Report of the
Environmental Technology Laboratory Millennium Panel

At the request of the NOAA Assistant Administrator for the Office of Oceanic and Atmospheric Research, Dr. David Evans, the ETL Millennium Panel met on May 23 and May 24, 2001 to examine the role and future of the lab with respect to scientific priorities in the context of the evolving needs of NOAA. The panel was composed of a distinguished group of science and technology experts representing a broad cross-section of the U.S. science and technology community.

The panel met separately with the retiring director, Dr. Steven Clifford, employee groups, and the senior management. We considered the history and recent trends in the Laboratory's research focus, its role within NOAA, external versus NOAA funding, the organizational structure of ETL, and desirable qualities that should be sought in the next ETL Director. The panel also discussed the ETL millennium committee report "NOAA's Environmental Technology Laboratory Looks to the Future", which was authored by 18 members of the ETL staff and chaired by Dr. Marty Ralph.

The panel's overall assessment is that there is a clear place for technology development within NOAA, and ETL with its existing expertise, is well positioned to fill that role. While the next director will have several challenges in the next 5-10 years, lab morale is high and there is a strong willingness to better align the lab's core business and the direction of its external partnerships with NOAA's interests.

Summary of Findings:

- ETL is playing a major role in the development of ground-based and airborne remote sensing systems within the U.S. and continues at the forefront of many sensing technologies
- ETL does a relatively good job of balancing technology development with research applications
- ETL is trying to reconcile its relatively small NOAA base with extensive external, non-NOAA funding
- There is a proliferation of small projects supporting individual and small groups of researchers
- ETL maintains a large and perhaps unsustainable number of instrument development projects
- Although there are some recent successes to build upon, relatively few projects have enjoyed a clear and efficient path from research to operational applications within NOAA
- ETL has no formal instrument pool that could be used by other researchers within NOAA or elsewhere because of its NOAA base/external funding mix

Current Status of ETL within the OAR Laboratory System

ETL employs about 130 people possessing a breath of talent with unique strengths in technology and science applications. ETL requires annual funding amounting to about $18M of which $3.3M is NOAA base funded and $3.3M is supported by other-NOAA funds. The laboratory has an energetic and highly talented staff covering science, modeling, and instrumentation expertise. ETL has particular unique scientific and engineering strengths in wave propagation and scattering theory and sensor development that allow it to lead, nationally and internationally, in several aspects of environmental remote sensing.

ETL, like many of the other NOAA OAR laboratories, is at a critical juncture where lack of creative leadership within OAR has propelled the laboratories towards an independent course where each is seeking to sustain staff and programs while base funds continue to remain static or decline. Despite a reasonably healthy research budget within OAR overall, each of the laboratories has a relatively small amount of NOAA base funds, which do not flow between the laboratories to grow strong programs or sunset weaker ones. Thus, sub-critical investments are the norm.

The focus of most of the laboratories, notably ETL, is on obtaining funds external to NOAA to support outside ongoing research rather than on the scientific leadership of NOAA programs. The absence of strong, effective leadership in the form of a Director of the Environmental Research Laboratories system may be one of the factors contributing to this problem. In any case, there is a lack of focus in the ETL science mission and confusion regarding their primary partners/customers. Whoever has money seems to get top priority, which does not always put NOAA first, nor does it conform with the role of a NOAA laboratory (i.e. a laboratory that performs unique and mission-critical research on time scales appropriate for developing and transferring technologies).

ETL espouses an end-to-end approach to remote sensing instrumentation: theory, development, and application. It has approximately 20 major remote sensing systems spanning both active and passive systems, and optical, electromagnetic and acoustic technologies. The large number of systems conflicts with the end-to-end approach in that ETL has insufficient staff to actively maintain end-to-end support on that many systems, and they do not share common data infrastructure or formats that would make data from the instruments more broadly useful.

ETL developed most of these systems under external contracts and each system seems to require an additional external contract for each subsequent deployment. As a consequence, the systems do not see the regular and diverse use, user feedback, and steady sequential improvements that systems on base funding might see. (There are notable exceptions, such as the wind profiler technology.) Contractors would prefer a federal laboratory make supporting measurements for existing systems, rather than sustain a long-term partnership to develop new technologies. As a result, there is little going toward long-term development of systems for the benefit of NOAA, and more going toward applications at ETL.
Outside of contract relationships, ETL seems to sustain relatively few formal partnerships with other NOAA units or with other instrumentation research and development

organizations. There have been some successes with programs such as NOAA-led, multi-laboratory Health of the Atmosphere program. Likewise, ETL has been the driver behind such integrated efforts as the Pacific Landfalling Jets Experiment benefitting NWS forecasts, and the fish lidar technology used by the National Marine Fisheries Service. ETL also has a significant number of local, national and international partners in the remote sensing community. However, despite these efforts, it appears that ETL is almost estranged from NOAA. The heavy demands to compete for non-NOAA funding then put ETL staff in competitive rather than collaborative modes and leave them little time for NOAA, or even intra-lab interactions. Few of the technology developments attributable to ETL have developed from research to operational systems within NOAA.

ETL seems to have particular strengths at present in passive and active microwave remote sensing, especially of ocean surface properties, and in lidar remote sensing. While the lab has had great success in weather radar and wind profiler programs, these have reached mature stages. One issue ETL must begin considering whether the number of core technologies on which it focuses should be limited, or whether the lab ought to maintain competencies to varying degrees in all relevant remote sensing technologies. Also, should systems development that combines mature instrument technologies to allow for more comprehensive measurements be the next step for some ETL work, and/or should some applications work be transferred out of the lab.

