GIGI-Next Meeting Summary
September 10-12, 2024
LASP Space Sciences Building
Boulder Colorado

The GOLD-ICON Guest Investigator (GIGI)-Next meeting was held in Boulder Colorado September 10-12 2024. The primary goals of the meeting were to celebrate scientific achievements enabled by the GOLD and ICON missions and to enhance communication by sharing new science results among all GIGI teams and with the science community. The meeting also served to catalyze new collaborations and interdisciplinary projects, brainstorm, plan, and advocate for future ionosphere-thermosphere science, share ideas and experiences among ionosphere-thermosphere researchers, network across generations, and empower young scientists. GIGI-Next brought together a diverse field of established researchers, early career scientists (ECSs), and students to highlight the results of the GIGI program to the community and to begin forming new collaborations for future investigations.

GIGI-Next meeting group photo taken September 12, 2024 at the LASP Space Sciences building in Boulder, Colorado.

The meeting was supported by a NASA TWSC grant (PI-Harvey). These resources allowed attendance by the science community without charging a registration fee. It also paid for travel expenses for 15 graduate students and ECSs to attend, catered lunches, IT support, web page development, and meeting planning activities. The core meeting organizing committee consisted of V. Lynn Harvey, Katelynn Greer, Larisa Goncharenko, and Chihoko Cullens. The meeting was further supported by ~20 meeting attendees who volunteered to take notes and monitor the zoom chat, and by LASP who provided posterboards, nametags, signs, parking assistance, and catering support. The meeting attracted 104 total attendees (~80 in-person and ~20 remote via

zoom). The agenda was as follows: There were 2 days of science talks by the NASA GOLD and ICON mission PIs, the NASA GIGI Program teams, and the heliophysics science community at-large. There was a poster session (22 posters) that showcased ECSs and an informal group dinner. Day 3 consisted of forward-looking sessions such as "Next Generation Science", "Next Generation Models", "Next Generation Instrumentation". Day 3 also provided a time to talk about current challenges faced by the Heliophysics community and how to grow an investigator network. These sessions specifically aimed to include, engage, and support emerging scientists. Talks, posters, photos, and a participant list can be found online in the GIGI-Next Public folder.

GIGI-Next meeting organizing committee and NASA representatives. From left to right: Larisa Goncharenko, V. Lynn Harvey, Susanna Finn, John McCormack, Katelynn Greer, and Chihoko Cullens.

Meeting Feedback

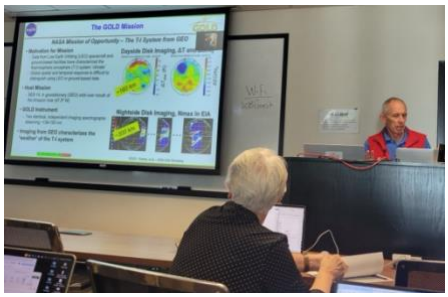
Feedback from meeting attendees collected in a post-meeting survey indicates the meeting was an enjoyable, valuable, and productive event. We encourage all meeting attendees to please fill out this short survey. One meeting attendee said, "This was one of the best workshops I've attended. Great science, great networking, great panel discussion, great posters. Very energizing, and I especially enjoyed the single-track plenary session and the efficient way you kept the talks and discussions moving forward." Another said, "This was a great workshop, and I thoroughly enjoyed it!". A group of ECSs said the following: "A major takeaway of the meeting is that we now have a better understanding of the GOLD and ICON missions, and we are eager to use these datasets to advance our ongoing projects. This workshop helped us to see how our research fits within the broader context of global ion-neutral dynamics across different altitudes and latitudes. It was particularly inspiring to see how senior scientists have collaborated to uncover new aspects and puzzles of space weather and put those questions out there for us to look at. This experience has given us insights into where we should focus our efforts, especially with upcoming NASA missions like GDC and DYNAMIC and advanced modeling capabilities like high-resolution WACCM. After attending the workshop, I feel motivated to take a closer look at the data I'm currently working on. It was also great to meet and receive advice from mid-career and senior scientists who have a broader understanding of these datasets." Results from a post-meeting survey indicate 85% of participants may or will definitely form new collaborations as a result of attending the meeting. The most popular sessions were the poster session and the session devoted to "Current Challenges faced by Heliophysicists". 95% of people felt there was adequate time for discussion and that these discussions were valuable. In terms of constructive feedback, emerging scientists asked for an anonymous method to ask questions (e.g., Slido) in addition to the option to go to a microphone center-stage and to add smaller break-out groups to encourage ECS participation. A meeting summary follows.

Meeting Summary

Day 1: Following opening remarks, **John McCormack** (GIGI Program Scientist) kicked off the meeting with details about the GIGI program and how to send science highlights to NASA.

The NASA GIGI program was solicited in ROSES 2020 with the intent to "maximize the scientific return from the GOLD and ICON missions by providing support for research beyond the scope of work of the mission science teams. It also allows scientists not associated with a mission team to participate in the mission science." The $1.75M/year budget supports 14 GIGI teams. John encouraged all scientists to pull science results and captivating images from progress reports and send to HQ-HelioHighlights@hq.nasa.gov. Focus on communicating answers to these basic questions: What was the question your project was trying to answer? How did you go about answering the question? What was the main outcome of the project? What is the benefit of this research?

The GOLD and ICON mission PIs then delivered keynote talks. **Richard Eastes** presented a comprehensive GOLD mission summary of science highlights by key members of the GOLD science team. Highlights included results by **Lumpe** on Tdisk, by **Greer** on O/N_2, by **Laskar** on temperature input into MSIS to get thermospheric density, X structures in EIA, and that data assimilation of O/N_2 and Tdisk improves model TEC, by **Gan** that O/N_2 at 40° latitude is correlated with the SW2, the Q6DW in post-sunset EIA, and that observed temperature and O/N_2 changes during April 14 2024 eclipse, by **Adkins & England** on EPBs, by **Karan** on storm influences on the EIA, EPB westward drift at the EIA crests and eastward drift at the Equator, and 2024 storm observations, and by **Cai** on > 250 K temperature increases and > 40% O/N_2 decreases during the April 23-24 2023 CME. **Tom Immel** presented a detailed schedule of ICON Phase-F (closeout) activities. These include: finalizing IVM ion velocities, level 1 data products, MIGHTI LOS and vector winds and temperatures, FUV O+ profiles, FUV composition, and level 2, 3, and 4 data products. A superior version 6 ICON dataset will soon be released. More information on these keynote talks (and all talks) please go to the GIGI-Next public talk folder.

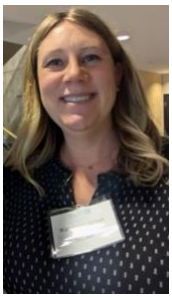

Richard Eastes giving the GOLD keynote.

Each of the GIGI teams then presented science highlights.

