ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

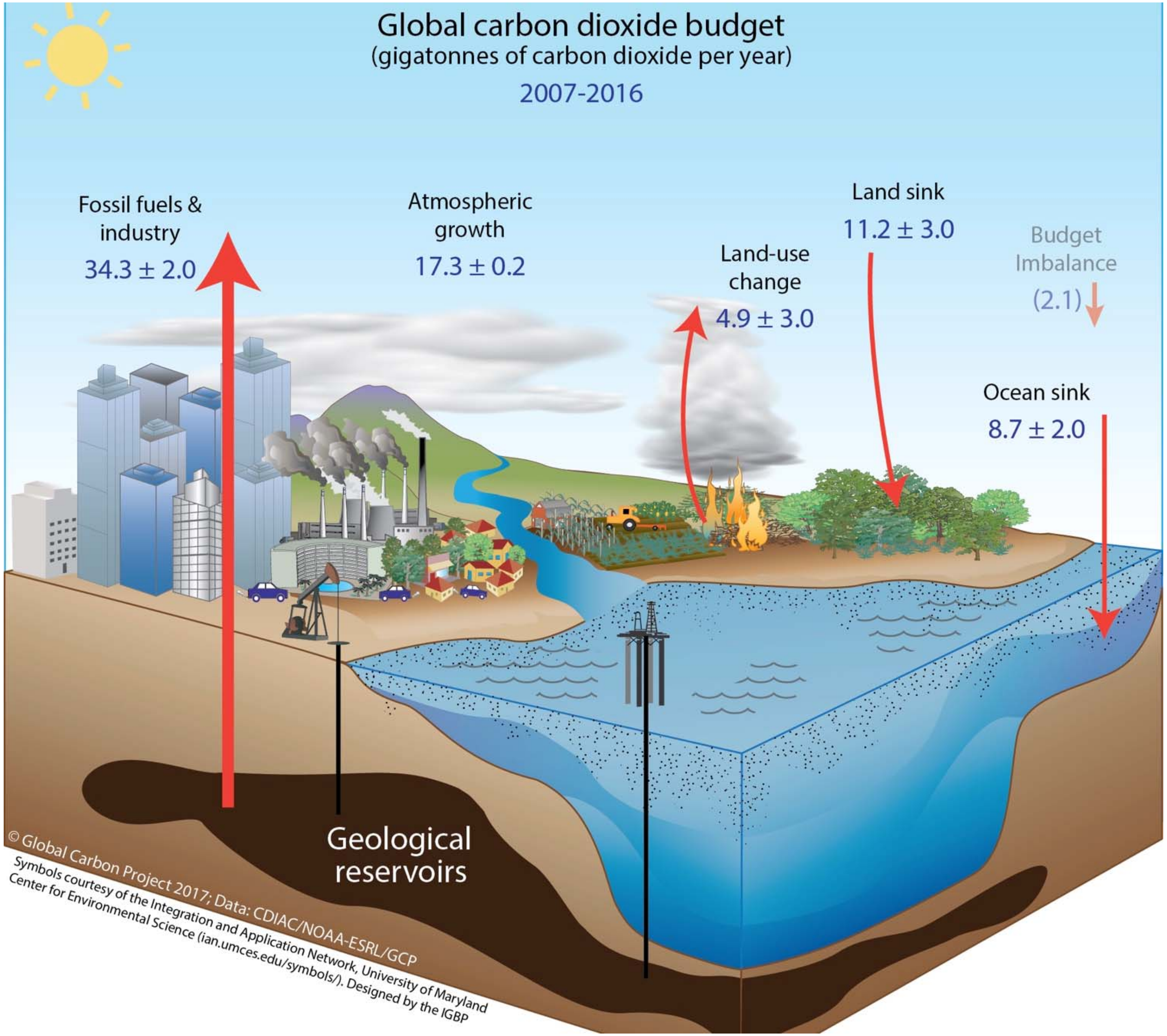
Miten hiilen sidonta todennetaan?

