MILAGRO

Megacity Initiative - Local and Global Research Observations

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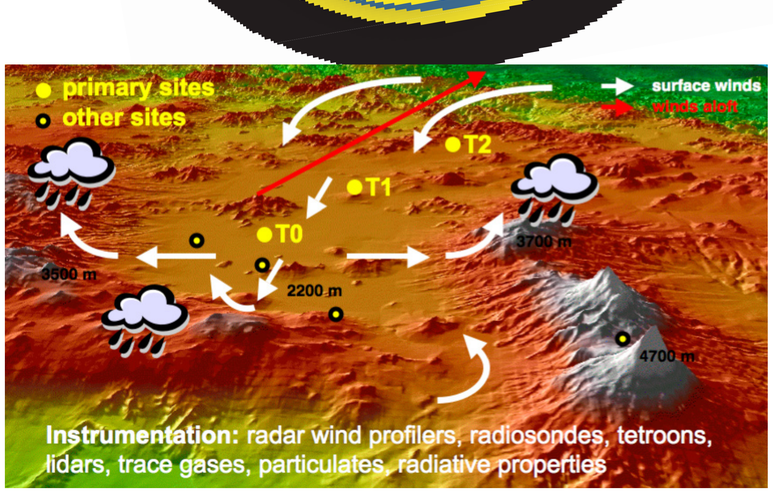
METEOROLOGICAL FORECASTING: MEASUREMENTS AND MODELING



Tethered Balloon

Many of the pollutants emitted by urban centers are accumulated and transformed during the first 1000 meters of altitude. The tethered balloon measures the vertical profiles of these pollutants. The vertical profiles indicate how the concentrations of pollutants vary in relation to the altitude.

Tethered balloons are usually anchored to the ground. They are elevated in order to measure ozone concentrations and other pollutants at different altitudes. They are also used to monitor meteorological parameters such as wind direction and velocity, temperature, relative humidity and barometric pressure.

These profiles are used to study the dispersion and transformation of pollutants, the evolution of the boundary layer (the atmospheric layer closest to the Earth's surface where the biosphere and the atmosphere interact), and the accumulation atmospheric pollutants during the night. They are also very useful in the evaluation of air quality photochemical models by comparing simulated vertical profiles with the vertical profiles measured by the tethered balloon.

Pilot Balloon

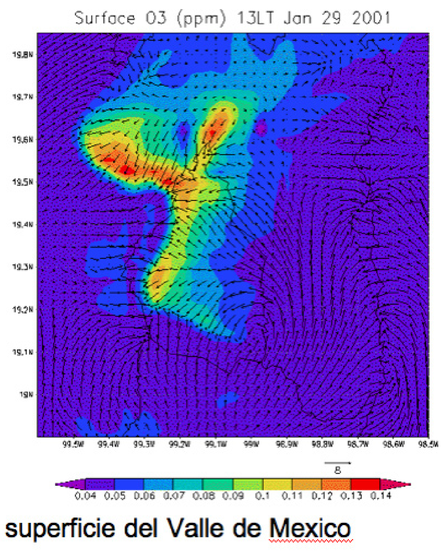
Different types of balloons are used to study the atmosphere; one of them is the pilot balloon. Pilot balloons study the dispersal and transformation of pollutants in the lower layers of the atmosphere. These balloons are deployed and their position is measured constantly as they make their way up into the atmosphere. A teodolite, a topographical instrument that is used to measure vertical and horizontal angles with great precision, is used to determine their position. The variations in the balloon's position during its ascent helps to calculate the wind direction and velocity at different altitudes, providing data on the direction taken by the pollutants carried by the wind.

Wind Profiler and Radiometer

A wind profiler makes sound waves to detect the wind speed and direction at various elevations above the ground. A radiometer is an instrument that measures the solar radiation once it reaches the Earth's surface.

