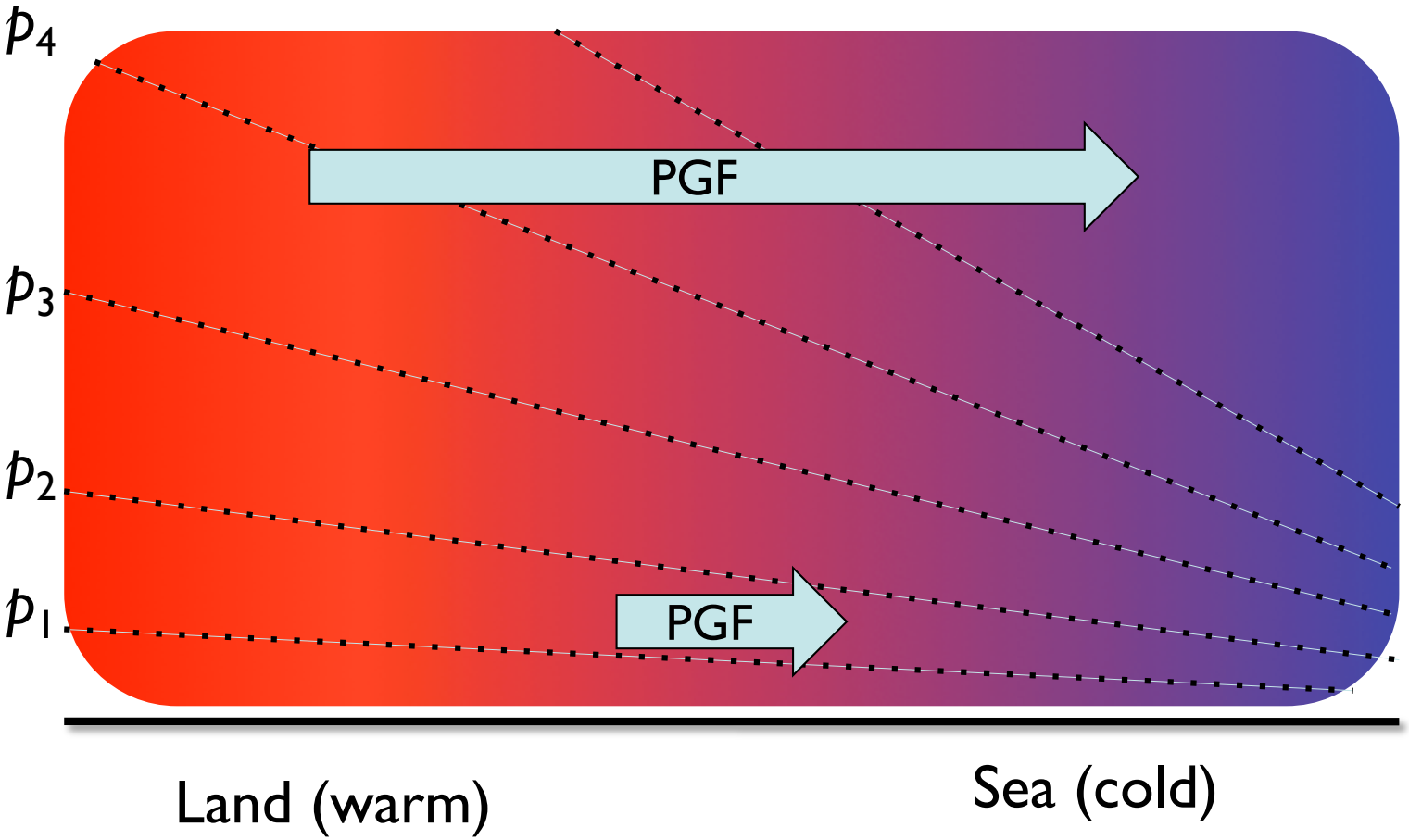
LAND AND SEA BREEZE

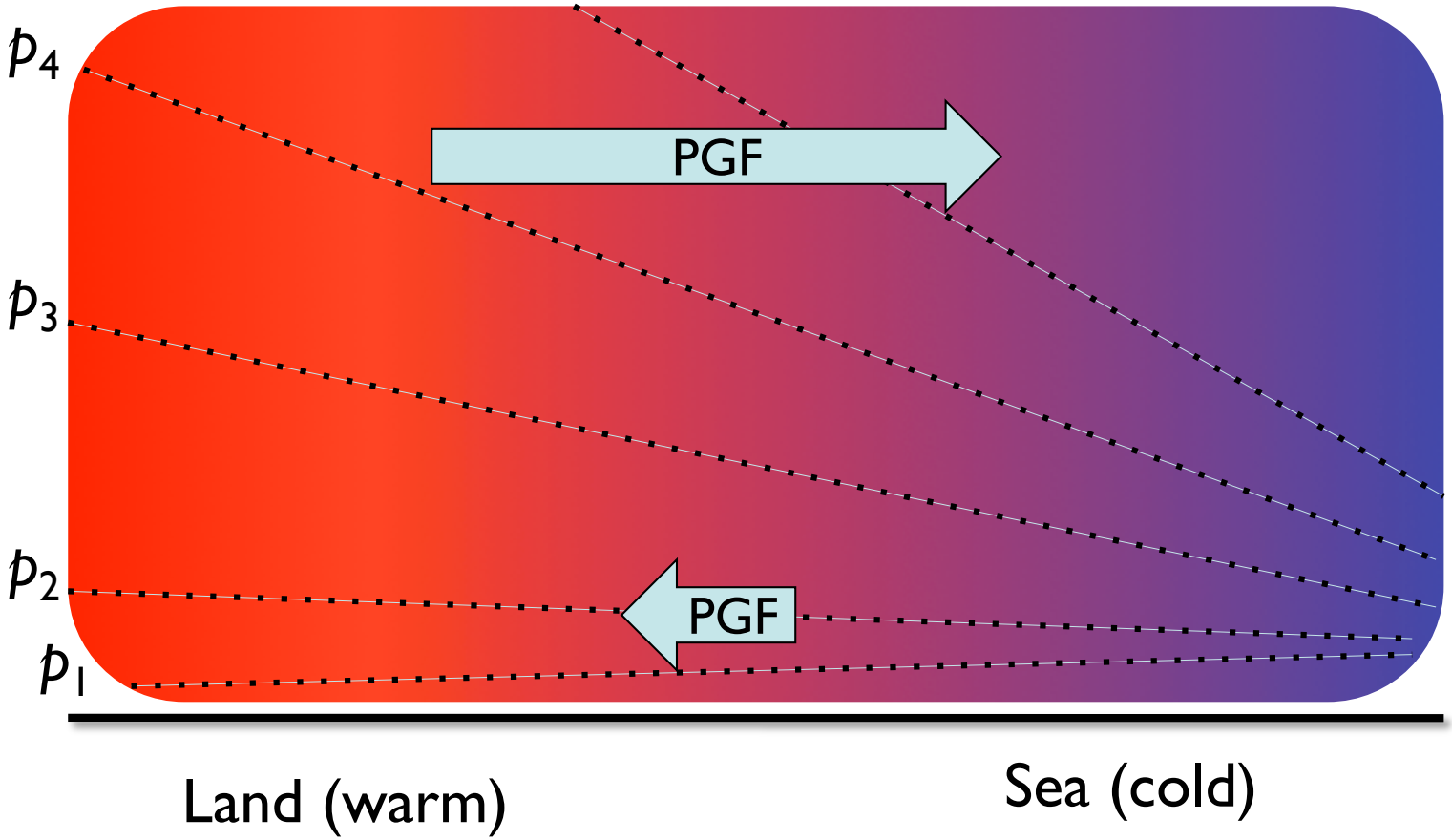
- During the day, the land heats up quickly, while the ocean heats up slowly
- The higher temperatures over land create lower pressure at the surface and the lower temperatures over the ocean create higher pressure at the surface
- This produces a pressure gradient from the ocean to the land
- The wind flows from the sea to the land – this is known as the *sea breeze*
- At night, this process reverses, and the land cools more quickly than the ocean. This creates an area of lower pressure over the sea, and an area of higher pressure over the land
- The wind then flows from the land to the sea – this is known as the *land breeze*

