

DOUGLAS H. LOWENTHAL

Research Professor

Division of Atmospheric Sciences, Desert Research Institute

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EDUCATION

Ph.D.	1986	Atmospheric Chemistry	Graduate School of Oceanography, University of Rhode Island
M.S.	1976	Chemical Oceanography	Graduate School of Oceanography, University of Rhode Island
B.A.	1970	Philosophy-Biology	Tufts University

PROFESSIONAL EXPERIENCE:

2019 to present	Research Professor Emeritus, Atmospheric Sciences Center, Desert Research Institute, Reno, Nevada
2008-2019	Research Professor, Atmospheric Sciences Center, Desert Research Institute, Reno, Nevada
1996-2008	Associate Research Professor, Atmospheric Sciences Center, Desert Research Institute, Reno, Nevada
1992-1996	Assistant Research Professor, Atmospheric Sciences Center, Desert Research Institute, Reno, Nevada
1989-1992	Assistant Research Professor, Energy and Environmental Engineering Center (EEEC), Desert Research Institute, Reno
1988-1989	Associate Marine Scientist, Graduate School of Oceanography, University of Rhode Island
1983-1987	Marine Research Specialist V, Graduate School of Oceanography, University of Rhode Island; (1981-1983) Marine Research Specialist III; (1978-1980) Research Assistant; (1976-1978) Research Assistant, Marine Ecosystems Research Laboratory, University of Rhode Island; (1974-1976) Research Assistant, Graduate School of Oceanography, University of Rhode Island
1973	Instructor, University of Rhode Island

PROFESSIONAL INTERESTS:

Dr. Lowenthal's research interests include interactions among natural and anthropogenic aerosols, cloud microphysical properties, snow formation, and aerosol light extinction and visibility. A long-term study supported by EPRI investigated the physical and hygroscopic properties of organic carbon aerosols in U.S. national parks as they relate to the IMPROVE equation, a tool used to establish compliance under the U.S. EPA Regional Haze rule. Dr. Lowenthal was the principle investigator on a National Science Foundation study to elucidate

snow growth processes in mixed-phase wintertime orographic clouds using stable water isotopes to follow gas-liquid-ice phase transitions, a co-investigator with Gannet Hallar on a Department of Energy project to interpret observations during StormVEx (Storm Peak Lab Cloud Property Validation Experiment), and a co-investigator on an NSF collaborative study with MIT to design, deploy and test an inlet for separating super-cooled cloud droplets from ice crystals.

MEDIA COVERAGE OF SCIENTIFIC RESEARCH:

<http://www.dri.edu/directory/4941-doug-lowenthal>

PUBLICATIONS:

