Arctic clouds

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Arctic is a cloudy region

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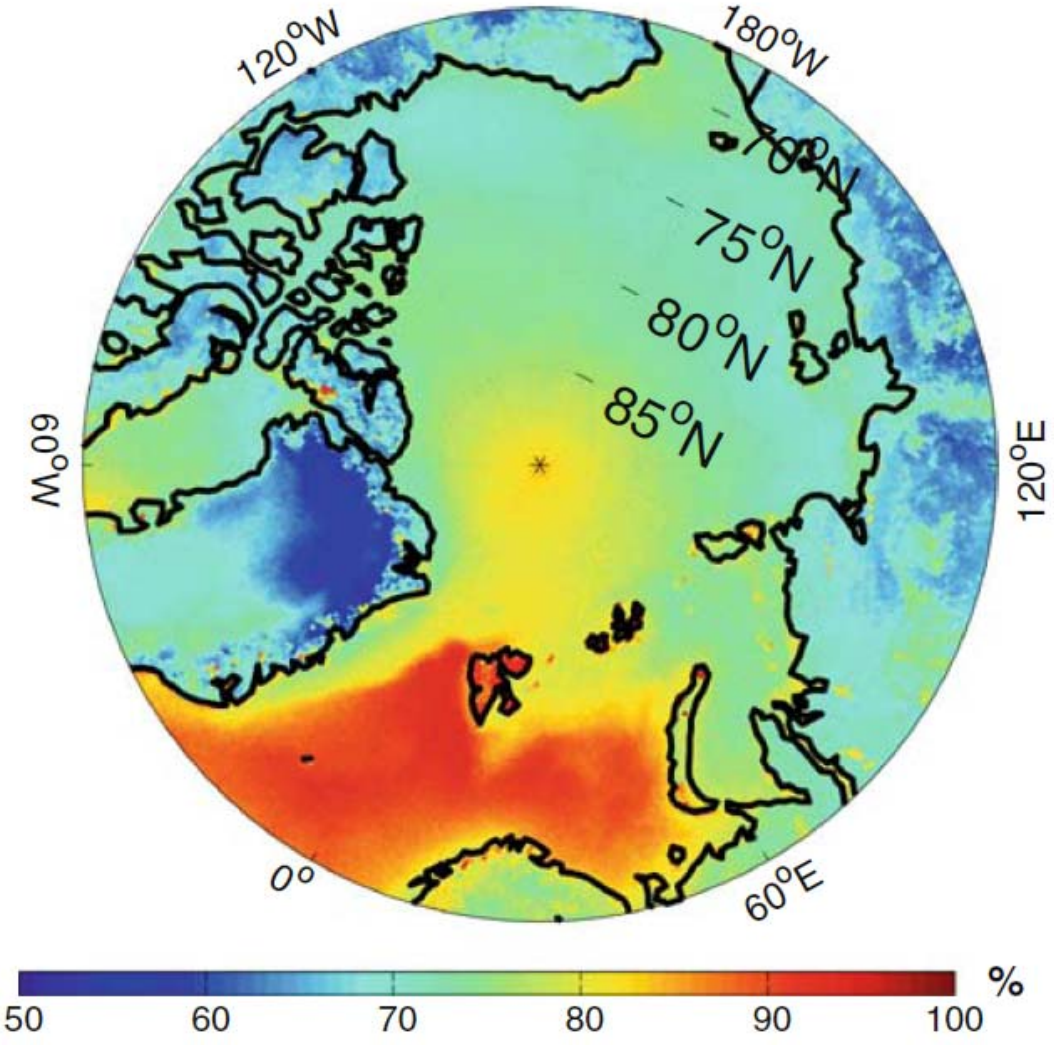

Climatological annual mean (1982-1999) total cloud cover north of the polar circle, APP-x product

Are arctic clouds different?

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- Arctic clouds act to heat the surface most of the year
- Different properties than clouds at lower latitudes
- Radiative conditions hugely different during winter and summer
- Large differences depending on the underlying surface
- 1 Wm^{-2} sustained difference over a year equals to about 0.1 m of sea ice melt
- Lack of observations

Arctic clouds in the AR4 models

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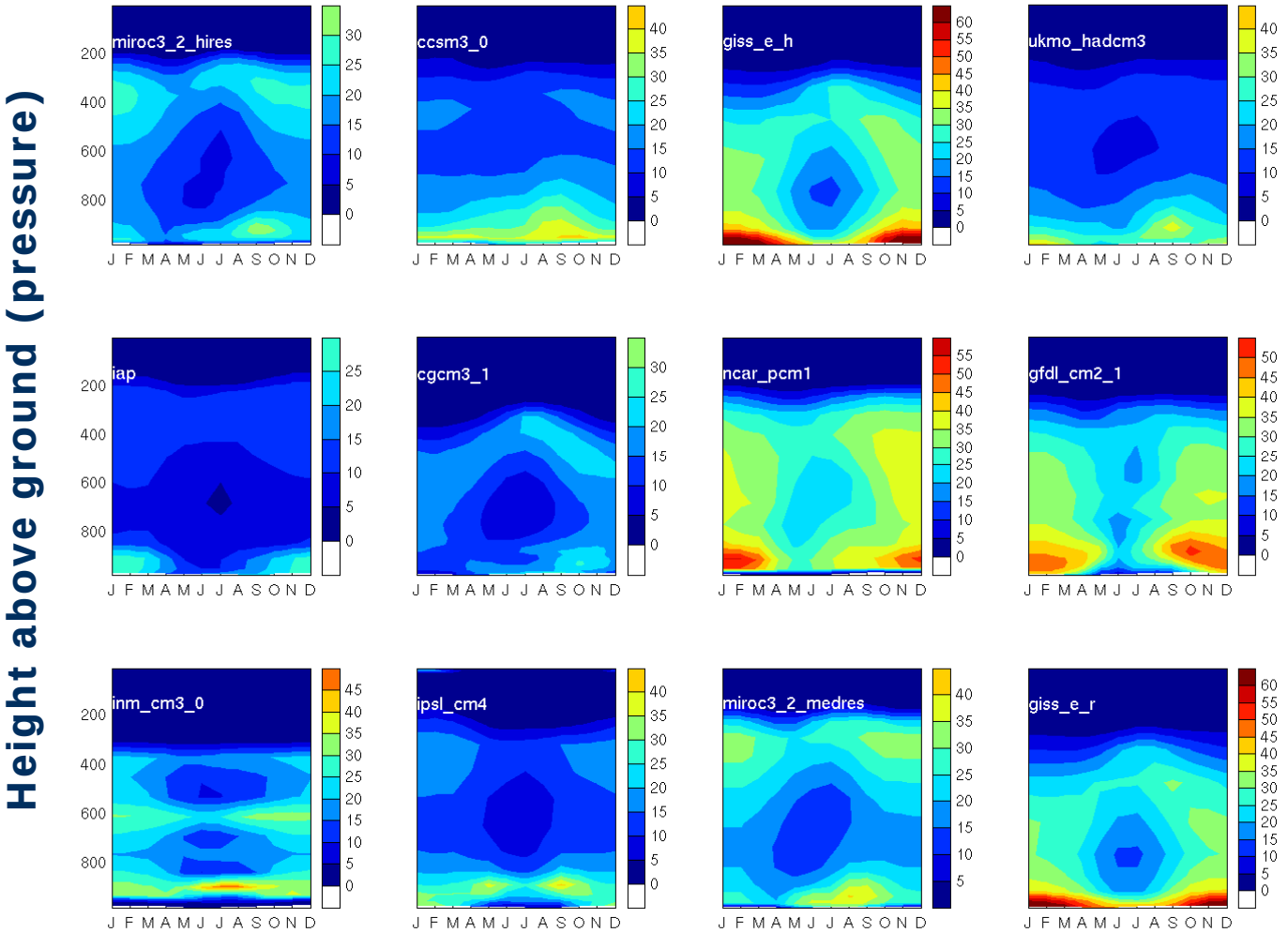
Regional mean cloud fraction north of 60ºN



