Validation of the Arctic and Canadian Arctic Archipelago Ice Thickness in High-resolution NEMO Simulations

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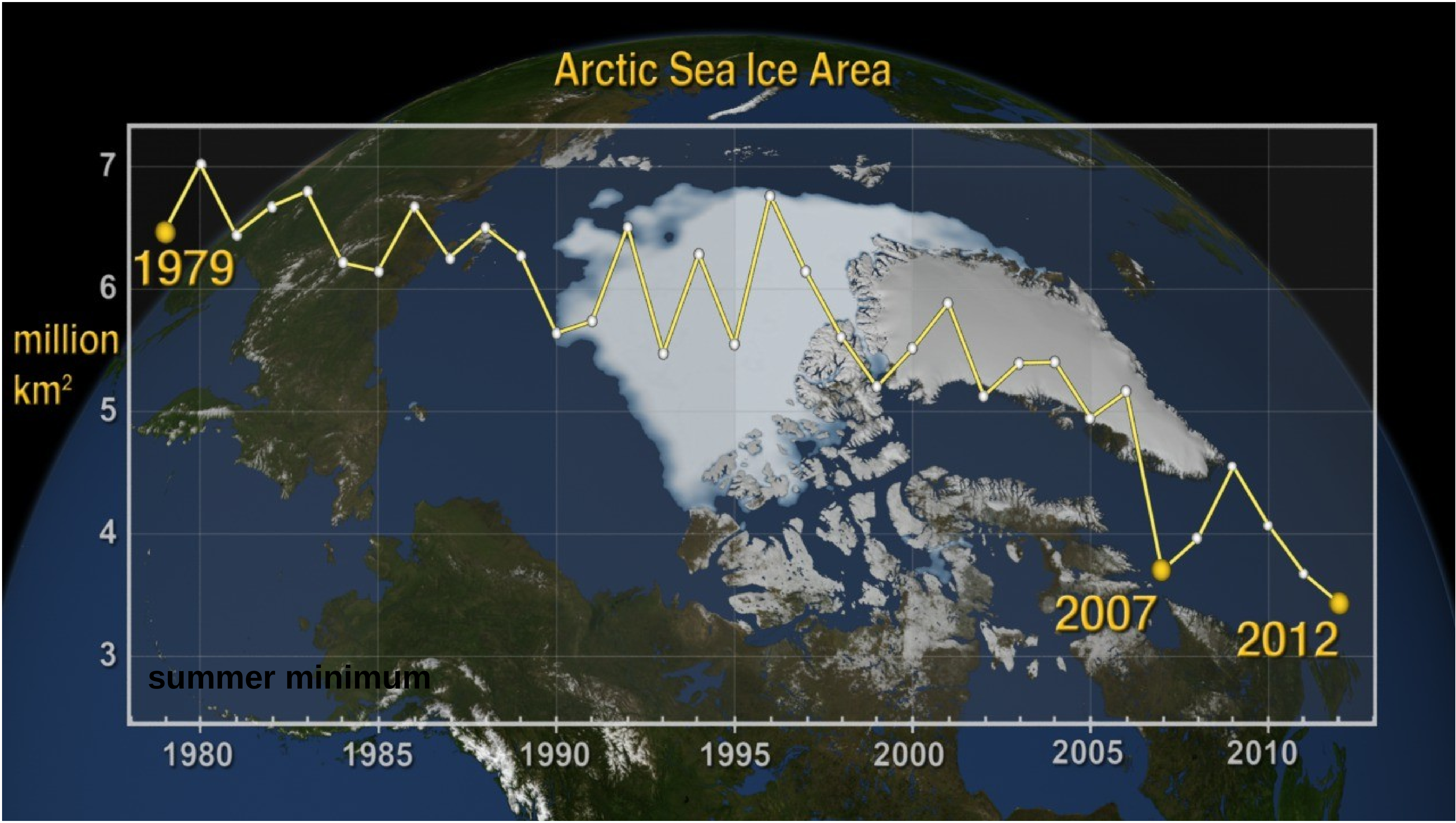
Outline

