

**Carbon sinks and biofuels:
Optimal greenhouse mitigation
strategies with inclusion of feedback
effects of the global carbon cycle.**

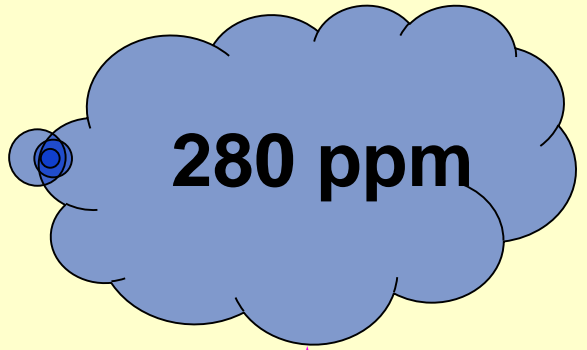
Miko U.F. Kirschbaum

**CSIRO Forestry and Forest Products &
CRC for Greenhouse Accounting**

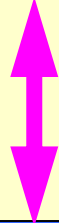
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Pre-industrially

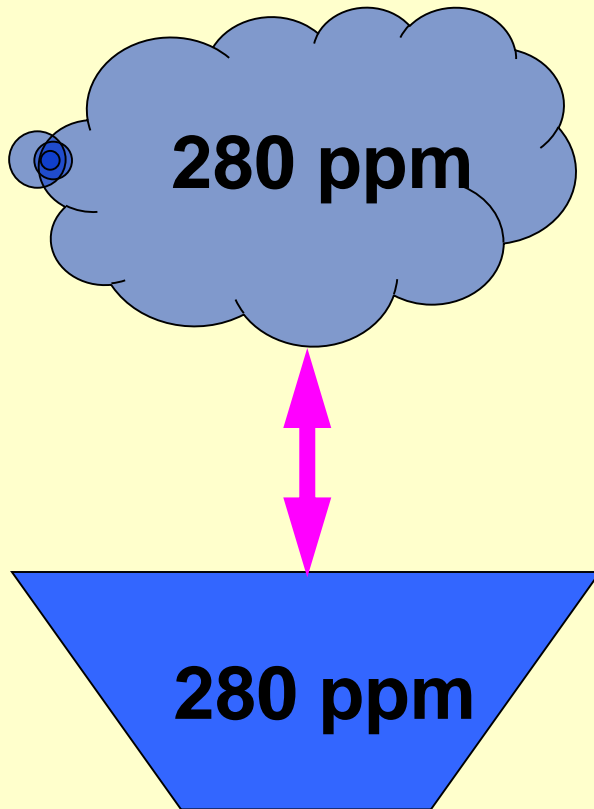


Atmosphere

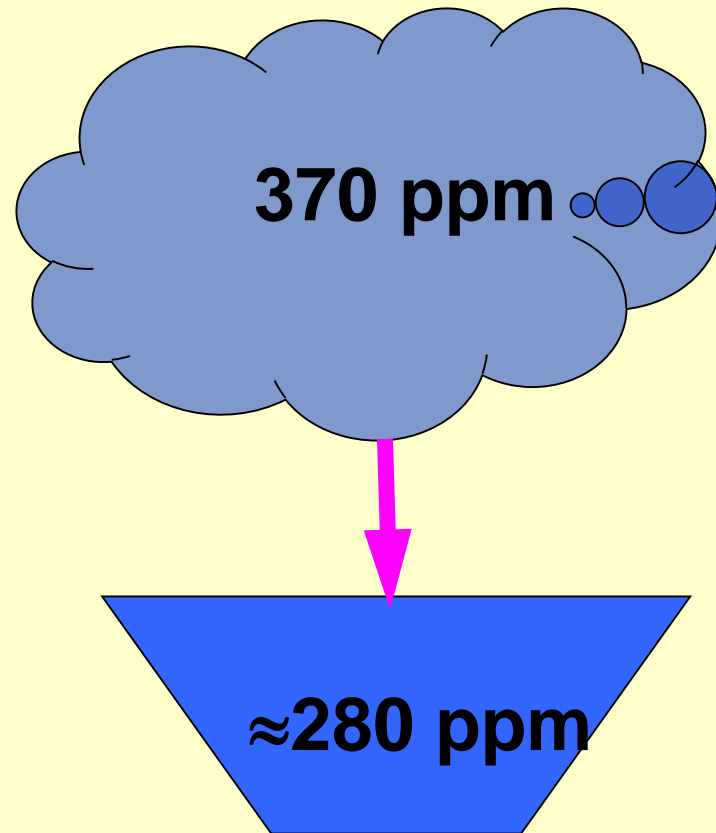


