ZHU Summer Weather Hazards

March 2012

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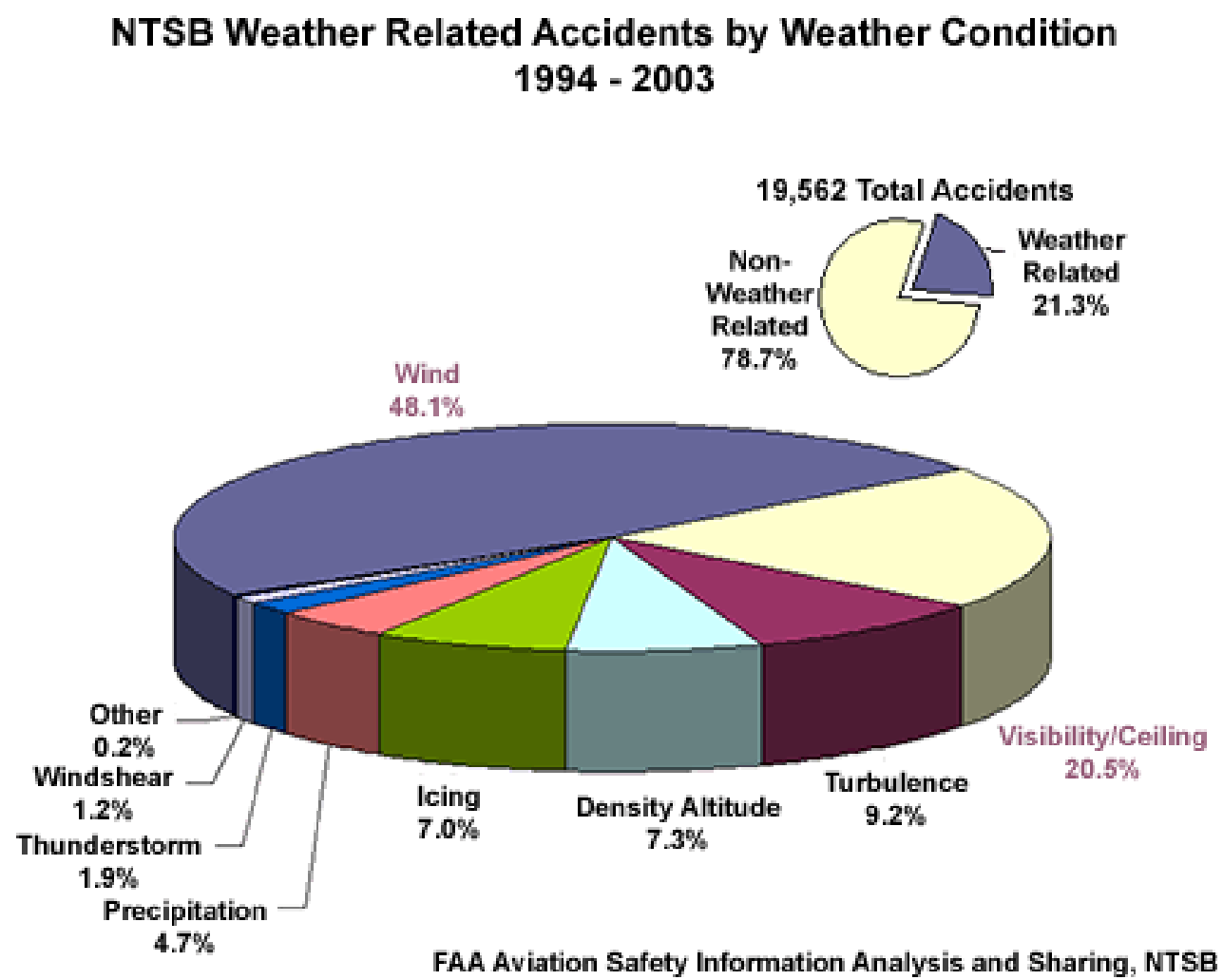
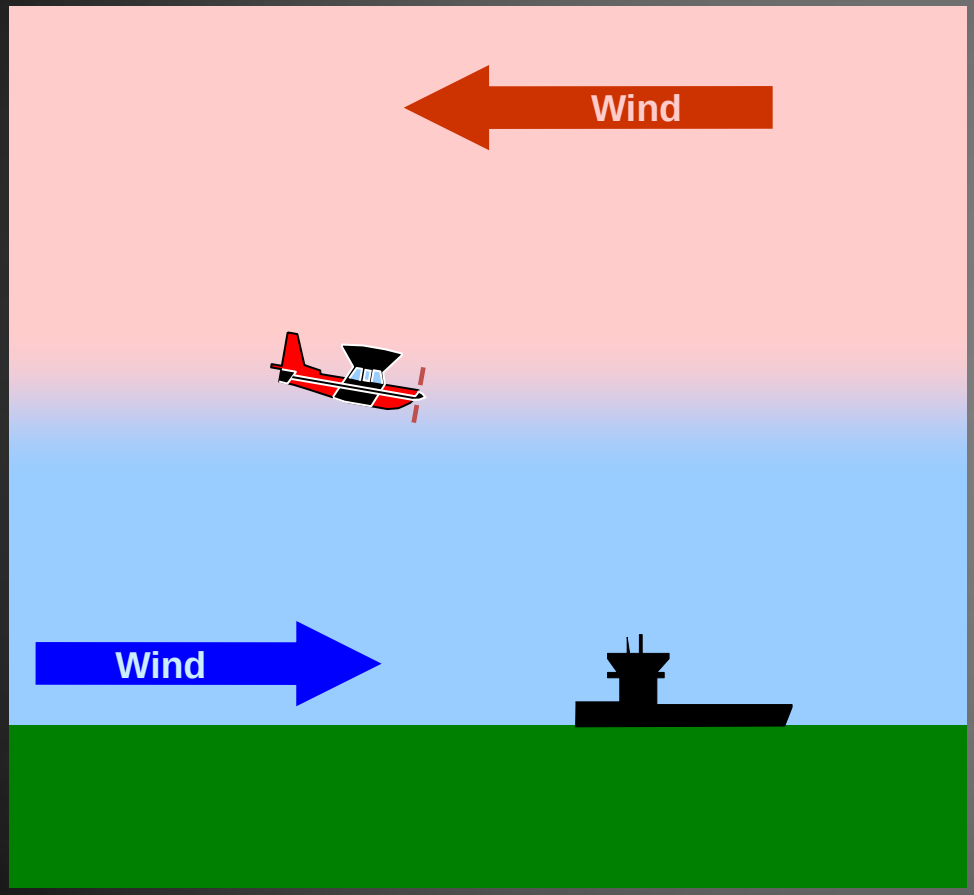
Motivation


NTSB Weather Related Accidents by Weather Condition
1994 - 2003
19,562 Total Accidents
Weather Related 21.3%
Non-Weather Related 78.7%
Wind 48.1%
Visibility/Ceiling 20.5%
Turbulence 9.2%
Density Altitude 7.3%
Icing 7.0%
Precipitation 4.7%
Thunderstorm 1.9%
Windshear 1.2%
Other 0.2%
FAA Aviation Safety Information Analysis and Sharing, NTSB