Land-sea breeze



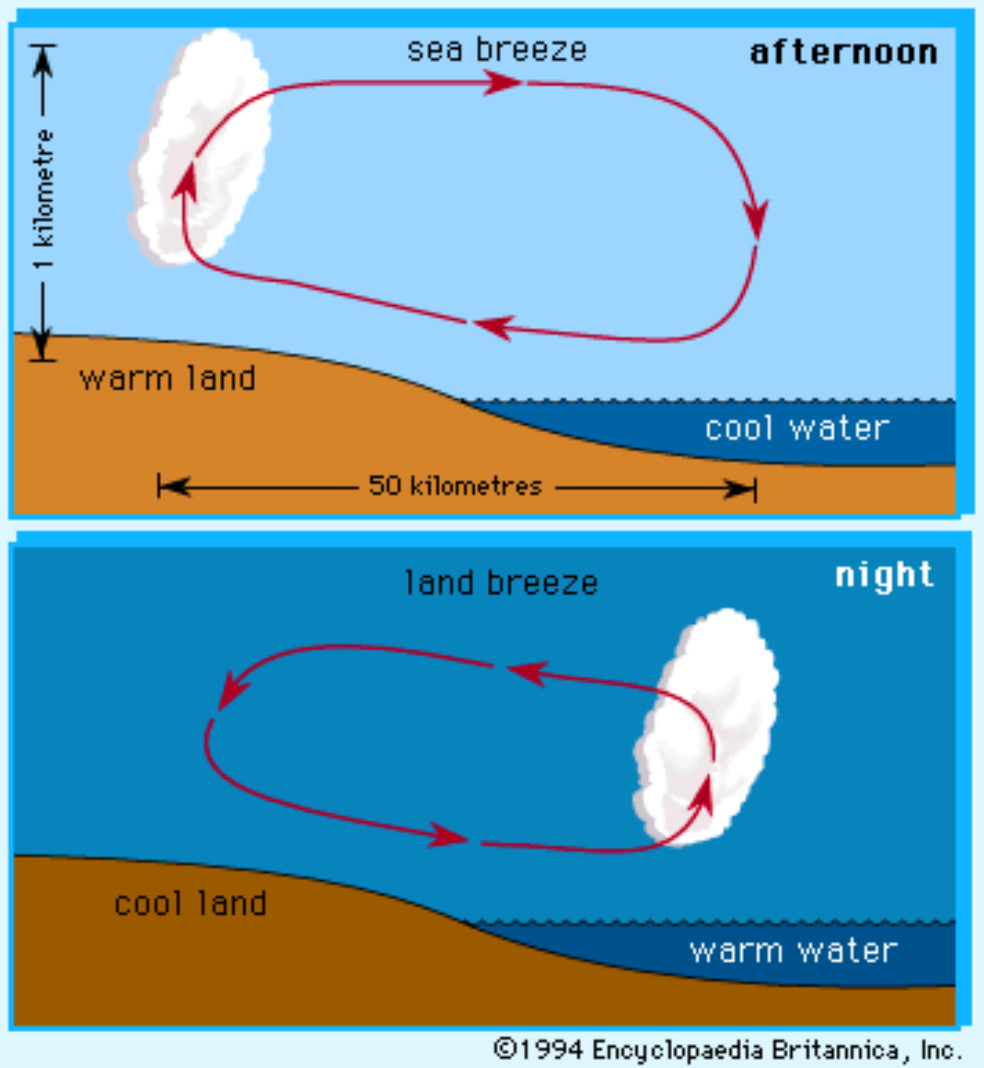
Initial net displacement of air from land to sea

Land-sea breeze



After a while, surface pressure build up over sea and decreases over land, creating return flow

Land-sea breeze



LAKE BREEZE

- The Great Lakes are a large enough body of water to cause the sea breeze effect to take place
- This is called the *lake breeze*

Lake breeze on Lake Michigan, July 13, 2000.

