Supplementary material

Increased aridity in southwestern Africa during the last-interglacial warmest periods

D.H. Urrego[1,2]*, M.F. Sánchez Goñi[1], A.-L. Daniau[3], S. Lechevrel[4], V. Hanquiez[4]

[1] Ecole Pratique des Hautes Etudes, Université Bordeaux, Centre National de la Recherche Scientifique (CNRS), Environnements et Paléoenvironnements Océaniques et Continentaux (EPOC), Unité Mixte de Recherche 5805, F-33400 Talence, France

[2] Université Bordeaux, Centre National de la Recherche Scientifique CNRS, de la Préhistoire à l'Actuel: Culture, Environnement, Anthropologie (PACEA), Unité Mixte de Recherche 5199, F-33400 Talence, France

[3] Centre National de la Recherche Scientifique CNRS, Université Bordeaux, Environnements et Paléoenvironnements Océaniques et Continentaux (EPOC), Unité Mixte de Recherche 5805, F-33400 Talence, France

[4] Université Bordeaux, Environnements et Paléoenvironnements Océaniques et Continentaux (EPOC), Unité Mixte de Recherche 5805, F-33400 Talence, France

*Corresponding author postal address: Avenue des Facultés B18, Université Bordeaux1, F-33405 Talence, France. e-mail: d.urrego@epoc.u-bordeaux1.fr. Ph. +33 (0)540 00 88 58. Fax +33 (0)556 84 08 48.

Supplementary Table 1. Description of surface samples collected in southwestern Africa and used to characterize the pollen spectra of four southwestern African biomes. Sample number and codes correspond to those of Fig. 1 and 2, and Supplementary Figures 2 and 3. Samples with low pollen concentration were not assigned a sample code and were not included in the analyses.

Sample number	Sample code	Latitude	Longitude	Biome	Sample type	Location
1	D1	-26.66	15.17	Desert	Sediment	Luderitz
2	D2	-26.61	16.08	Desert	Water	Namibia semi-desert
3	D3	-26.66	16.28	Desert	Water	Aus savanna
4	Nk4	-26.69	17.15	Nama-Karoo	Water	Buchholzbrunn
5	Nk5	-26.75	17.22	Nama-Karoo	Water	Konkiep
6	Nk6	-26.76	17.71	Nama-Karoo	Sediment	Bethanie
7	Nk7	-26.81	17.81	Nama-Karoo	Water	Seehein
8	Nk8	-26.59	18.14	Nama-Karoo	Sediment	Grunau 2
9	Nk9	-26.73	18.45	Nama-Karoo	Water	Grunau 3
10	Nk10	-26.88	18.57	Nama-Karoo	Sediment	Grunau 4

11	Nk11	-27.92	17.49	Nama-Karoo	Sediment	Fish river canyon
12	Nk12	-28.48	17.90	Nama-Karoo	Sediment	Noodower
13	Nk13	-28.50	17.87	Nama-Karoo	Water	Namibian border
14	Nk14	-28.74	17.61	Nama-Karoo	Sediment	Orange
15	Sk15	-29.21	17.78	Succulent-Karoo	Water	Namaqualand 23
16	-	-29.20	17.78	Succulent-Karoo	Sediment	Swart Doring
17	Sk17	-29.66	18.00	Succulent-Karoo	Moss	Goegab
18	Sk18	-30.82	18.12	Succulent-Karoo	Sediment	Olifant mouth
19	Sk19	-31.25	18.54	Succulent-Karoo	Moss	Namaqualand
20	-	-31.50	18.31	Succulent-Karoo	Water	Olifant river
21	Fy21	-32.19	18.96	Fynbos	Moss	Cederberg
22	Fy22	-32.23	18.85	Fynbos	Sediment	Typha swamp
23	Fy23	-32.39	18.95	Fynbos	Moss	Citrusdal
24	Fy24	-32.91	18.75	Fynbos	Moss	Piketberg 2
25	Fy25	-32.91	18.75	Fynbos	Moss	Piketberg 1
26	Fy26	-34.41	20.57	Fynbos	Sediment	De Hoop East
27	-	-34.49	20.39	Fynbos	Water	De Hoop reserve
28	Fy28	-34.45	20.40	Fynbos	Moss	De Hoop reserve
29	-	-34.30	20.31	Fynbos	Water	Bree river
30	Fy30	-34.45	20.73	Fynbos	Sediment	Klipdrift river
31	CF31	-34.02	23.90	Coastal forest	Moss	Tsitsikamma-Stormriver

