

Meteorology

Self-Study Topics

take home package #1

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Self study Topics #1

- Precipitation
- Visibility



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Definition of Precipitation

Forms of Precipitation

Clouds associated with different forms of Precipitation

PRECIPITATION

REF. 146-147 FTGU

Precipitation

- Recall: when water vapor cools and condense into water droplets (with the addition of condensation nuclei), clouds will form!
- Precipitation occurs when the water droplets grow big enough in size and weight to fall from the cloud to the ground as **rain, snow or other forms of precipitation**. The force pulling rain and snow from the cloud to the ground is called gravity.
- The vertical currents (instability) within unstable clouds are what cause water droplets to collide with other droplets and grow in size and weight
- There is even a slight amount of instability in stable clouds which is what causes the collision of water droplets in stable clouds. This is why rain can fall from stable, stratus clouds.
 - Steady and semi-moderate precipitation falls from stable stratoform clouds
 - Heavy and sporadic precipitation falls from cumuliform clouds because the energy being built up within cumuliform clouds is more pronounced than the energy in stable stratoform clouds. This energy in cumuliform clouds can be released at any time without warning

Precipitation con't

- There are thus many different forms of precipitation that can fall from clouds
 - Rain
 - Drizzle
 - Hail
 - Snow
 - Snow Pellets
 - Ice Prisms
 - Ice Pellets

Rain

- Precipitation (water droplets falling from a cloud) in the form of large water droplets is called rain
 - If the air is relatively warm, the falling water droplets will remain in a liquid form and simply fall as rain!
- Associated with altostratus, nimbostratus (designated as an actual rain cloud!) and stratocumulus clouds
- Freezing rain is composed of supercooled water droplets that freeze immediately on impacting an object or surface below 0C
 - Recall: supercooled water droplets exist in a liquid form below the freezing level
 - Once they strike any object or surface, they will thus immediately freeze

Drizzle

- Precipitation in the form of very small drops of water which appear to float through the air is called drizzle
- Associated with stratus and stratocumulus clouds
- When drizzle impacts an object or surface whose temperature is below 0C, the drizzle freezes on impact.
 - We define this as freezing drizzle

Hail

- See Figure 3–E
- Associated with unstable cumuliform clouds (like a CB cloud)
- So imagine an unstable cumuliform cloud where there are water droplets near the base of the cloud
- The instability in the cumuliform cloud pushes the water droplets to the top of the cloud and they collide with other water droplets, supercooled water droplets and ice within the cloud
 - The supercooled region is very important because as soon as the water droplets collide with supercooled water droplets, they freeze together and the size of the new droplet increases

Hail con't

- As the water droplets (now chunks of frozen water) approach the height of the cloud, they are heavy and thus drop back down to the base of the cloud
- This cycle repeats itself within the cloud until the water droplet “ice chunks” get so big and heavy that they fall from the cloud itself (notice how large hail can grow in Figure 3-E)
- We call these “ice chunks” falling from the cloud, Hail

Figure 3-E

(Hail)



Snow

- Recall: sublimation is the changing of water vapour directly into ice, bypassing the liquid state
- Snow is formed when water droplets that are falling from a cloud are frozen because they encounter cold air as they fall towards Earth
 - That's why we can't get snow in the Summer (warm air)!
- Associated with altostratus, nimbostratus (designated as an actual rain cloud!) and stratocumulus clouds

Snow Pellets

- See Figure 3–F
- Also known as “soft hail”
- Associated with unstable cumuliform clouds (like a CB cloud)
- If the water region below the supercooled region is not that deep or significant (i.e. not much water droplet content) the hailstone will not have a hard, transparent shell when it hits the Earth because all it is composed of is supercooled water droplets and ice
 - The water droplet region acts as the “meat” that makes up the a hail stone (notice how “skimpy” they look in Figure 3–F)
- We call these hail stones without the “meat” (water droplet moisture), snow pellets

Figure 3-F

(Snow Pellets)



Ice Prisms

- Ice Prisms are tiny ice crystals that fall in the form of “icy” needles
- They fall from a cloudless sky

Ice Pellets

- See Figure 3-G
- Also known as Sleet
- Ice Pellets are formed when rain drops (already fallen from cloud) freeze upon impacting one another.
 - They originate from any cloud that produces rain because they are only formed once the actual rain drops leave the cloud
 - Ice pellets that are continuous originate from stratiform clouds
 - Ice pellet showers originate from CB's (cumuliform clouds)
- They have a certain 'globular' shape to them and usually rebound off the ground or object that they are striking (they do not weight much at all)

Figure 3-G

(Ice Pellets)



Importance of Visibility
Definitions of Visibility
Restrictions to Visibility
VMC and IMC

VISIBILITY

REF. 148 FTGU

Why is Visibility Important?

