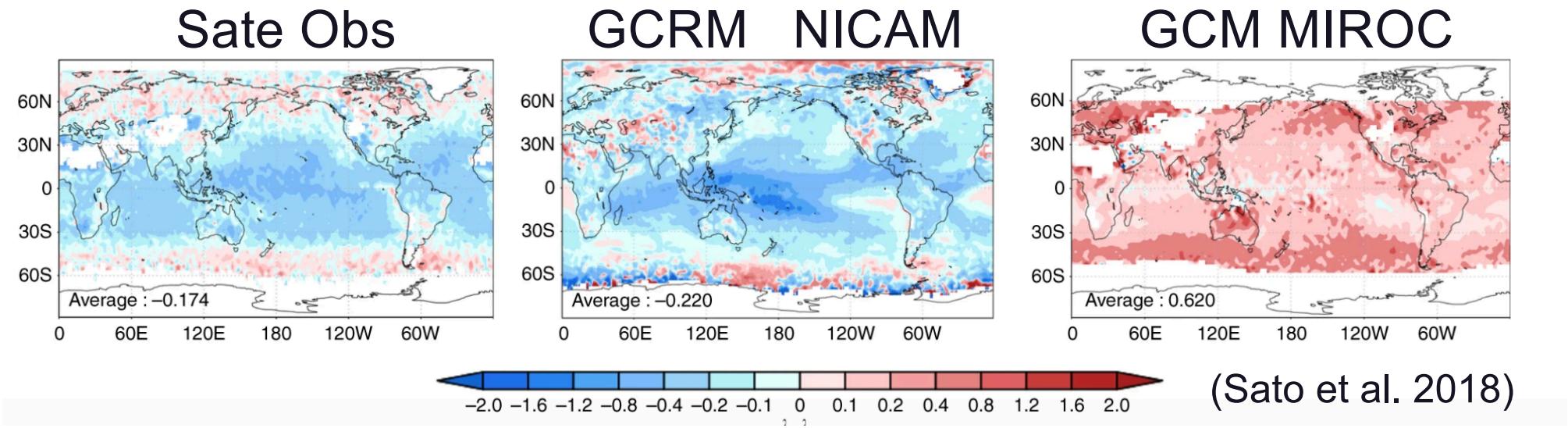
Motivation: How aerosol-cloud interaction depends on cloud microphysics?



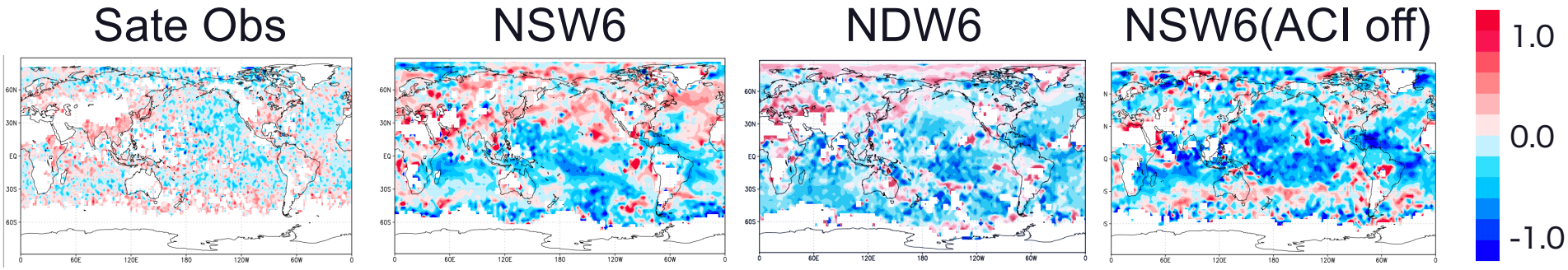
(Sato et al. 2018)

Aerosol effect on cloud water was successfully reproduced by NICAM. However,

- NSW6 (1-moment scheme) lacks in full prediction of number concentrations.
- Important microphysical process for cloud water response is uncertain.

We conducted NICAM simulations at horizontal resolution of 14km with NSW6(1-moment) / NDW6(2-moment) / NSW6 off(aerosol effect as CCN is off). We evaluated models against satellite observations to reveal key processes for aerosol-cloud interaction on the global scale.

