"The Bay of Biscay: a key spot for past AMOC reconstructions"

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(1) Laboratoire EPOC, EQUIPE PALEO

(2) GEOSCIENCES OCEAN

(3) LPG BIAF

(4) Ifremer

OUTLINE

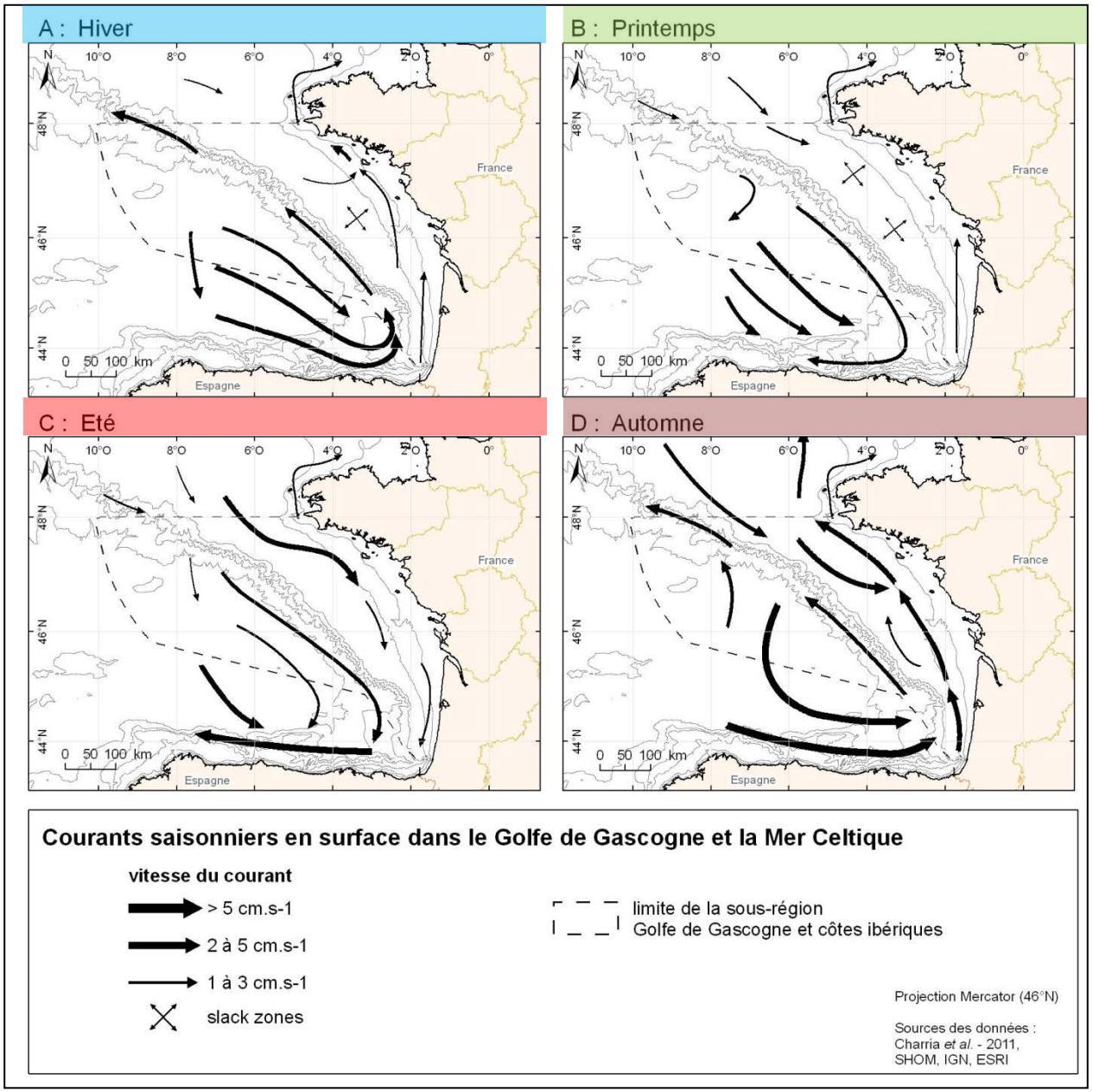
Modern setting

Past setting

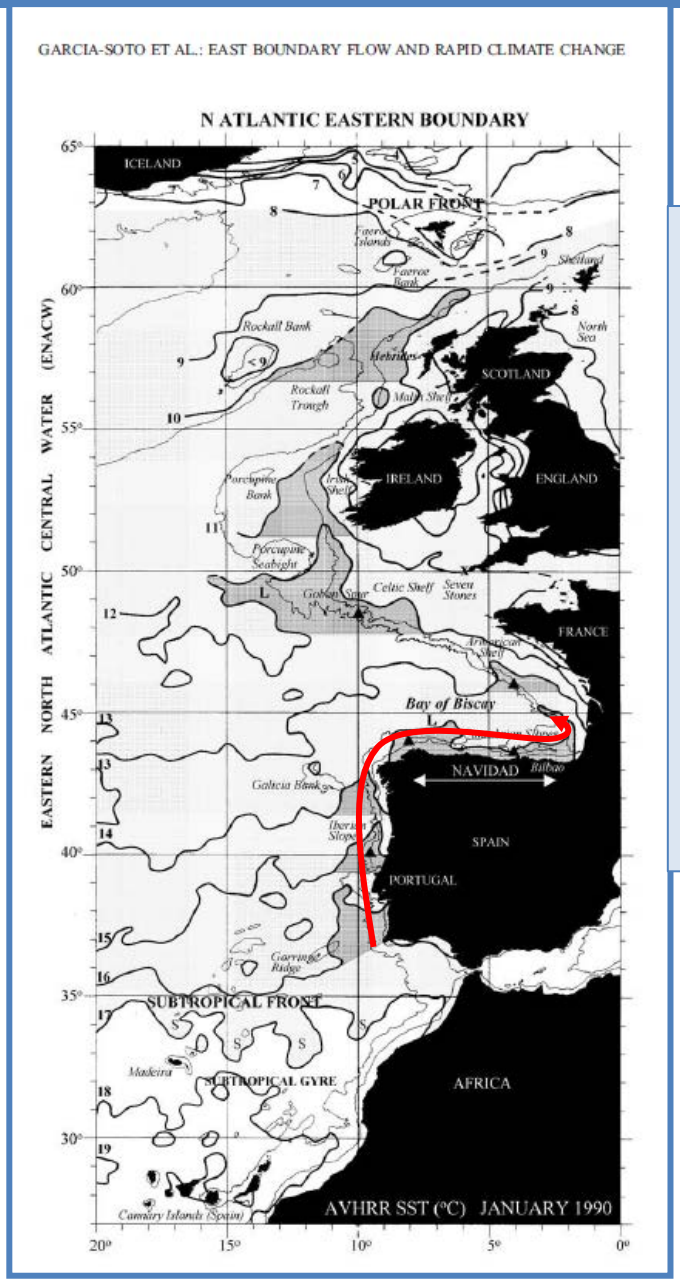
Some paleodata

Conclusion

The modern Bay of Biscay : a complex surface hydrography (September–October versus March -April SOMA pattern)



The modern Bay of Biscay : the IPC (Iberian Poleward Current)- Navidad current



AVHRR SST (°C)- January 1990

=> pulses of warm water (shaded regions) extending northward along the shelfbreak/slope region of the NE Atlantic from 35°N, near the Subtropical Front, to 60°N, near the Polar Front.

(200 m and 2000 m depth contours)

Navidad polward flow / meridional wind stress

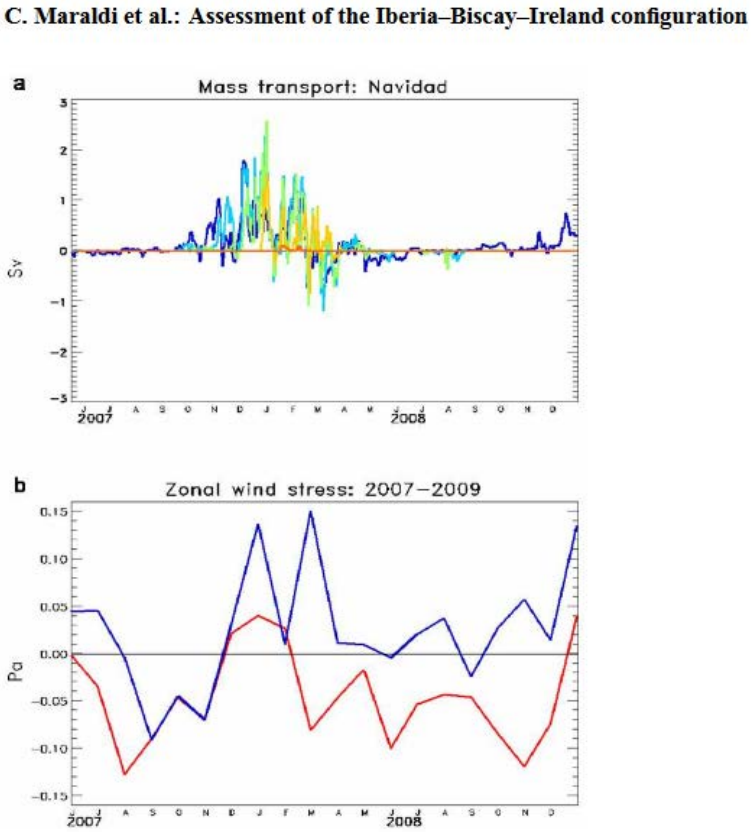
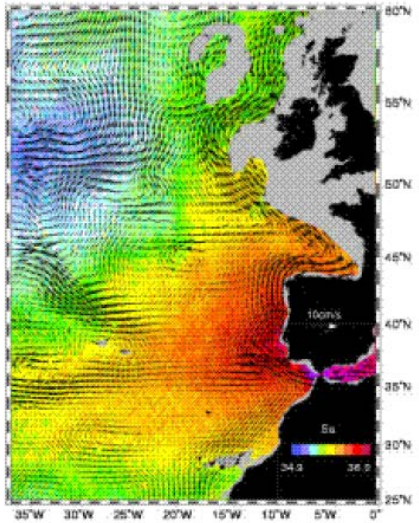


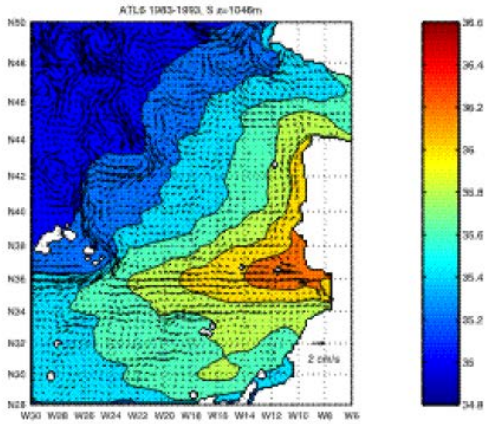
Fig. 18. (a) Transport (Sv) of the poleward flow for water mass warmer than 13.0 °C and saltier than 35.7 psu at 43.24° N (blue), 7.61° W (turquoise blue), 6.2° W (green), 3.8° W (yellow) and 44.4° N (orange). **(b)** Meridional wind stress τ_y (Pa) off western Iberia (red) and of the zonal wind stress τ_x off northern Iberia (blue). Boxes chosen for the spatial average of τ_x and τ_y have been chosen following the study of Le Cann and Serpette (2009).

