Supplement of

Reconstructing $\text{N}_2$-fixing cyanobacterial blooms in the Baltic Sea beyond observations using 6- and 7-methylheptadecane in sediments as specific biomarkers

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Table S1. Location of sediment trap, sediment cores, and monitoring stations.

| Station          | Lat. N   | Long. E   | Water depth (m) |
|------------------|----------|-----------|-----------------|
| Core MSM51/20    | 57°59.866| 19°52.845 | 198             |
| Core EMB1215/7   | 57°59.950| 19°52.950 | 197             |
| Core POS435/10   | 62°52.160| 19°02.550 | 214             |
| Sediment trap    | 57°18.300| 20°00.460 | 180             |
| 32               | 57°58.500| 20°31.999 |                |
| 34a              | 57°58.000| 21°33.000 |                |
| BMP J1           | 57°19.200| 20°03.000 |                |
| BY15             | 57°19.200| 20°03.000 |                |
| BY15 W           | 57°18.899| 19°54.600 |                |
| GB_12            | 57°11.640| 19°48.822 |                |
| GB_B13           | 57°26.652| 19°48.840 |                |
| GB_B14           | 57°11.658| 20°16.644 |                |
| TF0260           | 56°38.004| 19°34.998 |                |
| TF0270           | 57°51.900| 20°11.412 |                |
| TF0271           | 57°19.212| 20°03.018 |                |
| TF0271b          | 57°18.348| 20°04.650 |                |
| TF0272           | 57°04.002| 19°49.986 |                |
| TF0286           | 58°00.000| 19°54.000 |                |
Table S2. Core MSM51-2/20 age model based on an event stratigraphy.

| Depth (cm) | Age   | SR* (cm/yr) | Event                                |
|------------|-------|-------------|--------------------------------------|
| 0.00       | 2016  | 0.2         | Core recovery                        |
| 2.75       | 2003  | 0.2         | Major Baltic Sea Inflow              |
| 9.00       | 1994  | 0.7         | Major Baltic Sea Inflow              |
| 12.75      | 1986  | 0.5         | Tchernobyl accident                  |
| 16.90      | 1977  | 0.5         | Major Baltic Sea Inflow              |
| 22.00      | 1963  | 0.4         | start of atom weapons tests          |
| 25.00      | 1954  | 0.3         | maximum in atom weapons tests        |
| 31.00      | 1935  | 0.3         | start of PCB global production       |
| 35.00      | 1900  | 0.1         | rising use of Pb-containing petroleum|
| 44.00      | 1860  | 0.2         | linear extrapolation                 |

* Sedimentation Rate
Table S3. Trap sediment material, monitoring, and satellite data from the Eastern Gotland Basin.

| Date       | 7Me-C17:0 (µg/m²/day) | 6Me-C17:0 (µg/m²/day) | 6+7Me-C17:0 (µg/m²/day) | Aphanizomenon spp.* | Nodularia spp.* | Date       | Aphanizomenon spp. (mg/m³) | Nodularia spp. (mg/m³) | FCA |
|------------|------------------------|------------------------|--------------------------|---------------------|----------------|------------|--------------------------|------------------------|-----|
| 5/17/2010  | 29.9                   | 5.4                    | 35.3                     | 1                   | 5/6/2010       | 3.1        | --                       | --                     | 0.0 |
| 5/27/2010  | 7.0                    | 1.6                    | 8.7                      | 1                   | 5/17/2010      | 3.9        | --                       | 6/7/2010                | 0.0 |
| 6/21/2010  | --                     | --                     | --                       | --                  | 6/3/2010       | 16.3       | --                       | 6/12/2010               | 0.0 |
| 7/11/2010  | --                     | --                     | --                       | --                  | 7/1/2010       | 46.2       | 9.7                      | 6/17/2010               | 0.0 |
| 7/16/2010  | 104.9                  | 23.5                   | 128.4                    | 3                   | 7/22/2010      | 42.1       | 95.3                     | 6/22/2010               | 0.0 |
| 7/26/2010  | 2.9                    | 0.6                    | 3.4                      | 3                   | 8/19/2010      | 25.7       | 43.2                     | 6/27/2010               | 0.0 |
| 8/5/2010   | 7.8                    | 1.9                    | 9.7                      | 2                   | 9/16/2010      | 6.6        | --                       | 7/2/2010                | 0.2 |
| 8/15/2010  | 164.9                  | 33.3                   | 198.2                    | 2                   | 10/4/2010      | 36.0       | --                       | 7/7/2010                | 5.3 |
| 9/4/2010   | 43.4                   | 10.0                   | 53.4                     | 2                   | 11/11/2010     | 4.6        | --                       | 7/12/2010               | 38.4 |
