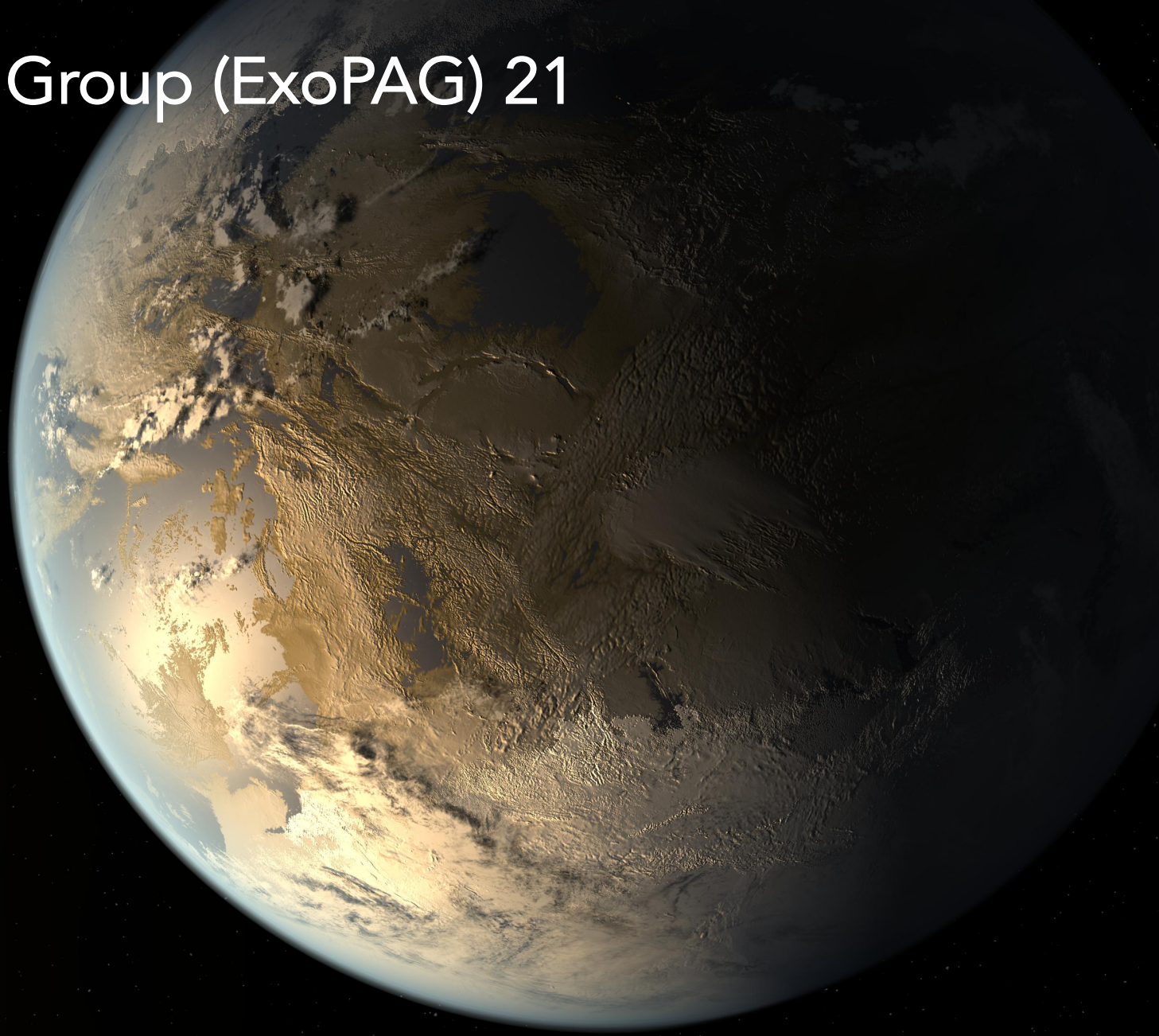
Exoplanet Program Analysis Group (ExoPAG) 21



Michael Meyer
Chair, ExoPAG Executive Committee

January 3-4, 2020
Honolulu, HI

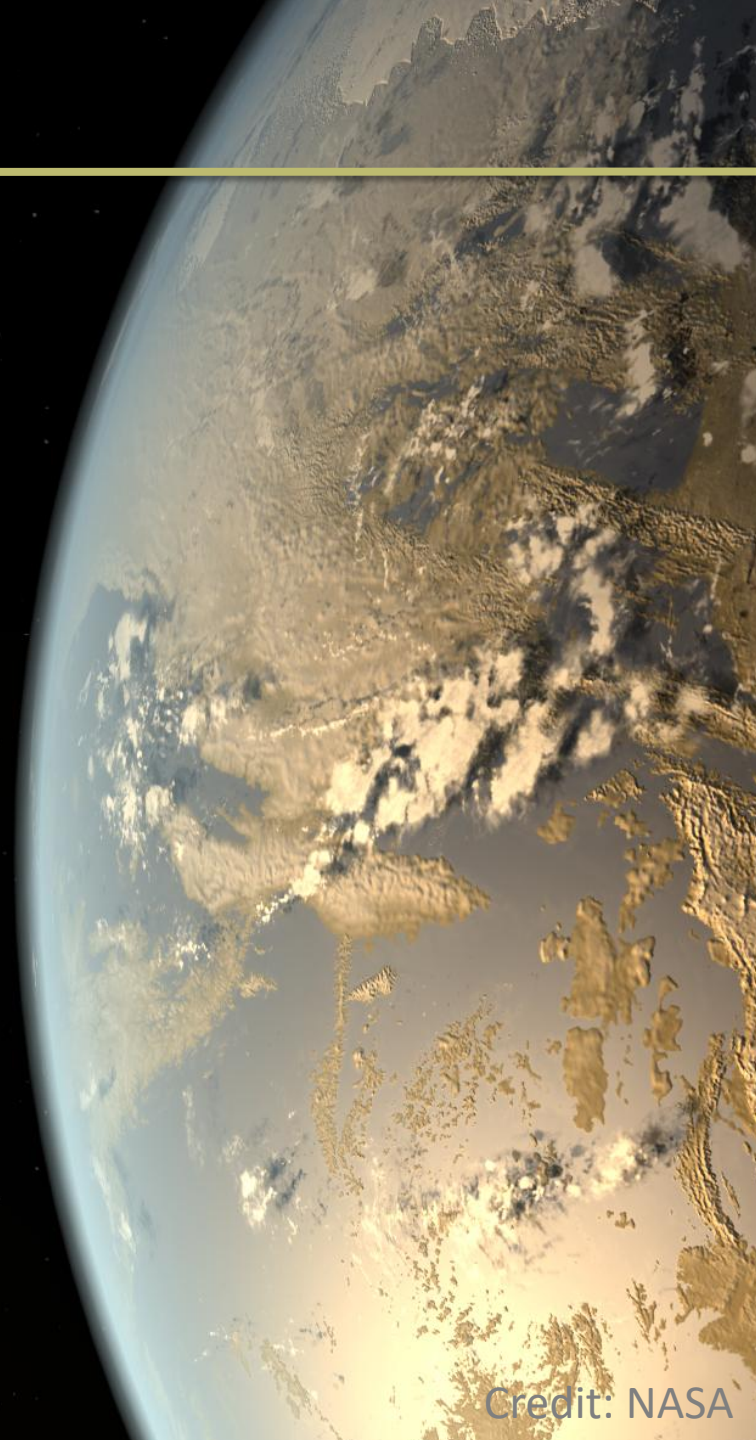
Credit: NASA

ExoPAG Executive Committee

ExoPAG activities and meetings are organized through an Executive Committee

Michael Meyer (Chair)	University of Michigan
Tom Barclay	University of Maryland
Jessie Christiansen	NExScI/Caltech
Rebecca Jensen-Clem	UC-Berkeley
Tiffany Kataria	JPL/Caltech
Eliza Kempton	*University of Maryland*
Josh Pepper	Lehigh University
Dmitry Savransky	Cornell
Chris Stark	Space Telescope Science Institute
Johanna Teske	*Carnegie Observatories*
Vikki Meadows (Past Chair)	University of Washington
Martin Still (ex officio)	NASA

