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# CONSCIOUS STUDY OF IMPACT OF DUST STORM ON AVIATION AND AIRPORT MANAGEMENT

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**Abstract: This paper assessed the ecotoxicity of dust storm on aviation and airport management risk in the various Arab countries environment. Here we are going to discuss the various aspects of dust storm and its effect on aviation. The study includes occasion's occurs of dust storm where many challenges has been faced by aviation at the time of flying as well as in airport also. In airport it is very difficult to manage take off and landing if there is an environment of dust storm. In this paper we are going to discuss issues related to dust storm in the field of aviation and airport management. We are also going to discuss the existing study solution provided by researchers which are having some limitations which leads us to have conscious study of impact of dust storm on aviation and airport management. This paper also provides solution ahead as per our study and survey. The basic objective of this paper is to provide information about the concept of dust storm as well as its impact on aviation and airport management. The another major objective is to draw attention on a series of potential problems that might be associated with the flight of aircrafts in dust loaded areas as well as to propose some means to minimize these problems At last, the basic prevention, detection and recovery ways of dust storm on aviation and airport also included in this study paper.**

**Keywords: Dust, Dust storm, Aviation, Airport, Aircraft**

## 1. INTRODUCTION

Estimates are created that, annually, up to concerning 2 billion heaps of mud ar carried up into the atmosphere, in the main by mud storms. One sandstorm will elevate and deposit quite two hundred heaps of mud (Griffin et al., 2002). The Arabia has been listed in concert of 5 major dust-producing regions (Idso, 1976), whereas Goudie (1983) adds that mud storms are frequent within the space.

Apart from being a hazard and a nuisance to the overall public, mud storms and sand storms are hazards to aviation. Poor visibility and stormy winds ar a danger to airplane landing and kicking off at United Arab Emirate's capital International field (ADIA) within the United Arab Emirates (UAE). This will result in pleased flights, delayed departures and attendant field operational issues. Different effects embrace the scouring of craft surfaces and injury to engines further as hampering ground operations.

A windstorm, or sand storm, may be an assortment of particles of dirt, or sand, smartly upraised to nice heights by a powerful and turbulent wind and also the visibility is reduced to below 1000m (UKMO, 1991). The visibility is presumably to be at its worst throughout sunlight hours once the wind is at its strongest (UKMO, 1994).

**Figure 1 : The Harbor International Airport Scenario**

At ADIA very little differentiation is sometimes created between whether or not the event is caused

by mud or by sand, till the visibility falls below 1000m once it's reportable as a sand storm by the observers at ADIA. Safar (1985) uses identical stipulations, however adds that once the visibility falls below 200m, the storm is classed as severe. The lot of general convention looks to be merely to discuss with mud haze and mud storms (Safar, 1985). To the authors' information no analysis has been created on once dirt events and mud storms occur at ADIA. This paper examines statistically once dirt events and mud storms occurred at ADIA throughout the 10 years from 1994 to 2003, a dirt event being once the visibility was reduced to 5000m, or less.

If we are talking about impact of African dust storm then when a sirocco hits, the powerful winds loft loosely certain mud particles into the air and might transport them thousands of miles from the storm's origin. The Yankee Society for biological science provides the calculable quantity of displaced desert mud from mud storms on Earth as zero.5 billion five to five} billion tons annually, with the desert and Sahel regions of geographical area tributary fifty p.c to seventy five p.c of that quantity. This huge quantity of mobile mud affects the surroundings in various ways that.

## 2. VARIOUS EFFECT OF DUST STORM IN ENVIRONMENT

### 2.1 Weather Transforms

The mobile particles from a duster absorb heat from the sun whereas the bottom below the cloud doesn't receive the maximum amount solar power. This can be like a cloud casting a shadow and interrupting the sun's rays from reaching the surface. As National Aeronautics and Space Administration points out, the heated cloud causes heat to be displaced from the Earth's surface into the atmosphere because it moves on. This contains a direct have an effect on the climate. It will lower the temperature of the region, still as actuation hotter air from close regions to come the temperature to its original level.

