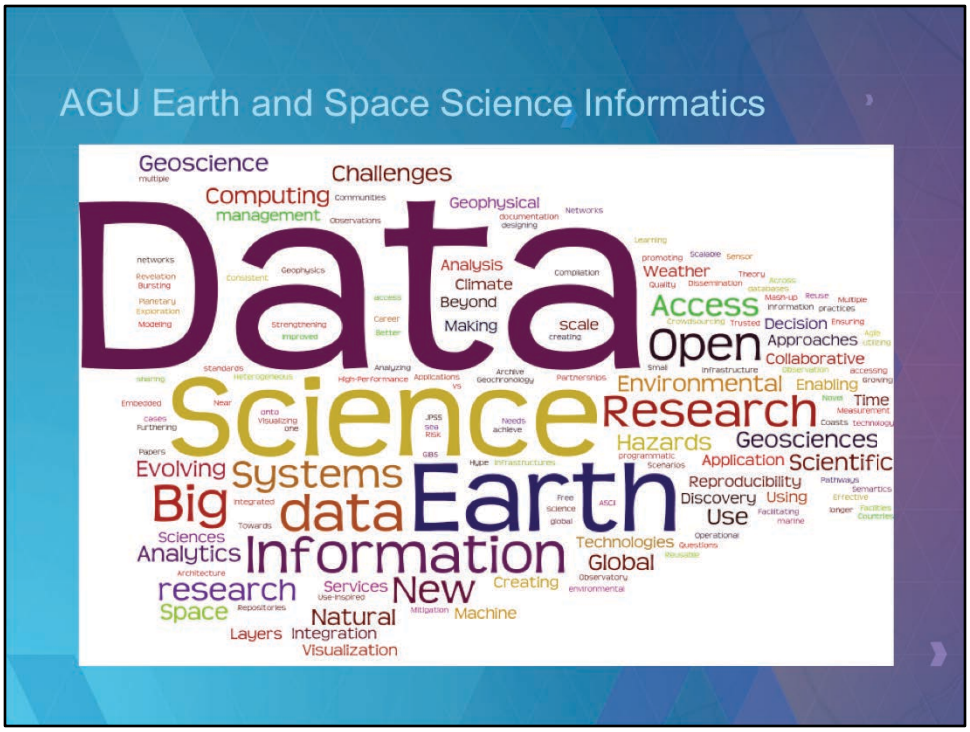
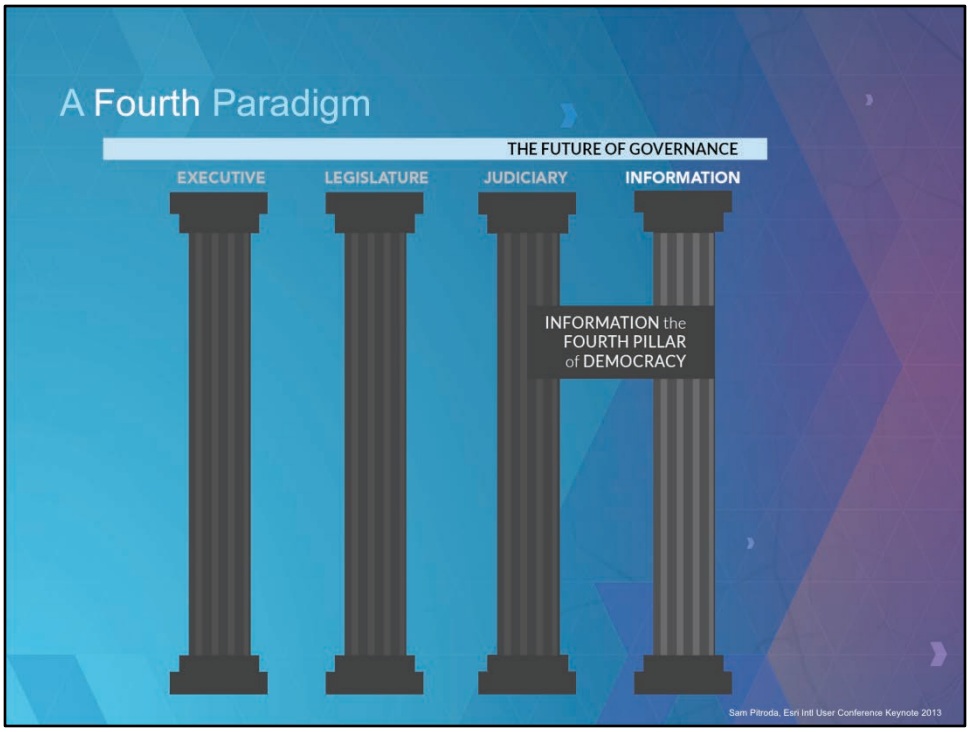
Many thanks to AGU and ESSI for establishing the lecture series and for giving me the opportunity to speak on behalf of my colleagues at Esri and our collaborators
I would have loved to have met Greg and appreciated learning about him by way of Chris Lynnes inaugural lecture in 2012

not only building bridges between data and science, but between **informatics** and **Earth sciences** (for many of us = betw pure computer science and domain science)



Customary “wordle” consisting of the words in the titles of this year’s ESSI sessions. Lots of amazing research being presented which I cannot hope to capture or fully comment on in this lecture. But I seek to contribute a few ideas that I hope you’ll find thought-provoking, stimulating, and helpful.

I want to start off with the “story of the fourth.”
Data and big data are leading to a new science paradigm, the new science of “big data” (the inundation of data from satellites, sensors, and other measuring systems and the issues associated with those large data sets), as heralded in these special issues of Nature and then Science
And there is also the 2009 book **The Fourth Paradigm, which posits a new paradigm of scientific discovery beyond the existing 3 paradigms of EMPIRICISM, ANALYSIS, and SIMULATION to a 4th where insight is discovered through the manipulation and exploration of large data sets.**



At the overarching level of SOCIETAL RELEVANCE, many are recognizing information as the FOURTH pillar of governance as described so eloquently last night at AGU by DJ Patil, Chief Data Scientist, US White House Office of Science, Technology and Policy (witness too the recent, BIPARTISAN Geospatial Data Act introduced in the US Senate)

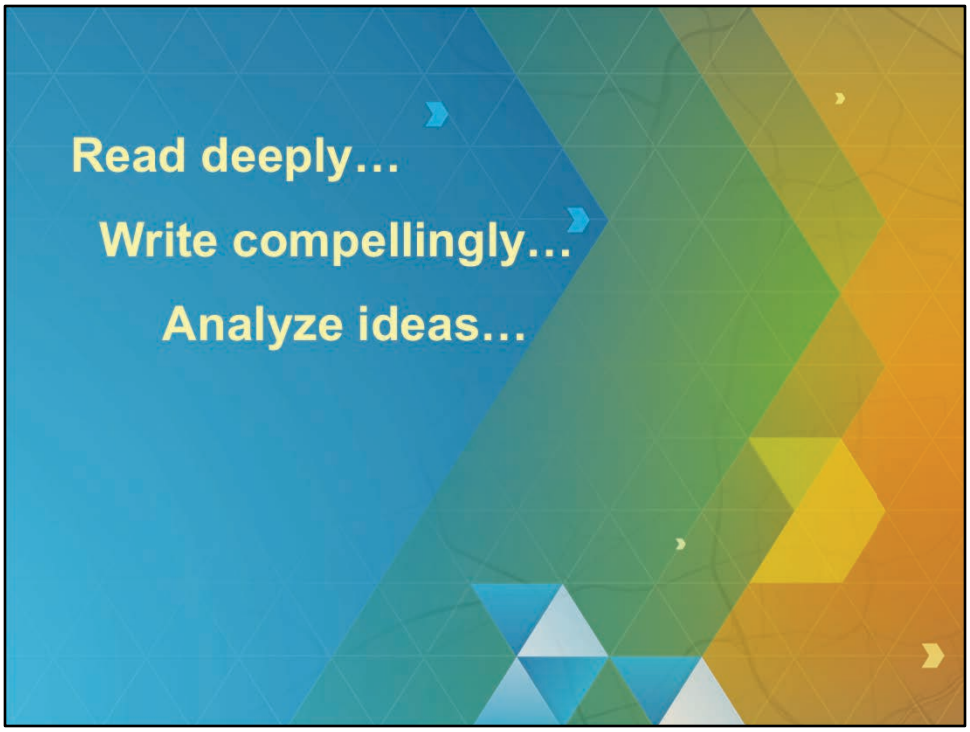
What is resilience? The ability to …

We often think in terms of using the power of informatics to help make our communities more resilient to CLIMATE CHANGE

