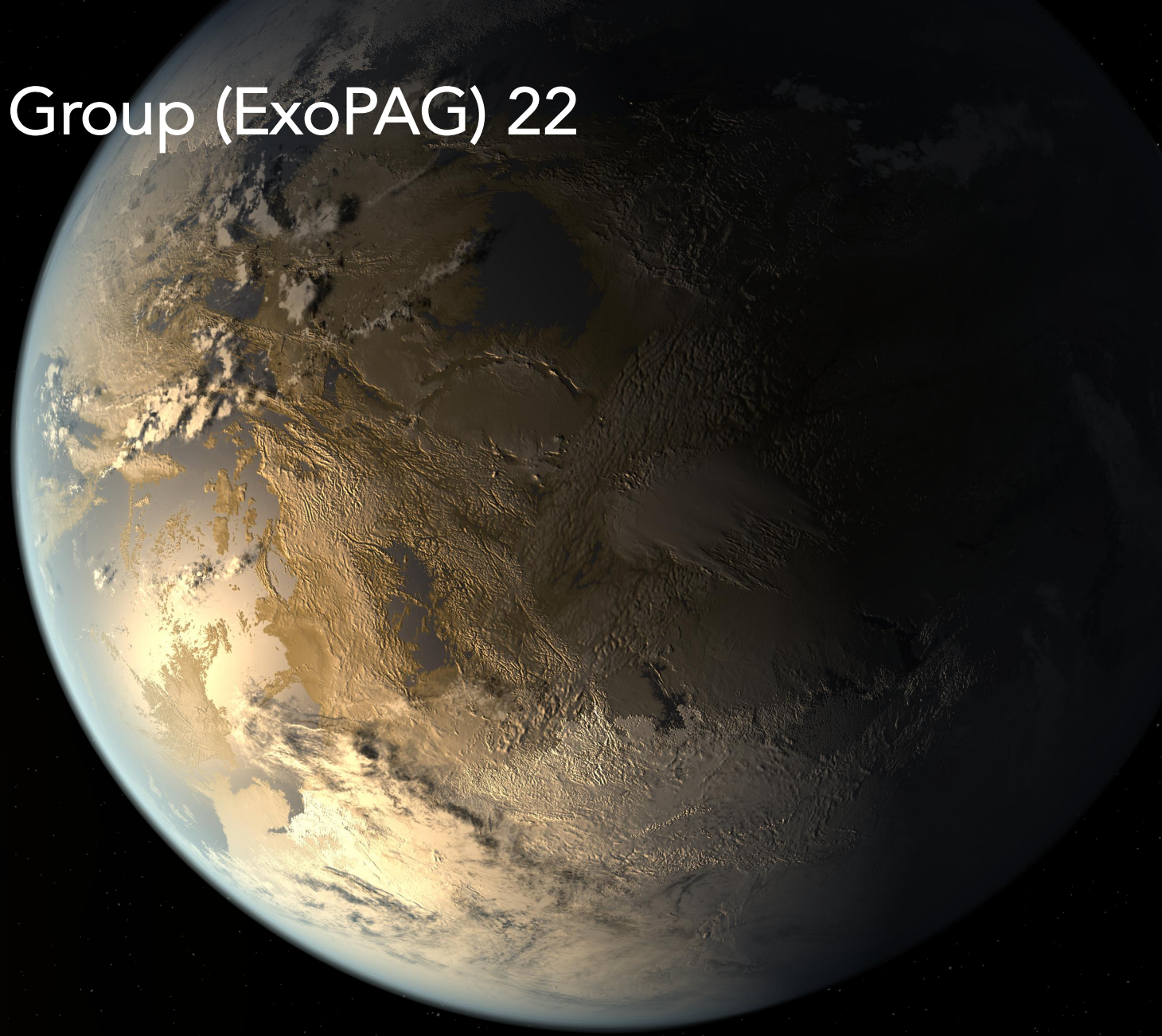
Exoplanet Program Analysis Group (ExoPAG) 22

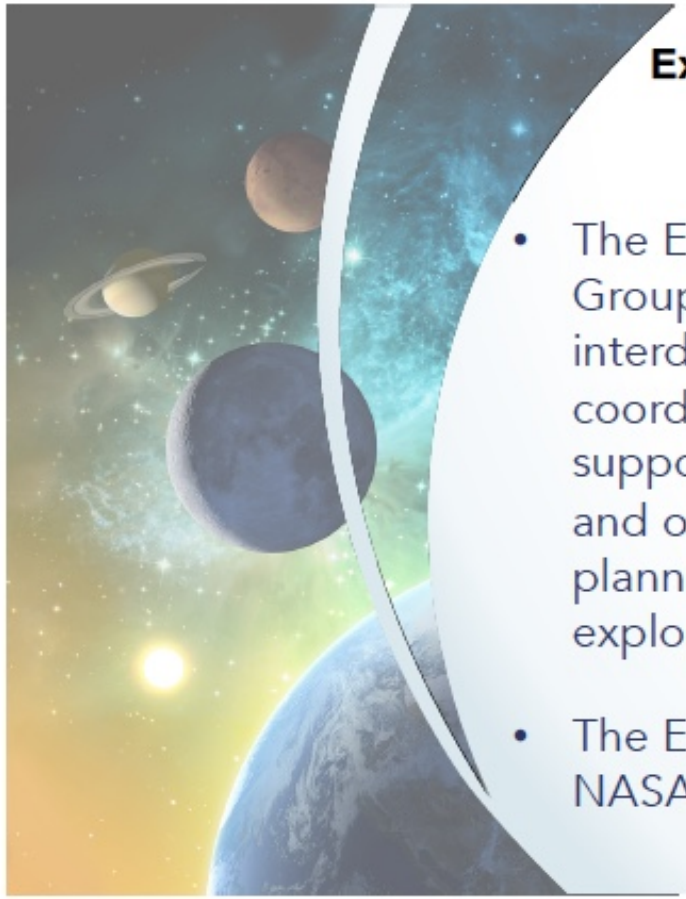


Michael Meyer (U. Michigan)
Chair, ExoPAG Executive Committee

June 18-19, 2020

Credit: NASA

Exoplanet Program Analysis Group: What is that anyway?



