

# Understanding the impact climate change on greenhouse gas emissions from the Arctic

Donatella Zona, San Diego State University



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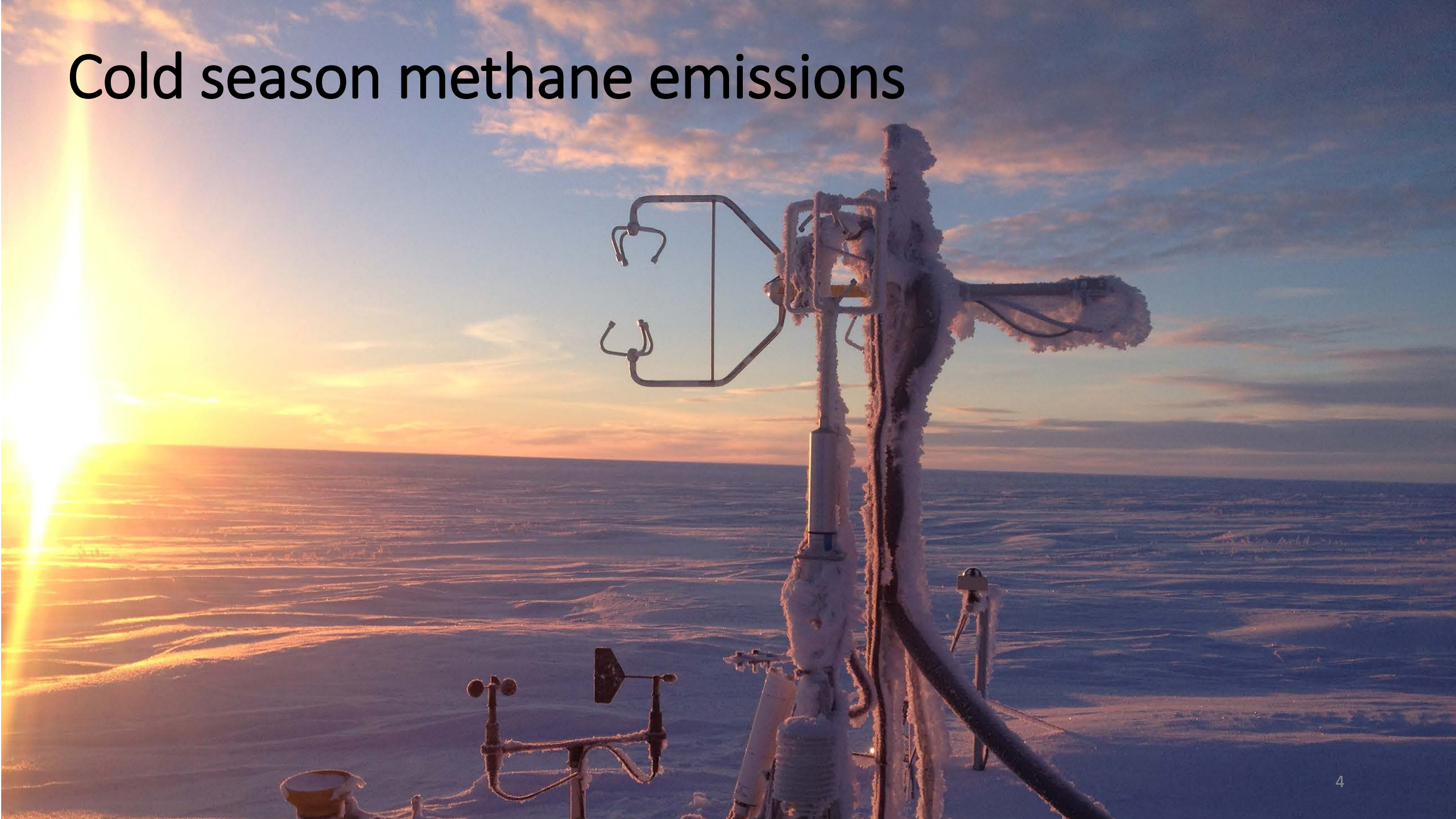
**Walter Oechel**  
**Kim Peterson**



