Methane in the Belgian coastal zone (North Sea)

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Université de Liège

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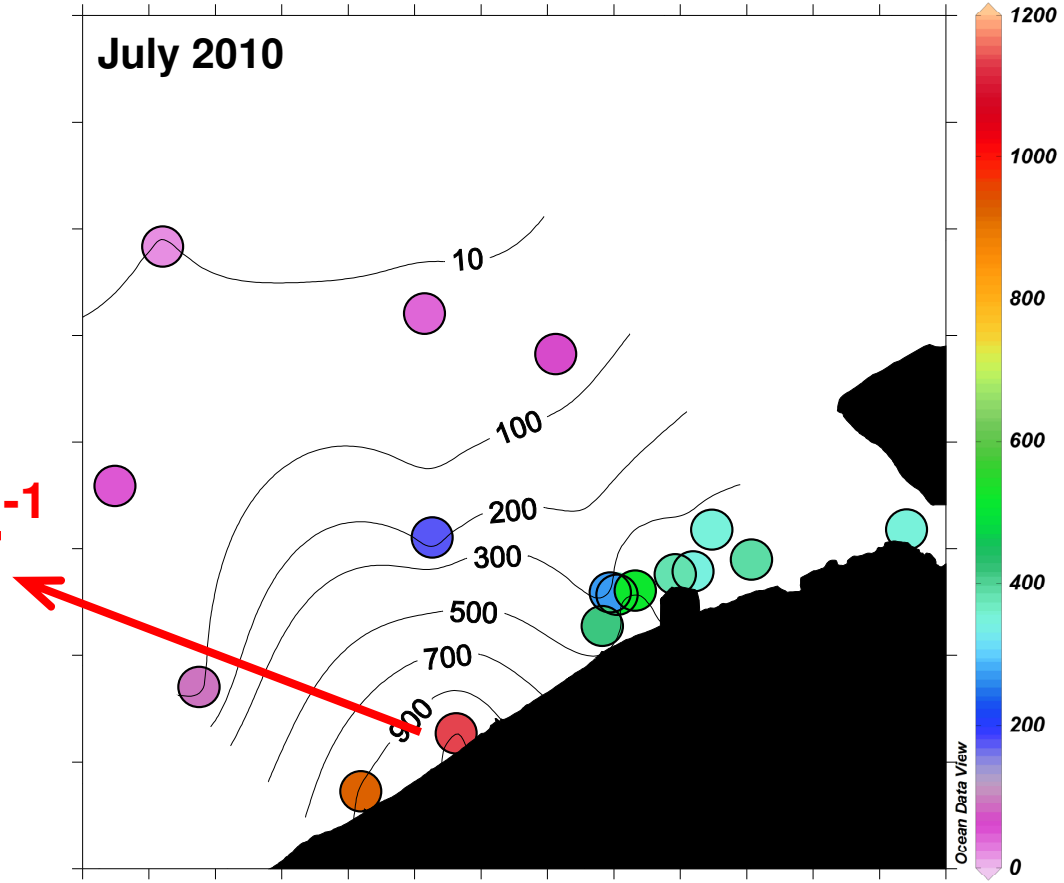
SoMAS School of Marine and Atmospheric Sciences
STONY BROOK UNIVERSITY

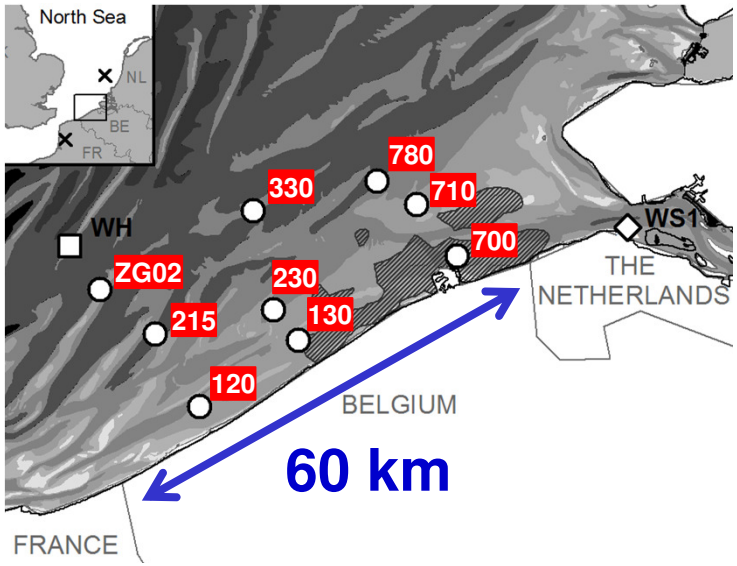
Methane in the Belgian coastal zone (July 2010)

