Analysis of Momentum Budget for TWP-ICE

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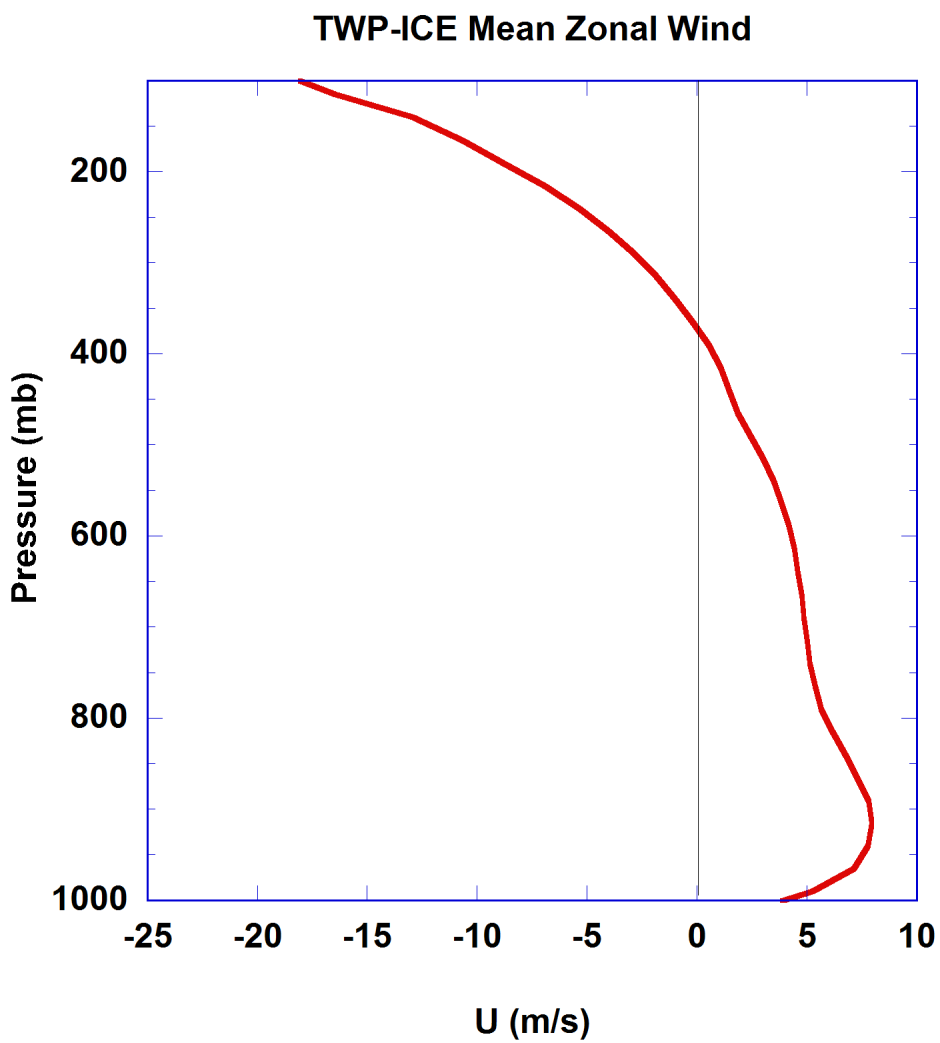
