

GOES-16 ABI L2+ Legacy Atmospheric Profile (LAP)
Full Data Quality
May 13, 2024
Read-Me for Data Users

GOES-R Advanced Baseline Imager (ABI) L2+ products will achieve Full Validation maturity by default after two years of Provisional and Operational use with no major anomalies reported (minor product improvements may still be occurring). As a result, GOES-16 Legacy Atmospheric Profile (LAP) is considered Full Validation maturity as of February 22, 2020.

The GOES-R ABI LAP products provide Legacy Vertical Temperature Profile (LVT), Legacy Vertical Moisture Profile (LVM), Total Precipitable Water (TPW), and Derived Atmospheric Stability Indices (DSI) over each 5x5 ABI pixels box with clear sky infrared band radiances. DSI includes five atmospheric instability indices: Lifted Index (LI), Convective Available Potential Energy (CAPE), Total Totals Index (TT), K-Index (KI), and Showalter Index (SI).

The GOES-R ABI LAP products are retrieved based on the ABI infrared band measurements with NWP (NOAA GFS) short-range forecasts as first guess. The LAP products are generated every 10 minutes over the ABI Full Disk (FD), every 5 minutes over the Continental United States (CONUS) region, and every 1 minutes over the Mesoscale (MESO) regions.

A full description and format of the LAP products can be found in the Product Definition and User's Guide (PUG) Volume 5: Level 2+ Products, located on OSPO's GOES-R documents webpage: <https://www.ospo.noaa.gov/Organization/Documents/goes-r.html>. The algorithm used to derive the LAP products from GOES-16 ABI observations is described in detail in the "GOES-R Advanced Baseline Imager (ABI) Algorithm Theoretical Basis Document for Legacy Atmospheric Moisture Profile, Legacy Atmospheric Temperature Profile, Total Precipitable Water, and Derived Atmospheric Stability Indices", located on STAR's GOES-R ATBD webpage: https://www.star.nesdis.noaa.gov/goesr/documentation_ATBDs.php.

Full maturity, by definition, means that:

- Validation, quality assurance, and anomaly resolution activities are ongoing.
- Incremental product improvements may still be occurring.
- Users are engaged and user feedback is assessed.
- Product performance for all products is defined and documented over a wide range of representative conditions via ongoing ground-truth and validation efforts.
- Products are operationally optimized, as necessary, considering mission parameters of cost, schedule, and technical competence as compared to user expectations.
- All known product anomalies are documented and shared with the user community.
- Product is operational.

Persons desiring to use the GOES-16 ABI Full maturity LAP products for any reason, including but not limited to scientific and technical investigations, are encouraged to consult the NOAA/NESDIS/STAR Algorithm Working Group (AWG) scientists for feasibility of the planned applications. The LAP product is sensitive to upstream processing that includes the quality of the calibration, navigation, and cloud mask.

Status of the LAP products and any remaining minor issues:

1. The LAP product performance has been stable (basically meeting the requirements) since it was declared Beta maturity on 16 May 2017.
2. Summary of the measured performance of the LAP product as measured against reference data including Suomi-Net GPS (Global Positioning System), AMSR2 (Advanced Microwave Scanning Radiometer 2), RAOB, ECMWF analysis and GDAS analysis, and AERI (Atmospheric Emitted Radiance Interferometer) boundary layer profiles from a GOES-16 field campaign.
 - Accuracy specification (1 mm) and precision specification (3 mm) are met for TPW product
 - Accuracy specification (1 K above boundary layer and below 400 hPa) and precision specification (2 K above boundary layer and below 400 hPa) are met for Legacy Vertical Temperature Profile
 - Accuracy specification (18 % between the surface and 300 hPa, 20 % between 300 and 100 hPa) and precision specification (same as accuracy specification) are met for Legacy Vertical Moisture Profile except for the comparison with RAOB above 300 hPa which is likely due to the dry bias of radiosonde observations
 - Accuracy specification (2 K, 1000 J/kg, 1 K, 2 K, 2K) and precision specification (6.5 K, 2500 J/kg, 4 K, 5 K, 6.5 K) are met for LI, CAPE, TT, KI, SI, respectively, except TT and KI when compared to radiosonde observations (RAOBs). The inclusion of only the atmospheric unstable cases makes the TT (>44) and KI (>26) results closer to the requirements.
3. Missing values are randomly discovered over some boxed areas in Full disk, which is due to the upstream processing: minor issue
4. The LAP products are affected by the migration of the sun which might be caused by the cloud mask: minor issue

Users should be aware, that due to the limited spectral information of the ABI, compared to high-spectral resolution infrared sounders, that the most reliable information are the temporal and spatial gradients. The vertical profiles have limited vertical information and hence integrated quantities, such as TPW are preferable. Users can find more on the validations of LAP products using this on-line tool: <http://soundingval.ssec.wisc.edu>. The page includes derived product imagery for all three sectors (Full Disk, CONUS, and meso-scale sectors) and both East and West satellites. The reference datasets include the GPS-IPW NOAA network, conventional RAOB sites, and AMSR2 TPW measurements.

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