DigitalWorld 2019 International Expert Panel:

Geo-Processing Sensor Information

February 26, 2019, Athens, Greece

DigitalWorld / The Eleventh International Conference on Advanced Geographic Information Systems, Applications, and Services (GEOProcessing 2019) / ALLSENSORS

GEOProcessing, ALLSENSORS / DigitalWorld
February 24–28, 2019 - Athens, Greece

DigitalWorld Expert Panel: . . . Contemporary Views . . .

Panelists and Contributors

- *Claus-Peter Rückemann* (Moderator),
  Westfälische Wilhelms-Universität Münster (WWU);
  Leibniz Universität Hannover; KiM, DIMF, Germany
- *Douglas Galarus,* *[Panelist and Contributor]*
  Utah State University
- *Weiping Yang,* *[Panelist and Contributor]*
  ESRI, USA
- *Newton Silva de Lima,* *[Panelist and Contributor]*
  SEDUC-ULBRA, Brazil
- *Claus-Peter Rückemann,* *[Panelist and Contributor]*
  WWU Münster / Leibniz Universität Hannover / DIMF, Germany

DigitalWorld / GEOProcessing 2019 / ALLSENSORS:

http://www.iaria.org/conferences2019/GEOProcessing19.html
http://www.iaria.org/conferences2019/ALLSENSORS19.html

Program: http://www.iaria.org/conferences2019/ProgramGEOProcessing19.html

DigitalWorld Expert Panel: . . . Contemporary Views . . .

Panel Statements and Preview:

- Sensors require sufficient complements in order to create insight from the gathered information.
- Knowledge and education, contributions from many different disciplines are required.
- Sensors: Is more really better?
- Thoughts on rapid progressions in transportation.
- Reality of the current state of the practice of sensing in rural intelligent transportation systems as used for traveler information.
- Data everywhere - but where are the connecting dots?
- BigData would be useless without solid analytical methods to discover meaningful patterns and connections.
- We have to dig into the details of domain specific patterns that may connect things and events.
- Practical results and contributions of remote sensors and instrumentation from environmental measurements.

DigitalWorld Expert Panel: . . . Contemporary Views . . .

Pre-Discussion-Wrapup:

- **Knowledge:** What kind of knowledge and education are required?
- **Implementation and realisation:** What are the complements, connectors, and integrators of sensor information and technology?
- **Data quality:** How to achieve and improve data quality (based on data quantity)?
- **Case scenarios:** What are the case scenarios (natural sciences, environment, transportation, humanities, . . .) and experiences?
- **Analysis:** What are experiences with and from integration, analysis, and interpretation of sensor information?
- **Views:** Are there differences in academia/industry applications/views?
- **Recommendations:** Which general and special recommendations?
- **Networking:** Discussion! Open Questions? Suggestions for next Expert Panel?

DigitalWorld Expert Panel: Conclusions / Post-Panel-Discussion Summary

Post-Panel-Discussion Summary (2019-02-26):

Resulting from the discussed topics, the essences regarding geo-processing sensor information are:

- **Sensors, complements and education:** Sensors require sufficient complements in order to create insight from gathered information. In general, knowledge and education, contributions from different disciplines are indispensable. (Rückemann)
- **Case of transportation data sources:** Correctness of measured data is an important issue. Data quality is one of the criteria. (Galarus)
- **Case of network and service data sources:** Big Data would be useless without solid analytical methods to discover meaningful patterns and connections. (Yang)
- **Case of environmental measurements:** Remote sensors and measured data require tools for correlation of measurements and data from secondary source data (e.g., temperature data and satellite images). (Lima)
- **Case of natural sciences data sources:** Sensors for scientific measurements, e.g., geophones in seismic arrays, require diligence, systematical, and methodological planning and realisation. (Rückemann)
- **Connecting "dots":** Recommendation is to take attention digging into details of domain specific patterns connecting things and events. (Yang)
- **Individual sensors and sources:** Crowd sensored data bears arbitrary variations of non-skilled to individually skilled ways of doing measurements as well as variations from different sensors/technologies and products.
- **Systematics and methodologies:** Systematical and methodological application and procedures are mandatory for many scenarios employing sensors. The extent can dependent on disciplines and methods.
- **Standards and documentation:** Standards and documentation are becoming increasingly important, e.g., in context of research data management.
- **Long-term persistent data:** Reduction of data and individually apropriate methods are mandatory for most big volume data scenarios, e.g., for long-term storage.

DigitalWorld Expert Panel: Table of Presentations, Attached

Panelist Presentations: (presentation order, following pages)

- **Information Science and Geosciences: The Complements of Sensor Information** (*Rückemann*)
- **Is more really better?** (*Galarus*)
- **Data, Data, Everywhere, but Where Are the Connecting Dots?** (*Yang*)
- **Geoprocessing of the Trends of the ENSO Phenomenon from Peru to the Atlantic Ocean in Brazil.** (*Lima*)

DigitalWorld 2019 International Expert Panel: Geo-Processing Sensor Information

Information Science and Geosciences: The Complements of Sensor Information

DigitalWorld / Eleventh International Conference on Advanced Geographic Information Systems, Applications, and Services (GEOProcessing 2019) / ALLSENSORS 2019
February 26, 2019, Athens, Greece

Dr. rer. nat. Claus-Peter Rückemann[1,2,3]

[1] Westfälische Wilhelms-Universität Münster (WWU), Münster, Germany
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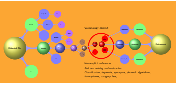

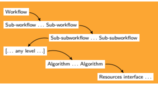

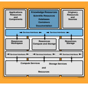

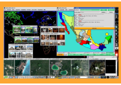

Status:

- **Complements:**
  Tools and sensors are often dealt with like add-ons and general purpose modules.
- **Information and (seamless) integration:**
  Education, integrators, connectors missing.
- **Value:**
  Often by economic interests.
- **Quantity:**
  The more “data” the better.
- **Quality:**
  A matter of re-definition.
- **Consequence:**
  Continuous increase of the numbers of promoted “solutions” and “improvements”.

