On the seasonal cycle of the Atlantic Water temperature within the Arctic Basin.

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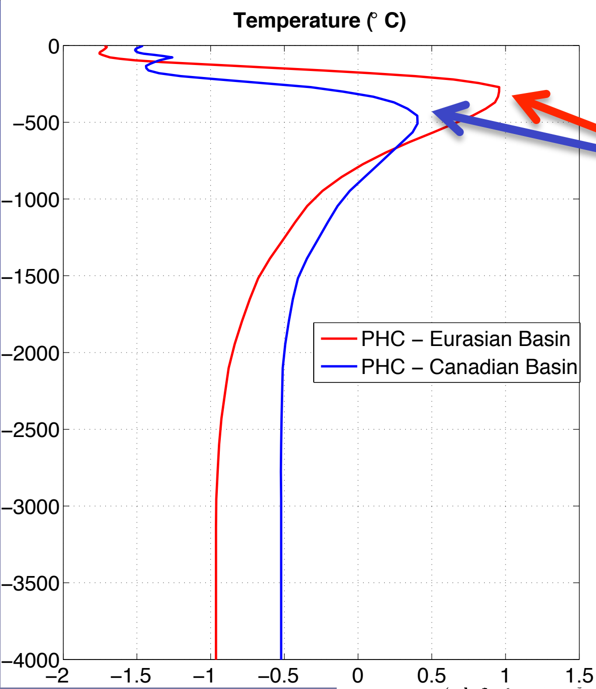
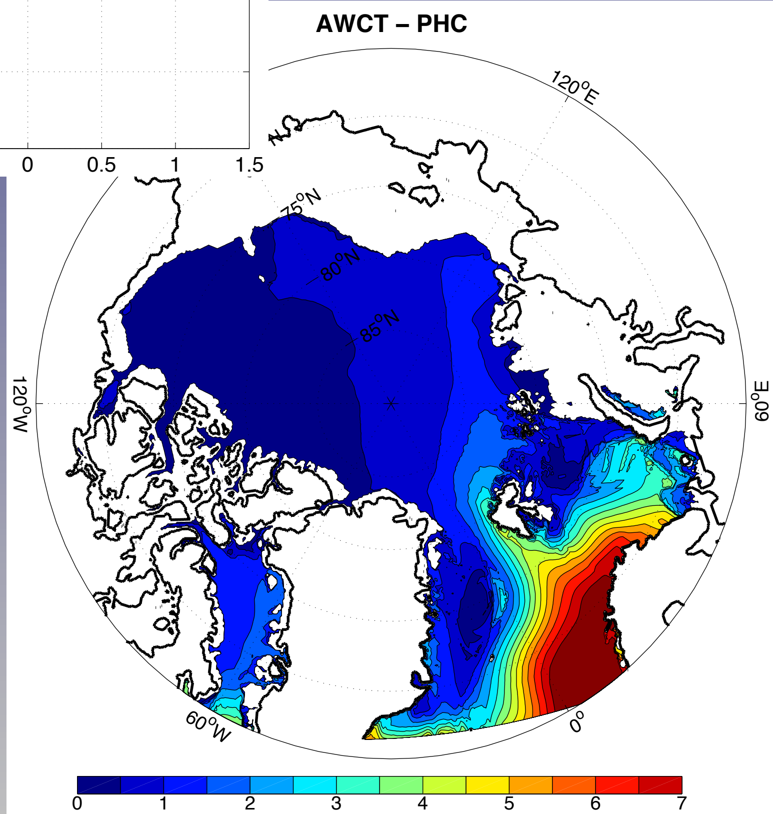
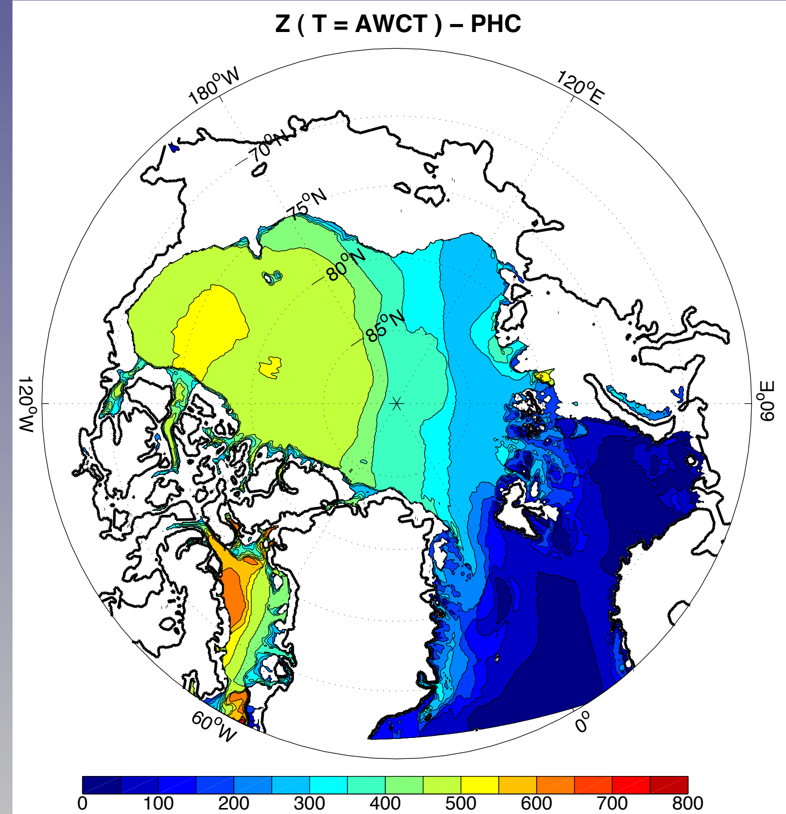
Following AW in the Arctic

Detection of the **temperature maximum** (AWCT) for each temperature profile.





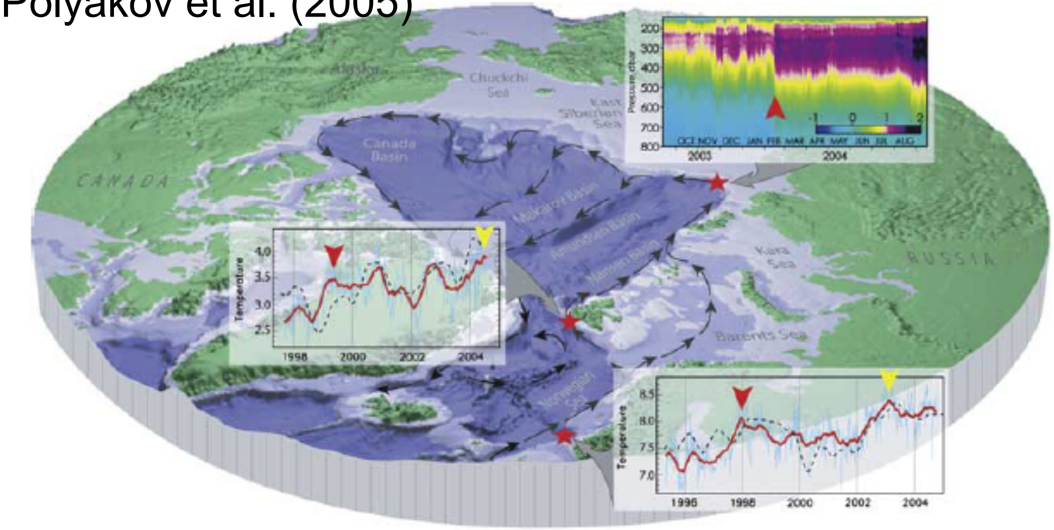


AW temperature variability

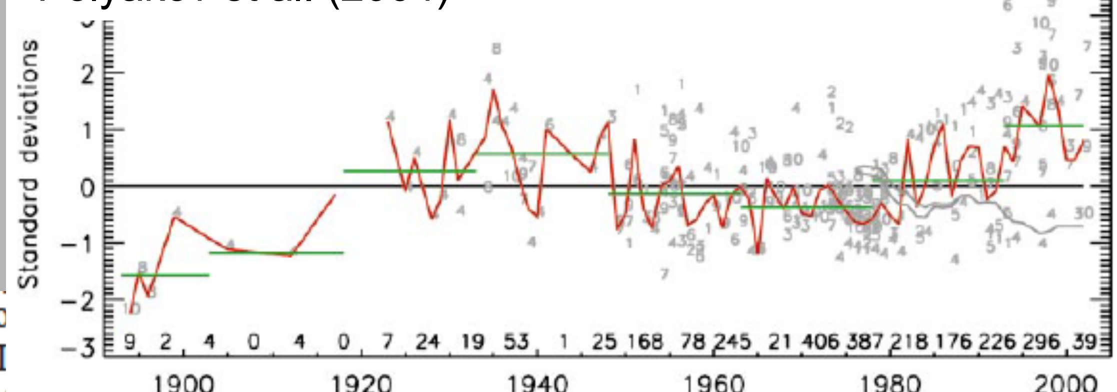
- Large warming events coming from Atlantic inflow. Propagation up to the Canadian Basin with the boundary current.

