Delta Framework

Annex 4:
Guidance for Irrigation Efficiency and Water Productivity indicators

Calculation of the rainfall data and daily Kc values

better cotton™

ICAC INTERNATIONAL COTTON ADVISORY COMMITTEE

INTERNATIONAL COFFEE ORGANIZATION

GLOBAL COFFEE PLATFORM for a sustainable coffee world

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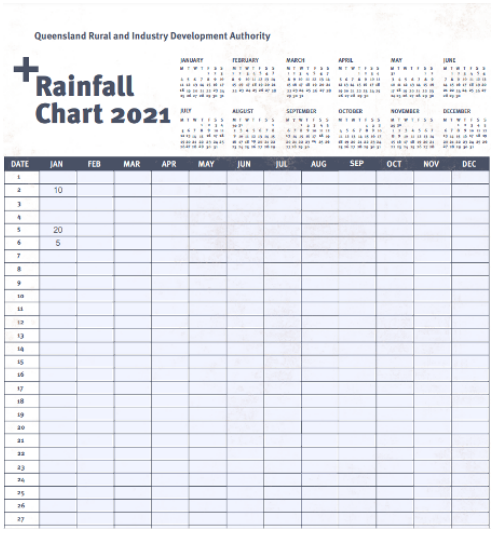
1 The four Delta Project partners are: Better Cotton, the Global Coffee Platform (GCP), the International Coffee Organisation (ICO), and the International Cotton Advisory Committee (ICAC).

A guide to obtaining rainfall data

Rain gauges can be sourced from hardware or gardening supply stores, or even homemade (an internet search can provide a variety of prototypes, e.g., https://www.education.com/science-fair/article/DIY-rain-gauge/ made from a drink bottle).

Volume of rain is recorded after each event (in millimetres) in a rainfall chart (e.g., https://qrida-files.s3.ap-southeast-2.amazonaws.com/s3fs-public/2020-10/QRIDA%20Rainfall%20Chart%202021_FILLABLE.pdf) and summed over the growing season. In the example below, 10 mm was recorded on 2nd January, 20 mm on 5th January and 5 mm on 6th January, giving a total of 35 mm for the month to date.


Queensland Rural and Industry Development Authority

Rainfall Chart 2021

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1												
2	10											
3												
4												
5	20											
6	5											
7												
8												
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25												
26												
27												

Rainfall data can also be obtained from meteorological data. For instance, official rainfall data from the Meteorological Department for India can be found at: https://mausam.imd.gov.in/imd_latest/contents/rainfall_statistics_3.php

A guide to obtaining daily Kc values from IrriSAT

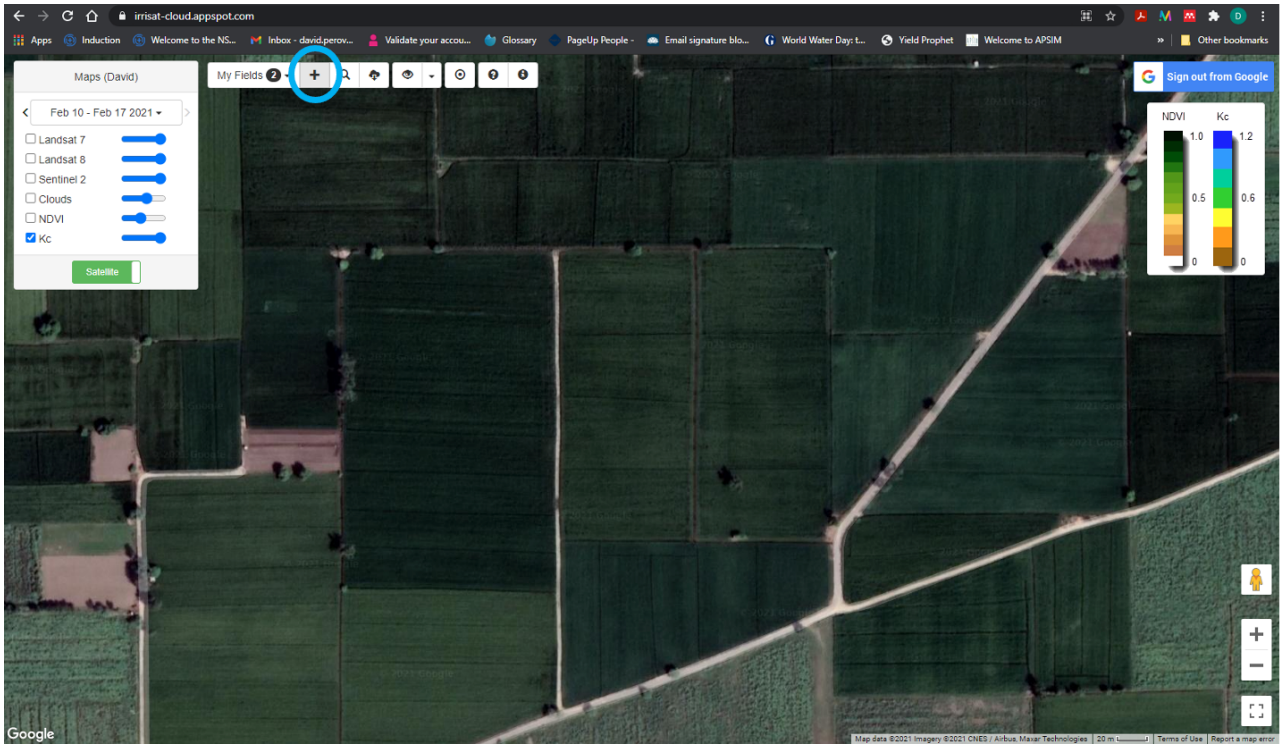
Step 1: Open the IrriSAT page: https://irrisat-cloud.appspot.com/

Step 2: Create account and sign in.

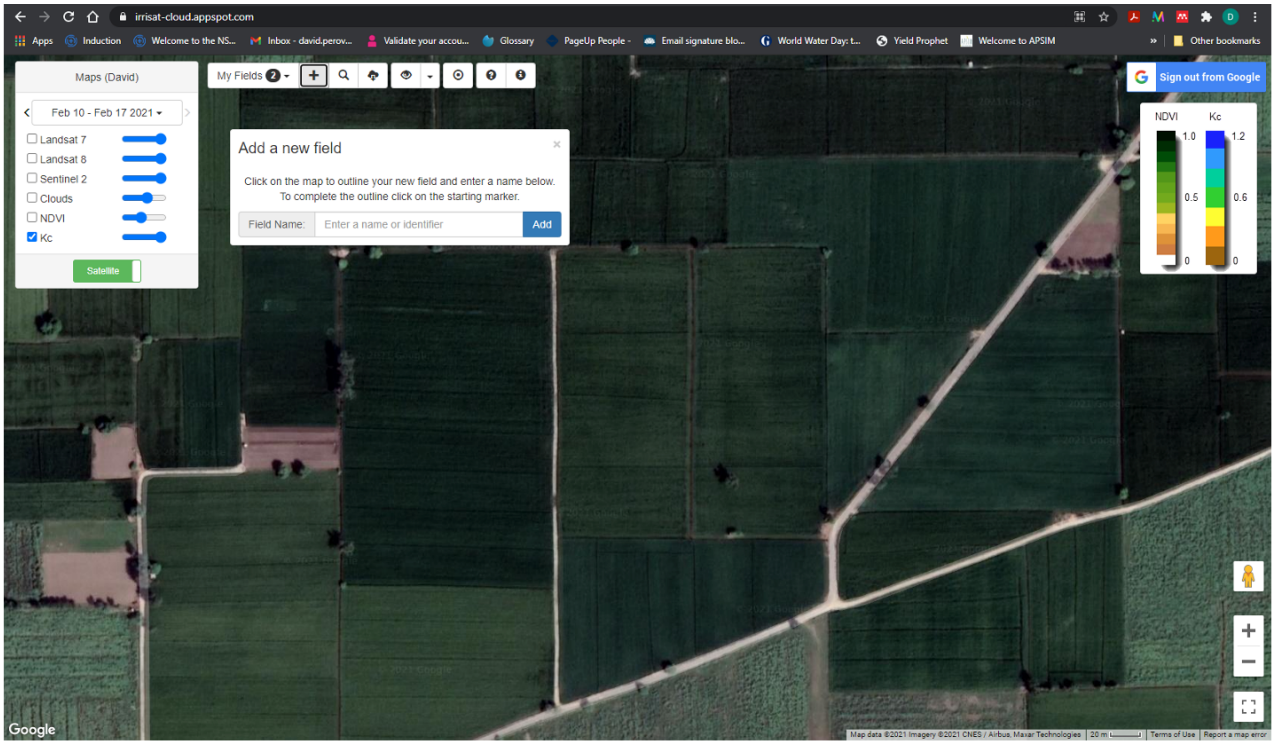
Step 3: Navigate map to region of interest.

