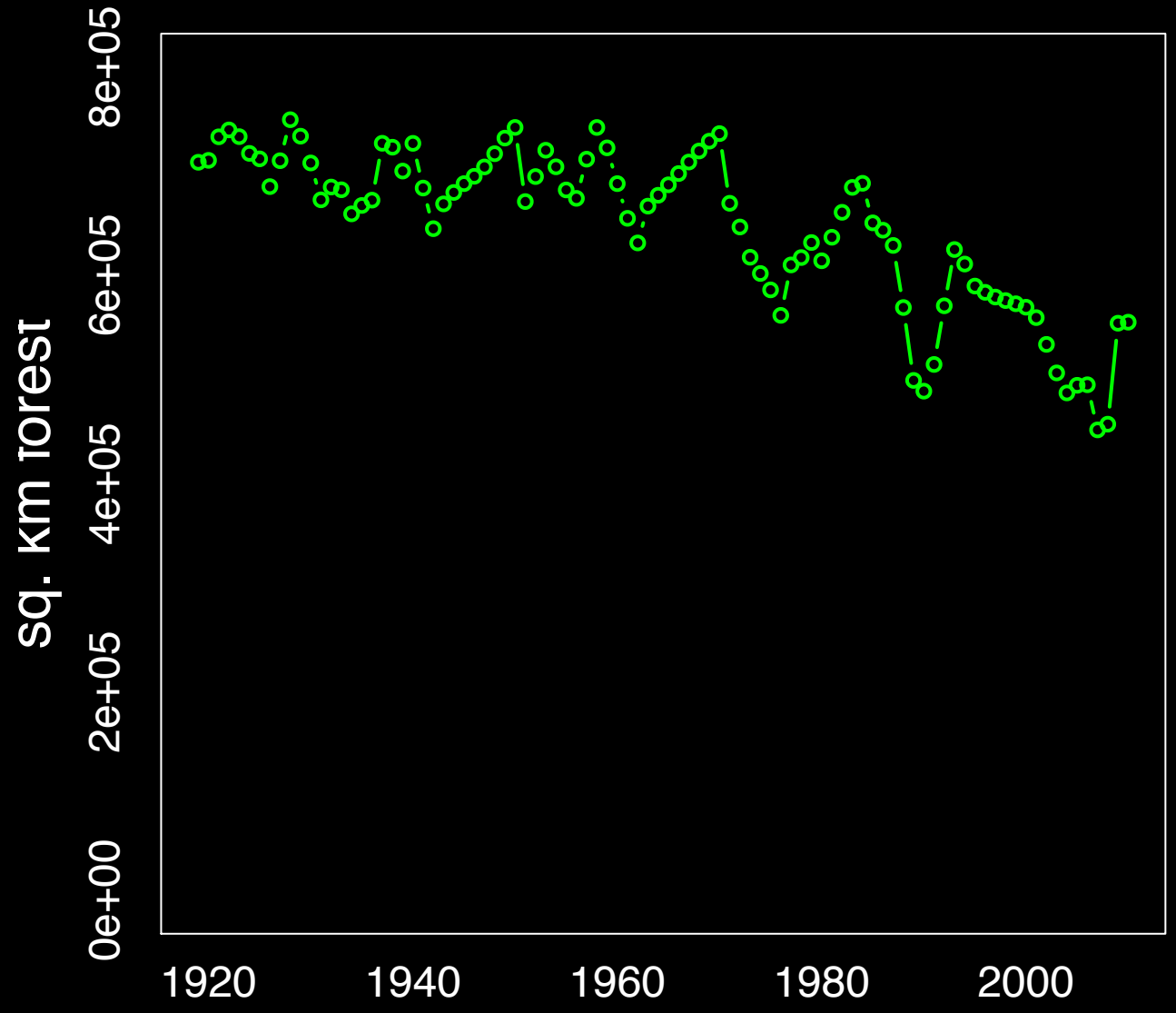
# Model Fitting: The Basic Concept

Cara Brook

$E^2M^2$, Centre ValBio

Ranomafana National Park, Madagascar

# What happened to Madagascar's forest?



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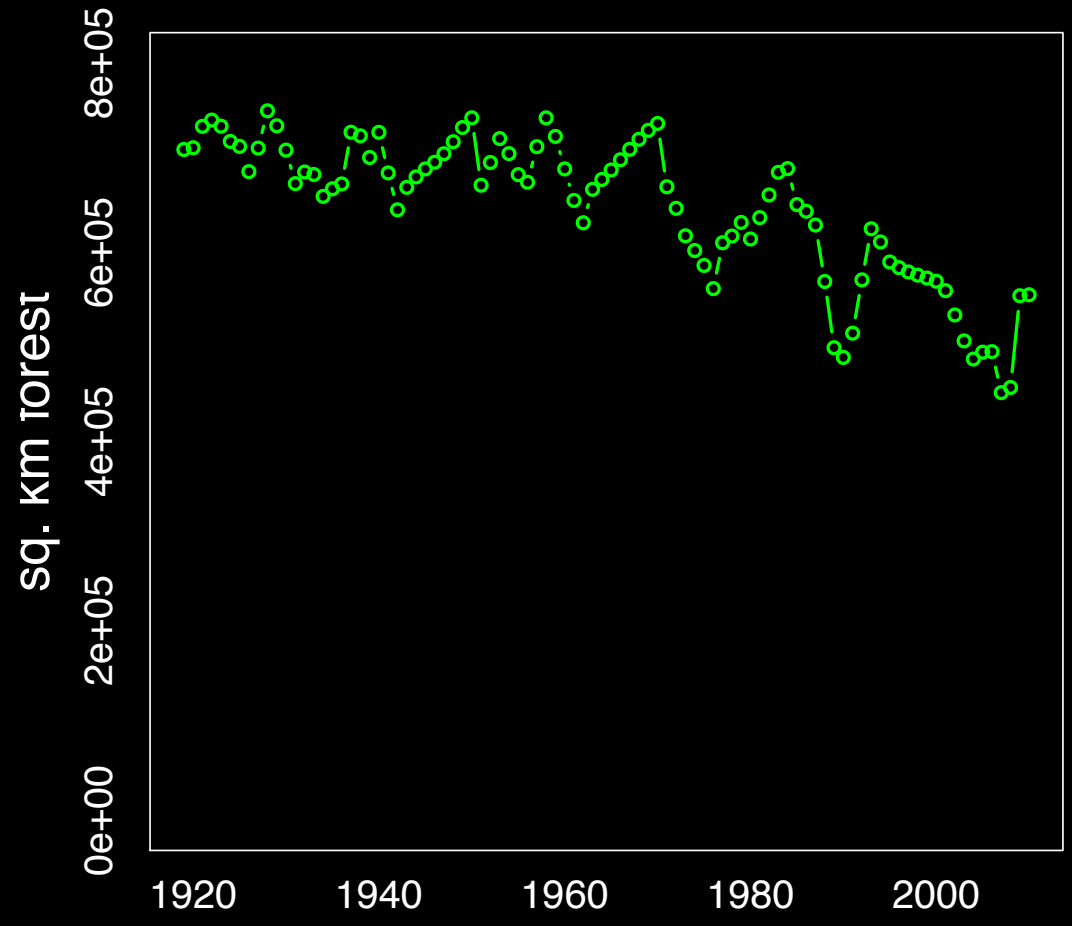


