ABoVE Vegetation Dynamics and Distribution Working Group Update and Syntheses

Howard Epstein and Brendan Rogers

Thirty-one projects and 87 individual members

Recent Publications

Bourgeau-Chavez, L.L., J.A. Graham, S. Endres, N.H.F. French, M. Battaglia, D. Hansen, and D. Tanzer. 2019. ABoVE: Ecosystem Map, Great Slave Lake Area, Northwest Territories, Canada, 1997-2011. *ORNL DAAC*, Oak Ridge, Tennessee, USA.

Eitel, J. U., Griffin, K. L., Boelman, N. T., Maguire, A. J., Meddens, A. J., Jensen, J., ... & Jennewein, J. S. (2020). Remote sensing tracks daily radial wood growth of evergreen needleleaf trees. *Global Change Biology*.

Maguire, Andrew J., Jan UH Eitel, Kevin L. Griffin, Troy S. Magney, Ryan A. Long, Lee A. Vierling, Stephanie C. Schmiege et al. "On the Functional Relationship Between Fluorescence and Photochemical Yields in Complex Evergreen Needleleaf Canopies." *Geophysical Research Letters* (2020): e2020GL087858.

Potter, C. and O. Alexander, 2020, Changes in vegetation phenology and productivity in Alaska over the past two decades, *Remote Sensing,* 12: 1546.

Potter, C., 2020, Changes in vegetation cover of Yukon River drainages in interior Alaska estimated from MODIS greenness trends, 2000 to 2018, *Northwest Science*, 94(2): (in press)

Boyd, M. A., Berner, L. T, Foster, A. C., Goetz, S. J., Rogers, B. M., Walker, X. J., & Mack, M. C. (Submitted) Historic declines in productivity portend aspen death during a contemporary leaf miner outbreak in interior Alaska. *Global Change Biology*

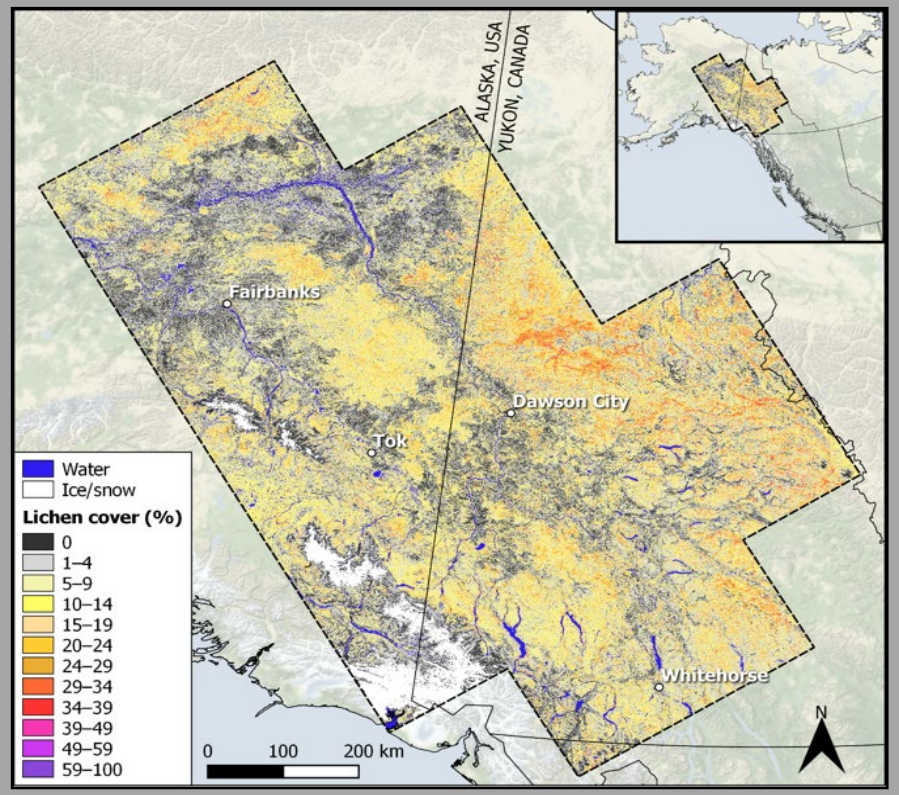
Lichen cover mapping for caribou ranges in interior Alaska and Yukon

