Wolfgang Langhans

Lawrence Berkeley National Laboratory
Earth Science Division
1 Cyclotron Road 74R316C
Berkeley, CA 94720
Phone: (510) 859-6090
Email: wlanghans@lbl.gov
Web: http://ocf.io/langhans/

Google scholar: wlanghans@lbl.gov
ResearcherID: J-6437-2014

Education

2009–2012 **Ph.D., ETH Zurich, Institute for Atmospheric and Climate Science**

- Ph.D. in Atmospheric Sciences
- Thesis title: *Multiscale aspects of cloud-resolving simulations of moist summer convection over complex terrain* [pdf]
- Adviser: Prof. Christoph Schär

2003–2008 **B.S. and M.S., University of Innsbruck, Institute of Meteorology and Geophysics**

- Mag.rer.nat. (M.S. equivalent) in Meteorology and Geophysics (with distinction)
- Thesis title: *Cloud-resolving simulations of the August 2005 Alpine flood - The sensitivity to microphysics parameterizations* [pdf]
- Adviser: Prof. Alexander Gohm

Research experience

01/2018 - present **Project Scientist**, *Climate and Ecosystem Science Division*
Lawrence Berkeley National Laboratory, Berkeley
Advisor: William Collins (LBL)

1) "Climate Model Development and Validation (CMDV): Coupling Mechanistically the Convective Motions and Cloud Macrophysics in a Climate Model"

   Funding: Department of Energy; DOE SC/BER DE-FOA-0001530

   Role: Improve and finalize the coupling of the Romps Stochastic Parcel Model to DOE's E3SM.

2) "Climate model optimization using surrogate models"

   Funding: Department of Energy; DOE SC/BER

   Role: Develop a framework for efficient parameter optimization in physical parameterizations in a collaboration with researchers at the Computational Research Division/LBNL.

09/2015 - 12/2017 **Postdoctoral research**, *Climate and Ecosystem Science Division*
Lawrence Berkeley National Laboratory, Berkeley
Advisor: Prof. William Collins (LBL)

1) "Climate Model Development and Validation (CMDV): Coupling Mechanistically the Convective Motions and Cloud Macrophysics in a Climate Model"

   Funding: Department of Energy; DOE SC/BER DE-FOA-0001530

   Role: Implemented the convective parameterization based on the Romps Stochastic Parcel Model into DOE's ACME. ACME is a computationally advanced coupled climate-energy model. This project will dramatically improve the representation of shallow clouds in ACME.

2) "An Integrative Parameterization of Boundary Layer and Convective Mixing: The Eddy-Diffusivity/Mass-Flux (EDMF) Approach"

   Funding: Department of Energy; DOE SC/BER (SciDAC DE-FOA-0001036)

   Role: Developed and implemented a parameterization for PBL mixing and shallow cumulus using an eddy-diffusivity mass-flux approach. The code was implemented into LBNL's climate model CHOMBO and the System for Atmospheric Modeling (SAM). Further, I developed a framework for efficient parameter optimization in a collaboration with researchers at the Computational Research Division/LBNL.

3) "Multiscale: Multiscale Methods for Accurate, Efficient, and Scale-Aware Models of the Earth System"

   Funding: Department of Energy; DOE SC/BER

   Role: The effect of a boundary-layer and shallow-cloud parameterizations on convective self-aggregation was studied using Eulerian fluid simulations based on the cloud-resolving model SAM.

01/2013 - 08/2015 **Postdoctoral research**, *Climate and Ecosystem Science Division*
Lawrence Berkeley National Laboratory, Berkeley
Advisor: Prof. David M. Romps

1) "Interactions among Cloud Processes, Convection, and Climate Change"

   Funding: Lab Directed Research and Development (LDRD)

   Role: Used Large-eddy simulations to study the origin of water vapor rings in the oceanic boundary layer impacted by deep convective outflow.

