



UNIVERSITÄT
LEIPZIG

MEASURING SNOWFALL PROPERTIES WITH THE OPEN-SOURCE VIDEO IN SITU SNOWFALL SENSOR (VISS)

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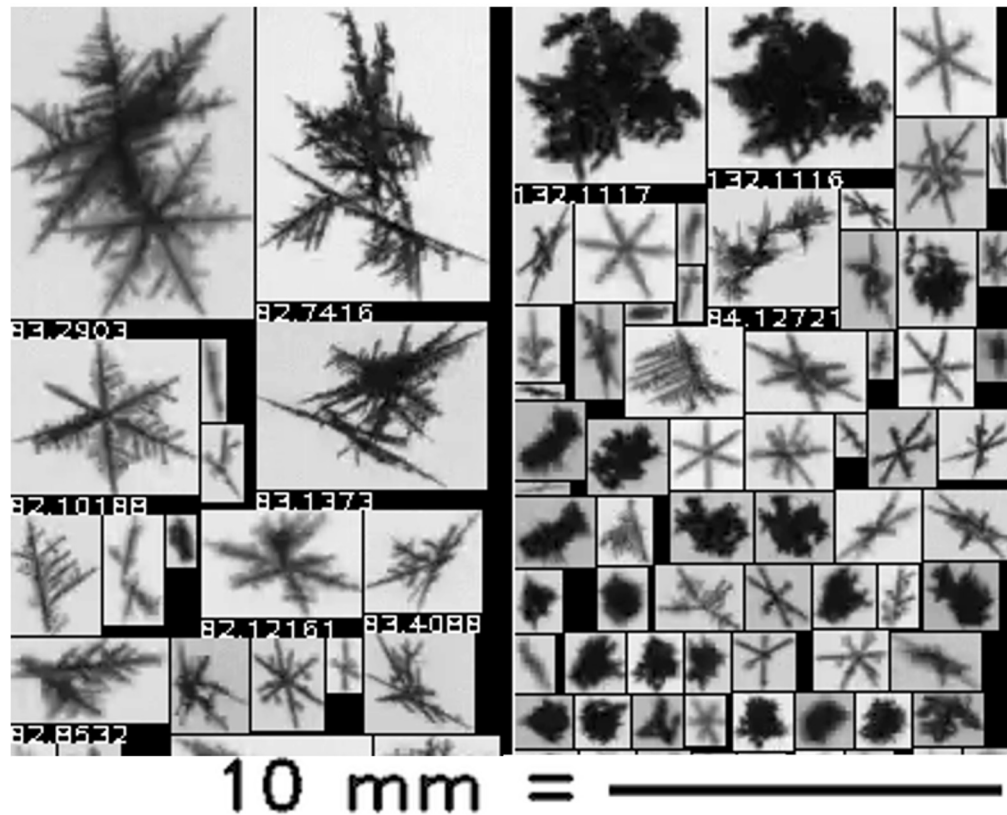
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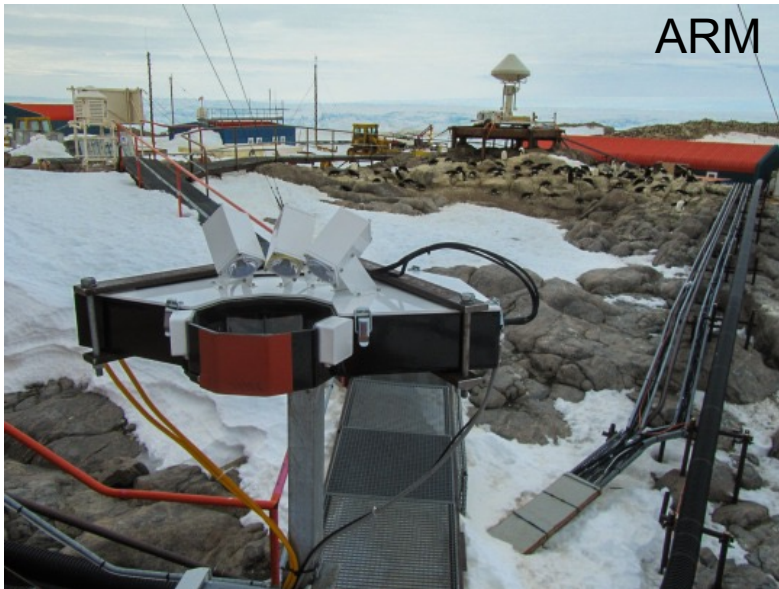
WHY OPTICAL SNOWFALL OBSERVATIONS?