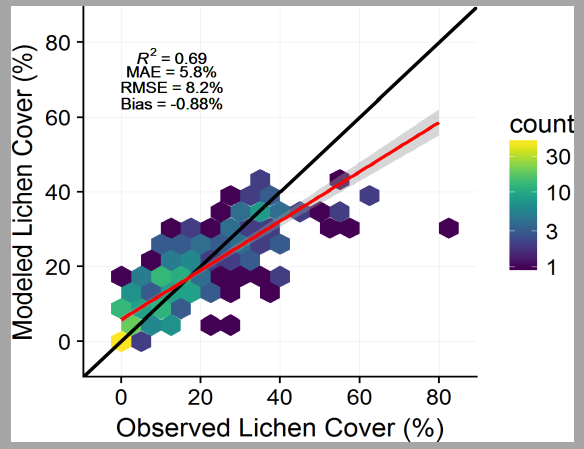
Matthew J Macander, Eric C Palm, Gerald V Frost, Jim D Herriges, Peter R Nelson, Carl Roland, Kelsey LM Russell, Mike J Suitor, Torsten W Bentzen, Kyle Joly, Scott J Goetz, Mark Hebblewhite **(ERL 2020)**

ABoVE biome shift project

Final map: terrestrial lichen cover

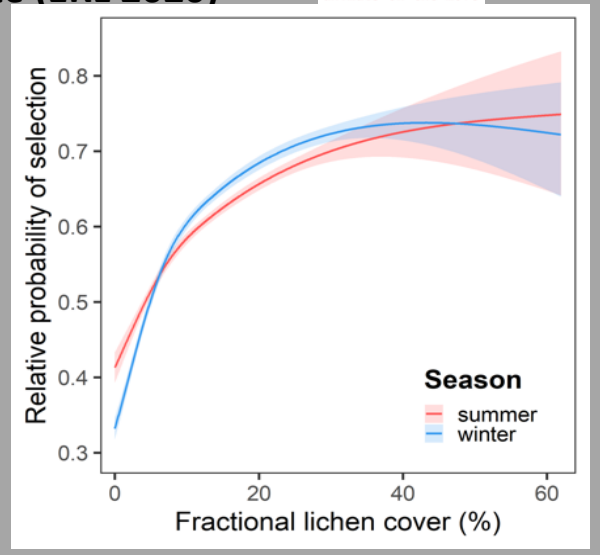
Our final lichen cover map incorporated extensive field data for model training and validation, and will be useful for understanding trends in lichen abundance and distribution, as well as for caribou research, management and conservation.