The modern Bay of Biscay : the imprint of Mediterranean Outflow Waters at depth

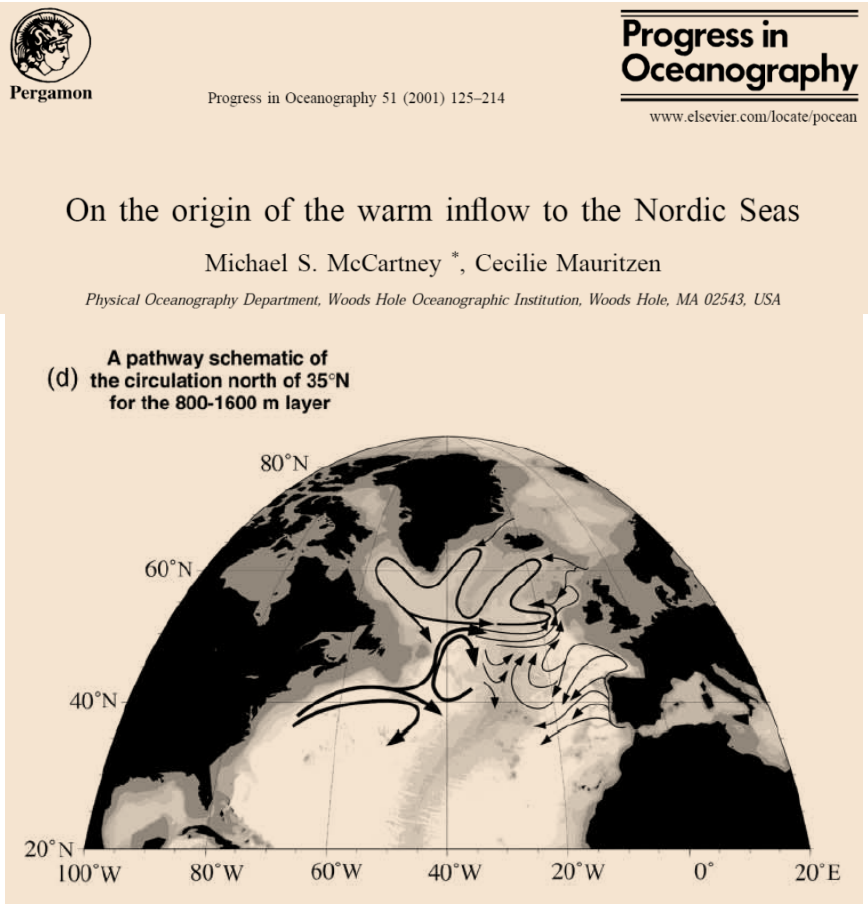
=> Salinity fields / transport ?



Salinity and currents at Isopycnal 0.5 = 29.9 (after Iorga et al).

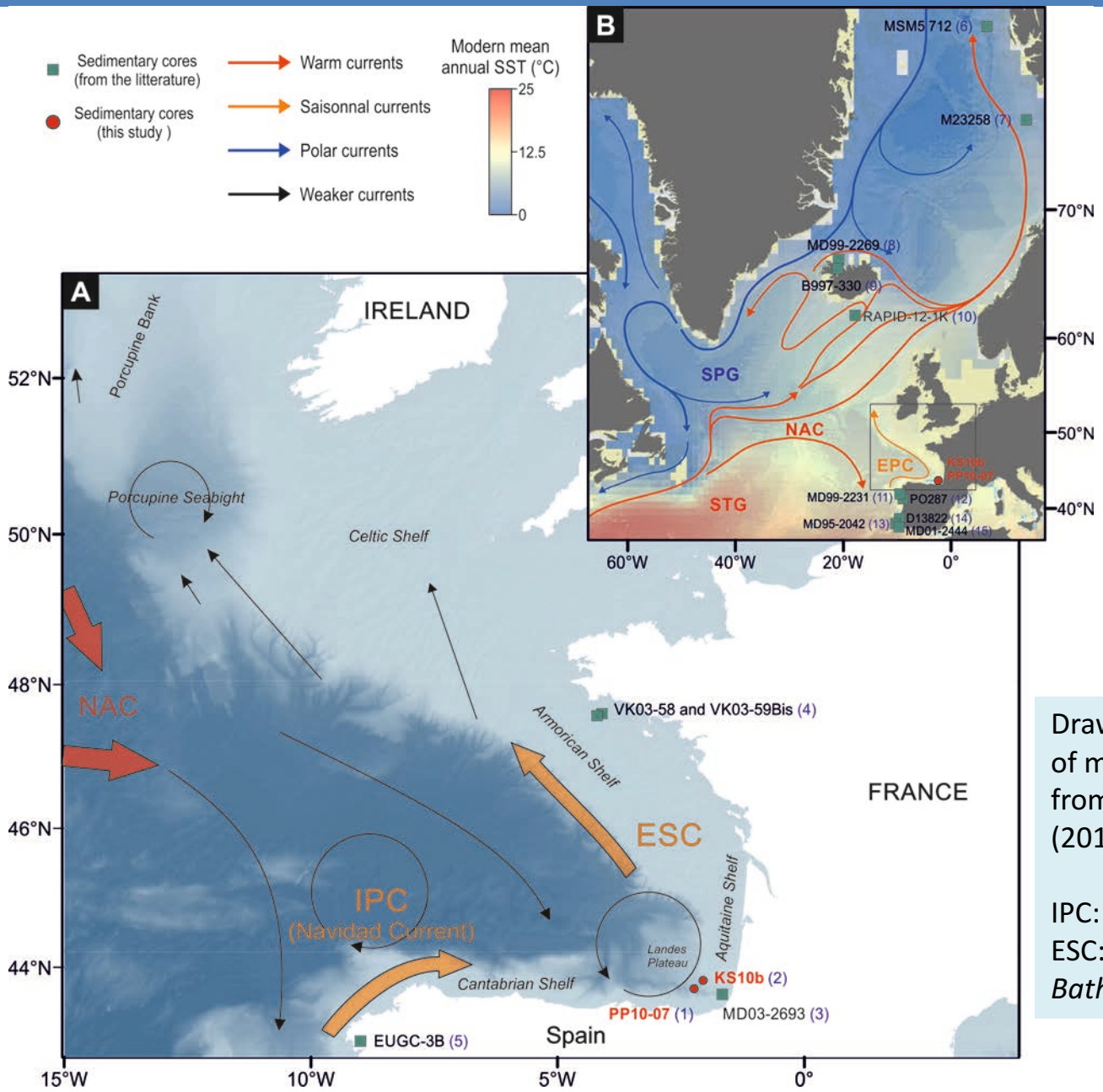


Salinity and currents at 1000 m (data CLIPPER-Atl6)



Source : Projet « EMA : Eau Méditerranéenne en Atlantique : Contribution au grand défi : 'Contribution à la prévision de la circulation océanique et de la variabilité climatique' - dossier scientifique et plan de mise / MERCATOR & CORIOLIS. »

The modern Bay of Biscay : key « modern » features (Mary et al., CP, 2017)



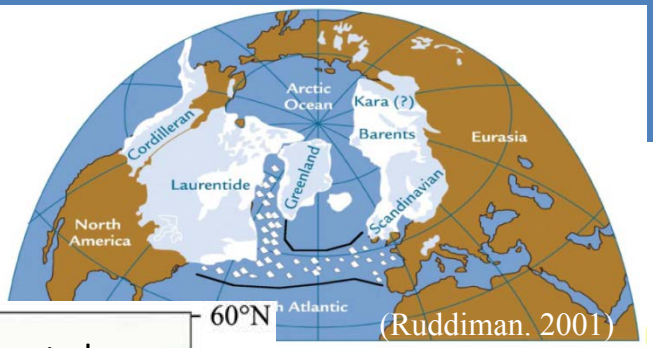
NAC: North Atlantic Current
SPG: subpolar gyre
STG: subtropical gyre
EPC: European Poleward Current (afterLherminier and Thierry, 2015)

