Arctic cloud feedbacks and response to sea ice loss from GOCCP and CESM1

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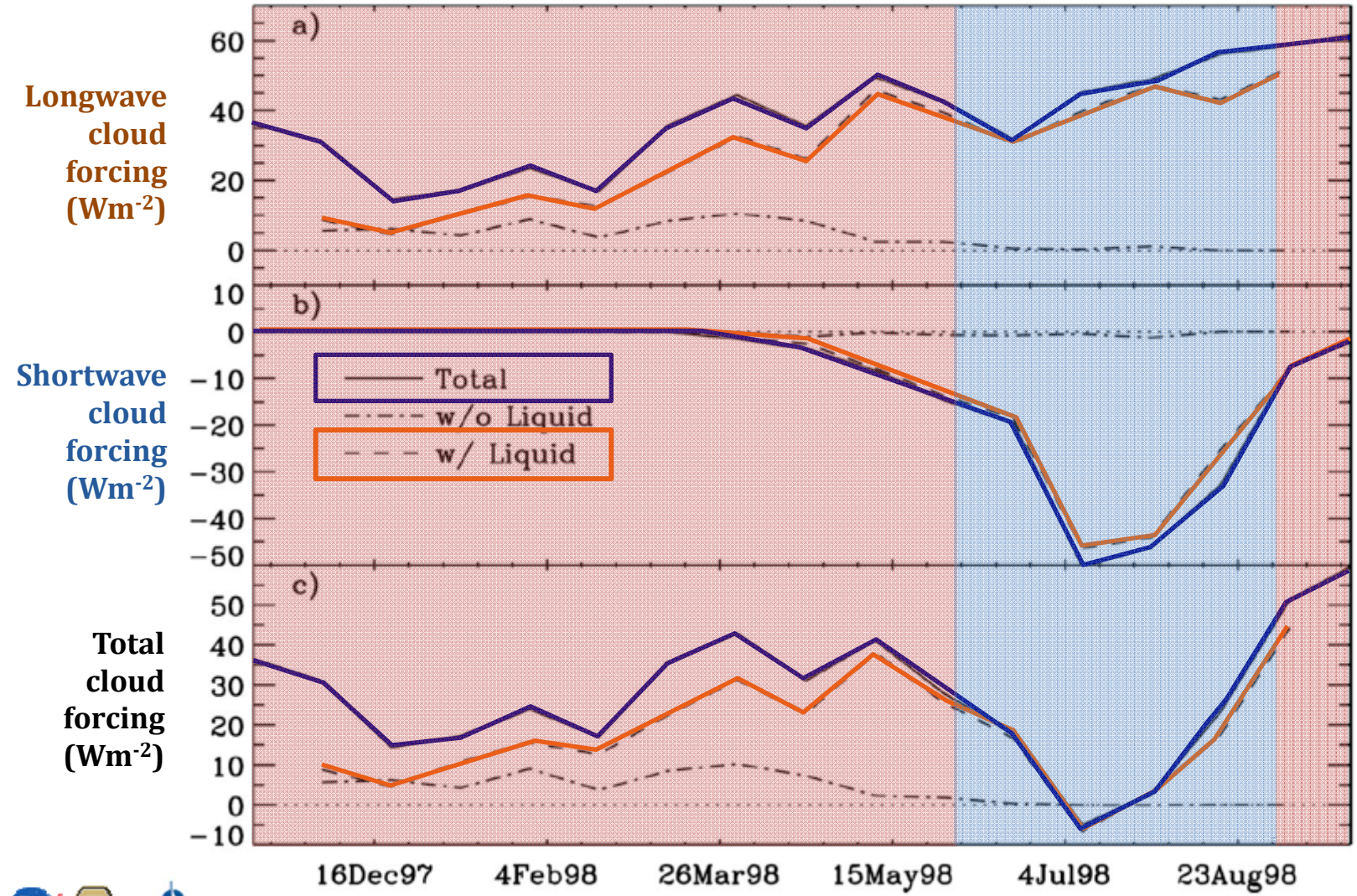
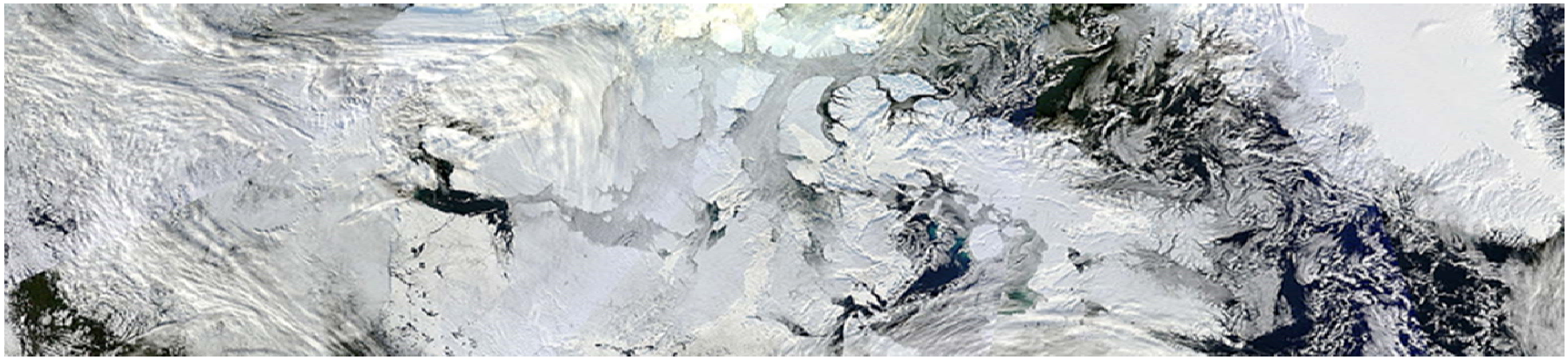
NASA - MODIS, 07/11/2011

How do Arctic Ocean liquid-containing clouds respond to sea ice loss?