| 9/24/2010  | --                     | --                     | --                       | 1                   | 11/16/2010     | 14.2       | --                       | 7/17/2010               | 21.5 |
| 10/4/2010  | 38.3                   | 9.7                    | 48.1                     | 3                   | 1/13/2011      | --         | --                       | 7/22/2010               | 21.4 |
| 10/24/2010 | --                     | --                     | --                       | 2                   | 2/7/2011       | 0.4        | --                       | 7/27/2010               | 15.8 |
| 11/25/2010 | --                     | --                     | --                       | --                  | 3/12/2011      | 0.1        | --                       | 8/1/2010                | 0.6 |
| 12/1/2010  | --                     | --                     | --                       | --                  | 3/26/2011      | --         | --                       | 8/6/2010                | 0.2 |
| 12/7/2010  | --                     | --                     | --                       | 1                   | 4/10/2011      | --         | --                       | 8/11/2010               | 0.0 |
| 12/13/2010 | --                     | --                     | --                       | 1                   | 5/14/2011      | 19.8       | --                       | 8/16/2010               | 0.6 |
| 12/25/2010 | --                     | --                     | --                       | 2                   | 8/21/2010      | 0.0        | --                       | 8/26/2010               | 0.0 |
| 1/9/2011   | --                     | --                     | --                       | 1                   | 8/30/2010      | 1.1        | --                       | 8/30/2010               | 0.0 |

* 1: present; 2: abundant; 3: highly abundant
Table S4. Data from core MSM51-2/20, monitoring stations (summer and annual means), and satellite imagery (summer) for the period 1983-2016.

| Year | 7Me-C\textsubscript{17:0} (µg/gTOC) | 6Me-C\textsubscript{17:0} (µg/gTOC) | 6+7Me-C\textsubscript{17:0} (µg/gTOC) | Aphanizomenon spp. (mg/m\textsuperscript{3}) | Nodularia spp. (mg/m\textsuperscript{3}) | Aphanizomenon spp. (mg/m\textsuperscript{3}) | Nodularia spp. (mg/m\textsuperscript{3}) | FCA |
|------|--------------------------------|--------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----|
| 2016 | --                           | 0.96                          | 1.19            | 33.6            | 121.6           | 15.0            | 24.4            | 14.3|
| 2015 | 0.96                         | 0.23                          | 1.19            | 120.5           | 66.0            | 51.6            | 17.1            | 19.2|
| 2014 | --                           | --                            | --              | 75.6            | 161.6           | 21.0            | 38.5            | 43.5|
| 2013 | --                           | --                            | --              | 266.0           | 37.1            | 97.3            | 10.3            | 6.0 |
| 2012 | 1.69                         | 0.29                          | 1.98            | 40.1            | 36.6            | 26.1            | 23.1            | 11.0|
| 2011 | --                           | --                            | --              | 66.8            | 89.0            | 25.3            | 28.0            | 18.6|
| 2010 | 1.05                         | 0.18                          | 1.22            | 36.3            | 57.3            | 15.0            | 16.0            | 11.0|
| 2009 | --                           | --                            | --              | 186.3           | 48.9            | 59.9            | 14.3            | 5.7 |
| 2008 | 1.06                         | 0.20                          | 1.26            | 85.8            | 149.1           | 46.3            | 41.5            | 47.2|
| 2007 | --                           | --                            | --              | 122.5           | 44.5            | 32.3            | 8.9             | 7.2 |
| 2006 | --                           | --                            | --              | 12.2            | 7.3             | 7.2             | 1.5             | 14.0|
| 2005 | 1.03                         | 0.23                          | 1.26            | 145.0           | 335.4           | 48.7            | 84.6            | 44.8|
| 2004 | --                           | --                            | --              | 73.2            | 256.8           | 33.6            | 77.5            | 9.7 |
| 2003 | 0.64                         | 0.12                          | 0.76            | 34.6            | 58.8            | 14.6            | 16.4            | 41.9|
| 2002 | 0.29                         | 0.05                          | 0.34            | 109.6           | 177.6           | 36.6            | 49.4            | 17.6|