Exoplanet Program Analysis Group (ExoPAG)

https://exoplanets.nasa.gov/exep/exopag/overview

- The Exoplanet Exploration Program Analysis Group (ExoPAG) is a community-based, interdisciplinary forum for soliciting and coordinating community analysis and input in support of Exoplanet Exploration objectives, and of their implications for architecture planning and activity prioritization for future exploration.
- The ExoPAG reports findings of analyses to the NASA Astrophysics Division Director.

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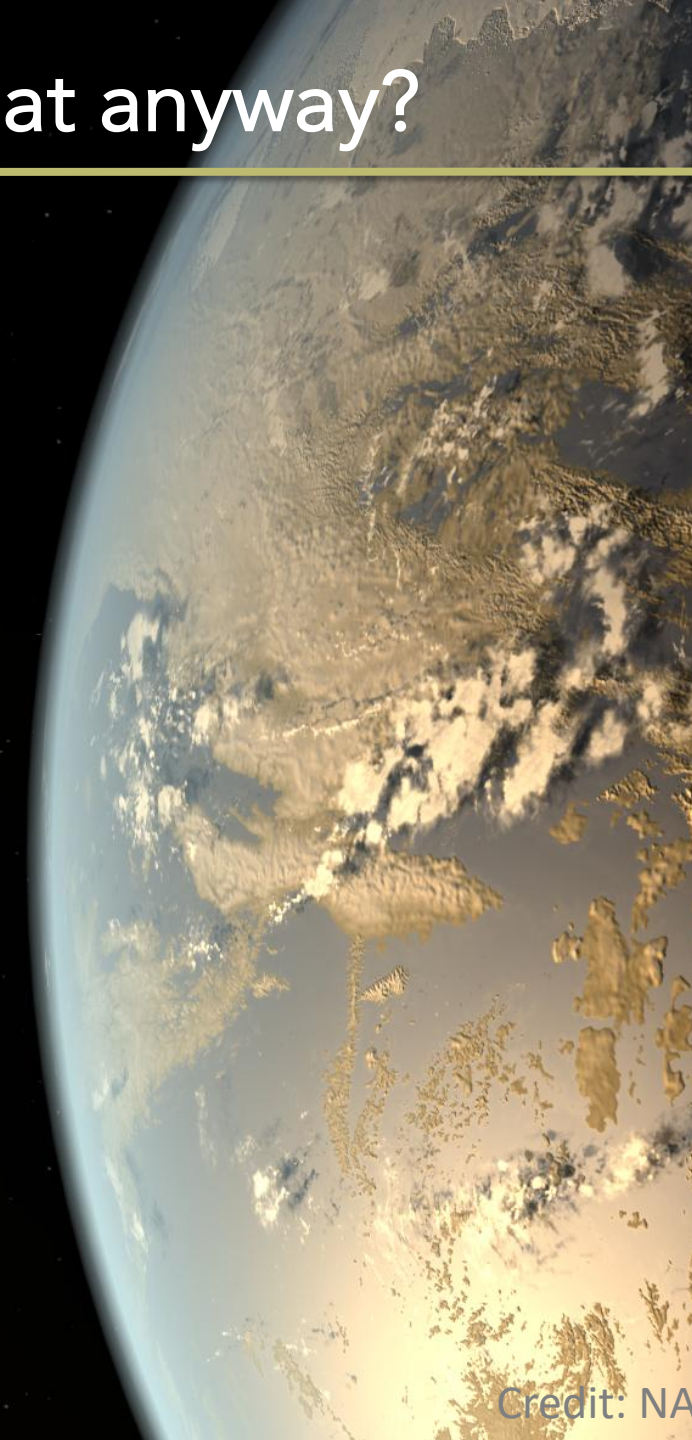

Credit: NA

Exoplanet Program Analysis Group: What is that anyway?

The Exoplanet Program Analysis Group (ExoPAG)

- The ExoPAG could be tasked to carry out one or more of the following:
  - Articulate and prioritize the key scientific drivers for Exoplanet Exploration research;
  - Evaluate the expected capabilities of potential ExEP missions for achieving the science goal of the program
  - Evaluate ExEP goals, objectives, investigations, and required measurements on the basis of the widest possible community outreach;
  - Articulate and prioritize focus areas for needed mission technologies; and
  - Provide findings on related activities that support the program, such as ground-based observing, theory and modeling programs, laboratory astrophysics, suborbital investigations, data archiving, and community engagement.

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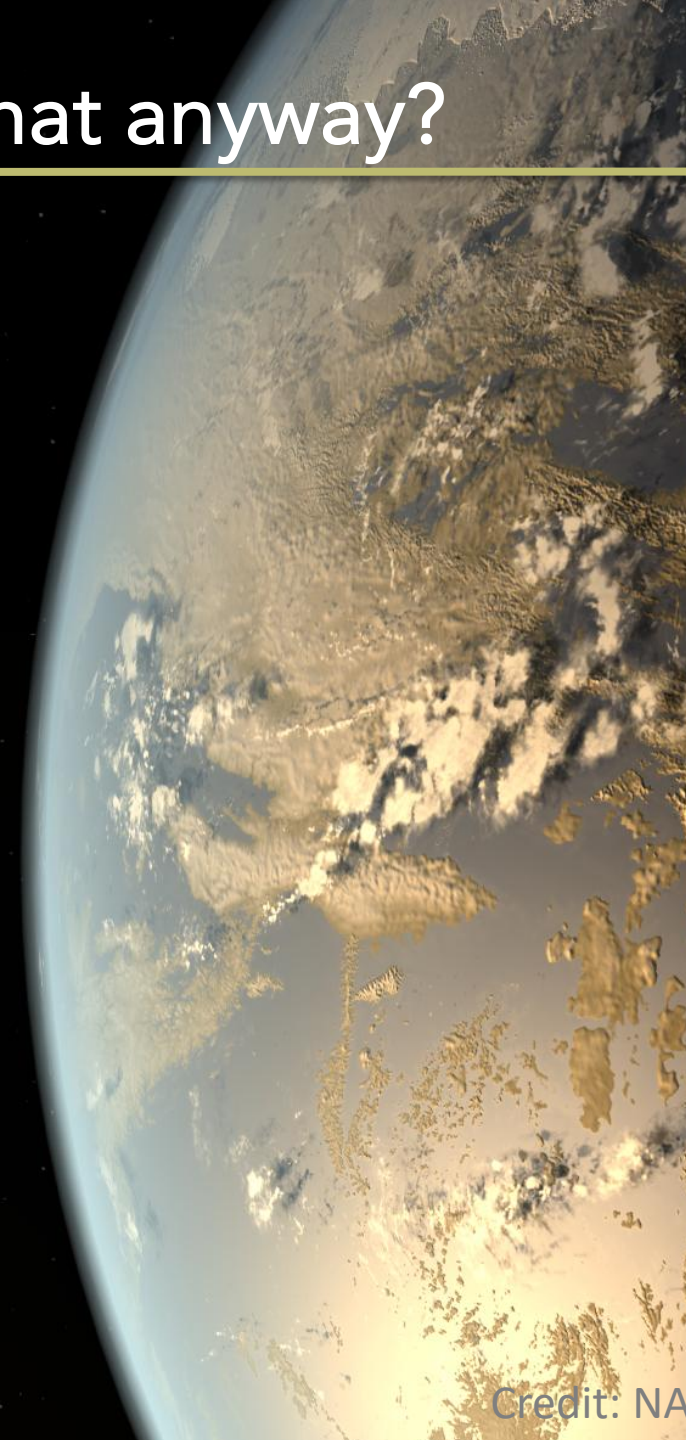