Shupe and Intrieri 2004

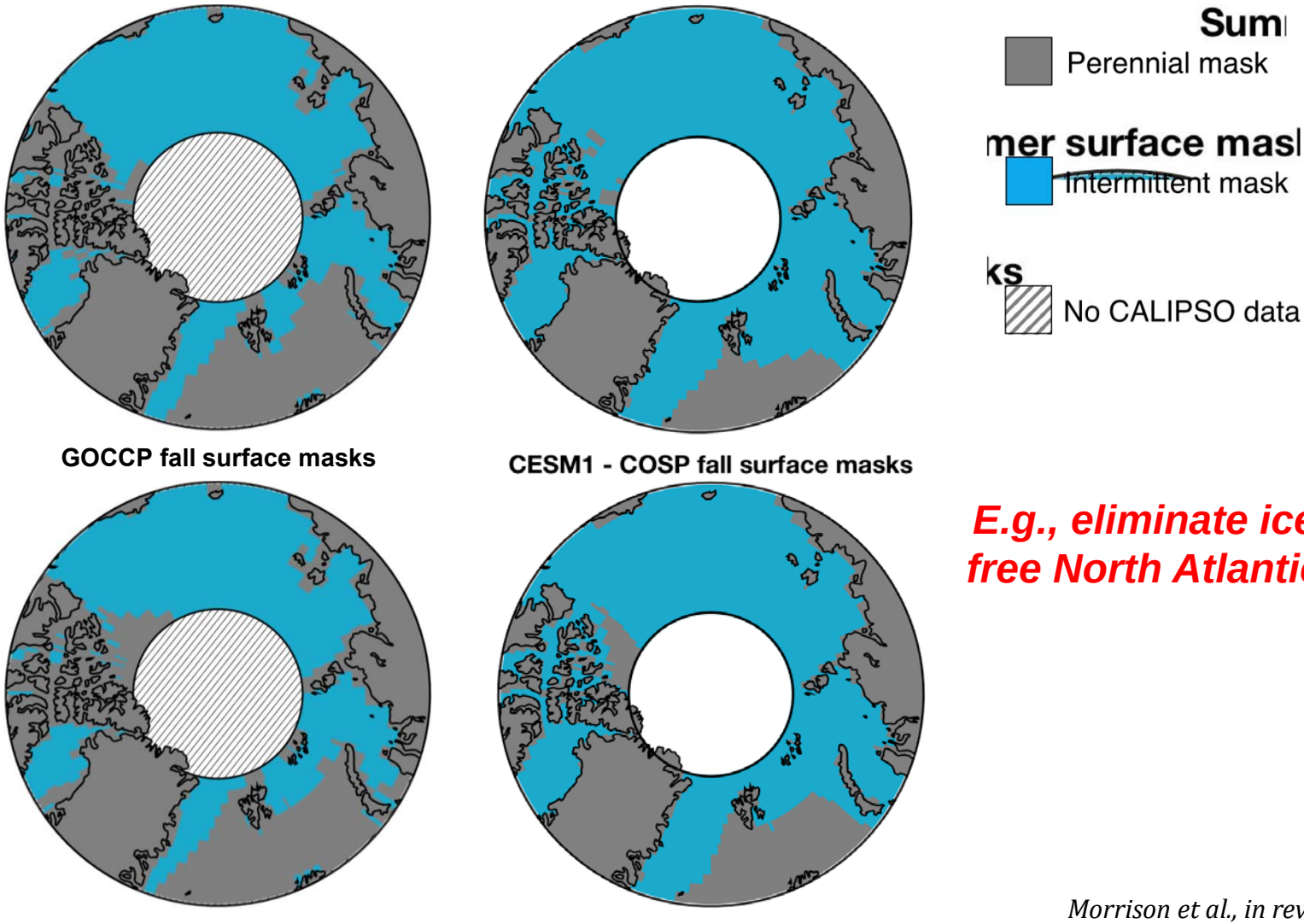
Evaluate with CALIPSO satellite



MODIS visible image (10/19/15)

Study region = intermittent mask

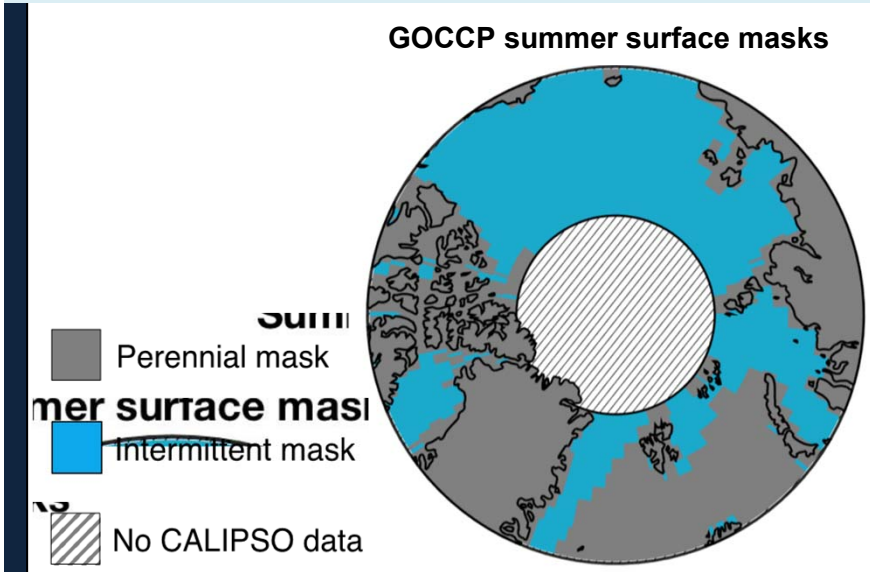
Where observed/modeled sea ice concentrations **vary**

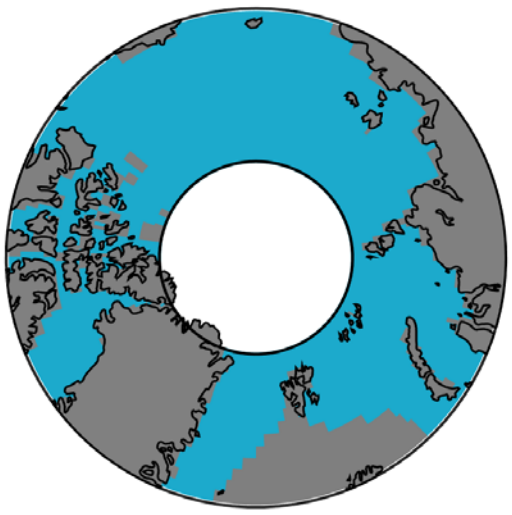


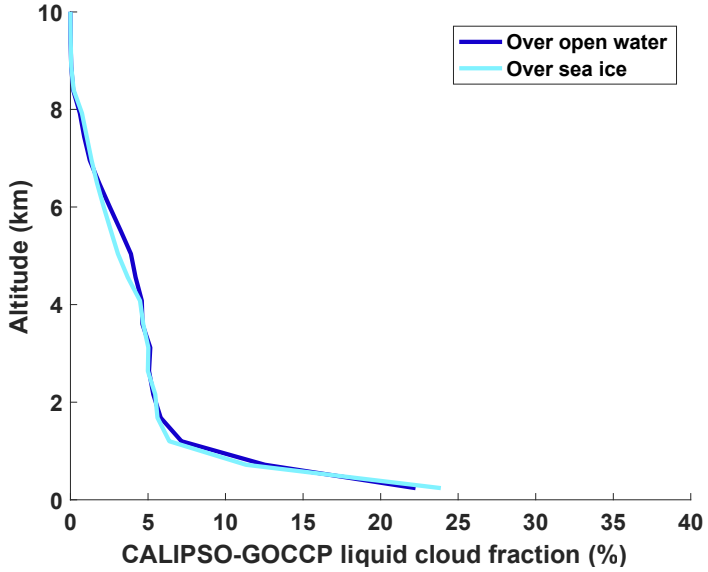
E.g., eliminate ice-free North Atlantic!

