A Prototype Precipitation Retrieval Algorithm Over Land Using Passive Microwave Observations Stratified by Surface Condition and Precipitation Vertical Structure

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- The fundamental problem for the precipitation retrieval: **non-unique solution** for the same observed TBs
- To alleviate this problem: using the ancillary parameters to **stratify the single database into many smaller but more homogeneous databases**

Four parameters to stratify the single database:

- surface type
- surface temperature
- land elevation
- ice layer thickness

By doing this:

both the surface condition and precipitation vertical structure are more homogenous in each stratified database.

Flow chart of this work

- Collocate SSMIS and NMQ (originally did by Nai-Yu for GPROF)
- Create database for snow and rain, separately
- Stratify the single databases into more homogenous databases
- Linear Discriminant Analysis (LDA) for detection and Bayesian form retrieval
- Compare detection and retrieval performance from the single database and stratified databases

POD (%) for rainfall

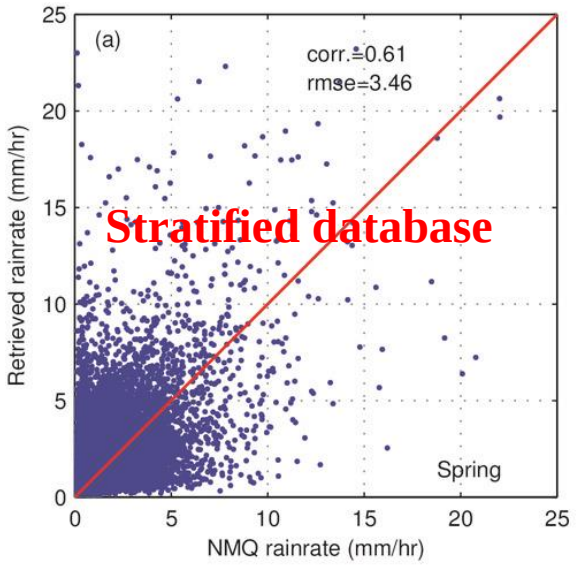
	Only TBs	TBs *rh* and *w*
Single database	75.9	78.5
Categorized database	84.0	85.1

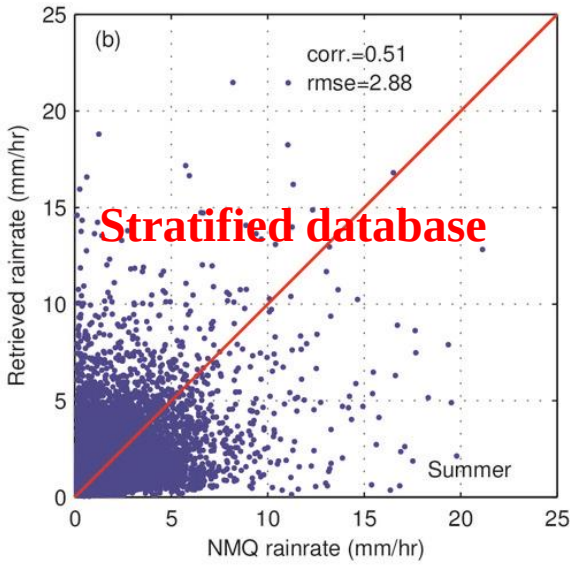
POD (%) for snowfall

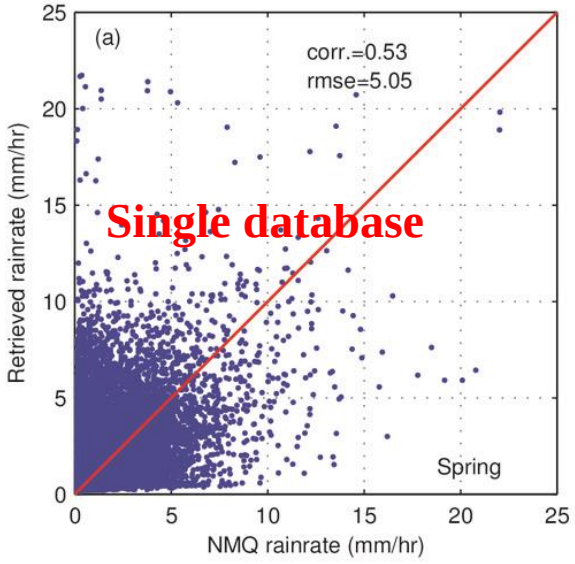
	Only TBs	TBs *rh* and *w*
Single database	56.0	67.2
Categorized database	68.0	76.4