Validation

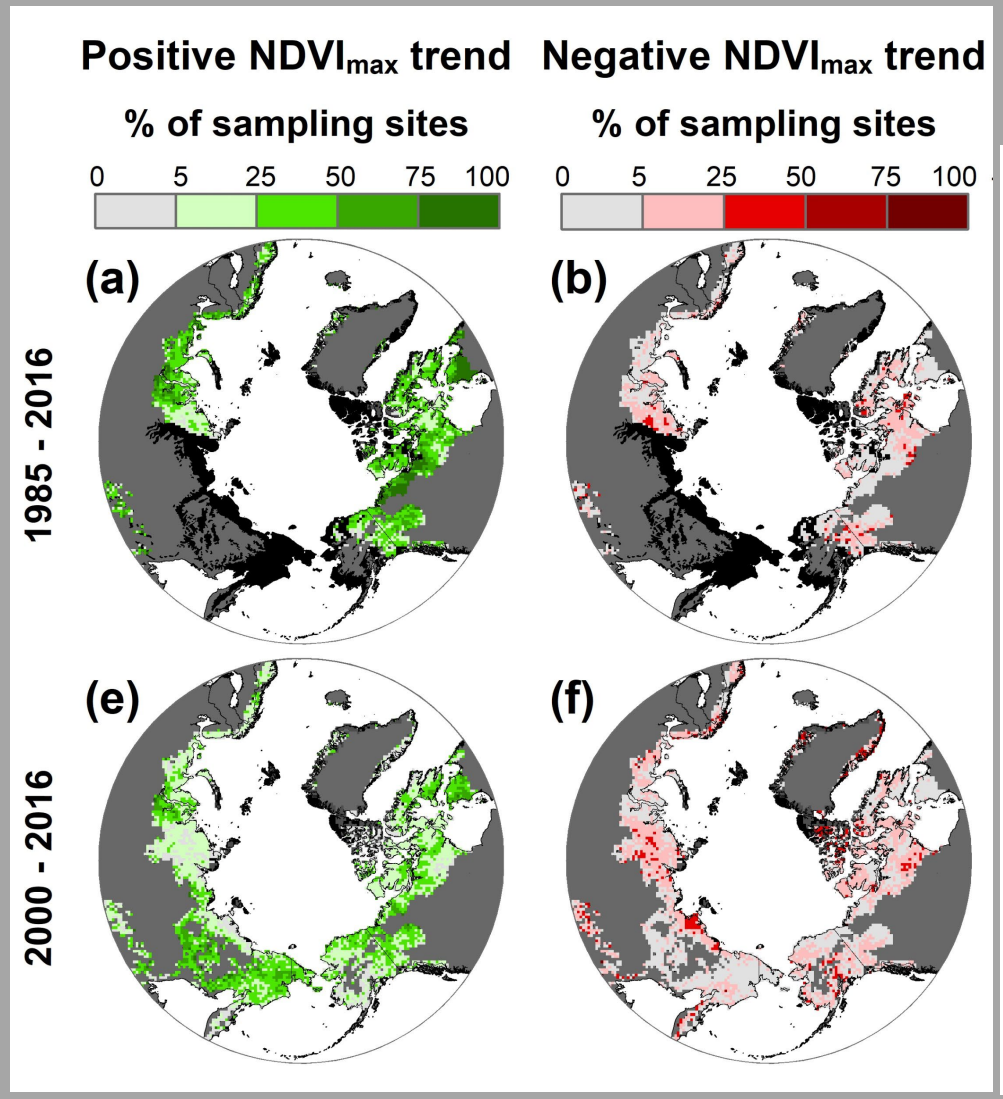
Our final lichen cover map validated very well overall (RMSE = 8.2%), and with aerial survey data (RMSE = 9.2%) and UAV imagery (RMSE = 6.5%).