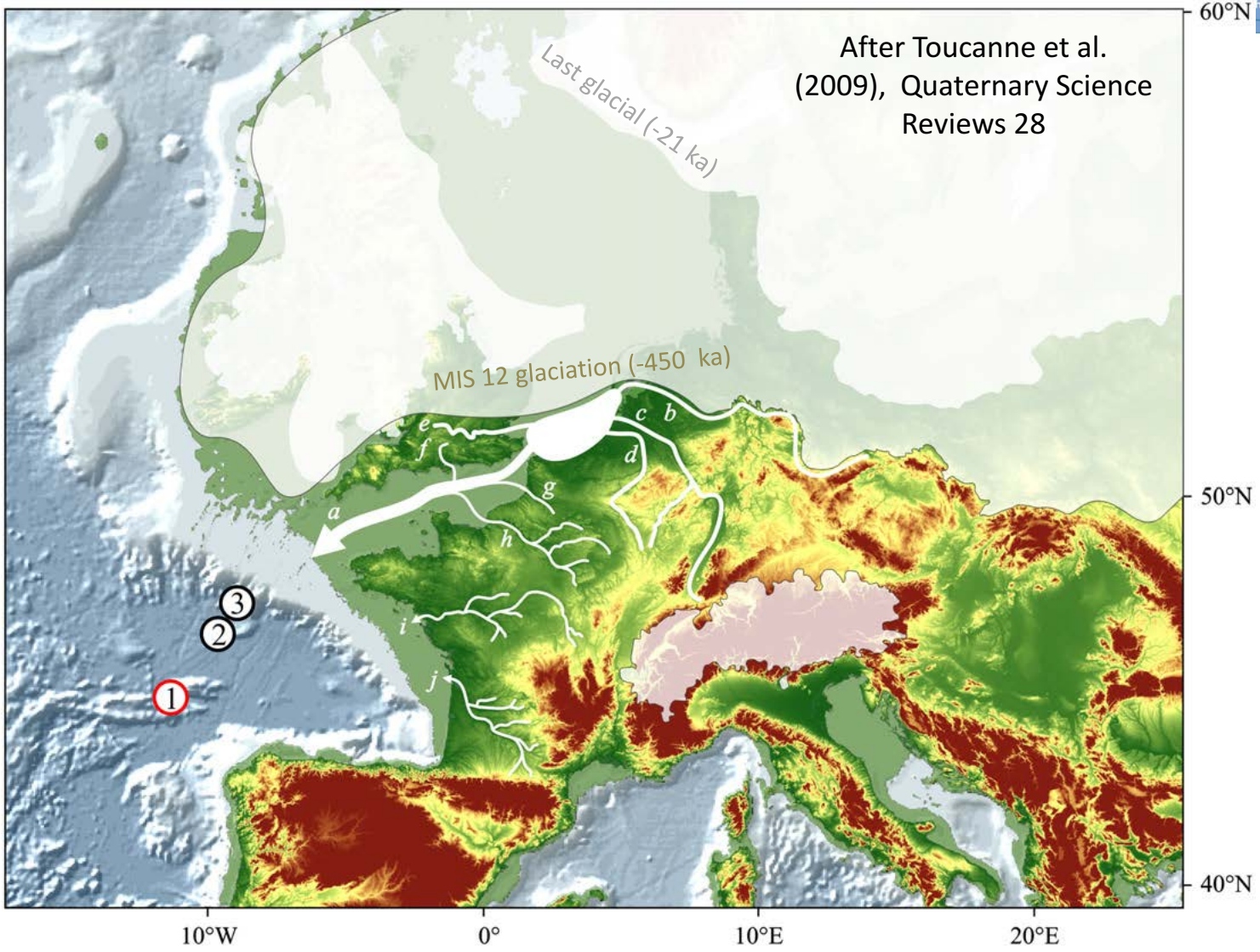
Drawn after the compilation of modern hydrological survey from Pingree and Garcia-Soto (2014).

IPC: Iberian Poleward Current
ESC: European Slope Current
Bathymetry from EMODNET.

The Bay of Biscay : key « past » features

During the past glacials : …European glaciers and sea-ice footprints





c: Rhine
d: Meuse
e: Thames
f: Solent
g: Somme
h: Seine
i: Loire
j: Gironde

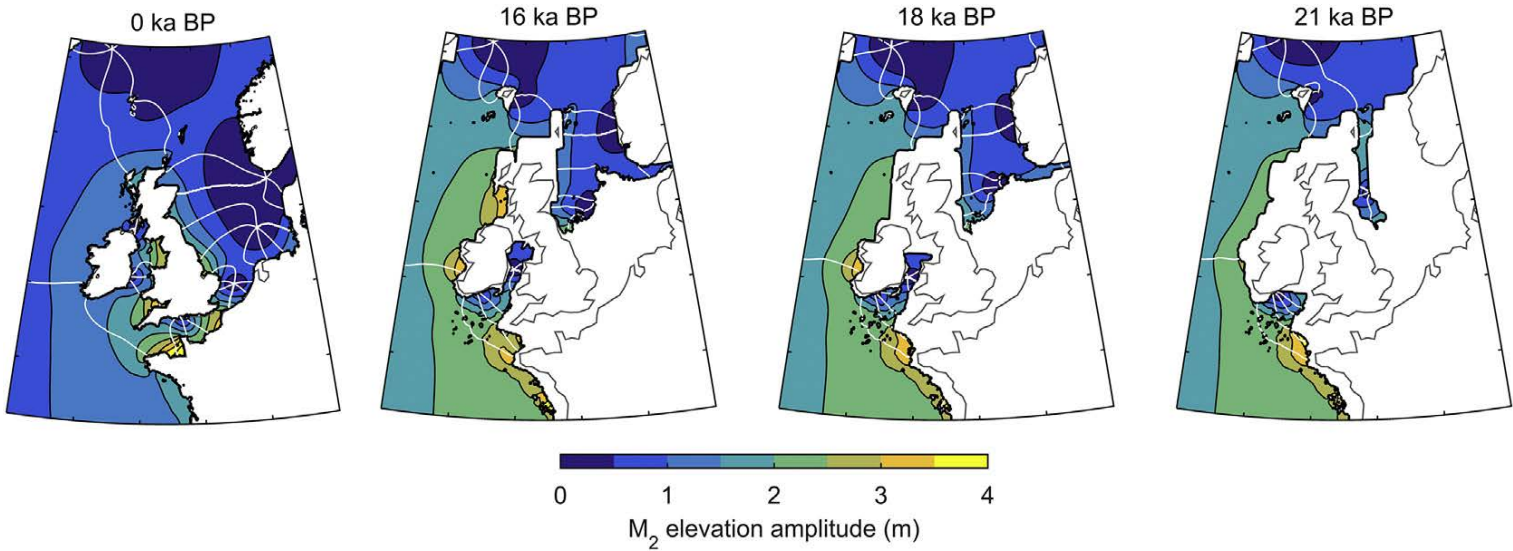
The Bay of Biscay : key « past » features

=> Sills /gateways…remodelling Europe

Artist view of the continental strait between Uk and France. / Crédits: Imperial College London, Chase Stone

e.g. Gupta et al. 2017. Two-stage opening of the Dover Strait and the origin of island Britain. *Nature Communications*, 04 Avril 2017

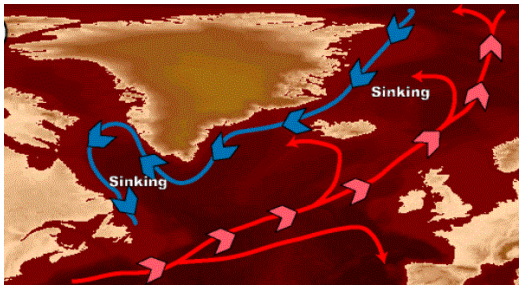
Paleotides = >
Ward et al. 2016
Quaternary Science Reviews 151

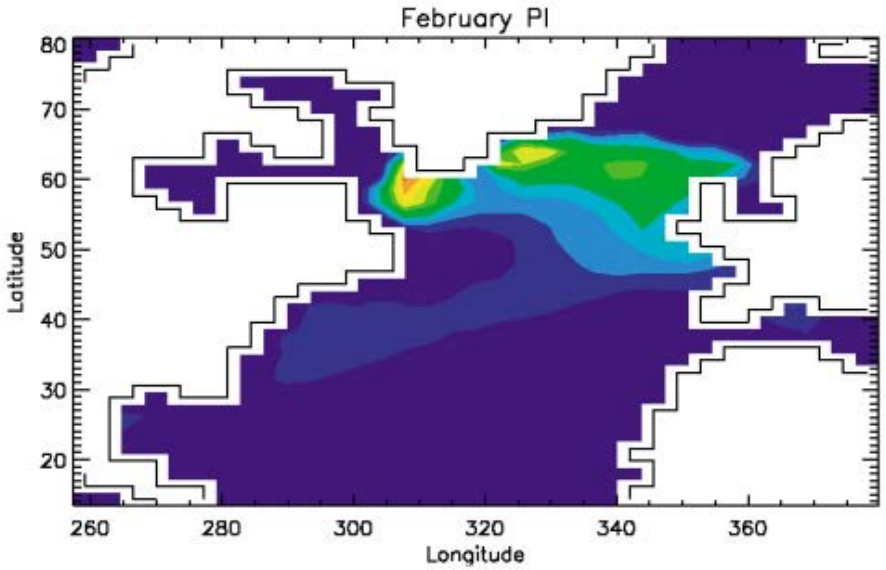


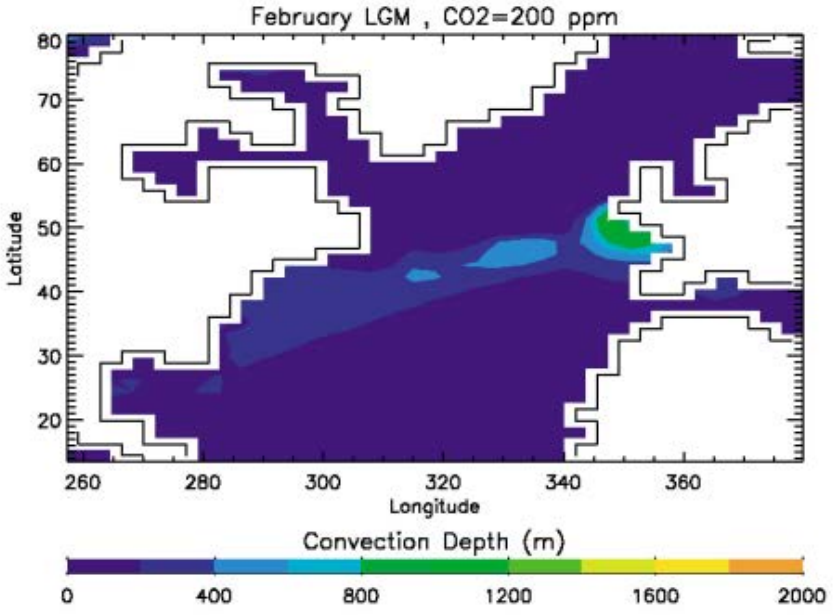
The Bay of Biscay : key « past » features

During the past glacials : …changes in the convection sites ?

