Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

The Canadian Drought Monitor
- New Developments -

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National Agroclimate Information Service

Regina, Saskatchewan, Canada

Improving the Effectiveness of Early Warning Systems for Drought:

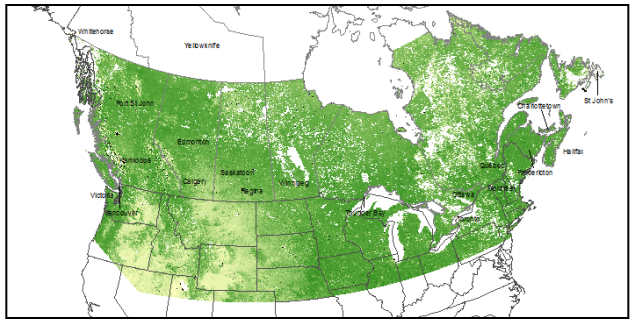
2020 Virtual Drought Summit, October 1, 2020

Canada

What is VegDRI?

- Hybrid drought index that combines satellite observations of vegetation health with climate station information and land biophysical information to determine drought categories.
- The index looks at anomalies in crop growth and builds a model that relates these to precipitation and temperature anomalies.

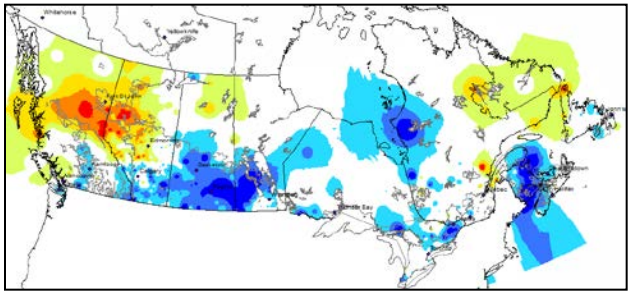
Remote Sensing Component



Satellite Normalized Difference Vegetation Index (NDVI)

+

Climate Component

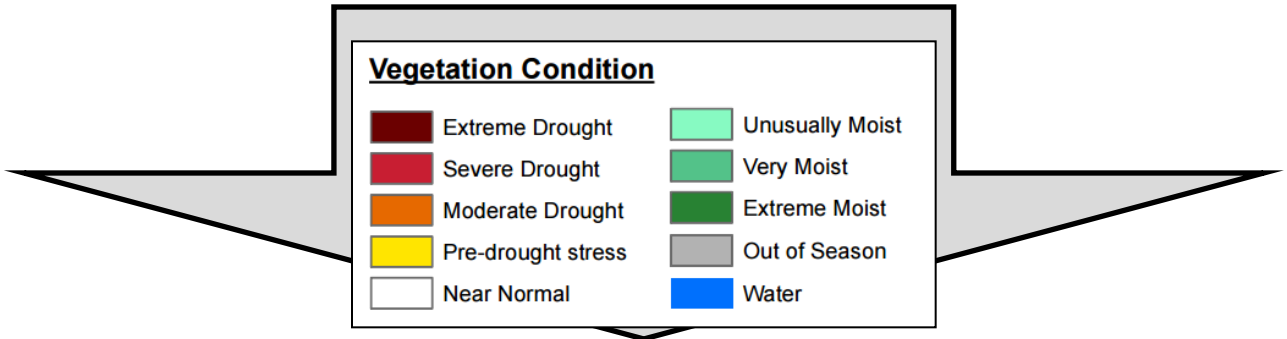


Standardized Precipitation Index (SPI)
Palmer Drought Severity Index (PDSI)

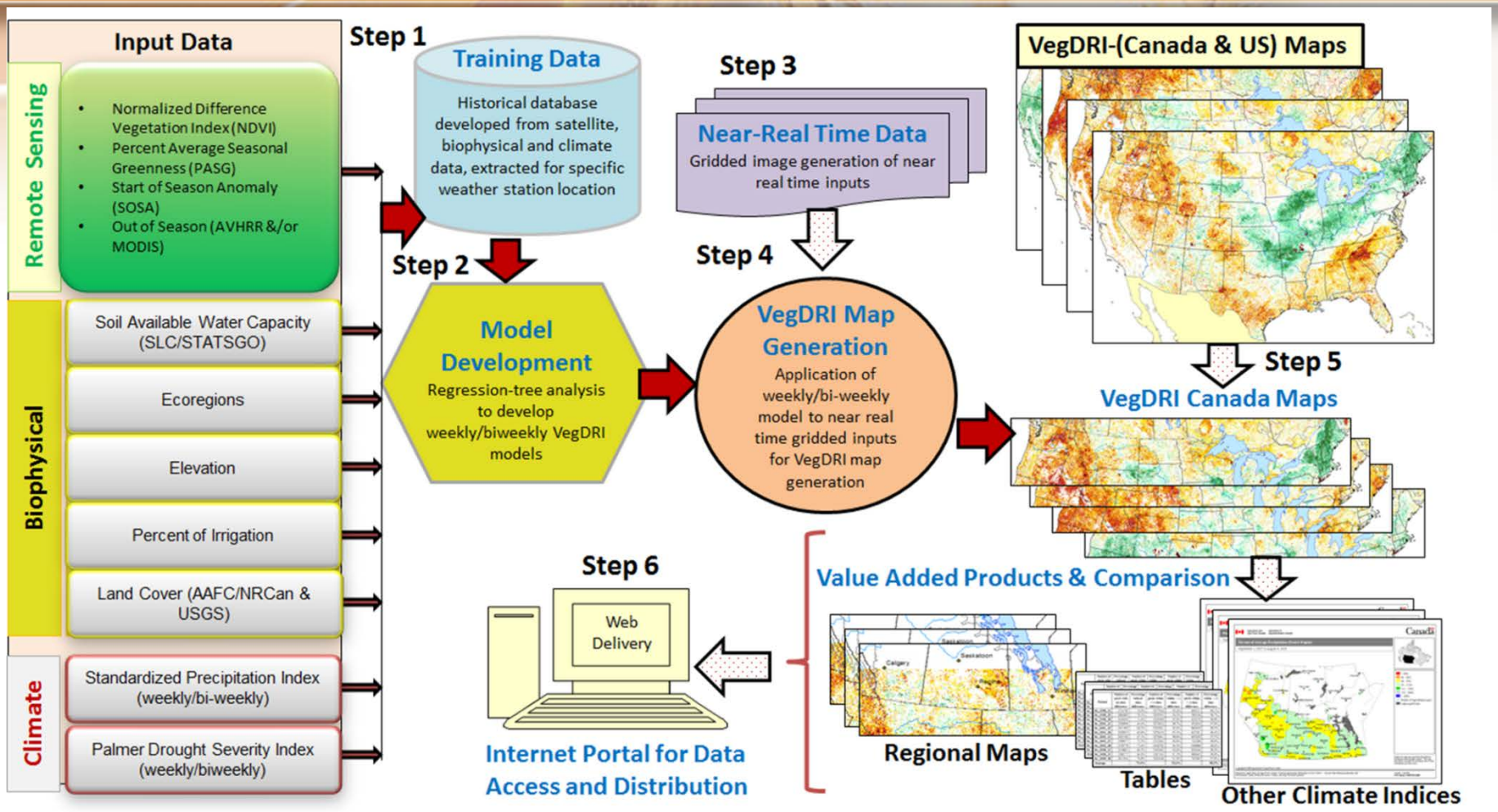
+

Biophysical Component

Land Cover; Irrigation; EcoZones; Soil Water Holding Capacity



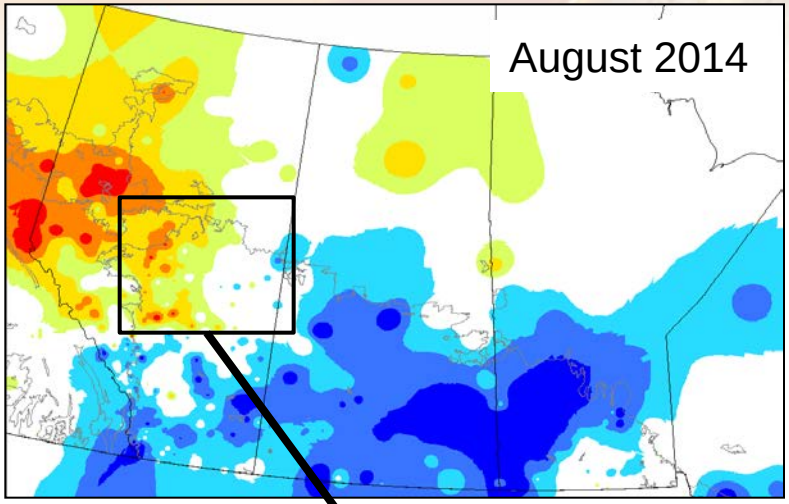
VegDRI Model Development (Tadesse et al 2015, 2017)…



