

**Contact Information** Jet Propulsion Laboratory  
California Institute of Technology  
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✉ : cfranken@jpl.nasa.gov

**Research**

**Interests** Remote sensing of atmospheric trace gases (with particular focus on greenhouse-gases), biogeochemical cycles (through observations of greenhouse gases and chlorophyll fluorescence), hydrological cycle and distribution of water isotopes, inverse methods, applied spectroscopy.

**Education Ruprecht-Karls-University, Heidelberg, Germany**

Dr. rer. nat., summa cum laude, Institute of Environmental Physics **Nov. 2005**

- Thesis: “Retrieval of methane and carbon monoxide using near infrared spectra recorded by SCIAMACHY onboard ENVISAT - Algorithm development and data analysis” ∅
- Advisor: Prof. Ulrich Platt and Prof. Jos Lelieveld

**University of Bayreuth, Bayreuth, Germany**

Diplom in Geoecology, with honors **May 2002**

- Thesis: “Evaluating Stationarity in Ecological Timeseries”
- Advisor: Dr. habil. Holger Lange and Prof. Otto Klemm
- Focus: Atmospheric chemistry, ecological modeling, micrometeorology, physical chemistry, numerical mathematics

Additional qualification in multimedia competence **2000-2002**

- Basic and advanced courses in programming and informatics

Vordiplom in Geoecology, with honors **Nov. 1999**

**Short courses** Spring School in Quant. Earth Obs. Data, Oxford, UK **Mar. 2003**  
Summer School, Environmental Physics, Heidelberg, Germany **Jul. 2001**

**Grants and awards** NASA Early Career Achievement Medal **Jul. 2012**  
JPL team bonus award **Jun. 2012**  
JPL Mariner award **Sep. 2011**  
JPL Mariner award **Jun. 2010**  
JPL team bonus award **May 2010**

**Academic Experience Jet Propulsion Laboratory - California Institute of Technology, Pasadena, USA**

Scientist **Jan. 2010 - present**

- Greenhouse gas retrievals from the Japanese GOSAT satellite and the upcoming NASA OCO-2 mission.
- Instrument concept development for future Greenhouse-Gas missions.
- Development and analysis of space-borne retrievals of chlorophyll fluorescence

**Netherlands Institute for Space Research, Utrecht, The Netherlands**

VENI (personal fellowship from the Dutch Science Foundation) Postdoctoral Researcher  
**Sep. 2006 - Dec. 2009**

- Retrieval of atmospheric methane using near-infrared space-borne spectrometers.
- Simultaneous retrievals of atmospheric H<sub>2</sub>O, HDO and CO.
- Laboratory studies of spectroscopic parameters, impact of spectroscopic uncertainties on trace gas retrievals.
- Co-supervision of a PhD student at the University of Heidelberg, Germany.
- Organiser and leader of group meetings in the Earth Observation Division.
- Responsible for public outreach using GoogleEarth visualisation.

**Institute of Environmental Physics**, Heidelberg, Germany

Postdoctoral Researcher

**Nov. 2005 – Aug. 2006**

- Retrieval of atmospheric methane and carbon monoxide using near-infrared space-borne spectrometers.
- Co-supervision of a graduate student.
- Responsible for software development and hardware maintenance of the Satellite Group.

**Publications** Web of Science: h-factor=15, 855 total citations

Under review and in prep.

Journal impact factor

[46] Parazoo, N. K. Bowman, **C. Frankenberg**, et al., Rising CO<sub>2</sub> Associated with GPP Loss During 2010 Amazon Drought, in preparation for publication in *Geophys. Res. Lett.*, 2012

[45] **C. Frankenberg**, Debra Wunch, Geoffrey Toon, Camille Risi, Remco Scheepmaker, Jung-Eun Lee, Paul Wennberg, and John Worden, Water vapor isotopologues retrievals from high resolution GOSAT short-wave infrared spectra, *AMTD*, *under review*

[44] J-E Lee, **C. Frankenberg (equal contribution)**, C. van der Tol, L. Guanter, C. K. Boyce, J. B. Fisher, E. Morrow, J. A. Berry, J. Worden1, S. Asefi, G. Badgley, S. Saatchi, Satellite observations of fluorescence capture the response of Amazonian productivity to seasonality and drought, *Proceedings of the Royal Society B*, under review, **IF=5**

Published (only peer reviewed papers listed)

Journal impact factor

[43] Kort, E., **Frankenberg, C.**, Miller, C, Oda, T. Space-based Observations of Megacity Carbon Dioxide, *Geophys. Res. Lett.* *in press*, 2012 **IF=3.5**

