

Arctic and Antarctic Stratiform Mixed-phase Cloud Properties

Poster #5 [B2]

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Motivation

- ❖ Stratiform mixed-phase clouds (SMCs) are prevalent at high latitudes and greatly impact radiative fluxes.
- ❖ Climate models underestimate supercooled liquid fraction in SMCs.
- ❖ Governed by factors that are poorly understood.
- ❖ Observational analyses are required to reduce model uncertainty



NSA Barrow	2011.07-2016.07
AWARE McMurdo	2015.12-2017.01

Property Retrievals for Stratiform Mixed-Phase Clouds

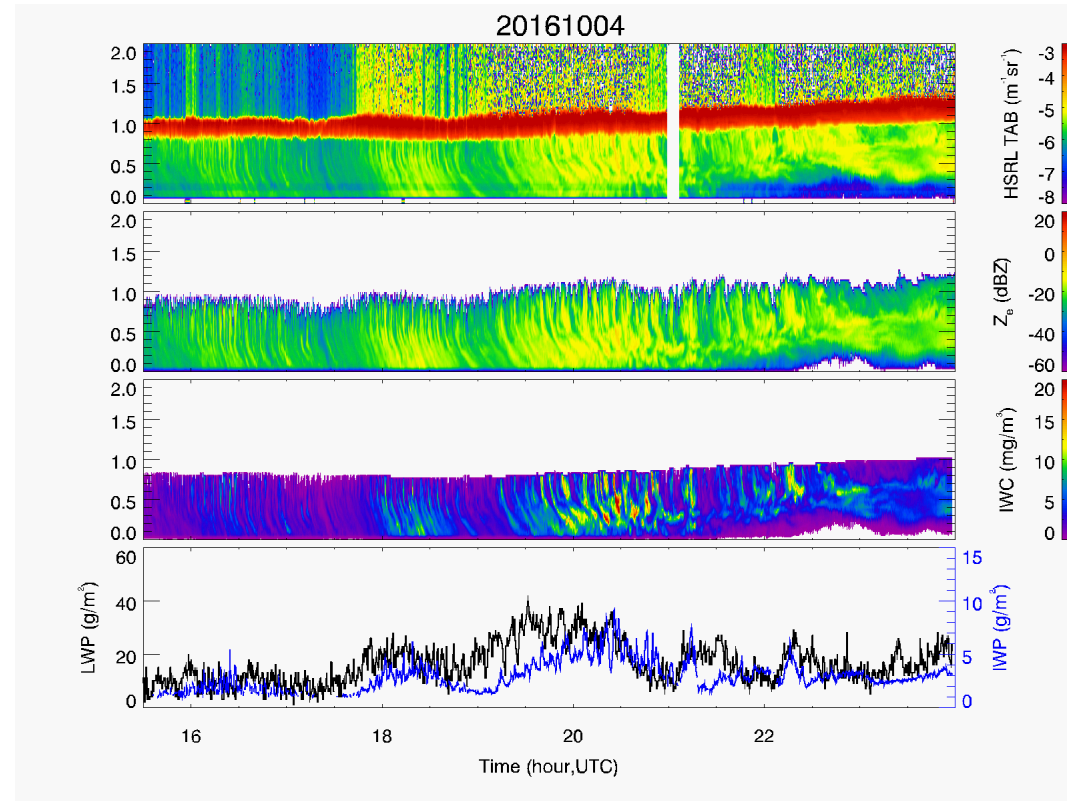
Retrieval algorithm inputs:

- MPL backscatter
- KAZR Z_e
- MWR
- Sounding measurements

Retrieved properties used:

