Citizen Science Campaign Spring 2018



March 1st – May 23rd, ~30 pupils, 2 teachers, 3 divers, 2 assistants of ASK

Spatial distribution (16 locations)

Temporal distribution distribution (98 measurements)





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DATA PROCESSING

1. Quality control

2. 3d - time-space interpolation of
irregularly distributed data
(3d-gridding => x,y,t-dataset)

- 3. Time slices gridding
- 4. Visualization in GIS







NO3 – maps

(High spatial variation => interpolation difficult, careful interpretation)



Left: weeks 9, 11,13,15,17,19,21 Below: week 12 in GIS

xib



Arnulf Schiller, Geological Survey of Austria

CECyTE spring measurements



Xib_TCS Dat	a sheet 2nd CECyTE campaign	March-May 2	018			01.03.2018								
						23.05.2018								
Name	Well_name	well_gps:La	well_gps:Lo	Date	time UTC	date		NO3	NO2	GH	kH	pН	CI	CO2
Jorge Danie	Cenote chemuyil	20.2154371	-87.465262	Thu Mar 01 00:00:00	20:35:00	01.03.2018	01.03.2018	0	0	21	0	6.8	0	15
Jorge Danie	Cenote chemuyil	20.2154432	-87.465272	Sun Mar 04 00:00:00	21:00:00	04.03.2018	04.03.2018	50	10	21	20	8	1.5	15
Jorge Danie	Cenote chemuyil	20.215416	-87.465276	Thu Mar 08 00:00:00	19:43:00	08.03.2018	08.03.2018	10	0	21	20	8	1.5	15
Jorge Danie	Cenote chemuyil	20.2153001	-87.465335	Thu Mar 22 00:00:00	22:30:00	22.03.2018	22.03.2018	0	0	21	20	7.2	0	35
Jorge Danie	Cenote chemuyil	19.5765867	-88.039158	Mon Mar 19 00:00:0	20:20:00	19.03.2018	19.03.2018	10	0.25	21	20	7.8	0	15
Jorge Danie	Cenote chemuyil	19.576736	-88.039044	Tue Mar 27 00:00:00	21:20:00	27.03.2018	27.03.2018	25	0.5	21	10	/	1.5	30
Jorge Danie	Cenote chemuyil	19.5766796	-88.039139	Sun Apr 29 00:00:00	20:21:00	29.03.2018	29.03.2018	10	0.5	21	15	7.8	0	15
Jorge Danie	Cenote chemuyii	19.5767124	-88.039055	Fri Apr 06 00:00:00 0	18:52:00	06.04.2018	00.04.2018	50	10	/	0	1.2	1.5	15
Jorge Danie	Cenote chemuyil	19.5/6/035	-88.059095	Sun Apr 08 00:00:00	20:35:00	11.04.2018	11 04 2018	10	0.25	21	20	7.6	0	15
Jorge Danie	Cenote chemuvil	20.2155085	-87.403322	Tue Apr 17 00:00:00	22:45:00	17.04.2018	17.04.2018	10	0.25	21	20	7.0	0	15
Jorge Danie	Cenote Chemuvil	20.0090117	-87.075005	Tue May 01 00:00:00	18:35:00	01.05.2018	01.05.2018	10	0.25	21	20	7.0	0	15
Jose Maria	Cenote Chemuvil	20.3480441	-87.35/085	Fri May 04 00:00:00	19:40:00	04.05.2018	04.05.2018	25	0.25	21	15	7.4	0.8	15
Jose Maria	Cenote Chemuvil	20.3400441	-07.004900	Wed May 09 00:00:0	19:30:00	09.05.2018	09.05.2018		0.25	21	20	7.4	0.0	20
Jose Maria	Cenote Chemuvil	20 3478459	-87 354972	Fri May 11 00:00:00	21:30:00	11 05 2018	11 05 2018	10	0.25	21	20	7.6	0.8	15
lose Maria	Cenote Chemuvil	20.3477612	-87 354985	Wed May 16 00:00:0	17:50:00	16 05 2018	16 05 2018	10	0.25	21	20	7.4	0	20
Jose Maria	Cenote Chemuvil	20.3477571	-87.354988	Fri May 18 00:00:00	20:40:00	18.05.2018	18.05.2018	10	0.25	21	20	7.2	0	35
Tomas Herr	Cenote cristal	20.2170465	-87.47685	Thu Mar 01 00:00:00	00:04:00	01.03.2018	01.03.2018	25	0.25	22	15	0.8	0	14
Tomas Herr	Cenote cristal			Wed Mar 07 00:00:0	21:04:00	07.03.2018	07.03.2018	0	0	22	15	7.6	0	14