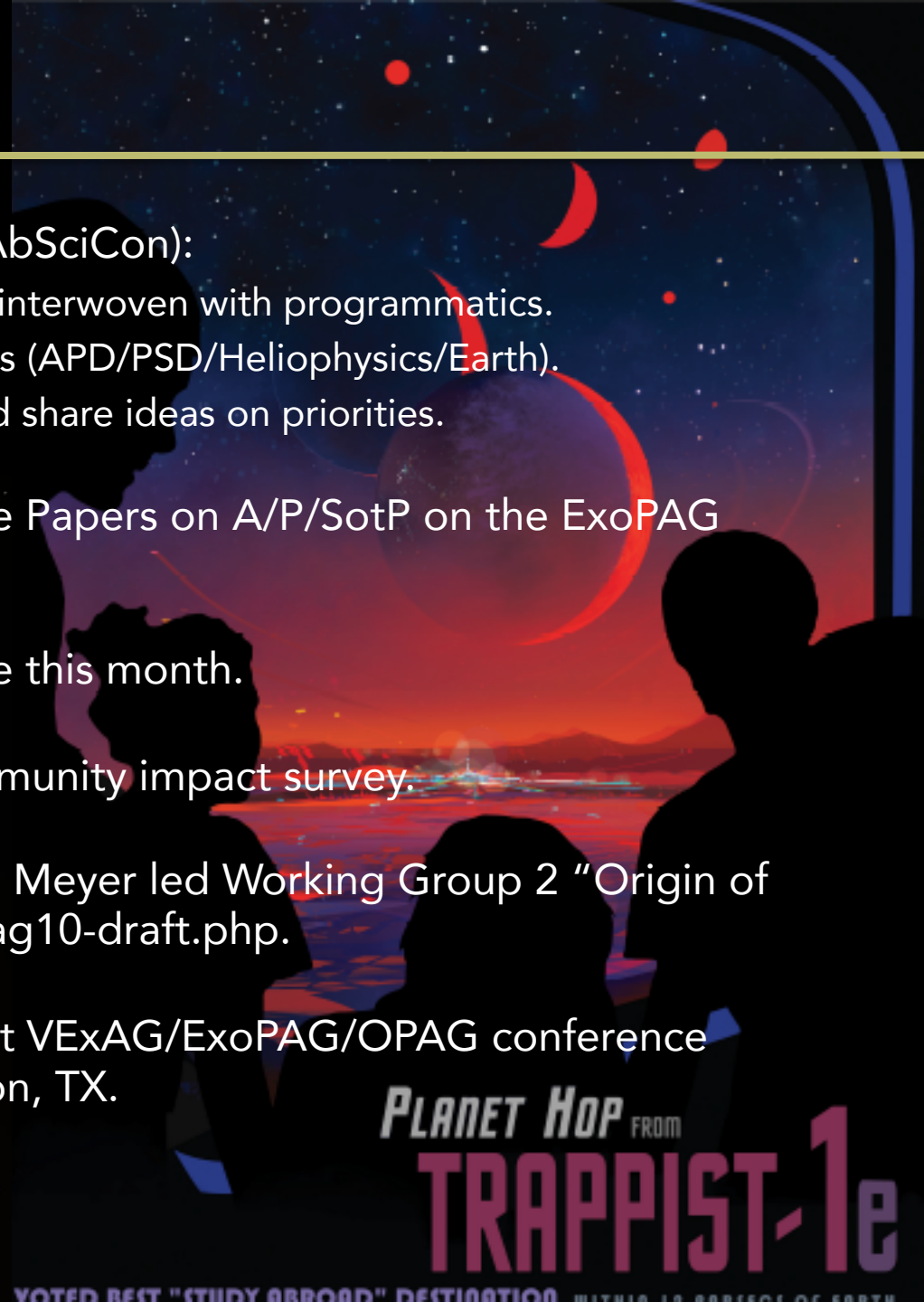
Nominations (self or others) for 3-year terms are due January 17!



Credit: NASA

ExoPAG Recent Activities

- Held the ExoPAG20 meeting in Seattle, June 23rd, 2019 (before AbSciCon):
  - Mini-science symposium on characterization of terrestrial exoplanets, interwoven with programmatics.
  - Programmatic theme of interdisciplinarity and cross-divisional activities (APD/PSD/Heliophysics/Earth).
  - The EC + ExEP met prior to the ExoPAG20 meeting to brainstorm and share ideas on priorities.
- Hosted spreadsheet for community coordination of Decadal White Papers on A/P/SotP on the ExoPAG website (14 papers listed, dozens of co-authors participated).
- SAG19 – D. Mawet and R. Jensen-Clem concluding data challenge this month.
- SAG20 – J. Teske and D. Deming completed the JWST delay community impact survey.
- ExoPAG participation in the Great Observatories cross-PAG SAG. Meyer led Working Group 2 "Origin of Planets and Life". Final report at https://cor.gsfc.nasa.gov/sags/sag10-draft.php.
- Meadows and Kataria serve as ExoPAG reps on the SOC for a joint VExAG/ExoPAG/OPAG conference "Exoplanets in Our Backyard", to be held Feb 5-7, 2020 in Houston, TX.



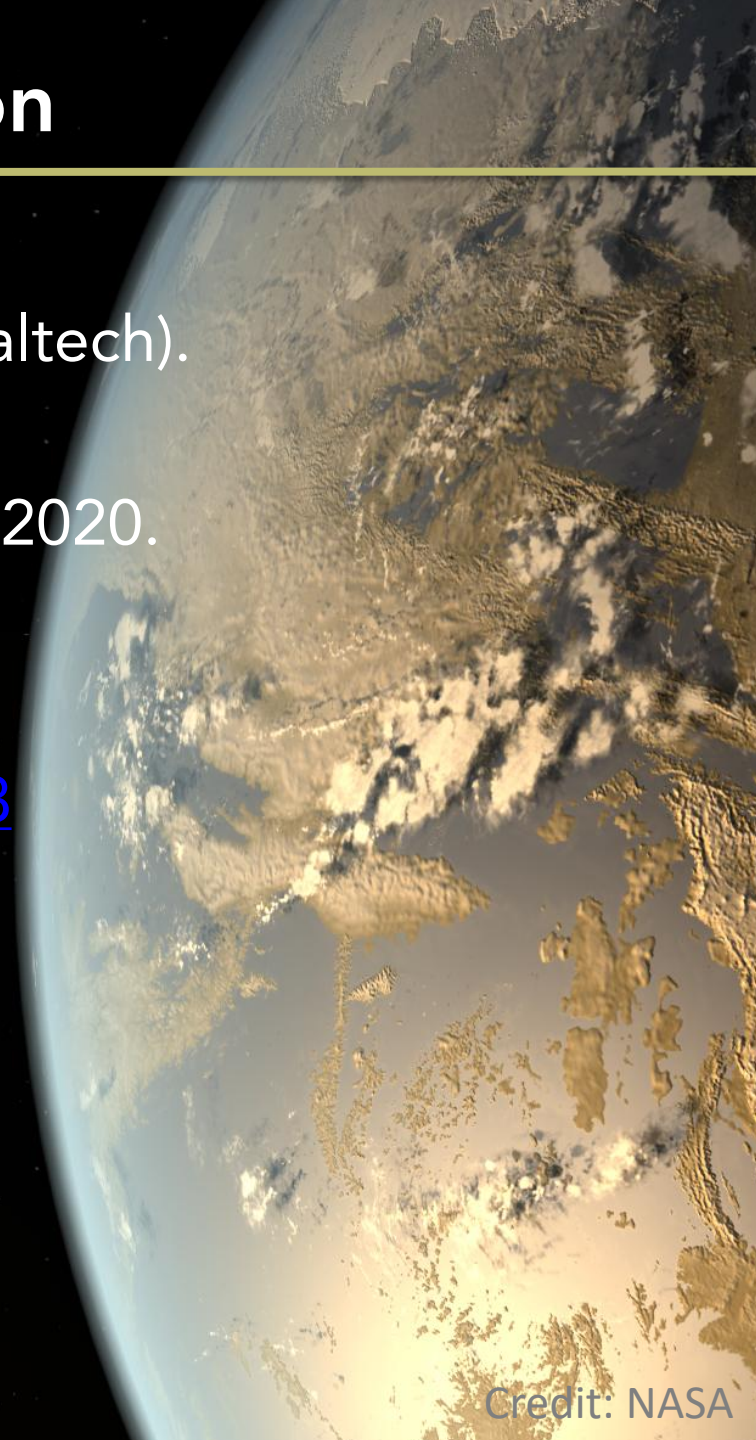
Current Status of SAGs and SIGs

Closeout Year	SAG or SIG	Title	Lead
--	SAG 19	Exoplanet imaging signal detection theory and rigorous contrast metrics (active - closeout expected in early 2020)	Mawet & Jensen-Clem
--	SIG 2	Exoplanet Demographics (on-going)	Christiansen & Meyer
--	SAG 20	Impact of JWST Delay on Exoplanet Science (closeout expected early 2020)	Teske & Deming
	SIG 3	Exoplanet Solar System Synergies (in formulation)	V. Meadows et al. – see slides in Business Meeting tomorrow.

