

# Mountain Leader Training

## Introduction to mountain weather

# Mountain Weather

- Why worry about the weather!
- How is weather created!
  - The atmosphere
  - Weather systems
    - Airmass modification
    - Depressions and fronts
    - Wind
- Weather in the mountains
- Weather maps and forecasting

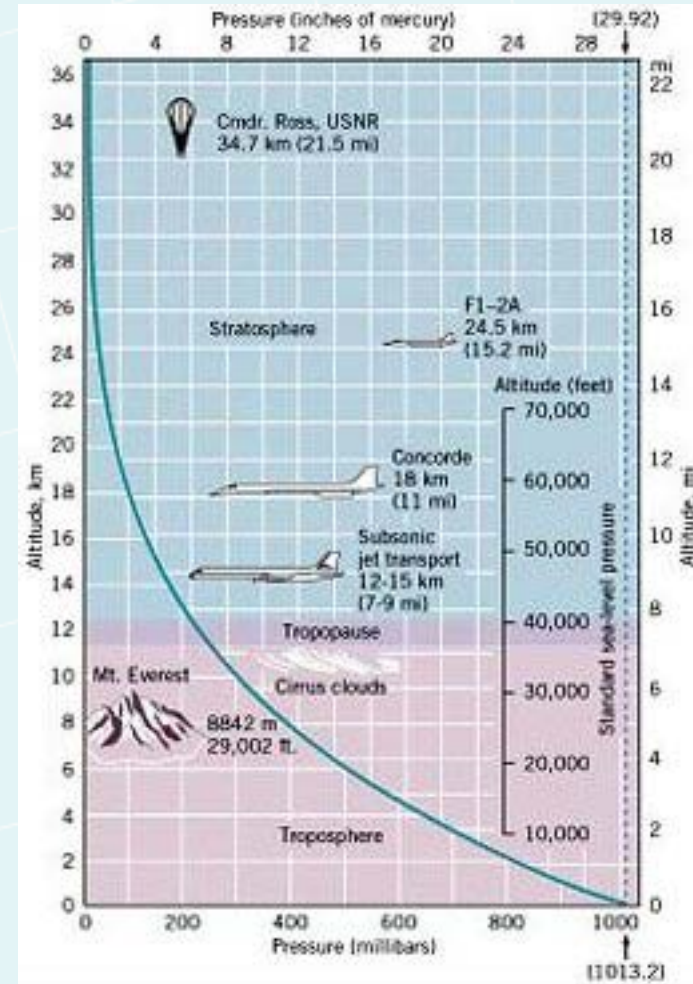
# 58 Why worry about the weather!

- 57 • Planning
  - Activities/route
  - Equipment
  - Food
- Clothing
- Navigation
- Morale



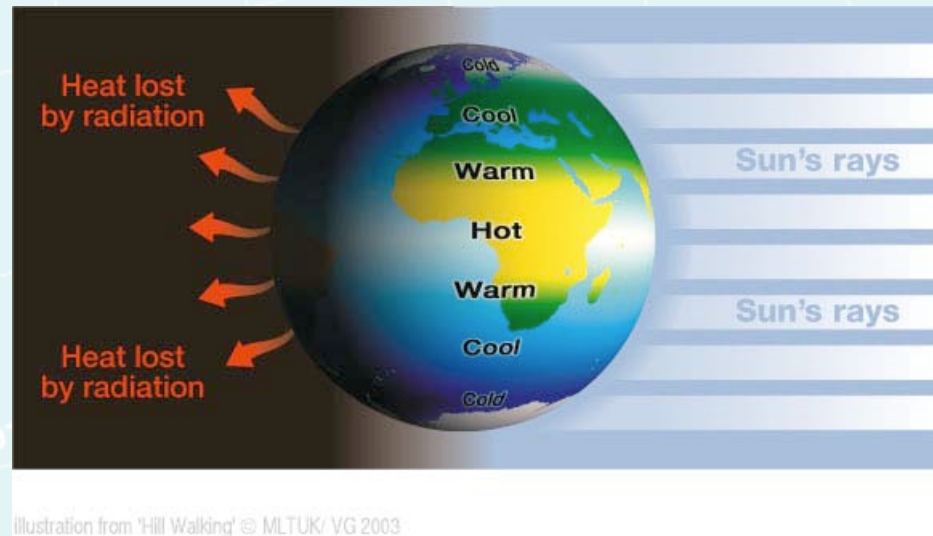
# How is weather created the atmosphere...

