**Supplementary material: A brief history of climate – the northern seas from the Last Glacial Maximum to global warming**

Tor Eldevik1, Bjørg Risebrobakken2, Anne E. Bjune2, Carin Andersson2, H. John B. Birks3,7,8, Trond M. Dokken2, Helge Drange1, Mirjam S. Glessmer1, Camille Li1, Jan Even Ø. Nilsen4, Odd Helge Otterå2, Kristin Richter5, and Øystein Skagseth6

1. Geophysical Institute, University of Bergen, and Bjerknes Centre for Climate Research, Bergen, Norway
2. Uni Research Climate, and Bjerknes Centre for Climate Research, Bergen, Norway
3. Department of Biology, University of Bergen, and Bjerknes Centre for Climate Research, Bergen, Norway
4. Nansen Environmental and Remote Sensing Center, and Bjerknes Centre for Climate Research, Bergen, Norway
5. Institute for Meteorology and Geophysics, University of Innsbruck, Innsbruck, Austria
6. Institute of Marine Research, and Bjerknes Centre for Climate Research, Bergen, Norway
7. Environmental Change Research Centre, University College London, London, UK
8. School of Geography and the Environment, University of Oxford, Oxford, UK

**Access to background data**

Published pollen data can be found in the European Pollen Database, EPD (http://www.europeanpollendatabase.net/). Previously unpublished pollen data are also to be deposited in EPD, and are until then available upon request from Anne E. Bjune (anne.bjune@uni.no) or John Birks (john.birks@bio.uib.no). All published marine records presented in this study, including background foraminifera census data, are available at PANGAEA (pangaea.de). Previously unpublished marine data are also to be deposited at PANGAEA, and are until then available upon request from Bjørg Risebrobakken (bjorg.risebrobakken@uni.no) or Trond Dokken (trond.dokken@uni.no).

