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Changes in Holocene meridional circulation and poleward Atlantic flow: the Bay of Biscay as a nodal point

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1. *Planktonic foraminifera assemblages*

Planktonic foraminifera assemblages from core PP10-07 (unpublished) were determined after counts (minimum of 300 specimens) in the > 150 µm fraction. Species identification follows Hemleben et al. (1989) and Kennett and Srinivasan (1983). Foraminiferal assemblages are here described by the relative percentages of each species, calculated relative to the total sum of planktonic foraminifera (Figure S1).

ORBU	*O. universa*
CONG	*G. conglobatus*
RUBR	*G. ruber rosea*
RUBA	*G. ruber alba*
TENE	*G. tenellus*
SACC	*G. sacculiferus*
DEHI	*S. dehiscens*
ADAM	*H. adamsi*
HAST	*H. aequilateralis*
CALI	*G. calida*
BULL	*G. bulloides*
FALC	*G. falconensis*
DIGI	*G. digitata*
RUBS	*G. rubescens*
HUMI	*T. humilis*
QUIN	*G. quinquloba*
PCHS	*N. pachyderma senestre*
PCHD	*N. pachyderma dextre*
DUTE	*N. dutertrei*
HEXA	*T. hexagona*
PULL	*P. obliquiloculata*
INFL	*G. inflata*
TRUS	*G. truncatulinoides senestre*
TRUD	*G. truncatulinoides dextre*
CRAS	*G. crassaformis*
HIRS	*G. hirsuta*
SCIT	*G. scitula*
MENA	*G. menardii*
TUMI	*G. tumida*
NITI	*C. nitida*
GLUT	*G. glutinata*
THEY	*G. theyeri*
UVUL	*G. uvula*
OTHER (not determined)	