Arctic clouds in the AR4 models

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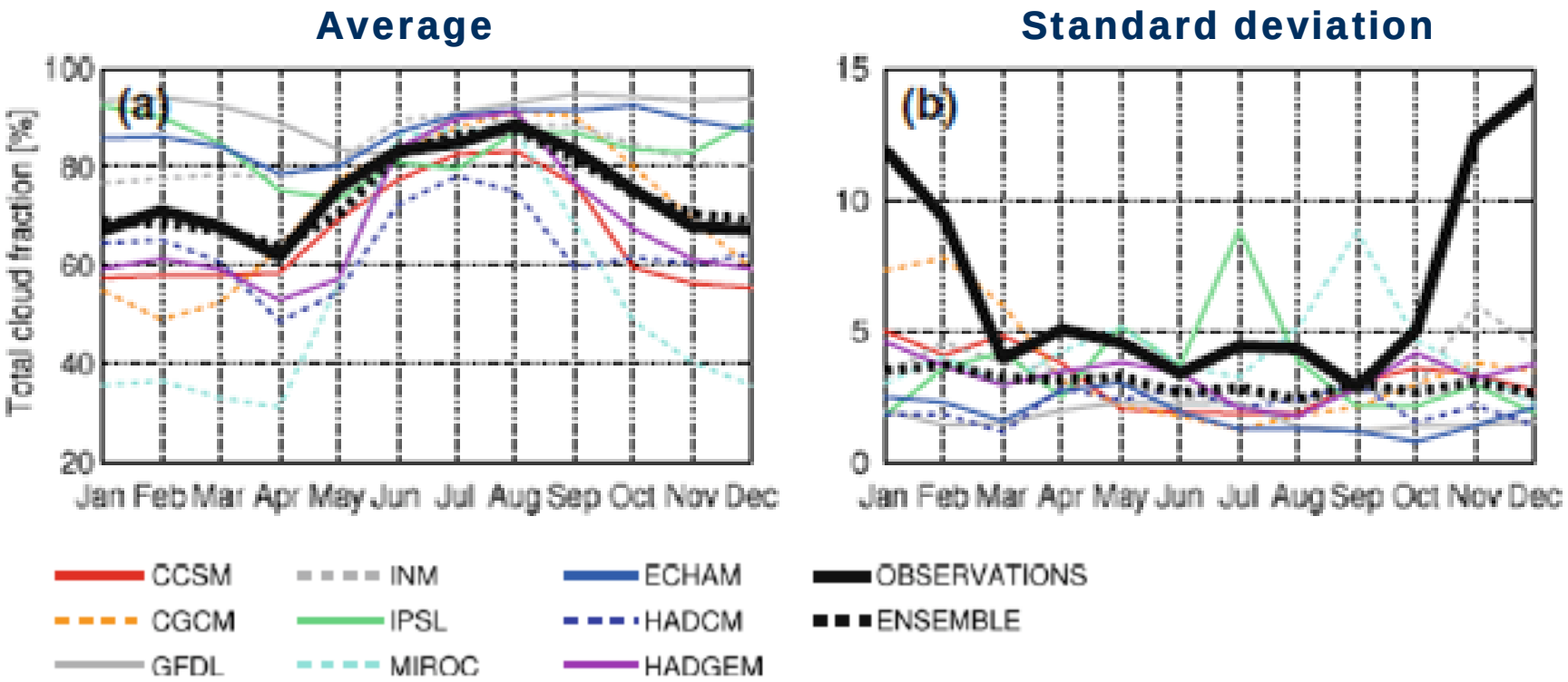

The climatological (1982-1999) annual cycle and standard deviation of total cloud cover north of the polar circle

Karlsson and Svensson, 2010

Arctic clouds in the AR4 models

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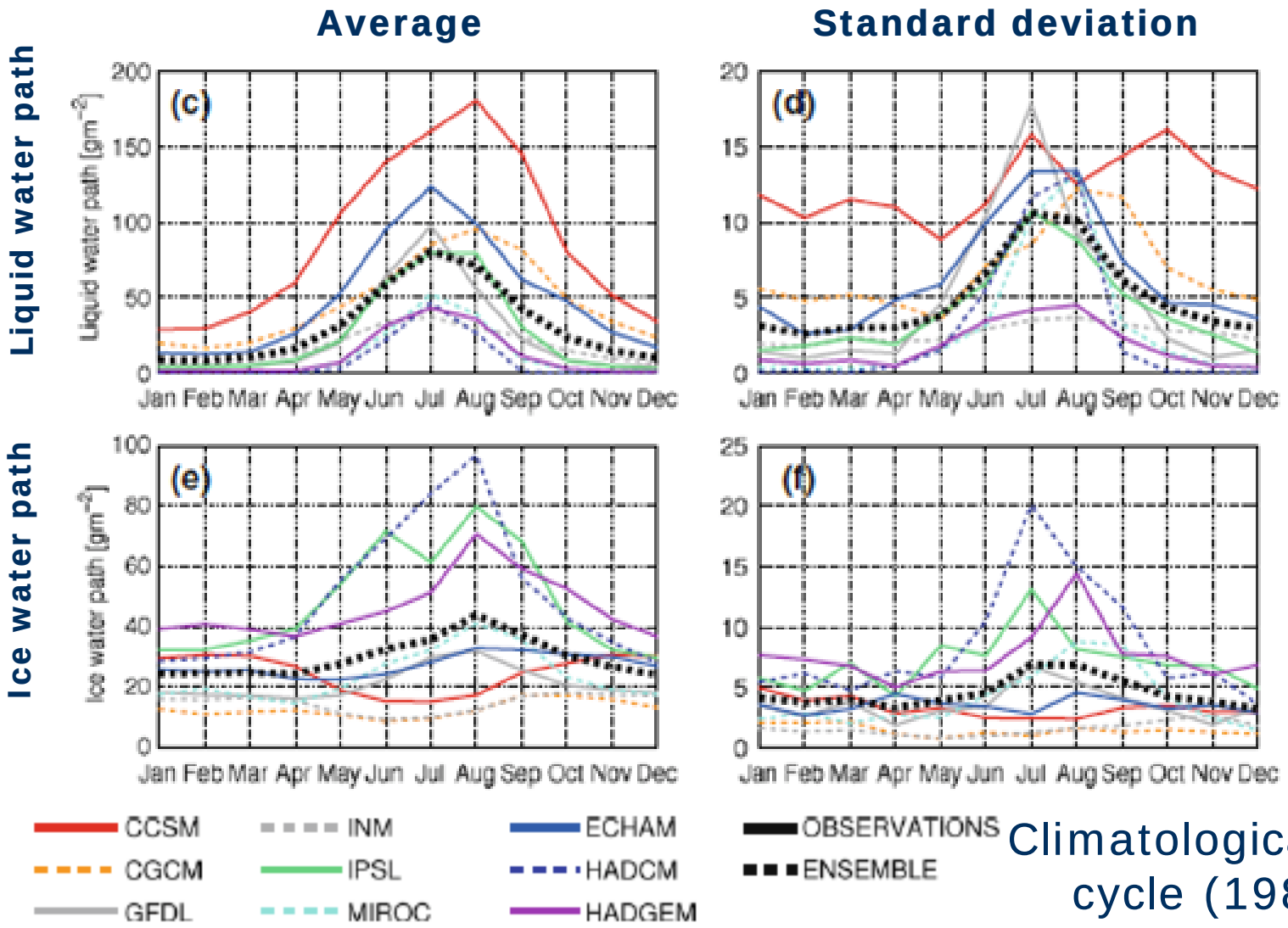

