

# Innovative Methods For Retrieving Cloud Properties From BASTA

## SOFOG-3D Science Meeting

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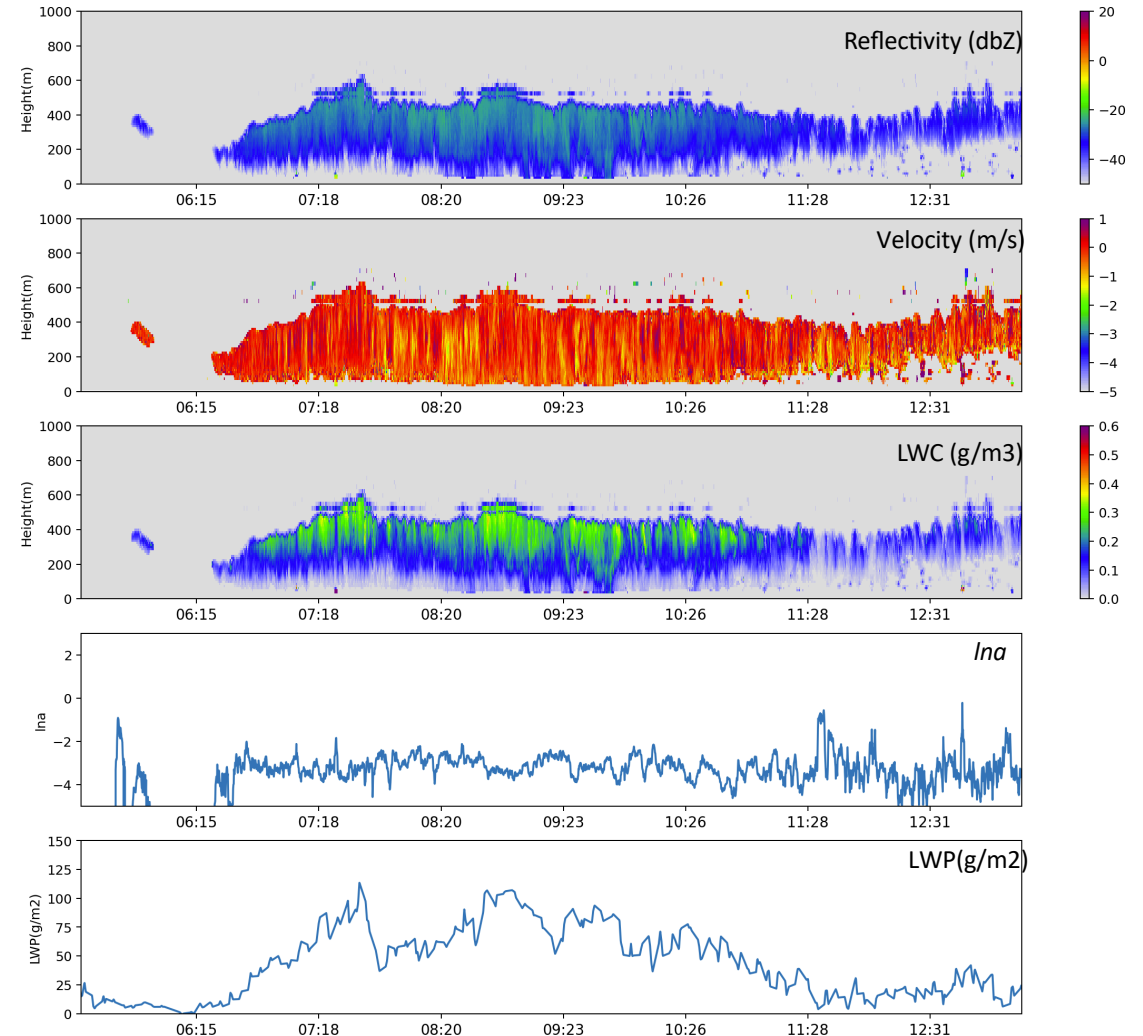
# LWC retrieval using BASTA(Z) and MWR(LWP)

- Z and LWC are related with a powerlaw equation

$$Z = a \text{ LWC}^b$$

$$\ln Z = \ln a + b * \ln \text{LWC}$$

- A retrieval algorithm with variational method to retrieve LWC and scaling factor  $\ln a$ .
- Given Z and LWP information LWC in liquid cloud is retrieved by adjusting scaling factor for each profile.
- Apriori of  $\text{LWC}$  and  $\ln a$  is considered in the retrieval from empirical relation from literature.