### 2.2 Air Quality

The mud aerosols caused by the African mud storms will drastically scale back air quality. This not affects the African regions that the sirocco blows through; the particles may also travel long distances across the ocean. in step with yank Society for biological science, it will take 3 to 5 days to cross the Atlantic Ocean to succeed in the Caribbean and therefore the Japanese and south-eastern elements of the us. These mobile mud particles will cause metabolism issues, asthma, respiratory organ injury and eye infections. The particles may additionally contain cytotoxic metals, like arsenic and mercury, that area unit terribly harmful to humans.

### 2.3 Agriculture

As the dirt storms blow through, they erode the bottom, displace the highest layer from the African soil and move it to alternative regions. This nutrient-rich soil edges the areas wherever it finally lands -- for example, the Caribbean and therefore the higher region of tropical rain forests in South America -- however it hurts Africa's agriculture potential.

### 2.4 Water Quality

Dust particles have an effect on the ocean further because the land. The dirt caused by African dirt storms could contain substances that spur virulent protects blooms in coastal environments, like red tides, that area unit dangerous to humans. However, dirt storms do transport some nutrients to the ocean, which may have a positive result on the marine biomass production, per the planet earth science Organization.

### 2.5 Spreading Bacteria and Disease

The dirt particles will obtain harmful substances, and therefore the wind transports these to alternative areas. Plant life spores, bacteria, viruses and spore area unit simply some things that may be picked up on the method and rapt to alternative areas. Infectious disease and fungal infection are area unit simply 2 diseases that may be connected to dirt storms.

## 3. EFFORT OF DUST STORMS ON AVIATIONS

Sand Storm activity results in reduced visibility and the ingestion of sand and dust particles into engines, pitot static systems and conditioning packs causing blockage and corrosion.

### 3.1 Rerouting due to poor visibility

Rerouting due to poor visibility due to adverse weather is a particularly acute problem when airports are operating near full capacity. Delays are compounded.

Visibility is even more critical in the military. When landing on an aircraft carrier, the runway is short and narrow. The pilots must precisely position their plane and snag a rope to decelerate rapidly. Visibility is frequently poor. And there is no other place to land. Visibility is also sometimes a problem at NASA. If Cape Canaveral is overcast shuttles must continue in

orbit, or alternatively, land in California and be air transported back to Cape Canaveral.

A better method of illuminating airports and runways is needed. The system of illumination which is needed must be able to penetrate rain, fog, and snow, so that visibility is extended in adverse weather conditions [1]

**3.2 Disturbances in airport operations**

The various operations which takes place at ground of the airport is getting disturb in airport navigation. Because of having dust storms on the airport there is a high possibility to get disturbance of airport operations which can be done by pilots while taking off flight. Apart from cleaning of all airlines are also getting disturb and it is also one of the biggest problem of operation at aviation.

**3.3 Massive cancelling of scheduled flights**

The disturbance which we have briefed above can create massive cancelling of scheduled flights. The various flights are getting cancelled because of having many issues by dust storms on aviation. Flights are not much clan to get a fly. Furthermore, it is having a problem in takeoff and landing of the flights. Due to these various reasons massive flights are getting cancelled and all scheduled get disturb. It is not only to cancel flights on airport it also delays flight going to land on airport.

**3.4 Mechanical problems such as erosion, corrosion, Pitot - static tube blockage or engine flame out in flight**

The various types of mechanical problems can occur on airport with airlines but in this paper there is a deliberative study of very few problems which has been listed above. This discussion will give brief about the selected problems of dust storms and their effect on airlines [2] [3].

**3.4.1 Erosion**

Desert dust and volcanic ash particles impact and bounce on cold areas of the engine (fan or propeller blades) causing surface damages and gap size augmentation leading to gas flow deterioration and gradual loss of performance of the engine. Damages are also caused at the external surface of the aircraft. The problem is more severe in the case of volcanic ashes due to their irregular shape with sharp edges.

