

Figure 4.2 Sea level pressure and station reports over Oklahoma and surrounding states on 14 February 2003 at 12 UTC

Table 5.1 Scales for some typical atmospheric phenomena. A planetary wave is a type of wave in the atmosphere that encircles the entire Earth (see Chapter 8). A foehn or a chinook is a strong wind that is created when air flows downhill from a high elevation (see Section 13.3) – such winds often have names associated with a particular mountain range

Type of motion	Horizontal length scale	Time scale
Cold front	50 km	1–2 days
Tornado	100 m	Minutes
Mid-latitude weather system	1000 km	Several days
Cumulus cloud	1 km	Tens of minutes
Surf	10 m	Seconds
Planetary wave	10 000 km	Weeks–months
European Alps foehn or Rocky Mountain chinook	10 km	Hours

Table 5.2 Typical scales for a mid-latitude weather system

Scale	Symbol	Magnitude
Horizontal wind scale	U	10 m s^{-1}
Vertical wind scale	W	10^{-2} m s^{-1}
Horizontal length scale	L	10^6 m
Vertical length scale (depth of troposphere)	H	10^4 m
Time scale (L/U)	T	10^5 s
Kinematic viscosity	ν	$10^{-5} \text{ m}^2 \text{ s}^{-1}$
Dynamic pressure scale	$\delta p / \rho$	$10^3 \text{ m}^2 \text{ s}^{-2}$
Total pressure scale	P / ρ	$10^5 \text{ m}^2 \text{ s}^{-2}$
Gravity	g	10 m s^{-2}
Density variation scale	$\delta \rho / \rho$	10^{-2}

Οριζόντια ανάλυση κλιμάκων

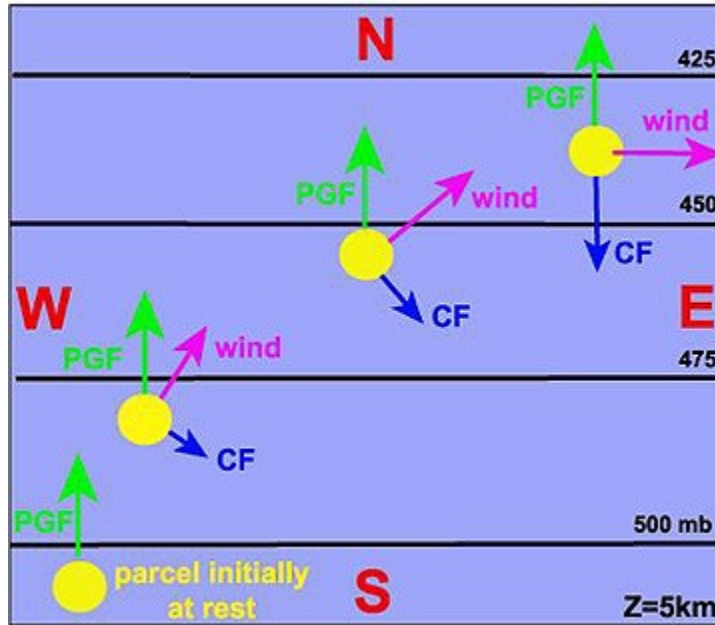
x-eqn	$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} + w \frac{\partial u}{\partial z}$	$= -\frac{1}{\rho} \frac{\partial p_d}{\partial x} + \nu \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right) + \nu \frac{\partial^2 u}{\partial z^2} + 2\Omega v \sin \phi - 2\Omega w \cos \phi$						
y-eqn	$\frac{\partial v}{\partial t} + u \frac{\partial v}{\partial x} + v \frac{\partial v}{\partial y} + w \frac{\partial v}{\partial z}$	$= -\frac{1}{\rho} \frac{\partial p_d}{\partial y} + \nu \left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} \right) + \nu \frac{\partial^2 v}{\partial z^2} - 2\Omega u \sin \phi$						
scale	$\frac{U^2}{L}$	$\frac{UW}{H}$	$\frac{\delta p}{\rho L}$	$\frac{\nu U}{L^2}$	$\frac{\nu U}{H^2}$	$f_0 U$	$\approx f_0 W$	
magnitude	10^{-4}	10^{-4}	10^{-5}	10^{-3}	10^{-16}	10^{-12}	10^{-3}	10^{-6}

