International Institute for Applied Systems Analysis
IIASA www.iiasa.ac.at

science for global insight

Recent Progress of WP3

Stephan A. Pietsch, Nicklas Forsell, Georg Kindermann, Aline Mosnier, Michael Obersteiner

CoForTips

Objectives

- Enhance the representation of Congo basin rain forests within the GLOBIOM modelling framework
- Calibrate GLOBIOM‘s G4M module with BGC-model derived growth curves
- Provide spatial data on natural forest growth potential
- (Give an outlook on tipping points)
- (Give an outlook on resilience landscapes)

Background I

- G4M:
  - Biophysical model of forest growth
  - principally it is a growth and yield model (although much more sophisticated)
- BIOME-BGC:
  - Biogeochemical model based on a few dozen differential equations giving a mechanistic descrition of the Energy, Water, C and N cycles within a given ecosystem
  - Explicitely considers site and climate conditions - i.e. once validated it is applicable over large regions devoid of observed data

Background II

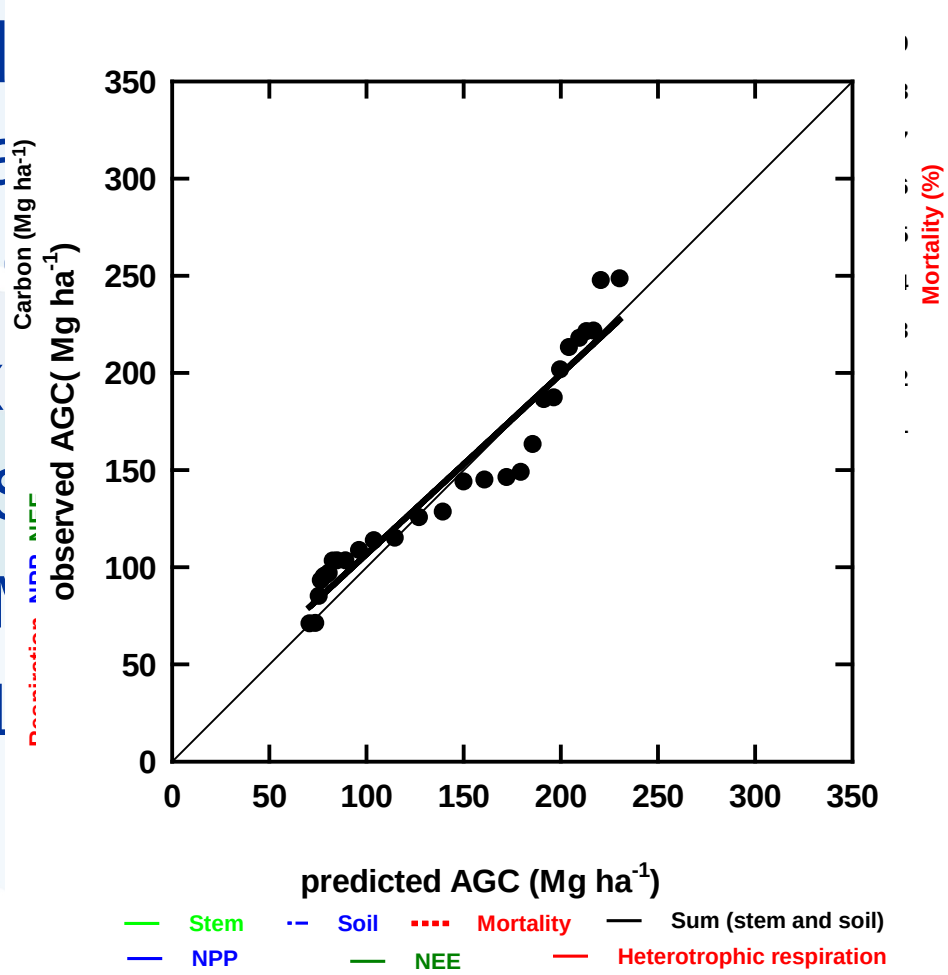
- Why BIOME-BGC ?
  - Recently calibrated and validated for the Congo basin for undisturbed conditions (Birougou Mountains in Gabon)
  - Model application to undisturbed sites with different site and climate conditions gave unbiased results
  - Model application to exploited forests gave unbiased predictions for regrowth and site restoration
  - Model application to Shifting Cultivation systems gave unbiased results

BGC- model study sites

- Birougou (clim. stable)
- Mondah (exploit. for. in regen.)
- Aboun (logged & unlogged & Shifting Cult.)
- Bambidie (Mosaic)

Previous Results I
– Model Validation (Birougou)

- Valid but equally unbia of AGC, Necr
  - Ex
    - S 1.9% (CI)
    - M 19.3% (PI)
    - L 34.3% (TI)



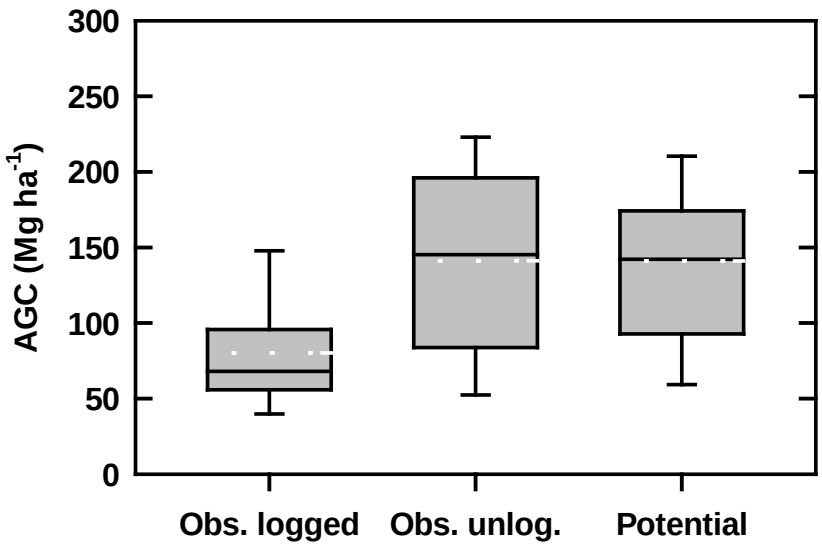
Previous Results II
– Application to other sites

