Towards SWIM Narratives for Sustainable Water Management

Raúl Alejandro Vargas Acosta[1], Luis Garnica Chavira[2], Natalia Villanueva Rosales[1], Deana Pennington[3]

[1]Department of Computer Science, [3]Department of Geology, The University of Texas at El Paso
[2]Git Gud Consulting SAS

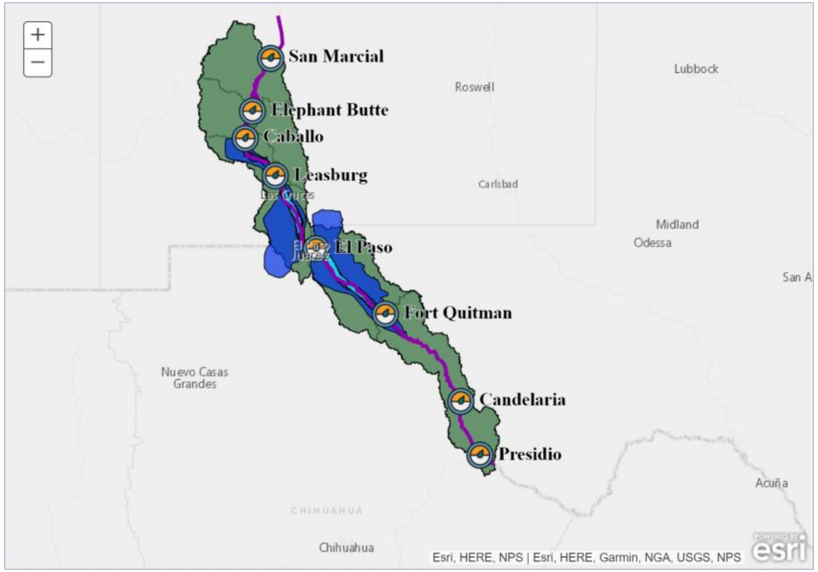
SemSci 2018: Enabling Open Semantic Science

co-located with the 17th International Semantic Web Conference

Monterey, California, USA **10/09/2018**

Water Sustainability in the US Southwest

- **Research Fields:** Economy, Hydrology, Climatology, Computer, Environmental, Earth Science, and Civil Engineering.
- **User Roles:** Farmers, Policy Makers, Citizens, Academics
- **Regions:** New Mexico, Texas, Chihuahua (MX)
- **Institutions:** UTEP, NMSU, UNM, UACJ, MTU, TAMU



Source: middleriogrande.org

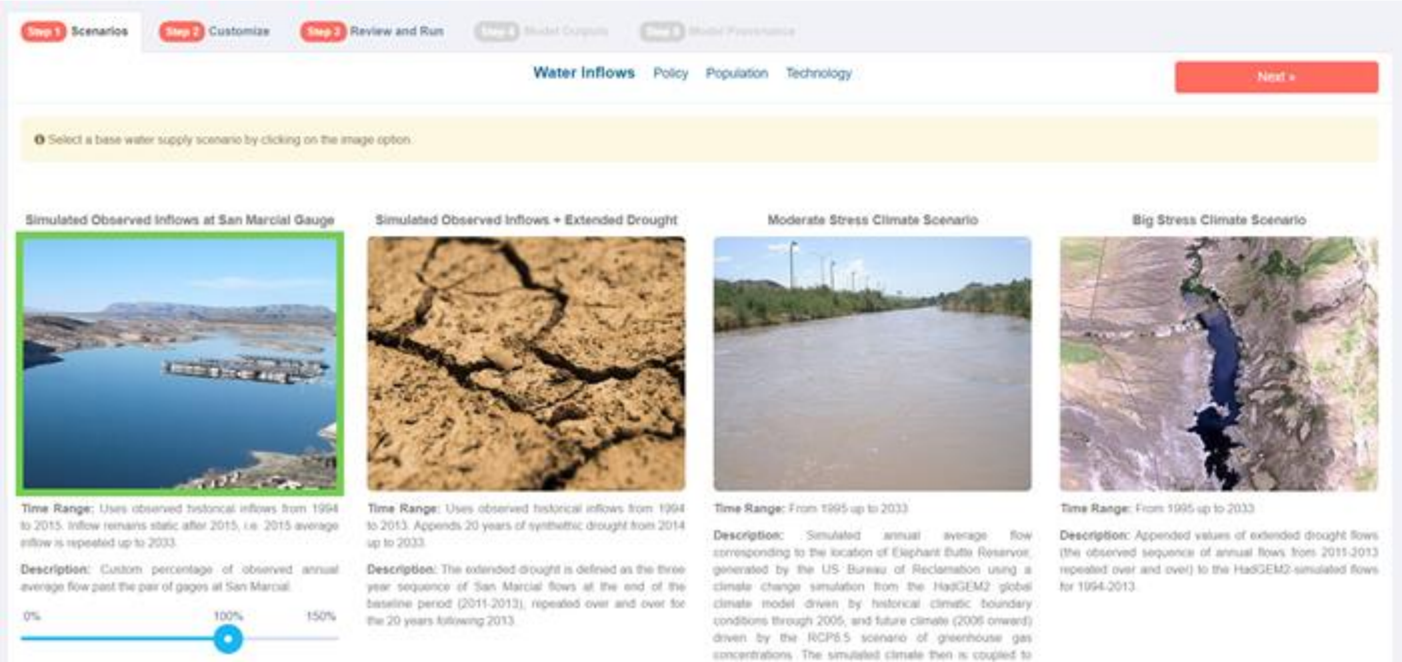
Sustainable Water through Integrated Modelling Framework (SWIM)

