CAN TREES BUY TIME?

AN UPDATE ON MIKO KIRSCHBAUM'S ORIGINAL WORK USING MAGICC7 / IPCC AR6

ANDY REISINGER

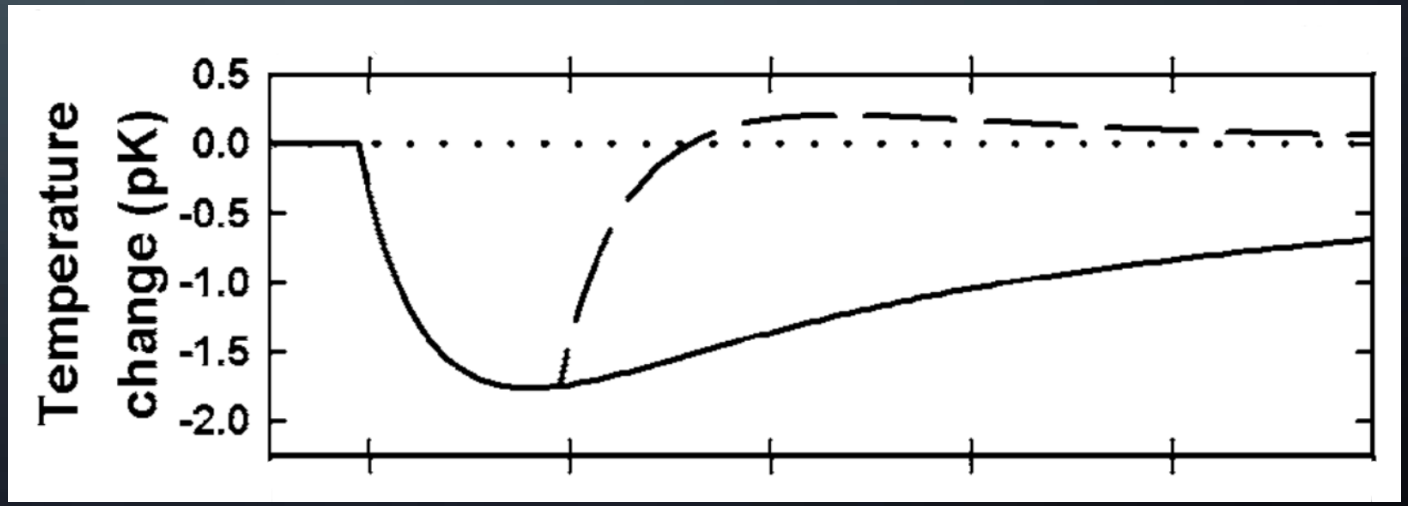
