APOGEO SPATIAL

ELEVATING GLOBAL AWARENESS

Moon Rush: The New Space Race

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"Through the collective shock and awe of this new, expanded self-awareness, we may end up learning more about ourselves than about space." -Claudia Welss, IONS Board Chair

"I firmly believe that we need to make a more robust conversation between science and the arts." -DJ Spooky, aka Paul D. Miller

FORMERLY Imaging NOTES

[Issue 1 2019 / Vol. 34 / No. 1]

The Earth's atmosphere, photo courtesy of NASA and astronaut Nick Hague from the International Space Station

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APOGEO SPATIAL

[Issue 1 2019 / Vol. 34 / No. 1]

Columns

Features

COVER IMAGE

The Earth's Atmosphere

This photo captures Earth's atmosphere, following along the curvature of the planet. It is a thin protective layer that makes life as we know it possible. The view from space provides a significantly broader perspective, of course. The value of this is that we can experience aspects of life of which we were unaware. Read more about this, and how important it is, on page 20.

The photo was taken from the International Space Station by NASA astronaut Nick Hague, who is living aboard the space station from March until October, 2019. See page 22 for more of his images and commentary.

Incidentally, our logo for Apogeo Spatial mimics the colors of the atmosphere, a deep blue that darkens as it goes into space.

Photo courtesy of NASA and astronaut Nick Hague from the International Space Station.

APOGEO SPATIAL

Formerly Imaging Notes

[Issue 1 2019 / Vol. 34 / No. 1]

MISSION

Apogeo Spatial communicates the power of geospatial tools and technologies in managing the world's environment and scarce resources, so that the global population has the security of water, food, and energy.

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Apogeo Spatial has strategic partnerships with Space for Humanity (www.spaceforhumanity.org), and
The Alliance for Earth Observations, a program of The Institute for Global Environmental Strategies (www.strategies.org).

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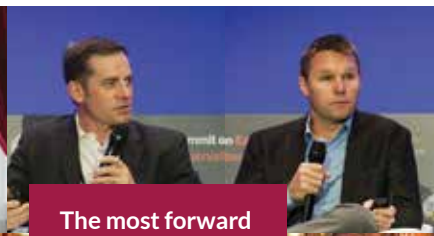

The most forward thinking leaders

A sample list of confirmed speakers

- **Philip Briscoe,** COO, **Rezatec**
- **Sebastian Carl,** CEO, **GAF AG**
- **Herve Clauss,** Director Global Imagery and Sourcing, **TomTom**
- **Jean Dusart,** Policy Officer, European Commission, DG Research & Innovation, Climate Action & Earth Observation, **EuroGEOSS**
- **Derek Edinger,** Chief Strategy Officer, Co-founder, **Ursa Space Systems**
- **Stefan Gardefjord,** President & CEO, **SSC**
- **Xingfa Gu,** Deputy Director General, **Asia-Oceania GEOSS**
- **Corentin Guillo,** CEO, **Bird-i**
- **Mark Johnson,** CEO, **Descartes Labs**
- **Steven Krekels,** Unit Manager Remote Sensing, **Vito**
- **Damien Lepoutre,** VP, Agtech Intelligence, **Land O'Lakes**
- **François Lombard,** SVP, Head of Intelligence Business, **Airbus Defence and Space**
- **Gareth Morgan,** CEO, **Terrabotics**
- **Dominique Rora,** Senior Insurance Underwriter, **Axa**
- **Prashant Shukle,** Director General, **Canada Centre for Mapping and Earth Observation (CCMEO)**
- **James Slifierz,** CEO, **SkyWatch Space Applications**
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LETTER FROM THE PUBLISHER

Myrna James Yoo
Publisher and
Managing Editor
Apogeo Spatial
www.ApogeoSpatial.com
Myrna@ApogeoSpatial.com

Dear Readers,

Apogeo Spatial is thrilled to announce a partnership with NASA to publish "live" photos from the International Space Station, taken by astronaut Nick Hague. He's living aboard the ISS from March through October, doing experiments and research, and launching satellites, such as the first one for a new quantum communications company based in Singapore, SpeQtral Space.

Nick's photos and comments appear on page 20, with a note of welcome by Claudia Welss, the Board Chair for IONS (the Institute for Noetic Sciences). We believe that the opportunity of going to space and seeing the earth "with new eyes" is an important one to help people look back at Earth and understand that we need to work together to save the planet.

More citizens will be going to space as the space tourism industry heats up. Several companies are proving to be ready, including Virgin Galactic with their first successful flights in December 2018, and Blue Origin, with several to date as well. Anyone can apply to go to space with Space for Humanity footing the bill, so apply at www.SpaceForHumanity.org.

Space is in the public consciousness like rarely before, as we celebrate the 50th anniversary of the first walk on the moon! Join us at Apollopalooza at Denver's Wings Over the Rockies museum, where an entire week of festivities will take place. On July 16 at 2:15, I'll be talking about how "Space Is for Everyone" with Dr. Michael Schmidt, who will share what happens to human bodies when we go into space, among other interesting things.

Space writer Leonard David will be discussing his new book, *Moon Rush: The New Space Race* on July 15 at 10:30. You can read about his book on page 11.

We are more committed than ever to publishing more about climate change and conservation of the planet and how our industry is so important. Real progress cannot be made without you – your software, your tools, your imagery, your data, and your commitment.

We know that every single one of the U.N. Sustainable Development Goals (SDGs) need geospatial solutions. In this issue, we revisit on page 8 the list of Geospatial Platforms that we featured from Fall 2015-Summer 2018, which included 28 companies! There is also a current list of platforms and a user-friendly guide to their differentiators.

Let this be a Clarion Call to Action. The Earth is calling out for our attention, with not enough water in droughts, too much water with floods and melting ice and sea-level rise, and fire and storms like never before. What will it take for us to hear this call?

In May, at Earth's Call (www.EarthsCall.org) in Aspen, Colorado, change-makers, activists, filmmakers, and musicians came together to hear the call, to tune into it with compassion and grace. Musician Michael Fitzpatrick, who has traveled with the Dalai Lama to play cello, created the event in order to share the earth's call and "tune" the planet. Many of us are now collaborating and working together to respond to the call.

DJ Spooky (aka Paul D. Miller) was there, and he shared how patterns and data are inherent in everything. Some of his projects are about the planet and its changes. My interview with him appears on page 16.

I challenge you as individuals, and as companies, to do more to contribute to saving our planet – the only place we currently have to live.

I invite you to partner with us to do even more to share your important stories. Join us by sponsoring our work to promote your work, and people will learn that they can apply your solutions. We all have a part to play.

YOU have a part to play. YOU are essential in saving the world.

Here are a few ways in which you can join us:

1. Sponsor an ongoing series in one area, such as Disaster Response or Reaching the U.N. SDGs or Fresh Water Access or Flood Risk or Food Security.

2. Sponsor an NGO column or series in which we will highlight their impactful work and projects.

3. Continue to advertise and invest your marketing dollars where it makes a difference, not just to increase your sales, but to increase coverage of important work towards saving the planet.

Reach out to me if this call resonates with you with the subject line: I want to join you to answer Earth's call.

Earth is calling out to us. Do you hear it? Do you feel it? Do you know it?

I do. It breaks my heart. Answering that call is my life's mission. If you hear it too, please join me.

Very sincerely,

Myrna

Blue Origin Founder Jeff Bezos in 2017 with the New Shepard capsule.

Myrna inside Blue Origin's New Shepard capsule that will take tourists to space.