Oceans

Pre-industrially

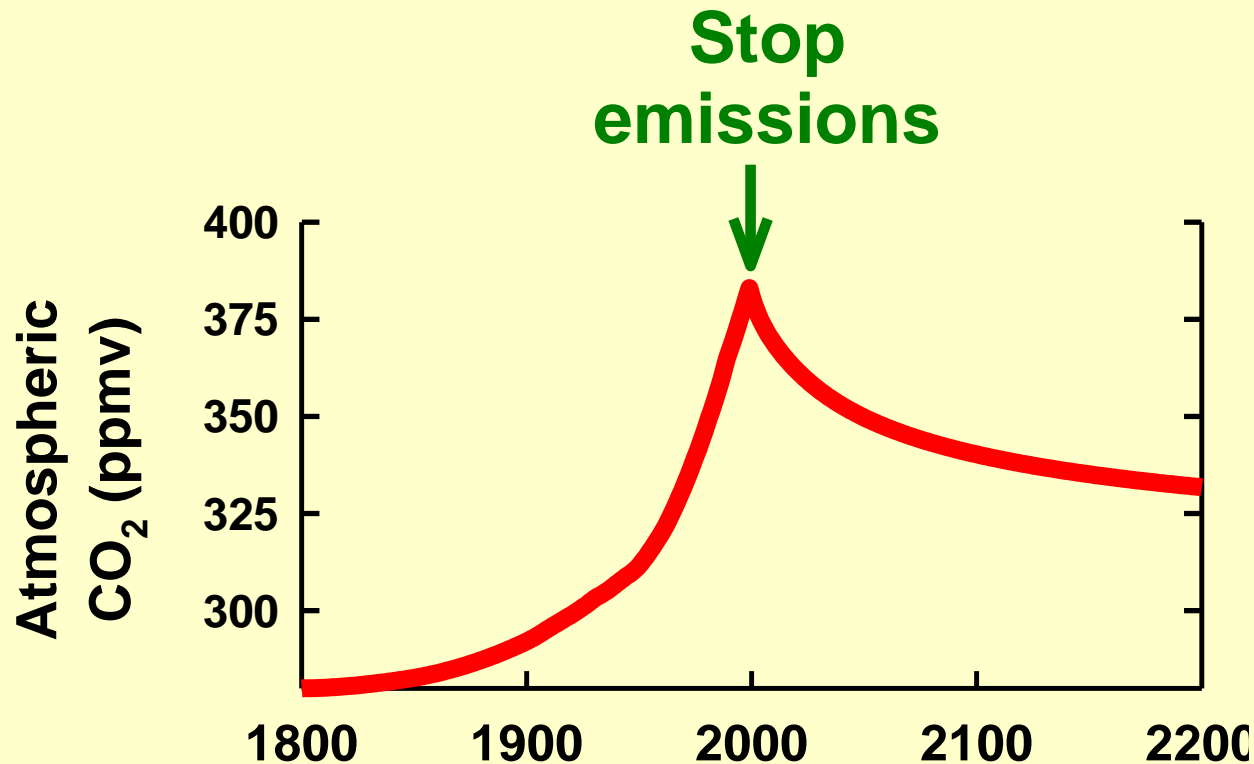


Currently

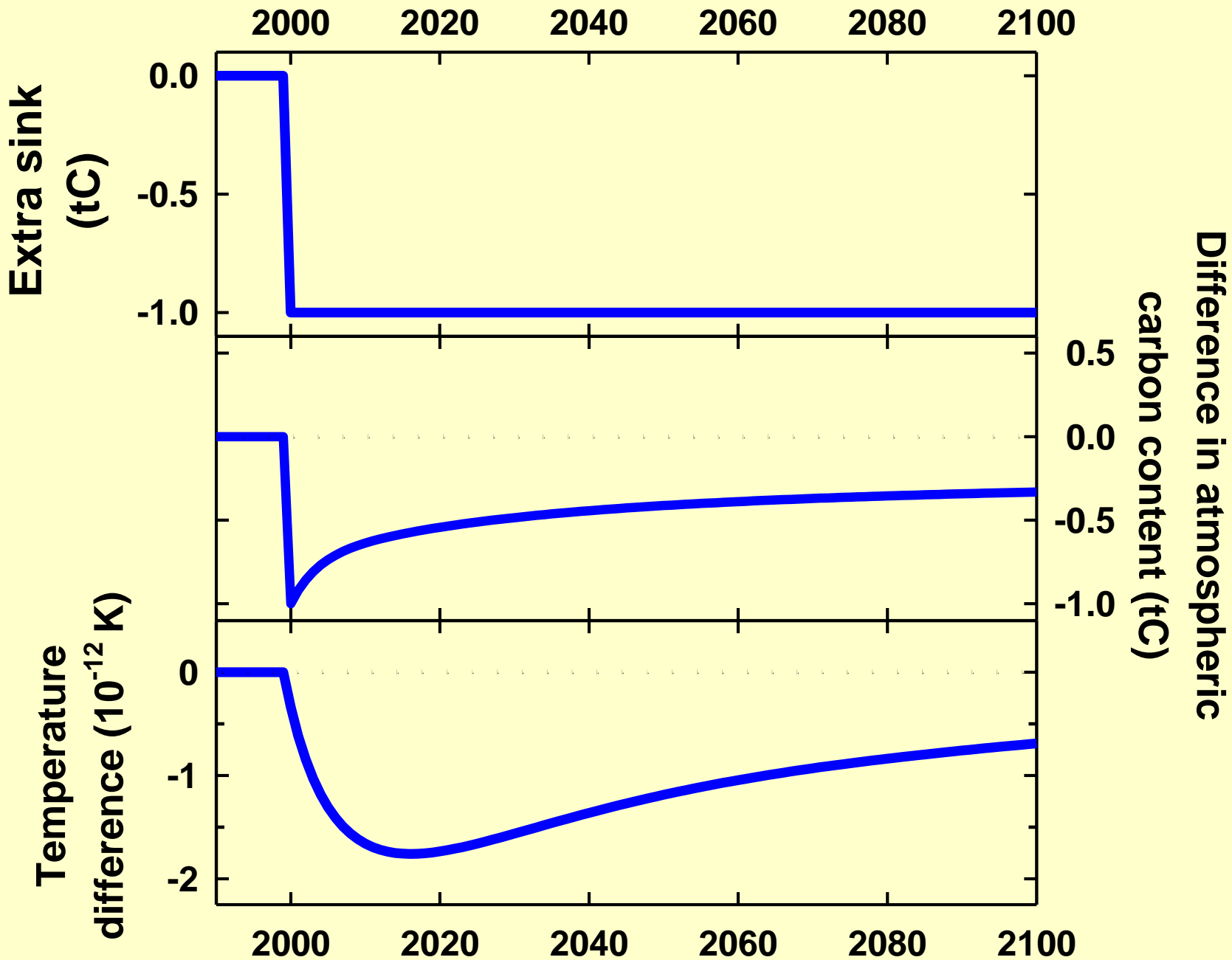


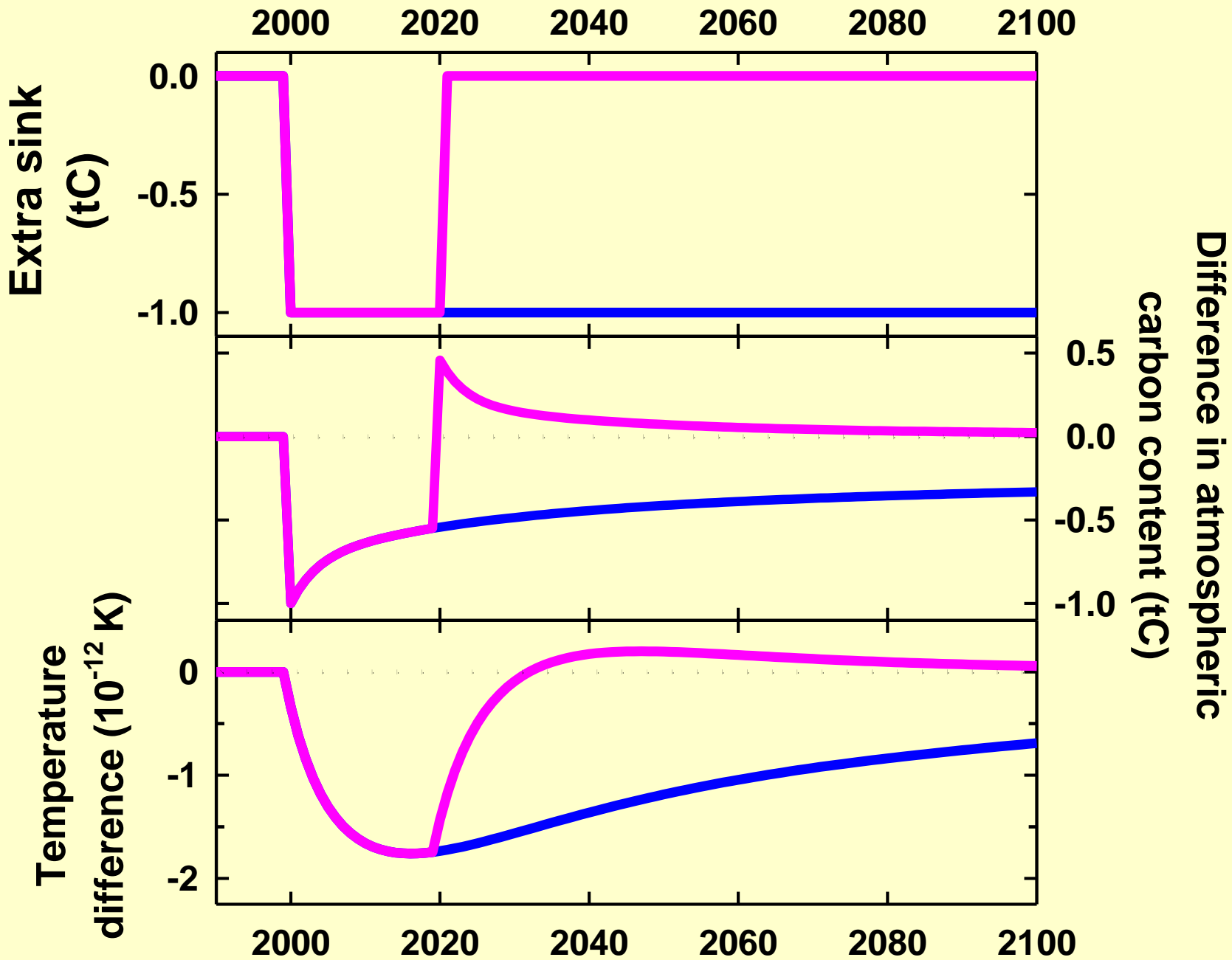
Various fractions of CO₂ in the atmosphere enter into pools with different turn-over times (shallow ocean, deep ocean, etc.).

About 18% remain permanently in the atmosphere.



Based on "Bern" model as given in IPCC (2000).





Which aspect of climate change impacts us most?

Instantaneous climatic conditions?

