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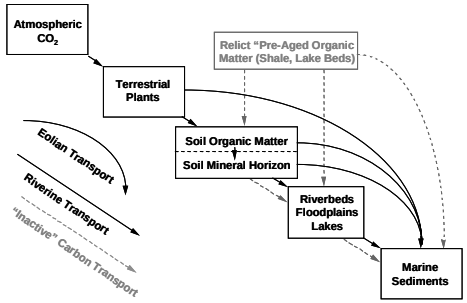
The Impact of Land Use Change on the Carbon Flux to the World's Oceans

Overview

This research aims to quantify the amount of time different reservoirs of organic matter (OM) spend on the continents before delivery to the global oceans, and how this 'residence time' is modified by changes in land use, such as urbanization and cultivation.

Figure 1 – The terrestrial component of the global carbon cycle.



Research Approach

All OM on land and in the oceans is originally biosynthesized from atmospheric CO_2 with a known concentration of radiocarbon ($\Delta^{14}C$). Direct ^{14}C dating of terrestrial OM components in recent marine sediments thus provides a direct metric of the total OM residence time on the continents.

Impacts

This research will establish whether the delivery of carbon from the continents to the oceans, which modifies the CO_2 content of the atmosphere and aids the development of coastal eutrophication, is being accelerated by human activity.

Figure 2 – The ^{14}C content (expressed as $\Delta^{14}C$) of various OM sources delivered to the oceans before (A) and after (B) atmospheric nuclear weapons testing.

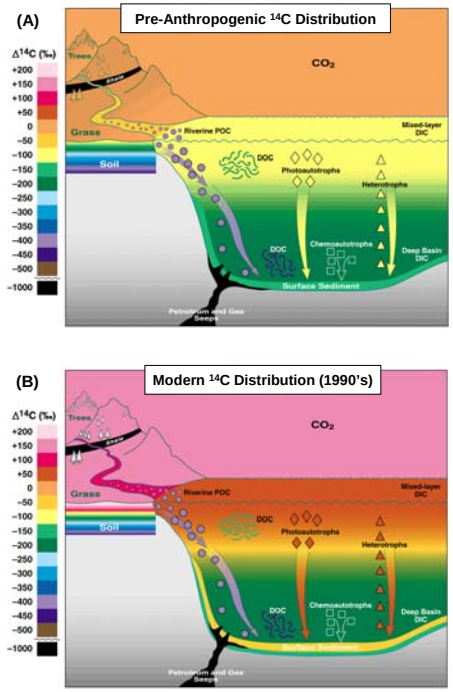
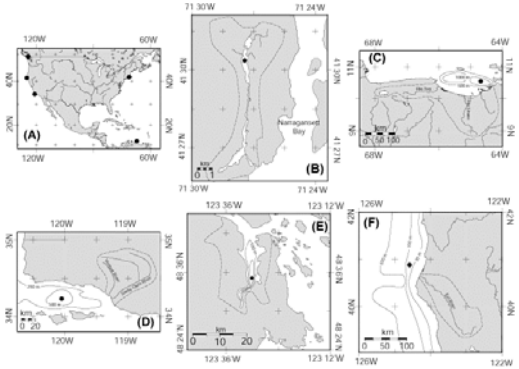
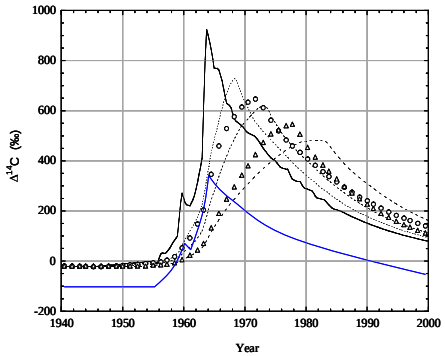


Figure 3 – The geographic distribution of study sites (A), Pettaquamscutt River (B), Cariaco Basin (C), Santa Barbara Basin (D), Saanich Inlet (E), and Eel River (F).





Highlights

Continuously depositing sediments can be used to construct a quantitative record of how this residence time has varied in the past by comparing the terrestrial OM and atmospheric ^{14}C profiles within a model of the carbon cycle. Moreover, measuring residence times at an array of study sites provides an opportunity to correlate these estimates with extant environmental parameters such as urbanization, deforestation, and precipitation patterns, as well as drainage basin size and topography.

Figure 5 – Profiles of total OM $\Delta^{14}C$ and ^{137}Cs (an independent dating tool) in a sediment core from the Eel River Margin.

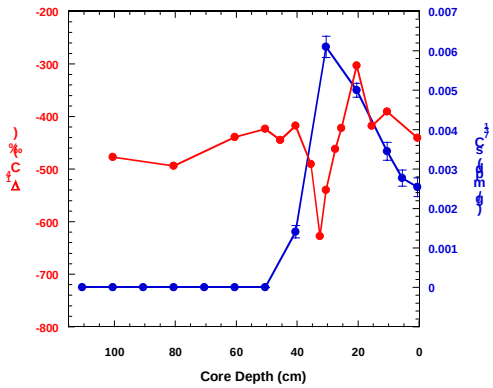


Figure 4 – Atmospheric ^{14}C record (black line) as well as model results for 5 (dot), 10 (dash), and 20 (strike) year residence time systems at steady state, and increasing (5 to 15 yr; circle) & decreasing (20 to 10 yr; triangle) non-steady state systems. The effect of adding 50% 1500 year old OM to a modern pool is shown in blue.

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