Jari Liski

@JariLiski

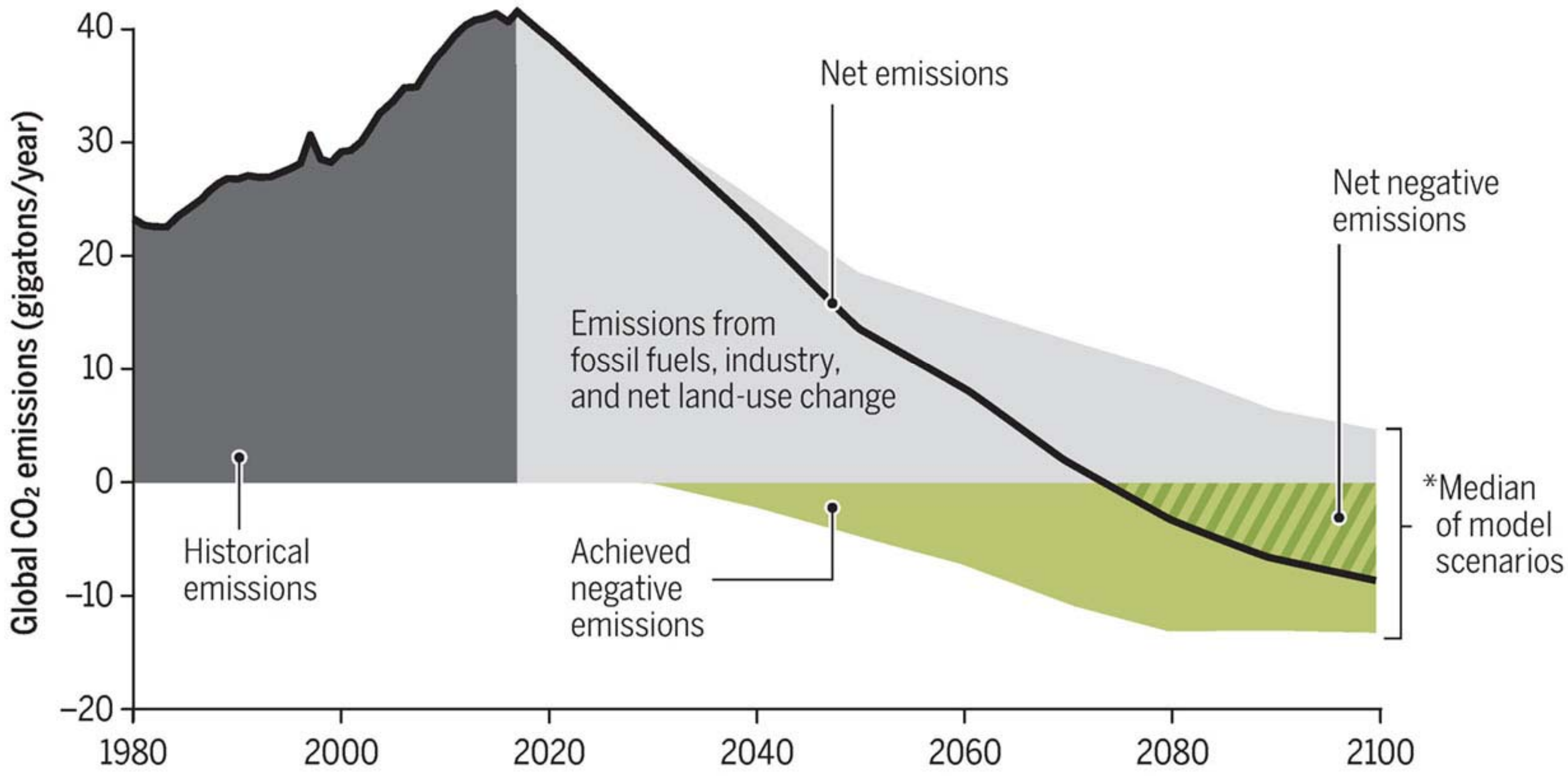
23.5.2019

Eloisa pelto – Hiiliviljelyn tutkimusta ja käytäntöjä


Global carbon dioxide budget
(gigatonnes of carbon dioxide per year)
2007-2016
Fossil fuels & industry
34.3 ± 2.0
Atmospheric growth
17.3 ± 0.2
Land-use change
4.9 ± 3.0
Land sink
11.2 ± 3.0
Budget Imbalance
(2.1)
Ocean sink
8.7 ± 2.0
Geological reservoirs
© Global Carbon Project 2017; Data: CDIAC/NOAA-ESRL/GCP
Symbols courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/symbols/). Designed by the IGBP

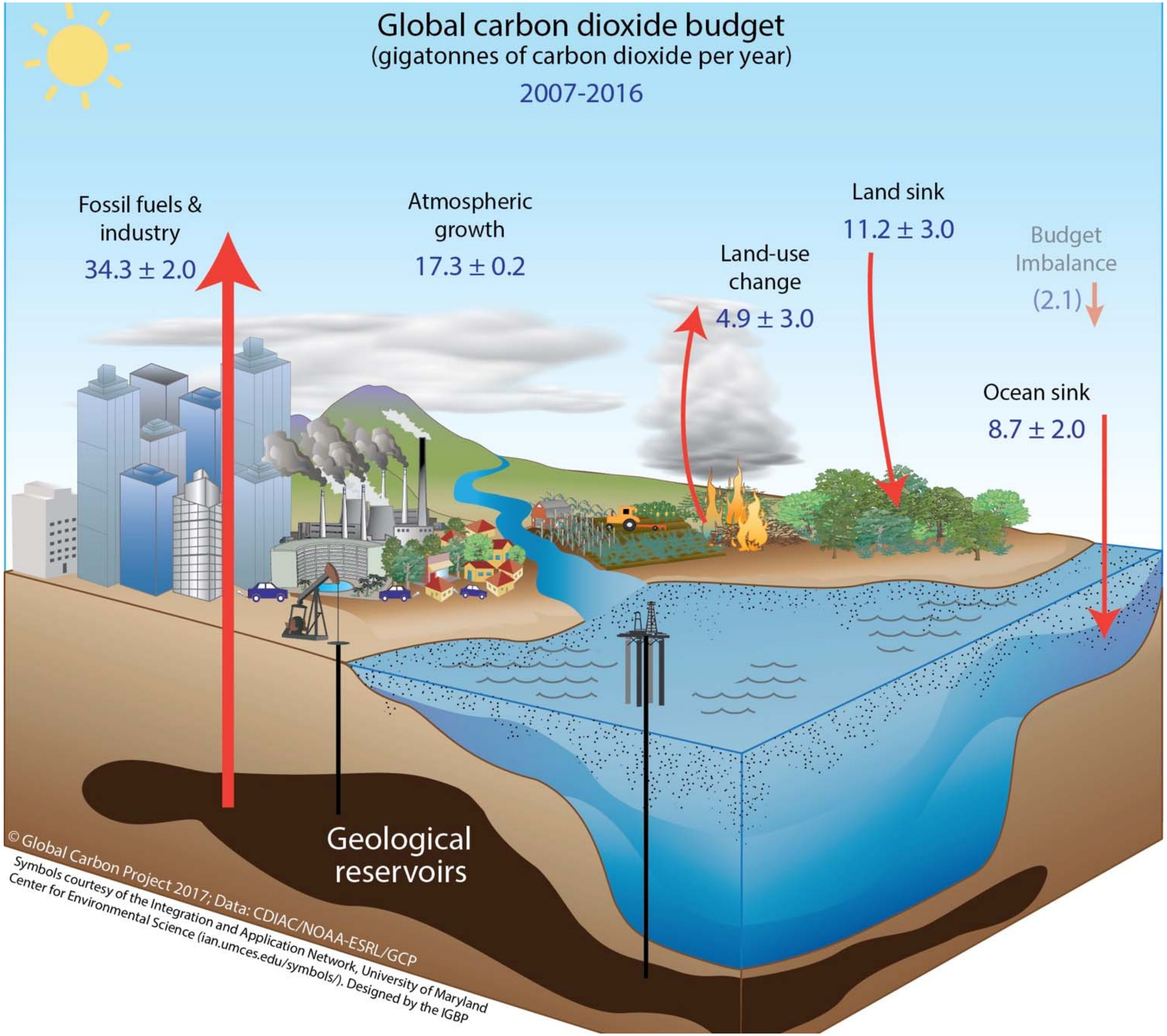
A global unwinding

In order to prevent the world from warming more than 2°C, models count on the fast development of NETs. But many scientists question whether they can be scaled up in time.



