

Curriculum Vitae – Henning Löwe

Dr. Henning Löwe
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Main research interests

My research is devoted to the physical understanding of microstructural controls on snow physical properties (heat transfer, mechanics, electromagnetics, crystal growth) in the context of remote sensing, polar climatology and natural hazards. I mainly rely on statistical physics, numerical simulations, and the analysis of experimental data (field and lab), in particular from micro-computed tomography experiments. My main goal is the unification of microstructural characterizations of snow to develop models that can be parametrized by micro-scale experiments to predict macro-scale behavior of snow for diverse applications in cryospheric sciences.

Education

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| 12 / 2004 | Dissertation, Theoretical Physics (with distinction, “Summa Cum Laude”) Supervisor: Prof. Annette Zippelius |
| 07 / 1999 – 12 / 2004 | Doctoral Studies, University of Göttingen, Germany |
| 06 / 1999 | Diploma, Physics (“Sehr gut”) Supervisor: Prof. Annette Zippelius |
| 10 / 1994 – 06 / 1999 | Diploma studies, University of Göttingen, Germany |

Employment history

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| since 2018 | Group leader a.i. , WSL Institute for snow and avalanche research SLF, Group Snow Physics |
| 08 / 2018 – 10 / 2018 | Visiting teacher , Université Grenoble Alpes, France, Institut des Géosciences de l’Environnement (with Dr. Maurine Montagnat) |
| since 2014 | Senior Researcher (permanent) , WSL Institute for snow and avalanche research SLF, Group Snow Physics (Head: Dr. Martin Schneebeli) |
| 09 / 2009 – 10 / 2009 | Visiting scientist , University of Alaska, Fairbanks, Department of Mechanical Engineering (Head: Prof. Jonah Lee) |
| 01 / 2008 – 12 / 2013 | Scientific staff member , WSL Institute for snow and avalanche research SLF, Group Snow Physics (Head: Dr. Martin Schneebeli) |
| 01 / 2005 – 12 / 2007 | Postdoc , Swiss Federal Institute for Snow and Avalanche Research SLF, Team Snow-cover and Micrometeorology (Head: Prof. Michael Lehning) |
| 07 / 1999 – 12 / 2004 | Research associate , University of Göttingen (Head: Prof. Annette Zippelius) |

Approved funding

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| 2018 | Swiss National Science Foundation, (PI , Total: 550 kCHF) <i>Unifying metamorphism, heat and mechanics for microstructure-based snow modeling</i> |
| 2017 | IPEV (Collaborator , 1-2 visits on Dome C) <i>Snow properties evolution in a changing climate in Antarctica</i> |
| 2015 | ESA-ITT (Sub-Contractor , Total: 199 k€) <i>Microstructural Origin of Electromagnetic Signatures in Microwave Remote Sensing of Snow</i> |
| 2012 | ESF Workshop – MicroDICE (Co-Organizer Total: 7.3 kCHF) <i>Snow Grain Size Workshop - Measurements and Applications</i> |
| 2012 | Swiss National Science Foundation (Co-PI , Total: 325 kCHF) <i>Snow dynamics: From microscopic experiments to macroscopic applications via dedicated mean-field modeling</i> |
| 2010 | Swiss National Science Foundation (PI , Total: 146 kCHF), <i>Evolution of density fluctuations of snow under the influence of external stress and surface energy induced coarsening</i> |

Boards, Panels

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| since 2016 | Member , WSL Research commission |
| since 2015 | Member , COST action <i>HarmoSnow</i> (Working Group and Management Committee Substitute) |
| since 2015 | Review Editor , <i>Frontiers in Earth Science, Cryospheric Sciences</i> |
| 2013 – 2017 | Science Officer Snow , Division on Cryospheric Sciences, European Geoscience Union |
| 2012 – 2016 | Co-Chair , Working Group <i>MicroSnow: From quantitative stratigraphy to microstructure-based modeling of snow</i> , International Association of Cryospheric Sciences (IACS) |
| since 2009 | Session convener , AGU's, EGU's, IUGG's, POLAR2018 |
| since 2005 | Reviewer , <i>Funding Agencies: NSF; FWF; INACH Journals: TC; J. Glac.; CRST; AAAR; Hydrol. Proc.; JGR; GRL; Granular Matter; Phys. Rev. E; Phil. Magazine; IEEE GRSL</i> |

