Analyzing the Storm Evolution and Microphysical Characteristics Using SMART

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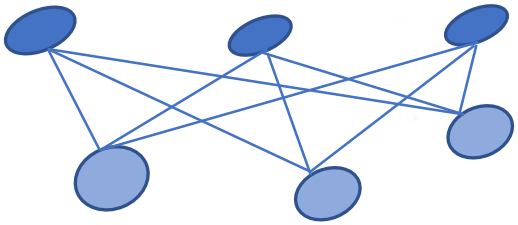
Introduction

❖Adopting the CPS identification algorithm from Dixon (1993) [吳(2019)]

❖2D & 3D CPS tracking：CPS distance and size differences between time-1 and time-2

Center distance: $d_p = [\,(x_{t1i} - x_{t2j})^2 + (y_{t1i} - y_{t2j})^2\,]^{(1/2)}$

Size difference: $d_A = |\,A_{t1i} - A_{t2j}\,|^{(1/2)}$



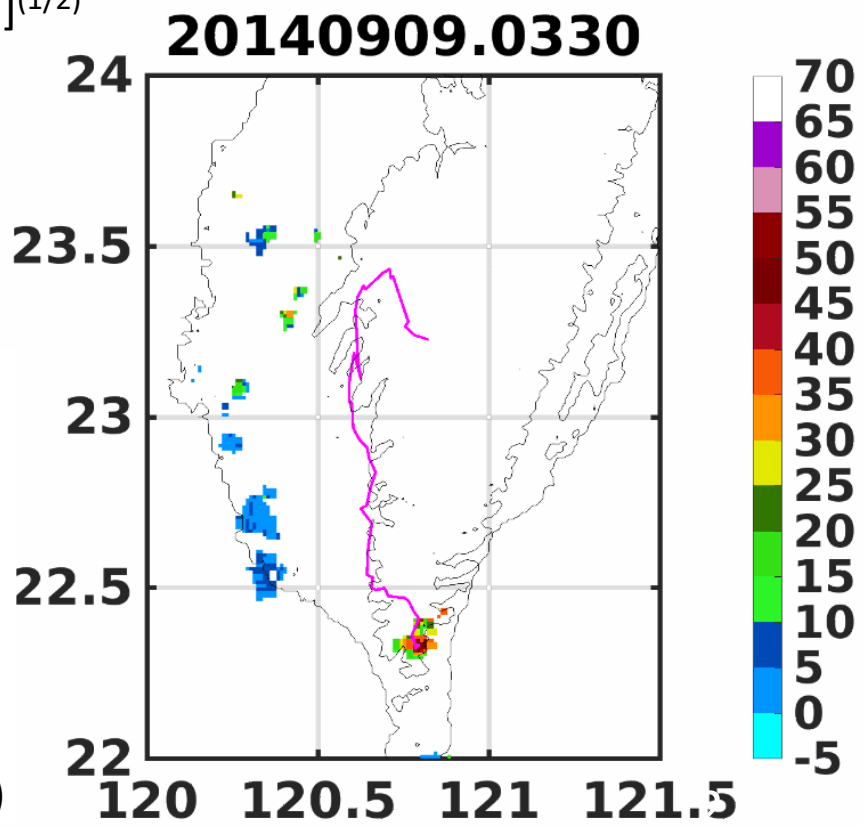
time-1

time-2

n^n combinations!!

❖Tracking information

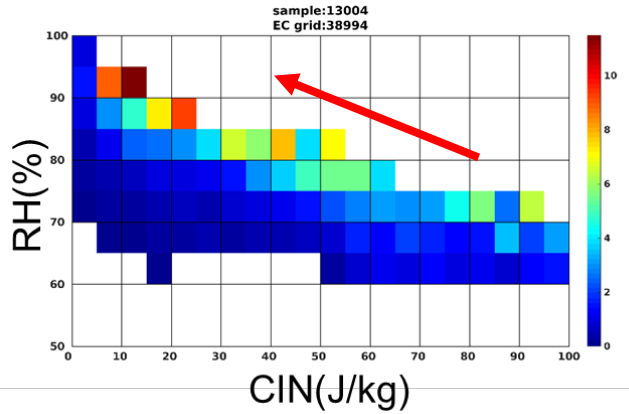
1. Duration (minutes)
2. Storm speed (m/s)
3. Storm moving direction (degree)
4. Evolution of structural characteristics (size, volume, maximum reflectivity, echo top)

