

**National Aeronautics and Space Administration**

**Science Mission Directorate**

**Earth Science Division**

**Applied Sciences Advisory Committee**

(Teleconference)

**March 30, 2015**

**NASA Headquarters**

**Washington, D.C.**

## **MEETING MINUTES**

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*Peter Meister*  
Executive Secretary

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*Kass Green*  
Chair

Submitted:  
Mark Bernstein  
ZantechIT Services  
April 6, 2015

**Applied Sciences Advisory Committee**

**NASA Headquarters**

**Washington, DC**

**March 30, 2015**

**Meeting Minutes**

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### Session 1: Overview and Meeting Objectives

Mr. Lawrence Friedl, Director, NASA Applied Sciences Program (ASP), opened the Applied Sciences Advisory Committee (ASAC) meeting; Mr. Peter Meister asked teleconference participants to announce their presence, and thanked all for attending. Mr. Friedl asked Ms. Kass Green, ASAC chair, if she had any opening remarks. Ms. Green welcomed all present.

Mr. Friedl presented a meeting overview. He said he would move quickly through the budgetary information. As a reminder, he stated that ASAC was looking to provide advice about application topics across the entire Earth Science Division (ESD). Objectives of today's teleconference, he said, included discussion of the President's budget request; items that might affect the data continuity study, and items that might affect the Decadal Survey. Further, he would seek comments on the letter that had been drafted by Ms. Kass Green.

He noted that Session 2 (ESD and Applied Sciences) and Session 3 (Decadal Survey and Measurement Continuity) were the most substantive. Session 4 was reserved for public comments; anyone wishing to speak should email *peter.g.meister@nasa.gov*. Session 5 would be a meeting synthesis.

Reviewing, Mr. Friedl presented slides giving the six main topics from the December 14, 2014 ASAC meeting and the seven primary recommendations cited in the January 2014 meeting and subsequent spring telecon. He noted that Dr. Susan Moran had raised the topic of science teams. He and Ms. Green agreed this was a rich topic, but he doubted the time available today would permit a substantive discussion. Perhaps it could be identified as a future topic.

### Session 2: ESD and Applied Sciences Program

This session, Mr. Friedl said, would cover the President's FY16 budget request; Earth science; sustainable land imaging; 2015 applied sciences senior review; and applied sciences. He presented slides showing, first, the full NASA science budget request, which totaled about \$5.5 billion for the Science Mission Directorate (SMD); and the ESD budget request, with a breakdown for the six relevant project lines. He next showed the differences between the FY16 request and the actual FY15 appropriation. Mr. Friedl commented that since 2012 ESD had operated in a fairly stable budget environment. The FY16 request is a step above FY15. He noted the differences between the administration's requests and the final appropriations.

Mr. Friedl reported that the President's FY16 request called for an increase of \$130 million. Under this request, he noted, NASA was given responsibility for all Earth science space measurements, with the exception of weather-related measurement, which remained with the National Oceanographic and Atmospheric Administration (NOAA). This additional responsibility had in part led to the increased request. The budget request would allow NASA to continue with all scheduled launches, continue the Venture Class missions, and the bring back OCO-3. Further, an increase of from \$8 million to \$35 million was proposed for non-flight

research, partly to restore the previous year's reduction. Office of Management and Budget (OMB) had supplied some explicit language on what the increases were to cover. Dr. Molly McCauley asked how the case was made internally for the applied sciences budget; could ASAC provide assistance. Mr. Friedl welcomed the question, suggesting the group return to it later in the telecon.

Relative to applied sciences, Mr. Friedl noted a "very nice" \$8 million to \$10 million increase not tied either to any specific OMB or administration instructions as to its use. Should it in fact be appropriated, some funds would likely be directed at the challenges of food security, water availability, and disaster response. Further, acceptance rates on research solicitations might be raised, both for capacity building and applications. Congressional budgeting required continued attention. Two budgets were planned: one, if the additional amounts were appropriated; the other, if they were not.

