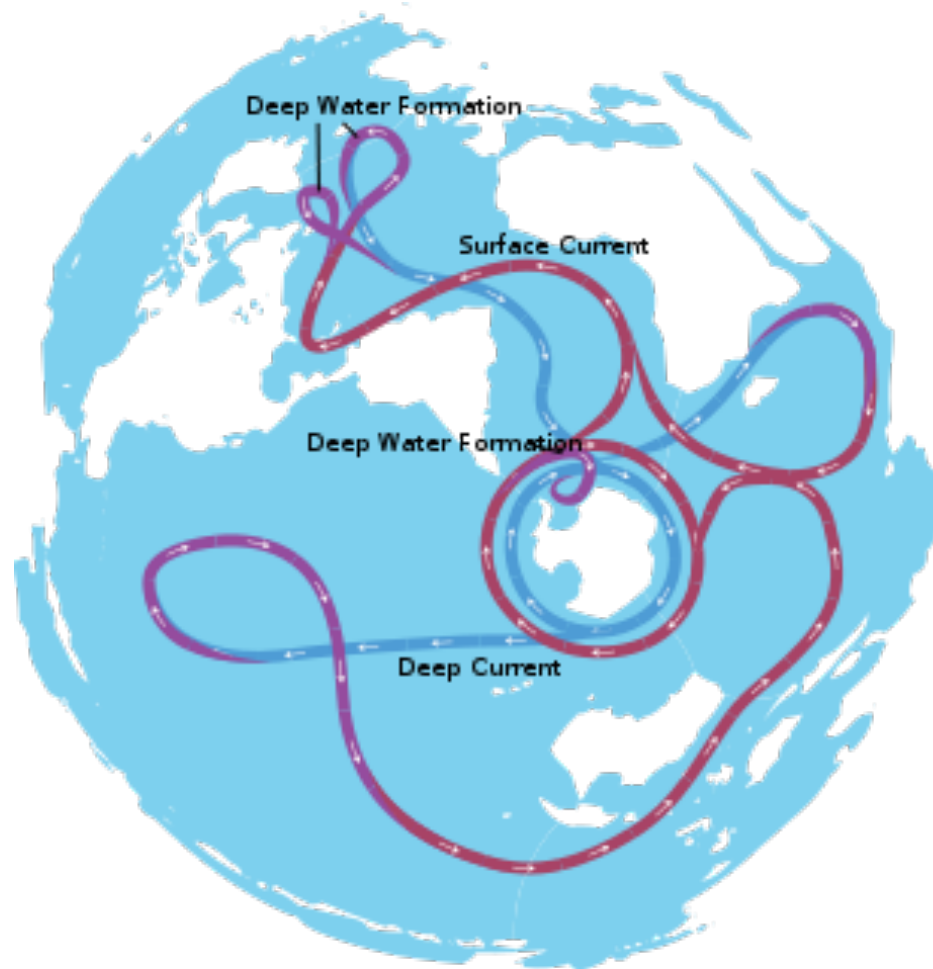
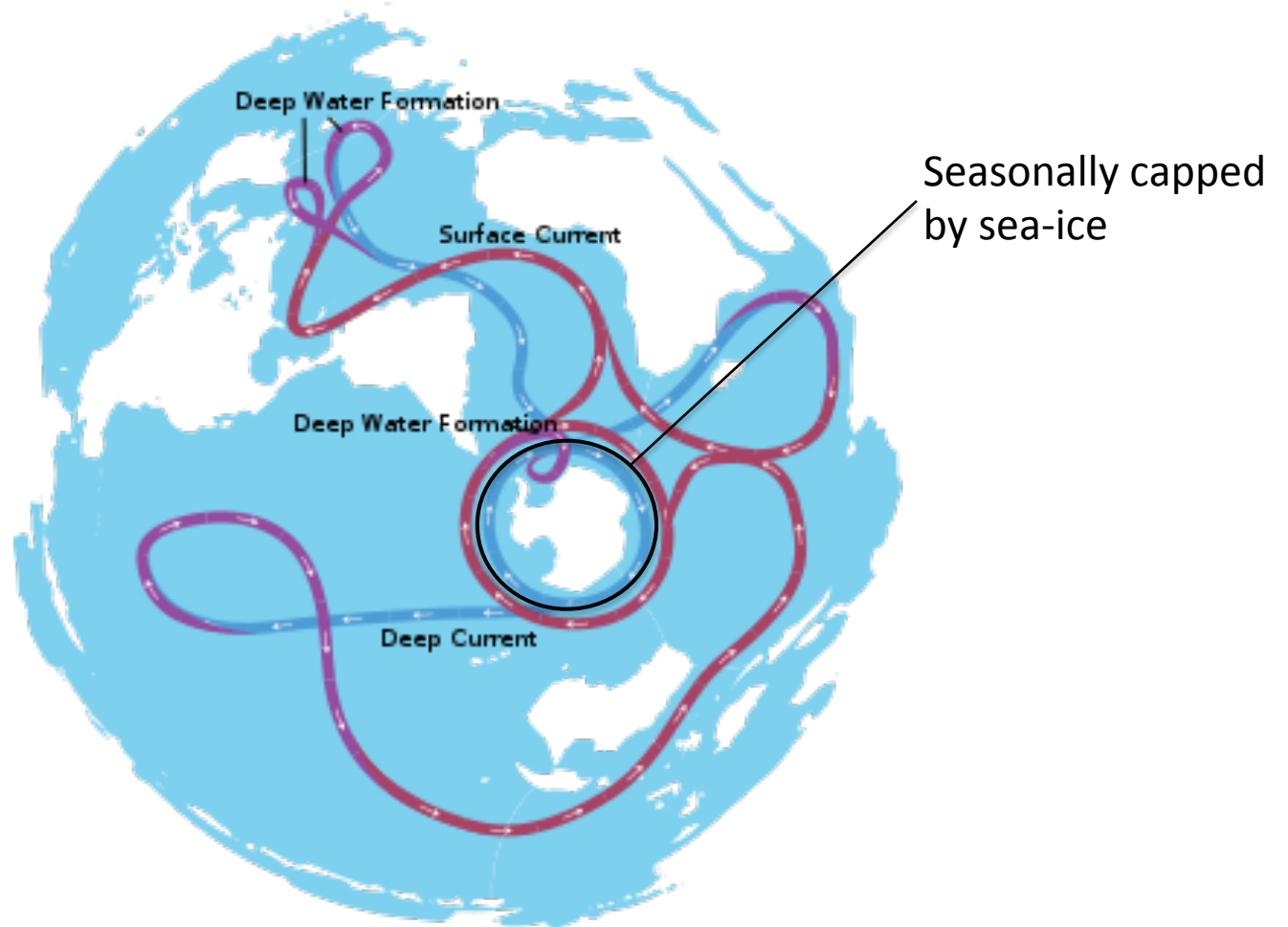


How sea-ice impacts large-scale circulation? What can be learned from the existing obs. system?

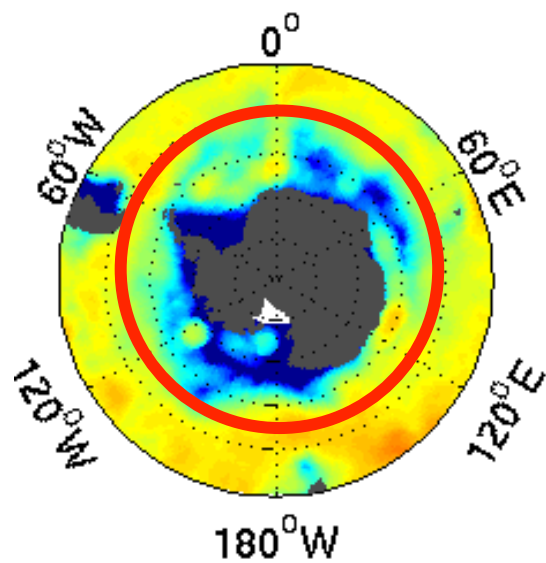
J-B. Sallée



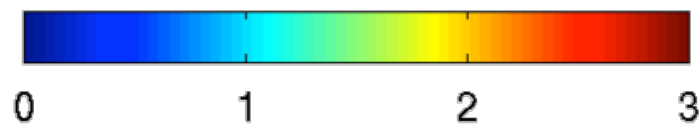
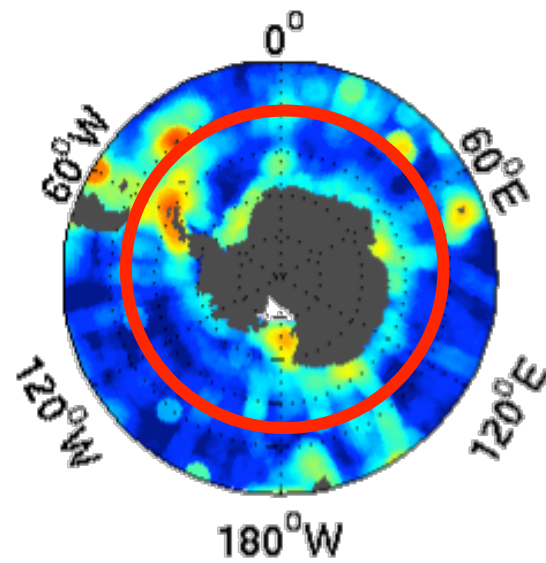




Argo
Data

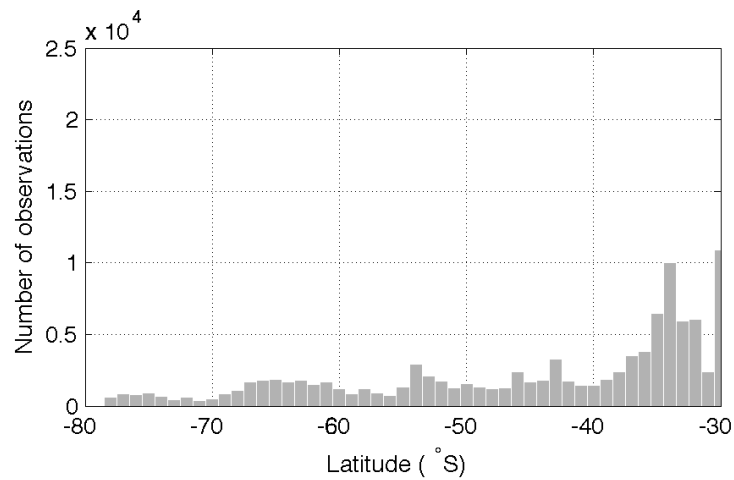
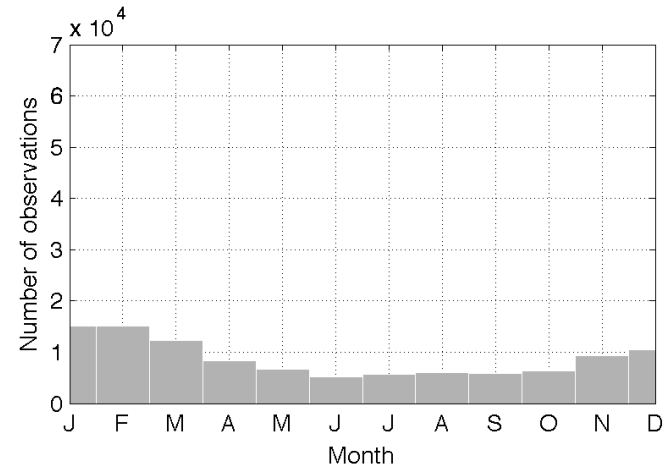
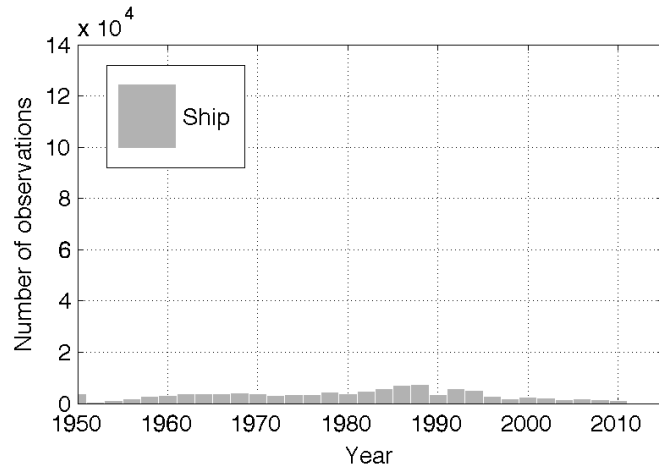


