

# James A. Sinclair

Research Scientist II

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## Education

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- 2010 - 2014     **DPhil Atmospheric, Oceanic & Planetary Physics**, University of Oxford, Oxford, United Kingdom  
*Thesis title: 'Seasonal and interannual variability in Saturn's stratosphere'*  
*Thesis advisor: Prof. Patrick Irwin*
- 2006 - 2010     **MPhys Astrophysics** (1st class), University of St. Andrews, St. Andrews, United Kingdom

## Research Experience

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- 2018 – Present     **Research Scientist II**, Jet Propulsion Laboratory/Caltech, Pasadena, CA, United States
- Currently analyzing a long-term mid-infrared dataset of Jupiter, and comparing results with measurements from the Juno spacecraft, in order to understand the variability of the jovian aurora.
  - Measured, processed and analyzed mid-infrared observations of Jupiter from Earth-based facilities, including NASA's Infrared Telescope Facility and the Subaru telescope, to support the Juno mission which lacks instrumentation at these wavelengths.
  - Performing a retrospective analysis of past mid-infrared observations of Neptune in order to understand the coupling between its troposphere and stratosphere.
- 2015 – 2018     **NASA Postdoctoral Fellow/Caltech Postdoctoral Scholar**, Jet Propulsion Laboratory/Caltech, Pasadena, CA, United States  
*Mentor: Dr. Glenn Orton*
- Performed analyses of mid-infrared spectra from the Voyager and Cassini spacecraft and Earth-based facilities in order to understand how Jupiter's auroral processes affect the thermal structure and composition of the stratosphere.
  - Served as secondary supervisor for a large team of undergraduate intern students performing reduction, calibration and analyses tasks on several datasets of Jupiter and Saturn from visible to far-infrared wavelengths.
- 2014 - 2015     **Postdoctoral Research Assistant, Atmospheric, Oceanic & Planetary Physics**, University of Oxford, Oxford, United Kingdom.  
*Supervisors: Prof. Patrick Irwin, Dr. Simon Calcutt*
- Performed radiative transfer simulations of the Martian atmosphere to determine the optimal channel selection for a future selective chopping radiometer.
  - Presented results at the International Workshop for Instrumentation for Planetary Missions at Goddard Space Flight Center in 2014.

## Expertise & Skills

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Planetary Physics	Expertise and research focus on the structure, chemistry and dynamics of the atmospheres of solar system planets with focus on Jupiter and Saturn.
Mid-infrared astronomy	Significant experience in measuring images and spectra of planetary atmospheres at mid-infrared wavelengths from ground-based observatories such as NASA's Infrared Telescope Facility, Subaru and Gemini-North.
Radiative transfer & inversion	Very experienced in forward-modelling and optimal estimation retrievals of spectra of planetary atmospheres using NEMESIS, a forward model and retrieval tool.
Data mining & Analysis	Use of programming languages to sort, handle and analyse large datasets.
Programming	Fortran, IDL, Python, C++, LaTeX, shell scripting, PBS high-performance supercomputer job scheduling.

## Service

- Current member of the National Optical Astronomy Observatories (NOAO) Solar System Telescope Allocation Committee.
- Served on peer review panels for NASA grant programs.
- Reviewer for journals including *Icarus*, *Geophysical Research Letters*, *Journal of Quantitative Spectroscopy and Radiative Transfer*, *Nature* and *Nature (Astronomy)*.