**3.4.2 Corrosion**

If dust particles or volcanic ashes impact on hot surfaces (combustor walls, turbine blades...) they will form a glass deposit with rough surface which may lead to a rapid loss of performance (potential risk during takeoff or landing operations) by disturbing the flow field. This deposit may also lead to thermal corrosion of a component of the engine or of electronic devises by blocking cooling holes

**3.4.3 Pitot - static tube blockage or damage**

Desert dust particles as well as volcanic ashes can lead to false flight speed reading by blocking pitot-static tubes. This may be extremely hazardous especially in low level flight as during takeoff or landing procedures.

**3.4.4 Engine flame out in flight**

The glass deposit on hot parts of the engine can significantly disturb the airflow, even leading to turbine blades stall and in flight engine flame out situation much more critical than external paint scratch.

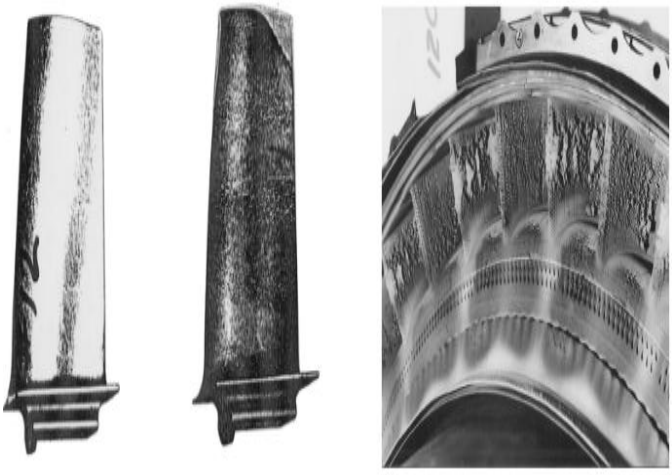

**Figure 2 : Engine Damages by Dust Integration**

It was a typical early summer evening in southern Arizona, U.S., and this past July 5. At 1751 local time, the Phoenix Sky Harbor International Airport was reporting 10 mi (16 km) visibility with winds of 7 kt. But all that changed in a matter of minutes.

A 1 mi (1.6 km)-high, 100-mi (1610 km)-wide wall of dust roared in from the southeast, moving at 30–40 mph (48–64 kph). At the airport, the leading edge of the dust cloud moved through at 1847. Within minutes, a full-blown dust storm or haboob — Arabic for “strong wind” — was well under way. At its worst, the visibility dropped to 1/8 mi (200 m) and the winds gusted to 46 kt. The airport was closed for 45 minutes. The reduced visibilities and strong winds lasted for hours [4].

Dust storms pose a significant hazard for aviation. Not only do they drastically reduce visibility, they

also are associated with very strong winds that can seriously affect an aircraft in flight. Engines can be damaged by ingesting the dust.

Strong winds associated with a dust storm were believed to be the cause of the May 26, 2011, crash of an air ambulance just outside Delhi, India.

Seven people in the airplane and three on the ground were killed when the Pilatus PC-12 turboprop fell from the sky into a residential neighborhood. Officials there said the airplane hit a "wall of air" and was "unable to move due to the strong winds." At the time of the crash, surface winds at the airport were gusting to 40 mph.

Even large airplanes can encounter difficulties. On March 11, 2005, an Airbus A321-200 operated by British Mediterranean Airways encountered a dust storm while trying to land at Khartoum Airport, Sudan (*ASW*, 3/08, p. 29). After two aborted approaches, a third approach was attempted. This approach also became unstable when the airplane descended too quickly as it neared the runway. With visibilities below acceptable minimums, the pilot initiated a go-around. The airplane was within 121 ft (37 m) of the ground before the crew pulled up. The event was officially described as a "serious incident." Three years later at the same airport, a Sudan Airways Airbus crashed on landing in a dust storm. Twenty-eight people lost their lives [5] [6].