Low-Level Wind Shear (LLWS)

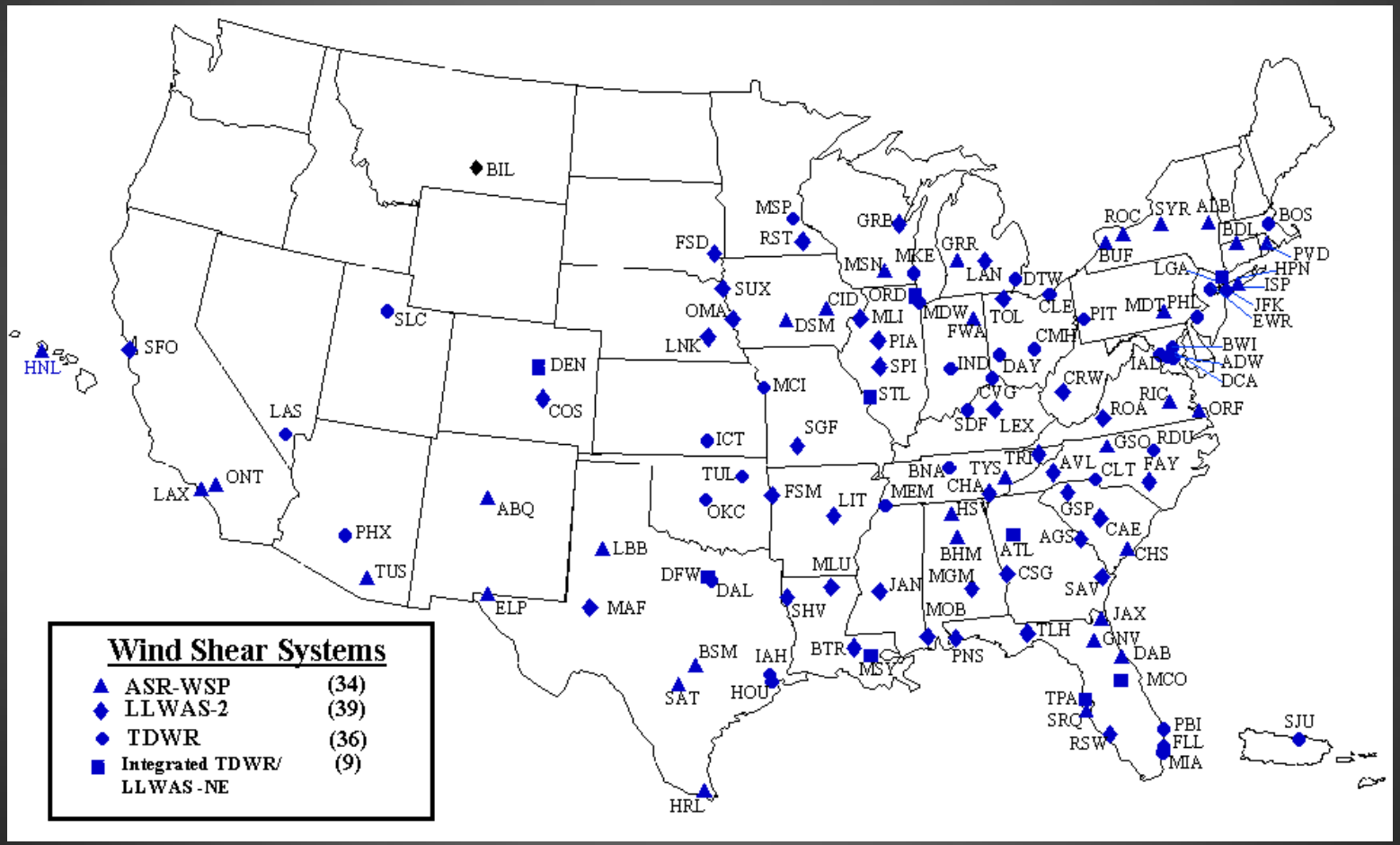


📖 Low-level wind shear (LLWS) – A wind shear of 10 knots or more per 100 feet in a layer more than 200 feet thick which occurs within 2,000 feet of the surface.

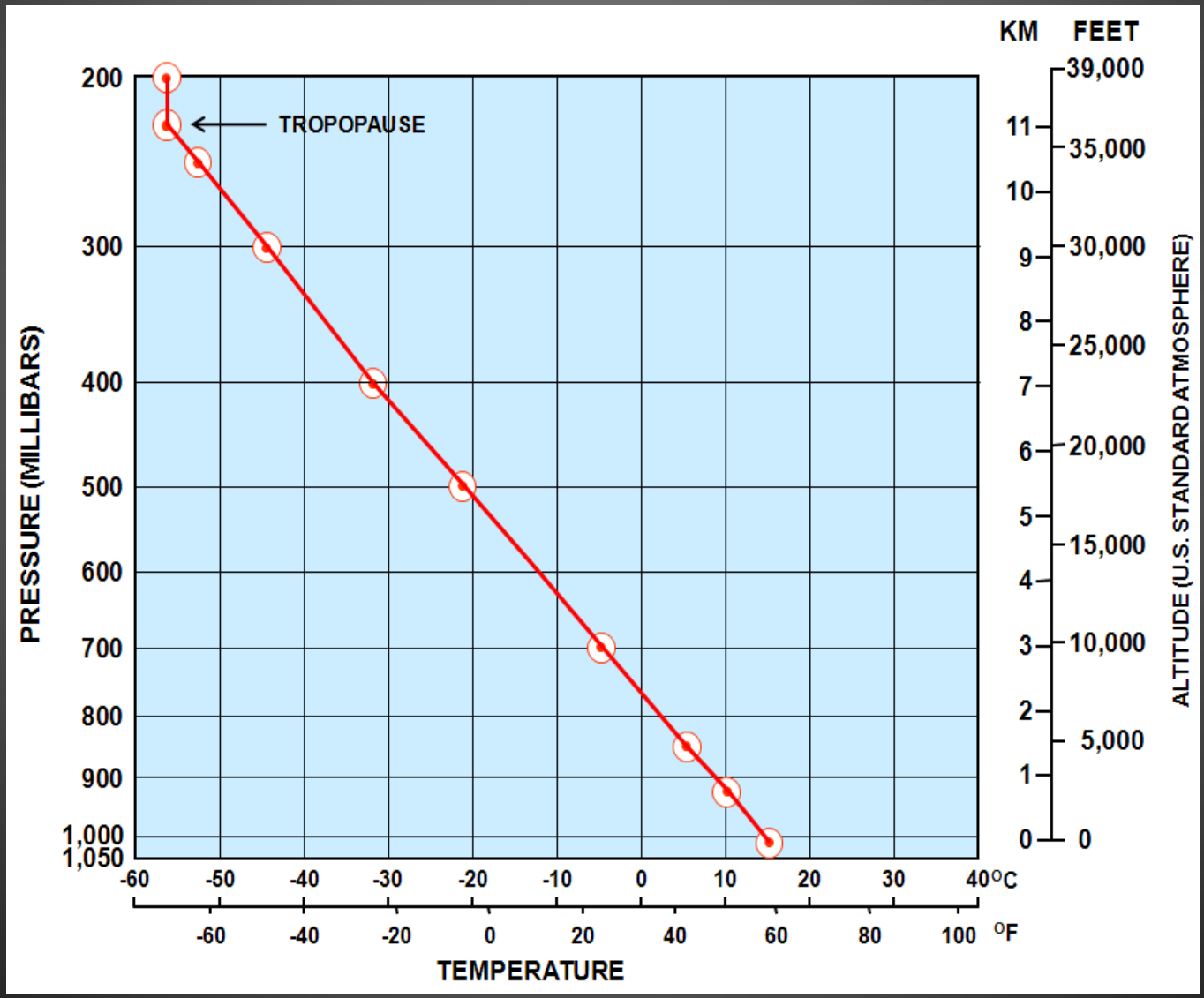
Wind Shear – Change From Headwind to Tailwind on Landing