[42] **Frankenberg, C.**, O'Dell, C., Guanter, L., and McDuffie, J.: Chlorophyll fluorescence remote sensing from space in scattering atmospheres: implications for its retrieval and interferences with atmospheric CO<sub>2</sub> retrievals, *Atmos. Meas. Tech. Discuss.*, 5, 2487-2527, doi:10.5194/amtd-5-2487-2012, 2012 (accepted, in press for AMT). **IF=3.3**

[41] Schepers, D., Guerlet, S., Butz, A., Landgraf, J., **C. Frankenberg**, Hasekamp, O. P., Blavier, J.-F., et al. (2012). Methane retrievals from Greenhouse Gases Observing Satellite (GOSAT) short-wave infrared measurements: Performance comparison of proxy and physics retrieval algorithms. *Journal of Geophysical Research*, 117(D10), D10307. doi:10.1029/2012JD017549 **IF=3.3**

[40] Crisp, D., Fisher, B., O'Dell, C., **C. Frankenberg**, Basilio, R., Bsch, H., Brown, L., et al. (2012). The ACOS CO<sub>2</sub> retrieval algorithm; Part II: Global XCO<sub>2</sub> data characterization. *Atmospheric Measurement Techniques*, 5(4), 687–707. **IF=3.3**

[39] **C. Frankenberg**, Hasekamp, O. P., O'Dell, C., Sanghavi, S., Butz, A., & Worden, J. (2012). Aerosol information content analysis of multi-angle high spectral resolution measurements and its benefit for high accuracy greenhouse gas retrievals. *Atmospheric Measurement Techniques*, 5(7),

1809–1821.

**IF=3.3**

[38] Guanter, L., **C. Frankenberg**, Dudhia, A., Lewis, P. E., Gmez-Dans, J., Kuze, A., Suto, H., et al. (2012). Retrieval and global assessment of terrestrial chlorophyll fluorescence from GOSAT space measurements. *Remote Sensing of Environment*, 121, 236–251. doi:10.1016/j.rse.2012.02.006 **IF=4.5**

[37] Worden, J., Kulawik, S., **C. Frankenberg**, Payne, V., Bowman, K. W., Cady-Peirara, K., Wecht, K., et al. (2012). Profiles of CH<sub>4</sub>, HDO, H<sub>2</sub>O, and N<sub>2</sub>O with improved lower tropospheric vertical resolution from Aura TES radiances. *Atmospheric Measurement Techniques*, 5(2), 397–411. **IF=3.3**

[36] C. Risi, D. Noone, J. Worden, **C. Frankenberg**, et al, Process-evaluation of tropospheric humidity simulated by general circulation models using water vapor isotopic observations. Part 2: using isotopic diagnostics understand the mid and upper tropospheric moist bias in the tropics and subtropics, *J. Geophys. Res.*, 117(D5), D05303. **IF=3.3**

[35] C. Risi, D. Noone, J. Worden, **C. Frankenberg**, et al.: Process-evaluation of tropospheric humidity simulated by general circulation models using water vapor isotopologues. Part 1: comparison between models and observations, *J. Geophys. Res.*, 117(D5), D05304 **IF=3.3**

[34] O’Dell, C. W., Connor, B., Bsch, H., O’Brien, D., **Frankenberg, C.**, Castano, R., Christi, M., Crisp, D., Eldering, A., Fisher, B., Gunson, M., McDuffie, J., Miller, C. E., Natraj, V., Oyafuso, F., Polonsky, I., Smyth, M., Taylor, T., Toon, G. C., Wennberg, P. O., and Wunch, D.: The ACOS CO<sub>2</sub> retrieval algorithm Part 1: Description and validation against synthetic observations, *Atmos. Meas. Tech.*, 5, 99–121, doi:10.5194/amt-5-99-2012, 2012. **IF=2.6**

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[32] **Frankenberg, C.**, et al. (2011), New global observations of the terrestrial carbon cycle from GOSAT: Patterns of plant fluorescence with gross primary productivity, *Geophys. Res. Lett.*, 38, L17706, doi:10.1029/2011GL048738. **IF=3.5**

[31] Yoshimura, K., **Frankenberg, C.**, J. Lee, M. Kanamitsu, J. Worden, and T. Roeckmann (2011), Comparison of an isotopic AGCM with new quasi global satellite measurements of water vapor isotopologues, *J. Geophys. Res.*, doi:10.1029/2011JD016035, in press. **IF=3.3**