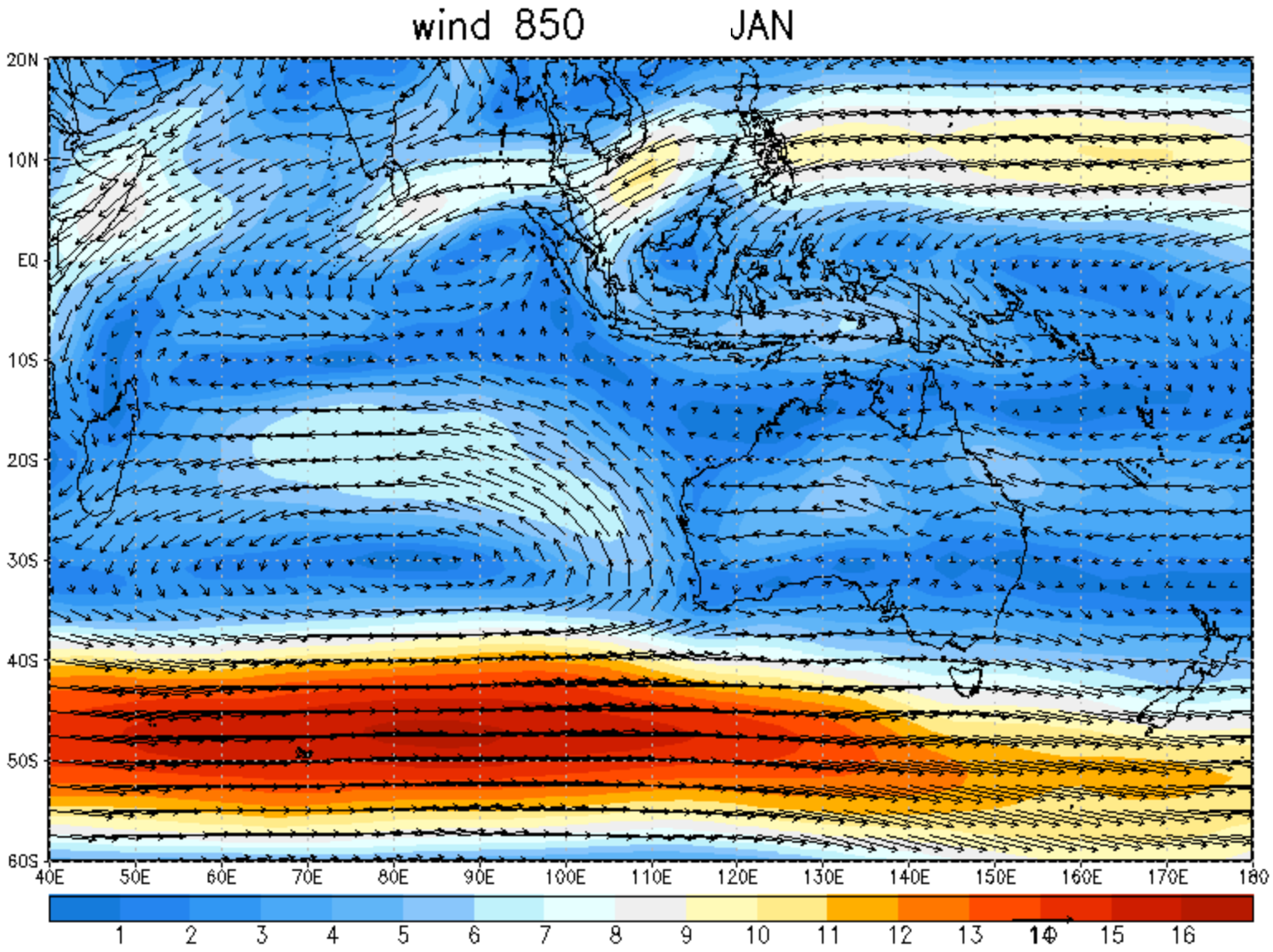
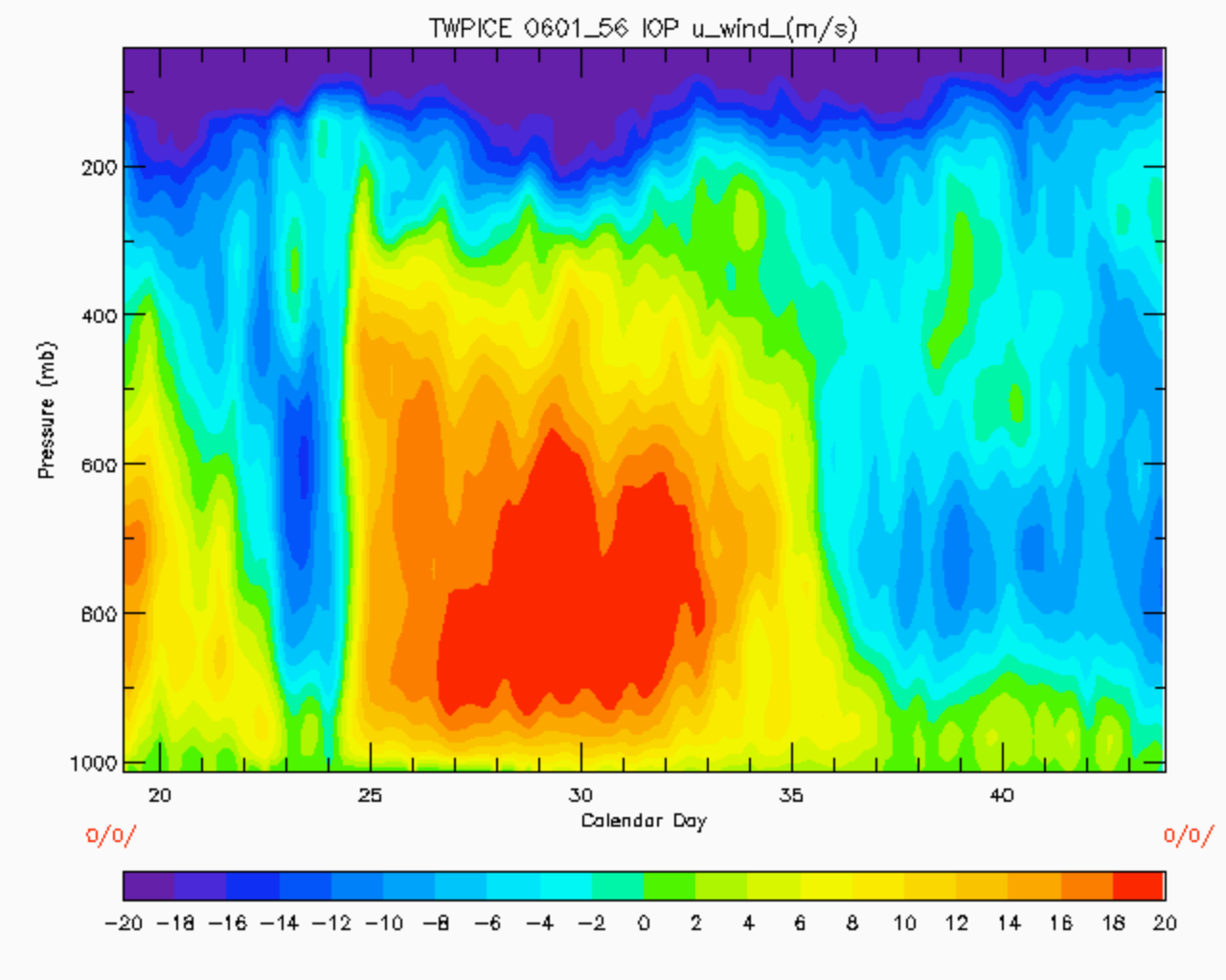
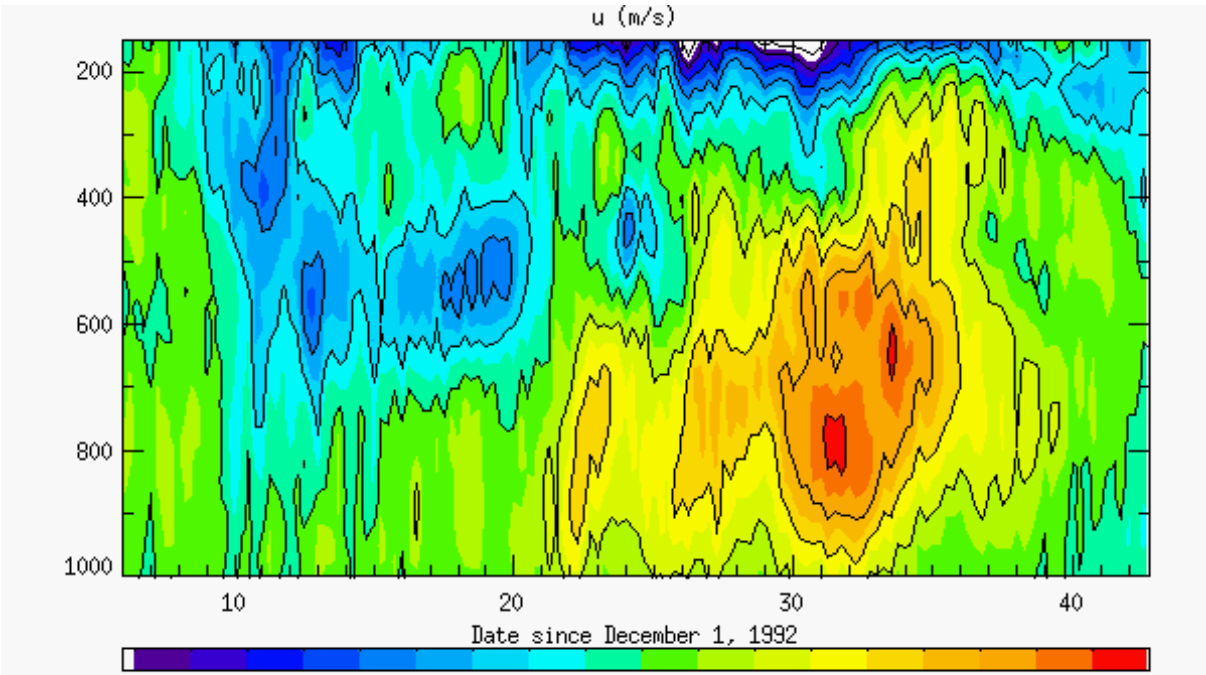
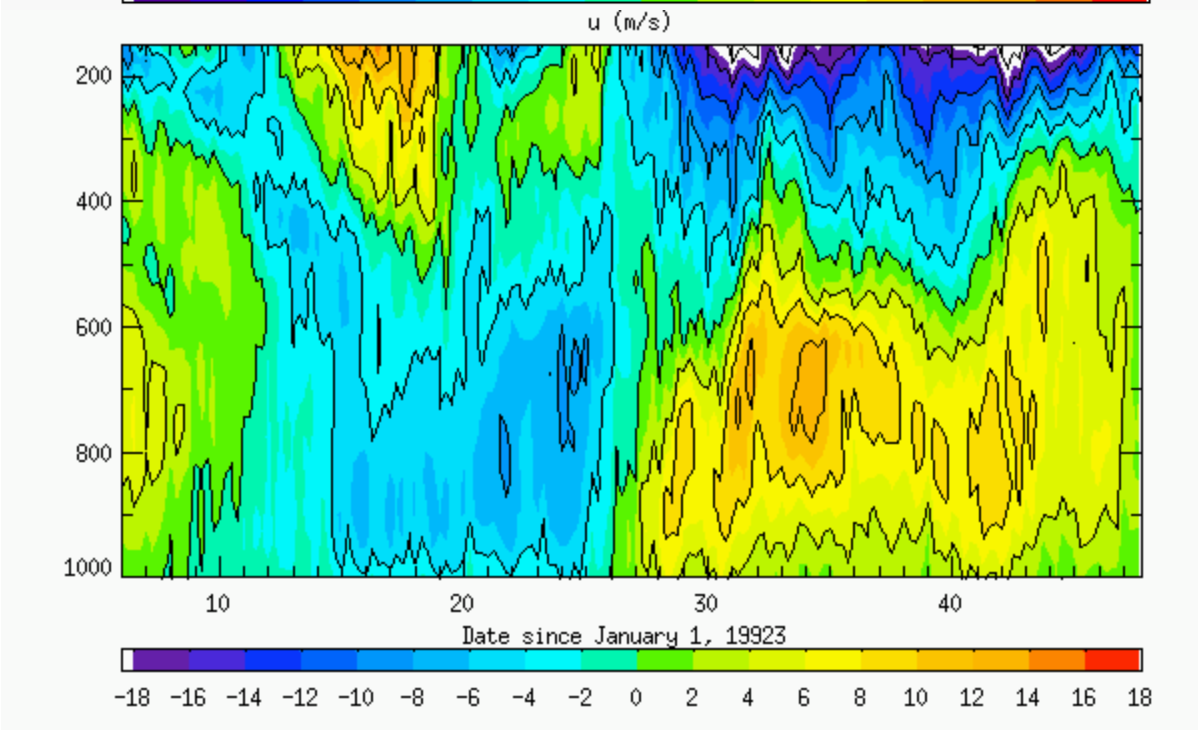