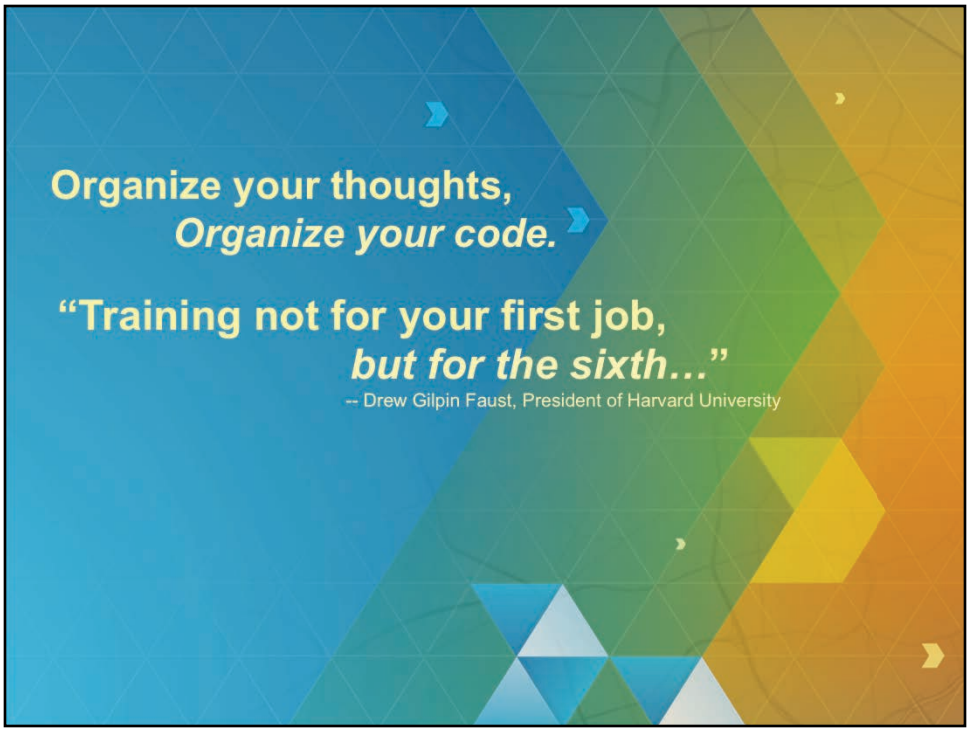
But what about the flip side of making informatics, the tools themselves and the associatied approaches more resilient? I call this not community resilience but digital reslience. As such, in the short amount of time that I have this morning I'd just like to share some ideas about how we can move toward this digitial resilience
(graphic refers to GIS as an example tool, also functioning as a system of record)


8 Ideas…
Toward Digital Resilience

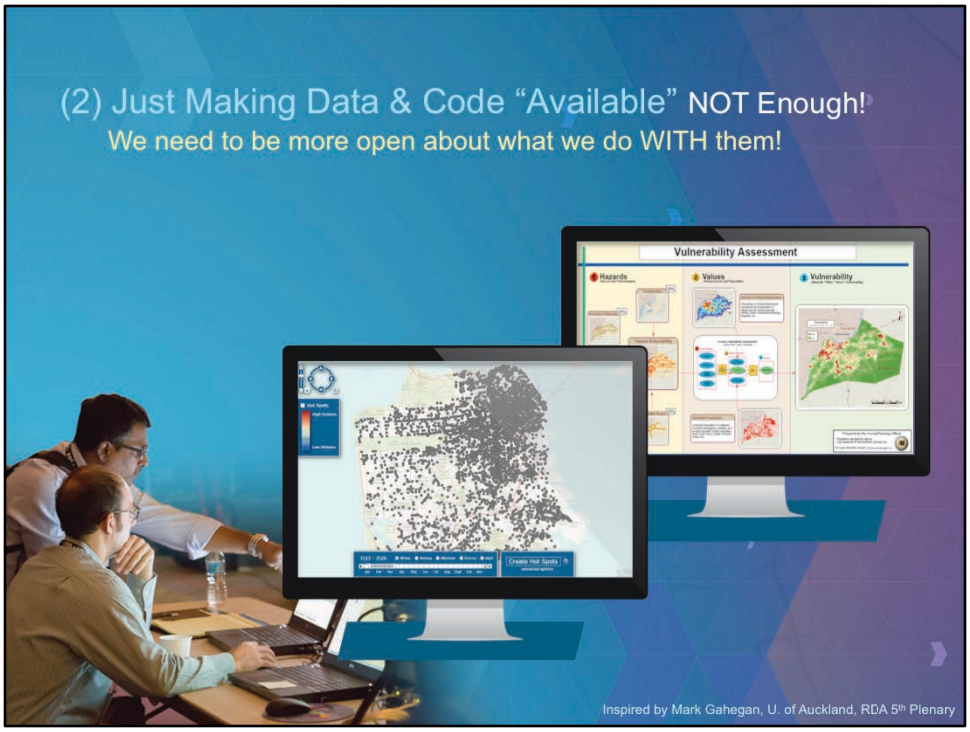
https://www.washingtonpost.com/opinions/why-stem-wont-make-us-successful/2015/03/26/5f4604f2-d2a5-11e4-ab77-9646eea6a4c7_story.html
No matter how strong your math, science, and computers skills are, you still need to know how to learn, think and write.

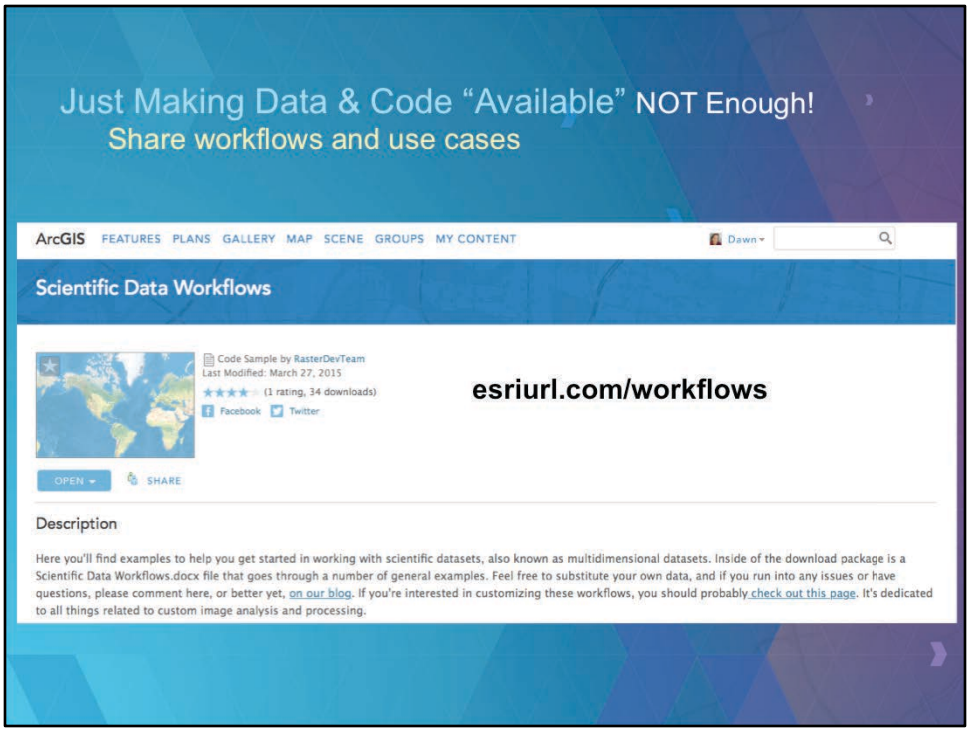


In “understanding our world” (Esri tag line), the ability to write code, especially Python, is important, but we can’t lose sight of the need to be able read deeply, write compellingly, think critically so that we can analyze ideas. The liberal arts education is still important, even for technologists.
For example, the importance of being able to write good technical reports and software documentation, as well as good code.



Indeed, being able to organize your thoughts will help you to organize your code. Quote is from a Harvard president.

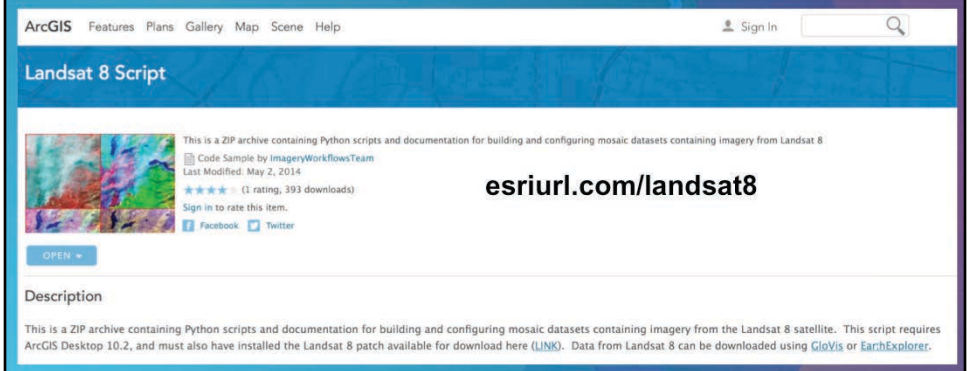

(2) Just Making Data & Code "Available" NOT Enough!
We need to be more open about what we do WITH them!
Vulnerability Assessment
Hazards
Values
Vulnerability
Create Hot Spots
Inspired by Mark Gahegan, U. of Auckland, RDA 5th Plenary



Includes scripts, a working toolbox, sample data, and step-by-step workflows in Word and pdf form to help scientists work with a variety of multidimensional datasets in GIS, including netCDF

Just Making Data & Code "Available" NOT Enough!