Radiosondes

Meteorological radiosondes are balloons with sensors used to measure the vertical profile through several kilometers of meteorological parameters, for example: temperature, wind velocity and direction, relative humidity and atmospheric pressure. In some instances, special sensors are attached to measure concentrations of pollutants such as ozone.

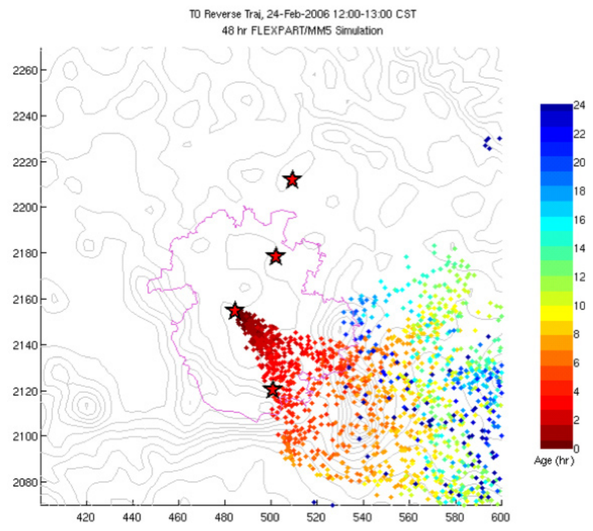


Ozone concentration at the surface site in the Mexico City Metropolitan Area

Air pollution control and protection measures are generally applied once a state of contingency has been declared. That is, when the pollution levels have surpassed the established standards and, as a result, come into effect only after the population has already been exposed to high levels of pollution. Therefore, it is very important to rely on a system capable of predicting the concentration indices of criteria pollutants (ozone, nitrogen oxides, sulfur dioxide, carbon monoxide), that would lead to the implementation of control measures in order to anticipate, avoid or reduce the number of contingencies, and alert the population before these occur. These systems have also proven useful in providing updated information on urban sites with high levels of pollution, even when it might not generate a state of contingency.

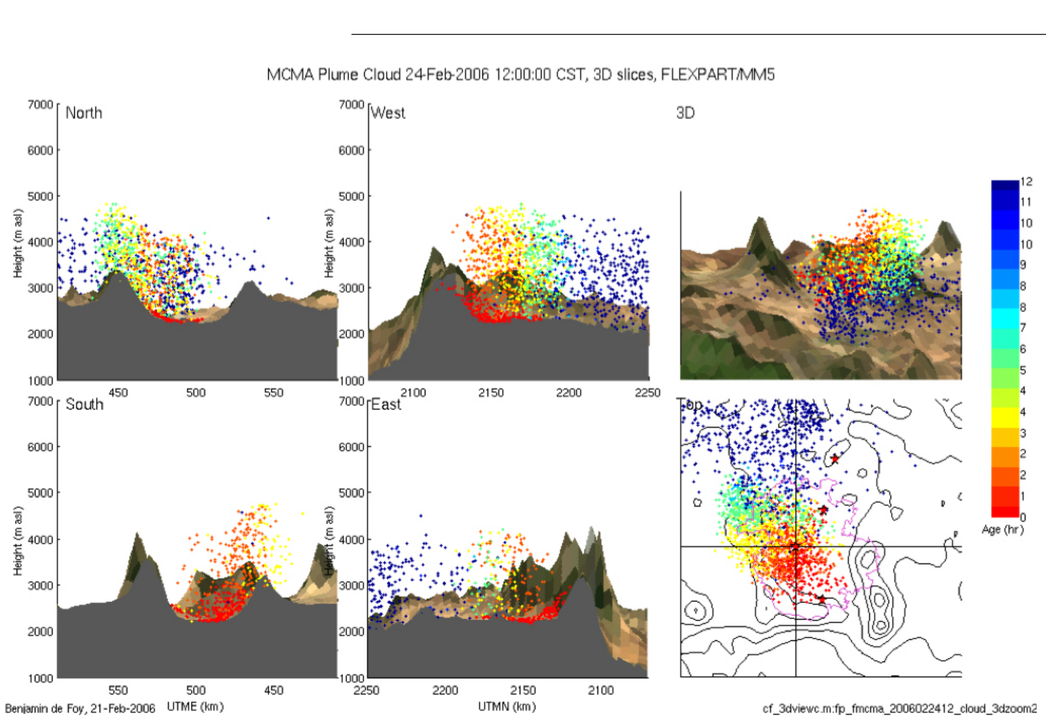
Cities such as Houston, Madrid and Washington have an air quality forecasting system in place, while Mexico City, one of the most polluted cities in the world, doesn't have a system to predict air quality. During the MILAGRO 2006 Campaign, a computerized system will be used that predicts air pollution in the Mexico City Metropolitan Area with 12, 24 and 48 hours of anticipation. The system will have to divide the Valley of Mexico into 4 km square cells to calculate the concentration of pollutants in each cell and be able to determine how pollutants are distributed in that specific region.