Step 4: Locate sample fields and zoom in.

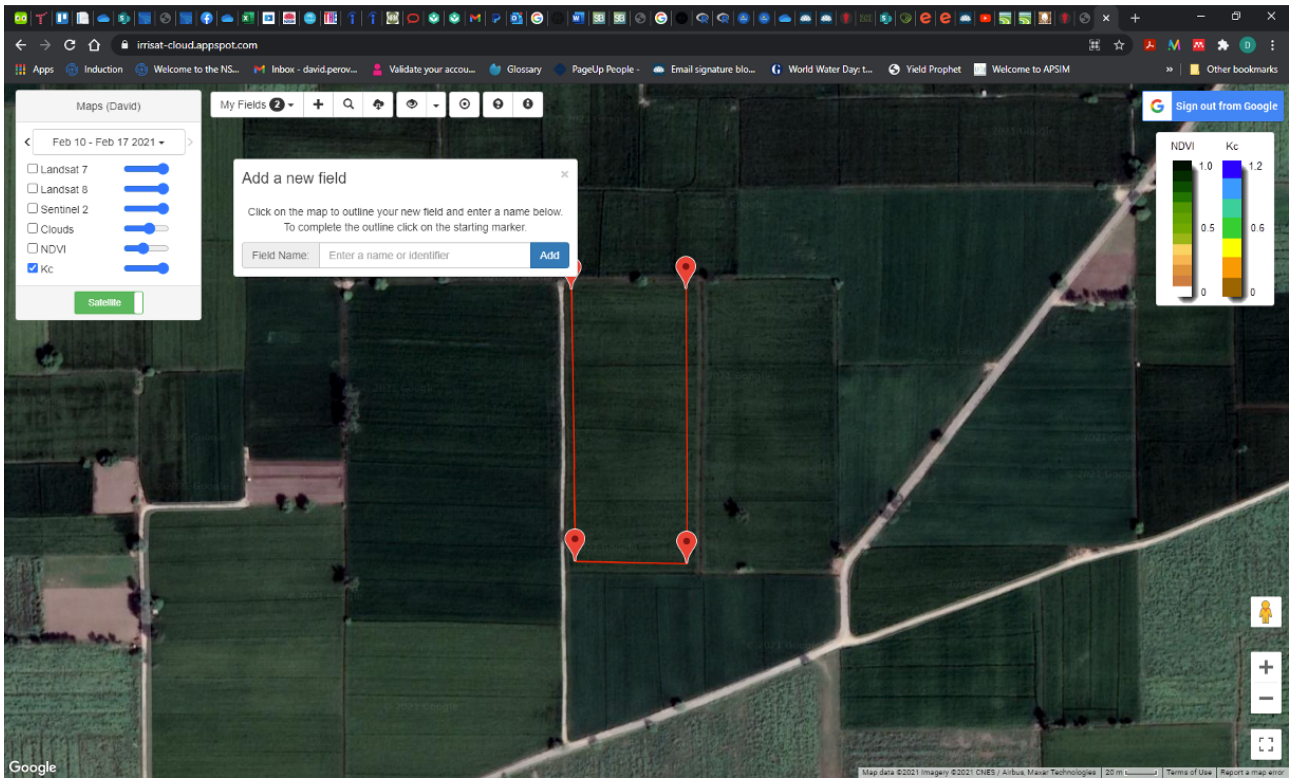
Step 5: Create a polygon for each sample field by first pressing the plus sign (indicated below with light blue circle) from the control buttons at the top of the screen.

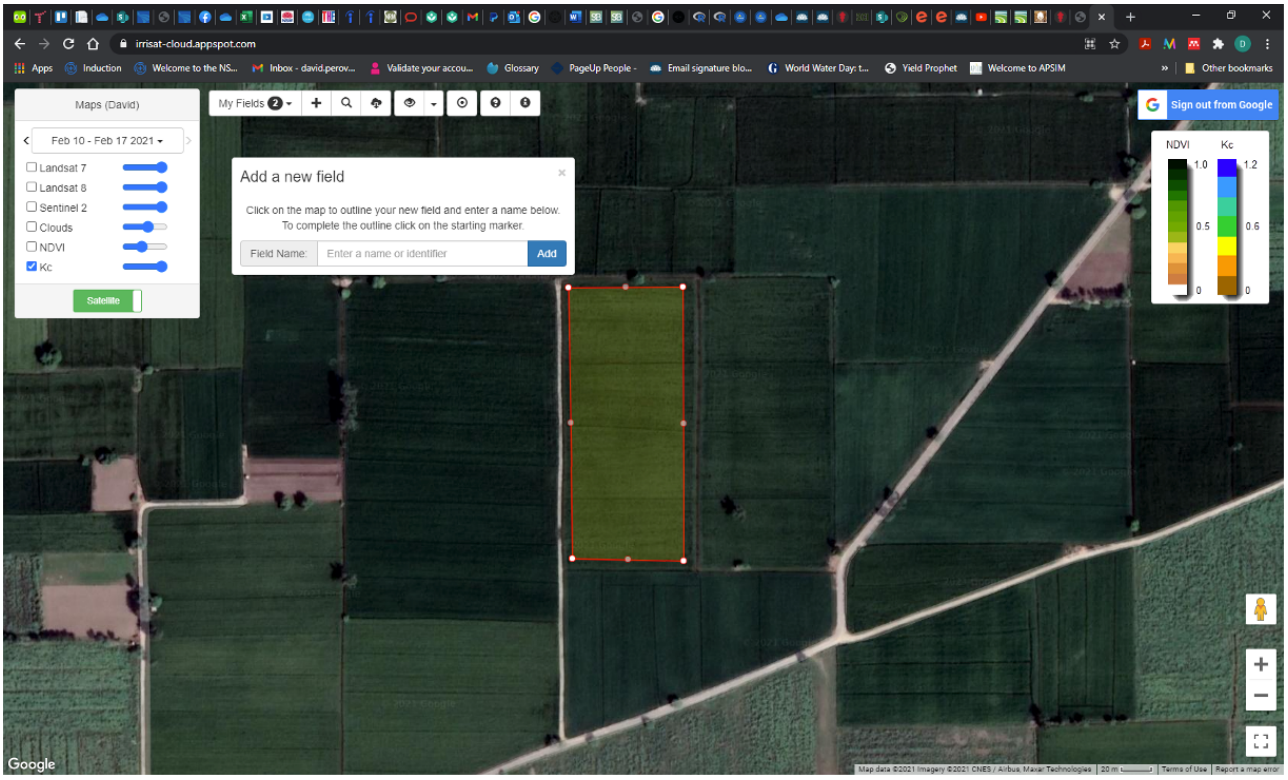


Step 6: This will promote you to "Add a new field".