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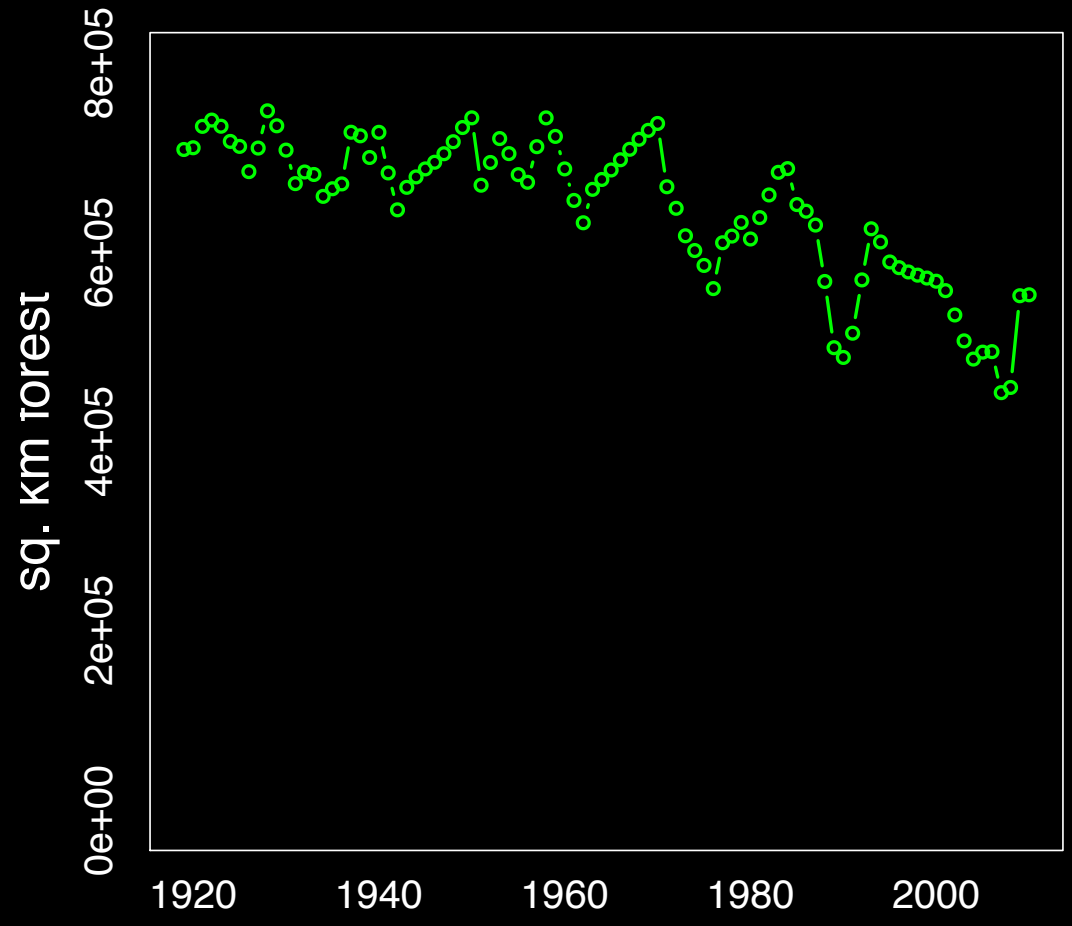


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*Can fit a linear regression.*

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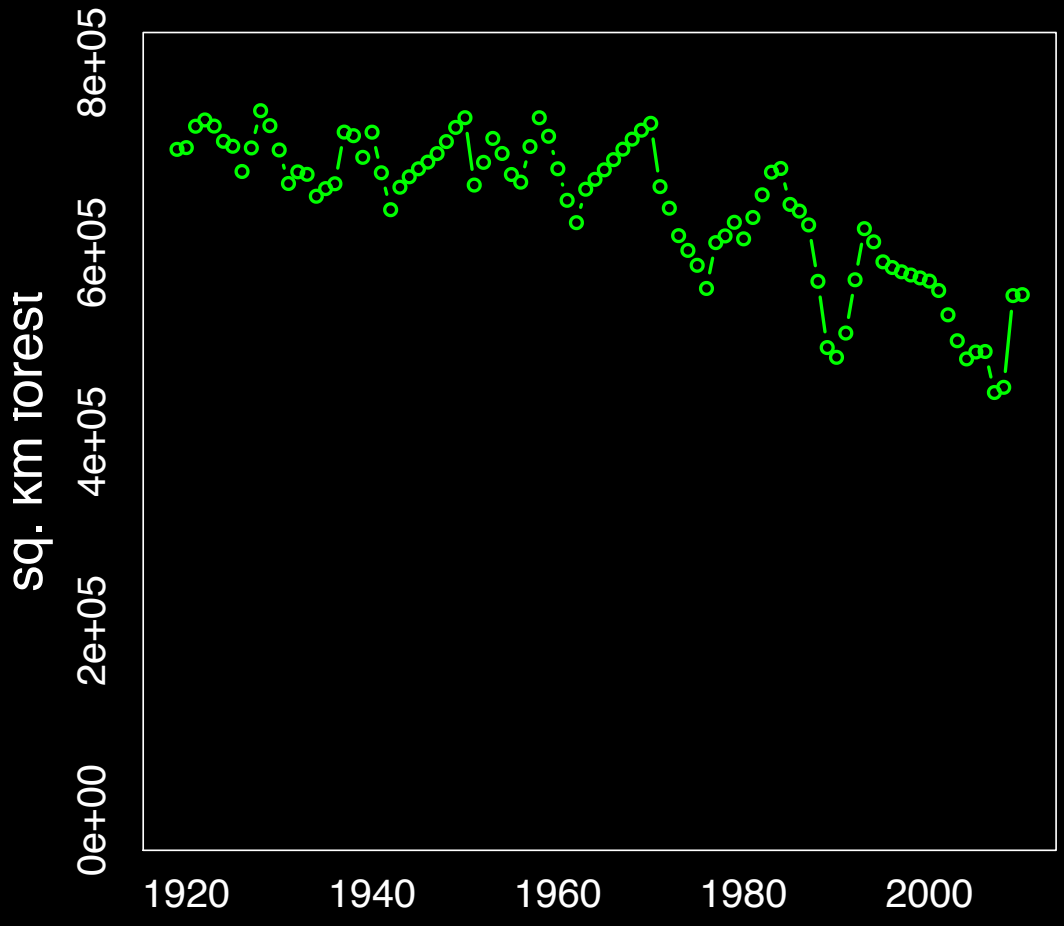