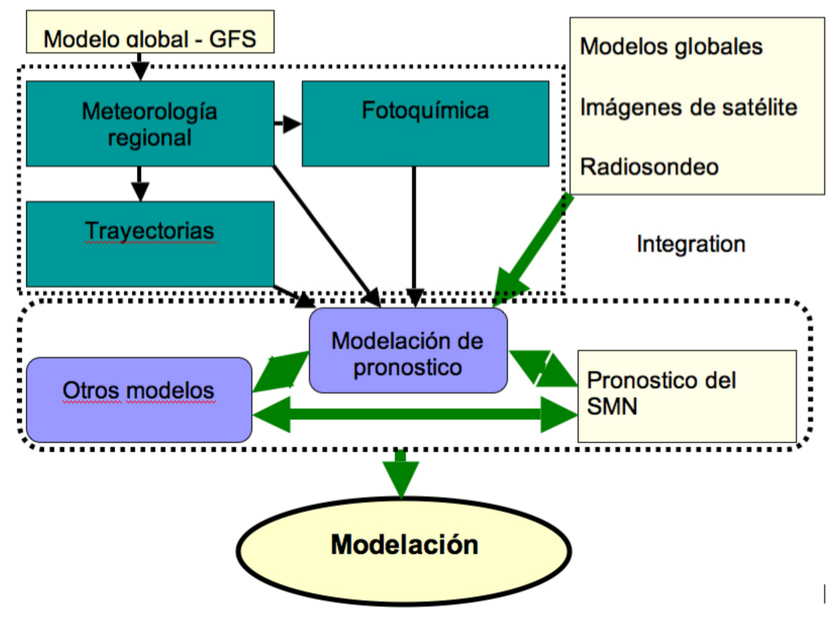
Air quality models are mathematical models that simulate different processes such as atmospheric chemistry, the transport and deposition of pollutants, etc. This is done in order to determine the ambient concentrations of secondary atmospheric pollutants in certain regions, which makes it necessary to identify the emissions concentrations of different primary pollutants (SO2, NO2, NO, hydrocarbons) and meteorological conditions (wind velocity, pressure, temperature, humidity, solar radiation, etc.). This provides information on the concentrations of secondary pollutants such as ozone (O3), nitrous acid (HONO), formaldehyde (HCHO), peroxyacetyl nitrate (PAN), etc.



: Where does air come from? Backward Trajectories from T0 (IMP)

Meteorological forecasting models are mathematical models that use atmospheric equations of motion to calculate different meteorological variables such as wind velocity and direction, ambient temperature and humidity up to 48 hours in advance. These models are built from information about the region being studied. The required information includes meteorological conditions at the time of calculation, the geographic and geophysical characteristics of the region and general circulation meteorological models.





The aforementioned models can be combined to generate air quality forecasts that can help to predict the levels of atmospheric pollution throughout the region 12, 24 and 48 hours in advance.

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