Contents

1. Dataset Description

Data resource: https://cran.r-project.org/web/packages/covid19.analytics/index.html

covid19.analytics: Load and Analyze Live Data from the COVID-19 Pandemic

Load and analyze updated time series worldwide data of reported cases for the Novel Coronavirus Disease (COVID-19) from different sources, including the Johns Hopkins University Center for Systems Science and Engineering (JHU CSSE) data repository <https://github.com/CSSEGISandData/COVID-19>, "Our World in Data" <https://github.com/owid/> among several others. The datasets reporting the COVID-19 cases are available in two main modalities, as a time series sequences and aggregated data for the last day with greater spatial resolution. Several analysis, visualization and modelling functions are available in the package that will allow the user to compute and visualize total number of cases, total number of changes and growth rate globally or for an specific geographical location, while at the same time generating models using these trends; generate interactive visualizations and generate Susceptible-Infected-Recovered (SIR) model for the disease spread.

Version:	2.1.3
Imports:	readxl, ape, rentrez, plotly, htmlwidgets, deSolve, gplots, pheatmap, shiny, shinydashboard, shinycssloaders, DT, dplyr, collapsibleTree
Suggests:	knitr, devtools, roxygen2, markdown, rmarkdown, testthat
Published:	2022-08-18
Author:	Marcelo Ponce [aut, cre], Amit Sandhel [ctb]
Maintainer:	Marcelo Ponce <m.ponce at utoronto.ca>
BugReports:	https://github.com/mponce0/covid19.analytics/issues
License:	GPL-2 | GPL-3 [expanded from: GPL (≥ 2)]
URL:	https://mponce0.github.io/covid19.analytics/
NeedsCompilation:	no
Citation:	covid19.analytics citation info
Materials:	README NEWS
In views:	Epidemiology
CRAN checks:	covid19.analytics results

Documentation:

Reference manual: covid19.analytics.pdf

Vignettes: covid19 Package

2. Data Extraction and loading

#library

>install.packages("covid19.analytics")

>library(covid19.analytics)

3. Data Preprocessing

#Data

#World

obtain all the records combined for " confirmed ", " deaths " and " recovered " cases

for the global (worldwide) * aggregated * data

>ag<-covid19.data(case='aggregated')

>View(ag)

	FIPS	Admin2	Province_State	Country_Region	Last_Update	Lat	Long_	Confirmed	Deaths	Recovered	Active	Combined_Key	Incident_Rate	Case_Fatality_Ratio
1	NA			Afghanistan	2022-11-29 04:21:05	33.939110	67.709953	205802	7833	NA	NA	Afghanistan	528.668817	3.80608546
2	NA			Albania	2022-11-29 04:21:05	41.153300	20.168300	333330	3594	NA	NA	Albania	11582.806310	1.07821078
3	NA			Algeria	2022-11-29 04:21:05	28.033900	1.659600	271079	6881	NA	NA	Algeria	618.181419	2.53837442
4	NA			Andorra	2022-11-29 04:21:05	42.506300	1.521800	46824	156	NA	NA	Andorra	60601.824888	0.33316248
5	NA			Angola	2022-11-29 04:21:05	-11.202700	17.873900	104491	1923	NA	NA	Angola	317.927791	1.84034989
6	NA			Antarctica	2022-11-29 04:21:05	-71.949900	23.347000	11	0	NA	NA	Antarctica	NA	0.00000000
7	NA			Antigua and Barbuda	2022-11-29 04:21:05	17.060800	-61.796400	9106	146	NA	NA	Antigua and Barbuda	9298.668409	1.60333846
8	NA			Argentina	2022-11-29 04:21:05	-38.416100	-63.616700	9727247	130025	NA	NA	Argentina	21522.468792	1.33670914
9	NA			Armenia	2022-11-29 04:21:05	40.069100	45.038200	445737	8710	NA	NA	Armenia	15042.247760	1.95406708
10	NA		Australian Capital Territory	Australia	2022-11-29 04:21:05	-35.473500	149.012400	212092	129	NA	NA	Australian Capital Territory, Australia	49542.630227	0.06082266
11	NA		New South Wales	Australia	2022-11-29 04:21:05	-33.868800	151.209300	3640480	5540	NA	NA	New South Wales, Australia	44844.542991	0.15217773
12	NA		Northern Territory	Australia	2022-11-29 04:21:05	-12.463400	130.845600	99737	79	NA	NA	Northern Territory, Australia	40609.527687	0.07920832
13	NA		Queensland	Australia	2022-11-29 04:21:05	-27.469800	153.025100	1693178	2331	NA	NA	Queensland, Australia	33098.973707	0.13767011
14	NA		South Australia	Australia	2022-11-29 04:21:05	-34.928500	138.600700	809861	1067	NA	NA	South Australia, Australia	46106.518645	0.13175100
15	NA		Tasmania	Australia	2022-11-29 04:21:05	-42.882100	147.327200	260950	201	NA	NA	Tasmania, Australia	48730.158730	0.07702625
16	NA		Victoria	Australia	2022-11-29 04:21:05	-37.813600	144.963100	2728384	6022	NA	NA	Victoria, Australia	41152.717236	0.22071673
17	NA		Western Australia	Australia	2022-11-29 04:21:05	-31.950500	115.860500	1209214	750	NA	NA	Western Australia, Australia	45967.231810	0.06202376
18	NA			Austria	2022-11-29 04:21:05	47.516200	14.550100	5550575	21189	NA	NA	Austria	61629.230325	0.38174423
19	NA			Azerbaijan	2022-11-29 04:21:05	40.143100	47.576900	824245	9976	NA	NA	Azerbaijan	8129.310324	1.21031975
20	NA			Bahamas	2022-11-29 04:21:05	25.025885	-78.035889	37476	833	NA	NA	Bahamas	9529.864106	2.22275590
21	NA			Bahrain	2022-11-29 04:21:05	26.027500	50.550000	696061	1536	NA	NA	Bahrain	40906.673374	0.22067031
22	NA			Bangladesh	2022-11-29 04:21:05	23.685000	90.356300	2036556	29432	NA	NA	Bangladesh	1236.604305	1.44518491
23	NA			Barbados	2022-11-29 04:21:05	13.193900	-59.543200	103955	564	NA	NA	Barbados	36174.492207	0.54254245
24	NA			Belarus	2022-11-29 04:21:05	53.709800	27.953400	994037	7118	NA	NA	Belarus	10519.665910	0.71606992
25	NA		Antwerp	Belgium	2022-11-29 04:21:05	51.219500	4.402400	747434	0	NA	NA	Antwerp, Belgium	40228.182559	0.00000000
26	NA		Brussels	Belgium	2022-11-29 04:21:05	50.850300	4.351700	496395	0	NA	NA	Brussels, Belgium	41239.361148	0.00000000
27	NA		East Flanders	Belgium	2022-11-29 04:21:05	51.036200	3.737300	627467	0	NA	NA	East Flanders, Belgium	41415.214143	0.00000000
28	NA		Flemish Brabant	Belgium	2022-11-29 04:21:05	50.916700	4.583300	453532	0	NA	NA	Flemish Brabant, Belgium	39569.175737	0.00000000
29	NA		Hainaut	Belgium	2022-11-29 04:21:05	50.525700	4.062100	509404	0	NA	NA	Hainaut, Belgium	37895.288122	0.00000000
30	NA		Liege	Belgium	2022-11-29 04:21:05	50.449600	5.849200	413131	0	NA	NA	Liege, Belgium	37320.143235	0.00000000
31	NA		Limburg	Belgium	2022-11-29 04:21:05	50.973900	5.342000	343031	0	NA	NA	Limburg, Belgium	39246.242769	0.00000000
32	NA		Luxembourg	Belgium	2022-11-29 04:21:05	50.054700	5.467700	121192	0	NA	NA	Luxembourg, Belgium	42577.589781	0.00000000
33	NA		Namur	Belgium	2022-11-29 04:21:05	50.331000	4.822100	199549	0	NA	NA	Namur, Belgium	40367.976534	0.00000000
34	NA		Unknown	Belgium	2022-11-29 04:21:05	NA	NA	62294	33057	NA	NA	Unknown, Belgium	NA	53.06610588

Showing 1 to 35 of 4,016 entries; 14 total columns

>str(ag)

'data.frame': 4016 obs. of 14 variables:

$ FIPS   : int NA NA NA NA NA NA NA NA NA NA ...

$ Admin2   : chr "" "" "" "" ...

$ Province_State : chr "" "" "" "" ...

$ Country_Region : chr "Afghanistan" "Albania" "Algeria" "Andorra" ...

$ Last_Update   : chr "2022-11-29 04:21:05" "2022-11-29 04:21:05" "2022-11-29 04:21:05" "2022-11-29 04:21:05" ...

$ Lat   : num 33.9 41.2 28 42.5 -11.2 ...

$ Long_   : num 67.71 20.17 1.66 1.52 17.87 ...

$ Confirmed   : int 205802 333330 271079 46824 104491 11 9106 9727247 445737 212092 ...

$ Deaths   : int 7833 3594 6881 156 1923 0 146 130025 8710 129 ...

$ Recovered   : logi NA NA NA NA NA NA ...

$ Active   : logi NA NA NA NA NA NA ...

$ Combined_Key   : chr "Afghanistan" "Albania" "Algeria" "Andorra" ...

$ Incident_Rate   : num 529 11583 618 60602 318 ...

$ Case_Fatality_Ratio: num 3.806 1.078 2.538 0.333 1.84 ...

#Check missing value

> is.null(ag)

[1] FALSE

obtain "time series" data for global combined for " confirmed ", " deaths " and " recovered " cases

tsa<-covid19.data(case = 'ts-All')

View(tsa)

	Province.State	Country.Region	Lat	Long	2020-01-22	2020-01-23	2020-01-24	2020-01-25	2020-01-26	2020-01-27	2020-01-28	2020-01-29	2020-01-30	2020-01-31	2020-02-01
1		Afghanistan	33.93911	67.709953	0	0	0	0	0	0	0	0	0	0	
2		Albania	41.15330	20.168300	0	0	0	0	0	0	0	0	0	0	
3		Algeria	28.03390	1.659600	0	0	0	0	0	0	0	0	0	0	
4		Andorra	42.50630	1.521800	0	0	0	0	0	0	0	0	0	0	
5		Angola	-11.20270	17.873900	0	0	0	0	0	0	0	0	0	0	
6		Antarctica	-71.94990	23.347000	0	0	0	0	0	0	0	0	0	0	
7		Antigua and Barbuda	17.06080	-61.796400	0	0	0	0	0	0	0	0	0	0	
8		Argentina	-38.41610	-63.616700	0	0	0	0	0	0	0	0	0	0	
9		Armenia	40.06910	45.038200	0	0	0	0	0	0	0	0	0	0	
10	Australian Capital Territory	Australia	-35.47350	149.012400	0	0	0	0	0	0	0	0	0	0	
11	New South Wales	Australia	-33.86880	151.209300	0	0	0	0	3	4	4	4	4	4	
12	Northern Territory	Australia	-12.46340	130.845600	0	0	0	0	0	0	0	0	0	0	
13	Queensland	Australia	-27.46980	153.025100	0	0	0	0	0	0	0	1	3	2	
14	South Australia	Australia	-34.92850	138.600700	0	0	0	0	0	0	0	0	0	0	

Showing 1 to 14 of 852 entries, 1047 total columns

obtain "time series" data for global " confirmed " cases

tsc<-covid19.data(case='ts-Confirmed')

View(tsc)

	Province.State	Country.Region	Lat	Long	2020-01-22	2020-01-23	2020-01-24	2020-01-25	2020-01-26	2020-01-27	2020-01-28	2020-01-29	2020-01-30	2020-01-31
1		Afghanistan	33.93911	67.709953	0	0	0	0	0	0	0	0	0	0
2		Albania	41.15330	20.168300	0	0	0	0	0	0	0	0	0	0
3		Algeria	28.03390	1.659600	0	0	0	0	0	0	0	0	0	0
4		Andorra	42.50630	1.521800	0	0	0	0	0	0	0	0	0	0
5		Angola	-11.20270	17.873900	0	0	0	0	0	0	0	0	0	0
6		Antarctica	-71.94990	23.347000	0	0	0	0	0	0	0	0	0	0
7		Antigua and Barbuda	17.06080	-61.796400	0	0	0	0	0	0	0	0	0	0
8		Argentina	-38.41610	-63.616700	0	0	0	0	0	0	0	0	0	0
9		Armenia	40.06910	45.038200	0	0	0	0	0	0	0	0	0	0
10	Australian Capital Territory	Australia	-35.47350	149.012400	0	0	0	0	0	0	0	0	0	0
11	New South Wales	Australia	-33.86880	151.209300	0	0	0	0	3	4	4	4	4	4
12	Northern Territory	Australia	-12.46340	130.845600	0	0	0	0	0	0	0	0	0	0
13	Queensland	Australia	-27.46980	153.025100	0	0	0	0	0	0	0	1	3	2
14	South Australia	Australia	-34.92850	138.600700	0	0	0	0	0	0	0	0	0	0

Showing 1 to 14 of 289 entries, 1046 total columns

obtain "time series" data for global " death " cases

tsd<-covid19.data(case = 'ts-deaths')

View(tsd)

	Province.State	Country.Region	Lat	Long	2020-01-22	2020-01-23	2020-01-24	2020-01-25	2020-01-26	2020-01-27	2020-01-28	2020-01-29	2020-01-30	2020-01-31	2020-02-0
1		Afghanistan	33.93911	67.709953	0	0	0	0	0	0	0	0	0	0	
2		Albania	41.15330	20.168300	0	0	0	0	0	0	0	0	0	0	
3		Algeria	28.03390	1.659600	0	0	0	0	0	0	0	0	0	0	
4		Andorra	42.50630	1.521800	0	0	0	0	0	0	0	0	0	0	
5		Angola	-11.20270	17.873900	0	0	0	0	0	0	0	0	0	0	
6		Antarctica	-71.94990	23.347000	0	0	0	0	0	0	0	0	0	0	
7		Antigua and Barbuda	17.06080	-61.796400	0	0	0	0	0	0	0	0	0	0	
8		Argentina	-38.41610	-63.616700	0	0	0	0	0	0	0	0	0	0	
9		Armenia	40.06910	45.038200	0	0	0	0	0	0	0	0	0	0	
10	Australian Capital Territory	Australia	-35.47350	149.012400	0	0	0	0	0	0	0	0	0	0	
11	New South Wales	Australia	-33.86880	151.209300	0	0	0	0	0	0	0	0	0	0	
12	Northern Territory	Australia	-12.46340	130.845600	0	0	0	0	0	0	0	0	0	0	
13	Queensland	Australia	-27.46980	153.025100	0	0	0	0	0	0	0	0	0	0	
14	South Australia	Australia	-34.92850	138.600700	0	0	0	0	0	0	0	0	0	0	

Showing 1 to 14 of 289 entries, 1046 total columns

#Check missing value

> is.null(tsa)

[1] FALSE

> is.null(tsc)

[1] FALSE

#Canada

#obtain Canada records combined for " confirmed ", " deaths " and " recovered " cases

can_ag<-covid19.Canada.data(case-'aggregated')

View(can_ag)

	pruid	prname	prnameFR	date	reporting_week	reporting_year	update	totalcases	numtotal_last7	ratecases_total	numdeaths	numdeaths_last7	ratedeaths	ratecases_last7	ratedeaths_last7	numtotal_last14	numdeaths_last14	ratetotal_last14
1	59	British Columbia	Colombie-Britannique	01-02-2020	5	2020	1	1	1	0.02	0	0	0.00	0.02	0.00	NA	NA	
2	48	Alberta	Alberta	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
3	47	Saskatchewan	Saskatchewan	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
4	46	Manitoba	Manitoba	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
5	35	Ontario	Ontario	01-02-2020	5	2020	1	3	3	0.02	0	0	0.00	0.02	0.00	NA	NA	
6	24	Quebec	Québec	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
7	10	Newfoundland and Labrador	Terre-Neuve-et-Labrador	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
8	13	New Brunswick	Nouveau-Brunswick	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
9	12	Nova Scotia	Nouvelle-Écosse	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
10	11	Prince Edward Island	Île-du-Prince-Édouard	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
11	60	Yukon	Yukon	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
12	61	Northwest Territories	Territoires du Nord-Ouest	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
13	62	Nunavut	Nunavut	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
14	99	Repatriated travellers	Voyageurs rapatriés	01-02-2020	5	2020	NA	0	0	NA	0	0	NA	NA	NA	NA	NA	
15	1	Canada	Canada	01-02-2020	5	2020	NA	4	4	0.01	0	0	0.00	0.01	0.00	NA	NA	
16	59	British Columbia	Colombie-Britannique	08-02-2020	6	2020	1	4	3	0.08	0	0	0.00	0.06	0.00	4	0	c
17	48	Alberta	Alberta	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
18	47	Saskatchewan	Saskatchewan	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
19	46	Manitoba	Manitoba	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
20	35	Ontario	Ontario	08-02-2020	6	2020	1	3	0	0.02	0	0	0.00	0.00	0.00	3	0	c
21	24	Quebec	Québec	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
22	10	Newfoundland and Labrador	Terre-Neuve-et-Labrador	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
23	13	New Brunswick	Nouveau-Brunswick	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
24	12	Nova Scotia	Nouvelle-Écosse	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
25	11	Prince Edward Island	Île-du-Prince-Édouard	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
26	60	Yukon	Yukon	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
27	61	Northwest Territories	Territoires du Nord-Ouest	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
28	62	Nunavut	Nunavut	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
29	99	Repatriated travellers	Voyageurs rapatriés	08-02-2020	6	2020	NA	0	0	NA	0	0	NA	NA	NA	0	0	
30	1	Canada	Canada	08-02-2020	6	2020	NA	7	3	0.02	0	0	0.00	0.01	0.00	7	0	c
31	59	British Columbia	Colombie-Britannique	15-02-2020	7	2020	1	4	0	0.08	0	0	0.00	0.00	0.00	3	0	c
32	48	Alberta	Alberta	15-02-2020	7	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c
33	47	Saskatchewan	Saskatchewan	15-02-2020	7	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	c

Showing 1 to 34 of 2,205 entries, 23 total columns

#Canada confirm cases

can_tsc<-covid19.Canada.data(case-'ts-Confirmed')

