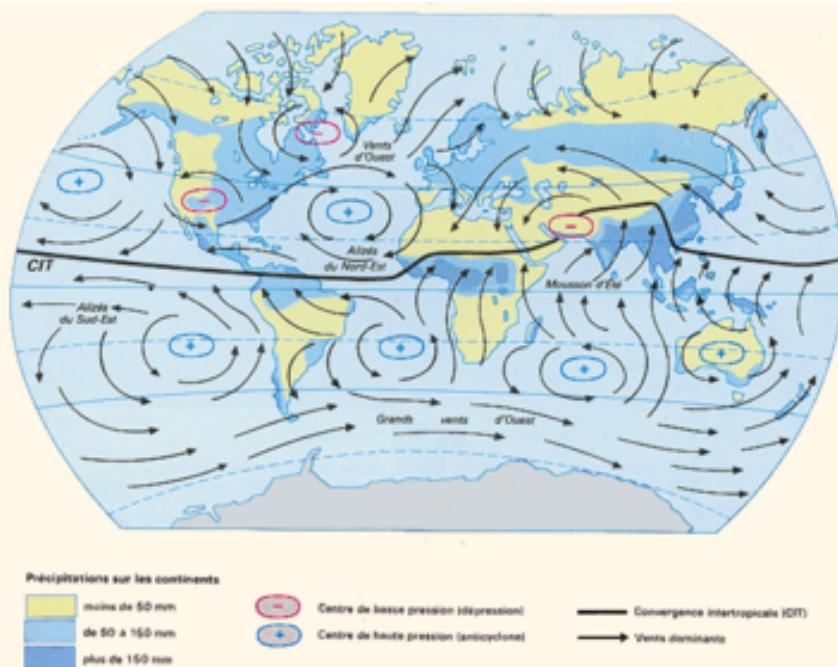


Partie I : étude des courants de surface

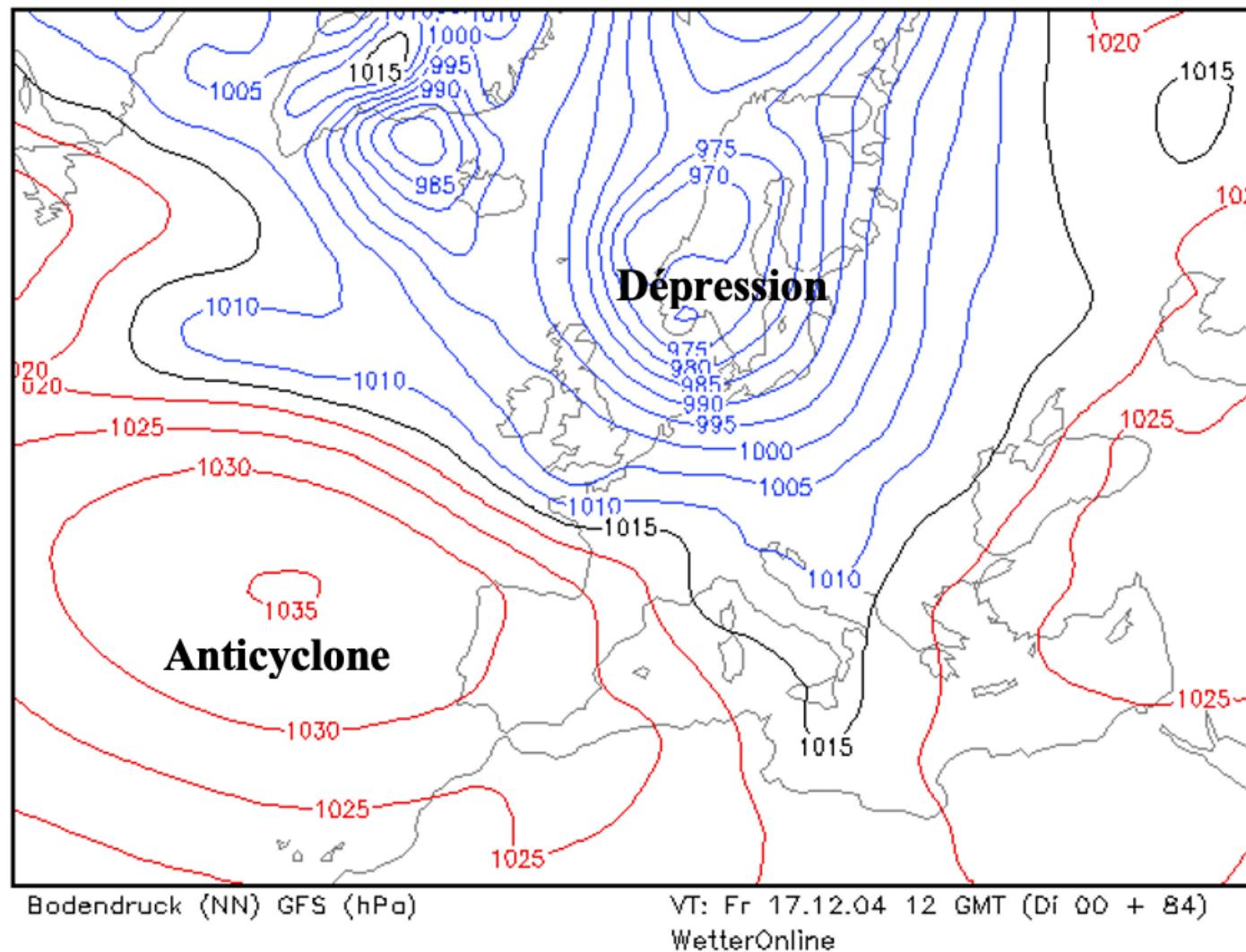
Carte de la circulation atmosphérique



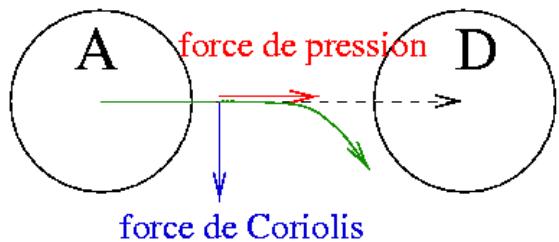
Carte de la circulation océanique de surface



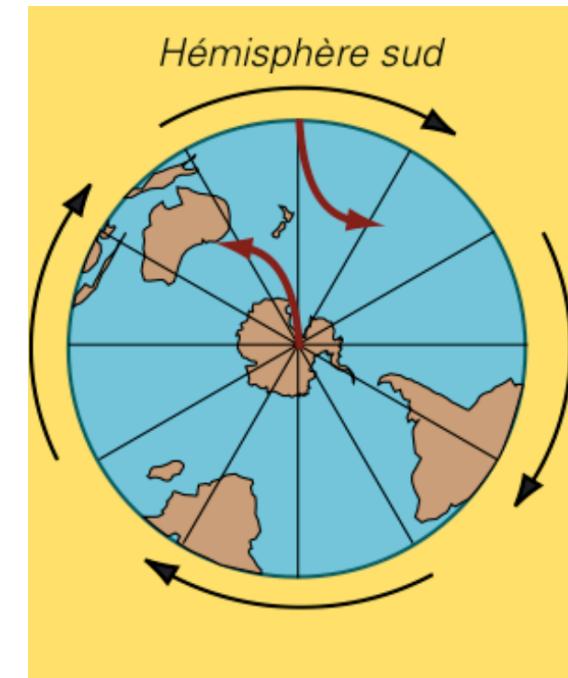
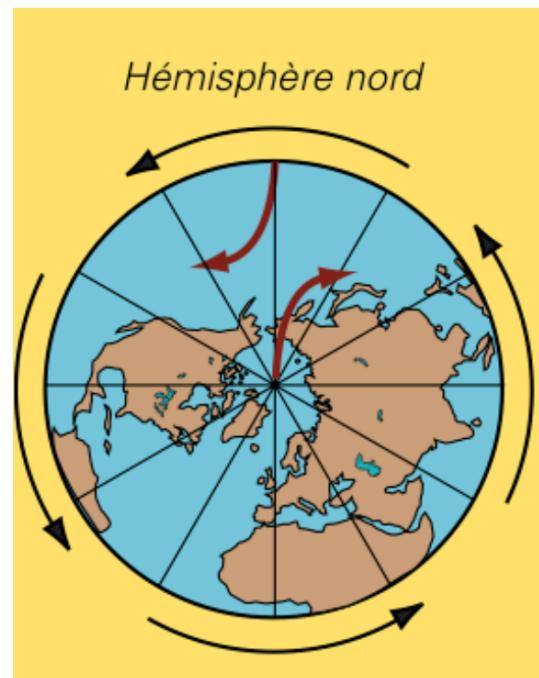
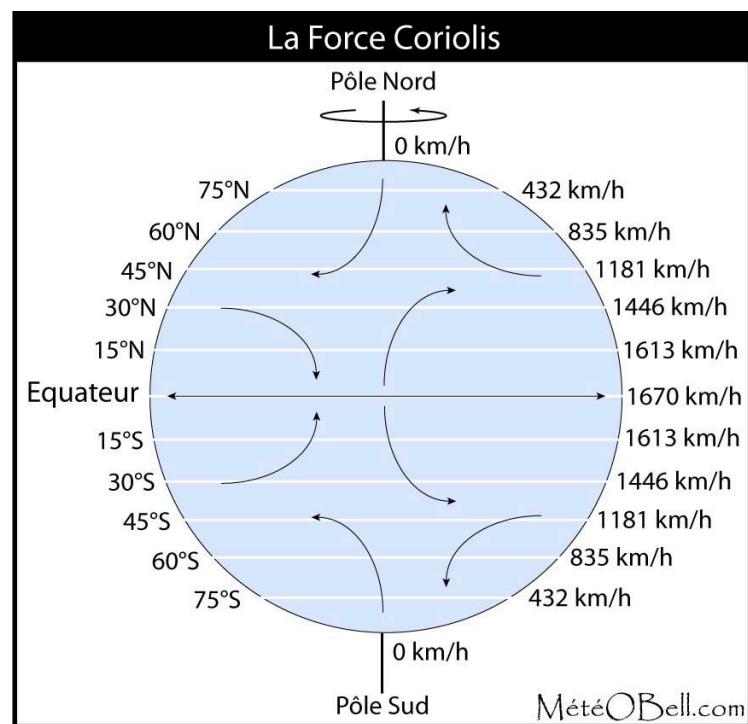
Partie I : étude des courants de surface



Partie I : étude des courants de surface



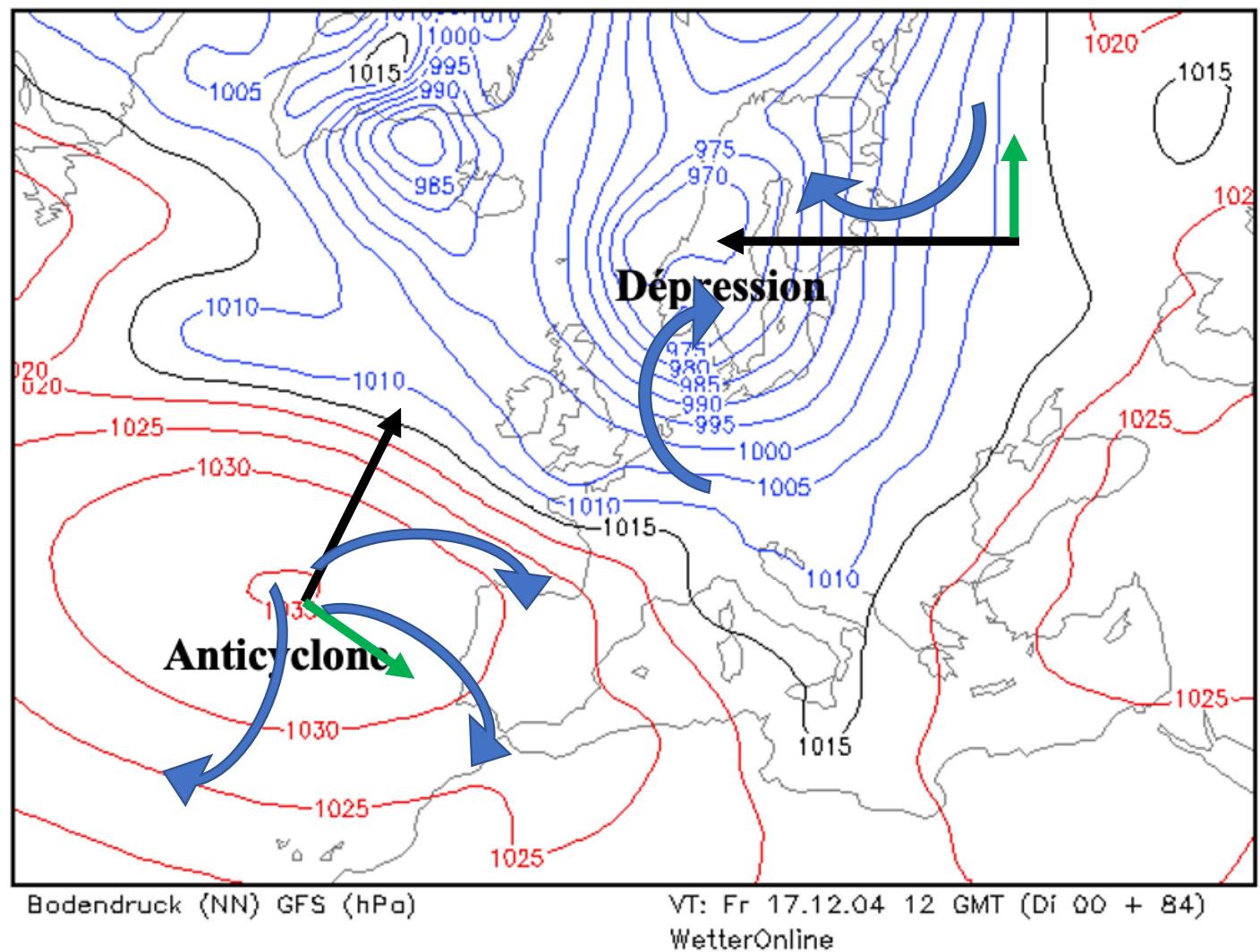
En pointillés, la trajectoire sans force de Coriolis.
La vraie trajectoire est en vert.