- **Expose** water sustainability models on the Web.
- Clearly identify the sources and processes used

for data **manipulation** for model consumption.

- **Describe** the science behind the models.

Sustainable Water through Integrated Modelling Framework (SWIM)



Source: middleriogrande.org

Scientific results hard to understand

Semantics behind the data

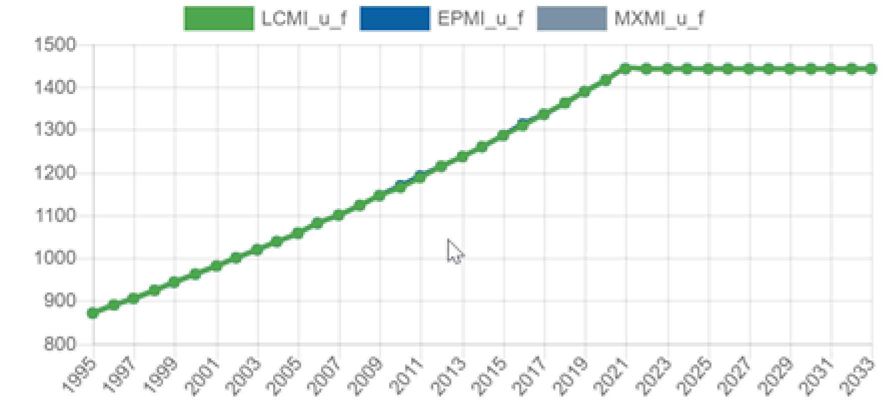
Year	Use Location	Value
1995	LCMI_u_f	$872.46
1996	LCMI_u_f	$889.95
1997	LCMI_u_f	$906.75
1998	LCMI_u_f	$924.47
1999	LCMI_u_f	$942.35
2000	LCMI_u_f	$961.10
2001	LCMI_u_f	$979.88
		avg: 1230.3341

Units: USD/AF

Urban Price

Urban water price

Use Locations:
LCMI_u_f = Las Cruces Municipal and Industrial
EPMI_u_f = El Paso Municipal and Industrial
MXMI_u_f = Ciudad Juarez Municipal and Industrial