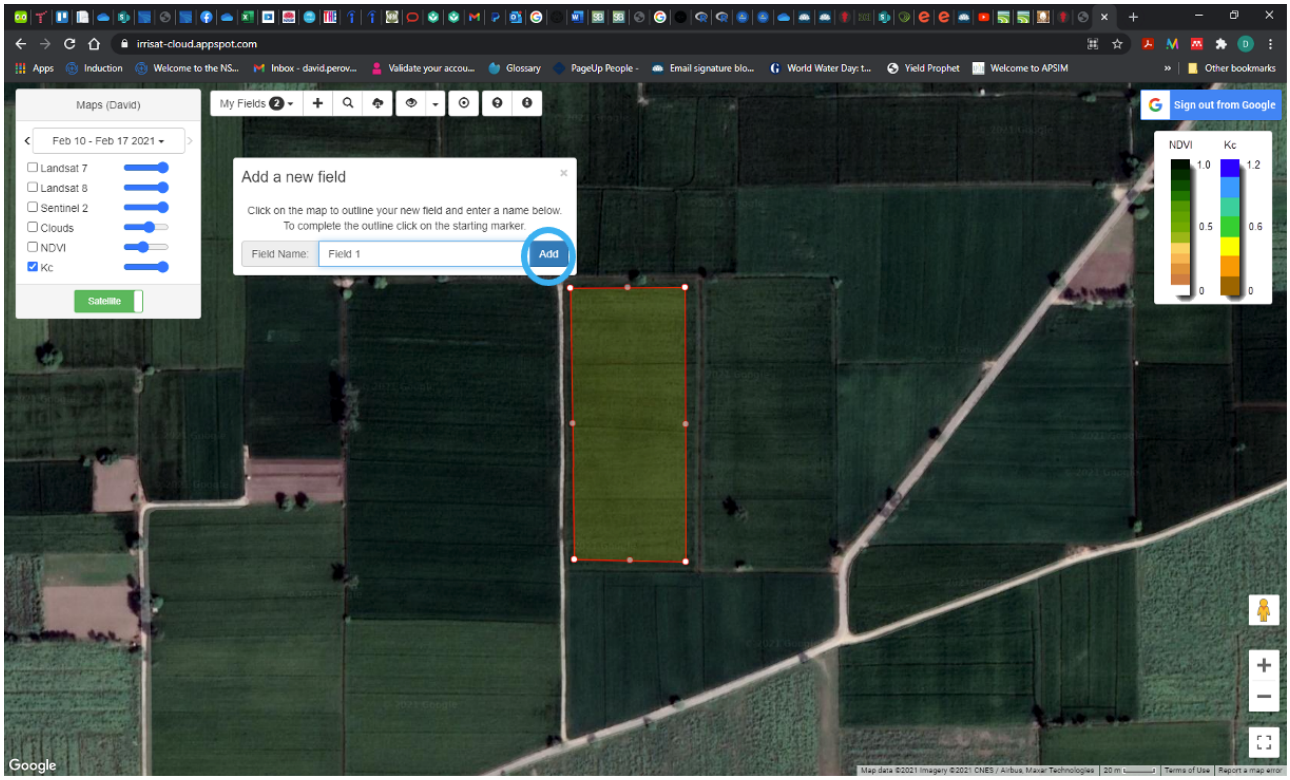


Step 7: Click the cursor on each corner of the field to mark out the polygon.



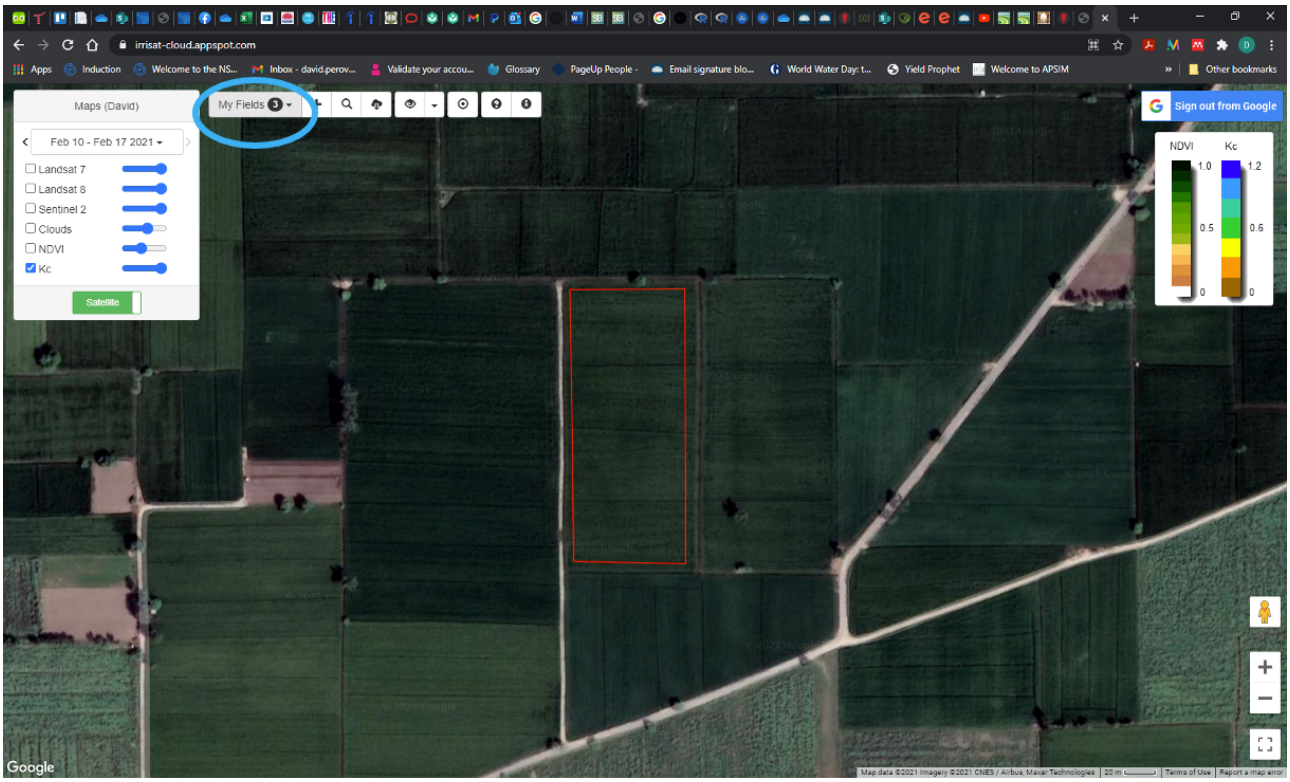


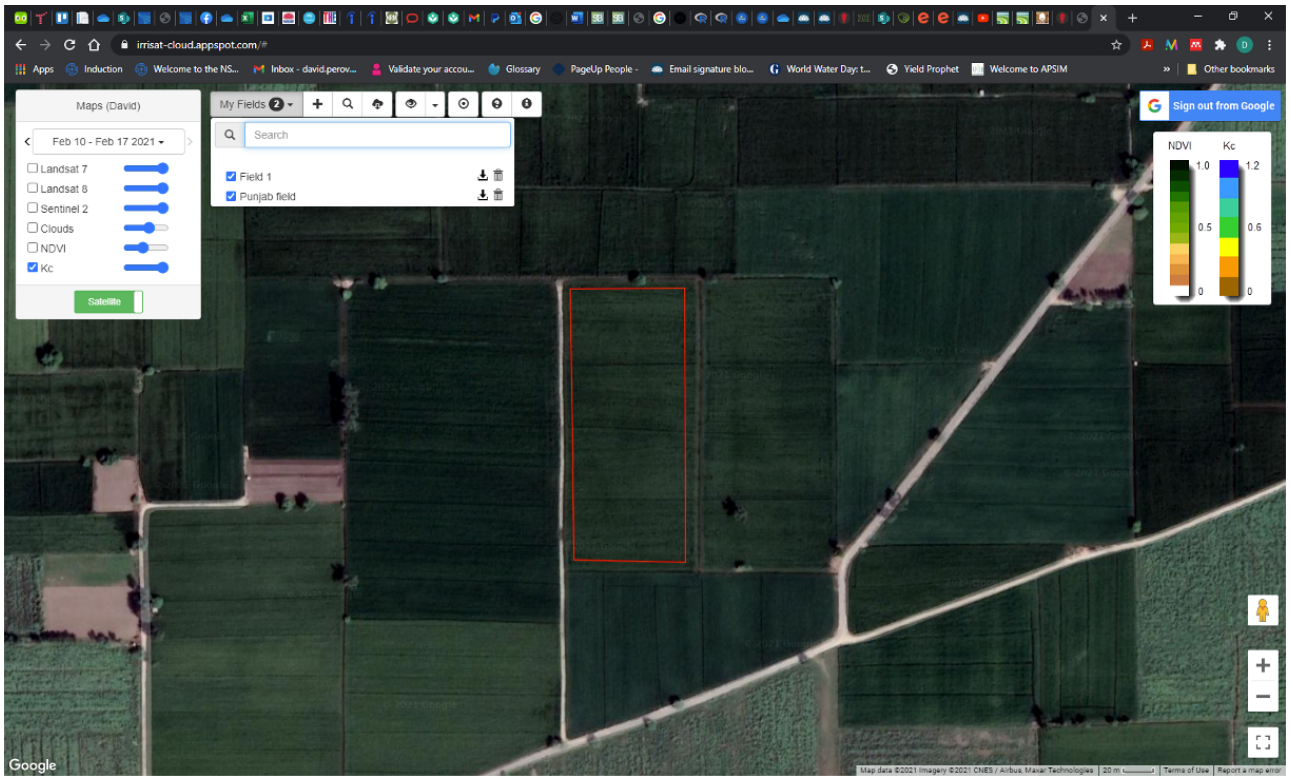
Step 8: Enter a name for the field and click "Add".



