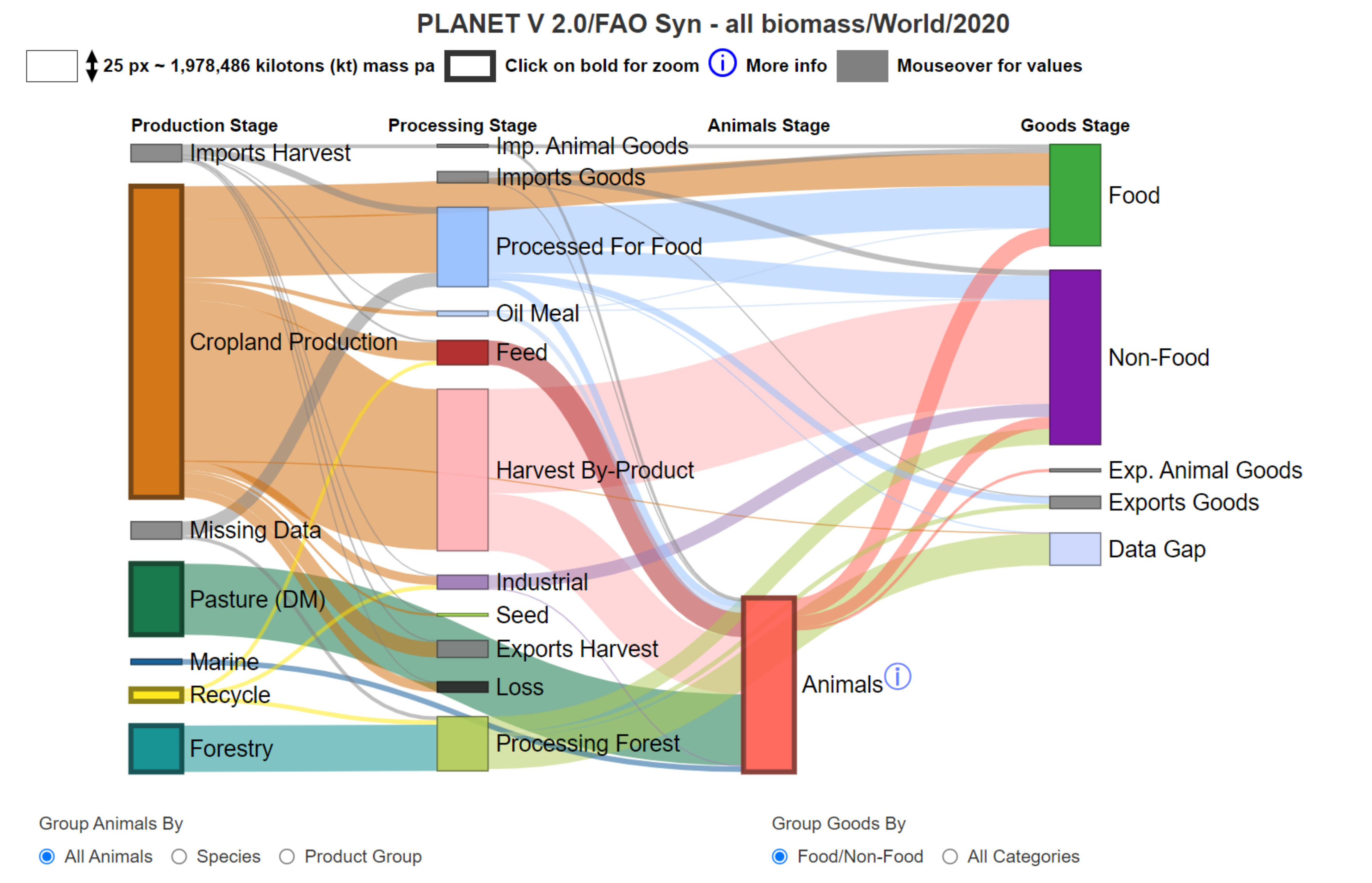
GOAL Sciences

Global Observatory for
Accurate Livestock Sciences

Klimawandel: Sind Kühe, Milchprodukte und Fleischverzehr doch nicht schuld?

2. Februar 2024

GOALSciences.org



Milchundklima.de

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Animal Frontiers – April 2023

System Summit final documentation on Sustainable Livestock, which we believe is a most appropriate statement to conclude this editorial piece. It reads: "*Human civilization has been built on livestock from initiating the bronze-age more than 5000 years ago toward being the bedrock of food security for modern societies today. Livestock is the millennial-long proven method to create healthy nutrition and secure livelihoods, a wisdom deeply embedded in cultural values everywhere. Sustainable livestock will also provide solutions for the additional challenge of today, to stay within the safe operating zone of planet Earth's boundaries, the only Earth we have.*"

Acknowledgments

This Special Issue of Animal Frontiers has been the product of 36 coauthors, and many more unnamed researchers who provided the groundwork for evidence and insights. We are more thankful than words can express for them to contribute their knowledge to this publication. Fourteen authors also presented their findings at the International Summit on the Societal Role of Meat, which was conducted on October 19/20, 2022 in Dublin. The Summit was hosted by Teagasc, the Irish Agriculture and Food Development Authority. Numerous helpers at Teagasc made the Summit possible, among whom we must especially single out the untiring organizational efforts by Dr. Kaye Burgess and Ciara McDonagh. We owe our sincere gratitude to them. At the Summit we were fortunate to welcome close to 200 leading decision makers from the global meat sector, hailing from public administration, associations, the meat and livestock production industries, and the sciences. Across four workshops, they provided invaluable feedback for refining the line of reasoning and avenues for further investigation. Almost 400 viewers watched the proceedings online. The sessions were skillfully moderated by Diana Rogers, Dr. Peter Ballerstedt, and Dr. Theo de Jager. A pre-workshop with around 50 participants for inviting feedback was organized by the Global Meat Alliance in Sacramento, California on September 2, 2022, under the masterly stewardship of Ashley Gray, Connor McGovern, and Kit Arkwright. Susan MacMillan has been an always-giving source of support in our communications. Our deep appreciation to all of you! We are also most thankful to the American Meat Science Association to give us the opportunity to provide their annual Special Issue of Animal Frontiers for our topic. The AMSA Managing Editor, Dr. Anna Dilger, and the Editor-in-Chief, Dr. James L. Sartin of Animal Frontiers, and their network of reviewers and production staff in the background have not only been most helpful and supportive, but also enormously patient and yielding to our many extraordinary demands on publishing this Special Issue. Dr. Marianna Behrends provided all coordination between the editors and the authors streamlining the process in an amazing manner. Their dedication to our science cannot be praised enough. As the two guest editors, we want to emphasize that this Special Issue as well as the International Summit in Dublin has been foremost the product of an incredibly dedicated team effort by six individuals, whose lives crossed paths first at the International Congress of Meat Science and Technology and Reciprocal Meat Conference leading us to this mission. Each member of the team already had a full plate of jobs and cleared the deck to make this effort possible. We therefore consider this Special Issue to be the work of all six members of the organizing team, who have as much claim to creatorship as us. Please therefore consider Collette Kaster (CEO, American Meat Science Association), Dr. Mohammad Koohmaraie (President, Meat Division, IEH Laboratories and Consulting Group), Dr. Rod Polkinghorne (CEO, Birkenwood International), and Dr. Declan Troy (Assistant Director of Research, Teagasc) as equal cocreators. And as last but never the least, we must express our thanks to dedicated team members behind the scenes: Urs Boesswetter, Dr. Holly Cuthbertson, Taras Iliushyk, Enrike Maree, and Alix Neveu who diligently supported all the planning, preparation, and execution throughout.

About the Author(s)

Peer Ederer is founder and director of GOALSciences, the Global Observatory of Accurate Livestock Sciences, which has the mission to research and communicate scientific evidence about the role of animals in the global food system. He has an MBA degree from Harvard University, a PhD in financial economics and holds an adjunct professorship for innovation studies. He has extensive experience in strategy advisory to private companies and public bodies in the global food system and is a frequent presenter on related topics. He has been engaged in scientific research in cooperation with globally leading universities from around the world and is a member of the Scientific Council of the World Farmers Organisation. **Corresponding author**: peer.ederer@goalsciences.org

Frédéric Leroy graduated as a Bioengineer (Ghent University, 1998) and obtained a PhD in Applied Biological Sciences at the Vrije Universiteit Brussel (VUB, 2002), where he now holds a professorship in food science and (bio)technology. His research deals with food processing, human and animal health, and interdisciplinary food studies. He is a Board member of various academic nonprofit societies, that is, the Belgian Association of Meat Science and Technology (president), Belgian Society for Food Microbiology (president), and Belgian Nutrition Society. On a nonremunerated basis, he also serves on various Scientific Boards (e.g., the World Farmers' Organization and the FAO/COAG Sub-Committee on Livestock).

The Dublin Declaration – October 2022

The Dublin Declaration

HNEN UNTERSCHRIFTEN AKTIVITÄTEN AUTHORSHIP ENGLISCH FRANZÖSISCH PORTUGIESISCH SPANISCH DEUTSCH ITALIENISCH

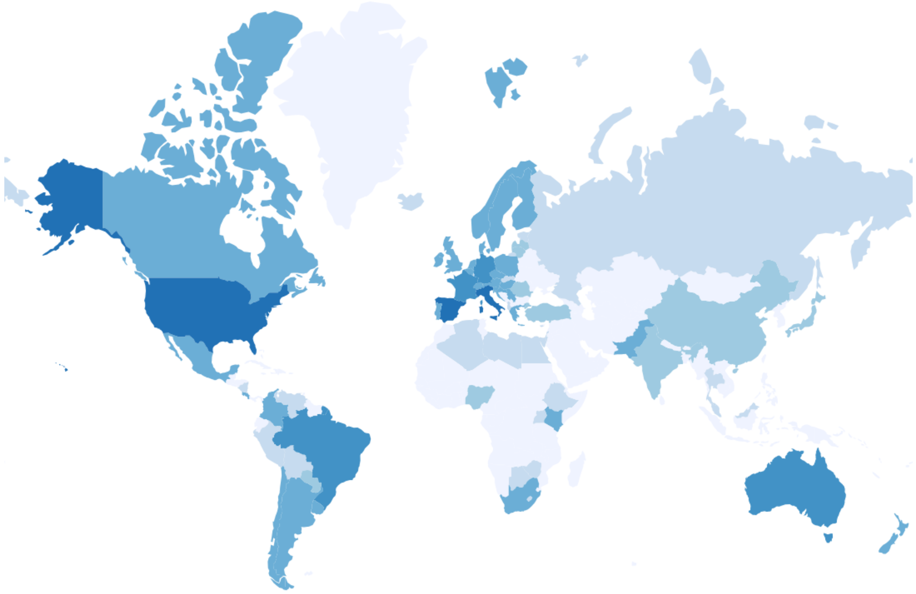
DIE DUBLIN DEKLARATION DER WISSENSCHAFTLER ZUR GESELLSCHAFTLICHEN ROLLE DER NUTZTIERHALTUNG

Absicht dieser Deklaration

Die Nutztierhaltung muss auf der Grundlage höchster wissenschaftlicher Standards weiterentwickelt werden. Sie ist für die Gesellschaft zu kostbar, um Opfer von Vereinfachung, Reduktion oder Fanatismus zu werden. Nutztiere müssen in der Gesellschaft integriert sein und breite Zustimmung finden. Dazu werden Wissenschaftler aufgefordert, verlässliche Nachweise für ihre Ernährungs- und Gesundheitsvorteile, ökologische Nachhaltigkeit, soziokulturelle und wirtschaftliche Werte sowie Lösungen für die vielen erforderlichen Verbesserungen zu liefern. Diese Erklärung soll den vielen Wissenschaftlern weltweit eine Stimme geben, die in den verschiedenen Disziplinen fleißig, ehrlich und erfolgreich forschen, um zu einem ausgewogenen Blick auf die Zukunft der Nutztierhaltung zu gelangen.

