



2025 Gateways to Blue Skies Competition:
AgAir | Aviation
Solutions for Agriculture

Q&A Session #1

November 20, 2024
3:30–5:00 PM Eastern

(Please mute all mics.)



The Gateway to Blue Skies: AgAir | Aviation Solutions for Agriculture Competition is sponsored by NASA's Aeronautics Research Mission Directorate's (ARMD's) University Innovation Project (UI) and managed by the National Institute of Aerospace (NIA).



Session Agenda



- Welcome & Introductions
- Context for and Discussion of 2025 Theme
- General Technical Remarks
- General Programmatic Remarks
- Questions Received in Advance
- Additional Questions (Time Permitting)
- Wrap Up

Program Team

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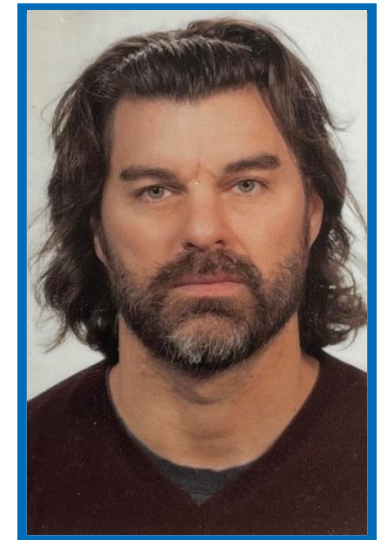
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GATEWAYS TO
BLUESKIES

**Context for and
Discussion of 2025
Theme:**

**AgAir | Aviation
Solutions for Agriculture**



Context for and Discussion of 2025 Theme



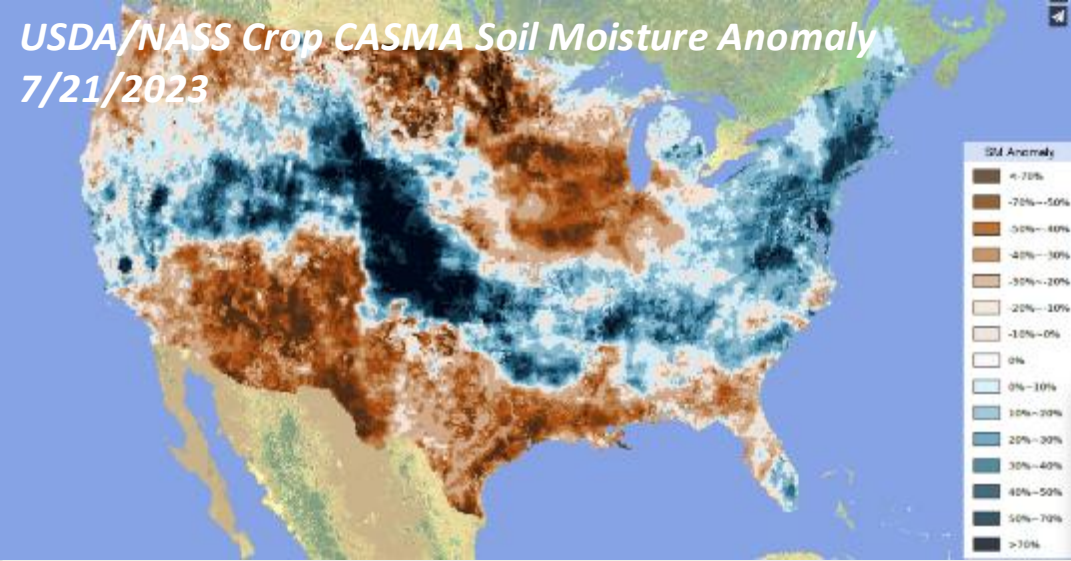
Through the 2025 Blue Skies Competition, collegiate-level student **teams will conceptualize novel aviation-related system(s) that can be applied to agriculture by 2035 or sooner with the goal of improving agriculture production, efficiency, environmental impact, and extreme weather/climate resilience.** Teams are encouraged to consider high-potential technologies and systems that aren't currently mainstream or highly regarded as becoming mainstream in the future and imagine beyond applying sensors to aviation systems.



