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O5.1-186

Seasonality of sea ice extent and microbarom amplitude at high-latitude IMS infrasound stations

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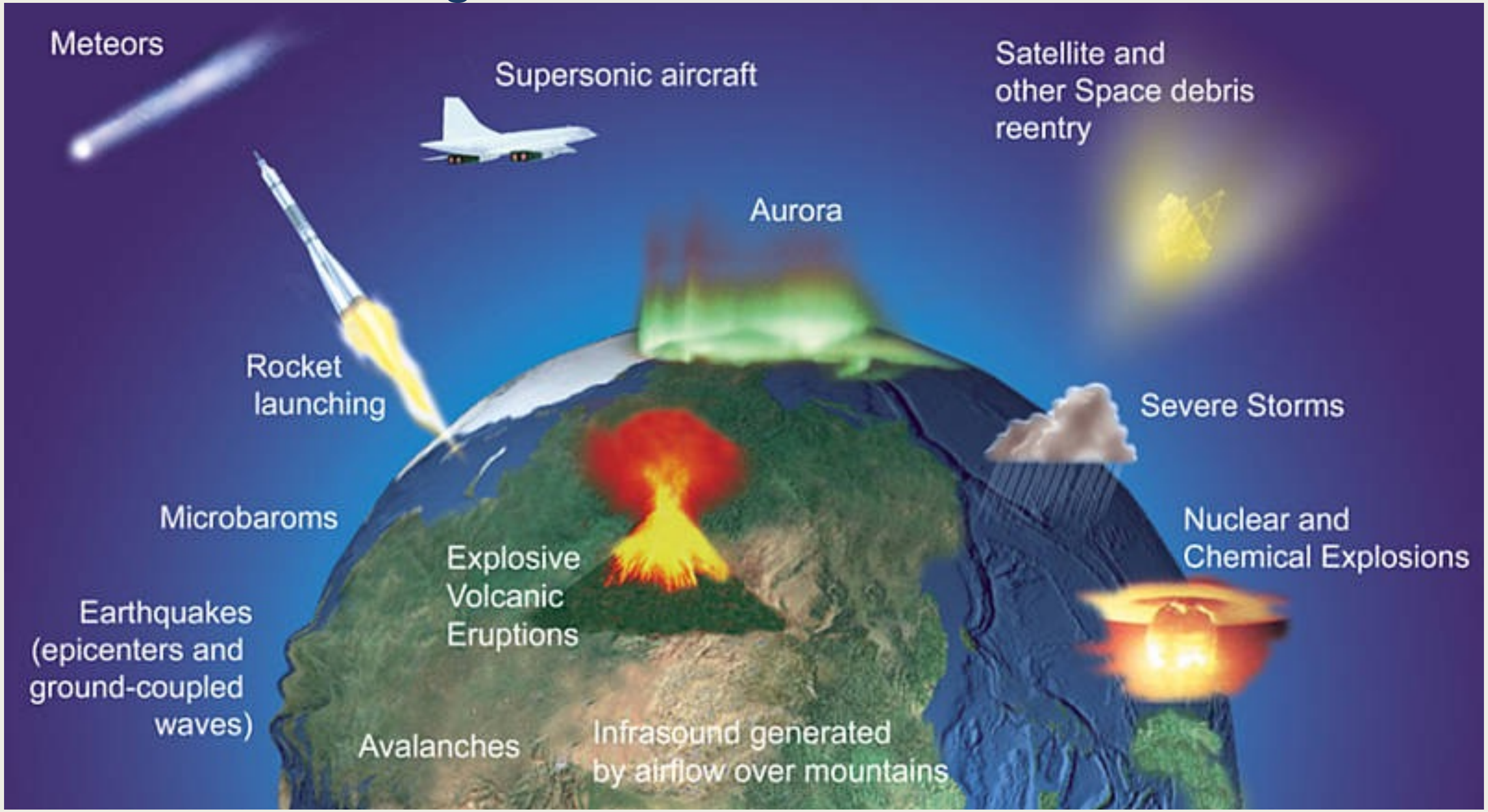
The global infrasound environment



