

# Tracking a newly predominant ice type

## SIZONet observations of FY ice thickness north of AK



Photo: David Ball, NRL

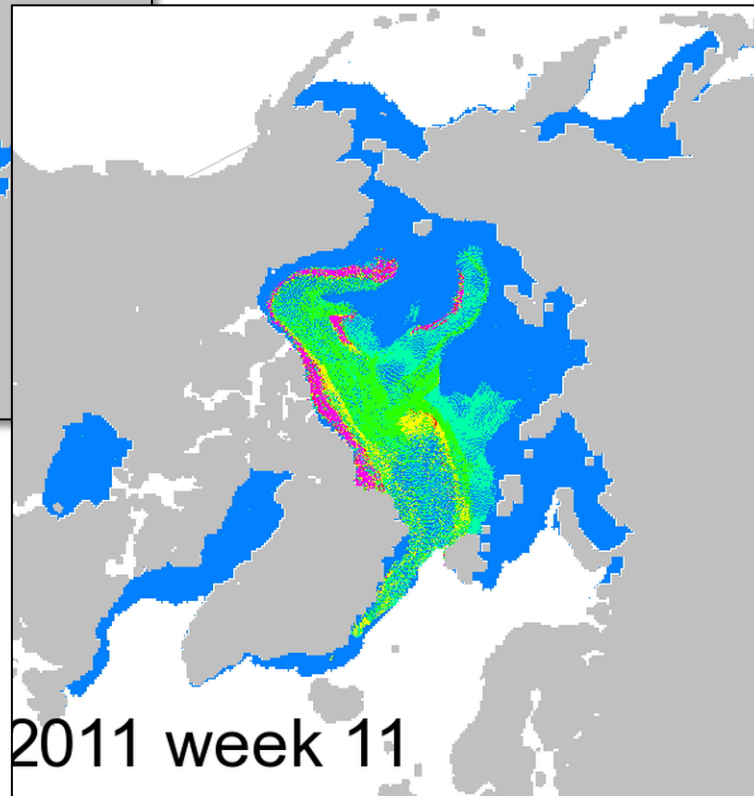
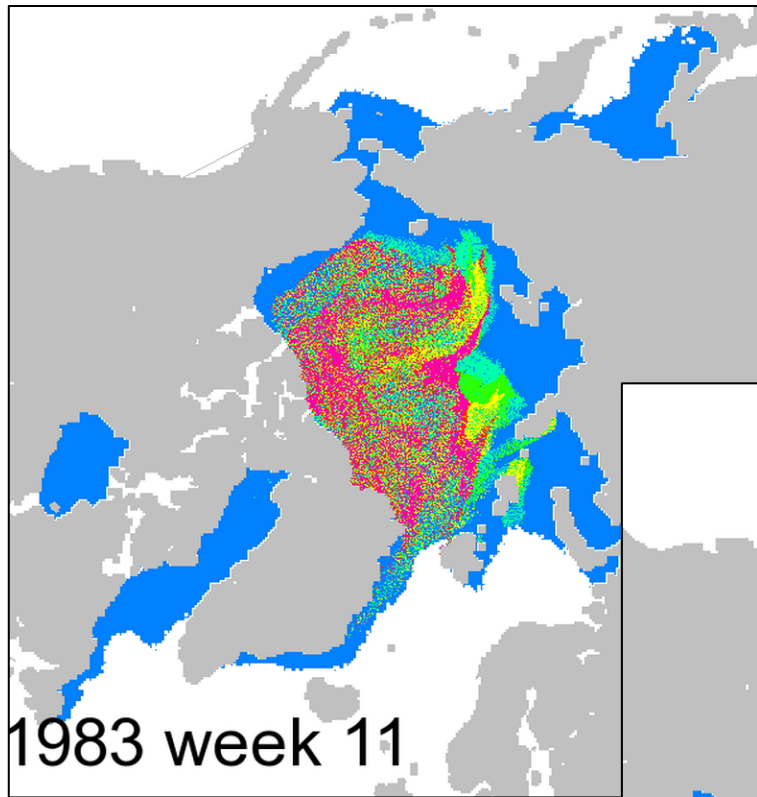
*Andy Mahoney<sup>1</sup>, Hajo Eicken<sup>1</sup> and Stefan Hendricks<sup>2</sup>*

*<sup>1</sup>University of Alaska Fairbanks*

*<sup>2</sup>Alfred Wegener Institute*



# A seasonally dominated Arctic Ocean

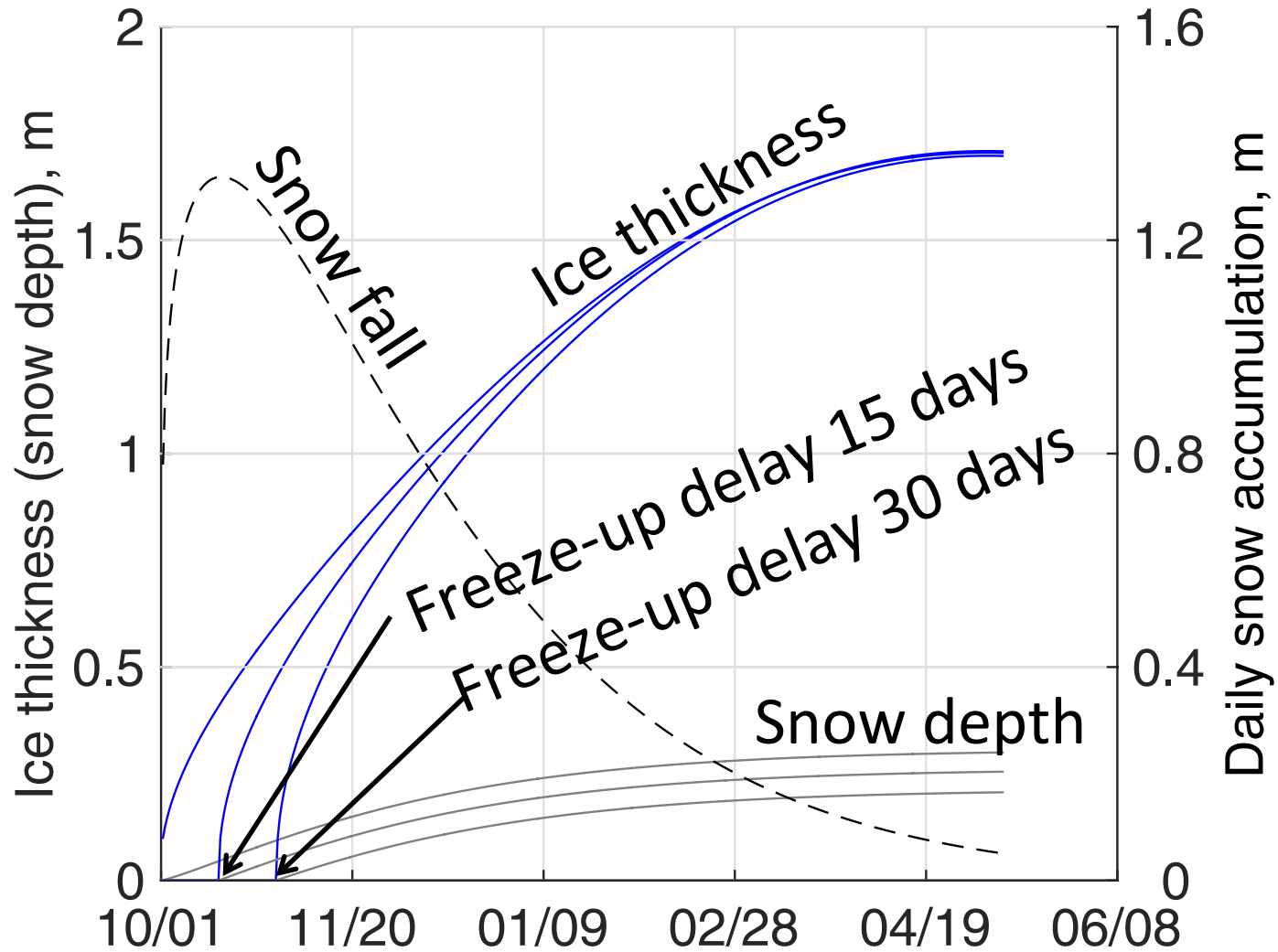


Sea ice age

- 1st year
- 2nd year
- 3rd year
- 4th year
- 5th year
- older

Data courtesy of  
Jim Maslanik  
U. Colorado

# Early ice catches the early snowfall?



# Barrow ice mass balance station (MBS)

**1999-2004**

## *Manual observations (stake farm)*

- “Hot-wire” ice thickness gauges
- Snow depth stakes
- Internally-logging in-ice thermistor string



