Curriculum Vitae for Arve Kylling

Contact points

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Education

- **Cand. Scient., Physics,** University of Oslo, Oslo, Norway *Sep. 1982 - Dec. 1985*
  - Thesis: A study of the χ_1 charmonium state in the R704 experiment at CERN's ISR
- **PhD, Atmospheric Science,** University of Alaska-Fairbanks, Fairbanks, USA *Sep. 1989 - Dec. 1992*
  - Thesis: Radiation transport in cloudy and aerosol loaded atmospheres

Work Experience

- **Programmer,** GECO (Geophysical Company of Norway), Stavanger, Norway *April 1986 - Oct. 1986*
  - Maintenance of the operational software for processing of seismic data.
- **Civil service,** Rogaland Research Institute, Stavanger, Norway *Oct. 1986 - Feb. 1987*
- **Research engineer,** Rogaland Research Institute, Stavanger, Norway *March 1987 - May 1988*
  - Part of team doing research on standing torsional waves in oil rig drill pipes.
- **Teaching Assistant,** Rogaland College, Stavanger, Norway *Jan. 1987 - Dec. 1987*
  - Responsible for laboratory courses and training exercises.
- **Research/Teaching Assistant,** University of Tromsø, Tromsø, Norway *Sep. 1988 - June 1989*
  - Responsible for laboratory courses and training exercises.
  - Development of software for radiative transfer in the Earth's atmosphere.
- **Teaching/Research Assistant,** University of Alaska-Fairbanks, Fairbanks, AK, USA *Sep. 1989 - Dec. 1992*
  - Responsible for laboratory courses and training exercises.
  - Courses for comprehensive exam.
  - Research for PhD.
- **Postdoctoral fellow,** University of Alaska-Fairbanks, Fairbanks, AK, USA *Jan. 1993 - Dec. 1995*
  - Project for NASA studying the effect of clouds and aerosol on photodissociation rates.
  - Initial development phase of the libRadtran software package.
- **Research Scientist,** NORUT IT, Tromsø, Norway *June 1993*
  - Implementation of algorithm for atmospheric correction for the Coastal Zone Color Scanner (CZCS) instrument.
- **Research Scientist,** NORUT IT, Tromsø, Norway *Jan. 1996 - Aug. 1997*
  - Modelling of UV radiation and effects of clouds, aerosol, and surface albedo. Comparison of measurements with model simulations. Funded by various EU and RCN projects including UVRAPPF, SUVDAMA, PAUR.
  - Development of the libRadtran software package.
- **Senior Research Scientist,** NILU, Tromsø and Kjeller, Norway *Sept. 1997 - Sept. 2004*
  - Modelling of UV radiation and comparison with surface and airborne measurements. Model and measurement studies of how clouds, aerosol, and surface albedo affect radiation. Funded by various EU and RCN projects including EDUCE, INSPECTRO, PAUR II, HIBISCUS.
  - Supervising development of NILU-UV instrument.
  - Particpation in design, construction and analysis of data from NILU-CUBE instrument.
  - Further development of the libRadtran software package.
- **Medical Physicist,** Cancer Department, Ålesund Hospital, Ålesund, Norway *Oct 2004 - Feb 2011*
  - Quality assurance of radiotherapy treatments.
  - Monte Carlo modelling of ionizing radiation applicable for radiotherapy.
- **Consultant,** Ålesund, Norway *Oct 2008 - Feb 2011*
  - Consultant for ESAS-Light project funded by ESA.
  - Inclusion of rotational Raman scattering in the libRadtran software package.
- **Senior Research Scientist,** NILU, Kjeller, Norway *Feb 2011 - present*
  - Radiative transfer modelling.
  - Radiative effects of clouds.

- Remote sensing of volcanic ash.
- WP leader FUTUREVOLC FP7 project.
- Analysis of UAS sensed surface albedo data and comparison with MODIS.

Research Interest

- Modelling of UV, visible, NIR and IR radiation in the Earth's atmosphere and the effects of clouds, aerosol and surface characteristics.
- Model/measurement intercomparisons for effect studies and model validation.
- Remote sensing of volcanic ash.
- General radiative transfer theory.

Relevant Peer-Reviewed Publications Past Five Years

Total of 44 peer-reviewed journal articles (17 as 1$^{\text{st}}$ author). Numerous conference presentations. ISI Web of Science h-index: 22.