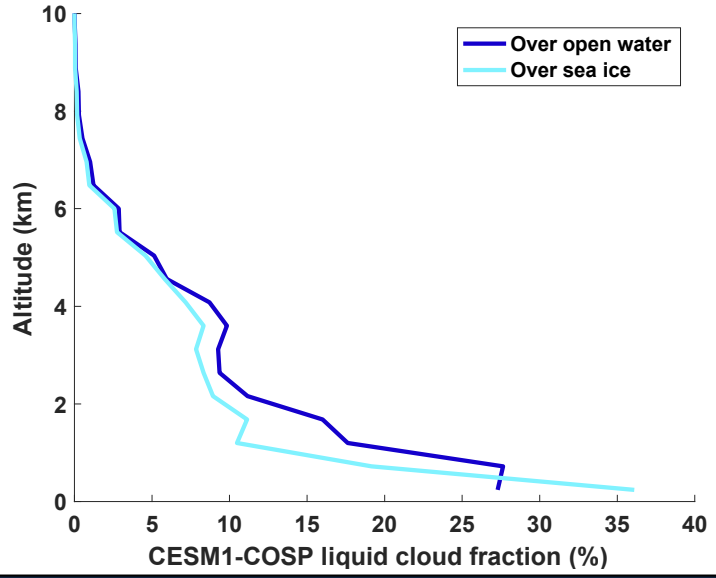
Morrison et al., in review

No summer cloud response to sea ice loss



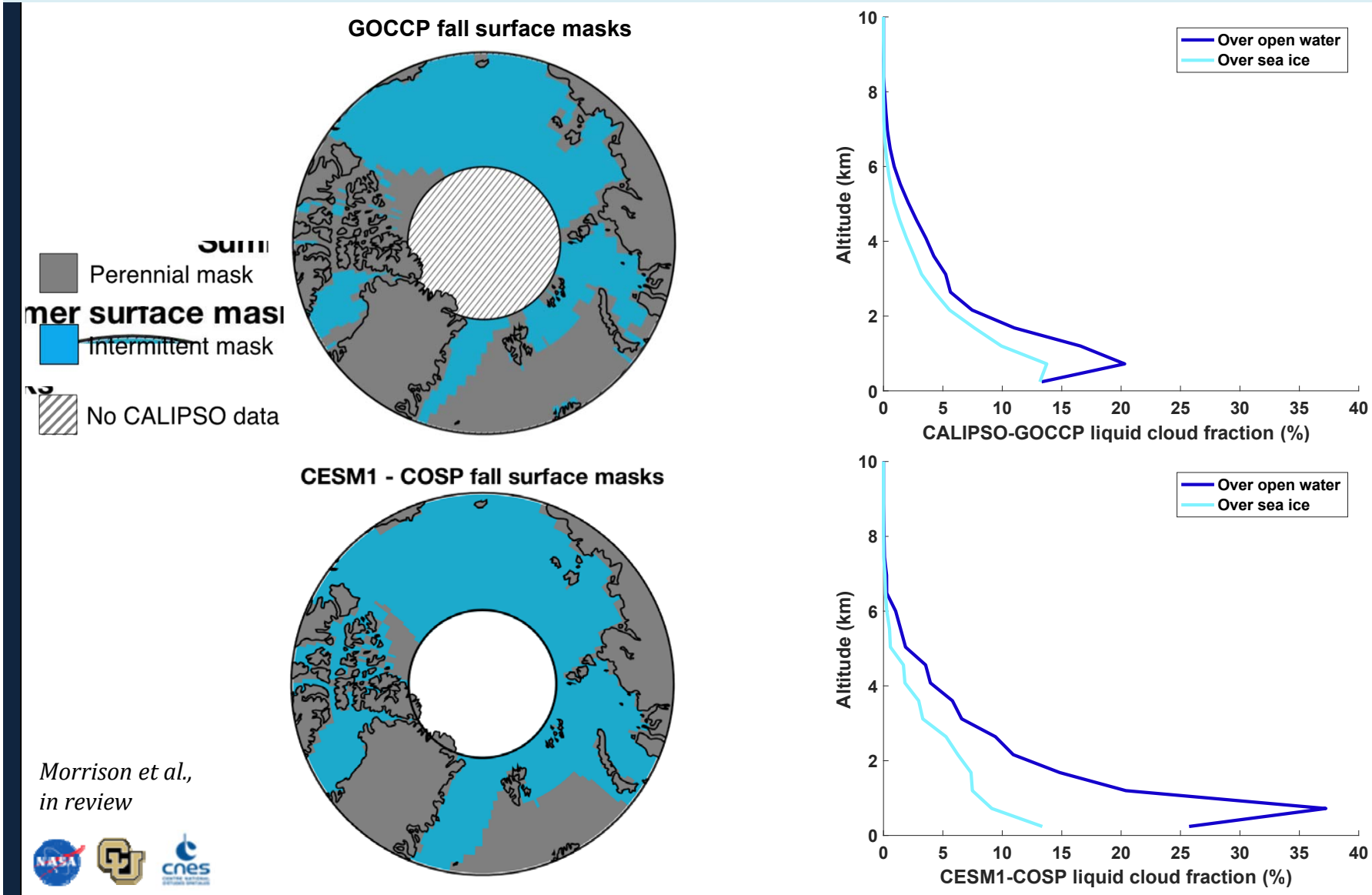






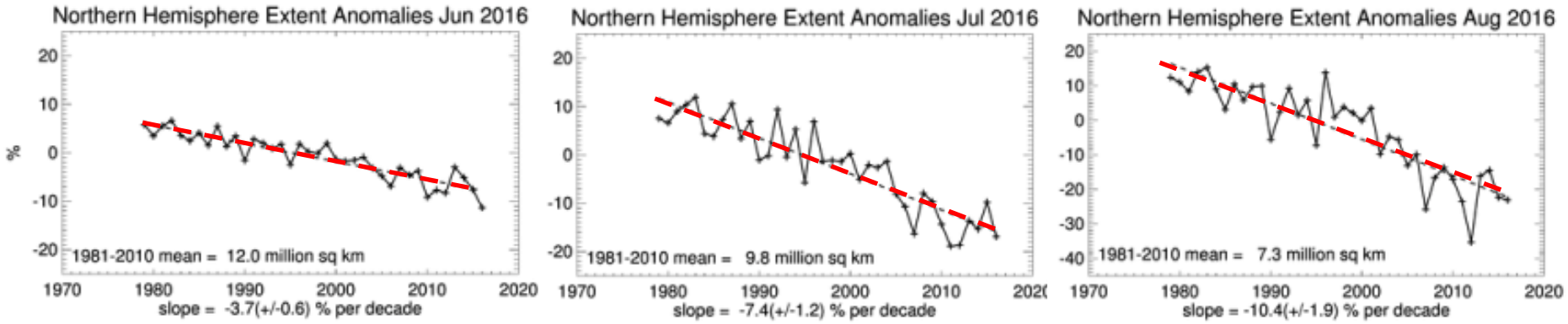
Morrison et al., in review

Robust fall response = more clouds over newly open water

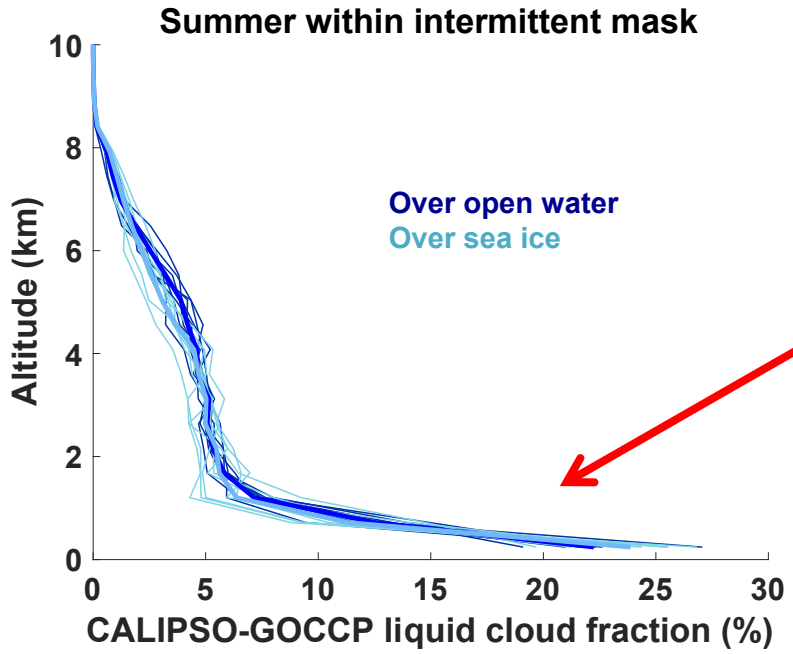


Morrison et al., in review

One lost bright surface (sea ice) is not replaced by another (clouds)…

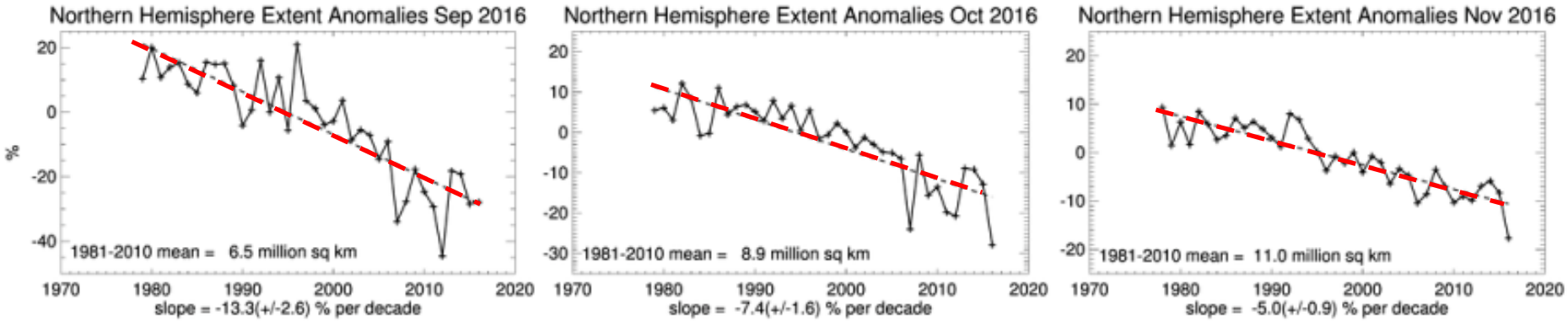


NSIDC



Summer clouds won't slow down summer sea ice loss