Mr. Friedl then presented a slide detailing "what's new" in the applied sciences budget. He reported that OMB, having become somewhat frustrated with the bickering between various agencies, had taken the "parent" role and had defined the respective roles of NASA and NOAA, with the latter being responsible for weather and space weather measurements and NASA being responsible for all other non-defense Earth science satellites. He noted the addition of a new mission – Pre-ACE (PACE), whose basic focus would be ocean color. Mr. Friedl presented a slide showing continuing operations, a slide the division director used to remind Congressional staffers of what was in progress. He spoke next to long-term measurements. One related to ocean height. He reported that NOAA now had responsibility in this area, but following Jason-3, that responsibility would revert back to NASA. Some question existed, he added, as to whether NASA was to do experimental missions or sustained missions; the FY16 budget supported NASA's doing both, with the exception of the weather work that would be done by NOAA. Mr. Friedl reported that a new framework had been created that will allow government and non-government agencies to provide input to NASA on their own needs and priorities. Currently, he said, OMB and the Office of Science and Technology Policy (OSTP) were defining the pertinent principles. NASA will need to clarify how it uses this information in developing its own programs. He said the U.S. Group on Earth Observations (USGEO) would manage the input from other agencies to NASA; NASA will develop its own process for response. He believed that, relatively to continuity, there may be a potential role in this area for ASAC.

Mr. Friedl then presented "Earth Science Missions through 2022." He noted that Tropical Rainfall Measuring Mission (TRMM) was in its final days, with re-entry expected in June. Partners were being informed that this source of data would cease and have been advised how to transit to other sources. He noted that Landsat 9 was in a 2023 launch time frame. Landsat 10 would enter into technology development with the FY16 budget. He noted that the President's budget submission through 2025 looked at having a Free Flyer to provide mitigation against an early loss of Landsat data. Ms. Green asked what thinking lay behind the decision to undertake a thermal Free Flyer rather than expedite Landsat 9. Dr. Woody Turner said the "big driver" was

the need to “bridge the gap.” The community’s strongest concern was with continuity of thermal measurements; the Free Flyer was the best way of assuring this. Ms. Green noted that the thermal community was not happy with this decision; they would have preferred Landsat 9 being moved up. Mr. Friedl asked Mr. Meister to take an action to get back to ASAC with information on the rationale for the Free Flyer. Dr. Macauley asked whether Mr. Friedl yet knew what role he and others would play in instrument selection and spacecraft. Mr. Friedl responded that applications people had been quite involved in this to date; for example, Dr. Woody Turner and Dr. Bradley Doorn had been working with the flight program in defining NASA’s position and working with the United States Geological Survey (USGS) on sustainable imaging. He believed there was recognition that applications be recognized when it came to Landsat. Some matters would be worked out, he added, as attention shifted to consideration of future Landsat needs and capabilities. Mr. Friedl added that no specific process had as yet been worked out, but he did not necessarily expect there to be a process that would be a repeated one. Dr. Macauley commented that it was still early in the process. Mr. Friedl informed the group that earlier this month NASA headquarters had issued the project authorization letter for Landsat 9.

Moving to the Senior Review, Mr. Friedl noted that this determined whether programs that had reached their intended lifespan still offered scientific value and/or were in the national interest and, additionally, were technically and financially viable. Ten projects were scheduled for review. The key reviewer, Mr. Friedl added, was the National Interests Panel, which would draw upon 16 different organizations. Six had been added since the previous Senior Review to bring in new perspectives. The participation of U.S. Geospatial Intelligence Foundation permitted perspectives from the intelligence community without engaging it in attribution.

Mr. Friedl then presented the “ESD (Earth Science Division)/Applied Sciences Program Budget,” noting that numbers may change. Dr. Macauley asked whether the breakdown into four categories at the bottom of the chart was new. Mr. Friedl said that while the “top line” figure came from OMB, the four budget lines had been created within the Division so people could see where applied sciences funds were expended. ESD Director Dr. Michael Freilich had sought this information. Dr. Macauley said this was good, unless it tied one’s hands if one wanted to reallocate money. Mr. Friedl responded that money could be moved between the four categories. Dr. Macauley observed that as she had gained administrative responsibilities she realized that ambiguity could be “your best budget friend.”