Herausforderungen für Nutztiere

Die heutigen Lebensmittelsysteme stehen vor einer beispiellosen doppelten Herausforderung. Einerseits wird gefordert, die Verfügbarkeit von Nahrungsmitteln aus Nutztieren (Fleisch, Milchprodukte, Eier) zu erhöhen, um dazu beizutragen, den ungedeckten Ernährungsbedarf von schätzungsweise drei Milliarden Menschen zu decken, für die Nährstoffmängel zu Wachstumshemmung, Auszehrung, Anämie und anderen Formen der Unterernährung beitragen. Andererseits stellen einige Methoden und der Umfang von Tierproduktionssystemen Herausforderungen in Bezug auf Biodiversität, Klimawandel und Nährstoffflüsse sowie Tiergesundheit und Tierschutz im Rahmen eines umfassenden One-Health-Ansatzes dar. Angesichts des starken Bevölkerungswachstums, das sich hauptsächlich auf sozioökonomisch gefährdete und städtische Bevölkerungsgruppen in der Welt konzentriert, und wo ein Großteil der Bevölkerung für ihren Lebensunterhalt auf Nutztiere angewiesen ist, wachsen die Herausforderungen in Bezug auf Versorgung und Nachhaltigkeit exponentiell und die Förderung evidenzbasierter Lösungen wird immer dringender.



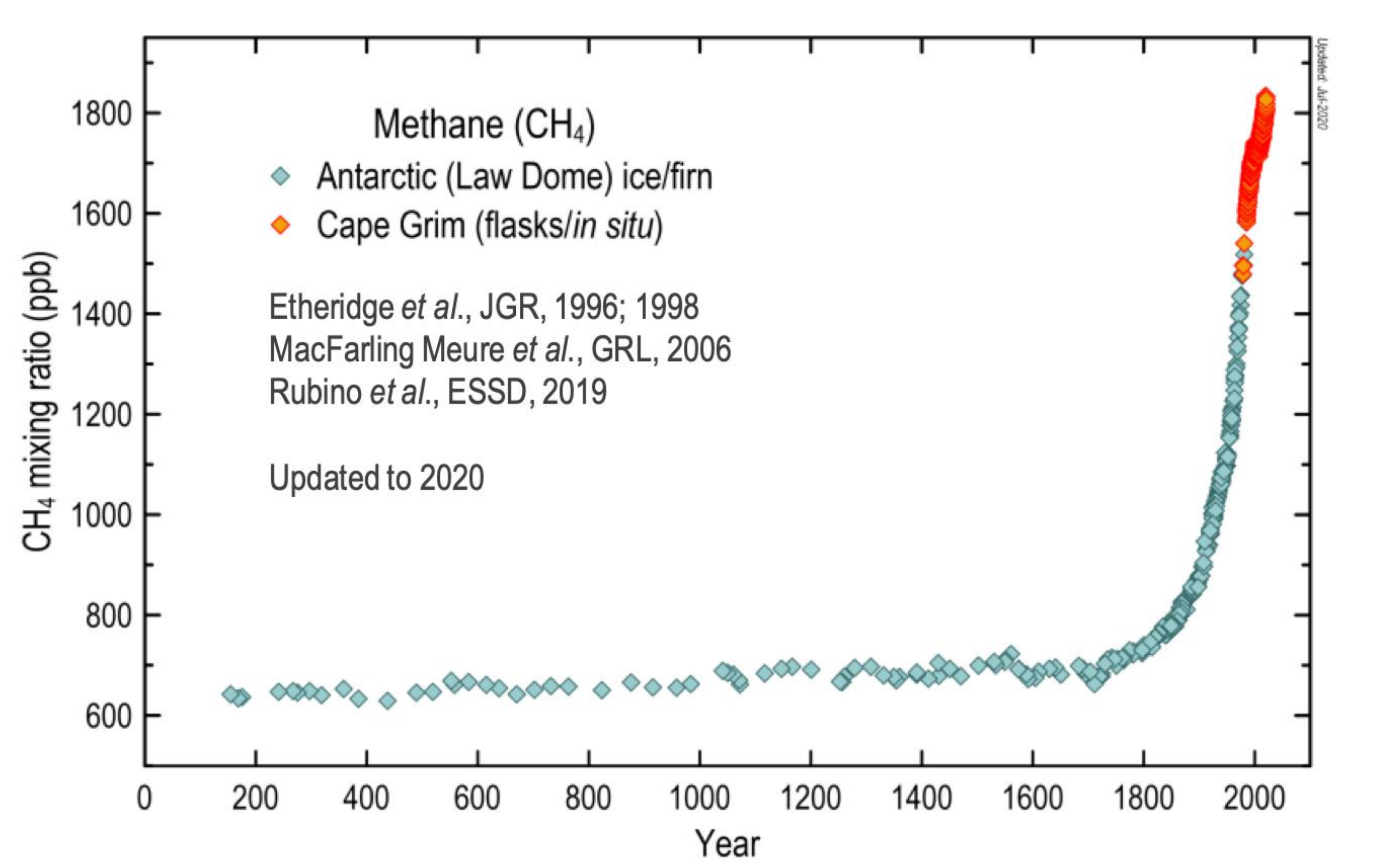
1173

UNTERSCHRIFTEN

Letzte Aktualisierung:
08. November 2023

Warum müssen wir genau schauen?

Warum sprechen wir über Methan ?



Source: https://futureearth.org/2020/07/15/global-methane-emissions-have-risen-nearly-10-percent-over-last-20-years/

…und weil Methan besonders klimarelevant ist

https://www.epa.gov/ghgemissions/overview-greenhouse-gases

Properties of Methane

Chemical Formula: CH_4
Lifetime in Atmosphere: 12 years
Global Warming Potential (100-year): 25[1]

https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

- Methane (CH_4) is estimated to have a GWP of 28–36 over 100 years (Learn why EPA's U.S. Inventory of Greenhouse Gas Emissions and Sinks uses a different value.). CH_4 emitted today lasts about a decade on average, which is much less time than CO_2. But CH_4 also absorbs

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1. Methan ist ein kurzlebiges Gas

2. Grasflächen sind ein essentieller Bestandteil unserer Biosphäre und müssen zwingend von Weidetieren bearbeitet werden

3. Andere Alternativen zur Milch (und anderer tierische Produkte) haben einen spürbar höheren CO2 Ausstoß pro Nährstoff

4. Biogenes Methan reichert sich vermutlich nicht in der Atmosphäre an

1. Methan ist ein kurzlebiges Gas

Ein CO2 Molekül wird in der Atmosphäre nicht abgebaut. Einmal ausgestoßen, verbleibt es dort auf alle Zeiten bis es irgendwann von Photosynthese wieder aufgenommen wird (vielleicht auch nie)

Ein CH4 Molekül verbleibt nur wenige Jahre in der Atmosphäre bis es abgebaut wird. Dh eine konstante Menge an Ausstoß hat keine weitere Klimawirkung zur Folge, und eine sinkende Menge hat eine kühlende Klimawirkung

(tatsächlich ist es noch viel komplizierter)

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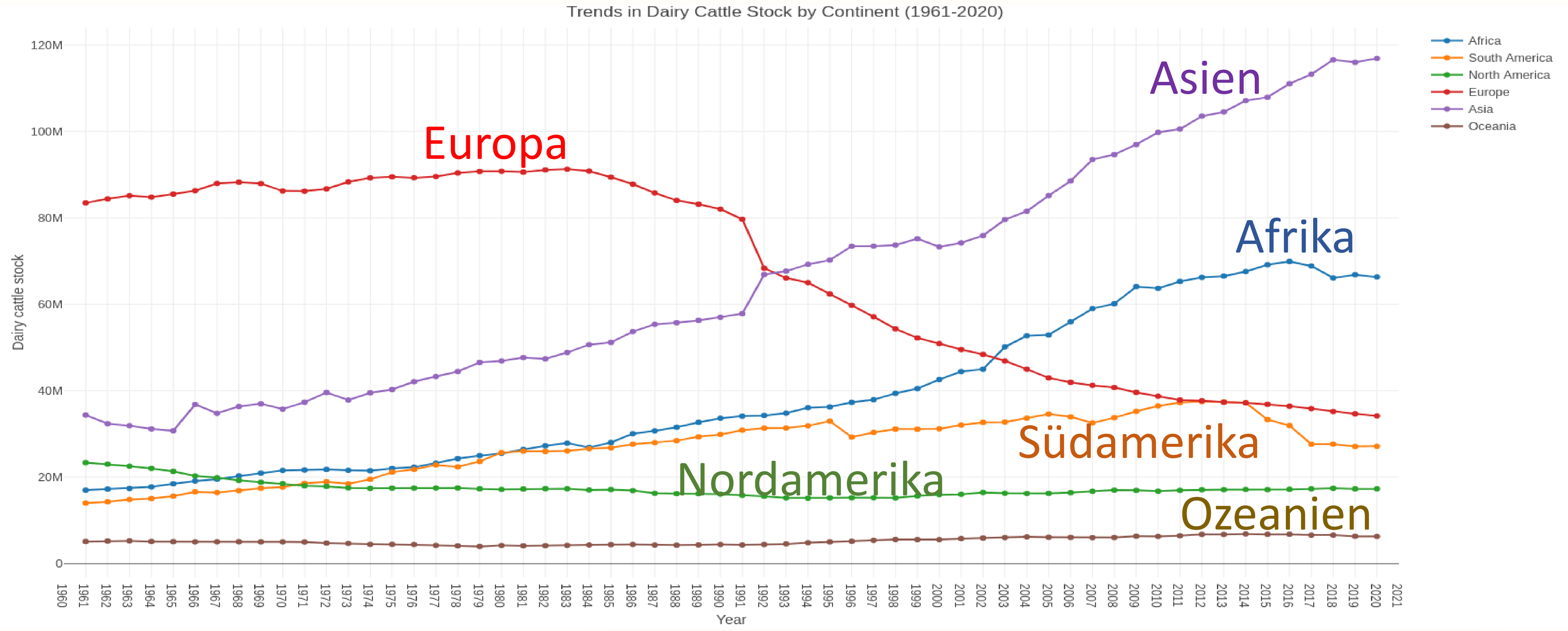
Anzahl Milchkühe weltweit 1960-2021



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Forschungsinstitut für Nutztierbiologie, 2022

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Enteric methane emission factors, total emissions and intensities from Germany's livestock in the late 19th century: A comparison with the today's emission rates and intensities

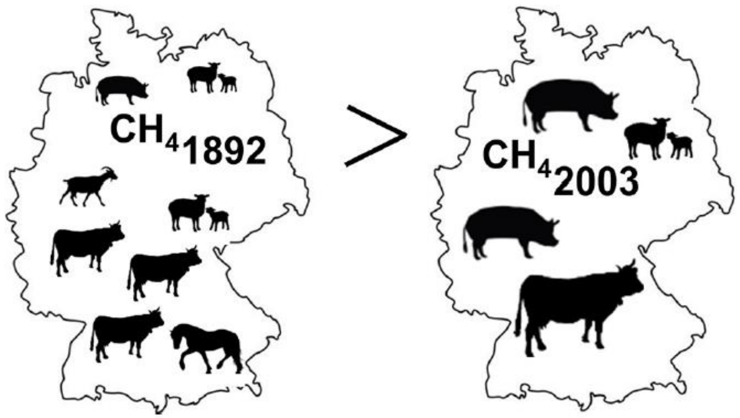
B. Kuhla [a,*], G. Viereck [b]

[a] Research Institute for Farm Animal Research (FBN), Institute of Nutritional Physiology "Oskar Kellner", Wilhelm-Stahl-Allee 2, 18196 Dummerstorf, Germany
[b] Research Institute for Farm Animal Research (FBN), Wilhelm-Stahl-Allee 2, 18196 Dummerstorf, Germany

HIGHLIGHTS

- Historic enteric CH_4 emission factors are greatest for adult male cattle.
- Enteric CH_4 emission from German livestock was 898 kt in 1883 and 1061 kt in 1892.
- Compared to 1892, Germany's livestock has been emitting less enteric CH_4 since 2003.
- CH_4 emission intensities for meat and milk decreased from 1883 to 2020.
- Animal performance gain reduced CH_4 emission intensities over the years.

