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DOCUMENT TITLE

METEOROLOGY FOR AUSTRALIA

CHAPTER 23 – HIGH LEVEL JET STREAM

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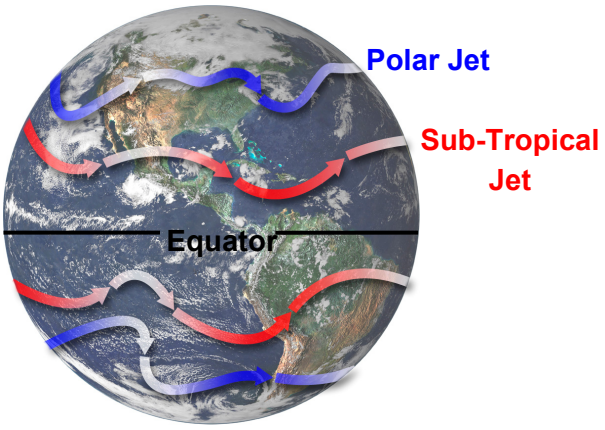
HIGH LEVEL JET STREAMS

INTRODUCTION



Thermal Winds and their formation were covered in detail in Chapter 11. The resultant of the Thermal Wind and the geostrophic wind gave us an upper wind. Should this upper wind become stronger than **60 kts**, then it would be called a jet stream.

A jet stream is a strong narrow current in the upper troposphere and is characterised by strong vertical and horizontal wind shears.

USUAL DIMENSIONS

Speed	>60 kts
Length	> 1,000 km (“hundreds of miles long”)
Width	> 300 km (“200 miles wide”)
Depth	> 3 km (“2 miles deep”)
Vertical shear	10 to 20 kts/kilometre (“5-10 kts/1,000’ “)
Lateral shear	10 kts/kilometre (“50 kts/100nm”)

A jet stream is produced when a westerly wind in the lower troposphere in reinforced by a westerly thermal wind component. This westerly wind will increase in speed up to the tropopause (above the troposphere, where the layer is isothermal, the temperature gradient may be reversed).

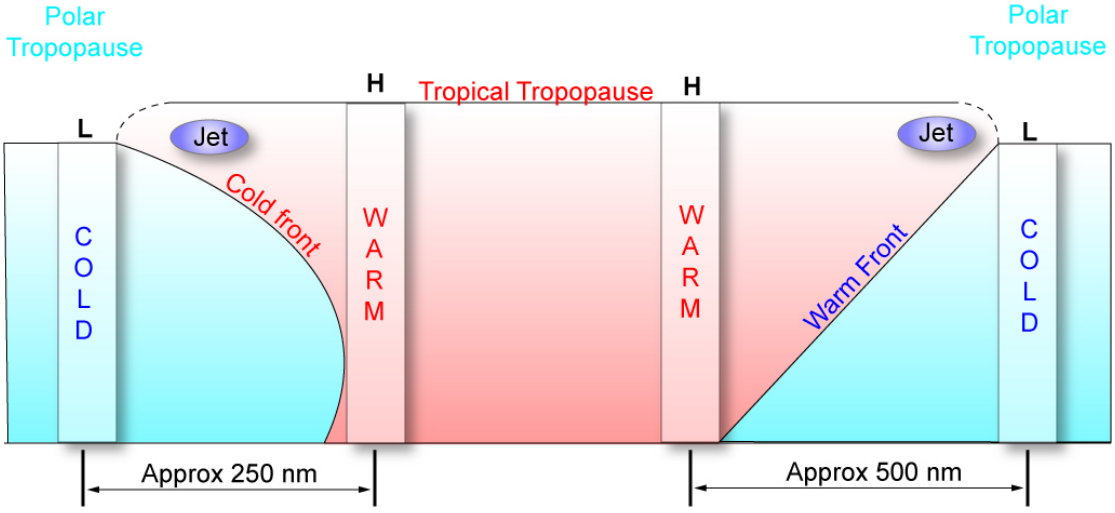
Bands of cirrus cloud are often a visual indication of jet streams. The area of maximum likelihood of turbulence is below and to the pole ward side of the jet stream core. A sharply curved jet stream will produce greater turbulence than a straight jet stream due to the extra windshear.

