

# *Atmospheric Pollution*

## *Lecture 13*

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*Physics Department*

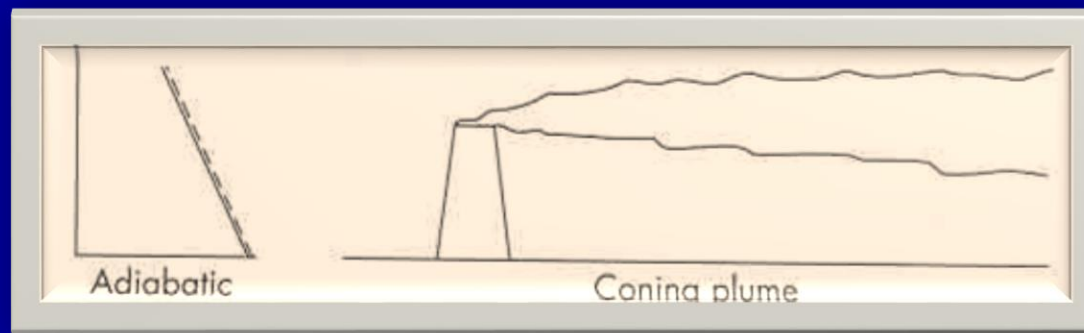
*Razi university*

<http://www.razi.ac.ir/sahraei>

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شنبه، ۲۲ اسفند

## Effect of atmospheric Stability on plume Dispersion

The dispersion of air pollutants is primarily determined by atmospheric conditions.



## Neutral Stability

Displace a parcel and it remains where you put it

It doesn't return to its original position

It doesn't fly away from its original position

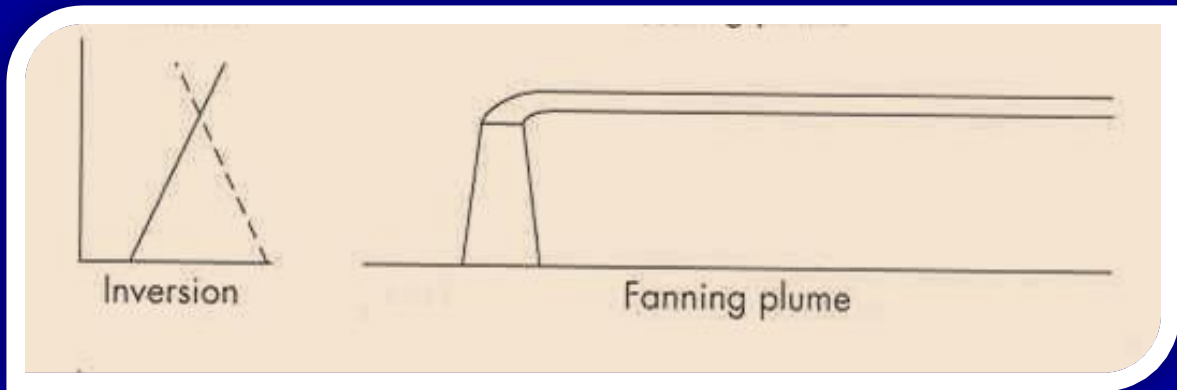
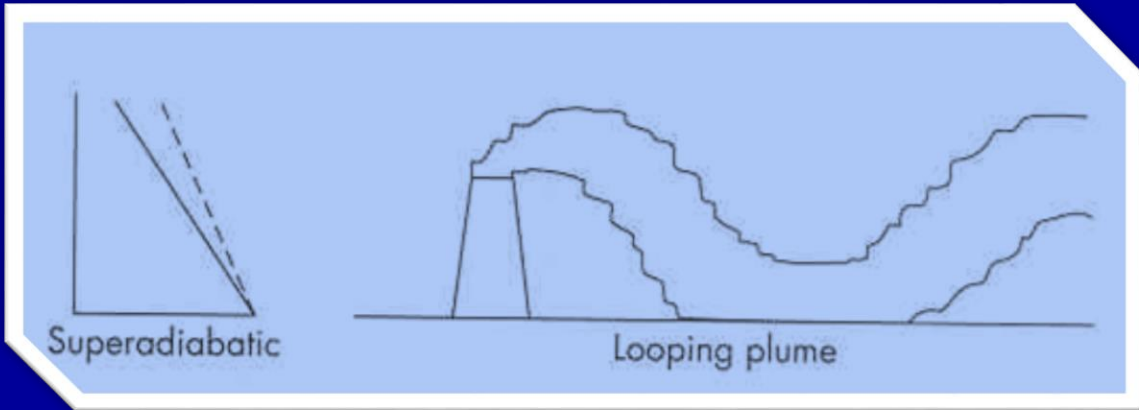
### Dry Neutral

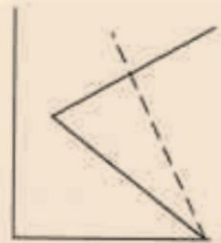
Environmental lapse rate equals the dry adiabatic lapse rate