Tomas Herr	Cenote cristal			Sat Mar 10 00:00:00	20:26:00	10.03.2018	10.03.2018	0	0	22	15	7.8	0	14
Tomas Herr	Cenote cristal			Wed Mar 14 00:00:0	20:54:00	14.03.2018	14.03.2018	0	0	22	15	7.6	0	14
Tomas Herr	Cenote cristal	20.2045963	-87.508844	Wed Mar 21 00:00:0	01:20:00	21.03.2018	21.03.2018	0	0	22	15	7.6	0	14
TomÃis Her	Cenote cristal	20.2046426	-87.508901	Fri Mar 30 00:00:00	22:41:00	30.03.2018	30.03.2018	0	0	22	15	7.8	0.8	14
TomÃis Her	Cenote cristal	20.2047129	-87.508912	Sat Mar 31 00:00:00	09:06:00	31.03.2018	31.03.2018	10	0.25	22	15	7.6	0	14
TomÃis Her	Cenote cristal	20.20463	-87.508828	Wed Apr 04 00:00:0	03:14:00	04.04.2018	04.04.2018	10	0.25	22	15	7.6	0	14
TomÃis Her	Cenote cristal	20.2045835	-87.509075	Wed Apr 11 00:00:0	01:53:00	11.04.2018	11.04.2018	10	0.25	22	15	7.8	0.8	14
TomÃis Her	Cenote cristal	20.2045965	-87.508917	Sun Apr 15 00:00:00	07:07:00	15.04.2018	15.04.2018	10	0	22	20	7.6	0	15
TomĂis Her	Cenote cristal	20.2046301	-87.508898	Sun Apr 22 00:00:00	22:36:00	22.04.2018	22.04.2018	25	0.25	22	15	7.6	0	14
TomĂis Her	Cenote cristal	20.2046573	-87.508845	Wed Apr 18 00:00:0	22:50:00	18.04.2018	18.04.2018	10	0	22	15	7.8	0.8	14
TomAis Her	Cenote cristal	20.2046301	-87.50884	Sun Apr 29 00:00:00	00:18:00	29.04.2018	29.04.2018	0	0	22	8	8.2	0	14
TomAis Her	Cenote cristal	20.2046253	-87.508874	Thu Apr 26 00:00:00	00:19:00	26.04.2018	26.04.2018	0	0	22	20	7.6	0	14
Tino Alfredo	Ecochemuyil	20.3481027	-87.352925	Thu Mar 01 00:00:00	00:27:00	01.03.2018	01.03.2018	10	0.25	22	20	8.2	0	14
Brandon Me	Ecochemuyil	20.3481052	-87.352922	Mon Mar 05 00:00:0	22:31:00	05.03.2018	05.03.2018	10	0.25	22	15	7	1.5	35
Jose Gabrie	Ecochemuyil	20.3481174	-87.352927	Thu Mar 08 00:00:00	23:15:00	08.03.2018	08.03.2018	10	0	22	21	8.2	0	14
Cesiah Kere	Ecochemuyil	20.3481017	-87.352933	Mon Mar 12 00:00:0	23:37:00	12.03.2018	12.03.2018	25	0.5	22	21	7.8	0	14
Tino Alfredo	Ecochemuyii	20.34811/3	-87.352933	Mon Mar 19 00:00:0	21:40:00	19.03.2018	19.03.2018	25	0.25	22	21	7.8	0.8	14
Cosiph koro	Ecochemusil	20.3403824	-87.555191	Mon Mar 22 00:00:00	20.56.00	22.05.2018	22.05.2018	10	0.25	22	20	7.2	0	35
Reandon Me	Ecochemusil	20.3481219	-87.332929	Thu Mar 20 00:00:0	20.12.00	20.05.2018	20.05.2018	40	0.5	22	21	7.6	0	14
Cesiab Hau	Ecochemuvil	20.3422504	-87.353333	Thu Mar 25 00:00:00	20:57:00	05.04.2018	05.04.2018	25	0.25	22	20	7.0	0	35
Tipo Garma	Ecochemuvil	20.3481038	-87 353	Thu Apr 03 00:00:00	21:37:00	12 04 2018	12 04 2018	25	0.25	22	20	7.2	0.8	14
Tino Garma	Ecochemuvil	20.3480977	-87 352946	Mon Apr 16 00:00:00	00:49:00	16.04.2018	16.04.2018	10	0.25	22	20	8.2	0.8	14
Cesiah Hau	Ecochemuvil	20.3487593	-87 353303	Fri Apr 20.00:00:00 I	00:07:00	20.04.2018	20.04.2018	10	0.25	22	20	7.6	0.0	14
Gabriel Mer	Ecochemuvil	20.3481075	-87.352924	Mon Apr 23 00:00:0	21:10:00	23.04.2018	23.04.2018	10	0.25	21	20	7.6	0	15
Tino Garma	Ecochemuvil	20.3480961	-87.352946	Sat Apr 28 00:00:00	00:48:00	28.04.2018	28.04.2018	10	0.25	22	20	7.8	0	14
Brandon me	Ecochemuyil	20.340342	-87.353117	Mon Apr 30 00:00:00	18:36:00	30.04.2018	30.04.2018	10	0.5	22	20	7.6	0	15