- **Erich Becker** posed the question "Are EPBs observed by GOLD triggered by MSVC over Europe?" He showed EIA amplitudes and that EPBs are reduced during the 2021 SSW due to reduced vertical drifts (consistent with Goncharenko et al., 2010). Possible mechanisms include stronger flow perpendicular to magnetic field, stronger plasma instabilities, stronger solar terminator waves, and GW-tidal interactions.
- **Phil Anderson's** talk on "Meridional Winds and Their Impact on Bubble Formation" was withdrawn.
- **Yue Deng** spoke about E-region neutral shears and impacts on the I-T system. She documented E-region wind shears as function of location and season. She showed largest daytime vertical wind shears from 95-107 km near 30°N occur in summer. She showed zonal wind shear can promote EPB growth within the shear region and suppress EPB formation at the edges.
- **Aaron Kirchman** spoke on behalf of GIGI PI **Paul Hysell** on the topic of Regional Simulations of Equatorial Spread F driven by ICON Satellite Measurements. Regional simulations

(initialized and driven by Incoherent Scatter radar observations) reproduce ESF observed by ICON on 27 out of 29 test orbits. They report ESF is predicted as simulated plumes that reach ICON altitudes (590 km), eastward winds play a significant role in instability development, and "if you can predict prereversal enhancements you can predict spread F".

- **Manbahrat Dhadly** spoke about short-term to inter-annual variability of DE3 and ionospheric impacts. DE3 is driven by tropospheric convection; short term variability (<30 days) is still unresolved and how it impacts the ionosphere is not well known. He developed and validated a Hough mode-based tidal fitting scheme that allows short-term estimation of DE3 using existing single satellite observations. He used TIDI and SABER temperature to quantify daily variability in the MLT and found monthly DE3 variations in the MLT matches COSMIC ionospheric variability but daily variability does not match. TIDI, MIGHTI, SABER intra-seasonal oscillations are in good agreement with each other and in agreement with COSMIC variability in the ionosphere – a likely source is the MJO.
- **Katelynn Greer** presented results on Strong Polar Vortex Impacts on the Longitudinal



Structure of Thermospheric Composition at Midlatitudes. It is well known that weak polar vortex events impact MLT temperatures and winds, tides, composition, and TEC. But what about strong polar vortex events? Are there opposite impacts? At 35°N magnetic latitude for strong polar vortex conditions, GUVI O/N_2 is higher over Asia and the Pacific and lower over N. America – TEC also tends to be elevated over Asia and the Pacific. GOLD results are consistent with GUVI over the American sector (O/N_2 suppressed during strong vortex). ICON O/N_2 is also consistent and shows elevated values over Asia. Strong polar vortex also impacts longitudinal patterns in ionospheric electron density.
- **Federico Gasperini** presented results on nonlinear interactions and complexity in the ITM system. Upward-propagating global-scale waves from below can significantly impact the lower/middle thermospheric zonal wind (U) and topside ionospheric ion density (Ni). ICON and COSMIC-2 IVM Ni and ICON MIGHTI lower and middle thermospheric U reveal large non-migrating diurnal tidal variations, a 2.5-day UFKW, and child waves from their interactions during August 2020. For a solar quiet period with large DE3 & UFKW, the combined effect of tides, the UFKW, and the child waves from their nonlinear interactions account for 20-80% of the total global low-latitude longitude variability in Ni.
- **Xian Lu** spoke about I-T variability induced by tides, gravity waves, & magnetospheric forcing. She used GOLD and ICON to quantify the impacts of terrestrial weather and space storms on the I-T system. She performed data assimilation of high latitude forcing (aurora, electric potential) using nested grid TIEGCM during the 2015 St Patrick's Day Storm (forcing from above) and during the Tonga eruption and easter tornado outbreak (forcing from below). Better development and understanding of the models is needed, pole-to-pole transport, and better understanding the physics.
- **Rezy Pradipta** spoke on behalf of GIGI PI **Carlos Martinis** on the "Investigation of different ionospheric perturbations at midlatitudes over the American sector". He used ICON IVM data and McDonald Observatory ASI instruments to look at seasonal behavior in MSTIDs and ESF and found peaks in both solstices over N. American sector. The evolution of MSTID

irregularities were captured in sequential ASI images and consecutive ICON passes showing strengthening of ROTI and spectral features.

- **Qian Wu** presented a talk entitled "Penetrating electric field study using ICON observations & MAGE simulations". He validated the MAGE model by comparing with ICON ion drift observations. He examined the penetrating and disturbed electric fields during the July 7-8, 2022 storm and found the disturbed electric field introduces structures on the nightside and the penetrating electric field reduces the nightside disturbed electric field. He also mentioned the upcoming WindCube mission to measure thermospheric winds.
- **Anthea Coster** presented "Day-to-Day variability of EPBs". First she showed statistical analysis of 4 years of GOLD night-time data and described the development of a bubble index (significant bubble when index > 0.2). Results show geomagnetic activity can either enhance or inhibit the development of bubbles, and there is large day-to-day variability in bubble formation despite quiet conditions due to forcing from below. During disturbed geomagnetic time periods, strong post-sunset EPBs and spread-F irregularities were observed starting at 23:20 UT on March 13 2022 and continued for a few hours, with an abnormally high-latitudinal extension that cut through the EIA crests all the way to the lower midlatitude area around 30° magnetic latitude.

- **Kostas Kalogerakis** spoke about ICON/MIGHTI as a nightglow probe. He found the SABER + MIGHTI atomic oxygen dataset to be superior to either dataset alone (MIGHTI has problems at low altitudes, SABER has problems at high altitudes). The main limitation is the small number of colocations. There is good agreement with O(^{1}S) VER profiles deduced from SABER atomic oxygen retrievals. Lab measurements are underway for the O_2(b-X) (0-0) and (0-1) band relative strength to fully calibrate the O_2 A-band.
- **Tomoko Matsuo** presented results on Whole atmosphere data assimilation. She found the NOAA WAM model biases and uncertainties are reduced when GOLD data is assimilated. Mass densities at 460 km are improved and tidal diagnostics are enhanced by assimilating GOLD radiance data into WAM. Next Steps: Assimilate ICON temperature. Address the science question: "How does the variability of the lower thermosphere temperature and composition impact exospheric temperature and mass density variations?"
- **Erdal Yigit** presented observations of vertical coupling during a major SSW observed by ICON & GOLD. He showed analysis of ICON zonal and meridional winds during the 2021 SSW and during non-SSW years. Results showed reduced GW amplitudes and increased SW2 amplitudes during SSWs. Changes in the horizontal circulation lead to enhanced low-latitude upwelling and cooling.

A discussion session followed the talks with a goal to integrate findings from the GIGI teams into broader research. We posed the question "What's next?". The idea was shared to combine

GOLD and ICON (and other) observations in more comprehensive ways. How can we leverage GB observations to do more comprehensive system science? It was mentioned that we need more comprehensive local time and high latitude sampling that will shed light on M-I coupling. It was also mentioned that understanding and predicting day-to-day variability (space weather) is key. **Jeff Thayer** remarked "What do we need from neutral wind observations? We need to get more specific in our ask. Do we need winds and plasma at the same time? Since it's a big ask we need to be clear what we need to get out of it." There was a discussion on the status of data assimilation in whole atmosphere models. There are currently large biases between modeled and observed winds even when winds are assimilated. It is complicated because geostrophic balance does not hold in the I-T and unresolved tidal motions are large.