2) "Atmospheric System Research at Berkeley Lab: Improving the Characterization of Clouds, Aerosols and the Cryosphere in Climate Models"

   Funding: Department of Energy; DOE SC/BER ESD08005

   Role: Developed novel Lagrangian framework to track water molecules in Eulerian Large-eddy simulations including phase changes based on a Monte-Carlo technique. The new framework led to new insights into cumulus-cloud water cycle

06/2012 - 12/2012 **Postdoctoral research**, *Institute for Atmospheric and Climate Science*
ETH Zurich
Advisor: Prof. Christoph Schär

"Towards Kilometer-Scale Climate Modeling"

Funding: Center for Climate Systems Modeling at ETH; CHIRP1

Role: Studied convective precipitation and valley winds in the European Alps using cloud-resolving models. Contributed to the development of a 1-km operational version of COSMO at MeteoSwiss.

2009 - 2012 **Ph.D. thesis research**, *Institute for Atmospheric and Climate Science*
ETH Zurich
Advisor: Prof. Christoph Schär

- Demonstrated convergence of bulk properties of CRMs at about 1 km using COSMO
- Showed numerical and theoretical evidence for a sensitivity of convective rainfall to numerical low-pass filtering

2008 **M.S. thesis research**, *Institute of Meteorology and Geophysics*
University of Innsbruck
Advisor: Prof. Alexander Gohm

- Explored organized convective structures during an Alpine heavy precipitation event
- Explored the sensitivity of modeled precipitation to microphysical parameterizations in WRF

Publications

Refereed Articles

- Seeley J., Jeevanjee N., **Langhans W.**, and Romps D. M., 2017: A new paradigm for tropical anvil clouds. *In review*.
- **Langhans, W.**, and Romps, D. M., 2015: The origin of water-vapor rings in tropical oceanic cold pools, *Geophys. Res. Lett.*, 42, 7825–7834.
- Hassanzadeh, H., Schmidli, J., **Langhans, W.**, Schlemmer, L., and Schär, C., 2015: Impact of topography on diurnal cycle of summertime moist convection in idealized simulations. *Meteorol. Z.*, doi: 10.1127/metz/2015/0653.
- Prein, A., **Langhans, W.**, Leung, L. R., and others, 2015: Convection-permitting climate modeling: Demonstrations, prospects, and challenges. *Rev. Geophys.*, 53, 323–361.
- **Langhans, W.**, Yeo, K., and Romps, D. M., 2015: Lagrangian investigation of the precipitation efficiency of convective clouds. *J. Atmos. Sci.*, 72, 1045–1062.
- Froidevaux, P., Schlemmer, L., Schmidli, J., **Langhans, W.**, and Schär, C., 2014: Influence of the background wind on the local soil moisture-precipitation feedback. *J. Atmos. Sci.*, 71, 782–799.
- **Langhans, W.**, Schmidli, J., Fuhrer, O., Bieri, S., and Schär, C., 2013: Long-term simulations of thermally-driven flows and orographic convection at convection-parameterizing and cloud-resolving resolutions. *J. Appl. Clim. and Meteorol.*, 52, 1490–1510.
- **Langhans, W.**, Schmidli, J., and Schär, C., 2012: Bulk convergence of kilometer-scale simulations of moist convection over complex terrain. *J. Atmos. Sci.*, 69, 2207–2228.
- **Langhans, W.**, Schmidli, J., and Schär, C., 2012: Mesoscale impacts of explicit numerical diffusion in a convection-permitting model. *Mon. Wea. Rev.*, 140, 226–244.

- **Langhans, W.**, Gohm, A., and Zängl, G., 2011: The orographic impact on patterns of embedded convection during the August 2005 Alpine flood. *Quart. J. Roy. Meteorol. Soc.*, 137, 2092-2105.
- Hohenegger, C., Walser, A., **Langhans, W.**, and Schär, C., 2008: Cloud-resolving ensemble simulations of the August 2005 Alpine flood. *Quart. J. Roy. Meteorol. Soc.*, 134, 889–904.