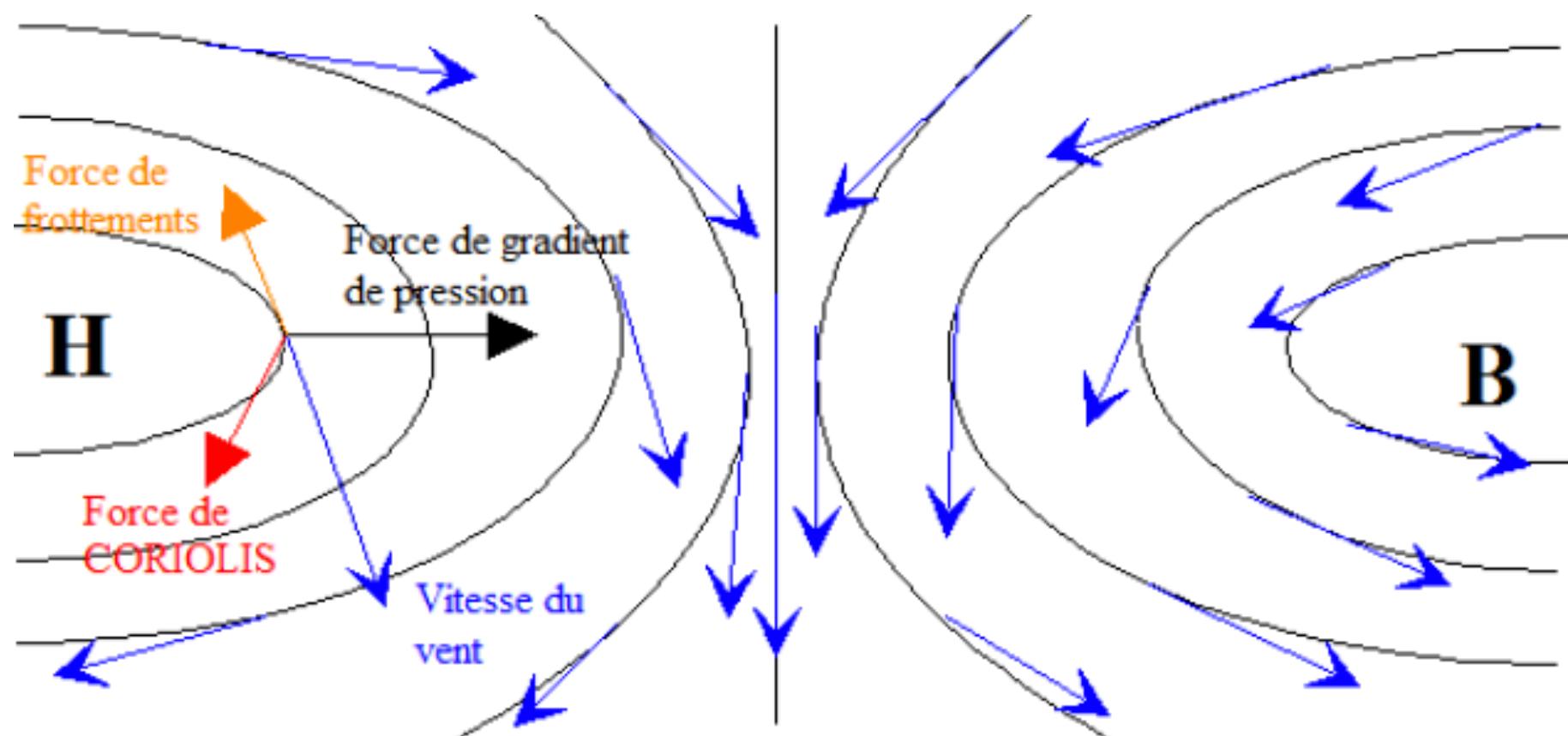


Force de gradient de pression

Force Coriolis

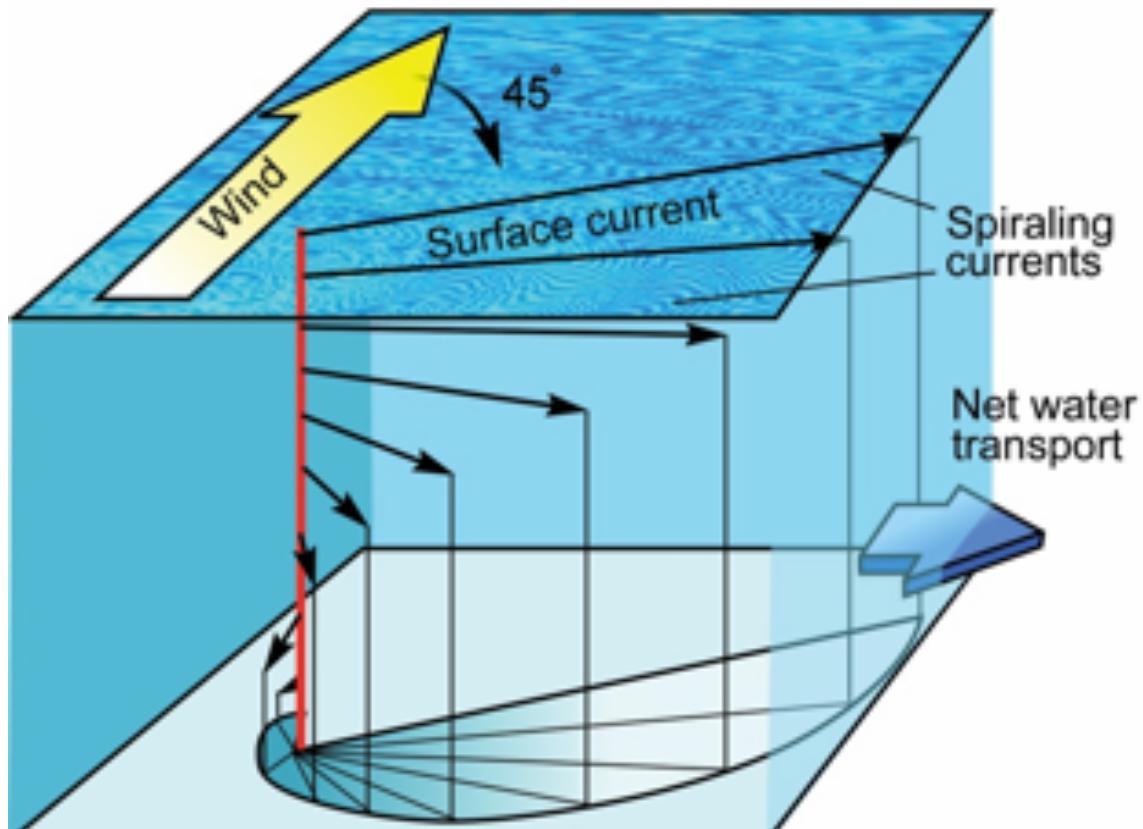


Déplacement des vents au niveau d'un anticyclone et d'une dépression



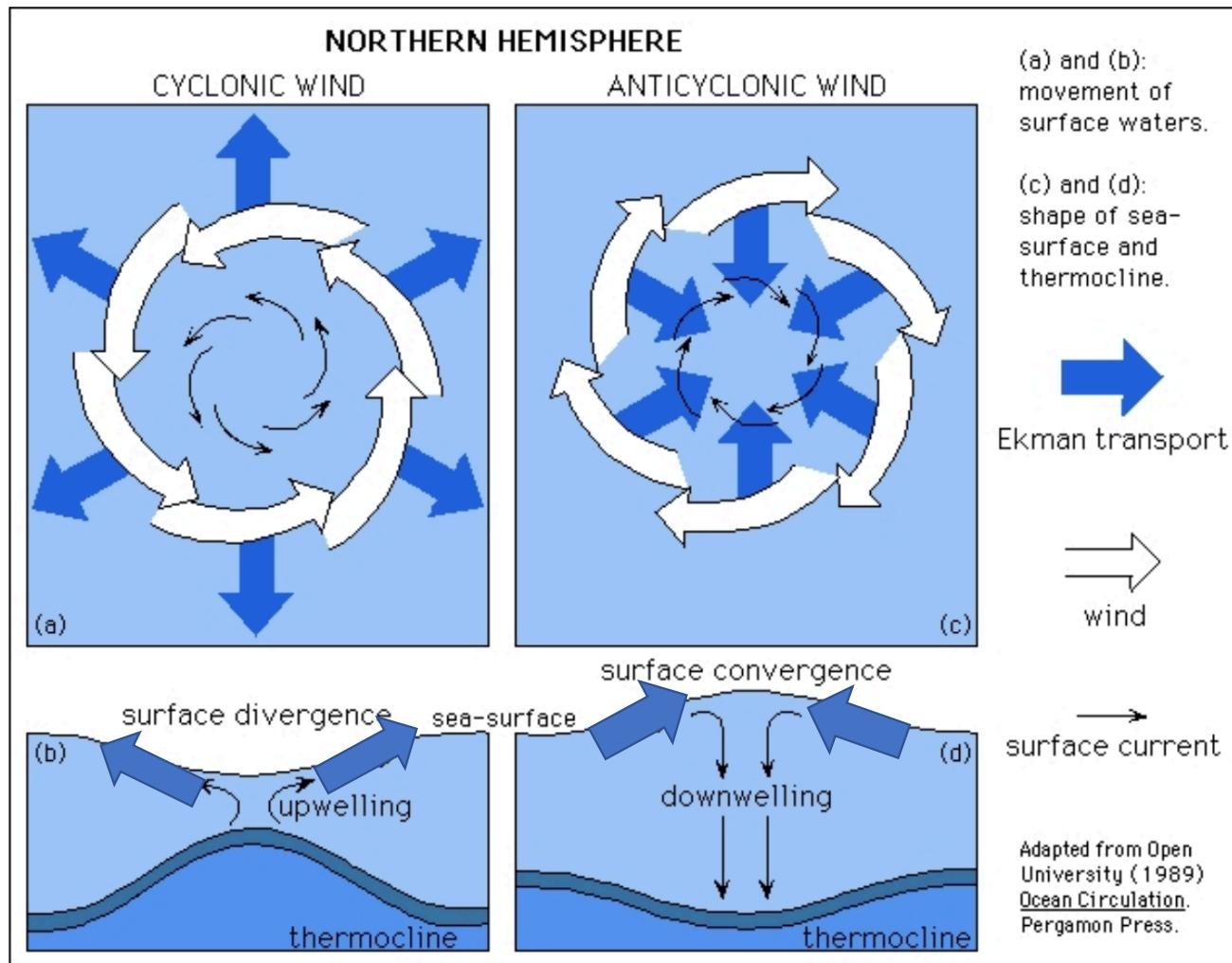
Partie I : étude des courants de surface

Spirale d'Ekman

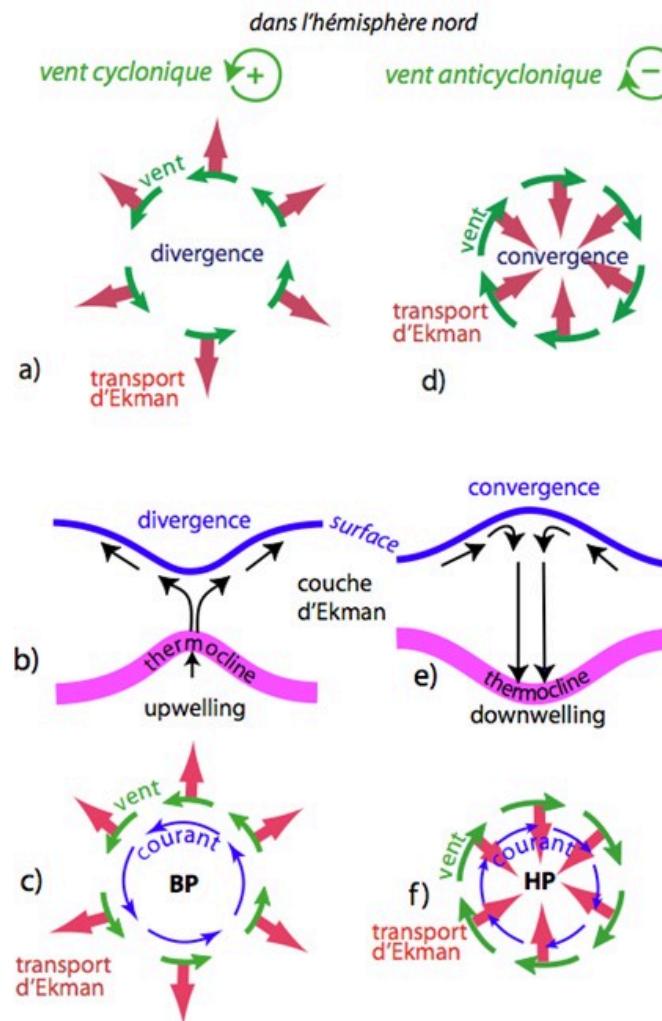


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Partie I : étude des courants de surface



