Initial progress toward ecosystem accounts in the United States

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EY

USGS
science for a changing world

Acknowledgements

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NCA in the U.S.: USGS-SESYNC working group

- **Goal:** By 2019, we will have demonstrated that NCA in the US is feasible and we will illustrate how to achieve that
- **Objectives:**
  - Develop a methodological and institutional strategy for NCA in the US
  - Develop the “proof of concept” for NCA in the US
  - Raise awareness of NCA among key private and public stakeholders

tinyurl.com/us-nca

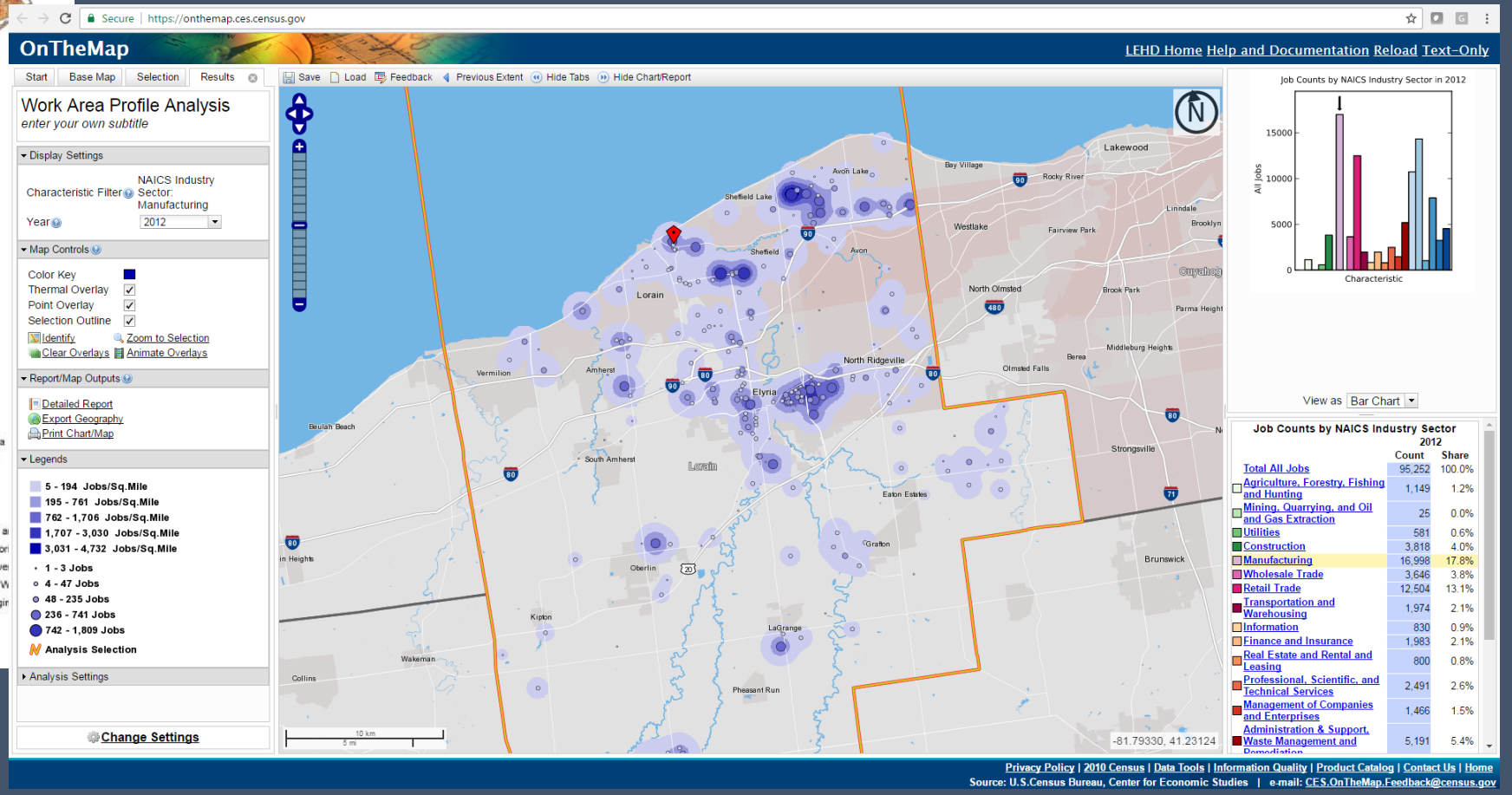
Multi-year workplan

- **2016-2017:**
  - Introductory journal article on NCA in the U.S.
  - First iteration U.S. & subnational land account
  - First iteration U.S. & subnational water account
  - Solicit critical feedback on land & water accounts
- **2017-2019:**
  - Second iteration U.S. & subnational land & water accounts
