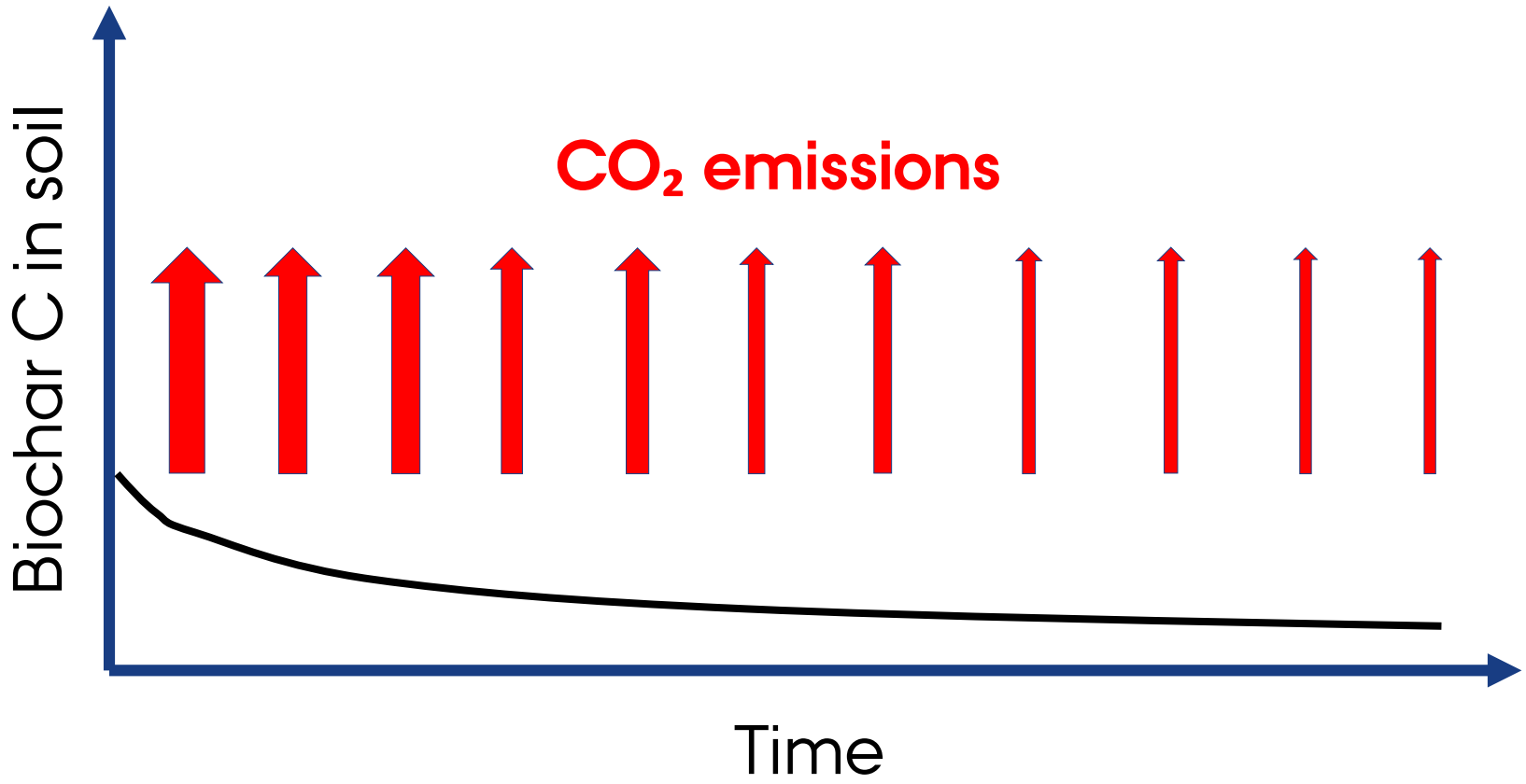
An example of *avoided atmospheric CO_2 load* calculation



Degradation of organic material is believed to follow the exponential formula:

$$RC(t) = Cexp(-kt)$$

where R*C* is the remaining C, C is the C content, *k* is the mineralization rate (1/MRT (which is *mean residence time*)), and t is time.

We agree to this!

However, although this is a good way to estimate the remaining C in the soil subsequent to incorporation of organic material, we believe that it does not reflect the impact on the climate in an optimal way.

