Network-SEIR model fitting - lastest results

Having taken into consideration what was discussed on the GM on 11.10.2017 I have constrained the exploration of the parametric space by the optimization routine to match reported values on the literature in the hope to fit a more sensible/realistic parameter set.

The intrinsic incubation period (IIP) which is the time that a fresh bitten healthy individual by an infected mosquito takes to become infectious, that is the σ parameter in our model is reported to be vary from 2 to 12 days, with a mean of approximately 37 days (Staples et al., 2009; Pialoux et al., 2007; Boëlle et al., 2008). We have explored an intervale for σ such as $\sigma \in [0.046, 0.5]$ which corresponds to evaluate IIP values between 2 to 21 days.

The reported duration of infection of CHIKV, which corresponds to γ^{-1} in our model, varies between 7–10 days and can persist for up to 2 weeks (Staples et al., 2009; Pialoux et al., 2007; Boëlle et al., 2008). In consequence, we have explored a parametric interval $\gamma \in [0.03, 0.2]$ which corresponds to evaluate values between 5 and 33 days.

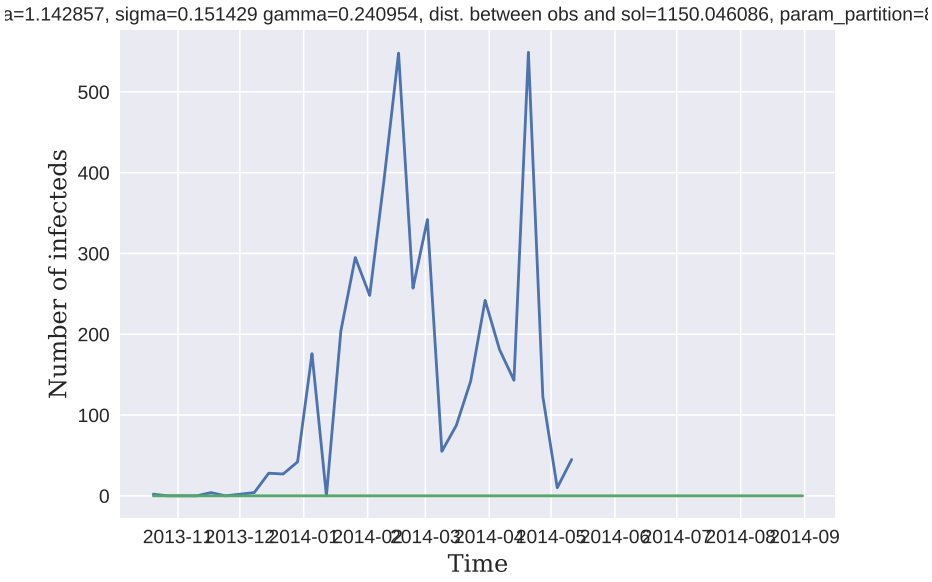
The instantaneous transmission rate β integrates both mosquito to human and human to mosquito human transmission rates. The product of this integration is not clear for CHIKV and it may depends in a number of factors, such as mosquito demography and population dynamics that can be linked in turn to local climate conditions among others. However we can explore a sensitive parametric space and have decided that from 0.5 to 10 days may suit for a sensible range that can contain a realistic value for this integrated transmission rate. Therefore we explore $\beta \in [0, 2]$.

Each interval has been lnearly divided in ten points that make for the sampling values for the optimizing algorhythm to assess. The triplet $(\hat{\beta}, \hat{\sigma}, \hat{\gamma})$ that produces the fittest solution, in the sense of porducing the less square errors regarding the observed vector, is considered the best estimate for the parameters.

Besides this redefinition of the parametric space on what the optimization is now being performed, I have realized that, by tweaking by hand and playing with the model, a rescale factor on the solution can help to improve further the fitting so I have explore a rescale factor space also in the search of a

better fit of the solution to the observed data. The rescale factor is simple a constant multiplied to the entire solution, so it is a linear scaling. I have explore 10 factors between 0 and 1, namely $C \in [0, 0.1, ..., 1]$.