- Low frequency oscillations (50-80 years timescale)

Polyakov et al. (2005)

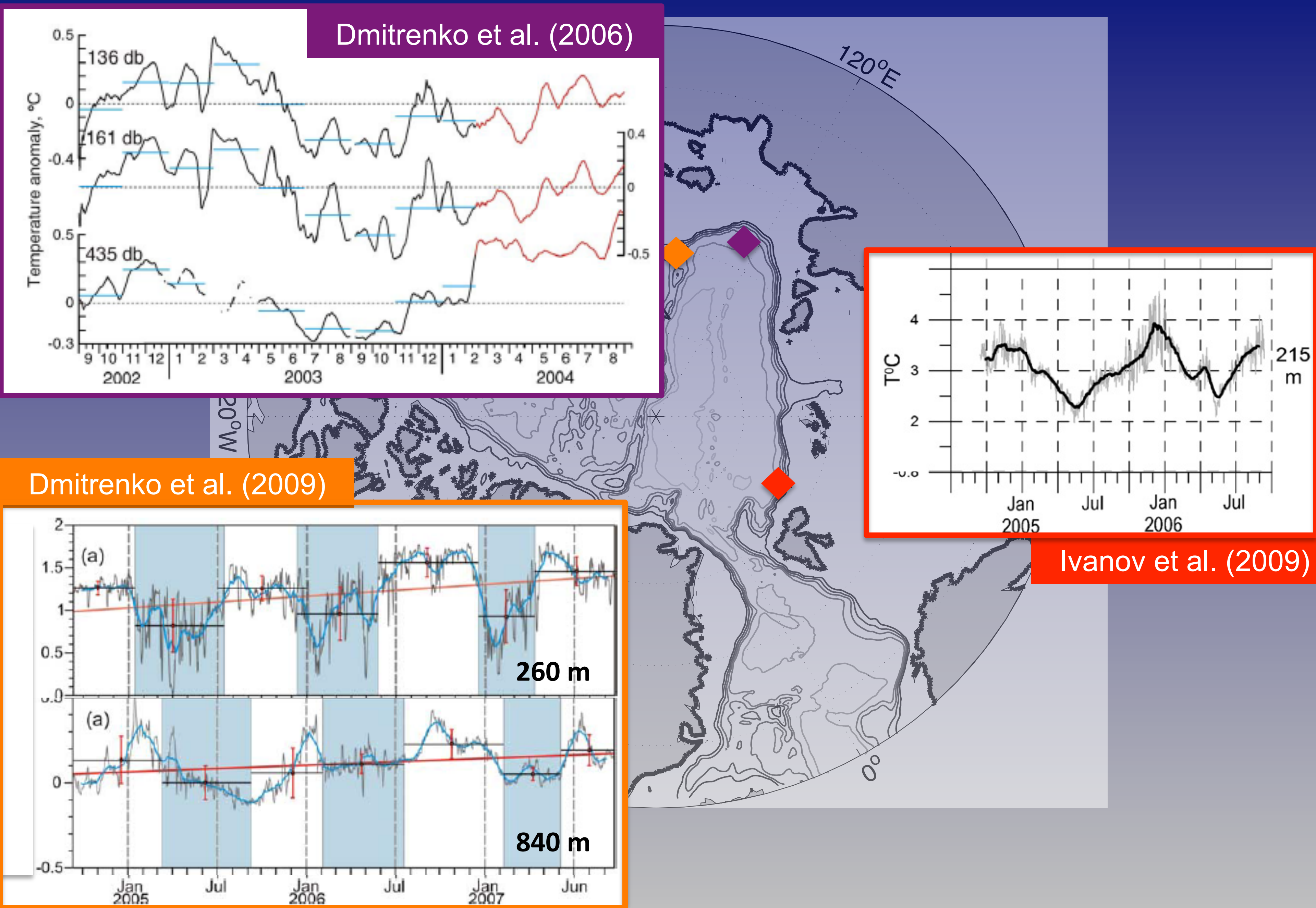


Polyakov et al. (2004)



187 stations within eight local Arctic regio
tistical estimates were not well constrained. I
the Arctic Ocean is divided into ten boxes (regions) of
approximately equal areas (Fig. 1). Individual (snapshot) measurements over the ten regions were averaged within a given year and region to produce ten regional time series of composite AWCT. The length of the re-

Observations of AW seasonality



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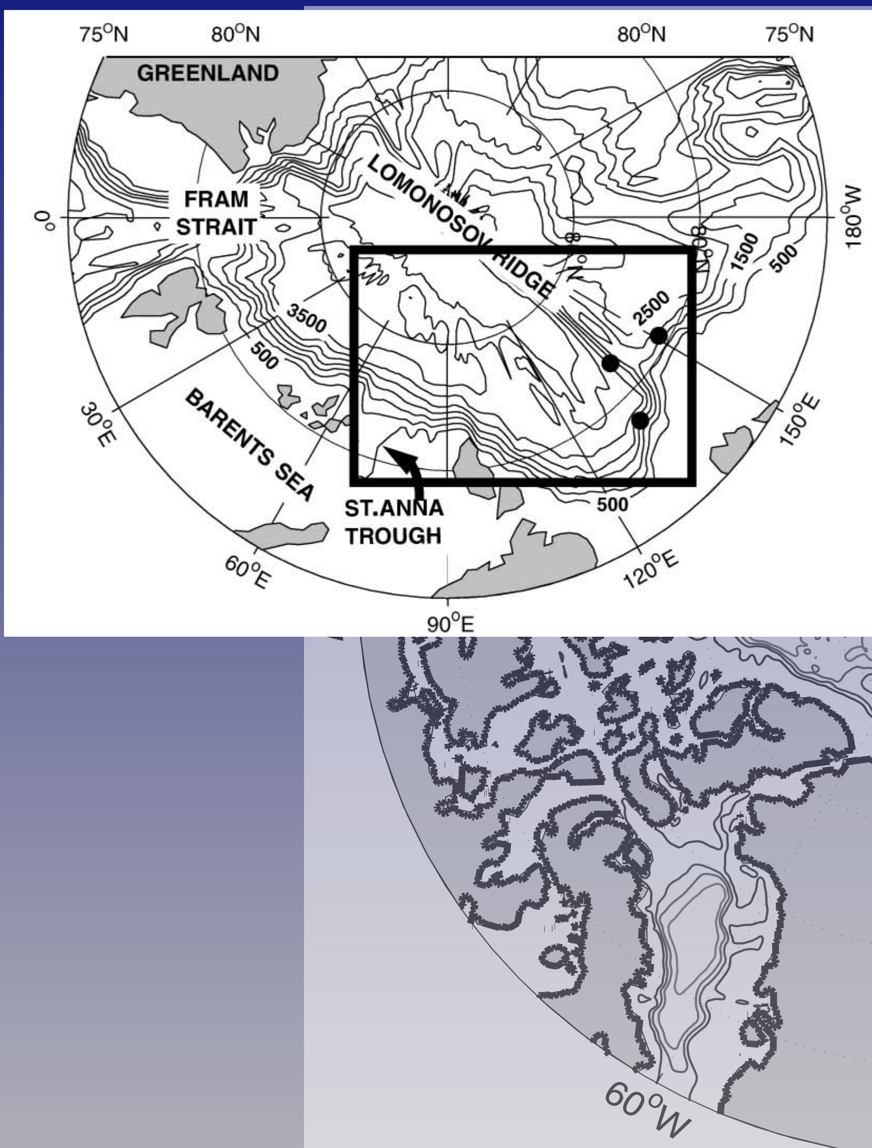
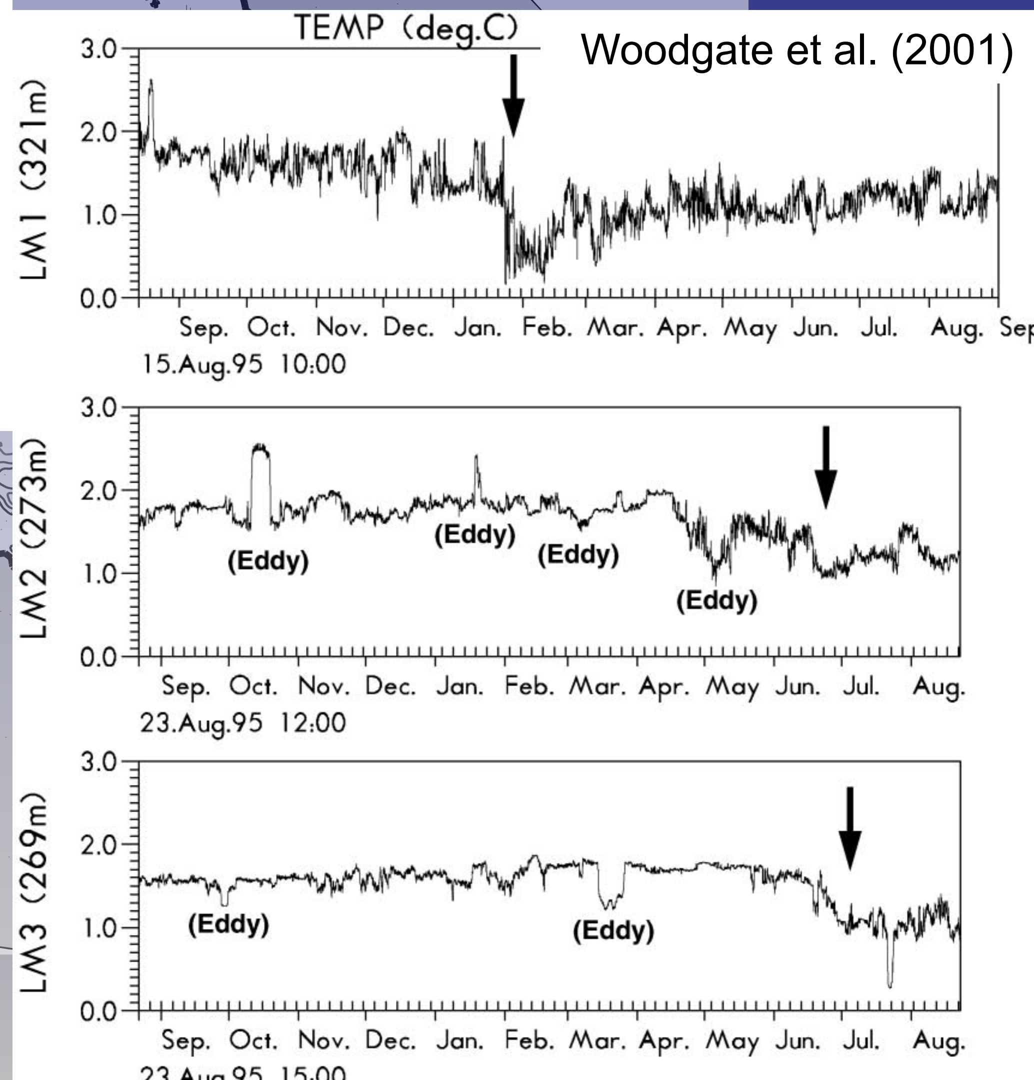