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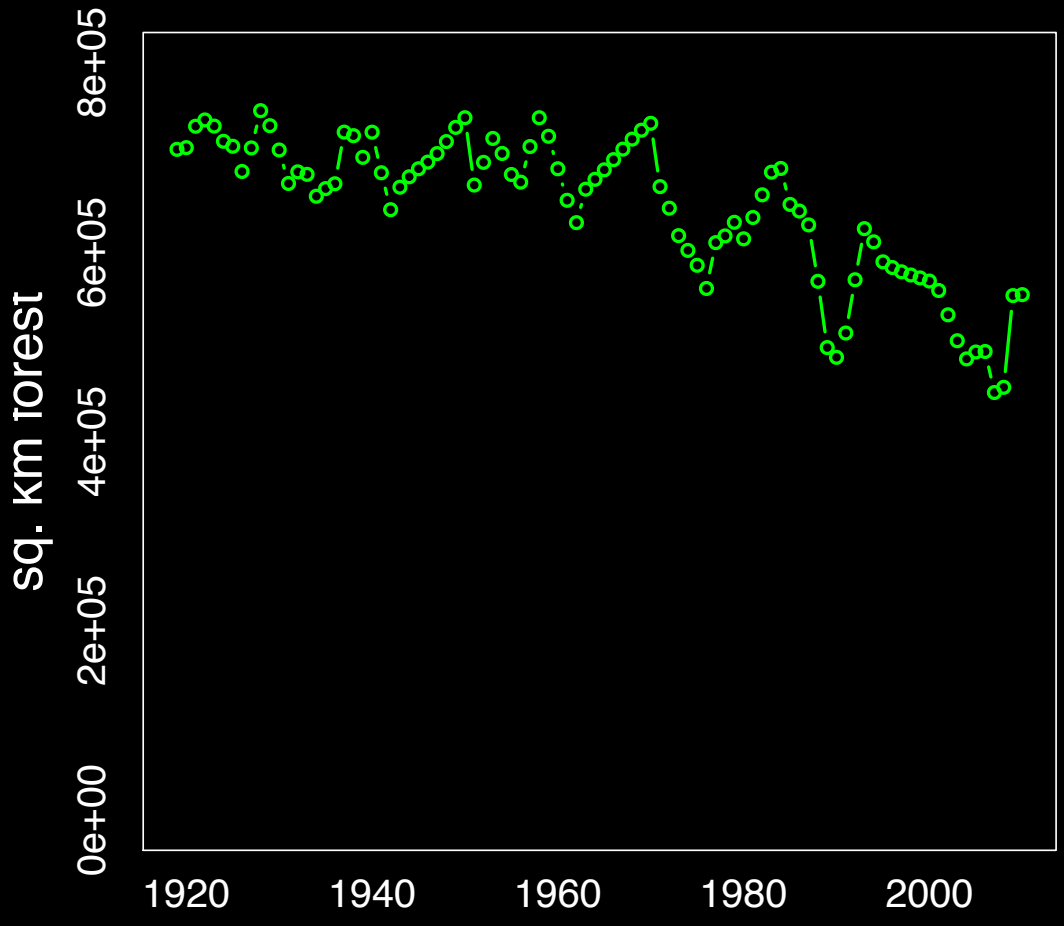


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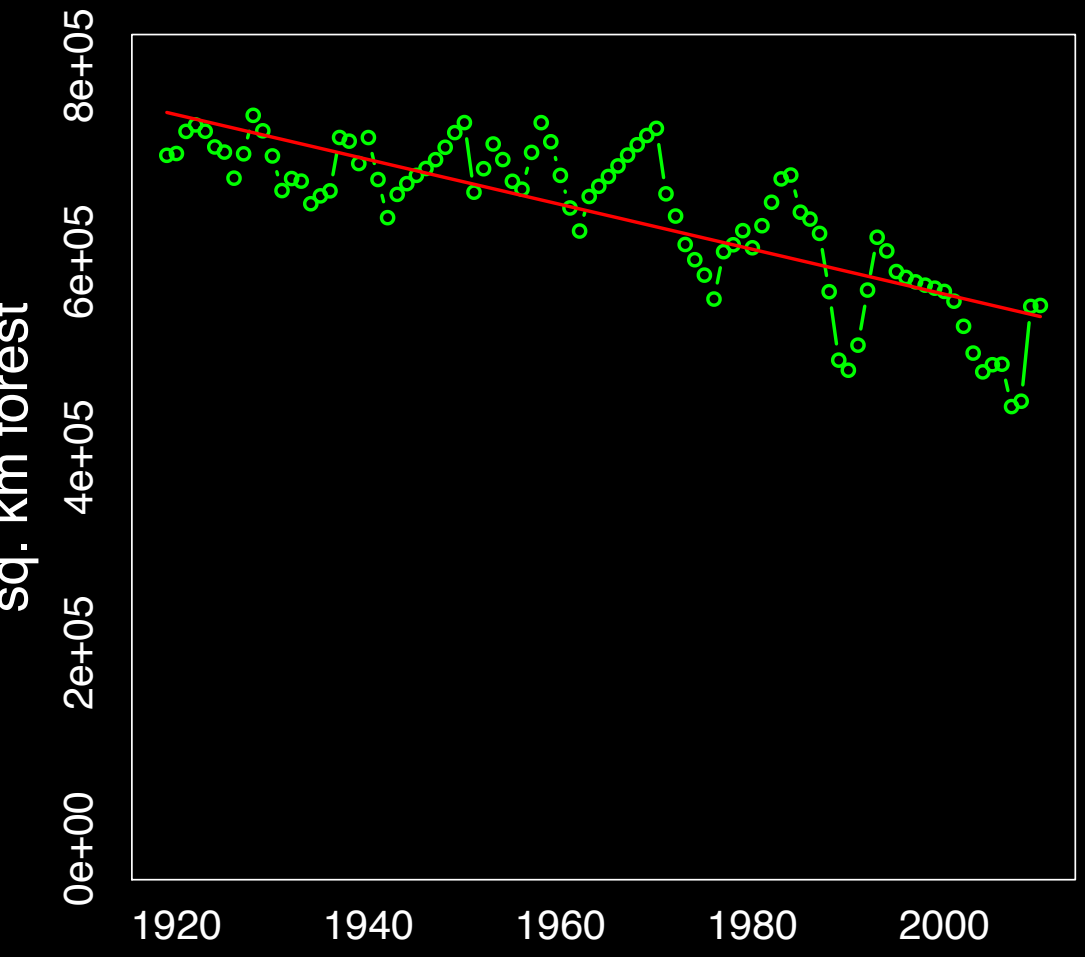