Partie I : étude des courants de surface

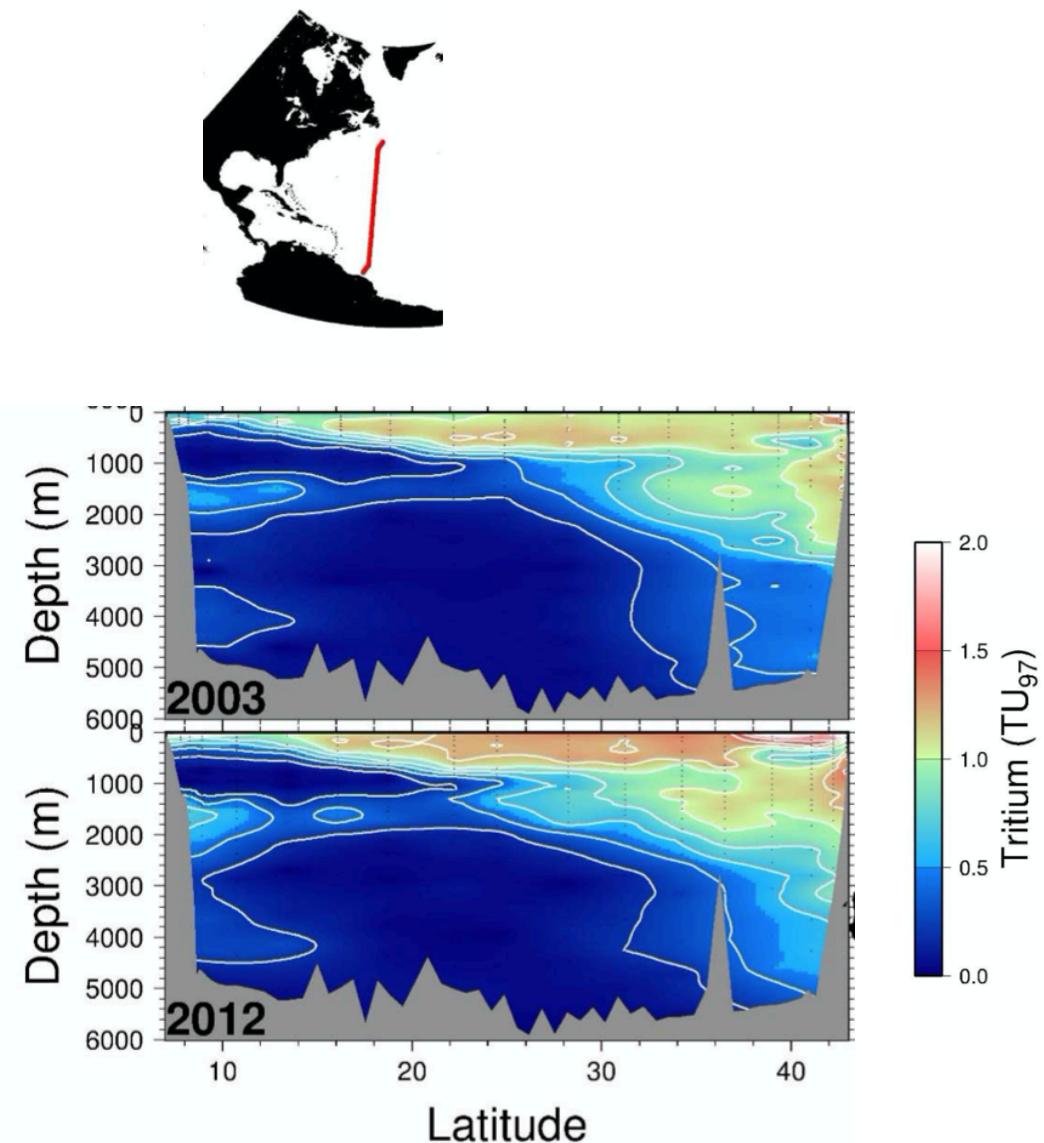
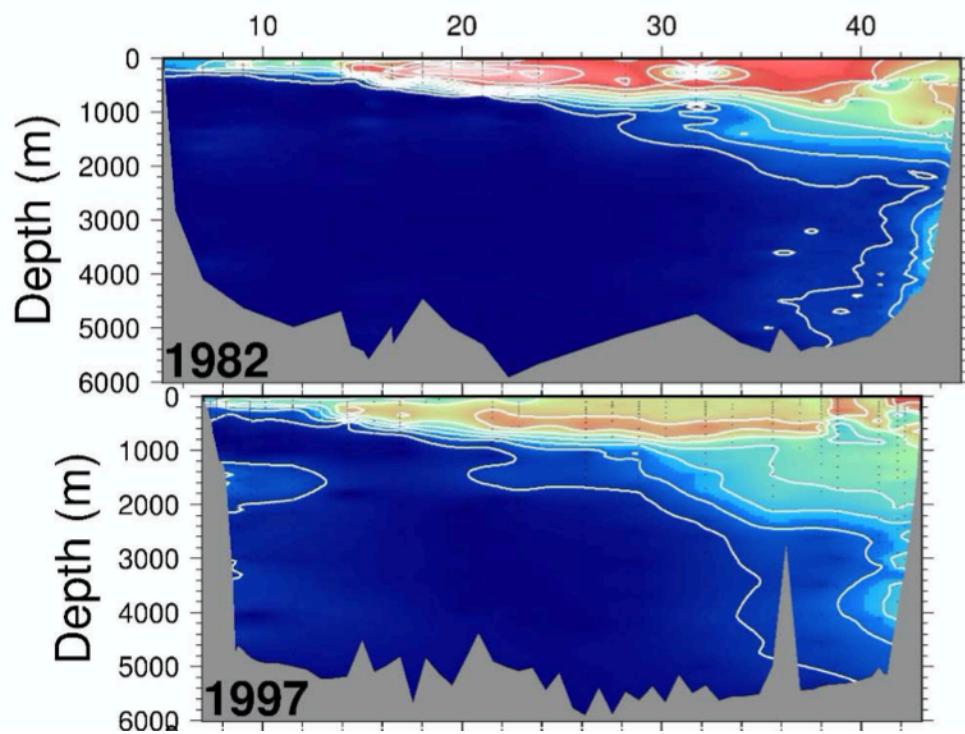


L'océan planétaire, Michèle Fieux et Chantal Andrié, ENSTA, 2010

Figure 1-65- Transports d'Ekman associés
 (a) à des vents cycloniques et une divergence ou
 (d) à des vents anticycloniques et une convergence ;
 (b) upwelling et (e) downwelling et pentes de la surface et de la thermocline associées ;
 (c) et (f) courants géostrophiques engendrés par les gradients de pression résultants
 (d'après Ocean Circulation, 1989).

Partie 2 : étude de la circulation océanique profonde

Teneur en tritium dans l'Atlantique



Partie 2 : étude de la circulation océanique profonde

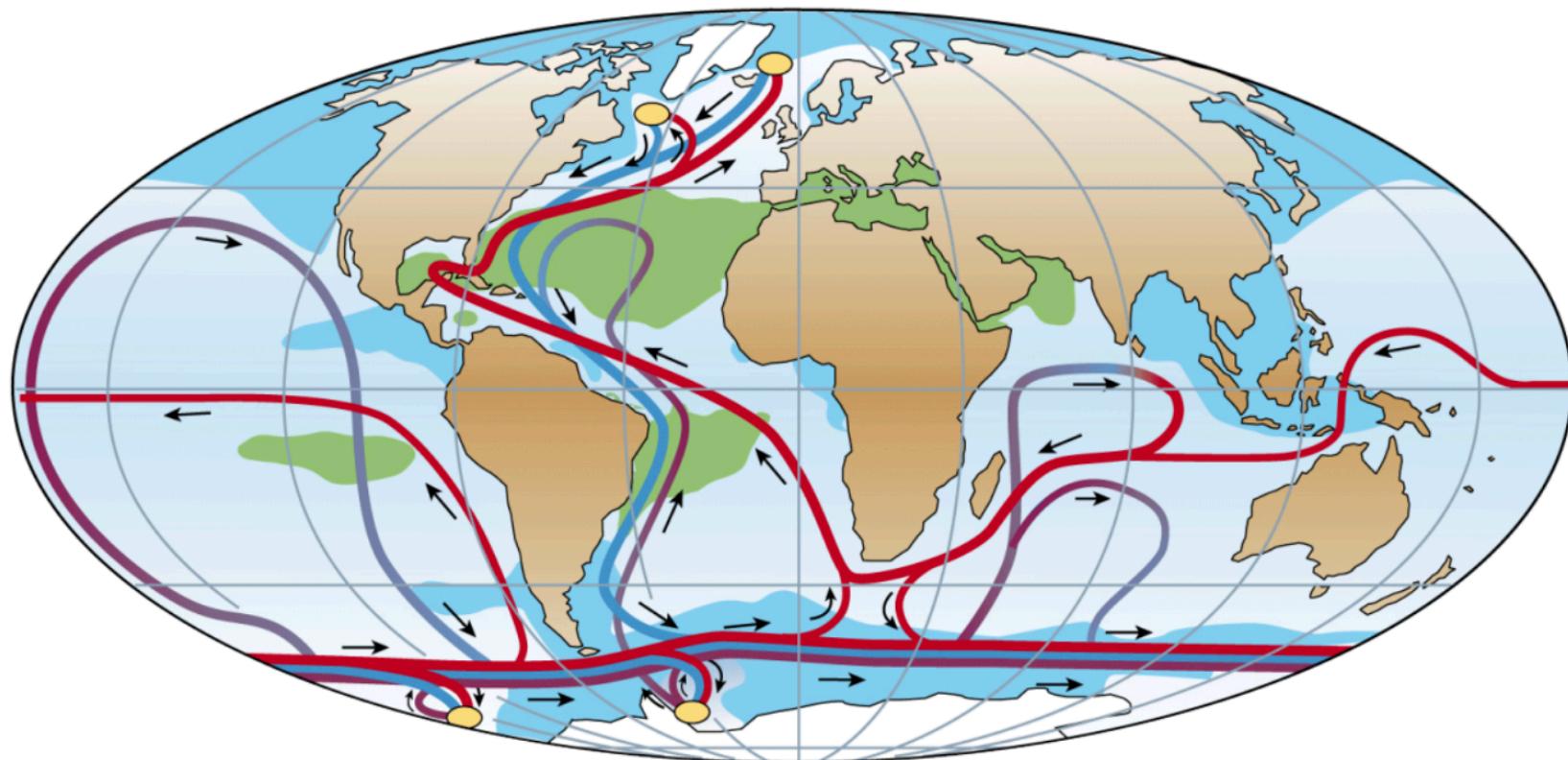
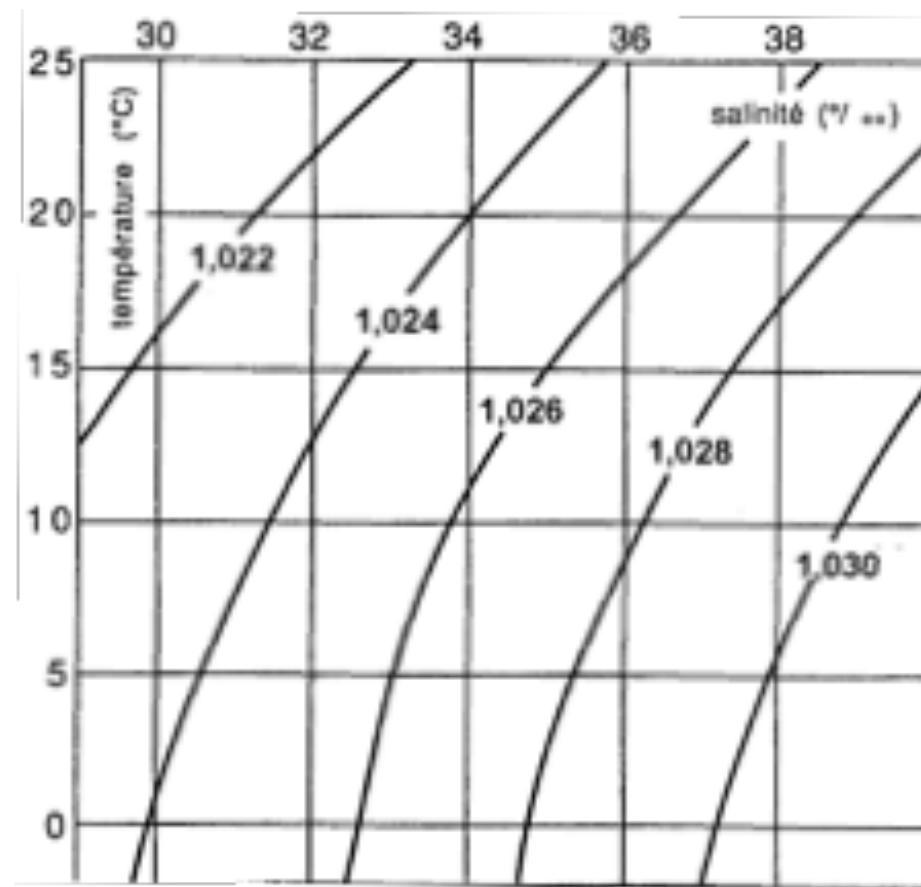


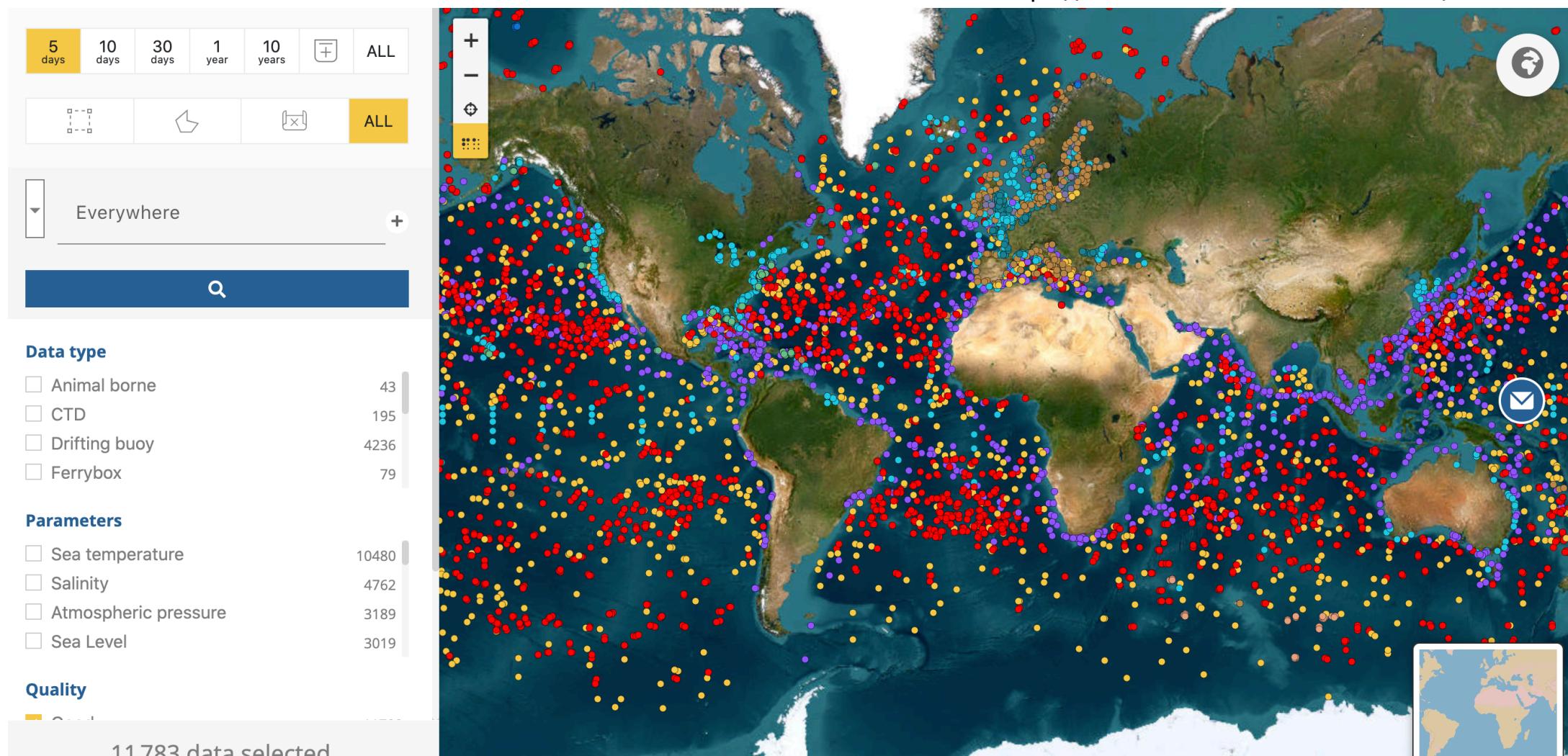
Figure 1.3. Simplified sketch of the global thermohaline circulation pathway, whereby yellow dots represent regions of deep-water formation; red path: near-surface ocean circulation; blue path: deep-water circulation and; purple path: bottom currents. The surface salinity gradient is also represented: green > light blue > blue. Figure from Rahmstorf, 2002.

