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Meteorological Satellite Applications

On February 17, 1959, the first weather satellite was launched into outer-space that was used for collection information on cloud cover. Currently thousands of other satellites have been launched into space that have changed the world as it is today. Satellites can be applied to many different areas; in particular they can be used for meteorological applications. The use of weather satellites are helpful tools for meteorologists in predicting the weather such as cloud formation and patterns, temperature patterns, can help indicate the atmospheric conditions based on the amount of pollution present.

There are two main types of satellites that can be used as weather predictors. They are meteosat satellites that move in a geostationary orbit (GEO) and polar orbiting satellites that move in a low earth orbit (LEO). Meteosat satellites typically will orbit about 23,300 miles above the earth's surface. Their orbit pattern is such that it follows the earth's rotation exactly. Which means that it spins parallel to a fixed position on the earth and takes pictures of one fixed location because it is orbiting at exactly same angle and speed as the earth's rotation (Figure 1.) Also, the information that they gather is immediately send to the receiving system on earth. Their advantage is that they are able to take large pictures that cover about one third of the earth's surface. The disadvantage of GEO satellites is that the image that is produced is often distorted and less detailed due to their high altitude and low angle in which the satellite can retrieve picture information. Also, since the satellites obits parallel to the equator of the earth the polar regions are often not included in photographs from GEO satellites (Weather Satellite 2008).

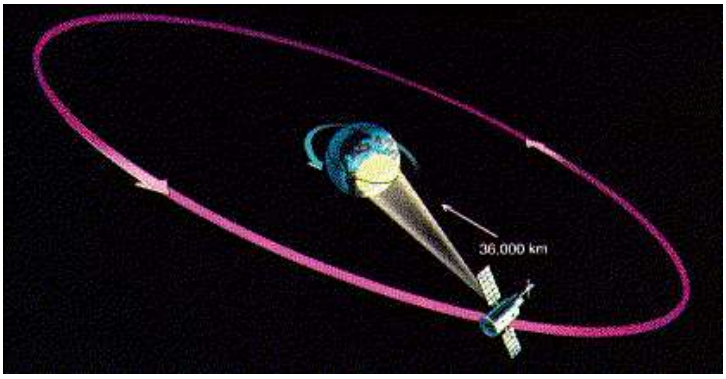

Figure 1. The satellite remains in a fixed position above the earth (Weather Satellite 2008).

Polar satellites orbit the earth at much lower altitudes, about 530 miles above the earth's surface. Another very important characteristic of them is that they orbit the north and south poles, thus paralleling the prime meridian. Each revolution takes less time than that of GEO satellites, so in each rotation they are able to take pictures of different geographical areas. This is because as the earth rotates eastward and the satellite reaches the same latitudinal location at different points in time. It takes a picture of that same latitudinal location, but different longitudinal location based on the time it takes for the satellite to rotate the earth one full revolution (Figure 2). Since polar satellites orbit at much lower altitudes they are able to take more detailed pictures of the earth and can provide more accurate photographs of storms and other meteorological patterns. But they fall short in the fact that they cannot focus on one area for very long because they are in constant rotation (Weather Satellite 2008).

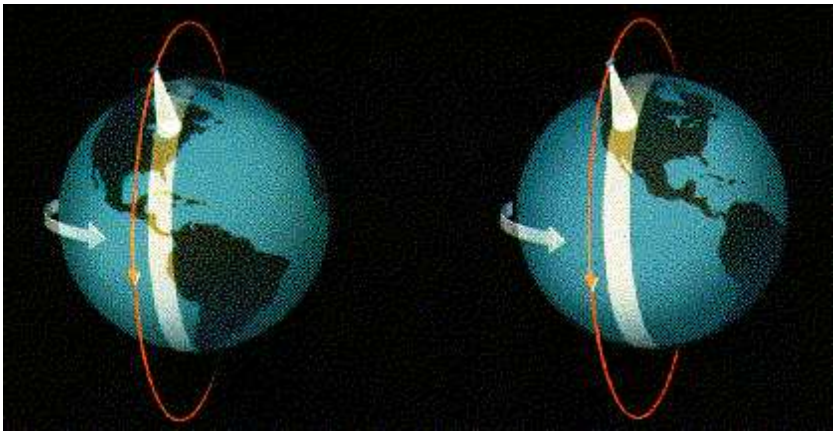
Figure 2. The LEO satellite orbits the poles and on each revoltion takes a more westward picture than on the revolution before (Weather Satellite 2008).

