ATom: Ozone Profiles from Ozonesonde Instrument, Antarctica, Fiji, and Hawaii

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Documentation Revision Date: 2021-11-29

Dataset Version: 1

Summary

This dataset contains ozone measurements from the Ozonesonde instrument in Antarctica, Hawaii, and Fiji taken during the Atom-4 campaign. The Electrochemical Concentration Cell (ECC) Ozonesonde is a balloon-borne instrument that collects ozone concentrations paired with a radiosonde to collect additional meteorological info along a vertical profile (as a result, unlike other ATom data, this dataset is not associated with DC-8). The balloon can ascend to altitudes of 35 km before bursting. Ozone in the stratosphere helps reduce UV radiation that reaches Earth's surface; however, ozone at ground level can negatively influence respiratory health.

There are three data files in ICARTT (*.ict) format included in this dataset.

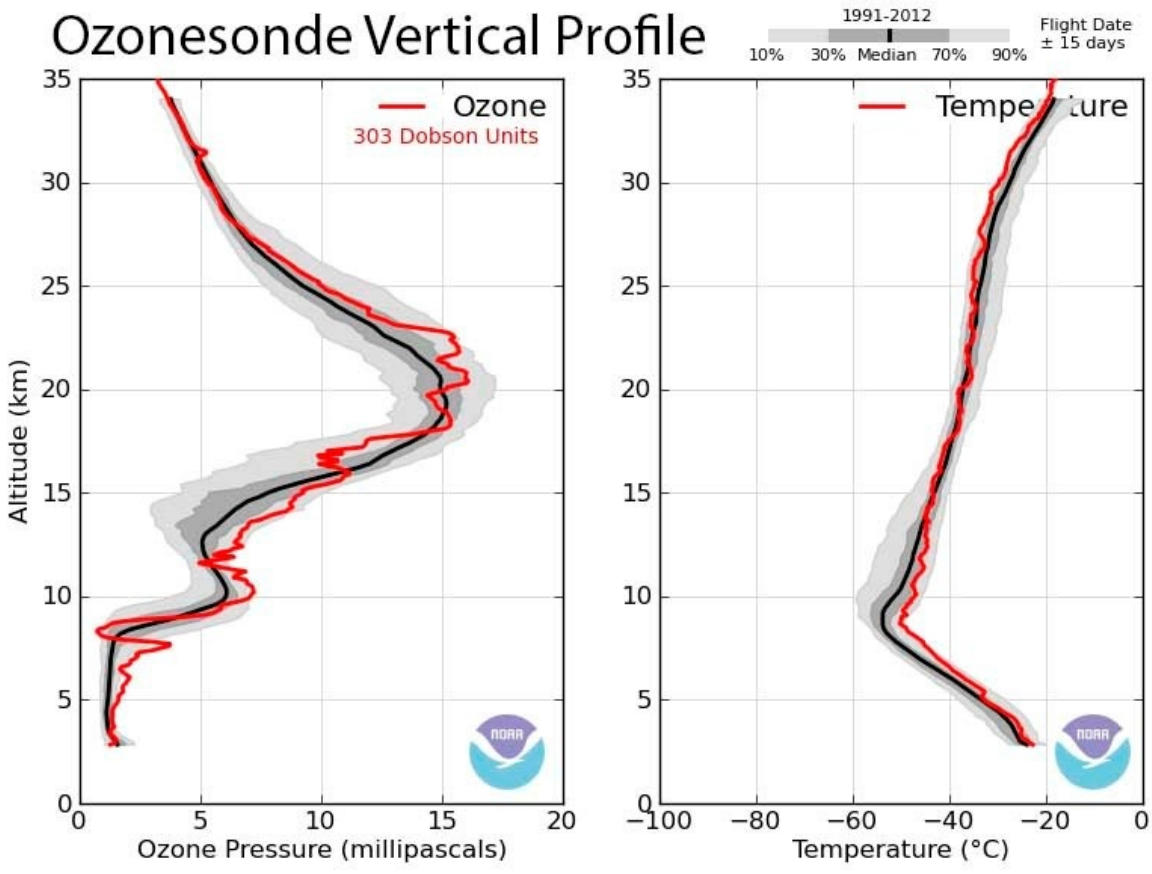

Figure 1. Example of a vertical profile created from Ozonesonde and radiosonde instruments. Source: https://gml.noaa.gov/ozwv/ozsondes

Citation

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1. Dataset Overview

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Project: Atmospheric Tomography Mission

The Atmospheric Tomography Mission (ATom) was a NASA Earth Venture Suborbital-2 mission. It studied the impact of human-produced air pollution on greenhouse gases and on chemically reactive gases in the atmosphere. ATom deployed an extensive gas and aerosol payload on the NASA DC-8 aircraft for systematic, global-scale sampling of the atmosphere, profiling continuously from 0.2 to 12 km altitude. Flights occurred in each of four seasons over a 4-year period.

