Thesis Progress Meeting

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Achieved Work (by projects)

- Cybergeo [1.6w] (ETA 1.5w)
- Gibrat-interaction [1.7w] (ETA 1.5w)
- Spatial Statistics [0.5w]
- Misc (AlgoSR, Scaling, MetaZipf, Lutecia, Chine, SFI prep.) [0.5w]
- Organisation/conference/biblio [0.7w]
- Side projects (Transportation, Ecotoxicology) [0.5w] (ETA 0.5w)

Model Description

$\rightarrow$ Rationale : extend an interaction model for system of cities by including physical network, to investigate its influence on system dynamics

$\rightarrow$ Work under Gibrat independence assumptions, i.e. $\mathrm{Cov}[P_i(t), P_j(t)] = 0$. If $\vec{P}(t+1) = \mathbf{R}\cdot\vec{P}(t)$ where $\mathbf{R}$ is also independent, then $\mathbb{E}\left[\vec{P}(t+1)\right] = \mathbf{R}\cdot\mathbb{E}\left[\vec{P}\right](t)$. Expectancies only for now (higher moments computable similarly)

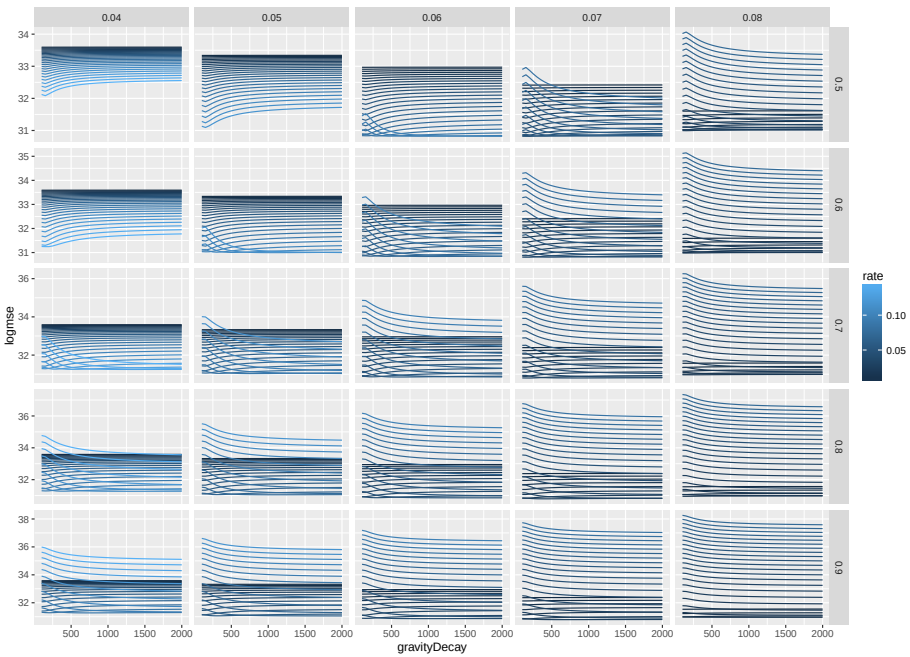
$\rightarrow$ With $\vec{\mu}(t) = \mathbb{E}\left[\vec{P}(t)\right]$, we generalize this approach by taking $\vec{\mu}(t+1) = f(\vec{\mu}(t))$

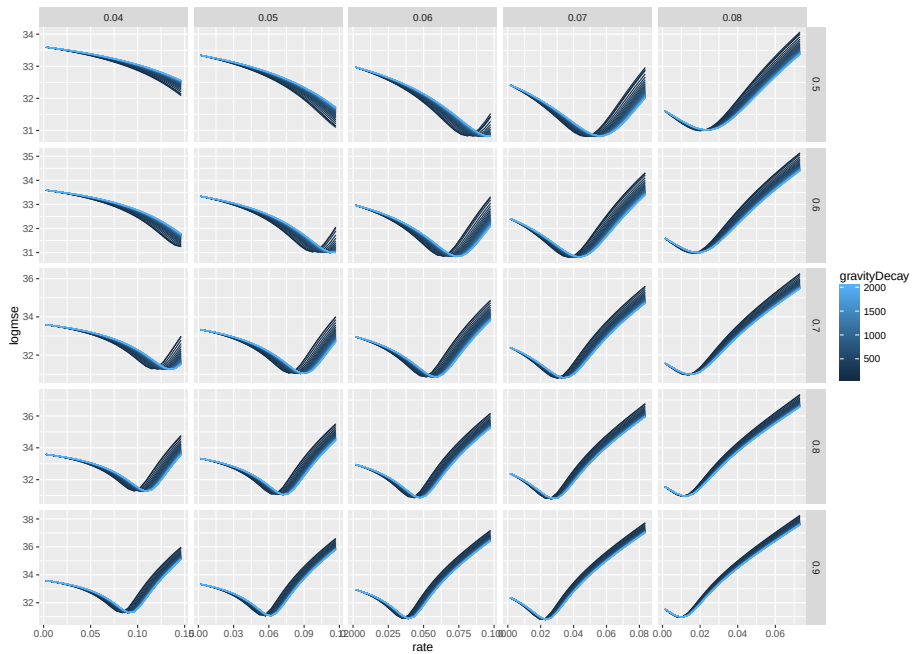
$\rightarrow$ In our case, $f(\vec{\mu}) = r_0 \cdot \mathbf{Id}\cdot\vec{\mu} + \mathbf{G}\cdot\mathbf{1} + \mathbf{N}\cdot$ with

