Institute of Earth Sciences
Faculty of Earth and Life Sciences

Holocene and future response of suspended sediment yield to land use and climate change:

a case study for the Meuse basin

VU University Amsterdam

climate changes spatial planning

KATHOLIEKE UNIVERSITEIT LEUVEN

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Philip Ward (philip.ward@falw.vu.nl)

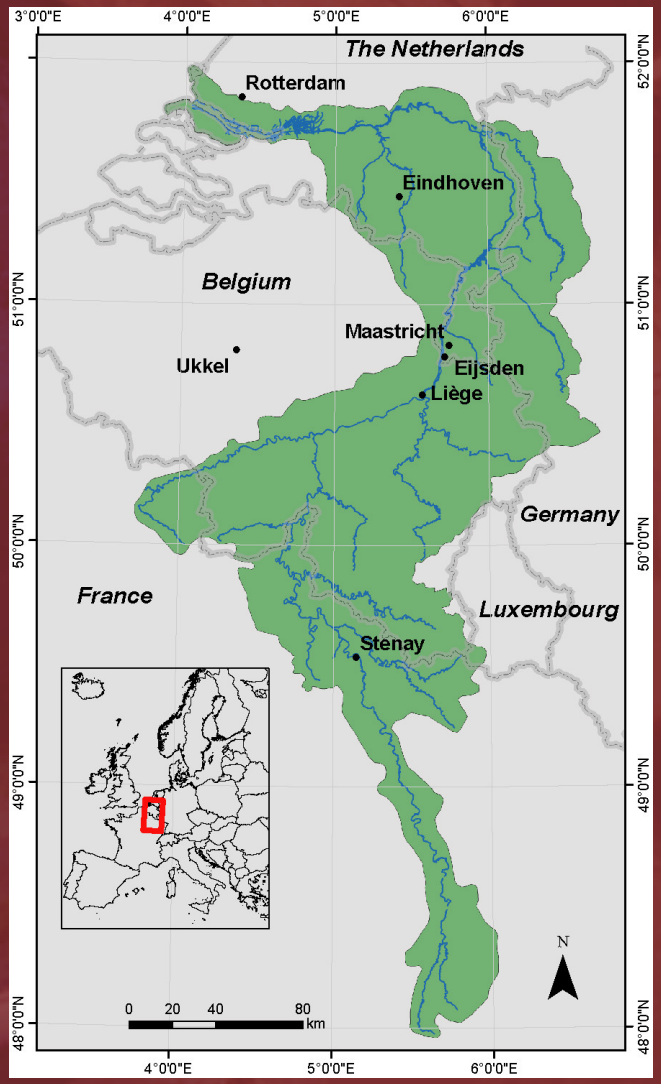
Co-authors:

Ronald van Balen, Gert Verstraeten, Hans Renssen, Jef Vandenberghe

vrije Universiteit amsterdam

Structure of presentation

- Aims and Rationale
- Approach and Methods
- Results
- Conclusions



Aims

Use a simple modelling approach to:

- estimate the background level of Meuse suspended sediment yield (SY) prior to significant human influence (4000-3000 BP);
- estimate the long-term changes in SY in the periods 4000-3000 BP, 1000-2000 AD, and the 21st Century AD;
- delineate the effects of land use and climate change on SY.

Rationale

WATEM/SEDEM

- GIS-based spatially distributed soil erosion and sediment delivery model.
- Erosion based on RUSLE.

$$E = R \cdot K \cdot LS_{2D} \cdot C \cdot P$$

- Sediment delivery based on transport capacities per grid-cell.
- Routing and slope based on DEM (100m x 100m).