Κατακόρυφη ανάλυση κλιμάκων

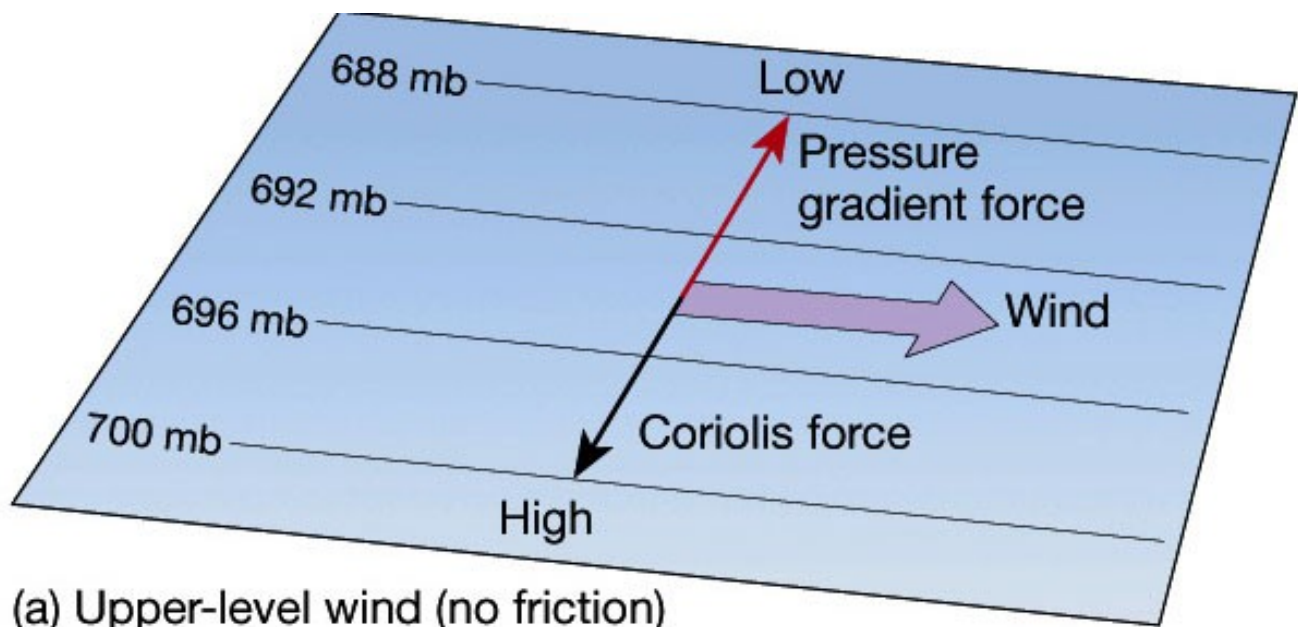
z-eqn	$\frac{\partial w}{\partial t} + u \frac{\partial w}{\partial x} + v \frac{\partial w}{\partial y} + w \frac{\partial w}{\partial z}$	$= -\frac{1}{\rho} \frac{\partial p}{\partial z} + \nu \left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2} \right) + \nu \frac{\partial^2 w}{\partial z^2} - g + 2\Omega u \cos \phi$						
scale	$\frac{UW}{L}$	$\frac{UW}{L}$	$\frac{W^2}{H}$	$\frac{P}{\rho H}$	$\frac{\nu W}{L^2}$	$\frac{\nu W}{H^2}$	g	$f_0 U$
magnitude	10^{-7}	10^{-7}	10^{-8}	10	10^{-19}	10^{-15}	10	10^{-3}

z-eqn	$\frac{\partial w}{\partial t} + u \frac{\partial w}{\partial x} + v \frac{\partial w}{\partial y} + w \frac{\partial w}{\partial z}$	$= -\frac{1}{\rho} \frac{\partial p_d}{\partial z} + \nu \left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2} \right) + \nu \frac{\partial^2 w}{\partial z^2} - \frac{(\rho - \rho_0)}{\rho} g + 2\Omega u \cos \phi$						
scale	$\frac{UW}{L}$	$\frac{UW}{L}$	$\frac{W^2}{H}$	$\frac{\delta p}{\rho H}$	$\frac{\nu W}{L^2}$	$\frac{\nu W}{H^2}$	$\frac{\delta \rho g}{\rho}$	$f_0 U$
magnitude	10^{-7}	10^{-7}	10^{-8}	10^{-1}	10^{-19}	10^{-15}	10^{-1}	10^{-3}