Wet scavenging process can cause the negative correlation

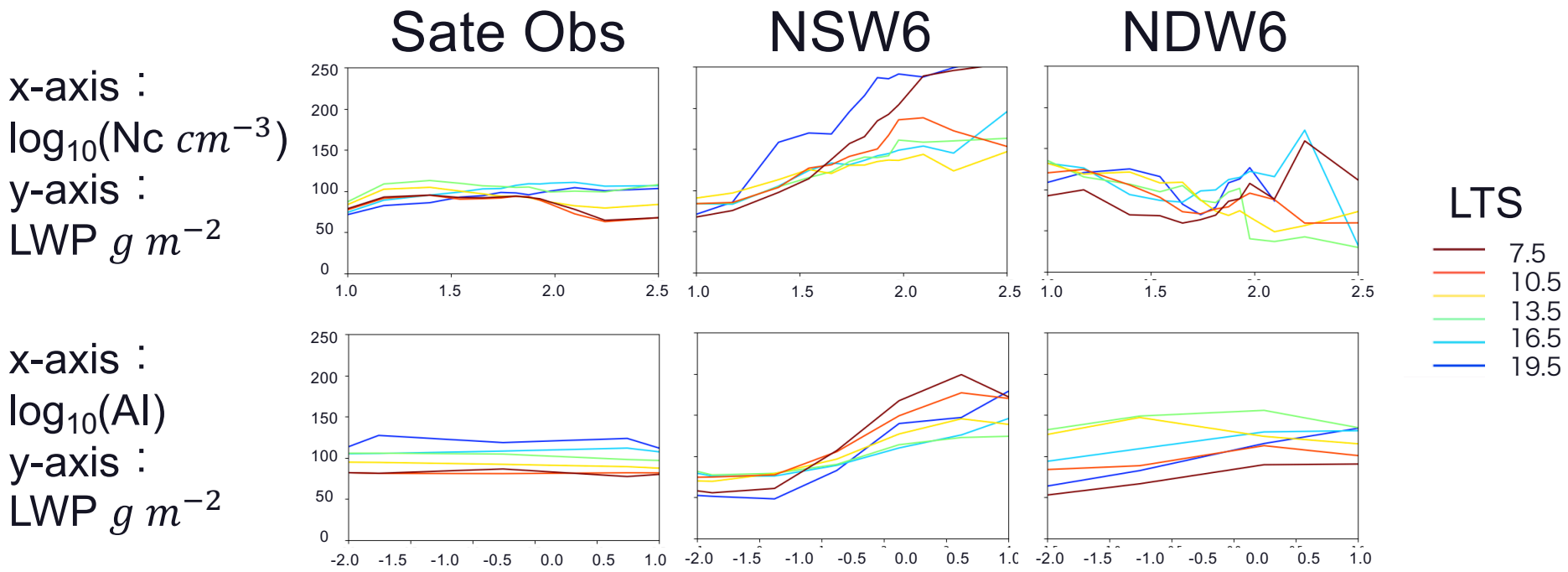


Correlations between aerosol number concentration and LWP $\frac{\partial \log(\mathrm{LWP})}{\partial \log(Na)}$

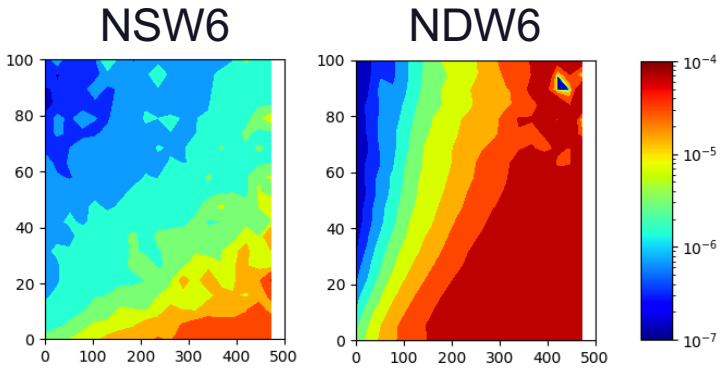
Both NSW6 and NDW6 scheme show the negative correlation consistent with the observations.

The negative correlation in NSW6(ACI off) is likely to be caused by wet scavenging process.