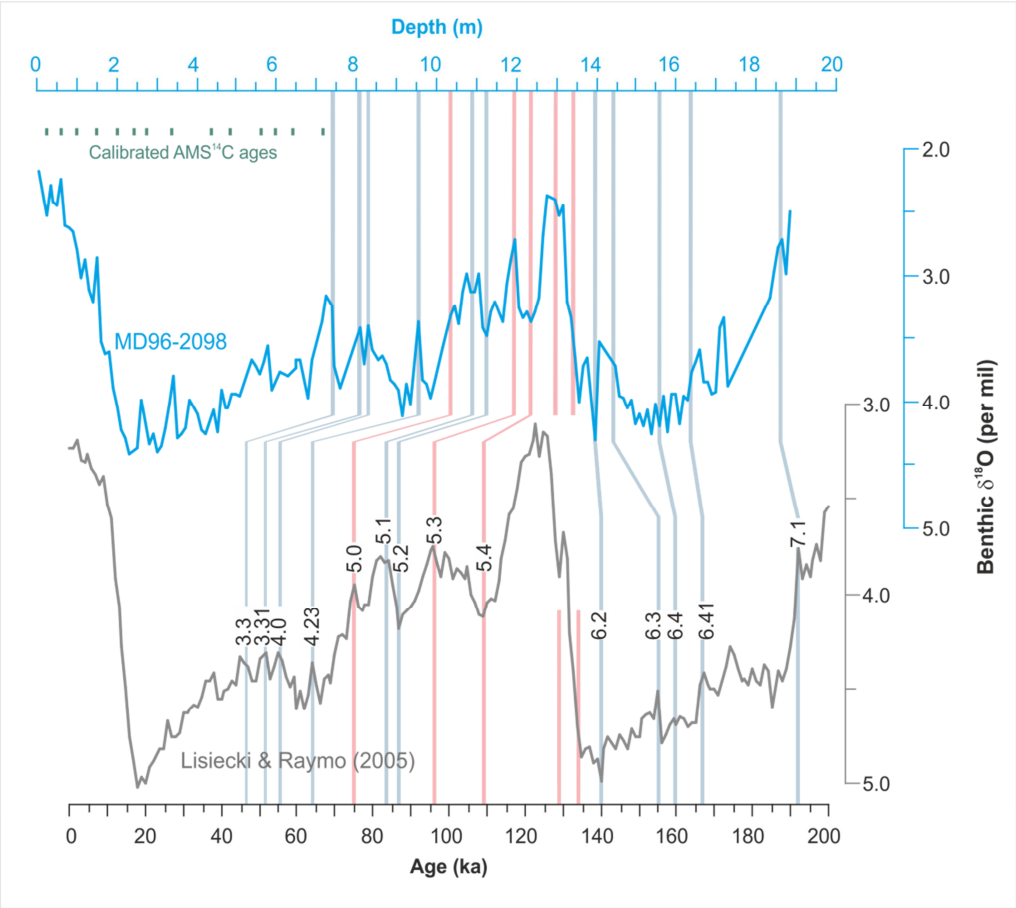
28

29

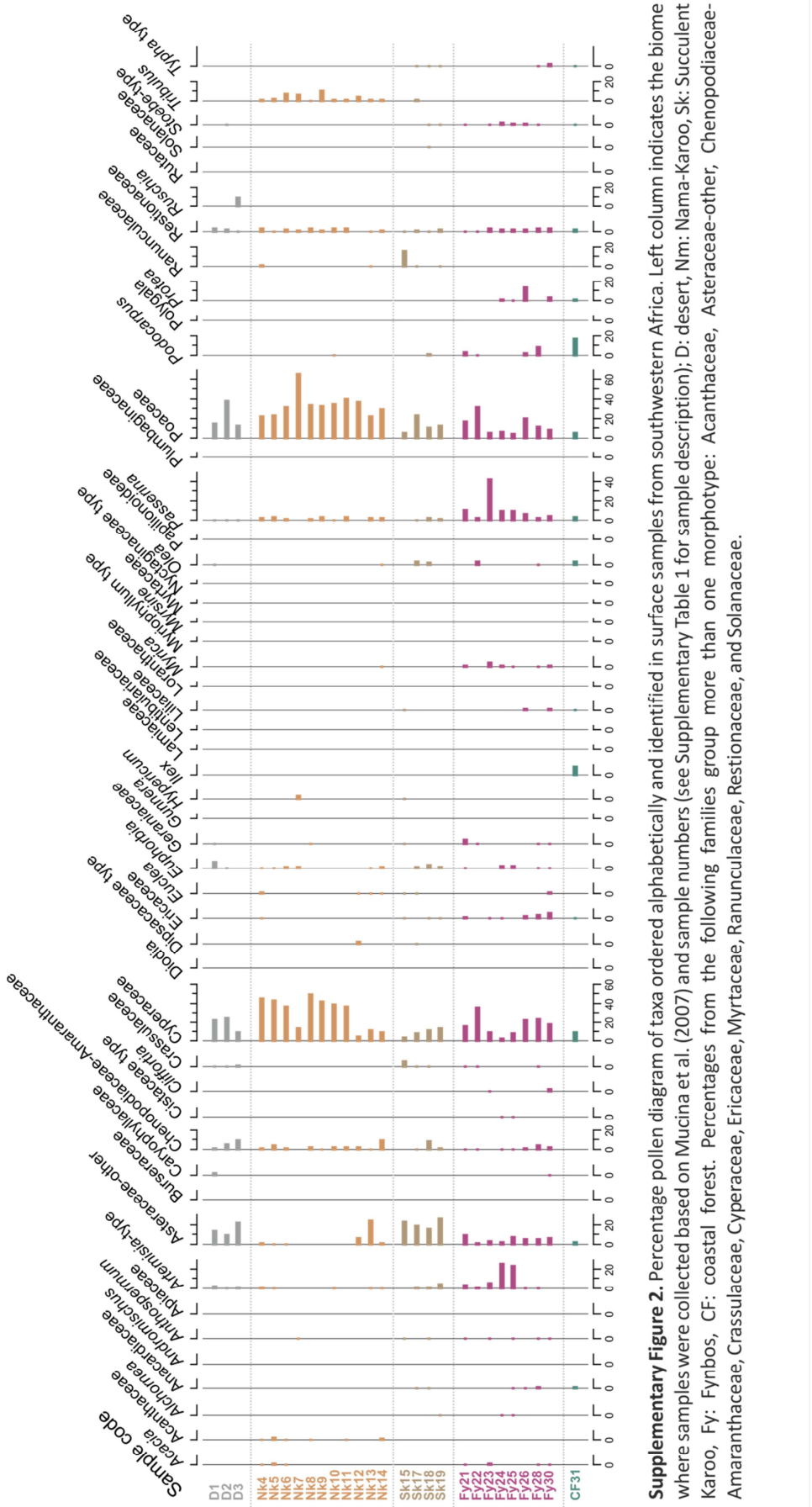
Supplementary Table 2. Chronological control for marine core MD96-2098 based on Accelerator Mass Spectrometer radiocarbon dates (AMS^{14}C) and marine isotope events (MIE) identified in the δ^{18}O record from benthic foraminifera *Cibicidoides wuellerstorfi* (Pichevin et al., 2005a;Pichevin et al., 2005b). Calibration details and sources for MIE ages are also shown.