This is due to the *temporal dynamics* of CO_2 emissions to the atmosphere.

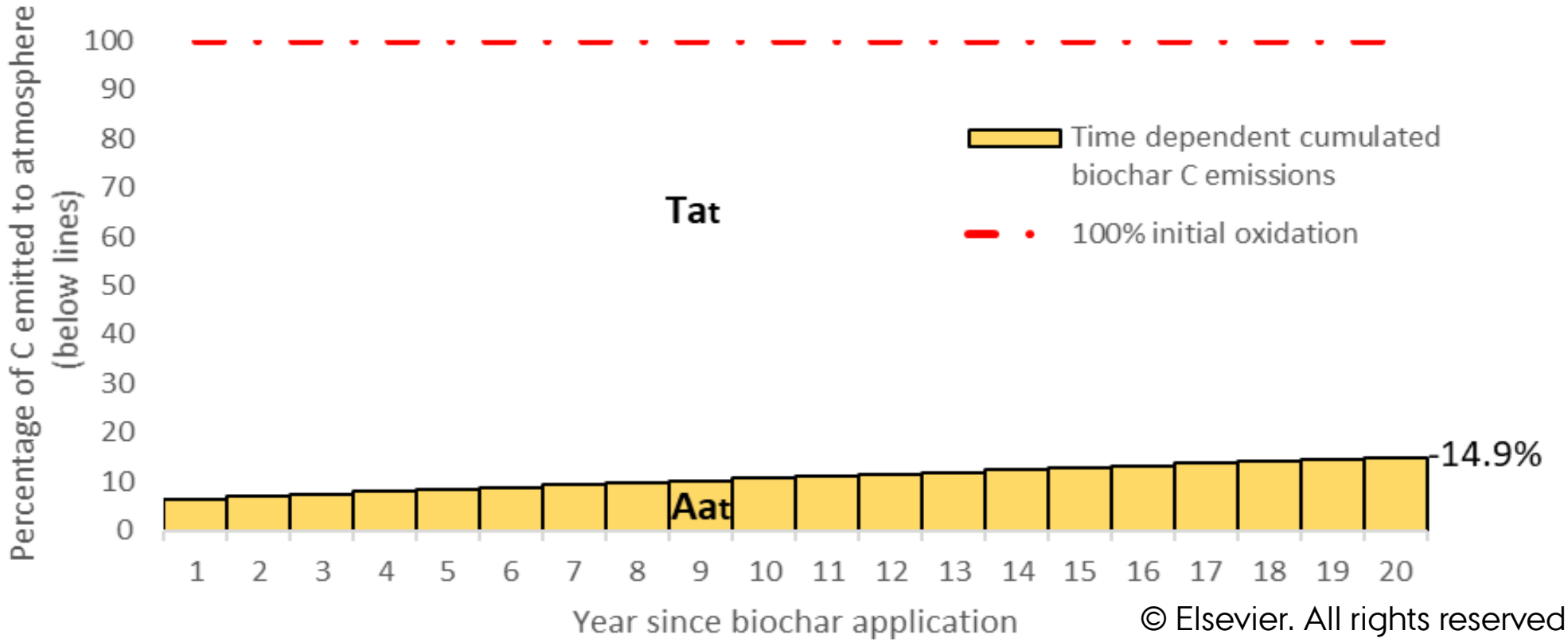
Example: Degradation and avoided atmospheric CO_2 load for a two-pool biochar (Thers et al., 2019)

The biochar is assumed to have fractions of 6% labile C and 94% recalcitrant C. Mean residence time (MRT) is 0 for the labile fraction and 200 years for the recalcitrant fraction. In a 20 years time perspective, this equals:

