41 years of atmospheric carbon dioxide monitoring in Hungary

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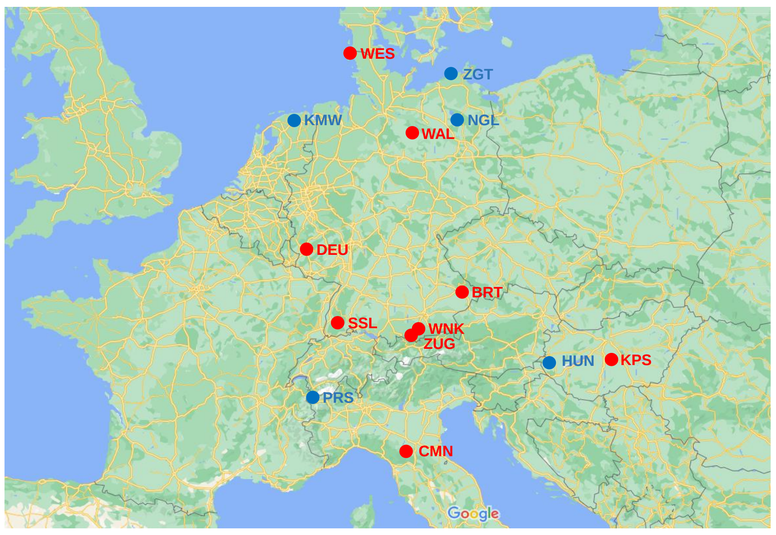
K-puszta (KPS, 1981-1999)

In situ CO_2 monitoring was started in Hungary by the Hungarian Meteorological Service at its regional background air pollution monitoring site K-puszta (46°58'N, 19°33'E, 125 m asl) on 5 June 1981 using a Siemens Ultramat 3 NDIR analyzer. The air intake was located at 10 m above ground. The station was located in a large forest clearing. The organic layer of the sandy soil was thin. The analyzer was regularly calibrated against three CO_2-in-N_2 standards prepared by Scripps Institution of Oceanography (1981-1993) and four CO_2-in-air standards prepared by National Oceanic and Atmospheric Administration (NOAA), U.S.A. (1993-1999). The 1981-1993 mole fraction data were retrospectively experimentally corrected for the pressure broadening effect, which involved non-negligible uncertainties. A combination of a humidifier and a gas cooler provided constant water vapor content (dew point approx. +4 °C) for both the standards and the air to be analyzed. The measurement data are publicly available at the WMO WDCGG database.

Location

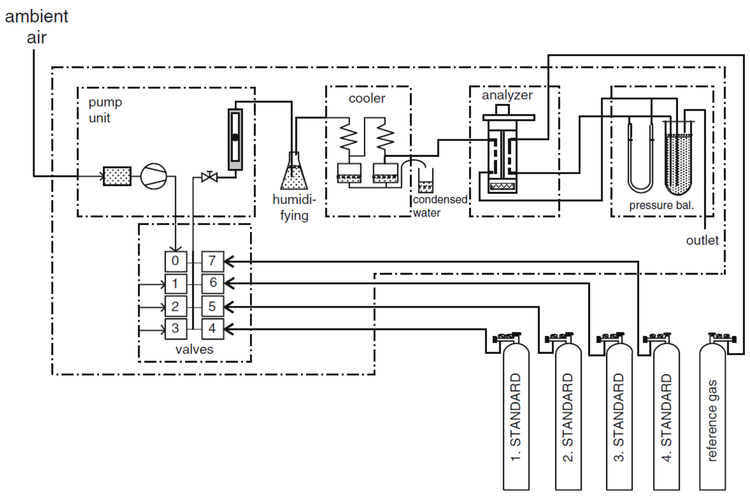


The European continental in situ CO_2 monitoring stations reporting data to WMO WDCGG in 1981 (red), and further stations established till1994 (blue)

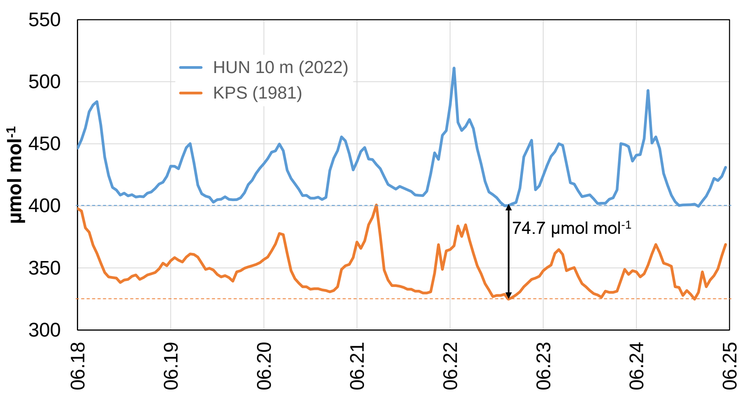
K-puszta (left) and Hegyhátsál (right) WMO GAW regional monitoring sites