Wind Shear – Change from a Tailwind to a Headwind on Landing

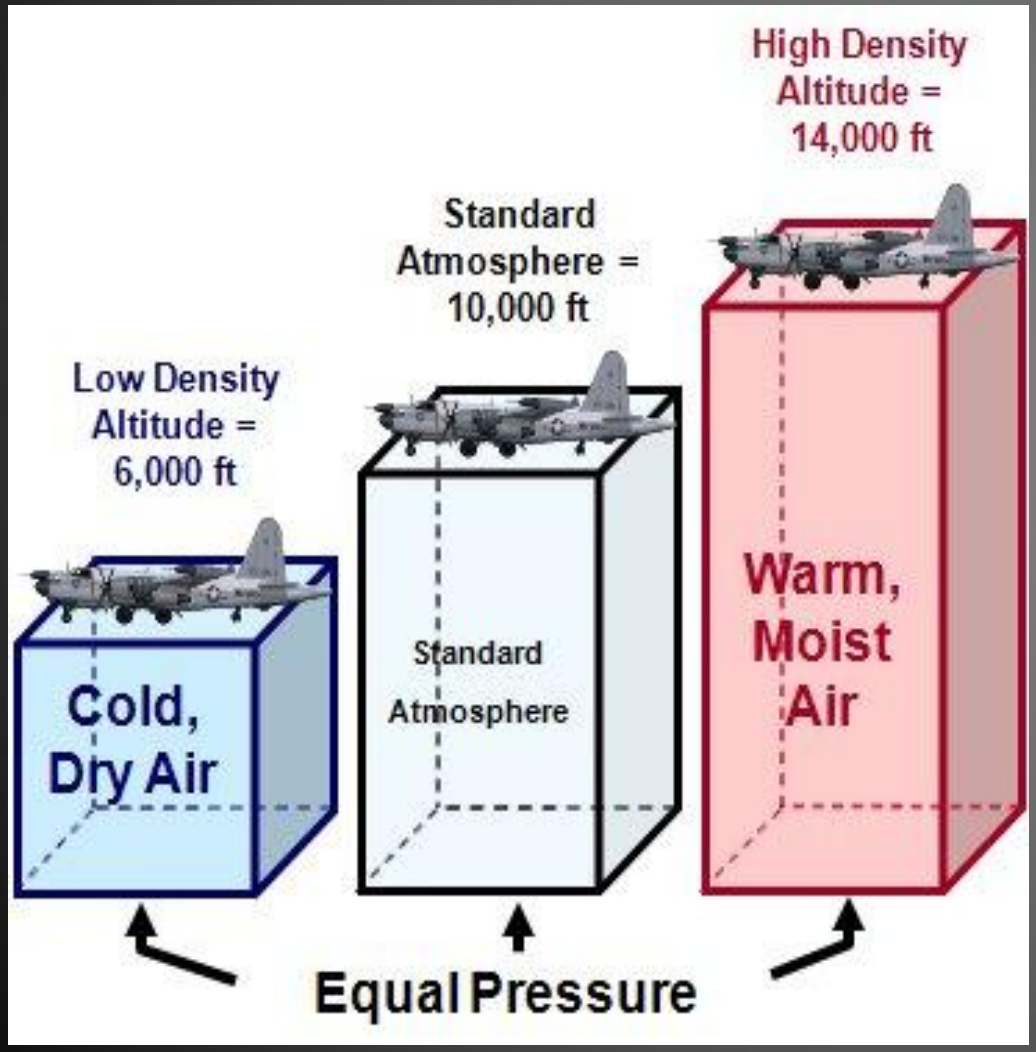
National Airspace System (NAS) Wind Shear Product Systems



High Density Altitude
U.S.Standard Atmosphere



Density Altitude

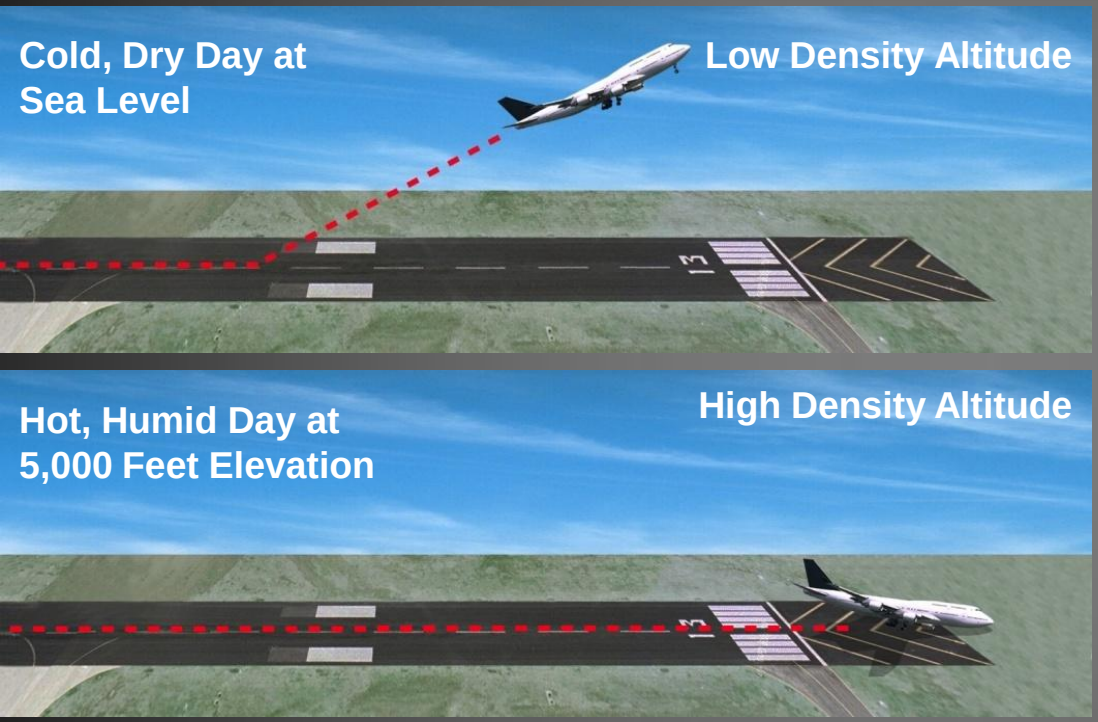


- Air density is related to pressure, temperature, and humidity

High Density Altitude

- Hazardous because it reduces aircraft:
  - Power
    - Engine ingests less air to support combustion
  - Thrust
    - Propeller has less “grip”
    - Jet exhausts less mass
  - Lift
    - Air exerts less upward force on the airfoils