Fall sea ice loss is partly due to human activities…



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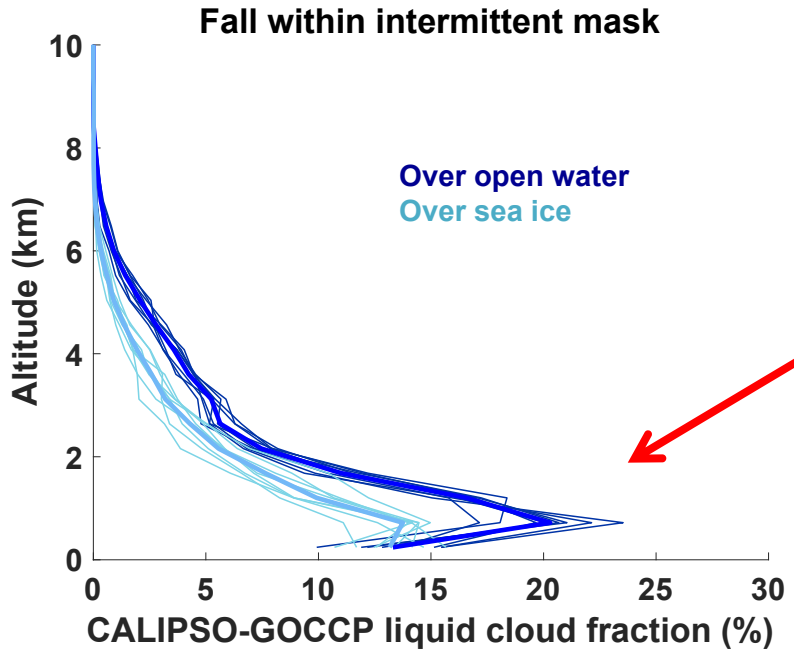
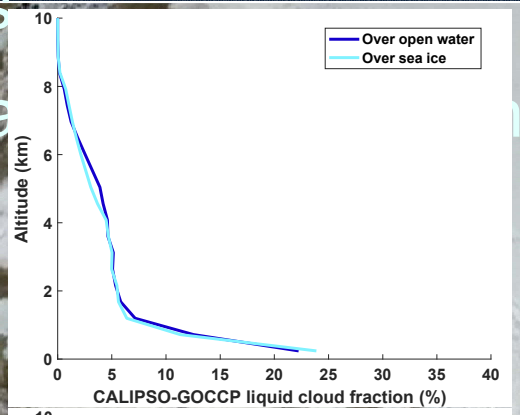


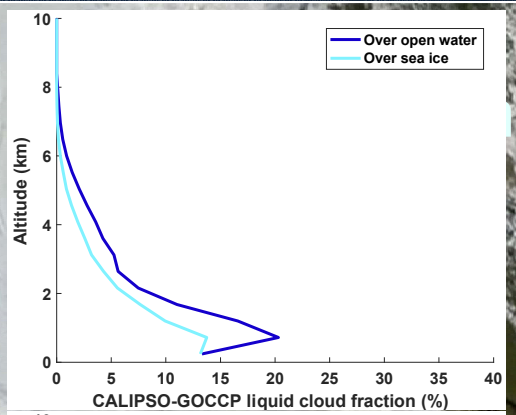
…So are these cloud changes!

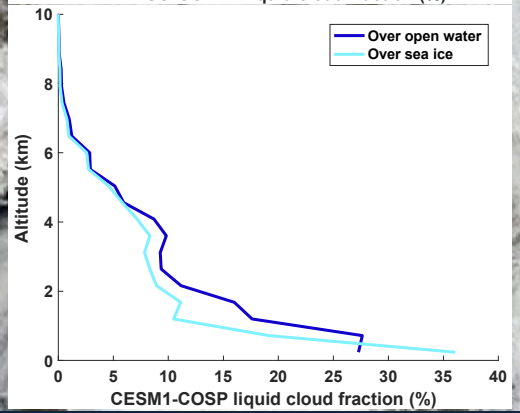
FOR OBSERVATIONS AND CESM1…

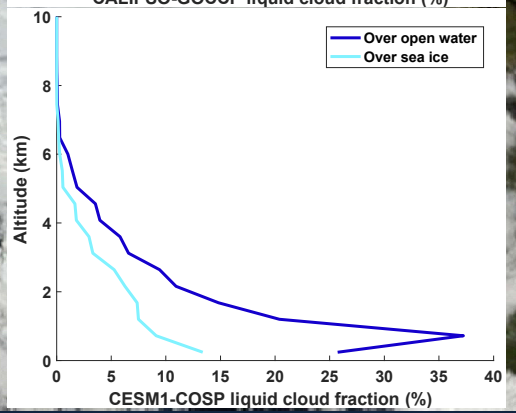
We isolate the cloud response to sea ice loss and find:

1. Summer liquid clouds do not respond to sea ice loss
2. Fa… …crease … water.









Thank you!

