Meteorological Society, Sim Aberson and James Franklin of the National Oceanic and Atmospheric Administration's (NOAA's) Hurricane Research Division in Miami, Florida, describe the payoff: The 1997 dropwindsonde observations improved storm-track forecasts by 31% 24 hours ahead, by 32% at 36 hours, and by 12% at 48 hours, they report, compared to computer forecasts made without the observations. The tropics were relatively quiet in 1997, prompting just five missions by the Gulfstream-IV, so "you don't want to make too much of the numbers," says Franklin. Still, he says, "we're fairly confident '98 will be like '97."

Along with better data, forecasters have better tools for interpreting the information. Their primary aid is computer modeling that incorporates the latest observations to create a picture of the storm and its surroundings and calculates how the storm will move and develop. "There has been a quantum increase in the skill of the models," says Stephen Lord, a deputy director at the NWS's National Centers for Environmental Prediction in Camp Springs, Maryland.

The prime example has been the hurricane model developed by Yoshio Kurihara, Morris Bender, and Robert Tuleya of NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) in Princeton, New Jersey. The GFDL model works on two scales. Like standard global atmospheric models, it simulates the atmosphere in broad strokes to capture the river of air, thousands of kilometers across, that sets the hurricane's overall course. But it also zooms in on the hurricane's vortex, using the latest satellite and in situ data to model the storm and the way it interacts with its surroundings in fine detail.

In tests prior to becoming operational at the National Hurricane Center (NHC) in 1995, the GFDL model outperformed its predecessor, logging average track errors that were about 12%, 24%, and 28% better at 24, 48, and 72 hours, respectively. Since then, "it's been the best performer" of the half-dozen models that NHC forecasters consult before issuing an official forecast, according to James Gross of the NHC.

Even so, it can be hard to tell whether better data and models are actually improving the official forecasts, because the improved tools are new and forecasters have always had good seasons and bad, depending on the nature of the storms. But meteorologist Colin McAdie of the NHC thinks track forecasts are improving at an accelerating pace. His recent analysis shows that at all forecast times, the predictions improved twice as fast during 1992 to '96, the period when the GFDL model debuted, as they had during the previous 2 decades. The routine dropwindsonde observations that began in 1997 seem to have helped sustain that progress.

Such improvements should allow the NWS to target its hurricane warnings more precisely. When the weather service issues a hurricane warning, prompting an evacuation, it generally includes a stretch of coast three times longer than the section that eventually suffers high winds, just to be sure—which means that hundreds of kilometers are cleared but suffer little damage. With costs averaging half a million dollars per kilometer of evacuated coast, according to the NWS, not to mention a toll in public goodwill, that's an expensive insurance policy. If the improvements of the '90s can be continued, averting hurricane disasters should be cheaper and less disruptive.

–RICHARD A. KERR

BUDGET RESOLUTION

R&D Takes a Hit, But Don't Count It Out

Dividing along party lines, Congress narrowly approved a Republican budget resolution on 15 April that would hold the line on federal spending and, in the process, slash most civilian R&D budgets. The $1.7 trillion budget for fiscal year 2000, which begins 1 October, would channel surplus revenue into tax cuts and the Social Security program while requiring steep reductions in future "discretionary" domestic programs. Over the next 5 years, according to an estimate by the American Association for the Advancement of Science (AAAS, which publishes *Science*), the cuts would range from 6% for the National Institutes of Health (NIH) to 14% at the National Science Foundation (www.aaas.org/spp/dspp/rd/bdgres.htm). But the gloomy resolution comes with a silver lining: There is almost no chance that Congress will stick to its numbers.