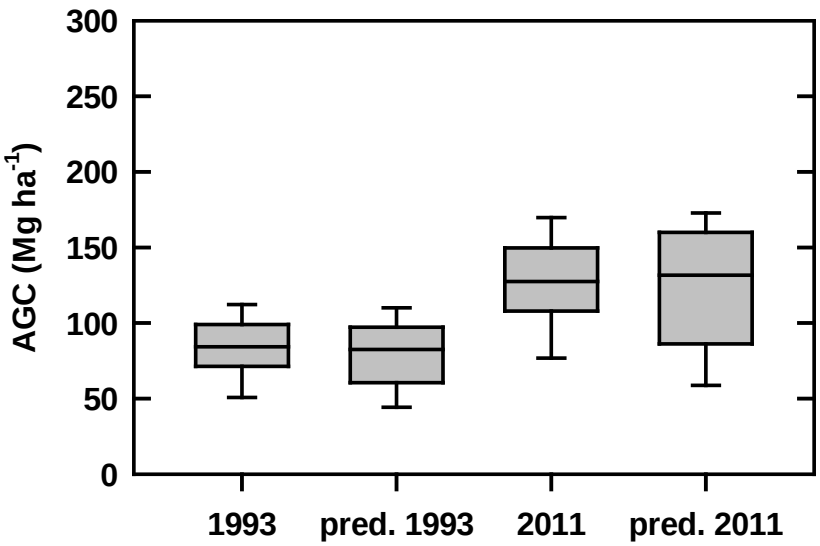
- Aboun

  (Logged & unlogged)

- Mondah

  (exploitation forest 20 & 40 years after conservation)





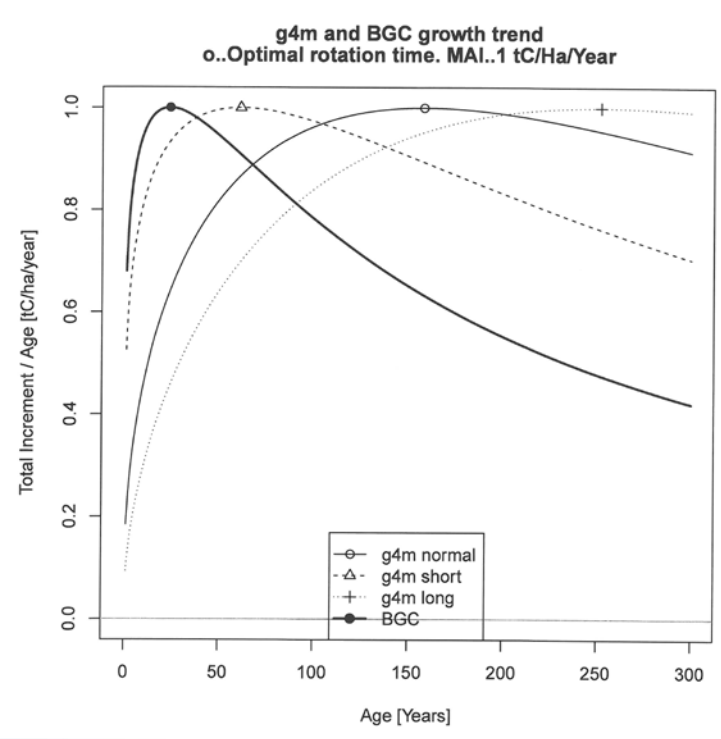
Conclusion – previous results

- BGC – model is capable to deliver unbiased growth dynamics for:
  - Undisturbed forests (Birougou, Aboun)
  - Regrowth after exploitation (Mondah)

- BGC-predictions deliver a trustworthy basis for the calibration of GLOBIOM‘s G4M module for Congo Basin Rain forests