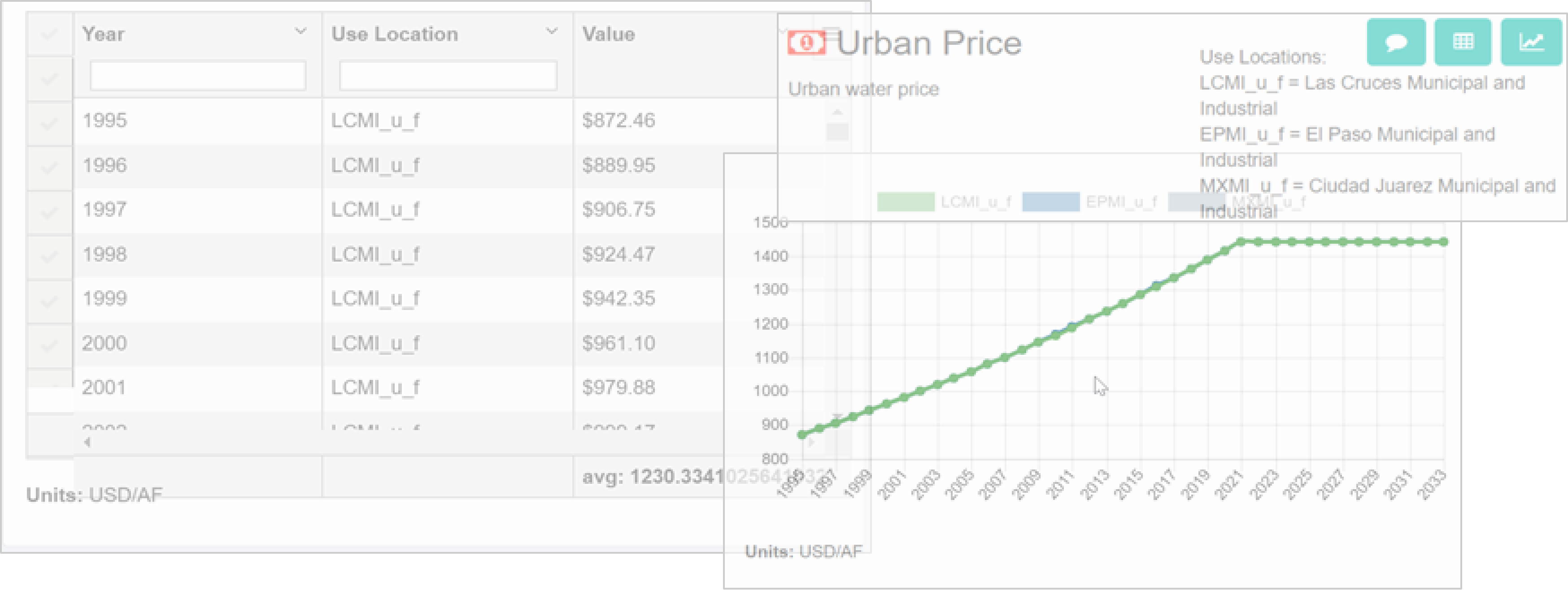


Units: USD/AF

Source: middleriogrande.org

SWIM narratives

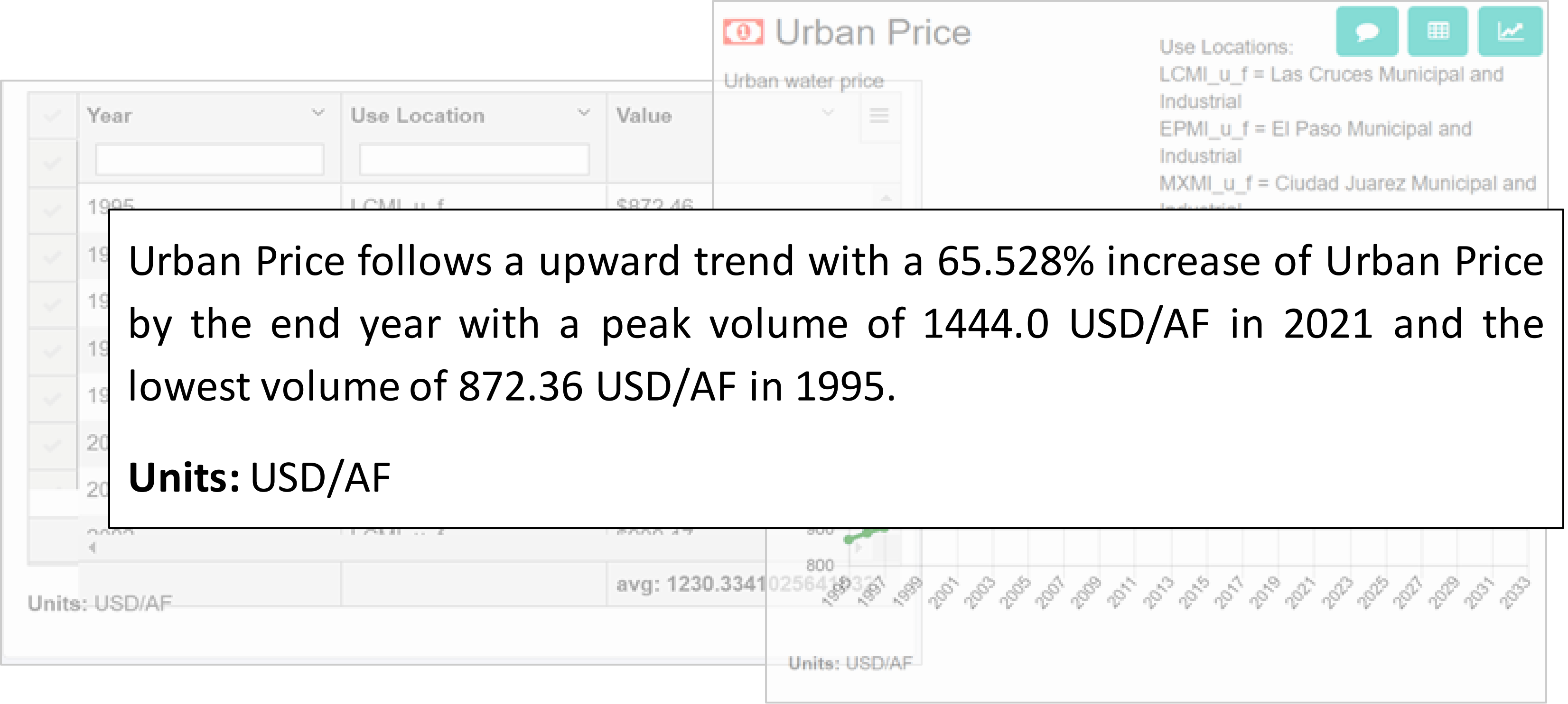
Customizable human-readable data explanations



*Inspired by Yolanda Gil and Daniel Garijo (2017) [1].

Source: middleriogrande.org

SWIM narratives



Urban Price follows a upward trend with a 65.528% increase of Urban Price by the end year with a peak volume of 1444.0 USD/AF in 2021 and the lowest volume of 872.36 USD/AF in 1995.