Overall, it seems that ETL currently has highly fragmented activities in too many directions for one relatively small group. Obviously, the necessary pursuit of external funds in the form of many small contracts has influenced this fragmentation. The ETL disconnect from many NOAA activities and initiatives seems especially striking given the talents at ETL and the obvious NOAA need for advanced environmental observing technologies and for broad technology strategic planning.

Future:

The base funds for ETL have been largely flat for the past fifteen years and it is clear that significant fiscal growth is unlikely within NOAA. ETL must be creative in developing a research agenda and staffing levels that are consistent with this reality. One option is to scale back the laboratory to operate nearly entirely on its base funding. This would ensure NOAA is the direct (and only) recipient of ETL work. A second option is to use the base funds as leverage for obtaining additional funding from NOAA and external sources with interests common to NOAA's mission. A third option is to maintain ETL at its current size and continue to apply the base funding to a few projects while the rest of the laboratory receives external funds for individual projects that may or may not be transitioned to other parts of NOAA.

The first approach would constitute major structural changes and is not necessarily desirable, given the laboratory's potential. While the third approach sustains individual research programs, it prevents larger integrated efforts from being developed. The second option, if carefully implemented, could be the key to enhancing ETL's position in NOAA.

The panel believes a sense of core business foci linked to NOAA must be developed at ETL with available base funds applied to these. Where possible, base funds should be leveraged to obtain external funding that advances these core areas for the benefit of NOAA. NOAA's return on investment for each project should be foremost in planning ETL's future research agenda.

A balance between scientific research and technology development must be maintained with emphasis on the unique niche developed by ETL in remote sensing. Fewer projects with greater focus on activities that could benefit future NOAA services are desirable. The research activities should showcase new remote sensing technologies and avoid channeling the laboratory's research branch into very narrow areas. Many of the research programs can be conducted within other NOAA laboratories with ETL as a technology partner. One example might be the development of a radar profiler for marine application that coincides with the National Weather Service's Technology Infusion Plan, and plans for the National Ocean Service's ocean forecast system, and has clear ties to other NOAA labs such as the Forecast Systems Laboratory and to the development of the Weather Research and Forecasting (WRF) model.

In the case of some of the mature instruments in ETL, the lab should begin focusing on how to integrate these into larger NOAA systems where appropriate. Weather radar and wind profiler technologies should be examined for possible integration with NOAA test bed concepts. Other ETL innovations could include combining instruments, such as the now mature cloud radar and lidars, into systems that yield more complete characterizations of the atmosphere. These are unique areas that, focused on NOAA's mission, would be appropriate paths for the lab's on-going efforts.

As stated above, external support is an inevitable reality of current and future funding scenarios. However, greater emphasis should be placed on those projects that will benefit both the NOAA mission and the external agent with greater emphasis on using base funds to cost-share co-beneficial research programs. This suggests creating partnerships with other agencies that go beyond a contractual relationship. The senior leadership team of ETL needs to encourage partnering that supports and benefits the strategic plan of the laboratory. The latter needs to be well-articulated with the aim of greater synergy within the laboratory.

There needs to be closer alignment with NWS, NOS, NMFS and NESDIS plans for future services to develop remote sensing systems that can meet emerging operational requirements. This requires greater focus on NOAA customer needs and a greater commitment to meeting these needs, both within ETL and by the NOAA services themselves. Some of the more mature NOAA-related applications work that has been successful could be considered for transition to other parts of OAR or NOAA. Developing mechanisms to transition such successes quickly and to sunset unwanted technologies is crucial.

The general growth in technology development in the private sector, in universities and the like suggests that there will be a greater role for ETL in assessing externally developed technologies on behalf of internal NOAA customers. One example is a recent opportunity for ETL to develop an NWS-compatible application of a network communications system

originally built by the private sector for a military environment. ETL has a major role to play in articulating this and other environmental observing systems of the future.

We note that other entities are changing their roles; for example, universities are increasingly keen to sustain long term funding to develop sensors and observing systems and to sustain the deployment of these systems operationally. Applied research and development is no longer the exclusive domain of government laboratories. It will be important to differentiate roles to ensure that the laboratory's mission is unique and not competitive with universities, which by nature of their resource pool are generally much cheaper than government institutions. Similarly greater differentiation must be made between NOAA laboratories, which should not be in competition with each other.

New Director

Following our discussion with the staff, we focused on the challenges facing the next director and posed the question: what type of leader does ETL need? There was general concurrence:

- The Director must be a leader of change, courageous, and able to sustain focus on the core business of the lab.
- An integrator and morale builder within ETL, and spokes-person for ETL to the wider community who has an ability to partner with other laboratories and entities within NOAA and with external agencies.
- Either a scientist with technology interests or a technologist with science communication skills could fill the leadership role.
- Familiarity with ETL and its resources (especially the people) is desirable
- Do not necessarily need someone who wishes to continue their own research agenda

A new ETL leader will need to establish strong connections and partnerships within and outside NOAA, instill a strong customer focus, and indulge in some tough but essential internal strategic planning and system decisions. At present, external technologies develop so fast that no technology R&D group can afford to wait for external funds before initiating improvements in existing systems and developments of new systems. The ETL leader must develop faster mechanisms for identifying, developing, and applying new technology in NOAA's research and operational settings.

ETL Millennium Panel Members: Dr. David Rogers (Chair), Dr. Paul Menzel, Dr. Albert Wheelon, Dr. Jack Hayes, Dr. Susan Avery, Dr. Randall Dole, Dr. F. Martin Ralph, Dr. Richard Lataitis, Dr. James Meagher, and Dr. David Carlson