

ICON Data Product 0P: EUV Ancillary Products

This document describes the data product for Ancillary Products for EUV Data Processing, which is in NetCDF4 format.

The EUV ancillary data file contains information on the ICON observatory as well as EUV specific information. This includes the pointing, position, and velocity of the ICON observatory. It also includes information on the status of the observatory such as maneuvers, being in or out of the Earth's shadow, and calibrations. Pertinent information for the EUV instrument is included such as locations and details at the EUV tangent points. These files are combined with the EUV Level 1 data to produce Level 2 data. ECEF is the Earth-centered, Earth-fixed reference frame. ECI is the Earth-centered inertial reference frame. We use J2000 ECI reference frame. LVLH is local-vertical, local-horizontal. We have two LVLH modes: normal and reverse. LVLH Normal is when the spacecraft is looking north with latitude tangent locations between ~12 S and ~42 N. LVLH Reverse is when the spacecraft is looking south with latitude tangent locations between ~42 S and ~12 N.

History

Version 02, Created by EUV Ancillary Processor v2.0.20 on Thu, 08 Oct 2020, 2020-10-08T17:41:47.000 UTC

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	6570
VERTICAL	108
VECTORS	3
EQUATORIAL_COORDINATE	2

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.

support_data

Variable Name	Description	Units	Dimensions
EPOCH	Calculated number of milliseconds since 1970 January 01 00:00:00 UTC to center of image integration. Number of milliseconds since 1970-01-01 00:00:00 UTC at the middle of the measurement integration.	milliseconds	EPOCH
ICON Ancillary EUV Time UTC String	Date and Time in UTC format ISO 8601 formatted UTC timestamp (at middle of reading). Taken from LOP EUV data file. E.g., 2017-05-27 00:00:00.380Z	string	EPOCH
ICON Ancillary EUV SC Position ECEF	Spacecraft Position in ECEF Coordinates Position of spacecraft in ECEF coordinates.	km	EPOCH, VECTORS
ICON Ancillary EUV SC Velocity ECEF	Spacecraft Velocity in ECEF Velocity of spacecraft in ECEF coordinates.	m/s	EPOCH, VECTORS
ICON Ancillary EUV Latitude	WGS84 Latitude of Spacecraft Position (Geodetic) Geodetic Latitude of Spacecraft in WGS84	degrees North	EPOCH
ICON Ancillary EUV Longitude	WGS84 Longitude of Spacecraft Position (Geodetic) Geodetic Longitude of Spacecraft in WGS84	degrees East	EPOCH
ICON Ancillary EUV Altitude	WGS84 Altitude of Spacecraft Position (Geodetic) Geodetic Altitude of Spacecraft in WGS84	km	EPOCH
ICON Ancillary EUV VNorth	North Velocity of Spacecraft North component of velocity vector for s/c derived from WGS84	m/s	EPOCH
ICON Ancillary EUV VEast	East Velocity of Spacecraft East component of velocity vector for s/c derived from WGS84	m/s	EPOCH
ICON Ancillary EUV VDown	Down (Perpendicular to Local Earth Surface) Velocity of Spacecraft Down component of velocity vector for s/c derived from WGS84 in m/s	m/s	EPOCH
ICON Ancillary EUV SC SZA	Spacecraft Solar Zenith Angle Spacecraft Solar Zenith Angle	degrees	EPOCH
ICON Ancillary EUV LST	Local Solar Time Local Solar Time at tangent point	hours, decimal	EPOCH