Ground operations at air terminals can be brought to a standstill by dust storms. Outside workers can be extremely hampered in, if not prohibited from, doing their jobs. And in the aftermath of the storm, there is the cleanup to deal with. Just as in a snowstorm, the sand/dust must be removed from runways and other critical areas.

To explain the workings of dust storms, we start by clarifying the difference between dust storms and sandstorms. True sandstorms only occur when there is actual sand in the air and therefore are usually confined to the sandy desert regions of the world and their immediate surroundings.

Sand grains are larger and heavier than dust and generally cannot be carried as high into the air. Dust storms comprise smaller soil particles which can be carried much higher into the atmosphere, sometimes thousands of feet. Dust storms are much more common than sandstorms. They occur in arid regions, but can also occur in other places and with other soil types, as long as the soil is dry. Drought conditions are often a prerequisite.

Besides loose, dry soil, significant wind is necessary for dust storm formation. Strong winds are needed to mix the dust from the surface into the air and then keep it suspended for a significant time. The wind, of course, will transport the dust particles and make the dust storm move. Fortunately, strong winds without precipitation are fairly unusual outside desert regions. Atmospheric instability can also play a role. The more instability, the more vertical mixing can occur. It is this vertical mixing that can allow the dust to be carried to great heights, as high as 20,000 ft.

As would be expected, dust storms are common in and around the arid and desert regions of the world. The lack of vegetation leaves the soil exposed, with nothing to slow the wind near the surface. However, even the more humid climates are not immune from dust storms. Droughts can dry topsoils and make them more prone to blowing. A weather system associated with strong winds but no precipitation can lead to significant blowing dust [7].

The strong winds associated with dust storms are produced by a variety of weather systems. In the desert southwest of the United States, they are usually convective. Strong downdrafts from thunderstorms produce most of the dust storms. At times, the precipitation from the storm evaporates in the dry air before reaching the surface. Only the strong winds make it to the ground. Even when rain reaches the ground under the main convective column, the outflow from the storm's downdrafts has spread out, well ahead of the main storm. The outflow boundary or gust front will be the leading edge of the dust storm. In time, the rain shaft may follow, turning the dust to mud. In the Phoenix dust storm, thunderstorms first developed over 100 mi away, just east of Tucson, in the afternoon. This complex of strong to severe storms moved northwest, with its outflow boundary, the leading edge of the dust storm, reaching Phoenix by evening.

Thunderstorms and the dust storms they produce occur in the summer in the Southwest. It is then that the usually dry region is invaded by moist, tropical air from the south. The "summer monsoons" usually begin in June but occasionally are delayed until July. The Phoenix area usually gets one to three dust storms each summer. Convective dust storms are also common in other parts of the world, such as the Sahara region.

"Convective dust storms" cannot be forecast in

advance, and that makes them extremely dangerous. In August 2000, a Bellanca 17-30 single-engine airplane crashed into the mountains outside of Scottsdale, Arizona, killing two. The situation was similar to the Phoenix event — a thunderstorm-generated dust storm.

The best forecast that meteorologists can make is to warn when conditions favor convective development. It is impossible to know exactly where the convective cells will develop and if they will produce a dust storm. Convective dust storms are fairly small — usually tens of miles across.

After a dust storm has formed, the U.S. National Weather Service issues either an "advisory" or a full-fledged "warning." A "blowing dust advisory" is issued if the visibility is forecast to temporarily decrease to between 1/4 mi (0.4 km) and 1 mi due to wind-borne sand or dust with winds of 25 mph (40 kph) or greater. A "dust storm warning" is issued if the visibility is expected to drop below 1/4 mi frequently, with winds of 25 mph or greater. The criterion of 25 mph is a minimum; winds frequently range from 40 to 60 mph (65 to 95 kph) in a dust storm [8].