High Density Altitude – Hazardous Effects

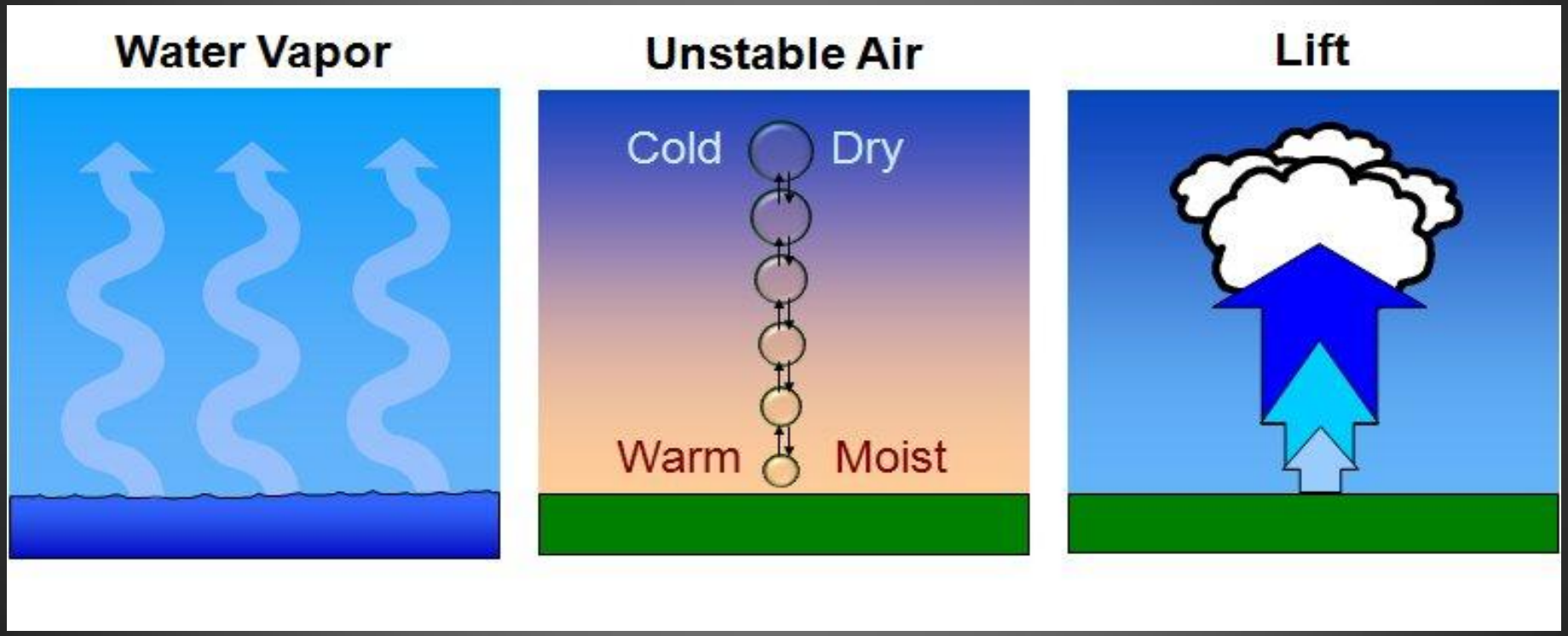


- Longer takeoff roll is required
- Smaller rate of climb
- Lowers aircraft's service ceiling
- Longer landing roll required

