National Aeronautics and Space Administration

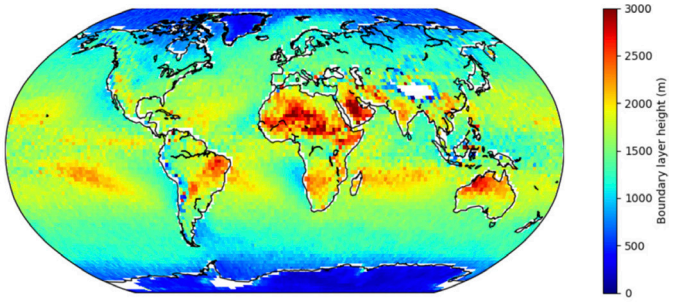
Merged GNSS-RO/Atmospheric Sounder Measurements for Planetary Boundary Layer Products

Satellite Needs Working Group - Solution Fact Sheet

The Planetary Boundary Layer (PBL) is the lowest 2-3 km of the Earth's atmosphere and is highly dynamic due to its direct contact with varying surface conditions. Due to the surface-atmosphere interactions occurring in this layer, scientific understanding of PBL variations is vital for interpreting processes such as cloud formation and pollution dispersal. The 2017 Decadal Survey selected the PBL as an Incubation Targeted Observable activity that seeks to identify and develop new technologies for improving the current understanding of the PBL's interactions with the atmosphere and the surface (e.g., biosphere-atmosphere exchanges, air-sea exchanges of chemical and energy fluxes).

As new technologies from this study reach maturity, the Satellite Needs Working Group (SNWG) supports the production of a moderate-resolution, global PBL dataset, derived from a combination of current Program of Record hyperspectral sounding data and complimentary Global Navigation Satellite System (GNSS) - Radio Occultations (RO). Using this combination, the merged PBL product will capture vertical profiles of atmospheric temperature and water vapor which will advance weather forecasting, air quality monitoring, and climate change projection and mitigation.

The figure (right) shows a global annual-mean climatology map of Planetary Boundary Layer Height (PBLH) from 2006 to 2019 derived from GNSS-RO data. The SNWG solution will combine GNSS-RO data with hyperspectral sounding data to create global PBL products for temperature and water vapor profiles, that can provide more comprehensive estimates of PBLH and other derived variables.



Credit: Kalmus, et al., 2022

Societal Benefit

- Provides accurate 3D profiles of temperature and water vapor in the critical lower troposphere to improve weather and air quality forecasting
- Combines hyperspectral sounding data with GNSS-RO data to support research on atmospheric processes and impacts on the cloud life cycle
- Aims to increase measurements of PBL variables over data-sparse regions, including oceans
- Identifies changes in critical components of the lower atmosphere (e.g., clouds, water vapor, temperature, stability) that are important for climatological modeling and projections

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Merged GNSS-RO/Atmospheric Sounder Measurements for Planetary Boundary Layer Products

Product	Threshold (Version 1)		Baseline (Version 2)	
Input Sources	AIRS, CrIS, AMSU, ATMS, COSMIC-1/2, Sentinel-6, GRACE-FO, Spire (Additional RO datasets will likely be included subject to availability)			
Output Variables	Temperature profiles and water vapor profiles at vertical height grids of 100 m within the PBL and above (0 to ~3 km altitudes)			
Processing Level	2	3	2	3
Temporal Coverage	2014-2023		2006-present	
Temporal Sampling	Dependent on GNSS-RO sounding sampling (varies over the time period but up to 10,000 profiles per day globally)	Monthly	Dependent on GNSS-RO sounding sampling (varies over the time period but up to 10,000 profiles per day globally)	Monthly
Latency	None required (potential real-time processing possible)	None required but potentially ~1 month	None required (potential real-time processing possible)	None required but potentially ~1 month
Spatial Coverage	Global			
Spatial Resolution	Horizontal: 50 km Vertical: 200 m	Horizontal: ~2 deg Vertical: ~200 m	Horizontal: 15 km Vertical: 200 m	Horizontal: ~1 deg Vertical: ~200 m

How do I access this data?

The Merged PBL products are not yet available. Once available, data will be distributed through NASA's Goddard Earth Sciences Data and Information Services Center (GES DISC).

NASA GES DISC

Where can I find more information?

More information on the Merged PBL Products solution and the PBL Incubation Study is available on the solution's webpage and the NASA Earth Science PBL Incubation Study webpage.

Merged PBL Products Webpage

NASA PBL Incubation Study Page

Background Image Credit: NOAA

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