Variable Name	Description	Units	Dimensions
ICON_ANCILLARY_EUV_SUN_STATUS	Spacecraft Sun/Shadow Status Code Spacecraft Sun status flag where 0=Sun, 1=Earth Shadow	binary	EPOCH
ICON_ANCILLARY_EUV_ORBIT_NUMBER	Orbit Number Integer Orbit Number	integer	EPOCH
ICON_ANCILLARY_EUV_SLEW_STATUS	Slew or off-point Status Code Binary Coded Integer where 1: LVLH Normal Mode 2: LVLH Reverse Mode 4: Earth Limb Pointing 8: Inertial Pointing 16: Stellar Pointing 32: Attitude Slew 64: Conjugate Maneuver 128: Nadir Calibration 256: Lunar Calibration 512: Stellar Calibration 1024: Zero Wind Calibration 2048-32768: SPARE	binary	EPOCH
ICON_ANCILLARY_EUV_TANGENTPOINTS_LATLONG_ALT	Tangent Locations in WGS84 (Latitude, Longitude, Altitude) Location of the tangent point of each pixel in WGS84.	mixed	EPOCH, VECTORS, VERTICAL
ICON_ANCILLARY_EUV_TANGENTPOINTS_ECEF	Tangent Locations in ECEF Location of the tangent point of each pixel in ECEF.	km	EPOCH, VECTORS, VERTICAL
ICON_ANCILLARY_EUV_TANGENTPOINTS_SZA	Tangent Points Solar Zenith Angle Solar zenith angle at tangent point locations.	degrees	EPOCH, VERTICAL
ICON_ANCILLARY_EUV_FOV_UNITVECTORS_ECEF	FOV Unit Vectors in ECEF Unit Vectors of each pixel across the Field of View in ECEF.	dimensionless	EPOCH, VECTORS, VERTICAL
ICON_ANCILLARY_EUV_TANGENTPOINT_DISTANCE	Distance to Tangent Points Straight Line Distance Between Spacecraft and Tangent Point.	km	EPOCH, VERTICAL
ICON_ANCILLARY_EUV_HORIZONTAL_BORESIGHT_SUN_ANGLE	Horizontal Boresight to Sun Angle Angle between the Sun and image horizontal (right)	degrees	EPOCH
ICON_ANCILLARY_EUV_VERTICAL_BORESIGHT_SUN_ANGLE	Vertical Boresight to Sun Angle Angle between the Sun and image vertical (up).	degrees	EPOCH
ICON_ANCILLARY_EUV_TOTAL_BORESIGHT_SUN_ANGLE	Total Boresight to Sun Angle Magnitude of the angle between instrument boresight and the Sun.	degrees	EPOCH

Variable Name	Description	Units	Dimensions
ICON Ancillary_EUV_FOV_Azimuth_Angle	FOV Celestial Azimuth Celestial Azimuth with respect to geographic north for each pixel in the field of view.	degrees	EPOCH, VERTICAL
ICON Ancillary_EUV_FOV_Zenith_Angle	FOV Celestial Zenith Angle between look direction and zenith for each pixel in the field of view.	degrees	EPOCH, VERTICAL
ICON Ancillary_EUV_Space_Environment_Region_Status	Space Environment Region Status Standardized for several missions, not all codes are relevant to ICON. Binary Coded Integer where 1: Earth Shadow 2: Lunar Shadow 4: Atmospheric Absorption Zone 8: South Atlantic Anomaly 16: Northern Auroral Zone 32: Southern Auroral Zone 64: Periapsis Passage 128: Inner & Outer Radiation Belts 256: Deep Plasma Sphere 512: Foreshock Solar Wind 1024: Solar Wind Beam 2048: High Magnetic Field 4096: Average Plasma Sheet 8192: Bowshock Crossing 16384: Magnetopause Crossing 32768: Ground Based Observatories 65536: 2-Day Conjunctions 131072: 4-Day Conjunctions 262144: Time Based Conjunctions 524288: Radial Distance Region 1 1048576: Orbit Outbound 2097152: Orbit Inbound 4194304: Lunar Wake 8388608: Magnetotail 16777216: Magnetosheath 33554432: Science 67108864: Low Magnetic Latitude 134217728: Conjugate Observation	binary	EPOCH
ICON Ancillary_EUV_Radius_To_Spacecraft	Earth Center to Spacecraft Distance Current radius of the spacecraft	km	EPOCH
ICON Ancillary_EUV_Radius_To_Tangent_Point	Earth Center to Tangent Point Distance Radius from the center of the Earth to the tangent point.	km	EPOCH, VERTICAL

Variable Name	Description	Units	Dimensions
ICON_ANCILLARY_EUV_STATUS	<p>EUV Status</p> <p>Binary Coded Integer where</p> <p>1: Earth Day View 2: Earth Night View 4: Calibration Target View 8: Off-target View 16: Sun Proximity View 32: Moon Proximity View 64: North Magnetic Footpoint View 128: South Magnetic Footpoint View 256: Science Data Collection View 512: Calibration Data Collection View 1024: RAM Proximity View 2048-32768: SPARE</p> <p>Activity is what the spacecraft was commanded to do while status is the spacecraft's natural state of operations. This means that activity should always be used over status if they differ, but will almost always be the same.</p>	binary	EPOCH
ICON_ANCILLARY_EUV_ACTIVITY	<p>EUV ACTIVITY</p> <p>Binary Coded Integer where</p> <p>1: Earth Day View 2: Earth Night View 4: Calibration Target View 8: Off-target View 16: Sun Proximity View 32: Moon Proximity View 64: North Magnetic Footpoint View 128: South Magnetic Footpoint View 256: Science Data Collection View 512: Calibration Data Collection View 1024: RAM Proximity View 2048-32768: SPARE</p> <p>Activity is what the spacecraft was commanded to do while status is the spacecraft's natural state of operations. This means that activity should always be used over status if they differ, but will almost always be the same.</p>	binary	EPOCH
ICON_ANCILLARY_EUV_FOV_UNITVECTORS_ECI	<p>FOV Unit Vectors in ECI</p> <p>Unit Vectors of each pixel across the Field of View in ECI, J2000.</p>	dimensionless	EPOCH, VECTORS, VERTICAL
ICON_ANCILLARY_EUV_FOV_RA_DEC	<p>Right Ascension and Declination</p> <p>Right Ascension and Declination for each pixel.</p>	degrees	EPOCH, EQUATORIAL_COORDINATE, VERTICAL
ICON_ANCILLARY_EUV_TANGENTPOINTS_LST	<p>Tangent Points Local Solar Time</p> <p>Local Solar Time at tangent points.</p>	hours, decimal	EPOCH, VERTICAL