Credit: NASA

SAG 19: Exoplanet Imaging Signal Detection

- Leads: Rebecca Jensen-Clem (EC) and Dimitri Mawet (Caltech).
- Direct Imaging Data Challenge extended to January 15. 2020.
  - https://exoplanet-imaging-challenge.github.io
  - https://competitions.codalab.org/competitions/20693
- Workshop to be held in Berlin, end of January:
  - For more information contact Rebecca Jensen-Clem (rjensenclem@berkeley.edu).
  - Final report to be issued this winter.



Credit: NASA

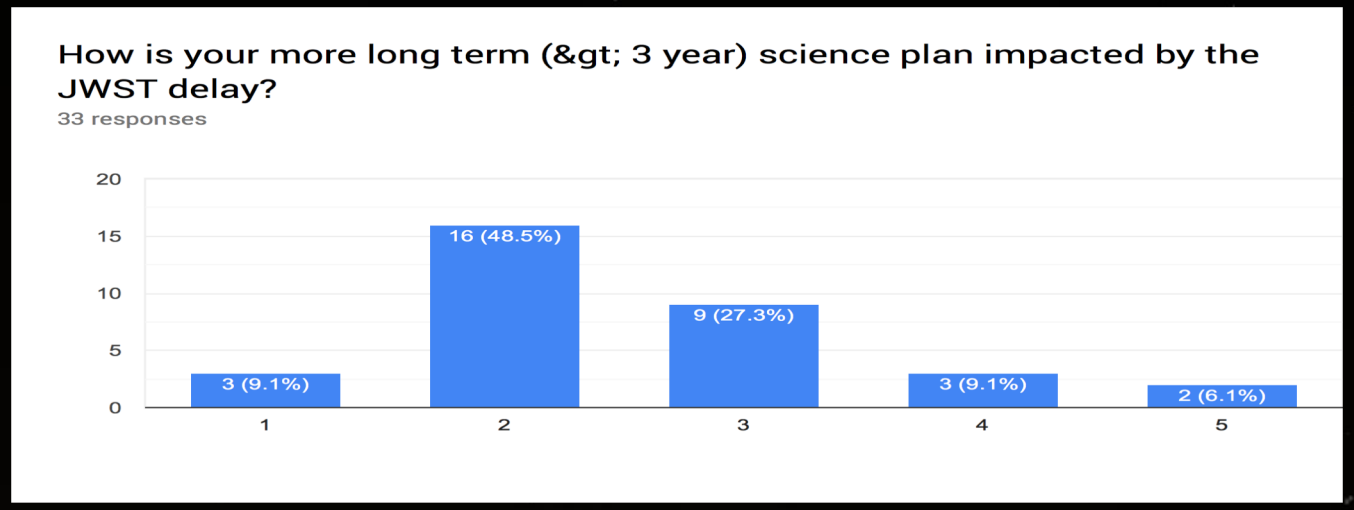
SIG 2 – Exoplanet Demographics

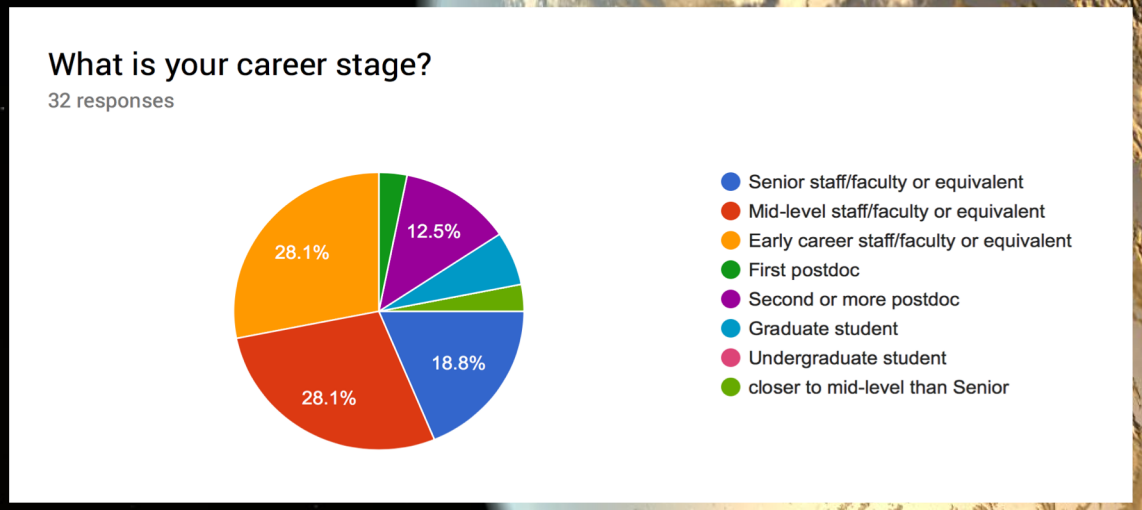
- **Leadership:** Christiansen & Meyer (EC) + Mulders & Bennett.
- **Motivation:** Exoplanet demographics reveal planet formation, migration and evolution processes, and are key to predicting the yields of future missions.
- **Goal:** To extend the Kepler-centric demographics of SAG13
- **Progress to date:**
  - Monthly telecons discuss new demographic results from multiple techniques (radial velocity, microlensing, transit, direct imaging).
  - Members prepared white paper for Astro2020 call.
  - Drafting report on value of public database of demographic products.
  - Curating a list of open questions/ongoing projects for the community.
  - Organized mini-symposium for this meeting!

Credit: NASA

SAG 20: Strategies for Mitigating the Impact of the JWST Delay on Exoplanet Science

- Leadership: Johanna Teske (ExoPAG EC) and Drake Deming (UMD)
- Survey Results: Adjustments being made by the community to prioritize ground-based observations and theory projects that will ultimately enhance JWST science observations, better target selection, analysis pipelines. Suggestions for mitigation include stepping up confirmation and characterization of TESS planets, community organization for large scale science projects, additional training in data analysis and retrieval, provision of simulated JWST data, and community venues to discuss data analysis techniques. Final report in preparation.