*Median values at 10-year time steps of 18 scenarios evaluated by six models using shared socioeconomic pathways assessed in the next report of the Intergovernmental Panel on Climate Change.

Rosen. 2018. Science.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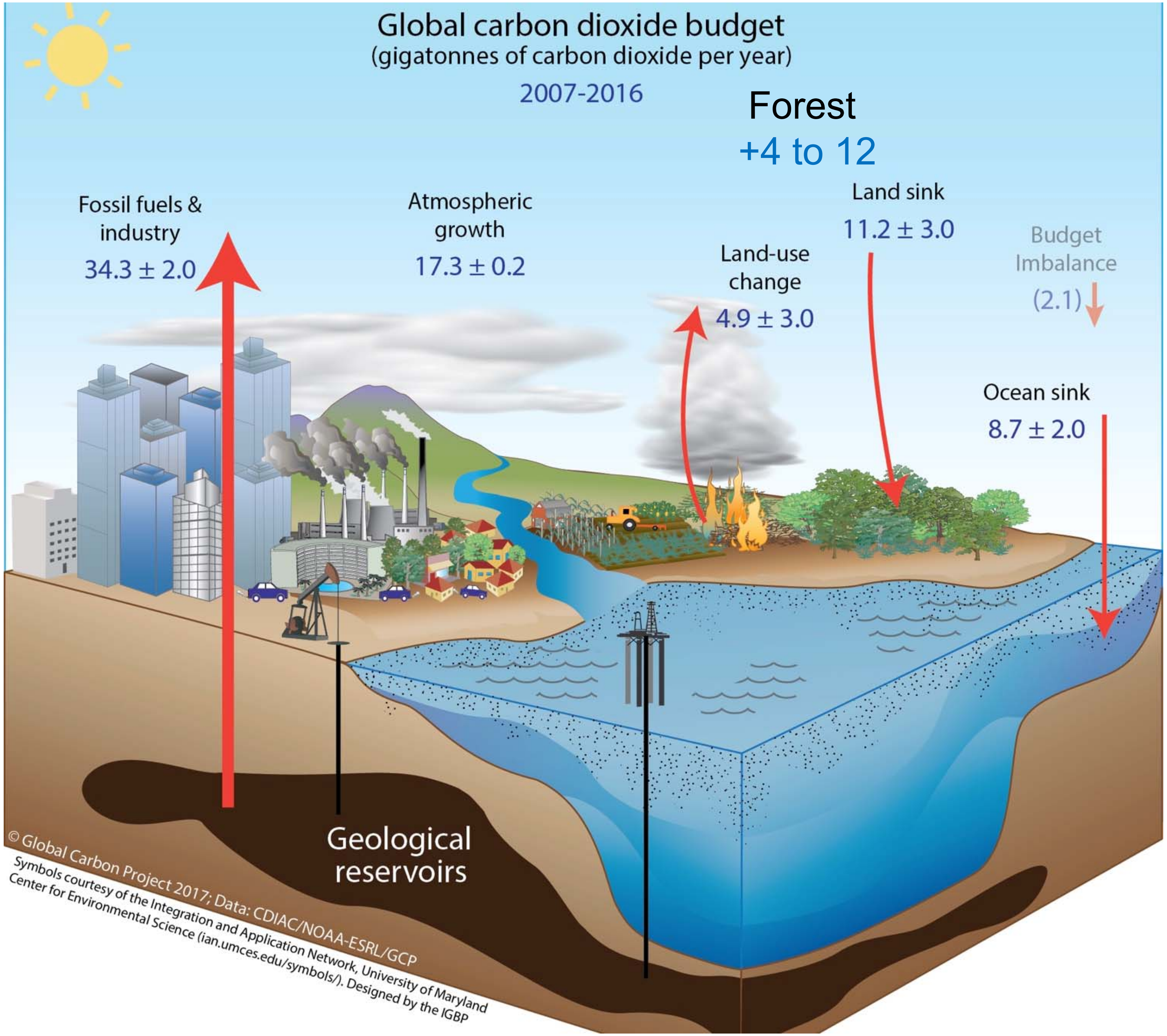
Global carbon dioxide budget
(gigatonnes of carbon dioxide per year)
2007-2016
Forest
+4 to 12
Fossil fuels & industry
34.3 ± 2.0
Atmospheric growth
17.3 ± 0.2
Land-use change
4.9 ± 3.0
Land sink
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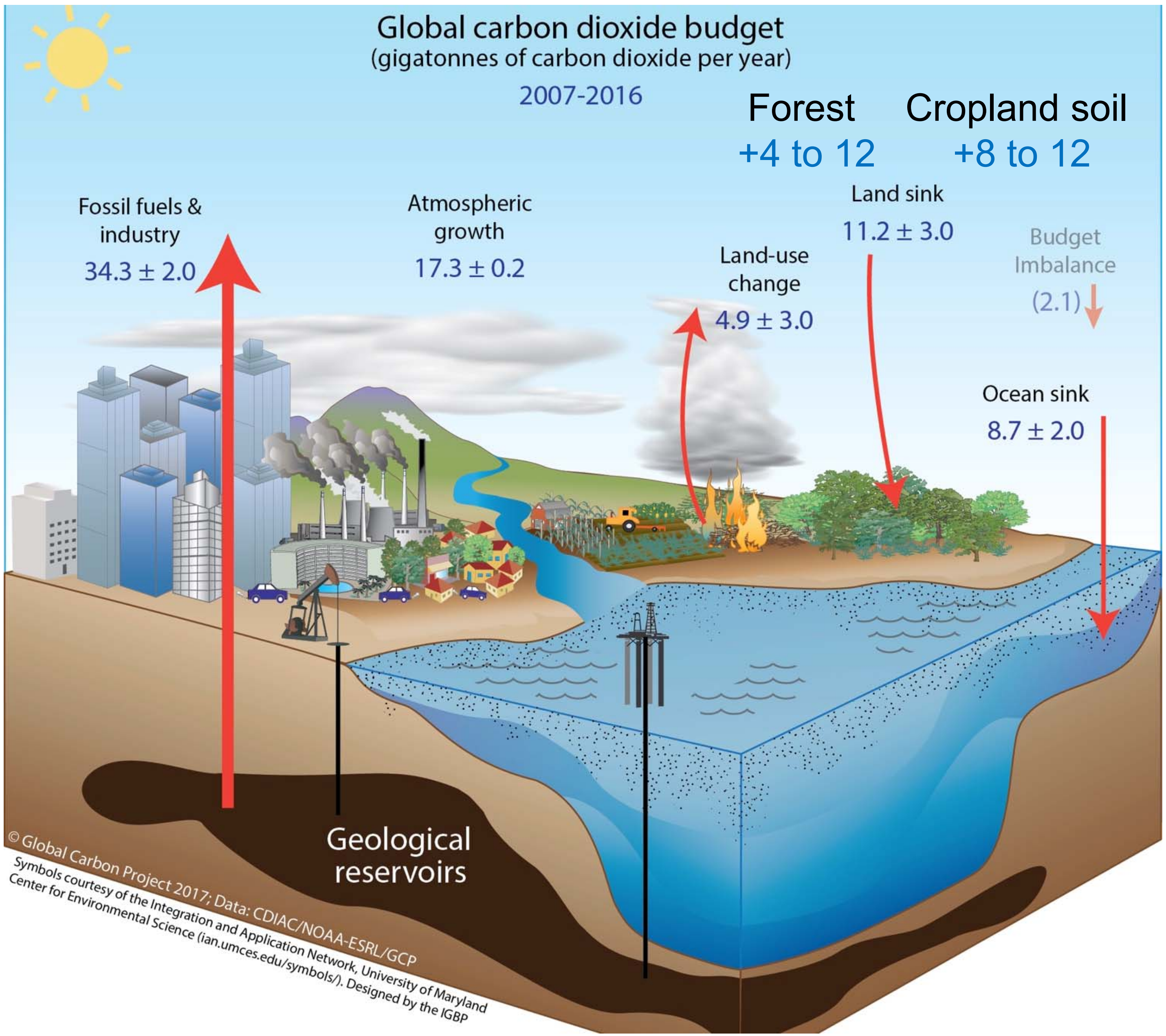
EASAC. 2018.