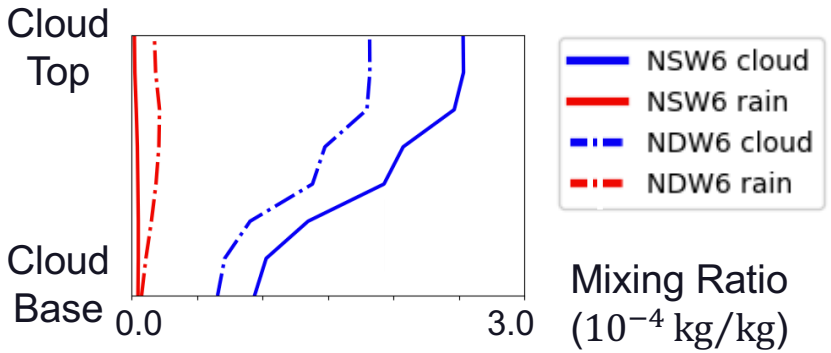
Weaker correlation between aerosol and cloud in NDW6 attributable to accretion process



Relationships between aerosol loading (X-axis) and liquid water path.



Accretion rate as a function of LWP(X-axis) and Nc (Y-axis)

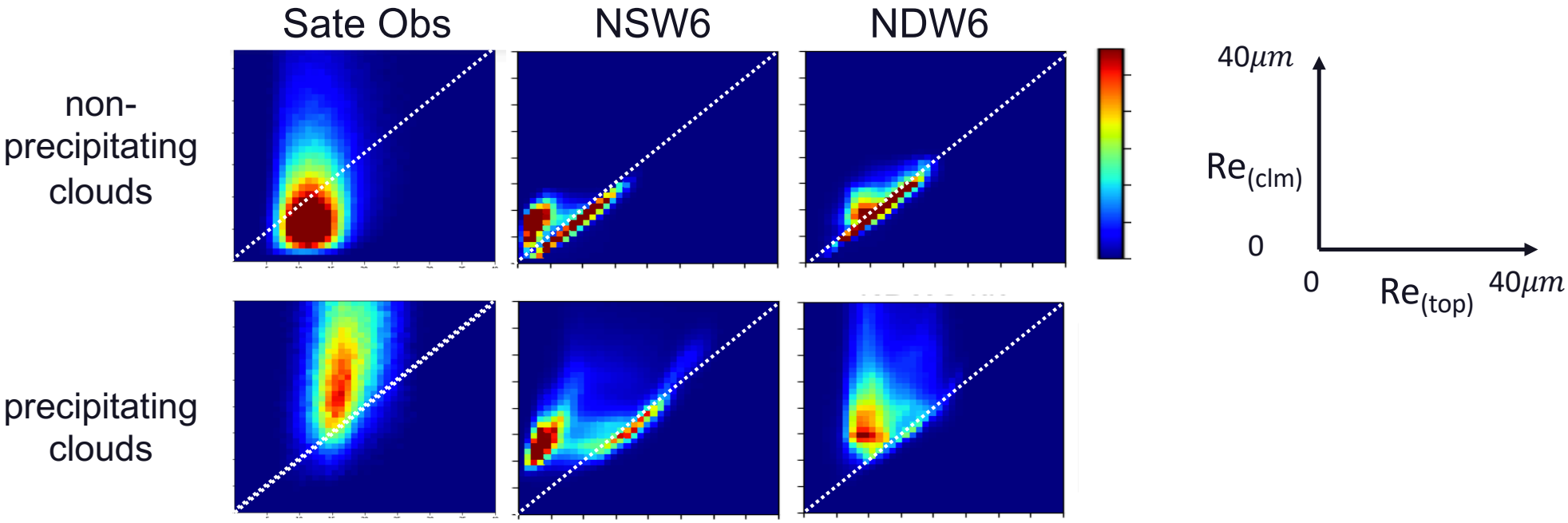


In-cloud mean profiles of water content

Vertical structure of droplet size

LWP estimated from path-integrated attenuation of radar is insensitive to vertical structure of droplet size.

Defined column-average effective radius as $Re_{(clm)}$: $\frac{3LWP}{2\tau\rho_w}$ (Masunaga et al. 2002)



PDFs of $Re_{(top)}$ (X-axis) and $Re_{(clm)}$ (Y-axis) depict microphysical process.

- $Re_{(top)} > Re_{(clm)}$ for non-precipitating clouds. Not reproduced by models.
- $Re_{(top)} < Re_{(clm)}$ for precipitating clouds. Well-captured by NDW6.

Future work : investigate regional characteristics, sensitivity tests.