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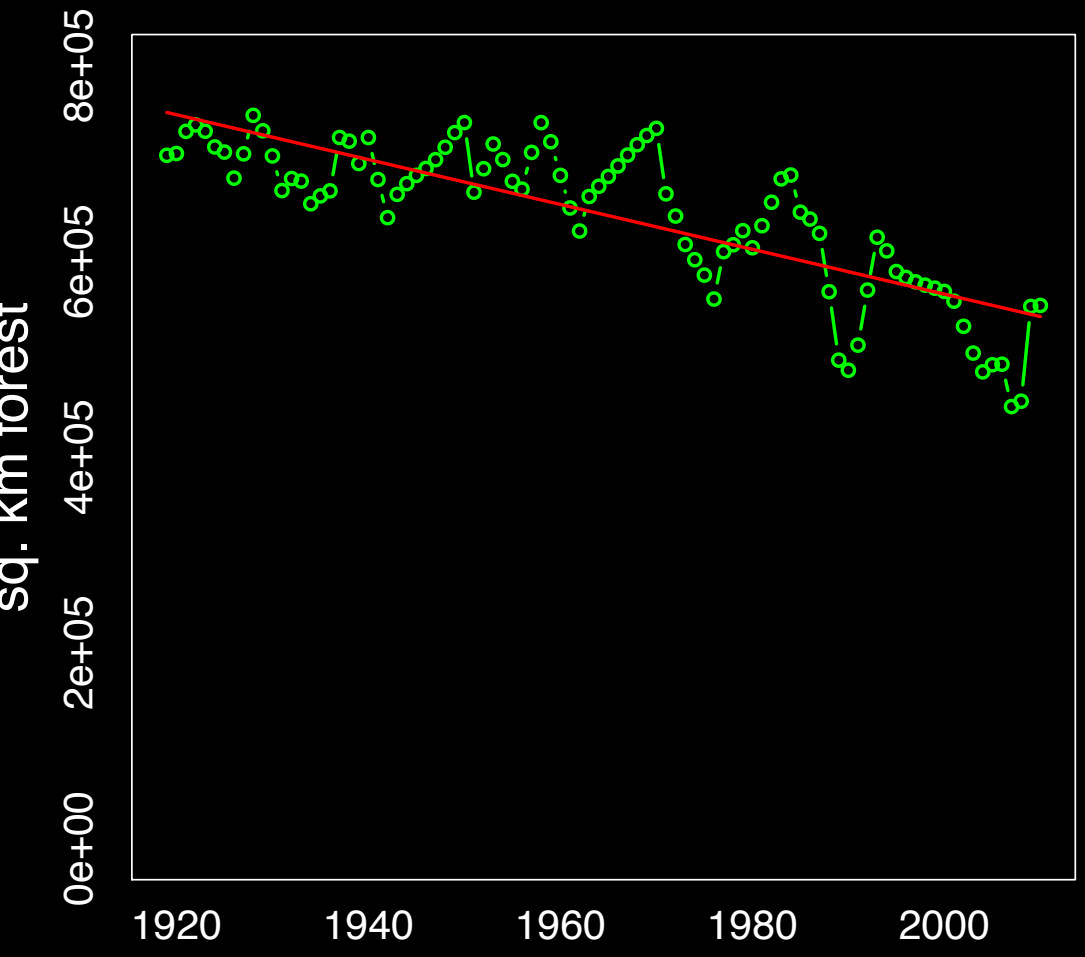


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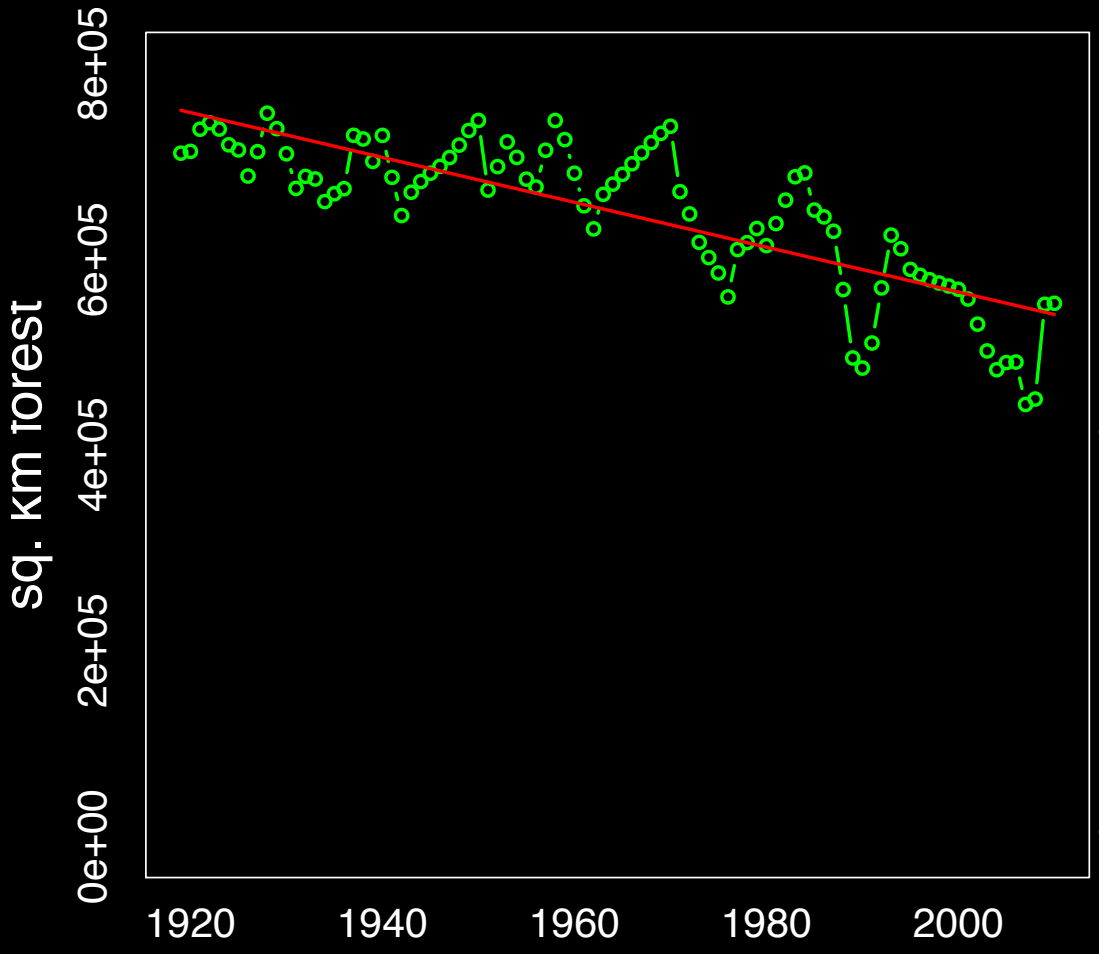