CTBTO

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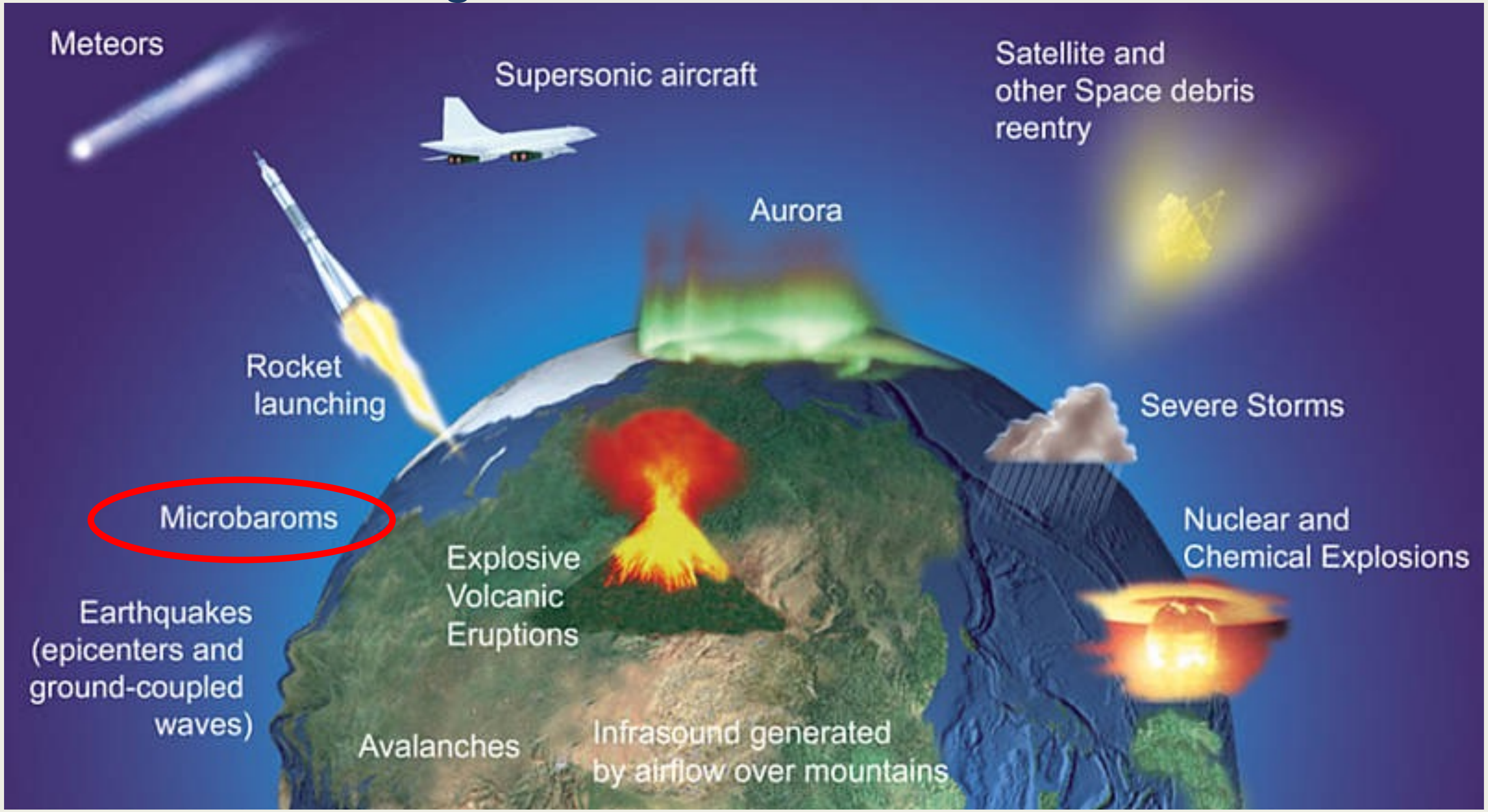

