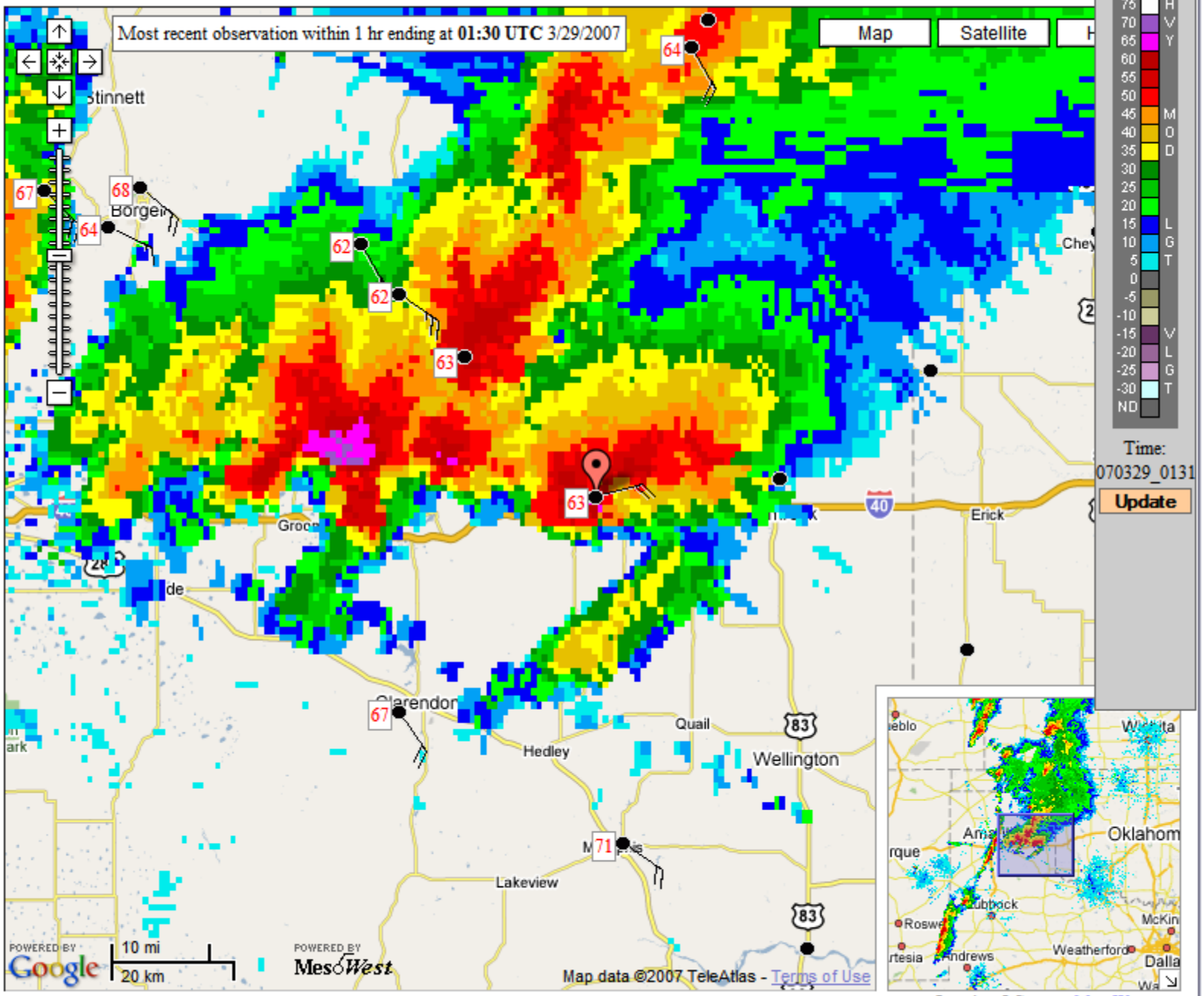
Tornado between Antelope Island and West Point, August 2, 2005
Photo courtesy of Lindsay Murdock



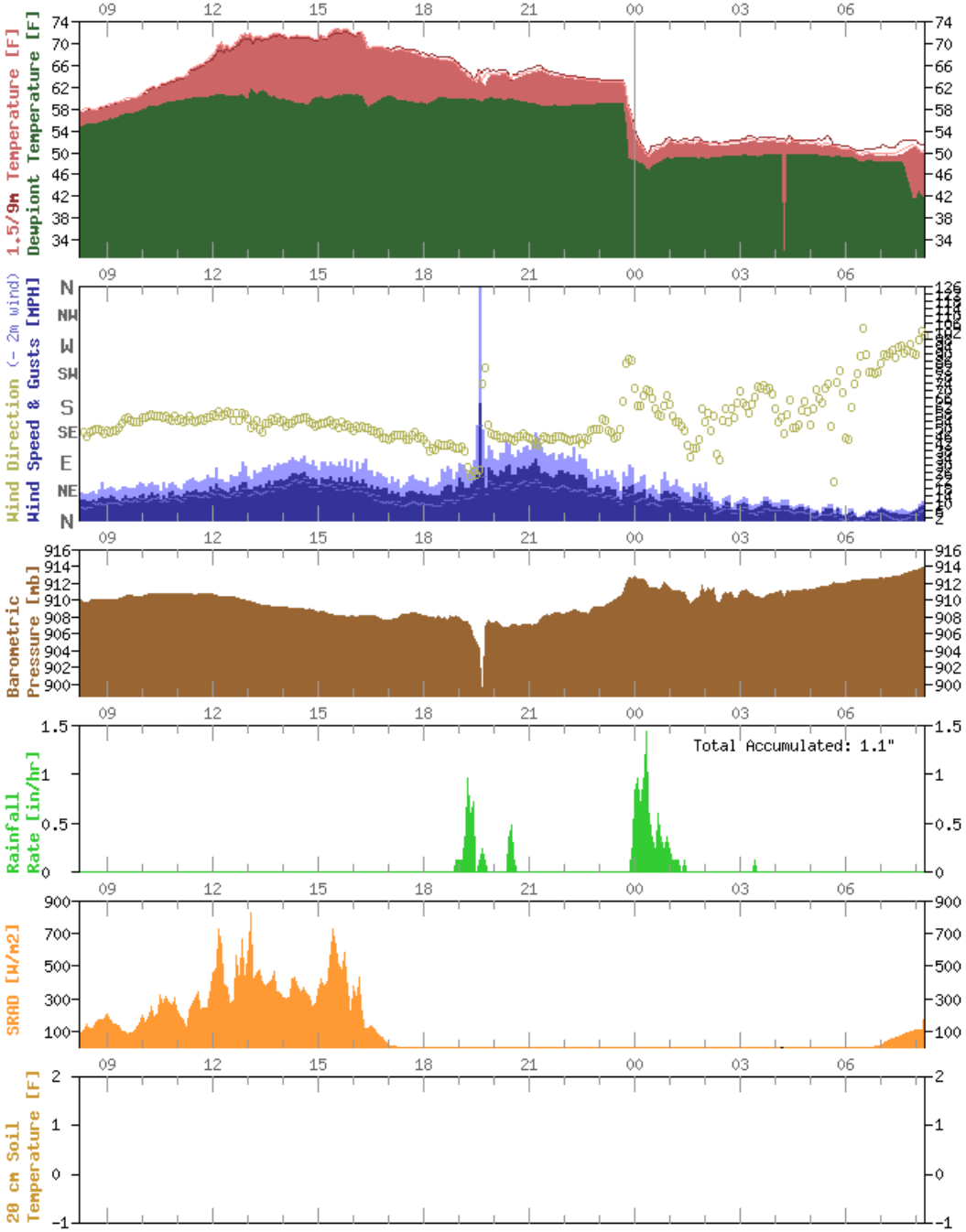
Questions? Contact MesoWest

Now: Mostly Cloudy, 45° F | Thu: 47° F | Fri: 52° F

West Texas Mesonet

McLean 24-Hour Meteogram

08:15 CST (Mar 28, 2005) through 08:10 CST (Mar 29, 2005)



F-scale Winds Expected Damages

F0	*Less than 72 mph*	**Light Damage:** Damage to chimneys and billboards, broken branches; shallow-rooted trees pushed over
F1	*72-112 mph*	**Moderate Damage:** The lower limit is near the beginning of hurricane wind speed. Surfaces peeled off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the road.
F2	*113-157 mph*	**Considerable Damage:** Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	*158-206 mph*	**Severe Damage:** Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off ground and thrown.
F4	*207-260 mph*	**Devastating Damage:** Well-constructed houses leveled; structures with weak foundations blown some distance; cars thrown and large missiles generated.
F5	*Above 260 mph*	**Incredible Damage:** Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air a farther than 100 meters; trees debarked; incredible phenomena occur.

Courtesy of John Jarboe, National Weather Service

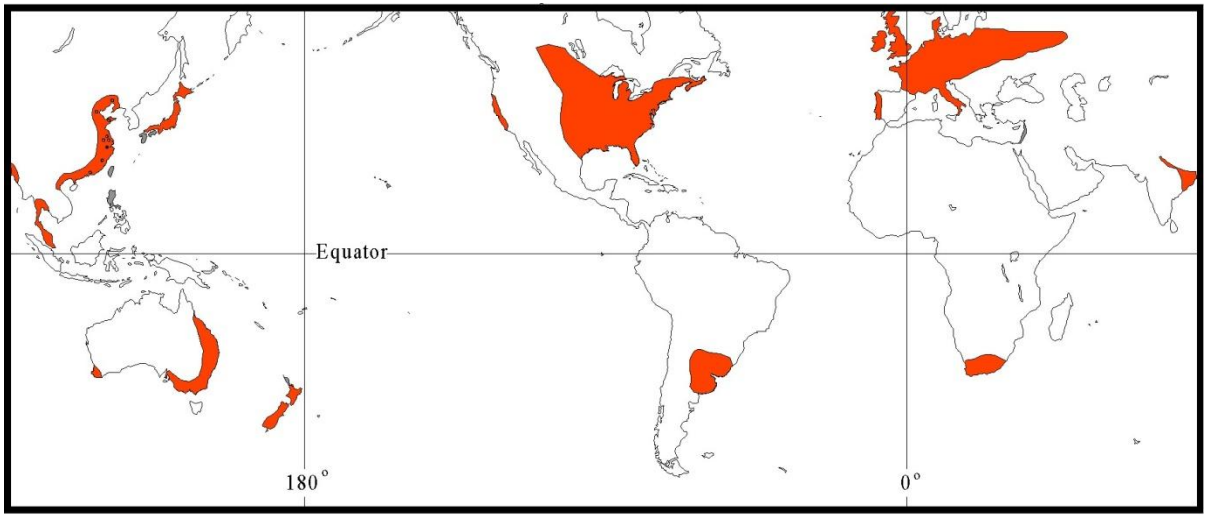
http://www.spc.noaa.gov/faq/tornado/ef-scale.html

Enhanced F Scale for Tornado Damage

An update to the the original F-scale by a team of meteorologists and wind engineers, to be implemented in the U.S. on 1 February 2007.

FUJITA SCALE			DERIVED EF SCALE		OPERATIONAL EF SCALE	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	**EF Number**	**3 Second Gust (mph)**
0	40-72	45-78	0	65-85	**0**	**65-85**
1	73-112	79-117	1	86-109	**1**	**86-110**
2	113-157	118-161	2	110-137	**2**	**111-135**
3	158-207	162-209	3	138-167	**3**	**136-165**
4	208-260	210-261	4	168-199	**4**	**166-200**
5	261-318	262-317	5	200-234	**5**	**Over 200**

*** **IMPORTANT NOTE ABOUT ENHANCED F-SCALE WINDS:** *The Enhanced F-scale still is a set of wind estimates (not measurements) based on damage.* Its uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to the 28 indicators listed below. These estimates vary with height and exposure. **Important**: The 3 second gust is not the same wind as in standard surface observations. Standard measurements are taken by weather stations in open exposures, using a directly measured, "one minute mile" speed.