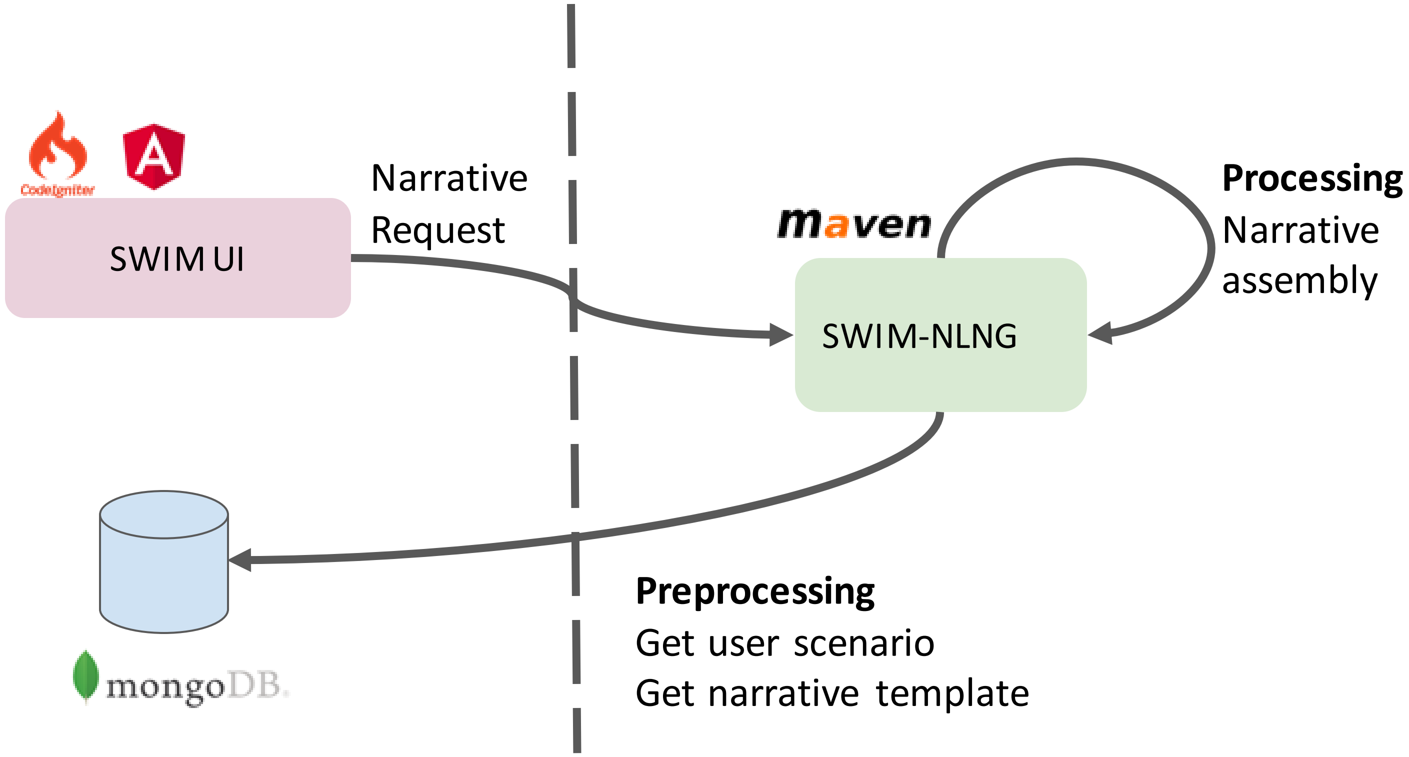
Units: USD/AF

Source: middleriogrande.org

Narrative components

Language	Spanish and English
User role	Farmers, policy makers, water administrators
Focus area	Urban, environmental
Geographical region	El Paso, Texas; Las Cruces, New Mexico; Ciudad Juarez, Mexico
Model element	Model inputs, model outputs, and scenarios
User scenario	Model run document

SWIM narrative generation



Preprocessing