Can result from thoroughly mixing air

### Moist Neutral

Environmental lapse rate equals the moist adiabatic lapse rate

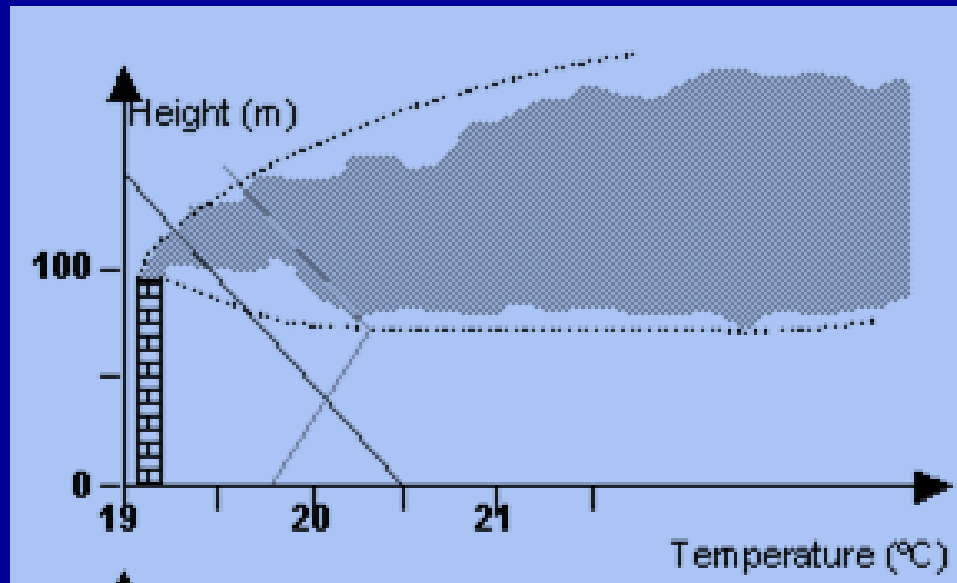


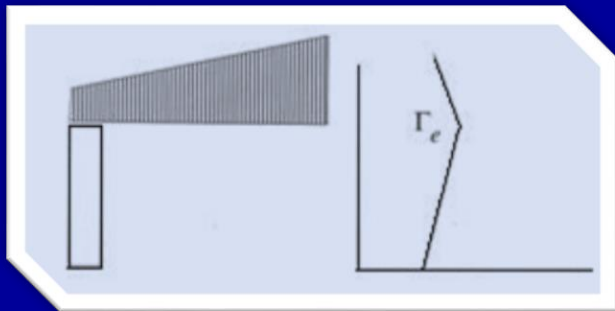
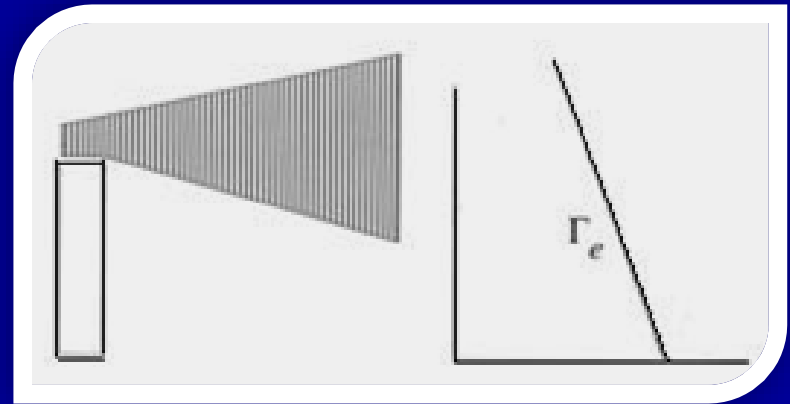
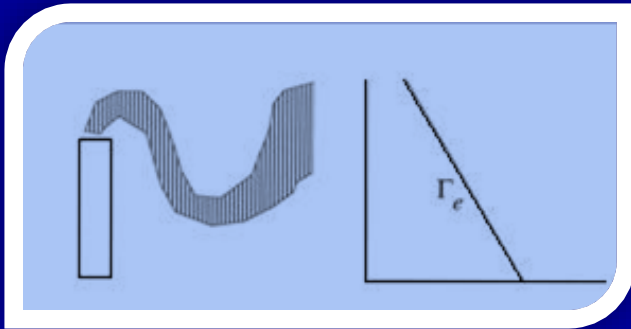
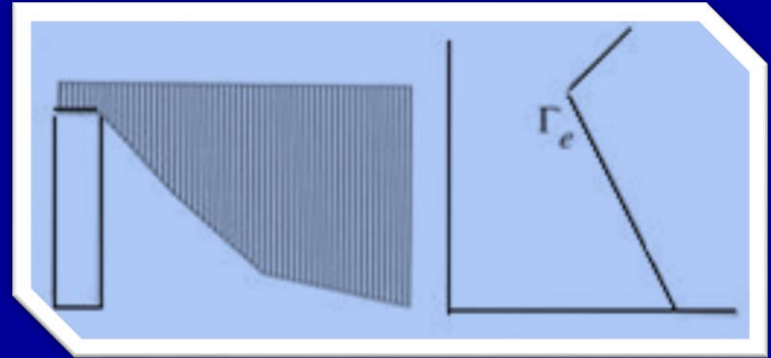
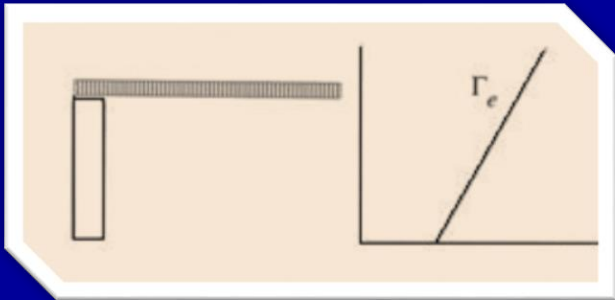


