

Performance of global black carbon emission inventories in the Arctic

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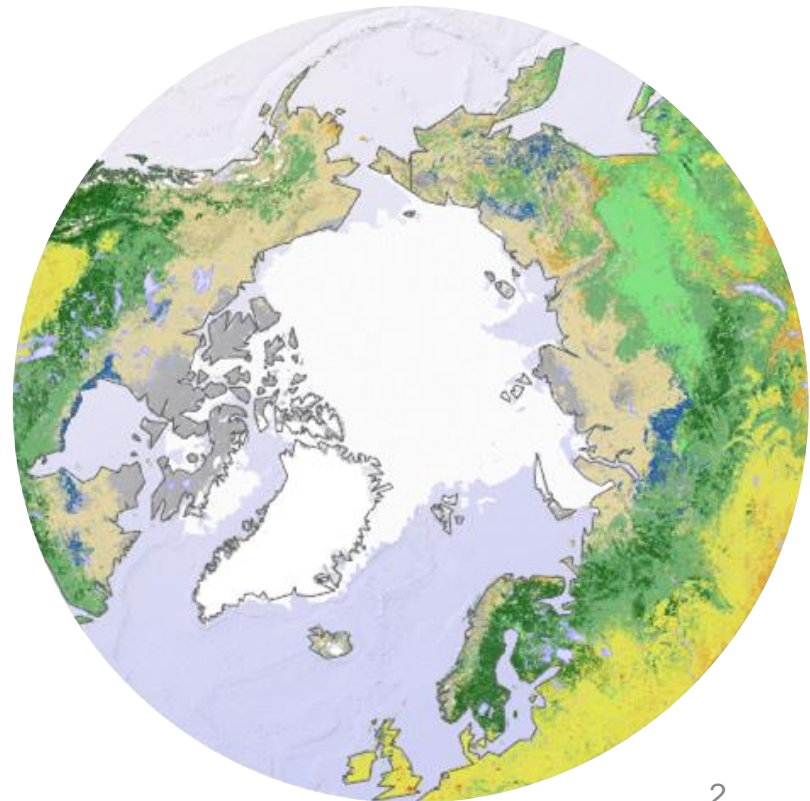
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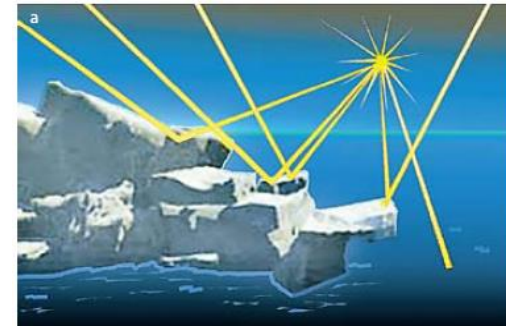


Introduction

- The Arctic climate is warming faster than global average
 - Arctic sea ice cover has been decreasing
- Short-lived climate pollutants have a major impact on Arctic climate
 - Especially black carbon (BC)
- How do emission inventories handle Arctic relevant BC emissions?
- To get an estimate, the research questions of this study were: (1) what kind of differences are there in global emission inventories in the Arctic; and (2) how can the models be improved?

Black Carbon (BC) in this work

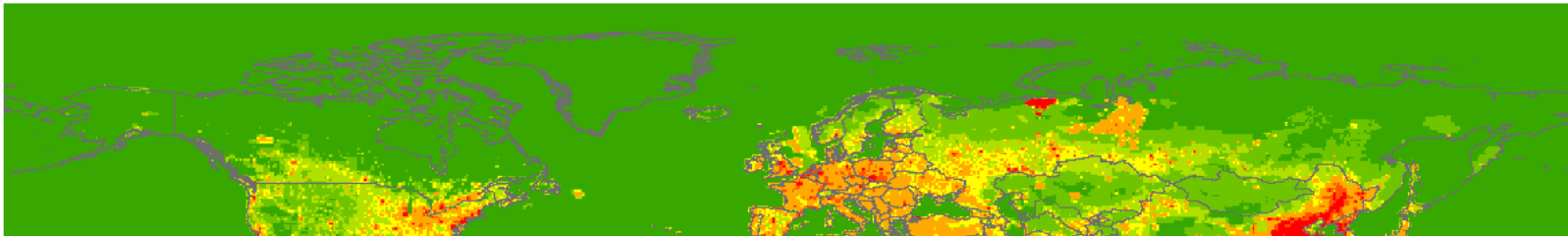
- BC deposited to snow and ice results in a positive radiative forcing
 - in the Arctic this exerts greater warming than the within-Arctic direct atmospheric radiative forcing
- BC per unit emitted near or within the Arctic have the greatest impact on Arctic climate



