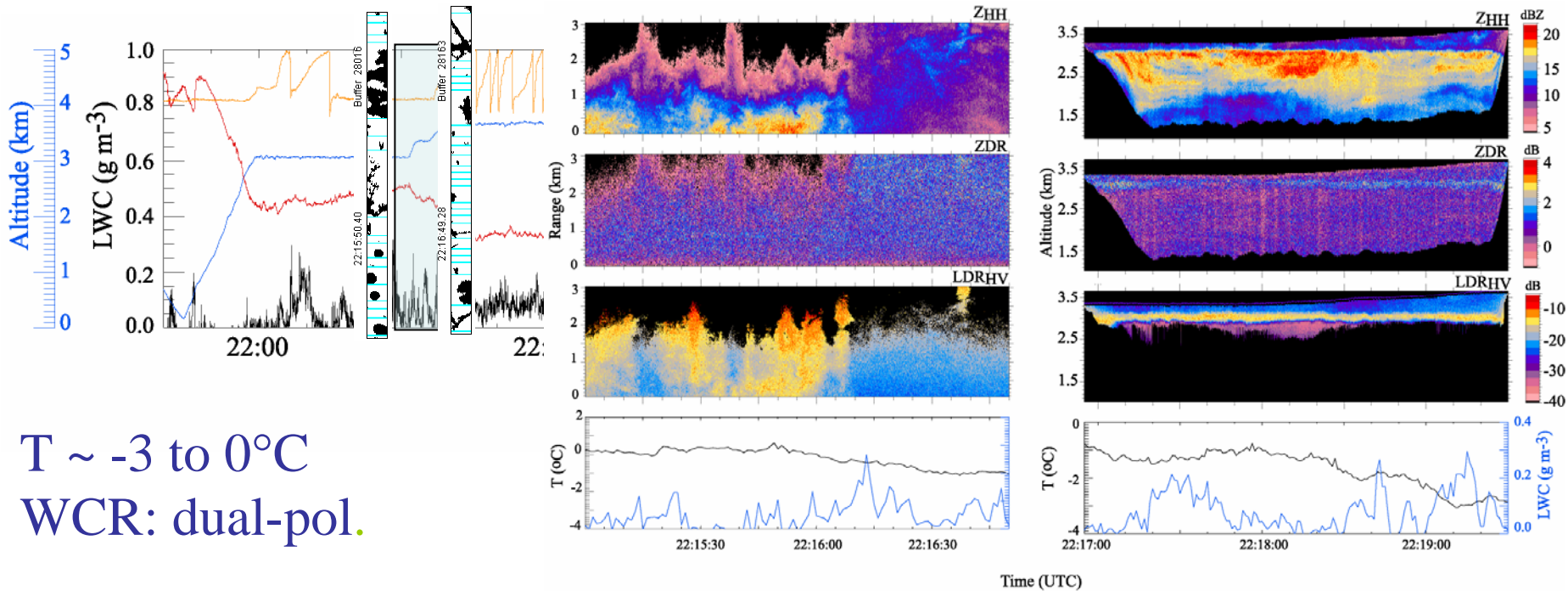


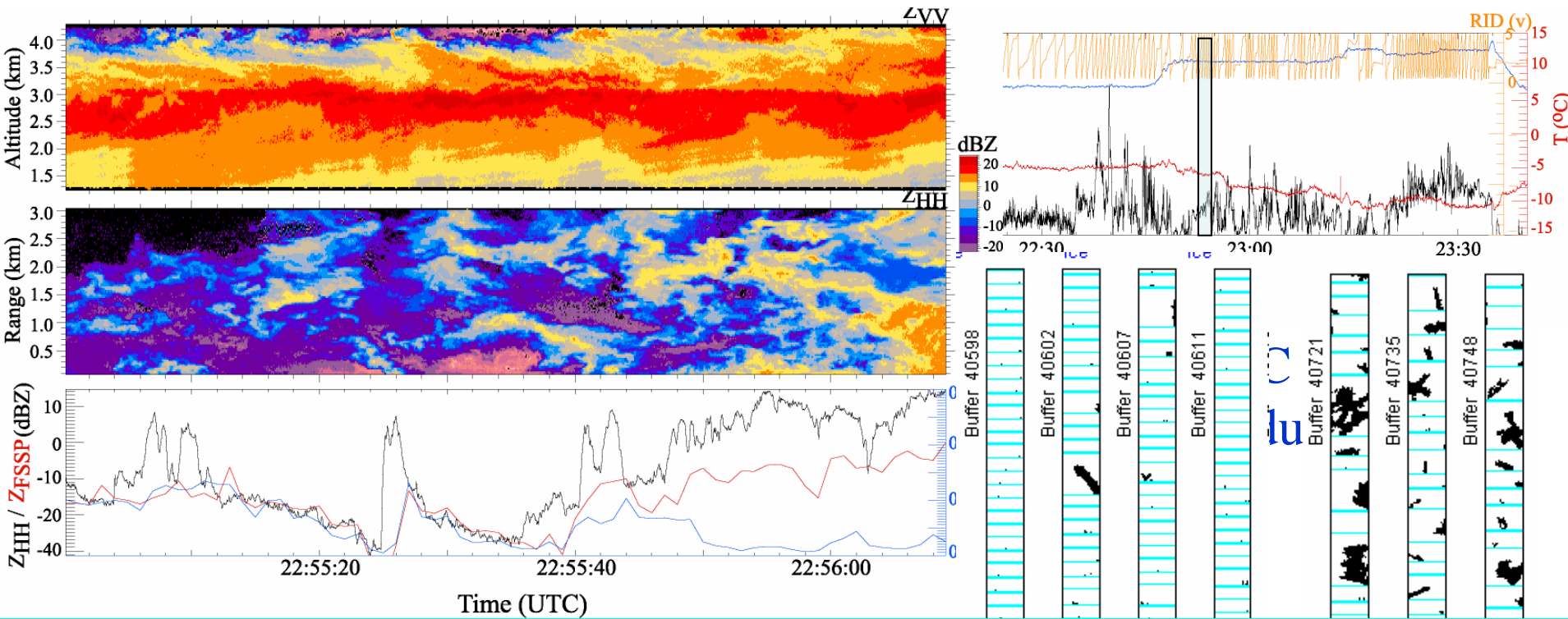
Nov 19, 2003 – Melting Layer to Mixed Phase



T ~ -3 to 0°C
 WCR: dual-pol.

- Melting layer: Z ~ 15-20 dBZ, LDR ~ -15 to -10 dB, ZDR ~ 0-3 dB
- Mixed phase: Z ~ 5-10 dBZ, LDR ~ -30 to -20 dB, ZDR ~ 0-1 dB
- Rain: LDR ~ < -30 dB, ZDR ~ 0 dB

Nov 19, 2003 – Cloud Top – Mixed Phase



- High Z change near cloud top (-30 to 10 dBZ), ML at 3 km
- Weak Z: calculated Z match the WCR Z at 75 m range
- High Z cores: mixed phase / ice

Radar vs. In-situ

- ❖ Good correlations between in-situ and radar data at close range (60-105 m)
 - ❖ Fine-scale cloud organization in icing and mixed phase segments
 - ❖ Measurable LDR and high ZDR in Pristine crystals
 - ❖ Icing layers (all liquid) weak Z (< -10 dBZ) and zero ZDR and no measurable LDR
- ❖ Next step:
- ➔ Automatic classifications of in-situ particle data
 - ➔ Obtain radar signatures of different particle types
 - ➔ Classify radar data into different particle types

Combining in-situ and radar data

AIRS II Statistical Analysis

File Edit Insert Operations Window Help

100%

One Flight One Day Total Data

SAVE SUBMIT CHANGES

AIRSII NAMUX

Displayed Parameter(s):

- Display ZHH
- Display ZW
- Display ZDR
- Display LDR-HV
- Display LDR-VH
- Display ALL

Option Settings:

Results Folder: F:\AIRSII_Results\

Display Range for Gates:

Initial Gate 1 Final Gate 3

Display Time Range (hhmmss,dd):

1. Initial 201322.25 Final 202734.15

Select Particle Type for Processing:

Display User Defined Particle Name: (Optional)

PARAMETERS

ANGLE SELECTION

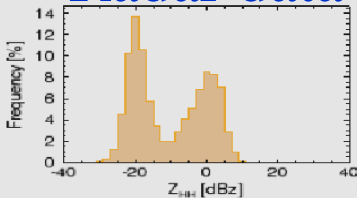
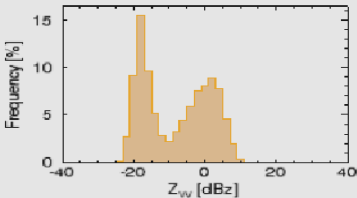
RAYS SETTINGS

CONSTANTS

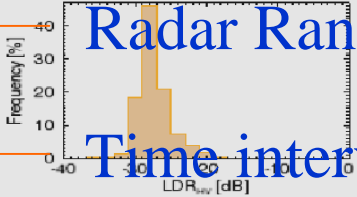
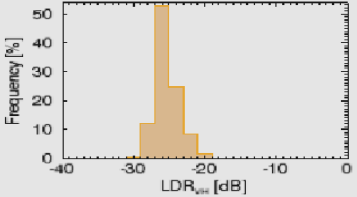
USER DISPLAY

A B C
 0: Zero_Particle 1: Small_Drizzle
 2: Large_Drizzle 3: Drizzle/Rain
 4: Drizzle/Odd_Crystal 5: Mixed_Rain/Ice
 6: Mixed_Drizzle/Ice 7: Circular_Ice
 8: Eight_Particle 9: Crystals
 10: Needles 11: Dendrites
 Process all particles Process each type

Radar data

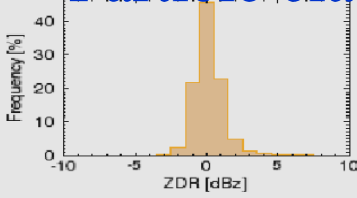
In-situ data range (T, LWC ...)

Radar Range

Time interval

Particle classification data (A, B, C...)



STATISTICAL ANALYSIS FOR NOVEMBER 11

Current File: A\2003-11-11-30-14-27

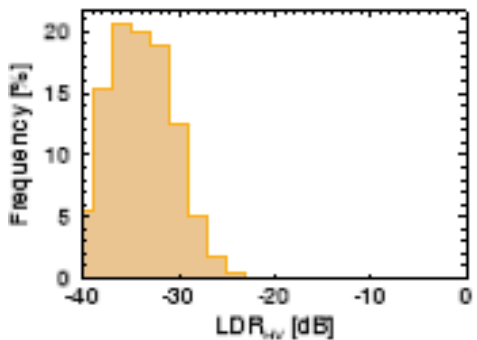
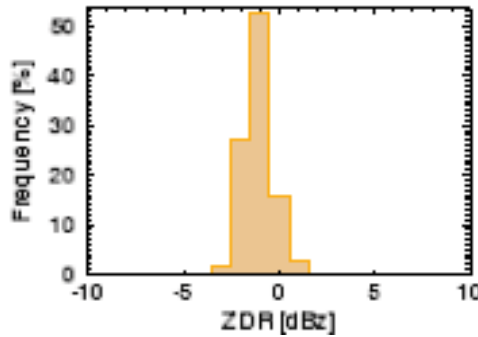
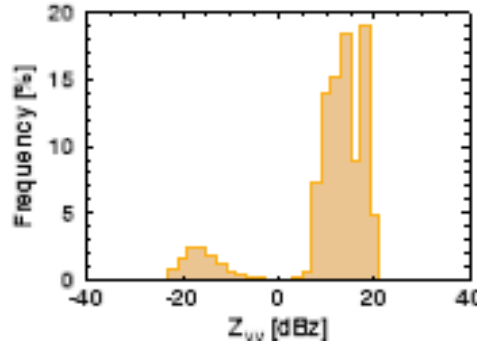
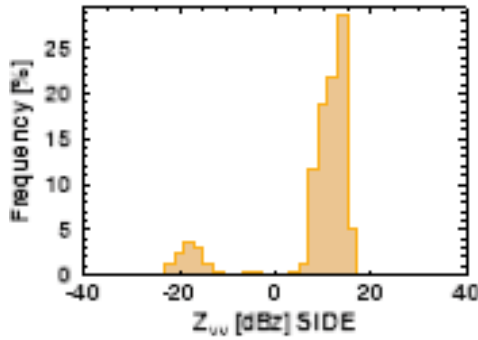
Time Range: 20:13:22.25 20:27:34.15