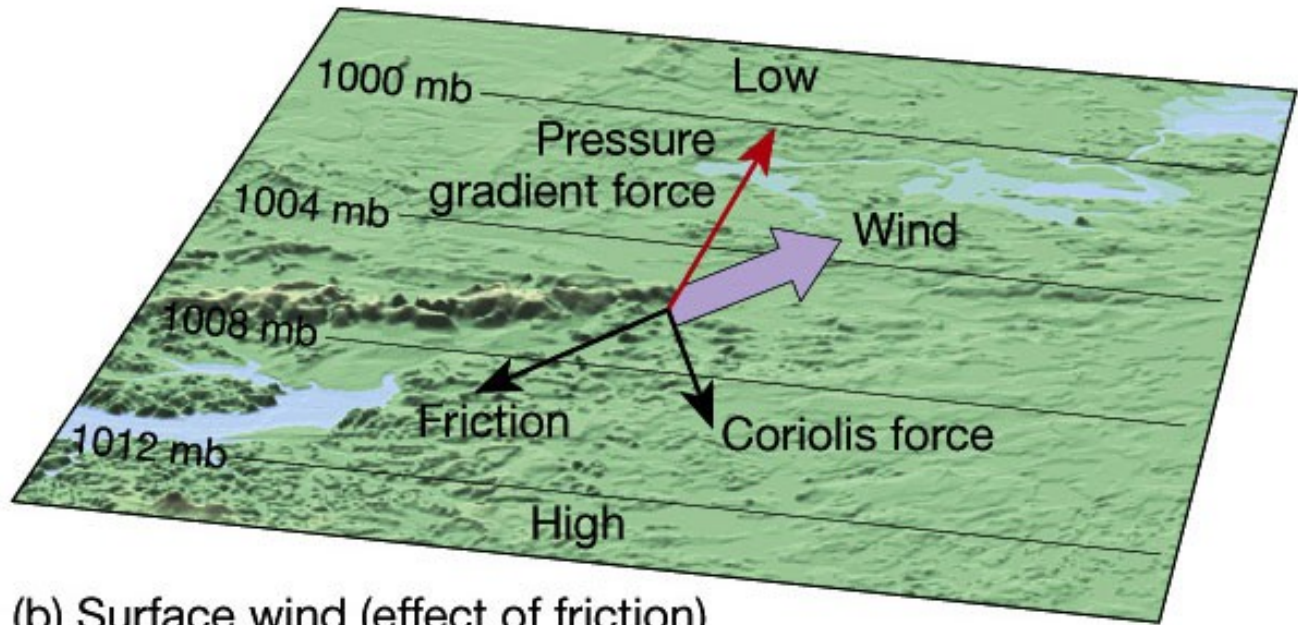
Μια μάζα αέρα που είναι αρχικά σε ισορροπία θα κινηθεί απο τις υψηλές πιέσεις προς τις χαμηλές. Καθώς κινείται θα αποκλίνει προς τα δεξιά (στο βόρειο ημισφαίριο) λόγω της δύναμης Coriolis. Με την αύξηση της ταχύτητας, αυξάνει και η δύναμη Coriolis μέχρι να εξισωθεί με τη δύναμη βαροβαθμίδας. Τότε η μάζα θα κινείται παράλληλα προς τις ισοβαρείς.



Η παρακάτω εικόνα δείχνει την επίδραση της τριβής κοντά στην επιφάνεια της γής. Λόγω της τριβής, το διάνυσμα της ταχύτητας υφίσταται μια περιστροφή αντίθετα με τη φορά των δεικτών του ρολογιού κατά περίπου 20° κοντά στην επιφάνεια της γής.



(a) Upper-level wind (no friction)



(b) Surface wind (effect of friction)