Vision and future:

- **Complements:**
  Knowledge (including information and data), technical implementation based on knowledge, education, and experience.
- **Information and (seamless) integration:**
  Reliable case studies, standards, and best practice scenarios for application, integration, and analysis.
- **Value:**
  Values are in knowledge (factual, conceptual, procedural, metacognitive, . . .).
- **Quantity:**
  Knowledge and is facets (including its accompanying information and data) are in many cases not depending on quantity of 'data'.
- **Quality:**
  A matter of education, experience, measurement, . . .
- **Consequence:**
  Fostering the relevant assets!

Conclusions:

- Sincere implementations and realisations based on knowledge (including information and data), technical components, educational frameworks, and experience.
- Creating and documenting reliable case studies, standards, definitions, and best practice scenarios for application, integration, and analysis.
- Education, focussed on (beyond-economic and beyond-‘plug-and play’) values, knowledge, and best practice.
- Taking unequivocal and reviewable stand for context-advisable intercourse and communication.

Thank you for your attention!

Wish you an inspiring conference
and a pleasant stay in Athens!

Is more really better?

Thoughts on rapid progressions in transportation, and the reality of the current state of the practice of sensing in rural intelligent transportation systems as used for traveler information.

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Utah State University
Logan, UT 84322-4205, United States
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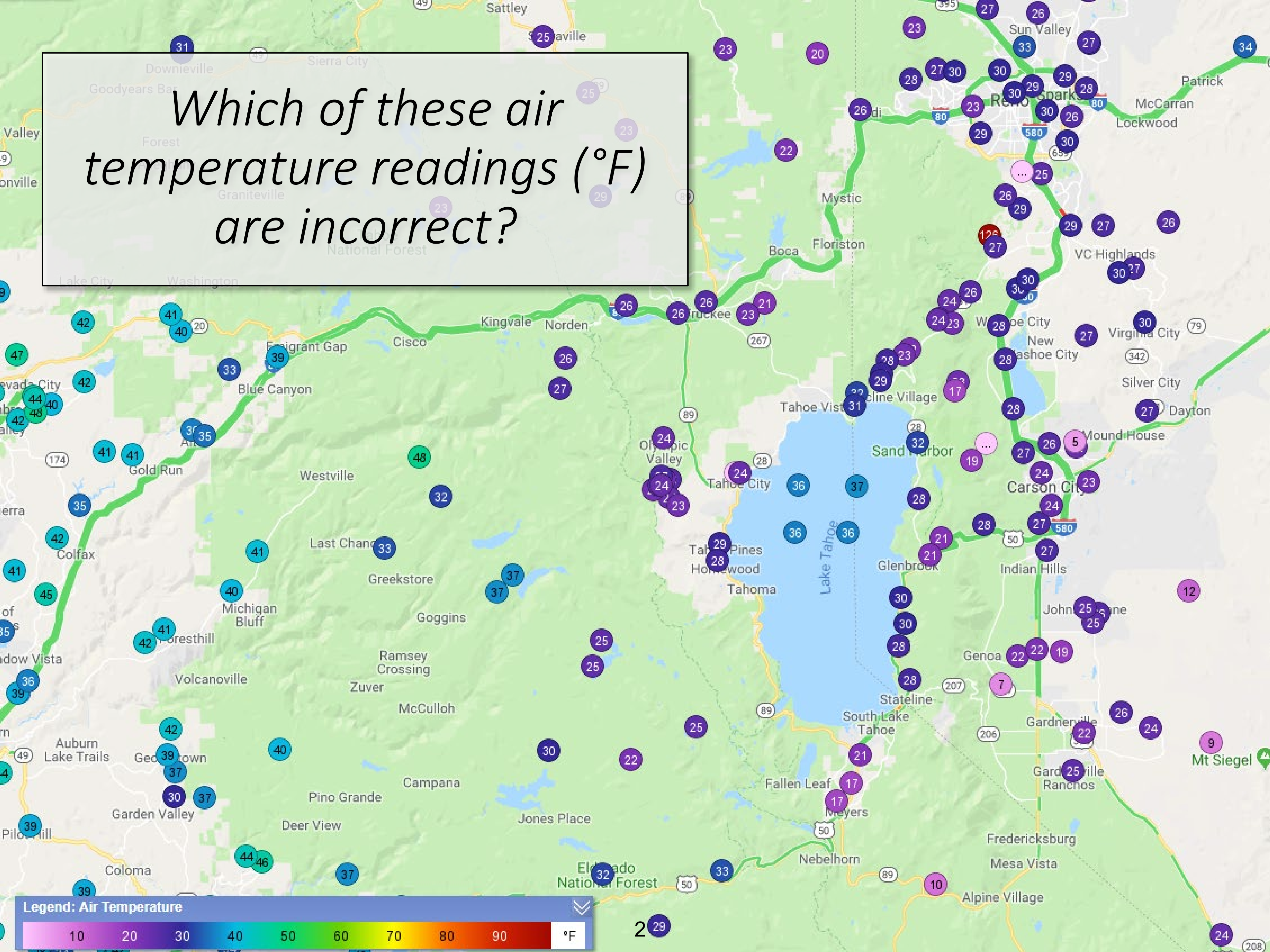
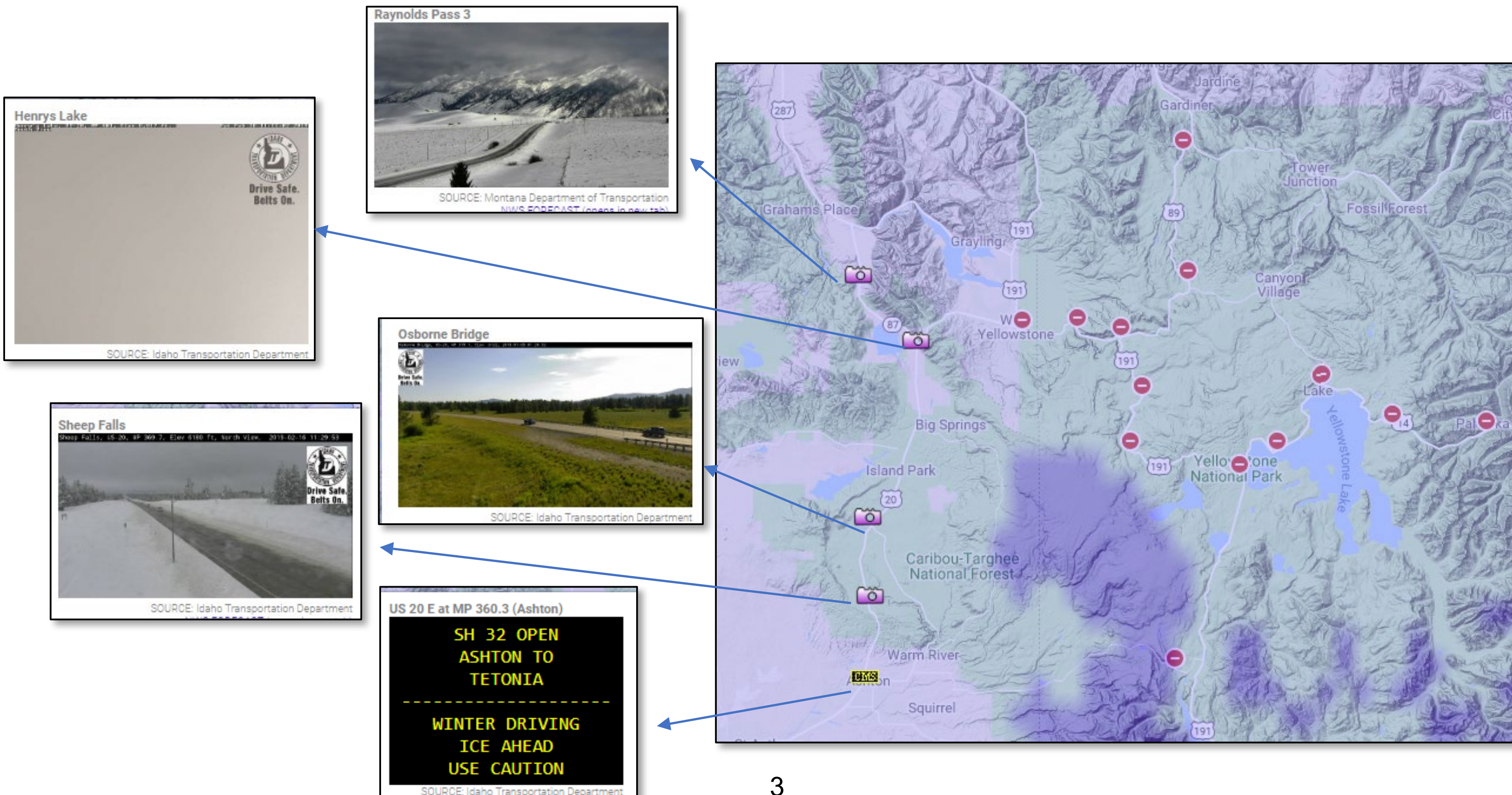
Panel Discussion for GEOProcessing 2019
February 26th, 2019 - Athens, Greece

