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Seasonal Variability in Tropospheric Ozone Distribution Over Qatar

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We report on the vertical distribution and seasonal variability in tropospheric ozone over the Middle East through one year of weekly ozonesondes launched from Doha, Qatar during 2014. A total of 49 2Z-V7 DMT/EN-SCI Electrochemical Concentration Cell (ECC) ozonesondes employing a 1% buffered potassium iodide solution (KI), coupled with iMet-1-RS GPS radiosondes were launched around 1300 local time. The authors used the SkySonde telemetry software (developed by CIRES and NOAA/ESRL) and developed robust in-house data quality assurance and validation methodologies.
The average height of the thermal tropopause is between 15-17.5 km (125-85 hPa). Monthly average relative humidity around the tropopause shows an enhancement during the months of June through the beginning of October. Monthly average temperature profiles show the development of the subtropical subsidence inversion around 5-6 km (450-520 hPa) between the months of April through October. The subsidence inversion is strongest during the months of June and July and is accompanied by a sharp drop in relative humidity over a 100-300 m in the vertical. The monthly average ozone background concentration between the Planetary Boundary Layer (PBL) height and the subsidence inversion increases from 50 ppb in the winter to almost 80 ppb in the summer months. An enhancement of up to 50% in the average ozone in the mid-to-upper troposphere (above the subsidence inversion) is strongest during the summer months (June through September) and results in average concentrations between 80-100 ppb. In the upper troposphere (above 13 km/200 hPa) ozone concentrations are highest during the spring and summer months. This is coupled with a drop in the average height of the tropopause.
HYSPLIT back-trajectory analysis shows the enhancement in mid-to-upper tropospheric ozone in the summer is due to persistent high pressure over the Middle East between the months of June through September. Evidence of Stratosphere-Troposphere Exchange (STE) in the winter and spring months and Monsoonal outflow observed in late summer are also reflected in the ozone profiles and HYSPLIT back-trajectories.