- $G_{ij} = w_G \cdot \frac{V_{ij}}{<V_{ij}>}$ and $V_{ij} = \left(\frac{\mu_i\mu_j}{\sum {\mu_k}^2}\right)^{\gamma_G} \exp\left(-d_{ij}/d_G\right)$
- $N_i = w_N \cdot \sum_{kl}\left(\frac{\mu_k\mu_l}{\sum\mu}\right)^{\gamma_N} \exp\left(-d_{kl,i}\right)/d_N$ where $d_{kl,i}$ is distance to shortest path between k, l computed with slope impedance ($Z = (1+\alpha/\alpha_0)^{n_0}$ with $\alpha_0 \simeq 3$)

Exploration : Gravity Only

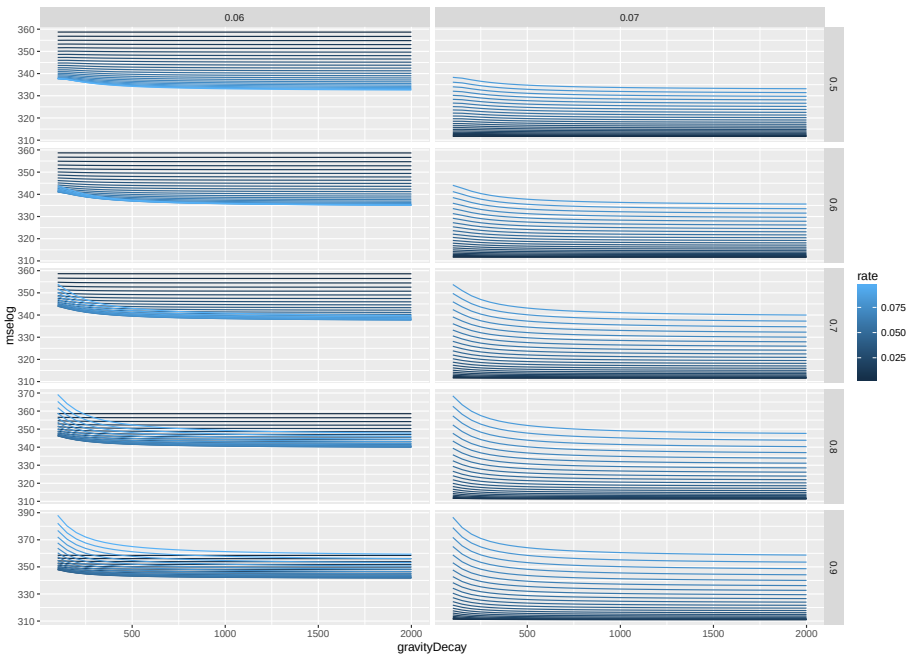
logmse : log of mean square error on populations

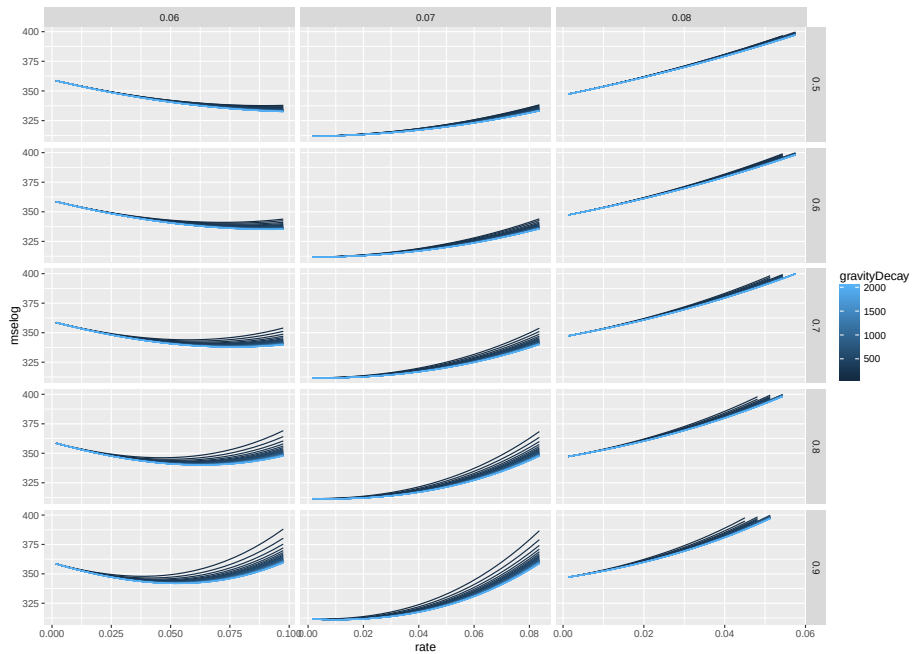




Exploration : Gravity Only

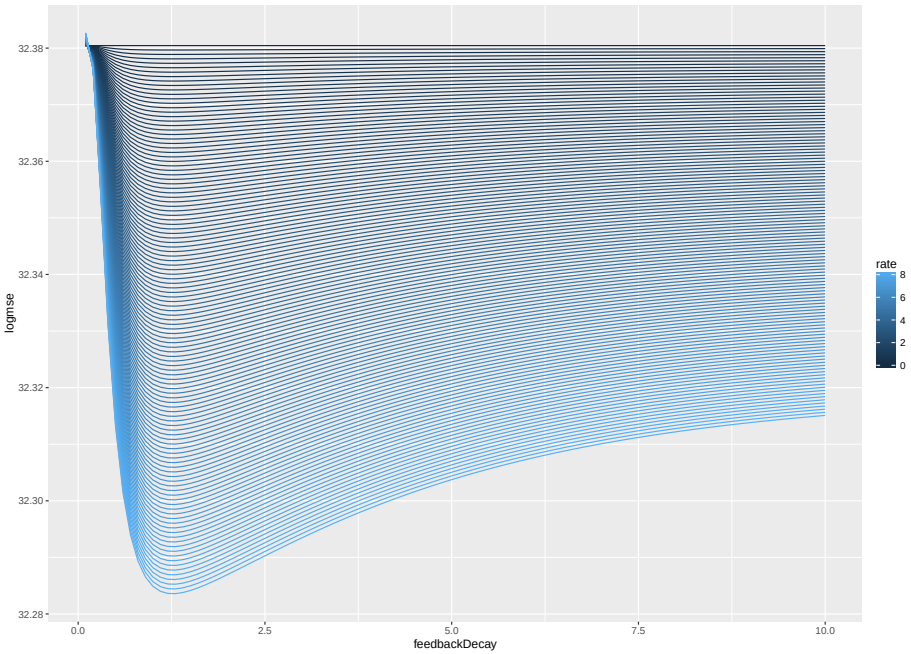
mselog : mean square error on log of populations

