Challenges for Pre-Hackthon

CHALLENGES I IDEATE AND CREATE!

Space Jockey

THE CHALLENGE

Build a tool that allows a user to virtually experience riding on any one of NASA’s current Earth observing satellites and allow for co-localization of data from various instruments.

NASA has eighteen satellite missions studying the Earth, and three Earth-observing instruments aboard the International Space Station (ISS). Additionally, several more missions are scheduled for launch in the coming years.

Your challenge is to develop a tool to allow a person to virtually experience riding aboard one of NASA’s current satellites as it orbits the Earth. What would you see when you looked down at Earth? What about when you looked around? Wave at the other satellites as you pass each other, and watch out for debris! Be sure to look out for the ISS and greet your fellow astronauts!

As you enjoy your tour around the globe, think about all the data these space instruments generate! Many Earth science problems require combining and comparing data from multiple instruments. So, as you orbit over the same stretch of Earth as a fellow satellite, or collect data for a region with ground sensors, ask yourself—are you measuring values from the same place at the same time?

Solving this problem of colocation—determining when two instruments are observing the same patch of the Earth—is not a simple task. Multiple satellites can cross the same geographic area at the same time, but that doesn't mean they're looking at the same patch of land. Individual instruments have different fields of view. For example, the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on the Terra and Aqua satellites can see 2,330 km from side to side, but the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) on CALIPSO can only see 70 m across, per orbit! In addition to having different orbital characteristics from one another, satellites also undergo orbital changes over their lifetimes as they are launched, adjusted, and eventually run out of fuel.

As you plan your ride around our home planet, incorporate a tool or tools to determine co-localized data points from other instruments and visualize them!

Dictionary of Earth

THE CHALLENGE

Develop a creative way for the public and scientists alike to learn the definitions of Earth-related scientific and technical terms, using the power of crowdsourcing.

Background: Aerosol optical depth, free-air anomaly, catchment area, Lagrange points, vicarious calibration… these are a sample of the thousands of "jargon" terms NASA Earth scientists and engineers use every day to talk about their work.

NASA's Earth-observing missions study our planet's atmosphere, vegetation, interior, water, and interaction with the Sun and space. Each of these fields, themselves divided into numerous specialties, is accompanied by its own suite of technical terms.

Navigating the resulting accumulation of names and terms is a problem not just for members of the public who want to understand NASA's work and our planet, but also for scientists and engineers from different fields who want to work together. Having the ability to consult a shared dictionary would allow people to talk in the same language, and help build a deeper understanding of Earth science. **Your challenge is to develop a creative tool for science enthusiasts and scientists to share and learn the definitions of Earth-related scientific and technical terms.** Harness the power of crowdsourcing and allow different users to add and edit entries. Think about how you would monitor the entries for accuracy, and how you would allow proper credit to be given through referencing. Finally, how will you make exploring the dictionary a fun and interactive experience for all?

Considerations:

- How can you use NASA data to make entries visual and intuitive?
- How can you make single entries easily found, and yet organize entries thematically so that viewers can explore entries within a certain subject area or applicable to a certain NASA mission?
- How can you handle the abbreviations and acronyms that are part of many technical terms?

Bring Your Own Solution

THE CHALLENGE

Follow your brain and your heart, and present a solution of your own choosing!

Background:

Do you have an idea that doesn't fit any of the other challenges? This is the place for you, whether you want to design and develop an app, create data visualization, hack on an Arduino... or anything else you can think of!

Take a look at the resources we have provided, maybe you'll find something to inspire you.

Considerations:

You can work in a team on something that you're all passionate about.

By choosing to Bring Your Own Solution, you will not be eligible for a Global Award.

CHALLENGES | OUR ECOLOGICAL NEIGHBORHOOD

Migratory Travels and Travel Stories

THE CHALLENGE

Pick a migratory species of your choice and build a tool that shows the distribution of their available habitats, and track their sightings in real time!

Background:

Migratory species travel around the world each year in the air, over land, and in the seas. **Pick a migratory species of your choice and build a tool to show the distribution of their available habitats. Allow users of your tool to track sightings of said species and input them into your visualization.**

Here, we provide the example of the great North American monarch butterfly, which crosses over national boundaries to link three countries together in its migration corridor! You can design a tool that helps users track these butterflies as they travel across their migration corridor.

Take it to the next level and show the environmental conditions in the species' habitats and along their routes of travel. Think about what environmental factors are important for the species' survival, and what factors they are sensitive to. For example, did you know that monarch butterflies need ultraviolet light to charge their internal magnetic compass, allowing them to orient themselves based on the Earth's magnetic field?