Geospatial Platforms: "Filling the Gap" Left by Google Earth Enterprise

Spring 2017, p. 14-19, bit.ly/GEEseries8

The Inside Story: Google Earth Enterprise Goes Open Source

Featuring:

- **AVNISH BHATNAGAR,** Technical Solutions Engineer, **Google**
- **CHRIS POWELL,** CTO, **NT Concepts**
- **AJ CLARK,** Founder, CEO, **Thermopylae Sciences + Technology**
- **DAVID MOORE,** Founder, President, and CEO, **Navagis**
- **PETER BATTY,** CTO, Geospatial Division, **Ubisense**

Fall 2015, p. 16-21, bit.ly/GEEseries1

1. The Demise of Google Earth Enterprise

ARCGIS EARTH & VRICON & OTHERS FILL THE GAP

Featuring:

- **REBECCA MOORE,** Google Earth Engine & Earth Outreach, **Google**
- **CHRIS ANDREWS,** 3D product manager for ArcGIS, **Esri**
- **ISAAC ZAWORSKI,** Vice President, **VRICON**

Winter 2016, p. 16-21, bit.ly/GEEseries2

2. Data Management & Visualization: Married or Separated?

GALDOS SYSTEMS INC., SKYLINE SOFTWARE SYSTEMS, AND ONIX NETWORKING CORP.

Featuring:

- **RON LAKE,** CEO, **Galdos Systems Inc.**
- **MATTHEW J. HARRISON,** Vice President, Defense Business Unit, **Skyline Software Systems**
- **DAL VANDERVORT,** Vice President for Public Sector Sales, **Onix Networking Corp.**

Spring 2016, p. 16-21, bit.ly/GEEseries3

3. Companies Pick Up Where Google Earth Enterprise Leaves Off

NGA COMMENTS ON THE DEMISE OF GEE

Featuring:

- **LT. COL. MICHAEL RUSSELL,** GEOINT Visualization Services (GVS) Program Manager, **National Geospatial-Intelligence Agency**
- **ANDREW HILL,** Chief Science Officer, **CartoDB**
- **JOHN-ISAAC CLARK,** Director, Product Management – Geospatial Big Data, **DigitalGlobe**

Summer 2016, p. 16-21, bit.ly/GEEseries4

4. From Selling Pixels to Selling Answers

DIGITALGLOBE: EXPANDING ACCESS TO INSIGHTS FROM SATELLITE IMAGERY

AGI: CESIUM DISSEMINATES 3D MODELS

MAPBOX: ENABLING DEVELOPERS TO BUILD CUSTOM MAPS

Featuring:

- **JOHN-ISAAC CLARK,** Director, Product Management – Geospatial Big Data, **DigitalGlobe**
- **TODD SMITH,** Cesium Product Manager, **Analytical Graphics, Inc.**
- **MATT IRWIN,** Business & Government, **Mapbox**

Fall 2016, p. 16-21, bit.ly/GEEseries5

5. Geospatial Solutions from PIXIA, Luciad, & BAE Systems

Featuring:

- **PAT ERNST,** Co-Founder and COO, **PIXIA**
- **RIORDON KOSSEN,** Field Marketing Manager, **Luciad**
- **KURT DEVENECIA,** Deputy Director GXP Product Development, GXP Technology Area, **BAE Systems**

Winter 2017, p. 26-33, bit.ly/GEEseries6

6. Building "Digital Earth": A new generation of geospatial intelligence helps to answer complex geographic questions

Featuring:

- **CARLA JOHNSON,** Founder and CEO, **Earthvisionz**
- **MLADEN STOJIC,** President, **Hexagon Geospatial**
- **PERRY PETERSON,** President and CEO, **PYXIS**

Spring 2017, p. 20-25, bit.ly/GEEseries7

7. Geospatial Visualization & Processing

THE FINAL FEATURE IN THE SERIES

Featuring:

- **PETER BATTY,** CTO, Geospatial Division, **Ubisense**
- **STUART BLUNDELL,** Director of Strategy and Business Development, Harris Geospatial Solutions, Harris Space and Intelligence Segment, **Harris Corporation**

By Matteo Luccio
Pale Blue Dot LLC
www.palebluedotllc.com

Remote Sensing Platform List

For Earth Observation Data

Editor's Note: Thanks to Radiant Earth Foundation for originating this list, which is not exhaustive. Radiant Earth works primarily with developing countries in the Global South, providing high-quality training data using machine learning for land cover issues, climate issues, small-leaseholder farmers, etc. They recommend these options as platforms for geospatial data.

From Fall 2015 through Spring 2017, *Apogeo Spatial* published in eight consecutive issues our "Filling the Gap" series, in light of the news at the time that Google was deprecating Google Earth Enterprise (GEE). We knew that this news would not be welcome by the companies that had chosen GEE as their platform for 10 years. In order to serve readers and geospatial companies, we continued covering this subject in our Geospatial Analytics-as-a-Service & Platforms Series (Fall 2017 to Summer 2018). In total, we featured 28 companies from 2015 to 2018. (link: http://bit.ly/2LIT2yV)

That timeframe is when Esri launched ArcGIS Earth, powered by the Esri Geospatial Cloud. ArcGIS Earth allows you to explore any part of the world working with a variety of 3D and 2D map data formats, including KML. The ArcGIS Platform contains the Living Atlas of the World, imagery partner data, ArcGIS Pro (extensive tools for imagery management), ArcGIS Image Server for scaling imagery and more. Long-time Esri Imagery Product Manager Peter Becker promised at the Esri Imagery Summit in July 2019 that Imagery-as-a-Service is coming soon.

During the three years of our series, Google changed their approach, and decided to turn GEE over to the open source community, as we reported in our exclusive interview with Avnish Bhatnagar, which concluded our series, "The Inside Story: Google Earth Enterprise Goes Open Source."

In the interest of providing readers with more resources, following is a non-comprehensive list of some excellent choices for geospatial platforms. Most of these platforms provide a free tier, with restrictions based on the amount of data used, time, or advanced functionalities.

Government

Copernicus Open Access Hub – ESA Sentinel Data
By the European Space Agency, Open Access Hub is the official location to access all Sentinel Data. Easy filter, AWS locations, and downloads are available. Additionally, ESA provides an open API to access Sentinel imagery.

Earth Explorer – USGS Landsat & ISERV Imagery
By USGS, Earth Explorer is the official location to access all USGS data, including Landsat and ISERV imagery. Many products and other imagery sources are accessible to download as well.

EOSDIS Worldview – NASA MODIS Data Viz
By NASA, Worldview gives access and visualization to a number of imagery products, including MODIS imagery. Visualization only is available. MODIS imagery is downloadable through LAADS DAAC.

Commercial

Descartes – All Free Data
By Descartes Labs, the platform includes access to Sentinel 1, 2, 3, Landsat 4-8, and MODIS. Descartes provides viewing, monitoring, and analyzing features of imagery. (link: http://apogeospatial.com/companies-offer-apis/)

EOS Landviewer – Commercial Imagery
By Earth Observing System, Landviewer combines with EOS's other high powered analysis. Landviewer provides search and visualization options, including contrast adjustment and download. Landviewer also offers easy purchase of commercial high resolution imagery. (link: http://apogeospatial.com/geospatial-analytics-as-a-service-platforms/)

GDBX – Maxar Data
By DigitalGlobe/MAXAR and Other Data, the GDBX provides resources to interact with imagery using Jupyter Notebooks. With minimal coding abilities, users are able to interact with imagery and run complex analyses at scale. (links: http://apogeospatial.com/from-selling-pixels-to-selling-answers/)

Google Earth Engine – Free and Commercial Data
By Google, GEE is designed for high-level processing and analysis of imagery. GEE leverages Landsat, Sentinel 2, MODIS, and other datasets along with the Google Cloud infrastructure to run analyses at scale. Earth Engine currently has restricted access.