Partie 2 : étude de la circulation océanique profonde



Partie 2 : étude de la circulation océanique profonde

<https://data-selection.odatis-ocean.fr/coriolis>



Partie 2 : étude de la circulation océanique profonde

Balises ARGOS



FEMELLE ÉLÉPHANT DE MER ÉQUIPÉE D'UNE BALISE ARGOS ET PRÊTE À PARTIR EN MER. © FRANEK2, WIKIMEDIA



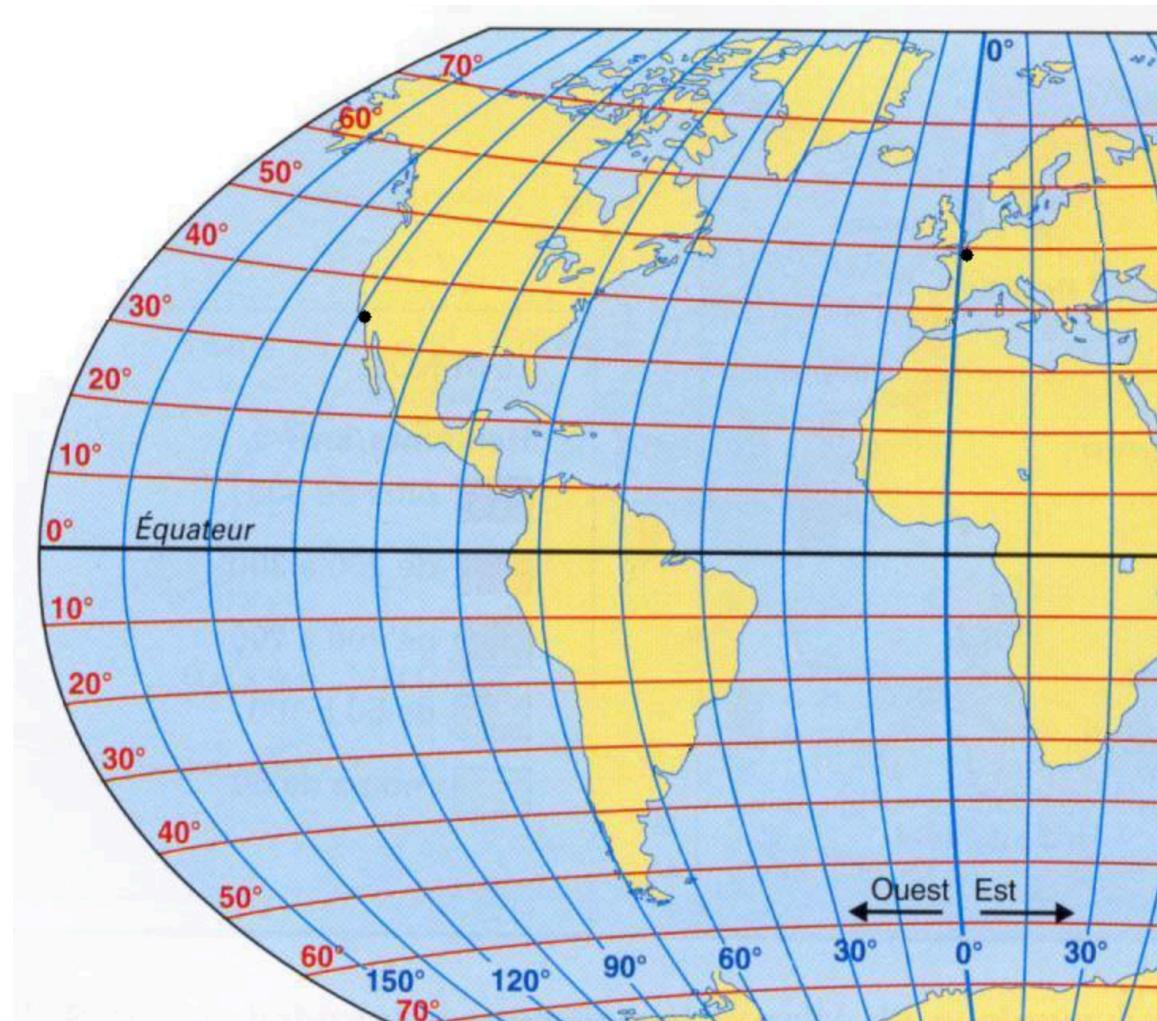
Balise Argos.