M. Cottet-Puinel et al. / Quaternary Science Reviews 23 (2004)

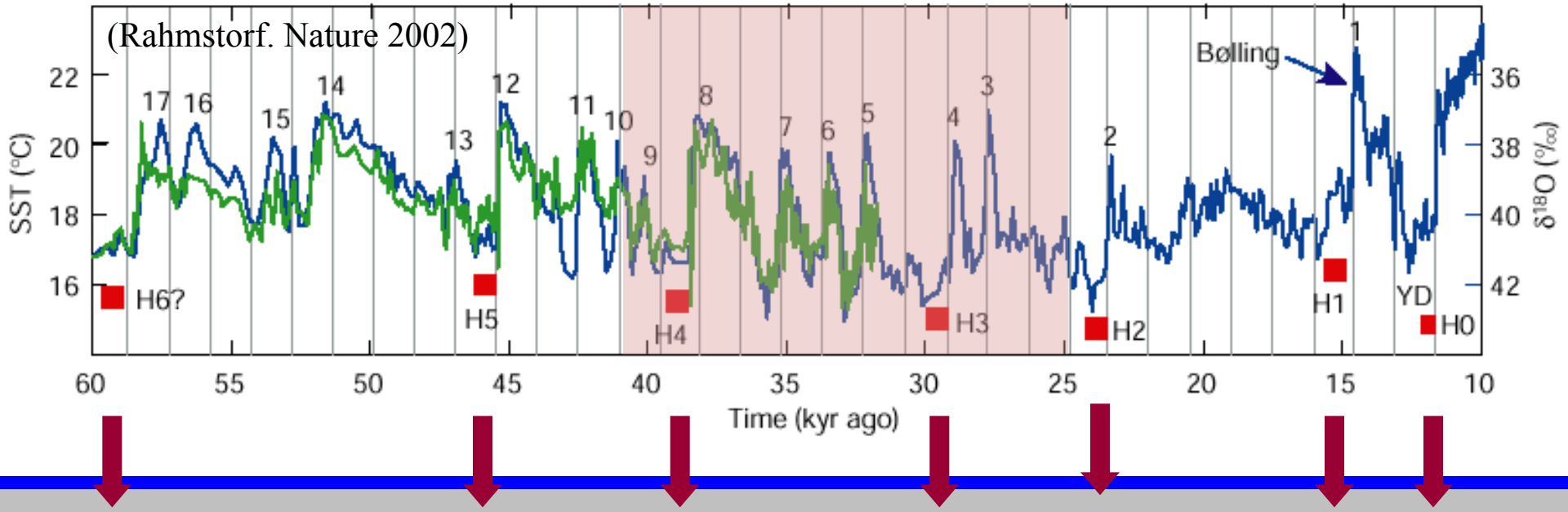




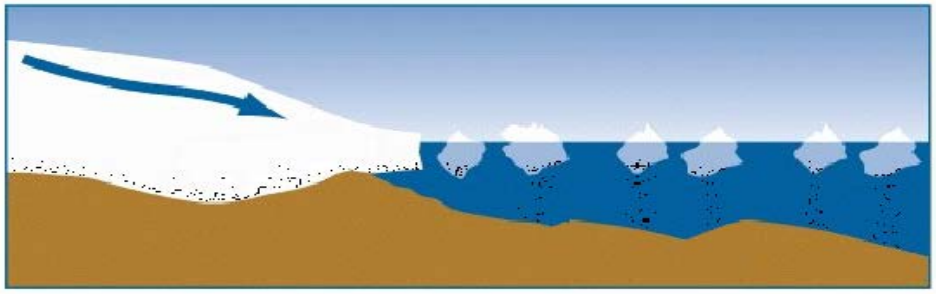


=> Heinrich (HEs)/ Dansgaard-Oeschger (DO) events

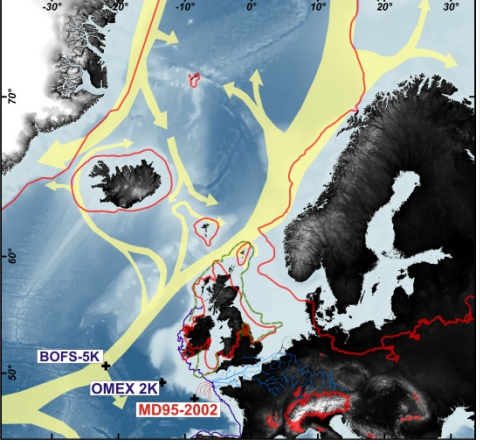
Marine isotopic stage - MIS3



HEs : ice-sheet collapses

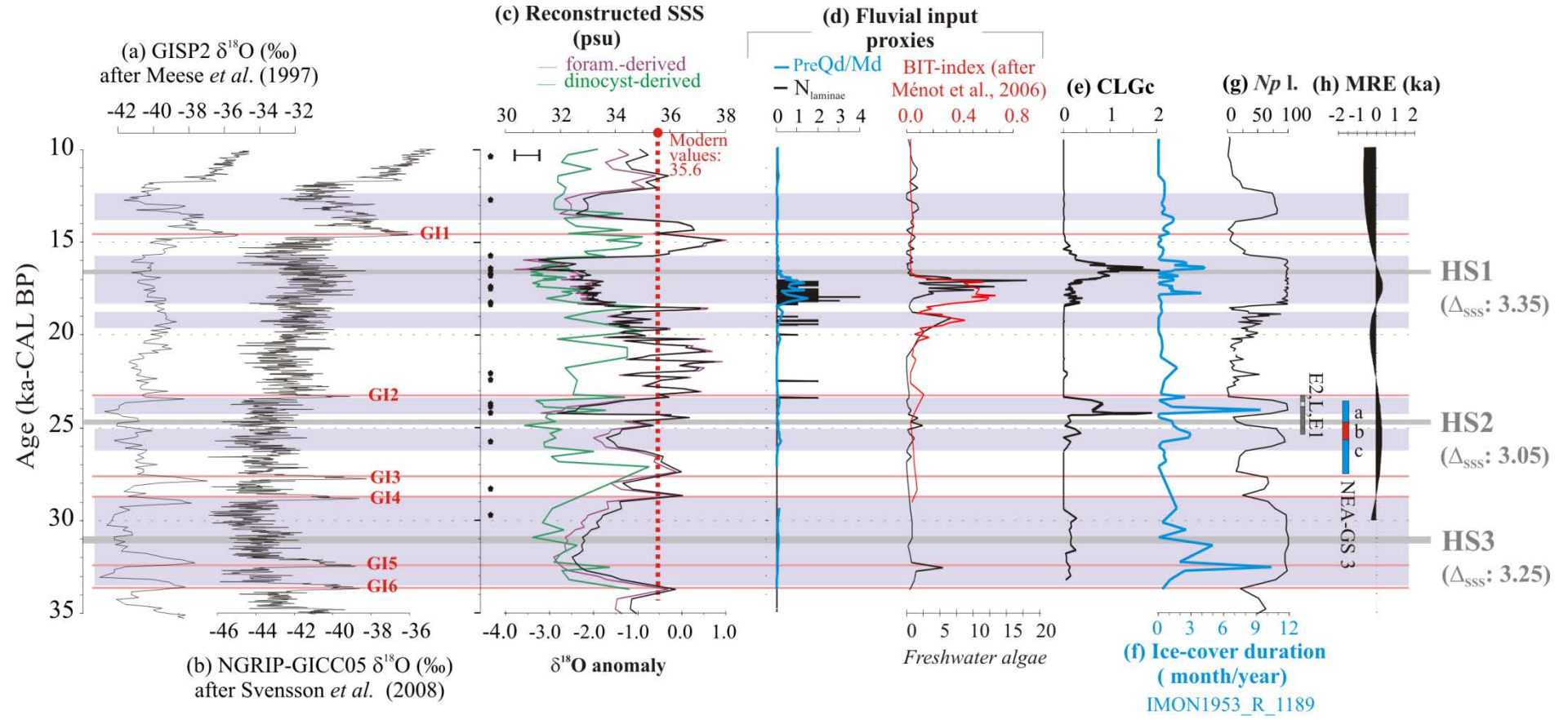


(Ruddiman. 2001)



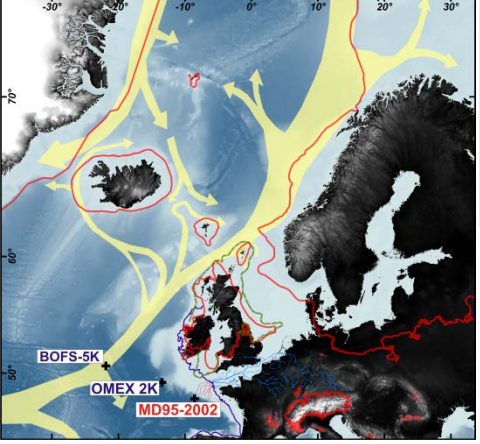
HEs => Their impact on the hydrography of the northern Bay of Biscay :

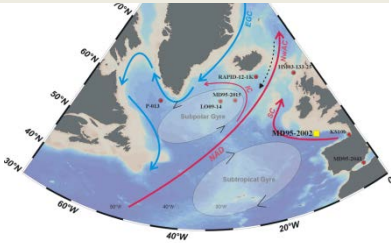
~5 units of salinity changes + a seasonal sea-ice cover