The follwing figure illustrate the results of these computations. I apologize that the figures show up as cluttered and with cut titles but this is an initial run (that takes some houers to produce these plots)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Number of infecteds
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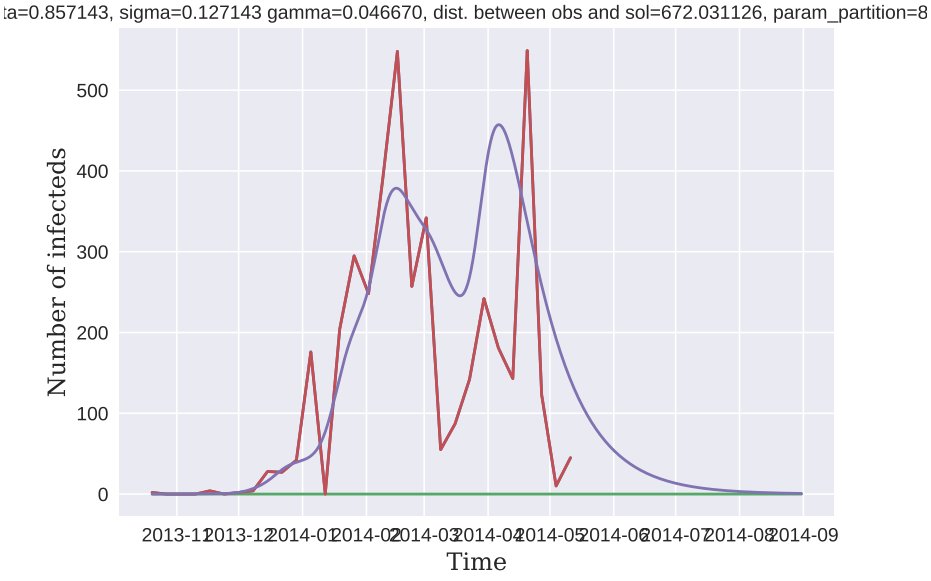
100
200
300
400
500
2013-11
2013-12
2014-01
2014-02
2014-03
2014-04
2014-05
2014-06
2014-07
2014-08
2014-09
Time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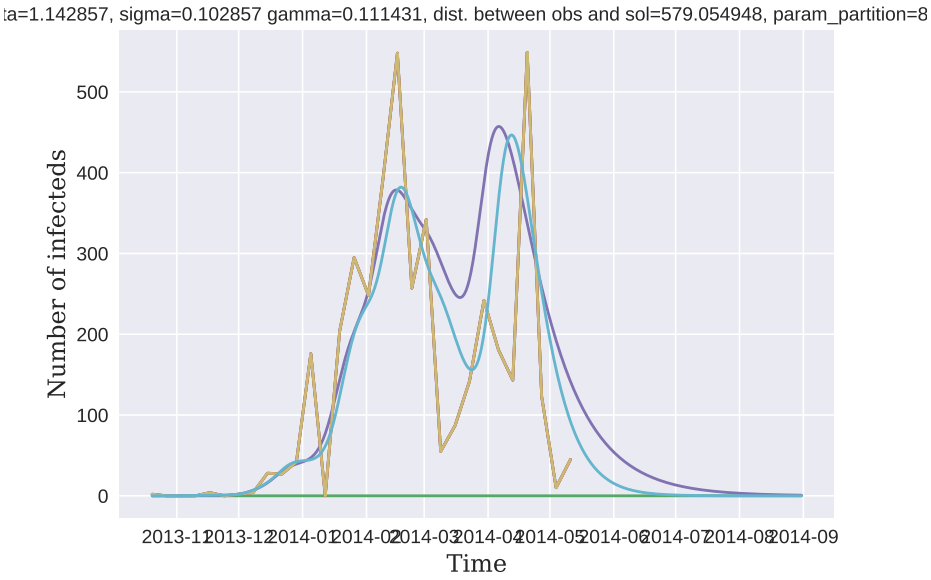
100
200
300
400
500
2013-11
2013-12
2014-01
2014-02
2014-03
2014-04
2014-05
2014-06
2014-07
2014-08
2014-09