Global carbon dioxide budget
(gigatonnes of carbon dioxide per year)
2007-2016
Forest
+4 to 12
Cropland soil
+8 to 12
Fossil fuels & industry
34.3 ± 2.0
Atmospheric growth
17.3 ± 0.2
Land sink
11.2 ± 3.0
Land-use change
4.9 ± 3.0
Budget Imbalance
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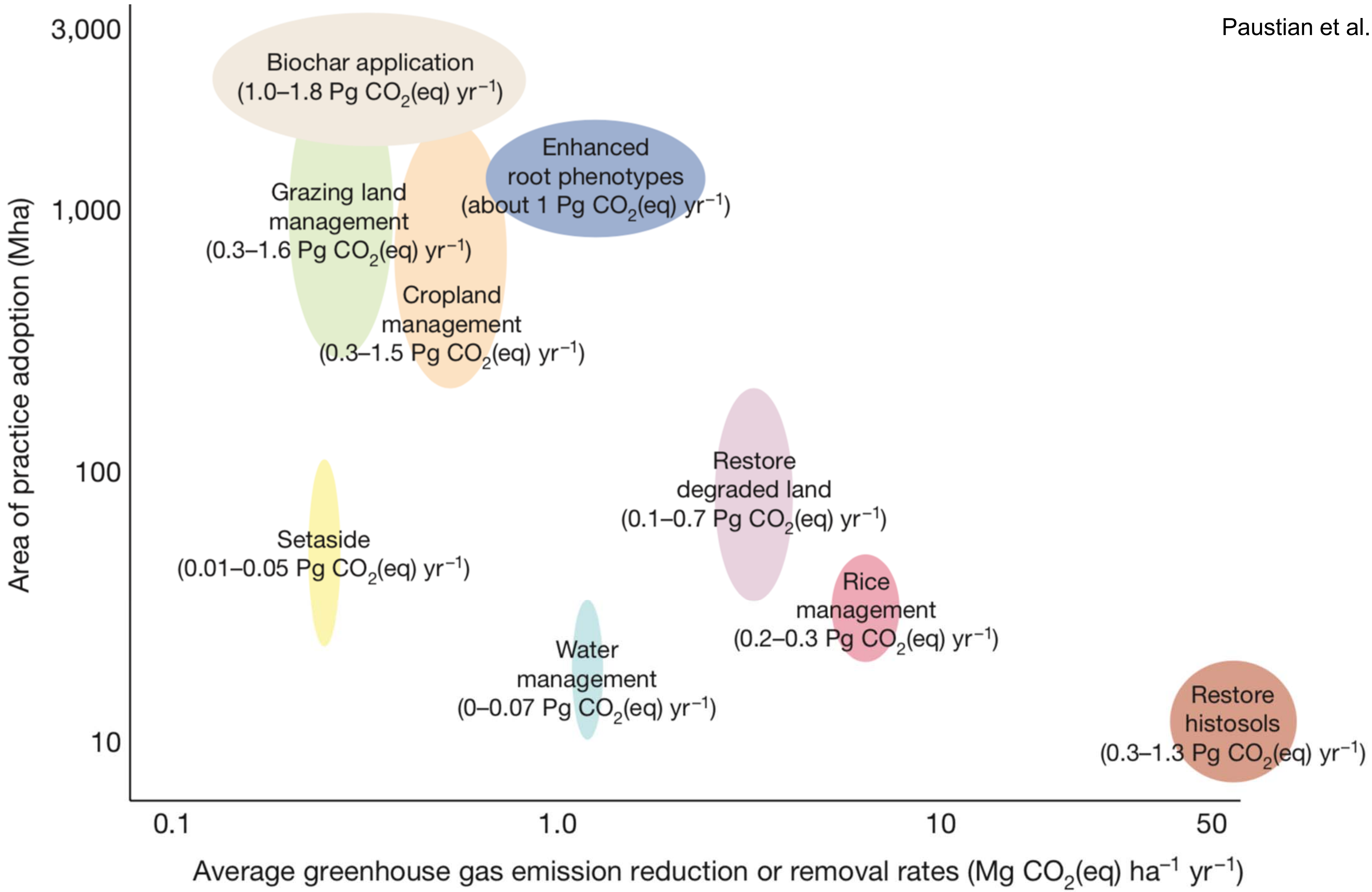
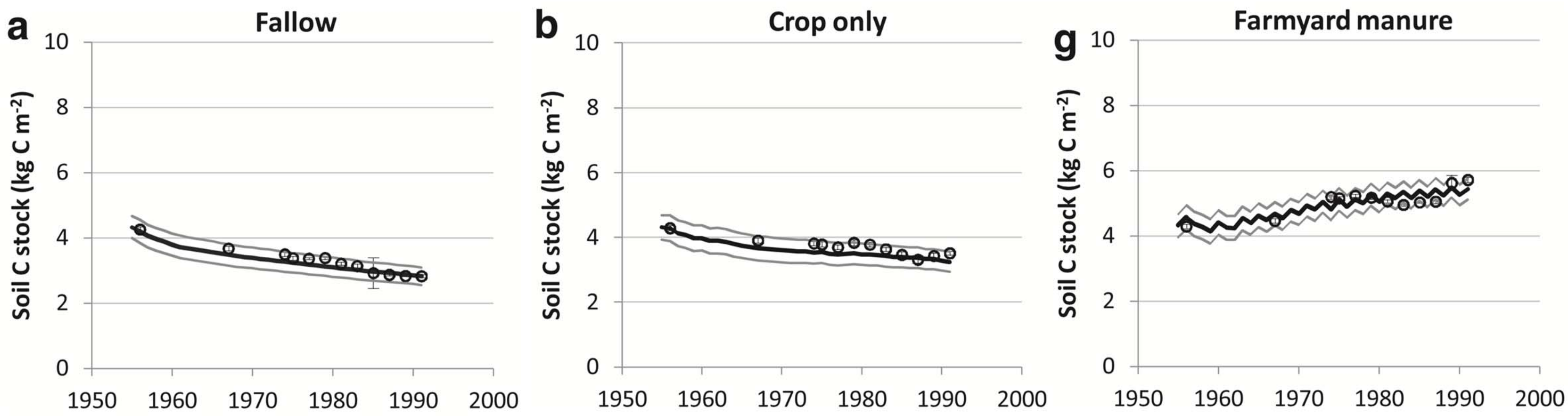