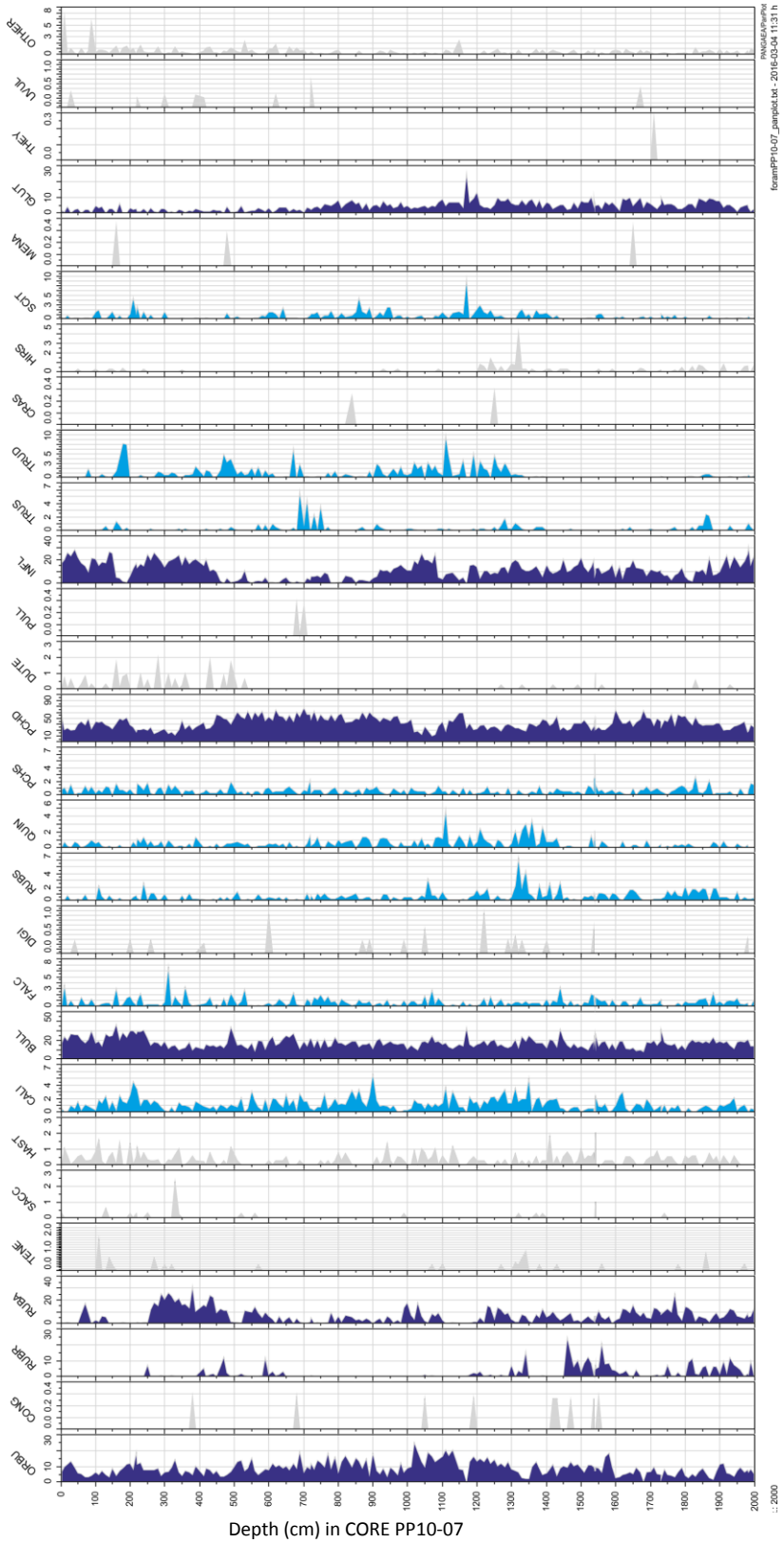

Figure S1: Planktonic foraminifera assemblages (relative abundances- %) in core PP10-07. Color code: Dark blue: characteristic species/ light blue: minor species/ grey: fortuitous species.

2. *SST reconstructions*

Relative abundance data obtained after the analysis of planktonic foraminifera assemblages (as published in Mojtahid et al., 2013 for core Ks10B, and from unpublished counts for core PP10-07, see above Figure S1) were used for MAT calculations (see Methods of the paper) according to the following root mean square errors of prediction (Table S3). Seasonal mean calculations are displayed on Figure S2 for core KS10b and Figure S3 for core PP10-07. These plots underline the good coherency with modern sea-surface conditions except during warm spells as discussed in the core manuscript. They also show that fall and spring seasons mirror the mean annual values in absolute values.

Hydrographical parameters	Mean Annual SST (°C)	Mean Winter (January-February -March) –JFM SST (°C)	Mean Spring (April May -June) –AMJ SST (°C)	Mean Summer (July- August-September) –JAS SST (°C)	Mean Fall (October -November -December) – OND SST (°C)
RMSEP	1.1	1.2	1.1	1.3	1.2

Table S1: Prediction error (RMSEP : root mean square error of prediction) of the MAT technique developed at EPOC (MATR_1007PF, e.g. Eynaud et al., 2013)**.**