1. Lowenthal, D., Hallar, G., David, R., McCubbin, I., and Borys, R., 2019: Mixed-phase orographic cloud microphysics during StormVEx and IFRACS. *Atmos. Chem. Phys.*, 19, 5387–5401, <https://doi.org/10.5194/acp-19-5387-2019>.
2. Petersen, R.C., Hallar, A.G., McCubbin, I.B., Ogren, J.A., Andrews, Lowenthal, D., Gorder, Purcell, R., Sleeth D., and Novosselov, I., 2019: Numerical, wind-tunnel, and atmospheric evaluation of a turbulent ground-based inlet sampling system, *Aerosol Sci. Technol.*, DOI: 10.1080/02786826.2019.1602718.
3. Gertler, A., Labib, M., and Lowenthal, D., 2017: Air quality issues in megacities: the challenge of Cairo, Egypt. *EM*, April, 15-19.
4. Taylor, N.F., Collins, D.R., Lowenthal, D.H., McCubbin, I.B., Hallar, A.G., Samburova, V., Zielinska, B., Kumar, N., and Mazzoleni, L.R., 2017: Hygroscopic growth of water soluble organic carbon isolated from atmospheric aerosol collected at US national parks and Storm Peak Laboratory. *Atmos. Chem. Phys.*, 17, 2555–2571, doi:10.5194/acp-17-2555-2017.
5. Hallar, A.G., Molotch, N. P., Hand, J. L., Livneh, B., McCubbin, I. B., Petersen, R., Michalsky, J., Lowenthal, D., and Kunkel, K. E., 2017: Impacts of increasing aridity and wildfires on aerosol loading in the intermountain Western U.S. *Environ. Res. Lett.*, 12, 014006, doi:10.1088/1748-9326/aa510a.
6. Lowenthal, D.H., and Kumar, N., 2016: Evaluation of the IMPROVE equation for estimating aerosol light extinction. *J. Air & Waste Manage. Assoc.*, 66(7), 726-737, doi:10.1080/10962247.2016.1178187.
7. Hallar, A.G., Petersen, R., McCubbin, I.B., Lowenthal, D., Lee, S., Andrews, E., and Yu, F., 2016: Climatology of new particle formation and corresponding precursors at Storm Peak Laboratory. *Aerosol Air Qual. Res.*, 16, 816-826, doi: 10.4209/aaqr.2015.05.034.
8. Lowenthal, D.H., Hallar, A.G., McCubbin, I., David, R., Borys, R., Blossey, P., Muhlbauer, A., Kuang, Z., and Moore, M., 2016: Isotopic fractionation in wintertime orographic clouds. I: isotopic measurements. *J. Atmos. Oceanic Technol.*, 33, 2663-2678, doi: 10.1175/JTECH-D-15-0233.1.
9. Hallar, A.G., Molotch, N.P., Hand, J.L., Livneh, B., McCubbin, I.B., Petersen, R., Michalsky, J., Lowenthal, D., and Kunkel, K., 2017: Impacts of increasing aridity and

- Wildfires on aerosol loading in the Intermountain Western U.S. *Environ. Res. Lett.*, 12, 014006, doi:10.1088/1748-9326/aa510a.
10. Watson, J.G., Chow, J.C., Lowenthal, D.H., Chen, L.-W.A., Shaw, S., Edgerton, E.S., and Blanchard, C.L., 2015: PM_{2.5} source apportionment with organic markers in the Southeastern Aerosol Research and Characterization (SEARCH) Study. *J. Air & Waste Manage. Assoc.*, 65(9), 1104-1108, doi:10.1080/10962247.2015.1063551.
 11. Chow, J.C., Lowenthal, D.H., Chen, L.-W.A., Wang, X., and Watson, J.G., 2015: Mass reconstruction methods for PM_{2.5}: a review. *Air Qual. Atmos. Health*, DOI 10.1007/s11869-015-0338-3.
 12. Chen, L.-W. A., Chow, J.C., Wang, X., Robles, J.A., Sumlin, B., Lowenthal, D.H., Zimmermann, R., and Watson, J.G., 2015: Multi-wavelength optical measurement to enhance thermal/optical analysis for carbonaceous aerosol. *Atmos. Meas. Tech.*, 8, 451-461.
 13. Lowenthal, D.H., Zielinska, B., Samburova, V., Collins, D., Taylor, N., and Kumar, N., 2015: Evaluation of assumptions for estimating chemical light extinction at U.S. national parks. *J. Air & Waste Manage. Assoc.*, 65(3), 249-260, DOI: 10.1080/10962247.2014.986307.
 14. Kristensen, T.B., Du, L., Nguyen, Q.T., Nojgaard, J.K., Bender Koch, C., Faurskov Nielsen, O., Hallar, A.G., Lowenthal, D.H., Nekat, B., Van Pinxteren, D., Herrmann, H., Glasius, M., Kjaergaard, H.G., and Bilde, M., 2015: Chemical properties of HULIS from three different environments. *J. Atmos. Chem.*, 72(1), 65-80.
 15. Gargava, P., Chow, J.C., Watson, J.G., and Lowenthal, D.H., 2014: Speciated PM₁₀ emission inventory for Delhi, India. *Aerosol and Air Qual. Res.*, 14(5), 1515-1526. (doi: 10.4209/aaqr.2013.02.0047).
 16. Lowenthal, D.H., Gertler, A.W., and Labib, M.W., 2014: Particulate matter source apportionment in Cairo: recent measurements and comparison with previous studies. *Int. J. Environ. Sci. Technol.*, 11, 657-670 (DOI: 10.1007/s13762-013-0272-6).
 17. Samburova, V., Hallar, A.G., Mazzoleni, L.R., Saranjampour, P., Lowenthal, D., Kohl, S., and Zielinska, B., 2013: Composition of water-soluble organic carbon in non-urban atmospheric aerosol collected at the Storm Peak Laboratory. *Environ. Chem.*, 10(5), 370-380.
 18. Hallar, A.G., Lowenthal, D.H., Clegg, S.L., Samburova, V., Taylor, N., Mazzoleni, L.R., Zielinska, B.K., Kristensen, T.B., Chirokova, G., McCubbin, I.B., Dodson, C., and Collins, D., 2013: Chemical and hygroscopic properties of aerosol organics at Storm Peak Laboratory. *J. Geophys. Res.*, 118, 1-13, doi:10.1002/jgrd.50373.
 19. Saleeby, S.M., Cotton, W.R., Lowenthal, D., Messina, J., and Benedict, K.B., 2013: Aerosol impacts on the microphysical growth processes of orographic snowfall. *J. Appl. Meteor. Climatol.* 52, 834-852. doi: <http://dx.doi.org/10.1175/JAMC-D-12-0193.1>.
 20. Mazzoleni, L.R., Saranjampour, P., Dalbec, M.M., Samburova, V., Hallar, A.G., Zielinska, B., Lowenthal, D., Kohl, S., 2012: Identification of water-soluble organic carbon in nonurban aerosols using ultrahigh-resolution FT-ICR mass spectrometry: organic anions. *Environ. Chem.*, 9, 285-297.