- Identify dominant growth process
 - aggregation
 - riming
- Constrain remote sensing observations
 - particle size
 - particle shape
 - particle type

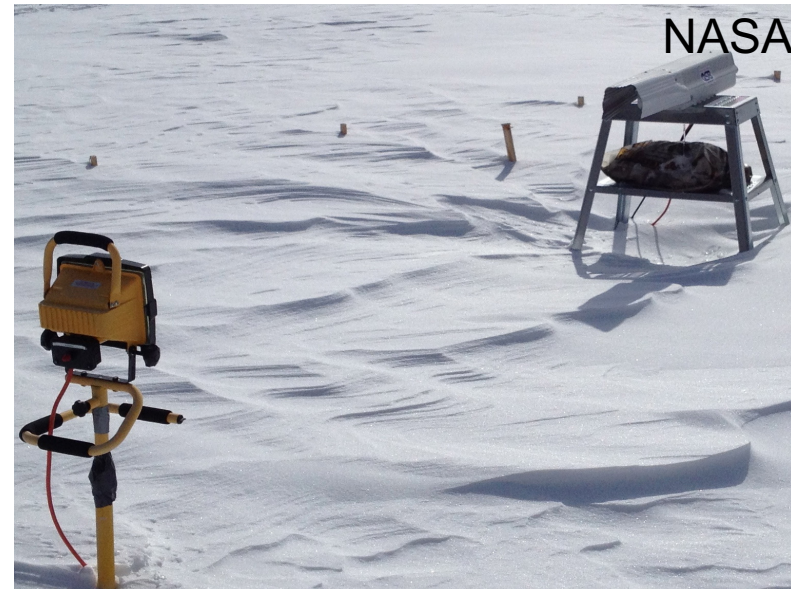
ESTABLISHED SENSORS

MASC



- + high resolution
- + three angles
- small observation volume
- fall velocity disturbed by instrument

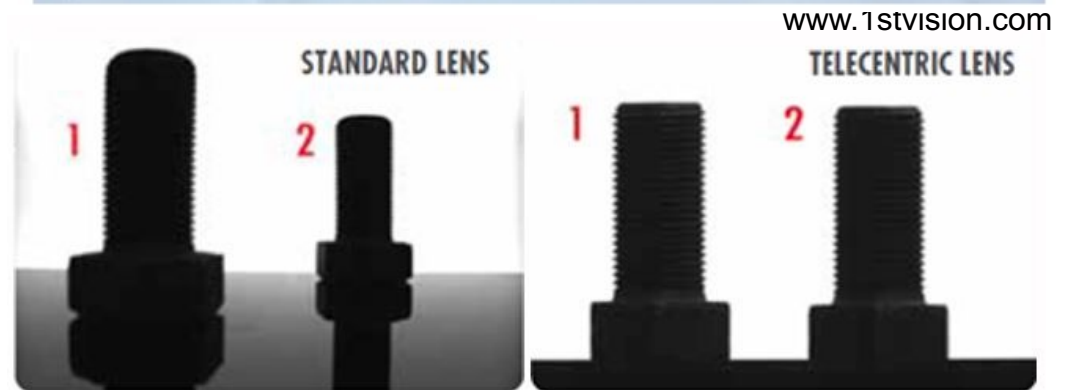
PIP



- + large observation volume
- + no disturbance of fall velocity by instrument
- medium resolution
- single angle

VIDEO IN SITU SNOWFALL SENSOR (VISS)