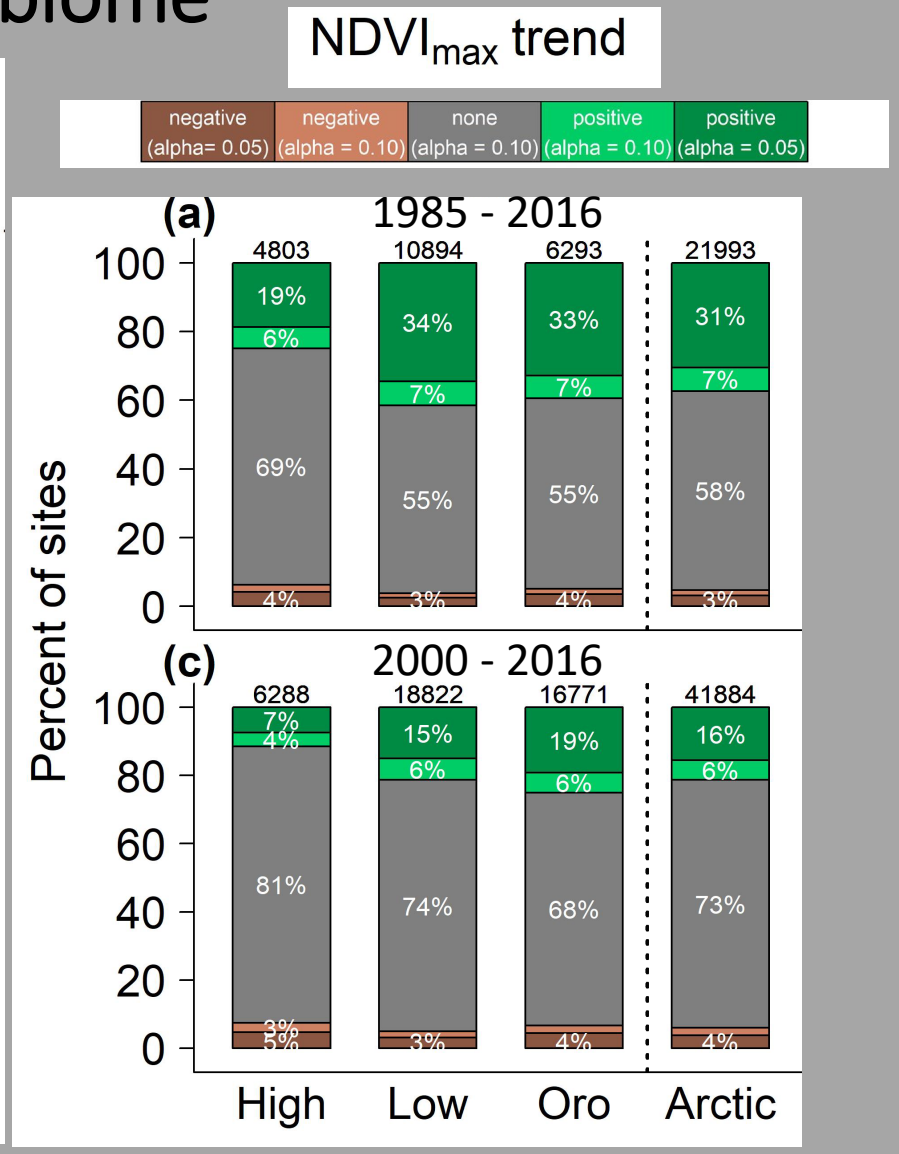


Caribou selection of lichens

Caribou avoided lichen-poor areas and showed stronger selection as lichen cover increased to ~30%, above which selection leveled off

Greening and browning in the tundra biome





Berner, L. T., Massey, R., Jantz, P., Forbes, B. C., Macias-Fauria, M., Myers-Smith, I. H., Kumpula, T., Gauthier, G., Andreu-Hayles, L., Gaglioti, B., Burns, P. J., Zetterberg, P., D'Arrigo, R., and Goetz, S. J.: Landsat satellites reveal widespread greening in the Arctic tundra biome over the past three decades, In revision at Nature Communications.

BOSTON UNIVERSITY

Disturbance suppresses the aboveground biomass carbon sink in North American boreal forests

Jonathan A Wang (1,2), Mary K Farina (3,4), Alessandro Baccini (2,3), James T Randerson (1), Mark A Friedl (2)

1 University of California, Irvine. 2 Boston University 3 Woods Hole Research Center 4 Montana State University

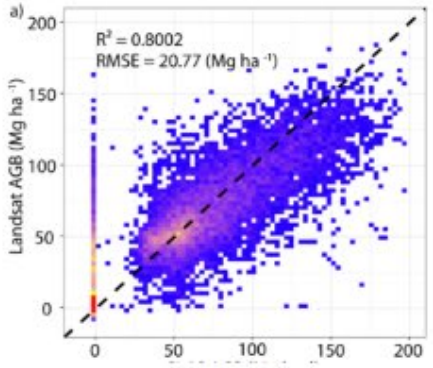
Background and Motivation

Research Questions

- How have AGB stocks varied in the ABoVE domain?
- How have disturbances influenced changes in these stocks?
- How has the influence of disturbances changed as the climate has changed?
- How do earth system models estimates compare?

OPEN

Aboveground Biomass Modeling

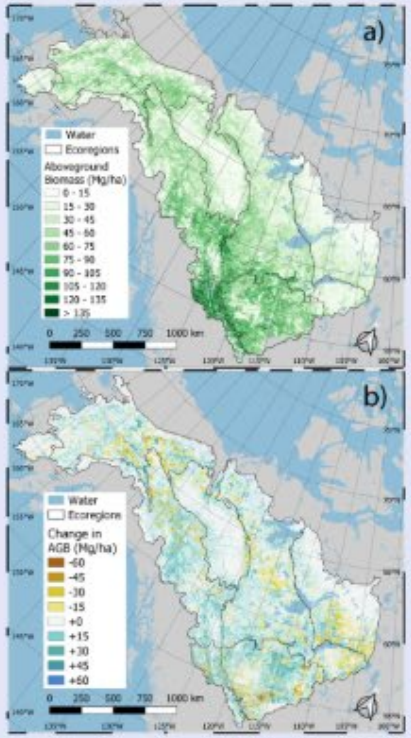


OPEN

AGB stocks and changes

mountains.