Climatological annual cycle (1982-1999) north of the polar circle

Karlsson and Svensson, 2010

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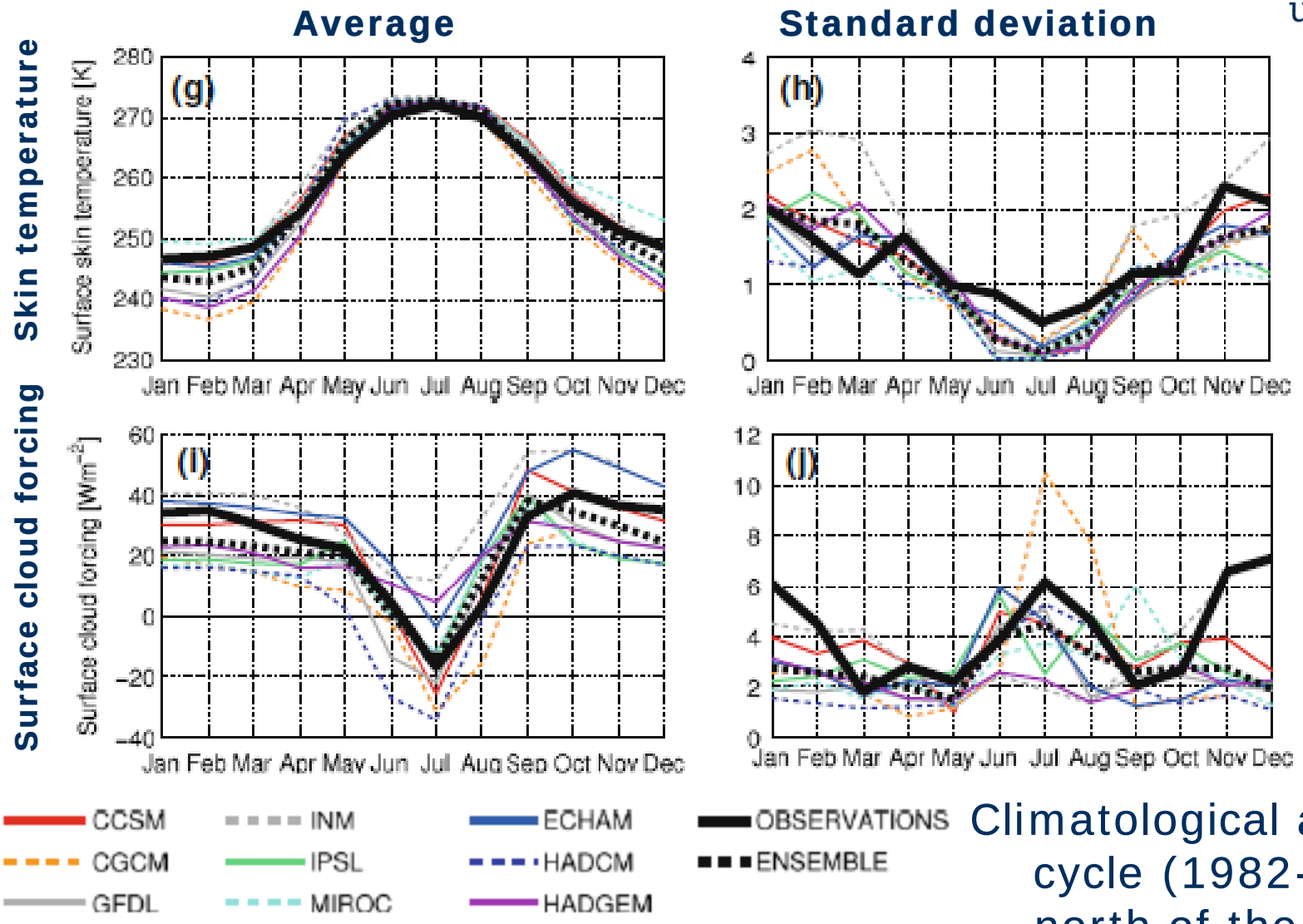

