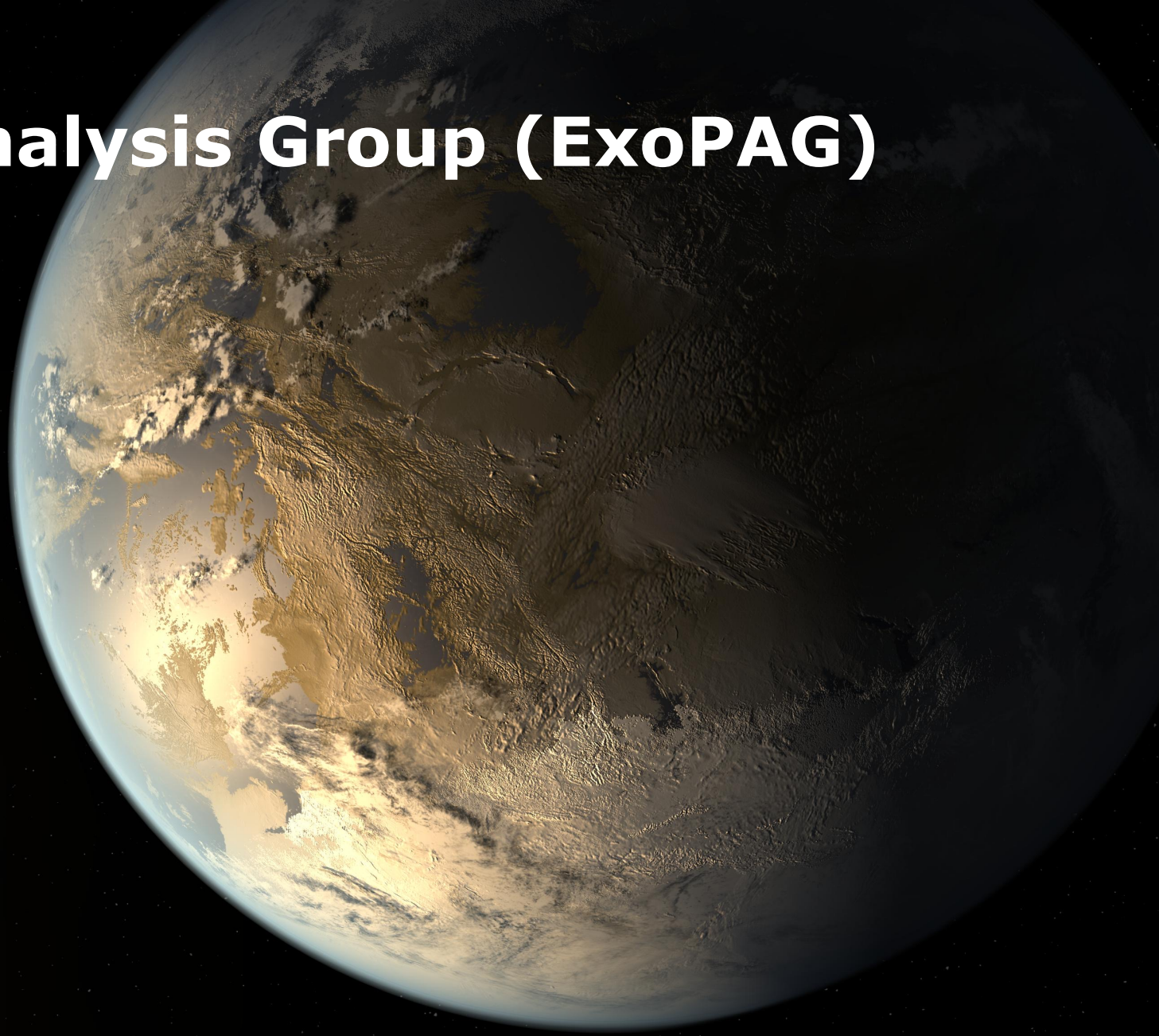
Exoplanet Program Analysis Group (ExoPAG) Report to APAC



