganov EA, Naurazhaev MM, Schweingruber FH, **Briffa KR** and Moell M (1996) An 840-year tree-ring width chronology for Taimir as an indicator of summer temperature changes. *Dendrochronologia* **14**, 193-205.

Luckman BH, **Briffa KR**, Jones PD and Schweingruber FH (1997) Tree-ring based reconstruction of summer temperatures at the Columbia Icefield, Alberta, A.D. 1073-1983. *The Holocene* **7**, 375-389.

Osborn TJ, **Briffa KR** and Jones PD (1997) Adjusting variance for sample-size in tree-ring chronologies and other regional-mean timeseries. *Dendrochronologia* **15**, 89-99.

Briffa KR, Jones PD, Schweingruber FH and Osborn TJ (1998a) Influence of volcanic eruptions on Northern Hemisphere summer temperatures over the past 600 years. *Nature* **393**, 450-455.

Briffa KR, Schweingruber FH, Jones PD, Osborn TJ, Harris IC, Shiyatov SG, Vaganov EA and Grudd H (1998a) Trees tell of past climates: but are they speaking less clearly today? *Philosophical Transactions of the Royal Society of London B*, **353**, 65-73.

Briffa KR, Schweingruber FH, Jones PD, Osborn TJ, Shiyatov SG and Vaganov EA (1998c) Reduced sensitivity of recent tree-growth to temperatures at high northern latitudes. *Nature* **391**, 678-682.

Cook ER, D'Arrigo RD and **Briffa KR** (1998) The North Atlantic Oscillation and its expression in circum-Atlantic tree-ring chronologies from North America and Europe. *The Holocene* **8**, 9-17.

Jones PD, **Briffa KR**, Barnett TP and Tett SFB (1998) High-resolution palaeoclimatic records for the last millennium: interpretation, integration and comparison with General Circulation Model control run temperatures. *The Holocene* **8**, 455-471.

Osborn TJ, **Briffa KR**, Tett SFB, Jones PD and Trigo RM (1999) Evaluation of the North Atlantic Oscillation as simulated by a coupled climate model. *Climate Dynamics* **15**, 685-702.

Briffa KR (2000) Annual climate variability in the Holocene: interpreting the message of ancient trees. *Quaternary Science Reviews* **19**, 87-105.

Briffa KR, Osborn TJ, Schweingruber FH, Harris IC, Jones PD, Shiyatov SG and Vaganov EA (2001) Low-frequency temperature variations from a northern tree ring density network. *Journal of Geophysical Research* **106**, 2929-2941.

Jones PD, Ogilvie AEJ, Davies TD and Briffa KR (eds.) (2001) *History and Climate: Memories of the future?* Springer, New York.

Jones PD, Osborn TJ and **Briffa KR** (2001) The evolution of climate over the last millennium. *Science* **292**, 662-667.

Roig FA, Le-Quesne C, Boninsegna JA, **Briffa KR**, Lara A, Grudd H, Jones PD and Villagran C (2001) Climate variability 50,000 years ago in mid-latitude Chile as reconstructed from tree rings. *Nature* **410**, 567-570.

Briffa KR, Osborn TJ, Schweingruber FH, Jones PD, Shiyatov SG and Vaganov EA (2002a) Tree-ring width and density data around the Northern Hemisphere: Part 1, local and regional climate signals. *Holocene* **12**, 737-757.

Briffa KR, Osborn TJ, Schweingruber FH, Jones PD, Shiyatov SG and Vaganov EA (2002b) Tree-ring width and density data around the Northern Hemisphere: Part 2, spatio-temporal variability and associated climate patterns. *Holocene* **12**, 759-789.

Collins M, Osborn TJ, Tett SFB, **Briffa KR** and Schweingruber FH (2002) A comparison of the variability of a climate model with paleo-temperature estimates from a network of tree-ring densities. *Journal of Climate* **15**, 1497-1515.

Eronen M, Zetterberg P, **Briffa KR**, Lindholm M, Merilainen J and Timonen M (2002) The supra-long Scots pine tree-ring record for Finnish Lapland: Part 1, chronology construction and initial inferences. *Holocene* **12**, 673-680.