GRAPHICAL ABSTRACT



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Die neue Strategie der Milchgegner

In den Klimamodellen ist dieser Unterschied zwischen lang- und kurzlebigen Substanzen hingegen berücksichtigt. Die Senkung der globalen Methanemissionen ist ein unverzichtbares und kurzfristig hochwirksames Mittel, um die globale Erwärmung auf maximal 1,5 bis 2 °C zu begrenzen. Denn eine Reduktion der Methanemissionen kann den Klimawandel kurzfristig wesentlich stärker eindämmen als dies in den Treibhausgasinventaren ersichtlich ist. Nur mit einer massiven Senkung dieser Emissionen verbleibt eine Chance, rechtzeitig Klimaneutralität zu erreichen. Ohne eine sol-

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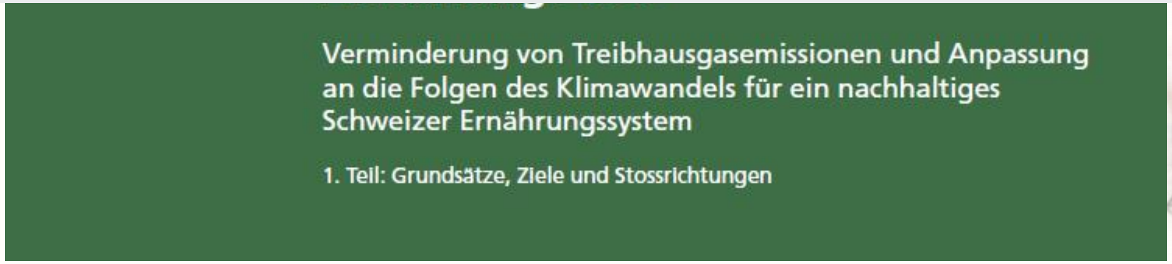
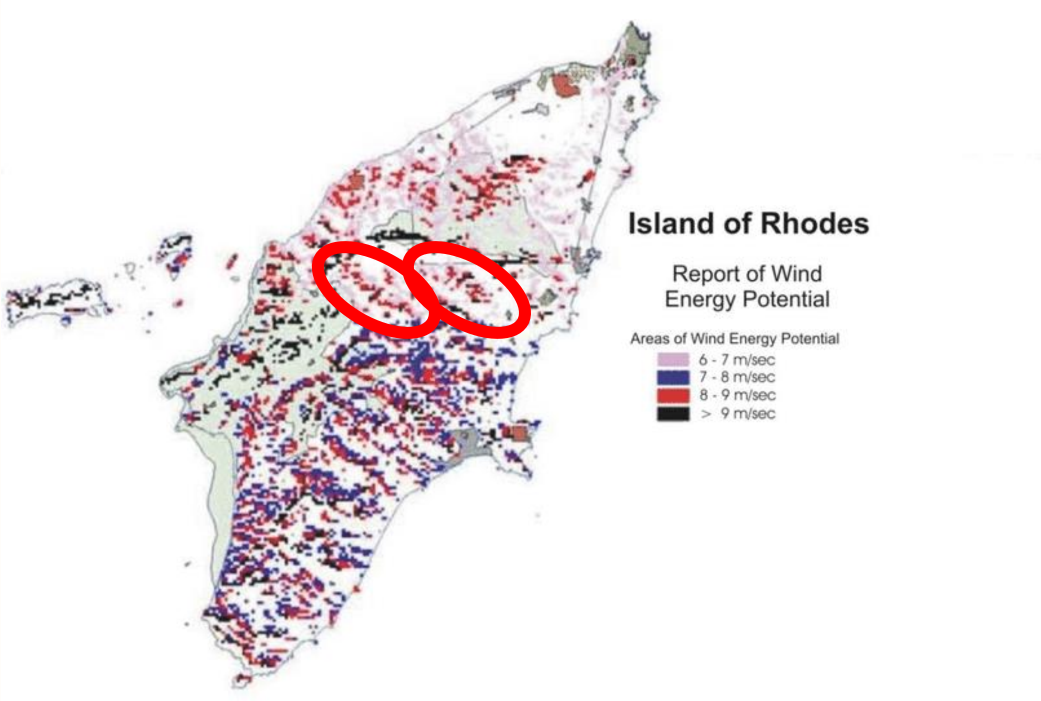
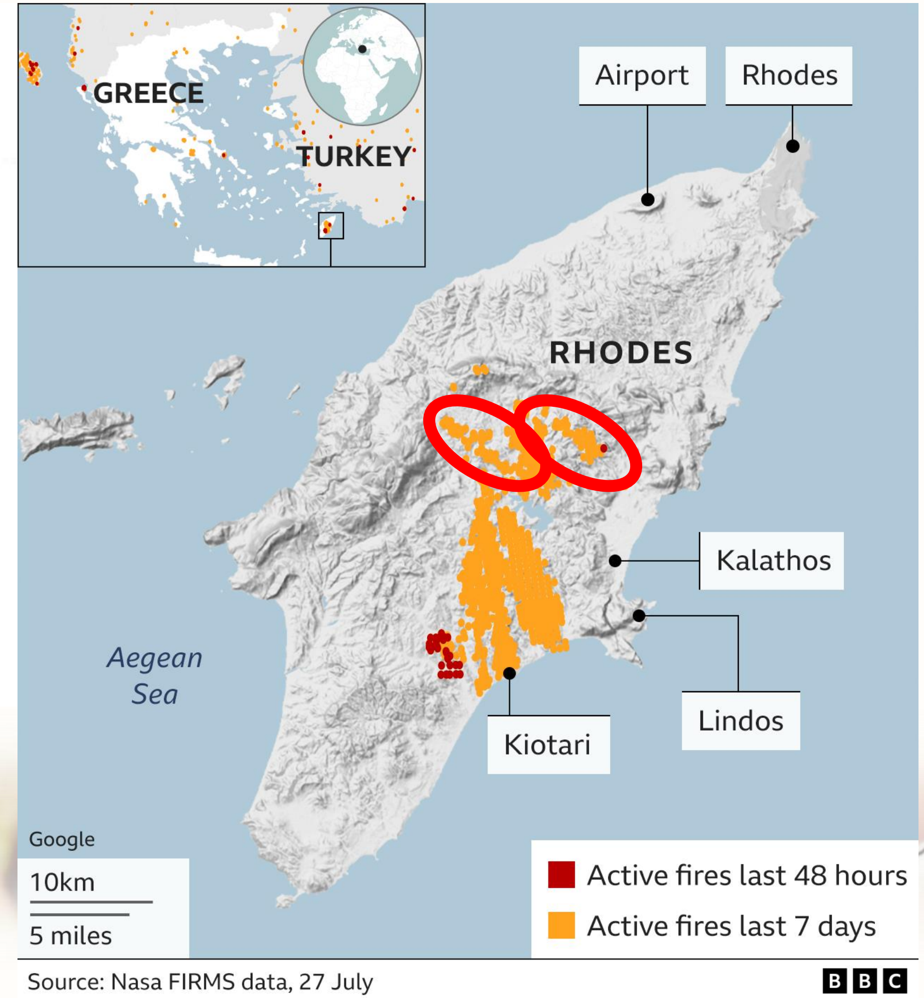


2. Grasflächen sind ein essentieller Bestandteil unserer Biosphäre und müssen zwingend von Weidetieren bearbeitet werden





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2. Grasflächen sind ein essentieller Bestandteil unserer Biosphäre und müssen zwingend von Weidetieren bearbeitet werden

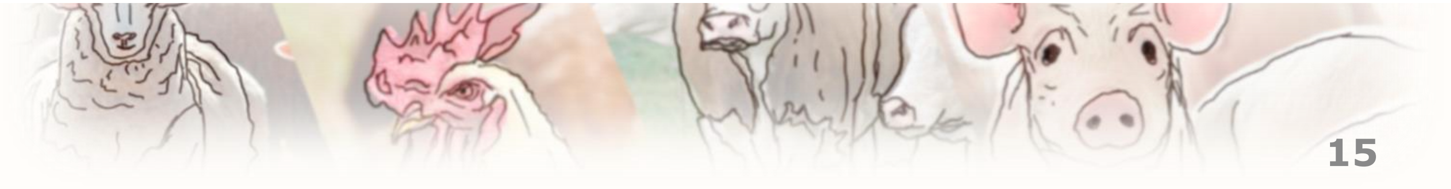
Hadjigeorgiou *Pastoralism: Research, Policy c*
http://www.pastoralismjournal.com/content/

RESEARCH

Past, present a

Ioannis Hadjigeorgiou

There have been severe consequences of the major decline in recent decades of farming activity in the mountainous and disadvantaged areas of Greece, mainly as a result of modern development forces ('modernization'), with the consequent abandonment of pastoral areas (Zervas 1998; de Rancourt et al. 2006; Hadjigeorgiou and Zervas 2009). This situation has brought changes in vegetation dynamics (mainly invasion of ligneous [woody] vegetation) and therefore in landscape structure and composition (Ispikoudis and Chouvardas 2005). Subsequently, there is an increasing risk of environmental hazards of which the most dramatic is the uncontrolled forest fires (such as those in August 2007 in much of southern Greece, which burned about 270,000 ha of agricultural and forest land), followed by the loss of biodiversity and water economy (Poux et al. 2006). Since unplanned expansion of human settlements has occurred in rural areas, there is a greatly increased risk of loss of life and property due to the wild fires (Keeley 2002) as in 2007 where 63 lives were lost and 1,500 houses burnt to



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3. Andere Alternativen zur Milch haben einen spürbar höheren CO2 Ausstoß pro Nährstoff