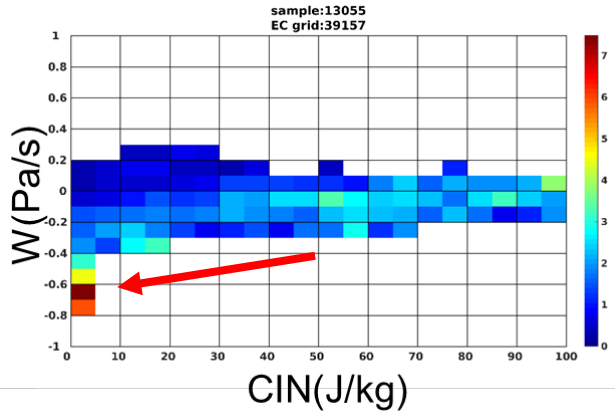


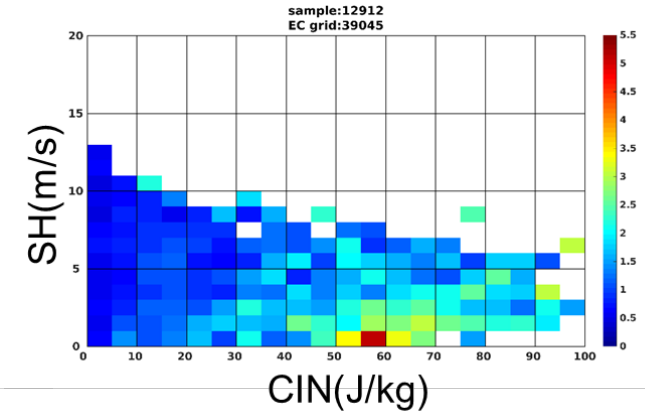
Introduction

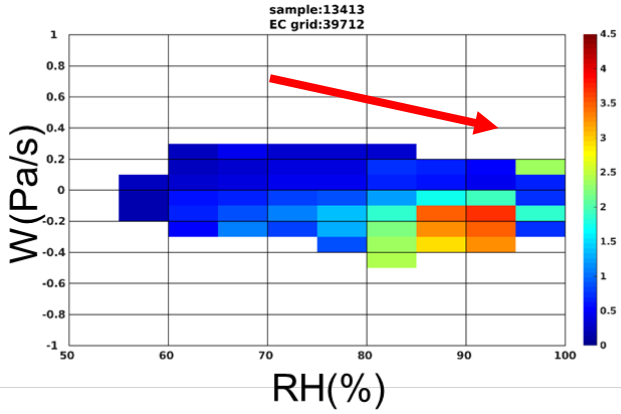
❖ [RH ↑ CIN ↓ ω ↓ SH ↓] → [CPS frequency ↑] [吳(2019)]