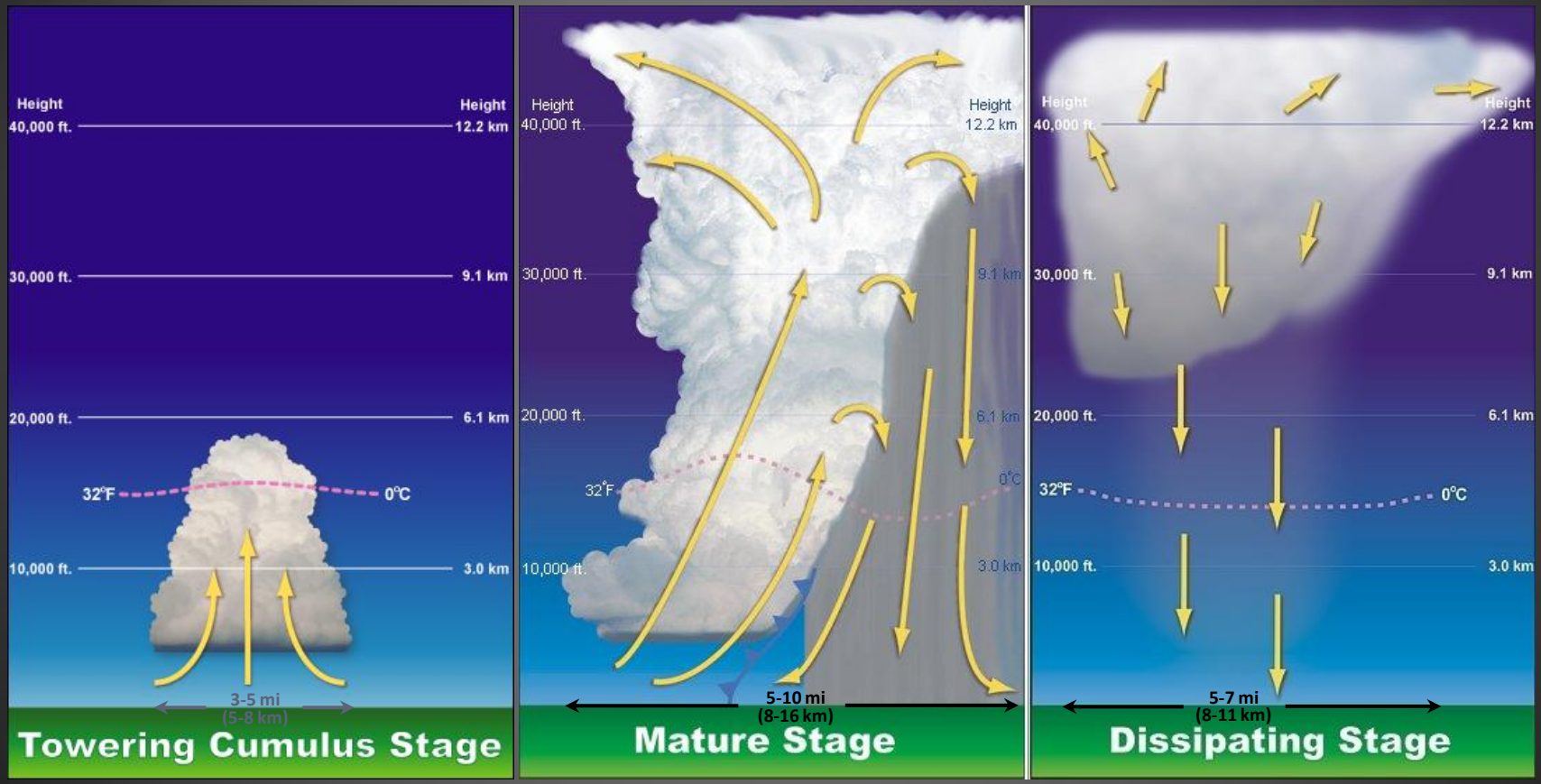
Thunderstorms

- Thunderstorm – A storm produced by a cumulonimbus (CB) cloud, and always accompanied by lightning and thunder, usually with strong gusts of wind, heavy rain, and sometimes with hail.

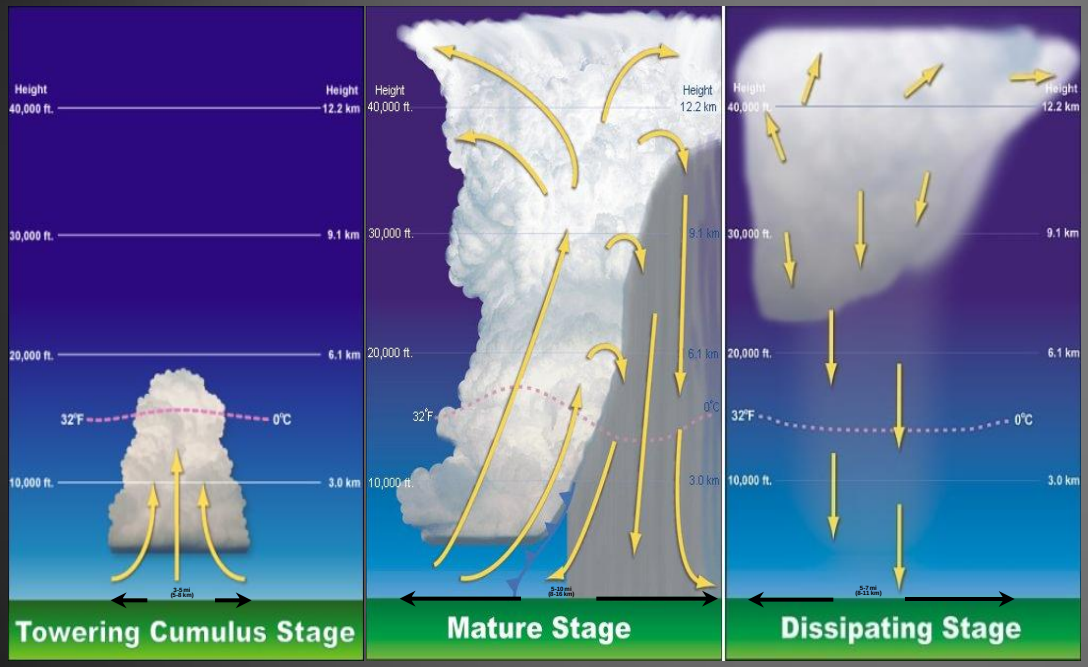
Necessary Ingredients for Thunderstorm Cell Formation



