Trajectory Mapping Results

Cecilia Valenzuela

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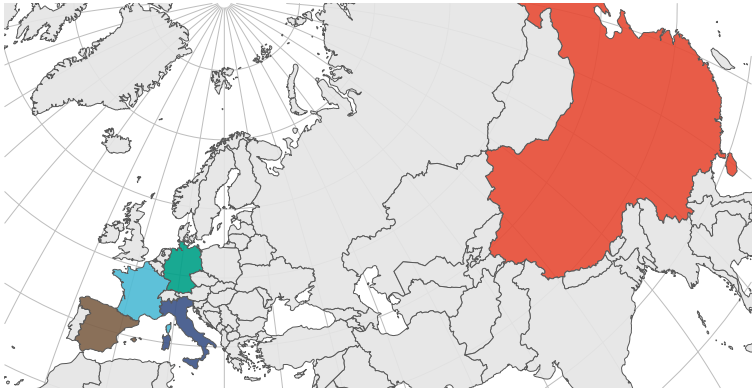
```
## -- Attaching packages ------------------------------------------------- tidyverse 1.3.0 --

## v ggplot2 3.3.0     v purrr   0.3.3
## v tibble  3.0.0     v dplyr   1.0.2
## v tidyr   1.0.2     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.5.0

## -- Conflicts ---------------------------------------------------- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

Deme configuration



demeID	deme	division	country	region	exclude_country	min_date	max_date
2	China		China	Asia		2019-12-24	2020-01-23
0	France		France	Europe		2020-01-23	2020-03-08
1	Germany		Germany	Europe		2020-01-28	2020-03-08
3	Italy		Italy	Europe		2020-01-29	2020-03-08
4	OtherEuropean			Europe	France,Germany,Italy,Spain	2020-01-29	2020-03-08
5	Spain		Spain	Europe		2020-02-24	2020-03-08

Table 2: Total number of cases reported to ECDC on March 8, 2020

deme	c19od	ecdc	owid
China	80904	80768	80222
France	963	613	948
Germany	902	684	799
Italy	6007	4636	5883
OtherEuropean	2183	1561	1760
Spain	1136	764	500

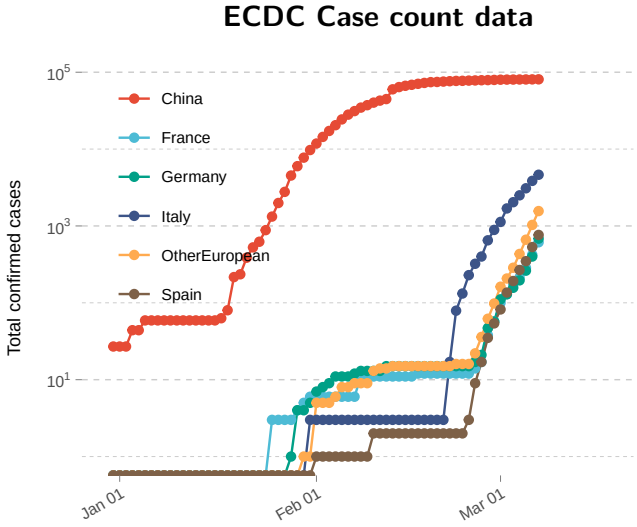


Figure 1: ECDC case counts for each deme from the beginning of the pandemic to March 8, 2020

Epidemic trajectory data

From the Stochastic Trajectory Mapping analysis, we sample with importance sampling one epidemic trajectory per set of parameters + typed node tree from the set of simulated trajectories.

The processing of the trajectory data includes the generation of two different datasets:

- `states`: We have the total number of inferred cases by trajectory, deme and time.
- `events`: We have each event that happened in a epidemic trajectory, with its type (origin, birth, death or migration), the source/destination deme and time.

Epidemic trajectory data

We use the events dataset to compute quantities of interest:

- `B`: transmissions (births) events
- `D`: becoming unifectious (deaths) events
- `IM`: migrations into the deme
- `OM`: migrations out of the deme
- `S`: sampling events
- `O`: origin
- `in_pop`: origin + transmissions + incoming migrations
- `out_pop`: deaths + outgoing migration + sampling events
- `active_pop`: origin + transmissions + incoming migrations - (deaths + outgoing migration + sampling events)

Epidemic trajectory data

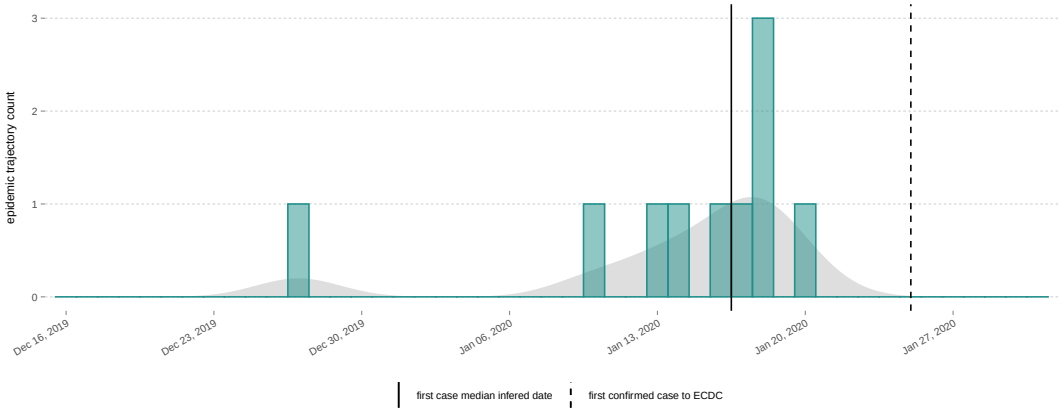
Table 3: Trajectories dataset

traj	var	deme	partner	date	value	cumvalue
1	active_pop	China		2019-12-08	1	1
1	in_pop	China		2019-12-08	1	1
1	O	China		2019-12-08	1	1
1	active_pop	China		2019-12-10	1	2
1	B	China		2019-12-10	1	1

To have a feasible time of analysis of the epidemic trajectories we take a random subsample of 500 trajectories.

