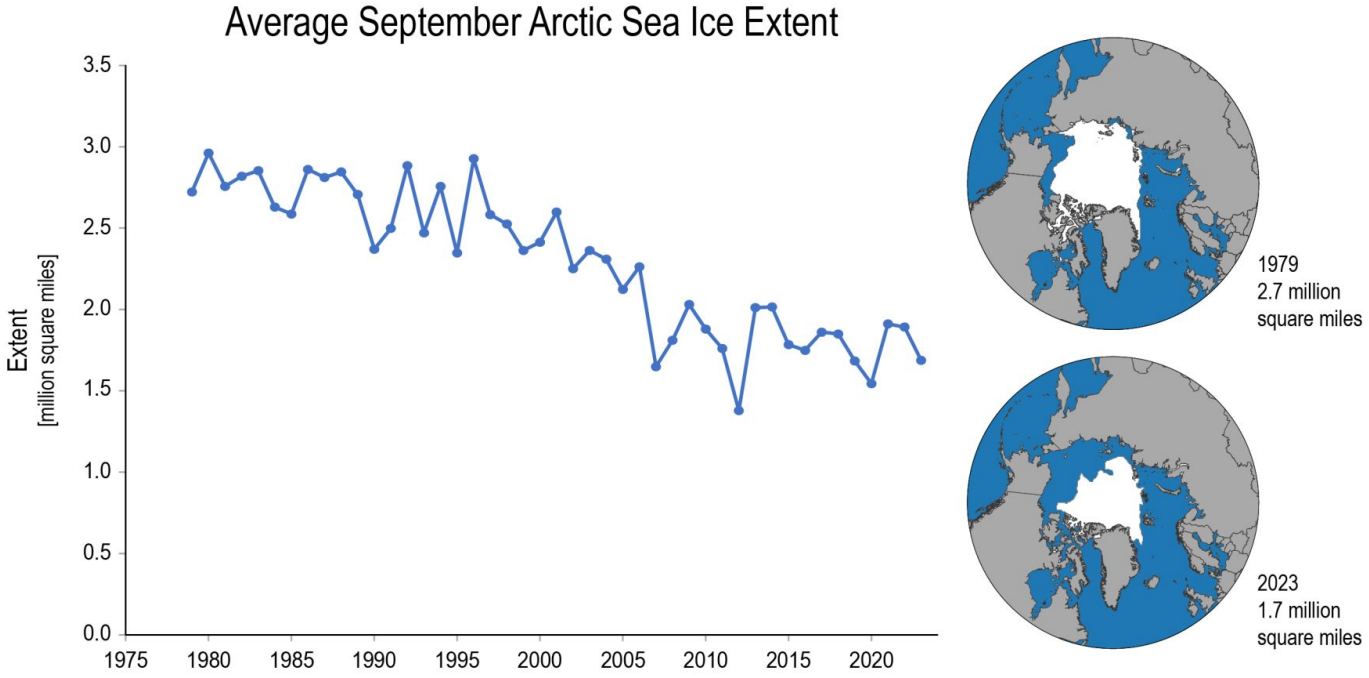
Life cycle of coherent low salinity anomalies in the Arctic

Phd student : Clément Van Straaten[1],
Supervisors : Camille Lique[1], Nicolas Kolodziejczyk[1]
[1] : LOPS

Signature of **climate change** : **rapid and large reduction of the Arctic sea ice cover** due to **melting**



➔ **Additional input of freshwater**

NASA, NOAA and NSIDC

➔ **Recent literature :**

Scarce detections of sea ice melting with satellite products, referred to as **meltwater lenses**

➔ **Characteristics :**

- Large scale
- SSS anomaly of up to 5 pss
- Persists for at least a month
- Coincides with a local sea ice melt