**Supplementary table 1.** Radiocarbon dates and calendar year calibrations that are used to calculate the age models for the terrestrial sites (site 1–14 in table I). The radiocarbon dates have been calibrated using the CLAM software (Blaauw 2010). The calibration is based on the IntCal13 calibration curve (Reimer et al. 2013). At Jansvatnet (site 13) the age-depth model is based on linear interpolation as only a few reliable 14C dates were available, at all the other sites age-depth models were constructed using a smooth spline run through randomly sampled point estimates from calibrated dates and iterating this process a thousand times (Blaauw 2010). Any models with age reversals were rejected.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 1 ID** | **Locality** | **Lab no.** | **Sample depth, cm** | **Material dated** | **14C age (BP)** | **Cal age range****±1σ** | **Lake cored** | **Top of core** | **Reference** |
| 1 | Dalane | Tua-2370A | 554-554,5 | Bulk sediment | 670±70 | 538-708 | 1997 | 515 cm | Eide et al. 2006 |
| 1 | Dalane | Tua-2371A | 618-618,5 | Bulk sediment | 1345±65 | 1172-1380 |  |  | Eide et al. 2006 |
| 1 | Dalane | Tua-2372A | 714-714,5 | Bulk sediment | 2905±65 | 2868-3217 |  |  | Eide et al. 2006 |
| 1 | Dalane | Tua-2373A | 774-774,5 | Bulk sediment | 3820±65 | 4080-4416 |  |  | Eide et al. 2006 |
| 1 | Dalane | Tua-2374A | 870-870,5 | Bulk sediment | 6365±70 | 7172-7422 |  |  | Eide et al. 2006 |
| 1 | Dalane | Tua-2375A | 922-922,5 | Bulk sediment | 8130±75 | 8929-9300 |  |  | Eide et al. 2006 |
| 1 | Dalane | Tua-2376A | 930-930,5 | Bulk sediment | 8690±75 | 9529-9912 |  |  | Eide et al. 2006 |
| 1 | Dalane | Tua2377A | 945,5-946 | Bulk sediment | 9750±85 | 11061-11325 |  |  | Eide et al. 2006 |
| 2 | Vestre Øykjamyrtjørn | Poz-801 | 34-35 | Plant macrofossils | 235±45 | 258-333 | 2001 | 0 cm | Bjune 2005, Bjune et al. 2005 |
| 2 | Vestre Øykjamyrtjørn | Poz-805 | 82-83 | Plant macrofossils | 1530±30 | 1352-1424 |  |  | Bjune 2005, Bjune et al. 2005 |
| 2 | Vestre Øykjamyrtjørn | Poz-803 | 130-131 | Plant macrofossils | 2830±40 | 2850-3062 |  |  | Bjune 2005, Bjune et al. 2005 |
| 2 | Vestre Øykjamyrtjørn | Poz-802 | 178-179 | Plant macrofossils | 4590±45 | 5258-5333 |  |  | Bjune 2005, Bjune et al. 2005 |
| 2 | Vestre Øykjamyrtjørn | Poz-804 | 201-202 | Plant macrofossils | 5930±50 | 6659-6884 |  |  | Bjune 2005, Bjune et al. 2005 |
| 2 | Vestre Øykjamyrtjørn | Poz-799 | 217-218 | Plant macrofossils | 6880±50 | 7618-7804 |  |  | Bjune 2005, Bjune et al. 2005 |
| 2 | Vestre Øykjamyrtjørn | Poz-800 | 227-228 | Plant macrofossils | 7630±55 | 8362-8542 |  |  | Bjune 2005, Bjune et al. 2005 |
| 2 | Vestre Øykjamyrtjørn | Poz-806 | 241-242 | Plant macrofossils | 7990±55 | 8694-9007 |  |  | Bjune 2005, Bjune et al. 2005 |
| 2 | Vestre Øykjamyrtjørn | Poz-813 | 302-303 | Plant macrofossils | 10070±50 | 11386-11826 |  |  | Bjune 2005, Bjune et al. 2005 |
| 2 | Vestre Øykjamyrtjørn | Poz-811 | 332-333 | Plant macrofossils | 10730±60 | 12578-12733 |  |  | Bjune 2005, Bjune et al. 2005 |
| 2 | Vestre Øykjamyrtjørn | Poz-1162 | 354-356 | Plant macrofossils | 11170±60 | 12854-13144 |  |  | Bjune 2005, Bjune et al. 2005 |
| 3 | Kattatjørn | Tua-2226A | 649-650 | Bulk sediment | 1695±100 | 1387-1825 | 1996 | 630 cm | This study |
| 3 | Kattatjørn | Tua-225A | 673-674 | Bulk sediment | 1565±60 | 1333-1568 |  |  | This study |
| 3 | Kattatjørn | Tua-2224A | 721,5-722 | Bulk sediment | 3545±65 | 3683-3985 |  |  | This study |
| 3 | Kattatjørn | Tua-2223A | 745,5-746 | Bulk sediment | 5080±60 | 5707-5929 |  |  | This study |
| 3 | Kattatjørn | Tua-2222A | 807,5-808 | Bulk sediment | 7315±50 | 8009-8205 |  |  | This study |
| 3 | Kattatjørn | Tua-2221A | 837-838 | Bulk sediment | 10795±65 | 12621-12802 |  |  | This study |
| 4 | Kråkenes (Holocene) | n.a. | 274-275 | Bulk sediment | 1995±75 | 1808-2147 | 1999 | 253 cm | This study |
| 4 | Kråkenes (Holocene) | n.a. | 361-362 | Bulk sediment | 1610±75 | 1350-1632 |  |  | This study |
| 4 | Kråkenes (Holocene) | n.a. | 473-474 | Bulk sediment | 4385±75 | 4840-5086 |  |  | This study |
| 4 | Kråkenes (Holocene) | n.a. | 521-522 | Bulk sediment | 6070±70 | 6780-7158 |  |  | This study |
| 4 | Kråkenes (Holocene) | n.a. | 607-608 | Bulk sediment | 7890±65 | 8581-8982 |  |  | This study |
| 4 | Kråkenes (Holocene) | n.a. | 654-655 | Bulk sediment | 8700±70 | 9537-9905 |  |  | This study |
| 4 | Kråkenes (Late Glacial) |  |  |  |  |  |  |  | All details are given in Lohne et al. 2013 |
