

Clouds and More Clouds AOSC 200

Tim Canty

Class Web Site: <http://www.atmos.umd.edu/~tcanty/aosc200>

Topics for today:

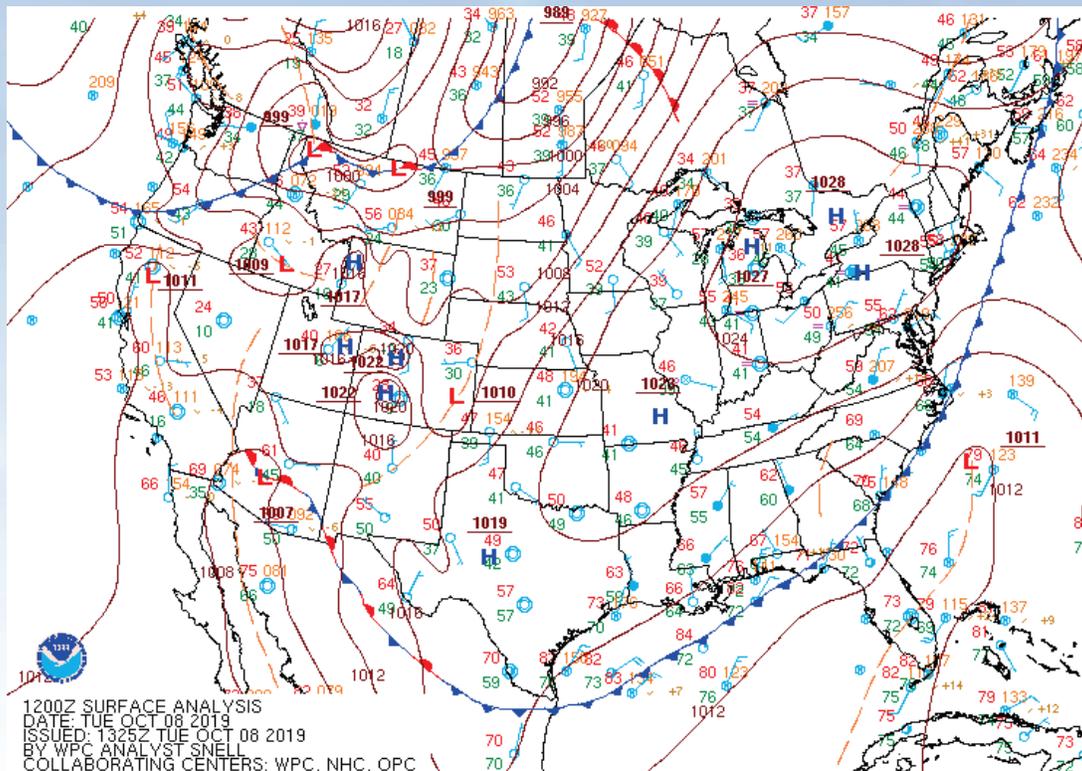
How to make clouds pt 2.

Lecture 13
Oct 8 2019

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Current Weather

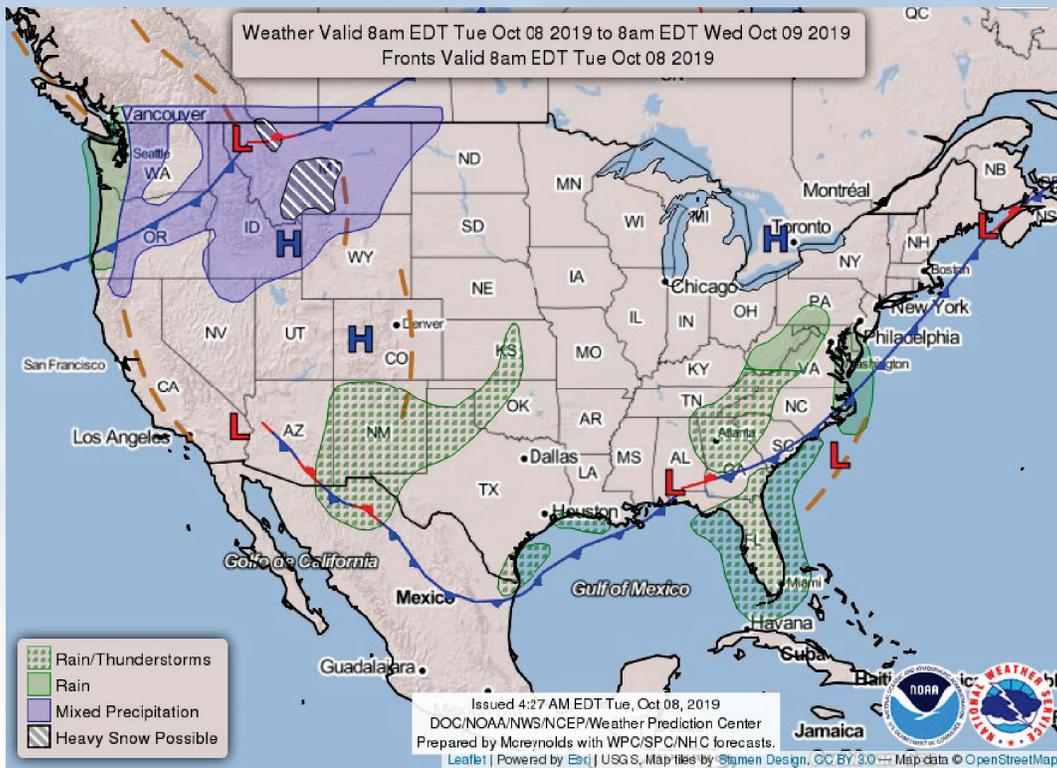


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<http://www.wpc.ncep.noaa.gov/sfc/namussfcwbq.gif>

