

# Lead/co-lead meeting of the PCN, June 18-19 2016 Potsdam, Germany



# Syntheses in progress

(summary slides with updates and new timelines available)

- **Reconciling permafrost region methane budgets:** a) onshore; b) coastal; c) atmospheric
  - *Lead: Dave McGuire, Jennifer Frederick, Robie McDonald*
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- **Quantifying relationships between vegetation structure and permafrost thermal dynamics**
  - *Lead: Mike Loranty, Heather Kropp, Sue Natali*
  -
- **Where and when will the Arctic become wetter or drier?**
  - *Lead: Christian Andresen, Cathy Wilson, Dave Lawrence*
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- **Carbon emissions from the Arctic during the non-growing season**
  - *Lead: Sue Natali*
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- **Strategizing a comprehensive laboratory protocol to determine the decomposability of soil organic matter in permafrost**
  - *Lead: Christina Schädel*
- **Dissolved organic matter composition in waters draining permafrost landscapes**
  - *Lead: Jon O'Donnell*

# New synthesis products:

- **Merging Tibetan Carbon stocks into Pangaea.de and updating spatial estimation**
  - *Lead: Yuanhe Yang, Gustaf Hugelius, Umakant Mishra*
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- **Subsea permafrost expert survey**
  - *Lead: Ben Abbott, Jennifer Frederick*
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- **Upland Thermokarst Conceptual Paper** (linking the ideas of carbon balance, geomorphological disturbance, and retarded glaciation)
  - *Lead: Ben Abbott et al.*
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- **Could Priming and nutrient effects from degrading permafrost alter dissolved organic matter dynamics in permafrost-zone waterways?**
  - *Lead: Ben Abbott et al.*
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**More details: [www.permafrostcarbon.org](http://www.permafrostcarbon.org)**

2015

# PERMAFROST CARBON NETWORK

5-YEAR SYNTHESIS REPORT



[www.permafrostcarbon.org](http://www.permafrostcarbon.org)