NASA Agriculture Overview

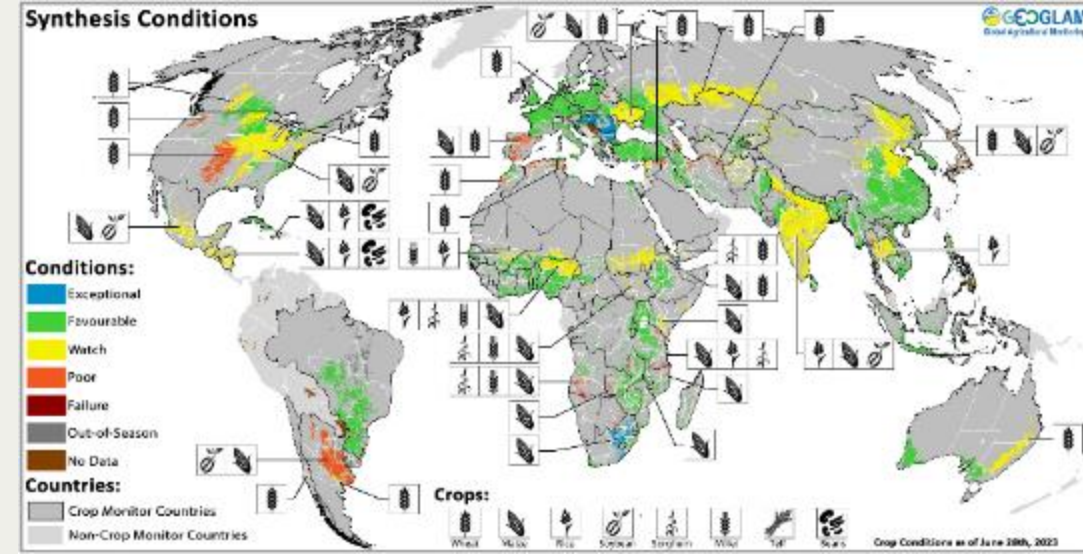
Bradley Doorn
Agriculture Application Area
Earth Action
Earth Science Division, NASA Headquarters





USDA NASS – CDLs and Crop Health

Carbon Monitoring System Research Program



Global Food Supply – Direct support of USDA/FAS (WASDE) and G20 Ag Minister/AMIS

USAID Famine Early Warning System



USAID FLDAS Supports Food Security Early Warning

FLDAS Land Surface Modeling Products and S2S Forecasts

FEWS NET Outlooks, Alerts, and IPC Acute Food Insecurity Phase Classification

Acute Food Insecurity: Near Term (August - September 2022)

IPC 3+ Acute Food Insecurity Phase

Reference Countries: 1. Stable, 2. Stressed, 3. Emergency, 4. Famine, 5. No longer in phase

Non-reference Monitoring Countries: 1. Stable, 2. Stressed, 3. Emergency, 4. Famine, 5. No longer in phase

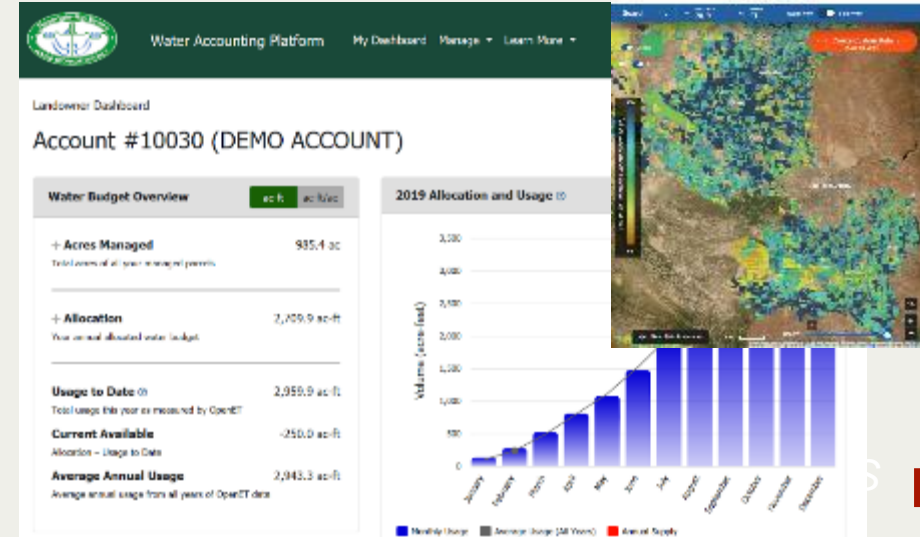
MARKETS & TRADE | AGROCLIMATE | LIVELIHOODS | NUTRITION

FEWS NET | UNIVERSITY OF MARYLAND

Monitoring Water Demand and Use: OpenET

Information and data services on agricultural water needs and consumptive use for the western U.S.

Web UI and data services



Field-scale (30m) ET data for the U.S. integrated into Irrigation Management Systems

Case studies across the West used to define requirements



Data review in the field with growers





NASA's Agriculture Program Area



www.NASAacres.org
@AcresProgram

NASA Acres = USA

Foci

- *On-farm and range tools*
- *Data privacy & autonomy*
- *Soil/Crop health*
- *Workforce development*

Established 2023

Director: Alyssa Whitcraft



www.NASAHarvest.org
@HarvestProgram

NASA Harvest = Global

Foci:

- *National to global policy support*
- *Food security*
- *Markets & Trade*

Established 2017

Director: Inbal Becker-Reshef

Key Activities

- Reach back into larger NASA research and mission activities
- Driven by needs for tools and information
- Focused on advancing methods, tools, and adoption of EO for the benefit of agriculture and food security
- Strong collaboration ethic, especially with private sector
- Feedback to space agencies on new missions
- Led by UMD + > 90 partners from gov't, commercial, farm association, NGO, intergovernmental, humanitarian sectors
- Core-funding from NASA to seed start + grow