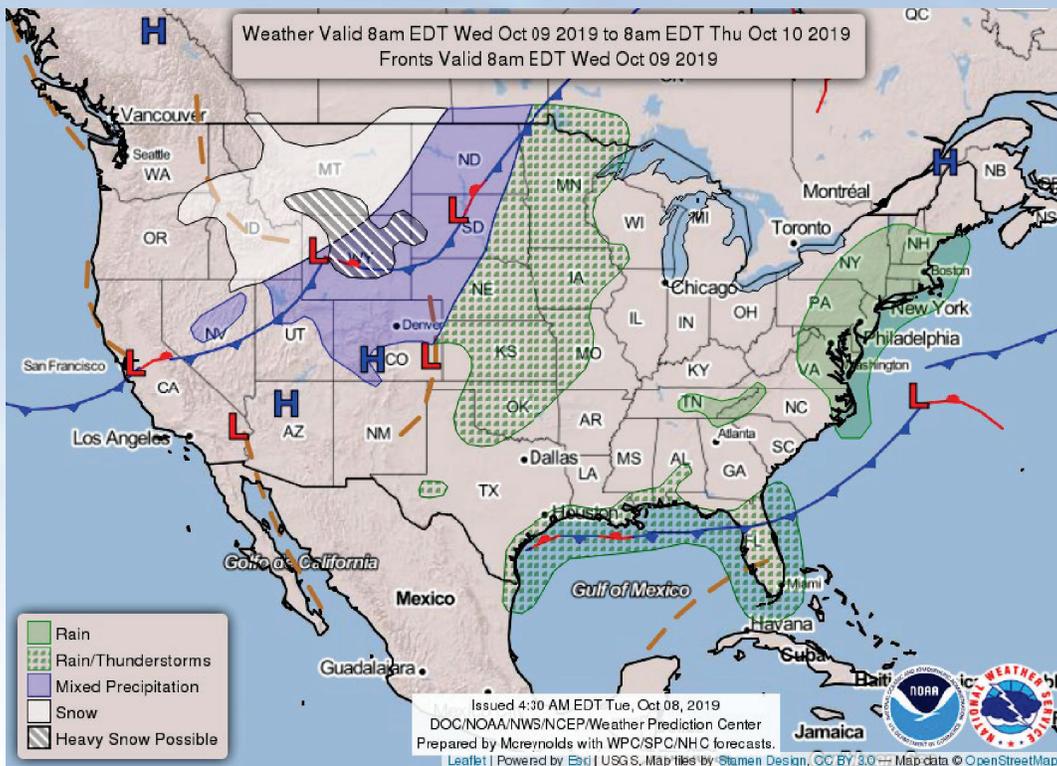
2

Today's Forecast



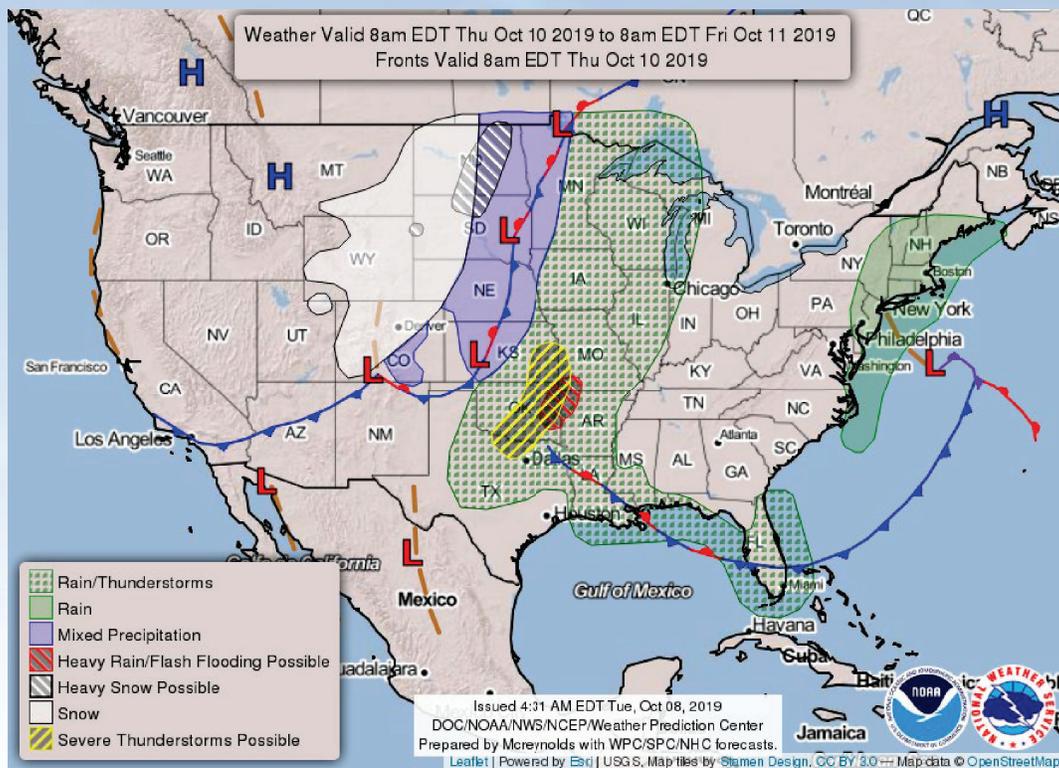
http://www.hpc.ncep.noaa.gov/national_forecast/natfcst.php