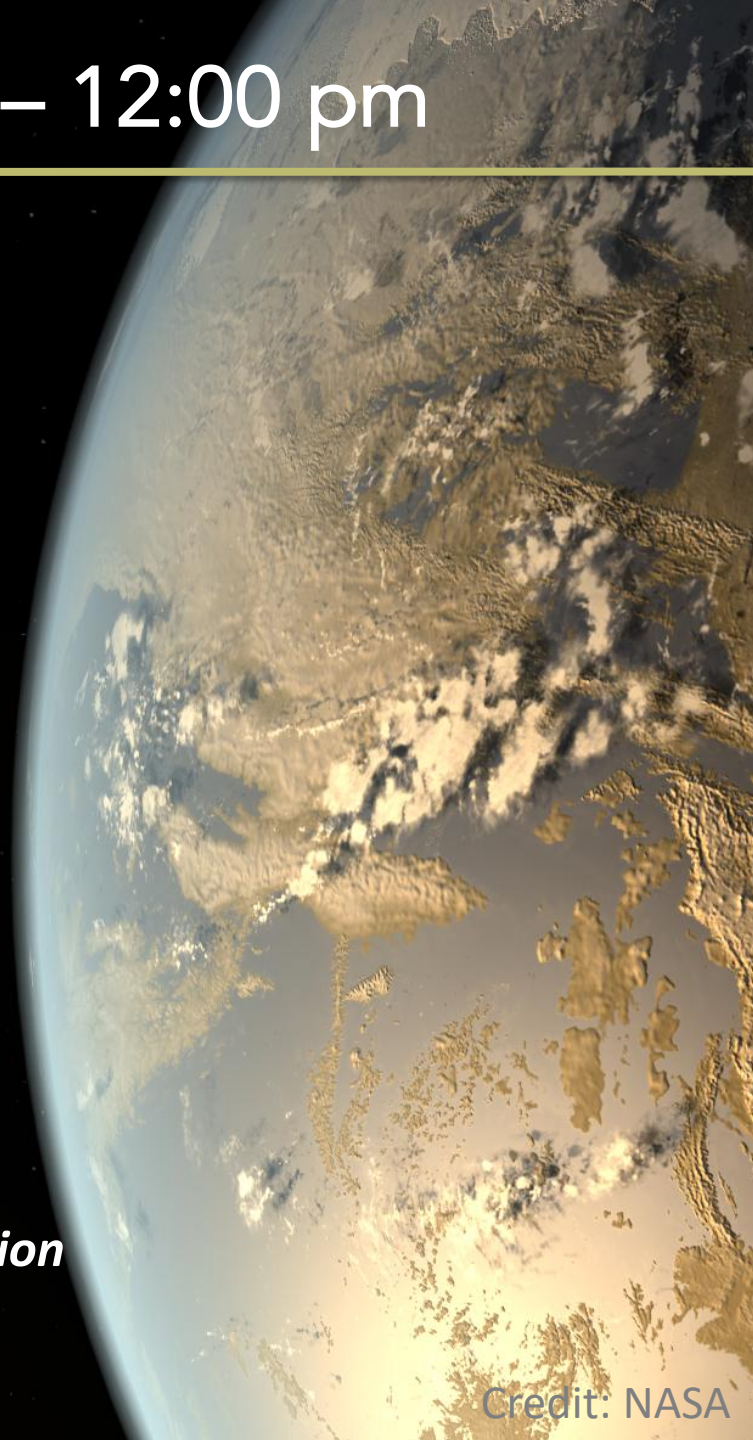


Credit: NASA

ExoPAG 21 Final Session: Saturday 10:40 am – 12:00 pm

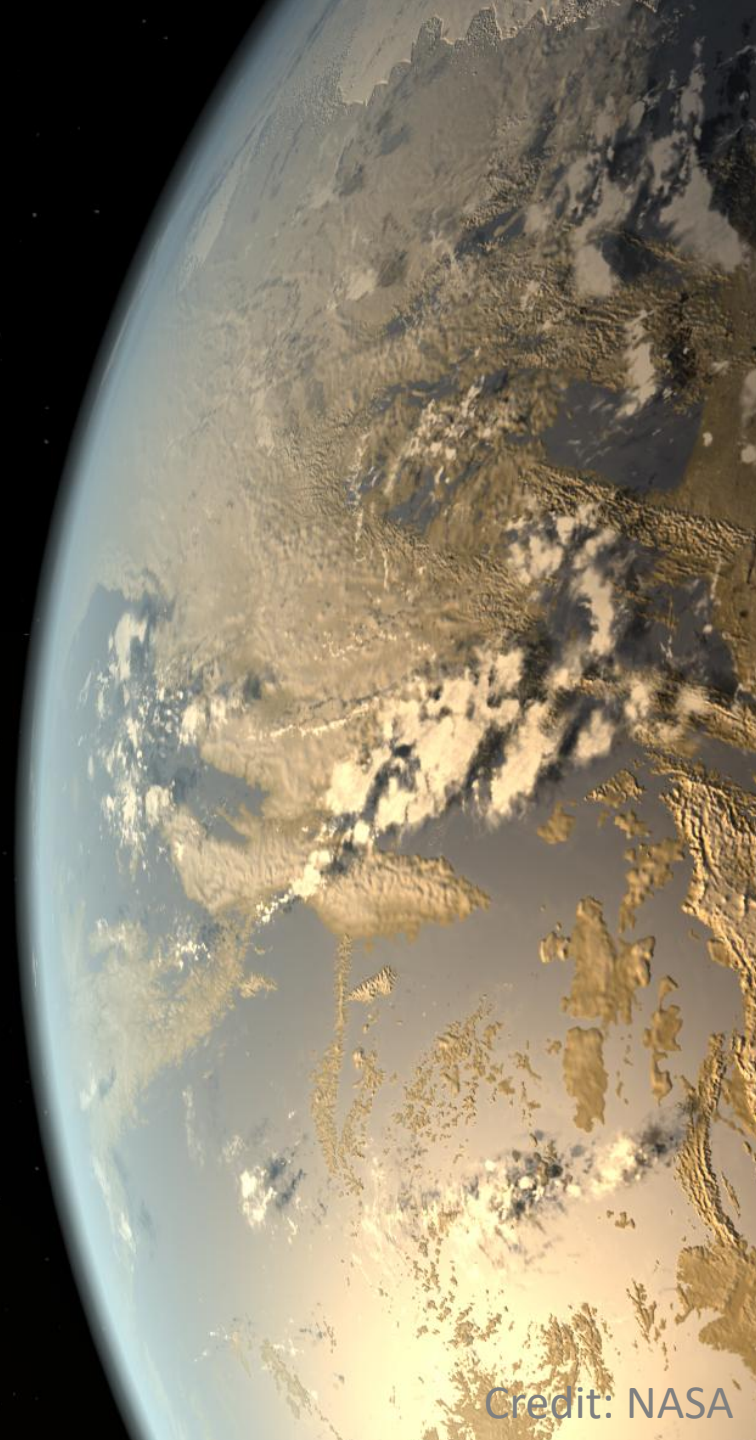
- Regular ExoPAG Business meeting.
- Feel free to share announcements for the community.
- Share new ideas for ExoPAG priorities and activities!
- Proposed discussion on potential “findings”:
  - **on the need for investment in databases to support programs related to achieving NASA’s strategic goals.**
  - **on the topic of ExoPAG providing and receiving input to/from other Divisions and programs on topics related to Exoplanets.**
  - **on the topic of evolution in the Exoplanet Research Program (XRP) outcomes and funding lines.**

Please see email 12-30-19 from E. Mamajek for full text of the topics for discussion (subject: Message from ExoPAG Chair)



Credit: NASA

Backup Slides



Credit: NASA

ExoPAG 20 Agenda
June 23, 2019 Bellevue, WA
Hyatt Regency Bellevue- Regency Room DEFG

See the ExoPAG website for remote connection info: https://exoplanets.nasa.gov/exep/events/270/exopag-20/
All times are PDT

		Session Chair	**Michael Meyer**
9:00	0:10	Welcome and Introduction to ExoPAG	Vikki Meadows
9:10	0:30	NASA Headquarters Update	Martin Still
9:40	0:15	Report Out On SAG20 (Survey on the Community Impact of the JWST Delay)	Drake Deming (remote)
9:55	0:20	Kepler Occurrence Rates and Eta Earth	Chris Burke
10:15	0:15	SIG2 Exoplanets Demographics Report	Jessie Christiansen
10:30	0:30	**Break**	
		Session Chair	**Jessie Christiansen**
11:00	0:20	ExEP Report on Future of Extreme Precision Radial Velocity	Eric Mamajek
11:20	0:30	Understanding Star-Planet Interactions and Space Weather, from X-ray to Radio	Rachel Osten (Remote)
11:50		**Lunch**	