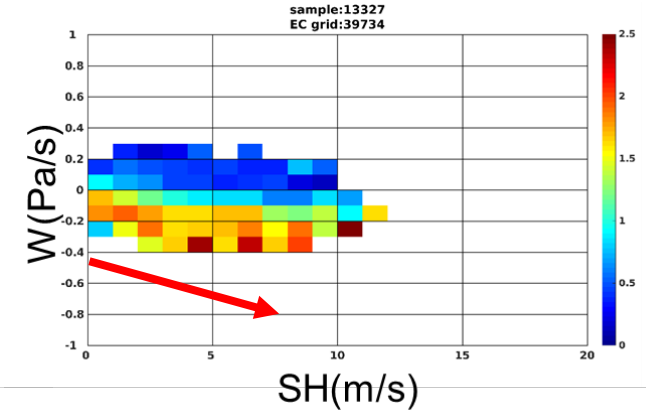
Land

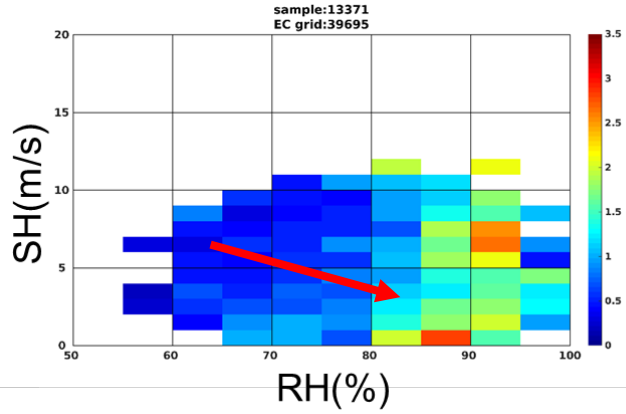






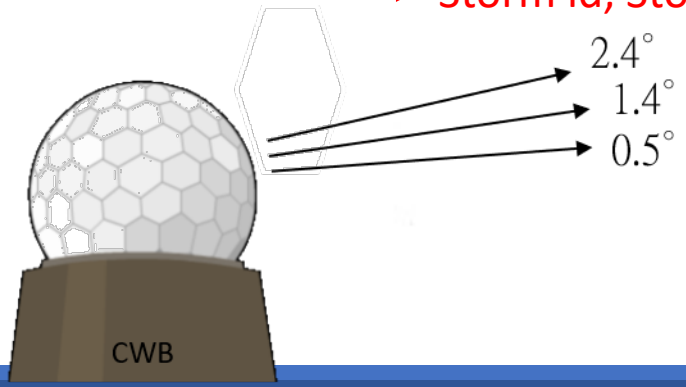


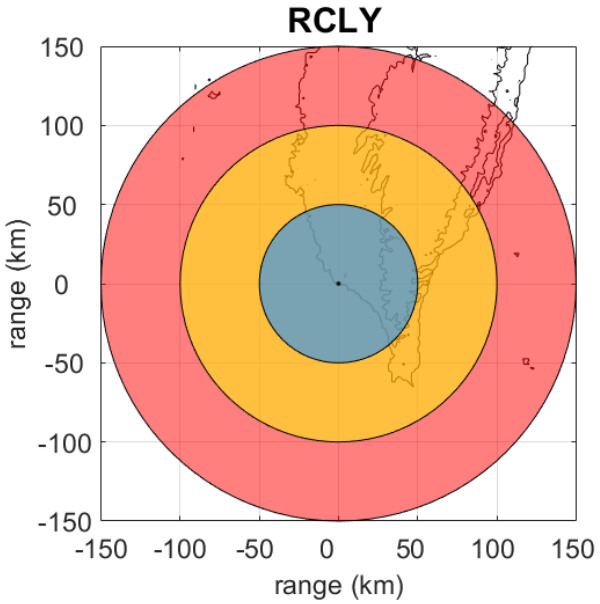




Introduction

- Storm Motion Analysis by Radar Tracking (SMART)
- QPESUMS Mosaic + PPI Data were use to identify storm locations.
- RCLY Radar Data is used in this study.
- Time resolution : 2 minute.
  - 4, 6, 8, 10 min.
- Variables : Z, Z_{dr}, K_{dp}, V_r, Phi_{dp}, ρ_{hv}, SW.
  - Storm id, Storm tracking.





Storm Motion Analysis by Radar Tracking (SMART)

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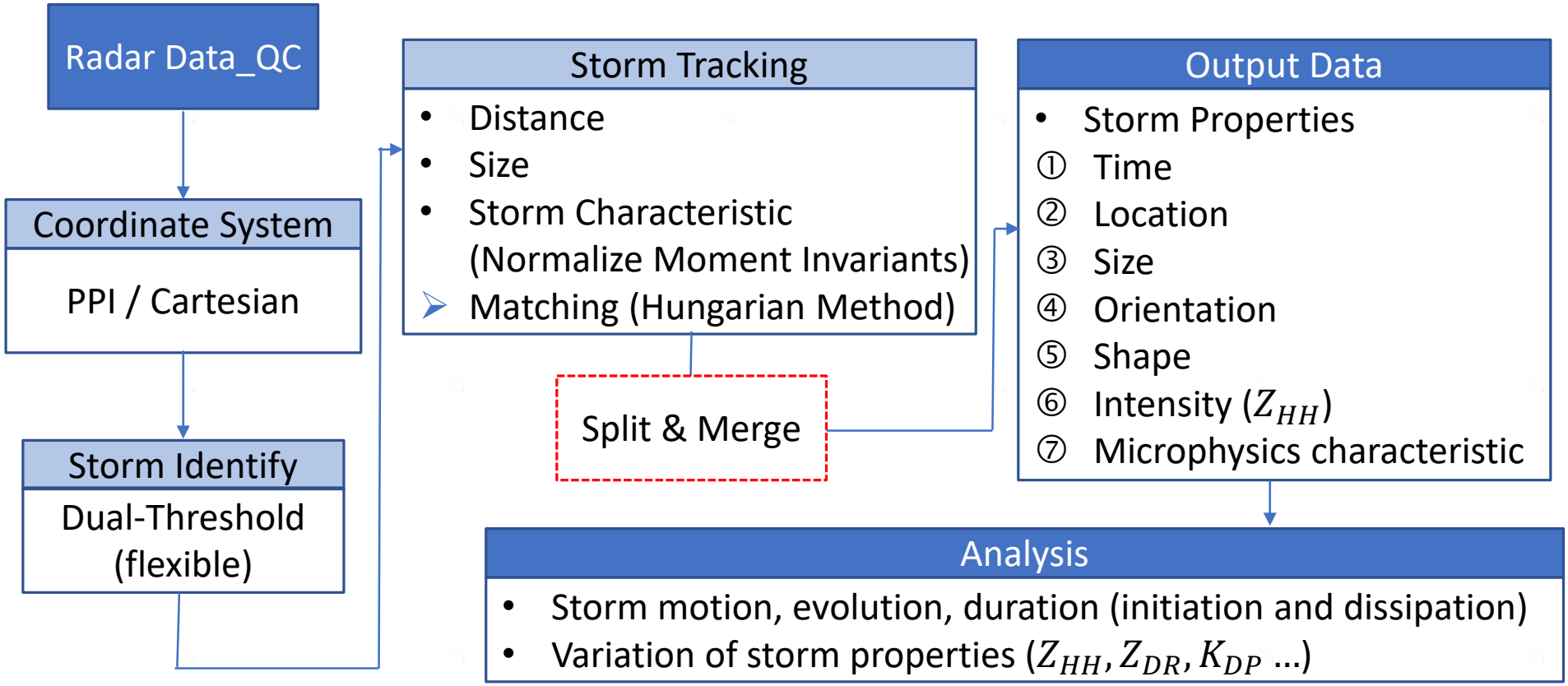