Use your tool to demonstrate habitat connectedness, and to identify emerging gap areas. Help users identify if their location is on or near these gaps along the migration route, so they can take action to help support habitat preservation for the species' populations. For example, users along the monarch butterfly migration routes can find habitat gaps and plant monarch food- and egg-laying plants in back yards, in parks, or on roofs, to help monarch populations.

Finally, allow users to see how the landscape, the land cover, and the environment along the species' migration corridor have changed over time. Have these changes affected their migration patterns?

This challenge addresses the following Sustainable Development Goals (SDGs), adopted by the United Nations General Assembly to engage all countries and all stakeholders in a collaborative partnership. The SDGs aim to build a better future for all people by achieving sustainable development in three dimensions – economic, social, and environmental – in the spirit of strengthened global solidarity:

- *Goal 15.5: Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species.*
- *Goal 15.9: By 2020, integrate ecosystem and biodiversity values into national and local planning, developmental processes, poverty reduction strategies and accounts.*

Our Planet, Our Home

THE CHALLENGE

Compare NASA Earth science data with data about people and tell your own story of human-environment interactions!

Background:

As the human population on Earth grows, we continue to shape and to be influenced by the environments we live in. What are some ways in which you and your community affect the environment? How do the local and global environments influence your life; for example, your day-to-day actions, and trends in your community?

Your challenge is to overlay Earth science data with human dimensions data from resources like NASA's Socioeconomic Data and Applications Center (SEDAC) and the United Nations Sustainable Development Goals Indicators Database, to see if any interesting patterns and stories emerge!

The SEDAC is a Data Center in NASA's Earth Observing System Data and Information System (EOSDIS). This center is hosted by the Center for International Earth Science Information Network (CIESIN) at Columbia University, New York, USA, and it stores data on several human dimensions of Earth Science.

On September 25th 2015, the United Nations General Assembly adopted 17 Sustainable Development Goals (SDGs), designed to engage all countries and all stakeholders in a collaborative partnership to end poverty, protect the planet, and ensure prosperity for all.

Considerations:

As you develop your solution, consider the following:

- What makes your story compelling? Why should others pay attention to these data?
- How can you show others how conditions have changed over time and across geography?
- How can you develop new information systems to track, monitor, and report on SDGs at different levels (for example, national, regional, and global)?

For example:

- Consider how deforestation and desertification – caused by human activities and climate variation – have affected the lives and livelihoods of millions of people around the world. You can correlate land cover data with socioeconomic data stored at NASA's SECAC, and trace the changes in terrestrial ecosystems with the trends in poverty and food security.
- In rural areas across the globe, good transport connectivity through road infrastructure and transport services is essential for achieving progress towards sustainable growth. You can overlay geospatial data with population density data to identify populations who are more than 2 km from all-season road access.

These examples address the following Sustainable Development Goals (SDGs), which aim to build a better future for all people by achieving sustainable development in three dimensions – economic, social, and environmental – in the spirit of strengthened global solidarity:

- *Goal 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.*
- *Goal 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.*

- *Goal 15.9: By 2020, integrate ecosystem biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts.*

Think of your own examples to craft stories of human-environment interactions!

Trace Invaders

THE CHALLENGE

Develop a tool to trace invasive species in your neighborhood over time!

Background:

Ecosystems around the world are facing threats from aliens! These aliens may be Earthlings, but instead of coming in peace, these invaders can cause environmental or economic harm, or harm to human health. When introduced to non-native habitats, invasive species (which can be plants, animals, or fungi) compete for the same space and resources of native species, and in some cases, they can drive an entire species to extinction! Changes in climate patterns can further worsen the impacts of invasive species on native species.

Your challenge is to develop a tool, such as a crowdsourcing application, to gather information about invasive species in your neighborhood.

1. Pick an ecological niche of your choice or of significance to your location. For example, participants in Seattle, Washington, may be interested in the Pacific rainforest, or participants in Brisbane, Australia, may choose the Great Barrier Reef.
2. Develop a tool to collect information about species in the niche over time from local residents, observers, and visitors to the region.
3. Consider tagging the information by date of observation (whether it is current or historical data) to compare trends of species over time.

4. Integrate environmental data into the observations to compare changes in local land cover, water resources, and weather to changes in the biological community.
5. Consider creative ways to share your data through visualizations or other media!

