Assessing Arctic atmospheric methane monitoring needs through synthetic data experiments

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Scenario's
Yedoma, ESAS

→

Synthetic observations
GEOS

→

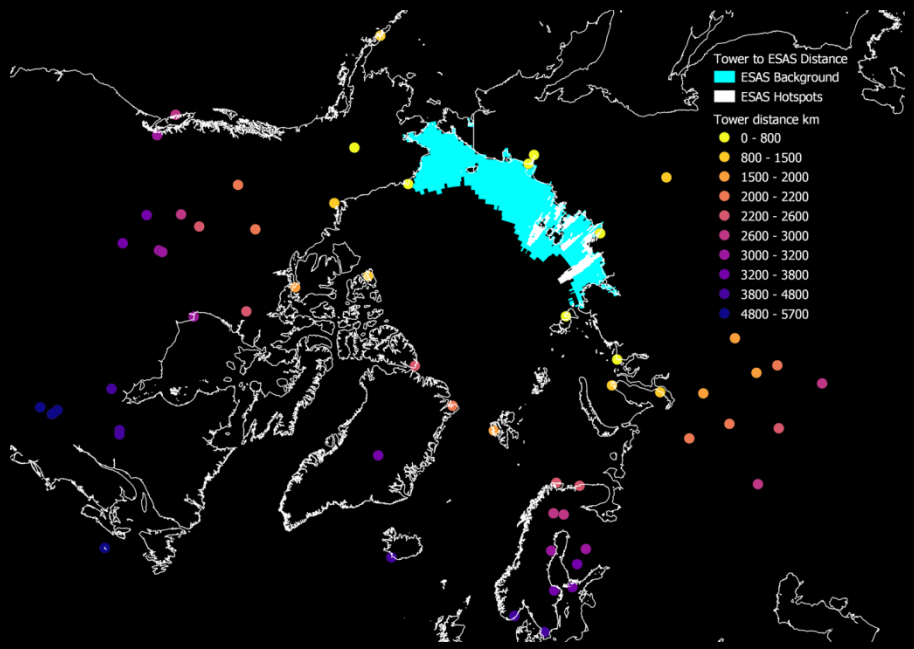
Signal detection
Towers, Satellite

→

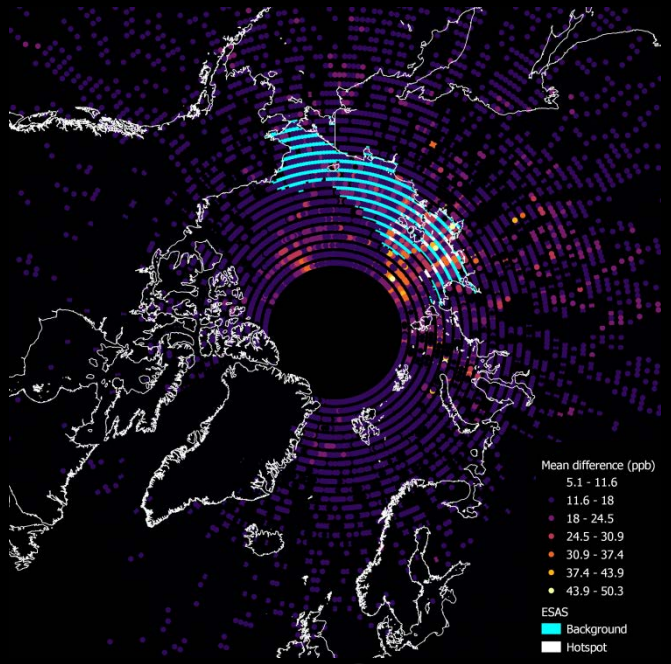
Inversion
future step

East Siberian Arctic Shelf (ESAS) CH_4 release[1]

Atmospheric tower network



Difference: baseline vs Scenario, Lidar



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International Max Planck Research School for Global Biogeochemical Cycles