Landsat Explorer (ESRI) – Landsat Data
By Esri, Landsat Explorer is designed to easily access and visualize Landsat data. Similar products may be provided by Esri. Landsat Explorer integrates well with other Esri products. You can visualize in any arrangement of bands and perform a change detection. Some downloading is available.

Planet Apps – Planet and Free Data
By Planet, apps include Planet Explorer which gives search access to commercial imagery from Planet in addition to exploring Sentinel 2 and Landsat 8. Planet Stories allows for the creation of comparison sliders and time-series GIFs published online. (link: http://apogeospatial.com/planet-lab/)

Open Source

QGIS – Open Data to Download
An open source software, QGIS is a powerful alternative to commercial and paid GIS and Remote Sensing software. Although there is no online version (and thus all imagery will have to be downloaded), QGIS has most imagery analysis capabilities and a growing body of tutorials.

Raster Foundry – Code Available on GitHub
By Azavea, Raster Foundry was the open source software that the platform upon which Radiant Earth platform was based. Raster Foundry allows easy integration with various imagery sources, custom raster algebra analyses, and easy sharing. No instances of Raster Foundry are currently open; the code is available on GitHub.

Sentinel Hub EO Browser – All Free Data
By Sinergise, Sentinel Hub is designed to easily access and visualize all levels of Sentinel data, Landsat, MODIS, and some other imagery sources. Visualization in any arrangement of bands (with several presets) and basic raster algebra is possible. Some downloading and time-lapse capture is available.

The EO Browser is available for free, and the source code is available on GitHub.

Moon Rush:
The New Space Race

A new book by Leonard David

Leonard David is a space journalist, reporting on space activities for over 50 years. He is winner of the 2010 National Space Club Press Award, among many others.

Leonard is author of the book, Moon Rush: The New Space Race, *published by National Geographic in May 2019.*

Mr. David is also author of Mars – Our Future on the Red Planet *published by National Geographic in October 2016. The book is the companion volume to* Mars – *a National Geographic Channel television series in its second season from executive producers Brian Grazer and Ron Howard.*

Leonard is co-author with Apollo 11's Buzz Aldrin of Mission to Mars – My Vision for Space Exploration, *released in May 2013 by the National Geographic Society. A soft cover edition of the book with a new essay was released in May 2015.*

In the National Geographic book, *Moon Rush: The New Space Race*, veteran space journalist Leonard David digs into the science and technology – past, present, and future – central to our explorations of Earth's only natural satellite. Launched in May, the book comes out in conjunction with celebrations of the 50th anniversary of the Apollo 11 mission in July 1969 that led to the first footprints on Earth's celestial companion.

In these rich pages, he explores the Moon in all its facets, from ancient myth to future "Moon Village" plans. He offers inside information about how the United States, allies and competitors, as well as key private corporations like Moon Express and Jeff Bezos's Blue Origin, plan to reach, inhabit, and even harvest the Moon in the decades to come.

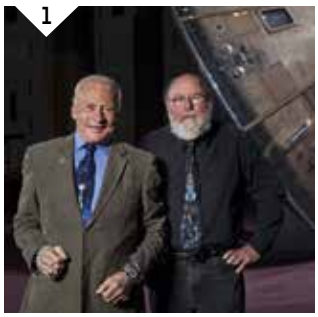
The 21st-century space race back to the Moon has become more urgent, and more timely, than ever. Accounts of new strategies are set against past efforts, including stories never before told about the Apollo missions and Cold War plans for military surveillance and missile launches from the Moon.

The volume spotlights the Moon's available resources – particularly water, but also unique places on the lunar surface to establish a base of operations. Also highlighted is the legal framework on divvying up the Moon, a subject likely to become more heated in years to come, and which may become a head-on collision between private enterprise and other forms of governance.

Spurred on by the Google Lunar XPRIZE – $20 million for the first to get to the Moon and send images home – the 21st-century space race back to the Moon is gaining attention from all sectors. On January 23, 2018, the X Prize Foundation announced that "no team would be able to make a launch attempt to reach the Moon by the March 31, 2018] deadline... and the US$30 million Google Lunar XPRIZE will go unclaimed."

On April 11, 2019, the SpaceIL spacecraft crashed while attempting to land on the moon. The SpaceIL team was awarded a $1 million "Moonshot Award" by the X Prize Foundation in recognition of touching the surface of the moon. Also timed with the 50th anniversary of the first moon walk is National Geographic's book, *Apollo to the Moon: A History in 50 Objects*, by Teasel Muir-Harmony.

For more information on these recent releases from National Geographic, go to: https://shop.nationalgeographic.com/collections/books-space



◀ FIGURE 1
Buzz Aldrin, 2nd man to walk on the moon in 1969, and Leonard David, pictured with the Apollo 11 capsule in which Buzz flew to the moon. Credit: Eric Long, NASM. Leonard was co-author of Buzz's book, *Mission to Mars: My Vision for Space Exploration.*

Apollopalooza Presentation to Feature David Discussing His Newest Book

David will be speaking about his latest book, *Moon Rush*, at Denver's celebration of the 50th anniversary of the Moon Landing, Apollopalooza, at Wings Over the Rockies, on July 15 at 10:30: https://wingsmuseum.org/event/keynote-presentation-leonard-david

ON THE EDGE

Climate Change Science More Widely Published

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IN A RECENT COLUMN, I IDENTIFIED MODERN CLIMATE CHANGE AS A SYMPTOM of a single-species high-energy pulse, with this pulse being the result of Homo sapiens being extremely successful in reducing all limitations to its growth. However, blinded by the success, humanity appears to be unable to recognize the many threats this basically unlimited growth of everything from people, resource usage, flows in the planetary physiology, changes in biodiversity and extinction, and pollution is creating.

Most scientists are very reluctant to interpret evidence they collect as indicators of existential threats. And those scientists who dare to point out that the current trajectory of Earth's life-support system is not pointing towards futures that are desirable, or even tolerable, for humanity are often immediately criticized as being alarmists, and their work is often censored and not published in "respected" scientific journals.

But that might be slowly changing. *Bloomberg Businessweek* is not a publication that easily rings the alarm bell, but on September 26, 2018, it published an article that summarizes a "New Climate Debate: How to Adapt to the End of the World," and refers to a number of recent publications indicating that more and more "researchers are thinking about social collapse and how to prepare for it."[1] The scientific papers cited in this article are at least partly published in highly respected journals, and they indicate that the climate system could be on a trajectory towards a hothouse planet.

The U.S. government also seems to have accepted that the very likely future is one of a much warmer planet – and decided that even trying to do something about it is futile: In a recent environmental impact statement concerning car emissions, the U.S. National Highway Traffic Safety Administration in the Department of Transportation concluded that the global temperature will likely increase by roughly 4° by 2100, and that it would be technologically and economically too challenging to try to change this. Therefore, the agency concluded, it makes little sense to attempt to limit car emissions, and justifies the U.S. President's decision to freeze federal fuel-efficiency standards.[2]

P. Garnett asks the question whether the modern human impact on all aspects of Earth's life-support system is leading to a total systemic failure of this system and suggests that humanity currently lacks "the tools and analytical capacity to understand the significance of these changes and therefore" cannot answer this question.[3] However, we know that a 4° increase of global temperature above the pre-industrial level would challenge modern civilization on a global scale and most likely lead to the social collapse that the scientists see as inevitable.[1]

This increase would push the Earth's climate as far above the pre-industrial level as the ice ages were below this level. And Earth during ice ages is a very different planet from what we know, with most of life taking place far away from the polar regions. On Earth in a hothouse state, life would have to concentrate far away from the tropics and closer to the polar regions. It is hard to imagine that our social and governance systems would be able to manage the migration of billions of people to new locations where the temperatures would still allow humans to go outside for some hours a day.