Investigate the characteristic of storm intensity and microphysics characteristic.
(from developing, mature to dissipation stage)

Storm Identification

Radar Data_QC

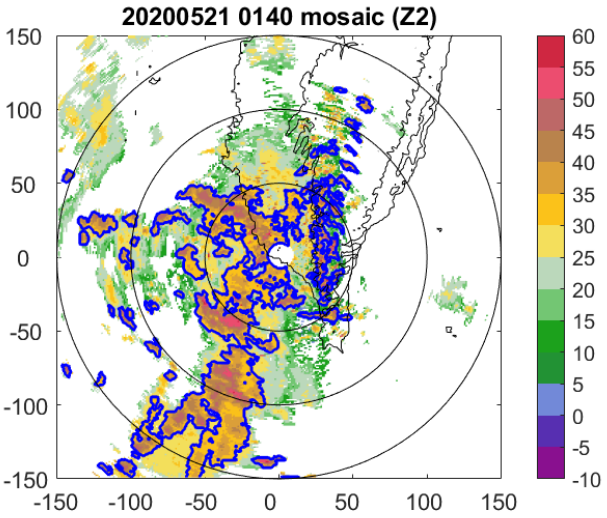
Reflectivity Threshold	Cell ID
35 dBZ	1, 2, 3, 4
20 dBZ	1, 2, 3
Dual_dBZ	1, 2