➔ **Impacts :**

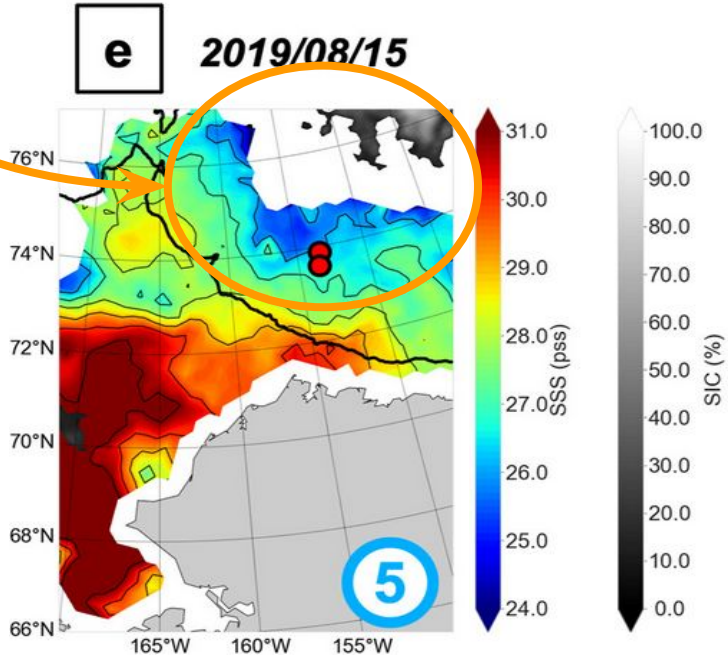
- Ice-ocean and ocean-atmosphere interactions
- Heat storage in upper layers (NSTM)
- Sea ice freezing

➔ **Using a model** :

Analyze and **quantify** spatial and temporal evolution of the **lenses** and their **physical properties**