Uncorrected depth (cm)	Corrected depth[1] (cm)	Sample code	AMS^{14}C age/MIE	95.4% (2s) cal age ranges[2]/calendar age (yr BP)	Calibration data[3]/ Source for MIE age
22.5	22.5	SacA 24476	2850±30	2310-2490	Hughen et al. (2004)
65	65	SacA 23251	6105±30	6280-6430	Hughen et al. (2004)
100	100	SacA 26970	8495±40	8750-9020	Hughen et al. (2004)
150	150	SacA 24477	10775±40	11,730-12,080	Hughen et al. (2004)
200	200	SacA 26971	13970±60	16,050-16,860	Hughen et al. (2004)
241	241	SacA 23252	15300±50	17,650-18,070	Hughen et al. (2004)
275	275	SacA 26972	15880±50	18,230-18,290	Hughen et al. (2004)
331	331	SacA 23253	18010±60	20,420-21,220	Hughen et al. (2004)
430.5	430.5	SacA 26973	19150±70	21,850-21,930	Hughen et al. (2004)
481	481	SacA 24478	24200±120	27,990-28,710	Hughen et al. (2004)
561	561	SacA 24479	28890±180	31,910-33,230	Hughen et al. (2004)
601	601	SacA 26974	31870±240	35,130-36,450	Hughen et al. (2004)
647	647	SacA 24480	30430±210*	33,960-34,990	Hughen et al. (2004)
719	704	SacA 23254	40010±520	42,740-44,410	Hughen et al. (2004)
740	725		3.3	46,000	Lisiecki and Raymo (2005)
970	807		3.31	51,000	Lisiecki and Raymo (2005)
1000	837		4	57,000	Lisiecki and Raymo (2005)
1120	957		4.23	64,000	Lisiecki and Raymo (2005)
1195	1032		MIS 5/4	73,500	Sanchez Goñi and Harrison (2010)
1250	1087		5.1	82,000	Lisiecki and Raymo (2005)
1280	1117		5.2	87,000	Lisiecki and Raymo (2005)
1360	1197		5.3	103,800	Drysdale et al. (2007)
1400	1237		5.4	110,400	Drysdale et al. (2007)
1460	1297		Onset of MIS 5	129,000	Masson-Delmotte et al. (2010), Waelbroeck et al. (2008)
1500	1337		MIS 6/5	135,000	Henderson and Slowey (2000)
1560	1397		6.2	140,000	Lisiecki and Raymo (2005)
1600	1437		6.3	155,000	Lisiecki and Raymo (2005)
1730	1567		6.4	160,000	Lisiecki and Raymo (2005)
1800	1637		6.41	166,000	Lisiecki and Raymo (2005)
2020	1857		7.1	192,000	Lisiecki and Raymo (2005)

