

File Revision Date:  
September 16, 2022

Data Set Description:

PI: Dr. Bryan Johnson

Instrument: ECC Ozonesondes

Sites: Boulder, CO USA 39.949°N, 105.197°W, 1743 masl  
Hilo, HI USA 19.717°N, 155.049°W, 10 masl  
South Pole, ANTARCTICA 45.038°S, 169.683°E, 370 masl  
Pago Pago, AMERICAN SAMOA 14.331°S, 170.714°W, 5 masl

Measurement Quantities: Ozone partial pressure, Ozone mixing ratio, Pressure, Temperature, Relative humidity, Geopotential height, GPS Altitude, Latitude and Longitude of payload (for most soundings since 2009), Horizontal wind speed and direction (for most soundings since 2009).

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Not at this time.

Data License:  
CC0

Reference Articles:

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Sterling, CW, BJ Johnson, SJ Oltmans, HGJ Smit, AF Jordan, PD Cullis, EG Hall, AM Thompson and JC Witte, 2018: Homogenizing and estimating the uncertainty in NOAAs long-term vertical ozone profile records measured with the electrochemical concentration cell ozonesonde *Atmos. Meas. Tech.*, COPERNICUS GESELLSCHAFT MBH, 11 ( 6 ), 3661-3687, doi: 10.5194/amt-11-3661-2018, issn: 1867-1381, ids: GK5WG, 26-Jun 2018

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Oltmans, S.J., A.S. Lefohn, H.E. Scheel, J.M. Harris, H. Levy II, I.E. Galbally, E.G. Brunke, C.P. Meyer, J.A. Lathrop, B.J. Johnson, D.S. Shadwick, E. Cuevas, F.J. Schmidlin, D.W. Tarasick, H. Claude, J.B. Kerr, O. Uchino, V. Mohnen, Trends of Ozone in the Troposphere, *Geophys. Res. Lett.*, 25, 139-142, 1998.

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Hofmann, D.J., Oltmans, S.J., Harris, J.M., Komhyr, W.D., Lathrop, L.A., Defoor, T., and Kuniyuki, D., Ozonesonde measurements at Hilo, Hawaii following the eruption of Pinatubo, *Geophys. Res. Lett.* 20, 1555-1558, 1993.

#### Instrument Description:

The ECC Ozonesonde (Electrochemical Concentration Cell Ozonesonde) is a lightweight, balloon-borne instrument mated to a meteorological radiosonde and flown to 30+ km while transmitting data back to a ground station. The heart of the ozonesonde is an electrochemical concentration cell (ECC) that senses ozone as it reacts with a dilute solution of potassium iodide to produce an electrical current proportional to the ozone concentration of the air.

ECC's connected to Vaisala RS-80-15 type radiosondes using En-Sci V2C interface board.

ECC's connected to Intermet iMet-1 type radiosondes using En-Sci V7 interface board.

ECC's connected to Intermet iMet-4-RSB type radiosondes using En-Sci V7 interface board.

TMAX interface board used for all 5A, 6A, and 1Z sondes

Analog data system used for most 4A sondes

Vaisala radiosonde receiving station was an ICOM receiver and 300 baud modem (V2C) or a KAM Plus programmable modem (TMAX) into the NOAA/CMDL data acquisition program: Strato version 7.2

Starting in 2009 with Intermet iMet-1 radiosondes, data is received with SkySonde software and ICOM receiver, or software modem built in to SkySonde.

#### Boulder:

Project start date: March 12, 1979

Pre-project period: April 27, 1967 to July 20, 1971

Start digital data acquisition: June 11, 1991

Switched from 1% KI buffered cathode solution to 2% KI unbuffered: August 21, 1997.

Switched from 2% KI unbuffered cathode solution to 1% 1/10th buffered: August-November, 2005.

Used Science Pump 4A, 5A, 6A and ENSCI 1Z, 2Z models.

#### Hilo:

Project start date: September 21, 1982

Start digital data acquisition: July 18, 1991

Switched from 1% KI buffered cathode solution to 2% KI unbuffered: April 15, 1998.

Switched from 2% KI unbuffered cathode solution to 1% 1/10th buffered: December 20, 2005.

Used Science Pump 4A, 5A, 6A and ENSCI 1Z, 2Z models.

#### S.Pole:

Project start date: January 20, 1986

Pre-project period: January 17, 1967 to October 14, 1971

Start digital data acquisition for ozonesondes: November 3, 1990

Switched from 1% KI buffered cathode solution to 2% KI unbuffered: March 4, 1998.

Switched from 2% KI unbuffered cathode solution to 1% 1/10th buffered: November 15, 2004.

Used Science Pump 4A, 5A, 6A and ENSCI 1Z, 2Z models.

#### Samoa:

Project start date: August 8, 1995

Pre-project period: April 1, 1986 to January 23, 1990

Start digital data acquisition: August 8, 1995

Switched from 1% KI buffered cathode solution to 2% KI unbuffered: April 17, 1998

Switched from 2% KI unbuffered cathode solution to 1% 1/10th buffered: October 22, 2005

Used Science Pump 4A, 6A and ENSCI 1Z, 2Z models.