  - Pilot test national-scale ecosystem accounts for selected ecosystem services
  - Conduct public & private-sector outreach

Land use: putting beneficiaries on the map for land & ecosystem accounts

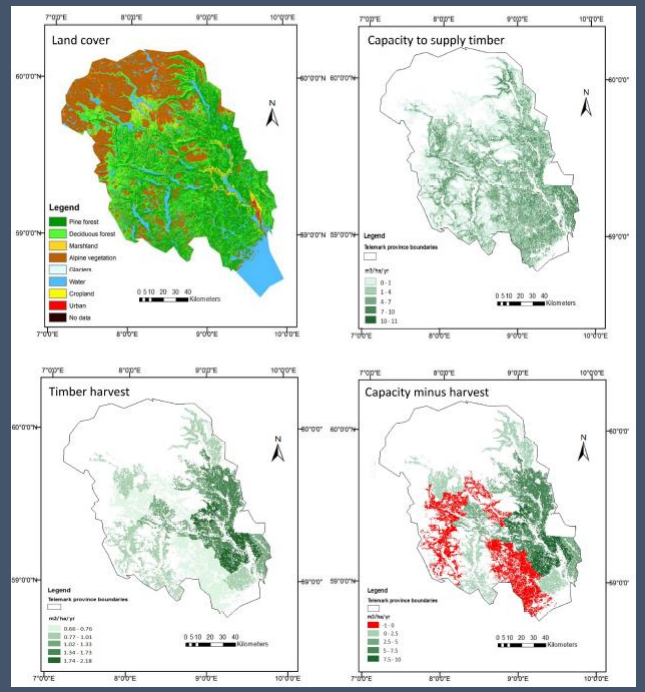
Theobald 2014

Census OnTheMap: Locates jobs by NAICS code



Mapping beneficiaries & ES flows in accounting

- Key concepts defined by Hein et al. (2016)
- Approaches tested for the Pacific Northwest USA (Bagstad et al. 2014); Norway (Schroter et al. 2014)



PLOS ONE

RESEARCH ARTICLE

Defining Ecosystem Assets for Natural Capital Accounting

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OPEN ACCESS

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Abstract

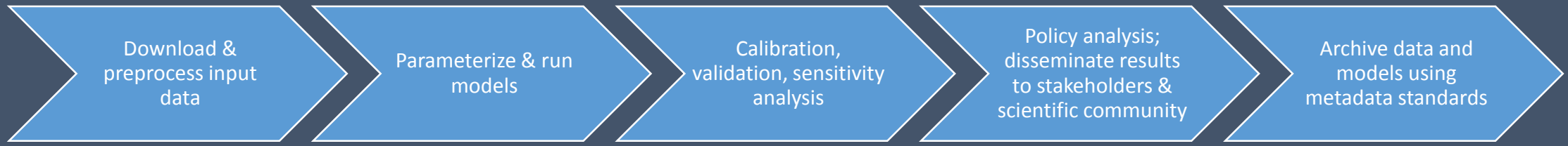
In natural capital accounting, ecosystems are assets that provide ecosystem services to people. Assets can be measured using both physical and monetary units. In the international System of Environmental-Economic Accounting, ecosystem assets are generally val-

Next working group meetings (May & late 2017)