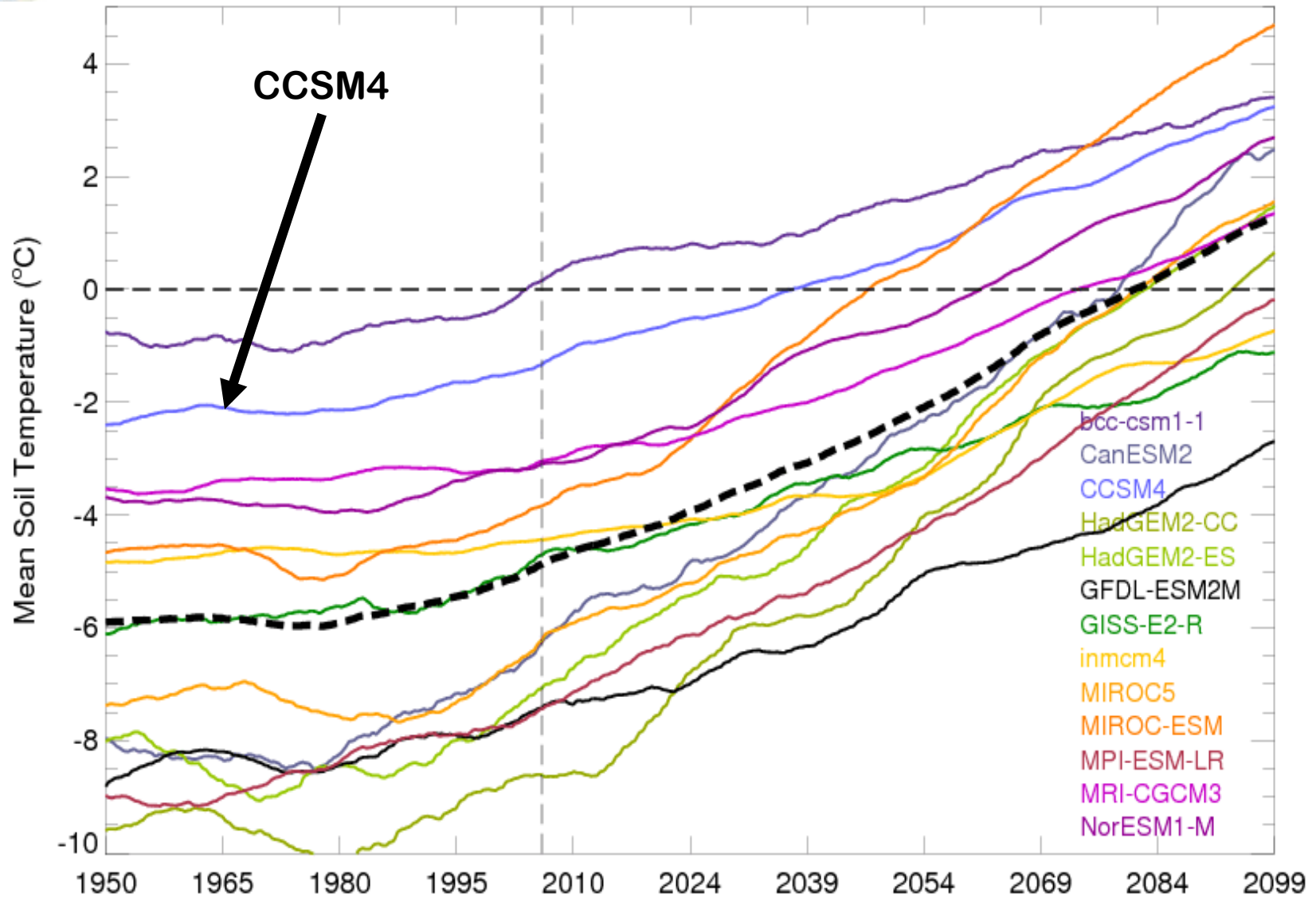


Schädel & Schuur 2015



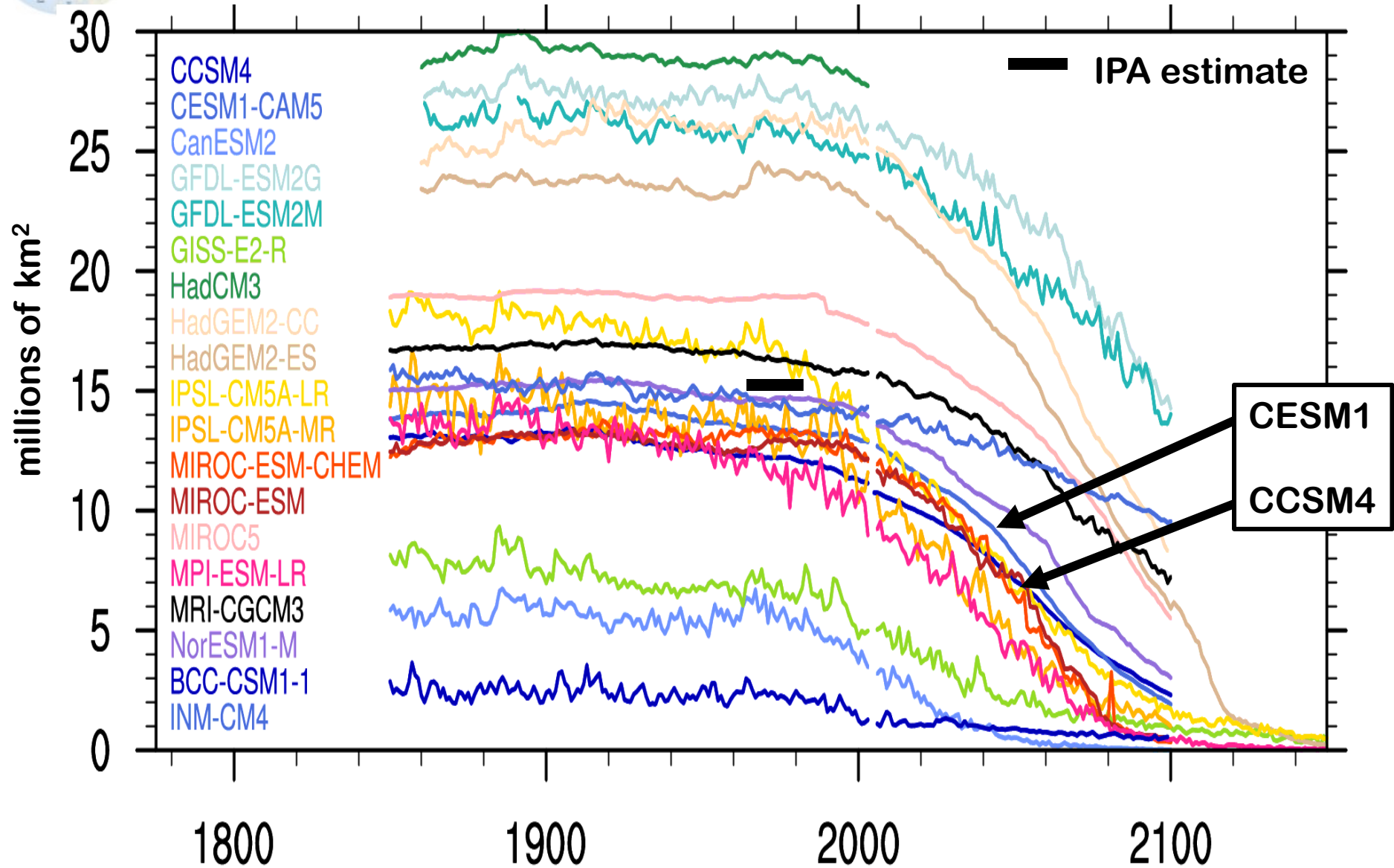


# CMIP5 Models: Mean Soil Temperature across permafrost domain @ 3.3m (RCP 8.5)





# CMIP5 Models: Near-surface permafrost extent (RCP 8.5)

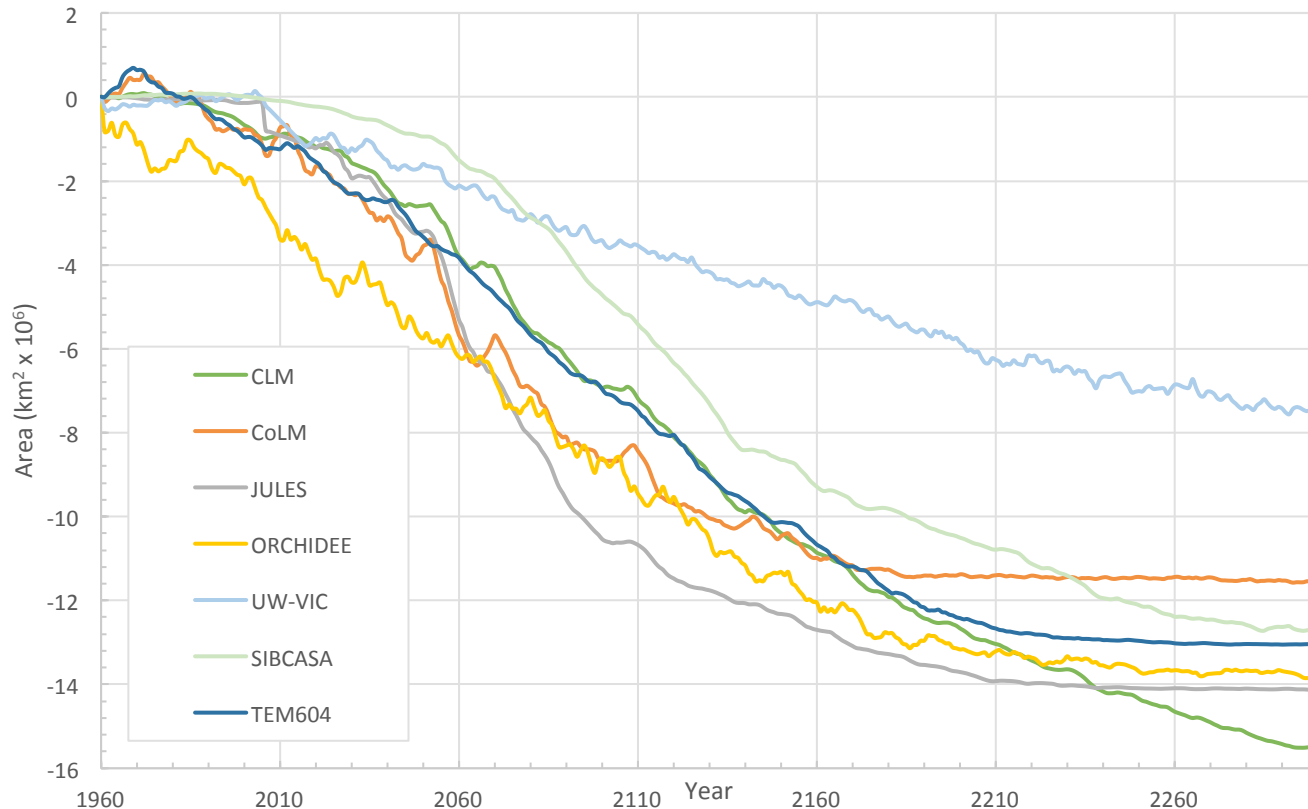


# PCN: “Permafrost Model intercomparison”

## Diverse permafrost loss predictions

Permafrost Area Loss 1960-2299 (RCP 8.5)