Climatological annual cycle (1982-1999) north of the polar circle

Kjellsson and Svensson, 2010

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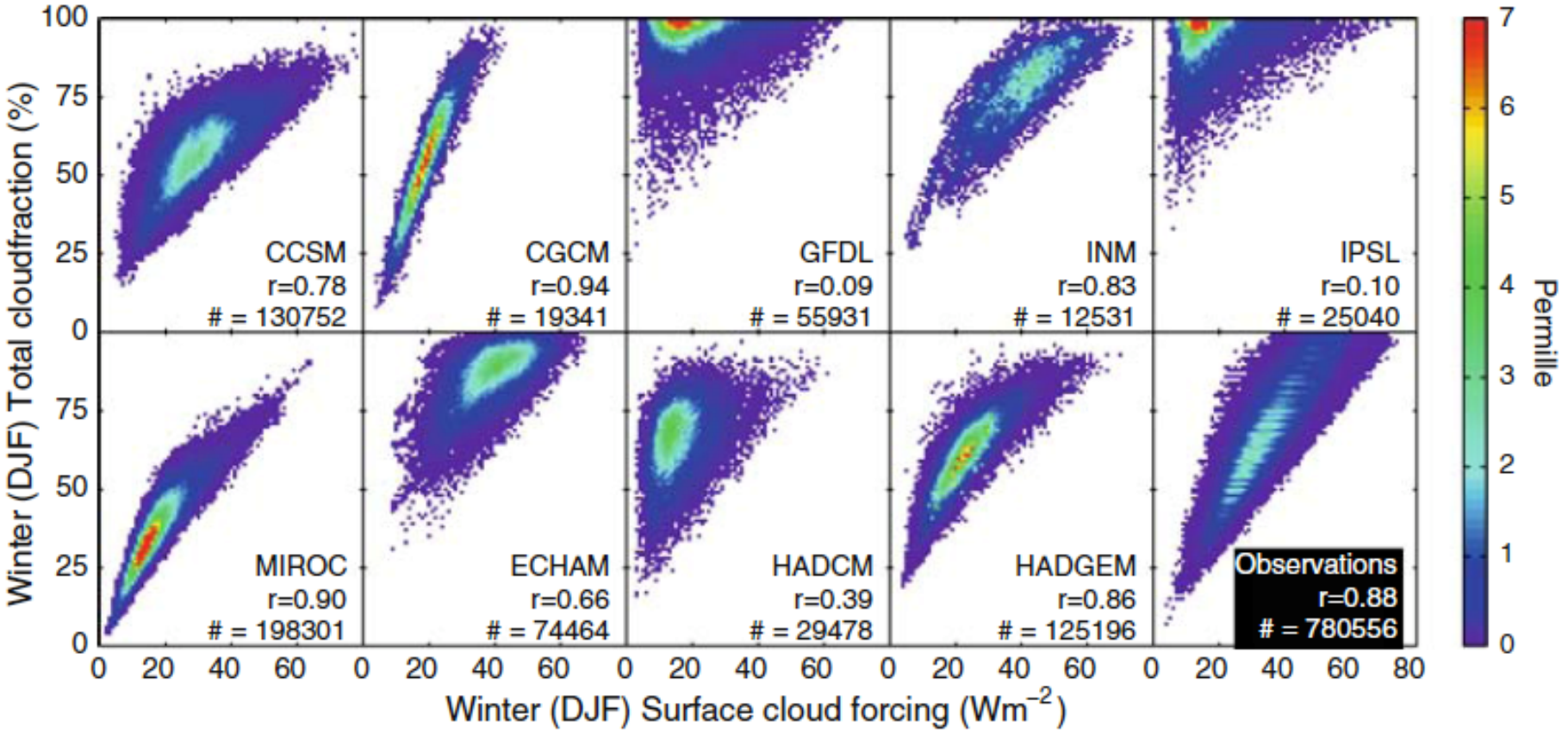

Wintertime (DJF) sea-ice covered grid points north of 66.6˚N

Karlsson and Svensson, 2010

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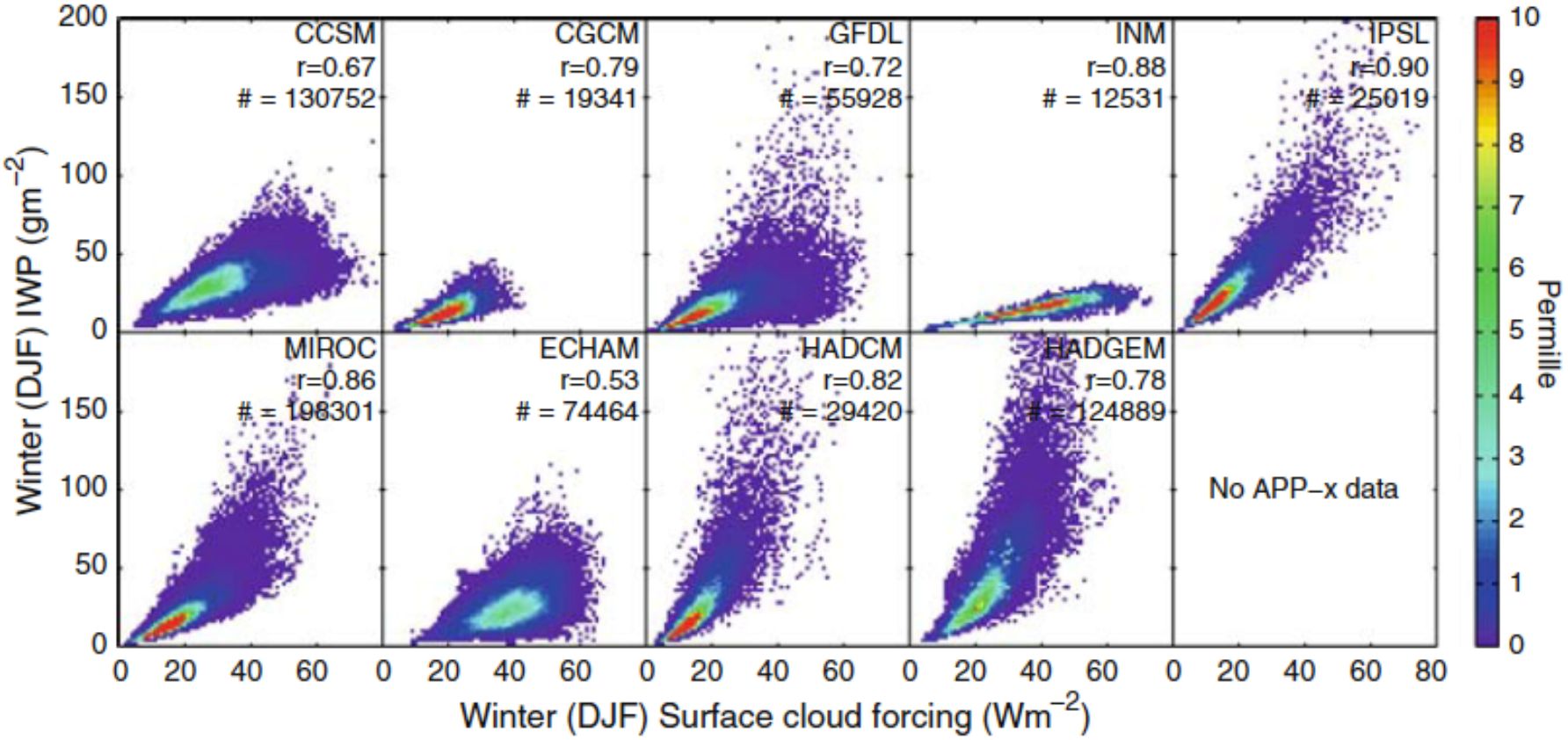