Grudd H, **Briffa KR**, Karlén W, Bartholin TS, Jones PD and Kromer B (2002) A 7400-year tree-ring chronology in northern Swedish Lapland: natural climatic variability expressed on annual to millennial timescales. *Holocene* **12**, 657-665.

Jones PD, **Briffa KR** and Osborn TJ (2003) Changes in the Northern Hemisphere annual cycle: implications for paleoclimatology? *Journal of Geophysical Research* **108**, 4588.

Briffa KR, Osborn TJ and Schweingruber FH (2004) Large-scale temperature inferences from tree rings: a review. *Global and Planetary Change* **40**, 11-26.

Matthews JA and **Briffa KR** (2005) The 'Little Ice Age': re-evaluation of an evolving concept. *Geografiska Annaler Series a-Physical Geography* **87A**, 17-36.

Rutherford S, Mann ME, Osborn TJ, Bradley RS, **Briffa KR**, Hughes MK and Jones PD (2005) Proxy-based Northern Hemisphere surface temperature reconstructions: Sensitivity to method, predictor network, target season, and target domain. *Journal of Climate* **18**, 2308-2329.

Osborn TJ and **Briffa KR** (2006) The spatial extent of 20th-century warmth in the context of the past 1200 years. *Science* **311**, 841-844.

Scourse J, Richardson C, Forsythe G, Harris IC, Heinemeier J, Fraser N, **Briffa KR** and Jones PD (2006) First cross-matched floating chronology from the marine fossil record: Data from growth lines of the long-lived bivalve mollusc Arctica islandica. *Holocene* **16**, 967-974.

van der Schrier G, **Briffa KR**, Jones PD and Osborn TJ (2006) Summer moisture variability across Europe. *Journal of Climate* **19**, 2818-2834.

van der Schrier G, **Briffa KR**, Osborn TJ and Cook ER (2006) Summer moisture availability across North America. *Journal of Geophysical Research* **111**, D11102.

Wilson R, Tudhope A, Brohan P, **Briffa KR**, Osborn TJ and Tett S (2006) Two hundred-fifty years of reconstructed and modeled tropical temperatures. *Journal of Geophysical Research* **111**, C1007 doi:10.1029/2005JC3188.

Jansen E, Overpeck J, **Briffa KR**, Duplessy JC, Joos F, Masson-Delmotte V, Olago D, Otto-Bliesner B, Peltier WR, Rahmstorf S, Ramesh R, Raynaud D, Rind D, Solomina O, Villalba R and Zhang DE (2007) Palaeoclimate. (In) *Climate Change 2007* (S Solomon, D Qin, M Manning, Z Chen, M Marquis, KB Averyt, M Tignor, HL Miller. Eds.) The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK

Juckes MN, Allen MR, **Briffa KR**, Esper J, Hegerl GC, Moberg A, Osborn TJ and Weber SL (2007) Millennial temperature reconstruction intercomparison and evaluation. *Climate of the Past* **3**, 591-609.

Briffa KR, Shishov VV, Melvin TM, Vaganov EA, Grudd H, Hantemirov RM, Eronen M and Naurzbaev MM (2008) Trends in recent temperature and radial tree growth spanning 2000 years across northwest Eurasia. *Philosophical Transactions of the Royal Society B-Biological Sciences* **363**, 2271-2284.

Larsen LB, Vinther BM, **Briffa KR**, Melvin TM, Clausen HB, Jones PD, Siggaard-Andersen ML, Hammer CU, Eronen M, Grudd H, Gunnarson BE, Hantemirov RM, Naurzbaev MM and Nicolussi K (2008) New ice core evidence for a volcanic cause of the AD 536 dust veil. *Geophysical Research Letters* **35**, L04708.

Melvin TM and **Briffa KR** (2008) A "Signal-Free" approach to dendroclimatic standardisation, *Dendrochronologia* **26**, 71-86.

Briffa KR, van der Schrier G and Jones PD (2009). Wet and dry summers in Europe since 1750: evidence of increasing drought. *International Journal of Climatology* **29**, 1894-1905.