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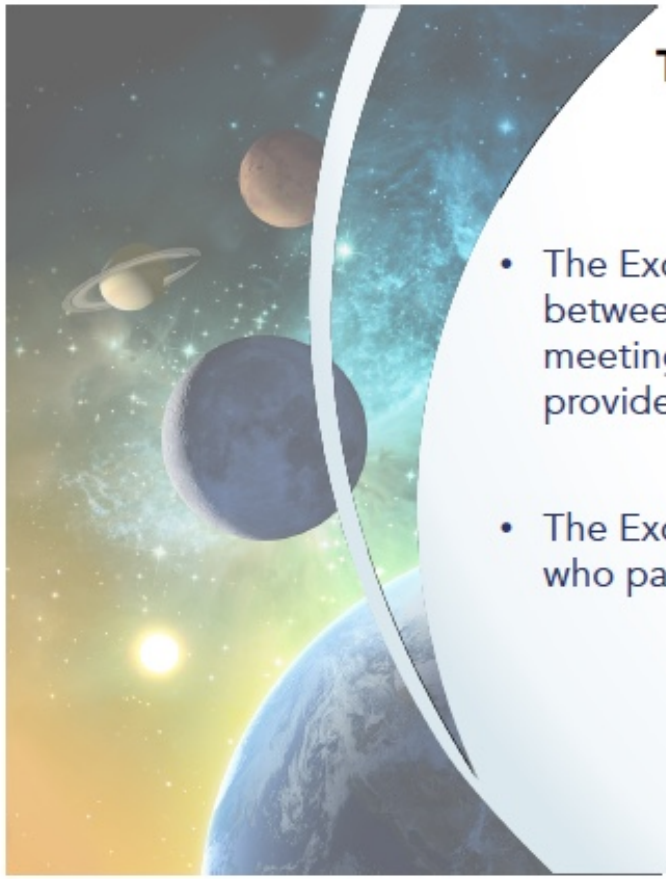
Exoplanet Program Analysis Group: What is that anyway?



The Exoplanet Program Analysis Group (ExoPAG)

- The ExoPAG enables direct regular communication between NASA and the community through public meetings that give the community opportunities to provide scientific and programmatic input.
- The ExoPAG consists of all members of the community who participate in these open meetings.

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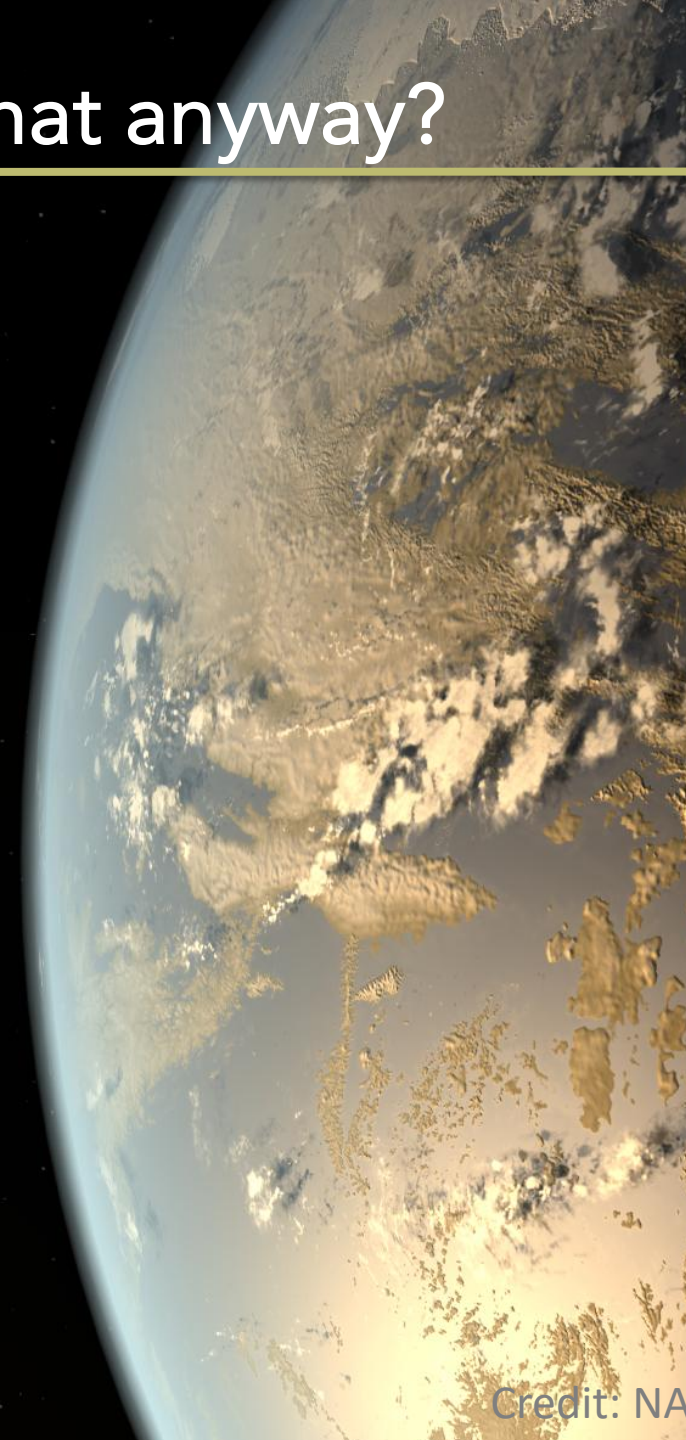

