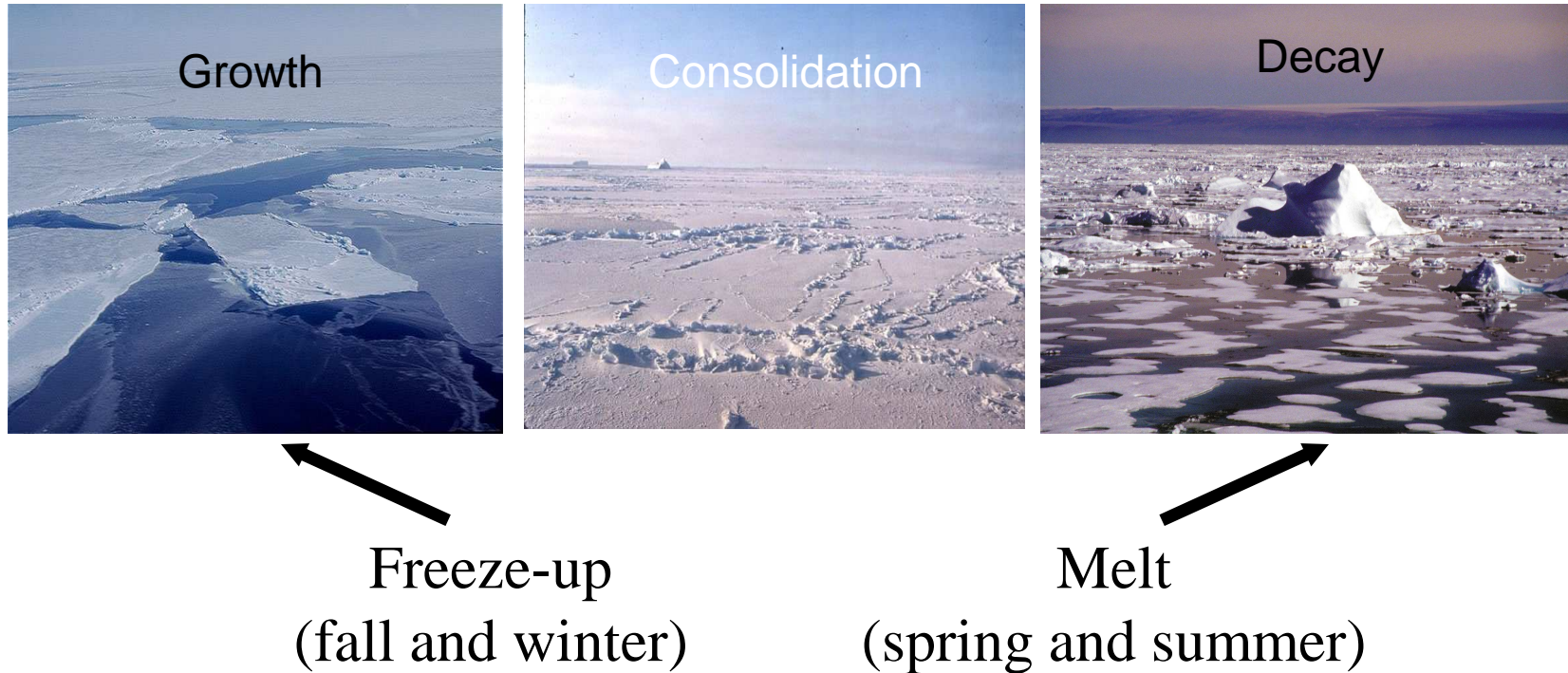


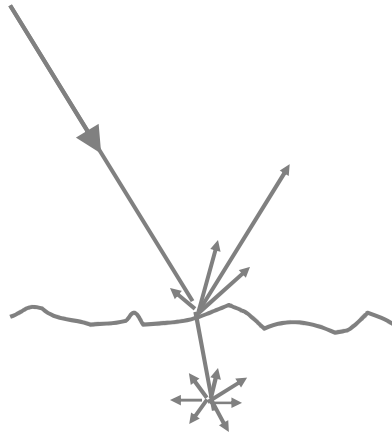
# Sea ice scenarios

- Sea ice growth is a process of steady desalination, thickening and deformation of the ice slab, followed by decay in summer.



