

# The Arctic Seen from Space: Enhancing STEM Education with Interactive Learning

Christine F. Waigl,  
Anupma Prakash, Rüdiger Gens  
University of Alaska Fairbanks





# What is this talk about?

1. Thoughts on quantitative literacy
2. Earth observation for STEM education in the circumpolar north
3. Engaging resources for teaching QL:
  - Image library from remote sensing
  - Web-based interactive content
4. Concluding remarks on using the resources



# Part 1 Quantitative Literacy



# Part 1 Quantitative literacy

M. Gail Jones (NC State U, 2013):

*"A quarter and a blood cell are the same size because I don't know the size of a blood cell but I have seen pictures in my book of cells and they were a little bit bigger than a quarter."*

(Middle school student)



# Part 1 Quantitative literacy

From L. A. Steen, ed. (2001):

*Unlike mathematics, numeracy does not so much lead upward in an ascending pursuit of abstraction as it moves outward toward an ever richer engagement with life's diverse contexts and situations [...] Even individuals who have studied trigonometry and calculus often remain largely ignorant of common abuses of data and all too often find themselves unable to comprehend (much less to articulate) the nuances of quantitative inferences.*



# Part 1 Quantitative literacy

Christopher Wolfe (Miami U, OH, 1993):

- Learning from data
- Quantitative expression
- Evidence and assertions
- Quantitative intuition



## Part 2 STEM Education for the North

Image credit: CW, Martin Stuefer



Part 2 STEM education in the North

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The everyday life of today's students of the circumpolar North...

- Vast spaces with little infrastructure
- Conservation and development
- Energy of the future in an extreme environment
- Rapid climate change