We then asked the GIGI PIs: What skills from ECSs would you find valuable?

- **Katie Greer** suggested emerging scientists master Machine Learning tools (with a knowledge of how the tool works).
- **Erdal Yigit** advised to learn how the atmosphere-ionosphere-magnetosphere interacts as a coupled system in order to understand internal variability on a variety of time scales.
- **Xian Lu** said to learn the details of the data, including all of its caveats. As an aside, she would like to have a GIGI meeting every year!
- **John McCormack**: Mentioned a TWSC proposal as a possibility for a follow on GIGI workshop, emphasizing that space weather occurs primarily within the IT system and there is a need to communicate this message effectively. He also suggested considering a Guest Investigator for the AWE mission or other projects.

On Day 2 the nation-wide science community presented GOLD and ICON science highlights. Please refer to the GIGI-Next meeting public talk folder online for more information. A brief summary of these talks are as follows:

- **Vincent Adkins** explored the relationship between EPBs in GOLD and meridional winds in coincident ICON observations. Preliminary results revealed a wide variety of meridional wind speeds with altitude for each EPB. The relationship between winds and EPBs may depend on local time.
- **Brian Harding** spoke about wind-driven variability in the pre-reversal enhancement (PRE). The PRE is a key driver of equatorial spread F. Better characterization of PRE using ICON-IVM data is necessary. He created a climatology of PRE and quantified the importance of wind drivers. Results show including TIEGCM-ICON seasonal and longitudinal variability in winds improves agreement with ICON-IVM PRE. Even with wind variability, the model reproduces the climatology to r=0.68. Deficiencies could be due to issues with TIEGCM-ICON not reproducing realistic conductivity gradients, underpredicting eastward thermospheric winds, or HMEs being insufficient to capture higher-order tides and solar terminator waves.
- **Saurav Aryal** presented GOLD observations of solar eclipses. He studied four solar eclipses since 2019 and looked along the path of totality for each. Cooling of 100 K and O/N_2 increases of 10-80% were observed by GOLD. The TIEGCM+GLOW model underestimates eclipse-induced O/N_2 changes by over an order of magnitude. O/N_2 increases travel with the path of totality.

- **Quan Gan** spoke about the equinox transition of thermospheric O/N_2 and circulation as observed by GOLD & ICON. He showed that GOLD observed a prominent AO and SAO in O/N_2 that varies with local time and there is hemispheric asymmetry in both the AO and SAO. Seasonal variations generally agree with WACCMX but overestimate O/N_2. He found the thermospheric meridional circulation displays the same asymmetry between spring and fall transitions and hypothesized that this may be responsible for the asymmetry in O/N_2 equinox transitions.

Quan Gan and Erich Becker

- **Sharon Vadas** presented a talk entitled "Determination of the intrinsic parameters of the ICON-MIGHTI GWs, and comparison with the higher-order GWs from the polar vortex jet and orographic forcing using the HIAMCM." She looked at GW activity from the polar vortex during the Arctic winter of 2020–2021. She showed multi-step vertical coupling of GWs from the polar vortex creates higher-order medium-to-large-scale GWs in the thermosphere. ICON-MIGHTI observations are in good agreement with HIAMCM and large-scale GWs (horizontal wavelengths ~3000 km) that propagate southwest. These global, large-scale GWs propagate against the tidal winds – a daytime phenomenon – and may create EPBs in the nighttime.
- **Scott England** delivered the talk "Watching the thermosphere respond to disturbances: tracking large-scale thermospheric gravity waves with GOLD" wherein he described a detailed method by which GW phase velocity can be derived from GOLD data. GW periods range from 0.5-6 hours, with phase speeds from 150-600 m/s, and wavelengths from 1000-6000 km. GWs propagate mostly meridionally. Using ICON winds, intrinsic properties and energy fluxes and momentum fluxes can be calculated.

Scott England speaking on day 2 of the GIGI-Next meeting.

- **Sovit Khadka** spoke about the response of the topside ionosphere to wave driving of tropospheric origin at low latitudes. It is well-known that upward propagating tides impact the temperature, neutral, and plasma density of the ITM system. SABER temperature in the MLT was used to identify PW structures and study their role in atmospheric coupling. Results showed PW2 neutral density amplitude dominates all other structures at June solstice but PW1 and PW4 are prominent at the end of 2021. DE3 tides are the main contributor for PW4 structures at 110 km but SE2 dominates at 400 km.
- **Deepak Karan** presented novel observations of nightside ionospheric activity by GOLD during the May 2024 super geomagnetic storm. GOLD observations began ~4 hours after initiation of the main phase of the storm and showed the southern EIA crest merged with aurora, influencing one another. Other notable observations include: the EIA and high-latitude aurora were observed in mid-latitudes, "V" shaped structures were observed in the southern EIA

crest, westward tilted bubbles extended into mid-latitudes, the EIA had large poleward speeds during the storm (~280-450 m/s), and large vertical drifts were observed at Jicamarca.

- **Joe Huba** spoke about zonal wind effects on EPB shape. The goal was to investigate the underlying wind structures that caused the various bubble shapes. Reverse-C and straight line bubbles that were observed in GOLD were reproduced with very short longitudinal separation in SAMI3 coupled to WACCMX. He claimed "Now that the model shows some fidelity in reproducing EPB shape, we can analyze the underlying winds to figure out why EPBs have these shapes." That led to the following questions and discussions: Are the bubbles merging or are they affected by large neutral winds? There are cases where the C-shaped structures move away from one another rather than merging towards one another. The 3D structure of the winds likely plays an important role in this alongside the conductivity structure. Simulation results are TEC whereas GOLD imagery is airglow emission at the footprints of field lines - not an apples-to-apples comparison.

Joe Huba and Jeff Thayer.

- **Xuguang Cai** presented concurrent GOLD and SABER observations of thermospheric composition and temperature responses to the April 23-24, 2023 geomagnetic storm. Previous studies have shown minimal geomagnetic activity can have large impacts on O/N_2 responses. Results show O/N_2 in the northern hemisphere recovers faster than in the southern hemisphere in the days following the storm. Tdisk observations show similar patterns to O/N_2 with large enhancements but quick recovery within 1-2 days.
- **Cheng Sheng** presented analysis of thermospheric temperature variations during geomagnetic storms using GOLD measurements. GOLD Tdisk data on August 5, 2019 shows a lot of structure in storm-time temperature enhancements. In general, the northern hemisphere has larger temperature enhancements than the southern hemisphere. It took about 2 hours for temperature enhancements to propagate from 40°N to 20°N, and the propagation was less clear in the southern (winter) hemisphere. Changes in Tdisk (in %) is larger in the morning sector, and different latitudes have similar recovery speeds. Next, these results will be compared to model simulations.