MID-LATITUDE JET

The Mid-Latitude Jet, also known as the MLJ, the Polar Jet or the Frontal Jet, has the following characteristics:

- It is a westerly wind
- Average speed is 80 kts
- It is found at 300 hPa (30,000 to 33,000 ft)
- It gets its name because it is found in the latitudes 30° to 60°N or 30° to 60°S
- It is associated with frontal systems. These jets are found in the warm sector.
- The strongest jet is in the northern hemisphere.

It blows in the warm air mass, aligned parallel to the surface fronts, just below the warm air tropopause at a height, typically, of about 33,000 ft. The jet associated with the warm front (the warm jet) is found about 400 to 500 miles ahead of the surface warm front. Because of the steeper slope of the cold front, the cold jet is usually located some 200 miles behind the cold front (the cold jet). The steeper slope of the cold front produces a steeper thermal gradient so that the cold jet is typically some 20 kts faster than the warm jet.



SUB-TROPICAL JET

The Sub-Tropical Jet, or STJ as it is sometimes known, has the following principal characteristics:

- It is a westerly wind
- Its average speed is 120 kts
- It is found at 200 hPa (38,000 ft)
- Its latitude in winter is 25° to 30°S (Central Australia)
- Its latitude in summer is 30° to 35°S (Adelaide)
- It is found vertically above the sub-tropical HP ridge
- The strongest jet is in the Southern Hemisphere.

The Sub-Tropical Jet tends to have more of a W to E orientation than the Polar Jet and tends to be more continuous. Its strength depends on the thermal gradient between the warm equatorial air and the cooler mid latitude air, and jets with a speed of up to 200 kt have been recorded.

Both the Sub-Tropical Jet and the polar jet migrate as the pressure systems migrate with the seasons. They both tend to travel towards the pole and weaken in summer but move towards the equator and strengthen in winter.

Sth. H.	winter	Central Aust.	20°S
	summer	Adelaide	30°S
Nth. H.	winter	Sahara Desert	20°N
	summer	North Africa	30°N

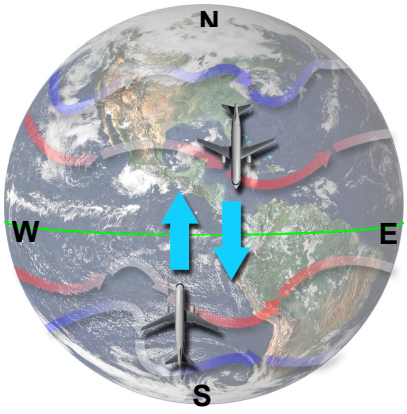
EQUATORIAL JET

At the ITCZ the upper winds are generally easterly. This is due to a reversed thermal wind component and due to the entrapment of the lower SE and NE Trades. The easterly is usually light, (10-20Kts.), with the exception of Singapore-India-East Africa in July when winds of up to 60kts occur. The principal characteristics of the Equatorial Jet are as follows:

- It is an easterly wind
- Its average speed 60 kts
- It is found at 150 hPa (45,000 ft)
- It is found in the latitudes 0 to 15°N
- It is vertically above the ITCZ
- It is found between SE Asia and East Africa over the Indian Ocean / Sub Continent area in June/July.

FLYING ABOVE OR BELOW A JET STREAM

Often in the Australian ATPL exam the concept arises of having to avoid upper air turbulence, i.e. the tropopause. If the aircraft is to avoid the turbulence (tropopause) you have to establish whether the aircraft is above or below the tropopause.