Inversion over  
superadiabatic



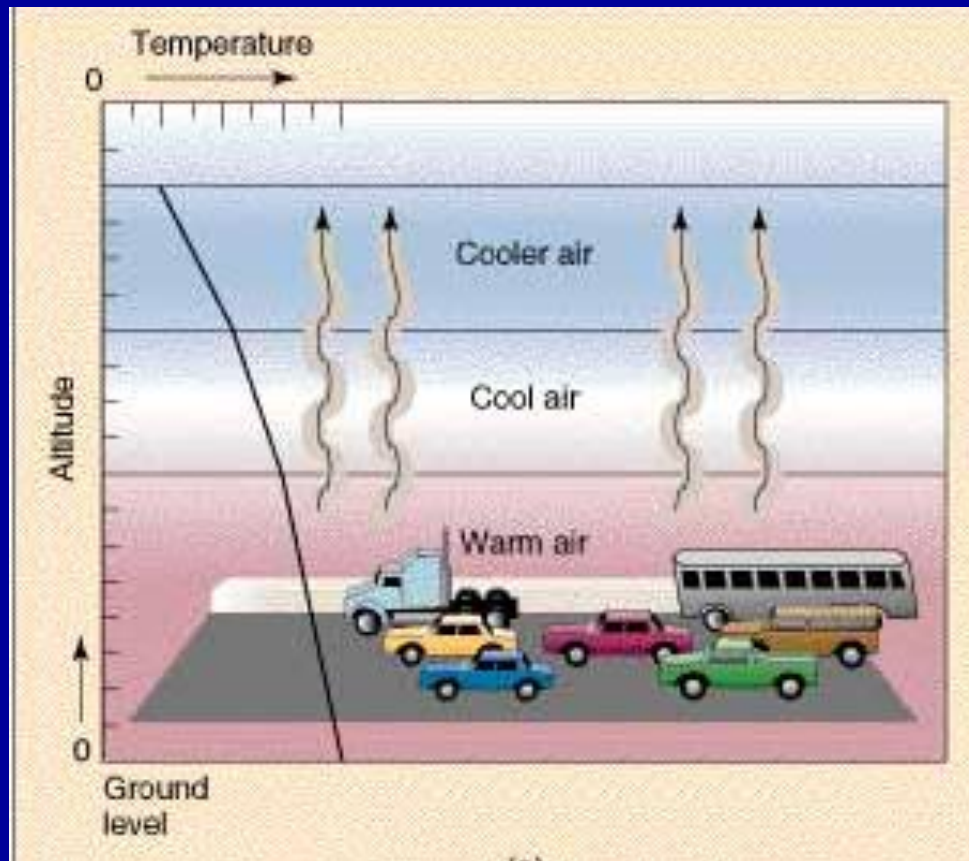
Fumigation





# TEMPERATURE INVERSION

Normally air temp decreases with increasing altitude.





# Air Molecule Density

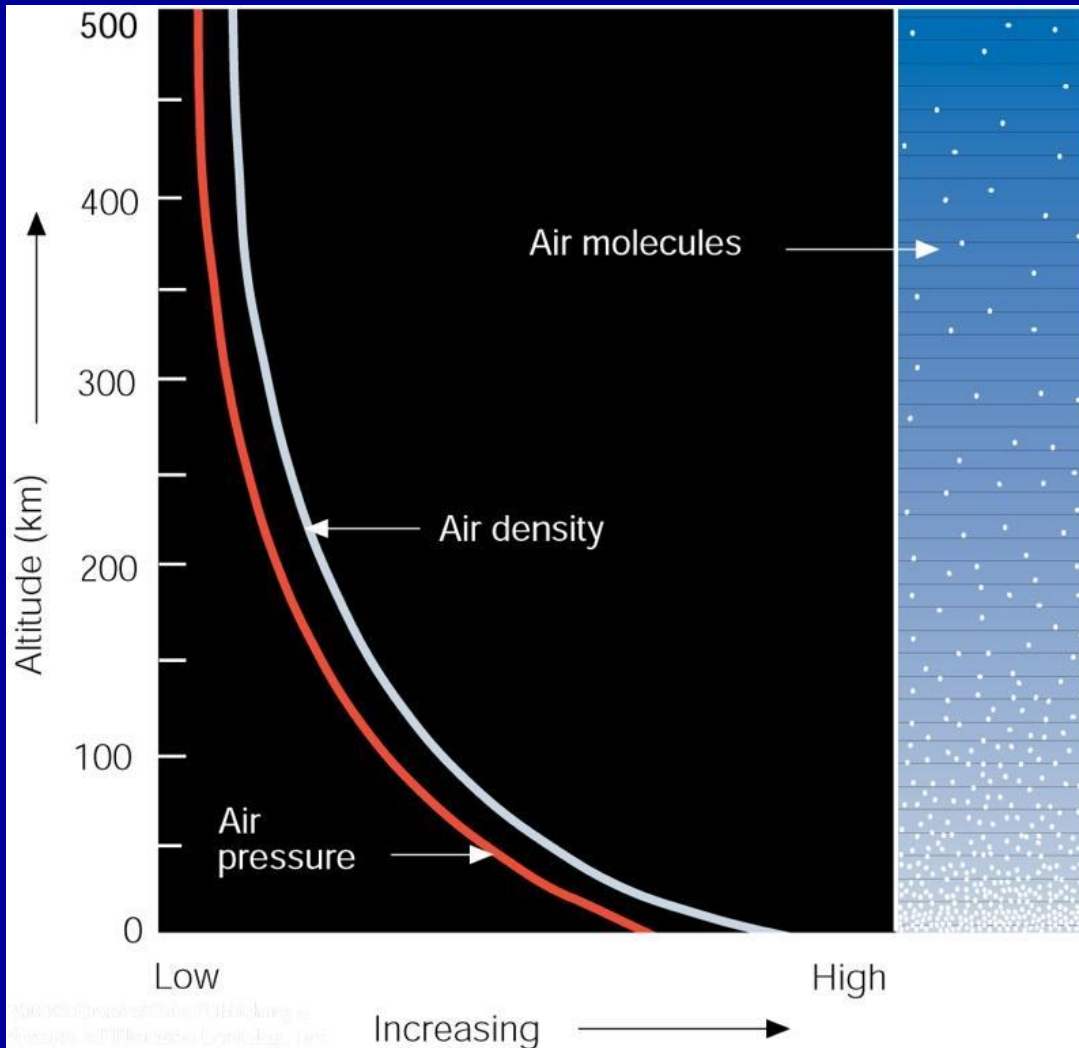
That is why  
it is hard  
to breathe  
at high  
altitudes.