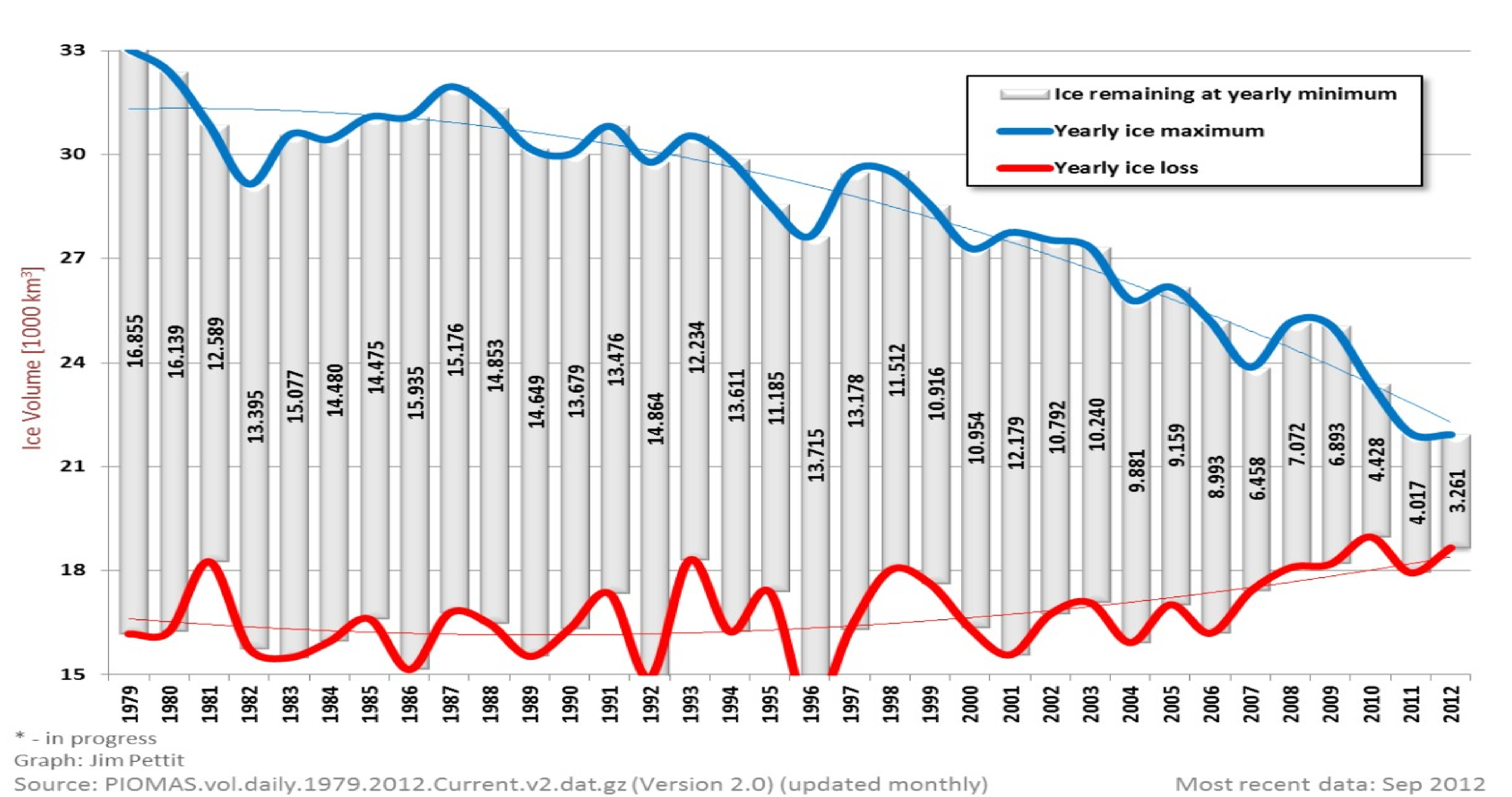
- **Background**
- **Model configuration and experiment**
- **Results**
  - Validation of ice thickness
  - Thermodynamic and dynamic ice thickness changes
- **Summary**

Arctic Sea Ice Decline



http://svs.gsfc.nasa.gov

Arctic Sea Ice Decline



PIOMAS (Pan-Arctic Ice Ocean Modeling and Assimilation System) from University of Washington

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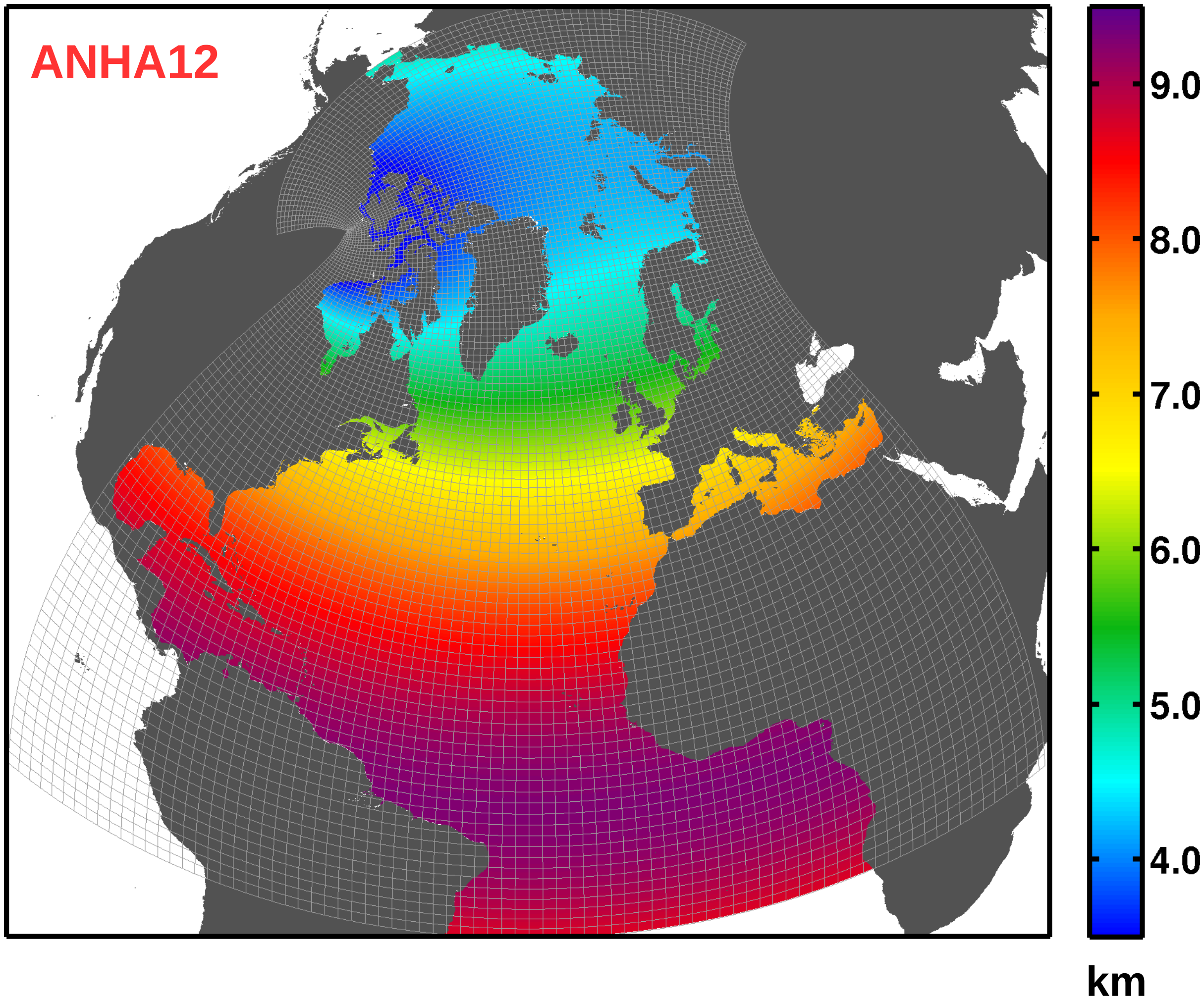
Model Configuration