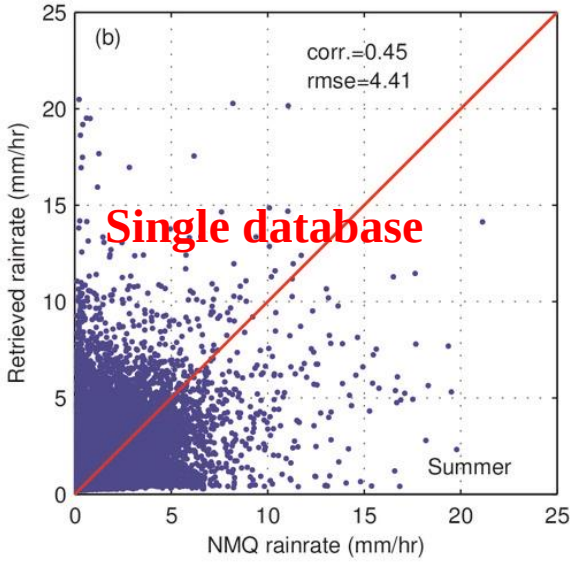
- Using categorized databases, the POD increases 8.1% and 12.0% for rainfall and snowfall detection, respectively.
- POD further increases to 76.4 by adding **relative humidity** (*rh*) and **vertical velocity** (*w*) for snow detection

Scatter plots between observed and retrieved rainfall









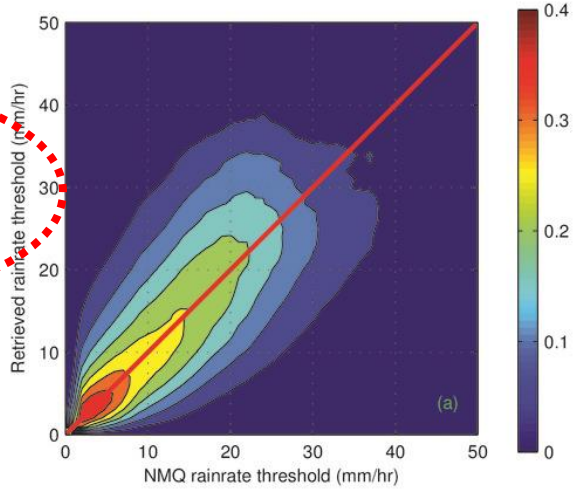
Using Stratified database:

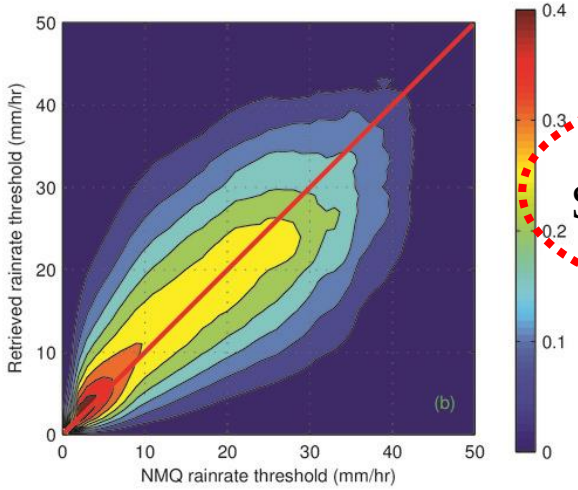
- **Larger correlation**
- **Smaller RMSE**

