

Driving processes of long-term and large-scale groundwater recharge in cold and humid climates

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Environnement et Lutte contre les changements climatiques

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1. Problem statement

Starting point:

Global change → major impacts on water resources in cold and humid climates Large-scale groundwater recharge (GWR) estimates = key for long-term water resource planning

Problem statement:

Driving processes of long-term and large-scale GWR in cold and humid climates?

Hypothesis:

- 1. Water budget model = relevant tool for transient and spatially-distributed GWR simulation
- 2. Multiple climate scenarios = identify patterns in future GWR changes
- 3. Land cover scenarios = associated to climate scenarios for global change impacts on GWR

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1.Problem

2. Material and methods2.1. Case study



1. 2.M&M 3. 4. 5. 6.

- 35 800 km²
- 8 watersheds
- Cold climate with hot summers and no dry season
- 1 100 mm/yr and 5.2°C
- 50% forest 40 % agriculture

2.2. Material

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3. Past GWR (1961-2017)

Significant changes in climate and GWR 2009 2013 1969 2007 2015 2017 963 1965 1967 973 979 983 1999 2005 2011 98 986 ò 66 66 2001 2003 197 97! .16 686 66 1450 **Lastic Linear Contraction** (mm/Jrl) **Lastic Lin** W1 W2 W3 W4 W5 W6 W7 (a) [W8 750 W1 W2 Temperature (°C) W3 W4 W5 W6 2 W7 W8 D 250 W1 W2 Pot. GWR (mm/yr) 200 W3 W4 150 W5 W6 W7 (ē) W8 50 1975 2009 2013 2015 2005 2011 2017 961 963 965 1969 1973 1977 1979 983 1985 989 993 995 1999 2001 2003 2007 967 997 981 991 987 197 Comparison to the 1961-1979 period Significant increase No significant variation

• Winter + spring GWR = 75% of annual GWR

3.Past GWR

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- Significant increases in precipitation and temperature
 - +80 to +125 mm/yr
 - +1.1 to +1.2°C
- No decrease in GWR

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4. Impact of climate change on GWR

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Changes in future monthly GWR compared to the 1981-2010 period for the 12 scenarios



5. Impact of land cover change on GWR



• RCP4.5 scenarios : changes with wider range of ΔT and ΔP

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• Increased GWR for RCP4.5 = afforestation

 Difference in GWR = decrease in runoff from December to May

Dubois et al., 2023

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6. Conclusion

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Past GWR

→ Seasonality and importance of the cold months

- Significant changes in GWR associated to specific changes in climate
 →Balance between change in cold months vs rest of the year
 →Thresholds in future climate conditions
- The role of land cover change in GWR simulation

 →Land cover change increased GWR sensitivity to climate change
 →Afforestation → increased GWR because decreased cold months runoff
 →(+ need to consider systematically global change)



Chaire de recherche Eau et conservation du territoire Environnement et Lutte contre les changements climatiques





Thank you for your attention

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