

Christoph Zülicke – Research & Publications

Waves & Circulation	1
Inertia-gravity waves and their role in coupling atmospheric layers.....	1
Trends and anomalies in planetary waves and global circulation.....	1
Turbulence & Fluxes	2
Turbulence, waves and mixing	2
Mesoscale fluxes and budgets	2
Noise & Diffusion.....	2
Nonlinear waves in reaction-diffusion systems	2
Time series analysis and stochastic dynamics.....	2
References	2

Waves & Circulation

Inertia-gravity waves and their role in coupling atmospheric layers

- Generation by unbalanced flow, convection, fronts and orography (Zülicke & Peters 2006; Mirzaei *et al.* 2014; Mirzaei *et al.* 2017; Hien *et al.* 2018; Schoon & Zülicke 2018; Amiramjadi *et al.* 2020; Haghighatnasab *et al.* 2020; Geldenhuys *et al.* 2021; Becker *et al.* 2022)
- Propagation and impact in the middle atmosphere (Serafimovich *et al.* 2006; Zülicke & Peters 2008; Stephan *et al.* 2020) and the lower atmosphere (Zülicke & Peters 2007)

Trends and anomalies in planetary waves and global circulation

- Climatology and impact of breaking Rossby waves (Zülicke & Peters 2008; Eixmann *et al.* 2010)
- Global circulation patterns such as SSW, QBO and SAO (Peters & Zülicke 2006; Zülicke & Becker 2013; Kishore Kumar *et al.* 2014; Peters *et al.* 2015; Zülicke & Becker 2017; Zülicke *et al.* 2018)

Turbulence & Fluxes

Turbulence, waves and mixing

- Stratification and wave effects in air-sea exchange (Zülicke & Hagen 1998; Zülicke 2005; Zülicke *et al.* 2012)
- Wave-turbulence interaction in the atmosphere (Söder *et al.* 2021)

Mesoscale fluxes and budgets

- Mixed layer and eddy dynamics (Hagen *et al.* 1996; Zülicke & Sattler 1996; Zülicke *et al.* 1998)
- Regional estimates of tracer budgets and biological activity (John *et al.* 1996; Kuss *et al.* 2011)

Noise & Diffusion

Nonlinear waves in reaction-diffusion systems

- Wave phenomena (Bär *et al.* 1992b; Bär *et al.* 1992a; Pineda *et al.* 2006), “dynamic bistability” and stable domains (Zülicke *et al.* 1990; Schimansky-Geier *et al.* 1991a, 1992; Bartussek *et al.* 1995; Schimansky-Geier *et al.* 1995), and noise-induced frontal dynamics (Schimansky-Geier & Zülicke 1991; Schimansky-Geier *et al.* 1992; Santos *et al.* 2001)
- Structure formation and information processing (Zülicke *et al.* 1989; Zülicke & Schimansky-Geier 1990; Ebeling *et al.* 1991)

Time series analysis and stochastic dynamics

- Harmonic noise in bistable systems (Schimansky-Geier & Zülicke 1990; Schimansky-Geier *et al.* 1991b)
- Persistence in geophysical time series (Zülicke & Peters 2010)

References

Amiramjadi, M., A. R. Mohebalhojeh, M. Mirzaei, C. Zülicke & R. Plougonven, 2020:
The spatio-temporal variability of nonorographic gravity wave energy and

