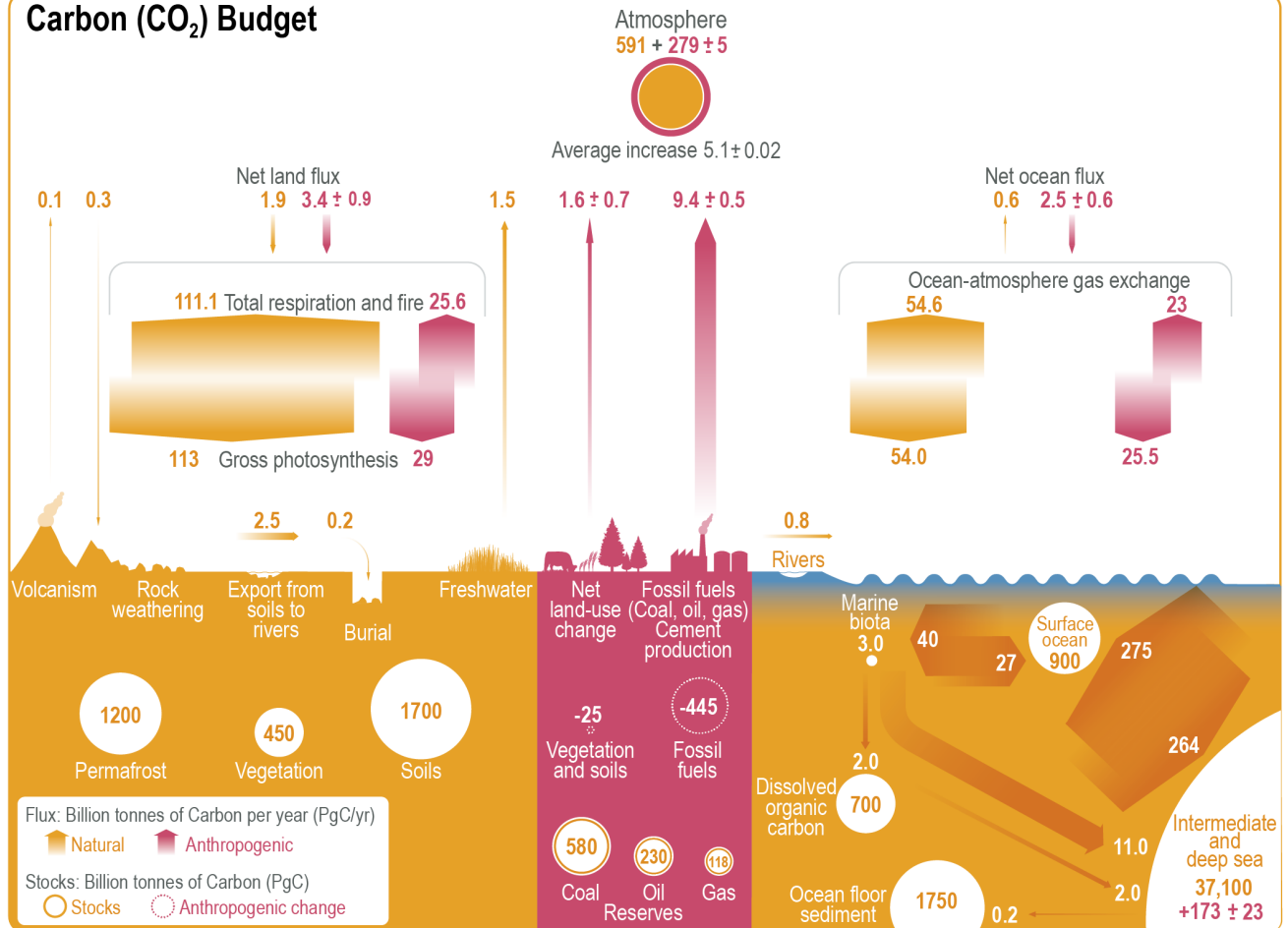


Global Carbon budget

Carbon (CO₂) Budget

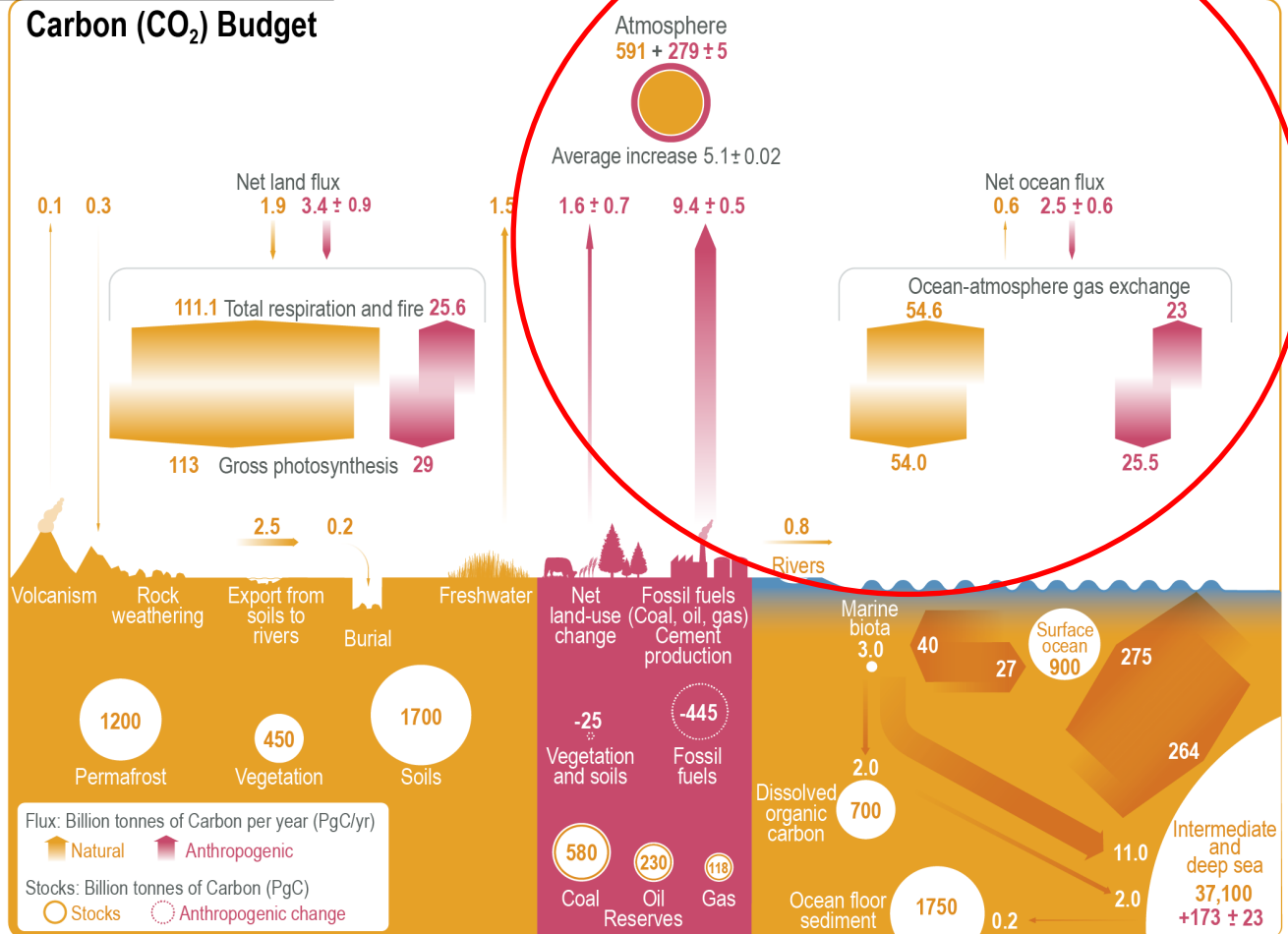