TWP-ICE Mean Zonal Wind
Pressure (mb)
200
400
600
800
1000
-25
-20
-15
-10
-5
0
5
10
U (m/s)


wind 850
JAN
20N
10N
EQ
10S
20S
30S
40S
50S
60S
40E
50E
60E
70E
80E
90E
100E
110E
120E
130E
140E
150E
160E
170E
180
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

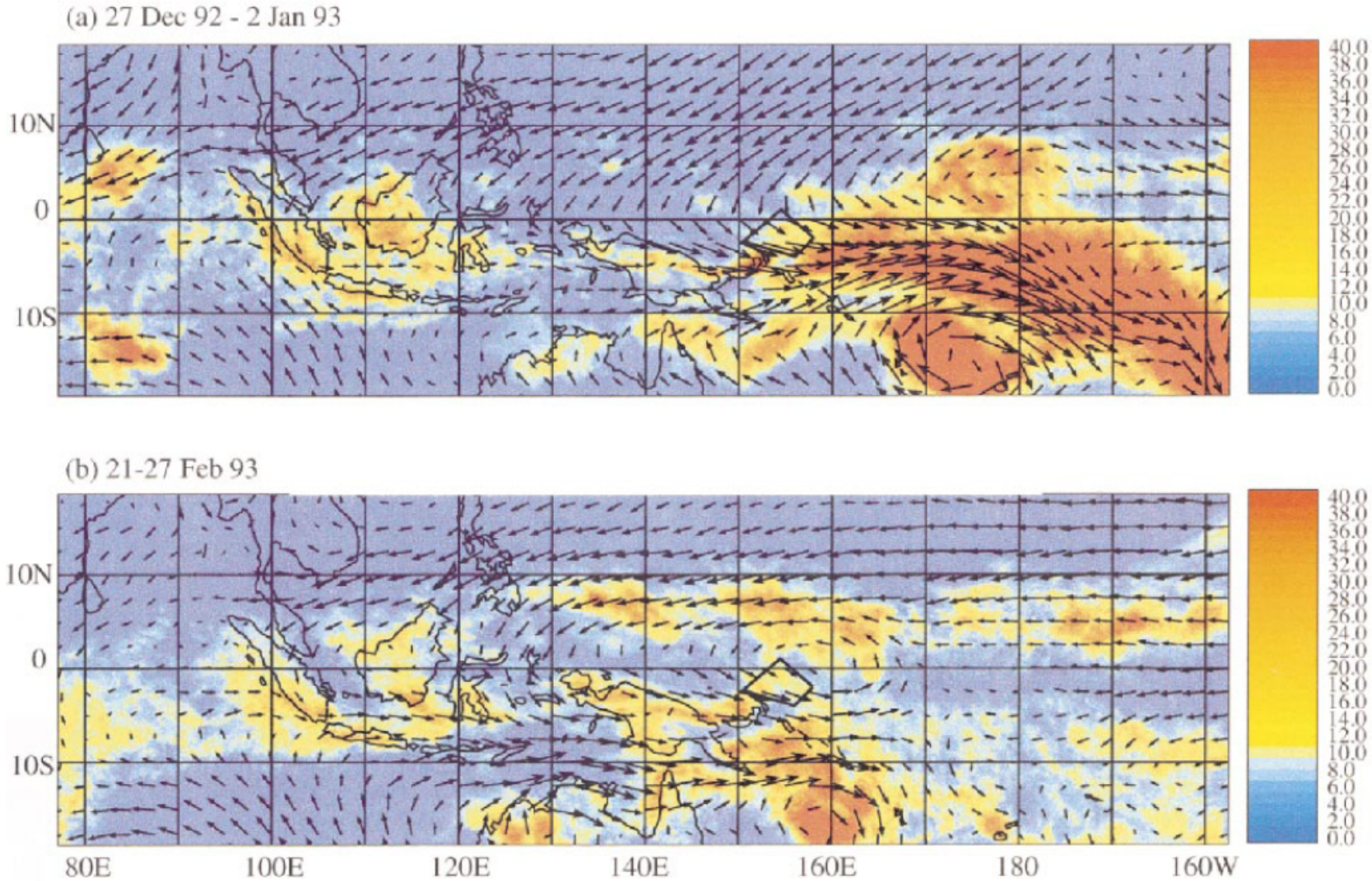

TWPICE 0601_56 IOP u_wind_(m/s)
Pressure (mb)
200
400
600
800
1000
20
25
30
35
40
Calendar Day
0/0/
0/0/
−20 −18 −16 −14 −12 −10 −8 −6 −4 −2 0 2 4 6 8 10 12 14 16 18 20