40 / 35 / 30 / 25 / 20

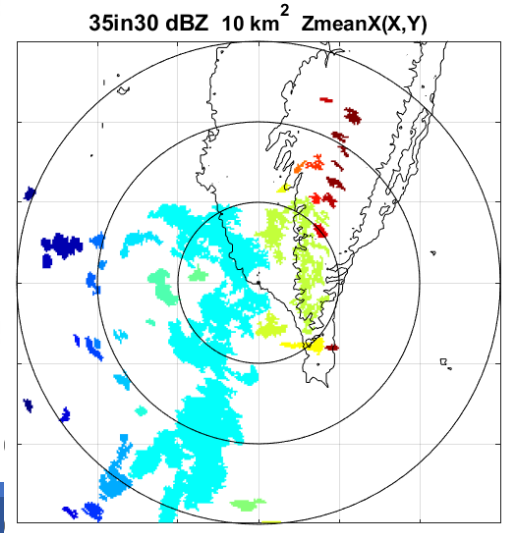
30 dBZ

- Convective system
- More area of precipitation

Cartesian Coordinate

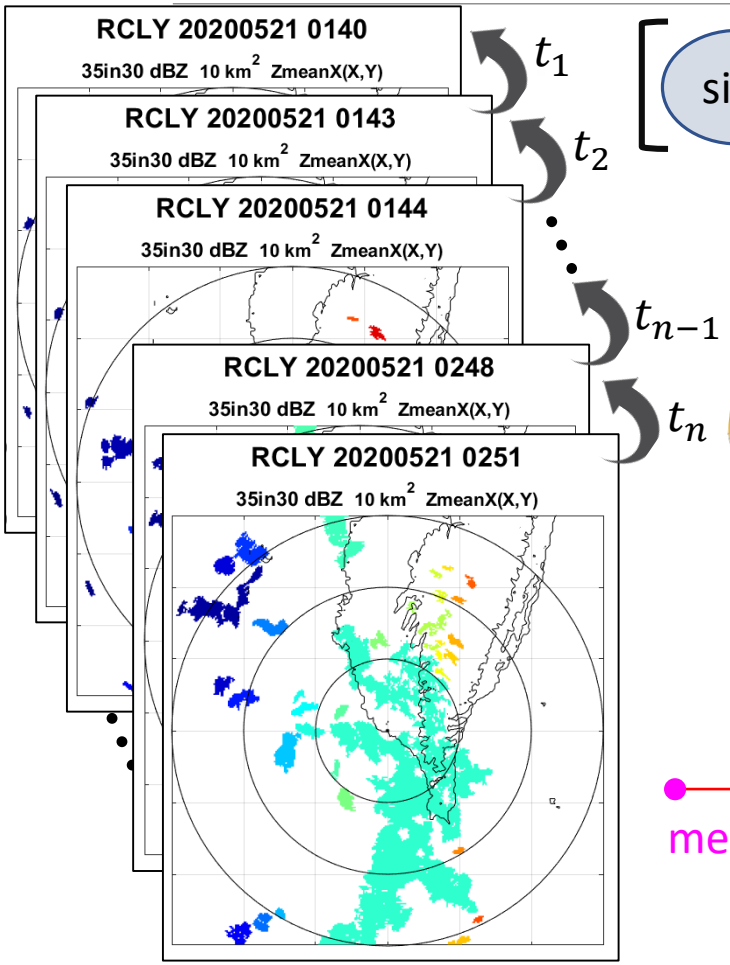


Storm Identification



Storm Tracking

Storm Identification



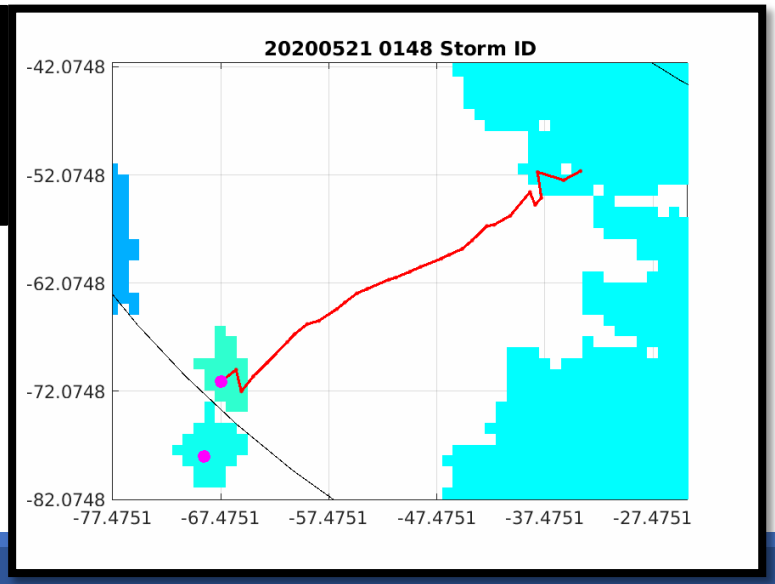
t_1 t_2 t_{n-1} t_n

$$\left[\text{size} + \text{distance} + \text{Moment Invariants}\right] = minimize$$

The more likely to be the same storm

Matching (Hungarian Method)