- relation to its source functions. *Mon. Wea. Rev.* **148**, 12: 4837–4857, doi:10.1175/MWR-D-20-0195.1.
- Bär, M., C. Zülicke, M. Eiswirth & G. Ertl, 1992a: Theoretical modeling of spatio-temporal selforganization in a surface catalyzed reaction exhibiting bistable kinetics. *J. Phys. Chem.* **96**, 11: 8592 - 8604, doi:10.1063/1.462312.
- Bär, M., M. Falcke, C. Zülicke, H. Engel, M. Eiswirth & G. Ertl, 1992b: Reaction fronts and pulses in the CO oxidation on Pt. Theoretical Analysis. *Surf. Sci.* **268/270**: 471-475, doi:10.1016/0039-6028(92)91294-L.
- Bartussek, R., C. Zülicke & L. Schimansky-Geier, 1995: One-dimensional domains in systems with long-range inhibition. *Chaos, Solitons and Fractals* **5**, 10: 1927-1934, doi:10.1016/0960-0779(94)00200-A.
- Becker, E., S. L. Vadas, K. Bossert, V. L. Harvey, C. Zülicke & L. Hoffmann, 2022: A high-resolution whole-atmosphere model with resolved gravity waves and specified large-scale dynamics in the troposphere and lower stratosphere. *J. Geophys. Res. Atmos.* **127**, 2: 035018, doi:10.1029/2021JD035018.
- Ebeling, W., A. Engel, L. Schimansky-Geier & C. Zülicke, 1991: Dynamics of fronts, nuclei and patterns in 2D random media. *Physica D* **49**: 170-176, doi:10.1016/0167-2789(91)90205-N.
- Eixmann, R., D. H. W. Peters, C. Zülicke, M. Gerding & A. Dörnbrack, 2010: On the upper tropospheric formation and occurrence of high and thin cirrus clouds during anticyclonic poleward Rossby wave breaking events. *Tellus* **62A**: 228 - 242, doi:10.1111/j.1600-0870.2010.00437.x, <https://www.tandfonline.com/doi/abs/10.1111/j.1600-0870.2009.00437.x>.
- Geldenhuis, M., P. Preusse, I. Krisch, C. Zülicke, J. Ungermann, M. Ern, F. Friedl-Vallon & M. Riese, 2021: Orographically-Induced Spontaneous Imbalance within the Jet Causing a Large Scale Gravity Wave Event. *Atmos. Chem. Phys.* **21**: 10393-10412, doi:10.5194/acp-21-10393-2021.
- Hagen, E., C. Zülicke & R. Feistel, 1996: Near-surface structures in the Cape Ghir filament off Morocco. *Oceanologica Acta* **19**, 6: 577-598, <https://archimer.ifremer.fr/doc/00096/20728/>.
- Haghighatnasab, M., M. Mirzaei, A. R. Mohebalhojeh, C. Zülicke & R. Plougonven, 2020: Application of the Compressible, Nonhydrostatic, Balanced Omega Equation in Estimating Diabatic Forcing for Parameterization of Inertia–

- Gravity Waves: Case Study of Moist Baroclinic Waves Using WRF. *J. Atmos. Sci.* **77**, 1: 113-129, doi:10.1175/jas-d-19-0039.1.
- Hien, S., J. Rolland, S. Borchert, L. Schoon, C. Zülicke & U. Achatz, 2018: Spontaneous inertia–gravity wave emission in the differentially heated rotating annulus experiment. *J. Fluid Mech.* **838**: 5-41, doi:10.1017/jfm.2017.883.
- John, H.-C., P. Re & C. Zülicke, 1996: Sardine larvae in a spring-upwelling event off Northern Portugal. *Cienc. Biol. Ecol. Syst. (Portugal)* **16**, 1/2: 193 - 198.
- Kishore Kumar, G., K. Kishore Kumar, W. Singer, C. Zülicke, S. Gurubaran, G. Baumgarten, G. Ramkumar, S. Sathishkumar & M. Rapp, 2014: Mesosphere and lower thermosphere zonal wind over low latitudes: Relation to local stratospheric zonal winds and global circulation anomalies. *J. Geophys. Res. Atmos.* **119**, 10: 5913 - 5927, doi:10.1002/2014JD021610.
- Kuss, J., C. Zülicke, C. Pohl & B. Schneider, 2011: Atlantic mercury emissions determined from continuous analysis of the elemental mercury air-sea concentration difference within transects between 50 °N and 50 °S. *Global Biogeochem. Cycles* **25**: GB3021, doi:10.1029/2010GB003998.
- Mirzaei, M., A. R. Mohebalhojeh, C. Zülicke & R. Plougonven, 2017: On the quantification of imbalance and inertia-gravity waves generated in numerical simulations of moist baroclinic waves using the WRF model. *J. Atmos. Sci.* **74**: 4241-4263, doi:10.1175/jas-d-16-0366.1.
- Mirzaei, M., C. Zülicke, A. R. Mohebalhojeh, F. Ahmadi-Givi & R. Plougonven, 2014: Structure, energy and parametrization of inertia-gravity waves in dry and moist simulations of a baroclinic wave life cycle. *J. Atmos. Sci.* **71**, 7: 2390 - 2414, doi:10.1175/JAS-D-13-075.1.
- Peters, D. H. W. & C. Zülicke, 2006: Atmospheric Angular Momentum Balance for the Southern Hemisphere During the Polar Vortex Break-up of September 2002. *Tellus* **58A**: 508 - 519, doi:10.1111/j.1600-0870.2006.00187.x.
- Peters, D. H. W., A. Schneidereit, M. Bügelmayer, C. Zülicke & I. Kirchner, 2015: Atmospheric circulation changes in response to a stratospheric zonal ozone anomaly. *Atmos.-Ocean* **53**, 1: 74 - 88, doi:10.1080/07055900.2013.878833.
- Pineda, M., R. Imbihl, L. Schimansky-Geier & C. Zülicke, 2006: Theoretical analysis of internal fluctuations and bistability in CO oxidation on nanoscale surfaces. *J. Chem. Phys.* **124**, 044701, doi:10.1063/1.2140709.