Tomorrow's Forecast



http://www.hpc.ncep.noaa.gov/national_forecast/natfcst.php

Thursday's Forecast



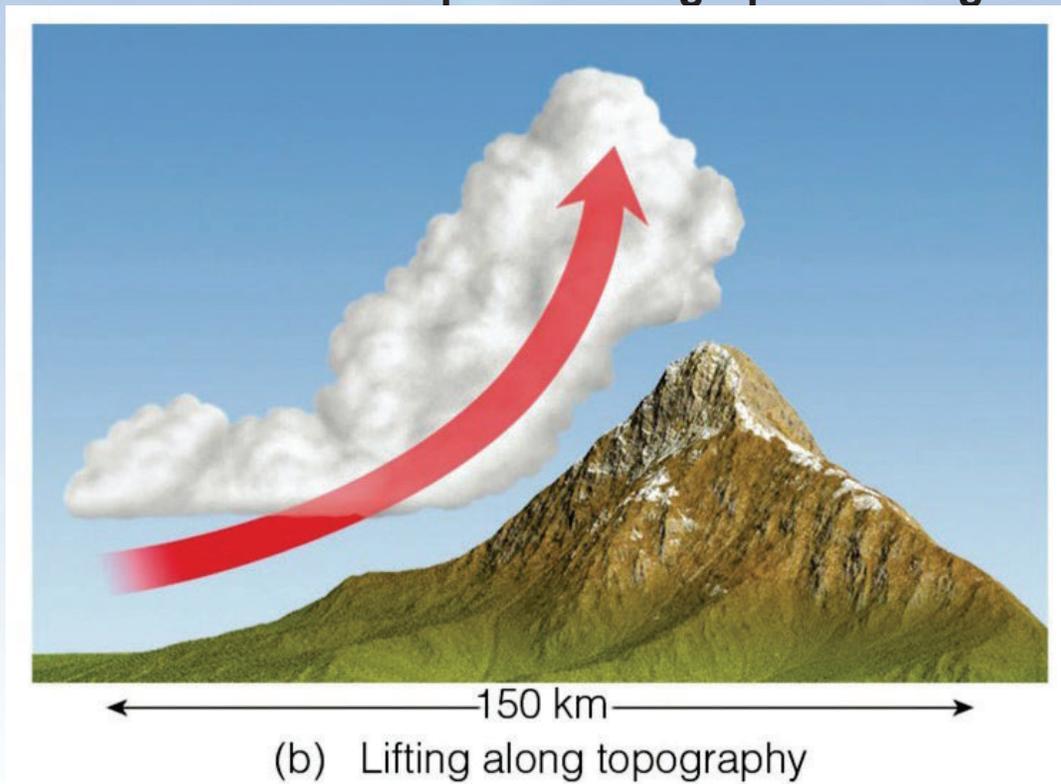
http://www.hpc.ncep.noaa.gov/national_forecast/natfcst.php

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Cloud Development: Orographic Lifting



Air is forced up the side of a mountain and cools as it rises

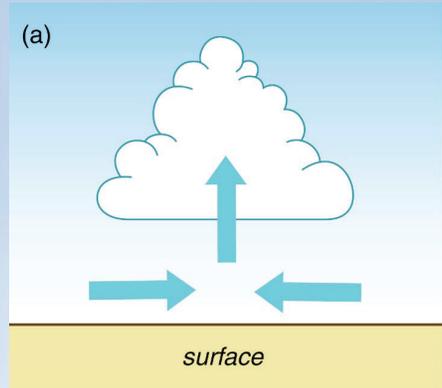
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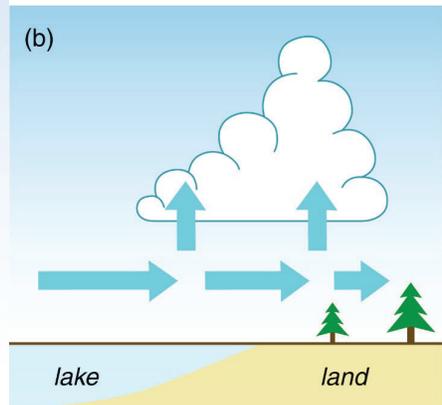
Fig 5.10: *Essentials of Meteorology*

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Cloud Development: Convergence



When wind meets from different directions, the air in between has no place to go but up