Milchprodukte (und auch Fleisch) sind essentiell für eine gute Gesundheit, insbesondere schützen sie vor Diabetes

Entsprechende Analogprodukte, zB Hafermilch, haben spürbar höhere CO2 Belastungen, wenn sie Nährstoff für Nährstoff verglichen werden

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3. Andere Alternativen zur Milch haben einen spürbar höheren CO2 Ausstoß pro Nährstoff

npj | science of food

www.nature.com/npjscifood

ARTICLE OPEN

Check for updates

How animal milk and plant-based alternatives diverge in terms of fatty acid, amino acid, and mineral composition

S. S. Moore[1], A. Costa[2]✉, M. Pozza[1], T. Vamerali[1], G. Niero[1], S. Censi[3] and M. De Marchi[1]

The decline in fresh milk in the Western world has in part been substituted by an increased consumption of plant-based beverages (PBB). These are often marketed as healthy and sustainable alternatives to milk and dairy foodstuff, although studies have suggested PBB to be of lower nutrient quality. The current study considered different brands of almond-, oat-, rice-, coconut- and soya-based beverages for a comparative analysis and found that they indeed presented lower contents of total protein, lipids, amino acids, and minerals than cow and goat milk. The only exception was given by soya-based beverages which approximated the protein content (3.47% vs. 3.42 and 3.25% in cow and goat milk, respectively) and amino acid composition of animal milk, and also demonstrated high mineral content. The natural presence of phyto-compounds in PBB characterised as antinutrients and their potential to exacerbate the issue of low nutrient quality by lowering bioavailability have been discussed.

npj Science of Food (2023)7:50 ; https://doi.org/10.1038/s41538-023-00227-w

3. Andere Alternativen zur Milch haben einen spürbar höheren CO2 Ausstoß pro Nährstoff

ESC European Society of Cardiology
European Heart Journal (2023) **00**, 1–20
https://doi.org/10.1093/eurheartj/ehad269
CLINICAL RESEARCH
Epidemiology, prevention, and health care policies

Diet, cardiovascular disease, and mortality in 80 countries

**Andrew Mente [1,2,*], Mahshid
Martin O'Donnell[3,4], Weihong I
Scott A. Lear[7], Li Wei[8], Rafael I
Patricio Lopez-Jaramillo [11], F
Manmeet Kaur[14], K Vijayakuma
Andrzej Szuba[18], Romaina Iqba
Rasha Khatib[22], Nafiza Mat Nas
Afzalhussein Yusufali [26], Edel
Antonio Dans[29], Khalid F Alhab
Hertzel C. Gerstein [1,2,3], and**

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Received 5 March 2022; revised 31 March 2023; accepted 25 April 2023

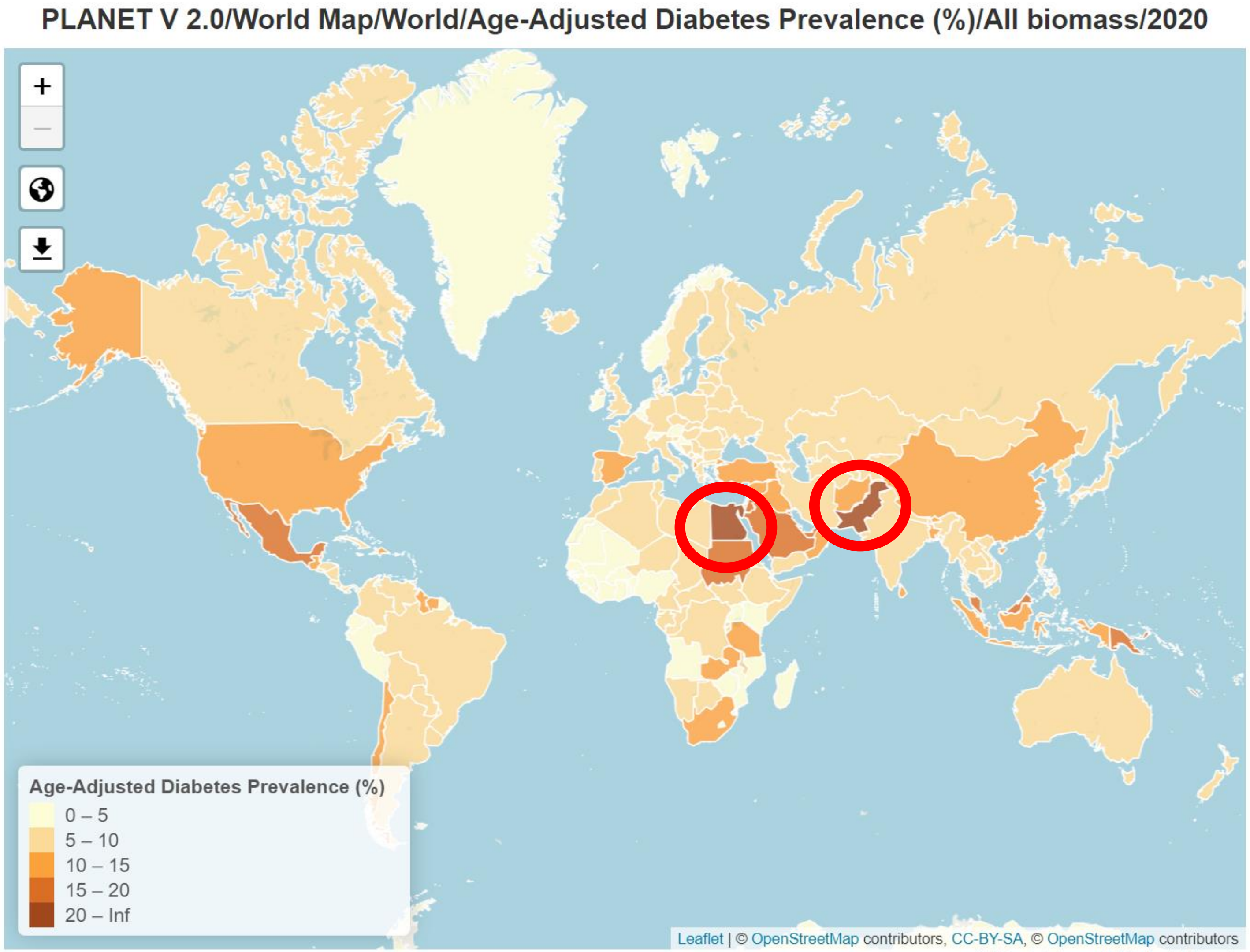
Box The PURE Healthy Diet score translated into a healthy eating pattern

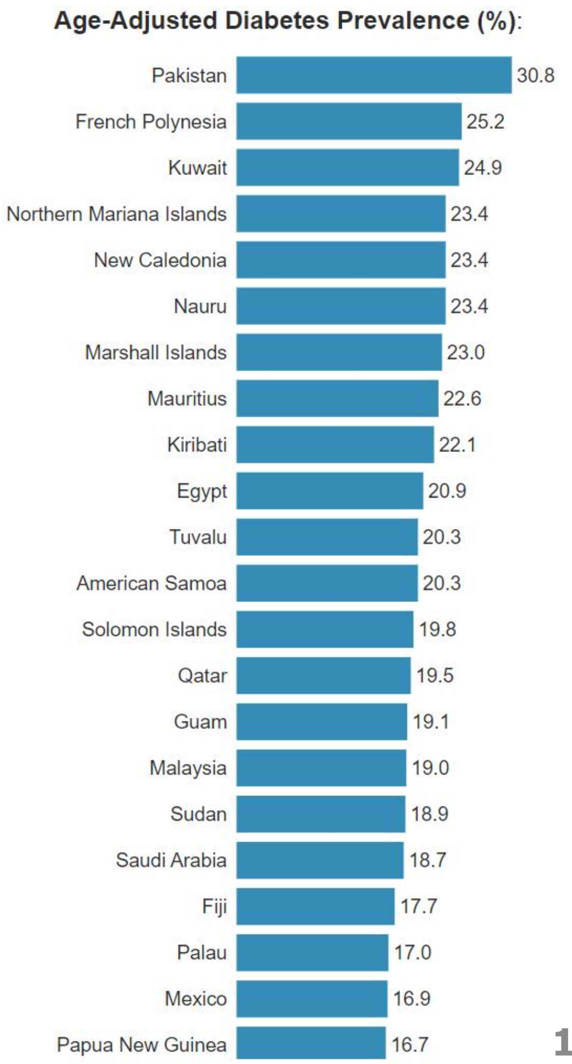
Eat More	Amount [a,b]	What counts as a serving?
Fruits and vegetables	4 to 5 servings *daily*	1 medium apple, banana, pear; 1 cup leafy vegs; 1/2 cup other vegs
Legumes	3 to 4 servings *weekly*	1/2 cup beans or lentils
Nuts	7 servings *weekly*	1 oz., tree nuts or peanuts
Fish	2 to 3 servings *weekly*	3 oz. cooked (pack of cards size)
Dairy	14 servings *weekly*	1 cup milk or yogurt; 1 ½ oz cheese
Whole grains	Moderate amounts (e.g. 1 serving *daily*) can be part of a healthy diet	1 slice (40 g) bread; ½ medium (40 g) flat bread; ½ cup (75–120 g) cooked rice, barley, buckwheat, semolina, polenta, bulgur or quinoa
Unprocessed meats[c]	Moderate amounts (e.g. 1 serving *daily*) can be part of a healthy diet	3 oz. cooked red meat or poultry

[a]Amounts shown are based on intakes among people in the upper quintile category of the PURE Healthy Diet score (i.e. a diet score of 5 or higher).
[b]Median daily intake values of food components in the overall PURE cohort are: Fruit, 145 g; vegetables, 250 g; legumes, 38 g; nuts, 9 g; fish, 12 g; dairy, 113 g; whole grains, 35 g; and unprocessed red meat or poultry, 58 g.
[c]When red meat or whole grains are included in the diet score in a sensitivity analysis, the findings were similar (neither stronger nor weaker) (**Appendix 9**), indicating that a moderate amount of whole grains or unprocessed meats can be part of a healthy diet. To this end, a healthy diet can be achieved in a number of ways which does not necessarily require either including or excluding any specific food category.