Who We Are

What We Are Doing

What's Next



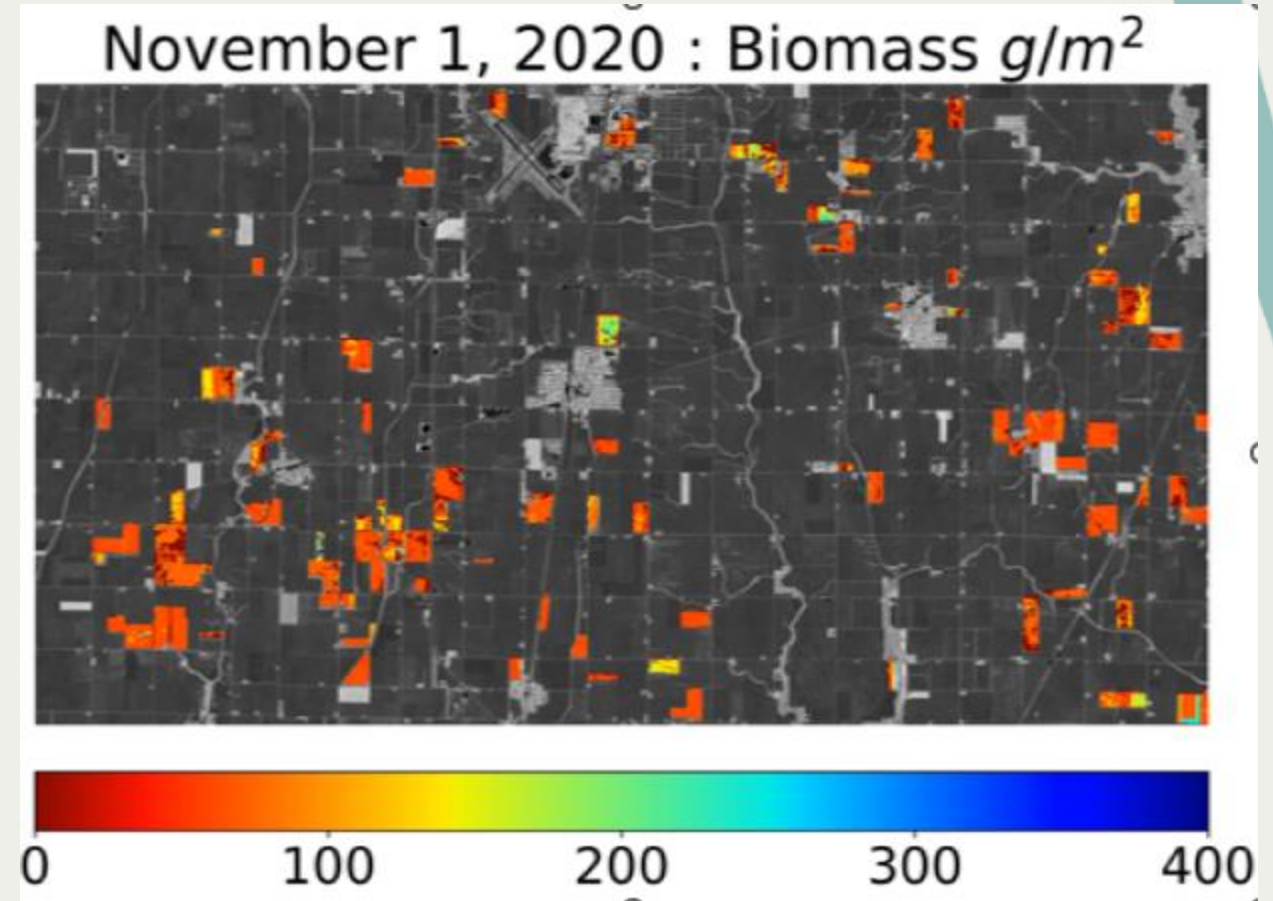
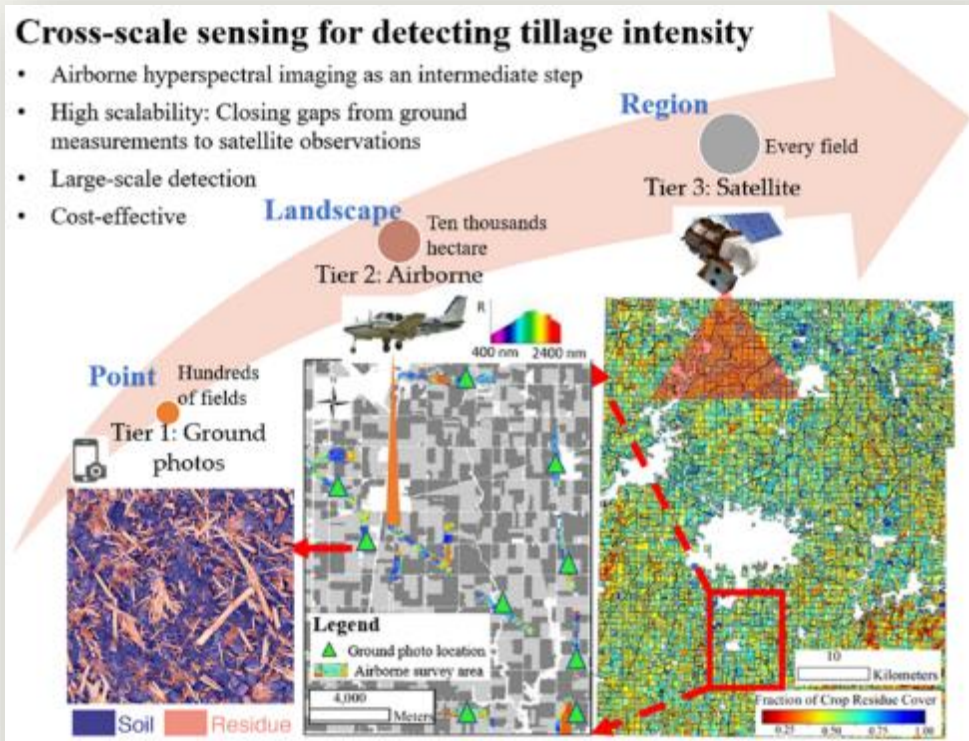
A. Essential Agriculture Variables