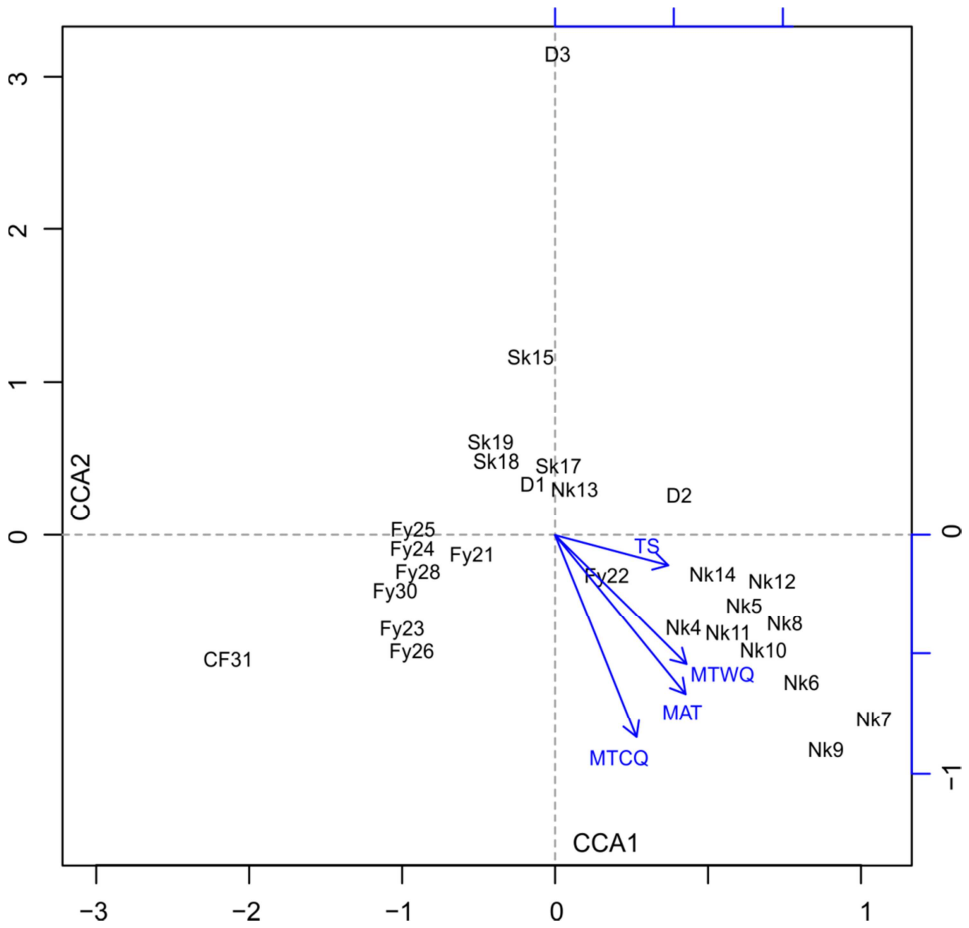
[1]Corrected depth for gaps reported in stratigraphic log; [2]rounded up to nearest 10 yr; [3]Marine09.14c curve, reservoir age correction = 157 (local delta R) + 400 (Global); *rejected age.



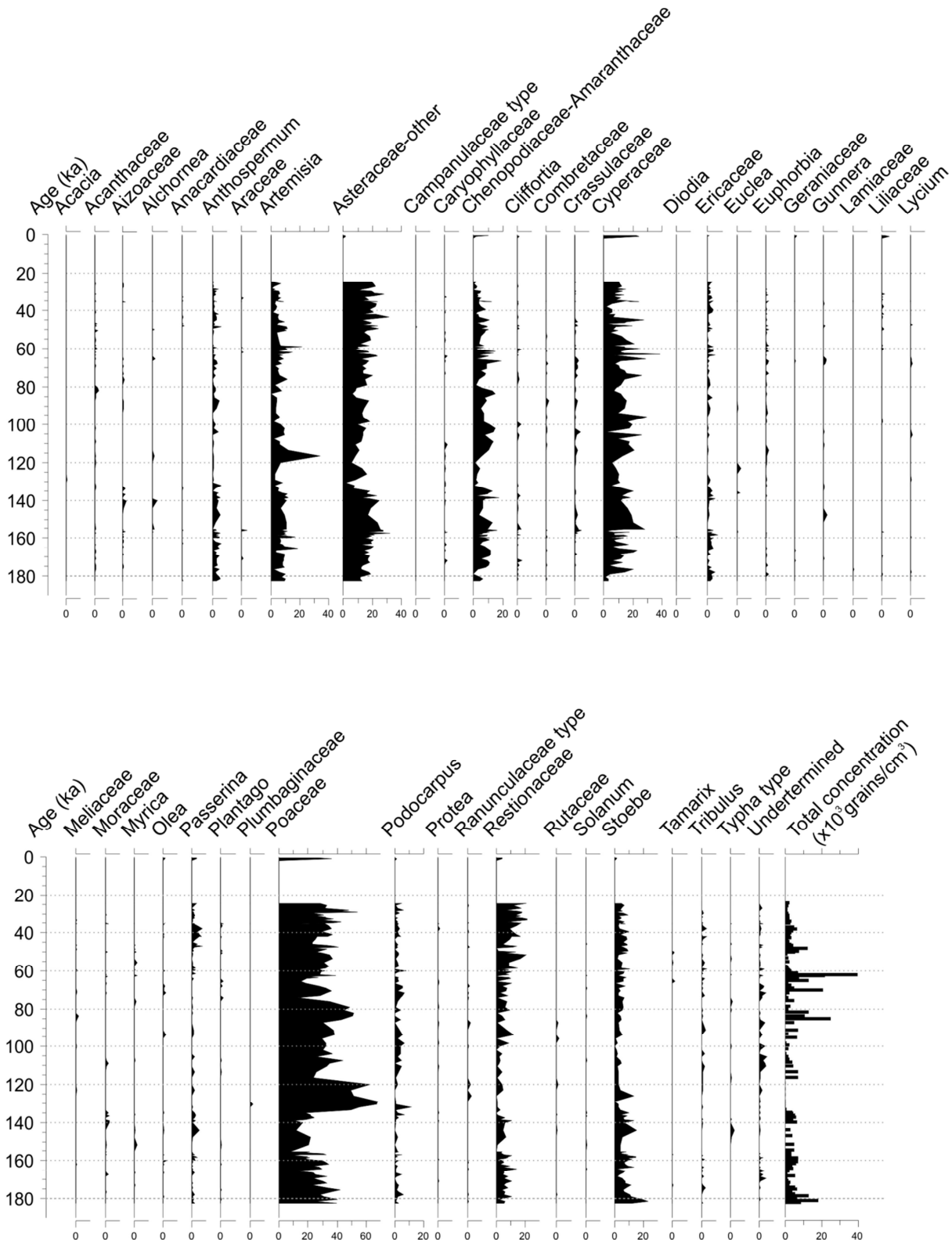
Supplementary Figure 1. Age control of core MD96-2098 based on 14 calibrated Accelerator Mass Spectrometer radiocarbon (AMS ^{14}C) ages (green dots) and 16 Marine Isotopic Events (MIE, grey and pink bars) from stable Oxygen profile of benthic foraminifera (Bertrand et al., 2002). Radiocarbon ages were calibrated using the Marine09.14c calibration (Stuiver and Reimer, 2005;Hughen et al., 2004), a delta R of 157 years, and global reservoir age of 400 years. Gray bands indicate MIE control points and ages derived from LR04 global stack (Lisiecki and Raymo, 2005). Pink bars indicate MIE ages derived from other chronologies: (Sanchez Goñi and Harrison, 2010), (Drysdale et al., 2007), (Masson-Delmotte et al., 2010;Waelbroeck et al., 2008), (Henderson and Slowey, 2000).