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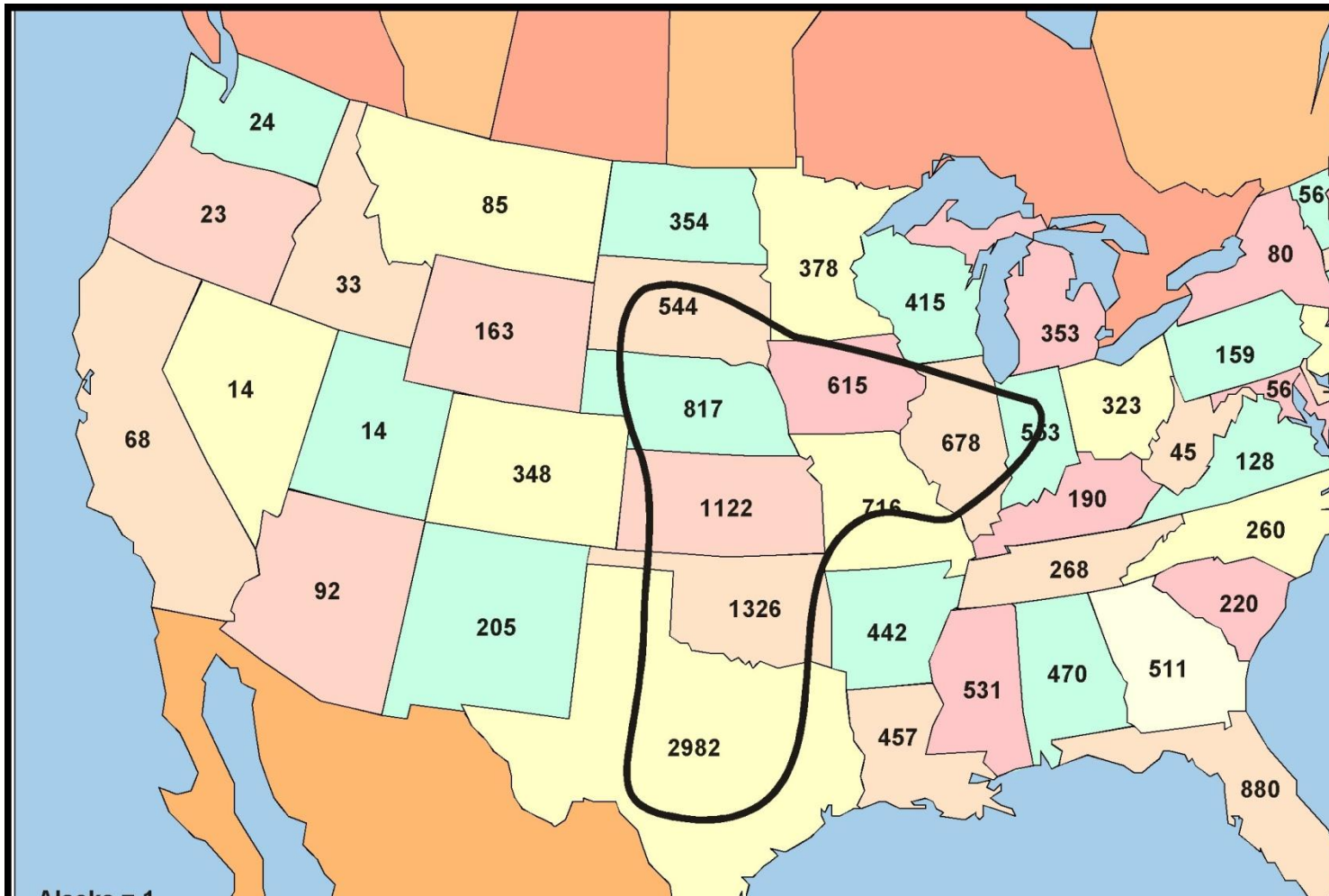
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23
85
354
378
56
80
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544
415
353
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163
14
817
615
323
56
68
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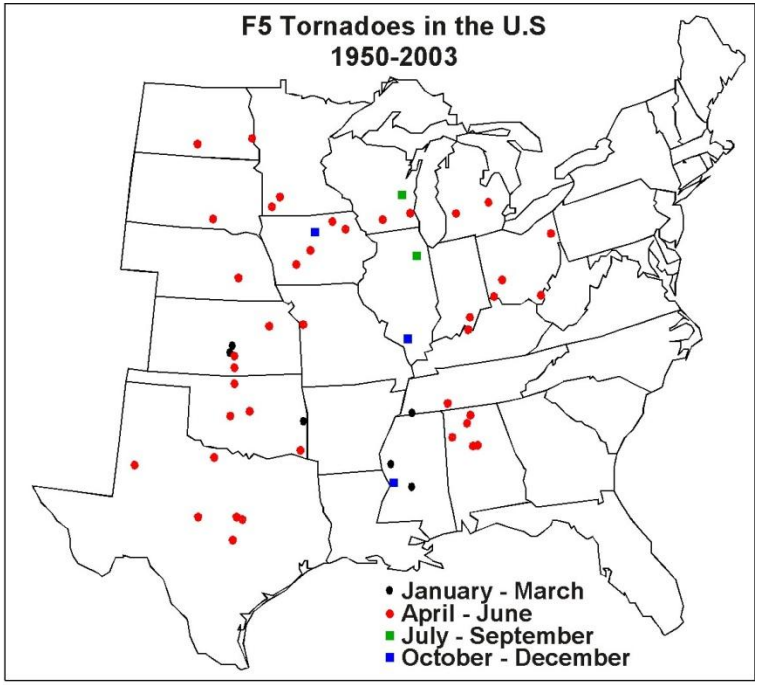
1326
442
220
531
470
511
2982
457
880



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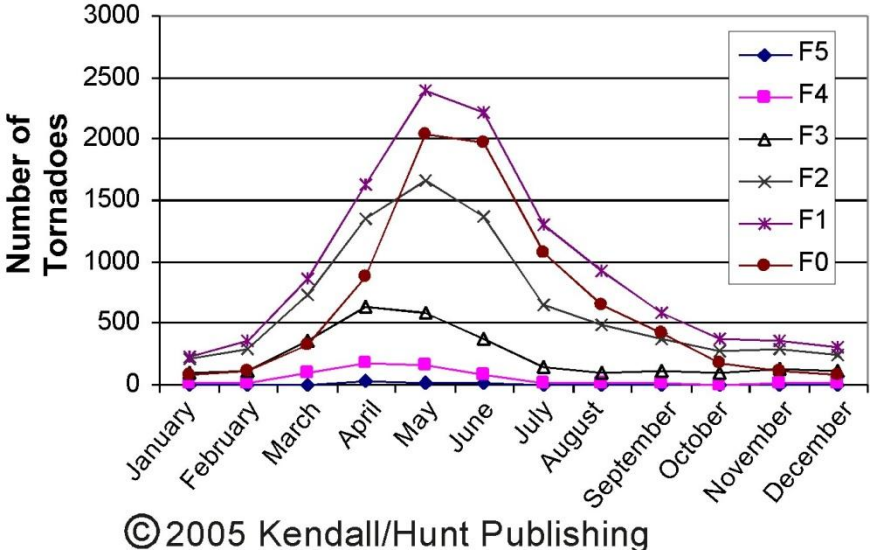

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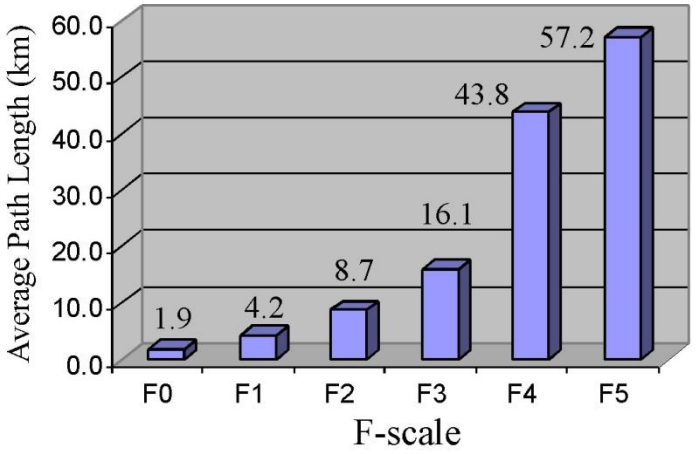

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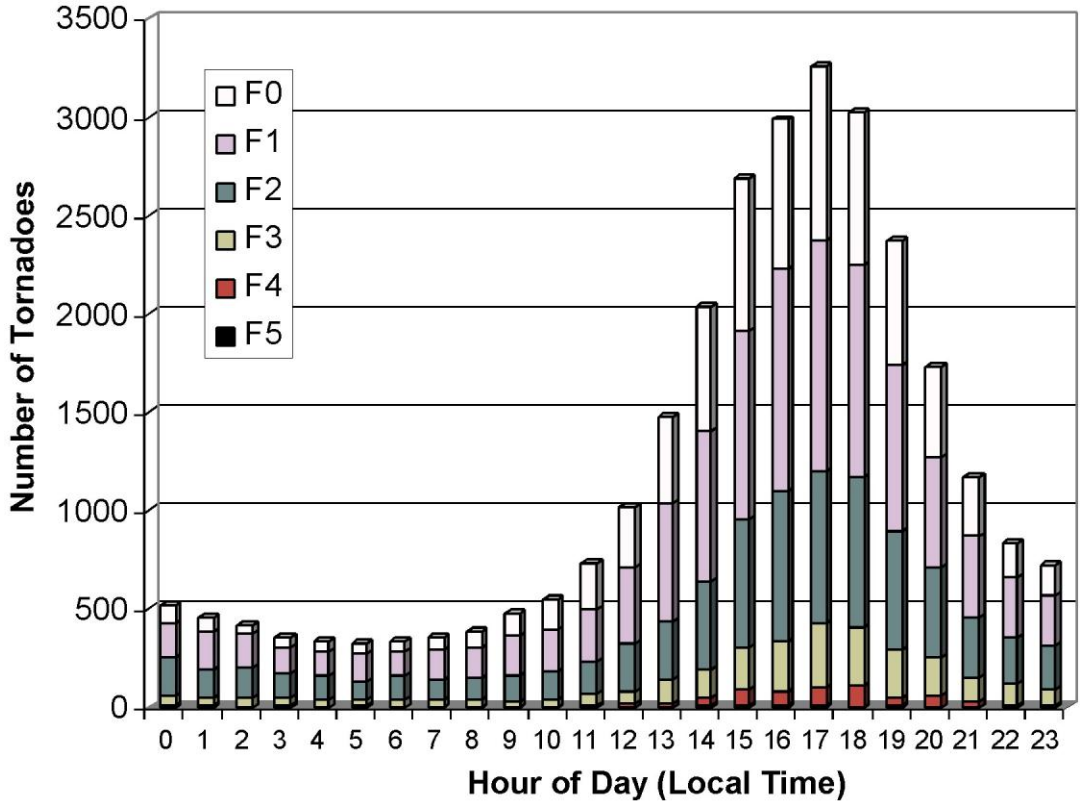

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Utah Tornadoes

Number of Tornadoes by Year:

1950	0	1970	5	1990	4
1951	0	1971	1	1991	5
1952	0	1972	0	1992	4
1953	2	1973	0	1993	6
1954	1	1974	0	1994	0
1955	3	1975	0	1995	2
1956	0	1976	0	1996	3
1957	1	1977	0	1997	1
1958	0	1978	1	**1998**	**8**
1959	0	1979	0	1999	5
1960	0	1980	0	2000	7
1961	1	1981	2	2001	4
1962	1	1982	3	2002	4
1963	1	1983	0	2003	4
1964	1	1984	6	2004	2
1965	5	1985	0	2005	4
1966	2	1986	3	2006	2
1967	2	1987	3		
1968	4	1988	1		
1969	3	1989	6		
					Total 123