| 5 | Storsandvatnet | Tua-3963A | 119,5-120 | Bulk sediment | 3280±45 | 3439-3609 | 2001 |  70 cm | This study |
| 5 | Storsandvatnet | Tua-3962A | 156,5-157 | Bulk sediment | 5130±40 | 5853-5944 |  |  | This study |
| 5 | Storsandvatnet | Tua-3961A | 204,5-205 | Bulk sediment | 6025±45 | 6772-6979 |  |  | This study |
| 5 | Storsandvatnet | Tua-3960A | 244,5-245 | Bulk sediment | 7750±50 | 8423-8603 |  |  | This study |
| 5 | Storsandvatnet | Tua-3959A | 274,5-275 | Bulk sediment | 8100±50 | 8970-9144 |  |  | This study |
| 5 | Storsandvatnet | Tua-3958A | 296,5-297 | Bulk sediment | 7155±50 | 7921-8055 |  |  | This study |
| 5 | Storsandvatnet | Tua-3957A | 314,5-315 | Bulk sediment | 9165±55 | 10231-10439 |  |  | This study |
| 5 | Storsandvatnet | Tua-3956A | 334,5-335 | Bulk sediment | 9495±60 | 10584-10882. |  |  | This study |
| 5 | Storsandvatnet | Tua-3955A | 349,5-350 | Bulk sediment | 9980±65 | 11247-11713 |  |  | This study |
| 5 | Storsandvatnet | Tua-3954A | 389,5-390,5 | Bulk sediment | 11620±90 | 13269-13614 |  |  | This study |
| 6 | Svanåvatnet | Poz-17479 | 41-42 | Plant macrofossils | 1525±30 | 348-1424 | 2003 | 0 cm | Bjune & Birks 2008 |
| 6 | Svanåvatnet | Poz-17473 | 68-69 | Plant macrofossils | 2585±35 | 2698-2770 |  |  | Bjune & Birks 2008 |
| 6 | Svanåvatnet | Poz-17480 | 199-200 | Plant macrofossils | 5850±40 | 6552-6750 |  |  | Bjune & Birks 2008 |
| 6 | Svanåvatnet | Poz-17482 | 219-222 | Plant macrofossils | 6390±40 | 7263-7418 |  |  | Bjune & Birks 2008 |
| 7 | Litlvatnet  | Tua-1414A | 691,5-692 | Bulk sediment | 2175±65 | 2037-2331 | 1994 | 635 cm | This study |
| 7 | Litlvatnet | Tua-1415A | 755,5-756 | Bulk sediment | 3425±80 | 3542-3874 |  |  | This study |
| 7 | Litlvatnet | Tua-1416A | 827,5-828 | Bulk sediment | 4770±100 | 5305-5664 |  |  | This study |
| 7 | Litlvatnet | Tua-1417A | 915,5-916 | Bulk sediment | 6935±95 | 7614-7941 |  |  | This study |
| 7 | Litlvatnet | Tua-1634A | 969,5-970 | Bulk sediment | 8200±100 | 8978-9466 |  |  | This study |
| 7 | Litlvatnet | Tua-1419A | 1015,5-1016 | Bulk sediment | 10655±110 | 12379-12757 |  |  | This study |
| 8 | Myrvatnet | Tua-1344A | 525,5-526 | Bulk sediment | 1650±70 | 1394-1710 | 1994 | 480 cm | This study |
| 8 | Myrvatnet | Tua-1345A | 653,5-654 | Bulk sediment | 4135±100 | 4421-4858 |  |  | This study |
| 8 | Myrvatnet | Tua-1346A | 743-744,5 | Bulk sediment | 6235±65 | 6966-7274 |  |  | This study |
| 8 | Myrvatnet | Tua-1347A | 783,5-784 | Bulk sediment | 7310±70 | 7982-8219 |  |  | This study |
| 8 | Myrvatnet | Tua-1348A | 810,5-811 | Bulk sediment | 8795±60 | 9603-9961 |  |  | This study |
| 8 | Myrvatnet | Tua-1349A | 819,5-820,5 | Bulk sediment | 11530±150 | 13086-13625 |  |  | This study |
| 9 | Bjørnfjelltjørn | Tua-1633A | 1315,5-1316 | Bulk sediment | 1475±100 | 1233-1569 | 1994 | 1290 cm | This study |
| 9 | Bjørnfjelltjørn | Tua-1632A | 1375,5-1376 | Bulk sediment | 3315±65 | 3439-3693 |  |  | This study |
| 9 | Bjørnfjelltjørn | Tua-1631A | 1398,5-1399 | Bulk sediment | 4020±75 | 4290-4713 |  |  | This study |
| 9 | Bjørnfjelltjørn | Tua-1630A | 1439,5-1440 | Bulk sediment | 5775±70 | 6435-9731 |  |  | This study |
| 9 | Bjørnfjelltjørn | Tua-1629A | 1457,5-1458 | Bulk sediment | 6790±85 | 7497-7795 |  |  | This study |
| 9 | Bjørnfjelltjørn | Tua-1628A | 1483,5-1484 | Bulk sediment | 7365±120 | 7974-8385 |  |  | This study |
| 9 | Bjørnfjelltjørn | Tua-1627A | 1511,5-1512,5 | Bulk sediment | 8315±80 | 9090-9486 |  |  | This study |
| 9 | Bjørnfjelltjørn | Tua-1626A | 1536-1540 | Bulk sediment | 9960±135 | 11180-11984 |  |  | This study |
| 10 | Lusvatnet | Poz-33966 | 169-170 | Plant macrofossils | 6160±35 | 6966-7163 | 2007 | 0 cm | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33967 | 193-194 | Plant macrofossils | 6960±40 | 7691-7865 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33968 | 209-210 | Plant macrofossils | 7470±40 | 8197-8371 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33969 | 225-226 | Plant macrofossils | 6580±40 | 7427-7519 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-30108 | 335-336 | Plant macrofossils | 8210±50 | 9020-9306 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33965 | 243-244 | Plant macrofossils | 8360±40 | 9289-9473 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33964 | 259-260 | Plant macrofossils | 8980±35 | 10131-10232 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-24476 | 271-272 | Plant macrofossils | 9230±50 | 10251-10520 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-30109 | 281-282 | Plant macrofossils | 9580±50 | 10737-11131 