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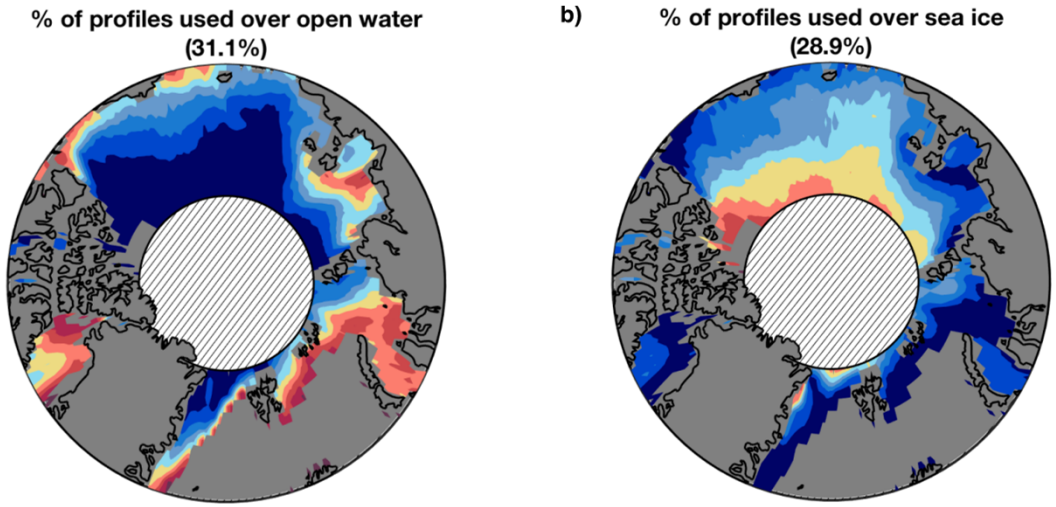
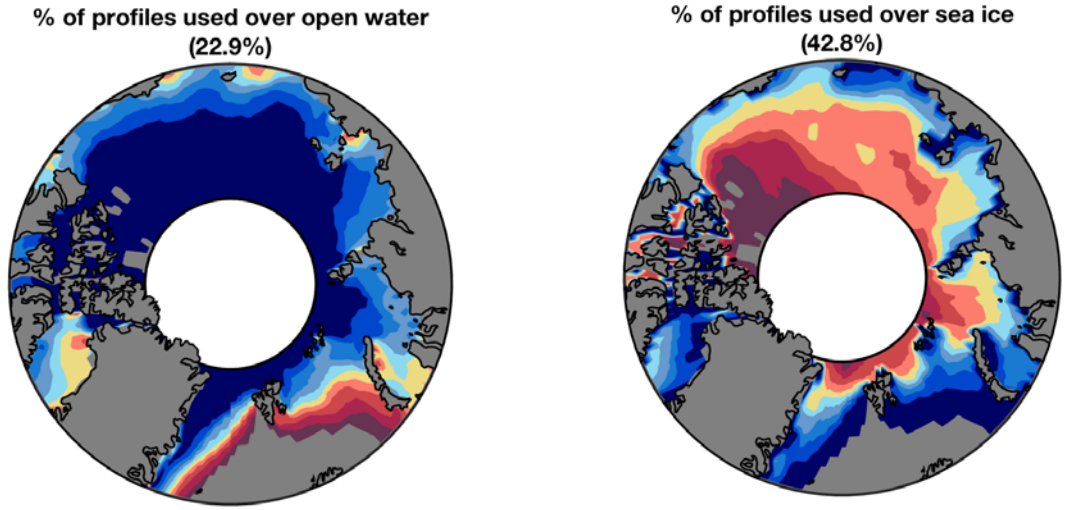
ALM and JEK supported by NASA CloudSat/CALIPSO grant 13005376; HC and RG supported by CNES; data available from ClimServ and CNES.

Where do summer cloud profiles come from?

GOCCP - observations



CESM - COSP

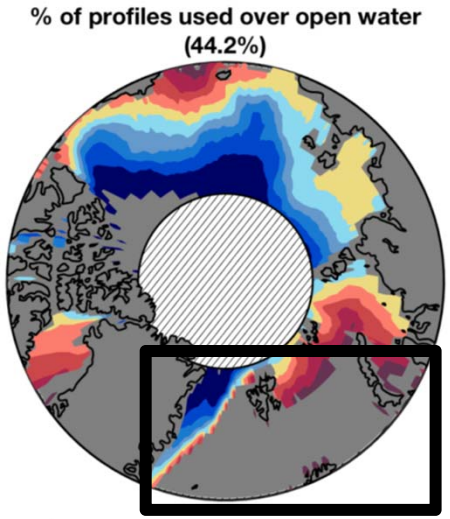


Morrison et al., submitted

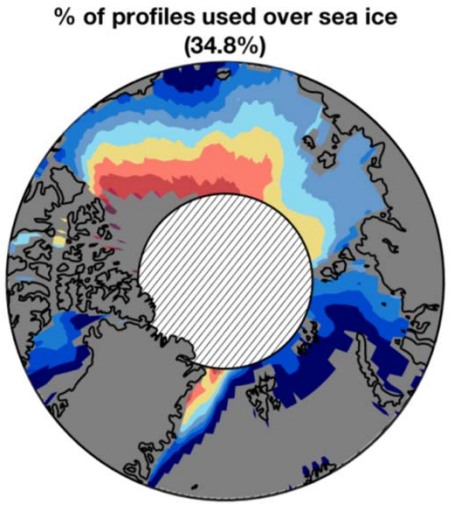
% cloud profiles used

Where do fall cloud profiles come from?

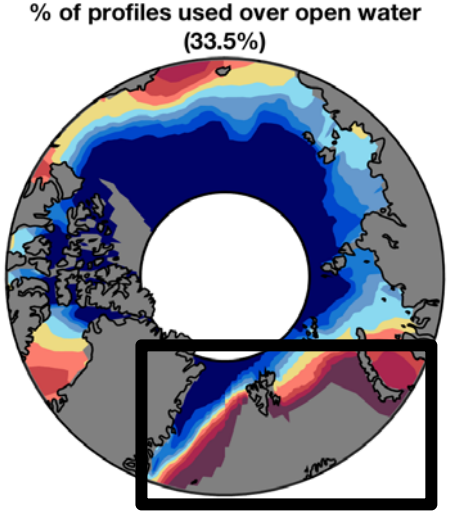
GOCCP - observations

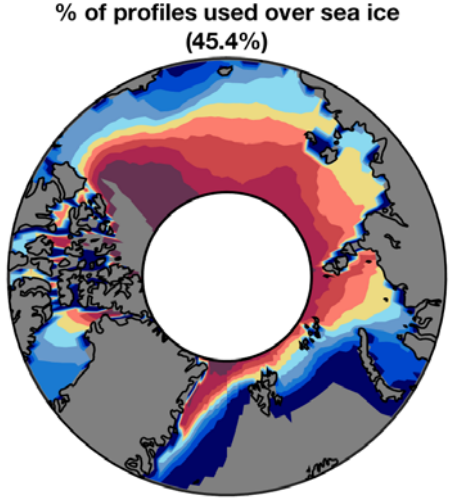


b)