Number of Tornadoes by Month

January	1	July	14
February	1	August	24
March	4	September	21
April	7	October	0
May	**29**	November	2
June	18	December	2
			Total 123

Stated Monetary Damage by Tornadoes

$1,200	June 1, 1955
$5,000	June 16, 1955
$20,000	June 3, 1963
$2,000	August 28, 1964
$10,000	April 17, 1966
$15,000	November 2, 1967
$50,000	August 14, 1968
$5,000	May 29, 1987
$3,000	May 29, 1988
$25,000	September 17, 1989
$500	March 23, 1990
$1,500	September 23, 1992
$8,000	April 4, 1993
$50,000	May 3, 1993
$15,000	June 2, 1993
$500,000	May 29, 1996
$170,000,000+	**August 11, 1999**
$100,000+	September 3, 1999
$100,000	May 25, 2000
$2,000,000	September 8, 2002
$100,000	March 23, 2004
$173,011,200+	Total

Utah's Strongest Tornadoes

F-scale ratings (from the Fujita Intensity Scale) have been assigned to these strong Utah tornadoes based on damages caused by these twisters and their probably wind speeds:

F2	January 22, 1943	Young Ward
F2	June 3, 1963	Bountiful
F2	November 2, 1967	Emery
F2	August 14, 1968	West Weber
F2	May 29, 1987	Lewiston
F3	**August 11, 1993**	**Uinta Mountains**
F2	August 11, 1999	Salt Lake City
F2	September 8, 2002	Manti

Uinta Mountain Tornado

- **Tornado, Chepeta Lake, Duchesne County *Intensity: F3***
  August 11, 1993, 1750 MST, 40 50'N, 109 59'W

- During the evening of August 11th, a line of thunderstorms moved across the Uinta Mountains. Below the thunderstorms, a tornado touched down three times. Its path width was up to a half mile wide.

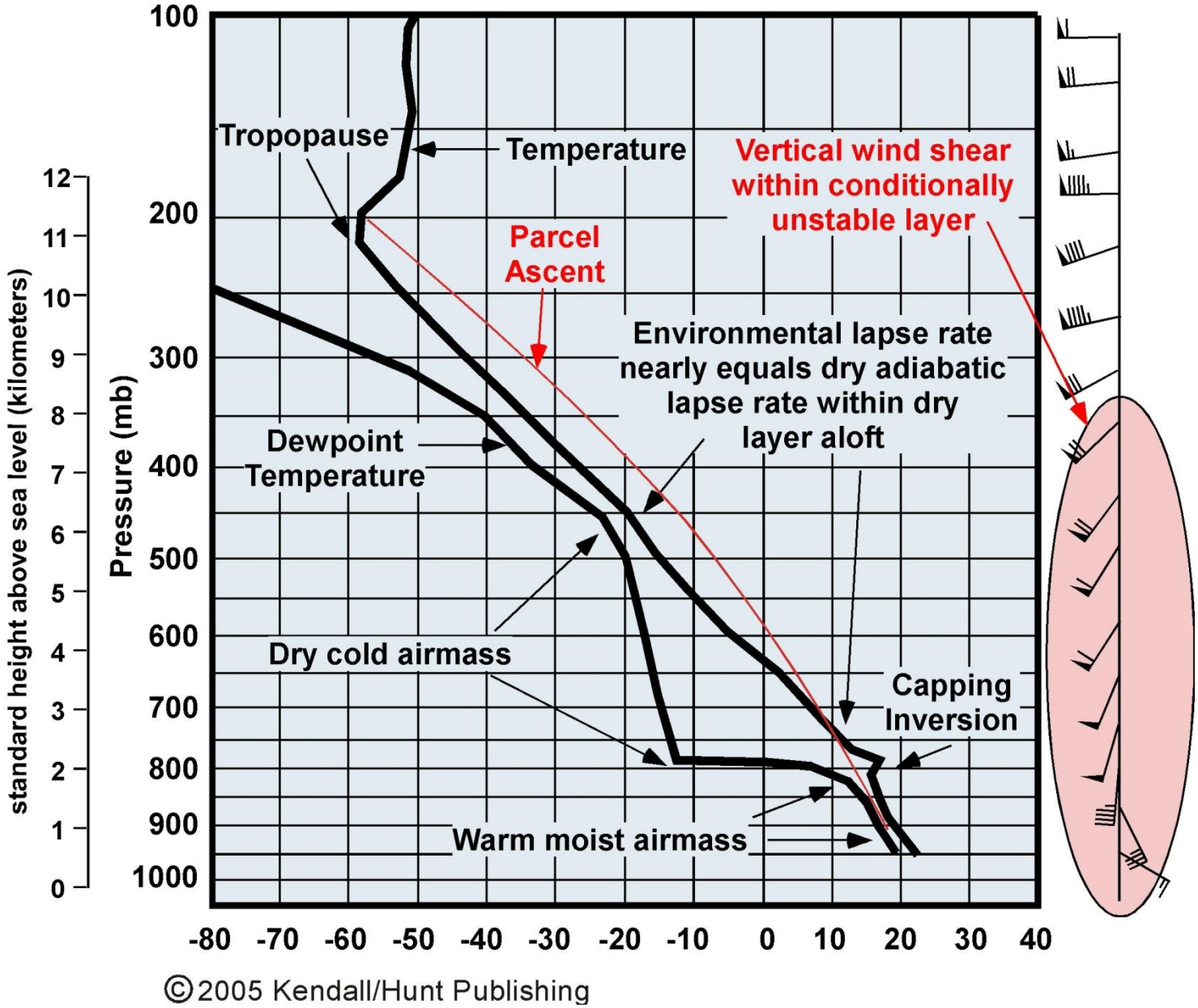
- The second touchdown was the most significant. At the west fork of the White Rock Drainage the tornado began to knock down and uproot trees over a 600 acre area.

- The tornado lifted once more before touching down for the third and final time near Chepeta Lake Drainage. Here the twister damaged over 400 acres of forest. A troop of 125 scouts were camped near the area of the third touchdown. No one was injured, but four vehicles were damaged by the tornado.

- The highest elevation where damage was found was at 10,800 feet—which makes this tornado the highest mountain tornado ever reported in Utah.

LIMBS: Ingredients for Severe Thunderstorms

- Lift: mechanism to trigger an updraft (lifting by terrain or heating of ground)
- Instability: conditionally unstable environmental lapse rate
- Moisture
- Boundaries: mechanism to initiate additional updrafts
- Shear: change in horizontal wind with height in lowest 6 km



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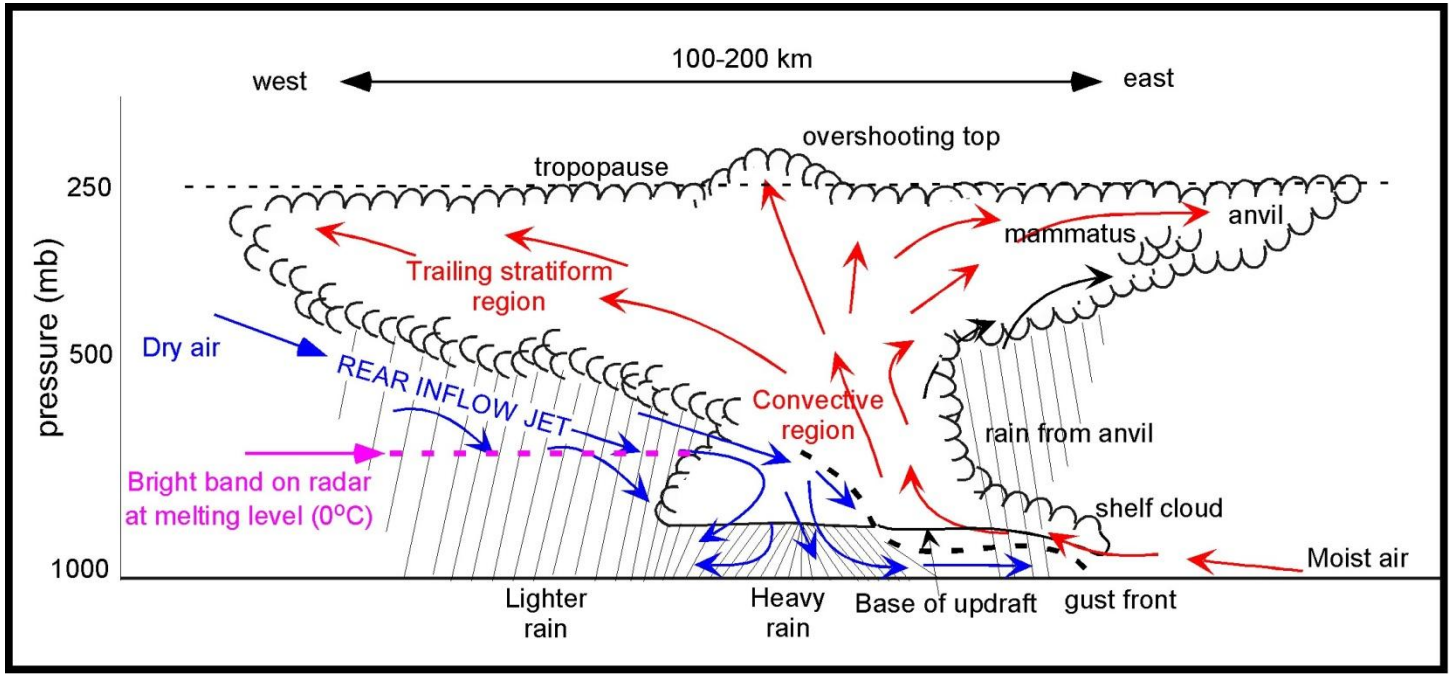
Summary of Classic Severe Weather Thunderstorm



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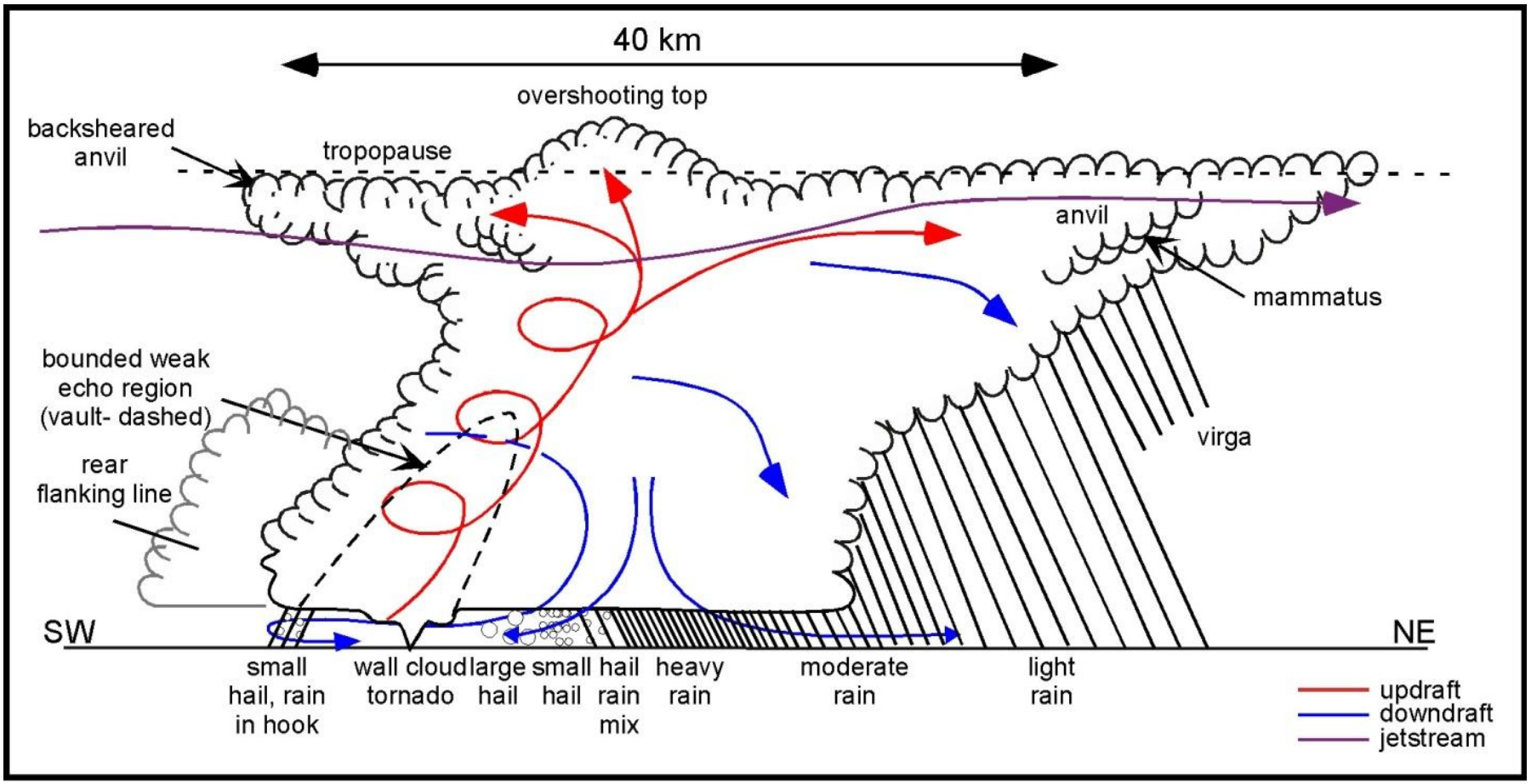