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33963 | 294-295 | Plant macrofossils | 9640±50 | 1078-11034 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33915 | 315-316 | Plant macrofossils | 9910±60 | 11214-11499 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-30107 | 319-320 | Plant macrofossils | 3420±35 | 3578-3728 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-24477 | 339-340 | Plant macrofossils | 10150±60 | 11599-12056 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-30106 | 379-380 | Plant macrofossils | 10350±50 | 12008-12401 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33914 | 388-389 | Plant macrofossils | 10600±60 | 12516-12697 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33913 | 399-400 | Plant macrofossils | 10640±60 | 12527-12714 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33911 | 415-416 | Plant macrofossils | 10630±60 | 12524-12711 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-22884 | 427-428 | Plant macrofossils | 10550±60 | 12386-12687 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33910 | 439-440 | Plant macrofossils | 10300±60 | 11931-12389 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-22885 | 442-443 | Plant macrofossils | 9910±50 | 11217-11411 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-33909 | 475-476 | Plant macrofossils | 11390±60 | 13096-13353 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-30105 | 489-490 | Plant macrofossils | 11220±60 | 12974-13225 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 10 | Lusvatnet | Poz-22886 | 511-512 | Plant macrofossils | 11920±60 | 13568-13867 |  |  | Aarnes et al. 2012, Birks et al. 2014 |
| 11 | Dalmutladdo | Hela-499 | 6-7 cm | Plant macrofossils | 605±70 | 521-671 | 2001 | 0 cm | Bjune et al. 2004 |
| 11 | Dalmutladdo | Hela-508 | 22-23 cm | Plant macrofossils | 775±65 | 642-800 |  |  | Bjune et al. 2004 |
| 11 | Dalmutladdo | Hela-500 | 48-49 cm | Plant macrofossils | 1725±65 | 1522-1820 |  |  | Bjune et al. 2004 |
| 11 | Dalmutladdo | Hela-509 | 75-76 cm | Plant macrofossils | 2555±105 | 2356-2804 |  |  | Bjune et al. 2004 |
| 11 | Dalmutladdo | Hela-513 | 113-114 cm | Plant macrofossils | 3495±65 | 3610-3925 |  |  | Bjune et al. 2004 |
| 11 | Dalmutladdo | Hela-510 | 137-138 cm | Plant macrofossils | 4615±75 | 5212-5482 |  |  | Bjune et al. 2004 |
| 11 | Dalmutladdo | Hela-502 | 173-174 cm | Plant macrofossils | 5620±85 | 6283-6569 |  |  | Bjune et al. 2004 |
| 11 | Dalmutladdo | Hela-511 | 210-211 cm | Plant macrofossils | 7225±115 | 7844-8312 |  |  | Bjune et al. 2004 |
| 11 | Dalmutladdo | Hela-503 | 226-227 cm | Plant macrofossils | 7730±90 | 8371-8728 |  |  | Bjune et al. 2004 |
| 11 | Dalmutladdo | Hela-512 | 247-248 cm | Plant macrofossils | 8110±120 | 8647-9321 |  |  | Bjune et al. 2004 |
| 11 | Dalmutladdo | Hela-504 | 265-266 cm | Plant macrofossils | 8765±110 | 9547-9968 |  |  | Bjune et al. 2004 |
| 12 | Ifjord | Hela-3616 | 142-152 | Bulk sediment | 6400±110 | 7155-7511 | 1993 | 0 cm | Seppä 1998, Seppä et al. 2002 |
| 12 | Ifjord | Hela-3617 | 202-212 | Bulk sediment | 8290±140 | 8980-9542 |  |  | Seppä 1998, Seppä et al. 2002 |
| 12 | Ifjord | Hela-3618 | 222-232 | Bulk sediment | 9360±100 | 10256-10794 |  |  | Seppä 1998, Seppä et al. 2002 |
| 12 | Ifjord | Hela-3619 | 282-297 | Bulk sediment | 10600±190 | 11947-12855 |  |  | Seppä 1998, Seppä et al. 2002 |
| 13 | Jansvatnet | Poz-11778 | 1190-1191 | Plant macrofossil | 8360±50 | 9260-9489 | 2000 | 920 cm | Birks et al. 2012 |
| 13 | Jansvatnet | Poz-11779 | 1204-1205 | Plant macrofossil | 8860±50 | 9762-10172 |  |  | Birks et al. 2012 |
| 13 | Jansvatnet | Poz-11863 | 1260-1261 | Plant macrofossil | 10360±550 | 12018-12407 |  |  | Birks et al. 2012 |
| 13 | Jansvatnet | Poz-11864 | 1280-1281 | Moss | 10430±50 | 12102-12444 |  |  | Birks et al. 2012 |
| 13 | Jansvatnet | Poz-11866 | 294-1295 | Moss | 10960±60 | 12716-12983 |  |  | Birks et al. 2012 |
| 13 | Jansvatnet | Poz-11867 | 1316-1317 | Moss | 12280±60 | 14013-1487 |  |  | Birks et al. 2012 |
| 14 | Hopseidet | Hela-3539 | 63-73 | Bulk sediment | 4400±110 | 4816-5320 | 1993 | 0 cm | Seppä 1996, 1998, Seppä et al. 2009 |
| 14 | Hopseidet | Hela-3540 | 113-123 | Bulk sediment | 6510±100 | 7259-7577 |  |  | Seppä 1996, 1998, Seppä et al. 2009 |
| 14 | Hopseidet | Hela-3541 | 178-188 | Bulk sediment | 9290±140 | 10200-10807 |  |  | Seppä 1996, 1998, Seppä et al. 2009 |
| 14 | Hopseidet | Hela-3542 | 194-204 | Bulk sediment | 10570±110 | 12361-12711 |  |  | Seppä 1996, 1998, Seppä et al. 2009 |