Thunderstorm Cell Life Cycle

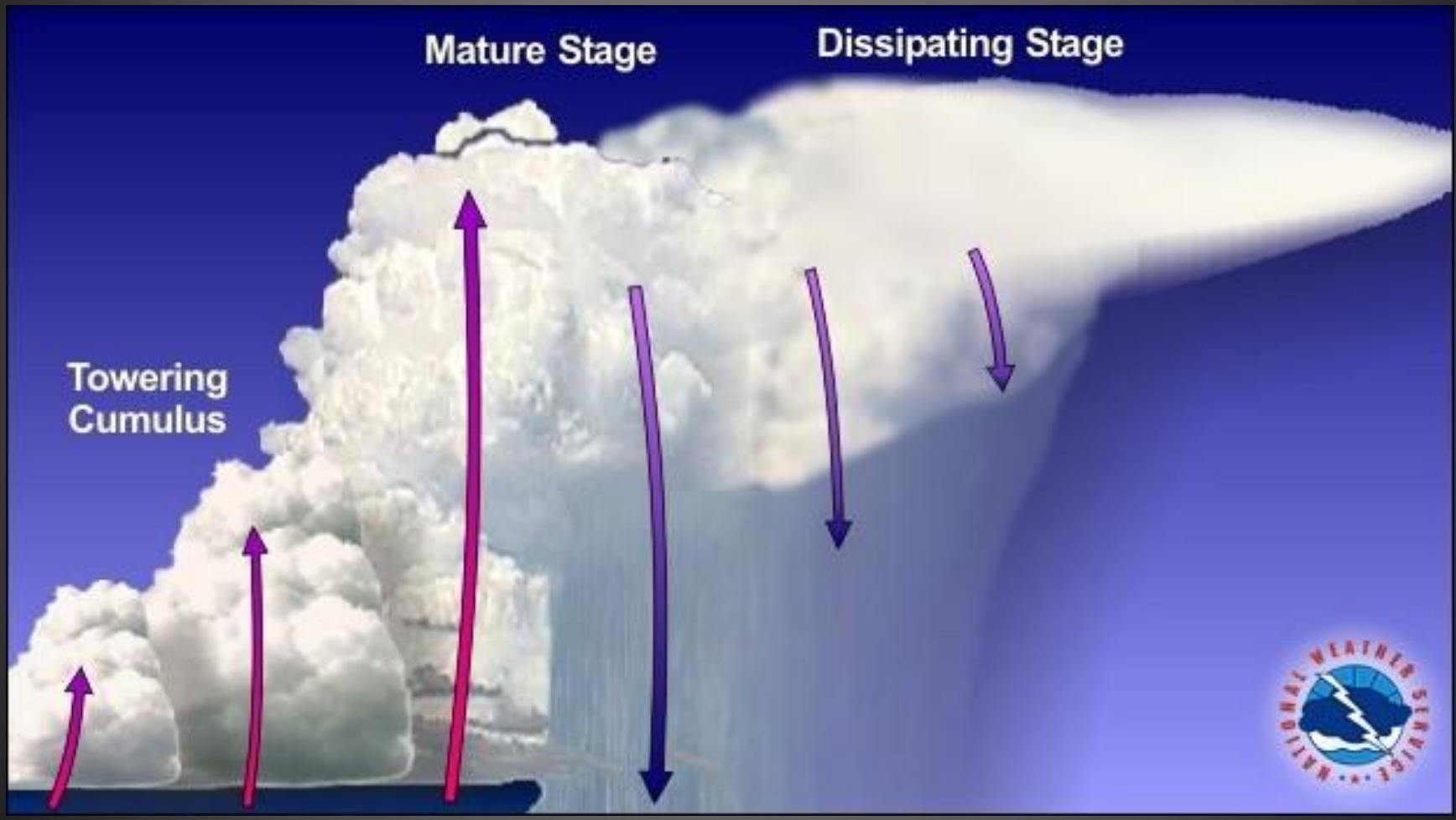


Single Cell

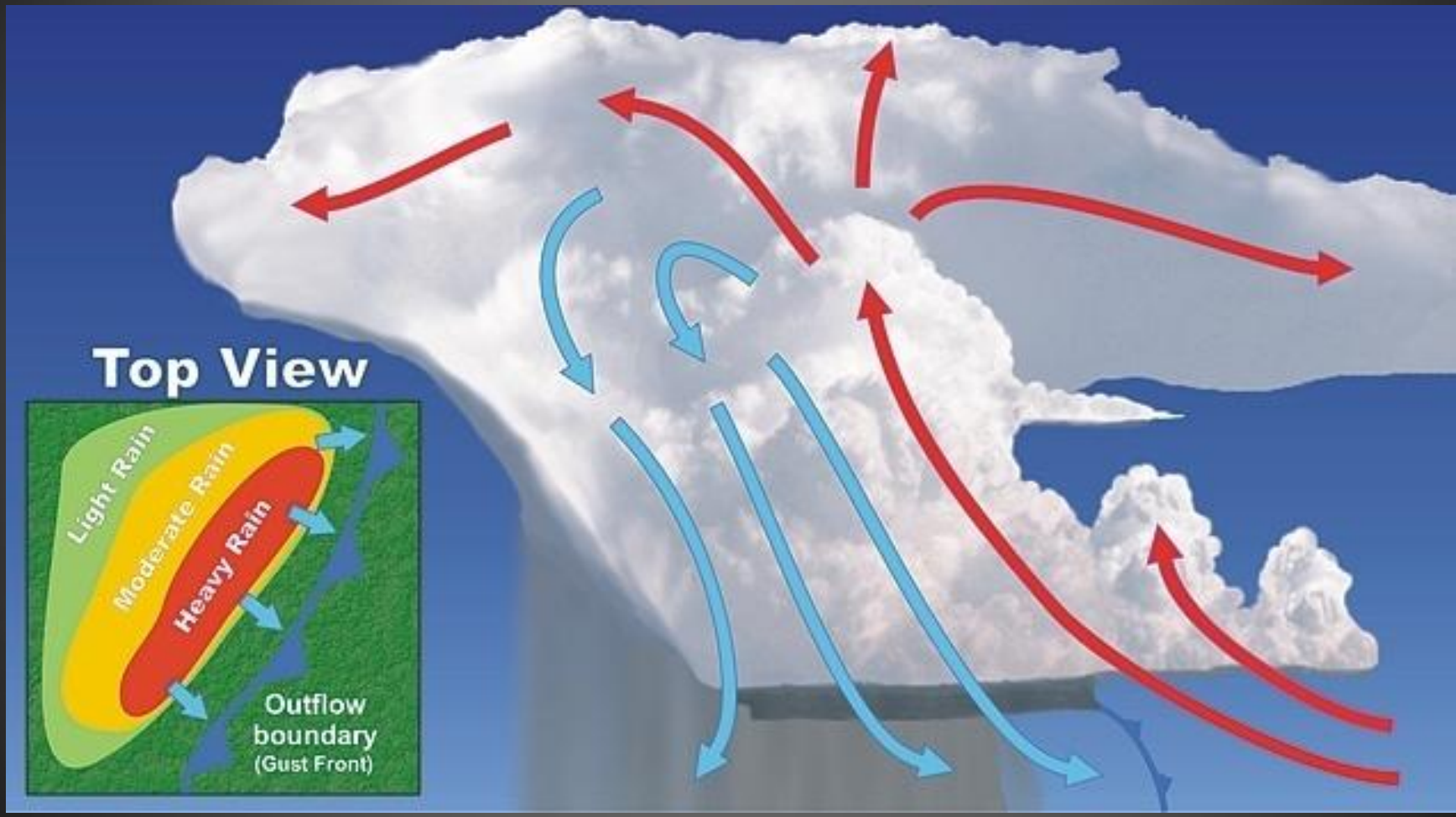


- Consists of one cell
  - Short lived (~30 min)
  - Easily circumnavigated visually by pilots
    - Except at night or when embedded
  - Rare
    - Almost all thunderstorms are multicell