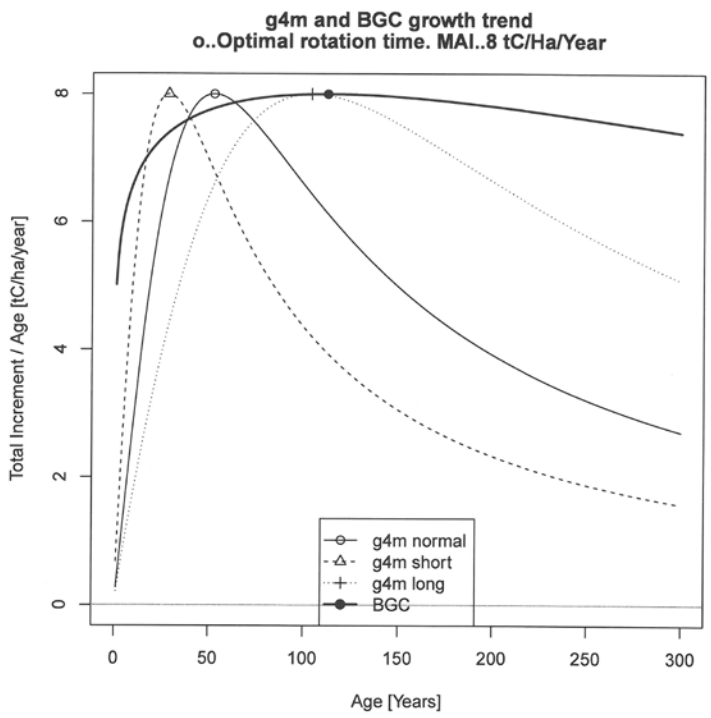
Changes to G4M due to BGC

Results I – low productive sites



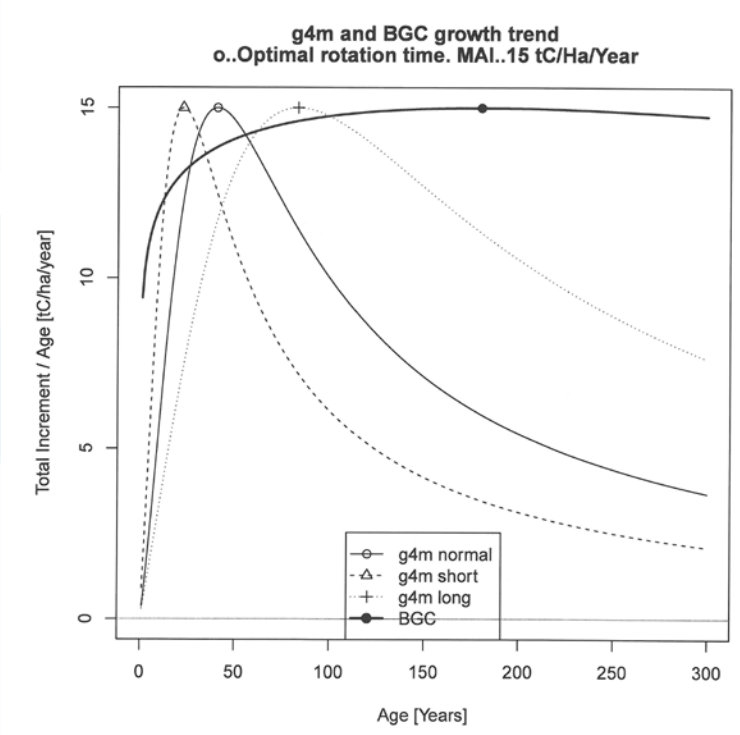
Changes to G4M due to BGC

Results II – medium productive sites



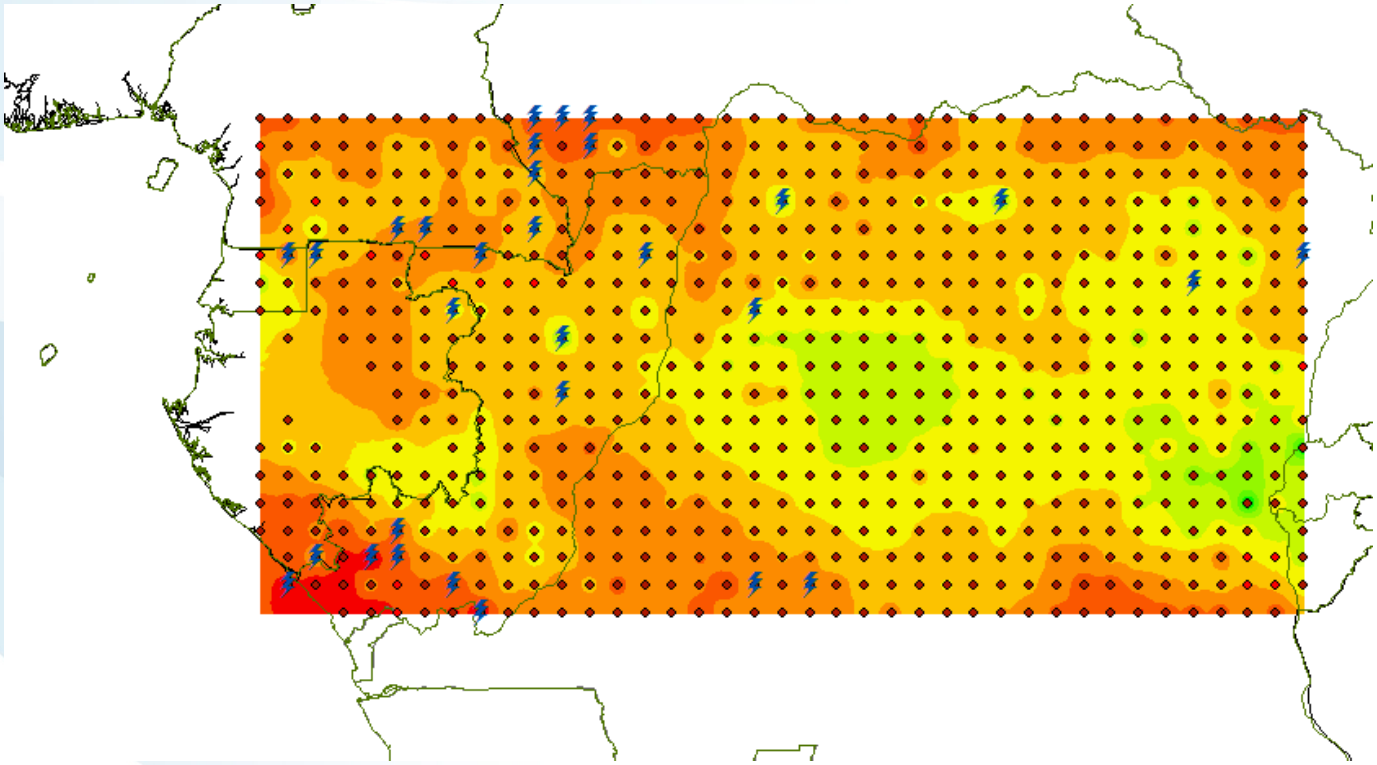
Changes to G4M due to BGC

Results III – highly productive sites



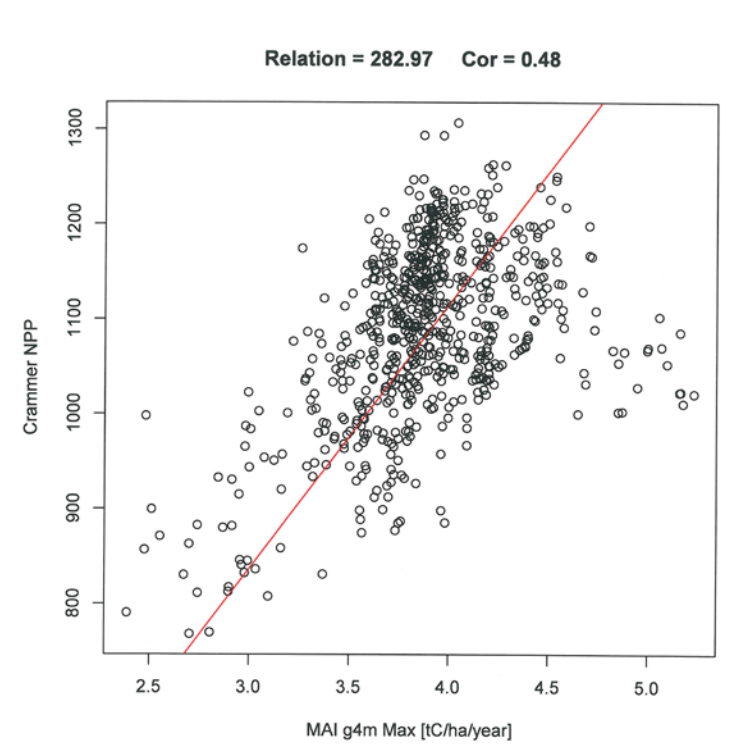
Spatial model results I

BGC : Natural forest growth potential (MAI)