| 2001 | 0.20                         | 0.05                          | 0.25            | 121.1           | 39.3            | 39.8            | 10.9            | 4.7 |
| 2000 | 0.46                         | 0.07                          | 0.52            | 25.2            | 113.6           | 12.3            | 28.4            | 25.7|
| 1999 | 1.34                         | 0.25                          | 1.58            | 56.5            | 192.8           | 28.4            | 48.3            | 37.3|
| 1998 | 0.63                         | 0.11                          | 0.74            | 52.0            | 41.4            | 26.4            | 10.7            | 7.7 |
| 1997 | 0.38                         | 0.07                          | 0.45            | 239.8           | 56.0            | 75.2            | 14.2            | 11.2|
| 1996 | 0.02                         | n.d                           | 0.02            | 47.1            | 69.7            | 39.4            | 27.8            | 3.1 |
| 1995 | 0.05                         | n.d                           | 0.05            | 104.1           | 60.8            | 39.5            | 14.3            | 5.1 |
| 1994 | 0.08                         | n.d                           | 0.08            | 319.1           | 228.4           | 97.7            | 65.3            | 24.4|
| 1993 | 0.22                         | n.d                           | 0.28            | 141.6           | 84.0            | 47.9            | 25.1            | 6.7 |
| 1992 | 0.40                         | 0.09                          | 0.50            | 69.3            | 2148.8          | 20.4            | 538.0           | 17.9|
| 1991 | 0.45                         | 0.11                          | 0.56            | 283.8           | 87.3            | 121.6           | 37.4            | 19.6|
| 1990 | 0.53                         | 0.12                          | 0.65            | --              | --              | --              | --              | 7.5 |
| 1989 | 1.12                         | 0.21                          | 1.33            | --              | --              | --              | 7.1             | 0.2 |
| 1988 | 1.23                         | 0.22                          | 1.44            | 70.5            | 19.5            | 6.9             | 0.0             | 3.3 |
| Year | Value1 | Value2 | Value3 | Value4 | Value5 | Value6 | Value7 | Value8 |
|------|--------|--------|--------|--------|--------|--------|--------|--------|
| 1987 | 1.44   | 0.29   | 1.73   | 24.4   | 19.1   | 6.2    | 24.3   | 0.3    |
| 1986 | 0.88   | 0.16   | 1.04   | 41.2   | 3097.9 | 12.0   | 886.2  | --     |
| 1985 | 0.99   | 0.18   | 1.18   | 105.3  | 203.3  | 45.2   | 110.5  | --     |
| 1984 | 0.13   | n.d.   | 0.13   | 46.3   | 16.3   | 17.5   | 5.4    | --     |
| 1983 | 0.15   | n.d.   | 0.15   | 117.0  | 0.0    | 45.7   | 0.0    | --     |
Table S5. Core MSM51-2/20 (7Me-C17:0, 6Me-C17:0, 6+7Me-C17:0, and TOC), AMO (Enfield et al., 2001), NAO (Hurrell, 1995; Jones et al., 1997), HadISST1 (Rayner et al., 2003), and annual riverine P input (Gustafsson et al., 2012) data since 1860.

| Depth (cm) | Year | 7Me-C17:0 (µg/gTOC) | 6Me-C17:0 (µg/gTOC) | 6+7Me-C17:0 (µg/gTOC) | TOC (%) | AMO winter (DJFM) | NAO summer (JJA) | HadISST1 (°C) | annual riverine P input (ktons) |
|-----------|------|---------------------|---------------------|-----------------------|---------|------------------|-----------------|---------------|-------------------------------|
| 0.25      | 2015 | 0.96                | 0.23                | 1.19                  | 15.9    | 0.10             | 8.16            | --            | --                            |
| 0.75      | 2012 | 1.69                | 0.29                | 1.98                  | 14.6    | 0.20             | 8.23            | --            | --                            |
| 1.25      | 2010 | 1.05                | 0.18                | 1.22                  | 15.2    | 0.34             | -10.15          | --            | --                            |
| 1.75      | 2008 | 1.06                | 0.20                | 1.26                  | 14.4    | 0.12             | 5.47            | 17.6          | --                            |
| 2.25      | 2005 | 1.03                | 0.23                | 1.26                  | 16.0    | 0.28             | -0.45           | 17.4          | 28.2                          |
| 2.75      | 2003 | 0.64                | 0.12                | 0.76                  | 14.6    | 0.22             | 1.59            | 18.0          | 24.5                          |
| 3.25      | 2002 | 0.29                | 0.05                | 0.34                  | 11.3    | 0.05             | 3.16            | 18.3          | 32.0                          |