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NASA

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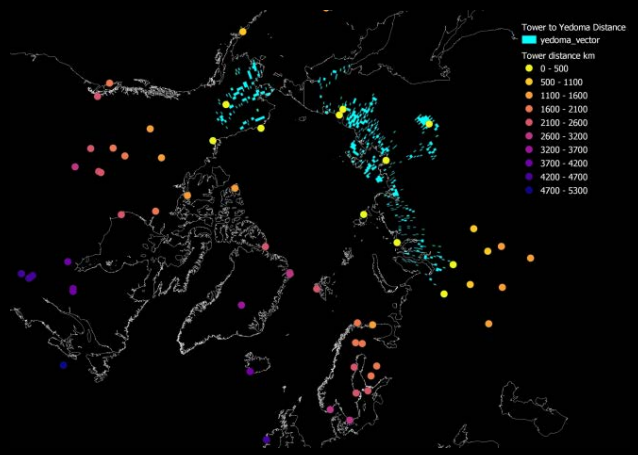
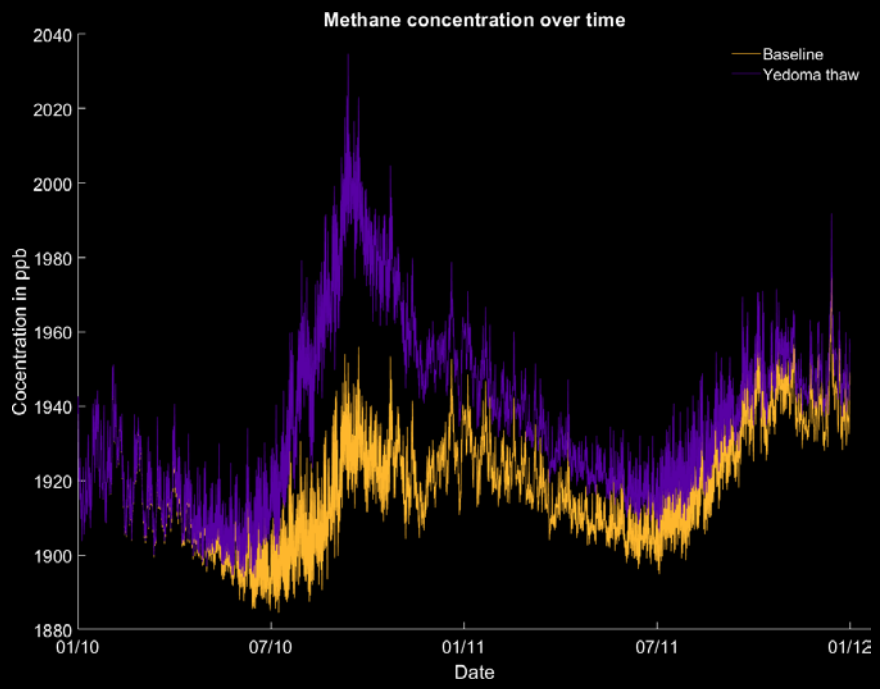
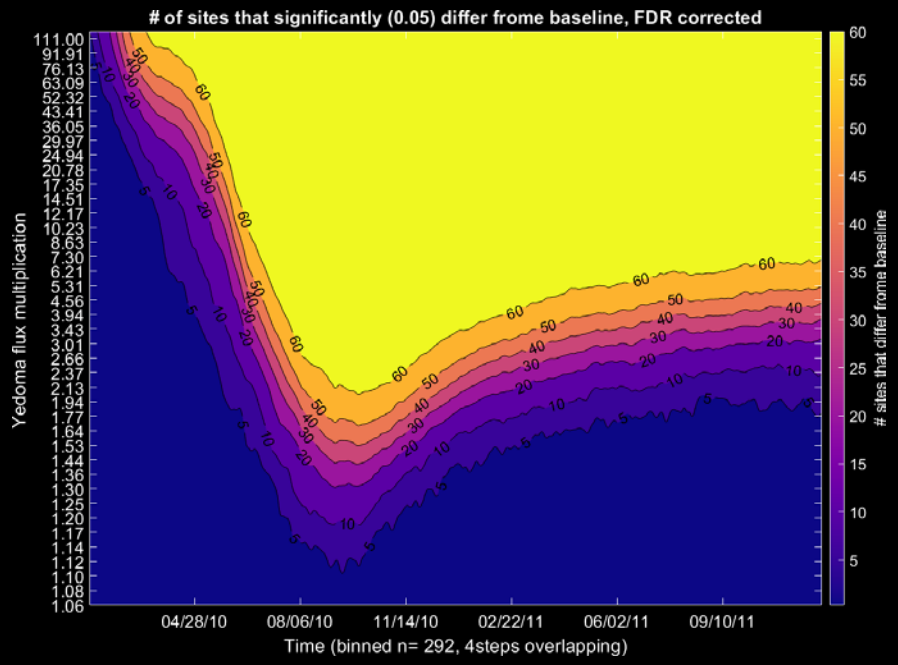
Yedoma –Atm. towers