Permafrost Area  $\Delta$  (rcp 8.5)



# PCN Model Intercomparison papers

- McGuire, A.D., C. Koven, D.M. Lawrence et al., 2016: A model-based analysis of the vulnerability of carbon in the permafrost region between 1960 and 2009. *Glob. Biogeochem. Cycles*, DOI: 10.1002/2016GB005405.
- Peng, S., P. Ciais, G. Krinner, et al., 2015: Simulate high-latitude soil thermal dynamics during the past four decades. *The Cryosphere*, **10**, 179-192, doi:10.5194/tc-10-179-2016.
- Xia, J., A.D. McGuire, D. Lawrence, et al., 2016: Terrestrial ecosystem model performance in simulating net primary productivity and its vulnerability to climate change in the northern permafrost region. *Submitted to J. Geophys. Res.*
- Wang, W., et al., 2016: Evaluation of air-soil temperature relationships simulated by land surface models during winter across the permafrost region. *The Cryosphere*, **10**, 1721-1737, doi:10.5194/tc-10-1721-2016.
- Lawrence, D.M., C.D. Koven, S.C. Swenson, W.J. Riley, and A.G. Slater, 2015: [Permafrost thaw and resulting soil moisture changes regulate projected high-latitude CO<sub>2</sub> and CH<sub>4</sub> emission](#). *ERL*, **10**, doi:10.1088/1748-9326/10/9/094011.
- Koven, C.D, E. A. G. Schuur, C. Schädel, et al., 2015: A simplified, data-constrained approach to estimate the permafrost carbon-climate feedback. *Phil. Trans. R. Soc. A*, DOI: 10.1098/rsta.2014.0423.
- Wang, W., A. Rinke, J.C. Moore, X.-F. Cui, D. Ji, Q. Li, N. Zhang, C. Wang, S. Zhang, D. M. Lawrence, A. D. McGuire, C. Koven, K. Saito, W. Zhang, A. MacDougall, C. Delire, E. Burke, 2016: Diagnostic and model dependent uncertainty of simulated Tibetan permafrost area. *The Cryosphere*, **10**, doi:10.5194/tc-10-287-2016.
- Rawlins, M.A., A. D. McGuire, J. K. Kimball, et al., 2015: Assessment of model estimates of land-atmosphere CO<sub>2</sub> exchange across Northern Eurasia. *Biogeosciences*, **12**, 4385-4405, doi:10.5194/bg-12-4385-2015.
- Schuur, E., A. McGuire, C. Schaedel, G. Grosse, J. Harden, D. Hayes, G. Hugelius, C. Koven, P. Kuhry, D. Lawrence, S. Natali, D. Olefeldt, V. Romanovsky, K. Schaefer, M. Turetsky, C. Treat, and J. Vonk, 2015: Climate change and the permafrost carbon feedback. *Nature*, **520**, doi:10.1038/nature14338.