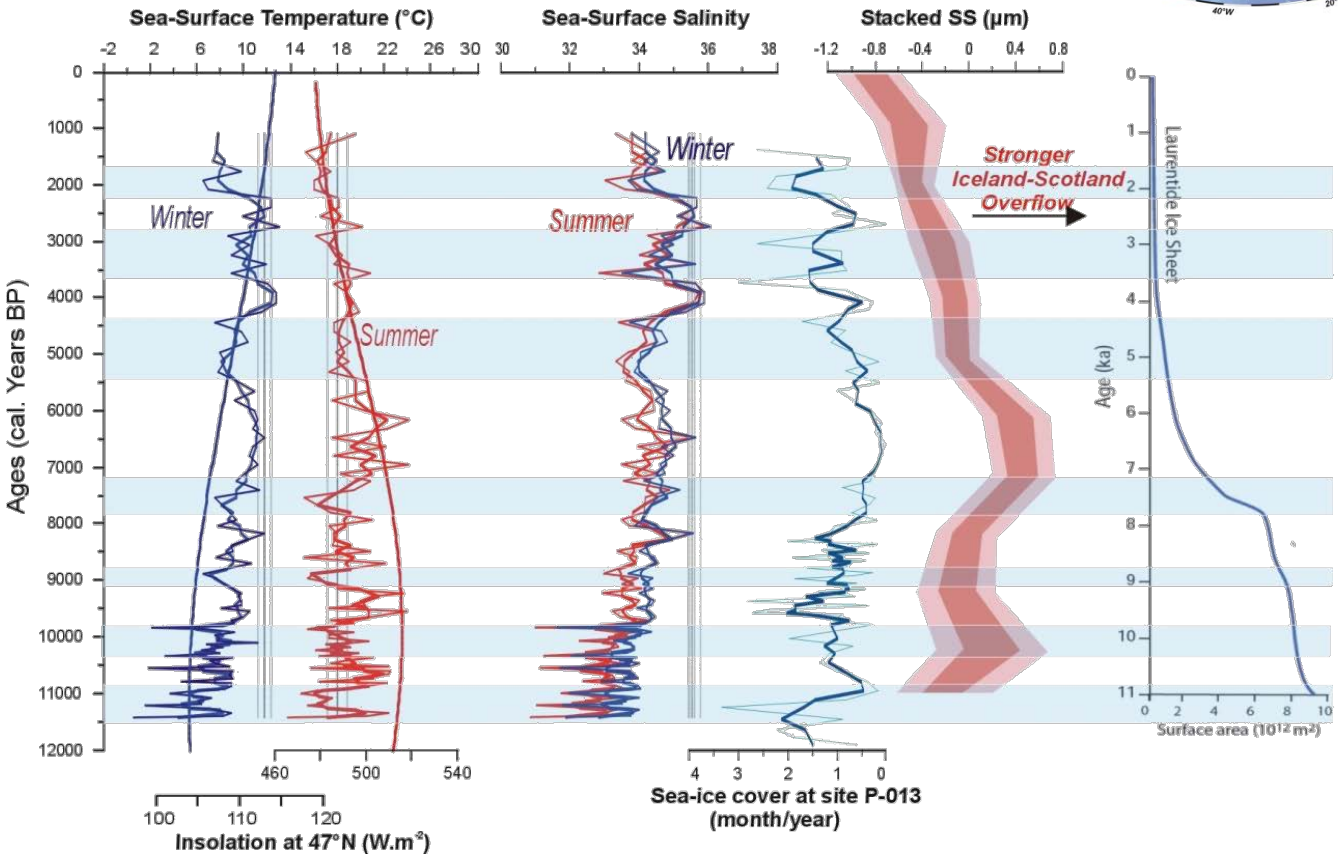


Eynaud et al. / GRL (2012)

=> Same site during the Holocene (last 10 ka)







Zumaque et al. / P3 (2017)

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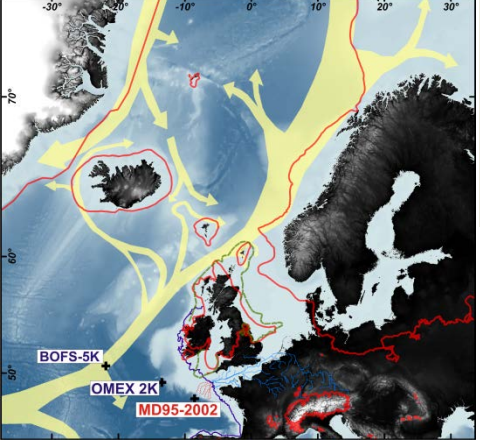

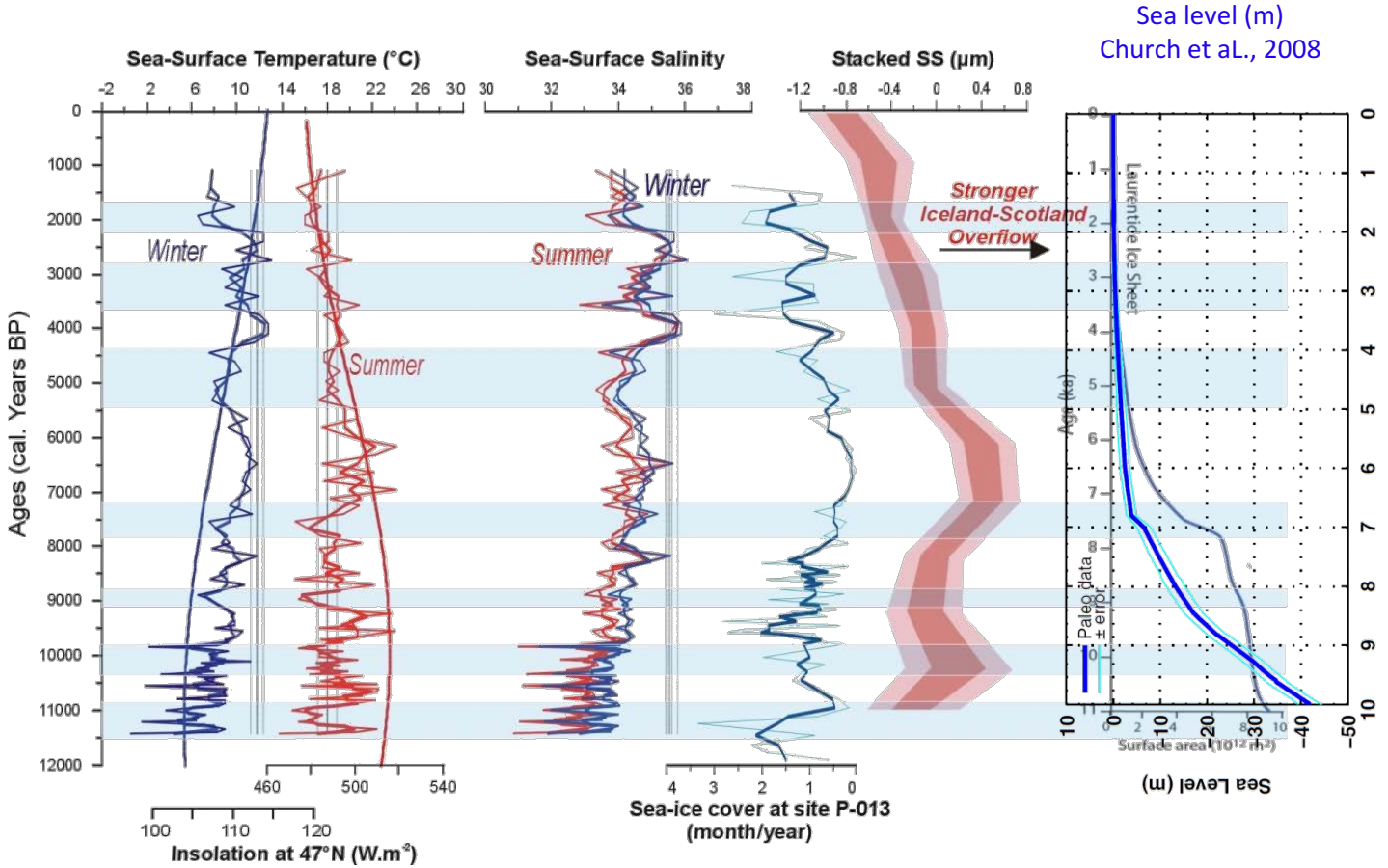

Zumaque et al. / P3 (2017)

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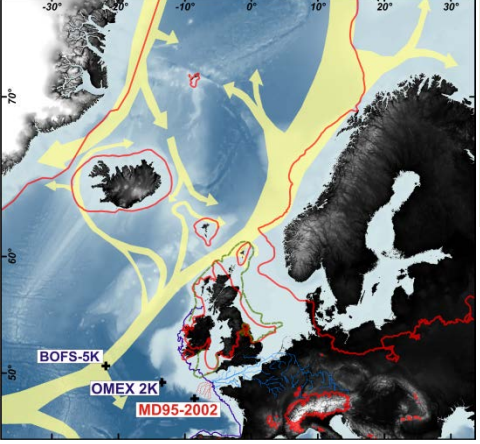