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Global Carbon budget

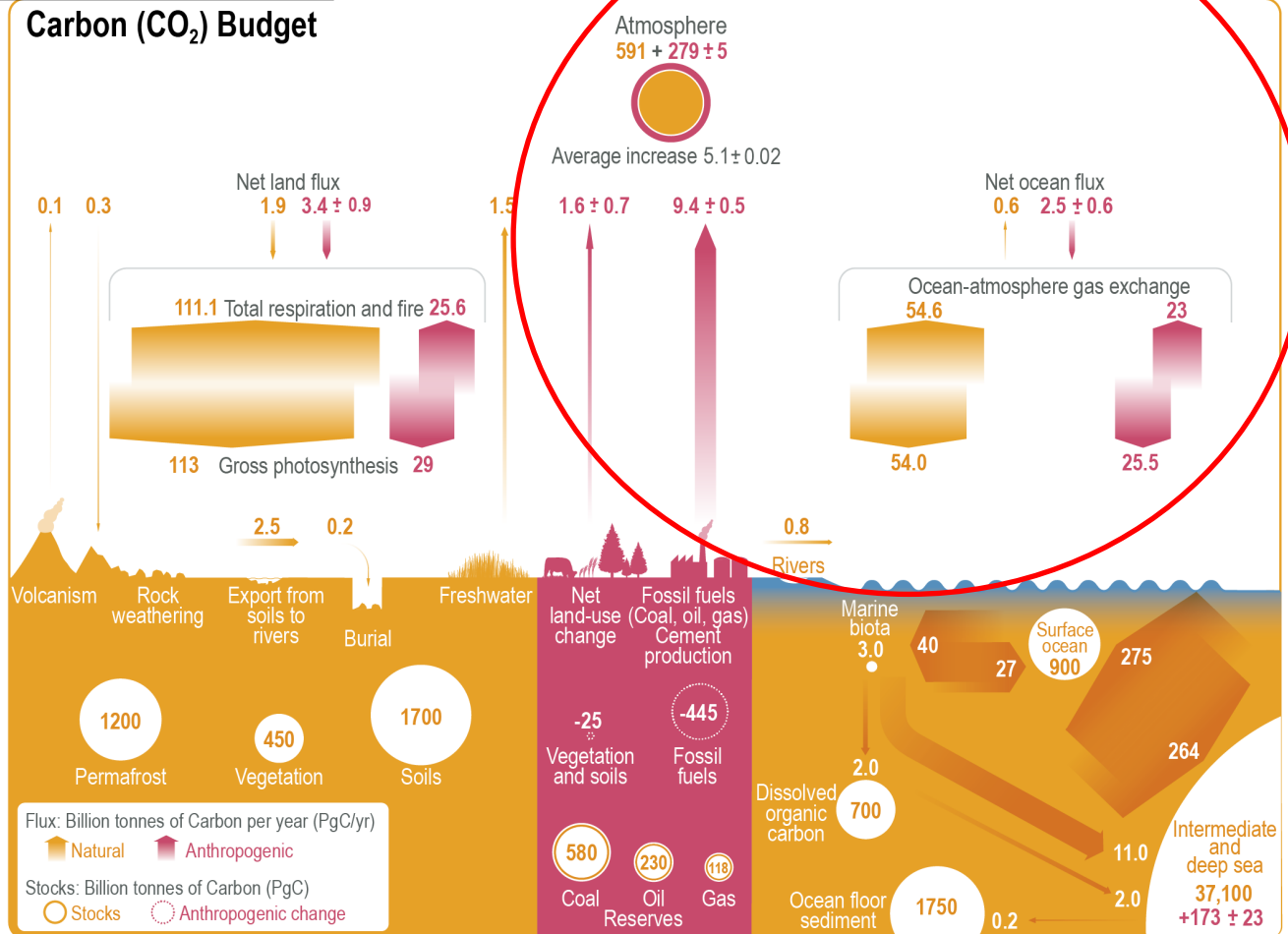
Carbon (CO₂) Budget