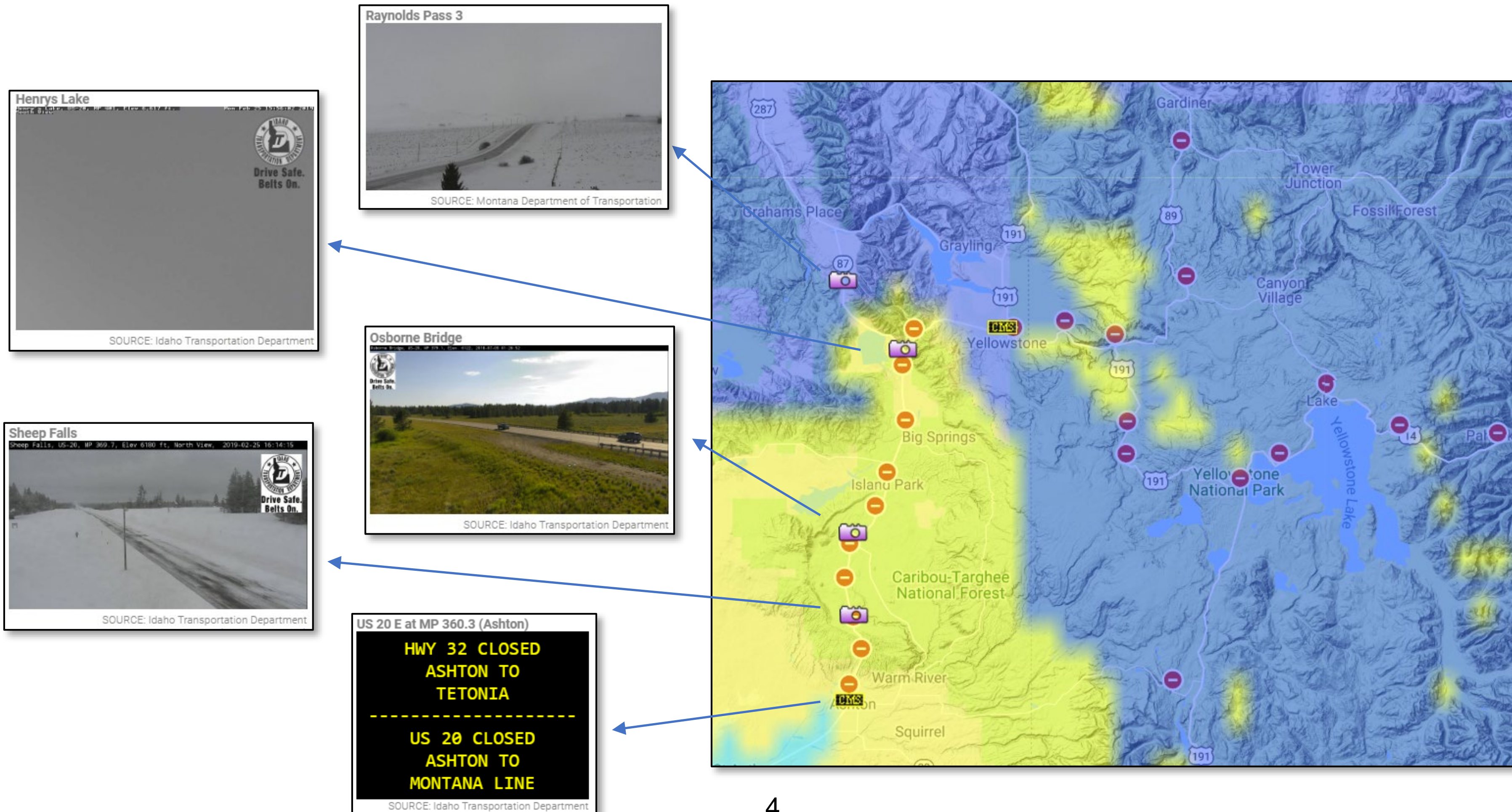
Which of these air temperature readings (°F) are incorrect?