R factor

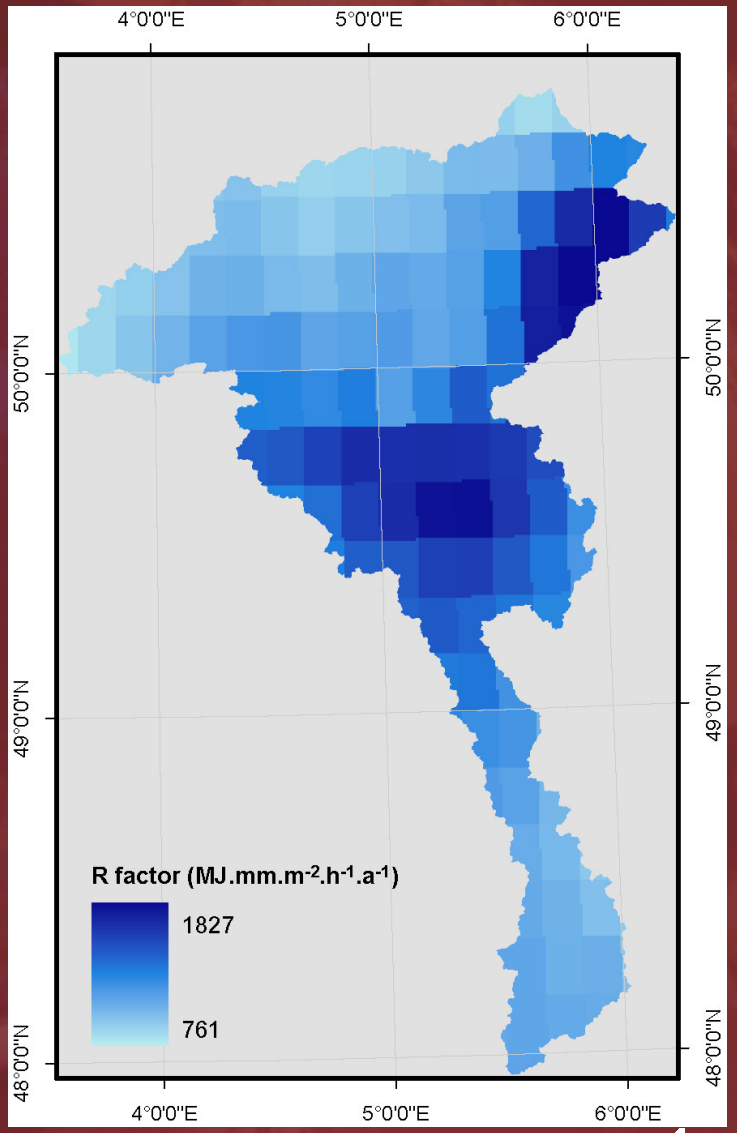
R factor: Rainfall erosivity

- Based on relationship between daily precipitation and R factor (Verstraeten et al., 2006).

$$R = \sum_{d=1}^{d=360} a \cdot pre_d^{1.8067}$$

- Daily temperatures obtained from climate model ECBilt-CLIO-VECODE, downscaled to Meuse basin (Ward et al., 2008).

- Spatial distribution compares well to observations (Bollinne et al., 1979).

