Accounting for Human Induced Flows in Nature

Matthew Chambers[1], Nils Brown[2], Kaia Oras[3], Aldo Femia[4], Sjoerd Schenau[5]

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1. U.S. BEA; 2. Stats Sweden; 3. Stats Estonia; 4. Istat; 5. Stats Netherlands

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bea
Bureau of Economic Analysis
U.S. DEPARTMENT OF COMMERCE

Background

- **SEEA CF physical flow accounts**: Flows occurring within the environment are specifically excluded (SEEA-CF 3.23)
- However, several **borderline cases**: physical flows in the environment that are clearly human induced
- **Aim of this paper**: define human induced flow and propose a framework for recording a these in the physical supply-use tables of the SEEA CF
- Contribute to the following issues in the **SEEA CF update issue list**:

  B3: Inclusion of LULUCF in air emission accounts.

  B4: Inclusion of carbon flows.

  B12: Borderline cases for the production boundary.

Overview

- What are “human induced flows in nature”?
- Examples
- Proposed framework
- Recommendations
- Questions for discussion
- Presentation of example from Estonia by Kaia Oras

Human Induced Flows in Nature

- “In nature”
- “Human induced”
- Examples
  - LULUCF
  - Carbon capture and storage
  - Secondary atmospheric particle formation
  - Transboundary pollution flows
- Currently excluded from SEEA CF
  - In practice
  - Explicitly

Proposed Framework

- Considerations:
  - Industry/period attribution may be difficult
  - Analogy with landfill emissions?
- Possible approaches (Schenau 2023):
  - Exclude (status quo)
  - Include and attribute to industries/sectors
  - Include without attributing to industries/sectors
- Proposal:
  - New (optional) group of columns in PSUTs
  - Columns generally represent processes, not industries
  - Choice of columns to include is left to countries

Land Use, Land Use Change, and Forestry

CO_2 from Land Use: Land Use, Land Use Change and Forestry (LULUCF)