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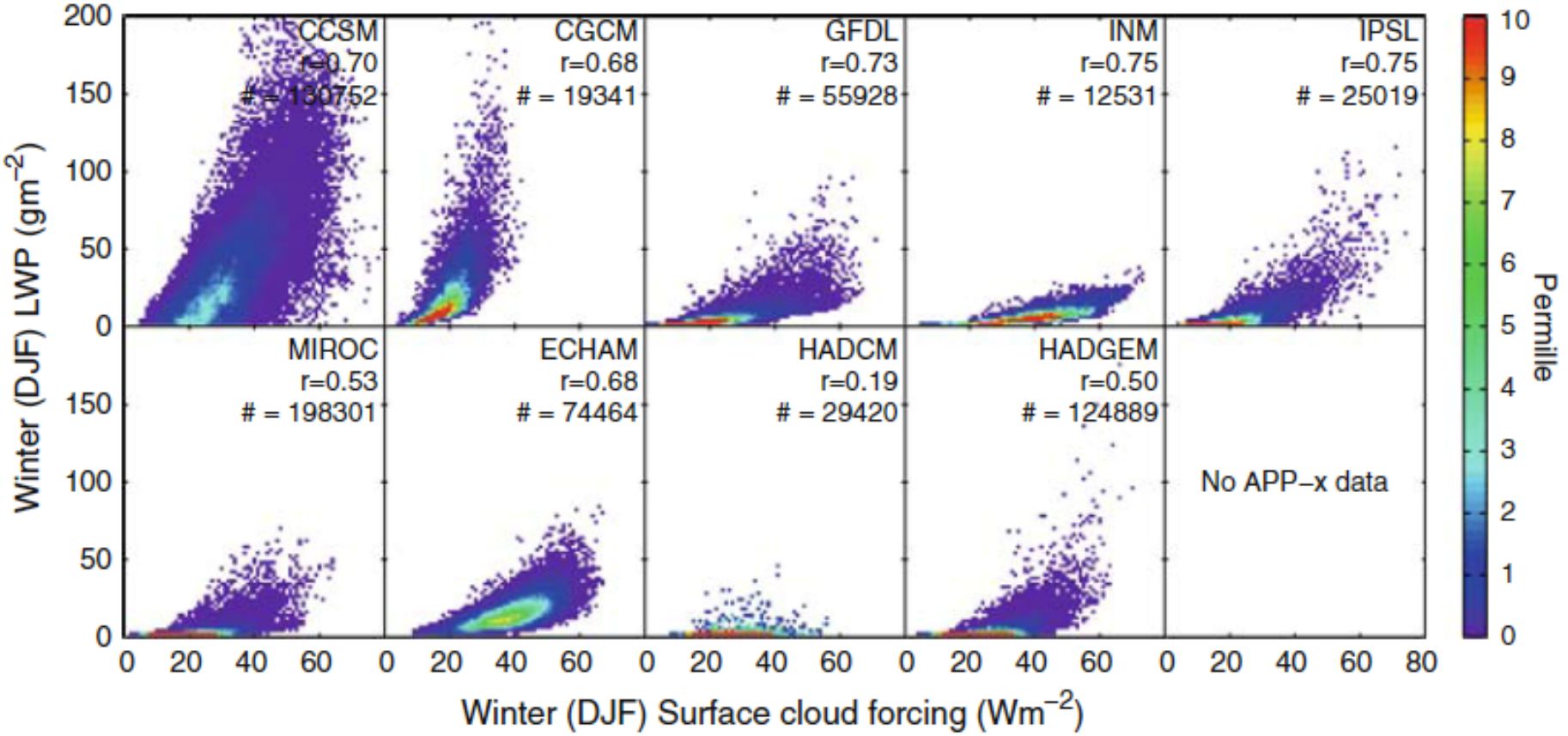

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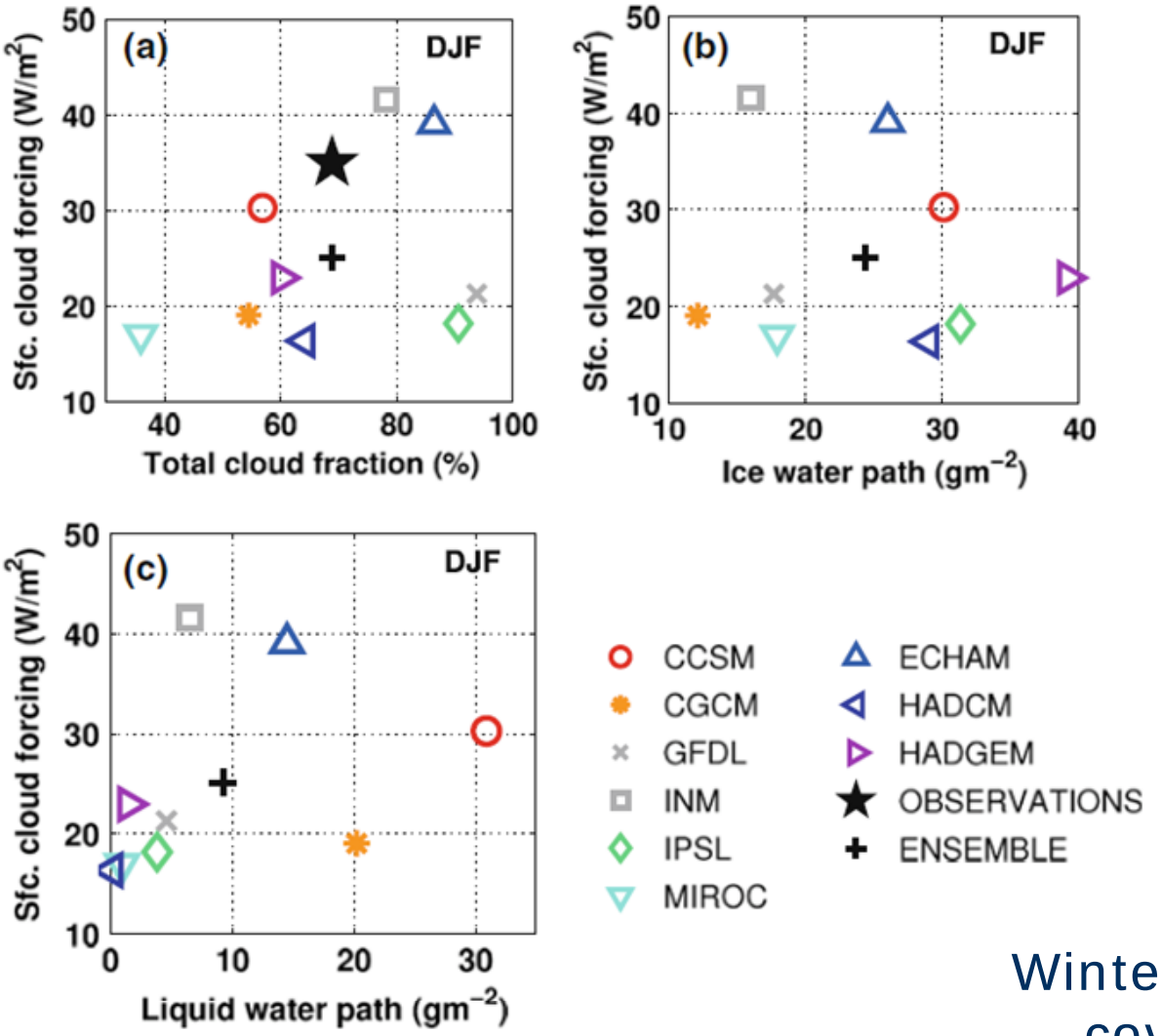

