Polarimetric Radar Characteristics of Simulated and Observed Intense Convective Cores for a Midlatitude Continental and Tropical Maritime Environment

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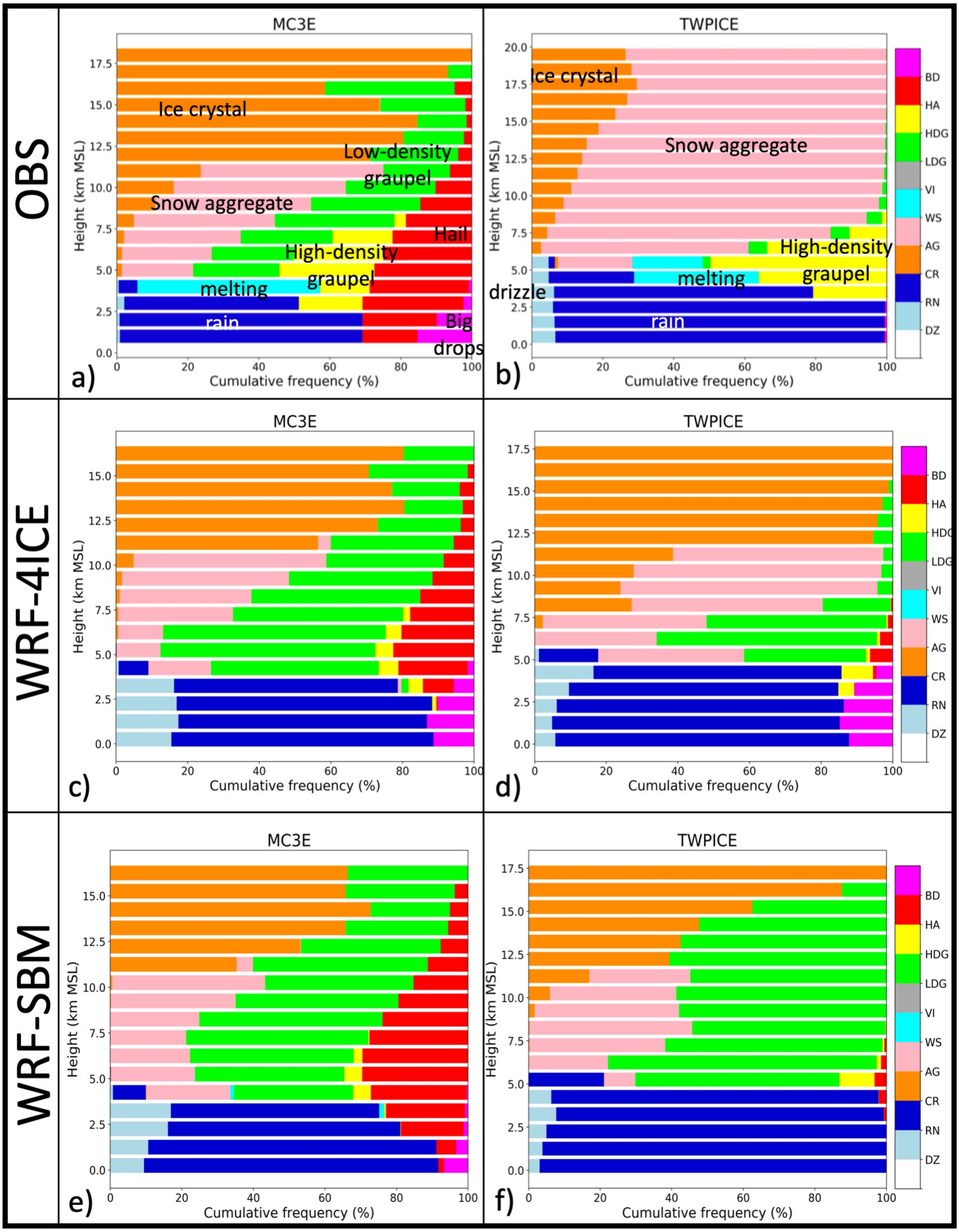
This study contrasts midlatitude continental and tropical maritime deep convective cores using polarimetric radar observables and retrievals from selected deep convection episodes during the MC3E and TWPICE field campaigns. The continental convective cores produce stronger radar reflectivities throughout the profiles, while maritime convective cores produce more positive differential reflectivity (Z_{dr}) and larger specific differential phase (K_{dp}) above the melting level. Hydrometeor identification retrievals revealed the presence of large fractions of rimed ice particles (snow aggregates) in the continental (maritime) convective cores, consistent with the Z_{dr} and K_{dp} observations. The regional cloud-resolving model simulations with bulk and size-resolved bin microphysics are conducted for the selected cases, and the simulation outputs are converted into polarimetric radar signals and retrievals identical to the observational composites. Both the bulk and the bin microphysics reproduce realistic land and ocean (L-O) contrasts in reflectivity, polarimetric variables of rain drops, and hydrometeor profiles, but there are still large uncertainties in describing Z_{dr} and K_{dp} of ice crystals associated with the ice particle shapes/orientation assumptions. Sensitivity experiments are conducted by swapping background aerosols between the continental and maritime environments, revealing that background aerosols play a role in shaping the distinct L-O contrasts in radar reflectivity associated with raindrop sizes, in addition to the dominant role of background thermodynamics.

Keywords: Polarimetric radar, continental and maritime deep convection, cloud-resolving model


OBS
WRF-4ICE
WRF-SBM
MC3E
TWPICE
Ice crystal
Low-density graupel
Snow aggregate
High-density graupel
Hail
melting
rain
Big drops
drizzle
Height (km MSL)
Cumulative frequency (%)
BD
HA
HDG
LDG
VI
WS
AG
CR
RN
DZ
a)
b)
c)
d)
e)
f)