View(can_tsc)

	pruid	prname	prnameFR	date	reporting_week	reporting_year	update	totalcases	numtotal_last7	ratecases_total	numdeaths	numdeaths_last7	ratedeaths	ratecases_last7	ratedeaths_last7	numtotal_last14	numdeaths_last14	ratetotal_last14
1	59	British Columbia	Colombie-Britannique	01-02-2020	5	2020	1	1	1	0.02	0	0	0.00	0.02	0.00	NA	NA	
2	48	Alberta	Alberta	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
3	47	Saskatchewan	Saskatchewan	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
4	46	Manitoba	Manitoba	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
5	35	Ontario	Ontario	01-02-2020	5	2020	1	3	3	0.02	0	0	0.00	0.02	0.00	NA	NA	
6	24	Quebec	Québec	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
7	10	Newfoundland and Labrador	Terre-Neuve-et-Labrador	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
8	13	New Brunswick	Nouveau-Brunswick	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
9	12	Nova Scotia	Nouvelle-Écosse	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
10	11	Prince Edward Island	Île-du-Prince-Édouard	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
11	60	Yukon	Yukon	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
12	61	Northwest Territories	Territoires du Nord-Ouest	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
13	62	Nunavut	Nunavut	01-02-2020	5	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	NA	NA	
14	99	Repatriated travellers	Voyageurs rapatriés	01-02-2020	5	2020	NA	0	0	NA	0	0	NA	NA	NA	NA	NA	
15	1	Canada	Canada	01-02-2020	5	2020	NA	4	4	0.01	0	0	0.00	0.01	0.00	NA	NA	
16	59	British Columbia	Colombie-Britannique	08-02-2020	6	2020	1	4	3	0.08	0	0	0.00	0.06	0.00	4	0	
17	48	Alberta	Alberta	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
18	47	Saskatchewan	Saskatchewan	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
19	46	Manitoba	Manitoba	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
20	35	Ontario	Ontario	08-02-2020	6	2020	1	3	0	0.02	0	0	0.00	0.00	0.00	3	0	
21	24	Quebec	Québec	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
22	10	Newfoundland and Labrador	Terre-Neuve-et-Labrador	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
23	13	New Brunswick	Nouveau-Brunswick	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
24	12	Nova Scotia	Nouvelle-Écosse	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
25	11	Prince Edward Island	Île-du-Prince-Édouard	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
26	60	Yukon	Yukon	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
27	61	Northwest Territories	Territoires du Nord-Ouest	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
28	62	Nunavut	Nunavut	08-02-2020	6	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
29	99	Repatriated travellers	Voyageurs rapatriés	08-02-2020	6	2020	NA	0	0	NA	0	0	NA	NA	NA	0	0	
30	1	Canada	Canada	08-02-2020	6	2020	NA	7	3	0.02	0	0	0.00	0.01	0.00	7	0	
31	59	British Columbia	Colombie-Britannique	15-02-2020	7	2020	1	4	0	0.08	0	0	0.00	0.00	0.00	3	0	
32	48	Alberta	Alberta	15-02-2020	7	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	
33	47	Saskatchewan	Saskatchewan	15-02-2020	7	2020	1	0	0	0.00	0	0	0.00	0.00	0.00	0	0	

Showing 1 to 34 of 2,205 entries, 23 total columns

4. Graph analysis/ Interpretation and reporting
 #Summary

##Summarize the number of top case display

report.summary(Nentries = 10, graphical.output = T)
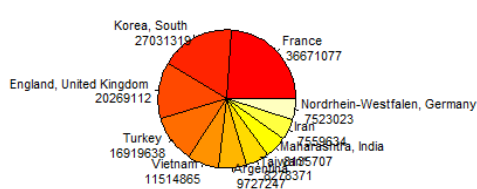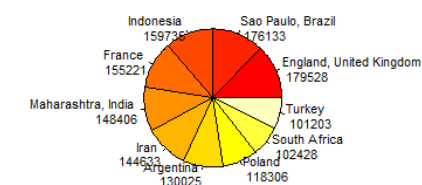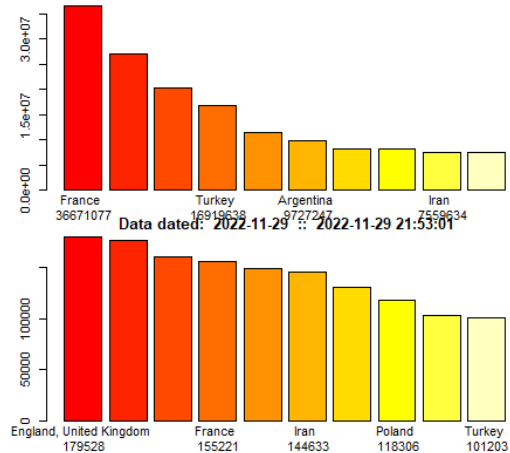
==Graphical output produced by the **report.summary** function.==

==The top row shows bar plots and pie charts for each respective category of reported cases, "confirmed" and "deaths" for the top 10 entries for time series data. The bottom row shows a combined plot for the aggregated data. The plots show the distribution of==

cases in the corresponding category for the locations list in the top entries, in this case the top 10.

```
##############################################################################
##### TS-CONFIRMED Cases  -- Data dated:  2022-11-28  ::  2022-11-29 21:52:57
##############################################################################
Number of Countries/Regions reported:  201
Number of Cities/Provinces reported:  92
Unique number of distinct geographical locations combined: 289
-----------------------------------------------------------------------------
Worldwide ts-confirmed  Totals: 641657307
-----------------------------------------------------------------------------
    Country.Region Province.State   Totals GlobalPerc LastDayChange   t-2    t-3    t-7   t-14   t-30
1               US                98628566     15.37         59717   4355   2190  54292  59393   3274
2            India                44673293      6.96           215    291    345    360    510   1336
3           France                36671077      5.72         93853      0      0  64464  48336      0
4          Germany                36419717      5.68         46552      1      0  33290  38610      1
5           Brazil                35149503      5.48             0      0      0  52657      0      0
6     Korea, South               27031319      4.21         71476  22327  47028  70324  66587  18510
7            Japan                24541816      3.82         49117  98476 125327 121236  99826  40611
8            Italy                24260660      3.78             0      0      0      0      0      0
9   United Kingdom               23998168      3.74             0      0      0      0      0      0
10          Russia               21273541      3.32          4980   5866   6026   4412   4400   6721
-----------------------------------------------------------------------------
Global Perc. Average:  0.35 (sd: 1.26)
Global Perc. Average in top  10 :  5.81 (sd: 3.56)
-----------------------------------------------------------------------------
==============================================================================
```

The top 10 countries for confirmed cases are: the USA, India, France, Germany, Brazil, South Korea, Japan, Italy, the UK and Russia.

```
##############################################################################
##### TS-DEATHS Cases   -- Data dated:  2022-11-28  ::  2022-11-29 21:52:59
##############################################################################
Number of Countries/Regions reported:  201
Number of Cities/Provinces reported:  92
Unique number of distinct geographical locations combined: 289
-----------------------------------------------------------------------------
Worldwide ts-deaths  Totals: 6631893
-----------------------------------------------------------------------------
    Country.Region Province.State   Totals  Perc LastDayChange  t-2  t-3  t-7 t-14 t-30
1               US                1079477  1.09           280    0    1  552  387    5
2           Brazil                 689442  1.96             0    0    0  248    0    0
3            India                 530615  1.19             1    2    4    5    2    8
4           Russia                 383993  1.81            50   51   51   59   63   74
5           Mexico                 330495  4.64             0    0    0   49    0   23
6             Peru                 217386  5.14            16   17   14    8  -91   33
7   United Kingdom                211893  0.88             0    0    0    0    0   89
8            Italy                 181098  0.75             0    0    0    0    0    0
9        Indonesia                 159735  2.40            59   35   41   51   41   26
10         Germany                 157657  0.43           162    0    0  139  223    0
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
==============================================================================
```

⇨ The top 10 countries for death cases are: the US, Brazil, India, Russia, Mexico, Peru, the UK, Italy, Indonesia, and Germany. However, Peru has the highest death rate at 5.11% of the total confirmed cases.

```
   ##### AGGREGATED Data  -- ORDERED BY  CONFIRMED Cases  -- Data dated:  2022-11-29  ::  2022-11-29 21:53:01
################################################################################################################
   Number of Countries/Regions reported: 201
   Number of Cities/Provinces reported: 599
   Unique number of distinct geographical locations combined: 4016
   ---------------------------------------------------------------------------------------------------------------
                     Location Confirmed Perc.Confirmed Deaths Perc.Deaths Recovered Perc.Recovered Active Perc.Active
1                     France 36671077         5.72 155221        0.42        NA            NA     NA         NA
2              Korea, South 27031319         4.21  30454        0.11        NA            NA     NA         NA
3      England, United Kingdom 20269112       3.16 179528        0.89        NA            NA     NA         NA
4                     Turkey 16919638         2.64 101203        0.60        NA            NA     NA         NA
5                    Vietnam 11514865         1.79  43170        0.37        NA            NA     NA         NA
6                  Argentina  9727247         1.52 130025        1.34        NA            NA     NA         NA
7                    Taiwan*  8278371         1.29  14276        0.17        NA            NA     NA         NA
8          Maharashtra, India  8135707         1.27 148406        1.82        NA            NA     NA         NA
9                       Iran  7559634         1.18 144633        1.91        NA            NA     NA         NA
10 Nordrhein-Westfalen, Germany  7523023       1.17  28971        0.39        NA            NA     NA         NA
================================================================================================================
   ##### AGGREGATED Data  -- ORDERED BY  DEATHS Cases  -- Data dated:  2022-11-29  ::  2022-11-29 21:53:01
################################################################################################################
   Number of Countries/Regions reported: 201
   Number of Cities/Provinces reported: 599
   Unique number of distinct geographical locations combined: 4016
   ---------------------------------------------------------------------------------------------------------------
                     Location Confirmed Perc.Confirmed Deaths Perc.Deaths Recovered Perc.Recovered Active Perc.Active
1  England, United Kingdom 20269112         3.16 179528        0.89        NA            NA     NA         NA
2        Sao Paulo, Brazil  6185851         0.96 176133        2.85        NA            NA     NA         NA
3                Indonesia  6653469         1.04 159735        2.40        NA            NA     NA         NA
4                   France 36671077         5.72 155221        0.42        NA            NA     NA         NA
5        Maharashtra, India  8135707         1.27 148406        1.82        NA            NA     NA         NA
6                     Iran  7559634         1.18 144633        1.91        NA            NA     NA         NA
7                Argentina  9727247         1.52 130025        1.34        NA            NA     NA         NA
8                   Poland  6351408         0.99 118306        1.86        NA            NA     NA         NA
9             South Africa  4040980         0.63 102428        2.53        NA            NA     NA         NA
10                  Turkey 16919638         2.64 101203        0.60        NA            NA     NA         NA
================================================================================================================
   ##### AGGREGATED Data  -- ORDERED BY  RECOVERED Cases  -- Data dated:  2022-11-29  ::  2022-11-29 21:53:01
################################################################################################################
   Number of Countries/Regions reported: 201
   Number of Cities/Provinces reported: 599
   Unique number of distinct geographical locations combined: 4016
   ---------------------------------------------------------------------------------------------------------------
                     Location Confirmed Perc.Confirmed Deaths Perc.Deaths Recovered Perc.Recovered Active Perc.Active
1                 Afghanistan  205802         0.03  7833        3.81        NA            NA     NA         NA
2                     Albania  333330         0.05  3594        1.08        NA            NA     NA         NA
3                     Algeria  271079         0.04  6881        2.54        NA            NA     NA         NA
4                     Andorra   46824         0.01   156        0.33        NA            NA     NA         NA
5                      Angola  104491         0.02  1923        1.84        NA            NA     NA         NA
6                  Antarctica      11         0.00     0        0.00        NA            NA     NA         NA
7          Antigua and Barbuda    9106         0.00   146        1.60        NA            NA     NA         NA
8                   Argentina 9727247         1.52 130025        1.34        NA            NA     NA         NA
9                     Armenia  445737         0.07  8710        1.95        NA            NA     NA         NA
10 Australian Capital Territory, Australia  212092  0.03   129     0.06        NA            NA     NA         NA
================================================================================================================
```

```
################################################################################
   ##### TS-RECOVERED Cases  -- Data dated:  2022-11-28  ::  2022-11-29 21:53:01
################################################################################
   Number of Countries/Regions reported:  201
   Number of Cities/Provinces reported:  76
   Unique number of distinct geographical locations combined: 274
   --------------------------------------------------------------------------
   Worldwide ts-recovered  Totals: 0
   --------------------------------------------------------------------------
          Country.Region          Province.State Totals LastDayChange t-2 t-3 t-7 t-14 t-30
1          Afghanistan                               0           0    0   0   0   0    0
2              Albania                               0           0    0   0   0   0    0
3              Algeria                               0           0    0   0   0   0    0
4              Andorra                               0           0    0   0   0   0    0
5               Angola                               0           0    0   0   0   0    0
6           Antarctica                               0           0    0   0   0   0    0
7    Antigua and Barbuda                             0           0    0   0   0   0    0
8            Argentina                               0           0    0   0   0   0    0
9              Armenia                               0           0    0   0   0   0    0
10    Australia Australian Capital Territory        0           0    0   0   0   0    0
   --------------------------------------------------------------------------
   --------------------------------------------------------------------------
================================================================================
```

#World

summary(ag)

```
> summary(ag)
      FIPS          Admin2         Province_State     Country_Region     Last_Update            Lat              Long_
 Min.   :   60   Length:4016      Length:4016        Length:4016        Length:4016       Min.   :-71.95   Min.   :-178.12
 1st Qu.:19049   Class :character Class :character   Class :character   Class :character  1st Qu.: 33.19   1st Qu.: -96.60
 Median :30068   Mode  :character Mode  :character   Mode  :character   Mode  :character  Median : 37.90   Median : -86.72
 Mean   :32406                                                                            Mean   : 35.74   Mean   : -71.11
 3rd Qu.:47042                                                                            3rd Qu.: 42.18   3rd Qu.: -77.36
 Max.   :99999                                                                            Max.   : 71.71   Max.   : 178.06
 NA's   :748                                                                              NA's   :91       NA's   :91
   Confirmed          Deaths          Recovered          Active         Combined_Key       Incident_Rate    Case_Fatality_Ratio
 Min.   :      0   Min.   :     0.0   Mode:logical     Mode:logical     Length:4016        Min.   :     0   Min.   :   0.000
 1st Qu.:   3591   1st Qu.:    45.0   NA's:4016        NA's:4016        Class :character   1st Qu.: 22844   1st Qu.:   0.897
 Median :  10240   Median :   129.0                                    Mode  :character   Median : 28054   Median :   1.299
 Mean   : 159775   Mean   :  1651.4                                                        Mean   : 27119   Mean   :   3.290
 3rd Qu.:  44736   3rd Qu.:   448.2                                                        3rd Qu.: 32487   3rd Qu.:   1.754
 Max.   :36671077  Max.   :179528.0                                                        Max.   :207692   Max.   :6522.973
                                                                                           NA's   :94       NA's   :43

> |
```

#Canada

#Summarize the current situation in Canada

report.summary(geo.loc = 'canada', graphical.output = TRUE, saveReport = FALSE)

GREGATED Data -- ORDERED BY CONFIRMED C -- Data dated: 2022-12-01 :: 2022-12-01 00:02:
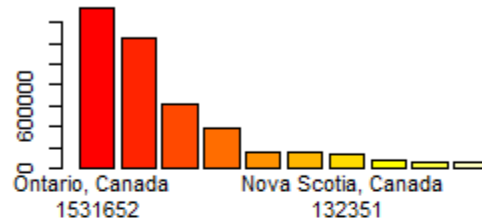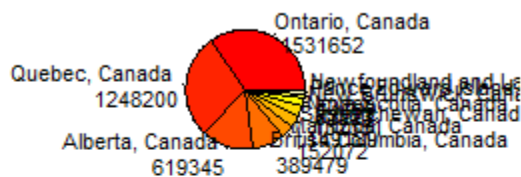
GGREGATED Data -- ORDERED BY DEATHS Ca: Data dated: 2022-12-01 :: 2022-12-01 00:02:3
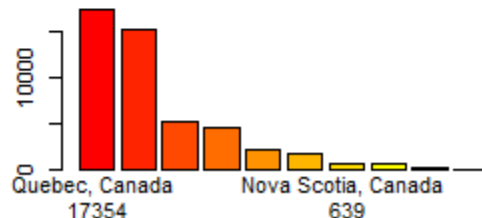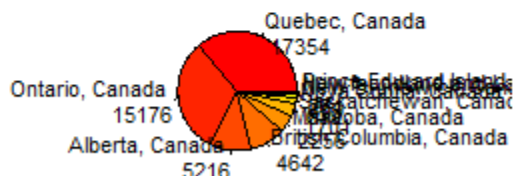
```
##########################################################################################################
##### AGGREGATED Data  -- ORDERED BY  CONFIRMED Cases  -- Data dated:  2022-12-01  ::  2022-12-01 00:02:37
##########################################################################################################
   Number of Countries/Regions reported: 1
   Number of Cities/Provinces reported: 16
   Unique number of distinct geographical locations combined: 16
   ------------------------------------------------------------------------------------------------------
                            Location Confirmed Perc.Confirmed Deaths Perc.Deaths Recovered Perc.Recovered Active Perc.Active
1                    Ontario, Canada   1531652          0.24  15176        0.99        NA             NA     NA          NA
2                     Quebec, Canada   1248200          0.19  17354        1.39        NA             NA     NA          NA
3                    Alberta, Canada    619345          0.10   5216        0.84        NA             NA     NA          NA
4           British Columbia, Canada    389479          0.06   4642        1.19        NA             NA     NA          NA
5                   Manitoba, Canada    152072          0.02   2256        1.48        NA             NA     NA          NA
6               Saskatchewan, Canada    149189          0.02   1701        1.14        NA             NA     NA          NA
7                Nova Scotia, Canada    132351          0.02    639        0.48        NA             NA     NA          NA
8              New Brunswick, Canada     82223          0.01    609        0.74        NA             NA     NA          NA
9       Prince Edward Island, Canada     54559          0.01     76        0.14        NA             NA     NA          NA
10 Newfoundland and Labrador, Canada     53299          0.01    271        0.51        NA             NA     NA          NA
==========================================================================================================
##########################################################################################################
##### AGGREGATED Data  -- ORDERED BY  DEATHS Cases  -- Data dated:  2022-12-01  ::  2022-12-01 00:02:37
##########################################################################################################
   Number of Countries/Regions reported: 1
   Number of Cities/Provinces reported: 16
   Unique number of distinct geographical locations combined: 16
   ------------------------------------------------------------------------------------------------------
                            Location Confirmed Perc.Confirmed Deaths Perc.Deaths Recovered Perc.Recovered Active Perc.Active
1                     Quebec, Canada   1248200          0.19  17354        1.39        NA             NA     NA          NA
2                    Ontario, Canada   1531652          0.24  15176        0.99        NA             NA     NA          NA
3                    Alberta, Canada    619345          0.10   5216        0.84        NA             NA     NA          NA
4           British Columbia, Canada    389479          0.06   4642        1.19        NA             NA     NA          NA
5                   Manitoba, Canada    152072          0.02   2256        1.48        NA             NA     NA          NA
6               Saskatchewan, Canada    149189          0.02   1701        1.14        NA             NA     NA          NA
7                Nova Scotia, Canada    132351          0.02    639        0.48        NA             NA     NA          NA
8              New Brunswick, Canada     82223          0.01    609        0.74        NA             NA     NA          NA
9  Newfoundland and Labrador, Canada     53299          0.01    271        0.51        NA             NA     NA          NA
10      Prince Edward Island, Canada     54559          0.01     76        0.14        NA             NA     NA          NA
==========================================================================================================
##########################################################################################################
##### AGGREGATED Data  -- ORDERED BY  RECOVERED Cases  -- Data dated:  2022-12-01  ::  2022-12-01 00:02:37
##########################################################################################################
   Number of Countries/Regions reported: 1
   Number of Cities/Provinces reported: 16
   Unique number of distinct geographical locations combined: 16
   ------------------------------------------------------------------------------------------------------
                            Location Confirmed Perc.Confirmed Deaths Perc.Deaths Recovered Perc.Recovered Active Perc.Active
1                    Alberta, Canada    619345          0.10   5216        0.84        NA             NA     NA          NA
2           British Columbia, Canada    389479          0.06   4642        1.19        NA             NA     NA          NA
3            Diamond Princess, Canada        0          0.00      1         Inf        NA             NA     NA          NA
4              Grand Princess, Canada       13          0.00      0        0.00        NA             NA     NA          NA
5                   Manitoba, Canada    152072          0.02   2256        1.48        NA             NA     NA          NA
6              New Brunswick, Canada     82223          0.01    609        0.74        NA             NA     NA          NA
7  Newfoundland and Labrador, Canada     53299          0.01    271        0.51        NA             NA     NA          NA
8        Northwest Territories,Canada     11511          0.00     22        0.19        NA             NA     NA          NA
9                Nova Scotia, Canada    132351          0.02    639        0.48        NA             NA     NA          NA
10                   Nunavut, Canada      3531          0.00      7        0.20        NA             NA     NA          NA
==========================================================================================================
```