That is  
also why it  
is colder  
at high  
altitudes

**Air Temperature**

# Pressure & Density



Gravity pulls gases toward earth's surface, and the whole column of gases weighs 14.7 psi at sea level, a pressure of 1013.25 mb .

The amount of force exerted Over an area of surface is called Air pressure!

Air Density is The number of air Molecules in a given Space (volume)

# Molecule Density Verses Temperature

Heat is from molecule collisions.

Fewer molecules.....

Fewer collisions.....

Less heat!

## Why Air Density Changes

The weight of the air causes the air at the ground to have high pressure.

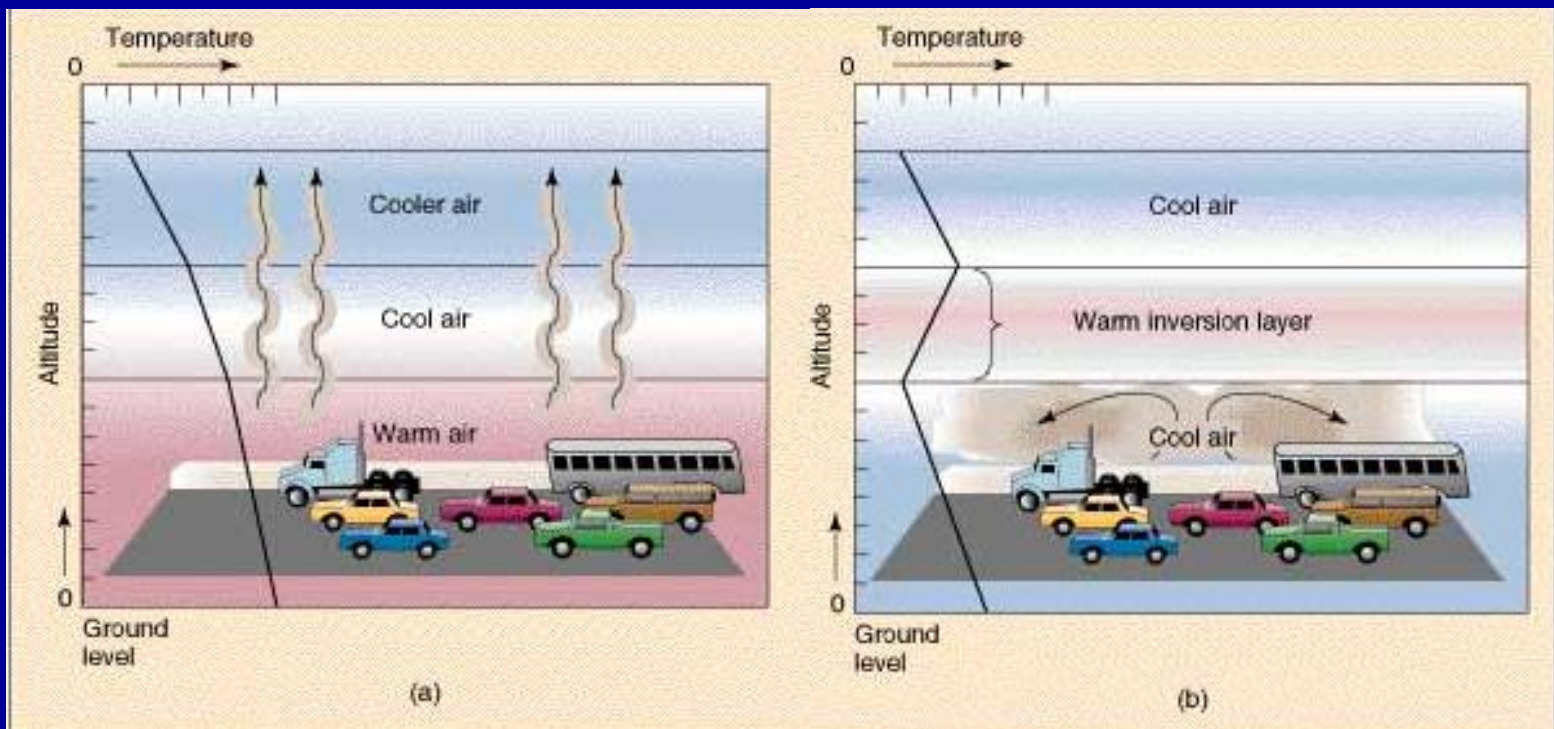
Gravity pulls the air close to the earth

The high pressure pushes the air molecules close together

# Smoke Rises in the Air, Normally



Temperature Inversion: occurs at ground level when cool air is created under or slips under relatively warmer air just above it



## Calm winds and the inversion result in poor air quality.



① The winter sun, low in the sky, supplies less warmth to the Earth's surface.