Model : NEMO 3.4
LIM2 + EVP

Resolution : 1/12 degree
1/4 degree

Mesh : 1632x2400
544x800

50 levels

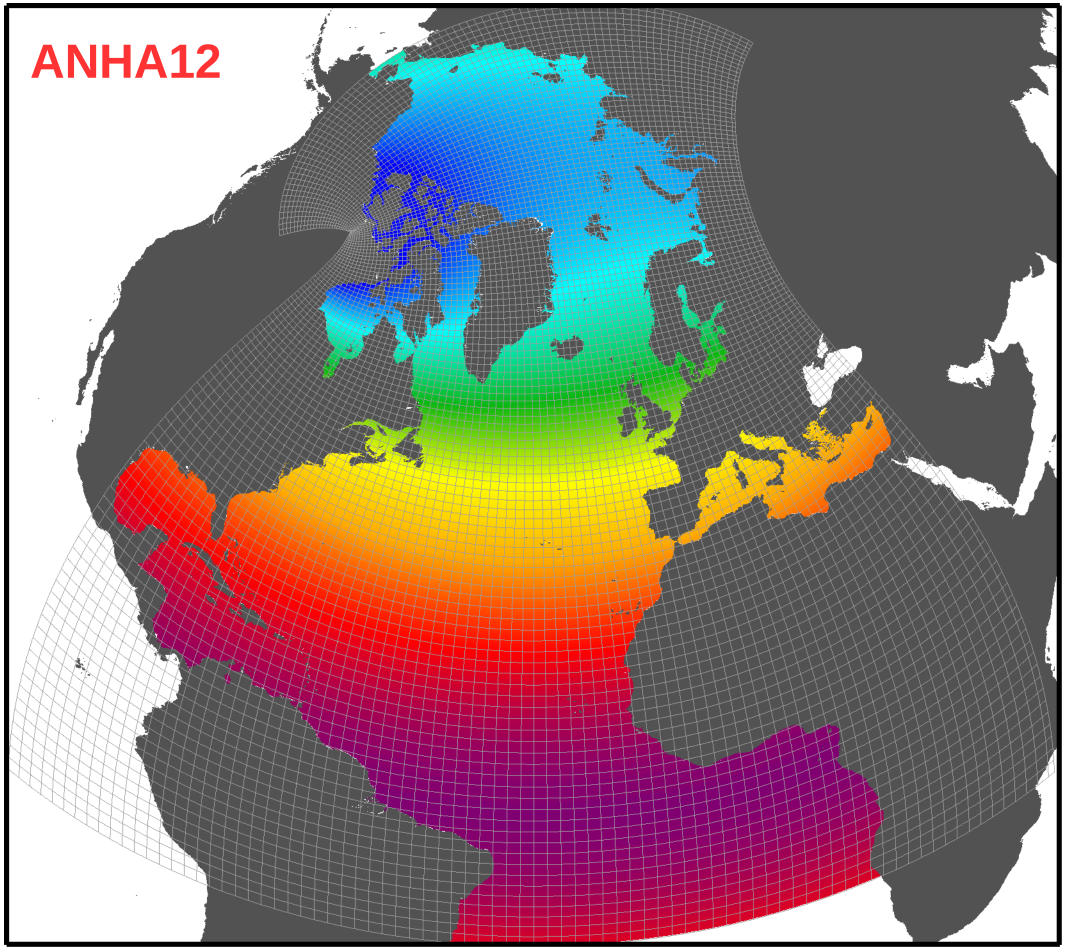
Arctic Ocean : < 5 km

<15 km

ANHA: Arctic and Northern Hemisphere Atlantic

ANHA12 & ANHA4

Experiment Setup



Initialization:

3D T, S, U and V (GLORYS1v1, Jan02)
Sea Ice

Atmospheric forcing:

T2, Q2, U10, V10
Precipitation
Radiation (SW & LW)

CGRF
hourly
33km

Snow: CORE2 (IA)
Runoff: Dai and Trenberth climatology

OBC:

U, V, T and S (GLORYS1v1)