1030 nmol L^{-1}

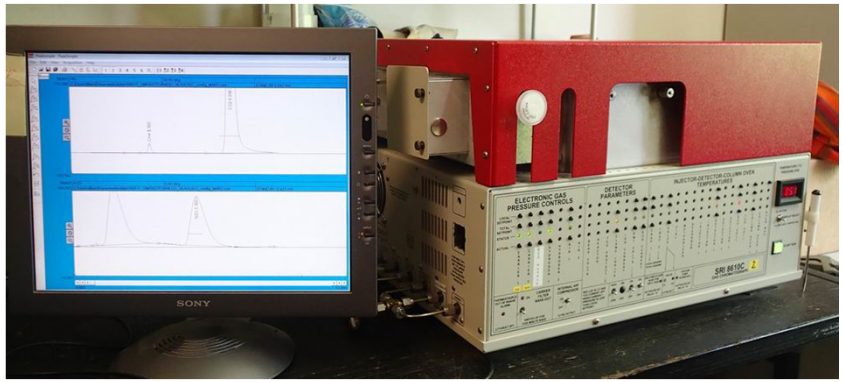


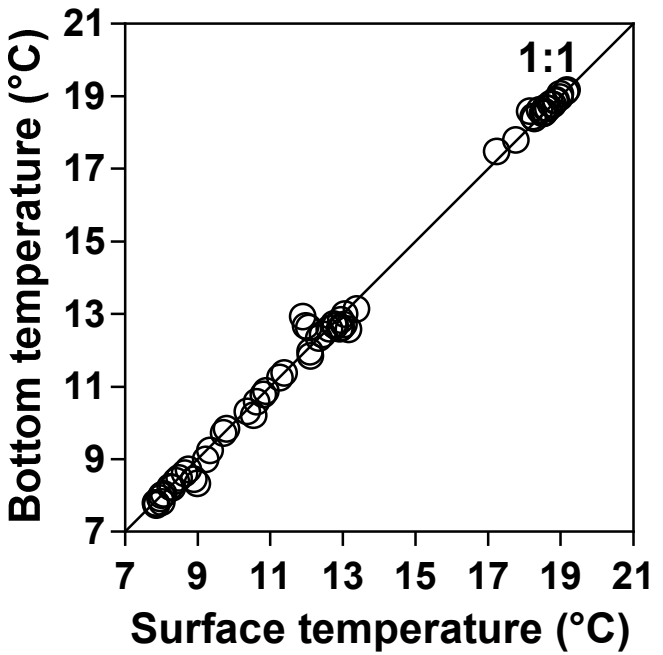
Open Ocean: <4 nmol L^{-1}

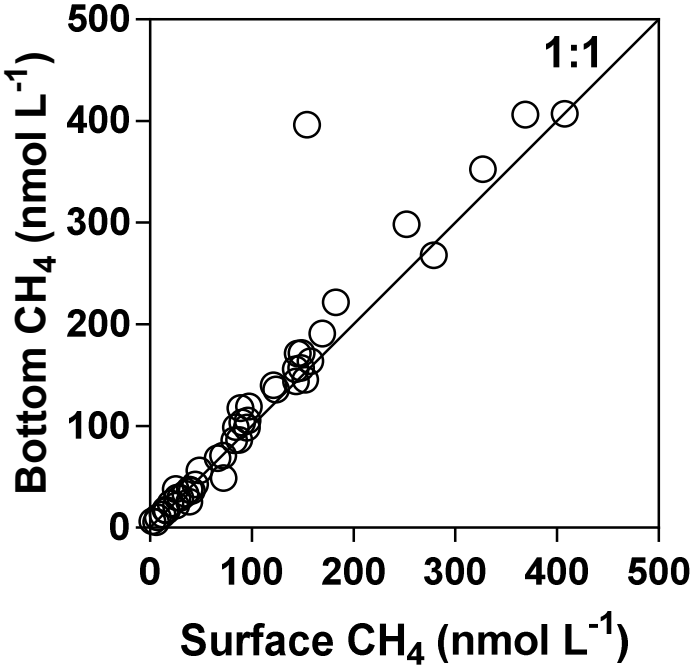
Coastal Ocean: <100 nmol L^{-1}

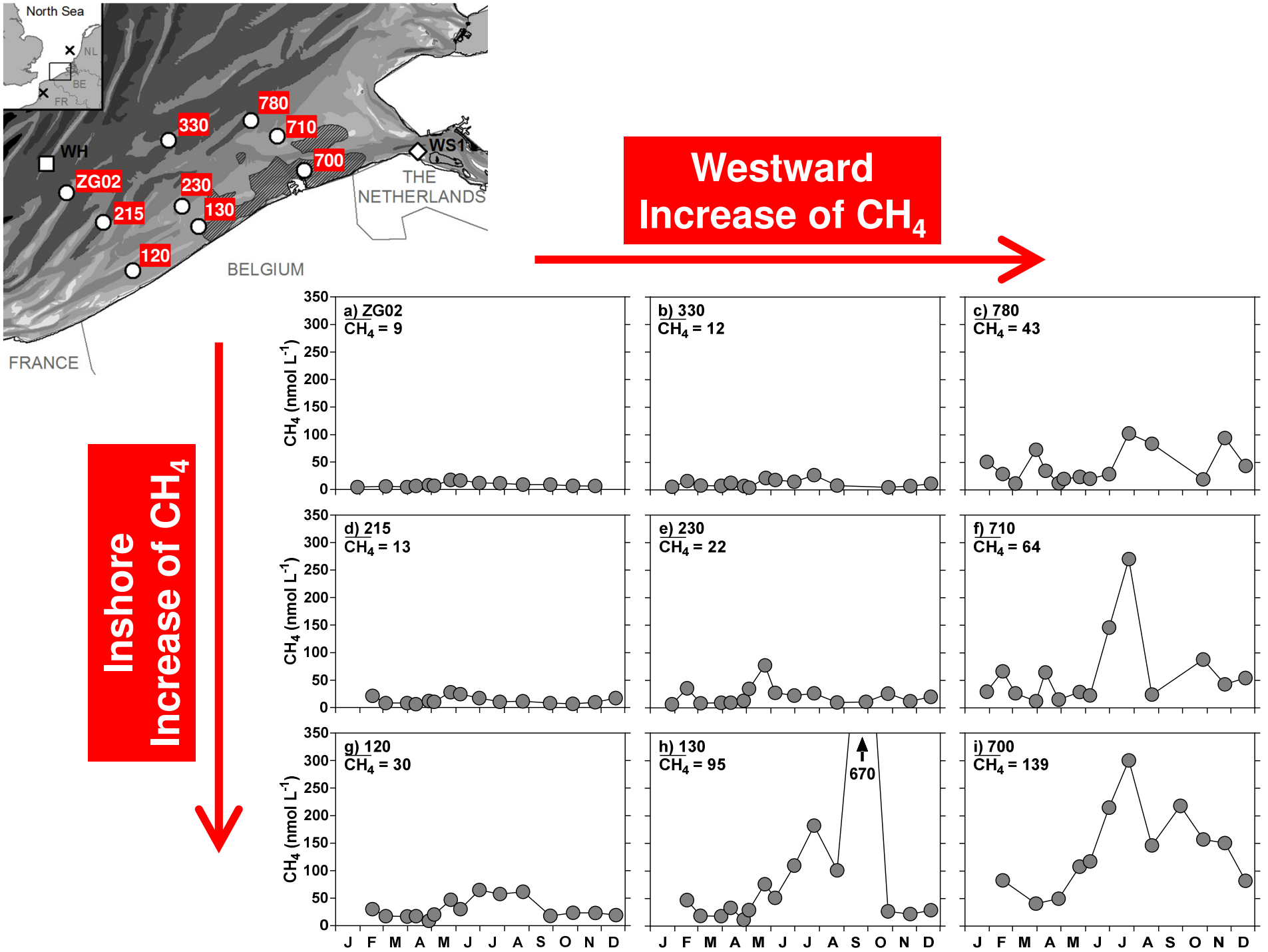


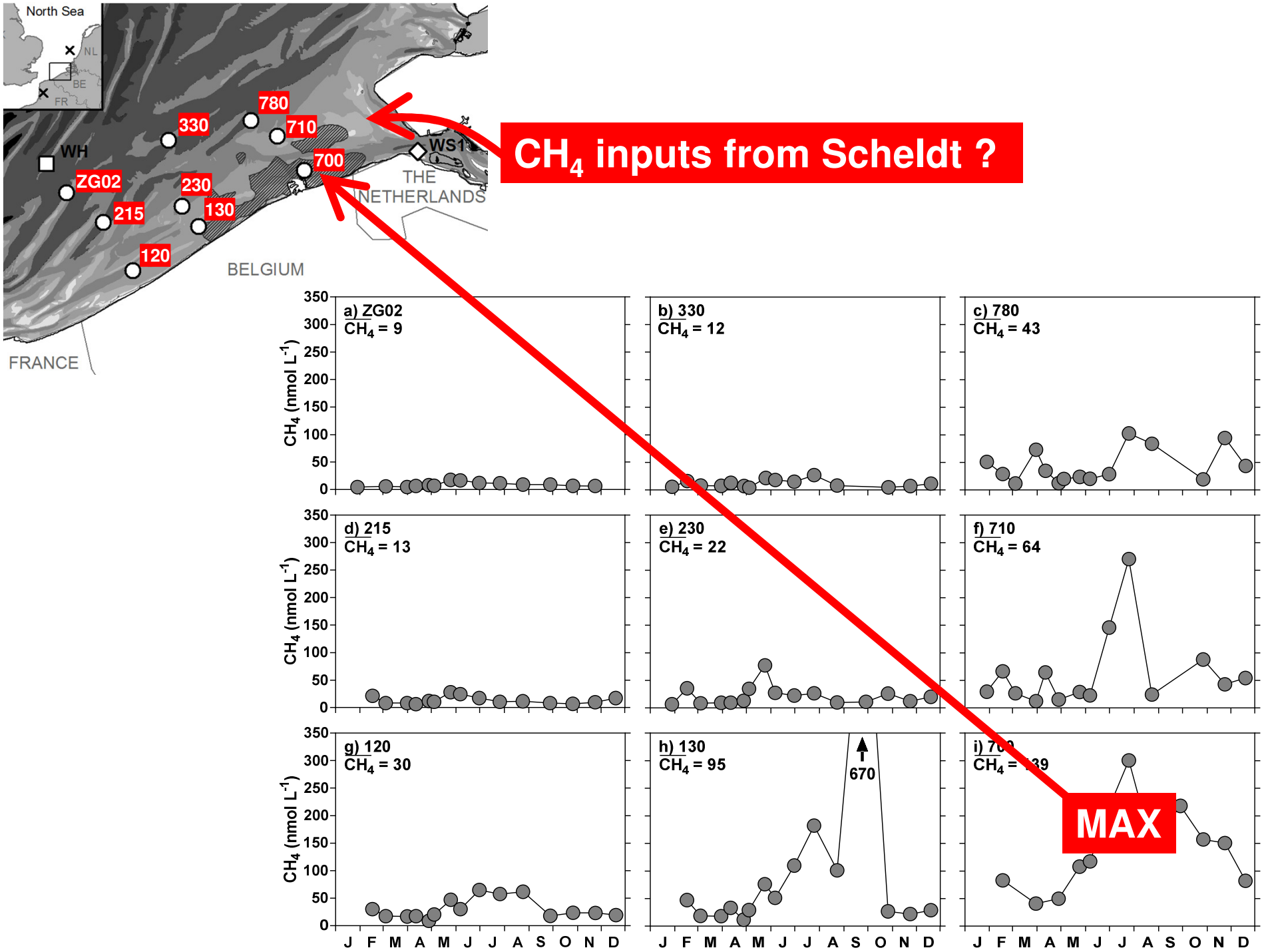
- Shallow (<30 m)
- Influenced by the Scheldt river
- Highly productive
- Permanently mixed
- Study of small scale variability