- Santos, M. A., C. Zülicke & L. Schimansky-Geier, 2001: Noise-induced dynamic bistability of front propagation. *Phys. Lett. A* **290**, 5/6: 270 - 276, doi:10.1016/S0375-9601(01)00685-5.
- Schimansky-Geier, L. & C. Zülicke, 1990: Harmonic noise: Influence on bistable systems. *Z. Physik B - Cond. Mat.* **79**: 451 - 460, doi:10.1007/BF01437657.
- Schimansky-Geier, L. & C. Zülicke, 1991: Kink propagation induced by multiplicative noise. *Z. Physik B - Cond. Mat.* **82**: 157-162, doi:10.1007/BF01313999.
- Schimansky-Geier, L., C. Zülicke & E. Schöll, 1991a: Domain formation due to Ostwald ripening in bistable systems far from equilibrium. *Z. Physik B - Cond. Mat.* **84**: 433-441, doi:10.1007/BF01314019.
- Schimansky-Geier, L., J. J. Hesse & C. Zülicke, 1991b: Harmonic-noise driven bistable dynamics. *Ber. Bunsenges. Phys. Chem.* **95**, 3: 349 - 352, doi:10.1002/bbpc.19910950321
- Schimansky-Geier, L., C. Zülicke & E. Schöll, 1992: Growth of domains under global constraints. *Physica A* **188**: 436, doi:10.1016/0378-4371(92)90285-X.
- Schimansky-Geier, L., H. Hempel, R. Bartussek & C. Zülicke, 1995: Analysis of domain solutions in reaction-diffusion systems. *Z. Physik B - Cond. Mat.* **96**: 417 - 427, doi:10.1007/BF01313065.
- Schoon, L. & C. Zülicke, 2018: A novel method for the extraction of local gravity wave parameters from gridded three-dimensional data: description, validation, and application. *Atmos. Chem. Phys.* **18**: 6971-6983, doi:10.5194/acp-18-6971-2018, <https://doi.org/10.5194/acp-18-6971-2018>.
- Serafimovich, A., C. Zülicke, P. Hoffmann, D. H. W. Peters, P. Dalin & W. Singer, 2006: Inertia gravity waves in the upper troposphere during the MaCWAVE winter campaign - Part II: Radar investigations and modelling studies. *Ann. Geophys.* **24**: 2863 - 2875, doi:10.5194/angeo-24-2863-2006, www.ann-geophys.net/24/2863/2006/.
- Söder, J., C. Zülicke, M. Gerding & F.-J. Lübken, 2021: High-resolution observations of turbulence distributions across tropopause folds. *J. Geophys. Res. Atmos.* **126**, 6: 033857, doi:10.1029/2020JD033857.
- Stephan, C. C., H. Schmidt, C. Zülicke & V. Matthias, 2020: Oblique Gravity Wave Propagation during Sudden Stratospheric Warmings. *J. Geophys. Res. Atmos.* **125**: 031528, doi:10.1029/2019JD031528.

