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Impact of soil erosion on C cycling and energy and water balance

Adrian Chappell
25 June, 2014; CABLE meeting

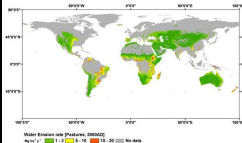
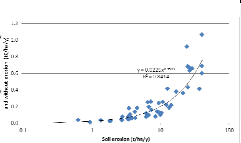
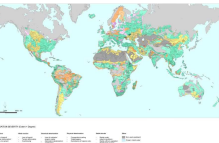
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Conclusion

- **Soil organic carbon erosion**
 - Preferential removal of fine, C- and nutrient-rich material
 - Globally dominated by water erosion
 - Omitted by C cycling used in land surface models
- **Under-estimate SOC flux**
 - Globally 0.4-1.3 PgC y⁻¹ (4-14% of GCA, 2012)
 - Between global regions 40-88 TgC y⁻¹ (2-78% of GCA, 2012)
- **SOC erosion spatially and temporally variable**
 - Within and between global regions
 - Land use change: clearing native vegetation (1), ploughing and grazing (2) and 'conservation' agriculture (3)
- **Erosion feedback dynamics**
 - Change C cycling drivers and energy and water budget: soil albedo, soil temperature, soil moisture and soil hydraulics.

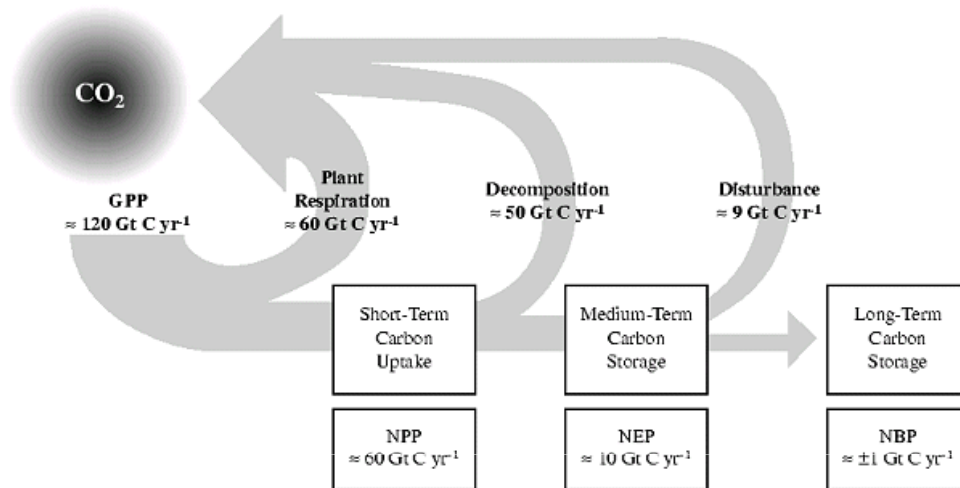
Global SOC erosion by water

	Min – max* water erosion (t ha ⁻¹ y ⁻¹)	SOC erosion (tC ha ⁻¹ y ⁻¹)	Water eroded area (ha x 10 ⁶) [#]	Total SOC erosion (TgC y ⁻¹)	Global Carbon Atlas C flux (2012 TgC y ⁻¹)	Difference (%)
						
Africa	3.7 – 12.9	0.08 – 0.26	1000	78.0 – 255.6	331	23.6 – 77.3
Asia	4.3 – 16.6	0.09 – 0.32	1550	138.2 – 503.5	4420	3.1 – 11.4
S. America	5.7 – 22.1	0.12 – 0.43	510	59.9 – 217.4	316	19.0 – 68.8
N. America	4.4 – 12.3	0.09 – 0.24	430	39.7 – 105.0	1664	2.4 – 6.3
Europe	6.7 – 13.4	0.14 – 0.27	300	41.0 – 79.5	1618	2.5 – 4.9
Oceania	1.7 – 9.5	0.04 – 0.19	460	17.5 – 87.9	112	15.6 – 78.4
Global	4.1 – 15.2	0.09 – 0.30	4250	369.0 – 1269.6	9106	4.1 – 13.9

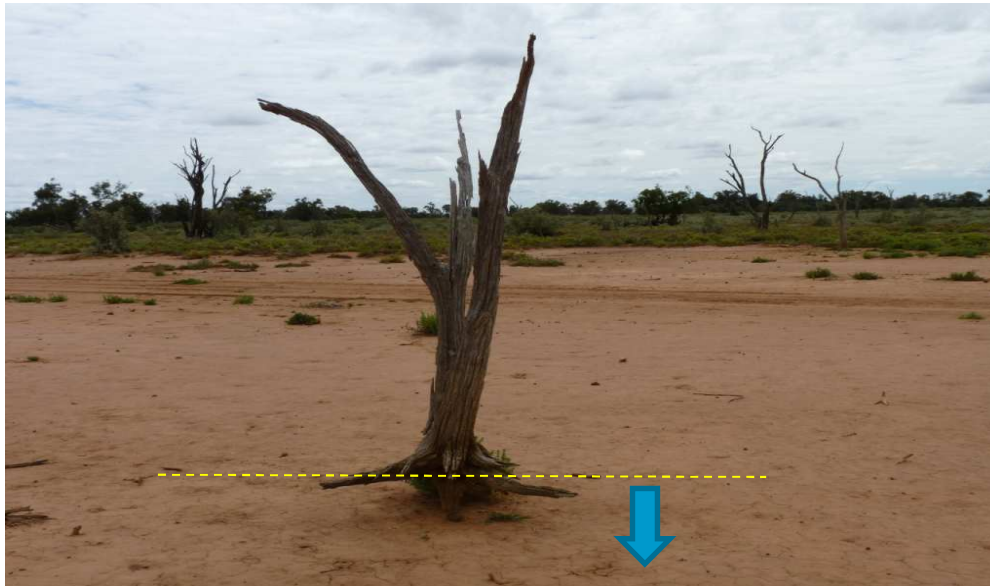
*Minima and maxima water erosion estimates for these regions were taken from Doetterl et al. (2012) and from Lal's (2003) collation of sediment yield estimates, respectively.

[#]Estimates of land area affected by water and tillage erosion were taken from Doetterl et al. (2012).

SOC erosion omitted process



- Direct effect minimal
e.g. $1 \text{ Gt C yr}^{-1} \sim$ 'disturbance'



- Interactive effect may be substantial change to drivers:
 - Preferential removal of fine, C-rich and nutrient-rich material
 - Soil albedo, soil temperature, soil moisture, soil hydraulics
 - C:N ratio

Thank you

CSIRO Land and Water/ Sustainable Agriculture Flagship

Adrian Chappell

Principal Research Scientist

t +61 2 6246 5925

e adrian.chappell@csiro.au

w <http://www.csiro.au/en/Organisation-Structure/Divisions/Land-and-Water/AdrianChappell.aspx>

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