

ICON Data Product 3.3: Daytime Oplus

This document describes the data product for ICON Daytime Oplus climatology. In this, 48-day windows of data from the L2.6 v03 product are collected into regular altitude, longitude, latitude, and local time bins. Uncertainty weighted mean and standard deviations of each parameter are reported in this file. Note that NMF2 and HMF2 data do not have an altitude component, OPLUS data has an altitude component. This single file spans the whole mission, which is in NetCDF4 format.

This describes the data product for ICON Level 3 EUV (DP 3.3), which is in NetCDF4 format.

The primary data products are ionospheric O+ density profiles derived from a retrieval detailed in, Stephan et al. (2017), <https://doi.org/10.1007/s11214-017-0385-1>.

As part of this, an estimation is made of electron density hmF2 and NmF2 values using the IRI 2007 model that underlies the retrieval algorithm. These files are named ICON_L3-3_EUV_vXXrZZZ.NC, where vXX shows the version number

and ZZZ shows the revision number of this file. Each individual file nominally contains the data for the entire mission.

The L3 EUV files are produced from the L2.6 EUV files.

All variables within the file are described in their Var_notes attribute. The data are identified in one of 2 var_types: data – which

contains the primary data product and support data – which contains parameters used in the retrieval such as geometry etc. that may also

be useful in any analysis of this data.

The dimensions of the data also indicate its type. For example, anything with epoch as a dimension means there is 1 value corresponding

to each instrument exposure.

History

Version 001, First release version based on latest current L2.6 files. S. L. England, B. Thurairajah

Revision 002, updated in response to Level 1 and Level 2 file updates, that flag values with high systematic uncertainty in the 83.4 nm observations.

Such values are correspondingly excluded from the averages here.

Dimensions

NetCDF files contain **variables** and the **dimensions** over which those variables are defined. First, the dimensions are defined, then all variables in the file are described.

The dimensions used by the variables in this file are given below, along with nominal sizes. Note that the size may vary from file to file. For example, the "Epoch" dimension, which describes the number of time samples contained in this file, will have a varying size.

Dimension Name	Nominal Size
Epoch	107
ICON_L33_Dates	48
ICON_L33_LocalTime	21
ICON_L33_Latitude	12
ICON_L33_Longitude	24
ICON_L33_Altitude	72

Variables

Variables in this file are listed below. First, "data" variables are described, followed by the "support_data" variables, and finally the "metadata" variables. The variables classified as "ignore_data" are not shown.

data

Variable Name	Description	Units	Dimensions
ICON_L33_HMF2	Binned HMF2 Uncertainty-weighted mean value of HMF2, taken over all good quality L2 datapoints in a 48-day time-span, as a function of longitude, latitude, time. Derived from ICON_L26_HMF2	km	Epoch, ICON_L33_LocalTime, ICON_L33_Latitude, ICON_L33_Longitude
ICON_L33_NMF2	Binned NMF2 Uncertainty-weighted mean value of NMF2, taken over all good quality L2 datapoints in a 48-day time-span, as a function of longitude, latitude, time. Derived from ICON_L26_NMF2	cm-3	Epoch, ICON_L33_LocalTime, ICON_L33_Latitude, ICON_L33_Longitude
ICON_L33_OPluses	Binned O+ Uncertainty-weighted mean value of number density of O+, taken over all good quality L2 datapoints in a 48-day time-span, as a function of altitude, longitude, latitude, time. Derived from ICON_L26_OPLUS	cm-3	Epoch, ICON_L33_LocalTime, ICON_L33_Latitude, ICON_L33_Longitude, ICON_L33_Altitude
ICON_L33_Data points	Number of data points Number of data points in each 48 day average, as a function of longitude, latitude, time	dimensionless	Epoch, ICON_L33_LocalTime, ICON_L33_Latitude, ICON_L33_Longitude
ICON_L33_Sigma_HMF2	Sigma HMF2 1 standard deviation of the good column HMF2 values used to compute the mean, as a function of longitude, latitude, time	km	Epoch, ICON_L33_LocalTime, ICON_L33_Latitude, ICON_L33_Longitude
ICON_L33_Sigma_NMF2	Sigma HMF2 1 standard deviation of the good column NMF2 values used to compute the mean, as a function of longitude, latitude, time	cm-3	Epoch, ICON_L33_LocalTime, ICON_L33_Latitude, ICON_L33_Longitude
ICON_L33_Sigma_OPlus	Sigma O+ 1 standard deviation of the good O+ values used to compute the mean, as a function of altitude, longitude, latitude, time	cm-3	Epoch, ICON_L33_LocalTime, ICON_L33_Latitude, ICON_L33_Longitude, ICON_L33_Altitude

support_data

Variable Name	Description	Units	Dimensions
Epoch	Milliseconds since 1970-01-01 00:00:00 UTC Time corresponding to the middle of each 48 day average, in milliseconds since Jan 1 1970.	milliseconds	Epoch
ICON_L33_Included_Dates	Date YYYY-MM-DD format Dates used in each 48 day bin, in string format, in the format: 2017-05-27	string	Epoch, ICON_L33_Dates
ICON_L33_Altitude	Altitude Bin Altitude corresponding to the binned quantities, in WGS84.	km	ICON_L33_Altitude
ICON_L33_LocalTime	Local Time Bin Local time binned in 0.5 hour intervals, local time +/- 0.25 hours.	hours	ICON_L33_LocalTime
ICON_L33_Latitude	Latitude Bin Latitude of the EUV data, binned in 5 degree intervals, latitude +/- 2.5 degrees. Derived from ICON_EUV_L26_Latitude	degrees	ICON_L33_Latitude
ICON_L33_Longitude	Longitude Bin Longitude of the EUV data, binned in 15 degree intervals, longitude +/- 7.5 degrees. Derived from ICON_EUV_L26_Longitude	degrees	ICON_L33_Longitude