GC
Sci

3. Andere Alternativen zur Milch haben einen spürbar höheren CO2 Ausstoß pro Nährstoff





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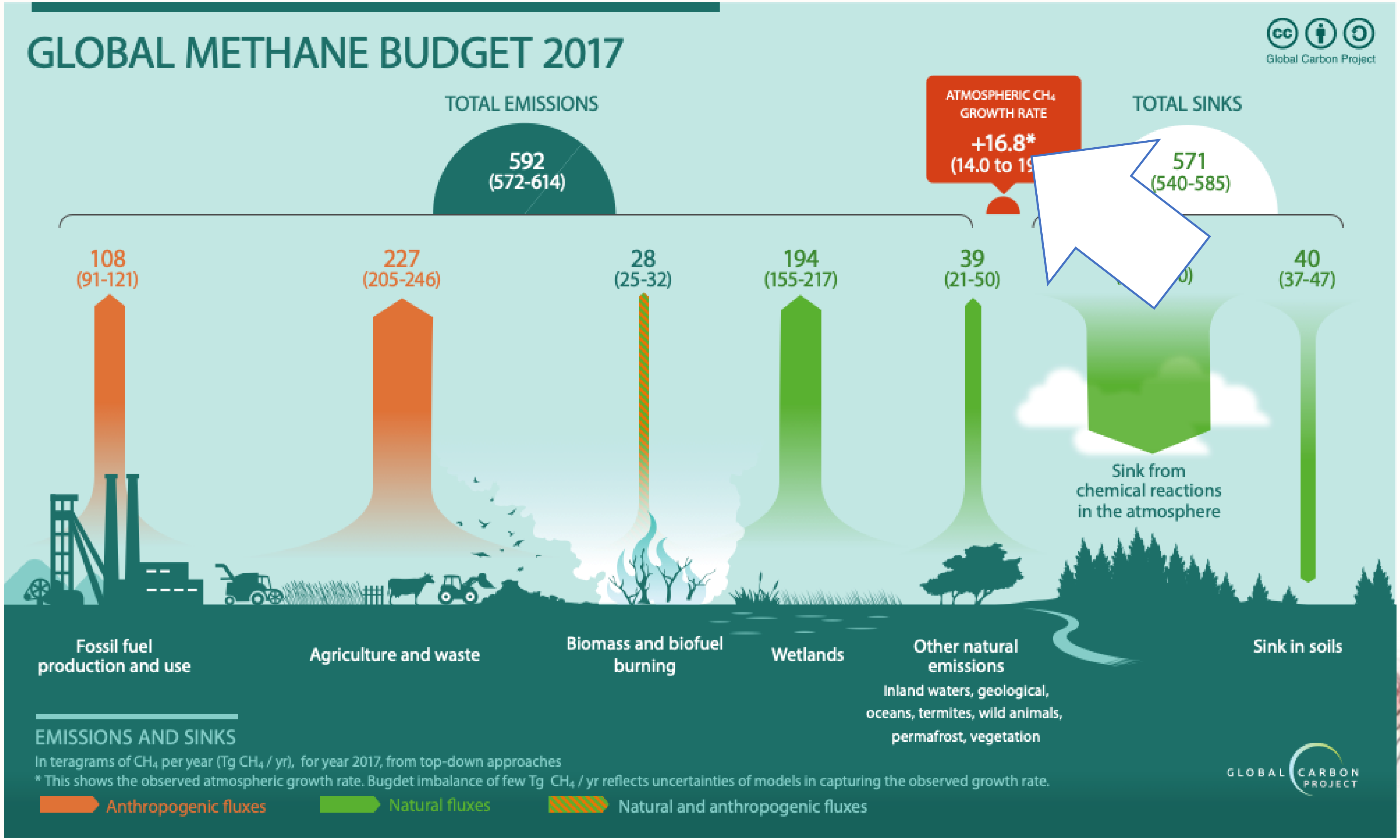
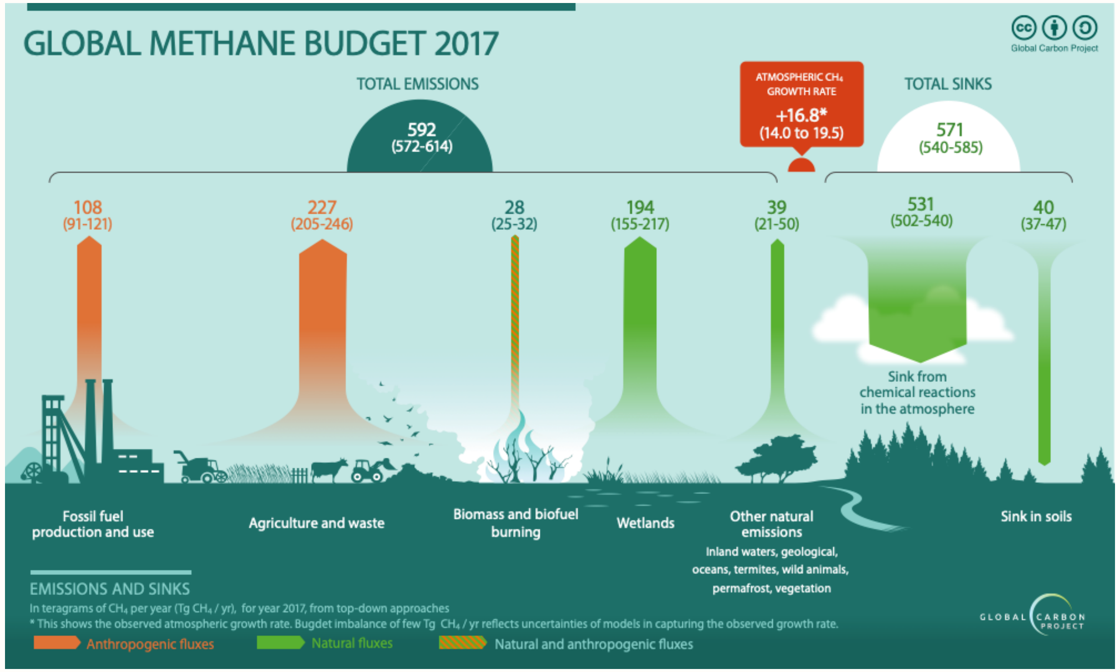
Vereinfachtes Narrativ: Methan Budget ~3% der Emissionen pa akkumulieren sich in der Atmosphäre, weil zuviel davon „menschenverursacht ist“

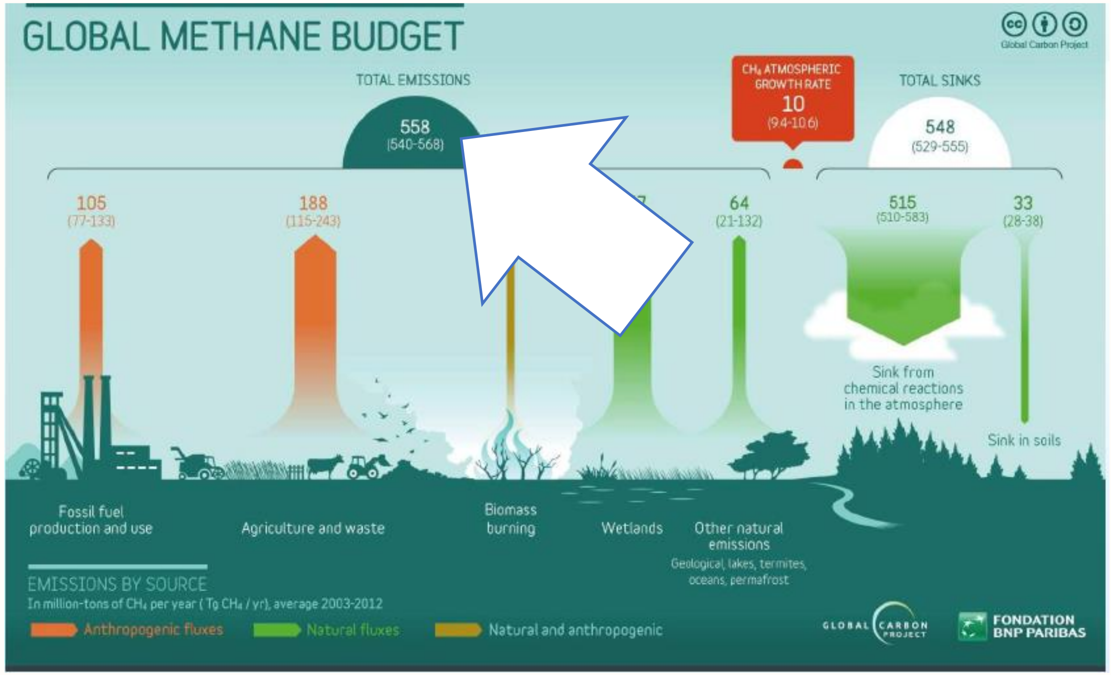


Aber die Methanzerstörungsrate war in 2017 größer als der Gesamtausstoß in 2012, also hätte es eine Nettoabbau in 2012 geben müssen…

2020 publication as per 2017:



2015 publication as per 2012:



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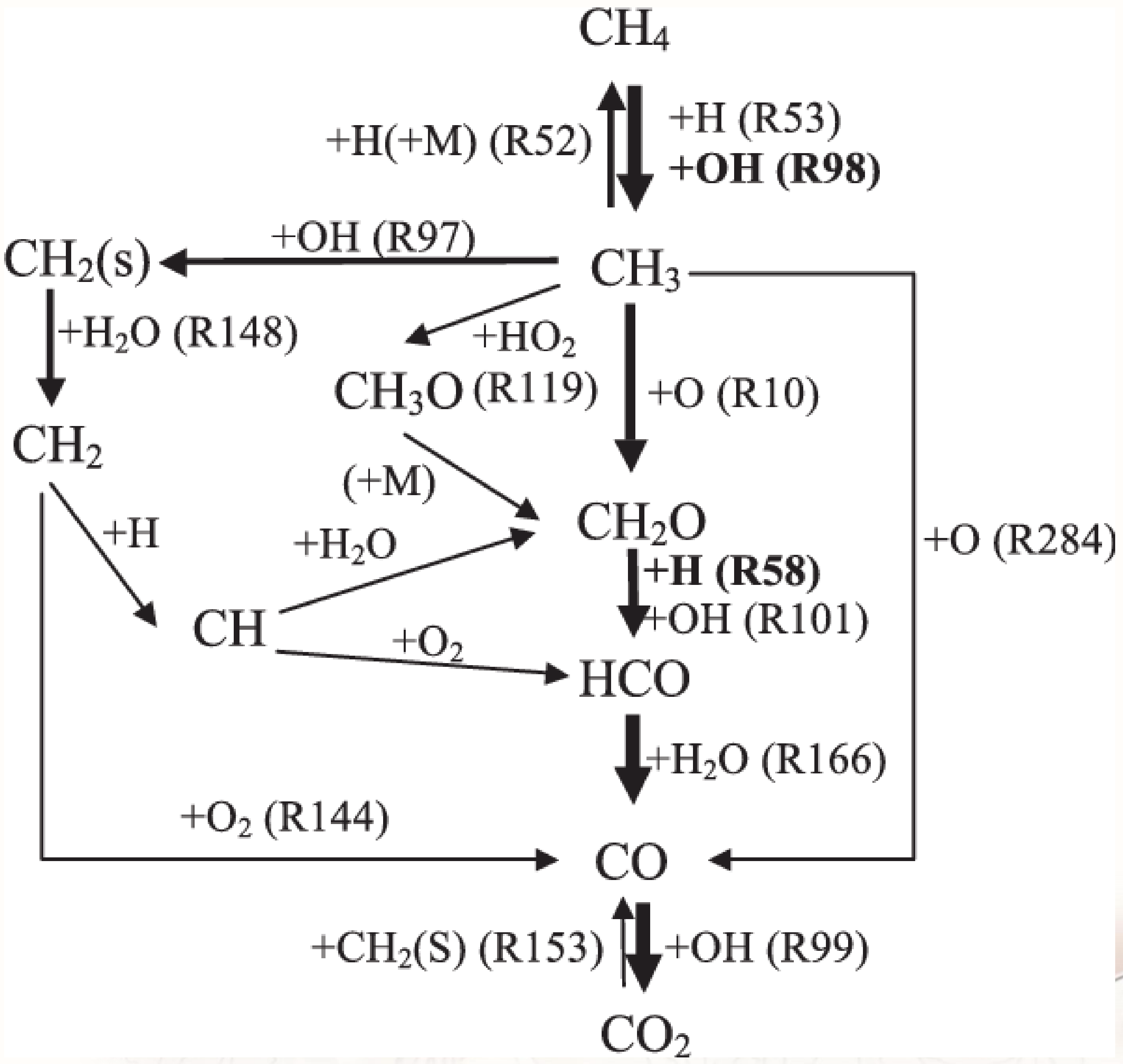
OH - Hydroxyl