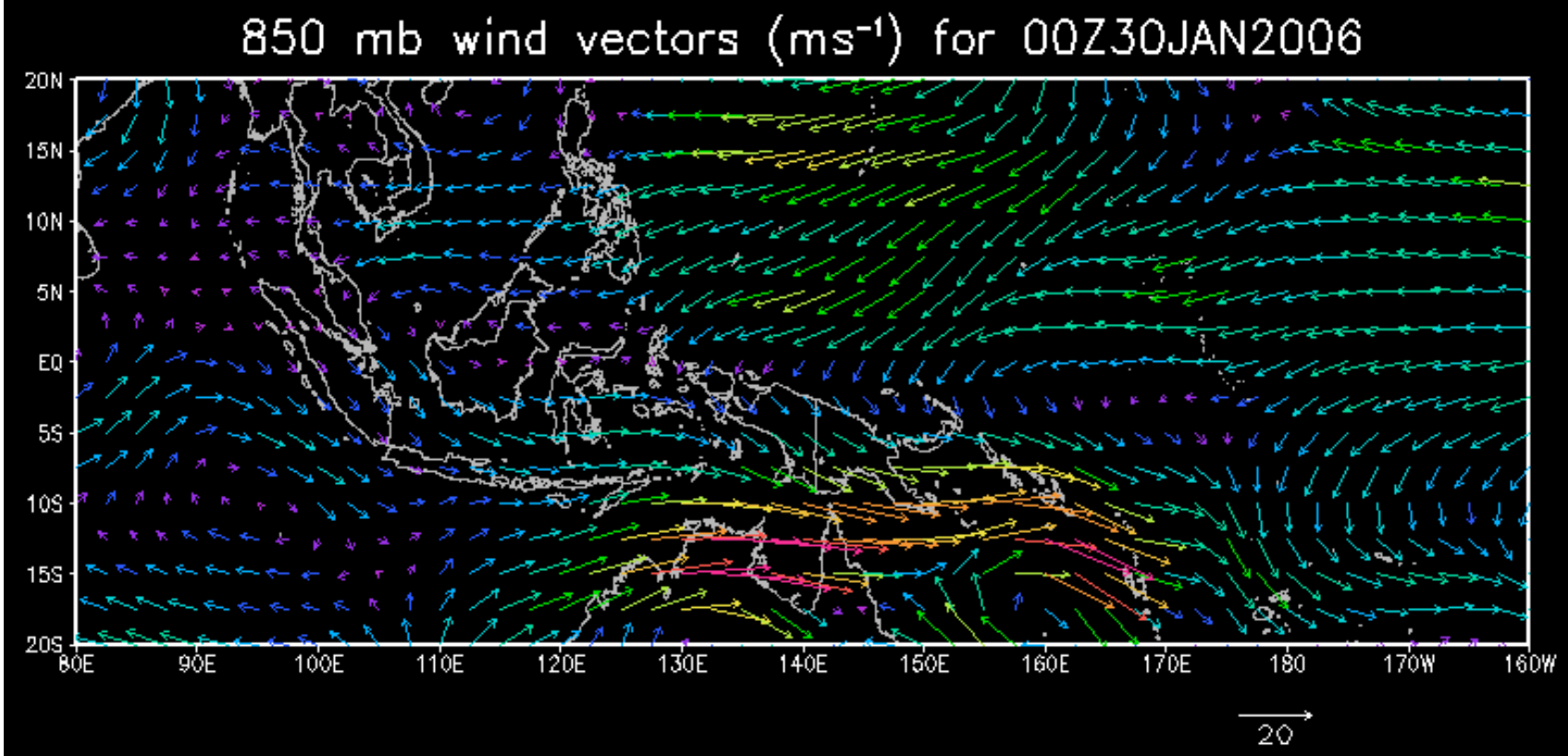
TOGA-COARE
December 1992

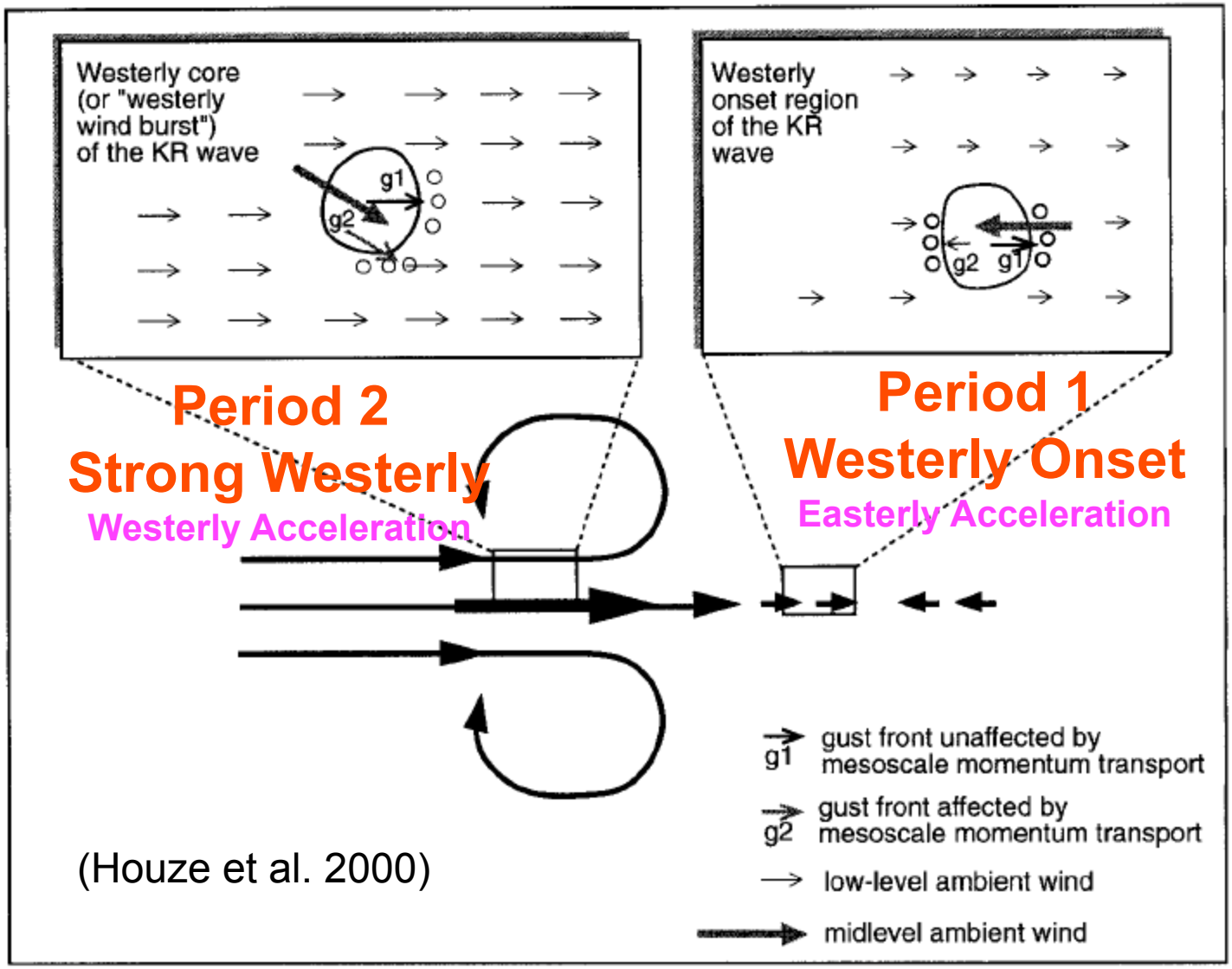


TOGA-COARE
January 1993

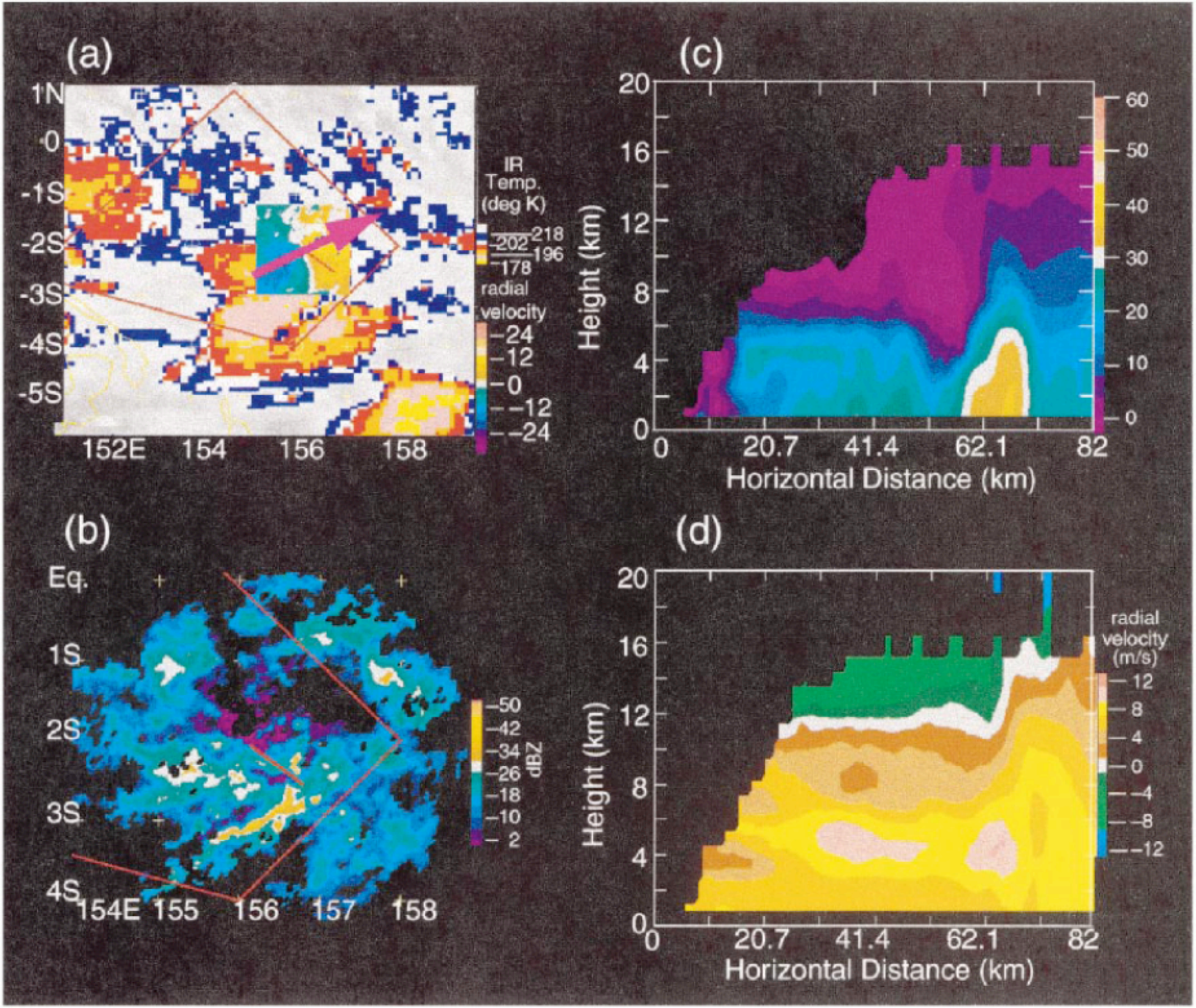


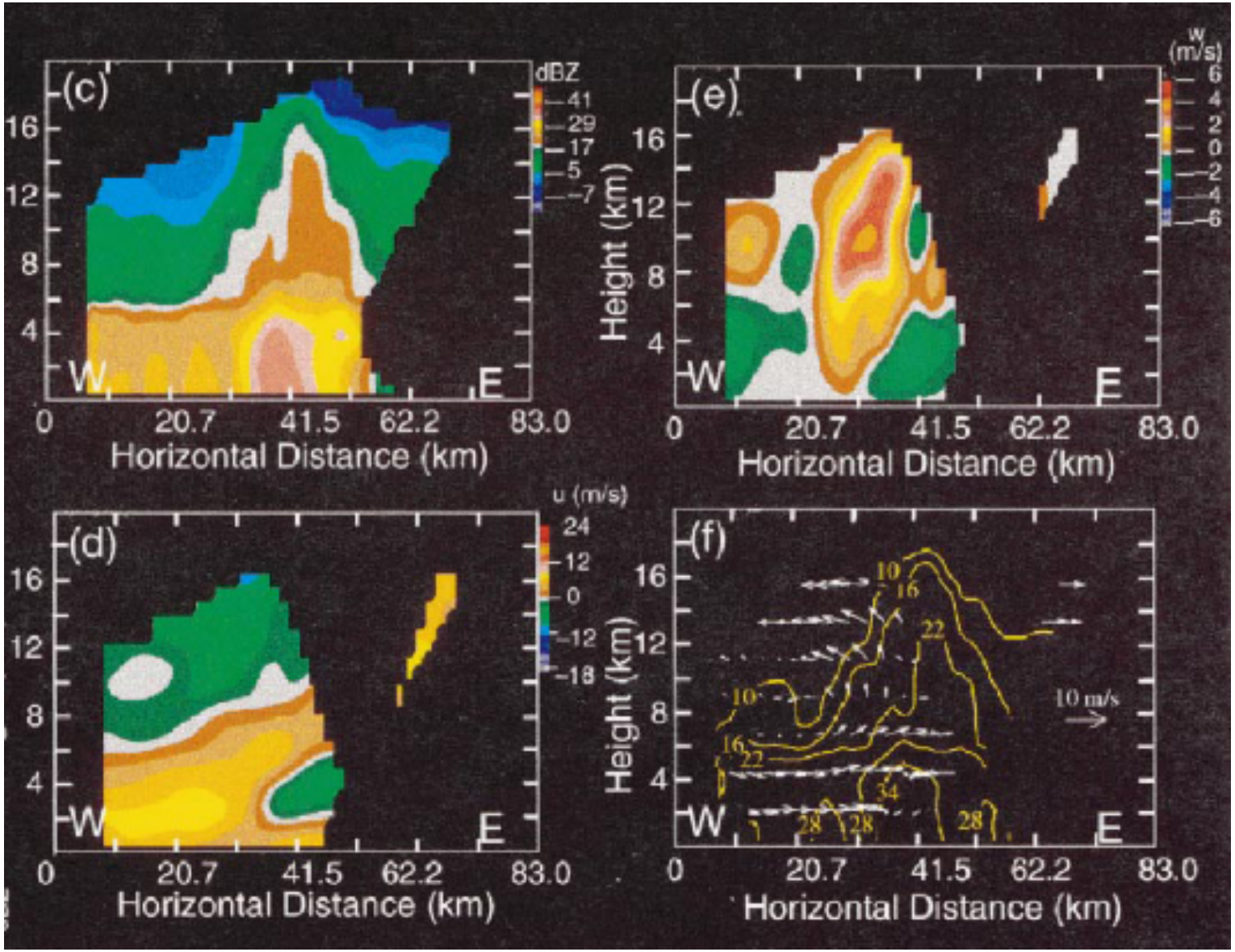
TOGA-COARE Two MJOs
(Houze et al. 2000)


850 mb wind vectors (ms-1) for 00Z30JAN2006
20N
15N
10N
5N
EQ
5S
10S
15S
20S
80E
90E
100E
110E
120E
130E
140E
150E
160E
170E
180
170W
160W
20



(Houze et al. 2000)


(a)
1N
0
-1S
-2S
-3S
-4S
-5S
152E
154
156
158
IR
Temp.
(deg K)
218
202
196
178
radial
velocity
24
12
0
-12
-24
(b)
Eq.
1S
2S
3S
4S
154E
155
156
157
158
50