- Which ecosystem services & geographies will we analyze?
  - Start smaller (state or large watershed), work up to national scale
  - 2001-2006-2011, with 2016 added late next year
- Which datasets and models can most credibly quantify ecosystem services in a large, heterogeneous country?
- How can we speed the process in ways that will make the job easier for us and others in the future (i.e., cloud/supercomputing, context-aware modeling, GIS tools)?
  - *3 C's: Collaborative, cloud-based, context-aware*

Speeding the process: Standard data & modeling flow

- First time running an environmental modelers:



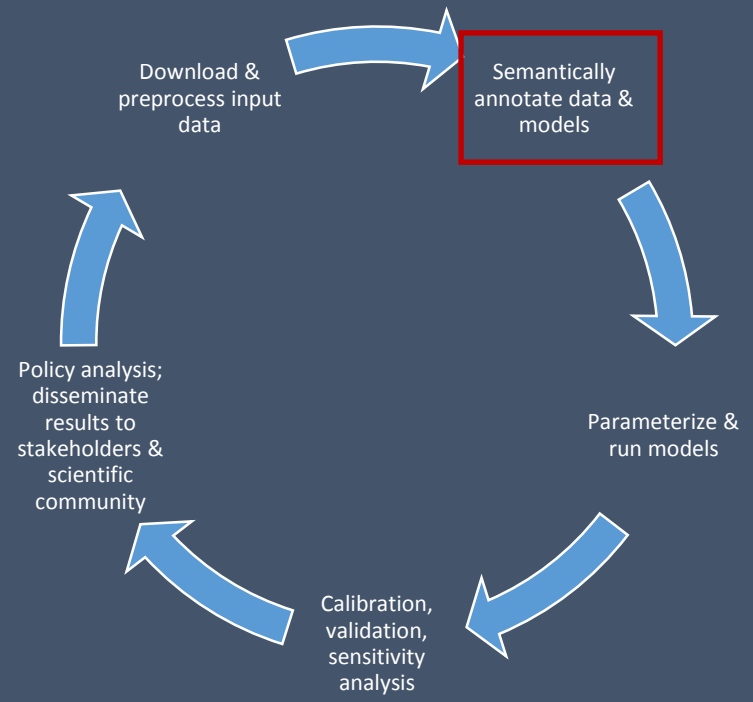
- Second, third, fourth time:

Same thing!

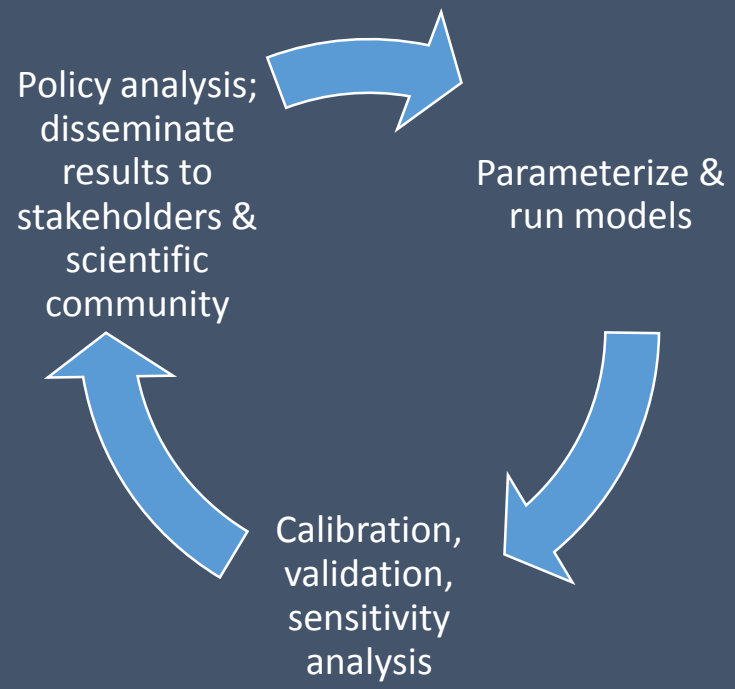
At the end of the project, budgets are tight, and people want to get the paper/report out without worrying about proper archiving