We are currently working with data quality associated with CCTV roadside camera images.



And the problem persists …



Data, Data, Everywhere, but Where Are the Connecting Dots?

- **Big Data are collected at lightning speed**
  - Internet: web browsing, searching, online shopping…
  - Social media: messages, photos, blogs, UGC, VGI…
  - Internet of Things: smart devices at homes, surveillance cameras…
  - Services & transactions: Uber trips, weather channels, PayPal processing…
- **GIS can help to make sense of Big Data**
  - Most (80%?) data has a spatial component. Geography Matters
  - GIS systems and services have increasing capabilities of querying, analysis, and simulations against geospatial data
  - GIS drives the discovery of visual patterns in Big Data. Hotspots, crime scenes, event locations, changes over time can be easily spotted
- **GIS also faces challenges in synthesizing Big Data**
  - Big Data are characterized by a bunch of Vs to be addressed by GIS
  - Volume: too big that GIS can no longer store and analyze data using traditional database technology => distributed storage and parallel processing
  - Velocity: new data are pouring in at speed of light => real time processing
  - Variety: raster, vector, text, photos, voices, structured, unstructured…
  - Veracity: uncertainty, undocumented, errors, inaccurate, noises…

- **GIS needs DM, ML, and DL algorithms for Big Data Analytics**
  - **Discover spatial-temporal patterns for human activities or natural changes**
  - **Detect clusters and outliers**
  - **Handle incomplete stream data within temporal windows**
  - **Handle partitioning of data to distribute in cluster nodes**
  - **Perform parallel processing for distributed data and algorithms**
- **GIS needs to blow up data silos for synthesized analysis**
  - **GIS professionals can be experts in geospatial data and patterns, they may and need not to be experts to uncover domain specific patterns or structures in social media text, photos, or voices.**
  - **GIS uncovered spatial-temporal patterns, querying results, or predictions could be better explained with input obtained from querying to other domain data objects**

Manicoré-Amazon-Brazil
2018/07/16 – 18 LT

Geoprocessing of the Trends of the ENSO Phenomenon, from Peru to the Atlantic Ocean in Brazil.

Newton Silva de Lima[*], Eriberto Façanha[*], Robson Matos Calazães[*], Ricardo Figueiredo[*], William Dennis Quispe[*], Aldemir Malveira[†], Roseilson Souza do Vale[‡]

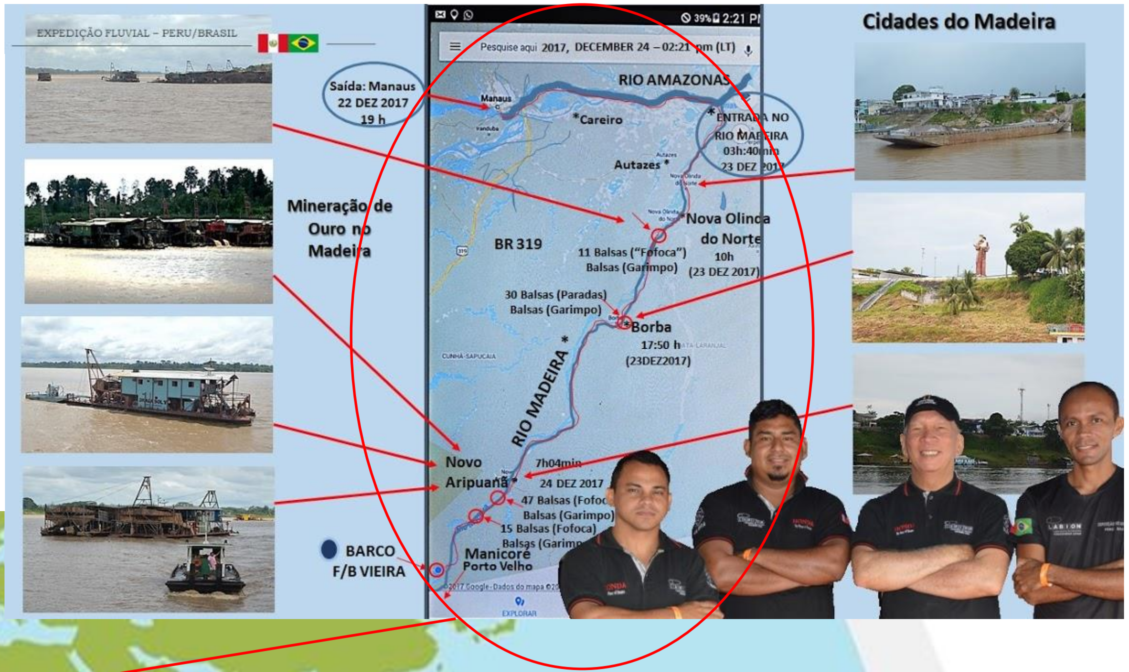
*Secretary of Education and Quality of Teaching of the State of Amazonas [*]Lutheran University Center of Manaus (Geosciences - Mathematics) / [†]Federal University of Amazonas (Mathematics)/ [‡]Federal University of Western Pará (Geosciences) / [*] [†]Manaus/ [‡]Santarém (Brazil)

SEDUC
ULBRA
LABION Laboratório da Ionosfera YOGESHWAR SAHAI
ATMOSPHERE 101

"... The great river in its long extension tranquilly rests every day after eons of services rendered to the population that witnesses its course from its birth in the Peruvian Andes to its farewell to the continent at the Atlantic Ocean, leaving in the memory of men and ships that it has carried to home and safe harbor, and of scientific discourse, such as the present work, a great story to tell..." (The authors).