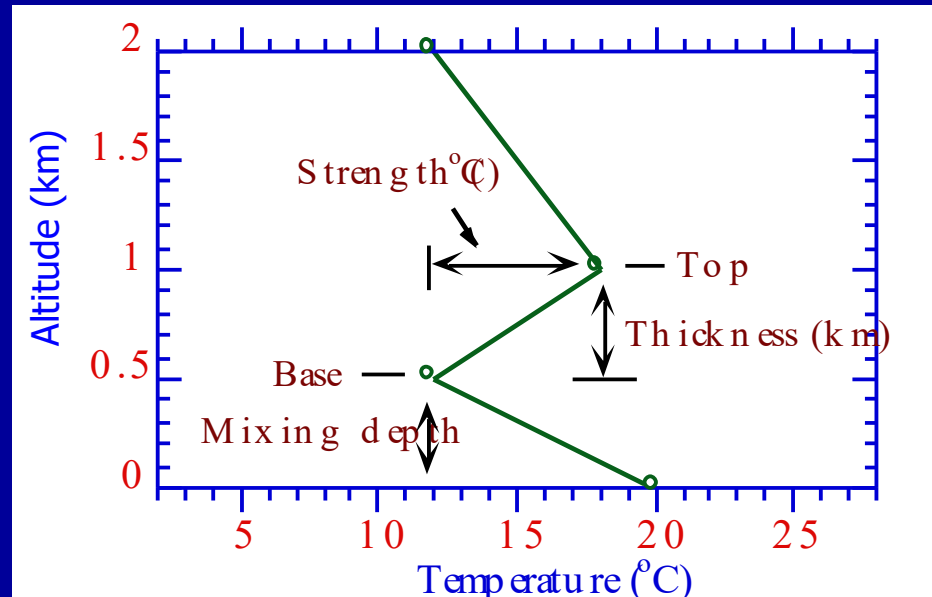
② Warmer air aloft acts as a lid and holds cold air near the ground.

③ Pollution from wood fires and cars are trapped by the inversion.

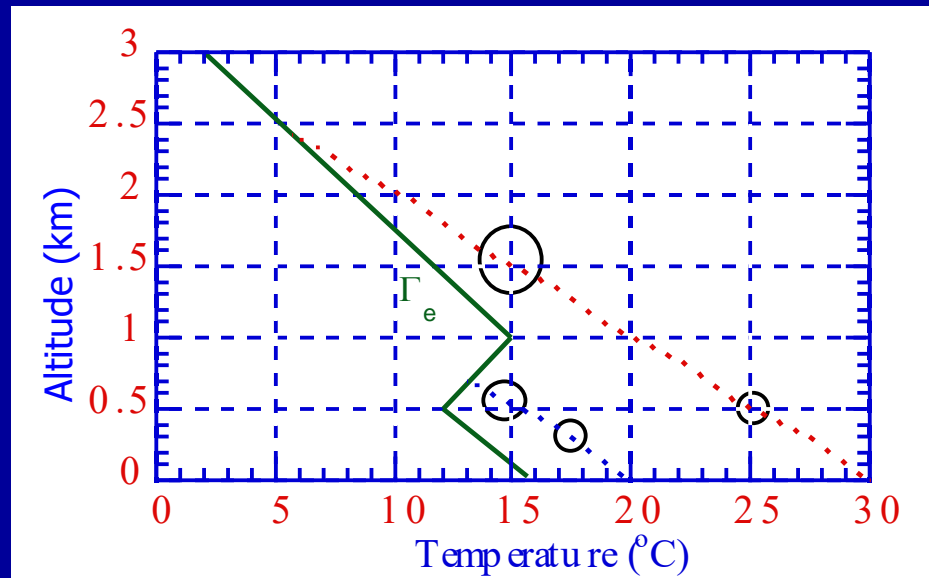
④ Mountains can increase the strength of valley inversions



# Temperature Inversion

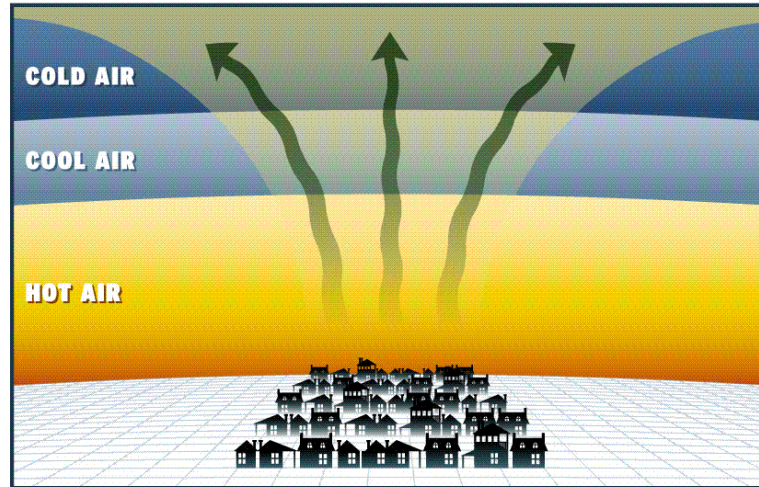


# Trapping Pollutants Under an Inversion

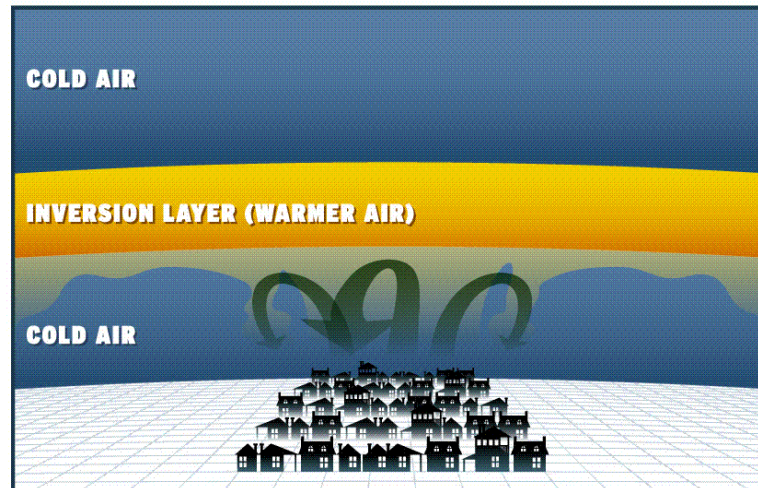




### NORMAL SITUATION



### TEMPERATURE INVERSION



Inversions form whenever a layer of air becomes colder than the layer of air above it. Common inversion types include :