| 3.75      | 2001 | 0.20                | 0.05                | 0.25                  | 10.9    | 0.10             | -2.00           | 18.0          | 35.1                          |
| 4.25      | 2000 | 0.46                | 0.07                | 0.52                  | 10.8    | 0.01             | 7.39            | 16.0          | 36.0                          |
| 4.75      | 1999 | 1.34                | 0.25                | 1.58                  | 10.6    | 0.10             | 3.93            | 18.0          | 37.4                          |
| 5.25      | 1998 | 0.63                | 0.11                | 0.74                  | 11.3    | 0.36             | 3.20            | 15.5          | 42.5                          |
| 6.00      | 1997 | 0.38                | 0.07                | 0.45                  | 10.6    | 0.04             | 0.70            | 18.6          | 34.6                          |
| 7.00      | 1996 | 0.02                | n.d                 | 0.02                  | 12.1    | -0.07            | -9.29           | 15.9          | 32.2                          |
| 8.00      | 1995 | 0.05                | n.d                 | 0.05                  | 12.5    | 0.12             | 9.75            | 16.4          | 40.3                          |
| 8.75      | 1994 | 0.08                | n.d                 | 0.08                  | 9.6     | -0.19            | 7.20            | 17.8          | 39.7                          |
| 9.25      | 1993 | 0.22                | 0.06                | 0.28                  | 9.2     | -0.23            | 5.70            | 15.4          | 33.5                          |
| 9.75      | 1992 | 0.40                | 0.09                | 0.50                  | 11.1    | -0.23            | 6.72            | 16.4          | 32.8                          |
| 10.25     | 1991 | 0.45                | 0.11                | 0.56                  | 11.7    | -0.15            | 0.82            | 16.8          | 32.9                          |
| 10.75     | 1990 | 0.53                | 0.12                | 0.65                  | 11.7    | -0.05            | 9.49            | 16.3          | 35.6                          |
| 11.25     | 1989 | 1.12                | 0.21                | 1.33                  | 9.9     | -0.10            | 11.44           | 16.6          | 34.9                          |
| 11.75     | 1988 | 1.23                | 0.22                | 1.44                  | 9.6     | -0.02            | 0.39            | 16.9          | 42.2                          |
| 12.25     | 1987 | 1.44                | 0.29                | 1.73                  | 9.8     | 0.05             | 1.35            | 13.5          | 42.2                          |
| Year | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 12.75| 0.88 | 0.16 | 1.04 | 10.8 | -0.29 | -0.13 | 15.9 | 38.8 |
| 13.25| 0.99 | 0.18 | 1.18 | 10.7 | -0.20 | -1.52 | 15.6 | 41.4 |
| 13.75| 0.13 | n.d. | 0.13 | 9.6  | -0.22 | 2.97  | 16.6 | 36.8 |
| 14.25| 0.15 | n.d. | 0.15 | 10.4 | -0.09 | 8.00  | 16.2 | 37.6 |
| 14.75| 0.13 | n.d. | 0.13 | 9.6  | -0.23 | 0.99  | 16.6 | 40.4 |
| 15.25| 0.08 | n.d. | 0.15 | 8.09 | -0.09 | 3.60  | 15.1 | 48.4 |
| 1860 | --   | --   | --   | --   | -0.03 | 0.29  | 16.1 | 45.2 |
| 15.75| 0.16 | n.d. | 0.16 | 7.6  | -0.13 | -5.38 | 15.4 | 40.0 |
| 16.25| 0.08 | n.d. | 0.08 | 8.3  | -0.19 | 1.32  | 15.1 | 38.4 |
| 16.75| 0.06 | n.d. | 0.06 | 8.09 | -0.20 | -4.38 | 14.8 | 38.7 |
| 17.25| 0.06 | n.d. | 0.06 | 8.7  | -0.38 | 2.34  | 15.8 | 25.5 |
| 18.25| 0.30 | 0.11 | 0.41 | 10.2 | -0.31 | 4.63  | 17.1 | 34.2 |
| 18.75| 0.47 | 0.07 | 0.54 | 8.5  | -0.37 | 0.30  | 17.0 | 27.2 |
| 19.25| 0.44 | n.d. | 0.38 | 8.2  | -0.32 | -2.56 | 15.2 | 28.9 |
| 19.75| 0.51 | 0.09 | 0.60 | 9.0  | -0.00 | -8.34 | 17.3 | 24.4 |
| 20.25| 0.18 | n.d. | 0.18 | 8.4  | -0.18 | -0.07 | 16.3 | 30.8 |
| 20.75| 0.10 | n.d. | 0.10 | 8.6  | -0.01 | 0.90  | 15.7 | 31.7 |
| 21.25| 0.20 | n.d. | 0.20 | 7.9  | -0.17 | -0.03 | 14.1 | 26.3 |
| 21.75| 0.21 | n.d. | 0.21 | 8.1  | -0.11 | -3.06 | 14.7 | 20.9 |
| 22.25| 0.14 | n.d. | 0.14 | 7.6  | -0.06 | -2.29 | 13.9 | 30.9 |
| 22.75| 0.60 | 0.14 | 0.74 | 9.8  | -0.09 | 8.06  | 15.1 | 24.3 |
| 23.25| 0.82 | 0.12 | 0.94 | 9.4  | -0.23 | -0.59 | 15.6 | 22.9 |
| 23.75| 0.26 | n.d. | 0.26 | 6.8  | 0.04  | 1.43  | 16.9 | 24.9 |
| 24.25| 0.31 | n.d. | 0.31 | 6.5  | 0.21  | -1.06 | 14.6 | 27.0 |
| 24.75| 0.20 | n.d. | 0.20 | 7.0  | 0.03  | 6.60  | 15.4 | 23.2 |
| 25.25| 0.11 | n.d. | 0.11 | 4.9  | 0.03  | 3.32  | 14.8 | 21.1 |
| 25.75| 1.00 | 0.24 | 1.24 | 3.0  | 0.18  | 4.84  | 16.4 | 20.7 |
| 1954 | --   | --   | --   | --   | 0.03  | 0.53  | 15.7 | 17.5 |
| Year | Annual Average | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 |
|------|----------------|------|------|------|------|------|------|------|