Non-refereed Publications

- **Langhans, W.**, 2012: Multiscale aspects of cloud-resolving simulations of moist summer convection over complex terrain . *ETH doctoral thesis*, No. 20363 [available online at `http://e-collection.library.ethz.ch`].
- **Langhans, W.**, Schmidli, J., and Szintai, B., 2012: A Smagorinsky-Lilly turbulence closure for COSMO-LES: Implementation and comparison to ARPS. *COSMO newsletter*, No. 12, 20-31 [available online at `www.cosmo-model.org/content/model/documentation/newsLetters/newsLetter12/`].
- **Langhans, W.**, Fuhrer, O., and Schmidli, J., 2012: Description and application of a budget diagnosis tool in COSMO. *COSMO newsletter*, No. 12, 43-51 [available online at `www.cosmo-model.org/content/model/documentation/newsLetters/newsLetter12/`].
- **Langhans, W.**, 2011: Towards kilometer scale climate modeling. *C2SM newsletter*, No. 5, 4 [available online at `www.c2sm.ethz.ch/news/letter/C2SM_Newsletter_5_March_2011.pdf`].

Seminars and conference talks

- **Langhans, W.**, Mueller, J., and Collins, W.D.: Alternatives to the EDMF parameterization uncovered through parameter optimization, California Institute of Technology, 2018, Pasadena, USA **(invited)**
- **Langhans, W.**: Using CRMs and LESs to advance our understanding of cloud processes. Cloud Processes Research Group, Lawrence Livermore National Lab, 2016, Livermore, USA **(invited)**
- **Langhans, W.**: The origin of water vapor rings in tropical oceanic cold pools. Workshop on Cloud and Boundary Layer Closures: The Next Decade, 2016, Zurich, Switzerland **(invited)**
- **Langhans, W.**: The origin of water vapor rings in tropical oceanic cold pools. HD(CP)^2 conference on Understanding Clouds and Precipitation, 2016, Berlin, Germany
- **Langhans, W.**: Deep convection, cold pools, and moist rings. Department of Meteorology and Climate Science, San Jose State University, 2015, San Jose, USA **(invited)**
- **Langhans, W.**: On the origin and pathway of water in cumulus clouds. School of Atmospheric Science at Nanjing University, 2015, Nanjing, China **(invited)**
- **Langhans, W.**, and Romps, D. M.: Lagrangian investigation of the precipitation efficiency of convective clouds. 20th Conference on Atmospheric and Oceanic Fluid Dynamics, 2015, Minneapolis, USA (June 2015)
- **Langhans, W.**: The origin and pathway of water molecules in maritime convective clouds. Center for Climate Sciences, JPL, 2015, Pasadena, USA **(invited)**
- **Langhans, W.** and Jeevanjee, N.: Initiation of deep tropical convection by cold pools: mechanics versus thermodynamics. Berkeley Atmospheric Sciences Center Symposium, 2015, Berkeley, USA **(invited)**
- Hassanzadeh, H., Schmidli, J., **Langhans, W.**, and Schär, C.: Far- and near-field influence of a mesoscale mountain on the diurnal cycle of summertime moist convection. 16th AMS Conference on Mountain Meteorology, 2014, San Diego, USA
- **Langhans, W.**, Yeo, K., and Romps, D. M.: Lagrangian investigation of the water processing by cumulus clouds. HOT Seminar Max-Planck Institute, 2014, Hamburg, Germany **(invited)**
- **Langhans, W.**, Yeo, K., Romps, D. M.: Lagrangian investigation of the precipitation efficiency of convective clouds. 31st AMS Conference on Hurricanes and Tropical Meteorology, 2014, San Diego, USA
- **Langhans, W.**, Yeo, K., and Romps, D. M.: Precipitation efficiency of cumulus clouds studied using a stochastic Lagrangian water-particle framework. ASR Science Team Meeting, 2014, Potomac, USA