Woodgate et al. (2001)



Questions & Methods

- Pan-Arctic description of the AW temperature seasonal cycle ?
- What are the mechanisms at play : advection vs. local formation ?
- Consequences for seasonally biased in-situ observations ?

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Method :

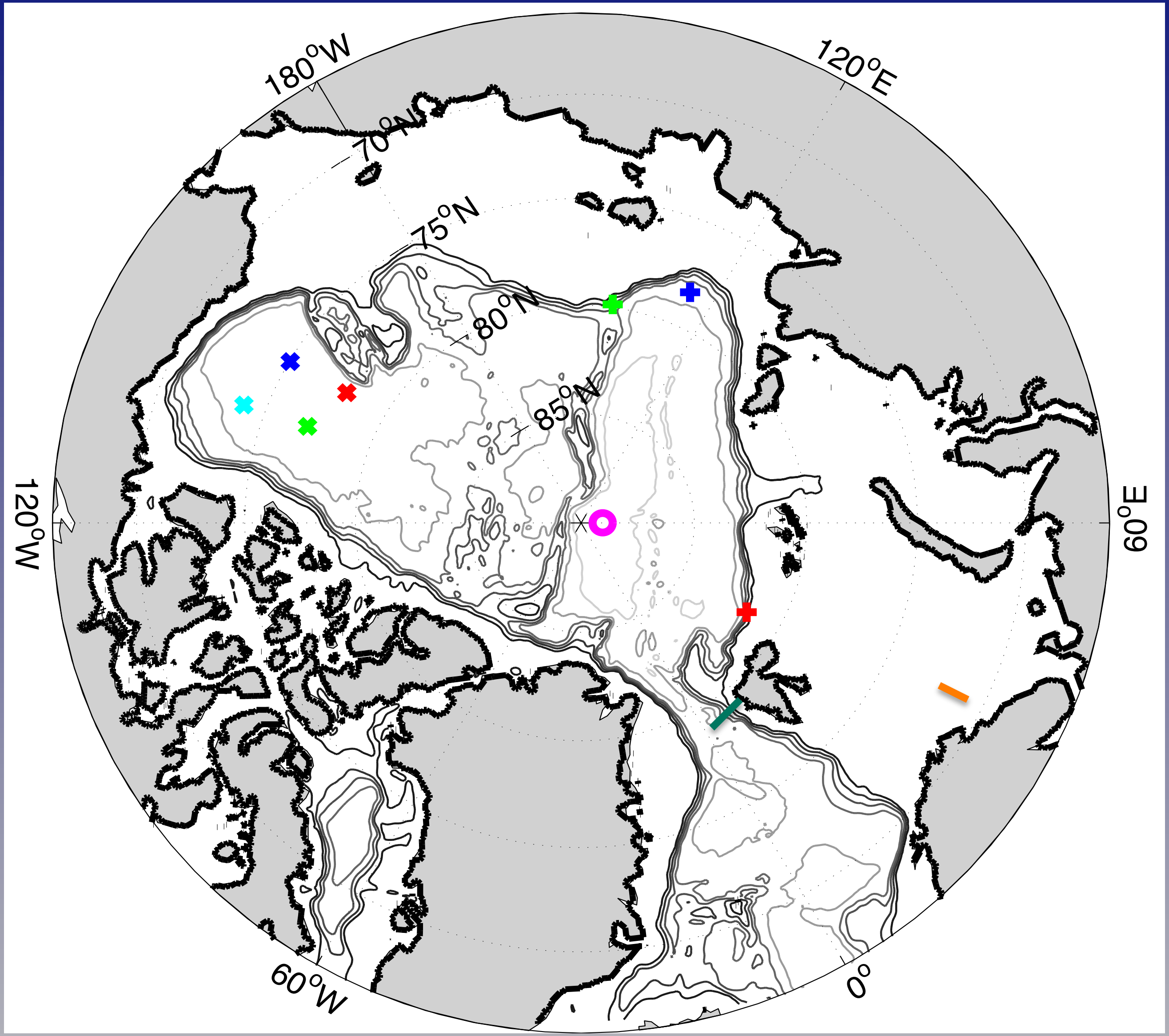
Available mooring observations :

- Fram Strait & Kola Section
- NABOS (2 fixed depth moorings + 1 profiling mooring)
- NPEO
- BGOS (4 profiling moorings)

The ORCA025 DRAKKAR model :

- Global ocean / sea-ice model, based on NEMO-OPA/LIM numerical codes
- Tripolar grid, 1/4° Resolution (~12 km in the Arctic), 75 layers (1m~200m thick)
- Simulation: 1958 – 2007 with interannual forcing (*Barnier et al. 2006, Lique et al. 2009, 2010*)
- Validation against mooring data, analyses of the period 1980 – 2007

AWCT seasonality from observations



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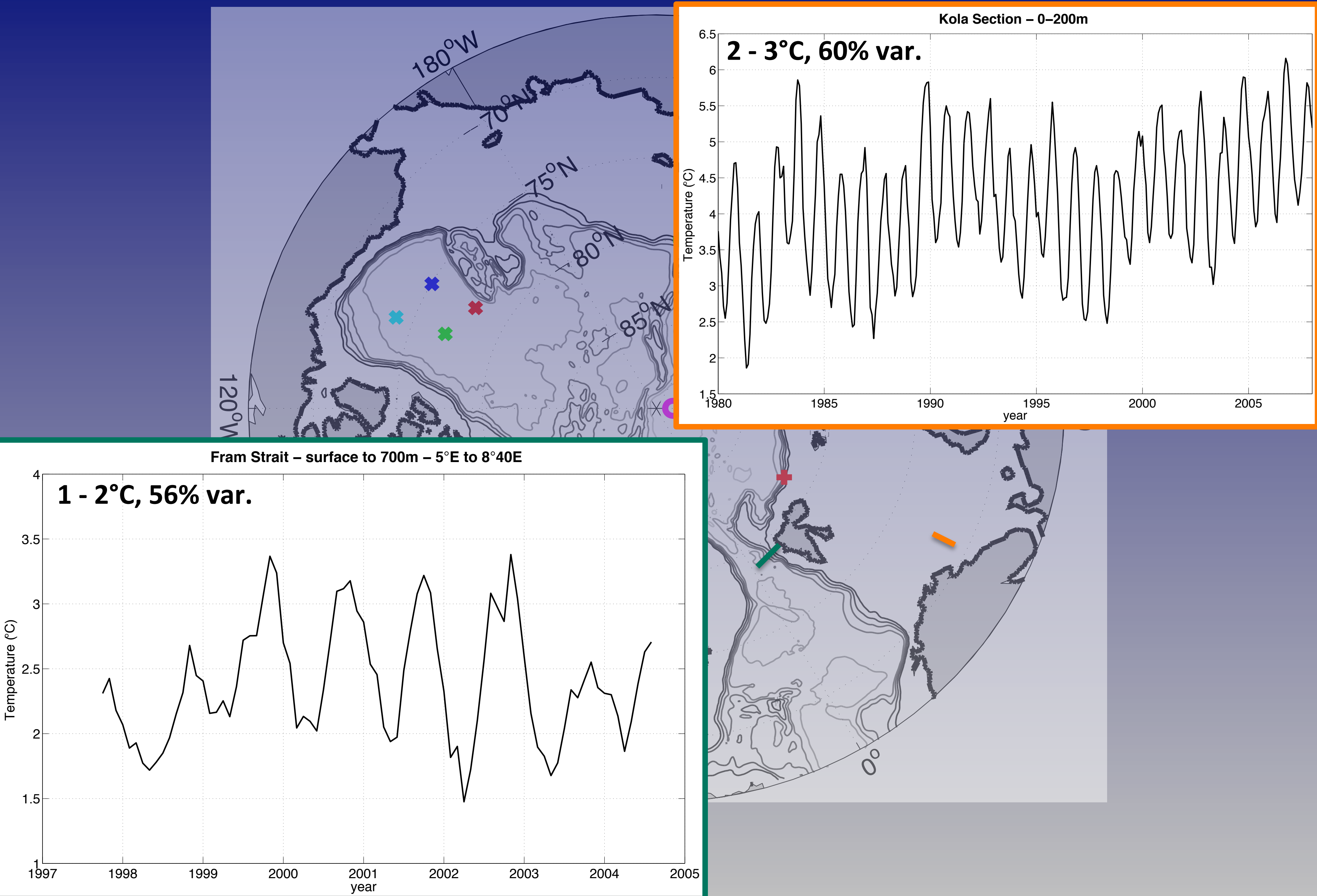