Based on the photographs that the satellite takes much information can be concluded from the data. Both visible and infrared images can be used to describe weather patterns. Visible images (Figure 3) show a picture that indicates cloud cover over a given region while infrared images (Figure 4) are formed from temperatures from fronts that contain clouds and temperature of earth's surface. As clouds increase in altitude they become more cool so they will show up more white on the infrared image and thus indicating that there is more cloud cover and potential for a storm (Weather Satellite 2008).

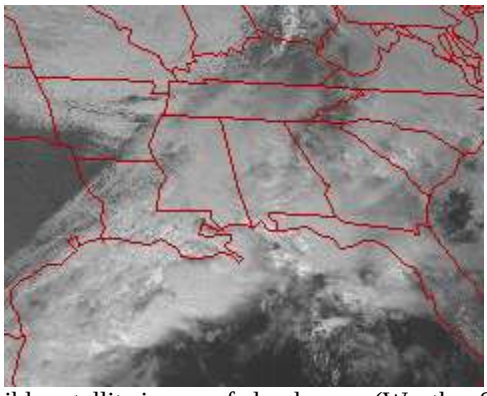

Figure 3. A visible satellite image of cloud cover (Weather Satellite 2008).

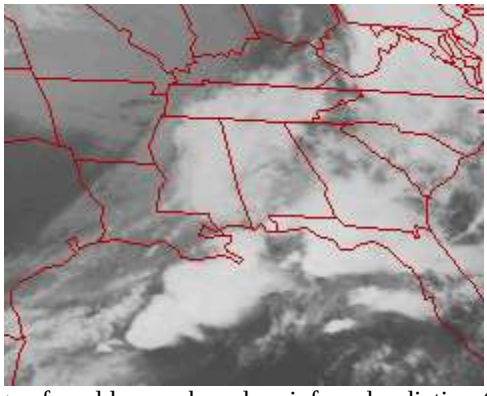

Figure 4. A infrared image of could cover based on infrared radiation (Weather Satellite 2008).

Another application of meteorological satellites is that they can give the current climatic conditions of a given area. For instance Africa is home to both arid and tropical regions. Figure 5 shows an image taken that reflects the various climates throughout Africa. This satellite application can be useful for farmers. It can help indicate whether they are they are in a drought

because reduced vegetation often reflects a brown color, or if they have ample biomass that indicates a good vegetative growth that is indicated by a green color (Motherplanet 2008).

Figure 5. The green color indicates a tropical climate while the brown areas indicate an arid climate (Motherplanet 2008).

Weather satellites can also be used to indicate the amount of pollution present in the atmosphere. Areas over cities often reveal greater amount of pollution than rural areas. Pollution from airplanes and rockets are can also be detected. Pollution can also be a product of natural causes. For example, dust storms from deserts can carry large amount of sediments in the air across the ocean (Figure 6). These particles in the air are required for condensation of water to occur. So, by understanding the amount of particles in the air it can help predict the formation of tropical storms (Beitler 2007).

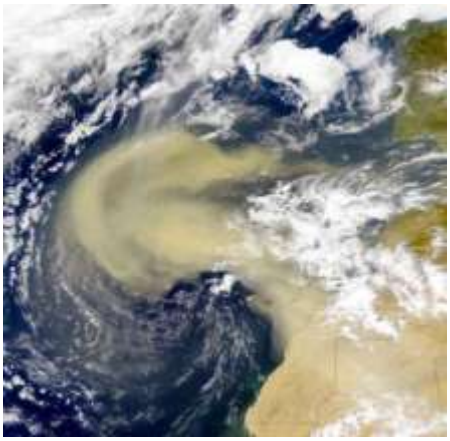

Figure 6. Meteorological satellite image of a dust storm (Beitler 2007).

Meteorological satellites have many applications, most of which aid humans in understanding the natural forces of the earth. The availability of meteorological information from weather satellites was an important tool in technology that is used and depended on today. Everyday people depend on weather satellites to provide forecasts that tell them simple things such as how to dress for work or more important things such as to seek refuge from an oncoming storm. The information they relay from outer space is magnificent in the fact that it can give such large scale picture of the earth and the conditions it faces. With satellite information technological advances countries are currently interested in building up their meteorological satellite systems in effort to understand and predict natural conditions such as the weather and use that information to maximize that information to their own economic benefit (Zhang 2007).

References

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