Agriculture non-CO_2 (CH_4, N_2O): Effort Sharing Regulation

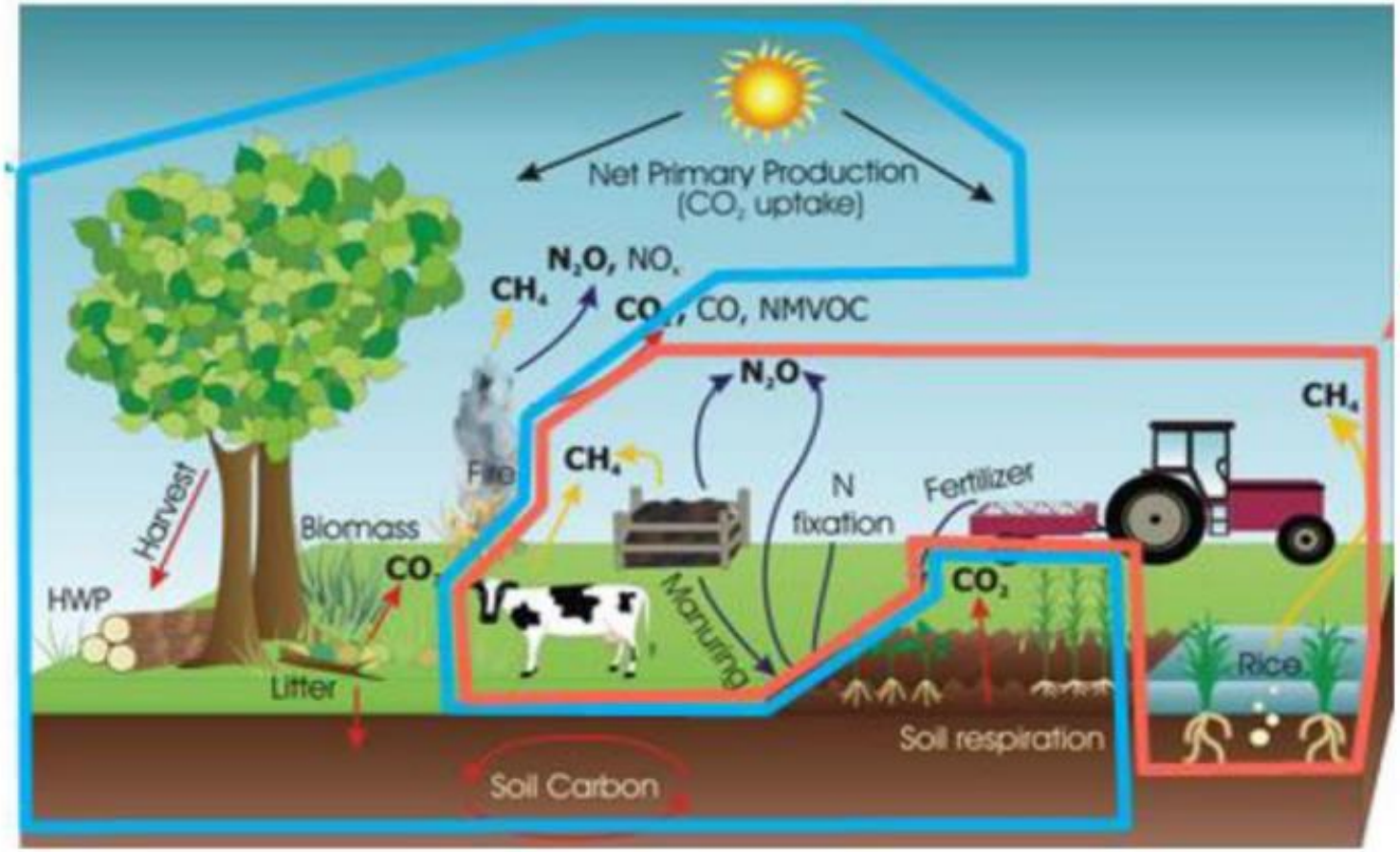


Illustration adapted from Schenau 2023

Example A.1: LULUCF

Supply	Industries			Accumulation		
	Agriculture	Forestry	Mining/ Manuf.	Gov't	Households	Landfills
CO_2	110	20	580	90	250	0
CH_4	35	0	0	0	0	16

Supply	Human Induced Flows in Nature								
	Land Use			Land Use Change					
	Forest	Cropland	Wetland	Forest	Cropland	Wetland	Settlement	HWP	Total
CO_2	30	80	15	0	25	5	35	20	1260
CH_4	0	0	8	0	0	0	0	0	59

Use	Human Induced Flows in Nature									
	Land Use			Land Use Change						
	Forest	Cropland	Wetland	Forest	Cropland	Wetland	Settlement	HWP	Environment	Total
CO_2	400	0	0	45	0	0	0	0	815	1260
CH_4	0	0	0	0	0	0	0	0	59	59

Example A.1: LULUCF

Supply	Industries					Accumulation
	Agriculture	Forestry	Mining/ Manuf.	Gov't	Households	Landfills
CO_2	110	20	580	90	250	0
CH_4	35	0	0	0	0	16

Supply	Human Induced Flows in Nature								
	Land Use			Land Use Change					
	Forest	Cropland	Wetland	Forest	Cropland	Wetland	Settlement	HWP	Total
CO_2	30	80	15	0	25	5	35	20	1260
CH_4	0	0	8	0	0	0	0	0	59

Use	Human Induced Flows in Nature									
	Land Use			Land Use Change						
	Forest	Cropland	Wetland	Forest	Cropland	Wetland	Settlement	HWP	Environment	**Total**
CO_2	400	0	0	45	0	0	0	0	815	**1260**
CH_4	0	0	0	0	0	0	0	0	59	**59**

Example A.2: Simplified LULUCF

Supply

	Industries			Accumulation				
	Agriculture	Forestry	Mining/ Manuf.	Gov't	Households	Landfills	**Human Induced Flows in Nature**	Total
CO_2	110	20	580	90	250	0	**210**	1260
CH_4	35	0	0	0	0	16	**8**	59