- ▶ **Within-Season Yield Forecasting**
- ▶ **Historical Yield Estimation**
- ▶ **Cropland & Crop Type Mapping**
- ▶ **Crop Area Estimation**
- ▶ **Crop Planting & Harvest Dates**
- ▶ **Cover Crop Utilization & Performance**
- ▶ **Crop Residue & Tillage Mapping**
- ▶ **Canopy Nitrogen Content**
- ▶ **Rangeland Productivity & Utilization**
- ▶ **Pest & Disease Mapping**
- ▶ **Soil Organic Carbon & Other Metrics of Soil Health**
- ▶ **Evapotranspiration**



A. Essential Agriculture Variables

Residue Cover & Tillage Intensity Mapping
(Wang, S., Guan, K., et al., 2023. *RSE*; UIUC)



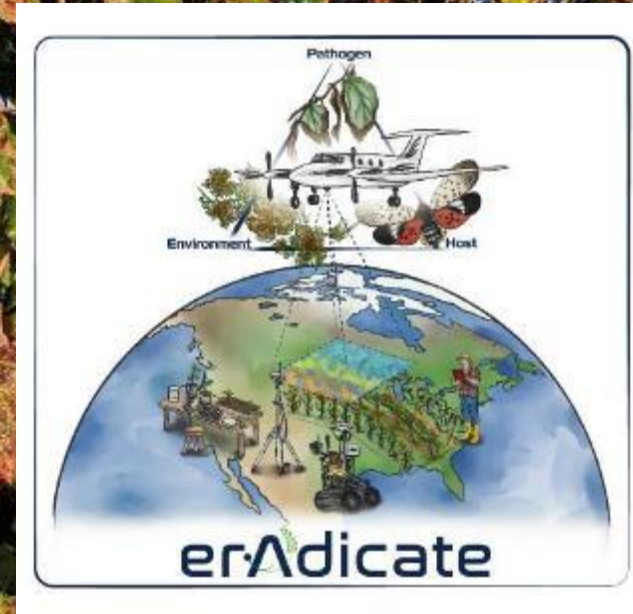
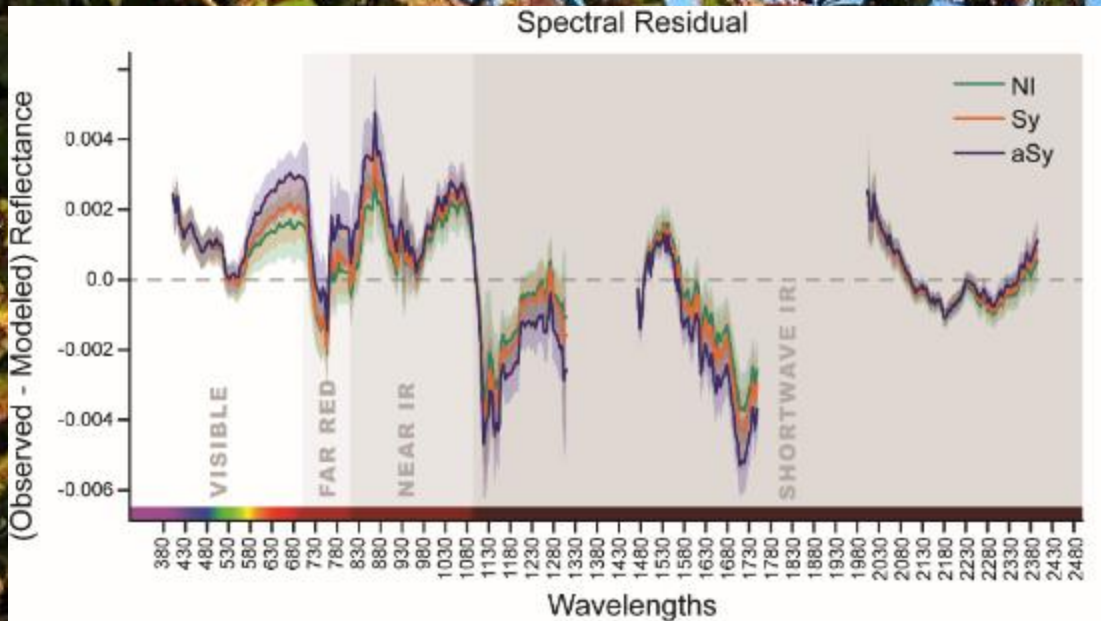
Cover Crop Mapping & Biomass Estimation
(Wang, S., Guan, K., et al., 2023. *RSE*; UIUC)

