COLLECTING THE DOTS | CONNECTING THE DOTS
Linked Sensor Data

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OUTLINE

- Application on Linked Sensor Data
- What is Linked Sensor Data
- Sensor Datasets Generated
- Data Generation Workflow
- Future Work
- Conclusion
What is Linked Sensor Data

- Weather Sensors
- Satellite Sensors
- GPS Sensors
- Camera Sensors

Sensor Dataset
What is Linked Sensor Data

Recommended best practice for exposing, sharing, and connecting pieces of data, information, and knowledge on the Web using URIs and RDF

GeoNames Dataset

RDF – language for representing data on the Web

Sensor Dataset

Publicly Accessible
Sensor Datasets

LinkedSensorDataset

- RDF Descriptions of ~20,000 weather stations in US
- Average 5 sensors/weather station
- Spatial attributes of the weather station
- Links to locations in Geonames

LinkedObservationDataset

- RDF descriptions of Hurricanes and Blizzard observations in US
- Observations generated by sensors described in LinkedSensorDataset

<table>
<thead>
<tr>
<th>Name</th>
<th>Storm Type</th>
<th>Date</th>
<th>#Triples</th>
<th>#Observations</th>
<th>Download</th>
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</thead>
<tbody>
<tr>
<td>ALL</td>
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<td>1,730,264,735</td>
<td>159,460,500</td>
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<td>Bill</td>
<td>Hurricane</td>
<td>August 17 - August 22, 2009</td>
<td>231,021,108</td>
<td>21,272,790</td>
<td>gzip</td>
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<td>Ike</td>
<td>Hurricane</td>
<td>September 1 - September 13, 2008</td>
<td>374,094,660</td>
<td>34,430,964</td>
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<td>Gustav</td>
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<td>258,378,511</td>
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<td>Bertha</td>
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<td>278,235,734</td>
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<td>April 1 - April 6, 2003</td>
<td>111,357,227</td>
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Data Generation Workflow

- MesoWest Service Data
- OGC Observation and Measurement (O&M)
- RDF Instance
- Virtuoso RDF store

O&M2RDFCONVERTER
Workflow – Phase 1

Mesowest Database Phenomena

Sensor Data
Workflow – Phase 2

Phenomena encoding in MesoWest

Observations encoded in MesoWest

4,1,2003, 0,00,MST, 54,18,24,9,19,192,OK,0,18,18
3,31,2003, 23,00,MST, 54,18,24,9,20,194,OK,0,18,18
3,31,2003, 22,00,MST, 54,17,1,23,8,16,187,OK,0,18.1,18
3,31,2003, 21,00,MST, 54,18,24,8,19,189,OK,0,18.1,18

Phenomena encoding in O&M

Observations encoded in O&M

Phenomena encoding in O&M
Ontology – formal representation of knowledge by a set of concepts and relationship between those concepts
Workflow – Phase 3

Sensor Observation encoded in O&M

```xml
<swe:values>
  2003-4-1T0:00:00-07:00,54,18,24,9,19,192,0K,0,18,18
  2003-3-31T23:00:00-07:00,54,10,24,9,20,194,0K,0,18,18
  2003-3-31T22:00:00-07:00,54,17,1,23,8,16,187,0K,0,18,18
  2003-3-31T21:00:00-07:00,54,10,24,8,19,189,0K,0,18,18
</swe:values>
```

Sensor Observation encoded in RDF-N3

```ruby
@prefix om-owl: <http://knoesis.wright.edu/ssw/ont/sensor-observation.owl#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix sens-obs: <http://knoesis.wright.edu/ssw/> .
@prefix owl-time: <http://www.w3.org/2006/time#> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix weather: <http://knoesis.wright.edu/ssw/ont/weather.owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .

sens-obs:System_SB1
  om-owl:generatedObservation
    sens-obs:Observation_AirTemperature_SB1_2003_3_31_21_00_00 .

sens-obs:Observation_AirTemperature_SB1_2003_3_31_21_00_00
  a weather:TemperatureObservation ;
  om-owl:observedProperty
    weather:_AirTemperature ;
  om-owl:procedure sens-obs:System_SB1 ;
  om-owl:result sens-obs:MeasureData_AirTemperature_SB1_2003_3_31_21_00_00 ;
  om-owl:samplingTime sens-obs:Instant_2003_3_31_21_00_00 .

sens-obs:MeasureData_AirTemperature_SB1_2003_3_31_21_00_00
  a om-owl:MeasureData ;
  om-owl:floatValue "54.0"^^xsd:float ;
  om-owl:uom weather:fahrenheit .

sens-obs:Instant_2003_3_31_21_00_00
  a owl-time:Instant ;
  owl-time:inXSDDateTime
    "2003-03-31T21:00:00-07:00"^^http://www.w3.org/2001/XMLSchema#dateTime" .
```
Workflow – Phase 4

System_SB1 at SensorPedia
http://knoesis.wright.edu/ssw/System_SB1

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<td>sens-obs-p:Observation_AirTemperature_SB1_2005_10_16_12_00_00</td>
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</table>

PUBBY - Linked Data Front End
Future Work

Linked Observation Dataset

Linked Sensor Dataset

Wikipedia Article: Hurricane Katrina

Spatial + Temporal
• Publicly accessible Rich Weather Sensor datasets
• Datasets are easy to query
• Able to query Sensors based on location names
• Built O&M2RDFConverter to generate more publicly accessible sensor datasets
ACKNOWLEDGEMENTS

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• Joshua Pschorr

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Wright-Patterson Air Force Base
QUESTIONS
• **Semantic Web** – is an *extension of the current web* in which *data* is expressed in a *common vocabulary* making such that the data becomes *machine processable*.

• **Ontology** – is a specification of *concepts and relationships* between them.

• **Triple** - a ternary relation containing an entity pair and a relationship that expresses the link between them i.e. *subject-predicate-object*

• **Entity/Concept** – an instance of a *thing*

• **URI** – a unique identifier for any resource/entity/thing on the web

• **LOD** - a semantic web initiative to provide a repository of semantically connected datasets