⇨ In Canada, the most confirmed cases are in Ontario (1,531,652 confirmed cases) and the most death cases are in Quebec (17,354 death cases). However, Manitoba has the highest death rate at 1.48% of total confirmed cases there.

summary(can_ag)

```
> summary(can_ag)
     pruid          prname           prnameFR            date          reporting_week  reporting_year     update         totalcases
 Min.   : 1.0   Length:2205       Length:2205        Length:2205       Min.   : 1.00   Min.   :2020    Min.   :0.0000   Min.   :       0
 1st Qu.:12.0   Class :character  Class :character   Class :character  1st Qu.:14.00   1st Qu.:2020    1st Qu.:1.0000   1st Qu.:     260
 Median :46.0   Mode  :character  Mode  :character   Mode  :character  Median :26.00   Median :2021    Median :1.0000   Median :    7353
 Mean   :39.2                                                          Mean   :26.39   Mean   :2021    Mean   :0.9697   Mean   :  229469
 3rd Qu.:60.0                                                          3rd Qu.:39.00   3rd Qu.:2022    3rd Qu.:1.0000   3rd Qu.:  136544
 Max.   :99.0                                                          Max.   :53.00   Max.   :2022    Max.   :1.0000   Max.   : 4408276
                                                                                                       NA's   :294
 numtotal_last7   ratecases_total     numdeaths       numdeaths_last7      ratedeaths        ratecases_last7   ratedeaths_last7   numtotal_last14
 Min.   :     0   Min.   :    0.0   Min.   :     0   Min.   :    0       Min.   :   0.00    Min.   :   0.000   Min.   : 0.0000    Min.   :     0.0
 1st Qu.:     2   1st Qu.:  120.3   1st Qu.:     1   1st Qu.:    0       1st Qu.:   1.33    1st Qu.:   2.067   1st Qu.: 0.0000    1st Qu.:     5.0
 Median :   259   Median : 1741.2   Median :    65   Median :    2.00    Median :  20.38    Median :  26.315   Median : 0.2500    Median :   260
 Mean   :  3998   Mean   : 4391.4   Mean   :  3235   Mean   :   43.34    Mean   :  38.83    Mean   :  92.395   Mean   : 0.6302    Mean   :  8037.7
 3rd Qu.:  2461   3rd Qu.: 7683.6   3rd Qu.:  2102   3rd Qu.:   27.00    3rd Qu.:  63.84    3rd Qu.:  86.845   3rd Qu.: 0.8500    3rd Qu.:  5037.5
 Max.   :285441   Max.   :31787.2   Max.   : 47781   Max.   : 1300.00    Max.   :1300.00    Max.   :2102.210   Max.   :10.2500    Max.   :541984.0
                  NA's   :147                                            NA's   :147        NA's   :147        NA's   :147        NA's   :15
 numdeaths_last14  ratetotal_last14   ratedeaths_last14  avgcases_last7   avgincidence_last7 avgdeaths_last7   avgratedeaths_last7
 Min.   :   0.00   Min.   :   0.000   Min.   : 0.000    Min.   :    0.00   Min.   :  0.0000   Min.   :  0.000   Min.   :0.00000
 1st Qu.:   0.00   1st Qu.:   4.593   1st Qu.: 0.000    1st Qu.:    0.29   1st Qu.:  0.2925   1st Qu.:  0.000   1st Qu.:0.00000
 Median :   4.00   Median :  54.780   Median : 0.560    Median :   36.98   Median :  3.7600   Median :  0.290   Median :0.04000
 Mean   :  87.02   Mean   : 185.679   Mean   : 1.264    Mean   :  571.20   Mean   : 13.1994   Mean   :  6.191   Mean   :0.09001
 3rd Qu.:  54.00   3rd Qu.: 176.760   3rd Qu.: 1.760    3rd Qu.:  351.57   3rd Qu.: 12.4075   3rd Qu.:  3.860   3rd Qu.:0.12000
 Max.   :2476.00   Max.   :4084.770   Max.   :19.640    Max.   :40777.29   Max.   :300.3200   Max.   :185.760   Max.   :1.46000
 NA's   :15        NA's   :161        NA's   :161                          NA's   :147                          NA's   :147
```

5. Data Mining

#Linear Regression for total confirmed cases in Canada

tots.per.location(tsc, geo.loc = "canada")

CANADA -- 4431111
============================== running
models...==============================
 Linear Regression (lm):
Call:
lm(formula = y.var ~ x.var)

Residuals:
   Min   1Q Median   3Q   Max
-730456 -303313 -19084 354180 854434

Coefficients:
          Estimate Std. Error t value Pr(>|t|)
(Intercept) -859400.92 25085.83 -34.26   <2e-16 ***
x.var   4966.97   41.63 119.32   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 404800 on 1041 degrees of freedom
Multiple R-squared: 0.9319,   Adjusted R-squared: 0.9318
F-statistic: 1.424e+04 on 1 and 1041 DF, p-value: < 2.2e-16

 Linear Regression (lm):

Call:
lm(formula = y.var ~ x.var)

Residuals:
   Min   1Q Median   3Q   Max
-9.2987 -0.4201 0.5008 1.0904 1.5203

Coefficients:
          Estimate Std. Error t value Pr(>|t|)
(Intercept) 9.2913025 0.1120056 82.95   <2e-16 ***
x.var   0.0073803 0.0001859 39.71   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.807 on 1041 degrees of freedom
Multiple R-squared: 0.6023,   Adjusted R-squared: 0.6019
F-statistic: 1577 on 1 and 1041 DF, p-value: < 2.2e-16

  GLM using Family [1] "poisson" :

Call:
glm(formula = y.var ~ x.var, family = family)

Deviance Residuals:
   Min   1Q Median   3Q   Max
-810.6 -436.8   16.1   228.0   524.4

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept) 1.209e+01 8.335e-05 145073   <2e-16 ***
x.var   3.427e-03 1.023e-07   33503   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 1612098770 on 1042 degrees of freedom
Residual deviance: 146713126 on 1041 degrees of freedom
AIC: 146728749

Number of Fisher Scoring iterations: 5

exp.model coefs: 9.291 ; 0.007
GLM-Poisson model coefs: 12.092 ; 0.003

CANADA

lm-exp GR = 1.01
glm-Poisson GR = 1

possible fits that the function attempts to perform to the data. In the lower panel, the number of cases is presented in linear scale and the horizontal axis shows the actual dates.

From this graph, we get the linear regression formula for number of confirmed cases (Y in log-scale) and the number of days (x) in Canada is:

$$Y = 9.291 + 0.007x$$

Furthermore, according to this graph (red and orange parts), the fastest growing rate of confirmed cases is in the first 100 days beginning January 22, 2020.

#Linear Regression for total confirmed cases in Ontario

tots.per.location(tsc, geo.loc = "ontario")

ONTARIO -- 1531652

=============================== running models... ================ ===============
 Linear Regression (lm):

Call:
lm(formula = y.var ~ x.var)

Residuals:
   Min   1Q Median   3Q   Max
-249807 -101354 -12837 98297 283160

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -284858.44   7819.78 -36.43   <2e-16 ***
x.var   1698.86   12.98 130.92   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 126200 on 1041 degrees of freedom
Multiple R-squared: 0.9427,   Adjusted R-squared: 0.9427
F-statistic: 1.714e+04 on 1 and 1041 DF, p-value: < 2.2e-16

 Linear Regression (lm):

Call:

lm(formula = y.var ~ x.var)

Residuals:
    Min   1Q Median   3Q   Max
-8.3568 -0.4300 0.5172 0.9822 1.4543

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 8.3495627 0.1039112   80.35   <2e-16 ***
x.var   0.0072181 0.0001724   41.86   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.677 on 1041 degrees of freedom
Multiple R-squared: 0.6273,   Adjusted R-squared: 0.627
F-statistic: 1752 on 1 and 1041 DF, p-value: < 2.2e-16

  GLM using Family [1] "poisson" :

Call:
glm(formula = y.var ~ x.var, family = family)

Deviance Residuals:
    Min   1Q Median   3Q   Max
-456.06 -275.57   -4.55 164.63 304.65

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) 1.109e+01 1.395e-04   79490   <2e-16 ***
x.var   3.353e-03 1.719e-07   19509   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 548388526 on 1042 degrees of freedom
Residual deviance: 56187586 on 1041 degrees of freedom
AIC: 56202137

Number of Fisher Scoring iterations: 5

ONTARIO

----

tots.per.location(tsc, geo.loc = c("canada", "US", "india", "china"))

CANADA -- 4431111
============================== running models...================
===============
  Linear Regression (lm):

Call:
lm(formula = y.var ~ x.var)

Residuals:
   Min   1Q Median   3Q   Max
-730456 -303313 -19084 354180 854434

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -859400.92   25085.83 -34.26   <2e-16 ***
x.var   4966.97   41.63 119.32   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 404800 on 1041 degrees of freedom
Multiple R-squared: 0.9319,   Adjusted R-squared: 0.9318
F-statistic: 1.424e+04 on 1 and 1041 DF, p-value: < 2.2e-16

  Linear Regression (lm):

Call:
lm(formula = y.var ~ x.var)

Residuals:
   Min   1Q Median   3Q   Max
-9.2987 -0.4201 0.5008 1.0904 1.5203

Coefficients:
            Estimate Std. Error t value Pr(>|t|)

(Intercept) 9.2913025 0.1120056   82.95   <2e-16 ***
x.var   0.0073803 0.0001859   39.71   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.807 on 1041 degrees of freedom
Multiple R-squared: 0.6023,   Adjusted R-squared: 0.6019
F-statistic: 1577 on 1 and 1041 DF, p-value: < 2.2e-16

  GLM using Family [1] "poisson" :

Call:
glm(formula = y.var ~ x.var, family = family)

Deviance Residuals:
   Min   1Q Median   3Q   Max
-810.6 -436.8   16.1   228.0   524.4

Coefficients:
         Estimate Std. Error z value Pr(>|z|)
(Intercept) 1.209e+01 8.335e-05 145073   <2e-16 ***
x.var   3.427e-03 1.023e-07   33503   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 1612098770 on 1042 degrees of freedom
Residual deviance: 146713126 on 1041 degrees of freedom
AIC: 146728749

Number of Fisher Scoring iterations: 5

US -- 98673988
============================== running models...====================
===========
  Linear Regression (lm):

Call:
lm(formula = y.var ~ x.var)

Residuals:
     Min   1Q   Median   3Q   Max
-10690086 -5671743   -17853 5337551 15502883

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -1.561e+07 4.189e+05 -37.27   <2e-16 ***
x.var   1.101e+05 6.951e+02 158.39   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6759000 on 1041 degrees of freedom
Multiple R-squared: 0.9602,   Adjusted R-squared: 0.9601
F-statistic: 2.509e+04 on 1 and 1041 DF, p-value: < 2.2e-16

  Linear Regression (lm):

Call:
lm(formula = y.var ~ x.var)

Residuals:
    Min   1Q Median   3Q   Max
-11.4726 -0.6364 0.6095 1.5983 1.9907

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 1.215e+01 1.505e-01   80.72   <2e-16 ***
x.var   7.898e-03 2.498e-04   31.62   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.429 on 1041 degrees of freedom
Multiple R-squared: 0.4899,   Adjusted R-squared: 0.4894
F-statistic: 999.8 on 1 and 1041 DF, p-value: < 2.2e-16

GLM using Family [1] "poisson" :

Call:
glm(formula = y.var ~ x.var, family = family)

Deviance Residuals:
    Min   1Q Median   3Q   Max
-3692.5 -1891.0   401.5 1175.6 2612.8

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept) 1.557e+01 1.580e-05 985407   <2e-16 ***
x.var   3.043e-03 1.980e-08 153677   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 3.3110e+10 on 1042 degrees of freedom
Residual deviance: 3.7428e+09 on 1041 degrees of freedom
AIC: 3742774418

Number of Fisher Scoring iterations: 5

  GLM using Family Family: Gamma Link function: log :

Call:
glm(formula = y.var ~ x.var, family = family)

Deviance Residuals:
    Min   1Q Median   3Q   Max
-5.2115 -0.5137 0.0064 0.2414 0.8959

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 1.457e+01 3.481e-02 418.60   <2e-16 ***
x.var   4.620e-03 5.776e-05   79.99   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for Gamma family taken to be 0.3154661)

    Null deviance: 2674.0 on 1042 degrees of freedom
Residual deviance: 1490.1 on 1041 degrees of freedom
AIC: 37509

Number of Fisher Scoring iterations: 13

INDIA -- 44673293
============================== running models...=============
======= ===========
  Linear Regression (lm):

Call:
lm(formula = y.var ~ x.var)

Residuals:
    Min   1Q   Median   3Q   Max
-8117011 -3241684 -427704 3803687 6627226

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -5554005.8   253018.5 -21.95   <2e-16 ***
x.var   55938.9   419.9 133.23   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4083000 on 1041 degrees of freedom
Multiple R-squared: 0.9446,   Adjusted R-squared: 0.9445
F-statistic: 1.775e+04 on 1 and 1041 DF, p-value: < 2.2e-16

  Linear Regression (lm):

Call:
lm(formula = y.var ~ x.var)

Residuals:

```
    Min      1Q   Median     3Q     Max
-10.5915  -1.1545   0.6608   1.9154   2.7913


Coefficients:
           Estimate Std. Error t value Pr(>|t|)
(Intercept) 1.052e+01  1.697e-01   61.97   <2e-16 ***
x.var       9.358e-03  2.816e-04   33.23   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


Residual standard error: 2.738 on 1041 degrees of freedom
Multiple R-squared:  0.5147,        Adjusted R-squared:  0.5143
F-statistic:  1104 on 1 and 1041 DF,  p-value: < 2.2e-16


-------------------------------------------------------------------------------
  GLM using Family [1] "poisson" :


Call:
glm(formula = y.var ~ x.var, family = family)


Deviance Residuals:
    Min      1Q   Median     3Q     Max
-3319.9  -2122.8   -321.4   1416.3   2770.0


Coefficients:
           Estimate Std. Error z value Pr(>|z|)
(Intercept) 1.529e+01  1.957e-05   781632   <2e-16 ***
x.var       2.652e-03  2.512e-08   105572   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


(Dispersion parameter for poisson family taken to be 1)


    Null deviance: 1.7317e+10  on 1042  degrees of freedom
Residual deviance: 4.0917e+09  on 1041  degrees of freedom
AIC: 4091748192


Number of Fisher Scoring iterations: 5


-------------------------------------------------------------------------------
```

CHINA -- 3705990

============================== running models...==============
================

  Linear Regression (lm):

Call:
lm(formula = y.var ~ x.var)

Residuals:
    Min   1Q Median   3Q   Max
-1116720 -532155   45555 540944 1707086

Coefficients:
        Estimate Std. Error t value Pr(>|t|)
(Intercept) -667555.1   38925.6 -17.15 <2e-16 ***
x.var   2556.5   64.6 39.58 <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 628100 on 1041 degrees of freedom
Multiple R-squared: 0.6008,   Adjusted R-squared: 0.6004
F-statistic: 1566 on 1 and 1041 DF, p-value: < 2.2e-16

  Linear Regression (lm):

Call:
lm(formula = y.var ~ x.var)

Residuals:
   Min   1Q Median   3Q   Max
-3.9217 -0.6508 0.1767 0.7063 0.9832

Coefficients:
        Estimate Std. Error t value Pr(>|t|)
(Intercept) 1.023e+01 4.854e-02 210.68 <2e-16 ***
x.var   3.985e-03 8.054e-05 49.48 <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.7832 on 1041 degrees of freedom
Multiple R-squared: 0.7016,   Adjusted R-squared: 0.7014
F-statistic: 2448 on 1 and 1041 DF, p-value: < 2.2e-16

  GLM using Family [1] "poisson" :

Call:
glm(formula = y.var ~ x.var, family = family)

Deviance Residuals:
    Min   1Q   Median   3Q   Max
-874.32 -234.82   77.68   284.33   698.48

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) 9.288e+00 1.997e-04   46519   <2e-16 ***
x.var   5.653e-03 2.255e-07   25075   <2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 1250572333 on 1042 degrees of freedom
Residual deviance: 146792127 on 1041 degrees of freedom
AIC: 146806883

Number of Fisher Scoring iterations: 5

  GLM using Family Family: Gamma Link function: log :

Call:
glm(formula = y.var ~ x.var, family = family)

Deviance Residuals:
    Min   1Q   Median   3Q   Max
-2.50246 -0.78213 -0.04737   0.44612   0.80257

Coefficients:

```
              Estimate Std. Error t value Pr(>|t|)
(Intercept) 1.042e+01  3.699e-02  281.62   <2e-16 ***
x.var       4.095e-03  6.138e-05   66.71   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for Gamma family taken to be 0.3562628)

    Null deviance: 2303.77  on 1042  degrees of freedom
Residual deviance:  518.47  on 1041  degrees of freedom
AIC: 27993

Number of Fisher Scoring iterations: 10
```
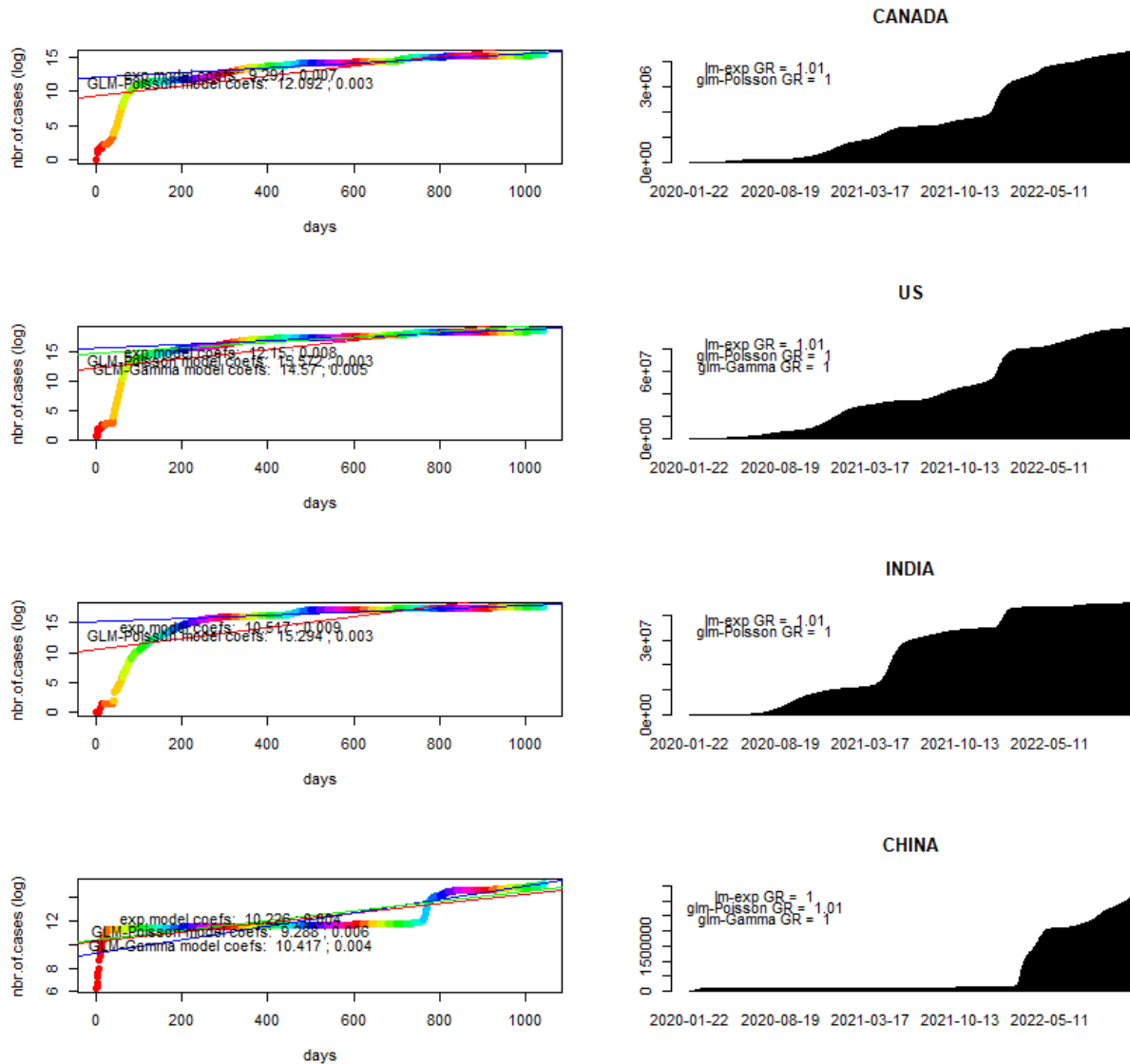
Graphical output produced by the totals.per.location function.
Each figure shows in the top row the number of cases in log-scale in the vertical axis and the number of days in the horizontal axis. The upper panel also includes the possible fits that the function attempts to perform to the data. In the lower panel, the number of cases is presented in linear scale and the horizontal axis shows the actual dates.