Jones PD, **Briffa KR**, Osborn TJ, Lough JM, van Ommen TD, Vinther BM, Luterbacher J, Wahl ER, Zwiers FW, Mann ME, Schmidt GA, Ammann CM, Buckley BM, Cobb KM, Esper J, Goosse H, Graham NE, Jansen E, Kiefer T, Kull C, Kuttel M, Mosley-Thompson E, Overpeck JT, Riedwyl N, Schulz M, Tudhope AW, Villalba R, Wanner H, Wolff E and Xoplaki E (2009) High-resolution paleoclimatology of the last millennium: a review of current status and future prospects. *Holocene* **19**, 3-49.

Kaufman DS, Schneider DP, McKay NP, Ammann CM, Bradley RS, **Briffa KR**, Miller GH, Otto-bliesner BL, Overpeck JT, Vinther BM (2009) Recent warming reverses long-term arctic cooling. *Science* **325**, 1236-1239.

Vinther BM, Jones PD, **Briffa KR,** Clausen HB, Andersen KK, Dahl-Jensen D and Johnsen SJ (2010) Climatic signals in multiple highly resolved stable isotope records from Greenland. *Quaternary Science Reviews* **29**, 522-538

Briffa KR and Melvin TM (2011) A closer look at Regional Curve Standardisation of tree-ring records: justification of the need, a warning of some pitfalls, and suggested improvements in its application. (In) *Dendroclimatology: Progress and Prospects* (MK Hughes, HF Diaz and TW Swetnam, Eds.), Springer-Verlag, 113-145.

Anchukaitis KJ, Breitenmoser P, **Briffa KR**, Buchwal A, Buntgen U, Cook ER, D'arrigo RD, Esper J, Evans MN, Frank D, Grudd H, Gunnarson BE, Hughes MK, Kirdyanov AV, Korner C, Krusic PJ, Luckman B, Melvin TM, Salzer MW, Shashkin AV, Timmreck C, Vaganov EA and Wilson RJS (2012) Tree rings and volcanic cooling. *Nature Geoscience* **5**, 836–837.

Barichivich J, **Briffa KR**, Myneni RB, Osborn TJ, Melvin TM, Ciais P, Piao SL and Tucker C (2013) Large-scale variations in the vegetation growing season and annual cycle of atmospheric CO_2 at high northern latitudes from 1950 to 2011. *Global Change Biology* **19**, 3167-3183.

Briffa KR, Melvin TM, Osborn TJ, Hantemirov RM, Kirdyanov AV, Mazepa VS, Shiyatov SG and Esper J (2013) Reassessing the evidence for tree-growth and inferred temperature change during the Common Era in Yamalia, northwest Siberia. *Quaternary Science Reviews* **72**, 83–107.

Cornes RC, Jones PD, **Briffa KR** and Osborn TJ (2013) Estimates of the North Atlantic Oscillation series back to 1692 using a Paris-London Westerly Index. *International Journal of Climatology* **33**, 228-248.

Cooper RJ, Melvin TM, Tyers I, Wilson RJS and **Briffa KR** (2013) A tree-ring reconstruction of East Anglian (UK) hydroclimate variability over the last millennium. *Climate Dynamics* **40**, 1019-1039.

Melvin TM, Grudd H and **Briffa KR** (2013) Potential bias in 'updating' tree-ring chronologies using regional curve standardisation: Re-processing 1500 years of Torneträsk density and ring-width data. *The Holocene* **23**, 364-373.

van der Schrier G, Barichivich J, **Briffa KR** and Jones PD (2013) A scPDSI-based global data set of dry and wet spells for 1901-2009. *Journal of Geophysical Research* **118**, 4025–4048.

Wilson R, Miles D, Loader NJ, Melvin TM, Cunningham L, Cooper R and **Briffa K** (2013) A millennial long March-July precipitation reconstruction for southern-central England. *Climate Dynamics* **40**, 997-1017.