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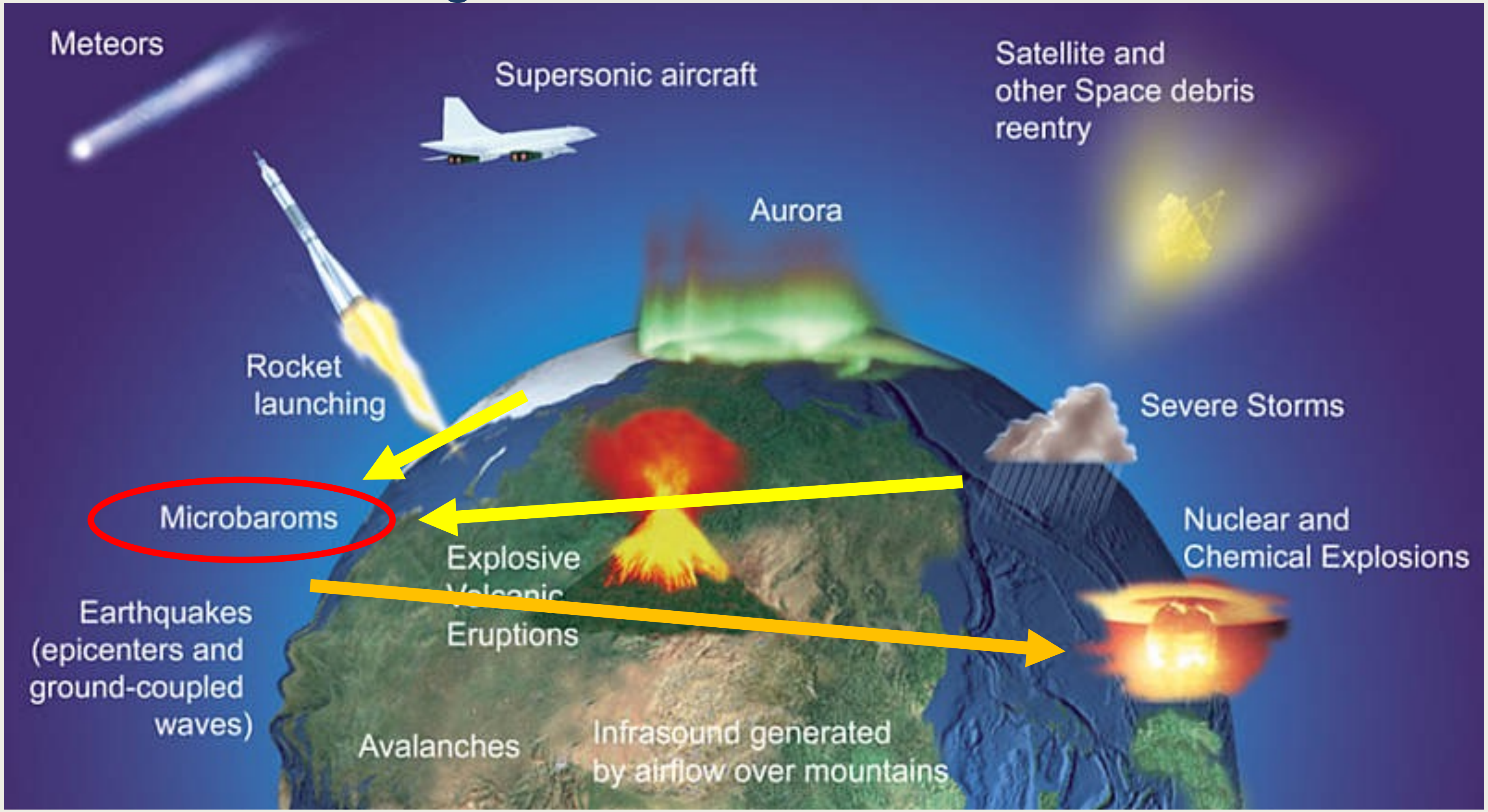