1. Kylling, A., et al., 'Technical Note: A new discrete ordinate first-order rotational Raman scattering radiative transfer model implementation and first results', *Atmos. Chem. Phys.*, **11**, 10471–10485, 2011.
2. Kylling, A., Buras, R., Eckhardt, S., Emde, C., Mayer, B. and Stohl, A., 'Simulation of SEVIRI infrared channels: a case study from the Eyjafjallajökull April/May 2010 eruption', *Atmospheric Measurement Techniques*, **6**, 3, 649–660, http://www.atmos-meas-tech.net/6/649/2013/, doi:10.5194/amt-6-649-2013, 2013.
3. Kylling, A., M. Kahnert, H. Lindqvist and T. Nousiainen, 'Volcanic ash infrared signature: porous non-spherical ash particle shapes compared to homogeneous spherical ash particles', *Atmospheric Measurement Techniques*, **7**, 4, 919–929, http://www.atmos-meas-tech.net/7/919/2014/, doi:10.5194/amt-7-919-2014, 2014.
4. Kylling, A. Kristiansen, N. Stohl, A. Buras-Schnell, R. Emde, C. and Gasteiger, J., 'A model sensitivity study of the impact of clouds on satellite detection and retrieval of volcanic ash', *Atmospheric Measurement Techniques*, **8**, 1935–1949, http://www.atmos-meas-tech.net/8/1935/2015/, doi:10.5194/amt-8-1935-2015, 2015.

Other Relevant Information

Languages: Norwegian (native), English (fluent), German (basic)

Computer Languages: C, Fortran, Perl, Python

Software projects: Development of the freely available libRadtran package for radiative transfer in the Earth's atmosphere (www.libradtran.org). The software package has been used in more than 300 peer-reviewed publications.

Complete Listing of Peer-Reviewed Publications

1. Baglin et al., (R704 collaboration), 'Search for the $^1P_1$ charmonium state in $p\overline{p}$ annihilations at the CERN intersecting storage rings', *Physics Letters B*, **172**, 135, 1986.
2. Baglin et al., (R704 collaboration), 'Formation of the χ_1 and χ_2 charmonium resonances in antiproton–proton annihilation and measurements of their masses and total widhts', *Physics Letters B*, **172**, 455, 1986.
3. Baglin et al., (R704 collaboration), 'Angular distribution in the reaction $p\overline{p} \to \gamma\psi \to \gamma e^+e^-$', *Physics Letters B*, **195**, 85, 1987.
4. Kylling, A., 'Discrete ordinate solution of the radiative transfer equation in the "polarization normal wave representation"', *Astrophysical Journal*, **383**, 243–249, 1991.
5. Kylling, A., and K. Stamnes, 'Efficient yet accurate solution of the linear transport equation in the presence of internal sources: the exponential–linear–in–depth approximation', *Journal of Computational Physics*, **102**, 265–276, 1992.
6. Kylling, A., K. Stamnes, R. R. Meier and D. E. Anderson, 'The 200–300nm radiation field in the stratosphere: comparison of models with observation', *Journal of Geophysical Research*, **98**, 2741–2745, 1993.
7. Kylling, A., K. Stamnes, and S.–C. Tsay, 'A reliable and efficient two–stream algorithm for radiative transfer; Documentation of accuracy in realistic layered media', *Journal of Atmospheric Chemistry*, **21**, 115–150, 1995.
8. Slusser, J., K. Hammond, A. Kylling, K. Stamnes, L. Perliski, A. Dahlback, D. Anderson and R. DeMajistre, 'Comparison of Air Mass Computations', *Journal of Geophysical Research*, **101**, 9315–9321, 1996.

9. Kylling, A., A. Albold, and G. Seckmeyer 'Transmittance of a cloud is wavelength–dependent in the UV–range: Physical interpretation', *Geophysical Research Letters*, **24**, 397–400, 1997.

10. Mayer, B., G. Seckmeyer, and A. Kylling, 'Systematic longterm comparison of spectral UV measurements and UVSPEC modeling results', *Journal of Geophysical Research*, **102**, 8755–8767, 1997.

11. Kylling, A., A. F. Bais, M. Blumthaler, J. Schreder, C. S. Zerefos and E. Kosmidis, 'The effect of aerosols on solar UV irradiances during the Photochemical Activity and Solar Radiation campaign', *Journal of Geophysical Research*, **103**, 26,051–26,060, 1998.