Gate Range: 1 3

All particle types have been processed

	# of pts	Min	Max	Mean	Stnd Dev
Z _{hh}	75316	-29.7	10.3	-10.3	10.1
Z _{ww}	67293	-23.4	11.3	-8.0	9.3
LDR _{hv}	16285	-39.2	-16.3	-27.3	2.3
LDR _{vh}	7849	-34.0	-19.1	-25.3	1.6
ZDR	66725	-3.2	8.1	0.2	1.0

Nov 11: Radar Signature – Circular



STATISTICAL ANALYSIS FOR NOVEMBER 11
 Current File: nov11
 Time Range 19:17:03.00 22:33:51.70
 Gate Range 1 3
 Processed Particles: Circular

	# of pts	Min	Max	Mean	Stnd Dev
Up/Down Antenna Configuration:					
Z ^{hh}	15321	-28.4	18.5	9.9	9.6
Z ^{vv}	15515	-23.0	21.0	12.5	9.9
Side/Side Antenna Configuration:					
Z ^{hh}	15129	-29.4	15.1	4.9	11.0
Z ^{vv}	14455	-23.0	17.5	8.2	9.9
LDR ^{hv}	9000	-40.0	-22.9	-34.0	3.3
LDR ^{vh}	9206	-39.2	-19.4	-28.6	3.1
ZDR	14385	-3.2	2.2	-1.1	0.7

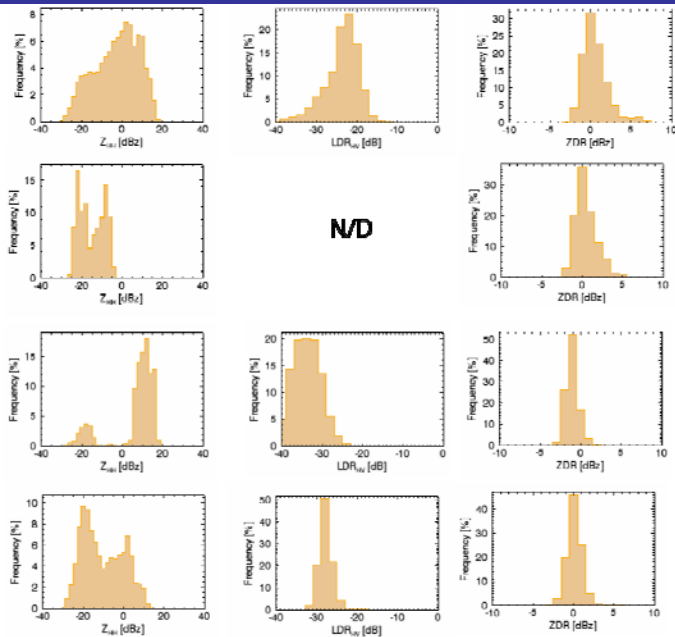
- ❖ Bi-modal Z distribution (cloud drop & drizzle/rain)
- ❖ LDR below detection limit of -30 dB
- ❖ ZDR ~ 0 dB (H/V gain bias in the data)

Hydrometeor Type Identification from Radar Polarimetric Signatures

- ❖ Fuzzy-logic based image classification
 - ✈ Modified NCAR (Dr. Vivekanandan) program
 - Use flight level temperature values
 - More functionality for airborne application
 - Use only Z, ZDR and LDR
 - Frequency distribution/thresholds based on in-situ data
 - work in progress