Patents, Licenses

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| 2018 | G. Picard, M. Sandells, H. Löwe, <i>Snow microwave radiative transfer model</i> , Licensed under GNU LGPL, (https://www.smrt-model.science/) |
| 2012 | E. Seta, T. Nakai, M. Schneebeli, D. Szabo, H. Loewe, M. Heggli, F. Hempel, M. Jaggi, and J. Graupeter, <i>Method for predicting tire performance and method for designing tire</i> , Patent WO/2012/011551 |

Supervision (as main supervisor)

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| Mirte van der Eyden | <i>Discrete element simulations of micro-penetration in cohesive granular materials</i> , Master thesis , University Amsterdam, 2017 (Dr. Edan Lerner) |
| Quirine Krol | <i>Upscaling the evolution of snow microstructure: From 4D image analysis to rigorous models</i> , Dissertation , EPFL Lausanne, 2017 (Prof. Michael Lehning) |
| Severin Mösinger | <i>Analysis of microscopic strain fluctuations in snow deformation from X-ray tomography data by digital volume correlation methods</i> , Master thesis , ETH Zürich, 2014 (Prof. Walter Steurer) |
| Stefan Schlee | <i>X-ray microtomography analysis of isothermal new snow densification</i> , Dissertation , ETH Zürich, 2014 (Prof. H. Herrmann) |
| Sebastian Fritschi | <i>Force correlations in micro-penetration of snow</i> , Master thesis , ETH Zürich, 2012 (Prof. H. Herrmann) |
| Nora Helbig | <i>Application of the radiosity approach to the radiation balance in complex terrain</i> , Dissertation , University of Zürich, 2009 (Prof. W. Haeberli) |
| Maxime Govaerts | <i>Droplet spreading on the quasi-liquid layer of ice</i> , Master thesis , EPFL Lausanne, 2008 (Dr. Alain Jacot) |

Teaching

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| 2018 | 1st SMRT Training School, Col du Lautaret: Organizing lecturer, <i>Snow microstructure, Electromagnetic theory</i> |
| 2017, 2018 | Snow Science Winter School (3rd, Sodankylä, 4th Col du Lautaret): Invited lecturer, <i>Snow microstructure</i> |
| 2016, 2018 | Risiko-Management bei Naturgefahren (Master), HTW Chur: Invited lecturer, <i>Schnee-physik, Lawinenbildung</i> |
| 2015, 2017 | Practice meets Science, Davos: Invited lecturer, <i>Snow physics, Snow mechanics</i> |
| since 2012 | Department of Earth Sciences, ETH Zürich: Organizing lecturer, <i>Snowcover: Physics and Modeling</i> (joint with Martin Schneebeli) |
| 2009 | Block course for Ph.D students, WSL/SLF Davos: Organizing lecturer, <i>Introduction to stochastic models</i> |
| 1998 – 2004 | Tutorial courses, Theoretical Physics (Diploma program), University of Göttingen: <i>Statistical physics, Quantum mechanics, Classical mechanics, Electrodynamics, Mathematical Methods</i> |

Workshops

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| 2018 | Co-Organizer of the <i>SMRT Training Workshop</i> , 8-11 February, Col du Lautaret, France |
| 2013 | Co-Organizer of the <i>Snow Grain Size Workshop - Measurements and Applications</i> , 2-5 April, Grenoble, France |

Awards

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| 2013 | Excellence in reviewing, Cold Regions Science and Technology |
| 2005 | Award of the Berliner–Ungewitter-Stiftung for outstanding dissertations, Faculty of Physics, University of Göttingen |

Memberships

Organizations AGU, EGU, DPG, IACS

Outreach

TV ARD, WDR, RSI, SWR

Print PM Magazin, Bild der Wissenschaft, New Scientist, Südostschweiz, Süddeutsche

