

# **CLARREO 2015 Directions Discussion**

## **Decadal Survey SDT Continuity Communication**

*Bruce Wielicki, discussion lead*

*CLARREO SDT Meeting  
NASA Langley/NIA, Hampton, VA  
Oct 28-30, 2014*

# Relevant Leadership Changes

- CLARREO: none
  - Note: Rosemary is at leadership training this week
- NASA HQ:
  - Steve Volz (SD mission/engineering lead) has taken a job leading NOAA NESDIS. Steve starts at NOAA Nov 1.
  - Steve Neeck is acting until a permanent replacement is selected.
  - We will need to bring Neeck up to speed on CLARREO, although he has been sitting in on annual reviews of the pre-phase A missions like CLARREO and did so at our end of the year report October 8, 2014.
  - Meanwhile, we have been dealing directly with Freilich on tech demo and risk reduction unit possibilities.

# CLARREO SDT Continuity

# CLARREO SDT Continuity

- The CLARREO SDT has been critical to success: exceptional expertise, diversity of ideas, and productivity
- The SDT continues to develop and advance tools and concepts that benefit the broader science community (e.g., OSSEs, PCRTM, MIIC Framework, On-orbit Verification, etc.)
- The number of journal publications are growing rapidly and helping to educate the climate science community on CLARREO
- ROSES call from Hal Maring: selected P.I.'s: H. Revercomb et al., S. Leroy et al., D. Feldman et al., X. Huang et al., Z. Jin et al., Y. Roberts et al., J. Wang (spectral IR/RS aerosol retrievals). 6 of 7 selected from CLARREO SDT
- What is not solicited as part of the ROSES call, the CLARREO project will consider funding directly (but limited \$s available): should know more as go over budget in the next few weeks
- Continue SDT meetings/collaboration with investigators funded both by direct project funding, as well as ROSES call funding.
- Continue international and interagency collaboration



**Continuity of the SDT is a critical part of CLARREO**

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# Activities since Jan 2014 meeting

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- Tech Demo IR and RS missions ISS submitted to HQ in July and Sept 2014
  - ~ \$40 to 50M per instrument, LASP, UW, GSFC
- Risk Reduction Unit instrument build cost estimates submitted to HQ Oct 2014
  - ~ \$22M per instrument, essentially EDU type builds, LaRC, GSFC
- Continued progress on LaRC and GSFC CDS systems
- LASP successful second high altitude balloon flight Aug 2014 (30km altitude)
- UW demonstration of TRL-6 including vacuum testing
- LaRC instrument design lab for lower mass/power/cost IR spectrometer (small enough to fit on a Pegasus launch vehicle)
- A wide range of SDT journal publications
  - Improved spectral fingerprinting (RS, and IR)
  - RS intercalibration sampling and polarization dependence models
  - IR/RS OSSEs
  - Use of High accuracy IR benchmark for Weather Prediction
  - Importance of understanding and observing Far-IR surface emissivity

# Activities since Jan 2014 meeting

- CLARREO SDT Mission Report: ~ 200 pages
- Studies to determine spectrally dependent accuracy requirements for:
  - SW fluxes, LW fluxes
  - Cloud Properties
  - Temperature and Water Vapor Profiles
  - Allow relaxation of requirements at short and long wavelength limits
  - Enable clearer communication of value to other climate observations
- Several invited talks on CLARREO and VOI
  - WCRP grand challenge on Climate Sensitivity, AMS Rad Conf, AOGS, India annual climate meeting, Climate Symposium 2014
  - At Climate Symposium 2014: about 40 to 50% of leadership got the lack of a climate observing system and importance of VOI. Expected endorsement from conference
- Meeting with Feldman and Collins discussing Decadal Survey, CLARREO, and climate modeling futures

# Activities since Jan 2014 Meeting

- NRC Continuity Panel: expected to release report early 2015 to help better understand and quantify the need for and value of long term climate observations
- NASA Ames workshop in May 2014: top science questions consistent with CLARREO objectives (e.g. climate sensitivity, cloud feedback)
- Meetings with VA senators (Kaine twice (in DC and at LaRC, Warner staff lead once in DC) and 3 VA congressmen on CLARREO and VOI
- ITOVS weather satellite meeting strong recommendation (Revercomb)
- BAMS paper on value of CLARREO to weather prediction bias corrections (Leroy)
- Studies at GSFC on NDVI trend uncertainties and MODIS calibration uncertainty