Partie 2 : étude de la circulation océanique profonde

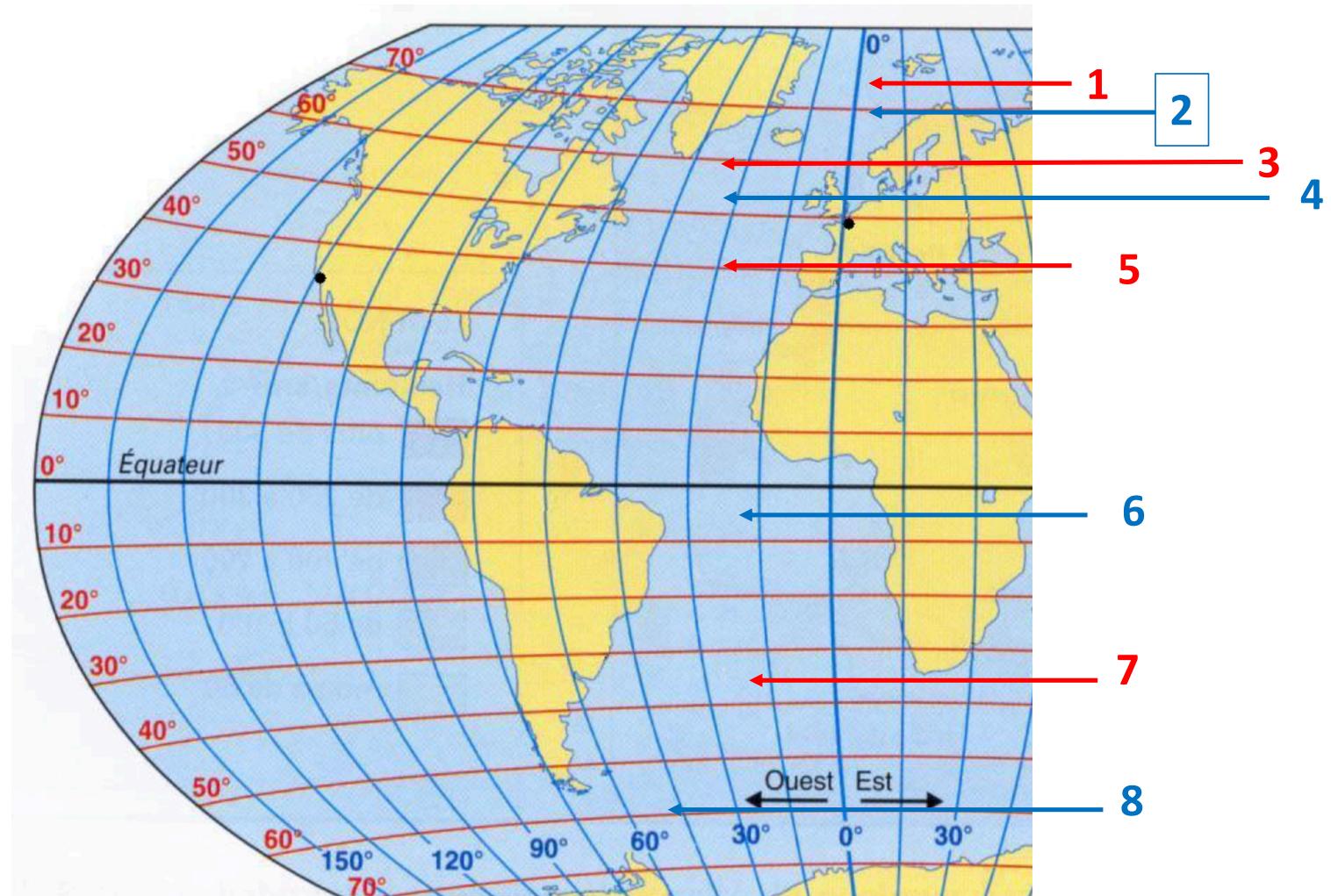
Balise 1

| TIME | DEPTH | DIRECTION | LATITUDE | LONGITUDE | POSITION_Q | PRES | PRES_ADJUS | PRES_ADJUS | PRES_QC | PSAL | PSAL_ADJUS | PSAL_ADJUS | PSAL_QC | TEMP | TEMP_ADJUS | TEMP_ADJUS | TEMP_QC | TIME_QC |
|------------|-------|-----------|------------|------------|------------|------|------------|------------|---------|--------|------------|------------|---------|-------|------------|------------|---------|---------|
| 23/12/2021 | 0 | 65 | 75,4240036 | 1,05200005 | 1 | 0 | 0 | 1 | 1 | 34,953 | 34,953 | 3 | 3 | 2,046 | 2,046 | 3 | 3 | 1 |
| 23/12/2021 | 1 | 65 | 75,4240036 | 1,05200005 | 1 | 1 | 1 | 1 | 1 | 34,946 | 34,946 | 3 | 3 | 2,052 | 2,052 | 3 | 3 | 1 |
| 23/12/2021 | 2 | 65 | 75,4240036 | 1,05200005 | 1 | 2 | 2 | 1 | 1 | 34,947 | 34,947 | 3 | 3 | 2,052 | 2,052 | 1 | 1 | 1 |
| 23/12/2021 | 3 | 65 | 75,4240036 | 1,05200005 | 1 | 3 | 3 | 1 | 1 | 34,948 | 34,948 | 3 | 3 | 2,053 | 2,053 | 1 | 1 | 1 |
| 23/12/2021 | 4 | 65 | 75,4240036 | 1,05200005 | 1 | 4 | 4 | 1 | 1 | 34,946 | 34,946 | 3 | 3 | 2,055 | 2,055 | 1 | 1 | 1 |
| 23/12/2021 | 5 | 65 | 75,4240036 | 1,05200005 | 1 | 5 | 5 | 1 | 1 | 34,946 | 34,946 | 3 | 3 | 2,057 | 2,057 | 1 | 1 | 1 |
| 23/12/2021 | 6 | 65 | 75,4240036 | 1,05200005 | 1 | 6 | 6 | 1 | 1 | 34,947 | 34,947 | 1 | 1 | 2,056 | 2,056 | 1 | 1 | 1 |
| 23/12/2021 | 7 | 65 | 75,4240036 | 1,05200005 | 1 | 7 | 7 | 1 | 1 | 34,946 | 34,946 | 1 | 1 | 2,059 | 2,059 | 1 | 1 | 1 |
| 23/12/2021 | 8 | 65 | 75,4240036 | 1,05200005 | 1 | 8 | 8 | 1 | 1 | 34,951 | 34,951 | 1 | 1 | 2,044 | 2,044 | 1 | 1 | 1 |
| 23/12/2021 | 9 | 65 | 75,4240036 | 1,05200005 | 1 | 9 | 9 | 1 | 1 | 34,944 | 34,944 | 1 | 1 | 2,041 | 2,041 | 1 | 1 | 1 |
| 23/12/2021 | 10 | 65 | 75,4240036 | 1,05200005 | 1 | 10 | 10 | 1 | 1 | 34,947 | 34,947 | 1 | 1 | 2,036 | 2,036 | 1 | 1 | 1 |
| 23/12/2021 | 16 | 65 | 75,4240036 | 1,05200005 | 1 | 16 | 16 | 1 | 1 | 34,943 | 34,943 | 1 | 1 | 2,024 | 2,024 | 1 | 1 | 1 |
| 23/12/2021 | 26 | 65 | 75,4240036 | 1,05200005 | 1 | 26 | 26 | 1 | 1 | 34,942 | 34,942 | 1 | 1 | 2,014 | 2,014 | 1 | 1 | 1 |
| 23/12/2021 | 35 | 65 | 75,4240036 | 1,05200005 | 1 | 35 | 35 | 1 | 1 | 34,941 | 34,941 | 1 | 1 | 2,012 | 2,012 | 1 | 1 | 1 |
| 23/12/2021 | 45 | 65 | 75,4240036 | 1,05200005 | 1 | 45 | 45 | 1 | 1 | 34,94 | 34,94 | 1 | 1 | 2,001 | 2,001 | 1 | 1 | 1 |
| 23/12/2021 | 56 | 65 | 75,4240036 | 1,05200005 | 1 | 56 | 56 | 1 | 1 | 34,941 | 34,941 | 1 | 1 | 2,007 | 2,007 | 1 | 1 | 1 |
| 23/12/2021 | 65 | 65 | 75,4240036 | 1,05200005 | 1 | 65 | 65 | 1 | 1 | 34,942 | 34,942 | 1 | 1 | 2,006 | 2,006 | 1 | 1 | 1 |
| 23/12/2021 | 75 | 65 | 75,4240036 | 1,05200005 | 1 | 75 | 75 | 1 | 1 | 34,94 | 34,94 | 1 | 1 | 1,993 | 1,993 | 1 | 1 | 1 |
| 23/12/2021 | 86 | 65 | 75,4240036 | 1,05200005 | 1 | 86 | 86 | 1 | 1 | 34,941 | 34,941 | 1 | 1 | 1,983 | 1,983 | 1 | 1 | 1 |
| 23/12/2021 | 95 | 65 | 75,4240036 | 1,05200005 | 1 | 95 | 95 | 1 | 1 | 34,94 | 34,94 | 1 | 1 | 1,978 | 1,978 | 1 | 1 | 1 |
| 23/12/2021 | 106 | 65 | 75,4240036 | 1,05200005 | 1 | 106 | 106 | 1 | 1 | 34,941 | 34,941 | 1 | 1 | 1,979 | 1,979 | 1 | 1 | 1 |
| 23/12/2021 | 116 | 65 | 75,4240036 | 1,05200005 | 1 | 116 | 116 | 1 | 1 | 34,941 | 34,941 | 1 | 1 | 1,975 | 1,975 | 1 | 1 | 1 |
| 23/12/2021 | 126 | 65 | 75,4240036 | 1,05200005 | 1 | 126 | 126 | 1 | 1 | 34,942 | 34,942 | 1 | 1 | 1,974 | 1,974 | 1 | 1 | 1 |
| 23/12/2021 | 135 | 65 | 75,4240036 | 1,05200005 | 1 | 135 | 135 | 1 | 1 | 34,943 | 34,943 | 1 | 1 | 1,976 | 1,976 | 1 | 1 | 1 |
| 23/12/2021 | 145 | 65 | 75,4240036 | 1,05200005 | 1 | 145 | 145 | 1 | 1 | 34,944 | 34,944 | 1 | 1 | 1,978 | 1,978 | 1 | 1 | 1 |
| 23/12/2021 | 156 | 65 | 75,4240036 | 1,05200005 | 1 | 156 | 156 | 1 | 1 | 34,946 | 34,946 | 1 | 1 | 1,984 | 1,984 | 1 | 1 | 1 |
| 23/12/2021 | 166 | 65 | 75,4240036 | 1,05200005 | 1 | 166 | 166 | 1 | 1 | 34,948 | 34,948 | 1 | 1 | 1,888 | 1,888 | 1 | 1 | 1 |
| 23/12/2021 | 176 | 65 | 75,4240036 | 1,05200005 | 1 | 176 | 176 | 1 | 1 | 34,954 | 34,954 | 1 | 1 | 1,727 | 1,727 | 1 | 1 | 1 |
| 23/12/2021 | 186 | 65 | 75,4240036 | 1,05200005 | 1 | 186 | 186 | 1 | 1 | 34,946 | 34,946 | 1 | 1 | 1,547 | 1,547 | 1 | 1 | 1 |
| 23/12/2021 | 196 | 65 | 75,4240036 | 1,05200005 | 1 | 196 | 196 | 1 | 1 | 34,945 | 34,945 | 1 | 1 | 1,491 | 1,491 | 1 | 1 | 1 |
| 23/12/2021 | 210 | 65 | 75,4240036 | 1,05200005 | 1 | 210 | 210 | 1 | 1 | 34,935 | 34,935 | 1 | 1 | 1,296 | 1,296 | 1 | 1 | 1 |
| 23/12/2021 | 230 | 65 | 75,4240036 | 1,05200005 | 1 | 230 | 230 | 1 | 1 | 34,933 | 34,933 | 1 | 1 | 1,134 | 1,134 | 1 | 1 | 1 |
| 23/12/2021 | 250 | 65 | 75,4240036 | 1,05200005 | 1 | 250 | 250 | 1 | 1 | 34,928 | 34,928 | 1 | 1 | 0,98 | 0,98 | 1 | 1 | 1 |
| 23/12/2021 | 270 | 65 | 75,4240036 | 1,05200005 | - | - | 270 | 1 | 1 | 34,921 | 34,921 | 1 | 1 | 0,771 | 0,771 | 1 | 1 | 1 |

Partie 2 : étude de la circulation océanique profonde

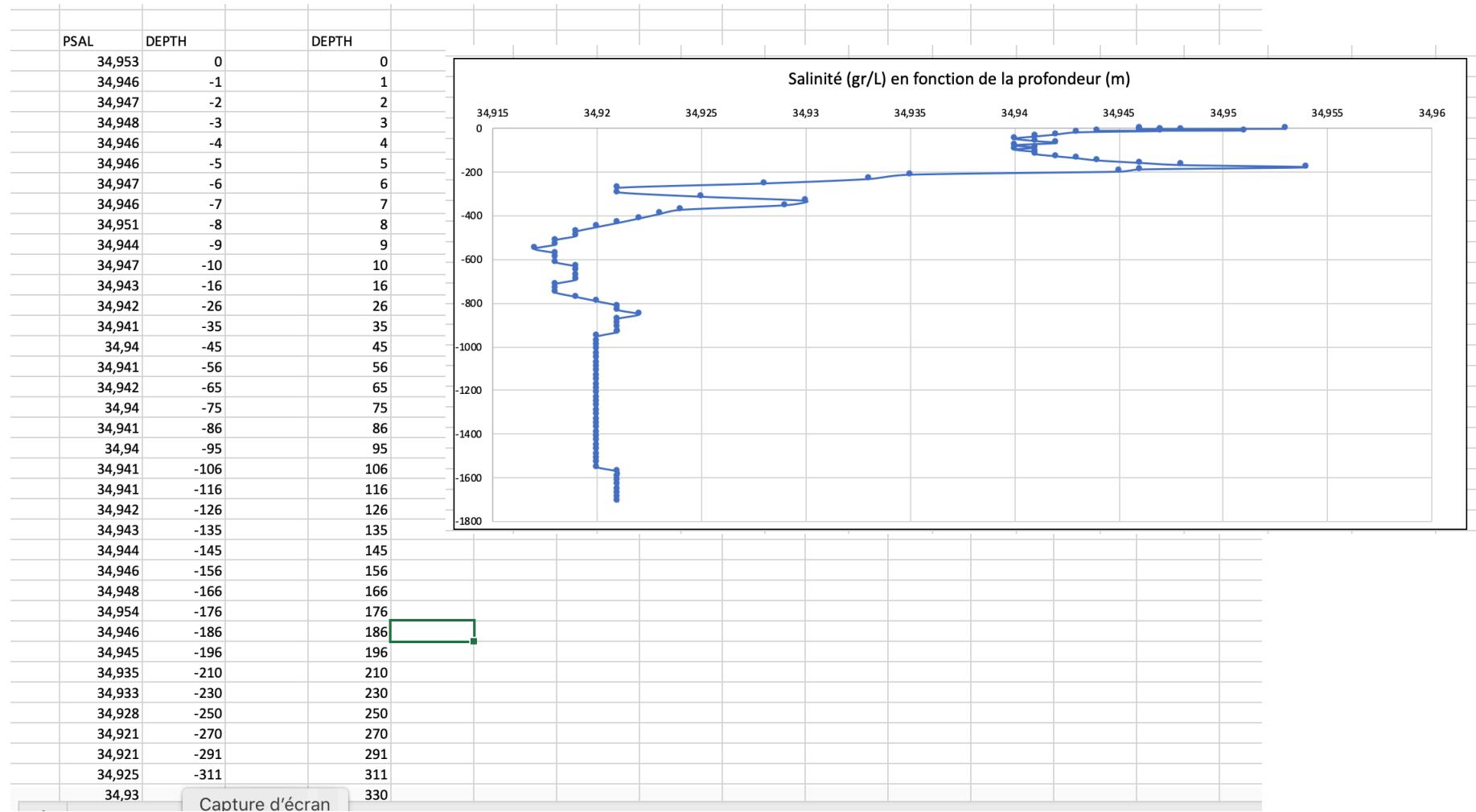


Partie 2 : étude de la circulation océanique profonde



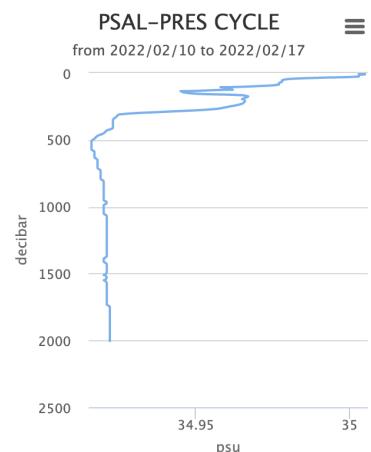
Partie 2 : étude de la circulation océanique profonde

Balise 1

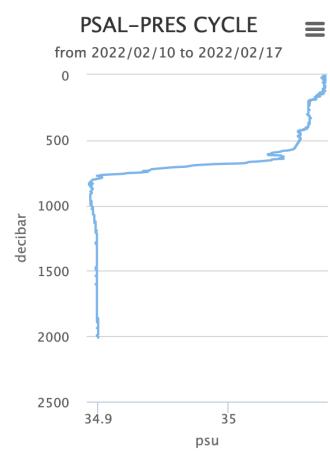


Partie 2 : étude de la circulation océanique profonde

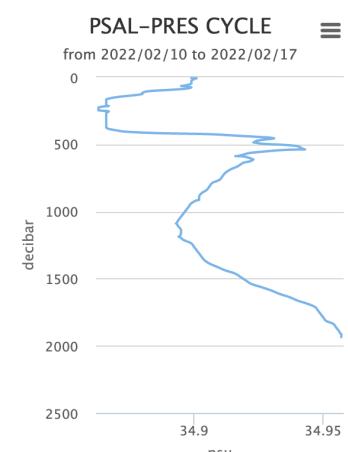
Balise 1



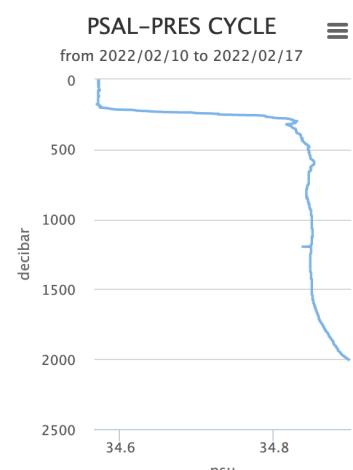
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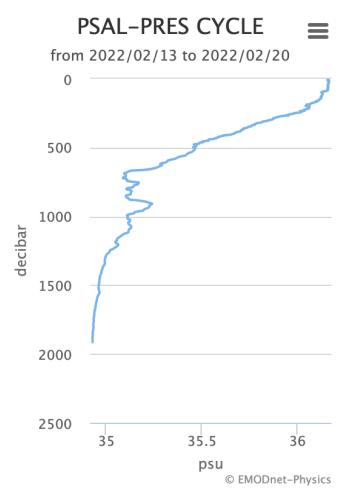
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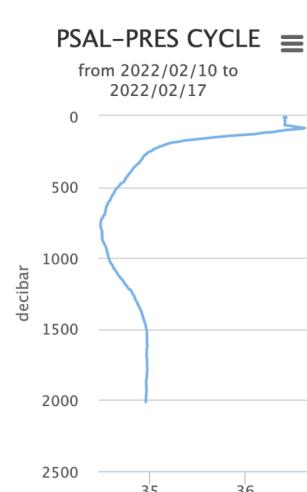
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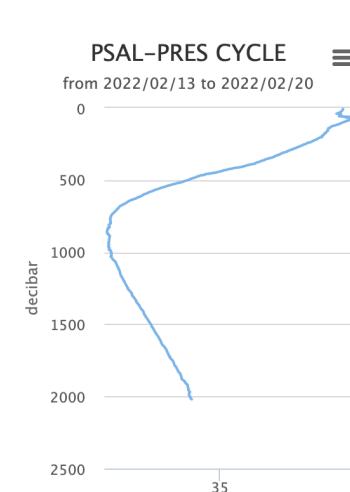
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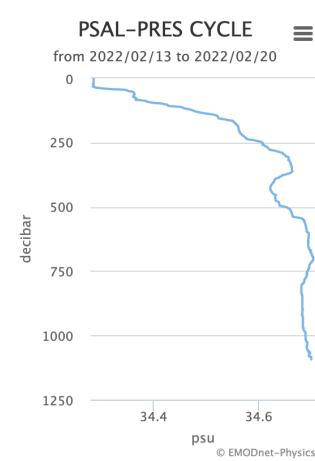
Balise 6