# Measuring the “breathing” of the tundra

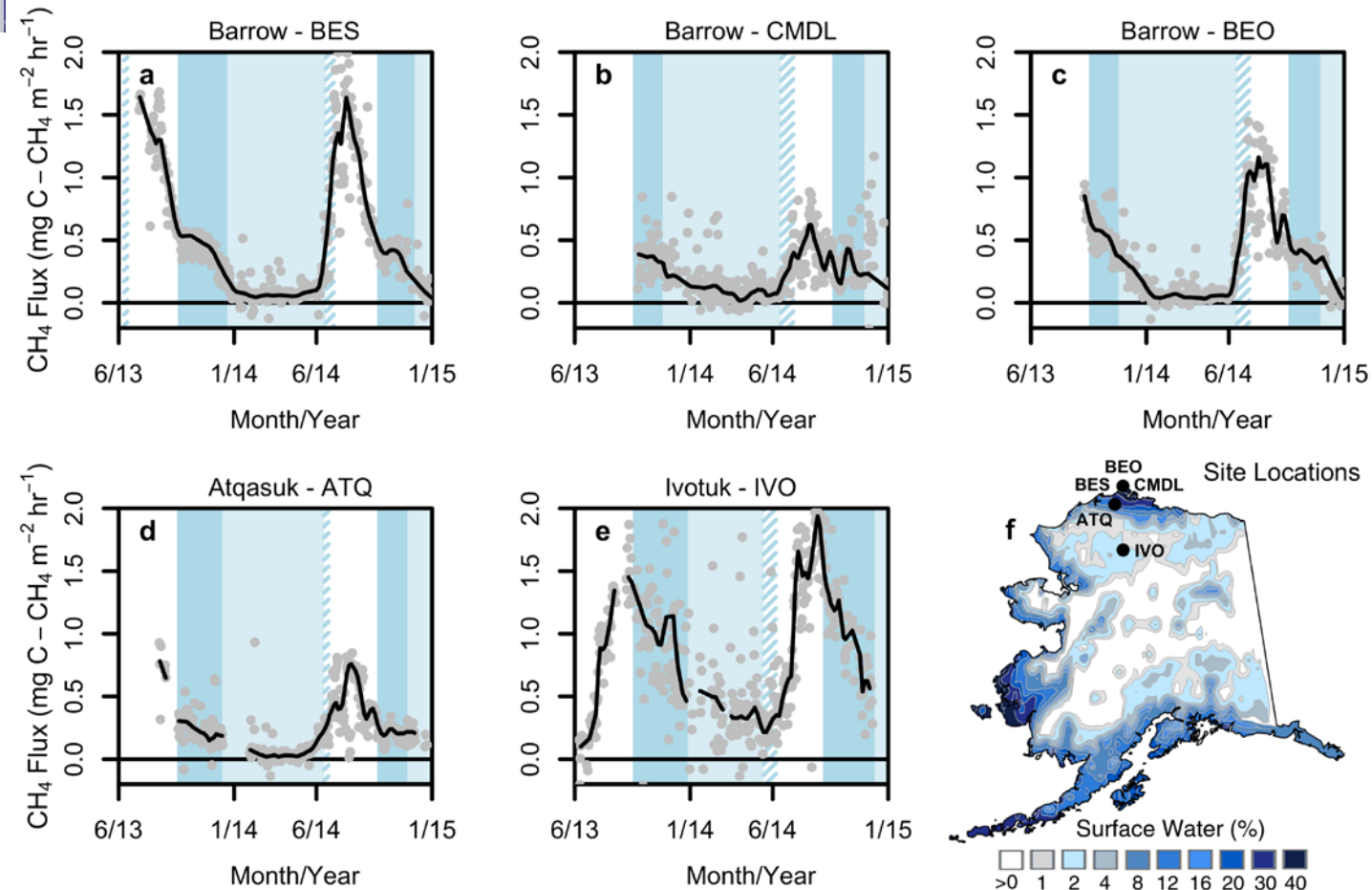


# Cold season methane emissions

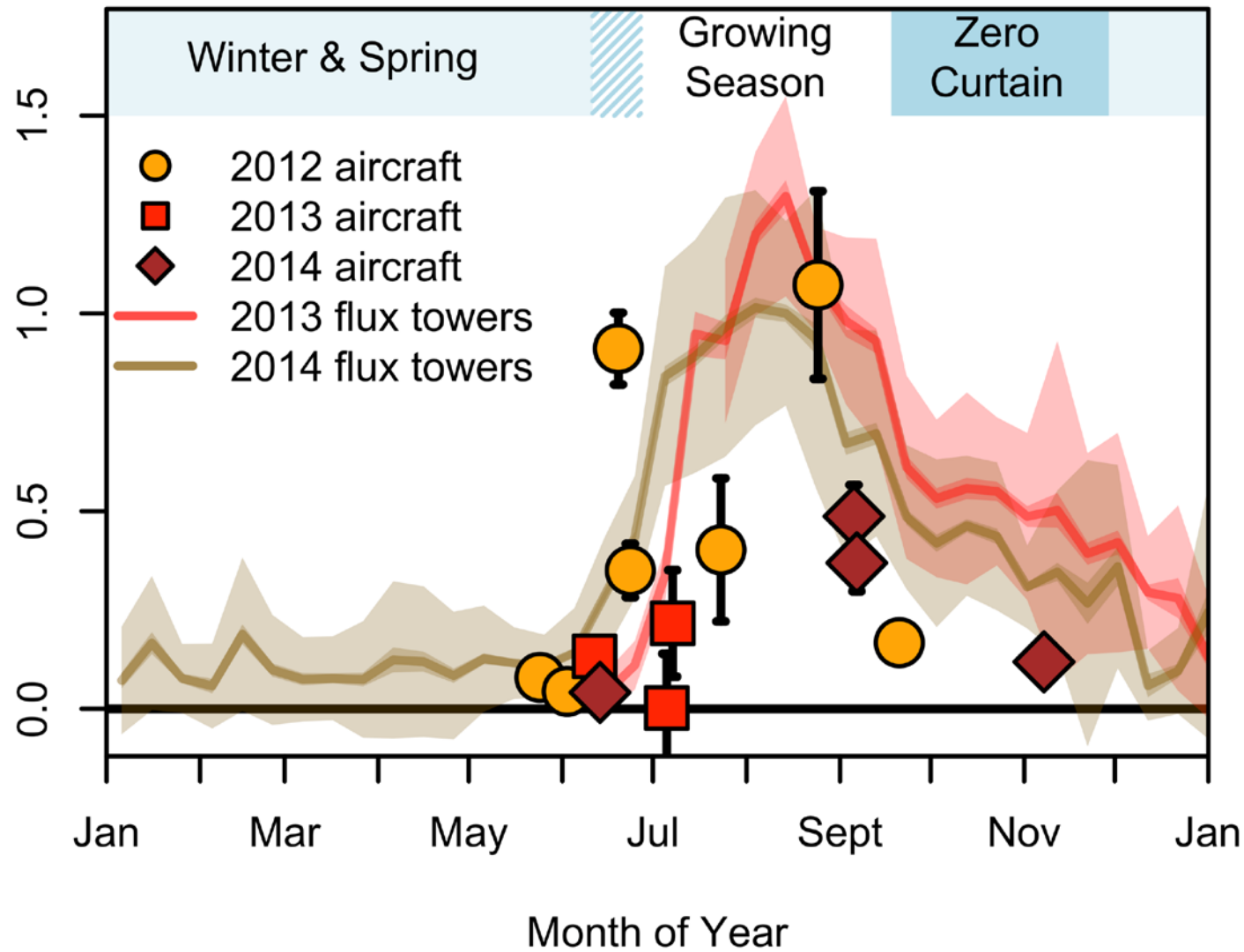


# Cold season emissions dominate the Arctic tundra methane budget

Donatella Zona<sup>a,b,1,2</sup>, Beniamino Gioli<sup>c,2</sup>, Róisín Commane<sup>d</sup>, Jakob Lindaas<sup>d</sup>, Steven C. Wofsy<sup>d</sup>, Charles E. Miller<sup>e</sup>, Steven J. Dinardo<sup>e</sup>, Sigrid Dengel<sup>f</sup>, Colm Sweeney<sup>g,h</sup>, Anna Karion<sup>g</sup>, Rachel Y.-W. Chang<sup>d,i</sup>, John M. Henderson<sup>j</sup>, Patrick C. Murphy<sup>a</sup>, Jordan P. Goodrich<sup>a</sup>, Virginie Moreaux<sup>a</sup>, Anna Liljedahl<sup>k,l</sup>, Jennifer D. Watts<sup>m</sup>, John S. Kimball<sup>m</sup>, David A. Lipson<sup>a</sup>, and Walter C. Oechel<sup>a,n</sup>



CH<sub>4</sub> Flux (mg C - CH<sub>4</sub> m<sup>-2</sup> hr<sup>-1</sup>)