Paustian et al. 2016. Nature.

Vaatimukset hiilen sidonnan todentamiselle

- Sovellettavissa laajasti
- Ei este hiilinielujen käytölle ilmastotyössä
- Huomioitava lisäisyys (additionality), pysyvyys (permanence), vuodot (leakage)
- IPCC Good Practice Guidelines ja Guidance
  - Transparent + Complete + Internally Consistent + Comparable between countries + Accurate
- ‘Hyväksyttävyys’

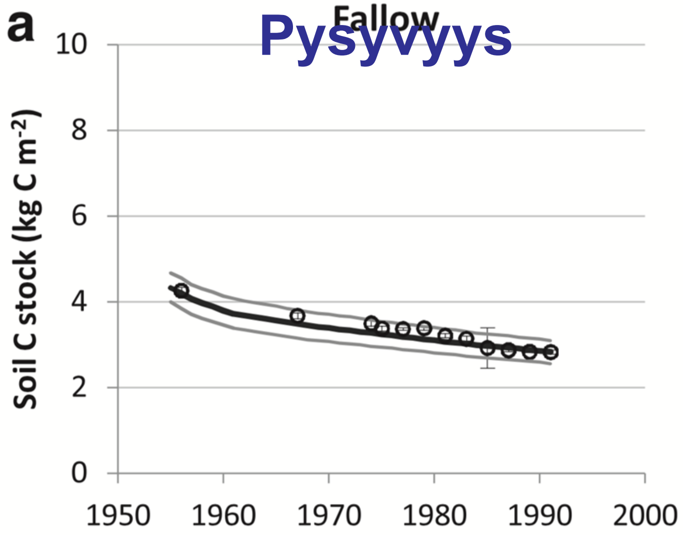
Lisäisyys ja pysyvyys maaperän hiilen sidonnassa



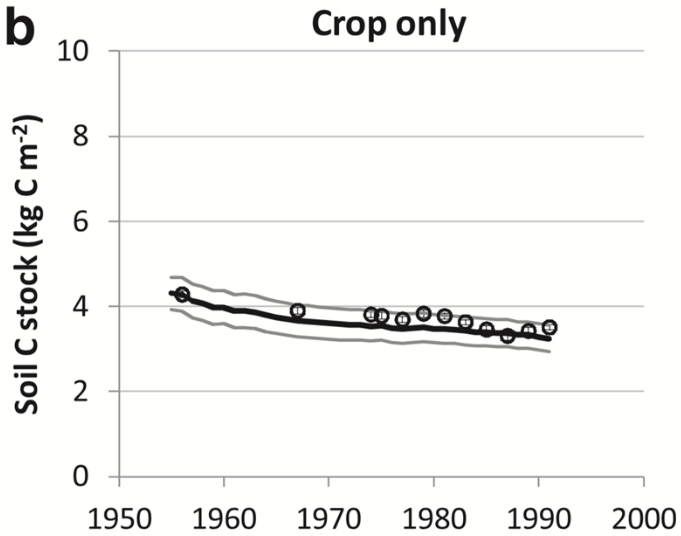
Karhu ym. 2012. Geoderma.