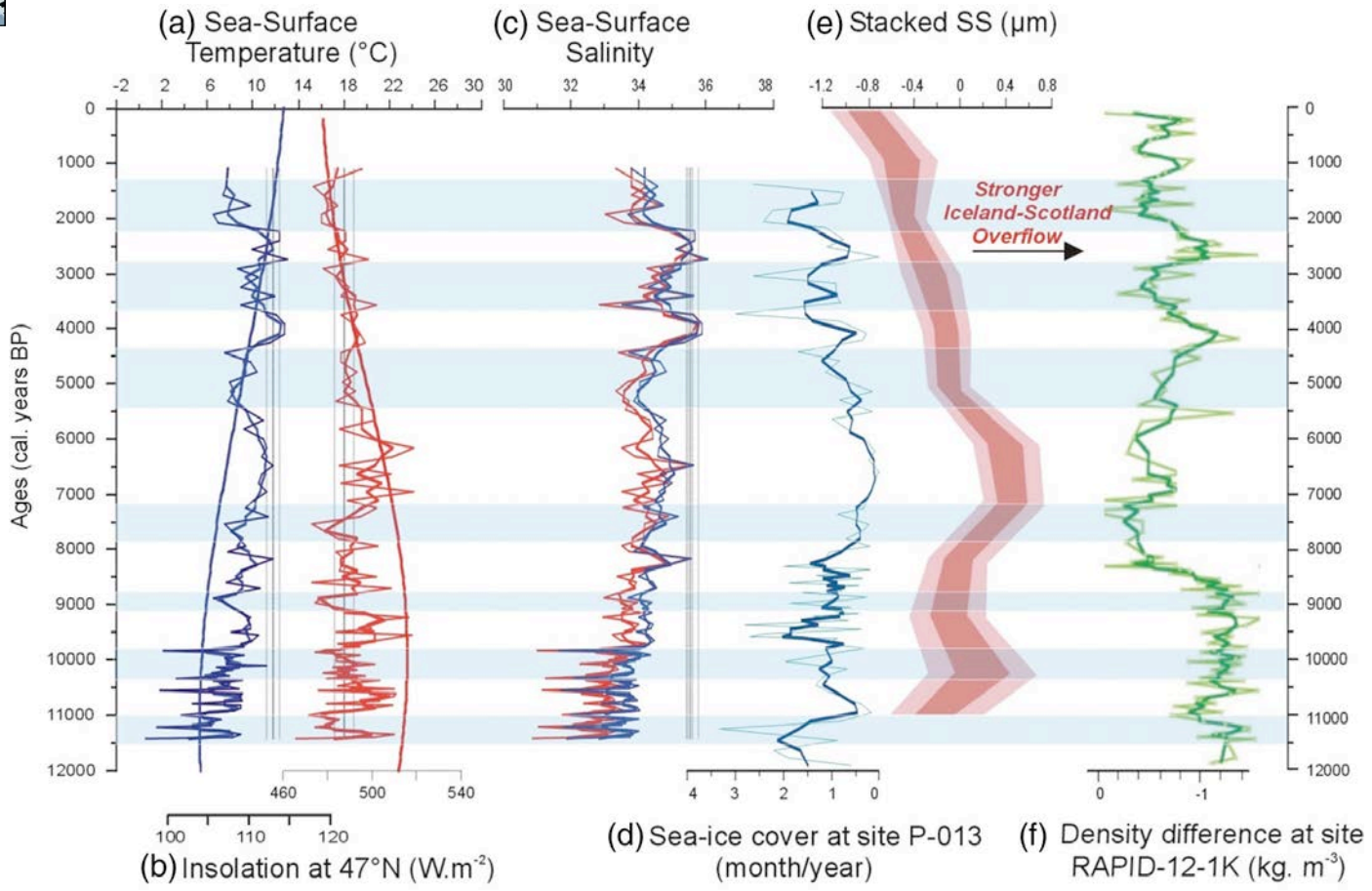

Zumaque et al. / P3 (2017)

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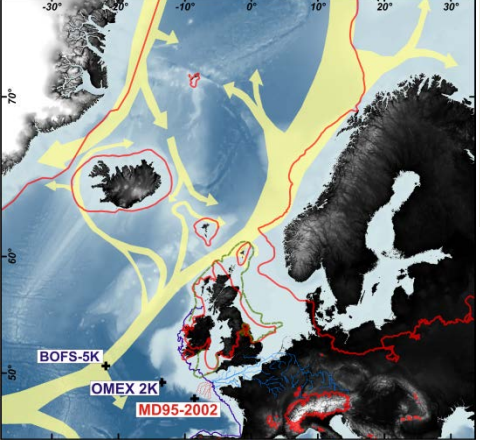
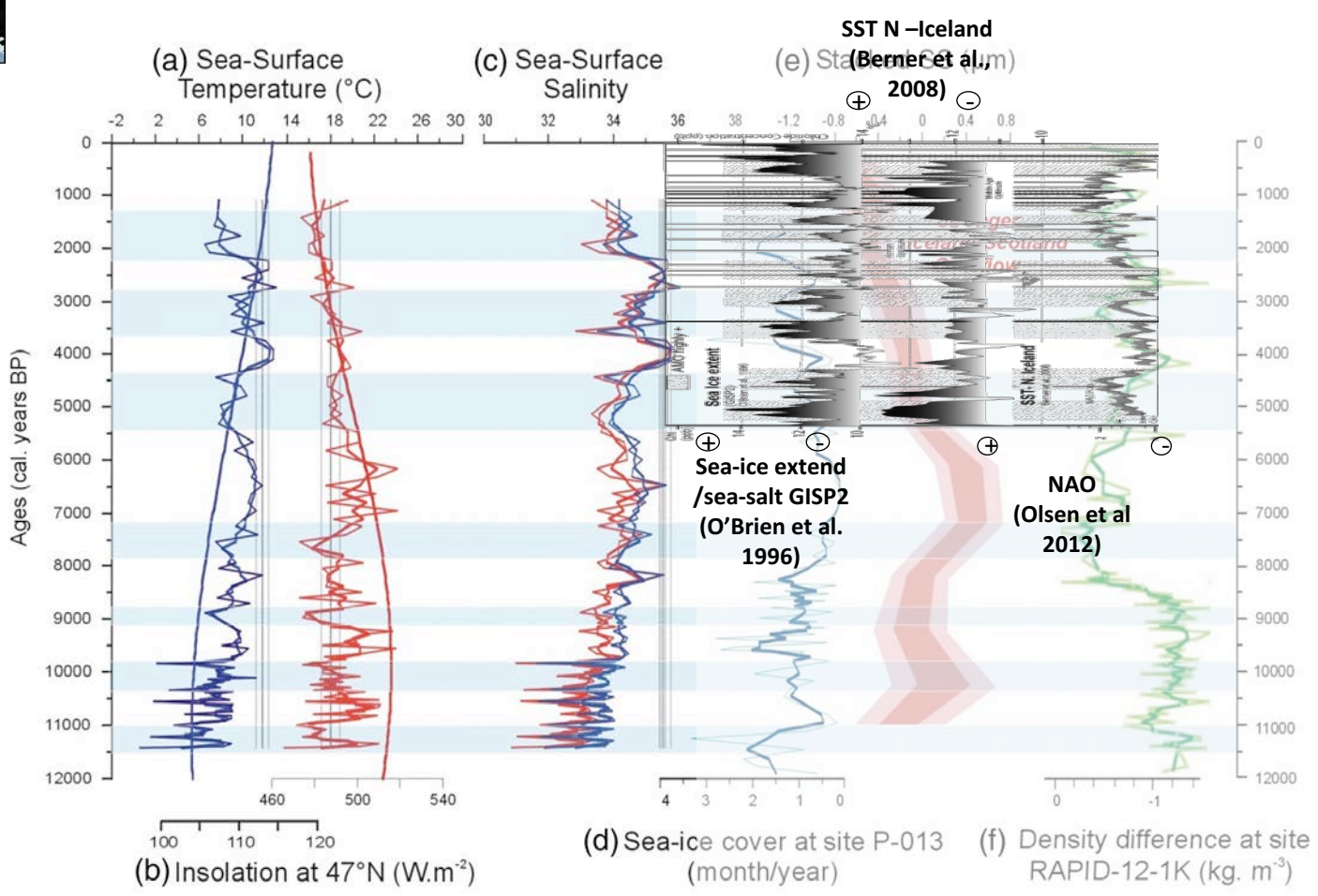


VanVliet Lanoe et al., 2014
The holocene / (part2)



Zumaque et al. / P3 (2017)

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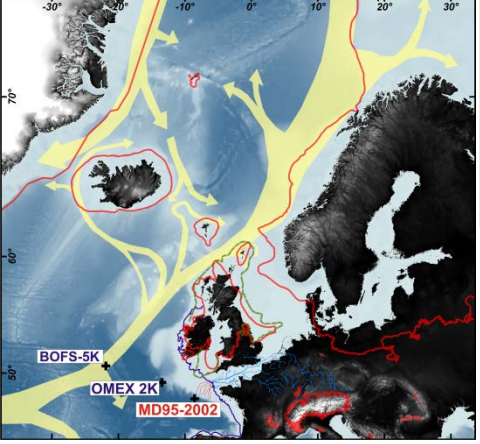
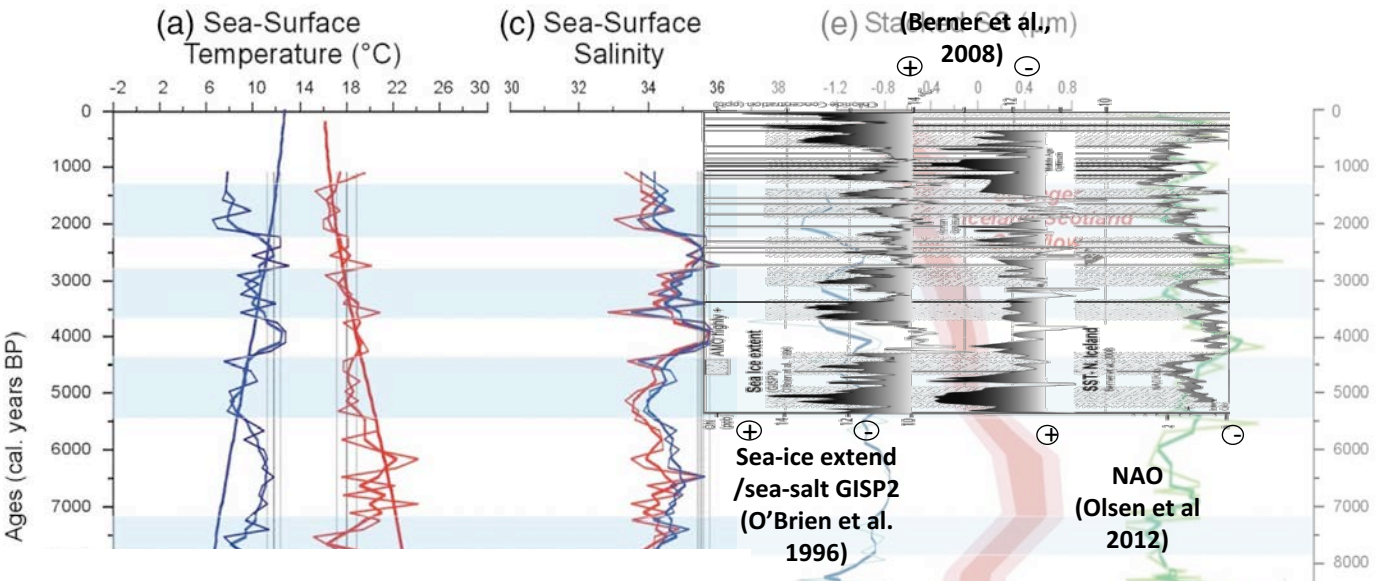


VanVliet Lanoe et al., 2014
The holocene / (part2)