Ilaria Pascucci (U. Arizona)
Chair, ExoPAG Executive Committee

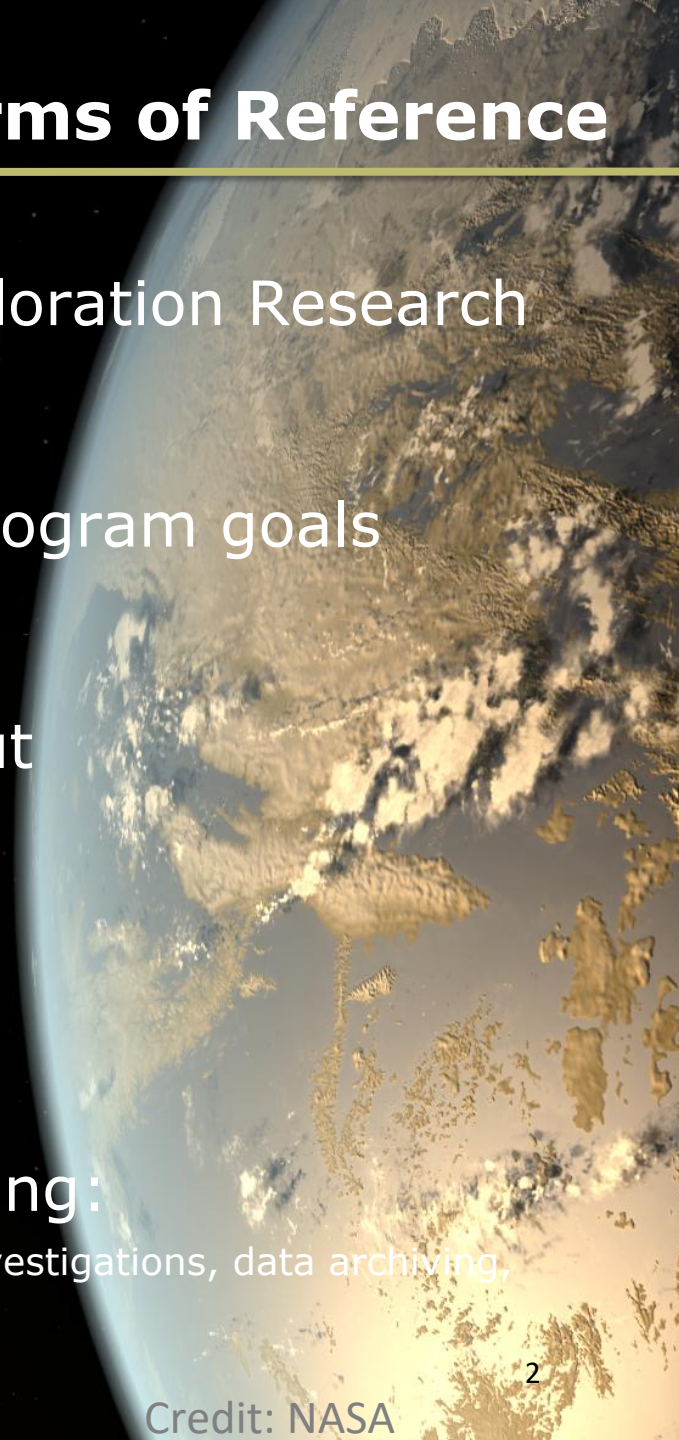
October 19-20, 2023

Credit: NASA

Exoplanet Program Analysis Group: Terms of Reference

- ❑ Articulate & prioritize science drivers for Exoplanet Exploration Research
- ❑ Evaluate capabilities of potential missions to achieve program goals
- ❑ Evaluate the ExEP activities with broad community input
- ❑ Articulate & prioritize new mission technologies
- ❑ Provide findings on all related program activities including:

ground-based observing, theory and modeling programs, laboratory astrophysics, suborbital investigations, data archiving, community engagement



Credit: NASA

ExoPAG ongoing & recent activities I (since the last APAC meeting)

- Organize monthly ExoPAG EC meetings (8/16, 9/20, 10/18), cross-PAG meetings (8/29, 9/27), rep. to APAC (I. Pascucci)
- Bylaws document in preparation, includes selection process of new EC members, EC voting and voting process within the ExoPAG, formation of new SIGs/SAGs… (J. Gregory and I. Pascucci)
- ExoPAG 28 meeting, just before the DPS (all EC members)
- Preparing the ExoPAG29 meeting at the 243rd AAS (all EC members, L. Zhao: mini-symposium for early career scientists)

