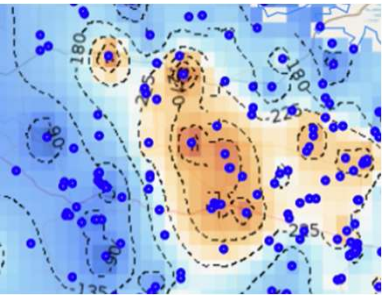
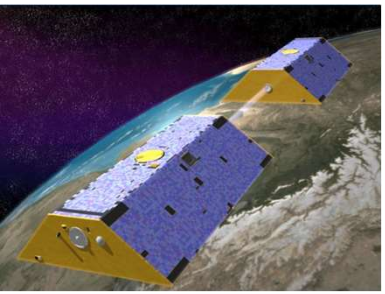
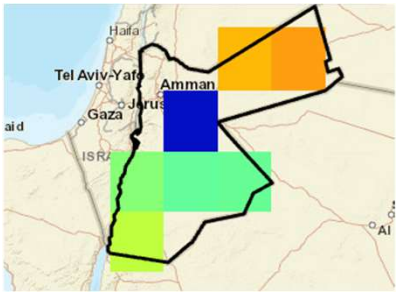
GRACE Groundwater Analysis for Jordan and Palestine

Use of the Gravity Recovery and Climate Experiment (GRACE) mission to monitor groundwater storage change: National workshop for Jordan and State of Palestine