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- *Goal 6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.*
- *Goal 11.4: Strengthen efforts to protect and safeguard the world's cultural and natural heritage.*
- *Goal 14.2: By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening resilience, and take action for their restoration in order to achieve healthy and productive oceans.*
- *Goal 15.5: Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species.*
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CHALLENGES | WARNING! DANGER AHEAD!

When Landslides Strike

THE CHALLENGE

Design an easy-to-use tool to allow the public to discover and understand landslide data, and to contribute their own observations for use by emergency managers.

Background:

Landslides are one of the most universal hazards in the world, and have caused more than 11,500 fatalities in 70 countries between 2007-2010 [1]. The most frequent trigger of landslides is intense and prolonged rainfall, which saturates soil on vulnerable slopes. However, the location of extreme precipitation isn't always the location of the resulting disaster. Weather forecasting can help predict future landslide events, while studying previous events can provide clues to identify locations that are most vulnerable to experiencing landslide impacts.

NASA's Global Landslide Catalog (GLC)* was developed with the goal of identifying rainfall-triggered landslide events around the world, regardless of size, impacts or location. The GLC considers all types of mass movements triggered by rainfall, which have been reported in the media, disaster databases, scientific reports, or other sources.

These important landslide data would have greater impacts the more accessible and discoverable they are. **Your challenge is to design a tool with visualization and crowd-sourcing**

capabilities to allow users to discover and understand landslide data, and to contribute their own observations easily. Make sure that the tool is easy to use, and the information easily accessible and understandable by the public and emergency managers who must respond to these types of disasters.

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- *Goal 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.*
- *Goal 11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.*
- *Goal 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.*

Considerations:

You may consider the following options as you design your tool:

- Build an interactive visualization tool that allows overlaying of landslide data and images on popular Earth browsers, or Earth mapping websites.

- Design a crowd sourcing data collection framework.

- You may use fields that are already being used in the GLC.
- Ensure that the mobile user interface is easy to use.
- Allow for users to contribute multiple field reports on a single occurrence.

- Provide desktop users a dashboard or similar option to revise information (for example, including basemaps and changing entered tracking information)
- Allow for addition of photos.

- Consider options to compare landslide data with other variables.

- You may link landslide data from the API with precipitation data, and compare these data with landslide models for improved validation (Precipitation API available at: https://pmm.nasa.gov/precip-apps, global landslide nowcasts information at: https://pmm.nasa.gov/applications/global-landslide-model)

And YOU can Help Fight Fires!

THE CHALLENGE

Build a fire-monitoring and crowdsourcing tool that will allow local fire managers to respond to wildfires.

Background:

Fires are increasing across landscapes throughout the world due to increased drought, increased temperatures, and human-driven changes (e.g., deforestation). When the weather is extreme, the fires are extreme, often spreading beyond countries' abilities to fight them. Fires can move quickly though landscapes and communities, causing immediate damage and extreme health risks due to smoke pollution.

Often, fires are so big that it is impossible to: (1) see the best paths out; (2) see the best paths available for rescue or fire management vehicles to enter; and (3) estimate where post-fire effects will be the strongest (debris flows, landslides). However, satellite data can see the entire landscape and help with valuable information for those who need it most!

Develop a tool that combines satellite data with crowd-sourced data from people on the ground near areas of concern, to help firefighters identify:

- Where a fire has started
- Where a fire is spreading or might spread
- Best paths for rescue and fire management teams to enter and navigate the areas of concern
- Best paths to help people evacuate

Take your tool a step further and incorporate short-term and long-term environmental data, such as regional weather systems, rainfall, etc., to predict post-wildfire hazardous events, including:

- Spread of ash and smoke
- Flooding
- Landslides

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Mayday, Mayday, Mayday!

THE CHALLENGE

Calculate and visualize the radiation exposure for an actual or hypothetical polar, or near-polar flight!

Background:

Earth is constantly being bombarded by radiation from our universe, including from the sun. The Earth's magnetic field deflects much of this radiation, protecting us from harmful effects. However, at the North and South poles, Earth's magnetic field no longer provides shielding, and instead accelerates radiation into the Earth's atmosphere. You may have seen the result of electrons colliding with our atmosphere in the form of the Aurora Borealis (Northern Lights) and Aurora Australis (Southern Lights)!

While people on the ground have atmospheric protection, those at higher altitudes are at greater risk of radiation exposure. For example, airline pilots and crew are particularly vulnerable from constant exposure to higher levels of radiation, especially when they fly over or near magnetic poles!