Ship
Data

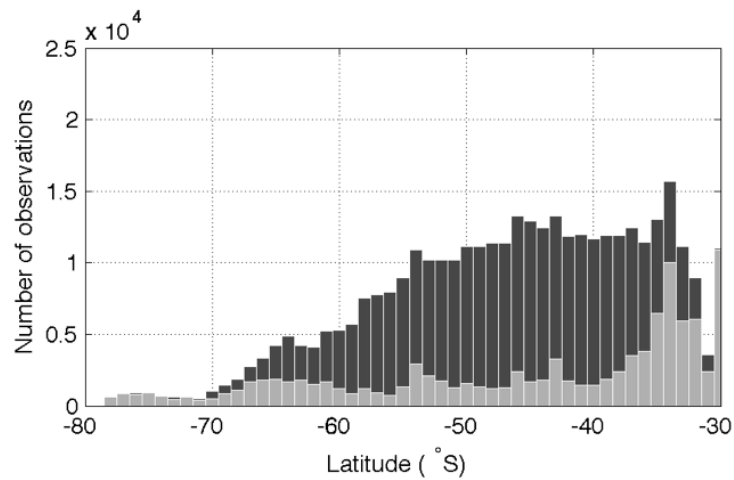
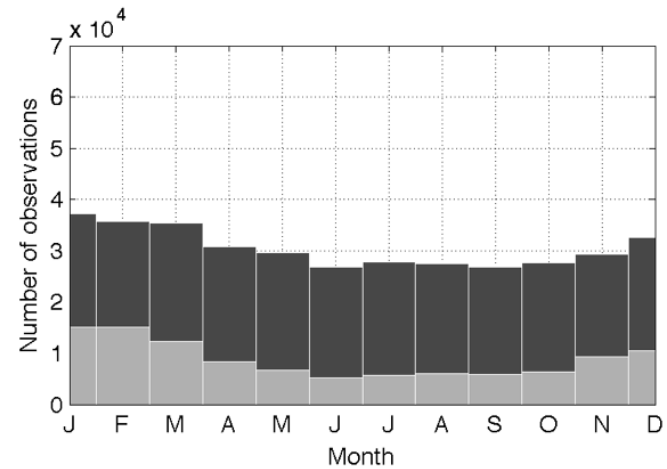
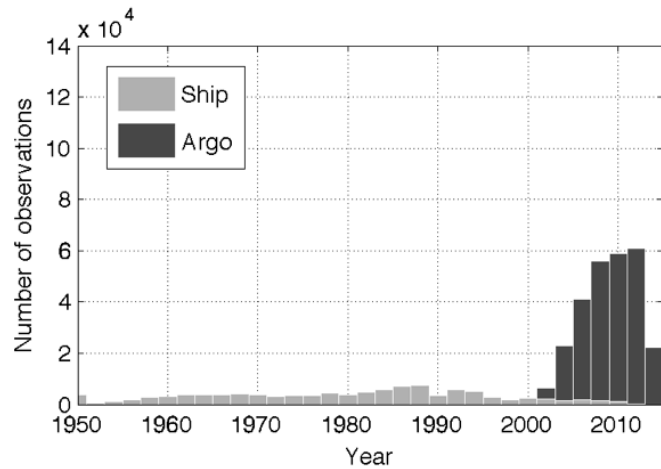


log 10 number of data

A Southern Ocean dataset from highly complementary sources

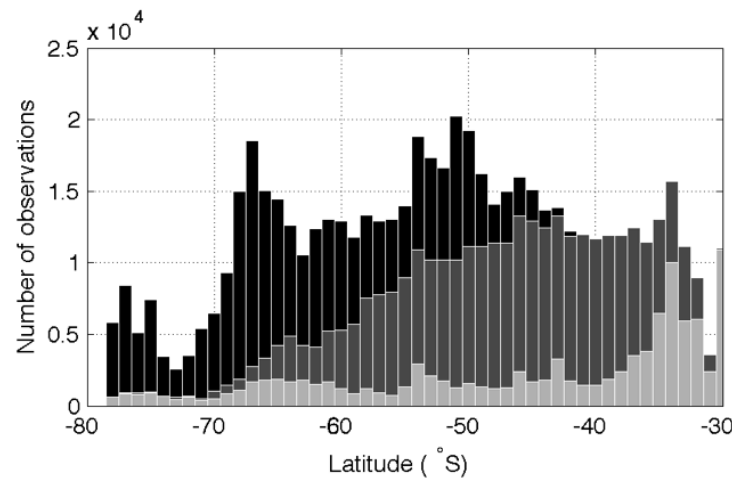
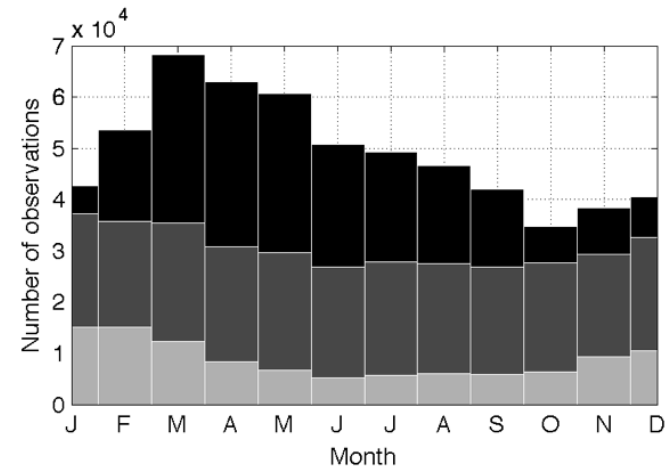
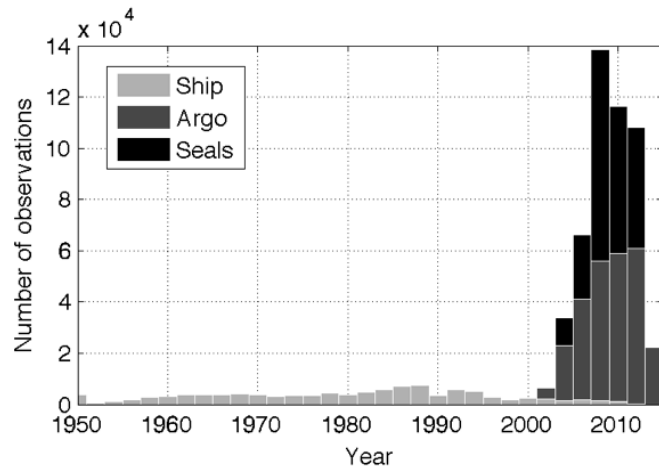


Ship-based: long baseline
summer biased



Ship-based: long baseline
summer biased

Argo: Sample winter months
and north ACC basins



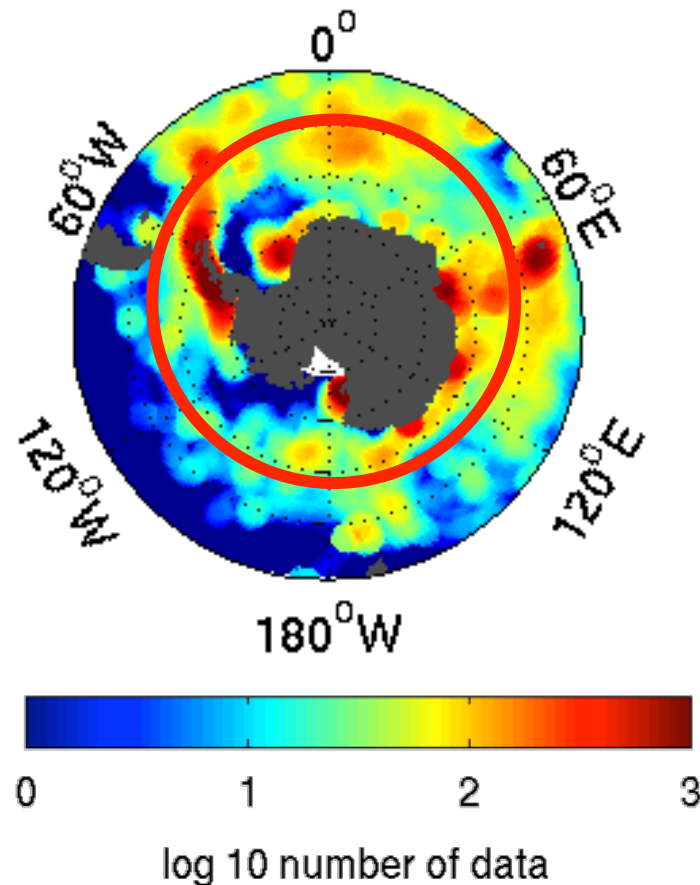
Ship-based: long baseline
summer biased

Argo: Sample winter months
and north ACC basins

Seals: Provides south of the
ACC obs

Since 2004 : instrumentation of Southern Elephant seals (CTD sensors)
→ GOOD COMPLEMENTARITY

Seal data covers some dataless areas (Roquet et al., 2014)



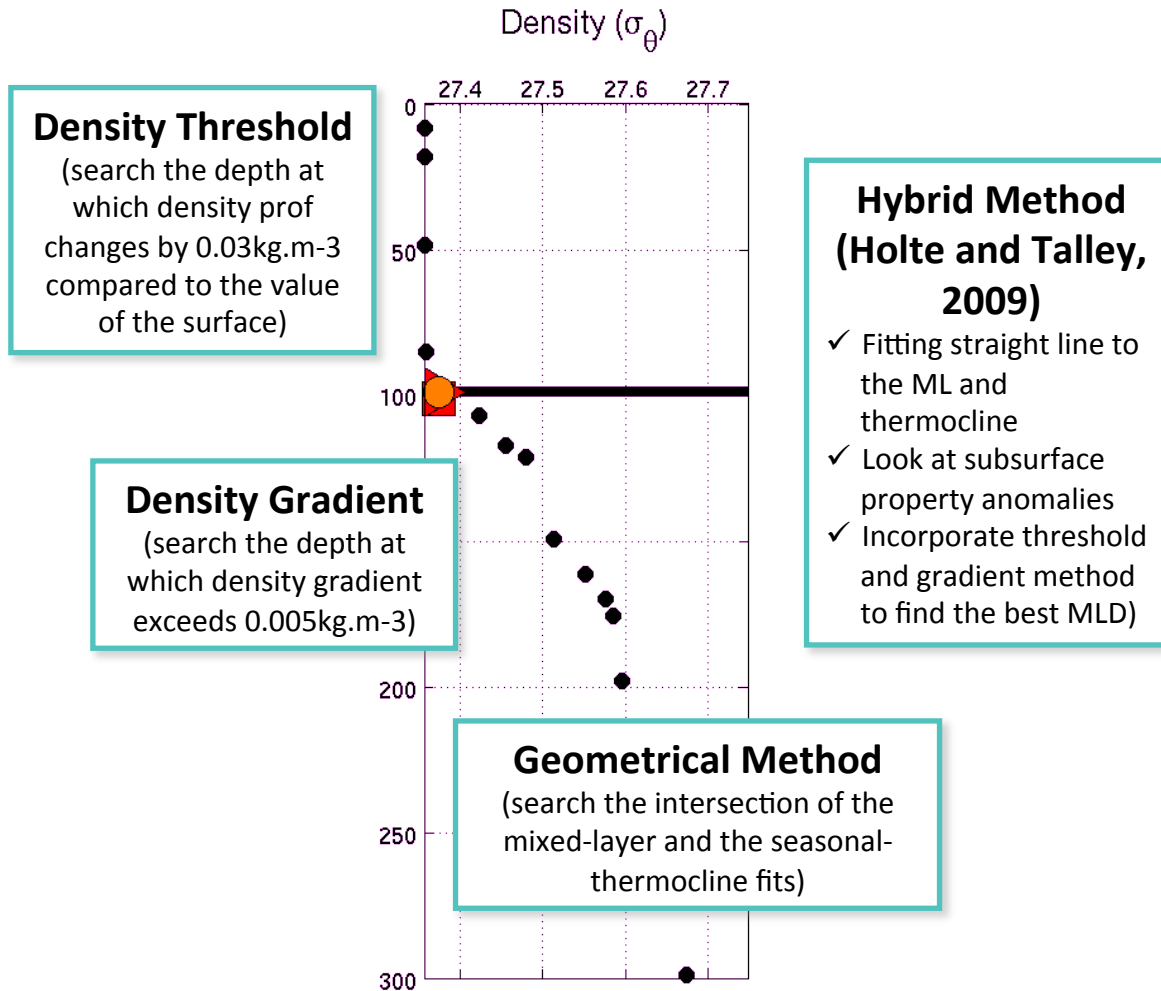
1. Characteristics of the surface ocean under ice