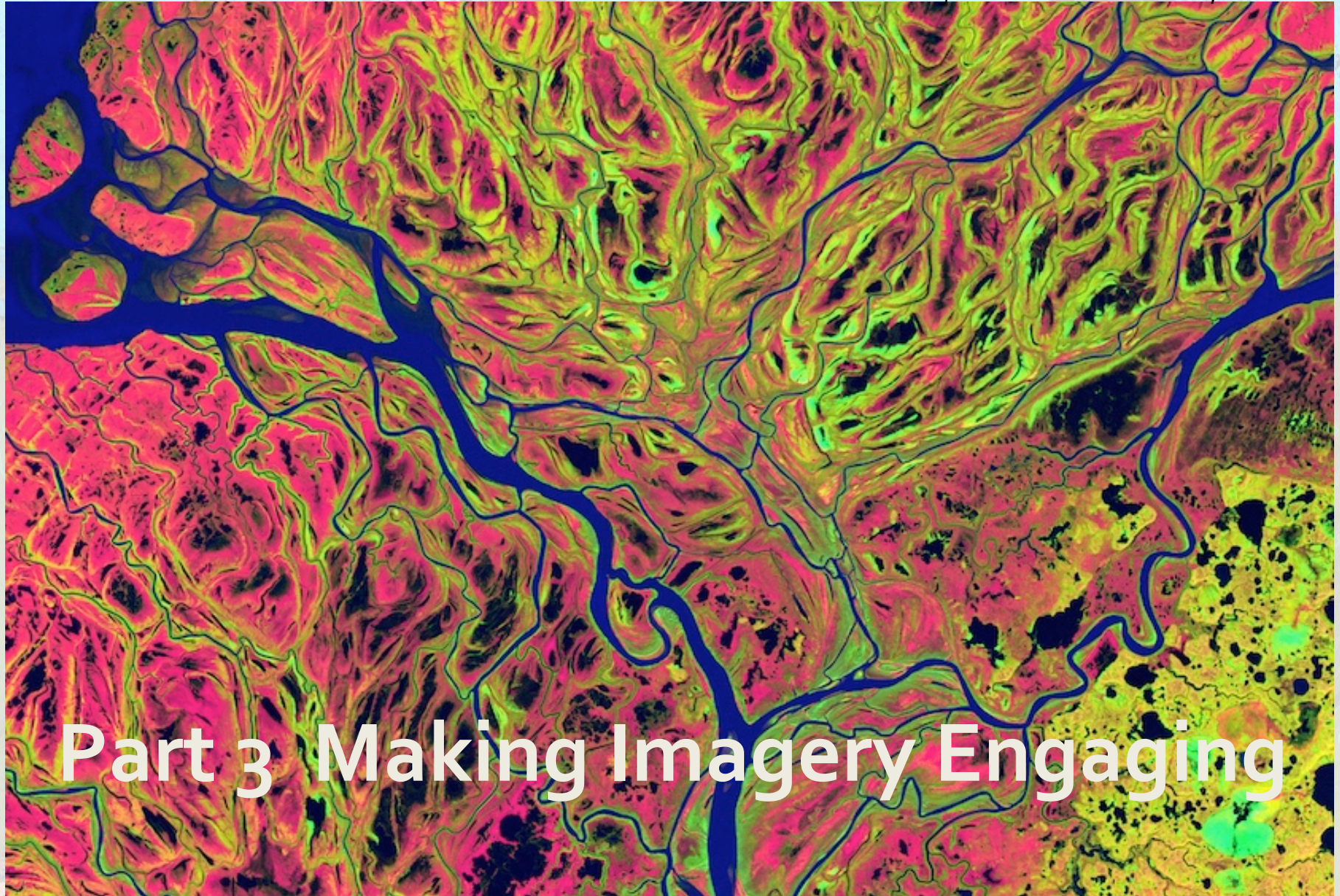


## Part 2 STEM education in the North

... is filled with challenges that require quantitative literacy:

- Understand spatial scales
- Understand time scales
- Make sense of data: images, numbers, maps, forecasts, interpretations
- There is the need to *engage* everyone, both math geeks and not