# Strategy of Retrieval Algorithm

- The observation vector and state vector for the retrieval are:

$$Y = [\ln Z_1, \ln Z_2 \dots, \ln Z_n, \ln LWP]$$

$$X = [\ln LWC_1, \ln LWC_2 \dots, \ln LWC_n, \ln a]$$

$$LWP = \sum(LWC)dz$$

- Stand alone retrieval of BASTA by using the climatology of  $\ln a$  from the above algorithm setup

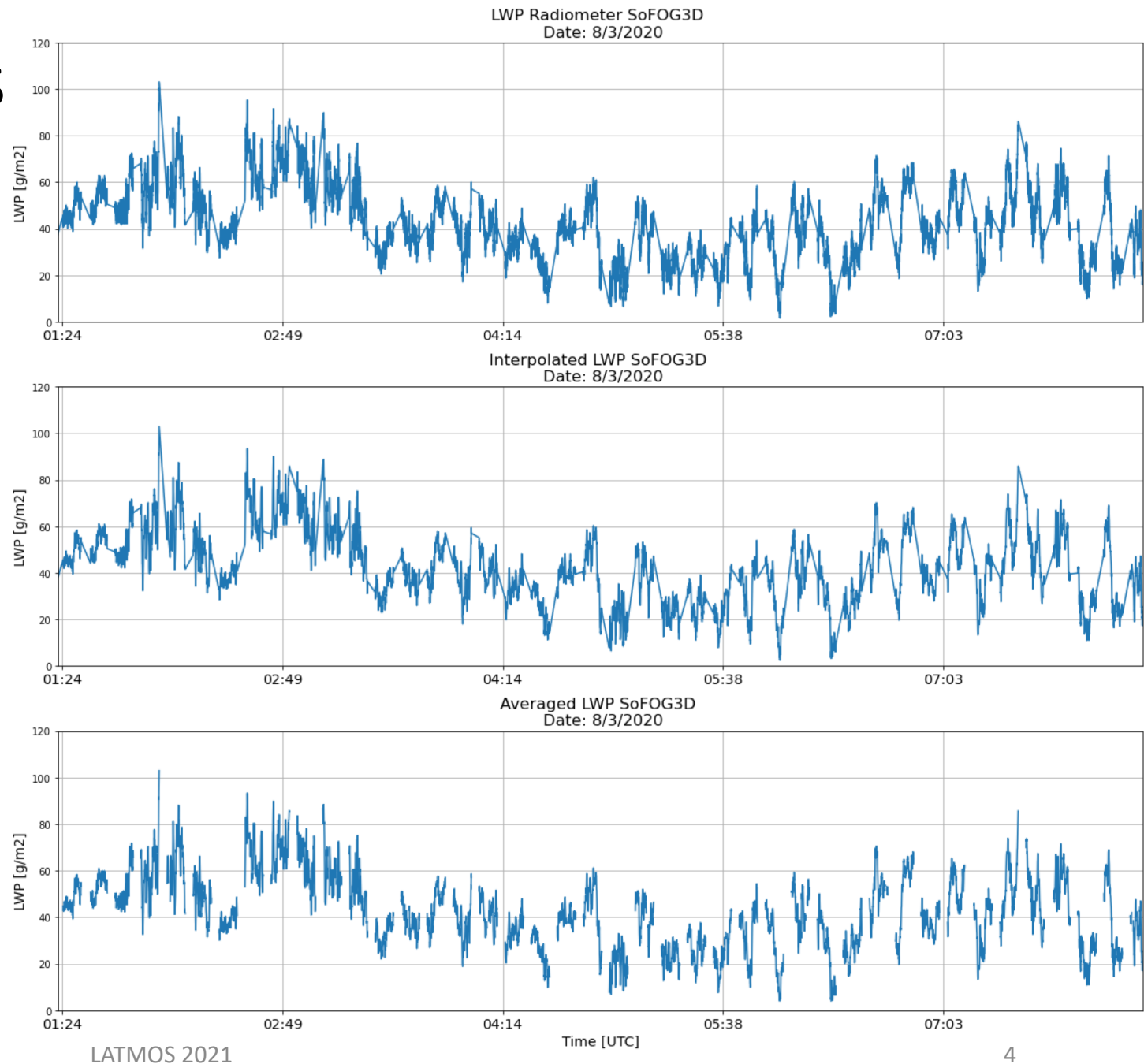
$$Y = [\ln Z_1, \ln Z_2 \dots, \ln Z_n]$$

