

# Adaptable Information Models in the Global Change Information System

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<http://data.globalchange.gov>  
<http://github.com/USGCRP/gcis>



# Outline

## 1. Introduction and Functionality

- About
- The Third National Climate Assessment
- Identifiers
- Lexicons
- RESTful API
- Semantic API

## 2. Information Model

- Relational
- Semantic

## 3. System Architecture

- Diagram
- Relational Model Changes
- Semantic Model Changes

## 4. Conclusion, Ongoing Work, Future Plans

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# About

<http://data.globalchange.gov>

# The Third National Climate Assessment

On May 6, 2014, the US Global Change Research Program released the Third National Climate Assessment (NCA3).

- PDF(s) (<http://data.globalchange.gov/report/nca3>)
- Website (<http://nca2014.globalchange.gov>)

# The Third National Climate Assessment

- 829 pages
- Over 300 [authors](#), numerous editors, analysts, graphics producers, scientists, data scientists, software developers, and web teams
- 161 [findings](#), 284 [figures](#), 3,395 bibliographic [references](#) (journal articles, books, reports)

# Identifiers

- /article/10.1080/15287390801997625
- /report/usfs-pnw-gtr-855
- /reference/007a7014-723e-4ceb-a395-5c986b1bf884
- /image/26fc56f4-b4e0-425b-adc8-14c6d961d558
- /organization/nasa
- /person/0000-0001-6667-7047
- /dataset/nca3-cddv2-r1
- /platform/aqua
- /instrument/modis
- /model/ccsm3

# Lexicons

Associations between GCIS identifiers and external terms.

- GCIS identifier : /podaac/aqua
- PODAAC identifier : AQUA
- CEOS identifier : 206



# RESTful API

The screenshot shows a web browser displaying a page from `nca2014.globalchange.gov`. The page features a figure titled "Global Temperature and Carbon Dioxide" with a caption explaining the data. Below the figure is a "Download" button. The browser's developer tools are open, showing the Network tab with a list of requests. An orange line traces the path from the browser's address bar, through the figure's metadata, and down to the Network tab, highlighting the data retrieval process.

Observed Change I

nca2014.globalchange.gov

Figure: Global Temperature and Carbon Dioxide

Caption: Global annual average temperature (as measured over both land and oceans) increased by more than 1.5°F (0.8°C) since 1880 (through 2012). Red bars show temperatures above the long-term average, and blue bars indicate temperatures below the long-term average. The black line shows atmospheric carbon dioxide (CO<sub>2</sub>) concentration in parts per million (ppm). While there is a clear long-term global warming trend, some years do not show a temperature increase relative to the previous year, and some years show greater changes than others. These year-to-year fluctuations in temperature are due to natural processes, such as the effects of El Niño, La Niñas, and volcanic eruptions. (Figure source: updated from Karl et al. 2009<sup>1</sup>).

Download (116 KB)

Figure Images

Keywords

Source Kenneth Kunkel, Cooperative Institute for Climate and Satellites - NC

Date Created 06 Nov 2013

Method	File	Domain	Type	Size	0 ms	18.24 s
384 GET	e251f59b-177e-4ba6-nca2014-globalchang...	nca2014.globalchang...	html	8.84 KB		
384 GET	.thumb-a835888b...	data.globalchang...	png	46.33 KB		
200 GET	26fc56f4-b4e8-45b...	data.globalchang...	json	3.63 KB		
200 GET	nca3-ncdc-gst-and...	data.globalchang...	json	2.13 KB		
200 GET	nca3-epi-co2-r2013...	data.globalchang...	json	1.92 KB		
200 GET	26fc56f4-b4e8-425b...	data.globalchang...	json	3.63 KB		
384 GET	cs_global_temp...	data.globalchang...	png	154.52 KB		
384 GET	bg-div_top.png	nca2014.globalch...	png	6.90 KB		

81 requests, 2,245.10 KB, 21.27

nca2014.globalchange.gov

data.globalchange.gov

# Semantic API



platform  
↑  
instrument  
↑  
dataset  
↑  
dataset  
↑  
journal article  
↑  
figure

# Semantic API

```
PREFIX gcis: <http://data.globalchange.gov/gcis.owl#> .
```

```
PREFIX prov: <http://www.w3.org/ns/prov#> .
```

```
SELECT ?figure ?article ?dataset ?another_dataset  
      ?instrument ?platform
```

```
FROM <http://data.globalchange.gov>
```

```
WHERE {
```

```
    ?figure prov:isDerivedFrom ?article .
```

```
    ?article prov:isDerivedFrom ?dataset .
```

```
    ?dataset prov:isDerivedFrom ?another_dataset .
```

```
    ?another_dataset gcis:hasInstrument ?instrument .
```

```
    ?instrument gcis:hasPlatform ?platform .
```

```
    ?figure gcis:isFigureOf ?chapter .
```

```
    ?chapter gcis:ChapterNumber "2" .
```

```
    ?report gcis:hasChapter ?chapter .
```

```
    ?report dcterms:title "The Third National Climate Assessment"
```

```
}
```