Advanced training

2011 Media Training with Steffen Lukesch (WSL/SLF, Davos)

2008 Project management course (ETH, Zurich, Switzerland)

2005 MPI Parallel Programming course (CSCS, Manno, Switzerland)

Invited talks

X-ray microtomography of porous ice media, Workshop, Trondheim, Norway, (2017); **International symposium of snow and avalanches**, Workshop, Niseko, JP, (2015); **Competence Center Computational Sciences**, Seminar, Basel, CH, (2015); **Workshop on Chemical Atmosphere-Snow-Sea Ice Interactions**, Cambridge, UK (2014); **13th Intern. Conference on the Physics and Chemistry of Ice**, Hanover (NH), USA (2014); **Institute for Theoretical Physics**, Seminar, Universität Göttingen (2012); **Institute of Materials Simulation**, Seminar Universität Erlangen, Germany (2012); **Materials Deformation: Fluctuations, Scaling, Predictability**, Workshop, Les Houches, France (2012); **AGU Fall meeting**, San Francisco, USA (2011); **Nucleation and Crystal Growth Workshop**, Nestlé Research Center, Lausanne, CH (2011); **12th Intern. Conference on the Physics and Chemistry of Ice**, Sapporo, Japan (2010); **EGU General Assembly**, Vienna, Austria (2010); **10th International Symposium on Physical Measurements and Signatures in Remote Sensing**, Davos, Switzerland (2007)

List of Publications – Henning Löwe

- ★ ResearcherID: <http://www.researcherid.com/rid/B-6279-2009>
- ★ ORCID: <https://orcid.org/0000-0001-7515-6809>
- ★ Google: <https://scholar.google.ch/citations?user=0nueNjoAAAAJ&hl=en&oi=ao>
- ★ ResearchGate: https://www.researchgate.net/profile/Henning_Loewe

Submitted publications

- Gouttevin, I., Langer, M., **Löwe, H.**, Boike, J., Proksch, M., and Schneebeli, M. *Observation and modelling of snow at a polygonal tundra permafrost site: spatial variability and thermal implications*, The Cryosphere Discuss , (2018)
- B. Reuter, M. Proksch, **Löwe, H.**, A. van Herwijnen, J. Schweizer *Comparing measurements of snow mechanical properties relevant for slab avalanche release*, submitted to J. Glac , (2018)
- R. Schlegel, A. Diez, **H. Löwe**, C. Mayer, A. Lambrecht, J. Freitag, H. Miller, C. Hofstede, O. Eisen *Comparison of elastic moduli from seismic diving-wave and ice-core microstructure analysis in Antarctic polar firn*, submitted to Annals of Glaciology , (2018)

Peer-reviewed publications

- [39] Picard, G., Sandells, M., and **Löwe, H.** *SMRT: an active–passive microwave radiative transfer model for snow with multiple microstructure and scattering formulations (v1.0)*, Geosci. Model Dev. **11**, 2763 (2018)
- [38] Krol, Q., **Löwe, H.** *Upscaling ice crystal growth dynamics in snow: rigorous modeling and comparison to 4D X-ray tomography data*, Acta Materialia **151**, 478 (2018)
- [37] Gaume, J.; **Löwe, H.**; Tan, S.; Tsang, L. *Scaling laws for the mechanics of loose and cohesive granular materials based on Baxter’s sticky hard spheres*, Physical Review E **96**, 032914 (2017)
- [36] Gerling, B.; **Löwe, H.**; Van Herwijnen, A. *Measuring the elastic modulus of snow*, Geophysical Research Letters **44**, 11088 (2017)
- [35] Q. Krol, **H. Löwe**, *Relating optical and microwave grain metrics of snow: The relevance of grain shape*, The Cryosphere **10**, 2847 (2016)
- [34] S. Leinss, **H. Löwe**, M. Proksch, J. Lemmetyinen, A. Wiesmann, and I. Hajnsek, *Anisotropy of seasonal snow measured by polarimetric phase differences in radar time series*, The Cryosphere **10**, 1771 (2016)
- [33] Q. Krol, **H. Löwe**, *Analysis of local ice crystal growth in snow*, Journal of Glaciology **62**, 378 (2016)
- [32] **H. Löwe**, G. Picard, *Microwave scattering coefficient of snow in MEMLS and DMRT-ML revisited: The relevance of sticky hard spheres and tomography-based estimates of stickiness*, The Cryosphere **9**, 2101 (2015)