Balise 7



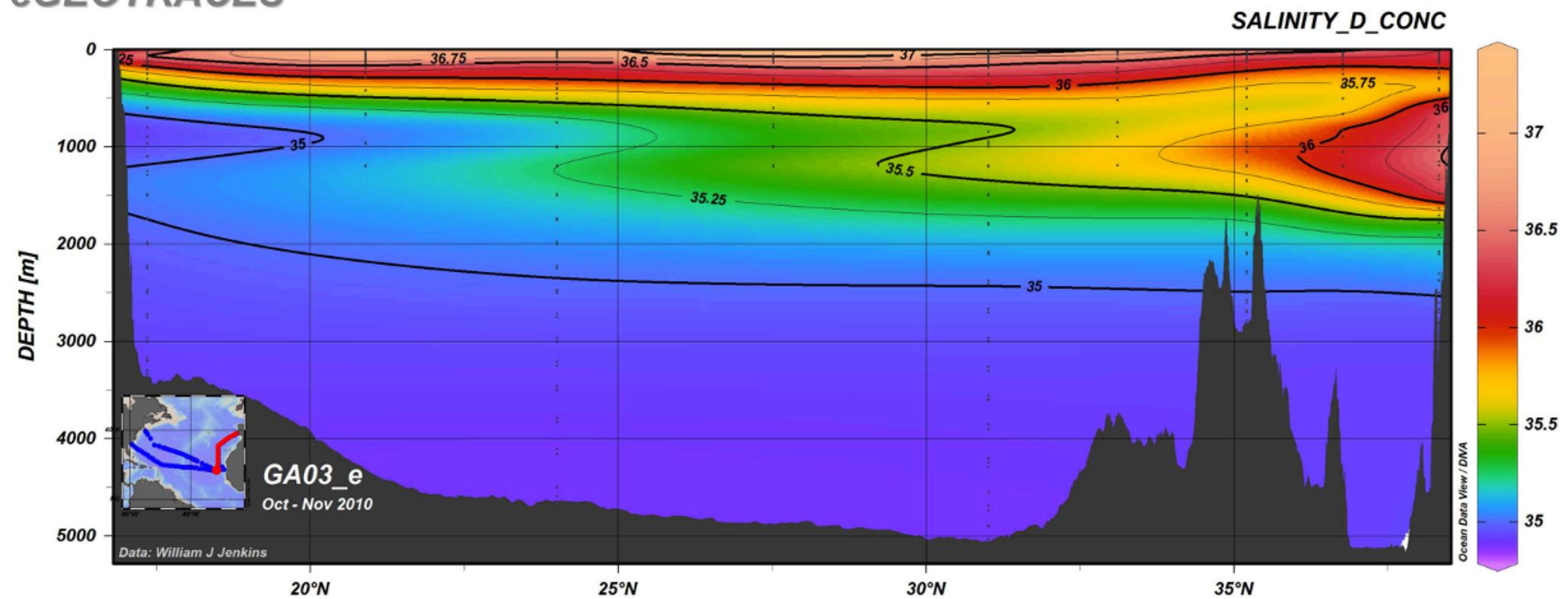
Balise 8



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Partie 2 : étude de la circulation océanique profonde

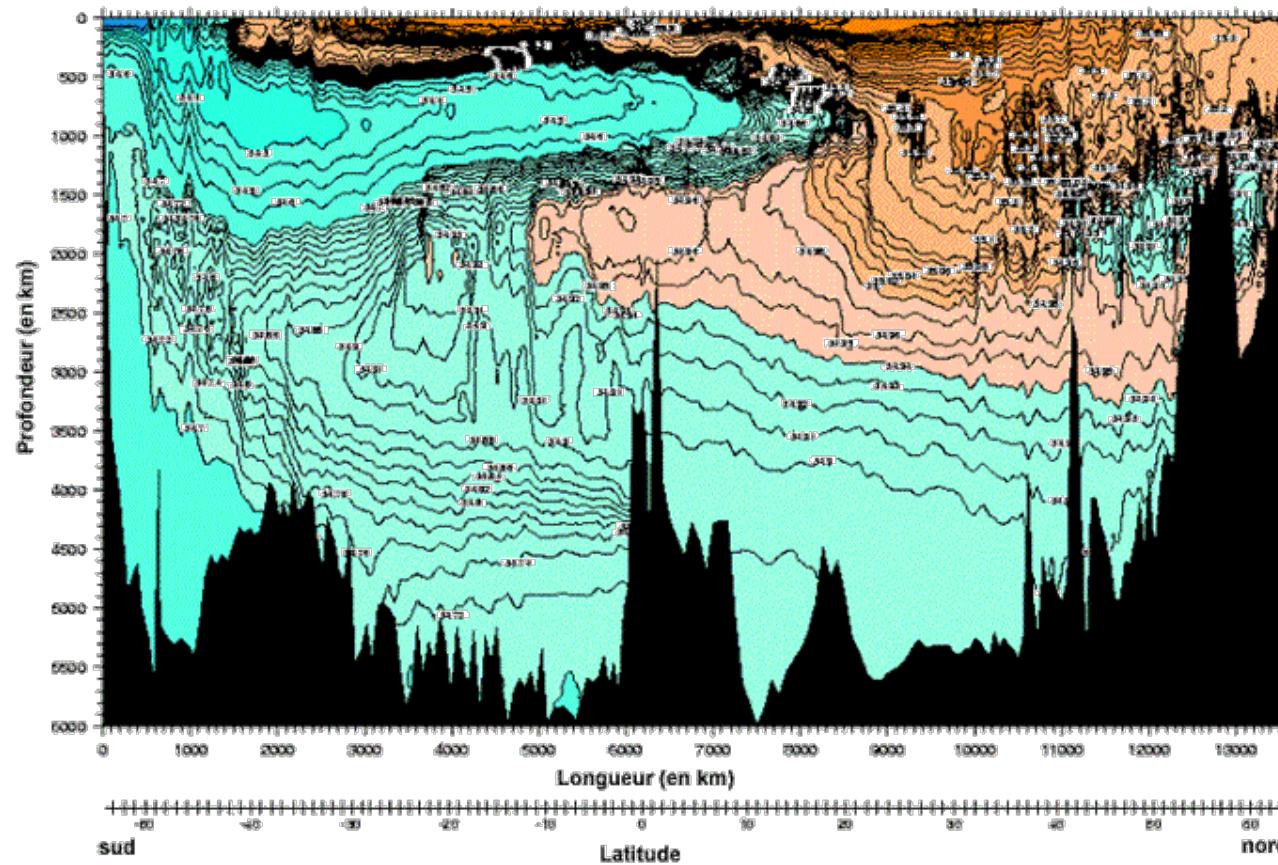
eGEOTRACES



https://www.egeotraces.org/sections/jpg/300dpi/GA03_e_SALINITY_D_CONC.jpg

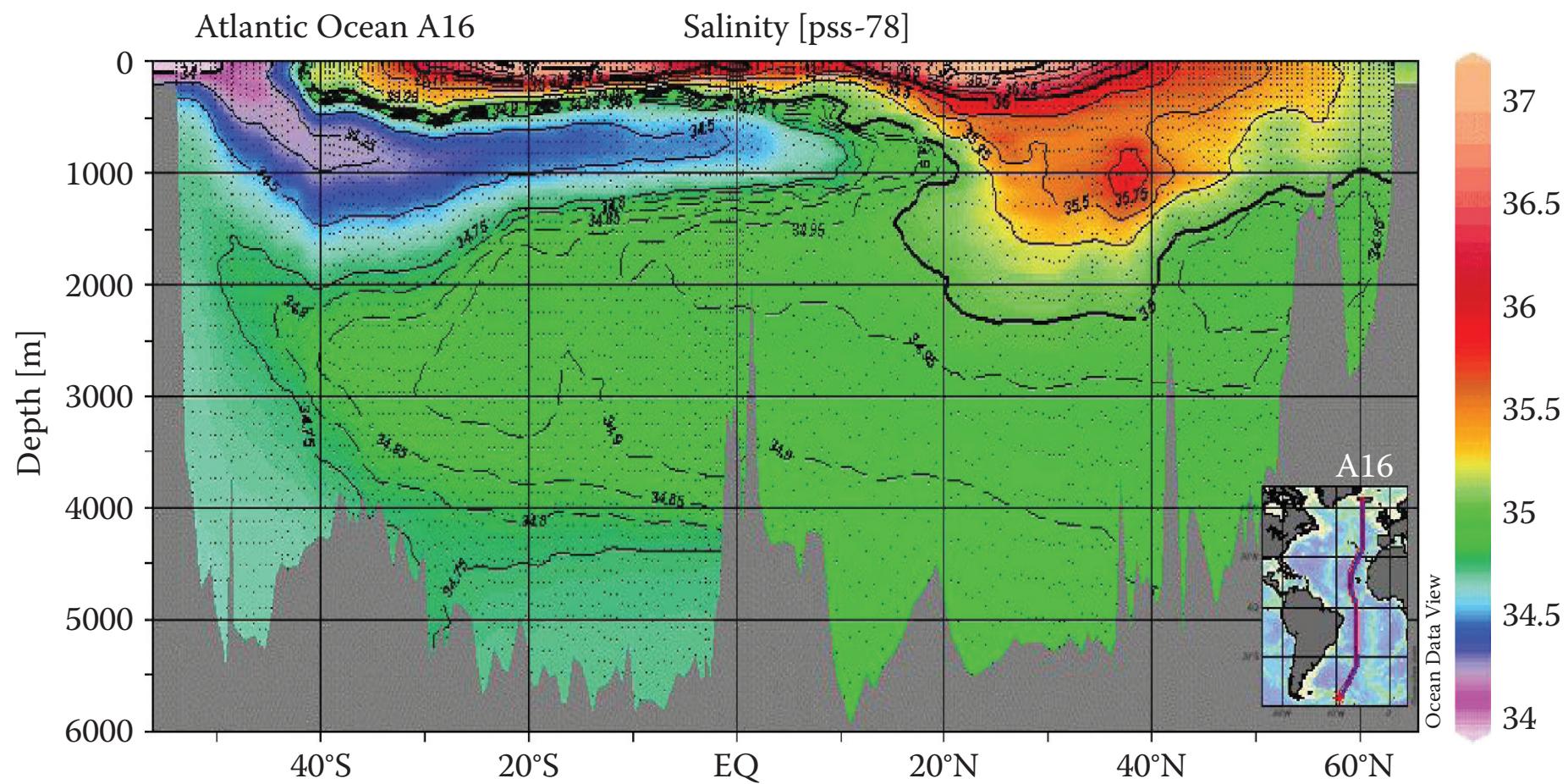
Partie 2 : étude de la circulation océanique profonde

Carte de salinité dans l'Atlantique en fonction de la profondeur entre le pôle sud et le pôle nord



<https://planet-terre.ens-lyon.fr/ressource/thermohalin-antarctique.xml>

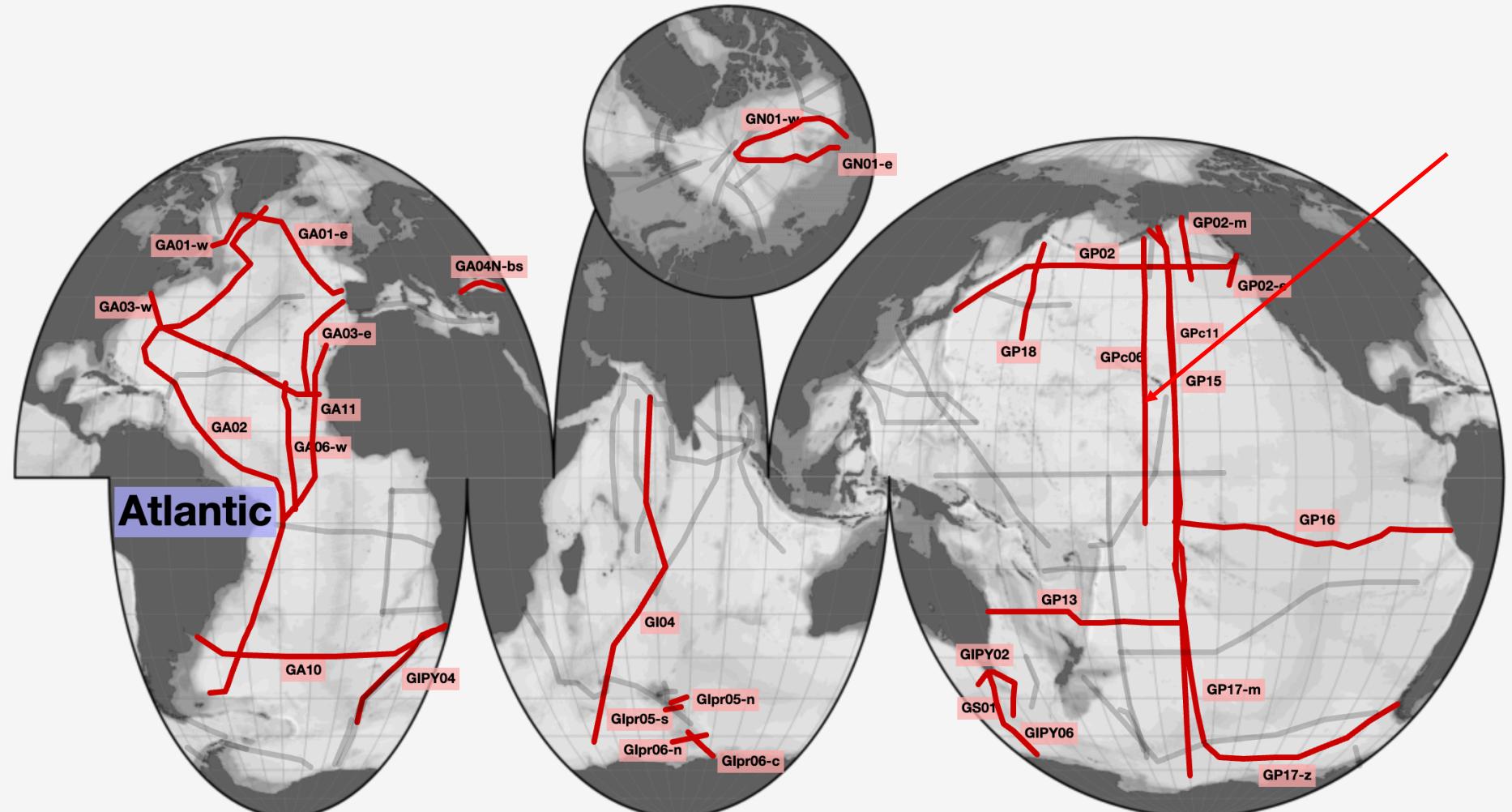
Partie 2 : étude de la circulation océanique profonde