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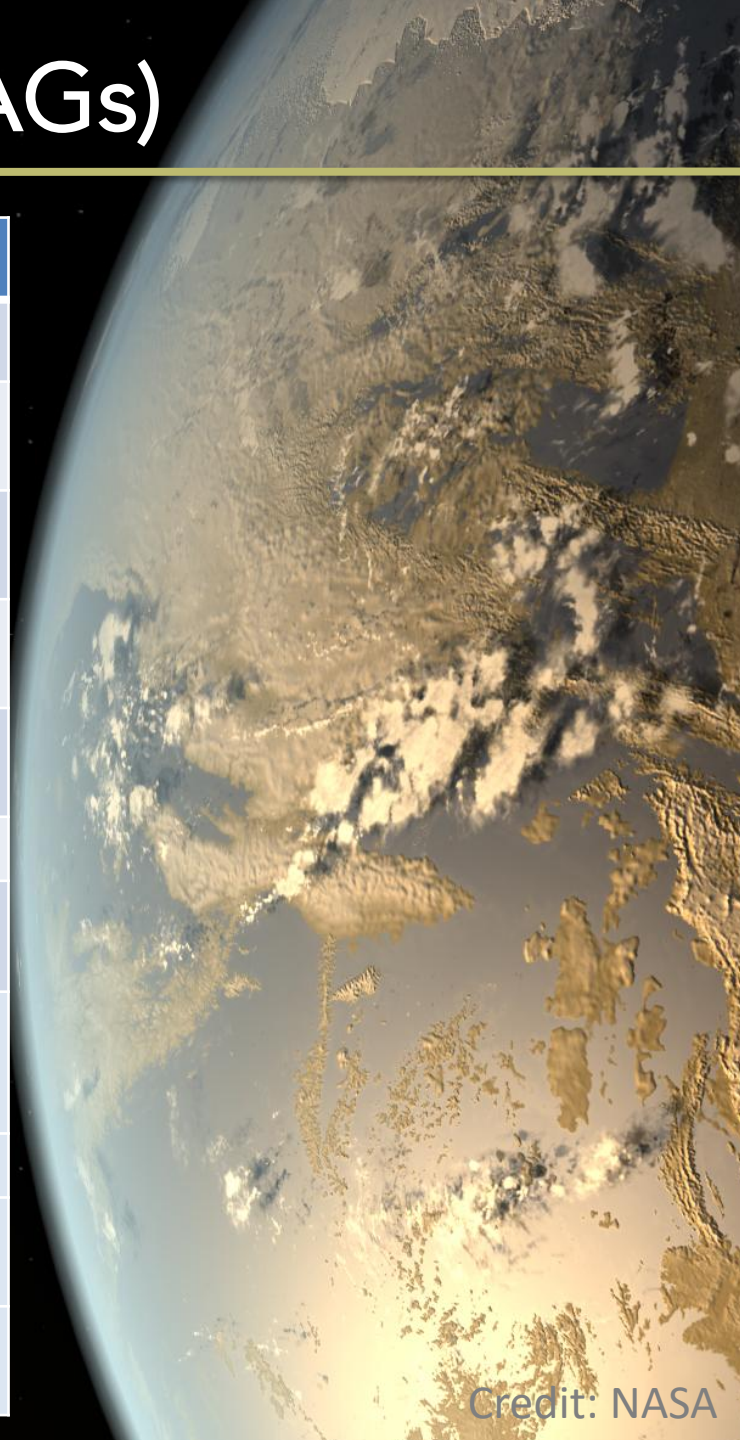
		Session Chair	**Vikki Meadows**
1:00	0:15	Observing Small Planets with JWST, Capabilities and Challenges	Natasha Batalha
1:15	0:15	The Detectability and Characterization of the TRAPPIST-1 Exoplanet Atmospheres with JWST	Jacob Lustig-Yaeger
1:30	1:00	Large Mission Concepts for Future Terrestrial Exoplanet Characterization: Overview and Discussion	Giada Arney, Scott Gaudi, Tiffany Kataria
2:30	0:30	ExEP Technology Report on Coronagraph Testbeds, Starshade, Detectors	Nick Siegler
3:00	0:30	**Break**	
		Session Chair	**Chris Stark**
3:30	0:30	Discussion of Community Needs for Molecular Opacities/Laboratory Astrophysics	Eliza Kempton and Natasha Batalha
4:00	0:40	VExAG/OPAG/ExoPAG Synergies	Vikki Meadows, Stephen Kane, Kathy Mandt
4:40	1:00	Science Gap List Discussion and General Suggestions	Karl Stapelfeldt, Vikki Meadows, Gary Blackwood
5:40		Adjourn	

If you have input on the Science Gap List, or suggestions on new activities or exoplanet community needs for the ExoPAG you can raise them in the 4:40 question session, or write them down in the ExoPAG Suggestions Google Doc, which can be found on the ExoPAG website!

11 Completed Study Analysis Groups (SAGs)

Year	SAG	Title	Lead
2012	1	Debris Disks & Exozodiacal Dust	Roberge
2010	2	Potential for Exoplanet Science Measurements from Solar System Probes	Bennett, Coulter
2013	5	Exoplanet Flagship Requirements and Characteristics	Noecker, Greene
2015	8	Requirements and Limits of Future Precision Radial Velocity Measurements	Latham, Plavchan
2015	9	Exoplanet Probe to Medium Scale Direct-Imaging Mission Requirements and Characteristics	Soummer
2015	10	Characterizing the Atmospheres of Transiting Planets with JWST and Beyond	Cowan
2014	11	Preparing for the WFIRST Microlensing Survey	Yee
2017	12	Scientific potential and feasibility of high-precision astrometry for exoplanet detection and characterization.	Bendek
2017	13	Exoplanet Occurrence Rates and Distributions (closed out since last June)	Belikov
2017	15	Exploring Other Worlds: Observational Constraints and Science Questions for Direct Imaging Exoplanet Missions (closed out since June)	Apai
2017	18	Metrics for Direct-Imaging with Starshades (closed out since last June)	Glassman & Turnbull



SAG 13: Exoplanet Occurrence Rates and Distributions (Rus Belikov, Chair)

Key objectives and questions:

1. Propose standard nominal conventions, definitions, and units for occurrence rates/ distributions to facilitate comparisons between different studies.
2. Do occurrence estimates from different teams/methods agree with each other to within statistical uncertainty? If not, why?
3. For occurrence rates where extrapolation is still necessary, what values should the community adopt as standard conventions for mission yield estimates?

Recent Progress:

- Computation/crowdsourcing of eta tables
- 11 participants submitted tables so far
- Latest estimates of occurrences of potentially habitable planets seem to be converging (at least to a factor of ~2-3), and explanations for discrepancies are starting to clarify
- Expected product in mid 2017: estimates of occurrence rates

SAG 16: Biosignatures (Shawn DomagalGoldman, Nancy Kiang, and Niki Parenteau, Co-Chairs)

Science Goals

We seek to answer 3 broad questions:

1) What are known remotely observable biosignatures, the processes that produce them, and their known nonbiological sources?

2) How can we identify additional biosignatures, and a more comprehensive framework for biosignature assessment?

3) What are the requirements for detecting these biosignatures to different levels of confidence?

A 3-day workshop was held on July 27-29, 2016, along with the NASA Astrobiology Institute (NAI) and the Nexus for Exoplanet System Science (NExSS). Plan is to draft a SAG report and a peer-reviewable paper by mid 2017, invite review and commentary from the community, and submit final SAG report by end of 2017.

SAG 17 – Community Resources Needed for K2 and TESS Planetary Candidate Confirmation (David Ciardi and Joshua Pepper, Co-Chairs)

- SAG 17 will study and enumerate the resources needed by the community to effectively and efficiently validate as many K2 and TESS candidates as possible, and propose methods to allow the community to coordinate and self-organize the process.
- Specific goals of SAG 17 include the following:
- Identify needed follow-up observations for K2 and TESS including but not limited to imaging, spectroscopy, and time-series follow-up
- Identify telescopes, instrument, and financial resources available to the US community
- Identify how archival resources can be utilized (e.g., Gaia)
- Identify how the community can be organized and communication facilitated particularly with regards TESS full frame images, candidate identification, single transiting events, and candidate prioritization.
- Identify needs to ensure efficient and effective characterization with JWST (and WFIRST)
- Identify connections to other SAG efforts (e.g., SAGs 15 and 16)

SAG 19 – Exoplanet Imaging Signal Detection Theory and Rigorous Contrast Metrics (Dimitri Mawet and Rebecca Jensen-Clem, Co-Chairs)

- Go back to the basics of Bayesian Signal Detection Theory (SDT), i.e., H0:signal absent / H1:signal present hypothesis testing.
- Rebuild a solid set of usual definitions used for or in lieu of “contrast” in different contexts, such as astrophysical contrast or ground truth, instrumental contrast used for coronagraph/instrument designs, and the measured onsky datadriven contrast.
- Identify what we can learn and apply from communities outside our field (e.g. medical imaging: receiver operating characteristic (ROC) curve).
- Define precise contrast computation and ROC curve computation recipes, a new “industry standard”.
- Identify how the new metrics and recipes can be used to define confidence levels for detection (H1) and subsequently error bars for photometric, spectroscopic, astrometric characterization.
- Perform a community data challenge before and after applying our proposed set of standardized SDT rules and recipes, and apply lessons learned.