October 1, 2023

Session 1 (Chair: Natalie Hinkel and Diana Dragomir)	**Speaker**	**Time (CDT)**	**Duration**	**End**
Welcome + overview of SIGs and SAGs	Ilaria Pascucci	9:00 AM	0:20	9:20 AM
Planetary Science and Astrobiology Decadal Survey	Robin Canup and Phil Christensen (Co-Chairs-Remote)	9:20 AM	0:30	9:50 AM
Exoplanet Program Office + Science	Karl Stapelfeldt	9:50 AM	0:15	10:05 AM
The ExoExplorers Program	Tiffany Kataria (remote)	10:05 AM	0:15	10:20 AM
What do exoplanet atmospheres tell us about planet diversity?	Sarah Moran	10:20 AM	0:20	10:40 AM
BREAK (20 min)		10:40 AM	0:20	11:00 AM
NASA Headquarters Exoplanet Exploration Program	Josh Pepper, Megan Ansdell	11:00 AM	0:30	11:30 AM
What do we know about Venus as an exoplanet analog?	Giada Arney (remote)	11:30 AM	0:20	11:50 AM
What do we know about Titan as an exoplanet analog?	Jason Barnes	11:50 AM	0:20	12:10 PM
What do we know about Uranus as an exoplanet analog?	Leigh Fletcher	12:10 PM	0:20	12:30 PM
LUNCH BREAK (90 min)		12:30 PM	1:30	2:00 PM
Session 2 (Chair: Ian Crossfield)	**Speaker**	**Time (CDT)**	**Duration**	**End**
Planet formation and migration in the Solar System, as constrained by the small body record	Will Grundy (remote)	2:00 PM	0:20	2:20 PM
Planet formation and migration processes constrained by exoplanet observations	Andre Izidoro	2:20 PM	0:20	2:40 PM
What can stellar compositions tell us about exoplanet compositions?	Romy Martinez	2:40 PM	0:20	3:00 PM
Geochemical evolution of terrestrial planets and biosignatures (HabWorlds)	Josh Krissansen-Totton (remote)	3:00 PM	0:20	3:20 PM
Star-planet interactions: Atmospheric escape in the Solar System and applicability to exoplanets (lessons from the Maven mission)	Michael Chaffin	3:20 PM	0:20	3:40 PM
Earth as an exoplanet: Relevant for detection of ExoEarth Candidates (HabWorlds)	Eddie Schwieterman	3:40 PM	0:20	4:00 PM
BREAK (20min)		4:00 PM	0:20	4:20 PM
Session 3 (Chair: Ilaria Pascucci)	**Speaker**	**Time (CDT)**	**Duration**	**End**
Business Meeting: Discuss New Finding (Osiris/APEX, **moderator: Natalie Hinkel**) Potential SAG- Reflectance Spectroscopy Mentimeter- Solicit feedback/new suggestions for ExEP or ExoPAG action Announcements, etc.	All	4:20 PM	1:30	5:50 PM
EC Closed Session	EC members only	6:00 PM	0:30	6:30 PM
Adjourn		6:30 PM		

ExoPAG 28: agenda

Goal: strengthen the connections between the astrophysics and planetary science communities in exoplanet science.

Excellent presentations!

ExoPAG 28: Business meeting

https://exoplanets.nasa.gov/exep/events/461/exopag-28/

APEX/OSIRIS Finding: Whereas the Astro2020 Decadal Survey recommended that NASA develop an exo-Earth direct imaging mission (recently dubbed the Habitable Worlds Observatory, HWO) and whereas whole-disk observations of the only known habitable world (Earth) at direct imaging-relevant wavelengths, timescales, and phase angles are extremely rare, so that the reflected-light spectral data for Earth adopted in the Decadal Survey are reliant on model predictions.

We find that the community of exoplanet scientists engaged in the development of HWO would benefit from novel whole-disk observations of solar system worlds, especially Earth. Data from spacecraft provide the only opportunity to make whole-disk observations of Earth and other solar system worlds without contamination from Earth's atmosphere. Thus, these observations are crucial analogs for the exoplanet data that would be produced by HWO. Whole-disk observations from spacecraft provide a key opportunity to (1) understand how reflected light observations of planets depend on wavelength, phase, and time and (2) validate the data and tools currently in-use for planning HWO. For Earth, (1) published whole-disk spectroscopy is wholly lacking at some visible wavelengths critical to HWO observations, (2) weather-induced brightness variability at HWO-relevant illumination phases has not been well-sampled at timescales beyond a single rotation, and (3) spectral observations at lower-illumination phases beyond quadrature, where models predict important scattering effects related to exoplanet ocean and cloud remote sensing, are extremely limited. As a near-term example, whole-disk observations of Earth from NASA PSD's OSIRIS-APEX mission could yield reflected-light spectroscopic data at wavelengths, phase angles, and timescales that heretofore have not been recorded for our planet and that are directly relevant to the science definition of an APD exo-Earth direct imaging mission.