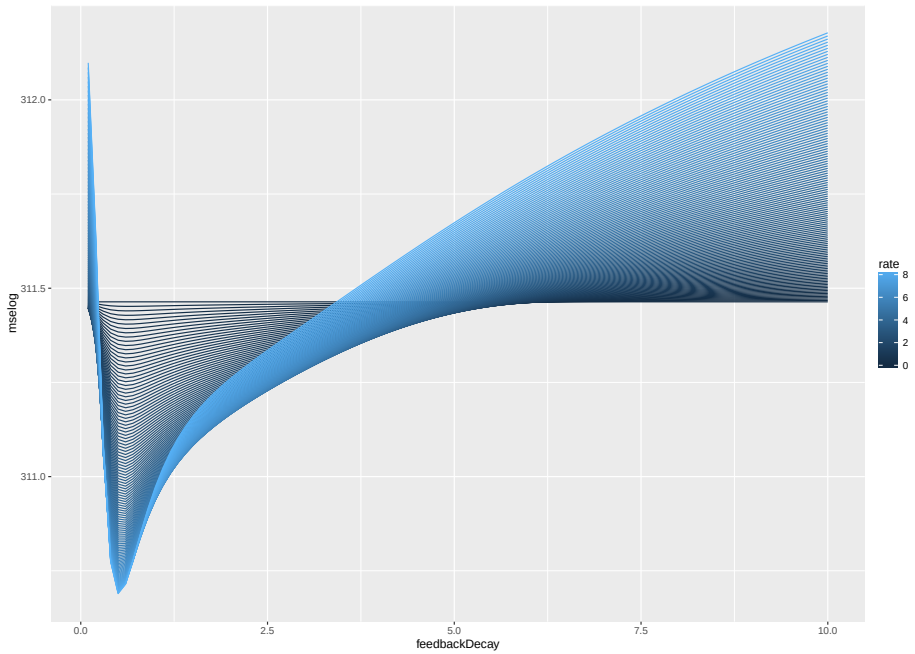




Exploration

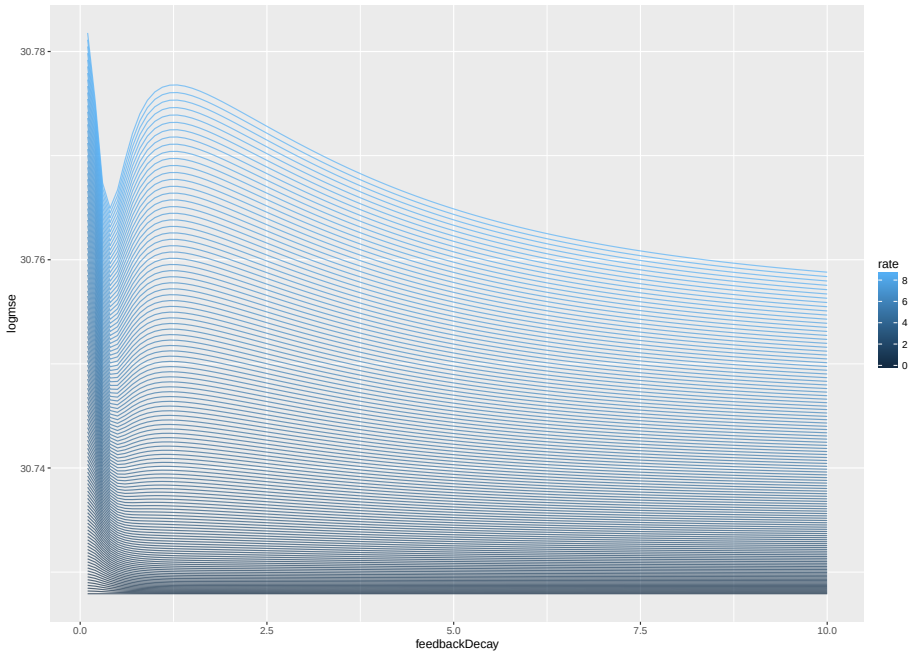
Feedback Only

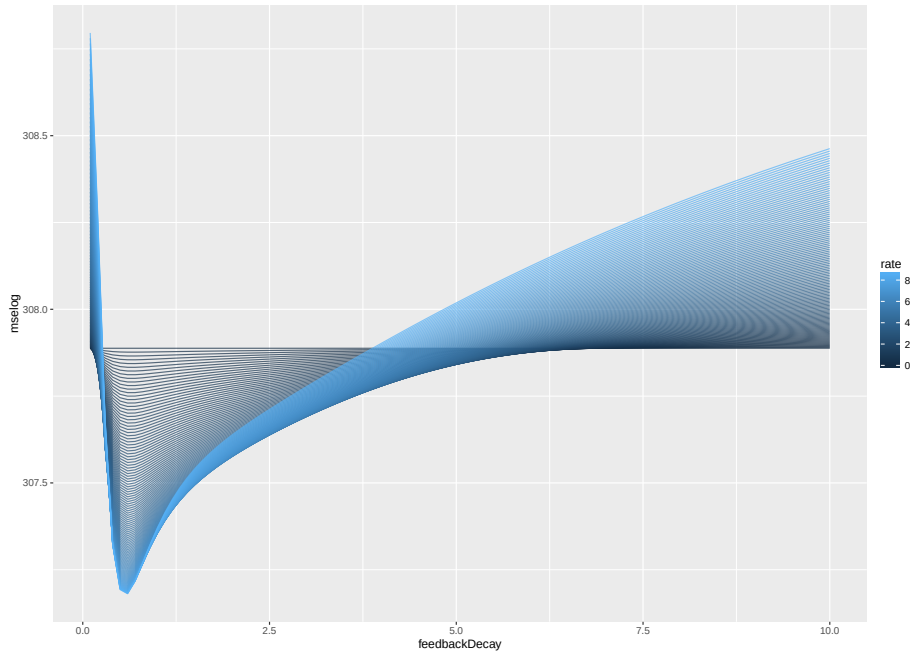