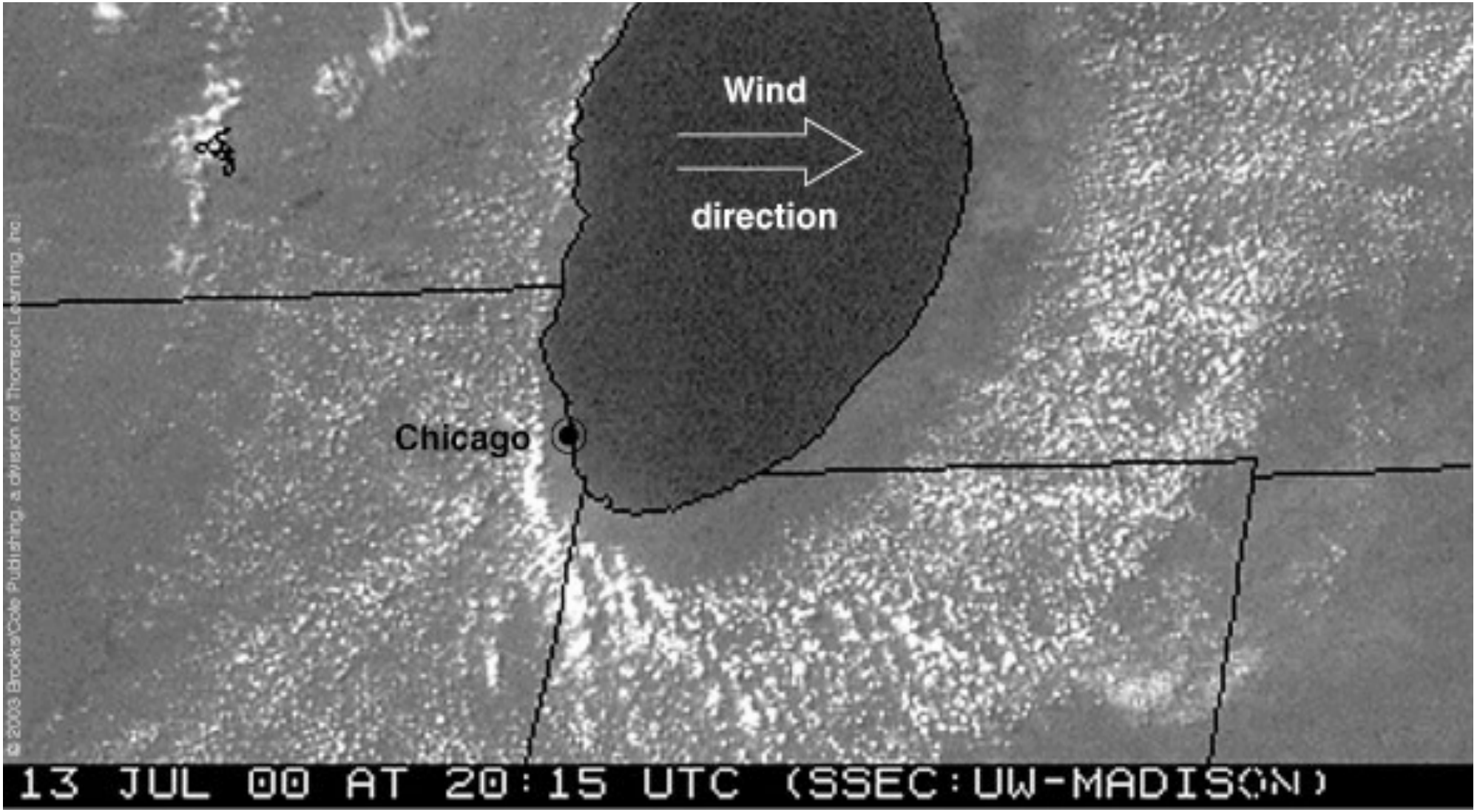
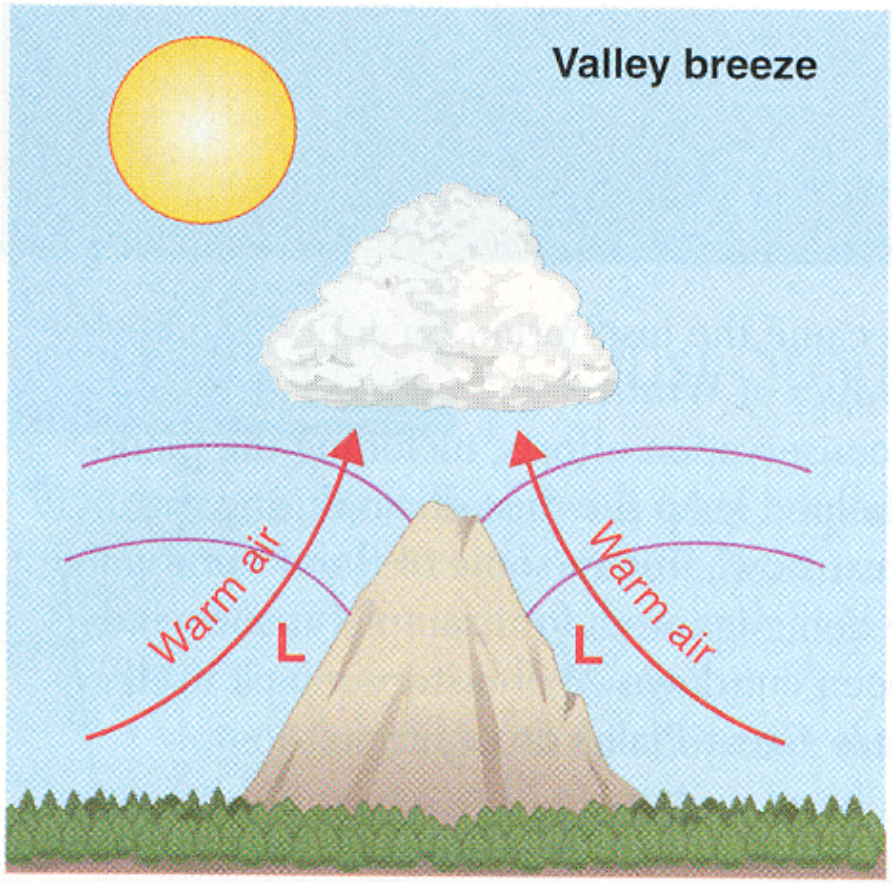


