

Karl Hübner
Cologne

The Weather Prophets

With the help of advanced technology, meteorologists around the world try to make reliable forecasts about weather developments.

Weather reports are the media's most popular service thanks to modern meteorology. The **German Weather Service in Offenbach** is an important source. The quality of its service depends on satellite data. A new satellite promises even more accurate forecasts.

► For the fans of a particular brand of German chocolates, the critical limit is 27 degrees Celsius. The manufacturer in Frankfurt only resumes chocolate sales after this summertime temperature is no longer exceeded. At higher temperatures, the company cannot guarantee the form, appearance and quality of its chocolates.

But how can the company be sure that the days with temperatures of 27 degrees are truly past? For the German chocolate producer this question is easily answered: by working with the German Weather Service

(DWD), one of the Top Five weather services in the world. This aspect of its production is so important that the company sends a delegation to Offenbach every year in August to find out more about the current weather situation and to obtain forecasts for the various regions of Germany.

A record summer of the century

This year the company in Frankfurt and the many fans of its products had to be patient somewhat longer than usual. The record summer in Central Europe kept the mercury

in Germany at critical heights for the special chocolates. The DWD ultimately confirmed with its own data that in 2003 the characterization "summer of the century" was indeed correct. At 19.6 degrees Celsius the average temperature registered in Germany for June, July and August was the highest since systematic weather recordings were begun in the year 1901, and 3.4 degrees Celsius above the mean reading. It was also the sunniest summer in Germany since 1951, and only four summers were drier in the past 102 years.



A network of 4,000 conventional weather stations in Germany supplements the satellite-supported observations from outer space.

Temperature forecasts are just one example of the many special services that DWD has to offer, which are also available to individual companies. "For instance, the German railway company requests forecasts of wind velocities to be able to adjust the speed of their fast trains that are affected by crosswinds," explains DWD press spokesman Gerhard Lux. There is also close cooperation with airports and airline companies. "This is not only a matter of choosing the direction of takeoffs and landings or planning the best routes," says Lux. "It also involves determining the maximum weight to be loaded in freight aircraft, which is equally dependent on weather conditions."

DWD offers the services of its 2,700 employees to many other groups as well, including balloon pilots, shipping lines, farmers, hobby fishermen or insurance companies. "Many now have the relevant data sent directly into their databases via the Internet," says Lux.

Dense network of data

The fact that DWD can supply such a wide variety of groups with information about the weather is due to the extensive amount of data that it collects. With nearly 4,000 measuring stations positioned throughout Germany – and of these more than 100 are manned, the staff in Offenbach oversee one of the most dense networks of data in the world. Added to this are the readings from ships, buoys and aircraft, as well as global satellite data, which enable an uninterrupted observation of all occurrences in the atmosphere. Furthermore, there are the elaborate computer programs that ultimately process these data into useful information. Their simulations allow relatively reliable forecasts. The large-scale computer currently in use – the fifth generation of its kind – manages three billion mathematical operations per second.

It is important to be able to process this information quickly because the flood of data is constantly growing. And the next, even bigger flood is on its way. In early 2004 the new joint European satellite MSG-1 (Meteosat Second Generation) will begin regular operations, thus replacing its predecessor, Meteosat-7. The geostationary satellite, positioned some 36,000 kilometers above Africa since 2002, has been supplying images of the Northern Hemisphere ever since. "Zerodur" glass ceramics from SCHOTT play an important role in the heart of MSG-1 (see also SCHOTT Info No. 102).

The DWD is currently working on the development of new electronic routines for extended data

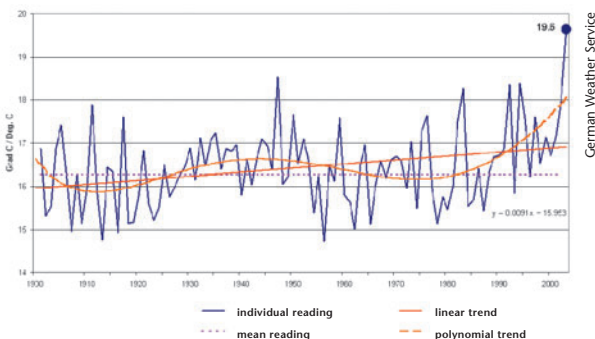
German Weather Service:

More than just tomorrow's forecast

- ▶ Provides a weather warning service (thunderstorms, severe storms, hail, etc.)
- ▶ Forecasts forest fires
- ▶ Safeguards air travel and sea navigation
- ▶ Monitors radioactivity and ozone concentrations in the stratosphere
- ▶ Determines current hazards due to UV radiation (www.uv-index.de)
- ▶ Records and documents meteorological data. Retrospective data can be required, for example, in the case of insurance damage claims.
- ▶ Advisory services for farmers and for companies that are, for example, investigating new sites for solar plants or wind power installations
- ▶ Provides relevant data for international climatic research
- ▶ Exchanges data with other weather services around the world
- ▶ Cooperates in international programs and organizations, such as the European weather satellite (EUMETSAT). Also a member of the UN World Meteorological Organization (WMO). In this connection, the DWD has assumed the role of the European center for certain special forecasts or also for the Global Precipitation Climatology Center.

The direct earnings of the DWD do not completely cover the costs. However, international studies commissioned by weather services have calculated a cost-benefit ratio of 1:20. This means that each euro invested in a weather service helps save 20 euros somewhere else – for example, by avoiding storm damage thanks to early warnings.

Average daily mean temperature in the summers from 1901 to 2003 in Germany.



processing. MSG-1 not only delivers new images at double the rate as the Meteosat-7, but it also registers data from 12 wavelength ranges of light, while the old Meteosat generation was only able to receive on three spectral channels. The experts in Offenbach claim they will have 20 times more data at their disposal compared with the amount received from Meteosat-7.

The increase in data allows not only more precise images and more exact forecasts of, for example, severe storms; completely new information is also accessible through the analysis of additional frequency ranges. For the first time ever, a geostationary satellite is now able to measure ozone concentrations on a continuous basis. Up to now this was only possible with polar-orbiting satellites, but they are only able to supply data for a certain region every 12 hours. Another new feature of the MSG-1 is the investigation of stratospheric winds. These data are important for airline companies because the winds affect routes, flight times and kerosene consumption.

"The better our data, the better our customers will be able to make their decisions," says Gerhard Lux. And it seems likely that next year fans with a sweet tooth will not have to wait so long for their beloved chocolates with the cherry. The DWD concluded the following in a press release on the record-breaking summer of 2003: "Even if the worst fears concerning an anthropogenic warming of the climate should materialize, a summer of this high caliber will not occur in Germany again so soon." ◀

www.dwd.de
www.schott.com/optics_devices

Spherical lenses made with optical glass record the duration of sunshine on a paper strip.



German Weather Service



EUMETSAT

The new joint European satellite, MSG-1, will replace the Meteosat series in 2004. The MSG-1 will have a central optical element made from SCHOTT's "Zerodur" glass ceramic.

ESA

Precision with glass ceramics

Satellites would be less effective if they were unable to direct the already weak radiation they collect completely and with great precision to the respective detectors. This requires sophisticated optics. Mirrors that must keep their shape even under extreme temperatures are the heart of this optical system. "Zerodur", a glass ceramic produced by SCHOTT, serves as the substrate material for the reflecting metal coating. It has zero thermal expansion, and the material can be polished to an extremely smooth surface. "Zerodur" has been tried and tested in geostationary satellites for more than 25 years and was already used in the first Meteosat weather satellite at the end of the 1970s.