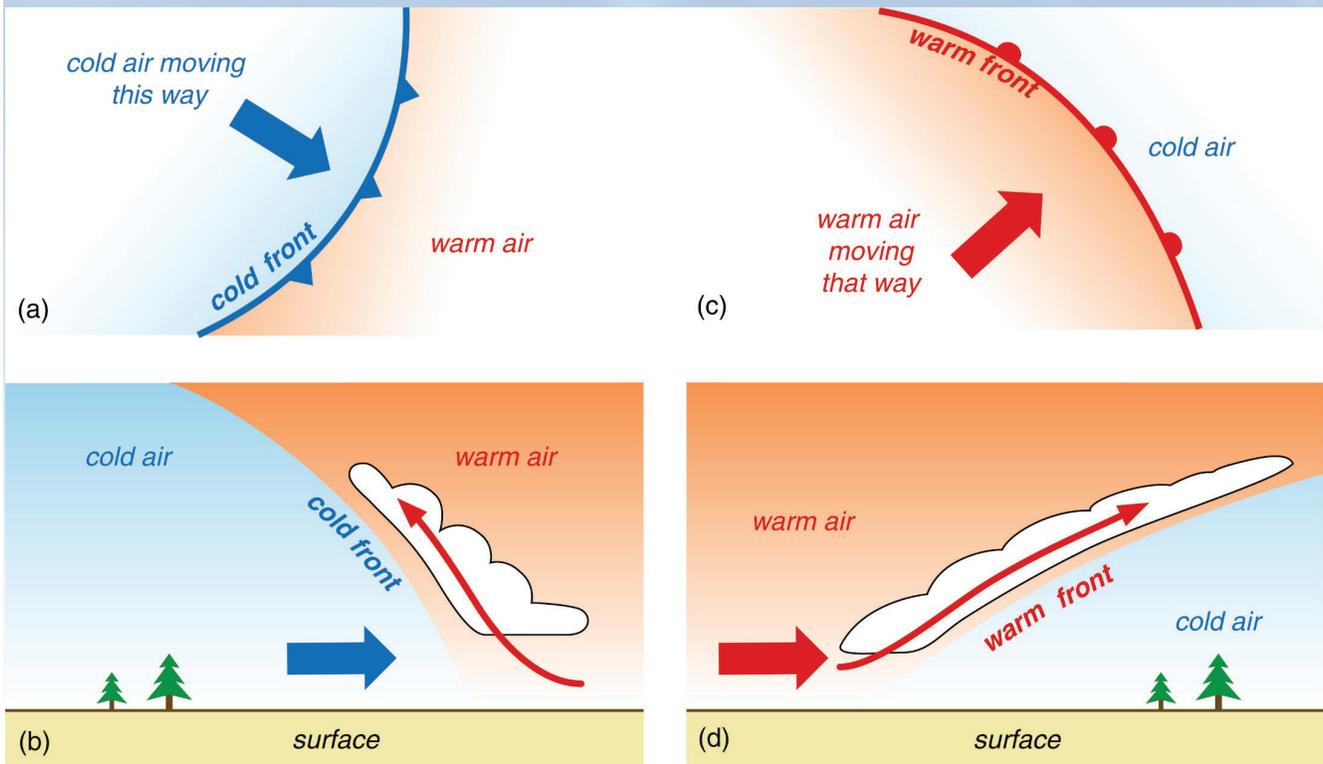


When the leading edge of the wind slows down, the wind behind “piles up”

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Fig 6.11 Weather: A Concise Introduction 7

Cloud Development: Frontal Lifting

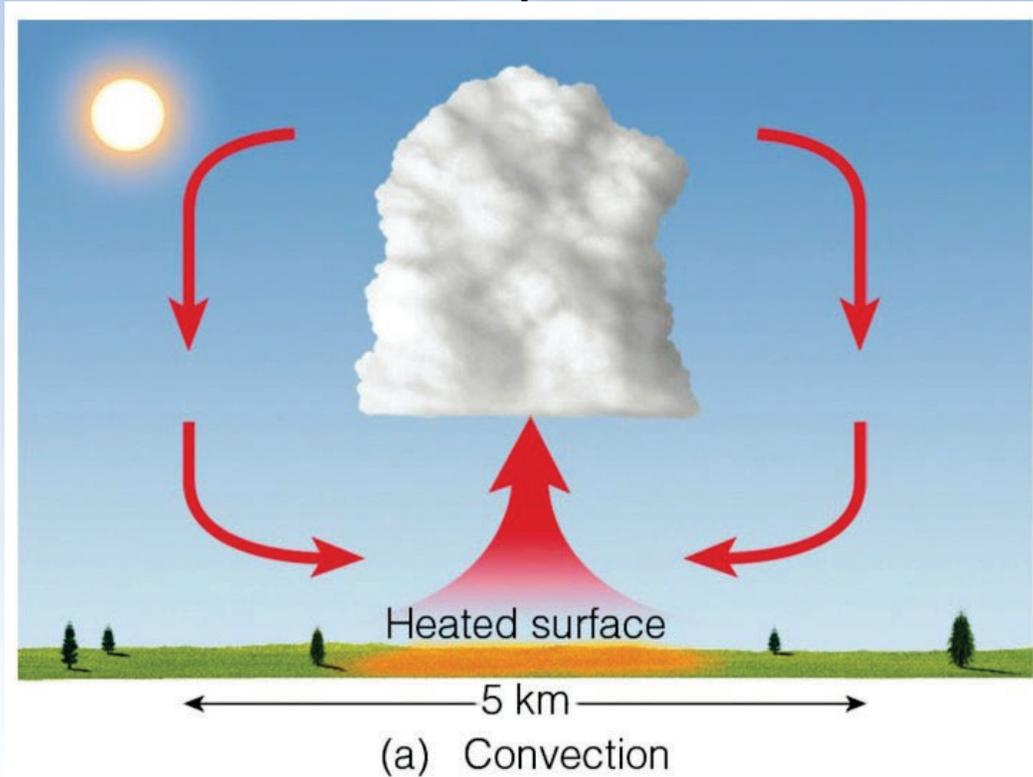


Warm air will ride up over cold air

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Fig 6.12 Weather: A Concise Introduction 8