## Part 3 Making Imagery Engaging





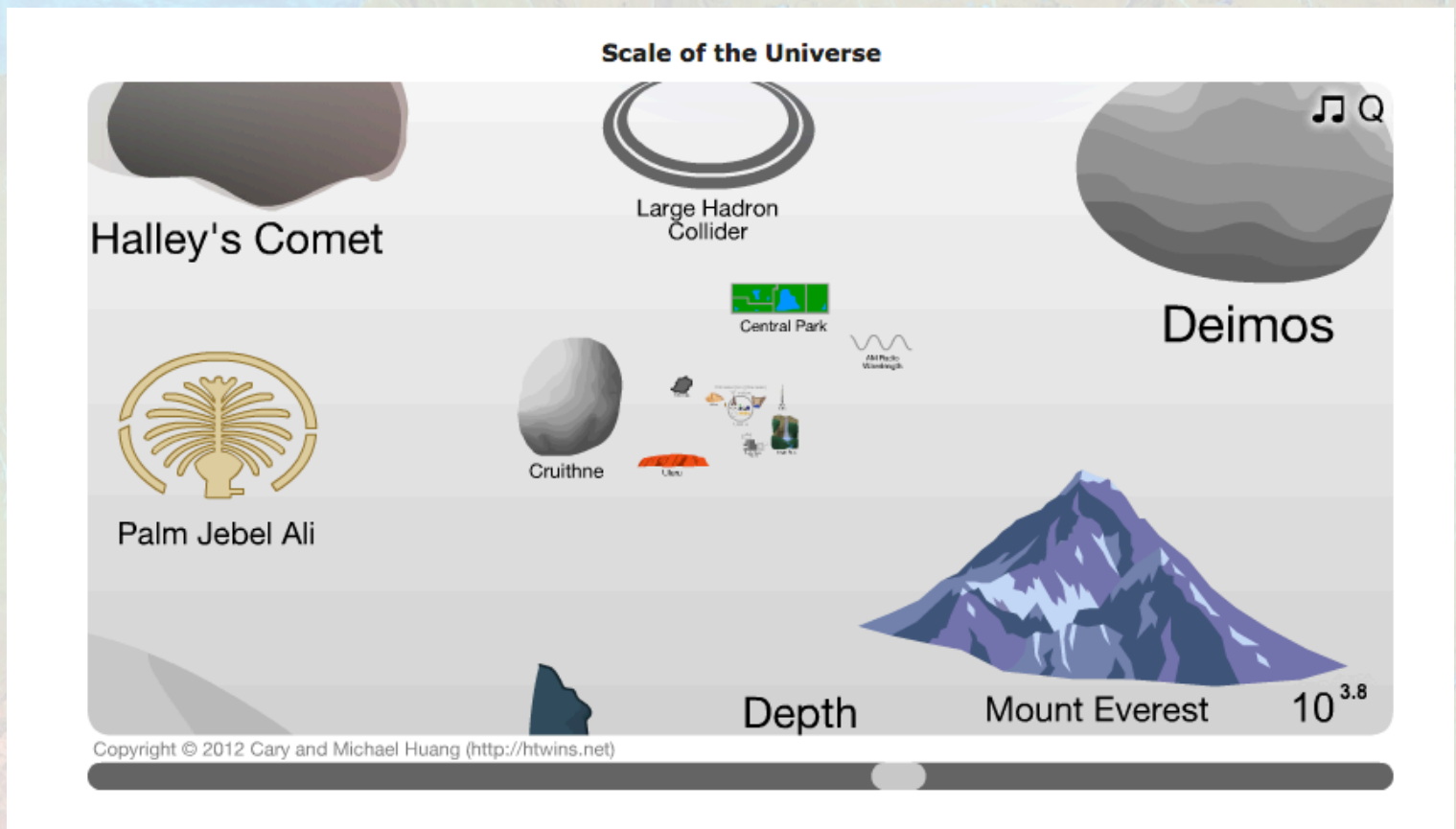
## Part 3 Making imagery engaging

- Engaging because it represents our environment
- Engaging because we can manipulate it
- Educational because it involves abstraction, interpretation, spatial relations