Amman Jordan, February 25-26



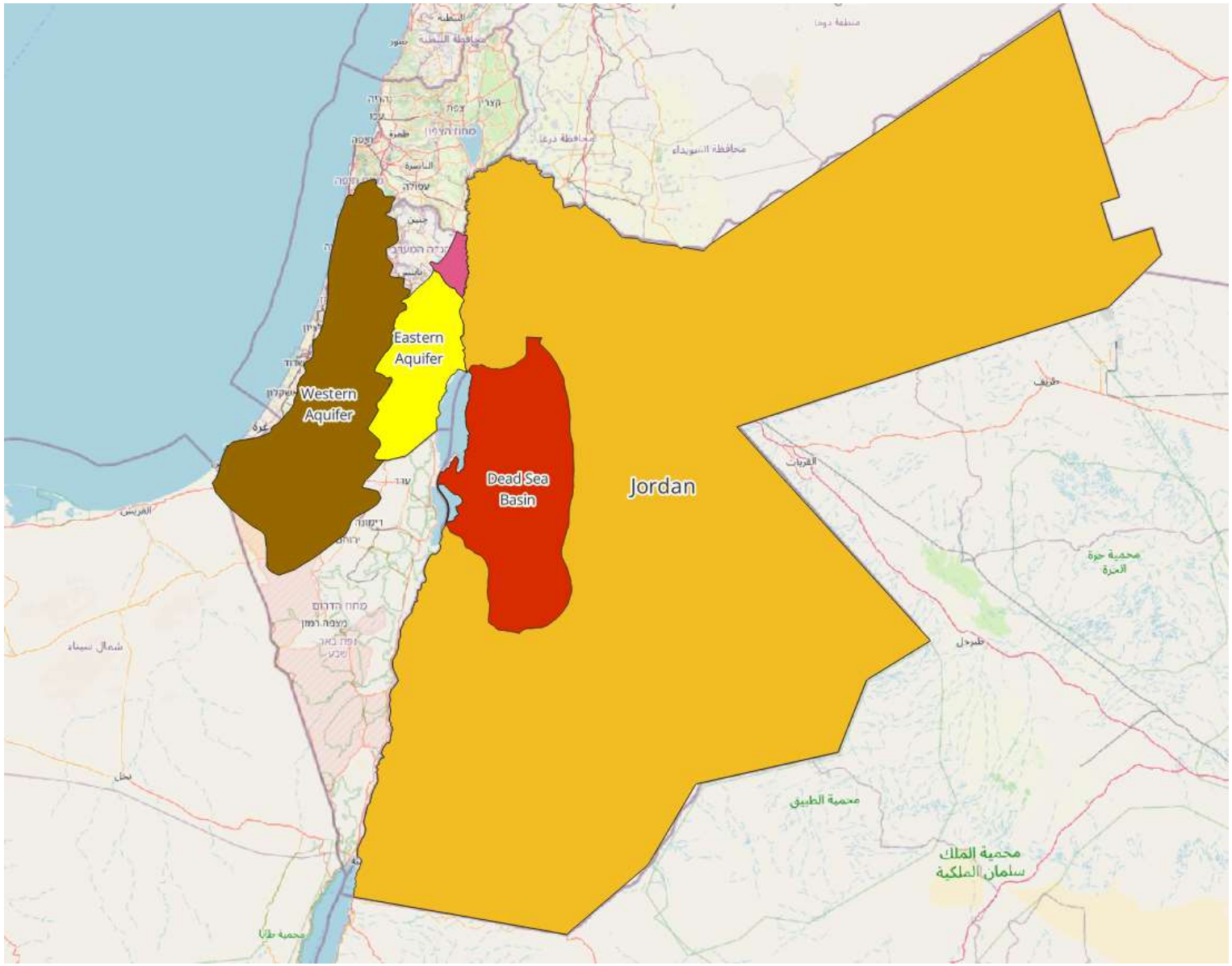




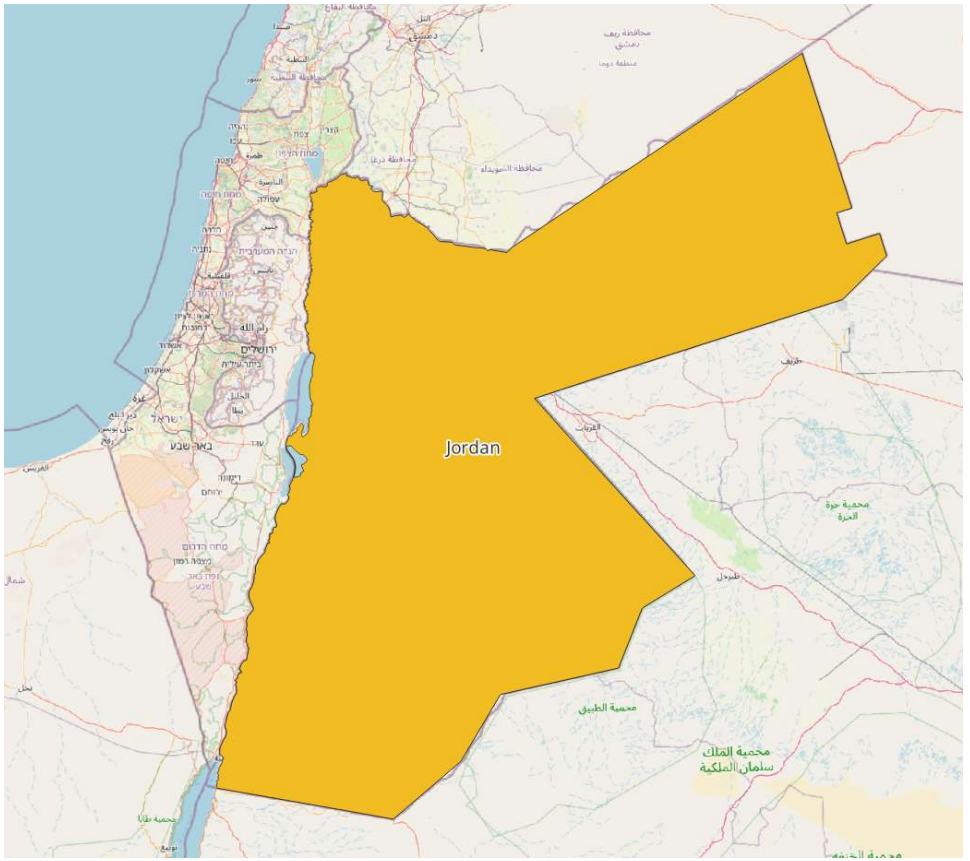
UNITED NATIONS
ESCWA
الاسكوا

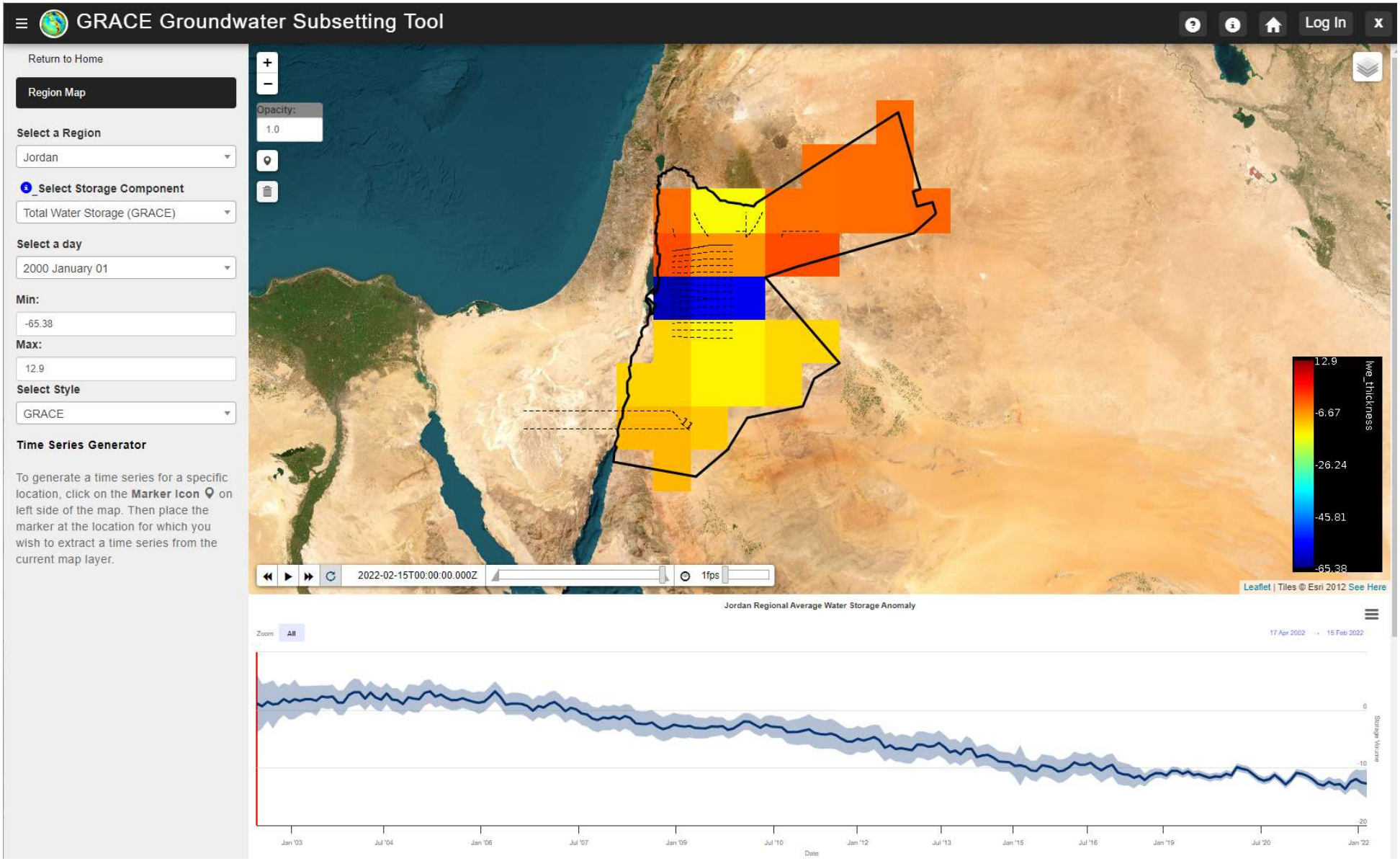
Shared Prosperity Dignified Life

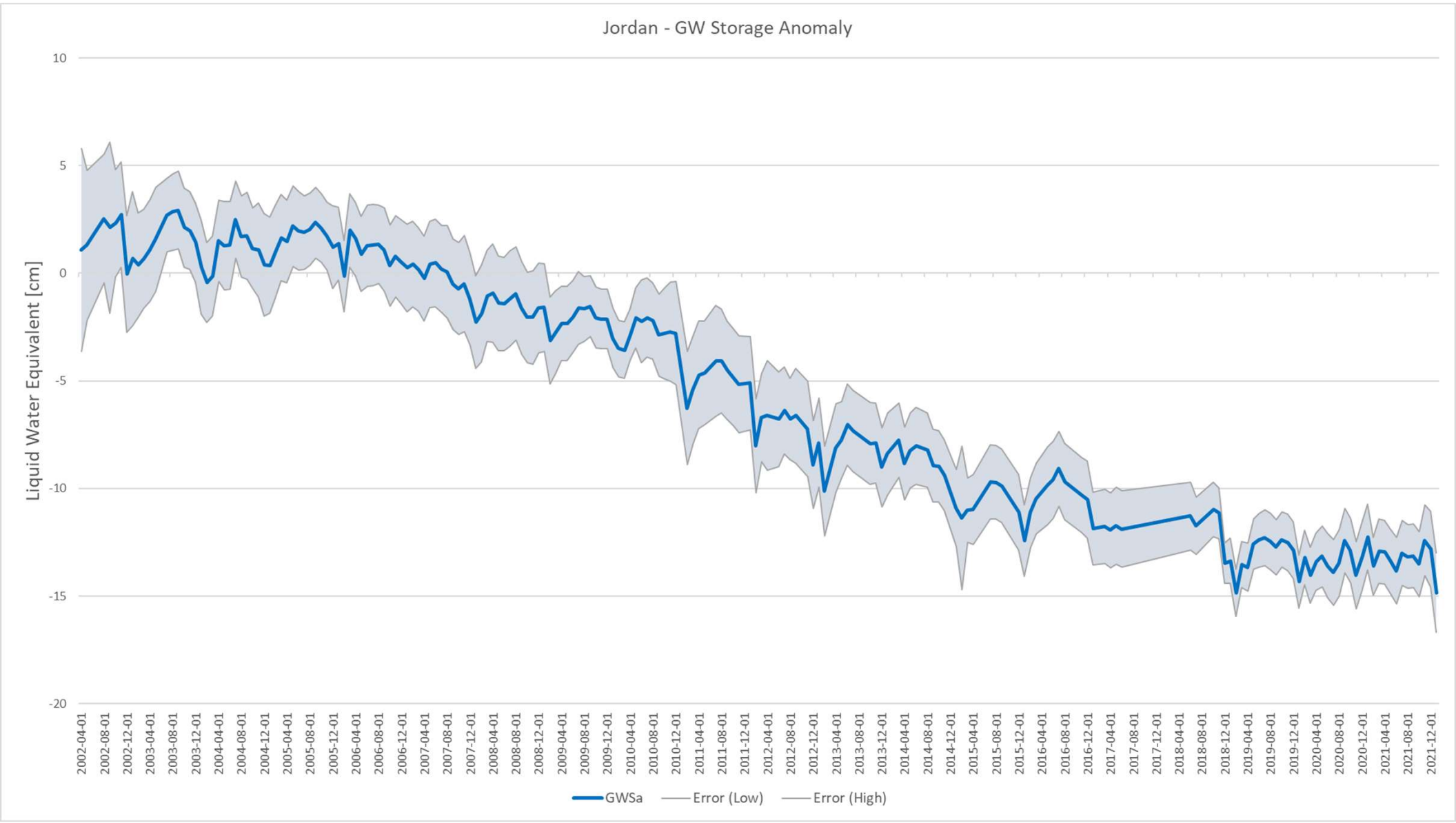
Sweden
Sverige

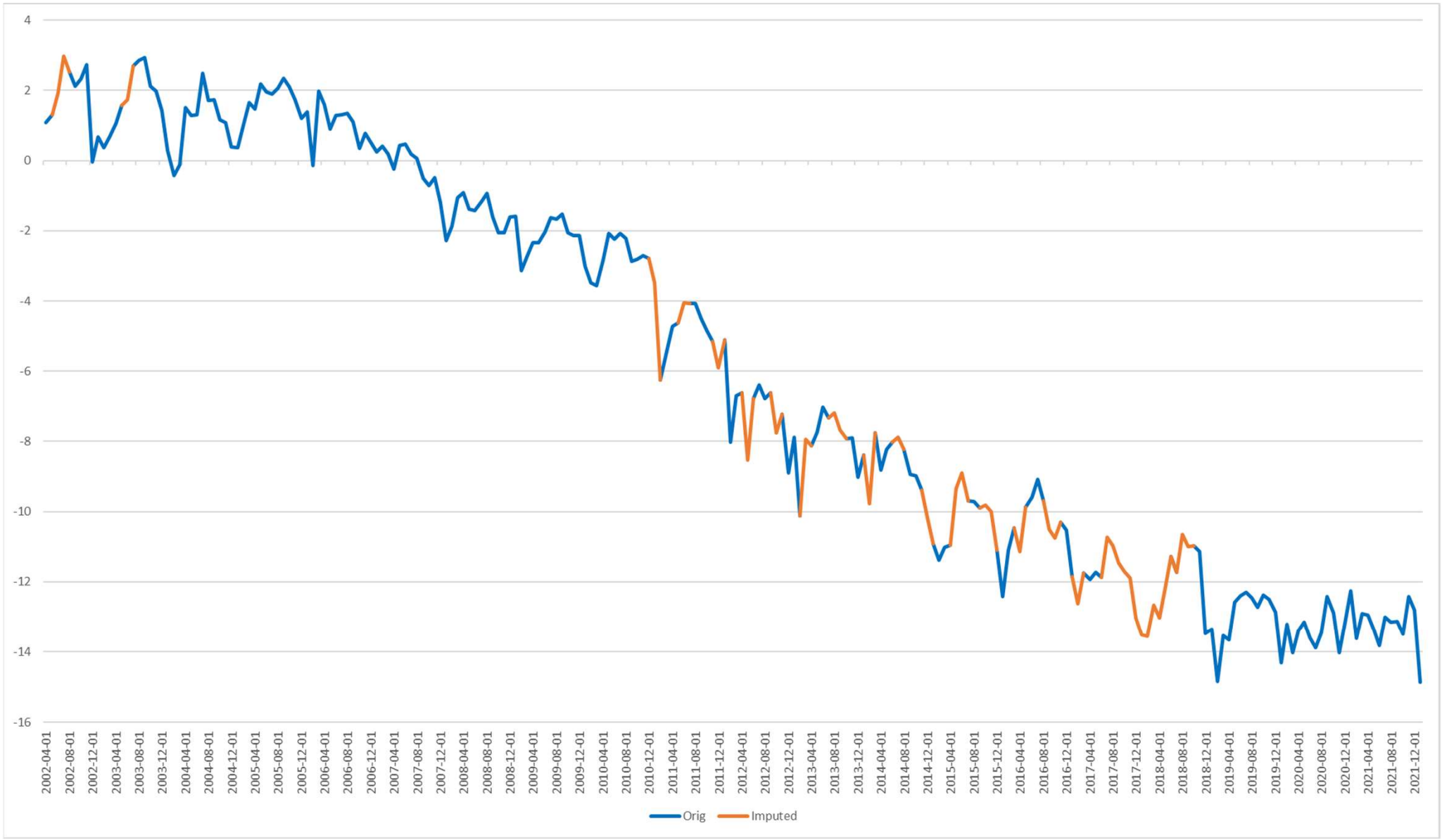

Eastern
Aquifer
Western
Aquifer
Dead Sea
Basin
Jordan

Jordan

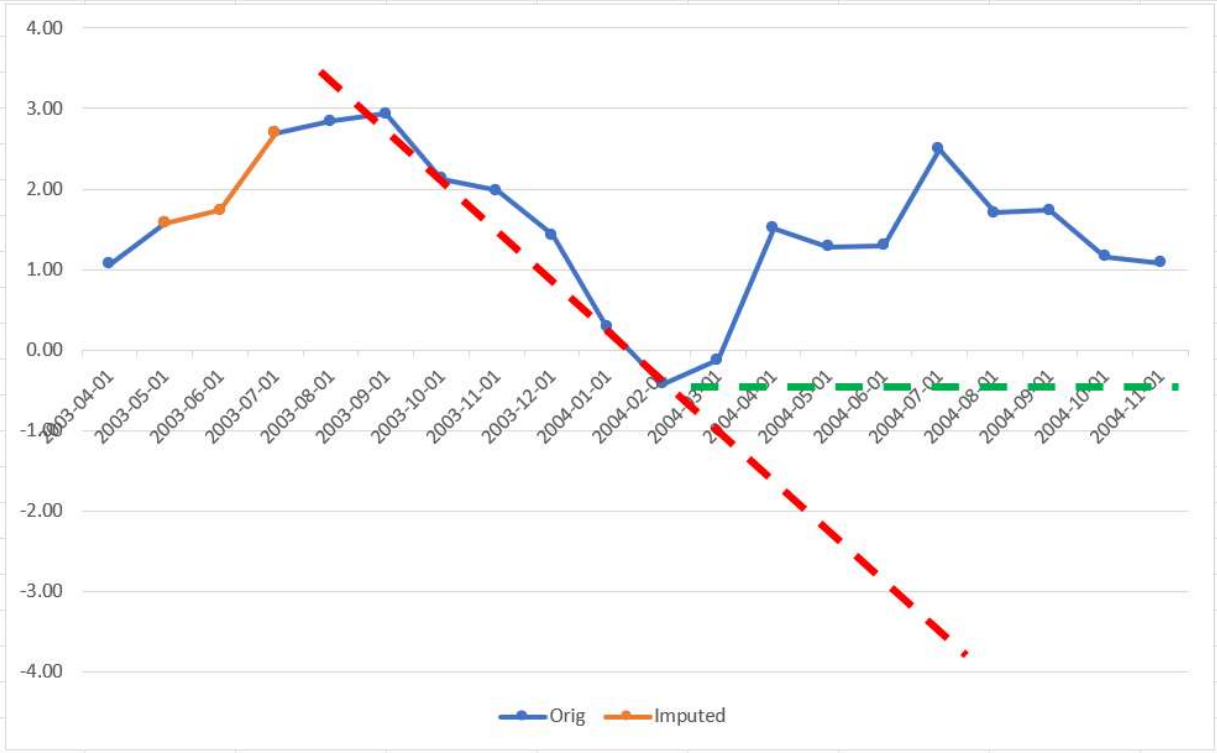

Jordan
ירושלים
באר שבע
محمية الطبق
محمية الملك سلمان الملكية


GRACE Groundwater Subsetting Tool
Log In
Return to Home
Region Map
Select a Region
Jordan
Select Storage Component
Total Water Storage (GRACE)
Select a day
2000 January 01
Min:
-65.38
Max:
12.9
Select Style
GRACE
Time Series Generator
To generate a time series for a specific location, click on the Marker Icon on left side of the map. Then place the marker at the location for which you wish to extract a time series from the current map layer.
Opacity:
1.0
2022-02-15T00:00:00.000Z
1fps
12.9
-6.67
-26.24
-45.81
-65.38
lwe_thickness
Leaflet | Tiles © Esri 2012 See Here
Jordan Regional Average Water Storage Anomaly
Zoom
All
17 Apr 2002
15 Feb 2022
Jan '03
Jul '04
Jan '06
Jul '07
Jan '09
Jul '10
Jan '12
Jul '13
Jan '15
Jul '16
Jan '19
Jul '20
Jan '22
Date