| 1921 |                |      |      |      |      |      |      |      |
| 1922 | 0.39           | n.d. |      |      |      |      |      |      |
| 1923 |                |      |      |      |      |      |      |      |
| 1924 |                |      |      |      |      |      |      |      |
| 1925 |                |      |      |      |      |      |      |      |
| 1926 |                |      |      |      |      |      |      |      |
| 1927 |                |      |      |      |      |      |      |      |
| 1928 |                |      |      |      |      |      |      |      |
| 1929 |                |      |      |      |      |      |      |      |
| 1930 |                |      |      |      |      |      |      |      |
| 1931 | 0.87           | 0.15 | 1.02 | 1.45 |      |      |      |      |
| 1932 |                |      |      |      |      |      |      |      |
| 1933 |                |      |      |      |      |      |      |      |
| 1934 |                |      |      |      |      |      |      |      |
| 1935 |                |      |      |      |      |      |      |      |
| 1936 |                |      |      |      |      |      |      |      |
| 1937 | 0.95           | 0.24 | 1.19 | 1.95 | 2.5  | 0.29 | 4.23 | 18.8 |
| 1938 |                |      |      |      |      |      |      |      |
| 1939 |                |      |      |      |      |      |      |      |
| 1940 | 0.71           | 0.17 | 0.88 | 3.0  | -0.03|      |      | 15.7 |
| 1941 |                |      |      |      |      |      |      |      |
| 1942 | 0.57           | 0.13 | 0.70 | 3.0  | 0.18 |      | -1.83| 14.9 |
| 1943 |                |      |      |      |      |      |      |      |
| 1944 | 0.52           | 0.10 | 0.62 | 3.1  | 0.34 | 0.83 |      | 16.1 |
| 1945 |                |      |      |      |      |      |      |      |
| 1946 |                |      |      |      |      |      |      |      |
| 1947 | 0.35           | n.d. |      |      |      |      |      |      |
| 1948 |                |      |      |      |      |      |      |      |
| 1949 | 0.41           | n.d. | 0.41 | 2.6  | 0.09 | 5.64 |      | 15.8 |
| 1950 |                |      |      |      |      |      |      |      |
| 1951 | 0.48           | n.d. | 0.48 | 3.3  | 0.20 |      | -2.14| 15.3 |
| 1952 |                |      |      |      |      |      |      |      |
| 1953 | 0.71           | 0.15 | 0.86 | 3.3  | 0.26 | 1.46 |      | 16.4 |
| 1954 |                |      |      |      |      |      |      |      |
| 1955 |                |      |      |      |      |      |      |      |
| 1956 |                |      |      |      |      |      |      |      |
| 1957 |                |      |      |      |      |      |      |      |
| 1958 |                |      |      |      |      |      |      |      |
| 1959 |                |      |      |      |      |      |      |      |
| 1960 |                |      |      |      |      |      |      |      |
| 1961 |                |      |      |      |      |      |      |      |
| 1962 |                |      |      |      |      |      |      |      |
| 1963 |                |      |      |      |      |      |      |      |
| 1964 |                |      |      |      |      |      |      |      |
| 1965 |                |      |      |      |      |      |      |      |
| 1966 |                |      |      |      |      |      |      |      |
| 1967 |                |      |      |      |      |      |      |      |
| 1968 |                |      |      |      |      |      |      |      |
| 1969 |                |      |      |      |      |      |      |      |
| 1970 |                |      |      |      |      |      |      |      |
| 1971 |                |      |      |      |      |      |      |      |
| 1972 | 0.39           | n.d. | 0.39 | 2.5  | -0.32| 5.56 |      | 15.6 |
| 1973 |                |      |      |      |      |      |      |      |
| 1974 |                |      |      |      |      |      |      |      |
| 1975 |                |      |      |      |      |      |      |      |
| 1976 |                |      |      |      |      |      |      |      |
| 1977 |                |      |      |      |      |      |      |      |
| 1978 |                |      |      |      |      |      |      |      |
| 1979 |                |      |      |      |      |      |      |      |
| 1980 |                |      |      |      |      |      |      |      |
| 1981 |                |      |      |      |      |      |      |      |
| 1982 |                |      |      |      |      |      |      |      |
| 1983 |                |      |      |      |      |      |      |      |
| 1984 |                |      |      |      |      |      |      |      |
| 1985 |                |      |      |      |      |      |      |      |