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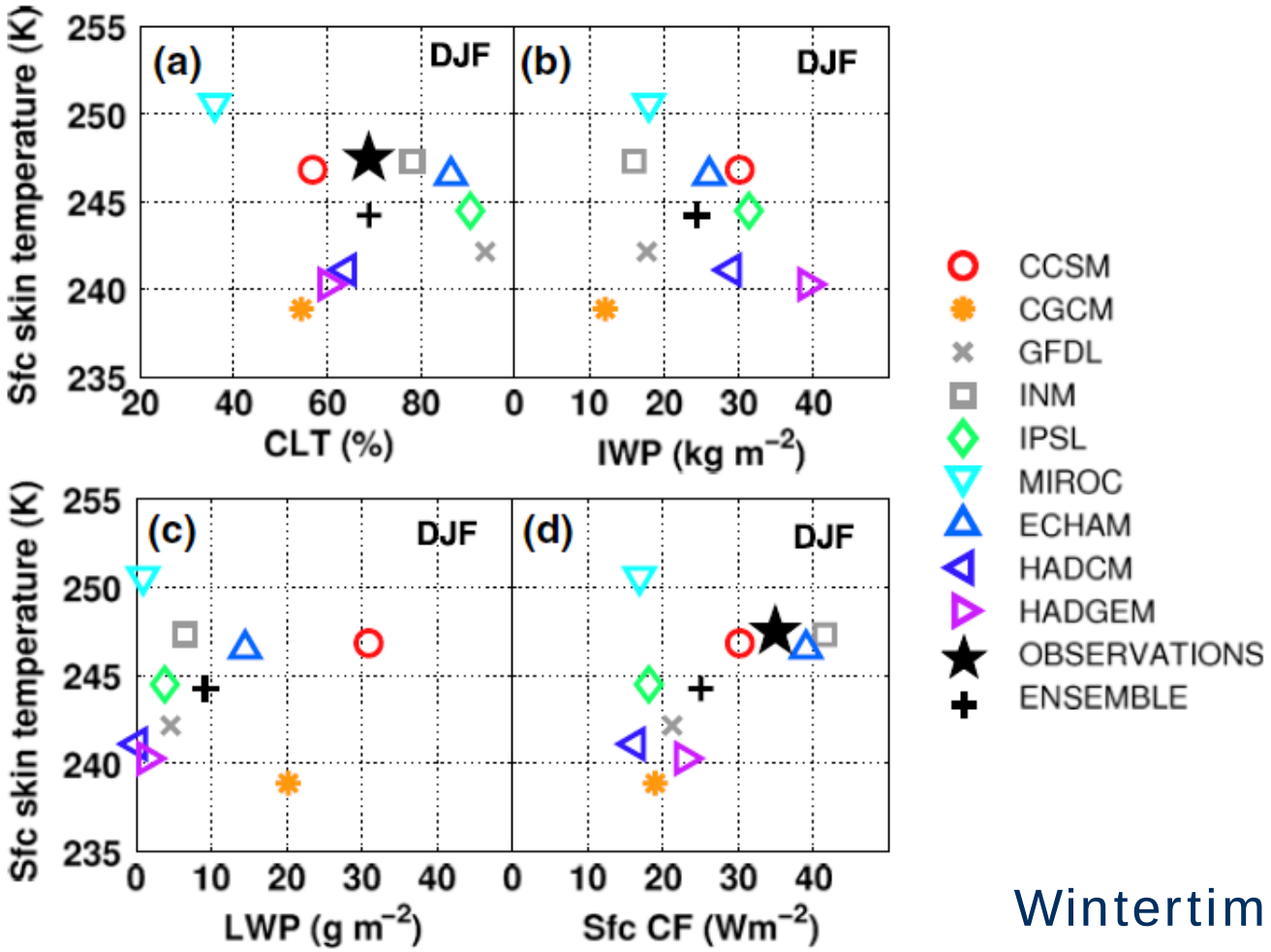

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Karlsson and Svensson, 2010

Arctic clouds in regional models

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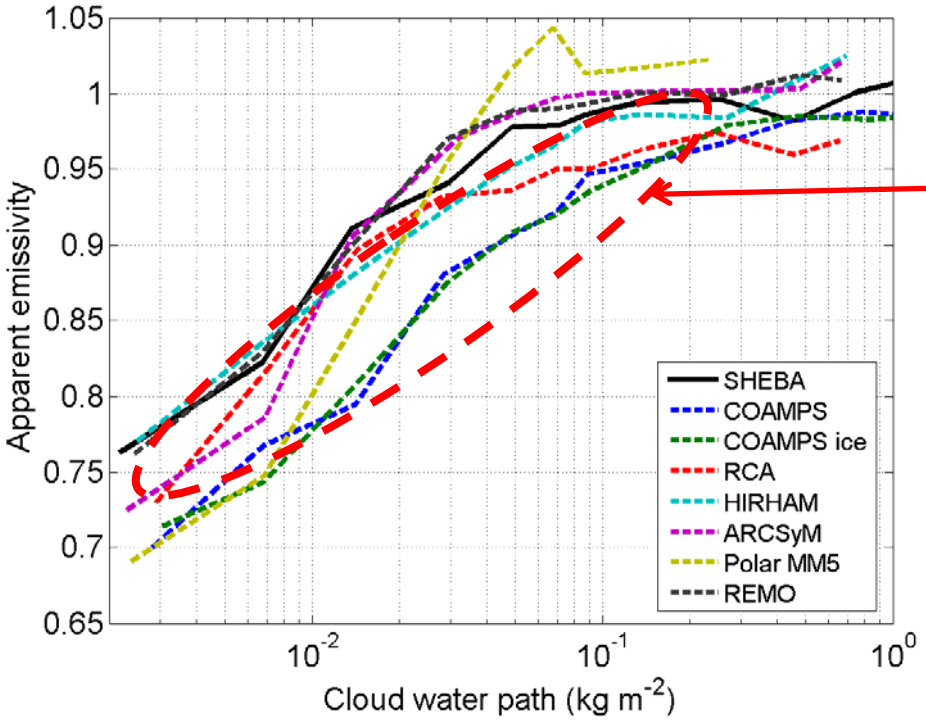
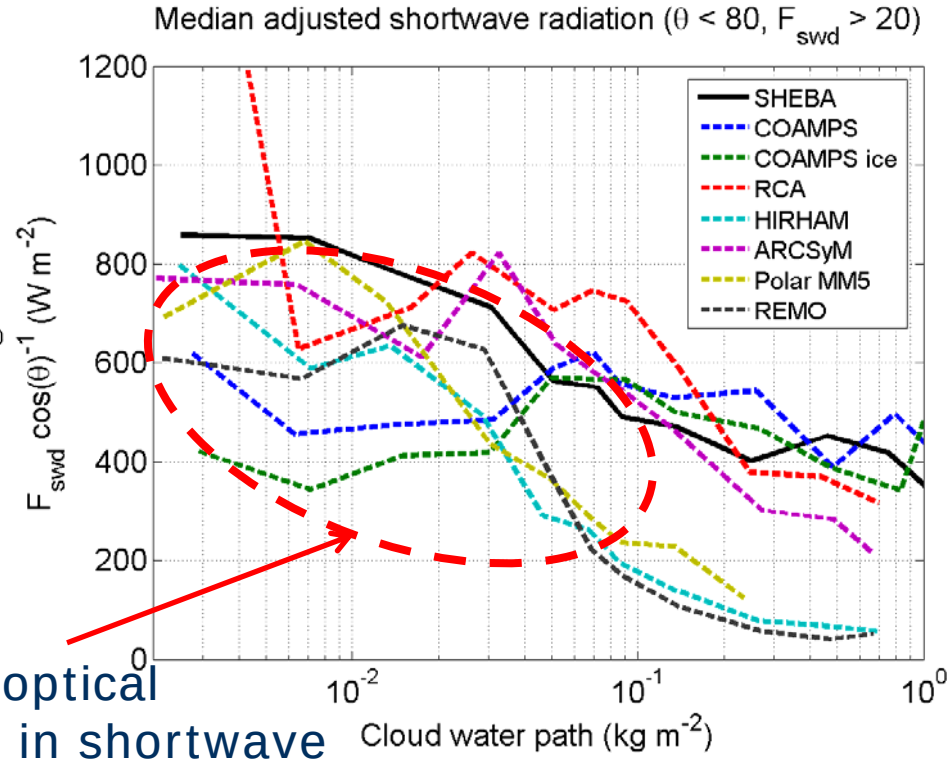