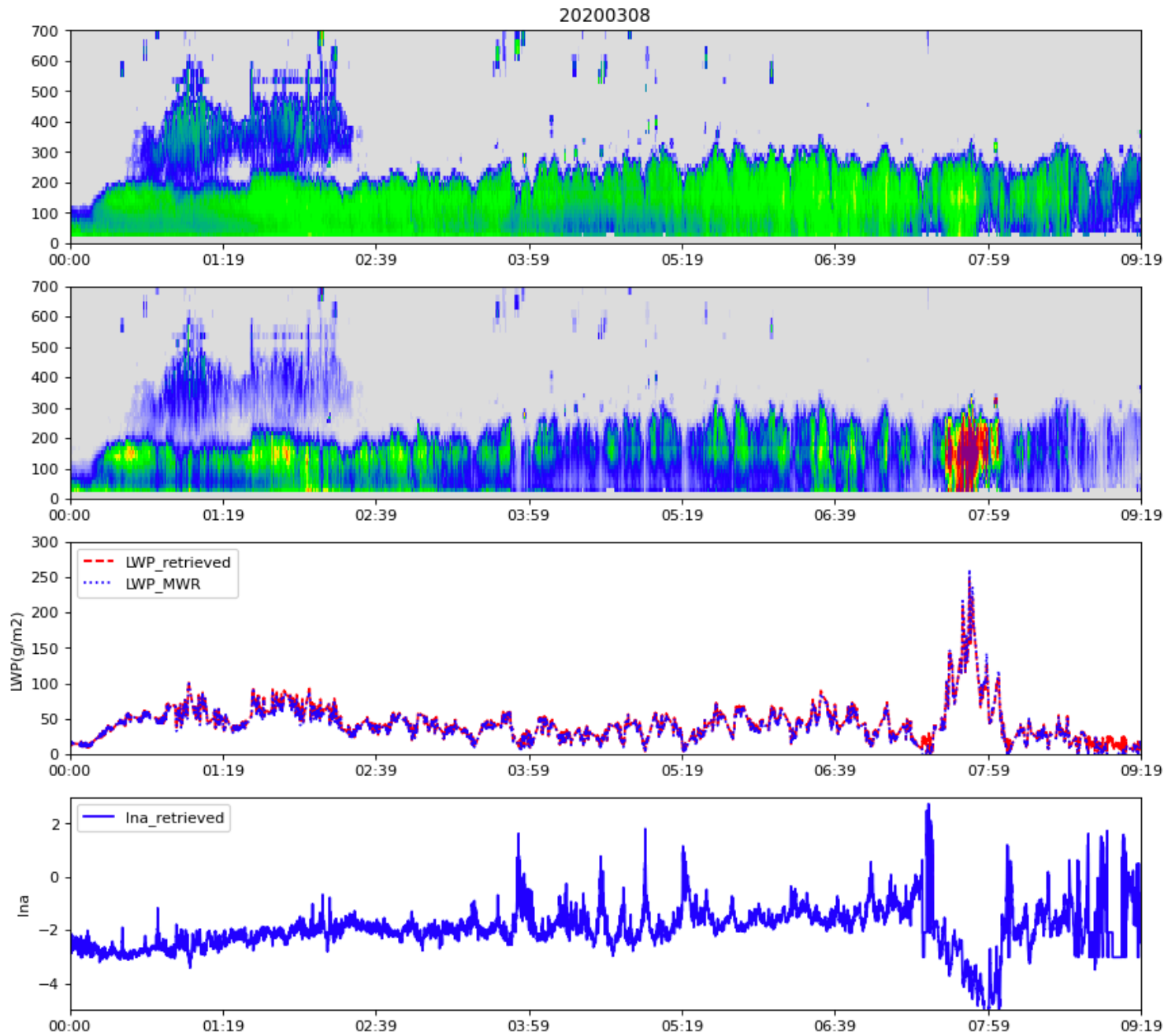
$$X = [\ln LWC_1, \ln LWC_2 \dots, \ln LWC_n, \ln a]$$

- Retrieval is constrained to give more weightage to  $\ln a$  a priori (derived from climatology) and LWC is retrieved.