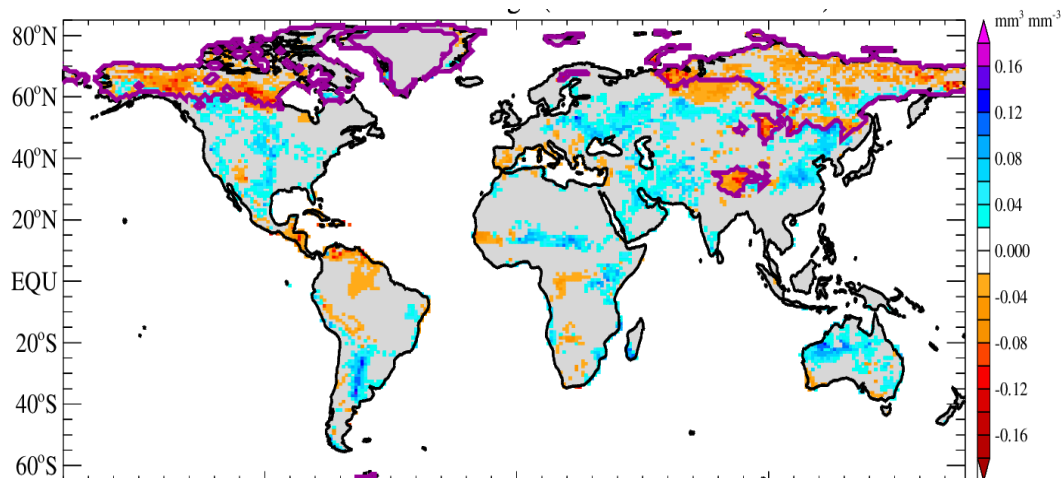




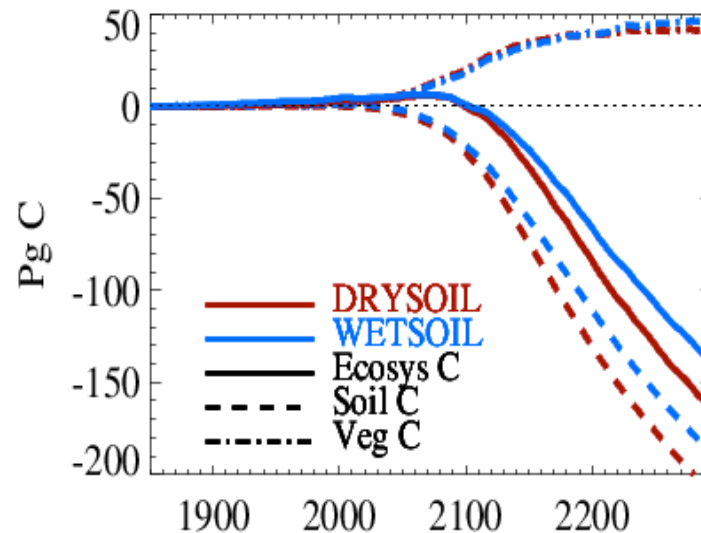
# Permafrost thaw impact on soil moisture