AMAP, 2011. The Impact of Black Carbon on Arctic Climate (2011). By: P.K. Quinn, A. Stohl, A. Arneth, T. Berntsen, J. F. Burkhardt, J. Christensen, M. Flanner, K. Kupiainen, H. Lihavainen, M. Shepherd, V. Shevchenko, H. Skov, and V. Vestreng. Arctic Monitoring and Assessment Programme (AMAP), Oslo

Emission Inventories

- Global inventories including BC emissions
- Data downloaded from the ECCAD-GEIA website (<http://eccad.sedoo.fr>)
- ACCMIP (2000)
- PEGASOS (2000)
- ECLIPSE versions 4 & 5 (2005)

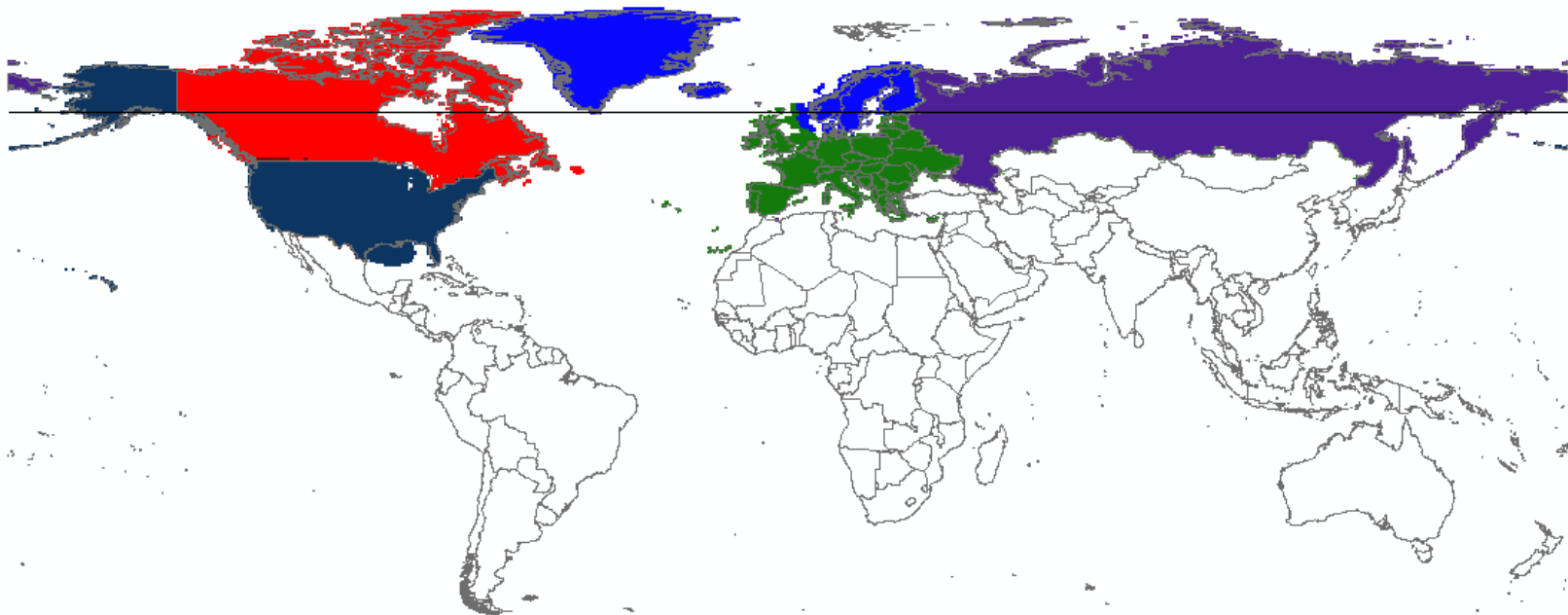


Emission Inventories

- Included sectors
 - land transportation
 - energy production and distribution
 - industrial processes and combustion
 - residential and commercial combustion
 - agricultural waste burning
 - waste treatment and disposal
 - agricultural production
- ACCMIP also includes aviation and maritime transport