Global Carbon budget

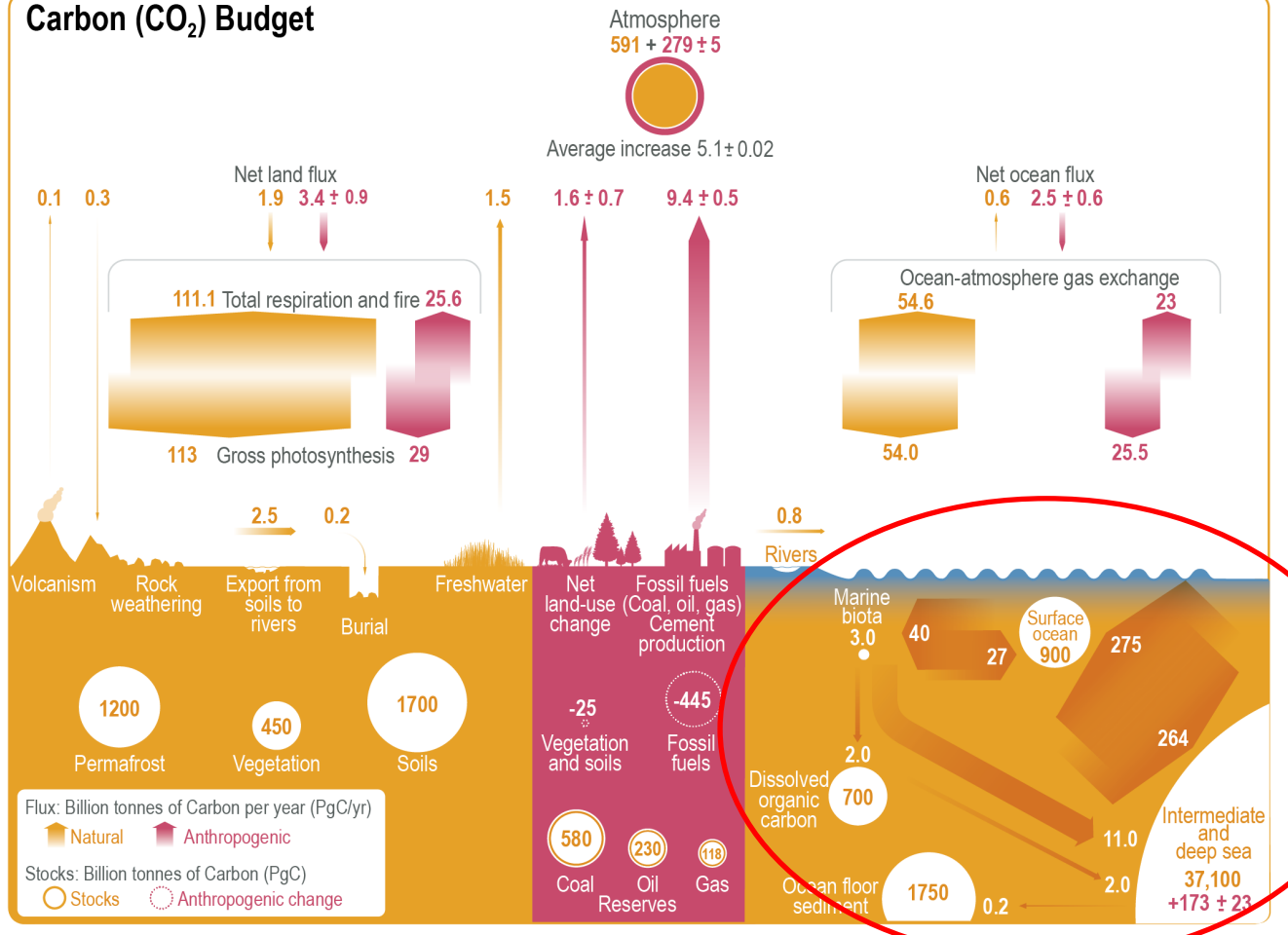
Units: Pg C yr⁻¹

- Atmospheric increase: 5
- Emissions (FF and Land use): 11
- Ocean uptake: 2.5
 - 0.6 Natural outgassing + 2.5 anthropogenic uptake = 1.9 Contemporary Ocean uptake