Time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Number of infecteds
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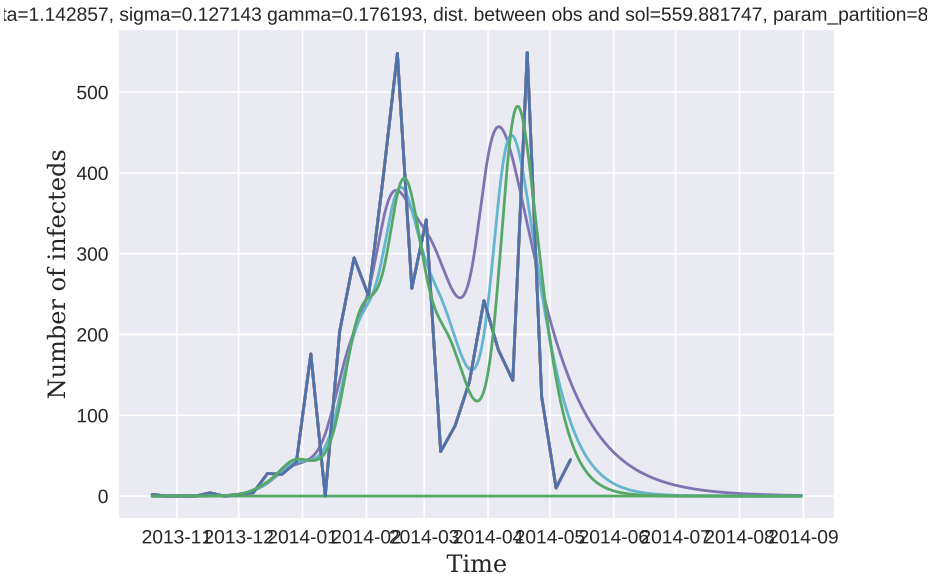
100
200
300
400
500
2013-11
2013-12
2014-01
2014-02
2014-03
2014-04
2014-05
2014-06
2014-07
2014-08
2014-09
Time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Number of infecteds
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100
200
300
400
500
2013-11
2013-12
2014-01
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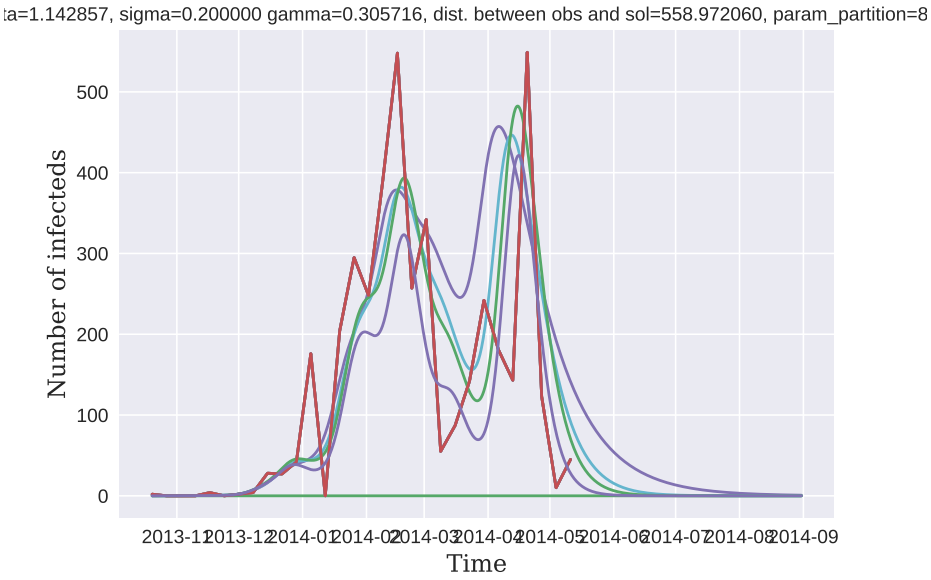
2014-05
2014-06
2014-07
2014-08
2014-09
Time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Number of infecteds
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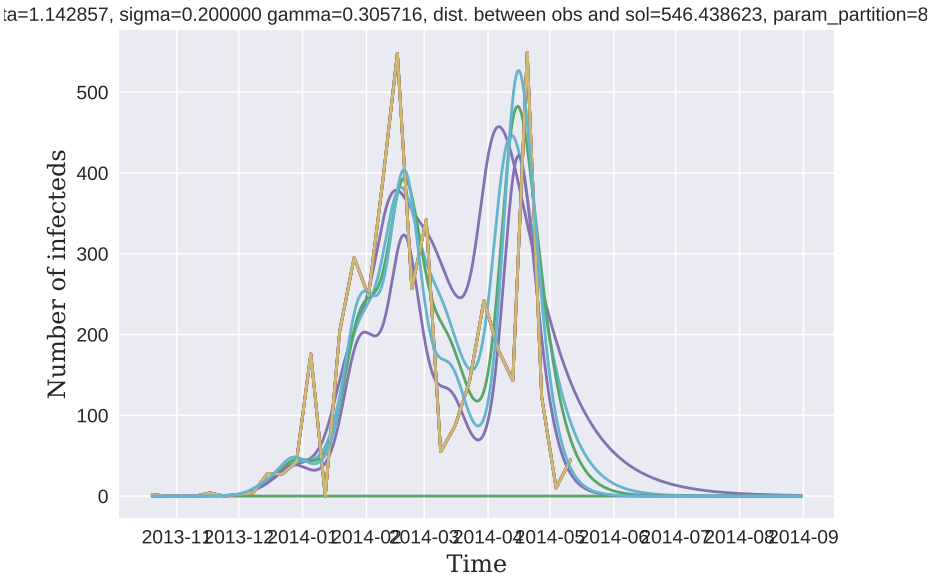