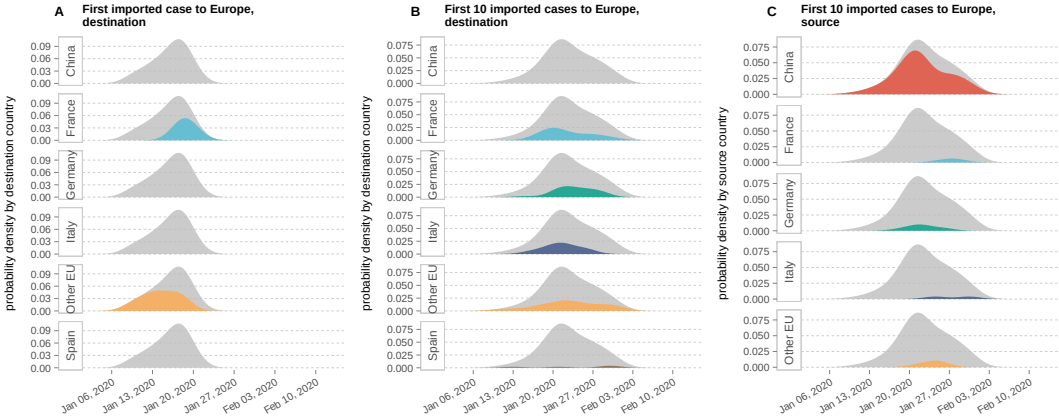
To facilitate visualization and summarise the results, we take a grid time of 1 day and summarise the number of events that day as the sum of the events in the corresponding time interval; and the number of inferred cases as the maximum of the interval.

Origin of SARS-CoV-2 in Europe



Median date: 2020-01-16
95% CCI: (2019-12-27, 2020-01-20)
ECDC first confirmed case: 2020-01-25

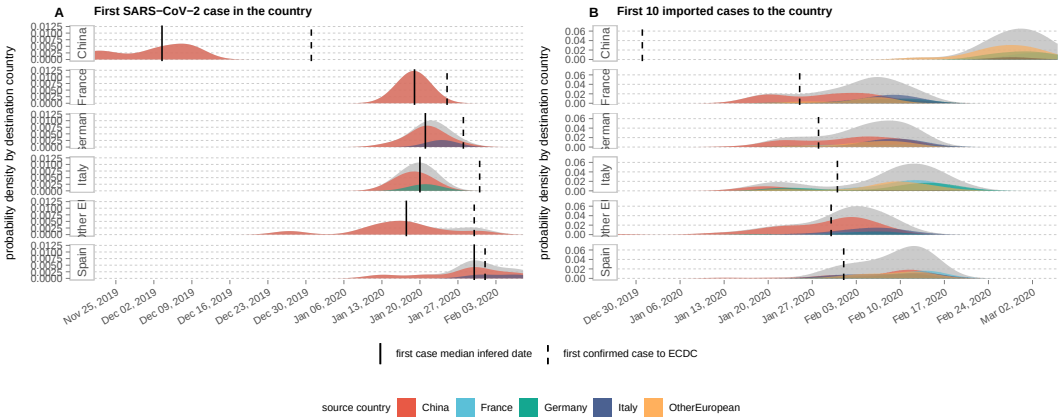
First imported cases to Europe, time and location



First imported cases to Europe, time and location

deme	n_1d	p_1d	n_10d	p_10d	n_10s	p_10s
France	3	0.3	25	0.25	4	0.04
Italy	1	0.1	20	0.20	4	0.04
OtherEuropean	6	0.6	30	0.30	7	0.07

First introductions to each country, source



First introductions to each country, source

deme	m	l	h
China	2019-12-03	2019-11-21	2019-12-10
France	2020-01-19	2020-01-16	2020-01-20
Germany	2020-01-21	2020-01-15	2020-01-27
Italy	2020-01-20	2020-01-16	2020-01-22
OtherEuropean	2020-01-17	2019-12-27	2020-01-31
Spain	2020-01-30	2020-01-13	2020-02-08

deme	partner	n_1s	p_1s
China	China	10	1.0
France	China	10	1.0
Germany	China	8	0.8
Germany	Italy	2	0.2
Italy	China	7	0.7
Italy	Germany	2	0.2
Italy	OtherEuropean	1	0.1
OtherEuropean	China	9	0.9
OtherEuropean	France	1	0.1
Spain	China	7	0.7
Spain	Germany	1	0.1
Spain	Italy	2	0.2