- [31] W. Steinkogler, J. Gaume, **H. Löwe**, B. Sovilla, M. Lehning, *Granulation of snow: From tumbler experiments to discrete element simulations*, Journal of Geophysical Research: Earth Surface **120**, 2169 (2015)
- [30] M. Proksch, C. Mätzler, A. Wiesmann, J. Lemmetyinen, M. Schwank, **H. Löwe**, and M. Schneebeli, *MEMLS3&a: Microwave Emission Model of Layered Snowpacks adapted to include backscattering*, Geosci. Model Dev. **8**, 2611 (2015)
- [29] M. Proksch, **H. Löwe**, M. Schneebeli, *Density, specific surface area, and correlation length of snow measured by high-resolution penetrometry*, J. Geophys. Res. Earth Surf. **120**, 346 (2015)
- [28] S. Schleef, **H. Löwe**, M. Schneebeli, *Influence of stress, temperature and crystal morphology on isothermal densification and specific surface area decrease of new snow*, The Cryosphere **8**, 1825 (2014)
- [27] N. Helbig, **H. Löwe**, *Parameterization of the spatially averaged sky view factor in complex topography*, J. Geophys. Res. Atmos. **119**, 4616 (2014)
- [26] S. Schleef, **H. Löwe**, M. Schneebeli, *Hot-pressure sintering of low-density snow analyzed by X-ray microtomography and in situ microcompression*, Acta Materialia **71**, 185 (2014)
- [25] S. Schleef, **H. Löwe**, M. Schneebeli, *An improved machine to produce nature-identical snow in the laboratory*, J. Glaciol **60**, 94 (2014)
- [24] **H. Löwe**, F. Riche, M. Schneebeli, *A general treatment of snow microstructure exemplified by an improved relation for thermal conductivity*, The Cryosphere **7**, 1473 (2013)
- [23] S. Schleef, **H. Löwe**, *X-ray microtomography analysis of isothermal densification of new snow under external mechanical stress*, J. Glaciol **59**, 233 (2013)
- [22] **H. Löwe**, N. Helbig, *Quasi-analytical treatment of spatially averaged radiation transfer in complex terrain*, J. Geophys. Res. Atmos. **117**, D19101 (2012)
- [21] N. Helbig, **H. Löwe**, *Shortwave radiation parameterization scheme for subgrid topography*, J. Geophys. Res. Atmos. **117**, D03112 (2012)
- [20] **H. Löwe**, A. van Herwijnen, *A Poisson shot noise model for micro-penetration of snow*, Cold Reg. Sci. Technol. **70**, 62 (2012)
- [19] T. Theile, **H. Löwe**, T.C. Theile, M. Schneebeli, *Simulating creep of snow based on microstructure and the anisotropic deformation of ice*, Acta Materialia **59**, 7104 (2011)
- [18] C.D.G. Zwaafink, **H. Löwe**, R. Mott, M. Bavay, M. Lehning, *Drifting snow sublimation: A high-resolution 3-D model with temperature and moisture feedbacks*, J. Geophys. Res. Atmos. **116**, D16107 (2011)
- [17] **H. Löwe**, J. Spiegel, M. Schneebeli, *Interfacial and structural relaxations of snow under isothermal conditions*, J. Glac. **57**, 499 (2011)
- [16] E. Seta, T. Nakai, M. Heggli, M. Jaggi, **H. Löwe**, M. Schneebeli, D. Szabo *Prediction of tire traction on a compacted snow road*, Physics and Chemistry of Ice 2010 , 45 (2011)
- [15] **H. Löwe**, J. Spiegel, B. Pinzer, T. Kaempfer, M. Schneebeli *The evolution of density fluctuations in snow during metamorphism under different driving conditions*, Physics and Chemistry of Ice 2010 , 21 (2011)
- [14] N. Helbig, M. Lehning, **H. Löwe**, B. Mayer *Explicit validation of a surface shortwave radiation balance model over snow-covered complex terrain*, J. Geophys. Res. **115**, D18113 (2010)
- [13] N. Helbig, **H. Löwe**, M. Lehning *Radiosity approach for the shortwave surface radiation balance in complex terrain*, J. Atmos. Sci. **66**, 2900 (2009)