SSS

(SMOS + SMAP SSS), Chukchi and Beaufort seas



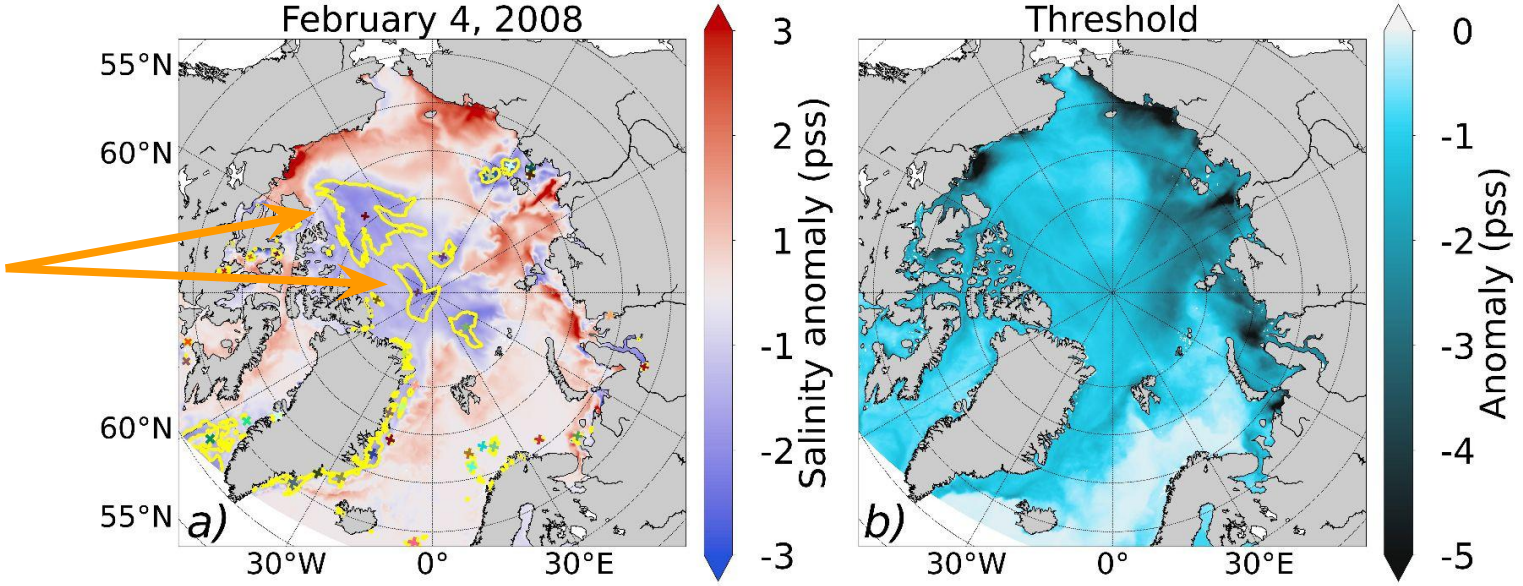
Supply et al., 2022

Detection method

- **SSS anomaly** definition using **climatologies**
- **Detection threshold : quantile 5%** of anomalies**,** spatially varying (0 to -5pss)

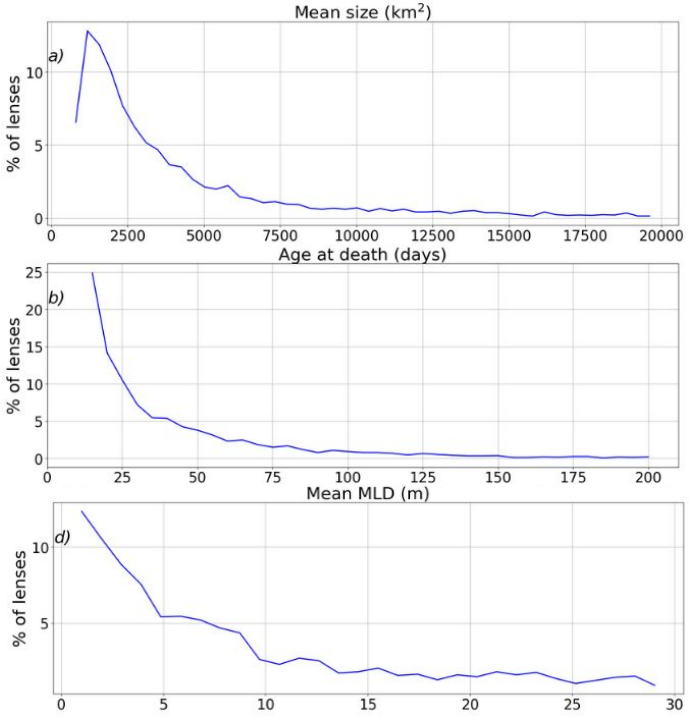
Lenses definition : closed **contour** of **anomalies** under the detection **threshold**