- Visibility is one of the most important elements of weather from a flight operations perspective
- The question always is: “How Much Can You See?”
 - The less you see, the harder it is to fly and in the case of VFR pilots (all of you someday), flying operations must be **ceased** if the visibility is too poor
 - Visibility is usually measured and reported in METARs and TAFs (we will learn shortly)
 - Visibility is usually reported in miles (statute miles, SM)

Why is Visibility Important? con't

- In terms of visibility, cloud bases are of a high concern because low cloud bases often are associated with poor visibilities
 - Not so much for pilots flying in accordance with Instrument Flight Rules (don't need a visual ground reference) but for Visual Flight Rule pilots, visibility is **crucial**.
 - If a VFR pilot cannot see the ground or enters a low cloud layer while flying en-route to a destination, he must either descent to remain VFR or land immediately at the nearest alternate airport
 - However, since **all** pilots must eventually land their airplanes, **all** pilots are concerned with the visibility and cloud bases while landing (even IFR pilots)
 - IFR pilots are concerned because “auto-pilots” can only fly the airplane down to certain altitudes before the pilot must assume manual control
 - if the visibility is too poor or cloud bases are too low, the pilot cannot legally land and must overshoot and reattempt or divert to an alternate!
 - ...unless of course we reference CAT IIIC ILS approaches... (<http://www.youtube.com/watch?v=IDtgguWISZc>)

Definitions of Visibility

- **Visibility**
 - the distance at which both an object can be seen during the day and at night (when lighted)
- **Flight Visibility**
 - average range of visibility forward from the cockpit of an airplane in flight
 - also known as air-to-air visibility
- **Slant Range Visibility**
 - distance a pilot can see over the nose of the airplane towards the ground
 - also known as approach visibility

Definitions of Visibility con't

- Ground Visibility
 - visibility at an airport, as reported by a ground observer on the ground
- Prevailing Visibility
 - distance at which objects of known distance are visible
 - if a Radio Tower is known to be 1 mile away (from a certain point) and it is not visible, then the visibility is less than 1 mile
- Runway Visual Range (RVR)
 - distance a pilot can see defined objects or lights down a runway
 - reported in 100's of feet
 - Examples: RVR1200, RVR200, RVR2400
 - small RVR's are associated with IFR conditions while big RVR's are associated with VFR conditions
 - small RVRs mean the pilot can see less down the runway = bad visibility = IFR
 - big RVRs mean the pilot can see far down the runway = good visibility = VFR

Restrictions to Visibility

- Restrictions to visibility can be anything that restricts your ability to see:
 - Clouds
 - If you fly into a cloud, the visibility will definitely be reduced
 - Precipitation
 - Heavy rain or snow can very easily restrict a pilot's visibility
 - Fog
 - Especially while on approach, fog can significantly reduce a pilots visibility
 - Haze
 - Acts like fog in restricting visibility
 - However, unlike fog, haze is mostly made up of carbon, soot and dust which can extremely reduce a pilots visibility

Restrictions to Visibility con't

–Smoke

- Although smoke does reduce a pilot's visibility, smoke in smaller quantities may only reduce visibility for a short amount of time... eventually the smoke will dissipate!

–Blowing Dust

- Can definitely reduce a pilots visibility because dust in any amount can cripple our ability to see... especially when its blowing dust!

–Blowing Snow

- Can produce very poor visibilities because they can essentially blind the pilot

VMC

(Visual Meteorological Conditions)

- This is a weather reporting term used by Flight Service (Weather) Specialists
- It is used to indicate that the **visibility, distance from cloud** and **ceiling** are equal to or better than the VFR minima required for VFR pilots to maintain while flying = VMC
 - Recall: VFR Minima may be found in your Air Law notes
 - If the VFR Minima cannot be maintained (weather deteriorates), the pilot must not takeoff, or in the case where he is en-route, land immediately!
 - Any attempt by a VFR pilot to fly in **non-VMC conditions** is deemed illegal by Transport Canada

IMC

(Instrument Meteorological Conditions)

- This is a weather reporting term used by Flight Service (Weather) Specialists
- It is used to indicate that the **visibility, distance from cloud** and **ceiling** are below VFR minima
- Only pilots flying under Instrument Flight Rules (IFR) can fly in these below-VFR conditions = IMC
 - In this case, pilots must have a special IFR endorsement by which they are allowed to fly the **properly equipped** airplanes in IMC conditions (they do not need a visual ground reference and can navigate and fly by way of their instruments)

Questions?