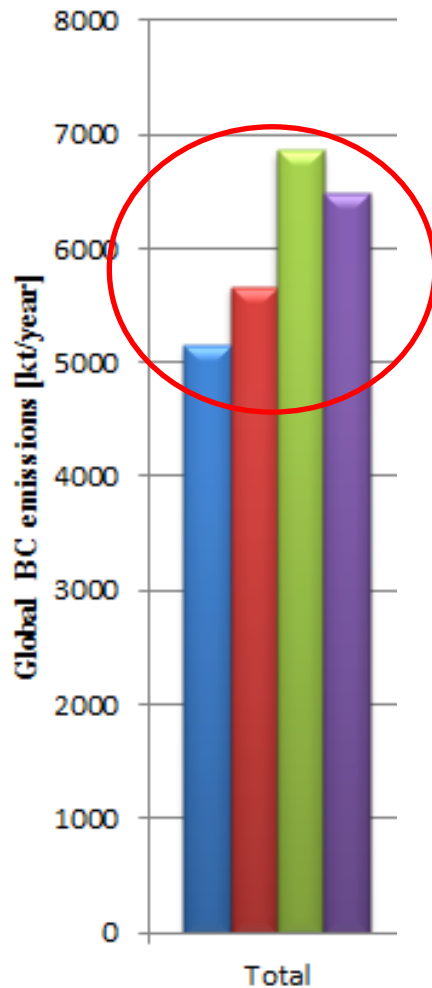
BC emission comparisons

- Sector by sector
- North of 60° latitude
- Regionally

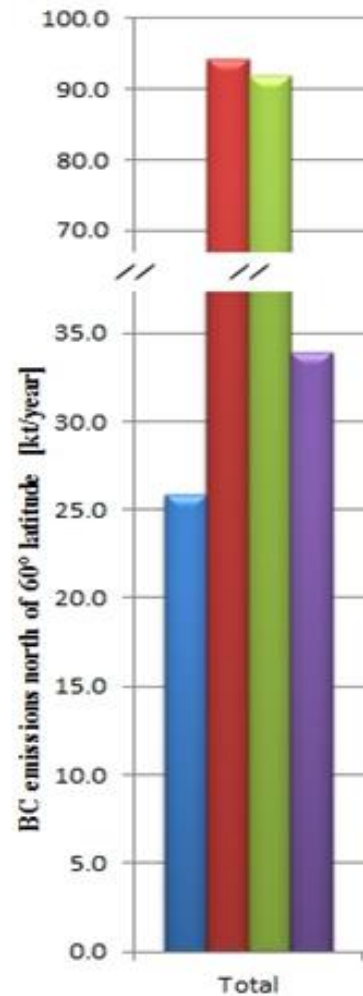


Global vs Arctic BC emissions

- 25% difference



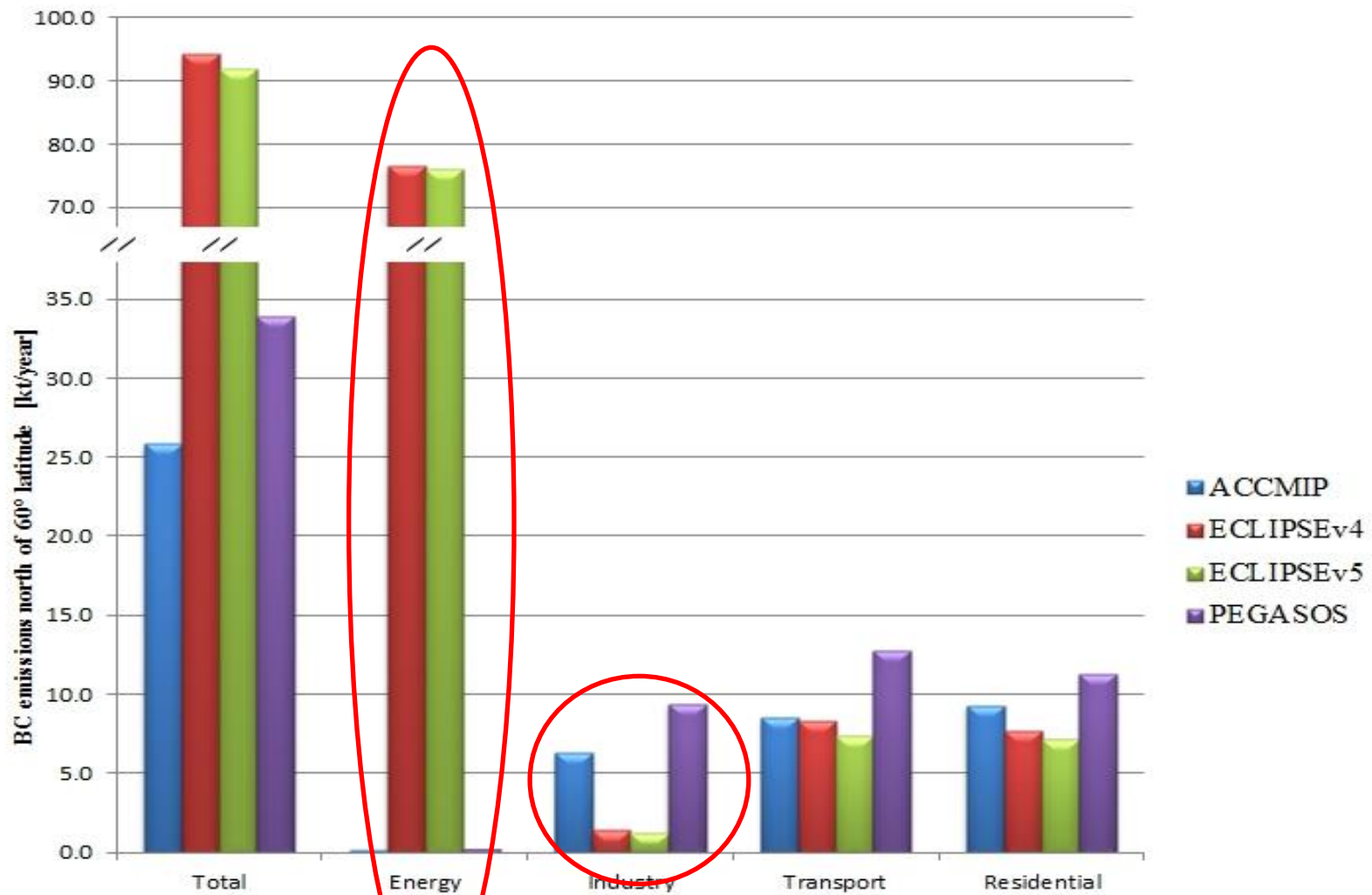
- 70% difference