- Stratosphere
- Tropopause
- Troposphere



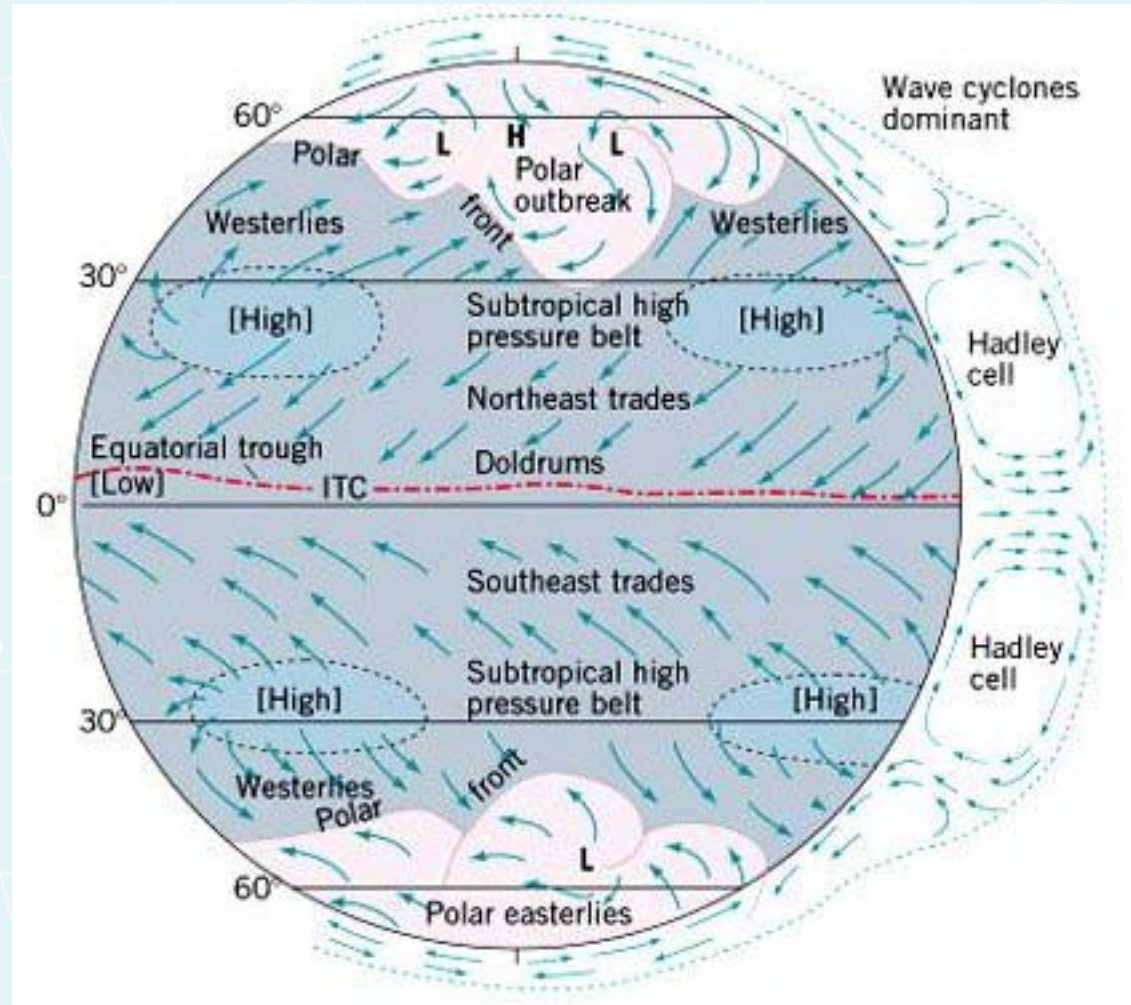
# The Atmosphere

- Stratosphere
- Tropopause
- Troposphere

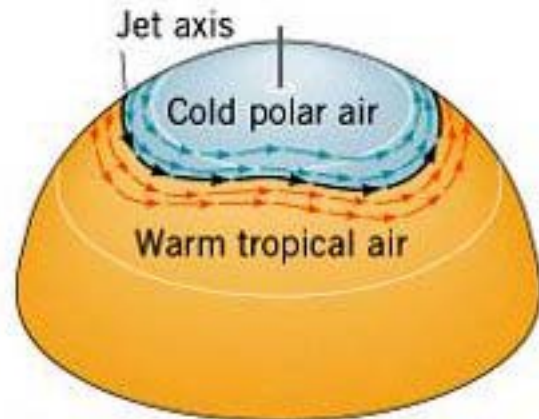


# The Atmosphere

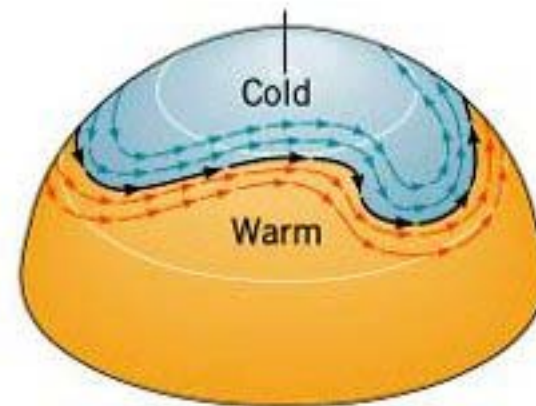
Hot air rises



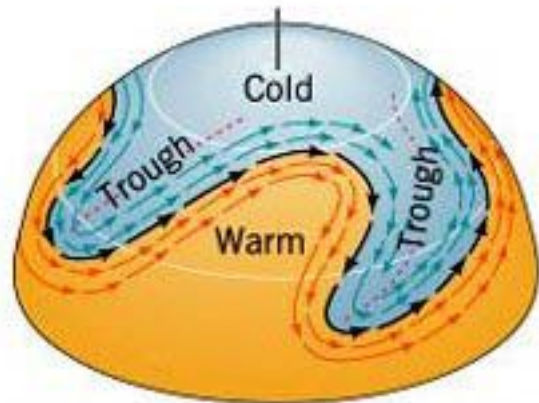
# The Atmosphere



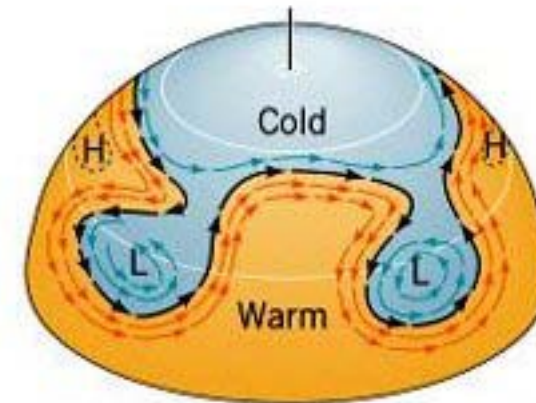
The jet stream begins to undulate.



Rossby waves begin to form.



Waves are strongly developed. The cold air occupies troughs of low pressure.



When the waves are pinched off, they form cyclones of cold air.

# How is weather created weather systems

As warm air rises it is spun by the rotation of the earth in an anticlockwise direction

As cold air sinks it is spun by the rotation of the earth in a clockwise direction

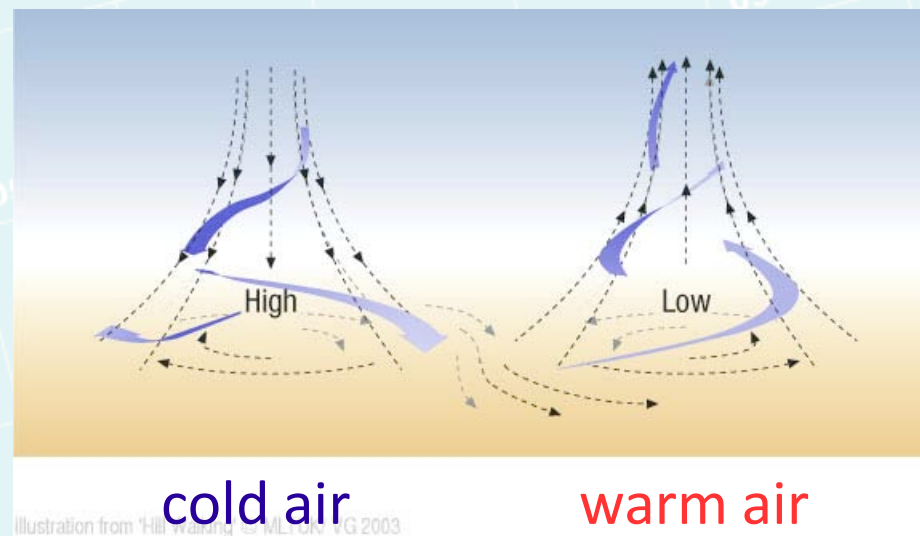


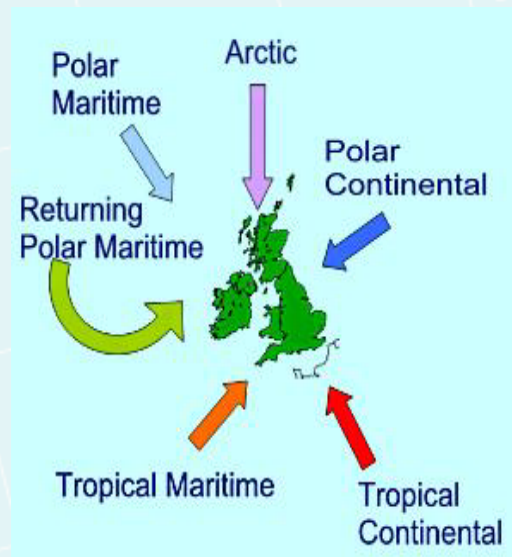
Illustration from "Hill Walking" by ML 1997, VG 2003

# Weather Systems

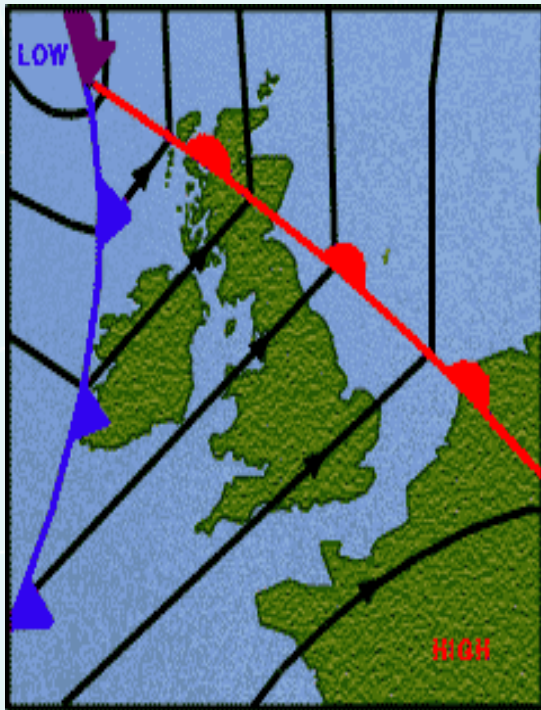
Where a weather system has come from will further modify its characteristics by the time it reaches the British Isles

Weather systems that have tracked over the sea will be wetter than weather systems that have tracked over the land