Tino Garma	Ecochemuyil	20.3481062	-87.352922	Thu May 10 00:00:00	22:26:00	10.05.2018	10.05.2018	10	0.25	22	20	7.6	0	15
Brandon Me	Ecochemuyil	20.348106	-87.35296	Wed May 23 00:00:0	21:36:00	23.05.2018	23.05.2018	10	0.25	22	20	7.8	0	14
Skanda	Monkey dust	20.1884162	-87.550161	Fri May 11 00:00:00	18:51:00	11.05.2018	11.05.2018	10	0.25	21	20	7.8	0	
Esther Garci	Pozo de nayeli	20.2161172	-87.475772	Wed Mar 21 00:00:0	19:22:00	21.03.2018	21.03.2018	40	0.25	22	20	8.2	0.8	14
Deysi paatt	Pozo de nayeli	20.2161172	-87.475772	Mon Mar 19 00:00:0	21:48:00	19.03.2018	19.03.2018	25	0.25	22	15	7.8	0.8	14
Manuel ma	Pozo de nayeli	20.2159574	-87.475619	Sat Mar 17 00:00:00	19:34:00	17.03.2018	17.03.2018	10	0.25	22	15	7.8	1.5	14
Alondra SÃi	Pozo de nayeli			Tue Mar 13 00:00:00	18:48:00	13.03.2018	13.03.2018	25	0.25	21	15	8	0	15
							00.01.1900							
Silvia	Xibalba	20.2059302	-87.509048	Sat Mar 10 00:00:00	19:07:00	10.03.2018	10.03.2018	10	0	21	20	7.6	0	15
Silvia	Xibalba	20.2058725	-87.508997	Thu Mar 08 00:00:00	18:47:00	08.03.2018	08.03.2018	0	1	7	8	6.4	1.5	35
Silvia	Xibalba	20.2058352	-87.50909	Wed Mar 14 00:00:0	17:44:00	14.03.2018	14.03.2018	175	2	20	15	7.8	0	15
Silvia	Xibalba	20.2058667	-87.50898	Sat Mar 17 00:00:00	19:35:00	17.03.2018	17.03.2018	25	0.5	21	20	7	0	35
SIIVIa	XIDalba	20.2058235	-87.509024	wed Mar 21 00:00:0	19:09:00	21.03.2018	21.03.2018	25	0.5	22	15	7.2	0	25
SIIVIA	Albalba	20.2059889	-87.509047	won war 26 00:00:0	17:18:00	26.03.2018	26.03.2018	25	0.5	22	15	/.6	0	14
Silvis	Vibalba	20.2059623	-67.509087	Sat War 31 00:00:00	18:46:00	51.05.2018	51.05.2018	10	0.25	22	21	8.2	0.8	14
Silvia	Xibalba	20.2184023	-87.4021/2	Sat Apr 07 00:00:00	20.04:00	07.04.2018	07.04.2018	25	0.5	22	20	70		14
Silvia	Xibalba	20.2104438	-87,402105	Wed Apr 19 00:00:00	20.55:00	18 04 2018	18.04.2018	25	0.25	22	20	7.8		14
Silvia	Xibalba	20 2182776	-87 462287	Wed Apr 11 00:00:0	18:26:00	11 04 2018	11 04 2018	25	0.5	22	15	7.4		15
Silvia	Xibalba	20 218303	-87 462166	Sat Apr 14 00:00:00	20:25:00	14 04 2018	14 04 2018	25	0.5	22	21	2.0		10
Silvia	Xibalba	20.2183183	-87.462143	Sat Apr 21 00:00:00	19:20:00	21.04.2018	21.04.2018	25	0.5	22	21	7.6	0	15
Silvia	Xibalba	20.2183953	-87.462027	Wed Apr 25 00:00:0	17:57:00	25.04.2018	25.04.2018	25	0.5	22	15	7.8	0	14
Silvia	Xibalba	20.2183428	-87.462084	Sat Apr 28 00:00:00	20:21:00	28.04.2018	28.04.2018	25	0.25	22	15	8.2	0	14
Silvia	Xibalba	20.2183865	-87.462066	Wed May 02 00:00:0	17:58:00	02.05.2018	02.05.2018	25	0.5	22	15		Ĭ	-1
Silvia	Xibalba	20.2183807	-87.462077	Sat May 05 00:00:00	16:20:00	05.05.2018	05.05.2018	25	0.5	22	15	7.6	0	14
Silvia	Xibalba	20.2183271	-87.462145	Wed May 09 00:00:0	18:19:00	09.05.2018	09.05.2018	25	0.5	22	21	7.8	0	14
Silvia	Xibalba	20.2184122	-87.462121	Sat May 12 00:00:00	17:13:00	12.05.2018	12.05.2018	25	0.5	22	21	7.6	0	15
Silvia	Xibalba	20.218374	-87.462085	Wed May 16 00:00:0	17:59:00	16.05.2018	16.05.2018	40	1	22	21	7.6	0	15
		21.1511189	-86.822191	Tue Mar 20 00:00:00	18:35:00	20.03.2018	20.03.2018							

