# Perspectives from 2014

- WCRP Grand Challenge on Climate Sensitivity (March, 2014)
  - Bjorn Stevens, Sandrine Bony, and Robert Pincus support
  - invited talk to Climate Symposium 2014
- AMS Radiation Conference: strong support from (July, 2014)
  - Julia Slingo, UK Met Office Chief Scientist
  - Ramaswamy, NOAA GFDL Director
  - Joe Schmetz, EUMETSAT Chief Scientist (Climate Symposium)
- AOGS: (Aug 2014)
  - Terry Nakajima: interested in VOI: everything in Japan is now economically justified space science. Retiring from Univ Tokyo, going to JAXA
- India invited presentations (through Sanjay Limaye at UW)
  - Strong interest in joint India/U.S. CLARREO mission
  - Working on possible India instrument additions: aerosol or water vapor RO?
  - India provides launch vehicle and spacecraft, U.S. CLARREO instruments?
  - Start higher level discussions with ISRO and NASA in a few months
  - ISRO budget is rising: strong interest from new prime minister
  - Freilich notified and supports the idea

# Perspectives from 2014

- Climate Symposium 2014 (Oct, 2014)
  - Good discussions with Freilich at the meeting.
    - Biggest challenge to get CLARREO going remains budget
    - Second challenge for CLARREO is long time scale of payback
    - Agrees with CLARREO quantitative science goals, OSSEs, science value matrix, likes VOI. Thinks NASA missions need more quantitative objectives (e.g. OSSEs could be used more extensively)
  - U.S. congress still not likely to increase funding in current political environment but other nations might
  - Agrees India a good option for initial collaborative mission, but not sure that they would do a long term series of CLARREO with us
  - Hank Revercomb was able to walk Freilich through his poster
  - About 40 to 50% of senior leaders there seem to get the fact that we lack a climate observing system and that the economic value of one is high.
  - The rest are either comfortable with what we have (worked hard to get what we have in JPSS, Sentinel, and Metop satellite observations) or think we need to do more with what we have or are just worried about a specific part of the observing system (i.e. the stovepipe view).

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# **Decadal Survey Activities Overview**

**(updated from recent Applied Sciences Review)**

# Earth Science Decadal Survey

- The 10-year anniversary of the Decadal Survey (DS) is in 2017
- A task statement for the next DS is currently being negotiated with NAS/NRC space studies board.
- Process
  - The NRC plans to release a broadly distributed RFI
  - There will likely be a primary steering committee with supporting panels
- Issues to be addressed by committee, include:
  - Revisiting mission backlog set forth in the 1st DS to determine if they are still relevant.
  - Maintain balance between flight, research, and applications
  - Navigate the budget realities – How to develop a plan that is realistic yet aspirational?

Event	End Date	Duration (months)
ESD preparation	Oct-13	15
Call for inputs	Jan-15	3
Community meetings	Apr-15	9
Report writing period	Jan-16	8
Final report editing	Sep-16	4
Release of NRC's 2nd Earth Science Decadal Survey	Jan-17	