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22. Taylor, N.F., Collins, D.R., Spencer, C.W., Lowenthal, D.H., Zielinska, B., Samburova, V., and Kumar, N., 2011: Measurement of ambient aerosol hydration state at Great Smoky Mountains National Park in the southeastern United States. *Atmos. Chem. Phys.*, 11, 12,085-12,107.
23. Chow, J.C., Watson, J.G., Lowenthal, D.H., Chen, L.-W.A., and Motallebi, N., 2011: PM_{2.5} source profiles for black and organic carbon emission inventories. *Atmos. Environ.* 45, 5407-5414.
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27. Watson, J.G., Chow, J.C., Chen, L.-W.A., Lowenthal, D.H., Fujita, E.M., Kuhns, H.D., Sodeman, D., Campbell, D.E., Moosmüller, H., Zhu, D., and Motallebi, N., 2011: Particulate emission factors for fossil fuel and biomass combustion sources. *Sci. Tot. Environ.* 409, 2384-2396.
28. Lowenthal, D.H., Borys, R.D., Cotton, W., Saleeby, S., Cohn, S.A., and Brown, W.O.J., 2011: The altitude of snow growth by riming and vapor deposition in mixed-phase orographic clouds. *Atmos. Environ.* 45, 519-522.
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35. Lowenthal, D.H., Zielinska, B., Mason, B., Samy, S., Samburova, V., Collins, D., Spencer, C., Taylor, N., Allen, J., O., and Kumar, N., 2009: Aerosol characterization studies at Great Smoky Mountains National Park, summer, 2006, *J. Geophys. Res.*, **114**, D08206, doi:10.1029/2008JD011274.
36. Vega, E., Lowenthal, D.H., Ruiz, H., Reyes, E., Watson, J.G., Chow, J.C., Viana, M., Querol, X., Alastuey, A., 2009: Fine particle receptor modeling in the atmosphere of Mexico City. *J. Air & Waste Manage. Assoc.*, **59**, 1417-1428.
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39. Watson, J.G., Chow, J.C., Lowenthal, D.H., and Magliano, K., 2008: Estimating aerosol light scattering at the Fresno Supersite. *Atmos. Environ.*, **42**, 1186-1196.
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42. Abu-Allaban, M. Lowenthal, D.H., Gertler, A.W., and Labib, M., 2007: Sources of PM₁₀ and PM_{2.5} in Cairo's ambient air. *Environ. Monit. Assess.*, **133**, 417-425.
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58. Wetzal, M., Meyers, M., Borys, R., McAnelly, R., Cotton, W., Rossi, A., Frisbie, P., Nadler, D., Lowenthal, D., Cohn, S., and Brown, W., 2004: Mesoscale snow prediction and verification in mountainous terrain. *Weather and Forecasting*, **19**, 806-828.
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PRESENTATIONS:

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2. Mazzoleni, L.R., Zhao, Y., Samburova, V., Hallar, A.G., and Lowenthal, D., 2016: Unraveling the complexity of atmospheric aerosol: insights from ultrahigh resolution mass spectrometry. Abstract EGU2016-15401 presented at the European Geosciences Union General Assembly 2016, April 17-22, 2016, Vienna, Austria.
3. Blossey, P.N., Moore, M., Kuang, Z., Muhlbauer, A., Lowenthal, D., Hallar, A.G., McCubbin, I., David, R., Wiegeler, A., Schneider, M., and Risi, C., 2015: Isotopic Fractionation in Snow (IFRACS) at Storm Peak Laboratory. Poster PP11B-2224, presented at 2015 Fall Meeting, AGU, San Francisco, CA, September 14-18, 2015.
4. David, R., Lowenthal, D., Hallar, A.G., McCubbin, I., and Avallone, L., 2014: Mountaintop Cloud Microphysical Properties: A Comparison between Storm Peak Laboratory and the University of Wyoming King Air during CAMPS. Abstract SES-137_1 presented at the Global Fair and Workshop on Long-Term Observing Systems of Mountain Social-Ecological Systems, July 16-19, 2014, Reno, NV.
5. Samburova, V., Hallar, A.G., Lowenthal, D.H., Mazzoleni, L.R., Murray, A., Yang, X., and Zielinska, B., 2014: Analysis of atmospheric biological and organic aerosols collected at high elevation mountain site (Storm Peak Laboratory). Abstract SES-138/216 presented at the Global Fair and Workshop on Long-Term Observing Systems of Mountain Social-Ecological Systems, July 16-19, 2014, Reno, NV.
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7. David, R., Lowenthal, D., and Hallar, A.G., 2014: The role of mesoscale dynamics on microphysics in orographic cloud during CAMPS. Poster #223, presented at the American Meteorological Society 14th Conference on Cloud Physics and Anthony Slingo Symposium, 7-11 July, Boston, MA.

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9. Mazzoleni, L.R., Habib, D.M.A., Zhao, Y., Dalbec, M.M., Samburova, V., Hallar, A.G., Zielinska, B., and Lowenthal, D., 2013: Functional Groups and Structural Insights of Water-Soluble Organic Carbon using Ultrahigh Resolution FT-ICR Tandem Mass Spectrometry. Abstract A33I-04 presented at the 2013 Fall American Geophysical Union Meeting, 9-13 December, 2013, San Francisco, CA.
10. Lowenthal, D.H., Zielinska, B., Collins, D., Taylor, N., Alexander, L., and Kumar, N., 2012: Aerosol Chemistry and Hygroscopic Growth in U.S. National Parks. Presented at the Air & Waste Management Association Specialty Conference Aerosol and Atmospheric Optics: Visibility and Air Pollution Whitefish, Montana, September 24-28, 2012.
11. Chirokova, G., Hallar, A.G., Lowenthal, D.H., Mccubbin, I.B., Avallone, L.M., Mace, G.G., Shupe, M., and Oolman, L.D., 2012: Vertical distribution of liquid water in mixed-phase clouds from in-situ ground and airborne measurements during simultaneous CAMPS and StormVEx field campaigns. Presented at the American Meteorological Society 15th Conference on Mountain Meteorology, 20-24 August, 2012, Steamboat Springs, CO.
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13. Mazzoleni, L.R., Saranjampour, P., Dalbec, M.M., Samburova, V., Hallar, A.G., Zielinska, B., and Lowenthal, D., 2012: Molecular Composition of Water-Soluble Organic Carbon in Nonurban Aerosols to be presented at American Association for Aerosol Research (AAAR) 31st Annual in Minneapolis, MN, October 8-12, 2012.
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15. Saranjampour, P., Samburova, V., Hallar, A.G., Lowenthal, D., Zielinska, B., and Mazzoleni, L., 2011: Ultrahigh-Resolution FT-ICR Mass Spectrometric Identification of Water-Soluble AOM in Nonurban Organic Aerosols, American Chemical Society, Fall 2011 National Meeting, Denver, Colorado, August 28-September 1, 2011.
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PATENT:

U.S. Patent No. 4,603,575, 5 August 1986: "Elemental tracer system for determining the source areas of pollution aerosol".