Zona et al., PNAS 2016

Energy and Environment

# Bad news: Scientists say we could be underestimating Arctic methane emissions

By [Chelsea Harvey](#) December 21, 2015

SCIENCE

## Arctic Methane Emissions Underestimated By Scientists - Study

Mary Nichols , Design & Trend Contributor  
Dec, 22, 2015, 05:46 AM

TAGS : SCIENCE , CLIMATE CHANGE



## Arctic Methane Emissions Persist in Winter

Wednesday, 30 December 2015 00:00

By [Alex Kirby](#), *Climate News Network* | *News Analysis*

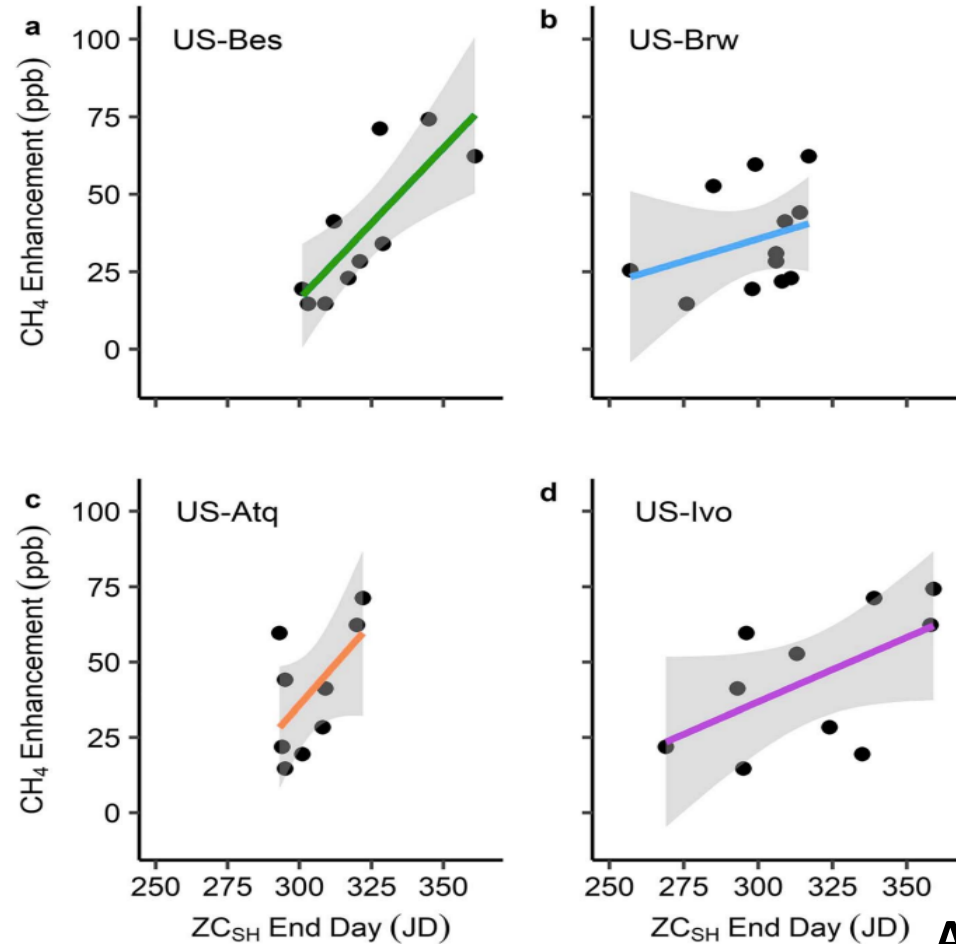
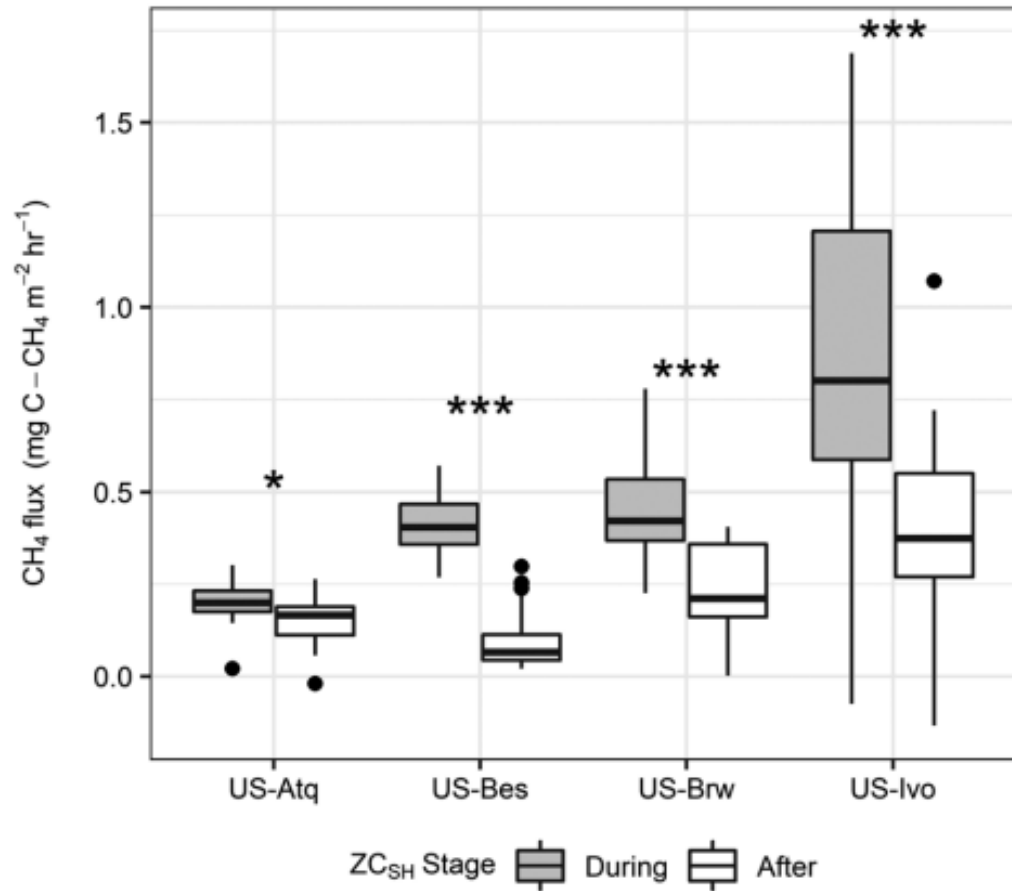
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## Sensitivity of Methane Emissions to Later Soil Freezing in Arctic Tundra Ecosystems