This work made use of Geoprocessing tools, with remote sensing (GPS, GLONASS and MODIS), satellite images and information processing in a large-scale travel office in North South America, from the Andes Mountains in Peru, to the edge of the continent on the Brazilian coast in the Atlantic Ocean, showing the severity of the ENSO phenomenon in 2016 and the water quality of the Amazon River.

GPS – GLONASS (MODIS – Aqua/Terra)



The Geoprocessing

(Remote Sensors)

GEOProcessing

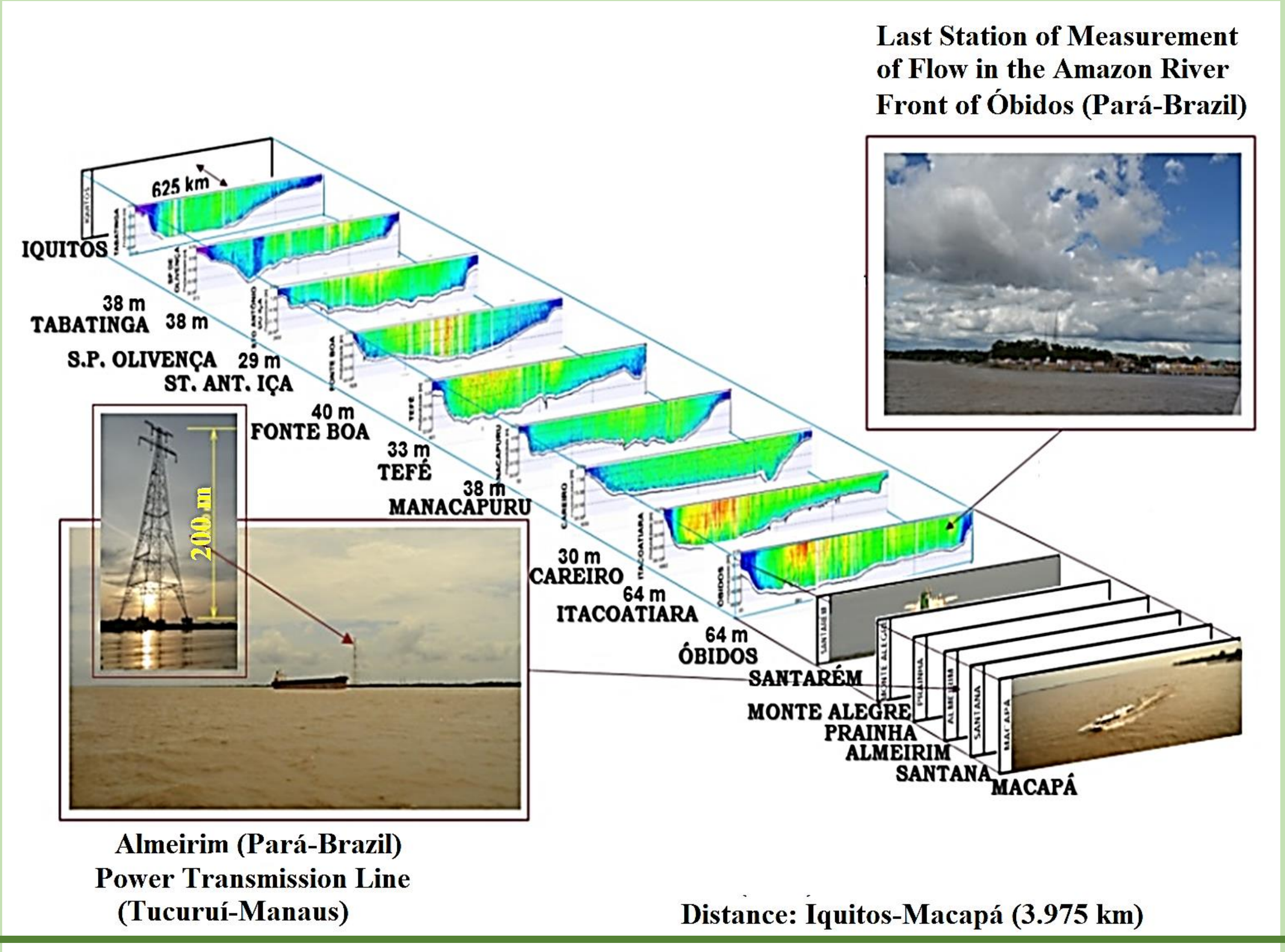
The product

Meeting of the waters between the Negro and Amazon rivers in front of the City of Manaus - Brazil