2. Subpolar gyre circulation

3. Overturning circulation

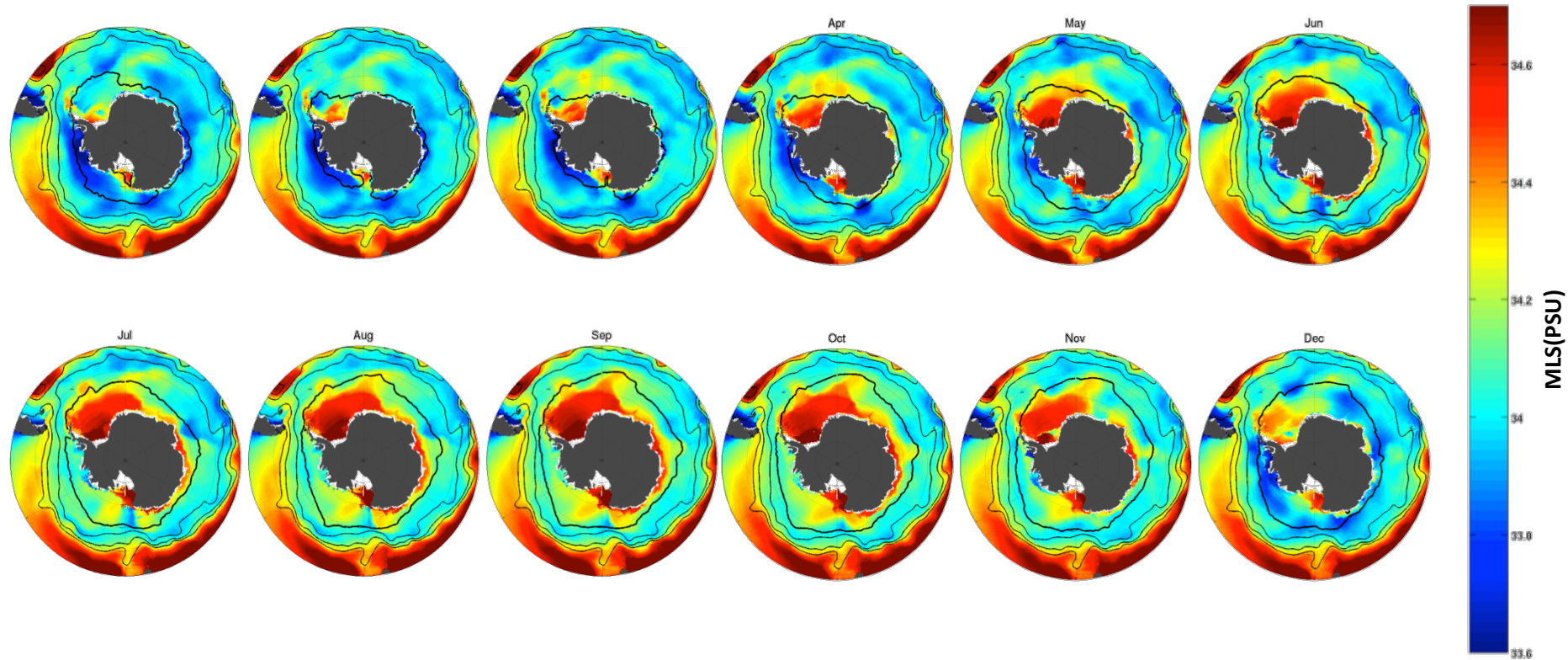
4. Gaps and ways to fill them

1. Characteristics of the surface ocean under ice



1. Characteristics of the surface ocean under ice

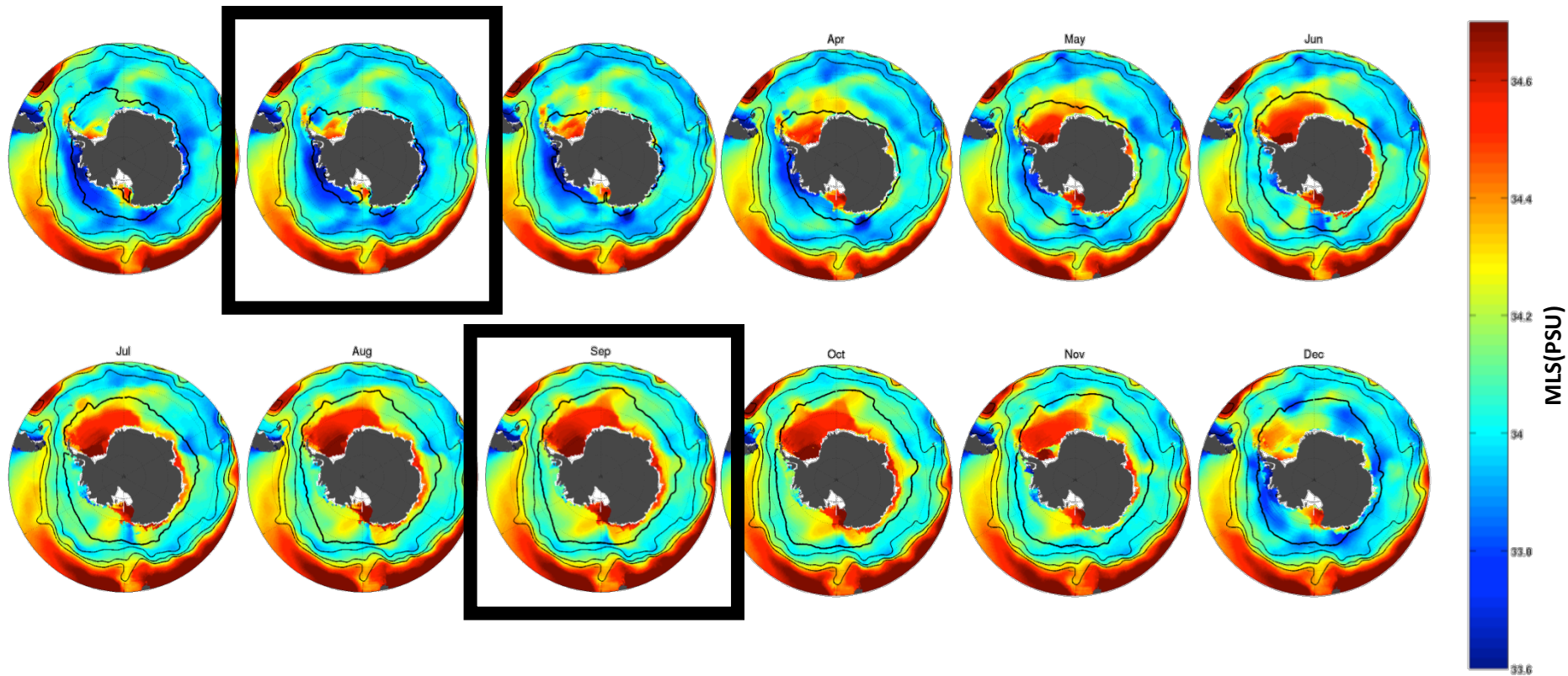
Mixed-layer salinity



Pellichero et al., 2016

1. Characteristics of the surface ocean under ice

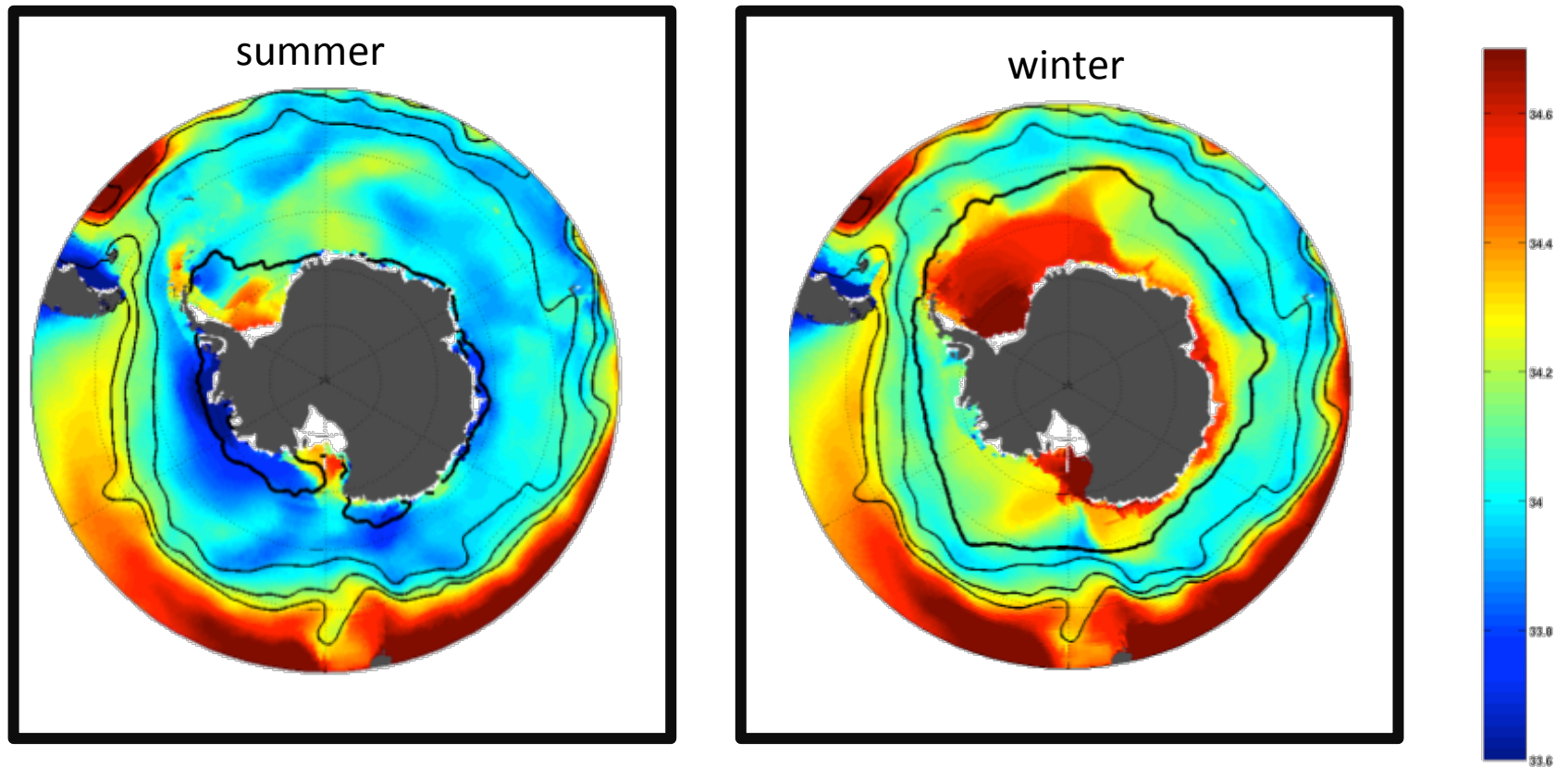
Mixed-layer salinity



Pellichero et al., 2016

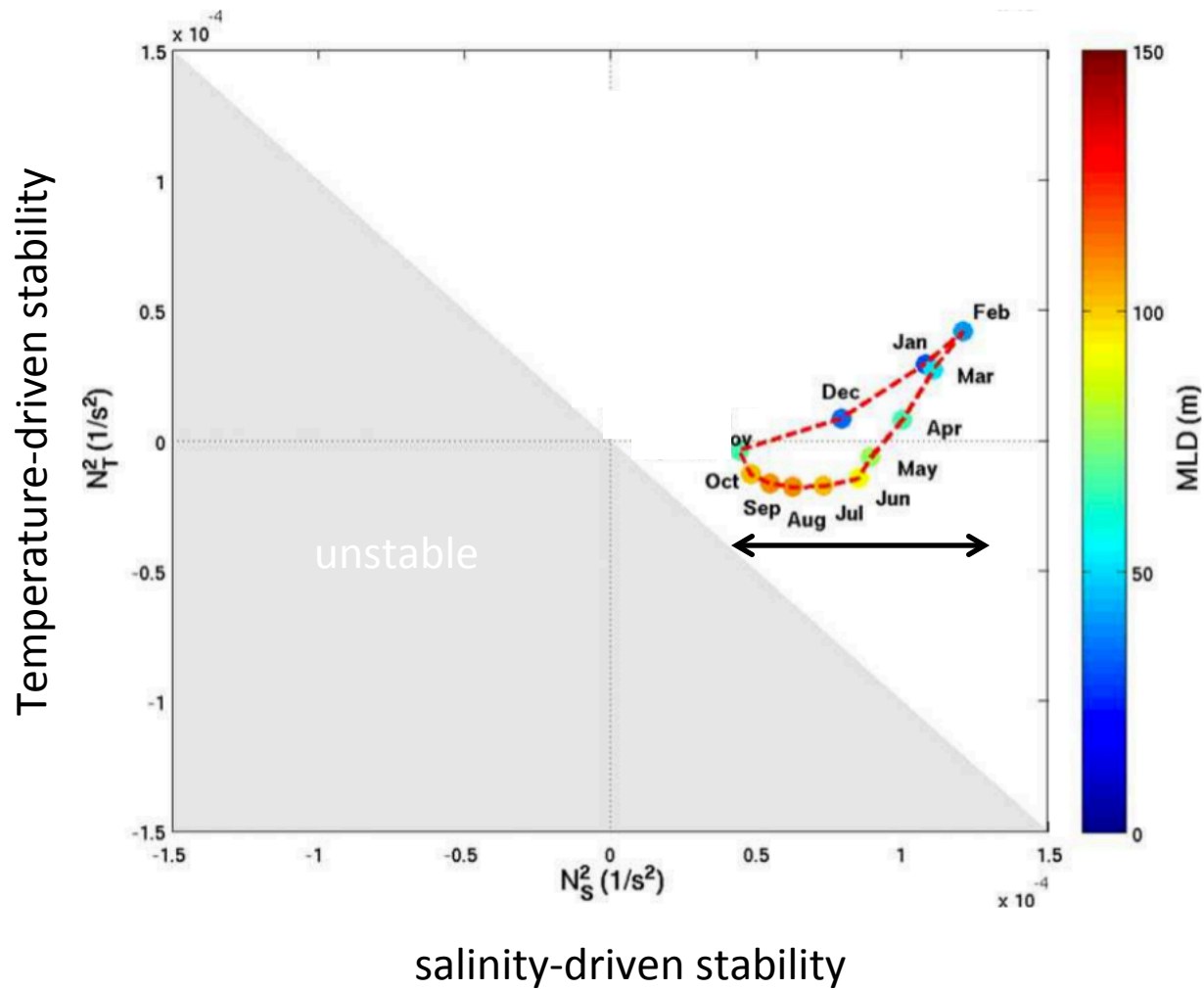
1. Characteristics of the surface ocean under ice