IEA BIOENERGY TASK 45

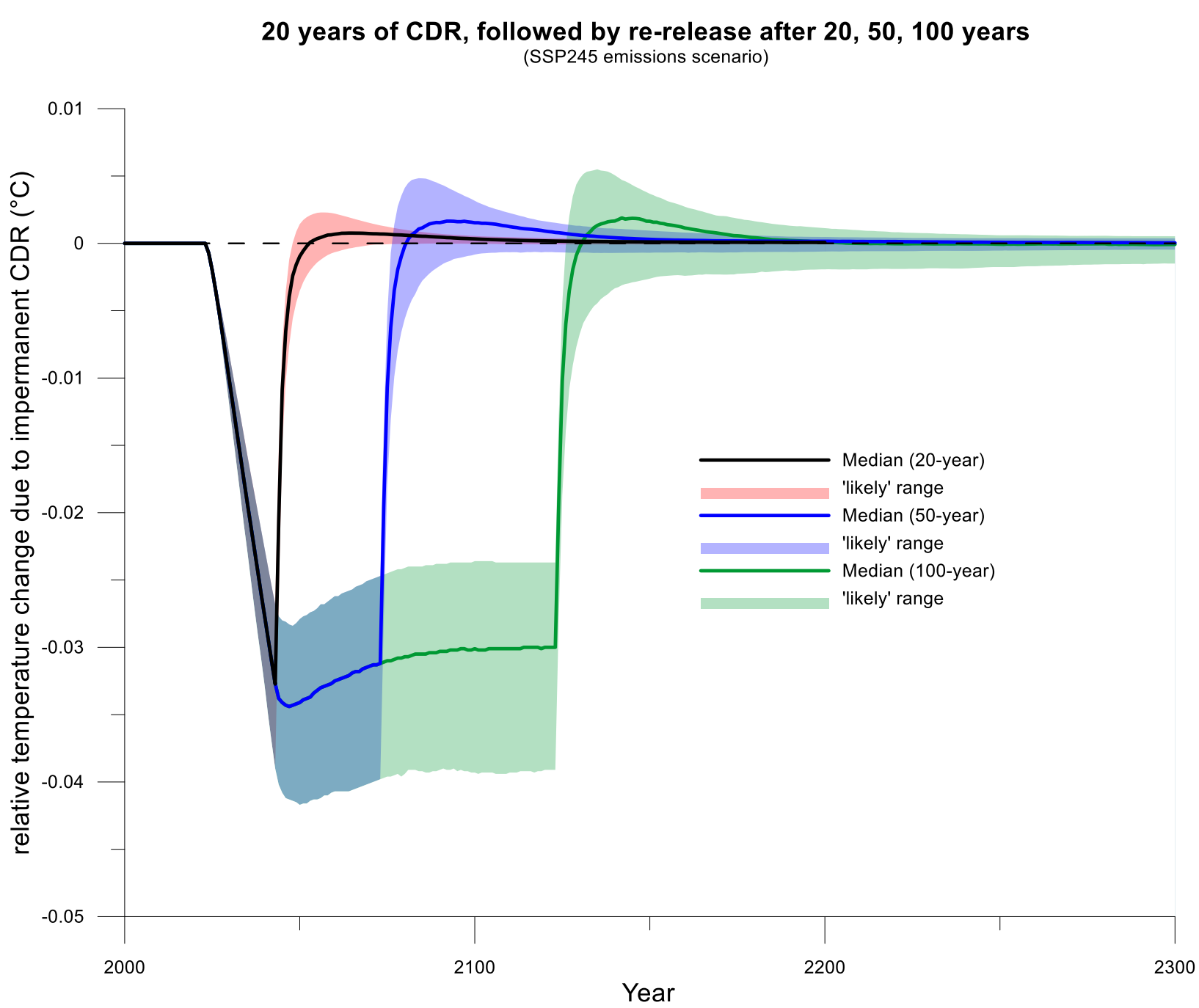
TEMPORARY CARBON STORAGE WORKSHOP SESSION 1