{"varLabel": "Surface Water Storage",**"varName": "water_stocks"**,
"varDescription": "Reservoir water storage","varUnit": "KAF/yr",
"varValue": [{"res": "Store_res_s","t": "1996","value": 2061.5},{"res": "Store_res_s","t": "1997","value":
2213.49}...}

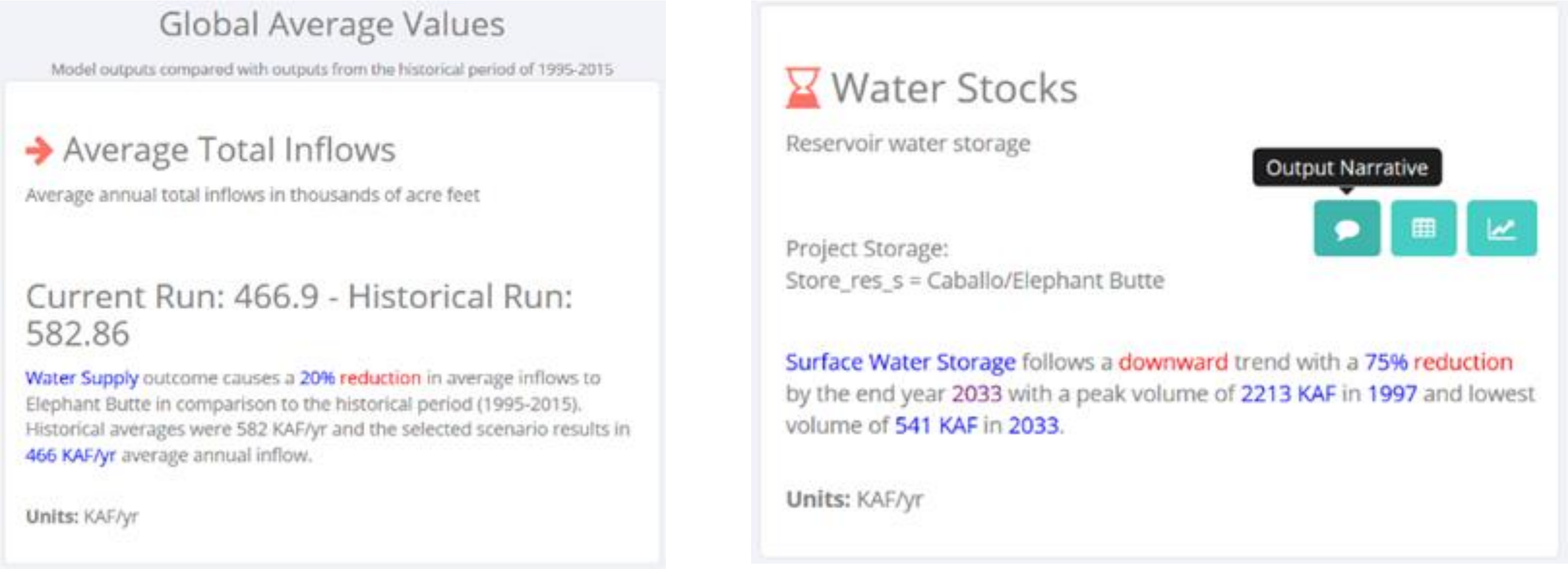
Excerpt of an executed scenario serialized as JSON using SWIM's data model. The response contains metadata and result values for the output variable "water stocks."