Related Datasets

Wofsy, S.C., S. Afshar, H.M. Allen, E.C. Apel, E.C. Asher, B. Barletta, J. Bent, H. Bian, B.C. Biggs, D.R. Blake, N. Blake, I. Bourgeois, C.A. Brock, W.H. Brune, J.W. Budney, T.P. Bui, A. Butler, P. Campuzano-Jost, C.S. Chang, M. Chin, R. Commane, G. Correa, J.D. Crounse, P. D. Cullis, B.C. Daube, D.A. Day, J.M. Dean-Day, J.E. Dibb, J.P. DiGangi, G.S. Diskin, M. Dollner, J.W. Elkins, F. Erdesz, A.M. Fiore, C.M. Flynn, K.D. Froyd, D.W. Gesler, S.R. Hall, T.F. Hanisco, R.A. Hannun, A.J. Hills, E.J. Hintsa, A. Hoffman, R.S. Hornbrook, L.G. Huey, S. Hughes, J.L. Jimenez, B.J. Johnson, J.M. Katich, R.F. Keeling, M.J. Kim, A. Kupc, L.R. Lait, K. McKain, R.J. Mclaughlin, S. Meinardi, D.O. Miller, S.A. Montzka, F.L. Moore, E.J. Morgan, D.M. Murphy, L.T. Murray, B.A. Nault, J.A. Neuman, P.A. Newman, J.M. Nicely, X. Pan, W. Paplawsky, J. Peischl, M.J. Prather, D.J. Price, E.A. Ray, J.M. Reeves, M. Richardson, A.W. Rollins, K.H. Rosenlof, T.B. Ryerson, E. Scheuer, G.P. Schill, J.C. Schroder, J.P. Schwarz, J.M. St.Clair, S.D. Steenrod, B.B. Stephens, S.A. Strode, C. Sweeney, D. Tanner, A.P. Teng, A.B. Thames, C.R. Thompson, K. Ullmann, P.R. Veres, N.L. Wagner, A. Watt, R. Weber, B.B. Weinzierl, P.O. Wennberg, C.J. Williamson, J.C. Wilson, G.M. Wolfe, C.T. Woods, L.H. Zeng, and N. Vieznor. 2021. ATom: Merged Atmospheric Chemistry, Trace Gases, and Aerosols, Version 2. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1925.

- Data from all ATom instruments and all four flight campaigns, including aircraft location and navigation data, merged to several different time bases.

Wofsy, S.C., and ATom Science Team. 2018. ATom: Aircraft Flight Track and Navigational Data. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1613

- Flight path (location and altitude) data for each of the four campaigns provided in KML and CSV formats.

2. Data Characteristics

Spatial Coverage: Hawaii, Fiji, Antarctica

Spatial Resolution: Point locations

Temporal Coverage: Periodic flights during the ATom-4 campaign only

Deployment	Date Range
ATom-1	July 29 - August 23, 2016
ATom-2	January 26 - February 21, 2017
ATom-3	September 28 - October 28, 2017
ATom-4	April 24 - May 21, 2018

Temporal Resolution: 1 second

Data File Information

There are three data files in ICARTT (*.ict) format included in this dataset that contain ozone measurements along a vertical profile at each location. Data files conform to the ICARTT File Format Standards V1.1. The file names are named O3SONDE_Sonde_**YYYYMMDD_R#**.ict, where **YYYYMMDD** is the start date (in UTC time) of the flight and **R#** is the file version or revision number.

Data for Hawaii are provided in O3SONDE_Sonde_20180501_R0.ict, data for Fiji are provided in O3SONDE_Sonde_20180503_R0.ict, and data for Antarctica are provided in O3SONDE_Sonde_20180509_R0.ict.

Data File Details

Missing data are indicated by -9999.000.

Table 1. Variable names and descriptions for files named O3SONDE_Sonde _YYYYMMDD_R#.ict.