SSS anomalies, detected lenses in yellow



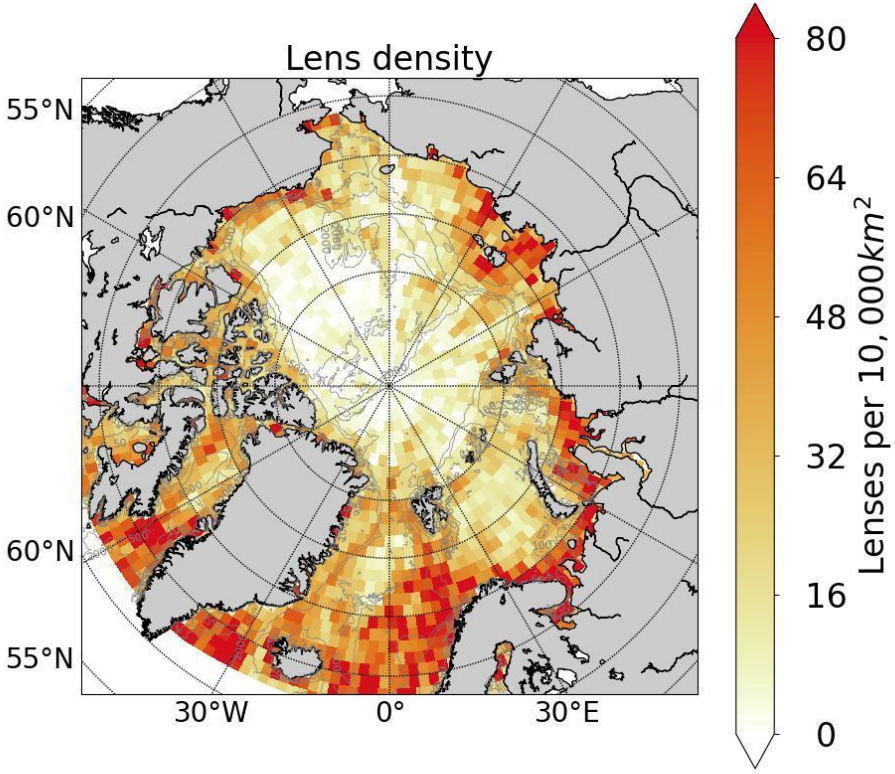
Characteristics

- Size between **1,000 and 10,000km²**, (up to 1,000,000km²)
- Lifespan between **15 and 100 days** (up to 2 years)
- **MLD** (~vertical extent) between **1 and 30m**



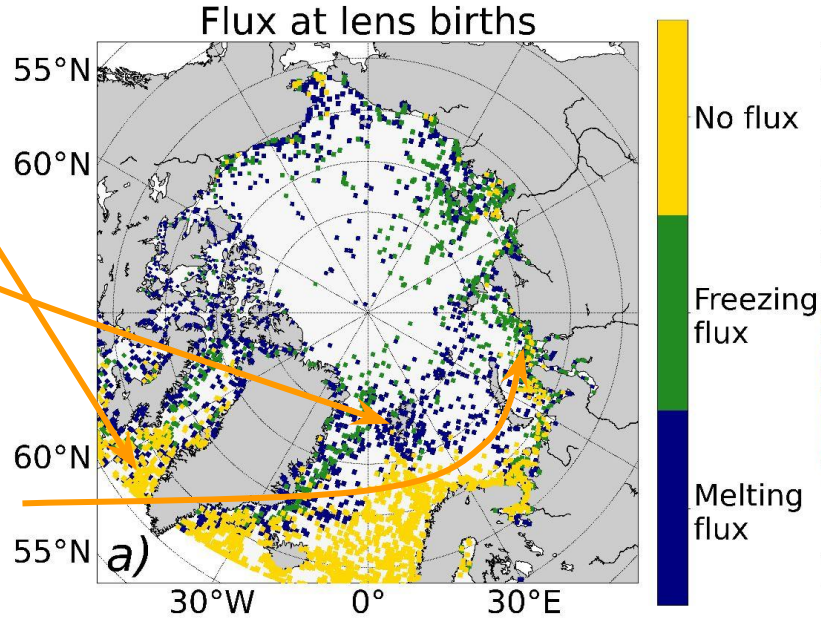
Spatial extent

- **8969** lenses detected and tracked in 21 years
- Lenses spread **all across** the Arctic
- Lens field **denser** in **continental shelves** and around **marginal sea ice zones**



Formation

- At **lower latitudes** or **ice free area**, forms with **no freezing/melting** fluxes
- **Large number** formed with **melting fluxes** in **Barents** and **Nordic seas**
- Lenses formed with **freezing flux** may appear because of **lower brine rejection**
- Close to **coastlines**, formation with **all kind of fluxes** :
  - **influence of runoffs**



Summary :

Lenses definition : closed contours of **salinity anomaly** below the **quantile 5%** value in reference to the **daily SSS climatology**

Development of a **detection** and **tracking** method on a **high resolution model**