| 1986 |                |      |      |      |      |      |      |      |
| 1987 |                |      |      |      |      |      |      |      |
| 1988 |                |      |      |      |      |      |      |      |
| 1989 |                |      |      |      |      |      |      |      |
| 1990 |                |      |      |      |      |      |      |      |
| 1991 |                |      |      |      |      |      |      |      |
| 1992 |                |      |      |      |      |      |      |      |
| 1993 |                |      |      |      |      |      |      |      |
| 1994 |                |      |      |      |      |      |      |      |
| 1995 |                |      |      |      |      |      |      |      |
| 1996 |                |      |      |      |      |      |      |      |
| 1997 |                |      |      |      |      |      |      |      |
| 1998 |                |      |      |      |      |      |      |      |
| 1999 |                |      |      |      |      |      |      |      |
| 2000 |                |      |      |      |      |      |      |      |
| 2001 |                |      |      |      |      |      |      |      |
| 2002 |                |      |      |      |      |      |      |      |
| 2003 |                |      |      |      |      |      |      |      |
| 2004 |                |      |      |      |      |      |      |      |
| 2005 |                |      |      |      |      |      |      |      |
| 2006 |                |      |      |      |      |      |      |      |
| 2007 |                |      |      |      |      |      |      |      |
| 2008 |                |      |      |      |      |      |      |      |
| 2009 |                |      |      |      |      |      |      |      |
| 2010 |                |      |      |      |      |      |      |      |
| 2011 |                |      |      |      |      |      |      |      |
| 2012 |                |      |      |      |      |      |      |      |
| 2013 |                |      |      |      |      |      |      |      |
| 2014 |                |      |      |      |      |      |      |      |
| 2015 |                |      |      |      |      |      |      |      |
| 2016 |                |      |      |      |      |      |      |      |
| 2017 |                |      |      |      |      |      |      |      |
| 2018 |                |      |      |      |      |      |      |      |
| 2019 |                |      |      |      |      |      |      |      |
| 2020 |                |      |      |      |      |      |      |      |
| Year | Value1 | Value2 | Value3 | Value4 | Value5 | Value6 | Value7 | Value8 | Value9 | Value10 | Value11 | Value12 | Value13 | Value14 | Value15 |
|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|----------|----------|----------|----------|----------|
| 1920 | --     | --     | --     | --     | -0.34  | 10.17  | 15.7   | 11.7   |        |          |          |          |          |          |          |
| 1919 | --     | --     | --     | --     | -0.19  | 1.57   | 14.4   | 10.8   |        |          |          |          |          |          |          |
| 1918 | --     | --     | --     | --     | -0.26  | 0.96   | 15.7   | 10.9   |        |          |          |          |          |          |          |
| 1917 | --     | --     | --     | --     | -0.28  | -6.68  | 15.0   | 11.5   |        |          |          |          |          |          |          |
| 1916 | --     | --     | --     | --     | -0.08  | 1.36   | 14.6   | 11.4   |        |          |          |          |          |          |          |
| 1915 | --     | --     | --     | --     | 0.09   | 2.22   | 15.4   | 9.6    |        |          |          |          |          |          |          |
| 1914 | --     | --     | --     | --     | -0.29  | 5.98   | 18.2   | 9.9    |        |          |          |          |          |          |          |
| 1913 | 0.16   | n.d.   | 0.16   | 2.5    | -0.39  | 8.75   | 16.1   | 11.0   |        |          |          |          |          |          |          |
| 1912 | --     | --     | --     | --     | -0.23  | 4.16   | 16.9   | 11.1   |        |          |          |          |          |          |          |
| 1911 | --     | --     | --     | --     | -0.21  | 1.37   | 15.8   | 10.0   |        |          |          |          |          |          |          |
| 1910 | --     | --     | --     | --     | -0.25  | 6.49   | 15.2   | 10.5   |        |          |          |          |          |          |          |
| 1909 | --     | --     | --     | --     | -0.14  | 0.68   | 14.7   | 10.0   |        |          |          |          |          |          |          |
| 1908 | --     | --     | --     | --     | -0.13  | 4.54   | 15.8   | 9.8    |        |          |          |          |          |          |          |