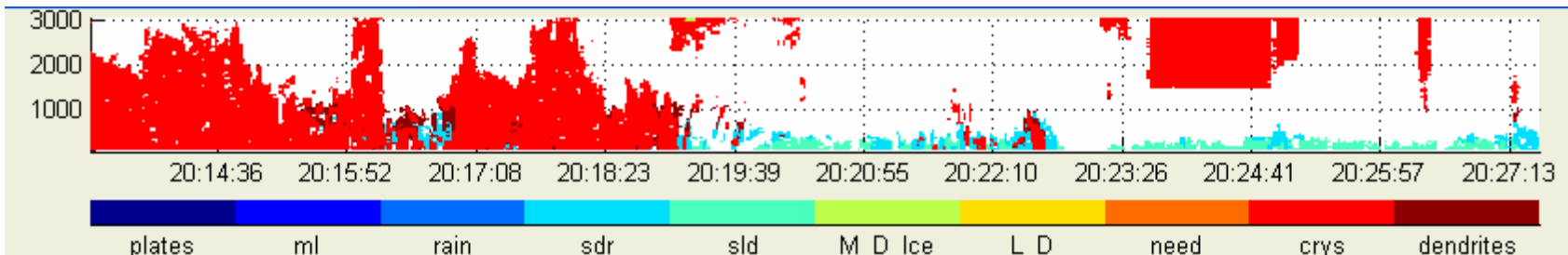
Fuzzy-logic based particle classification

Radar signatures of particles – coincident