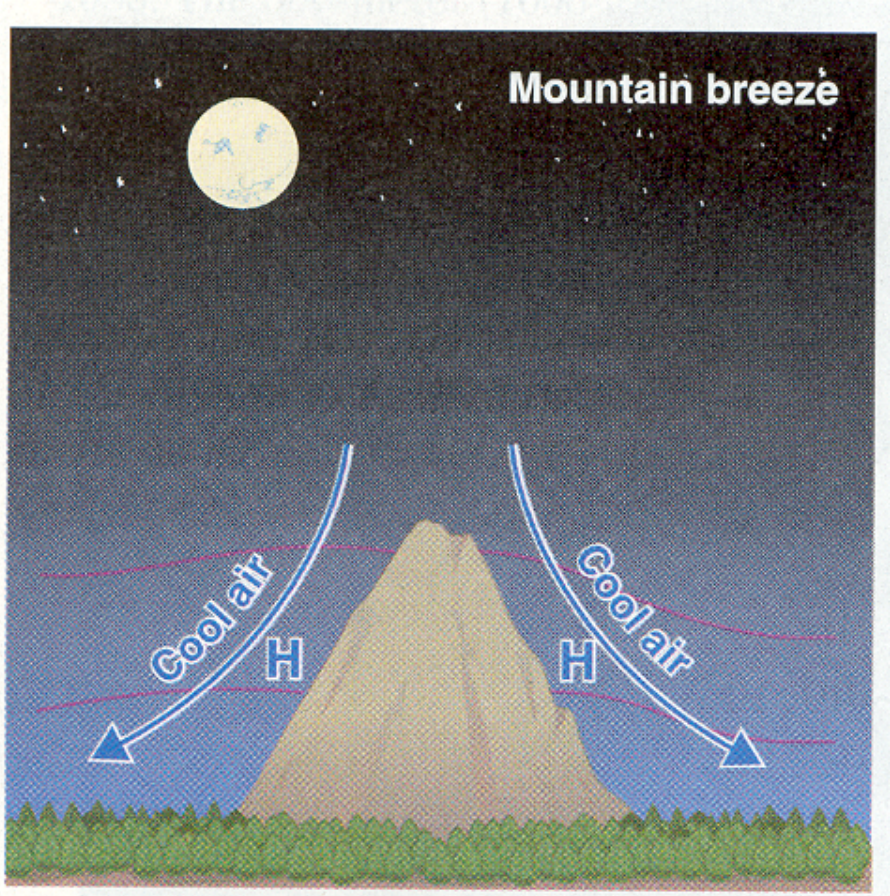
Fig. 12.10

MOUNTAIN AND VALLEY BREEZE

- During the day, the slopes of the mountain heat up more quickly than the valley floor
- Like the sea breeze, the flow goes from higher pressure and cooler temperatures (the valley/sea) to lower pressure and warmer temperatures (the mountain slope/land)
- Valley breeze
- At night, the mountain slopes cool more quickly than the valley floor, and the winds reverse – this is the *mountain breeze*