But climate change is not the only existential threat humanity faces. The threats of mass extinction and an impending state shift in the global biosphere are leading scientists to demand a Paris-style agreement "to promote increased habitat protection and restoration, national- and ecoregion-scale conservation strategies."[4] The threat to life in the oceans resulting from global warming, overload with nutrients and carbon, and plastic pollution has motivated many to step up and demand actions to protect the ocean.[5]

Having this clear view of what it means to push the planet outside of a state safe for humanity – and possibly into a hothouse state – it is surprising that we are not making every effort to avoid these increasingly likely and highly undesirable futures. Some thinkers argue that human animals are still mainly instinct-driven and that this leads us, like many other animals, to take more out of the Earth's life-support system than it produces and put more waste back into it than it can handle, with little to no considerations for other human and non-human animals and little thoughts about the future.[6] But unlike other animals, which can move on when their environment no longer supports them, humans are the only animal that utilizes the whole planetary life-support system with no place left to move to if this planetary system no longer is a safe space for humans.

Some speculate that humans evolved to solve problems that pose immediate threats such as terrorism[7] and to handle medium-sized, fast-moving challenges but not climate change,[8] while others argue that humans did not evolve to not be able to handle slowly developing threats.[9] In fact, it appears that the ability to recognize slowly developing threats documented in evidence and to act on this evidence depends more on cultural biases than on biological preconditions.[10] This notion is also supported by the wide range of responses to the various global threats from ignoring the threats, to fundamentally redesigning consumption and production, to adapting to the already visible impacts.

Most of the dialogues about these existential threats are either focusing on justifying the knowledge about the past and the projections of the future or on discussing limited solutions addressing only parts of the challenge. Addressing these threats poses wicked or super-wicked problems. Wicked problems are social or cultural problems that are difficult or impossible to solve because of incomplete or contradictory knowledge, a lack of agreement on the definition of the problem, the number of people and opinions involved, the large economic burden associated with progress towards a solution, and the interconnected nature of these problems with other problems. Even more so, our collective ability to handle super-wicked problems is very limited. Super-wicked problems have four additional characteristics:

(1) time is running out;

(2) there is no central authority to address the problem;

(3) those seeking to solve the problem are also causing it;

(4) policies discount the future irrationally.[11]

Moreover, there is limited focus on developing foresight by considering the full spectrum of possible futures. The "Future Cone"[12] is a good way of illustrating the different types of futures (Figure 1). The working hypothesis is that the future does not exist. Constrained by the past and pushed by decisions made in the present, it is created as time progresses. What we do today has an impact on the future that will emerge. This working hypothesis implies a deep responsibility for all of us: individuals, communities, businesses, governmental agencies, international organizations, etc.

Among others, the future is found to be archetypal with four generic types: Continue, Collapse, Discipline, Transformation.[13] Much of the scientific discussion focuses on the projected and probable futures, which are constructed assuming that these futures are of the generic type "Continue." Continued economic growth is typically the focus of this archetype, "which is the most common of the four archetypes because it is the 'official' future of all governments, educational systems, and corporations."[13]

Considering futures of the "Collapse" type is very unattractive and several of our cognitive biases keep us from doing so, but these futures are well within the possible futures and overlap with the plausible ones. For the desirable futures, it is hard to imagine that they can be reached without major changes in human society, and they most likely are all in the generic types of "Discipline" and "Transformation." This limits the dialog about these futures to often marginal groups.

It may be that most humans are not well equipped and trained to handle wicked and super-wicked problems. What if we would start by finding out what we can agree on and have a dialog on what futures we want – and what futures we don't want?

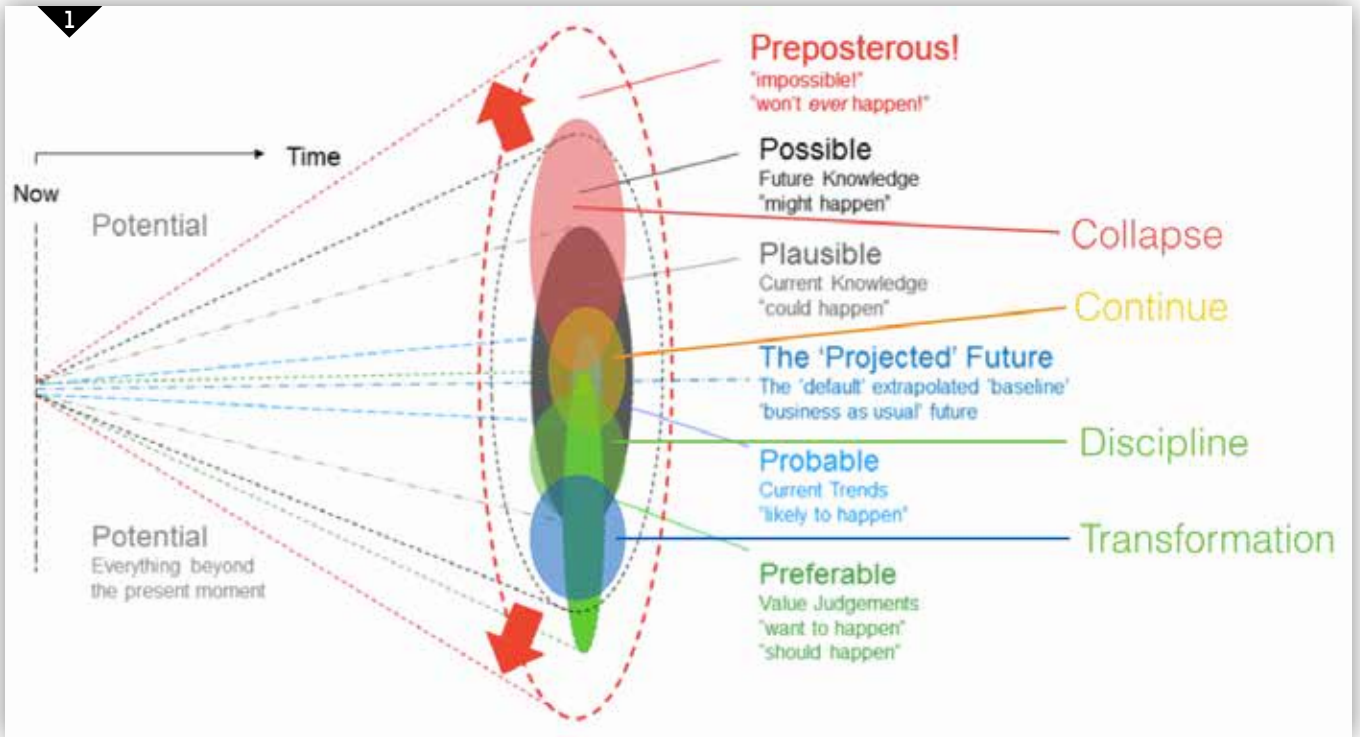
Can we agree on what we need to be fully developed humans? Physiologically, we all need air to breath, water to drink, and food to eat. We also need space to build our dwellings and grow food, and we need security and safety. We can only expect to meet these basic needs if we ensure a functioning planetary life-support system. Humanity is embedded in the Earth's life-support system and is interacting with it through flows that have accelerated recently very rapidly, initiating a shift to a new system state.