Q1. List<Narrative> outputNarrative = mDataStore.createQuery(Narrative.class).filter("element.name", varName).asList();

R1. ~element_label follows a ~adjective_trend trend with a ~percent ~adjective_behaviour by the end year ~constant_year with a peak volume of ~maxValue ~element_unit in ~maxYear and lowest volume of ~minValue ~element_unit in ~minYear.

Query to retrieve narrative template for an output variable and result.

Narratives



Summary narrative (a) and single output narrative (b)

Current results (1)

- **Specification** of the narrative components.
- One narrative **template** document per model element (scenario, input or output).
- In-house **ontology** for SWIM specific terms.
- Semantically annotated **narrative schema** formatted in JSON-LD.

Current results (2)

- **Stand-alone web service**: Natural Language Narrative Generator (NLNG).
- **Data interpretations** through the ingest of individual model elements (single value or time series), target user metadata and baseline model runs.
- Narrative addition to **SWIM UI**.

Future work

Extension of narrative templates for **different roles**.

Generalization of SWIM narratives.

Evaluation with stakeholders and scientific team.

Expose SWIM's annotated data as **knowledge graphs**, e.g., Cayley.

Predefined user preferences through Machine Learning algorithms.

International, Interdisciplinary Research Team

Bill Hargrove
Soil and Water Management

Josiah Heyman
Anthropologist

Deana Pennington
Geoscientist

Alex Mayer
Civil Engineering

Frank Ward
Economist

Dave Gutzler
Climate Change

Sarah Sayles
Water Science and Management

Alfredo Granados
Soil Science and Agronomy

Luis Garnica
Software Engineering

Availability

Project Website:

http://purl.org/swim

SWIM-NLNG Service:

http://purl.org/swim/services/nlng

SWIM Vocabulary (JSON-LD):

http://purl.org/swim/vocab

SWIM Terms (OWL):

http://purl.org/swim/terms

Backend Source Code:

https://github.com/iLink-CyberShARE/SWIM-NLNG

Acknowledgements

Thank you for the contributions of SWIM's modeling team, especially Frank Ward, and Dave Gutzler. This material is based upon work supported by the National Institute of Food and Agriculture, U.S.D.A. Grant# 2015-68007-23130 "Sustainable water resources for irrigated agriculture in a desert river basin facing climate change and competing demands: From characterization to solutions." This work used resources from Cyber-ShARE Center of Excellence, supported by National Science Foundation Grant #HRD-0734825.

Cyber-ShARE

References

[1] Towards Automating Data Narratives. In Proceedings of the *22Nd International Conference on Intelligent User Interfaces* (IUI ’17), 565–576. DOI:https://doi.org/10.1145/3025171.3025193

Towards SWIM Narratives for Sustainable Water Management

Raúl Alejandro Vargas Acosta[1], Luis Garnica Chavira[2], Natalia Villanueva Rosales[1], Deana Pennington[3]

[1]Department of Computer Science, [3]Department of Geology, The University of Texas at El Paso
[2]Git Gud Consulting SAS

SemSci 2018: Enabling Open Semantic Science

co-located with the 17th International Semantic Web Conference

Monterey, California, USA **10/09/2018**