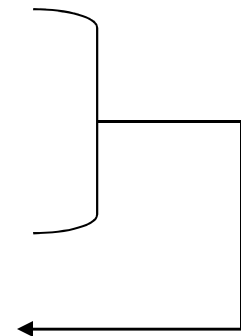
# Sea ice detection

- Sea ice detection is routinely performed by microwave *radars* and *radiometers* (unaffected by persistent cloud cover)
- Discrimination with microwave sensors is based on the strong dielectric contrast between **ocean** and **ice**



- Permittivity	High	Low
- Polarization	High	Low
- Anisotropy	High	Low
- Directivity	High	Low

Surface vs. Volume  
effects on backscatter



# New QSCAT algorithm at KNMI

- Based on distances to empirical ice/ocean backscatter models

1) normalized distance to ice/ocean model  $D_{model}(X) = \frac{(X - X_{model})^2}{\Delta X_{model}^2}$

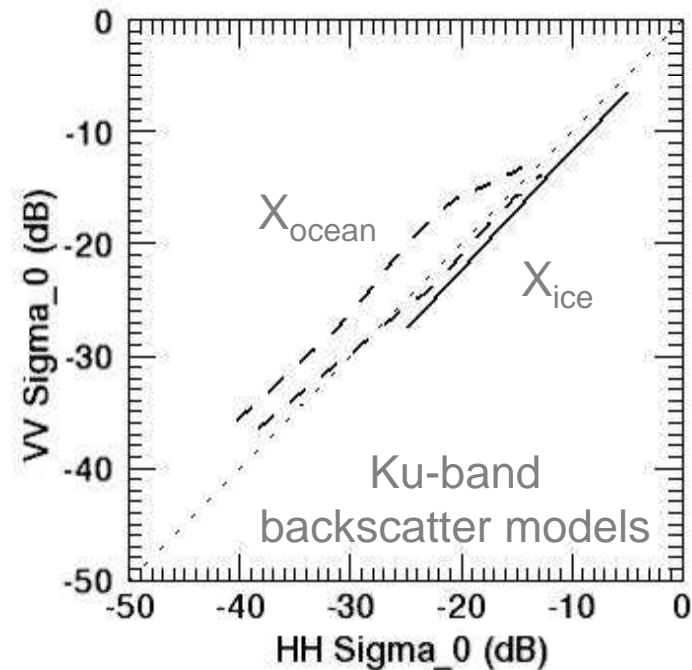
2) chi-square probabilities

$$p(X | ice) = \sqrt{\frac{D_{ice}(X)}{2\pi}} e^{-D_{ice}(X)/2}$$

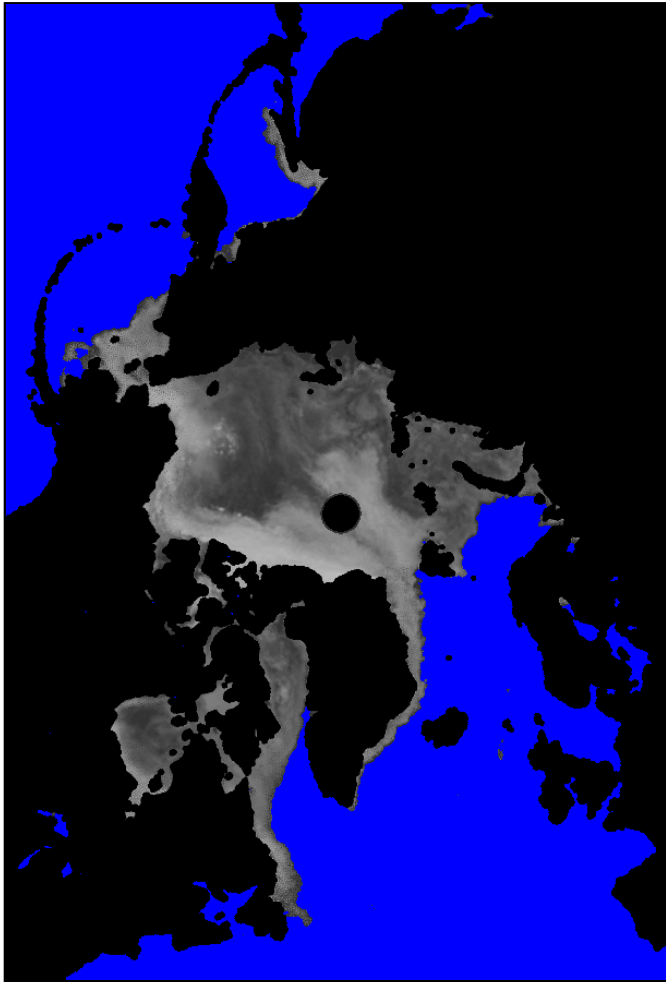
$$p(X | ocean) = \frac{1}{2} e^{-D_{ocean}(X)/2}$$