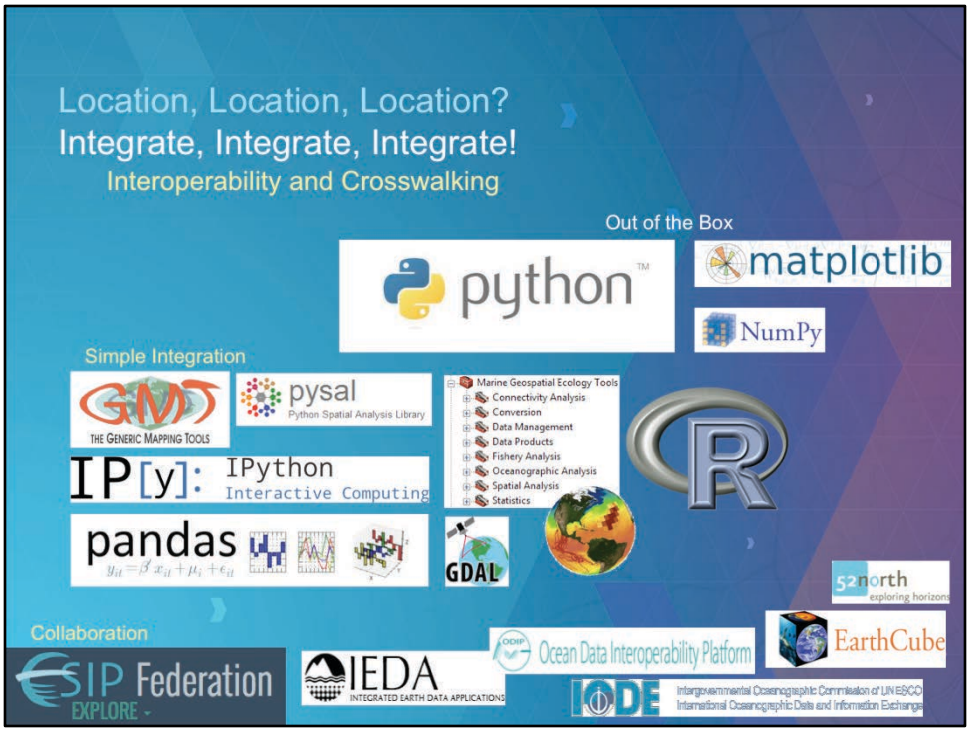
Share workflows and use cases



esriurl.com/landsat8

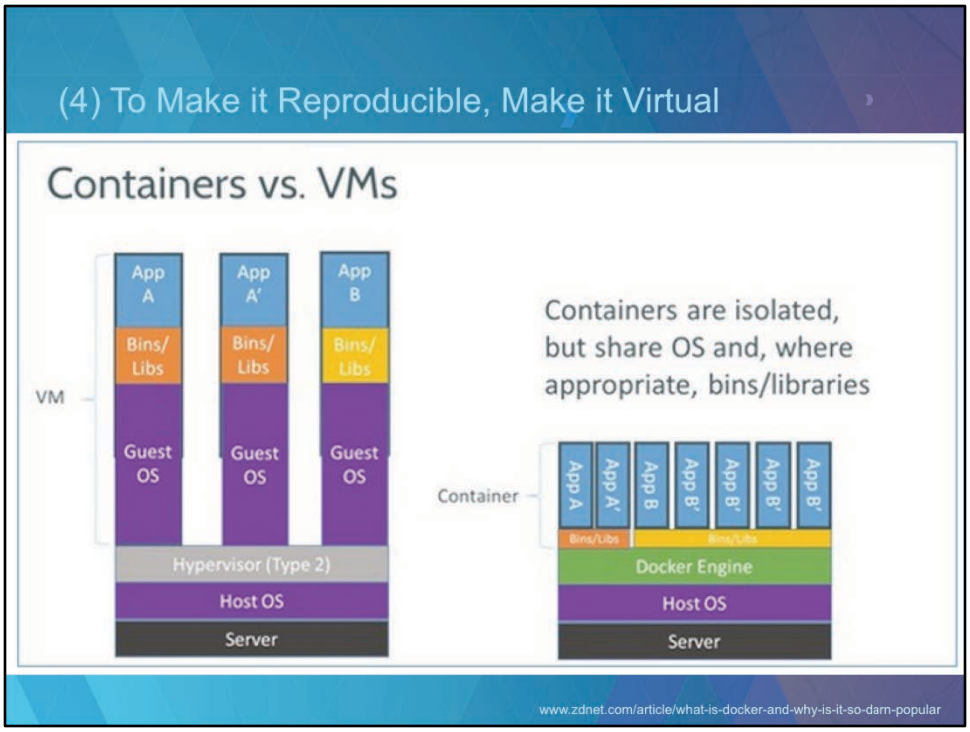
Integrate With Your Other Systems and Data Assets

Bringing in Data And Making Connections To Your Other Systems

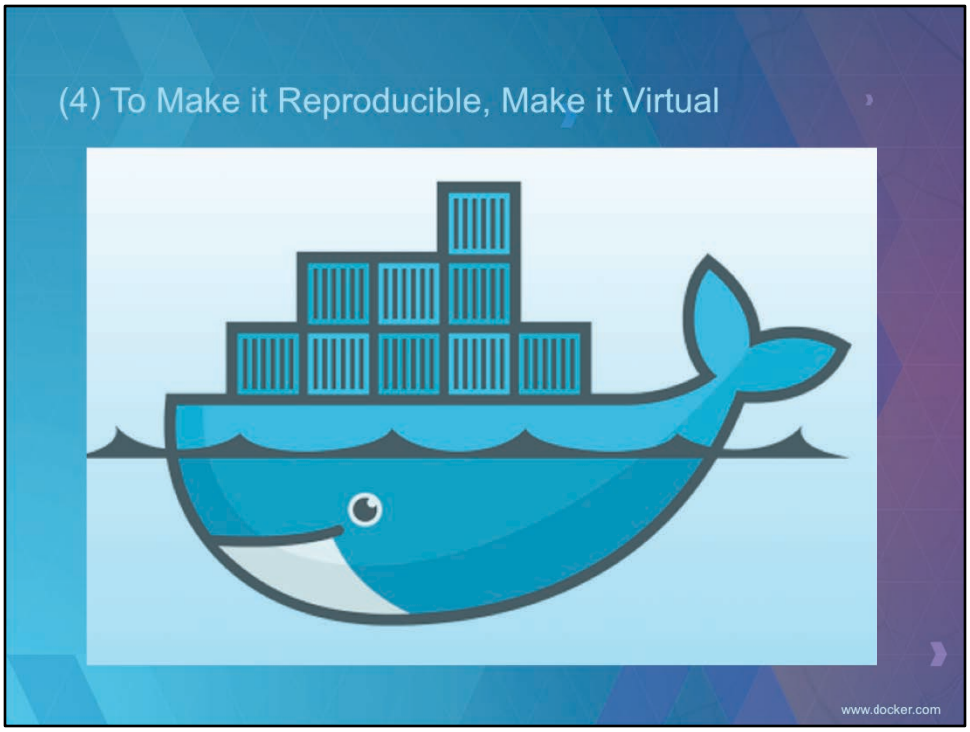


Along these lines we certainly want to engender interoperability and crosswalking among approaches, such as the examples here with the **Python Scientific Computing Environment**, or simple integration with a host of scientific tools and libraries. Collaborations that help us integrate and interoperate are vitally important too. Listed on the slides are some of the most critical collaborations that Esri is involved in.

Repeatability/reproducible
DOIs
Virtual, living journals
Ben Domenico's idea at Digital Earth of being able to run code or run analyses with data as we read the journal article.



Containers is a technology to keep an eye on for packaging and shipping programs that might be included in virtual journals. They are simpler and more lightweight than Virtual Machines, and allow a developer or researcher to package up a collection of integrated technologies –an operating system, server, traditional database, Hadoop or Spark (big) data store, etc.—in a single executable file that "just runs" for you.



The most popular platform for containers at the moment appears to be Docker. The 1.0 release came out in June of this year. Our big data team at Esri is experimenting a bit with it and finding good results. The platform also has one of the most whimsical logos I've seen, which also reminds me of my next Lego building project over Christmas break.

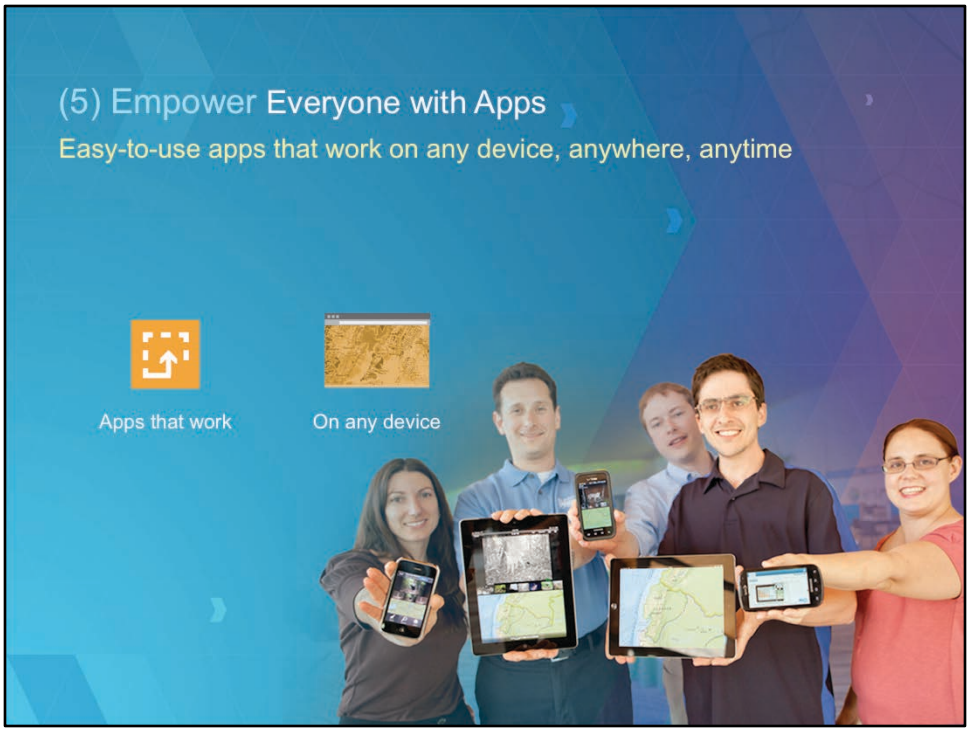
But I digress!