| 1907 | --     | --     | --     | --     | -0.23  | 5.24   | 13.3   | 10.4   |        |          |          |          |          |          |          |
| 1906 | --     | --     | --     | --     | -0.07  | 5.50   | 15.9   | 10.8   |        |          |          |          |          |          |          |
| 1905 | --     | --     | --     | --     | -0.20  | 7.01   | 16.6   | 11.1   |        |          |          |          |          |          |          |
| 1904 | 0.09   | n.d.   | 0.09   | 2.4    | -0.35  | 1.66   | 13.9   | 11.6   |        |          |          |          |          |          |          |
| 1903 | --     | --     | --     | --     | -0.19  | 11.46  | 14.4   | 12.1   |        |          |          |          |          |          |          |
| 1902 | --     | --     | --     | --     | -0.10  | 0.87   | 14.2   | 10.2   |        |          |          |          |          |          |          |
| 1901 | --     | --     | --     | --     | 0.09   | 0.99   | 16.0   | 9.5    |        |          |          |          |          |          |          |
| 1900 | --     | --     | --     | --     | 0.10   | -4.97  | 15.6   | 9.2    |        |          |          |          |          |          |          |
| 1899 | --     | --     | --     | --     | 0.13   | 2.15   | 16.2   | 10.0   |        |          |          |          |          |          |          |
| 1898 | 0.04   | n.d.   | 0.04   | 2.4    | 0.08   | 2.89   | 15.1   | 9.4    |        |          |          |          |          |          |          |
| 1897 | --     | --     | --     | --     | 0.11   | 5.13   | 15.7   | 9.0    |        |          |          |          |          |          |          |
| 1896 | --     | --     | --     | --     | 0.11   | 3.51   | 16.9   | 9.2    |        |          |          |          |          |          |          |
| 1895 | --     | --     | --     | --     | -0.09  | -6.08  | 15.3   | 9.9    |        |          |          |          |          |          |          |
| 1894 | --     | --     | --     | --     | -0.24  | 8.33   | 15.6   | 9.2    |        |          |          |          |          |          |          |
| 1893 | 0.08   | n.d.   | 0.08   | 2.3    | 0.00   | -0.16  | 15.5   | 10.2   |        |          |          |          |          |          |          |
| 1892 | --     | --     | --     | --     | -0.09  | -1.65  | 15.0   | 10.1   |        |          |          |          |          |          |          |
| 1891 | --     | --     | --     | --     | 0.04   | -0.84  | 16.0   | 8.8    |        |          |          |          |          |          |          |
| 1890 | --     | --     | --     | --     | -0.14  | 5.75   | 15.3   | 8.7    |        |          |          |          |          |          |          |
| 1889 | 0.04   | n.d.   | 0.04   | 2.4    | 0.20   | 1.81   | 15.5   | 9.2    |        |          |          |          |          |          |          |
| 1888 | --     | --     | --     | --     | 0.20   | -5.16  | 14.0   | 10.7   |        |          |          |          |          |          |          |
| Year | Value | Unit | Value | Unit | Value | Unit |
|------|-------|------|-------|------|-------|------|
| 1887 | 0.12  | --   | 3.20  | --   | 15.1  | --   |
| 1886 | 0.13  | --   | 1.27  | --   | 15.8  | --   |
| 1885 | -0.02 | --   | 0.17  | --   | 15.8  | --   |
| 1884 | 0.04  | n.d. | 2.5   | -0.07 | 5.90  | 16.7 |
| 1883 | 0.02  | --   | 1.19  | --   | 15.9  | --   |
| 1882 | -0.02 | --   | 12.65 | --   | 16.7  | --   |
| 1881 | 0.05  | --   | 5.21  | --   | 14.8  | 9.3  |
| 1880 | 0.13  | n.d. | 0.12  | 2.5   | 2.98  | 15.8 |
| 1879 | 0.12  | --   | -0.03 | --   | 1.19  | 15.9 |
| 1878 | 0.46  | --   | 5.53  | --   | 15.7  | 8.9  |
| 1877 | 0.25  | --   | 2.77  | --   | 14.6  | 10.0 |
| 1876 | 0.09  | n.d. | 0.09  | 2.5   | -0.02 | 1.64 |
| 1875 | 0.04  | --   | 2.14  | --   | 15.5  | 8.5  |
| 1874 | 0.01  | --   | 7.11  | --   | 15.3  | 8.8  |
| 1873 | 0.05  | --   | 1.00  | --   | 15.6  | 8.9  |
| 1872 | 0.10  | --   | 0.22  | --   | 16.3  | 8.4  |
| 1871 | 0.12  | n.d. | 0.12  | 2.5   | 0.04  | 0.01 |
| 1870 | 0.03  | --   | -4.42 | --   | 15.5  | 7.9  |
| 1869 | 0.10  | --   | 7.25  | --   | 9.3   | --   |
| 1868 | 0.16  | --   | 7.80  | --   | 7.9   | --   |
| 1867 | 0.21  | n.d. | 0.21  | 2.4   | 0.15  | 0.57 |
| 1866 | 0.21  | --   | 3.23  | --   | 9.0   | --   |
| 1865 | 0.16  | --   | 2.07  | --   | 8.4   | --   |
| 1864 | 0.07  | --   | 2.15  | --   | 8.1   | --   |
| 1863 | -0.11 | --   | 9.02  | --   | 8.3   | --   |
| 1862 | -0.19 | --   | 3.86  | --   | 7.9   | --   |
| 1861 | 0.19  | --   | 0.16  | --   | 8.2   | --   |
| 1860 | 0.09  | --   | 1.63  | --   | 8.6   | --   |

n.d. = not detected
Table S6. Correlation coefficients ($r$) and p values (in italic). $r$ values are in bold for $p < 0.05$.