3) Bayesian combination

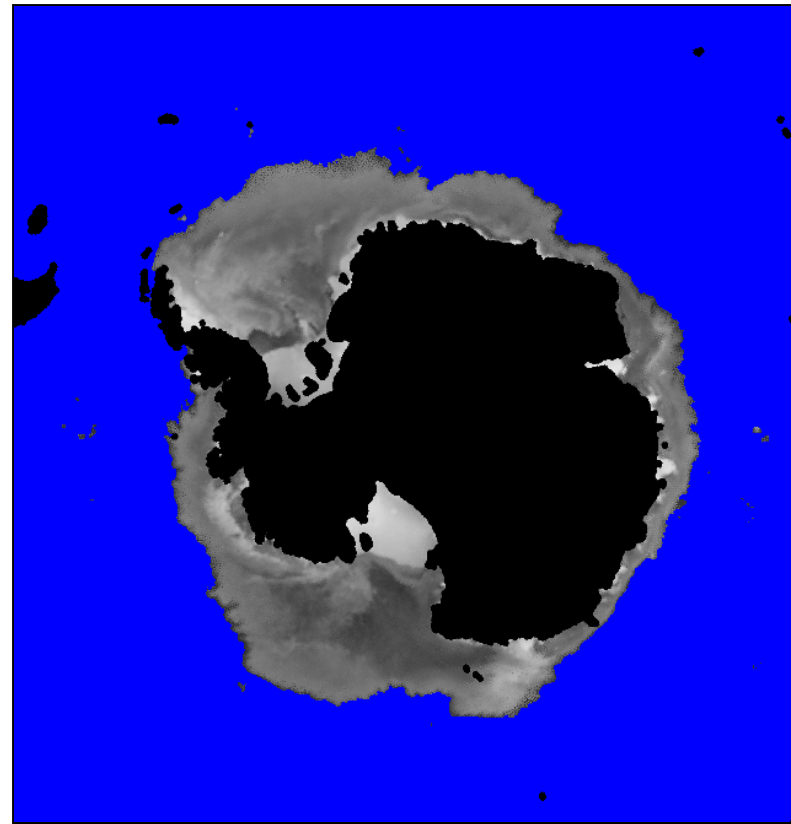
$$p(ice | X) = \frac{p(X | ice)}{p(X | ice) + p(X | ocean)}$$



