

MET 101

Fog Formation

- wet haze forms as water vapor condenses on condensation nuclei
- condensation on the hygroscopic nuclei can begin when the RH is around 75%
- as the RH increases the visibility decreases as the landscape becomes masked by a grayish tint
- as the RH approaches 100% more and more water vapor is condensing on all types of nuclei causing the droplets to get bigger until they become visible to the human eye
- this decreases the visibility even more
- when the visibility drops to less than 6 miles and the difference between the T and T_d is 5 F° or less the wet haze is now referred to as a cloud at or near the ground called fog
- The NWS refers to the fog as dense when the visibility is less than ¼ of a mile

- **It should be clear that for fog to form the RH must increase to 100% and this can happen in three different ways:**
 - 1) **Cool the air to its T_d (most of the fog types form in this manner)**
 - 2) **Increase the water vapor content**
 - 3) **Mix cold air with warm moist air**

3 Methods of Fog Formation and the Resulting Types of Fog

1) **Cool the air to its T_d (most of the fog types form in this manner)**

A) Radiation Fog (also called Ground Fog or Valley Fog) - Fog produced over land when radiational cooling at night reduces the air temperature to or below its dew point (T_d).

- Forms best on clear nights with light winds (3 mph)
- Shallow layer of moist air near the ground, under drier air
- Thickest around sunrise
- Dissipates as sunlight penetrates fog and warms the ground
- This in turn warms the foggy air, which causes some of the fog droplets to evaporate
- Common in the California central valley

B) Advection Fog - Fog that forms when warm moist air moves over a cold surface. The cold surface quickly cools the warm moist air to its dew point (T_d).

- Can be a very thick fog, up to 1500 feet (~ 0.5 km) thick
- Common along Pacific Coast
- Important source of moisture for Redwood trees in California.

C. Advection-Radiation Fog - Fog that forms as relatively warm moist air moves in over a colder surface, that cooled mainly by radiational cooling.

- Forms over land
- Mainly in the winter
- Common in Southeastern US and the British Isles

D. Upslope Fog - Fog that forms when moist, stable air flows upwards due to topography

- Westward from the Mississippi River the elevation gradually increases towards the Rocky Mountains
- Occasionally air from the plains moves westward, the air rises because of the gradual upward slope towards the mountains
- As the air rises it cools adiabatically
- Forms on the eastern side of the Rocky Mountains into the Great Plains

2) Increase the water vapor content

A) Precipitation Fog (also called Frontal Fog) - Forms when raindrops fall from a cloud and evaporate in the air below the cloud

- Eventually the air under the cloud becomes saturated forming fog
- Forms best on snow covered surfaces, because melting snow removes heat from the air, cooling the air further
- Common ahead of a warm front

3) Mix cold air with warm moist air

A) Steam Fog - Forms when cold air moves over warm water

- Occurs in the fall/early winter over water
- Water (lakes, oceans, rivers and pond) has a high specific heat and takes longer to cool in the fall
- The air right above this water is warmer and moister than the air over the land
- As a cold air mass moves over this still warm water it quickly cools the air to its Td forming a layer of fog 1-2 meters thick

B) Ice Fog - Fog that forms when warmer ocean air moves over an ice or snow surface allowing ice crystals to form instead of liquid fog drops

C) Exhale Fog - Forms when humans exhale warm moist air from their lungs into cold air

- Usually evaporates within inches or up to one foot from the persons mouth

Any of the above types of fog could also become:

Acid Fog- Fog droplets combining with gaseous pollutants, such as oxides sulfur and nitrogen. Fog has a pH less than 5.0

- Causes respiratory problems