100
200
300
400
500
2013-11
2013-12
2014-01
2014-02
2014-03
2014-04
2014-05
2014-06
2014-07
2014-08
2014-09
Time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100
200
300
400
500
2013-11
2013-12
2014-01
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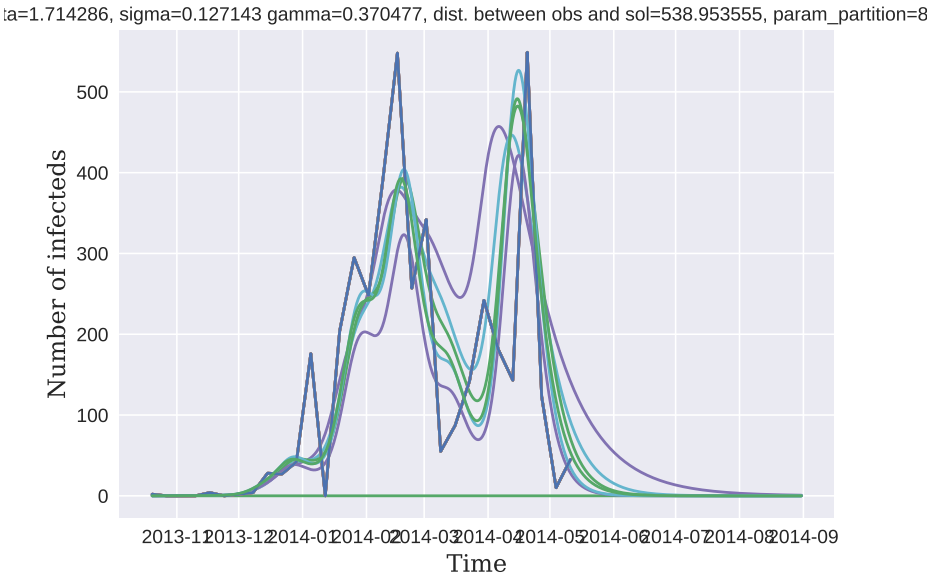
2014-05
2014-06
2014-07
2014-08
2014-09
Time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Number of infecteds
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100
200
300
400
500
2013-11
2013-12
2014-01
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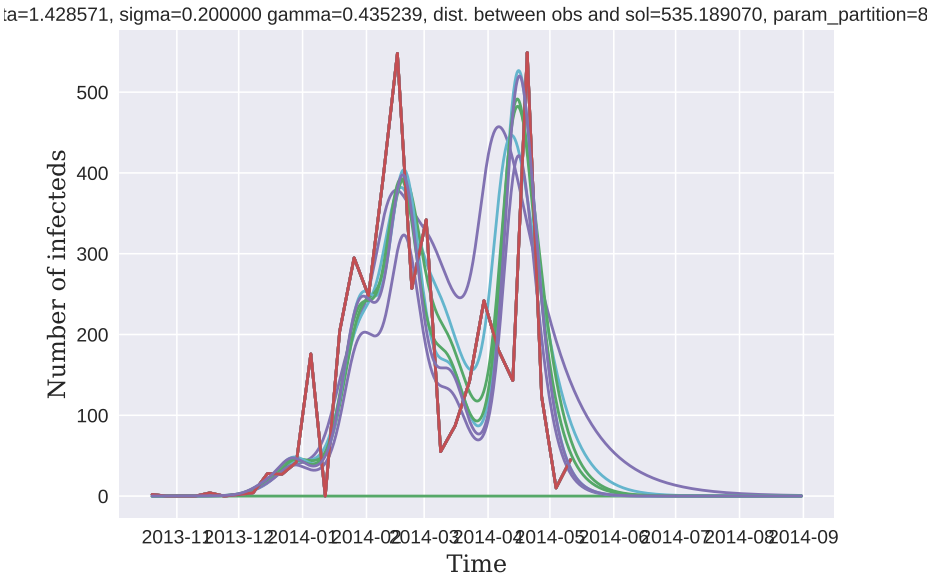
2014-05
2014-06
2014-07
2014-08
2014-09
Time