#Growth rate

growth.rate(tsc, geo.loc = 'canada')

```
> #Growth rate
> library(pheatmap)
> library(gplots)
> growth.rate(tsc, geo.loc = 'canada')
Processing... CANADA
$Changes
       geo.loc 2020-01-23 2020-01-24 2020-01-25 2020-01-26 2020-01-27 2020-01-28 2020-01-29 2020-01-30 2020-01-31 2020-02-01
       2020-02-02 2020-02-03 2020-02-04 2020-02-05 2020-02-06 2020-02-07 2020-02-08 2020-02-09 2020-02-10 2020-02-11
       2020-02-12 2020-02-13 2020-02-14 2020-02-15 2020-02-16 2020-02-17 2020-02-18 2020-02-19 2020-02-20 2020-02-21
       2020-02-22 2020-02-23 2020-02-24 2020-02-25 2020-02-26 2020-02-27 2020-02-28 2020-02-29 2020-03-01 2020-03-02
       2020-03-03 2020-03-04 2020-03-05 2020-03-06 2020-03-07 2020-03-08 2020-03-09 2020-03-10 2020-03-11 2020-03-12
       2020-03-13 2020-03-14 2020-03-15 2020-03-16 2020-03-17 2020-03-18 2020-03-19 2020-03-20 2020-03-21 2020-03-22
       2020-03-23 2020-03-24 2020-03-25 2020-03-26 2020-03-27 2020-03-28 2020-03-29 2020-03-30 2020-03-31 2020-04-01
       2020-04-02 2020-04-03 2020-04-04 2020-04-05 2020-04-06 2020-04-07 2020-04-08 2020-04-09 2020-04-10 2020-04-11
       2020-04-12 2020-04-13 2020-04-14 2020-04-15 2020-04-16 2020-04-17 2020-04-18 2020-04-19 2020-04-20 2020-04-21
       2020-04-22 2020-04-23 2020-04-24 2020-04-25 2020-04-26 2020-04-27 2020-04-28 2020-04-29 2020-04-30 2020-05-01
       2020-05-02 2020-05-03 2020-05-04 2020-05-05 2020-05-06 2020-05-07 2020-05-08 2020-05-09 2020-05-10 2020-05-11
       2020-05-12 2020-05-13 2020-05-14 2020-05-15 2020-05-16 2020-05-17 2020-05-18 2020-05-19 2020-05-20 2020-05-21
       2020-05-22 2020-05-23 2020-05-24 2020-05-25 2020-05-26 2020-05-27 2020-05-28 2020-05-29 2020-05-30 2020-05-31
       2020-06-01 2020-06-02 2020-06-03 2020-06-04 2020-06-05 2020-06-06 2020-06-07 2020-06-08 2020-06-09 2020-06-10
       2020-06-11 2020-06-12 2020-06-13 2020-06-14 2020-06-15 2020-06-16 2020-06-17 2020-06-18 2020-06-19 2020-06-20
       2020-06-21 2020-06-22 2020-06-23 2020-06-24 2020-06-25 2020-06-26 2020-06-27 2020-06-28 2020-06-29 2020-06-30
       2020-07-01 2020-07-02 2020-07-03 2020-07-04 2020-07-05 2020-07-06 2020-07-07 2020-07-08 2020-07-09 2020-07-10
       2020-07-11 2020-07-12 2020-07-13 2020-07-14 2020-07-15 2020-07-16 2020-07-17 2020-07-18 2020-07-19 2020-07-20
       2020-07-21 2020-07-22 2020-07-23 2020-07-24 2020-07-25 2020-07-26 2020-07-27 2020-07-28 2020-07-29 2020-07-30
       2020-07-31 2020-08-01 2020-08-02 2020-08-03 2020-08-04 2020-08-05 2020-08-06 2020-08-07 2020-08-08 2020-08-09
       2020-08-10 2020-08-11 2020-08-12 2020-08-13 2020-08-14 2020-08-15 2020-08-16 2020-08-17 2020-08-18 2020-08-19
       2020-08-20 2020-08-21 2020-08-22 2020-08-23 2020-08-24 2020-08-25 2020-08-26 2020-08-27 2020-08-28 2020-08-29
       2020-08-30 2020-08-31 2020-09-01 2020-09-02 2020-09-03 2020-09-04 2020-09-05 2020-09-06 2020-09-07 2020-09-08
       2020-09-09 2020-09-10 2020-09-11 2020-09-12 2020-09-13 2020-09-14 2020-09-15 2020-09-16 2020-09-17 2020-09-18
       2020-09-19 2020-09-20 2020-09-21 2020-09-22 2020-09-23 2020-09-24 2020-09-25 2020-09-26 2020-09-27 2020-09-28
       2020-09-29 2020-09-30 2020-10-01 2020-10-02 2020-10-03 2020-10-04 2020-10-05 2020-10-06 2020-10-07 2020-10-08
       2020-10-09 2020-10-10 2020-10-11 2020-10-12 2020-10-13 2020-10-14 2020-10-15 2020-10-16 2020-10-17 2020-10-18
       2020-10-19 2020-10-20 2020-10-21 2020-10-22 2020-10-23 2020-10-24 2020-10-25 2020-10-26 2020-10-27 2020-10-28
       2020-10-29 2020-10-30 2020-10-31 2020-11-01 2020-11-02 2020-11-03 2020-11-04 2020-11-05 2020-11-06 2020-11-07
       2020-11-08 2020-11-09 2020-11-10 2020-11-11 2020-11-12 2020-11-13 2020-11-14 2020-11-15 2020-11-16 2020-11-17
       2020-11-18 2020-11-19 2020-11-20 2020-11-21 2020-11-22 2020-11-23 2020-11-24 2020-11-25 2020-11-26 2020-11-27
       2022-11-28 2022-11-29
 [ reached 'max' / getOption("max.print") -- omitted 1 rows ]

$Growth.Rate
       geo.loc 2020-01-24 2020-01-25 2020-01-26 2020-01-27 2020-01-28 2020-01-29 2020-01-30 2020-01-31 2020-02-01 2020-02-02
       2020-02-03 2020-02-04 2020-02-05 2020-02-06 2020-02-07 2020-02-08 2020-02-09 2020-02-10 2020-02-11 2020-02-12
       2020-02-13 2020-02-14 2020-02-15 2020-02-16 2020-02-17 2020-02-18 2020-02-19 2020-02-20 2020-02-21 2020-02-22
       2020-02-23 2020-02-24 2020-02-25 2020-02-26 2020-02-27 2020-02-28 2020-02-29 2020-03-01 2020-03-02 2020-03-03
       2020-03-04 2020-03-05 2020-03-06 2020-03-07 2020-03-08 2020-03-09 2020-03-10 2020-03-11 2020-03-12 2020-03-13
       2020-03-14 2020-03-15 2020-03-16 2020-03-17 2020-03-18 2020-03-19 2020-03-20 2020-03-21 2020-03-22 2020-03-23
       2020-03-24 2020-03-25 2020-03-26 2020-03-27 2020-03-28 2020-03-29 2020-03-30 2020-03-31 2020-04-01 2020-04-02
       2020-04-03 2020-04-04 2020-04-05 2020-04-06 2020-04-07 2020-04-08 2020-04-09 2020-04-10 2020-04-11 2020-04-12
       2020-04-13 2020-04-14 2020-04-15 2020-04-16 2020-04-17 2020-04-18 2020-04-19 2020-04-20 2020-04-21 2020-04-22
       2020-04-23 2020-04-24 2020-04-25 2020-04-26 2020-04-27 2020-04-28 2020-04-29 2020-04-30 2020-05-01 2020-05-02
       2020-05-03 2020-05-04 2020-05-05 2020-05-06 2020-05-07 2020-05-08 2020-05-09 2020-05-10 2020-05-11 2020-05-12
       2020-05-13 2020-05-14 2020-05-15 2020-05-16 2020-05-17 2020-05-18 2020-05-19 2020-05-20 2020-05-21 2020-05-22
       2020-05-23 2020-05-24 2020-05-25 2020-05-26 2020-05-27 2020-05-28 2020-05-29 2020-05-30 2020-05-31 2020-06-01
       2020-06-02 2020-06-03 2020-06-04 2020-06-05 2020-06-06 2020-06-07 2020-06-08 2020-06-09 2020-06-10 2020-06-11
       2020-06-12 2020-06-13 2020-06-14 2020-06-15 2020-06-16 2020-06-17 2020-06-18 2020-06-19 2020-06-20 2020-06-21
       2020-06-22 2020-06-23 2020-06-24 2020-06-25 2020-06-26 2020-06-27 2020-06-28 2020-06-29 2020-06-30 2020-07-01
       2020-07-02 2020-07-03 2020-07-04 2020-07-05 2020-07-06 2020-07-07 2020-07-08 2020-07-09 2020-07-10 2020-07-11
       2020-07-12 2020-07-13 2020-07-14 2020-07-15 2020-07-16 2020-07-17 2020-07-18 2020-07-19 2020-07-20 2020-07-21
       2020-07-22 2020-07-23 2020-07-24 2020-07-25 2020-07-26 2020-07-27 2020-07-28 2020-07-29 2020-07-30 2020-07-31
       2020-08-01 2020-08-02 2020-08-03 2020-08-04 2020-08-05 2020-08-06 2020-08-07 2020-08-08 2020-08-09 2020-08-10
       2020-08-11 2020-08-12 2020-08-13 2020-08-14 2020-08-15 2020-08-16 2020-08-17 2020-08-18 2020-08-19 2020-08-20
       2020-08-21 2020-08-22 2020-08-23 2020-08-24 2020-08-25 2020-08-26 2020-08-27 2020-08-28 2020-08-29 2020-08-30
       2020-08-31 2020-09-01 2020-09-02 2020-09-03 2020-09-04 2020-09-05 2020-09-06 2020-09-07 2020-09-08 2020-09-09
       2020-09-10 2020-09-11 2020-09-12 2020-09-13 2020-09-14 2020-09-15 2020-09-16 2020-09-17 2020-09-18 2020-09-19
       2020-09-20 2020-09-21 2020-09-22 2020-09-23 2020-09-24 2020-09-25 2020-09-26 2020-09-27 2020-09-28 2020-09-29
       2020-09-30 2020-10-01 2020-10-02 2020-10-03 2020-10-04 2020-10-05 2020-10-06 2020-10-07 2020-10-08 2020-10-09
       2020-10-10 2020-10-11 2020-10-12 2020-10-13 2020-10-14 2020-10-15 2020-10-16 2020-10-17 2020-10-18 2020-10-19
       2020-10-20 2020-10-21 2020-10-22 2020-10-23 2020-10-24 2020-10-25 2020-10-26 2020-10-27 2020-10-28 2020-10-29
       2020-10-30 2020-10-31 2020-11-01 2020-11-02 2020-11-03 2020-11-04 2020-11-05 2020-11-06 2020-11-07 2020-11-08
       2020-11-09 2020-11-10 2020-11-11 2020-11-12 2020-11-13 2020-11-14 2020-11-15 2020-11-16 2020-11-17 2020-11-18
       2020-11-19 2020-11-20 2020-11-21 2020-11-22 2020-11-23 2020-11-24 2020-11-25 2020-11-26 2020-11-27 2020-11-28
```
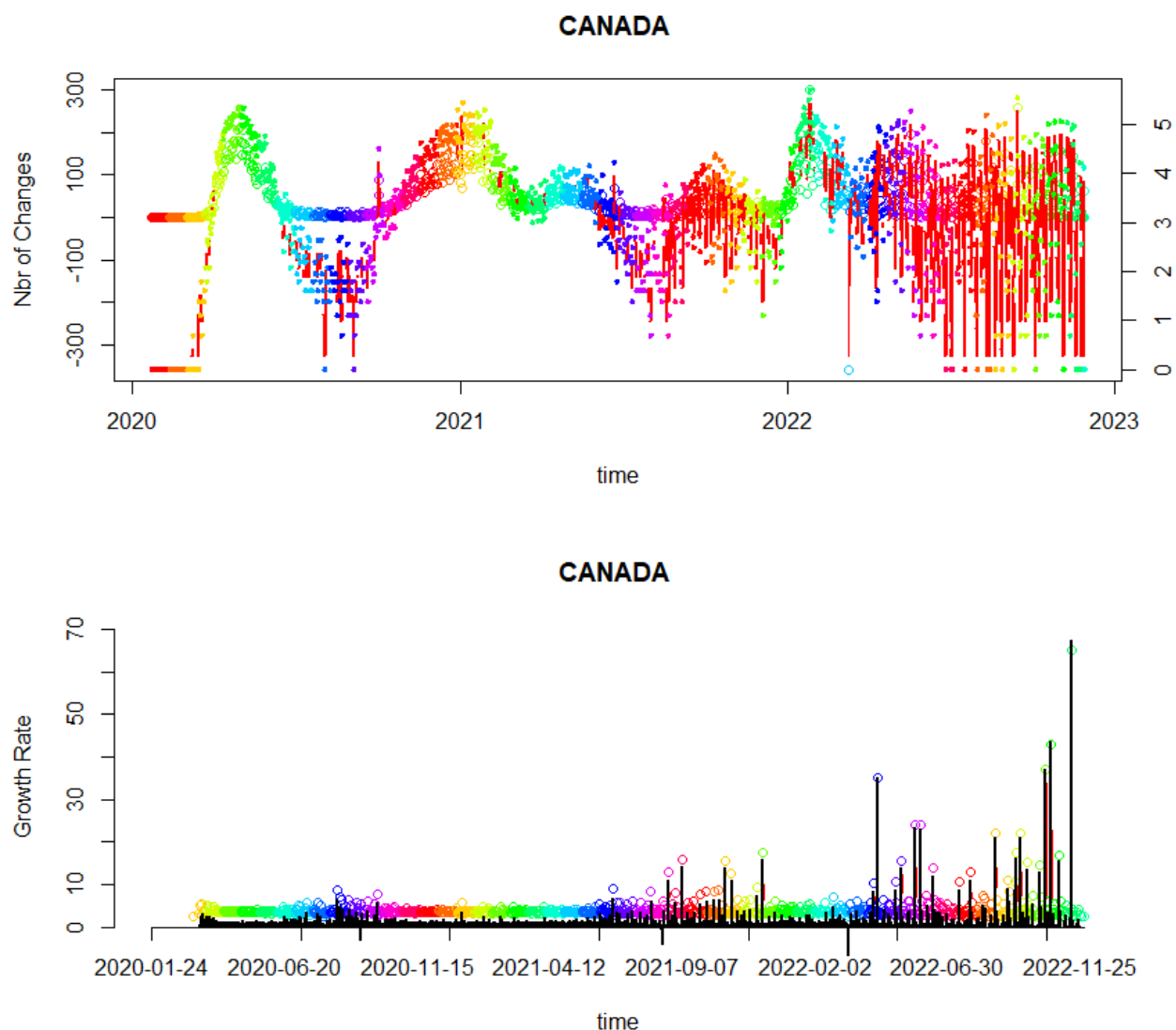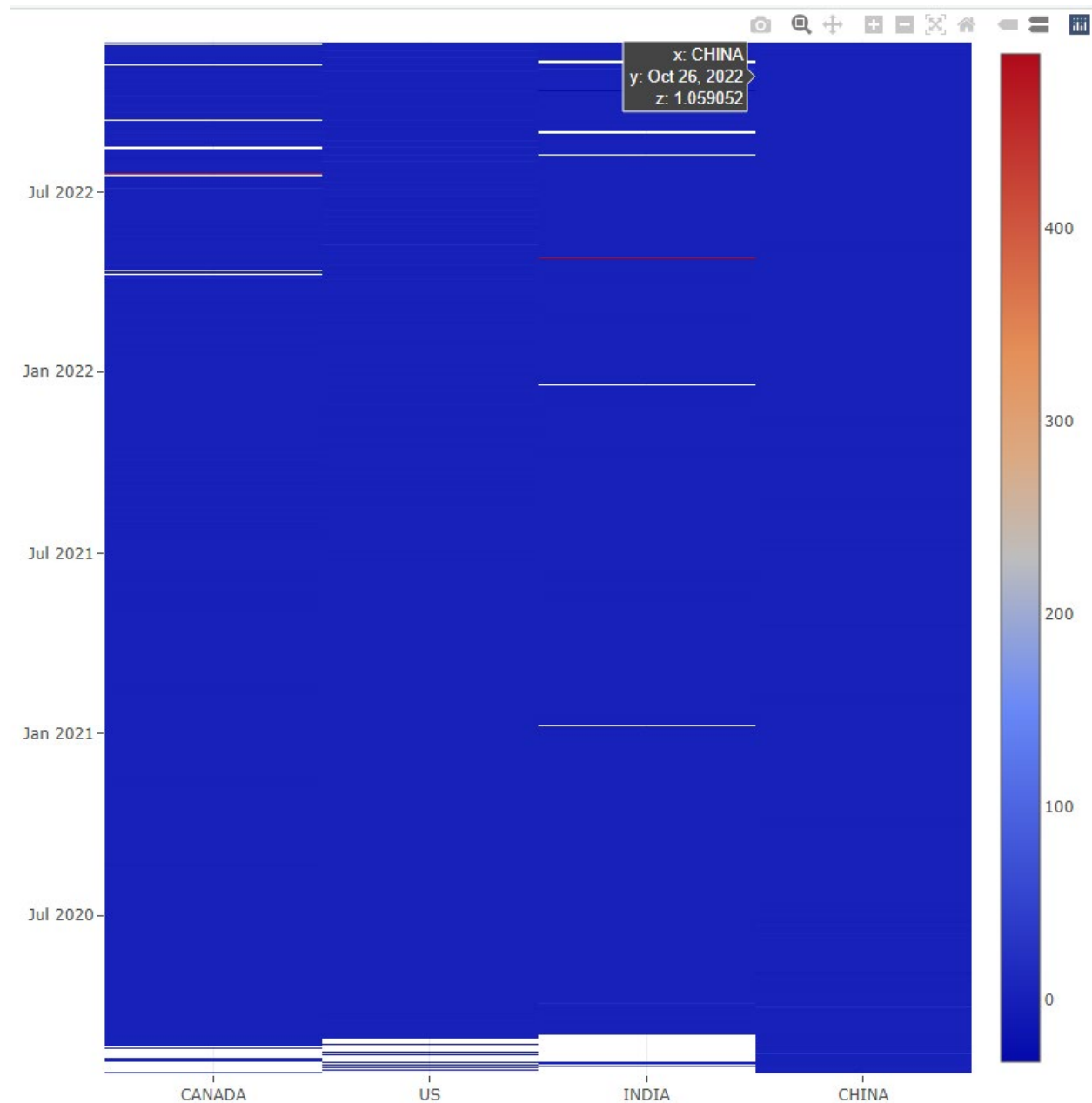
CANADA

CANADA

Graphical output produced by the growth.rate function to compute changes and growth rates of **confirmed cases** for Canada.