Speeding the process: Semantic data & modeling flow in ARIES

- First time modelers:



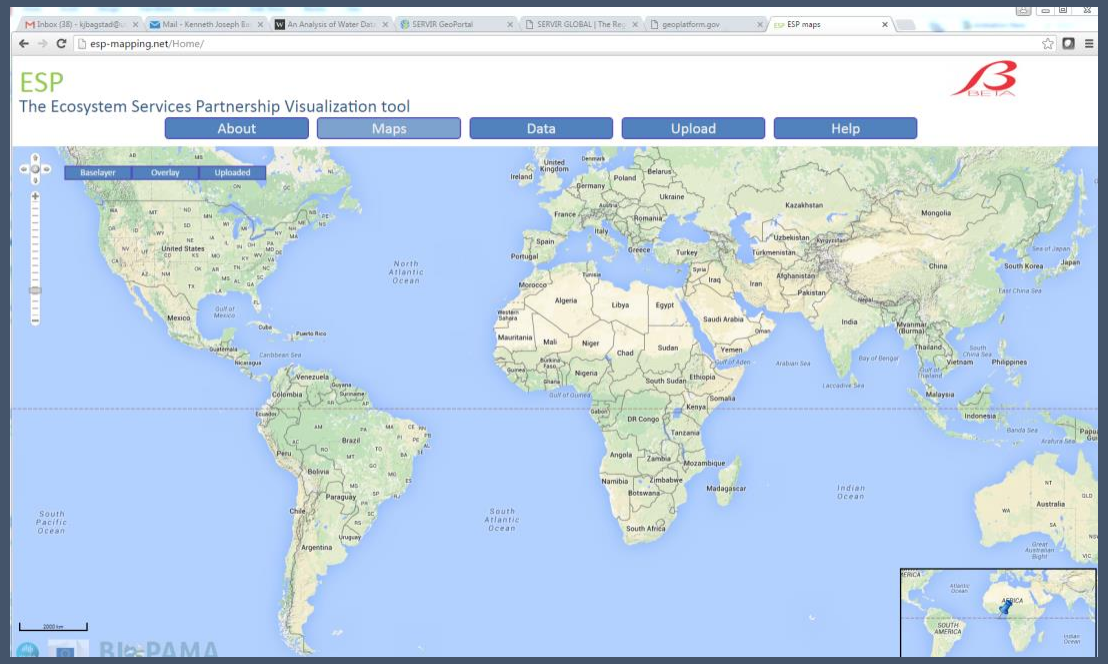
Second, third, fourth time modelers:



- Archival work is *up front*, after that it's usable by anyone

Collaboration: how well do we currently share data?

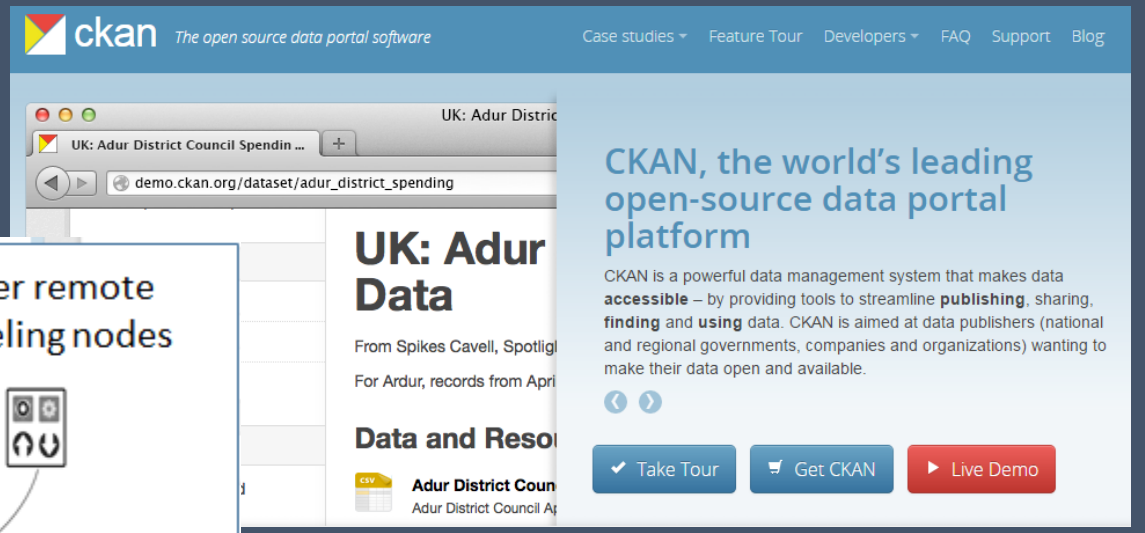
- ESP Visualization Tool (Drakou et al. 2015) has been online since January 2015, and currently hosts 29 ecosystem service maps derived from 9 studies
  - What are our data sharing & documentation incentives (new open data initiatives?)
  - Why not use Open Geospatial Consortium (OGC) standards & make it machine readable?