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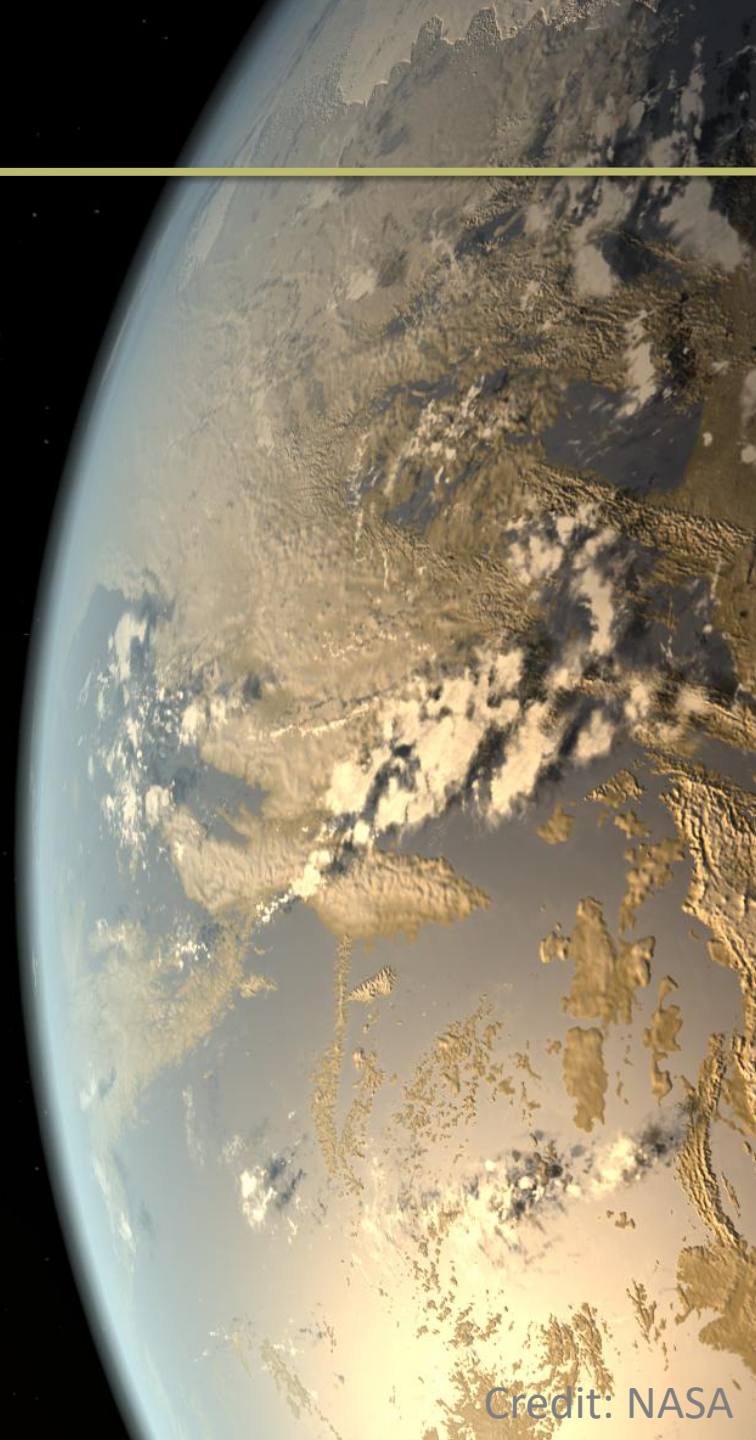
ExoPAG Executive Committee

ExoPAG activities and meetings are organized through an Executive Committee

Michael Meyer (Chair)	University of Michigan
Tom Barclay	University of Maryland
Natasha Batalha	*NASA-Ames*
Jacob Bean	*The University of Chicago*
Jessie Christiansen	NExScI/Caltech
Rebecca Jensen-Clem	UC-Santa Cruz
John Debes	*Space Telescope Science Institute*
Tiffany Kataria	JPL/Caltech
Josh Pepper	Lehigh University
Dmitry Savransky	Cornell
Laura Schaefer	*Stanford University*
Vikki Meadows (Past Chair)	University of Washington
Doug Hudgins (Astrophysics)	NASA HQ
Doris Daou (Planetary)	*NASA HQ*
Richard Eckmann (Earth)	*NASA HQ*

Please join me in welcoming our newest members!



Credit: NASA

ExoPAG Recent Activities

- ExoPAG21 meeting in Honolulu, January 3-4, 2020 (before AAS):
  - Mini-symposium on exoplanet demographics (SIG2, J. Christiansen).
  - Exoplanet Small Sat study reports, NExSS/ICAR update, plus Joint PAG Session.
  - Three findings approved and forwarded to Astrophysics Division.
  - The EC + ExEP met following to ExoPAG21 to discuss priorities.

- New EC Members appointed!
- EPRV recommendations released.
- Cross-PAG “Exoplanets in Our Backyard”, Feb 5-7 (findings released).

- Business for APAC in March:
  - SAG20 JWST impact survey closed out.
  - SIG1 closed out.
  - SIG3 formally approved.
  - Preview of new SAGs to be proposed (see business meeting).

- COVID-19 Survey initiated by COPAG.

