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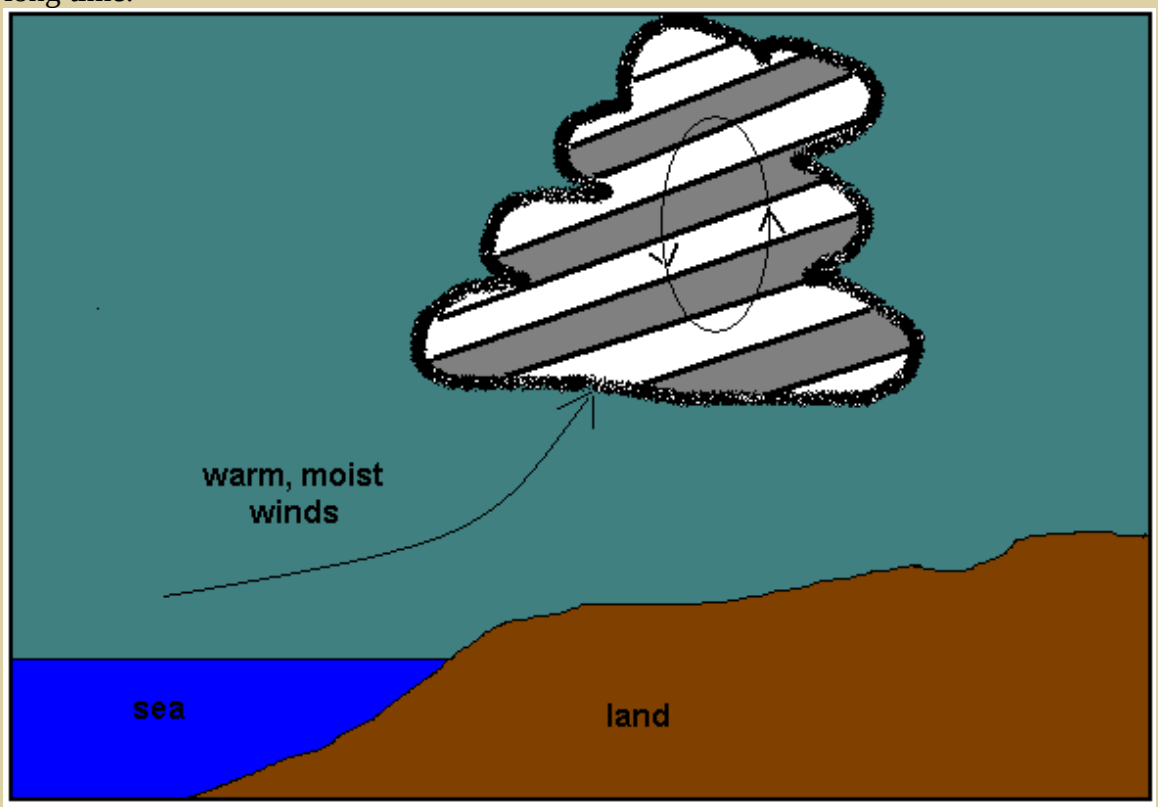
Better tools for the weatherman

The weatherman’s store of tricks is often not enough to match the manoeuvres of the weather, says S.Ananthanarayanan.

The grim week we just passed in Mumbai (last week of June 2005) is an example of unprecedented rain that took everyone by surprise.

Rain formation

Rain-clouds usually form when warm moisture-laden air or wind meets a cooler air mass or begins to rise and cools due to expansion. As the air mass cools, its capacity to carry water vapour reduces and it is soon saturated. This is when tiny droplets of water may form and still be suspended in the cloud as a fine mist. If the temperature should fall or nuclei for raindrops should become available, the surplus water vapour in the cloud comes down as rain. But long before this happens, currents within the clouds can support massive quantities of water, ready to rain down when the conditions are right. And as one cloud degenerates, it can help form another one and the activity can be sustained for a long time.

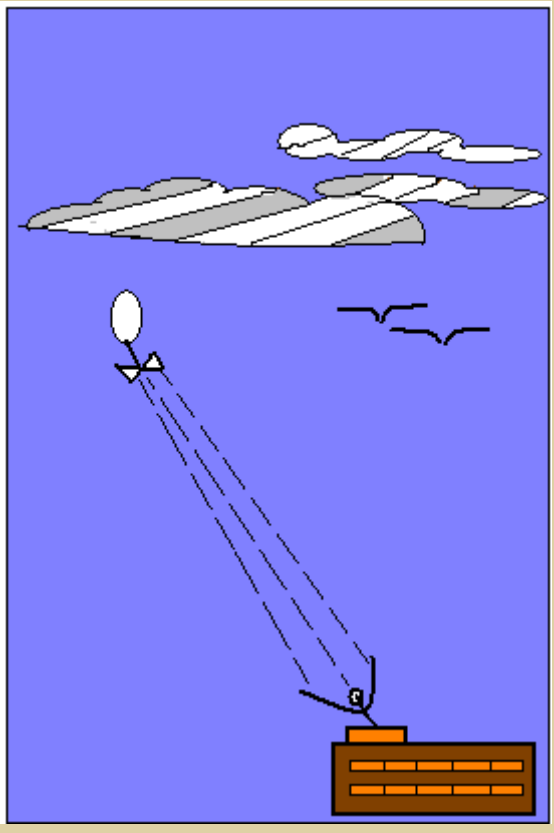


On 27th July, last week, the Mumbai Meteorological department was aware of such a formation, fifteen km high, over Santa Cruz are of Mumbai. The development was quite fast, the entire cloud system formed in just half an hour. While some warnings of 'heavy rainfall' were issued, the administration was taken off guard when the downpour actually started and continued to break all-time records.

The tools

The tools that the meteorology department has at is its disposal are mainly a regular radar scan of the contents of the atmosphere surrounding Mumbai and periodic assessments of the winds at various altitudes, at different points in the state. This is supplemented by satellite pictures of the cloud and water vapour distribution over the area.

Radar pictures are with the help of radio waves that are sent out in a rapidly rotating beam that scans the surroundings. Water vapour, droplets of rain, crystals of ice, hail, all reflect the radio waves and the antenna that sends out the beam also picks up the reflection..



A series of scans at different inclinations, or angle of tilt soon generates a picture of the distribution of rain-laden clouds in the area. The satellite pictures, through radar as well as cameras, also show direct views of the distribution of clouds and water vapour.

The distribution of wind speeds is estimated by a method that has remained unchanged for many years. A lighter-than-air balloon with a metallic reflector is freed to rise rapidly into the air. As the balloon and reflector speed upwards, the reflector is tracked by radar, and every swing of the balloon from the straight vertical is recorded. By the time the balloon has reached as high as it can go, the radar has an accurate picture of the wind speeds at different altitudes, above that place.

This kind of trial is conducted at the same time at different met centers in a wide area. The data from all the centers is put together to provide a map of the winds at different heights, all over the area covered.

For a dynamic picture

The trouble is that the picture is always a few hours old and rapid changes do not become evident. A more effective system, which eliminates the need to send up and track balloons, to get the wind velocity map, is the ***Doppler radar***. This is a little more sophisticated type of radar, which goes a step beyond locating a water droplet or a vapour concentration from the reflected radio waves received. When the reflecting bodies are moving, rather than stationery, they increase or reduce the frequency of the reflected radio waves, depending on which way they are moving. Radars that are able to make out this change in frequency can then not only locate the reflecting bodies but also work out their movements.

This kind of equipment, which the Mumbai Met Department is understood to be in the process of procuring, would be able to keep up a continuous picture of the winds and currents within clouds and enable faster reaction to developments.