

Atmospheric Stability and Clouds for A level Geography Teachers' Notes

The aim of this exercise is to present students with 3 highly idealised weather case studies. By looking at the temperature profiles, they should be able to work out what sort of cloud will form.

Use the Introductory PowerPoint provided, or one of these:

Useful References:

http://www.metlink.org/pdf/teachers/iop_atmospheric_stability.pdf

David Waugh's book "Geography an Integrated Approach"

www.geo.utexas.edu/courses/387h/Lectures/Stability_Clouds.pdf

Gavin Pretor-Pinney's Book "A Cloudspotter's Guide" page 97-99

Case Study 1

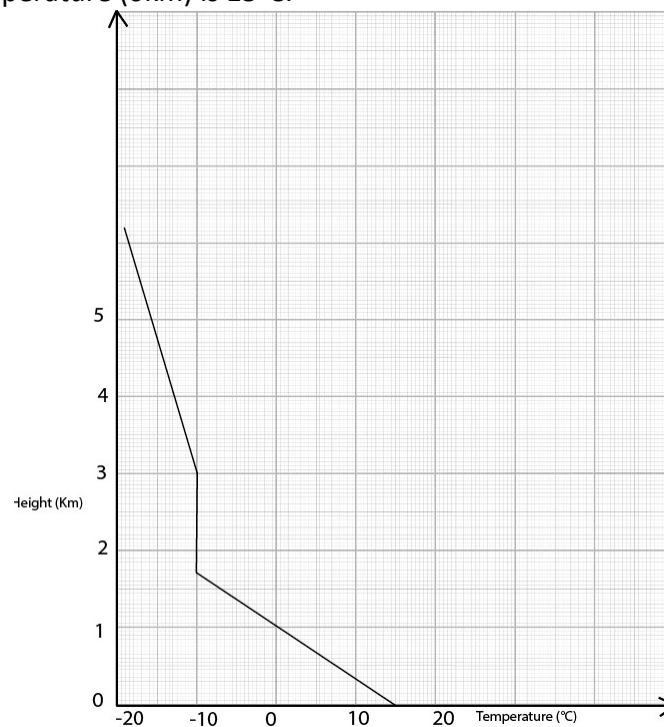
Students should make the following assumptions for this idealised situation:

The Dry Adiabatic Lapse Rate is $10^{\circ}\text{C}/\text{km}$

The Saturated Adiabatic Lapse Rate is $5^{\circ}\text{C}/\text{km}$

The air cools at the DALR when the air temperature is above 5°C . When the air temperature is lower than 5°C , cloud droplets can form and the air cools at the SALR.

The ground temperature (0km) is 15°C .



How to find out what sort of cloud will form:

- Have a look at the Environmental Lapse Rate (ELR) for this day. *The temperature falls with height through the lower troposphere, but then becomes isothermal between about 1500 and 3000m.*
- Mark a cross on the ground (0km) at 15°C.
- Draw a line at the DALR.
- Is the air stable or unstable near the ground? *Unstable*
- Identify where cloud base will be. *About 1000m*
- Change to the SALR
- Where will the top of the cloud be? *About 5000m*
- What sort of cloud is this? *Cumulus*



Case Study 2

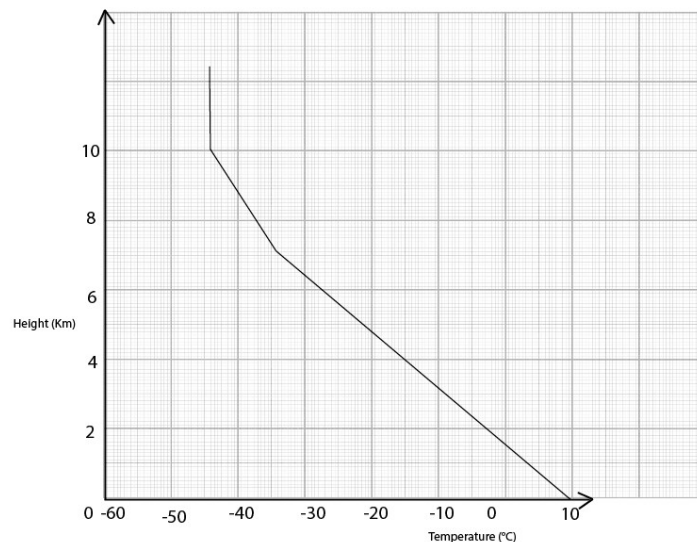
Students should make the following assumptions for this idealised situation:

The Dry Adiabatic Lapse Rate is $10^{\circ}\text{C}/\text{km}$

The Saturated Adiabatic Lapse Rate is $5^{\circ}\text{C}/\text{km}$

The air cools at the DALR when the air temperature is above 5°C . When the air temperature is lower than 5°C , cloud droplets can form and the air cools at the SALR.