The upper figure shows in the top row the number of cases in log-scale in the vertical axis and the time (year) in the horizontal axis. In the lower panel, the number of cases is presented in linear scale and the horizontal axis shows the time.

The lower figure shows the grow rate in the number of confirmed cases in the vertical axis and the actual dates in the horizontal axis. The grow rate was extremely high in October 2020 and September 2021 (red color).

#death case

```
growth.rate(tsd, geo.loc = 'canada')

growth.rate(tsc, geo.loc = c('canada','US','india','china'),

        staticPlt = TRUE,

        interactiveFig = TRUE)
```


Graphical output produced by the growth.rate function to compute changes and growth rates of **death cases** for Canada.

The upper figure shows in the top row the number of cases in log-scale in the vertical axis and the time (year) in the horizontal axis. In the lower panel, the number of cases is presented in linear scale and the horizontal axis shows the time.

Static (left) and interactive (right) figures generated by the single.trend and itrends functions respectively.

The static figure includes several representations of the daily changes in the **active cases in Toronto**. The interactive figure offers a quick overview of the trend compared to the straight diagonal line included, which represents "exponential growth".

```
ont.data <- tsc[tsc$Province.State == "Ontario",]

single.trend(ont.data)
```
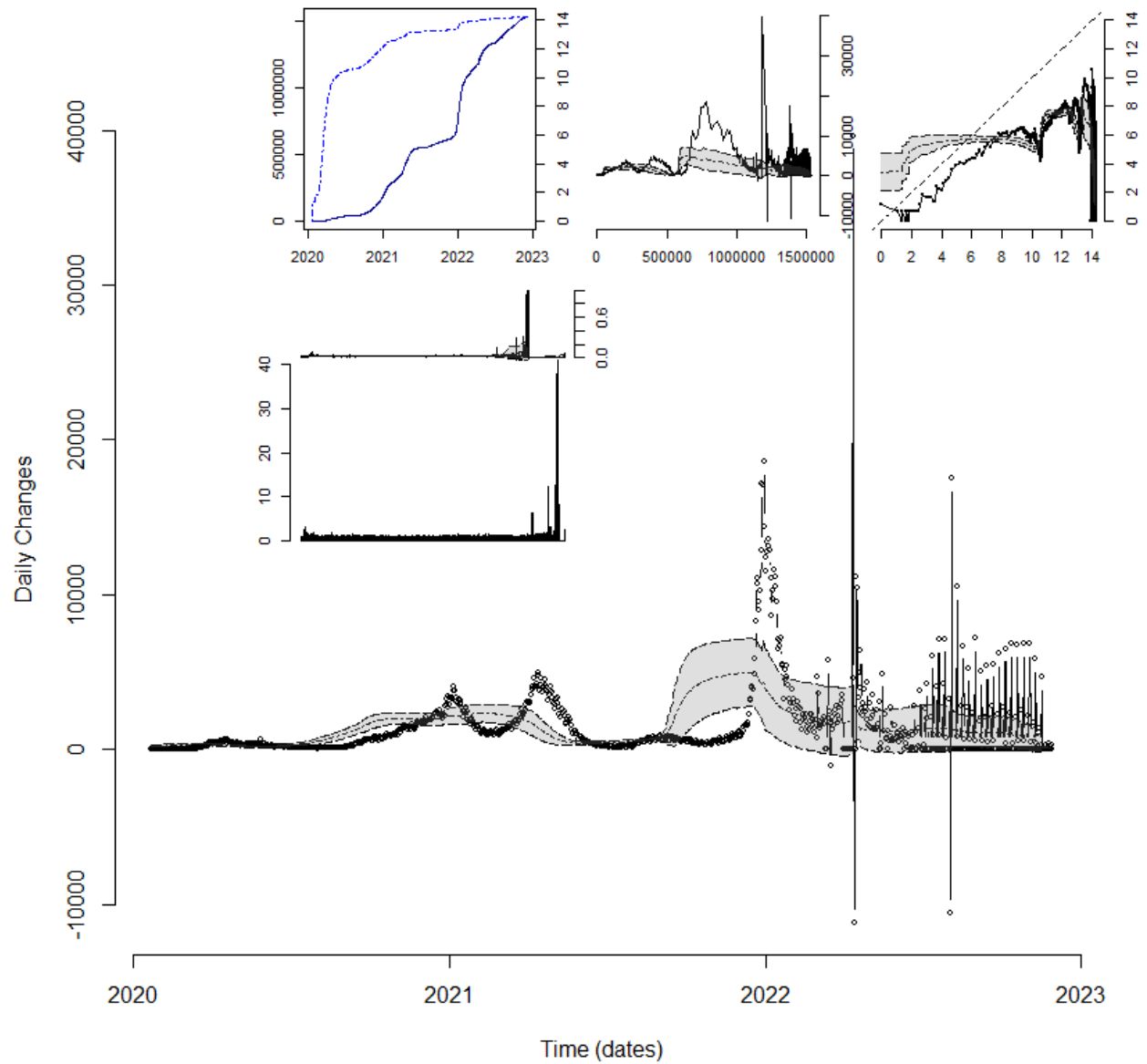
The static figure includes several representations of the daily changes in the **confirmed cases in Ontario**. While the interactive figure, offers a quick overview of the increasing trend compared to the straight diagonal line included which represents "exponential growth".

#Trend of death cases in Ontario

```
ont.death.data <- tsd[tsd$Province.State == "Ontario",]

single.trend(ont.death.data)

itrends(ont.death.data)
```
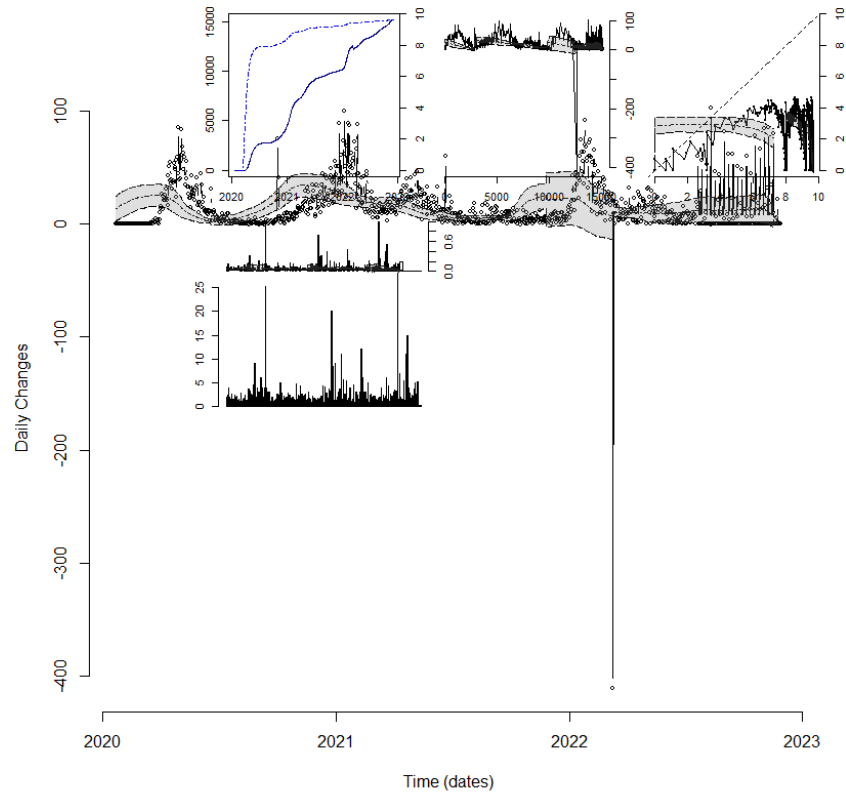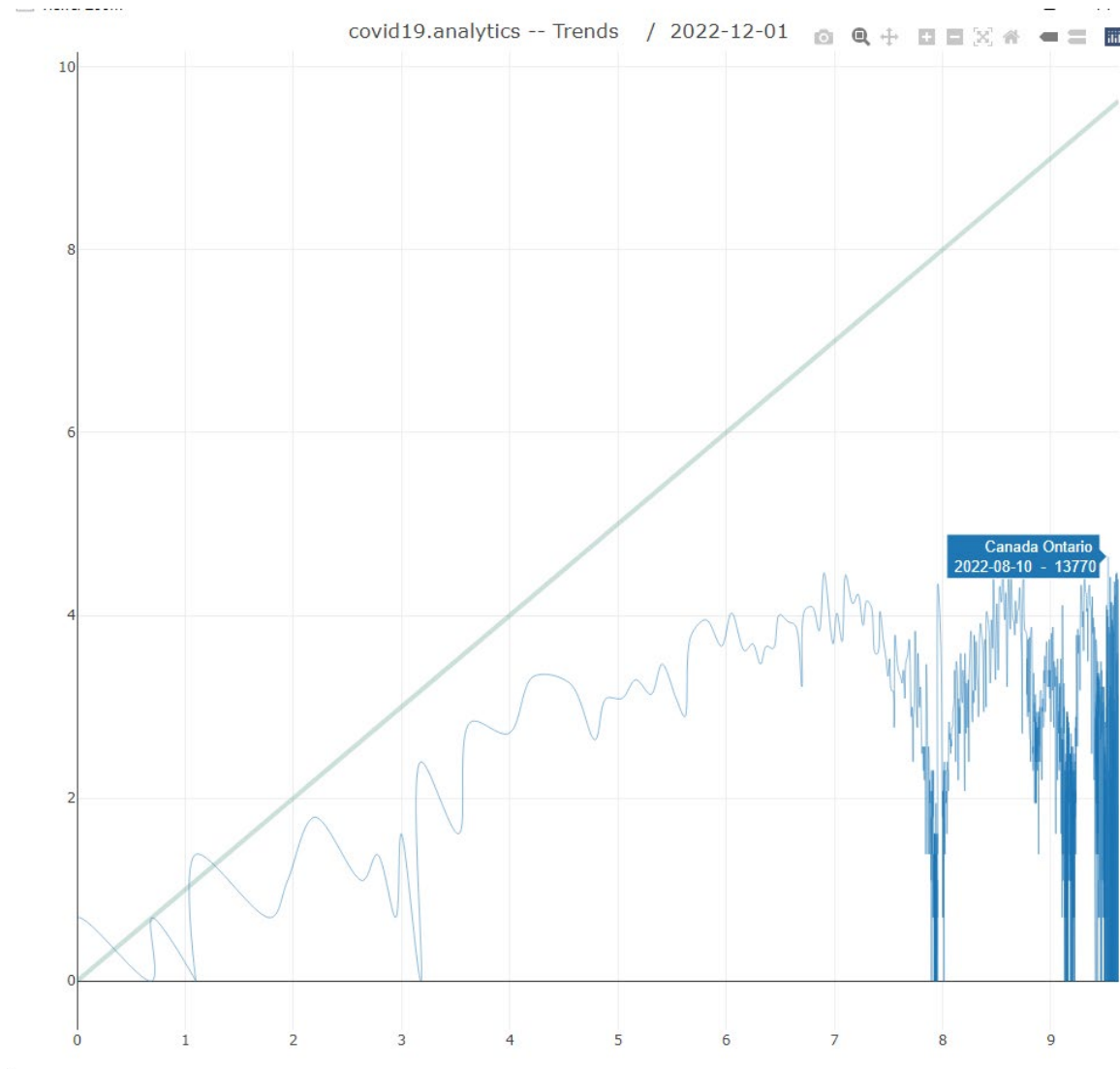
Static (left) and interactive (right) figures generated by the single.trend and itrends functions respectively.

The static figure includes several representations of the daily changes in the **death cases in Ontario**. While the interactive figure, offers a quick overview of the increasing trend compared to the straight diagonal line included which represents "exponential growth".

Can.data <- tsc[tsc$Country.Region == "Canada",]

single.trend(Can.data)
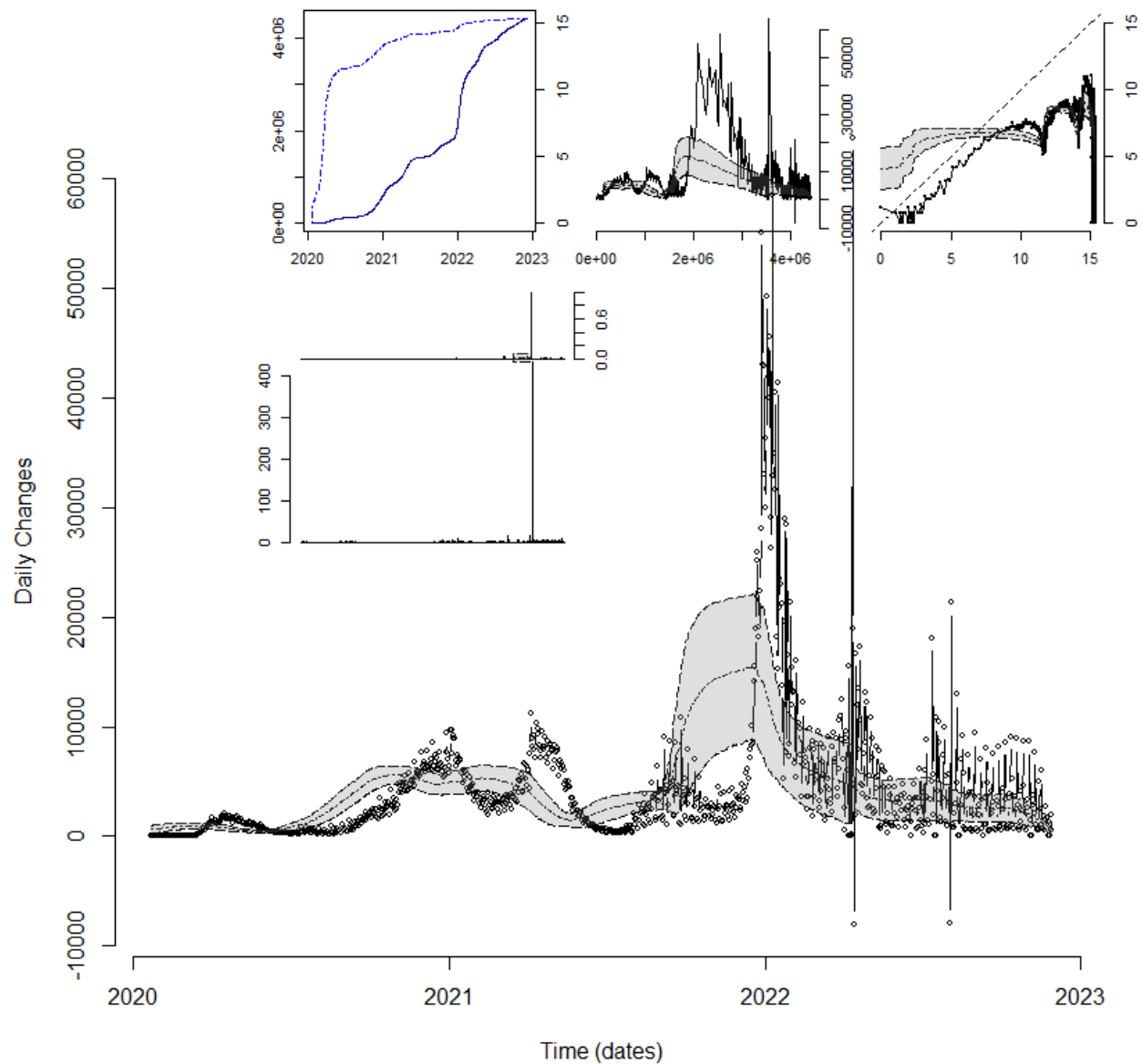
The static figure includes several representations of the daily changes in the **confirmed cases in Canada.**

#Trend of death cases in Canada

Can.death.data <- tsd[tsd$Country.Region == "Canada",]

single.trend(Can.death.data)
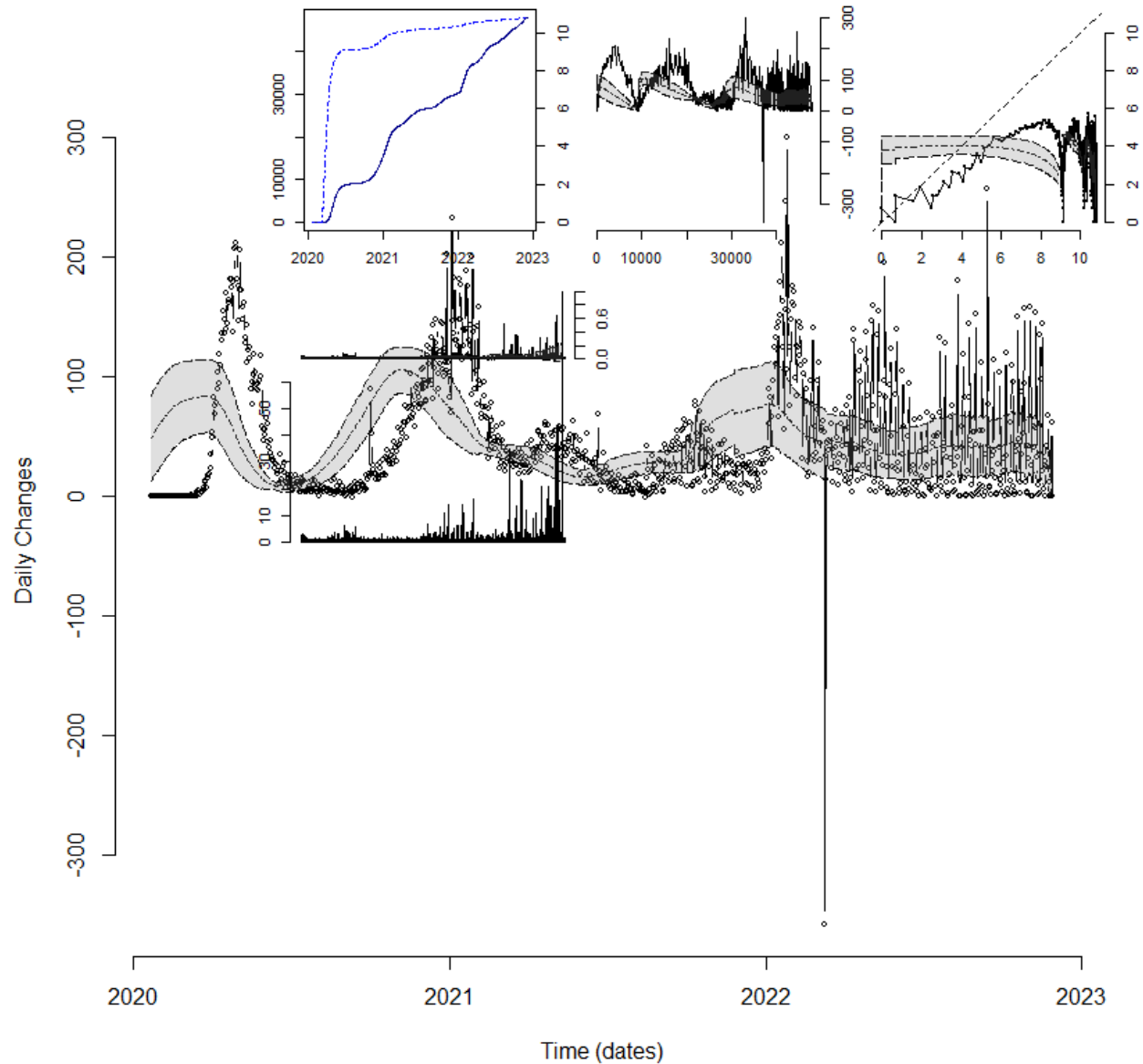
The static figure includes several representations of the daily changes in the **death cases in Canada.**