12. Mayer, B, A. Kylling, S. Madronich and G. Seckmeyer, 'Enhanced Absorption of UV Radiation due to Multiple Scattering in Clouds: Experimental Evidence and Theoretical Explanation', *Journal of Geophysical Research*, **103**, 31,241–31,254, 1998.

13. Weele et al., 'From model intercomparison towards benchmark UV spectra for six real atmospheric cases', *Journal of Geophysical Research*, **105**, 4916–4925, 2000.

14. Kylling, A., T. Persen, B. Mayer and T. Svenøe, 'Determination of an Effective Spectral Surface Albedo From Ground Based Global and Direct UV Irradiance Measurements', *Journal of Geophysical Research*, **105**, 4949–4959, 2000.

15. Lapeta et al, 'Sensitivity of surface UV radiation and ozone column retrieval to ozone and temperature profiles', *Journal of Geophysical Research*, **105**, 5001–5007, 2000.

16. Jonson, et al., 'Chemical effects of UV fluctuations inferred from total ozone and tropospheric aerosol variations', *Journal of Geophysical Research*, **105**, 14,561–14,574, 2000.

17. Taalas, P., et al., 'The impact of greenhouse gases and halogenated species on future solar UV radiation doses', *Geophysical Research Letters*, **27**, 1127–1131, 2000.

18. Kylling, A., A. Dahlback and B. Mayer, 'The effect of clouds and surface albedo on UV irradiances at a high latitude site', *Geophysical Research Letters*, **27**, 1411–1414, 2000.

19. Kylling, A., and B. Mayer, 'Ultraviolet radiation in partly snow covered terrain: Observations and three-dimensional simulations', *Geophysical Research Letters*, **28**, 3665–3668, 2001.

20. Hofzumahaus, A., A. Kraus, A. Kylling, and C. Zerefos, 'Solar actinic radiation (280-420 nm) in the cloud-free troposphere between ground and 12 km altitude: Measurements and model results', *Journal of Geophysical Research*, **107**, doi:10.1029/2001JD900142, 2002.

21. Webb et al., 'Measuring spectral actinic flux and irradiance: Experimental results from the ADMIRA (Actinic Flux Determination from Measurements of Irradiance)', *J. Atm. Ocean Technol.*, **19**, 1049-1062, 2002.

22. Shetter et al., 'Photolysis frequency of NO2: Measurement and modeling during the International Photolysis Frequency Measurement and Modeling Intercomparison (IPMMI)', *J. Geophys. Res.*, **108**, doi:10.1029/2002JD002932, 2003.

23. Bais et al., 'International Photolysis Frequency Measurement and Model Intercomparison (IPMMI): Spectral actinic solar flux measurements and modeling', *J. Geophys. Res.*, **108**, doi:10.1029/2002JD002891, 2003.

24. Kylling et al., 'Twilight tropospheric and stratospheric photodissociation rates derived from balloon borne radiation measurements', *Atmos. Chem. Phys.*, **3**, 377-385, 2003.

25. Høiskar et al., 'Multichannel moderate-bandwidth filter instrument for measurement of the ozone-column amount, cloud transmittance, and ultraviolet dose rates', *Appl. Opt.*, **42**, 3472-3479, 2003.

26. Kylling et al., 'Actinic flux determination from measurements of irradiance', *J. Geophys. Res.*, **108**, doi:10.1029/2002JD003236, 2003.

27. Orsolini et al., 'Summertime low-ozone episodes at northern high latitudes', *Q. J. R. Meteorol. Soc.*, **129**, 3265-3275, 2003.

28. Kahnert, M., and A. Kylling, 'Radiance and flux simulations for mineral dust aerosols: Assessing the error due to using spherical or spheroidal model particles', *J. Geophys. Res.*, *Journal of Geophysical Research*, **109**, D09203, 10.1029/2003JD004318, 2004.

29. Hofzumahaus, A., et al., 'Photolysis frequency of O_3 to $O(^1D)$: Measurements and modeling during the International Photolysis Frequency Measurement and Modeling Intercomparison (IPMMI)', *Journal of Geophysical Research*, **109**, D08S90, 10.1029/2003JD004333, 2004.

