

Investigation of the ductile-to-brittle transition in snow with compression tests and tomography monitoring

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Context & questions

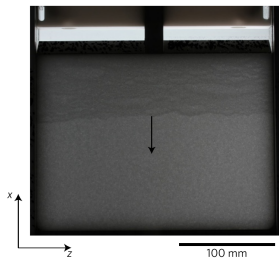
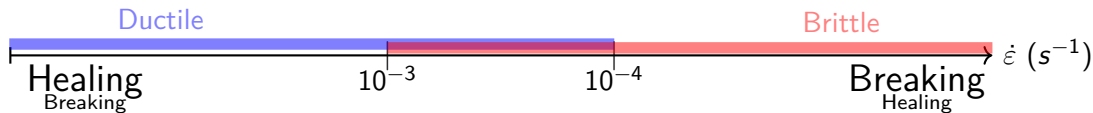


Figure: From [Barraclough et al., 2016]



Which evidences and implications of the rate-dependency of snow mechanical behavior ?

Context & questions

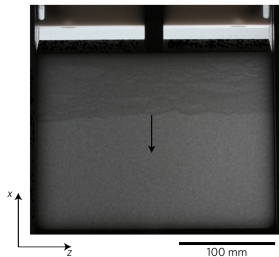
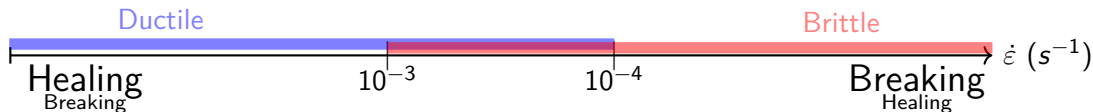
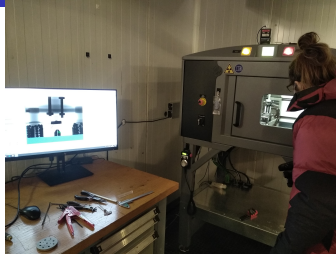
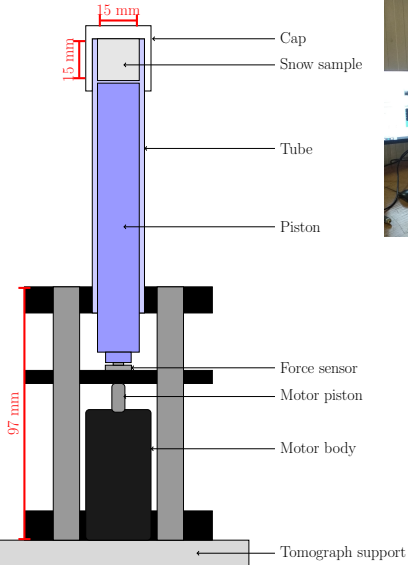


Figure: From [Barraclough et al., 2016]



Which evidences and implications of the rate-dependency of snow mechanical behavior ?

Methodology



Parameters: $T = -18.5^{\circ}\text{C}$;
 $10^{-6} \text{ s}^{-1} < \dot{\epsilon} < 10^{-2} \text{ s}^{-1}$

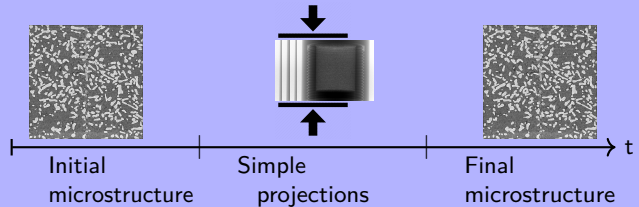
Measurements:

Test device $\longrightarrow \epsilon, \sigma$

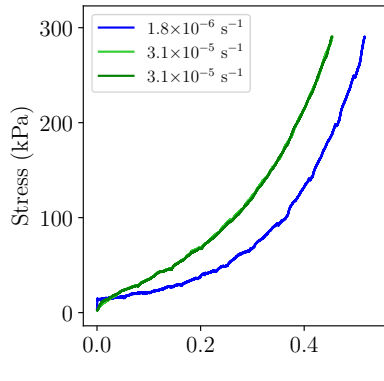
3D-images $\longrightarrow \rho, \text{SSA}, \dots$