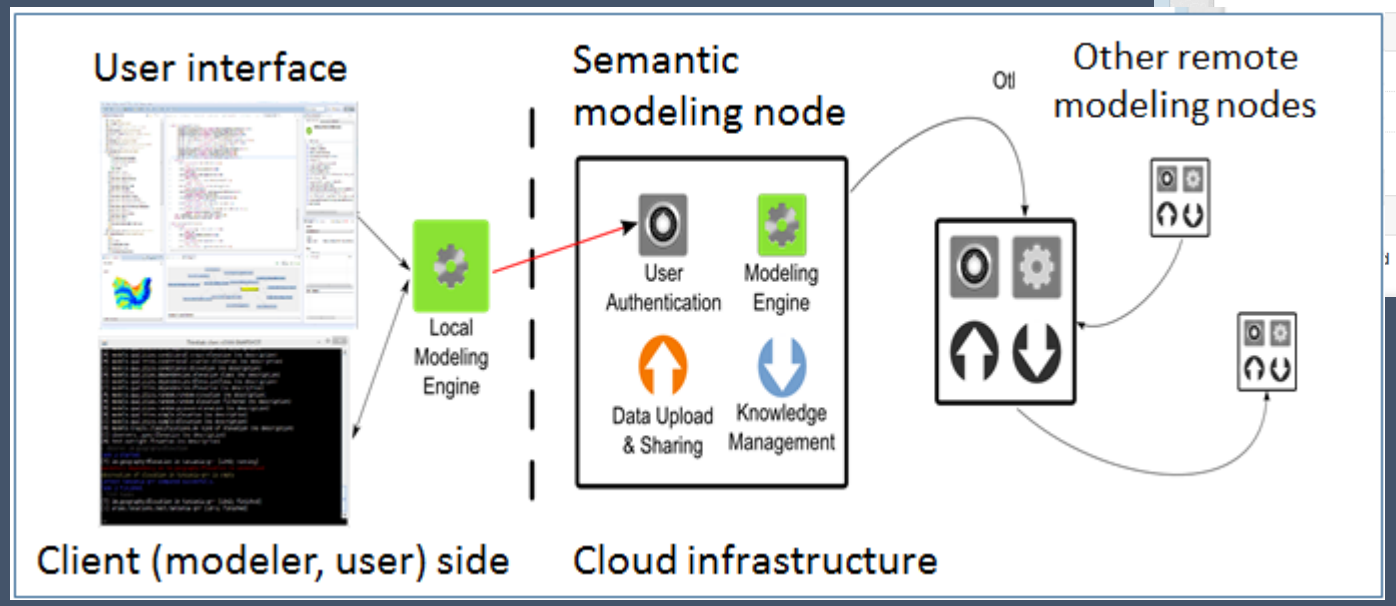


www.esp-mapping.net

Collaboration facilitated with *cloud-based* data and models

- Machine-readable datasets, served by using OGC standards (e.g., Web Coverage Service (WCS)/Web Feature Service (WFS), JSON)
- Data export protocols (e.g., CKAN)





GeoServer

Heterogeneous environments necessitate *context awareness*: automates data & model assembly using best available knowledge

Set context: Runoff, Big Island, Hawaii

Query available models

Found 2 models: Wet & dry tropics appropriate

IF annual precipitation < 2,500 mm RUN MODEL A, OTHERWISE RUN MODEL B

Find & query annual precipitation layer

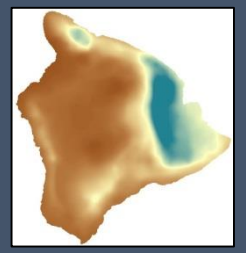
Identify data needs to run each model (DEM, precipitation, soils, vegetation, etc.)