#Canada SIR model

generate.SIR.model(tsc,'Canada', tot.population = 38250000, add.extras = TRUE)

Confirmed Cases 2019-nCoV: CANADA

SIR model 2019-nCoV: CANADA
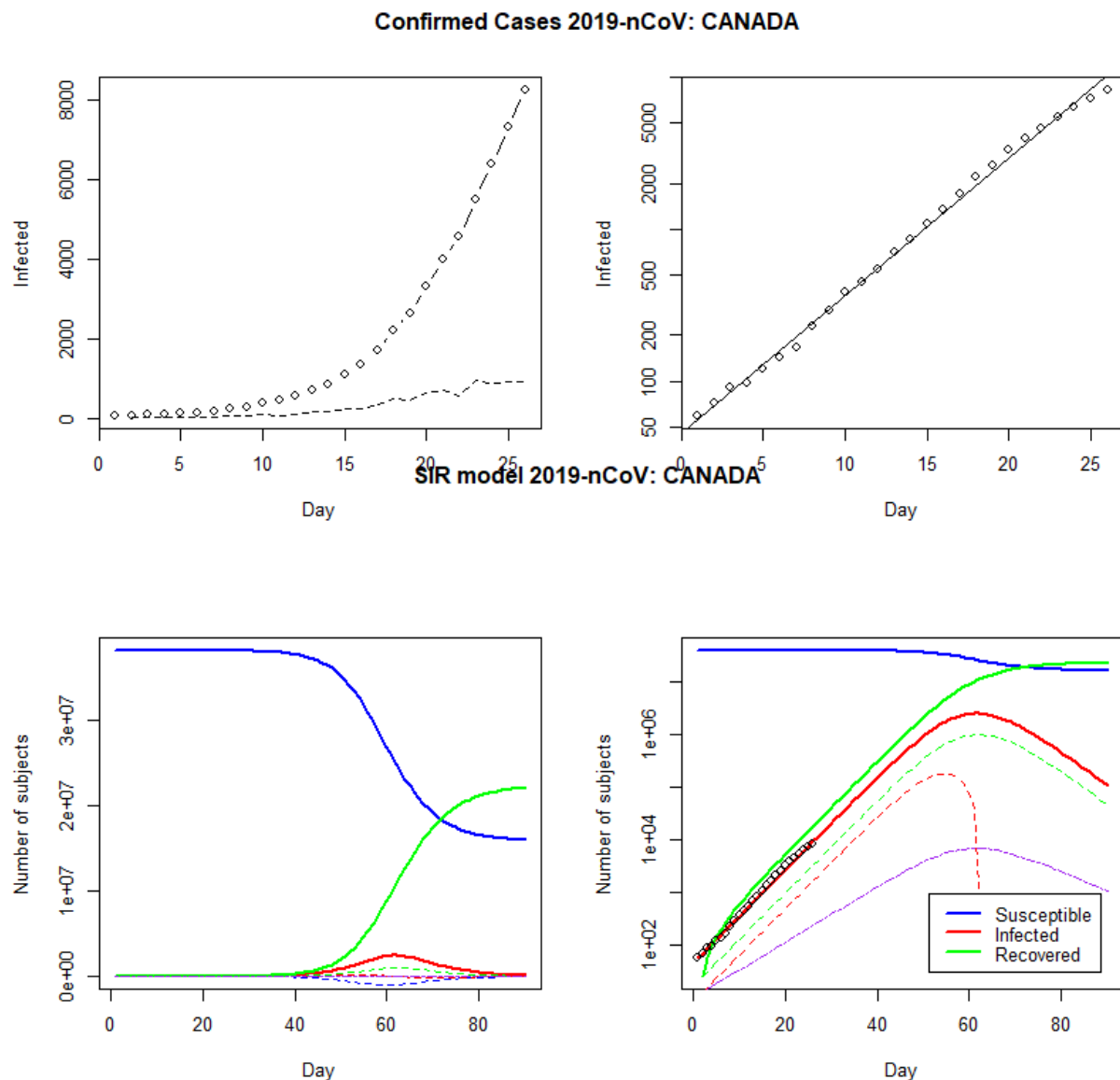
Graphical output of the SIR model applied to the confirmed cases of Canada.

In the upper plots of these 4 graphs, the number of infected people in the region is shown on a linear scale (left) and a log scale (right) as a function of time. The bottom panels show the SIR model solution in linear (left panel) and log-scale (right panel), as well as the data points used to determine the transition rate parameters and for the model. The purple dashed-dotted line in the left figure (Canada) represents the force of

#Ontario SIR model

generate.SIR.model(tsc ,"Ontario",tot.population = 14570000 , add.extras = TRUE)
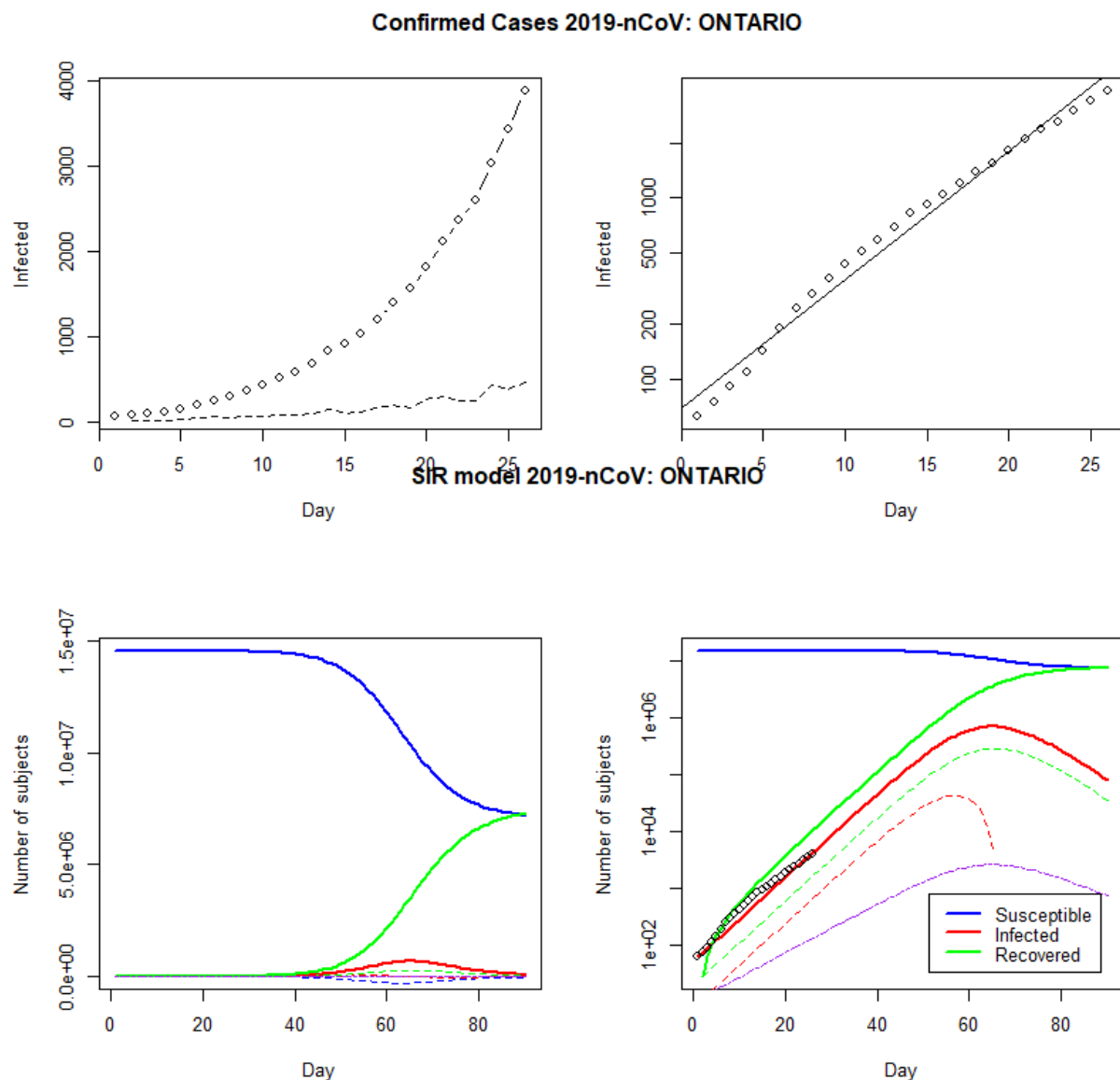
Graphical output of the SIR model applied to the confirmed cases in Ontario.

```r
# modelling the spread for Canada, storing the model

Can.SIR.model <- generate.SIR.model(tsc,'Canada', tot.population = 38250000,
add.extras = TRUE)


#and generating an interactive visualization
# plotting and visualizing the model

plt.SIR.model(Can.SIR.model,"Canada", interactiveFig =TRUE ,
        fileName ="Can.SIR.model",
        add.extras = TRUE )
```
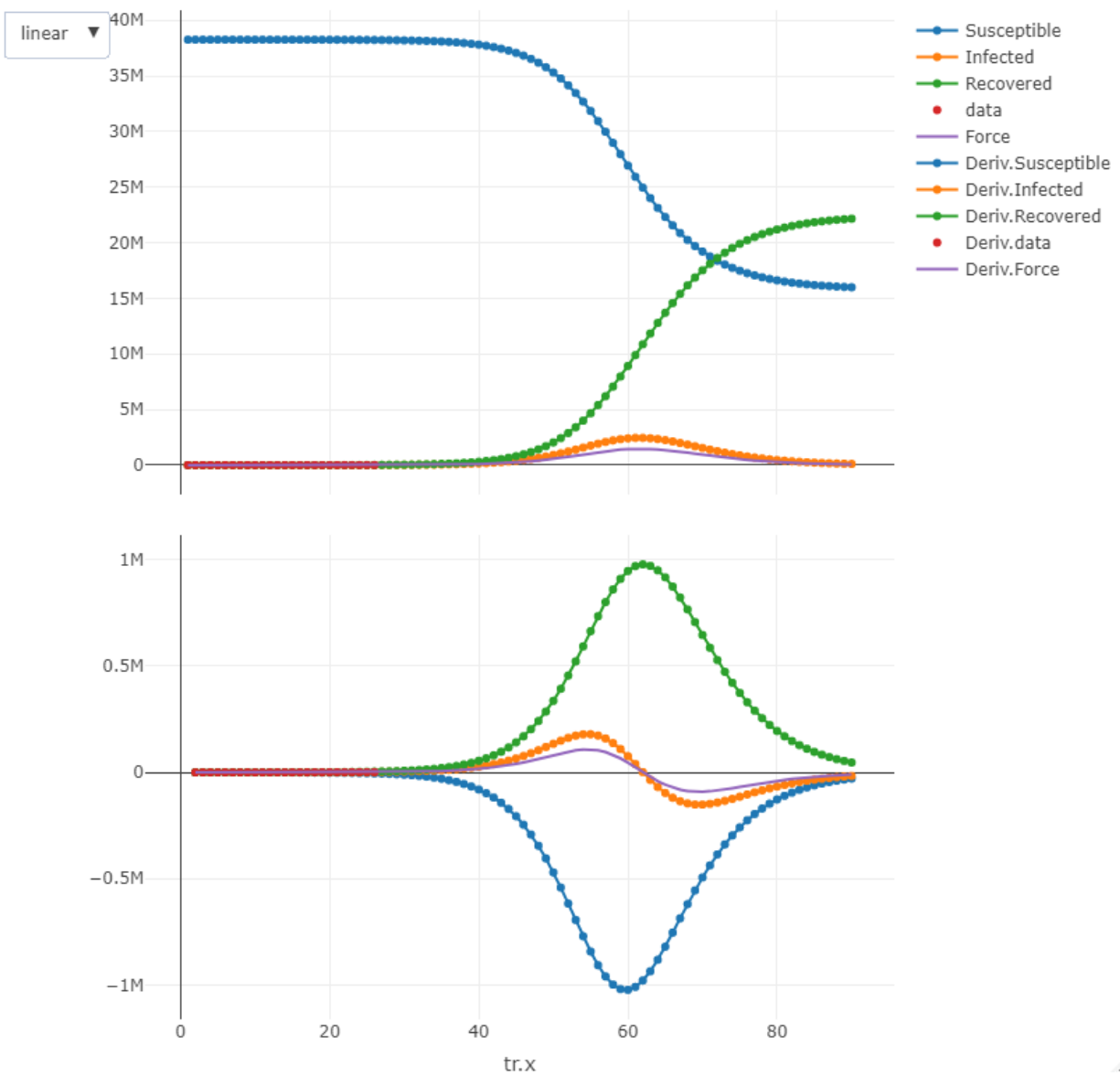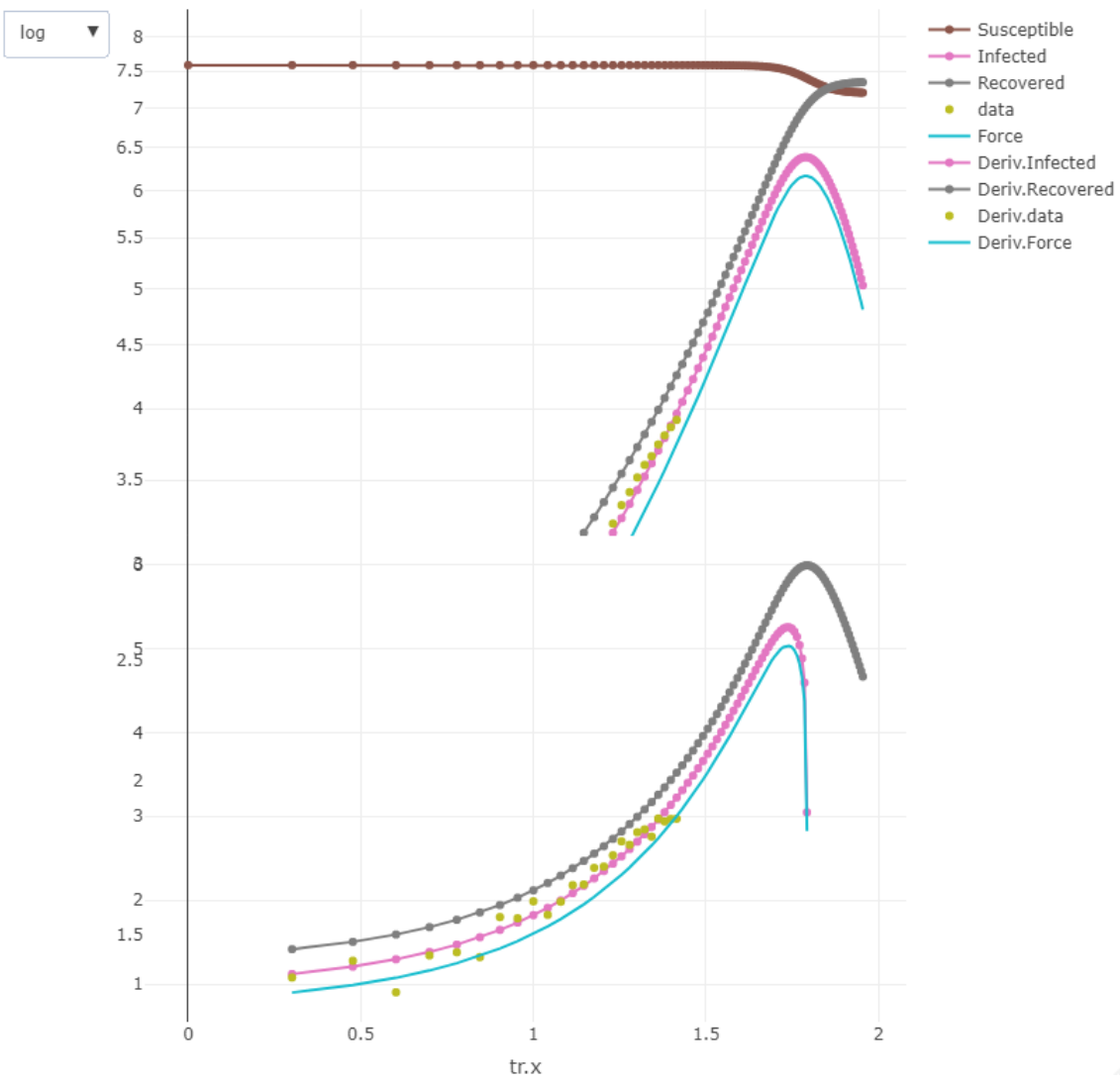
6. Data visualization and Reporting