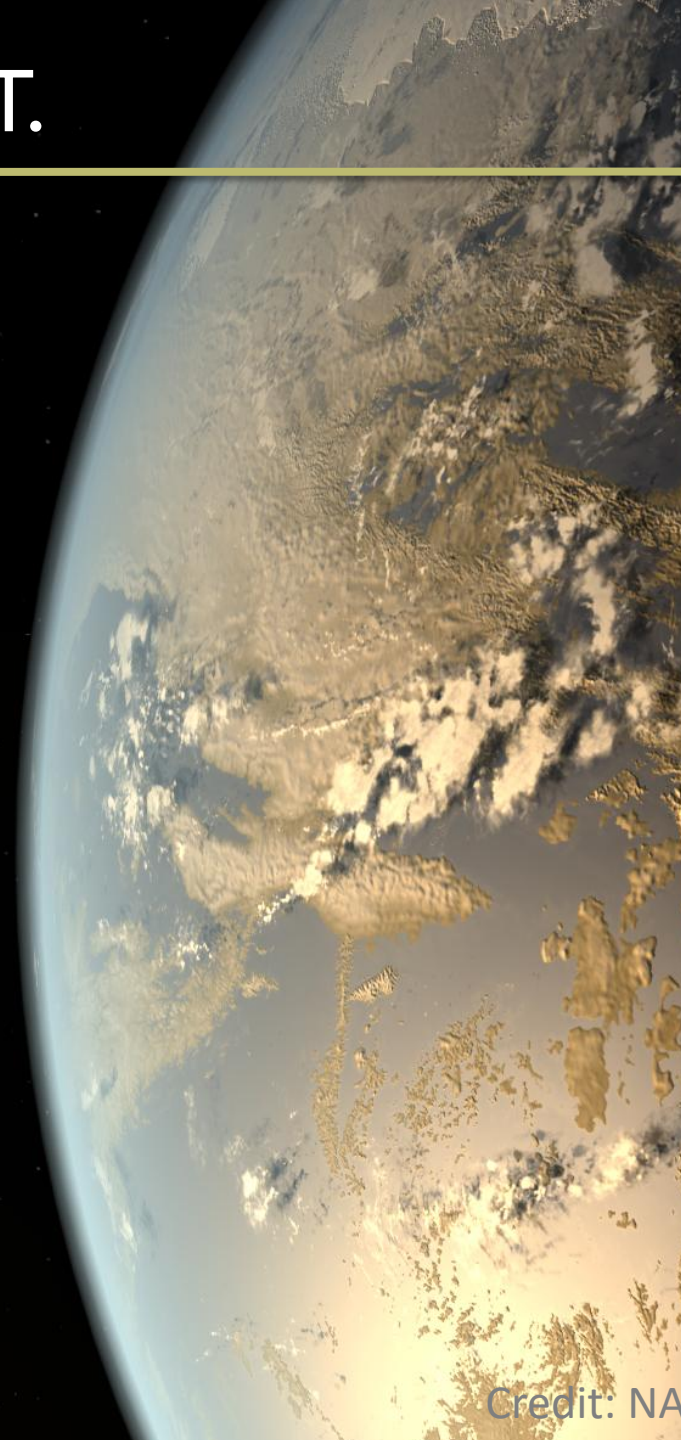
Current Status of SAGs and SIGs

Close Year	SAG or SIG	Title	Lead
2020	SAG 19	Exoplanet imaging signal detection theory and rigorous contrast metrics (active - closeout expected soon)	Mawet & Jensen-Clem
----	SIG 2	Exoplanet Demographics (on-going)	Christiansen & Meyer
----	SIG 3	Exoplanet Solar System Synergies (approved).	Meadows & Mandt
----	SAG 2X	Stellar Contamination on Transit Spectra (in formulation)	Rackham &Espinoza (Barclay)
----	SAG 2X	Exoplanet Host Properties (in formulation)	Pepper, Stark, & Hinkel

ExoPAG 22 Final Session: Friday 2:30-3:30 EDT.

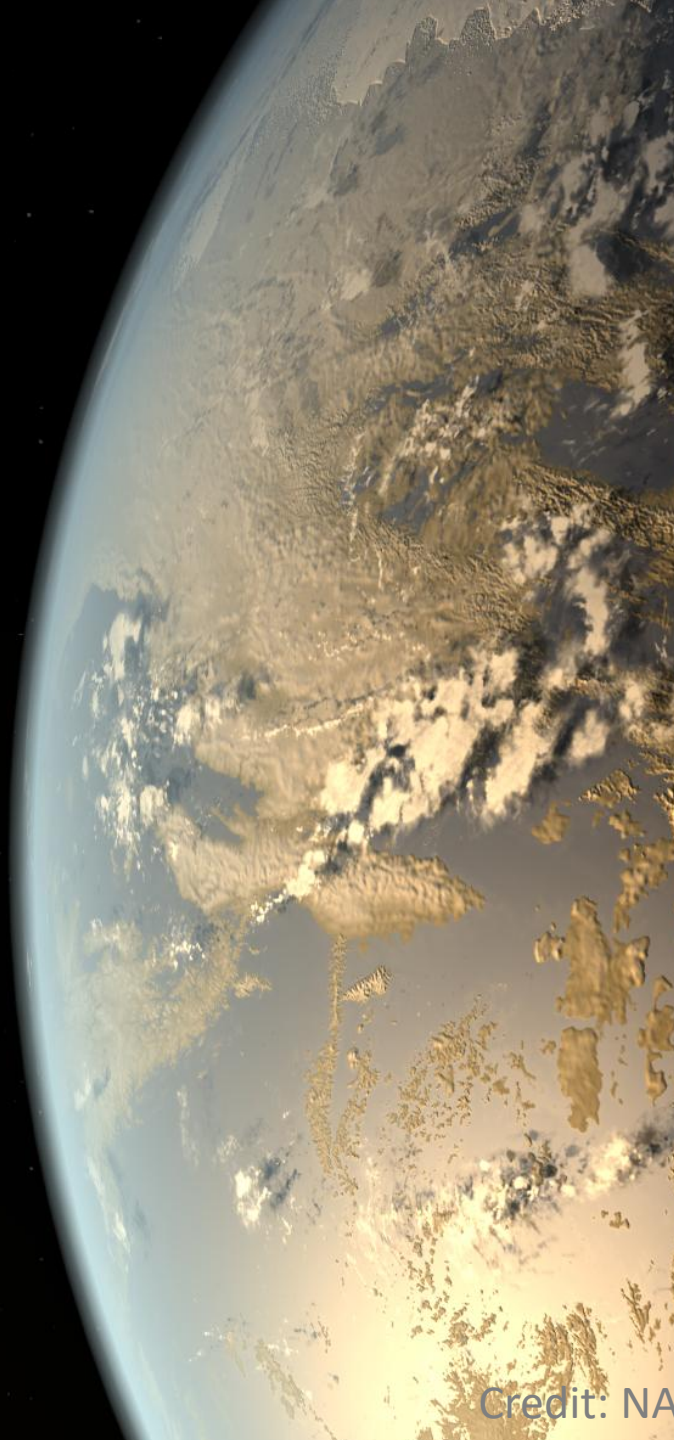
- Regular ExoPAG Business meeting.
- Feel free to share announcements for the community.
- Updates on SIGs and SAGs.
- Discussion of support for planetary decadal survey.
- Share new ideas for ExoPAG priorities and activities!
- Proposed discussion on potential “findings”:

Finding #1: On the value of investing in interdisciplinary exoplanet science of scale over longer periods of performance (see full text shared through ExoPAG Announcement).