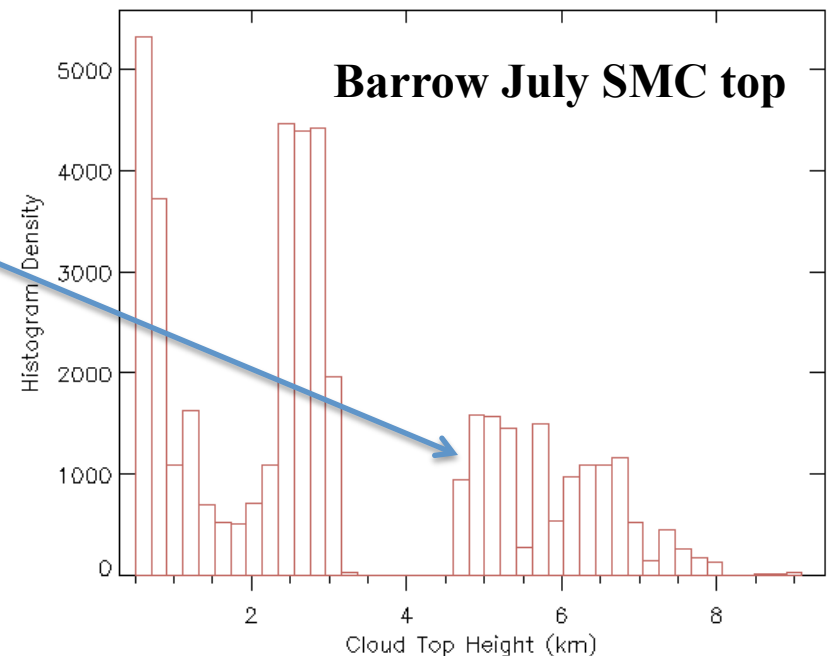
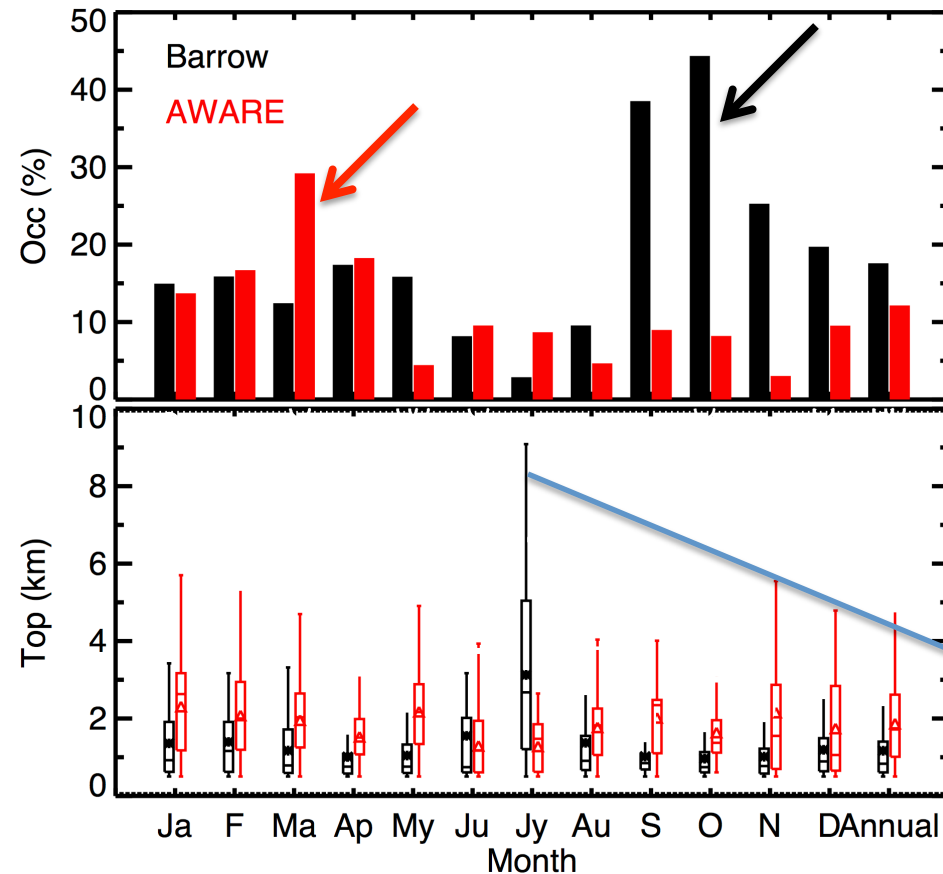
- SMC identification
- SMC top height and T
- MWR LWP
- IWC/P profiles using Z_e -Temperature-IWC (Hogan et al., 2006)
- (Also water and ice particle size, N_w , N_i)