- combine high resolution images (42 to 59 μm) and large sampling volume (up to 75 x 75 x 61 mm)
- use two cameras to observe from two angles and constrain observation volume
- high framerate (150 - 250 Hz) allows for tracking of particles
- minimize wind disturbance
- telecentric lenses eliminate sizing error
- open source hardware & software



DEPLOYMENTS



MOSAiC, 2019/20



Hyytiälä, Finland 2021/22



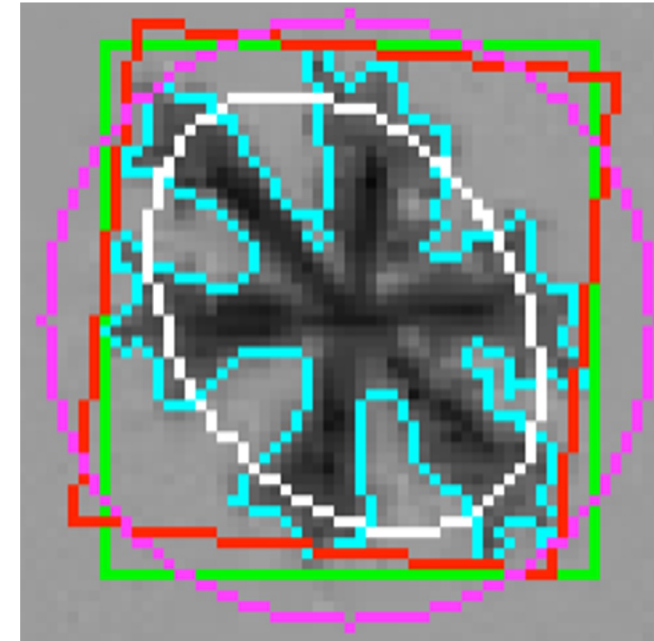
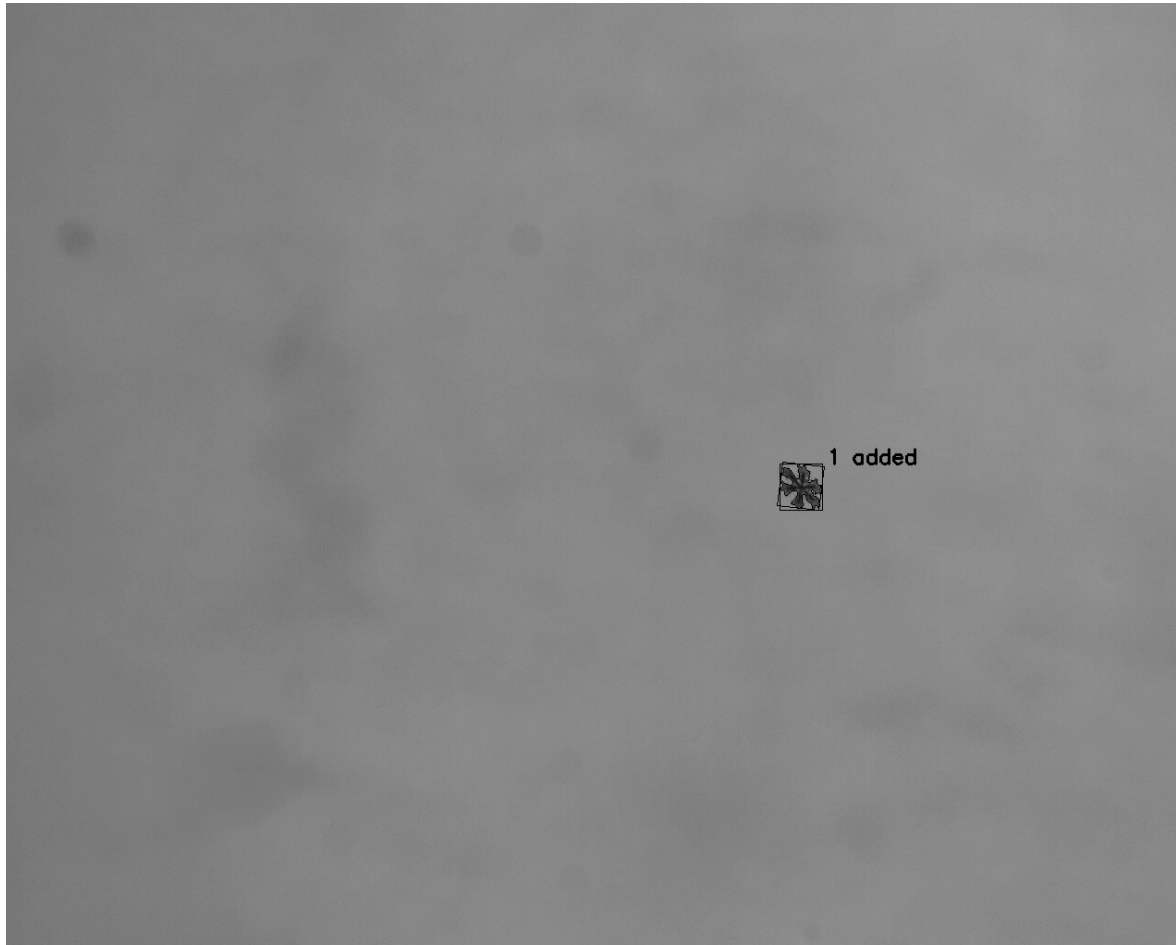
SAIL, Colorado 2022/23