Credit: NA

Backup Slides



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.

SIG 2 – Exoplanet Demographics

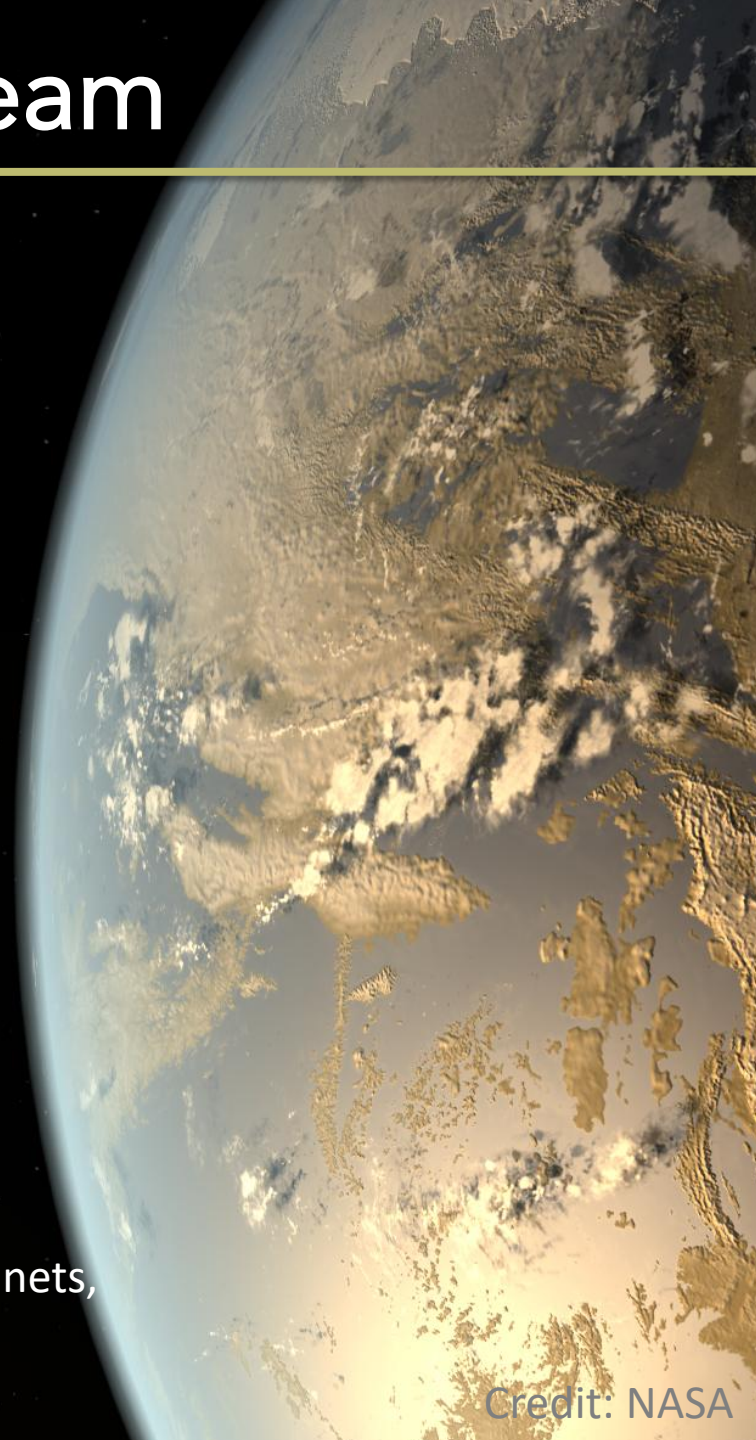
- **Leadership:** Christiansen & Meyer (EC) + Mulders & Bennett.
- **Motivation:** Exoplanet demographics reveal planet formation, migration and evolution processes, and are key to predicting the yields of future missions.
- **Goal:** To extend the Kepler-centric demographics of SAG13
- **Progress to 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: NA

SIG 3 ExoSS Synergies – Founding Team

Victoria Meadows (Co-Chair)	**University of Washington, ExoPAG EC**
Kathy Mandt (Co-Chair)	**JHUAPL, OPAG EC**
Giada Arney	GSFC, VExAG EC
Chuanfei Dong	Princeton
Tony Del Genio	GISS/retired
Shawn Domagal-Goldman	GSFC
Noam Izenberg	JHUAPL, VExAG Deputy Chair
Stephen Kane	UC-Riverside
Tiffany Kataria	JPL/Caltech, ExoPAG EC
Mark Marley	NASA Ames
Niki Parenteau	NASA Ames
Abi Rymer	JHUAPL, OPAG EC
Karl Stapelfeldt	JPL/Caltech, ExEP

Founding team members span ExoPAG, OPAG and VExAG, and include expertise in exoplanets, Solar System science, Earth science and star-planet interactions.