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- *This tells us that the time trend in forest cover is negative (declining) and that there was ~5*10^6 sq. km of forest in 1920.*
- *But we know nothing about causation.*

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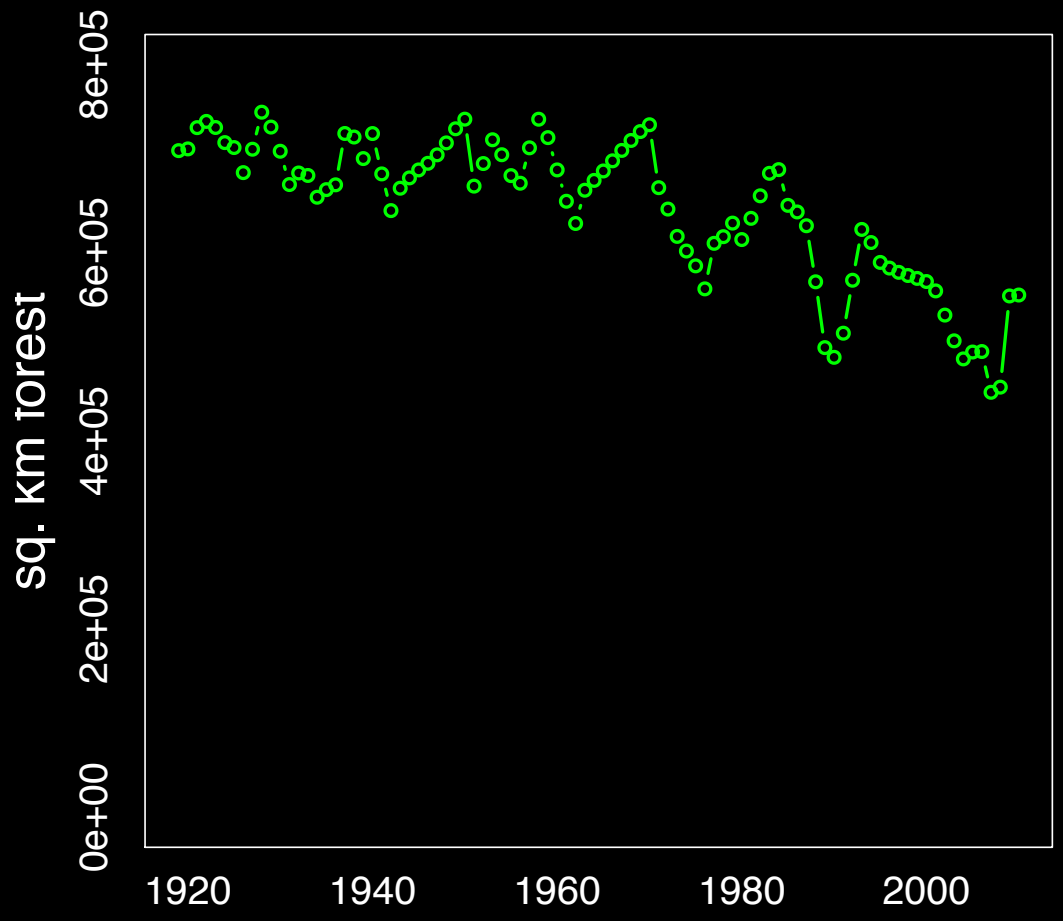
- *What state variables are captured in our data?*

# These data give us forest over time…



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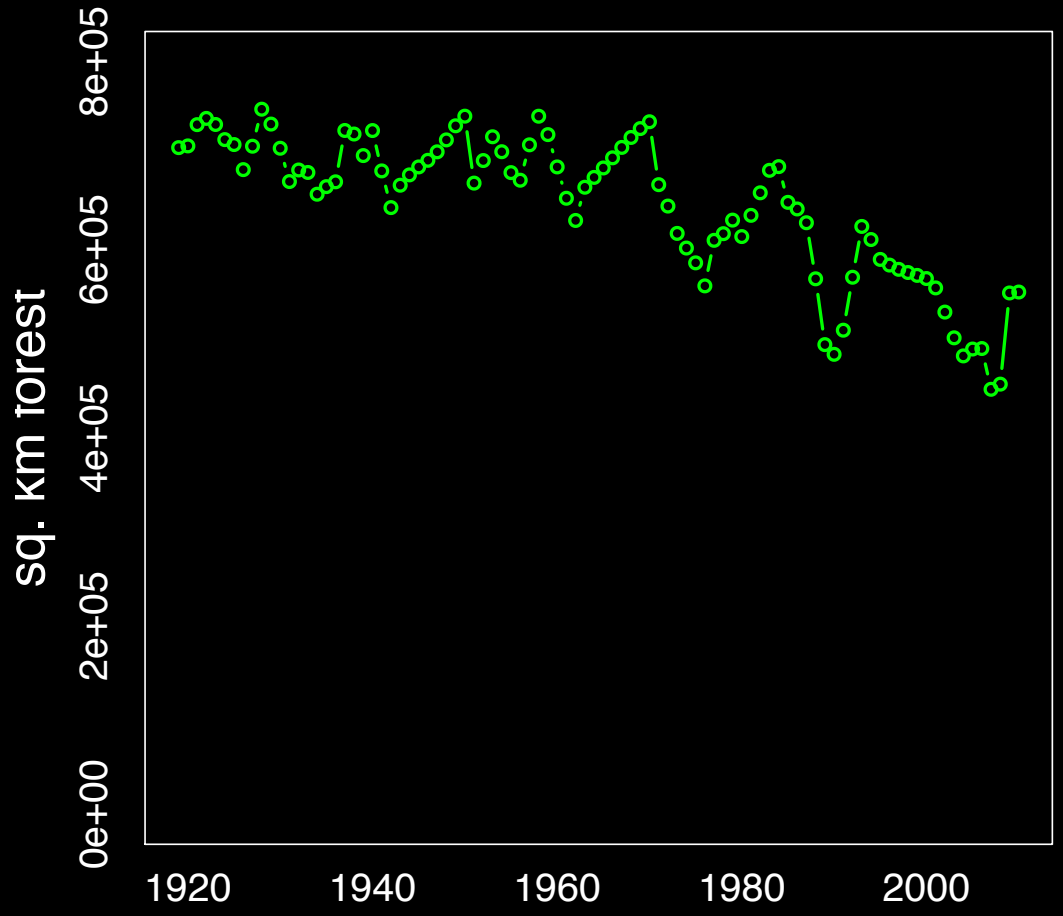
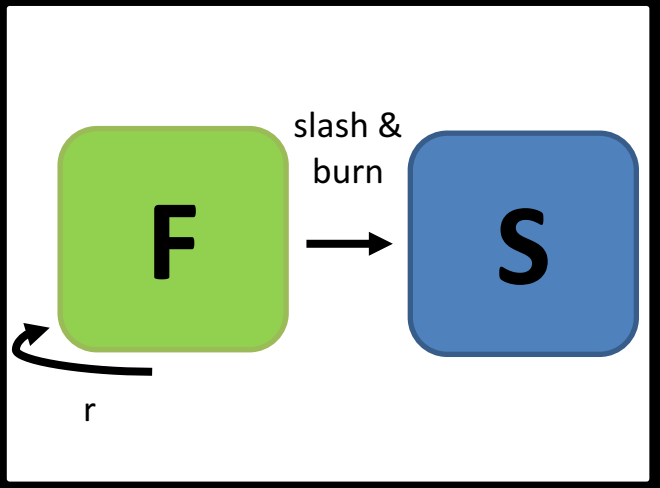



What *processes* contribute to the "forest" state in our system?