42
34
26
18
10
2
dBZ
(c)
Height (km)
Horizontal Distance (km)
0
4
8
12
16
20
0
20.7
41.4
62.1
82
60
50
40
30
20
10
0
(d)
Height (km)
Horizontal Distance (km)
radial
velocity
(m/s)
12
8
4
0
-4
-8
-12

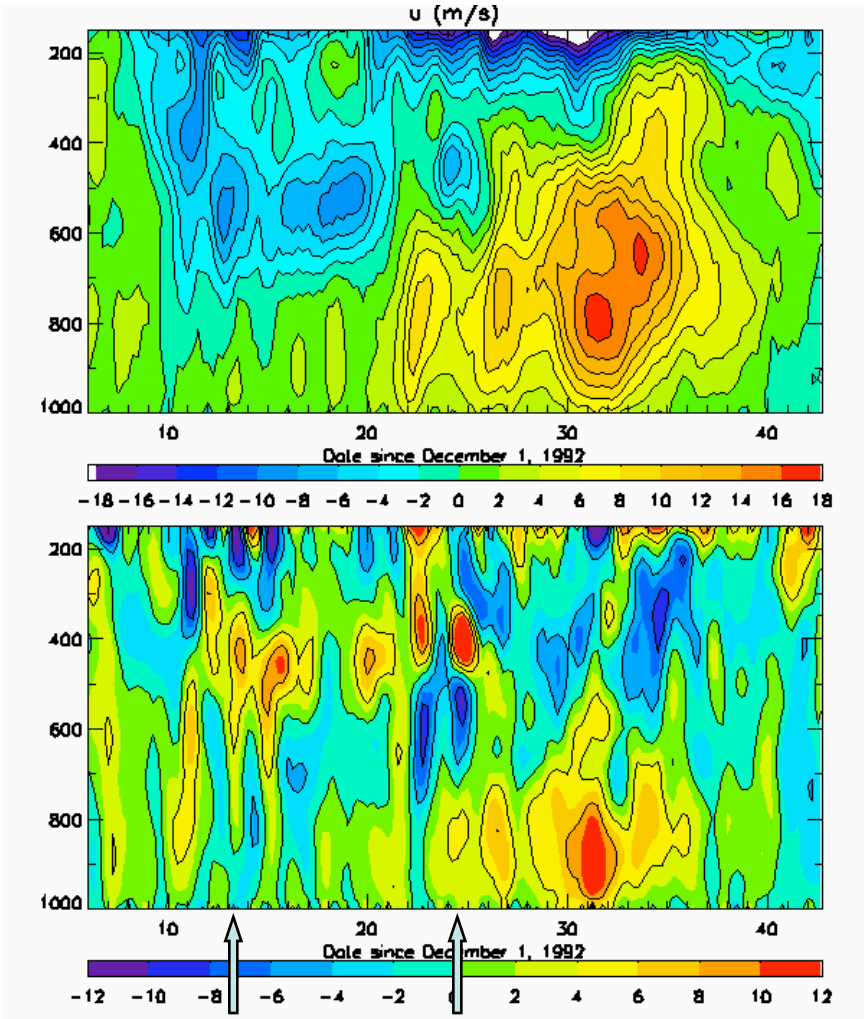

(c)
dBZ
41
29
17
5
−7
(e)
w (m/s)
6
4
2
0
−2
−4
−6
(d)
u (m/s)
24
12
0
−12
−18
(f)
10 m/s
Height (km)
Horizontal Distance (km)
W
E
0
20.7
41.5
62.2
83.0
4
8
12
16

$$< \nabla \cdot \vec{V} >= -\frac{1}{g}\frac{dp_s}{dt}$$

$$\frac{\partial < q >}{\partial t} + < \nabla \cdot \vec{V}q >= E_s - Prec - \frac{\partial < q_l >}{\partial t}$$