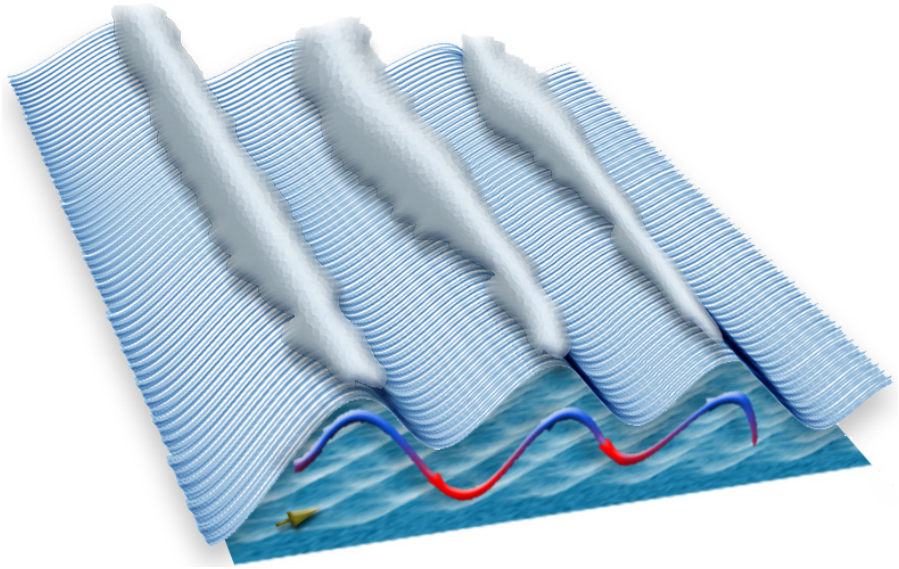
Mountain and Valley Breeze





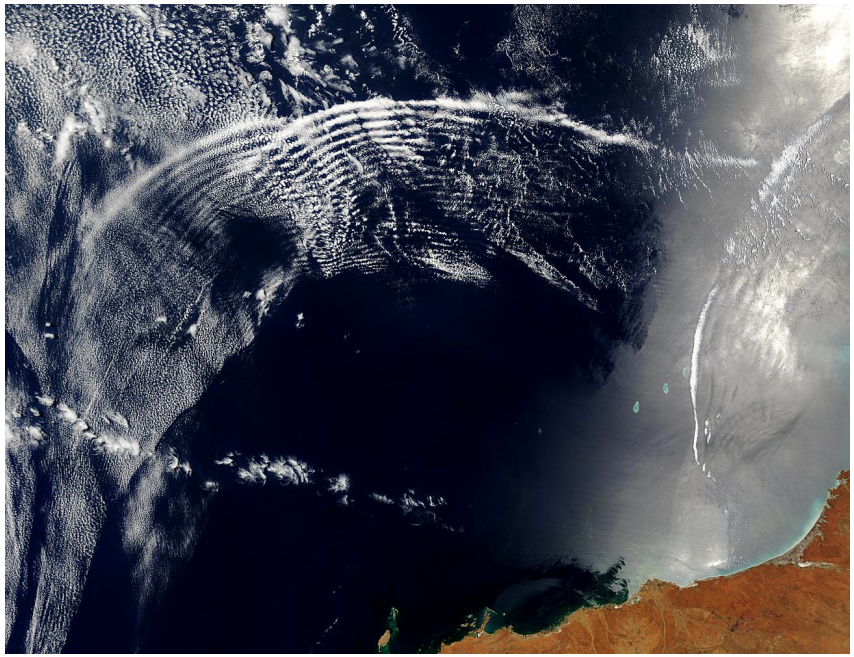
Gravity waves

• Atmosphere is *stably stratified:* a vertically displaced parcel spontantaneously returns to its original height
• Parcel *overshoots*, and an oscillation ensues
• The oscillation perturbs neighbouring parcels, and a wave is formed
• Surface ripples on a pond when a stone is thrown in are an example of gravity waves



In a moist atmosphere, the upward part of the parcel motion may be associated with condensation and cloud formation