CH_4
+H(+M) (R52)
+H (R53)
+OH (R98)
CH_2(s)
+OH (R97)
CH_3
+H_2O (R148)
+HO_2
CH_3O (R119)
+O (R10)
CH_2
(+M)
+H
+H_2O
CH_2O
+O (R284)
+H (R58)
+OH (R101)
CH
+O_2
HCO
+H_2O (R166)
+O_2 (R144)
CO
+CH_2(S) (R153)
+OH (R99)
CO_2

2016 Publikation zu OH-hydroxyl

Atmos. Chem. Phys., 16, 12477–12493, 2016
www.atmos-chem-phys.net/16/12477/2016/
doi:10.5194/acp-16-12477-2016

Atmospheric Chemistry and Physics
Open Access
EGU

Global tropospheric hydroxyl distribution, budget and reactivity

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Received: 29 February 2016 – Published in Atmos. Chem. Phys. Discuss.: 11 March 2016
Revised: 27 August 2016 – Accepted: 18 September 2016 – Published: 5 October 2016

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Lelieveld: OH Reaktionskapazität ist „buffered = gepuffert“ – dh es gibt eigentlich immer genug davon

Global tropospheric hydroxyl distribution, budget and reactivity

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Received: 29 February 2016 – Published in Atmos. Chem. Phys. Discuss.: 11 March 2016
Revised: 27 August 2016 – Accepted: 18 September 2016 – Published: 5 October 2016

Abstract. The self-cleaning or oxidation capacity of the atmosphere is principally controlled by hydroxyl (OH) radicals in the troposphere. Hydroxyl has primary (P) and secondary (S) sources, the former mainly through the photodissociation of ozone, the latter through OH recycling in radical reaction chains. We used the recent Mainz Organics Mechanism (MOM) to advance volatile organic carbon (VOC) chemistry in the general circulation model EMAC (ECHAM/MESSy Atmospheric Chemistry) and show that S is larger than previously assumed. By including emissions of a large number of primary VOC, and accounting for their complete breakdown and intermediate products, MOM is mass-conserving and calculates substantially higher OH reactivity from VOC oxidation compared to predecessor models. Whereas previously P and S were found to be of similar magnitude, the present work indicates that S may be twice as large, mostly due to OH recycling in the free troposphere. Further, we find that nighttime OH formation may be significant in the polluted subtropical boundary layer in summer. With a mean OH recycling probability of about 67 %, global OH is buffered and not sensitive to perturbations by natural or anthropogenic emission changes. Complementary primary and secondary OH formation mechanisms in pristine and polluted environments in the continental and marine troposphere, connected through long-range transport of O_3, can maintain stable global OH levels.

1 Introduction

The removal of most natural and anthropogenic gases from the atmosphere – important for air quality, the ozone layer and climate – takes place through their oxidation by hydroxyl (OH) radicals in the troposphere. The central role of tropospheric OH in the atmospheric oxidation capacity (or efficiency) has been recognized since the early 1970s (Levy II, 1971; Crutzen, 1973; Logan et al., 1981, Ehhalt et al., 1991). The primary OH formation rate (P) depends on the photodissociation of ozone (O_3) by ultraviolet (UV) sunlight – with a wavelength of the photon ($h\nu$) shorter than 330 nm – in the presence of water vapor:

$O_3 + h\nu\ (\lambda < 330\,\mathrm{nm}) \rightarrow O(^1D) + O_2,$

$O(^1D) + H_2O \rightarrow 2OH.$

(Note that the formal notati… ing one unpaired elect… omit the do… radi…

…ized gases …atile organic com… po… …oxide (CO), so that these gas… …amounts, e.g.,

$CO + \ldots \rightarrow CO_2 + H,$ (R3)

$H + O_2(+M) \rightarrow HO_2(+M),$ (R4)

where M is an air molecule that removes excess energy from reaction intermediates by collisional dissipation. Because OH is highly reactive, it has an average tropospheric lifetime of about 1–2 s. After the initial OH reaction (Reaction R3) peroxy radicals are produced (Reaction R4), which can combine to form peroxides:

$HO_2 + HO_2 \rightarrow H_2O_2 + O_2,$ (R5)

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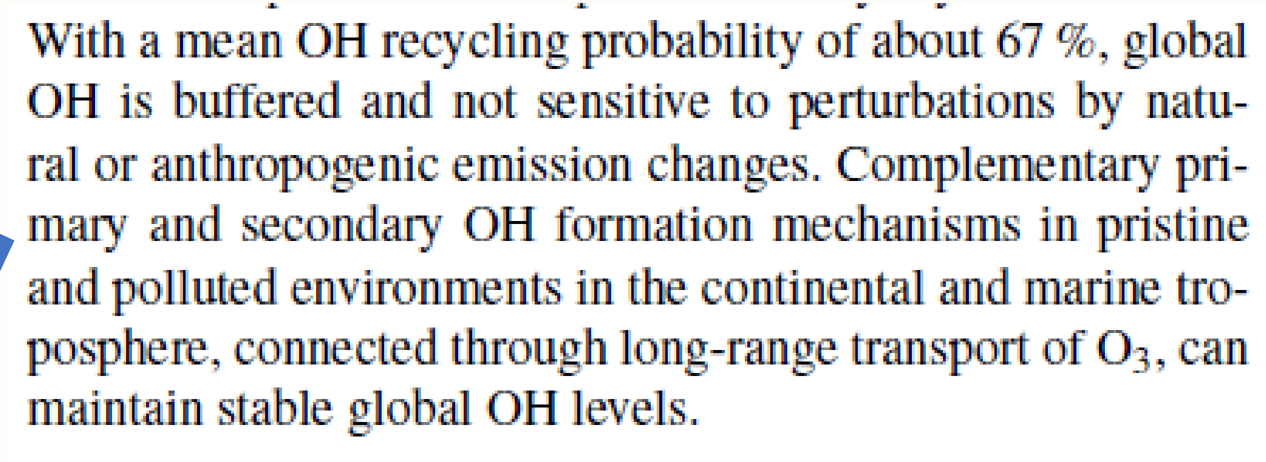
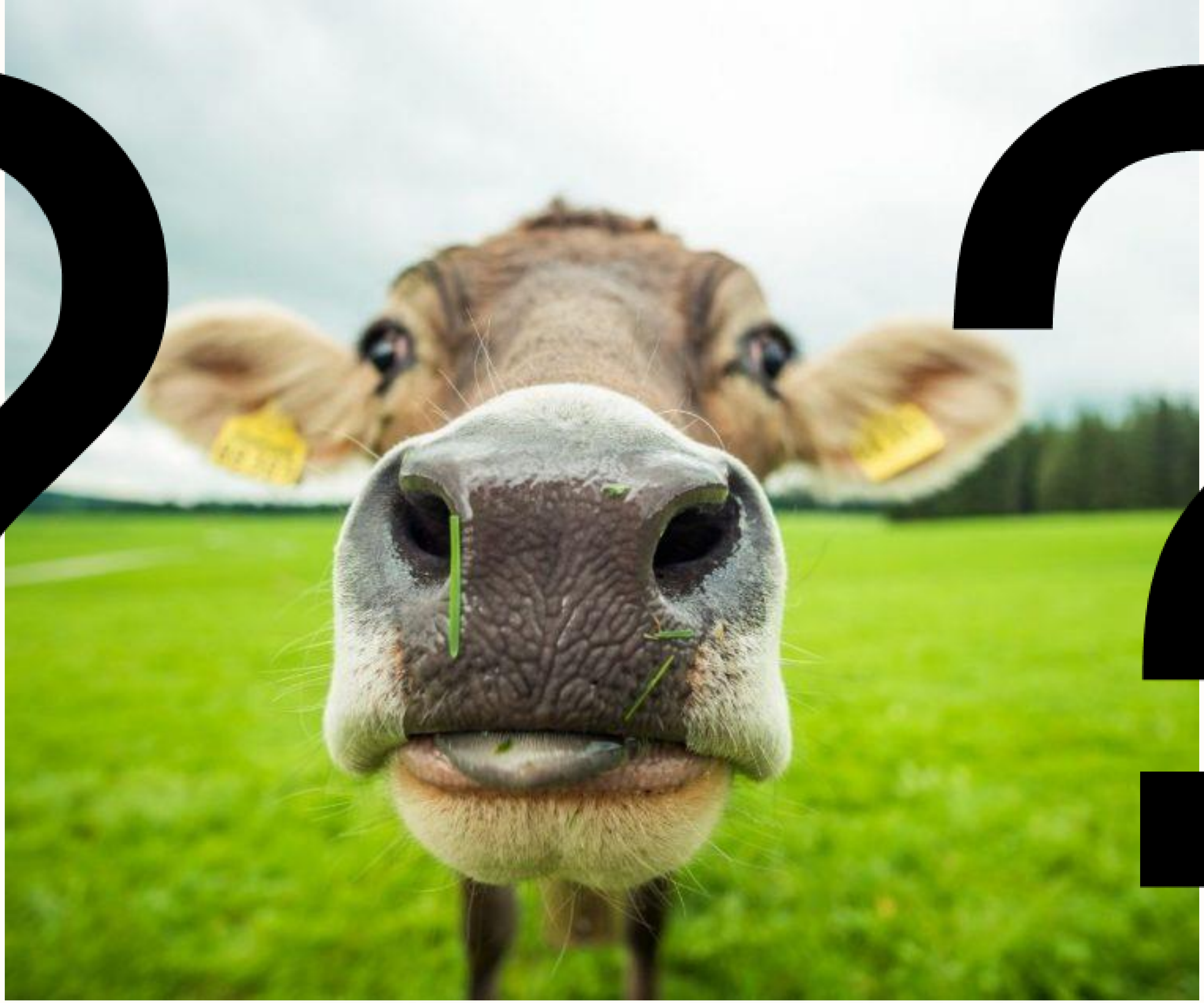


With a mean OH recycling probability of about 67 %, global OH is buffered and not sensitive to perturbations by natural or anthropogenic emission changes. Complementary primary and secondary OH formation mechanisms in pristine and polluted environments in the continental and marine troposphere, connected through long-range transport of O_3, can maintain stable global OH levels.

?



?