Mixed-layer salinity

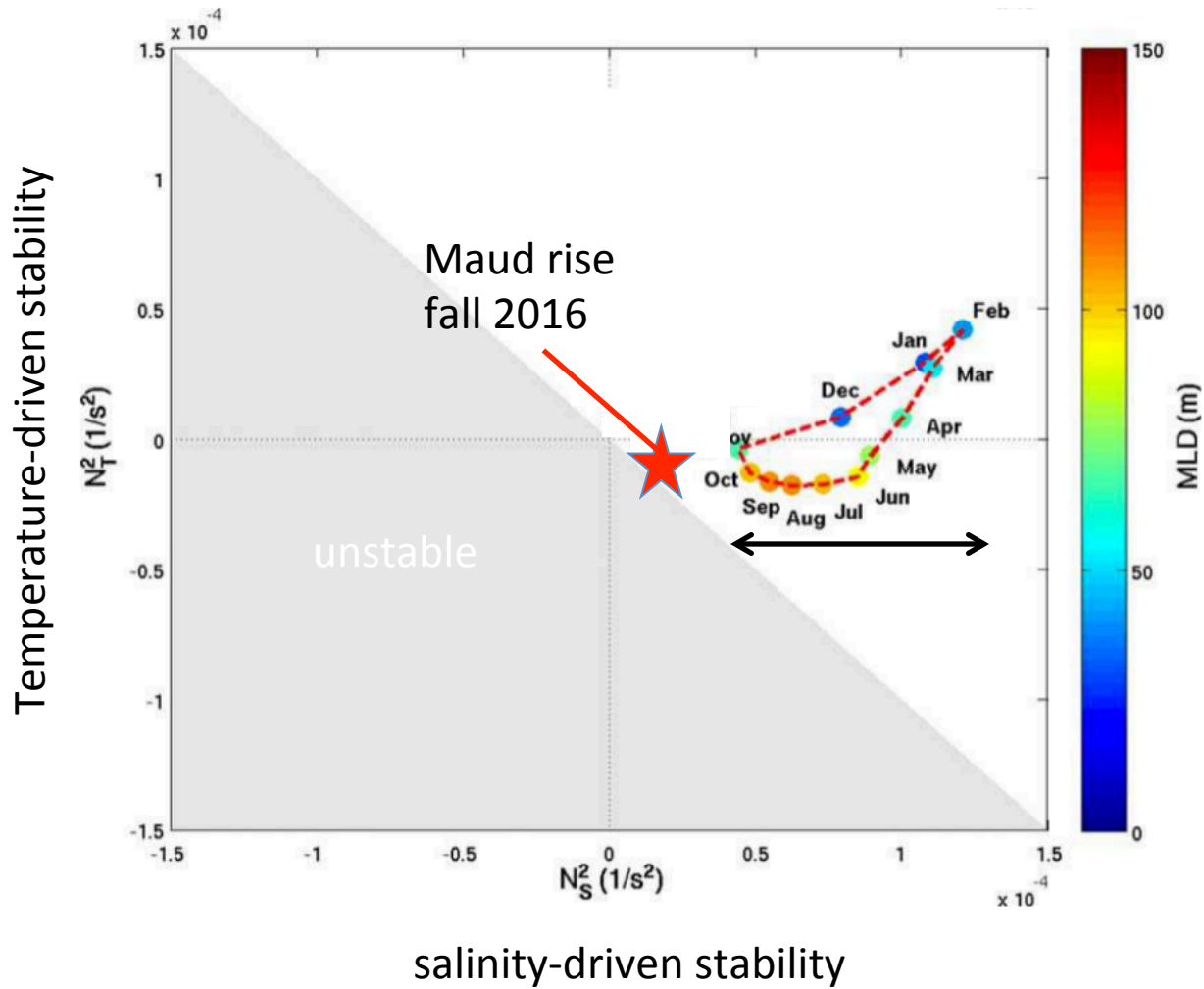


Pellichero et al., 2016

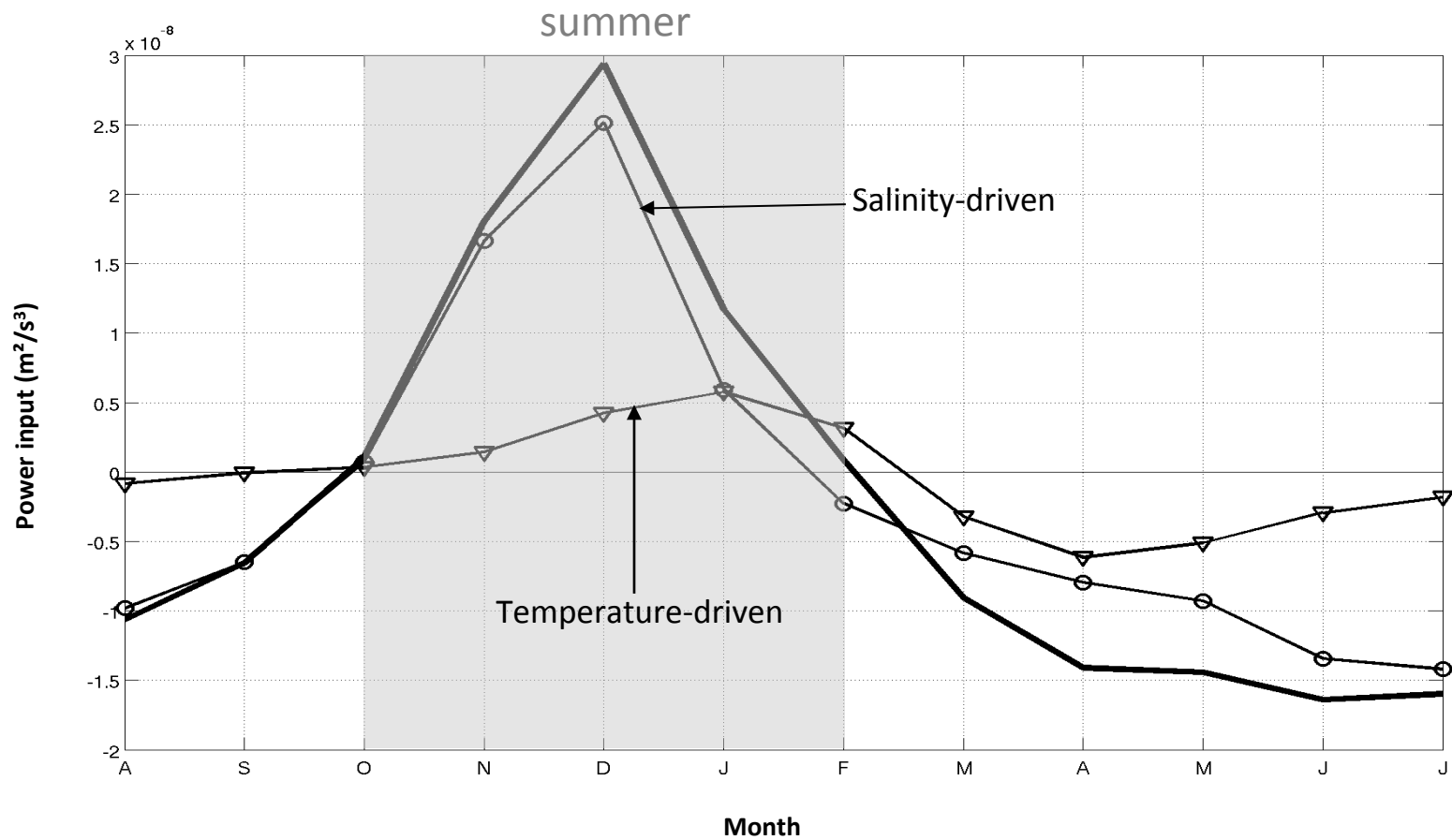
Mixed-layer stability



Mixed-layer stability



ML buoyancy content change



ML buoyancy content change

ML buoyancy content change = Air/Ice/Sea flux + Mixing + Entrainment + Ekm + adv geo

ML buoyancy content change

ML buoyancy content change = Air/Ice/Sea flux + Mixing + Entrainment + Ekm + adv geo

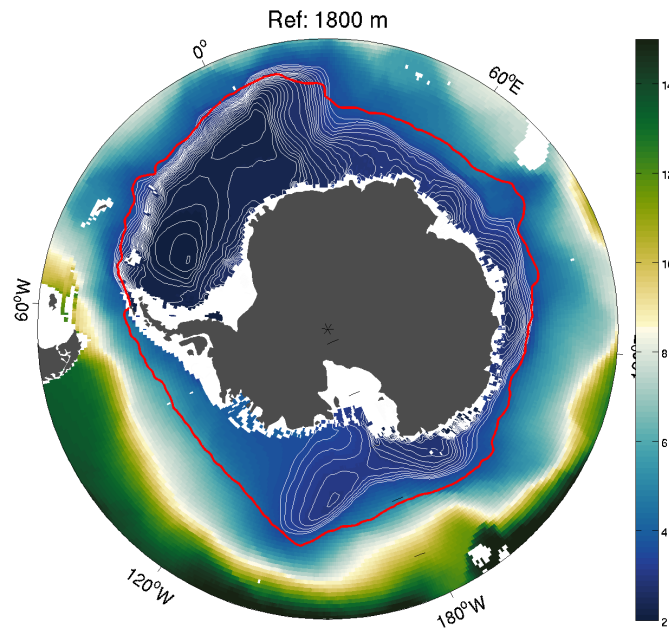
↓
ARGO/SEALS/SHIP
(Pellichero et al., 2016)

↓
ARGO/SEALS/SHIP
(Pellichero et al., 2016)

↓
CSFR
(atm. Renalysis)

↓
from DTU 10 &
AVISO

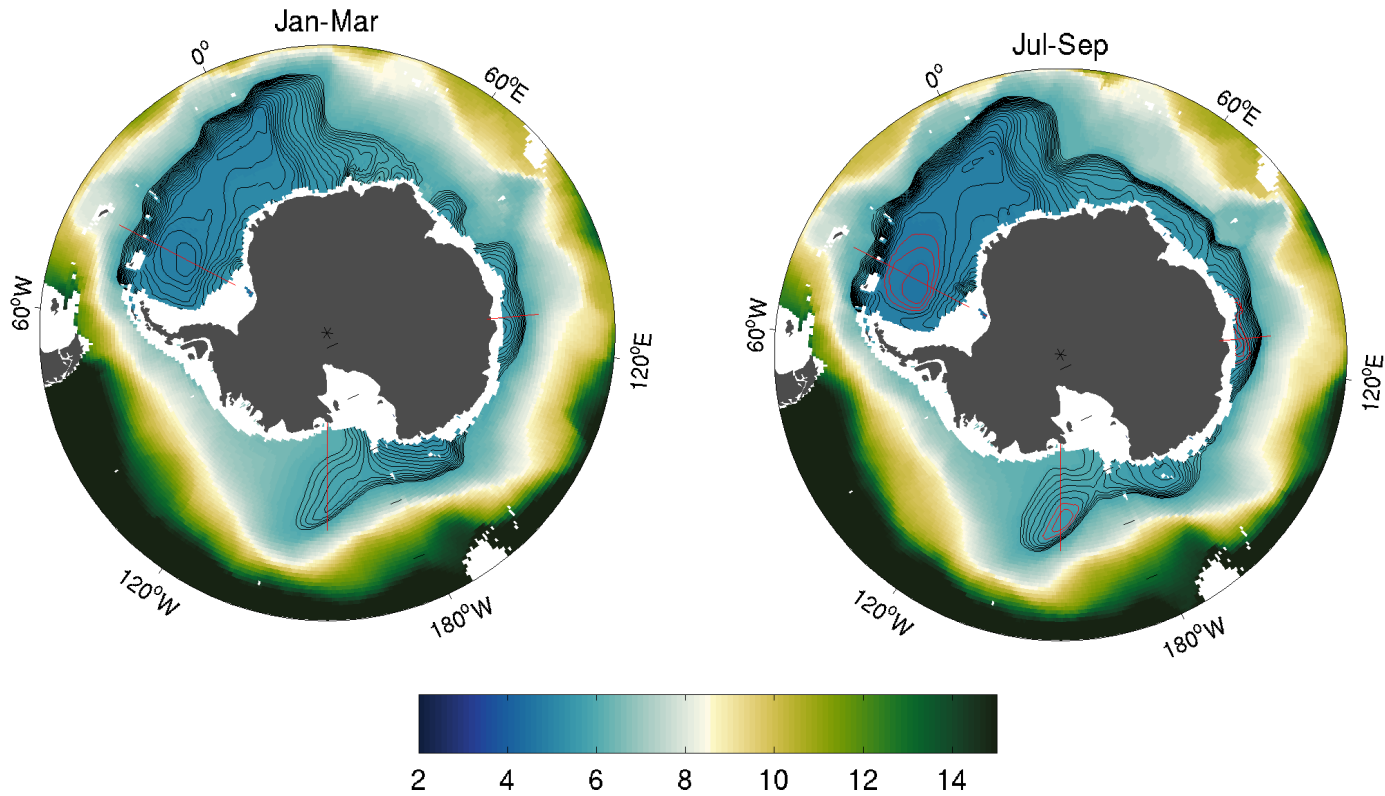
2. Subpolar Gyre circulation



Subpolar gyre streamfunctions: annual mean

Sallée et al., 2017

2. Subpolar Gyre circulation



Subpolar gyre streamfunctions: seasonal cycle

ML buoyancy content change

ML buoyancy content change=Air/Ice/Sea flux + Mixing + Entrainment + Ekm + adv geo

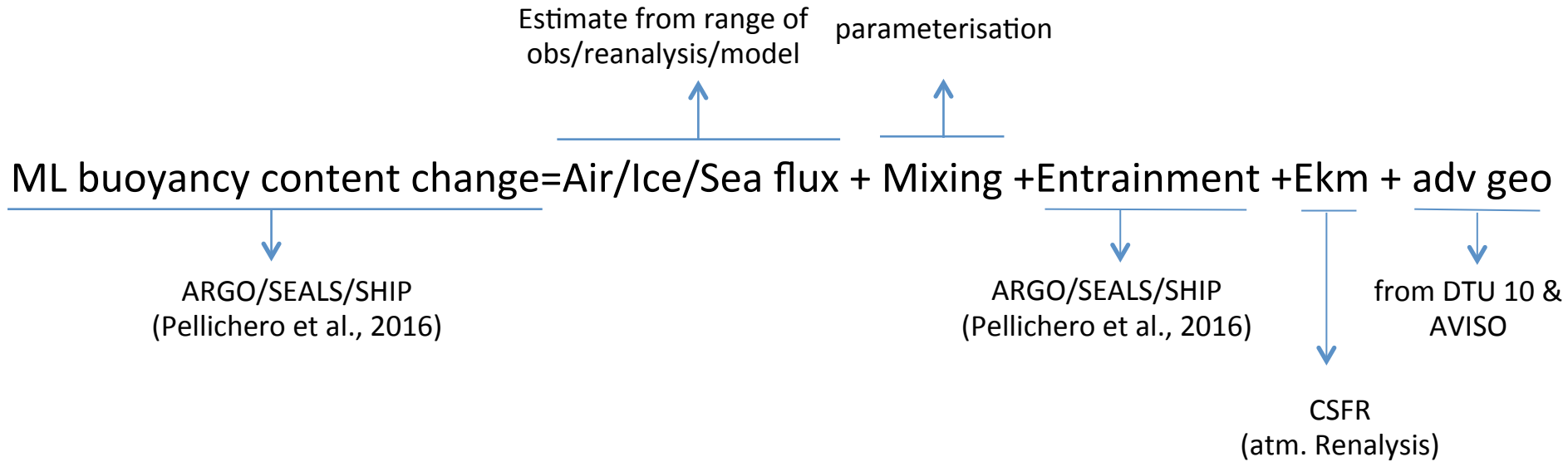
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ARGO/SEALS/SHIP
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ARGO/SEALS/SHIP
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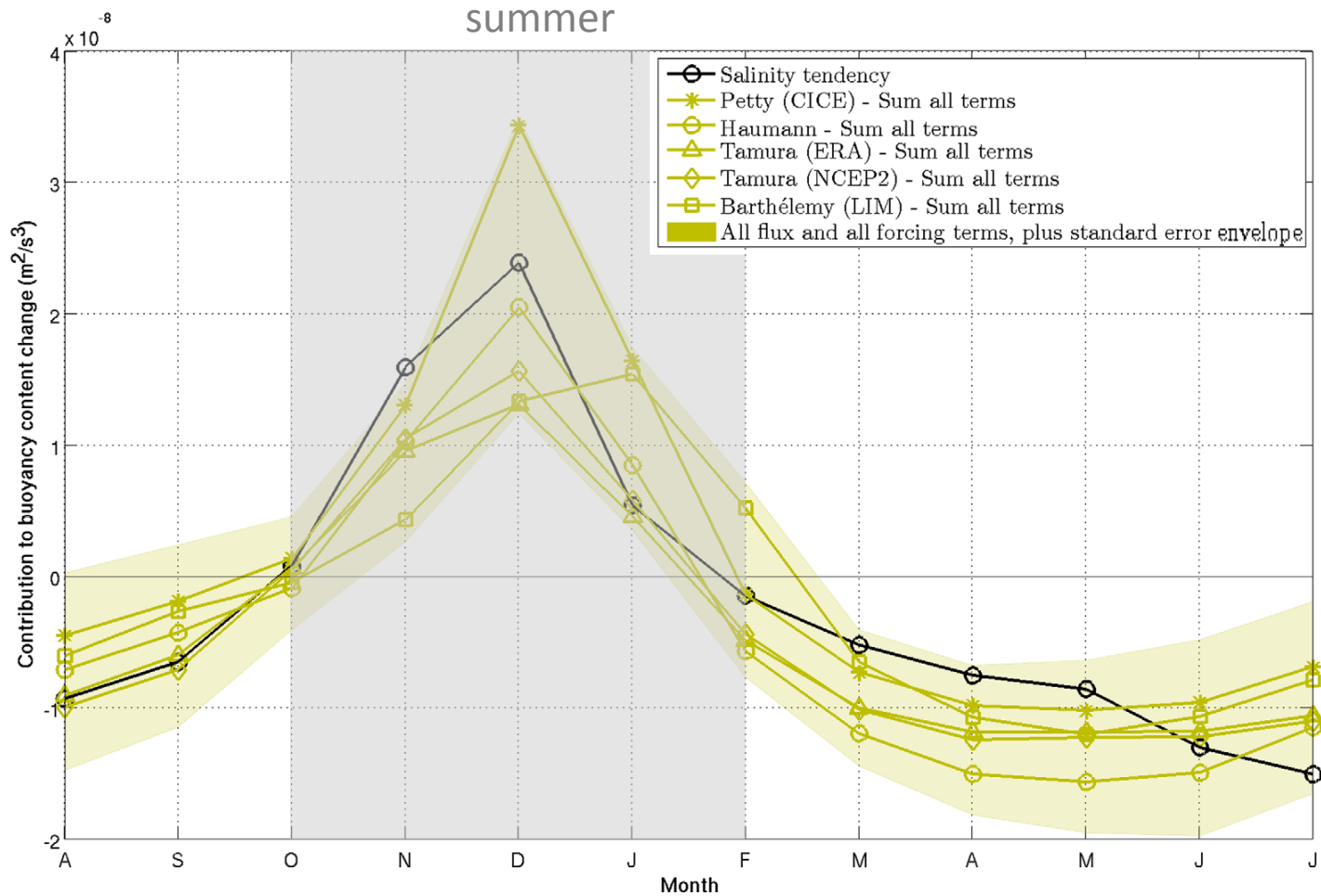
↓
CSFR
(atm. Renalysis)