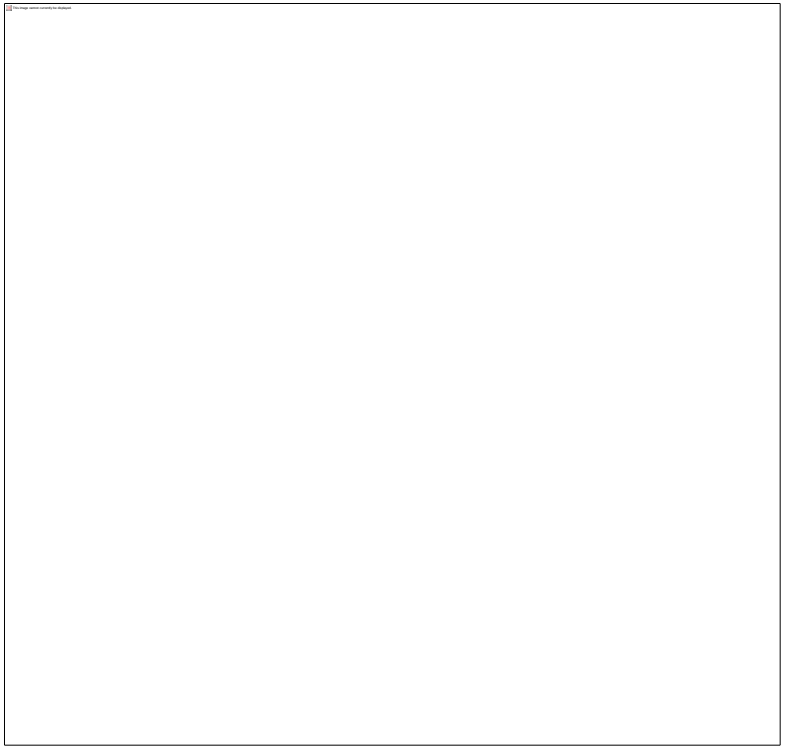


Spatial model results II

G4M vs. Crammer



BGC vs. Crammer



Conclusion

- BGC calibration increased G4M accuracy
  - For unfavourable site conditions :
    - Shorter rotation time -> higher yields
  - For medium site conditions :
    - Slightly prolonged rotation -> higher y.
  - For optimal site conditions :
    - Doubling of rotation time -> higher y.

Merci pour votre attention!