# LWP for SOFOG-3D cases

- For every 10 minutes LWP observation is missing due to boundary layer scan for temperature.
- LWP for the gaps is interpolated.
- LWP is averaged between two consecutive BASTA time as the frequency of two instrument is different.

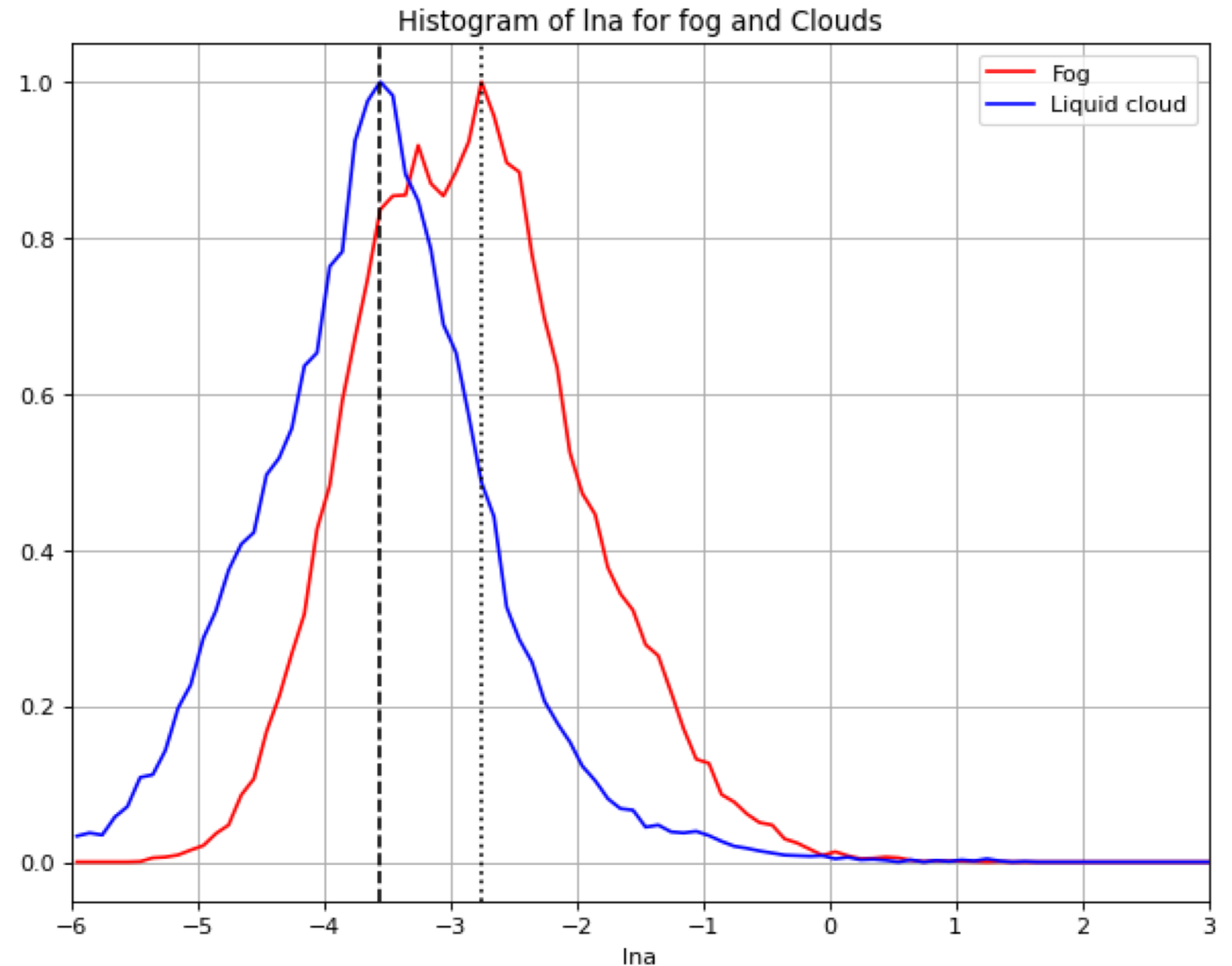




- Averaged LWP is assimilated with Z for each profile
- Retrieved LWP is compared with LWP from MWR.
- Validation of distribution of LWC is yet to be done
- There is some high value of LWC and LWP around 8:00 hrs.

