Earth Science Subcommittee Teleconference
Minutes

April 11, 2013

AGENDA

1:15 - 1:30 pm Introductory Comments
1:30 - 2:00 pm Science Plan /Dan Woods
2:00 - 2:30 pm Discussion on Performance Goals/All
2:30 - 3:00 pm Data Center Study Brief /Larry Smarr
3:00 - 3:30 pm Discussion /All

Introduction

Earth Science Subcommittee (ESS) Executive Secretary Dr. Lucia Tsaoussi opened the meeting, noting that ESS would hear a brief update on the budget for FY14. ESS Chair, Dr. Byron Tapley, focused on two major activities from the agenda, which were to provide initial inputs to the Science Mission Directorate's Science Plan, which would require some discussion of terminology, such as a definition of "performance goals." More pressingly, he wished to address information technology (IT) recommendations with respect to NASA data centers, as ESS is being asked for a position to report to the NASA Advisory Council's Science Committee (NAC SC; meeting 18-19 April). The intent for the subcommittee is to draft a summary of its position, for presentation to the SC.

FY14 Budget

Earth Science Division (ESD) Director Dr. Michael Freilich addressed the recent rollout of the President's FY14 budget, reporting that fundamentally, the ESD budget is up by several tens of millions for 2014, while basically flat and declining slightly over the 5-year budget request. It is consistent with the previous several years of the Obama administration's budgets. Dollar stability continues, but pressures ESD will be facing is that along with the extra money, the division has also inherited some scope from Agency decisions and other divisions; the primary addition of scope, shared with the U.S. Geological Survey (USGS), is the inheritance of a sustained land-imaging system LandSat follow-on). NASA will be responsible for the spaceborne component of the LandSat Data Continuity Mission *(LDCM). ESD has received $30M for studies in FY14, and $450M for FY14-18. NASA will define the mission in collaboration with USGS; it does not have to be a LandSat 9. Other scope additions: the National Oceanic and Atmospheric Administration (NOAA) has given NASA the opportunity to fund sustained solar irradiance in the Joint Polar Satellite System (JPSS)-2 timeframe and beyond. To that end, ESD has received a one-time $40M increase in 2014. NOAA will no longer carry out those long-term climate measurements. ESD will also have a one-year expanded Venture-class program, and has inherited as well the completion of the integration of Earth-observing instruments on DSCVR, plus a rudimentary ground system. Overall, the division will be doing more work with a negligibly larger amount of money. Implications for the near-term are modest; ESD remains ready to launch in 2014: GPM in February, OCO-2 in July, SMAP in October, and SAGE III in 2014 (SAGE is experiencing some hexapod workmanship issues at present).

There are 7 missions planned for 2015-20, among them PACE and SWAT, TEMPO, IceSat-2, and the GRACE follow-on. ESD is keeping the balance between flight and research at a ratio of 62 to 38 percent. Dr. Tapley commented that this sounded like a good news scenario, with real continuity for LandSat. An ESS member asked if there would be any prospect of inheriting weather satellite responsibilities from NOAA. Dr. Freilich responded that that would be a political decision made in Congress- the President's budget does not do this. He added that the increased scope does stretch the ESD program thin; if the scope increases, some things will not get done. Asked whether he might characterize the LandSat decision as an administration decision, Dr. Freilich responded that LDCM is a high priority for the White House. He reported having had good discussions with NOAA, and believed a realistic program would not significantly impact ESD. Dr. Tapley commented that it is fair to say that there is a committed land imaging effort under way in the community, and wondered whether there was a set of measurements that could satisfy both NASA and community needs. Dr. Freilich stated that ESD would provide the maximum amount of synergy possible, as it has both ends of the program, as it has under its purview both research instruments and preserving the 41-year time series. This however also needs to be balanced with the entire ESD portfolio. Asked if this meant delays and cutbacks in future, Dr. Freilich answered: possibly. As an example, in land imaging, there will be decisions based on risk tolerance versus technology infusion. The near-term ESD missions will not be affected. He remained optimistic that there would not be significant impact on the 7 missions through 2020. Dr. Konrad Steffen noted that he was glad that solar irradiance is NASA's responsibility and asked if there were any way to optimize sensors. Dr. Freilich responded that ESD will look at the needs and desires of the NASA climate program as well as the capabilities of the mission agencies, and figure out what can be done within the budget. Dr. Tapley suggested ESS take a more in-depth look at the budget during a future teleconferences.