Mr. Friedl said a new ASP website was being launched. Testing remained and additional material would be added. Ms. Green asked when it would be appropriate to provide feedback. Mr. Friedl said feedback would be welcomed before the website went live, but not yet. He asked Mr. Meister to take an action note on this. Mr. Friedl noted that the December and January meetings included discussion on improving communications activities. Some suggestions were document style; others were “more edgy” – for example, how Earth habitation data could be used to identify appropriate habitats for specific species. Additionally, work proceeded with the Earth Observatory website, which wished to increase attention paid to the applications side. Earth

Observatory, Mr. Friedl said, had “a great team of science writers and visualizers” and had 6.5 million “likes” on Facebook. Increased applications on this website, he said, may help draw people to the applied sciences website. A draft statement of work for the communications manager would be issued before the end of April. Ms. Green welcomed this information, saying it justified rewriting the portion of the draft letter on communications.

Mr. Friedl described Earth Science engagement with global challenges: food security; water availability, and disaster response. Here, he said, Phase II – related to collecting and assessing information, and analyzing and prioritizing candidates – was complete. Phase III – high level meetings to discuss opportunities with partners – would begin soon. The first set of partners included Conservation International, Mercy Corps, Durick Insurance, Microsoft and Google. A second set might follow.

Mr. Friedl stated that work would begin soon on the applications handbook. He expected a working group to be formed in April. He wished to assure ASAC that the advice in its draft letter would be considered.

Mr. Friedl then invited questions. Dr. Philip Ardanuy called attention to the rearrangement of responsibilities between NASA and NOAA. If one took the case of ocean measurements, then the Imager, which had a number of ocean color bands, would now fall outside of NOAA’s responsibility. If one looked into the future, what would be the process whereby systems engineering and application requirements for ocean observing would flow down so as to satisfy that needs of the EPA and others? Mr. Friedl termed this a great question, adding that the matter had come up in conversation with USGEO. One principle all had agreed upon was that there was “no wrong door” for data to enter. Part of the process for either NASA or USGEO was to forward what was required to the appropriate agency. He noted that Dr. Ardanuy was correct that some instruments on the “weather satellites” had roles in research. It remained to be established, he added, how information would flow to NOAA. Mr. Friedl said the guidelines and principles were intended to address how NASA was to receive input about which measurements that governmental or non-government bodies wish to see continued. This, he added, will influence the Senior Review. He offered the example of Soil Moisture Active Passive satellite (SMAP), which provided various agencies with their principal soil moisture data. These guidelines would allow agencies to weigh in on why they wished this measurement continued.

### Session 3: Decadal Survey & Measurement Continuity

Dr. Lawrence Friedl addressed the Decadal Survey, focusing on what the Division and ASAC had been doing. The Statement of Task was nearly complete. The NRC needed that statement before it could negotiate a contract. It would likely be summer 2017 before a report was complete. He noted in the ESD Director’s response to the ASAC’s May 2014 report the ASAC was encouraged to engage with the Decadal Survey and to work with their respective communities. Mr. Friedl said he wished to address what the program had been doing; what