Can we expect to meet our basic needs in a hothouse state? Can we move together peacefully if a large part of the planet becomes uninhabitable because of heat, droughts, loss of soil, ecosystem collapse, floods, hurricanes, tornadoes, sea-level rise, and other still unknown environmental conditions on a hothouse Earth? Can we expect to have the life support we need if most of the mammals are gone, much of the topsoil is lost, and most pollinators are no longer around to ensure reproduction of plants that we need as food for us and our livestock? Most likely not!

Now we can ask whether we want a future where the basic physiological and safety needs no longer can be met for a large number, or even most, of humans. What morality would we be able to defend in a world that keeps many, if not most, from meeting their basic needs? This brings up the question central to deep adaptation: "What are the valued norms and behaviors that human societies will wish to maintain as they seek to survive?"[14]

If we agree that we want a future where most of the planet is still habitable for humans, providing the basic services each of us needs, and if we agree, as even the U.S. federal administration does, that we are currently on a trajectory that is not making this a probable scenario, can we then agree that we want to make at least an attempt to divert the trajectory somewhat towards a more desirable future? If so, we need a better understanding of the abundant evidence of humanity's impact on the planetary system's trajectory and to use this understanding to inform our efforts of carving a pathway to the future we want.

One transdisciplinary approach to wicked and super-wicked problems is participatory modeling, which brings societal agents together in a joint effort to create a shared agreement on the goals and a shared evidence-based understanding of the challenges. There is an urgent need for enabling people to participate in such participatory modeling efforts. How can we best make evidence available to those engaging in participatory modeling? Scientists, Earth observation communities, those engaged in the development of collaborative data platforms, experts in artificial intelligence – we all can contribute to the development of means that provide societal



> "On Earth in a hothouse state, life would have to concentrate far away from the tropics and closer to the polar regions. It is hard to imagine that our social and governance systems would be able to manage the migration of billions of people to new locations where the temperatures would still allow humans to go outside for some hours a day."

agents access to the mounting evidence that tells the story of past interference with the life-support system and tools to explore the full spectrum of plausible futures.

This insight could support the development of societal therapies to correct the wrongs of the past and promote the right in the present. As an immediate action, the incapacity of fully assessing the human impact on our life-support system[3] should lead us to moving forward very carefully and should put focus on less being better, instead of more economic growth that is clearly degrading the Earth's life-support system.

> "The U.S. government also seems to have accepted that the very likely future is one of a much warmer planet and decided that even trying to do something about it is futile."

◀ Figure 1. The Future Cone: A spectrum of possible futures, modified and extended from The Voroscope, endnote 12.

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Paul D. Miller
A.K.A. DJ Spooky

Myrna James Yoo
Publisher, Apogeo Spatial

The Intersection of Tech, Data & Music and the Iconic Year 1969

A Conversation with DJ Spooky, aka Paul D. Miller

PAUL D. MILLER, AKA DJ SPOOKY, IS A COMPOSER, MULTIMEDIA ARTIST, AND WRITER WHOSE WORK IMMERSES AUDIENCES IN A BLEND OF GENRES, GLOBAL CULTURE, AND ENVIRONMENTAL AND SOCIAL ISSUES. MILLER HAS COLLABORATED WITH AN ARRAY OF RECORDING ARTISTS, INCLUDING METALLICA, CHUCK D, STEVE REICH, AND YOKO ONO. HIS 2018 ALBUM, DJ SPOOKY PRESENTS: PHANTOM DANCEHALL, DEBUTED AT #3 ON BILLBOARD REGGAE. HIS LARGE-SCALE, MULTIMEDIA PERFORMANCE PIECES INCLUDE "REBIRTH OF A NATION;" TERRA NOVA: SINFONIA ANTARCTICA, COMMISSIONED BY THE BROOKLYN ACADEMY OF MUSIC; AND SEOUL COUNTERPOINT, WRITTEN DURING HIS 2014 RESIDENCY AT SEOUL INSTITUTE OF THE ARTS. HIS MULTIMEDIA PROJECT SONIC WEB PREMIERED AT SAN FRANCISCO'S INTERNET ARCHIVE IN 2019.
HE IS CURRENTLY THE INAUGURAL ARTIST-IN-RESIDENCE AT GOOGLE ARTS & CULTURE. HE WAS THE INAUGURAL ARTIST-IN-RESIDENCY AT THE METROPOLITAN MUSEUM OF ART'S THE MET REFRAMED, 2012-2013. IN 2014, HE WAS NAMED NATIONAL GEOGRAPHIC EMERGING EXPLORER.

MYRNA JAMES YOO: Paul, I am really excited to speak with you today. Thank you so much for joining us.

PAUL MILLER: Hey, it's a pleasure. Beautiful day here in New York.

MYRNA JAMES YOO: And in Denver as well.

I think one thing I'd like discuss is the urgency of what's happening with the climate, because in the end if we don't take serious action, we, humanity, won't have a place to live. One way to reach people with this message is with music and art.

So that's where you come in. Can you introduce yourself? Some of our readers may not be aware of who you are.

PAUL MILLER: Sure. Well first of all, I'm Paul Miller. That's my real name, and then my performer name is DJ Spooky. That's D as in 'digital' and J as in 'join.' I'm from Washington, D.C. I went to Bowdoin College in Maine. My degrees are in philosophy and French literature. Both my parents were professors. I grew up in a household that very much valued information. So it's a situation where you find yourself in 2019 - there have been so many evolutions of how people look at art or data or what I now call "data-driven aesthetics." Now, it's its own world at this point. That's where DJ culture and the arts connect. It's all about pattern recognition.

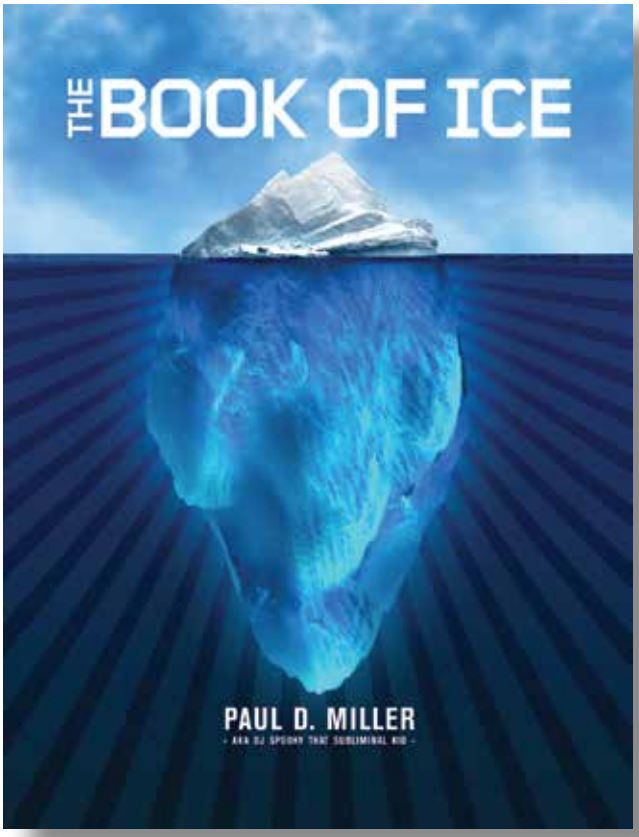
MYRNA JAMES YOO: Right. That's great. I've really just been realizing the past few years how important art and music are in the whole conversation of the changing planet. I've been publishing *Apogeo Spatial* for 16 years, and I have really focused on the science, which is of course very important as well.