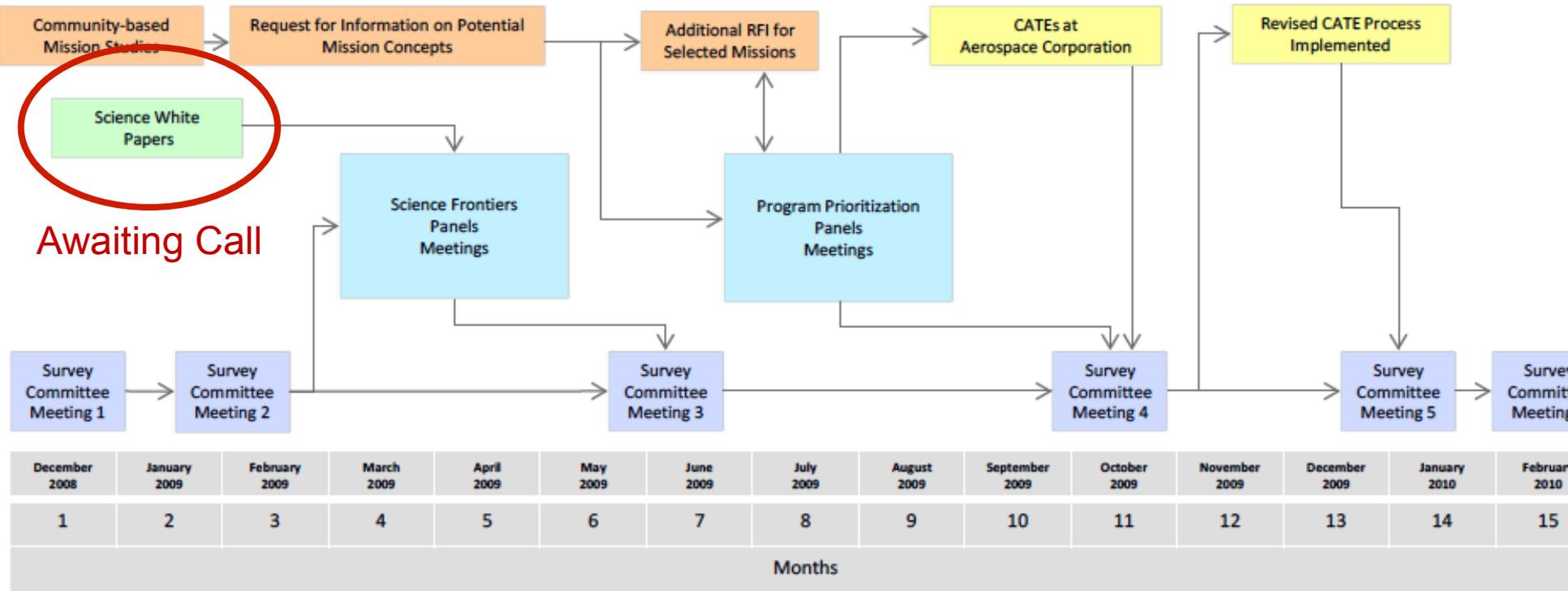
Notional Schedule – Delay expected

# Recommendations for next DS

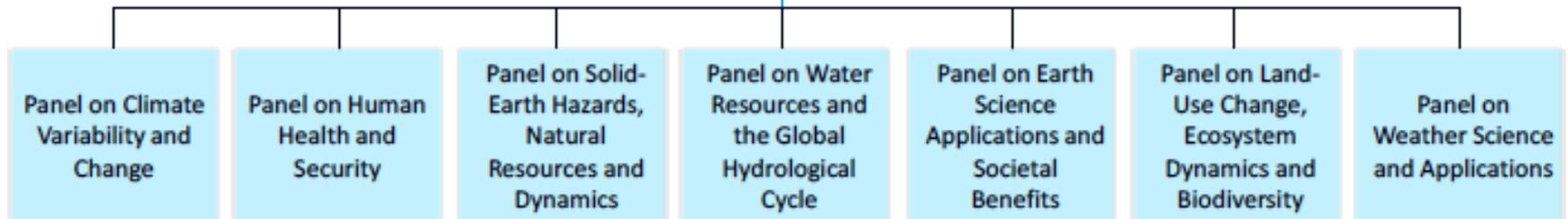
Assuming similar call for candidate missions for next DS:

- Define science missions that address **high priority national objectives** and provide **evidence** of the **impact** of those missions on science goals.
- Candidate missions are **much stronger** if it is aligned with a **community consensus mission** that is documented in a report or paper.
- Mission is **strongest** if it addresses high priority needs in **multiple panels**.
- Assemble the **strongest science team** possible to show broad community support for candidate mission.
- **Technological readiness** for mission implementation needs to be **credible and documented**.
- **Cost realism** will be carefully reviewed due to problems in first DS.
- Submit white papers that cover **all high priority missions**– don't depend on panel members to insert for you.