Yedoma thaw[2]

- A 10% increased CH4 flux from yedoma can already be detected by 5 sites.
- A 130% increase means the entire network will detect it.

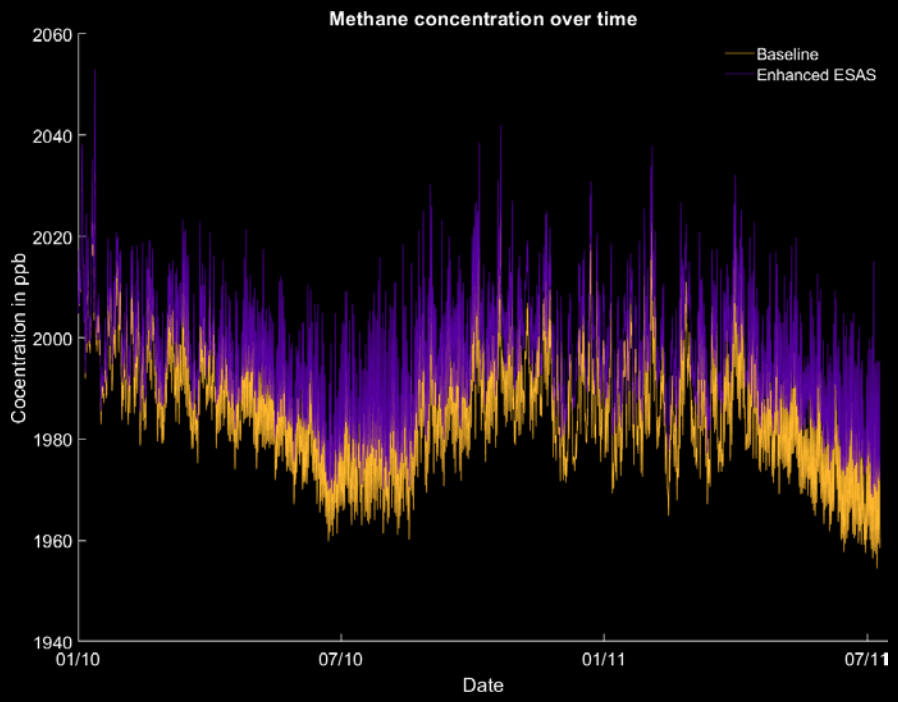


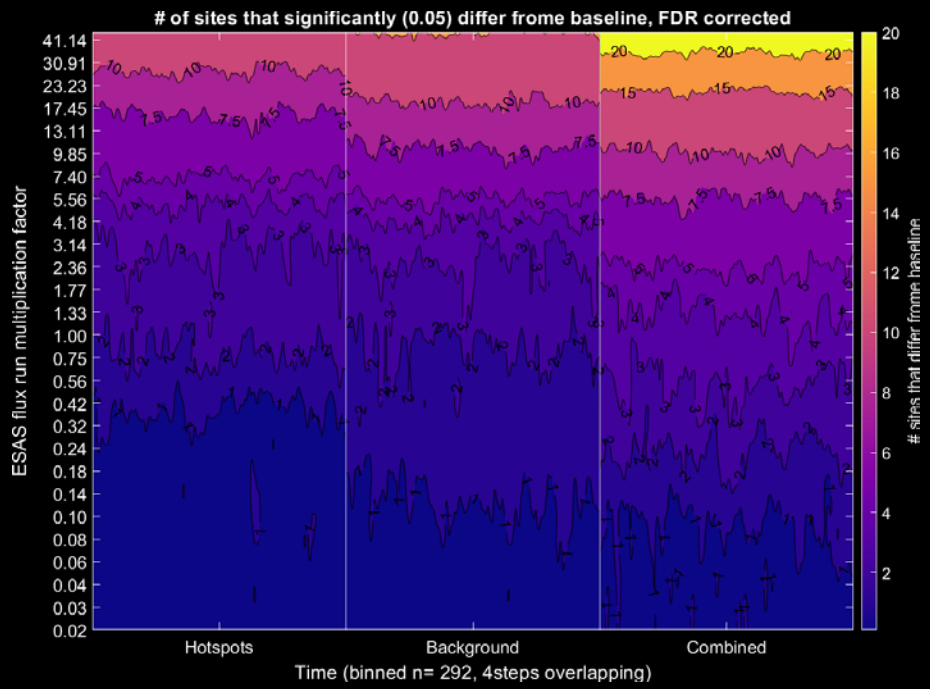