|          | AMO | winter NAO | summer HadISST | P input | $6+7\text{Me-C}_{17\,2}$ |
|----------|-----|------------|----------------|---------|---------------------------|
| AMO      |     | 0.03       | 0.00           | 0.01    | 0.01                      |
| winter NAO | -0.25 |          | 0.13           | 0.76    | 0.43                      |
| summer HadISST | 0.38 | 0.18       |               | 0.01    | 0.04                      |
| P input  | -0.30 | -0.04     | -0.30          |         | 0.47                      |
| $6+7\text{Me-C}_{17\,2}$ | 0.30 | 0.10       | 0.25           | -0.09   |                           |
### Table S7. Core POS435/10 data.

| Depth (cm) | Age (yr cal. BP) | 7Me-C\(_{17:0}\) (µg/gTOC) | 6Me-C\(_{17:0}\) (µg/gTOC) | 6+7Me-C\(_{17:0}\) (µg/gTOC) |
|------------|------------------|----------------------------|-----------------------------|-----------------------------|
| 0.25       | -61.8            | 0.90                       | 0.30                        | 1.18                        |
| 32.5       | -40.9            | 0.22                       | 0.04                        | 0.27                        |
| 58.5       | -0.6             | 1.10                       | 0.30                        | 1.41                        |
| 85         | 50.0             | 0.24                       | 0.03                        | 0.27                        |
| 115        | 130.1            | 0.50                       | 0.20                        | 0.69                        |
| 145        | 210.1            | 1.19                       | 0.19                        | 1.38                        |
| 175        | 290.2            | 0.70                       | 0.20                        | 0.92                        |
| 205        | 370.3            | 1.96                       | 0.35                        | 2.31                        |
| 260        | 533.5            | 0.64                       | 0.23                        | 0.87                        |
| 310        | 717.0            | 0.20                       | 0.04                        | 0.24                        |
| 340        | 827.1            | 0.28                       | 0.07                        | 0.36                        |
| 410        | 1083.9           | 0.48                       | 0.10                        | 0.58                        |
| 465        | 1285.7           | 1.05                       | 0.25                        | 1.30                        |
| 500        | 1414.2           | 0.30                       | 0.11                        | 0.41                        |
| 520        | 1515.3           | 0.18                       | 0.04                        | 0.20                        |
| 540        | 1617.2           | 1.00                       | 0.26                        | 1.26                        |
| 560        | 1719.0           | 0.66                       | 0.19                        | 0.86                        |
| 580        | 1820.9           | 1.17                       | 0.33                        | 1.50                        |
| 600        | 1922.7           | 0.17                       | 0.03                        | 0.18                        |
| 610        | 1977.4           | 0.40                       | 0.10                        | 0.49                        |
| 620        | 2053.1           | 0.23                       | 0.06                        | 0.25                        |
| 640        | 2204.7           | 1.57                       | 0.36                        | 1.93                        |
| 650        | 2280.5           | 1.87                       | 0.65                        | 2.52                        |
| 660        | 2466.8           | 2.60                       | 0.60                        | 3.20                        |
| 670        | 2642.3           | 1.82                       | 0.49                        | 2.30                        |
| 680        | 2817.8           | 0.20                       | 0.05                        | 0.28                        |
| 707        | 3291.6           | 0.13                       | 0.02                        | 0.15                        |
| 731        | 3733.3           | 0.12                       | 0.03                        | 0.14                        |
| 739        | 3884.0           | 0.13                       | 0.05                        | 0.25                        |
| 747        | 4034.7           | 0.69                       | 0.17                        | 0.86                        |