Step 9: Repeat for all sample fields.

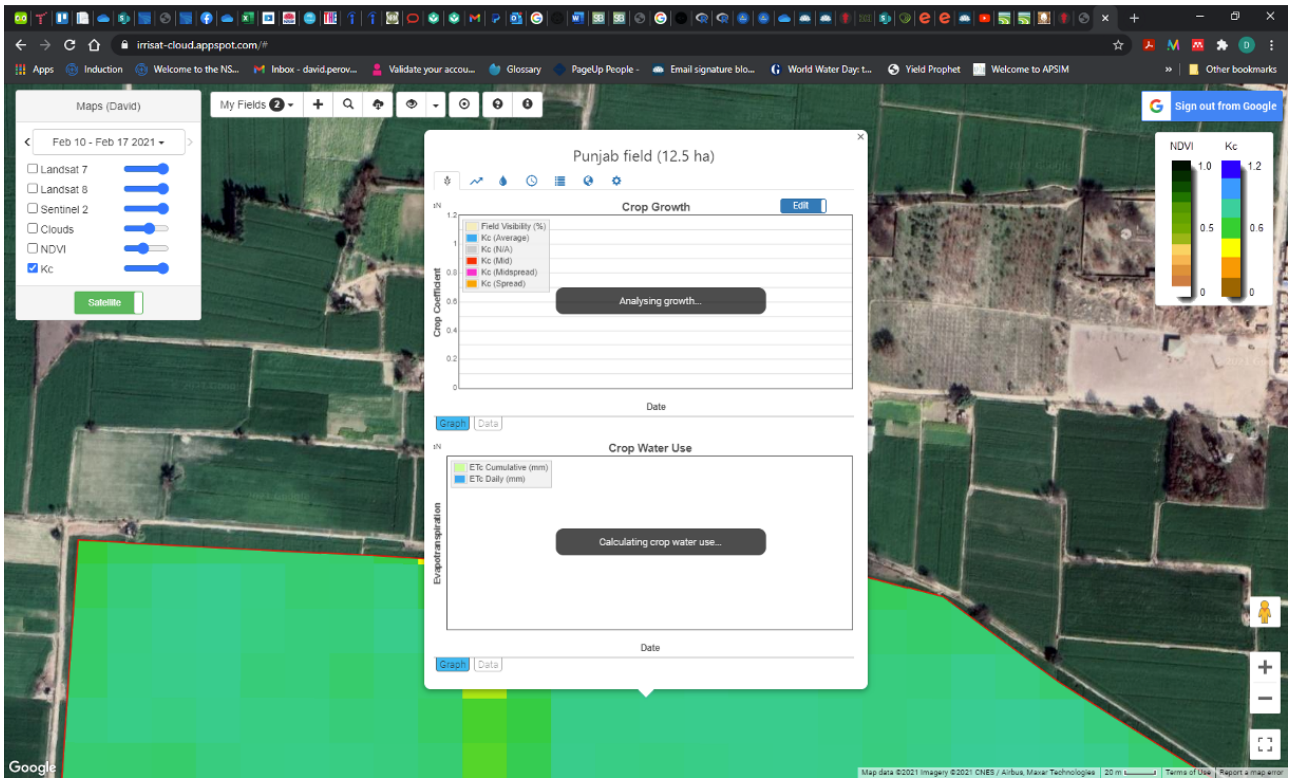
Step 10: To access fields and extract Kc values, click the "My Fields" button.





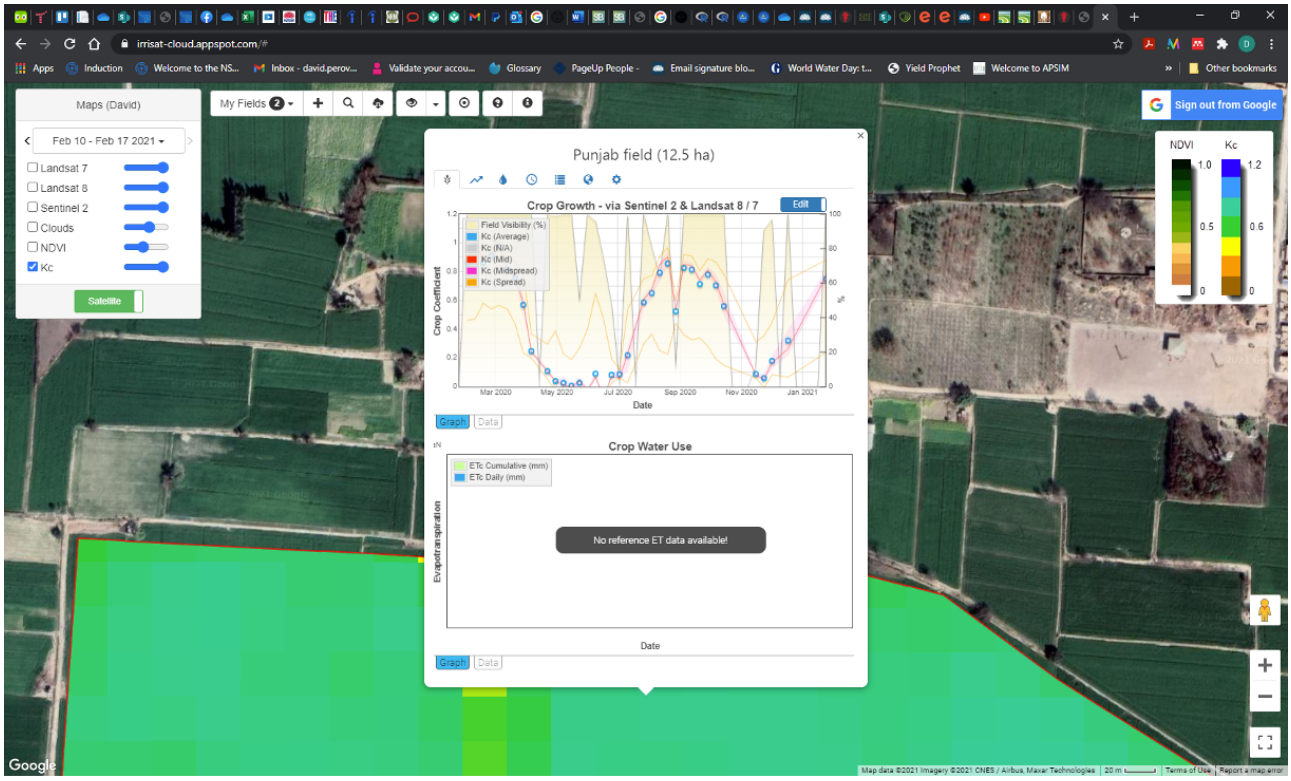
Step 11: Chose a field by clicking on the name of the field and the map will zoom to that field.

Step 12: Click within the polygon.