AWARE HSRL + KAZR + Retrievals

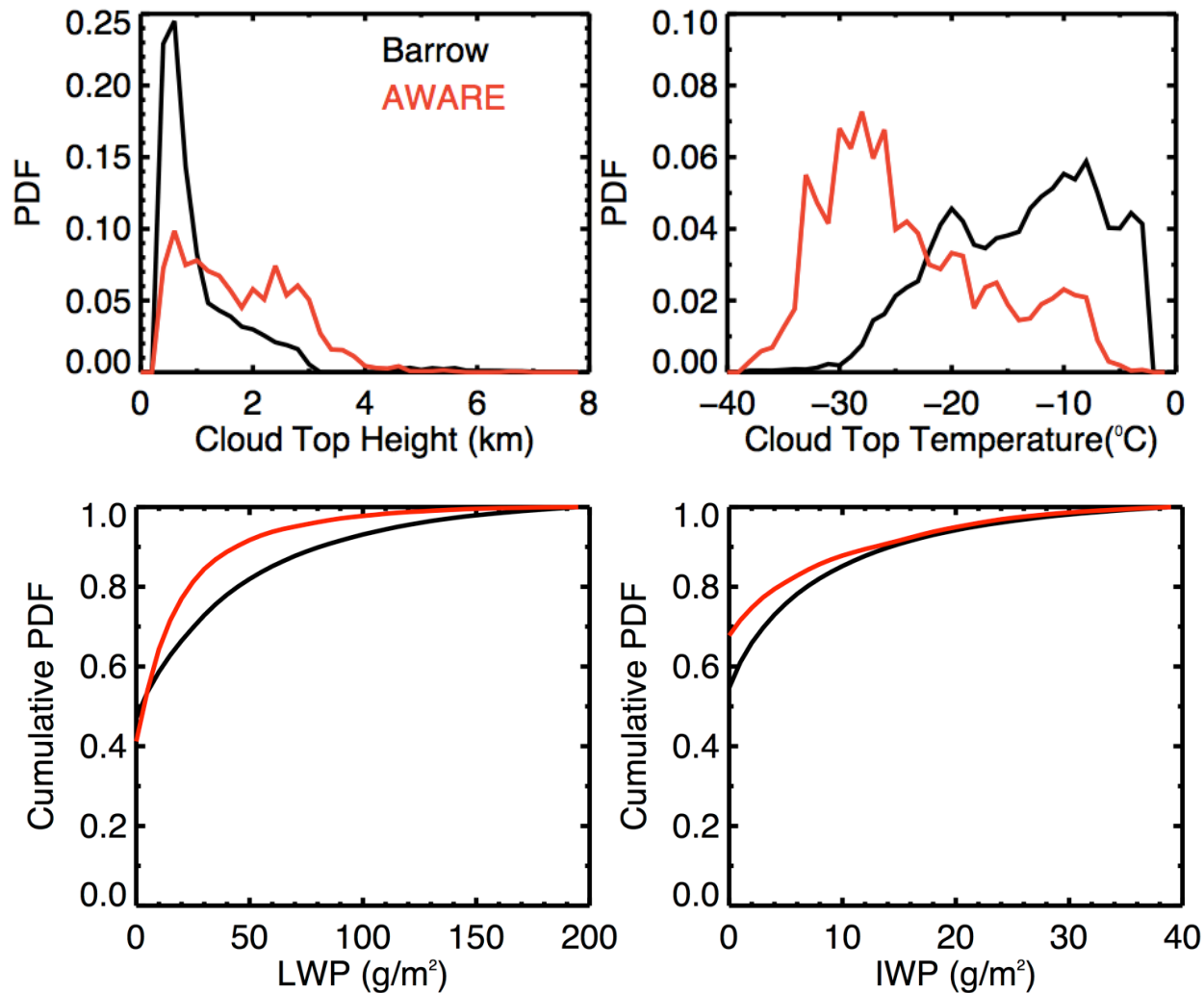


Macrophysical Properties for Stratiform Mixed-Phase Clouds

- ❖ Maximum occurrence in fall season
- ❖ Annual mean: 18% at Barrow, 12% at AWARE
- ❖ AWARE clouds are higher (except in July)