ESAS – Atm. towers

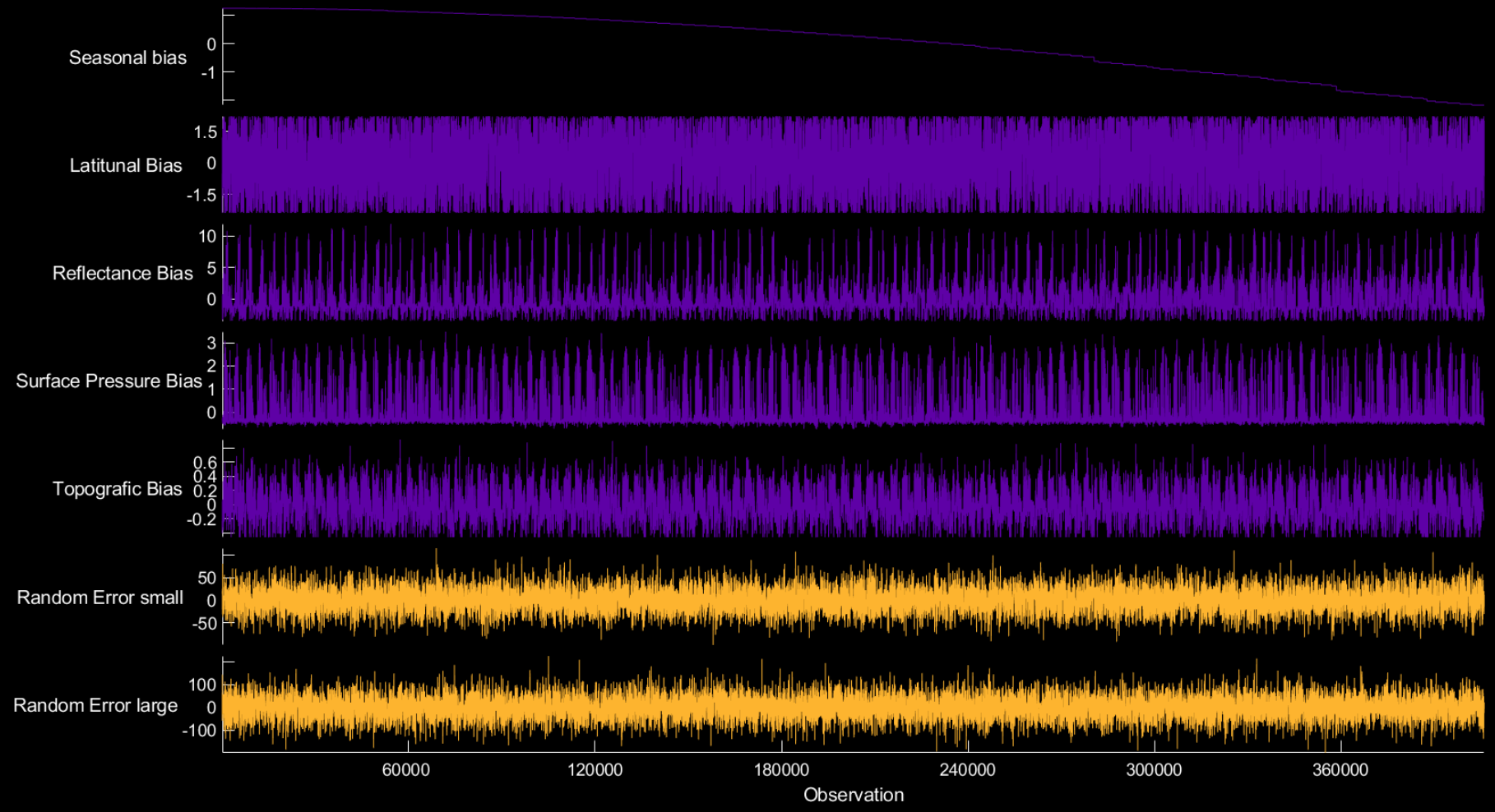
- **Low fluxes as reported should be detectable by at least 3 towers.**
- **10% of fluxes reported should be detectable by at least one tower.**