ASAC had been doing, and what might need to be done. He asked Ms. Kass Green for comments. She said *Photogrammetric Engineering & Remote Sensing (PE&RS)* would be publishing an article stressing the importance of involving applications people; she sought help with the text. Dr. Molly Macauley reported that she and others, when submitting nominations, had emphasized the need to involve in the Decadal Survey people who understood applications. She thought mainstream Earth scientists had developed a greater appreciation of the importance of applications. Previously, applications people had been viewed as sitting at “the children’s table.” Applications were now at the main table. Ms. Green suggested that ASAC members collaborate on an editorial, perhaps for *Space News*, focusing on why applications should be a primary focus of the Decadal Survey. Dr. Philip Ardanuy, Dr. William Hooke, and Dr. William Gail expressed interest. Dr. Macauley asked if this editorial should be a formal ASACs undertaking. The consensus was that it should not, but that contributors’ affiliations should be provided. Dr. Susan Moran reported that she and others had written an editorial published in the *Journal of Hydrometeorology* that raised points pertinent to the Decadal Survey. She would circulate a .jpg once it was in hand. Ms. Green said she would draft an editorial on the importance of involving both applications and research people. Mr. Friedl asked Mr. Meister to note that as an action item. Mr. Friedl asked Dr. Hooke and Dr. Macauley whether they believed that identifying the challenges, the associated research, and the potential societal benefits of meeting those challenges needed reinforcement within the community as a lead-in to the decadal survey. Dr. Hooke said he did. He thought the first Decadal Survey had assumed people would identify the applications needs; this had not occurred. He believed continuing education of the community was very helpful. Dr. Macauley said a written piece was needed to stress that applications work was research; applications research could be very quantitative. The failure to appreciate the scientific rigor of applications work undermined the value of all ESD efforts. Perhaps, she suggested, some language from Ms. Green’s letter could be used. Dr. Hooke agreed. People who were unaware of the new aspects of applications work needed to have them drawn to their attention. Dr. Moran said the focus of the *Applied Science Research* editorial was that applications work was research; it needed to produce publishable results, and this tied into the decadal survey. Mr. Friedl suggested that, once individuals had Ms. Green’s draft in hand, they consider whether venues beyond *Space News* should be pursued.

Mr. Friedl noted that a wildfires team meeting had occurred in early February. Time had been specifically dedicated to the decadal survey, including the identification and nomination of applications people. Further, key challenges and opportunities had been identified, both on the research and decision support fronts. A similar approach had been taken in the water resources team meeting. Mr. Friedl was asked to review the timeline. His notional thought was that the Statement of Task would be completed and the contract awarded by April 2015. Nominations would be open for several months. He asked Mr. Meister to determine what Dr. Art Charos’ expectations were and to report back.

Mr. Friedl turned attention to Applications and Measurement Continuity. A National Academies of Science/National Research Council (NAS/NRC) ad hoc committee was providing guidance to help ESD determine what measurements should be collected for extended periods; how to prioritize their importance, and what gaps for data were allowable. A report on this from the research perspective was forthcoming, but the subject might not be as clearly handled from the applications perspective. A framework was being created to determine when mandates should be accepted and how data gaps could be identified. Some lack of clarity existed on the applications side; the December 2014 meeting had discussed a possible ASAC action related to continuity. This was especially interesting, he said, as with FY16 budget NASA would receive input from other agencies on their needs for observation and satellite measurement. He believed input was likelier on the applications than the research side. The comment was made that while continuity was important, one also needed to evolve over time and the capacity for evolving needed to be “engineered in.” Mr. Friedl said that once input was received, NASA may need help in determining criteria to be used in responding to that input. This could not begin until the continuity report was complete. He wished to emphasize, however, that the FY16 budget provided a broader context for input. He suggested an ASAC telecon should discuss the document once it was completed. Ms. Green said ASAC could determine at that point if it wished to produce a report. Dr. Gail agreed, commenting that the group might be surprised by the continuity report.

#### Session 4: Public Comments

Mr. Peter Meister reported no requests for public comment had been received.