Lisäisyys ja pysyvyys maaperän hiilen sidonnassa

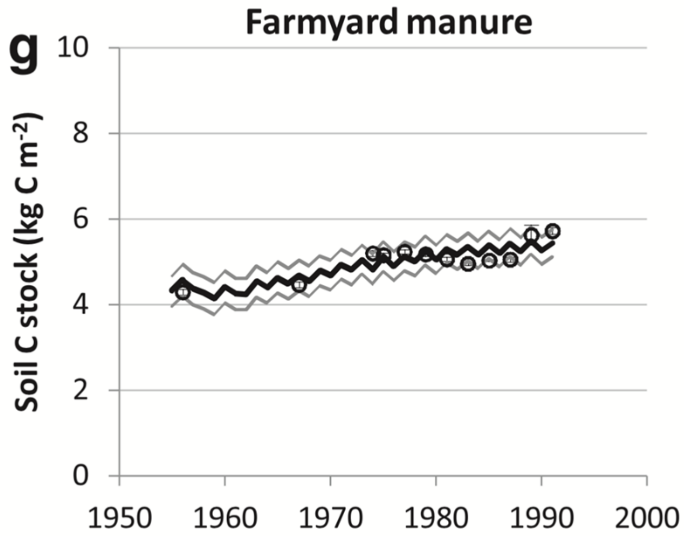
Pysyvyys



Baseline



Hiiliviljely



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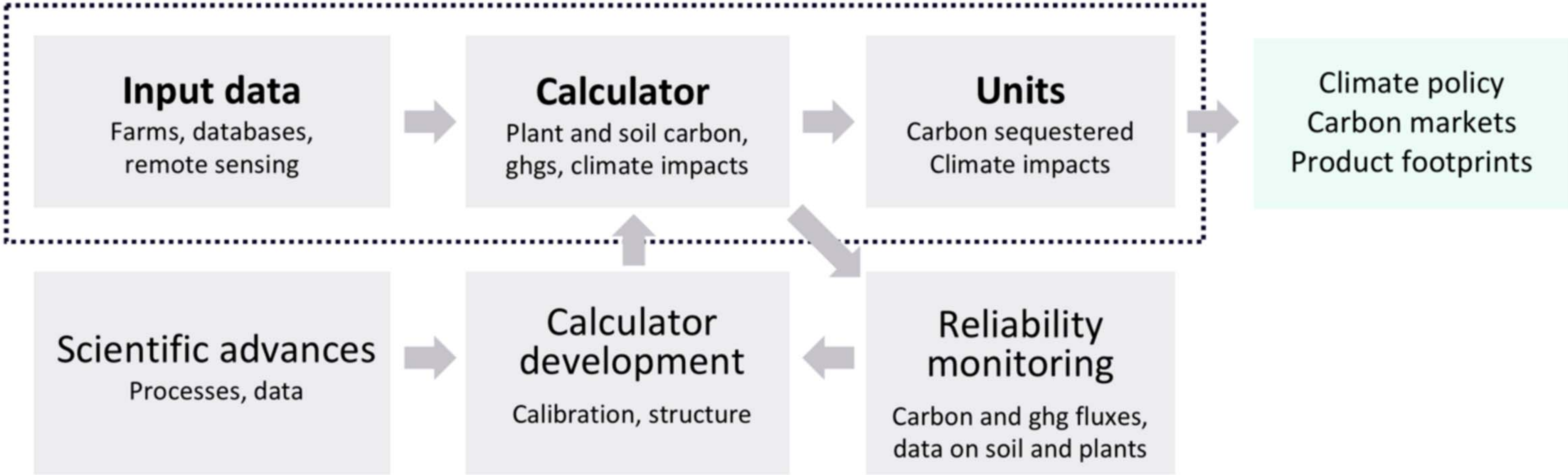
Karhu ym. 2012. Geoderma.

Hiilen sidonnan todentamisjärjestelmä



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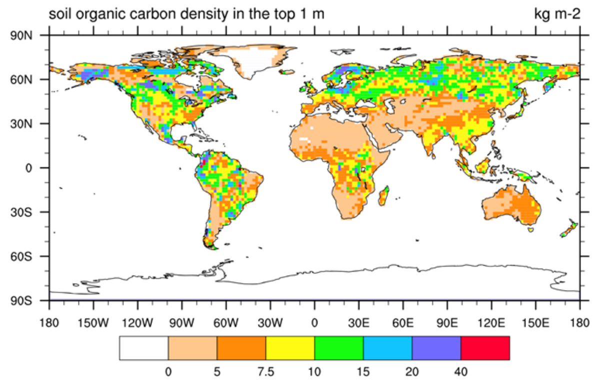
Jari Liski 2019

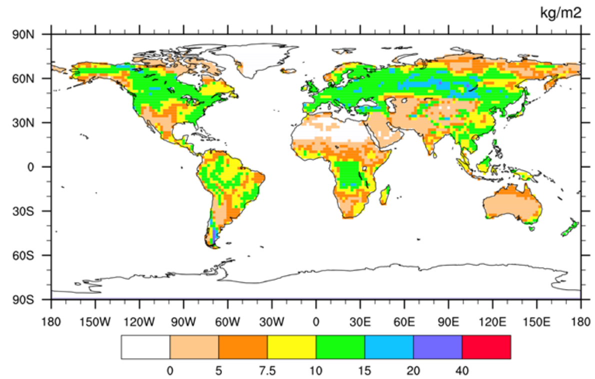
Soil carbon model Yasso

- FMI's soil carbon model
  - Based on a large global dataset (n=20 000)
  - Advanced mathematics
- Applications
  - Standard component of Max Planck Institute Earth System Model
  - UNFCCC National Greenhouse Gas Inventories (9 countries)
  - Various other modelling systems
  - About 200 scientific publications
- https://en.ilmatieteenlaitos.fi/yasso