- Schmidli, J., **Langhans, W.**, Fuhrer, O., Bieri, S., and Schär, C.: Evaluation of thermally driven flows and orographic convection at cloud-resolving resolutions. AGU, 2013, San Francisco, USA
- **Langhans, W.**, Yeo, K., Romps, D. M.: Tracking water using stochastic Lagrangian particles. LBNL Climate Sciences Department Seminar, 2013, Berkeley, USA (**invited**)
- **Langhans, W.**, Schmidli, J., and Schär, C.: Bulk convergence of cloud-resolving simulations of diurnal moist convection over complex terrain. European Geosciences Union General Assembly, 2013, Vienna, Austria
- Schär, C., **Langhans, W.**, Schmidli, J., and Nikolina, B.: Do cloud-resolving climate models converge? 5th International Workshop on Cloud-Resolving Global Modelling, 2012, Schloss Ringberg, Germany
- Nikolina, B., Schmidli, J., **Langhans, W.**, and Schär, C.: Evaluation of a 10-year cloud-resolving climate simulation driven by ERA-Interim, 2012, AGU Fall Meeting, San Francisco, CA
- Schmidli, J., Nikolina, B., **Langhans, W.**, and Schär, C.: Cloud-resolving climate change scenarios: Challenges and first results. 1st International Conference on Frontiers in Computational Physics: Modeling the Earth System, 2012, Boulder, CO
- **Langhans, W.**: Numerical weather prediction: Factors governing convergence. Computational Science and Engineering ETH, 2012, Zurich, Switzerland **(invited)**
- **Langhans, W.**, Schmidli, J., and Schär, C.: Multiscale aspects of cloud-resolving simulations over complex terrain, Federal Office of Meteorology and Climatology MeteoSwiss, 2012, Zurich, Switzerland **(invited)**
- Hassanzadeh, H., Schmidli, J., **Langhans, W.**, and Schär, C.: Mountain size and atmospheric conditions' impact on the diurnal cycle of clouds and precipitation. 10th Swiss Geoscience Meeting, 2012, Bern, Switzerland
- Hassanzadeh, H., Schmidli, J., **Langhans, W.**, and Schär, C.: Sensitivity of the diurnal cycle of moist convection to terrain geometry. CLM-Community Assembly, 2012, Leuven, Belgium
- **Langhans, W.**, Schmidli, J., and Schär, C.: Bulk convergence of kilometer-scale simulations of moist convection over complex terrain. 31th International Conference on Alpine Meteorology, 2011, Aviemore, Scotland
- **Langhans, W.**, Schmidli, J., and Schär, C.: Bulk convergence of kilometer-scale simulations of moist convection over complex terrain. 9th International SRNWP-Workshop on Nonhydrostatic Modelling, 2011, Bad Orb, Germany
- **Langhans, W.**, Schmidli, J., and Schär, C.: Horizontal resolution in a convection-permitting model: Convergence of bulk flow properties over complex terrain. 14th AMS Conference on Mountain Meteorology, 2010, Squaw Valley, CA
- **Langhans, W.**, Schmidli, J., and Schär, C.: Horizontal resolution in a convection-permitting model: Convergence of bulk flow properties over complex terrain. 10th EMS Annual Meeting, 2010, Zurich, Switzerland
- **Langhans, W.**, Schmidli, J., and Schär, C.: Mesoscale impacts of explicit numerical diffusion in a convection-permitting model. European Geosciences Union General Assembly, 2010, Vienna, Austria
- **Langhans, W.**, Schmidli, J., and Schär, C.: Convection-permitting simulations using explicit numerical diffusion. 8th International SRNWP-Workshop on Nonhydrostatic Modelling, 2009, Bad Orb, Germany

---

Conference posters

- **Langhans, W.**, J. Müller, and Collins. B. D.: Multi-modal solution of Eddy-Diffusivity/Mass-Flux approach through parameter optimization. 21st Conference on Atmospheric and Oceanic Fluid Dynamics, Portland, USA.
- **Langhans, W.**, and Romps, D. M.: The origin of water-vapor rings in tropical cold pools. AGU, 2014, San Francisco, USA
- **Langhans, W.**, Yeo, K., and Romps, D. M.: A new framework to study convective transport of non-conserved quantities using stochastic Lagrangian particles. AGU, 2013, San Francisco, USA