Variable Name	Description	Units	Dimensions
ICON Ancillary EUV Quality Flag ICON Ancillary EUV Quality Flag	<p>Quality Flag</p> <p>Binary Coded Integer where</p> <ul style="list-style-type: none"> 1: STATE_NO_DATA 2: STATE_UNCONVERGED 4: STATE_LOW 8: STATE_MED 16: STATE_HIGH 32: AD_NO_DATA 64: AD_DIVERGING 128: AD_NOT_STARTED 256: AD_CONVERGING 512: AD_COARSE_CONVERGED 1024: AD_FINE_CONVERGED 2048-32768: SPARE <p>STATE_NO_DATA: No telemetry available for this time period. States are propagated from the last valid solution.</p> <p>STATE_UNCONVERGED: The GOODS KF solution is unconverged and should not be used. States are propagated from the last valid solution.</p> <p>STATE_LOW: The GPSR solution is better than the GOODS solution (The position accuracy is worse than 150 m, 1-sigma)</p> <p>STATE_MEDIUM: The GOODS solution is better than the GPSR solution (The position accuracy is better than 150 m, 1-sigma)</p> <p>STATE_HIGH: The GOODS solution is better than the GPSR solution, and meets its performance requirements (20 m position and 0.02 m/sec velocity, 1-sigma).</p> <p>AD_NO_DATA: No telemetry available for this time period. Attitude is copied from the last valid solution.</p> <p>AD_DIVERGING: Tolerances on the diagonal elements of the covariance matrix diverging and exceeds 9.9e9 asec² for attitude sigma and 9.9e9 asec²/sec² for rate sigma or negative values</p> <p>AD_NOT_STARTED: KF has not started processing measurements</p> <p>AD_CONVERGING: KF is in state of updating measurements and filter started to converge</p> <p>AD_COARSE_CONVERGED: Tolerances on the diagonal elements of the covariance matrix converging and below 200K asec² for x, y and 1000K for z in tracker frame for attitude and 10 asec²/sec² for x, y and z for rate</p> <p>AD_FINE_CONVERGED: Tolerances on the diagonal elements of the covariance matrix converging and below 1000 asec² for x, y and z in tracker frame for attitude and 1 asec²/sec² x, y and z for rate</p> <p>Nominal value of 1040: STATE_HIGH (16) and AD_FINE_CONVERGED (1024). All values are a combination of a STATE value and an AD (attitude determination) value. It is up to the user to determine if data outside 1040 is usable. AD values NOT AD_FINE_CONVERGED should be suspect. STATE_HIGH is expected, but STATE_MED is possible during maneuvers.</p>	binary	EPOCH

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. Guidelines for the use of this product are described in the ICON Rules of the Road (<https://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>

Responsibility for the validation of the L1 data products falls to the instrument lead investigators/scientists.

- * EUV: Dr. Eric Korpela : <https://doi.org/10.1007/s11214-017-0384-2>
- * FUV: Dr. Harald Frey : <https://doi.org/10.1007/s11214-017-0386-0>
- * MIGHTI: Dr. Christoph Englert : <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 and N2 profiles: Dr. Andrew Stephan : <https://doi.org/10.1007/s11214-018-0477-6>
- * Daytime (EUV) O+ profiles: Dr. Andrew Stephan : <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: Dr. Jonathan Makela : <https://doi.org/10.1007/s11214-017-0359-3>
- * Neutral Temperature profiles: Dr. Christoph Englert : <https://doi.org/10.1007/s11214-017-0434-9>
- * Ion Velocity Measurements : Dr. Russell Stoneback : <https://doi.org/10.1007/s11214-017-0383-3>

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

- * Hough Modes : Dr. Chihoko Yamashita : <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.

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.

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 available on the ICON website (<http://icon.ssl.berkeley.edu/Data>).

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