Asymptomatic crop disease detection with airborne imaging spectroscopy

- Romero Galvan et al. 2023, *Phytopathology*
- Rubambiza & Romero Galvan et al. 2023, *JGR Biogeosciences*
- NASA Press Release August 4, 2023

Cornell **CALS**

College of Agriculture
and Life Sciences



Technique has great transferability to other threatening diseases and pests in both agricultural and natural systems. Offers early warning for intervention and effective mitigation.

Airborne imaging spectroscopy can detect visible and non-visible crop viral infection with high accuracy on California grapevine. Prototype cloud-native data system design facilitates high-accuracy machine learning-based detection at scale for stakeholders while maintaining grower privacy

Training	Data Location	Data Size	Compute	Storage	Runtime	Accuracy
Edge	Local	4MB	8 CPUs	256GB	27.1s	82%
Edge	Cloud	-	8 CPUs	256GB	35.6s	84%
Azure ML	Cloud	-	2 vCPUs	100GB	86.5s	84%

Project next steps:

Spectral biology: To what extent is asymptomatic detection driven by spectral biology vs spectral latent space?

Uncovering true pattern of spread: Can remote sensing derive more accurate maps of GLRV spread over the past decade?

Game theory: How does grower management decision making influence epidemic outcome?



Airborne Observations for Agriculture – Examples of Concepts

- Airborne data are valuable for linking *in situ* observations and fine spatial scales with coarser-scale satellite data, and understanding how spatial patterns in key agriculture variables at spatial scales of 5 cm to 30 m influence accuracy and uncertainty in satellite data products
- Airborne data play a key role in validating satellite data products and developing new or improved algorithms for satellite mapping of agricultural variables allowing collection of calibration and validation data at spatial scales that are larger than can be measured using ground-based instrumentation alone
- Airborne data are valuable for mapping fine-scale spatial patterns for agricultural variables that change slowly over time (e.g., field boundaries, the locations of irrigation infrastructure), and that are valuable for agricultural modeling or summarizing coarser-scale satellite data products
- Looking for more innovations from the Blue Skies Competition





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General Technical Remarks



Proposal and Video Expectations

- What are we looking for in the proposal?
- What are we looking for in the video?
- What we **DO** want to see in the Competition:
 - High-level systems concepts,
 - Understanding of current agricultural management techniques,
 - Consideration of operational environment (physical and logistical),
 - End-user consideration and engagement,
 - Decisive and scoped concept choices (one system does not fit all solutions)
 - The ability to close gaps in current aviation-related agricultural needs
- What do we **NOT** want to see in the Competition:
 - Detailed aircraft design studies
 - Physical prototypes

Programmatic Remarks



- Primary Academic Advisor must sign the Proposal.
- Finalists selected based on Proposal and Video Submission.
 - Final scoring starts with technical paper/infographic and ends with presentation at the Forum. In other words, you **CAN** and **NEED TO** provide updates between the proposal and final technical paper!
- Be sure to read the Competition Guidelines in full before diving into analysis.
 - The Competition Guidelines are the foundation upon which your submission will be judged!
 - Carefully review the evaluation criteria.
- Remember: You will need to submit a W-9/Vendor Form with your Proposal.
- YOU are selling your proposed concept to the judges!