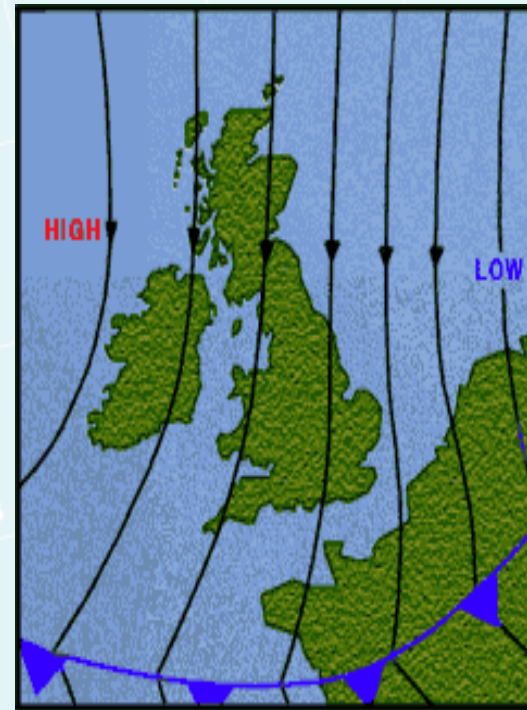
There are six distinct influences on weather systems affecting the British Isles



# How is weather created airmass modification...

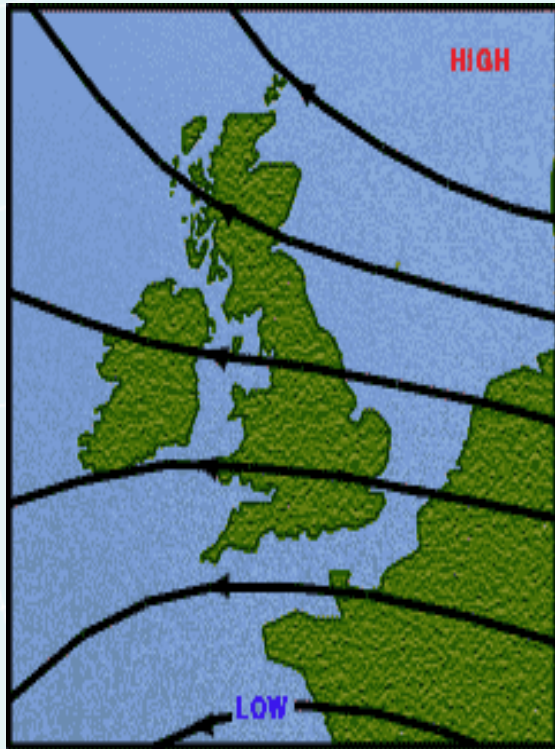


Tropical Maritime

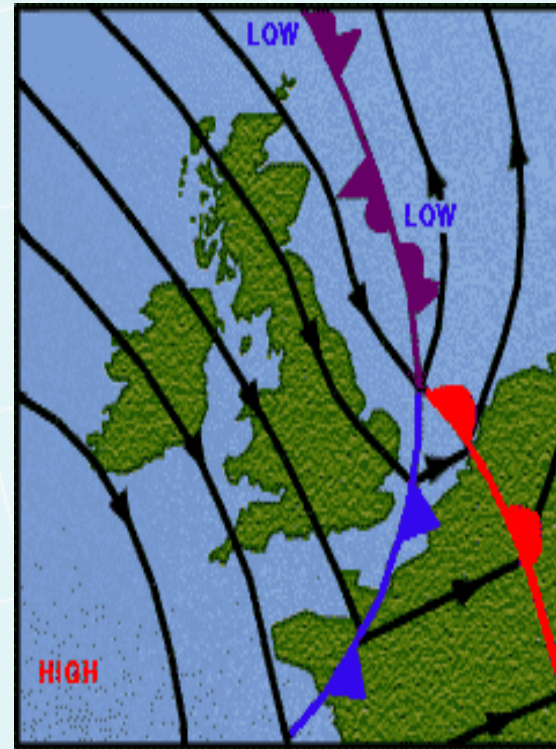


Arctic

# Airmass Modification

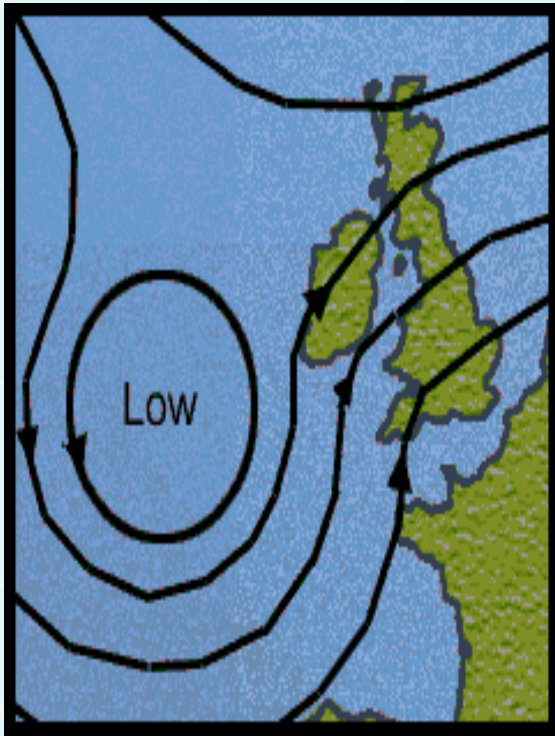


Polar Continental

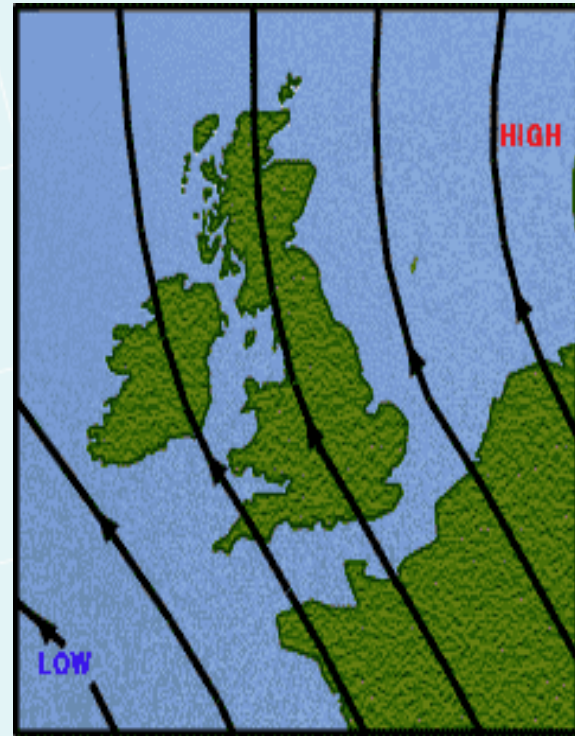


Polar Maritime

# Airmass Modification



Returning Polar  
Maritime



Tropical Continental

# How is weather created depressions and fronts

Most of our severe weather - i.e. persistent or heavy rain or snow - is associated with depressions (frontal systems) and fronts