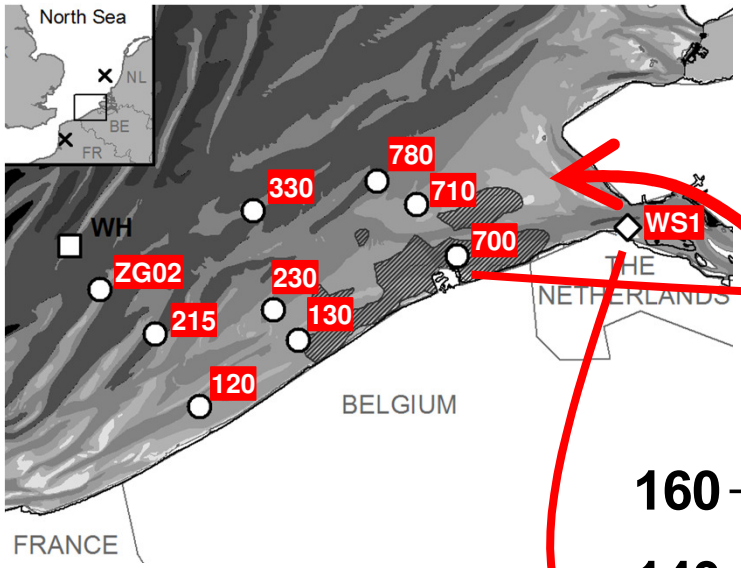




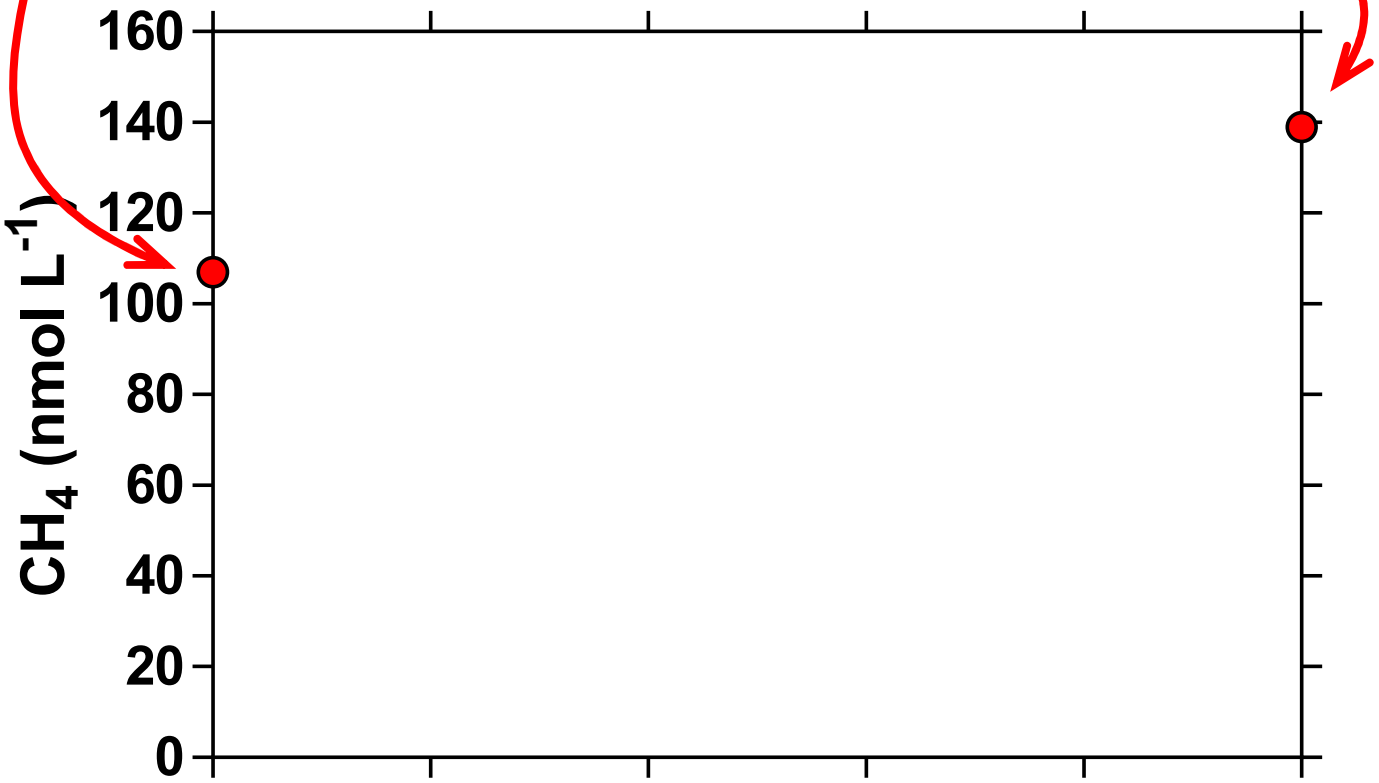


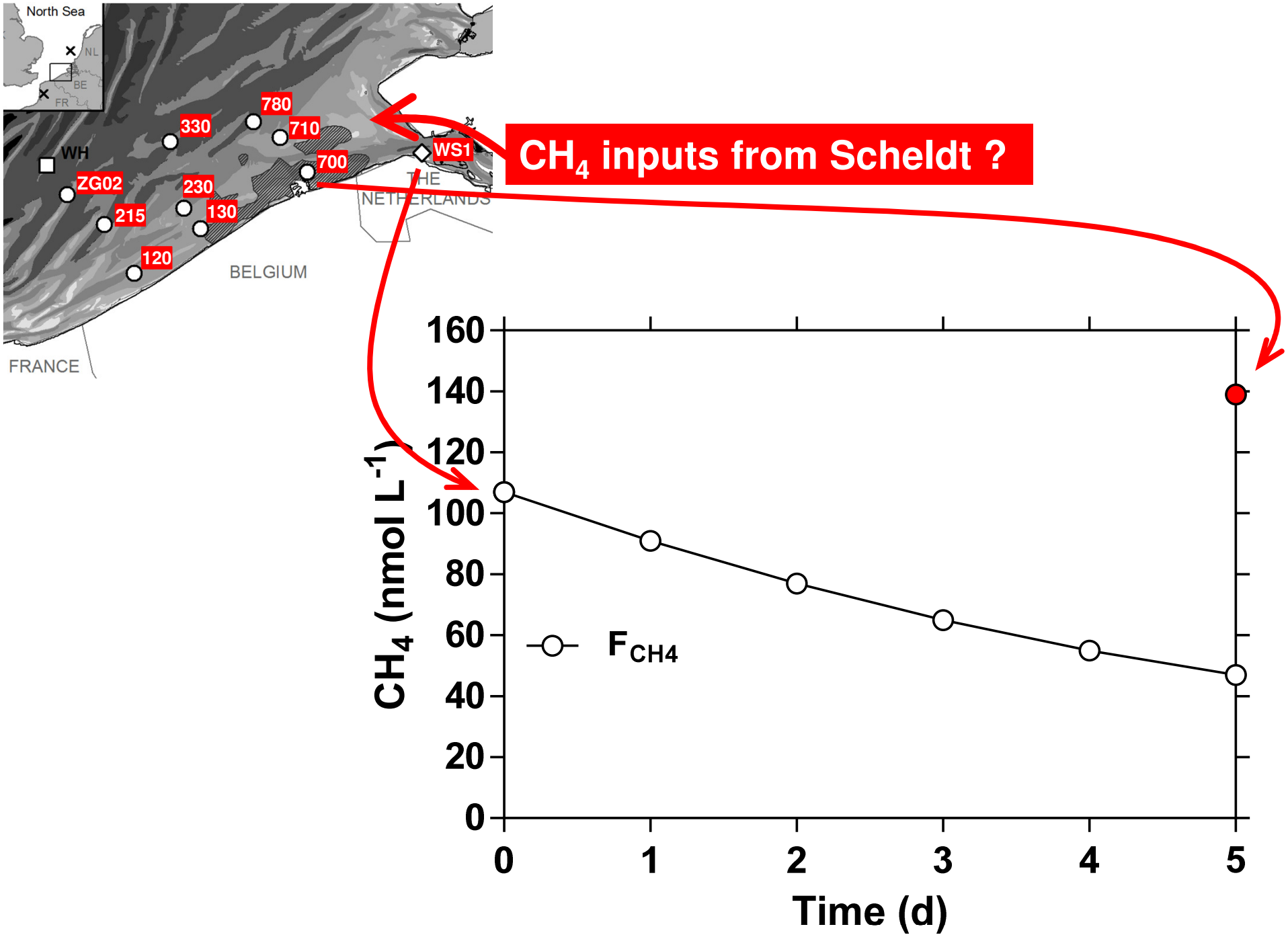

North Sea
NL
BE
FR
WH
ZG02
215
120
330
230
130
780
710
700
WS1
THE NETHERLANDS
BELGIUM
FRANCE
Westward Increase of CH4
Inshore Increase of CH4
a) ZG02
CH4 = 9
b) 330
CH4 = 12
c) 780
CH4 = 43
d) 215
CH4 = 13
e) 230
CH4 = 22
f) 710
CH4 = 64
g) 120
CH4 = 30
h) 130
CH4 = 95
670
i) 700
CH4 = 139
CH4 (nmol L-1)
0
50
100
150
200
250
300
350
J F M A M J J A S O N D