**NEXT
DEADLINE**



**Competition
Guidelines PDF**

**2025 Competition
Announced**
(August 6, 2024)

Q&A Session 2
(January 23, 2025)

**Proposal & Video
Submissions Due**
(February 17, 2025)

**Selection
Notifications**
(March 14, 2025)

**Forum at NASA
Armstrong**
(May 20-21, 2025)
{Subject to Change}



Q&A:

Technical Questions



- **Are we tasked with designing a specific technology? Or designing a larger system/workflow?**
 - Gateways to Blue Skies is a competition seeking systems-level concepts and solutions. While many new technologies may be used, we don't expect teams to design new technologies.
- **How is 'agriculture' defined in the scope of the competition?**
 - For this competition, participants were asked to focus on the areas of agriculture that included cropland, rangeland, and/or livestock management.
- **How are 'mainstream technologies' defined in the scope of the competition?**
 - It is a loose definition. We want people to consider new ways to use existing or widely used technologies in addition to new technologies.

Q&A:

Technical Questions



- **The competition RFP expresses using caution when including sensors in the system's design. Should the system limit its use of sensors, or can the design include sensors while also including other advanced, developing technologies? Can you explain more about what it means to think "beyond applying sensors to aviation systems"?**
 - We used that wording to get teams to think outside the box. We imagine most of the system will have some sort of sensors, but we wanted people to think about what else can be done beyond sensing to encourage diversity and innovation in proposals. If we received mostly applications that are primarily focused on the sensing aspect, we would likely have significant overlap in the proposed concepts and less unique proposals.

Q&A:

Technical Questions



- **The rules indicate that we are excluded from developing on ideas of aquaculture, but what of intersections between aquaculture and agriculture? For example, are we allowed to pursue projects that track what happens with wastewater from pesticides?**
 - Teams may propose projects that explore the downstream effects of agricultural land management because they focus on how farming practices influence water quality, soil health, biodiversity, and ecosystem services. Projects such as these would aim to understand both the immediate effects of agricultural practices and also promote sustainable land management strategies that safeguard environmental health and enhance agricultural productivity. This type of work would be different from aquaculture as defined in the question above.

Q&A:

Technical Questions



- **To what extent should our project reflect real-world feasibility based on today's research and technology, versus speculative advancements that might only be plausible by 2035? Should ideas be grounded in current technology, or should we explore possibilities that require significant technological advancements? Does the competition prefer realistic solutions or groundbreaking innovation that might be technically challenging today?**
 - You have found one of the great challenges our teams face every year! There are groundbreaking things you can propose with today's technology as well as revolutionary things you can do with tomorrow's technology. Picking one or the other or balancing the fine line in between can be a challenge. Teams on both ends of that spectrum have won awards in our competition. Speculative advancements only plausible by 2035 are welcome, if they are well-justified regarding how they are expected to come to be broadly and specifically related to the proposed technology. Arbitrary, science fiction worlds without reasonable justification will not be viewed favorably. After all, 2035 is just nearly 10 years away.

Q&A:

Technical Questions



- **Can you clarify whether we need to restrict our geographical scope for a solution to the United States, or can we focus on a different area of the world and/or address issues of a global nature? For example, Russia and Ukraine account for 12% of total calories traded. Would systems that consider the ramifications of conflict in breadbasket nations be permitted?**
 - The geographical scope was intentionally not limited for this project. Teams may choose to address a challenge or gap in any area of the world or choose to focus more broadly on global issues that a technology or concept can solve. If you select a broad scope, be sure you have ample space in your paper and supporting materials to adequately justify your concept and its application in the selected landscape. We imagine ramifications of conflicts would have analogues to other types of potential issues that agricultural systems deal with. If considering these ramifications, the project should focus on the agriculture impacts of events and not the actual conflict or causes of conflict.

Q&A:

Technical Questions



- **Can you clarify whether this competition allows us to concentrate on the application of aerial remote sensing in agriculture, or is the emphasis more on innovations in aviation technology itself?**
 - Both are options and teams must make a case for their choices and show that the innovations will make an impact that is worth the investment.
- **What qualifies as an “improvement” on an existing technology? Improved efficiency, safety, cost?**
 - There are many ways the teams may choose to try to improve an agricultural system. At the end of the day, the systems will need to financially make sense, but teams will be aiming for improvements in different aspects (safety, yield, cost, etc.).

Q&A:

Technical Questions



- **Are there any specific agricultural or environmental challenges expected to intensify by 2035 that NASA would like us to address in our design?**
 - Water scarcity, conservation of soils, efficient inputs to save money and reduce environmental impacts, and extreme weather are all issues that will increase in the next decade. This list is not exclusive. We expect teams to do their research on specific agricultural or environmental challenges expected to intensify by the 2035 timeframe that affect or can be addressed by the proposed solution.
- **Should the system be designed to address one single prominent issue concerning farmers, or can the team develop a system that helps farmers reduce workload on farmland such that it has multiple applications to a single system?**
 - This choice is up to the teams! We want to see a range of solutions across the submissions.

Q&A:

Technical Questions



- **Would using satellite data be a valid incorporation of aviation technology?**
 - For this competition, we do not consider satellites or their data to count as the aviation portion of the concept.
- **Is the system limited to aerial vehicles only, or would an assisting ground vehicle working with an aircraft be permitted?**
 - A team could add capabilities via a ground vehicle, but that should not be the focus (should be aviation focused) as the competition is looking at aviation solutions for advancing agriculture. Be prepared for questions and to justify the complexity, costs, etc. for using a ground-based system to enhance or augment.