**Supplementary table 2.** Radiocarbon dates, ash horizons and calendar year calibrations that are used to calculate the age models of the marine sites (15–20 in Table 1). Ages for Vedde Ash and Saksurnavatn Ash are from [Rasmussen et al., 2006]. ∆R shows the geographically and time dependent reservoir corrections that have been used (based on Bondevik et al., 2006; Mangerud et al., 2006). ∆R values representative for HS1 and LGM in the Nordic Seas are not known. Here, HS1 is considered to be comparable to YD and LGM to the Holocene, based on present knowledge on the oceanography of the study for these time periods. We have, however, increased the ∆R uncertainty used for HS1 and LGM to acknowledge that there are larger uncertainties related to the chosen ∆R values for these time periods. The ∆R values used are: Holocene 7±11 yr; YD 250±50 yr; Allerød 100±50 yr; Bølling 7±11 yr; HS1 250±100 yr and LGM 7±100 yr. The radiocarbon dates has been calibrated using Calib 7.0 and the Marine13 calibration data set [Reimer et al., 2013]. Ages are defined by linear interpolation between dated tie points. A few dates have been omitted as they gave inverted ages, probably due to resedimentation. NPD=*N. pachyderma* (dex), NPS= *N. pachyderma* (sin).

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 1 ID** | **Locality** | **Lab no.** | **Sample depth,****cm** | **Material dated** | **14C age****(BP)** | **∆R** | **Cal age range ±1σ** | **Rel prob** | **Cal age BP 1950 (med prob)** | **Comment** | **Reference** |
| 20 | PSh-5159N | Poz-15130 | 7.5 | Mollusc fragments, benthic foraminifera | 102.46\_0.32pMC | 71±21 |  |  |  |  | Ivanova et al. (2008) |
| 20 | PSh-5159R | Poz-20399 | 14.17 | Lenticulina sp. | 635±30 | 71±21 | 145-16780-285 | 0.2010.799 | 197 |  | Ivanova et al. (2008)  |
| 20 | PSh-5159N | Poz-19995 | 21.5 | Bulk foraminifera | 1670±30 | 71±21 | 1120-1214 | 1 | 1167 |  | Ivanova et al., (2008)  |
| 20 | PSh-5159N | Poz-19997 | 40.5 | Bulk foraminifera | 2845±30 | 71±21 | 2430-2604 | 1 | 2513 |  | Risebrobakken et al. (2010) |
| 20 | PSh-5159N | Poz-20568 | 45.5 | Bulk foraminifera | 4960±40 | 71±21 | 5132-5286 | 1 | 5204 |  | Risebrobakken et al. (2010) |
| 20 | PSh-5159N | Poz-15131 | 50.5 | Mollusc fragments | 6105±35 | 71±21 | 6392-6499 | 1 | 6450 |  | Risebrobakken et al. (2010) |
| 20 | PSh-5159N | Poz-19998 | 60.5 | Bulk foraminifera | 7040±40 | 71±21 | 7423-7506 | 1 | 7471 |  | Risebrobakken et al. (2010) |
| 20 | PSh-5159N | Poz-12701 | 69.5 | Brachiopod | 7500±40 | 71±21 | 7843-7938 | 1 | 7891 |  | Risebrobakken et al. (2010) |
| 20 | PSh-5159N | Poz-19999 | 86.5 | Bulk foraminifera | 8550±50 | 71±21 | 9006-9165 | 1 | 9099 |  | Risebrobakken et al. (2010) |
| 20 | PSh-5159N | Poz-15132 | 99.5 | Mollusc fragments, benthic foraminifera, ostracode | 9700±50 | 71±21 | 10435-10586 | 1 | 10515 |  | Risebrobakken et al. (2010) |
| 20 | PSh-5159R | Poz-19991 | 122.5 | Mollusc | 10010±50 | 71±21 | 10804-11013 | 1 | 10908 |  | Chistyakova et al. (2010); Risebrobakken et al. (2010) |
| 20 | PSh-5159N | Poz-15133 | 133.5 | Mollusc fragments | 10290±50 | 250±50 | 10943-11144 | 1 | 11032 |  | Risebrobakken et al. (2010) |
| 20 | PSh-5159N | Poz-12629 | 148.5 | Astarte crenata | 10360±50 | 250±50 | 11039-11196 | 1 | 11109 |  | Risebrobakken et al. (2010) |
| 20 | PSh-5159R | Poz-16594 | 241 | Bulk benthic foraminifera | 12150±70 | 71±21 | 13873-1387713925-14139 | 0.0080.992 | 14023 |  | Chistyakova et al. (2010); Risebrobakken et al. (2010) |
| 20 | PSh-5159R | Poz-19992 | 333 | Bulk benthic foraminifera | 13550±70 | 250±50 | 15255-15558 | 1 | 15409 |  | Chistyakova et al. (2010); Risebrobakken et al. (2010) |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 19 | M23258 | KIA7648 | 25 | NPS | 1165±35 | 71±21 | 622-689 | 1 | 656 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA7649 | 51 | NPS | 2555±30 | 71±21 | 2071-2212 | 1 | 2145 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA7650 | 67 | NPS | 3500±35 | 71±21 | 3245-3355 | 1 | 3300 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA7651 | 93 | NPS | 4825±40 | 71±21 | 4889-5067 | 1 | 5002 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA11534 | 118 | NPD | 6140±70 | 71±21 | 6406-6581 | 1 | 6494 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA7653 | 154 | NPS | 7660±45 | 71±21 | 7986-8109 | 1 | 8048 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA7654 | 177 | NPS | 8380±45 | 71±21 | 8793-8966 | 1 | 8868 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA8553 | 192 | NPS | 8760±40 | 71±21 | 9308-9423 | 1 | 9364 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA11535 | 207 | NPD | 8955±55 | 71±21 | 9469-9592 | 1 | 9536 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA9193 | 241 | NPS | 9330±70 | 71±21 | 9958-99829993-10179 | 0.0910.909 | 10065 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA8554 | 249 | NPS | 9235±50 | 71±21 | 9868-10090 | 1 | 9955 | Not used | Sarnthein et al. (2003) |