In the more poleward arid regions and in other drier areas in the mid-latitudes, the strong winds that produce dust storms usually are associated with larger weather systems. To further the discussion, we need to discuss how wind is actually produced. Wind, or horizontal air movement, is the result of pressure differences. Air tries to move from higher to lower pressure. The greater the pressure difference, the stronger the winds.

Standard surface weather maps use isobars, lines of equal pressure, to illustrate the pressure field. When the isobars are closer together, there is a stronger pressure gradient and the winds are stronger. The laws of physics confirm what we see in real-world high-pressure areas that have weaker pressure gradients and light winds, whereas lows with tighter pressure gradients have stronger winds. Fronts, associated with lower pressure, can also be accompanied by strong winds.

Low-pressure areas, or cyclones, produce winds that rotate counterclockwise in the northern hemisphere, clockwise below the equator. Stronger cyclones, with lower pressures, produce stronger winds. Winds over 50 mph (80 kph) can be expected with these storms. The winds occur regardless of precipitation. If a source of moisture is available, then as the air is lifted into the low-pressure centers, clouds and precipitation usually form. If moisture is not available, the low only produces wind and the potential for dust storms.

Dust storms associated with these larger, "synoptic-scale" systems are much more widespread than those associated with thunderstorms, often affecting hundreds or even thousands of square miles. On April 4, 2009, a strong low-pressure area to the north generated a dust storm that affected all of central Texas. Lubbock reported wind gusts to 41 kt and reduced visibilities due to blowing dust. At Amarillo, it was even worse, with winds gusting to 55 kt and visibilities as low as 3 mi (5 km) in blowing dust [9].

In May 2004, dust storms were generated in five different countries on the Arabian Peninsula by the same weather system. On Sept. 23, 2009, a dust storm 300 mi (483 km) wide and 600 mi (965 km) long affected two states in Australia. It was the worst dust storm in Sydney in 70 years. Air traffic was halted at Sydney Airport, where the visibility dropped to 1/4 mi with gale-force winds. An intense cyclone and frontal system produced the strong winds.

Besides low-pressure areas themselves, fronts associated with some lows can also cause problems. Dry cold fronts are the worst. Again, the lack of a moisture source prohibits precipitation formation. Dry cold fronts are also often accompanied by steep temperature lapse rates, which increase instability and the vertical depth of any dust storm. On Feb. 24, 2007, a major low-pressure area moved out of the U.S. Rocky Mountains and into the central Great Plains. With a tight pressure gradient, the system was producing strong winds throughout much of the central part of the United States. Of particular concern was a strong, dry cold front extending southward from the low and moving through Texas. At the Dallas/Fort worth International Airport, strong southerly winds ahead of the front gusted over 20 kt. But the air was moist with dew points near 60 degrees F (16 degrees C). A wind shift to west-southwest near 0900 local time accompanied the frontal passage.

Although a few rain showers had preceded the front, the air quickly dried behind it. Dew points dropped precipitously, reaching as low as 9 degrees F (minus 13 degrees C). Winds increased and at times gusted to nearly 50 kt. By 1500, dust and sand moved in from the west. Horizontal visibility plummeted, dropping at times below 1 mi with the vertical visibility below 1,000 ft (305 m). The combination of

low visibility and strong winds persisted for hours. Much of Texas dealt with similar conditions.

Even with these larger weather systems, dust storms are difficult to predict. It takes just the right combination of wind and dry soil. And dust storms are becoming more common around the world. In the United States, the Colorado Plateau region saw a record 14 large dust storms in 2009 [10].

Northern China now averages 30 dust storms a year. Iran is reporting an ever-increasing number of events. In some regions, dust storms can be linked to poor agricultural practices. In other areas, drier conditions and more drought occurrences are significant factors. Some believe that global climate change is tied into this. Regardless of the causes, dust storms will continue to be a major aviation hazard in many parts of the world.