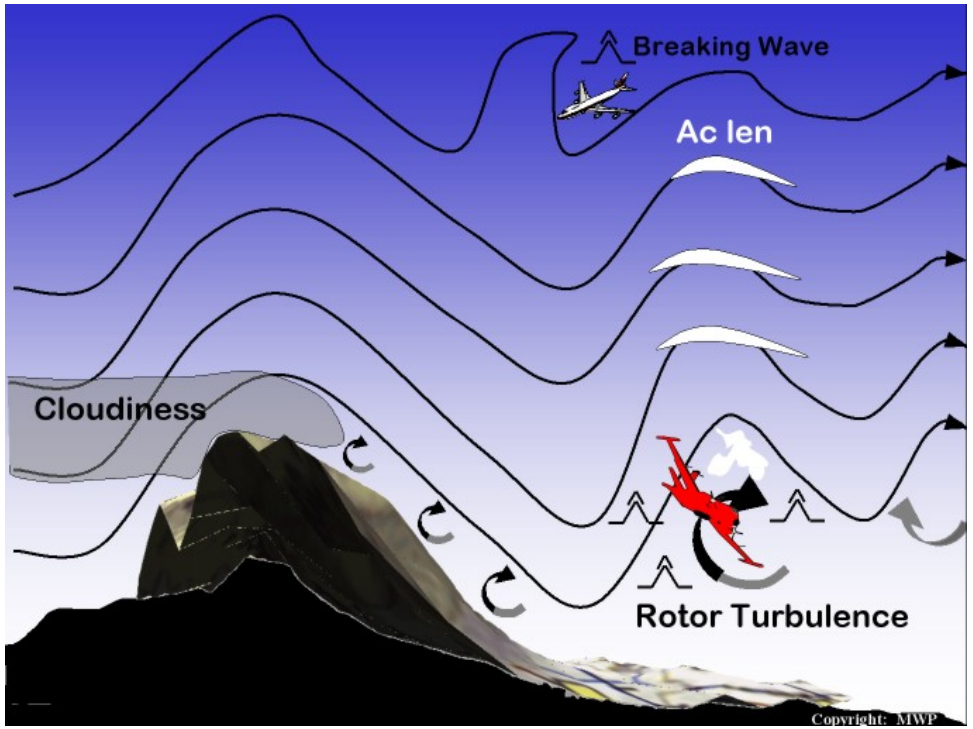
Gravity waves



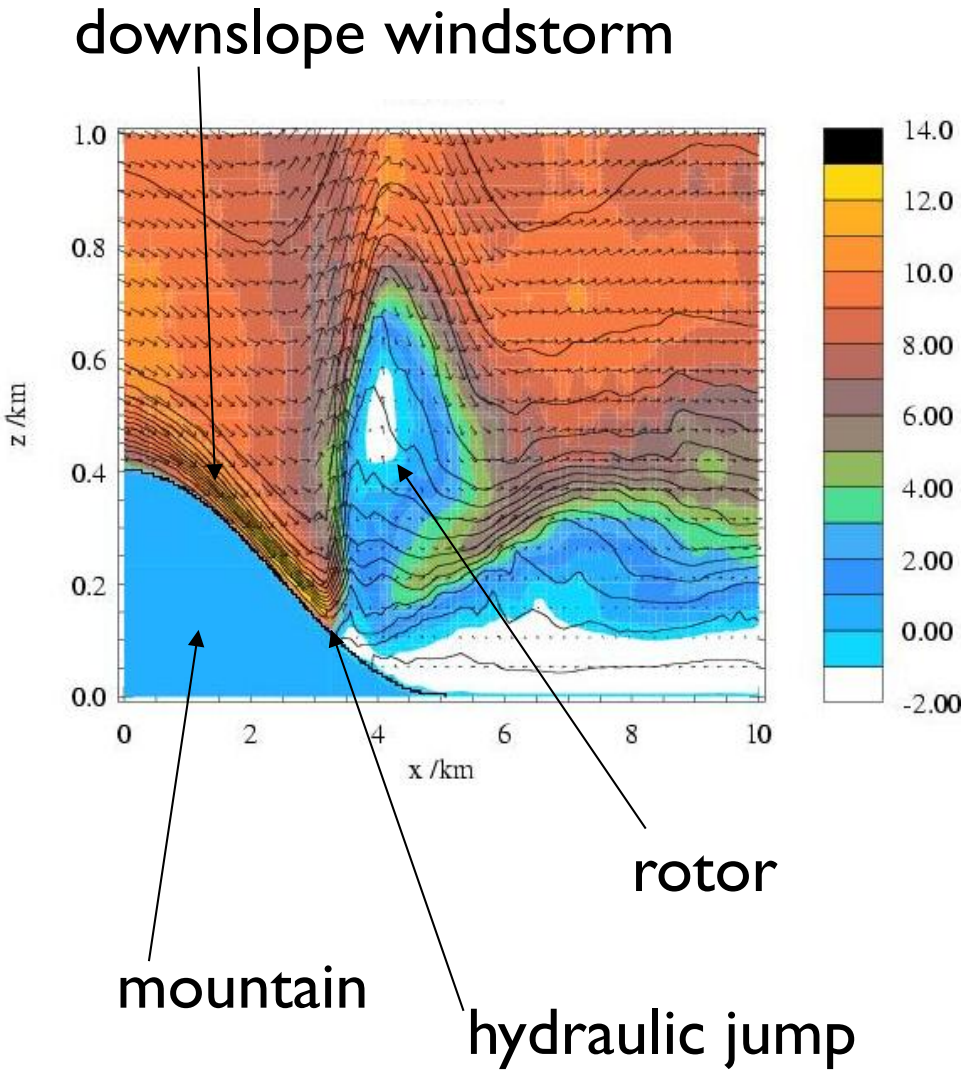
breaking gravity waves

Mountain (or lee) waves

- They are gravity waves excited by large-scale wind flowing over mountains
- Create stationary (non-propagating) waves
- Fixed *lenticular clouds* downwind of mountain
- Strong downslope wind and turbulence poses important hazards