Interpretation:

- temporally moderate to high NO3-contamination in Cenotes Xibalba, Chemuyil, Cristal
- Simultanous Cl2-rise indicates water originating from public water supply => waste water input, NO3 rise without Cl2 rise indicates different origin.
- Pozo de Nayeli: Higher pH => salt water influence.
- pH temporally also high at other locations which may also be a consequence of saltwater presence.
- High CO₂ variation at locations Xibalba and Chemuyil, constant CO₂ at Ecochemuyil and Cristal reasons to be analysed.



Time series: Comparison Cenotes Xibalba (south, blue) Chemuyil (north, orange) 8.3. - 16.5. 2018

Red marked period: Indication of possible wastewater input in Cenote Chemuyil (orange)





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CO2

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Citizen Science – Summary of experience:



- Xib_TCS = test of a new method (,complex sensor network', capturing dynamics)
- Reaching citizen scientists (Internet $\sqrt{1}$, direct contact, events, schools (1))
- Significant organizational and social effort (local mobilizer, cont. support)
- Data quality control
- Feed back (communicating significance of results, successes, problems,...)
- Transmission/publication of data and results considering stakeholders => sensitive (population, tourism, community, education, preservation of nature and culture)
- Slow start but interest and problem awarness accelerating (schools are doors to community, CS projects need ,warm up')
- High potential in optimizing integration of classic, automatic and citizen science monitoring