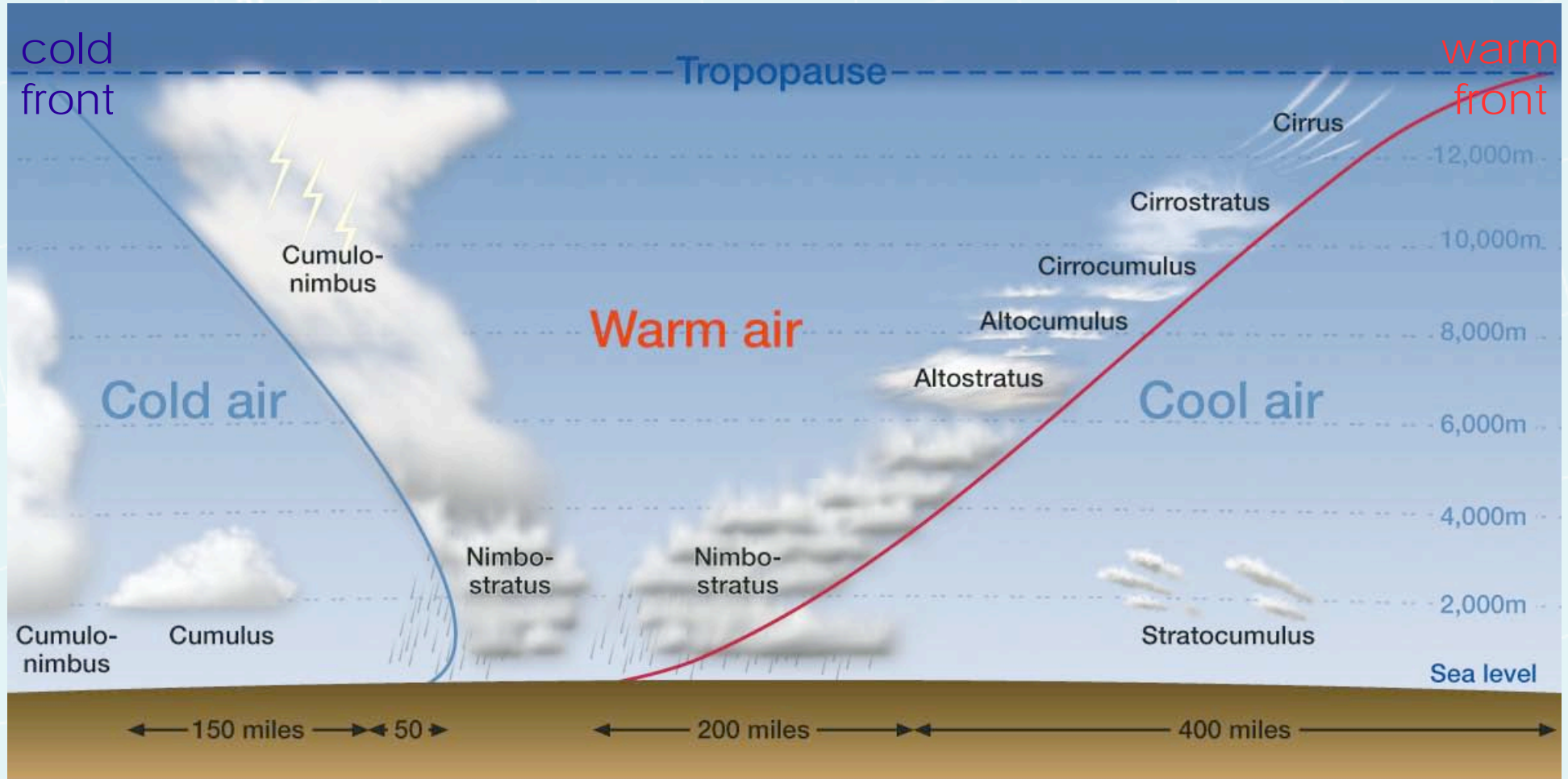
Depressions are formed at the boundary between warm subtropical air and cold polar air

# Depressions and fronts

At a boundary between warm and cold air the cold, dense air tends to undercut the warm, less dense air, forcing it to rise

- as a result the warm air cools
- as the air cools water condenses into clouds
- if enough water condenses, it falls as rain

# How is weather created? depressions and fronts



Cross section through a depression

Illustration from 'Hill Walking' © MLTUK/ VG 2003

# Lightening strikes



# How is weather created depressions and fronts

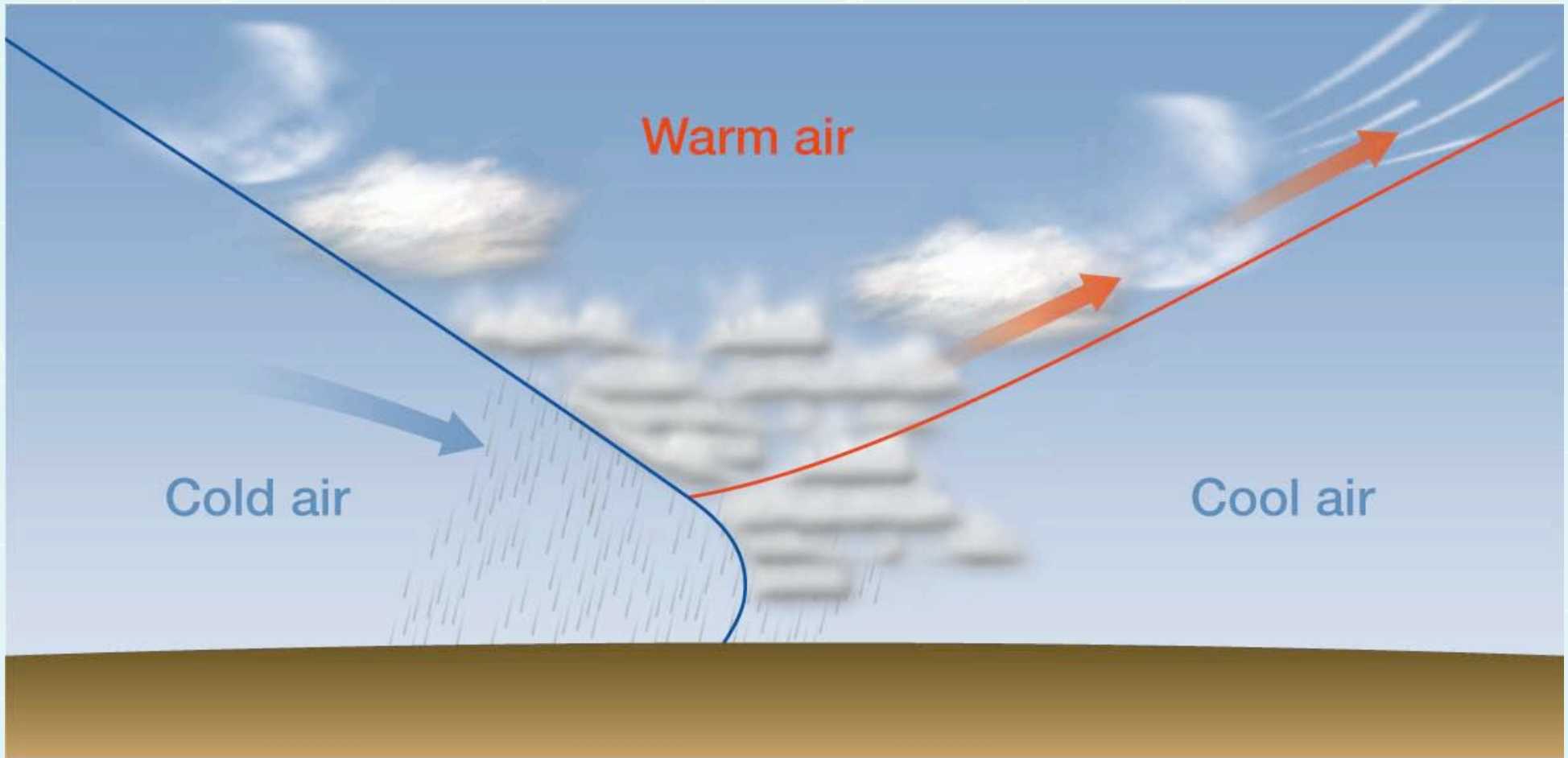
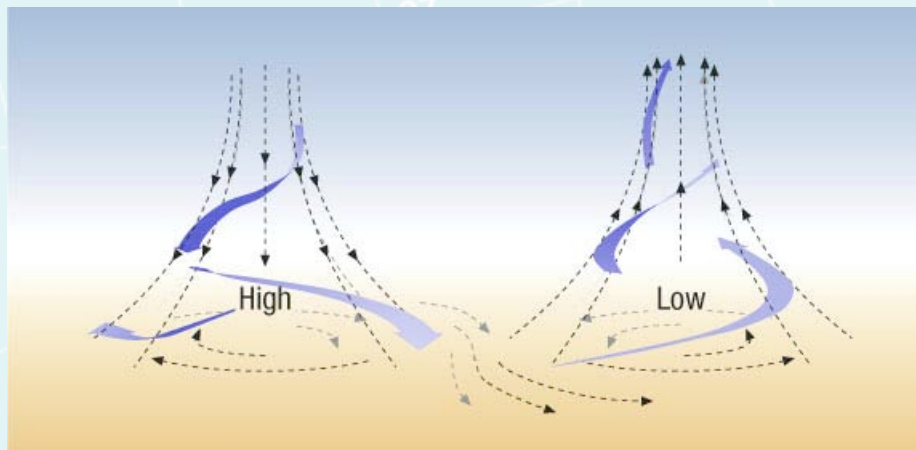