Hopefully you have seen this article in Eos which talk about the related issue of data provenance, another ingredient of this category of resilience

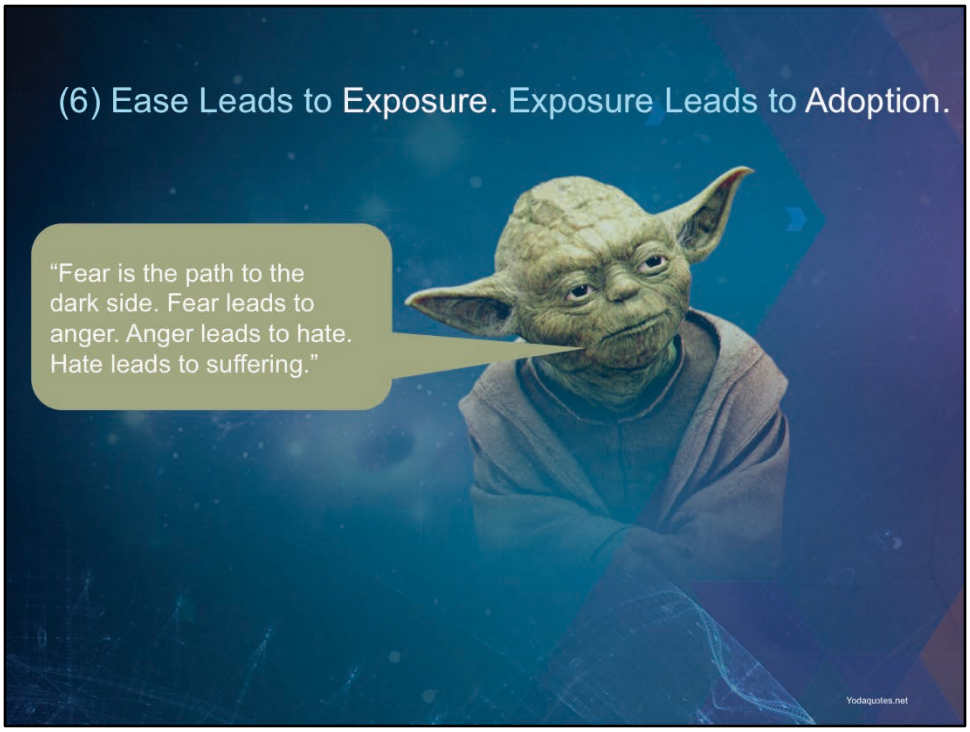
How data citation is great but may not completely solve the provenance problem

Provenance and Context Content Standard (PCCS) advocated by ESIP

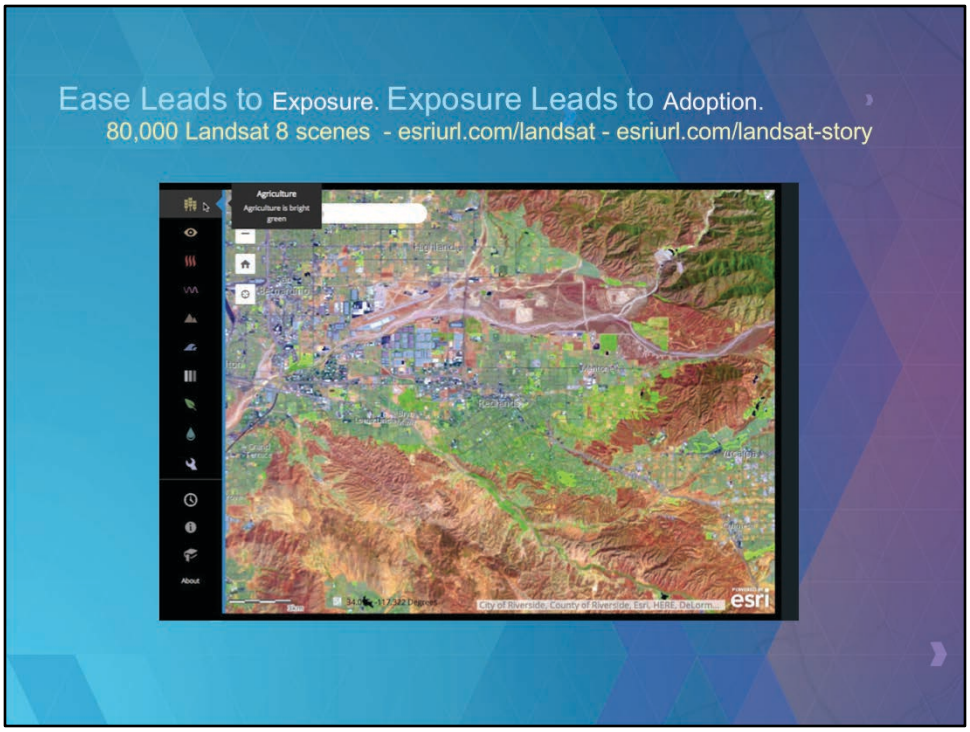
Journals need to require that data become not just available but reusable – container technologies can help with that



In the spirit of location enlightenment, this is actually a big thing in the geospatial community, the GIS community
But for broader informatics I argue that apps can help to broaden the appeal of our concepts, our approaches, our code to much wider audiences, both speciaist and non-specialist
A great way to practice what we preach in terms of true interop with an app that can work on any device
Students are embracing apps in droves. Great example is a course on Computational ARTS at Santa Barbara High School that was highlighted last week during Computer Science Education Week. Courses like this, with their focus on app-building, are attracting more young women and young people of color.
Indeed the trajectory of app building will likely rise, as some argue that the education of geographers and GI scientists, and of data scientists today needs to prepare students to be MAKERS, not just users, of software tools. A lot of this can be accomplished through app building

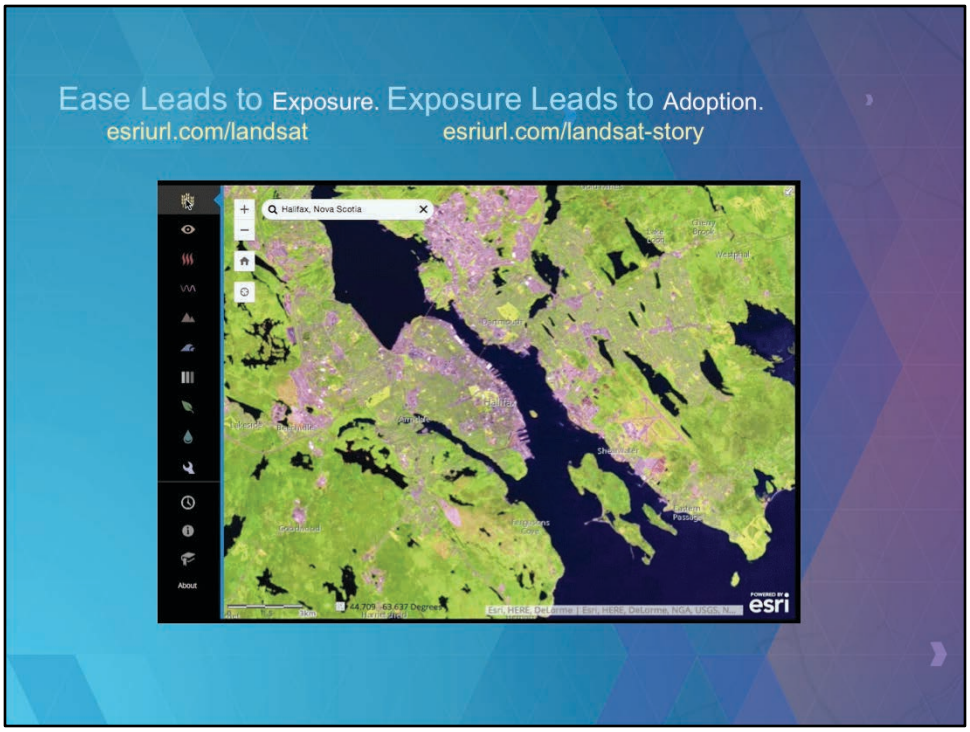


“Fear is the path to the dark side. Fear leads to anger. Anger leads to hate. Hate leads to suffering.”
In the previous slide on apps there was an emphasis on EASY. Why? Because, as Master Yoda says, “Ease leads to exposure. Exposure leads to adoption.” We can’t be digitally resilient unless our intended audiences are USING what we build.