Jordan - GW Storage Anomaly
Liquid Water Equivalent [cm]
10
5
0
-5
-10
-15
-20
2002-04-01
2002-08-01
2002-12-01
2003-04-01
2003-08-01
2003-12-01
2004-04-01
2004-08-01
2004-12-01
2005-04-01
2005-08-01
2005-12-01
2006-04-01
2006-08-01
2006-12-01
2007-04-01
2007-08-01
2007-12-01
2008-04-01
2008-08-01
2008-12-01
2009-04-01
2009-08-01
2009-12-01
2010-04-01
2010-08-01
2010-12-01
2011-04-01
2011-08-01
2011-12-01
2012-04-01
2012-08-01
2012-12-01
2013-04-01
2013-08-01
2013-12-01
2014-04-01
2014-08-01
2014-12-01
2015-04-01
2015-08-01
2015-12-01
2016-04-01
2016-08-01
2016-12-01
2017-04-01
2017-08-01
2017-12-01
2018-04-01
2018-08-01
2018-12-01
2019-04-01
2019-08-01
2019-12-01
2020-04-01
2020-08-01
2020-12-01
2021-04-01
2021-08-01
2021-12-01
GWSa
Error (Low)
Error (High)

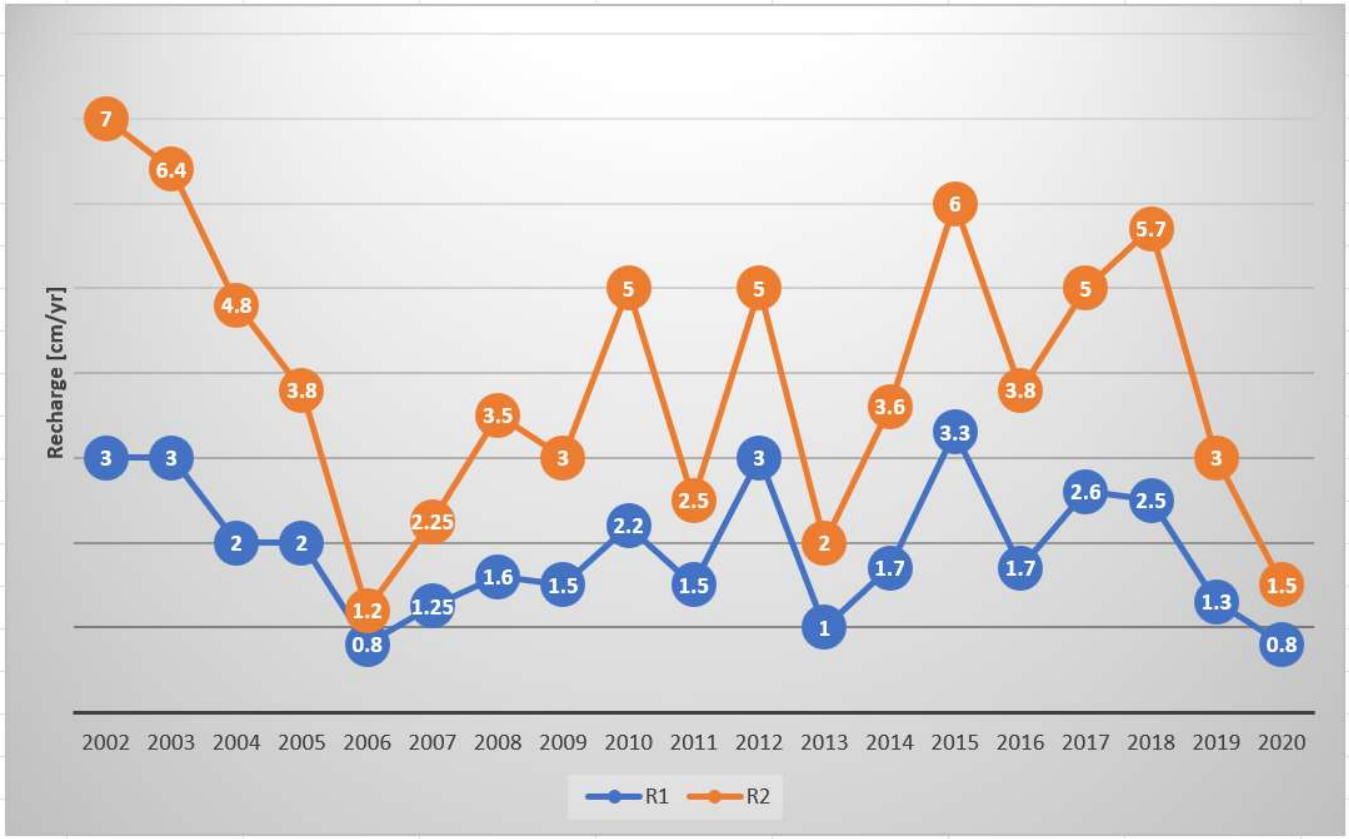

4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
2002-04-01
2002-08-01
2002-12-01
2003-04-01
2003-08-01
2003-12-01
2004-04-01
2004-08-01
2004-12-01
2005-04-01
2005-08-01
2005-12-01
2006-04-01
2006-08-01
2006-12-01
2007-04-01
2007-08-01
2007-12-01
2008-04-01
2008-08-01
2008-12-01
2009-04-01
2009-08-01
2009-12-01
2010-04-01
2010-08-01
2010-12-01
2011-04-01
2011-08-01
2011-12-01
2012-04-01
2012-08-01
2012-12-01
2013-04-01
2013-08-01
2013-12-01
2014-04-01
2014-08-01
2014-12-01
2015-04-01
2015-08-01
2015-12-01
2016-04-01
2016-08-01
2016-12-01
2017-04-01
2017-08-01
2017-12-01
2018-04-01
2018-08-01
2018-12-01
2019-04-01
2019-08-01
2019-12-01
2020-04-01
2020-08-01
2020-12-01
2021-04-01
2021-08-01
2021-12-01
Orig
Imputed

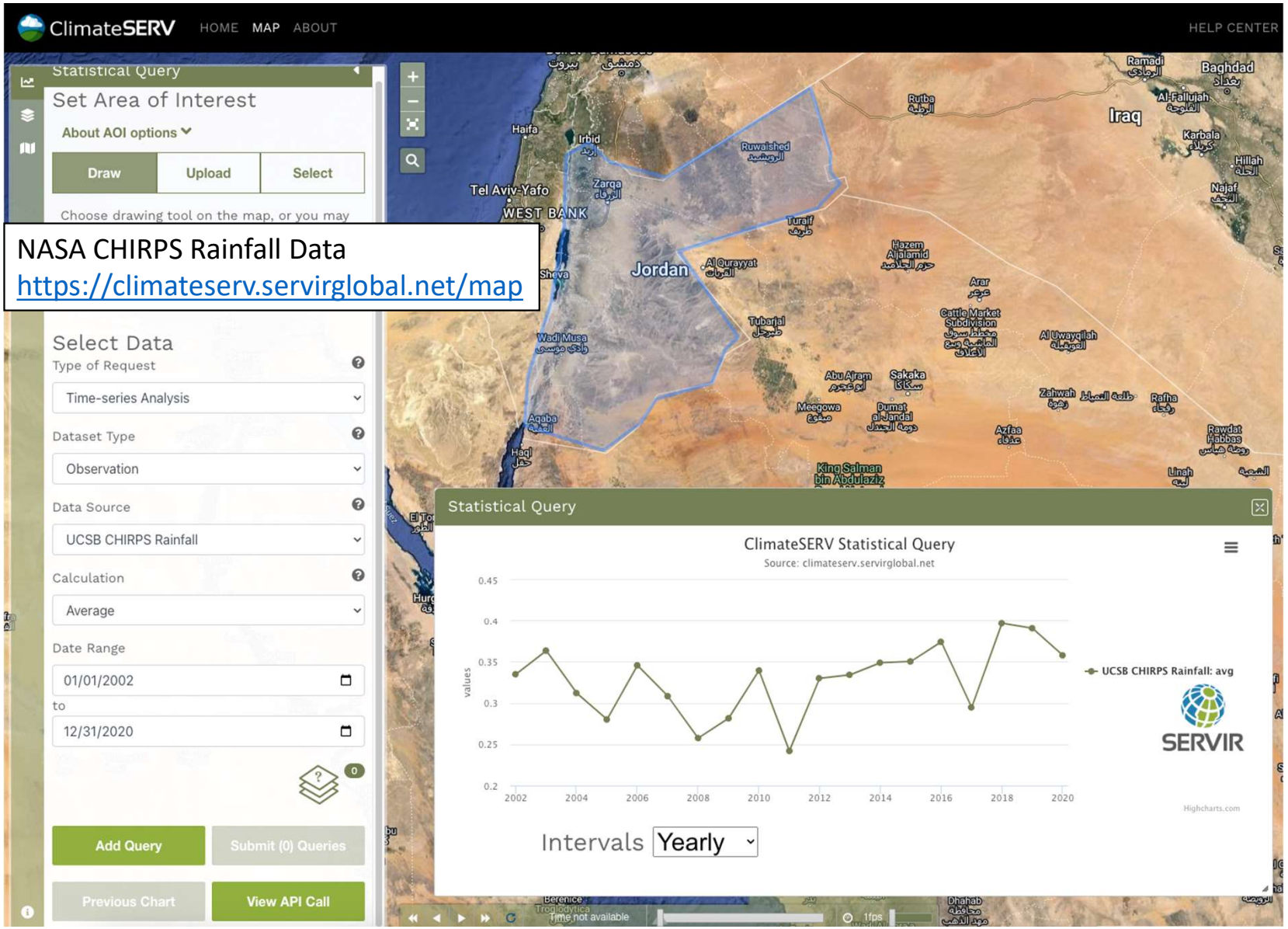
	B	C	D	E	F	G
1	**2003**					
2						
3	**GWSa**	**Orig**	**Imputed**			
4	1.07	1.07	#N/A			
5	1.58	1.58	1.58		SP	2.6
6	1.73	#N/A	1.73		SB	-0.4
7	2.70	2.70	2.70		SL	-3.8
8	2.84	2.84	#N/A			
9	2.93	2.93	#N/A		RS	3
10	2.13	2.13	#N/A		RD	3.4
11	1.98	1.98	#N/A			
12	1.43	1.43	#N/A		R1	**3**
13	0.29	0.29	#N/A		R2	**6.4**
14	-0.42	-0.42	#N/A			
15	-0.13	-0.13	#N/A			
16	1.51	1.51	#N/A			
17	1.28	1.28	#N/A			
18	1.30	1.30	#N/A			
19	2.49	2.49	#N/A			
20	1.70	1.70	#N/A			
21	1.74	1.74	#N/A			
22	1.16	1.16	#N/A			
23	1.08	1.08	#N/A			
24						