- **Fazlul Laskar** spoke about impacts of assimilating GOLD disk O/N_2 observations on the T-I system. Results show that assimilating GOLD data improves the model T-I and reduces forecast errors, however, spurious features can arise in both temperature and O/N_2. Next steps are to assimilate both O/N_2 and Tdisk data together and quantify the relative impacts.
- **Charles Lin** gave a talk entitled "Space weather effects observed by FORMOSAT-7/COSMIC-2, ICON, & GOLD". COSMIC-2 radio occultation (RO) provides many observations – and combining with GOLD and ICON provides an even more comprehensive picture. There are ongoing efforts to apply machine learning approaches to determine when RO would be affected by plasma bubbles utilizing GOLD and ICON data along with COSMIC-2.
- **Valery Yudin** spoke on twin-OSSEs and OSEs in the enhanced resolution whole atmosphere models of SD-WACCMX and WAM. Models with 25 km horizontal resolution are used to

explicitly simulate GWs. The main targets of the OSSEs are a) the 3d diurnal cycle, b) thermospheric composition, c) mesoscale waves, and d) the impact of data coverage in DA. The community needs more infrastructure to support OSSEs both retrospective (using GOLD, ICON, and other available data) and also for upcoming missions such as DYNAMIC.

A discussion session followed the talks with the goal to identify collaborations and synergies. We posed the question "GOLD and ICON have enabled a wide variety of collaborative projects – in the era of system science, how can we collaborate even more effectively?". Ruth Lieberman mentioned that AWE data will soon be available and should be integrated into GW studies. We then asked "How can we ensure that ECSs are effectively integrated into these collaborations and have opportunities to contribute meaningfully?"

Erdal Yigit and Mark Moldwin having discussions.

- **Mark Moldwin** reminded us to be intentional about being inclusive. e.g., AGU asks that one convener be ECS. Guest Investigator awards can set aside money for ECS. Involve ECSs in missions.
- **Larisa Goncharenko** said to get involved in CEDAR student day activities and noted that student conveners are strongly encouraged at CEDAR and AGU meetings.
- **Sharon Vadas** – (To ECSs) Write your questions down during talks and find the speaker during coffee breaks and ask them.
- **Fazlul Laskar** – Submit early career proposals.
- **Xian Lu** – Include emerging and established scientists in smaller and more focused groups to encourage conversations.
- **Shikha Raizada** – NSF has early career opportunities. https://new.nsf.gov/funding/early-career-researchers

We then asked "How can these findings from GOLD and ICON be better integrated with data from ground-based instruments and other current or upcoming missions?"

- **Katie Greer** – Why isn't ISR data more prevalently used in our work?
    - **Xian Lu** – See ECS poster for discussion about use of ISR
    - **Anthea Coster -** Using ionosonde data with GOLD/ICON data was critical to their findings
    - **Larisa Goncharenko** – These presentations centered on ICON and GOLD. Jicamarca and GNSS TEC have been shown but we could perhaps do more. More science can be done with inclusion of meteor radar data.
    - **Sharon Vadas** – I've worked with Gunter Stober's meteor radar and saw upward and downward GWs. Also EISCAT radars and GPS networks. It's extremely valuable to compare models to as many data sources as you can.
    - **Rebecca Bishop** – We need error analysis too – when we compare models and data we need to know how large the errors are in both.
    - **Brian Harding** – Collaborating broadly and using many data types requires broad technical expertise.

Finally, we asked "What are some effective strategies for sharing knowledge and resources across different research groups, and how can we improve these practices?"

- **Larisa Goncharenko** - Jupyter notebooks are planned to be developed to help new CEDAR Madrigal data users.
- **Brian Harding** - Start publishing your code when you publish a paper so ECSs can openly use that code
- **Suzanne Finn** – NASA is requiring that all data available to the public.
- **John McCormack** – Be aware of HDRL, the Heliophysics Data Research Library.

Day 2 concluded with a poster session that featured 22 total posters, 15 by ECSs. There were many lively discussions and a post-meeting survey revealed that ECSs felt they received sufficient feedback on their work.

Photos from the poster session that showcased ECSs at the end of day 2 at the GIGI-Next meeting.

There was an informal group dinner on the evening of Day 2. About 20 meeting attendees and a half dozen ECSs joined together for food and conversation at Avanti Food and Beverage on Pearl Street in Downtown Boulder.

Photos from the informal group dinner at Avanti Food and Beverage on Pearl St. in downtown Boulder Colorado.

On Day 3 sessions looked to the future and "What's Next?" in terms of space science, instruments, and models. What's on the horizon in terms of emerging new developments for consideration? We also shared insights and sought solutions to current challenges we face in Heliophysics. Finally, we discussed strategies and best practices for how to build and nurture an investigator network. It was our hope that the sessions on Day 3 would get folks thinking outside the box, brainstorm and advocate for our future, as well as reach out to ECSs by sharing our knowledge and wisdom gained over many years. Day 3 speakers were all invited based on their specific areas of expertise.

Day 3 kicked off with a session on ***Next Generation Science***. For this session we invited the following 4 speakers:

- **Larry Paxton** gave a talk entitled "The Science that we should be doing vs. the science we can afford". He emphasized the importance of being able to clearly communicate what we do to others, especially to the non-experts. When we talk to the public, congress or sponsors, we can start with an answer to, Why do we study the ITM? We study the ITM to 'sustain the outward journey'. To accomplish that we need flagship-class missions in Heliophysics. The current NASA priority is human exploration - Moon to Mars. Heliophysics safeguards that journey by studying space weather on the Earth, Moon and Mars. To sustain the outward journey, Heliophysics enables us to protect our home, protect human and robotic explorers, understand the physics that shapes planetary environments, and discover how our solar system compares to other astrospheres. Very Low Earth Orbit (VLEO) is a new frontier that sustains the outward journey. VLEO operations are challenging because orbital lifetimes are short. The VLEO environment is an important part of any planetary atmosphere, especially those that are driven by planetary magnetospheres. Our goal is to make the case for an enhanced Heliophysics budget that opens mission capabilities on planetary missions. We know the science we want to do; we just need to describe it in a compelling way. We can work as a community to push for new ITM opportunities as well as the GDC and DYNAMIC missions. Both these missions provide information important to understanding the VLEO environment.

- **Doug Rowland** presented "Next generation science: GDC+DYNAMIC, and the ITM Great Observatory". The science questions within Heliophysics require a systems approach. The Worldwide Heliophysics community needs to unify under a shared strategic vision. Heliophysics has had four primary eras. Discovery era- Regions (1958-1975), Discovery era-Dynamics (1975-1990), Era of coarse system science (1990-2005), Era of microscales (2005-present). The fifth era is up to us to define. We can call this fifth era "Mesoscales, the system of systems, quantitative dynamics". NASA's GDC+DYNAMIC – the hub for an ITM great observatory. Three DYNAMIC concept studies are underway, while GDC is in active development. Congress asked for a plan to launch GDC by the end of the decade. It is possible to launch in 2031 if funding is provided in 2025-2026. The future of Heliophysics rests in our hands. Our common problem is the flat budget. We need the budget to implement GDC+DYNAMIC, or any future Decadal-specified missions. The confluence of our strategic focus on GDC+DYNAMIC aligns well with major NASA efforts. Communicating the importance of Heliophysics will promote strategic and focused investment. Heliophysics needs a coherent science strategy, and a clean science message and organization.