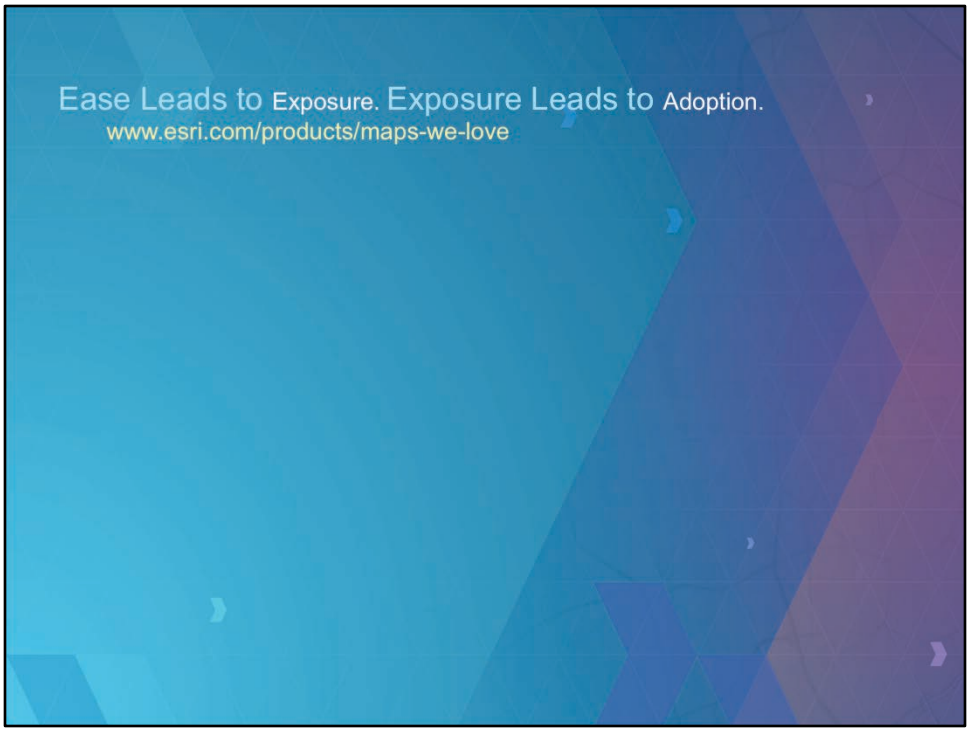


An example of the great effort Esri has gone to with Landsat via a collaboration with Amazon web services. Each night Esri downloads and processes HUNDREDS of new Landsat scenes

This web app helps many more people to understand and USE this valuable resource. Not just a pretty picture but the full information content. Not just cached images but are dynamic, high-performance image services that perform on-the-fly processing and dynamic mosaicking of Landsat's multi-spectral and multi-temporal imagery.



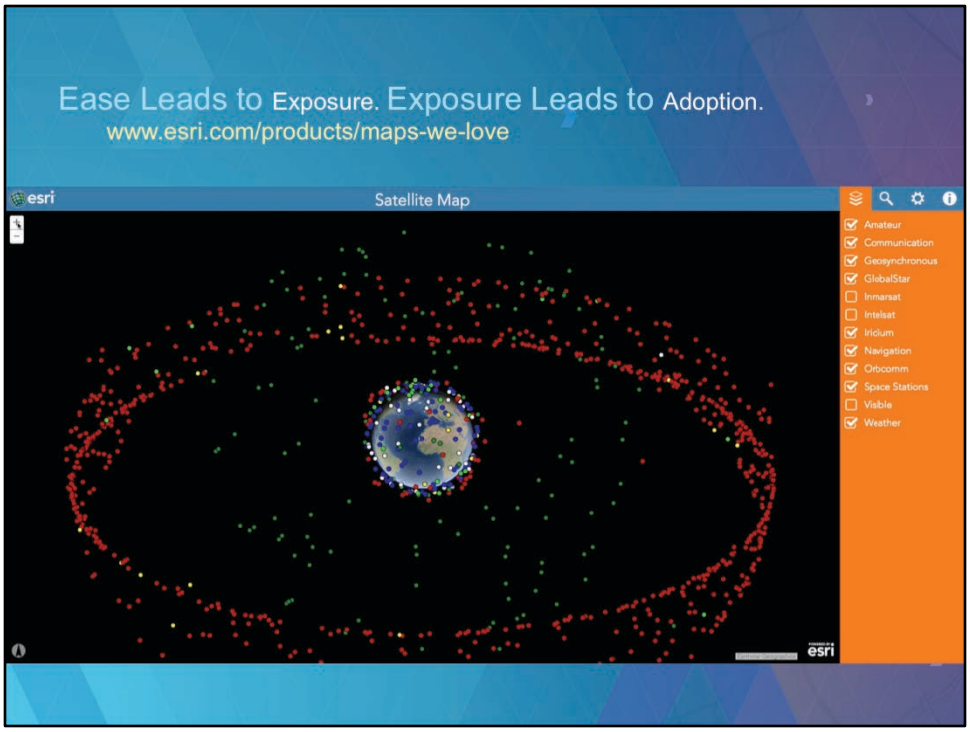
Exploring the different BANDS and then temporal and spectral profiles



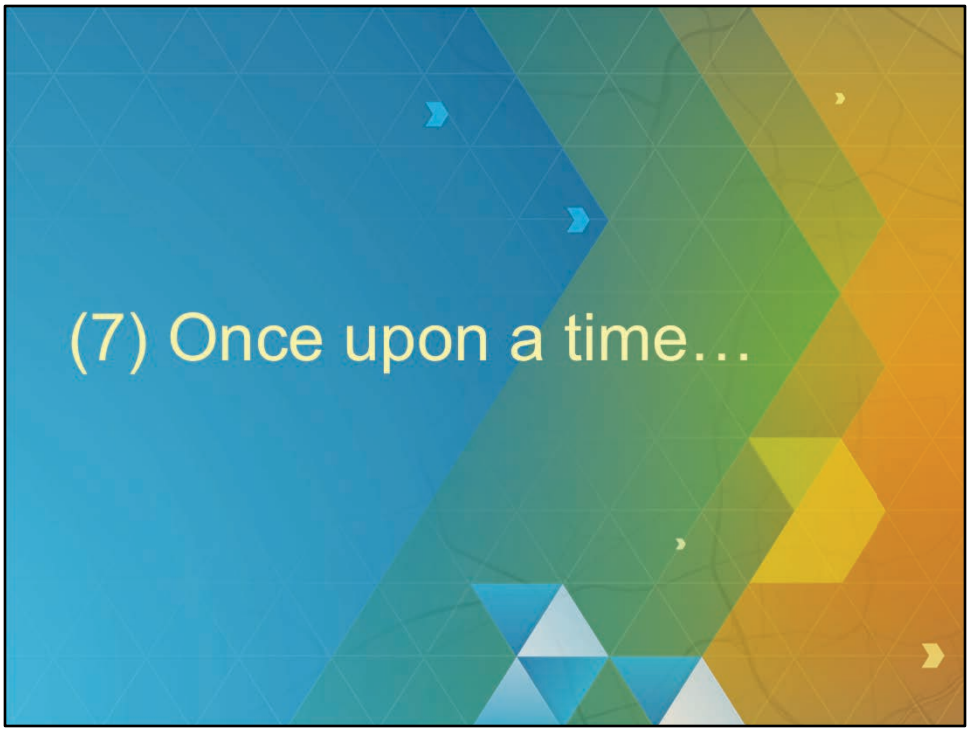
Javascript appplication for which you can not only view but download the code – easy way to see all 14,000+ satellites currently in space, including space junk

Beyond just exploring the different orbits that satellites occupy, good for estimating when the flyover will be over a natural disaster area

Track satellites by nation, by orbit, by type (weather)



Javascript library and ArcGIS for Javascript API
Javascript appplication for which you can not only view but download the code – easy way to see all 14,000+ satellites currently in space, including space junk
Beyond just exploring the different orbits that satellites occupy, good for
estimating when the flyover will be over a natural disaster area
Track satellites by nation, by orbit, by type (weather)

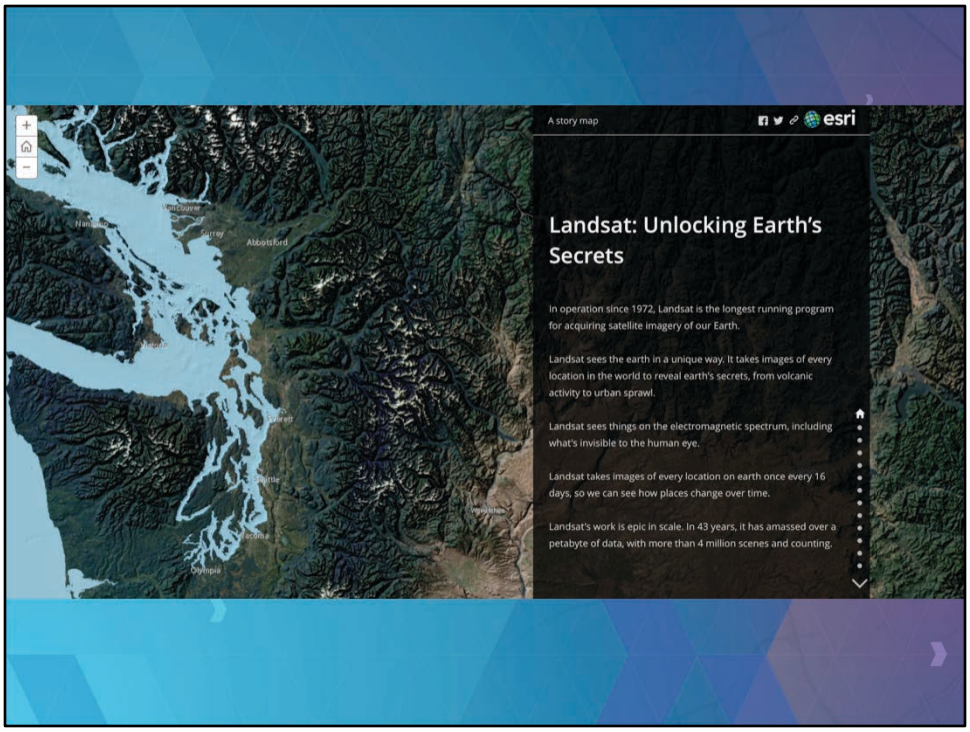


We may get maps, we very often don't get graphs, but we are absolutely hardwired to understand stories. As such, scientists MUST tell their STORY and understand the importance of story
Every single scientific success is perfect fodder for a narrative structure
"People are moved by emotion. The best way to emotionally connect other people to our agenda begins with "Once upon a time…"
Science backs up the long-held belief that story is the most powerful means of communicating a message. Over the last several decades psychology has begun a serious study of how story affects the human mind. Results repeatedly show that our attitudes, fears, hopes, and values are strongly influenced by story. In fact, fiction seems to be more effective at changing beliefs than writing that is specifically designed to persuade through argument and evidence."