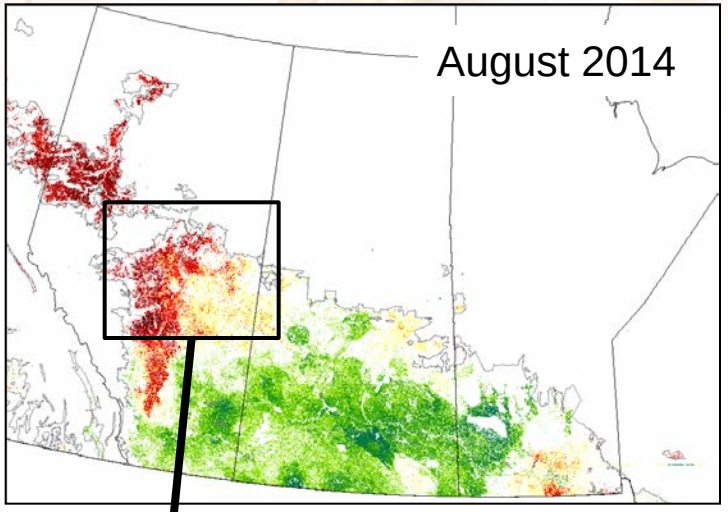
Tadesse, T., Champagne, C., Wardlow, B.D., Hadwen, T.A., Brown, J.F., Demisse, G.B., Bayissa, Y.A., & Davidson, A.M. (2017). Building the vegetation drought response index for Canada (VegDRI-Canada) to monitor agricultural drought: first results. ***GIS Science & Remote Sensing***, pp1-28.

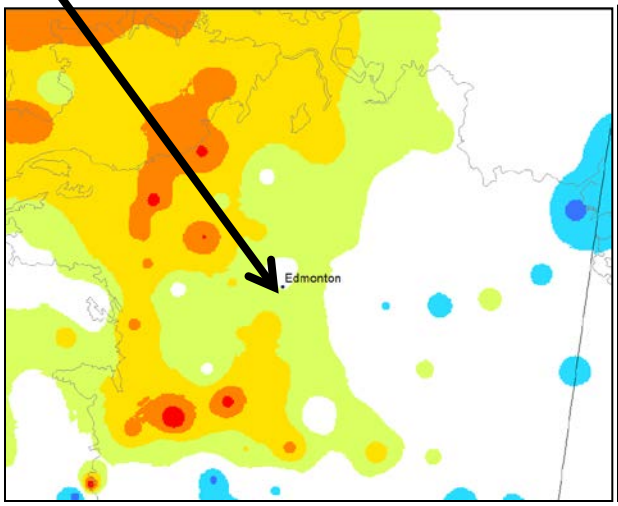
VegDRI provides higher spatial resolution on the impacts of drought…

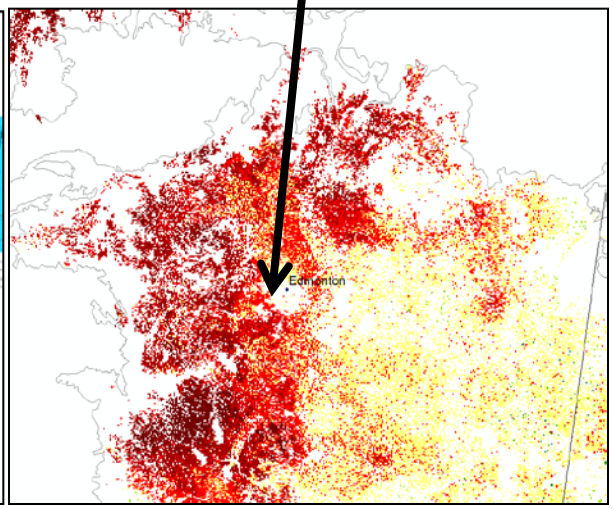
Interpolated Standardized Precipitation Index (SPI)



Vegetation Drought Response Index (VegDRI)



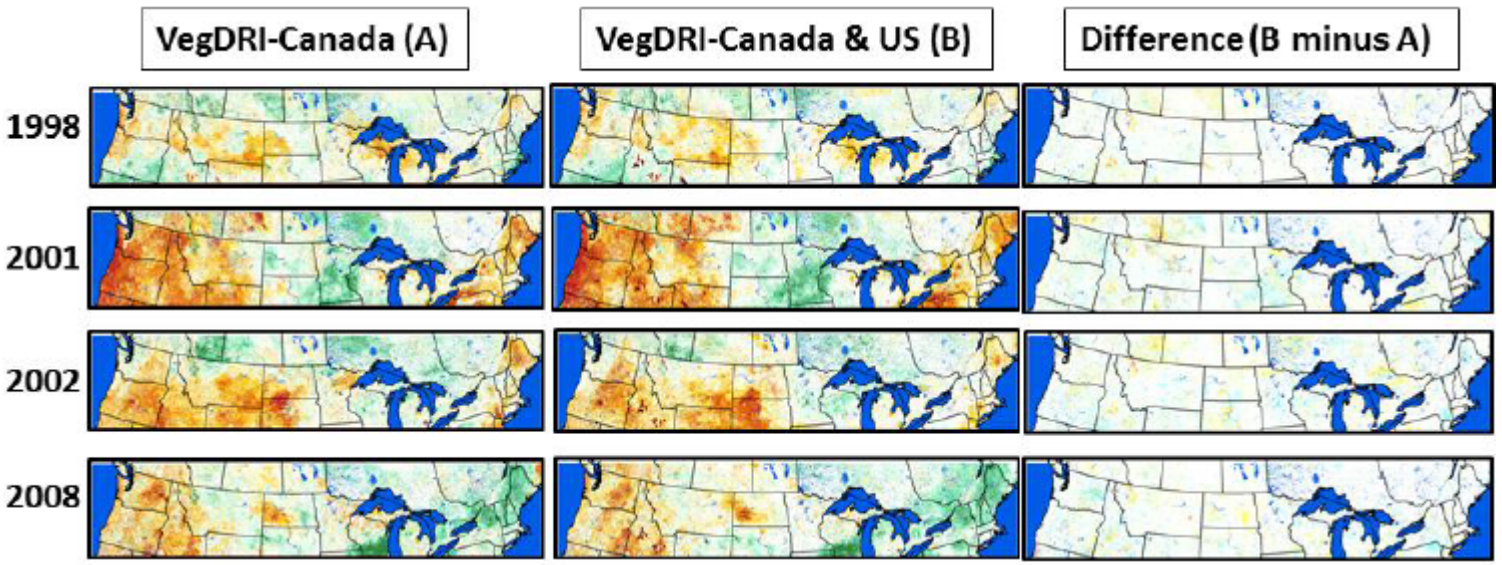




Impact of Data Inputs on VegDRI

Difference Maps:

(VegDRI-US & Canada) minus VegDRI-Canada [B-A] for Early Season (4 – 18 Jun)