Rebecca Bishop, Doug Rowland, Rod Heelis, and Jeff Thayer having a discussion at the GIGI-Next meeting.

- **Phil Erikson and Lara Waldrop** spoke about CEDAR science, strategic plans and GIGI: Harmonizing the next steps. Understanding geospace as a complex dynamical system requires close coordination between measurement, data analysis, and modeling. Problems most conducive to a systems science approach are typically beyond the capabilities of individual investigations, requiring the attention of interdisciplinary teams. This GIGI-Next meeting is a great start for fostering these collaborations. Comprehensive and diverse state measurements are vital for characterizing the quasi-equilibrium geospace state, understanding its transient response to sporadic drivers, and detecting persistent evolution. Taken together, space and ground-based assets have important multi-scale information essential for GOLD and ICON data analysis. The heterogeneous approach is information-rich: multiplicity of parameters spanning varied scales in both space and time.

A 15-minute discussion session followed the talks.

- **Allison Jaynes –** We heard that we need a unified message to sell our science. What is the tag line for GDC and DYNAMIC?
    - **Larry Paxton**: The reason we need to fly GDC and DYNAMIC, is that it's the precursor/ discovery level mission, which is going to give us the first real comprehensive look and sets the stage for future missions.
    - **Mark Moldwin:** When you look at how space has changed in the last four years, there is an exponential growth of commercial satellite communication networks. We should train scientists and engineers to understand effects and implications of our science on radio wave propagation and the thermospheric drag.

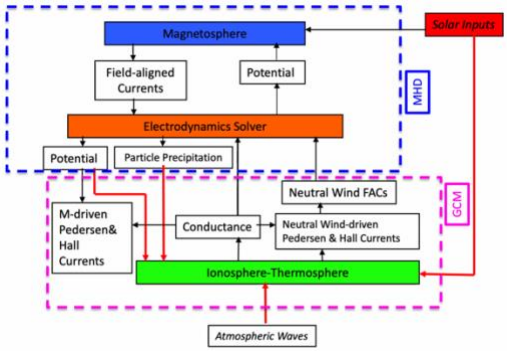
- **Rebecca Bishop:** GDC is the Rosetta stone of science missions; it's going to provide in-situ global measurements that's going to allow us to interpret everything that's going on. To students: you don't need to focus on the whole system, just focus on one piece and collaborate.

Rebecca Bishop and Doug Rowland.

- **Joe Huba:** The things we do, how are they important for society? It's important for communications.
- **Cora Randall –** We need to leverage collaborations and synergies between Earth science and Heliophysics. Cross-cutting instruments, programs, etc.
- **Doug Rowland:** To better understand the planet we live in.
- **Erdal Yigit –** We need to educate the public and our representatives.
- **Phil Erikson:** When I communicate with the next generation, I show them the very low earth orbit space environment. I tell them VLEO is your future; right now, things are happening in that environment that we can't predict because we don't have a basic knowledge of the background in which those stuff are happening. It seems to grab people. This particular message can be another compelling way to go to partially address Allison's question.
- **Scott Bailey:** There was a spacewalk today, we'll have future factories in space, GPS, self-driving cars and planes. Understanding the ionosphere and geospace environment is critical for our future. We have a problem with marketing.
- **Larry Paxton:** We need something that is simple so that it can be explained to people who don't have much understanding of space.
    - **Anthea Coster** – We need communications during natural disasters (phone, TV, internet) during natural disasters. People actually communicated through ham radio when that happened. Radio waves remain one of important communication methods

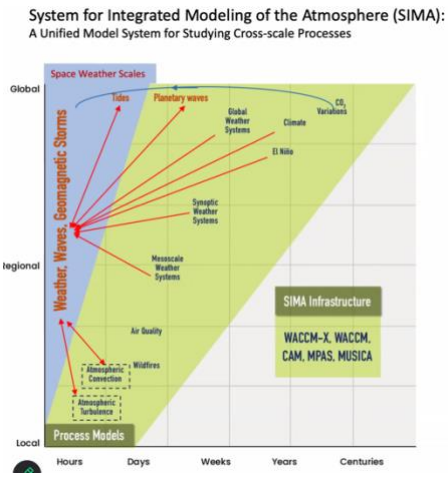
The next session hosted 3 invited speakers to discuss ***Next Generation Models***.

- **Yue Deng** spoke about multi-scale simulation of the I-T system and the GDC mission. The sun contributes 70% of the energy to the upper atmosphere; the solar cycle is clear in thermospheric density at 400 km. Waves from the lower atmosphere also modulate thermospheric density. There is also coupling within the I-T system and medium and large-scale TIDs occur concurrently – can we model these multi-scales that occur simultaneously? Yue is an expert with the GITM model. In terms of forcings, we need to generate global specification of multi-scale forcing using data science techniques. We need to provide high-resolution and high-cadence drivers for models. In terms of impacts, we need to improve multi-scale simulation capabilities by including multi-

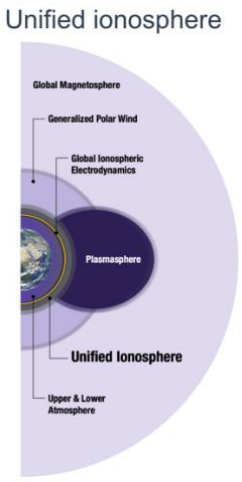


scale forcing specification, flexible grids, and specification of physical processes. We also need more data-model comparisons.

- **Hanli Liu** presented the Status, Capabilities, and Outlook for WACCMX. WACCM is part of the System for Integrated Modeling of the Atmosphere (SIMA). It is a physics-based whole atmosphere general circulation model (0-700 km) that solves for dynamics, radiative transfer, photolysis, and energetics. It has fully interactive chemistry including ion chemistry. It includes ionospheric electrodynamics using a fully interactive dynamo. There is ion transport in the F-region. Magnetospheric inputs are either empirical (Heelis/Weimer) or specified (AMIE, GAMERA). Tropospheric/stratospheric meteorology can be constrained by MERRA2 or GEOS5. There is high-resolution (~25 km/0.1 scale height) capability. Combined high-resolution and specified dynamics simulations are referred to as "Nature Runs". There is whole atmosphere data assimilation of SABER, MLS, GOLD, ICON, and COSMIC-2 observations. WACCM-X can be run on request at the NASA CCMC. New model capabilities include: 1) WACCM-X species-dependent Spectral Element (SE) dynamical core with a quasi-uniform grid (cubed sphere). 2) Molecular viscosity/diffusion in the horizontal and vertical dimensions. 3) Regridding between physics mesh and geomagnetic grid. 4) High-resolution. 5) Specified dynamics. High-resolution WACCM still uses a deep convection parameterization (does not resolve convection explicitly) but agrees pretty well with observations, as does the convective GW patterns at a variety of altitudes. Future development goals include: 1) development of non-hydrostatic, deep atmosphere dynamical core (Modeling for Prediction Across Scales, MPAS), 2) convection permitting scale simulations, 3) scale-aware parameterization, and 4) integration with the whole geospace model MAGE (Multi-scale Atmosphere-Geospace Environment).