the radiation inversion

the large-scale subsidence inversion

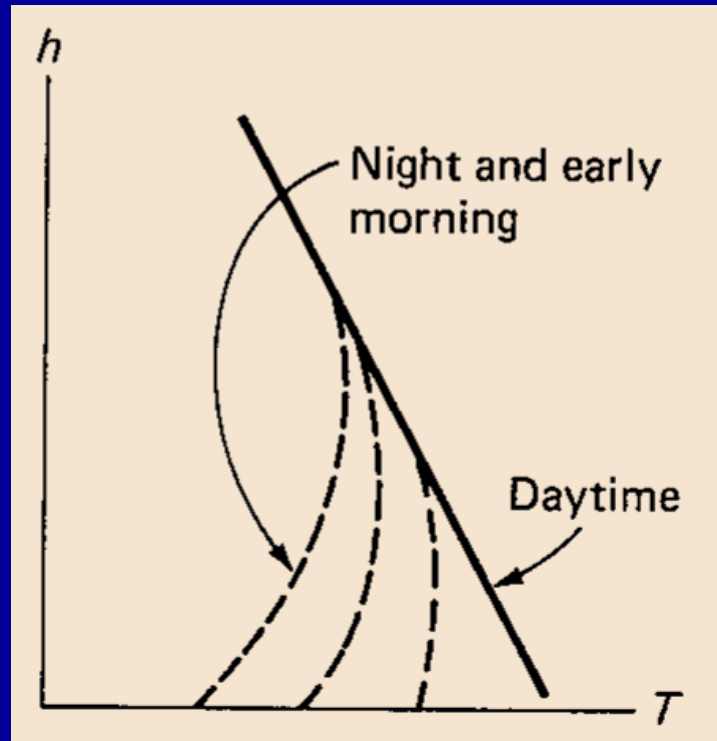
the marine inversion

the frontal inversion

small-scale subsidence inversion

## The radiation inversion,

radiation at night from the earth's surface into the local atmosphere



## Radiational Inversions

Result from radiational cooling of the ground

Occur on cloudless nights - nocturnal

Typically surface based

Are intensified in river valleys

Cause pollutants to be "trapped"

# Radiational Inversions

Breakup after sunrise

Breakup results in elevated ground level concentrations

Breakup described as a fumigation



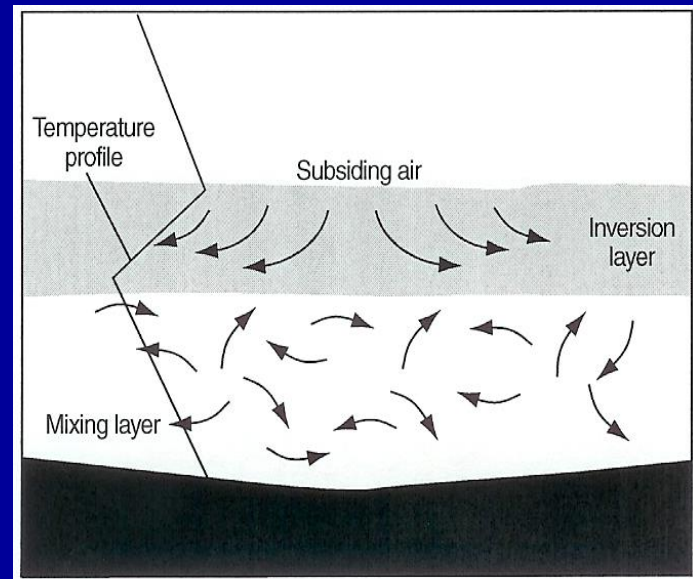
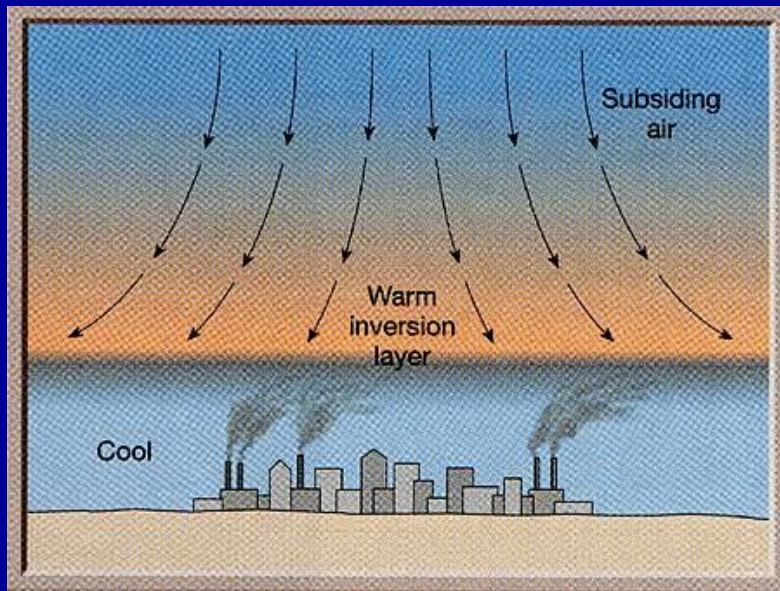
# Subsidence Inversion