- Size **~10^5km²,** persist 3 months up to two years with a vertical extent of a few dozen meters
- Strong **seasonal cycle** : 2/3 of lenses in summer
- **Various origins** : not only sea ice melting but river plumes, eddies …
- Account for up to **30% melting** (with ~10% coverage in summer) and **5% freezing** (with ~3% coverage in winter) in the Arctic

Further :

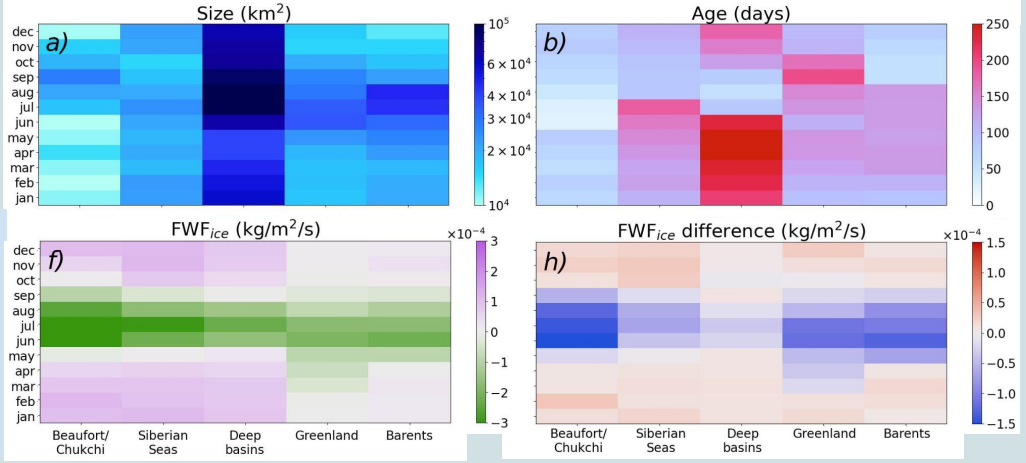
➔ Investigate and quantify formation origins
➔ Improve tracking by using physical properties

Thank you

I. Life cycle of coherent low salinity anomalies in the Arctic, **model**

Results

Mean size, age, freshwater fluxes and difference to the mean fluxes of the region, of lenses by months by regions



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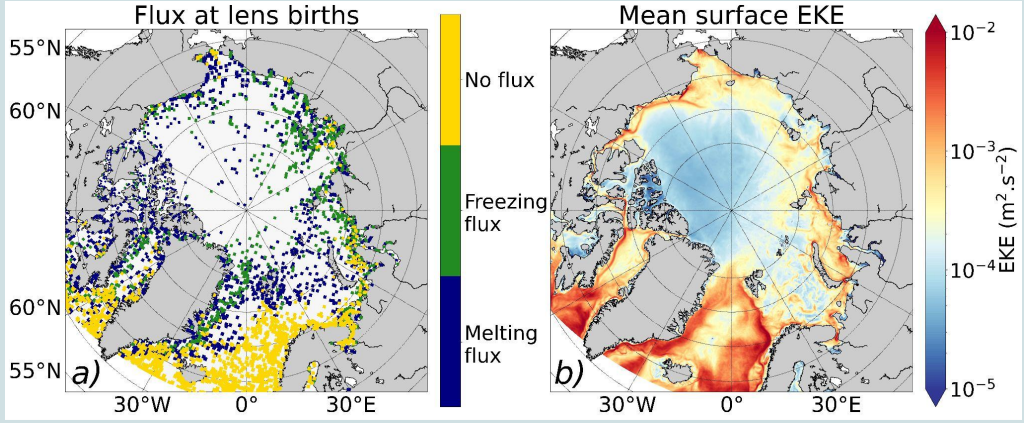