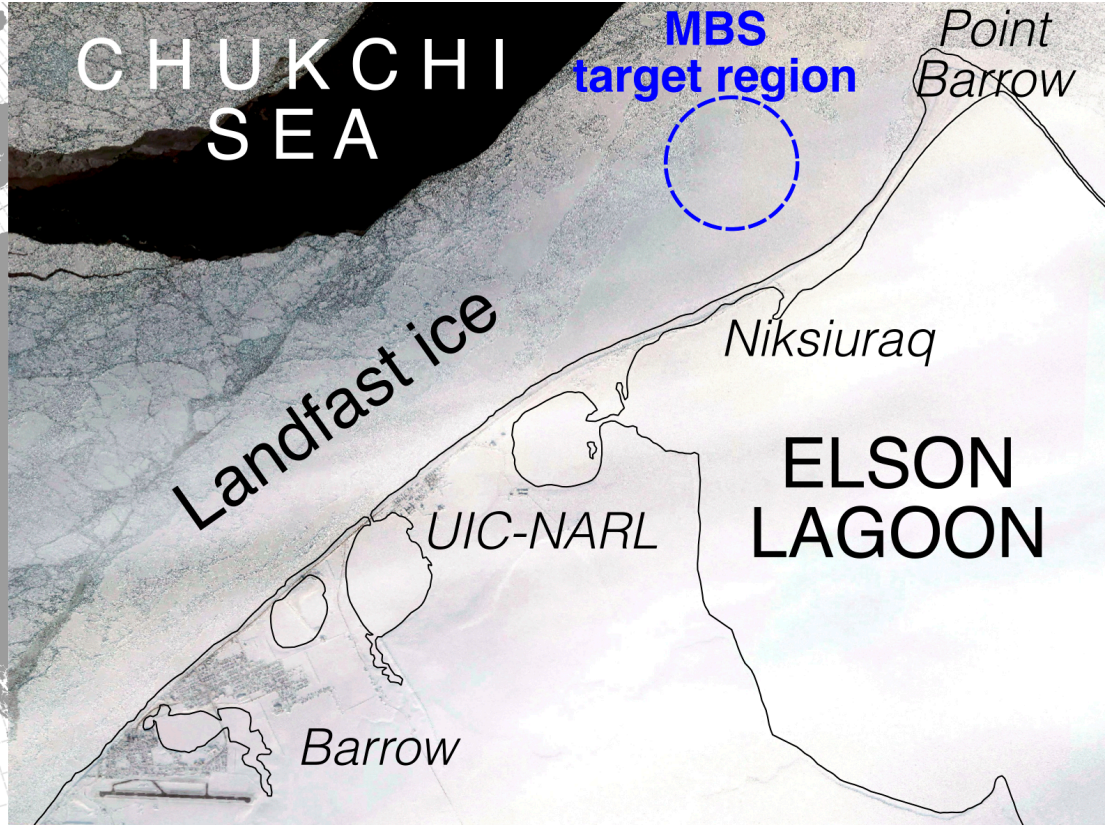
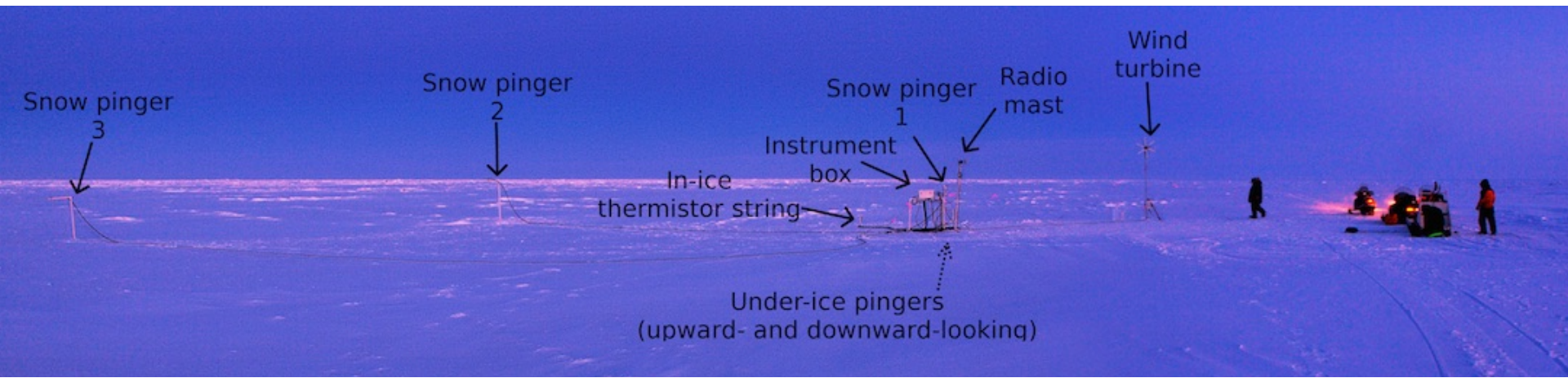
**2005-present**

## *Automated mass balance station*

- Acoustic measurements of snow depth, ice thickness and water depth
- In-ice thermistor string
- Air and water temperature
- Data transmitted to shore station by VHF link

