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OP-ED CONTRIBUTOR

Earth, the Final Frontier

By Adam Frank

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Rochester — On April 1, 1960, the newly established National Aeronautics and Space Administration heaved a 270-pound box of electronics into Earth orbit. In those days, getting anything into space was a major achievement. But the real significance of that early satellite, Tiros-1, was not its survival, but its mission: Its sensors were not pointed outward toward deep space, but downward, at the Earth.

Tiros-1 was the first world's first weather satellite. After its launch, Americans would never again be caught without warning as storms approached.

This small piece of history says a lot about the call by Bob Walker, an adviser to President-elect Donald J. Trump who worked with his campaign on space policy, to defund NASA's earth science efforts, moving those functions to other agencies and letting it focus on deep-space research. "Earth-centric science is better placed at other agencies where it is their prime mission," he told The Guardian.

NASA critics have long wanted to shut the agency out of research related to climate change. The problem is, not only is earth science a long-running part of NASA's "prime mission," but it is uniquely positioned to do it. Without NASA, climate research worldwide would be hobbled.

NASA's role in earth science began at its inception: The Space Act of 1958, which created NASA, made the study of our atmosphere one of its top priorities. During the Reagan years, Congress amended the act to make Earth the first of NASA's nine fundamental missions. Right now there are at least 15 earth-science satellites that NASA helped build, launch and operate; they monitor everything from global rainfall to soil moisture.

These spacecraft foster billions of dollars of economic activity and affect millions of lives. Soil moisture measurements, for example, make their way back to farmers planning their crops. Ice-pattern measurements find their way to the shipping industry for navigation. Space-based measurements of environmental conditions make it to medical workers predicting the spread of mosquito-borne illnesses.

None of these missions were explicitly designed to study climate change. They were planned to study the Earth, which naturally includes the climate. But the data from these missions tell us that Earth's climate is changing.

Consider NASA's Gravity Recovery and Climate Experiment, or Grace, mission. It was designed to study Earth's gravity field, meaning the planet's distribution of mass. Grace could "see" changes in ocean currents, precipitation runoff on land and changes in groundwater storage. Grace showed us the spreading of drought conditions as water tables dropped. In this way the Grace data speak directly to a fundamental mistake of the agency's critics. Climate change is not *the direction* of NASA's earth-science enterprise; it's a *conclusion* of that effort.

The sheer scale of NASA's 60-year mission to study Earth is why conclusions about climate change caused by human activity are so firmly established. And it's that scale that makes proposals to move NASA's earth-science program somewhere else a recipe for taxpayer waste.

Critics make it seem like the program's $2 billion budget goes to a handful of climate-crazed computer modelers, and that moving earth science from NASA would just be an exercise in pushing desks around. But that money covers a lot: It goes to thousands of technicians building satellites for NASA and its contractors. It goes to people at Cape Canaveral who launch satellites atop of 100-foot pillars of high explosives. It goes to engineers operating those satellites as they wheel some 300 miles overhead.

NASA's storied success comes in part through its economies of scale. Engineers building instruments for a Mars mission will bring their expertise to developing sensors for an earth-science satellite. Thus the kind of experience NASA has built isn't fungible. Just as it would be folly to ask the Army to build and operate submarines, asking someone else to do NASA's job would be an invitation to organizational chaos.

Agencies like the National Oceanic and Atmospheric Administration and the United States Geological Survey also represent monumental accomplishments of American science. But neither has the reach or experience to take on what America asks of NASA. NOAA, an agency of the Department of Commerce, has a budget of just $6 billion, a fraction of which is spent on earth science. Asking it to absorb part or all of NASA's earth science effort would be like watching a snake try to swallow an elephant.

Proposals to get NASA "back to" some other kind of science not only ring false but their wasteful price tag would also fly in the face of fiscal conservative values. And worse, NASA's climate critics miss an essential point in their effort to politicize the science. The planet *is* changing, and that change will pose challenges and opportunities. NASA brings the capacity to know something about what tomorrow will

bring. We would be foolish to mess with that kind of competence.

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