## Selected journal publications

- Hue, V., Hersant, F., Cavalie, T., Dobrijevic, M., **Sinclair J. A.**, Photochemistry, mixing and transport in Jupiter's stratosphere constrained by Cassini, *Icarus* 307: 106-123, 2018.
- **Sinclair, J. A.**, Orton G. S., Greathouse, T. K., Fletcher, L. N., Moses, J. I., Hue, V., Irwin, P. G. J., 'Jupiter's auroral-related stratospheric heating and chemistry II: analysis of IRTF-TEXES spectra measured in December 2014, *Icarus* 300: 305-326, 2018.
- Dunn, W., Btanduardi-Raymont, G., Ray, L., Jackman, C., Kraft, R. Elsner, R., Rae, I. J., Yao, Z., Vogt, M., Jones, G., Gladstone, G., Orton, G. S., **Sinclair, J.**, Ford, P., Graham, G., Caro-Carretero, R., Coates, A., The Independent Pulsations of Jupiter's Northern and Southern X-ray Auroras, *Nature Astronomy* 1: 758-764, 2017.
- Fletcher, L. N., Orton, G. S., **Sinclair, J. A.**, Donnelly, P., Melin, H., Rogers, J. H., Greathouse, T. K., Kasaba, Y., Fujiyoshi, T., Sato, T. M., Fernandes, J., Irwin, P. G. J., Giles, R. S., Simon, A. A., Wong, M. H., Vedovato, M., Jupiter's North Equatorial Belt expansion and thermal wave activity ahead of Juno's arrival, *Geophysical Research Letters* 44, doi:10.1002/2017GL073383
- **Sinclair, J. A.**, Orton G. S., Greathouse, T. K., Fletcher, L. N., Moses, J. I., Hue, V., Irwin, P. G. J., Melin, H., Giles, R. S., 'Stratospheric warming of Jupiter's southern auroral region from 2014 to 2016', *Geophysical Research Letters* 44(11), 5345-5354, 2017b.
- **Sinclair, J. A.**, Orton G. S., Greathouse, T. K., Fletcher, L. N., Moses, J. I., Hue, V., Irwin, P. G. J., Jupiter's auroral-related heating and chemistry I: Analysis of Voyager-IRIS and Cassini-CIRS spectra, *Icarus* 292, 182-207, 2017a.

- Fletcher, L. N., Greathouse, T. K., Orton, G. S., **Sinclair, J. A.**, Giles, R. S., Irwin, P. G. J., Ecrenaz, T., Mid-infrared mapping of Jupiter's temperatures, aerosol opacity and chemical distributions with IRTF/TEXES, *Icarus* 278, 128-161, 2016.
- Moses, Julianne I.; Armstrong, Eleanor S.; Fletcher, Leigh N.; Friedson, A. James; Irwin, Patrick G. J.; **Sinclair, James A.**; Hesman, Brigitte E., Evolution of stratospheric chemistry in the Saturn storm beacon region, *Icarus* 261, 149-168, 2015.
- **Sinclair, J. A.**; Irwin, P. G. J.; Calcutt, S. B.; Wilson, E. L., On the detectability of trace chemical species in the martian atmosphere using gas correlation filter radiometry, *Icarus* 260, 103-127, 2015.
- Fletcher, Leigh N.; Irwin, P. G. J.; **Sinclair, J. A.**; Orton, G. S.; Giles, R. S.; Hurley, J.; Gorius, N.; Achterberg, R. K.; Hesman, B. E.; Bjoraker, G. L., Seasonal evolution of Saturn's polar temperatures and composition, *Icarus* 250, 131-153, 2015.
- Fletcher, Leigh N.; Greathouse, T. K.; Orton, G. S.; Irwin, P. G. J.; Mousis, O.; **Sinclair, J. A.**; Giles, R. S., The origin of nitrogen on Jupiter and Saturn from the  $^{15}\text{N}/^{14}\text{N}$  ratio, *Icarus* 238, 170-190, 2014.
- **Sinclair, J. A.**, Irwin, P. G. J., Fletcher, L. N., Greathouse, T. K., Guerlet, S., Hurley, J., Merlet, C., From Voyager-IRIS to Cassini-CIRS: Interannual variability in Saturn's stratosphere?, *Icarus* 233, 281-292, 2014.
- **Sinclair, J. A.**, Irwin, P. G. J., Fletcher, L. N., Moses, J. I., Greathouse, T. K., Friedson, A. J., Hesman, B., Hurley, J., Merlet, C., Seasonal variations of temperature, acetylene and ethane in Saturn's atmosphere from 2005 to 2010, as observed by Cassini-CIRS, *Icarus*, 225, 257-271, 2013.
- Hurley, J., Fletcher, L. N., Irwin, P. G. J., Calcutt, S. B., **Sinclair, J. A.**, Merlet, C., Latitudinal variations of upper tropospheric  $\text{NH}_3$  on Saturn from Cassini/CIRS far-infrared measurements, *P & SS* 73(1), 347-363, 2012.
- Fletcher, L. N., Hesman, B. E., Achterberg, R. K., Irwin, P. G. J., Bjoraker, G., Gorius, N., Hurley, J., **Sinclair, J.**, Orton, G. S., Legarreta, J., García-Melendo, E., Sánchez-Lavega, A., Read, P. L., Simon-Miller, A. A., Flasar, F. M., The origin and evolution of Saturn's 2011-2012 stratospheric vortex, *Icarus*, 221(2), 560-586, 2012.
- Hurley, J., Irwin, P. G. J., Fletcher, L. N., Moses, J. I., Hesman, B., **Sinclair, J.**, Merlet, C., Observations of upper tropospheric acetylene on Saturn: no apparent correlation with 2000 km-sized thunderstorms, *P & SS*, 65(1), 21-37, 2012.
- **Sinclair, J. A.**, Helling, Ch., Greaves, J. S., The impact of stellar model spectra in disc detection, *MNRAS*, 409(1), L49-L53.