Supplementary Figure 2. Percentage pollen diagram of taxa ordered alphabetically and identified in surface samples from southwestern Africa. Left column indicates the biome where samples were collected based on Mucina et al. (2007) and sample numbers (see Supplementary Table 1 for sample description); D: desert, Nm: Nama-Karoo, Sk: Succulent Karoo, Fy: Fynbos, CF: coastal forest. Percentages from the following families group more than one morphotype: Acanthaceae, Asteraceae-other, Chenopodiaceae-Amaranthaceae, Crassulaceae, Cyperaceae, Ericaceae, Myrtaceae, Ranunculaceae, Restionaceae, and Solanaceae.



Supplementary Figure 3. Canonical correspondence analysis (CCA) summarizing changes in pollen spectra from surface samples and their temperature bioclimatic variables extracted for individual collection points from the WorldClim dataset (Hijmans et al., 2005). MTWQ: mean temperature of warmest quarter, MTCQ: mean temperature of coldest quarter, TS: temperature seasonality, MAT: mean annual temperature. Labels indicate sample numbers and biome where samples were collected: D: desert, Nk: Nama-Karoo, Sk: Succulent-Karoo, Fy: Fynbos, CF: coastal forest.



Supplementary Figure 4. Complete pollen record and total pollen concentrations from MD96-2098. Percentages from the following families group more than one morphotype: Acanthaceae, Aizoaceae, Anacardiaceae, Asteraceae-other, Chenopodiaceae-Amaranthaceae, Crassulaceae, Cyperaceae, Ericaceae, Liliacaee, and Restionaceae.

62 **References**

63 Archibald, S., Scholes, R. J., Roy, D. P., Roberts, G., and Boschetti, L.: Southern African fire regimes as
64 revealed by remote sensing, International Journal of Wildland Fire, 19, 861-878,
65 http://dx.doi.org/10.1071/WF10008, 2010.
66 Beal, L. M., and Bryden, H. L.: The velocity and vorticity structure of the Agulhas Current at 32°S,
67 Journal of Geophysical Research: Oceans, 104, 5151-5176, 10.1029/1998jc900056, 1999.
68 Beal, L. M., De Ruijter, W. P. M., Biastoch, A., and Zahn, R.: On the role of the Agulhas system in
69 ocean circulation and climate, Nature, 472, 429-436, 10.1038/nature09983, 2011.
70 Bereiter, B., Lüthi, D., Siegrist, M., Schüpbach, S., Stocker, T. F., and Fischer, H.: Mode change of
71 millennial CO2 variability during the last glacial cycle associated with a bipolar marine carbon
72 seesaw, Proceedings of the National Academy of Sciences, 109, 9755-9760,
73 10.1073/pnas.1204069109, 2012.
74 Bertrand, P., Balut, Y., Schneider, R., Chen, M. T., Rogers, J., and Shipboard Scientific Party: Scientific
75 report of the NAUSICAA-IMAGES II coring cruise. Les rapports de campagne à la mer à bord du
76 Marion-Dufresne, URA CNRS 197, Université Bordeaux1, Departement de Geologie et
77 Oceanographie, Talence, France, 382 pp, 1996.
78 Bertrand, P., Giraudeau, J., Malaize, B., Martinez, P., Gallinari, M., Pedersen, T. F., Pierre, C., and
79 Vénec-Peyré, M. T.: Occurrence of an exceptional carbonate dissolution episode during early
80 glacial isotope stage 6 in the Southeastern Atlantic, Marine Geology, 180, 235-248,
81 10.1016/s0025-3227(01)00216-x, 2002.
82 Bertrand, P., Pedersen, T. F., Schneider, R., Shimmield, G., Lallier-Verges, E., Disnar, J. R., Massias, D.,
83 Villanueva, J., Tribovillard, N., Huc, A. Y., Giraud, X., Pierre, C., and Vénec-Peyre, M.-T.: Organic-
84 rich sediments in ventilated deep-sea environments: Relationship to climate, sea level, and
85 trophic changes, Journal of Geophysical Research, 108, 3045, 10.1029/2000JC000327, 2003.