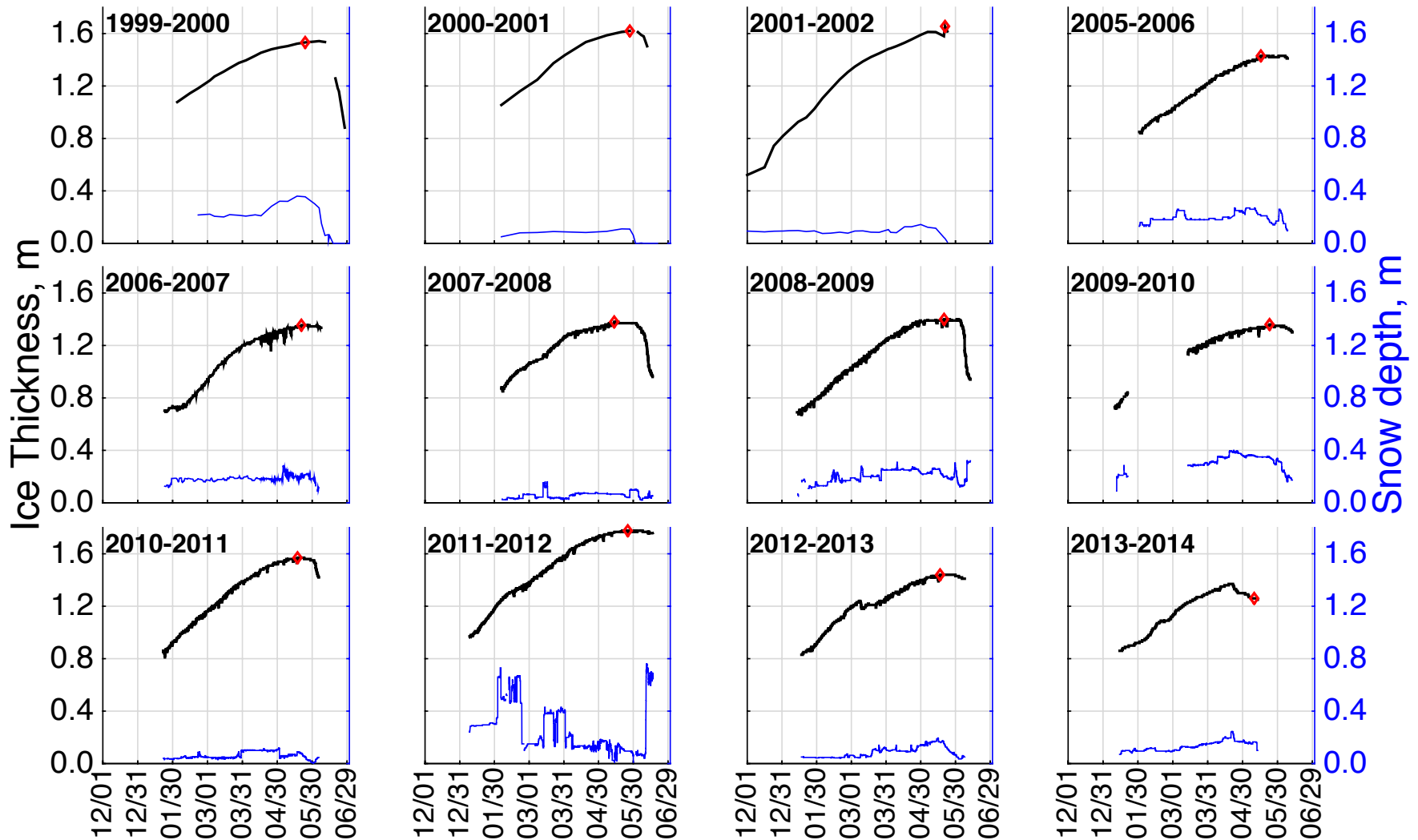


# Barrow ice mass balance station (MBS)

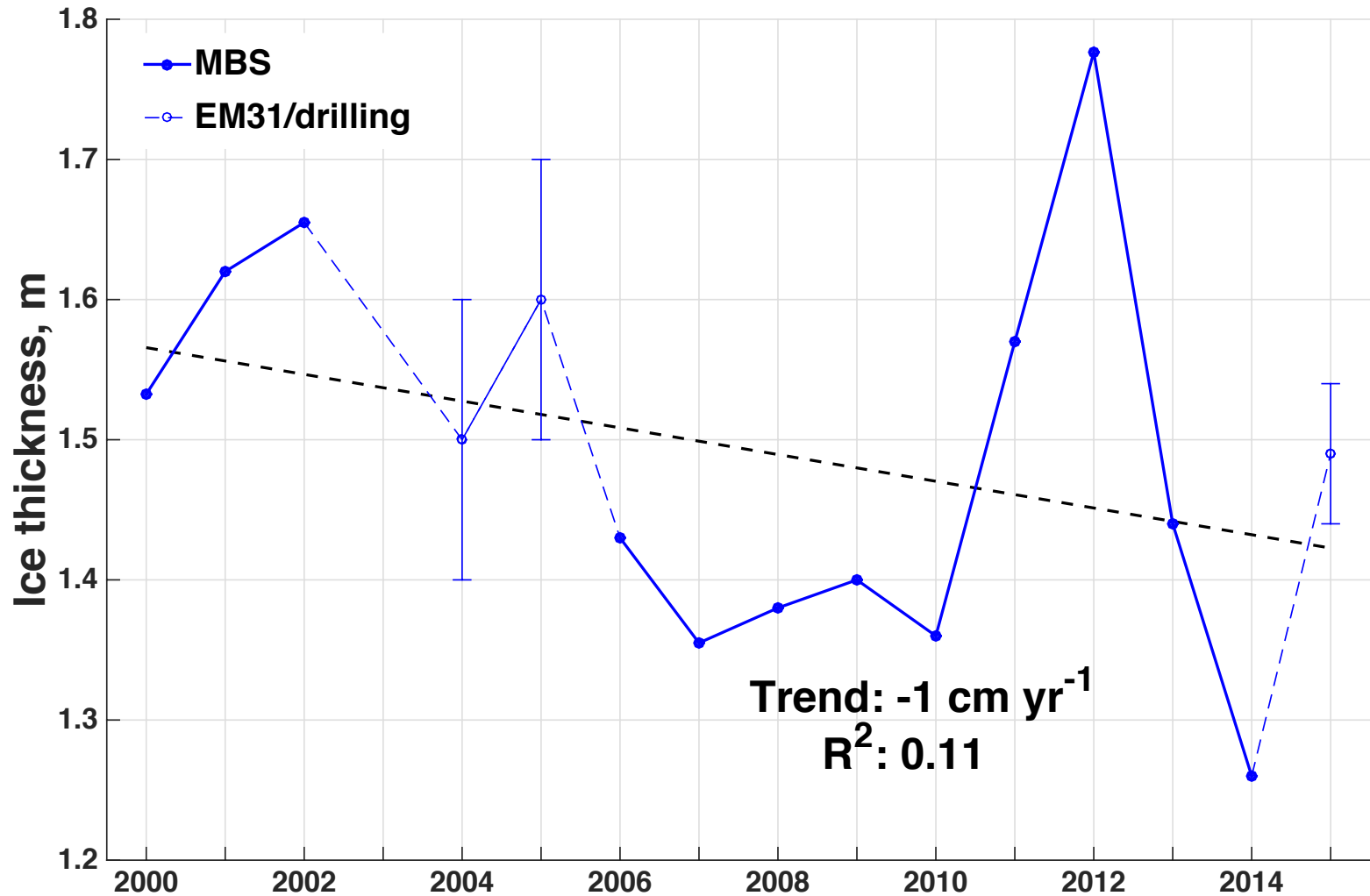


# 12 seasons of FY ice growth

Diamonds show max thickness in last 3 weeks of May

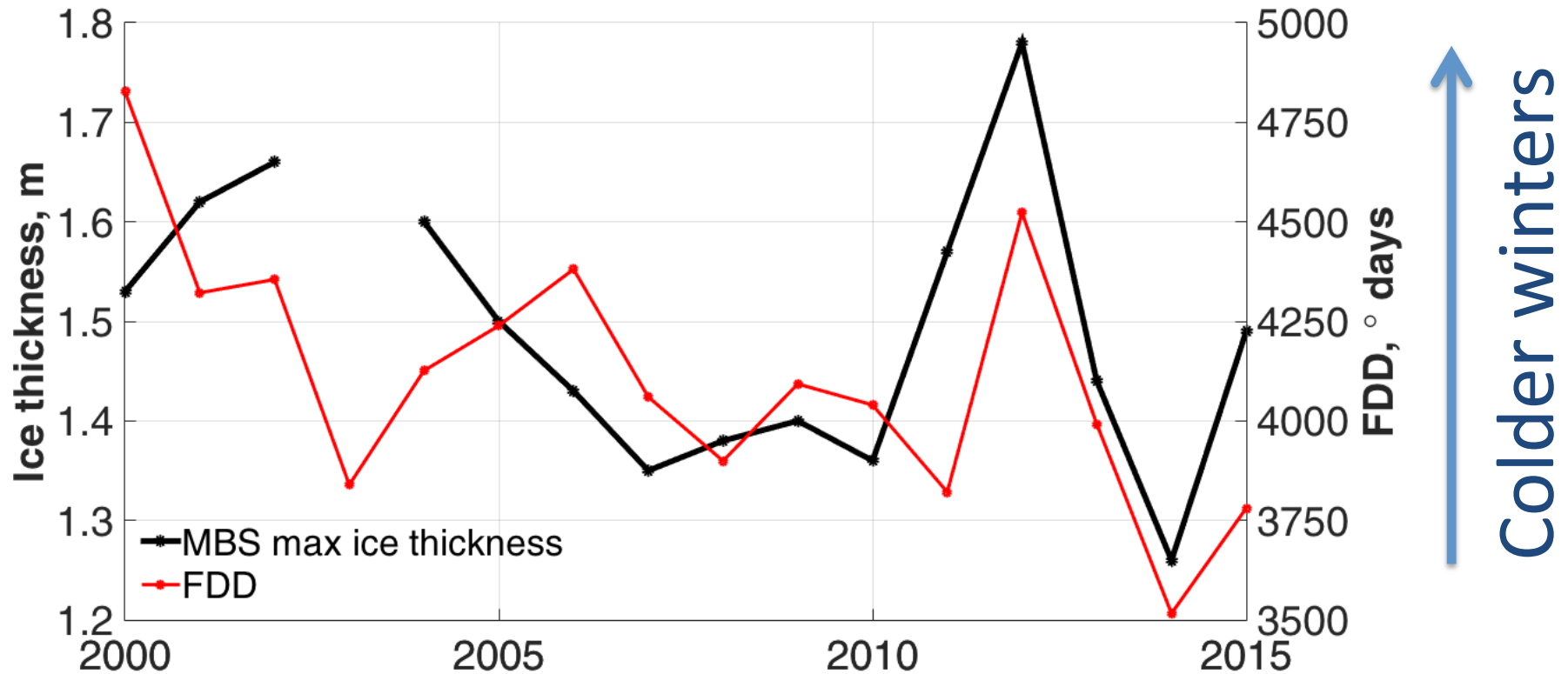