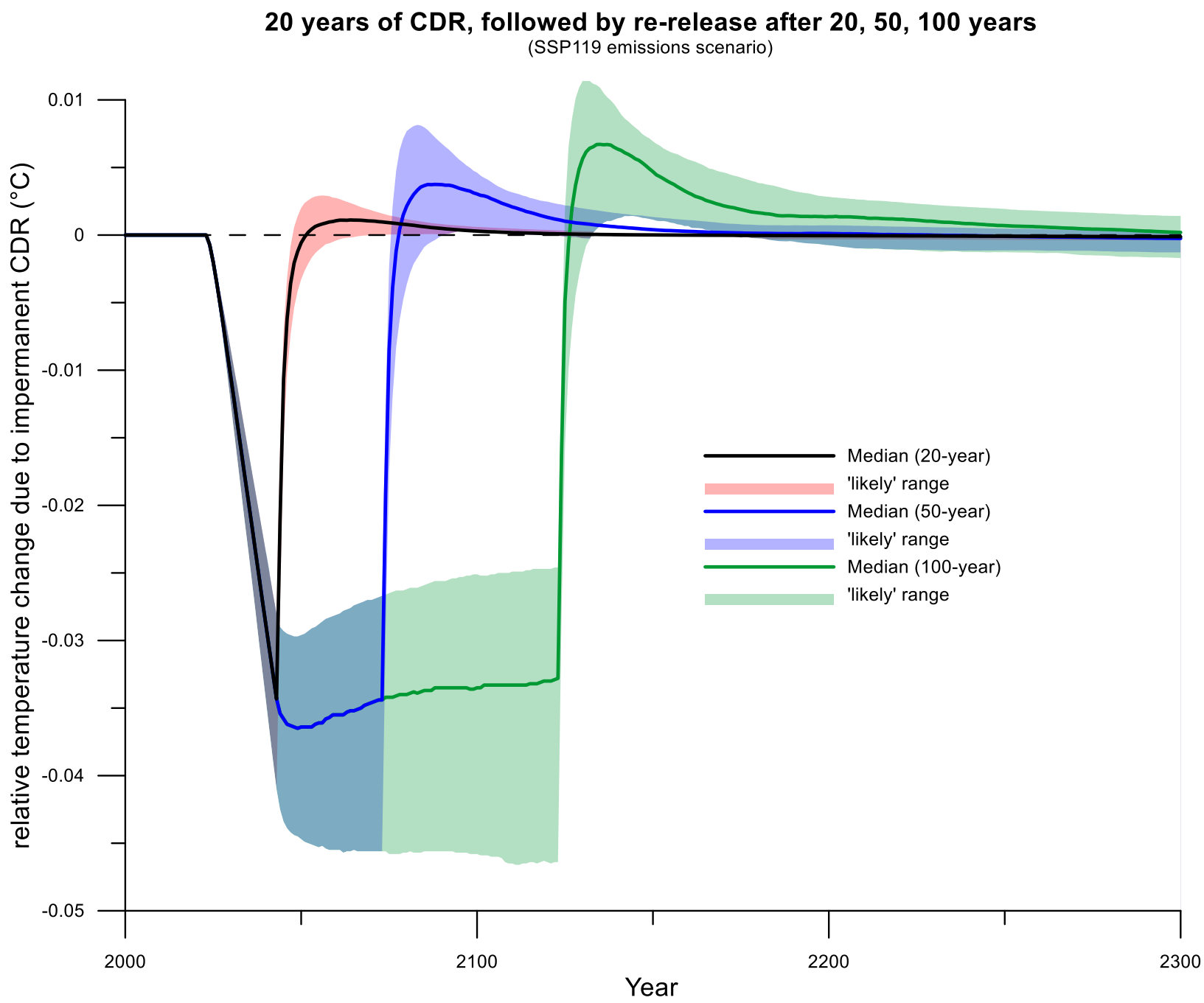
30 NOVEMBER/1 DECEMBER 2023

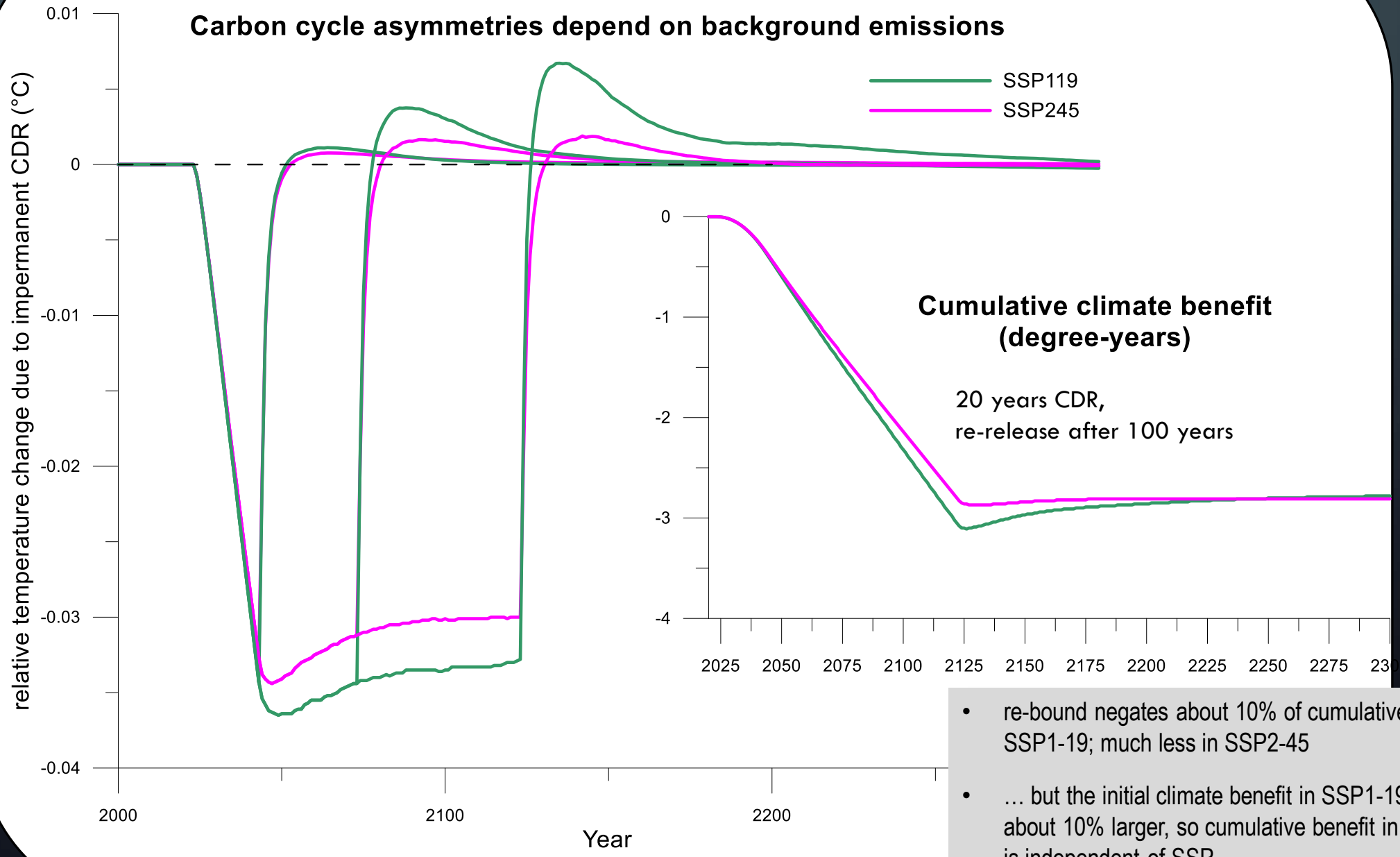
- Re-release of carbon results in more warming than if no carbon had been stored
- Asymmetry depends on emissions scenario and carbon cycle, climate-carbon cycle feedbacks
- An update using MAGICC 7.5.3, calibrated to the physical climate response in IPCC AR6