CLM4.5

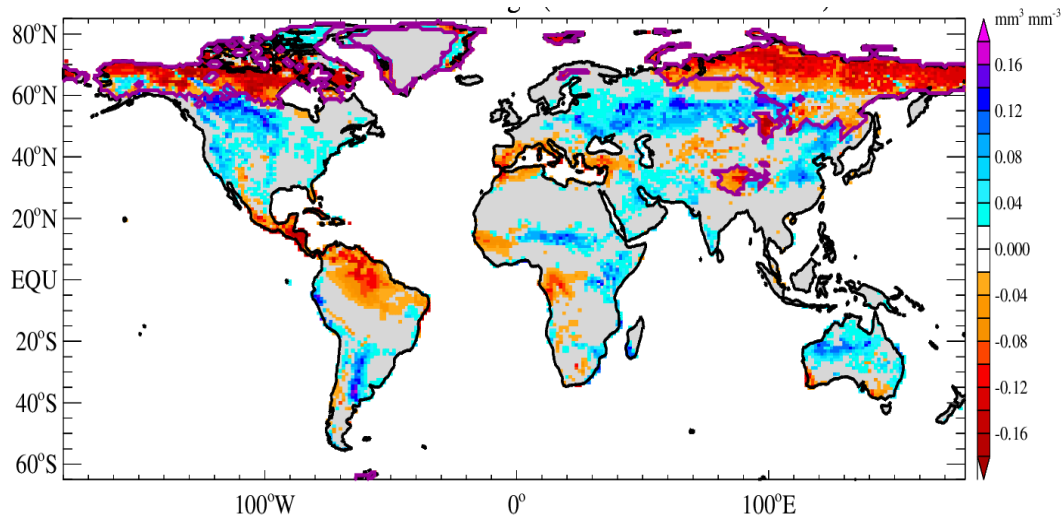
## Column soil moisture change by 2100



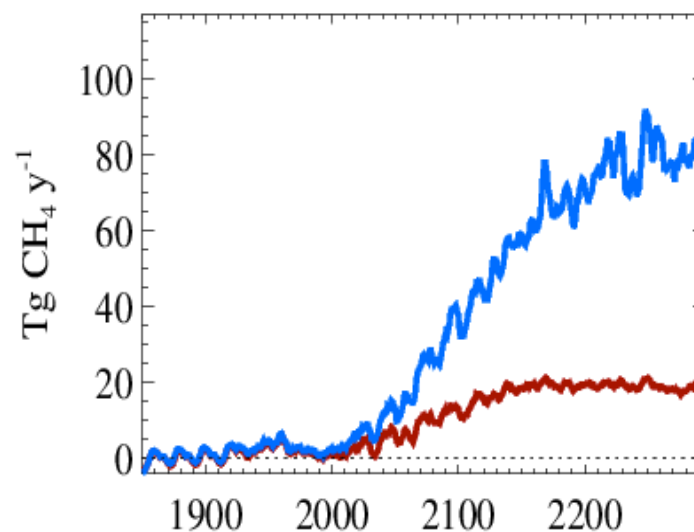
## Δ Carbon Stock



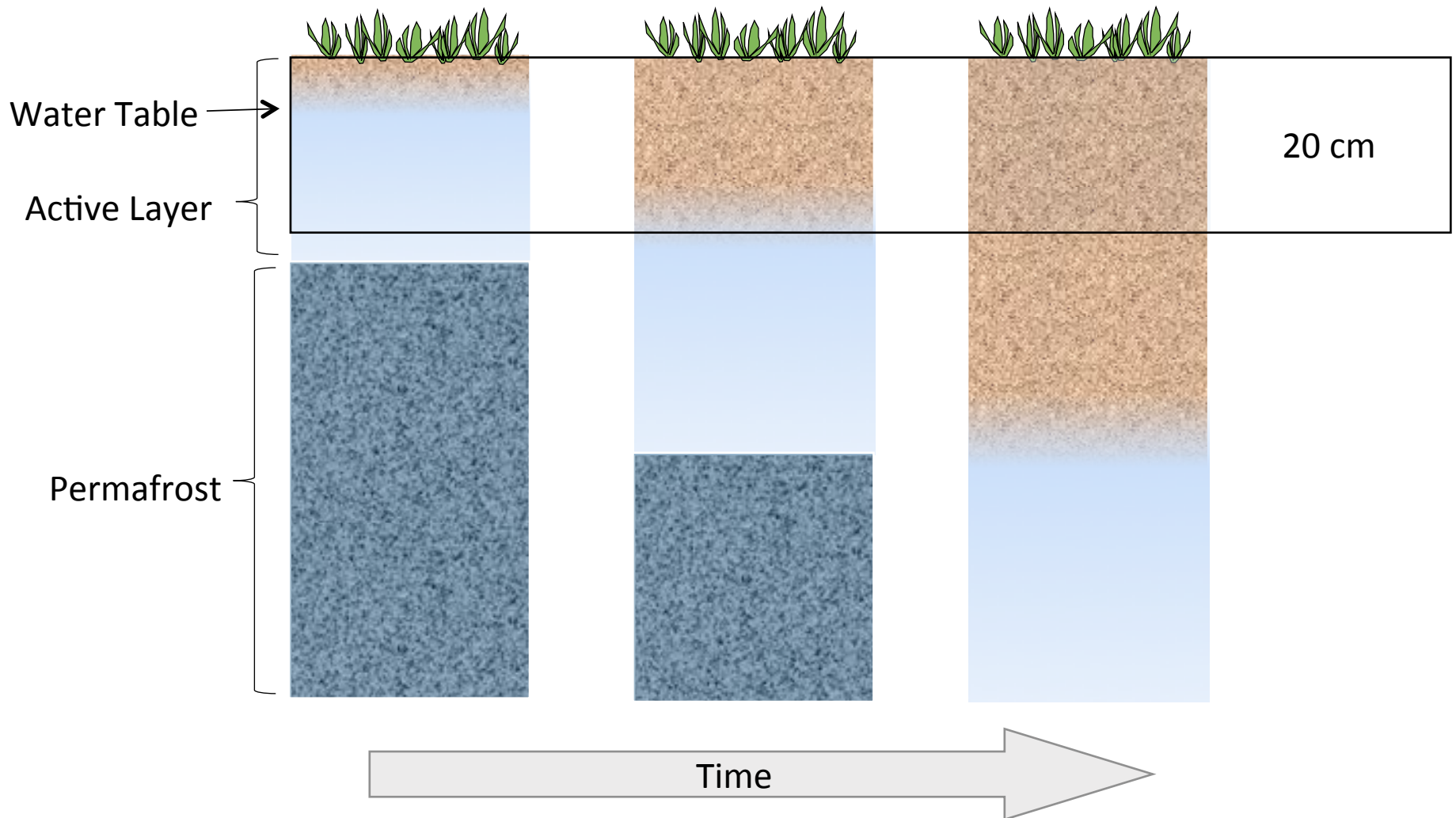