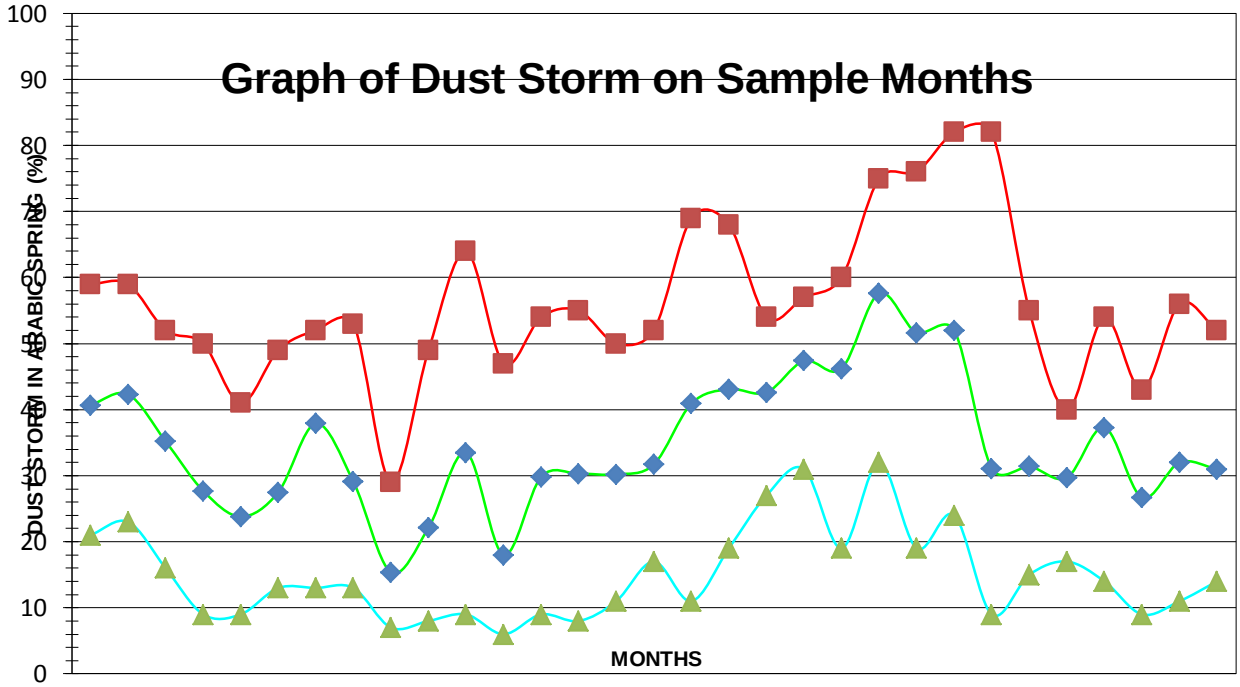


**Figure 3 : Sample of Dust Storm on Airport in Arabic Spring**

In above figure 3 the graph showed dust storms with respect to selected 35 months as a part of study. The sample data set is available online on various link listed in reference. In this study, it has been explained that there are high, low and medium level of dust storm in Arabic spring which affects to the aviation. The basic fundamental of the above graph shows effect of dust storm on aviation in Arabic spring. From the study of graph we can come to know that there is a 60% effect at most of dust storm on aviation where as there is a minimum 20% dust storm during the selected 35 months in Arabic spring or nations.

## CONCLUSION

Desert and volcanic mud also as ocean salt particles have safety and maintenance implications on craft operations. The activity of those particles has impacts on the craft performance that aren't absolutely explored nevertheless for the region trade. The Sand and dirt storms occur rather more typically than volcanic eruptions and have an effect on aviation operations in several places on the planet with vital safety and money implications. For this reason maintenance and operation plans ought to be revised. A lot of specifically, flight methods and flight management in dust-covered environments should be re-assessed.

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