ExoPAG 28: Business meeting

https://exoplanets.nasa.gov/exep/events/461/exopag-28/

- Discussion of two additional SAGs:

- SAG on Exoplanet Reflectance Spectroscopy for HWO (R. Hu and T. Robinson): compare and converge on the practices for simulation of, and retrieval on, exoplanet reflectance spectra, with a focus on terrestrial exoplanets relevant to HWO

- SAG on Technosignatures (J. Wright): produce analysis and findings on how NASA's efforts in astrobiology, exoplanetary astrophysics, and other areas can better serve the search for technosignatures

ExoPAG 28: Business meeting

https://exoplanets.nasa.gov/exep/events/461/exopag-28/

- Open discussion on how to further strengthen collaborations between astrophysicists and planetary scientists in relation to exoplanet science:

- Interest in having one of the semi-annual ExoPAG meetings in connection with a large planetary science meeting (e.g., DPS, AbSciCon…)

- Integrate the ExoPAG meeting within the conference program

- Advertize meetings earlier, more broadly, need of travel funding

- Targeted funding for cross-disciplinary exoplanet science

ExoPAG ongoing & recent activities II (since the last APAC meeting)

- *New Great Observatories* cross-PAG SAG (ExoPAG EC rep.: M. Rice): report in Early 2024 about the scientific advances enabled by a fleet of future Great observatories

- *Time Domain and Multi-Messenger Astrophysics* cross-PAG SIG (ExoPAG EC rep.: I. Crossfield)

- *Astrophysics With Equity: Surmounting Obstacles to Membership (AWSOM)* cross-PAG SAG (9/22, ExoPAG EC rep.: K. Follette)

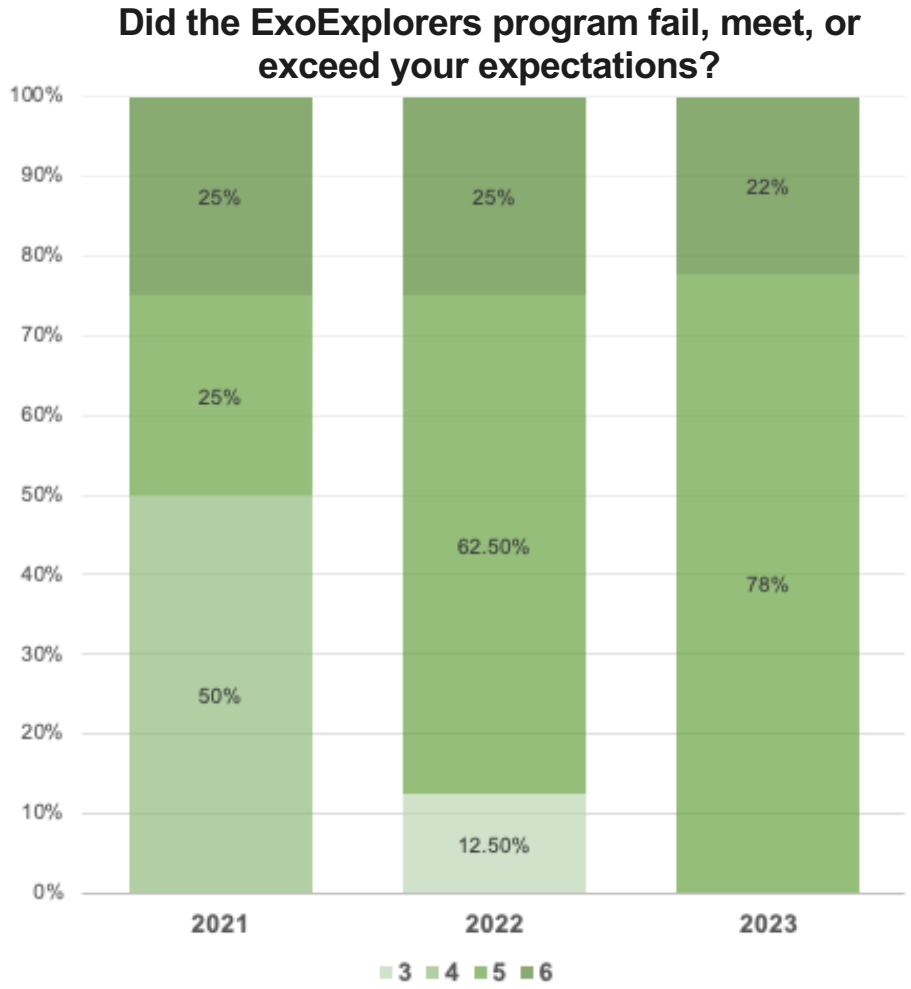
ExoExplorers Program Update

(ExoPAG EC rep.: K. Colon)