# Previous Decadal Survey Process



## Committee on Earth Science and Applications from Space



# Earth Science Decadal Survey

- **Upcoming Events**

- Applied Science Advisory Committee (Dec. 11-12) San Francisco – Topics – Strategy for 2015-2020, **Decadal Survey**, Data and Data Access Items. (Note: Increased emphasis on Applied Science expected in the next DS.)
- AGU Fall Meeting (Dec. 15-19)

- **Preparing for the Decadal Survey White Paper Process**

- Encourage white papers in areas of interest to CLARREO to help influence the eventual DS content.
- Encourage participation on subcommittee or panels, if requested.

# Lessons Learned

- **Lessons Learned in Decadal Planning in Space Science: Summary of a Workshop**
- **Authors:** Lewis Groswald and David H. Smith, Rapporteurs; Space Studies Board; Board on Physics and Astronomy; Division on Engineering and Physical Sciences; National Research Council
- **Description:** The National Research Council (NRC) has been conducting decadal surveys in the Earth and space sciences since 1964, and released the latest five surveys in the past 5 years, four of which were only completed in the past 3 years. Lessons Learned in Decadal Planning in Space Science is the summary of a workshop held in response to unforeseen challenges that arose in the implementation of the recommendations of the decadal surveys. This report takes a closer look at the decadal survey process and how to improve this essential tool for strategic planning in the Earth and space sciences.



# Lessons Learned – What's contained within the report?

- Summary of Keynote Speakers Remarks
- Overview of DS Process
- DS Chairs' Perspectives
- **Sponsor Agencies Perspectives**
- Opportunities for Improvement
- Role of Cost Estimates
- Planning for High Profile Missions
- International Partnering
- DS Stewardship

# Sponsor Agencies Perspectives

- **Panelists:** Michael Freilich, Director, NASA Earth Science Division; Jeffrey Newmark, Strategic Planning Lead, NASA Heliophysics Division; Lisa May, Mars Program Executive, NASA Planetary Science Division; Paul Hertz, Director, NASA Astrophysics Division; John Pereira, Chief, Advanced Satellite Planning Division, NOAA/NESDIS
- **Questions posed by moderator:**
  - How do you interpret and use decadal surveys?
  - What works well and what does not work well?
  - What would you like to see in future surveys?
  - How do you coordinate within your agency on common issues and recommendations?

# Sponsor Agency – Key Takeaways

- Role of NOAA and NASA in Earth Science DS
  - When a national program is dependent on key roles for each agency, one agency cannot be left “off the hook” so that it can decline to accept its responsibilities. (Freilich) Reference to Nunn-McCurdy. Lack of resources.
- Focus on **prioritizing science objectives more than missions** because science priorities can be more enduring and more robust than a recommended mission queue
  - Counter point made by audience - Moving from prioritizing science to prioritizing missions can often resolve competing ideas that are otherwise impossible to compare; Concerns expressed about **vulnerability to congressional earmarks**
- **International participation** needs to be better incorporated into the survey process. The different planning processes in two sides of a potential international partnership can actually interfere with each other, and that obstacle needs attention. (All)
- **Look for synergistic opportunities across SMD.** (Freilich)

# Sponsor Agency – Key Takeaways

## COSTS

- Cost and Technical Evaluation (CATE) - When a mission concept is only roughly defined, it can only be costed up to a point. (All)
- Science priorities are heavily influenced by technical and fiscal feasibility, so even the highest-priority science can be demoted to a lower priority if it requires a prohibitively expensive mission or non-existent technology. (Abbott)
- LV costs must be factored into the assessment (Freilich)
- What question is CATE trying to answer? (Freilich)
  - What does the NRC think that a mission will cost, given a specific set of capabilities? Potential for error is great.
  - What does the decadal survey panel think is a reasonable amount of money to spend in this general area to have some of these sorts of capabilities? (Mid-Term DS focused on the latter question)
- Societal benefits role in determining what a mission is worth. (Pereira)