PAUL MILLER: Right.

MYRNA JAMES YOO: So music and art help to bridge the gaps that are out there and they also open people's hearts, which changes the perception of what you're talking about. I'm really working on this wake-up call for humanity so we can all change what we can do in our lives to have a future; I think that there are a lot of things that you are doing that speak directly to that. Do you want to share anything about any of your particular projects?

PAUL MILLER: Sure. 2019 is a strange year. On one hand, it's the 30th anniversary of the web. So Tim Berners-Lee wrote the first source code for the web as we know it in 1989. But ARPANET, as we know it, started in 1969. So it's the 50th anniversary of the internet and the 30th anniversary of the web.

My current project I'm doing is called *Quantopia* – it's quantified utopia. It's done with a sense of humor – the landscape and a culture made of numbers. It's about how we look at data-driven society especially with the way networks such as the internet or web has transformed culture. That's my current, it's a music composition that looks at what I call "the acoustic portrait of the entire internet." When you think about *Quantopia*, look at composers like John Cage on one hand, or scientists like Galileo, or Johannes Kepler, all of whom were inspirations for me.



TerraNova: The Melting of Ice in Antarctica

PAUL MILLER: There's another project which is called *The Science of Terra Nova*, and it's a project where I went to Antarctica for several weeks, and wrote a massive music composition based on looking at the geometry of ice.

MYRNA JAMES YOO: That's really great. One of the most important things that you do is put music to things that people wouldn't expect. You literally were listening to the ice, and putting music to the melting of the ice to make a point, right?

What was involved with the project?

PAUL MILLER: It's a multimedia project. I'm more into interdisciplinary, and so film is a component and it's composing, it's performance art and things like that. This one went to the Met (The Metropolitan Museum of Art) in New York, the American Museum of Natural History, and it traveled to a whole bunch of museums throughout the country, and Europe as well. These are all projects that travel and score as concerts, so they're film, they become books, and so on and so on.

(Editor's Note: The presentation that traveled to museums is called Terra Nova: Sinfonia Antarctica. In order to understand better the fragile environment and ecosystem of Antarctica, Paul traveled to the continent with a mobile recording studio in order to capture sounds of ice and the reverberations it produces.)

MYRNA JAMES YOO: I see. So you do your projects as multimedia and they all have original compositions within them that you've written. In this Antarctica project, did you make the point about the melting ice as it relates to climate?

PAUL MILLER: Well, melting is a temperature differential that I applied to music. I'll give you an example. Melting ice or freezing ice occurs at very specific temperatures, so even the geometry of ice would only come into play if there's a certain temperature that triggers that phase transition.

MYRNA JAMES YOO: So it's an indicator of what's happening.

PAUL MILLER: Right, so what makes water become ice is just this small temperature differential on this sort of compact molecules, and stuff like that. It's pretty amazing to see. I really enjoy seeing how these kind of phenomena make you realize that there's mathematics in nature at every level.

You guys are focused on geospatial issues. One of my favorite ways for portraying that is called Ichnographic Representation. It's basically an axonometric kind of representation that Leonardo da Vinci started around 1502. Many map makers looked at his first map of a fort in the city of Imola, Italy, as one of the first ways of thinking about satellite image representation.

That kind of stuff inspires me, the fact that before we had the silos separating math from philosophy or math from music, people just did what they did, they had to think about patterns. This is the 500th year of da Vinci's death this year too, so we have the 50th year of the internet, and 500 years of da Vinci so, it's a good year of anniversaries.

50th Anniversaries and the Significance of 1969

MYRNA JAMES YOO: Wow. It's also the 50th anniversary of walking on the moon on July 20th, and 50 years ago, Jack Dangermond started his iconic GIS company, Esri.

PAUL MILLER: So in 1969 you had a man on the Moon, you had the internet, you had Woodstock, and you had the beginning of the industry that organizes all the geospatial data.

MYRNA JAMES YOO: Culturally that's just incredible isn't it?

So back to da Vinci, that's amazing that he was able to do accurate drawings of an aerial view, which we now take for granted, as we see photography from airplanes, and space and drones every day. He was so ahead of his time in so many ways. Incidentally, we have one of the biggest exhibitions of his work here in Denver right now at the Museum of Nature and Science, which is fantastic. He's a hero of mine, and was a true Renaissance man.

MYRNA JAMES YOO: And also what it could mean, right? It has so much meaning for so many people.

PAUL MILLER: Yeah, so, there's a lot to be said for how people and the arts can kind of be reflector sites for the sciences. I actually firmly believe that we need to make a more robust conversation between science and the arts, so that's something I'm really interested in overall.

MYRNA JAMES YOO: It's also interesting that it's time yet again to break down silos, because everything is connected; everything affects everything else, in our lives and in the world. So, it's an important conversation to have, and I think that's one of the things that will help us leap-frog forward in understanding and communicating what's really happening with the planet – with the Earth – is to break down more

PAUL MILLER: Oh I will check that out. I'll be in Colorado next week.

MYRNA JAMES YOO: I love the idea of thinking about everything that was happening at once back then and that there's something to be celebrated about these anniversaries.

The Importance of the Arts

PAUL MILLER: Well the thing that is the common denominator for all the things in 1969 – you have someone on the Moon, you have the internet, and you have Woodstock – is that these are where pop culture and technology have been a swirling cocktail of all sorts of different issues that led to us being more and more of an information-based society. Woodstock, one could argue, shattered so many of the norms and how people felt that sound could be represented, whether it be noise, or rock, or anything, all of which was technology-driven.

of those silos. You know, that's one reason that your work is so important. It's because you're doing that and demonstrating, literally, how everything is connected.

PAUL MILLER: Right. Thank you, I really appreciate that. My motto these days is all about pattern recognition and we have to really think of different approaches to how the arts can give people different patterns; that's the point.

So, when you're talking about geospatial issues, the Cold War is what really set up much of the issues that we are thinking about today with satellites. So in 1957 was the first launch of the Sputnik from Russia and the Explorer satellite went up soon after.

MYRNA JAMES YOO: Yeah, we had the great competitive "Space Race" with the Russians and now of course we're collaborative with the Russians at the space station, which is an important thing.

PAUL MILLER: I'm just saying that the legacy of those satellites that were put into orbit actually created a whole different perspective that still ties back to Leonardo da Vinci, because he was the first artist to think about satellite representation before there were satellites. He drew these kinds of maps in 1502 that look exactly like Google Maps, but at that time nobody had that sense of perspective.

A lot of people are very intrigued by his history of map making, but every cell phone that you have, everyone on the planet, amusingly enough, we're still dealing with the geospatial cold war. The legacy of that is in mobile media in a lot of different levels – whether it be 4G LTE that was invented during World War II, or at least the precursor to it, and so on.

MYRNA JAMES YOO: Right. Is there anything else in particular you'd like to share or talk about?

PAUL MILLER: Yeah, so when you look at hip-hop, or techno, or dubstep, or any of the major forms of music that are going right now, they're all based on quantized rhythms, usually 4/4 tempo and the variation in tempo. Techno is a little faster than hip-hop, hip-hop is a little slower than other styles, and dubstep is a little slower than that.

To me these are all really fascinating ways of human beings organizing experience, and putting a tempo or rhythm to it, and that's what's beautiful about math is that we understand those differentials and can actually use them to generate music. That's part of my compositional approach, that I use math as a component, but it still should be reasonably accessible. That's what I just wanted to wrap it up with.