- Zülicke, C., 2005: Air-sea fluxes including the effect of the molecular skin layer. *Deep-Sea Res. Pt. II* **52**: 1220 - 1245, doi:10.1016/j.dsr2.2005.01.008.
- Zülicke, C. & L. Schimansky-Geier, 1990: Pattern dynamics in distributed light-dependent chemical systems. *Z. phys. Chem. (Leipzig)* **271**, 2: 357-368, doi:10.1515/zpch-1990-27145, <https://www.degruyter.com/view/journals/zpch/271O/1/article-p357.xml>.
- Zülicke, C. & C. Sattler, 1996: Ekman transport in shallow waters under fluctuating winds. *Dynamik, Evolution, Strukturen*, J. A. Freund, Ed., Verlag Dr. Köster, Berlin: 145 - 157.
- Zülicke, C. & E. Hagen, 1998: Impact of the skin effect on the near-surface temperature profile. *Phys. Chem. Earth* **23**, 5-6: 531-535, doi:10.1016/S0079-1946(98)00066-4.
- Zülicke, C. & D. H. W. Peters, 2006: Simulation of inertia-gravity waves in a poleward breaking Rossby wave. *J. Atmos. Sci.* **63**, 12: 3253 - 3276, doi:10.1175/JAS3805.1.
- Zülicke, C. & D. H. W. Peters, 2007: Impact of upper-level jet-generated inertia-gravity waves on surface wind and precipitation. *Atmos. Chem. Phys. Discuss.* **7**: 15873, doi:10.5194/acpd-7-15873-2007, <http://www.atmos-chem-phys-discuss.net/7/15873/>.
- Zülicke, C. & D. H. W. Peters, 2008: Parameterization of strong stratospheric inertia-gravity waves forced by poleward breaking Rossby waves. *Mon. Wea. Rev.* **136**, 1: 98 - 119, doi:10.1175/2007MWR2060.1.
- Zülicke, C. & D. H. W. Peters, 2010: On the estimation of persistence in geophysical time series. *Eur. Phys. J. - Special Topics* **187**: 101 - 108, doi:10.1140/epjst/e2010-01275-2.
- Zülicke, C. & E. Becker, 2013: The structure of the mesosphere during sudden stratospheric warmings in a global circulation model. *J. Geophys. Res. Atmos.* **118**: 2255 - 2271, doi:10.1002/jgrd.50219.
- Zülicke, C. & E. Becker, 2017: Relation between equatorial mesospheric wind anomalies during spring and middle atmosphere variability modes. *Sci. Online Lett. Atmos.* **13A**: 31-35, doi:10.2151/sola.13A-006.

- Zülicke, C., W. Ebeling & L. Schimansky-Geier, 1989: Dynamic pattern processing with adaptive excitable media. *BioSystems* **422**, 1: 261-272, doi:10.1016/0303-2647(89)90047-6.
- Zülicke, C., A. S. Mikhailov & L. Schimansky-Geier, 1990: Dynamic bistability of front propagation and stable localized domains in systems with first-order phase transition. *Physica A* **163**, 1: 559-583, doi:10.1016/0378-4371(90)90145-I.
- Zülicke, C., E. Hagen & A. Stips, 1998: Dissipation and mixing in a coastal jet: A Baltic Sea case study. *Aquat. Sci.* **60**, 3: 220 - 235, doi:10.1007/s000270050038.
- Zülicke, C., K. A. Degreif & B. Jähne, 2012: Air-sea interaction model for momentum, mass and turbulence including wind waves: in preparation.
- Zülicke, C., E. Becker, V. Matthias, D. H. W. Peters, H. Schmidt, H.-L. Liu, L. de la Torre Ramos & D. M. Mitchell, 2018: Coupling of stratospheric warmings with mesospheric coolings in observations and simulations. *J. Climate* **31**: 1107-1133, doi:10.1175/JCLI-D-17-0047.1.