MR. LUTHER REMARKS AT EO-1 TECHNOLOGY WORKSHOP

January 11, 2001

Good morning.   Let me add my welcome and thanks for your participation in this workshop. While we have been very busy deploying the Earth Observing System, we have also invested a great deal of effort in envisioning the future of Earth observation from space for the next decade and beyond. I'd like to provide you with a brief sketch of this future, and then describe how E0-1 and this workshop will help make it possible.

Science-driven advances in technology pave a crucial pathway on the Enterprise's roadmap toward a proactive Earth system prediction capability. The Enterprise seeks technology solutions to both lower the cost of meeting existing observing requirements and make possible measurements that have never before been taken from space. NASA is both a supplier of and customer for advanced technologies, provoking and leveraging three ongoing technology revolutions to shape the future of Earth observation.

*** Geospatial**: New sensor technologies are making new kinds of observations and data possible. Where passive remote sensing systems (e.g., Landsat) yield two-dimensional imagery, active remote sensing systems (radars and lidars) enable three-dimensional views of the Earth's surface and atmosphere. We can begin to see beyond active sensors to "photon-less" sensors that measure gravity and magnetic fields. These will allow us to "see" the internal structure of the Earth. With such tools we could study changes in the world's fresh water aquifers, make reliable predictions of volcanic eruptions, and even attempt 1 to 5 year prediction of earthquake activity at the neighborhood level. To go with new sensor types, the geospatial revolution also offers new vantage points. Sensors now flying in low Earth orbit can be migrated to geostationary orbit, or even to L1 and L2 a million miles away. These vantage points offer instantaneous, full-time continental or global views, in contrast to the narrow slices and infrequent revisit times available from low Earth orbit. Finally, the geospatial revolution will include networks of sensors, working in tandem to form intelligent, reconfigurable constellations that can respond to rapidly emerging events on Earth, or recover from failures on orbit. We will demonstrate this “sensorweb” concept in the EOS era by ‘formation flying’ several EOS satellites and processing the data as if the formation were a single “superinstrument”.

* **Computing**: The computing requirements for such a system will be enormous, growing from today’s terabytes (10^{12}) to tomorrow’s petabytes (10^{15}) of data per day. Industry will provide the advances in computing; NASA’s job will be to put these capabilities to use both on Earth and in space to enable data processing, data compression and information extraction. NASA will also need to do the software design that will allow these high performance computing machines to run the coupled Earth system models that make possible prediction of Earth’s weather, climate and natural hazards. We want to help drive weather forecasting, for example, to the theoretical limits of prediction (about 14 days), rather than be limited by the capacity of computers to handle the large volumes of data and numerous complex model calculations required.

* **Communications**: Advanced communications are also needed to enable broad access to knowledge. Our goal is to enable Earth system prediction that is broadly available in society. In our space-based observing context, it could mean on-board data fusion to allow transmission of tailored information products directly to a user's desktop at no more that the cost of today's international telephone call. As with computing, many of the tools will come from industry. NASA's role will focus on those aspects with particular utility to Earth science, such as knowledge generation via data mining, and knowledge presentation via new visualization techniques like immersive environments.

- The New Millennium Program Earth Observing-1 mission is one critical step toward this future. EO-1 provides both lower cost and wholly new capabilities for acquiring geospatial data.
  - The Advanced Land Imager is designed to provide improved quality Landsat-type data with one-fourth the mass, one-fifth the power, twice the data rate, and most importantly, one-fourth the cost of the current ETM+.
  - The Hyperion instrument is the first hyperspectral imager providing scientific quality land imaging data successfully flown in space. It is capable of resolving 220 spectral bands at 30m resolution. Detailed classification of land assets through the Hyperion will enable more accurate remote mineral exploration, better predictions of crop yield, and assessments, and better containment mapping.
  - The Atmospheric Corrector will demonstrate the ability to measure atmospheric absorption for accurate reflectance to improve data from any land imaging instrument.

    - One key to achieving our vision of a “sensorweb” over the Earth is the capability for formation flying several spacecraft together. Our first demonstration of this concept will be a land imaging constellation comprising Landsat 7, EO-1, Argentina’s SAC-C, and Terra. EO-1 will demonstrate enhanced formation flying software to enable the “virtual superplatforms” of the future.

- In addition to these advances for collecting geospatial data, EO-1 is demonstrating technologies for advanced computing and communications.
    - The Wideband Advanced Recorder Processor will capture and store high rate data from the three instruments. It will also perform some on-orbit compression and processing of land image scenes.
    - The X-band Phased Array Antenna demonstrates the capability for electronic pointing rather than mechanical pointing. It will provide a low cost, low mass, highly reliable means of transmitting hundreds of megabits per second to low cost ground terminals.

- Our goal at NASA is get these technologies out into the industrial community so that you can in turn supply NASA and other customers with spacecraft, instruments and science data that meet our research needs. We do this in three ways.
    - The first is to partner with industry in the development of these technologies; that is what the New Millennium Program is all about.
    - The second is to offer participation with the science team that analyzes and validates the data that NMP instruments return. You will be hearing about each of the EO-1 instruments today, and can query the science teams about their validation plans.

  - The third is to offer opportunities to industry to task and exercise the capability of New Millennium missions once their primary demonstration requirements have been fulfilled. In the case of EO-1, this means it would be possible for outside interests from U.S. industry and academia to select EO-1 imagery for its own purposes – to evaluate instrument capabilities, to experiment with new algorithms, or whatever your interests might be. You will be hearing about that both today and in the technology workshop planned for the Summer.

- We want to explore innovative partnerships for development, transfer, and utilization of NASA technologies.
  - There is no "one size fits all" approach. Thus, we are willing to work with the private sector to identify and structure mutually beneficial partnerships in these three areas.
  - We wish to maintain and strengthen this dialog, as we are now making plans for expanding our knowledge of Earth Science throughout this decade and beyond.

Our message is this: We are putting these exciting new technologies from EO-1 "on the table" for American industry and academia. I invite you to join us in squeezing the highest return possible out of this unique technology demonstration mission. This workshop should tell you how.