"Melting is a temperature differential that I applied to music. I'll give you an example. Melting ice or freezing ice occurs at very specific temperatures, so even the geometry of ice would only come into play if there's a certain temperature that triggers that phase transition"

MYRNA JAMES YOO: Oh that's really great. I just met a mother whose son has autism and he's a music savant – you know a lot of autistic people have something they're very, very good at – and he did not understand math at all. Then when he was about 15 years old, he was playing the saxophone, when he really learned the music, and the math just clicked in. I think this verifies what you're saying – that math is underlying all of those types of things; it brings us back to everything being connected, doesn't it?

Thank you so much! This was really great.

PAUL MILLER: Excellent, thanks.

Art in Space

Artist Trevor Paglen's Satellite-as-Art

Artist Trevor Paglen's art installation "Orbital Reflector," is "installed" in space, but has not been activated, waiting for clearance from the federal government. Trevor is an American artist, geographer, and author whose work tackles mass surveillance and data collection. This particular piece of art is a 30-metre-long reflective, diamond-shaped balloon made from a material similar to Mylar – a form of plastic sheet made from polyester resin. A brick-sized smallsat containing the inflatable artwork was launched into Earth's low orbit on December 3, 2018 as part of a SpaceX launch on a Falcon 9 rocket with 64 satellites.

Humanity Star

Humanity Star, the first satellite launched purely as art, was launched in January 2018, and plunged back to Earth only two months later. It was launched by Rocket Lab's Peter Beck. It was a highly reflective "disco ball" satellite, designed to be seen from Earth.

NASA Partnership Brings "Live" Photos of the Earth from the ISS

Apogeo Spatial is thrilled to announce a partnership with NASA where we are publishing photos from astronauts in space, "live," as they are living on the ISS! Following are the first six photos by Nick Hague, published exclusively here, as well as his comments about each one.

We are anticipating his return in October, to debrief and hear about how the experience changes him. He is excited about serving on the mission, and about how he might evolve via the Overview Effect. We interviewed him before he went in March; listen to the conversation here: http://apogeospatial.com/apogeo-spatial-podcast/.

Nick shares with us from his home on the ISS, "Perspective makes all the difference. From our perch on the ISS 250 miles above, the living history of the Earth jumps out at you through buckles, folds, and giant fans. I am so thankful for all of the spectacular geology and geography training I received at NASA to help me decipher how our world continually changes around us."

The Overview Effect, according to Tim Fernholz, editor of Quartz' Space Business (www.qz.com), is "the realization, reported by astronauts, of deep solidarity with humanity and Earth—as the song goes, you don't know what you've got until you're flying around it at 17,500 mph."

Why does this "realization" matter? Why does "increasing our consciousness" matter? Because we need a new mindset to solve the problems that we have created in the world. We can perhaps be forgiven, because we didn't know when we became dependent on vehicles and fossil fuels that those behaviors, among others, would create an imbalance in our atmosphere – that we would inadvertently destroy many species forever, that we would upset the ecosystem to an extent that we are experiencing the worst droughts, floods, fires and storms than we have ever seen before.

We all know this, but it's worth repeating: "We cannot solve our problems with the same thinking we used when we created them," as Albert Einstein noted. The literal change in our minds is essential. The realizations are essential. We must wake up.

Also, the more unity that exists on Earth with these new realizations, the less conflict we will have. "You cannot hate someone whose story you know," as Meg Wheatley noted. I can relate because I had my own Overview Effect in 1998 after traveling solo around the world. My trip made the world seem so small and fragile, which in turn makes us realize that we must take care of it.

We truly are all on this planet together – we are in this together. No boundaries exist; no borders are seen; no national-states are visible on the images. What is visible is the thin fragile layer of atmosphere, our only protection from the vast nothingness of space, pictured by Nick Hague on the front cover. As an homage to this, our *Apogeo Spatial* logo is the color of the sky, getting darker into black as it mimics the colors of the atmosphere.

Experiencing the Overview Effect is a profound way to grow as a human – to evolve, to get to a higher level. It's not the only way, of course, but it's a pretty amazing way.

It is with great pleasure that I bring you the incredible Claudia Welss, whom I met in 2007 as we served together on the organizing committee of ISDE5, the 5th International Symposium on Digital Earth, at University of California, Berkeley. She's currently the Chair of the Board for the Institute of Noetic Sciences (IONS). She shares why the images of Earth from space are so important, as well as the story of the founding of IONS by Astronaut Edgar Mitchell after walking on the moon with Apollo 14, and seeing that magical Earth, dangling in space.

The Power and Awe of Seeing Earth from Space

Bringing the Overview Effect Down to Earth

"If somebody had said before the flight, 'Are you going to get carried away looking at the earth from the moon?' I would have said, 'No, no way.' But yet when I first looked back at the earth, standing on the moon, I cried." -Alan Shepard, Astronaut on Apollo 14 in February 1971

In the upcoming drama/sci-fi feature film Lucy In the Sky, Natalie Portman plays an astronaut (loosely based on real-life astronaut Lisa Nowak) struggling to readjust to life on Earth after experiencing the vastness of space. Who wouldn't be changed by the experience? It's well known that seeing Earth from space has a profound effect on the human psyche; some astronauts even report coming home needing to readjust to life in new, "deeply religious" states. For many, the effect is truly life-altering.

To date, almost 500, or two-thirds of all astronauts, have reported experiencing what author Frank White termed "The Overview Effect" (OE). The OE is a phenomenon signifying the predictable outcome of astronauts developing a radically new philosophical point of view in order to accommodate a radically new physical perspective – like seeing Earth as a unified but fragile presence with a paper-thin atmosphere protecting her inhabitants from the harshness of space. Concepts like Buckminster Fuller's "Spaceship Earth" — where humans are not passengers, but crew — become visceral realities instead of abstract ideas. But it's the cocktail of overwhelming emotion created by feelings of wonder, reverence, humility and oneness that appears responsible for astronauts being prompted into sudden, unexpected moments of self-transcendence (the expansion of one's sense of identity and purpose) through the transformational power of awe.

Such was the case with Dr. Edgar D. Mitchell, Apollo 14 lunar module pilot and 8th man to walk on the moon. Gazing at Earth from space, Dr. Mitchell had what he described as "an explosion of awareness and a profound sense of interconnectedness accompanied by ecstasy... an epiphany." This sense of oneness with all of life expanded his view not just of our planet, but of himself, humanity, and humanity's potential for determining its future. He saw that it was critical to our collective survival that we change the stories we tell ourselves about the limits of our capabilities as human beings. In fact, he believed his direct experience of unity foreshadowed a new wave of evolution in human consciousness, and this belief changed the course of his life.

Dr. Mitchell noted, "You develop an instant global consciousness, a people orientation, an intense dissatisfaction with the state of the world, and a compulsion to do something about it. From out there on the moon, international politics look so petty."

So on his return, Dr. Mitchell set out to understand his experience by applying the same scientific rigor that was being used by NASA to study outer space to the study of "inner space," or human consciousness. In 1973, he founded the Institute of Noetic Sciences (IONS) whose mission in the 21st century is to illuminate the interconnected nature of reality through scientific exploration and personal discovery, empowering a more compassionate, thriving world.

Today, this mission translates into two major initiatives. IONSx is a five-year multidisciplinary program to understand the relationship between mind and matter in an effort to advance the current scientific paradigm beyond its dominant materialistic stance. The IONS Discovery Lab (IDL), hosted online and at Earthrise (our 200-acre Northern California campus named after that

By Claudia Welss, Chairman of the Board, Institute of Noetic Sciences, Berkeley, Calif., www.noetic.org

Claudia is also an Executive Producer of the Edgar Mitchell Overview Effect Virtual Reality Experience, a sophisticated simulation being produced by IONS in late 2019.