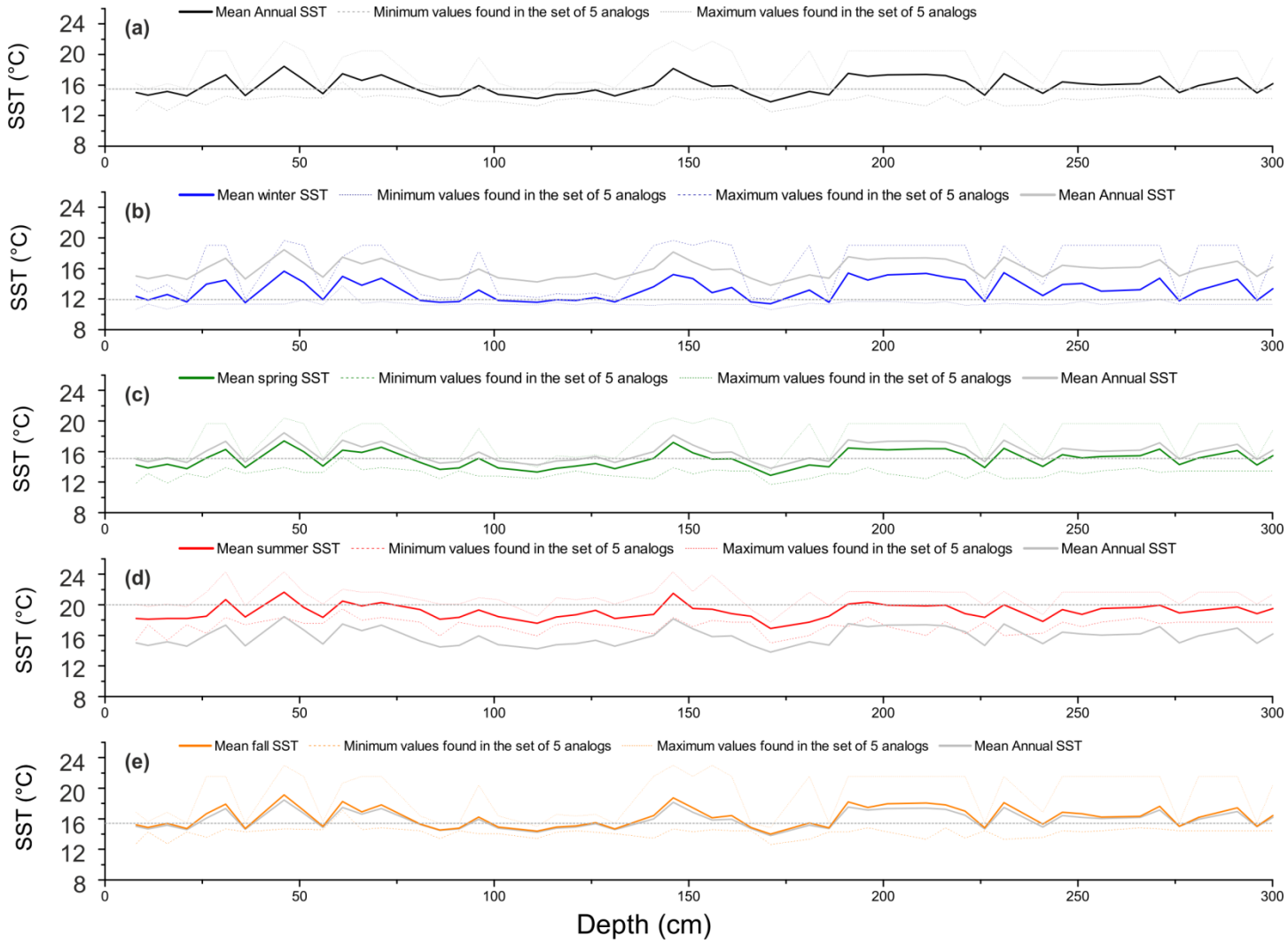

Figure S2: SST quantifications after MATR_1007PF on core Ks10b, with from the top to the bottom: (a) mean annual SST, (b) mean winter (JFM), (c) mean spring (AMJ), (d) mean summer (JAS), (e) mean fall (OND) SST. The seasonal means are compared to the annual one (grey curve). On each graph, colored dotted lines identify the respective minimal and maximal SST values found in the set of the 5 selected analogs. The horizontal grey dotted lines correspond to the modern values for each season after **Schäfer-Neth and Manschke, 2002 -WOA sample tool**. Available at: http://www.geo.uni-bremen.de/geomod/staff/csn/ woasample.html