Identified 3 digital elevation models (DEMs)

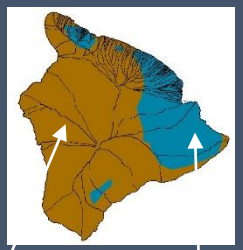
Select appropriate datasets to populate models; run models

Integrated modeling results & provide provenance diagram

Raw precipitation data



Reclassified precipitation data



Run Model A

Run Model B

DEM 1: Global DEM, 90 m resolution, reliability score = 70

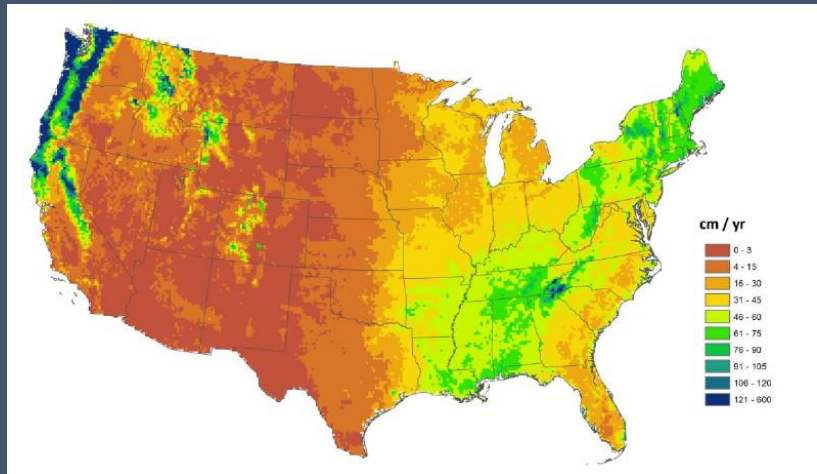
DEM 2: State DEM, 10 m resolution, reliability score = 85

DEM 3: Study area DEM, 5 m resolution, reliability score = 90

Data integration

Existing environmental & ecosystem service models

- LandCarbon
- SPARROW (nutrient models)
- Various water models (e.g., Brown et al. 2016)
- National pollination assessment (Koh et al. 2016)
- National coastal flood models (e.g., Narayan et al. 2016)
- Past InVEST, ARIES, or other ES model applications (need to be context-aware)
- Models already in or being ported into ARIES: distributed water model, LPJ-GUESS, InVEST models, some ESTIMAP models