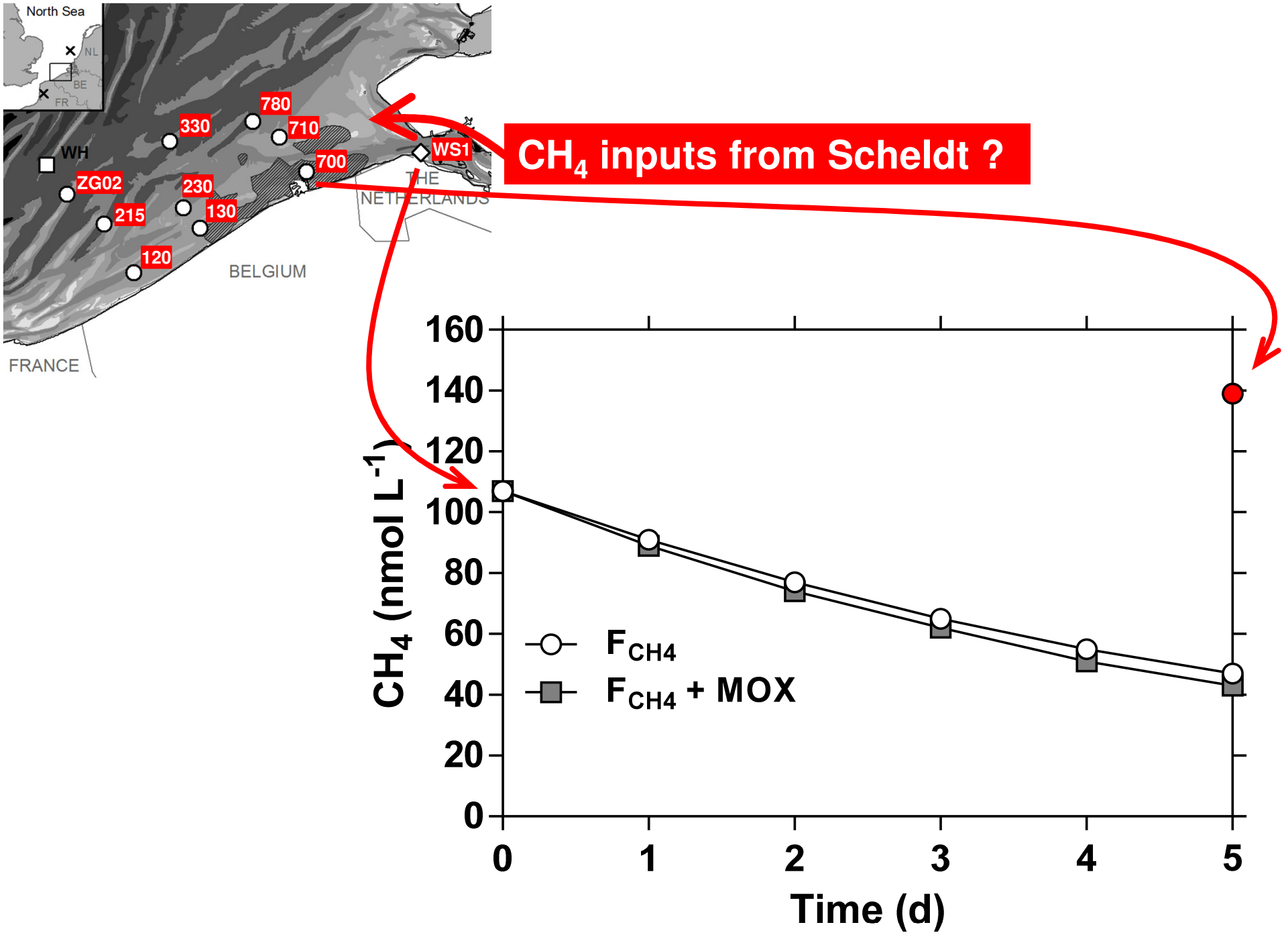

North Sea
NL
BE
FR
WH
ZG02
215
120
330
230
130
780
710
700
WS1
THE NETHERLANDS
BELGIUM
FRANCE
CH4 inputs from Scheldt ?
a) ZG02
CH4 = 9
b) 330
CH4 = 12
c) 780
CH4 = 43
d) 215
CH4 = 13
e) 230
CH4 = 22
f) 710
CH4 = 64
g) 120
CH4 = 30
h) 130
CH4 = 95
670
MAX
CH4 (nmol L-1)
0
50
100
150
200
250
300
350
J F M A M J J A S O N D

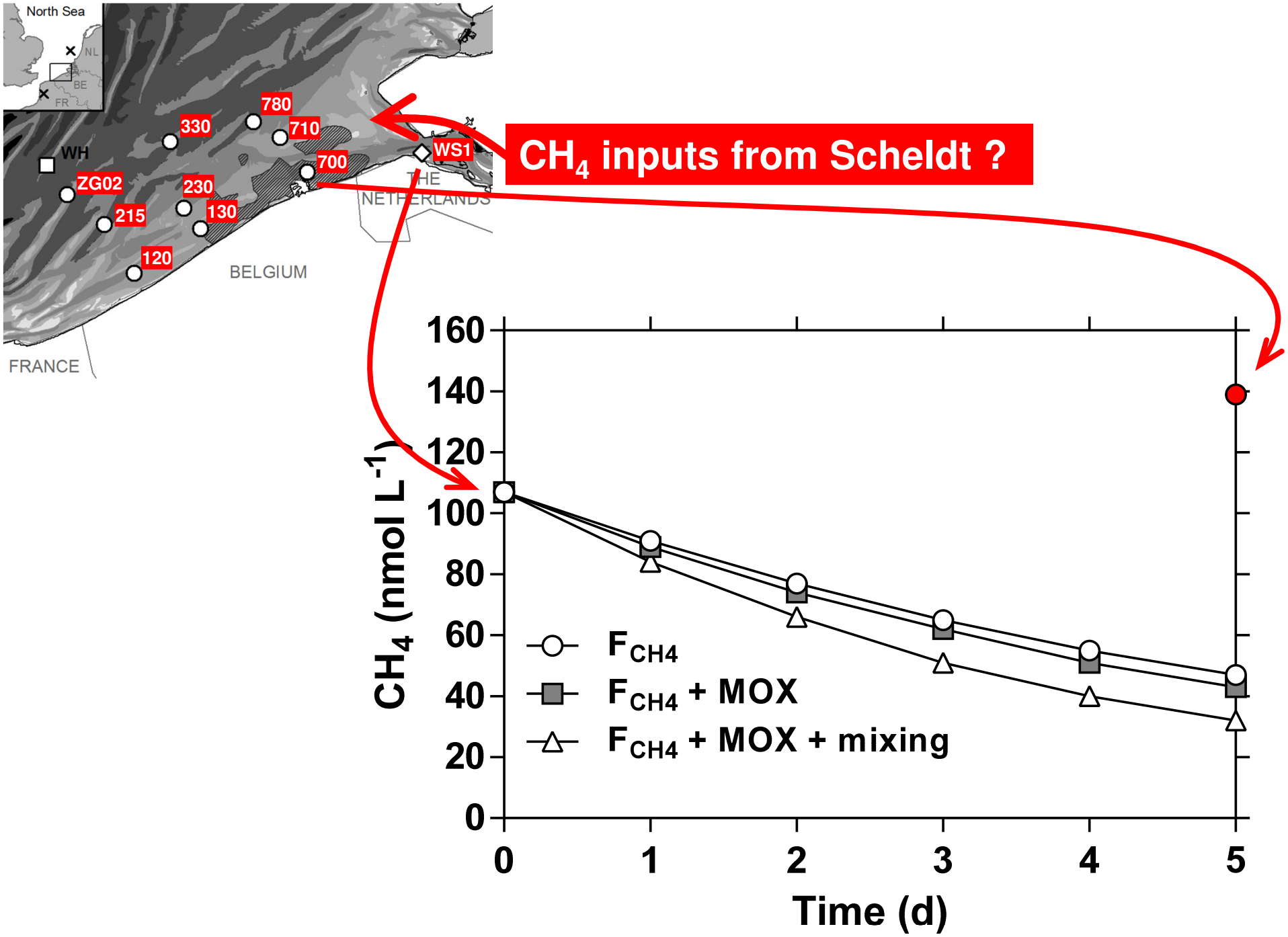


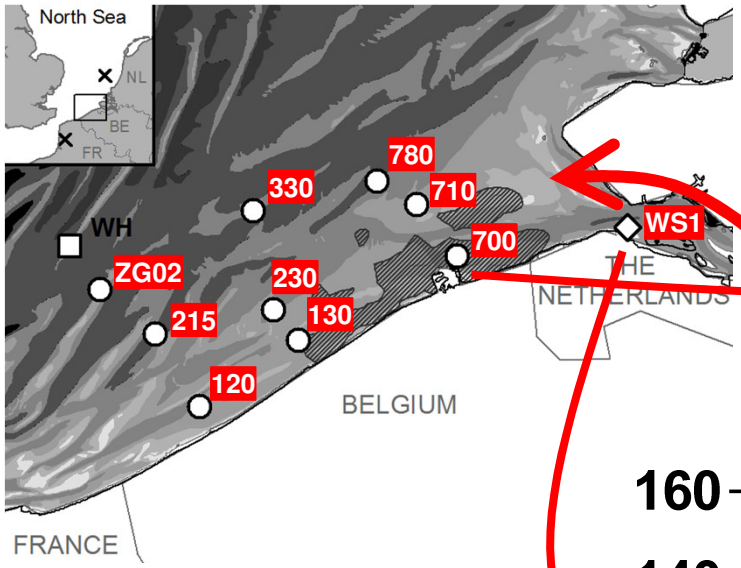
CH_4 inputs from Scheldt ?