Your challenge is to visualize radiation exposure for the flight crew and passengers of a polar or near-polar flight. Choose an historical, current, or a hypothetical flight path that includes flying over or near one of the magnetic poles. Calculate and visualize the radiation exposure for the people on that flight based on auroral conditions at the time of the flight.

Considerations:

- Remember that Earth's magnetic poles are not the same as Earth's geographic poles!
- How can solar phenomena like solar storms affect radiation exposure?
- How do atmospheric conditions affect radiation exposure for the flight crew and passengers? Do these conditions differ at the magnetic North and magnetic South poles, thereby affecting the amount of radiation exposure?

CHALLENGES | PLANETARY BLUES

Where's the Water?

THE CHALLENGE

Use satellite and other data to allow farmers, landowners, and land managers in your locale to identify and visualize water resources in their surroundings.

Background:

Farmers, land owners, and land managers need to be able to understand their nearby water resources and how the water may change in availability, quantity, and location over time.

Your challenge is to use satellite and other data to allow these stakeholders in your community to visualize and understand your landscapes and the sources of water near you. Use data from Earth-observing satellites to identify the broad sweep of groundwater levels below you and surface water supplies, and determine how environmental conditions affect these water resources.

Track the identified resources over time to see how water levels have changed over time (seasons to years).

How can you combine the satellite and other data with local knowledge to help stakeholders understand why these changes may be taking place?

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Icy Polar Opposites

THE CHALLENGE

Design a data analysis and/or visualization tool to show the spatial and temporal changes in Arctic and Antarctic ice to a general audience.

Background:

The Arctic and Antarctica are polar opposites, not just because they house the North and South Poles, respectively, but also because their geographies are opposite as well! The Arctic is a semi-closed ocean almost entirely surrounded by land, while Antarctica is a landmass that is entirely surrounded by an ocean.

Data about ice at the poles aren't just useful to scientists who study the cryosphere, but they are also useful for international trade (sea ice forecasts for the Northwest Passage), and planetary science (comparing changing ice on Earth to that on other planets).

NASA studies help us understand how ice structures in the Arctic and Antarctica are evolving in a changing environment. In addition to presence and absence of sea ice, ice sheets are also observed in three dimensions, so that measurements of how the sheets are changing from above and below, as well as side-to-side, can be made.

Analyze and visualize NASA's Arctic and/or Antarctic ice sheets and sea ice data to tell their story over time and over the three spatial dimensions. In addition to seasonal changes in the extent of the ice, are there other patterns of change to be seen? For example, are there differences in ice coverage in the same location between one day of the year (e.g. April 29, 2017) and the same day of other years (April 29, 2016; April 29, 2015; and so on…)?

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- *Goal 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries*
- *Goal 13.3: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning.*

Considerations:

Consider comparing changes in ice sheets and sea ice over time and space with atmospheric and ocean conditions in the two regions.

Resource Descriptions:

Resources for this particular challenge are described below, instead of only appearing as links in the Resources menu on the right.

- Airborne Topographic Mapper (ATM) – A laser altimeter that measures the elevation of ice (Greenland / Antarctic ice sheets; Arctic / Antarctic sea ice). Products vary from dense point clouds to general surface shape at specific times, to time series of how is the ice raising or lowering over time. Includes ice sheets and sea ice products.
- CReSIS radar – Various frequencies of radar that shoot through the uppermost layers of the ice sheet (snow layer only; upper few meters; thousands of meters deep) and image internal layers within the ice, or in some cases, look all the way to the bedrock beneath the ice.

- Digital Mapping System (DMS) – A downward-looking camera that captures tiny scenes. The CAMBOT optical sensor precedes this, allowing a look farther back in time.
- ArcticDEM (digital elevation model) – This is a map of the land surface elevation for (nearly) the entire Arctic, at one snapshot in time.
- IceBridge DEM – This map of the land surface elevation captures multiple points in time.
- Land, Vegetation, and Ice Sensor (LVIS) – Measures the height of vegetation in the polar regions.
- Gravity anomalies from AIRGrav – Measures how the gravity differs in local regions (which happens due to more or less local mass, e.g. mountains).

Water, Water, Everywhere!

THE CHALLENGE

Develop a tool that provides emergency management personnel with an up-to-date flood-risk map for an area of interest.

Background:

Flooding is a pervasive natural hazard with devastating consequences on people's lives, homes, and livelihoods. Mapping floodwater extent for active floods is critical for local and regional officials, and also for disaster relief workers who are trying to determine where to focus their efforts. Additionally, it can be critical to monitor vulnerable regions for water pollution, or the spread of water-borne illnesses like cholera.