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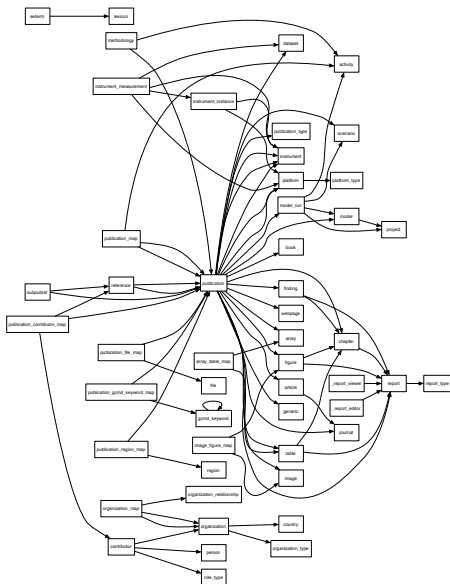
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# Relational

- Canonical representation
- One-many, many-one, many-many relationships
- Referential integrity
- Strict type checking
- Column constraints
- Cascading updates and deletes
- Well-known optimization techniques
- Wide-spread adoption
- Extendable (hstores in PostgreSQL)
- Closed world assumption

# Relational



# Semantic

- Relationships are first class objects
- Concepts are formally defined in an ontology
- Formal definitions help remove ambiguities
- Interoperability with other systems
- Open world assumption

# Semantic

<http://bit.ly/gcis-dbpedia>

```
PREFIX bibo: <http://purl.org/ontology/bibo/>
PREFIX gcis: <http://data.globalchange.gov/gcis.owl#>
PREFIX cito: <http://purl.org/spar/cito/>
PREFIX dcterms: <http://purl.org/dc/terms/>
PREFIX dbprop: <http://dbpedia.org/property/>
PREFIX dbpo: <http://dbpedia.org/ontology/>

SELECT DISTINCT ?dbpjournal ?gcisjournal ?issn
FROM <http://data.globalchange.gov>
WHERE {
  SERVICE <http://data.globalchange.gov/sparql> {
    ?gcisjournal a bibo:Journal .
    ?gcisjournal bibo:issn ?issn .
    ?gcisjournal dcterms:hasPart ?gcisarticle .
    ?gcisarticle a bibo:Article .
    ?gcisarticle dcterms:isPartOf ?gcisjournal .
    ?gcisarticle cito:isCitedBy <http://data.globalchange.gov/report/nca3> .
  }
  SERVICE <http://dbpedia.org/sparql> 1
  ?dbpjournal dbprop:frequency "Monthly" @en .
  ?dbpjournal dbpo:issn ?issnd .
}
FILTER(?issnd = ?issn)
}
```

Find monthly journals that have had an article cited by the NCA3 report.



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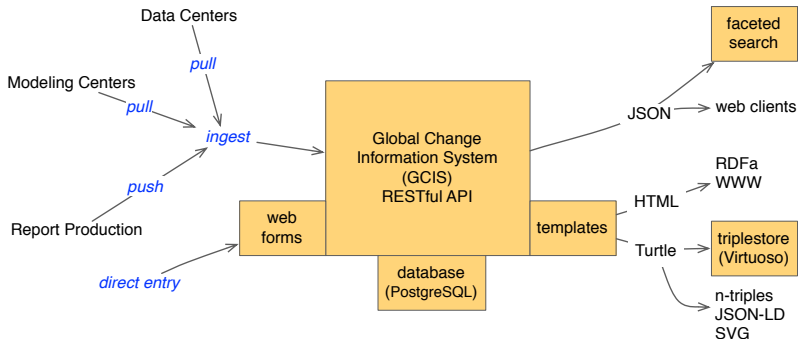
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# Diagram



# Relational Model Changes

Changes to the schema propagate to the JSON API. JSON key names match the column names, and nested JSON objects correspond to relationships.

1. Write a test for new REST functionality.
2. Run the tests. Do the tests pass?
3. Yes? Done.
4. No? Write a schema patch.
5. Goto step 2.

The tests remain part of the test suite, which is run continuously.

# Semantic Model Changes

Change to the triple are handled by turtle templates.

1. Write a test with a SPARQL query that should succeed.
2. Run the tests. Do they pass?
3. Yes? Done.
4. No? Modify the turtle templates.
5. Go to step 2.

The tests remain part of the test suite, which is run continuously.

# Semantic Model Changes

Sample turtle template :

```
@prefix gcis: <http://data.globalchange.gov/gcis.owl#> .  
@prefix dcterms: <http://purl.org/dc/terms/> .  
  
<<%= article->uri %>> a gcis:Article;  
<<%= article->uri %>> dcterms:isPartOf  
  <<%= article->journal->uri %>>;
```

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Current work involves extending the data model for models and model runs, *in situ* station data, spatial metadata (PostGIS), agency-wide publication systems, authors of journal articles, and connecting to disparate sources of information using lexicons, APIs and semantic queries.

# Thank You

<http://data.globalchange.gov/about> (mailing list)

<http://www.globalchange.gov>

<http://github.com/usgcrp/gcis>

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