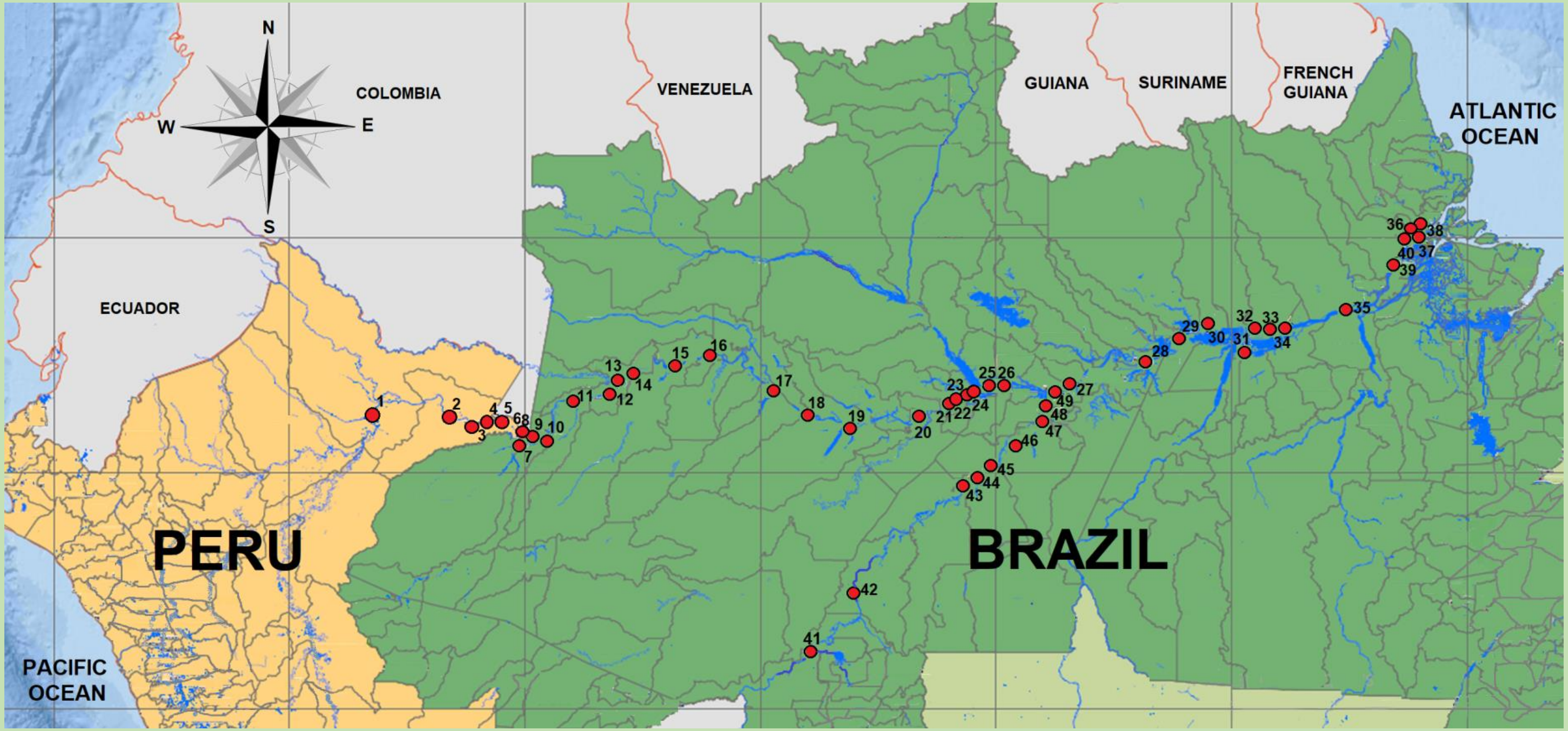
The Site

Fig. 2: The main cities of Iquitos (Peru) to Macapá (Brazil). The average depth of the river is shown in the dry season.

Source: Adapted from Project Integrated and Sustainable Management of Cross - Border Water Resources in the Amazon River Basin, Considering the Variability and Climate



GIS - Geographic Information System



Point	Place of Collections
1	PUERTO IQUITOS (PERU)
2	SAN ANTÔNIO (PERU)
3	SAN PABLO (PERU)
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Samples	Geographic Coordinates		Water	Temp..
	Latitude	Longitude	pH	°C
1	S 03° 43' 37.6"	W 073° 14' 23.8"	6.61	28.8
2	S 03° 48' 18.8"	W 071° 34'25.4"	7.31	26
3	S 04° 00' 59.6"	W 071° 06' 07.5"	7.29	26
4	S 03° 55' 40.8"	W 070° 47' 10.4"	7.22	25
5	S 03° 53' 49"	W 070° 30' 19.1"	7.79	26
6	S 04° 06' 39.7"	W 070° 03' 13.8"	6.92	29
7	S 04° 13' 04.7"	W 069° 57' 19.1"	6.89	27
8	S 04° 13' 44.4"	W 069° 56' 41.0"	7.2	27
9	S 04° 22' 19.5"	W 070° 01' 34.3"	7.15	26
10	S 04° 18' 31.2"	W 069° 33' 27.5"	6.6	24
11	S 03° 27' 42.2"	W 068° 57' 26.4"	7.17	24
12	S 03° 21' 14.5"	W 068° 11' 04.2"	7	24
13	S 03° 06' 29.1"	W 067° 56' 39.6"	5.81	23
14	S 02° 51' 47"	W 067° 46' 13.4"	6.15	26
15	S 02° 44' 33.8"	W 066° 46' 19.5"	6.16	25
16	S 02 ° 29' 40.6"	W 066° 04' 05.1"	7	25,5
17	S 03° 16' 32.1"	W 064° 43' 12.1"	6.87	25.5
18	S 03° 47' 18.3"	W 064° 02' 19.8"	6.93	27
19	S 04° 03' 17.1"	W 063° 04' 54.0"	6.89	26
20	S 03° 47' 17.2"	W 061° 37' 05.8"	6.76	25
21	S 03° 33' 34.6"	W 060° 53' 16"	6.75	24.5
22	S 03° 28' 34.8"	W 060° 45' 22.9"	6.76	26
23	S 03° 19' 17.3"	W 060° 37' 00.6"	6.81	23
24	S 03° 19' 17.3"	W 060° 37' 00.6"	6.77	27
25	S 03° 08' 11.1"	W 059° 53' 59.1"	5.53	28