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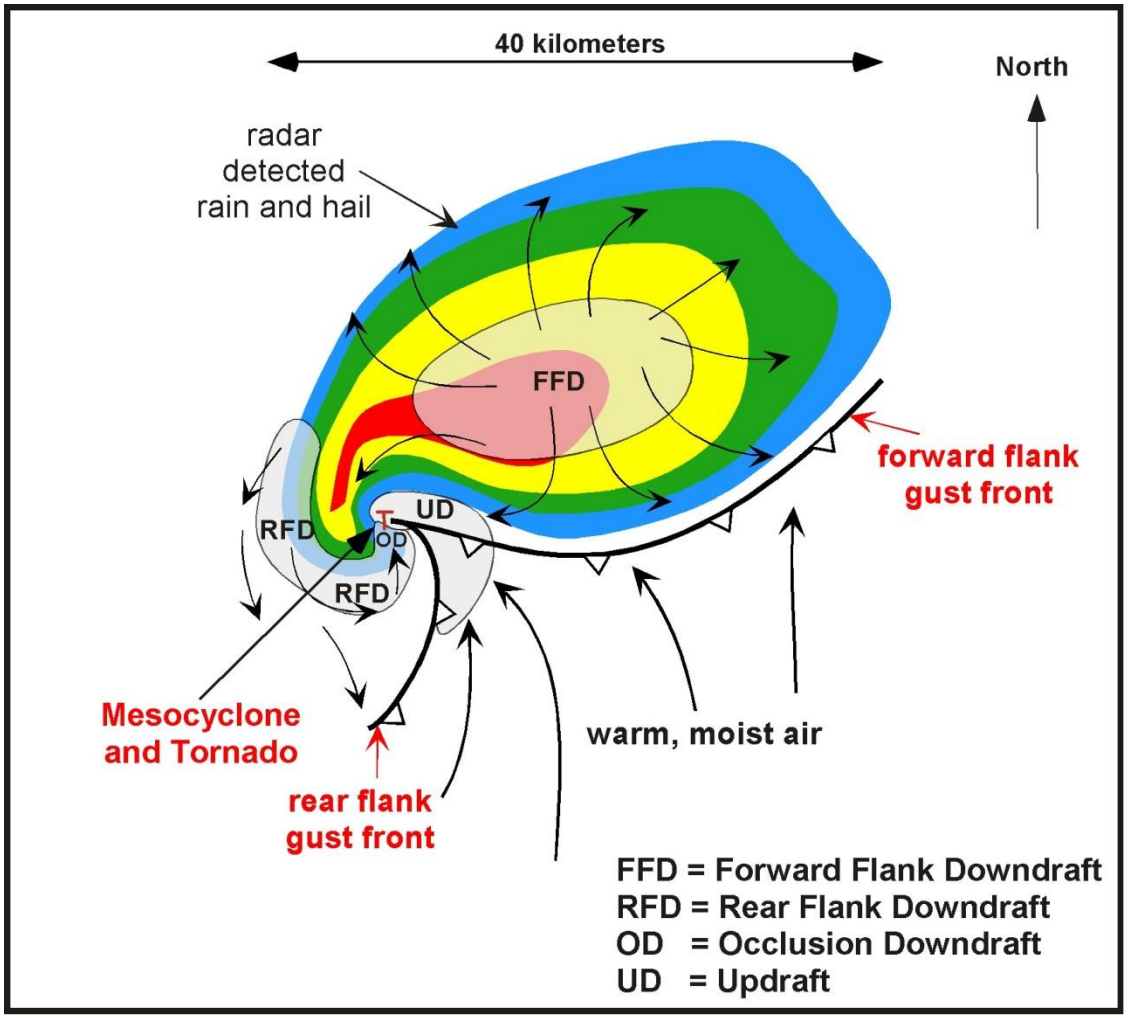

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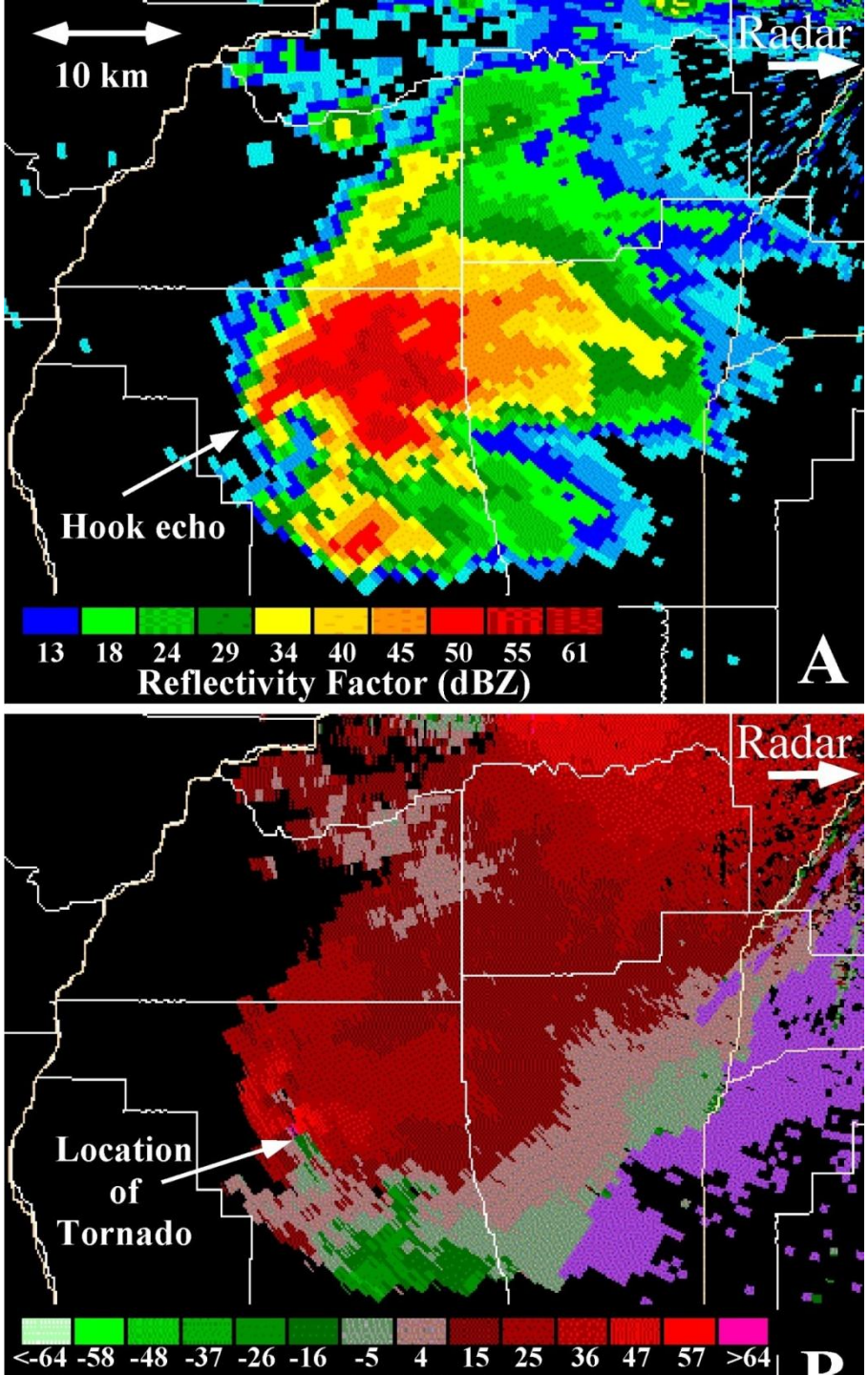
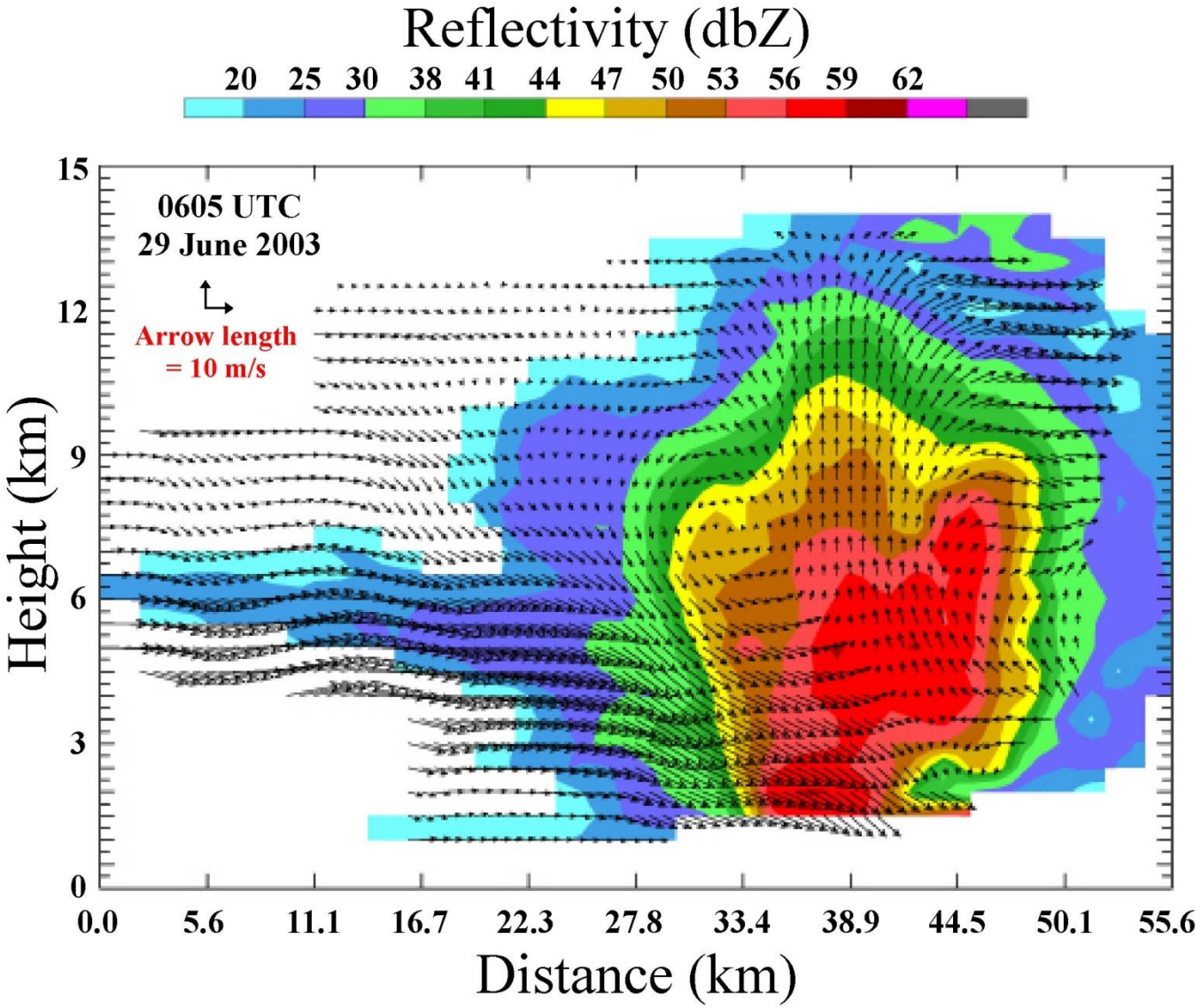