Measurements



Yasso & MPI-ESM



Goll et al. 2014. GBC

BOX 2.2E

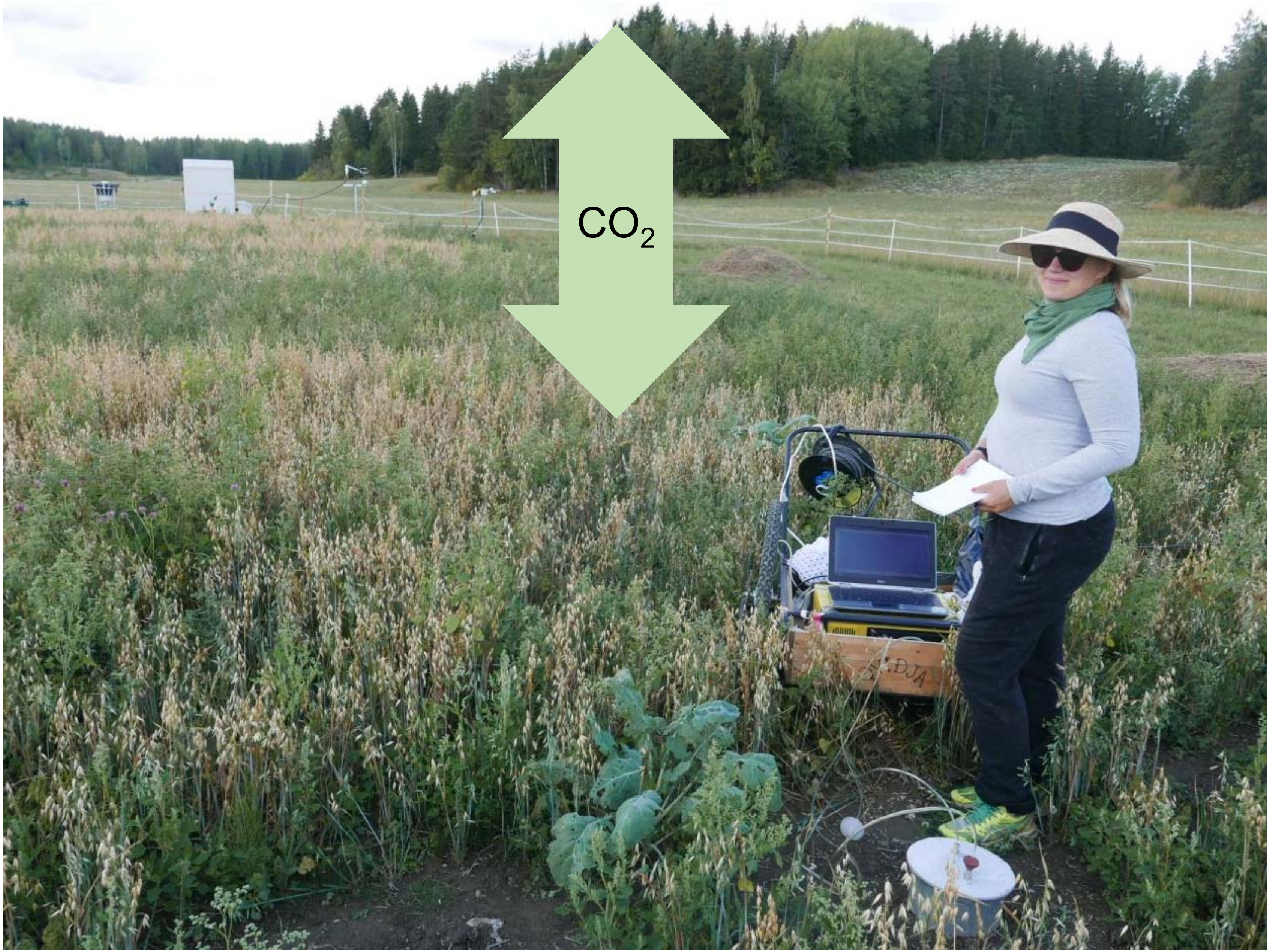
EXAMPLES OF TIER 3 MINERAL SOIL C STOCK CHANGE METHODS (CONTINUED)

Finland

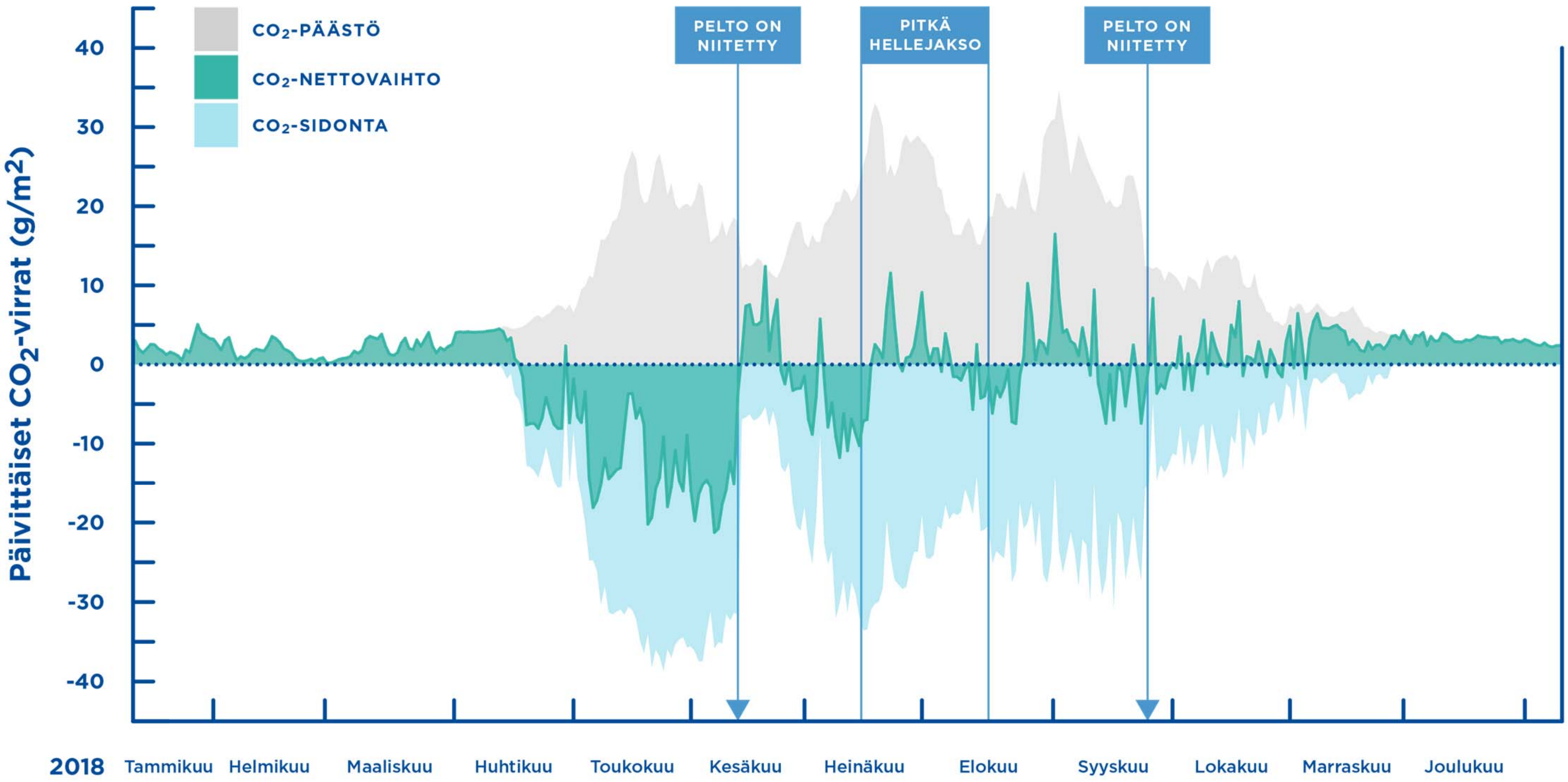
Finland uses Yasso07 soil carbon model as a Tier 3 method to report carbon stock changes on forest and agricultural lands as well as in the cases of land use change (Statistics Finland 2017). Yasso07 is based on a few explicit assumptions on soil carbon cycling and these assumptions form a conceptual model further formulated into mathematical equations (Tuomi *et al.* 2011b; US-EPA 2017). The model has four state variables based on the solubility of the organic material (acid-, water-, ethanol- and non-soluble and in addition, there is a humus pool that has the lowest decay rate.