- Patches of both AGB gains and losses in all ecoregions



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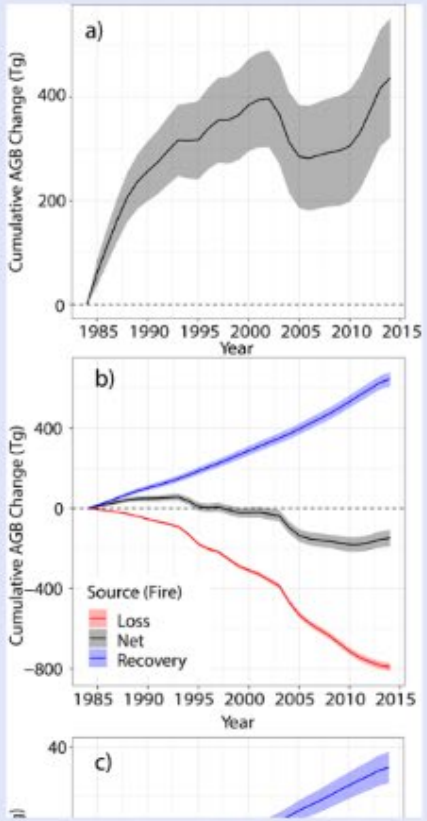
Temporal dynamics of AGB change



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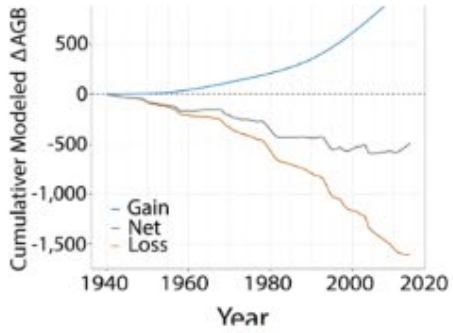
Influence of disturbances accelerating with time



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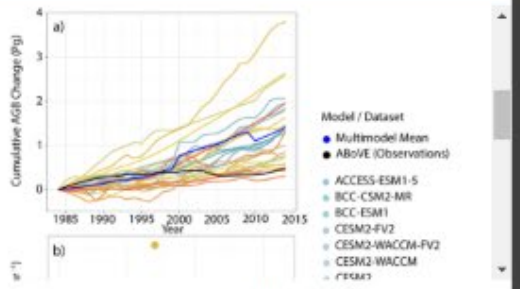
Earth System Model comparisons



OPEN

Wang et al. to be submitted to *Nature Climate Change*

RECENT SYNTHETIC PAPERS LED (OR CONTRIBUTED TO) BY ABoVE TEAM MEMBERS

PERSPECTIVE
https://doi.org/10.1038/s41558-019-0688-1
nature climate change

Complexity revealed in the greening of the Arctic

Isla H. Myers-Smith[1,2r*], Jeffrey T. Kerby[2,3,2r*], Gareth K. Phoenix[4], Jarle W. Bjerke[5], Howard E. Epstein[6], Jakob J. Assmann[1,7], Christian John[2], Laia Andreu-Hayles[8], Sandra Angers-Blondin[1], Pieter S. A. Beck[9], Logan T. Berner[10], Uma S. Bhatt[11], Anne D. Bjorkman[12,13], Daan Blok[14], Anders Bryn[15], Casper T. Christiansen[16], J. Hans C. Cornelissen[17], Andrew M. Cunliffe[18], Sarah C. Elmendorf[19], Bruce C. Forbes[20], Scott J. Goetz[19], Robert D. Hollister[21], Rogier de Jong[22], Michael M. Loranty[23], Marc Macias-Fauria[24], Kadmiel Maseyk[25], Signe Normand[7], Johan Olofsson[26], Thomas C. Parker[27], Frans-Jan W. Parmentier[28,29,30], Eric Post[3], Gabriela Schaepman-Strub[31], Frode Stordal[32], Patrick F. Sullivan[33], Haydn J. D. Thomas[1], Hans Tømmervik[5], Rachael Treharne[4], Craig E. Tweedie[33], Donald A. Walker[34], Martin Wilmking[35] and Sonja Wipf[36]

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

ELSEVIER

Review

Recent trends and remaining challenges for optical remote sensing of Arctic tundra vegetation: A review and outlook

Alison Beamish[a,g,*], Martha K. Raynolds[b], Howard Epstein[e], Gerald V. Frost[d], Matthew J. Macander[d], Helena Bergstedt[c], Annett Bartsch[f,1], Stefan Kruse[g], Victoria Miles[h], Cemal Melih Tanis[i], Birgit Heim[g], Matthias Fuchs[a], Sabine Chabrillat[a], Iuliia Shevtsova[g], Mariana Verdonen[j], Johann Wagner[k]