The Exoplanet Explorers (ExoExplorers) Science Series, sponsored by the ExoPAG Executive Committee and the NASA's Exoplanet Exploration Program, aims to enable the professional development of a cohort of graduate students and/or postdocs in exoplanet research ("ExoExplorers").

October 2023

- The fourth year of the ExoExplorers program is kicking off soon! 2024 ExoExplorers and ExoGuide applications were due October 12, 2023 and included a call out to inclusion resources to provide further guidance to applicants. Selections will be announced in January 2024.
- The ExoExplorer Steering and Organizing Committees (SC and OC) currently solicit feedback from the cohorts via an anonymous survey at the beginning and end of the program. Survey topics include goals, a self-assessment, professional development interests, and interest in engagement opportunities with the SC and OC.
- An example of a survey question and the responses received over the first three years of the program is shown to the right.
- The SC and OC use this feedback to tailor the program more to the needs of the ExoExplorers, which has led to increased satisfaction with the program as shown in the figure on the right. Additional types of feedback may be collected in the future in order to continue to increase the impact of the program.



Scale from 1 to 6, where 6 = highest/best

https://exoplanets.nasa.gov/exep/exopag/exoexplorers/exoexplorers-welcome/

ExoPAG ongoing & recent activities III (since the last APAC meeting)

- Active Science Interest Groups (SIGs) and Study Analysis Groups (SAGs):

- SIG2 "Exoplanets Demographics", change in leadership (Fernandes & Johnson)
- SIG3 "Exoplanets Solar System Synergies", on-going (Meadows & Mandt)

- SAG23 "The Impact of Exo-Zodiacal Dust on Exoplanet Direct Imaging Surveys" (Debes, Rebollido, Hasegawa)
- SAG24 "Exploring the Complementary Science Value of Starshade Observations" (Seager & Shaklan)

SIG 2 - Exoplanet Demographics

Chairs: Rachel Fernandes (PennState) Samson Johnson (JPL)

- *Previous report on value of public database of demographic products, covering all techniques: https://arxiv.org/abs/2304.12442*
  - *Led by the previous chairs Jessie Christiansen and Michael Meyer*

- Curating a list of open questions/ongoing projects for the community
  - Eta-Earth considerations for HWO
  - Exoplanet demographics with Roman Space Telescope
  - Synthesizing demographics from multiple detection techniques

- *Actively seeking to recruit new members, especially ECRs!*
  - *join us! https://exoplanets.nasa.gov/exep/exopag/sigs/#sig2*

Credit: NASA

SIG3 “Exoplanets Solar System Synergies”

(Chairs: Meadows & Mandt)

- Gathering community input on key ExoSS synergies: https://tinyurl.com/yxbnyfwu
- ExoSS Slack Channel – news updates, paper-sharing, collaborations, all are welcome! 170 members (If you would like to join: meadows@uw.edu)
- Run monthly SIG3 Tutorials/JC that explain key concepts within our different communities. Talks have been recorded and are available here: : http://nexss.info/community/exoss-synergy
- Helped coordinate speakers for the ExoPAG28
- Upcoming: Develop a community review paper that will find overlaps and synergies, and link the science initiatives of Astro2020 and Origins, Worlds and Life 2023

SAG23 "The Impact of Exo-Zodiacal Dust on Exoplanet Direct Imaging Surveys"

(Chairs: Debes, Hasegawa, Rebollido)

- SAG23 Workshop on 9/15/2023 at STScI Baltimore, MD
- 50+ attendees (35 online, 20 in person) half were non-SAG members, good mix of early, mid-career, and senior attendees
- 3 external speakers with late breaking updates
- Review of 9 subject area preliminary findings
- Much to learn about exozodi-hot dust properties and the need for understanding the conversion between IR dust emission and scattered light emission critical for future missions
- Final report to be expected in late 2023/early 2024

https://exoplanets.nasa.gov/exep/exopag/sag/#sag23

SAG24 "Exploring the Complementary Science Value of Starshade Observations"