Global Carbon budget

Carbon (CO₂) Budget

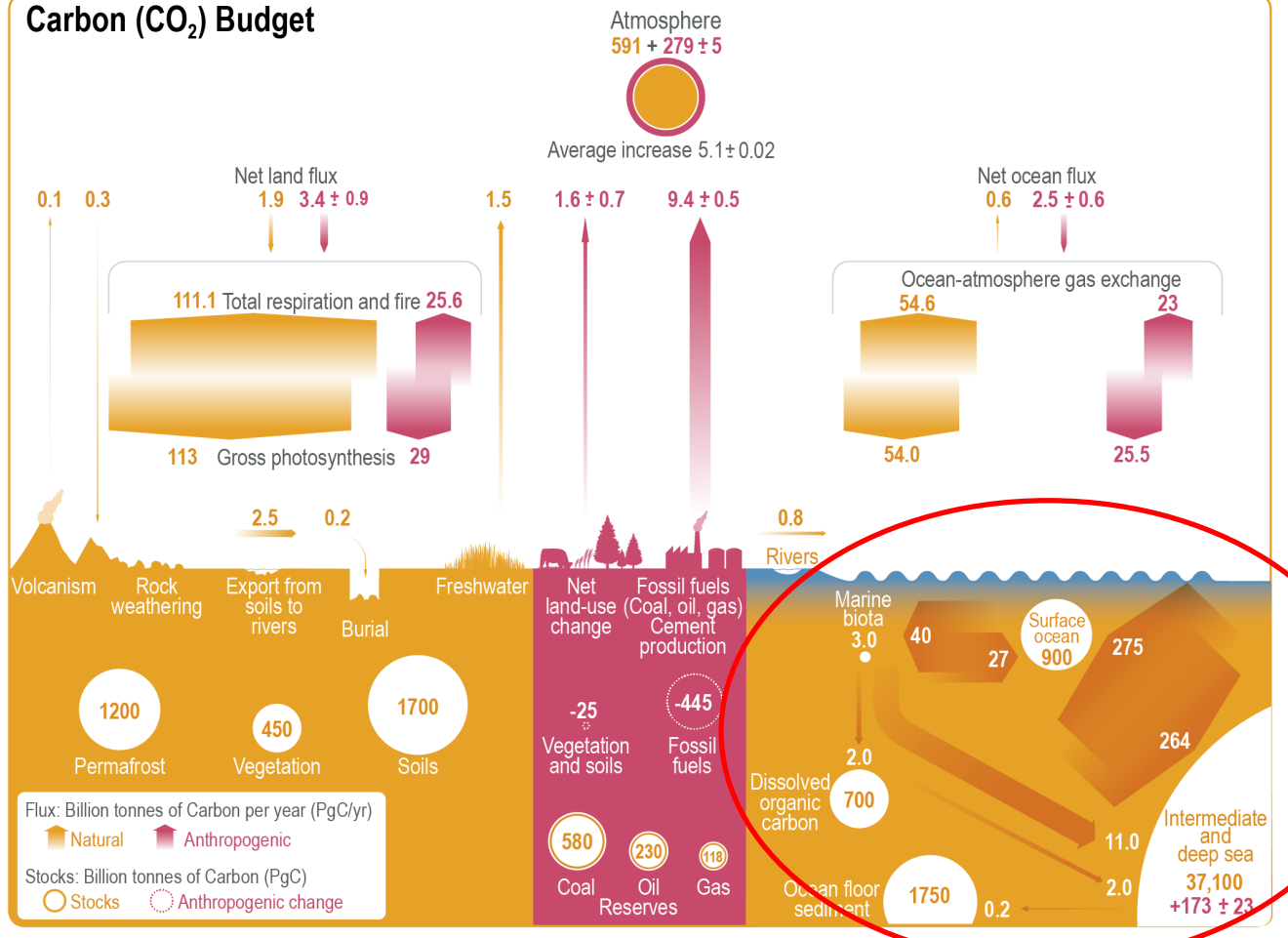


Global Carbon budget

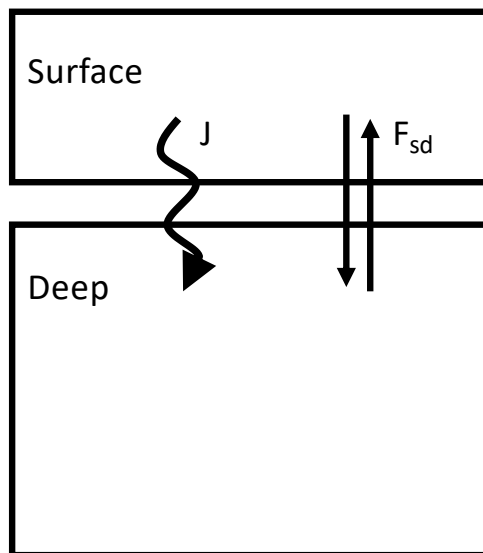
Units: Pg C yr⁻¹

- Bio pump (ANCP): ~13
- Solubility pump: 264 down, 275 up
- Biological carbon export is ~5-10% the magnitude of the solubility pump
 - Significant uncertainty in control / response to changes
 - Provides an avenue for long-term burial
- Sediment: 0.2
- Does biological carbon pump contribute to ocean's uptake of anthropogenic carbon?

Carbon (CO₂) Budget

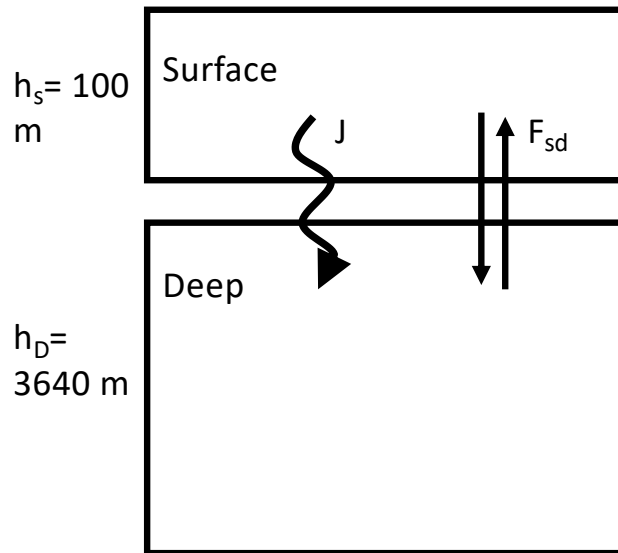


Box models: two boxes



- What are the mass balance equations in the upper ocean?
What about the deep ocean?