NO temperature & salinity restoring

Jan 2002 – 2010

CGRF: CMC GDPS reforecasts
GDPS: Global Deterministic Prediction System
CMC: Canadian Meteorological Centre
GLORYS: GLobal Ocean ReanalYses and Simulations

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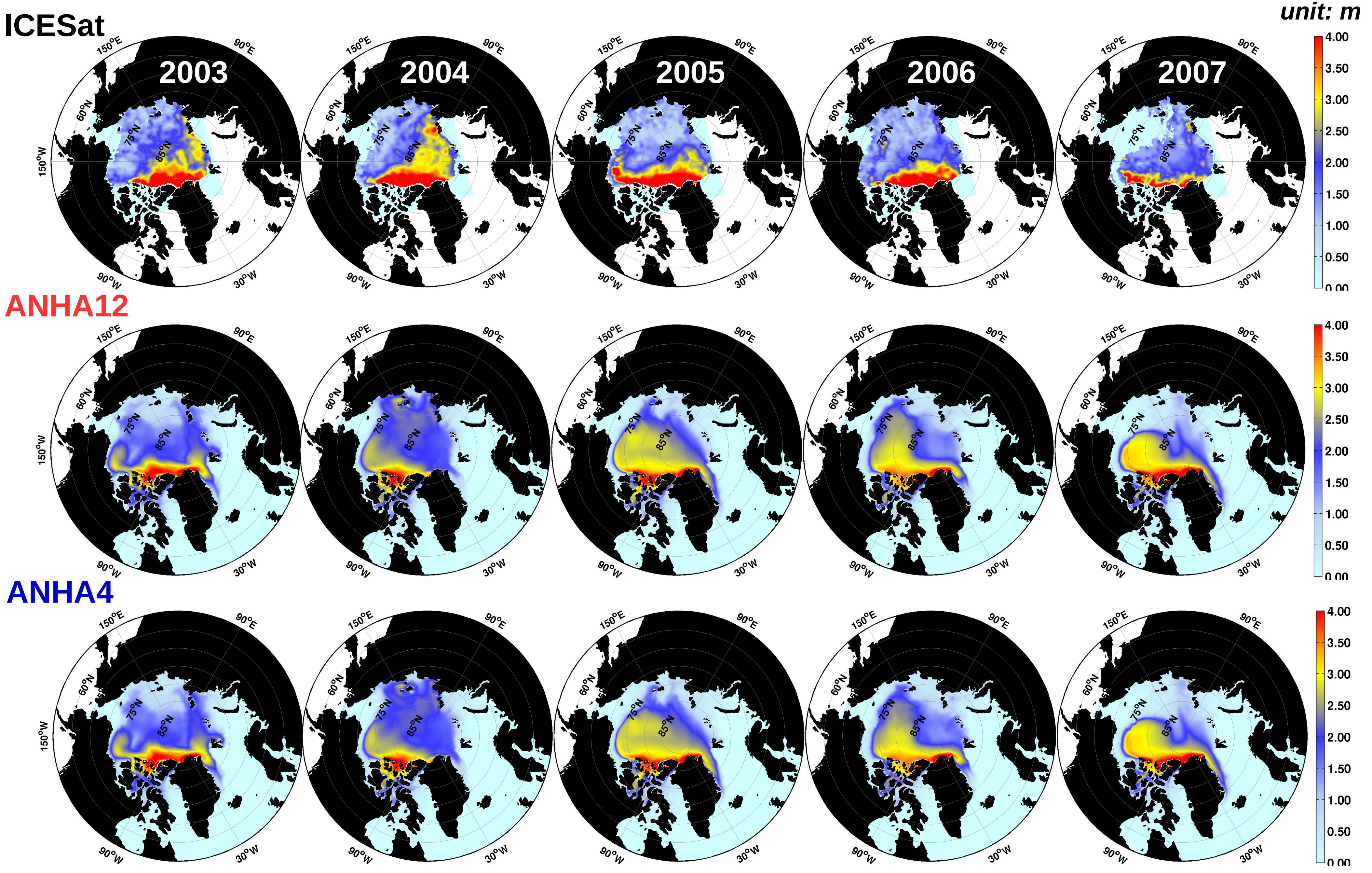
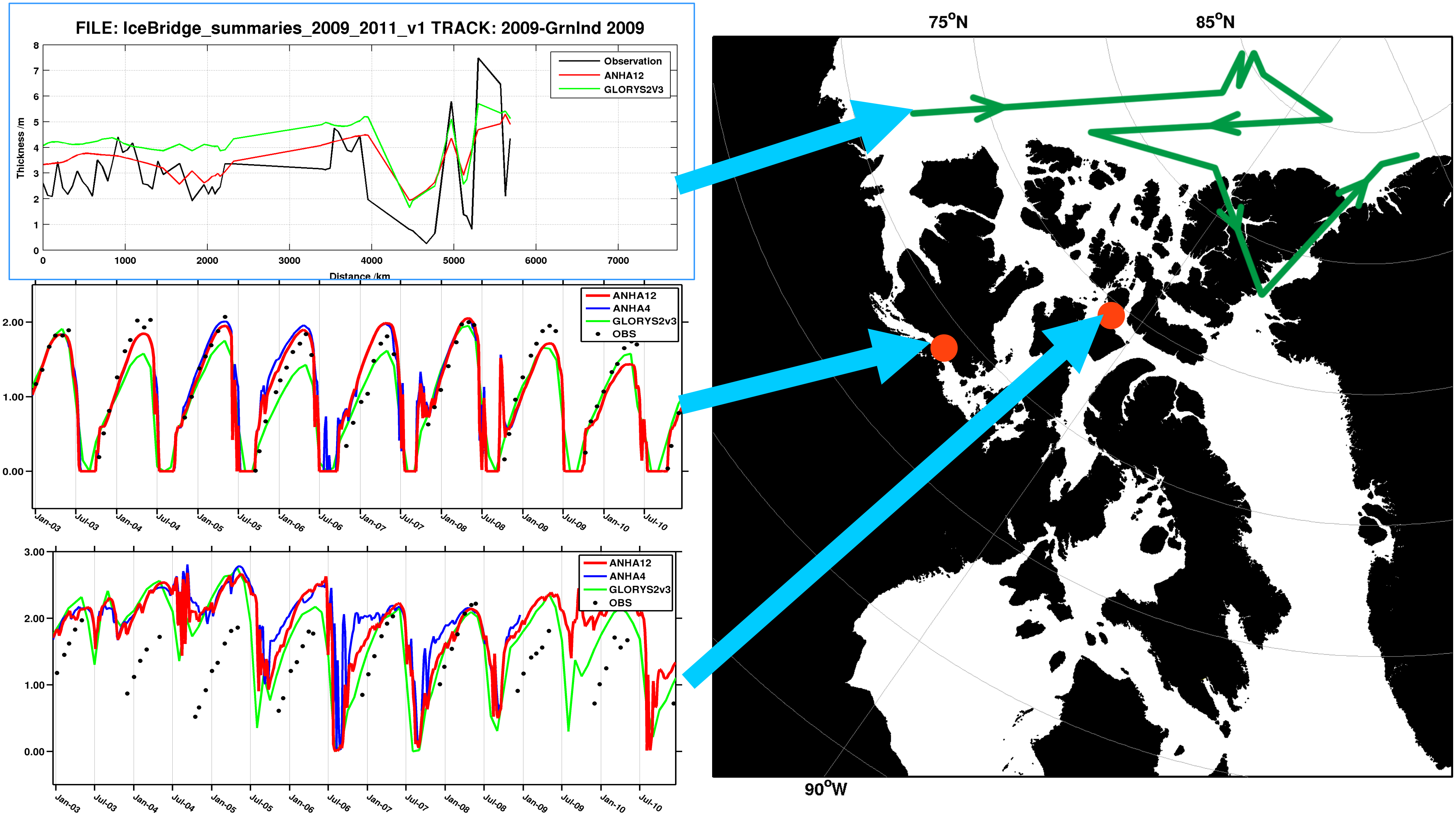
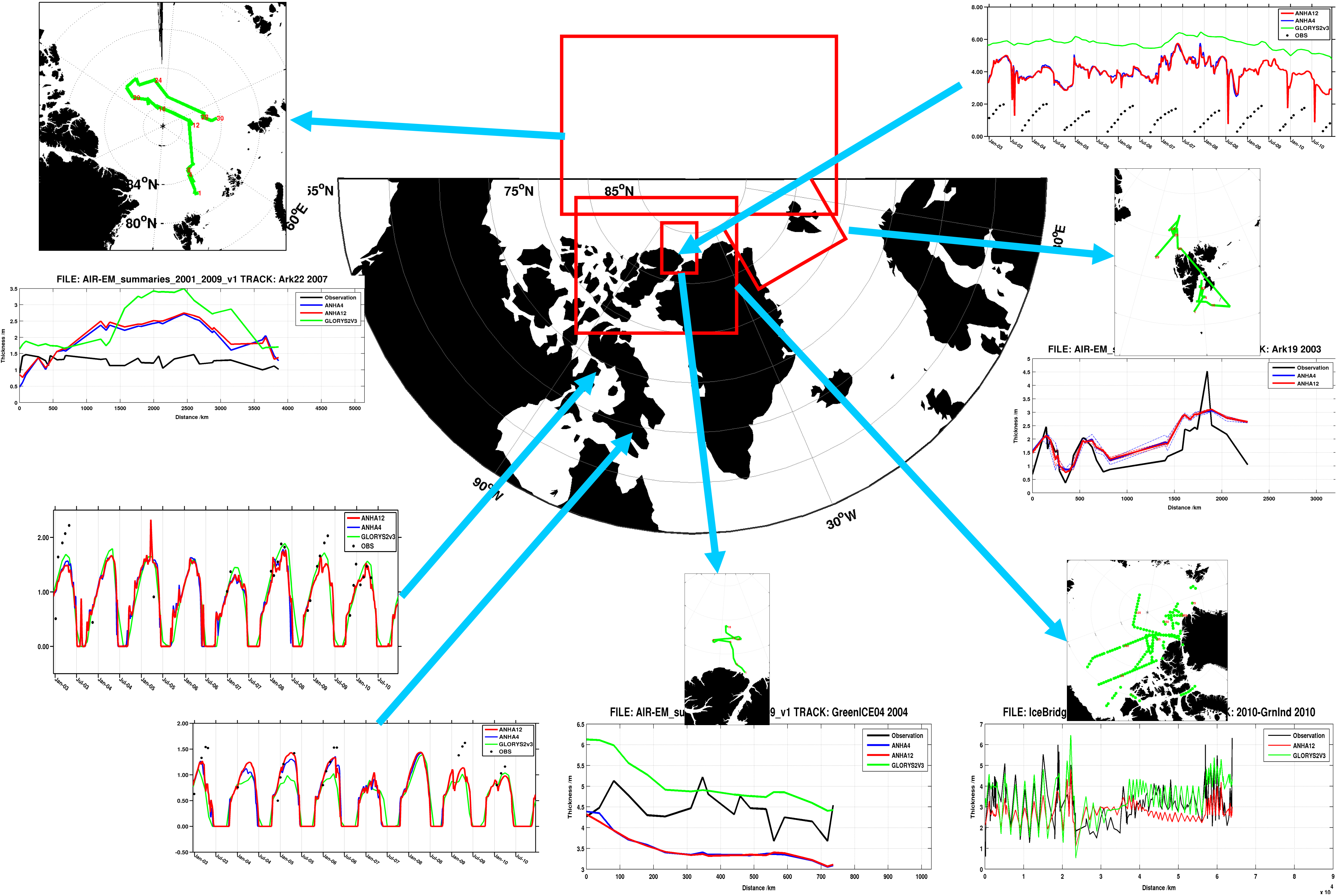
Autumn (Oct -- Nov) Ice Thickness