Barichivich J, **Briffa KR**, Myneni R, van der Schrier G, Dorigo WA, Tucker CJ, Osborn TJ and Melvin TM (2014) Temperature and snow-mediated moisture controls of summer vegetation photosynthetic activity in northern terrestrial ecosystems between 1982 and 2011. *Remote Sensing* **6**, 1390-1431.

Melvin TM and **Briffa KR** (2014) CRUST: Software for the implementation of Regional Chronology Standardisation: Part 1. Signal-Free RCS. *Dendrochronologia* **32**, 7-20.

Trenberth KE, Dai A, van der Schrier G, Jones PD, Barichivich J, **Briffa KR** and Sheffield J (2014) Global warming and changes in drought. *Nature Climate Change* **4**, 17–22.

Yang B, Qin C, Wang J, He M, Melvin TM, Osborn TJ and **Briffa KR** (2014) A 3,500-year tree-ring record of annual precipitation on the northeastern Tibetan Plateau. *Proceedings of the National Academy of Sciences of the United States of America* **111**, 2903–2908.

Cook ER, Seager R, Kushnir Y, **Briffa KR**, Buntgen U, Frank D, Krusic PJ, Tegel W, van der Schrier G, Andreu-Hayles L, Baillie M, Baittinger C, Bleicher N, Bonde N, Brown D, Carrer M, Cooper R, Cufar K, Dittmar C, Esper J, Griggs C, Gunnarson B, Gutierrez E, Haneca K, Helama S, Herzig F, Heussner KU, Hofmann J, Janda P, Kontic R, Kose N, Kyncl T, Levanic T, Linderholm H, Manning S, Melvin T, Miles D, Neuwirth B, Nicolussi K, Nola P, Panayotov M, Popa L, Rothe A, Seftigen K, Seim A, Svarva H, Svoboda M, Thun T, Timonen M, Touchan R, Trotsiuk V, Trouet V, Walder F, Wazny T, Wilson R and Zang C (2015) Old world megadroughts and pluvials during the Common Era. *Science Advances* **1**, e1500561.

Wilson R, Anchukaitis K, **Briffa KR**, Buntgen U, Cook E, D'Arrigo R, Davi N, Esper J, Frank D, Gunnarson B, Hegerl G, Helama S, Klesse S, Krusic PJ, Linderholm HW, Myglan V, Osborn TJ, Rydval M, Schneider L, Schurer A, Wiles G, Zhang P and Zorita E (2016) Last millennium northern hemisphere summer temperatures from tree rings: Part i: the long term context. *Quaternary Science Reviews* **134**, 1–18.

Anchukaitis KJ, Wilson R, **Briffa KR**, Buntgen U, Cook ER, D'Arrigo R, Davi N, Esper J, Frank D, Gunnarson BE, Hegerl G, Helama S, Klesse S, Krusic PJ, Linderholm HW, Myglan V, Osborn TJ, Zhang P, Rydval M, Schneider L, Schurer A, Wiles G and Zorita E (2017) Last millennium northern hemisphere summer temperatures from tree rings: Part ii, spatially resolved reconstructions. *Quaternary Science Reviews* **163**, 1–22.

Helama S, Melvin TM and **Briffa KR** (2017) Regional curve standardization: state of the art. *Holocene* **27**, 172-177.

Wang J, Yang B, Ljungqvist FC, Luterbacher J, Osborn TJ, **Briffa KR** and Zorita E (2017) Internal and external forcing of multidecadal Atlantic climate variability over the past 1,200 years. *Nature Geoscience* **10**, 512-517.

A complete list of Keith Briffa's publications between 1983 and 2017 can be found at https://crudata.uea.ac.uk/cru/people/briffa/Keith_R_Briffa_full_publication_list.pdf

Plates

Plate 1. Keith Briffa, Tom Melvin and Michael Grabner assessing sub-fossil tree samples in the Austrian Alps, 2006. Photo: Kurt Nicolussi.

Plate 2. Fritz Schweingruber and Keith Briffa during field work, Southern Urals, 1999. Photo: Stepan Shiyatov.

Plate 3. Keith Briffa visiting Ed Cook at the Tree-Ring Lab, Lamont Doherty Earth Observatory, 2007.