Exploration

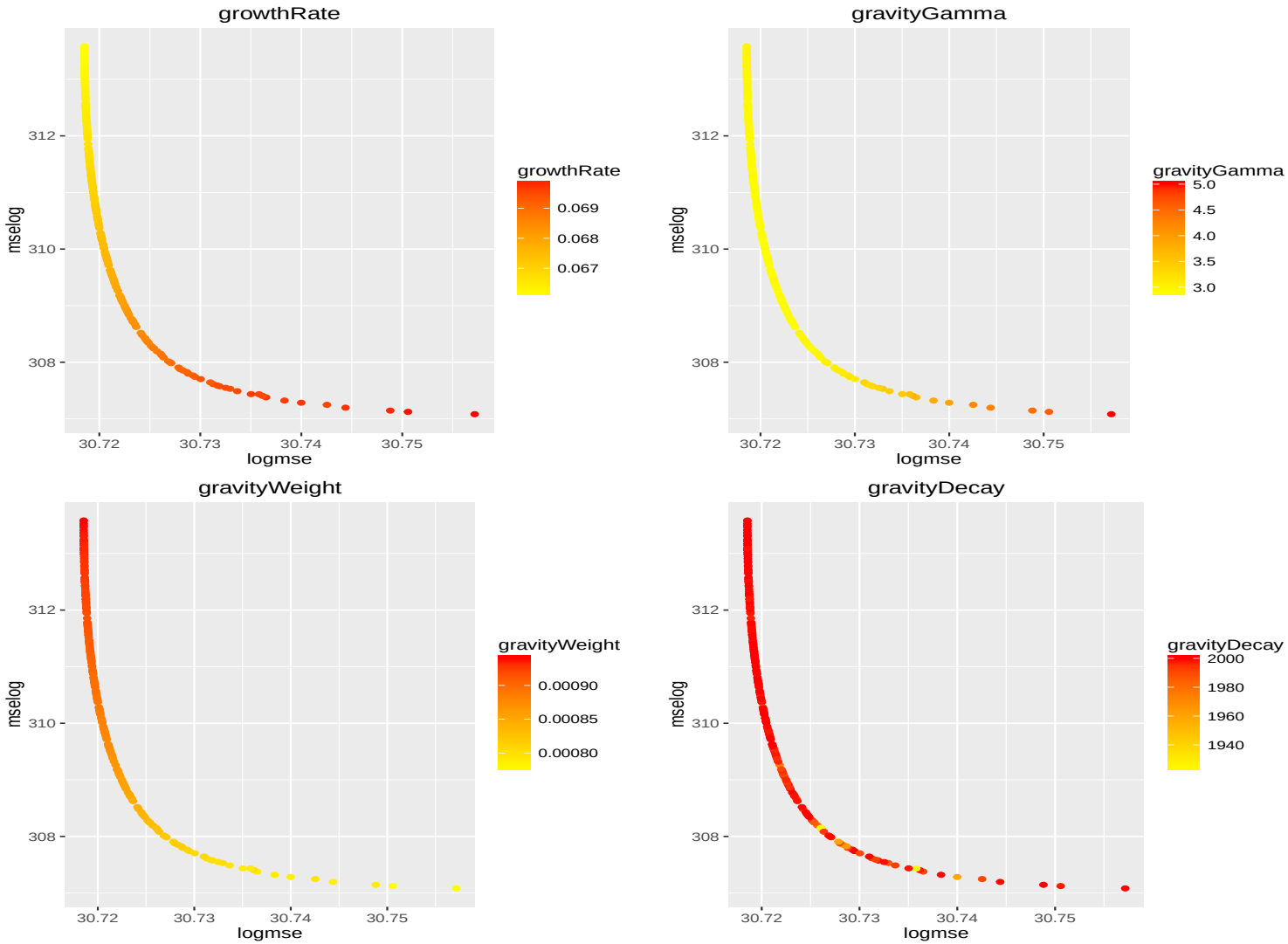
Feedback with fixed gravity : first evidences of network effects ; confirmed with effect of α_0