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from DTU 10 &
AVISO

ML buoyancy content change



ML buoyancy content change



ML buoyancy content change=[**Air/Ice/Sea flux + Mixing**] +Entrainment +Ekm + adv geo

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ARGO/SEALS/SHIP
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CSFR
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↓
from DTU 10 &
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ML buoyancy content change = [**Air/Ice/Sea flux + Mixing**] + Entrainment + Ekm + adv geo

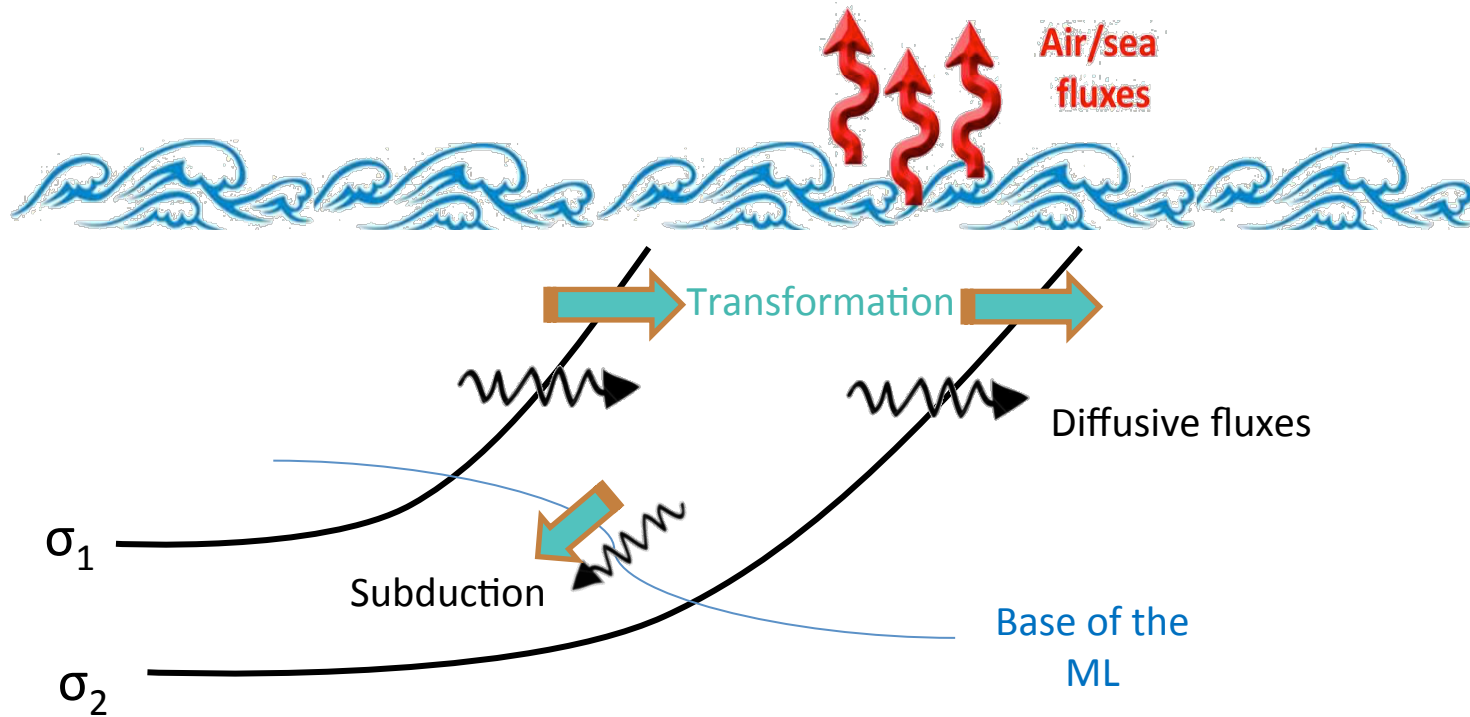
↓
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ARGO/SEALS/SHIP
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↓
from DTU 10 &
AVISO
↓
CSFR
(atm. Renalysis)

Subduction → balance of (**Air/Ice/Sea flux + Mixing**)

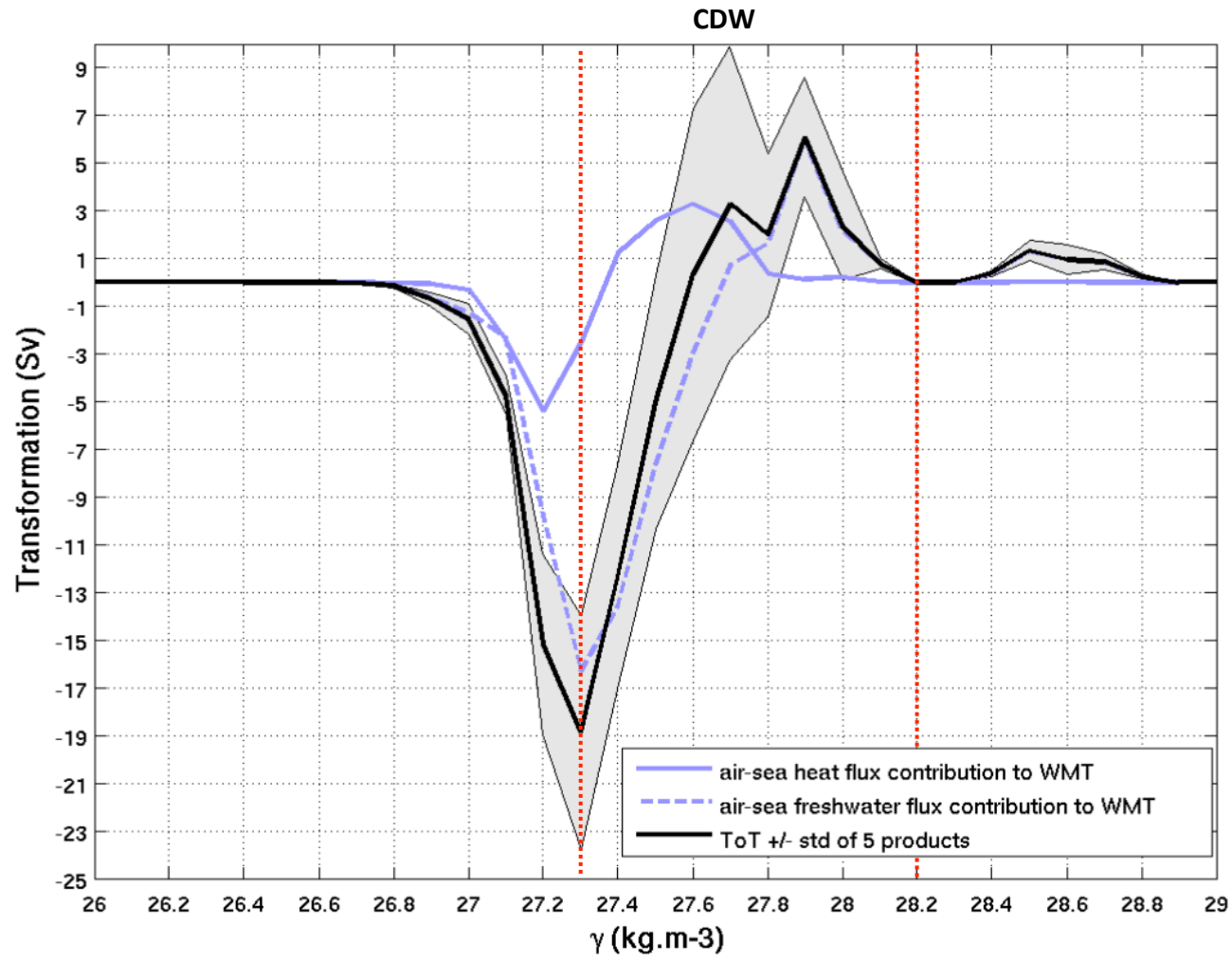
3. Overturning circulation



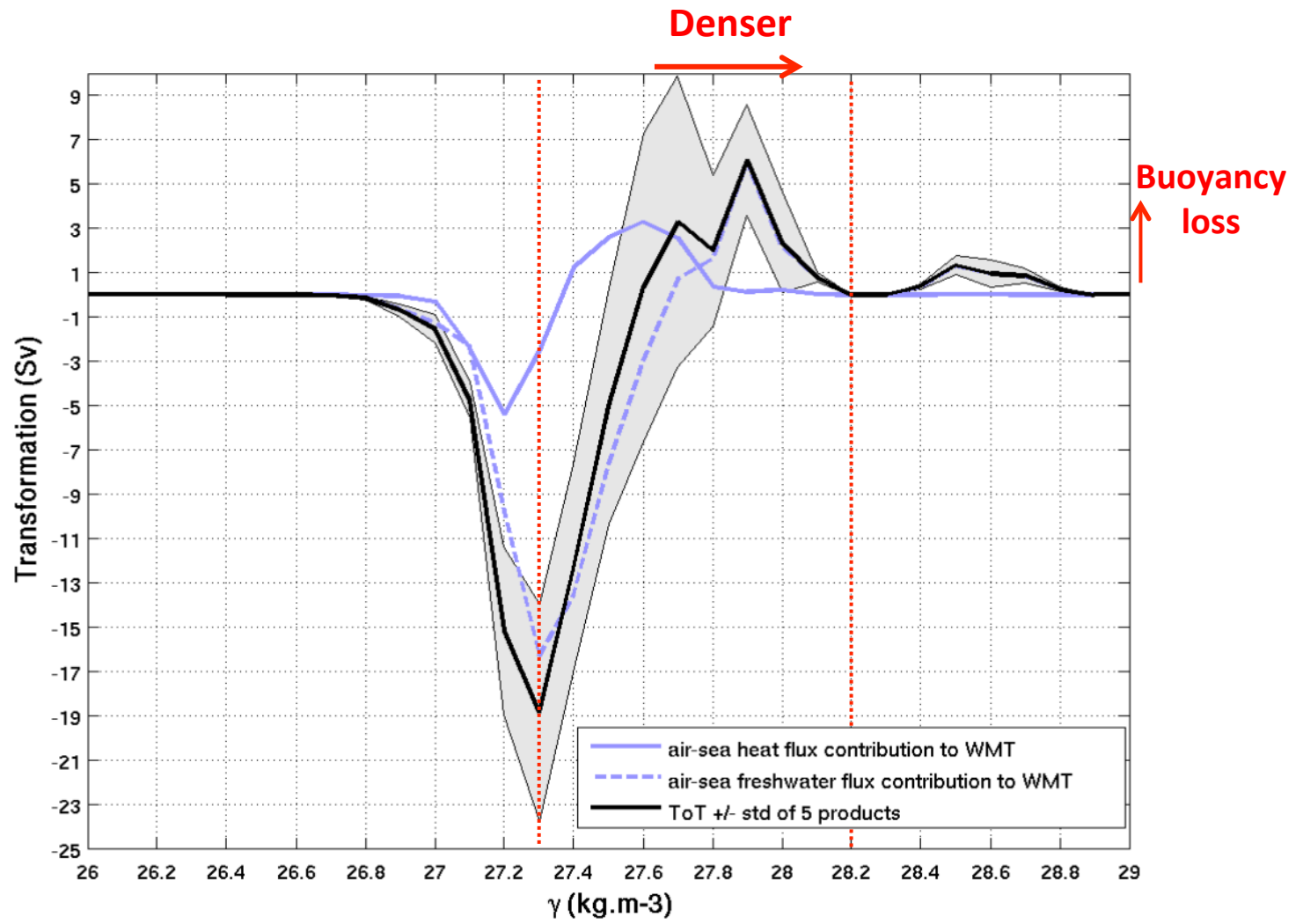
Subduction \rightarrow balance of (Air/Ice/Sea flux + Mixing)

(Walín, 1982; Speer and Tziperman, 1992)