- **Slava Merkin** presented modeling efforts for the NASA DRIVE Science Center for Geospace Storms (CGS). Geospace is a complex system that is multi-scale and multi-physics. Because of collective cross-scale interactions in storm-time geospace, understanding and predicting space weather requires models that treat geospace as a whole. Mesoscale processes are important because they lead to emergent global behavior. A "whole geospace model" must include two-way coupling to the lower atmosphere. The MAGE model extends from 0-2M km and resolves multi-scale features in the lower and middle atmosphere, the I-T, and the magnetosphere collectively. The model includes an exosphere and hydrogen/geocorona, kinetic plasmasphere and high-latitude outflow (wave-particle interactions), realistic magnetic field models for the plasmasphere and outflow, electron reconnection physics, thin current sheets, a "unified ionosphere", the ability to model small-scale processes in the ionosphere such as FB instability, precipitation, and lower/middle atmosphere coupling. **Challenges in global geospace modeling from first principles**: Huge dynamical range &



disparate physics, Heterogeneous supercomputer architectures, Scalable coupling for interconnected, multi-physics, multi-scale systems, New self-consistent physical models & algorithms, Multigenerational integrated teams of domain and computational scientists, research software engineers, students & postdocs, project managers. **Outlook for the future**: Leveraging computing power of tomorrow and data-model fusion.

The next session hosted 4 invited scientists to sit on a panel to discuss ***"Current Challenges in Heliophysics"***. This session was intended to facilitate a discussion between established and emerging scientists wherein knowledge gained over many years would be shared. The 4 panelists were:

- **Mack Jones,** Research Physicist in the Space Science Division at the US Naval Research Laboratory. His research focuses on understanding how synoptic scale waves of lower atmospheric origin impact the IT system. His community service activities, currently include co-leading the CEDAR DEI Task Force, and serving as a member of the Decadal Survey's State of the Profession Panel.
- **Tzu-Wei Fang,** leader of the thermosphere and ionosphere team at NOAA Space Weather Prediction Center (SWPC). Her team at SWPC supports customers from multiple industries (Satellite, Aviation, GNSS) to better understand the impact of space weather on their operations. She oversees several government-funded projects and works closely with government agencies and industrial partners to improve the tools and specifications of the IT system.
- **Ian Cohen**, Deputy Chief Scientist of APL's Space Exploration Sector and Chair of the AGU/Space Physics and Aeronomy Advocacy Committee. As part of his advocacy efforts, he leads the Heliophysics Coalition effort, which brings together major Heliophysics institutions across academia and industry to partner in Heliophysics advocacy efforts.
- **Mark Moldwin**, Professor of Climate and Space Sciences and Engineering at the University of Michigan and the Director of the University's Office of Postdoctoral Affairs. He is currently co-chair of the Decadal Survey's State of the Profession Panel and PI of NASA's GDC NEMISIS magnetometer instrument.

We posed the following questions to the panelists and allowed each of them a 2-minute response. The audience then asked the panelists questions.

- Question 1: How to stay motivated throughout our careers? (I've found myself morphing into new research areas to keep things interesting. But this requires that I learn new stuff and that can be taxing.) How to balance between keeping work interesting vs. it being overwhelming?
    - **Tzu-Wei**: Question yourself, why are you doing this research? Does it bring joy?
    - **Mark:** Take advantage of all training, keep eye for latest techniques.
    - **Mack:** Balance and manage life vs. work.

Tzu-Wei Fang and Astrid Maute.

- Question 2: How can we ensure that our field reflects the larger population? How to ensure that our field is accessible? How do we retain good early career scientists (ECS)?

    - **Tzu-Wei**: Communicate our research to society, reach out to agencies.
    - **Mark**: Increase the salary for early career scientists.
    - **Mack:** Volunteer time for students, communicate your science to your relatives.
    - **Ian:** Communicate your science to lay-people understand our field.
- Question 3: How do we improve communication between science, industry, government, and data users?
    - **Tzu-Wei**: Communicate knowledge to industry and data users; think about what they need from us; listen to clients and learn what they want from us.
    - **Mack:** Use plain language to explain our research to the public.
    - **Ian:** Think about what would be of interest to commercial users, military personnel.
- Question 4: How do we stay funded in a hostile (or competitive) funding environment? How to stay motivated to write proposals when excellent ones are declined!?
    - **Mark**: Submit to multiple funding sources.
    - **Lynn:** First give the proposal to senior scientist for feedback

The next session hosted 7 invited scientists to sit on a panel to discuss ***"Next-Generation Instrumentation"***. The 7 panelists were:

- **Doug Rowland** at NASA Goddard as the Project Scientist for the Geospace Dynamics Constellation mission. Since 2019, he has coordinated the GDC science team and worked with the GDC science and project teams to develop the mission concept, from science requirements to mission implementation plans.
- **Rebecca Bishop**, Principal Scientist in The Aerospace Corporation's Space Science Applications Laboratory where she supports various space enterprise programs as well as performs basic research focusing on the ionosphere/thermosphere. She is the PI of a GPS radio occultation sensor for the CubeSat formfactor which has flown on five CubeSat/NanoSatellites missions. She is the PI for the Low-Latitude I-T Enhancements in Density (LLITED) mission consisting of two 1.5U CubeSats that recently re-entered after successfully obtaining neutral/plasma density observations in the lower I-T.
- **Asti Bhatt,** Research scientist from SRI with over 10 years of experience in the field of ionosphere-thermosphere-magnetosphere science. She is the PI of two NSF facilities – the MANGO network of all sky imagers and the AMISR radars, which produce near-continuous data for the broad geospace community use. As part of these projects, she ensures science data acquisition and helps science community researchers interpret the data. She also advocates for robust data infrastructure from geospace instruments.
- **Fabiano Rodrigues**, Associate Professor of Physics and Electrical Engineering at UT Dallas. He is been involved with ground-based geospace instrumentation for educational and research purposes. Current efforts include the development and deployment of low-cost ionospheric scintillation and TEC monitors, and help with the expansion of radar capabilities at the Jicamarca Radio Observatory.
- **Tomoko Matsuo,** Associate Professor in the Ann and H.J. Smead Department of Aerospace Engineering Sciences at the University of Colorado. She was a member of ENLoTIS Working Group as well as ESA Deadalus Mission Advisory Group and GDC Science Technology Definition Team. She is currently leading one of DYNAMIC Phase A concept studies as PI.