http://www.fastcocreate.com/1680581/why-storytelling-is-the-ultimate-weapon

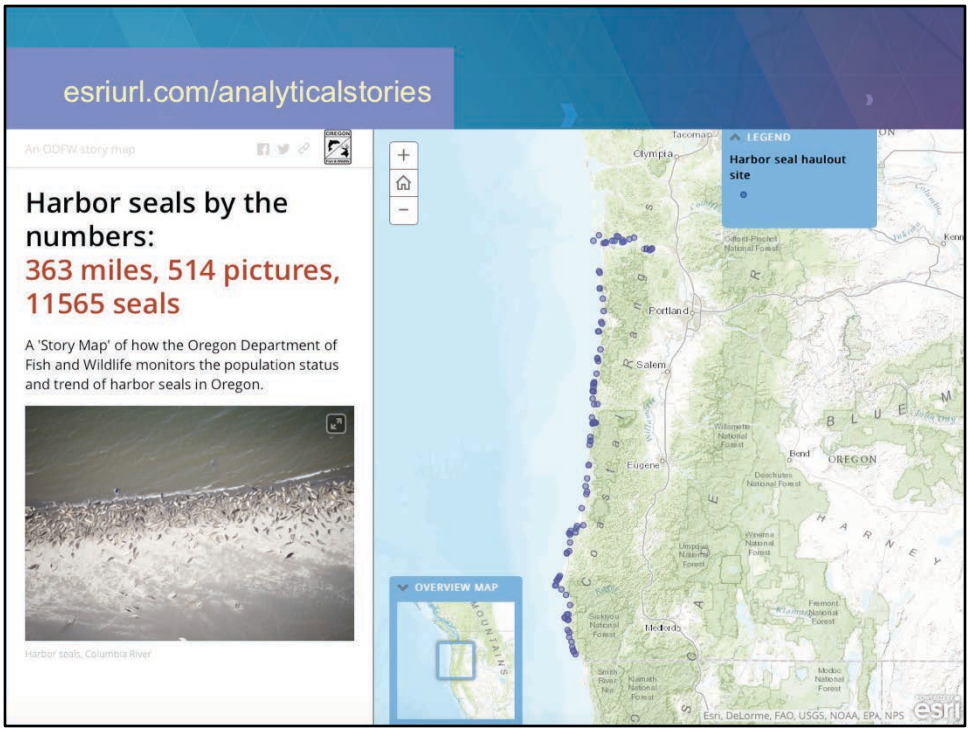
Scientists are often encouraged not to publish their work until it constitutes a complete story.

Why not combine BOTH, especially to take advantage of the power of maps and geography to educate, inform, and inspire people to action as well?

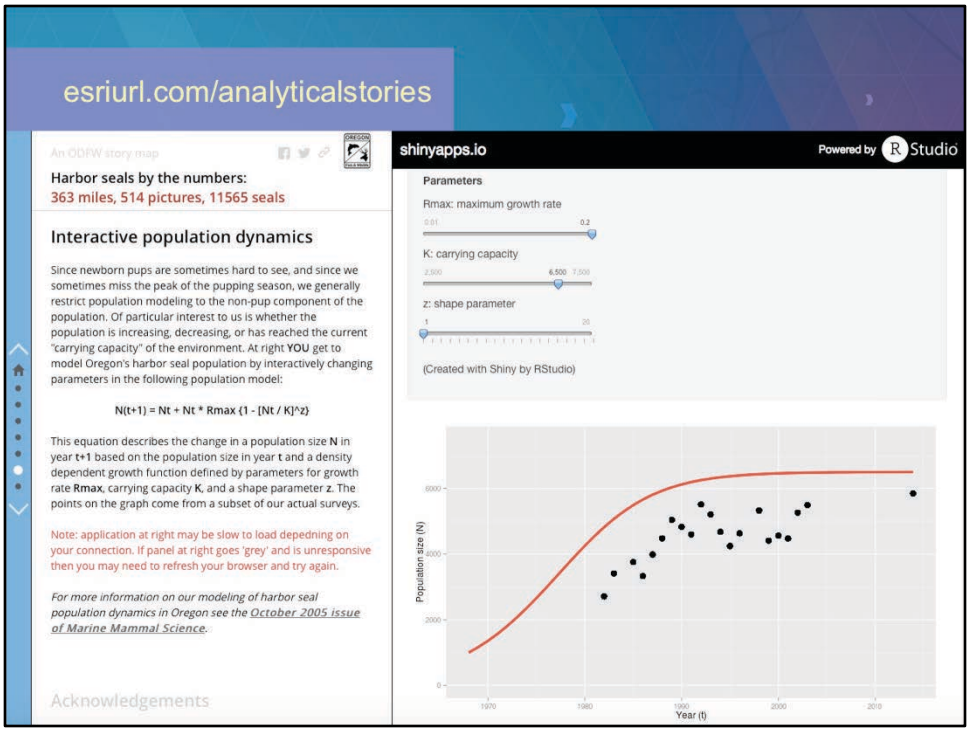


Story map to go with the Landsat web app just shown to show and explain all the band combinations in more details

Danish Sargasso Sea Story Map
Technical University of Denmark's (DTU) research vessel Dana was on an expedition in the Sargasso Sea in March and April 2014 to examine the role of climate-induced changes in spawning zones in the violent decline of sole in Europe.



Oregon Department of Fish & Wildlife created this story map to explain their field monitoring work but also to share a population dynamics model (based on statistical code written in R), that can be run interactively inside the story map



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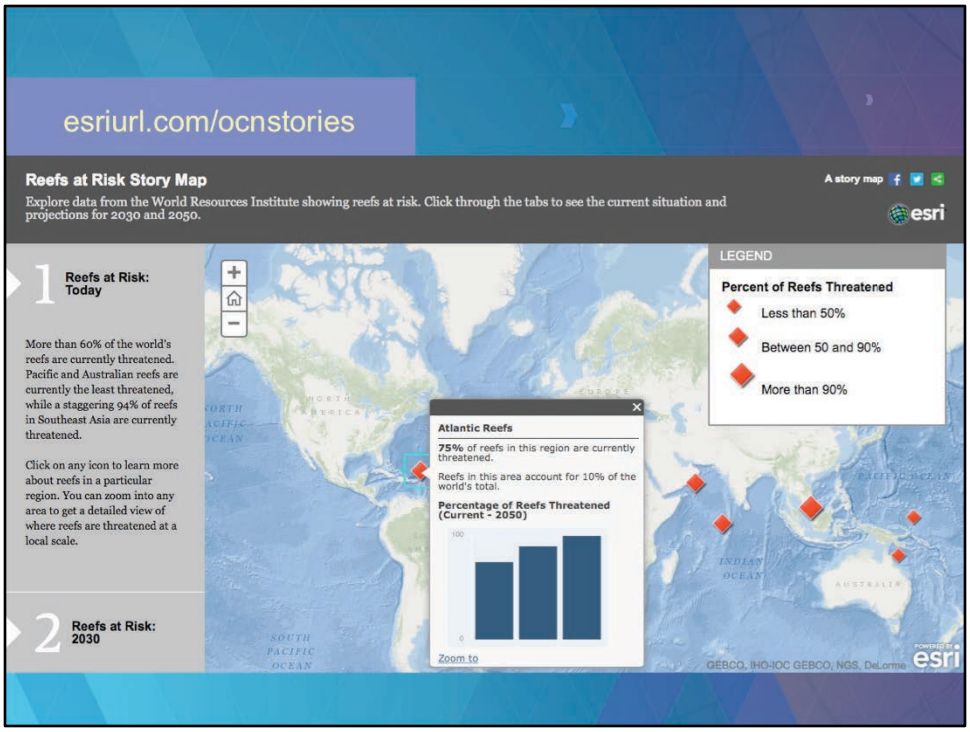
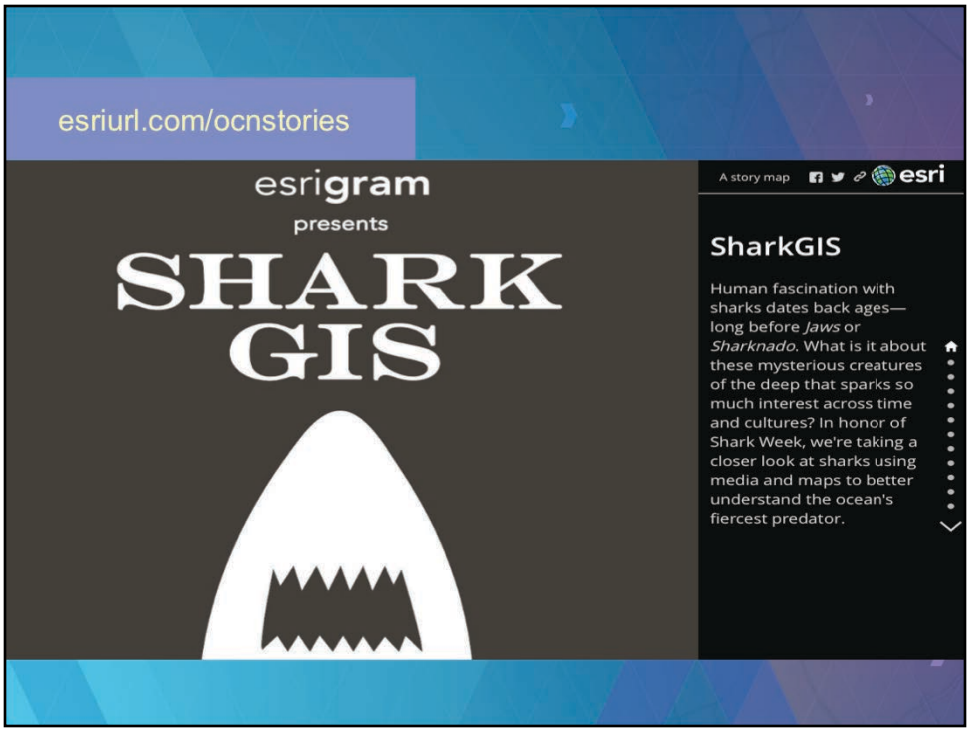