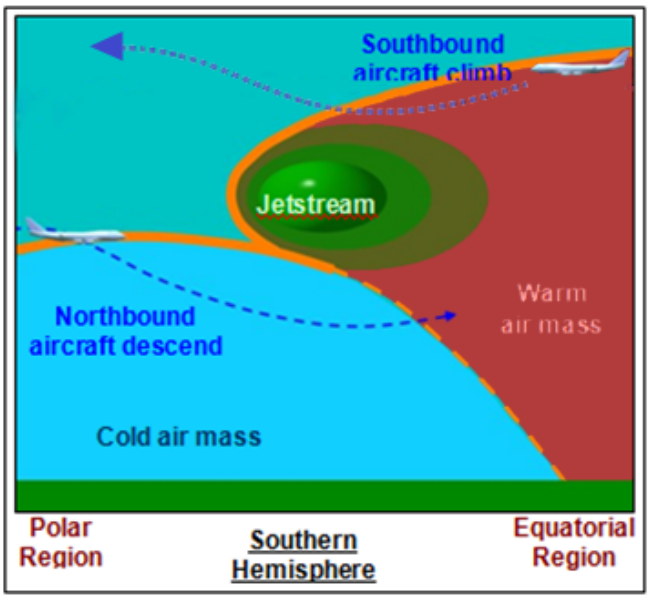
Assume the flights are N-S in orientation

Assume the jet streams are W-E in orientation

BELOW the tropopause the winds are westerly in nature (hot at the equator, cold at the poles)

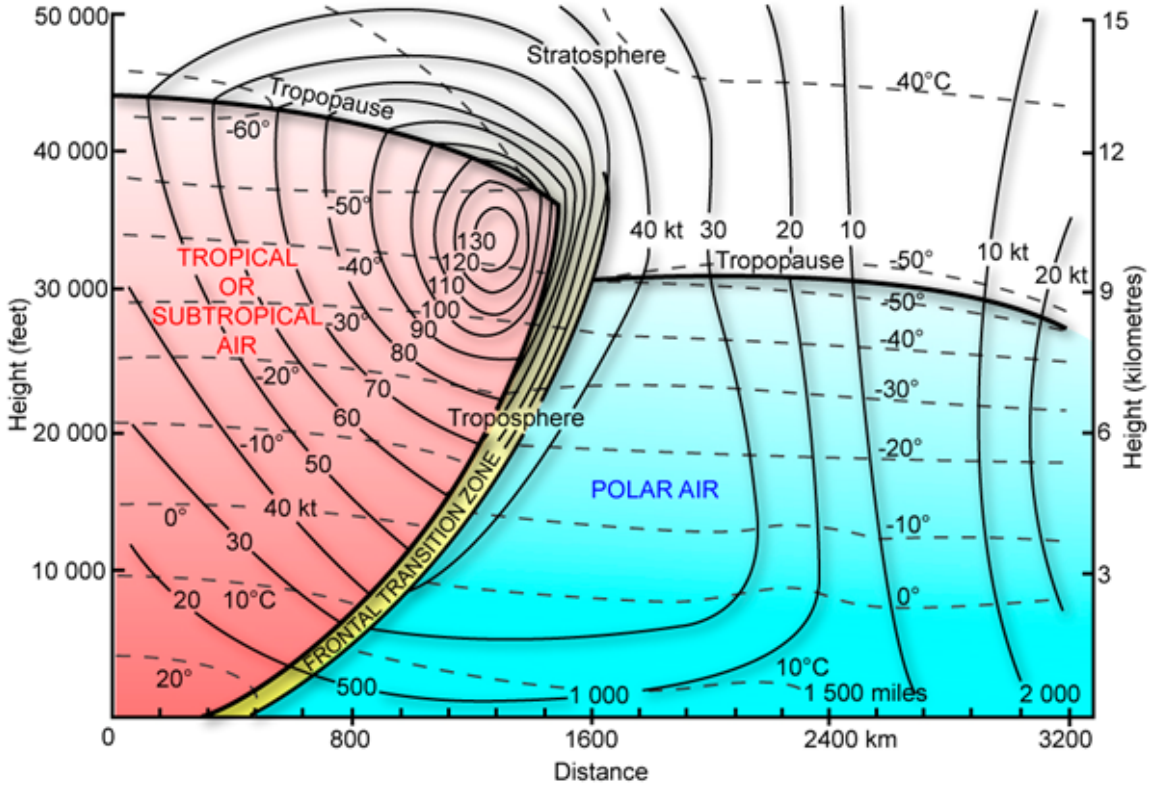
ABOVE the tropopause the thermal gradient is reversed (cold at the equator, warm at the poles). This has the effect of reducing the westerly winds as an easterly component is introduced.

