DETECTION OF THE DIURNAL VARIATION OF THE PLANETARY BOUNDARY LAYER HEIGHT OVER OCEANS USING COSMIC-2 DATA

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The planetary boundary layer (PBL) is an essential component of the troposphere. It controls rapid exchanges of heat, moisture, and chemical constituents between the surface and free atmosphere. A fundamental variable of the PBL is the top height (PBLH). The PBL structure is complicated, and the PBLH usually exhibits a strong diurnal cycle associated with the daily variation of solar radiation.

Utilizing the strength of Global Navigation Satellite System (GNSS) Radio Occultation (RO) with the high vertical resolution (~ 200 meters) and deeper penetration (50% of profiles penetrate to below 500 meters), the PBLH can be identified as the layer at the sharp atmospheric density changes near the surface. COSMIC-2 provide more than 4000 atmospheric bending angle profiles per day over the tropical and sub-tropical regions from 45°N - 45°S. COSMIC-2 constellation consists of 6 Leo satellites, covering relatively uniform local time than other currently operating RO missions.

In this work, the COSMIC-2 BA data from October 2019 to Dec. 2021 processed by UCAR are used to detect the PBLH. A sharpness parameter, defined by the relative minimum refractivity gradient, is used to identify the less distinguished vertical changes related to the ambient cloud and other non-PBL atmospheric structures. A Locally Weighted Scatterplot Smoothing (LOWESS) approach is deployed to eliminate high-frequency BA variation in the original COSMIC-2 BA profiles. We define the local minimum in the BA lapse rate in 50 meters intervals between 0.5 km to 3 km altitude as the PBLH. CALIPSO provides high-resolution vertical profiles of aerosols and clouds. In situ observations have intensively validated the cloud-top layer determined by CALIPSO. The accuracy of CALIPSO cloud-top height is within 100 meters. The global CALIPSO data provide a unique opportunity to validate the RO-derived PBLH in regions dominated by marine PBL clouds. We compared the COSMIC-2 derived PBLH with those collocated low cloud top heights detected by the CALIPSO. We focus our comparison on a well-known stratocumulus cloud-dominated region (25S to 15S and 85W to 70W). This study showed that over this region, the diurnal variation of PBLH determined from the RO observations is consistent with those from CALIPSO, which brings us confidence in the COSMIC-2 derived PBLH on the overall ocean and land and combination of all GNSS RO missions.