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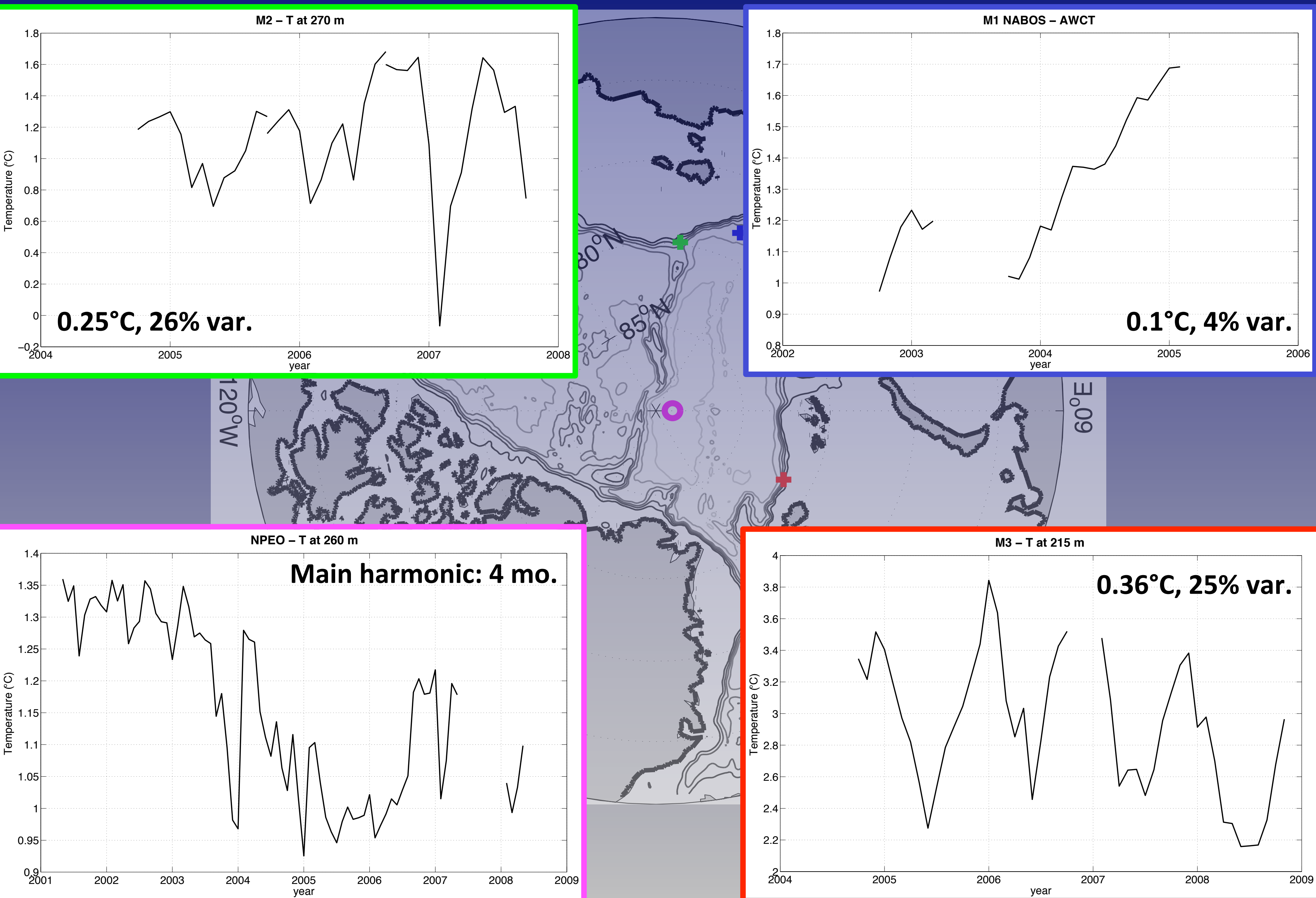