## Column soil moisture change by 2300



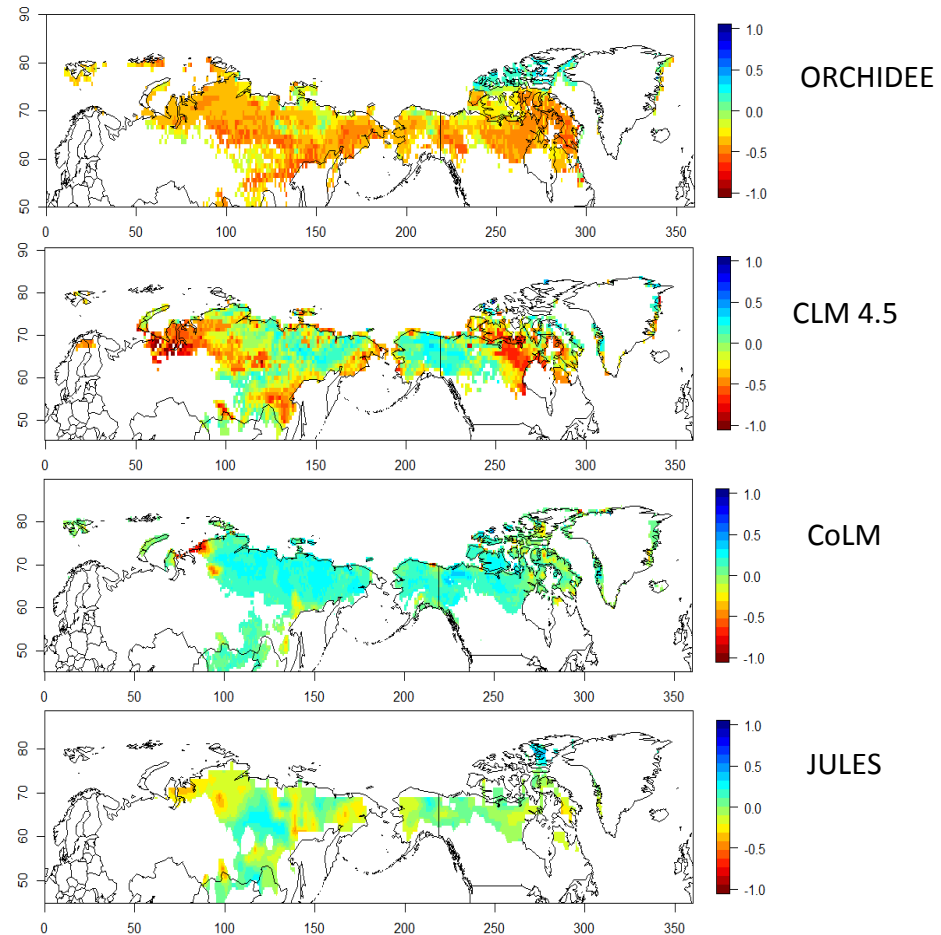
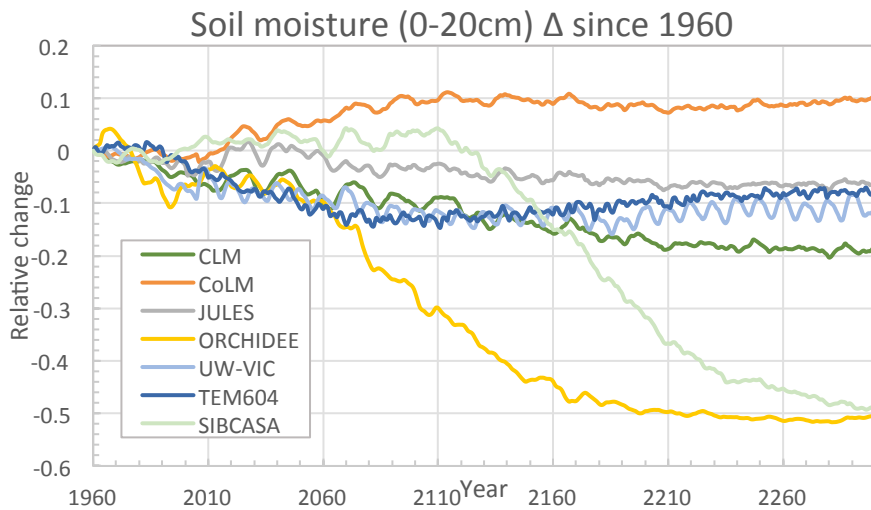
## Δ CH<sub>4</sub> emissions