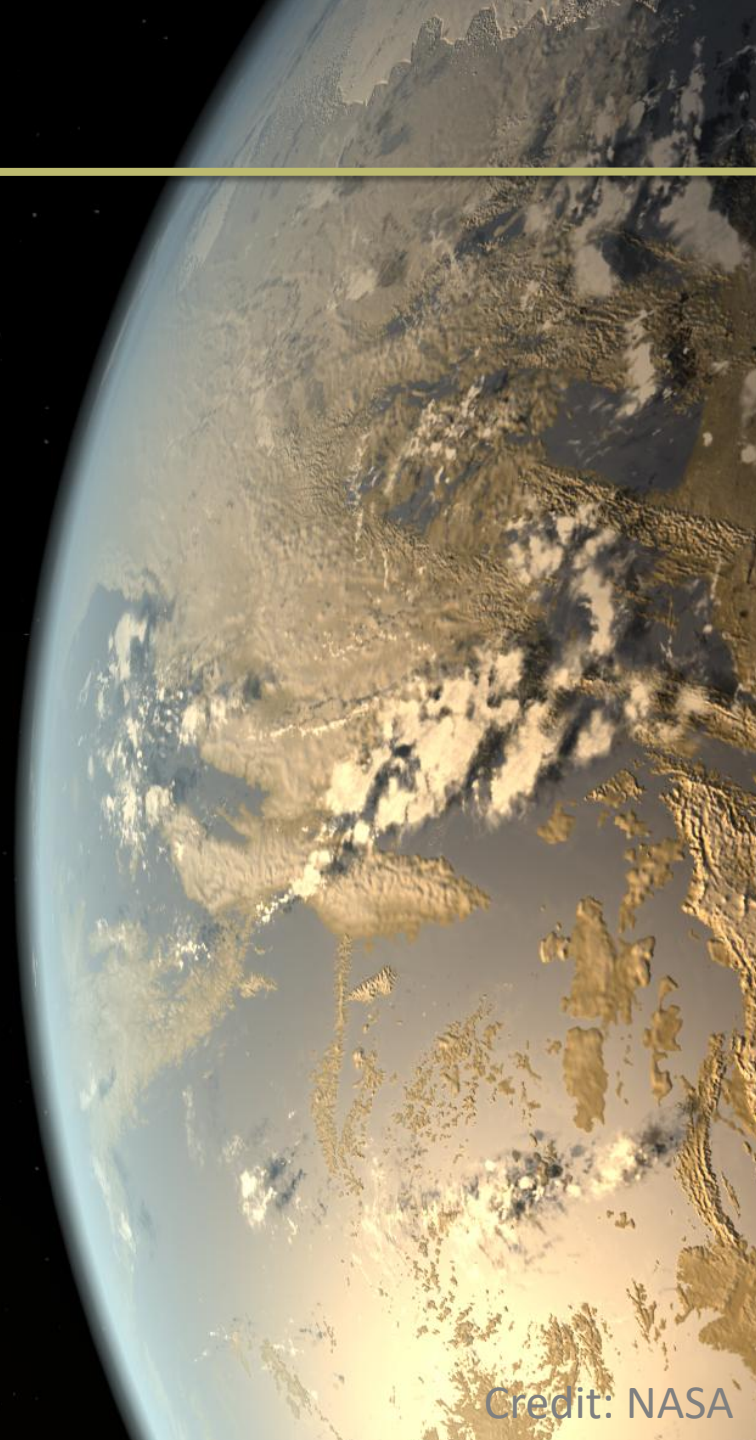
Credit: NASA

SIG 3 ExoSS Synergies – Context

- We propose to initiate an ExoPAG Science Interest Group on Exoplanet/Solar System Synergies to:
  - Provide opportunities for ongoing discussions on Exo/SS comparative planetology
  - Explore how exoplanet and Solar System missions can benefit from each other.

- In 2010 ExoPAG SAG 2 held and reported on a workshop that explored the potential for exoplanet science measurements from Solar System probes.
  - workshop completed a decade ago
  - SAG had relatively narrowly focus on exoplanet advantages from Solar System missions.

- The proposed SIG3 will be broader in scope, ongoing, and will endeavor to identify multiple initiatives that could be mutually beneficial for both communities.