- **Langhans, W.**, Bieri, S., Schmidli, J., and Schär, C.: Observations and numerical simulations of Alpine pumping and its interaction with moist convection. 31th International Conference on Alpine Meteorology, 2011, Aviemore, Scotland
- **Langhans, W.**, Schmidli, J., and Schär, C.: Kilometer-scale simulations of Alpine summertime convection. CLM-Community Assembly, 2009, Karlsruhe, Germany
- **Langhans, W.**, Gohm, A., and Zängl, G.: The orographic impact on patterns of embedded convection during the August 2005 Alpine flood. 30th International Conference on Alpine Meteorology, 2009, Rastatt, Germany.
- **Langhans, W.**, Gohm, A., and Zängl, G.: Numerical sensitivity study of August 2005 Alpine flood. 13th AMS Conference on Mountain Meteorology, 2008, Whistler, Canada

Awards

- Best Poster Award, 31th International Conference on Alpine Meteorology, Aviemore, Scotland, 2011
- European Meteorological Society Youth Scientist Travel Award, AMS Mountain Meteorology, Whistler, 2008

Teaching experience

Department of Earth & Planetary Science, University of California, Berkeley

2013 **Discussion leader**, *Pizza, Beer, & Thermodynamics (PBT)*

Institute for Atmospheric and Climate Science, ETH Zurich

2010-2011 **Teaching assistant**, *Numerical prediction of weather and climate* (Prof. C. Schär)

2009-2011 **Teaching assistant**, *Boundary Layer Meteorology & Air Pollution Modeling* (Prof. M. Rotach/Dr. J. Schmidli)

Institute of Meteorology and Geophysics, University of Innsbruck

2008 **Teaching assistant**, *Geophysical Fluid Dynamics and Theoretical Meteorology* (Priv.-Doz. Dr. H. Weber)

Mentoring experience

Institute for Atmospheric and Climate Science, ETH Zurich

2012-2015 **Ph.D. thesis co-advisor**, *Hanieh Hassanzadeh*

2013 **M.S. thesis co-advisor**, *Paul Froidevaux*

2011 **M.S. thesis co-advisor**, *Susanne Bieri*

Teaching training

2014 - Intensive course on evidence-based teaching, Postdoc Teaching Opportunities Program (PTOP), Berkeley, CA

Additional professional training

2011 - Parallel Programming Summer School at the Swiss Center for Scientific Computing, Manno, Switzerland

2010 - ECMWF training course *Numerical methods and adiabatic formulation of models*, Reading, UK

- Took classes *Turbulent Flows* (Prof. Kleiser) and *Turbulence Modeling* (Prof. Jenny), Institute of Fluid Dynamics, ETH Zurich

2009 - COSMO training course on *Model dynamics and physics*, Langen, Germany

2008 - 8th International NCCR Climate Summer School *Climate variability, forcings, feedbacks and responses: the long-term perspective*, Grindelwald, Switzerland

- ECMWF training course *Parameterizations of diabatic processes*, Reading, UK
- AMS/COMET/MSC Mountain Weather Workshop *Bridging the gag between Research and Forecast*, Whistler, Canada

2007 - COPS summer school *Convective and Orographically-induced Precipitation Study*, Black Forest, Germany

- Internship under the guidance of Dr. Daniela Jacob at MPI on *Intercomparison of ECHAM5 and REMO simulations*, Hamburg, Germany
- Internship under the guidance of Dr. Cathy Hohenegger at ETH on *Dynamical aspects of the August 2005 Alpine flood*, Zurich, Switzerland

---

Community service and outreach

Service and outreach

06/2014-06/2015 - Organizer of the weekly CESD Brownbag seminar series

10/2013 - Scientist in NOVA-LABS's cloud lab: Online Q&A with students and other participants [`pbs.org/wgbh/nova/labs/`]

06/2012 - Interview for ETH Globe on "Gewitter im Rechner" (thunderstorm in a computer): *ETH Globe*, No. 2, pp. 26-28 [pdf available online (in German)]

Review activity

- Journal of the Atmospheric Sciences
- Monthly Weather Review
- Quarterly Journal of the Royal Meteorological Society
- Climate Dynamics
- Geophysical Research Letters
- Advances in Science and Research

Membership

- American Meteorological Society
- American Geophysical Union

- Climate Limited-area Modeling (CLM) Community [www.clm-community.eu]