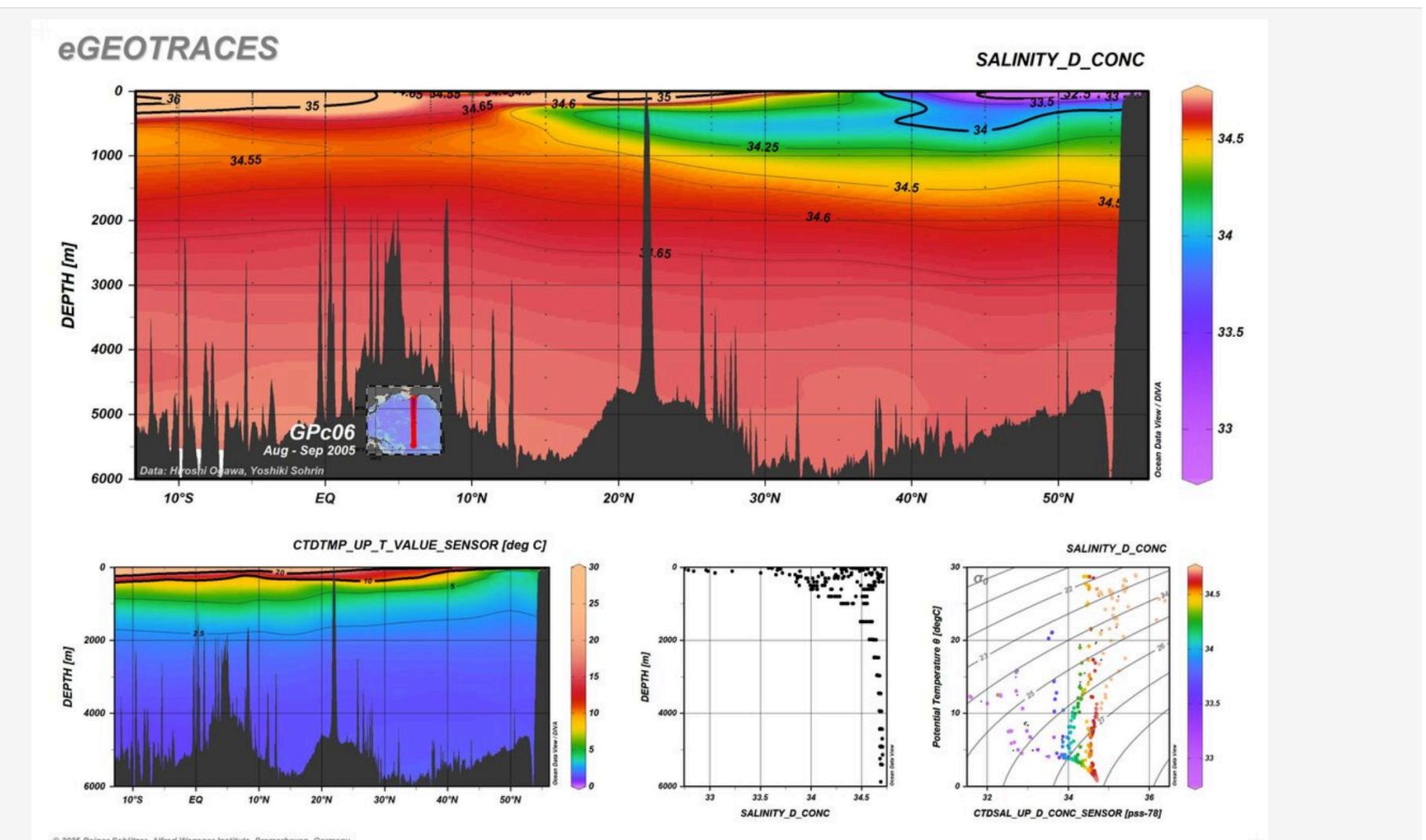
Partie 2 : étude de la circulation océanique profonde

Hydrography and Inert Gases Salinity

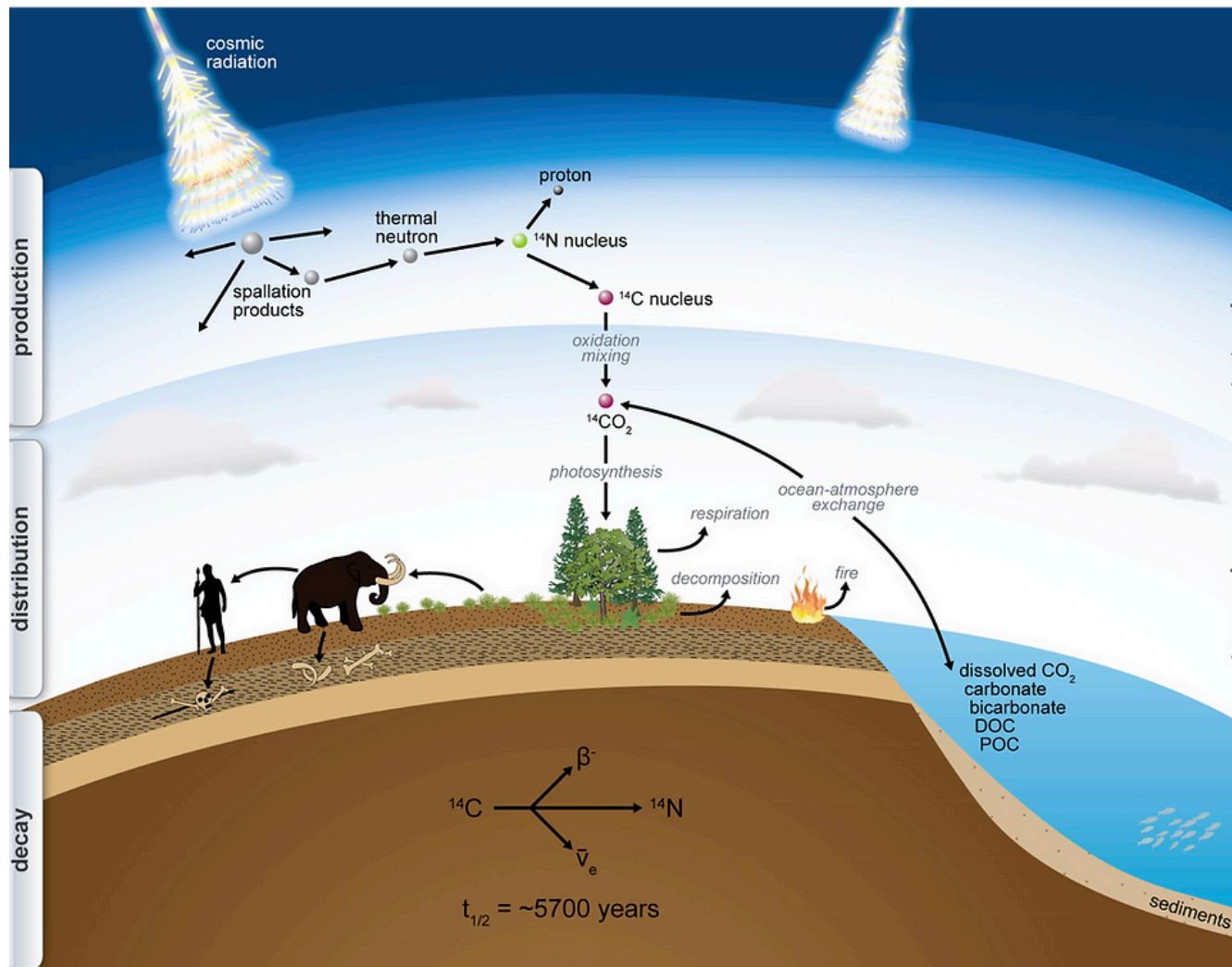
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Partie 2 : étude de la circulation océanique profonde



Partie 2 : étude de la circulation océanique profonde



Partie 2 : étude de la circulation océanique profonde

âges des masses d'eau à 1500m de profondeur calculées en utilisant le ^{14}C et exprimées en années

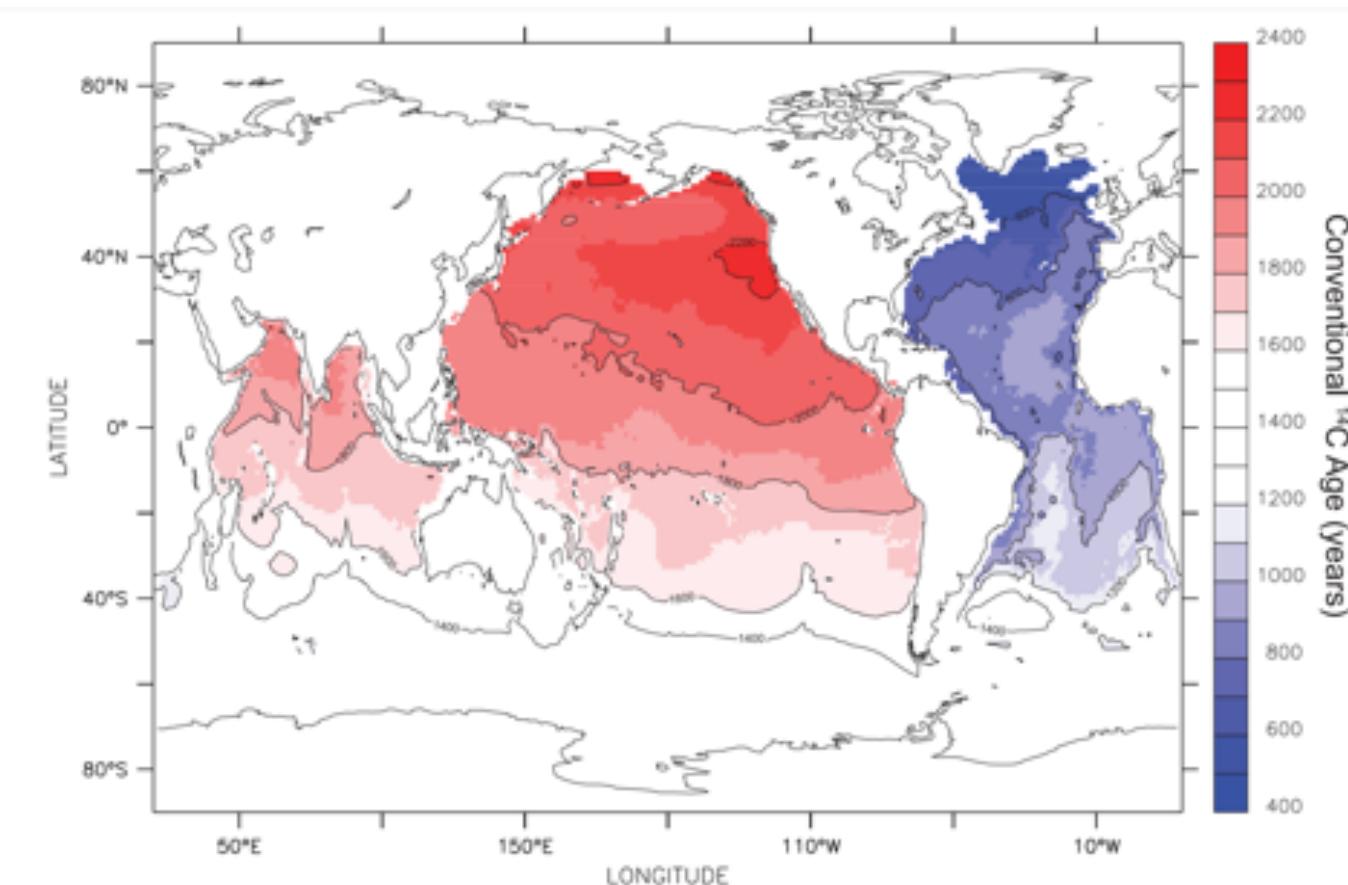
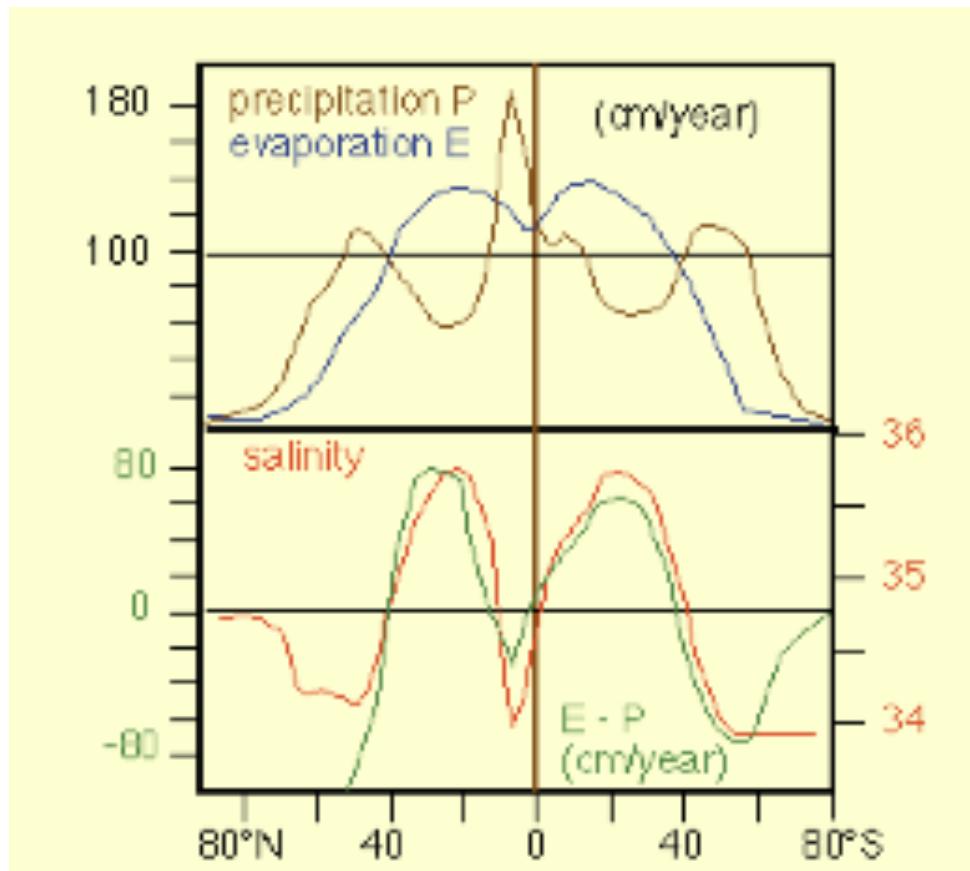


Figure 1. An objectively mapped conventional ^{14}C age of natural radiocarbon below 1500 m, following Matsumoto and Key [2004]. Unit is years.