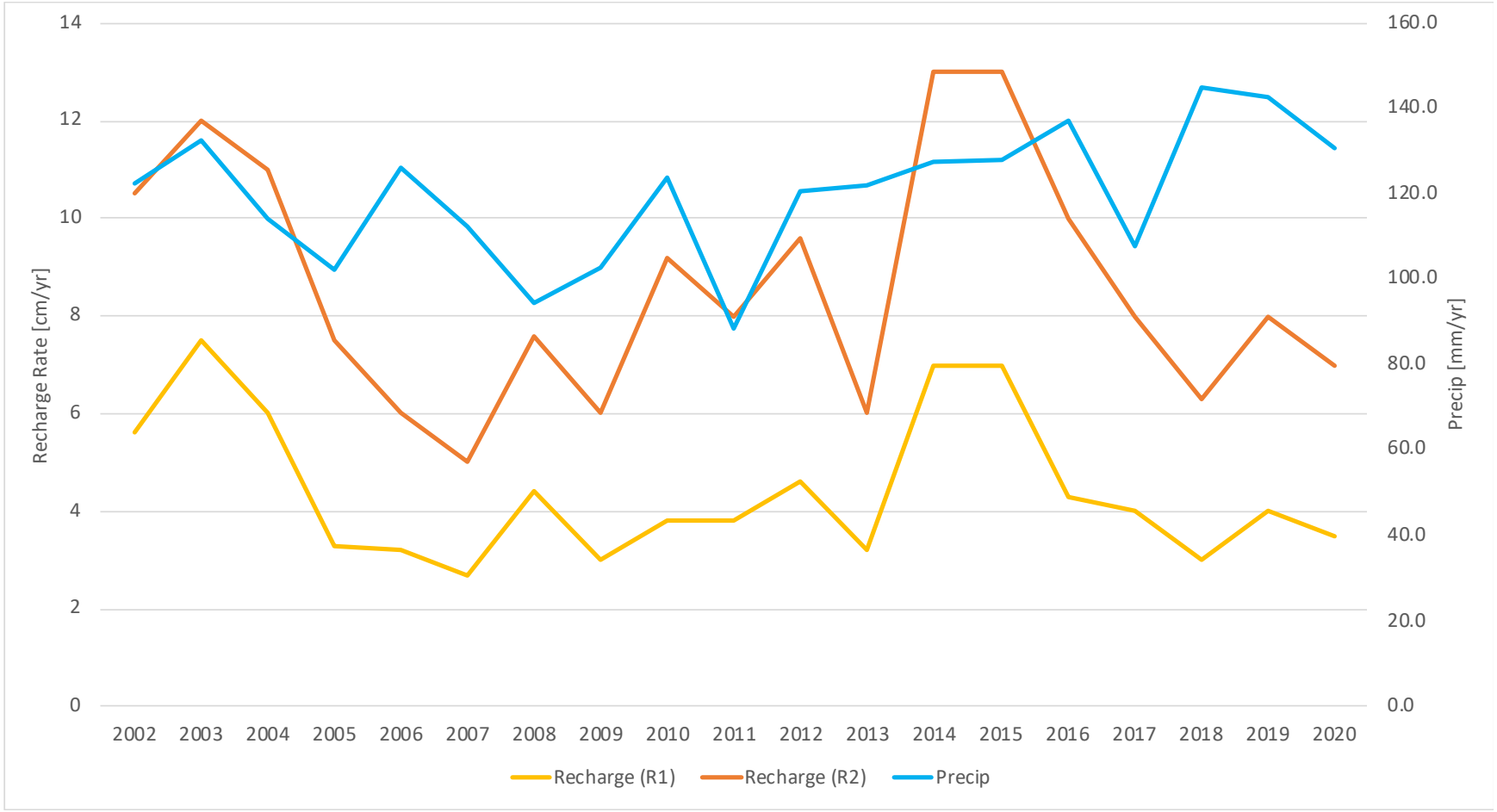
Recharge Rate Sumary

Year	R1	R2
2002	3	7
2003	3	6.4
2004	2	4.8
2005	2	3.8
2006	0.8	1.2
2007	1.25	2.25
2008	1.6	3.5
2009	1.5	3
2010	2.2	5
2011	1.5	2.5
2012	3	5
2013	1	2
2014	1.7	3.6
2015	3.3	6
2016	1.7	3.8
2017	2.6	5
2018	2.5	5.7
2019	1.3	3
2020	0.8	1.5
Mean	**1.9**	**4.0**




ClimateSERV
HOME
MAP
ABOUT
HELP CENTER
Statistical Query
Set Area of Interest
About AOI options
Draw
Upload
Select
Choose drawing tool on the map, or you may
NASA CHIRPS Rainfall Data
https://climateserv.servirglobal.net/map
Select Data
Type of Request
Time-series Analysis
Dataset Type
Observation
Data Source
UCSB CHIRPS Rainfall
Calculation
Average
Date Range
01/01/2002
to
12/31/2020
Add Query
Submit (0) Queries
Previous Chart
View API Call
Statistical Query
ClimateSERV Statistical Query
Source: climateserv.servirglobal.net
values
0.45
0.4
0.35
0.3
0.25
0.2
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
UCSB CHIRPS Rainfall: avg
SERVIR
Highcharts.com
Intervals
Yearly
Jordan
WEST BANK
Iraq
Haifa
Tel Aviv-Yafo
Irbid
Zarqa
Ruwaished
Turaif
Sheva
Al Quraiyyat
Hazem Al Jalamid
Arar
Tubarjal
Wadi Musa
Cattle Market Subdivision
Al Uwayqilah
Abu Ajram
Sakaka
Meegowa
Dumat al Jandal
Zahwah
Rafha
Aqaba
Haql
Azfaa
King Salman bin Abdulaziz
Rawdat Habbas
Ramadi
Baghdad
Al-Fallujah
Karbala
Hillah
Najaf
Rutba
Time not available
1fps