Brown et al. 2016

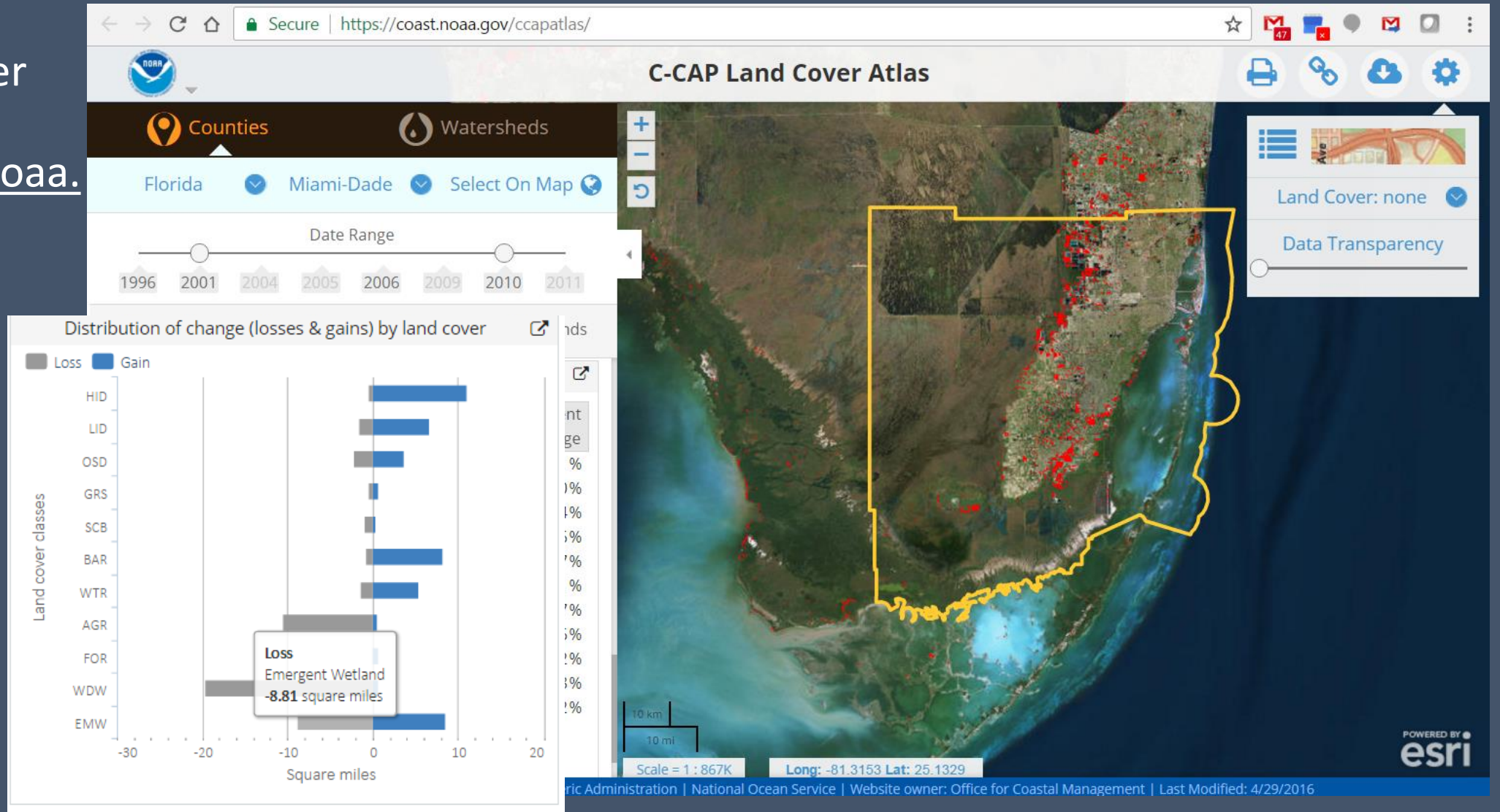
Key EO datasets

National Land Cover Dataset	Potential ecosystems (USGS)
National Land Use Dataset	Census TIGER & Homeland Security (infrastructure)
National Hydrography Dataset	Cropland Data Layer (USDA)
LANDFIRE (forests & forestry)	Census LEHD (employment by industry)
PRISM (climate)	Census (demographics)
GAP (ecosystems, biodiversity)	National Flood Hazard Dataset
National Elevation Dataset	GeoMAC (wildfire)