Use

	Human Induced Flows in Nature	Environment	Total
CO_2	**445**	815	1260
CH_4	**0**	59	59

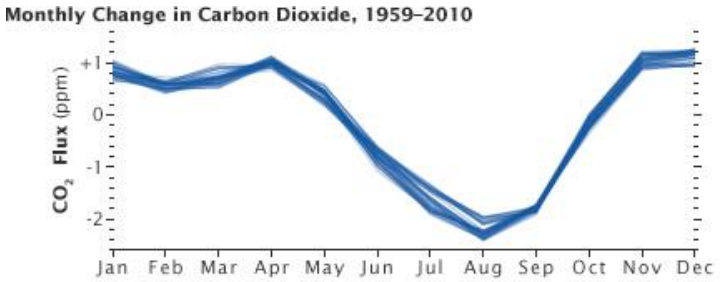
Carbon Cycles

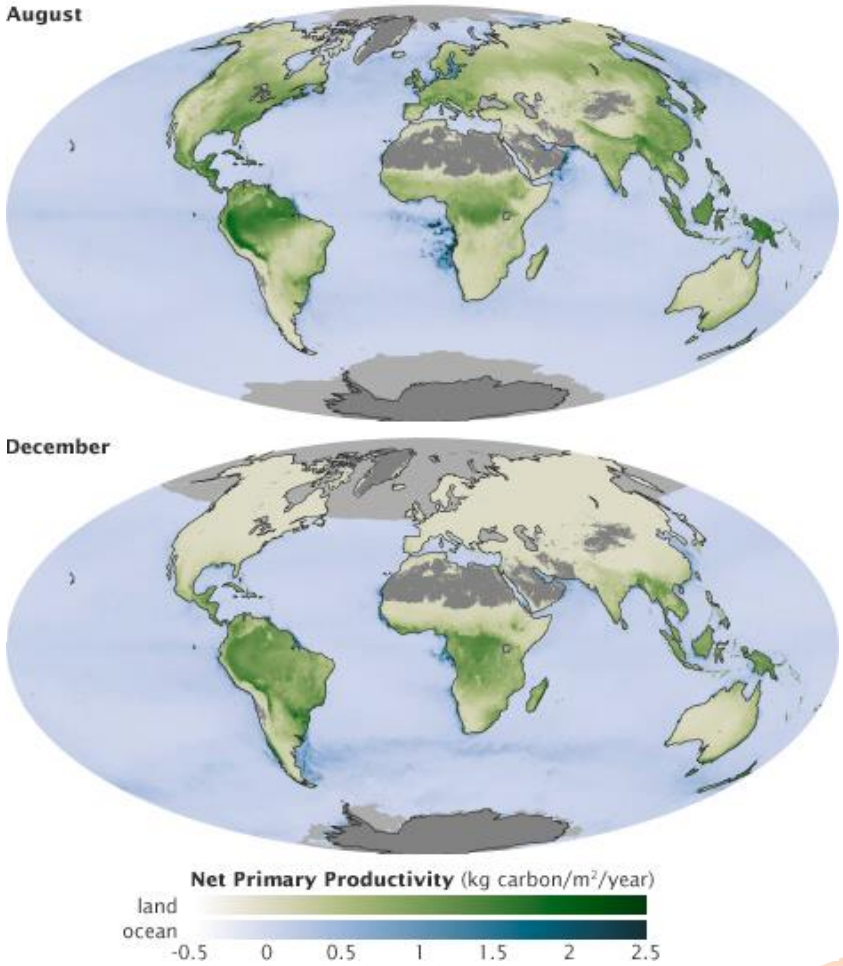
- Biogenic vs. fossil carbon
  - Radiative forcing
  - Policy treatment
  - Biomass fuel is very important in some countries