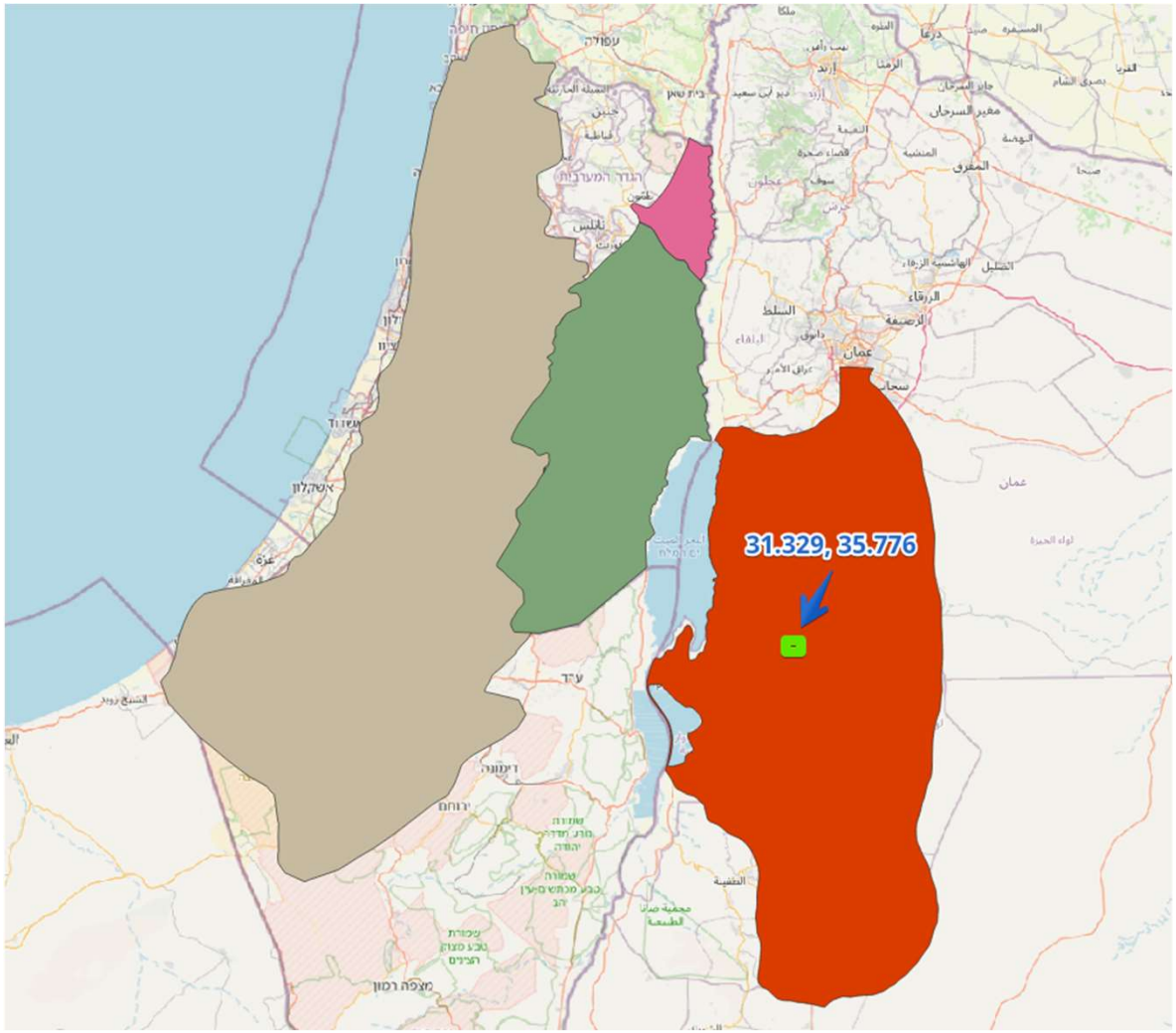
Recharge vs Rainfall - Jordan

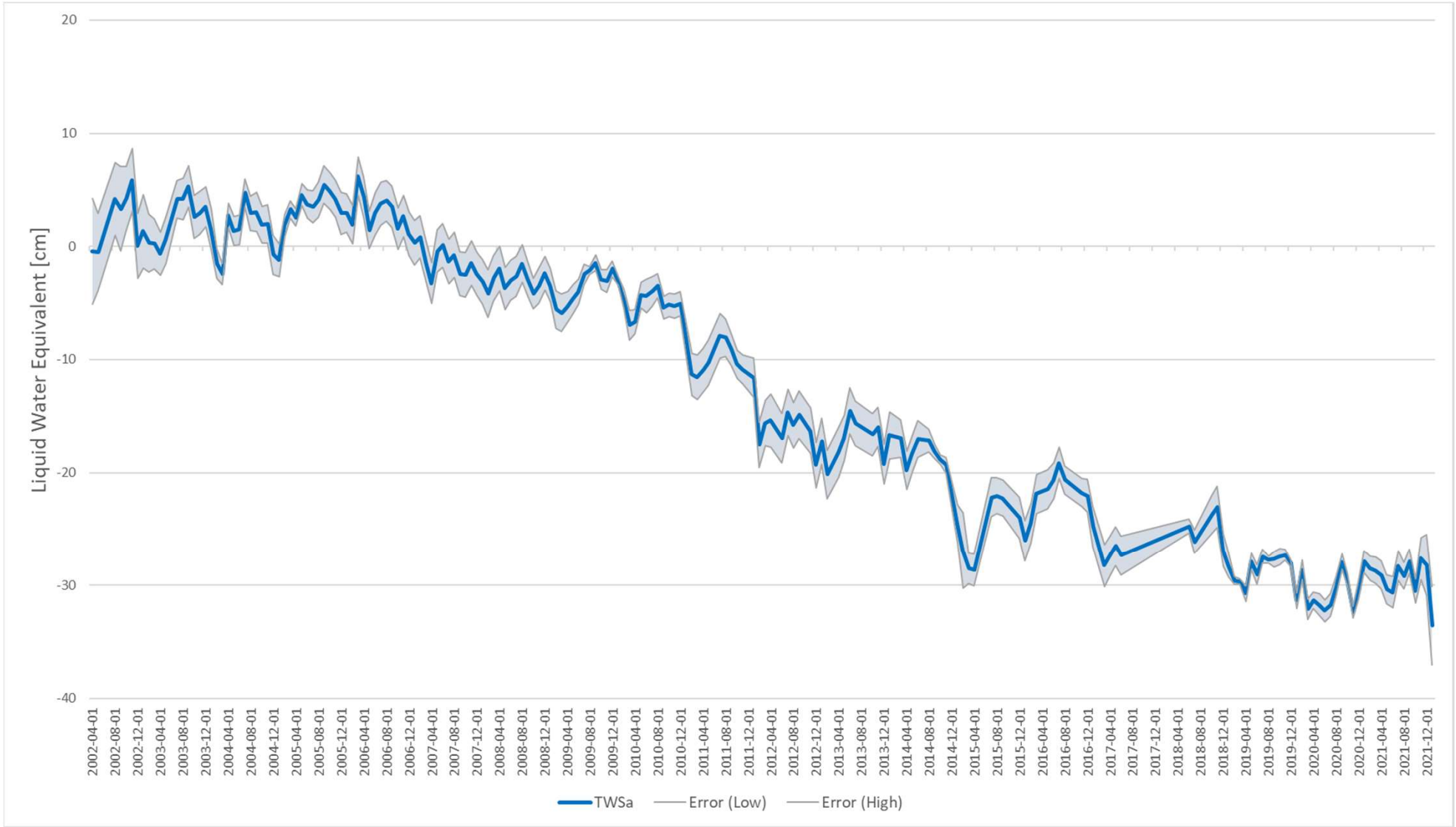


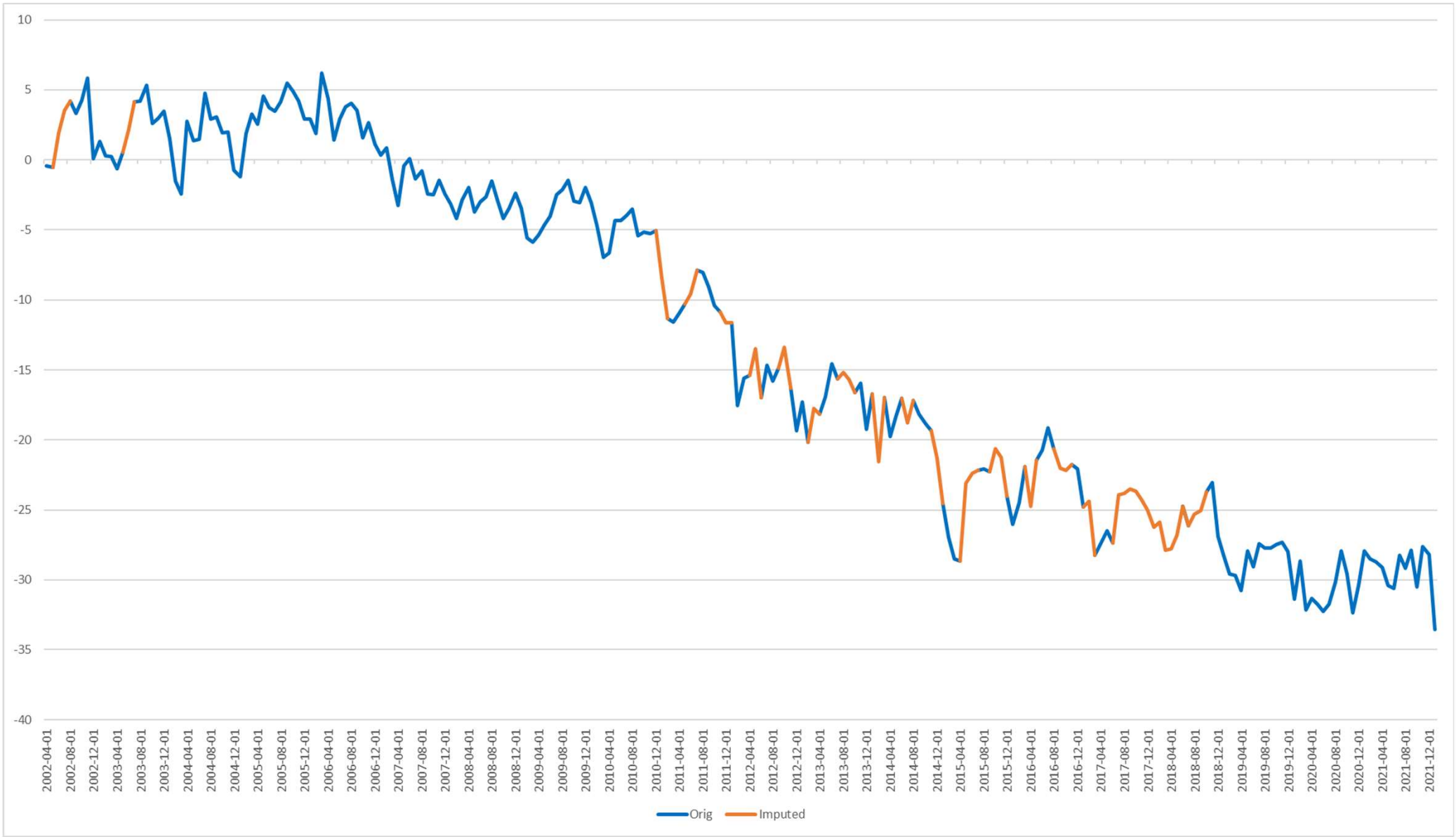
Dead Sea Basin

The basin is too small to process using the regional subsetting. Therefore we selected a point in the basin and performed a point analysis using the GGST API Python script.

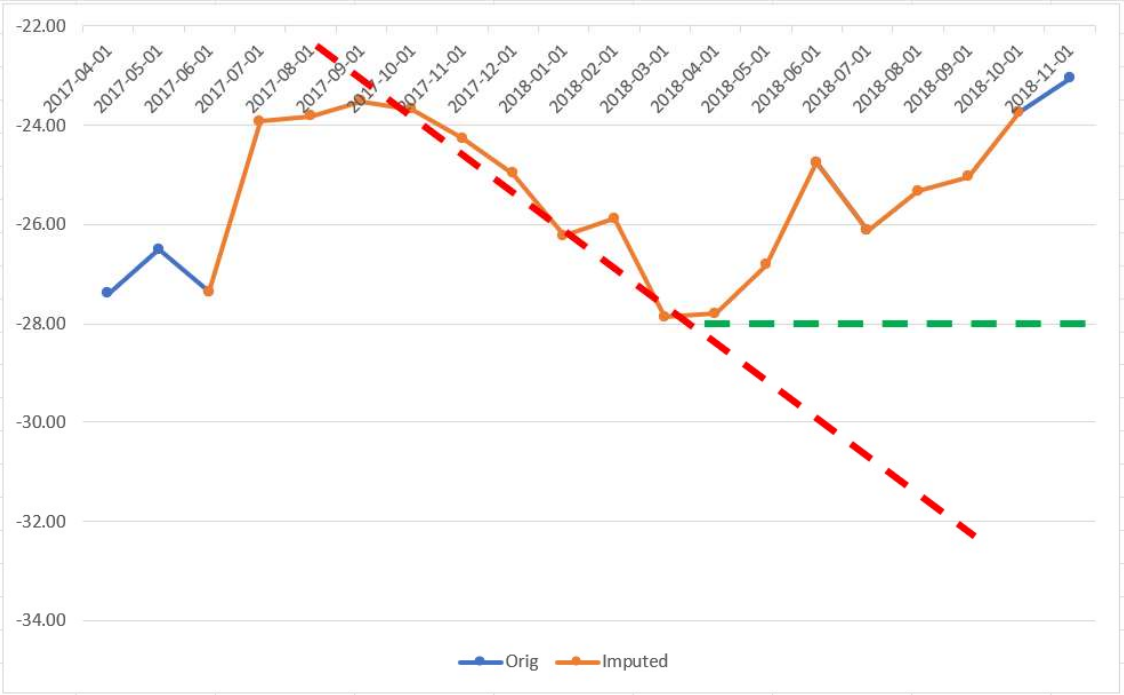
This method finds the GRACE grid cell containing the point and returns the groundwater storage anomaly (GWSa) for that cell.




Liquid Water Equivalent [cm]
20
10
0
-10
-20
-30
-40
2002-04-01
2002-08-01
2002-12-01
2003-04-01
2003-08-01
2003-12-01
2004-04-01
2004-08-01
2004-12-01
2005-04-01
2005-08-01
2005-12-01
2006-04-01
2006-08-01
2006-12-01
2007-04-01
2007-08-01
2007-12-01
2008-04-01
2008-08-01
2008-12-01
2009-04-01
2009-08-01
2009-12-01
2010-04-01
2010-08-01
2010-12-01
2011-04-01
2011-08-01
2011-12-01
2012-04-01
2012-08-01
2012-12-01
2013-04-01
2013-08-01
2013-12-01
2014-04-01
2014-08-01
2014-12-01
2015-04-01
2015-08-01
2015-12-01
2016-04-01
2016-08-01
2016-12-01
2017-04-01
2017-08-01
2017-12-01
2018-04-01
2018-08-01
2018-12-01
2019-04-01
2019-08-01
2019-12-01
2020-04-01
2020-08-01
2020-12-01
2021-04-01
2021-08-01
2021-12-01
TWSa
Error (Low)
Error (High)