Chase, B. M., and Meadows, M. E.: Late Quaternary dynamics of southern Africa's winter rainfall zone, Earth-Science Reviews, 84, 103-138, http://dx.doi.org/10.1016/j.earscirev.2007.06.002, 2007.

Chen, M.-T., Chang, Y.-P., Chang, C.-C., Wang, L.-W., Wang, C.-H., and Yu, E.-F.: Late Quaternary sea-surface temperature variations in the southeast Atlantic: a planktic foraminifer faunal record of the past 600 000 yr (IMAGES II MD962085), Marine Geology, 180, 163-181, 10.1016/s0025-3227(01)00212-2, 2002.

Cowling, R. M., Esler, K. J., Midgley, G. F., and Honig, M. A.: Plant functional diversity, species diversity and climate in arid and semi-arid southern Africa, Journal of Arid Environments, 27, 141-158, 1994.

Cowling, R. M., Richardson, D. M., and Mustart, P. J.: Fynbos, in: Vegetation of Southern Africa, edited by: Cowling, R. M., Richardson, D. M., and Pierce, S. M., Cambridge University Press, Cambridge, UK, 99-130, 1997a.

Cowling, R. M., and Hilton-Taylor, C.: Phytogeography, flora and endemism, in: The Karoo. Ecological Patterns and Processes, edited by: Dean, W. R. J., and Milton, S., Cambridge University Press, Cambridge, UK, 42-56, 2009.

Daniau, A.-L., Sánchez Goñi, M. F., Martinez, P., Urrego, D. H., Bout-Roumazeilles, V., Desprat, S., and Marlon, J. R.: Orbital-scale climate forcing of grassland burning in southern Africa, Proceedings of the National Academy of Sciences, 10.1073/pnas.1214292110, 2013.

Dewar, G., Reimer, P. J., Sealy, J., and Woodborne, S.: Late-Holocene marine radiocarbon reservoir correction (ΔR) for the west coast of South Africa, The Holocene, 10.1177/0959683612449755, 2012.

Drysdale, R. N., Zanchetta, G., Hellstrom, J. C., Fallick, A. E., McDonald, J., and Cartwright, I.: Stalagmite evidence for the precise timing of North Atlantic cold events during the early last glacial, Geology, 35, 77-80, 2007.

Dupont, L.: Orbital scale vegetation change in Africa, Quaternary Science Reviews, 30, 3589-3602, 10.1016/j.quascirev.2011.09.019, 2011.

Dupont, L. M., and Wyputta, U.: Reconstructing pathways of aeolian pollen transport to the marine sediments along the coastline of SW Africa, Quaternary Science Reviews, 22, 157-174, 2003.

Dupont, L. M., Behling, H., Jahns, S., Marret, F., and Kim, J.-H.: Variability in glacial and Holocene marine pollen records offshore from west southern Africa, Vegetation History and Archaeobotany, 16, 87-100, 10.1007/s00334-006-0080-8, 2007.

Dupont, L. M., Caley, T., Kim, J. H., Castañeda, I., Malaizé, B., and Giraudeau, J.: Glacial-interglacial vegetation dynamics in South Eastern Africa coupled to sea surface temperature variations in the Western Indian Ocean, Climate of the Past, 7, 1209-1224, 10.5194/cp-7-1209-2011, 2010.

EPICA: One-to-one coupling of glacial climate variability in Greenland and Antarctica, Nature, 444, 195-198, 10.1038/nature05301, 2006.

Faegri, K., and Iversen, J.: Textbook of Pollen Analysis, 4th ed., Wiley, Chichester, 328 pp., 1989.

Gajewski, K., Lézine, A.-M., Vincens, A., Delestan, A., and Sawada, M.: Modern climate–vegetation–pollen relations in Africa and adjacent areas, Quaternary Science Reviews, 21, 1611-1631, 10.1016/s0277-3791(01)00152-4, 2002.

Giorgi, F.: Climate change hot-spots, Geophys. Res. Lett., 33, L08707, 10.1029/2006gl025734, 2006.

Henderson, G. M., and Slowey, N. C.: Evidence from U-Th dating against Northern Hemisphere forcing of the penultimate deglaciation, Nature, 404, 61-66, 10.1038/35003541, 2000.

Henshilwood, C. S., and Dubreuil, B.: The Still Bay and Howiesons Poort, 77–59 ka: Symbolic Material Culture and the Evolution of the Mind during the African Middle Stone Age, Current Anthropology, 52, 361-400, 10.1086/660022, 2011.

Heusser, L., and Balsam, W. L.: Pollen distribution in the northeast Pacific Ocean, Quaternary Research, 7, 45-62, 10.1016/0033-5894(77)90013-8, 1977.

Hijmans, R. J., Cameron, S. E., Parra, J. L., Jones, P. G., and Jarvis, A.: Very high resolution interpolated climate surfaces for global land areas, International Journal of Climatology, 25, 1965-1978, 2005.

Honig, M. A., Linder, H. P., and Bond, W. J.: Efficacy of Wind Pollination: Pollen Load Size and Natural Microgametophyte Populations in Wind-Pollinated Staberoha banksii (Restionaceae), American Journal of Botany, 79, 443-448, 1992.

Hooghiemstra, H., Agwu, C. O. C., and Beug, H.-J.: Pollen and spore distribution in recent marine sediemnts: a record of NW-African seasonal wind patterns and vegetation belts., Meteor Forschungs-Ergebnisse C, 40, 1986.