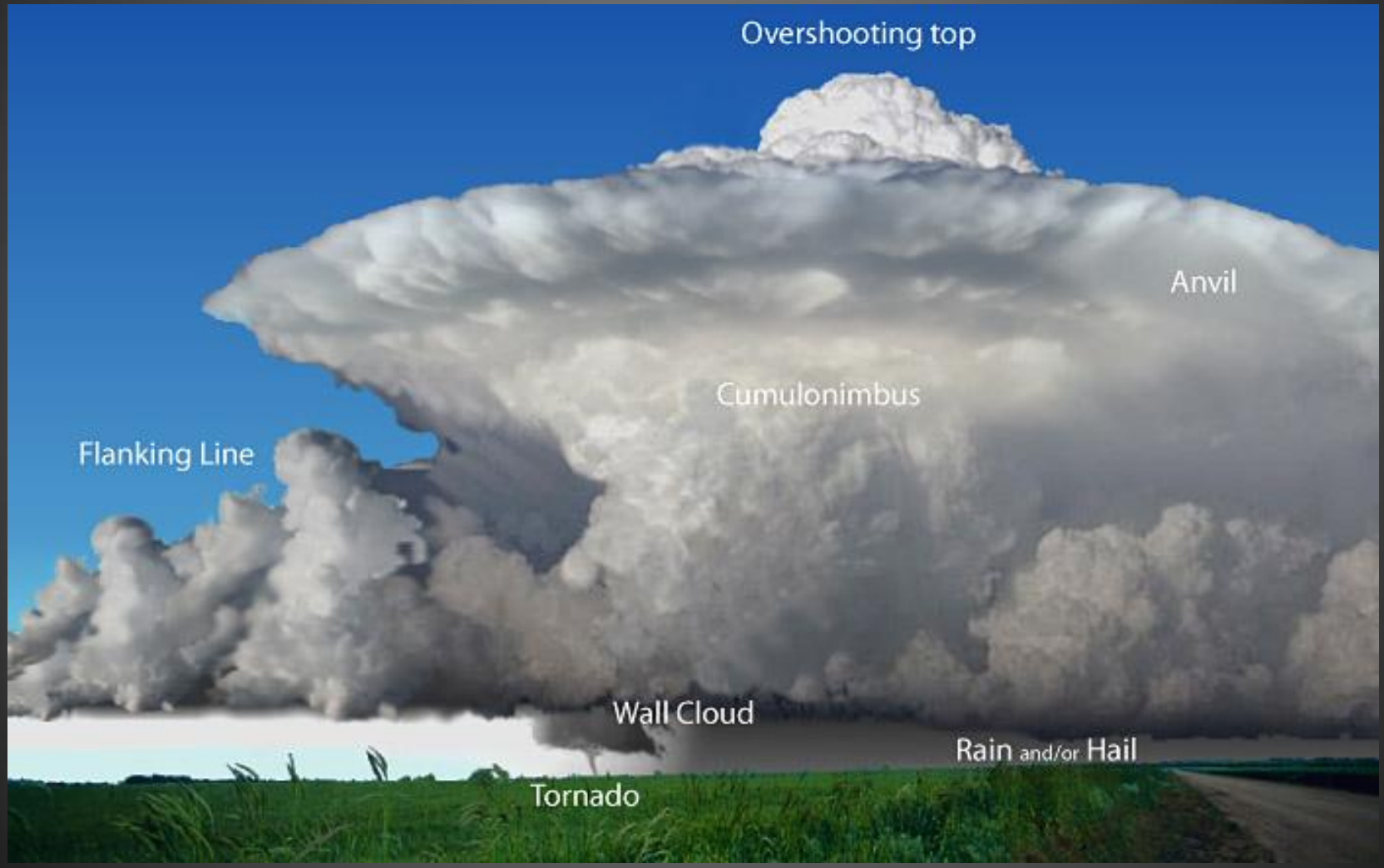
Multi-cell Cluster



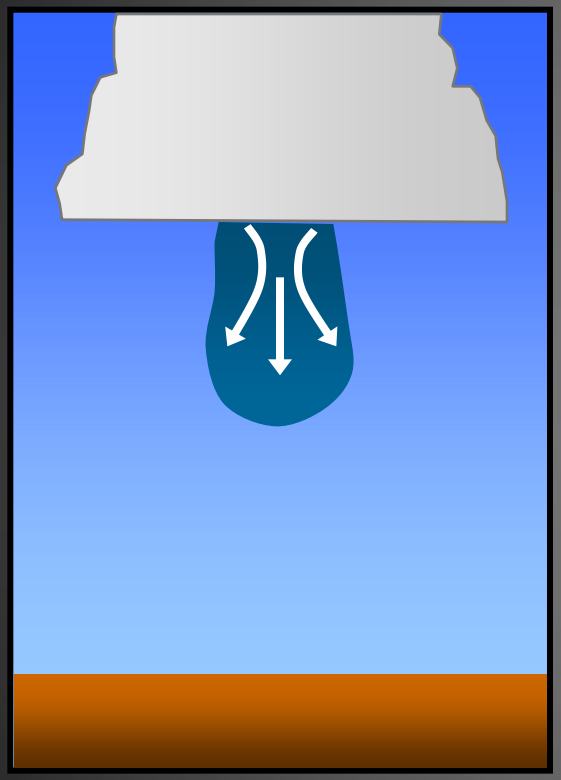
Multi-cell Line (Squall Line)



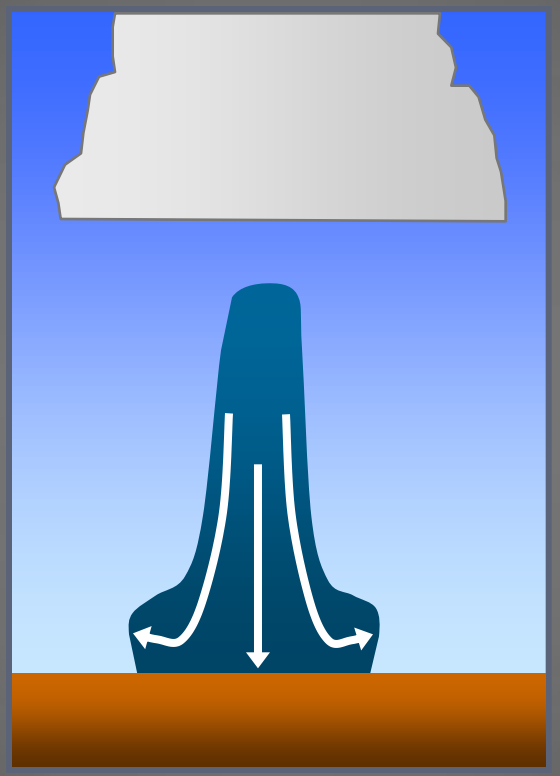
Supercell


Overshooting top
Anvil
Cumulonimbus
Flanking Line
Wall Cloud
Rain and/or Hail
Tornado