| 19 | M23258 | KIA9354 | 250 | NPS | 9435±55 | 71±21 | 10142-10255 | 1 | 10203 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA7657 | 315 | NPS | 10980±70 | 200±50 | 11993-12351 | 1 | 12163 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA7659 | 355 | NPS | 12010±55 | 71±21 | 13370-13508 | 1 | 13444 |  | Sarnthein et al. (2003) |
| 19 | M23258 | KIA9354 | 394 | NPS | 12390±60 | 71±21 | 13702-13881 | 1 | 13790 |  | Sarnthein et al. (2003) |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 16 | MD95-2010 |  | 34.5 | Vedde ash - base |  |  |  |  | 12170 | Vedde | Dokken and Jansen (1999) |
| 16 | MD95-2010 | KIA6551 | 54.5 | NPS | 11415±55 | 100±50 | 12695-12860 | 1 | 12784 |  | [Dokken and Jansen (1999](#_ENREF_2)) |
| 16 | MD95-2010 | KIA6552 | 136.5 | NPS | 13250±60 | 250±100 | 14667-15174 | 1 | 14879 |  | [Dokken and Jansen (1999](#_ENREF_2)) |
| 16 | MD95-2010 | KIA6553 | 173.5 | NPS | 14750±110 | 250±100 | 16931-17394 | 1 | 17134 |  | [Dokken and Jansen (1999](#_ENREF_2)) |
| 16 | MD95-2010 | KIA6554 | 197.5 | NPS | 15620±70 | 250±100 | 18032-18341 | 1 | 18192 |  | [Dokken and Jansen (1999](#_ENREF_2)) |
| 16 | MD95-2010 | KIA6555 | 300.5 | NPS | 16990±110 | 7±100 | 19792-20197 | 1 | 19999 |  | [Dokken and Jansen (1999](#_ENREF_2)) |
| 16 | MD95-2010 | GifA96476 | 449.5 | NPS | 19830±130 | 7±100 | 23140-23595 | 1 | 23381 |  | [Dokken and Jansen (1999](#_ENREF_2)) |
| 16 | MD95-2010 | GifA96477 | 450.5 | NPS | 20030±110 | 7±100 | 23293-23743 | 1 | 23511 |  | [Dokken and Jansen (1999](#_ENREF_2)) |
| 16 | MD95-2010 | GifA96487 | 459.5 | NPS | 19930±120 | 7±100 | 23450-23846 | 1 | 23635 |  | [Dokken and Jansen (1999](#_ENREF_2)) |
| 16 | MD95-2010 | GifA96489 | 464.5 | NPS | 20340±120 | 7±100 | 23781-24175 | 1 | 23977 |  | [Dokken and Jansen (1999](#_ENREF_2)) |
| 16 | MD95-2010 |  | 484,5 | NPS | 20450±120 | 7±100 | 23916-24295 | 1 | 24101 |  | This study |
| 16 | MD95-2010 |  | 521,5 | NPS | 21590±190 | 7±100 | 25295-25737 | 1 | 25504 |  | This study |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 17/18 | JM97-948/2A | KIA 6285 | 21.75 | NPD | 735±40 | 7±11 | 316-418 | 1 | 371 |  | Risebrobakken et al. (2003) |
| 17/18 | JM97-948/2A | KIA 4800 | 30.75 | NPD | 940±40 | 7±11 | 493-565 | 1 | 536 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | Poz-8245 | 5 | NPD | 1020±100 | 7±11 | 516-661 | 1 | 595 | Not used | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | GifA96471 | 10.5 | NPD | 980±60 | 7±11 | 521-616 | 1 | 569 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | KIA 5600 | 24.5 | NPD | 1590±40 | 7±11 | 1089-1206 | 1 | 1146 | Not used | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | KIA 3925 | 30.5 | NPD | 1040±40 | 7±11 | 564-643 | 1 | 605 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | KIA 5601 | 47.5 | NPD | 1160±30 | 7±11 | 664-724 | 1 | 698 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | Poz-8244 | 55.5 | NPD | 1530±90 | 7±11 | 973-1171 | 1 | 1079 | Not used | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | KIA 3926 | 70.5 | NPD | 1460±50 | 7±11 | 935-1052 | 1 | 1003 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | KIA 6286 | 89.5 | NPD | 1590±30 | 7±11 | 1092-11921198-1200 | 0.9860.014 | 1148 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | Poz-8246 | 102 | NPD | 1790±60 | 7±11 | 1271-1387 | 1 | 1333 |  | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | KIA 3927 | 130.5 | NPD | 2350±40 | 7±11 | 1897-2016 | 1 | 1962 | Not used | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | KIA 6287 | 154 | NPD | 2335±25 | 7±11 | 1998-1982 | 1 | 1943 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | GifA96472 | 170.5 | NPD | 2620±60 | 7±11 | 2185-2353 | 1 | 2293 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | Poz-8242 | 225 | NPD | 3000±50 | 7±11 | 2719-2815 | 1 | 2769 |  | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | Poz-8241 | 250 | NPD | 3380±70 | 7±11 | 3149-3333 | 1 | 3232 |  | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | KIA 10011 | 269.5 | NPD | 3820±35 | 7±11 | 3703-3818 | 1 | 3760 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | Poz-8240 | 300 | NPD | 4080±70 | 7±11 | 3998-4216 | 1 | 4112 |  | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | KIA 463 | 320.5 | NPD | 4330±50 | 7±11 | 4388-4522 | 1 | 4456 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | Poz-8238 | 451 | NPD | 6420±160 | 7±11 | 6717-7103 | 1 | 6897 |  | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | KIA 464 | 520.5 | NPD | 7260±60 | 7±11 | 7651-7783 | 1 | 7717 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | Poz-8237 | 528.5 | NPD | 7690±110 | 7±11 | 8025-8265 | 1 | 8145 |  | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | Poz-8236 | 533.5 | NPD | 8530±160 | 7±11 | 8978-9374 | 1 | 9142 | Not used | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | Poz-8235 | 541.5 | NPD | 8280±140 | 7±11 | 8613-8986 | 1 | 8810 |  | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | Poz-8234 | 570.5 | NPD | 8700±90 | 7±11 | 9264-9461 | 1 | 9350 |  | Risebrobakken et al. (2011) |
| 17/18 | MD95-2011 | TUa-3315 | 703.5 | NPS | 10775±85 | 250±50 | 11475-1150611534-11962 | 0.0520.948 | 11725 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 |  | 709.5 | Tephra |  |  |  |  | 12170 | Vedde Ash | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | TUa-3316 | 730.5 | NPS | 11875±140 | 100±50 | 13104-13393 | 1 | 13242 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | KIA465 | 750.5 | NPS | 12220±90 | 7±11 | 13546-13779 | 1 | 13667 |  | Risebrobakken et al. (2003) |
| 17/18 | MD95-2011 | KIA3519 | 813.5 | NPS | 13450±90 | 250±100 | 15064-15528 | 1 | 15256 |  | Dreger (1999) |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 15 | MD99-2284 | KIA-10676 | 2.5 | NPS | 1690±30 | 7±11 | 1216-1281 | 1 | 1245 |  | Risebrobakken et al. (2011) |
| 15 | MD99-2284 | Poz-10150 | 19.5 | NPS | 3515±35 | 7±11 | 3350-3437 | 1 | 3394 |  | Risebrobakken et al. (2011) |
| 15 | MD99-2284 | Poz-10151 | 36.5 | NPS | 5295±35 | 7±11 | 5593-5678 | 1 | 5643 |  | Risebrobakken et al. (2011) |
| 15 | MD99-2284 | Poz-10157 | 53.5 | NPS | 7300±40 | 7±11 | 7696-7802 | 1 | 7753 |  | Risebrobakken et al. (2011) |
| 15 | MD99-2284 | Poz-33098 | 71.5 | NPS | 7940±70 | 7±11 | 8324-8468 | 1 | 8396 |  | Risebrobakken et al. (2011) |
| 15 | MD99-2284 | TUa-3301 | 100.5 | NPS | 8680±85 | 7±11 | 9248-9443 | 1 | 9332 |  | Bakke et al. (2009) |
| 15 | MD99-2284 | Poz-33098 | 165.5 | NPS | 9340±90 | 7±11 | 10024-10276 | 1 | 10162 |  |  |
| 15 | MD99-2284 |  | 185.5 | Tephra |  |  |  |  | 10350 | Saksurnavatn Ash | [Bakke et al. (2009](#_ENREF_1)) |
| 15 | MD99-2284 | TUa-3302 | 213.5 | NPS | 10050±95 | 7±11 | 10911-11159 | 1 | 11022 |  | [Bakke et al. (2009](#_ENREF_1)) |
| 15 | MD99-2284 | TUa-3304 | 249.5 | NPS | 10700±90 | 250±50 | 11350-11784 | 1 | 11592 |  | [Bakke et al. (2009](#_ENREF_1)) |
| 15 | MD99-2284 |  | 362.5 | Tephra |  |  |  |  | 12170 | Vedde Ash | [Bakke et al. (2009](#_ENREF_1)) |
| 15 | MD99-2284 | Poz-29526 | 423.5 | NPS | 11440±80 | 250±50 | 12603-12758 | 1 | 12689 |  | Risebrobakken et al. (2011) |
| 15 | MD99-2284 |  | 450.5 | NPS | 11960±90 | 7±11 | 13309-13488 | 1 | 13405 |  | This study |
| 15 | MD99-2284 |  | 472.5 | NPS | 12240±75 | 7±11 | 13581-13793 | 1 | 13689 |  | This study |
| 15 | MD99-2284 |  | 502.5 | NPS | 12600±130 | 7±11 | 13873-14301 | 1 | 14126 |  | This study |
| 15 | MD99-2284 |  | 542.5 | NPS | 12980±130 | 250±100 | 14071-14711 | 1 | 14420 |  | This study |
| 15 | MD99-2284 | Poz-10154 | 546.5 | NPS | 13080±60 | 250±100 | 14229-14790 | 1 | 14557 |  | This study |
| 15 | MD99-2284 |  | 600.5 | NPS | 13500±70 | 250±100 | 15151-15544 | 1 | 15341 |  | This study |
| 15 | MD99-2284 |  | 650.5 | NPS | 13550±100 | 250±100 | 15199-15634 | 1 | 15417 |  | This study |
| 15 | MD99-2284 | POZ-10155 | 687.5 | NPS | 13710±60 | 250±100 | 15416-15819 | 1 | 15632 |  | This study |
| 15 | MD99-2284 |  | 749.5 | NPS | 14320±115 | 250±100 | 16252-16729 | 1 | 16500 |  | This study |
| 15 | MD99-2284 |  | 788.5 | NPS | 15330±70 | 7±100 | 19990-18293 | 1 | 18142 |  | This study |
| 15 | MD99-2284 |  | 805.5 | NPS | 15550±190 | 7±100 | 18137-18621 | 1 | 18377 |  | This study |
| 15 | MD99-2284 |  | 819.5 | NPS | 15730±70 | 7±100 | 18459-18724 | 1 | 18583 |  | This study |
| 15 | MD99-2284 |  | 849.5 | NPS | 16110±120 | 7±100 | 18785-19132 | 1 | 18964 |  | This study |
| 15 | MD99-2284 |  | 900.5 | NPS | 17195±90 | 7±100 | 20078-20426 | 1 | 20250 |  | This study |
| 15 | MD99-2284 |  | 1000.5 | NPS | 19725±120 | 7±100 | 23047-23468 | 1 | 23260 |  | This study |
| 15 | MD99-2284 |  | 1100.5 | NPS | 21975±160 | 7±100 | 25692-26003 | 1 | 25845 |  | This study |