Airborne Electromagnetic & Upward Looking Sonar Data



BLACK: observation **RED: ANHA12** **BLUE: ANHA4**



BLACK: observation **RED: ANHA12** **BLUE: ANHA4**

Thermodynamic and Dynamic Ice Thickness Changes

$$\Delta H = \Delta H_{thermal} + \Delta H_{dynamic}$$

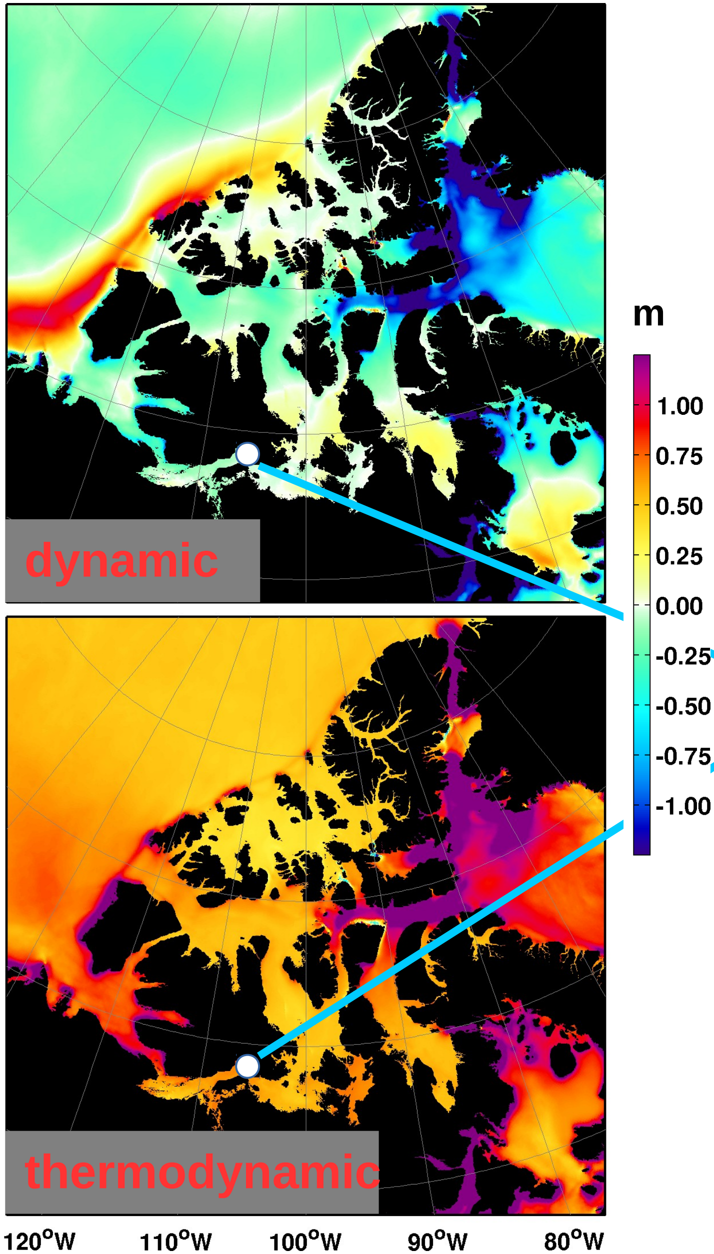
total changes

due to "ice production"
(vertical thermal processes)