Samples	Geographic Coordinates		Water	Temp.
	Latitude	Longitude	pH	°C
26	S 03° 08' 21.3"	W 60° 01' 35.1"	5.14	27.6
27	S 03° 08' 54.3"	W 58° 26' 54.1"	6.56	27
28	S 02° 38' 01.6"	W 56° 45' 21.7"	6.7	27
29	S 02° 09' 05.9"	W 56° 05' 43.1"	6.54	27
30	S 01° 55' 22.2"	W 55° 30' 55.3"	6.75	27
31	S 02° 24' 52.1"	W 054° 44' 13.8"	6.16	27
32	S 02° 25' 00"	W 054° 43' 22.2"	6.07	27
33	S 02° 00' 35.1"	W 054° 04' 10.0"	6.54	27
34	S 02° 00' 35.3"	W 054° 04' 11.8"	6.41	26.6
35	S 01° 31' 58.7"	W 052° 34' 34.5"	6.45	28
36	S 00° 03' 27.4"	W 051° 10' 42.1"	6.5	27
37	N 00° 01' 37.4"	W 051° 02' 55.1"	6.6	26.3
38	N 00° 02' 00.2"	W 051° 02' 43.1"	6.44	27
39	S 00° 31' 20"	W 051° 29' 59.7"	6.81	26.6

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Samples	Conductivity µS/cm	Alkalinity (mgHCO3/L)	Dissolved Oxygen %	Dissolved Oxygen mg/L	Turbidity (NTU)
1	48.3	22.57	113.5	9.5	15.6
2	112	51.24	117.6	10.02	104
3	123.7	48.19	105.7	8.46	83.72
4	119.9	46.36	103.7	8.27	53.56
5	117.4	47.58	111.8	8.81	50.18
6	78.1	36.6	108.1	9.31	8.84
7	106.5	48.19	108	8.56	79.56
8	103.7	44.53	109.2	9.44	75.4
9	104.3	47.58	110.2	8.36	73.06
10	28.3	13.42	115.8	9.29	41.08
11	100.3	42.09	124	9.85	83.98
12	98.1	43.31	113.2	9.75	82.42
13	9.51	4.27	99.8	9.71	6.24
14	17.45	9.15	117.5	9.61	21.06
15	17.92	9.76	109	8.99	10.92
16	75	32.33	119.5	9.48	54.6
17	68.5	29.89	118.9	9.92	63.44
18	69.3	31.72	108.3	9.07	42.12
19	64.2	30.5	110	9.42	44.2
20	54.4	25.01	100.7	8.34	29.38
21	50.7	23.79	103.8	7.79	44.46
22	48.1	22.57	119.1	9	20.8
23	48.5	22.57	129.7	10.45	29.38
24	48.6	22.57	108.5	9.11	24.44
25	9	3.66	114.8	9.61	3.64
26	7.92	2.44	77	5.76	3.9
27	53.3	17.08	76.6	5.35	35.36
28	51.3	16.47	69.3	5.66	44.46
29	51.2	15.25	70.5	5.63	37.44
30	52.8	18.3	68.8	5.64	38.48
31	13.8	7.32	74.9	5.68	4.68
32	13.92	6.1	82.5	6.36	2.6
33	45.7	16.47	67.2	5.29	57.46
34	50	17.69	64.05	4.98	41.34
35	47.5	21.96	71.2	5.28	33.28
36	53.1	23.18	58.4	4.70	27.56
37	53.3	22.57	71.9	5.96	27.56
38	56.5	25.01	67.7	5.37	27.3
39	45.9	21.35	65.3	4.94	36.92