Associated with high-pressure systems

Inversion layer is formed aloft

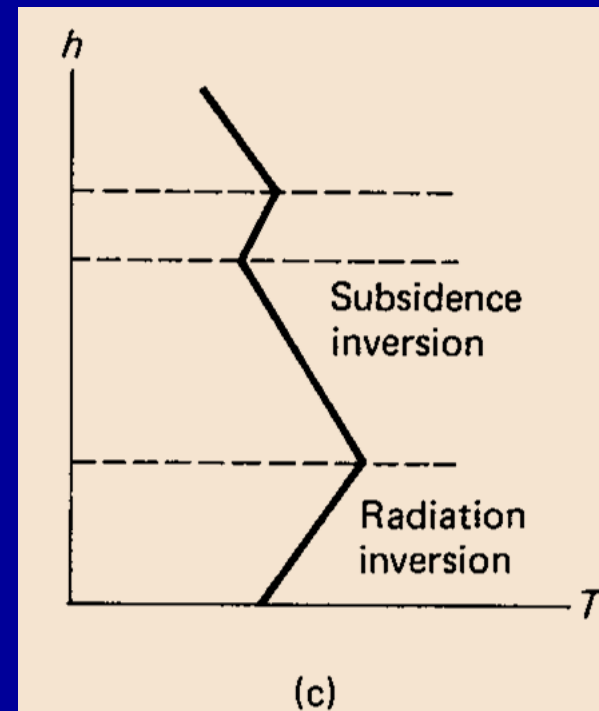
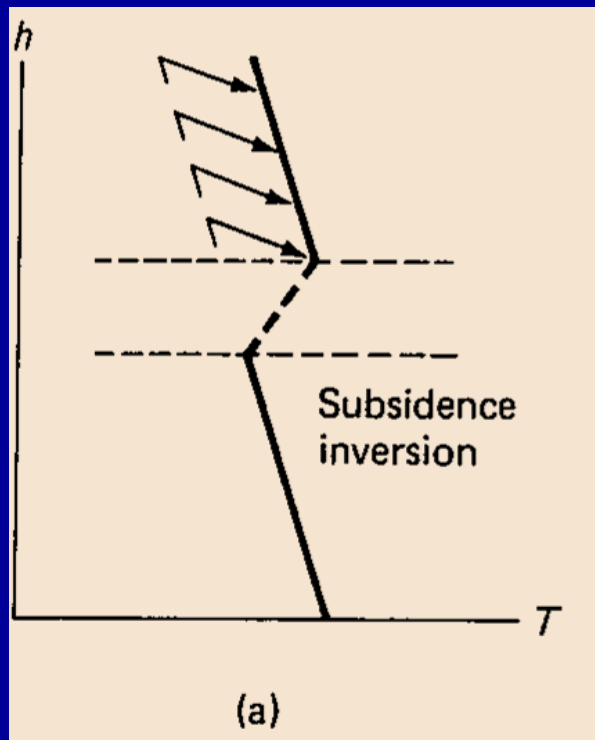
Covers hundreds of thousands of square kms

Persists for days



## Large-Scale Subsidence Inversion

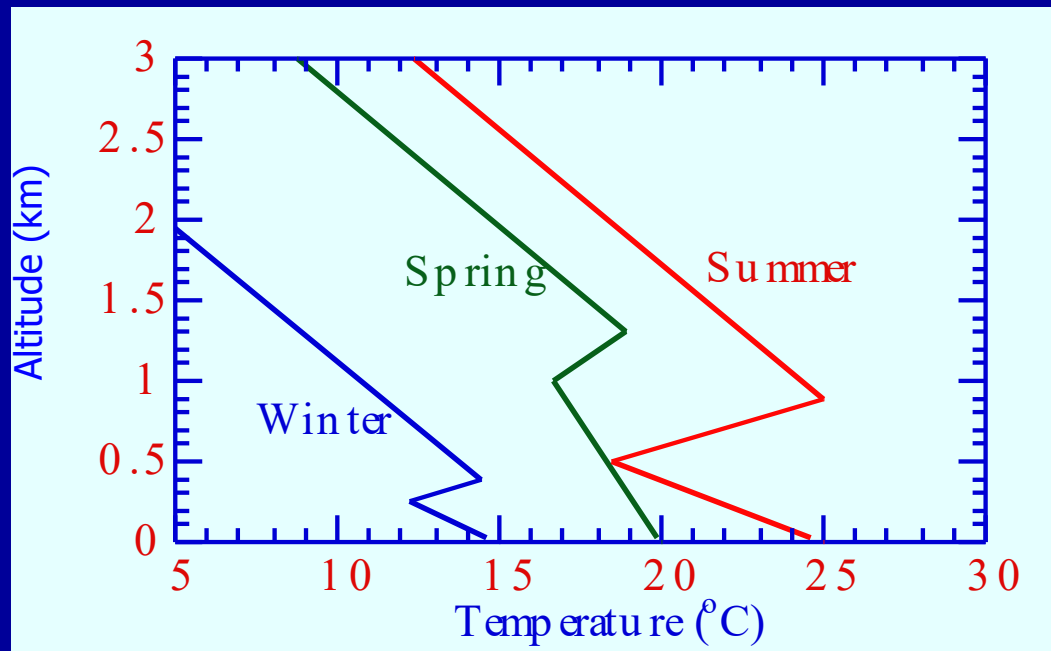
descent of a layer of air with in a high pressure air mass



# Seasonal Variation of Inversions

Figure illustrates the seasonal variation of afternoon inversion profiles in Los Angeles. During the winter, the Pacific high is further from Los Angeles than it is during any other season, and the large-scale subsidence inversion strength is weak.