ta=1.428571, sigma=0.200000 gamma=0.435239, dist. between obs and sol=535.189070, param_partition=8
Number of infecteds
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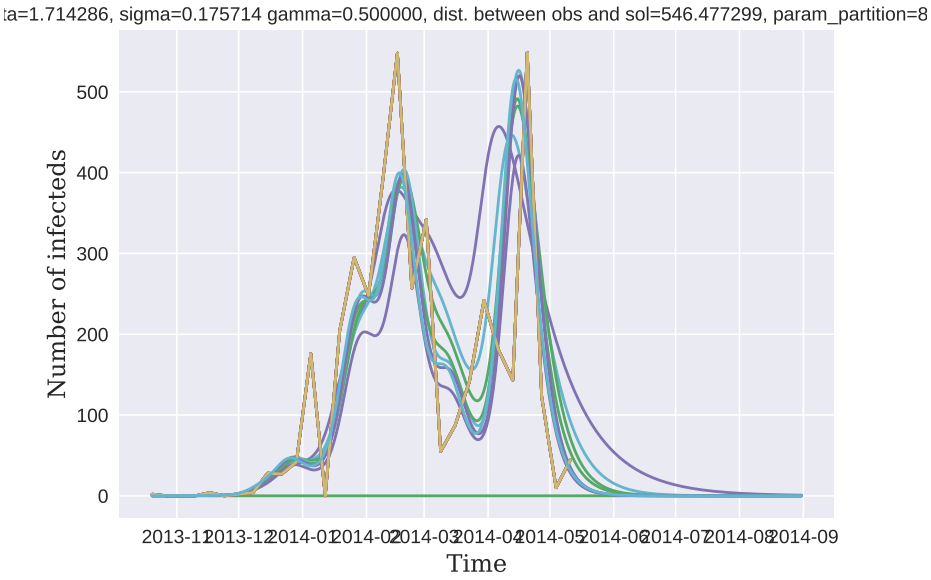
100
200
300
400
500
2013-11
2013-12
2014-01
2014-02
2014-03
2014-04
2014-05
2014-06
2014-07
2014-08
2014-09
Time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Number of infecteds
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100
200
300
400
500
2013-11
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2014-01
2014-02
2014-03
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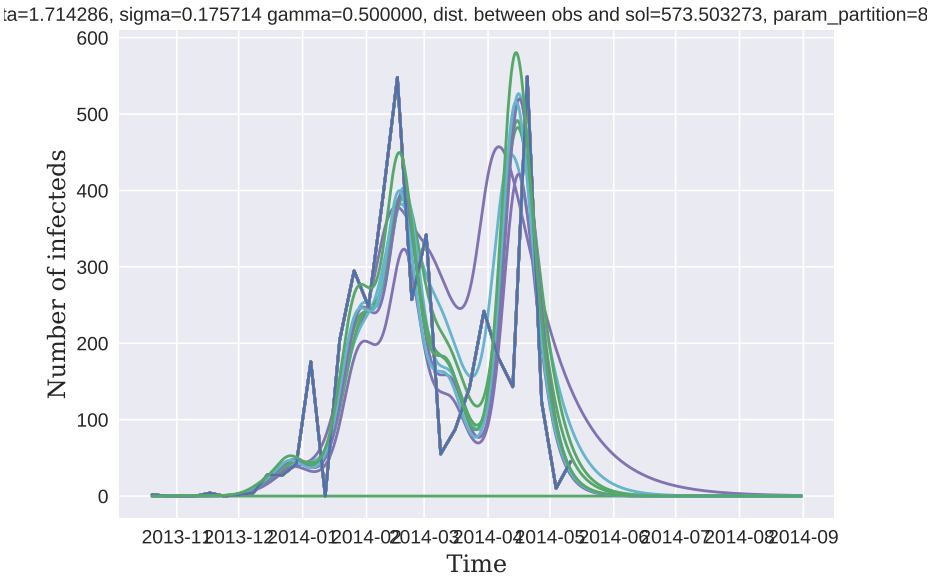
2014-05
2014-06
2014-07
2014-08
2014-09
Time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Number of infecteds