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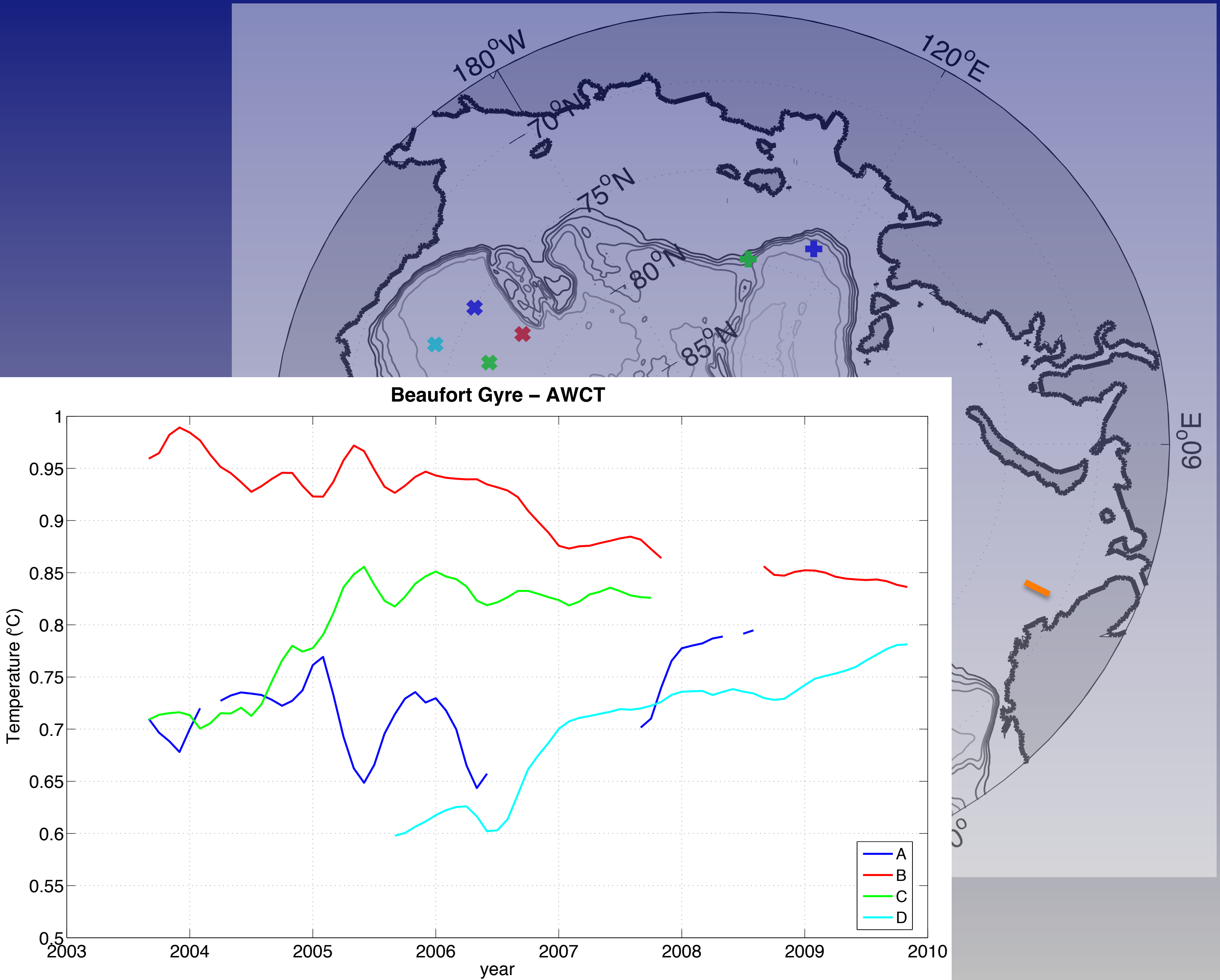
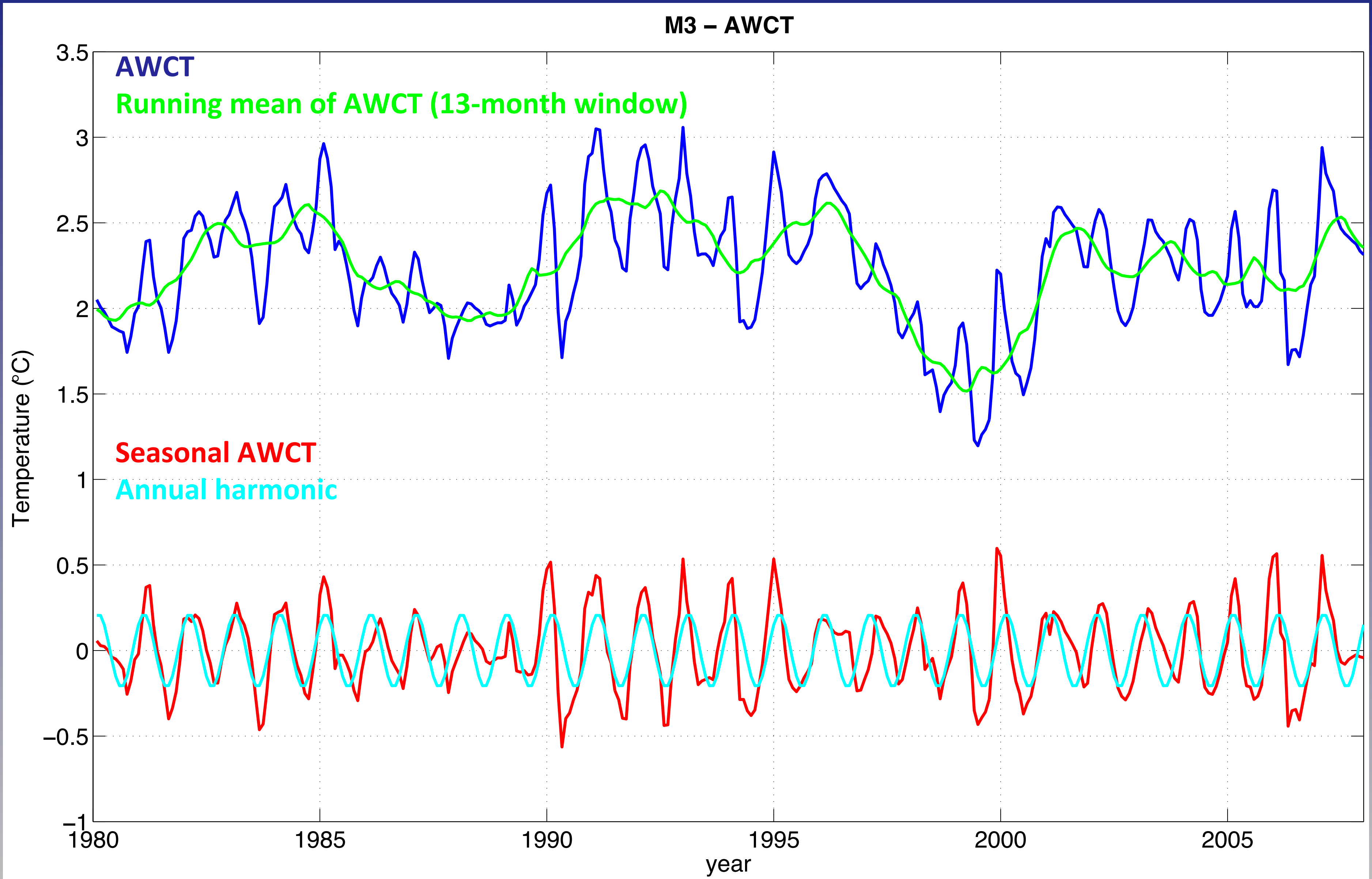
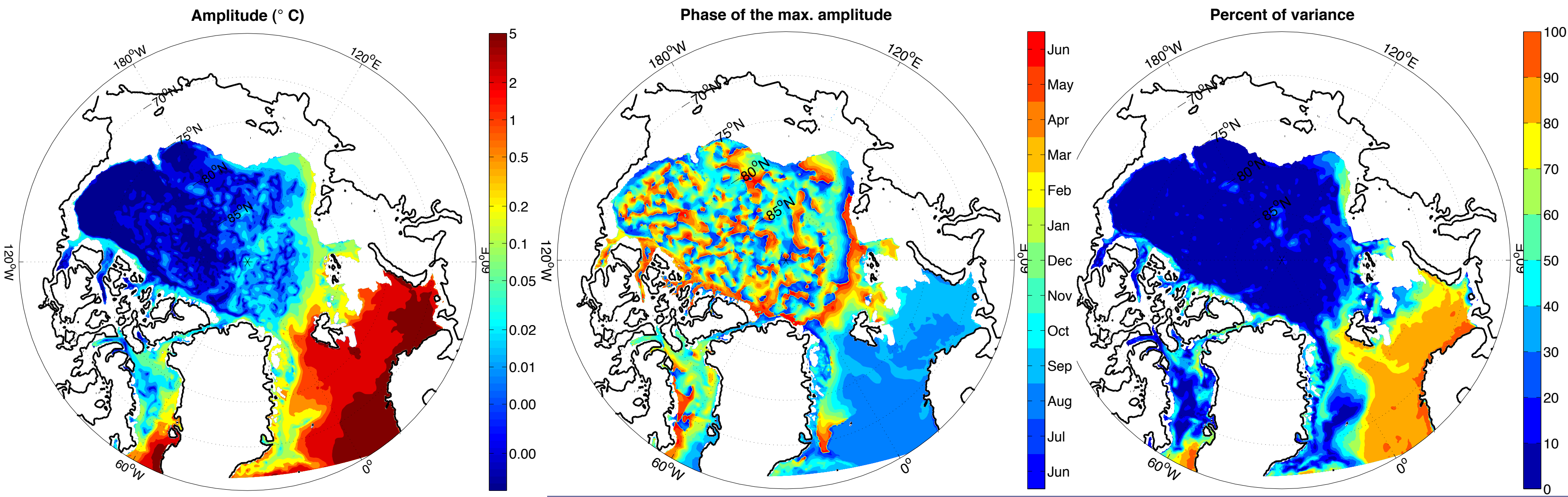