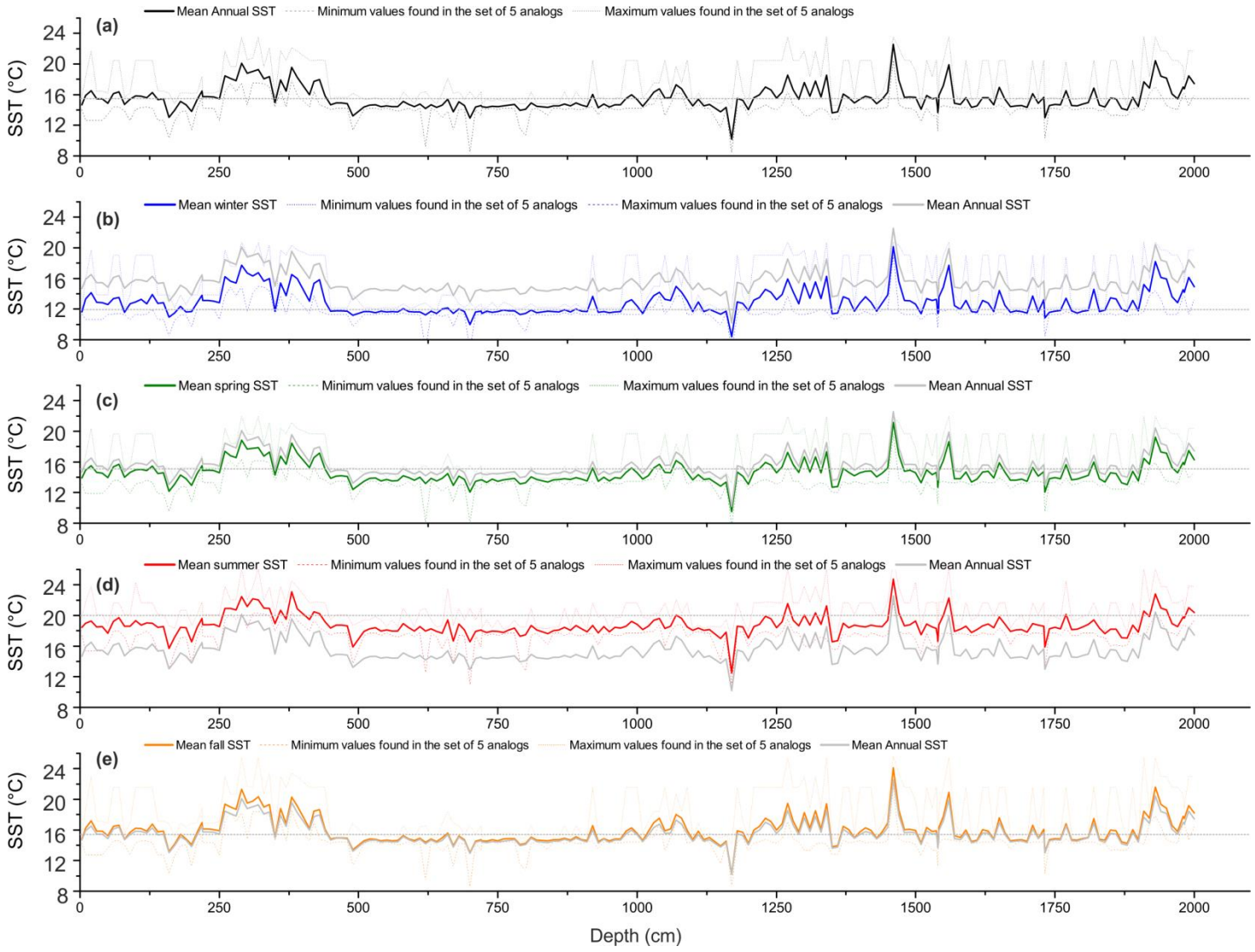

Figure S3: SST quantifications after MATR_1007PF on core PP10-07, with from the top to the bottom: (a) mean annual SST, (b) mean winter (JFM), (c) mean spring (AMJ), (d) mean summer (JAS), (e) mean fall (OND) SST. The seasonal means are compared to the annual one (grey curve). On each graph, colored dotted lines identify the respective minimal and maximal SST values found in the set of the 5 selected analogs. The horizontal grey dotted lines correspond to the modern values for each season after **Schäfer-Neth and Manschke, 2002 -WOA sample tool**. Available at: http://www.geo.uni-bremen.de/geomod/staff/csn/ woasample.html