- **Aimee Merkel**, Principal Investigator and instrument scientist for the DYNAGLO CubeSat mission due to launch in early 2026, and the Principal Investigator of the recently-selected DYNAMIC DAPHNE mission concept now entering Phase A. She is a research associate at the Laboratory for Atmospheric and Space Physics with over 100 publications on Earth and planetary atmospheres and 28 years of instrument scientist experience.
- **Scott Bailey,** Professor at Virginia Tech and director of the Center for Space Science and Engineering Research. He is also the principal investigator for one of the three selected DYNAMIC proposals.
- **Larry Paxton** is part of a long chain of UV enthusiasts that extends from APL to NRL and LASP back to the original work done at Johns Hopkins University 140 years ago by Henry Rowland of Rowland circle spectrograph fame – that's the design used by DMSP SSUSI and TIMED GUVI. New frontiers in far ultraviolet imaging include new all-reflection spatial heterodyne spectrometers that achieve extremely high spectral resolution; wide bandgap semiconductors for single-photon solar-blind detectors; UV-grade freeform optical designs enabling wide FOV and aberration correction; high-efficiency mirror/grating coatings to improve SNR. Larry admires these new technologies from the sidelines while finding that many fundamental problems in aeronomy can be addressed by well-understood, relatively inexpensive technology if given the chance.

Next-Generation Instrumentation panel members (from left to right): Astii Bhatt, Aimee Merkel, Rebecca Bishop, Doug Rowland, Scott Bailey, Larry Paxton, and Tomoko Matsuo. Fabiano Rodrigues served remotely via zoom.

We allowed each of the panelists a 3-minute answer to one of the following questions. The audience then asked the panelists questions.

- Question 1: Imagine 10 years in the future – what instrumentation will be cutting edge to deliver the science we need?
- Question 2: Describe how instruments in your area of expertise are going to change
- Question 3: Besides costs, what are the challenges we face in developing new instruments in the next 10, 20, 30 years?

Panelists responses were as follows:

Doug Rowland – GDC: We need balanced toolboxes and people trained to use the tools. Need both GB and satellite in-situ and remote satellites, cubesats and smallsats, need a pipeline to transfer knowledge.

Rebecca Bishop – SmallSats: In 5, 10 years we will build instruments that get in-situ neutral wind and density measurements. Instruments need to leverage "signals of opportunity". Mass-less payloads – every satellite has GPS on it and there is a way to extract information on other things (use ancillary information to our advantage).

Asti Bhatt - Networks of small instruments. ISRs: In order to carry out multi-scale science, SpWx prediction, model-measurement comparisons, we need to focus on 3 goals for SpWx needs. 1)

Need networks capable of both high temporal and spatial resolution. 2) Need highly precise instruments. 3) The things we build need to be operated and maintained.

Fabiano Rodriguez – Large instruments, GB + satellite. We need measurements of multiple parameters at the same place and time. Need to augment current ISR capabilities.

Tomoko Matsuo – ENLoTIS WG, DYNAMIC PI: We must complete our last DS science priorities. We've come a long way. Now we need to learn to predict space weather. We need temperature, winds, and composition at the same time! This will benefit the world.

Aimee Merkel – DYNAMIC PI. Challenges we face: we need community support. How do we continue developing instrumentation and getting it in space? We need multi-agency support. Cubesats need to be included to increase TRL.

Scott Bailey – DYNAMIC PI: Access to space has become less expensive but we're not taking advantage of it. In 10 years? What does the community need to know? We need observations of tides. We need temperature and wind observations that will deliver what we need to know. 10 years from now we'll have incredible new observations. But it's taken too long. We need to work harder at marketing.

Larry Paxton – In 10 years there will be 100,000 LEO satellites (a 10-fold increase). That will enable thousands of observations. Far UV instruments.

The audience then asked the following questions of the panelists:

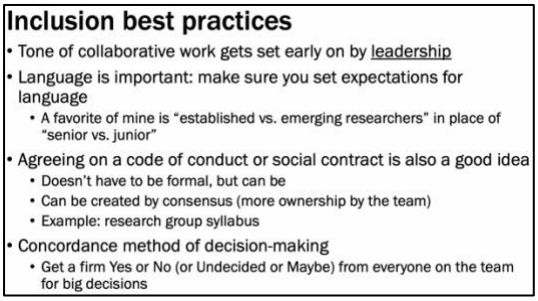
- **Larisa Goncharenko** – How do we get more from cubesats? Are cubesats the answer to our data needs?
  - **Rebecca** – Progress in cubesat capabilities is slow. The trend is the satellites are getting bigger.
  - **Aimee** – HFORT is requiring more science.
  - **Larry** – Let's buy buses off-the-shelf and focus on building instruments
- **Mark Moldwin** – There will be millions of LEO satellites. How should we build them to better leverage massless payloads?
  - **Rebecca** – better GPS and accelerometers.
- **Cora Randall** – How do we best communicate with the public? Could we think about crowd-sourcing instrumentation? Develop instruments that everyone can use? Put them into K-12 - drones, get general public, get teachers and school boards involved in taking the measurements?
  - **Larisa** – space weather station prototypes are <$500
  - **Asti** – We aspire to put MANGO network instruments at High Schools. We need to also deliver a coherent message describing why measurements are significant.
- **Katelynn Greer** – There are funding mechanisms for citizen science, why don't we do this more often?
  - **Rebecca** – Commercial companies want to solve the climate crisis. Communication is often hindered by NDAs.

The final session of the workshop was ***"Building and Nurturing Investigator Networks"***. We invited 6 scientists to speak in this session. They represented a broad cross-section of the community who offered diverse perspectives.

- **Lindsey Goodwin** gave a talk entitled "From newcomer to networker: Creating a collaborative community." Lindsey is an ECS who performs a lot of community service and this increases her visibility. She suggests being open minded and to get engaged – to do whatever interests you. The following challenges remain in the process of building a network: We need to figure out what ECSs want and need; we need ways to celebrate everyone. We need to engage and interface with the community - to talk to people. Don't see others as your competition, it's good to collaborate!

- **Dave Brain** spoke about "How to build a network. What is a network?". His career includes experience on several planetary mission science teams, leading a NASA DRIVE center, and serving on National Academies panels. He presented a 10-point plan to create a web of collaborators with complementary skills to his.
    - 1) Networking is not beneath you
    - 2) Plan ahead
    - 3) Show up, then show up again
    - 4) Bring something to the table
    - 5) Communicate Clearly
    - 6) Be available
    - 7) Don't overstate or understate your value
    - 8) Build teams deliberately
    - 9) A network can include more than scientists
    - 10) Value integrity and collegiality

- **Allison Jaynes** spoke about "Positive team dynamics & DEIA in collaborative work". There are many "best practices" to create inclusive teams. These include setting the tone of a collaborative project early, be precise with your language, agree on a code of conduct, and use the concordance method of decision-making (where you get a yes or no from everyone). As scientists we are not trained in these areas and we often don't have the time or interest to implement and master them. What should we do? Spend time thinking about and implementing these best practices. Listen to presentations, read reports, and talk to established leaders that embody these principles in their leadership. Open up about your path and possibly your struggles. Spend time thinking about succession plans and shadowing (GEM mentoring program). In terms of DEIA in projects/missions, there are 6 evidence-based guiding principles for STEM pathway investments: 1) promote the development of STEM identities, 2) establish flexible and relevant STEM education-to-career pathways, 3) intentionally recruit from historically underrepresented groups, 4) provide access to diverse mentorship, 5) foster career-life balance, and 6) promote systemic change around DEI. There are lots of existing programs at NASA etc. that you can tap into.