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- Nominations (self/colleagues) for ExoPAG EC due 1-17-20!
- Announcements: Proposed SIG3 charge (V. Meadows). Other?
- Review actions/share new ideas for ExoPAG priorities and activities.
- Proposed discussion on potential "findings":
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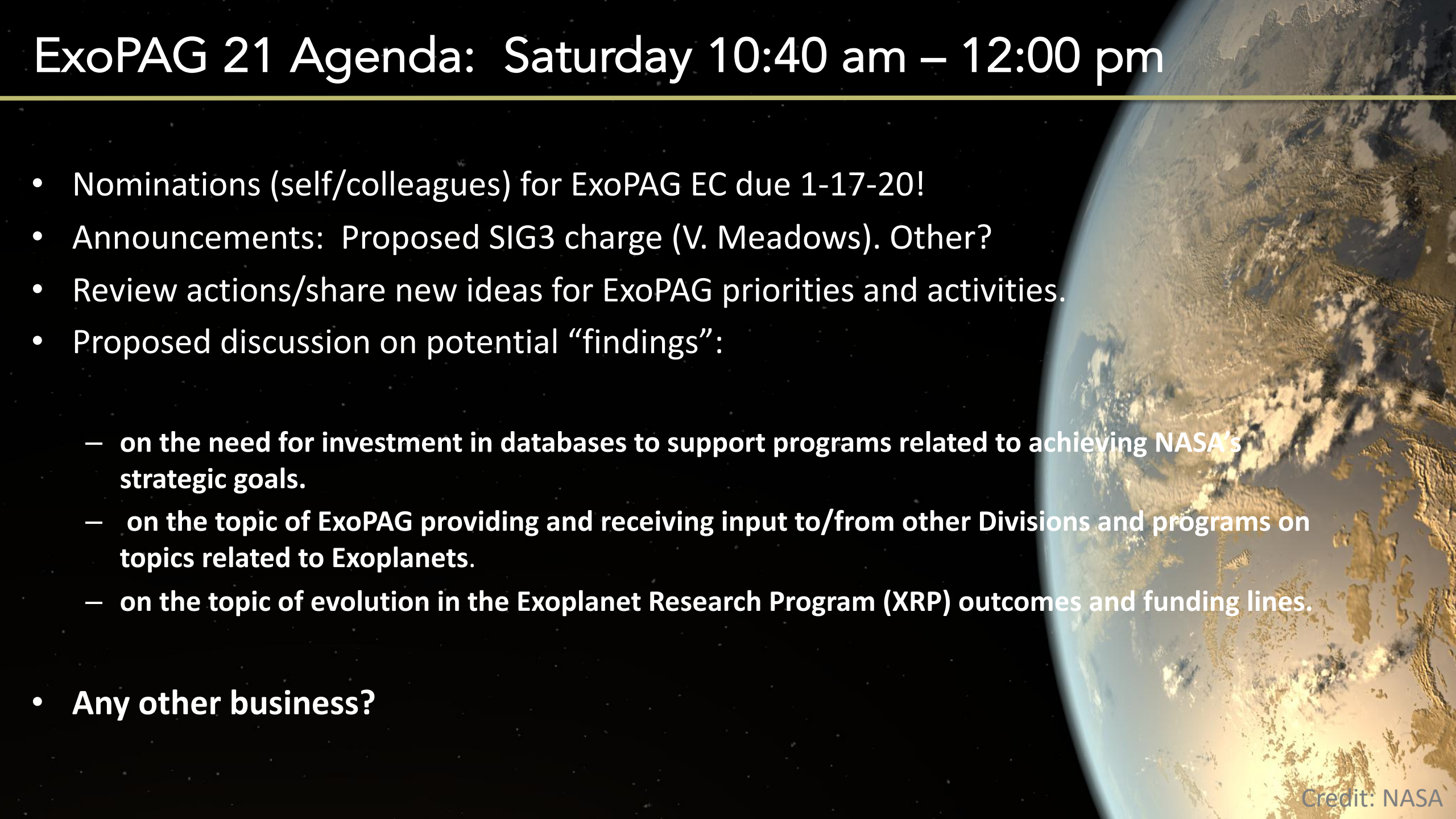
  - **on the topic of evolution in the Exoplanet Research Program (XRP) outcomes and funding lines.**
- **Any other business?**



Credit: NASA

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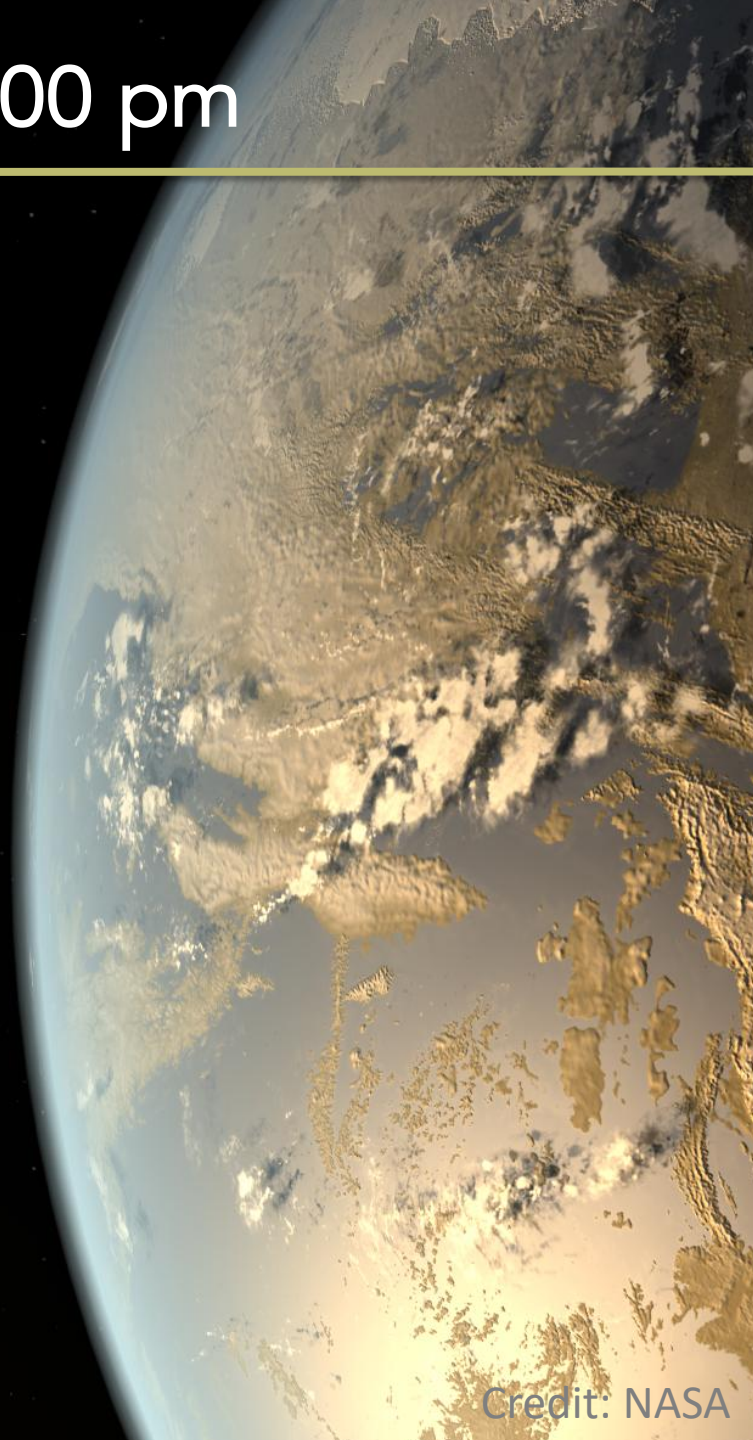
- Insert slides from Vikki and Gary here.



