

EGU21-4268

<https://doi.org/10.5194/egusphere-egu21-4268>

EGU General Assembly 2021

© Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.



Radiocarbon in modern carbon cycle research

Ingeborg Levin

Heidelberg University, Institut für Umweltphysik, Dept. of Physics, Heidelberg, Germany (ingeborg.levin@iup.uni-heidelberg.de)

Atmospheric nuclear weapon testing in the 1950s and 1960s has been worrying, however, in many aspects it was extremely beneficial for environmental sciences. The artificial production of more than 6×10^{28} atoms or about 0.6 tons of radiocarbon (^{14}C), leading to a doubling of the $^{14}\text{C}/\text{C}$ ratio in tropospheric CO_2 of the Northern Hemisphere, has generated a prominent spike in 1963. This “bomb-spike” has been used as transient tracer in all compartments of the carbon cycle, but also to study atmospheric dynamics, such as inter-hemispheric and stratosphere-troposphere air mass exchange. Moreover, our attempt to accurately determine total bomb produced ^{14}C led to improved estimates of the atmosphere-ocean gas exchange rate and to a new constraint of the residence time of carbon in the terrestrial biosphere. Today, the transient bomb-radiocarbon signal has levelled off, and the anthropogenic input of radiocarbon-free fossil fuel CO_2 into the atmosphere has become the dominant driver of the $^{14}\text{C}/\text{C}$ ratio in global atmospheric CO_2 . The observed decreasing $^{14}\text{C}/\text{C}$ trend in atmospheric CO_2 may thus help scrutinising the total global release of fossil fuel CO_2 into the atmosphere. On the local and regional scale, atmospheric $^{14}\text{C}/\text{C}$ measurements are already routinely conducted to separate fossil fuel from biogenic CO_2 signals and to estimate trends of regional fossil fuel CO_2 emissions. Some prominent examples where the bomb $^{14}\text{CO}_2$ disturbance has been successfully used to study dynamic processes in the carbon cycle are discussed as well as our current activities applying this unique isotope tracer for continental scale carbon cycle budgeting.