CESM - COSP

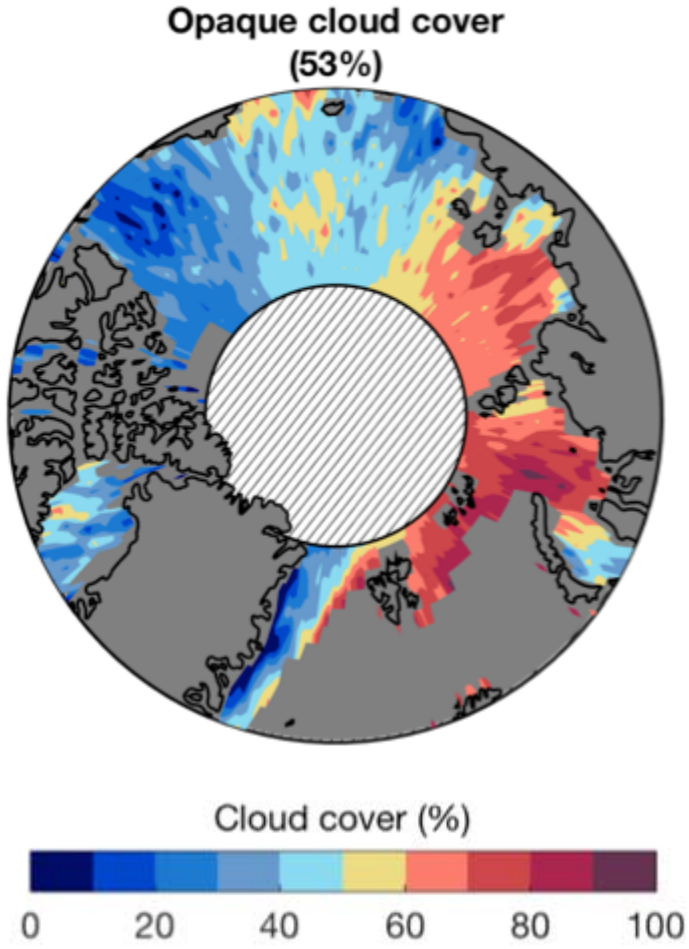


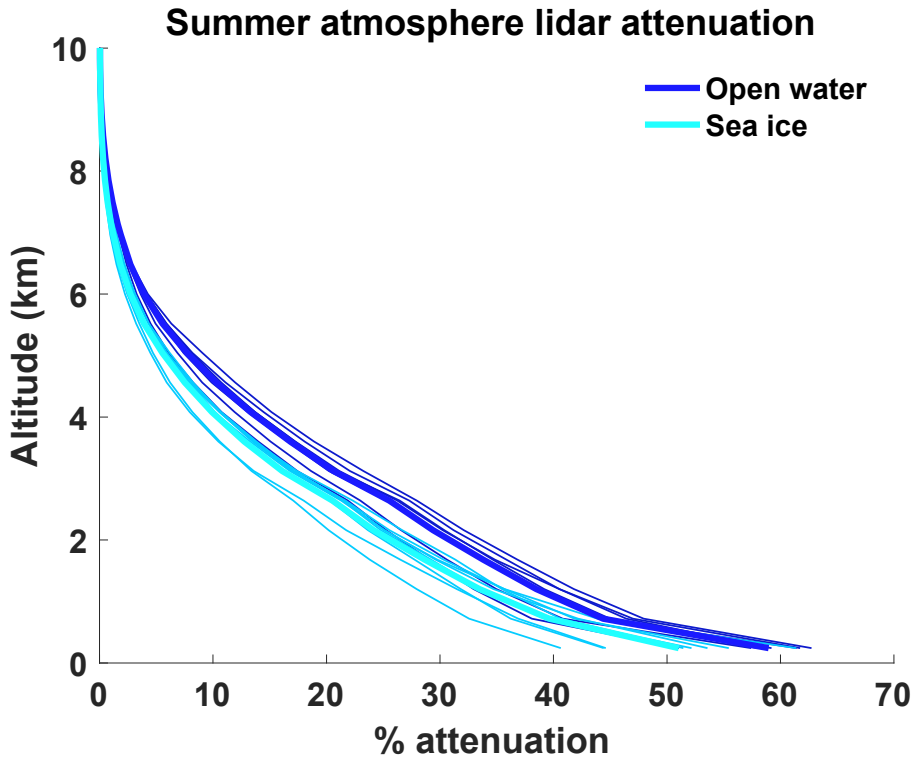


Morrison et al., submitted

% cloud profiles used

Does lidar attenuation affect summer results?



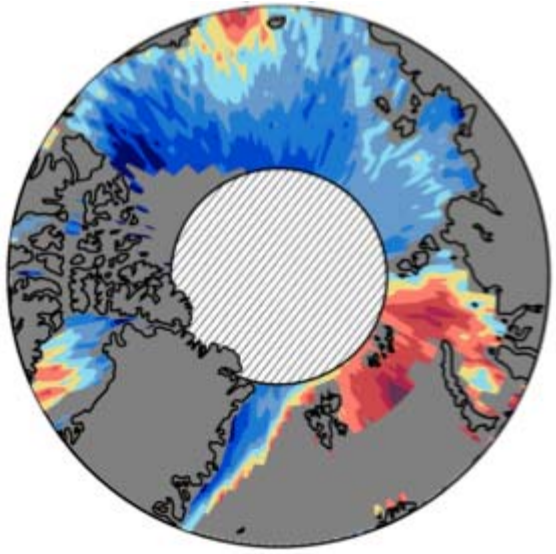


No difference in attenuation over open water and over sea ice

Morrison et al., submitted

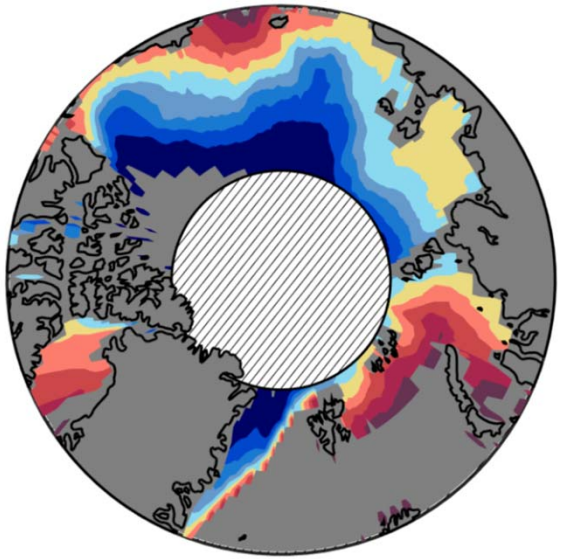
Does lidar attenuation affect fall results?

Opaque cloud cover (44%)



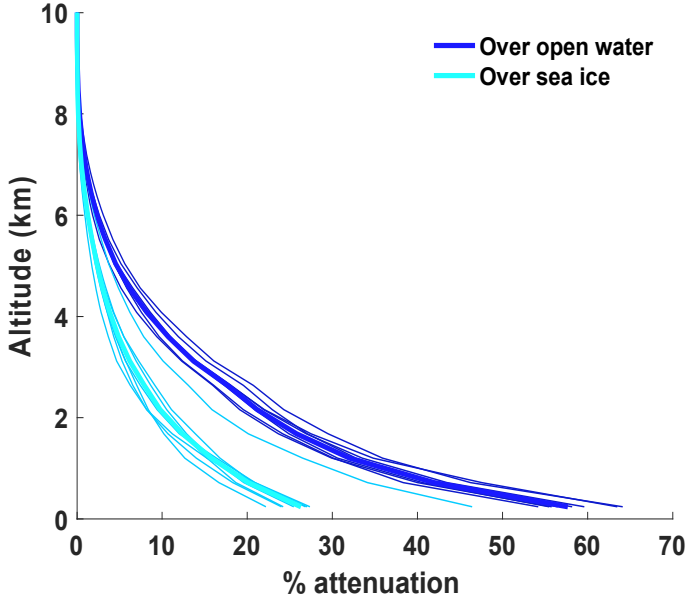
Cloud cover (%)

% profiles used over open water (44%)