Box models: two boxes



- What are the mass balance equations in the upper ocean?
What about the deep ocean?

Given:

$$[\text{PO}_4^{3-}]_{\text{deep}} = 2.2 \mu\text{mol/kg}$$

$$[\text{PO}_4^{3-}]_{\text{surface}} = 1.0 \mu\text{mol/kg}$$

$$[\text{O}_2]_{\text{surface}} = 275 \mu\text{mol/kg} \text{ (the saturation value)}$$

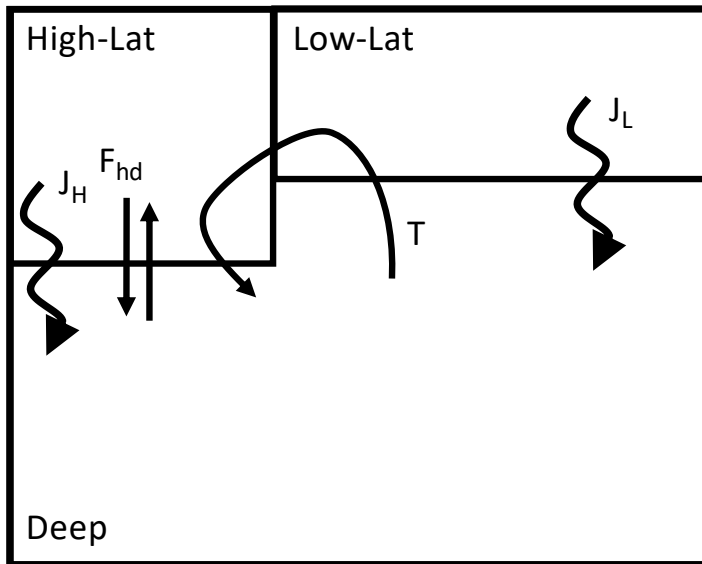
P:N:C:O₂ ratio in particles is 1:16:106:-154

All particles are respired in the deep ocean.

Ocean area: $3.6 \times 10^{14} \text{ m}^2$

$F_{SD} = 3.5 \text{ m y}^{-1}$, what is the particle flux of phosphate and carbon?

Box models: three boxes



- Mass balance equations for three boxes?