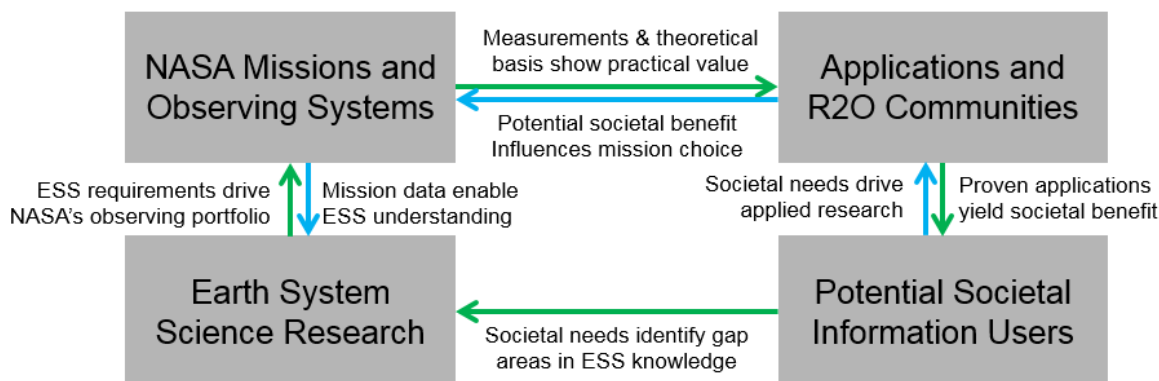
#### Session 5: ASAC Meeting Synthesis

Dr. Susan Moran asked Dr. Lawrence Friedl to review the FY16 budget process. Mr. Friedl responded that when OMB and OSTP had assigned responsibility for weather, they had recognized that many agencies had an interest in what NASA did in Earth observations. In consequence, they established the principle that NASA was required to receive input from other agencies and, further, to report back on what had been done with that input. USGEO had been charged with gathering the input. Dr. Moran said it appeared the missions side would be catering to the application side. Mr. Friedl said this was very much the case. SMAP was an example. People who wished to continue receiving soil moisture data would support SMAP-2. Absent an unexpected influx of funds, NASA could not maintain everything it was doing and undertake all measurements other agencies might seek. The desire for measurement continuity and the desire for new measurements must be balanced. The continuity study may provide information on how to address this from a research standpoint. If the study did not address applications, ASAC might consider it as an opportunity to jump in.



Dr. Lawrence Friedl presented the draft recommendations, reflecting the March 23, 2015 draft letter from Ms. Kass Green, ASAC chair, to Dr. Michael H. Freilich, ESD Director. Ms. Green noted each committee member had contributed to the draft. “Wordsmithing” changes should be sent her directly. She asked if any fundamental points been omitted. Dr. William Gail said the December 2014 discussion had emphasized that applications had passed a milestone: it was now initiating demands; not just responding to them. He felt this had been lost in the letter. Ms. Green said it had not been left out, but some text had been omitted as “professorial.” She invited Dr. Gail to “bulk up” that section, if he wished. Dr. Gail said he would. Dr. Nancy Dickson questioned the suitability of the italicized statement about “repeatability” in the draft letter’s second paragraph. After further discussion, Ms. Green suggested that Dr. Dickson and Dr. Gail rework the passage so that it fit better into the general context.

Dr. Molly Macauley said the diagram [included below for reference] was intriguing: it captured a new paradigm and perhaps should be included in the decadal survey.



Ms. Green said many ASAC members had worked on the diagram, which she regarded as important. Mr. Friedl said the diagram was a “nice, concise way” to show important relationships. He believed, however, that it failed to assert that “Earth System Science Research” also provided societal benefits. Dr. Hooke agreed, suggesting an arrow be added between the lower two boxes. Mr. Friedl also thought the arrow between the upper boxes reading “Potential societal benefit influences mission choice” was insufficient, as consideration of applications also influenced mission design. Dr. Gail noted that the box (“NASA Missions and Observing Systems”) stood out because the other three boxes represented communities; it represented a thing. He suggested placing “NASA Missions and Observing Systems” in the center, with arrows proceeding outward. Dr. Gail accepted Ms. Green’s suggestion that he distribute a new drawing for comment. The observation was made that the old diagram was linear; perhaps juxtaposing it

with the new model would underscore the new diagram's more interactive nature. Dr. Gail thought such juxtaposition would "start to look like a treatise." The central point, he added, was that instead of things being linear, a much richer conversation was going on between sectors, admittedly with some fuzzing on the boundaries. Mr. Friedl announced that all changes to the draft letter should be presented by week's end.

