Radiocarbon monitoring in the Czech Republic and Hungary

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In the Czech Republic and Hungary is performed monitoring of atmospheric 14CO2 on localities: Prague-Bulovka (CZ, bordering part of Prague, close to frequent road, with greater load from local fossil fuel combustion), Kostice (CZ, relatively clear area in Czech-Moravian highland without presence of greater local sources of fossil CO2), Dunaföldvár (H, clear area with small road in the vicinity), Paks (HU, control point of NPP). Purposes of this monitoring are:

1. quantification of actual 14C activity level in the areas influenced by regional Suess effect;
2. determination of local anthropogenic influencing caused both by 14C releases from NPPs and by fossil fuel combustion.

It can be supposed that each area in central European countries is loaded by fossil fuel combustion. Resulting activities of atmospheric 14CO2 were subtracted from long term trend in Jungfraujoch high mountain monitoring station (CH) to estimate size of local and regional Suess effect (Suess 1955).

It is evident from calculated/estimated size of local and regional Suess effect, minimal differences from Jungfraujoch monitoring station occur during summer, where also 14C activities in the locality with expected greater load from fossil fuel combustion (Prague-Bulovka) approximates to values observed on Jungfraujoch. Size of local Suess effect in Prague-Bulovka locality is generally similar to regional, except winter minimum when expands (compare left and right diagram).

In the air of NPPs (Nuclear Power Plants) surrounding can be 14CO2 activity surplus partly compensated by influencing from local sources of fossil carbon. Such “compensation” effect is eliminated in the case of 14CO2 activity concentration. Such parameter is given only by 14CO2 amount in volume unit of air with normalized conditions (or in weight unit of dry air) and is not influenced by presence of fossil CO2.

To calculate activity concentration of atmospheric 14CO2 there is necessary to measure both 14CO2 activity and concentration of CO2. Likewise, additional parameters including temperature, pressure and humidity of sampled air are necessary. In the locality Prague-Bulovka (Czech Republic) was monitoring of activity concentration experimentally launched during 2001 utilizing volumetric determination of CO2.

Time series of exact measurement of atmospheric 14CO2 activity concentration could demonstrate decreasing amount of bomb 14C in the troposphere or seasonal changes connected with CO2 (and 14CO2) intake by biota or 14CO2 releases from soils as a result of saprophobic processes. Unfortunately, our determinations of atmospheric 14CO2 concentration are charged by great uncertainty given by volumetric determination of CO2 concentration.

To calculate more precise course of 14C02 activity amount in the atmosphere, we utilized published data from station Schauinsland (D), where is measured 14CO2 activity and CO2 concentration contemporaneously.

It is evident, namely from annual mean values from Schauinsland, there is not visible decreasing trend beginning of 1994.

- If we suppose stable amount of air in the atmosphere, it implies relative stable amount of 14C atoms / 14CO2 molecules in the air.
- If the quantity of 14C atoms / 14CO2 molecules in the atmosphere is stable, decreasing activity of atmospheric 14C / 14CO2 can be explained by increasing global Suess effect with only small/negligible influence from decreasing amount of bomb 14C.
- If we suppose stable intake of 14C into atmosphere from natural and anthropogenic sources, stable 14C quantity implies stable 14CO2 removal from the atmosphere (as a tracer of CO2), without any accumulation effect. At such case, increasing concentration of CO2 seems to be namely caused by increasing anthropogenic releases.

References

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- CDFAC http://cdiac.ornl.gov

Chaunusland, annual mean values of 14CO2 activity concentration, mBq.m⁻³