% instantaneous profiles used

Fall atmosphere lidar attenuation



Fall opaque clouds follow open water

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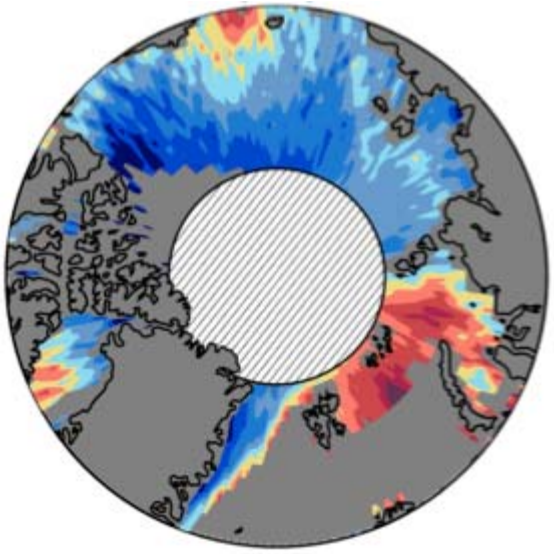
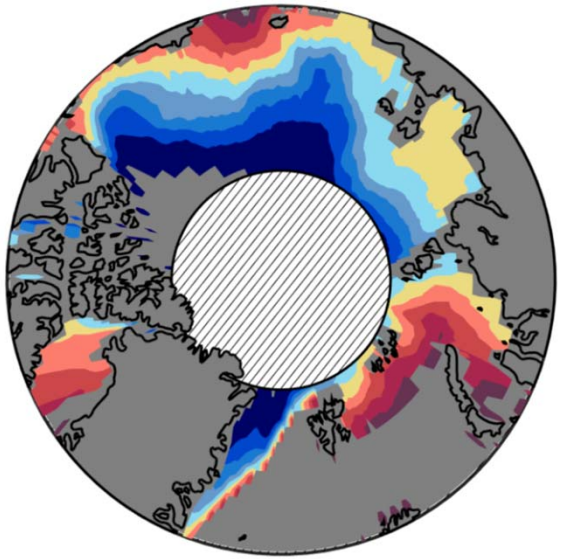
Does lidar attenuation affect fall results?

Opaque cloud cover (44%)



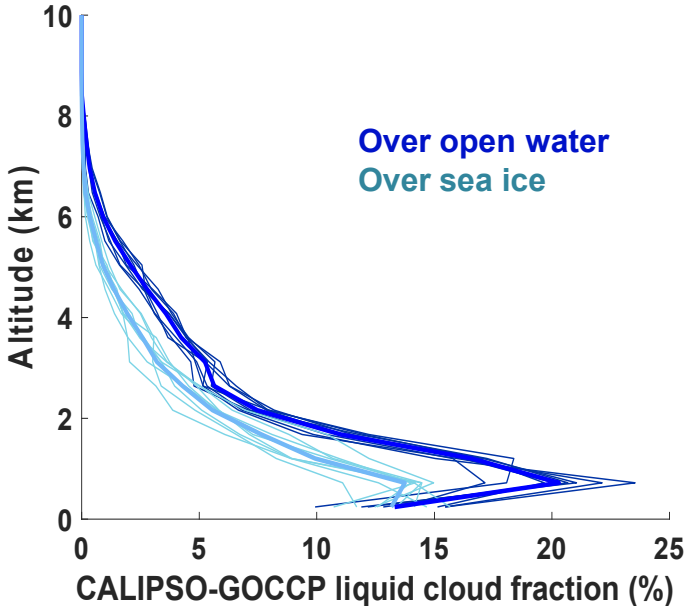
Cloud cover (%)

% profiles used over open water (44%)