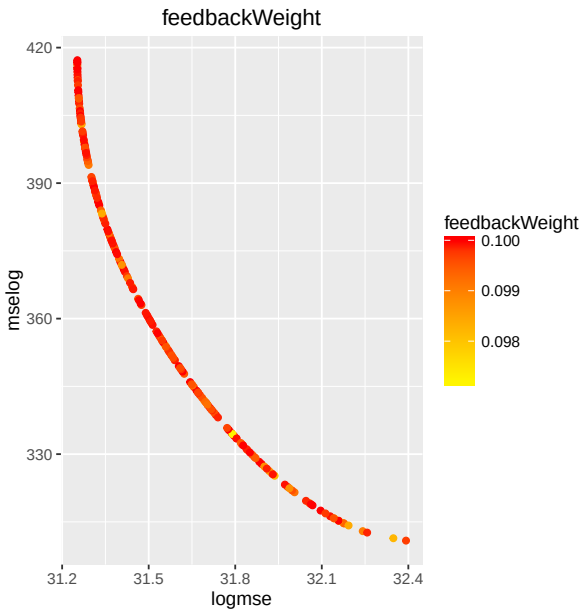
Calibration

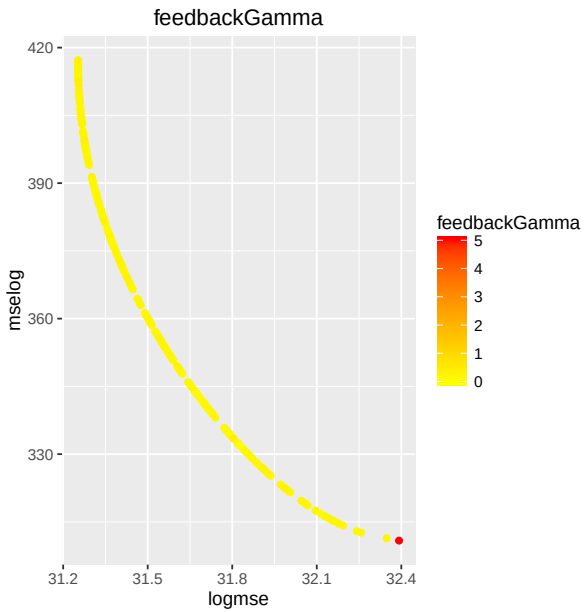
Gravity only

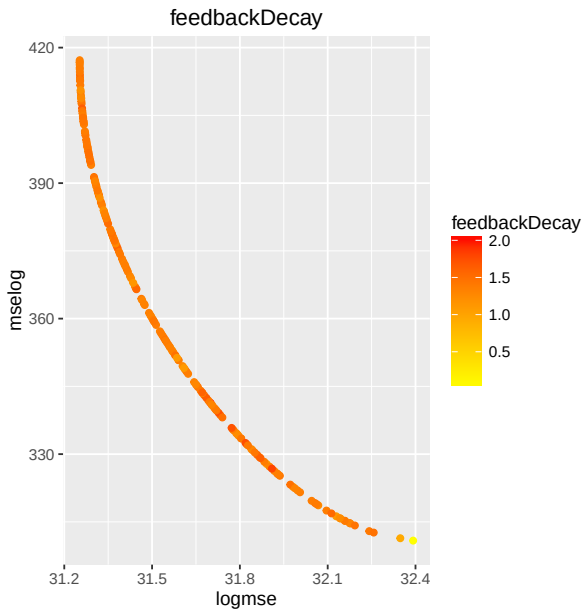


Calibration

Feedback only

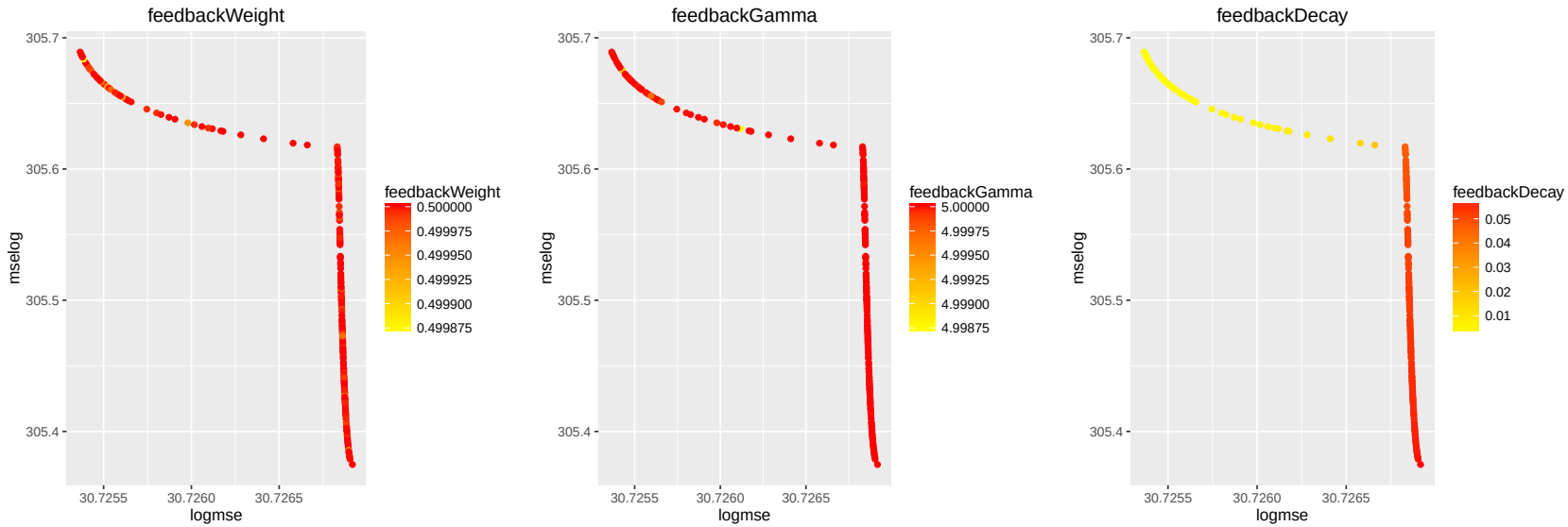