Illustration from 'Hill Walking' © MLTUK/ VG 2003

Cross section through an occluded front

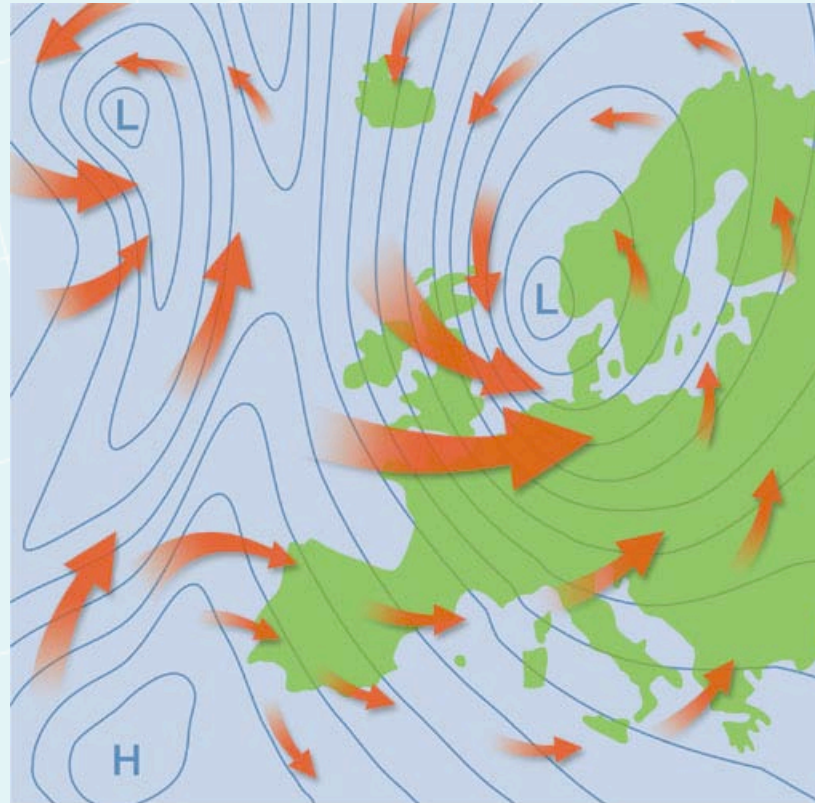
# How is weather created winds

- Wind is the flow of air from an area of high pressure to an area of low pressure
- However once the air starts to move the rotation of the earth deflects its path
- The resultant wind, the **geostrophic** wind, blows parallel to **isobars**, lines of equal pressure on weather maps



Air movement in high & low pressure

# Winds



Wind direction and isobars

# Winds

- Winds up to 40 mph
  - gale force but generally tolerable
- Winds up to 60 mph
  - gale to hurricane force and unpleasant
- Winds over 60 mph
  - unmanageable for most with risk of being blown over

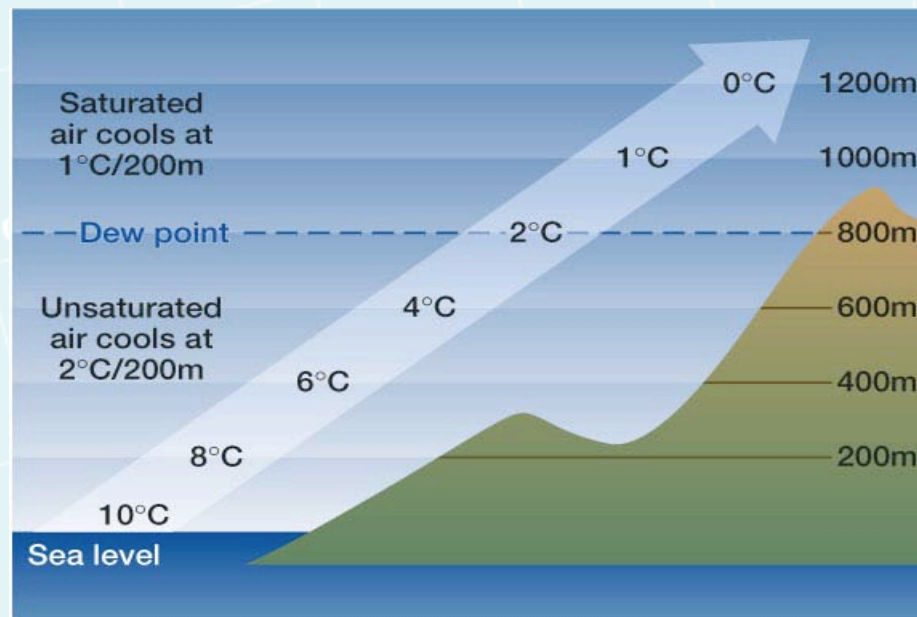
# Weather in the Mountains

- Temperature and altitude
- Wind in the mountains
- Convection
- Orographic lifting
- Banner clouds
- Fog, frost and inversions

# Weather in the Mountains

## temperature

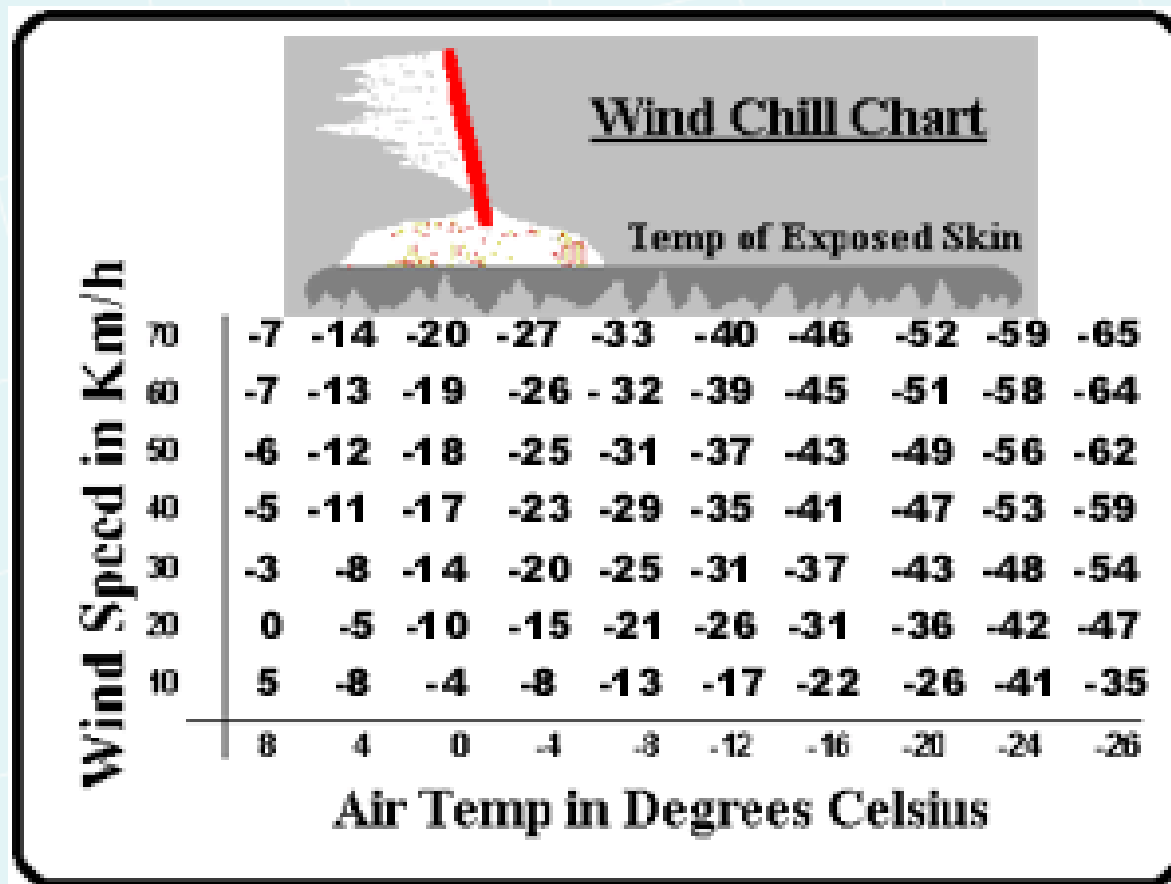
- Temperature decreases with altitude
- The relationship between altitude and temperature is called the lapse rate
- Saturated air cools at  $1^{\circ}\text{C}$  per 200m
- Unsaturated air cools at  $2^{\circ}\text{C}$  per 200m