Projections $\longrightarrow \text{Localizations}$

Scanning procedure:

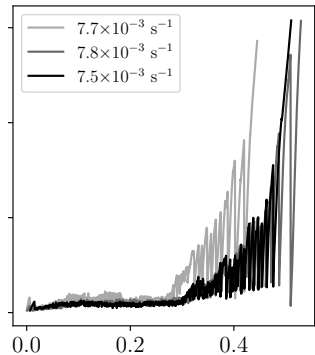
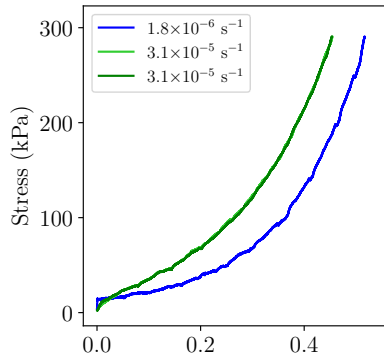


Results - Stress-strain curve



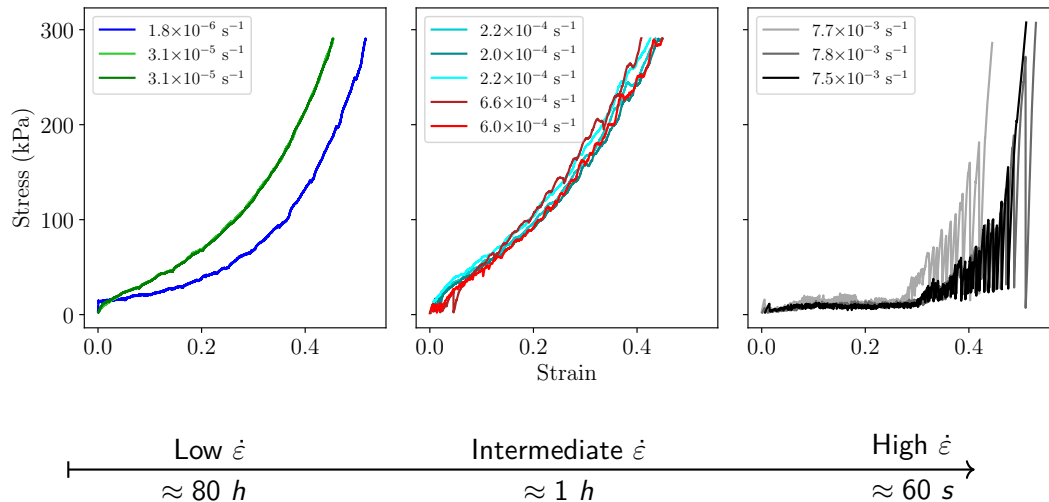
Low $\dot{\epsilon}$
 $\approx 80 \text{ h}$

Results - Stress-strain curve



Low $\dot{\epsilon}$ $\approx 80 \text{ h}$ High $\dot{\epsilon}$ $\approx 60 \text{ s}$

Results - Stress-strain curve



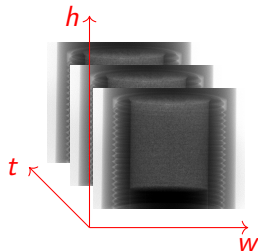
Results - Compaction bands at high $\dot{\epsilon}$

Intermediate $\dot{\epsilon} = 6.0 \times 10^{-4} \text{ s}^{-1}$

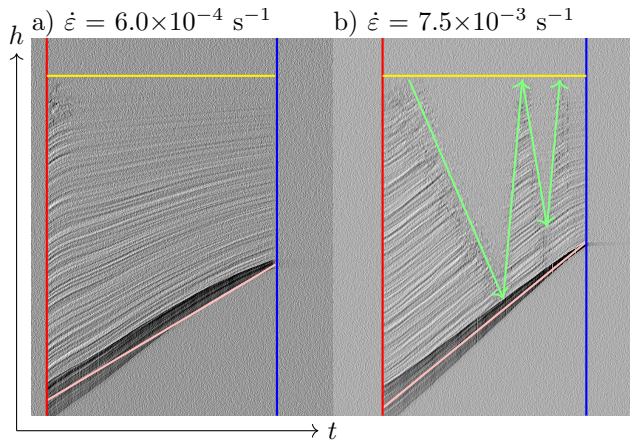
High $\dot{\epsilon} = 7.5 \times 10^{-3} \text{ s}^{-1}$