**References**

Aarnes, I., Bjune, A.E., Birks, H.H., Balascio, N.L., Bakke, J., Blaauw, M., 2012. Vegetation response to rapid climatic change during the last deglaciation 13,500-8,000 years ago on southwest Andøya, arctic Norway. *Vegetation History and Archaeobotany* 21, 17-35.

Bakke, J., Lie, Ø., Heegaard, E., Dokken, T., Haug, G.H., Birks, H.H., Dulski, P., Nilsen, T., 2009. Rapid oceanic and atmospheric changes during the Younger Dryas cold period. Nature Geoscience 2, 202-205.

Birks, H.H., Jones, V.J., Brooks, S.J., Birks, H.J.B., Telford, R.J., Juggins, S., Peglar, S.M., 2012. From cold to cool in northernmost Norway: Lateglacial and early Holocene multi-proxy environmental and climate reconstructions from Jansvatnet, Hammerfest. *Quaternary Science Reviews* 33, 100-120.

Birks, H.H., Aarnes, I., Bjune, A.E., Brooks, S.J., Bakke, J., Kühl, N., Birks, H.J.B., 2014. Late-glacial and early-Holocene climate variability reconstructed from multi-proxy records on Andøya, northern Norway. *Quaternary Science Reviews* 89, 108–122.

Bjune, A.E., Birks, H.J.B., Seppä, H., 2004. Holocene vegetation and climate history on a continental-oceanic transect in northern Fennoscandia based on pollen and plant macrofossils. *Boreas* 33, 211-223.

Bjune, A.E., 2005. Holocene vegetation history and tree-line changes on a north - south transect crossing major climate gradients in sothern Norway - evidence from pollen and plant macrofossils in lake sediments. *Review of Palaeobotany and Palynology* 123, 249-275.

Bjune, A.E., Bakke, J., Nesje, A., Birks, H.J.B., 2005. Holocene mean July temperature and winter precipitation in western Norway inferred from lake sediment proxies. *The Holocene* 15, 177-189.

Bjune, A.E., Birks, H.J.B., 2008. Holocene vegetation dynamics and inferred climate changes at Svanåvatnet, Mo i Rana, northern Norway. *Boreas* 37, 146-156.

Blaauw, M., 2010. Methods and code for ’classical’ age-914 modellingof radiocarbon sequences. *Quaternary Geochronoloy* 5, 512-518.

Chistyakova, N., Ivanova, E., Risebrobakken, B., Ovsepyan, E.A., Ovsepyan, Y.S., 2010. Reconstruction of Postglacial environments in the south - western Barents Sea based on foraminiferal assemblages. Oceanology 50, 573-581 DOI:510.1134/S0001437010040132 (English Translation).

Dokken, T.M., Jansen, E., 1999. Rapid changes in the mechanism of ocean convection during the last glacial period. Nature 401, 458-461.

Dreger, D., 1999. Decadal-to-centennial-scale sediment records of ice advance on the Barents shelf and meltwater discharge into the northeastern Norwegian Sea over the last 40 kyr, Institut für Geowissenschaften, der Mathematisch-Naturwissenchaftlichen-Fakultät. Christian-Albrechts-Universitât, Kiel, p. 71.

Eide, W., Birks, H.H., Bigelow, N.H., Peglar, S.M., Birks, H.J.B., 2006. Holocene forest development along the Setesdal valley, southern Norway, reconstructed from macrofossil and pollen evidence. *Vegetation History and Archaeobotany* 15, 65-85.

Ivanova, E.V., Ovsepyan, E.A., Risebrobakken, B., Vetrov, A.A., 2008. Downcore distribution of living calcareous foraminifera and stable isotopes in the western Barents Sea. Journal of Foraminiferal Research 38, 337-356.

Risebrobakken, B., Dokken, T., Smedsrud, L.H., Andersson, C., Jansen, E., Moros, M., Ivanova, E.V., 2011. Early Holoene temperature variability in the Nordic Seas: The role of oceanic heat advection versus changes in orbital forcing. Paleoceanography 26, PA4206, doi:4210.1029/2011PA002117.

Risebrobakken, B., Jansen, E., Andersson, C., Mjelde, E., Hevrøy, K., 2003. A high-resolution study of Holocene paleoclimatic and paleoceanographic changes in the Nordic Seas. Paleoceanography 18, 1017, doi:1010.1029/2002PA000764.

Risebrobakken, B., Moros, M., Ivanova, E., Chistyakova, N., Rosenberg, R., 2010. Climate and oceanographic variability in the SW Barents Sea during the Holocene. The Holocene 20, 609-621.

Sarnthein, M., van Kreveld, S., Erlenkauser, H., Grootes, P.M., Kucera, M., Pflaumann, U., Schulz, M., 2003. Centennial-to-millennial-scale periodicities of Holocene climate and sediment injections off the western Barents shelf, 75ºN. Boreas 32, 447-461.

Seppä, H., 1996. Post-glacial dynamics of vegetation and tree-lines in the north of Fennoscandia. *Fennia* 174, 1-96.

Seppä, H., 1998. Postglacial trends in palynological richness in the northern Fennoscandian tree-line area and their ecological interpretation. *The Holocene* 8, 43-53.

Seppä, H., Birks, H.H., Birks, H.J.B., 2002. Rapid climatic changes during the Greenland stadial 1 (Younger Dryas) to early holocene transition on the Norwegian Barents Sea coast. *Boreas* 31, 215-225.

Seppä, H., Bjune, A.E., Telford, R.J., Birks, H.J.B., Veski, S., 2009. Last nine-thousand years of temperature variability in Northern Europe. *Climates of the Past* 5, 523-535.