Average Over all Periods

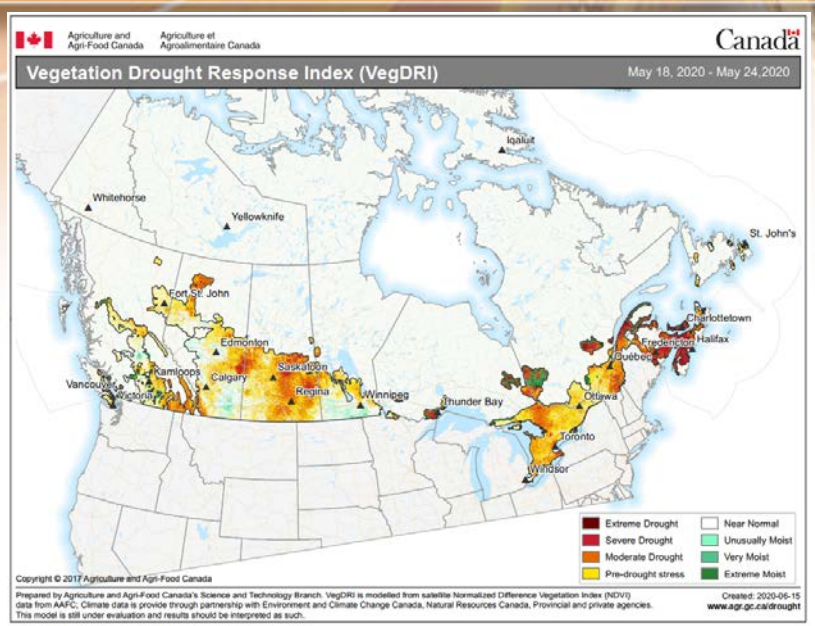
71% Pixels had no class difference

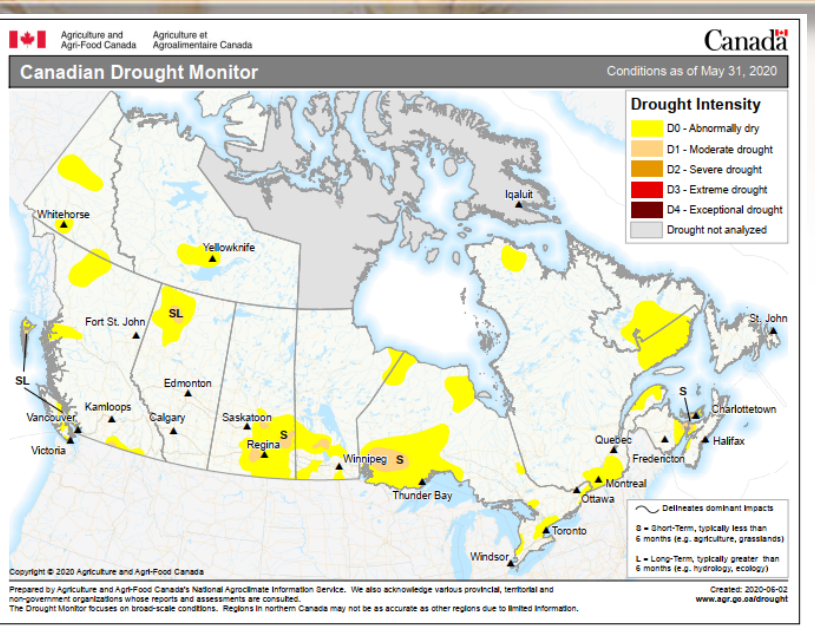
92% of pixels were within +/- 1 Class

98% of pixels were within +/- 2 Class

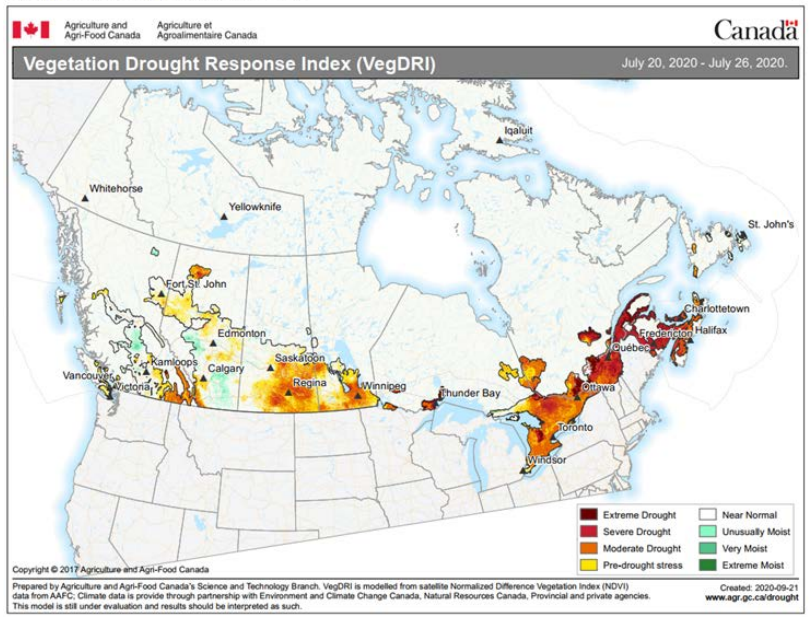
Test results from the 2020 Canadian VegDRI Model