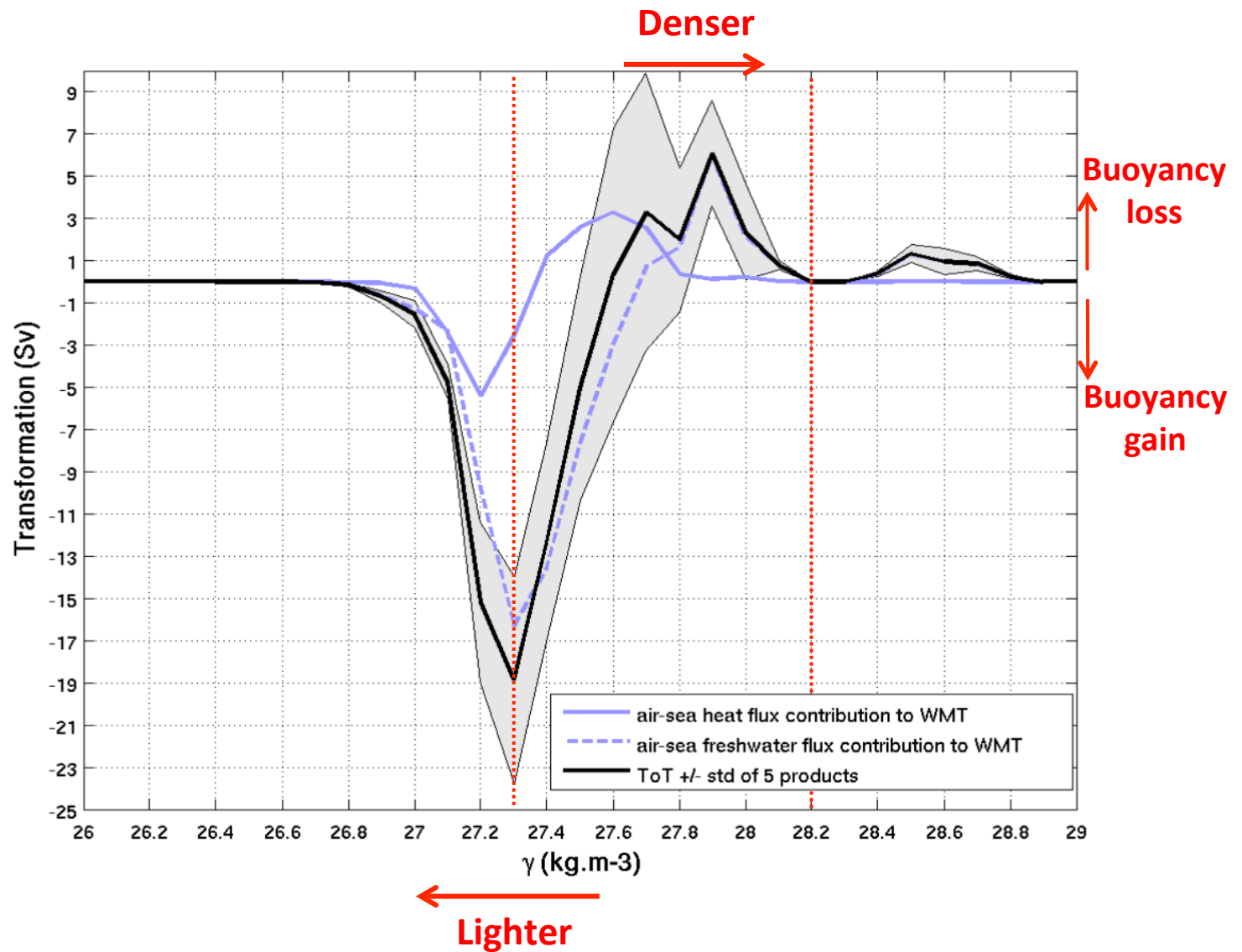
3. Overturning circulation



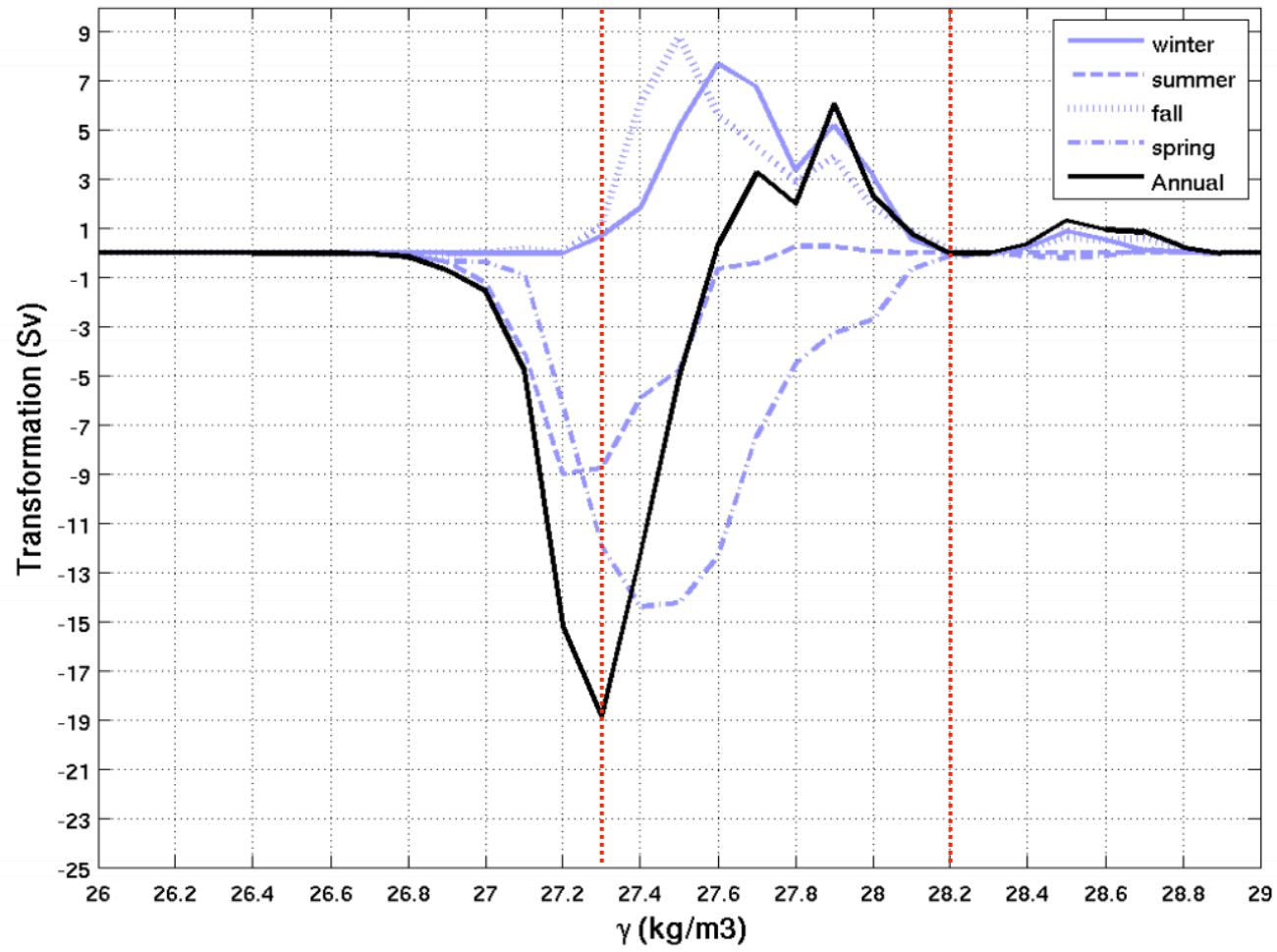
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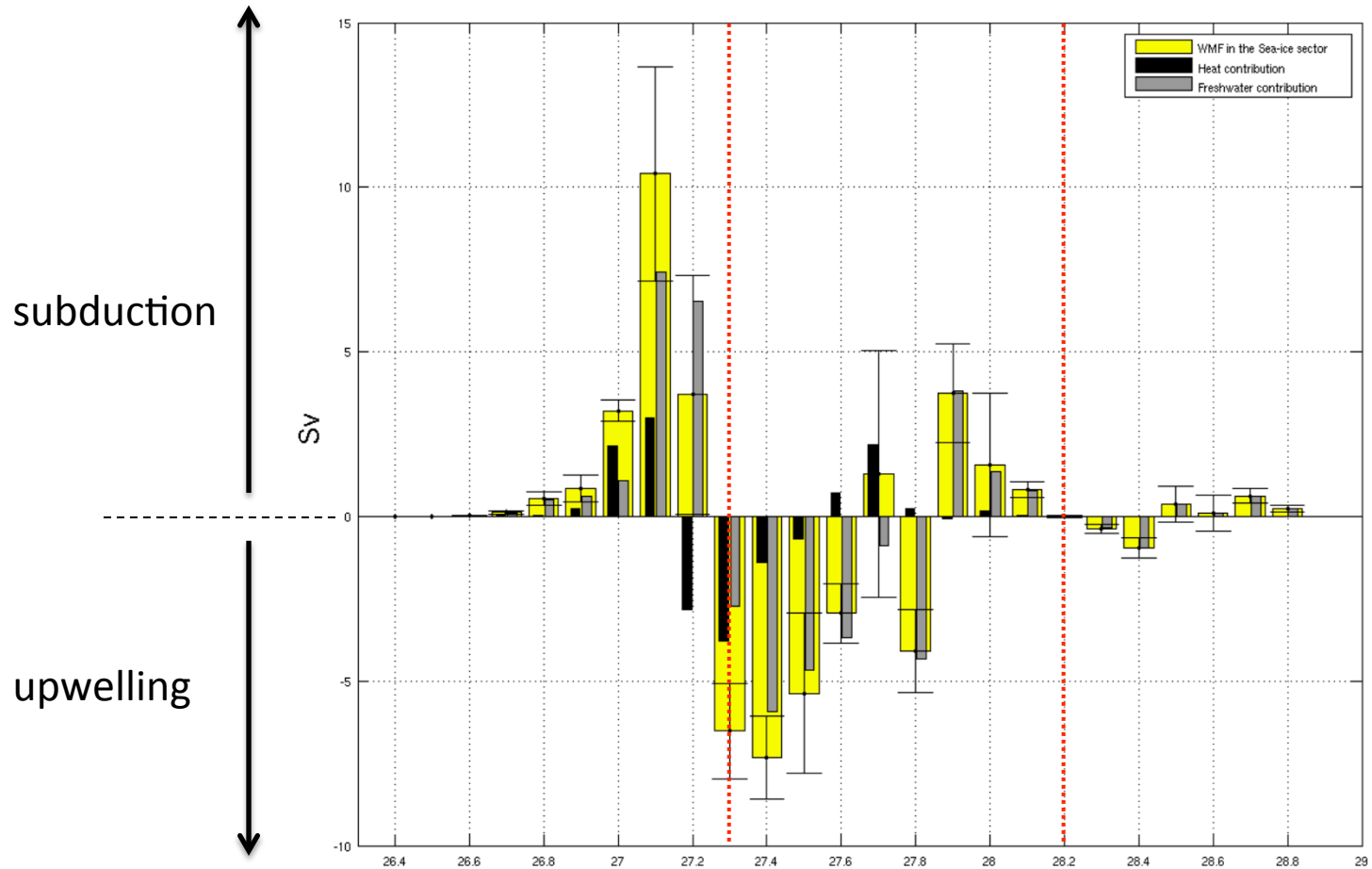
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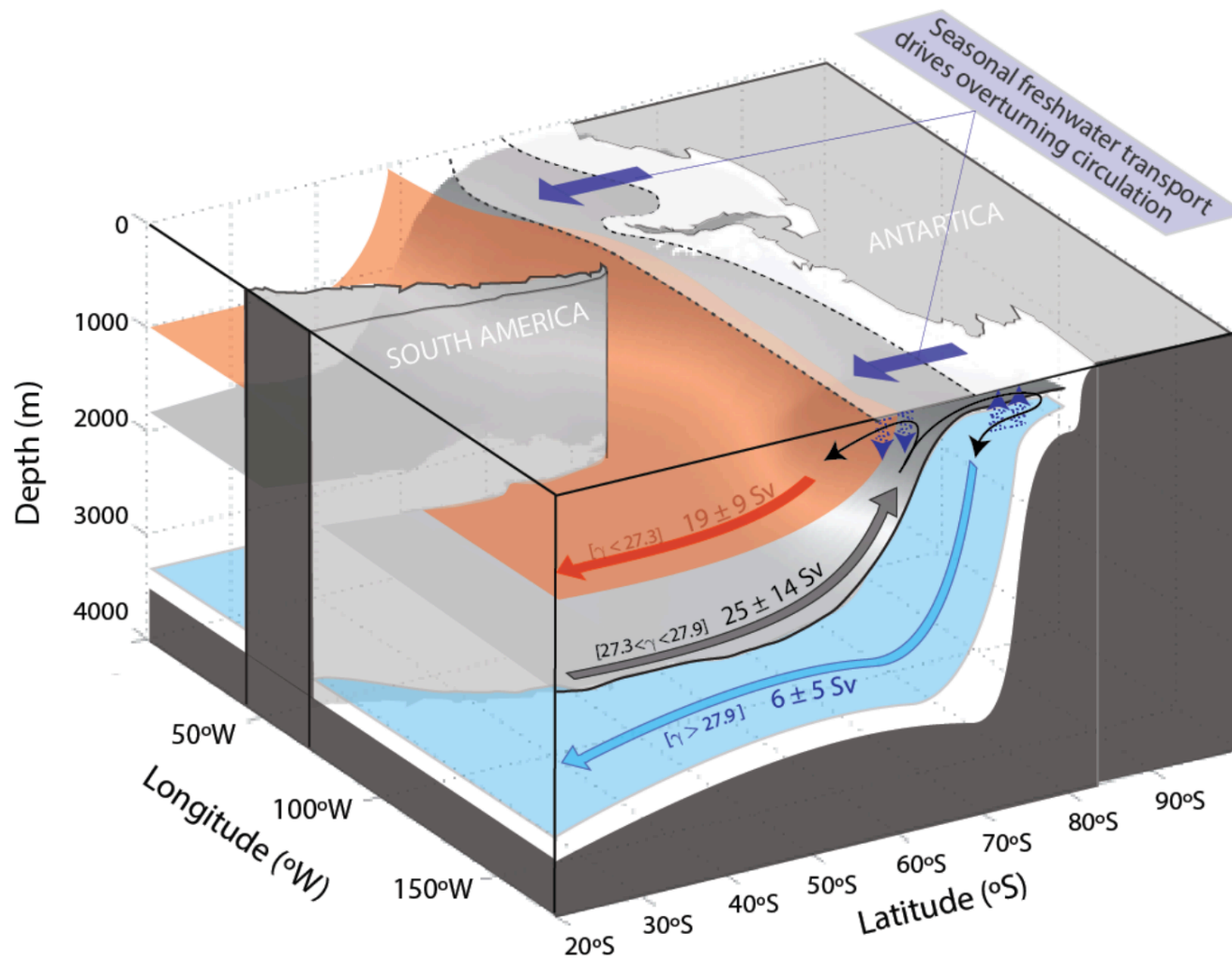
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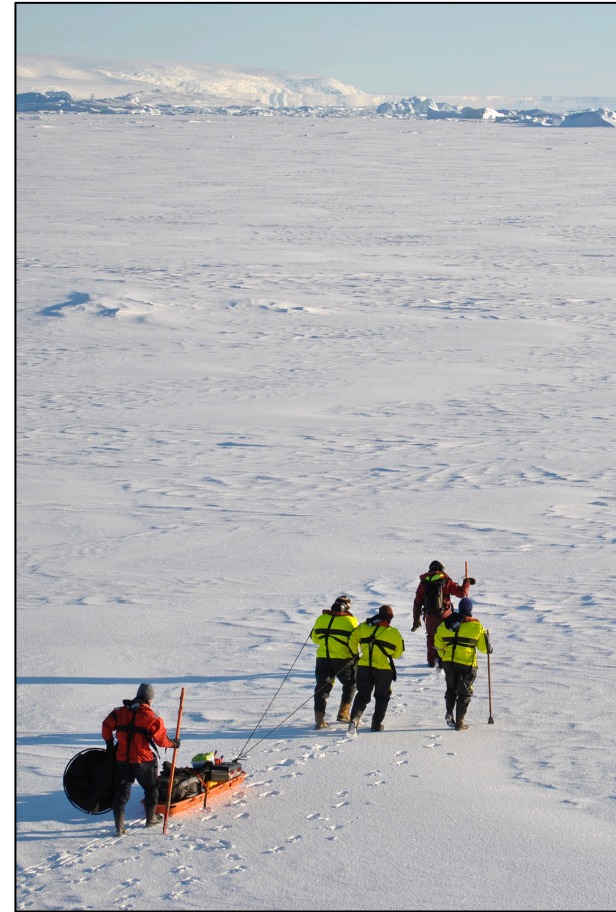
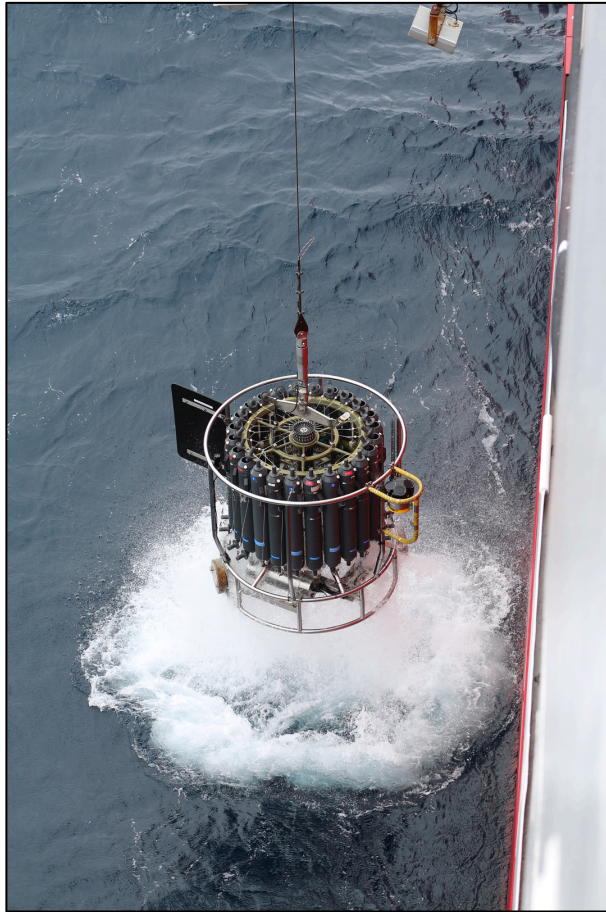