Your challenge is to develop a tool that displays an up-to-date flood-risk map for an area of interest and is easy for the public to use and understand. The ideal solution should be general enough to apply to any area worldwide for which sufficient relevant data are available.

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Considerations:

Consider combining satellite, airborne, *in situ* and/or simulation data from different sources. These may include:

- Meteorological/rain forecasts
- Geological and geometric characteristics of the terrain
- Soil moisture content
- Proximity to a river and/or dam, and saturation level of that river and/or dam
- Riverbed conditions
- Presence of bridges and other flow-disrupting structures
- Urban sewage and drainage infrastructure
- Flood model outcomes
- Flooding history of the area

Consider overlaying data on human factors that influence flood-related hazards, such as:

- Population density
- Endemic diseases, particularly water-borne illnesses and vector-borne diseases
- Local presence of hazardous chemicals or other dangerous materials

Let's go to the Beach!

THE CHALLENGE

Build a tool for beach-goers to monitor for hazards and to alert them of precautionary measures for protection on their swim- and surf-filled adventures!

Background:

The salty smell of the ocean, the sand beneath your feet, the breeze in your hair, and the warmth of the sun– who doesn't love going to the beach?

But before we jump in our swimsuits, let's make sure we are well prepared!

According to the World Health Organization [1], overexposure to sunlight can cause harm to our skin, our eyes, and our immune systems. In fact, protecting ourselves from UV damage, for example by using hats, sunglasses, and sunscreen, can prevent four out of five cases of skin cancer.

Additionally, harmful algal blooms (HABs) can also pose a threat at your next beach trip. According to the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce, HABs occur when colonies of algae in the sea and in freshwater grow out of control [2]. They can produce toxins that cause rashes, breathing problems, and liver damage [3]. Satellite-based images of ocean color can help forecast the presence of HABs in water bodies, and can direct you to HAB-free beach areas near you!

Develop a tool that alerts beach-goers to the precautions they need to take before heading out to the shores.

-Predict their sun exposure based on:

- The time of the day, and thus the distance from the sun, and the angle of the sun's rays
- The location of the beach (latitude, altitude, etc.)
- The month of the year, and thus the position of the Earth relative to the sun
- The cloudiness of the sky

-Suggest alternative times of the day, or days when sun exposure levels are lower.

-Warn users of presence of HABs in local beaches, and direct them to safer regions, where available.

-Add other precautionary and safety alerts as you see fit!

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- *Goal 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries*

Considerations:

-Explain the data in easy-to-grasp ways.

- For example, 15 minutes of exposure to the sun between noon and 2 pm is equivalent to X minutes between 2 pm and 5 pm. What kind of recommendation would you give to beach-goers?

-Add informative layers in your tool to explain to users the science behind the data and recommendations.

- For example, how would you caution users that sun exposure is greater at higher altitudes?

-Consider combining sun exposure data with weather forecasting to warn beach-goers of unpredictable and rapidly emerging conditions.

-Consider adding a game component in your tool to encourage the public to take proper precautions before heading out to the beach!

1] "Sun Protection." Ultraviolet radiation and the INTERSUN Programme. World Health Organization. Website Accessed March 2017. http://www.who.int/uv/sun_protection/en/

2] "Harmful Algal Blooms: Tiny Plants with a Toxic Punch." National Ocean Service. National Oceanic and Atmospheric Administration, U.S. Department of Commerce. Website Accessed March 2017. http://oceanservice.noaa.gov/hazards/hab/

3] “Nutrient Pollution: The Effects.” United States Environmental Protection Agency. Website Accessed March 2017.
https://www.epa.gov/nutrientpollution/effects

You are my Sunshine

THE CHALLENGE

Create a medium to help people understand energy output from a solar panel, and a tool to plan energy consumption based on expected energy output from solar technologies.

Background:

Earth-orbiting spacecrafts, such as the International Space Station (ISS), require a source of power to be able to perform various functions in space. For example, ISS relies on electrical power to allow the crew to live comfortably, operate the station, and perform scientific experiments.

In space, the sun is a readily available source of energy. NASA has, and continues to develop technologies to convert sunlight into power for ISS and satellite missions, including the Orbiting Carbon Observatory 2 (OCO-2). These technologies include photovoltaic systems (such as solar panels) and solar batteries, which are charged during the sunlit part of the spacecraft’s orbit, storing energy to be used when the spacecraft is not in direct sunlight.