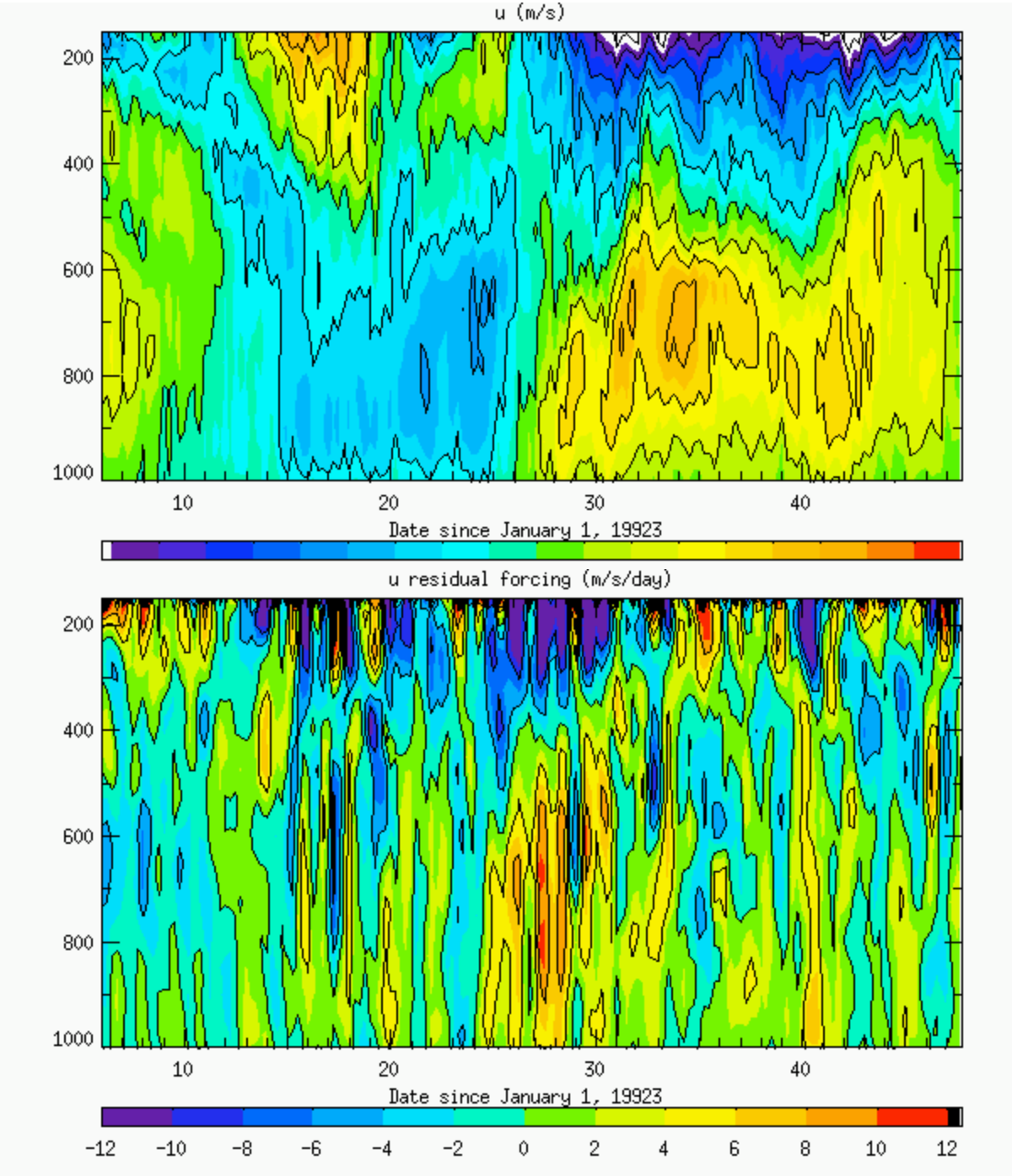
$$\frac{\partial < s >}{\partial t} + < \nabla \cdot \vec{V}s >= R_{TOA} - R_{SRF} + LPrec + SH + \frac{\partial < q_l >}{\partial t}$$

$$\frac{\partial < \vec{V} >}{\partial t} + < \nabla \cdot \vec{V}\vec{V} > + f\vec{k} \times < \vec{V} > + \nabla < \phi >= \vec{\tau}_s$$