Congressional leaders took great pride in getting the budget resolution approved early, only the second time in 12 years that they have met the deadline of 15 April. But legislators are already planning ways of getting around a measure that presents a politically unpalatable set of fiscal options. The first opportunity may arrive in a few weeks as Congress takes up an emergency bill to pay for current U.S. military operations in Kosovo. This "veto-proof" supplemental spending bill could become a vehicle for other budget-busting military ex-

ScienceScope

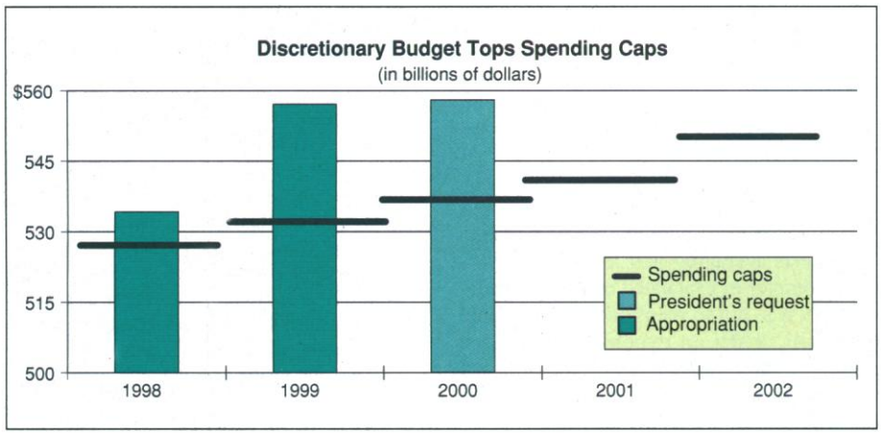
Diplomatic Overture The State Department wants to have some frank and fruitful exchanges with leading scientists. Under a proposal outlined by Under Secretary Frank Loy last week, members of the diplomatic corps would join with experts in a particular area—such as genetically modified crops—for roundtable discussions designed to increase the envoys' understanding of technical controversies.

The idea is one of five early responses to the findings of a National Academy of Sciences review panel, which last fall concluded that U.S. diplomats lack science savvy. Other potential improvements include appointing a special science ambassador to advise the secretary of state and beefing up science training for the agency's 25,000 employees, of whom 5% hold technical degrees. "We have heard the criticism," Loy said at a Washington conclave sponsored by AAAS, publisher of *Science*.

The plans—which Loy says are moving ahead—please panel leader Robert Frosch of Harvard University. "Sounds like a promising beginning," he says. His committee hopes to release its final communiqué on the issue this fall.

Deep Impact: The Sequel A year after astronomers had to humbly retract one warning of a possible catastrophic asteroid impact with Earth, another doomsday asteroid report has scientists up in arms. The flap began earlier this month, when Benny Peiser, who runs an electronic mailing list on neocatastrophism, found a Web preprint of a paper by Italian astronomer Andrea Milani. Milani concluded that there is a remote chance that asteroid 1999 AN_{10}, discovered last January, will slam into Earth in August 2039. In a press release, Peiser accused Milani's group of hiding the news, "instead of informing the interested public about their potentially explosive findings." The story made headlines around the world, although many reporters emphasized the one-in-a-billion odds of impact.

The attack on Milani and the ensuing coverage have outraged many astronomers. In posting the unpublicized preprint for other researchers to review, "Milani did the right thing," says David Morrison of NASA's Ames Research Center in Mountain View, California. But astronomers could use guidance on how to handle predictions and the press, he adds. He and others will try to hammer out guidelines for releasing potentially scary news at a meeting in Turin, Italy, in June. Says Morrison: "We're still in a learning process."



Over the top. Congress once again seems likely to exceed levels set in a 1997 law designed to curb so-called discretionary spending.

penditures as well as a means to negotiate increases in education, transportation, and other popular programs.

How did Congress get itself into such a fix? The problem goes back to a 1997 law that imposed "caps" on specific budget areas. Adopted during a time of deficits, the caps have become a headache now that the government anticipates annual budget surpluses. Last year, Congress and the Clinton Administration retained the caps but circumvented them by labeling many programs as "emergency" measures. That label exempted them from a requirement that any increase be offset by a cut of equal or greater size. As a result, federal outlays officially remained below the caps in 1999. In reality, however, Congress overshot its target by some $20 billion (see table). Analysts say that the same thing is likely to happen in 2000.

Among Republicans, the most outspoken critics of the budget gimmicks are members who draft the spending bills—the chairs of appropriations committees. Early this month, for example, Senator Ted Stevens (R–AK), chair of the Senate Appropriations Committee, said: "I don't think we can live under these caps." On 14 April, Representative John Porter (R–IL), chair of the House subcommittee that writes the appropriations bill for NIH, told the National Health Council, a biomedical interest group, that he wanted to duplicate last year's 15% increase for NIH. Porter said that both Democrats and Republicans want to change the rules to allow hefty increases but that neither wants to be the first to propose it. "In the end," Porter predicted, "the White House and Congress will sit down and quietly raise the caps."