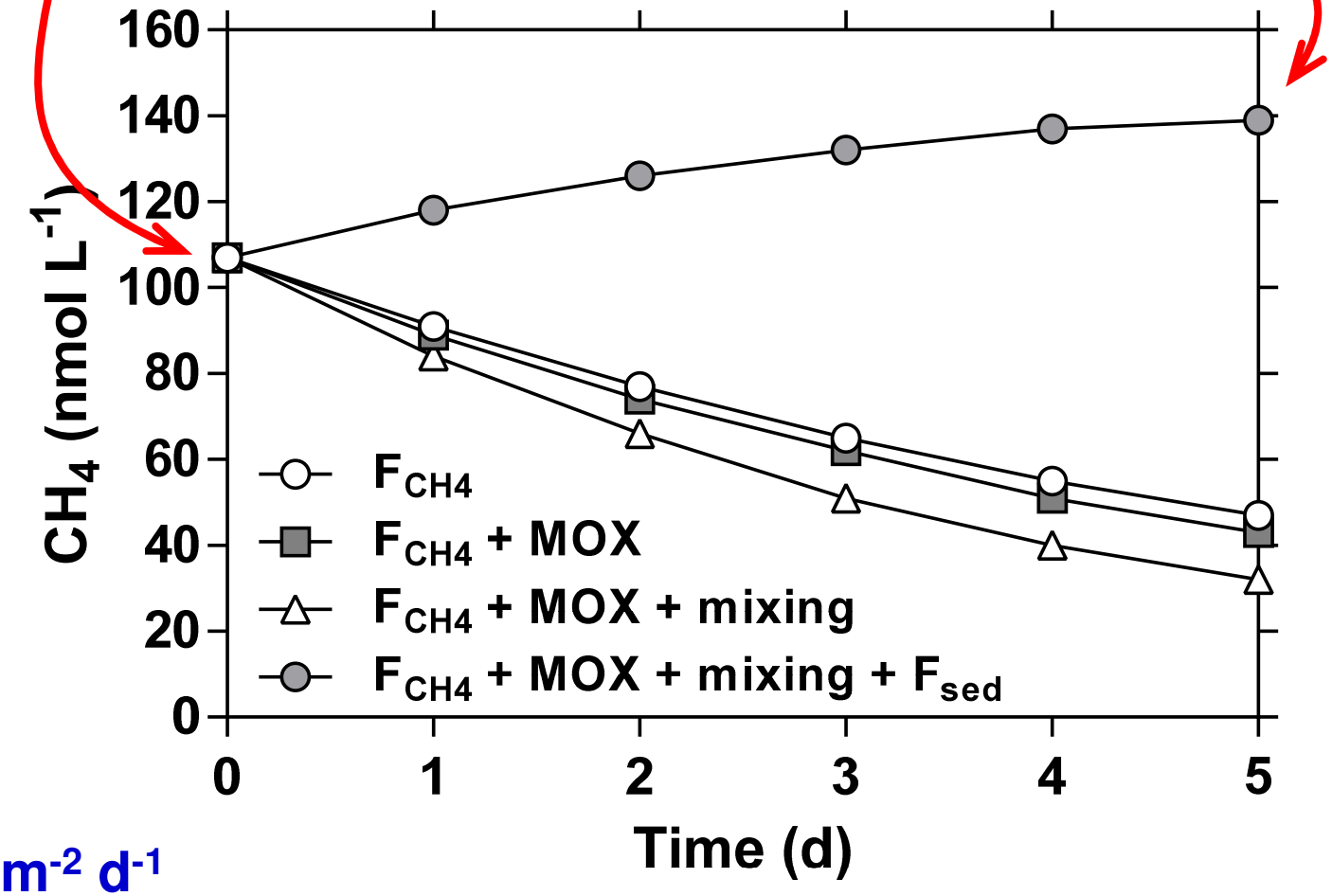

North Sea
NL
BE
FR
780
710
330
WH
700
WS1
ZG02
230
130
215
120
THE NETHERLANDS
BELGIUM
FRANCE
CH4 inputs from Scheldt ?
160
140
120
100
80
60
40
20
0
CH4 (nmol L-1)
FCH4
0
1
2
3
4
5
Time (d)


North Sea
NL
BE
FR
780
710
330
WS1
WH
700
ZG02
230
130
215
120
THE NETHERLANDS
BELGIUM
FRANCE
CH4 inputs from Scheldt ?
160
140
120
100
80
60
40
20
0
CH4 (nmol L-1)
FCH4
FCH4 + MOX
0
1
2
3
4
5
Time (d)

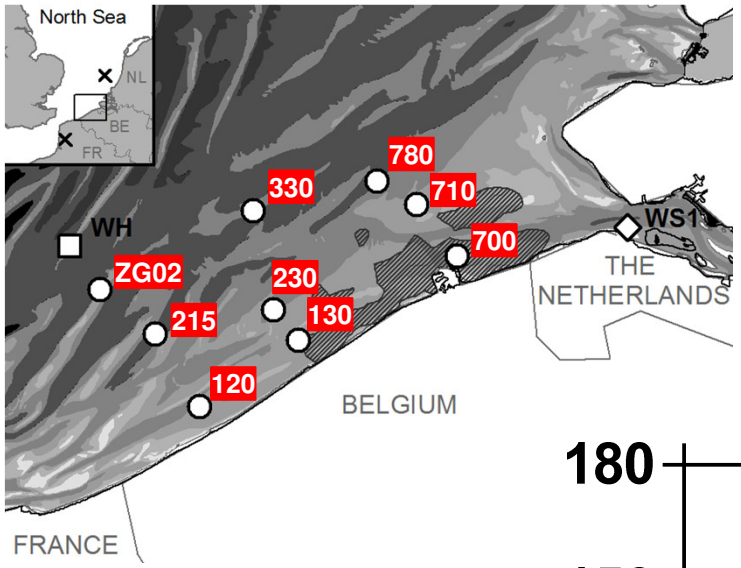

North Sea
NL
BE
FR
WH
ZG02
215
120
330
230
130
780
710
700
WS1
THE NETHERLANDS
BELGIUM
FRANCE
CH4 inputs from Scheldt ?
CH4 (nmol L-1)
160
140
120
100
80
60
40
20
0
0
1
2
3
4
5
Time (d)
FCH4
FCH4 + MOX
FCH4 + MOX + mixing



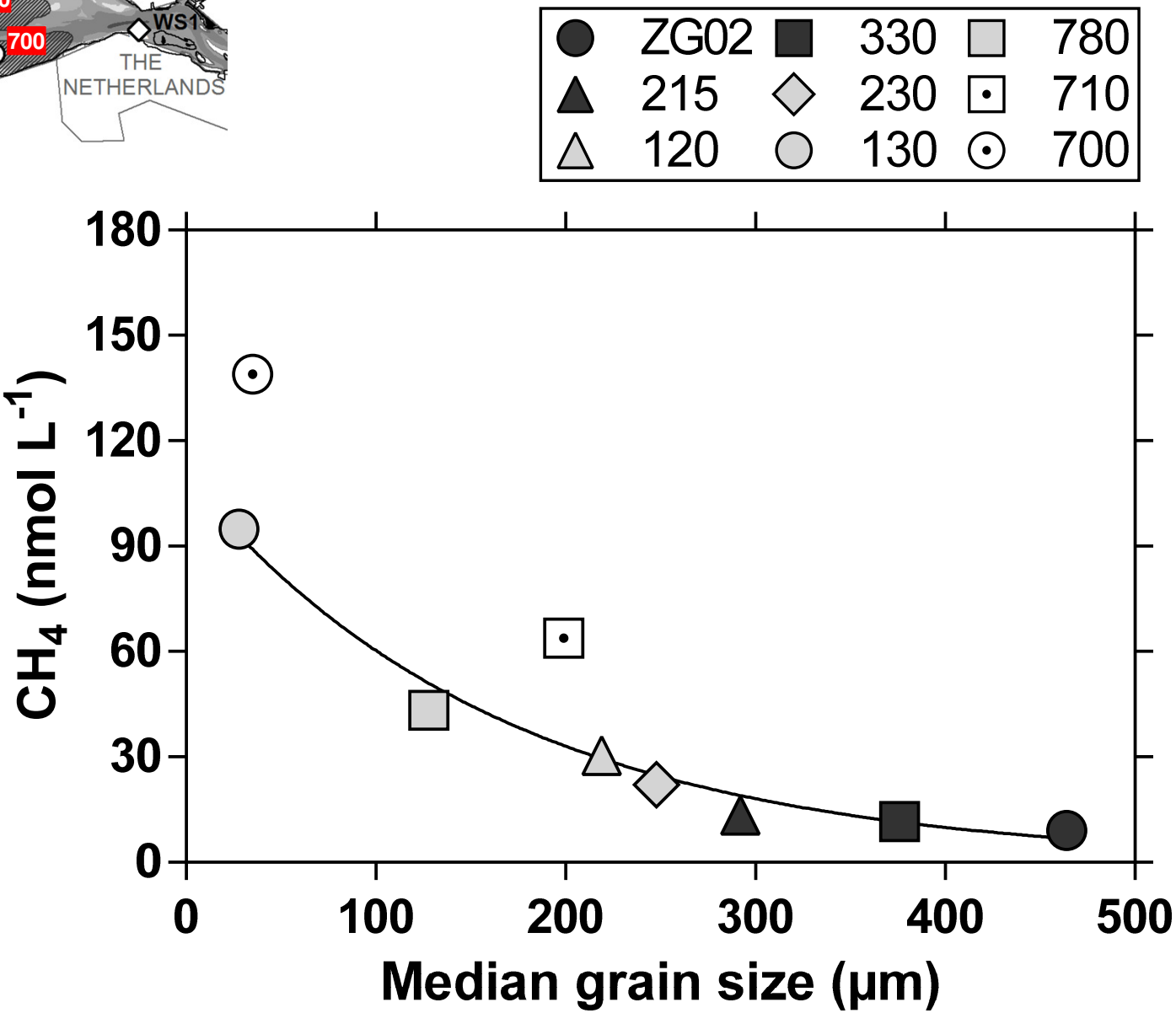
CH_4 inputs from Scheldt ?