- [12] M. Bavay, M. Lehning, T. Jonas, **H. Löwe** *Simulations of future snow cover and discharge in Alpine headwater catchments*, Hydrol. Process. **23**, 95 (2009)
- [11] C. Manes, M. Guala, S. Bartlett, **H. Löwe**, L. Egli *Statistical properties of fresh snow roughness*, Water Resour. Res **44**, W11407 (2008)
- [10] M. Lehning, **H. Löwe**, M. Ryser *Inhomogeneous precipitation distribution and snow transport in steep terrain*, Water Resour. Res **44**, W07404 (2008)
- [9] R. Mott, F. Faure, M. Lehning, **H. Löwe**, B. Hynek, G. Michlmayer, A. Prokop, W. Schonert *Simulation of seasonal snow-cover distribution for glacierized sites on Sonnblick, Austria, with Alpine3D model*, Ann. Glaciol. **49**, 155 (2008)
- [8] C. H. Köhler, **H. Löwe**, P. Müller, and A. Zippelius *Variational Bounds for the shear viscosity of gelling melts*, Europhys. Lett **78**, 46002 (2007)
- [7] **H. Löwe**, L. Egli, S. Bartlett, M. Guala, C. Manes *On the evolution of the snow surface during snowfall*, Geophys. Res. Lett **34**, L21507 (2007)
- [6] **H. Löwe**, P. Müller, and A. Zippelius *Dynamics of gelling liquids: a short survey*, J. Phys.: Condens. Matter **17**, S1659 (2005)
- [5] **H. Löwe**, P. Müller, and A. Zippelius *Rheology of gelling polymers in the Zimm model*, J. Chem. Phys. **122**, 014905-1-8 (2004)
- [4] M. Küntzel, **H. Löwe**, P. Müller, and A. Zippelius *Diffusion of gelation clusters in the Zimm model*, Eur. Phys. J. E **12**, 325 (2003)
- [3] K. Broderix, **H. Löwe**, P. Müller, and A. Zippelius *Anomalous stress relaxation in random macromolecular networks*, Physica A **302**, 379 (2001)
- [2] K. Broderix, **H. Löwe**, P. Müller, and A. Zippelius *Critical dynamics of gelation*, Phys. Rev. E **63**, 011510 (2001)
- [1] K. Broderix, **H. Löwe**, P. Müller, and A. Zippelius *Shear viscosity of a crosslinked polymer melt*, Europhys. Lett. **48**, 421 (1999)

Non-reviewed publications

- [5] Calonne, N.; Cetti, C.; Fierz, C.; Van Herwijnen, A.; Jaggi, M.; Löwe, H.; Matzl, M.; Schmid, L.; Schneebeli, M. *A unique time series of daily and weekly snowpack measurements at Weissfluh-Joch, Davos, Switzerland*, Proceedings of the International Snow Science Workshop, Breckenridge, CO, USA, (2016)
- [4] H. Löwe *Microstructure models for snow in current microwave models*, Proceedings of the ESA Workshop on Novel Mission Concepts for Snow and Cryosphere Research, Noordwijk, NL, (2014)
<http://congrexprojects.com/Custom/14C19/index.htm>
- [3] W. Steinkogler, J. Gaume, H. Löwe, B. Sovilla and M. Lehning *Granulation of snow: experiments and discrete element modeling*, Proceedings of the 2014 International Snow Science Workshop, Banff, Canada, (2014)
- [2] M. Proksch, B. Reuter, H. Löwe, J. Schweizer and M. Schneebeli *Quantitative Snow Stratigraphy and Stability Derived From High-Resolution Penetrometry*, Proceedings of the 2014 International Snow Science Workshop, Banff, Canada, (2014)

- [1] B. Reuter, M. Proksch, H. Löwe, A. van Herwijnen, J. Schweizer *On how to measure snow mechanical properties relevant to slab avalanche release*, Proceedings of the 2013 International Snow Science Workshop, Grenoble, France , 7 (2013)

Book chapters

H. Löwe, *Schnee als Material*, in: Schnee, WSL-Institut für Schnee- und Lawinenforschung SLF, Primus Verlag, Darmstadt, 2013

Dissertation

H. Löwe, *Critical dynamics of gelling polymer solutions*, University of Göttingen
<http://webdoc.sub.gwdg.de/diss/2005/loewe/>