Cloud Development: Convection



As surface air is warmed by the sun, it becomes less dense and rises

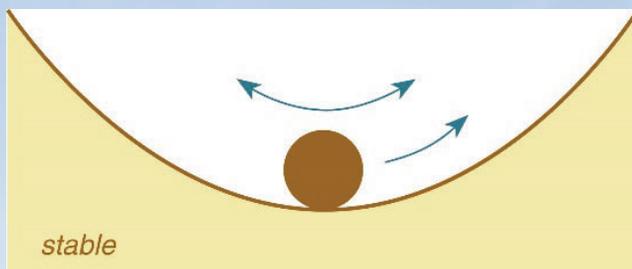
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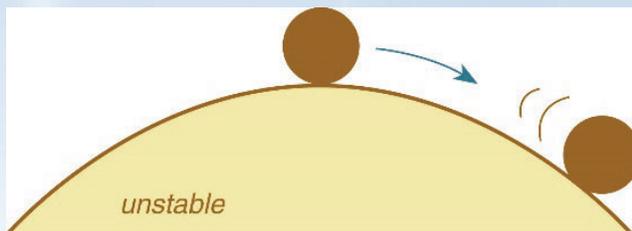
Fig 5.10: *Essentials of Meteorology*

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Stability vs. Instability



In a stable atmosphere, air won't rise unless something forces it up



In an unstable atmosphere, air can rise on its own through convection



In an conditionally unstable atmosphere the air will rise on its own but it needs a push first.

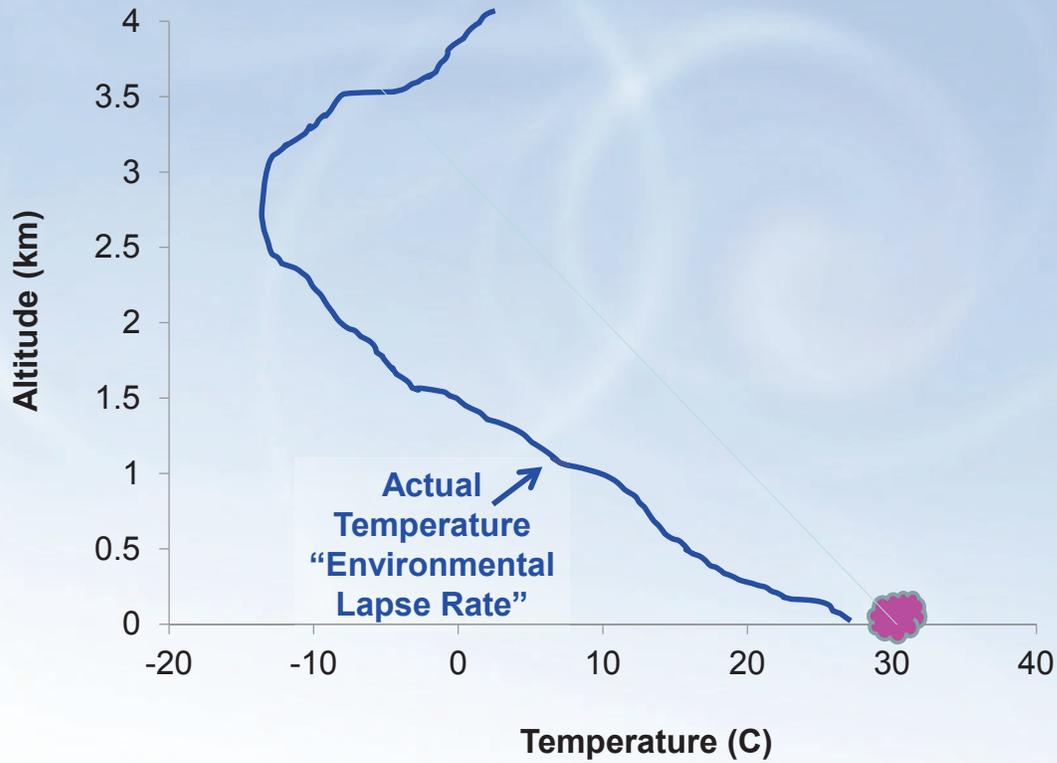
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Fig 6.5.1-4 *Weather: A Concise Introduction*