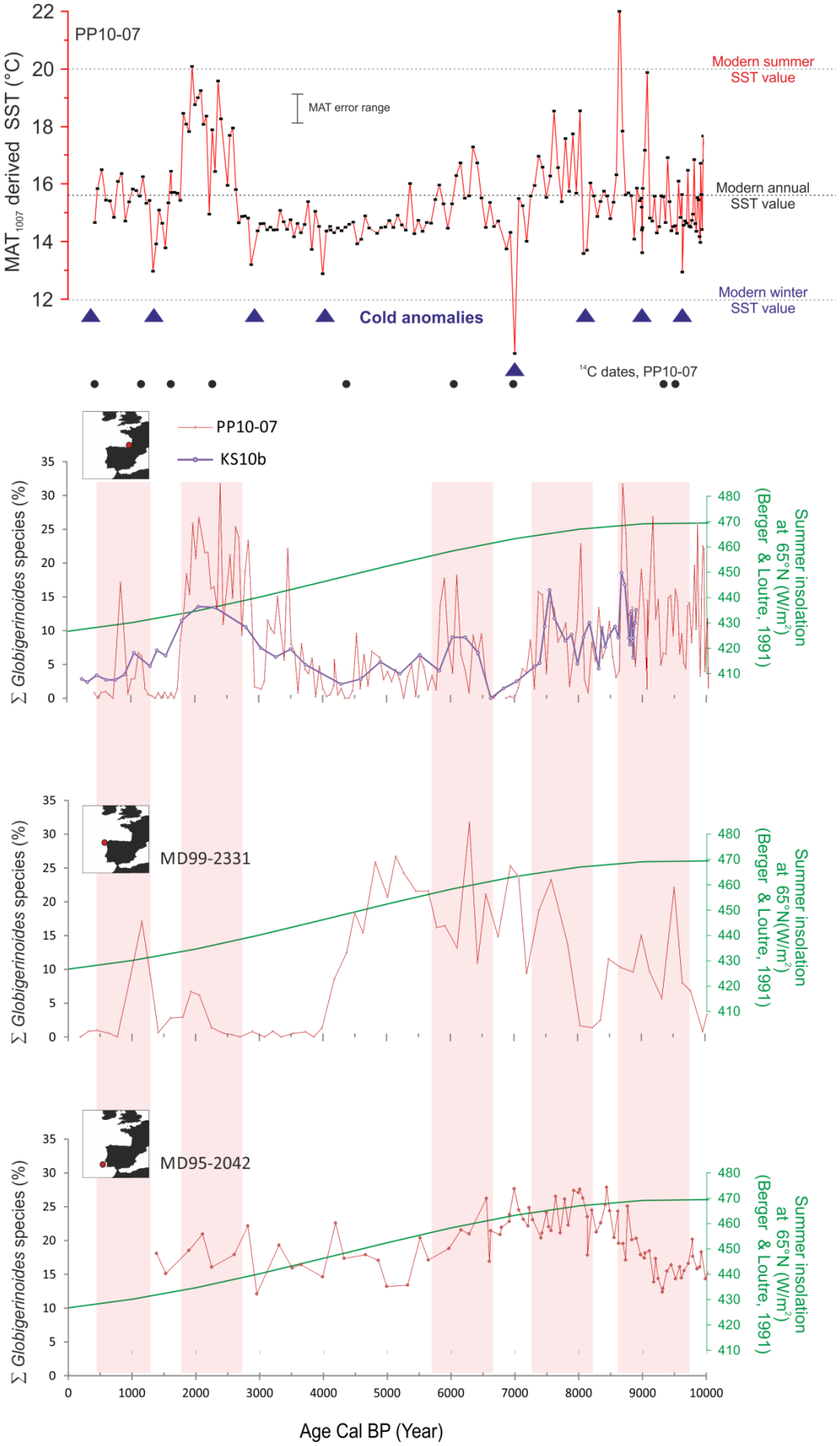

Figure S4: comparison of warm assemblages of the *Globigerinoides* species along latitudes (same cores and legend as in Figure 3)

Forcings/ mechanisms	Bond et al. 2001		Thornalley et al. 2009		Giraudeau et al. 2010		Sorel et al. 2012		Staine-Urias et al. 2013		Morley et al. 2014		Synthesis on BB SST anomalies (This work) integrating the comparison with key Holocene sequences (Fig 4 and 5)	
SPG strength SPG extension	not specified		"strong " longitudinal (E-W) ↔	"weak" latitudinal (N-S) ↕	not specified		longitudinal (E-W) ↔	"weak" latitudinal (N-S) ↕	"strong " longitudinal (E-W) ↔	"weak" latitudinal (N-S) ↕	"strong " longitudinal (E-W) ↔	"weak" latitudinal (N-S) ↕	"strong" if we follow the consensus but divergent pattern with IC longitudinal (E-W) ↔	"weak" if we follow the consensus but divergent pattern with IC latitudinal (N-S) ↕
NAO index		rather NAO- (but not a basin wide expression)			NAO like pattern		NAO+	NAO-	NAO+	NAO-	modern conditions	1930 condtions	NAO+ ? If based on the Medieval anomaly	
Atlantic Inflow in the Nordic seas IC/ Denmark strait pathway					low	high			not specified	not specified	low inflow	high inflow	high inflow detected at hight latitude of the GIN seas (Barents sea margin) high inflow except at 6 ka	lowest IC inflow
South iceland salinity				Saline intervals										saline
South iceland upper water stratification				low (negative) density diff									Different patterns if late or early Holocene	rather low (negative) density diff
Westerlies/ Europe				decreasing wind stress				shifted to the south	strong, warmth/ moist					
Storms over Europe Climate over Europe							**low activity**	**high activity** cool events					**low activity** Warm	**high activity** Coolings
Freshening/ export of sea-ice along Greenland	low	high	increase		low	high							Different patterns if late or early Holocene (residual ice-sheet melting ?)	
Solar (nuclide production)	minima	maxima											Not obvious see reply to Sebastian Luening' comment and Figure 5	

Table S2: Compilation of relevant paleo-observation done with various bibliographic sources since the Bond et al. (2001) paper. The two last columns gather observations in the Bay of Biscay (BB) with those provided in the selected bibliography.