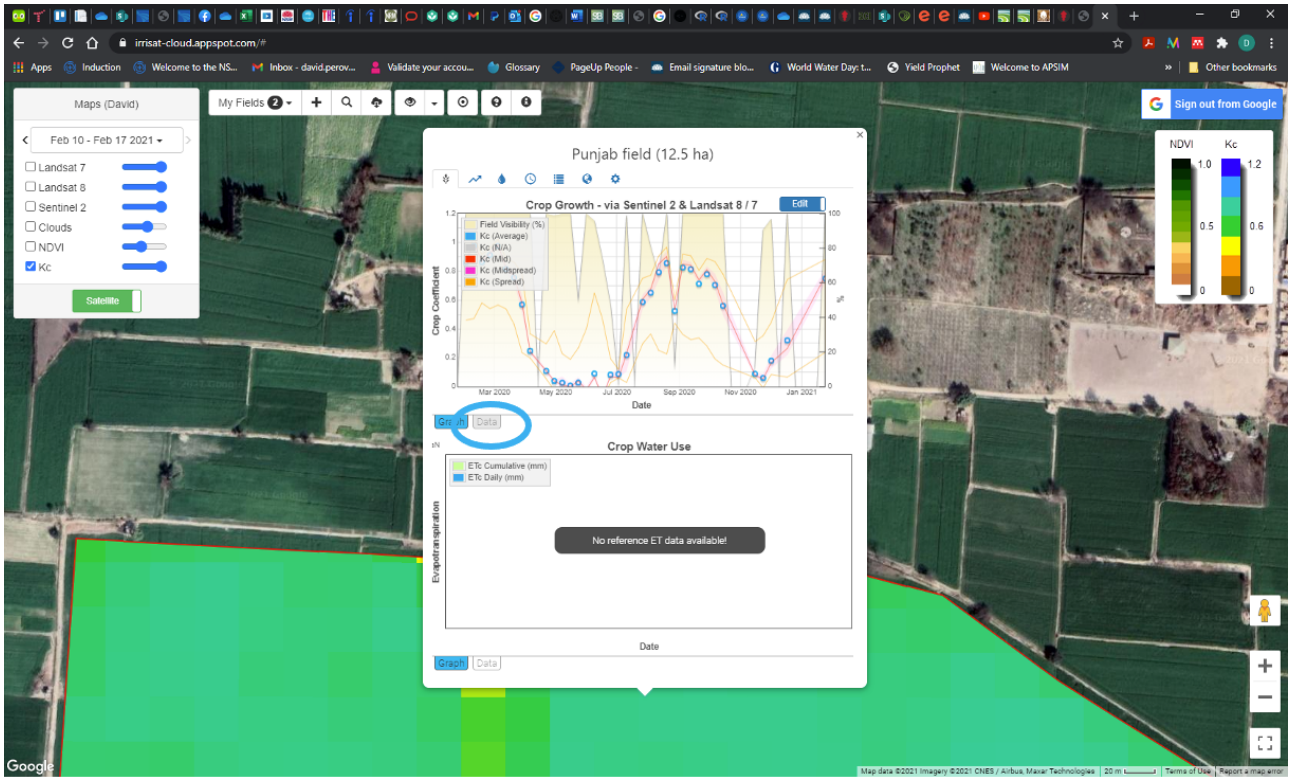
Step 13: A dialogue box will come up for that field.

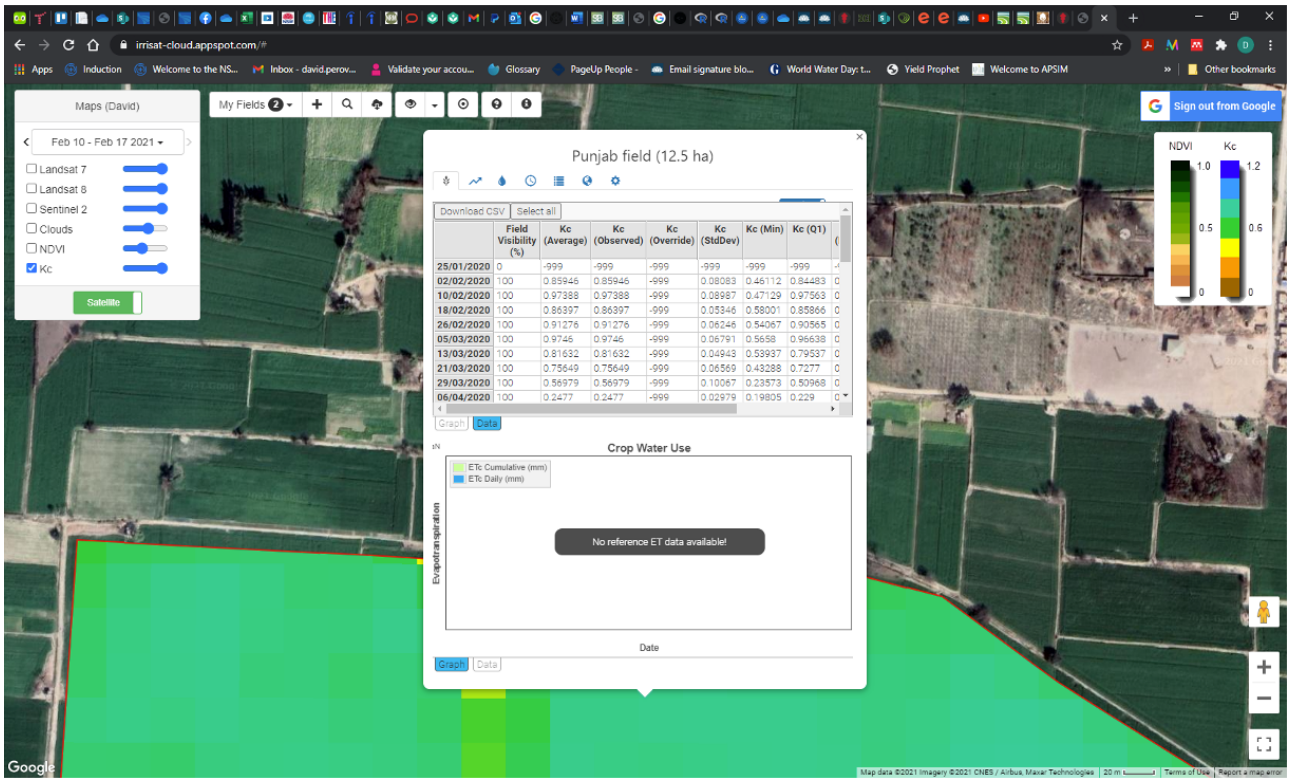
Step 14: Wait while it loads.



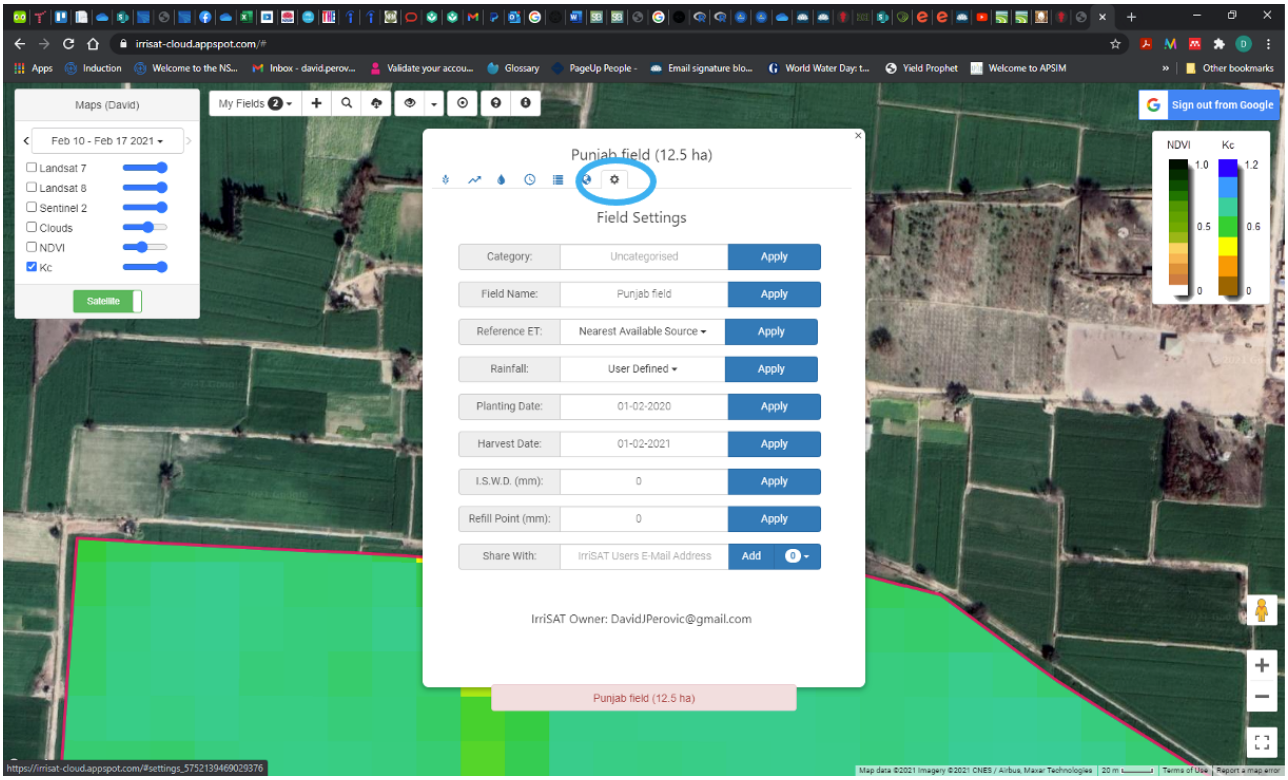
Step 15: IrriSAT will calculate the crop coefficient box at the top but the evapotranspiration box will fail as the reference ET is linked to the Australian Bureau of Meteorology, and no reference ET is available for areas outside Australia.

