Erosion Assessment of Cultivated Histosols Using Caesium-137 Measurements

Abstract No. 68

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Background

- **Drained histosols** have a major importance for vegetable production in Quebec.
- Their drainage triggers **rapid degradation** due to oxidation of organic matter, erosion and compaction.[2, 3]
- This research aim to **study the extent of their erosion using ^{137}Cs measurements**, a method validated for mineral soils and natural peatlands. [4, 5]


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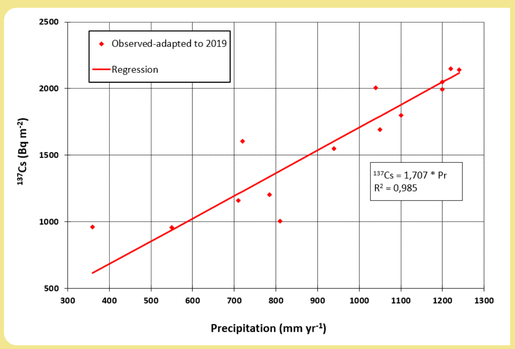
Methodology

- 22 fields were bulk sampled (0 - 65 cm depth).
- Variations of ^{137}Cs activity were converted to soils movements with *Mass Balance One* model.[6]
- Reference values obtained by relating ^{137}Cs fallout to the average annual precipitation rate of the study area.[7]

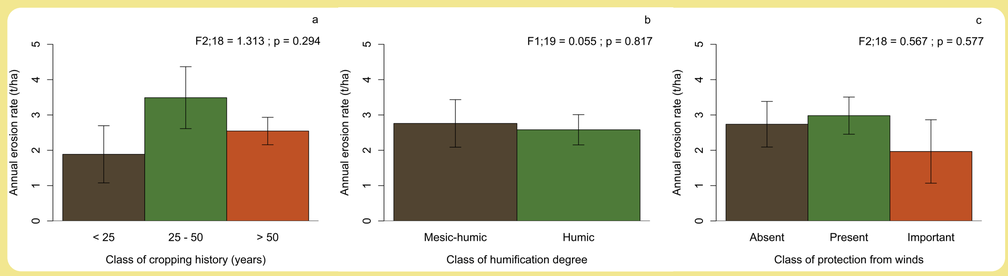


- **Relate erosion to** (1) **fields age**, (2) **wind exposure** and (3) **degree of humification**, as well as (4) various characteristics related to **erodibility**.
- Surface (0 – 20 cm) soil samples analyzed for particle size distribution, organic matter content and humification.

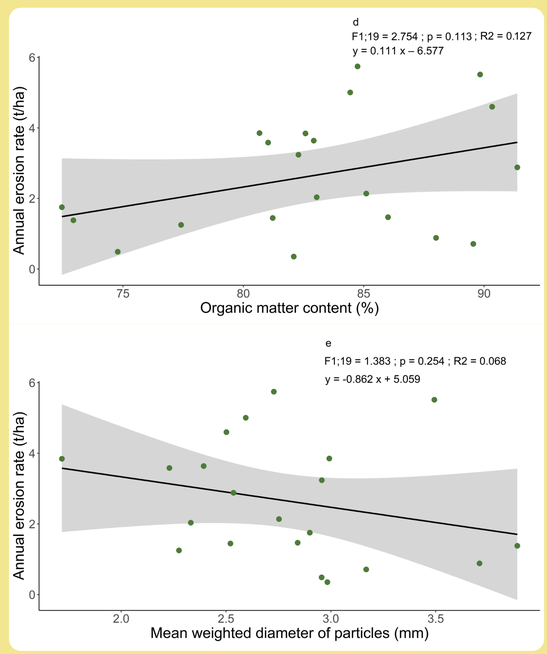
Results

- Estimated annual erosion rates between 0.4 and 8.8 t/ha (average of 2.9 t/ha).
- Comparable to those of an ongoing study on the health of Quebec's agricultural soils (average of 3.6 t/ha).
- The initial estimate, based on limited field measurements, was 4.1 - 54.6 t/ha.

- **Erosion rates decreased in fields** with (a) **cropping history < 25 years**, (b) **higher degree of humification** and (c) **important protection from winds.**



- **Soil loss increased** with the **organic matter content** (d) and **decreased** with the **mean weighted diameter of particles** (e).



Conclusion

Results suggest the **need to adapt the fallout radionuclide methods for soil erosion assessment of cultivated histosols**, focusing on the **development of a conversion model** adapted to their particular following antagonistic effects :

1. Concentration of ^{137}Cs in the surface layer due to oxidation of organic matter can result in a lower soil loss for a given inventory variation.
2. Densification over time, so a variation of ^{137}Cs could correspond to higher soil loss.
3. Net effect of the two previous points on how to set the enrichment ratio of eroded sediments used in conversion models.

- 1 - Photography taken by **Andrés Felipe Silva Dimaté** in June 2020
- 2 - **Driessen, P., Deckers, J., Spaargaren, O. and Nachtergaele, F. 2001**. *Lecture Notes on the Major Soil of the World*. Edited by Driessen, P. and Deckers, J. Food and Agriculture Organisation of the United Nations (FAO). Rome, Italy. 334 pages.
- 3 - **Esselami, D., Boudache, M. and Grenon, L**. 2014. *L'évolution des terres noires et le problème de la compaction*. Prisme Consortium. Presentation.
- 4 - **Fulajtar, E., Mabit, L., Renschler, C. S. and Lee Zhi Yi, A**. 2017. *Use of ^{137}Cs for soil erosion assessment*. Food and Agriculture Organization of the United Nations (FAO) and International Atomic Energy Agency (IAEA). Rome, Italy. 63 pages.
- 5 - **Mabit, L., Bernard, C., Wicherek, S. and Laverdière, M. R**. 2002. *Vertical Redistribution of Radioceasium (^{137}Cs) in an Undisturbed Organic Soil of Northeastern France* (p. 197-203). In *Applied Geomorphology : Theory and Practice*. R. J. John Wiley and Sons eds. New York City, State of New York, United States of America. 480 pages.
- 6 - **Walling, D.E., Zhang, Y. and He, Q.** 2014. Pages 125-148. *Conversion models and related software* (p. 125 to 148). In *Guidelines for using fallout radionuclides to assess erosion and effectiveness of soil conservation strategies*. IAEA-TECDOC-1741. Vienna. 213 pages.
- 7 - Adapted from **Bernard, C., Mabit, L., Laverdière, M.R. and Wicherek, S**. 1998. *Césium-137 et érosion des sols*. Cahiers Agricultures, Vol. 7, p. 179 à 186.

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