10 km
Radar
Hook echo
13 18 24 29 34 40 45 50 55 61
Reflectivity Factor (dBZ)
A
Radar
Location
of
Tornado
<-64 -58 -48 -37 -26 -16 -5 4 15 25 36 47 57 >64
B



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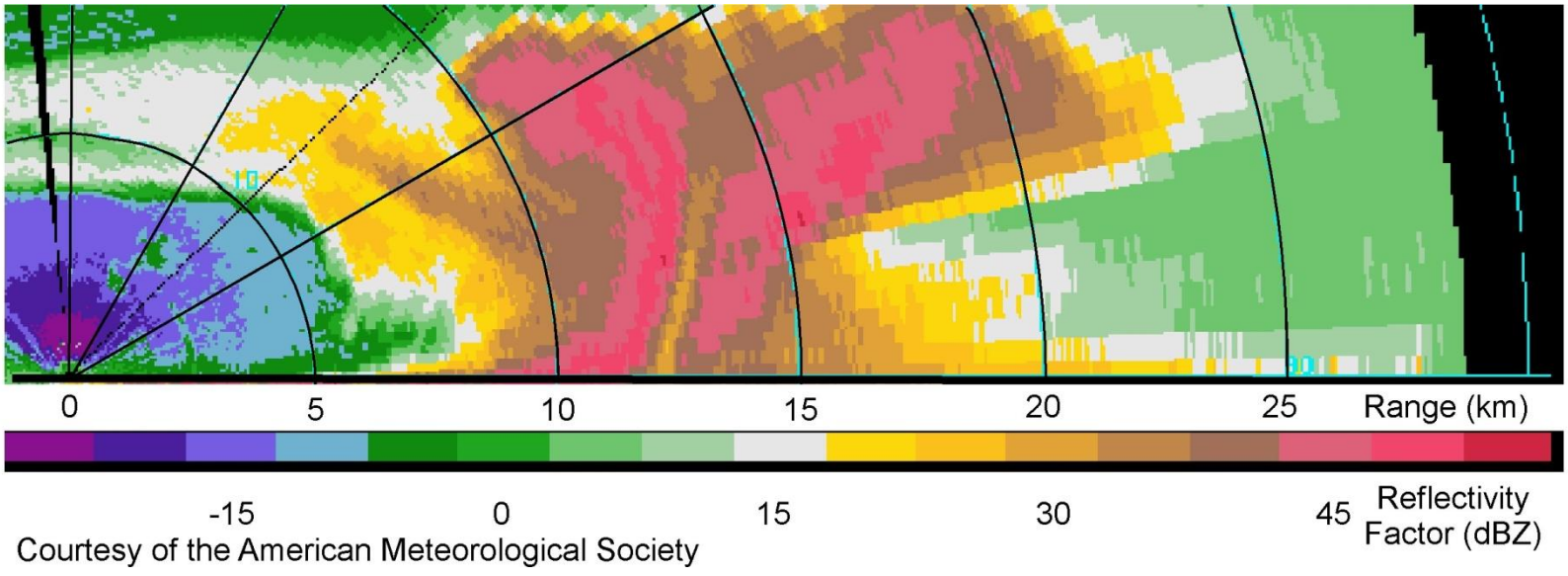
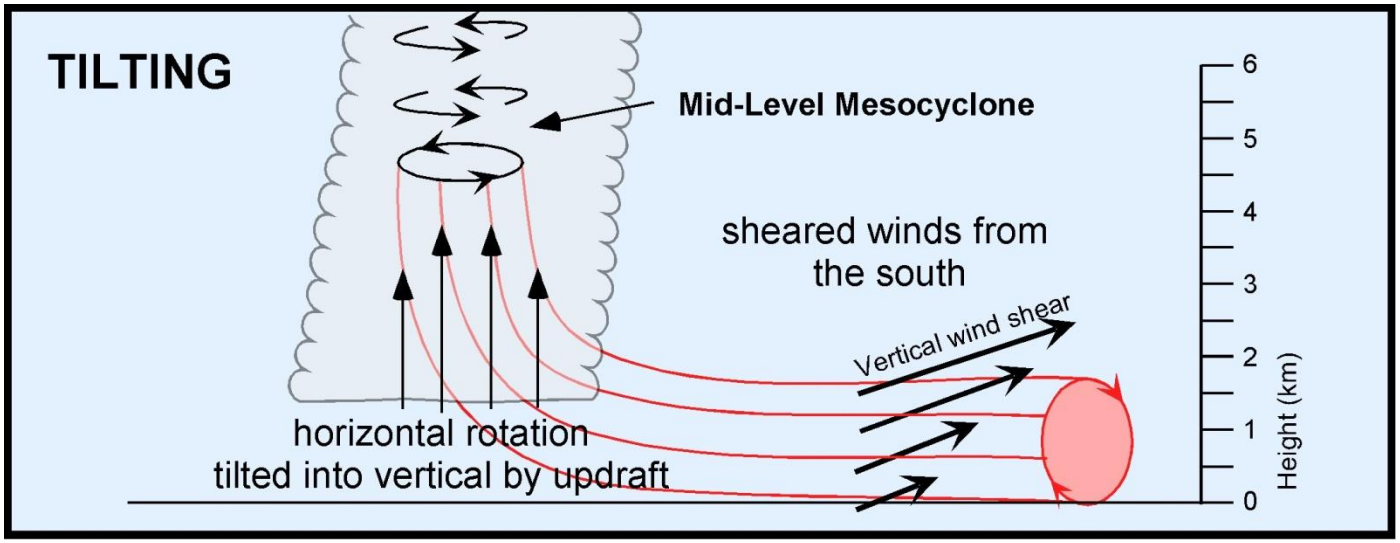


Courtesy of the American Meteorological Society



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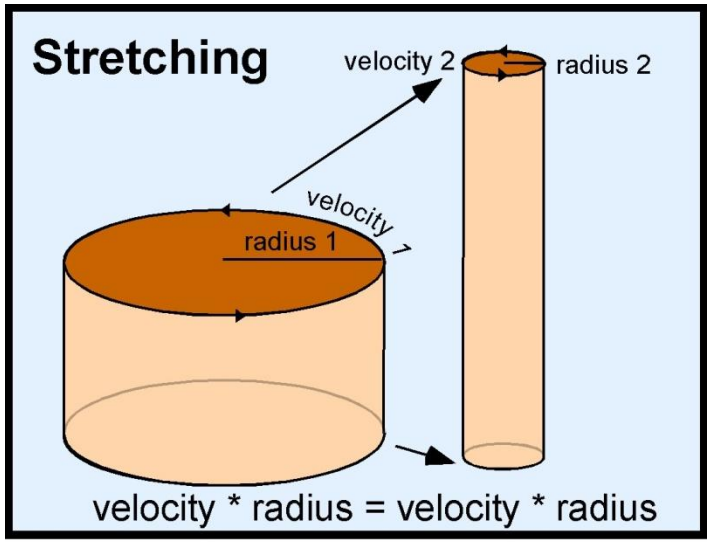

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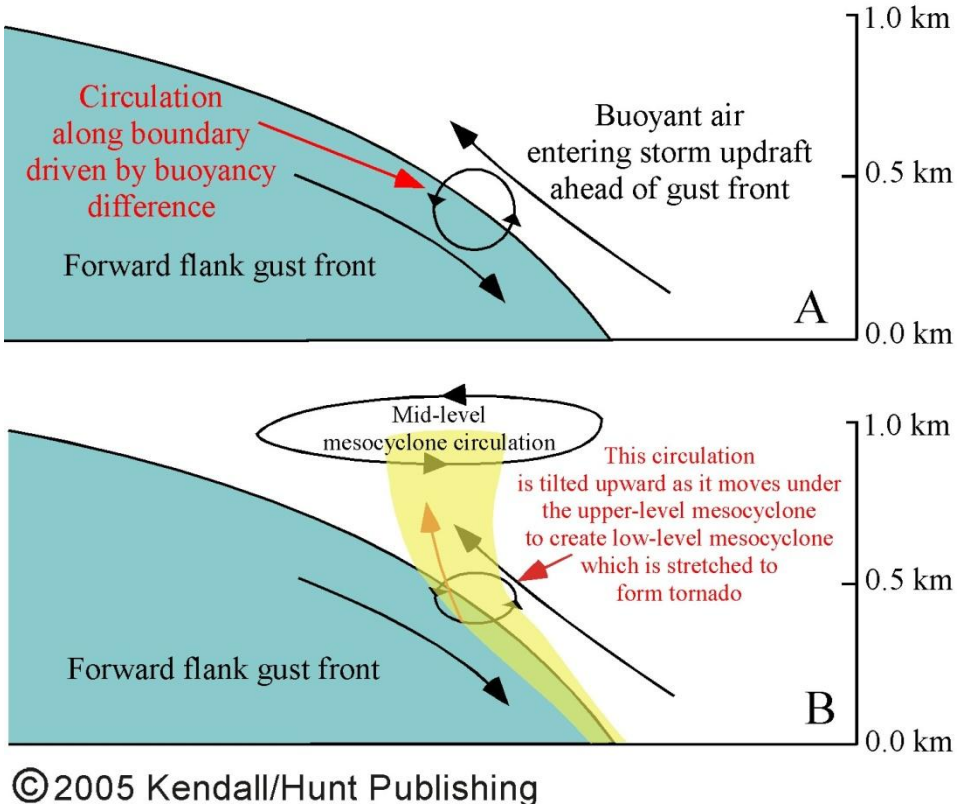