Results - Compaction band at high $\dot{\epsilon}$

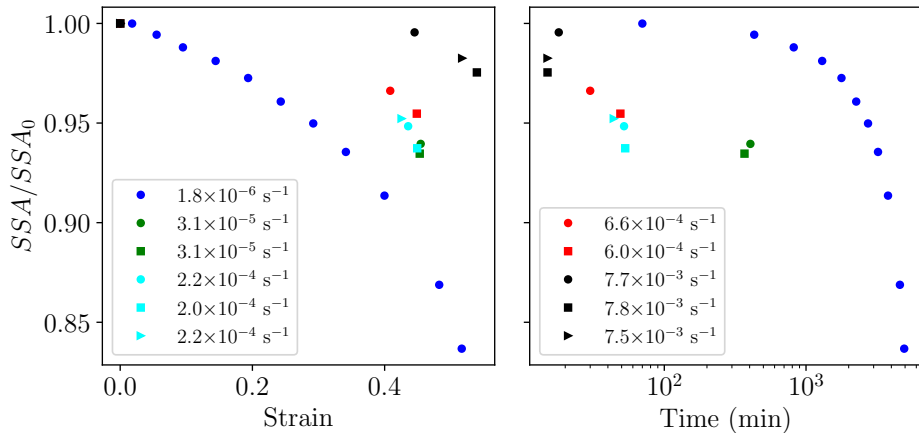
From a series of
X-ray projections:



we make
spatiotemporal diagram

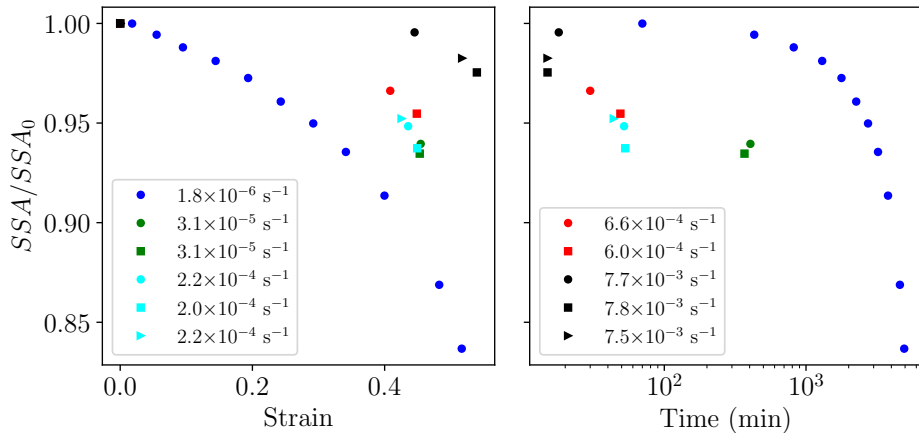


Results - SSA evolution for several $\dot{\epsilon}$



⇒ Time, strain and strain rate indirectly affect SSA decrease rate and dynamic.

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Conclusion & Prospects

Keys results :

- snow mechanical response is multiple, [de Montmollin, 1982, Yosida et al., 1956]
- compaction bands observation from X-ray tomography, [Barracclough et al., 2016]
- SSA decreases faster with greater strain rate, [Wang and Baker, 2013]

TO-DO :

- **Linking macro-observations and micro-mechanisms ?** Use 3D-images to relate $\sigma = f(\varepsilon, \dot{\varepsilon})$ to microstructural properties,
- **What about bond connectivity ?** Bonds creation, expansion or breakage quantification is of great interest (mincut MC , euler characteristic χ , number of coordinations N , ...),

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If any questions or enquiries, I am also available by e-mail :

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or
after the session.