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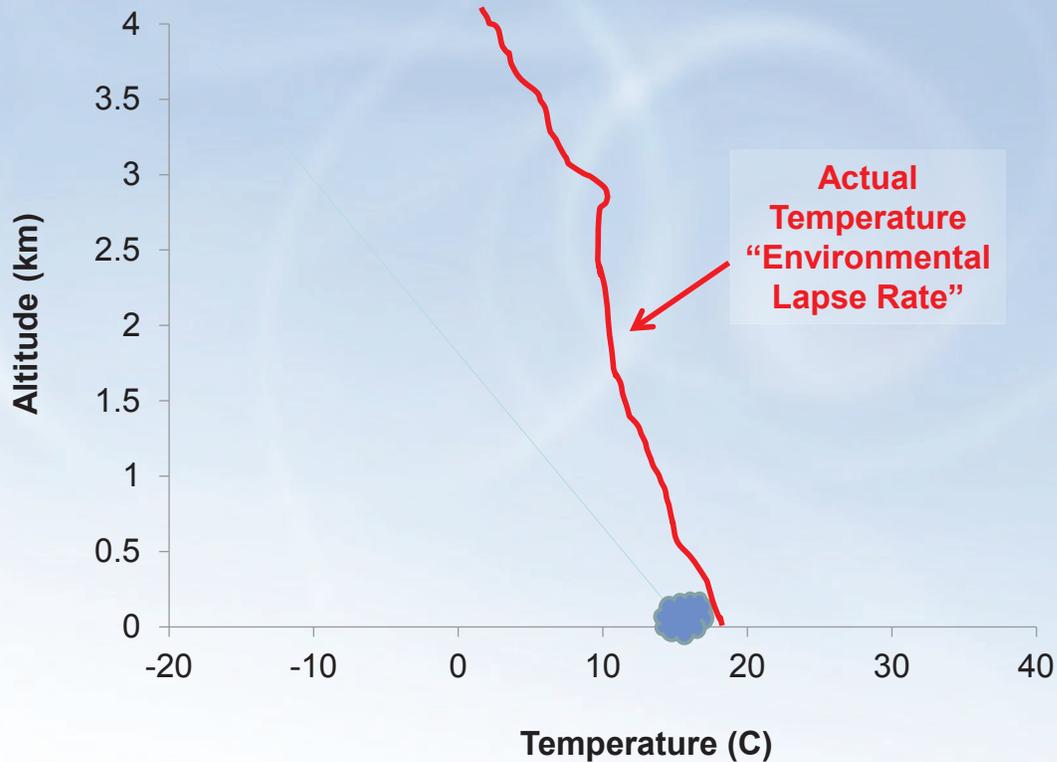
Lapse Rate: Unstable Atmosphere



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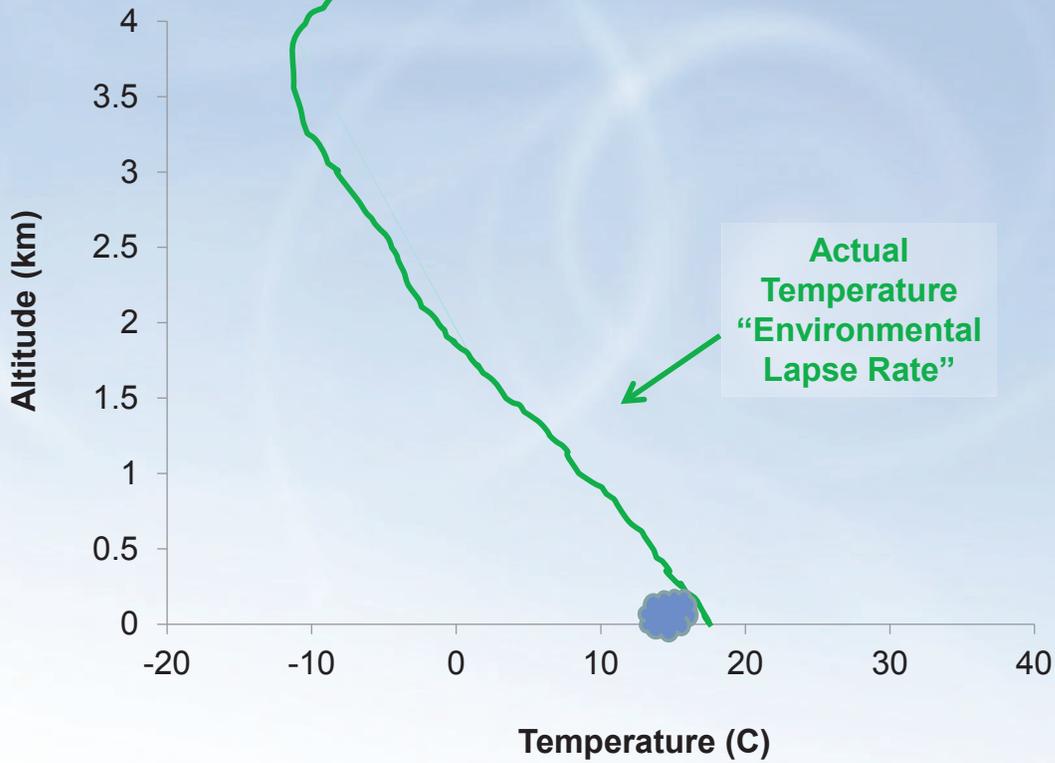
Lapse Rate: Stable Atmosphere