# How to fit a model to data

1. Build a model that uses explicit processes to recover the same states as the data.

   Ft+1 = Ft - slash*Ft*St

   Can be discrete or continuous . Let's try it!

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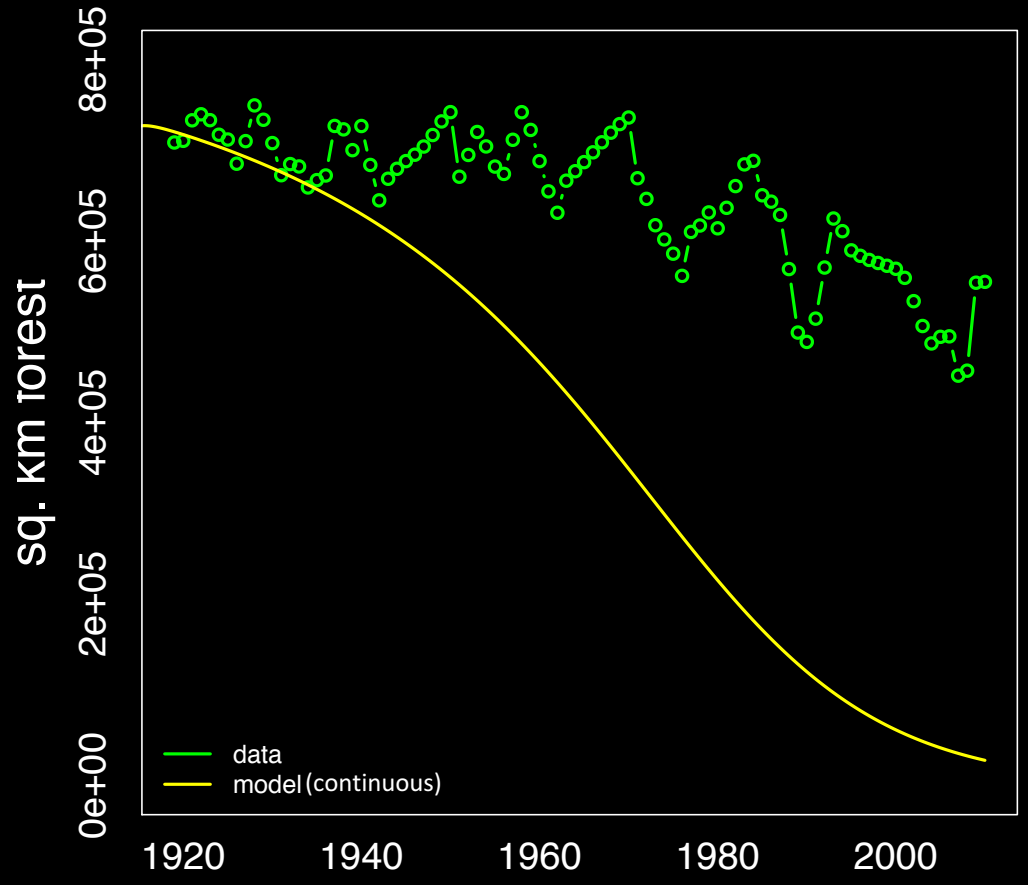

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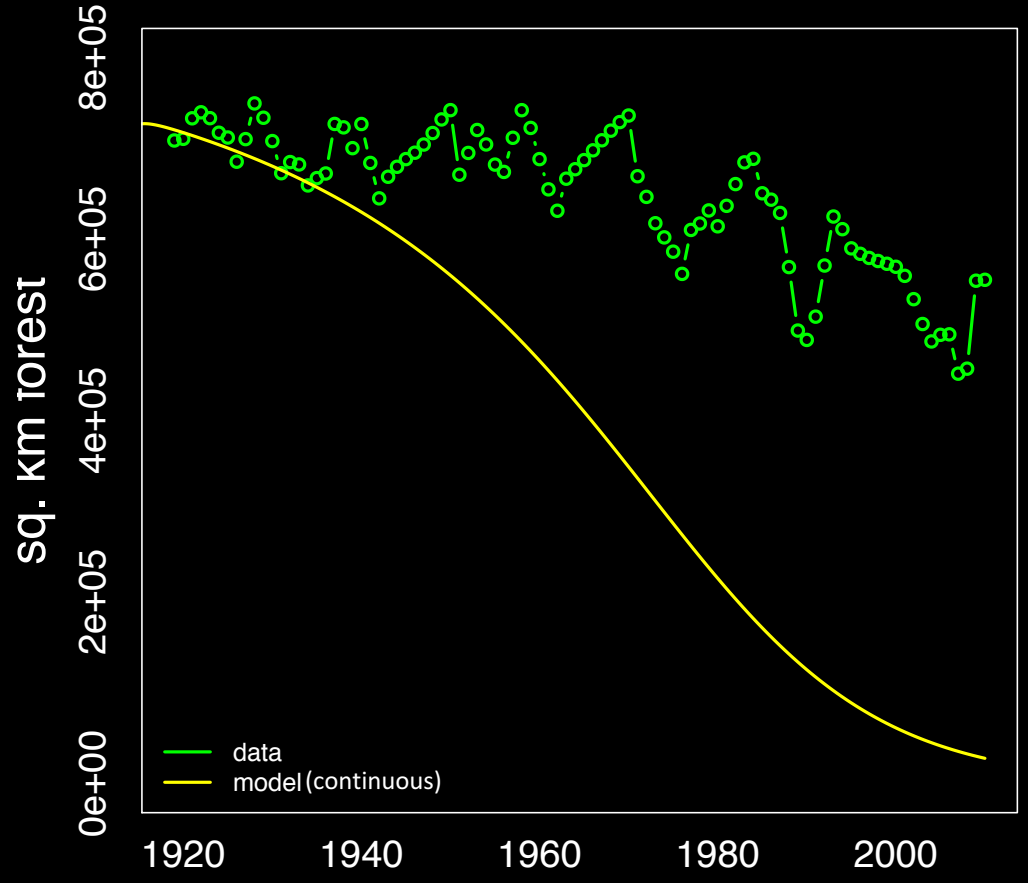
- Using least squares we ask, assuming our model is true, how likely are we to recover the observed data?