- Concepts: spatial scale, temporal scale (time series, image pairs), shape, texture, perspective



# Part 3 Making imagery engaging

Manipulation of scale: [Scale of the Universe](#)







## Part 3 Making imagery engaging

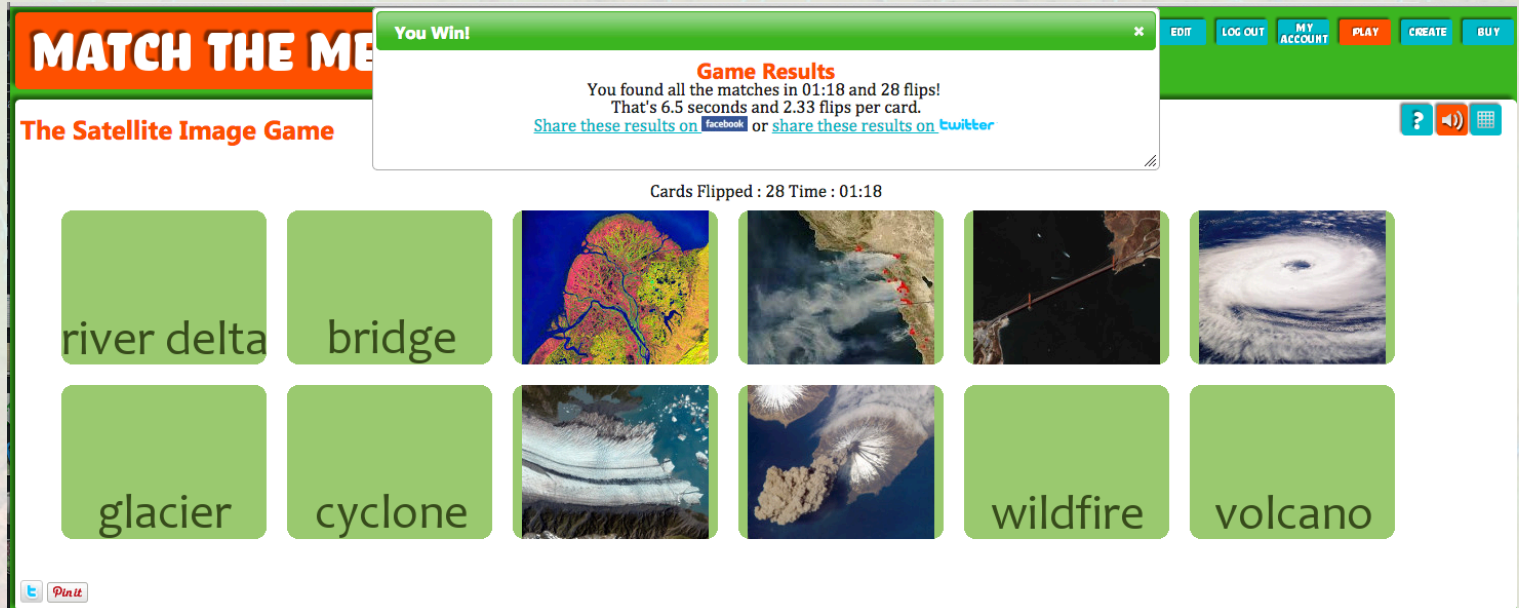
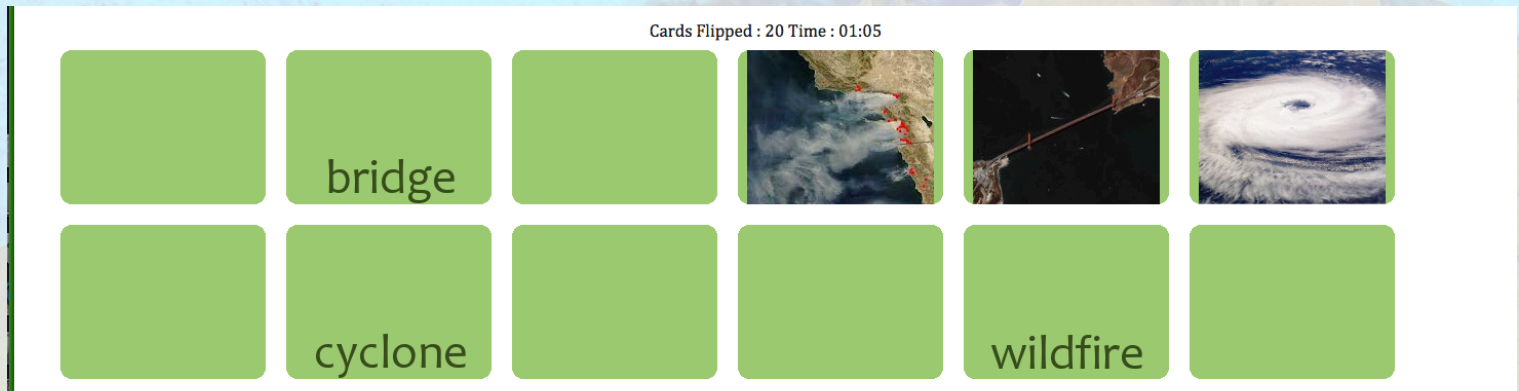
Simple matching game: [Match the Memory](#)

