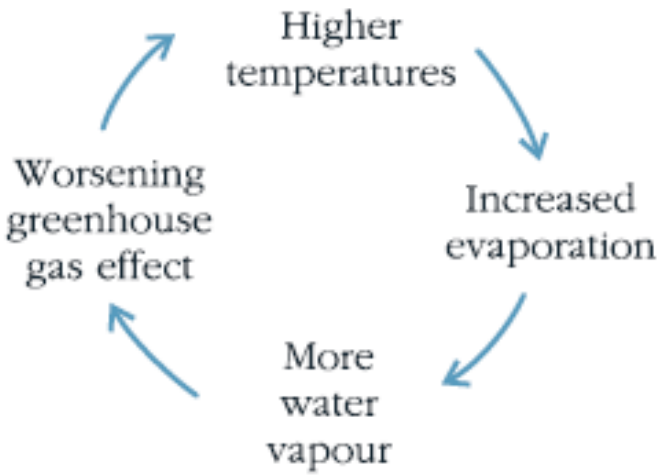
Causal loop diagrams

- Conceptual modelling was developed in response to the failure of quantitative systems analysis to cope with the problems. Different methods have been developed to address these problems.
- Causal loop diagrams provide an example of a qualitative systems tool. The modelling process starts by identifying variables and causal links between them and then proceeds with identification of feedback loops, such as closed chains of causal connections. This language was developed initially to help people identify circular patterns that are often hidden by our default assumption that all causation is linear.

11 out of 12 hottest years since 1830 have occured since 1995. Temperatures may rise 6°C by 2100.

Evaporation of oceans is rising because of higher temperatures. Arctic sea ice is melting at a faster pace.



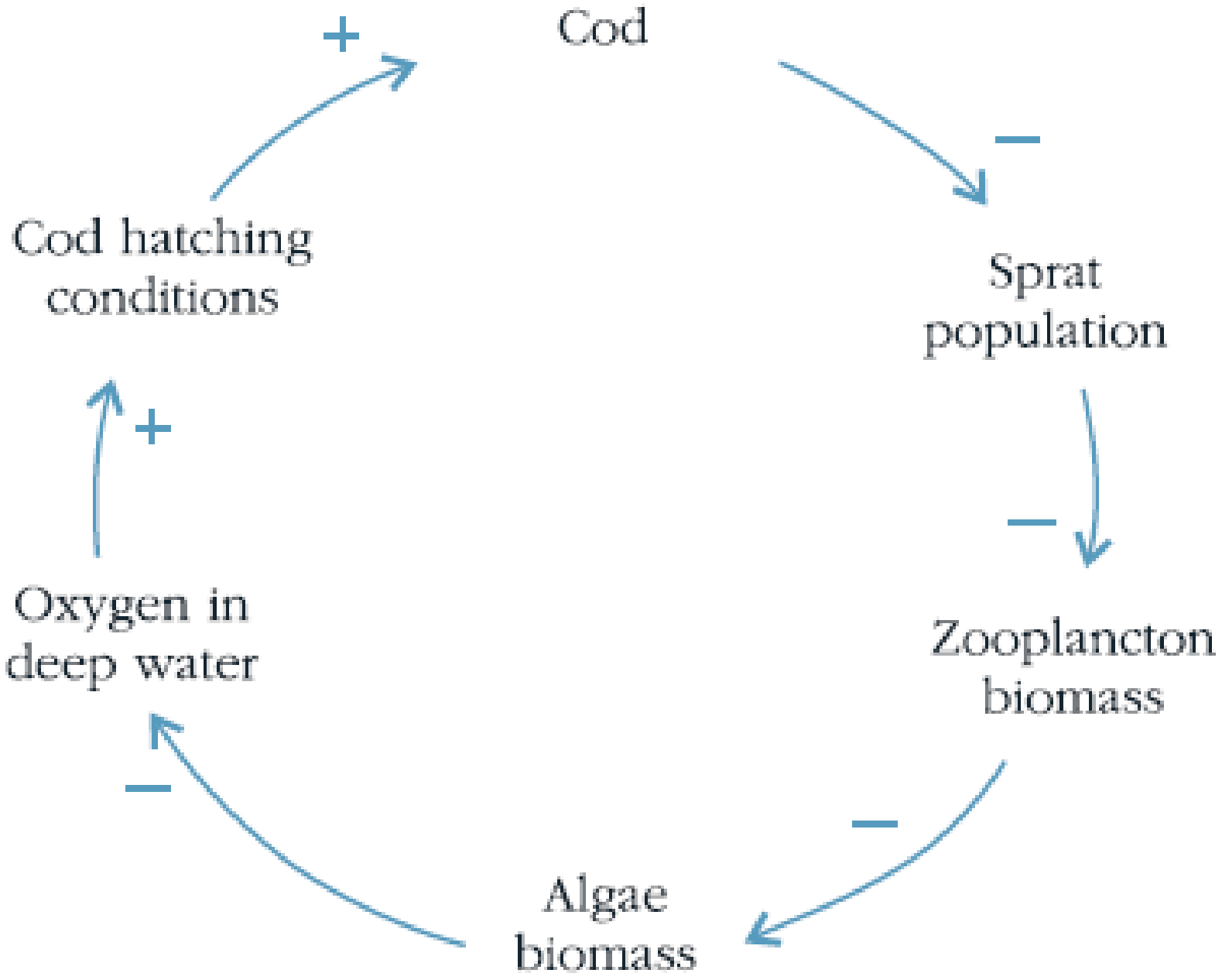
Earth's ability to absorb CO_2 is reduced. CO_2 levels could rise by 44% this century, further raising temperatures.

Atmosphere concentrations of water vapour are 4% higher than in 1970 as a result of rise in evaporation.

Figure 2.1. Causal loop diagram illustrating vicious circle of global warming

Table 2.2. Guidelines for reading causal loop diagrams

	Arrows denote causal relationships.
	Double crossing an arrow means that an effect is delayed.
	A plus sign at an arrowhead means that both variables change in the same direction, for example increase of a cause results in increase of an effect.
	A minus sign at an arrowhead means that variables change in opposite directions, for example increase of a cause results in decrease of an effect.
	Closed chains of causes and effects constitute feedback loops. Loops are numbered and they can be balancing or reinforcing. The character and number of a feedback loop is given inside the loop symbol.


Cod
+
−
Sprat population
−
Zooplancton biomass
−
Algae biomass
−
Oxygen in deep water
+
Cod hatching conditions

Balancing feedback loop

- Balancing feedback loops are equilibrating or goal-seeking structures in systems and are both sources of stability and sources of resistance to change.
- Balancing feedback loop guarantees system resilience.

Reinforcing feedback loop

- Reinforcing feedback loops are self-enhancing, leading to exponential growth or to runaway collapses over time.
- Reinforcing feedback loop is central driver of growth in an economy.
- It could lead to vicious circle.
- Like with epidemy

Computer programs

- Microsoft has a special software for diagrams – **MS Visio**. You can create diagrams there and than import them to Word (or any other program).

  You can also use some free alternatives to Visio:
  http://www.lucidchart.com
  http://dia-installer.de/index.html.en
- http://cmap.ihmc.us/
- http://dia-installer.de/