#Total Plots

totals.plt()

covid19.analytics -- Totals / 2022-11-30

log ▾   1B

- Global confirmed
- Global recovered
- Global deaths
- Global active cases
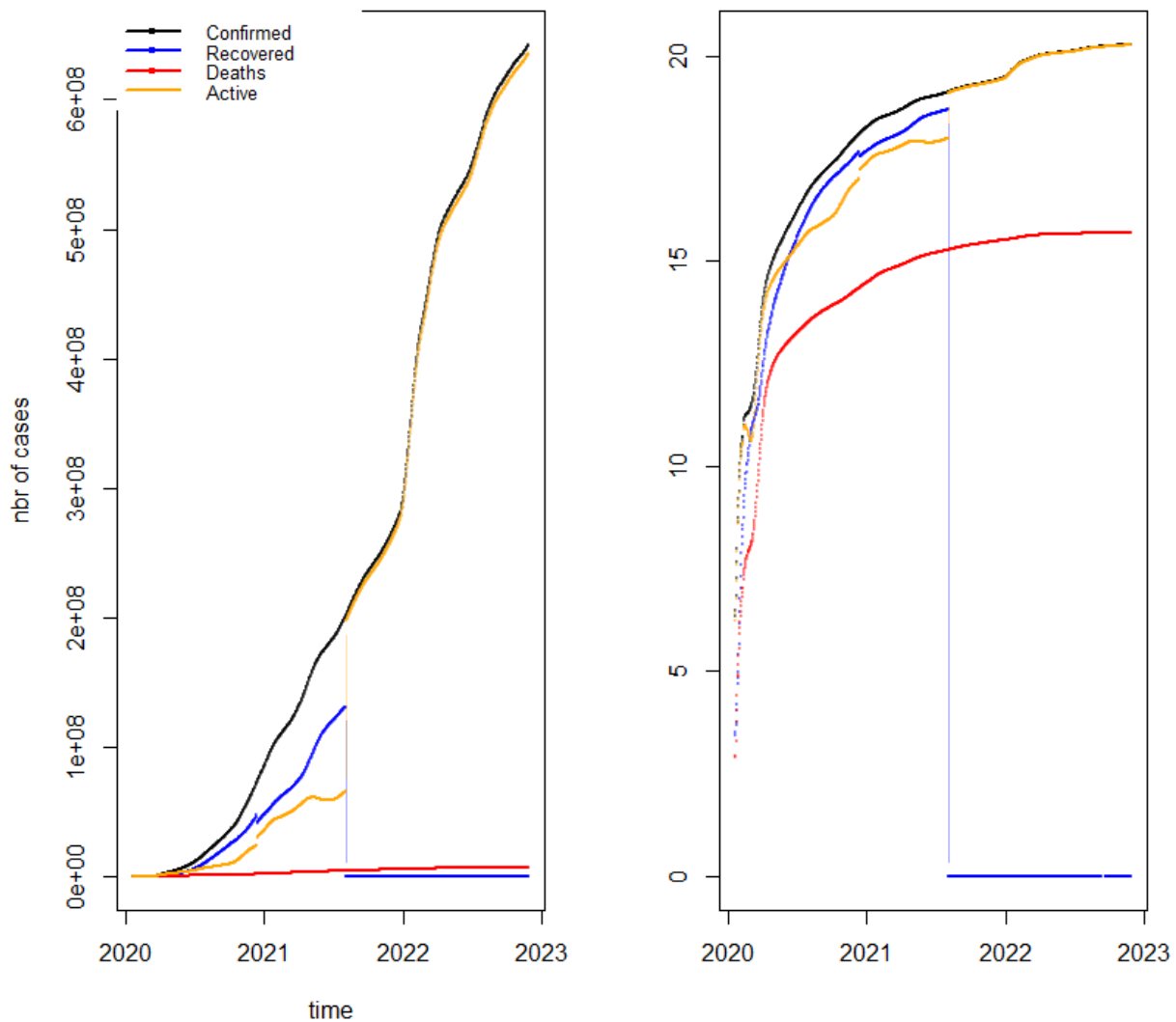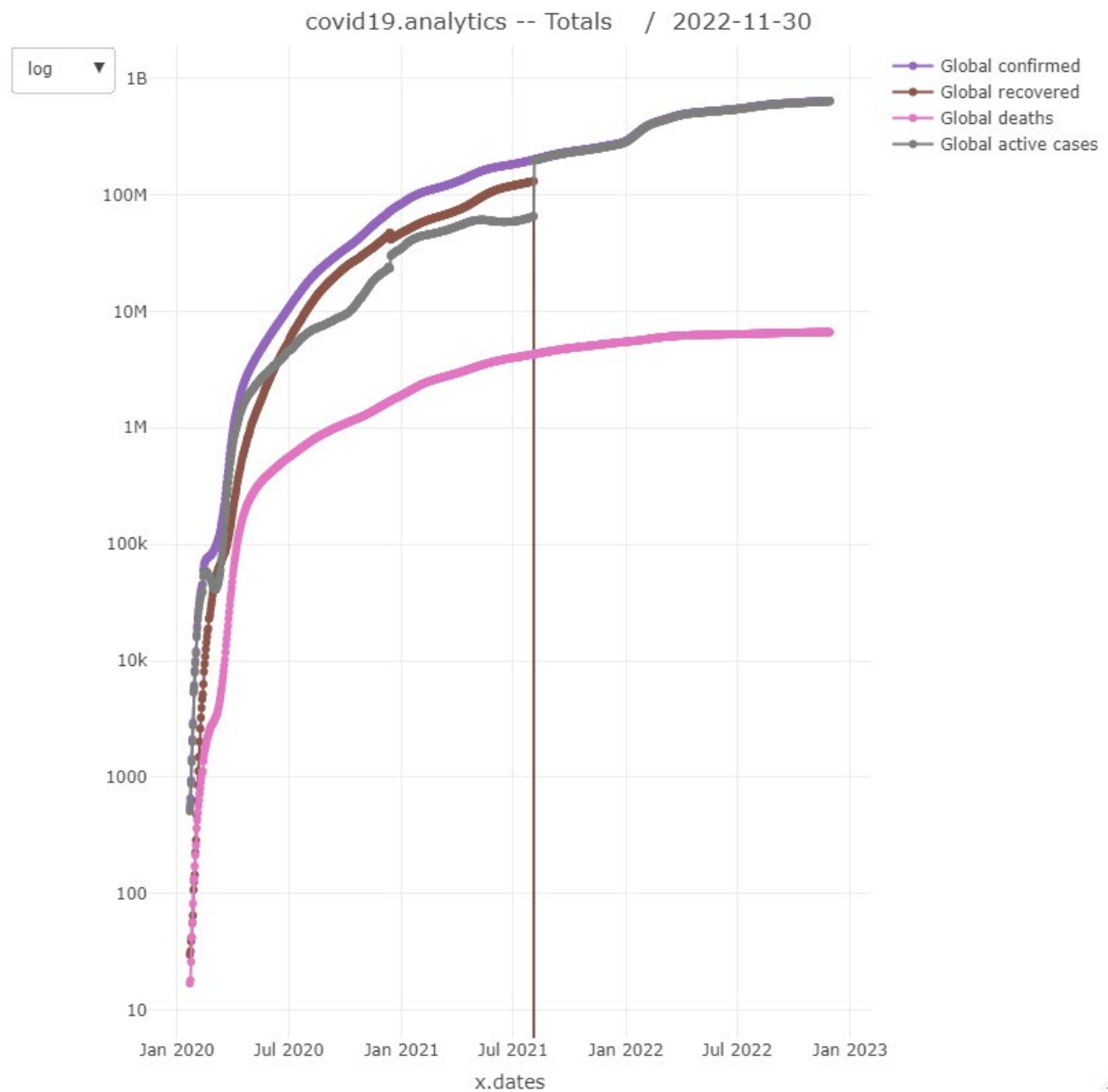
The total number of death cases around the world has stopped being recorded as of July 2021.
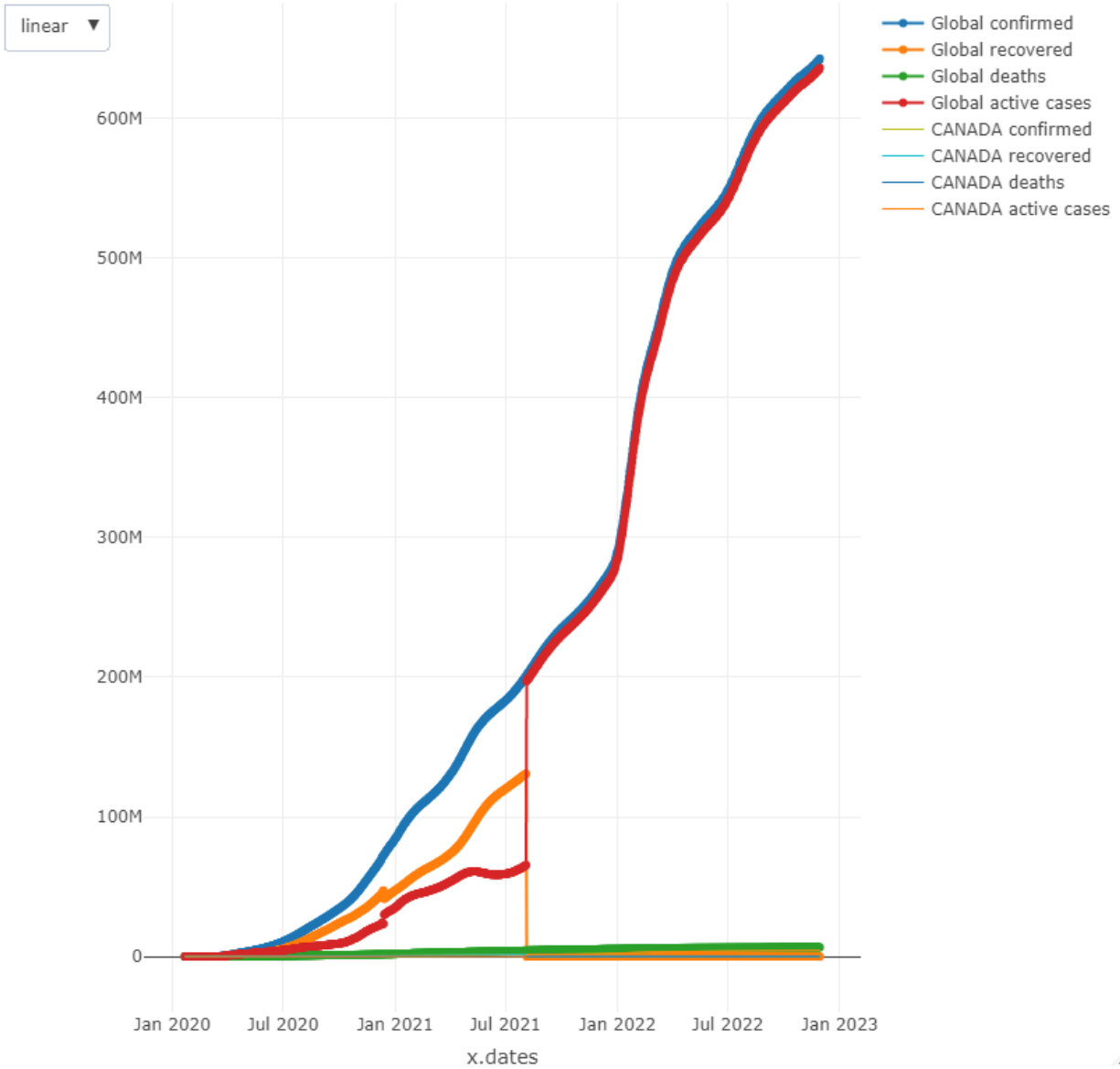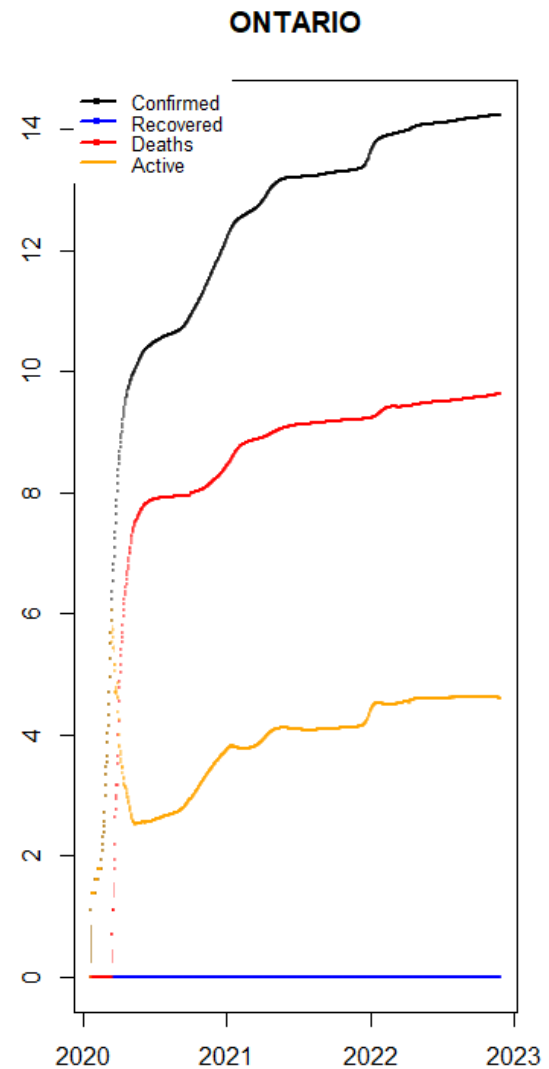
#Plot total cases in Canada

totals.plt(tsa, "Canada")
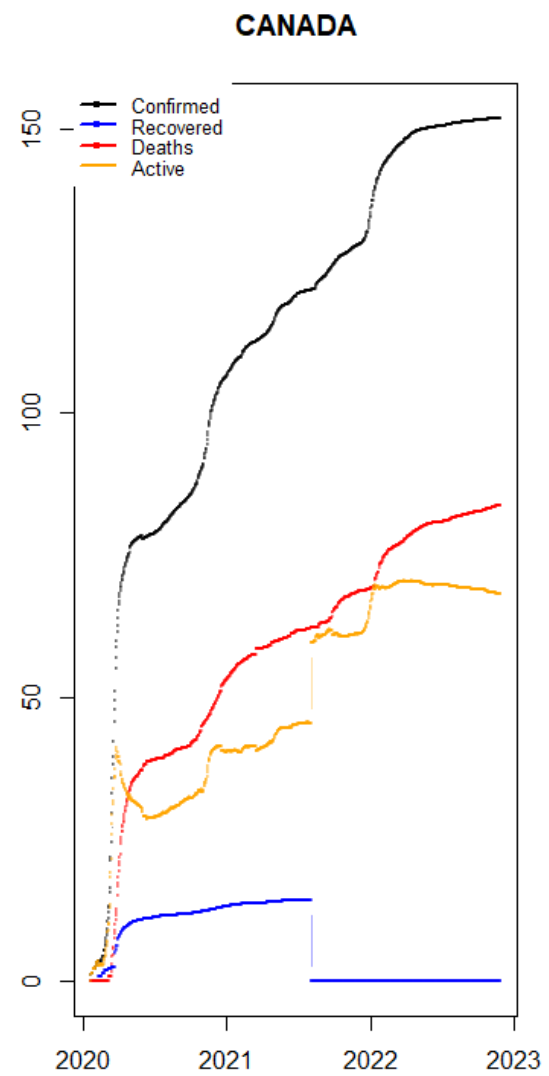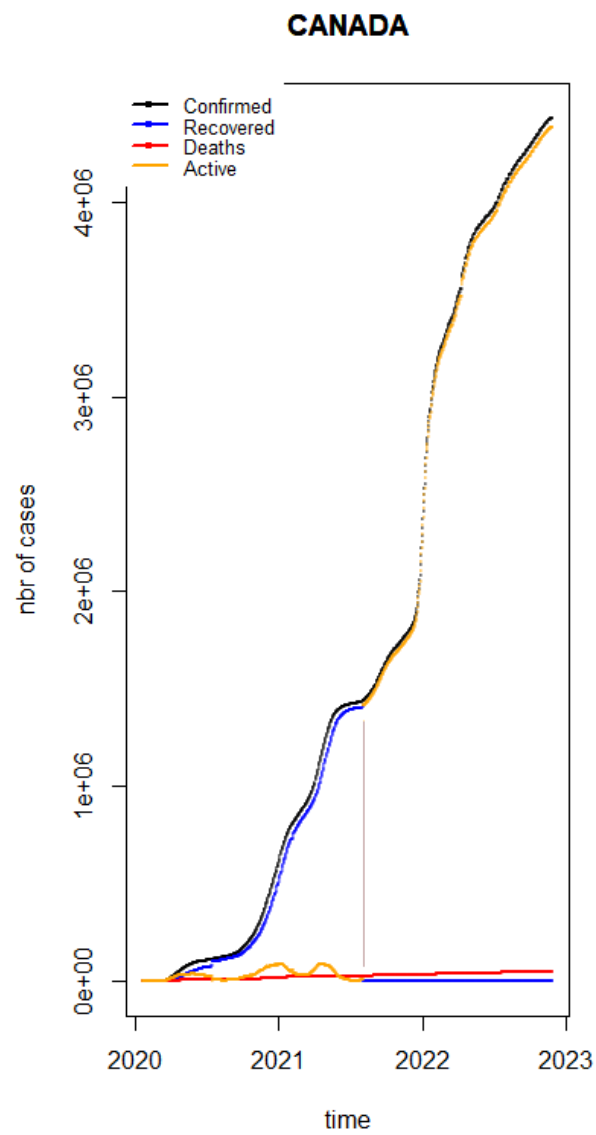
CANADA
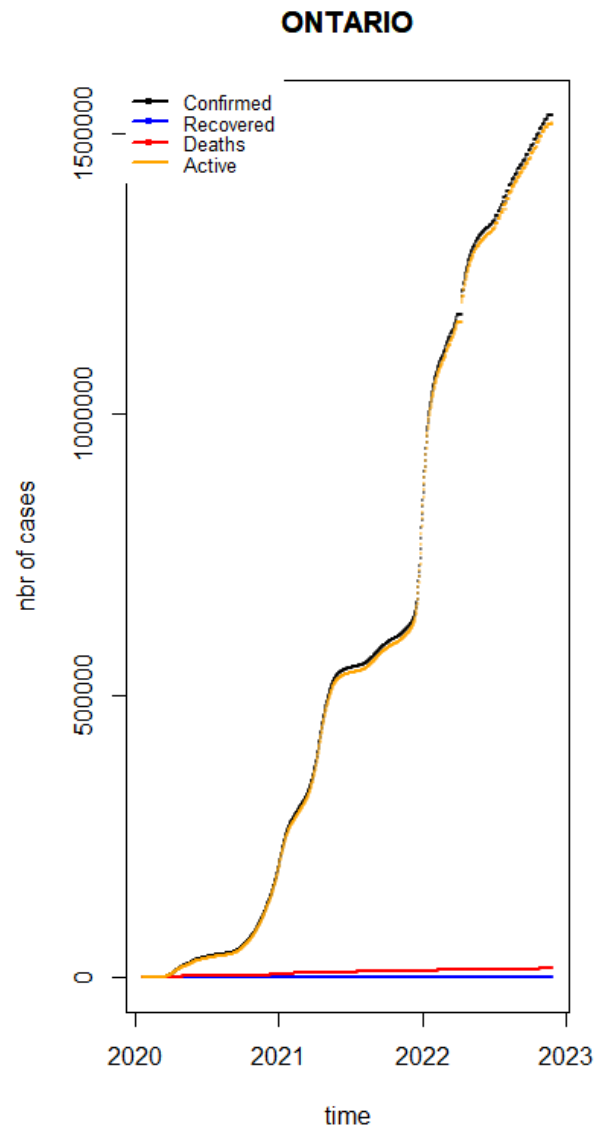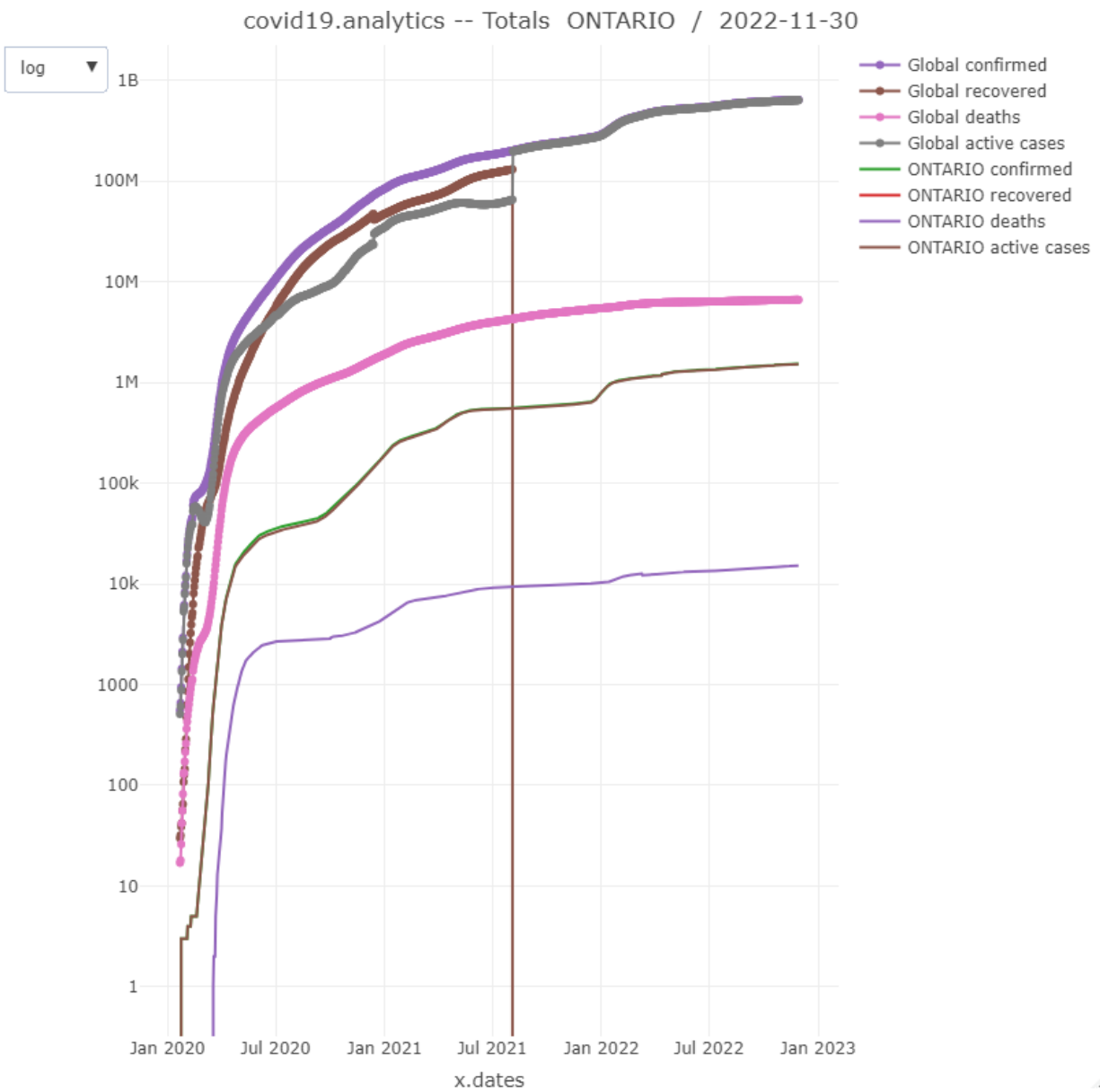
CANADA