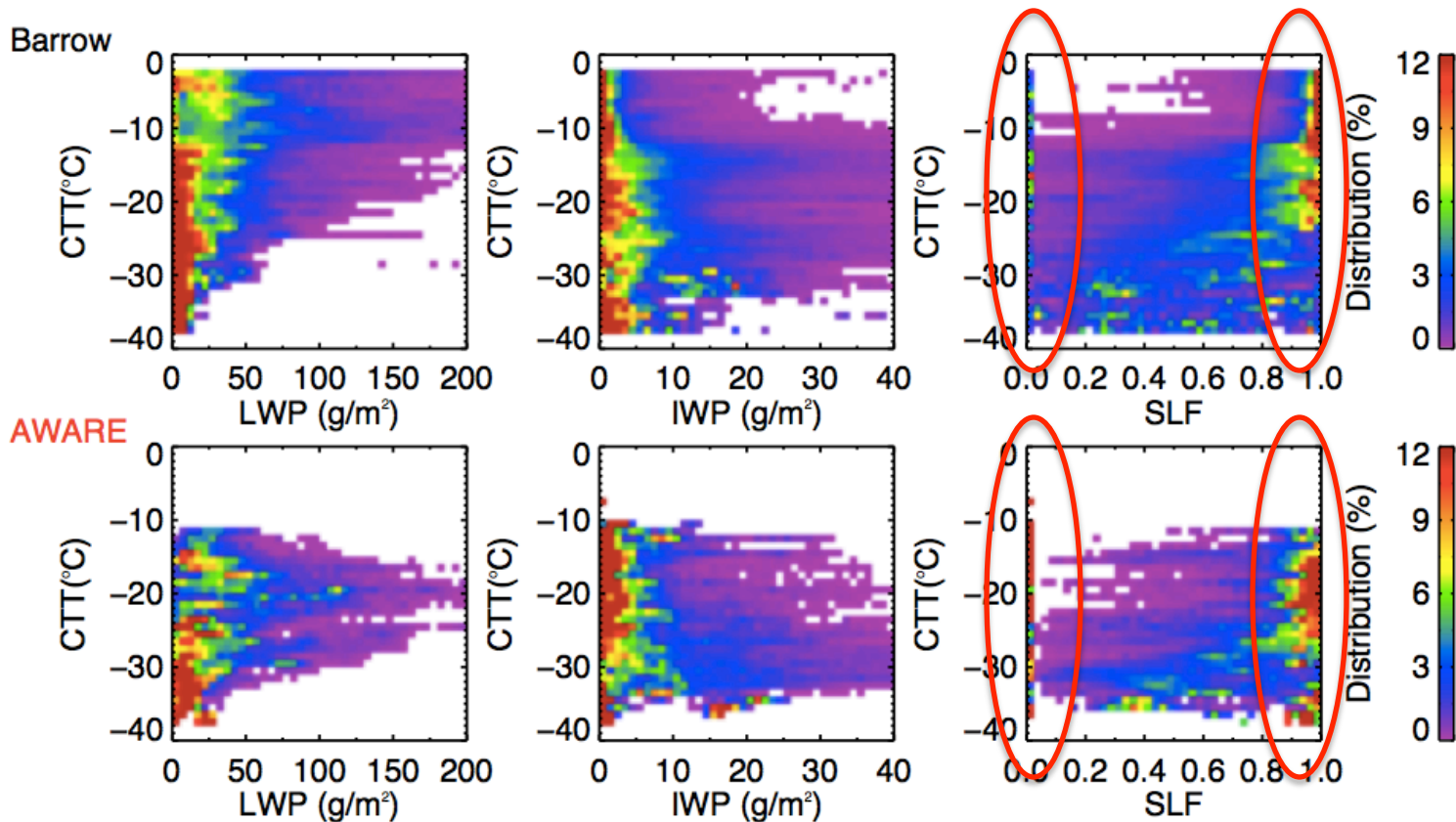


Macrophysical Properties for Stratiform Mixed-Phase Clouds



- ❖ AWARE SMCs are higher and colder
- ❖ Barrow SMCs have larger LWPs

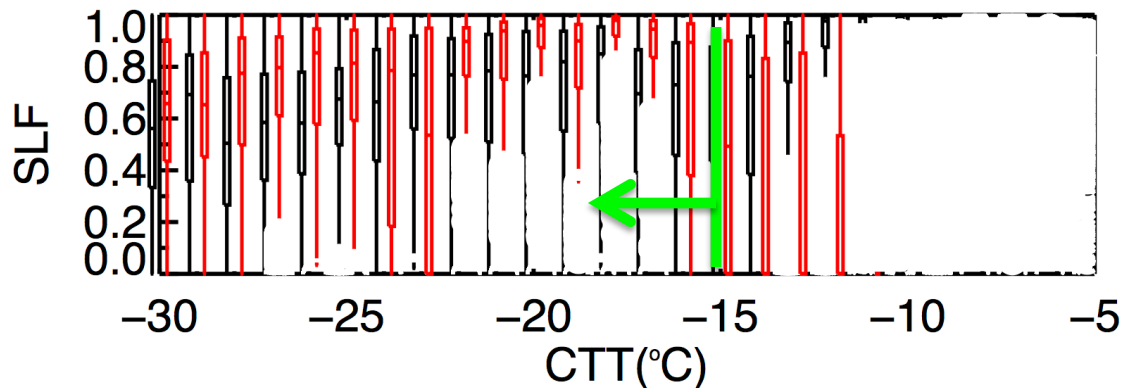
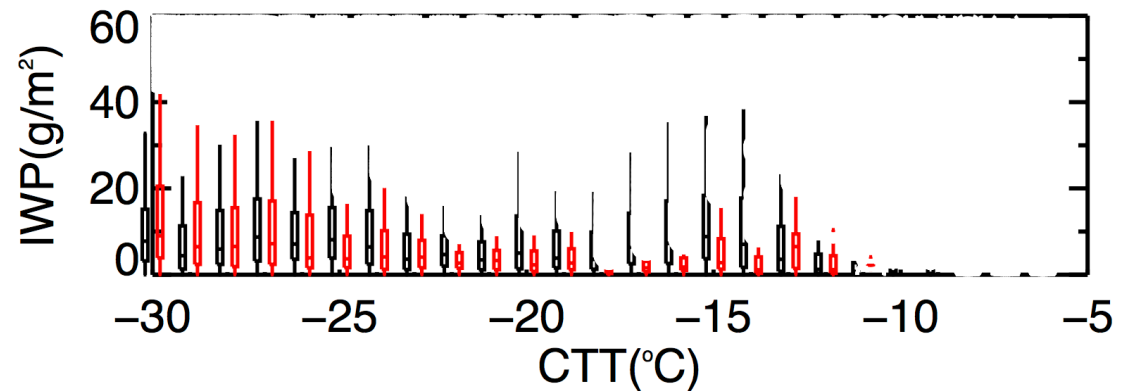