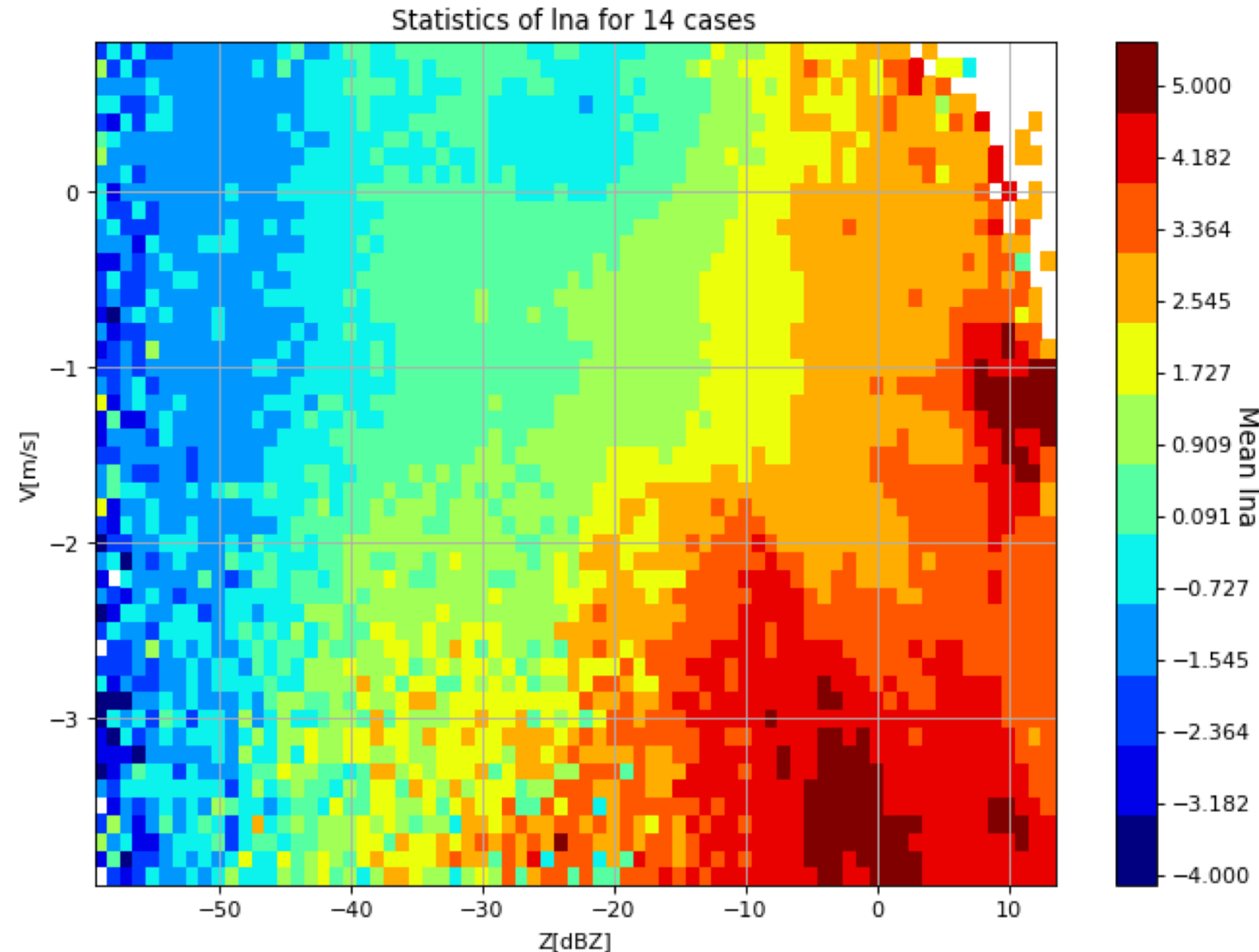
# *Ina* retrievals for fog and cloud at SIRTA

- Set of fog and cloudy cases are used for discuss the behavior of retrieved *Ina*
- The range of *Ina* varies from -6 to 0
- Peak *Ina* values are used for profiles without LWP information.