AWCT seasonality from simulation: Method



AWCT seasonality from simulation

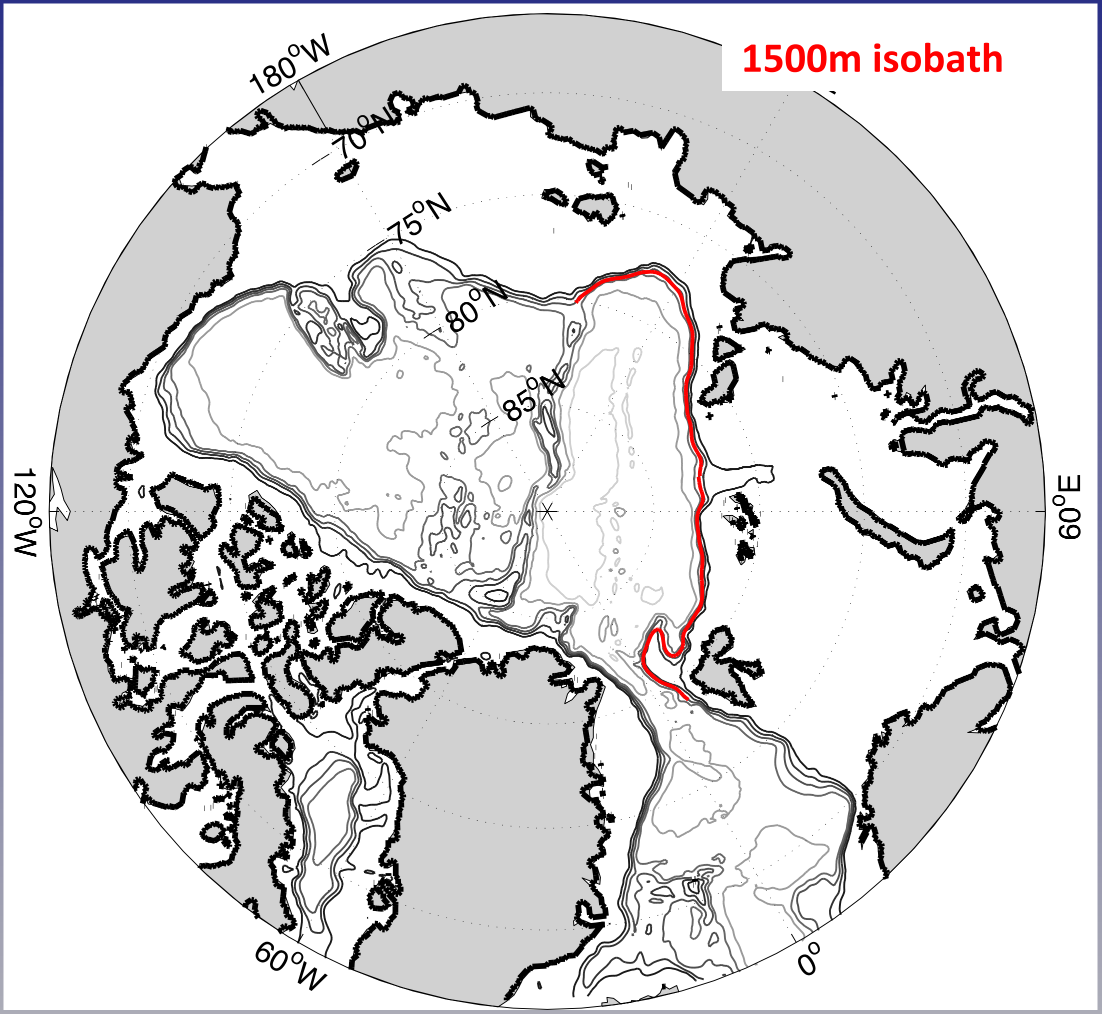


- Annual harmonic explains ~ 70 % in the North Atlantic, ~ 40 % along the Nansen slope and almost nothing everywhere else.

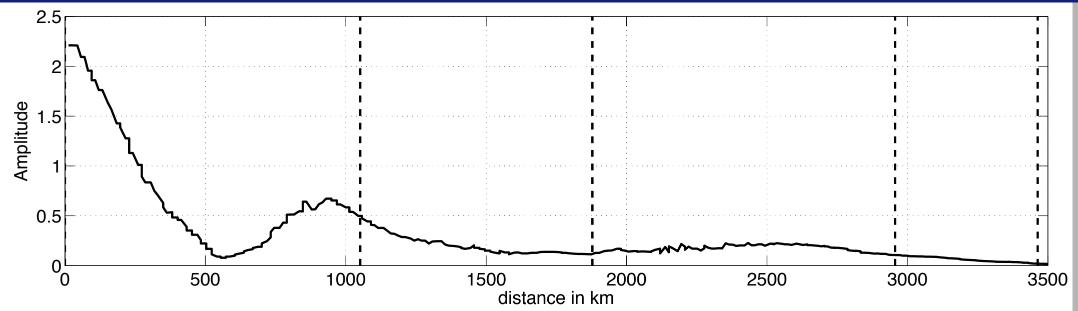
- Phase: max in Sept-Oct in the North Atlantic, gradually delays along the slope. Suggests an advection process ?

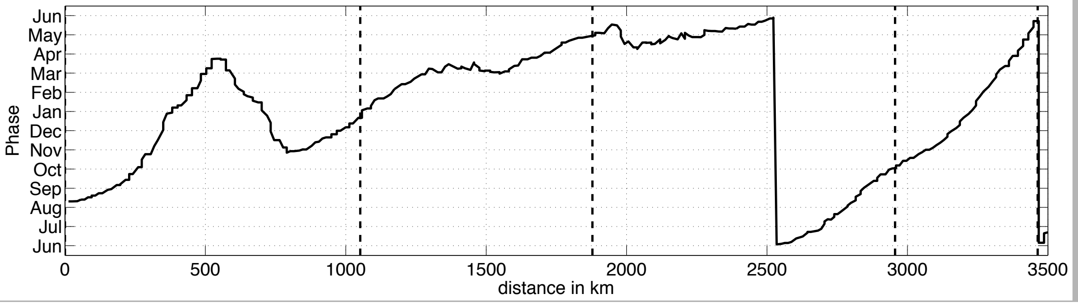
- Large interannual variations of the amplitude (even along the slope). This makes is it difficult to characterize the seasonal cycle from short time period observations.