Name	Units	Description
Time_UTC	seconds	Number of seconds since 0000 UTC
Pressure	hPa	Radiosonde pressure
Geopot_Alt	Km	Geopotential altitude
Air_Temp	Celsius	Radiosonde air temperature
Theta	Kelvin	Potential temperature
RS_RH	%	Radiosonde relative humidity with respect to liquid water
O3_PP	mPa	ECC Ozonesonde ozone partial pressure

O3_MR	ppmv	ECC Ozonesonde ozone mixing ratio
GPS_Lat	Decimal degrees	GPS latitude
GPS_Lon	Decimal degrees	GPS longitude
GPS_Alt	Km	GPS altitude
GPS_Head	Degrees	GPS heading from launch
GPS_El_Angle	Degrees	GPS elevation angle from launch

3. Application and Derivation

ATom builds the scientific foundation for mitigation of short-lived climate forcers, in particular, methane (CH_4), tropospheric ozone (O_3), and Black Carbon aerosols (BC).

ATom Science Questions

Tier 1

- What are chemical processes that control the short-lived climate forcing agents CH_4, O_3, and BC in the atmosphere? How is the chemical reactivity of the atmosphere on a global scale affected by anthropogenic emissions? How can we improve chemistry-climate modeling of these processes?

Tier 2

- Over large, remote regions, what are the distributions of BC and other aerosols important as short-lived climate forcers? What are the sources of new particles? How rapidly do aerosols grow to CCN-active sizes? How well are these processes represented in models?
- What type of variability and spatial gradients occurs over remote ocean regions for greenhouse gases (GHGs) and ozone-depleting substances (ODSs)? How do the variations among air parcels help identify anthropogenic influences on photochemical reactivity, validate satellite data for these gases, and refine knowledge of sources and sinks?

Significance

ATom delivers unique data and analysis to address the Science Mission Directorate objectives of acquiring “datasets that identify and characterize important phenomena in the changing Earth system” and “measurements that address weaknesses in current Earth system models leading to improvement in modeling capabilities.” ATom will provide unprecedented challenges to the CCMs used as policy tools for climate change assessments, with comprehensive data on atmospheric chemical reactivity at global scales, and will work closely with modeling teams to translate ATom data to better, more reliable CCMs. ATom provides extraordinary validation data for remote sensing.

4. Quality Assessment

Uncertainties for Ozonesonde variables are

- ± 10% for *H2O_MR*
- ± 2 ppbv (± 3%) for *O3_MR*

5. Data Acquisition, Materials, and Methods

Project Overview

ATom makes global-scale measurements of the chemistry of the atmosphere using the NASA DC-8 aircraft. Flights span the Pacific and Atlantic Oceans, nearly pole-to-pole, in continuous profiling mode, covering remote regions that receive long-range inputs of pollution from expanding industrial economies. The payload has proven instruments for in situ measurements of reactive and long-lived gases, diagnostic chemical tracers, and aerosol size, number, and composition, plus spectrally resolved solar radiation and meteorological parameters.

Combining distributions of aerosols and reactive gases with long-lived greenhouse gasses and ozone depleting substances enables disentangling of the processes that regulate atmospheric chemistry: emissions, transport, cloud processes, and chemical transformations. ATom analyzes measurements using customized modeling tools to derive daily averaged chemical rates for key atmospheric processes and to critically evaluate Chemistry-Climate Models (CCMs). ATom also differentiates between hypotheses for the formation and growth of aerosols over the remote oceans.

NOTE: The data contained in this dataset was NOT collected aboard NASA DC-8 and were collected only during the ATom-4 campaign.

Ozonesonde Instrument

The Electrochemical Concentration Cell (ECC) Ozonesonde is a lightweight, balloon-borne instrument paired with a meteorological radiosonde. It is fixed with a telemeter to transmit data to a ground receiving station. This data includes ozone concentrations and standard meteorological quantities such as pressure, temperature, and humidity. The balloon will ascend to altitudes of 35 km before bursting. Additional information about this instrument can be found in Sterling et al. (2018) and on the NOAA Ozonesonde instrument webpage.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

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Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

7. References

Sterling, C.W., B.J. Johnson, S.J. Oltmans, H.G. J. Smit, A.F. Jordan, P.D. Cullis, E.G. Hall, A.M. Thompson, and J.C. Witte. 2018. Homogenizing and estimating the uncertainty in NOAA’s long-term vertical ozone profile records measured with the electrochemical concentration cell Ozonesonde. Atmospheric Measurement Techniques 11:3661–3687. https://doi.org/10.5194/amt-11-3661-2018.

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