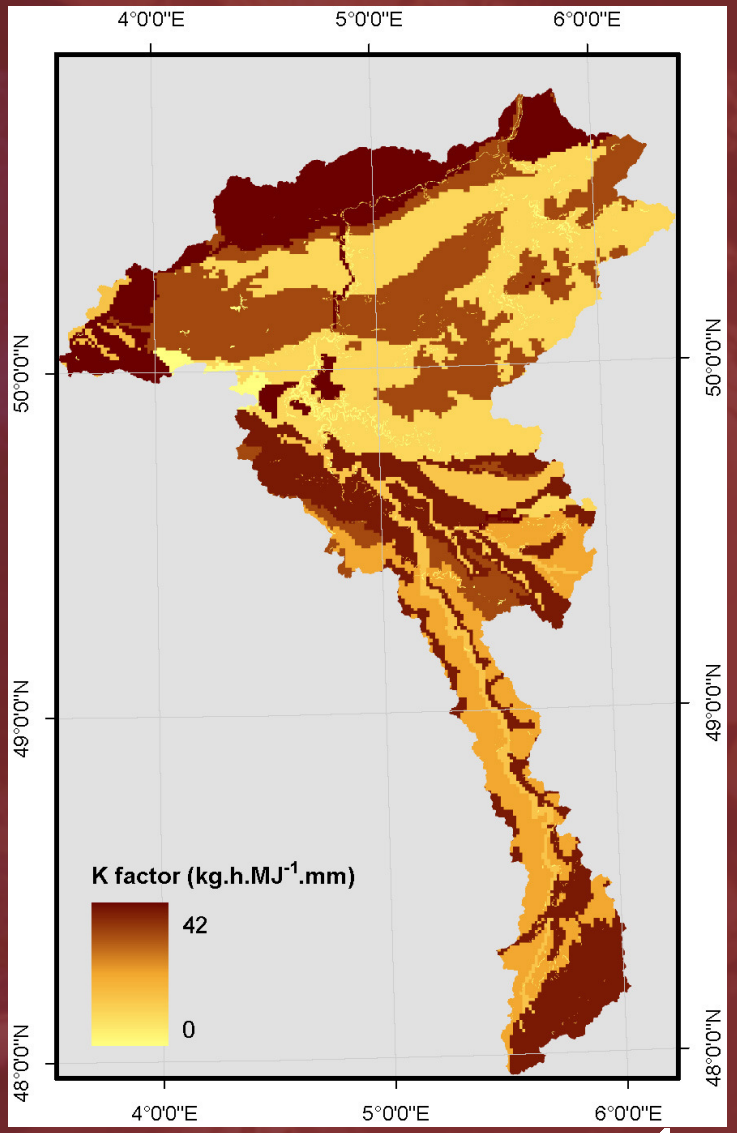


K factor

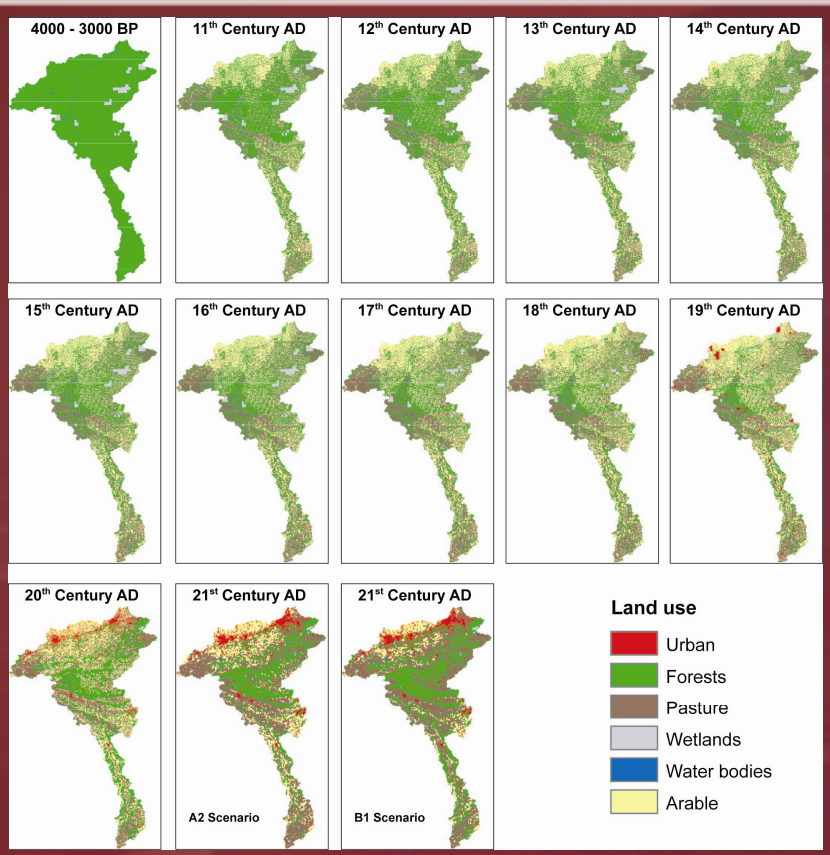
K factor: Soil erodibility

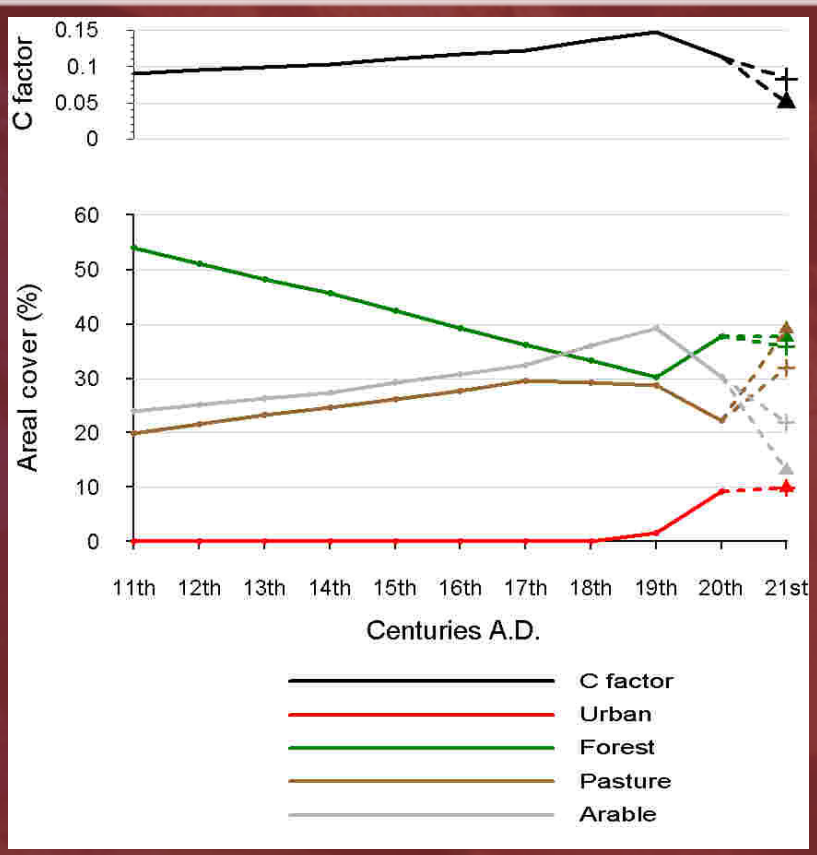
- Based on European Soil Database (ESDB) (Van Liedekerke et al., 2006) data on:
  - soil texture;
  - stoniness.

- Bare rock on steep slopes of Ardennes have little influence on total sediment yield.