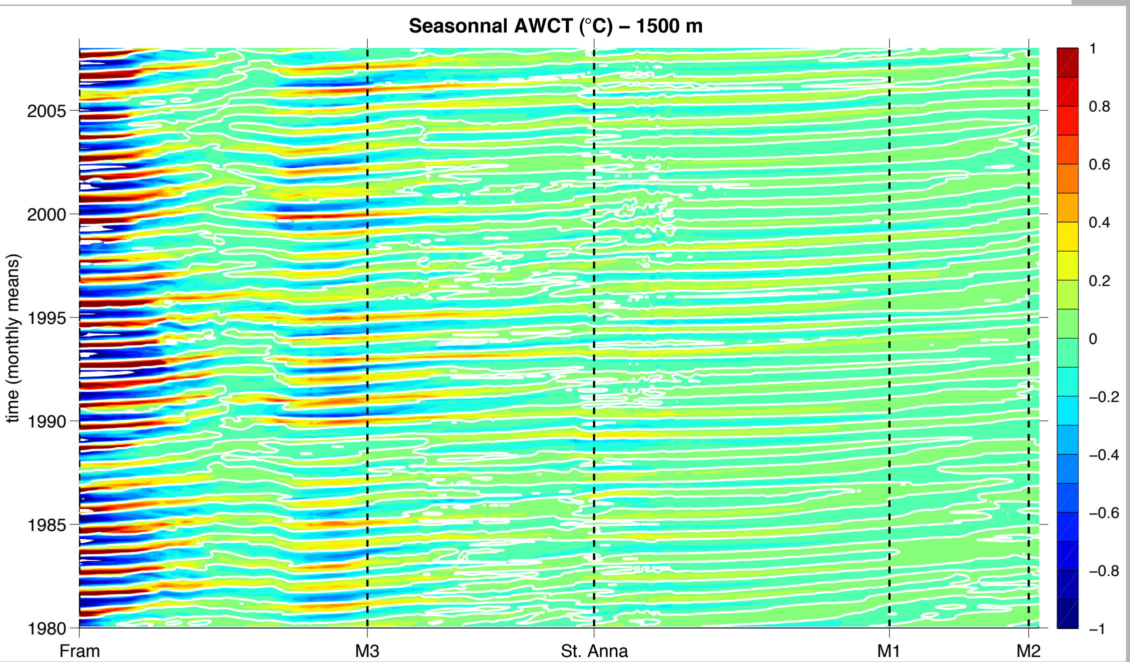
Processes at play

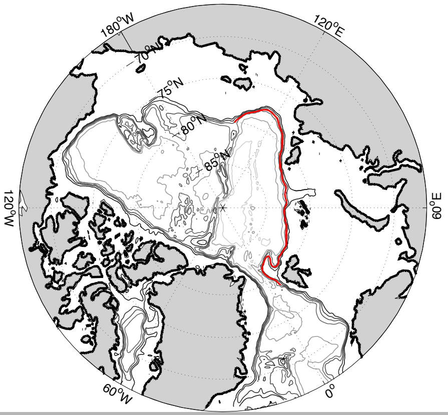


Processes at play







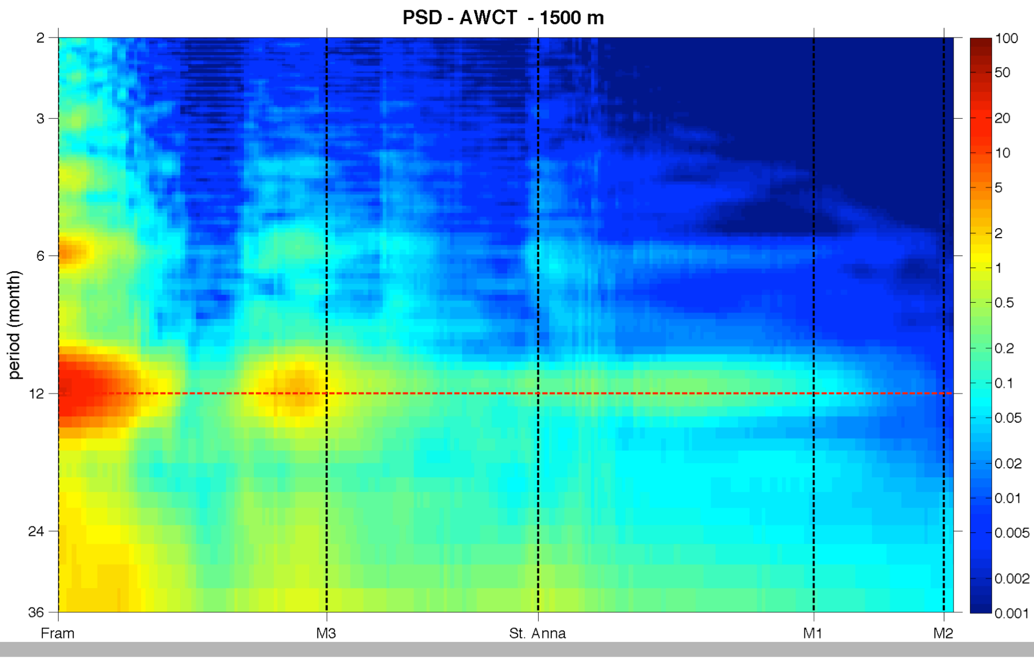


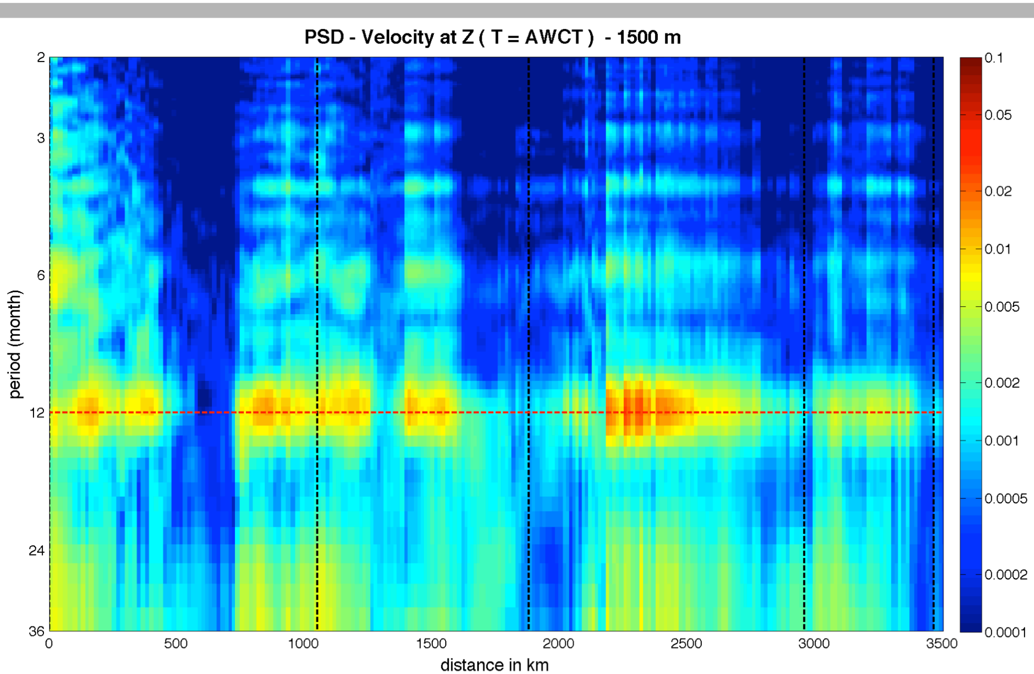
- The seasonal cycle amplitude decreases along the 1500m-isobath, while its phase increases (by a year from Fram to M2).

- As it propagates, the seasonal cycle becomes less regular

- Barents Sea Branch timing nearly constructive with the Fram Strait Branch one.

Processes at play





- Power density spectrum of the AWCT and the speed at each grid point following the 1500m-isobath

- AWCT: energy at 12-month frequency decreases from Fram to St. Anna, and from St. Anna to M2.

- Velocity: seasonal cycle in phase all along the isobath

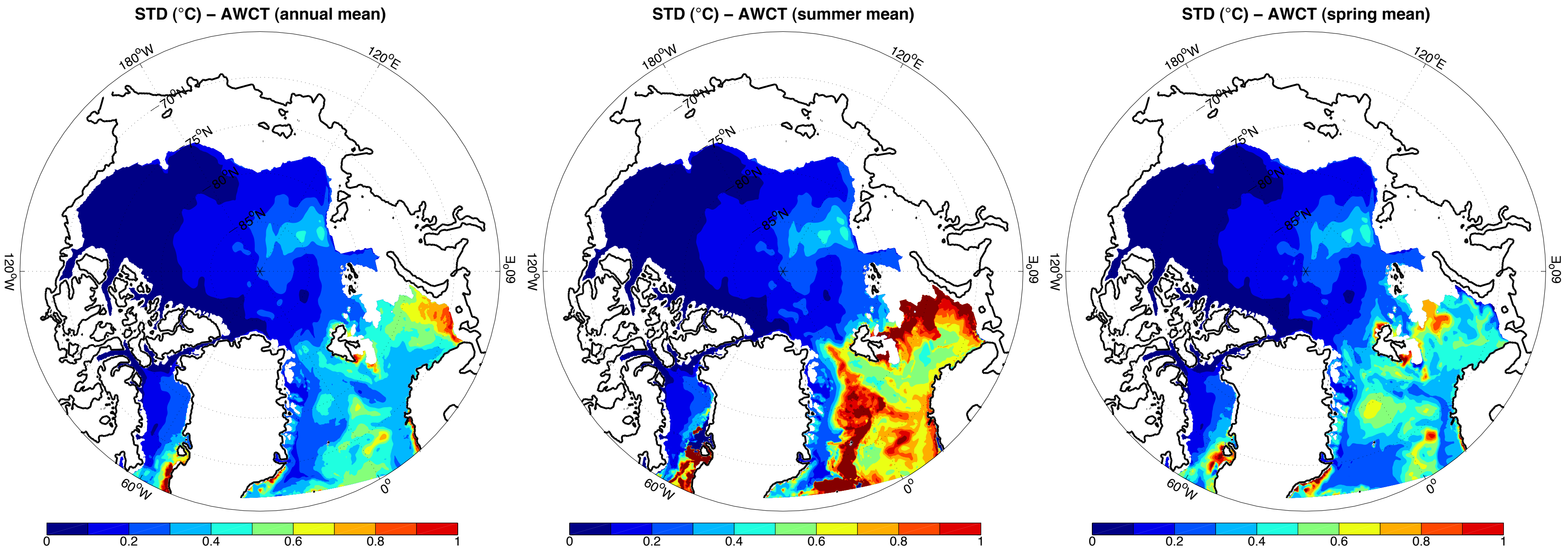
Summary

• Mooring data and model output reveals that the seasonal cycle of AW temperature is significant only in the Nansen Basin along the continental slope.

• AW temperature seasonal cycle advected from Fram Strait up to St. Anna Trough, and then re-energized by the Barents Sea Branch. Seasonal cycle can survive over ~ 1000 km, weakened by mixing/diffusion processes.

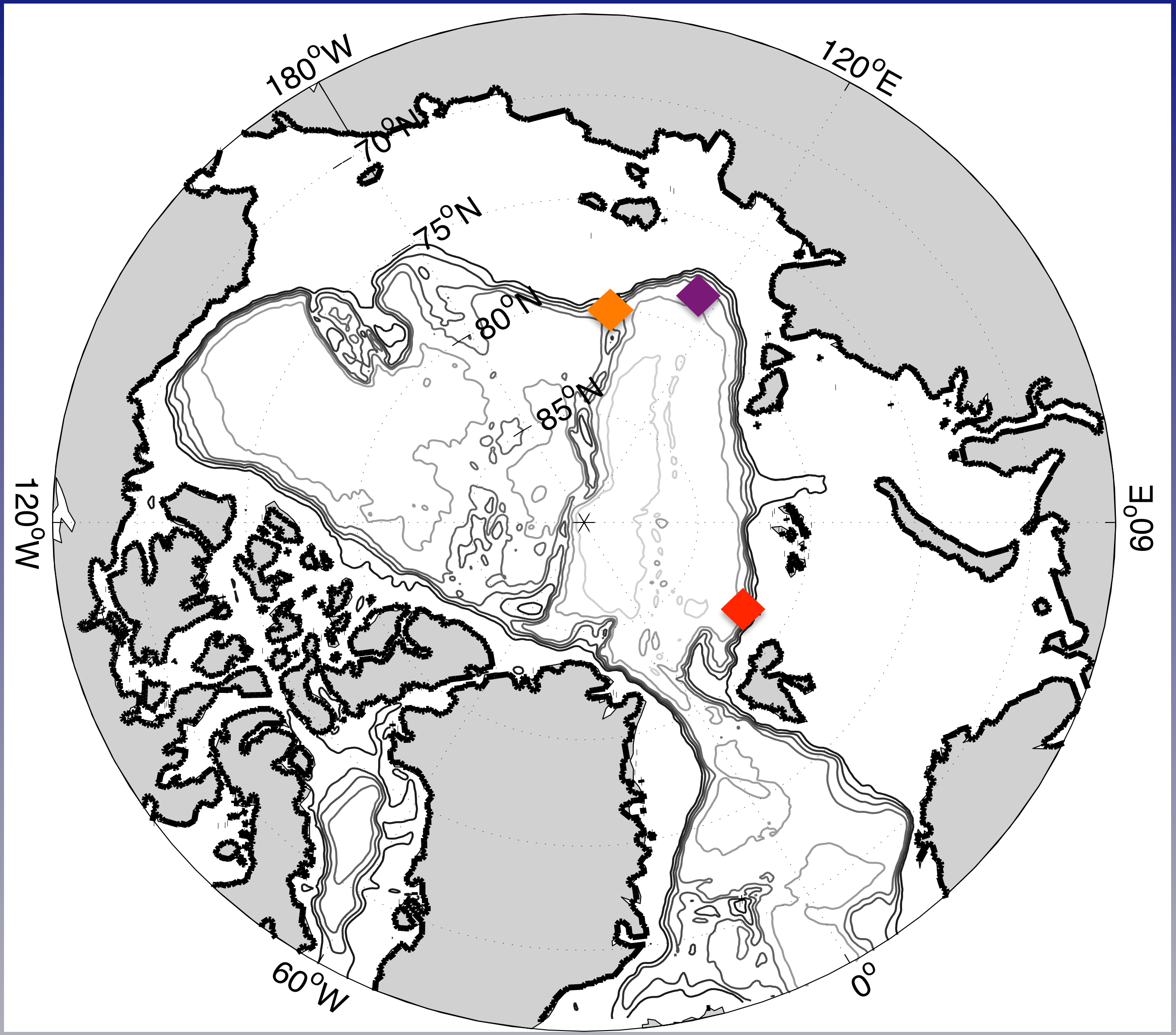
• Error induces by seasonally biased in-situ observations ?