GIS - Geographic Information System

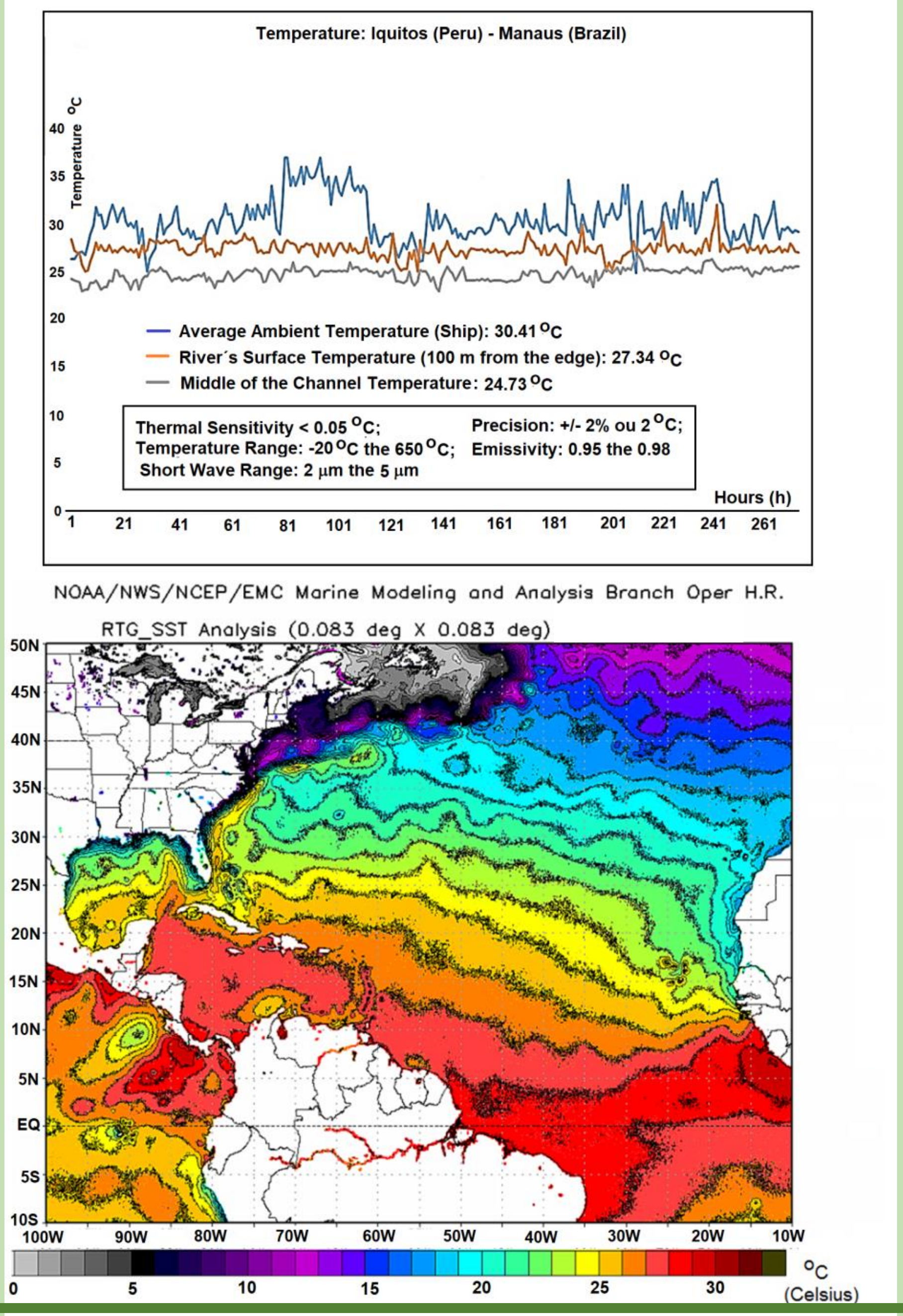

Fig. 3: Time series of temperature along the Amazon River during the first stage of the Expedition (Iquitos/Peru – Manaus/Brazil), and compared to data from the *Marine Modeling and Analysis Branch Oper. H. R.* (Verification Ensembles) of NOAA/NWS/NCEP/EMC.

Source: Amazon River Expedition and NOAA, 2016.

AMAZON RIVER EXPEDITION

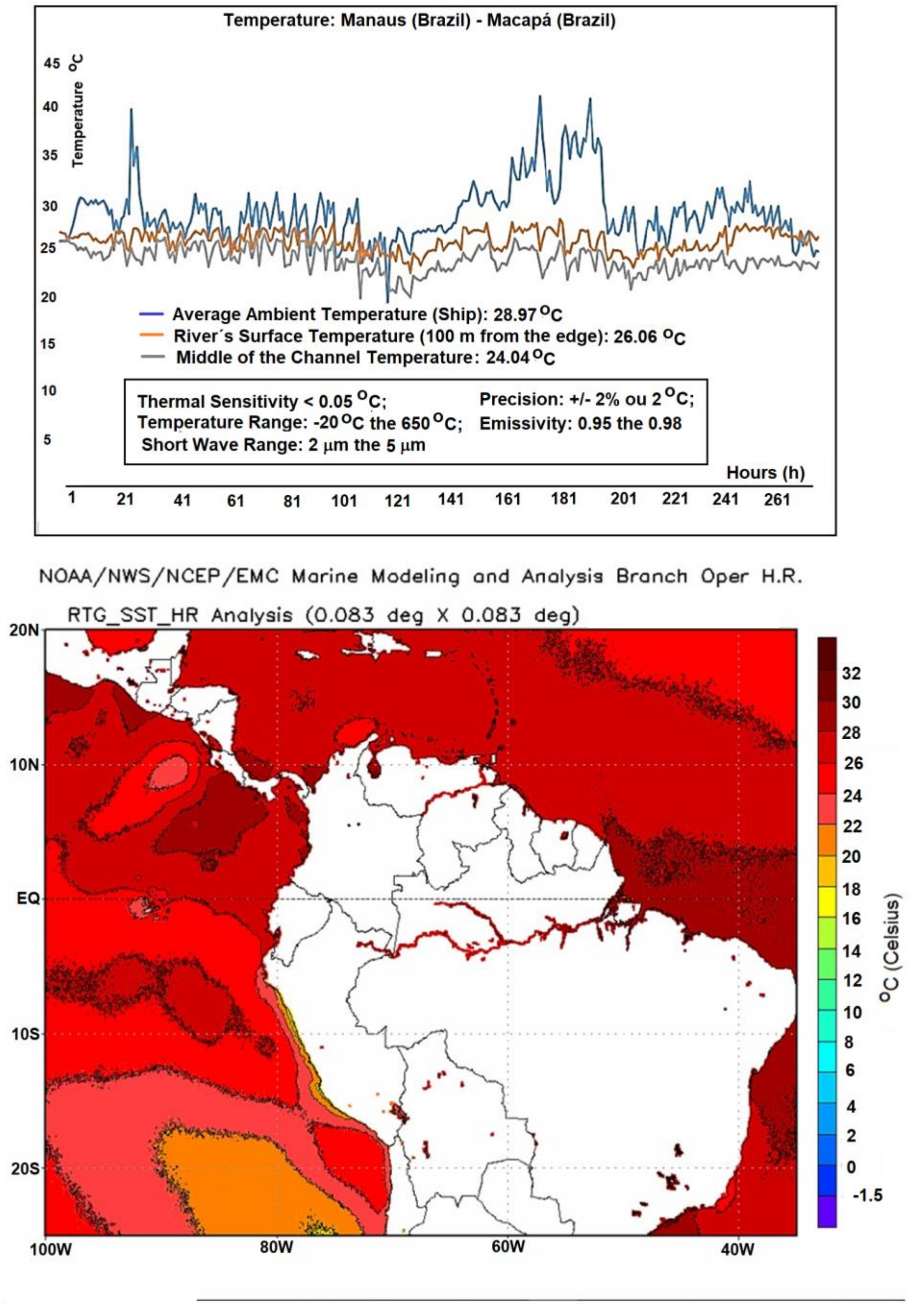

Fig. 4: Time series of temperature along the Amazon River during the 2nd stage of the Expedition (Manaus/Brazil – Macapá-Brazil) and compared to data from the *Marine Modeling and Analysis Branch Oper. H. R.* (Verification Ensembles) of NOAA/NWS/NCEP/EMC.

Source: Amazon River Expedition and NOAA, 2016.

CONCLUSION

With the help of georeferencing, it was possible to show the correlation between temperature measurements and satellite images throughout the trip from the city of Iquitos in Peru to the Brazilian city of Macapá, near the interface of Brazil and the Atlantic Ocean. The sea surface temperature stimulated the establishment of an increasing temperature gradient in the equatorial region along the river, combined with a tendency for regional warming during the El Niño event of 2016.

AMAZON RIVER EXPEDITION

Imagem: Robson de Matos Calazães (Manicoré-AM, 17 Julho 2018 , 10:45 HL)

Thank you!

I want to see more:

https://sites.google.com/view/amazonriverexpedition