# Annual maximum FY ice thickness



# Possible drivers of thinning FY ice

## Freezing Degree Days

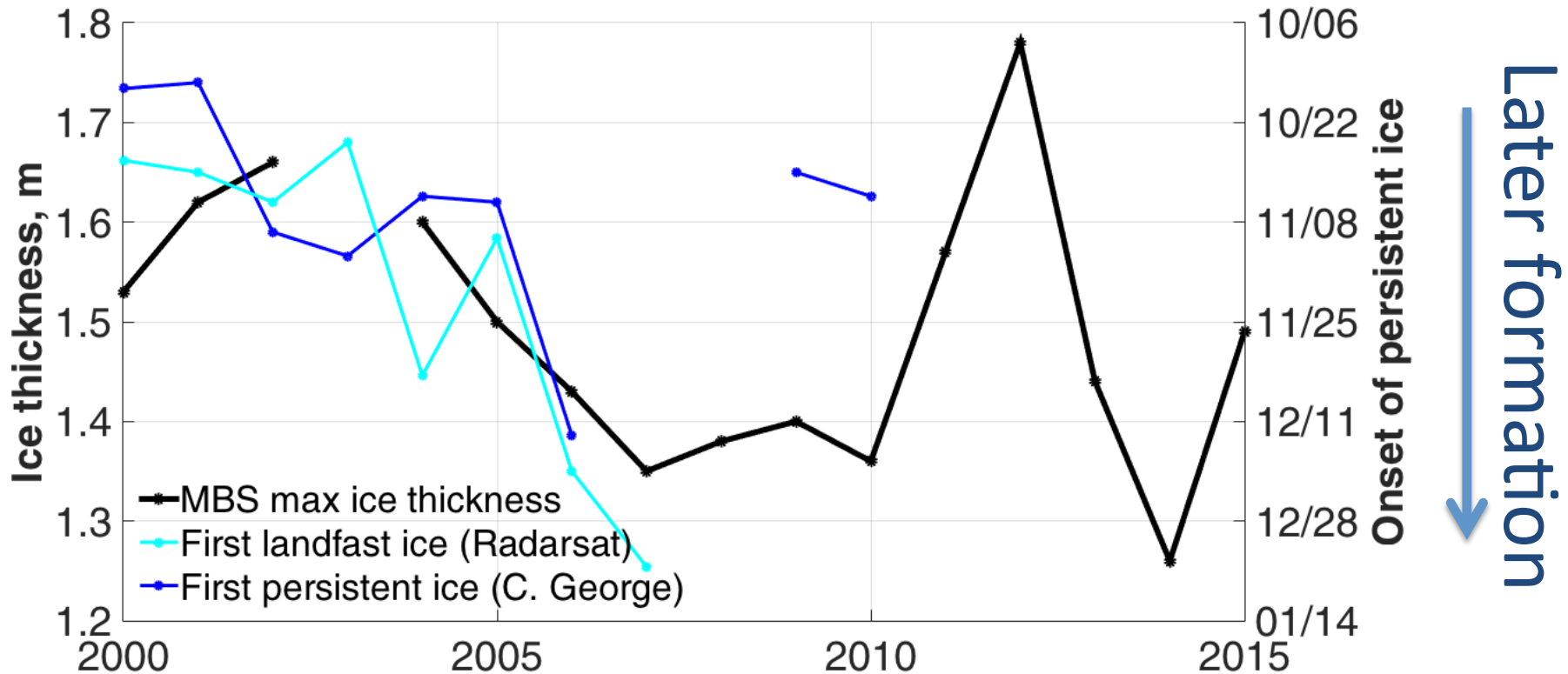


- Significant trend toward fewer FDDs



# Possible drivers of thinning FY ice

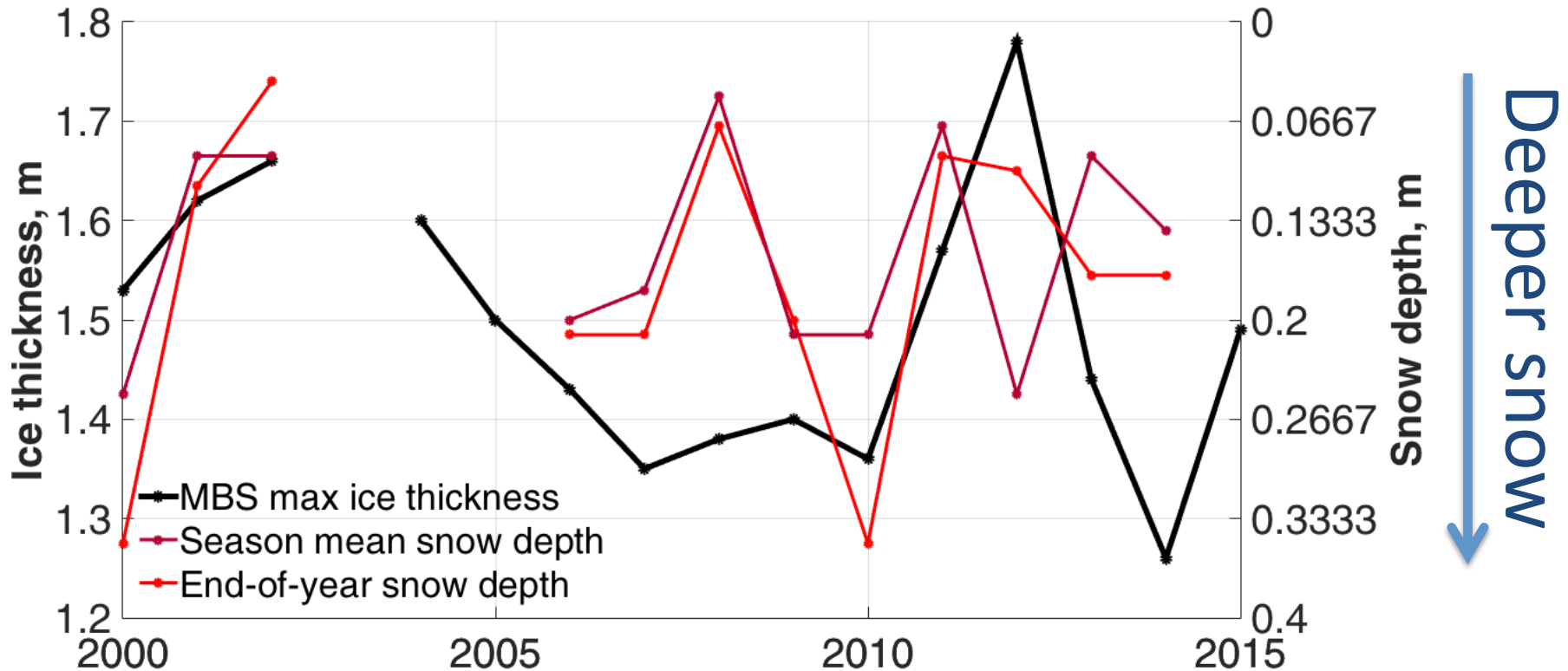
## Date of “freeze-up”