Hughen, K., Baillie, M., Bard, E., Bayliss, A., Beck, J., Bertrand, C., Blackwell, P., Buck, C., Burr, G., Cutler, K., Damon, P., Edwards, R., Fairbanks, R., Friedrich, M., Guilderson, T., Kromer, B., McCormac, F., Manning, S., Ramsey, C. B., Reimer, P., Reimer, R., Remmele, S., Southon, J., Stuiver, M., Talamo, S., Taylor, F., Plicht, J. v. d., and Weyhenmeyer, C.: Marine04 Marine radiocarbon age calibration, 26 - 0 ka BP, Radiocarbon, 46, 1059-1086, 2004.

Imhoff, M. L., Bounoua, L., Ricketts, T., Loucks, C., Harriss, R., and Lawrence, W. T.: Global patterns in human consumption of net primary production, Nature, 429, 870-873, 2004.

Jurgens, N., Burke, A., Seely, M. K., and Jacobson, K. M.: Desert, in: Vegetation of Southern Africa, edited by: Cowling, R. M., Richardson, D. M., and Pierce, S. M., Cambridge Unversity Press, Cambridge, 189-214, 1997.

Kirst, G. J., Schneider, R. R., Müller, P. J., von Storch, I., and Wefer, G.: Late Quaternary Temperature Variability in the Benguela Current System Derived from Alkenones, Quaternary Research, 52, 92-103, 10.1006/qres.1999.2040, 1999.

Laskar, J.: The chaotic motion of the solar system: A numerical estimate of the chaotic zones, Icarus, 88, 266-291, 1990.

159 Laskar, J., Robutel, P., Joutel, F., Gastineau, M., Correia, A. C. M., and Levrard, B.: A long-term
160 numerical solution for the insolation quantities of the Earth Astronomy & Astrophysics, 428,
161 261-285, 10.1051/0004-6361:20041335, 2004.
162 Lisiecki, L. E., and Raymo, M. E.: A Pliocene-Pleistocene stack of 57 globally distributed benthic d18O
163 records, Paleoceanography, 20, PA1003, 10.1029/2004pa001071, 2005.
164 Lutjeharms, J. R. E., and Meeuwis, J. M.: The extent and variability of South-East Atlantic upwelling,
165 South African Journal of Marine Science, 5, 51-62, 10.2989/025776187784522621, 1987.
166 Masson-Delmotte, V., Stenni, B., Pol, K., Braconnot, P., Cattani, O., Falourd, S., Kageyama, M., Jouzel,
167 J., Landais, A., Minster, B., Barnola, J. M., Chappellaz, J., Krinner, G., Johnsen, S., Rˆthlisberger,
168 R., Hansen, J., Mikolajewicz, U., and Otto-Bliesner, B.: EPICA Dome C record of glacial and
169 interglacial intensities, Quaternary Science Reviews, 29, 113-128, 2010.
170 McCune, B., and Grace, J. B.: Analysis of Ecological Communities, MjM, Gleneden Beach, Oregon,
171 300 pp., 2002.
172 Meadows, M. E., Chase, B. M., and Seliane, M.: Holocene palaeoenvironments of the Cederberg and
173 Swartruggens mountains, Western Cape, South Africa: Pollen and stable isotope evidence from
174 hyrax dung middens, Journal of Arid Environments, 74, 786-793,
175 http://dx.doi.org/10.1016/j.jaridenv.2009.04.020, 2010.
176 Milton, S. J., Yeaton, R. I., Dean, W. R. J., and Vlok, J. H. J.: Succulent karoo, in: Vegetation of
177 Southern Africa, edited by: Cowling, R. M., Richardson, D. M., and Pierce, S. M., Cambridge
178 Unversity Press, Cambridge, 131-166, 1997.
179 Mucina, L., Rutherford, M. C., and Powrie, L. W.: Vegetation Map of South Africa, Lesotho and
180 Swaziland, 2nd ed., South African National Biodiversity Institute Pretoria, 2007.
181 Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A., and Kent, J.: Biodiversity
182 hotspots for conservation priorities, Nature, 403, 853-858, 2000.

O'Connor, T. G., and Bredenkamp, G. J.: Grassland, in: Vegetation of Southern Africa, edited by: Cowling, R. M., Richardson, D. M., and Pierce, S. M., Cambridge University Press, Cambridge, UK, 215-257, 1997.

Palmer, A. R., and Hoffman, M. T.: Nama-Karoo, in: Vegetation of Southern Africa, edited by: Cowling, R. M., Richardson, D. M., and Pierce, S. M., Cambridge Unversity Press, Cambridge, 167-188, 1997.

Partridge, T. C., Demenocal, P. B., Lorentz, S. A., Paiker, M. J., and Vogel, J. C.: Orbital forcing of climate over South Africa: A 200,000-year rainfall record from the pretoria saltpan, Quaternary Science Reviews, 16, 1125-1133, http://dx.doi.org/10.1016/S0277-3791(97)00005-X, 1997.

Peeters, F. J. C., Acheson, R., Brummer, G.-J. A., de Ruijter, W. P. M., Schneider, R. R., Ganssen, G. M., Ufkes, E., and Kroon, D.: Vigorous exchange between the Indian and Atlantic oceans at the end of the past five glacial periods, Nature, 430, 661-665, 10.1038/nature02785, 2004.