Q&A:

Technical Questions



- **How much should the restrictive nature of Part 107 inform our design? If flights using our solution do not conform to Part 107, should waiver submissions be included when charting a path to deployment, or can the regulatory environment be largely ignored?**
 - Consider existing laws and regulations when planning requirements for all systems.
- **Is NASA required to be considered as a stakeholder?**
 - While NASA is a stakeholder for the competition, NASA is most likely not a stakeholder for the imagined end use case for the concepts that teams are developing.

Q&A:

Technical Questions



- **Is cost a significant evaluated design factor for this competition? For example, should we provide estimated costs for the proposed methodology, e.g., operating cost, equipment setup, etc.?**
 - Teams should try to make sure their concepts are economically viable (see [Competition Guidelines](#), Page 5, Part 3). Teams will go into different amounts of detail on how they justify costs, depending on their proposed concept.
- **For the development of our proposal, should we include estimated costs based on current prices, or is it more appropriate to provide a futuristic cost prediction aligned with expected advancements?**
 - Teams should analyze their concept's economic viability for the proposed implementation. Teams will go into different amounts of detail on how they justify costs, account for inflation, etc.

Q&A:

Technical Questions



- **If we incorporate AI into our solution, are we expected to include a full-scale analysis of the algorithm? What depth of analysis is expected? Similarly, if we develop software for the project, will it need to be submitted with the proposal, or is it sufficient to reference in the document?**
 - This is a systems level concept, so we do not expect an in-depth analysis on the algorithm. Justifications of its use and impact will need to be present. We do not expect teams to develop software or physical prototypes for this project.

Q&A:

Technical Questions



- **What technology readiness level range is acceptable today, to be implemented into the 2035? How detailed should our justification be for meeting technology readiness by 2035?**
 - Teams should "provide a pathway and timeline to deployment for the systems by 2035 or sooner," which includes technology readiness levels (see [Competition Guidelines](#), Page 5, Item 4). Teams tend to include a timeline to show how their concept reaches implementation by 2035. Top teams will present justified arguments for their intended pathway, particularly for lower or mid-TRL items as they consider inherent risks and a deployment schedule.

Q&A:

Technical Questions



- **For our submission, are we expected to present concrete results based on data or simulations, or is it acceptable to discuss potential outcomes as projections or expectations, considering certain variables and constraints?**
 - The latter, "potential outcomes as projections or expectations, considering certain variables and constraints." As a systems-level concept, we don't expect students to be running simulations.

Q&A:

Miscellaneous Questions



- **Are there specific problems that inspired this year's theme? What drove you to select agriculture as the focus?**
 - There are not specific problems that drove this year's topic selection, but many challenges exist primarily due to the changing climate. With these challenges, agricultural business operators are among those more open to change and adoption of new technologies to secure their business and ensure resilience.
- **What defining features has set winning teams apart from others?**
 - Winning teams tend to have solid deliverables across the board (proposals, videos, infographics, presentations, etc.). They not only complete all requirements of the competition, but they are also often innovating with today's technologies or pushing the boundaries of what could be done by the target date listed in the [Competition Guidelines](#).

Q&A:

Programmatic Questions



- **What constitutes a completed, fully-fleshed-out project? Can you spend some time clarifying and providing more detail about the goal of our proposals?**
 - A complete proposal will be a written paper that addresses all criteria listed in the Proposal & 2-Minute Video section of the competition guidelines, addressing all listed components with equal weight and adequate justification through research and projection grounded in reasonable thought. (See pages 9-14 of the [Competition Guidelines](#).) The goal of your proposal is to conceptualize a solution at a higher, systems level for this year's topic, justifying the needs and the various aspects of the conceptualized solution.

Q&A:

Programmatic Questions



- **Should the proposal focus on a conceptual paper, or should it include a practical component with a prototype? If we create a prototype, will it be factored into judging? If it's not required, can we still include a prototype if we want to?**
 - Proposals should focus on the technology/concept and its application, justification, and technology readiness analysis. That said, prototypes can be a valuable additional modality for teams to display and discuss concepts for other stakeholders if they have any but are not needed for this competition. Teams will not earn extra points for physical prototypes.

Q&A:

Programmatic Questions



- **What is the grading criteria of the competition? Is novelty or practicality more important? Are there certain sections or content areas that are weighted more heavily? What aspect of the systemwide design should we focus most on?**
 - Proposal and Video evaluation criteria can be found within the [Competition Guidelines](#), on page 12. There is a link to the official scoring matrix on that page of the guidelines, which outlines how scores are allocated. Generally speaking, this competition asks teams to present novel ideas that are well-justified in all areas listed in the Competition Theme Description and Details (Page 5). Teams are responsible for determining how best to allocate their material within the allotted page count to present a compelling proposal. Innovation comes in many different forms; how each team chooses to balance the line of innovation practicality and pushing the boundary is unique. While proposals are scored on innovation, they are also scored on concept of operations and implementation.