Carbon Cycles

- Biogenic vs. fossil carbon

- Short/fast carbon cycle
  - Biosphere
  - Days to years
  - Biogenic fuel

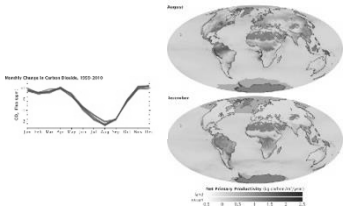




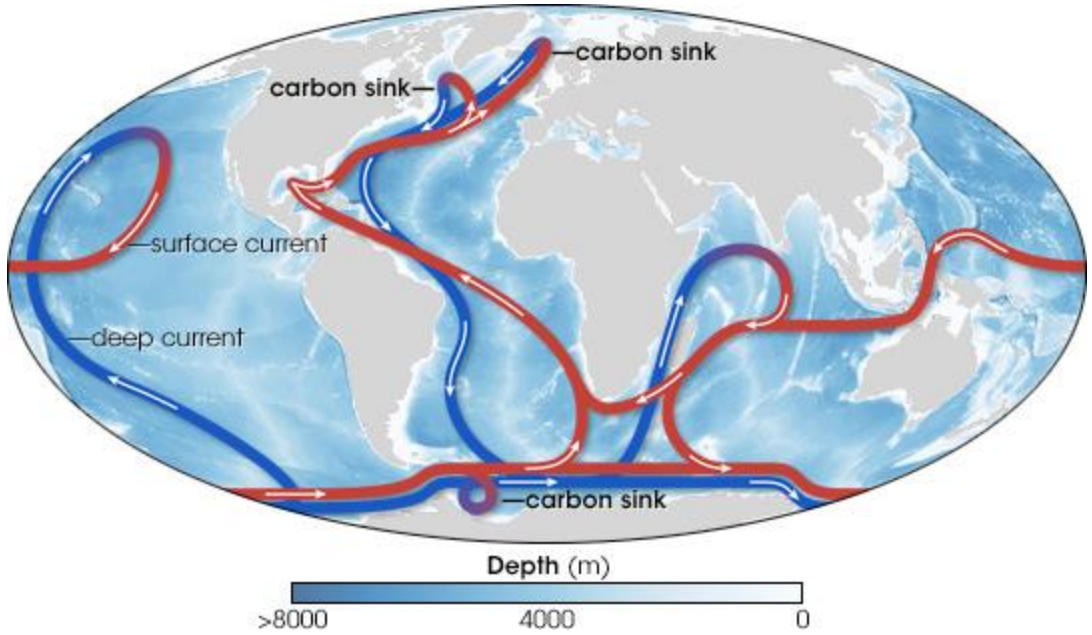
Graph by Marit Jentoft-Nilsen and Robert Simmon, using data from the NOAA Earth System Research Laboratory. Maps by Robert Simmon and Reto Stöckli, using MODIS data.

Carbon Cycles

- Biogenic vs. fossil carbon
- Short/fast carbon cycle



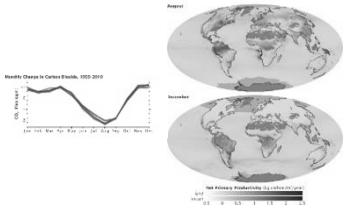
- Long/slow carbon cycle
  - Geologic and oceanic
  - Centuries to millions of years
  - Fossil fuel+



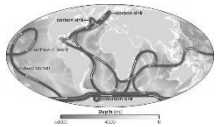
Map by Robert Simmon, adapted from the IPCC 2001 and Rahmstorf 2002.