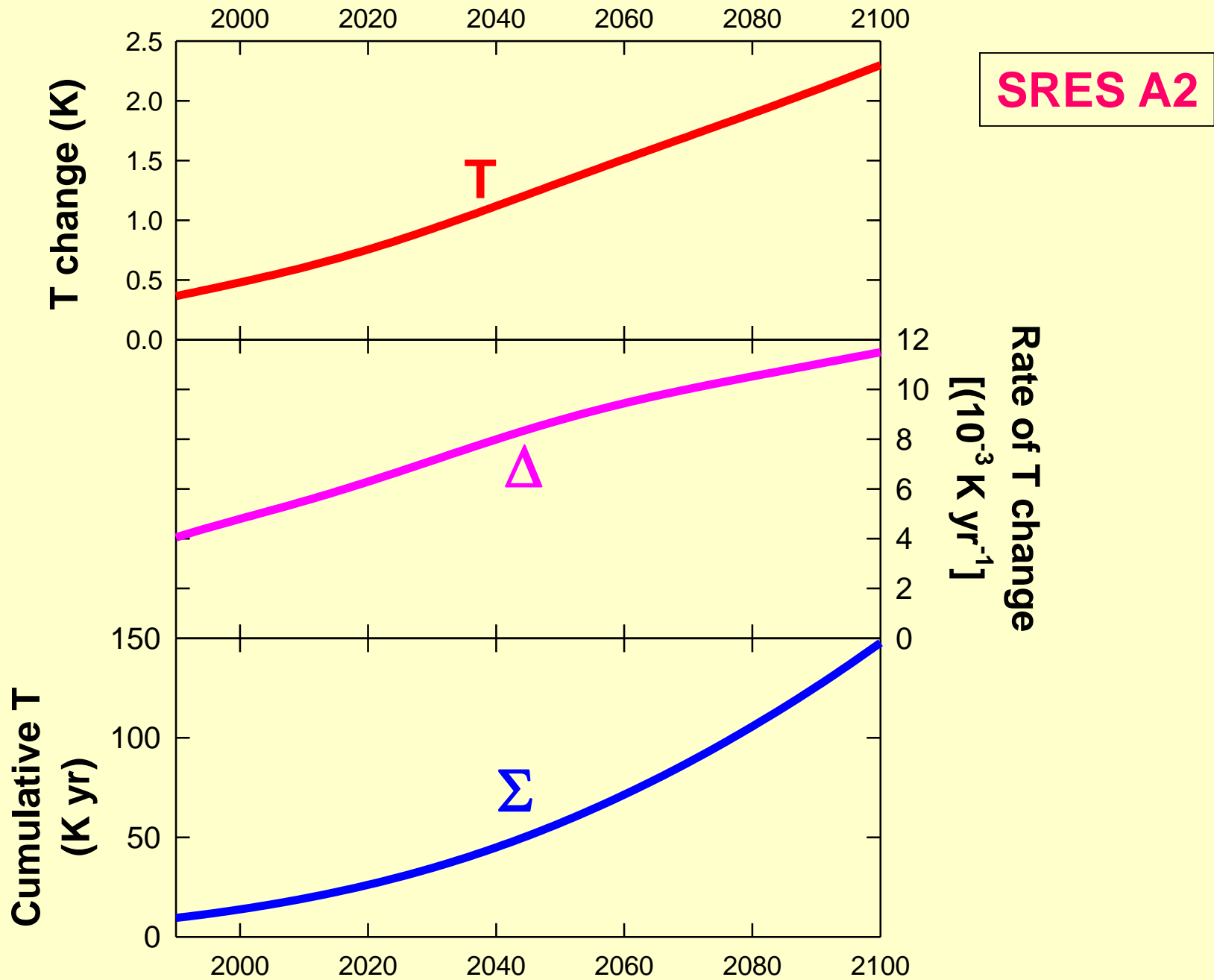
- Heat damage
- Severe weather
- Tropical diseases (e.g. malaria)
- Food production

Rate of climate change?

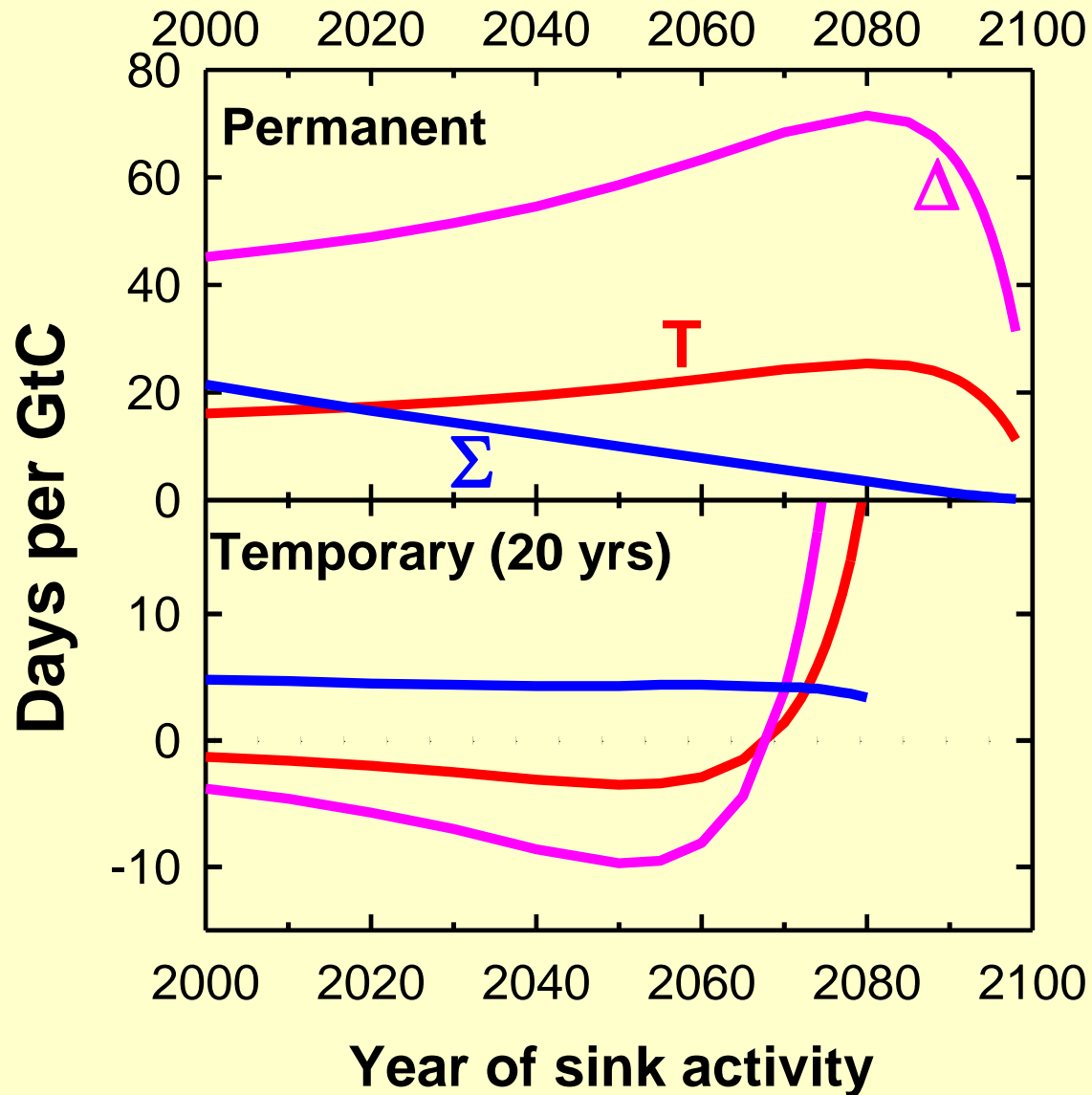
- Ecological mal-adaptation
- Socio-economic institutions

Cumulative climate change?