Kyle A. Arndt<sup>1,2</sup> , Walter C. Oechel<sup>1,3</sup> , Jordan P. Goodrich<sup>4,1</sup> , Barbara A. Bailey<sup>5</sup>,  
Aram Kalhori<sup>1</sup> , Josh Hashemi<sup>1,2</sup>, Colm Sweeney<sup>6</sup> , and Donatella Zona<sup>1,7</sup> 







# Methane-Releasing Tundra Soils Freezing Later Each Year

*Scientists find links between delayed freezing of Alaskan soils and higher atmospheric methane concentrations during the cold season.*

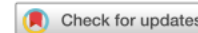
By Sarah Stanley 18 September 2019



New research suggests that soil temperatures may be far more useful than air temperatures in predicting the effects of climate change on methane emissions from the Alaskan tundra. Credit: Kyle Arndt

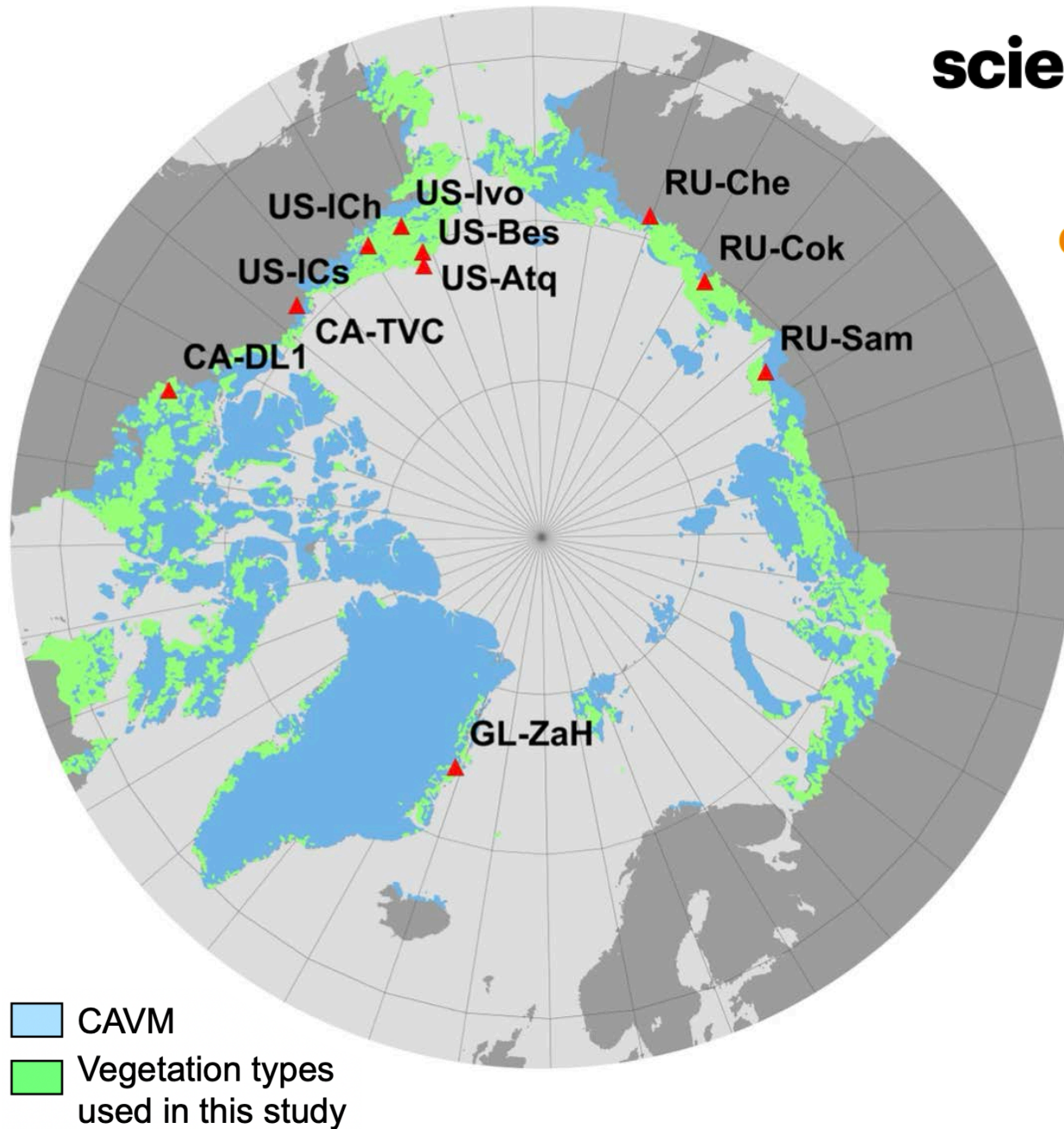
<https://eos.org/research-spotlights/methane-releasing-tundra-soils-freezing-later-each-year>