Credit: NASA

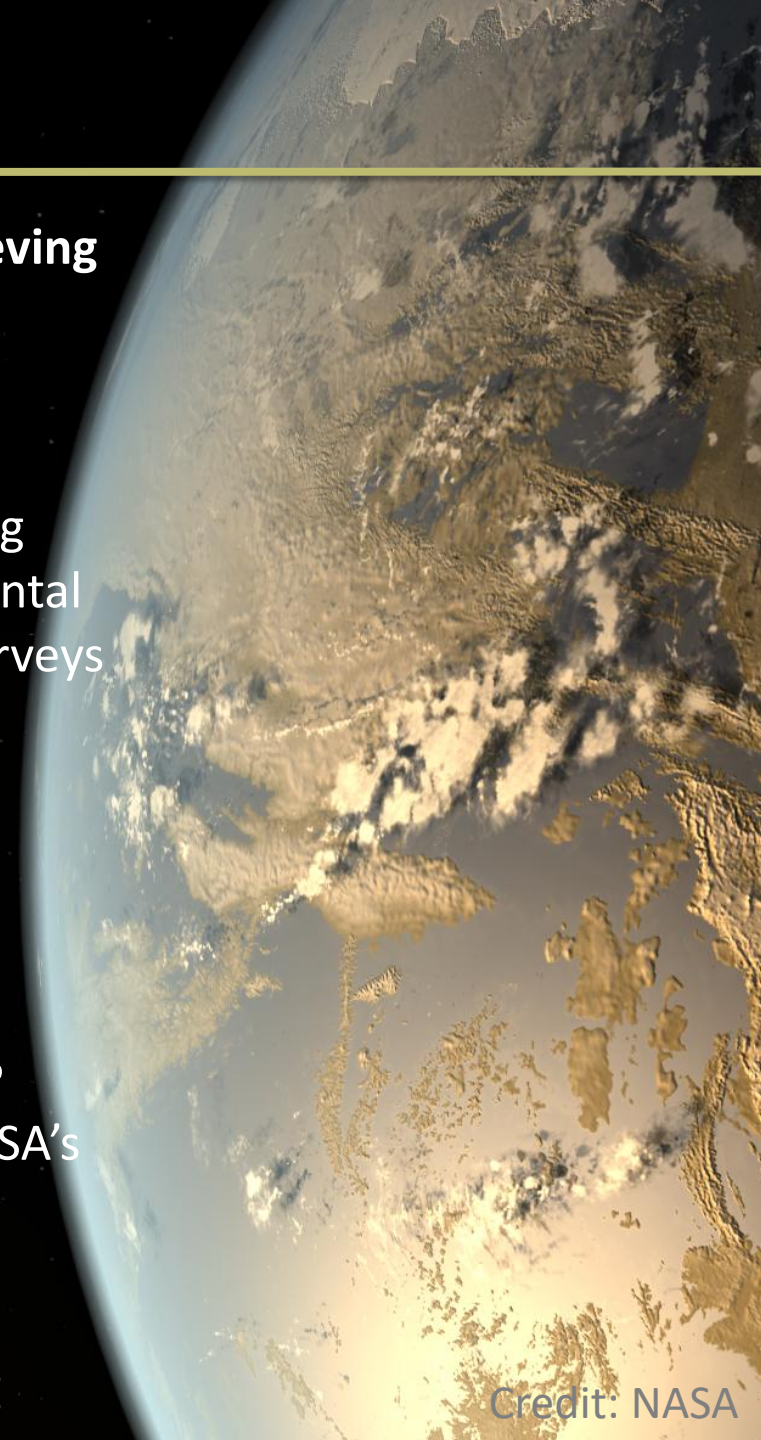
ExoPAG 21 Proposed Findings #1:

on the need for investment in databases to support programs related to achieving NASA's strategic goals.

Whereas future direct imaging missions will likely observe a limited number of nearby target stars, and whereas each mission has different criteria for selecting targets, and whereas a comprehensive database of the physical and environmental properties of all nearby stars and their planetary systems could make future surveys more efficient (e.g. understanding the multiplicity or composition of potential targets given apparent correlations between these properties and exoplanet demographics), perhaps more cost effective, and probably lower risk,

We find that assembling such an archive can potentially save significant NASA resources, and would help future missions address specific questions (e.g. ExEP Science Gaps 06, 07, and 10) which will contribute significantly to achieving NASA's strategic goals.

More info: https://docs.google.com/document/d/1Dj5IQknwR-f_bMpKJhLaBB2puozVXmRwtR-XTUeJRk8/edit?ts=5e0a98ea



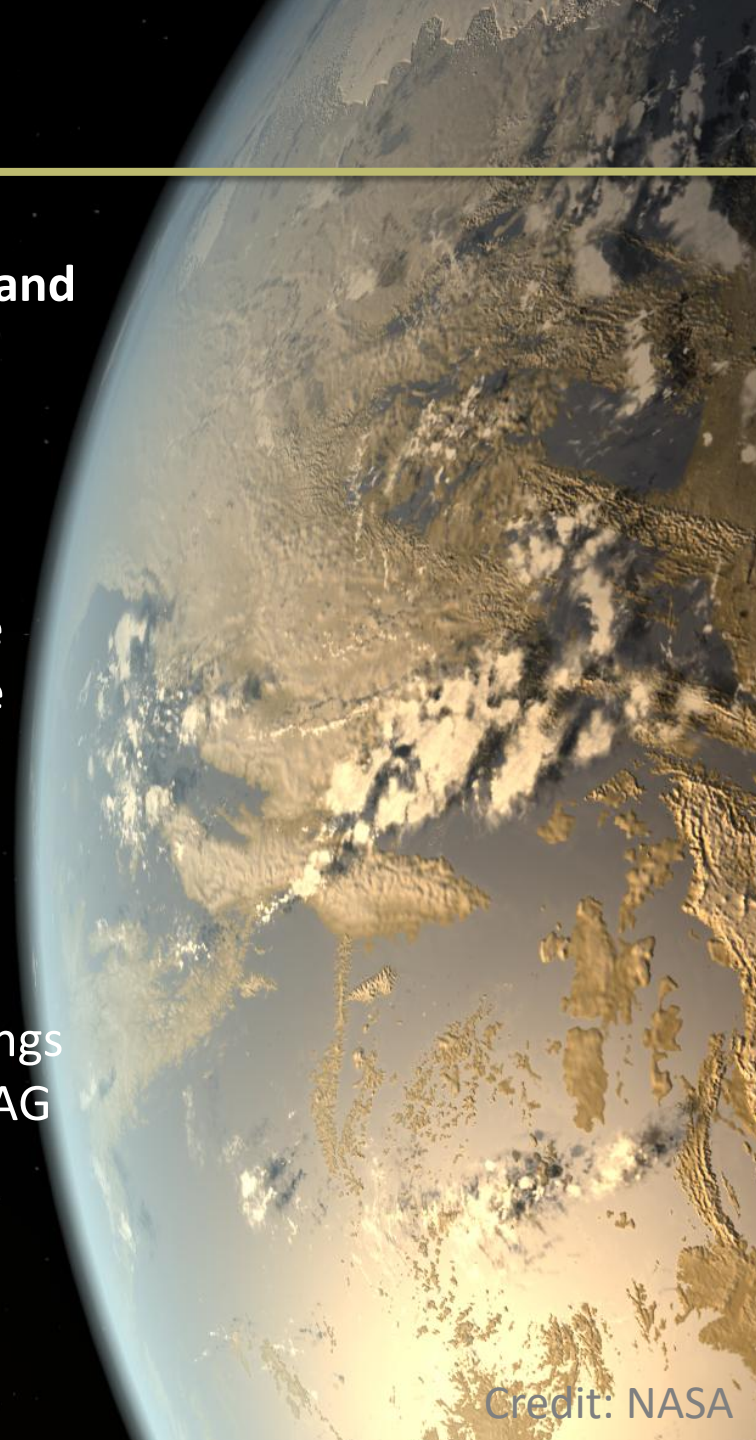
Credit: NASA

ExoPAG 21 Proposed Findings #2:

on the topic of ExoPAG providing and receiving input to/from other Divisions and programs on topics related to Exoplanets.