The ground temperature (0km) is 10°C .



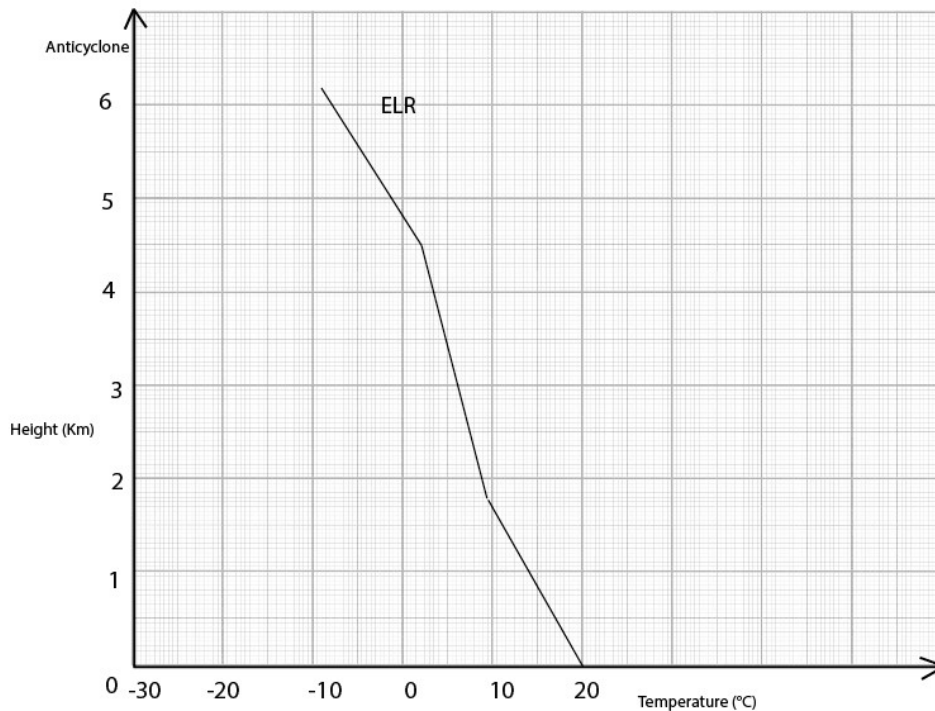
How to find out what sort of cloud will form:

- Have a look at the Environmental Lapse Rate (ELR) for this day. *The temperature falls with height through the troposphere, then becomes isothermal in the stratosphere (above 10km).*
- Mark a cross on the ground (0km) at 10°C .
- Draw a line at the DALR.
- Is the air stable or unstable near the ground? *Stable*
- Identify where cloud base will be. *About 500m*
- Change to the SALR
- At what height does the air become unstable? If the air has to blow over a 2km mountain, will cloud form? *The air becomes unstable at about 1500-1800m. If the air is forced to rise 2km by a mountain, it will carry on rising.*
- Where will the top of the cloud be? *About 10500m*
- What sort of cloud is this? *Cumulonimbus*





Case Study 3



Students should make the following assumptions for this idealised situation:

The Dry Adiabatic Lapse Rate is $10^{\circ}\text{C}/\text{km}$

The Saturated Adiabatic Lapse Rate is $5^{\circ}\text{C}/\text{km}$

The air cools at the DALR when the air temperature is above 5°C . When the air temperature is lower than 5°C , cloud droplets can form and the air cools at the SALR.

The ground temperature (0km) is 20°C .

How to find out what sort of cloud will form:

- Have a look at the Environmental Lapse Rate (ELR) for this day. *The temperature falls slowly with height through the troposphere.*
- Mark a cross on the ground (0km) at 20°C .
- Draw a line at the DALR.
- Is the air stable or unstable near the ground? *Stable*
- Identify where cloud base would be if the air were forced to rise. *About 1500m*
- Change to the SALR
- Does the air become unstable? *The air never becomes unstable.*
- What sort of weather situation is this? *The sky will be clear, this might be associated with high pressure and generally sinking air. A cloud would only form if the air were forced to rise over a mountain, but the cloud would not spread further up into the atmosphere.*