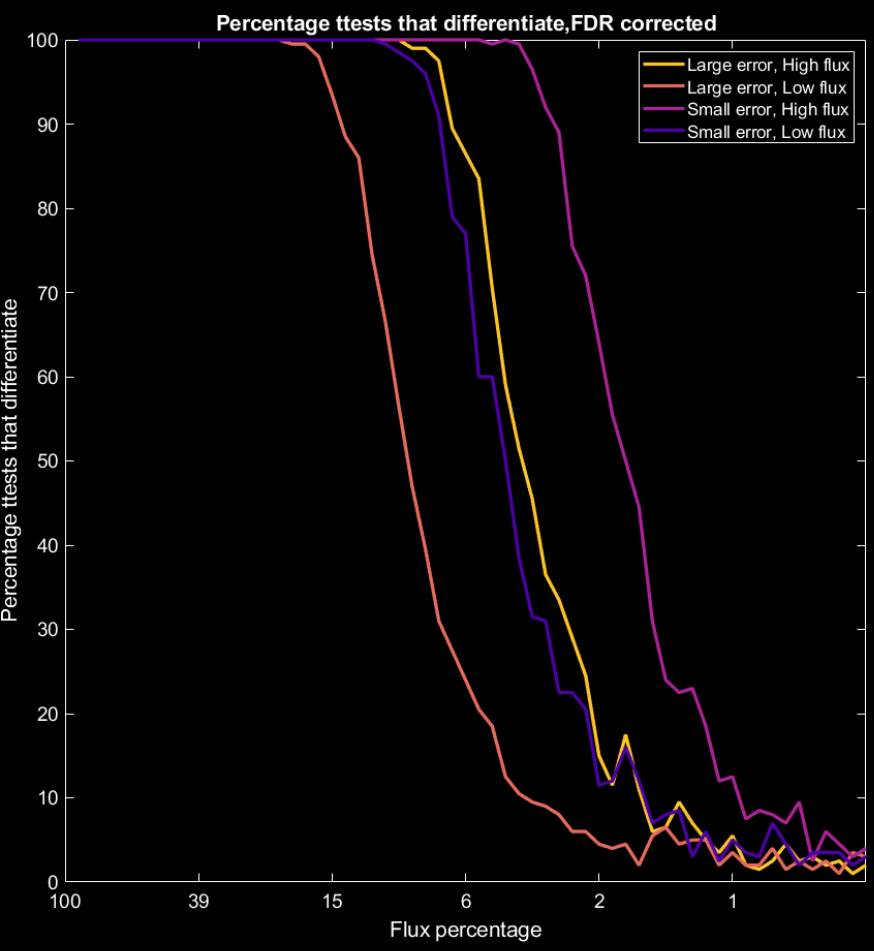


ESAS – MERLIN(like)