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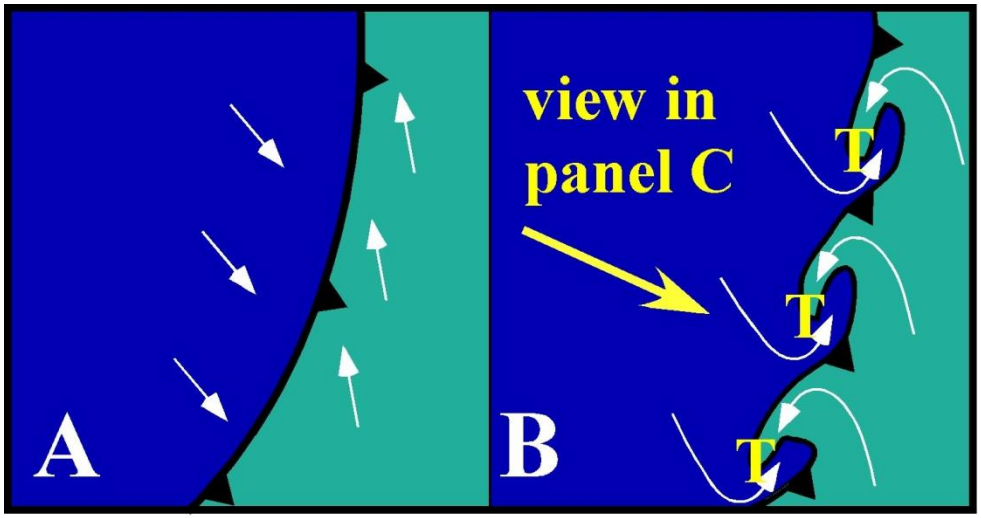
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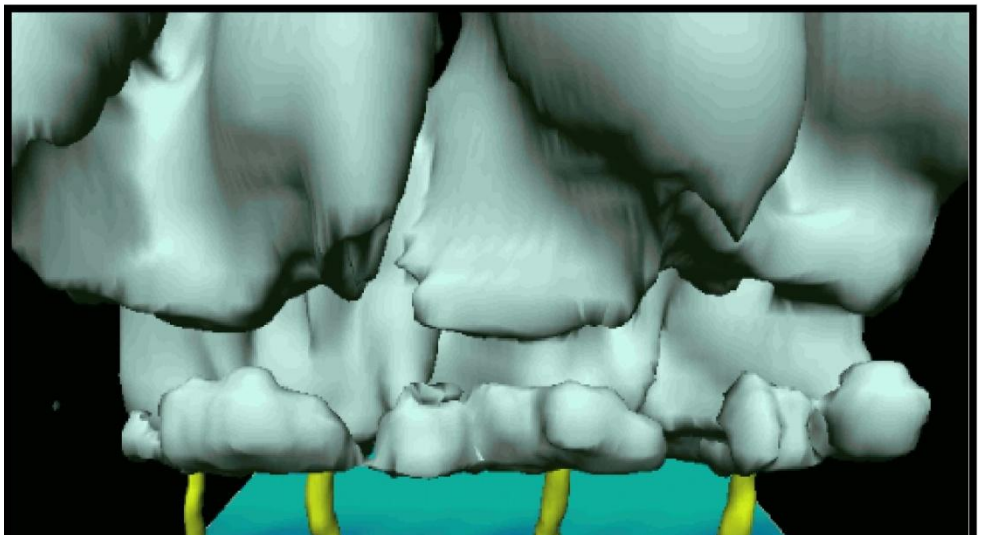
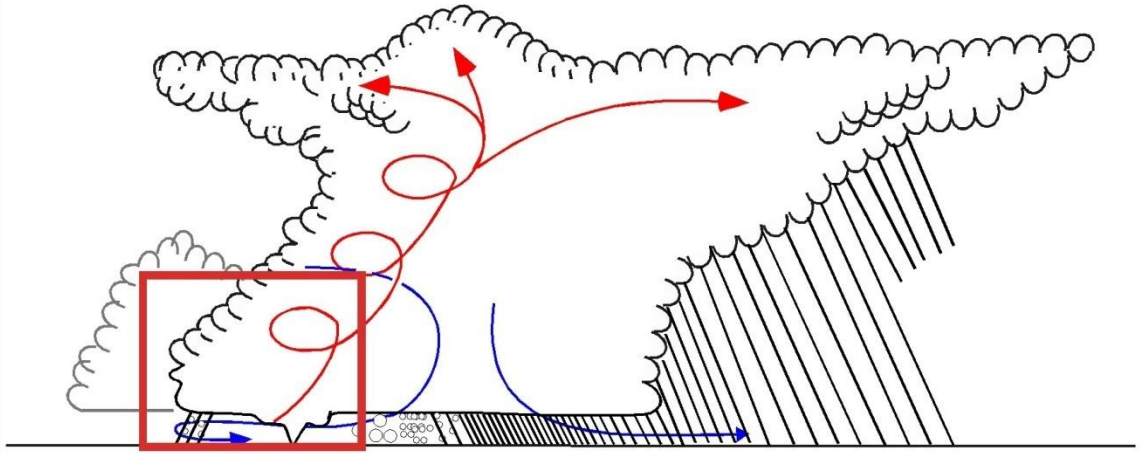


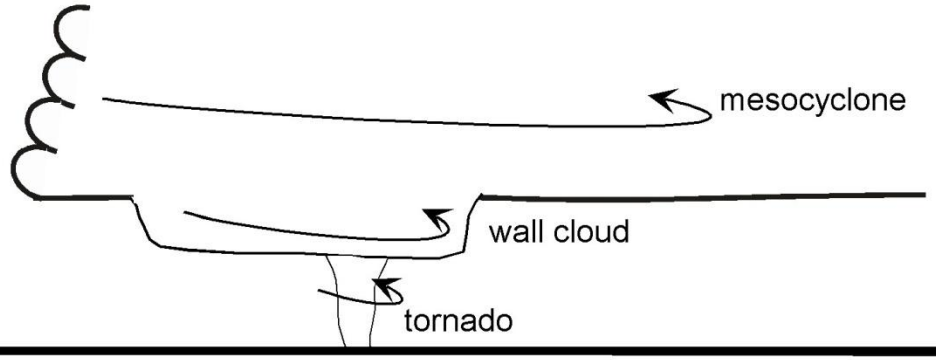


Conservation of Angular Momentum and Tornado Winds

r = radius, v = rotational velocity

r(meso) * v(meso) = r(wall) * v(wall) = r(tornado) * v(tornado)

4000 m * 2.5 m/s = 1000 m * 10 m/s = 100 m * 100 m/s



Courtesy of Bruce Lee

(A)

(D)

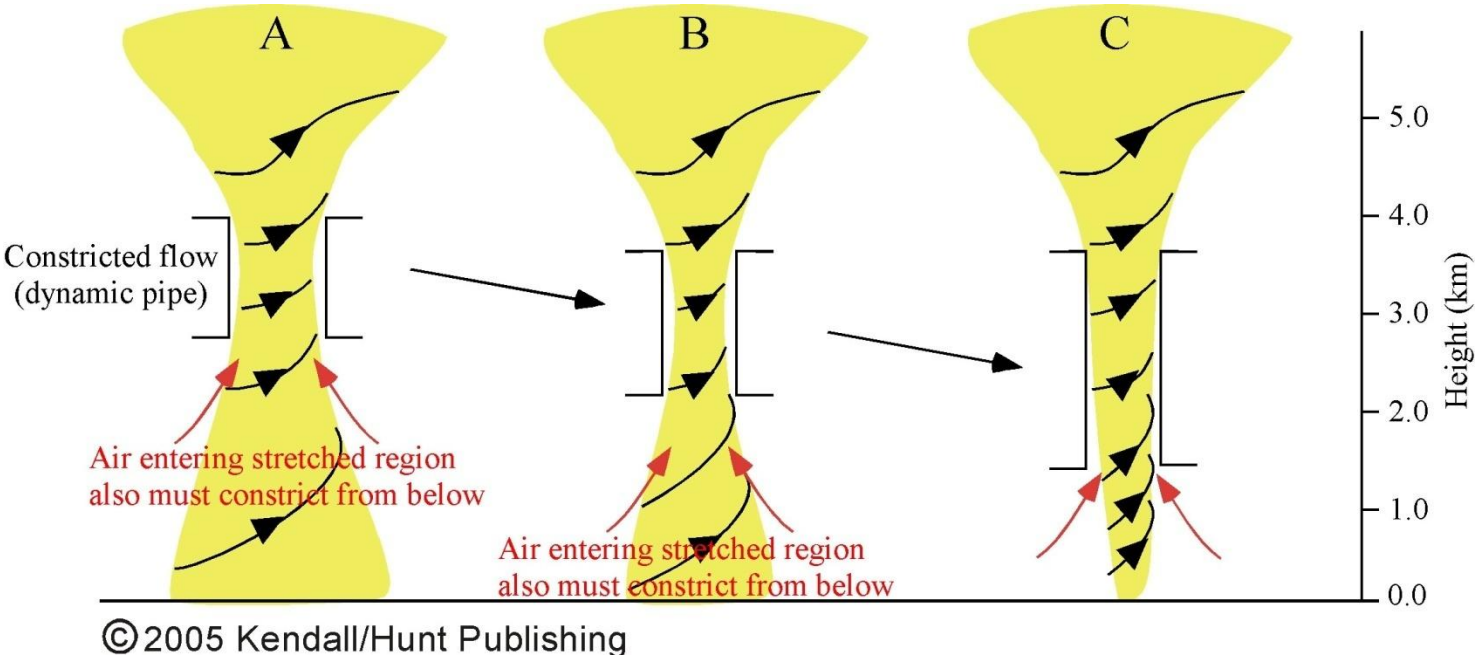
(B)

(E)

(C)

(F)