Lapse rate and dew point

# Weather in the Mountains temperature

The wind chill factor is the term given to the combined effect of temperature and wind

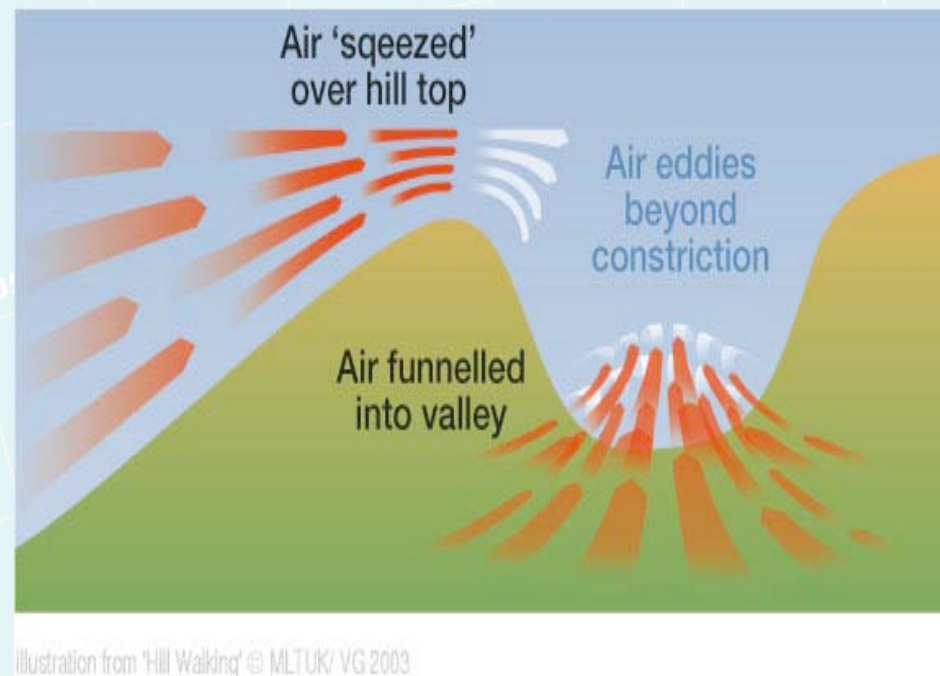


# Weather in the Mountains

## wind

Mountains can funnel wind causing dramatic local variations in wind speed

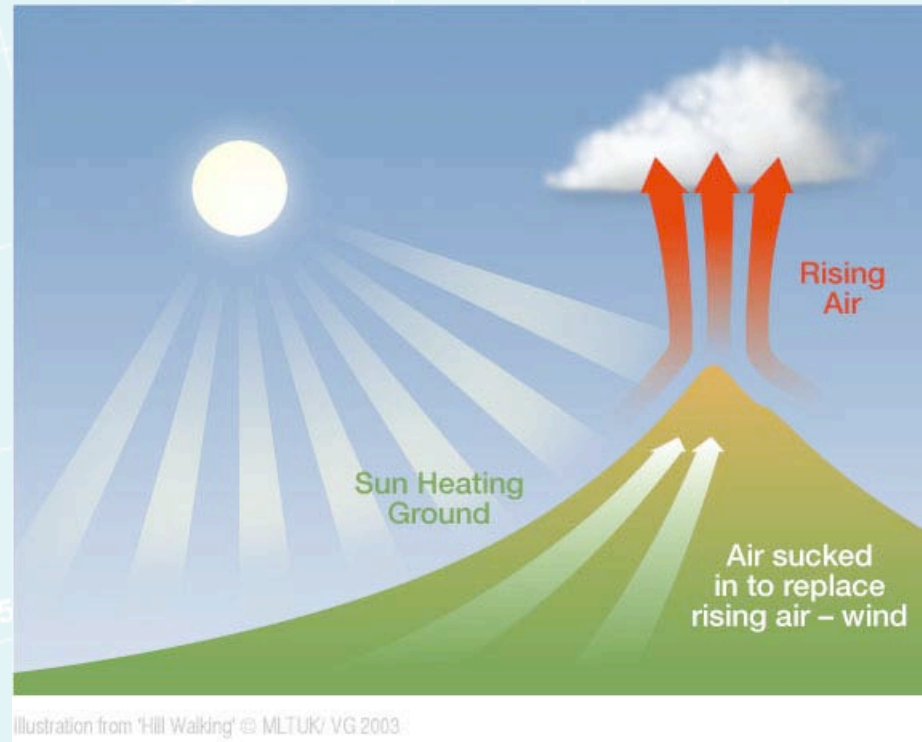
Air is squeezed between the mountain and the tropopause forcing it to accelerate



# Weather in the mountains convection

- On a clear day the south facing side of a hill and its summit are heated by the sun
- The adjacent air warms and rises, producing local currents called thermals
- As the air rises it cools and may reach the dew point, forming clouds and rain
- Strong heating may set up strong currents resulting in afternoon thunderstorms