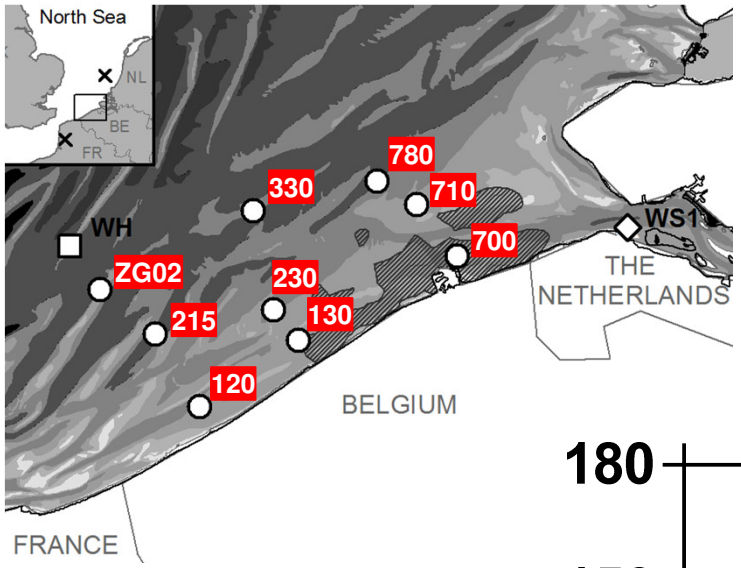


Fsed = 103 µmol m^{-2} d^{-1}

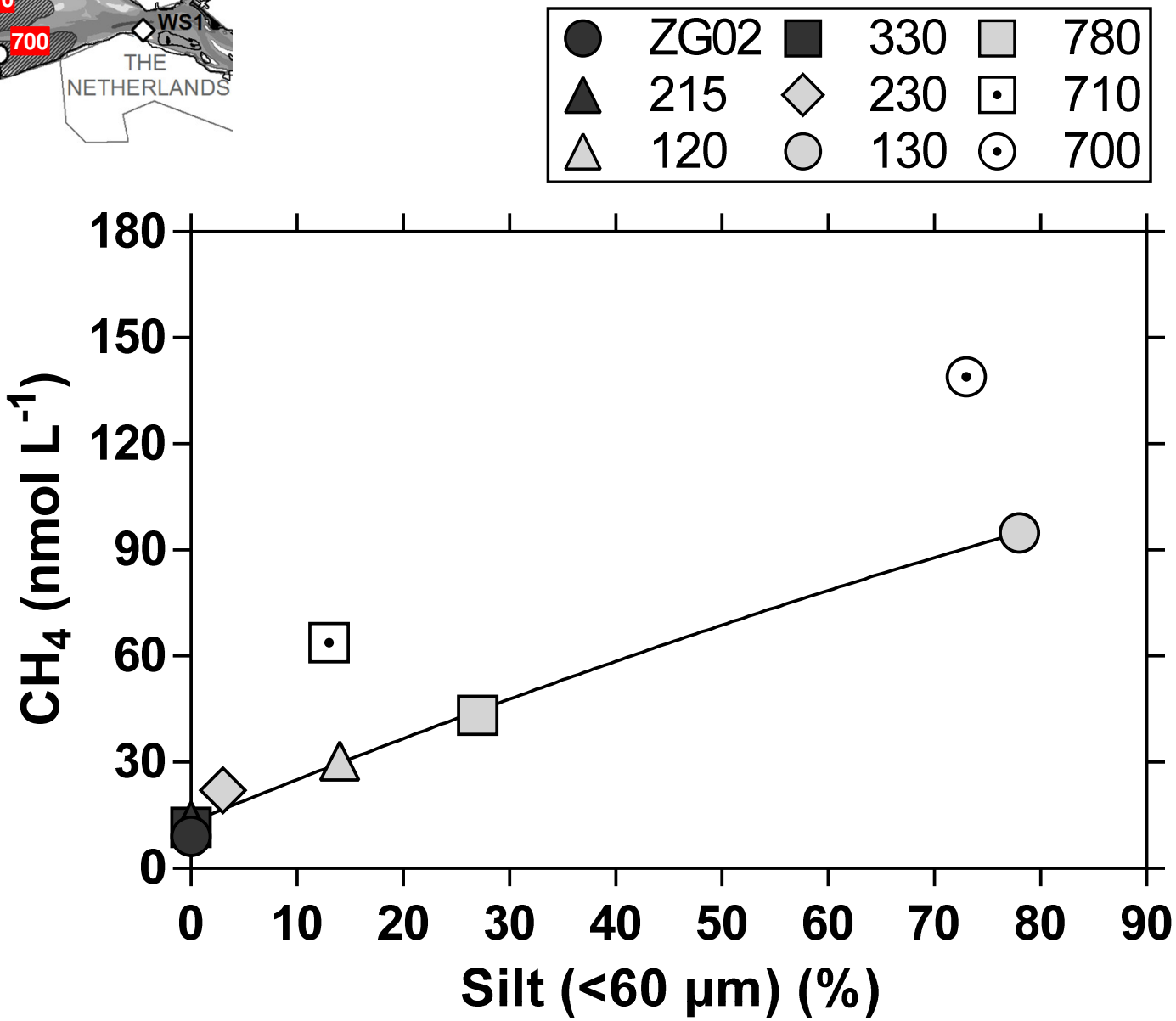


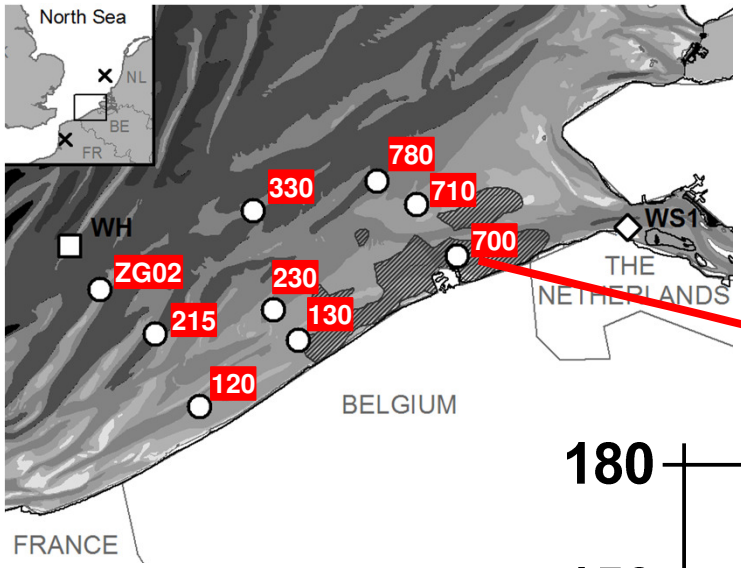
Drivers of spatial variability of CH_4?





Drivers of spatial variability of CH_4?





Drivers of spatial variability of CH_4?

ZG02 330 780
215 230 710
120 130 700

CH_4 (nmol L^{-1})

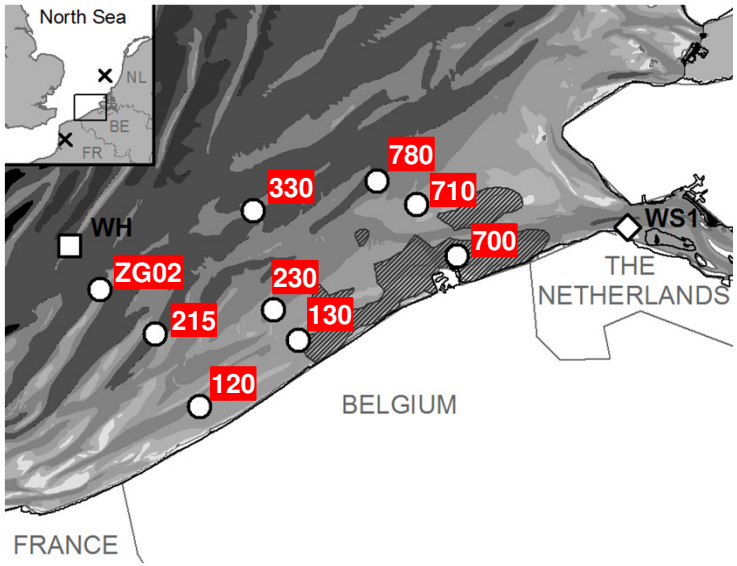
180
150
120
90
60
30
0

0.0 0.5 1.0 1.5 2.0 2.5

%Organic matter (%)

Inputs from gassy sediments

Enhancement benthic methanogenesis with organic matter availability



Drivers of spatial variability of CH_4?