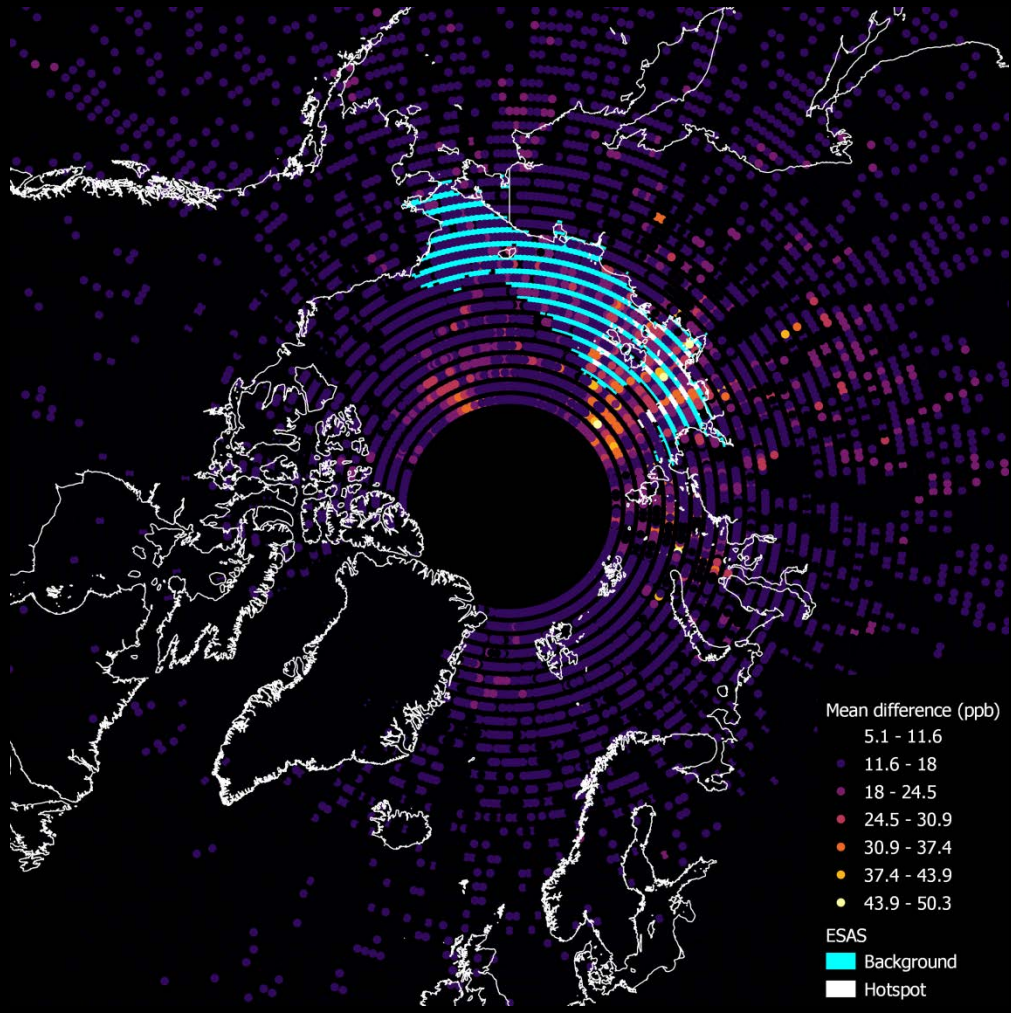
Synthetic observations, Biases and Errors. Based on Bousquet 2018[3]



ESAS – MERLIN(like)



Difference between baseline and high flux



Wrap-up

Conclusions

- Both scenario's should be detectible, with the current atmospheric tower network.
- Despite random errors at least an order of magnitude higher, Merlin(like) lidar functions just as well if not better than atmospheric towers, this can be attributed to its high rate of sampling and spatial coverage.
- Active sensors like Merlin can play a crucial role in understanding the high latitude carbon cycle.

Future

- Lidar based sampling for Yedoma case
- Tropomi like synthetic sampling
- Network optimization
- Inversion

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1 Shakovha et al. 2010, 2014
2 Strauss et al. 2017
3 Bousquet et al. 2018