Blue Carbon Losses
With Salt Marsh Drainage

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https://chmuralab.weebly.com/
2006 revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories

then the 2013 Supplement on Wetlands

Chapters
1 Introduction
Chapter 2 Drained Inland Organic Soils
Chapter 3 Rewetted Organic Soils
Chapter 4 Coastal Wetlands
Chapter 5 Inland Wetland Mineral Soils
Chapter 6 Constructed Wetlands for Wastewater Treatment
Chapter 7 Cross-cutting Issues and Reporting

Emission factors produced for land use change

www.IPCC.ch – see publications/methodologies
C loss assumed to extend to 1 m. Emissions persist for as long as it takes soil OC (organic matter) to be oxidized (that is until loss is equivalent to stocks reported in earlier tables).

### Table 4.13 Annual Emission Factors (EF\textsubscript{DR}) Associated Drainage (EF\textsubscript{DR}) on Aggregated Organic and Mineral Soils (Tonnes C ha\textsuperscript{-1} yr\textsuperscript{-1})

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>EF\textsubscript{DR}</th>
<th>95% CI</th>
<th>Range</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal marshes and mangroves</td>
<td>7.9\textsuperscript{1}</td>
<td>5.2, 11.8</td>
<td>1.2 – 43.9</td>
<td>22</td>
</tr>
</tbody>
</table>

\textsuperscript{1} Camporese et al. (2008), Deverel & Leighton (2010), Hatala et al. (2012), Howe et al. (2009), Rojstaczer & Deverel (1993)

Data from 3 sites:
- Camporese et al. - a drained cropped peatland south of Venice, Italy (was a Phragmites site)
- Deverel & Leighton, Hatala et al., Rojstaczer & Deverel - Sacramento-San Joaquin Delta, California, USA, freshwater tidal
- Howe et al. - Hunter Estuary, Australia (mangroves and salt marsh)
Climate of these sites

Sacramento Delta, California
8-24 °C

Venice Lagoon, Italy
0-7°C

Hunter Estuary, NSW Australia
10°C
Compare IPCC sources to climate of other sites where drainage has been prevalent & in some cases continues to occur.
Marsh “reclamation” or dyking & drainage has been extensive on Canada’s east coast, particularly the mesotidal St. Lawrence (2-3 m) & macrotidal Bay of Fundy (6-11 m).

dyking on St. Lawrence Estuary
1859
Fundy
mid 17th century
Methods –
Decomposition bag study in marsh and farm
Aboveground on soil surface
Belowground material at 15 cm soil depth

van Ardenne et al. in preparation
Results –
Decomposition bag study in marsh and farm
Shows considerable carbon can be lost in the first year
Discount role of temperature:
a 3-6% increase in decay rate per °C (Kirwan et al. 2014)
Farm soil was ~1 °C higher = 6% increase in decay

We assume wherever drainage has occurred, a minimum of 37.6% blue carbon lost in the 1st yr.
Cored to basal marine clay in farm and marsh, controlling for compaction, measuring bulk density and OC by LOI.

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Flooded marsh
(3 cores)

Carbon density (g cm\(^{-3}\))

Bulk density (g cm\(^{-3}\))

Drained marsh
(14 cores)

Carbon density (g cm\(^{-3}\))

Higher C density in surface due to agricultural management

Mean ±sd
Results –

Despite the surface C enrichment due to agriculture...
The deposit above the marine clay in the undrained marshes is thicker & stores 265 - 642 tonne C ha\(^{-1}\)
farm soil deposit stores 47 - 461 tonne C ha\(^{-1}\)

Average Rate of loss
4.91 tonnes C ha\(^{-1}\) yr\(^{-1}\)

IPCC average
7.9 tonnes C ha\(^{-1}\) yr\(^{-1}\)

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As much as 39% of the original C stock has been lost.

Farms may still be losing C and we can regain carbon by restoring them – but we have to convince the agriculture community.

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Acknowledgements

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Thanks!

Abandoned dyke
Bay of Fundy

St. Lawrence River estuary
Recent History of Lusby Marsh

1935

1959

1979

Filling the gaps: Return of ecosystem services
Filling the gaps: Return of ecosystem services