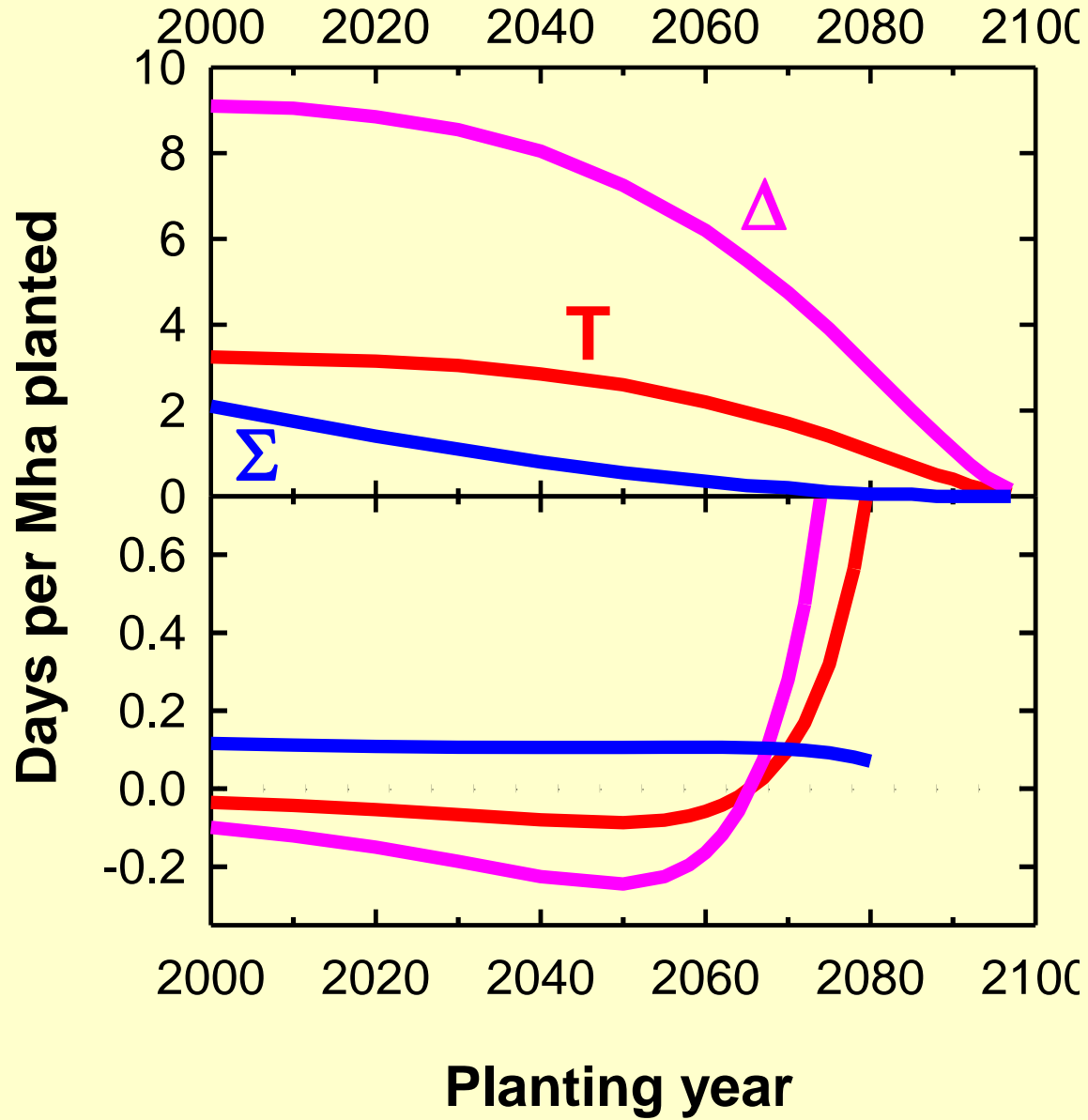
- Sea level rise



Time 'bought' by sinks

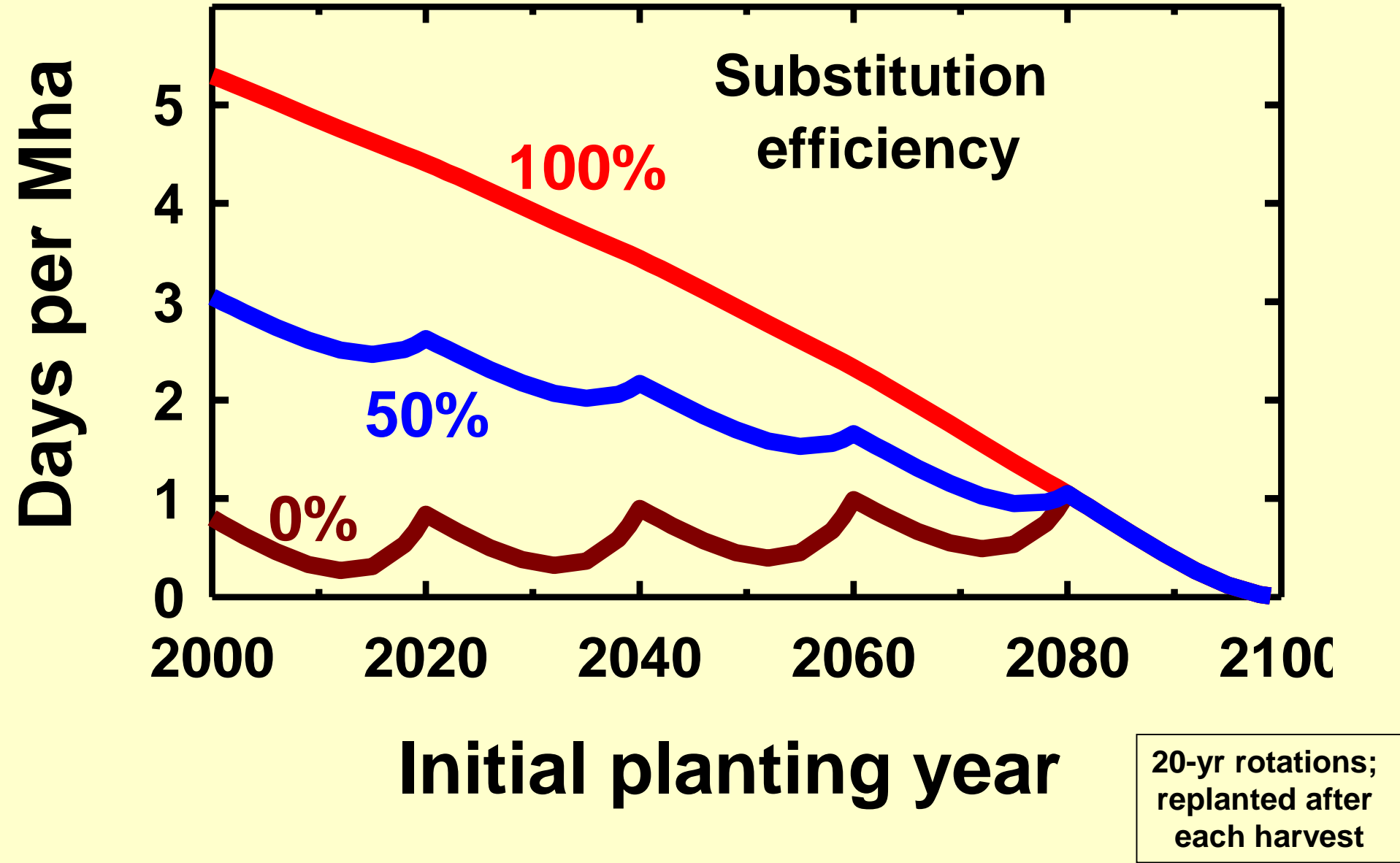


Time 'bought' by planted forests

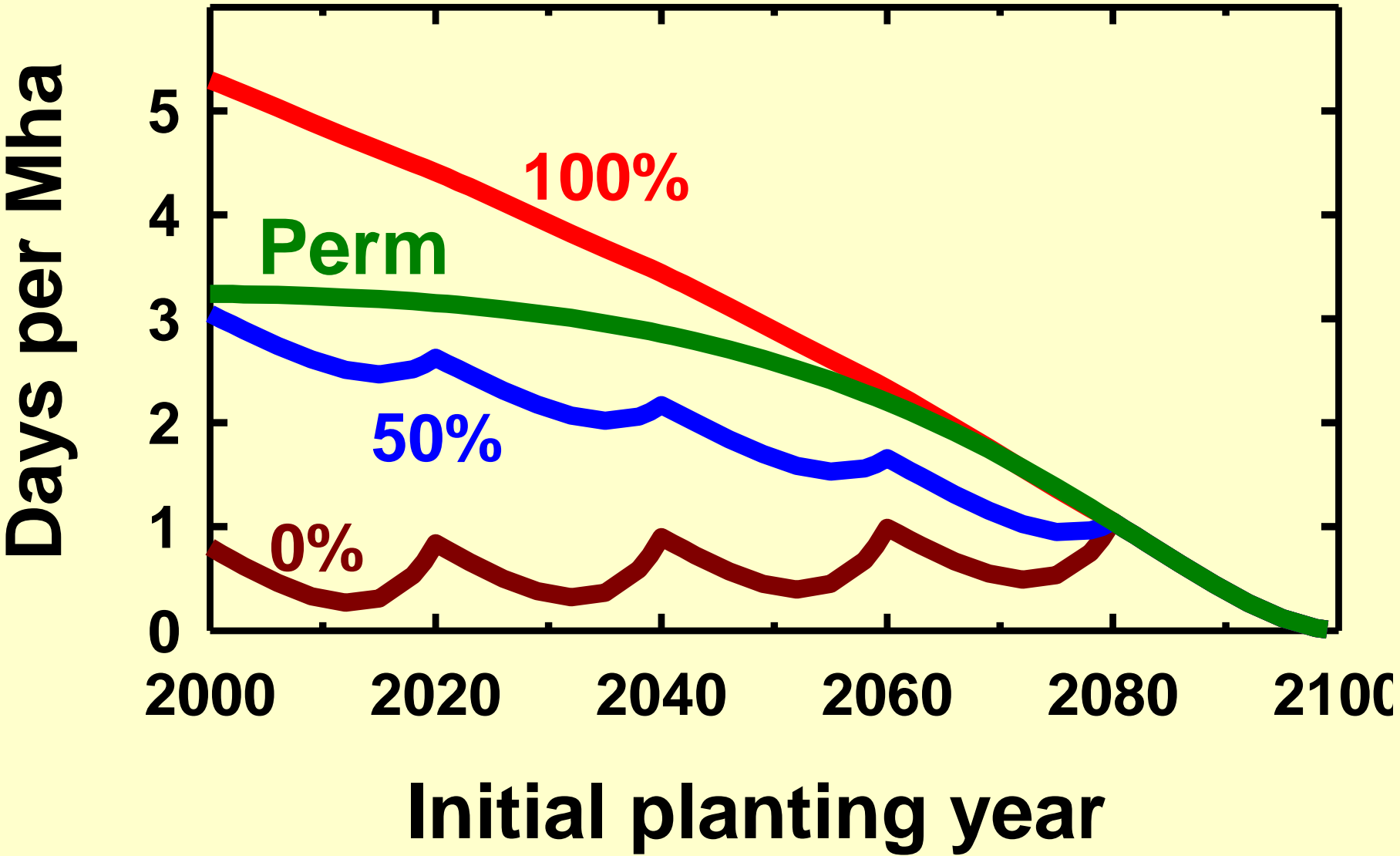


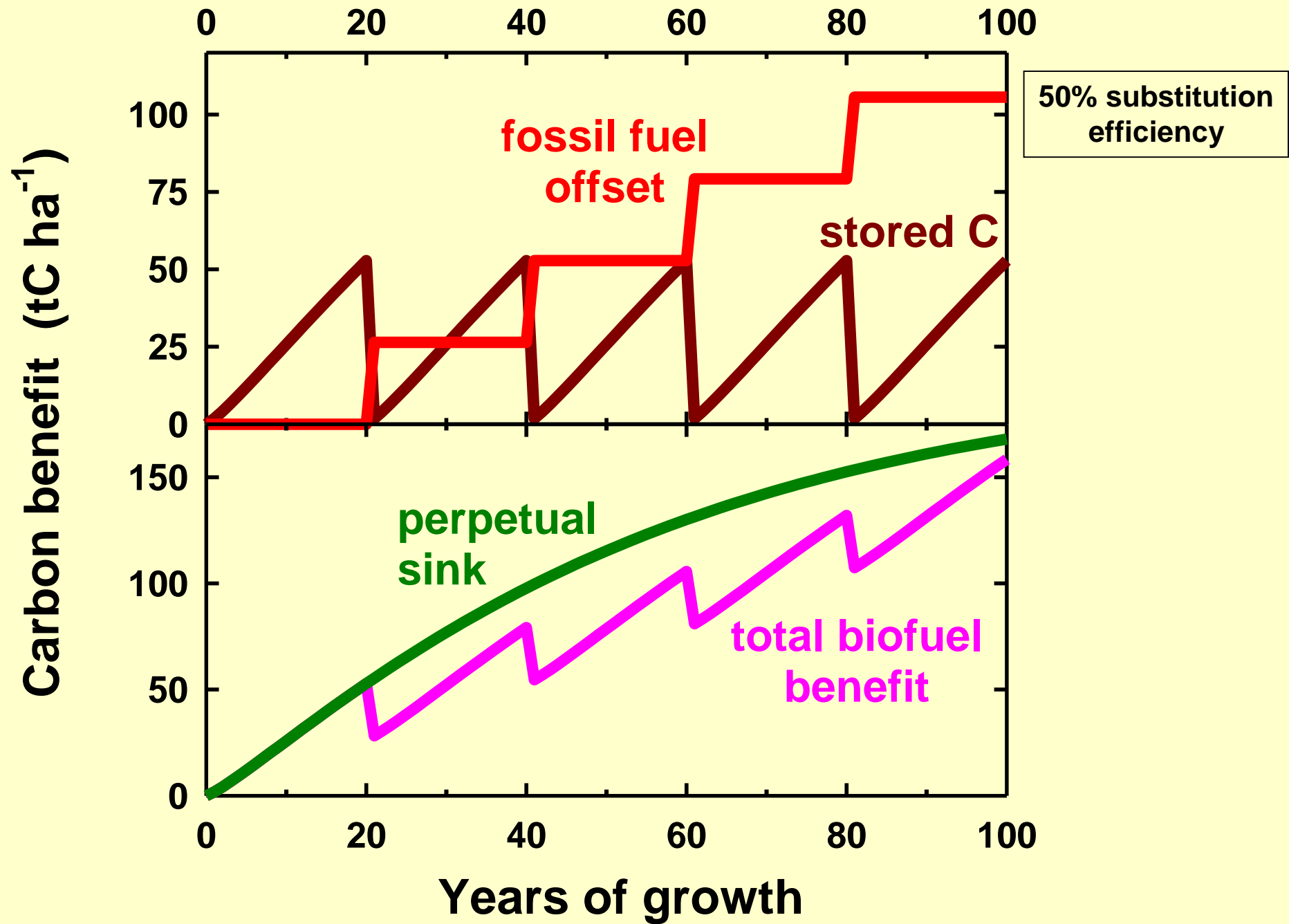
Instantaneous
impacts only

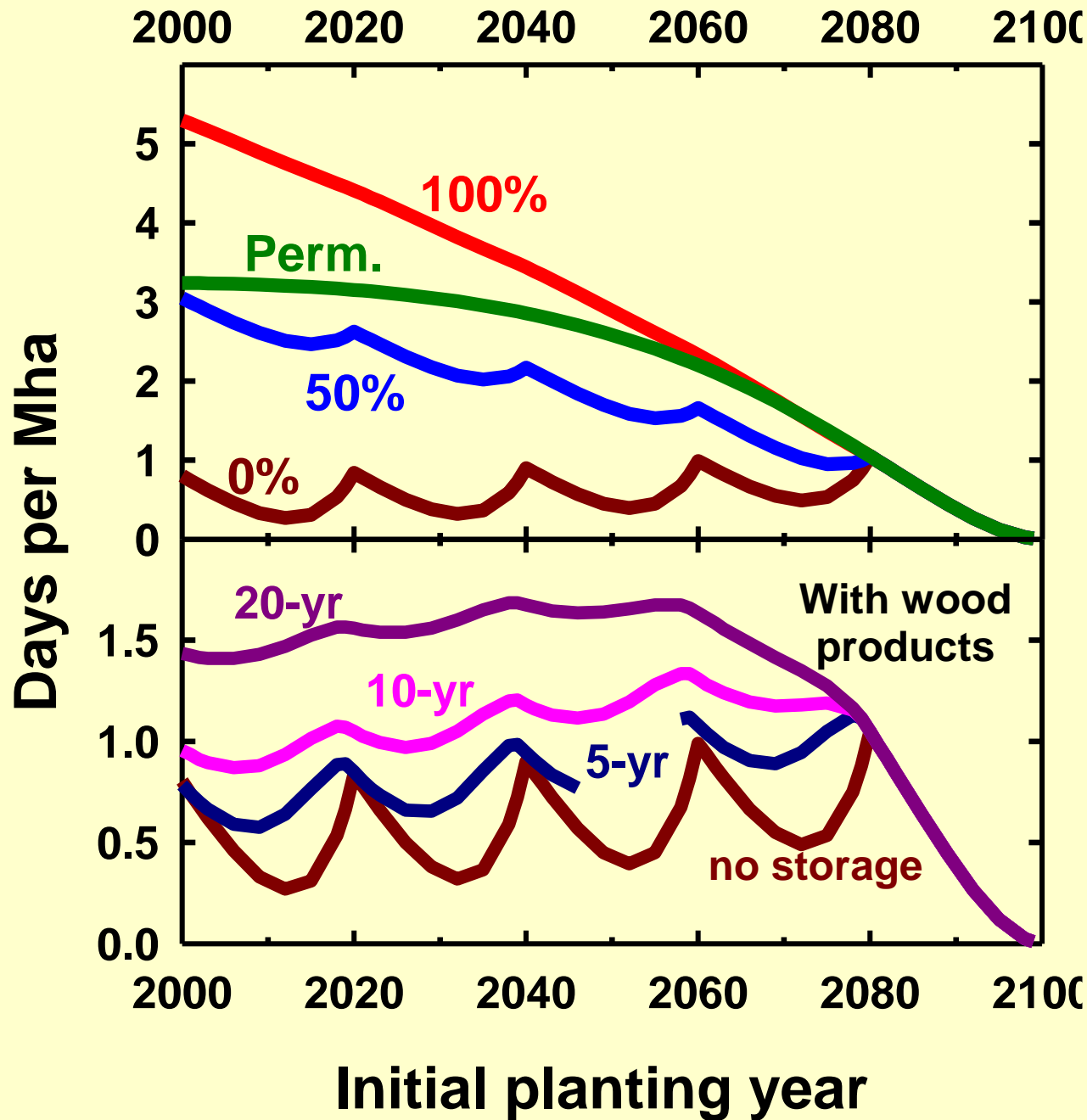
Biofuels



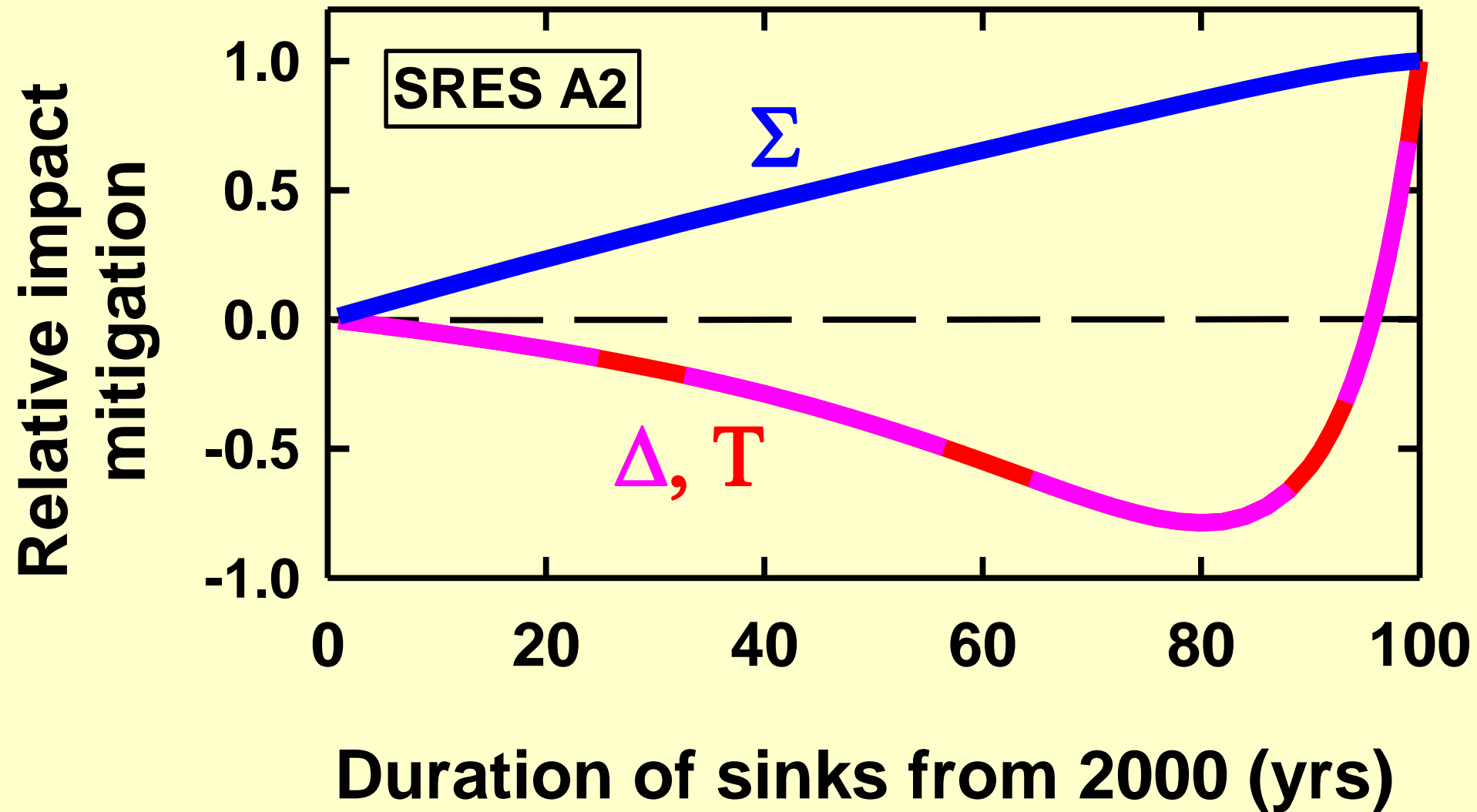
Biofuels and permanent sinks