PERGAMON

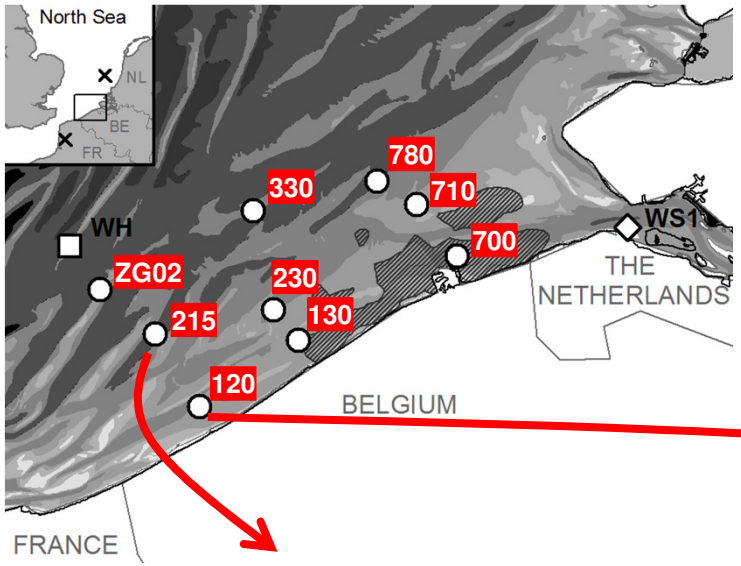
Continental Shelf Research 22 (2002) 2291–2301

CONTINENTAL SHELF RESEARCH

www.elsevier.com/locate/csr

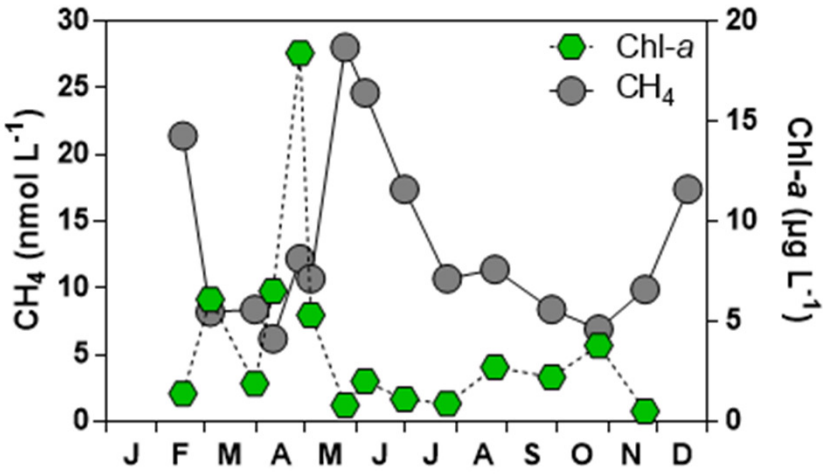
Very high-resolution seismic mapping of shallow gas in the Belgian coastal zone

T. Missiaen[a,*], S. Murphy[b,1], L. Loncke[a], J.-P. Henriet[a]

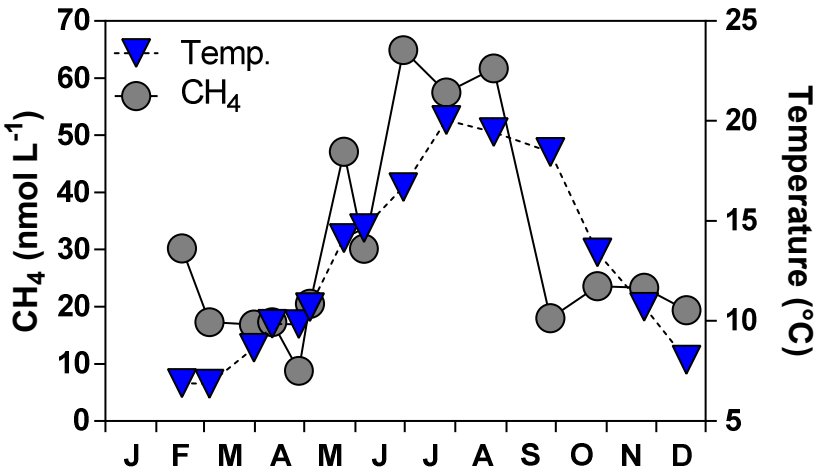


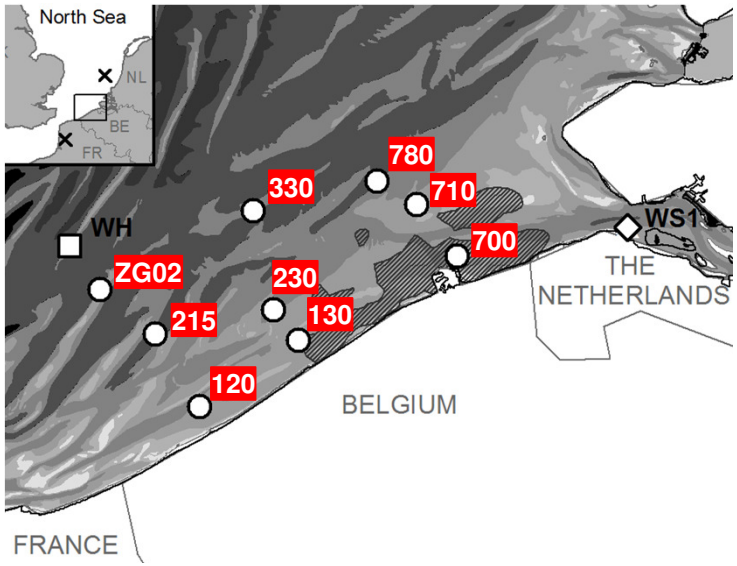
Drivers of seasonal variability of CH_4?

Off-shore sandy
Low organic sediments
Phyto = fresh organic inputs

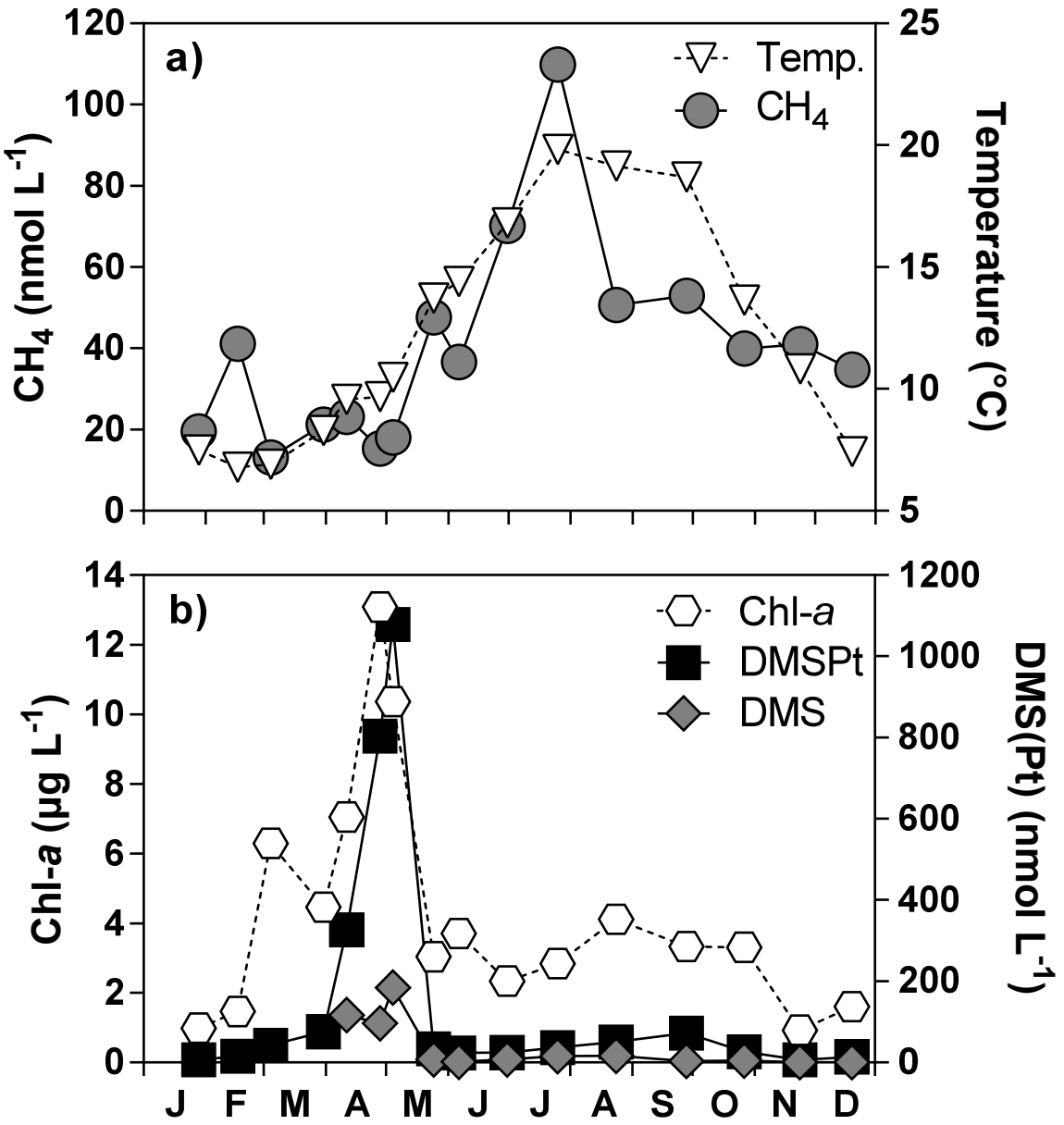


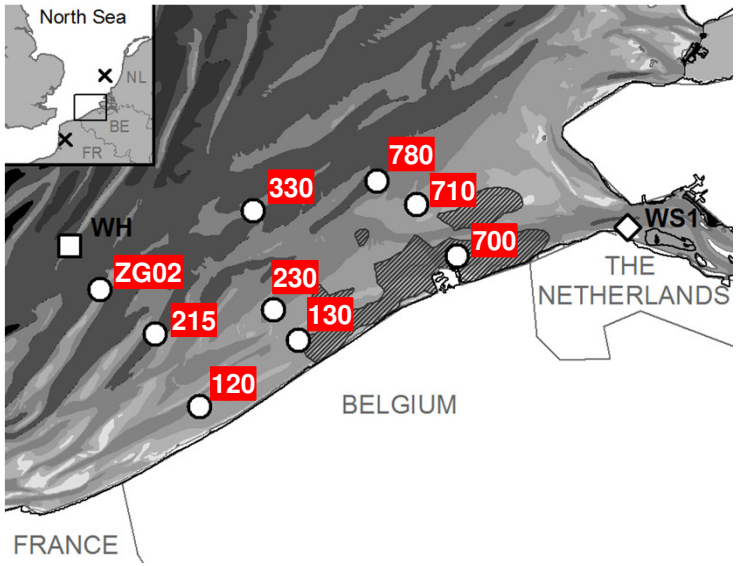
Near-shore muddy
High organic sediments
Temperature controlled