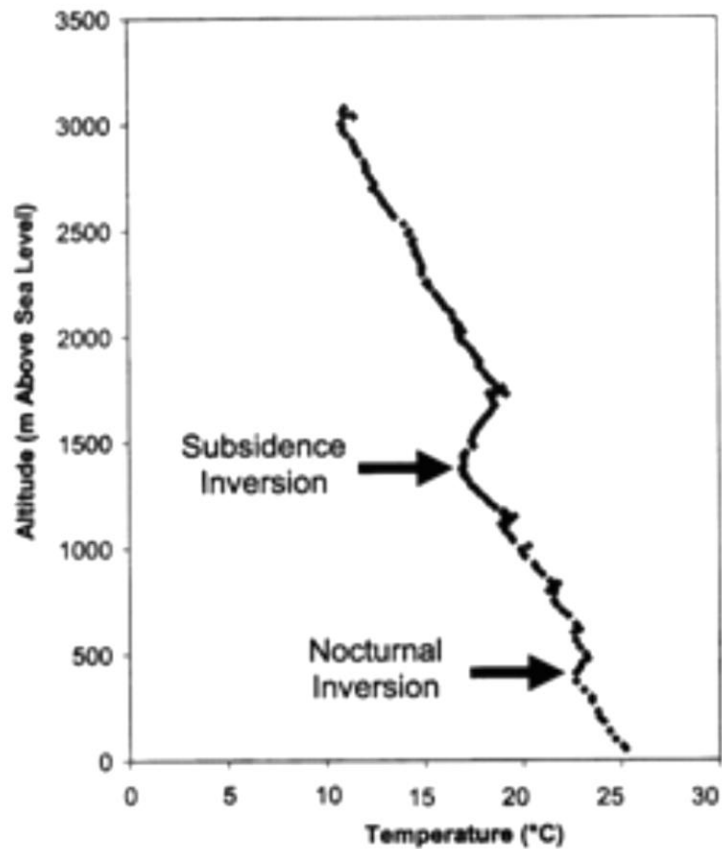
During the summer, the inversion is strong because the center of the Pacific high is closer to Los Angeles than it is during any other season.





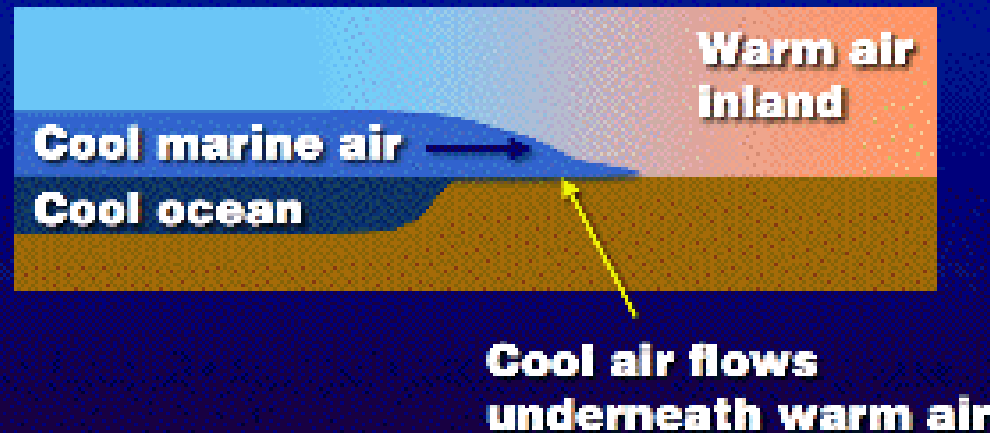
# Fort Meade profile 6/19/2001

Fort Meade Profile 9:06-9:35 EDT 6/19/2001

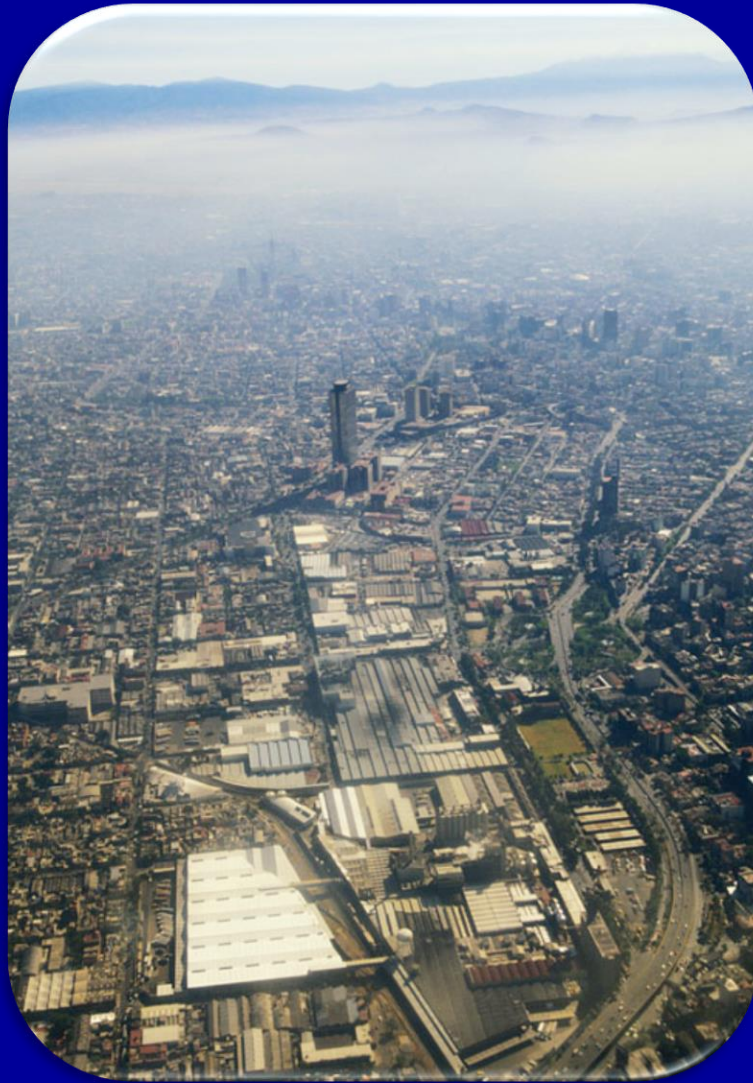


**Frontal** - warm air overrides cooler air

## **Advection Inversion**



**In Southern California,  
called the "Marine Layer"**



*THANKS*

*FOR*

*YOUR*

*ATTENTION*