# Weather in the mountains convection



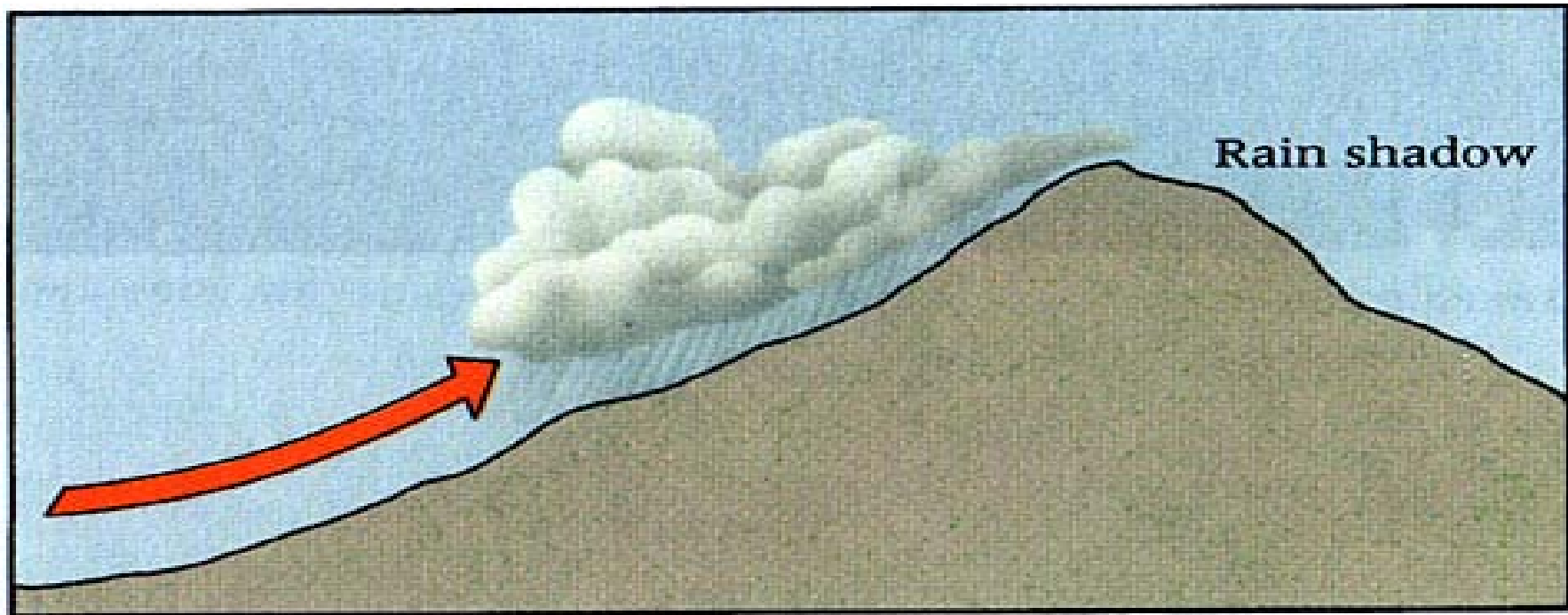
# Weather in the Mountains

## orographic lifting

- The mountains force air to rise up over them
- As the air rises it cools and may reach the dew point, forming clouds
- If cooled enough the air loses some of its moisture as rain
- The air on the lee side is therefore relatively dry – a rain shadow is created

# Weather in the Mountains

## orographic lifting



Orographic

# Weather in the Mountains

## banner clouds

Air flowing around a mountain top will form an eddy on its lee side

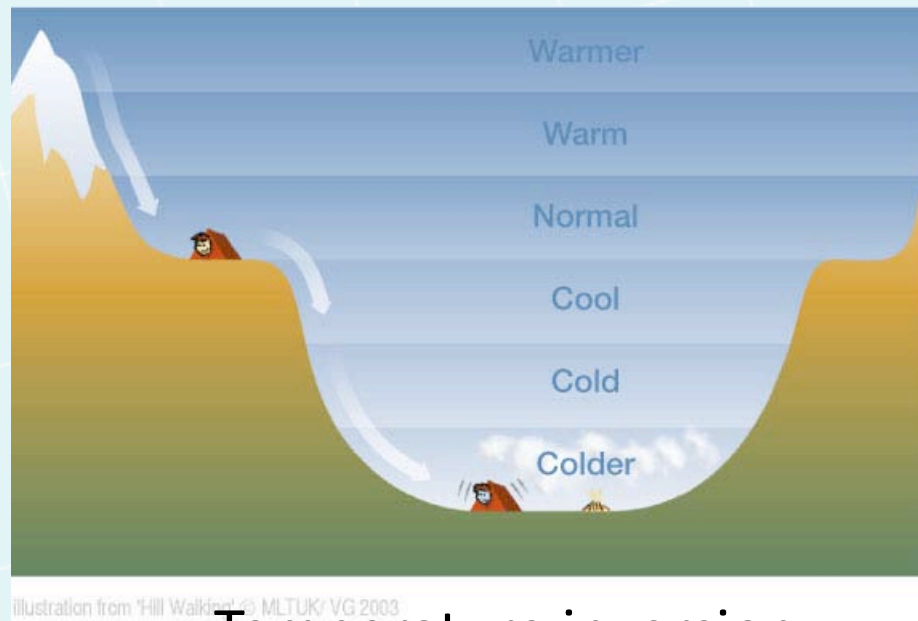


Illustration from 'Hill Walking' © MLTUK/ VG 2003

Formation of banner clouds

# Weather in the Mountains fog, frost and inversions

- As cool air sinks it pours into hollows
- It can settle there, trapped by its own density with a layer of warm air above
- This is a temperature inversion



Temperature inversion

# Weather Maps

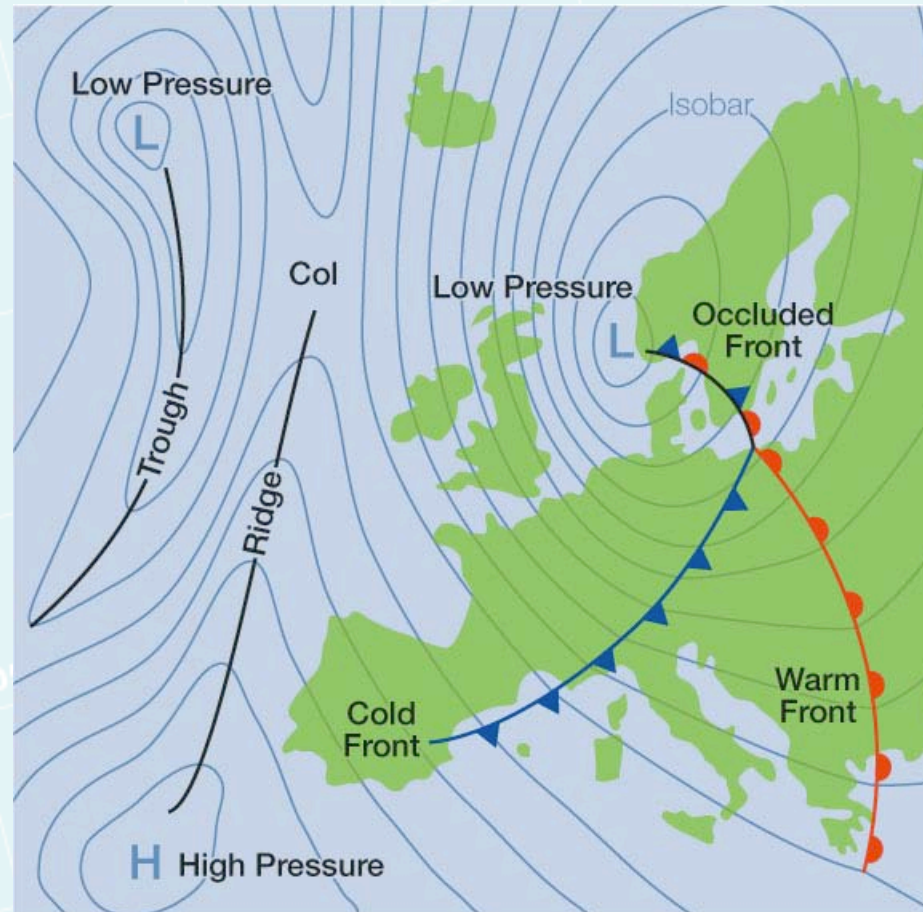
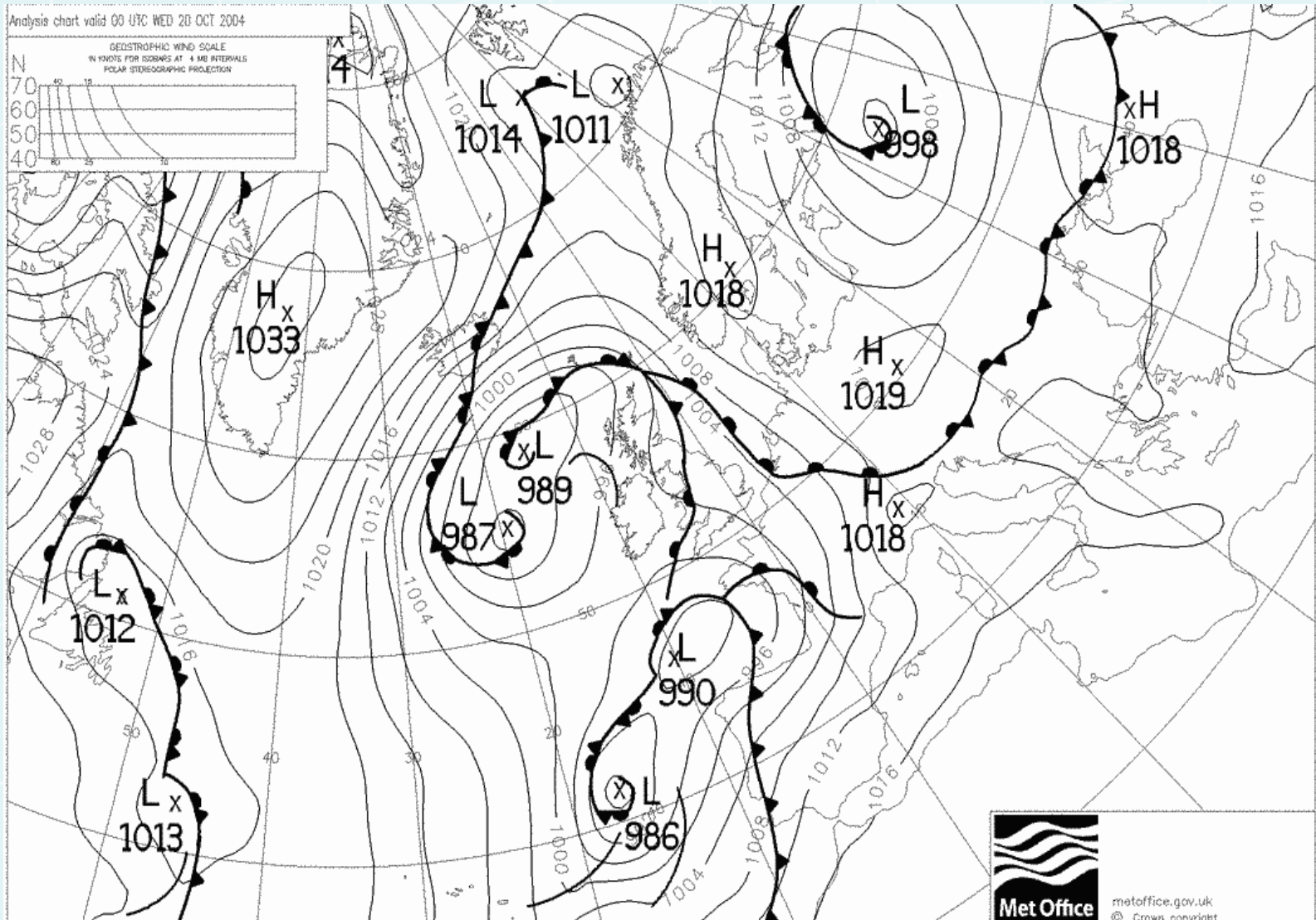