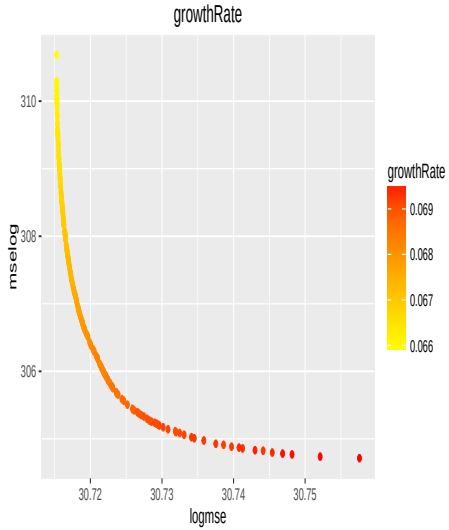
Calibration

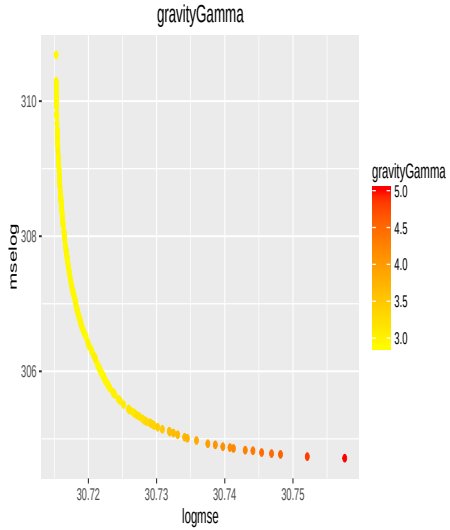
Full Model, Iterative Calibration

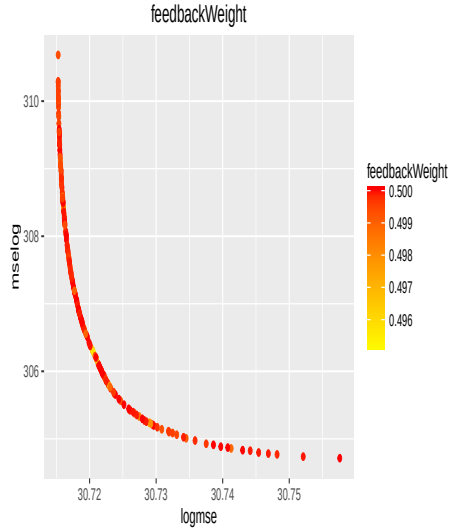


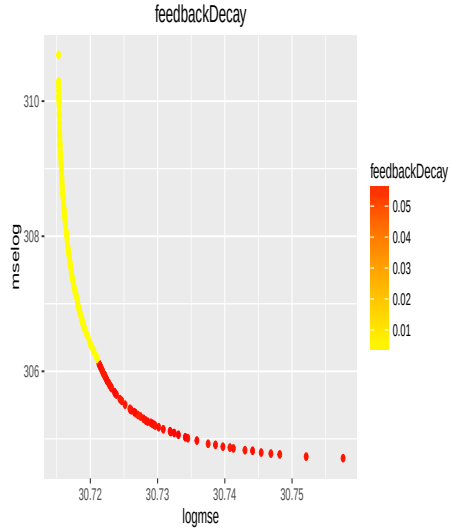
Calibration

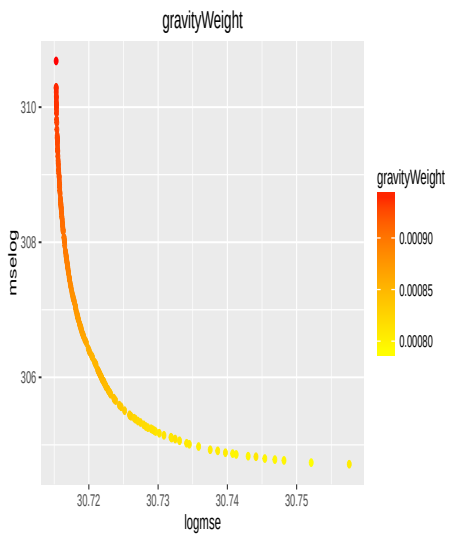