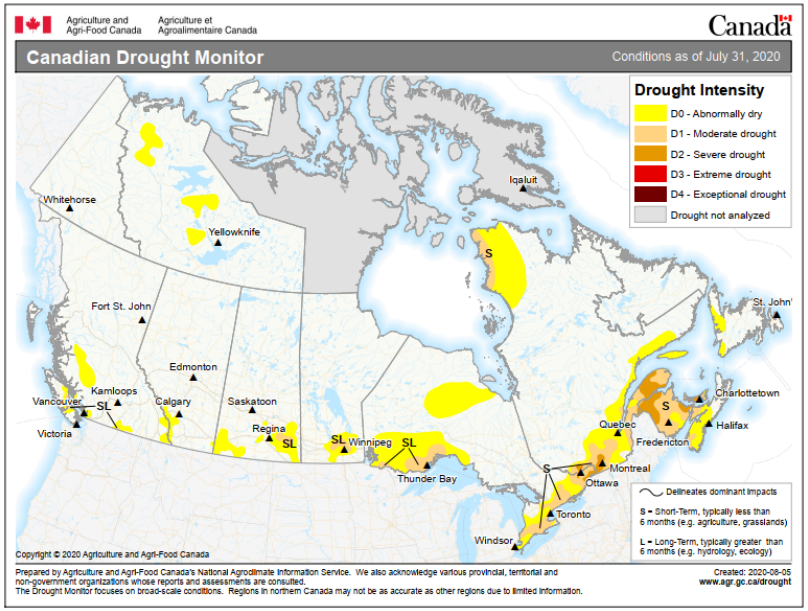
May 2020



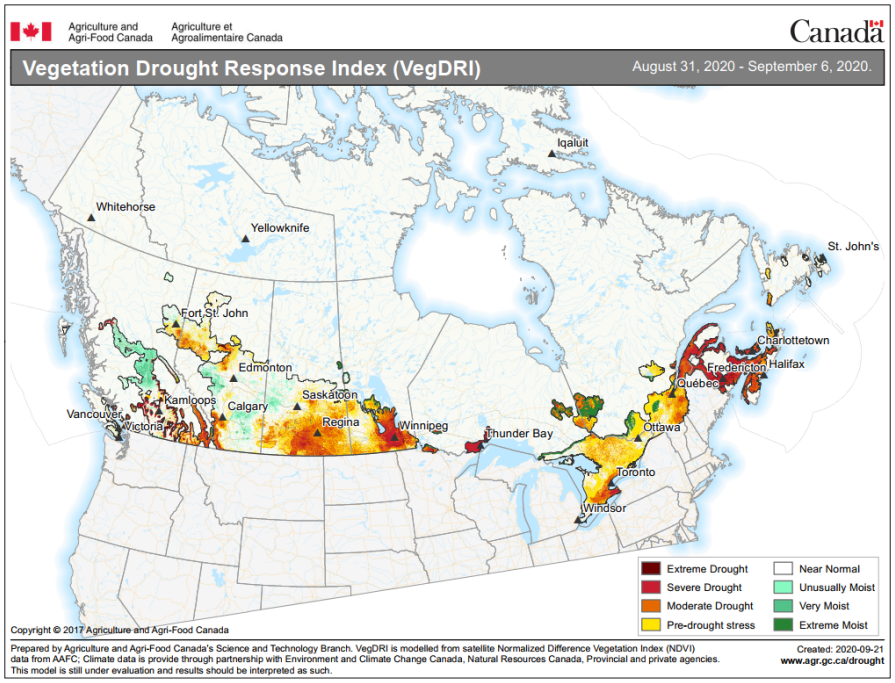


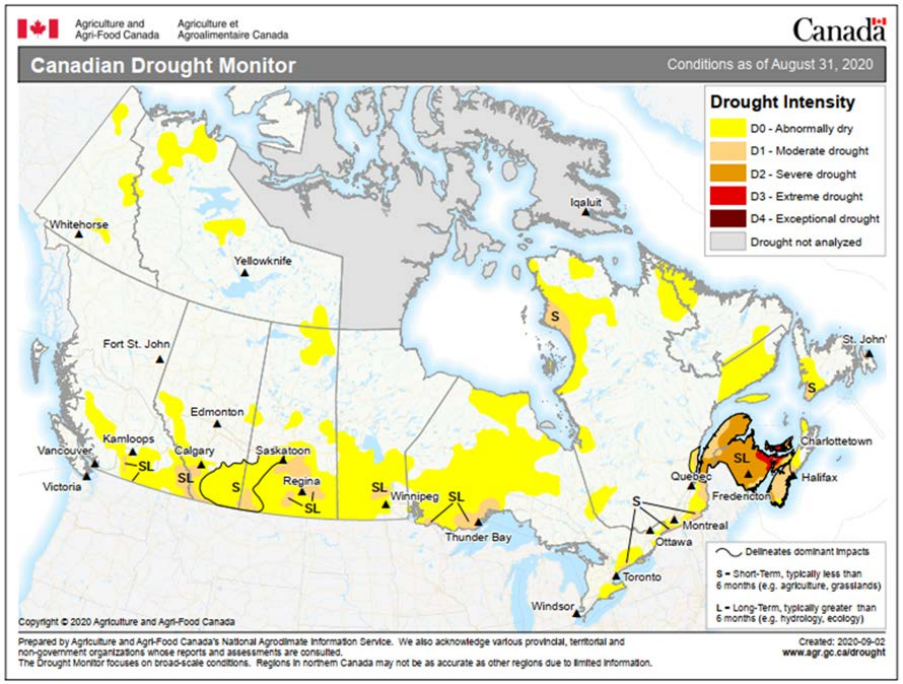
June 2020





August 2020 VegDRI – CDM Comparison

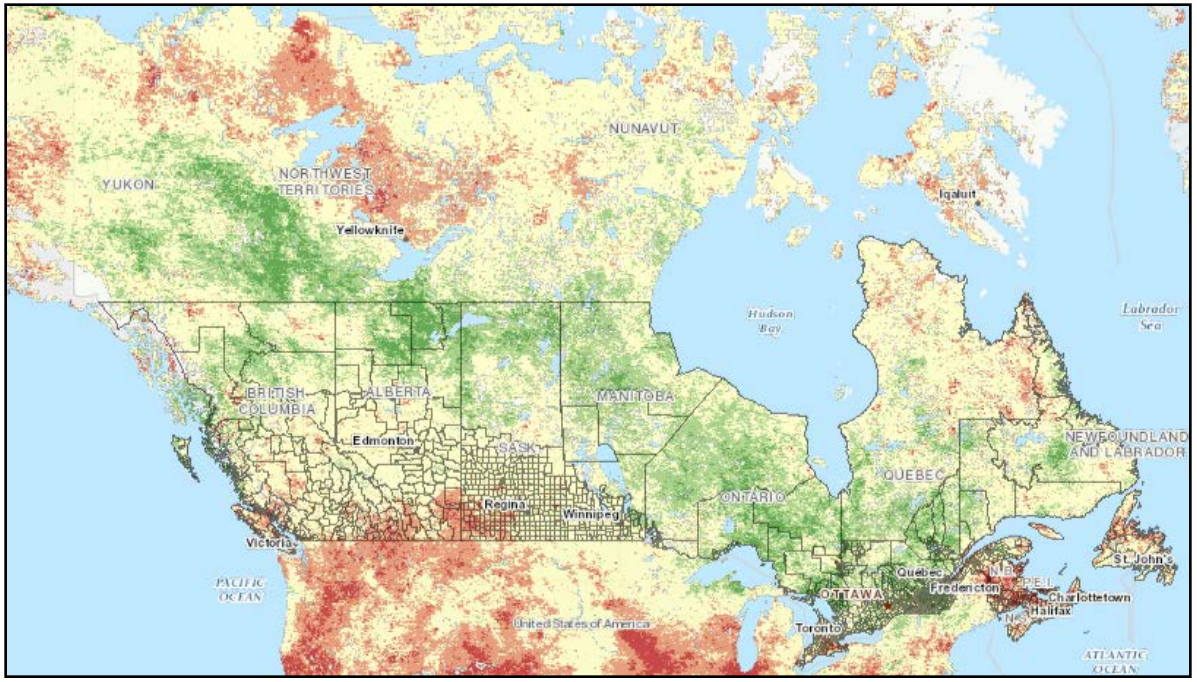




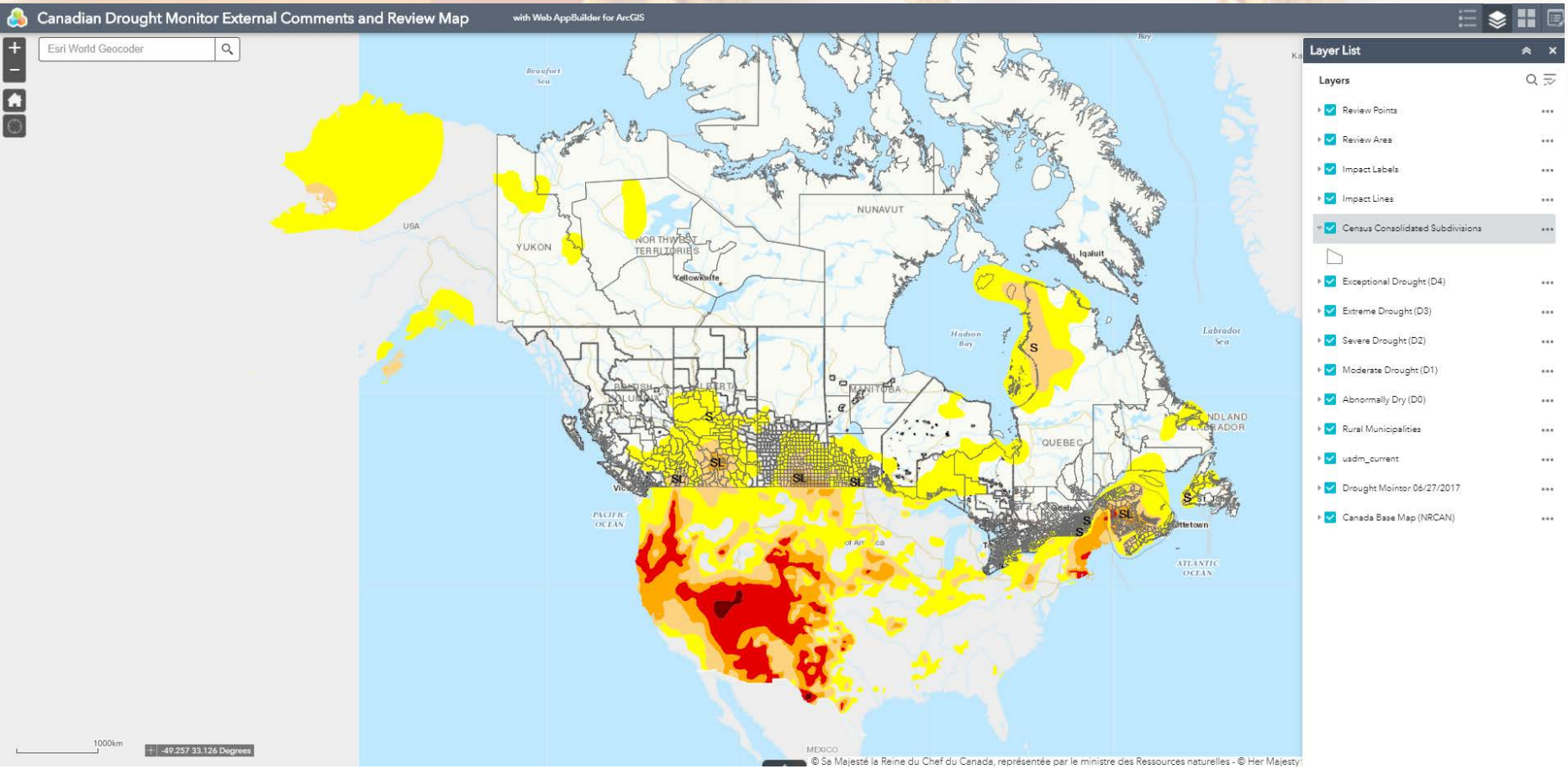
The Canadian VegDRI will be released and posted regularly on Drought Watch website www.agr.gc.ca/drought in 2021

The Evaporative Stress Index (ESI)

- The ESI describes temporal anomalies in ET, highlighting areas with high or low rates of water use.
- The ESI has the capability for capturing early signals of “flash drought”, brought on by extended periods of hot, dry and windy conditions leading to rapid soil moisture depletion.