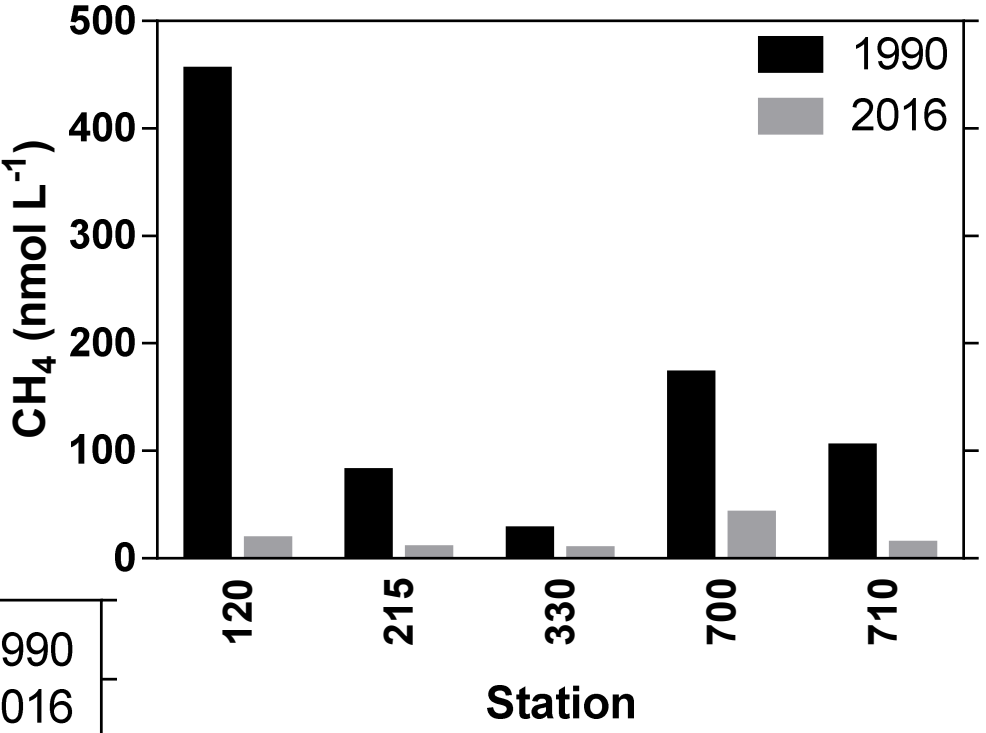


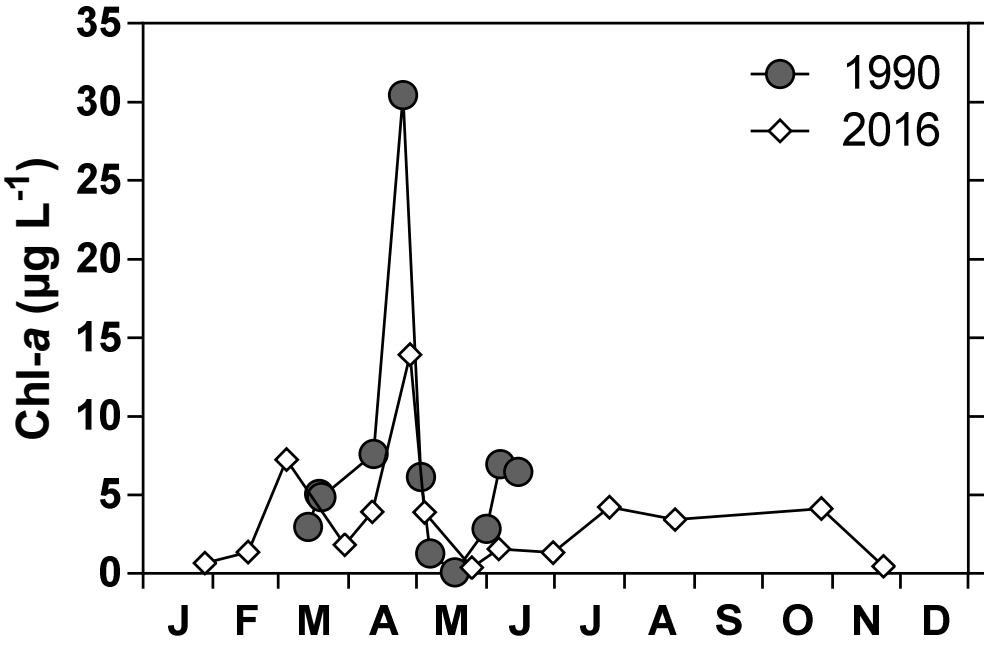
Drivers of seasonal variability of CH_4?



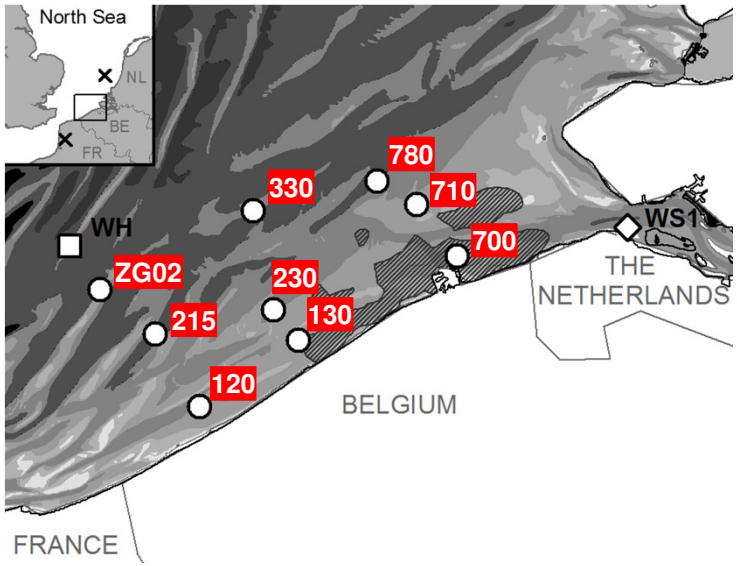


Long-term changes in CH_4 ?





Decrease of eutrophication
Decrease of phyto biomass
Decrease of CH_4 production



Emissions of CH_4 to the atmosphere

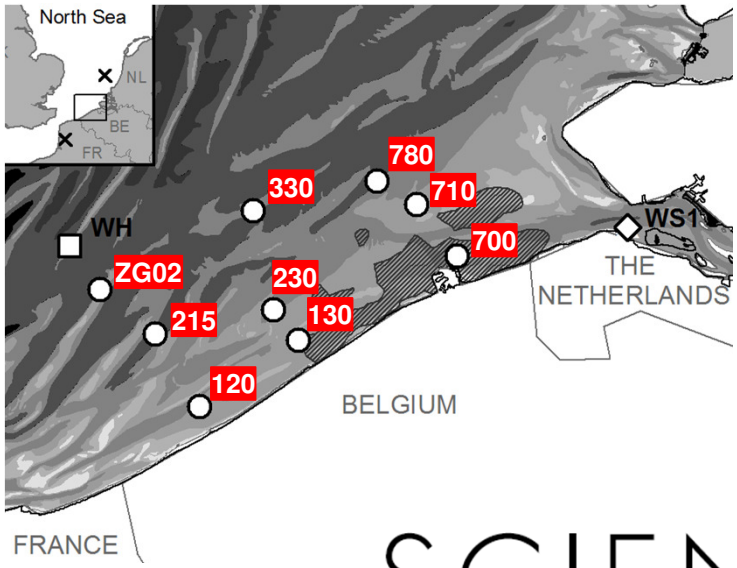
Station	CH_4 emission (mmol m^{-2} yr^{-1})		
ZG02	8	±	8
330	12	±	13
780	66	±	66
215	17	±	17
230	23	±	27
710	88	±	116
120	42	±	42
130	152	±	274
700	184	±	176
Nearshore stations*	126	±	200
Offshore stations**	28	±	47
All stations	66	±	134

* 120,130,700

** ZG02, 330, 780

Open ocean 0.1 mmol m^{-2} yr^{-1} (Rhee et al. 2009)

280 to 1260 times higher



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OPEN

Massive marine methane emissions from near-shore shallow coastal areas

Alberto V. Borges[1], Willy Champenois[1], Nathalie Gypens[2], Bruno Delille[1] & Jérôme Harlay[1]

Borges et al. (in revision)