# Results



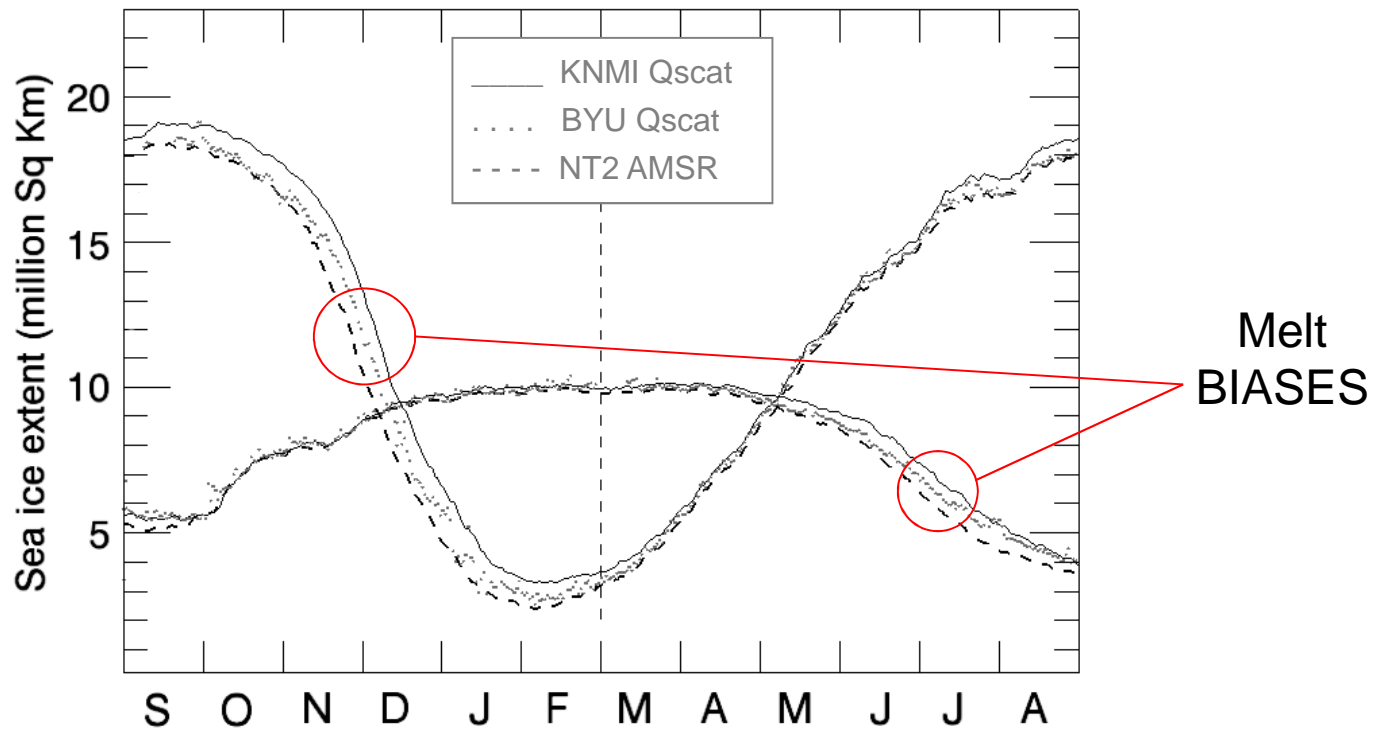
(8th May 2009)



- Daily Arctic and Antarctic sea ice extents

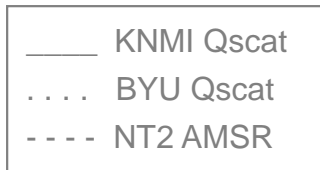
# Validation

KNMI QSCAT vs. BYU SIRF QSCAT vs. NASA T2 AMSR

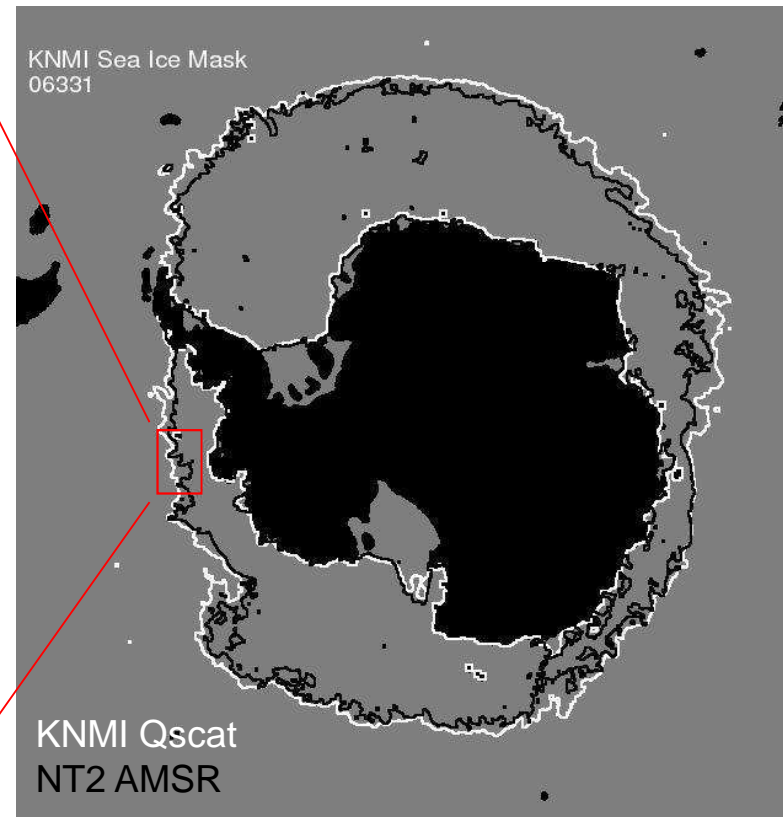


- Good agreement during freeze-up season (fall-winter)
- Large biases during melt season (spring-summer)