Too low optical thickness in longwave calculations



Too high optical thickness in shortwave calculations

Tjernström et al. 2008

Downwelling radiation, regional models

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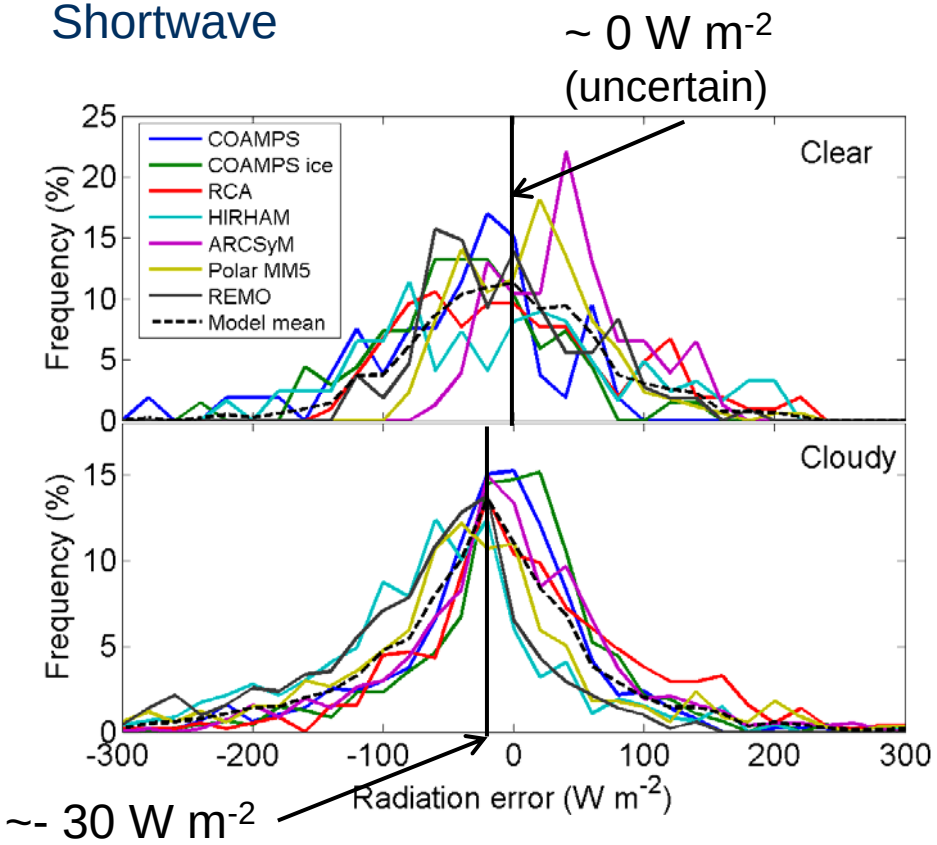
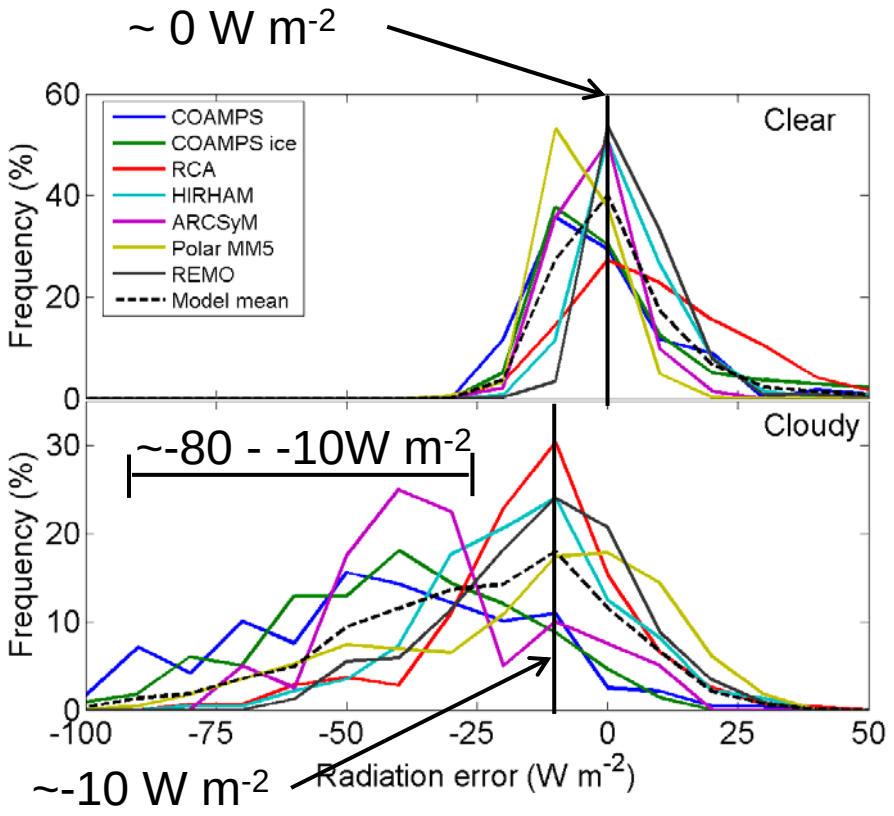
Shortwave