3. Overturning circulation



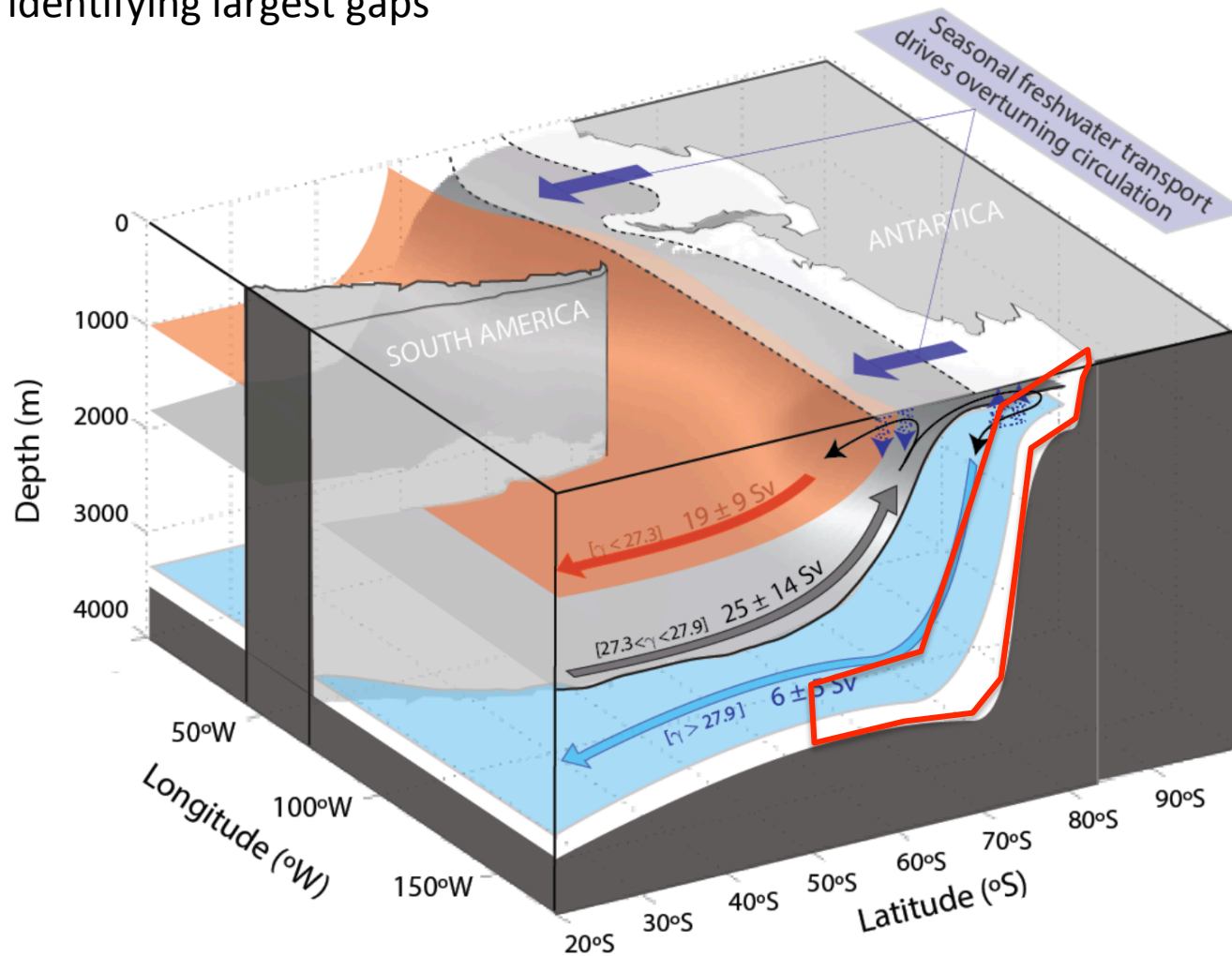
4. Gaps and ways to fill them

Continuing building up existing databases



4. Gaps and ways to fill them

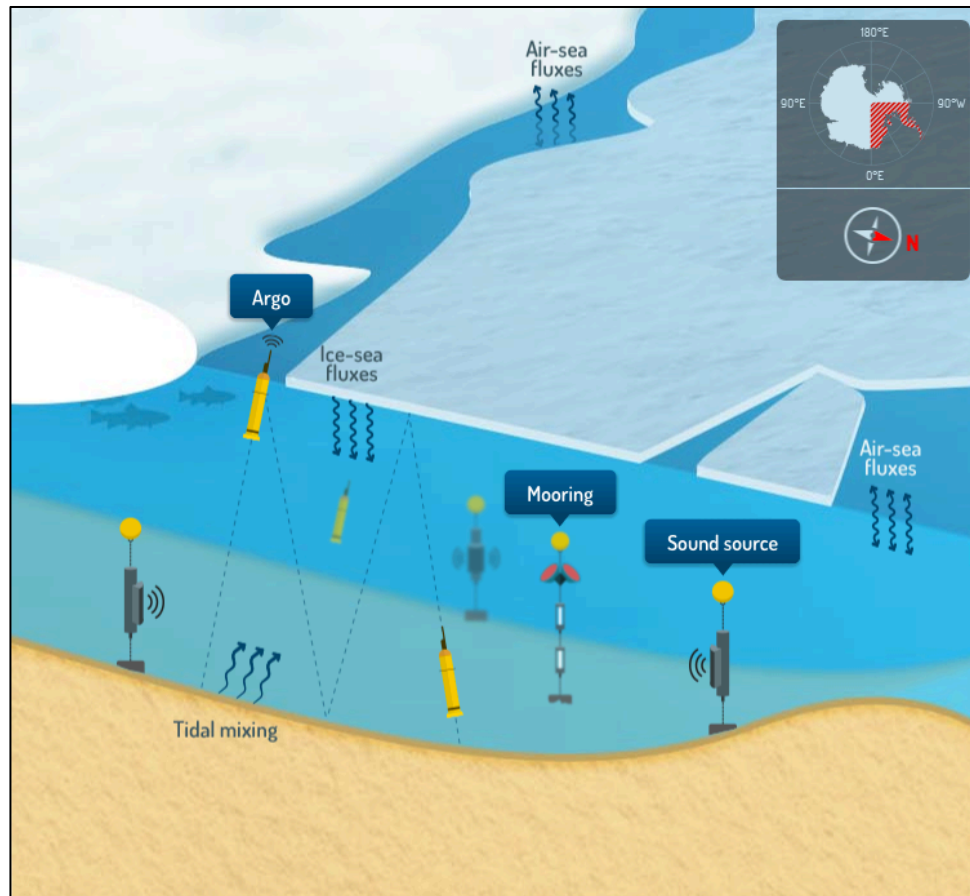
But also identifying largest gaps



- Continental shelf transformation ?
- Role of polynya ?
- Dense water plume dynamics and mixing ?

4. Gaps and ways to fill them

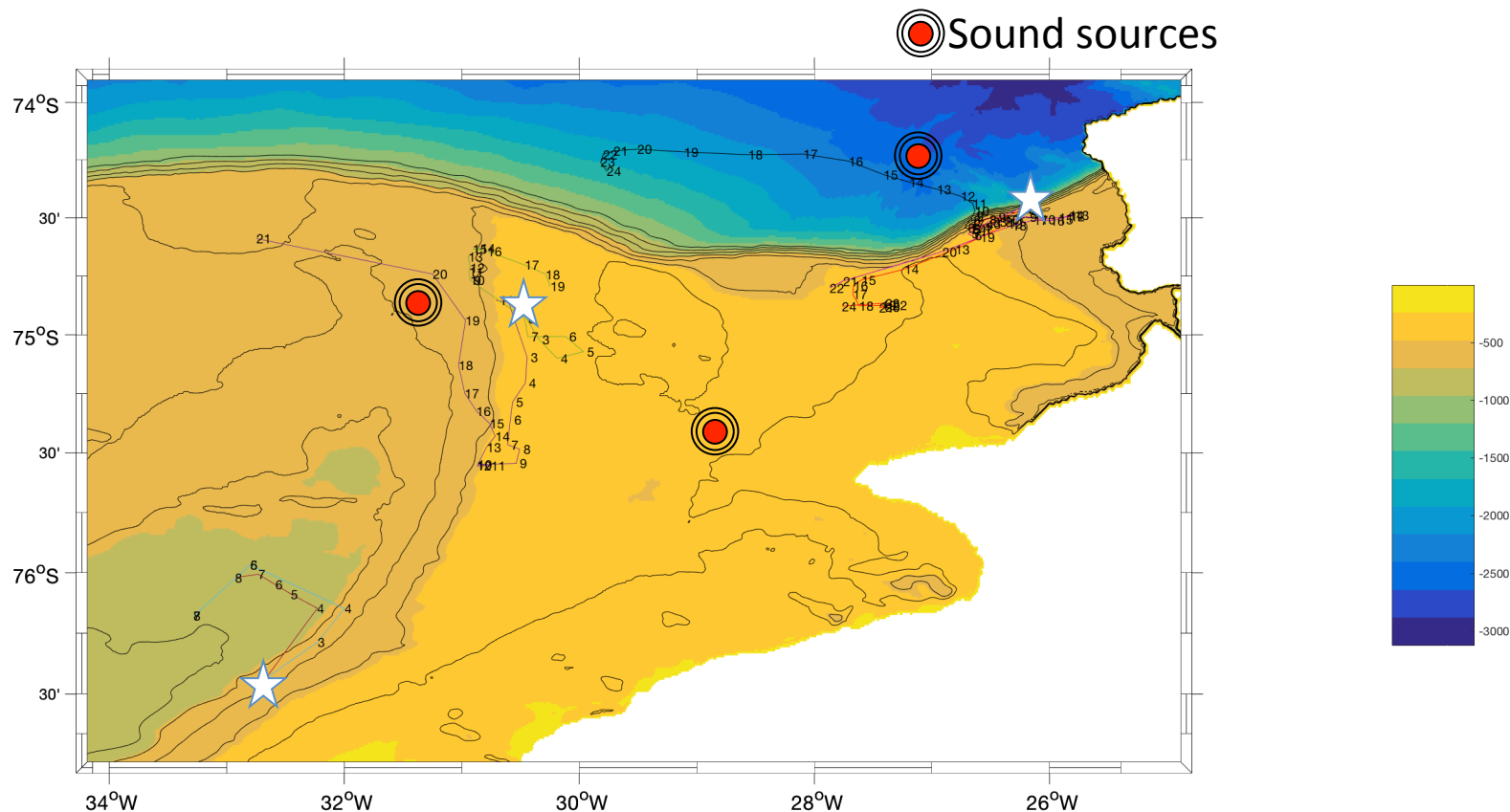
- Continental shelf transformation ?
- Role of polynya ?



