Bulletin GPoM-epidemiologic no 11
Coronavirus Covid-19 epidemic (2019-2020)

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Centre d'Etudes Spatiales de la Biosphère
CESBIO / OMP (CNES / CNRS / UPS / IRD / INRA)

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Methodology

- **Models** of canonical form (GPoM tools) were **obtained for the outbreaks of Covid-19** at **several locations in the world**: for several Chinese provinces (**Hubei**, etc.), and for **South Korea**, **Japan** and **Italy**

- **These models** are **applied to other outbreaks** of Covid-19 **in other countries**

- The objective is to identify which are the **closest scenarios** for these other countries

Analysis

- For each country, **all the models** available **are run** (five initial conditions used with each model)
- Diverging models are directly rejected as inconsistent
- Other models are plotted. **Scenarios of inconsistent behavior** are **rejected** (e.g. a decreasing cumulative number of case proves that the scenario must be rejected)
- Among the remaining **consistent scenarios**, the ones showing the **best consistency with the recent observations** are considered as curently **more realistic**

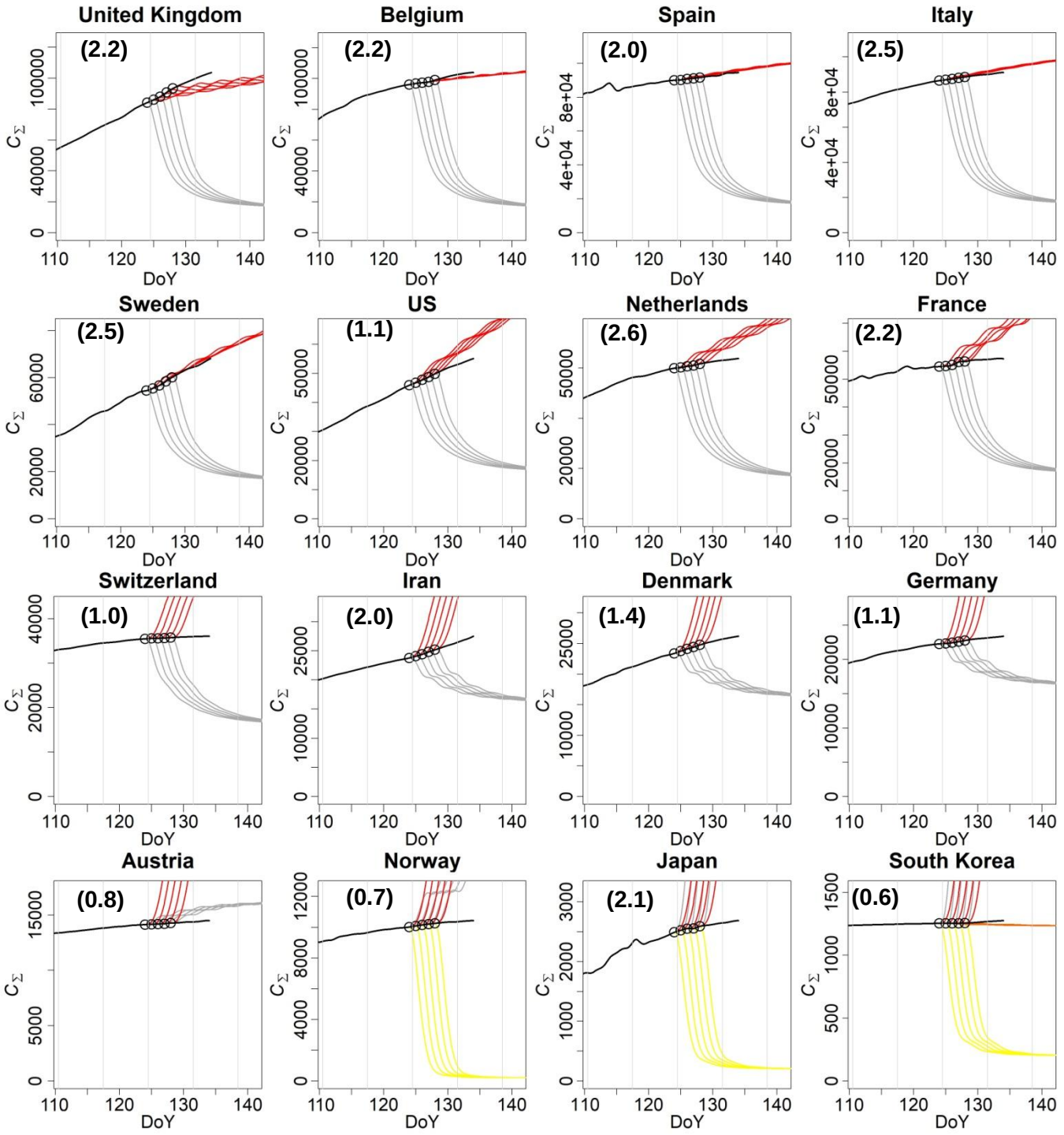
Note: Correction factor are applied to the time series in order to ensure their consistency.