# Validation - 1



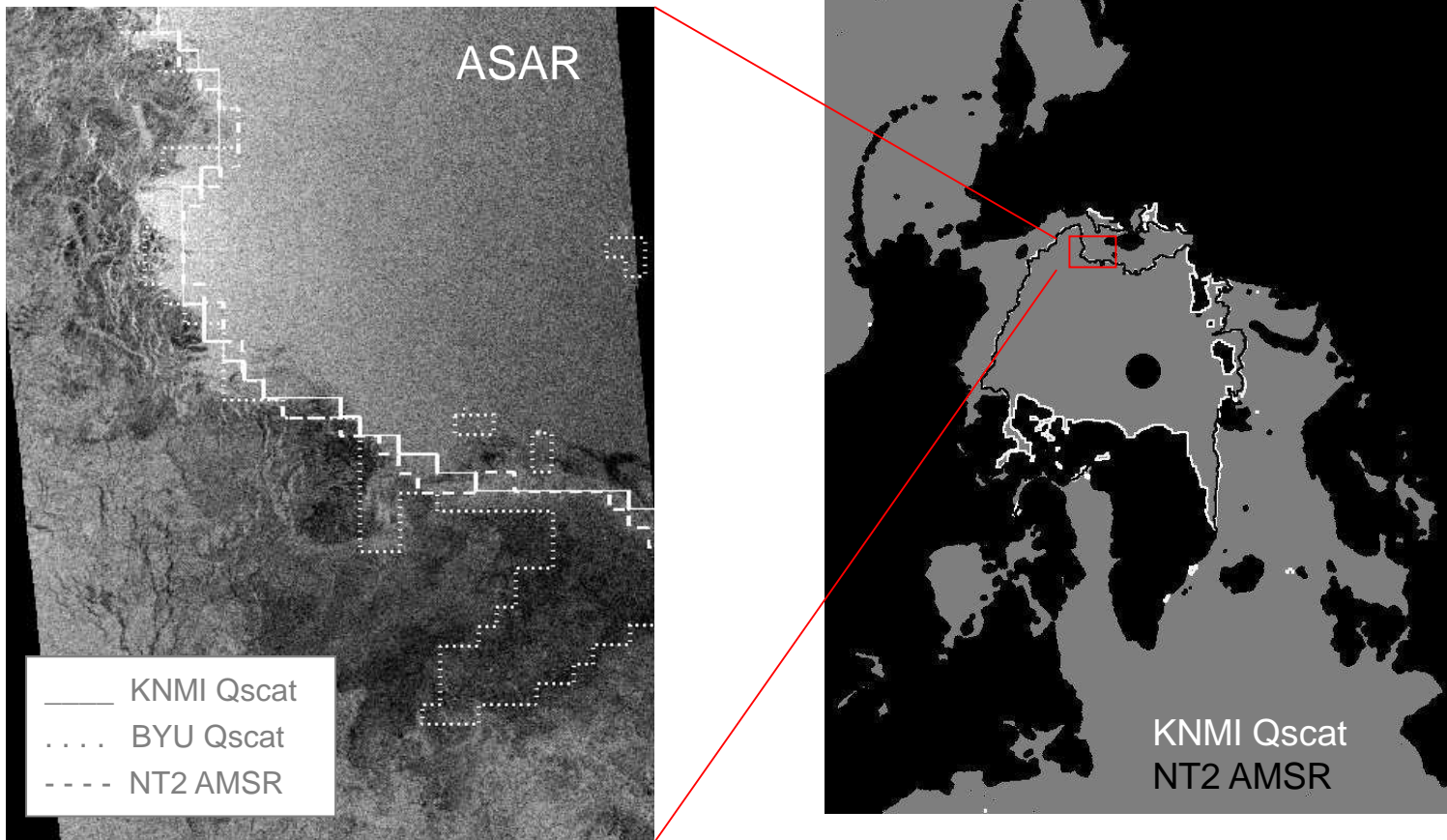
- New algorithm does not miss low concentration sea ice in Antarctica.