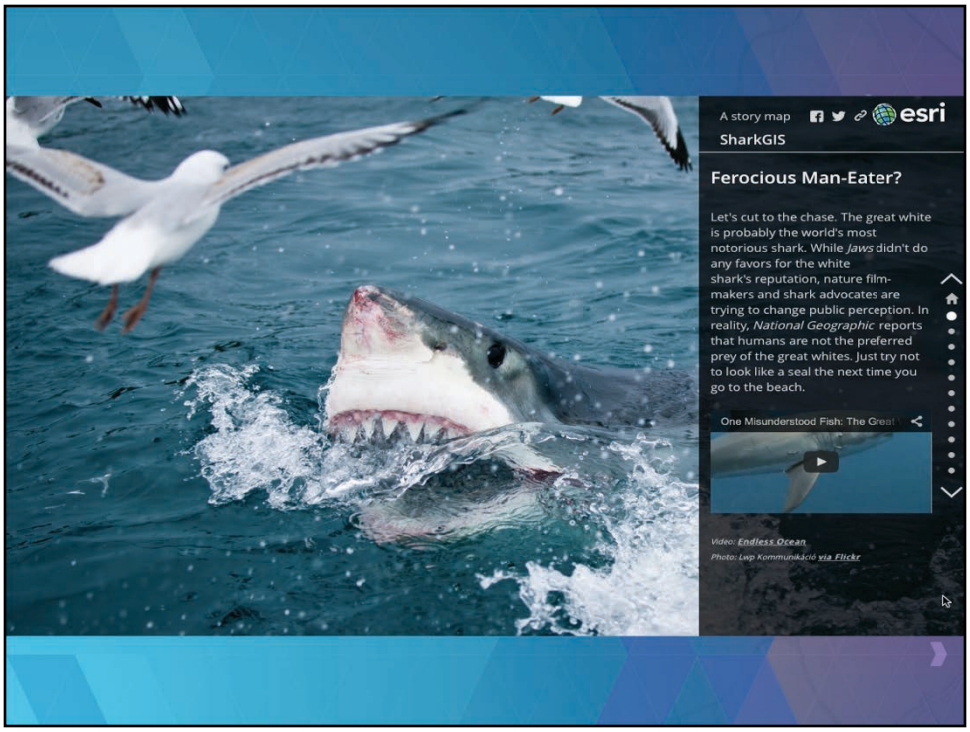
We did this story map in collaboration with World Resources Institute to show the results of GIS vulnerability analyses at varying scales

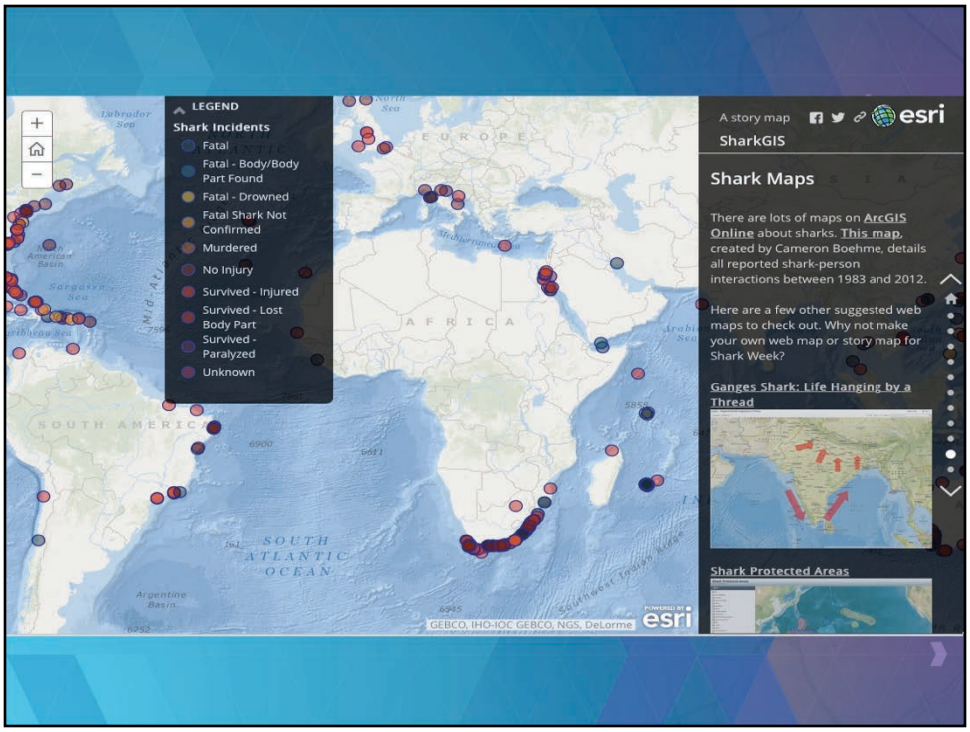
Focus on a societal issue – this is an atlas of the Anthropocene

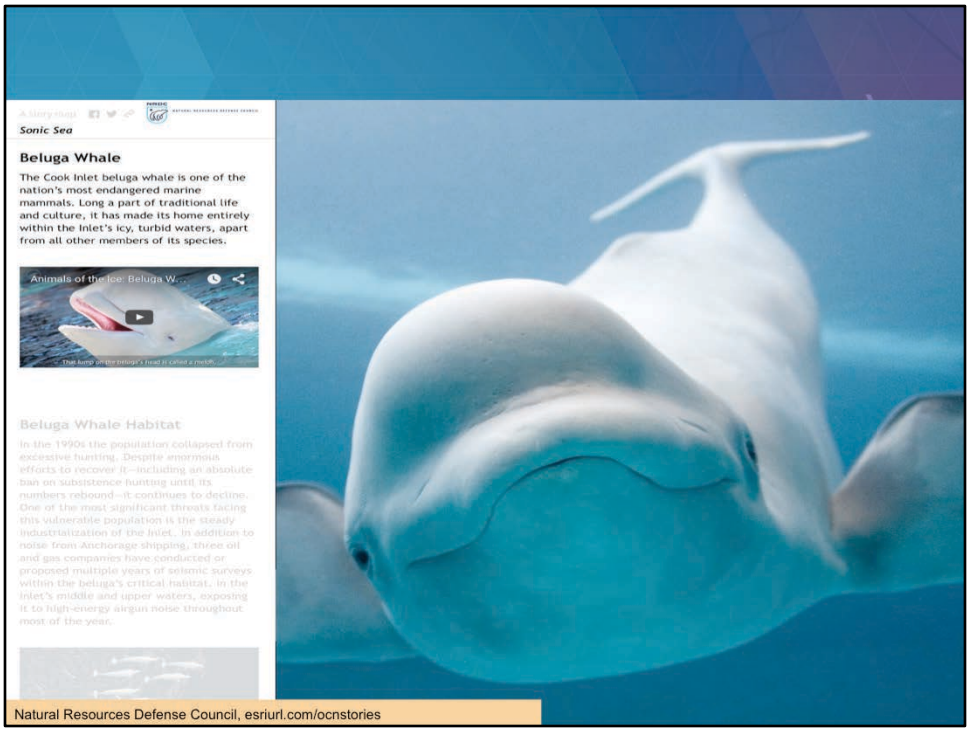
Focus on a societal issue. This Atlas for a Changing Planet was prepared expressly for COP21 in Paris and shows a broad range of climate change data to help scientists communicate with policymakers, planners and activists.