SMD Science Plan

Dr. Dan Woods presented aspects of the SMD Science Plan, where it now stands and how it will fit into the NASA Strategic Plan, which is targeted for completion in February 2014. The purpose of the presentation was to obtain feedback and input from ESS. Dr. Smarr explained that a Working Group is looking at the 2010 Plan as a template, and is retaining the outline for the 2014 Plan. Principles, strategies and challenges will require some tweaking here and there. New sections dealing with "strategic decisions for future missions informed by national needs" and "accomplishing breakthrough science and applications" are being added to the Science Plan. Referring to Chart 7 of the presentation, Dr. Woods indicated sections 1 through 3; covering science elements. The Agency has asked that related elements be added in this section that include strategic goals in space, expansion of opportunities in space, improvement of life on Earth, and "how to be a better Agency." Dr. Steffen felt that "breakthrough science and applications" was a bit unrealistic in tone. Referring to chart 8 on Agency strategic goals; Dr. Woods wanted ESS to be aware that from these goals, he and his team had been asked to come up with SMD strategic objectives that line up with Agency strategic goals. While updating what was used in the 2010 plan, the revision team has submitted an updated strategic goals statement and believes that thus far, the various levels of Agency reviewers are pleased with how things are proceeding.

An ESS member asked how might these SMD strategic goals be tested. For instance, how do we "improve life on Earth?" Dr. Daniel Jacob commented that ESD has at the very least, performance metrics to answer questions surrounding some focused science goals. Dr. Tapley asked if at the highest level, there had been a conscious decision to leave out the shorter-term events that impact Earth? Dr. Freilich noted that there is a feature that treats episodic events. Improving life on Earth is not something NASA can do itself, however, and this is not so clear; it will involve other agencies. The emphasis would

be on delivering a societal benefit. At the Agency strategic level, improving life on Earth is really talking about the space goal. At the Agency level, this will align with the Earth and Space Science part. Dr. Tsaoussi suggested that improving life on the planet is meant to capture the impact of the scientific advances. Dr. Freilich felt there was a clear justification (societal benefit statement) for applied sciences and all the work NASA does in measurements. ESD does itself a disservice to parse the statement to any finer degree. Dr. Martha Maiden commented the Decadal Survey gave NASA some room for applied sciences. Dr. Freilich agreed.

Dr. Wood concluded a discussion of the Science Plan schedule over the next year; the plan will be vetted by all the subcommittees as well as the Science Committee. A first draft is scheduled by 1 July, and will be submitted to the Office of Management and Budget (OMB), the Office of Science and Technology Policy (OSTP), etc., so that all the groups can comment by the end of July. The draft will then be reviewed by the National Research Council (NRC) from August through December, and will be released by mid-February 2014 to coincide with the new budget and the release of the new NASA Strategic Plan.

ESS considered the wording of the ESD strategic objectives and science goals, including 6 focus areas plus an applied science goal. "Advance the understanding of Earth radiation balance, ozone layer, and air quality associated with changes in composition" was deemed a bit wordy. Dr. Tapley cautioned against the unqualified use of "predict," especially as there are centennial/daily/weekly/yearly time scales to consider. Other concerns ~~raised~~ were raised about limiting the utility of NASA measurements if they are confined to the "prediction" of weather. Dr. Annika Michalak suggested that there might be a simpler way to say "advance the understanding" and leave prediction for the weather, by using a single heading that discusses understanding and prediction and response. Dr. Marshall recommended focusing on the weather bullet, to characterize prediction within a broader context of understanding and diagnostics to "NASAfy" it. An ESS member noted that the Earth Science goals are encumbered by issues beyond just "advancing the science." The phrase "accurately predict" was also raised as troublesome. Dr. Tapley noted that bullet 4 raises the question with regard to the water cycle; the immediate action is how to manage resources; the bullet loses this meaning as currently written. Dr. Woods requested written input from ESS before the 18-19 April SC meeting. All modifications were to be sent to Dr. Tsaoussi.

Findings and recommendations

Dr. Tapley addressed the state of NASA's current data sets, stressing that the operability status of the current set, assimilation into data sets, effective archiving and distributing; and commenting that given the fact that NASA is serving a large and diverse population of inhomogeneous users, is doing a good job. A past concern raised by ESS was with respect to the complexity of the system: e.g., questions framed, cost and affordability, control of system, and algorithmic development (how is this done). Going forward, ESS is concerned with how to make the system more universal, protect the integrity of measurements, and to evolve without affecting the current functionality. There are elements of the system that look like a cloud, as the nature of the system is distributive; the bandwidth could be improved, however. Who controls the algorithmic structure; how is this done?