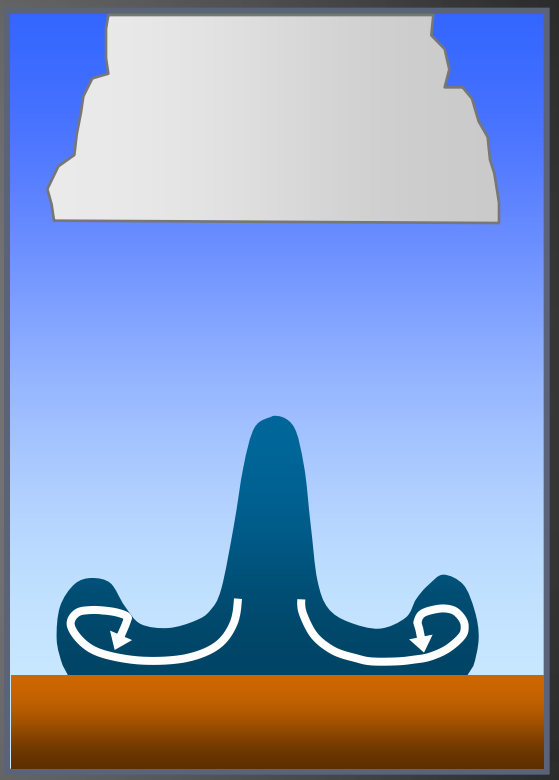
Downburst Lifecycle



FORMATION – Evaporation and precipitation drag forms downdraft



IMPACT – Downdraft quickly accelerates and strikes ground

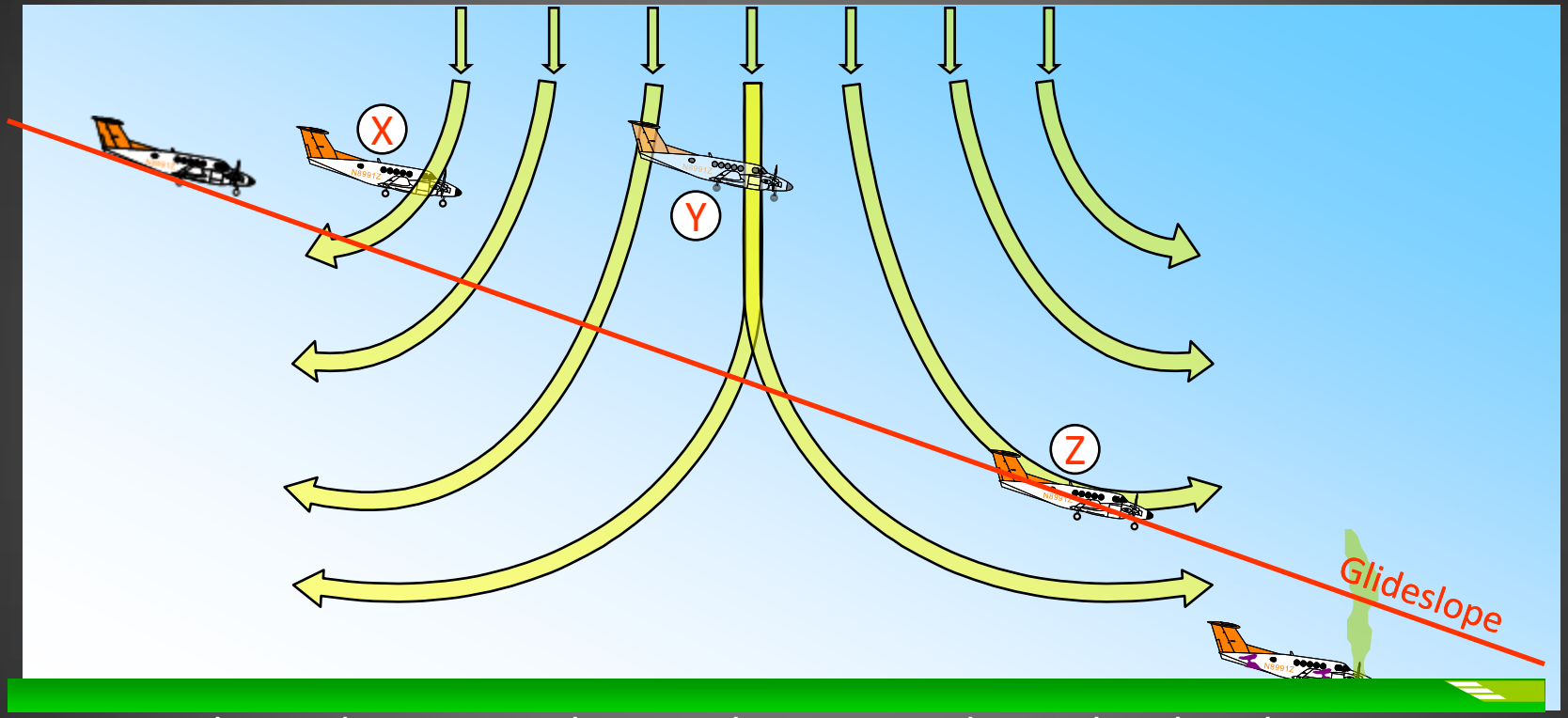


DISSIPATION – Downdraft moves away from point of impact

Microburst Types

- A dry microburst is associated with virga
  - Downdraft is driven by evaporative cooling of raindrops falling through dry, unsaturated air
- A wet microburst is associated with a concentrated rain shaft
  - Downdraft is driven by both evaporative cooling and precipitation drag of raindrops dragging air to the ground

Landing in a Microburst

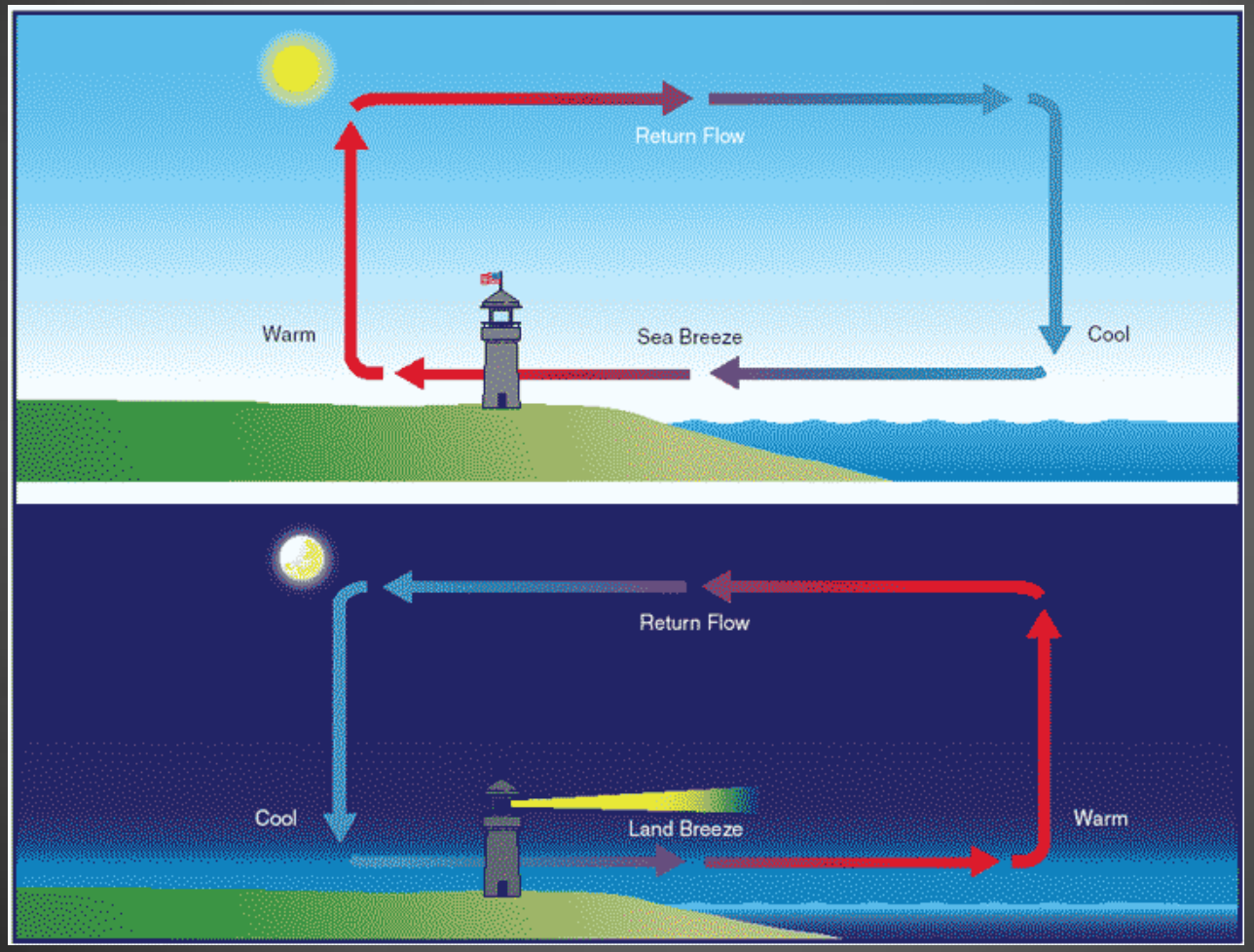


At point X, the airplane enters the microburst zone where a headwind causes it to balloon above the normal glideslope.

At the center of the microburst, point Y, there is a downdraft which causes the airplane to sink.

At point Z, the airplane enters the most lethal zone where a sudden tailwind causes the airplane to lose airspeed.

Sea Breeze Thunderstorm



Thank you!