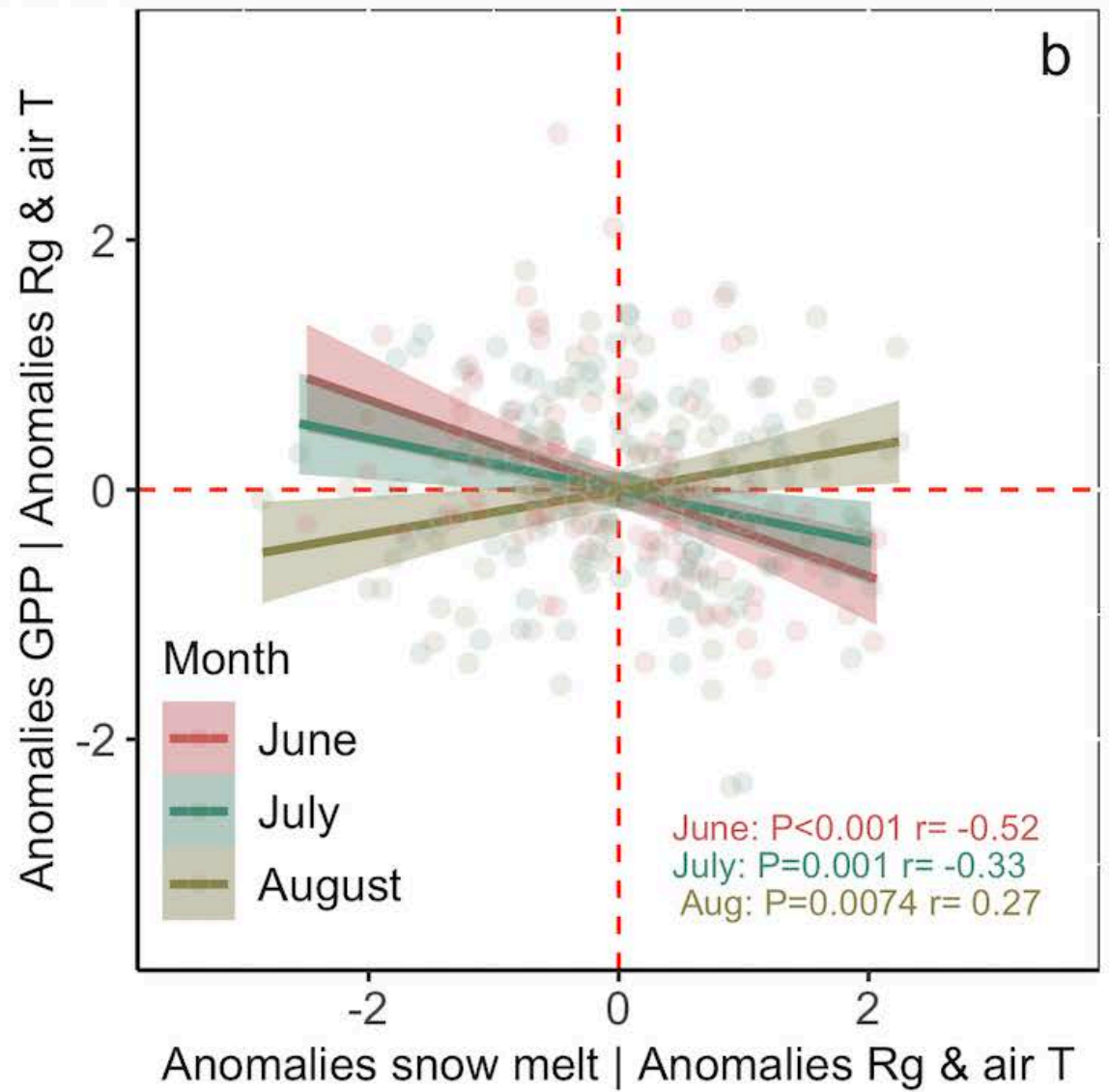