$$RC(20) = 0.94exp(-0.005*20) = 0.851$$

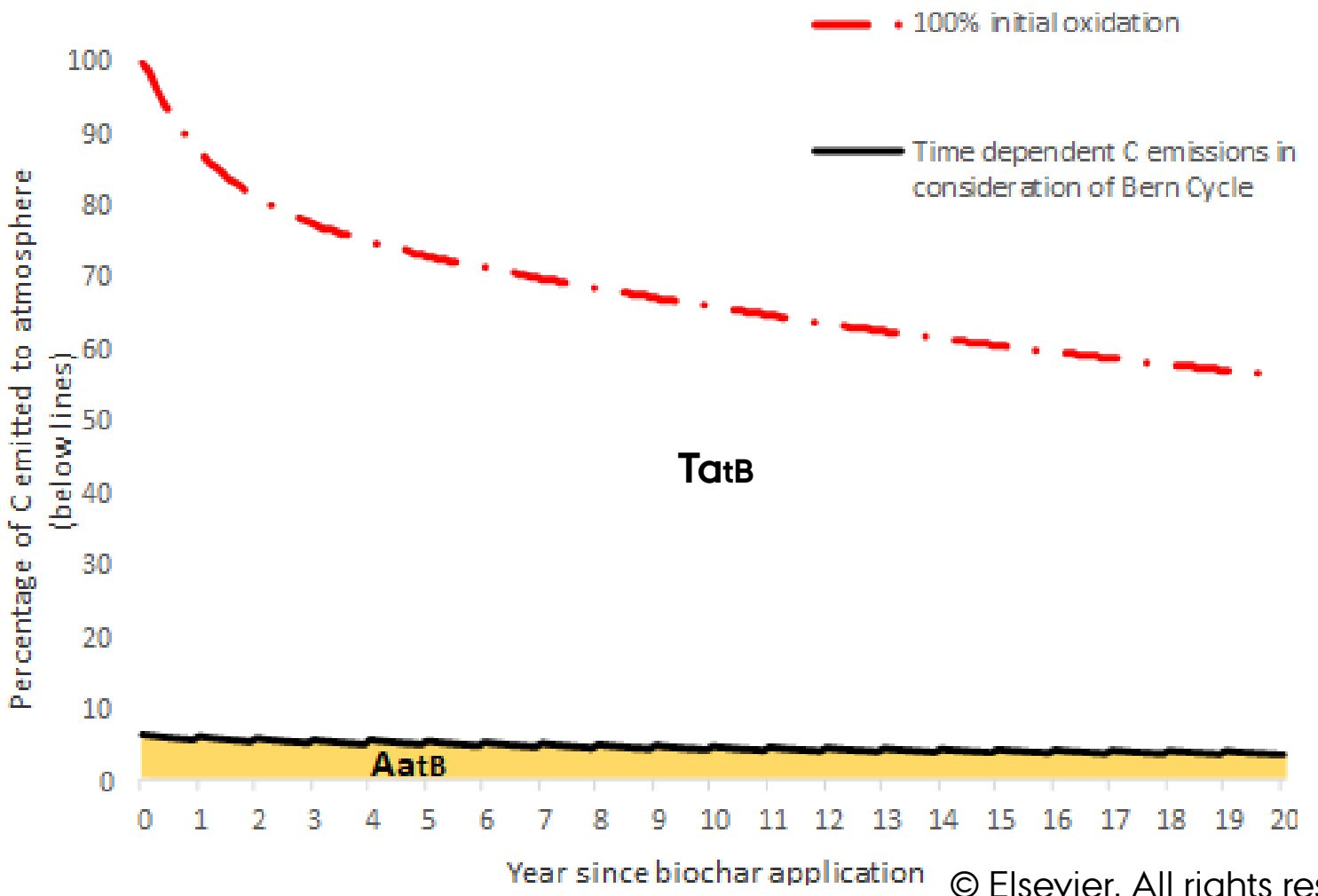
Which means that 85.1% of the C remains in the soil after 20 years

To include the temporal aspect, we calculate integrals of: (1) An initial 100% oxidation of the C (Tat), and (2) the cumulative emissions quantified each year (Aat).



The yellow area comprises the proportional impact to climate as compared to a 100% initial oxidation; in this case 10.0% ((2000/200.5)*100), reflecting a C sequestration of 90%.

The emissions shown in the previous slide is now combined with the Bern cycle, thereby getting the avoided atmospheric CO_2 load of 88.9%. {(AatB/TatB)*100 equals (1358.5/150.8)*100)}.



The C sequestration calculated by the simple (traditional) way resulted in a C sequestration of 85.1% of applied C in a 20 years perspective. Using the concept of avoided atmospheric C load results in a C sequestration of 88.9% of applied C.

Reference

Thers, H., Djomo, S.N., Elsgaard, L., Knudsen, M.T., 2019. Biochar potentially mitigates greenhouse gas emissions from cultivation of oilseed rape for biodiesel. Science of the Total Environment. 671, 180–188. doi:10.1016/j.scitotenv.2019.03.257

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