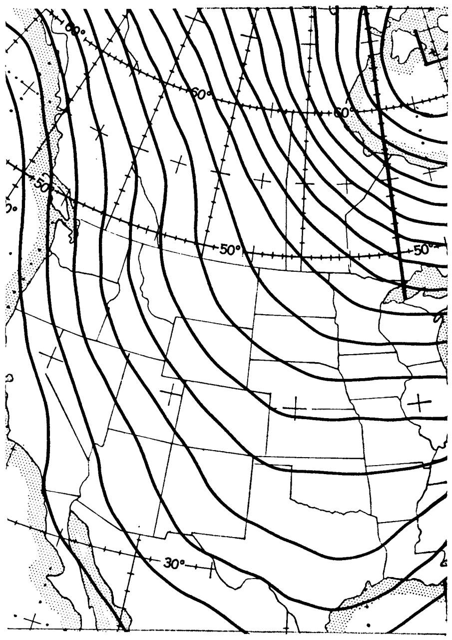
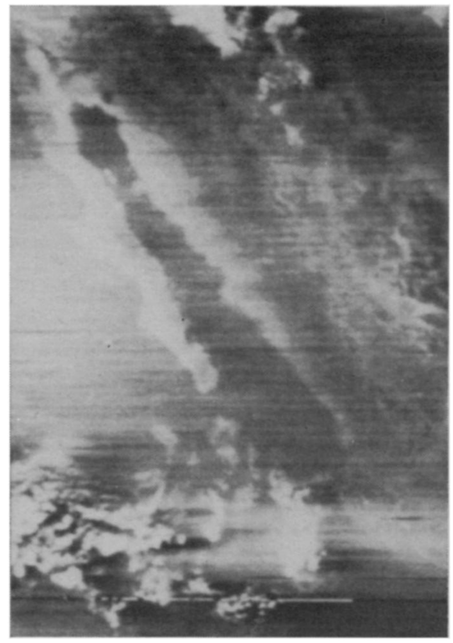
METEOROLOGY





ESSA/NASA

Future merger: satellite's cloud cover patterns into computer's equations.

weather by the numbers

by Ann Ewing

Computer weather prediction is proving as accurate as expected

The tired jokes about the weatherman haven't changed in decades—but the weatherman has. Numerical prediction, a computer-based technique, has enabled him to almost double forecast accuracy, and is edging him, against heavy odds, in the direction of better scores.

The introduction of the computer into routine daily weather forecasts in the spring of 1955 brought a revolutionary change in the way predictions are made. Instead of having to rely on the skill and knowledge weathermen had acquired during years of practice, forecasters could virtually eliminate subjective judgments for all but the surface layer of the atmosphere.

The mathematical models of the atmosphere on which the computer calculations are based have improved greatly since 1955. However, operational forecasts are still made in basically the same way—the computer is told the state of the atmosphere around the hemisphere as it is known at a given time, then it computes what will happen in the next 24 or 48 hours, in a series of steps of 10 minutes or slightly longer each.

The time interval on which the computations for the next jump are based depends on the capacity of the computer, the mathematical model and the available data (SNL: 11/14/53).

Each time there has been an improvement in the mathematical models on which the numerical forecasts are based, meteorologists have made a solid advance in their ability to predict surface weather, but only after they have had some experience learning how to apply their knowledge to the new information.

Forecasting skill, which is rated on a scale as impartial as the Weather Bureau and its critics can devise, has gone from 33 percent when the first numerical method went into operation to slightly more than 60 percent for the period Oct., 1966 to May, 1967, the last for which figures are available.

Another way of judging forecasting ability is based on a scale of error, arrived at by a complicated formula that allows for the fact that it is easier to predict large-scale patterns during stable periods than during such times as the transition from winter to spring.

On this basis, the most recent numerical model, a six-layer atmospheric sandwich, brings the error down to about 45; a rating of 30 is taken as being as close to perfect as possible, with 200 being no better than chance.

The latest improvement in operational numerical computing, introduced in late January, involves a mathematical sharpening of the equations so that the 48-hour prediction can be made in 48 minutes, lopping seven minutes off the previous time. Although seven minutes may not seem like much time, it releases the computer for research studies to test even more advanced models of the atmosphere, provided the researchers can find the funds to finance operation of the machine.

This free time is important because one basis for the next jump in forecasting skill for operational predictions depends upon such improved theoretical models. Unfortunately the next jump also depends on additional data from the many parts of the Northern Hemisphere not now covered, such as the oceans and the Sahara, and on a new generation of computers that can handle three or four times more data than the CDC-6600 that routinely churns out Northern Hemispheric pressure charts.

Extending the coverage is critical to further improvement.

When computers calculate patterns for areas near the boundaries of the model, a problem known as the "edge effect" occurs. One boundary, for example is close to Baja California. Very little meteorological information is available from this area and, if the weather pattern is more north-south than west-east, the computer's forecast for this region can be badly wrong.

Incorporating cloud cover data from satellites, such as the Applications Technology Satellites that hover near the equator, into the computer's equations would help to overcome this difficulty. U.S. Weather Bureau scientists are working on a way to do this.

One improvement that the National Meteorological Center in Suitland, Md., is now testing is a method to include accurate precipitation forecasts in the machine's equations. The problem is that precipitation can vary widely within the relatively large-scale mesh, 200 miles between latitude points, on which the computer predictions are made.

In the relatively near future, Meteorological Center scientists hope to be able to shrink the mesh on which the machine calculations are made for the United States and immediately surrounding areas, although there is little hope of doing this for the whole Northern Hemisphere because of lack of data. Such rescaling would improve surface forecast accuracy.

Also in the near future, scientists hope to work out a better way of presenting data to the machine. The problem is that the grid points from which the machine calculates are not the same as the spots from which the temperature, humidity and winds are observed. This information, therefore, has to be translated for the computer to the grid points at the cost of some accuracy.