Ny-Ålesund, Svalbard
since 2021

VISS DATA PROCESSING

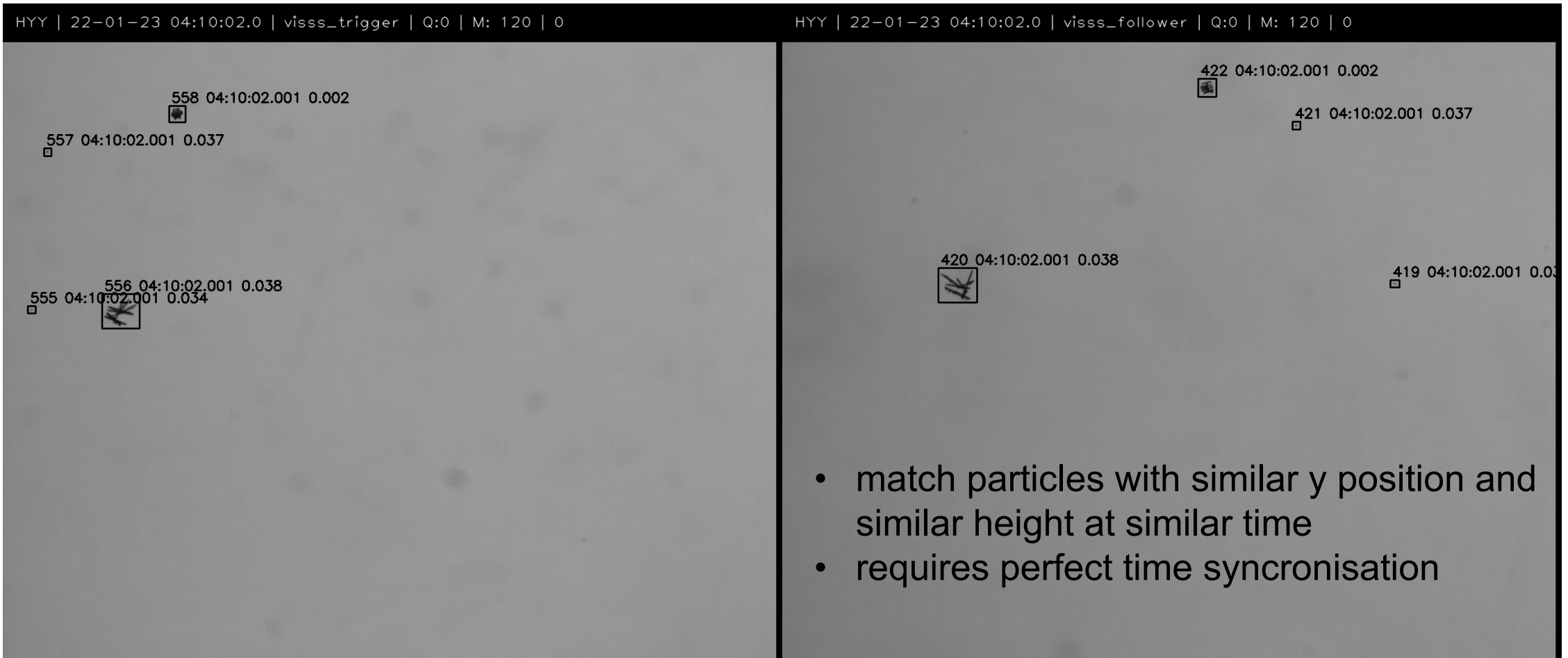
(1) PARTICLE DETECTION AND SIZING



openCV: estimate Dmax
(magenta), perimeter (cyan), area
(cyan), aspect ratio (red/white)