Solar energy technologies are critical to current Earth-observing missions, as well as to our next steps in deep space, including the journey to Mars. Additionally, these technologies have significant applications for ensuring access to reliable and sustainable energy for all on Earth.

In fact, the current NASA-funded Hawaii Space Exploration Analog and Simulation V (HI-SEAS V), a habitat on an isolated Mars-like site on the Mauna Loa side of the Big Island of Hawaii, relies on photovoltaic panels and solar batteries to power its long-duration Mars analog simulation studies. The crew of six uses electricity generated by solar technologies to conduct activities ranging from conducting experiments to cooking and exercising, and thus they must strictly calculate and monitor energy generation by their solar panels.

The concept of solar energy is not instinctively tangible. While we may appreciate the capacity of solar panels and solar batteries, many of us don't understand how much energy a solar panel actually produces.

Your challenge is to create a means to help people understand how much energy comes from a solar panel. Take your solution a step further, and create a tool to allow the HI-SEAS crew, or other explorers reliant on solar panels, to plan their daily energy consumption for all their human necessities and other planned activities based on expected energy output from solar panels.

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- *Goal 7.1: By 2030, ensure universal access to affordable, reliable and modern energy services.*
- *Goal 7.2: By 2030, increase substantially the share of renewable energy in the global energy mix.*

Considerations:

- There are many different types of solar panels. Think of how they are built, what use they are designed for, and where they are to be used (for example, on Earth or in space).
- How would environmental conditions, such as a cloudy or a dusty day, affect energy generated by a solar panel? For example, if it's an overcast day, will you be able to charge your computer or take a hot shower?
- Compare your solar panel data with information about the energy consumption of various common household things that might be needed in the HI-SEAS habitat, or other habitats.
- How would the location of a solar panel affect its energy output? How much energy does the same panel generate in various locations on Earth versus in space

What's for Dinner?

THE CHALLENGE

Map the life cycle of your favorite food product or dish, and put on your chef's hat to create its most environmentally sustainable version!

Background:

The growing human population presents challenges to ensuring that all people have access to safe and nutritious food. A changing climate is of further concern for risks to sustainable food supplies, and vulnerability of populations to environmental and other shocks. Addressing these challenges of food security involves approaches to improve agricultural practices, while ensuring that the environmental impacts of these practices are minimal.

According to the Food and Agriculture Organization of the United Nations, almost one-third of the food produced for human consumption is wasted every year![1] This waste is a tremendous missed opportunity for improving food security and simultaneously minimizing environmental impacts, such as air pollution, landscape degradation, water use, biodiversity loss, and deforestation.[2]

Employing life cycle analyses (LCAs) to evaluate all stages in the production and consumption of food, including raw material growth or production, processing, distribution, use, and disposal, can facilitate integration of environmental impact assessment in decision-making.

Your challenge is to map the life cycle of your favorite food or dish and integrate seasonal environmental patterns to determine the best time and way to eat it! Conduct a comprehensive analysis of the processes that bring the food to your plate— from growing crops and managing livestock to transporting products into your city. Use Earth observations to assess agricultural productivity and identify environmental risks to sustainability.

This challenge addresses the following Sustainable Development Goals (SDGs), adopted by the United Nations General Assembly to engage all countries and all stakeholders in a collaborative partnership. The SDGs aim to build a better future for all people by achieving sustainable development in three dimensions – economic, social, and environmental – in the spirit of strengthened global solidarity:

- *Goal 1.5: By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.*
- *Goal 2.1: By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.*
- *Goal 2.4: By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.*
- *Goal 12.3: By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.*

- *Goal 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.*

Considerations:

-Consider the spatial and temporal distributions of crop production for the food products/ingredients of your interest.

- What are sources of waste during the production of your items of interest?
- How long does your food item have to travel before it gets to you? Are there ways to minimize use of resources for food transportation?
- Are there alternatives that may satisfy your palate and belly, while minimizing resource use and food waste?

-Does your food item have a short shelf life or spoil easily? Can measures be taken to improve the shelf life of these items? Do these improvement measures come at additional environmental costs?

-Are there alternative uses for these end-of-life waste products, including spoiled food?

[1] “Food loss and waste facts.” SAVE FOOD: Global Initiative on Food Loss and Waste Reduction, Food and Agriculture Organization of the United Nations. Website Accessed April 12th, 2017. http://www.fao.org/save-food/resources/infographic/en/

[2] Food and Agriculture Organization of the United Nations. “Food wastage footprint, Full-cost accounting: Final Report.” 2014.