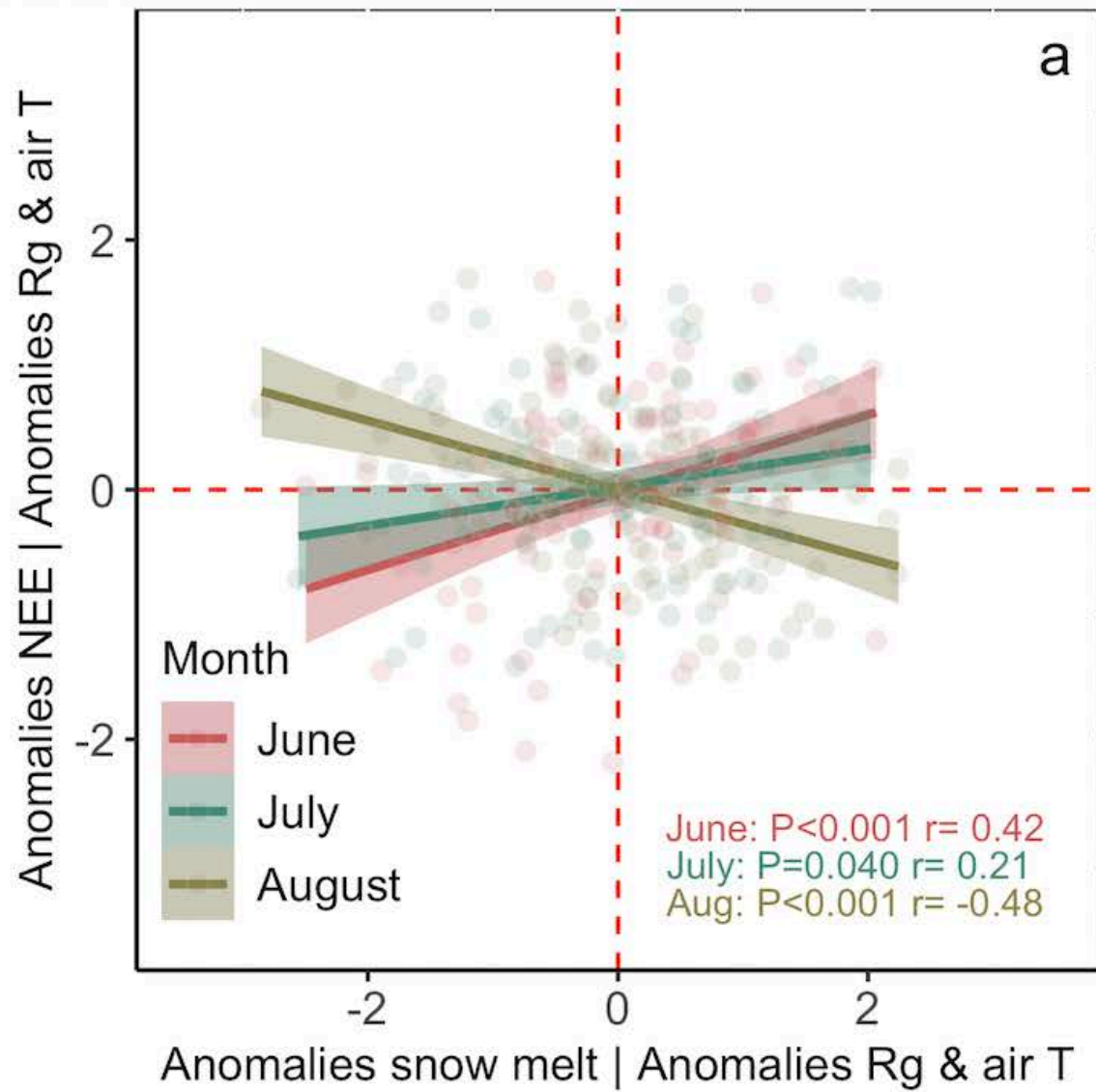
# scientific reports

