Radiocarbon - a unique tool for modern carbon cycle research

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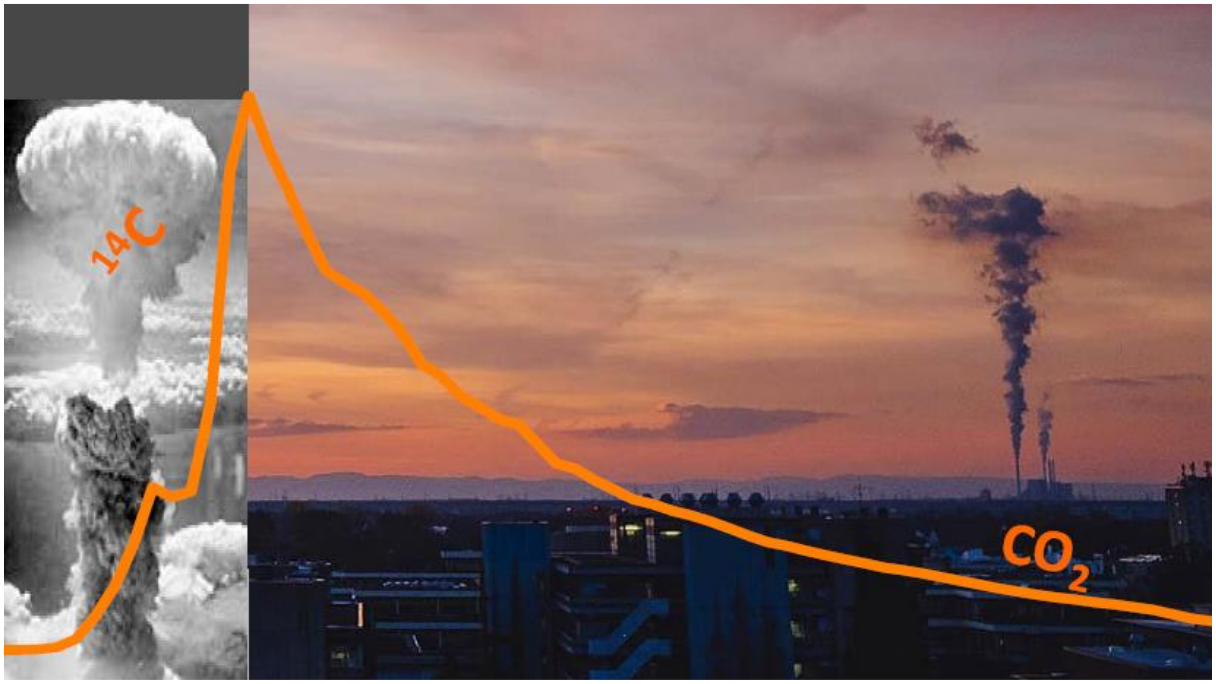

Atmospheric nuclear weapon testing during the cold war in the 1950s and 1960s has been worrying, though including a unique beneficial aspect in the area of environmental sciences. The artificial nuclear production of more than 6 x 10^{28} atoms or about 1.4 tons of ^{14}C led to a doubling of the $^{14}C/C$ ratio in tropospheric CO_2 of the Northern Hemisphere. The prominent so-called bomb spike peaking in 1963 can be used as transient tracer to understand carbon dynamics in the Earth System. This information is indispensable to estimate the residence times of carbon in ocean and biosphere reservoirs. Knowing these residence times is key to model the fate of man-made CO_2 emissions from burning of fossil fuels and land-use changes. Today, the transient bomb-radiocarbon signal has levelled-off in most carbon compartments and the anthropogenic input of ^{14}C-free fossil fuel CO_2 dominates the decreasing trend of the $^{14}C/C$ ratio in tropospheric CO_2. On the regional scale, the lack of ^{14}C in fossil fuel CO_2 emissions uniquely marks this anthropogenic CO_2 component, therewith allowing a so-called top-down verification of fossil CO_2 emissions and their changes. I will present some prominent examples where the ^{14}C bomb spike is successfully used to unravel dynamic processes in the carbon cycle and introduce our activities as Central Radiocarbon Laboratory in the recently established Integrated Carbon Observation System Research Infrastructure (ICOS RI).