30. Lenoble, J., A. Kylling, and I. Smolskaia, 'Impact of snow cover and topography on ultraviolet irradiance at the Alpine station of Briançon', *J. Geophys. Res.*, **109**, D16209, doi:10.1029/2004JD004523, 2004.

31. Webb, A. R., A. Kylling, M. Wendisch, and E. Jäkel, 'Airborne measurements of ground and cloud spectral albedos under low aerosol loads', *J. Geophys. Res.*, **109D**, D20205, doi:10.1029/2004JD004768, 2004.

32. Engelsen, O., and A. Kylling. 'Fast simulation tool for ultraviolet radiation at the Earth's surface', *Optical Engineering*, **44(4)**, 041012, 2005.

33. Kylling, A. et al., 'Spectral actinic flux in the lower troposphere: measurement and 1-D simulations for cloudless, broken cloud and overcast situations', *Atmos. Chem. Phys.*, **5**, 1975-1997, 2005.

34. Mayer, B., and A. Kylling, 'Technical Note: The libRadtran software package for radiative transfer calculations: Description and examples of use'. *Atmos. Chem. Phys.*, **5**, 1855-1877, 2005.

35. Hendrick, F. et al., 'Intercomparison exercise between different radiative transfer models used for the interpretation of ground-based zenith-sky and multi-axis DOAS observations', *Atmos. Chem. Phys.*, **6**, 93-108, 2006.

36. Thiel, S., et al., 'Influence of clouds on the spectral actinic flux in the lower troposphere (INSPECTRO): overview of the field campaigns', *Atmos. Chem. Phys.*, **8**, 1789-1812, 2008.

37. Kylling, A., et al., 'Technical Note: A new discrete ordinate first-order rotational Raman scattering radiative transfer model implementation and first results', *Atmos. Chem. Phys.*, **11**, 10471–10485, 2011.

38. Almberg, S. A. et al., 'Monte Carlo linear accelerator simulation of megavoltage photon beams: Independent determination of initial beam parameters', *Medical Physics*, **39**, 40–47, 2012.

39. Kylling, A., Buras, R., Eckhardt, S., Emde, C., Mayer, B. and Stohl, A., 'Simulation of SEVIRI infrared channels: a case study from the Eyjafjallajökull April/May 2010 eruption', *Atmospheric Measurement Techniques*, **6**, 3, 649–660, http://www.atmos-meas-tech.net/6/649/2013/, doi:10.5194/amt-6-649-2013, 2013.

40. Kylling, A., M. Kahnert, H. Lindqvist and T. Nousiainen, 'Volcanic ash infrared signature: porous non-spherical ash particle shapes compared to homogeneous spherical ash particles', *Atmospheric Measurement Techniques*, **7**, 4, 919–929, http://www.atmos-meas-tech.net/7/919/2014/, doi:10.5194/amt-7-919-2014, 2014.

41. Kylling, A. Kristiansen, N. Stohl, A. Buras-Schnell, R. Emde, C. and Gasteiger, J., 'A model sensitivity study of the impact of clouds on satellite detection and retrieval of volcanic ash', *Atmospheric Measurement Techniques,* **8***, 1935–1949, http://www.atmos-meas-tech.net/8/1935/2015/, doi:10.5194/amt-8-1935-2015, 2015.*

42. Bogren, W. S., Burkhart, J. F., and Kylling, A., 'Tilt error in cryospheric surface radiation measurements at high latitudes: a model study', The Cryosphere, **10**, 2, 613–622, http://www.the-cryosphere.net/10/613/2016/, doi:10.5194/tc-10-613-2016, 2016.

43. Emde, C., Buras-Schnell, R., Kylling, A., Mayer, B., Gasteiger, J., Hamann, U., Kylling, J., Richter, B., Pause, C., Dowling, T., and Bugliaro, L., 'The libRadtran software package for radiative transfer calculations (version 2.0.1)', Geoscientific Model Development, **9**, 5, 1647–1672, http://www.geosci-model-dev.net/9/1647/2016/, doi:10.5194/gmd-9-1647-2016, 2016.

44. Kylling, A., 'Ash and ice clouds during the Mt Kelud February 2014 eruption as interpreted from IASI and AVHRR/3 observations', Atmospheric Measurement Techniques, **9**, 15, 2103–2117, http://www.atmos-meas-tech.net/9/2103/2016/, doi:10.5194/amt-9-2103-2016, 2016.