#Canada compares with Global

covid19.analytics -- Totals CANADA / 2022-11-30

linear ▼

- Global confirmed
- Global recovered
- Global deaths
- Global active cases
- CANADA confirmed
- CANADA recovered
- CANADA deaths
- CANADA active cases

x.dates

totals.plt(tsa, "Ontario")

covid19.analytics -- Totals ONTARIO / 2022-11-30
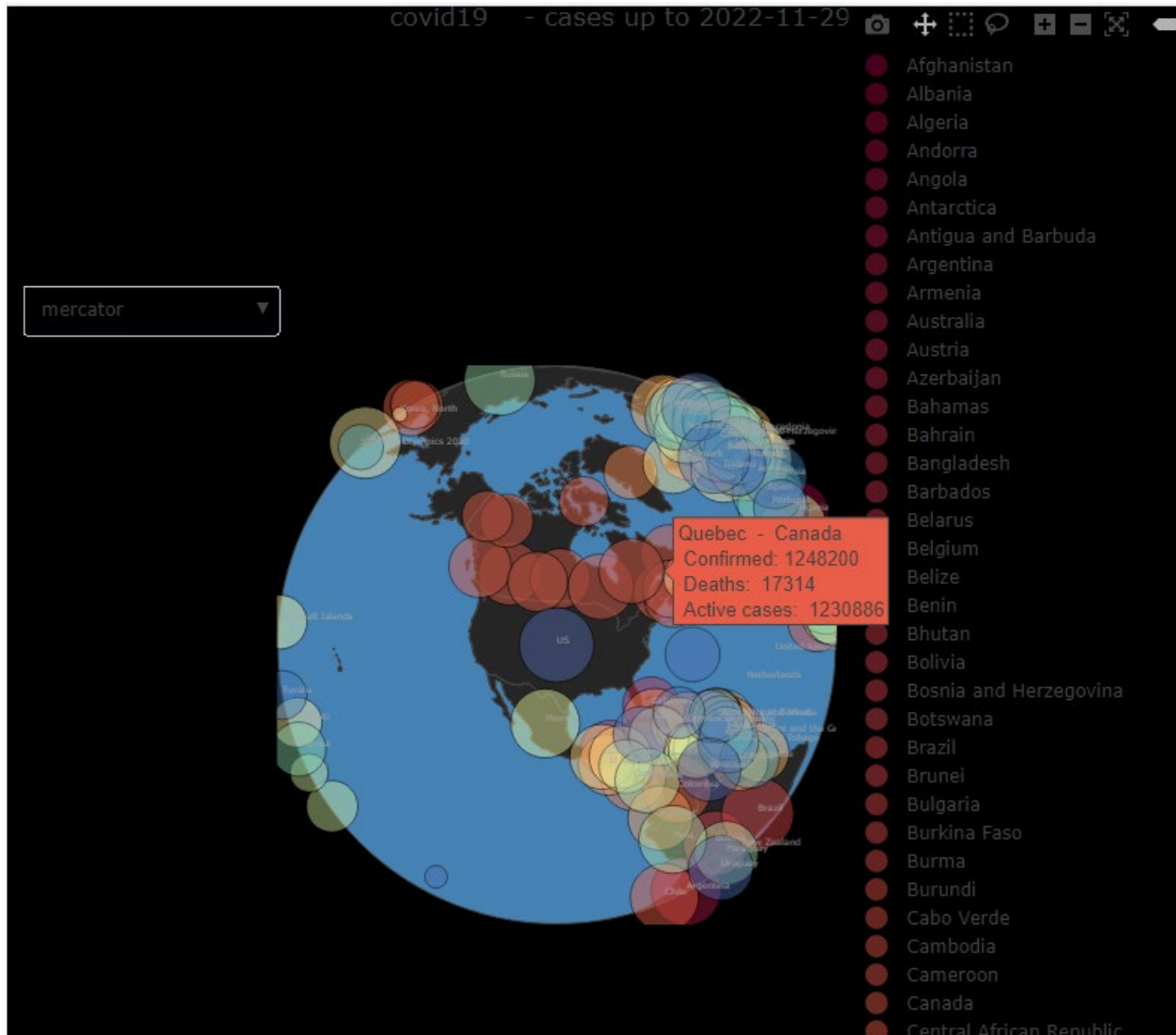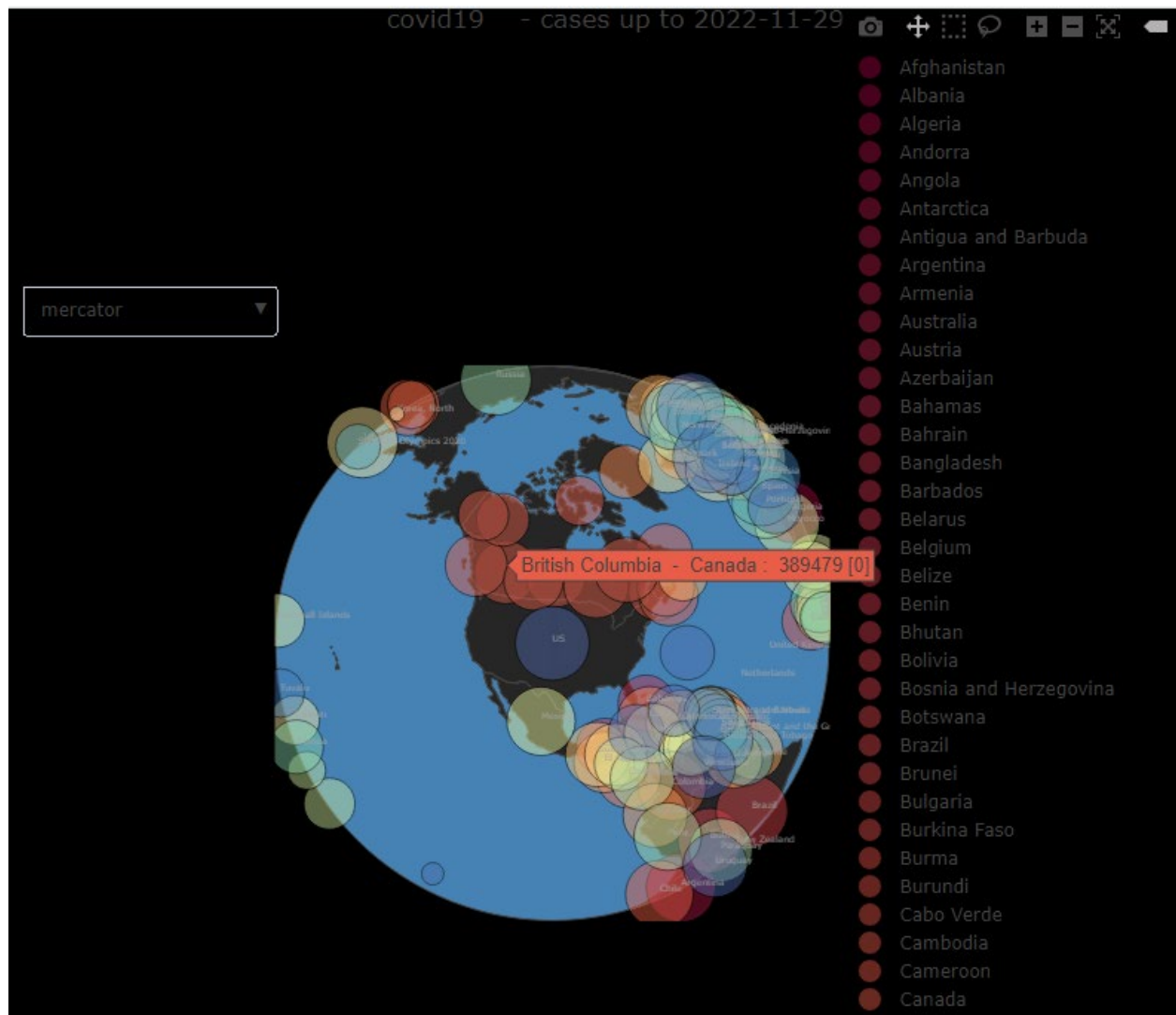
World Map

Live map all cases

live.map(tsa)

The interactive figures generated using the live.map (upper row, for time series and aggregated data respectively)

Live map confirmed cases

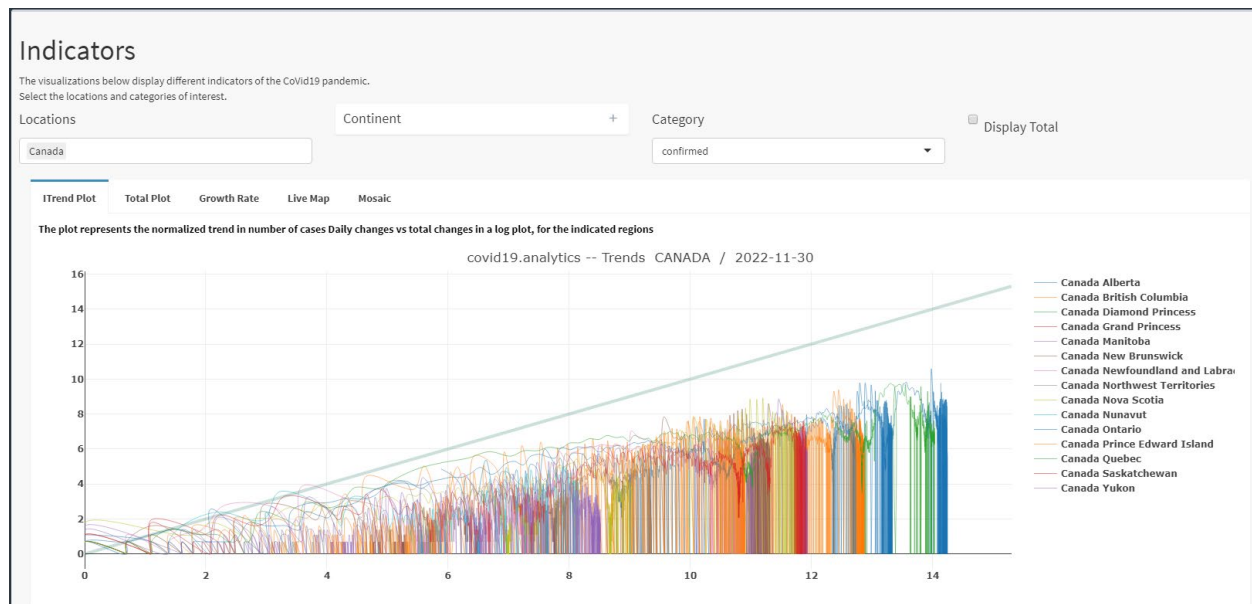live.map(tsc)

#Live map death cases

live.map(tsd)

We can also use the Explorer dashboard to read all the above plots.

#covid19.analytics explorer dashboard

covid19Explorer(locn = NULL)

COVID19.ANALYTICS ≡

① INDICATORS

GENOMIC experimental

🗎 MODELS ‹

🗎 DATASETS & REPORTS ‹

REFERENCES ‹

ABOUT US

Indicators

The visualizations below display different indicators of the CoVid19 pandemic.
Select the locations and categories of interest.

Locations

Continent +

Category confirmed ▾

☐ Display Total
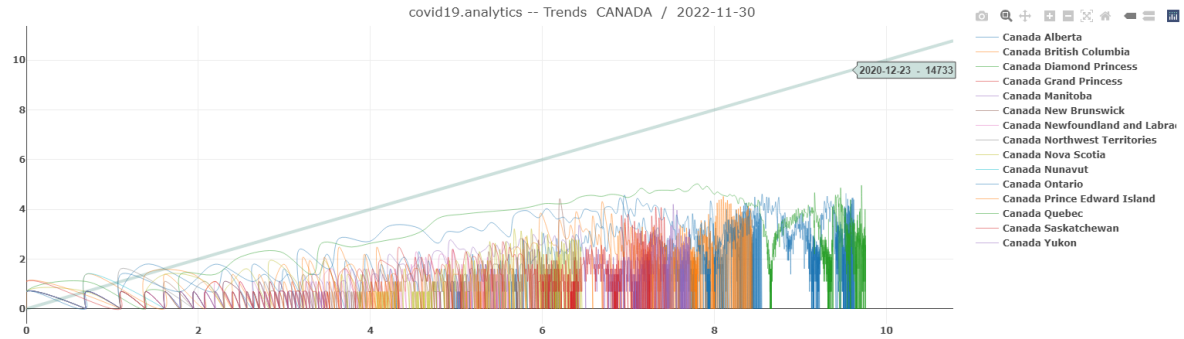
Canada

ITrend Plot | Total Plot | Growth Rate | Live Map | Mosaic

The plot represents the normalized trend in number of cases Daily changes vs total changes in a log plot, for the indicated regions

covid19.analytics -- Trends CANADA / 2022-11-30

— Canada Alberta
— Canada British Columbia
— Canada Diamond Princess
— Canada Grand Princess
— Canada Manitoba
— Canada New Brunswick
— Canada Newfoundland and Labra
— Canada Northwest Territories
— Canada Nova Scotia
— Canada Nunavut
— Canada Ontario
— Canada Prince Edward Island
— Canada Quebec
— Canada Saskatchewan
— Canada Yukon

Indicators

The visualizations below display different indicators of the CoVid19 pandemic.
Select the locations and categories of interest.

Locations

Continent   +   Category   Display Total

Canada   deaths   ▼
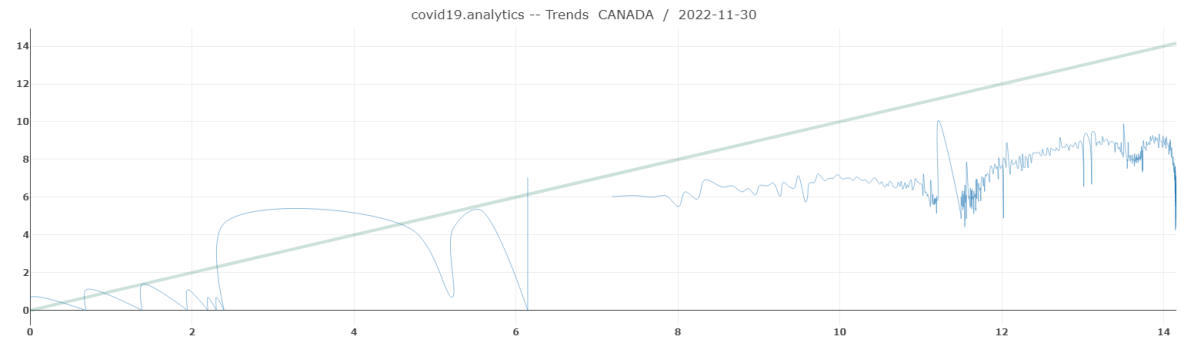
ITrend Plot   Total Plot   Growth Rate   Live Map   Mosaic

The plot represents the normalized trend in number of cases Daily changes vs total changes in a log plot, for the indicated regions

covid19.analytics -- Trends CANADA / 2022-11-30

—— Canada Alberta
—— Canada British Columbia
—— Canada Diamond Princess
—— Canada Grand Princess
—— Canada Manitoba
—— Canada New Brunswick
—— Canada Newfoundland and Labra
—— Canada Northwest Territories
—— Canada Nova Scotia
—— Canada Nunavut
—— Canada Ontario
—— Canada Prince Edward Island
—— Canada Quebec
—— Canada Saskatchewan
—— Canada Yukon

2020-12-23 - 14733

Indicators

The visualizations below display different indicators of the CoVid19 pandemic.
Select the locations and categories of interest.

Locations

Continent   +   Category   Display Total
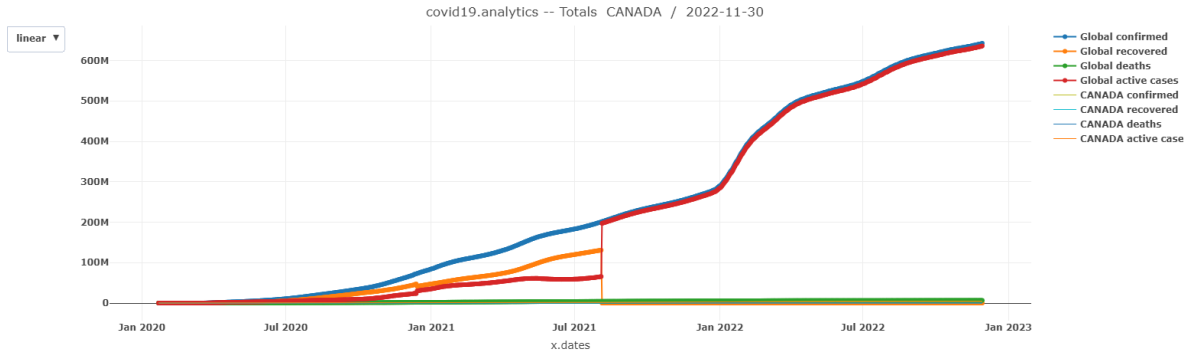
Canada   recovered   ▼

ITrend Plot   Total Plot   Growth Rate   Live Map   Mosaic

The plot represents the normalized trend in number of cases Daily changes vs total changes in a log plot, for the indicated regions

covid19.analytics -- Trends CANADA / 2022-11-30

Indicators

The visualizations below display different indicators of the CoVid19 pandemic.
Select the locations and categories of interest.

Locations	Continent	+	Category	
Canada			deaths	▼

☐ Display Total

ITrend Plot **Total Plot** **Growth Rate** **Live Map** **Mosaic**

Live map is an interactive map displaying cases around the world

○ Time Series ◉ Aggregated ○ Both   ☐ Display Projection   ☐ Hide Legend

covid19 - cases up to 2022-11-30

● Afghanistan
● Albania
● Algeria
● Andorra
● Angola
● Antarctica
● Antigua and Barbuda
● Argentina
● Armenia
● Australia
● Austria
● Azerbaijan
● Bahamas
● Bahrain
● Bangladesh
● Barbados
● Belarus
● Belgium
● Belize
● Benin