# Sponsor Agency – Key Takeaways

## PREPARATION FOR NEXT SURVEY

- Michael Freilich said that a modest investment in a critical review of the capabilities and plans of NASA's international partners (in the Earth sciences) would probably be exceedingly useful to the Survey
- Develop the requisite technology to a reasonable technology readiness level so that the missions that technology can support can be evaluated realistically and prioritized accordingly. (Hertz)
- Identify gaps in the heliophysics system, which is important because of the integrated nature of the heliophysics program—much akin to the Earth science program. Societal benefits role in determining what a mission is worth. (Newmark)

# 2015 Key Tasks

- Key journal papers we still need to publish:
  - CLARREO orbit sampling paper (Doelling et al., in draft revision)
  - IR intercalibration sampling paper (Tobin et al., in preparation)
  - IIP and CDS calibration methods and accuracy level papers (UW, LaRC, LASP, GSFC, joint with NIST partners)
  - Improved rigor in Economic value paper (Cooke et al in draft)
  - Broaden BAMS accuracy requirements to other climate variables (Xu, Rose, Roberts, etc)
  - Broader audience Climate Obs/VOI paper
- Updates to Summary Report for CLARREO web site and for background support of decadal survey white paper.
- Input White paper to Decadal Survey (length unknown)

# Action Items

- **Contact Freilich for response on Tech Demo slides he received last week. Drive home that CLARREO was a Tier 1 mission and was only stopped for budget reasons: which the Tech Demo overcomes, should not need to be EV proposal route. (*Wielicki/Baize*)**
- **Get Tech Demo slides to Steve Neeck, Volz replacement (*Wielicki/Baize*)**
- **Get ITOVS Recommendation for CLARREO IR cal to Freilich and Neeck/Volz (*Wielicki/Baize*)**
- **Get NOAA/EUMETSAT to write letter to Freilich stating need for CLARREO for sounder calibration in orbit for weather and climate (*Revercomb, Smith*)**
- **Can we get a similar operational satellite endorsement for calibration of VIIRS, AVHRR, etc? (*Revercomb, Smith, Xiong?*)**
- **Get time with Sellers to better explain lack of a climate observing system, CLARREO critical to climate change, VOI (*Baize/Wielicki/Thome*)**

# Action Items

- **Write broader community paper on lack of a climate observing system and VOI of an improved system in much broader science and public publications** (Science, Nature, PNAS, NY Times, Foreign Affairs, Foreign Policy, etc) (*Wielicki, Cooke, Collins, non CLARREO broad community leaders*)
- **Get NASA HQ Press release for next VOI paper** (*Wielicki/Baize/Jucks*)
- **Resolve understanding of stratospheric temperature trends and natural variability. Do we need separate stratosphere/zonal/seasonal accuracy requirements or does larger natural variability deal with it (like BAMS paper). Recall that global annual usually drives accuracy reqmt.** (*Xu Liu/Knuteson*)
- **Resolve our understanding of the RO dry temperature uncertainty for climate change applications (both accuracy and change over time for algorithms and instrument capabilities)** (*Ao/Manucci/Knuteson*)

# Action Items

- **Discussion of QCL line shape need for instrument: separate workshop/telecon? Use of atmospheric absorption lines vs QCL? Walmart versus MCR instrument versions** (*Johnson, Dykema, Revercomb*)
- **Discussion of number of multiple temperature verifications needed to verify SI traceability in orbit, especially for nonlinearity effects. Examine LaRC CDS results vs other interferometer calibrations (CrIS, IASI, UW IIP instrument, NAST-I, etc): how many temperature levels and what range of temperature is needed to meet CLARREO requirements? Cost vs accuracy confidence trade** (*Johnson, Revercomb, Dykema*)
- **Continue to publish results in peer reviewed journals!** (*All*)
- **Continue progress on CDS and IIP instruments and NIST collaboration** (*GSFC, LaRC, UW, CU-LASP*)
- **Continue progress on international collaboration, especially with India** (*Wielicki, Baize, Limaye*)

# Action Items

- **Improve time efficiency of IR presentations** (*IR session speakers*)

# Backup Slides