Petit, J. R., Jouzel, J., Raynaud, D., Barkov, N. I., Barnola, J.-M., Basile, I., Bender, M., and Chappellaz, J.: Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica, Nature, 399, 429-436, 1999.

Pichevin, L., Cremer, M., Giraudeau, J., and Bertrand, P.: A 190 ky record of lithogenic grain-size on the Namibian slope: Forging a tight link between past wind-strength and coastal upwelling dynamics, Marine Geology, 218, 81-96, 10.1016/j.margeo.2005.04.003, 2005a.

Pichevin, L., Martinez, P., Bertrand, P., Schneider, R., Giraudeau, J., and Emeis, K.: Nitrogen cycling on the Namibian shelf and slope over the last two climatic cycles: Local and global forcings, Paleoceanography, 20, PA2006, 10.1029/2004pa001001, 2005b.

Rogers, J., and Rau, A. J.: Surficial sediments of the wave-dominated Orange River Delta and the adjacent continental margin off south-western Africa, African Journal of Marine Science, 28, 511-524, 10.2989/18142320609504202, 2006.

Ruddiman, W. F.: Orbital changes and climate, Quaternary Science Reviews, 25, 3092-3112, 2006.

208 Rutherford, M. C.: Categorization of biomes, in: Vegetation of Southern Africa, edited by: Cowling, R.
209 M., Richardson, D. M., and Pierce, S. M., Cambridge University Press, Cambridge, UK, 1997.
210 Sanchez Goñi, M. F., and Harrison, S. P.: Millennial-scale climate variability and vegetation changes
211 during the Last Glacial: Concepts and terminology, Quaternary Science Reviews, 29, 2823-2827,
212 2010.
213 Scholes, R. J.: Savanna, in: Vegetation of Southern Africa, edited by: Cowling, R. M., Richardson, D.
214 M., and Pierce, S. M., Cambridge University Press, Cambridge, UK, 258-277, 1997.
215 Scott, L.: Late Quaternary fossil pollen grains from the Transvaal, South Africa, Review of
216 Palaeobotany and Palynology, 36, 241-268, 1982.
217 Scott, L., Marais, E., and Brook, G. A.: Fossil hyrax dung and evidence of Late Pleistocene and
218 Holocene vegetation types in the Namib Desert, Journal of Quaternary Science, 19, 829-832,
219 10.1002/jqs.870, 2004.
220 Scott, L., Neumann, F. H., Brook, G. A., Bousman, C. B., Norström, E., and Metwally, A. A.: Terrestrial
221 fossil-pollen evidence of climate change during the last 26 thousand years in Southern Africa,
222 Quaternary Science Reviews, 32, 100-118, http://dx.doi.org/10.1016/j.quascirev.2011.11.010,
223 2012.
224 Shi, N., Dupont, L. M., Beug, H.-J., and Schneider, R.: Correlation between Vegetation in
225 Southwestern Africa and Oceanic Upwelling in the Past 21,000 Years, Quaternary Research, 54,
226 72-80, 10.1006/qres.2000.2145, 2000.
227 Shi, N., Schneider, R., Beug, H.-J., and Dupont, L. M.: Southeast trade wind variations during the last
228 135 kyr: evidence from pollen spectra in eastern South Atlantic sediments, Earth and Planetary
229 Science Letters, 187, 311-321, 10.1016/s0012-821x(01)00267-9, 2001.
230 Southon, J., Kashgarian, M., Fontugne, M., Metivier, B., and Yim, W. W.-S.: Marine reservoir
231 corrections for the Indian Ocean and Southeast Asia, Radiocarbon 44, 167-180, 2002.
232 Stuiver, M., and Reimer, P. J.: Extended 14C database and revised CALIB radiocarbon calibration
233 program, Radiocarbon, 35, 215-230, 1993.

Stuut, J.-B. W., Prins, M. A., Schneider, R. R., Weltje, G. J., Jansen, J. H. F., and Postma, G.: A 300-kyr record of aridity and wind strength in southwestern Africa: inferences from grain-size distributions of sediments on Walvis Ridge, SE Atlantic, Marine Geology, 180, 221-233, 10.1016/s0025-3227(01)00215-8, 2002.

Stuut, J.-B. W., and Lamy, F.: Climate variability at the southern boundaries of the Namib (southwestern Africa) and Atacama (northern Chile) coastal deserts during the last 120,000 yr, Quaternary Research, 62, 301-309, http://dx.doi.org/10.1016/j.yqres.2004.08.001, 2004.

Toggweiler, J. R., and Russell, J.: Ocean circulation in a warming climate, Nature, 451, 286-288, 2008.

Tyson, P. D.: Atmospheric circulatiosn changes and palaeoclimates of southern Africa, South African Journal of Science, 95, 194-201, 1999.

Tyson, P. D., and Preston-Whyte, R. A.: The weather and climate of southern Africa, Oxford University Press Southern Africa, Cape Town, 396 pp., 2000.

Waelbroeck, C., Frank, N., Jouzel, J., Parrenin, F., Masson-Delmotte, V., and Genty, D.: Transferring radiometric dating of the last interglacial sea level high stand to marine and ice core records, Earth and Planetary Science Letters, 265, 183-194, 2008.

White, F.: The vegetation of Africa: a descriptive memoir to accompany the Unesco/AETFAT/UNSO vegetation map of Africa, Paris, 356, 1983.