Hegyhátsál (HUN, 1994-)

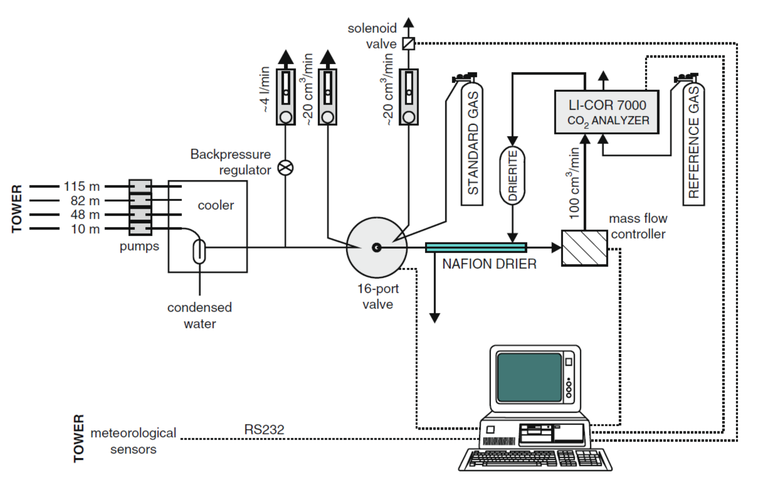
Hegyhátsál tall-tower GHG monitoring station (46°57'N, 16°39'E, 248 m asl) was established as a flask sampling site by the Hungarian Meteorological Service in cooperation with National Oceanic and Atmospheric Administration (NOAA), U.S.A. in 1993. In situ CO_2 monitoring started at four elevations (10 m, 48 m, 82 m, 115 m) on 29 September 1994. The tower is located in an agricultural region, far from any direct anthropogenic pollution. The soil type in the region is lessivated brown forest soil. The measurements were carried out using NDIR analyzers until 2020 (1994-2007: Li-6251; 2007-2020: Li-7000) when a Picarro G2301 CRDS analyzer was installed. The analyzers were regularly calibrated against four CO_2-in-air standards prepared by NOAA. The NOAA flask air samples have been providing independent quality control on the in situ measurements. The monitoring station has been operating by the Institute for Nuclear Research (ATOMKI) since 2020. The measurement data are publicly available at the WMO WDCGG database.



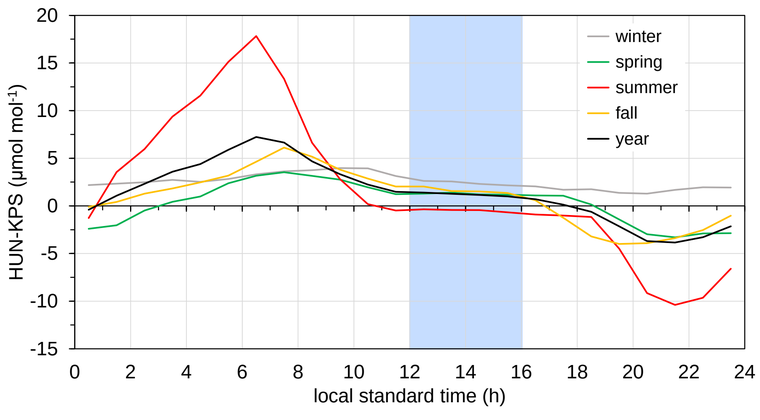
Schematic of the CO_2 monitoring system used at K-puszta



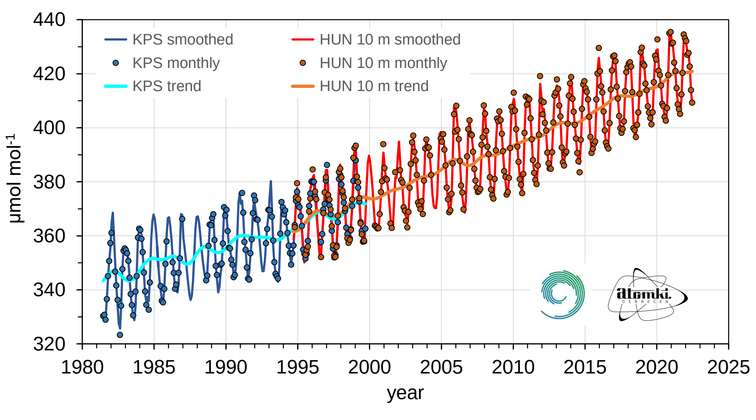
Temporal variations of CO_2 mole fractions at K-puszta at the beginning of the measurements (18-24 June, 1981), and at Hegyhátsál at the same time 41 years later