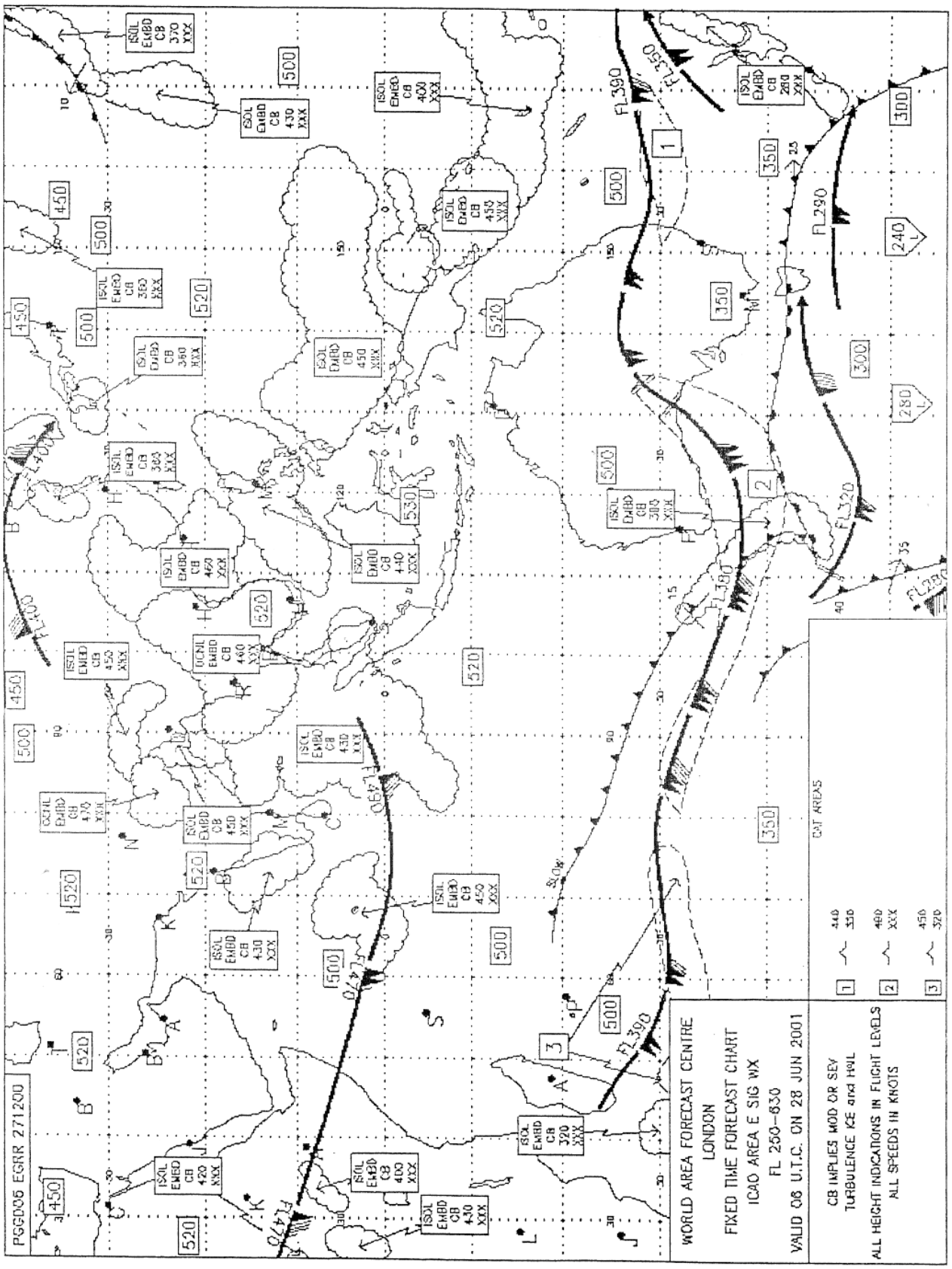
For example:



"On a flight from Darwin to Adelaide, the aircraft is experiencing turbulence. The OAT is increasing; would you climb or descend to avoid turbulence"

If you are flying southwards and the OAT is increasing, the aircraft must be above the tropopause. A descent could lead to increased turbulence as the aircraft would descend into the tropopause. The aircraft would climb to minimise turbulence.

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