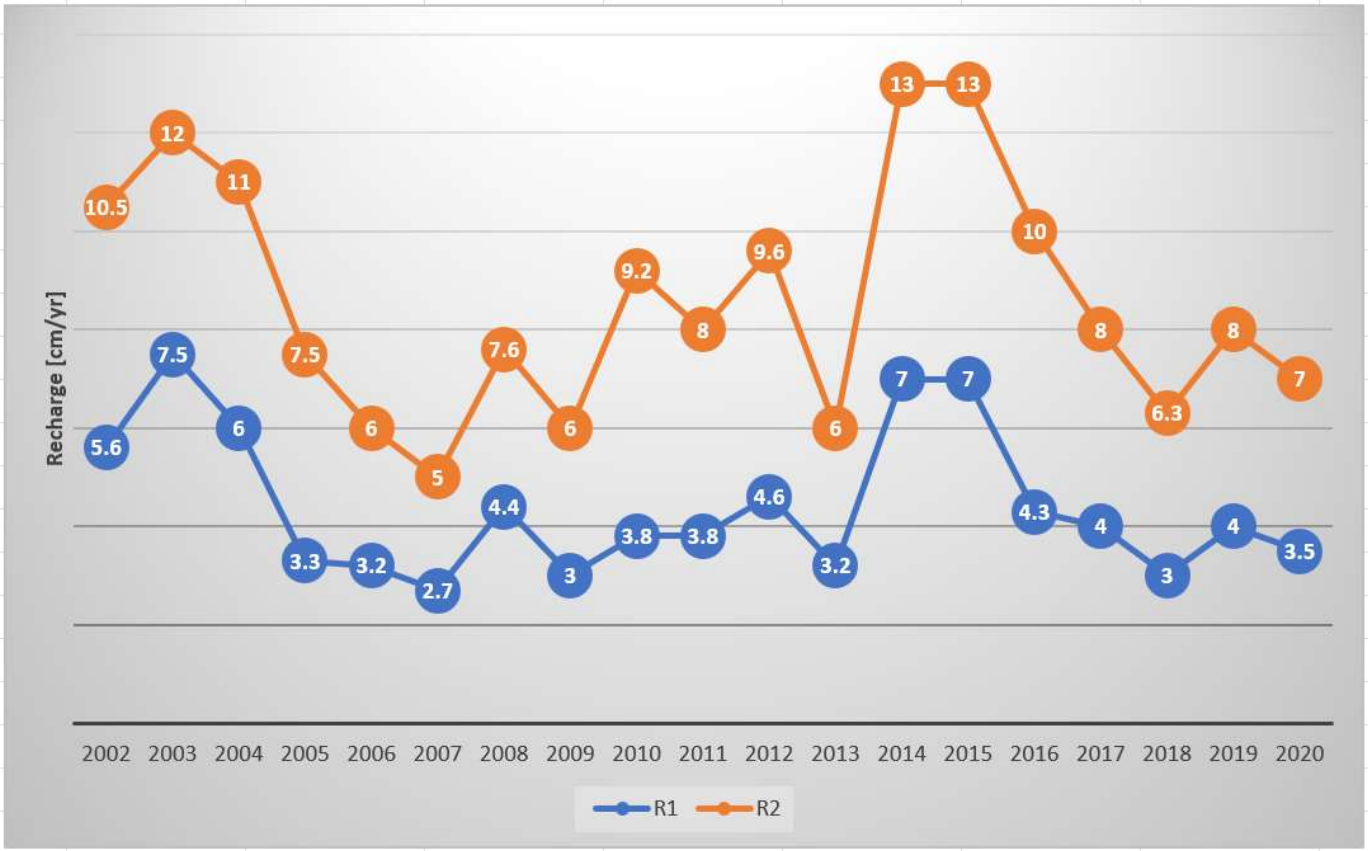

10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
2002-04-01
2002-08-01
2002-12-01
2003-04-01
2003-08-01
2003-12-01
2004-04-01
2004-08-01
2004-12-01
2005-04-01
2005-08-01
2005-12-01
2006-04-01
2006-08-01
2006-12-01
2007-04-01
2007-08-01
2007-12-01
2008-04-01
2008-08-01
2008-12-01
2009-04-01
2009-08-01
2009-12-01
2010-04-01
2010-08-01
2010-12-01
2011-04-01
2011-08-01
2011-12-01
2012-04-01
2012-08-01
2012-12-01
2013-04-01
2013-08-01
2013-12-01
2014-04-01
2014-08-01
2014-12-01
2015-04-01
2015-08-01
2015-12-01
2016-04-01
2016-08-01
2016-12-01
2017-04-01
2017-08-01
2017-12-01
2018-04-01
2018-08-01
2018-12-01
2019-04-01
2019-08-01
2019-12-01
2020-04-01
2020-08-01
2020-12-01
2021-04-01
2021-08-01
2021-12-01
Orig
Imputed

	A	B	C	D	E	F	G
1	**Year:**	**2017**					
2							
3	**Date**	**GWSa**	**Orig**	**Imputed**			
4	2017-04-01	-27.39	-27.39	#N/A			
5	2017-05-01	-26.50	-26.50	#N/A		SP	-24
6	2017-06-01	-27.36	-27.36	-27.36		SB	-28
7	2017-07-01	-23.92	#N/A	-23.92		SL	-32
8	2017-08-01	-23.81	#N/A	-23.81			
9	2017-09-01	-23.52	#N/A	-23.52		RS	4
10	2017-10-01	-23.68	#N/A	-23.68		RD	4
11	2017-11-01	-24.27	#N/A	-24.27			
12	2017-12-01	-24.98	#N/A	-24.98		R1	**4**
13	2018-01-01	-26.22	#N/A	-26.22		R2	**8**
14	2018-02-01	-25.88	#N/A	-25.88			
15	2018-03-01	-27.87	#N/A	-27.87			
16	2018-04-01	-27.79	#N/A	-27.79			
17	2018-05-01	-26.82	#N/A	-26.82			
18	2018-06-01	-24.76	-24.76	-24.76			
19	2018-07-01	-26.12	-26.12	-26.12			
20	2018-08-01	-25.33	#N/A	-25.33			
21	2018-09-01	-25.04	#N/A	-25.04			
22	2018-10-01	-23.73	-23.73	-23.73			
23	2018-11-01	-23.06	-23.06	#N/A			
24							
25							

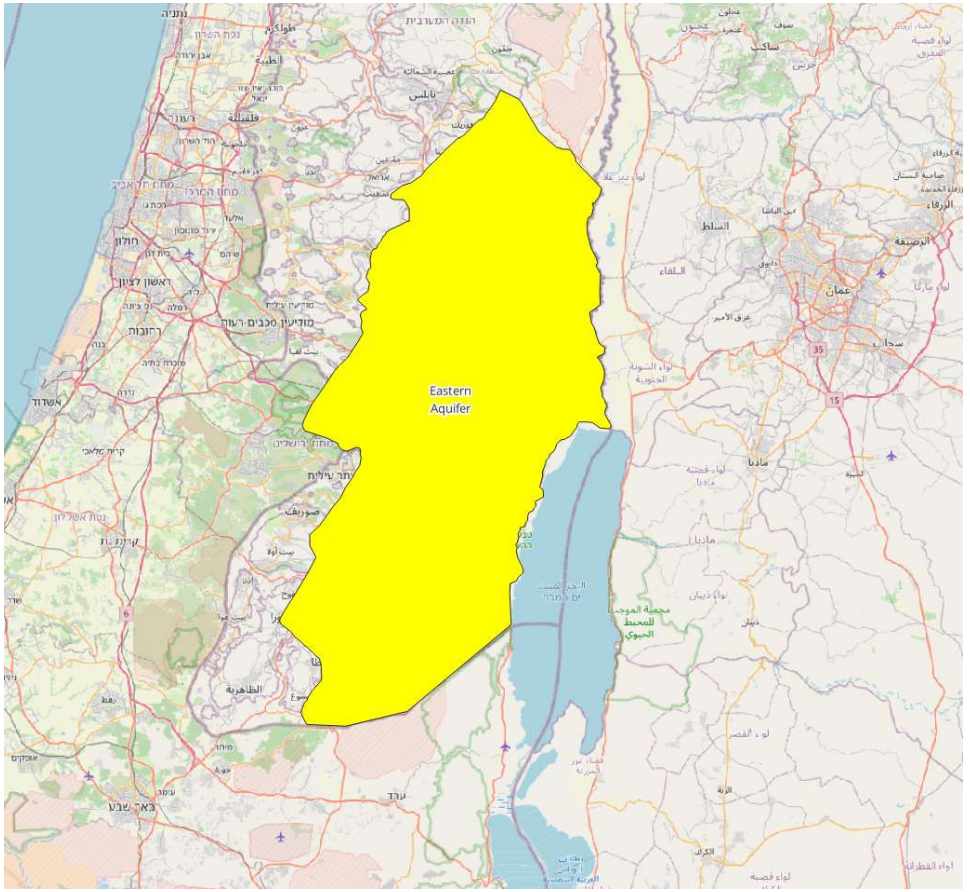


Recharge Rate Sumary

Year	R1	R2
2002	5.6	10.5
2003	7.5	12
2004	6	11
2005	3.3	7.5
2006	3.2	6
2007	2.7	5
2008	4.4	7.6
2009	3	6
2010	3.8	9.2
2011	3.8	8
2012	4.6	9.6
2013	3.2	6
2014	7	13
2015	7	13
2016	4.3	10
2017	4	8
2018	3	6.3
2019	4	8
2020	3.5	7
Mean	**4.4**	**8.6**