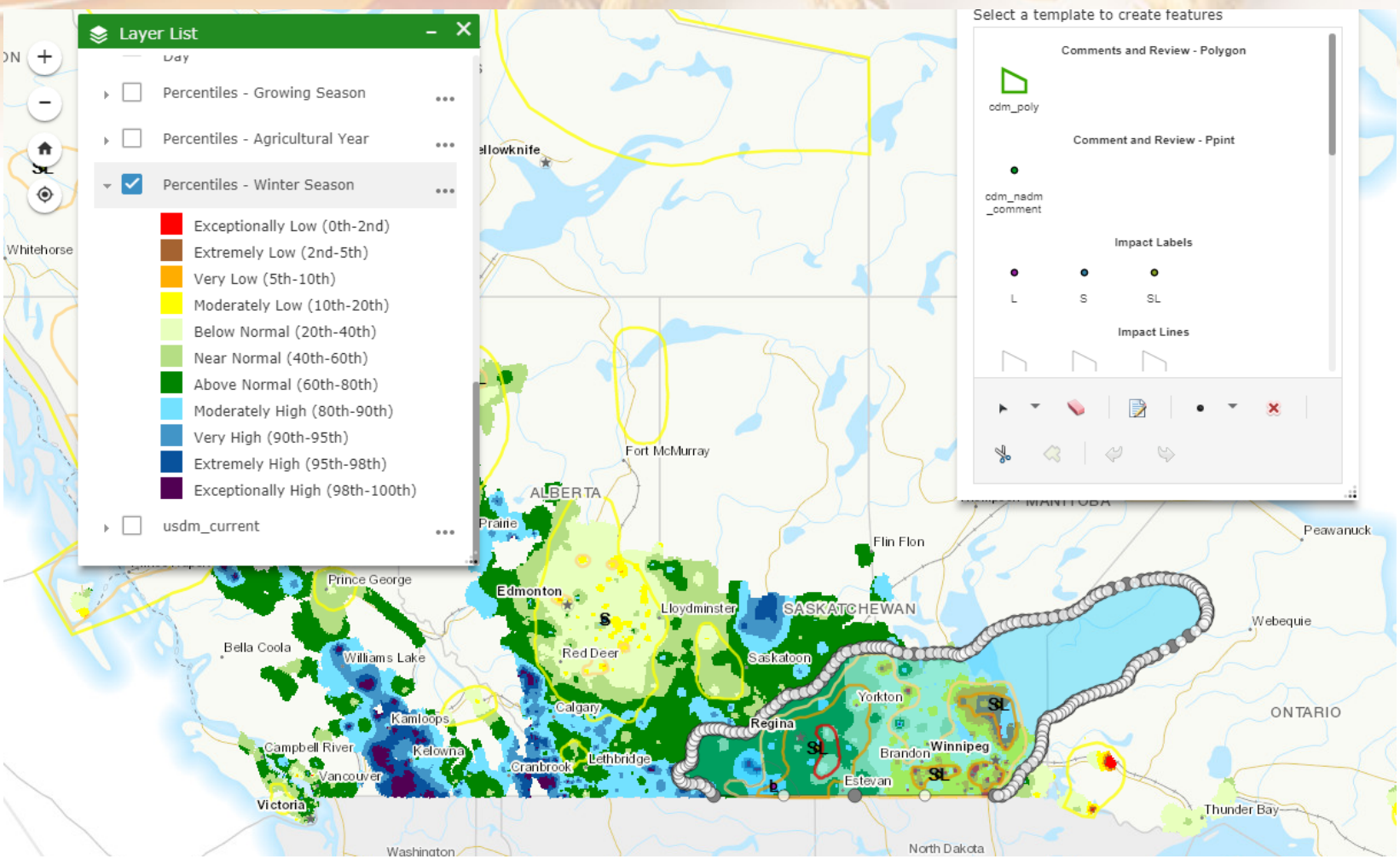


CDM Reviewer Application



http://aafc.maps.arcgis.com/apps/webappviewer/index.html?id=63e9d3dfe5bd455c9dfa58df8258b337

CDM Reviewer Application



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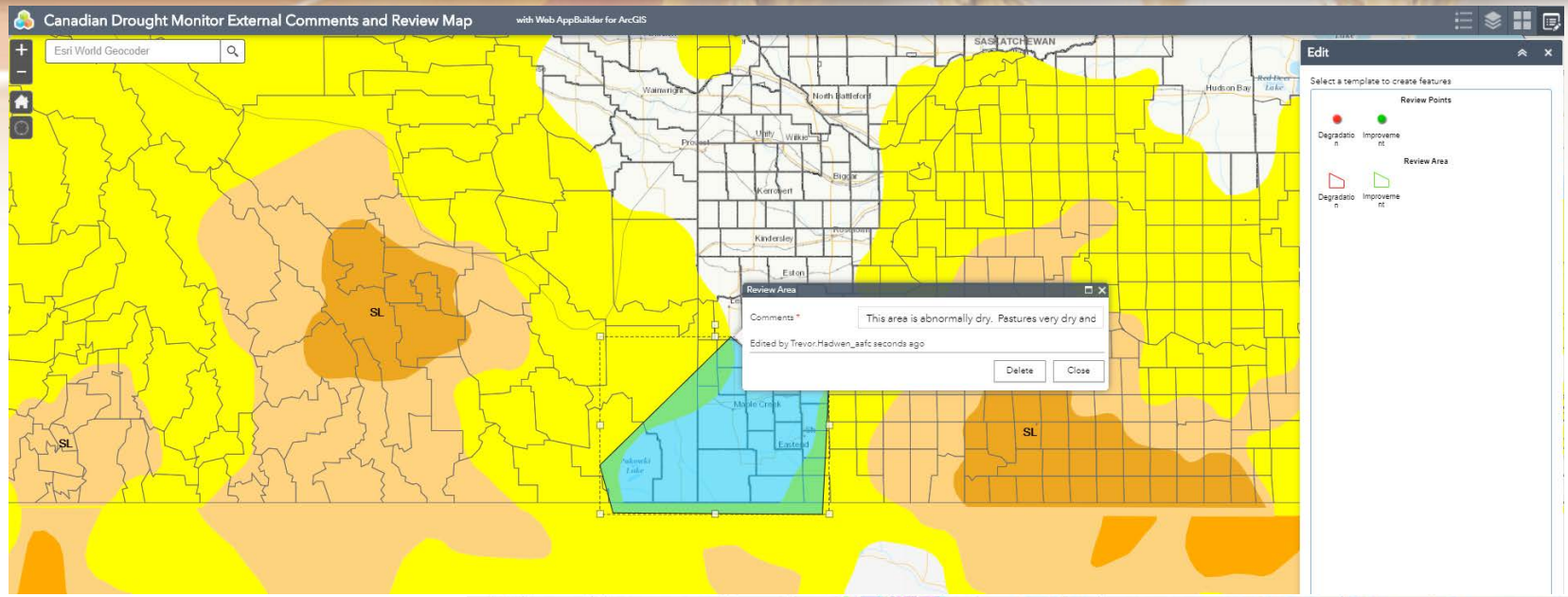
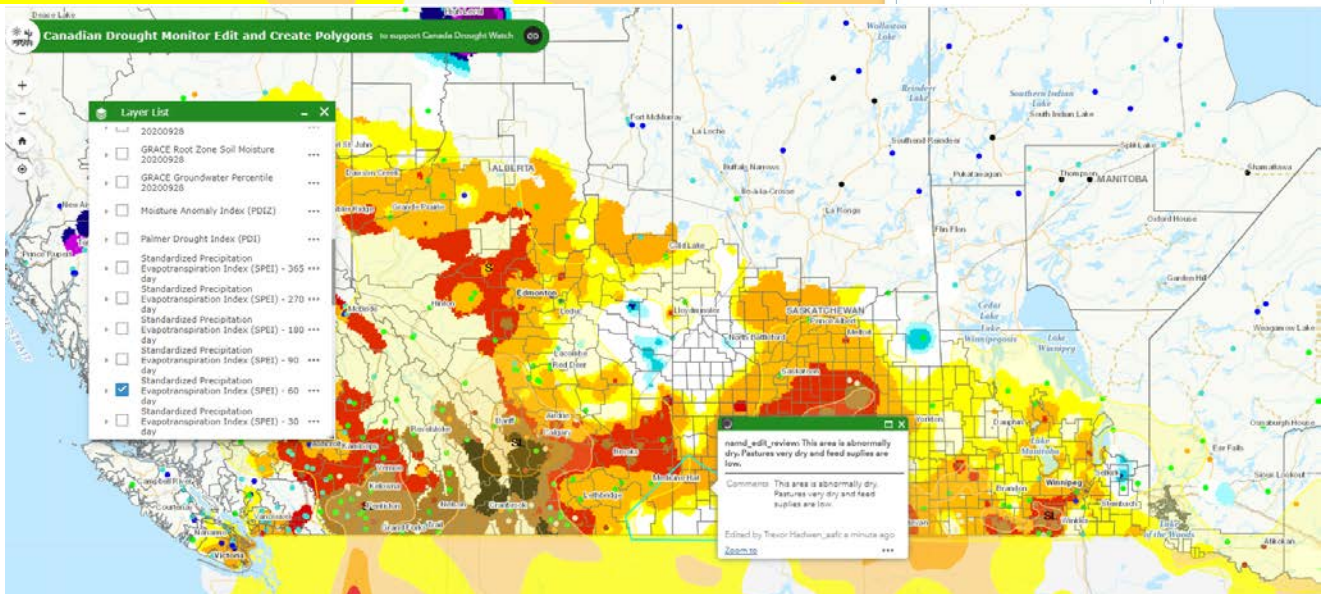




Objective Blends and Drought Indices Table

- The goal of this project is to develop a Table that would provide a quick assessment of each indicator for each climate station in the country.
- The table would incorporate the indicators into short and long term objective blends
- The stations could then be displayed as a service on our CDM editor application or an application on our website.