C factor

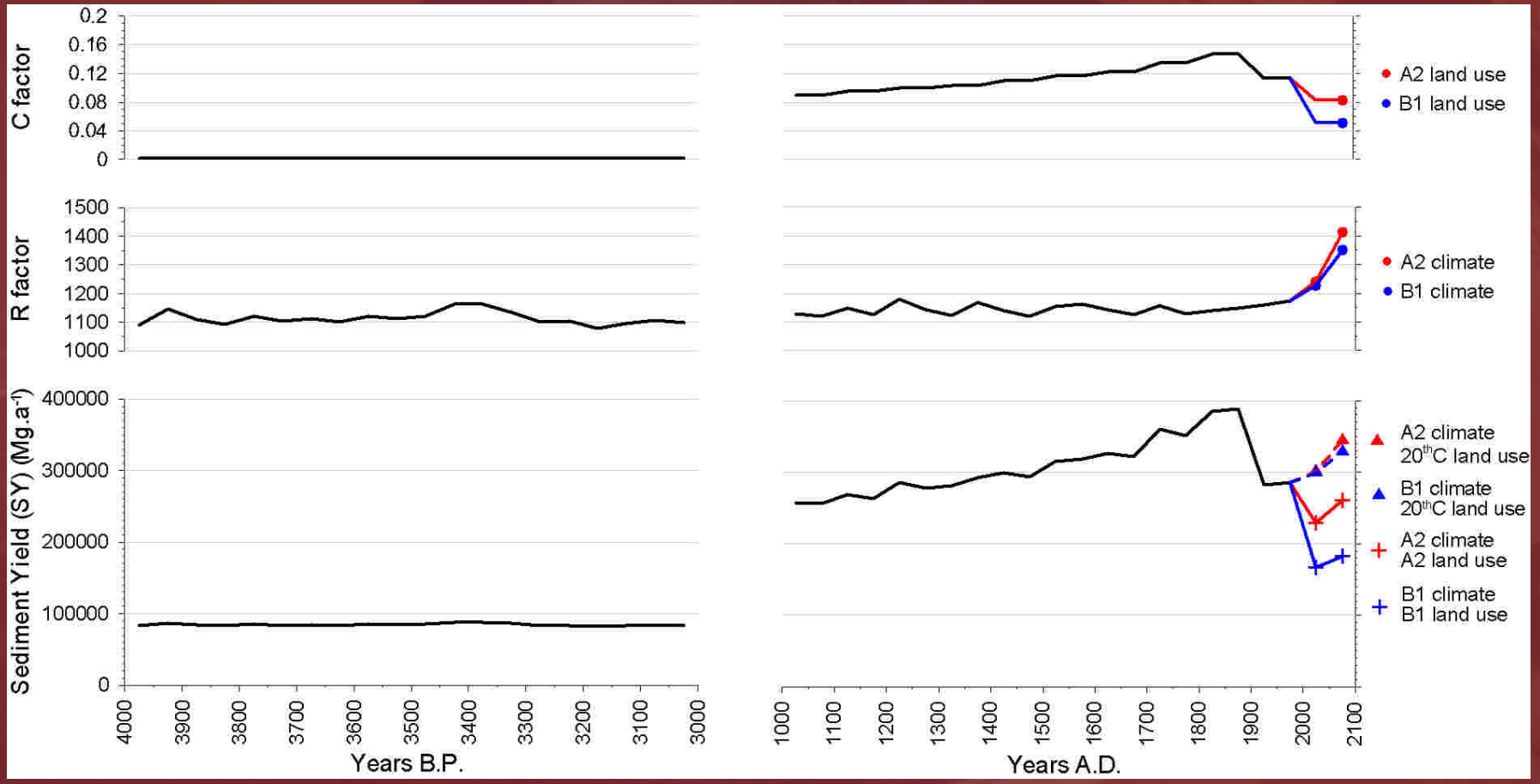




Land use → Crop factors (Verstraeten et al., 2003)