Step 16: To extract the daily Kc values, click the "Data" tab at the bottom left of the "Crop Coefficient" box.



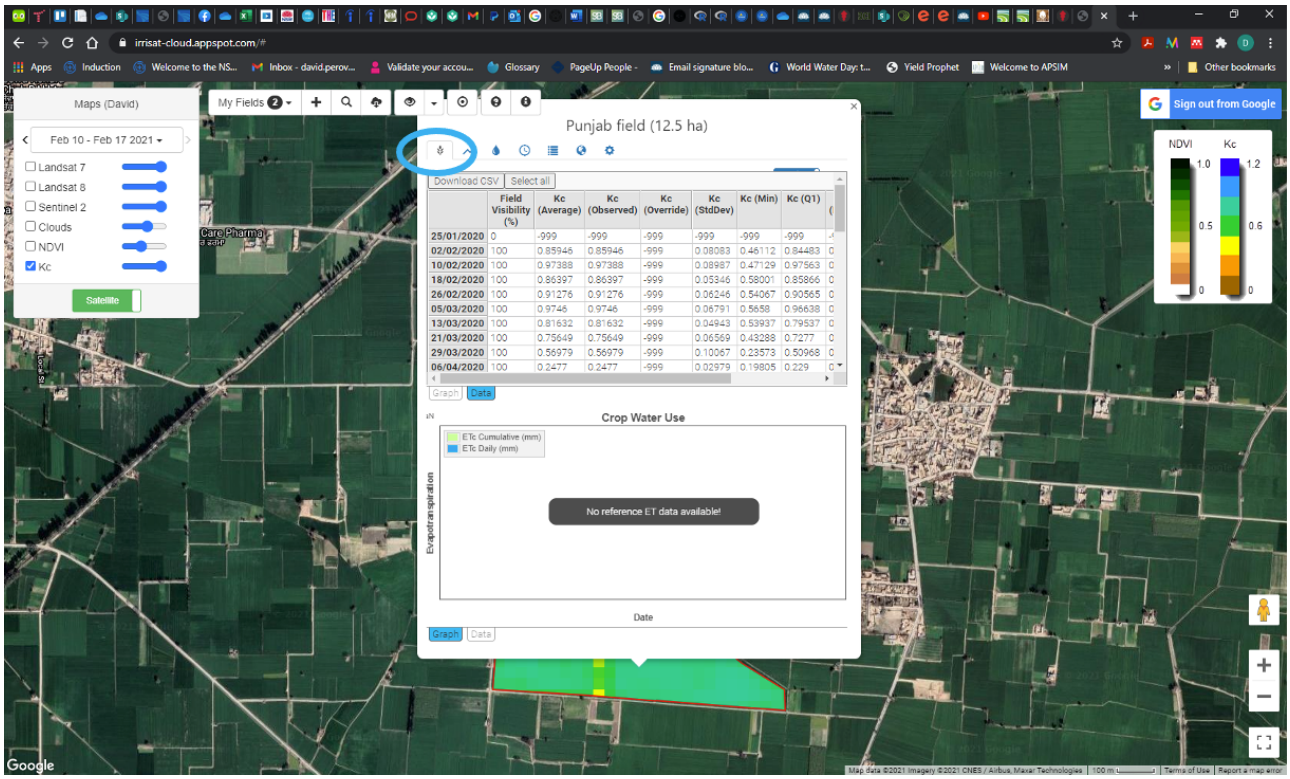


Step 17: Now click the "Field Settings" tab (cog icon).

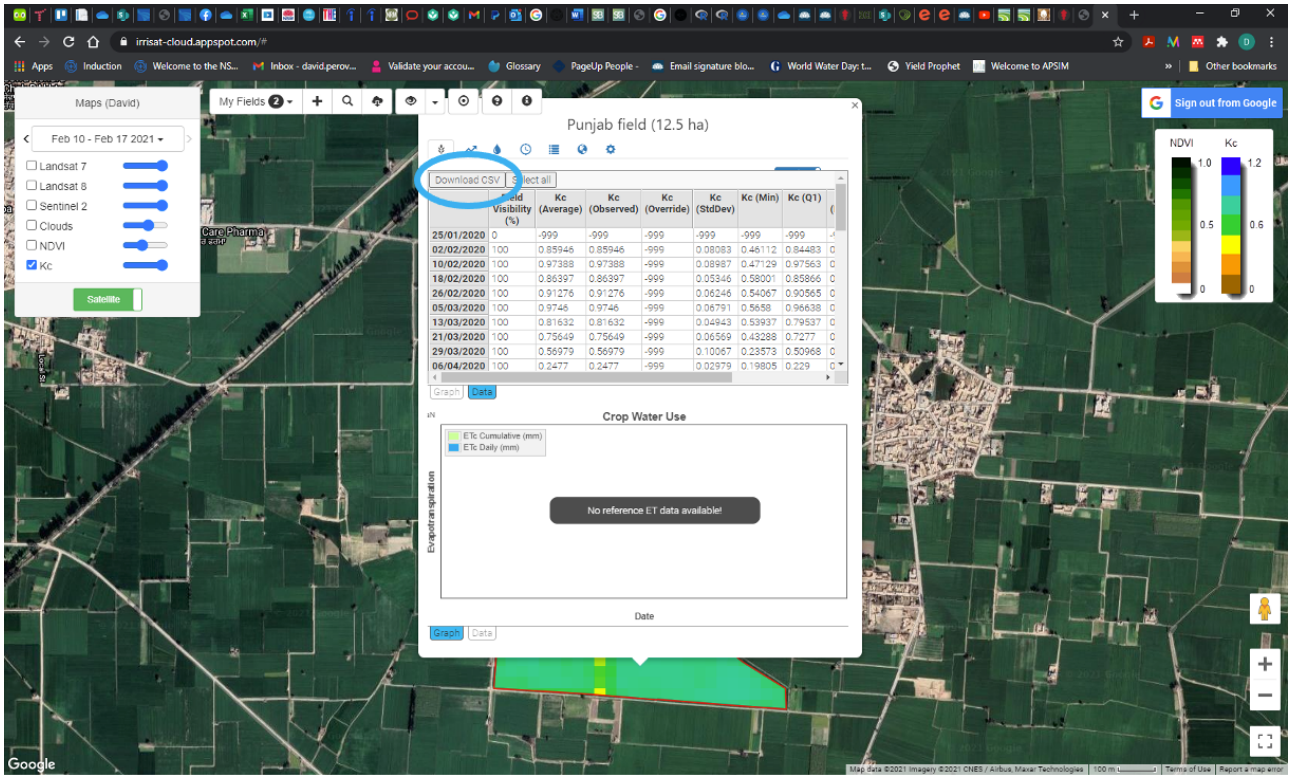


Step 18: Fill in the appropriate "Planting Date" and "Harvest Date" and remember to click the adjacent blue "Apply" button after completing both.