UNDERSTANDING NORTHERN LATITUDE VEGETATION GREENING AND BROWNING

PROCEEDINGS OF A WORKSHOP

April Melvin, *Rapporteur*

Polar Research Board

Board on Life Sciences

Division on Earth and Life Studies

ARCTIC PROGRAM

NOAA 2019 ARCTIC REPORT CARD

Tundra Greenness

G.V. Frost[1], U. S. Bhatt[2], H. E. Epstein[3], D.A. Walker[4], M. K. Raynolds[4], L.T. Berner[5], J.W. Bjerke[6], A. L. Breen[2], B. C. Forbes[7], S. J. Goetz[5], C. M. Iversen[8], M. J. Lara[9], M. J. Macander[1], G. K. Phoenix[10], A.V. Rocha[11], V. G. Salmon[8], P. E. Thornton[8], H. Tømmervik[6], and S. D. Wullschleger[8]

GREENING AND BROWNING LITERATURE SYNTHESIS

Purpose: Synthesize the knowledge base on the drivers of Arctic greening and browning and identify knowledge gaps

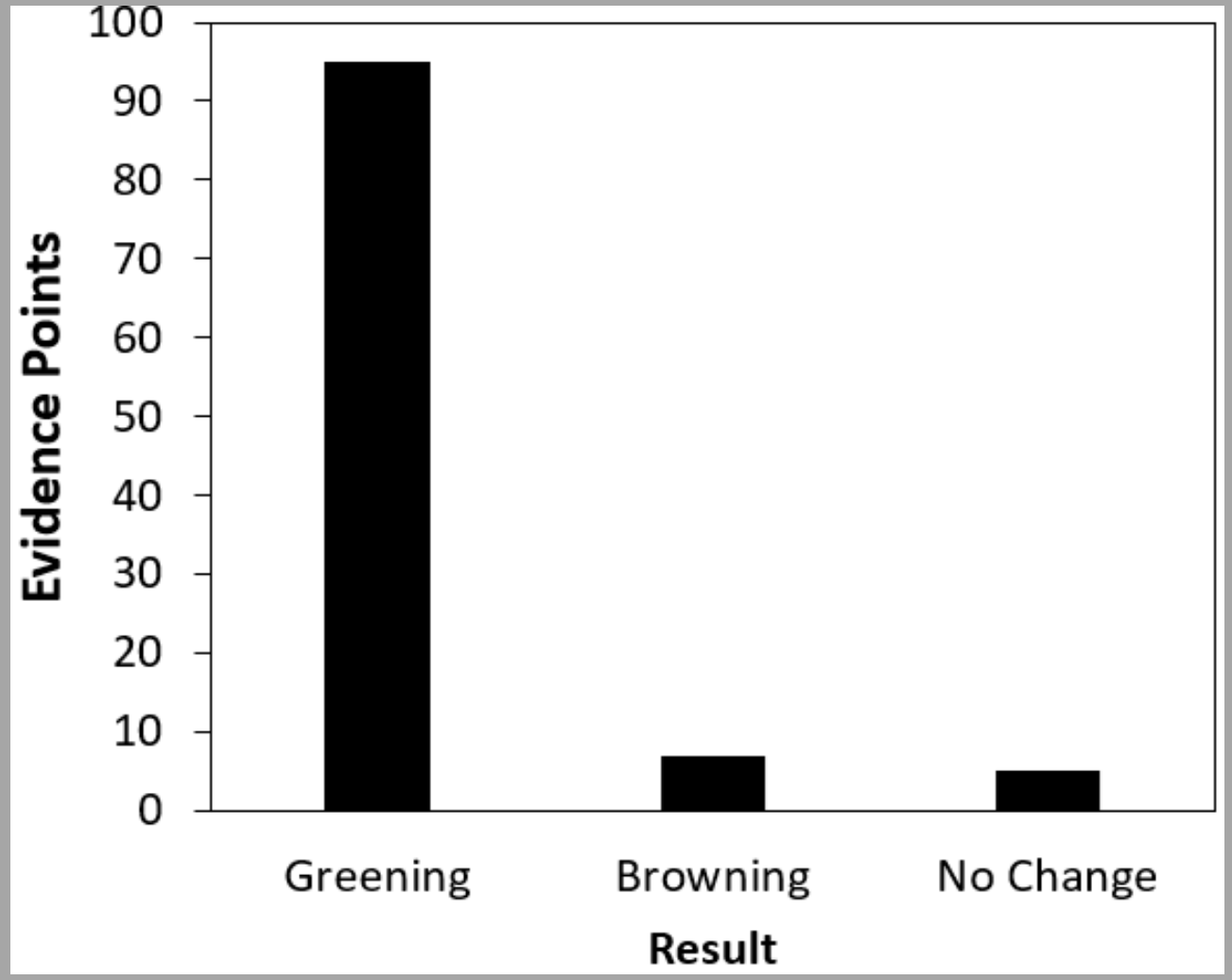
Progress:

85 papers spanning 1999 to 2010 have been reviewed

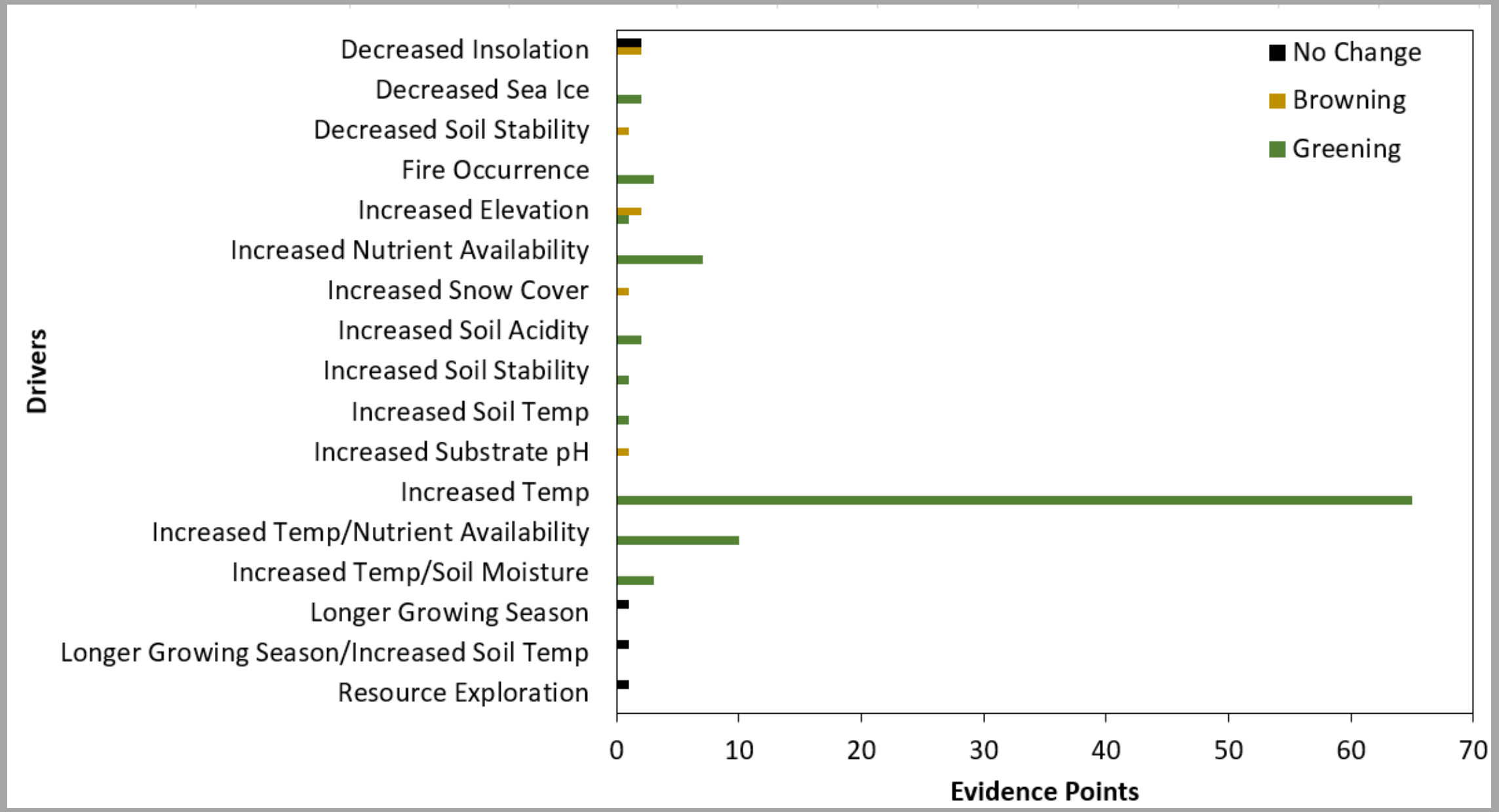
28 studies have meet the selection criteria