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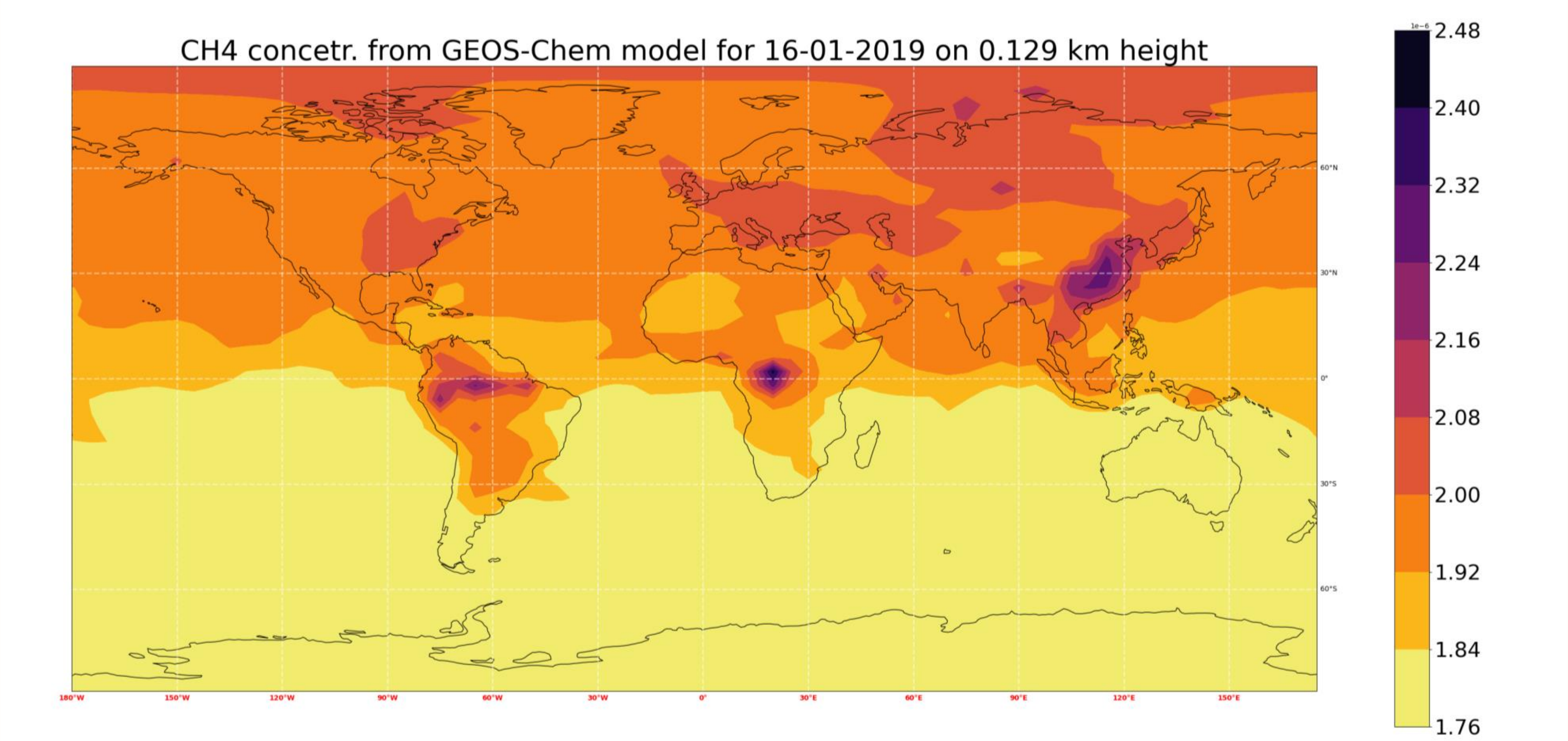
Sehr viel mehr Methan in der Nord Halbkugel



Source: GOALSciences direct data download and image processing from GEOS-Chem Inverse model

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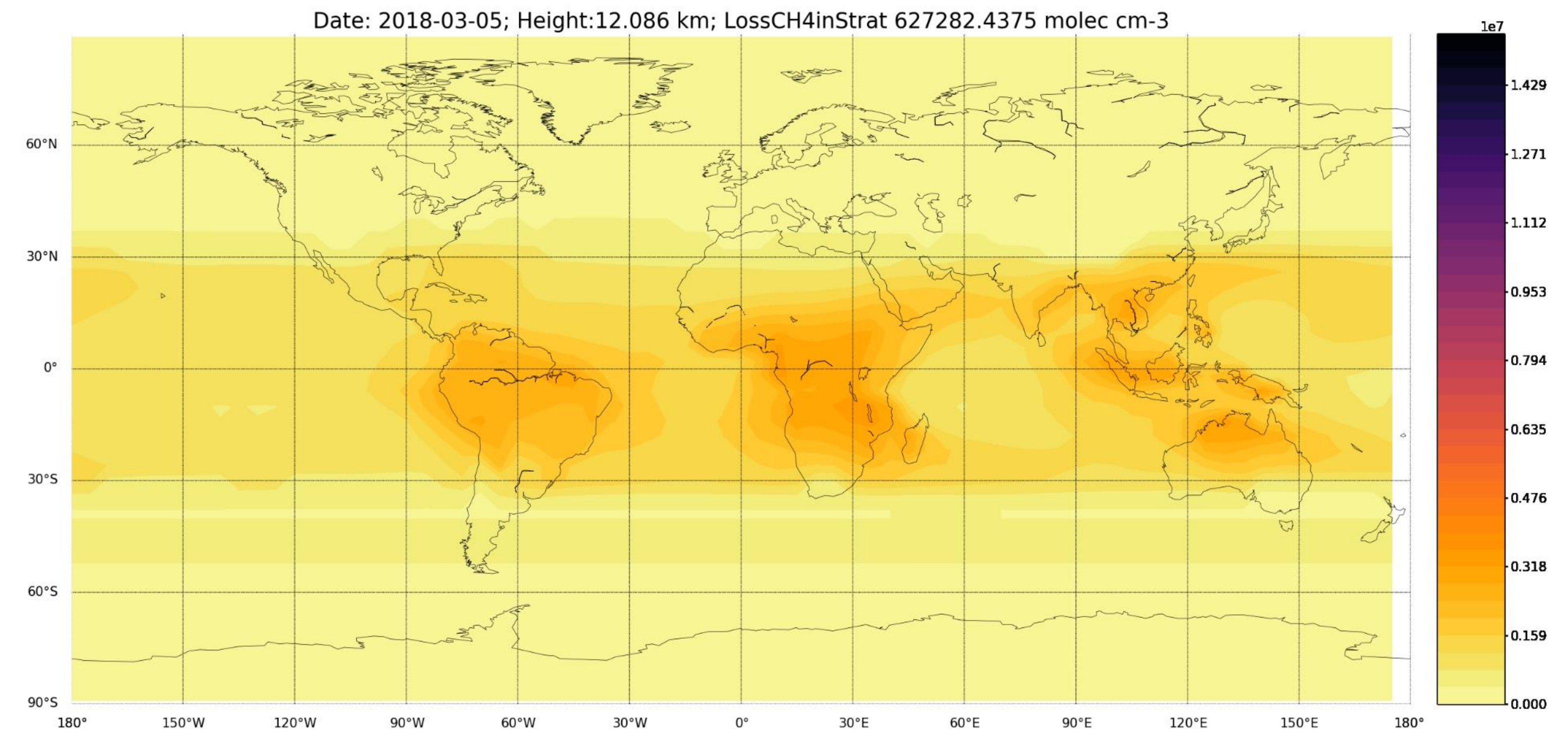
Zerstörung des Methan in den Tropen



Source: GOALSciences direct data download and image processing from GEOS-Chem inverse model

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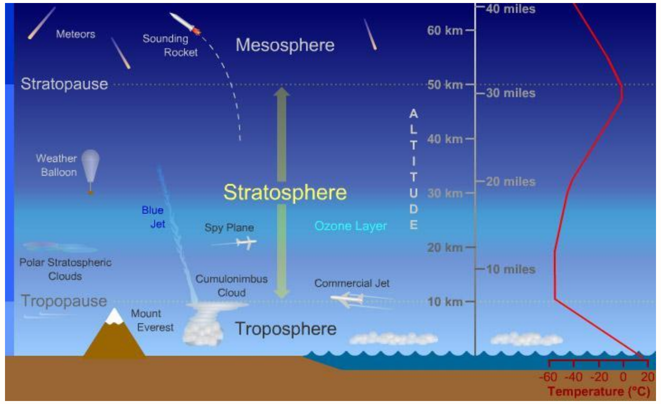
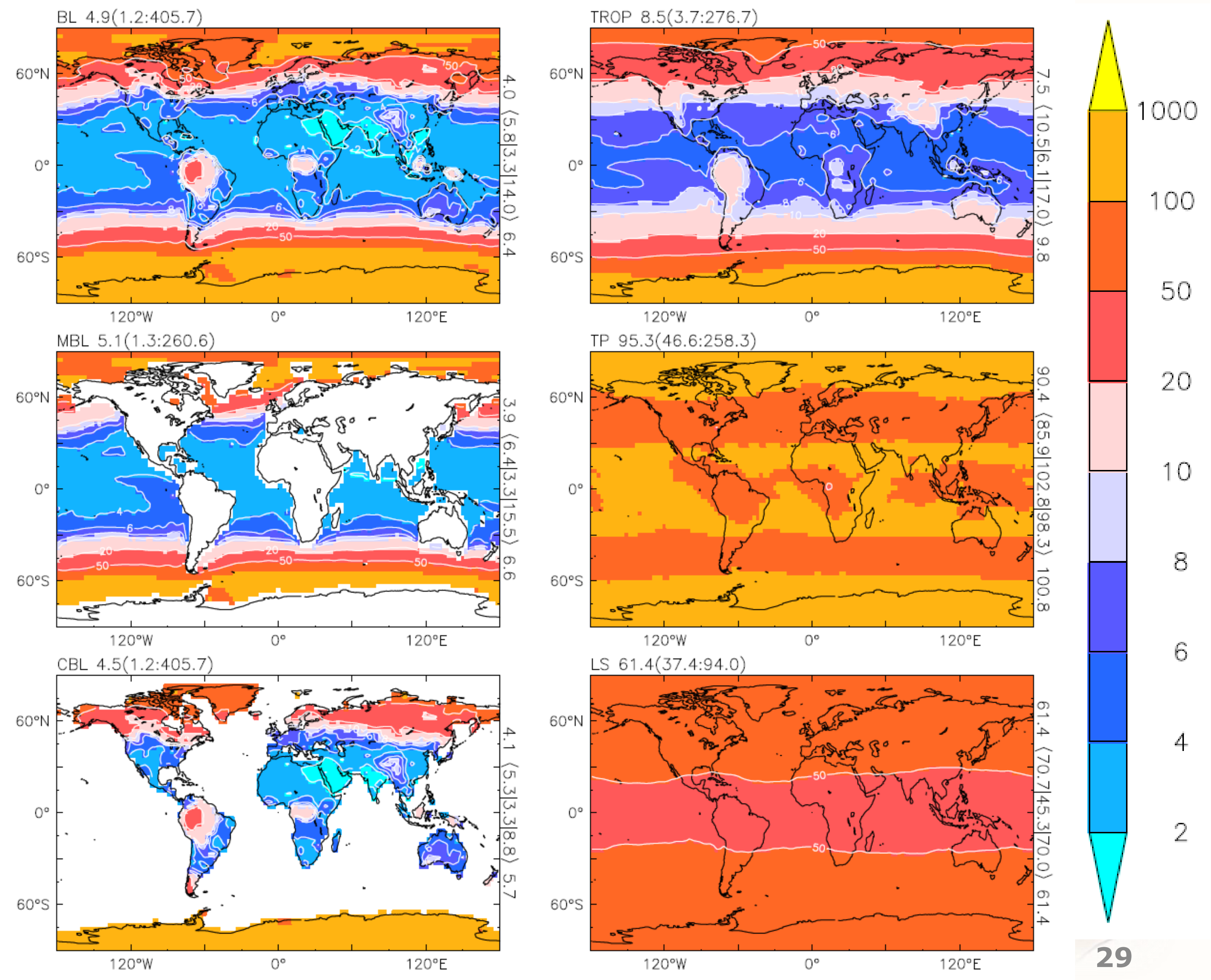
Lelieveld: Methan-Lebensdauer in Atmosphäre