Copyright Howard B. Bluestein



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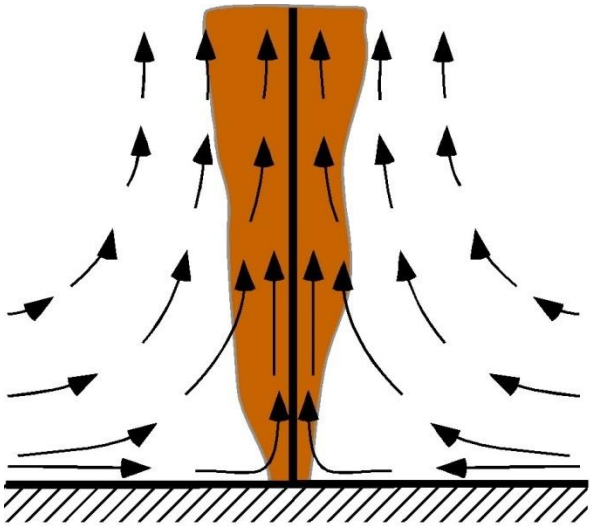
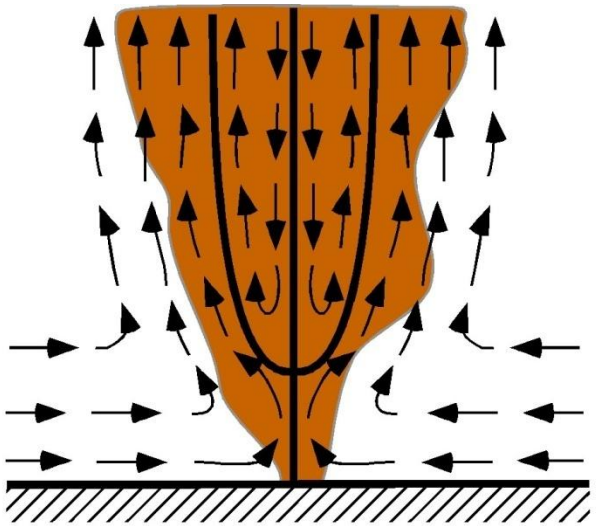
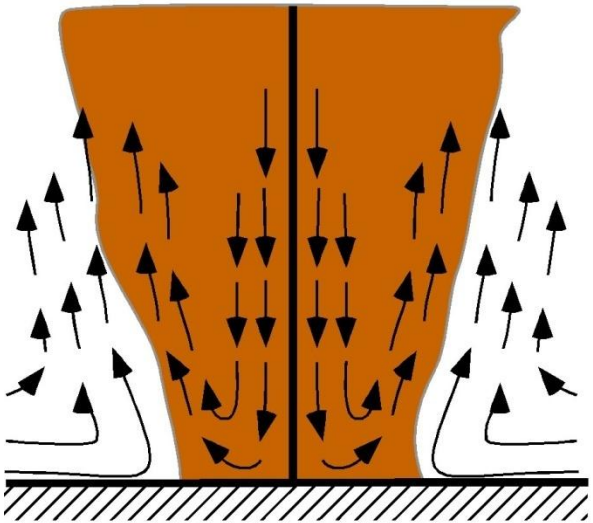
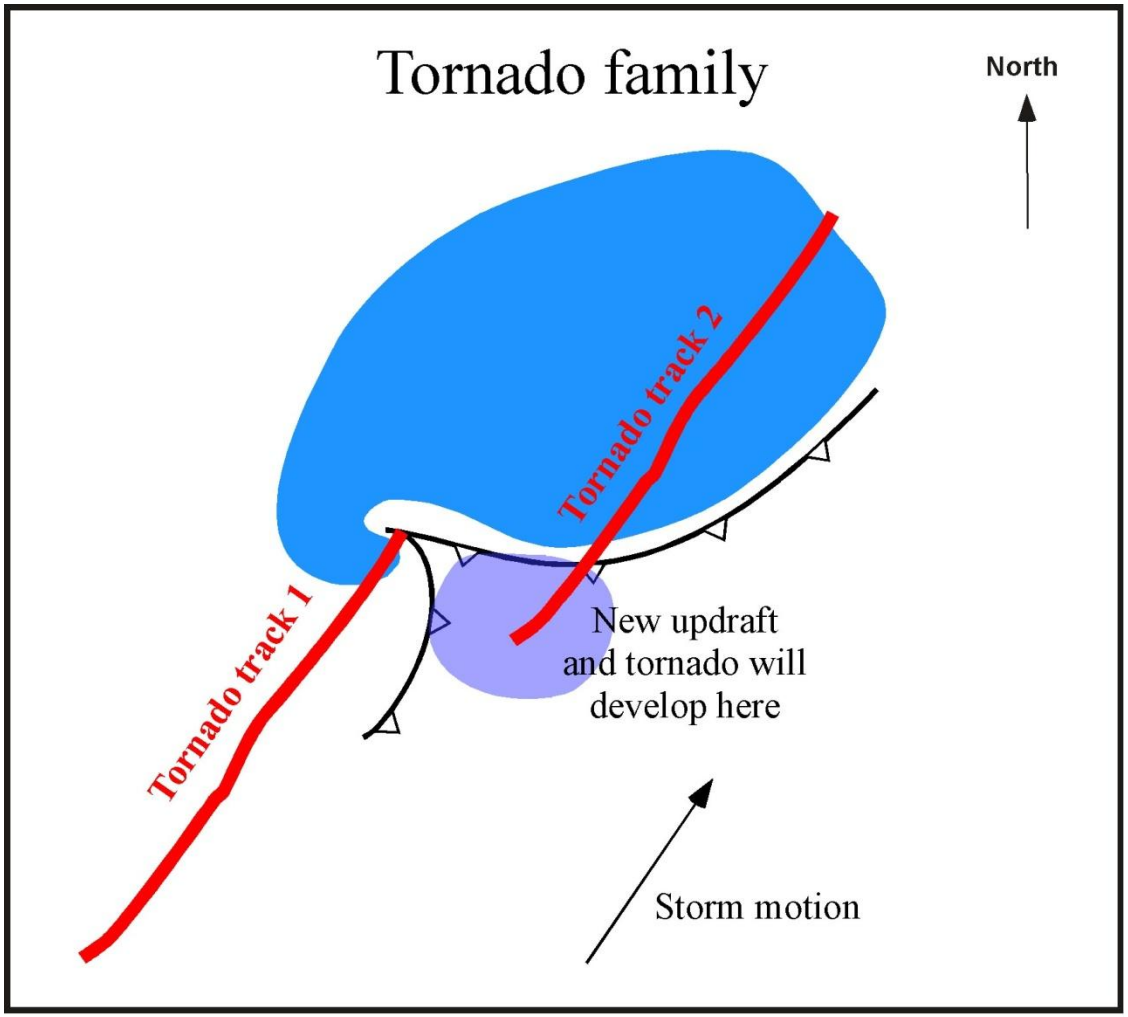


A. central updraft



B. vortex breakdown





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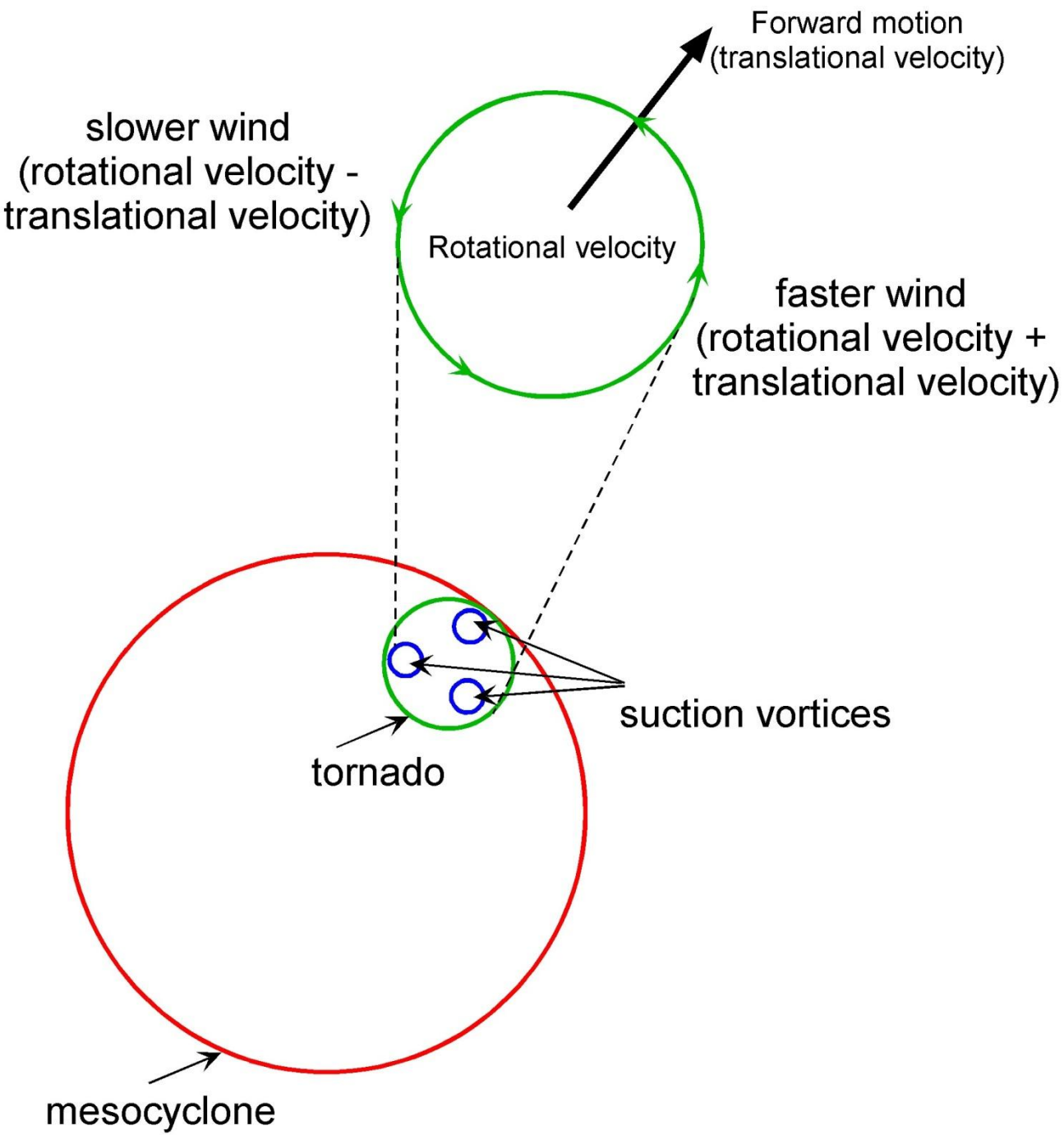
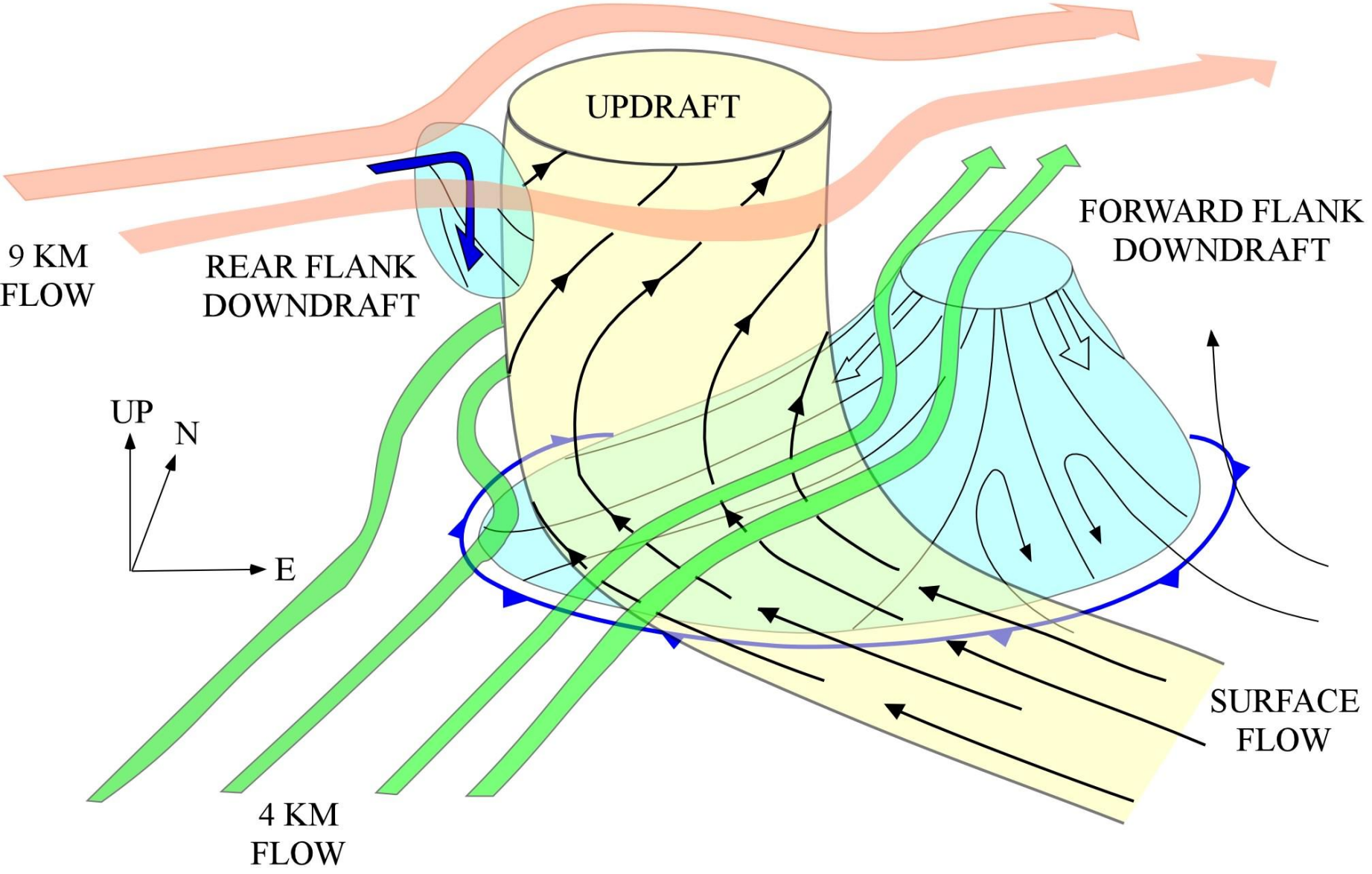
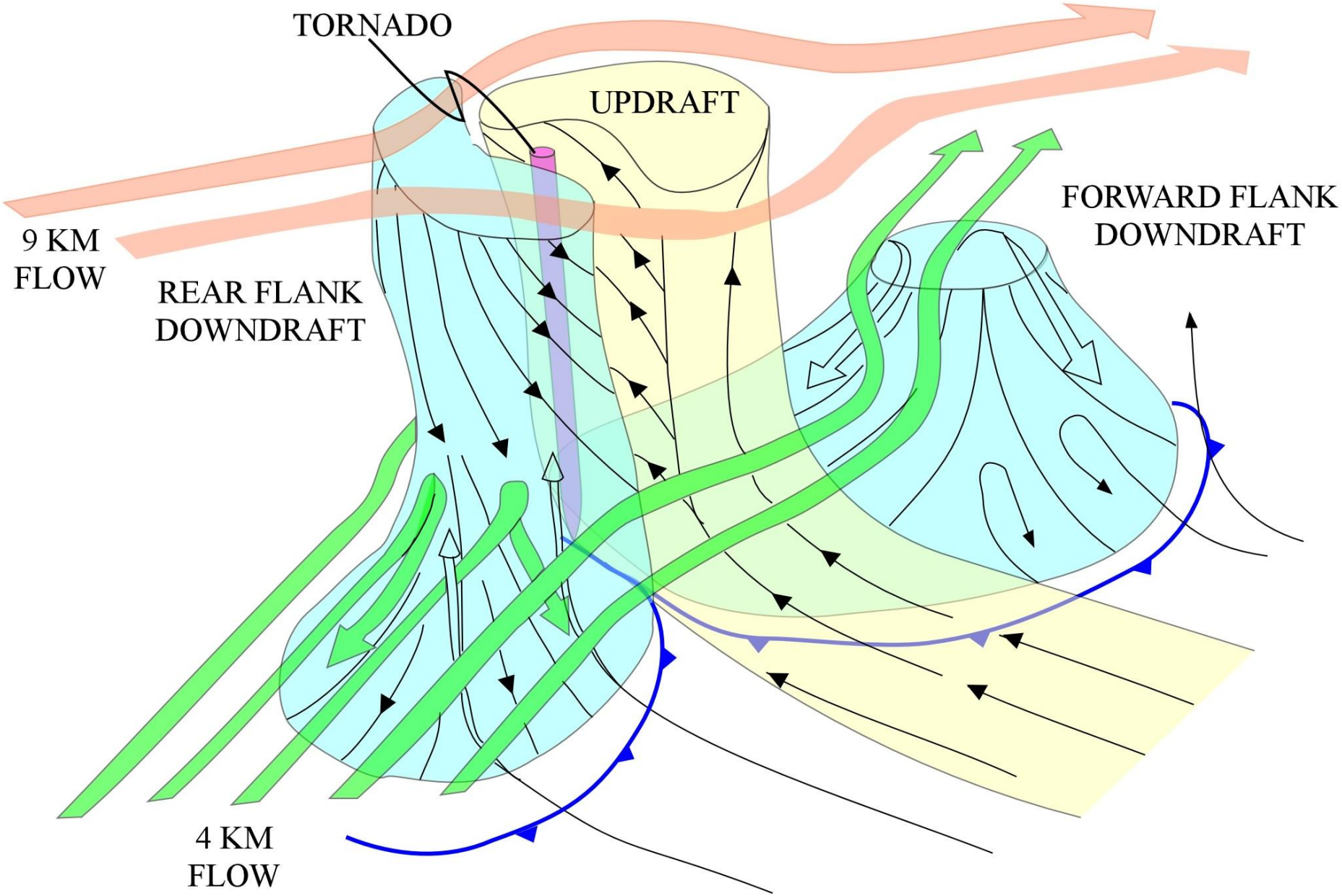
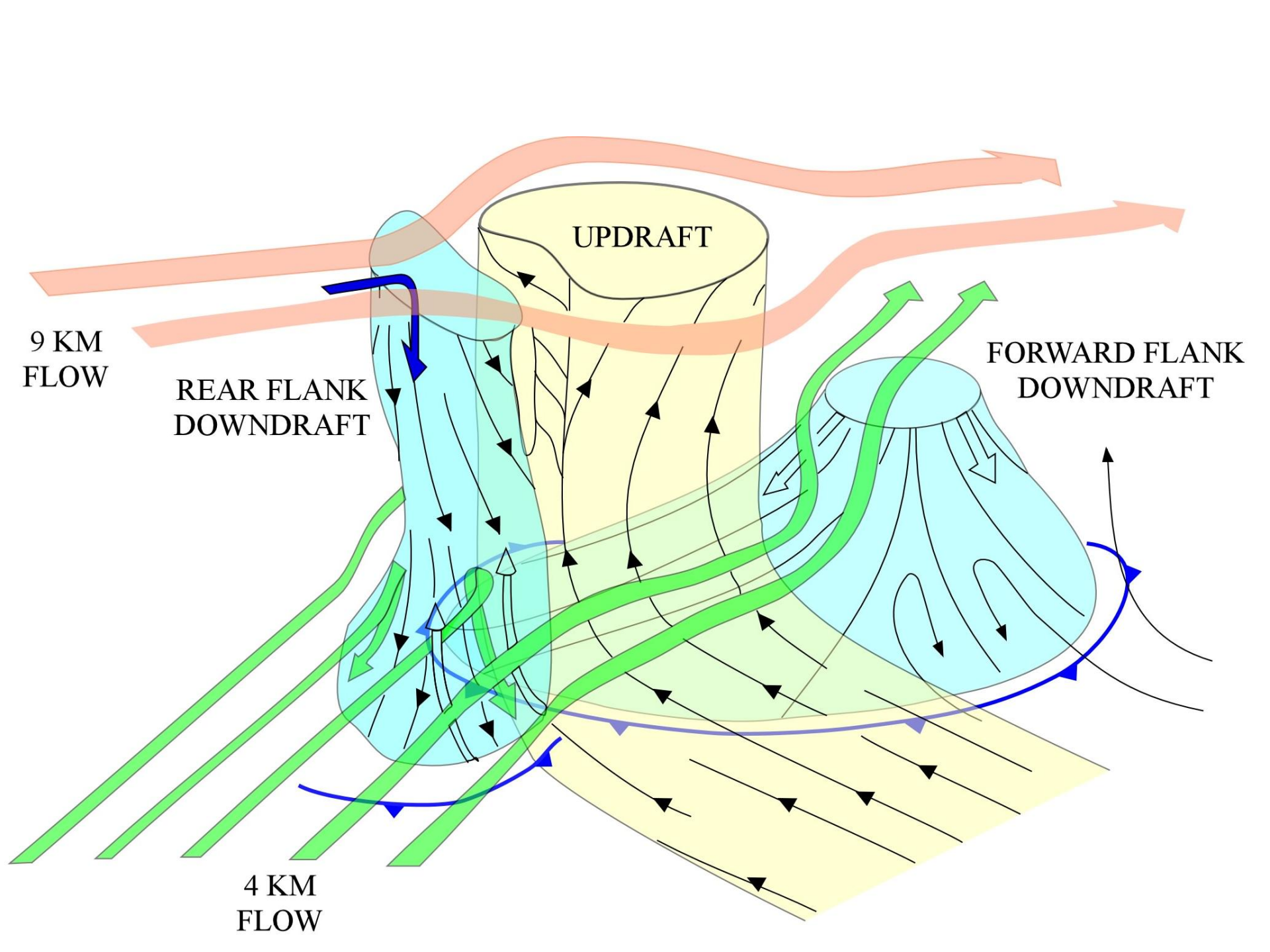