Viewer Zoom

Show 1,000 entries Search:

ClimDist	prov	RegionNAME	RegionalSB	RegionalLB
		Basin		
506	MB	Nelson and Churchill River Basin	100	100
601	ON	Patricia	54.17	26.39
602	ON	Rainy River	1.39	25
603	ON	Kenora	9.72	29.17
604	ON	Thunder Bay	4.17	16.67
606	ON	Sudbury	94.44	97.22
607	ON	Timiskaming and Cochrane	55.56	52.78
608	ON	Nipissing	18.06	31.94
609	ON	Manitoulin Island		
610	ON	Eastern Ontario Counties	45.83	87.5
611	ON	Georgian Bay Counties	34.72	56.94
612	ON	Lake Huron Counties	6.94	43.06
613	ON	Lake Erie and Niagara Counties	25	76.39
614	ON	West Central Counties	13.89	44.44
615	ON	Lake Ontario Counties	12.5	90.28
616	ON	East Central Counties	5.56	51.39
701	QC	Mid St. Lawrence River Basin - North	62.5	63.89
702	QC	Mid St. Lawrence River Basin - South	41.67	58.33
703	QC	Lower Ottawa and Gatineau River Basin	37.5	83.33
704	QC	Lower St. Lawrence River Basin - North	47.22	40.28
705	QC	Lower St. Lawrence River Basin - South	20.83	19.44
706	QC	Lake St. John Basin	59.72	62.5
707	QC	Upper St. Maurice River Basin	56.94	66.67
708	QC	Upper Ottawa River Basin	75	84.72
709	QC	James Bay Basin	70.83	59.72
710	QC	Husdon Bay Basin		

Showing 1 to 79 of 79 entries Previous 1 Next

Objective Blends and Drought Indices Table

prov	ClimDiv	StationID	NAME	lat	lon	SD	LD	1 Month	2 Month	3 Month	4 Month	1 Year	2 Year	5 Year	PDSI	PHDI	WPLMI	Z-Index	SoilMoisture
BC	109	1091174	BURNS LAKE DECKER LAKE	54.38	-125.86	71.88	28.38	0.7960	0.8192	0.8017	0.5331	0.3318	0.2066	0.1273	100	100	206	853	22.234
BC	110	1100351	ABBOTSFORD	49.03	-122.36	83.11	16.36	0.8647	0.8798	0.7301	0.5084	0.3643	0.2341	0.4028	41	42	86	590	18.099
BC	110	1100319	AGASSIZ CS	49.23	-121.77	82.44	18.36	0.5728	0.5832	0.4733	0.2932	0.1823	0.1778	0.2183	47	54	103	382	11.112
BC	110	1108824	WEST VANCOUVER AUT	49.35	-123.18	69.82	20.01	0.5325	0.6033	0.4187	0.0658	0.2491	0.4395	0.6824	107	103	135	459	0.005
BC	110	1108416	WHITE ROCK CAMPBELL SCIENTIFIC	49.02	-122.78	44.91	10.72	0.4959	0.4404	0.6806	0.3211	0.4139	0.3943	0.8253	146	177	205	403	0.344
BC	110	1100178	PITT MEADOWS CS	49.21	-122.69	66.74	32.89	0.4298	0.497	0.6152	0.2034	0.401	0.327	0.294	133	184	195	592	18.965
BC	110	1108440	VANCOUVER HARBOUR CS	49.3	-123.12	35.89	10.35	0.3932	0.4746	0.4606	0.1004	0.3452	0.2987	0.732	49	49	40	343	0.005
BC	110	1102415	DELTA BURNS BOG	49.13	-123	29.22	10.68	0.4427	0.5288	0.4423	0.107	0.5124	0.1044	0.4002	31	31	27	274	0.348
BC	111	1113342	HOPE	49.37	-121.5	82.69	97.5	0.6446	0.8281	0.8845	0.8975	0.9059	0.83	0.8301	791	793	796	883	20.684
BC	111	1114019	LILLOOET	50.68	-121.93	57.1	58.1	0.6187	0.4274	0.588	0.6151	0.5459	0.7861	0.915	335	388	365	478	6.272
BC	111	1114744	LYTTON RCS	50.22	-121.58	49.08	23.54	0.588	0.5844	0.4633	0.1778	0.2137	0.2208	0.3318	141	152	119	440	14.284
BC	112	1125973	MERRITT	50.11	-120.78	60.27	89.99	0.5384	0.7898	0.9032	0.889	0.8772	0.8253	0.8985	741	739	745	428	10.087
BC	112	1123939	KELOWNA	49.96	-119.38	58.1	94.24	0.477	0.7688	0.9481	0.8749	0.841	0.8194	0.7827	743	731	728	407	10.523
BC	112	1120E1	SUMMERLAND CS	49.56	-119.64	39.87	91.99	0.2715	0.7273	0.9985	0.7662	0.8808	0.7745	0.865	734	737	699	240	10.974
BC	112	1126146	PENTICTON	49.46	-119.6	31.55	66.28	0.2857	0.48	0.8312	0.6234	0.6988	0.5171	0.7748	435	443	408	219	14.02
BC	112	1128702	VERNON AUTO	50.22	-119.18	28.21	66.11	0.2255	0.4673	0.7828	0.4451	0.7249	0.5478	0.3483	289	407	280	188	28.236
BC	112	1125N6M	PRINCETON CS	49.47	-120.51	25.38	66.78	0.2834	0.4965	0.7881	0.7581	0.7096	0.5677	0.6578	415	600	402	183	8.155
BC	112	1123E02	OSOYOOS CS	49.03	-119.44	24.37	97.38	0.1677	0.5431	0.8312	0.8548	0.8847	0.8654	0.7827	788	778	748	104	14.3
BC	114	1145287	NAKUSP CS	50.27	-117.81	62.77	75.79	0.5832	0.4227	0.4788	0.3081	0.7487	0.7107	0.8819	747	550	472	470	14.075
BC	114	1148189	CRESTON CAMPBELL SCIENTIFIC	49.08	-116.5	34.23	10.35	0.4274	0.7648	0.5549	0.1181	0.2547	0.0308	0.1877	44	49	48	336	23.013
BC	114	1148705	WARFIELD RCS	49.11	-117.74	8.35	10.35	0.2682	0.3621	0.4128	0.1851	0.2845	0.1027	0.2545	45	45	45	82	17.996
BC	114	1145M29	NELSON CS	49.49	-117.31	0.08	1	0.242	0.2721	0.4545	0.0343	0.0378	0.0178	0.0803	2	2	2	72	23.338
BC	115	1157931	SPARWOOD CS	49.73	-114.89	66.11	83.2	0.1074	0.4098	0.8133	0.8111	0.7402	0.5412	0.4747	602	612	648	523	14.249
BC	115	1152105	CRANBROOK	49.61	-115.78	3.34	10.02	0.0897	0.1488	0.3837	0.1248	0.1322	0.0883	0.2965	32	33	33	46	13.721
BC	116	1160115	ASHCROFT	50.76	-121.28	66.32	82.32	0.8845	0.8217	0.9551	0.961	0.8949	0.8028	0.5891	729	717	733	784	13.919
BC	116	1161665	CLINTON RCS	51.10	-121.51	82.96	81.47	0.8845	0.7721	0.8052	0.7025	0.6578	0.8052	0.7102	643	605	648	789	17.273
BC	116	1163899	BLUE RIVER CS	52.10	-119.29	77.33	69.23	0.7757	0.8315	0.7757	0.5384	0.4589	0.3282	0.1405	282	310	409	606	2.88
BC	116	1163842	KAMLOOPS AUT	50.7	-120.44	66.78	87.95	0.8035	0.8541	0.8386	0.7458	0.621	0.5525	0.7155	547	652	551	523	20.866
BC	116	116FRAN	SALMON ARM CS	50.7	-119.29	55.82	57.28	0.4652	0.691	0.8194	0.5134	0.3932	0.3837	0.6045	284	340	486	458	11.072

Drought Outlook

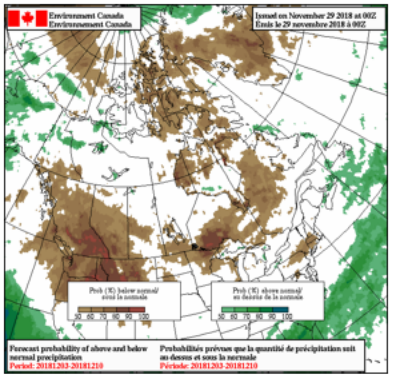
The high-level approach

- Use existing forecasts from ECCC MSC (one month forecasts to start, then seasonal) to produce various drought indices.
- Create and automate a system to classify areas of intensity of drought based on the CDM classifications using a blend of the forecast indices.
- Develop output product(s) that show forecast conditions

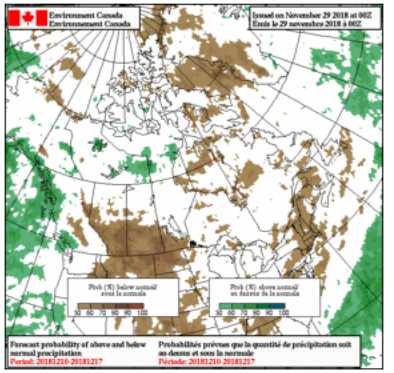
Drought Outlook Data Sources

- GEPS Forecast (http://dd.weather.gc.ca/ensemble/geps/)
  - Forecasts in 3/6 hour steps to 16/32 days
  - Regularly spaced ~0.5 degree resolution
  - 21 ensemble members