Full Model

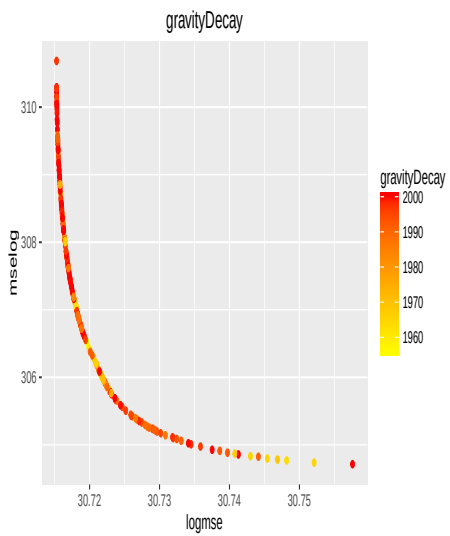


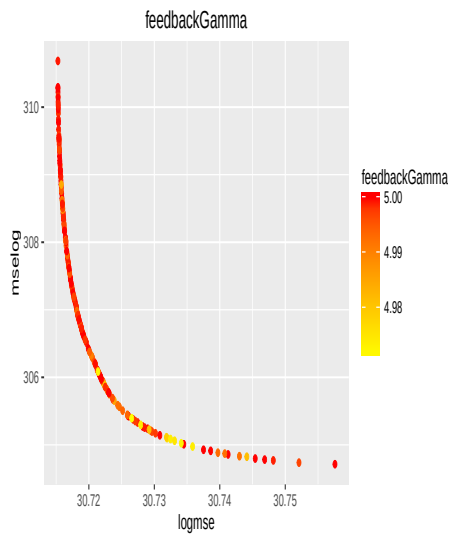






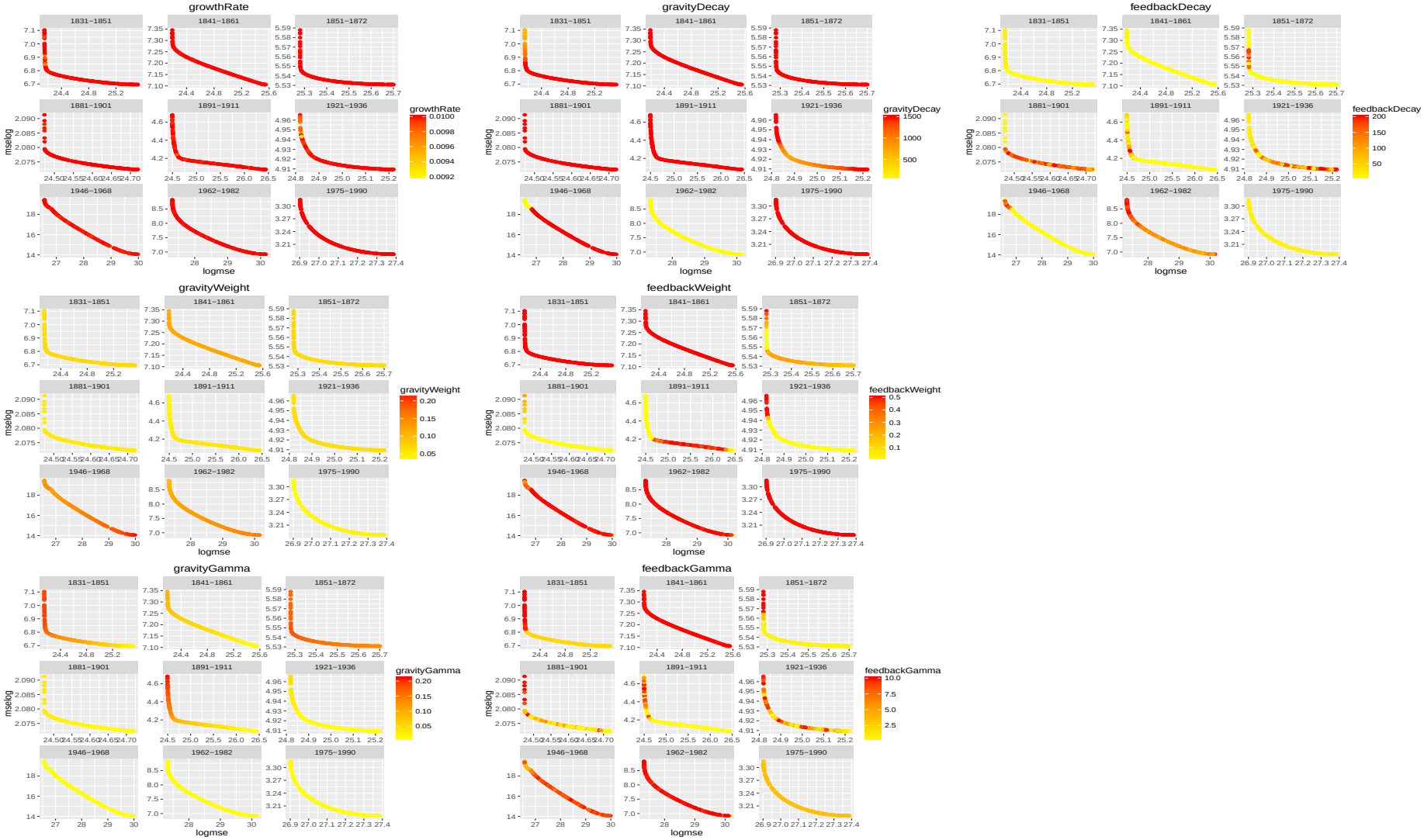






Temporal moving window

Calibration by normalized periods (no wars, same number of data points)