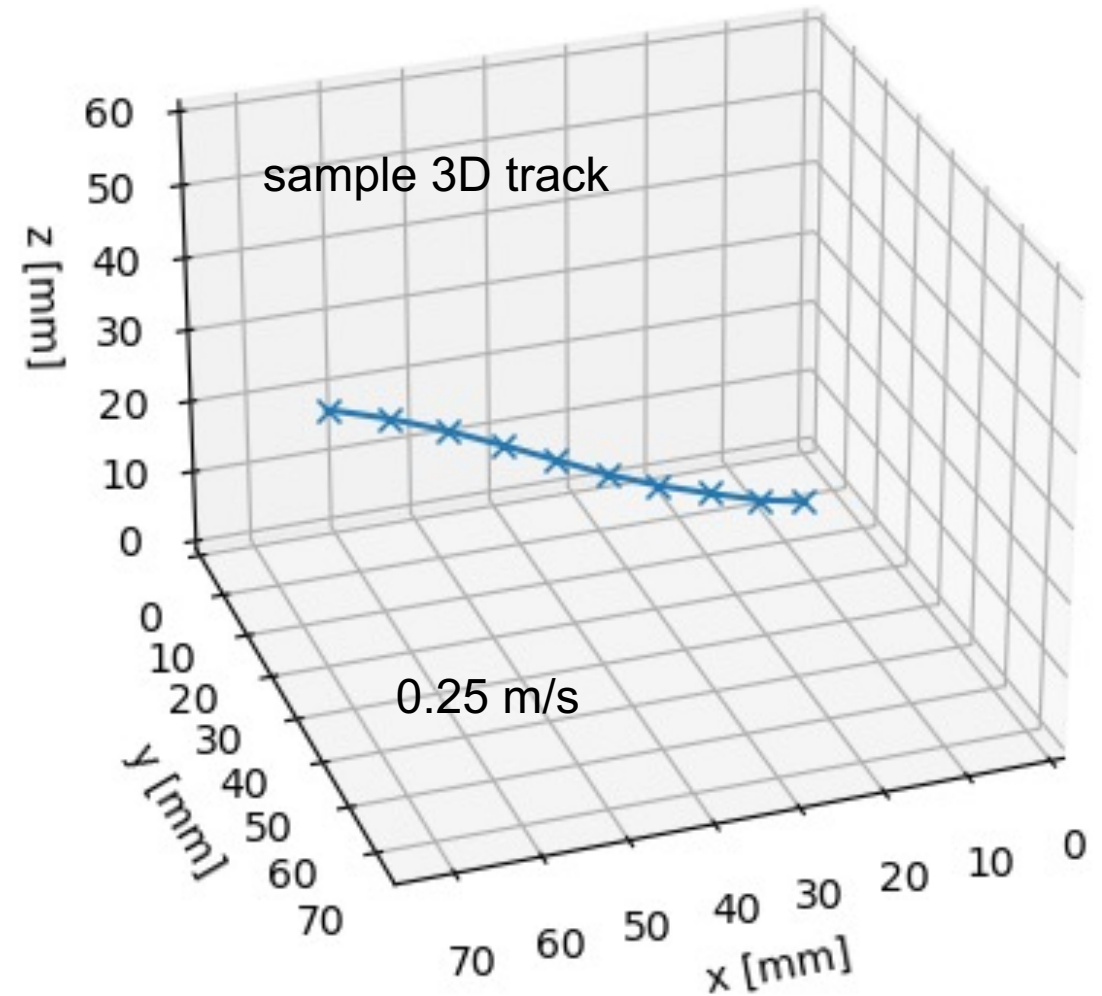
VISS DATA PROCESSING

(2) PARTICLE MATCHING



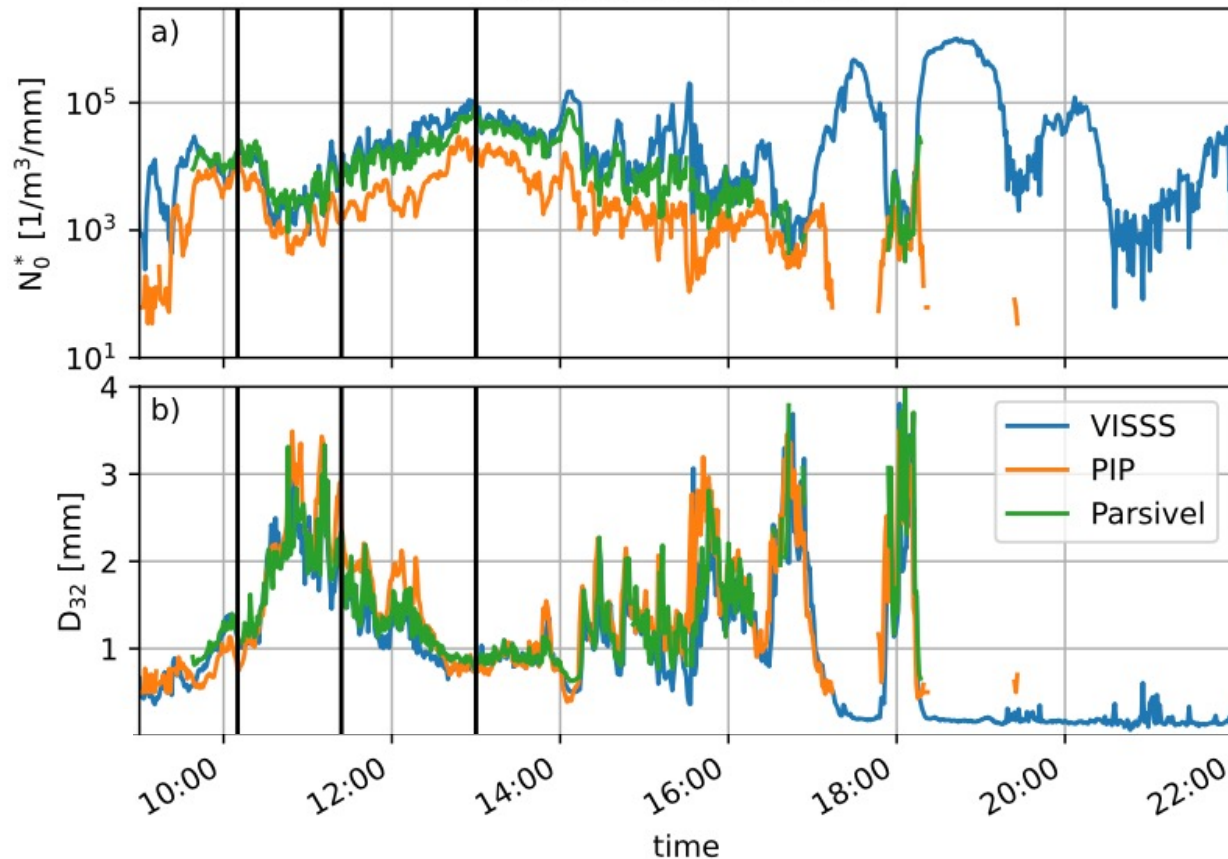
VISS DATA PROCESSING (3) PARTICLE TRACKING (IN PROGRESS)

- typically 8 to 10 images per particle
- estimate 3D trajectory and fall velocity from matching particles from frame to frame