- “Freeze-up” not easily defined
- Landfast ice forming later

# Possible drivers of thinning FY ice

## Snow depth

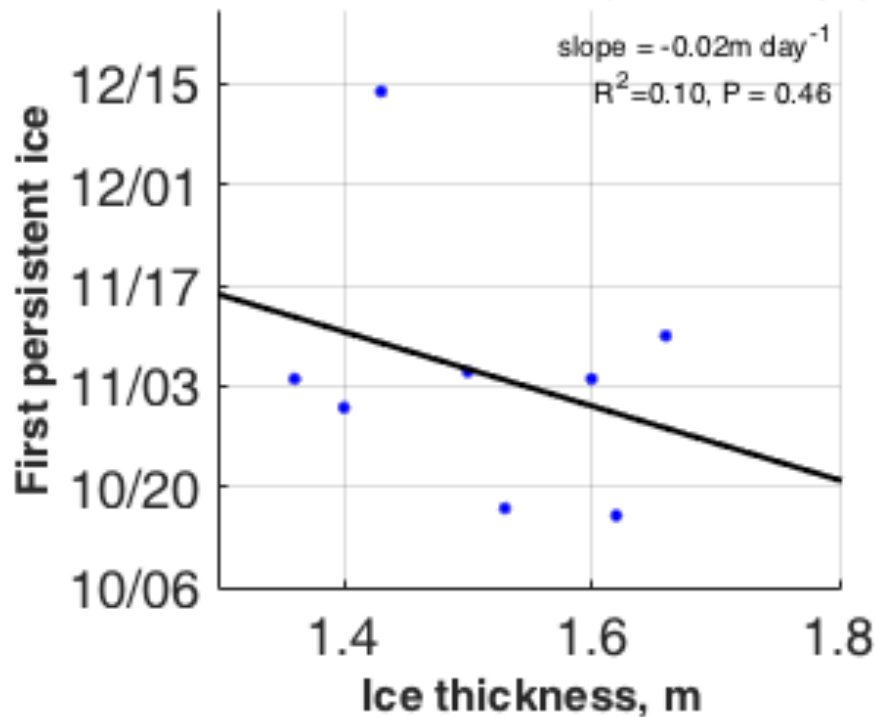


- No significant trend in snow depth

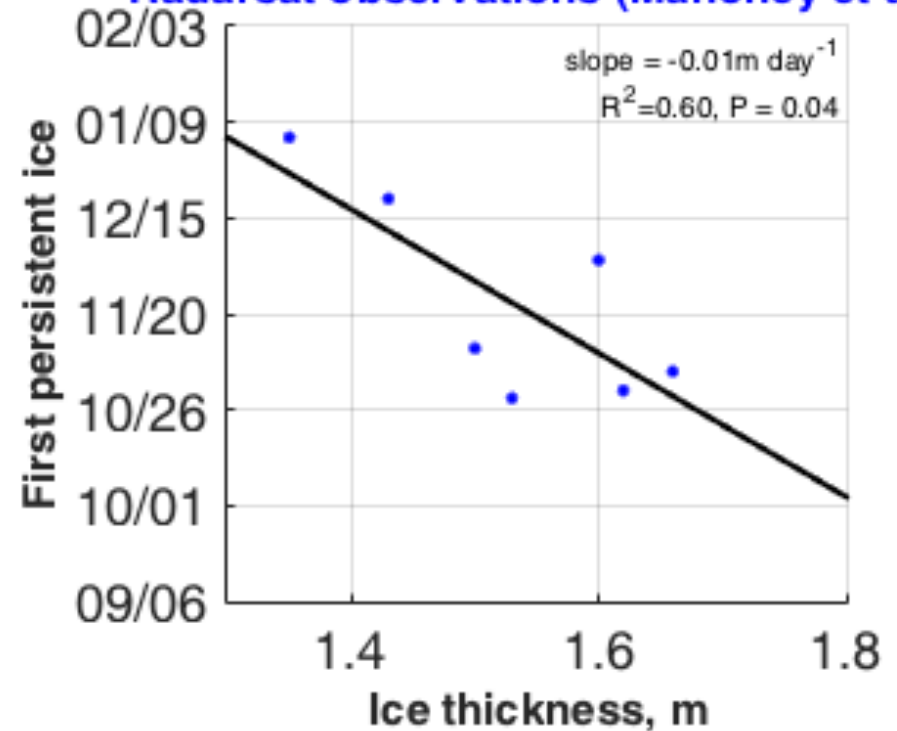
# Possible drivers of thinning FY ice

## Ice thickness vs Date of “freeze-up”

Local observations (J.C. George)



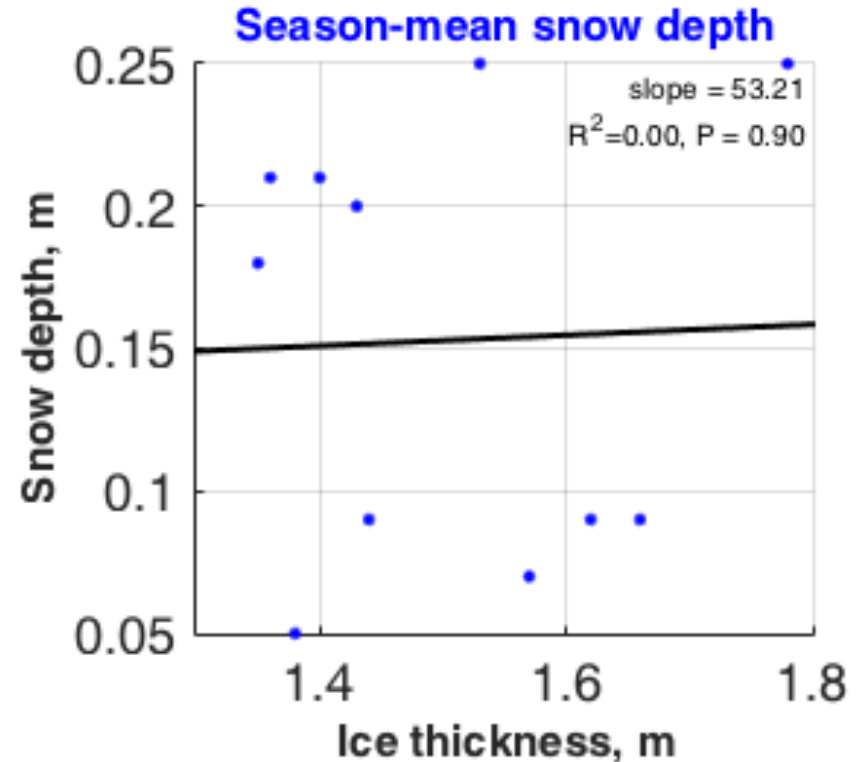
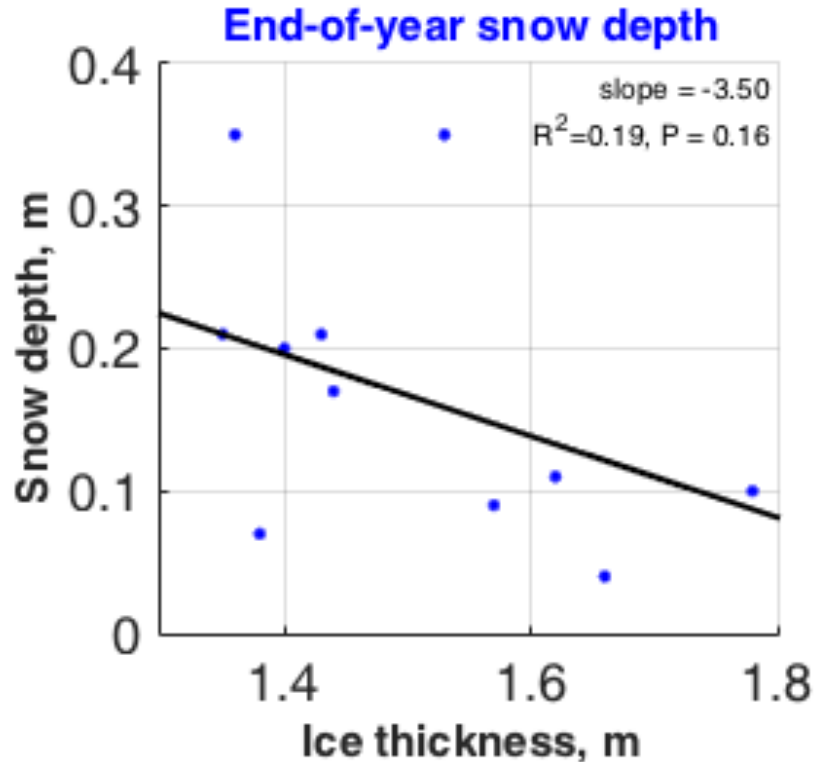
Radarsat observations (Mahoney et al.)