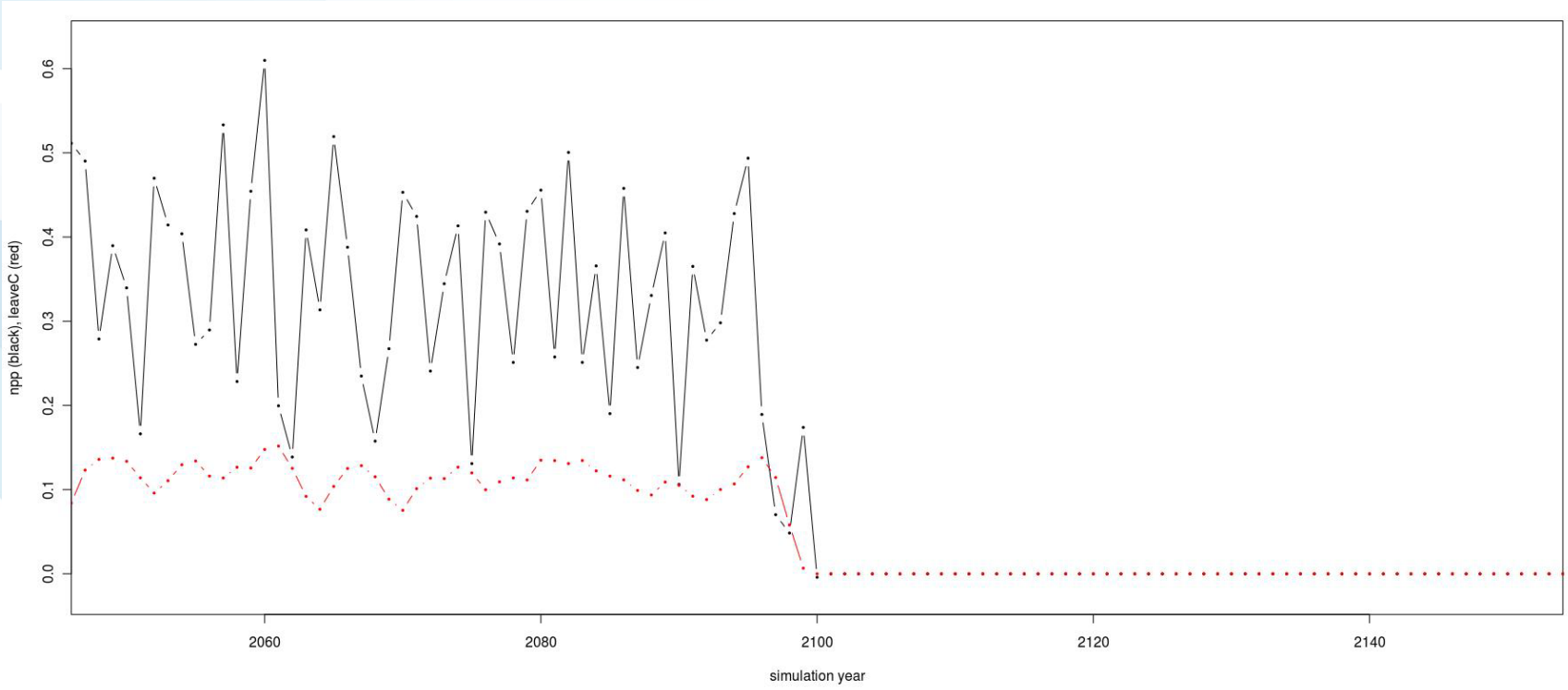
pietsch@iiasa.ac.at

Outlook I : Tipping points

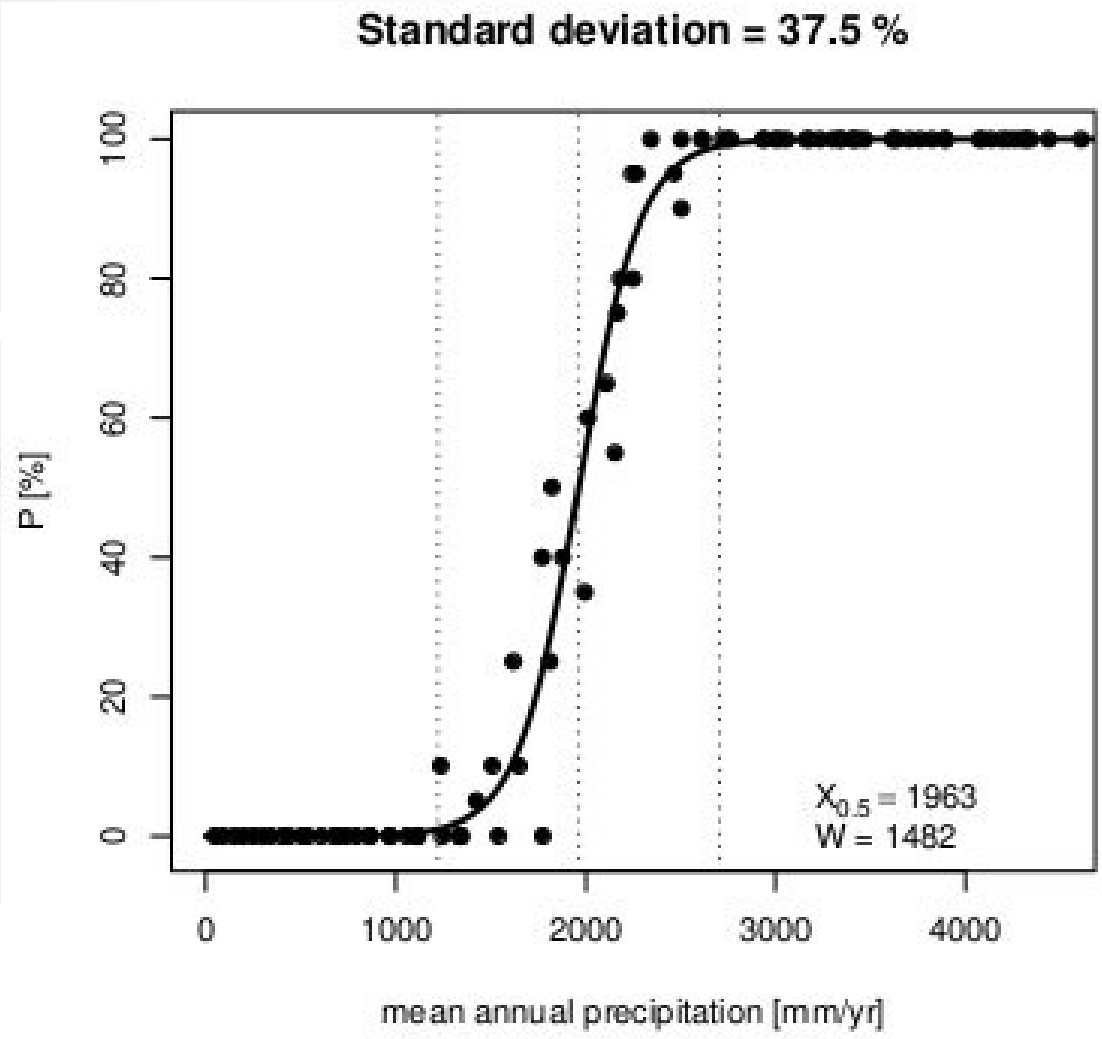
- Climatically induced tipping points
- Exploitation induced tipping points
- Shifting cultivation induced tipping points

Climatic tipping points
– simulation for Bambidie

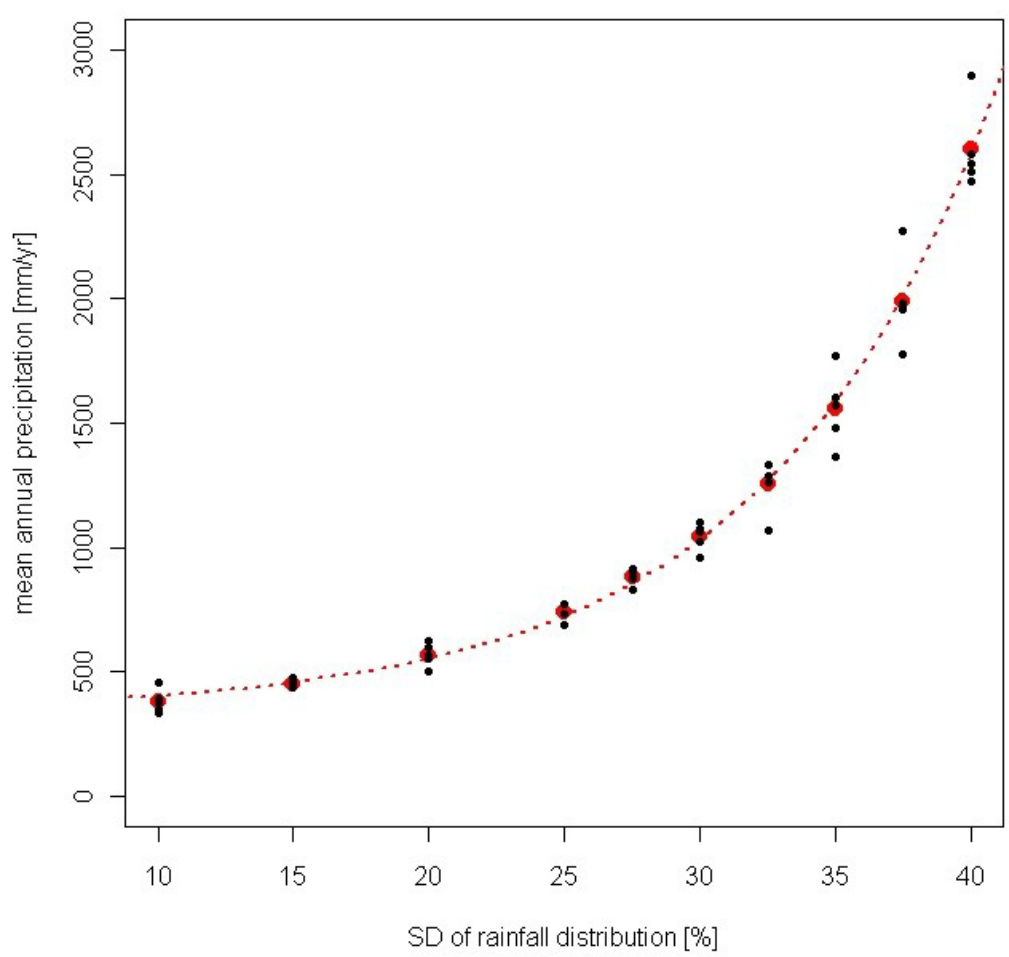
Forest simulations for the mosaic exhibited sudden diebacxk of forest patches