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[28] Spahni, R., Wania, R., Neef, L., van Weele, M., Pison, I., Bousquet, P., **Frankenberg, C.**, Foster, P. N., Joos, F., Prentice, I. C., and van Velthoven, P.: Constraining global methane emissions and uptake by ecosystems, *Biogeosciences*, 8, 1643–1665, doi:10.5194/bg-8-1643-2011 **IF=3.6**

[27] **Frankenberg, C.**, A. Butz, and G. C. Toon (2011), Disentangling chlorophyll fluorescence from atmospheric scattering effects in O<sub>2</sub> A-band spectra of reflected sun-light, *Geophys. Res.*

- Lett.*, 38, L03801, doi:10.1029/2010GL045896. **IF=3.5**
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- [25] **Frankenberg, C.**, I. Aben, P. Bergamaschi, E. J. Dlugokencky, R. van Hees, S. Houweling, P. van der Meer, R. Snel, and P. Tol (2010), Global column-averaged methane mixing ratios from 2003–2009 as derived from SCIAMACHY: Trends and variability, *J. Geophys. Res.*, 116, D04302, doi:10.1029/2010JD014849 **IF=3.3**
- [24] Butz, A., O.P. Hasekamp, **C. Frankenberg**, J. Vidot, and I. Aben (2010), CH<sub>4</sub> retrievals from space-based solar backscatter measurements: performance evaluation against simulated aerosol and cirrus loaded scenes, *J. Geophys. Res.*, doi:10.1029/2010JD014514. **IF=3.3**
- [23] Risi, C., S. Bony, F. Vimeux, **C. Frankenberg**, D. Noone, and J. Worden (2010), Understanding the Sahelian water budget through the isotopic composition of water vapor and precipitation, *J. Geophys. Res.*, doi:10.1029/2010JD014690, D24110. **IF=3.3**
- [22] Petersen, A. K., Warneke, T., **Frankenberg, C.**, Bergamaschi, P., Gerbig, C., Notholt, J., Buchwitz, M., Schneising, O., and Schrems, O.: First ground-based FTIR observations of methane in the inner tropics over several years, *Atmos. Chem. Phys.*, 10, 7231–7239, doi:10.5194/acp-10-7231-2010, 2010. **IF=5.3**
- [21] H. Tran, J.-M. Hartmann, G. Toon, L.R. Brown, **C. Frankenberg**, T. Warneke, P. Spietz and F. Hase: The  $2\nu_3$  band of CH<sub>4</sub> revisited with line mixing: Consequences for spectroscopy and atmospheric retrievals at 1.67  $\mu\text{m}$ , *Journal of Quantitative Spectroscopy and Radiative Transfer* Volume 111, Issue 10, July 2010, Pages 1344–1356 (2010). **IF=2.3**
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- [19] F. Keppler, M. Boros, **C. Frankenberg**, J. Lelieveld, A. McLeod, A.M. Pirtillae, T. Roeckmann, and J.P. Schnitzler: Methane formation in aerobic environments, *Environmental Chemistry*, 6, 459–65 (2009). **IF=1.8**
- [18] P. Bergamaschi, **C. Frankenberg**, J.F. Meirink, M. Krol, M.G. Villani, S. Houweling, F. Dentener, E.J. Dlugokencky, J.B. Miller, A. Engel, and I. Levin: Inverse modeling of global and regional CH<sub>4</sub> emissions using SCIAMACHY satellite retrievals, *J. Geophys. Res.*, 114, D22301, (2009) **IF=3.3**
- [17] Schrijver, H. and Gloudemans, A.M.S. and **Frankenberg, C.** and Aben, I., Water vapour total columns from SCIAMACHY spectra in the 2.36 m window, *Atmos. Meas. Tech.*, 2, 561–571 (2009). **IF=2.6**
- [16] **Frankenberg, C.**, K. Yoshimura, T. Warneke, , I. Aben, A. Butz, N. Deutscher, D. Grith, F. Hase, J. Notholt, M. Schneider, H. Schrijver, and T. Roeckmann, Dynamic Processes Governing Lower-Tropospheric HDO/H<sub>2</sub>O Ratios as Observed from Space and Ground. *Science*, 325 (5946), 1374 (2009). **IF=31.3**
- [15] Butz, A., O. P. Hasekamp, **C. Frankenberg**, and I. Aben (2009), Retrievals of atmospheric CO<sub>2</sub> from simulated space-borne measurements of backscattered near-infrared sunlight: accounting for aerosol effects, *Appl. Opt.* 48, 3322–3336, DOI:10.1364/AO.48.003322. **IF=1.7**
- [14] **Frankenberg, C.**, P. Bergamaschi, A. Butz, S. Houweling, J. F. Meirink, K. Petersen, H. Schrijver, T. Warneke, and I. Aben (2008), Tropical methane emissions: A revised view from SCIA-

