1. Climate sensitivity

global surface temperature change varies with atmospheric CO₂

\[ \Delta T = \Delta T_{2 \times CO₂} \frac{\ln(CO₂(t_{equilib}))/CO₂(t_o))}{\ln 2} \]

climate sensitivity = 2 to 4.5 K, mean of 3 K

2. Longterm atmospheric CO₂ and carbon emissions

+ve feedback:
- atmospheric CO₂ rises,
- increase ocean acidity,
- less carbonate, more ocean CO₂,
- inhibits ocean uptake of CO₂

CO₂(t_{equilib}) = CO₂(t_o) \exp(ΔI_{emission}/I_B)

I_B is 3500 PgC, nearly conserved for emissions up to 4000 PgC

3. Implications for surface warming & steric sea level rise

\[ \Delta T = \left( \frac{\Delta T_{2 \times CO₂}}{I_B \ln 2} \right) \Delta I_{emission} \]

surface temperature change

Cumulative carbon emission

\[ \Delta \eta = \left( \frac{\alpha D \Delta T_{ocean:2 \times CO₂}}{I_B \ln 2} \right) \Delta I_{emission} \]

surface steric change

Cumulative carbon emission

\[ \Delta T_{ocean:2 \times CO₂} \]

Ocean climate sensitivity is poorly known, ~ 1 K

Our theory:
- emission of 5000 PgC, longterm steric sea level rise is 1 to 5 m, plus mass change