$C_\Sigma(t)$ Cumulative Cases per 10M

Scenarios:

- Italy
- Hubei
- South Korea
- Jiangxi

Observations:



Note:

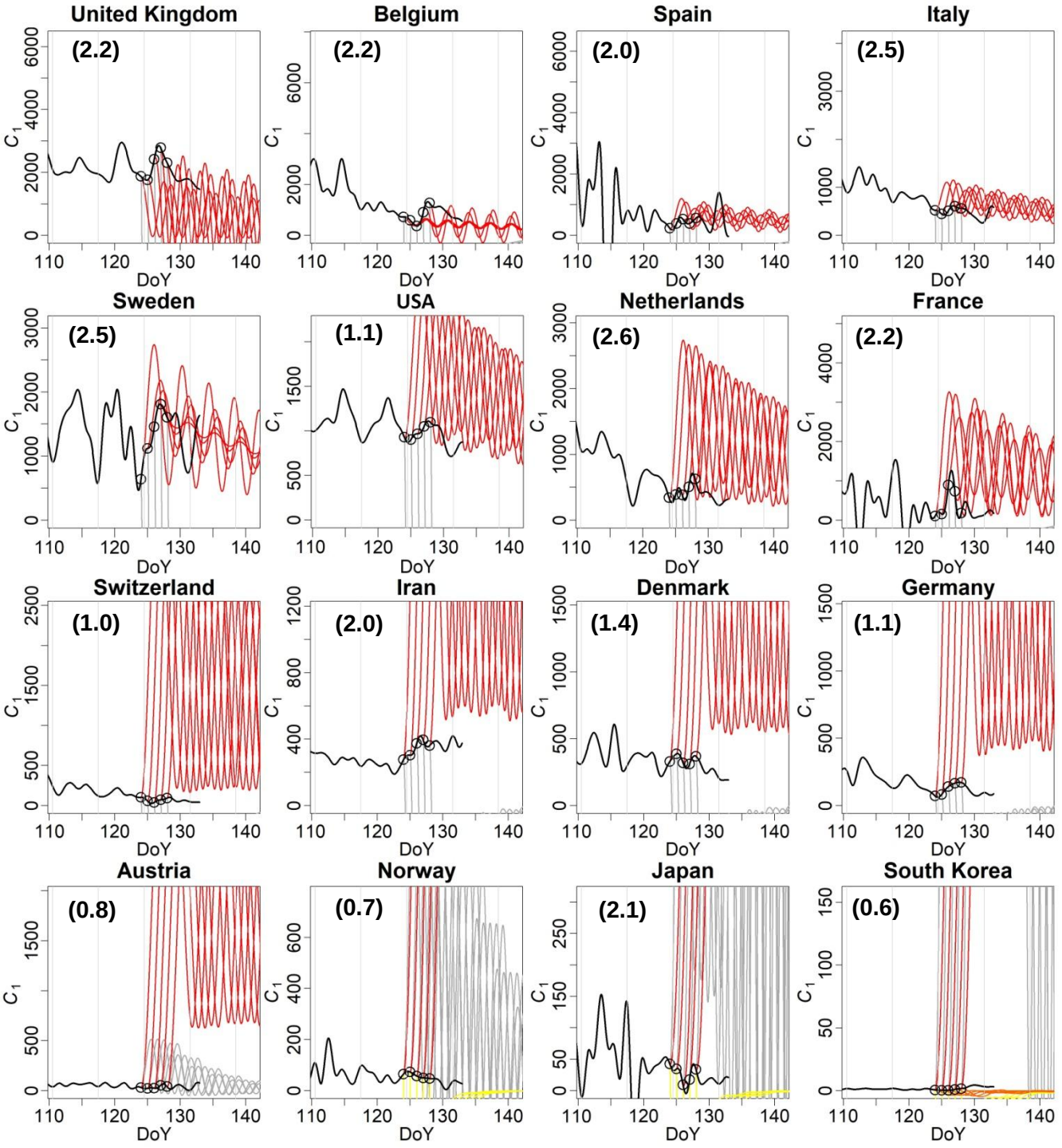
- A correction factor is applied to each time series to account for the under-estimations of infected cases in comparison to deaths
- This correction is provided in brackets (from 0.6 to 3.0)

$C_1(t)$ Daily new Cases per 10M

Scenarios:

- Italy
- Hubei
- South Korea
- Jiangxi

Observations:



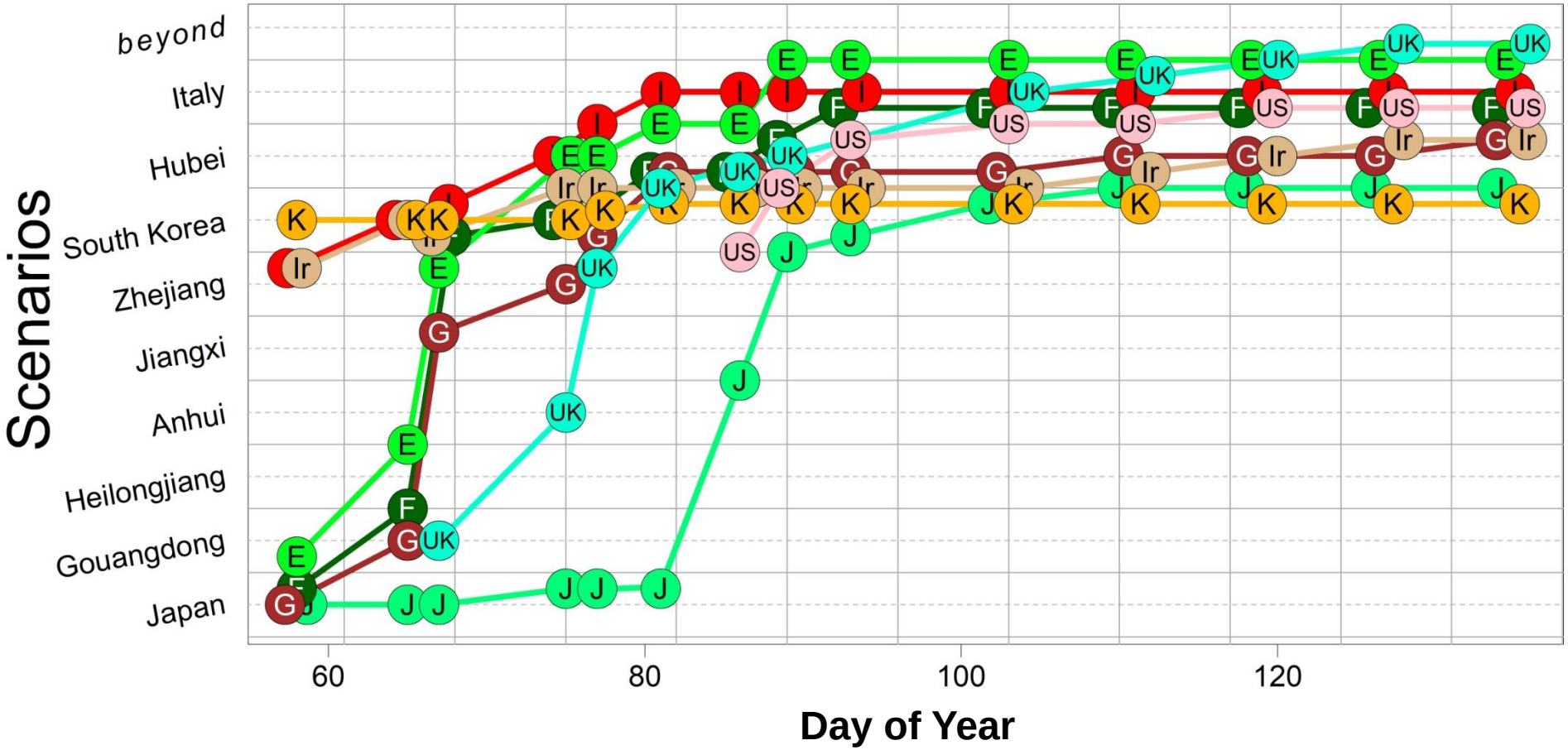
Note:

- A correction factor is applied to each time series to account for the under-estimations of infected cases in comparison to deaths
- This correction is provided in brackets (from 0.6 to 3.0)

Results

- The **United Kingdom** has also **overtaken the Italy scenario** the its evolution is clearly **not yet stabilized**
- **Belgium**, **Spain** and **Sweden** have now **overtaken** the **Italy scenario** in terms of cases per 10 M, and their evolution seems stabilized
- **Netherlands** is progressively reaching the **Italy scenario** and its evolution is stabilizing
- **France** is stabilizing below, but close to, the Italy scenario
- The **USA** is now close to the **Italy scenario**. Note that an **important heterogeneity** takes place in the USA, this behaviour is thus the combined result of both light and severe scenarios inside the country. Its **situation is not stabilzed yet**
- **Switzerland**, **Denmark** and **Germany** have now all largely exceeded the Hubei scenario. Their evolution is stabilizing
- **Iran** is experiencing an important restart
- **Austria** and **Norway** are stabilizing below the Hubei scenario
- **Japan** and **South Korea** are experiencing a small restart

Scenarios evolution



Closest scenanios are monitored for:
Japan (J), Germany (G), France (F), Spain (E), Iran (Ir), Italy (I),
South Korea (K) United Kingdom (UK), United States of America (US)

Scenarios evolution

- For a given country, the **scenario** can largely evolutate in time
- This evolution **highly depends on the control measures** taken to curb (or slow down) the outbreak
- In practice, the resulting scenario **highly depends on** the **type**, **earlyness** and **strength** of the control measures, and on the **acceptation of the control measures** aswell

Details about the methodology can be found in:

Mangiarotti, S., Peyre, M., Zhang, Y., Huc, M., Roger, F., & Kerr, Y. (2020). Chaos theory applied to the outbreak of Covid-19: An ancillary approach to decision-making in pandemic context. *Epidemiology and Infection,* 1-29. https://doi.org/10.1017/S0950268820000990

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