Implications for observational strategy

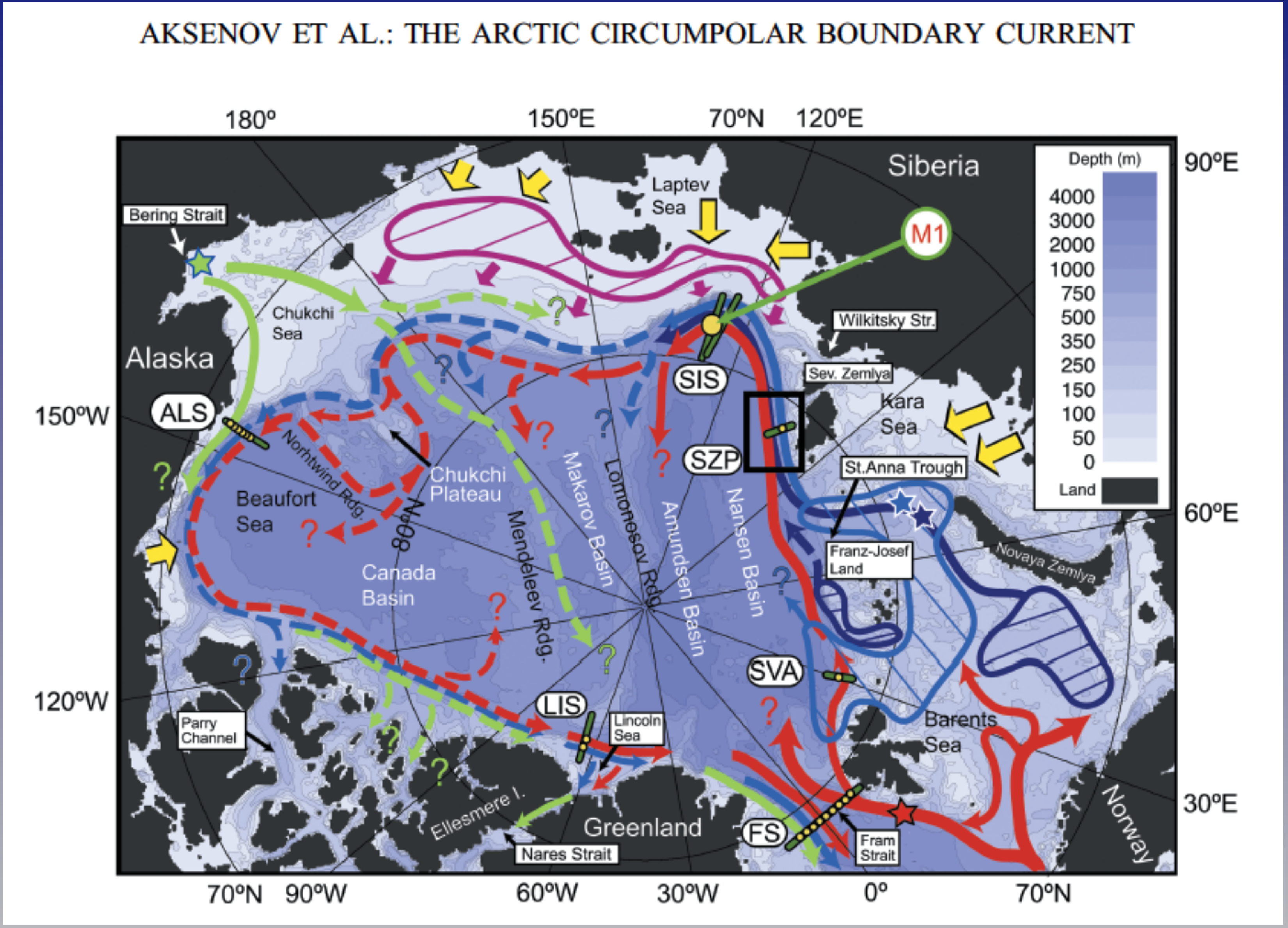


- In situ measurements are conducted mainly during Spring (April-May) and Summer (August-September).
- Seasonally biased obs. do not induce a significant error when considering interannual-to-decadal variations of AW temperature.
- Seasonal cycle accounts for a small/negligible part of AW temperature variability.

Observations of AW seasonality

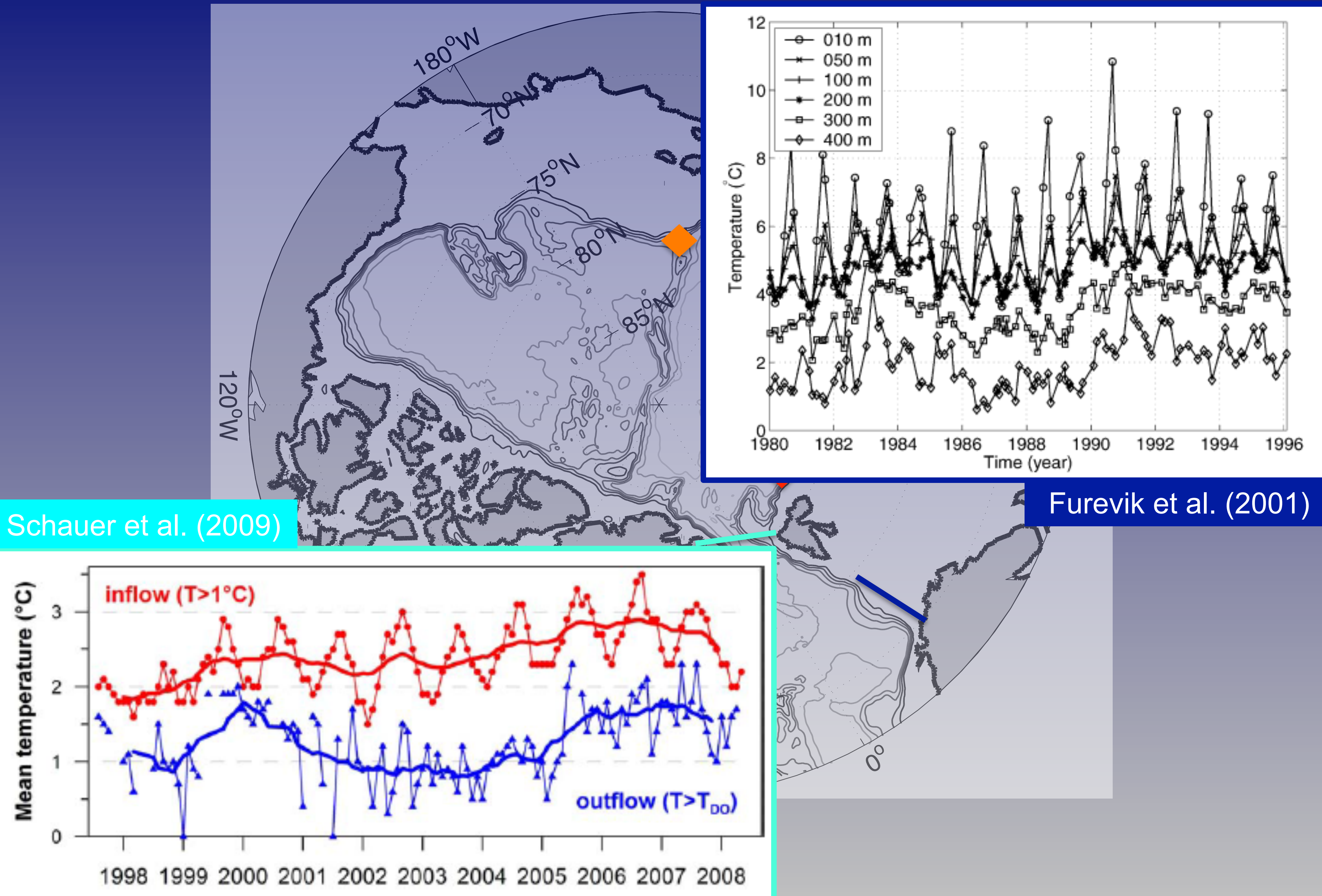


AW circulation in the Arctic



Aksenov et al. (2011)

Observations of AW seasonality



Furevik et al. (2001)

Schauer et al. (2009)