Democrats were even more critical. Senator Jay Rockefeller (D–WV), a member of the Senate Commerce subcommittee for science, described the 15 April vote as a setback for research. "Now is not the time to turn our back" on science and technology, Rockefeller said at a Senate hearing on the Administration's R&D budget request for 2000. Representative George Brown (D–CA), ranking member on the House Science Committee, summed up the prevailing skepticism about the fate of the budget resolution in a press release issued last week. The bad news, Brown said, is that the budget resolution "treats R&D very poorly. ... The good news is that this budget is almost entirely irrelevant."

–ELIOT MARSHALL

ASTRONOMY

Black Holes Enter the Middleweights

Black holes have seemed to come in only two varieties: "supermassive" ones, which power brilliant galaxies called quasars and weigh millions to billions of times more than the sun, and "stellar mass" black holes, which have about the mass of one large star. But at the meeting of the High Energy Astrophysics Division of the American Astronomical Society in Charleston, South Carolina, last week, two groups reported the discovery of a new class of black holes right in the middle.

Astronomers believe that stellar mass black holes form when a massive star reaches the end of its life and collapses to a point of infinite density. Supermassive black holes are more mysterious. "No one really knows" where they come from, says astronomer Richard Griffiths of Carnegie Mellon University in Pittsburgh. One theory holds that they form in so-called starburst galaxies, which contain seething cauldrons of young, hot stars that flare up suddenly in the galaxy's core and burn out just as fast, leaving behind a pile of stellar debris, including stellar mass black holes. These may lump together and feed off the remains of other stars, growing into giant black holes.

To test this hypothesis, astronomers have searched nearby galaxies for the intermediate-size black holes that should form along the way. Black holes are invisible, of course, but the hot, gaseous accretion disks that encircle and feed them are not. The hot gas emits copious x-rays, and its spectrum also has an x-ray "tail," thought to result as ultraviolet photons from deep inside the disk collide with fast-moving electrons at the surface, gaining energy. The total disk luminosity fluctuates dramatically, but theorists think that the maximum luminosity is proportional to the mass of the central black hole. Earlier searches turned up several x-ray sources bright enough to be intermediate-mass black holes, but these sources did not seem to have the expected tail or the rapid variability.

Now, two groups have taken a closer look at several of these x-ray sources. Griffiths and his Carnegie Mellon colleague Andrew Ptak pointed the Japanese x-ray satellite ASCA at one source in the starburst galaxy M82. They found a fluctuating x-ray source whose luminosity and variability pattern matches that of a disk around a black hole weighing 460 times the mass of our sun. X-ray astronomers Ed Colbert and Richard Mushotzky of the Goddard Space Flight Center in Greenbelt, Maryland, examined 39 archived galaxy spectra compiled by the x-ray satellite ROSAT and found the telltale x-ray tail in six sources. The high luminosities of another 15 sources suggest that they are also black holes ranging from 100 to 10,000 times the mass of the sun, although they lack the complete spectral fingerprint of an accretion disk.

"The two studies complement each other nicely," says Griffiths. He adds that the studies, which are appearing in this month's *Astrophysical Journal* and *Astrophysical Journal Letters*, are "a major clue" that the objects are supermassive black holes in their infancy.

The observers "have done a very uncertain exercise very carefully," says astrophysicist Jean-Pierre Lasota of the Meudon Observatory in France. But not everyone agrees that these middle-sized black holes are newly formed from collapsed stars and are on their way to becoming even bigger. Astrophysicist Fred Lamb of the University of Illinois, Urbana-Champaign, for example, thinks it is more likely that both middleweight and supermassive black holes condensed out of primordial material in the early universe.

Sorting out these possibilities will take some time. "No one ever thought much about" middleweight black holes, Mushotzky points out, "because no one had ever seen one."

–MARK SINCELL

Mark Sincell is a free-lance science writer in Tucson, Arizona.

SOURCE: AAAS