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100
200
300
400
500
600
2013-11
2013-12
2014-01
2014-02
2014-03
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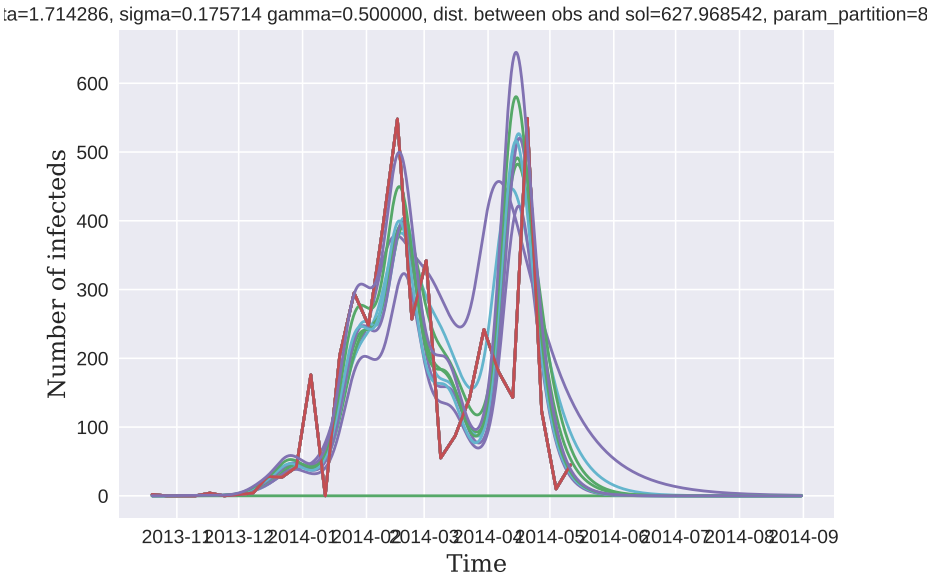
2014-05
2014-06
2014-07
2014-08
2014-09
Time



The Re-scaling fcator that produced a better fit on the previous optimization on the constrained parametric space previously described is $C = 0.7$ along with the parameter estimates $(\hat{\beta}, \hat{\sigma}, \hat{\gamma}) = (1.42, 0.2, 0.44)$. The total sum square error decreases from 638.1 of the last fitted model exposed in teh GM of 11.10.2017 (with scale factor $C = 1$) to 535.1 (with a rescaling of $C = .7$)