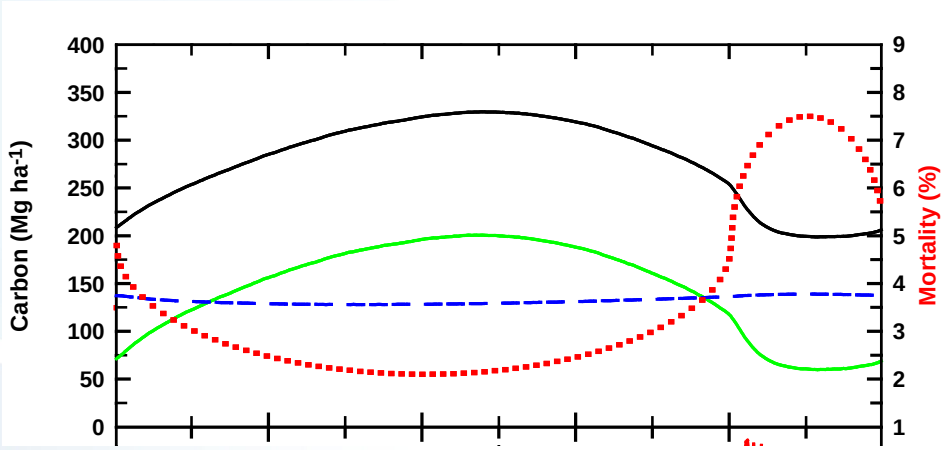
Climatic tipping points
– Synthesis I

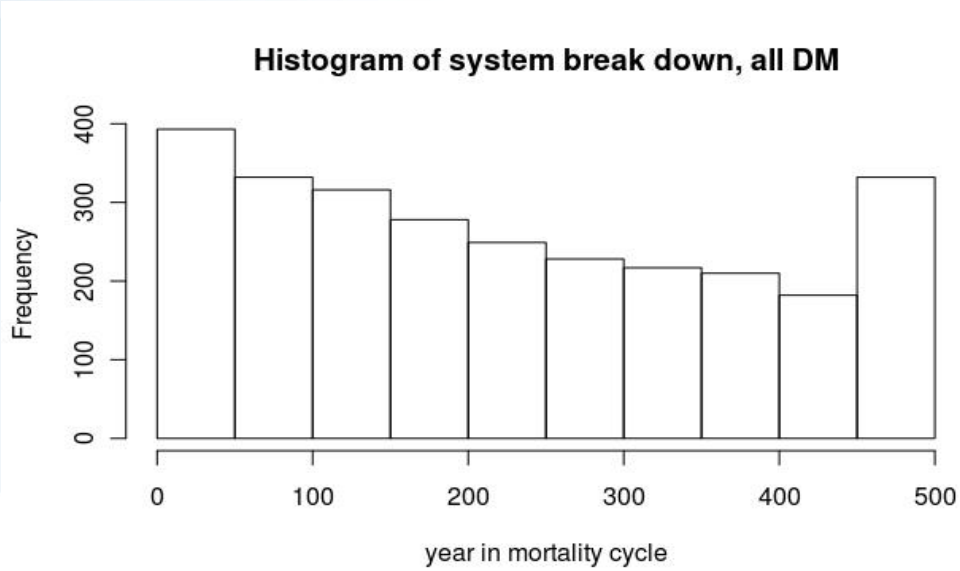


Climatic tipping points
– Synthesis II



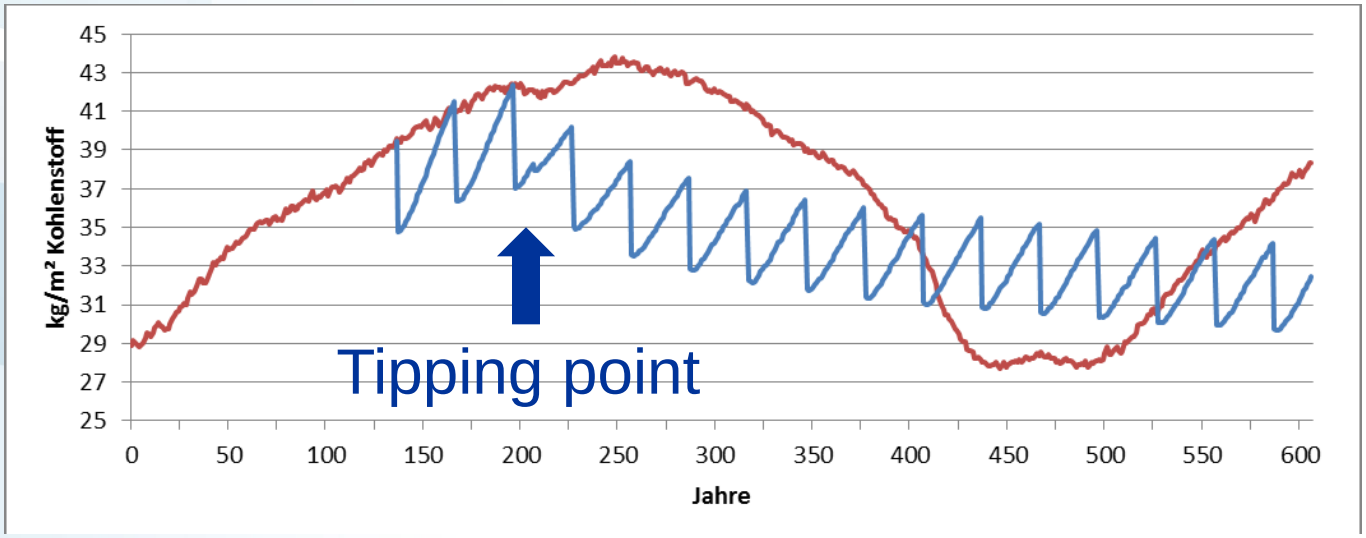
Climatic tipping points
– Synthesis III





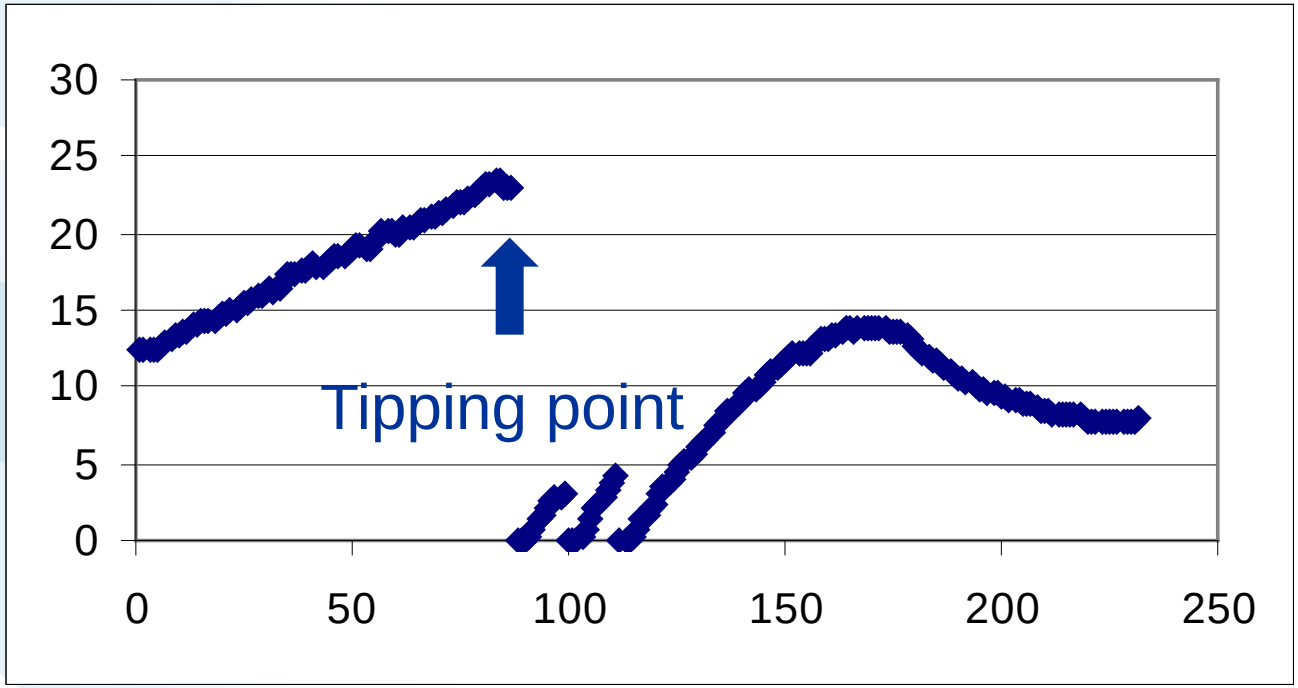
Management tipping points I

- Exploitation



Management tipping points II

- Shifting cultivation

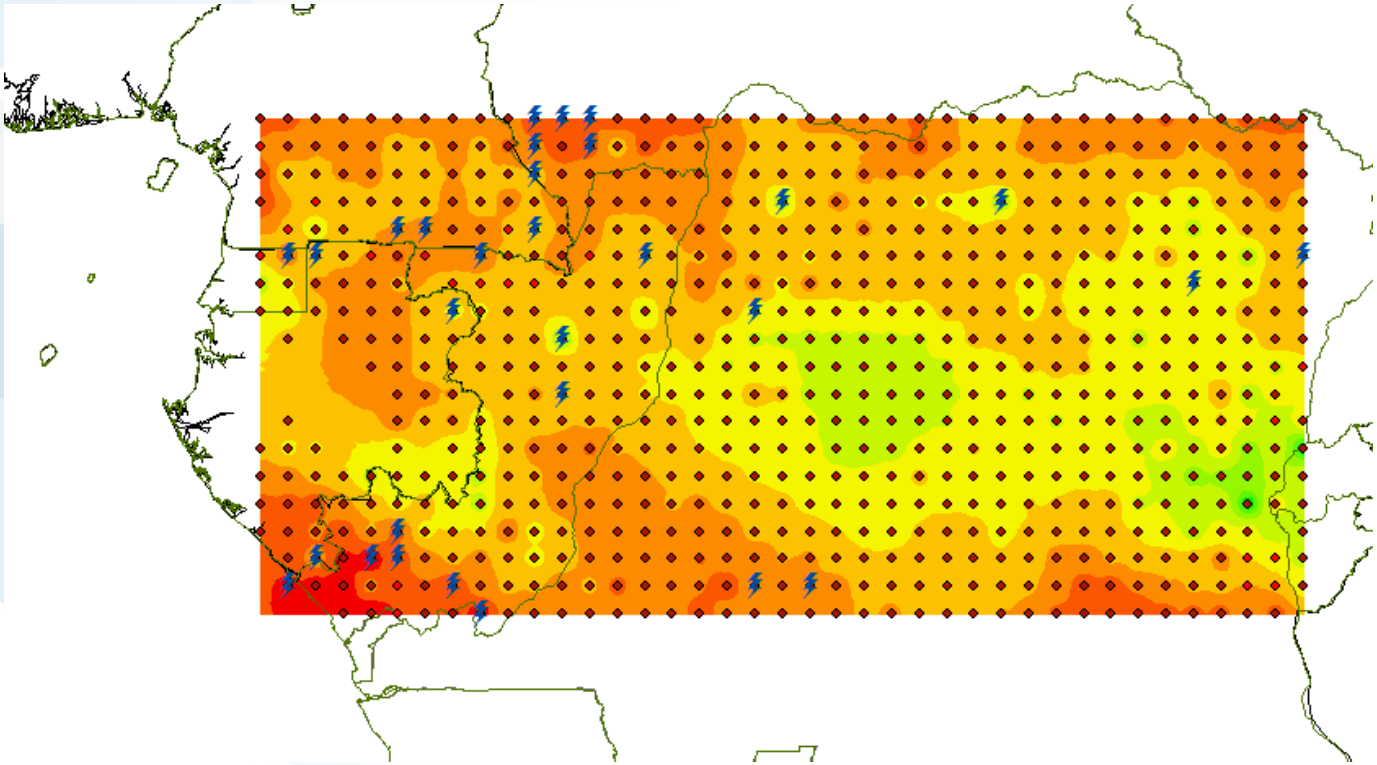


Merci pour votre attention!

pietsch@iiasa.ac.at

Outlook II : Resilience landscapes

The Flash-symbols indicate points exhibiting occassional cimate induced forest dieback



Merci aux étudiants (Aboun & Mondah)

DI. Patrick Stanzl (VMS Gabon)

DI. Franziska Schier (GIZ)

DI. Carmen Schmid (UBA)

Merci aux étudiants (Modelisation)

Dr. Sishir Gautam (Tree Canada)

MSc. Johannes E. Bednar (Siemens Engineering)

Dr. Richard Petritsch (Risk assessment VBAG)