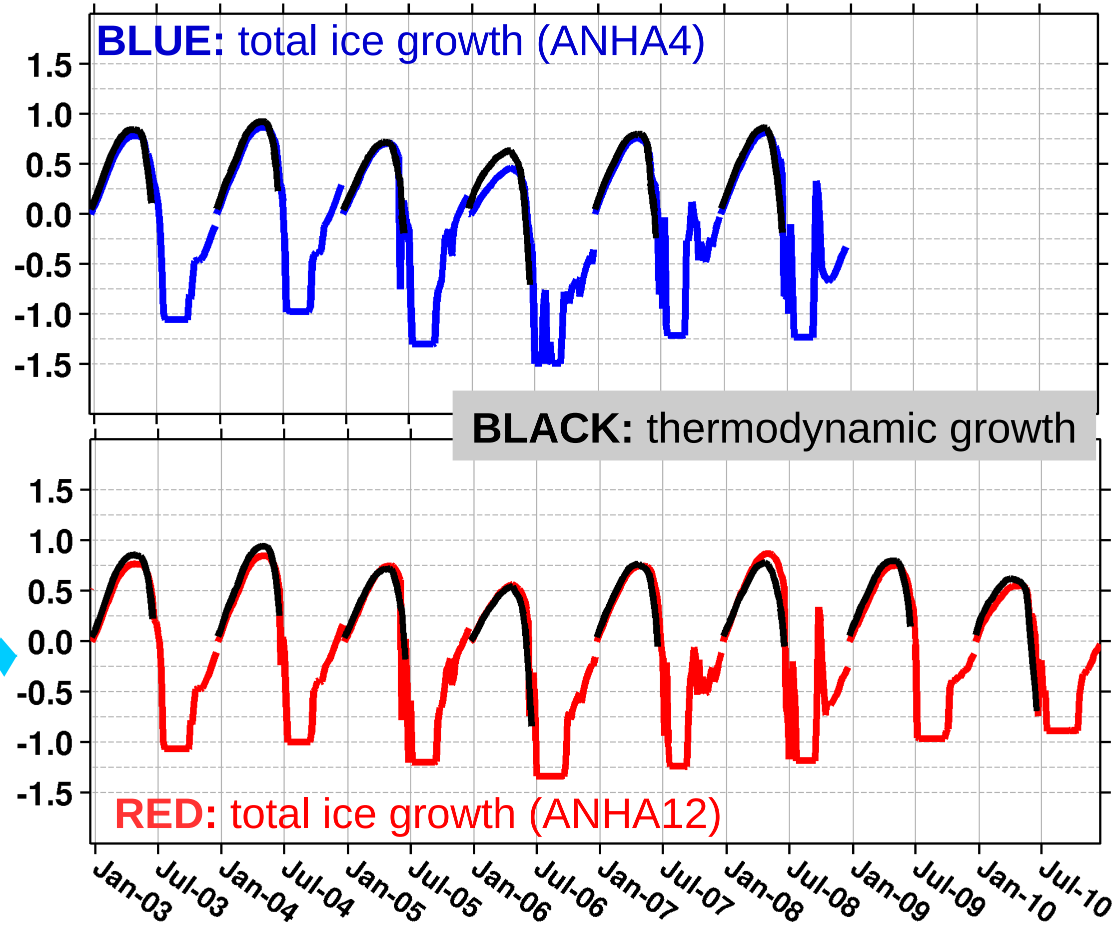
remaining part
(lateral processes)