Mr. Friedl then said Recommendation 3 needed to be "fleshed out." Clarification was needed: were applications to be integrated into the Decadal Review or to be presented as a separate chapter? Ms. Green said she had "gone back and forth" on this. Dr. Hooke said he thought both perspectives had merit. Improving applications methodologies was a cross-cutting activity that benefited everything in ESD. The flip side was the desire that what was known about applications should be embedded in everything. Mr. Friedl felt this distinction needed clarifying. Mr. Friedl said Dr. Michael Freilich, ESD Director, was looking for guidance on what the community wanted. It remained to be seen whether there would be a separate chapter on applications. Ms. Green said she would redraft the final paragraph on communications to reflect information provided earlier in the telecom. She noted that several persons would rework the diagram and restated that everything should be circulated by week's end so final drafting could occur.

Mr. Friedl sought ideas for topics of later meetings. He noted that science teams would be discussed; such teams were central to validating new data products. He directed as an action item that a future meeting address the role of applications in science teams. Dr. Moran said she had written a short description of the importance of science teams. She wanted to know more about how such teams worked now and might work better. She would distribute a summary of what she had written as a "teaser." Mr. Friedl said that Dr. Moran's questions – How now? How better? – established a good framework. Input could be sought from people who had worked with science teams, including an applications-oriented person who had been involved with at least one such effort.

Mr. Friedl suggested a telecon be held to discuss the continuity study following its release. This drew general assent. He suggested the next "in person" meeting be held in early fall and asked people to consult their calendars. With thanks to all participating, Mr. Friedl called the telecon closed.

*The telecon ended at 3:00 p.m.*

## Appendix A: Agenda

### *Annotated Agenda – Final*

#### **Background**

The Applied Sciences Advisory Committee (ASAC) serves as a community-based, multi-sector forum to discuss Earth science applications and provide strategic and programmatic guidance to the Earth Science Division (ESD) and the Applied Sciences Program. The ASAC provides analysis, findings, advice and recommendations to inform decisions on the programmatic scope, ambition, and priorities regarding applied research, knowledge utilization, and applications.

Within ESD, the Applied Sciences Program has a specific focus on expanding Earth science applications, building applications knowledge and capacity, and enhancing the applications value of satellite missions. There are some topics, such as data continuity, that are ongoing issues and cut across ESD overall.

#### **Purpose & Objectives**

The meeting serves to inform the ASAC of key issues facing ESD on applications, discuss key topics, and receive ASAC advice and recommendations, and identify topics needing special analysis. The primary topic of this meeting is a summary of the President's FY2016 budget for NASA Earth Science.

The overall set of topics for this teleconference-based meeting includes:

- NASA Earth Science Update
- FY16 Budget Submission
- NRC Data Continuity Study Update
- Decadal Survey Outreach

Important objectives of the meeting include:

- Inform ASAC on FY16 budget
- Discuss and identify plans for data continuity study (if possible)
- Review outreach activities for Earth Science Decadal Survey by ASAC and Applied Sciences
- Discuss findings and set plan for December 2014 ASAC meeting report

A product of the meeting is a draft summary or outline of the ASAC's findings and recommendations.

**March 30, 2015**

***Set-up and Introductions*** **12:50 – 13:00**

**Session 1: Overview and Meeting Objectives** **13:00 – 13:05**

**Opening Remarks** (*Green, Friedl, Meister*)

This session will briefly review the agenda and purpose of the meeting.  
We will notify members of the public the process to provide remarks.

*ASAC Decision or Action*

None planned.

**Session 2: ESD and Applied Sciences Program** **13:05 – 13:45**

**ESD and Program Activities** (*Friedl*)

**Discussion** (*Led by Friedl and Green*)

*Background*

This session will briefly summarize activities within NASA Earth Science and Applied Sciences. The session will present information on the FY16 President's Budget Request for NASA Earth Science. This session will also present plans for the 2015 NASA Earth Science Senior Review.