The model is used in the GHG inventory to generate annual C stock change rates per hectare based on regional estimates of organic matter input (forest and crop statistics) and annual climate parameters. Litter input is given in the four solubility fractions based on laboratory measurements. Organic matter decays in the five model fractions driven by temperature and precipitation. The resulting C stock change rates are applied on the respective land areas to produce regional estimates of C stock change. The model is used consistently across different land use categories so that e.g. the initial C allocation to different model compartments in forest land converted to cropland is based on the results of the simulation of forest soil remaining forest soil.

Model parameters rely on a large global database of measurements of litter decay, wood decay and soil carbon and all parameter values have been estimated using Markov chain Monte Carlo method. Alternative details in the model structure have been evaluated using Bayesian criteria (Tuomi *et al.* 2011a). The results of Yasso07 model are characterized by statistical probability distributions that represent uncertainty about the parameter values. The Yasso07 approach makes it possible and easy to add new data to the database and develop the model continuously (model-data-fusion). Model has been extensively tested against independent data on forest lands (Lehtonen *et al.* 2016; Rantakari *et al.* 2012; Tupek *et al.* 2016) and also on croplands (Karhu *et al.* 2012). Yasso07 is a standard component of Max Planck Institute Earth System Model (Goll *et al.* 2017) and the model is used for UNFCCC reporting in several countries (e.g. Austria, Benin, Czech Republic, Estonia, Ireland, Finland, Latvia, Norway, Romania and Switzerland), see Hernandez *et al.* (2017). The model is widely used because it is simple, transparent, verifiable, freely available and easy to apply. For more information, consult: http://en.ilmatieteenlaitos.fi/yasso


CO_2

PELLON HIILITASETTA VOIDAAN MITATA JATKUVASTI



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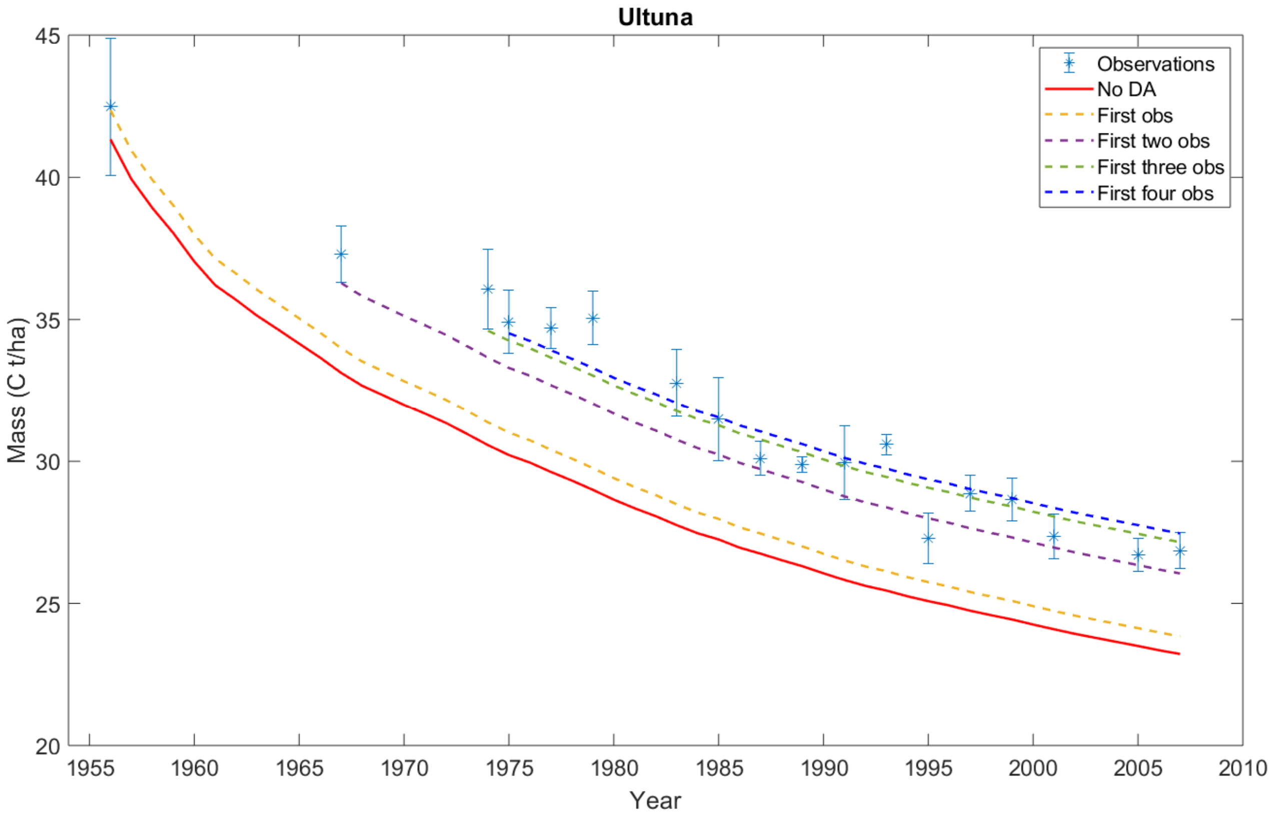
Maaperän hiilimäärän mittaukset tarkentamassa malliennusteita



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Maisa Laine ja Toni Viskari 2019

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Yhdistämällä
- Ymmärrys
- Mittaukset
- Laskenta

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