107 evidence points have been generated from these 28 studies

Tassone and Epstein



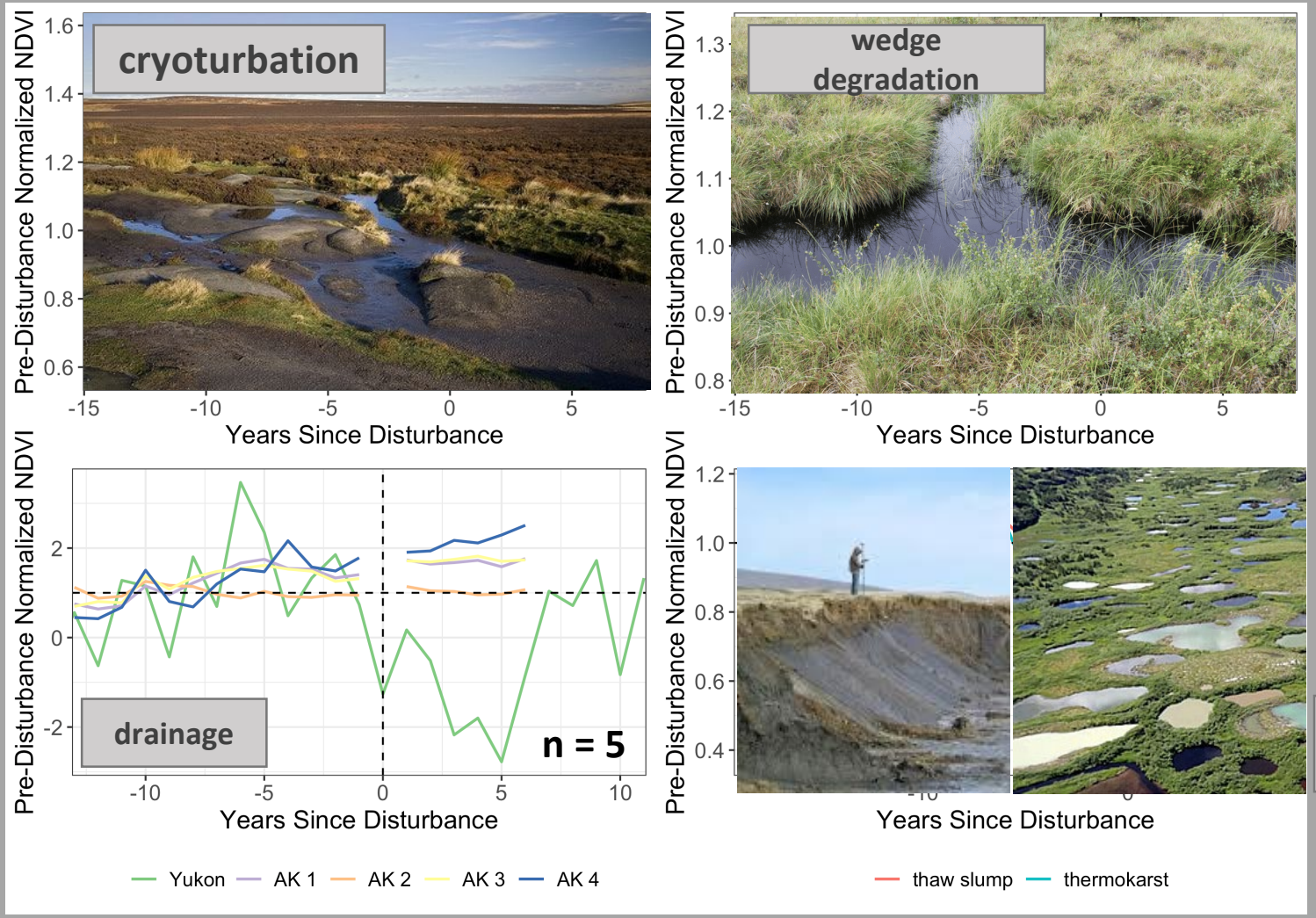
GREENING AND BROWNING LITERATURE SYNTHESIS



Preliminary Findings

Permafrost/Hydrology Case Study Points

NDVI



thaw slump
thermokarst

ADDITIONAL SYNTHESES TBD