- ACCMIP
- ECLIPSEv4
- ECLIPSEv5
- PEGASOS

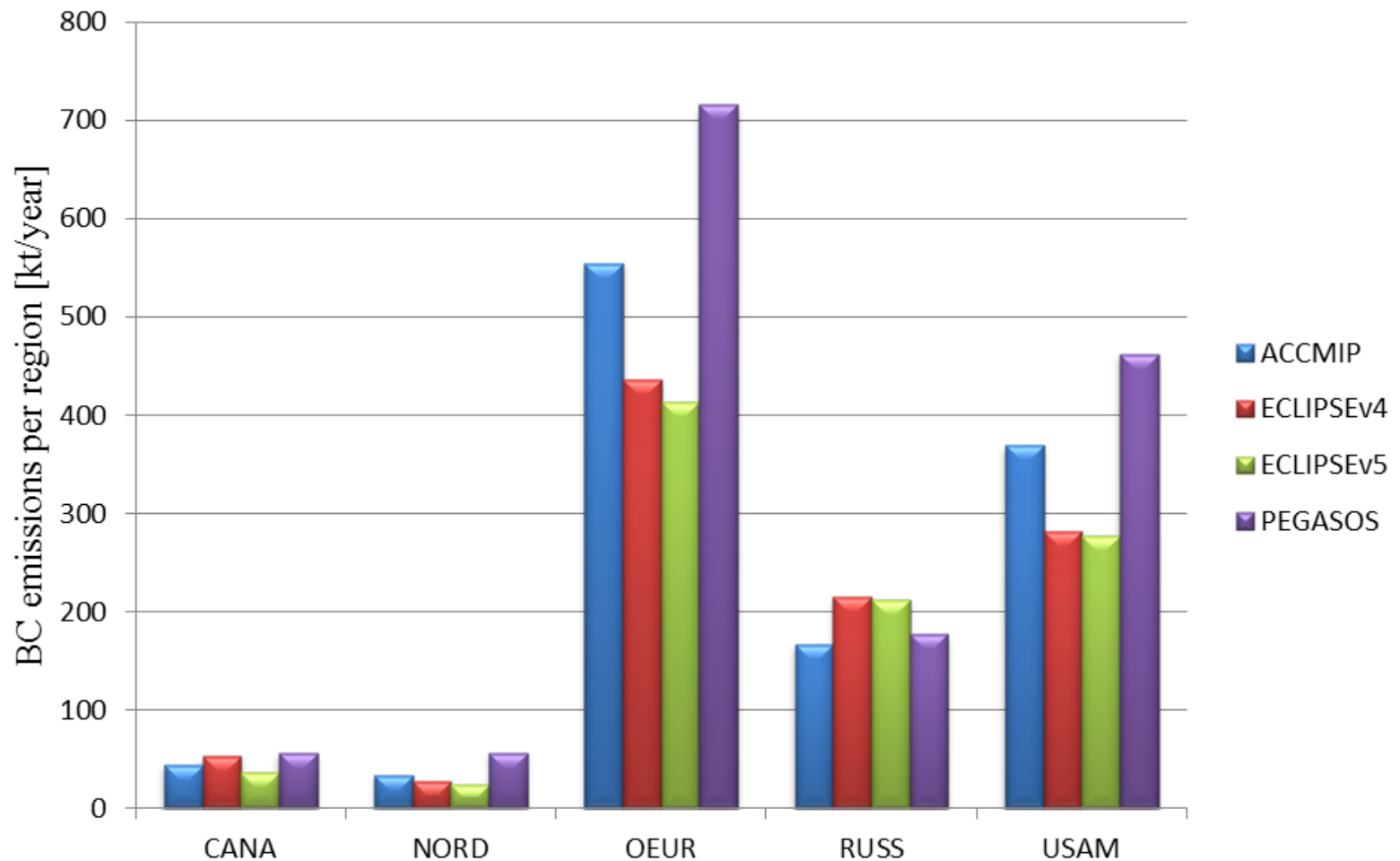
BC Emissions North of 60° Latitude

- Flaring



Regional Emissions

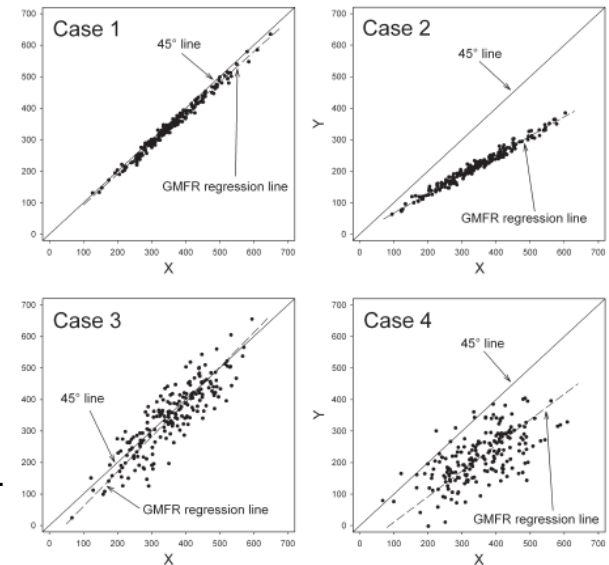
- Large, unsystematic differences



Spatial Agreement

Spatial agreement with agreement coefficient (AC)

- Developed by Ji and Gallo (2006)
- Two parts
 - Systematic AC, difference that could be corrected from the other dataset by a linear model
 - Unsystematic AC, random differences
- ~ 1 good agreement
- ≤ 0 no agreement
- Done for emissions north of 60° latitude