Caaba–model: 3384 chemische Reaktionen um 5 Minuten CH4/OH zu berechnen < Modelle mit jeweils halbe Millionen Softwarezeilen

```python
from itertools import permutations
polygon_pairs = list(permutations(regions_polygon, 2))
polygon_pairs_label = [(i[0][1], i[1][1]) for i in polygon_pairs]

intersection_polygons = pd.DataFrame()
sorted_intersects = pd.read_excel('intersection_sorted.xlsx')
sorted_intersects_labels = list(sorted_intersects.apply(lambda x: tuple((x[0], x[1])), axis=1))
sorted_indexes = [polygon_pairs_label.index(x) for x in sorted_intersects_labels if x in polygon_pairs_label]
polygon_pairs = [polygon_pairs[i] for i in sorted_indexes]

for polys_pair in polygon_pairs:
    mask = np.empty(shape=0)
    intersection = polys_pair[0][0].intersection(polys_pair[1][0])
    if not intersection.is_empty:
        for p in points:
            point = Point(p) # create point
            mask = np.append(mask, polys_pair[0][0].intersection(polys_pair[1][0]).intersects(point))
        mask = mask.reshape(lons.shape)
        region_ch4_conc = np.ma.masked_where(mask == 0, nc_data[ATTR][0, 0, :, :])
        region_ch4_conc = np.ma.masked_where(region_ch4_conc < 1.845E-06, region_ch4_conc)
        area = np.ma.masked_where(mask == 0, nc_data['AREA'][:, :])
        #area = np.ma.masked_where(region_ch4_conc.mask, nc_data['AREA'][:, :])
        weighted_sum = np.ma.multiply(region_ch4_conc, area).sum()
        df2 = pd.DataFrame([{'Polygon_1':polys_pair[0][1], 'Polygon_2':polys_pair[1][1],
                             'conc_sum': region_ch4_conc.sum(), 'weighted_sum': weighted_sum,
                             'pixels_num':region_ch4_conc.count(),
                             'Area (km2)':area.sum()*1e-06}])
        if type(region_ch4_conc) is not np.ma.core.MaskedConstant:
            intersection_polygons = pd.concat([intersection_polygons, df2])
```

```python
intersection_polygons = intersection_polygons.rename(columns={'Polygon_1':'Zone'})
intersection_polygons = intersection_polygons.groupby('Zone'). \
    agg({'conc_sum':'sum', 'weighted_sum':'sum', 'pixels_num':'sum','Area (km2)':'sum'}).reset_index()

df = df.groupby('Zone').\
    agg({'conc_sum':'sum', 'weighted_sum':'sum', 'pixels_num':'sum','Area (km2)':'sum'}).reset_index()
df = pd.merge(df, intersection_polygons, how='left', on='Zone')
df['conc_sum'] = df.fillna(0)['conc_sum_x'] - df.fillna(0)['conc_sum_y']
df['weighted_sum'] = df.fillna(0)['weighted_sum_x'] - df.fillna(0)['weighted_sum_y']
df['pixels_num'] = df.fillna(0)['pixels_num_x'] - df.fillna(0)['pixels_num_y']
df['Area (km2)'] = df.fillna(0)['Area (km2)_x'] - df.fillna(0)['Area (km2)_y']
df = df.loc[:, ['Zone', 'conc_sum', 'weighted_sum', 'pixels_num', 'Area (km2)']]
df = df.groupby('Zone').agg({'conc_sum':'sum', 'weighted_sum':'sum', 'pixels_num':'sum','Area (km2)':'sum'}).reset_
df['weighted_average'] = df['weighted_sum']/(df['Area (km2)']*1e06)
df['percentage'] = df['conc_sum']/nc_data[ATTR][0, 0, :, :].sum()*100
df = df.rename(columns={'conc_sum':'concetration_sum'})
```

```python
def draw_screen_poly(lats, lons, fill_color, label=''):
    xy = np.c_[np.asarray(lats).ravel(), np.asarray(lons).ravel()]

    poly = plotlib_poly(list(xy),  edgecolor=fill_color,
                        linewidth=4, alpha=1,fill=False, label=label)
    plt.gca().add_patch(poly)
```

```python
fig = plt.figure(figsize=(40,30))
ax = plt.subplot(111,projection=ccrs.PlateCarree())
#ax.coastlines()
resol = '50m'  # use data at this scale
sum_pixels  = 0
land = cartopy.feature.NaturalEarthFeature('physical', 'land', \
    scale=resol,  facecolor='#2d2d2d')
ocean = cartopy.feature.NaturalEarthFeature('physical', 'ocean', \
    scale=resol, edgecolor='none', facecolor='#000000')

for file_name in os.listdir(os.path.join(os.getcwd(), 'sentinel', 'CH4', DATE)):
    layer = xr.open_dataset(os.path.join(WORK_DIR, 'sentinel', 'CH4', DATE, file_name), group='PRODUCT')
    lon = layer['longitude'][:][0,:,:]
    lat = layer['latitude'][:][0,:,:]
    ch4 = layer['methane_mixing_ratio_bias_corrected'][0,:,:]
    ch4 = np.ma.array(ch4, mask=np.isnan(ch4))
    sum_pixels += ch4.shape[0]*ch4.shape[1]
    unit = layer['methane_mixing_ratio'].units
    pos = ax.get_position()
    ax.coastlines(resolution='110m')
    ax.add_feature(land)
    ax.add_feature(ocean)
    z = ax.pcolormesh(lon, lat, ch4, zorder=4,\
                      vmin=vmin, vmax=vmax, \
                      cmap='inferno_r', transform=ccrs.PlateCarree())

gl = ax.gridlines(crs=ccrs.PlateCarree(), linewidth=2, color='white', alpha=0.5, linestyle='--', draw_labels=True)
gl.xlabels_top = False
gl.ylabels_left = False
gl.ylabels_right=True
gl.xlines = True
gl.xlocator = mticker.FixedLocator(range(-180, 180, 30))
gl.ylocator = mticker.FixedLocator(range(-90, 90, 30))
gl.xformatter = LONGITUDE_FORMATTER
gl.yformatter = LATITUDE_FORMATTER
gl.xlabel_style = {'color': 'red', 'weight': 'bold'}
plt.title(f'Reprocessed CH4 concetr. from Sentinel for {DATE}', fontdict={'fontsize':40})
cbar = plt.colorbar(z, shrink=0.6)
tick_font_size = 30
cbar.ax.tick_params(labelsize=tick_font_size)
plt.savefig(f'Reprocessed CH4 concetr. from Sentinel for {DATE}.png')
```

Source: Lelieveld

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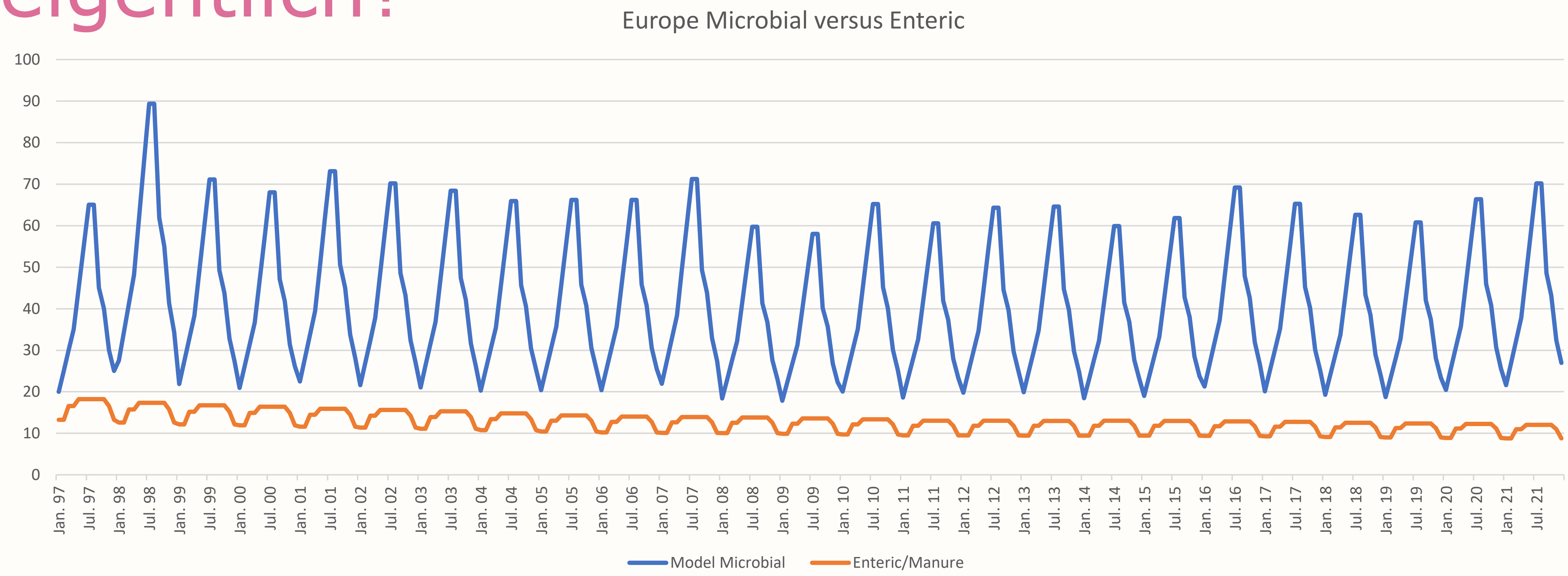
Was emittiert denn das Methan eigentlich?



Source: NOAA

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Meat industry

Revealed: the i 'declaration of eating

Document used to target to health policies but climate

Damian Carrington
Environment editor
@dpcarrington

Fri 27 Oct 2023 12.00 CEST

Ederer runs the Global Food and Agribusiness Network (GFAN), a company that provides research and advice to clients in the meat and livestock sector. He said recently on social media that veganism was an "eating disorder requiring psychological treatment" and likened it to the Heaven's Gate cult.

Indefinite delay

In November 2022, the EU's leading agrifood lobby groups wrote to Wojciechowski using the Dublin Declaration to argue against a plan to end public funding for the promotion of red meat. The EU has spent hundreds of millions of euros advertising meat and dairy products but the plan to end th funding is deadlocked in Brussels.

The declaration was also highlighted to the European Commission's group o chief scientific advisers as it produced its advice on moving "towards sustainable food consumption".

The EU's sustainable food systems legislation was expected to be published in September but has since been dropped. "It's clear that this commission, when it comes to food and farming, started with a very high level of commitment, at least in words, but it has ended up with basically nothing," said Marco Contiero, Greenpeace's EU policy director on agriculture.

Bitte folgen Sie mir auf GOAL Sciences