- Extend AWI Weddell sound source network onto the continental shelf
- Use RAFOS-enabled ARGO (APEX) floats

4. Gaps and ways to fill them

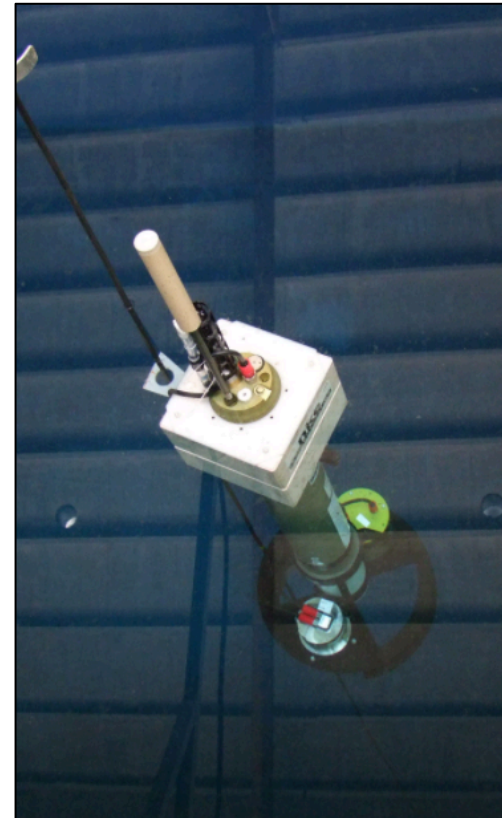
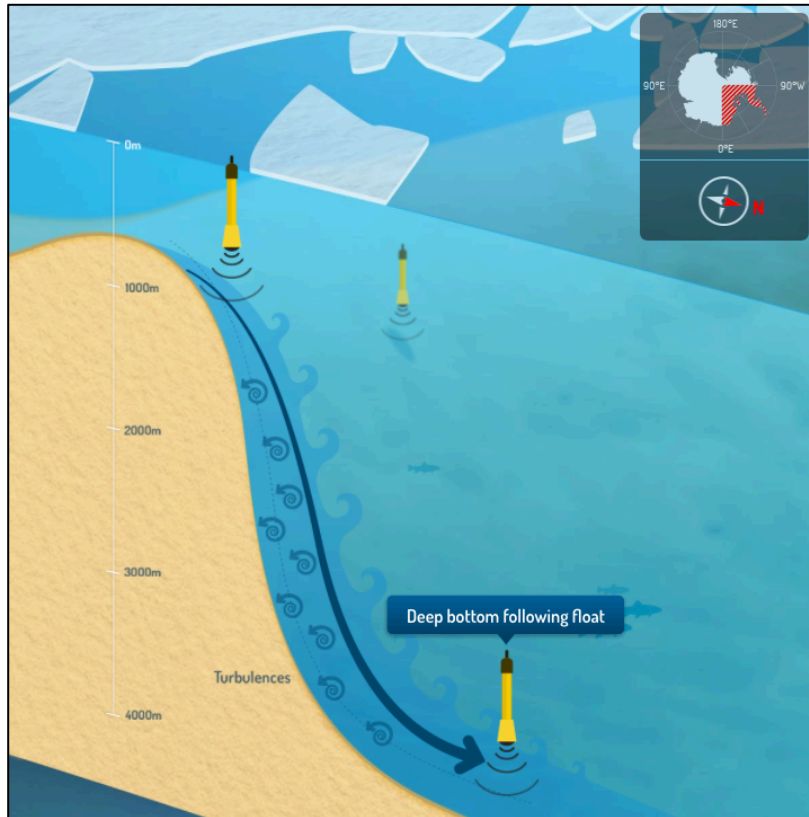
- Continental shelf transformation ?
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- Extend AWI Weddell sound source network onto the continental shelf
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4. Gaps and ways to fill them

- Dense water plume dynamics and mixing ?



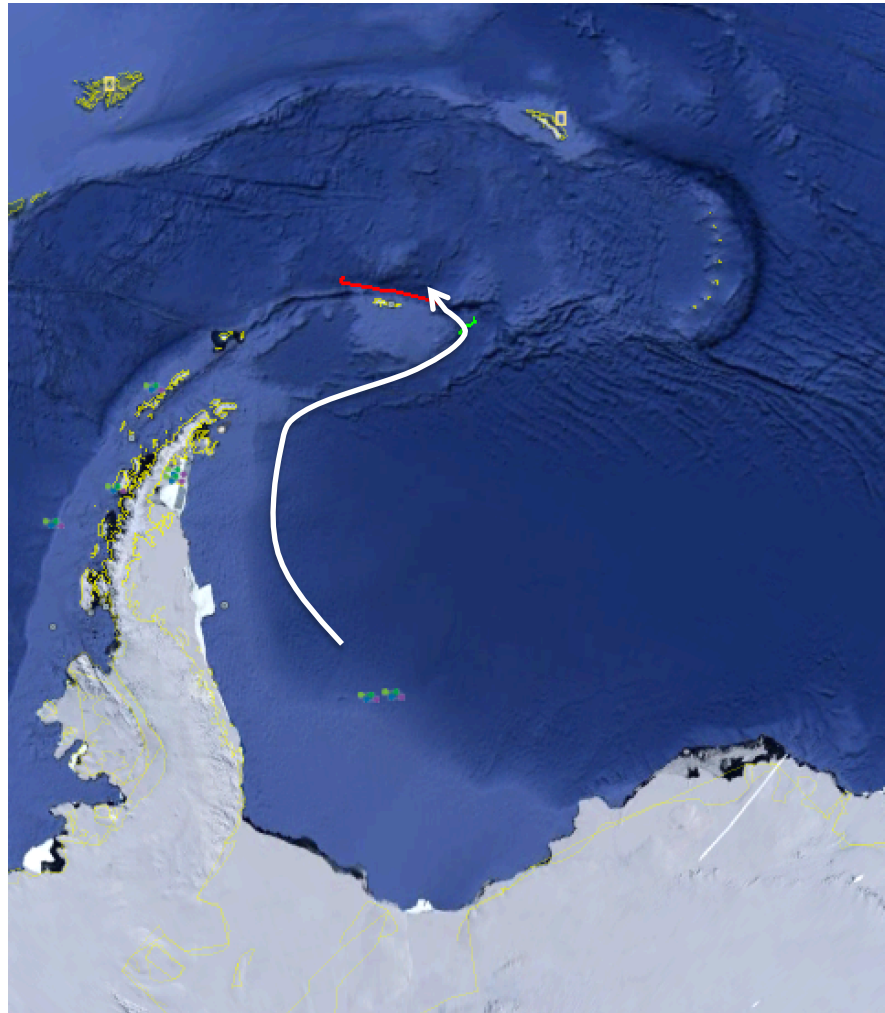
- Develop and deploy floats capable of following dense overflow

4. Gaps and ways to fill them

- Dense water plume dynamics and mixing ?

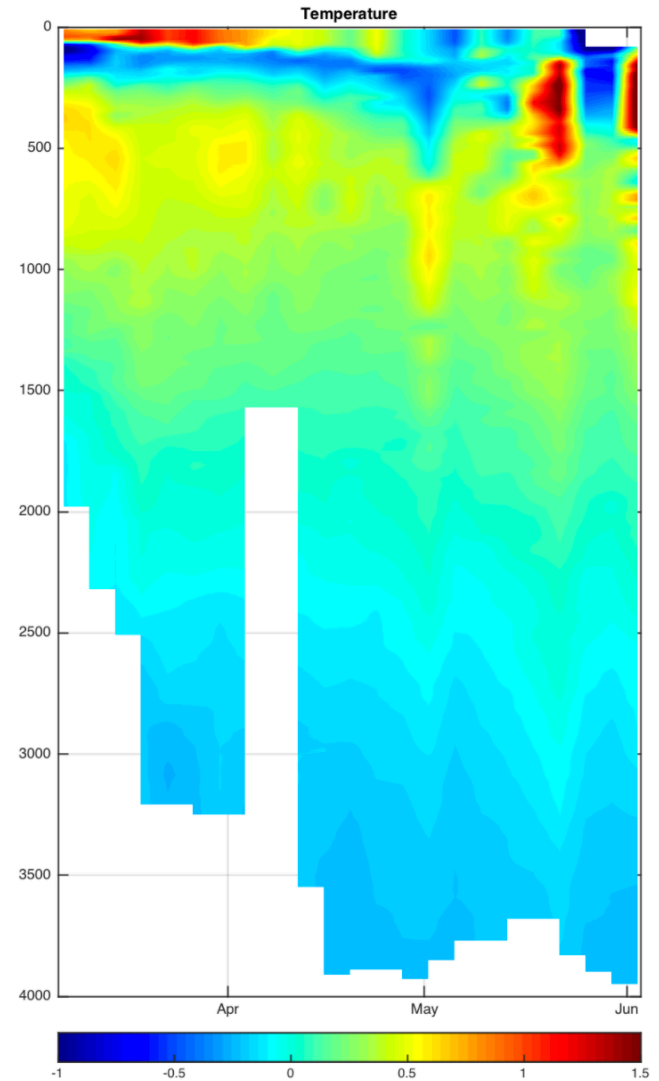
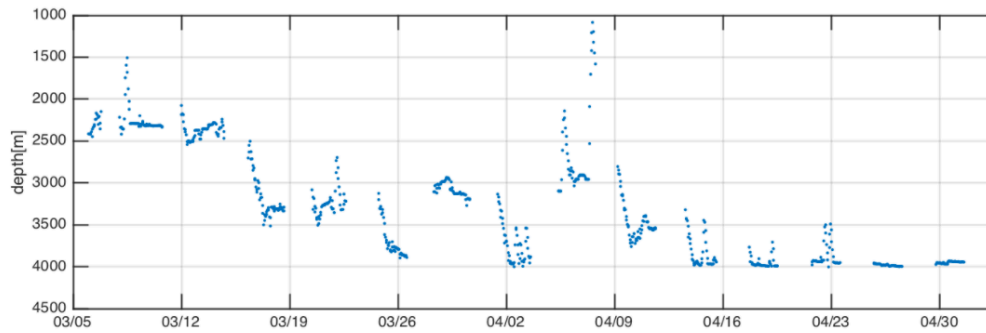
4. Gaps and ways to fill them

- Dense water plume dynamics and mixing ?



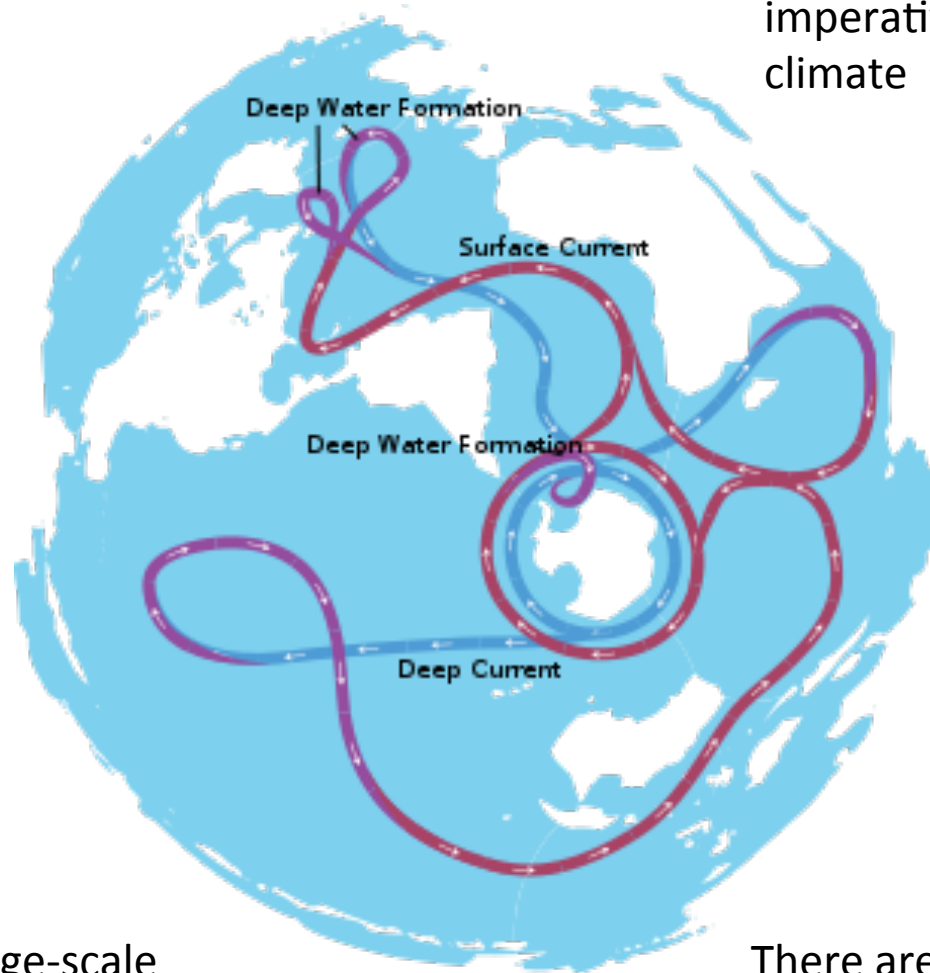
4. Gaps and ways to fill them

- Dense water plume dynamics and mixing ?



Sea-ice is key for driving horizontal and vertical Southern Ocean circulation

Observing ocean under ice has therefore global relevance and is imperative for our understand of climate



The existing large-scale observation program allows to start constructing a mean state understanding

There are still large gaps to be filled and in the context of changing sea-ice distribution, observation effort must increase to understand ocean and large-scale implications