Water, Urban:	0
Forests, Wetlands	0.001
Pasture:	0.005
Arable:	0.37

Late Holocene and future sediment yield

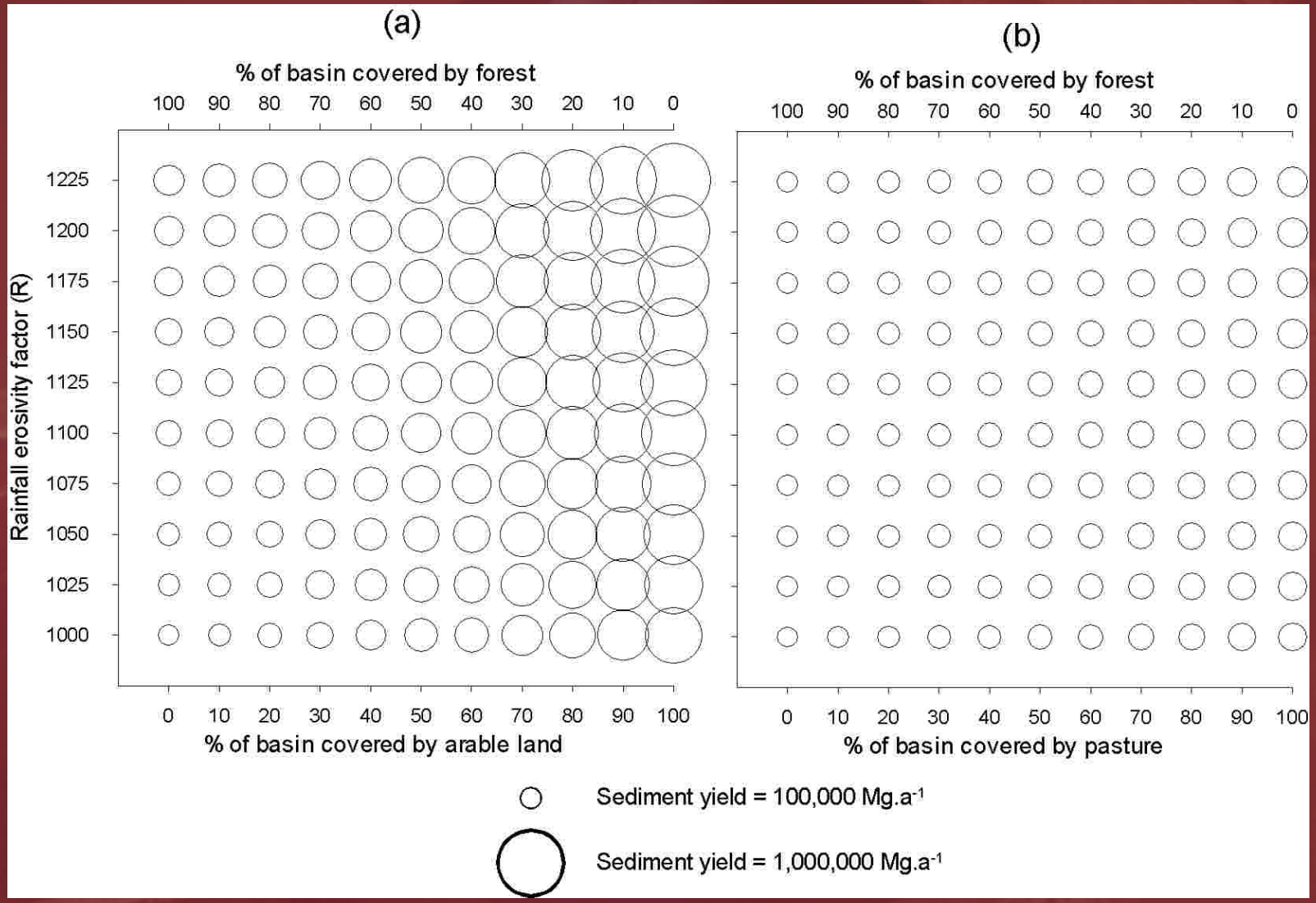


Effects of climate vs. land use change

	Change in SY between 4000-3000 BP and 20th Century AD	
	δSY (Mg. a^{-1})	δSY (%)
Climate change only	+8,475	+9%
Land use change only	+181,174	+198%
Climate and land use change	+189,649	+207%

	Change in SY between the 20th and 21st Centuries AD			
	A2 scenario		B1 scenario	
	δSY (Mg. a^{-1})	δSY (%)	δSY (Mg. a^{-1})	δSY (%)
Climate change only	+34,344	+12%	+23,495	+8%
Land use change only	-72,998	-26%	-129,789	-46%
Climate and land use change	-38,654	-14%	-106,294	-38%

Sensitivity of SY to climate and land use change



Conclusions

- Three-fold increase in Meuse SY between 4000-3000 BP and 1000-2000 AD, almost entirely due to conversion of forest to agriculture.
- For 21st Century, SY is extremely sensitive to scenario (land use and climate) used. Large increase in rainfall erosivity simulated for 21st Century; but resultant increases in SY more than compensated for by land use driven SY decrease.
- Sensitivity of SY to climatic change increases as forested area decreases.
- Simple modelling approach assists in the identification of long-term trends and mechanisms.
- However, due to simplification absolute values must be treated with caution.

Thank you!

- Poster

  Strong increase in the flood frequency of the River Meuse in response to Holocene and future climate and land use change: a new perspective for long-term modelling.

- Poster Hall A – Poster Board A0178

- **Today** – author in attendance: **17.30-19.00**