Storm Tracking Result

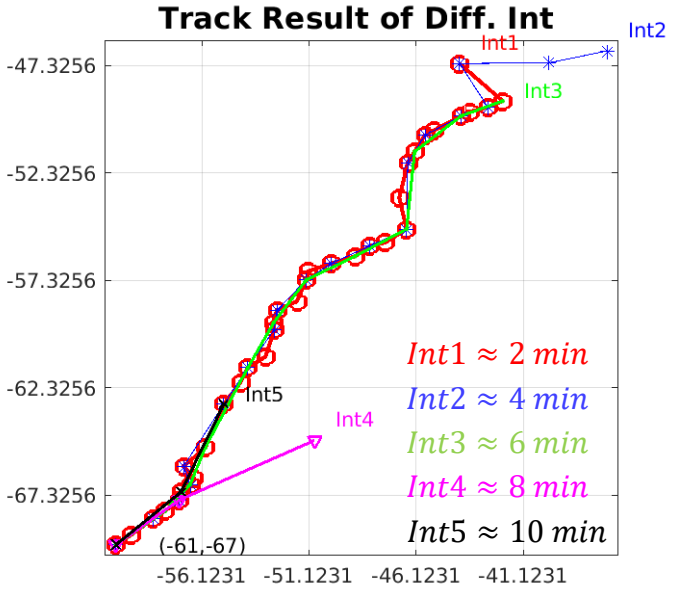


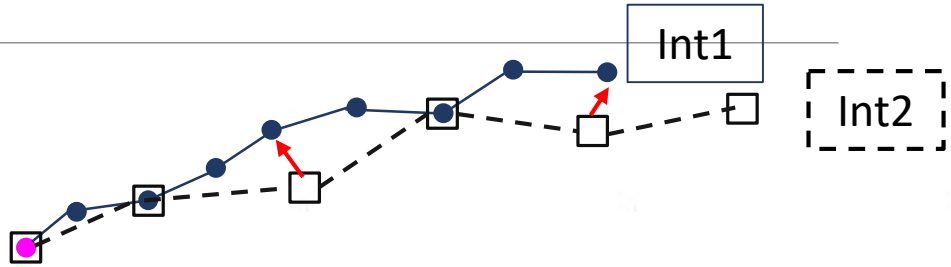
Track Path

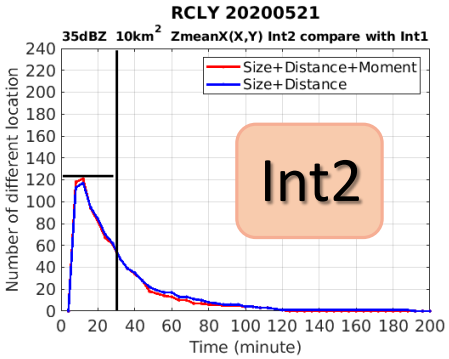
mean(x,y)

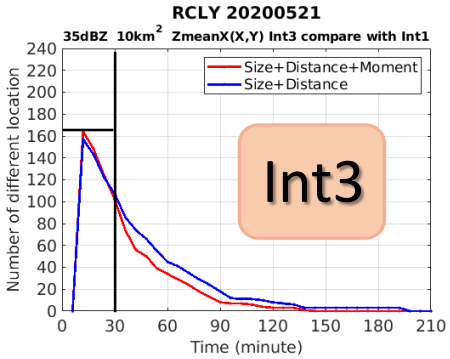
Analysis

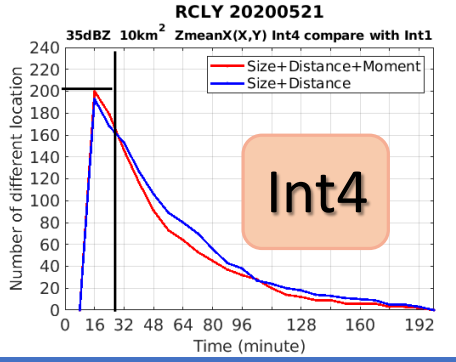
Tracking results in different time resolution