*ASAC Decision or Action*

No specific action or decision planned. Some actions or advice may emerge from the discussion.

**Session 3: Decadal Survey & Measurement Continuity** **13:45 – 14:15**

**Introduction of Topic & Summary of Activities** (*Friedl*)

**Discussion** (*Led by Friedl and Green*)

*Background*

This session will review two items discussed at the December 2014 ASAC – the NRC Data Continuity Study and the Earth Science Decadal Survey.

This session will address the issue of applications in the context of the upcoming Decadal Survey, including ways to enable an integrative approach amongst research and applications. The session will receive an update on planning for the Decadal Survey. Also, in December 2014, the ASAC was requested to do some outreach on the on the upcoming Decadal Survey. This session will discuss the status of the ASAC outreach efforts, including possible tools that would be enable the ASAC to do this outreach.

The session will also provide an update on the NRC Data Continuity study. This study is providing guidance, framework and metrics to assist NASA ESD in the determination of when a measurement(s) or dataset(s) should be collected for extended periods, prioritize the relative importance, and identify the characteristics of and extent to which data gaps and/or performance degradation are acceptable for given measurement(s). This topic is one that NASA will request an in-depth analysis from ASAC in 2015 based on the findings and recommendations of the study, so this session will review the status of the report and possibly discuss the ASAC analysis (if the report is out).

#### *ASAC Decision or Action*

For the Decadal Survey, the ASAC action is to review, update, and establish steps to promote applications in the context of the upcoming Decadal Survey as well as steps to organize ASAC-led items for Decadal Survey.

For the Measurement Continuity, the ASAC action is to formulate an approach for the in-depth analysis, assuming the report has been released.

### **Session 4: Public Comments**

**14:15 – 14:20**

#### **Open Period for Public to Make Statements for the Record**

This session allows for members of the public to make statements for the record. If there are significant numbers of public commenters, we will ask for written statements.

#### *ASAC Decision or Action*

None planned. ASAC can determine whether to formulate actions in response to comments, topics, or issues raised by the public.

### **Session 5: ASAC Meeting Synthesis**

**14:20 – 15:00**

#### **Findings and Recommendations; Review of Draft Meeting Report (*Green*)**

This session will review key findings and recommendations from this meeting together with those from the December 2014 ASAC meeting in discussion of an ASAC report to NASA.

The session will also discuss the timeframe for the next ASAC telecon/meeting.

*ASAC Decision or Action*

One output is a set of key topics for the letter/report, identification of writing assignments, and agreement on a schedule for production.

Additional outputs include a list of actions, topics, and timeframe for next ASAC meeting.

***Adjourn ASAC***

***15:00***

*Note: The teleconference line can be available longer than 15:00.*

## Appendix B: Applied Sciences Advisory Committee Membership

Ms. Kass Green, Chair/Kass Green and Associates

Dr. Philip E. Ardanuy/Raytheon Company

Dr. Pietro Ceccato/International Research Institute for Climate and Society

Dr. Nancy Dickson/Harvard Kennedy School

Dr. Bill Hooke/American Meteorological Society

Dr. William B. Gail/Global Weather Corporation

Dr. Molly Macauley/Resources for the Future

Dr. Susan Moran/USDA

## Appendix C: Participants

### Persons present at NASA HQ:

Lawrence Friedl (ASC Director)  
Peter Meister (Executive Secretary)  
Kathryn Carroll  
(Mark Bernstein, meeting reporter, ZantechIT)

### Persons participating by telephone:

#### Applied sciences Advisory Committee members:

Kass Green (chair)  
Philip Ardanuy  
Pietro Ceccato  
Nancy Dickson  
Bill Gail  
Bill Hooke  
Molly Macauley  
Susan Moran

#### Other telephone participants:

Vincent Ambrosia  
Lucien Cox  
Sue Estes  
Randy Friedl  
David Green  
Dan Irwin  
Ana Prados  
Merna Saad  
Joseph Skiles  
Amber Soja  
Tim Stough  
William Turner