Carbon Cycles

- Biogenic vs. fossil carbon
- Short/fast carbon cycle



- Long/slow carbon cycle



- Differentiating in the accounts
  - Short-cycle CO_2: biofuels and LULUCF
  - Long-cycle CO_2: all other emissions

Example A.3: Carbon Cycles

Supply

	Industries					Accumulation
	Agriculture	Forestry	Mining/ Manuf.	Gov't	Households	Landfills
Long-cycle CO_2	110	20	530	90	250	0
Short-cycle CO_2	0	0	50	0	0	0
CH_4	35	0	0	0	0	16

Supply

	Human Induced Flows in Nature								
	Land Use			Land Use Change					
	Forest	Cropland	Wetland	Forest	Cropland	Wetland	Settlement	HWP	Total
Long-cycle CO_2	0	0	0	0	0	0	0	0	1000
Short-cycle CO_2	30	80	15	0	25	5	35	20	260
CH_4	0	0	8	0	0	0	0	0	59

Use

	Human Induced Flows in Nature									
	Land Use			Land Use Change						
	Forest	Cropland	Wetland	Forest	Cropland	Wetland	Settlement	HWP	Environment	Total
Long-cycle CO_2	0	0	0	0	0	0	0	0	1000	1000
Short-cycle CO_2	400	0	0	45	0	0	0	0	-185	260
CH_4	0	0	0	0	0	0	0	0	59	59

Example B: Carbon Capture and Storage

Use	Human Induced Flows in Nature								Environment		
	Land Use			Land Use Change							
	Forest	Cropland	Wetland	Forest	Cropland	Wetland	Settlement	HWP	Atmosphere	**Geologic Storage**	Total
Long-cycle CO_2	0	0	0	0	0	0	0	0	900	**100**	1000
Short-cycle CO_2	400	0	0	45	0	0	0	0	-235	**50**	260
CH_4	0	0	0	0	0	0	0	0	59		59

Secondary Fine Particle Air Pollution (PM 2.5)

- Formed through chemical reactions from:
  - Sulfur dioxide
  - Nitrogen oxides
  - Volatile organic compounds
  - Ammonia
- In some places, a majority of PM 2.5
- Complex; expert consultation needed to characterize

Example C: Secondary PM 2.5

Supply	Industries					Human Induced Flows in Nature	
	Agriculture	Utilities	Manufacturing	Gov't	Households	PM 2.5-Forming Reactions	Total
Primary PM 2.5	70	100	40	35	40		285
Secondary PM 2.5						**400**	**400**
SO_2	0	130	60	0	0		190
NO_x	0	100	60	50	150		360
NH_3	350	5	5	5	15		380
VOCs	80	15	250	80	200		625

Use	Human Induced Flows in Nature		
	PM 2.5-Forming Reactions	Environment	Total
Primary PM 2.5	**0**	285	285
Secondary PM 2.5	**0**	**400**	**400**
SO_2	**75**	115	190
NO_x	**100**	260	360
NH_3	**200**	180	380
VOCs	**275**	350	625

Example D: Transboundary Pollution Flows

Supply

	Industries					Human Induced Flows in Nature		
	Agriculture	Utilities	Manufacturing	Gov't	Households	PM 2.5-Forming Reactions	**Imports**	Total
Primary PM 2.5	70	100	40	35	40		**20**	305
Secondary PM 2.5						400	**50**	450
SO_2	0	130	60	0	0		**15**	205
NO_x	0	100	60	50	150		**70**	430
NH_3	350	5	5	5	15		**160**	540
VOCs	80	15	250	80	200		**60**	685

Use

	Human Induced Flows in Nature			
	PM 2.5-Forming Reactions	**Exports**	Environment	Total
Primary PM 2.5	0	**40**	265	305
Secondary PM 2.5	0	**75**	375	450
SO_2	75	**30**	100	205
NO_x	100	**60**	270	430
NH_3	200	**130**	210	540
VOCs	275	**75**	335	685

Recommendations

- Extend SEEA-CF to include human induced flows in the environment
- An optional new column group in the PSUTs titled “Human induced flows in nature”
- Countries should choose which human induced flows in nature to include based on magnitude, policy relevance, and data availability
- Include the examples described in this paper in the SEEA-CF

Questions for Discussion

- Other flows in scope for this framework?
- Secondary PM 2.5 formed from anthropogenic and natural reactants?
- Long-cycle/short-cycle methane?
- Peat-related carbon flows: short- or long-cycle?
- Geologic carbon dioxide storage: economy or environment?
- Experiences of countries working along similar lines?