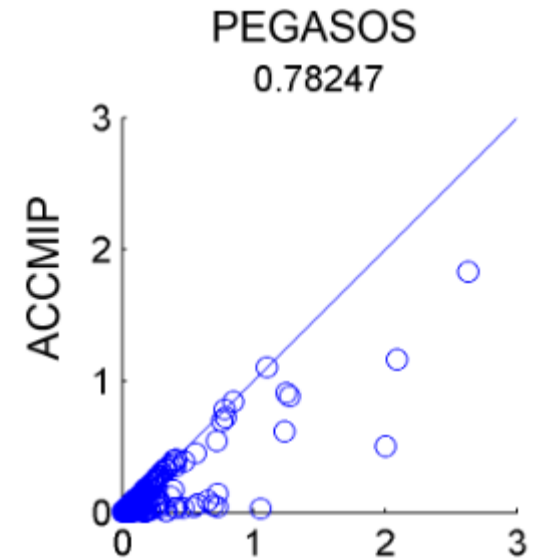
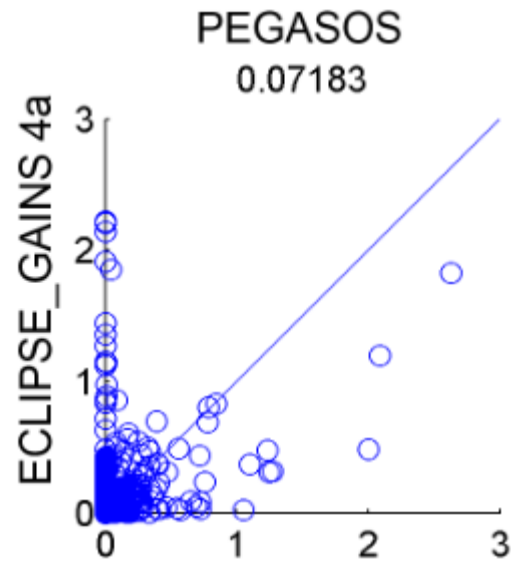
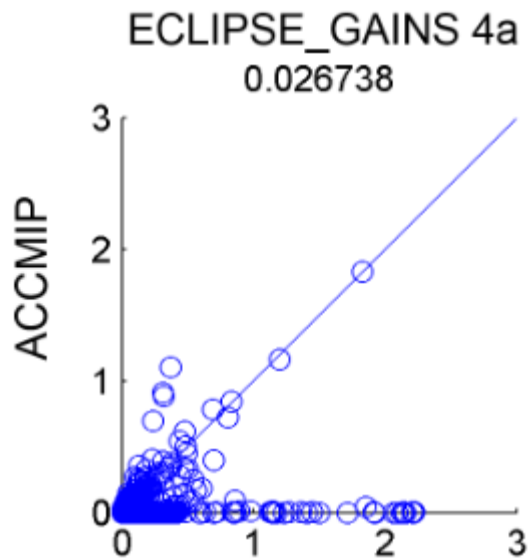


Ji, L., & Gallo, K. (2006). An agreement coefficient for image comparison. *Photogrammetric Engineering and Remote Sensing*, 72(7), 823–833.

Spatial Agreement

		Sector	AC	ACs	ACu
ACCMIP	ECLIPSEv4	Total	-4.334	-1.741	-1.594
		Energy	-0.599	-0.586	0.987
		Industrial	-0.323	-0.308	0.985
		Residential	-0.847	0.974	-0.821
		Transportation	0.861	0.990	0.871
ACCMIP	PEGASOS	Total	0.558	0.800	0.759
		Energy	0.759	0.936	0.822
		Industrial	0.362	0.675	0.687
		Residential	0.866	0.964	0.902
		Transportation	0.494	0.733	0.761
ECLIPSEv4	PEGASOS	Total	-2.439	0.021	-1.460
		Energy	-0.599	-0.583	0.984
		Industrial	-1.570	-1.422	0.852
		Residential	-0.672	0.846	-0.518
		Transportation	0.226	0.602	0.625

Scatterplots Between the Inventory Values



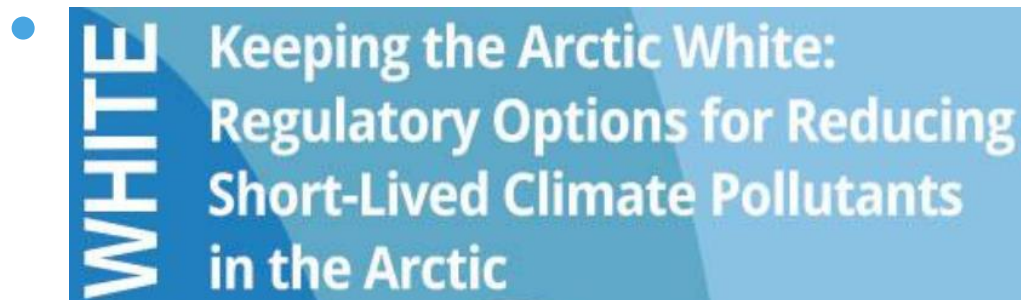
Conclusions

- Significant differences both in sectoral and regional emissions in the different inventories
 - Larger near the Arctic than at the global scale, which can lead to uncertainties in impact assessments
- Differences in representation of sectors
 - Flaring
 - International shipping
- Future work
 - Regional inventories
 - Closer look at the spatial proxies
 - Emission hot spots
 - Other SLCPs
 - General aim is to develop robust spatial emission inventories to support Arctic climate impact studies

Thank You!

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- This work was supported by



- ADHIW



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- The logo for the International Institute for Applied Systems Analysis (IIASA), featuring a blue square with a white circle and a white cross inside, and the text "IIASA" below it.

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