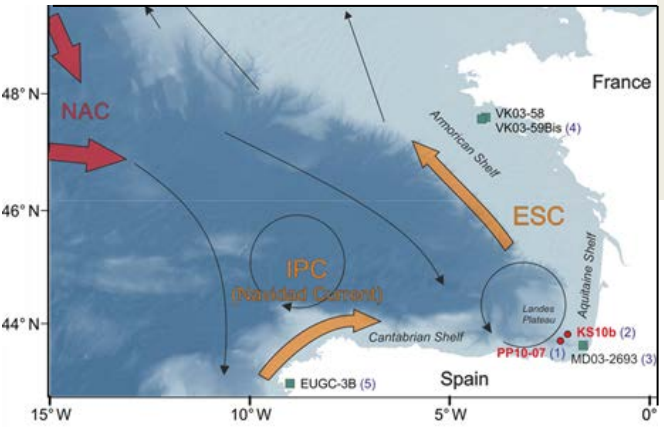
SST N –Iceland (Berner et al., 2008)

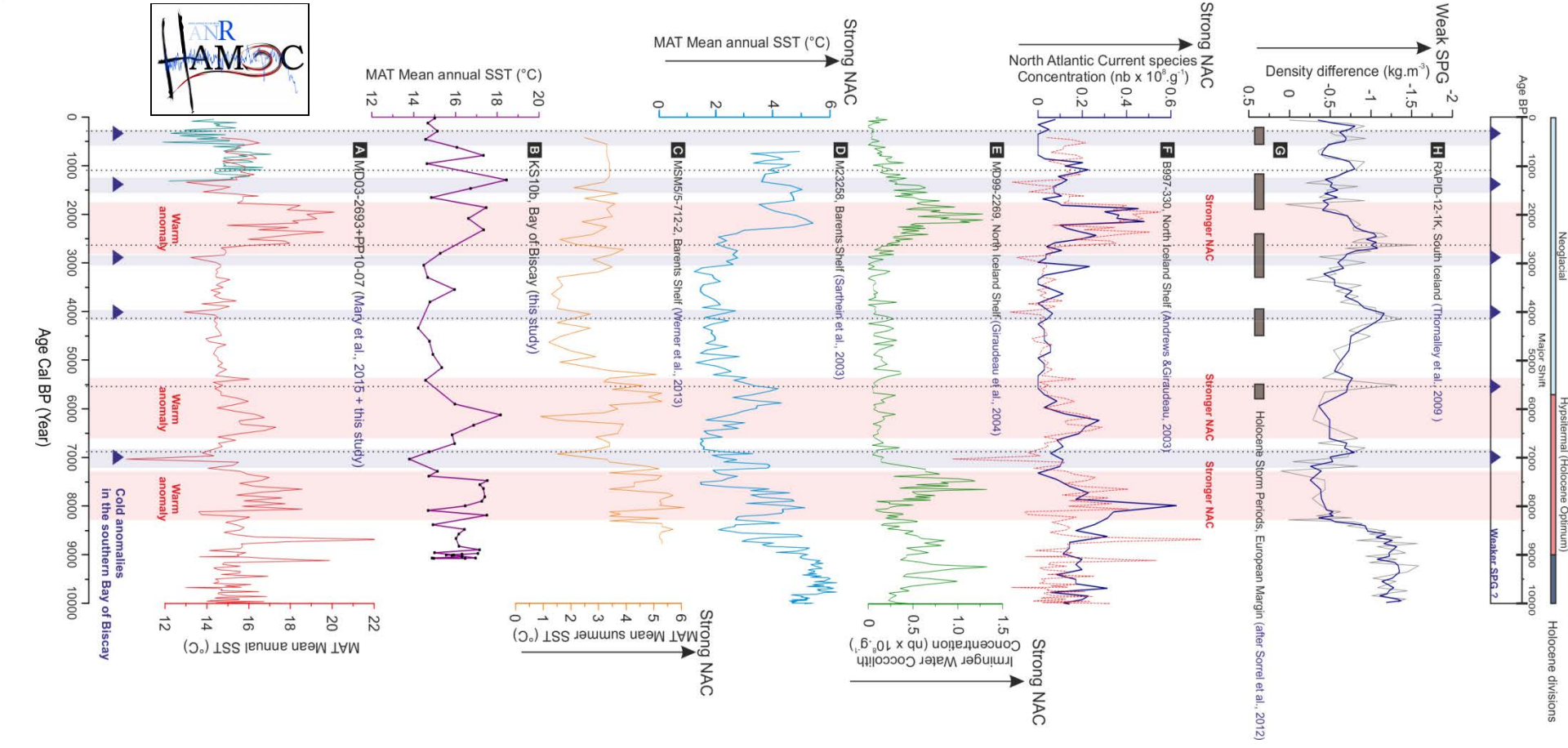


⇒ A strong zonal teleconnection (E-W)

Zumaque et al. / P3 (2017)

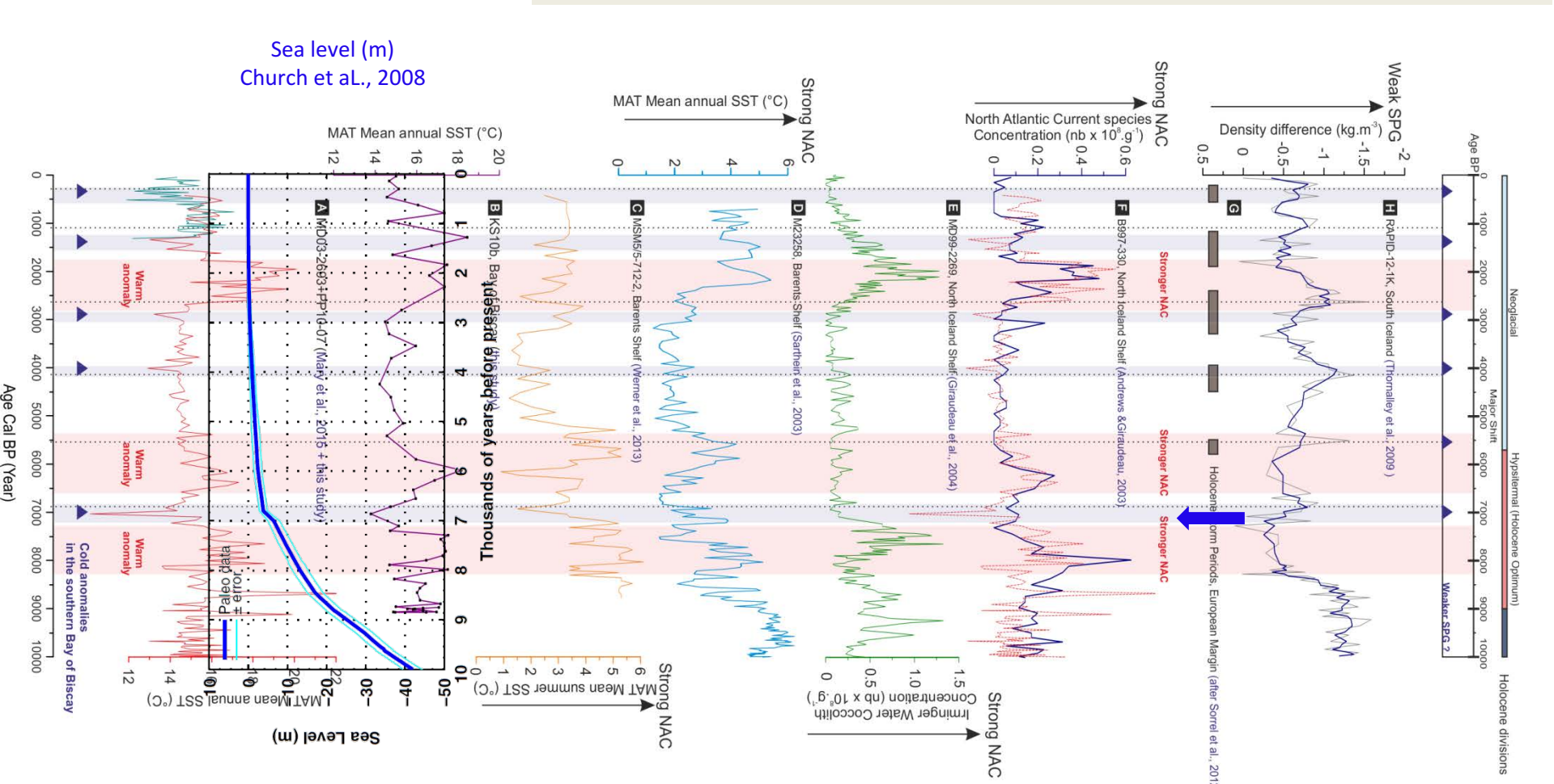
=> The Southern Bay of Biscay during the Holocene ?





Mary et al., CPD 2016, CP 2017. Changes in Holocene meridional circulation and poleward Atlantic flow: the Bay of Biscay as a nodal point

=> The Southern Bay of Biscay during the Holocene ?