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# Weather Maps



# Weather Maps

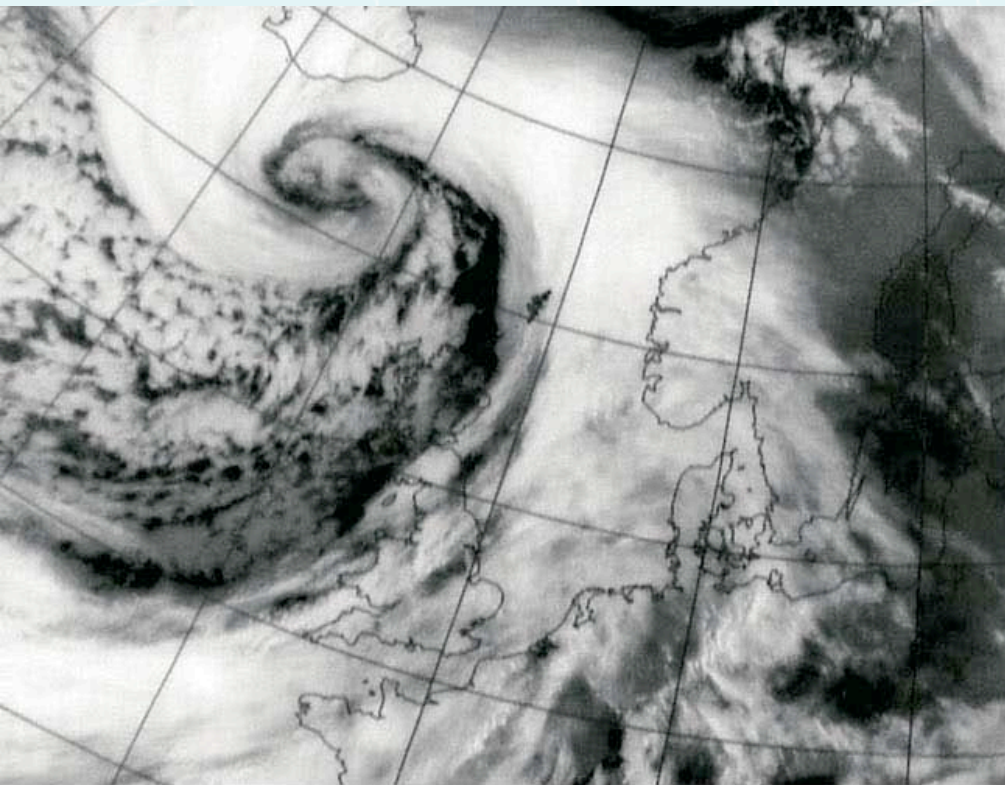
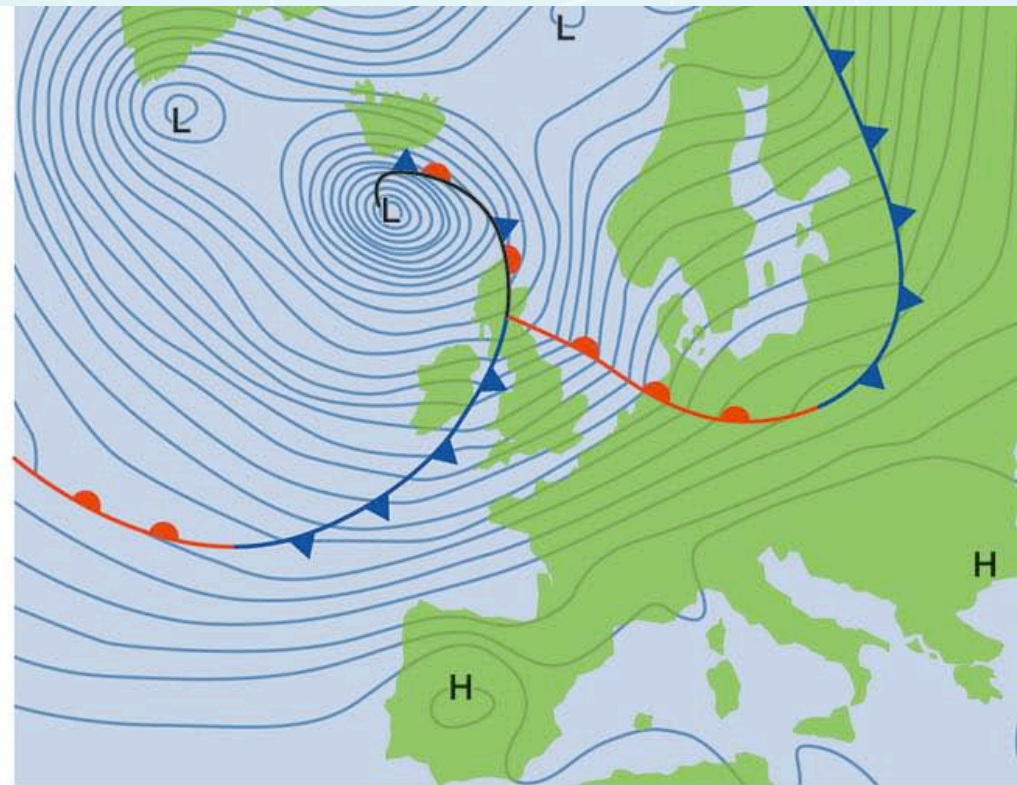


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# Weather Forecasting

- Sources of weather forecasts
  - telephone/fax
  - TV
  - internet
  - newspaper
  - posted bulletins
  - radio
  - observation