Forward motion
(translational velocity)
slower wind
(rotational velocity -
translational velocity)
Rotational velocity
faster wind
(rotational velocity +
translational velocity)
suction vortices
tornado
mesocyclone


UPDRAFT
9 KM
FLOW
REAR FLANK
DOWNDRAFT
FORWARD FLANK
DOWNDRAFT
UP
N
E
SURFACE
FLOW
4 KM
FLOW


TORNADO
UPDRAFT
9 KM
FLOW
REAR FLANK
DOWNDRAFT
FORWARD FLANK
DOWNDRAFT
4 KM
FLOW


UPDRAFT
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FLOW
REAR FLANK
DOWNDRAFT
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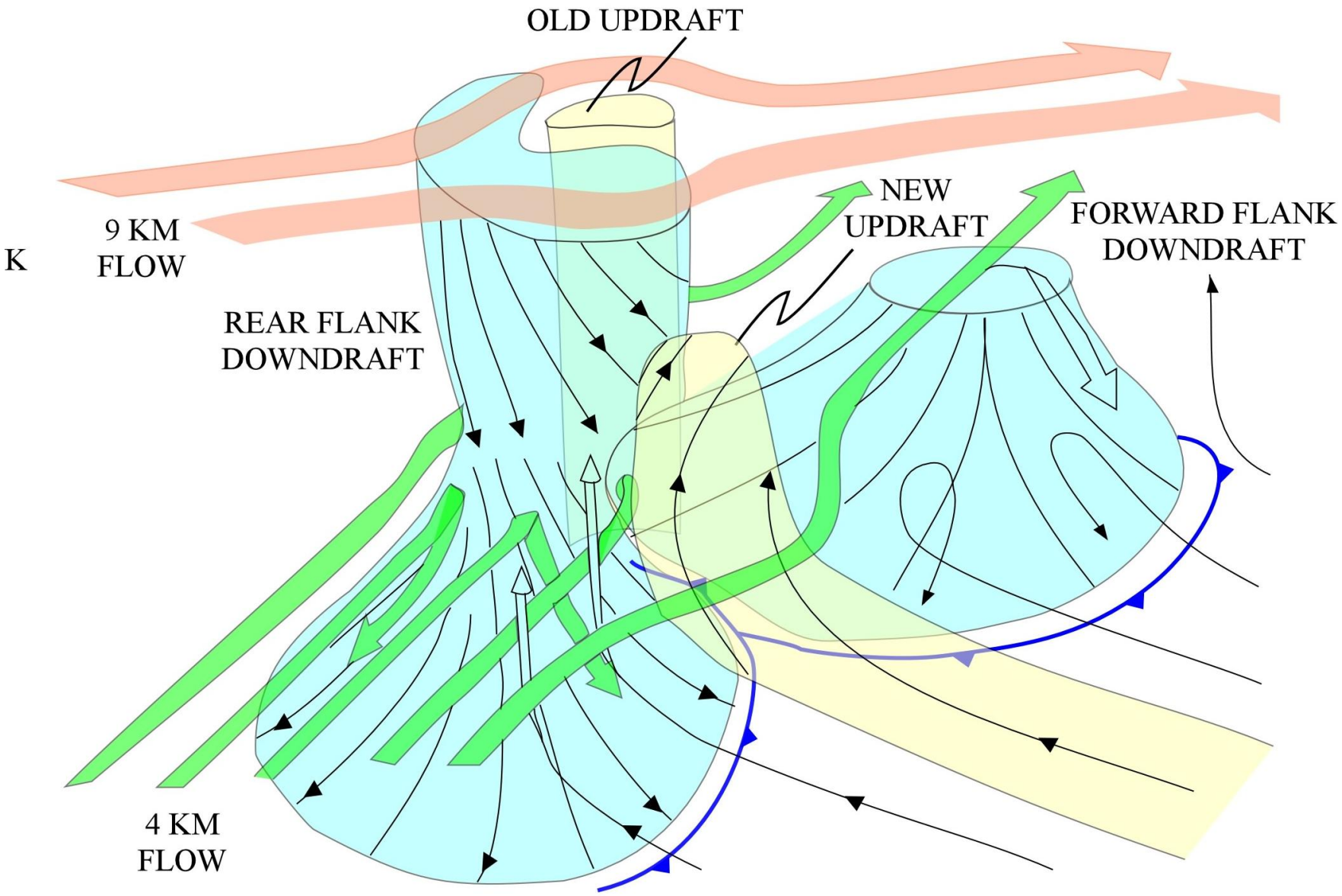
OLD UPDRAFT
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FLOW
NEW
UPDRAFT
FORWARD FLANK
DOWNDRAFT
REAR FLANK
DOWNDRAFT
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FLOW