Inventors: Kenneth A. Rahn and Douglas H. Lowenthal
Assignee: Board of Governors for Higher Education, State of Rhode Island and Providence Plantations, Providence

PAST RESEARCH GRANTS AND CONTRACTS:

1. National Science Foundation

5/1/90-10/31/90 \$29,499

Elemental Tracers of Volcanic Emissions in Antarctic Aerosol and Snow Samples.
(Subcontract, PI: J. Palais, Co-PI: B. Mosher)

2. National Science Foundation

5/1/91-10/31/91 \$25,000

Long-Range Transport of Kuwaiti Oil-Fire Emissions.
(Supplement, PI: R. Borys, Co-PI: D. Lowenthal)

3. National Science Foundation

5/1/92-4/30/94 \$20,955

Continental and Regional Sources of Pollution Aerosol at Summit and Dye 3, Greenland.
(PI: B. Mosher, Co-PI: D. Lowenthal)

4. Mr. Barron Hilton

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Earthwinds Balloon Flights (PI: D. Lowenthal, Co-PIs: M. Wetzel, R. Borys)

5. Arizona Department of Environmental Quality

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Diesel Study. (PI: D. Lowenthal, Co-PI: B. Zielinska)

6. Environmental Protection Agency

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Characterization of Motor Vehicle Emissions.
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7. Environmental Protection Agency (EPSCoR)

10/1/94-9/30/96 \$97,572

The Relationships Among Air Quality, Meteorology and Climate in an Arid Environment.
(PI: D. Lowenthal, Co-PIs: M. Wetzel, D. Koracin)

8. Department of Energy

7/1/93-10/31/95 \$191,129

The Relationship Between CCN Chemistry, CCN Sources, Cloud Microphysics, and
Precipitation in the Eastern Sierra. (PI: R. Borys, Co-PIs: D. Lowenthal, D. Mitchell)

9. E.L. Wiegand Foundation

8/23/94-12/31/95 \$10,000

Earthwinds Balloon Flights (PI: D. Lowenthal, Co-PIs: M. Wetzel, R. Borys)

10. National Science Foundation

9/15/94-9/30/98 \$356,650

An Assessment of the Role of Natural and Anthropogenic CCN on Droplet Size Distributions in Marine Stratus in the North Atlantic. (PI: R. Borys, Co-PI: D. Lowenthal)

11. Electric Power Research Institute

9/1/96-12/31/98 \$52,574

Feasibility of Using Receptor Models for Attributing Atmospheric Mercury Concentrations to Sources: Simulations.

12. Electric Power Research Institute

5/15/97-1/1/99 \$33,579

Feasibility of Using Receptor Models for Attributing Atmospheric Mercury Concentrations to Sources: Simulations.

13. National Science Foundation

8/1/95-7/31/99 \$406,130

PM₁₀ Source Apportionment at McMurdo Station, Antarctica. (PI: D. Lowenthal, Co-PI: J. Chow)

14. National Science Foundation

1/15/98-12/31/01 \$234,167

Relationships Among Aerosol Chemistry, Size, and CCN Activity. PI: D. Lowenthal, Co-PIs: J. Hudson, F. Rogers.

15. National Science Foundation

9/1/00-8/31/02 \$200,000

Acquisition of New Instrumentation for Atmospheric Aerosol Research at Storm Peak Laboratory. (PI: R. Borys, Co-PIs: D. Lowenthal, M. Wetzel).