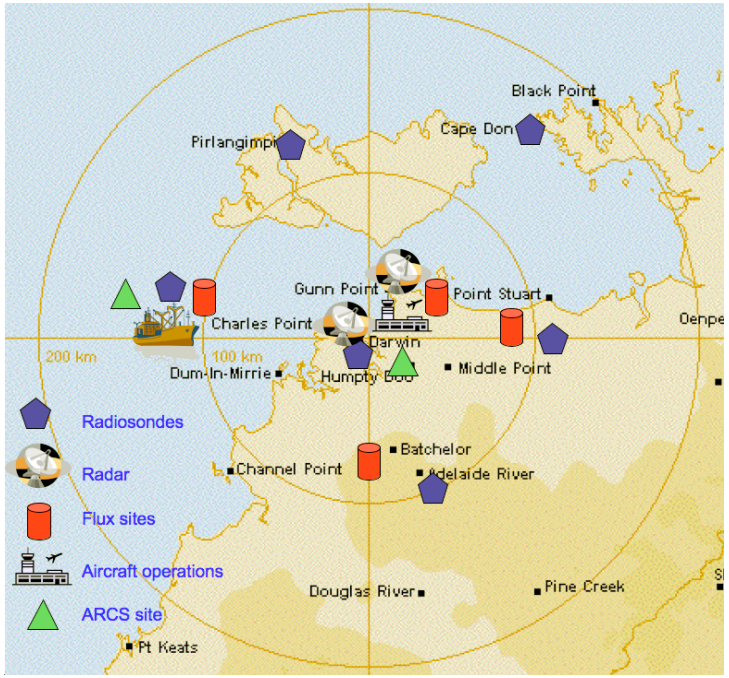
Period 1 **Period 2**

TOGA-COARE
December 1992

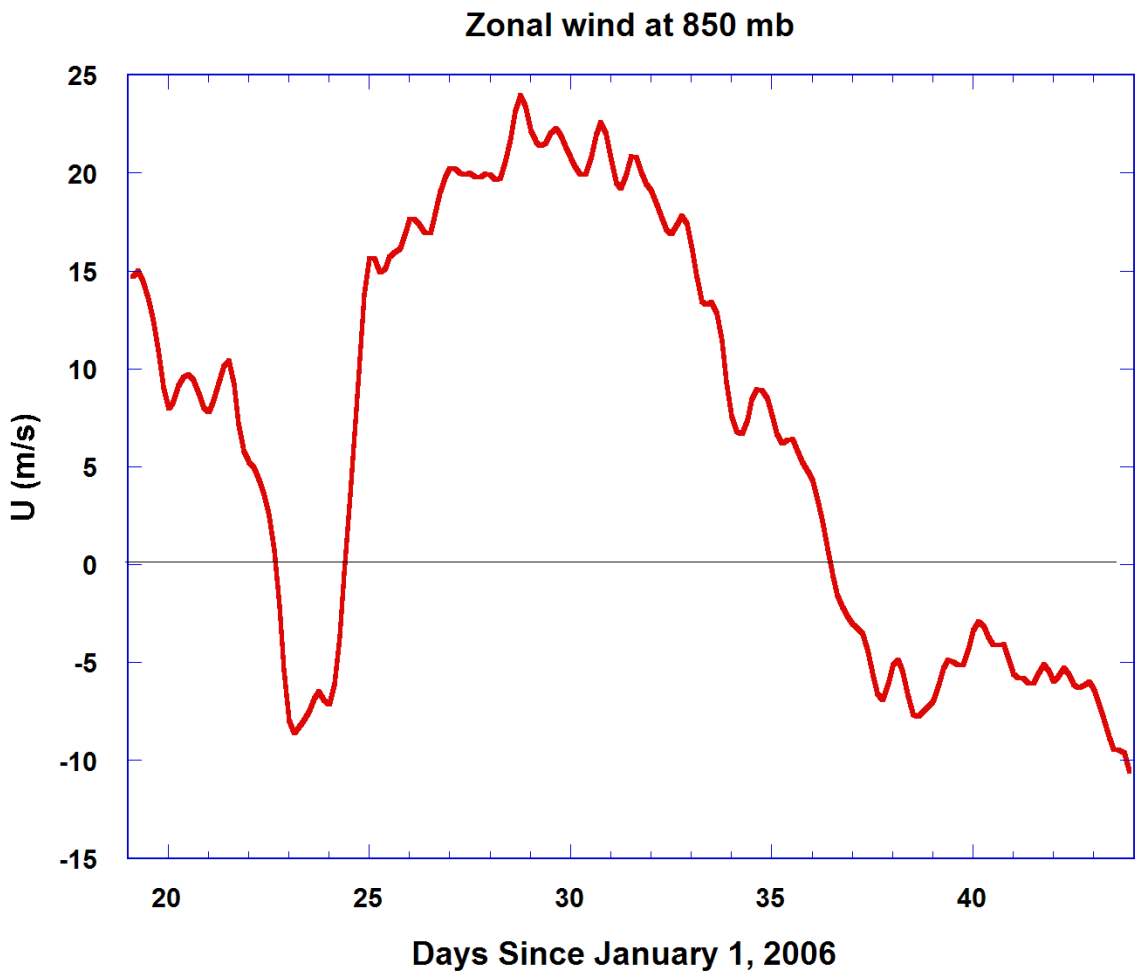


TOGA-COARE
January 1993

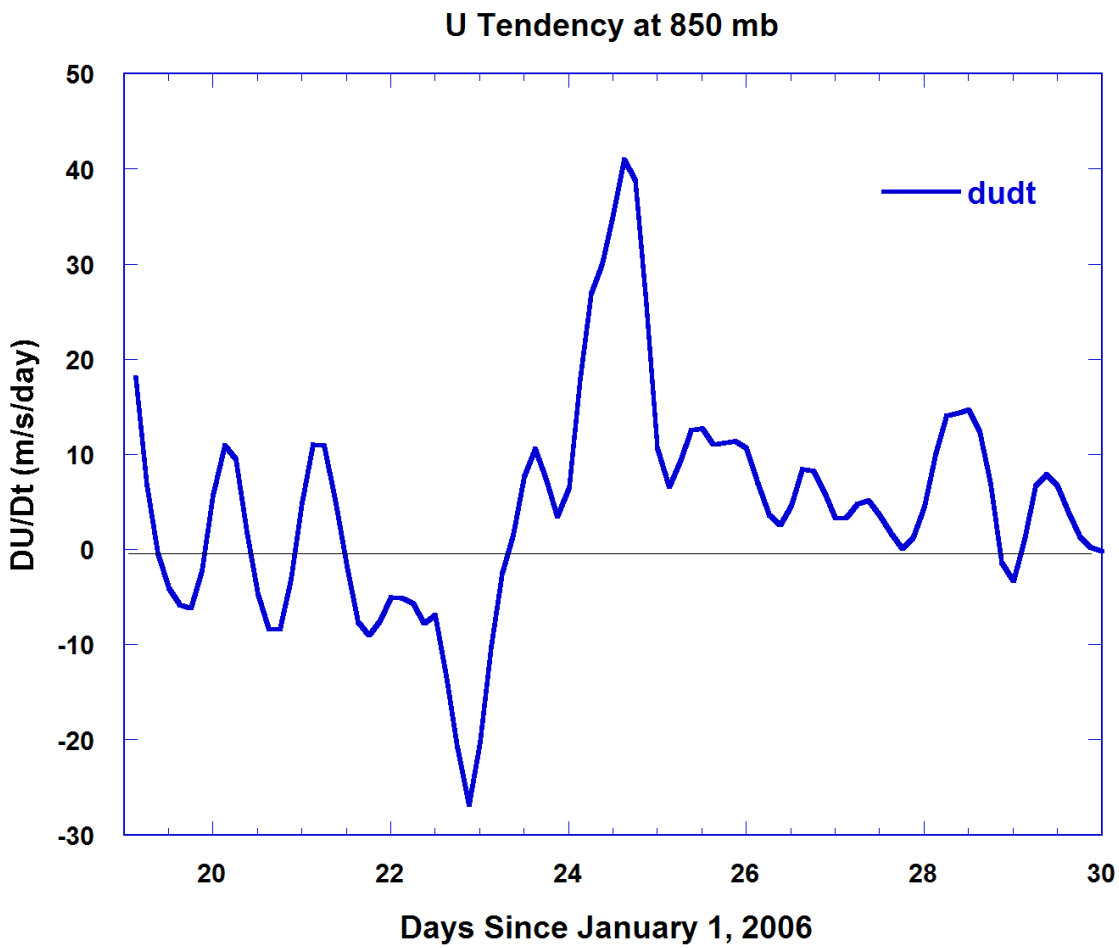
$$Q_3 = \frac{\partial \vec{V}}{\partial t} + \vec{V} \cdot \nabla \vec{V} + \omega \frac{\partial \vec{V}}{\partial p} + f \vec{k} \times \vec{V} + \nabla \phi = -\nabla(\overline{\vec{V}'\vec{V}'}) - \frac{\partial \overline{\omega' \vec{V}'}}{\partial p}$$



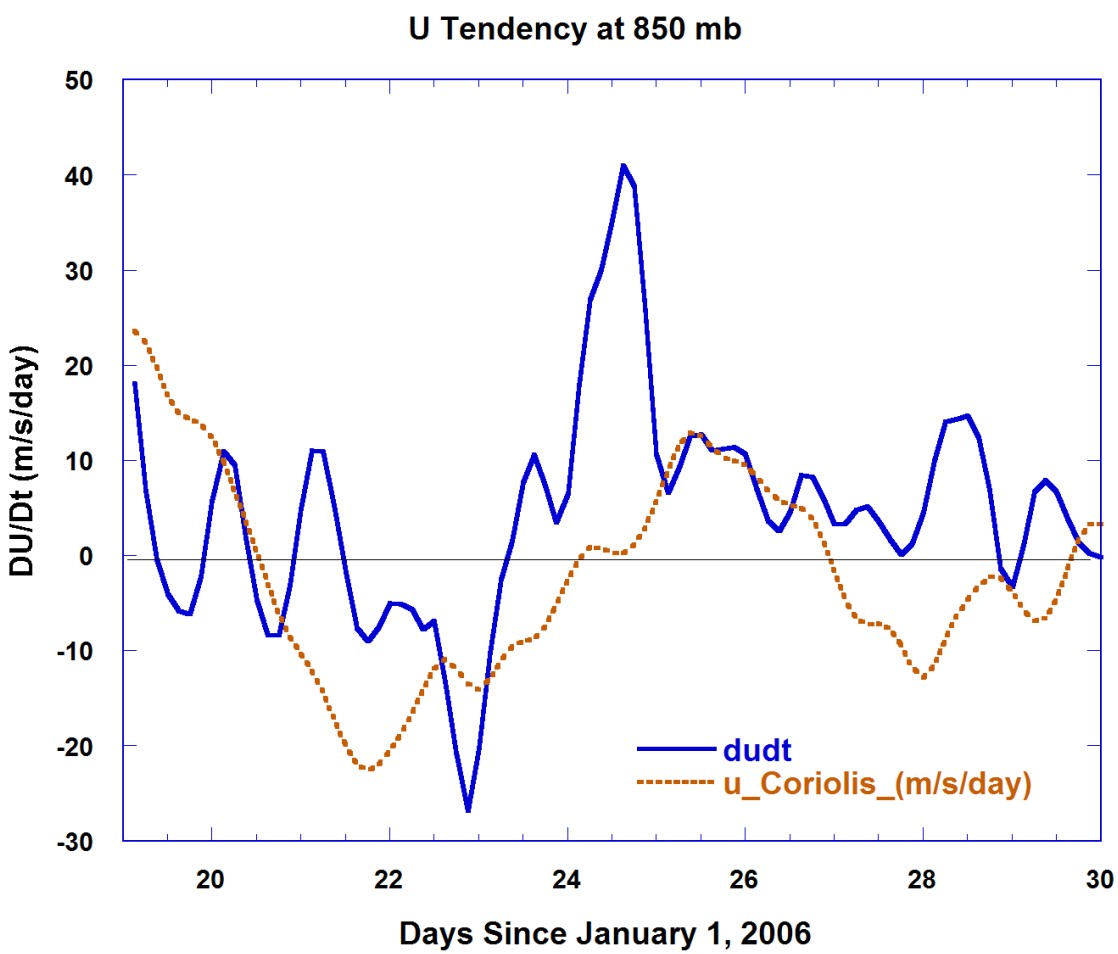
$$\frac{\partial u}{\partial t} + \vec{V} \bullet \nabla u + \omega \frac{\partial u}{\partial p} = -\frac{\partial \phi}{\partial x} + f\,v + Q_x$$