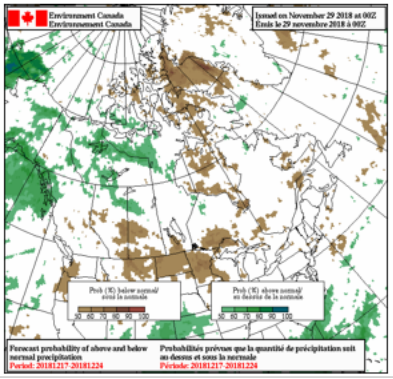
Week 1



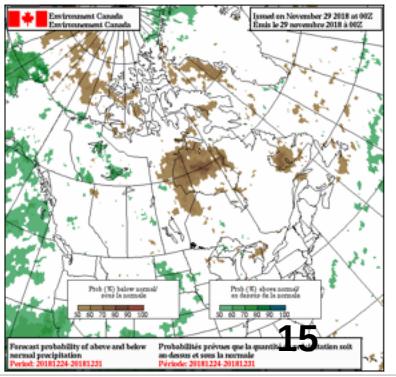
Week 2



Week 3

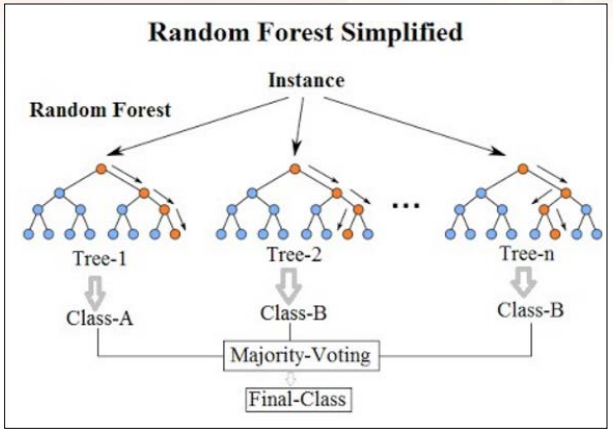


Week 4



Drought Outlook

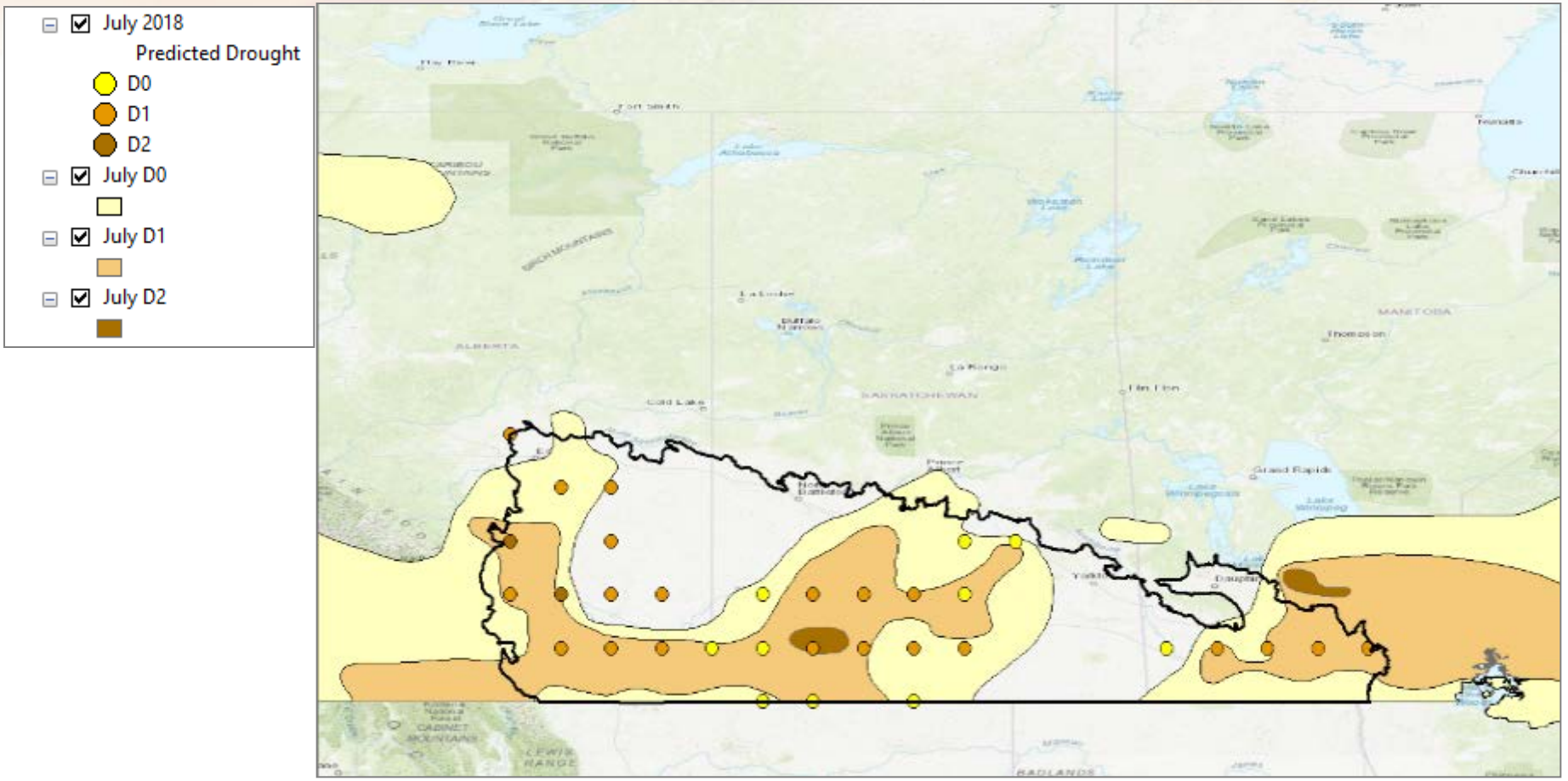
- "Forest" made of up of random partial decision trees



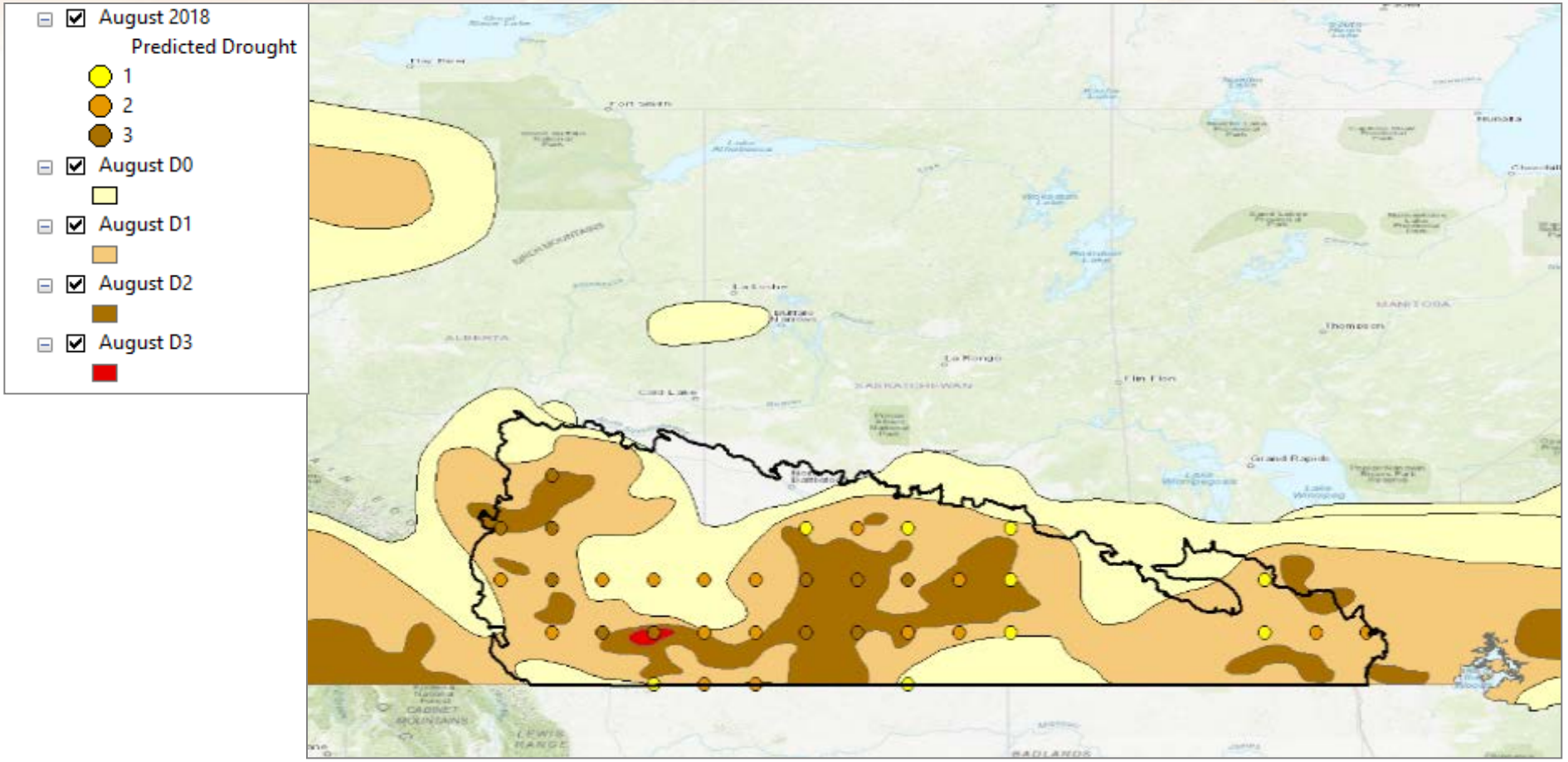
Trained machine learning algorithm
- Drought indices (2004-2015)
- Historical CDM (2004-2015)
- Auxiliary data (Ecozones map, month, etc)