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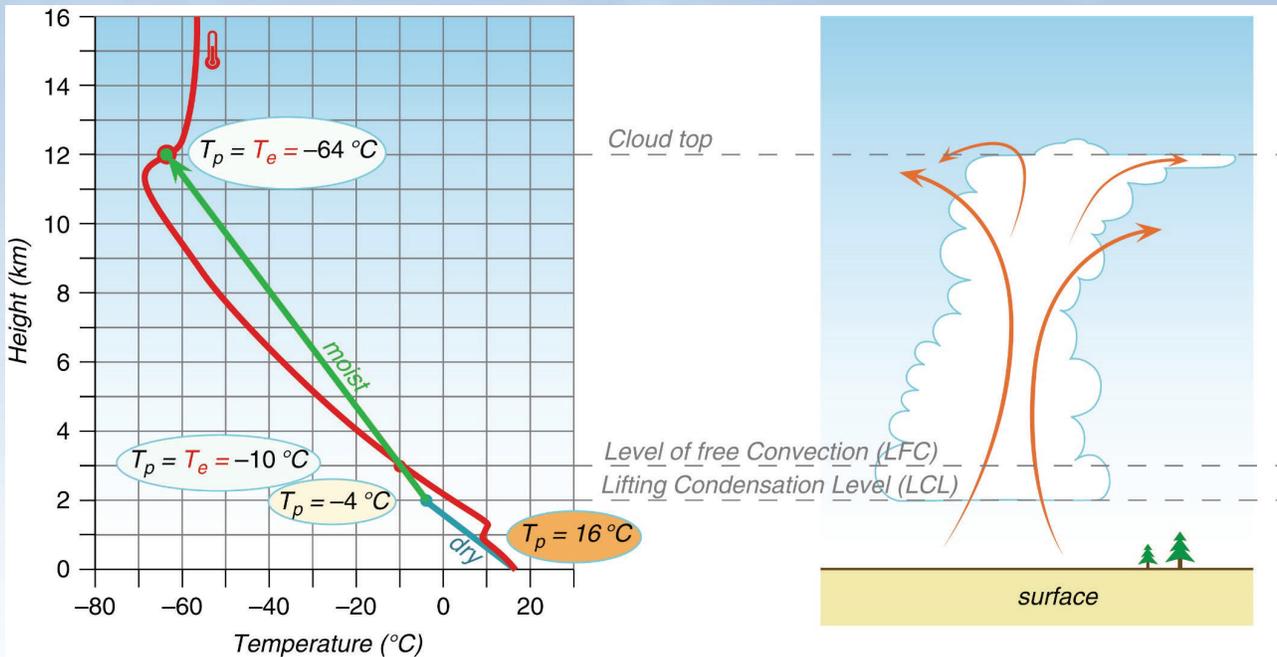
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Lapse Rate: Conditionally Unstable Atmosphere



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Putting it all together



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Fig 6.22 Weather: A Concise Introduction

Clouds!!!

Stratus – Layer
Cumulus – heap or pile
Nimbus – rain
Alto – high
Cirrus – ringlet or curling

TABLE 4.2 Approximate Height of Cloud Bases Above the Surface for Various Locations

CLOUD GROUP	TROPICAL REGION	MIDDLE-LATITUDE REGION	POLAR REGION
High Ci, Cs, Cc	20,000 to 60,000 ft (6000 to 18,000 m)	16,000 to 43,000 ft (5000 to 13,000 m)	10,000 to 26,000 ft (3000 to 8000 m)
Middle As, Ac	6500 to 26,000 ft (2000 to 8000 m)	6500 to 23,000 ft (2000 to 7000 m)	6500 to 13,000 ft (2000 to 4000 m)
Low St, Sc, Ns	surface to 6500 ft (0 to 2000 m)	surface to 6500 ft (0 to 2000 m)	surface to 6500 ft (0 to 2000 m)

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Clouds come in three altitude categories...

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Table 4.2: *Essentials of Meteorology*

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Clouds!!!

TABLE 4.1 The Four Major Cloud Groups and Their Types

- | | |
|---|--|
| <p>1. High clouds
 Cirrus (Ci)
 Cirrostratus (Cs)
 Cirrocumulus (Cc)</p> | <p>3. Low clouds
 Stratus (St)
 Stratocumulus (Sc)
 Nimbostratus (Ns)</p> |
| <p>2. Middle clouds
 Altostratus (As)
 Altocumulus (Ac)</p> | <p>4. Clouds with vertical development
 Cumulus (Cu)
 Cumulonimbus (Cb)</p> |

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...but there are 4 major cloud groups in total