IT Cyberstructure Briefing

Dr. Larry Smarr, Chair of the Information Technology Infrastructure Committee (ITIC), presented a briefing on the status of NASA's cyberinfrastructure. He reported having visited most of the NASA data centers, as well as those of other federal agencies, and reported being very impressed with EOS data systems in general; NASA has been a leader in this area. As the ITIC has looked around, however, it has

seen that NASA has trouble keeping up with advances in technology, given that science missions need the best support to be able to do their jobs. It had been recommended to the NAC last year to conduct a joint Science/IT review of data systems for SMD missions, to determine what is best of breed. ITIC has had good cooperation with the SC. Generally, ITIC has found that NASA does data repositories in an ad hoc way; an increasing number of new publications have begun to mine the data archives. There is also public interest in getting NASA images, with many NASA applications and crowdsourcing capability. As NASA data gets more popular and as the data files themselves get bigger, this will put a strain on the system. The Department of Energy (DOE) is very interested in working with NASA in using the DOE network backbone. There are supercomputer architectures for data analysis at universities (1-2TB per RAM), offering the opportunity to do more analysis of large sets of data than in the past. The PLEIADES system is one example, though not optimally designed for large data analysis. JAGUAR at Oak Ridge, and Blue Water are multi-core systems that are also useful. NASA is perceived in the community as not being "big data." ITIC is therefore trying to raise the issue, to try to get NASA to see SMD (not the OCIO) as the driver for the needs of NASA's cyberinfrastructure. Dr. Bernard Minster commented that he remembered the NASA data system being described as the best achieved. The data within the DACs has some limitations, one of which is giant files, and the other a very large number of files. But it seems that the DIS system is doing very well. Dr. Smarr remarked that the problem is that the "best of breed" at NASA is not visible, but nobody at the level of the NAC knows this. The danger is that the higher-level decision makers could cut NASA's already excellent data systems for lack of visibility. Dr. Minster agreed that NASA must do a better job in advertising what exists and how well it functions. Dr. Smarr felt it would be possible to strengthen the network between the repositories, and make sure there is appropriate end-to-end (E2E) bandwidth from the repositories to the users.

Dr. Tapley felt it would be useful to bring together these massive processing centers with the archiving/distribution side; individual processing units seem to be doing well, but NASA could improve the communication between them. He ~~suggested~~ expressed concern about questions on further evolution to cloud-computing. Dr. Smarr expressed skepticism as to this evolution; NASA has never had a true cloud and probably could not afford one. ESS data is not particularly suitable for cloud-computing, although he did believe that some sort of cloud infrastructure for tertiary storage/distribution would be useful. He recommended approaching this subject via some small pilot studies. It is most difficult to get control over the E2E network connectivity. So far, NASA does not think in this way. In typical shared networks, one only allows for incremental change of the status quo. One needs to move at the speed of thought instead of the speed of the Internet. Dr. Smarr reported having heard through ESS that the bandwidth is not ideal, but did not know how to bubble up user issues versus what officially gets reported to the NAC.

Dr. Bill Large commented that ESD seems to produce more data than it can store and archive, and asked Dr. Smarr how fast are things changing in this area. Dr. Smarr replied that this depends; storage seems to be moving faster over the last decade. A device like the ARISTA switch, however, is a game-changer; this switch can route and switch an enormous number of lines. Most of the wavelengths on the fiber are not used most of the time; under software control, an extra "HOV lane" opens up for a user, and then goes back to sleep. The backbone of the Internet on a typical campus is one 10-GB system. The cost of switching at this scale is just a couple of 100 dollars. All the capital investment is digging up the ground and laying fiber. What is more annoying is the move to multi-core systems; the Moore's law advances of the last decade are over. Software problem is not a lot better if you are not getting a lot more speed. For most, multicore plus GPU, represents a serious challenge from a software point of view. Dr. Smarr

recommended providing the SA with specific problems (e.g., it takes forever to download a GB image from Goddard).