Model has the right trajectory but forest declines faster than in the data.

What does this suggest about our guess for the slash and burn rate?

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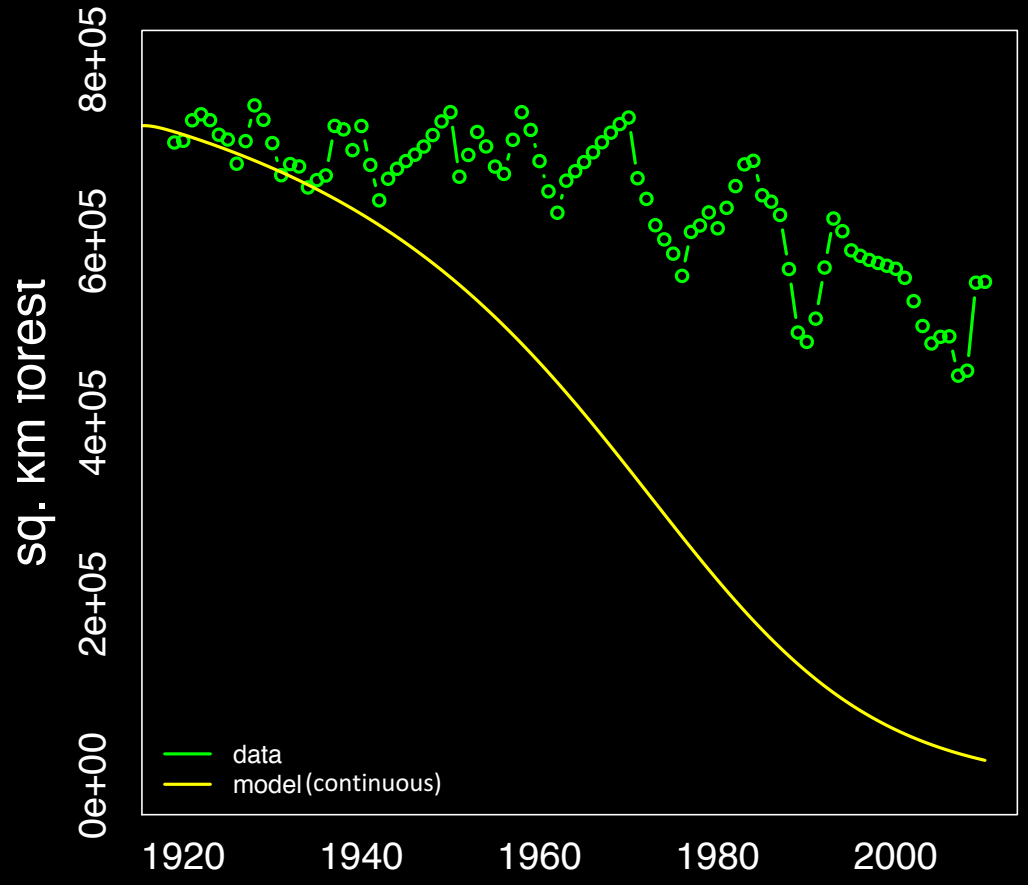


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What does this suggest about our guess for the slash and burn rate?

sum.sq = 3.914575e+13

Can we make that smaller?

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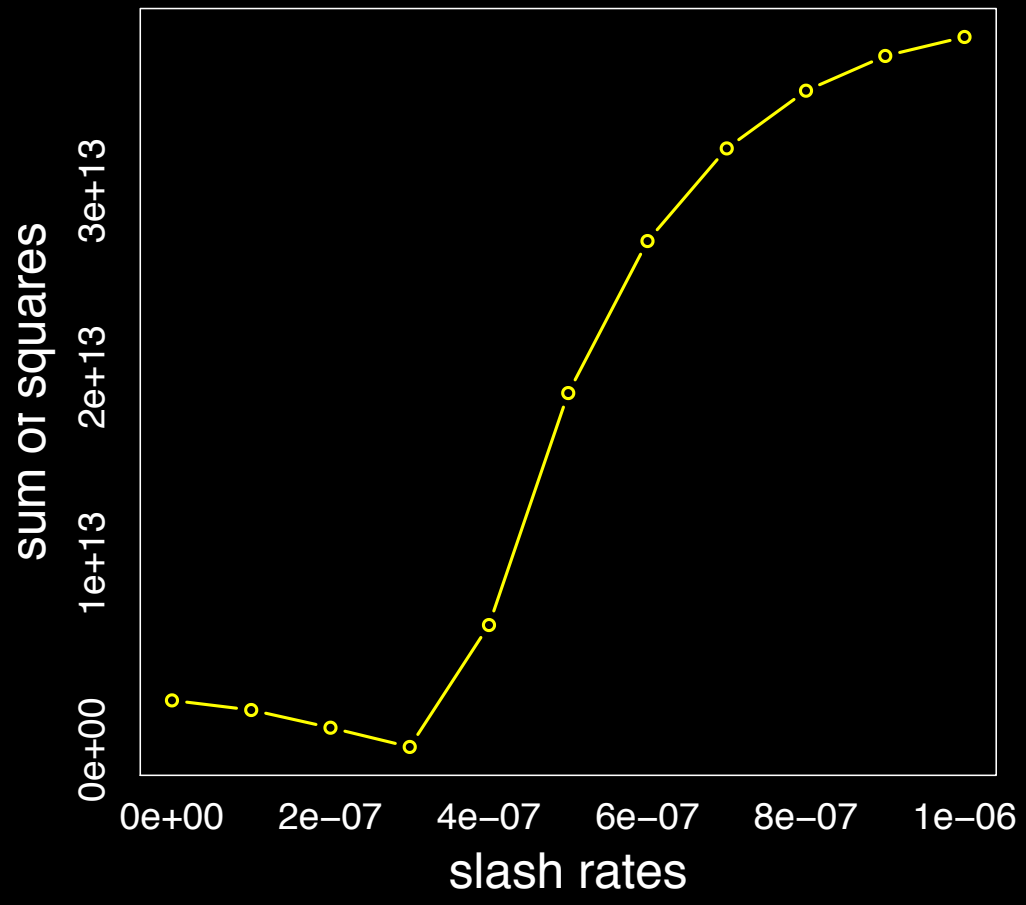
2. Optimize the parameters behind the processes to make the model most likely to recover the data.