note: they are not actually decoupled

Ice Growth in Cambridge Bay

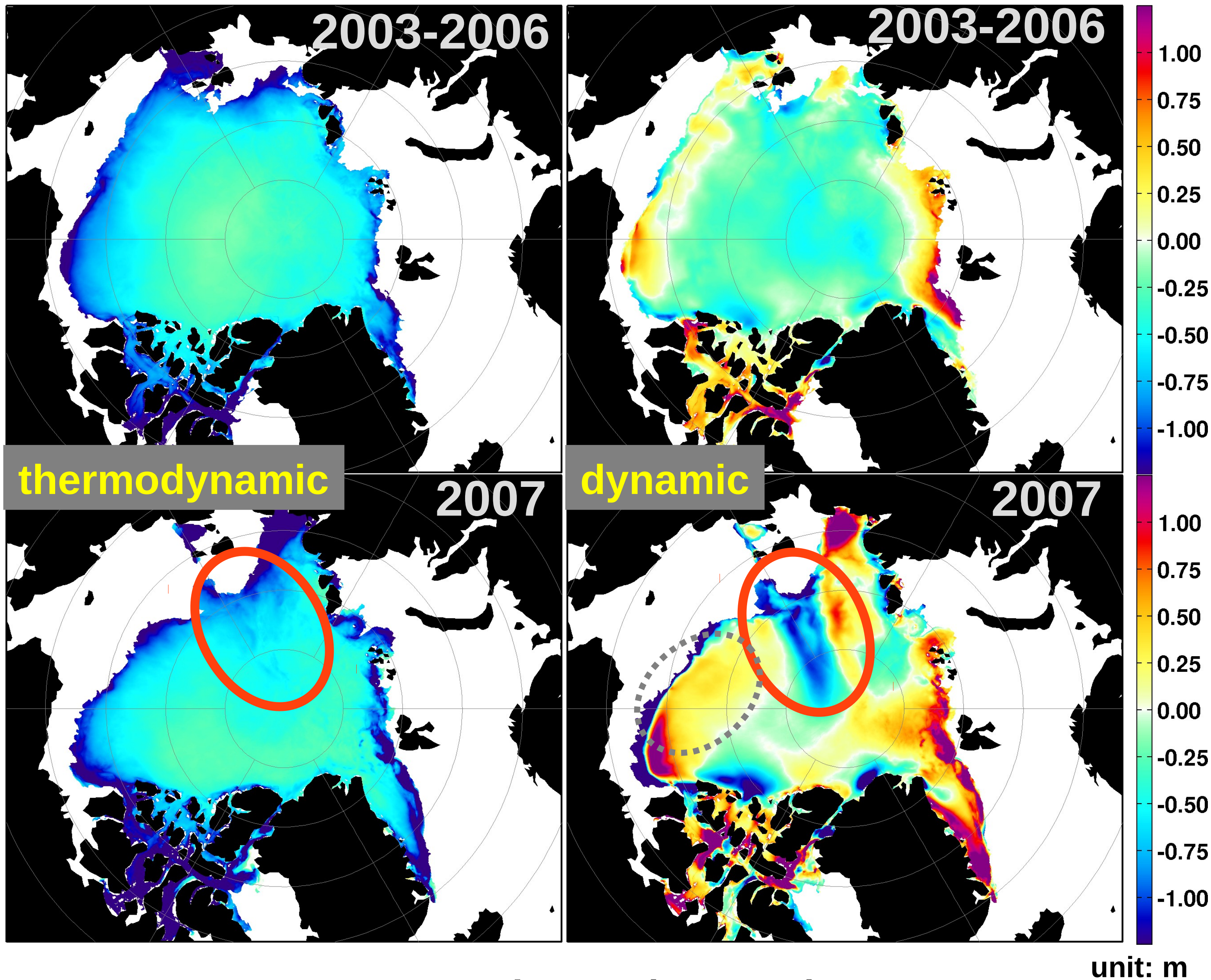


2003-2008 (Jan-Mar)



- **mainly thermodynamic (first half year)**
- **more dynamic in autumn (or just local circulation)**

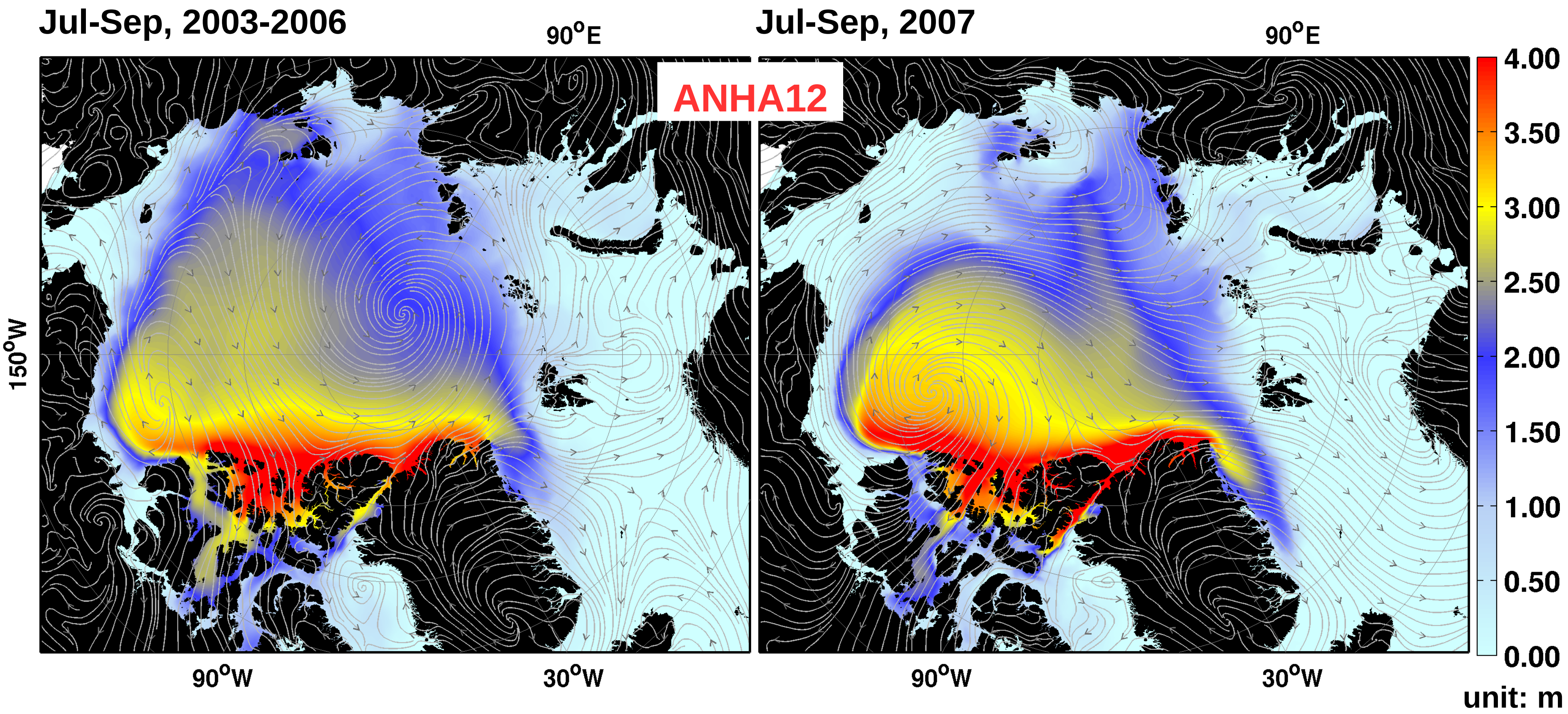
Thinning of Sea Ice in 2007



Jul – Sep (ANHA12)

- thinning due to both
- increase due to dynamic change

Changes in 10-m Wind Field



Stronger Beaufort Gyre ==> thicker sea ice

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Summary

- model produces reasonable large scale pattern but too thick sea ice in Beaufort Sea, which is likely due to the ice dynamics
- thermodynamic component of sea ice model might work well (e.g., in Cambridge Bay); dynamic component still needs further improvement
- thinning in 2007 is attributed to both thermodynamic and dynamic changes