Dr. Tapley asked for suggestions on how can data be managed better. Dr. Smarr felt this was more of an appearance issue. “Big data” is a dumb phrase but it has taken off. Congress thinks NASA doesn’t have these needs, and this is exactly why NASA needs to make the issue more visible; the Agency needs to illustrate how this slows down science. There is no uniform architecture/uniform access. Dr. David Siegel raised the issue of the directionality of data, especially for collaborative principal investigators. Dr. Smarr commented that NASA ought to have a mechanism whereby a user can make a request based on his/her needs for science, to get to a gateway to where the end-users are.

Dr. Tapley suggested that the ESS recommendation discuss the impact on SMD, and that ESS should further assess how ESD delivers data, compared to what is being done on the outside, to feed into an Agency-wide assessment of the cyberinfrastructure. Dr. Smarr suggested that NASA carry out a short, lightweight study, based on input from all 4 NAC subcommittees. The issue should be user-driven, not technology driven. Once the recommendation goes to the NAC, the Administrator has to respond. Dr. Smarr felt that the Administrator recognized the problem, but does not have a lot of money. ESS should tailor the recommendation to make a difference. Dr. Minster noted that it should be very clear that PIs will have a tendency to scale back goals to match what is easy to access; how do we get people to start thinking bigger? Dr. Smarr pointed out that the NSF supercomputing project is an example of how to do this. NASA could take advantage of the DOE 100GB backbone through a joint NASA/DOE call to do big experiments on the backbone. Dr. Tapley noted that there is an implied cost to doing this. Dr. Smarr remarked that someone has to do it first, and inexpensively, to see if it will work. Remember that a 100-Mb Ethernet was once a big deal. There will have to be a formal effort to get NASA to focus on this. Include concrete examples in the recommendation.

The subcommittee discussed possible recommendations. Dr. Minster suggested considering ways to take steps toward Dr. Smarr’s thinking, such as how to trigger proposals to notch up toward fast processing/modeling. Dr. Tapley suggested one-stop shopping at data archive, citing previous issues with connectivity in the GRACE mission as areas for specific improvement. A recommendation for any action should contain a statement to not fix what is not broken; any changes should be evolutionary and should not impact the present NASA/data-user relationship. Dr. Martha Maiden offered various tools, such as user surveys, feedback boxes, or a working group. NASA already has a pretty intimate relationship with users. She further offered to provide a chart of data centers and wide-area networks. Dr. Minster suggested creating a map of connectivity between various nodes. With respect to moving to next generation techniques, NASA will have to fund scientists to do this. Dr. Siegel recommended asking what kind of science can be done with specific cyberinfrastructure improvements? What is possibly transformative? An allosphere for Earth? The fractal nature of world? PDF visualization? How much does it cost to make a data set, and how much does it cost to take it out? What increased understanding would we get from our investment?

ESS members crafted a fundamental finding that would be refined off-line: Don’t do damage to the current system (while addressing a self-assessment on NASA information process and distribution/archiving with an eye to future improvements). The bandwidth of the home institution to the NASA archive, and communication within NASA centers and DACs should be examined, as well as

examples of problems. Dr. Tsaoussi noted that NASA could choose to do this through the National Academies or by appointing a panel.

Drs. Steffen, Minster, and Tapley agreed to work together to assimilate a finding, as well as to develop a statement on inputs to the Science Plan. Dr. Maiden took an action to to send out a connectivity map.

The meeting was adjourned at 4:10P.

Teleconference participants

Stephen	Clark	Space Flight Now
Dominick	Conte	Independent
Prasad	Gogineni	University of KS
Daniel	Jacob	Harvard University
Bethany	Johns	Suborbital Coalition
Taylor	Jordan	US House of Representatives
Jack	Kaye	NASA
Jennifer	Kearns	NASA
William	Large	NCAR
Greg	Lee	Northrop Grumman
Larry	Liou	Glenn Research Center
Martha	Maiden	NASA
Amy	Marshall	NASA
John	McCarthy	Orbital Sciences
Alfred	McEwen	University of AZ
Anna	Michalak	Carnegie Institution for Science
Bernard	Minster	UCSD
Mahta	Moghaddam	USC
Doreen	Neil	LaRC
Travis	Reed	Caltech
Steven	Running	University of MT
Marshall	Shepherd	University of GA
David	Siegel	UC Santa Barbara
Larry	Smarr	UCSD
Marcia	Smith	spacepolicyonline.com
Konrad	Steffen	Space Federal Research Institute
Byron	Tapley	University of TX
Amy	Walton	ESTO
Joan	Zimmermann	Independent Contractor