Credit: NASA

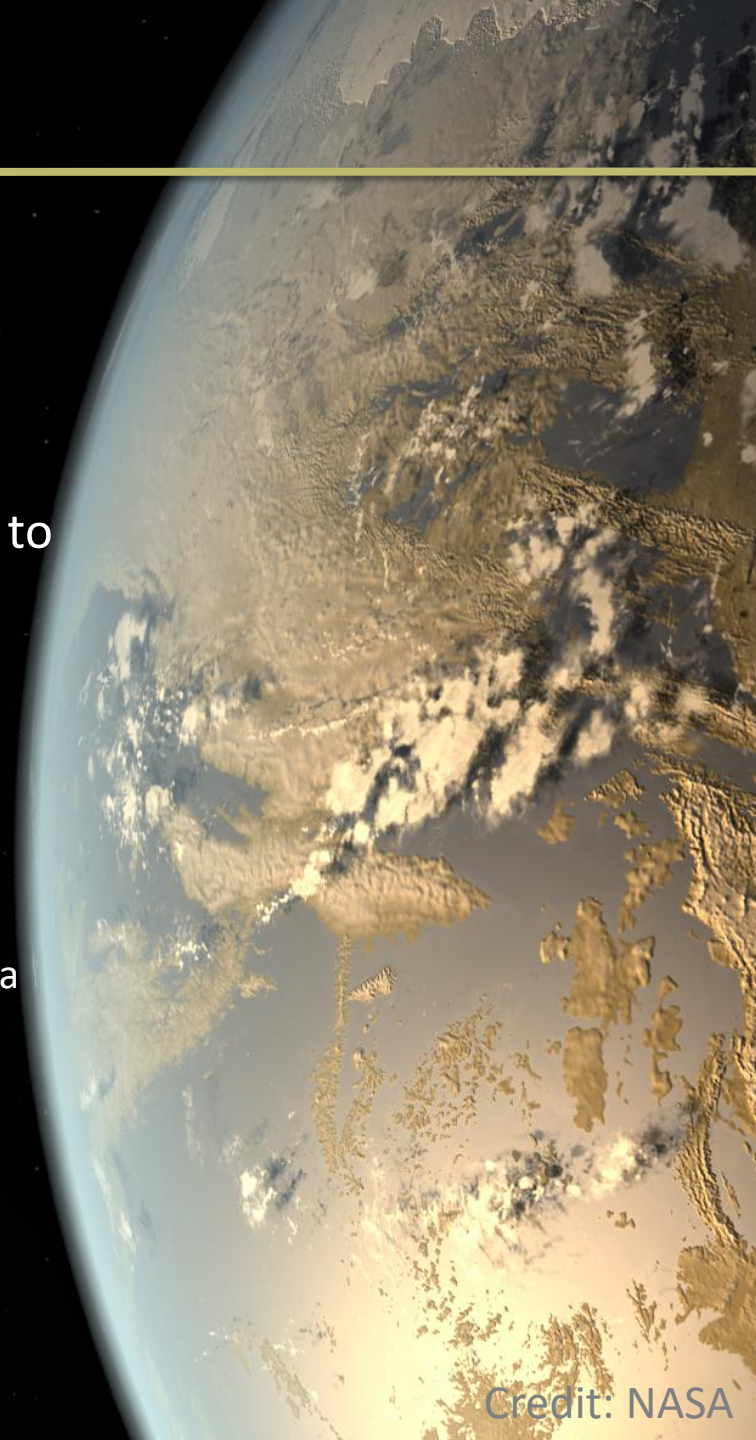
SIG 3 ExoSS Synergies – Motivation

- Characterization capabilities for exoplanets is improving
  - Large statistical datasets
  - Observations of a diversity of ice giant to giant exoplanets
  - Beginning attempts to observe terrestrial exoplanet atmospheres.

- Both communities are moving towards a systems- and process-based approach to understanding planet formation, evolution, habitability, biosignatures.
  - Requires synthesis of observations, theory and laboratory research from multiple disciplines.

- The two fields have unique perspectives that can benefit each other
  - knowledge and techniques developed from detailed studies of Solar System planets, including Earth, benefit exoplanet science.
  - The diversity of worlds beyond those in our Solar System provides key statistics to understand a broader range of planetary processes, including star-planet interactions.
  - Exoplanets are the broader cosmic context for Solar System planets/architecture.

- Comparative planetology that spans Solar System and exoplanets has the potential to greatly expand our understanding of planets as a whole.
- Effort is needed to encourage communities to interact and collaborate.



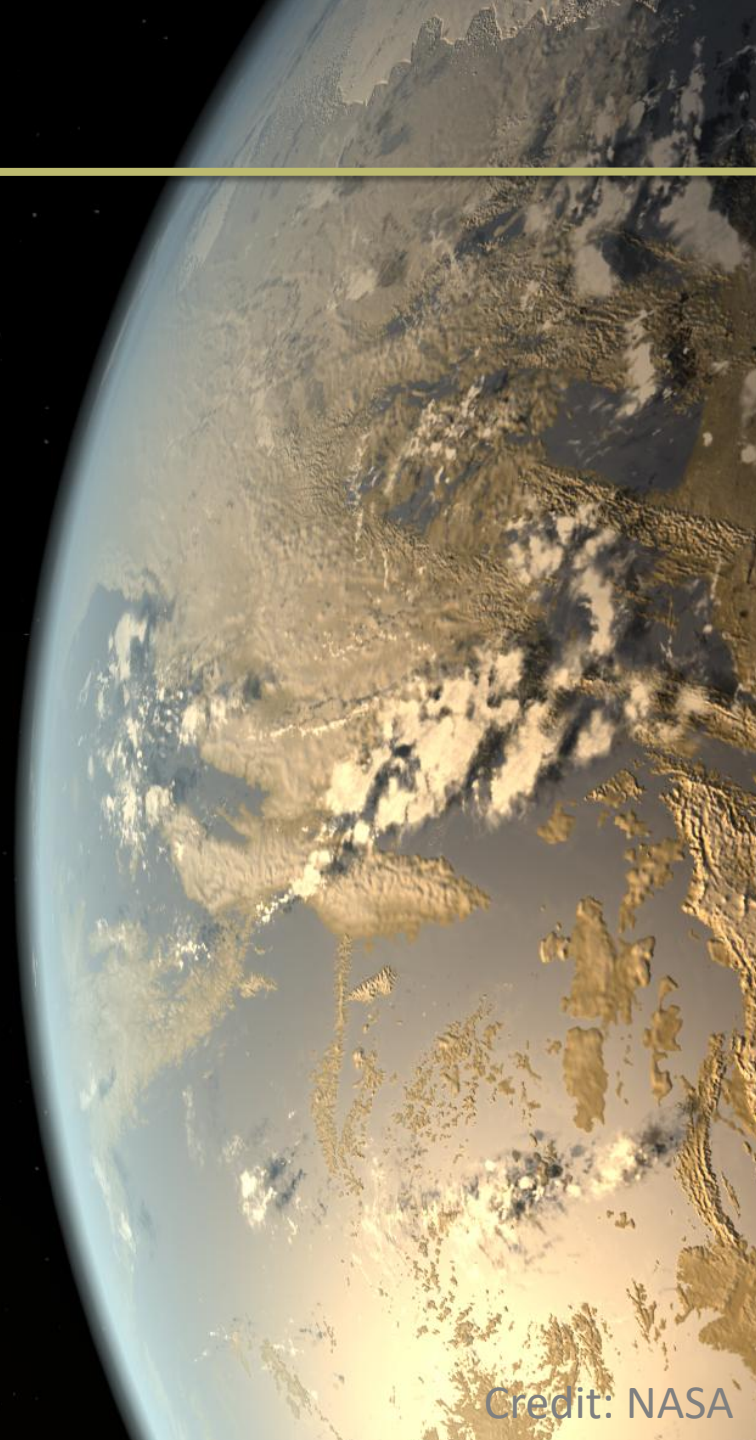
Credit: NASA

SIG 3 ExoSS Synergies – Goals

- We propose to provide a forum for interaction between the Solar System and exoplanet communities on topics of mutual interest, and to work to identify ways in which NASA could enhance these interactions.

- Example activities:
  - coordination of monthly webinars with Solar System/exoplanet presenters,
  - discussion fora,
  - development of workshop proposals (e.g. Exoplanets in Our Backyard Feb 5-7, after OPAG),
  - other cross-PAG/AG activities and presentations,
  - joint SIG reports/review papers that identify beneficial avenues for future joint research between the exoplanet and Solar System communities.

- As a longer term goal, this SIG will encourage cross-disciplinary interaction between PAGs/AGs in all four NASA Divisions.
- It will report at least twice per year to the ExoPAG EC through their monthly telecons, and at least once annually at the bi-annual ExoPAG meetings.
- This SIG3 will be open to all interested community members (please contact Vikki or Kathy if interested!)



Credit: NASA

1 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