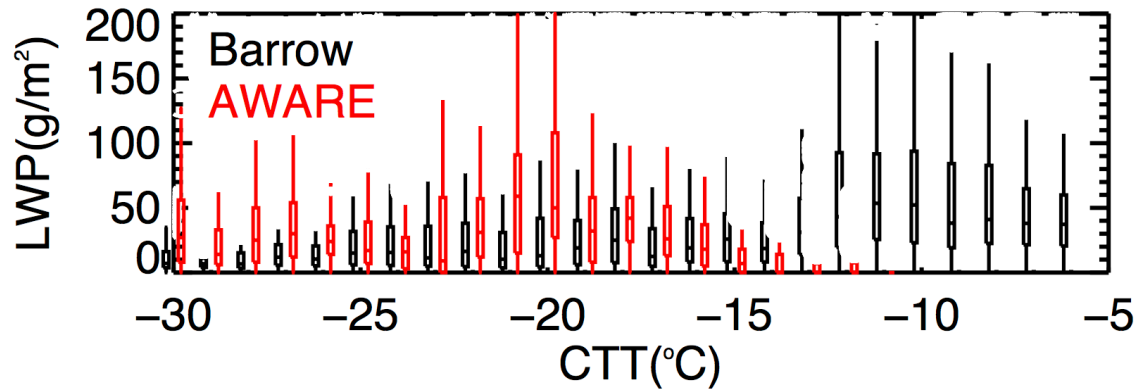
Microphysical Properties for Stratiform Mixed-Phase Clouds



- ❖ Focus on single-layer SMCs
- ❖ Supercooled Liquid Fraction (SLF) = $LWP / (LWP + IWP)$
- ❖ Statistically SMCs are always either liquid-dominated or ice-dominated