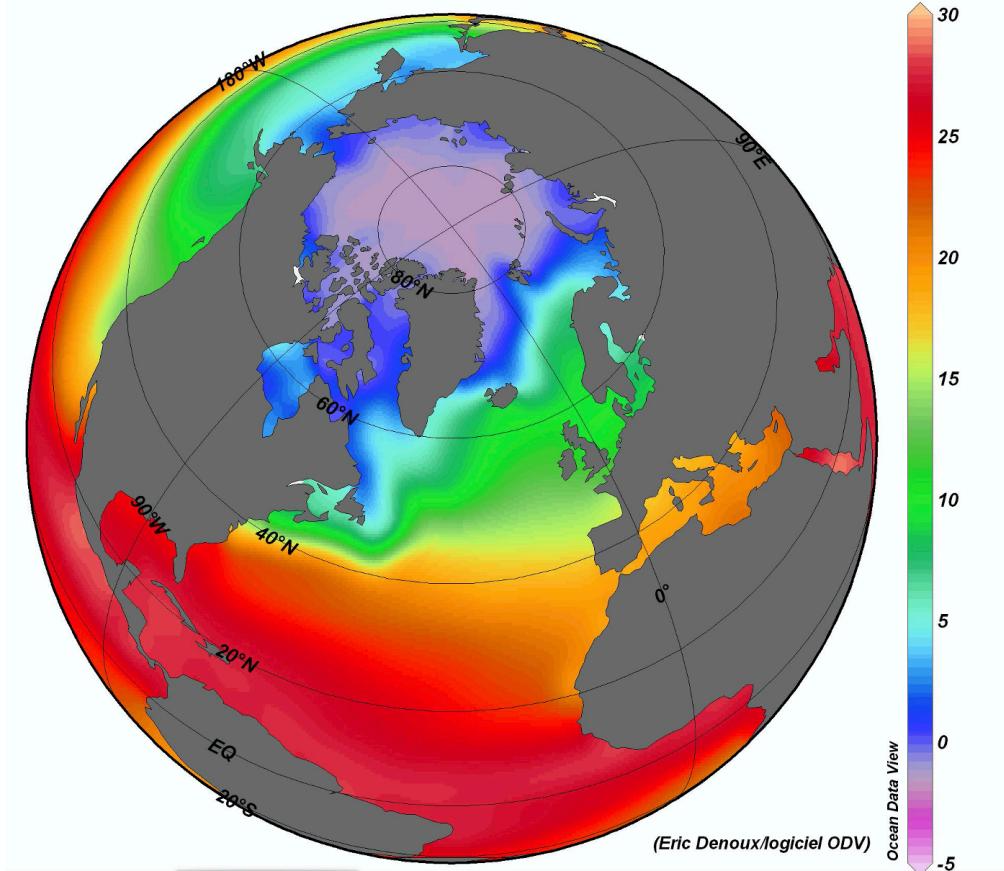
Partie 2 : étude de la circulation océanique profonde

Bilan hydrologique.

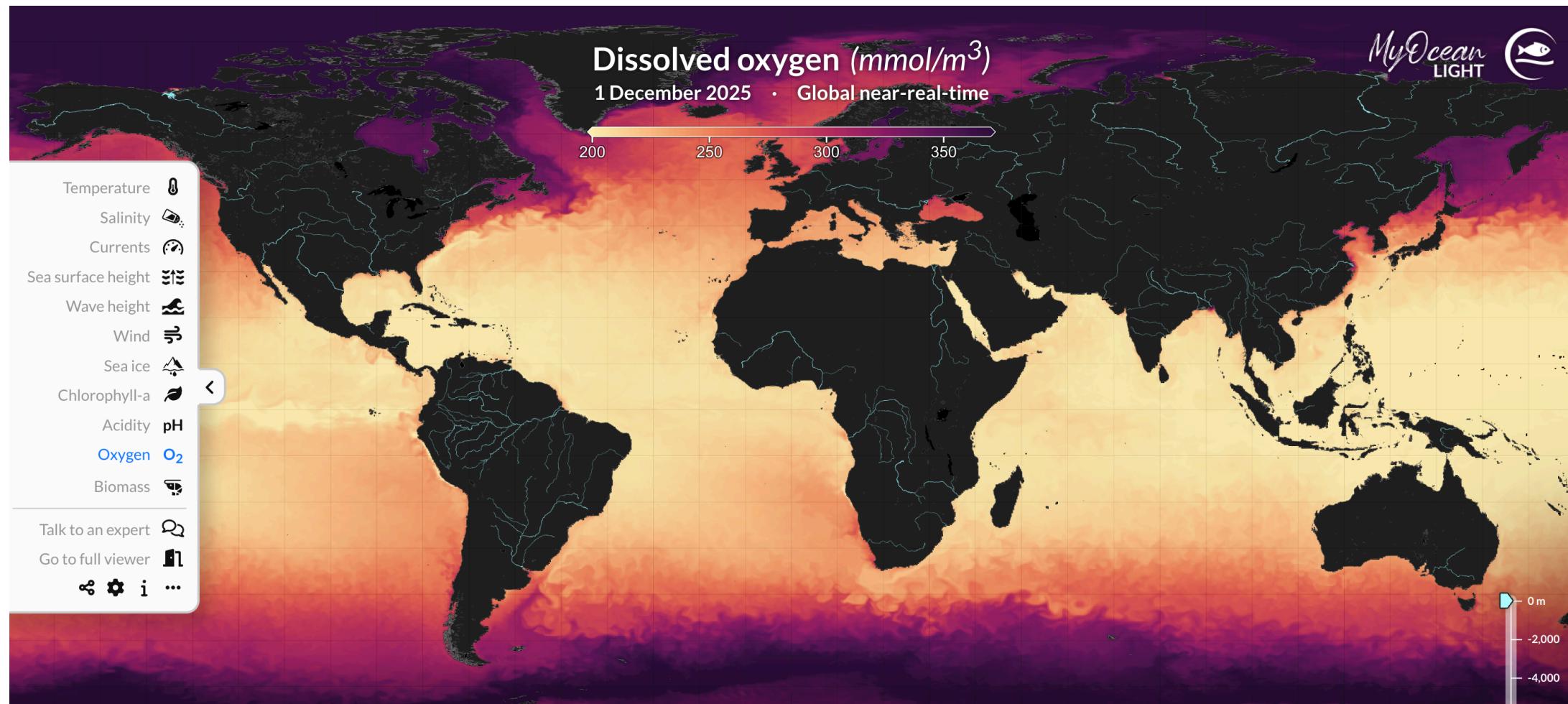


La salinité est exprimée en ‰.

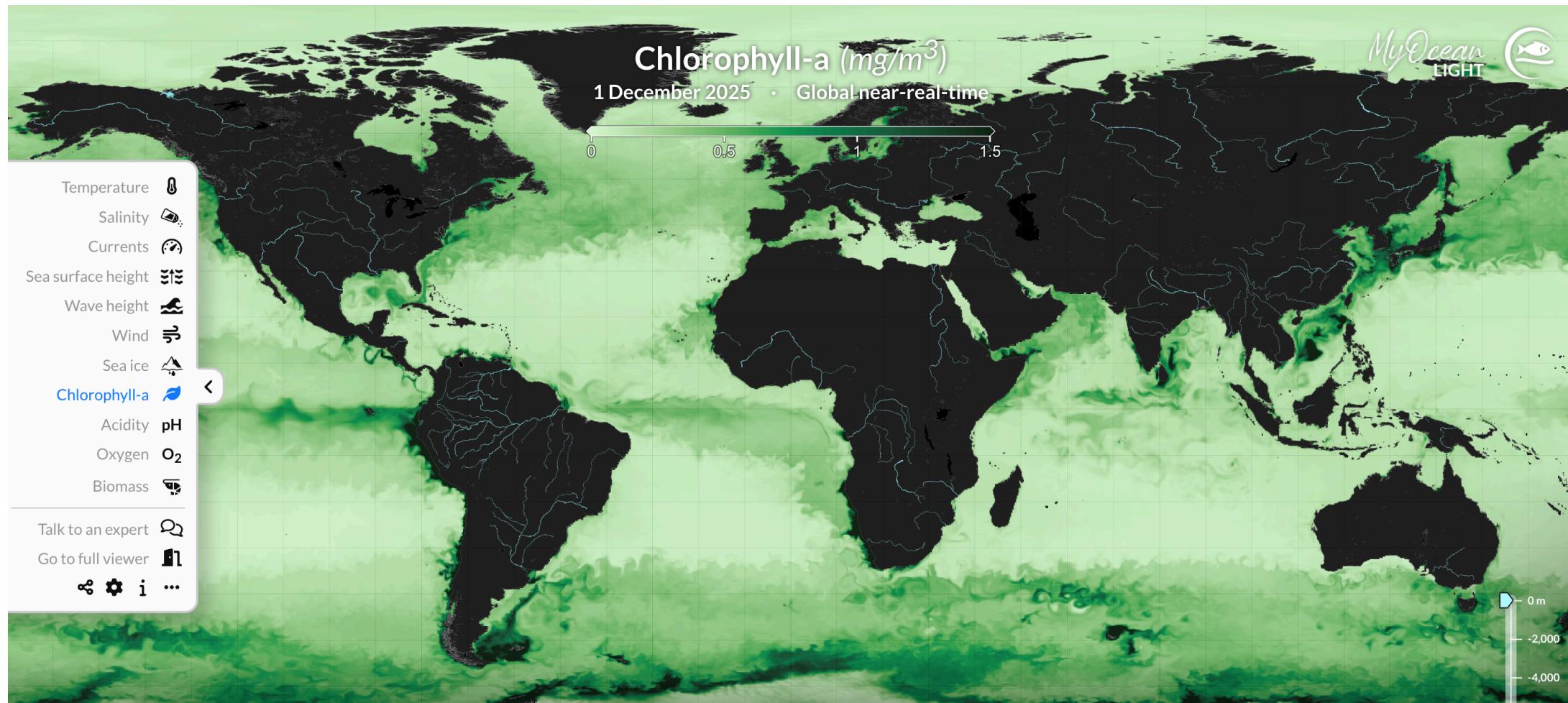
Température de surface océanique moyenne en 2001 en °C



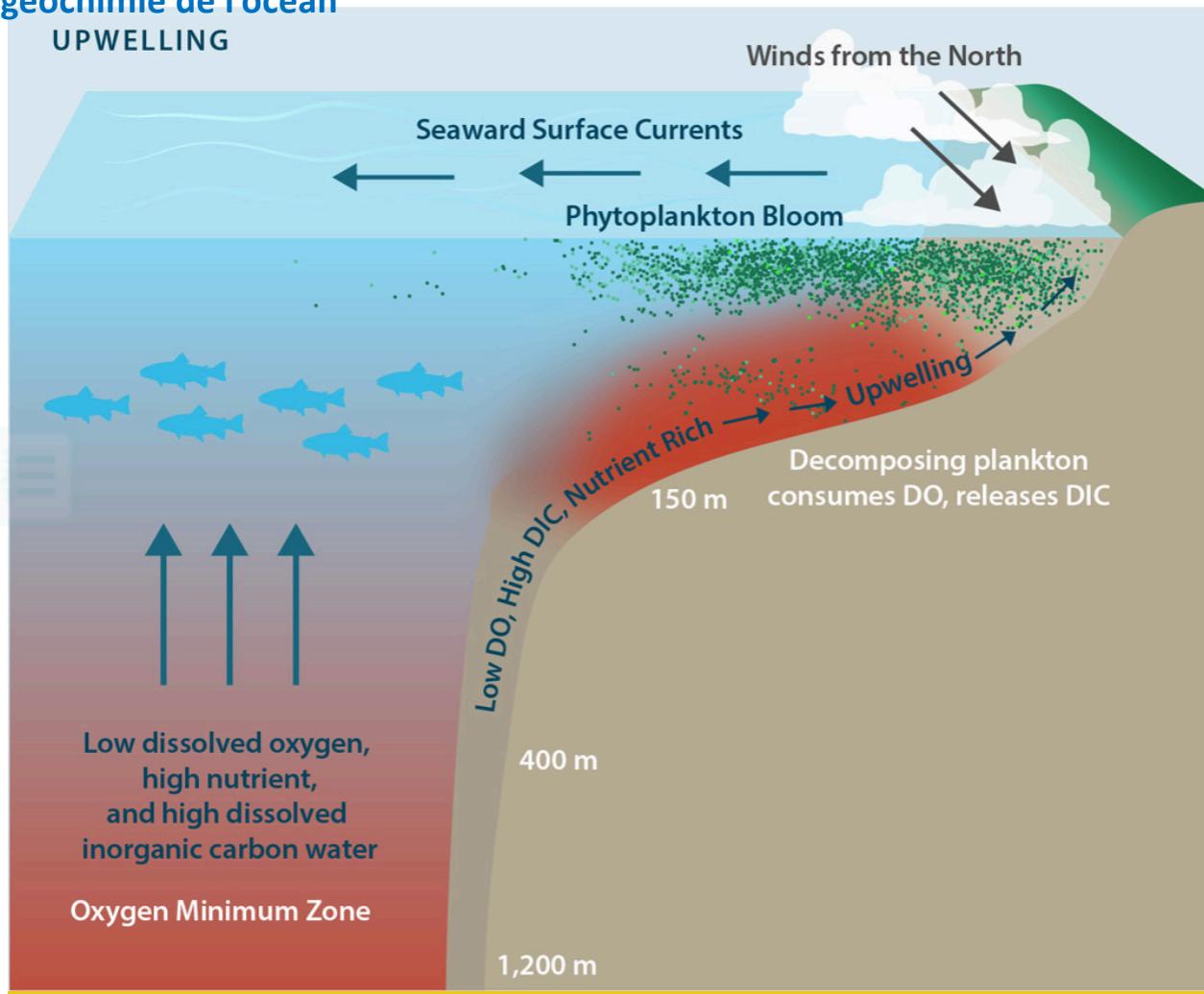
Partie 3 : étude de la biogéochimie de l'océan



Partie 3 : étude de la biogéochimie de l'océan



Partie 3 : étude de la biogéochimie de l'océan



Mécanisme de formation des blooms à travers un phénomène d'upwelling. Crédit photo : Francis Chan, John A. Barth, Kristy J. Kroeker, Jane Lubchenco and Bruce A. Menge. Modified from Gewin (2010) by Moni Kovacs., CC BY-SA 4.0 via Wikimedia Commons

Partie 3 : étude de la biogéochimie de l'océan