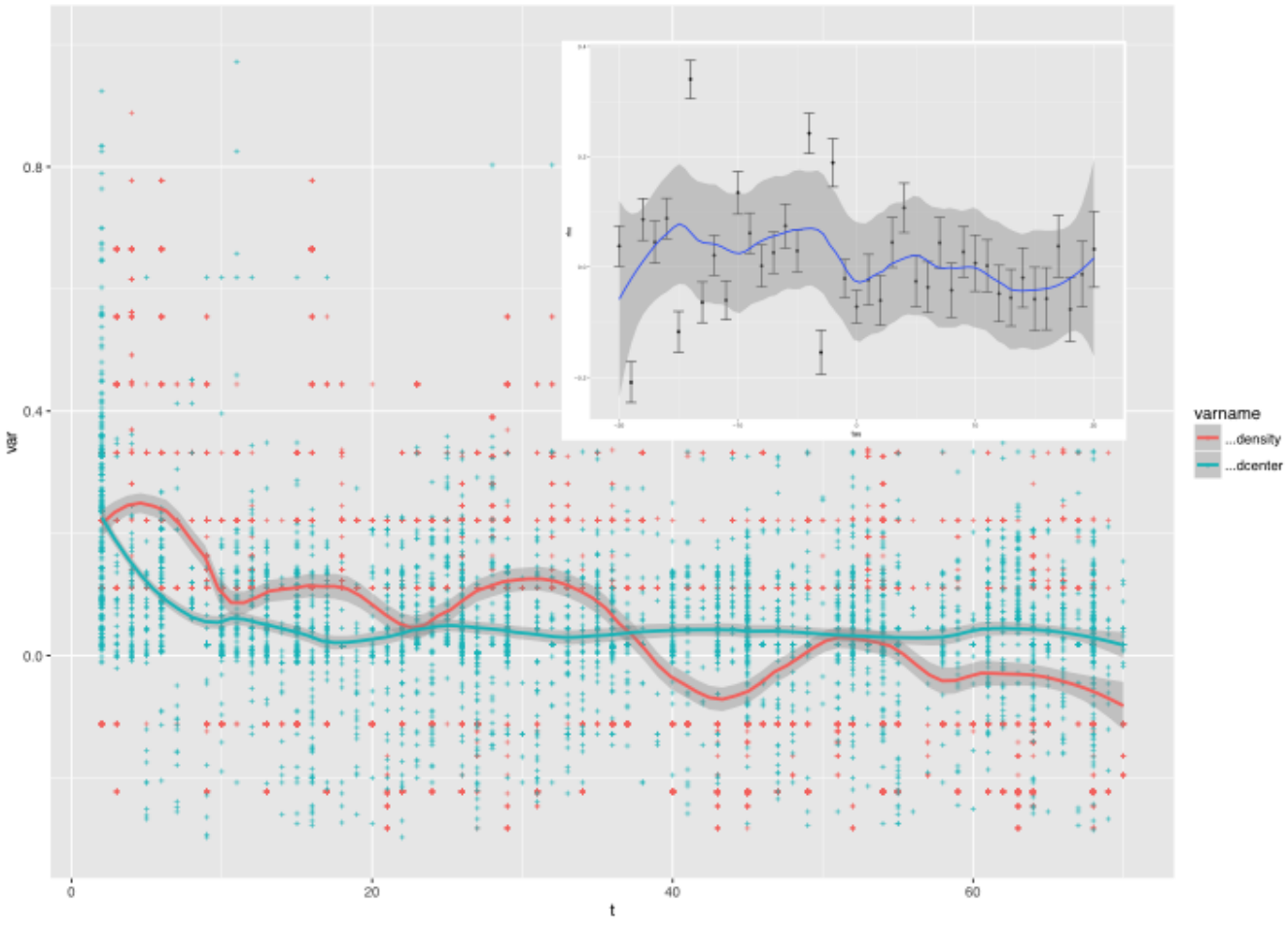


Next steps

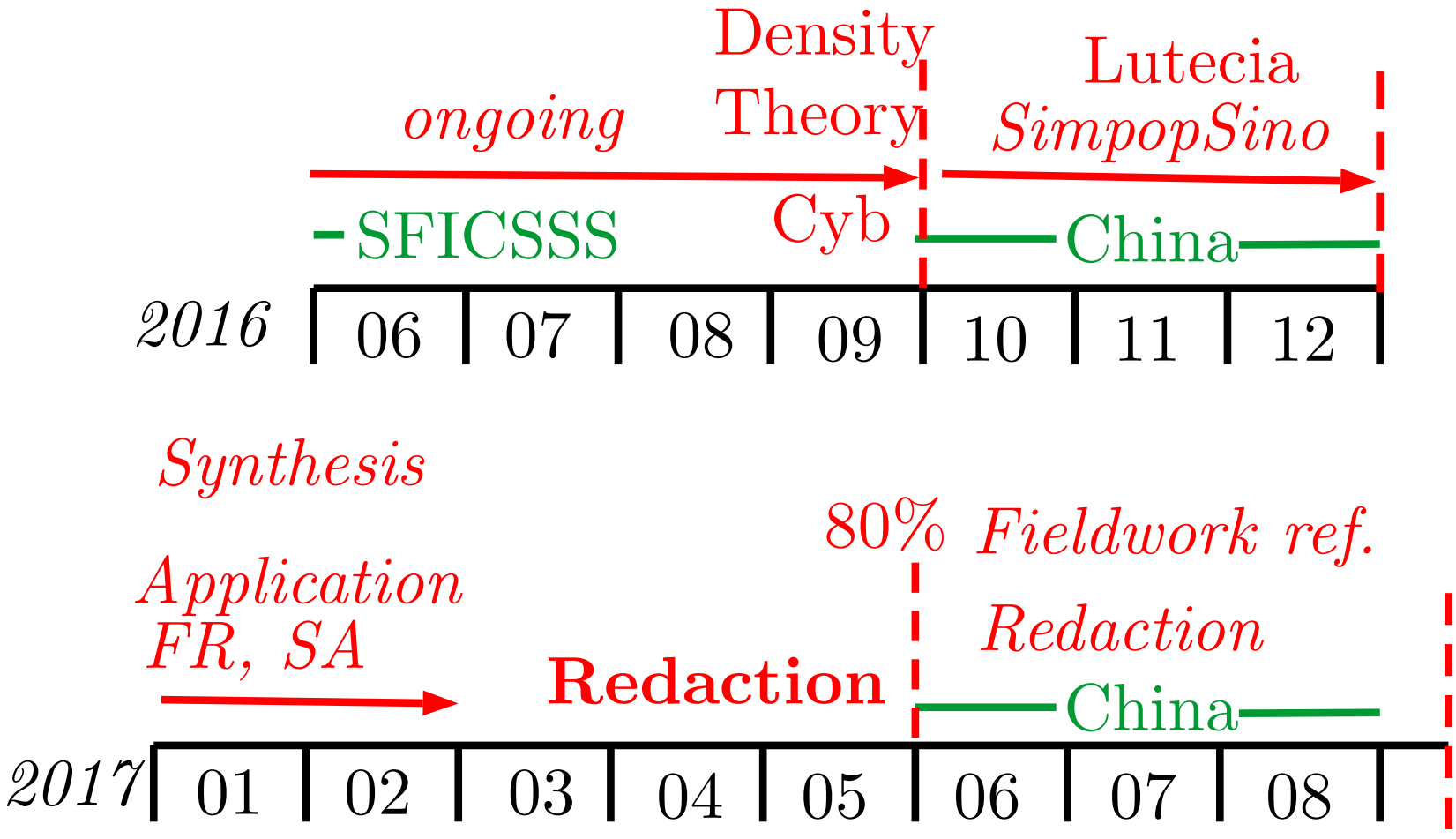
- Compute empirical AIC to check if improvement is worth additional parameters. Various approaches :
  - Via empirical likelihood
  - Via non-linear sparse regression
  - Via behavior space and statistical multimodeling
- Calibration profiles (still running)
- Link with models with covariance : propose a general framework (extending the Simon-Gibrat work)

Spatial Statistics

First work on Granger causality for spatial statistics : synthetic data by RBD model



Thesis Organisation



Next steps (until August 30th 2016)

- SFICSSS [4w] (+ holidays [2w])
- Cybergeo Paper [1w]
- Density Paper [1w]
- Theoretical Paper [1w]
- Static Correlations (presentation at RGS conference on 31th) [1w]
- China project [1w]