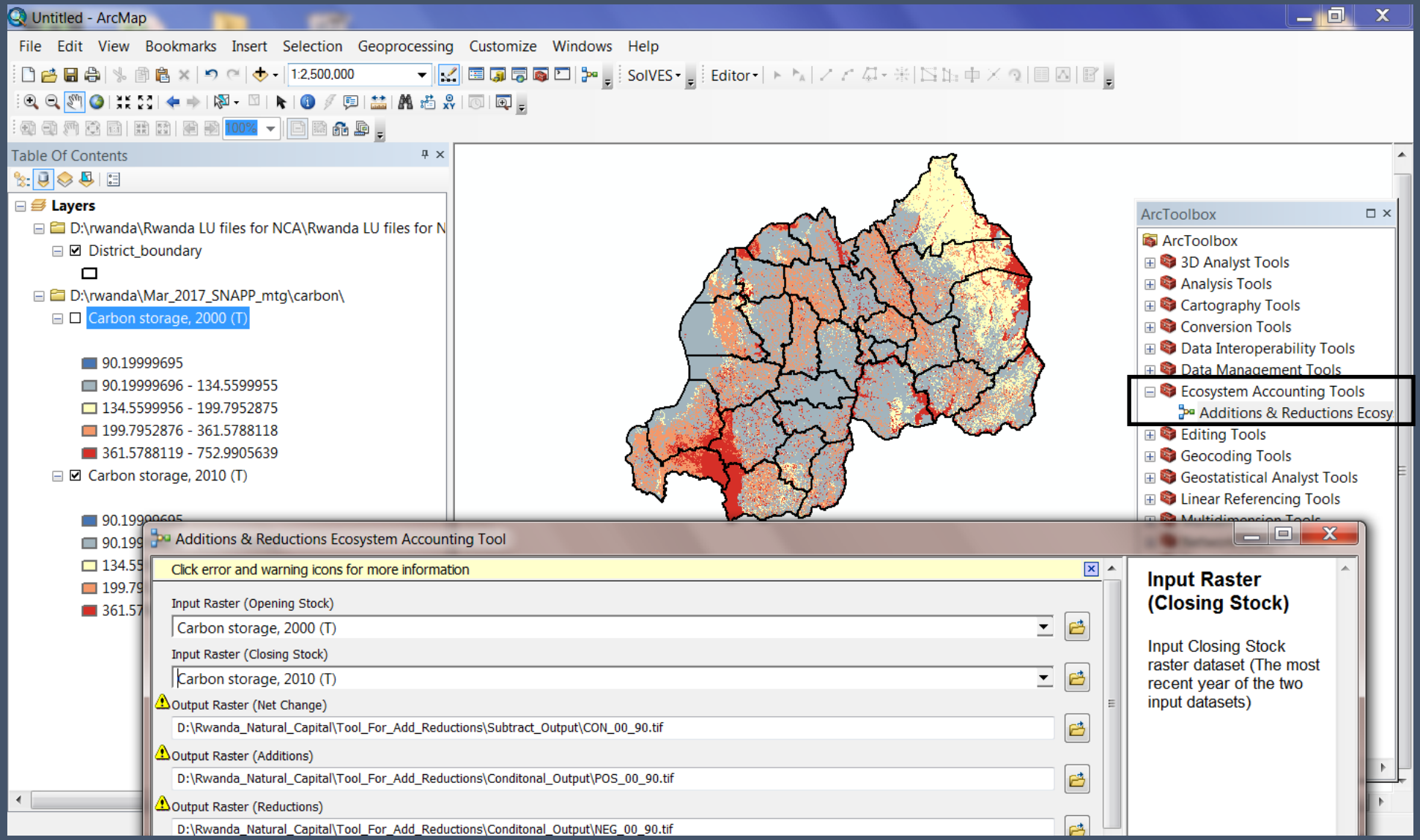
Most at 30 m spatial resolution, updated periodically (annually to decadally)
Hosted on GeoServer (OGC-compliant) for machine readability

Tools to speed ecosystem accounting

- CCAP Land Cover Atlas (https://coast.noaa.gov/ccapatlas/)



Tools to speed ecosystem accounting



Summary

- We need new tools and approaches to:
  1) Simulate ecosystem services accurately across large, heterogeneous contexts
  2) Leverage supercomputing/cloud computing power to work at high spatiotemporal resolution *and* large extent
  3) Build on each others' work, rather than start at square one (i.e., enable collaborative modeling and reuse of growing data archives, incl. EO, crowdsourced data) – semantics, machine readability
  4) Allow relatively quick and easy updating of ecosystem accounts in new years
- 3 C's: Coding data & models within a collaborative, cloud-based, context-aware approach like ARIES is a promising technique to meet these challenges