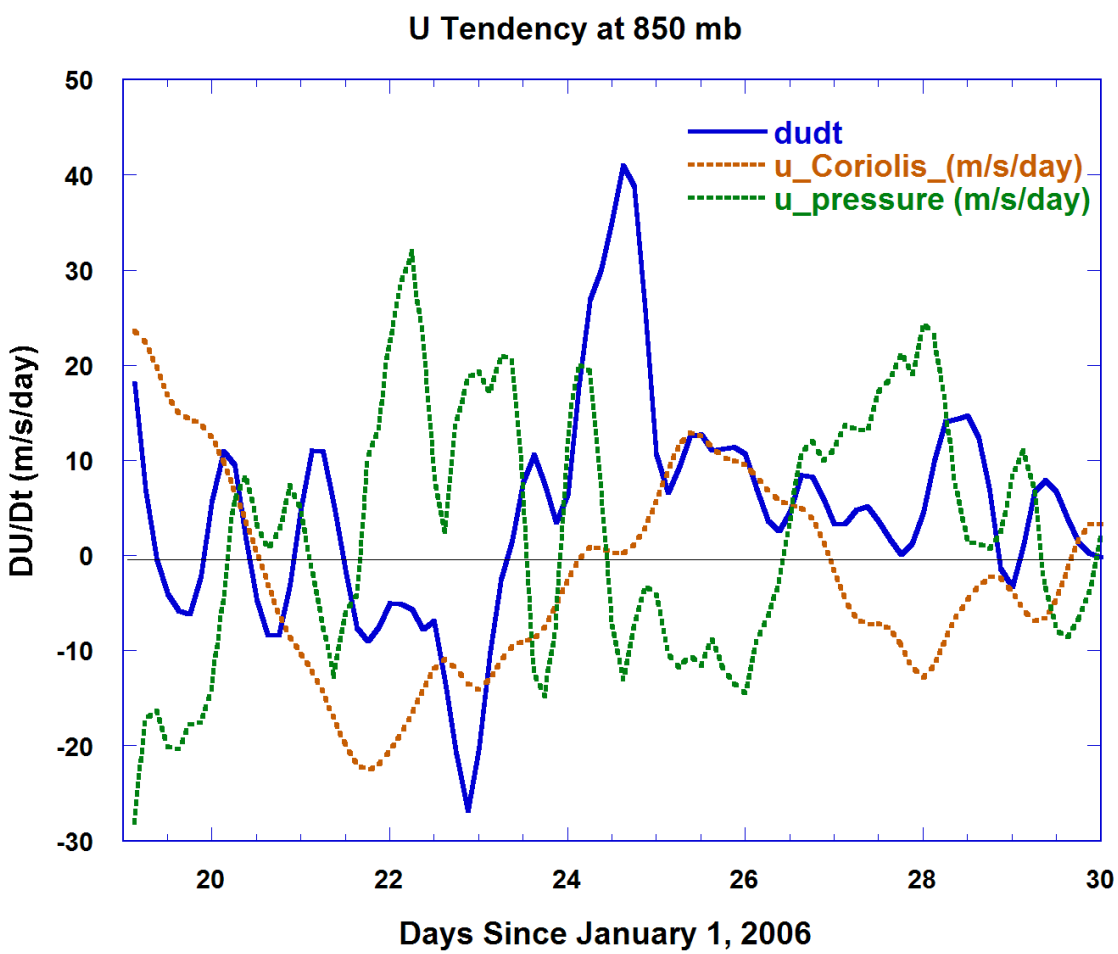
$$\frac{\partial u}{\partial t} + \vec{V} \bullet \nabla u + \omega \frac{\partial u}{\partial p} = -\frac{\partial \phi}{\partial x} + f\,v + Q_x$$



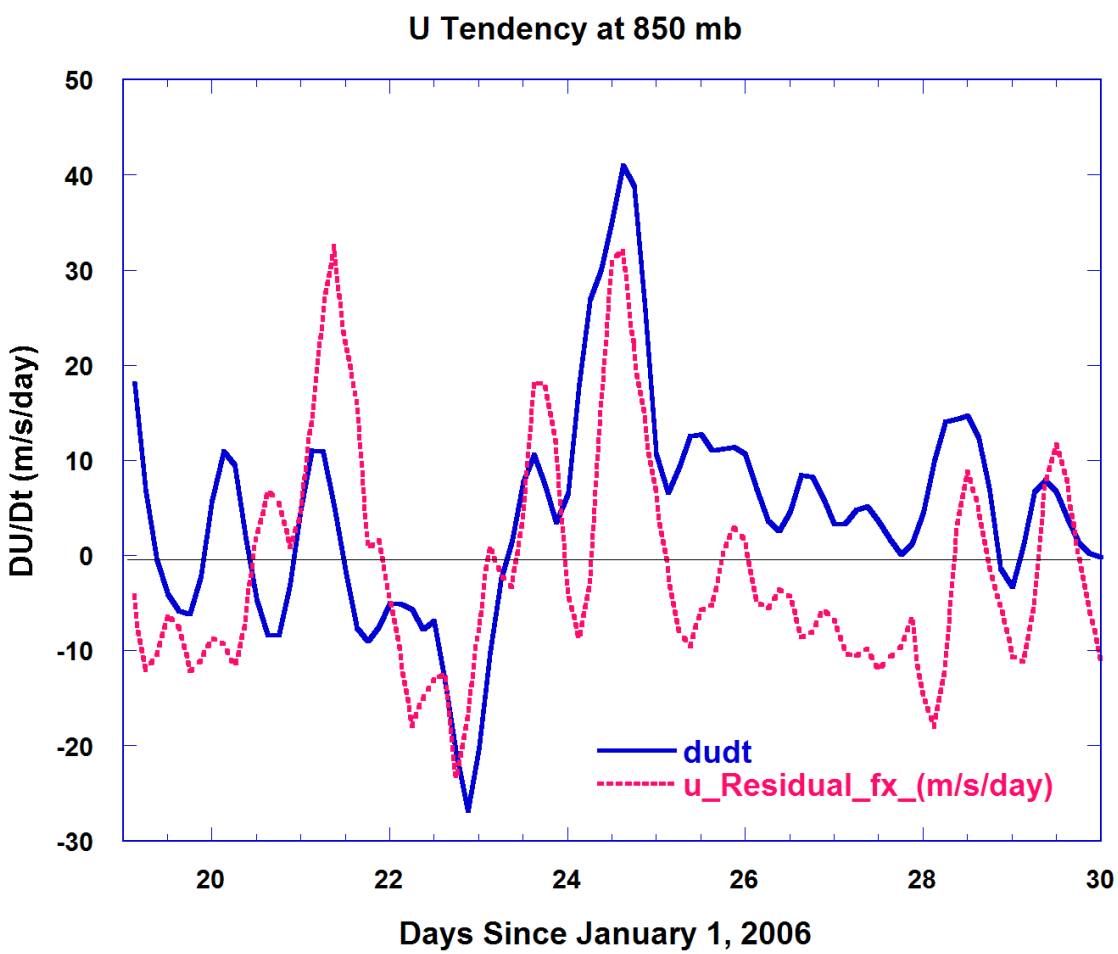
$$\frac{\partial u}{\partial t} + \vec{V} \bullet \nabla u + \omega \frac{\partial u}{\partial p} = -\frac{\partial \phi}{\partial x} + f\,v + Q_x$$



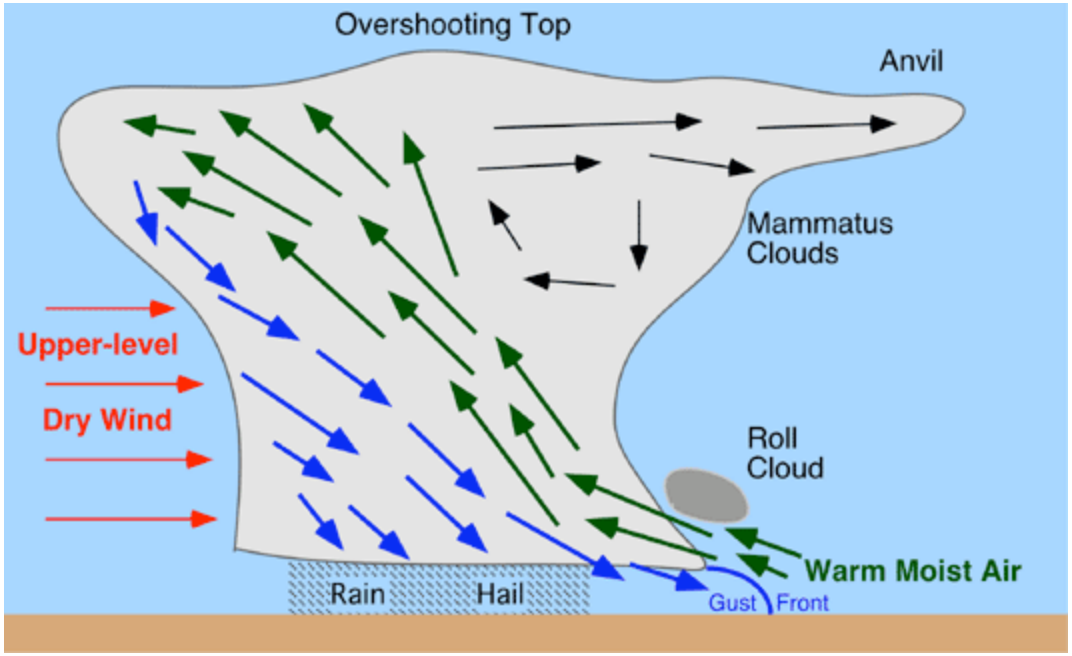
$$\frac{\partial u}{\partial t} + \vec{V} \bullet \nabla u + \omega \frac{\partial u}{\partial p} = -\frac{\partial \phi}{\partial x} + f\,v + Q_x$$



$$\frac{\partial u}{\partial t} + \vec{V} \bullet \nabla u + \omega \frac{\partial u}{\partial p} = -\frac{\partial \phi}{\partial x} + f\, v + Q_x$$



Momentum Transport in a Westerly Phase



(From Encyclopedia of Earth)

Summary

Positive Subgrid Scale Momentum Transport in the Lower Troposphere During Westerly Phase

Consistent with TOGA-COARE