- **Mangala Sharma** spoke about NSF funding opportunities to build & nurture researcher collaborations. She discussed the objectives of NSF to support the community. She discussed the opportunity of faculty in universities to develop the research in the universities. Did you know that NSF encourages networks building among academia and industry? There is also NSF support to organize conference/meetings/workshops. There is money available to plan proposals - this helps to conceptualize a larger plan that can be submitted to NSF. There are opportunities for international collaborations, check out "AccelNet".
- **Jeff Thayer** gave the talk "Our future leaders". Leadership is critical for the continuation of existing programs and for the initiation of new programs. Sarah Gillis, the civilian astronaut who did the spacewalk today, was in Jeff's class and he remembers that she was inquisitive. Leadership is not about titles, positions, or flow charts. It is about one life influencing another in a positive way. Jeff went from private industry to become a professor to influence other's lives. Attributes of a good leader are: Inspiration, Trustworthiness, Responsibility, Empowerment of others, Resilience, and Decisiveness. Leadership can happen at all levels.
    - **Mark**: We need to distinguish leadership from authority. As ECSs you can advocate for e.g., child care. Change needs everyone.
    - **Katie** – How do we train positive leadership? What are actions to do this?
    - **Allison** – Grant PIs need leadership training.
        - **Susanna Finn** will get information on PI training schools
        - **Rebecca** – last PI school happened at JPL and focused on working on a team. Offer it every other year.
- **Larry Paxton** spoke about "Creating opportunities for the next generation - to learn to how to build, calibrate, & test instruments". We each need to understand what we want to be involved with. We need to maintain the workforce. Engineers build instruments and they have to work with scientists to know what to build. Airborne and rocket programs supplement satellite missions as well as commercial opportunities. NASA and NSF could collaborate to train the next generation. How to shape the future, together? Imagine if you had the answer to the fundamental questions – what would that enable? Envision the future. How do we get there? What do we have to know? Who do we have to connect with to build that future? We are all passengers on one-way time machines – we move into the future one day at a time. We can send a message into the future by what we do for our community today.

Larry Paxton and Lindsay Goodwin.

A 15-minute discussion session followed the talks where we posed the following questions and had informal discussions.

- How do we train the next generation of instrument builders?
- There are many challenges – what are the solutions?
- How do you translate being inspired into action? What can we do?

Closing Remarks

At the end of the meeting **Susanna Finn** announced that she is open for anyone to email and reach out to her for whatever reason (susanna.c.finn@nasa.gov). She also asked that both

Larisa Goncharenko and Susanna Finn.

emerging and established scientists **please volunteer** to review NASA ROSES proposals! This is an important service to the community and a great way to improve your proposal writing skills. Post-docs and early career scientists are encouraged to participate as panelists. Grad students are encouraged to volunteer to be Executive Secretary to assist the panels and see how the process works. Go to: https://science.nasa.gov/researchers/ → More → Volunteer to Review Proposals

See NASA ROSES Solicitations:

https://nspires.nasaprs.com/external/solicitations/solicitations!init.do and search "b." to find all Heliophysics opportunities, search "f." for cross-divisional opportunities

- Some newer opportunities that might be of interest:
  - B.16 Heliophysics Artificial Intelligence/Machine Learning-Ready Data
  - B.12 Heliophysics Data Environment Enhancements
  - F.14 High Priority Open-Source Science
  - F.8 Supplements for Open-Source Science
  - F.7 Support for Open-Source Tools, Frameworks, and Libraries
  - F.9 Citizen Science Seed Funding Program
  - B.21 Heliophysics Citizen Science Investigations

Check out the HEliophysics Strategic Technology Office (HESTO)

Check out Heliophysics Data Portals

- Heliophysics Digital Resource Library (HDRL): https://hdrl.gsfc.nasa.gov/
  - One-stop shop for SPDF, SDAC, HDMC, Helioviewer, and more
- SMD Heliophysics Data website: https://science.nasa.gov/heliophysics/data/
  - Links to OSDMP (Open Science Data Management Plan) template, Heliophysics Science Data Policy, HDRL, and more

GIGI-Next Meeting Participant List

First Name	Last Name	Affliation
Vincent	Adkins	VT
Phil	Anderson	UT Dallas
Saurav	Aryal	LASP
Scott	Bailey	VT
Erich	Becker	NWRA
Asti	Bhatt	SRI International
Rebecca	Bishop	The Aerospace Corporation
Dave	Brain	LASP

Xuguang	Cai	LASP
Clayton	Cantrall	JHUAPL
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Iurii	Cherniak	COSMIC Program Office, University Corporation for Atmospheric Research
Hayley	Clevenger	Embry-Riddle Aeronautical University
Ian	Cohen	JHU/APL
Anthea	Coster	MIT Haystack Observatory
Chihoko	Cullens	LASP
Satyaki	DAS	University of Alaska, Fairbanks
Yue	Deng	University of Texas at Arlington
Yue	Deng	University of Texas at Arlington
Jason	Derr	United States Military Academy
Manbharat	Dhadly	NRL
Brandon	diLorenzo	University of Colorado - Boulder
Richard	Eastes	LASP
Ana	Elias	FACET, Universidad Nacional de Tucuman & INFINOA
Scott	England	VT
Scott	Evans	CPI
Tzu-Wei	Fang	NOAA SWPC
Agri	Faturahman	National Research and Innovation Agency of Republic Indonesia
Susanna	Finn	NASA HQ
Bruce	Fritz	NRL
Quan	Gan	LASP
Federico	Gasperini	Orion Space Solutions
Claire	Gasque	UC Berkeley
Larisa	Goncharenko	MIT Haystack Observatory
Gilda	Gonzalez	UC Berkeley
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Katelynn	Greer	LASP
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V. Lynn	Harvey	LASP
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Taylor	Lindley	Auburn University
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Gang	Lu	National Center for Atmospheric Research
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John	McCormack	NASA HQ
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Slava	Merkin	JHU/APL
Mark	Moldwin	University of Michigan
Luis	Navarro	SWx-TREC, CU Boulder
Mukta	Neogi	Clemson University
Larry	Paxton	JHU/APL
Agustina	Peck	Utah State University
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Anh	Phan	Utah State University
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Mangala	Sharma	NSF
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Andrew	Stephan	NRL
Jeff	Thayer	University of Colorado Boulder

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Valery	Yudin	Catholic University of America
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Jiarong	Zhang	Utah State University