Astronaut Edgar Mitchell, founder of IONS and Claudia Welss, Board Chair, pictured at Cape Canaveral, Florida

Edgar Mitchell on the surface of the moon as part of Apollo 14, 1971

The Lunar Lander

famous first image of Earth from space), will be the largest study ever done on unlocking the mechanisms of wellness, personal transformation and extended human capacities that transcend our current understanding of space and time. Perhaps someday we may even be able to measure markers of transformation in astronauts as they encounter the Overview Effect in space.

"The feeling of unity is not simply an observation. With it comes a strong sense of compassion and concern for the state of our planet and the effect humans are having on it. It isn't important which sea or lake you observe. You are standing guard over the whole of our Earth." -Yuri Gagarin, Soviet Cosmonaut and first human in space in 1961

Fifty years ago, in 1968, Apollo 8 astronaut Bill Anders took what wilderness photographer Galen Rowell called, "the most influential environmental photograph ever taken" — and what poet Drew Dellinger called "our first cosmic selfie" – the image known as Earthrise. It has been published countless times over the years, and is still considered one of the most iconic images of the planet.

As we absorb these beautiful "live" astronaut photos from the ISS, courtesy of *Apogeo Spatial* and NASA, it's worth considering what it could mean for more and more people to be forever changed by the OE, especially with the rise of space tourism and the emerging space economy. Virtual reality pioneer David Beaver has said that a mass experience of the OE caused by space travel will "eventually be seen as a major driver of one of the greatest shifts in world awareness in the modern world, equivalent to or greater than the Copernican Revolution or the discovery of the New World. Whether by direct experience, sophisticated simulation or artistic representation, the experience is forever altering the life we think we are living and world we think we are in."

Through the collective shock and awe of this new, expanded self-awareness, we may end up learning more about ourselves than about space — which may end up being the most powerful reason for going.

"Once a photograph of the Earth, taken from outside, is available... a new idea as powerful as any in history will be let loose." -Astronomer Fred Hoyle, 1948

Astronaut Nick Hague's "Live" Images from the ISS

1

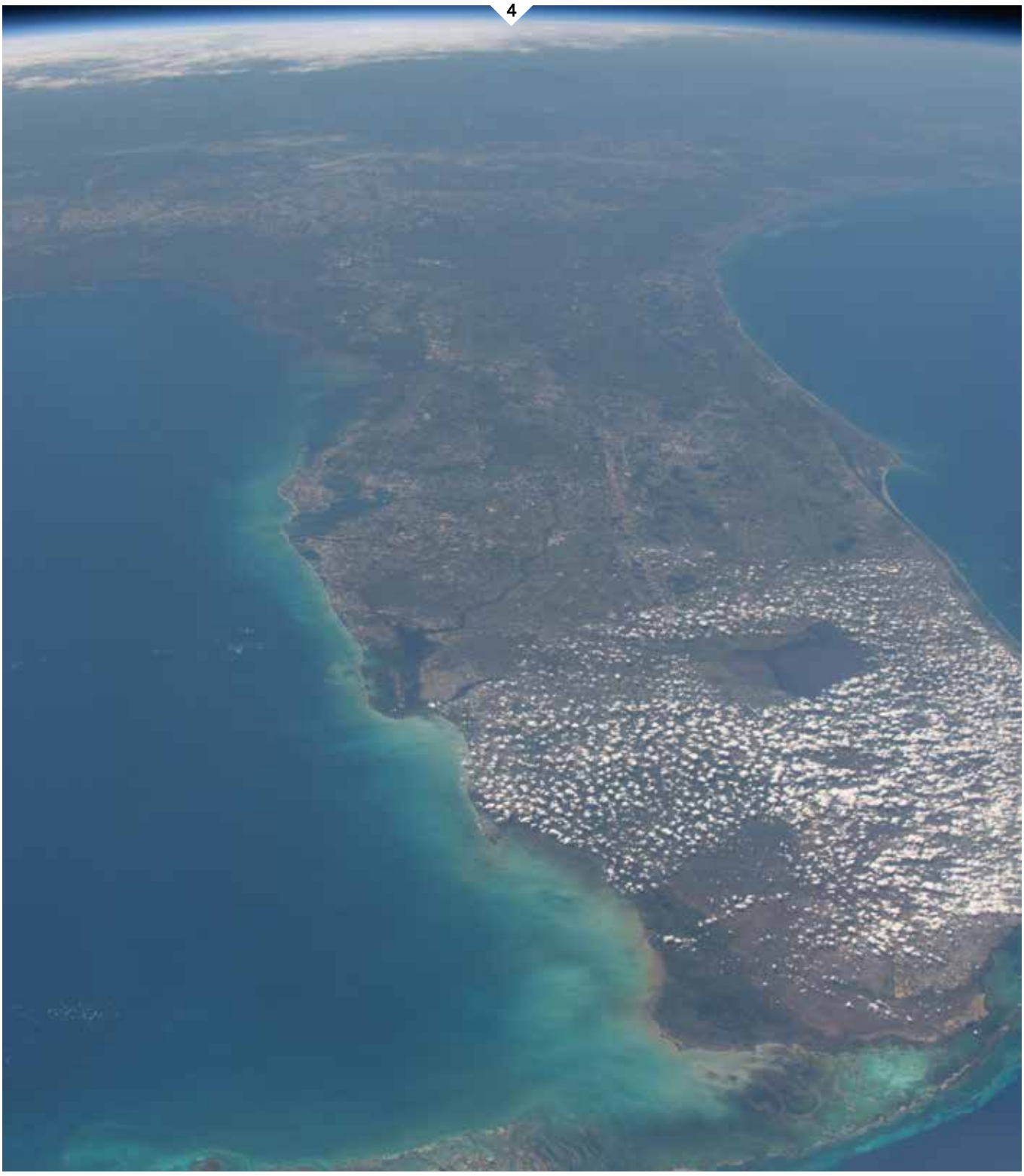
◀ **FIGURE 1**
Easily spotted from space, one striking geologic feature is the "Eye of the Sahara," in Mauritania, a country in northwest Africa.

Nick Hague, NASA Astronaut

2

▶ **FIGURE 2**
"I see the Moon, and the Moon sees me." Watching the Moon rise from the Earth, I am reminded of the song sung to babies for generations, and I think of the generations to come who will call the Moon home.

▼ **FIGURE 3**
Entranced by the eerie dance of the Aurora Borealis, aka the Northern Lights, I can't help but remember sitting next to my children watching the movie "Frozen," listening to the theme song, "Let it go. Let it go." In the isolation of spaceflight, views of the Earth often evoke memories of time spent with loved ones. The lights are a weather phenomenon caused by electrically-charged electrons and protons colliding with neutral atoms in the upper atmosphere.



▲ **FIGURE 4**
From only a few hundred miles up, you can see the entire state of Florida, and in the distance, also the curvature of the planet. The human footprint fades and the blue and turquoise waters around the state draw you in. Here is where we will launch ourselves to the Moon, as we continue to explore the mysteries of our universe.

5

▲ **FIGURE 5**
The weather systems from space seem picturesque and serene against the dark of the cosmos. Storms the size of countries seem to idle in place. Yet, those in their path face the sheer destructive power of nature. This contrast highlights our small role in the universe, and how precious our oasis called Earth is.

▼ **FIGURE 6**
The Soyuz spacecraft and Progress cargo spacecraft docked to the space station are seen flying over Gibraltar, on Spain's south coast.

6

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