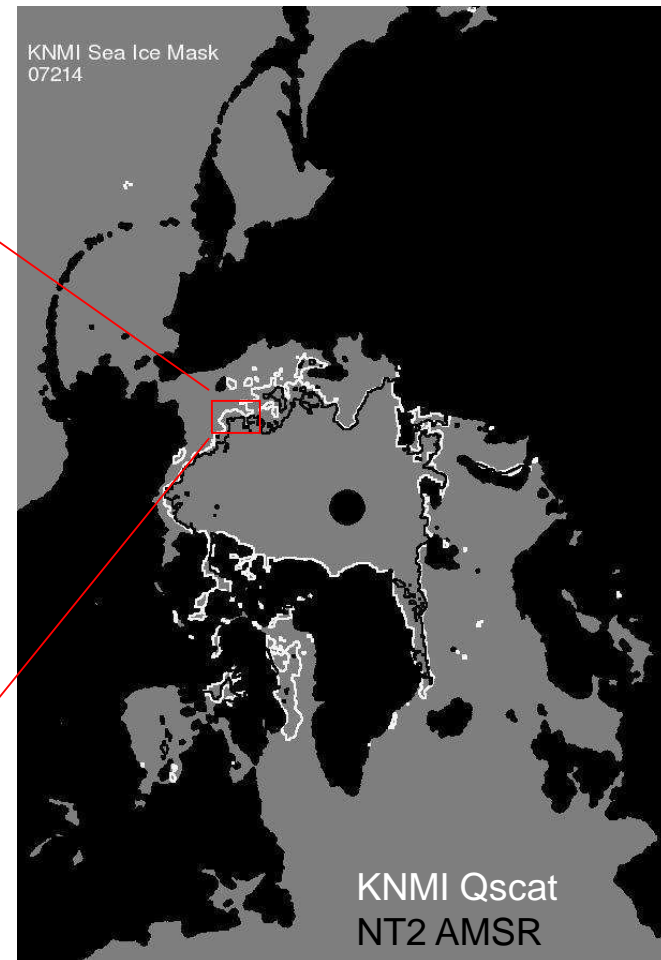
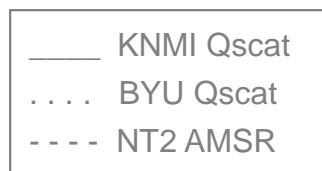
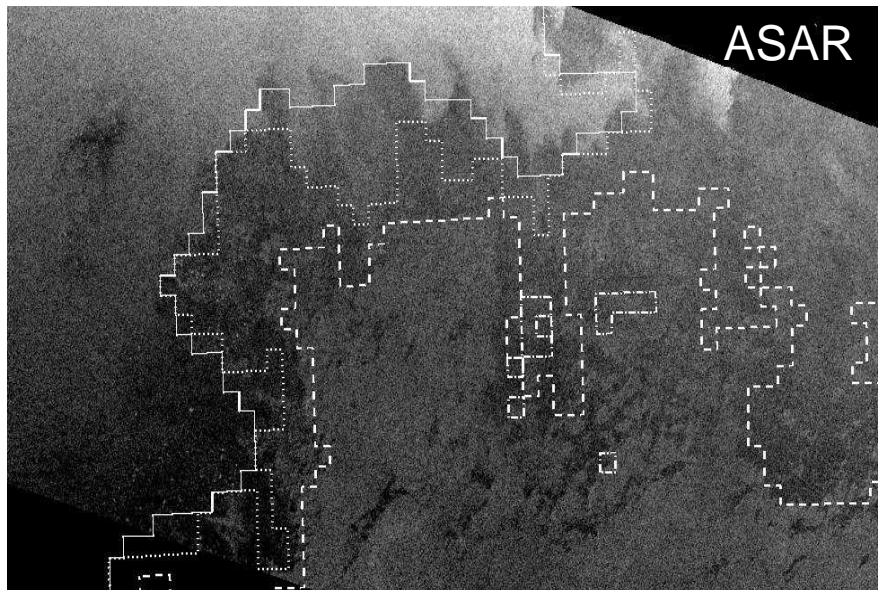
# Validation – 2

- New algorithm does not miss rapidly forming thin ice in fall.



# Validation – 3

- New algorithm does not miss water saturated summer sea ice.





# Conclusions

- New algorithm agrees with existing techniques over consolidated winter sea ice to within ~ 25 km resolution.
- New algorithm proves very sensitive to low concentration, water saturated and rapidly forming sea ice.
- New KNMI Bayesian approach provides most inclusive sea ice detection algorithm to date:
  - Quantifies summer errors in passive microwave extents
  - Overcomes spring errors in previous radar algorithms
- NRT maps of sea ice extent and ice brightness are provided on a daily basis and pre-operationally.