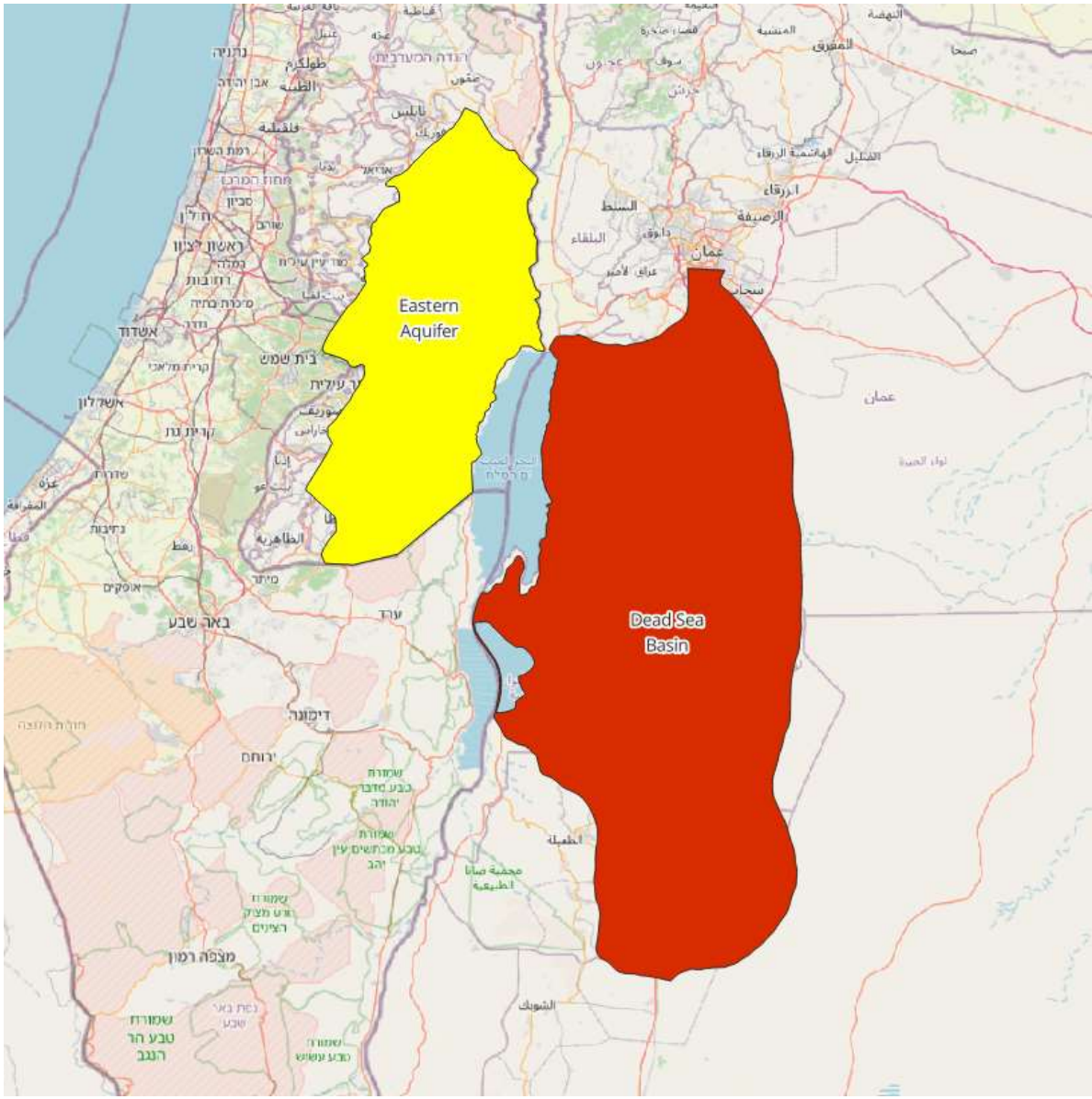


Eastern Aquifer

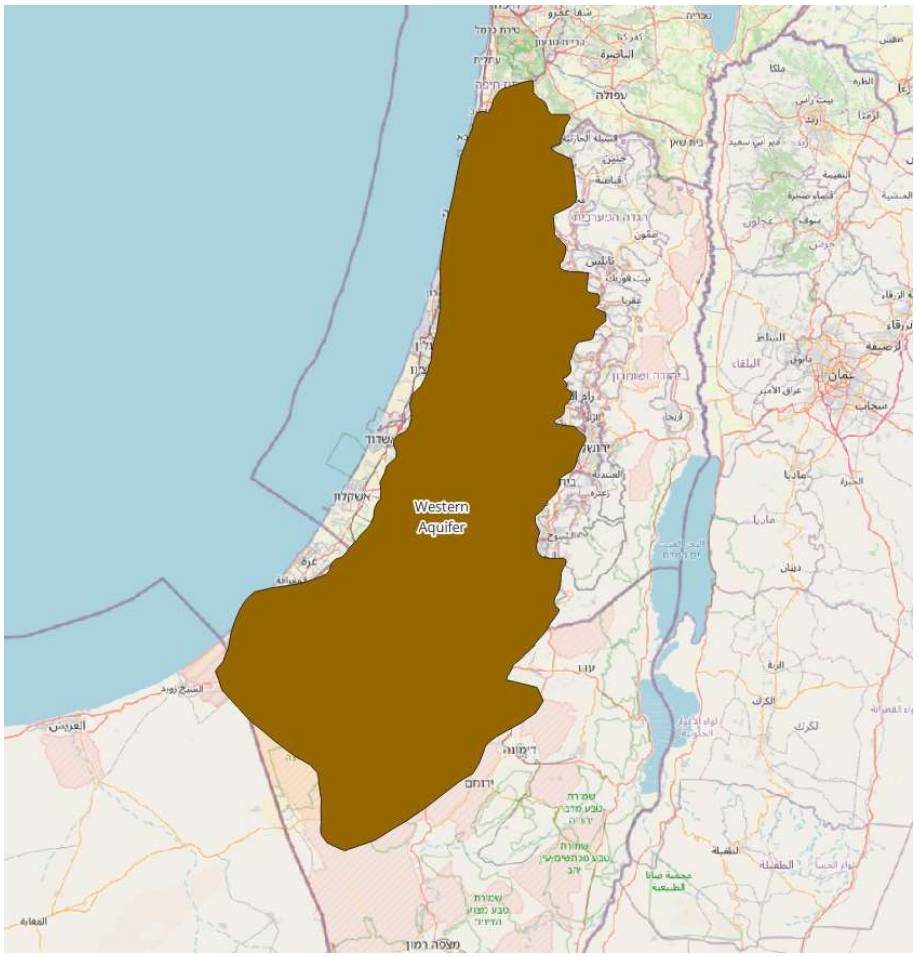


Once again, the basin is too small to process using the regional subsetting. We selected a point in the basin and performed a point analysis using the GGST API Python script.

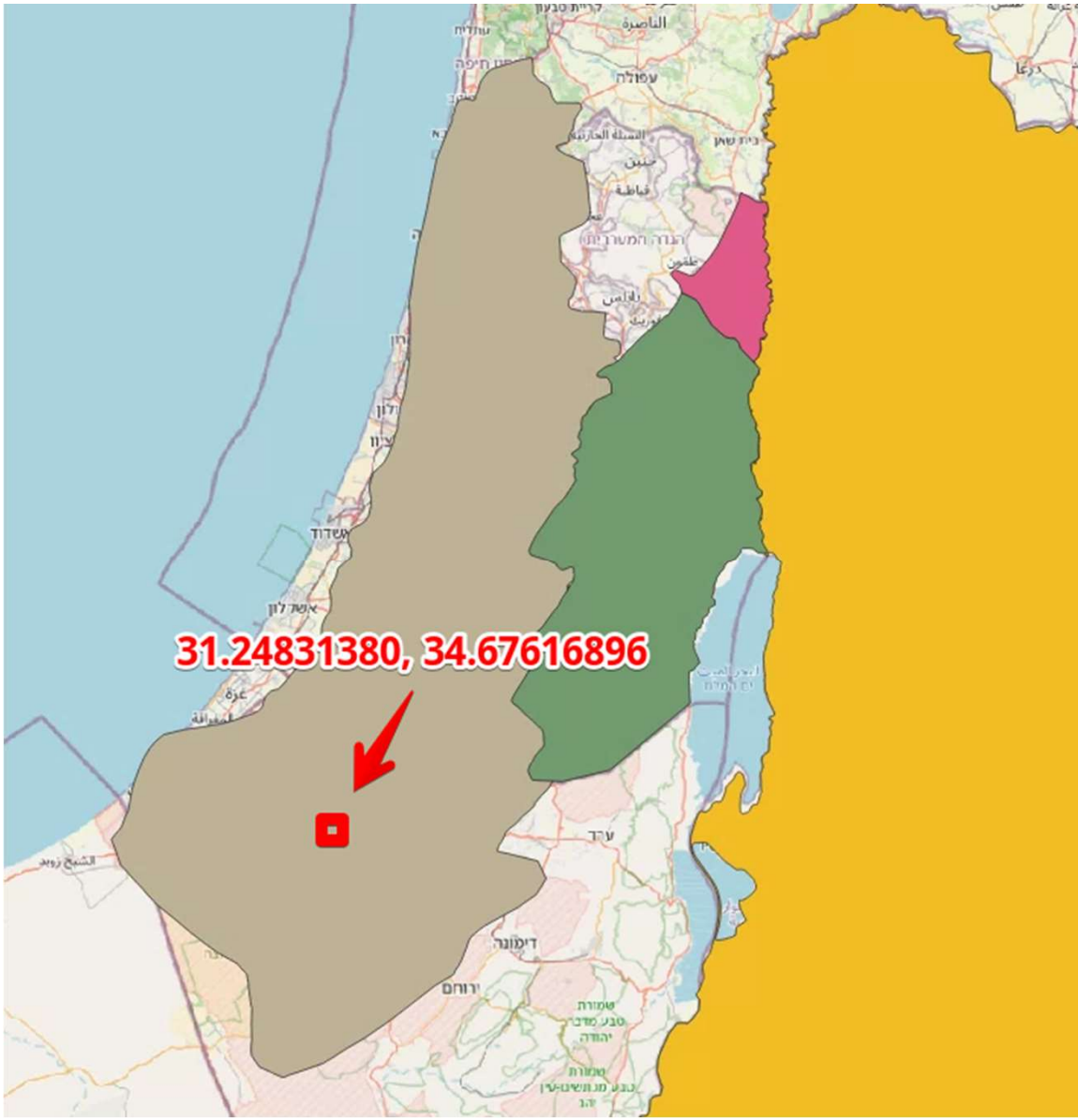
However, the point we selected (near the center) returned the same results as the Dead Sea Basin.