MACHY onboard envisat, *Geophys. Res. Lett.*, *35*, L15811, DOI:10.1029/2008GL034300. **IF=3.5**

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[12] Wagner, T., S. Beirle, T. Deutschmann, E. Eigemeier, **C. Frankenberg**, M. Grzegorski, C. Liu, T. Marbach, U. Platt, M. Penning de Vries (2008), Monitoring of atmospheric trace gases, clouds, aerosols and surface properties from UV/vis/NIR satellite instruments, *J. Opt. A: Pure Appl. Opt.* *10* DOI: 10.1088/1464-4258/10/10/104019 **IF=1.66**

[11] **Frankenberg, C.**, T. Warneke, A. Butz, L. R. Brown, F. Hase, P. Spietz, and I. Aben (2008), Methane spectroscopy in the near infrared and its implication on atmospheric retrievals, *Atm. Chem. Phys.*, *8*, 5061–5075. **IF=5.3**

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[8] Kuehl, S., Wilms-Grabe, W., **Frankenberg, C.**, Grzegorski, M., Platt, U., & Wagner, T. (2006). Comparison of OClO nadir measurements from SCIAMACHY and GOME. *Advances in Space Research* *37* (2006) 2247–2253 doi:10.1016/j.asr.2005.06.061 **IF=1.07**

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<b>Invited talks</b>	AGU fall meeting, San Francisco, USA	Dec. 2012
	AGU fall meeting, San Francisco, USA	Dec. 2011
	EGU general assembly, Vienna, Austria	May 2010
	Water Isotope workshop, Paris, France	Apr. 2010
	AGU fall meeting, San Francisco, USA	Dec. 2008
	Institute of Environmental Physics, University of Bremen, Germany	May 2008
	Institute for Meteorology and Climate Research, Karlsruhe, Germany	May 2007
<b>Public Presentations</b>	Press event	May 2008
	“Exploring Environmental Change: SCIAMACHY - Six years in space”	
	Oral presentation: “SCIAMACHY and Climate Change”	
<b>Projects</b>	<b>Projects in which I participate(d)</b>	
	OCO-2, Orbiting Carbon Observatory,	○
	GOSAT, Greenhouse gases Observing SATellite by the Japan Aerospace Exploartion Agency (JAXA), PI of a GOSAT Research Announcement	○
	ACCENT, the European Network of Excellence on Atmospheric Composition Change. PI in the Satellite Remote Sensing Task of ACCENT.	○
	ADAGUC, Atmospheric data access for the geospatial community	○
	HYMN, Hydrogen, Methane and Nitrous oxide EU 6th Framework Programme	○
	EVERGREEN, EnVisat for Environmental Regulation of GREENhouse gases Project supported by the European Commission. Fifth Framework Programme on Energy, Environment and Sustainable Development	○
<b>Technical Skills</b>	Extensive experience in scientific computing using Matlab and, for larger projects, object oriented C++. Experience in storage hardware (RAID systems) and relational database systems (MySQL, Postgres).	
	Standard scientific software packages: Matlab, IDL	
	Programming: C++, Gnu Scientific Library, Python, Java, PHP, UNIX shell scripting, SQL, SVN	
	Operating Systems: Linux, MacOS X, Microsoft Windows	
<b>Other activities</b>	Development, implementation and maintenance (as team with 2 co-students) of an automized web-based evaluation system of lectures given at the faculty of Biology, Chemistry and Geosciences at Bayreuth University. Self-initiated and voluntary project using Java Servlets, MySQL and L <sup>A</sup> T <sub>E</sub> X. Features: Automatic generation of online evaluation forms, password protection, statistical analysis and pdf export of a statistical summary. Used for about 100 lectures a year.	
	2000-2002	
	Network assistant, Bayreuth University, Computer center	1999-2001
	Paramedic education	June-July 1997
<b>Reviewer</b>	Atmospheric Chemistry and Physics, Journal of Geophysical Research, Remote Sensing of the Environment, Nature, Nature Geoscience, Geophysical Research Letter, Jorunal of Quantitative Spectroscopy and Radiative Transfer	