- **Similar features for snowfall**

Heidke skill score

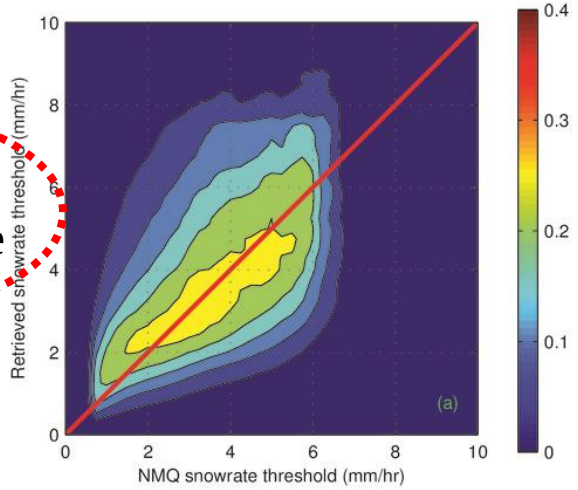
Rainfall
Single database

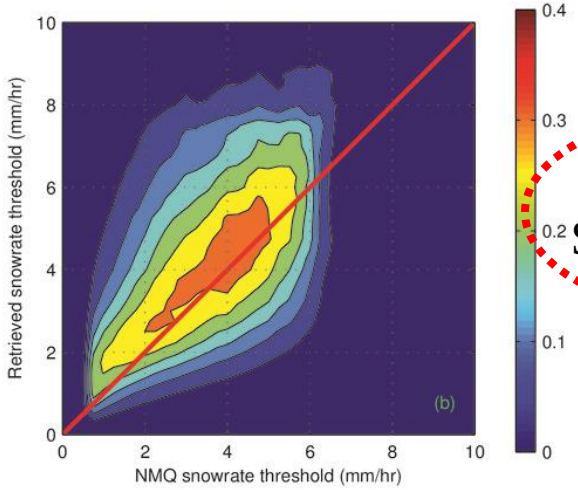




Rainfall
Stratified database

Snowfall
Single database

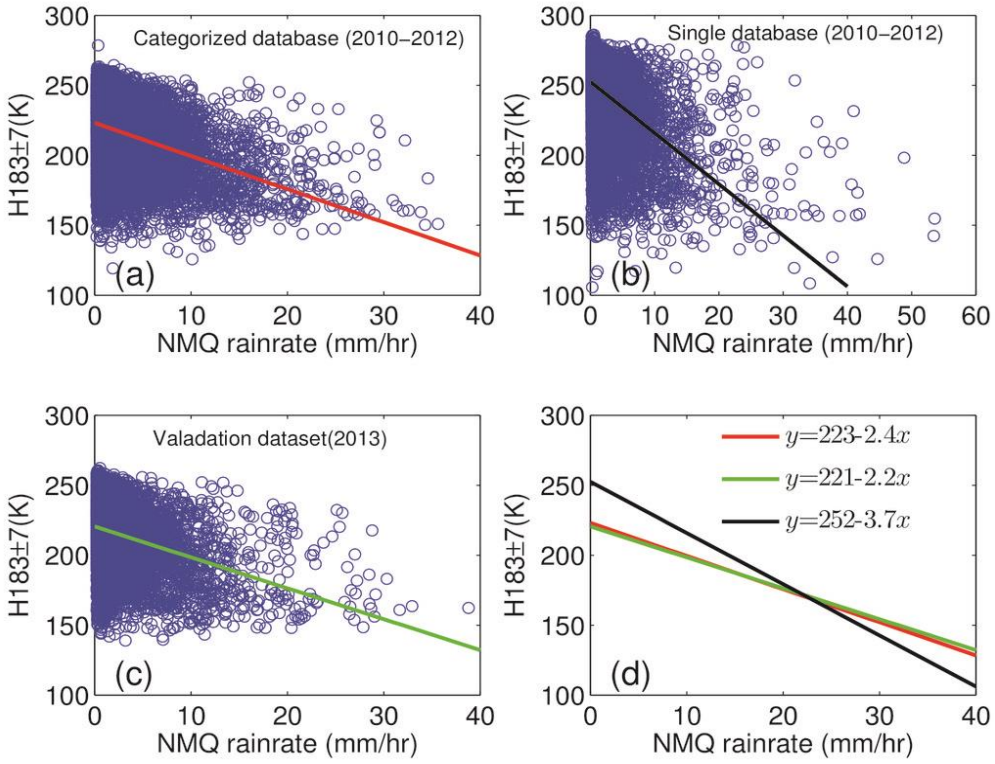




Snowfall
Stratified database

- **Larger HSS from stratified databases, indicates better performance.**

Why stratified databases perform better



- the TB-precipitation relation for new observations is much closer to that from the historical data in the corresponding category.

In summary

- **Using stratified databases, both the detection and retrieval performance are superior to that using the single database.**
- **The POD increases 8.1% and 20.6% for rainfall and snowfall detection by using the categorized databases.**
- **The correlation increases from 0.42 to 0.63 for rainfall, and 0.39 to 0.47 for snowfall when categorized databases are utilized.**
- **Applying this retrieval framework to the sounders within the GPM constellation (e.g., ATMS and MHS) is currently in progress.**