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(1), pp. 47–71

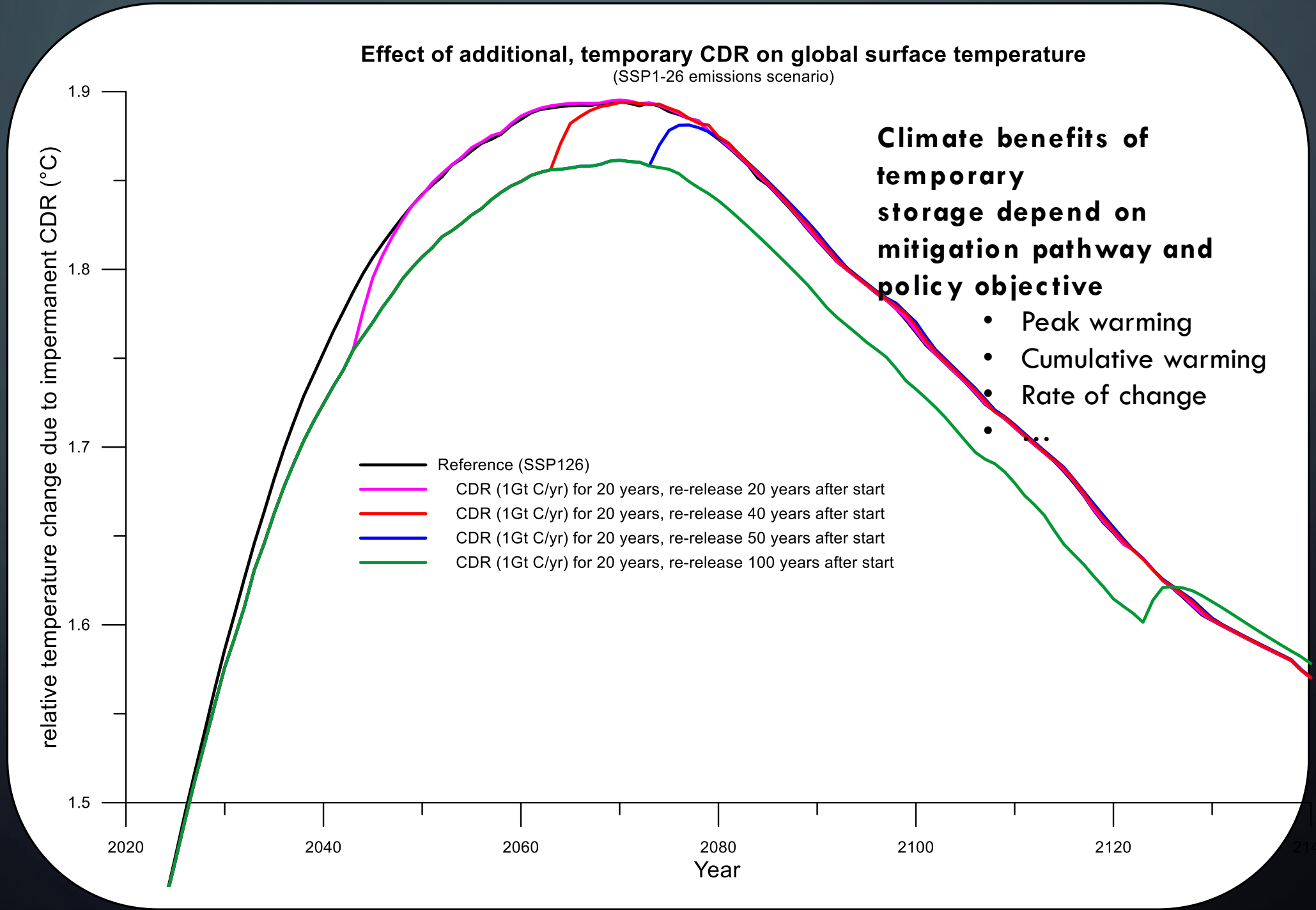



20 years of CDR, followed by re-release after 20, 50, 100 years
(SSP245 emissions scenario)
relative temperature change due to impermanent CDR (°C)
0.01
0
-0.01
-0.02
-0.03
-0.04
-0.05
2000
2100
2200
2300
Year
Median (20-year)
'likely' range
Median (50-year)
'likely' range
Median (100-year)
'likely' range


20 years of CDR, followed by re-release after 20, 50, 100 years
(SSP119 emissions scenario)
relative temperature change due to impermanent CDR (°C)
0.01
0
-0.01
-0.02
-0.03
-0.04
-0.05
2000
2100
2200
2300
Year
Median (20-year)
'likely' range
Median (50-year)
'likely' range
Median (100-year)
'likely' range



- re-bound negates about 10% of cumulative benefit in SSP1-19; much less in SSP2-45
- … but the initial climate benefit in SSP1-19 is also about 10% larger, so cumulative benefit in long run is independent of SSP


Effect of additional, temporary CDR on global surface temperature
(SSP1-26 emissions scenario)
relative temperature change due to impermanent CDR (°C)
1.9
1.8
1.7
1.6
1.5
2020
2040
2060
2080
2100
2120
2140
Year
Reference (SSP126)
CDR (1Gt C/yr) for 20 years, re-release 20 years after start
CDR (1Gt C/yr) for 20 years, re-release 40 years after start
CDR (1Gt C/yr) for 20 years, re-release 50 years after start
CDR (1Gt C/yr) for 20 years, re-release 100 years after start
Climate benefits of temporary storage depend on mitigation pathway and policy objective
• Peak warming
• Cumulative warming
• Rate of change
• …

- Updated simulations using MAGICC 7 indicate that temperature asymmetry is non-trivial and depends on background emissions scenario
- Climate benefit of temporary storage depends on policy objective: cost-benefit or cost-effectiveness

  Cullenward, D. (2023) *A framework for assessing the climate value of temporary carbon storage*. Brussels, Belgium: Carbon Market Watch, p. 45. Available at: https://carbonmarketwatch.org/publications/a-framework-for-assessing-the-climate-value-of-temporary-carbon-storage/.

  - If cost-effectiveness
    - re-release before peak negates all benefit and leads to slightly worse outcome than if no storage had occurred
    - if re-release after peak it lowers peak temperature ("peak shaving")
  - If cost-benefit, always a benefit dependent on storage time; almost independent on emissions scenario in long-run, but in short-run both benefits and rebound are greater for stringent mitigation scenarios