- image → text label
- image → related image
- zoomed out image → zoomed in image
- satellite image → photograph
- ...

Only the imagination is the limit (nearly).



# Part 3 Making imagery engaging





# Part 3 Making imagery engaging

Time series  
slider  
manipulation:  
[Wildfire](#)

Stuart Creek 2 before and after

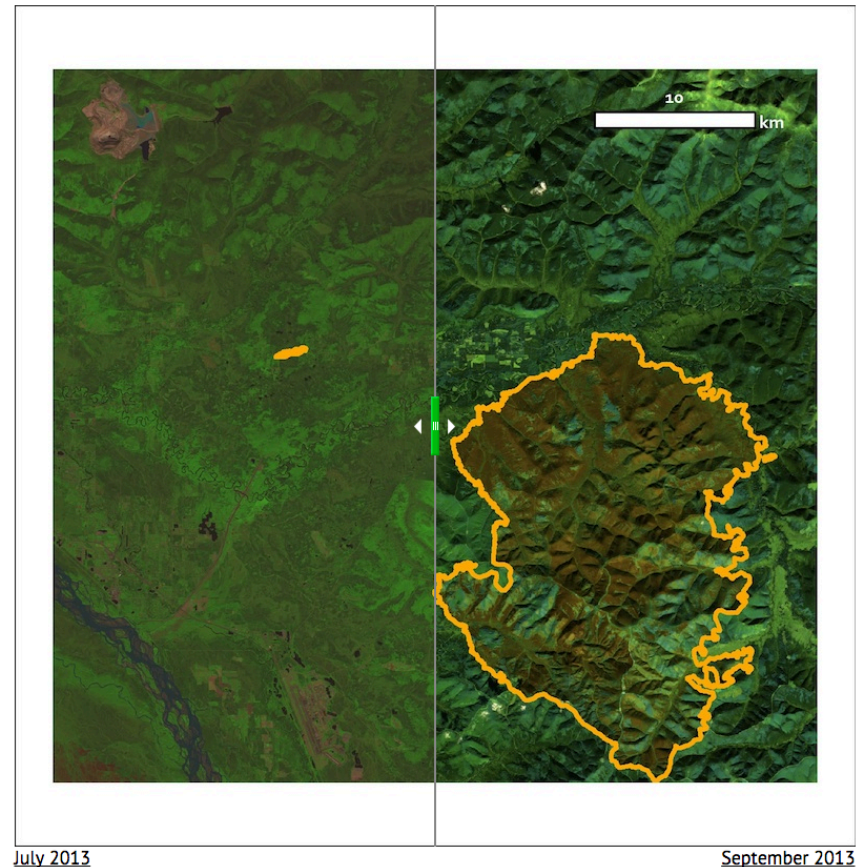


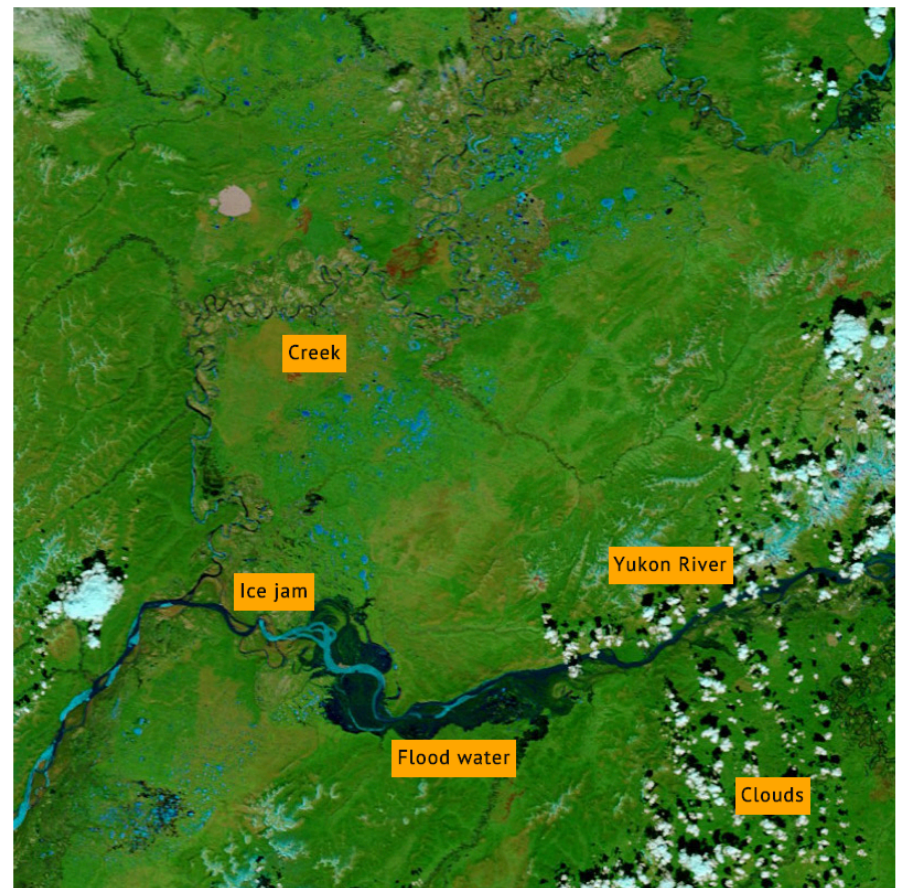
Image source:  
Landsat 8  
Processed by:  
Chris Waigl



# Part 3 Making imagery engaging

Draggable  
labels:

[2013 Galena  
flood](#)





# Part 3 Making imagery engaging

Time series  
slider:

[Muir Glacier  
retreat](#)

Muir Glacier retreat





# Part 3 Making imagery engaging

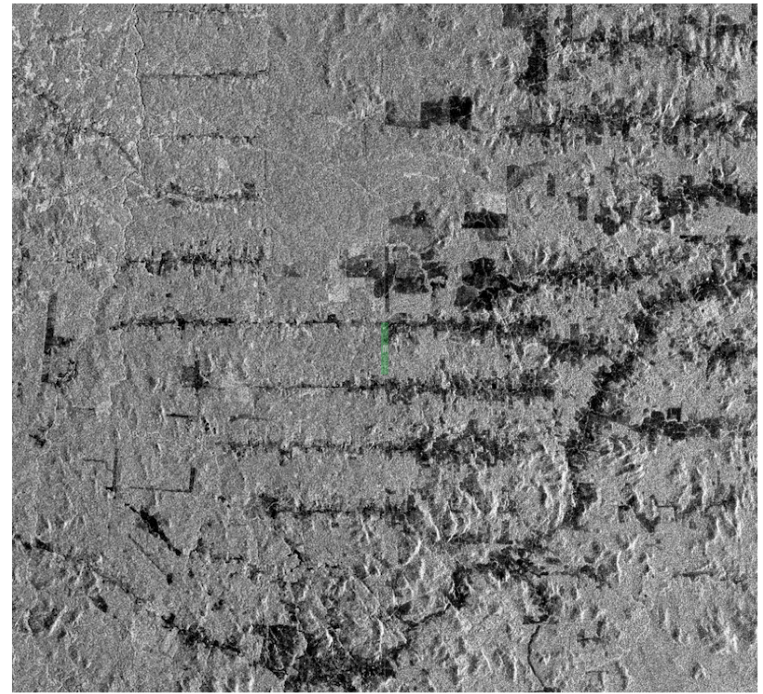
Time series

slider:

[Amazon](#)  
[deforestation](#)

with synthetic  
aperture radar  
(SAR)

Deforestation of the Amazon





# Part 3 Making imagery engaging

Time series  
slider:  
[Earthquake  
devastation](#) in  
Columbia

Armenia, Columbia, before and after



before quake

after quake

Image credit:  
ITC, Netherlands





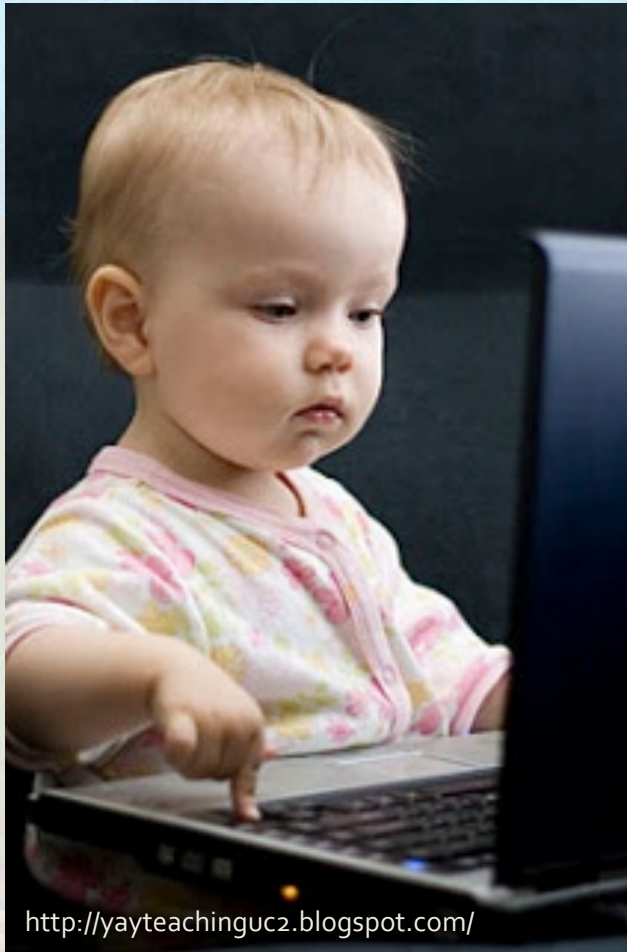


# Part 4 Using the resources

- Elements for educators and instructors to integrate into their practice
- Link with curriculum would require collaboration
- Right now: can be downloaded and used
- Easiest use would be at science fests, camps, enrichment activities



# Quantitative literacy for everyone



... and you may enjoy it as much as the youngsters.



# Web links

NASA Earth as Art: <http://eros.usgs.gov/imagegallery/>  
(image download),  
[http://www.nasa.gov/connect/ebooks/earth\\_art\\_detail.html](http://www.nasa.gov/connect/ebooks/earth_art_detail.html)  
(eBook)

Scale of the Universe: <http://htwins.net/scale2/>

Match the Memory games:  
<http://matchthememory.com/satellitespy1> etc.

Interactive resources for this talk:  
<http://www2.gi.alaska.edu/~cwaigl/pages/stemimages.html>



# References

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- Wolfe, C. R. (1993). Quantitative Reasoning across a College Curriculum. *College Teaching*, 41(1), 3–9.





# EXTRA SLIDES



# Who am I?

- Physicist by training
- Taught 2 years in the French school system
- 10 years in the software industry
- Came to Alaska, fell in love with the North
- PhD student (remote sensing of active wildfires)

As professionals or scientists, it's our duty to consider how to make our insights and tools useful to the younger generations.





Graciela Chichilnisky (Columbia U):

*"All of the very dynamic sunrise sectors [of the world's economies] are merging between themselves and altering themselves through the use of mathematical tools. ... Mathematics works for today's society like the fossil fuels worked for the industrial society. Today, to get energy, we don't burn fossil fuels. Now, to get knowledge, we use mathematics."*

(Quoted in Keith Devlin's talk Mathematics: Making the invisible visible, Stanford 2012 [[YouTube](#)])