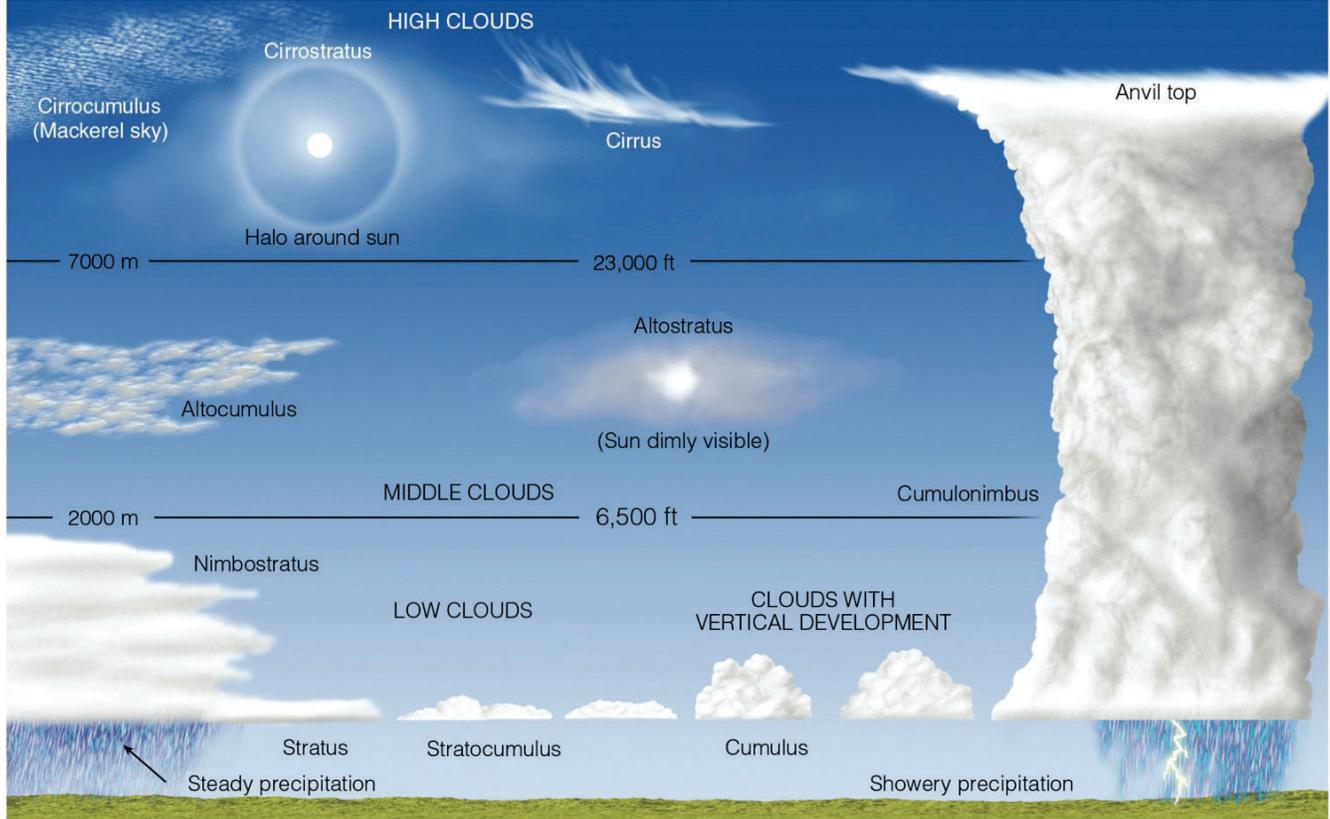
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Table 4.1: *Essentials of Meteorology*

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Fig 4.36: Essentials of Meteorology

Contrails (not “chemtrails”)

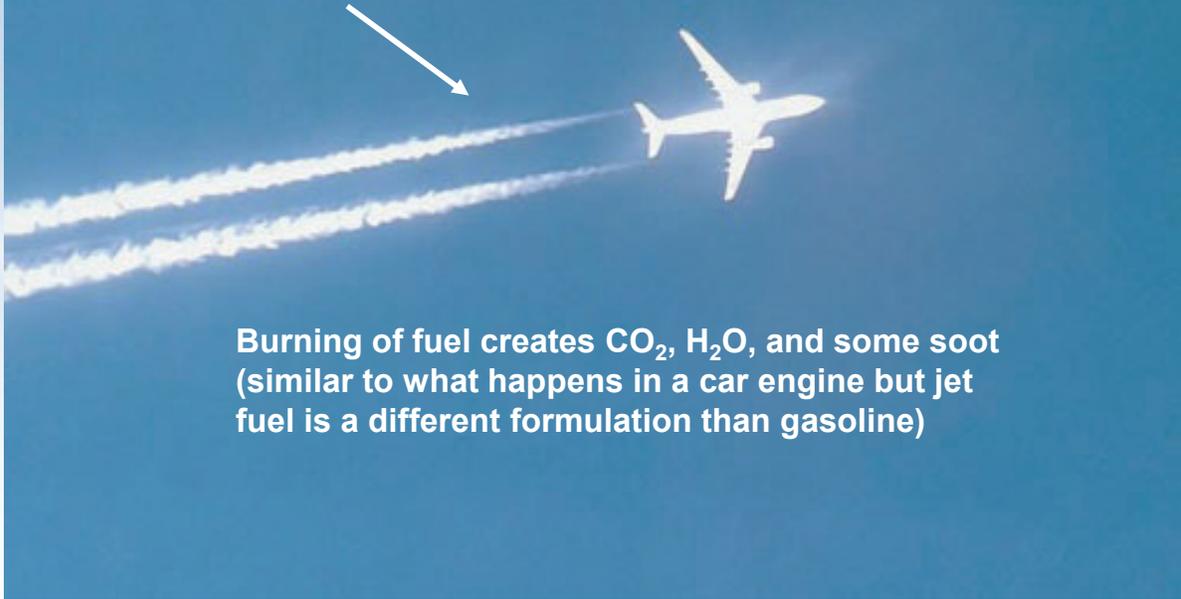


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Contrails

The air coming out of the jet engines is hot but what happens to the water vapor when it gets cold enough?



Burning of fuel creates CO_2 , H_2O , and some soot (similar to what happens in a car engine but jet fuel is a different formulation than gasoline)

<http://ngm.nationalgeographic.com/contrails>

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Contrails: what can they tell us about the upper air?

Can you think of a reason some contrails would disappear quickly while others hang around for a while?

If the air is dry (low humidity) the contrail will evaporate and disappear. The drier the air, the more quickly the contrail disappears.

If the air already has enough moisture in it then the contrail may stick around for a while, get moved around by wind patterns, and maybe create more clouds.

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