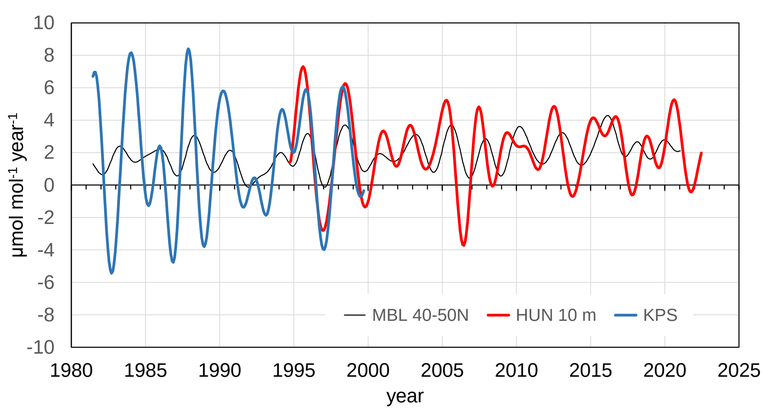
Schematic of the CO_2 monitoring system used at Hegyhátsál



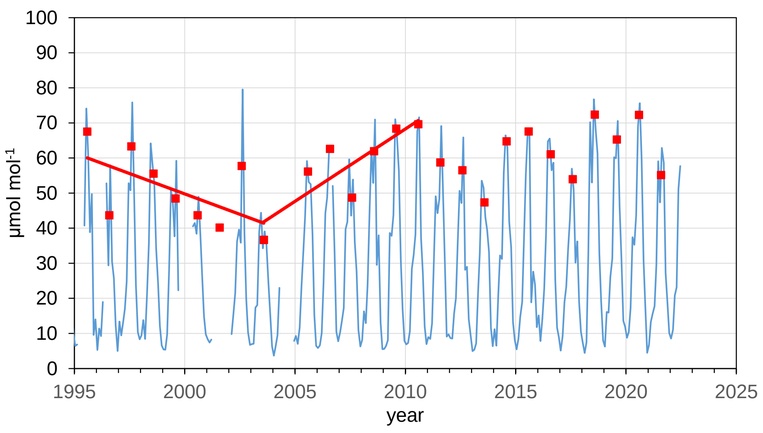
Diurnal variation of the average deviation between the mole fractions measured at HUN and KPS in 1994-1999 (same latitude, 220 km distance)



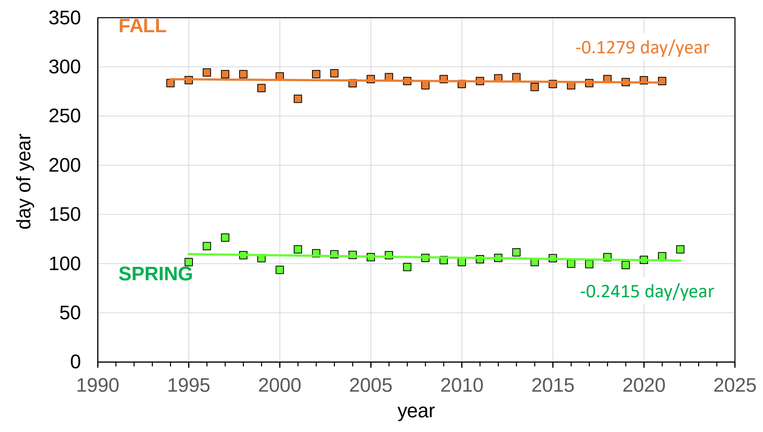
Early afternoon (12-16 h LST) monthly averages, smoothed temporal variations, and trends at KPS and HUN



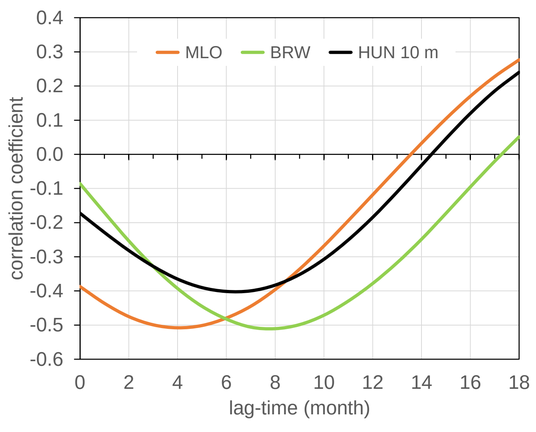
Temporal variation of growth rates of early afternoon (12-16 h LST) CO_2 at KPS and HUN, as weel as in the Marine Boundary Layer 40-50°N band (https://gml.noaa.gov/ccgg/mbl/mbl.html)



Temporal variation of the monthly mean daily amplitude (blue line), and the July-August mean (red square). Development of increasing drought towards 2003, and the recovery



Trends in the start and the end of the CO_2 annual deficit seasons (relative to the annual average) at HUN



Correlation of the growth rate at HUN and two NOAA baseline stations, and the Southern Oscillation Index (SOI) as the function of lag-time

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The poster presents excerpts from a comprehensive study in progress.

ACKNOWLEDGMENT:

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