Acknowledgement

This is a data product from the NASA Ionospheric Connection Explorer mission, an Explorer launched at 21:59:45 EDT on October 10, 2019, from Cape Canaveral AFB in the USA. Guidelines for the use of this product are described in the ICON Rules of the Road (<http://icon.ssl.berkeley.edu/Data>).

Responsibility for the mission science falls to the Principal Investigator, Dr. Thomas Immel at UC Berkeley: Immel, T.J., England, S.L., Mende, S.B. et al. Space Sci Rev (2018) 214: 13. <https://doi.org/10.1007/s11214-017-0449-2> Immel, T.J., England, S.L., Harding, B.J. et al. Space Sci Rev (2023) 219: 41. <https://doi.org/10.1007/s11214-023-00975-x>

Responsibility for the validation of the L1 data products falls to the instrument lead investigators/scientists. EUV: Dr. Martin Sirk and Dr. Eric Korpela : <https://doi.org/10.1007/s11214-023-00963-1>, and <https://doi.org/10.1007/s11214-017-0384-2> FUV: Dr. Harald Frey : <https://doi.org/10.1007/s11214-023-00969-9>, and <https://doi.org/10.1007/s11214-017-0386-0> MIGHTI: Dr. Christoph Englert : <https://doi.org/10.1007/s11214-023-00971-1>, <https://doi.org/10.1007/s11214-017-0358-4>, and <https://doi.org/10.1007/s11214-017-0374-4> IVM: Dr. Roderick Heelis : <https://doi.org/10.1007/s11214-017-0383-3>

Responsibility for the validation of the L2 data products falls to those scientists responsible for those products.

- * Daytime O/N2 ratio : Dr. Robert Meier : <https://doi.org/10.1007/s11214-018-0477-6>
- * Daytime (EUV) O+ profiles: Dr. Andrew Stephan : <https://doi.org/10.1007/s11214-022-00933-z>, and <https://doi.org/10.1007/s11214-017-0385-1>
- * Nighttime (FUV) O+ profiles: Dr. Farzad Kamalabadi : <https://doi.org/10.1007/s11214-018-0502-9>
- * Neutral Wind profiles: Brian Harding : <https://doi.org/10.1007/s11214-017-0359-3>, and <https://doi.org/10.1029/2020JA028947>
- * Neutral Temperature profiles: Dr. Michael Stevens : <https://doi.org/10.1007/s11214-022-00935-x>, and <https://doi.org/10.1007/s11214-017-0434-9>
- * Ion Velocity Measurements : Dr. Roderick Heelis : <https://doi.org/10.1007/s11214-017-0383-3>

Additional theoretical work in support of these products was supported by Dr. Robert Meier

Daytime O/N2 product <https://doi.org/10.1029/2020JA029059>
Daytime (EUV) O+ profiles : <https://doi.org/10.1029/2023JA031533>

Additional validation work was performed by Dr. Jonathan Makela, Dr. Gilles Wautelet, and Dr. Yen-Jung (Joanne) Wu:

Neutral wind profiles : <https://doi.org/10.1029/2020JA028726>
Nighttime (FUV) O+ profiles : <https://doi.org/10.1007/s11214-023-00970-2>
Daytime (EUV) O+ profiles : <https://doi.org/10.1007/s11214-022-00930-2>
Ion Velocity Measurements : <https://doi.org/10.1007/s11214-023-00993-9>

Responsibility for Level 4 products falls to those scientists responsible for those products.

- * Hough Modes : Dr. Chihoko Cullens : <https://doi.org/10.1186/s40645-020-00330-6> and <https://doi.org/10.1007/s11214-017-0401-5>
- * TIEGCM : Dr. Astrid Maute : <https://doi.org/10.1007/s11214-017-0330-3>
- * SAMI3 : Dr. Joseph Huba : <https://doi.org/10.1007/s11214-017-0415-z>

Pre-production versions of all above papers are available on the ICON website.
<http://icon.ssl.berkeley.edu/Publications>

Overall validation of the products is overseen by the ICON Project Scientist, Dr. Scott England.

NASA oversight for all products is provided by the Mission Scientist, Dr. Jeffrey Klenzing (2018-2022) and Dr. Ruth Lieberman (2022-present).

Users of these data should contact and acknowledge the Principal Investigator Dr. Immel and the party directly responsible for the data product (noted above) and acknowledge NASA funding for the collection of the data used in the research with the following statement : "ICON is supported by NASA's Explorers Program through contracts NNG12FA45C and NNG12FA42I".

These data are openly available as described in the ICON Data Management Plan on the ICON website (<http://icon.ssl.berkeley.edu/Data>).

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