radar and in-situ measurements

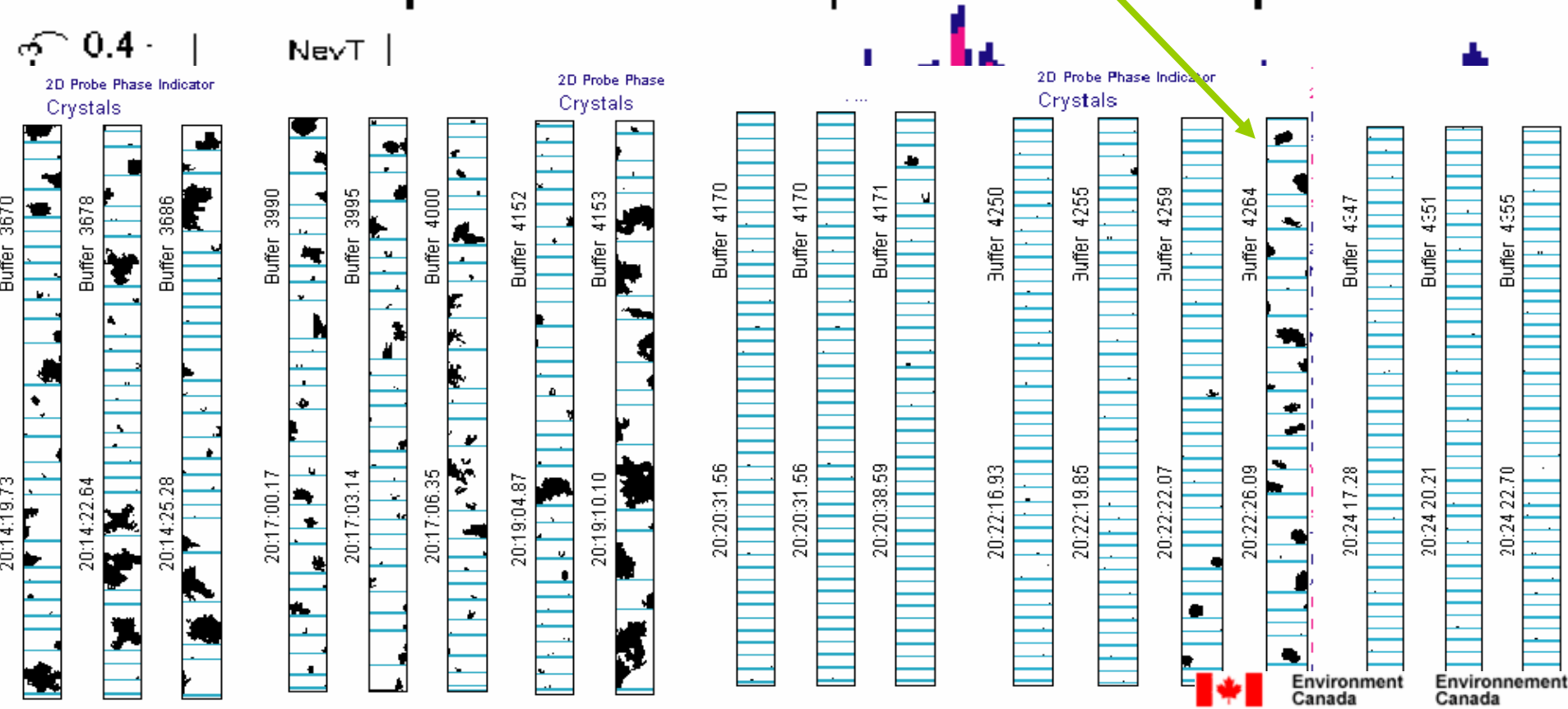
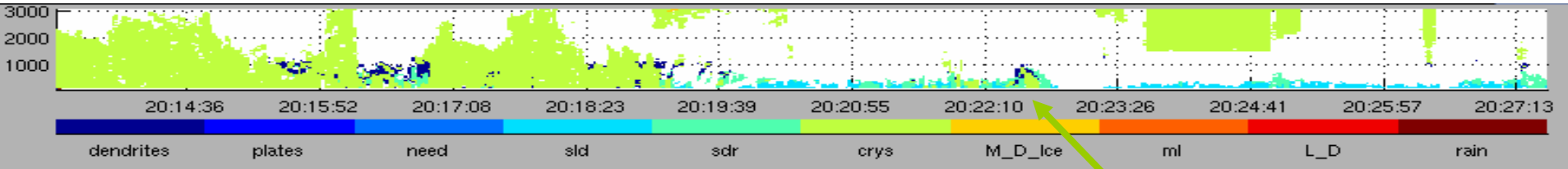