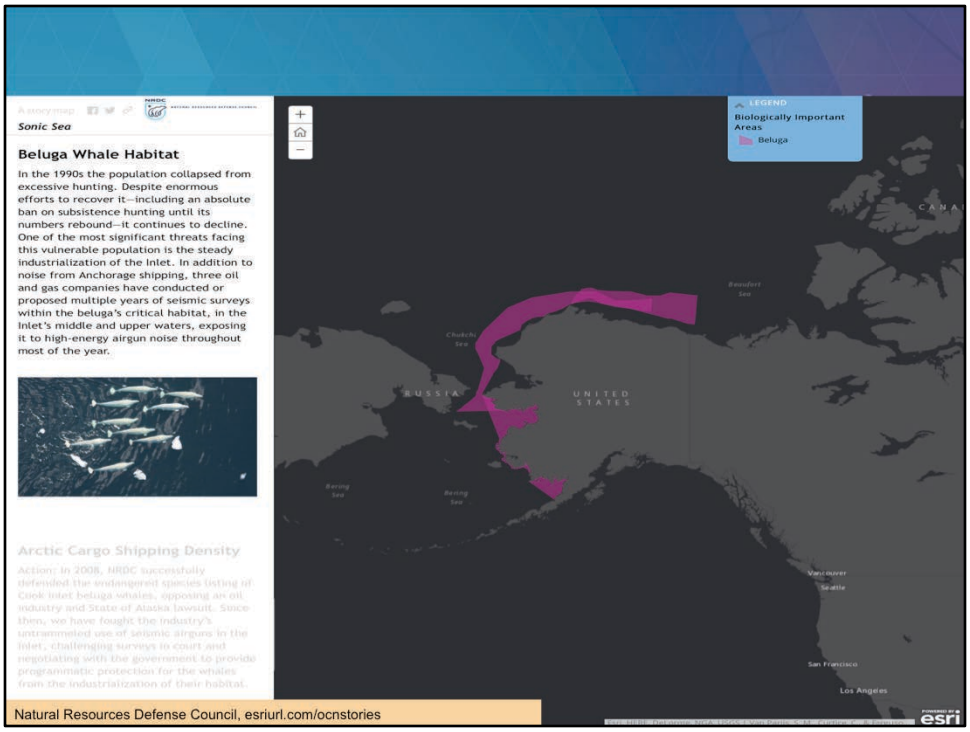
Focus on a conservation issue, prepared expressly for Shark Week


A story map
esri
SharkGIS
Ferocious Man-Eater?
Let's cut to the chase. The great white is probably the world's most notorious shark. While *Jaws* didn't do any favors for the white shark's reputation, nature film-makers and shark advocates are trying to change public perception. In reality, *National Geographic* reports that humans are not the preferred prey of the great whites. Just try not to look like a seal the next time you go to the beach.
One Misunderstood Fish: The Great
Video: Endless Ocean
Photo: Lwp Kommunikáció via Flickr

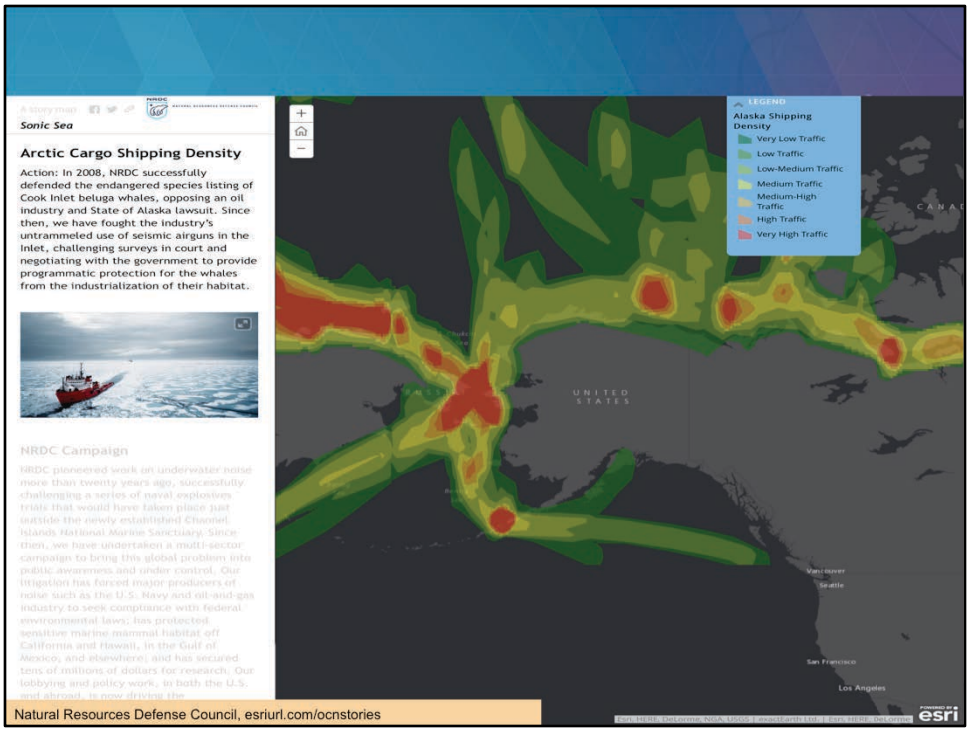

LEGEND
Shark Incidents
Fatal
Fatal - Body/Body Part Found
Fatal - Drowned
Fatal Shark Not Confirmed
Murdered
No Injury
Survived - Injured
Survived - Lost Body Part
Survived - Paralyzed
Unknown
EUROPE
AFRICA
SOUTH AMERICA
SOUTH ATLANTIC OCEAN
GEBCO, IHO-IOC GEBCO, NGS, DeLorme
esri
A story map
esri
SharkGIS
Shark Maps
There are lots of maps on ArcGIS Online about sharks. This map, created by Cameron Boehme, details all reported shark-person interactions between 1983 and 2012.
Here are a few other suggested web maps to check out. Why not make your own web map or story map for Shark Week?
Ganges Shark: Life Hanging by a Thread
Shark Protected Areas



More conservation – Natural Resources Defense Council prepared this story map



Natural Resources Defense Council, esriurl.com/ocnstories

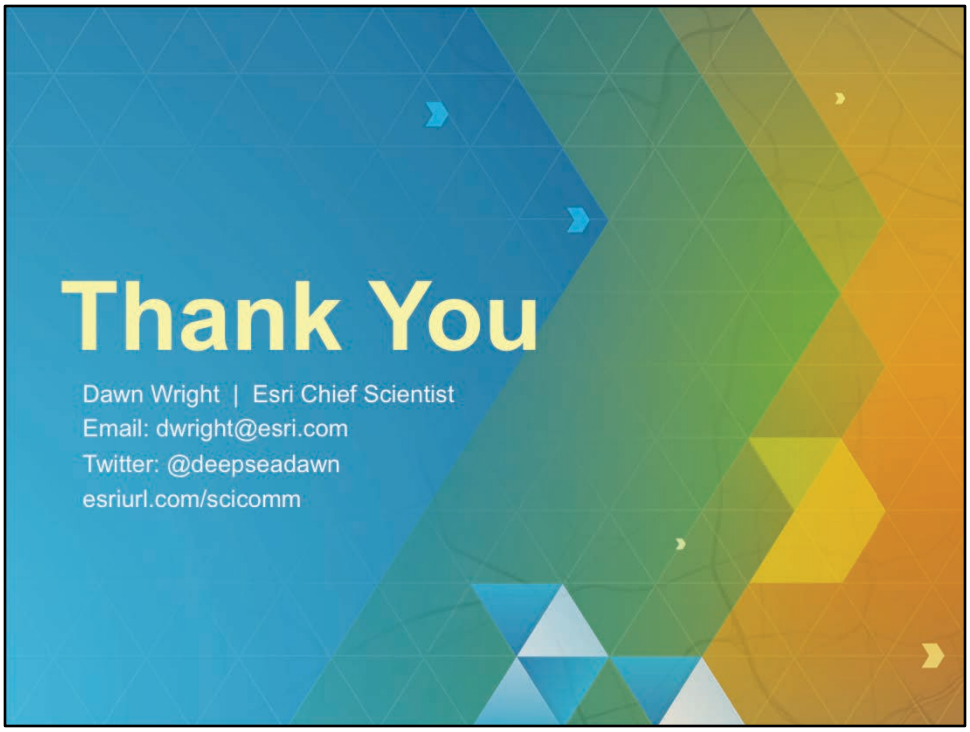


Natural Resources Defense Council, esriurl.com/ocnstories


(8) Promote a Culture of Sharing, Engagement, Collaboration
Enable People to Work Together by Securely Sharing Data, Apps, and Knowledge
Naveen
IT
ACCESS
FUNCTIONALITY
Meghan
Lead
Scientist
ACCESS
FUNCTIONALITY
Manny
Student
Programs
ACCESS
FUNCTIONALITY
David
Field Ops
ACCESS
FUNCTIONALITY
Kristin
Resource
Manager
ACCESS
FUNCTIONALITY

RETURNING to Chris Lynnes' original Leptoukh lecture in which he emphasized the bridging of informatics and EARTH SCIENCE ….

Preprints of a forthcoming peer-reviewed article in Elementa are available for those interested.


Thank You
Dawn Wright | Esri Chief Scientist
Email: dwright@esri.com
Twitter: @deepseadawn
esriurl.com/scicomm