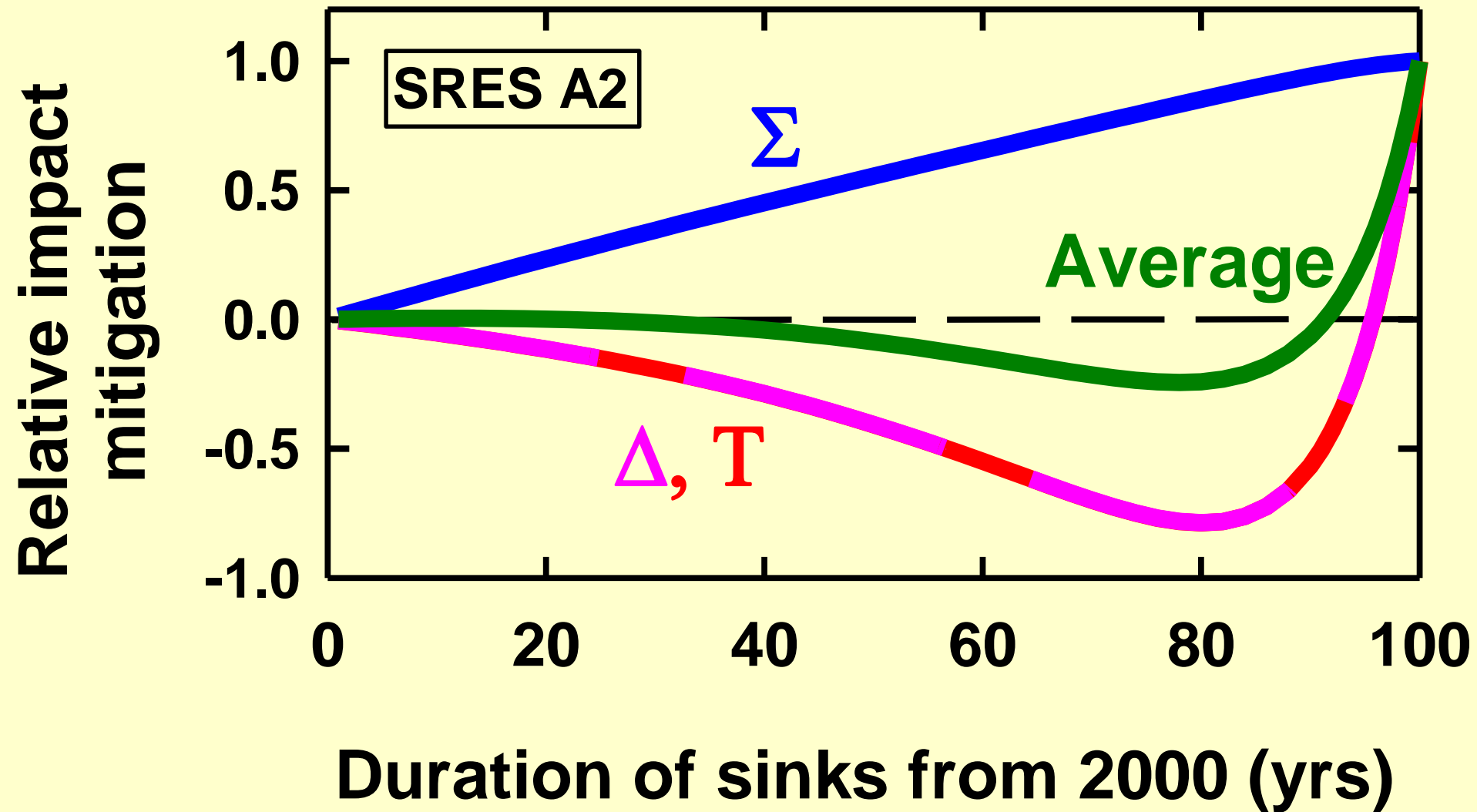




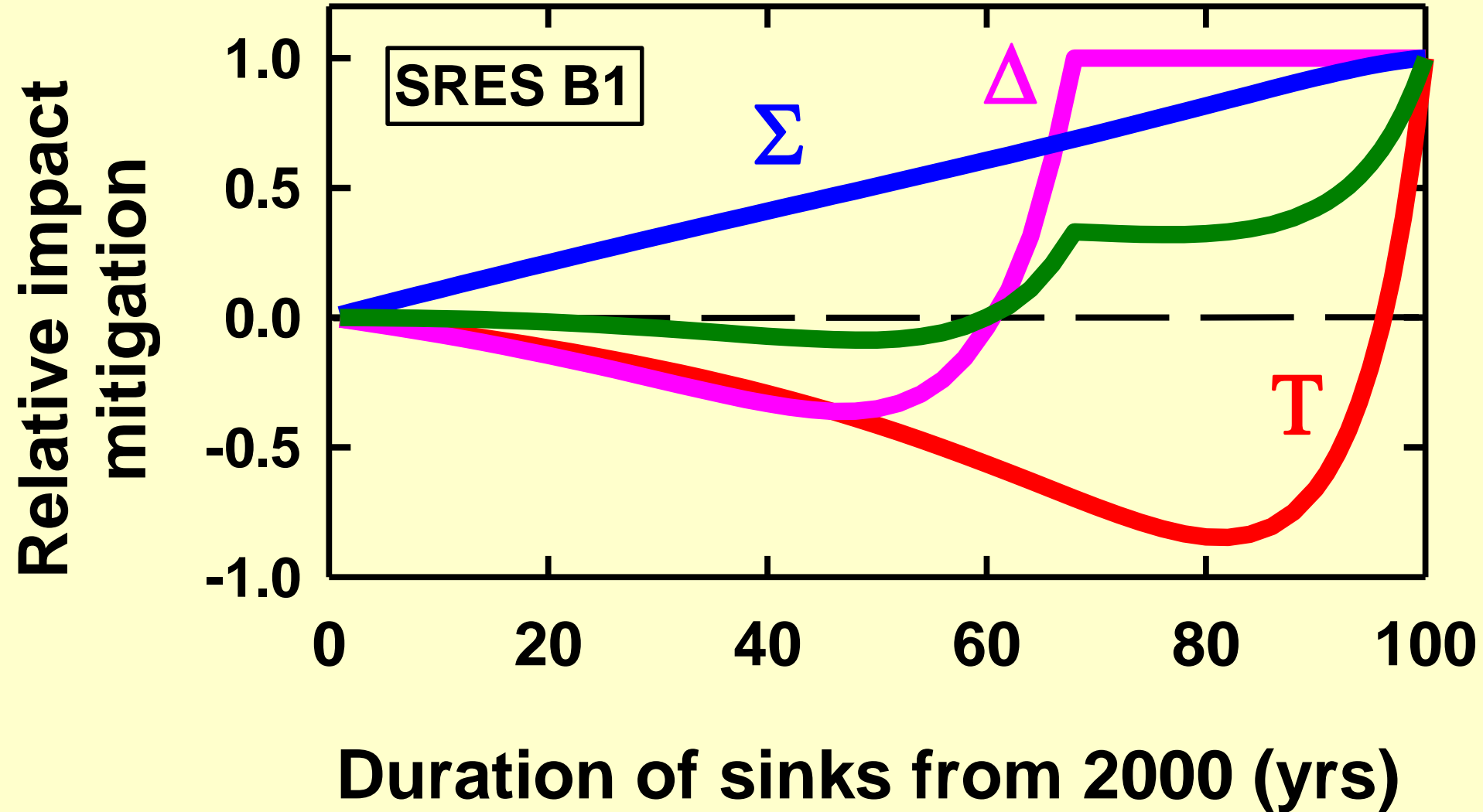
“Business-as-usual” scenario



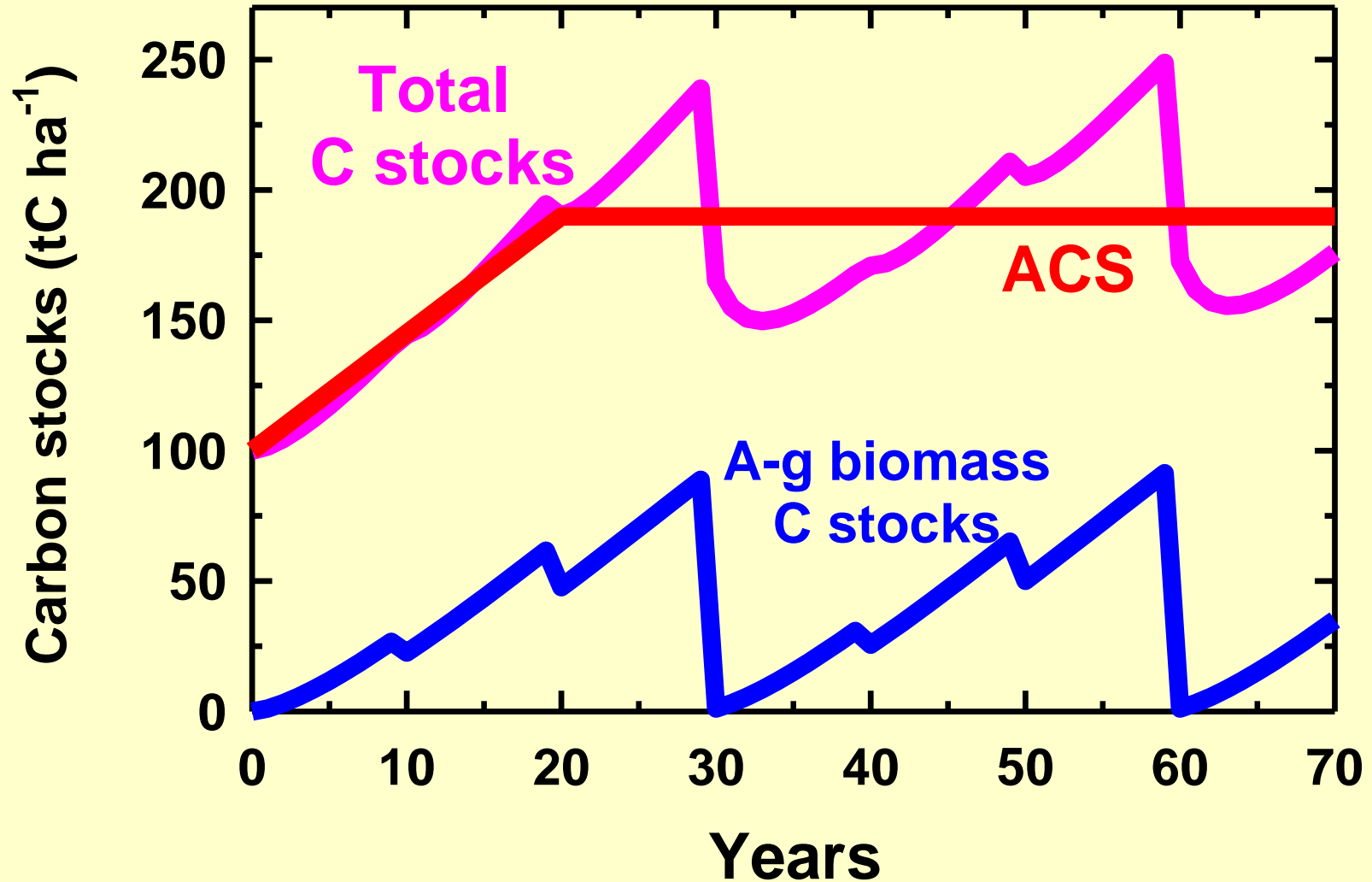
“Business-as-usual” scenario



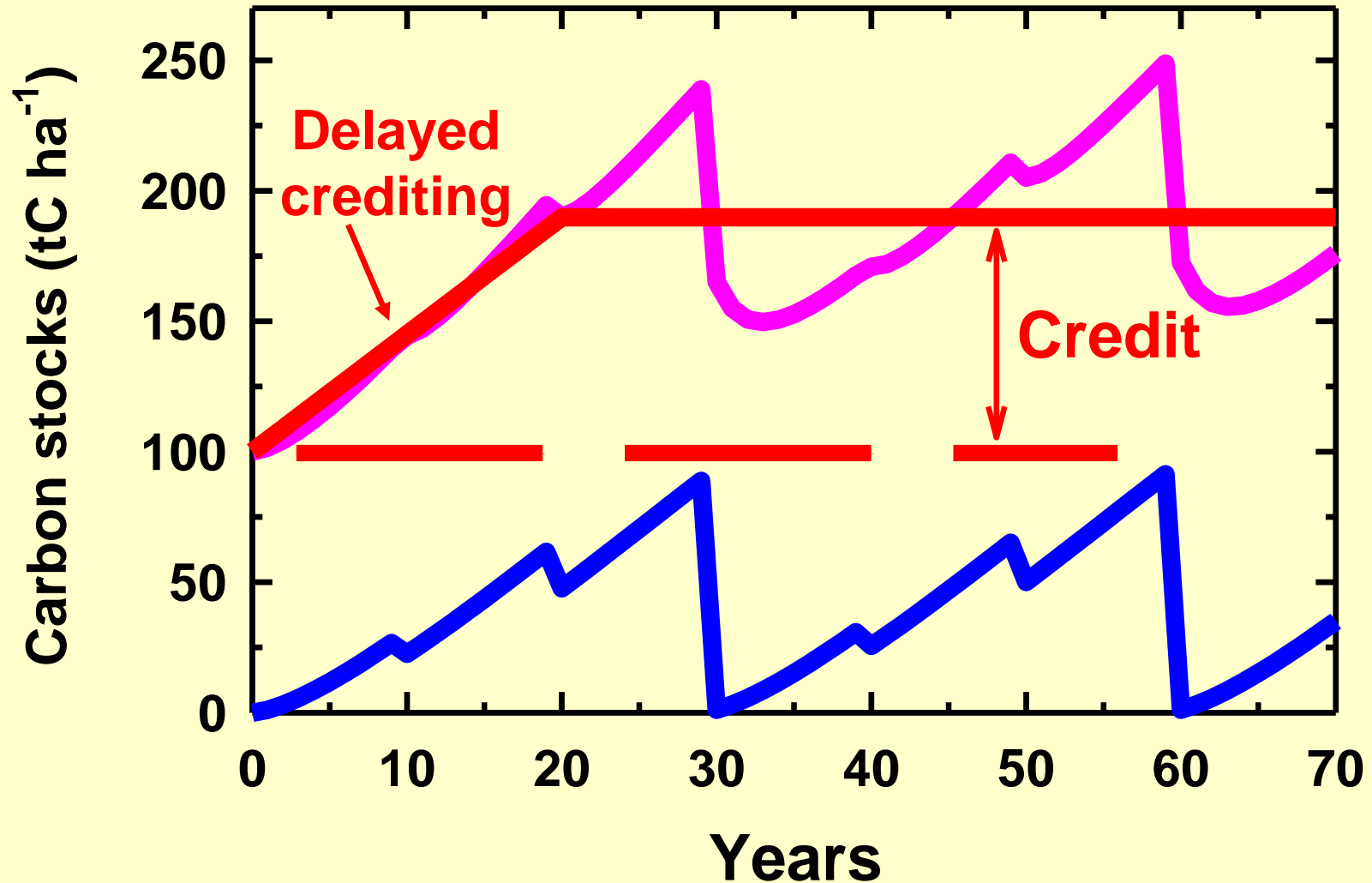
“Sustainable” scenario



Average Carbon Stock accounting



Average Carbon Stock accounting



Conclusions (1)

- **Permanent carbon storage in vegetation sinks can make a small, but useful contribution.**
- **Temporary storage is much less valuable than permanent storage, or not valuable at all.**

Conclusions (2)

- **The best timing of tree planting depends on the nature of climate change impacts:**

Plant now if cumulative impacts are main concern;

Otherwise, later planting may be better (but that also depends on growth rate).

Conclusions (3)

- **Biofuels can make on-going contribution (similar to permanent).**
- **Climate-mitigation policy needs to ensure permanent storage (not tonne-year accounting).**

References:

- 1. Kirschbaum, M.U.F., Schlamadinger, B., Cannell, M.G.R., Hamburg, S.P., Karjalainen, T., Kurz, W.A., Prisley, S., Schulze, E.-D., and Singh, T.P. (2001): A generalised approach of accounting for biospheric carbon stock changes under the Kyoto Protocol. *Environmental Science and Policy* 4: 73-85.**
- 2. Kirschbaum, M.U.F. (2003). To sink or burn? A discussion of the potential contributions of forests to greenhouse gas balances through storing carbon or providing biofuels. *Biomass and Bioenergy* 24: 297-310.**
- 3. Kirschbaum, M.U.F. (2003). Can trees buy time? An assessment of the role of vegetation sinks as part of the global carbon cycle. *Climatic Change* 58: 47-71.**

Thank you!