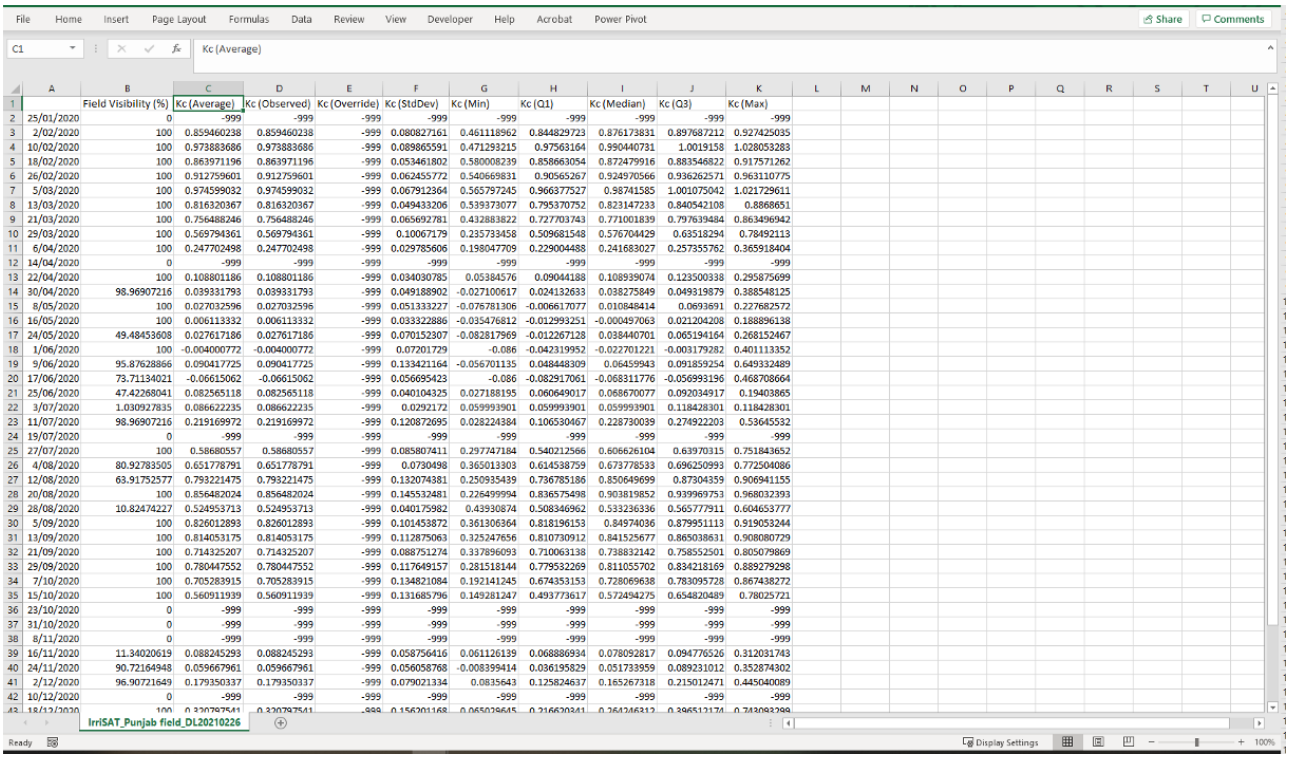
Step 19: Now click on the "Crop Health" tab (plant icon).



Step 20: You can now extract the Kc data for the selected period by clicking the "Download CSV" tab.



Step 21: Once you have downloaded this file, open it in a spreadsheet.



	A	B	C	D	E	F	G	H	I	J	K
1		Field Visibility (%)	Kc (Average)	Kc (Observed)	Kc (Override)	Kc (StdDev)	Kc (Min)	Kc (Q1)	Kc (Median)	Kc (Q3)	Kc (Max)
2	25/01/2020	0	-999	-999	-999	-999	-999	-999	-999	-999	-999
3	2/02/2020	100	0.859460238	0.859460238	-999	0.080827161	0.461118962	0.844829723	0.876173831	0.897687212	0.927425035
4	10/02/2020	100	0.973883686	0.973883686	-999	0.089865591	0.471293215	0.97563164	0.990440731	1.0019158	1.028053283
5	18/02/2020	100	0.863971196	0.863971196	-999	0.053461802	0.580008239	0.858663054	0.872479916	0.883546822	0.917571262
6	26/02/2020	100	0.912759601	0.912759601	-999	0.062455772	0.540669831	0.90565267	0.924970566	0.936262571	0.963110775
7	5/03/2020	100	0.974599032	0.974599032	-999	0.067912364	0.565797245	0.966377527	0.98741585	1.001075042	1.021729611
8	13/03/2020	100	0.816320367	0.816320367	-999	0.049433206	0.539373077	0.795370752	0.823147233	0.840542108	0.8868651
9	21/03/2020	100	0.756488246	0.756488246	-999	0.065692781	0.432883822	0.727703743	0.771001839	0.797639484	0.863496942
10	29/03/2020	100	0.569794361	0.569794361	-999	0.10067179	0.235733458	0.509681548	0.576704429	0.63518294	0.78492113
11	6/04/2020	100	0.247702498	0.247702498	-999	0.029785606	0.198047709	0.229004488	0.241683027	0.257355762	0.365918404
12	14/04/2020	0	-999	-999	-999	-999	-999	-999	-999	-999	-999
13	22/04/2020	100	0.108801186	0.108801186	-999	0.034030785	0.05384576	0.09044188	0.108939074	0.123500338	0.295875699
14	30/04/2020	98.96907216	0.039331793	0.039331793	-999	0.049188902	-0.027100617	0.024132633	0.038275849	0.049319879	0.388548125
15	8/05/2020	100	0.027032596	0.027032596	-999	0.051333227	-0.076781306	-0.006617077	0.010848414	0.0693691	0.227682572
16	16/05/2020	100	0.006113332	0.006113332	-999	0.033322886	-0.035476812	-0.012993251	-0.000497063	0.021204208	0.188896138
17	24/05/2020	49.48453608	0.027617186	0.027617186	-999	0.070152307	-0.082817969	-0.012267128	0.038440701	0.065194164	0.268152467
18	1/06/2020	100	-0.004000772	-0.004000772	-999	0.07201729	-0.086	-0.042319952	-0.022701221	-0.003179282	0.401113352
19	9/06/2020	95.87628866	0.090417725	0.090417725	-999	0.133421164	-0.056701135	0.048448309	0.06459943	0.091859254	0.649332489
20	17/06/2020	73.71134021	-0.06615062	-0.06615062	-999	0.056695423	-0.086	-0.082917061	-0.068311776	-0.056993196	0.468708664
21	25/06/2020	47.42268041	0.082565118	0.082565118	-999	0.040104325	0.027188195	0.060649017	0.068670077	0.092034917	0.19403865
22	3/07/2020	1.030927835	0.086622235	0.086622235	-999	0.0292172	0.059993901	0.059993901	0.059993901	0.118428301	0.118428301
23	11/07/2020	98.96907216	0.219169972	0.219169972	-999	0.120872695	0.028224384	0.106530467	0.228730039	0.274922203	0.53645532
24	19/07/2020	0	-999	-999	-999	-999	-999	-999	-999	-999	-999
25	27/07/2020	100	0.58680557	0.58680557	-999	0.085807411	0.297747184	0.540212566	0.606626104	0.63970315	0.751843652
26	4/08/2020	80.92783505	0.651778791	0.651778791	-999	0.0730498	0.365013303	0.614538759	0.673778533	0.696250993	0.772504086
27	12/08/2020	63.91752577	0.793221475	0.793221475	-999	0.132074381	0.250935439	0.736785186	0.850649699	0.87304359	0.906941155
28	20/08/2020	100	0.856482024	0.856482024	-999	0.145532481	0.226499994	0.836575498	0.903819852	0.939969753	0.968032393
29	28/08/2020	10.82474227	0.524953713	0.524953713	-999	0.040175982	0.43930874	0.508346962	0.533236336	0.565777911	0.604653777
30	5/09/2020	100	0.826012893	0.826012893	-999	0.101453872	0.361306364	0.818196153	0.84974036	0.879951113	0.919053244
31	13/09/2020	100	0.814053175	0.814053175	-999	0.112875063	0.325247656	0.810730912	0.841525677	0.865038631	0.908080729
32	21/09/2020	100	0.714325207	0.714325207	-999	0.088751274	0.337896093	0.710063138	0.738832142	0.758552501	0.805079869
33	29/09/2020	100	0.780447552	0.780447552	-999	0.117649157	0.281518144	0.779532269	0.811055702	0.834218169	0.889279298
34	7/10/2020	100	0.705283915	0.705283915	-999	0.134821084	0.192141245	0.674353153	0.728069638	0.783095728	0.867438272
35	15/10/2020	100	0.560911939	0.560911939	-999	0.131685796	0.149281247	0.493773617	0.572494275	0.654820489	0.78025721
36	23/10/2020	0	-999	-999	-999	-999	-999	-999	-999	-999	-999
37	31/10/2020	0	-999	-999	-999	-999	-999	-999	-999	-999	-999
38	8/11/2020	0	-999	-999	-999	-999	-999	-999	-999	-999	-999
39	16/11/2020	11.34020619	0.088245293	0.088245293	-999	0.058756416	0.061126139	0.068886934	0.078092817	0.094776526	0.312031743
40	24/11/2020	90.72164948	0.059667961	0.059667961	-999	0.056058768	-0.008399414	0.036195829	0.051733959	0.089231012	0.352874302
41	2/12/2020	96.90721649	0.179350337	0.179350337	-999	0.079021334	0.0835643	0.125824637	0.165267318	0.215012471	0.445040089
42	10/12/2020	0	-999	-999	-999	-999	-999	-999	-999	-999	-999
43	18/12/2020	100	0.320787541	0.320787541	-999	0.156201168	0.065028645	0.216630341	0.264246312	0.396513174	0.743083299