% instantaneous profiles used

Fall within intermittent mask

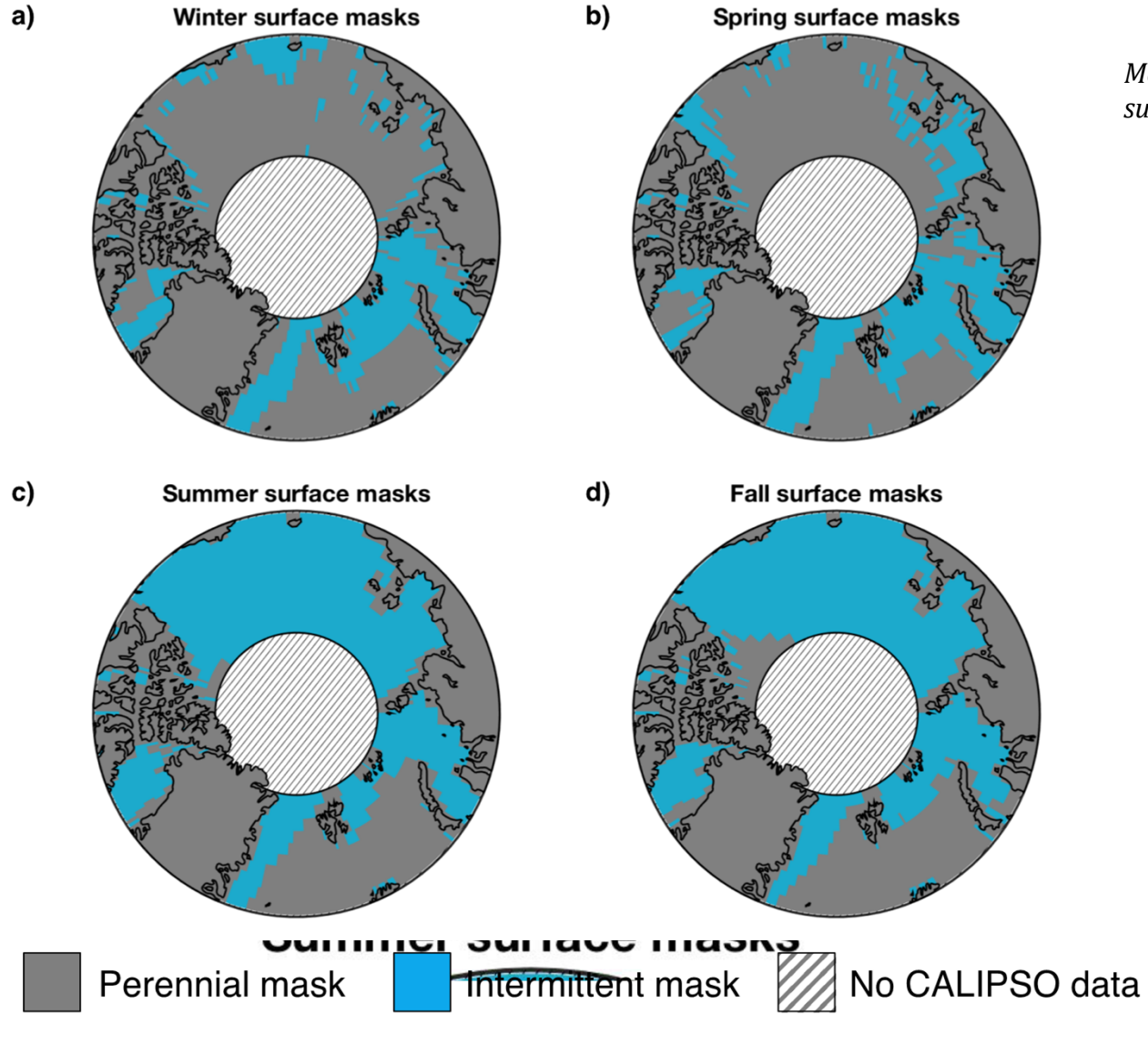


Missing clouds increase separation between open water and sea ice profiles

Morrison et al., submitted

Study region = intermittent mask

Where sea ice concentrations vary from **2008-2015**



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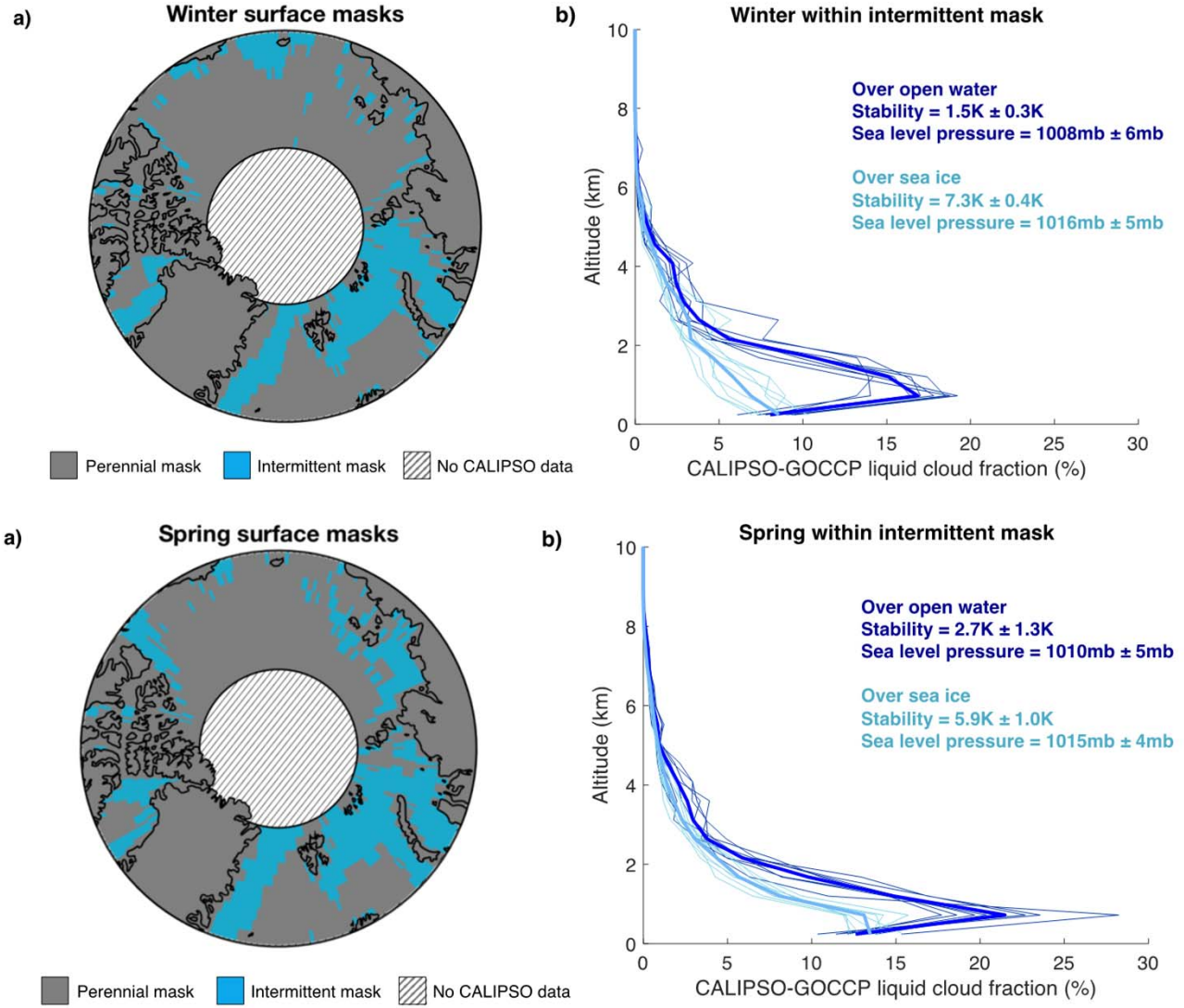
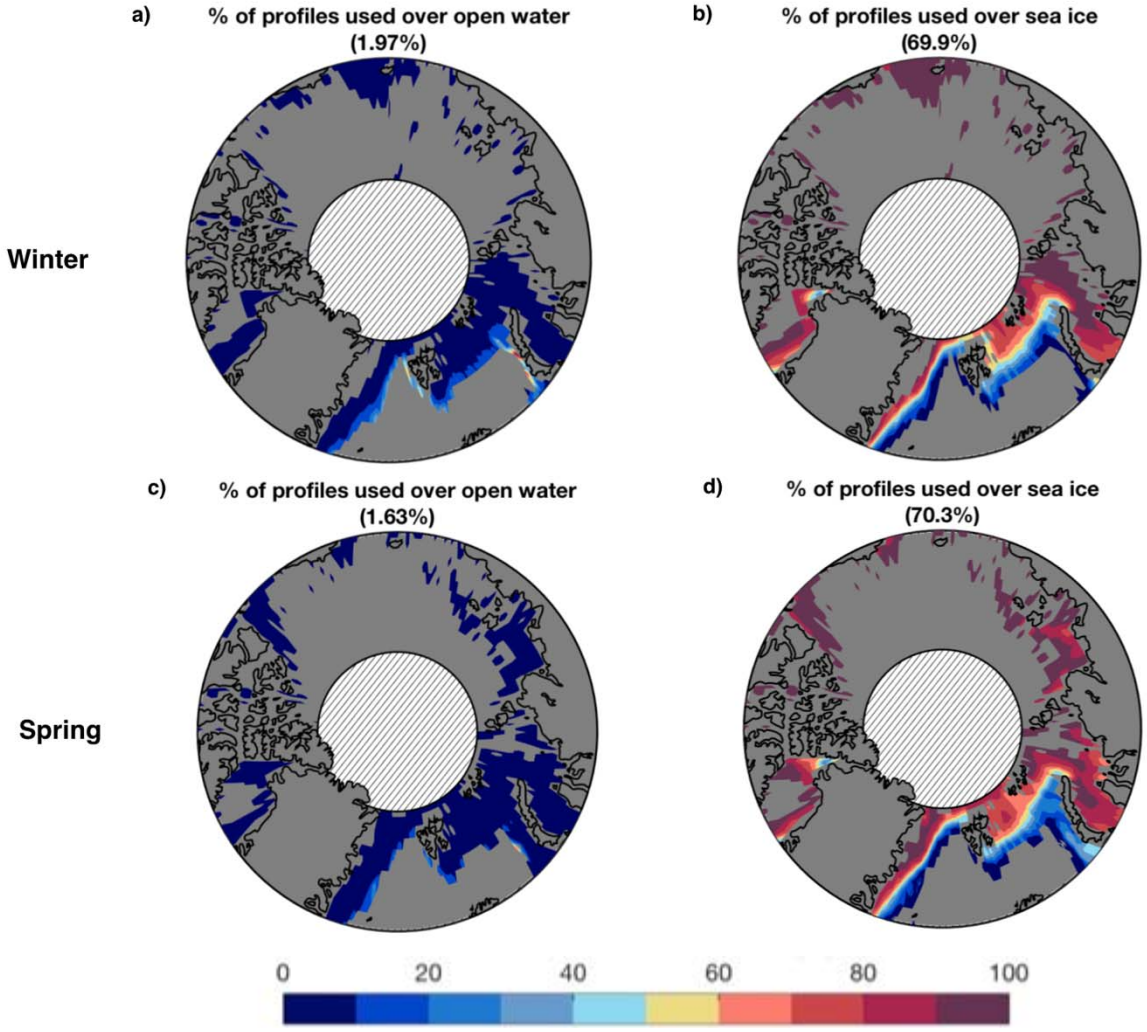
Winter and spring cloud responses to sea ice loss



Morrison et al., submitted

Winter and spring cloud responses to sea ice loss



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