Mountain (or lee) waves

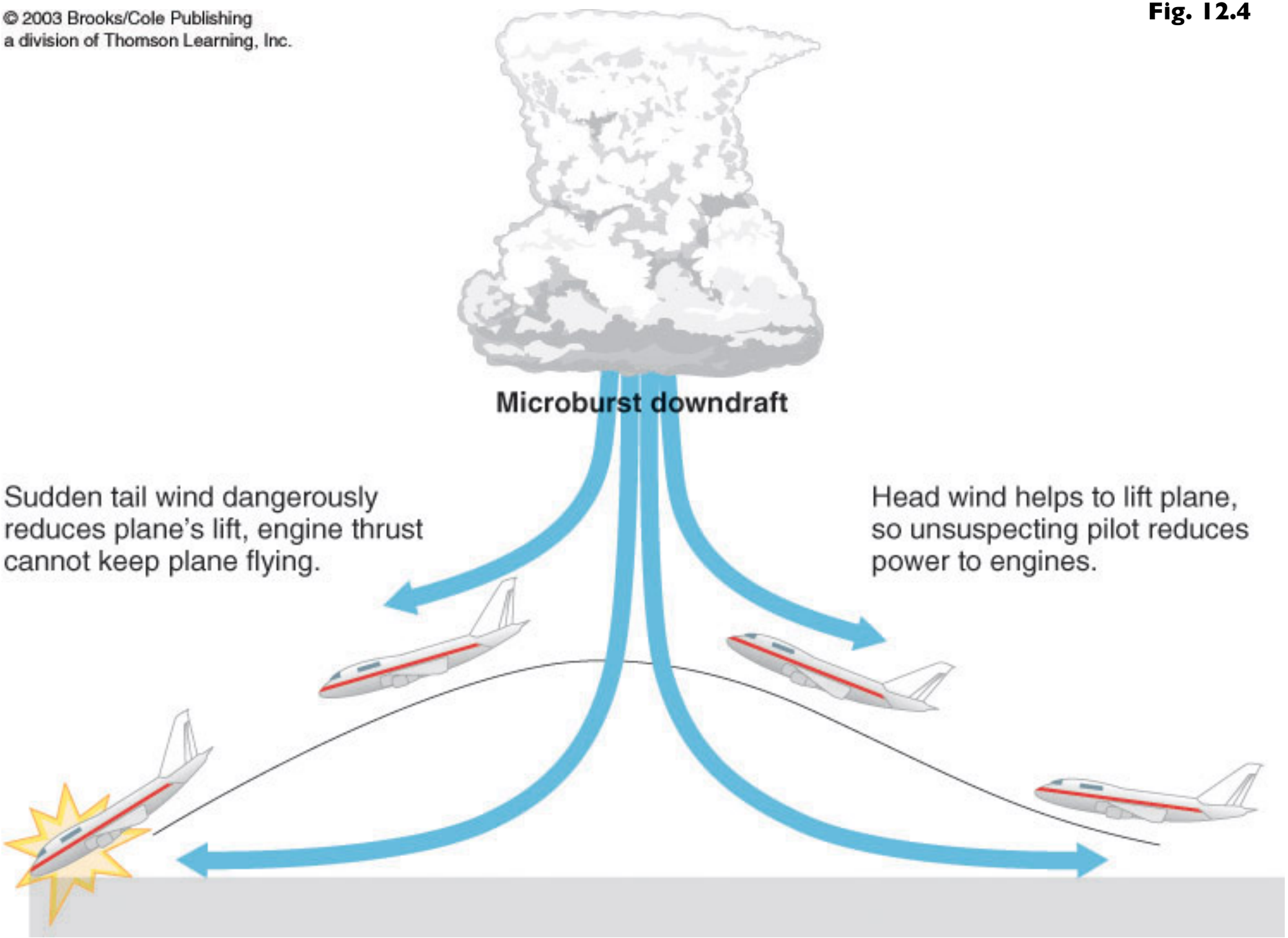


lenticular cloud

MICROBURSTS

- *Microbursts* are small scale (<4km), intense downdrafts
- They can sometimes be caused by the evaporation of rain below a thunderstorm
- This creates cold, heavy air, which then plunges to the Earth's surface, where it spreads outward and upward
- The intense winds last ~10 minutes, and can cause as much damage as a small tornado
- In the past, microbursts have been the cause of deadly airplane crashes while taking off and landing
- Nowadays, airports have microburst detectors

Fig. 12.4



Chinook (Föhen) winds

- These occur along the eastern edge of the Rocky Mountains, and south of the Alps where the mountains meet the flatlands
- When air from the west hits the mountains, it is lifted up over the mountains
- As the air is lifted, it loses much of it's water vapor
- When the air descends on the other side, it has little to no moisture in it, and as it sinks, it compresses and heats
- The dry, warm wind that results is called a *Chinook* (snow eater) in the US, and *Föhen wind* in Austria.
- In 1943, near Rapid City, SD, a chinook raised the temperature from -4°F to 45°F in two minutes!

Chinook or Föhen wind