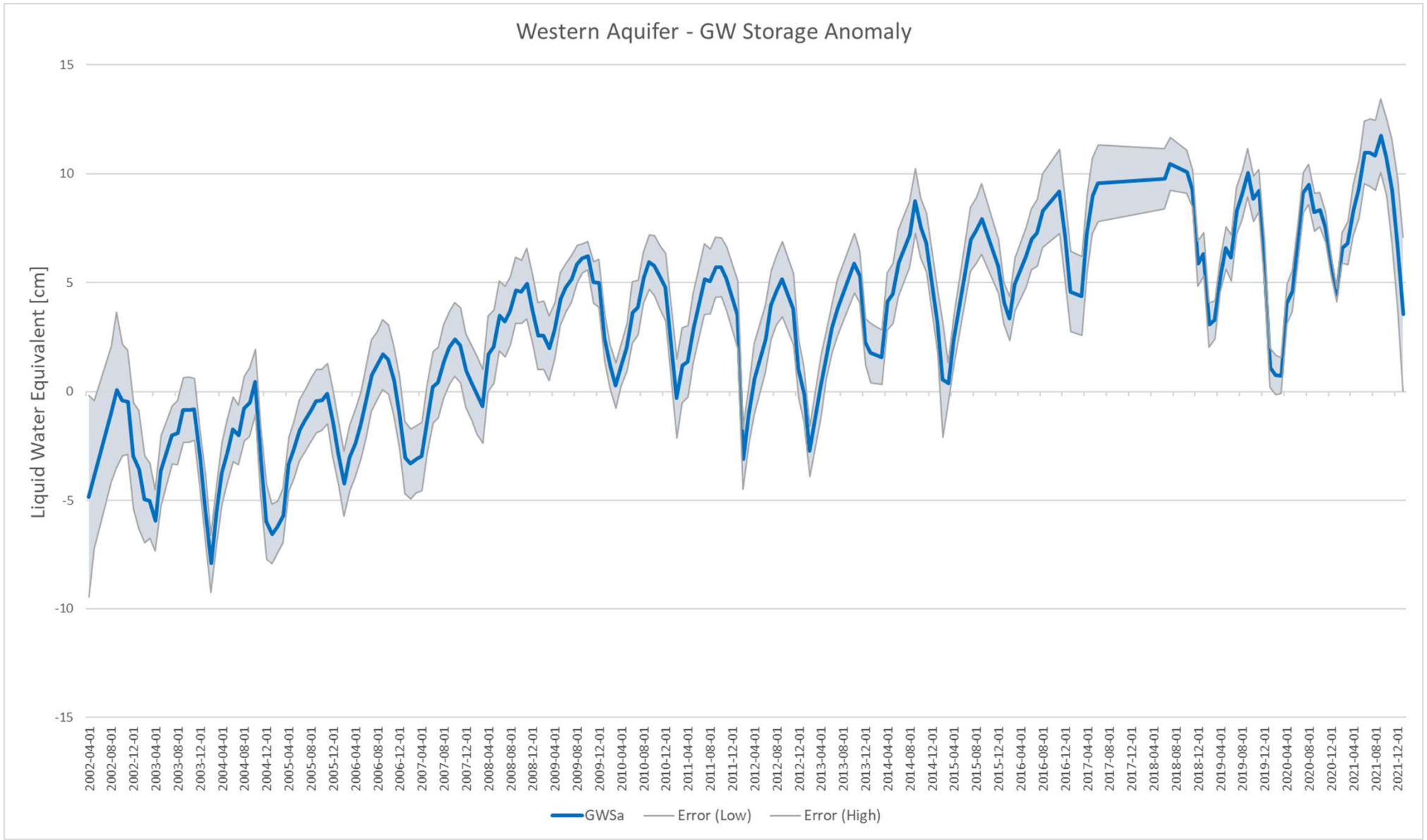


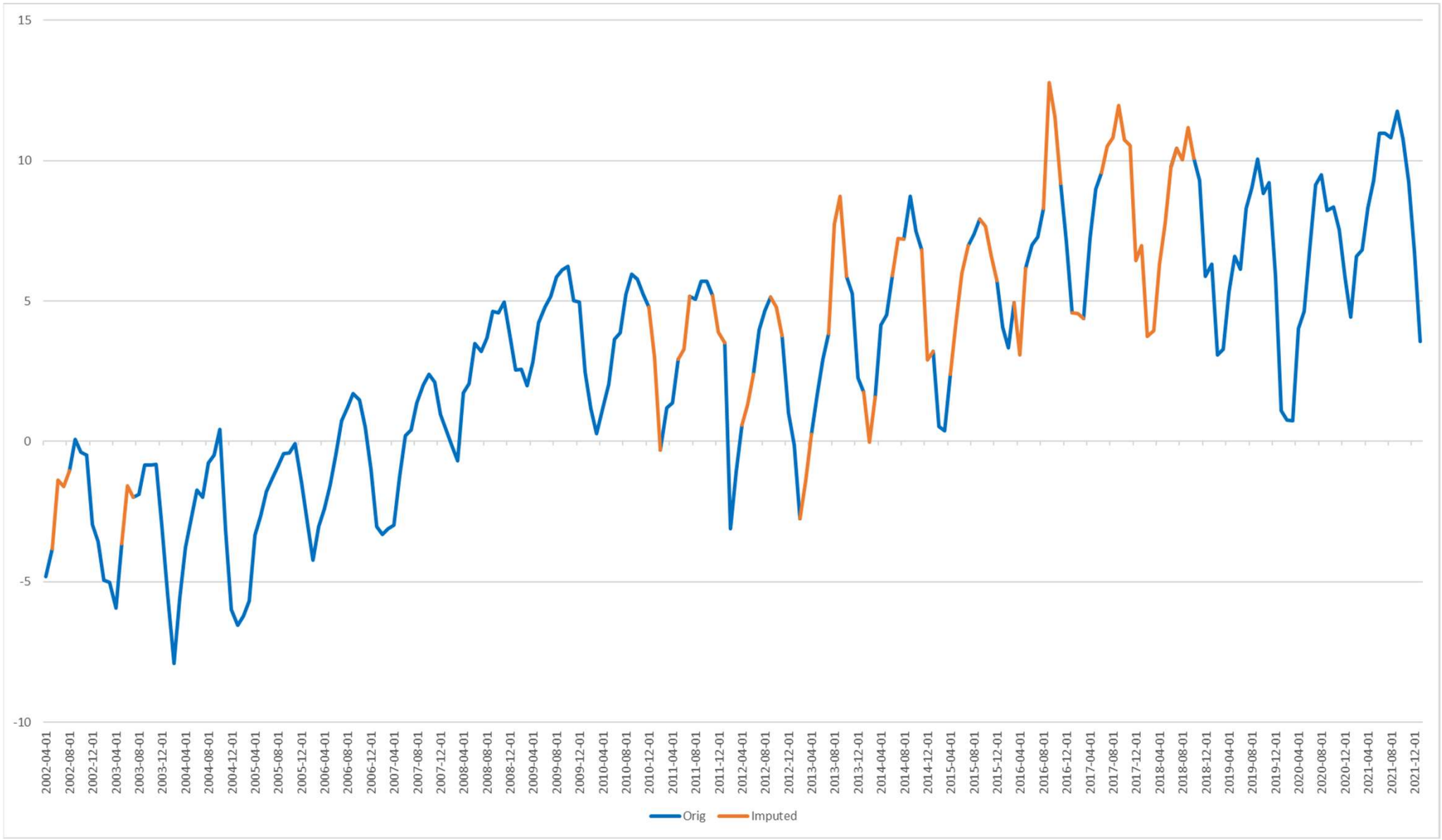
Western Aquifer



Once again, the basin is too small to process using the regional subsetting. This time, we selected a point in southern part of the basin and were able to successfully peform a point analysis using the GGST API Python script.



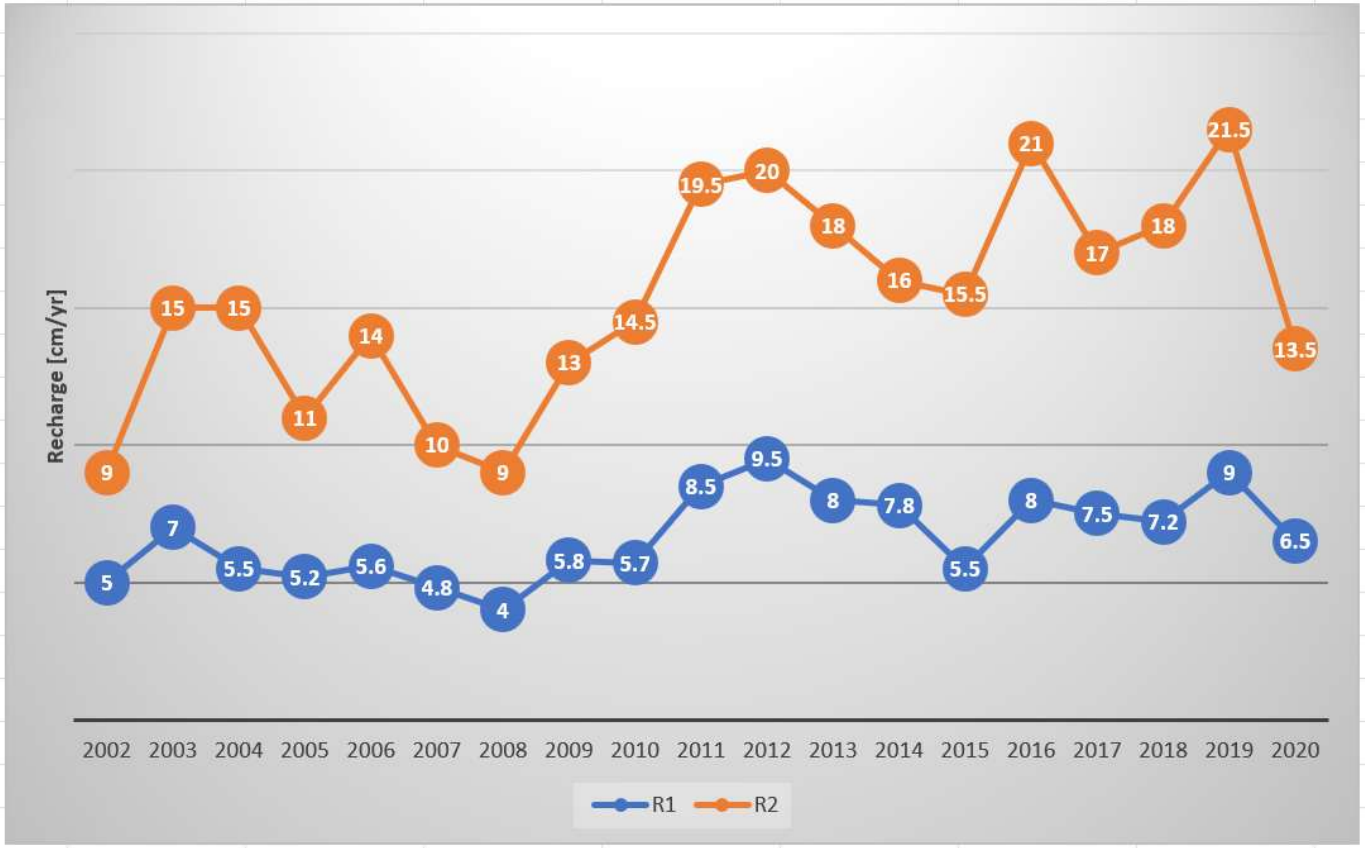

Western Aquifer - GW Storage Anomaly
Liquid Water Equivalent [cm]
15
10
5
0
-5
-10
-15
2002-04-01
2002-08-01
2002-12-01
2003-04-01
2003-08-01
2003-12-01
2004-04-01
2004-08-01
2004-12-01
2005-04-01
2005-08-01
2005-12-01
2006-04-01
2006-08-01
2006-12-01
2007-04-01
2007-08-01
2007-12-01
2008-04-01
2008-08-01
2008-12-01
2009-04-01
2009-08-01
2009-12-01
2010-04-01
2010-08-01
2010-12-01
2011-04-01
2011-08-01
2011-12-01
2012-04-01
2012-08-01
2012-12-01
2013-04-01
2013-08-01
2013-12-01
2014-04-01
2014-08-01
2014-12-01
2015-04-01
2015-08-01
2015-12-01
2016-04-01
2016-08-01
2016-12-01
2017-04-01
2017-08-01
2017-12-01
2018-04-01
2018-08-01
2018-12-01
2019-04-01
2019-08-01
2019-12-01
2020-04-01
2020-08-01
2020-12-01
2021-04-01
2021-08-01
2021-12-01
GWSa
Error (Low)
Error (High)


15
10
5
0
-5
-10
2002-04-01
2002-08-01
2002-12-01
2003-04-01
2003-08-01
2003-12-01
2004-04-01
2004-08-01
2004-12-01
2005-04-01
2005-08-01
2005-12-01
2006-04-01
2006-08-01
2006-12-01
2007-04-01
2007-08-01
2007-12-01
2008-04-01
2008-08-01
2008-12-01
2009-04-01
2009-08-01
2009-12-01
2010-04-01
2010-08-01
2010-12-01
2011-04-01
2011-08-01
2011-12-01
2012-04-01
2012-08-01
2012-12-01
2013-04-01
2013-08-01
2013-12-01
2014-04-01
2014-08-01
2014-12-01
2015-04-01
2015-08-01
2015-12-01
2016-04-01
2016-08-01
2016-12-01
2017-04-01
2017-08-01
2017-12-01
2018-04-01
2018-08-01
2018-12-01
2019-04-01
2019-08-01
2019-12-01
2020-04-01
2020-08-01
2020-12-01
2021-04-01
2021-08-01
2021-12-01
Orig
Imputed

	B	C	D	E	F	G
1	**2006**					
2						
3	**GWSa**	**Orig**	**Imputed**			
4	-2.40	-2.40	#N/A			
5	-1.54	-1.54	#N/A		SP	2
6	-0.46	-0.46	#N/A		SB	-3.6
7	0.75	0.75	#N/A		SL	-12
8	1.20	1.20	#N/A			
9	1.70	1.70	#N/A		RS	5.6
10	1.47	1.47	#N/A		RD	8.4
11	0.51	0.51	#N/A			
12	-0.99	-0.99	#N/A		R1	**5.6**
13	-3.03	-3.03	#N/A		R2	**14**
14	-3.31	-3.31	#N/A			
15	-3.11	-3.11	#N/A			
16	-2.98	-2.98	#N/A			
17	-1.26	-1.26	#N/A			
18	0.20	0.20	#N/A			
19	0.41	0.41	#N/A			
20	1.38	1.38	#N/A			
21	2.01	2.01	#N/A			
22	2.38	2.38	#N/A			
23	2.12	2.12	#N/A			
24						

Recharge Rate Sumary

Year	R1	R2
2002	5	9
2003	7	15
2004	5.5	15
2005	5.2	11
2006	5.6	14
2007	4.8	10
2008	4	9
2009	5.8	13
2010	5.7	14.5
2011	8.5	19.5
2012	9.5	20
2013	8	18
2014	7.8	16
2015	5.5	15.5
2016	8	21
2017	7.5	17
2018	7.2	18
2019	9	21.5
2020	6.5	13.5
Mean	**6.6**	**15.3**



Questions?