slash.list[which.min(sm.sq)] =
3e-7



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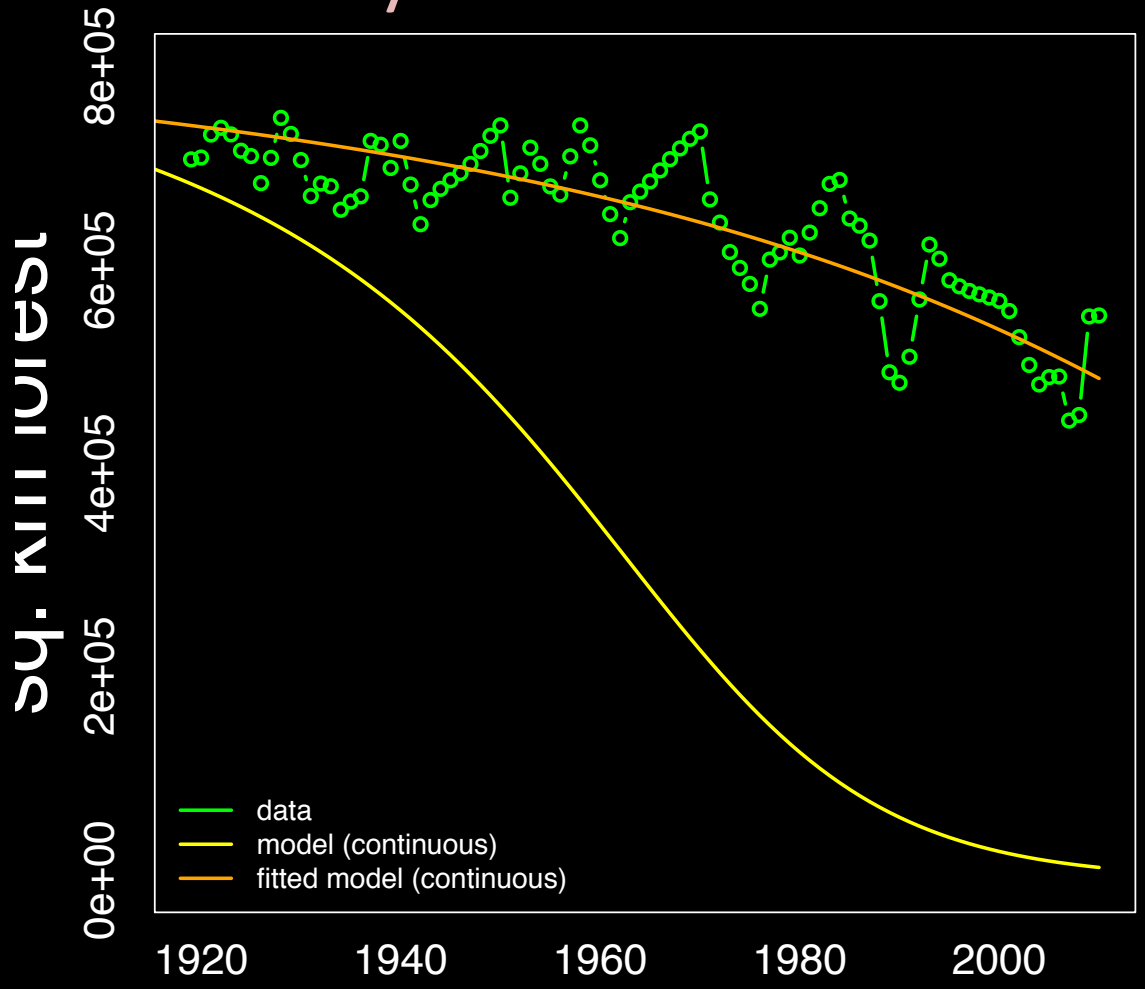
2. Optimize the parameters behind the processes to make the model most likely to recover the data.

New slash fits better!



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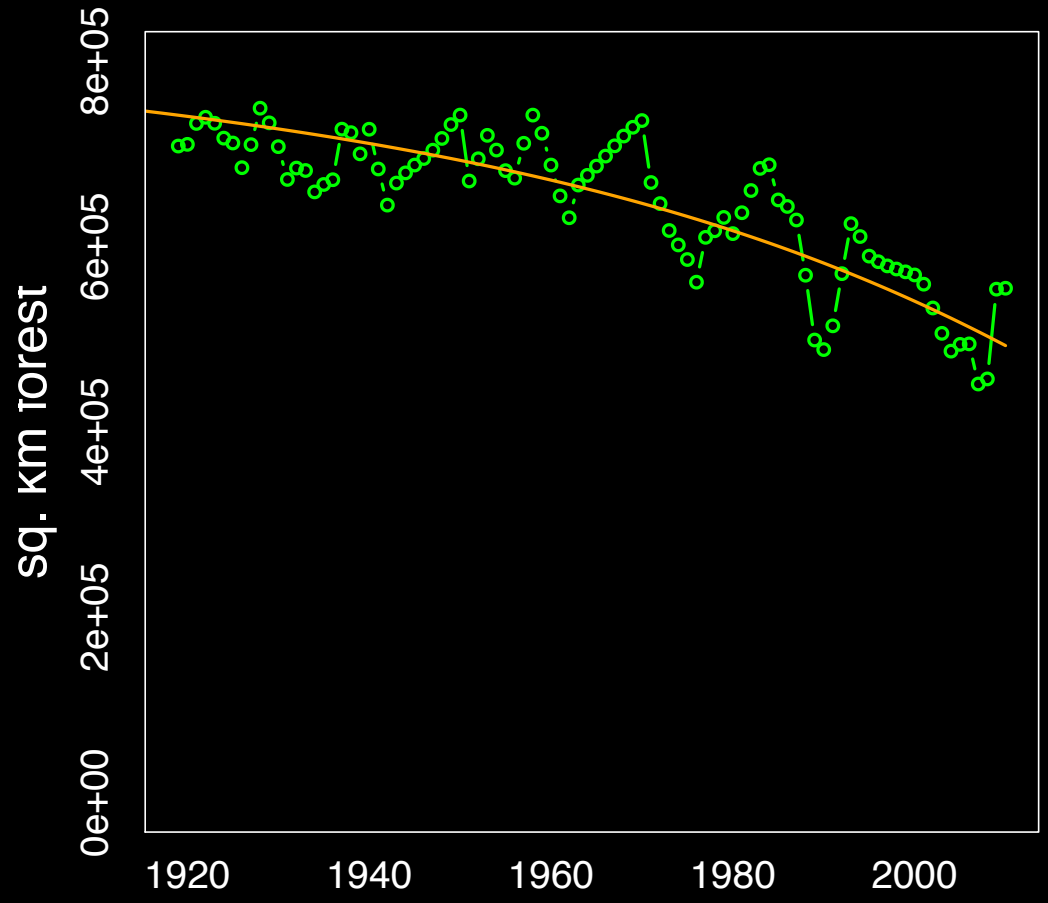


We are good!

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- Estimate: time series of state variables/parameters of interest ➔ DATA
- Inference: Build model to recapture data. Fit to optimize parameters and "infer" the process underlying the data
- Model assessment: Assess plausibility or model comparison
- End goal: explain observed patterns or predict