Whereas ExoPAG is inherently an interdisciplinary research community whose expertise and interests are relevant to some programs covered by the Earth Science, Heliophysics, Planetary Science, and Astrophysics Divisions, and whose science could benefit from expertise within these programs, and whereas some programs administered by NASA, such as XRP, draw resources from multiple divisions, and whereas new initiatives, such as the Lunar Development and Analysis Program, could benefit from input from communities such as ExoPAG,

We find that multiple audiences would benefit from receiving reports and findings generated by the ExoPAG to help shape their research programs, and that ExoPAG would benefit from receiving relevant reports and findings from other Program Analysis, Analysis, and Assessment Groups.



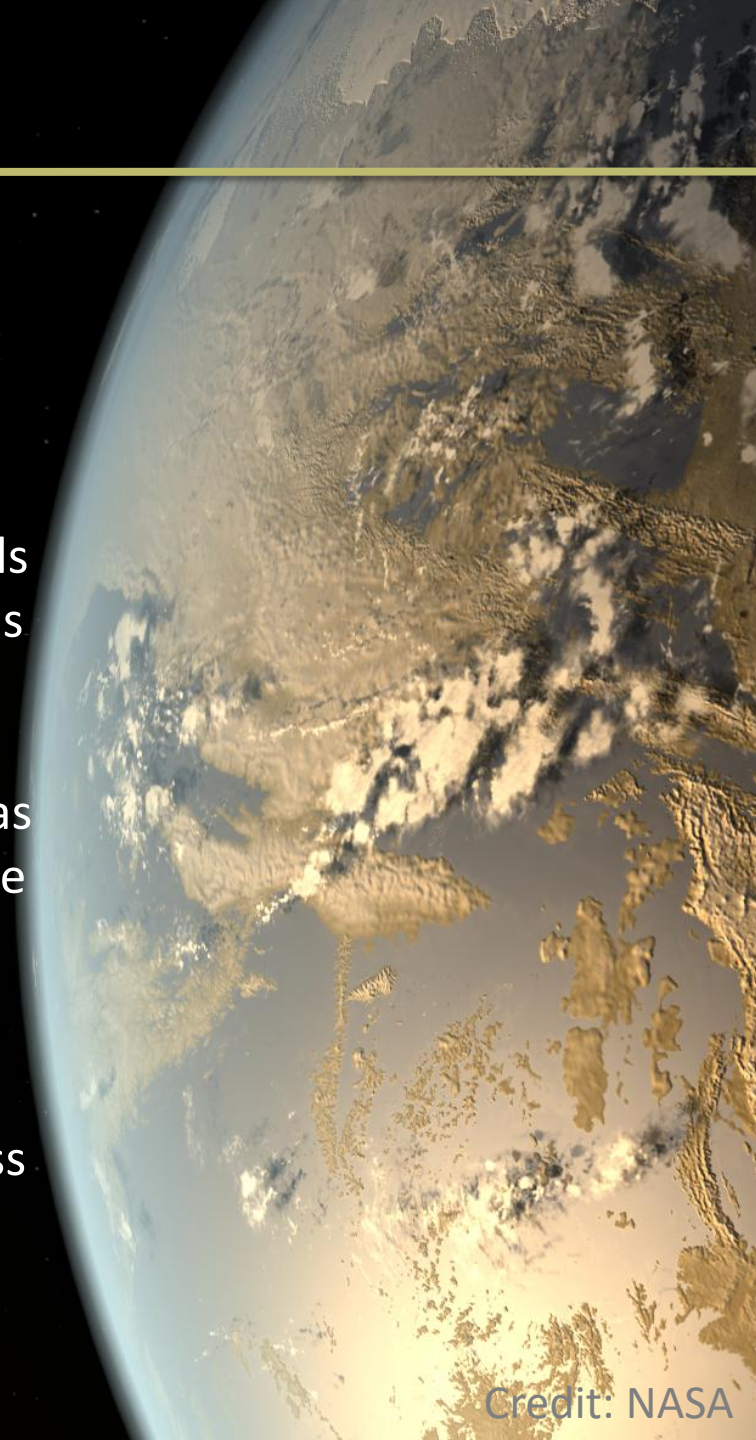
Credit: NASA

ExoPAG 21 Proposed Findings #3:

on the topic of evolution in the Exoplanet Research Program (XRP) outcomes and funding lines.

Whereas the Exoplanet Research Program (XRP) has been one of NASA's most successful R&A programs in addressing critical elements of NASA's strategic goals specifically related to exoplanet science, and whereas the research community is growing and dynamic having the highest rate of new NASA R&A PIs of any other program, and whereas the success rate has dropped to the lowest rate of any other R&A program (with the exception of the FINESST fellowships), and whereas the funding mechanisms, as well as the scope of the calls, are expected to evolve in the coming year as other divisions participate,

We find that close monitoring of the program, scrutiny of success rates, along with feedback from and communication with the community would help address concerns within the community during this evolution and ensure a healthy and robust program.



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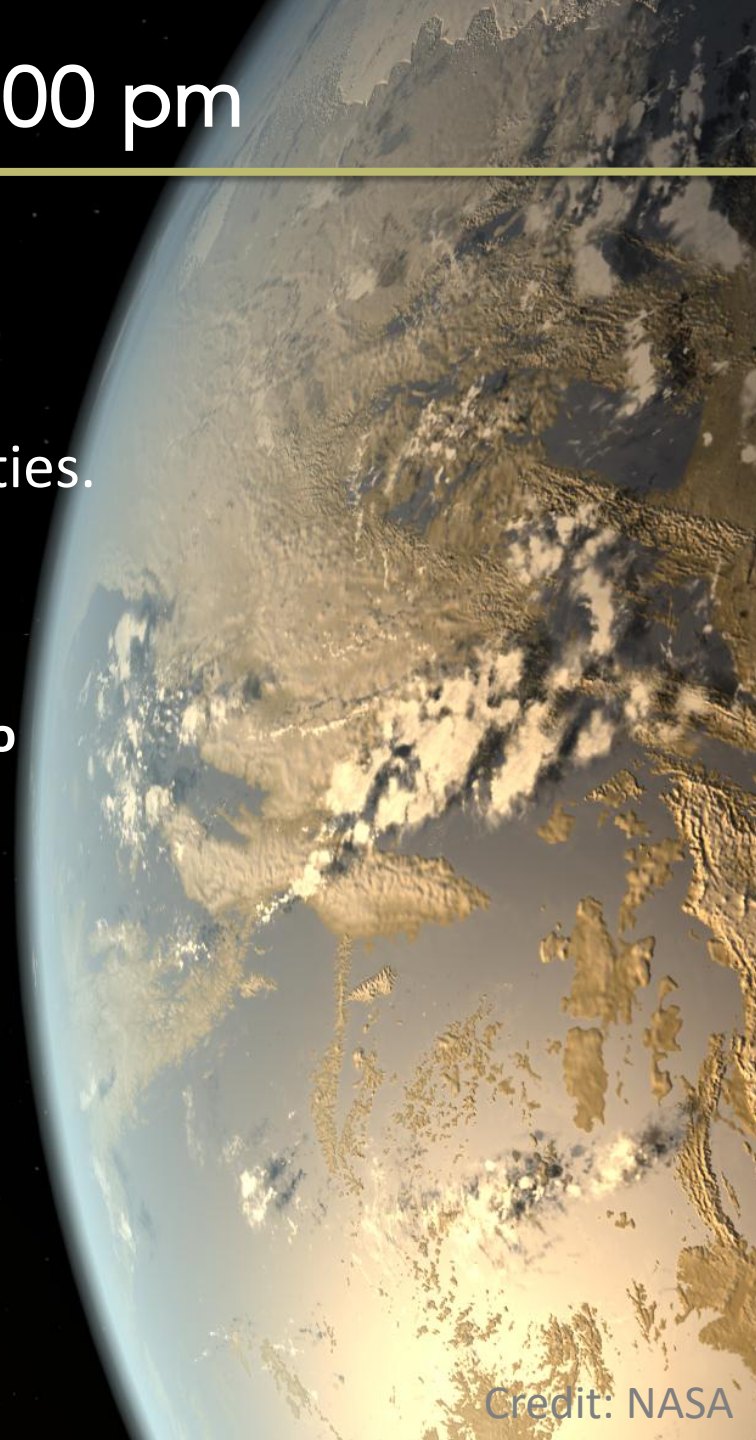
- **Any other business?**
  - **Next ExoPAG planned for mid-July in Pasadena, CA.**



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