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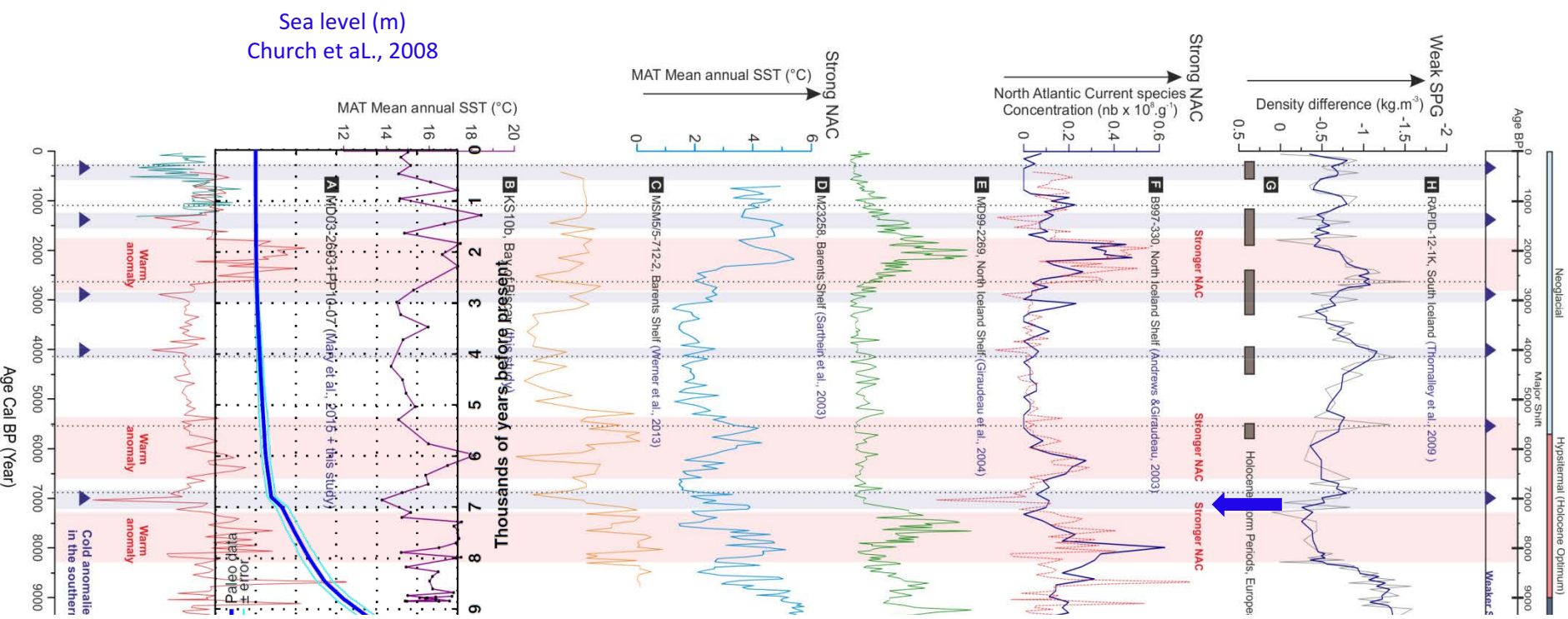
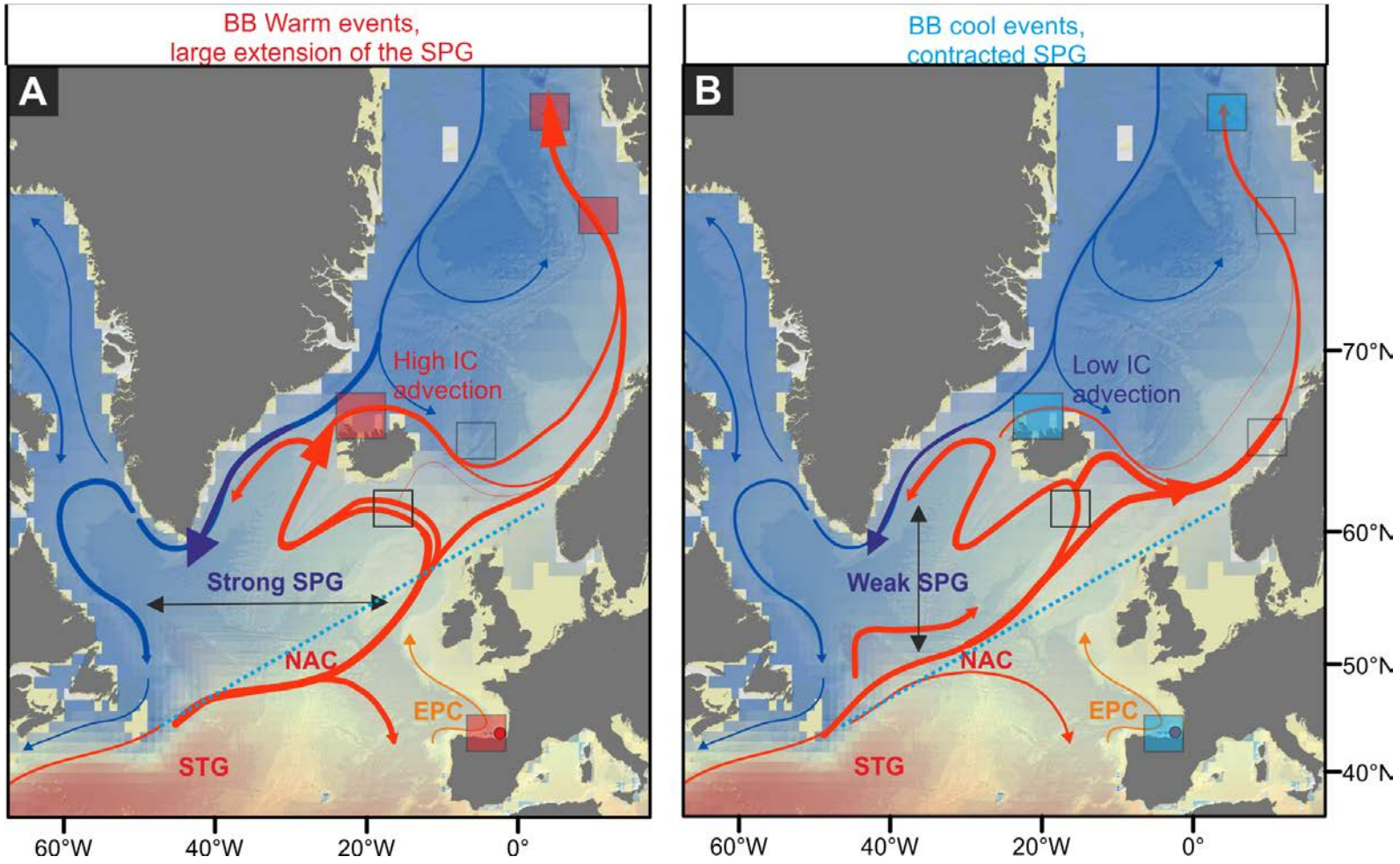


=> Strong zonal teleconnections (E-W and S-N)

Mary et al., CPD 2016, CP 2017. Changes in Holocene meridional circulation and poleward Atlantic flow: the Bay of Biscay as a nodal point



⇒ Towards a comprehensive synthesis? (compiled after Staines-Urías et al. 2013, Morley et al. 2014)

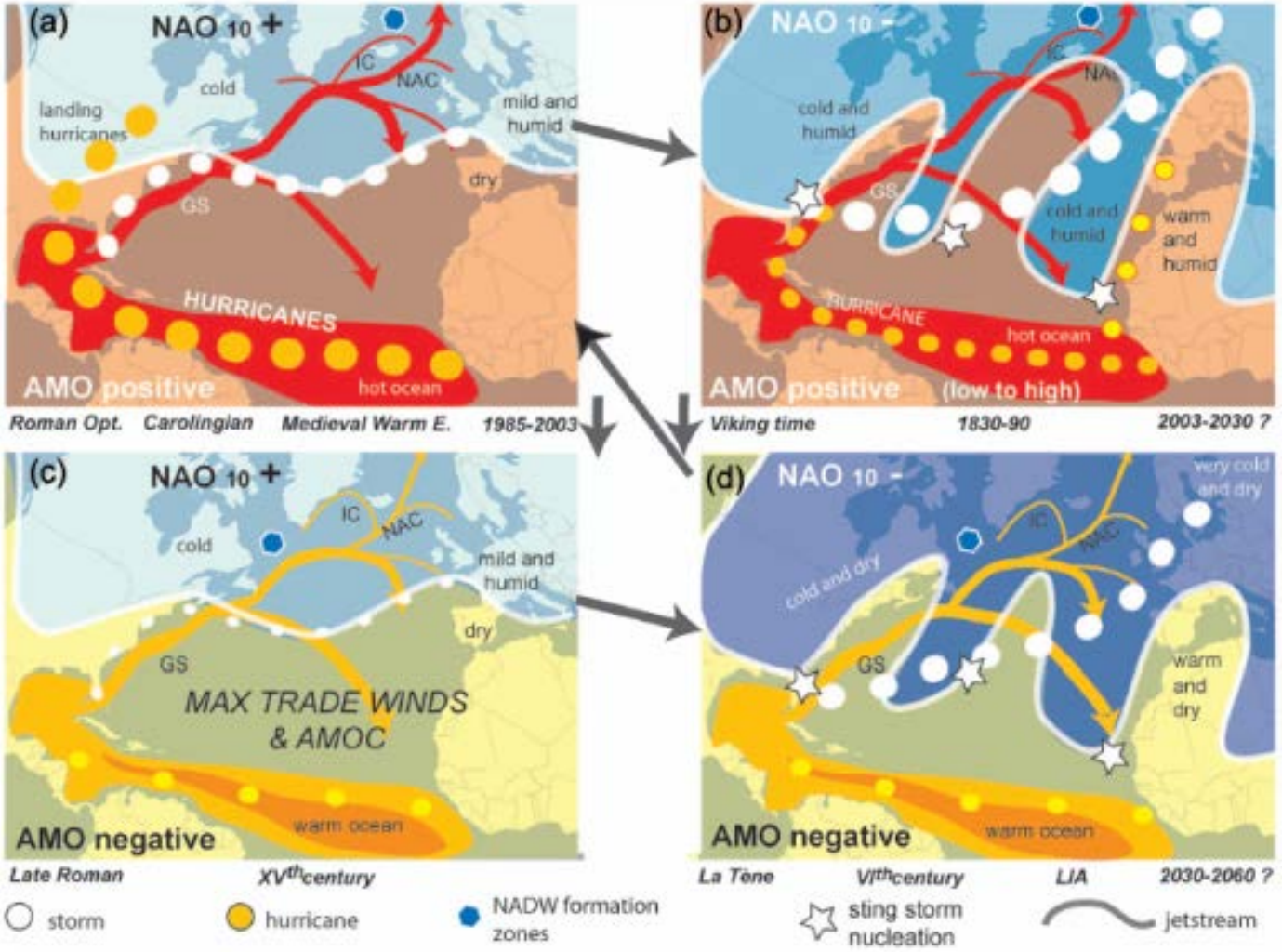


Figure 7. Synoptic scheme of the different storminess patterns linked with AMO and NAO 10.
AMO: Atlantic Multidecadal Oscillation; NAO: North Atlantic Oscillation; GS: Gulf Stream; IC: Irminger Current; NAC: North Atlantic Current.

VanVliet Lanoe et al., 2014
The holocene / (part2), Storms along Brittany shores

MESSAGES TO TAKE HOME :

- one of the most interesting hydrographic area is at our door…

- past and modern processes in the Bay of Biscay are key features to understand AMOC dynamics (amplified sensitivity?)

- observations need to be re-evaluated coupling depth and surface processes (…internal waves/productivity)

- THANKS FOR YOUR ATTENTION -