**OPEN**

## Earlier snowmelt may lead to late season declines in plant productivity and carbon sequestration in Arctic tundra ecosystems

Donatella Zona<sup>1,2</sup>, Peter M. Lafleur<sup>3</sup>, Koen Hufkens<sup>4,5</sup>, Barbara Bailey<sup>1</sup>, Beniamino Gioli<sup>6</sup>, George Burba<sup>7,8</sup>, Jordan P. Goodrich<sup>9</sup>, Anna K. Liljedahl<sup>10,11</sup>, Eugénie S. Euskirchen<sup>12</sup>, Jennifer D. Watts<sup>11,13</sup>, Mary Farina<sup>11</sup>, John S. Kimball<sup>13</sup>, Martin Heimann<sup>14,15</sup>, Mathias Göckede<sup>14</sup>, Martijn Pallandt<sup>14</sup>, Torben R. Christensen<sup>16,17</sup>, Mikhail Mastepanov<sup>16,17</sup>, Efrén López-Blanco<sup>16,18</sup>, Marcin Jackowicz-Korczynski<sup>16,19</sup>, Albertus J. Dolman<sup>20</sup>, Luca Beletti Marchesini<sup>21,22</sup>, Roisin Commane<sup>23</sup>, Steven C. Wofsy<sup>24</sup>, Charles E. Miller<sup>25</sup>, David A. Lipson<sup>1</sup>, Josh Hashemi<sup>1</sup>, Kyle A. Arndt<sup>26</sup>, Lars Kutzbach<sup>27</sup>, David Holl<sup>27</sup>, Julia Boike<sup>28,29</sup>, Christian Wille<sup>30</sup>, Torsten Sachs<sup>30</sup>, Aram Kalhori<sup>30</sup>, Xia Song<sup>1</sup>, Xiaofeng Xu<sup>1</sup>, Elyn R. Humphreys<sup>31</sup>, Charles D. Koven<sup>32</sup>, Oliver Sonnentag<sup>33</sup>, Gesa Meyer<sup>33</sup>, Gabriel H. Gosselin<sup>33</sup>, Philip Marsh<sup>34</sup> & Walter C. Oechel<sup>1,35</sup>







Kyle Arndt, Ph.D. '20 checks tundra monitoring instruments in Ivotuk, Alaska, 2016. Photo by Matt Pender.

Monday, March 21, 2022

# Arctic 'Greening' Could Have Unexpected Climate Consequences

A new study led by SDSU biologist Donatella Zona says an earlier spring could jeopardize the tundra's ability to store carbon.

By **Susanne Clara Bard**



## Arctic Greening Won't Save the Climate—Here's Why

The growing season on the tundra is starting earlier as the planet warms, but the plants aren't sequestering more carbon, a new study finds.

**Donatella Zona**

Mar 30, 2022

### THE CONVERSATION

Academic rigor, journalistic flair

Search

# Arctic greening won't save the climate – here's why

Published: March 29, 2022 8.36am EDT

# Research gaps

- Understanding the origin of CH<sub>4</sub> during the cold period
- Long term temporal changes in the greenhouse gas balance –NSF AON
- Understanding the role of permafrost degradation on the full greenhouse gas balance (including CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O)- NSF ANS

# Helicopter campaign in summer 2023



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What facilities, resources and logistical support are needed by scientists in your field to address these needs and to promote a sustainable, diverse, and inclusive space for Arctic research and knowledge co-production on the North Slope?





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# Any questions?