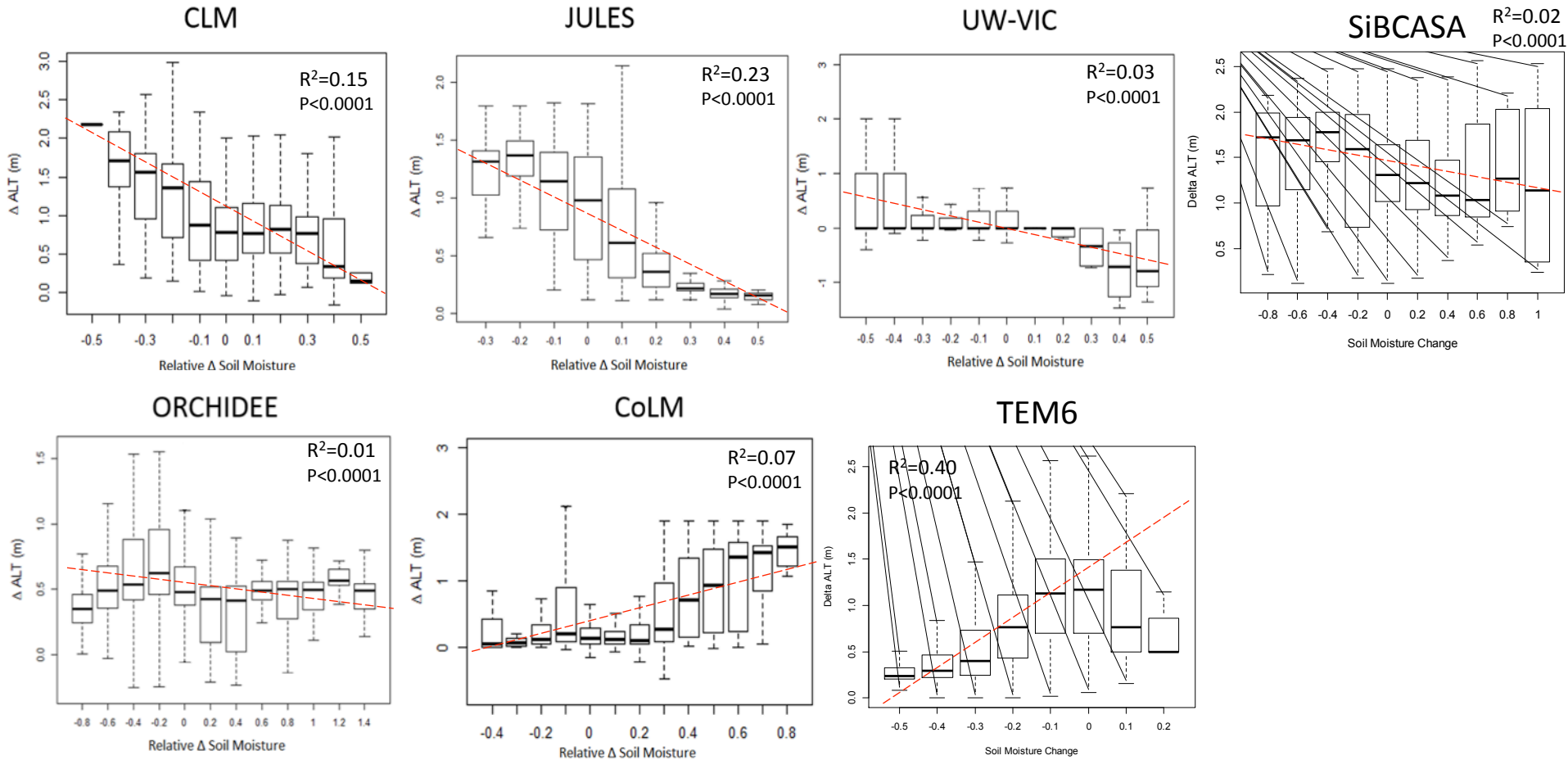
# Models: Top layer drains as permafrost thaws?



# Soil moisture predictions: Arctic drying



# ALT vs Soil Moisture



Cells in initial permafrost domain 1960  
 $\Delta$  = mean of 2070-2099 - mean of 1960-1989

# Diverse soil column configuration among land models