**+1 day of delayed fast ice formation  $\approx$  -1cm ice thickness**

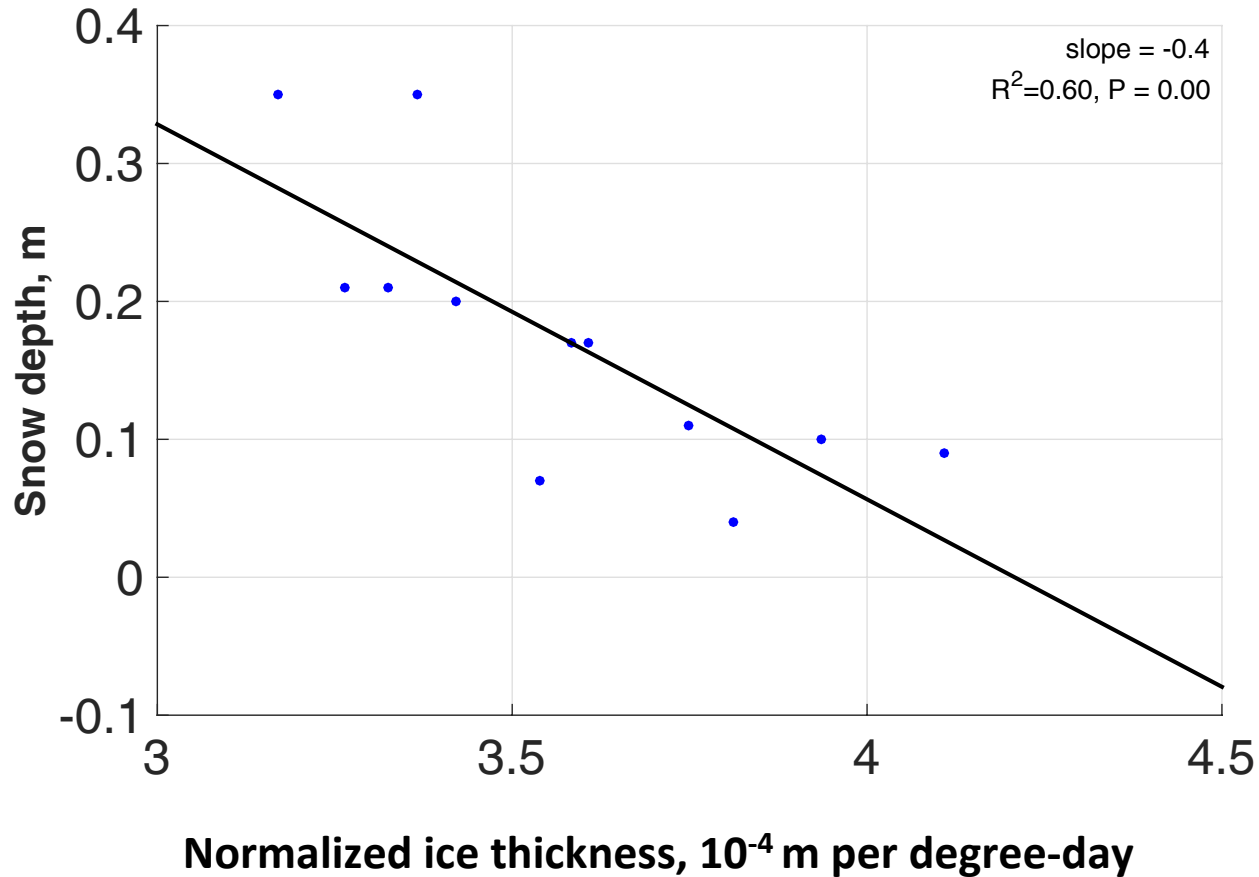
# Possible drivers of thinning FY ice

## Ice thickness vs Snow depth



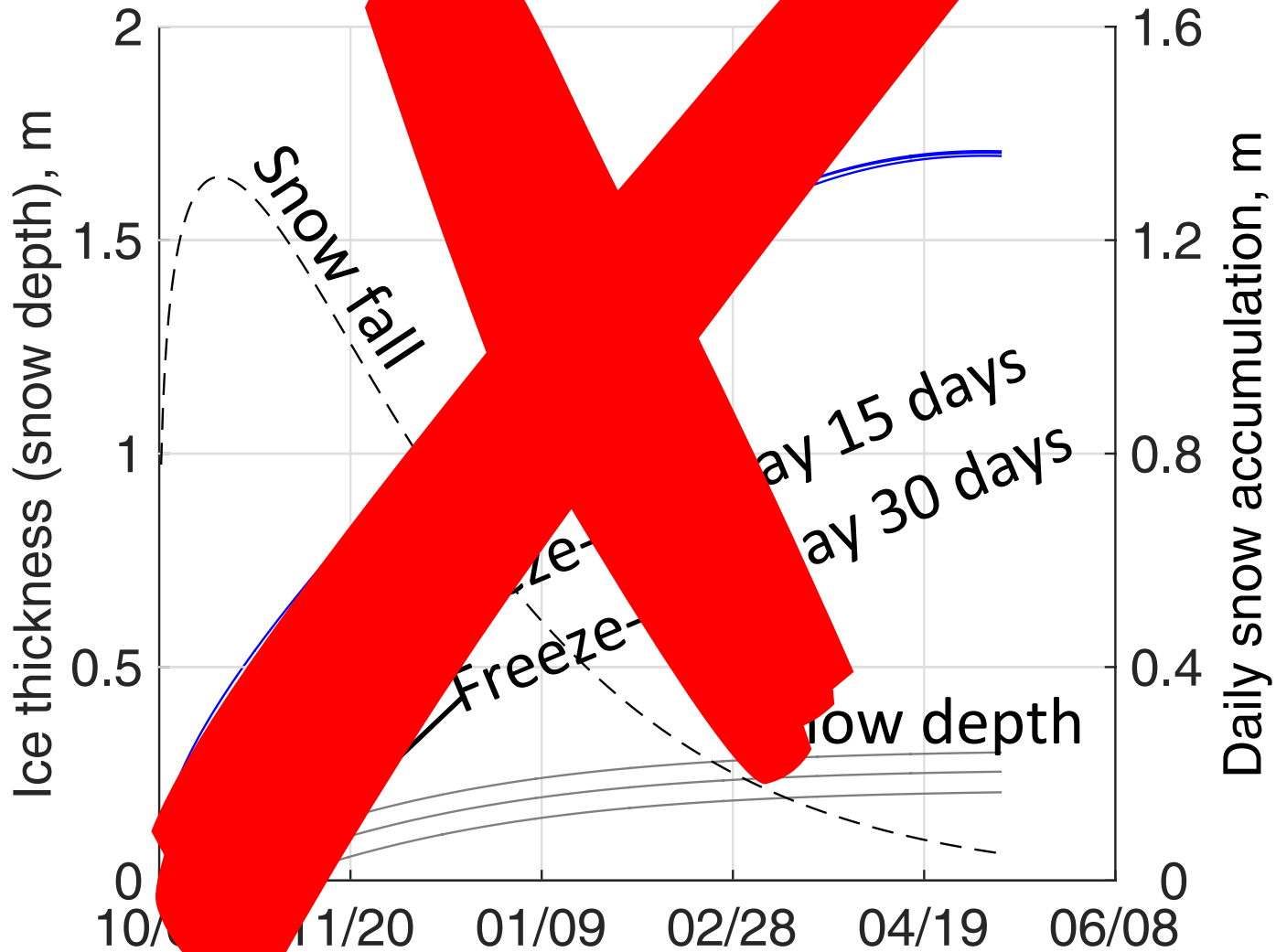
# Possible drivers of thinning FY ice

Ice thickness/FDD vs Freezing degree days



**+1 cm of snow ~ -1.7 cm of ice growth**  
*(In a "typical" 4200-FDD winter)*

# Early ice catches the early snowfall?

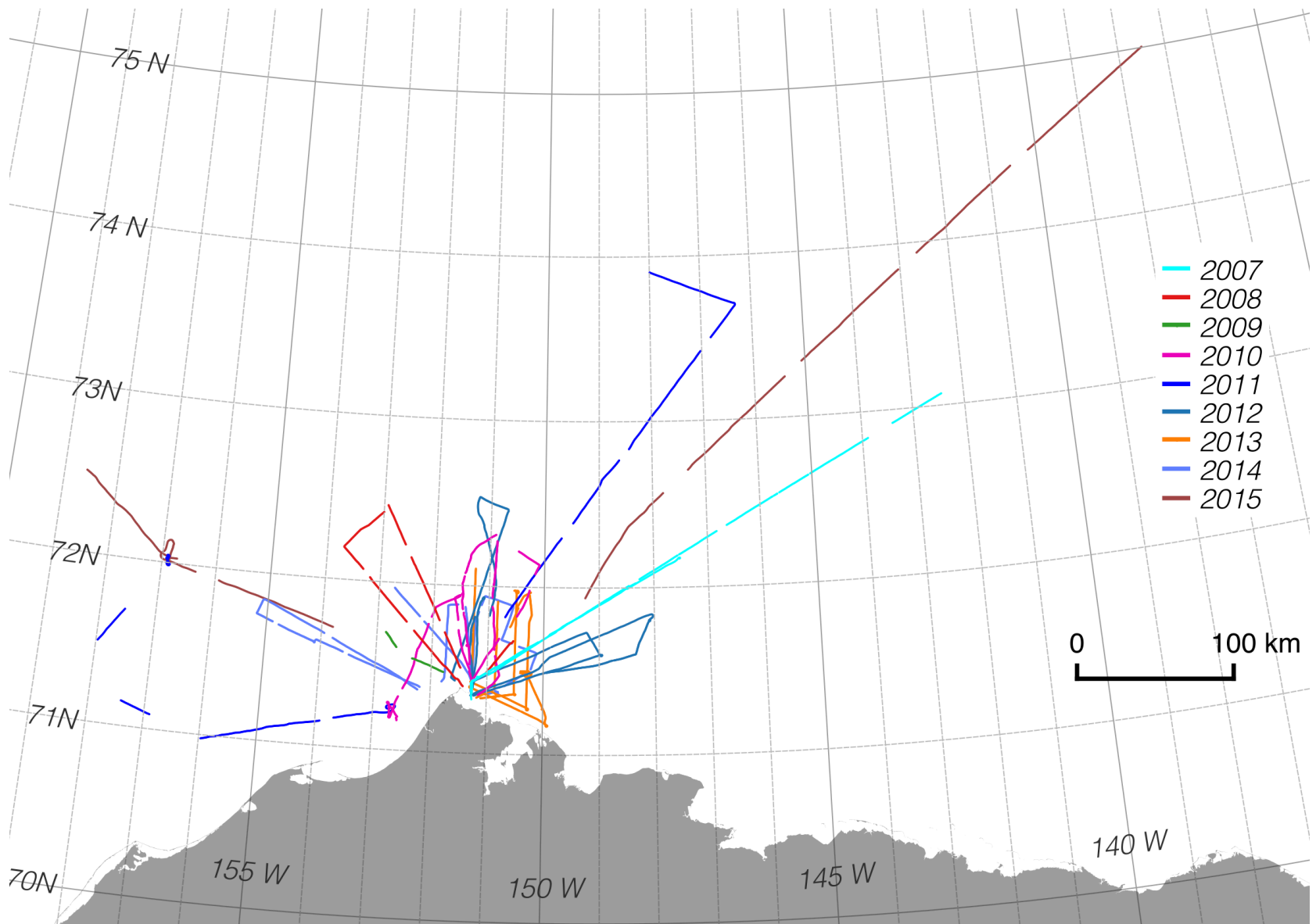


# Airborne electromagnetic (AEM) surveys



*Photo: David Ball, Naval Research Lab.*