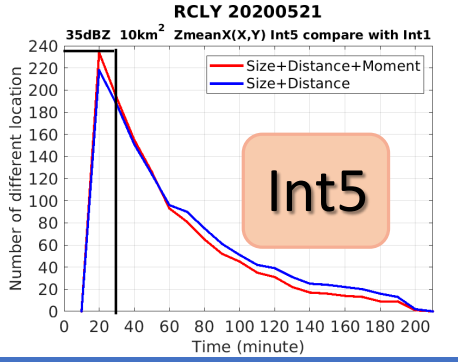




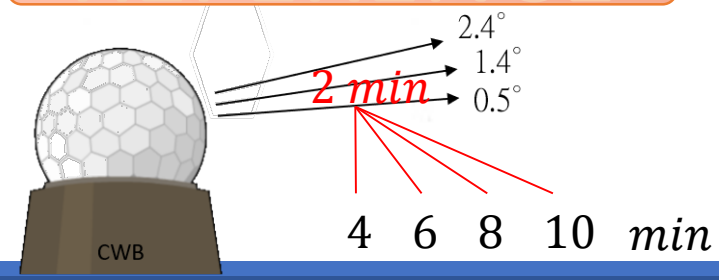






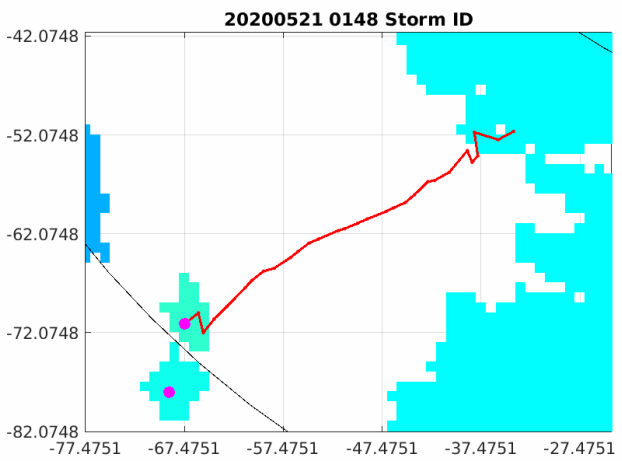


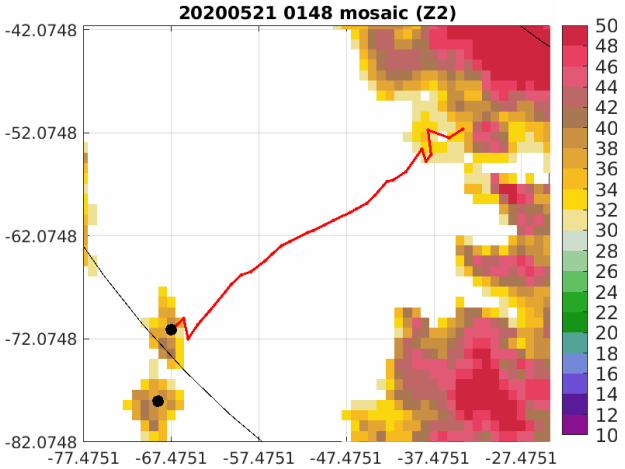
Int1 Size Distance Moment

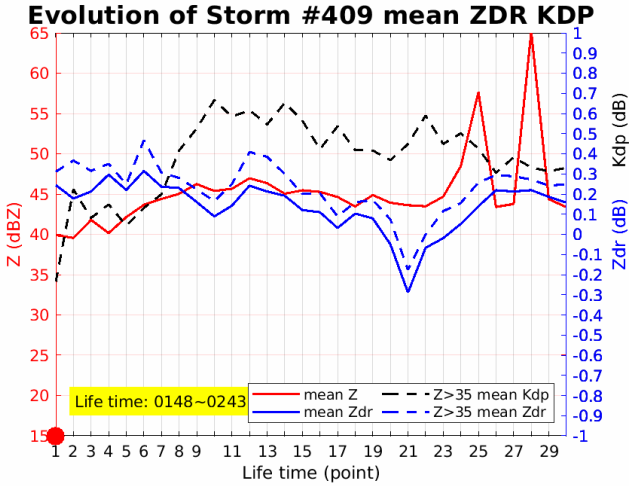


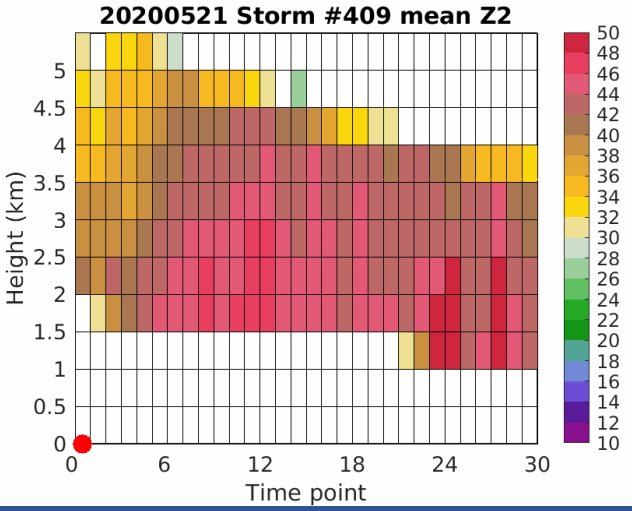
Analysis

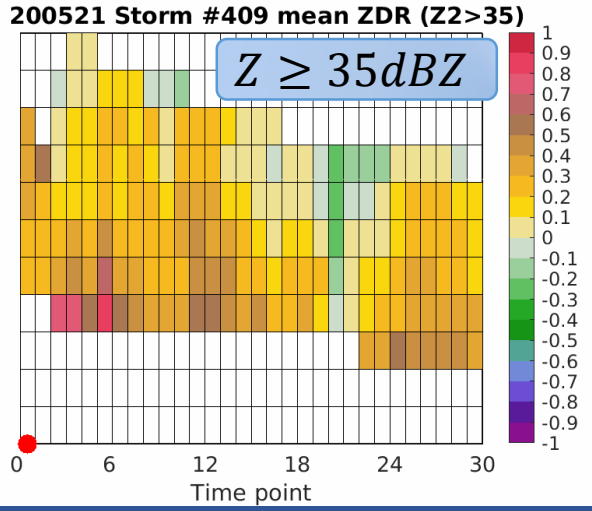
Int1 Area + Distance + Moment

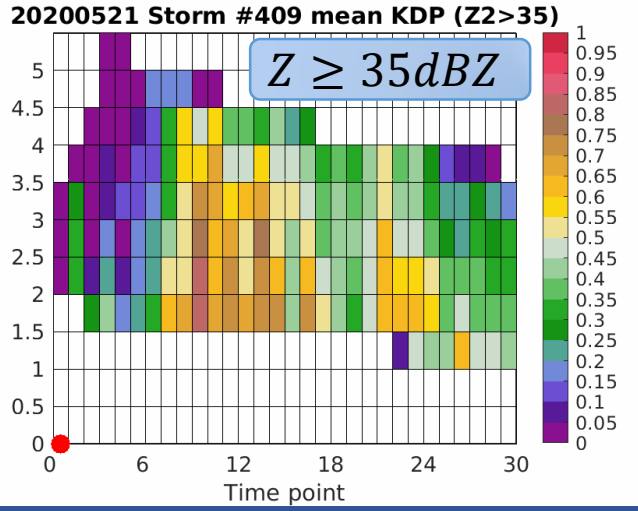






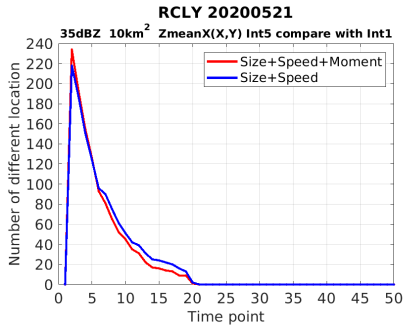


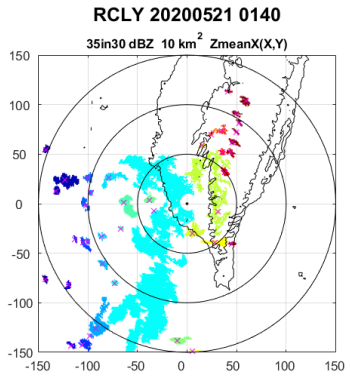


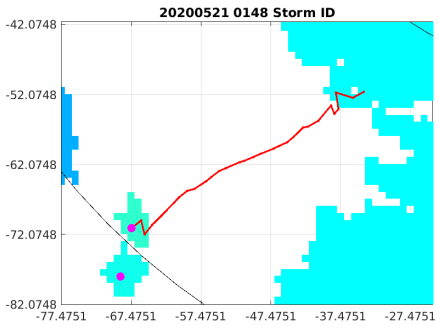