16. USAID

10/1/97-12/31/00 \$21,304

Cairo Air Study (PI: Alan Gertler)

17. National Science Foundation

12/1/00-11/30/03 \$411,135

Snowfall Rate Reduction by Pollution Aerosols (PI: R. Borys, Co-PI: D. Lowenthal)

18. Electric Power Research Institute

5/15/01-6/30/06 \$242,372

Hygroscopic Organic Aerosols (PI: D. Lowenthal; Co-PIs: J. Chow, B. Zielinska)

19. Environmental Protection Agency

1/1/05-12/31/07 \$436,687

Evaluation of Regional Scale Receptor Models (PI: D. Lowenthal; Co-PIs: J. Watson, D. Koracin, A. Chen)

20. California Air Resources Board

11/30/04-6/30/08 \$377,332

Black Carbon Analysis (PI: J. Chow; Co-PIs: O. Chang, A. Chen, D. Lowenthal, H. Moosmuller, J. Watson)

21. Electric Power Research Institute

5/15/04-12/31/07 \$66,458

Evaluation of Uncertainties in the Application of Regional Scale Receptor Models to Synthetic IMPROVE Data. (PI: D. Lowenthal; Co-PI: J. Watson)

22. National Science Foundation

11/1/05-10/31/08 \$514,001

Collaborative Research: Inhibition of Snowfall by Pollution Aerosols (PI: R. Borys, Co-PI: D. Lowenthal)

23. San Joaquin Valley Air Pollution Study Agency

12/15/11-6/30/12 \$99,999

Reformulation of PM_{2.5} Mass Reconstruction Assumptions for the SJV (PI: J. Watson; Co-PIs: J. Chow, D. Lowenthal)

24. National Science Foundation

12/15/08-11/30/12 \$244,804

Collaborative Research: Inhibition of Snowfall by Pollution Aerosols (PI: D. Lowenthal)

25. Electric Power Research Institute

6/12/06-5/31/13 \$538,105

Advanced IMPROVE Studies (PI: D. Lowenthal; Co-PI: B. Zielinska)

27. National Science Foundation

9/1/09-8/31/14 \$347,253

Collaborative Research: Hygroscopic Properties of Aerosol Organics (PI: G. Hallar; Co-PI's: D. Lowenthal, B. Zielinska)

28. Electric Power Research Institute

10/1/11-12/31/12 \$50,000

Source Apportionment with Organic Markers (PI: J. Chow; Co-PIs: D. Lowenthal, J. Watson)

29. National Science Foundation

04/01/11-03/31/15 \$217,880

MRI: Acquisition of New Generation of Aerosol, Trace Gas, and Water Isotope Instruments for Storm Peak Laboratory (PI: G. Hallar; Co-PI: D. Lowenthal).

30. National Science Foundation

06/01/10-05/31/15 \$179,889

Collaborative Research: Colorado Airborne Multi-Phase Cloud Study (CAMPS) (PI: D. Lowenthal)

31. Electric Power Research Institute

04/14/14-03/31/15 \$50,017

Evaluation of Advanced IMPROVE Study Results (PI: D. Lowenthal)

32. National Science Foundation

09/18/12-08/31/16 \$390,000

Chemical Nature and Origins of Atmospheric Brown Carbon Aerosol (PI: J. Chow; Co-PI: A. Chen; Co-PI: D. Lowenthal)

33. National Science Foundation

06/01/13-05/31/18 \$576,114

Collaborative Research: Isotopic Fractionation in Snow (IFRACS) (PI: D. Lowenthal)

34. Department of Energy

07/15/15-07/14/18 \$361,252

Aerosol-Cloud-Precipitations during StormVEx (PI: A.G. Hallar; Co-PI: D. Lowenthal)

35. National Science Foundation

06/01/13-05/31/18 \$50,000

Collaborative Research: Isotopic Fractionation in Snow (IFRACS Supplement) (PI: D. Lowenthal)

CURRENT RESEARCH GRANTS AND CONTRACTS:

1. National Science Foundation

04/01/18-03/31/21 \$215,465

Collaborative Research: An In Situ Closure Study of Mixed Phase Clouds at Storm Peak (PI: G. Hallar; Co-PI: D. Lowenthal)