### **Selected conference, meeting abstracts and seminars**

- **American Geophysical Union**, New Orleans, LA, December 2017, "High spatial and spectral resolution measurements of Jupiter's auroral regions using Gemini-North-TEXES", P24A-08.
- **American Astronomical Society's Division of Planetary Sciences**, Provo, UT, October 2017, "Solar wind control of stratospheric temperatures in Jupiter's auroral regions?", 211.02.
- **Magnetospheres of the Outer Planets**, Uppsala, Sweden, June 2017, "Evolution and morphology of Jupiter's auroral-related stratospheric heating".
- **Invited seminar**, University of Leicester, Leicester, United Kingdom, June 2017. . "Understanding Jupiter's auroral-related heating and chemistry from mid-infrared spectroscopy".
- **European Geophysical Union**, Vienna, Austria, April 2017, "Variability of Jupiter's stratospheric-auroral heating during the Juno mission, as measured by TEXES", EGU2017-10369.

- **Invited seminar**, Gemini observatory, Hilo, HI, March 2017. “Understanding Jupiter’s auroral-related heating and chemistry from mid-infrared spectroscopy”.
- **American Geophysical Union Fall Meeting**, San Francisco CA, December 2016, “Evolution of Jupiter’s auroral-related stratospheric heating and chemistry”, P33C-2149.
- **European Planetary Science Congress & Division of Planetary Sciences**, Pasadena CA, October 2016, “Evolution of Jupiter’s auroral-related stratospheric heating and chemistry”, 402.01.
- **Workshop on Jupiter’s Aurora: Anticipating Juno’s arrival**, LASP, University of Colorado, Boulder CO, March 2016, “Jupiter’s auroral heating and chemistry from IRTF-TEXES and Cassini-CIRS observations”.
- **Division of Planetary Sciences**, Washington DC, November 2015, “Jupiter’s auroral-related heating from IRTF-TEXES observations”, 311.13.
- **European Planetary Science Congress**, Nantes, France, September 2015, “Stratospheric temperature and composition of Jupiter’s polar aurora from IRTF-TEXES”, EPSC2015-374.
- **European Planetary Science Congress**, Nantes, France, September 2015, “On the detectability of Martian trace gas species from gas correlation filter radiometry”, EPSC2015-376.
- **Cassini PSG meeting**, Caltech, Pasadena, CA, June 2015, “Seasonal and interannual variability in Saturn’s stratosphere from Voyager-IRIS and Cassini-CIRS”.
- **Invited seminar**, Caltech, Pasadena, CA, May 2015, “Seasonal and interannual variability in Saturn’s stratosphere from Voyager-IRIS and Cassini-CIRS”.
- **Invited seminar**, University of California Los Angeles, Los Angeles, CA, May 2015, “Seasonal and interannual variability in Saturn’s stratosphere from Voyager-IRIS and Cassini-CIRS”.
- **International Workshop on Instrumentation for Planetary Missions**, Goddard Space Flight Center, Greenbelt, MD, November 2014, ‘On the detection of trace gas species in the Martian atmosphere using gas correlation filter radiometry”.
- **Invited seminar**, University of Oxford, Oxford, United Kingdom, May 2014, “Seasonal and interannual variability in Saturn’s stratosphere from Voyager-IRIS and Cassini-CIRS”.
- **European Planetary Science Congress**, London, United Kingdom, September 2013, “Interannual variability in Saturn’s stratosphere from Voyager-IRIS and Cassini-CIRS observations”, EPSC2013-35.
- **Division of Planetary Science**, Reno NV, October 2012, “Seasonal variations in temperature, acetylene and ethane in Saturn’s stratosphere”, 500.03.
- **European Planetary Science Congress & Division of Planetary Sciences**, Nantes, France, 2011, “Seasonal variations in hydrocarbons on Saturn from Cassini-CIRS”, EPSC-DPS2011-511