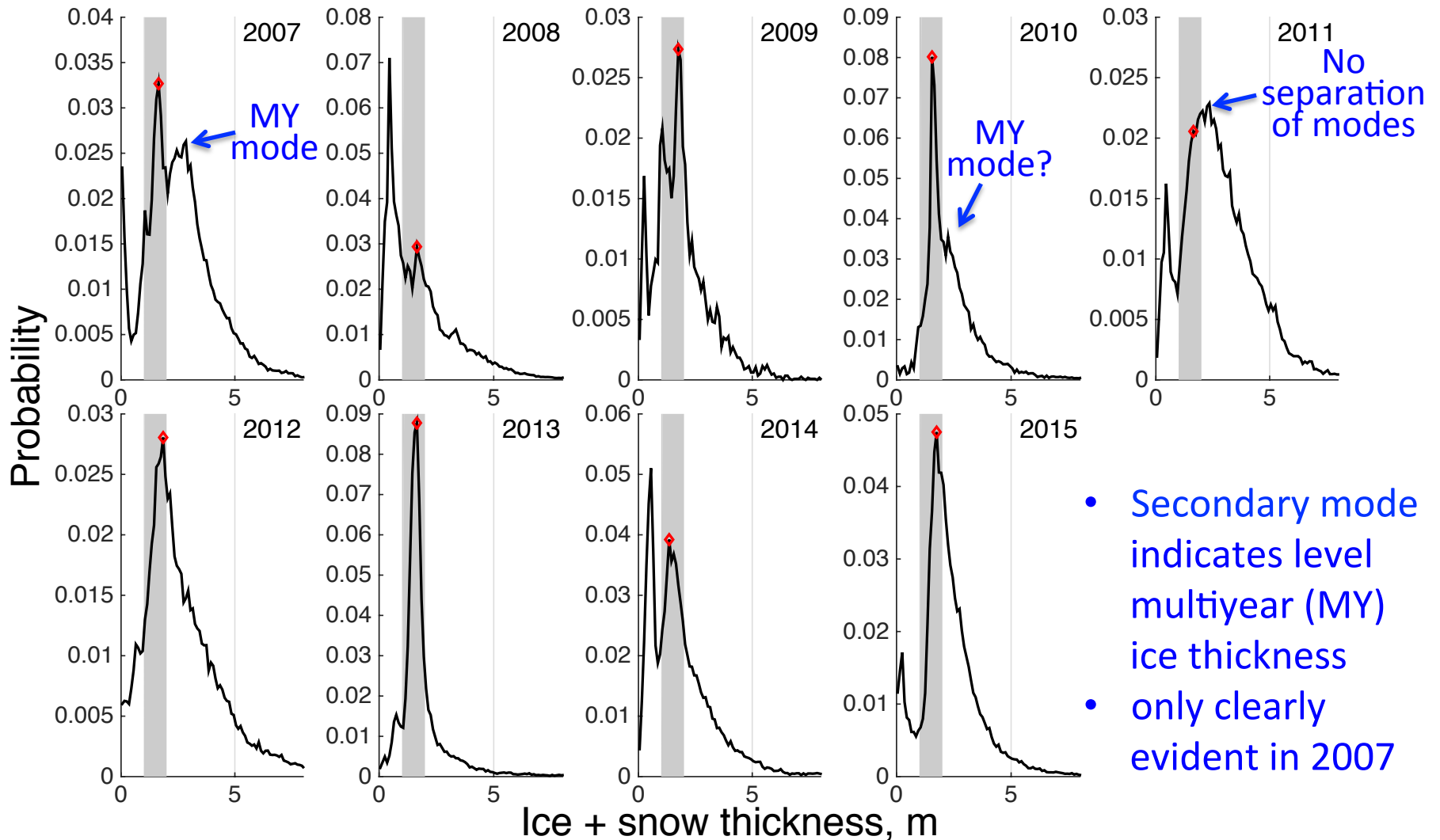
# 9 years of Barrow AEM campaigns





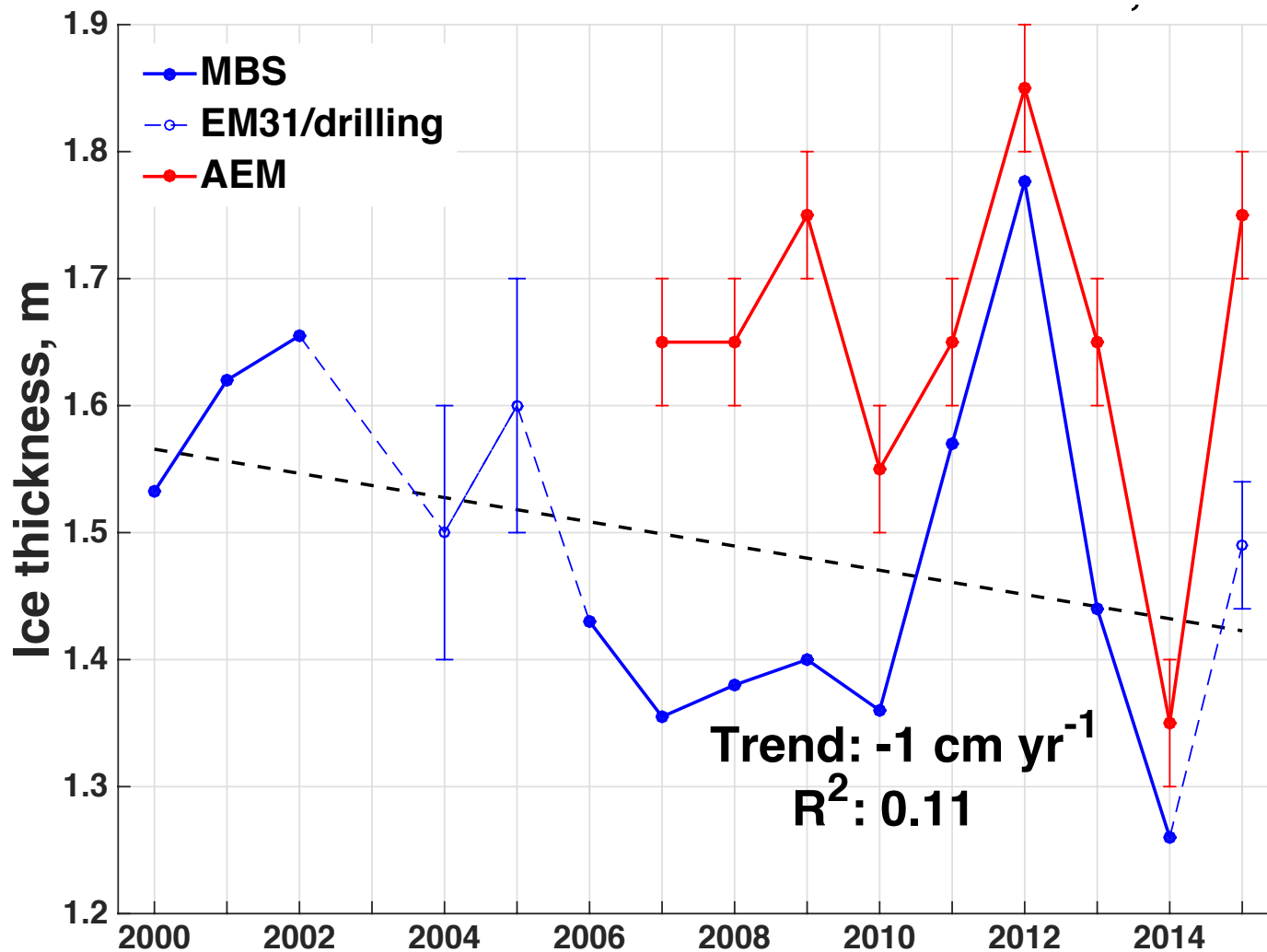
# PDFs of AEM ice + snow thickness

Diamonds show modal thickness in FY range



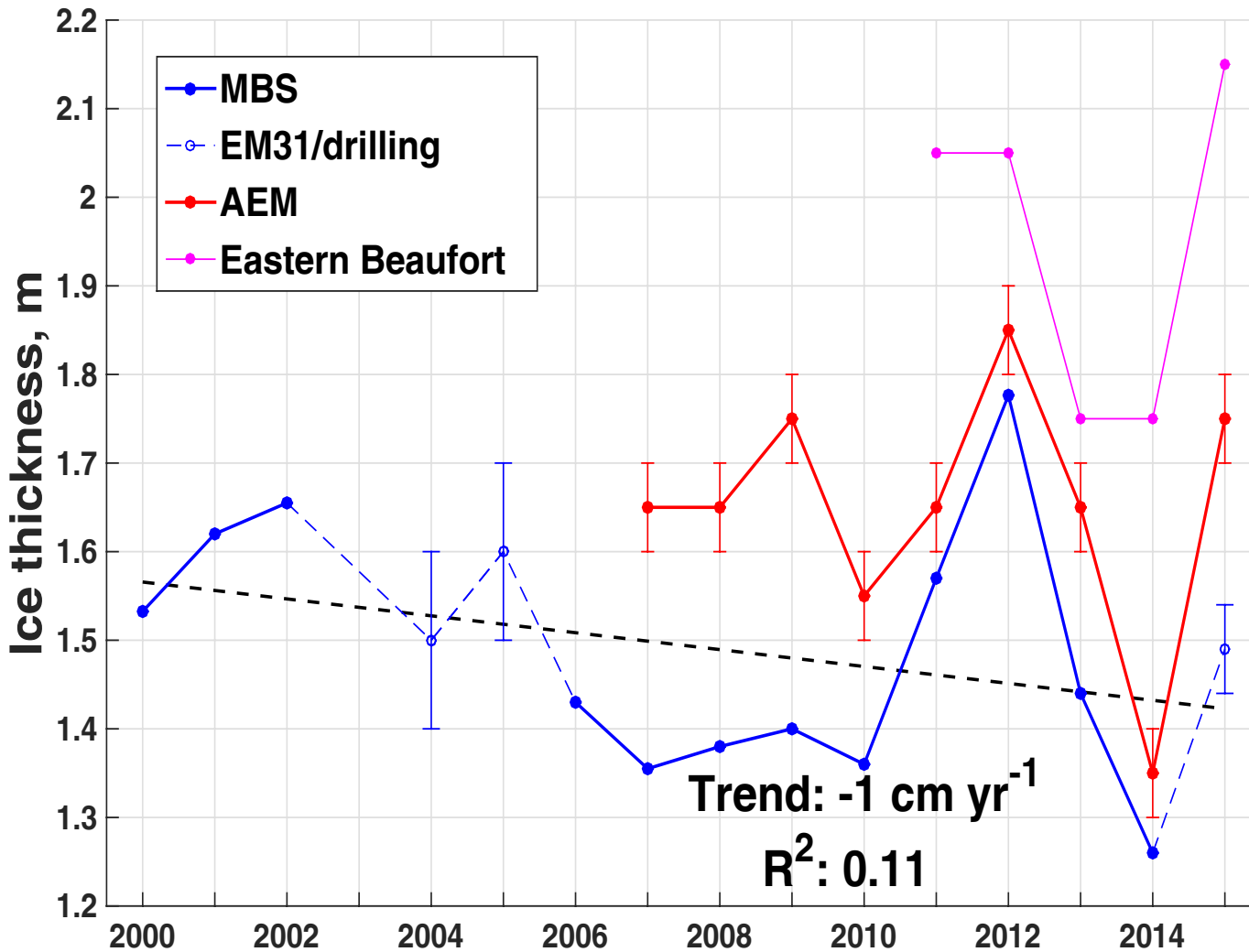
# Comparison of MBS and AEM ice thicknesses

MBS and AEM show similar interannual variability  
Particularly since 2010

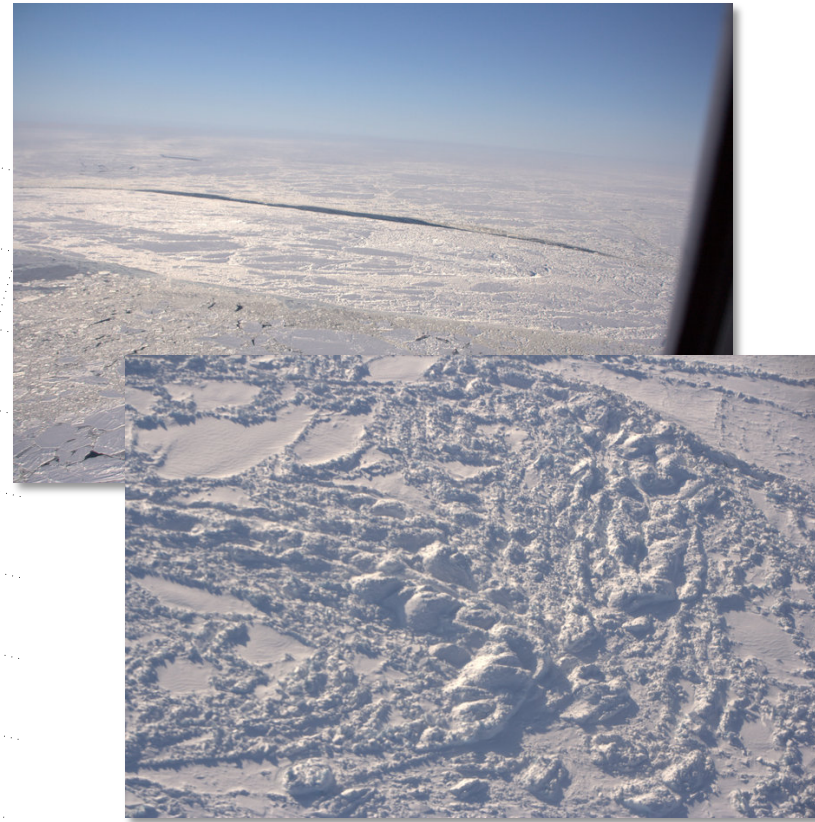
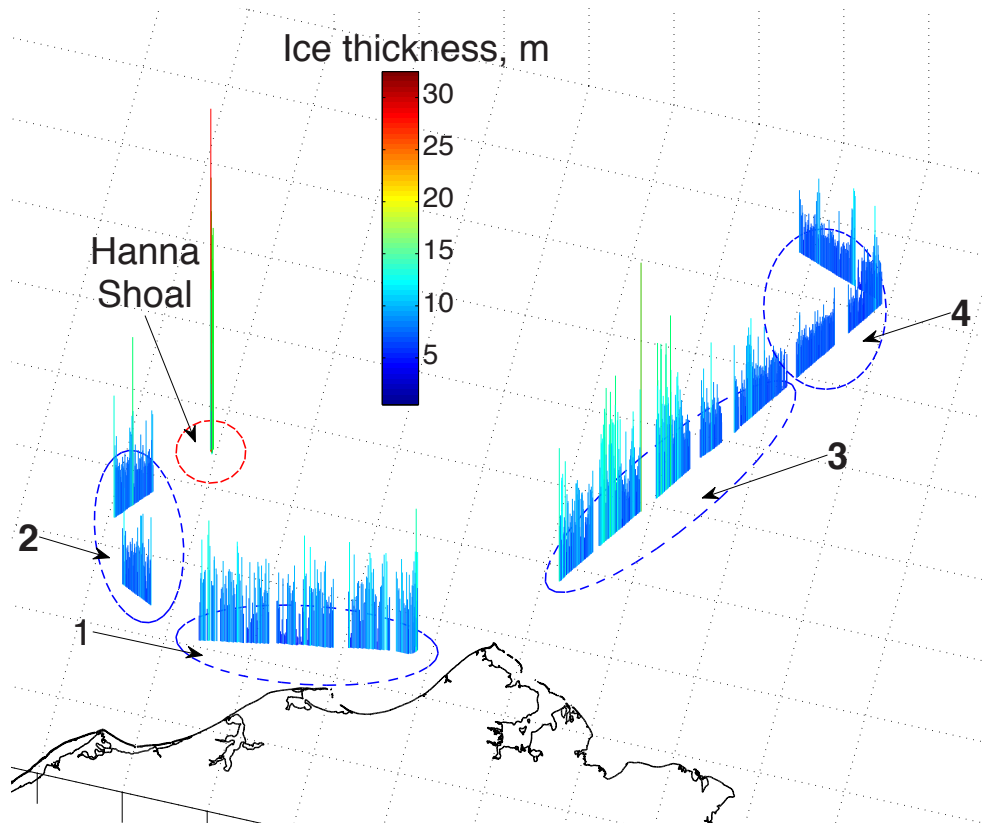


# Comparison of MBS and AEM ice thicknesses

Evidence of similar variability in eastern Beaufort Sea



# Deformed ice thickness



## Hanna Shoal generates the thickest ice in the Chukchi Sea

- importance as late-summer habitat for walrus
- significant hazard for maritime activities
- recurs every year, but forming later in season

# Summary

First-year sea ice north of Alaska is thinning

- *largely driven by shorter, warmer winters*
- *delayed freeze-up not offset by thinner snow*

Impacts on marine mammal habitat and ice-related hazards unclear

- *significant source regions of thick, deformed ice still present*

*Coordinated observations of seasonal ice zone critical for understanding the transitioning Arctic Ocean*