Longwave, Winter



Tjernström et al. 2008

Arctic clouds are different

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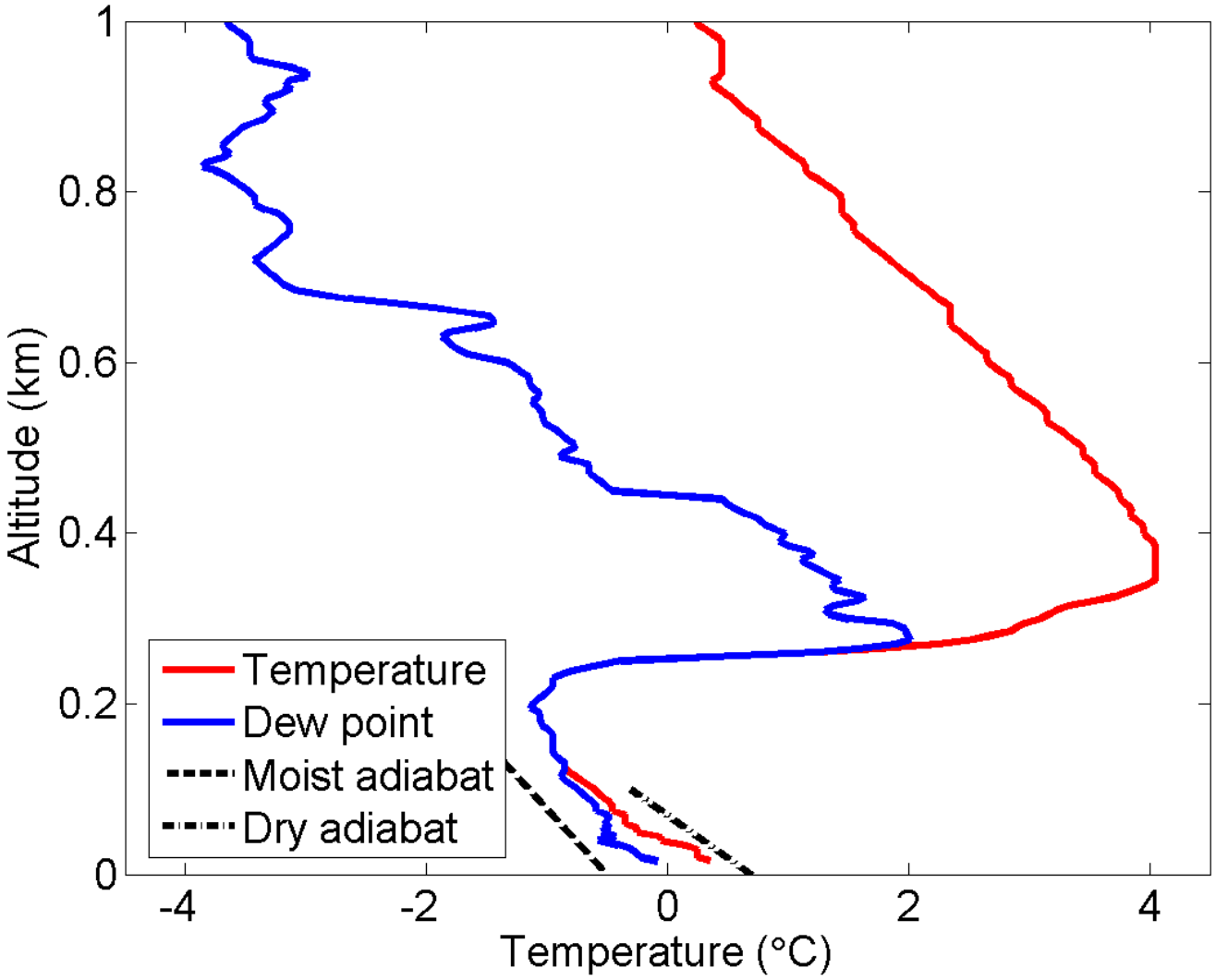
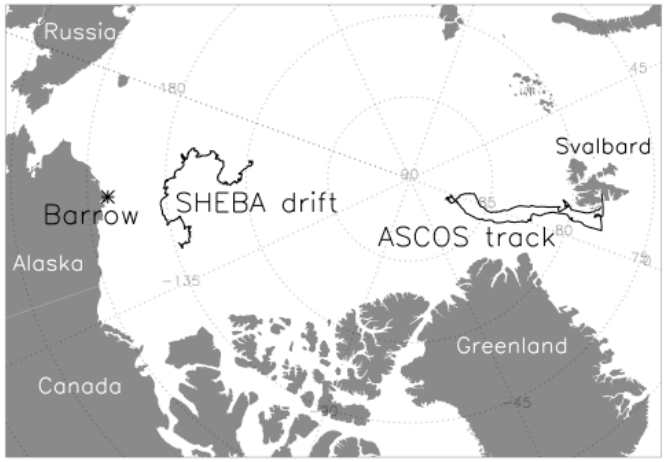
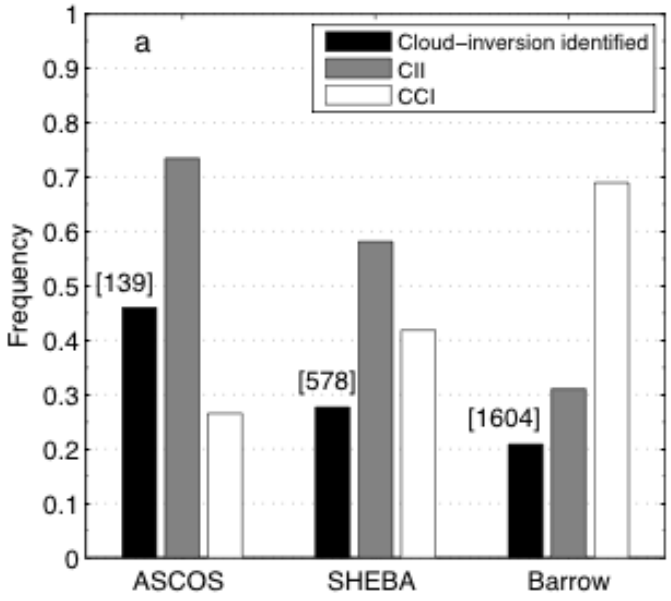


Sounding summer 2008 high arctic, ASCOS

Sedlar et al. 2010

Arctic clouds are different





BLACK: Total number of occasions with at least one cloud-inversion interaction (fraction of total vertical profiles)

GRAY: CII – Cloud Inside Inversion (fraction of the black)

WHITE: CCI – Cloud Capped by Inversion (fraction of the black)

Sedlar et al. 2010

Summary

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- Arctic clouds are poorly represented both in global and regional models
- The insulating effect of clouds are underestimated in winter
- AR4 models show a substantial across-model spread in cloudiness and some models underestimate the cloud liquid water content
- Arctic clouds are different than lower latitude clouds both regarding microphysics and dynamics