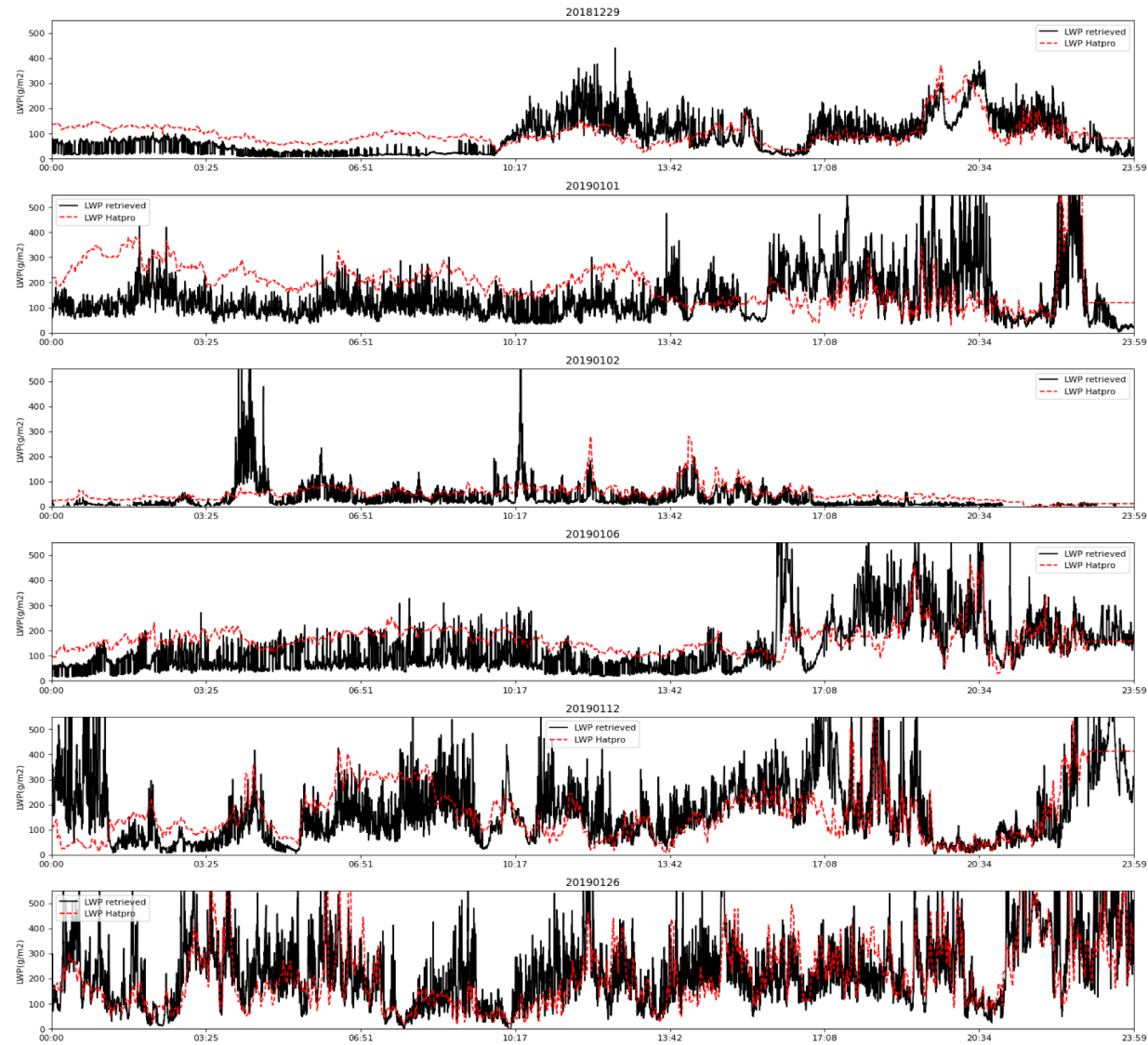


# Climatology of $I_{na}$

- Variation on  $I_{na}$  for 14 cloudy and fog cases is shown as a function of  $Z$  and  $V$ .
- This statistics is useful for  $I_{na}$  a priori for LWC retrieval of missing LWP profiles.



# Using *Ina* a priori for without LWP assimilation: SIRTA





# Future work

- Validation of LWC distribution using tethered balloon and other in situ measurements.
- Statistical analysis of '*ln $\alpha$* ' for SOFOG3D cases.
- Retrieval of LWC without LWP assimilation for missing LWP observation.

Thank you