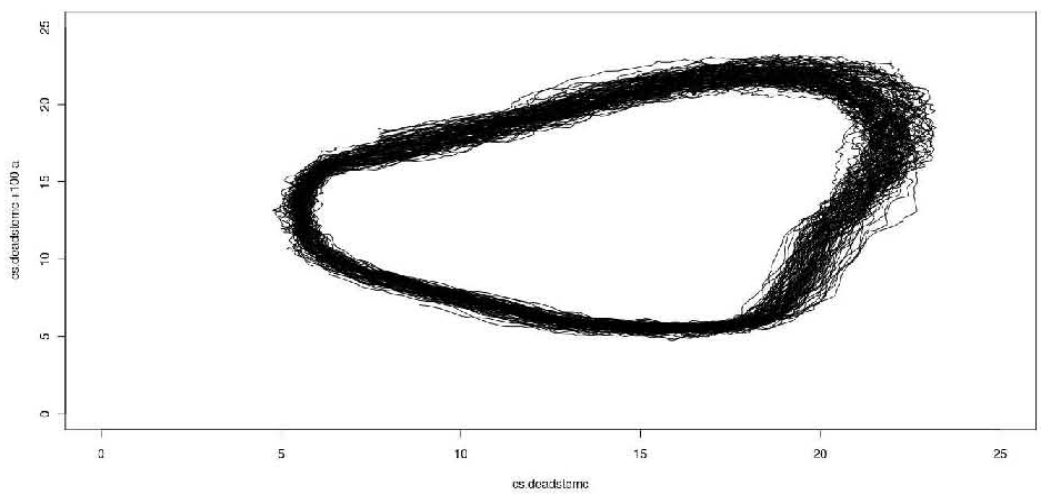
pietsch@iiasa.ac.at

Synthesis

– Impact on predictability

Lyapunov exponents give mean rate of trajectory divergence.
Stable conditions:Time horizon for prediction is long

Birougou:
- doubling of predicton uncertainty: > 1000 yrs.



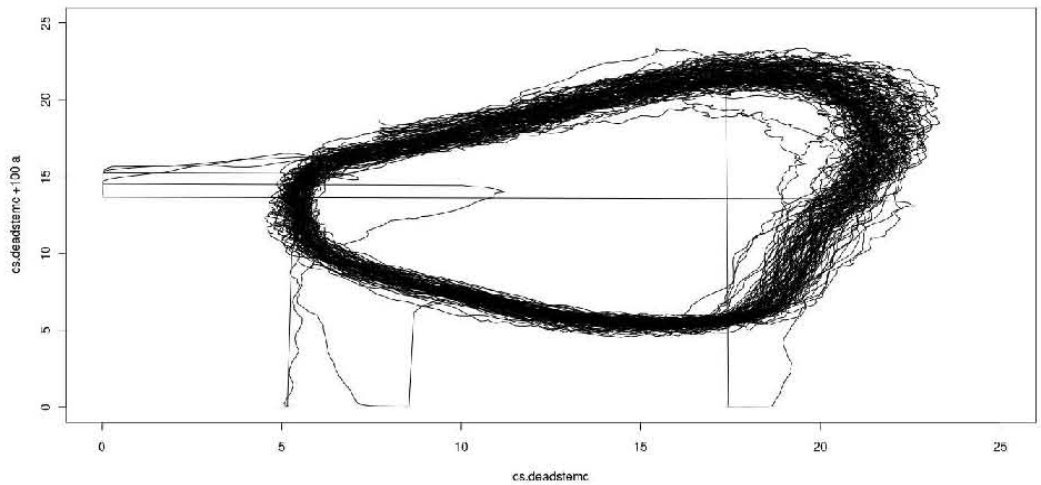
Synthesis

– Impact on predictability

Lyapunov exponents give mean rate of trajectory divergence.
Stable conditions:Time horizon for prediction is long

Mosaic:

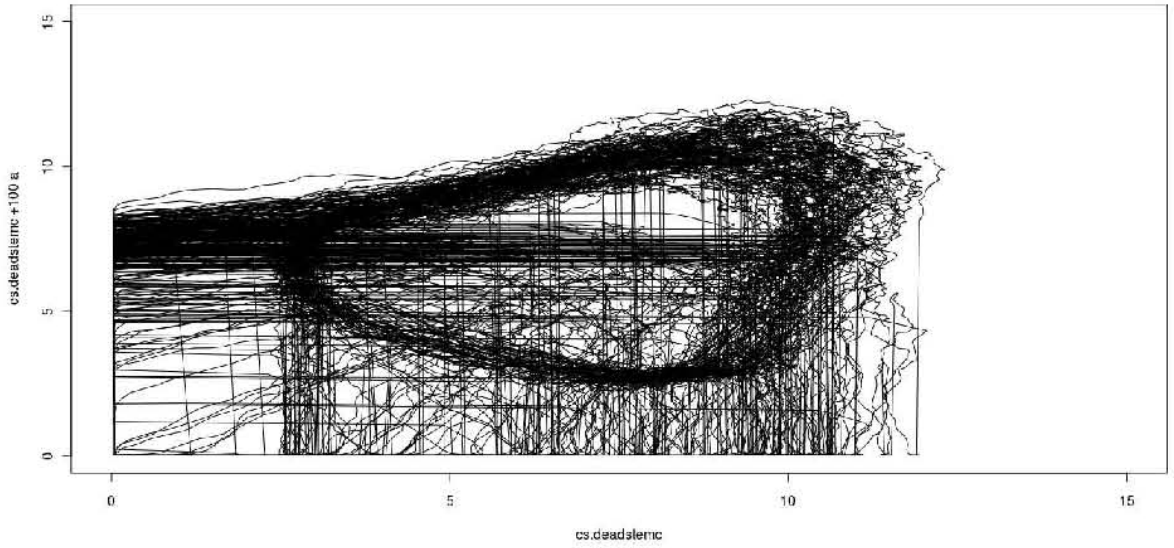
- doubling of predicton uncertainty: ~ 250 yrs.



Synthesis
– Impact on predictability

Lyapunov exponents give mean rate of trajectory divergence.
Stable conditions:Time horizon for prediction is long

Unstable climate:
- doubling of predicton uncertainty: < 10 yrs.



Conclusion

- Model is capable of predicting C-pools and C-fluxes for WCLRF.
- Climatically tipping points are evident.
- Increase in interannual variation triggers catastrophic forest breakdown.
- Regeneration and optimum growth stages are more susceptible to breakdown.
- Management induced tipping points evident.

Merci pour votre attention!

pietsch@iiasa.ac.at