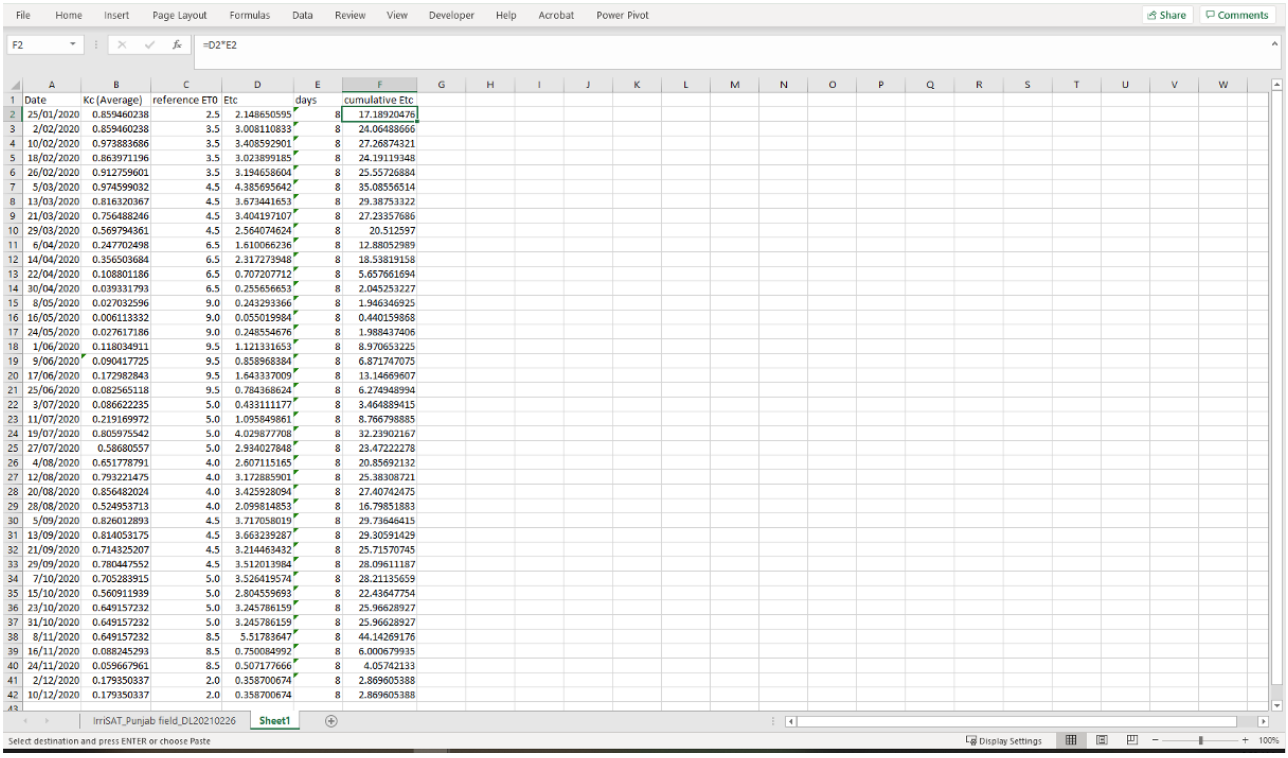
Step 22: The Kc average and date (columns A and C) are all that is needed from this output.

But please note that where Field Visibility (%) was zero (during the satellite pass), there will be no Kc estimate for the period until the next pass of the satellite. These will be indicated by a Kc value of negative 999. All negative Kc values will need to be corrected. Instead use the previous Kc value (row above) or an average of the previous and next values (average row above and row below).

Step 23: You can now input reference ET0. In the example below, reference ET0 is taken from Giridhar et al. Figs 1-12 were calculated on a monthly time frame.

Step 24: The next step is to calculate the ETc by multiplying the Kc by the corresponding ET0 values.

Step 25: Finally, to calculate cumulative ETc, multipy ETc (column D below) by the number of days between readings (8 days), this will give the cumulative ETc over those 8 days (column F). The sum of all cumulative ETc values over the growing season gives the overall crop water use of cumulative ETc.



Date	Kc (Average)	reference ET0	Etc	days	cumulative Etc
25/01/2020	0.859460238	2.5	2.148650595	8	17.18920476
2/02/2020	0.859460238	3.5	3.008110833	8	24.06488666
10/02/2020	0.973883686	3.5	3.408592901	8	27.26874321
18/02/2020	0.863971196	3.5	3.023899185	8	24.19119348
26/02/2020	0.912759601	3.5	3.194658604	8	25.55726884
5/03/2020	0.974599032	4.5	4.385695642	8	35.08556514
13/03/2020	0.816320367	4.5	3.673441653	8	29.38753322
21/03/2020	0.756488246	4.5	3.404197107	8	27.23357686
29/03/2020	0.569794361	4.5	2.564074624	8	20.512597
6/04/2020	0.247702498	6.5	1.610066236	8	12.88052989
14/04/2020	0.356503684	6.5	2.317273948	8	18.53819158
22/04/2020	0.108801186	6.5	0.707207712	8	5.657661694
30/04/2020	0.039331793	6.5	0.255656653	8	2.045253227
8/05/2020	0.027032596	9.0	0.243293366	8	1.946346925
16/05/2020	0.006113332	9.0	0.055019984	8	0.440159868
24/05/2020	0.027617186	9.0	0.248554676	8	1.988437406
1/06/2020	0.118034911	9.5	1.121331653	8	8.970653225
9/06/2020	0.090417725	9.5	0.858968384	8	6.871747075
17/06/2020	0.172982843	9.5	1.643337009	8	13.14669607
25/06/2020	0.082565118	9.5	0.784368624	8	6.274948994
3/07/2020	0.086622235	5.0	0.433111177	8	3.464889415
11/07/2020	0.219169972	5.0	1.095849861	8	8.766798885
19/07/2020	0.805975542	5.0	4.029877708	8	32.23902167
27/07/2020	0.58680557	5.0	2.934027848	8	23.47222278
4/08/2020	0.651778791	4.0	2.607115165	8	20.85692132
12/08/2020	0.793221475	4.0	3.172885901	8	25.38308721
20/08/2020	0.856482024	4.0	3.425928094	8	27.40742475
28/08/2020	0.524953713	4.0	2.099814853	8	16.79851883
5/09/2020	0.826012893	4.5	3.717058019	8	29.73646415
13/09/2020	0.814053175	4.5	3.663239287	8	29.30591429
21/09/2020	0.714325207	4.5	3.214463432	8	25.71570745
29/09/2020	0.780447552	4.5	3.512013984	8	28.09611187
7/10/2020	0.705283915	5.0	3.526419574	8	28.21135659
15/10/2020	0.560911939	5.0	2.804559693	8	22.43647754
23/10/2020	0.649157232	5.0	3.245786159	8	25.96628927
31/10/2020	0.649157232	5.0	3.245786159	8	25.96628927
8/11/2020	0.649157232	8.5	5.51783647	8	44.14269176
16/11/2020	0.088245293	8.5	0.750084992	8	6.000679935
24/11/2020	0.059667961	8.5	0.507177666	8	4.05742133
2/12/2020	0.179350337	2.0	0.358700674	8	2.869605388
10/12/2020	0.179350337	2.0	0.358700674	8	2.869605388

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