N/D

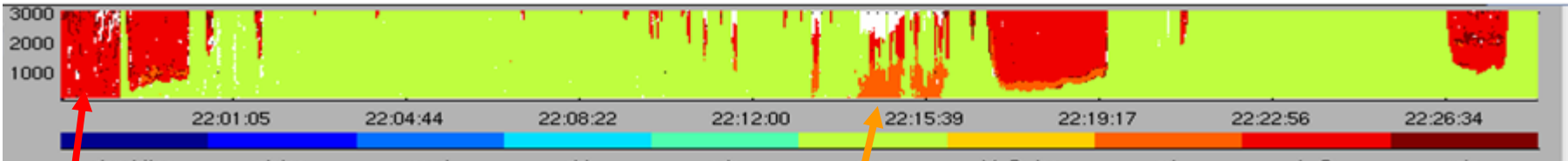
Determine particle membership functions



Nov 11: Particle type: Radar / In-situ



Nov 19: Particle type: Radar / In-situ



2D Probe Phase Indicator
Drizzle/Rain

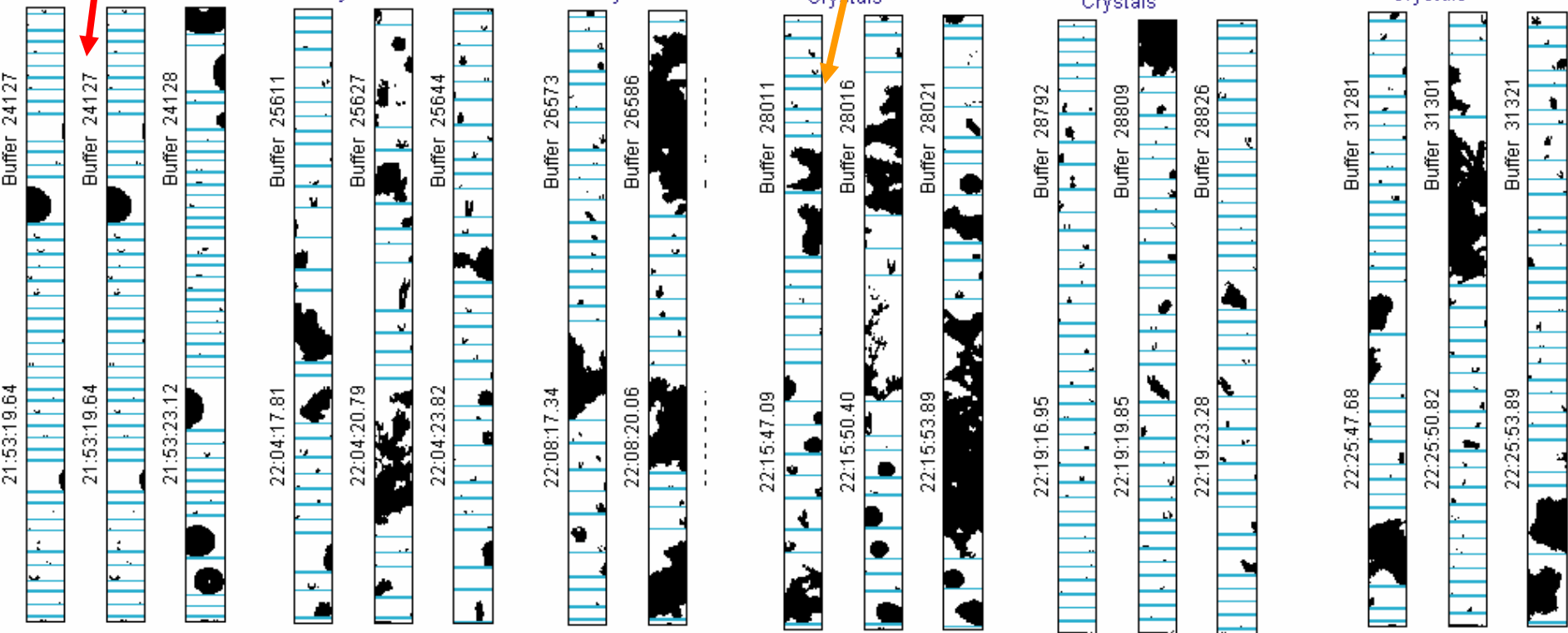
2D Probe Phase Indicator
Crystals

2D Probe Phase I
Crystals

2D Probe Phase Indicator
Crystals

2D Probe Phase Indicator
Crystals

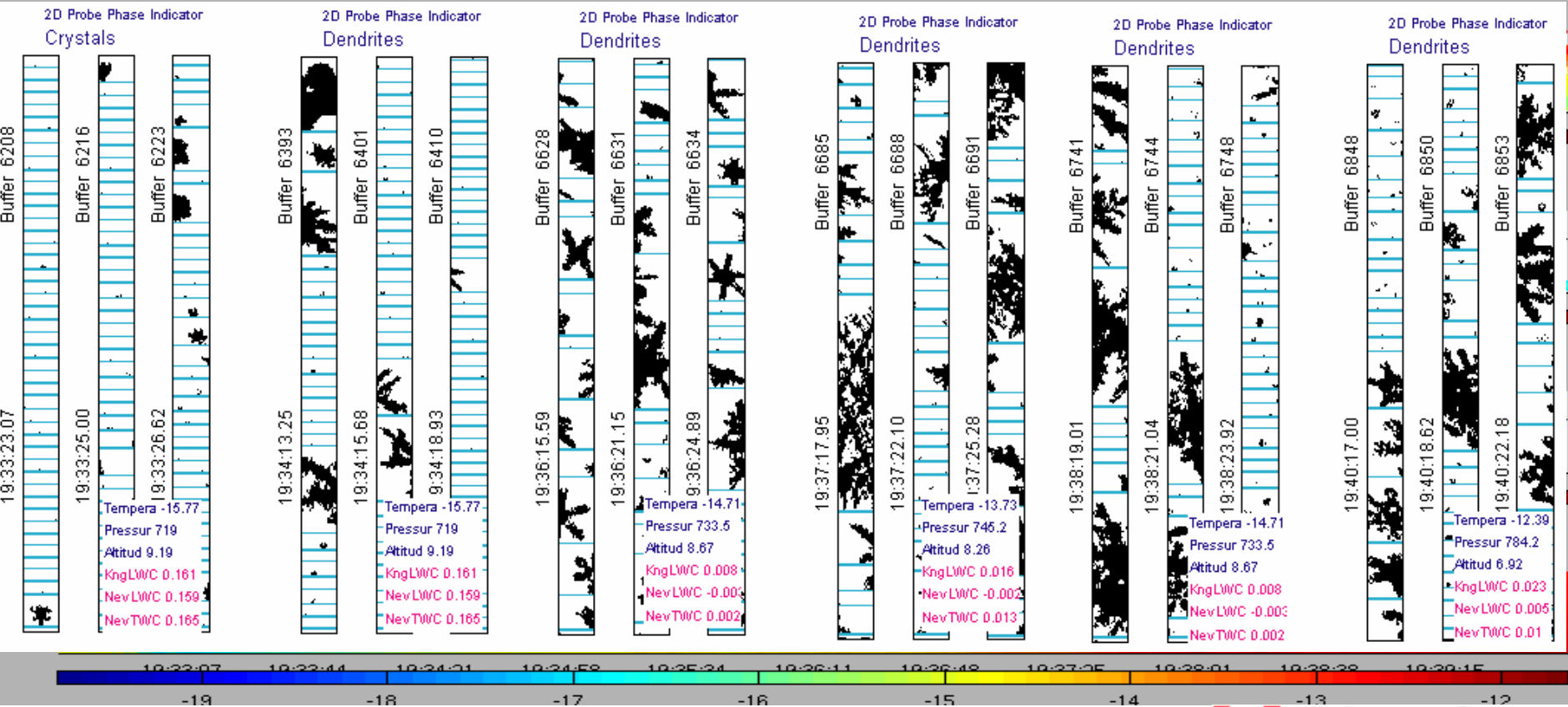
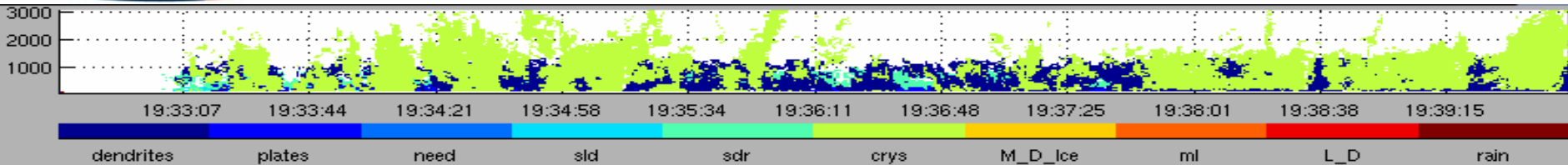
2D Probe Phase Indicator
Crystals



Ireg 5-9 214 Circle 5

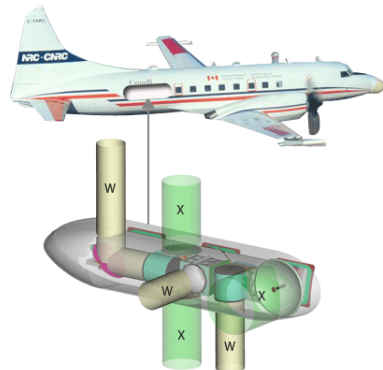


Nov 24: Particle type: Radar / In-situ



Particle Types Identification

- ❖ Good agreement between fuzzy-logic particle type classification result including icing from radar with in-situ cloud microphysics data
- ❖ Issues/Future work:
 - Identification of mixed phase clouds – plan to add other radar variables: Doppler velocity field, Dual-frequency option, more polarimetric variables
 - Image classification from in-situ measurements



<http://www.nawx.nrc.gc.ca>