- Uses all available information to classify drought
- Apply trained Machine Learning to predict drought
  - Forecasted drought indices created from GEPS data

Sample Results – July 2018

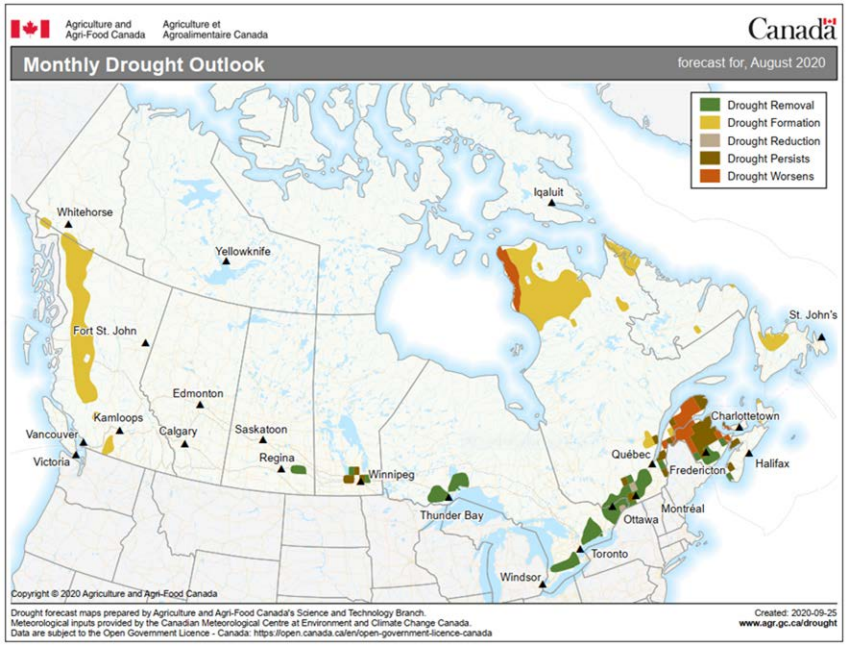


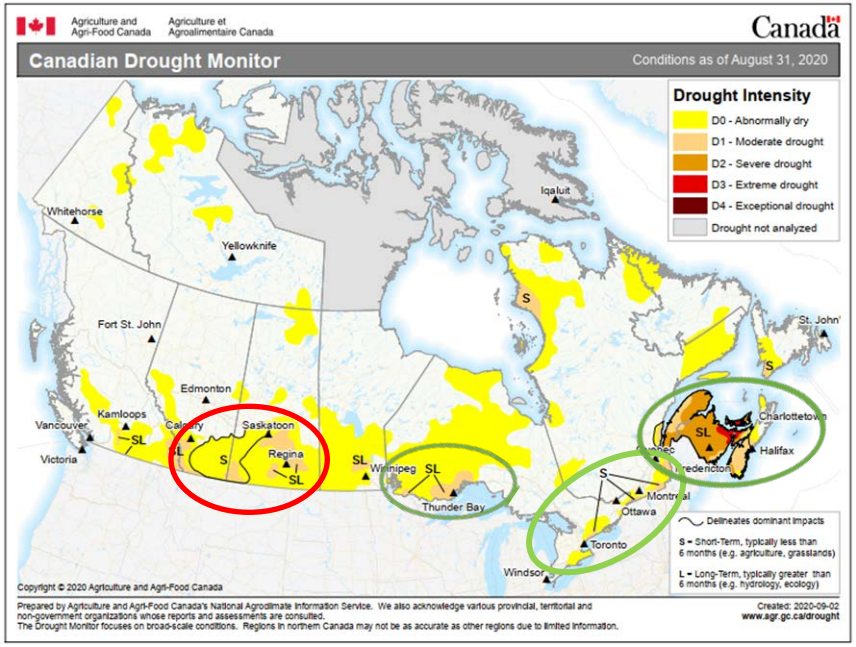
Sample Results – August 2018



Canadian Drought Outlook

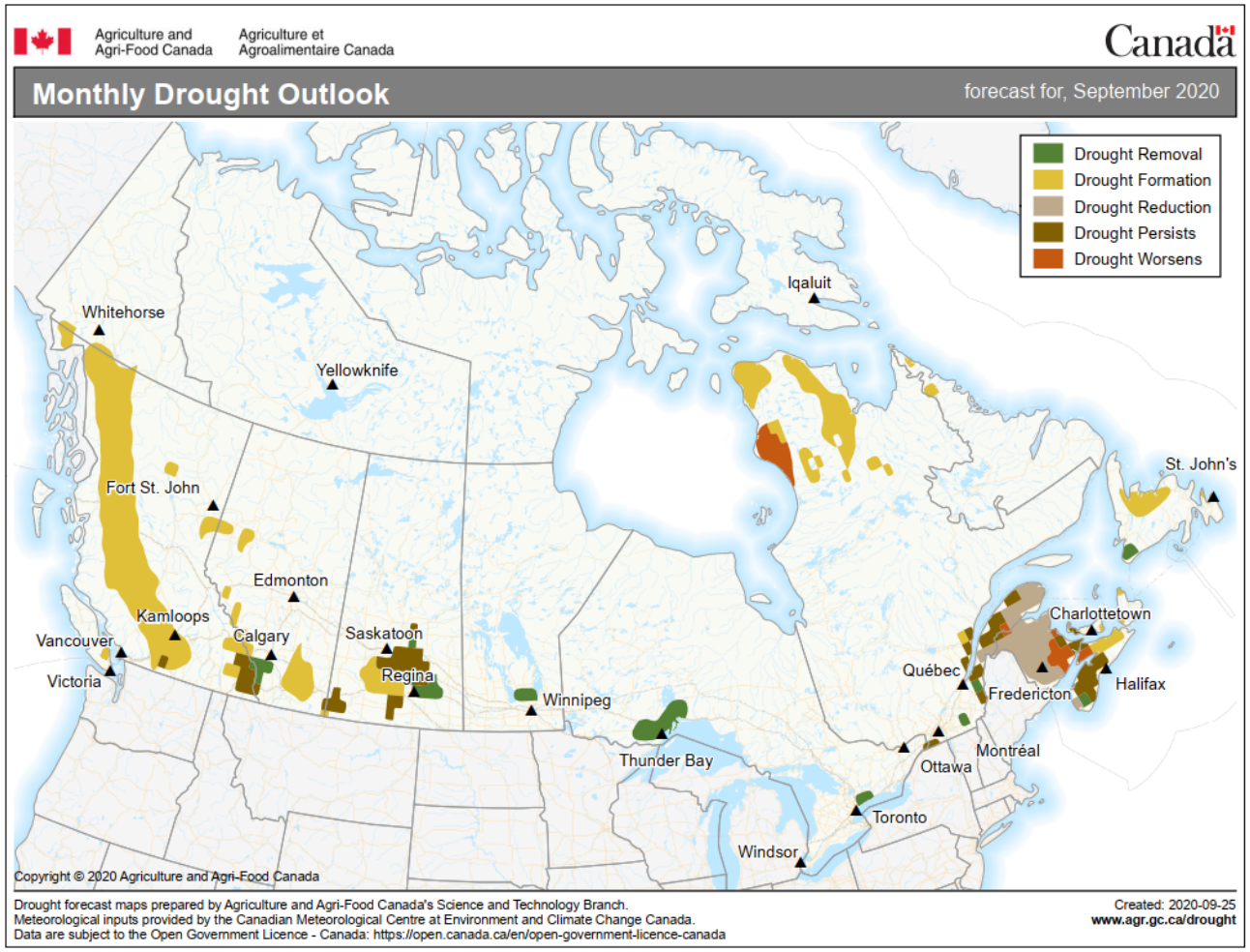
August forecast compared with the August CDM assessment





Canadian Drought Outlook

September forecast



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Drought Watch

http://www.agr.gc.ca/drought