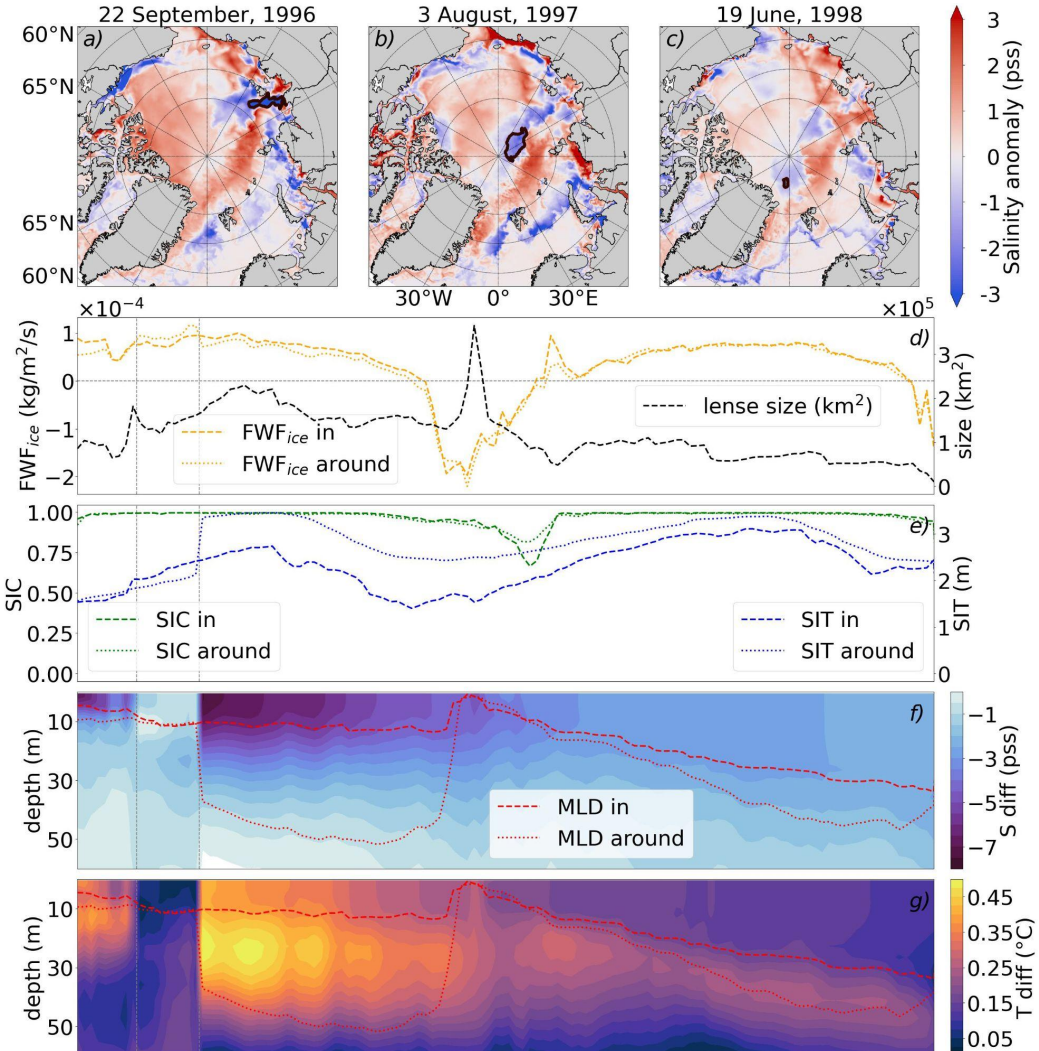
22 September, 1996
3 August, 1997
19 June, 1998
a)
b)
c)
60°N
65°N
65°N
60°N
30°W
0°
30°E
Salinity anomaly (pss)
3
2
1
0
-1
-2
-3
×10⁻⁴
×10⁵
d)
FWF_ice (kg/m²/s)
size (km²)
FWF_ice in
FWF_ice around
lense size (km²)
e)
SIC
SIT (m)
SIC in
SIC around
SIT in
SIT around
f)
depth (m)
MLD in
MLD around
S diff (pss)
g)
depth (m)
T diff (°C)