Microphysical Properties for Stratiform Mixed-Phase Clouds

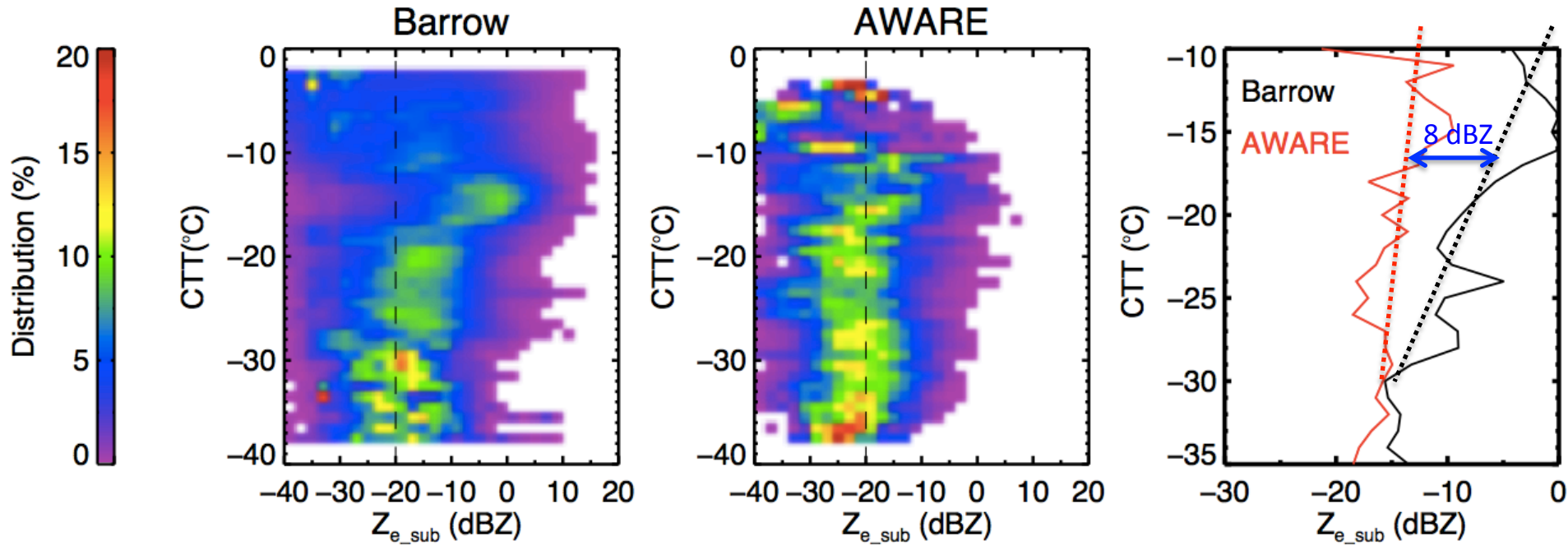
Single Layer (only)



- ❖ AWARE single-layer SMCs have larger median LWP, and larger SLF at a given CTT

Microphysical Properties for Stratiform Mixed-Phase Clouds

Single Layer only



- ❖ Z_{e_sub} : radar Z_e between the liquid-dominated cloud layer base and 100 m below.
- ❖ Barrow SMCs have up to 8 dBZ larger Z_{e_sub} at a given CTT, which indicates a factor of ~ 6 higher ice number concentration (Zhang et al., *ACP*, 2018)

Summary and Future Plan

- ❖ Comprehensive datasets of stratiform mixed-phase clouds (SMCs) using remote sensing measurements at NSA Barrow and AWARE are built.
- ❖ SMCs occur 18% and 12% at Barrow and AWARE, with maximum occurrences in fall season.
- ❖ AWARE SMCs have higher cloud top heights and colder cloud top temperatures (CTT).
- ❖ At a given CTT, AWARE single-layer SMCs have larger median LWP, and larger SLF.
- ❖ Barrow SMCs have up to 8 dBZ larger Z_{e_sub} at a given CTT, indicating a factor of ~ 6 higher ice number concentration.
- ❖ Investigation of other microphysical properties such as particle size and concentration will be conducted.