COMPARISON WITH PIP AND PARSIVEL AT HYYTIÄLÄ

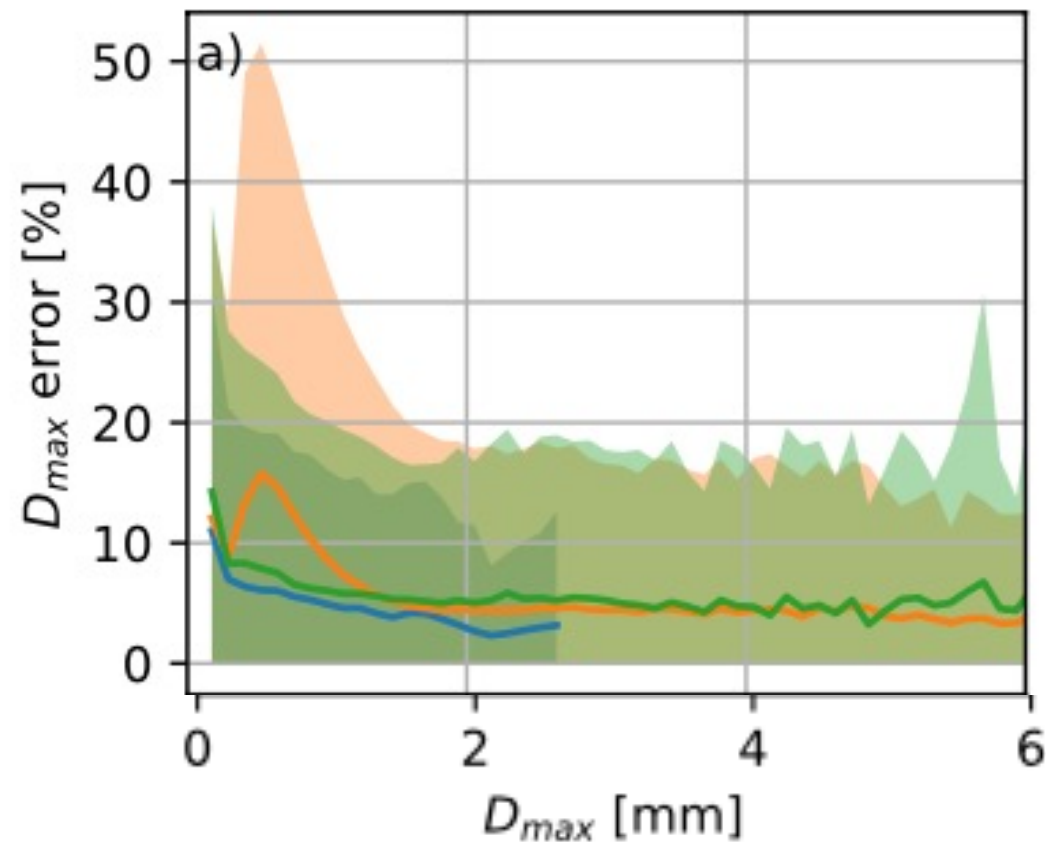
Hyytiälä 2022-01-26



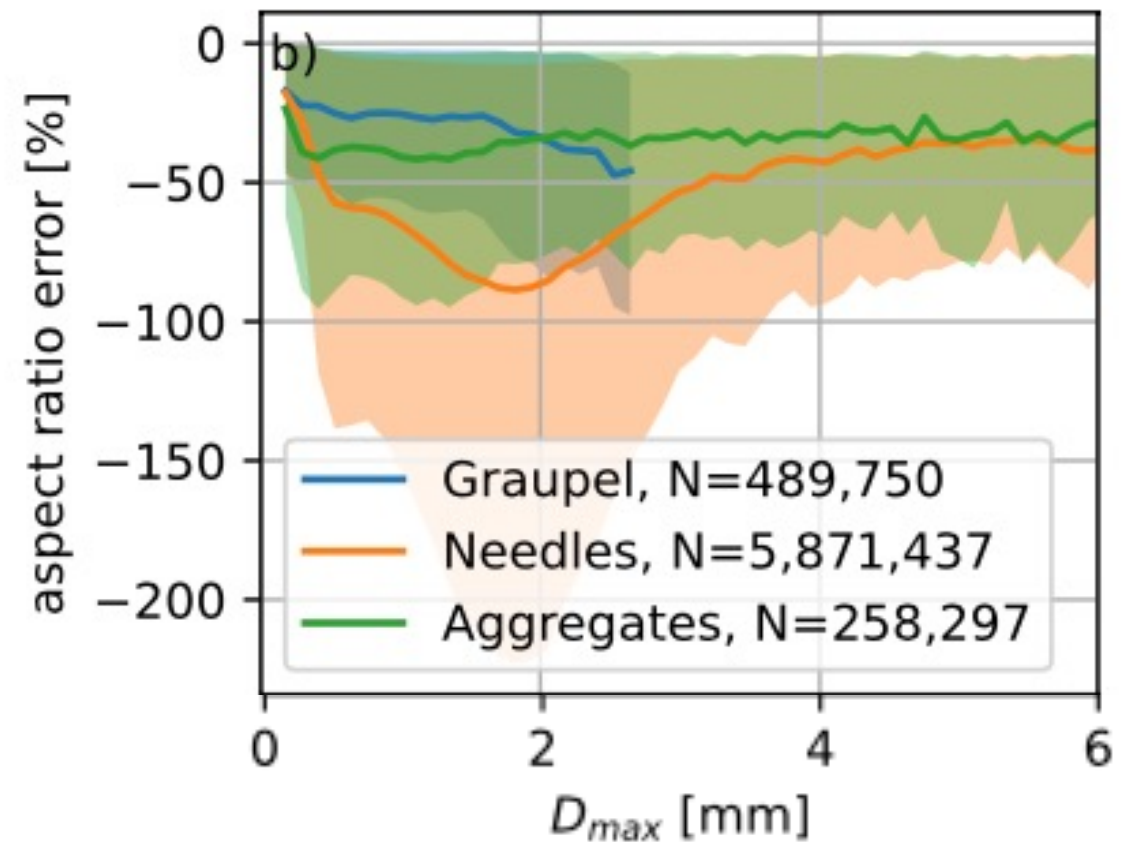
- Good agreement of mass weighted mean diameter
- VISSS (and Parsivel) N_0 larger than PIP N_0 , likely due to better sensitivity to small particles ($D < 1\text{mm}$)
- VISSS observes up to 100.000 particles per minute
- For drizzle spectra (not shown), excellent agreement with Parsivel for $D > 0.5\text{ mm}$

ADVANTAGE OF 2ND CAMERA

MAXIMUM DIMENSION



ASPECT RATIO

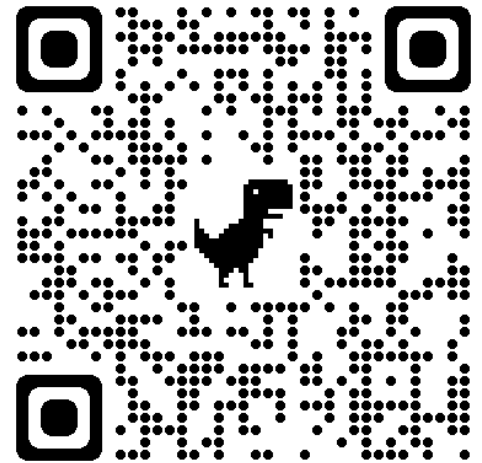


SUMMARY

- VISSS new instrument for in situ snowfall observations
- Open-source design
- Improved sensitivity to small particles
- Excellent statistics
- Research with VISSS only at the beginning
- Potential for insect monitoring?
- AMT Preprint available
- Thank you!



checkout AMT preprint:



CALIBRATION

- Use 1 to 3 mm bearing balls made from steel or ceramics
- Slope $58.92 \mu\text{m}/\text{px}$ close to manufacturer specification $58.75 \mu\text{m}/\text{px}$
- Intercept parameter 0.35 px from discrete camera resolution