Q&A:

Programmatic Questions



- **Are we permitted to reach out to agricultural companies or organizations to understand common challenges in the industry and gather insights on potential aviation technologies they would find beneficial? What about anyone at NASA?**
 - Absolutely! It is highly encouraged to work with industry professionals to understand the opportunities and needs that exist within your chosen area of research and development. Teams may additionally contact individuals at NASA, provided the NASA contact is not serving on the judging panel (it is expressly forbidden for judges to interact with teams related to Blue Skies prior to the forum) nor are sponsors of the program (i.e., teams may not reach out to anyone at the University Innovation Project for anything related to Gateways to Blue Skies). While NASA may have many subject matter experts in many innovative technologies that would be happy to talk, NASA would most likely not be the target end user or stakeholder for the types of concepts this competition seeks.

Live Q&A



Open Call for Additional Questions

Use the "Raise Hand" Function
or type your question in the Chat!

Q&A: If time permits

Technical Questions



- **Can we address multiple issues related to agriculture and aviation, or must the focus remain on a single issue?**
 - Teams may address as many issues as they'd like, as long as they can adequately meet the requirements as outlined in the [Competition Guidelines](#). Space is limited, so teams should use discretion on determining how many issues to address while being sure to delve as deeply as possible into the required analytical elements.

Q&A: If time permits

Technical Questions



- **Are there existing frameworks, metrics, or case studies in NASA projects that can measure quantifiable improvements (like yield gains or cost reductions) for small farms using precision agriculture tools?**
 - You can certainly explore the work being done in NASA's Agriculture program under Science, but we do not have any specific frameworks, metrics, case studies we expect the teams to use. We also hope that teams look at all the existing frameworks, metrics, case studies, etc. that they can for their concept's chosen area, looking well beyond what NASA is doing.
- **Are there any existing industry standards or regulations for aviation in agriculture? If so, are we allowed to develop a concept that aligns with those standards?**
 - Regulations, laws, etc. are an important aspect and sometimes a potential barrier to innovative systems that our Gateways to Blue Skies teams consider every year when producing their concepts. Some teams might choose to align to existing regulations/standards or even advocate for some changes by 2035.

Q&A: If time permits

Technical Questions



- **Who will be the main users of our designs: farmers, government agencies, private companies?**
 - End users will vary by team based on their concept. Teams should think about their end user when developing their concepts.
- **How much should available resources like funding, requirements for testing equipment, staffing requirements, influence our design?**
 - While teams don't need those types of resources for participation in Gateways to Blue Skies, it's important to consider realistic costs and economic viability for the proposed concept.

Q&A: If time permits

Technical Questions



- **Are there any restrictions on the use of specific platforms or resources, such as software, hardware, or data?**
 - We don't have any specific restrictions, but for any use, teams would need to make sure it is viable and economical for implementation by potential end users.
- **Is it appropriate to use an off-the-shelf camera/sensor system, or should we be using developer ready cameras/sensors.**
 - Teams can use either, depending on their goals.

Q&A: If time permits

Programmatic Questions



- **What if you don't have a team, how do you find and join one?**
 - Interested participants are responsible for building their own teams. Neither NIA nor NASA provides assistance in linking potential team members. Recommendations for finding team members are as follows:
 - Contact a faculty member at your college or university to inquire about supporting the project, with the first step being identifying avenues for locating interested peers.
 - Connect with engineering student groups on campus to spread the word and attend a meeting or two to gauge interest.
 - Tap friends in similar programs at different universities to see if anyone would be interested in collaborating or building a team at their location.

Q&A: If time permits

Programmatic Questions



- **If a finalist team has leftover funds from the \$8k award are there restrictions on what we can use those funds for?**
 - The \$8,000 check received by finalists in the Gateways to Blue Skies competition is provided as an unrestricted sponsorship intended to facilitate full participation in the 2025 Blue Skies Forum at NASA's Armstrong Flight Research Center in Edwards, CA, May 19-21, 2024. There is no other contract or agreement attached to the use of the funds, and as such, there is no period of performance or other regulations placed on the funds by NIA. Any leftover funds (if any) should be reinvested into the engineering department at the discretion of each team's advisor. Checks are provided directly to the university via ACH, and it is the advisor's responsibility to access and distribute the funds in accordance with university policy.

Future Questions?



**PLEASE SEND ALL FUTURE QUESTIONS TO:
BLUESKIES@NIANET.ORG**

Each question will be responded to directly, as well as posted on the [FAQ](#) Webpage for everyone to see.

We encourage you to visit the FAQ Webpage frequently for updates:
<https://blueskies.nianet.org/faq/>

**Scan the QR Code to view the 2025 Gateways to
Blue Skies Competition Guidelines Document.**