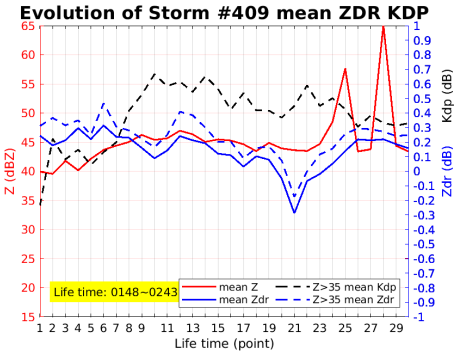
Summary

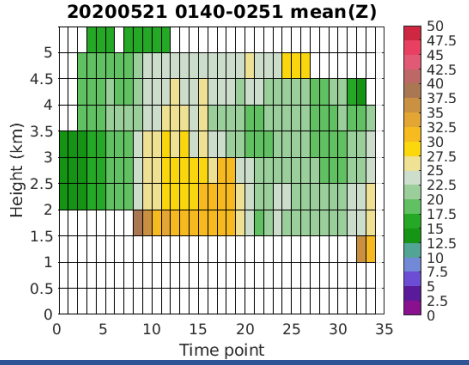
- Storm Motion Analysis by Radar Tracking (SMART)
- Storm identification, Storm tracking, Storm characteristic (Intensity, Microphysics …)
- Improve tracking technique using 2 min data:
  → Size + Distance (+Moment) is better
- Preliminary analysis of the evolution of dual-Pol measurements
- Threshold for Moment Invariants
- Consider storm split and storm merge into storm tracking algorithm











Thank for listening !