#### Algorithm Description:

Ozone is calculated as a partial pressure. PTU data from the sonde is not used directly in the calculation except in the pump correction.

$$PPOZ(nb) = 0.004307 * i * Temperature * t * pcf$$

where:

i is the current from the sensor - background in uA.

t is the time in seconds to pump 100 CCs of air through the pump.

Temperature is the pump temperature (K).

Pcf is the pump correction factor to account for loss in pump efficiency at lower pressures.

Background current is assumed to be constant.

The average pump correction factor (pcf) is calculated from an average of ozonesonde flow rates measured at NOAA/CMDL using an oil bubble flow meter inside an environmental chamber.

Pressure	(pcf)
5.0	1.255
7.0	1.191
10.0	1.137

20.0	1.074
30.0	1.056
50.0	1.041
100.0	1.025
300.0	1.007
1000	1.000

Expected Precision/Accuracy of Instrument:

Ozonesonde:

hPa	Accuracy	Precision	Resolution
1000	+/- 5%	+/- 4%	0.3km
100	+/- 5%	+/- 3%	0.3km
10	+/- 5%	+/- 3%	0.4km
4	+/- 10%	+/- 10%	0.4km

Vaisala RS80 Radiosonde Measurements of Pressure, Temperature and Relative Humidity

Pressure:

Resolution 0.1 hPa

Accuracy +/- 0.5 hPa

Temperature:

Resolution 0.1 K

Accuracy +/- 0.2 K

Relative Humidity:

Resolution 1% RH

Accuracy +/- 2% RH

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InterMet iMet-1-RSB Measurements of Pressure, Temperature and Relative Humidity (PTU)

Pressure:

Resolution 0.01 hPa

Accuracy +/- 0.5 hPa

Temperature:

Resolution 0.01 K

Accuracy +/- 0.2 K

Relative Humidity:

Resolution 0.1% RH

Accuracy +/- 5 % RH

Geopotential Height:

Calculated using radiosonde PTU measurements.

Errors due to uncertainty in the PTU values.

### Instrument History:

#### ECC Ozonesondes:

Manufacturer:	Model #	Time Period Used	Ozonesonde Design and Changes
Science Pump	1A	1967-1981	Rectangular pump/square Teflon sensor cell Thermistor at base of ozonesonde body Analog data acquisition
Science Pump	3A	1979-1982	Commutator moved to electronics board
Science Pump	4A	1982-1991	Cylindrical piston pump
Science Pump	5A	1990-1996	Digital data acquisition Pump Temperature thermistor epoxied to corner of pump block
Science Pump	6A	1996-present	Pump temperature thermistor inside of pump block
EN-SCI	1Z	1994-2000	Different manufacturer but the same design as Science Pump 6A
EN-SCI	2Z	1997-present	Circular molded plastic sensor cell

#### Boulder:

1A: April 1967 - June 1981  
3A: September 1981 - June 1982  
4A: June 1982 - December 1989  
5A: June 1991 - October 1994  
1Z: March 1994 - January 1999  
6A: January 1997 - Present (Most before November 2005)  
2Z: January 1998 - Present

#### Hilo

4A: September 1982 - July 1991  
5A: July 1991 - December 1994  
1Z: April 1994 - March 1998  
6A: January 1997 - November 1998  
2Z: July 1998 - Present

#### S.Pole

#### Samoa

4A: April 1, 1986 - January 23, 1990  
1Z: August 8, 1995 - January 23, 1997  
6A: January 30, 1997 - May 4, 2007  
2Z: January 27, 2006 - Present

#### Solution Recipe Changes:

1967-1998 - 1% KI, 1.0x buffer  
1998-2005 - 2% KI, no buffer  
2005-present 1% KI, 0.1x buffer

Radiosonde changes:

1967-1991 - VIZ "A" radiosondes and analog data recording.

Feb 1991-2009 - Vaisala RS-80 radiosondes

May 2009-2020/2022 Intermet iMet-1 radiosondes

2020/2022-present Intermet iMet-4 radiosondes

Boulder:

Switched from 1% KI buffered cathode solution to 2% KI unbuffered: August 21, 1997.

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Hilo:

Switched from 1% KI buffered cathode solution to 2% KI unbuffered: April 15, 1998.

Switched from 2% KI unbuffered cathode solution to 1% KI 1/10th buffered: December 20, 2005.

S.Pole:

Switched from 1% KI buffered cathode solution to 2% KI unbuffered: March 4, 1998.

Switched from 2% KI unbuffered cathode solution to 1% KI 1/10th buffered: November 15, 2004.

Samoa:

Switched from 1% KI buffered cathode solution to 2% KI unbuffered: April 17, 1998.

Switched from 2% KI unbuffered cathode solution to 1% KI 1/10th buffered: October 22, 2005.