(Chairs: Seager & Shaklan)

The main goal is to clarify which areas of Starshade science are unique and complementary to the coronagraph and should be prioritized in the coming years

Example of specific goals:

1. Assess the scientific value of access to e.g., a) Broad, instantaneous spectral bandwidth (~100%); b) Unrestricted outer working angle…

2. Estimate the yield of a notional Starshade for HWO covering 250 nm to 2 um to be used in conjunction with a visible-only HWO coronagraph

https://exoplanets.nasa.gov/exep/exopag/sag/#sag24

NATIONAL ARCHIVES

FEDERAL REGISTER

The Daily Journal of the United States Government

Notice

Request for Information: NASA Public Access Plan for Increasing Access to the Results of NASA-Supported Research

A Notice by the National Aeronautics and Space Administration on 05/18/2023

Publication Date: 05/18/2023

Comments Close: 08/17/2023

Comments on the proposed NASA plan regarding sharing and archiving of research software

https://www.federalregister.gov/documents/2023/05/18/2023-10643/request-for-information-nasa-public-access-plan-for-increasing-access-to-the-results-of

-Robert McMillan & Renu Malhotra, LPL; 2023 August 14
Contact: malhotra@arizona.edu

1. Sharing of Software Can Tend to Discourage Innovation:

Many researchers use established software packages to save time, and this is appropriate when done with knowledge of the limitations of the tools. However, the sharing requirements proposed by NASA will tend to spread this practice to avoid having to document new code, and will tend to discourage innovation.

2. Sharing of Software Can Corrupt Scientific Investigations:

Instead of developing new code specific to novel science investigations, researchers take the easy path of writing minimal wrappers to established software tools. This practice, without mastery of the underlying characteristics and limitations of those tools, can introduce biases, flaws, and even gross errors in new investigations.

3. Sharing of Software Inhibits Competition:

The skills and accomplishments of a research group are their stock in trade in competition for research grant awards. If their software can be adopted freely by their competitors, then the distinction between research proposals is blurred. The NASA panelists on the webcasts did not seem to appreciate the intensity of competition for grant funds, and instead described a bewildering campaign of social re-engineering toward an ideal of communal collaboration. The unintended but predictable consequence of such a policy is elimination of competition and a lowering of the rate of scientific progress.

4. Sharing of Software Can Pre-empt Fundamental Education:
Students are increasingly using large, established simulation and modeling software tools without learning the fundamentals underlying the subject. Furthermore, the rare, truly innovative students may be discouraged from developing new methods by the pressure of time and the tendency of the community to accept more readily results derived with known tools. This also will have the predictable consequence of lowering the rate of scientific progress.

5. Sharing of Software "as-is" for Peer Scrutiny is Appropriate:
The scientific process requires demonstration of the validity of claimed findings, and the currently established peer-review process for small-to-modest-scale projects accommodates such rigor, including for projects that develop and use in-house software tools. (An example of this process working well is found in the refutation by Mutel & Fix (JGR 109, 1171 (2003), doi:10.1029/2002JA009391) of the claim for a huge population of small comets near Earth that turned out to be due to a bug in a Fortran program.) So making one's source code available as-is to scrutiny by other researchers is logical and appropriate. However, see #6 below.

6. Sharing of Software for general users is Burdensome to Individual Investigator Research:
To have to fully document all software and support it for others to use beyond its original purpose would be a disproportionately high burden on individual-investigator research projects. Code written for one purpose with implicit assumptions about boundary conditions and parametric cases will require considerable work to become generalized. That required level of technical support is not commonly available to individual researchers with small grants. The NASA webinar panelists were not convincing in the promise that additional funds will be made available for such support because they cannot predict or control future allocations of funds. Moreover, requiring individual investigators to support software for others would take away from their research time. A reasonable approach may be to adopt a software documentation, sharing and support requirement for projects that are focused on the development of software tools and for "large projects", e.g., those of funding exceeding $10M per year or exceeding $100M in total. Such projects are likely to have sufficient personnel to comply with such software policy requirements.

ExoPAG Actions requested from APAC

The ExoPAG requests APAC to discuss NASA’s plans regarding sharing and archiving of research software along with community inputs at future meetings