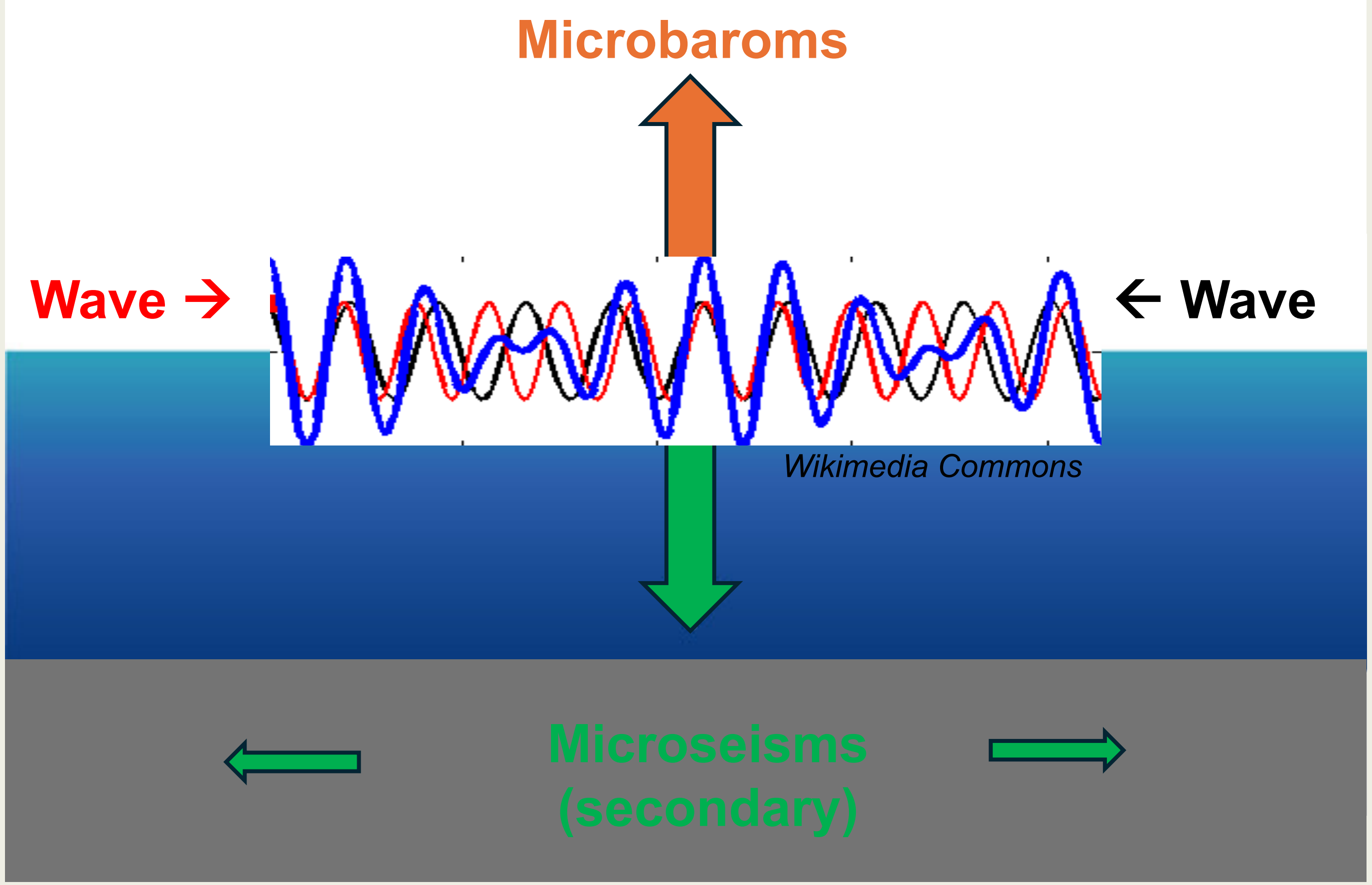
CTBTO

Microbaroms and microseisms

- Noise created by interference of opposing wavetrains with similar frequency[1,2]

- Dominant noise features on Earth, ubiquitous, persistent
  - Microbaroms: 0.1 – 0.5 Hz
  - Microseisms: 0.125 – 0.25 Hz (secondary)

- Seasonal – greatest in winter, due to larger, more frequent storms[3,4]



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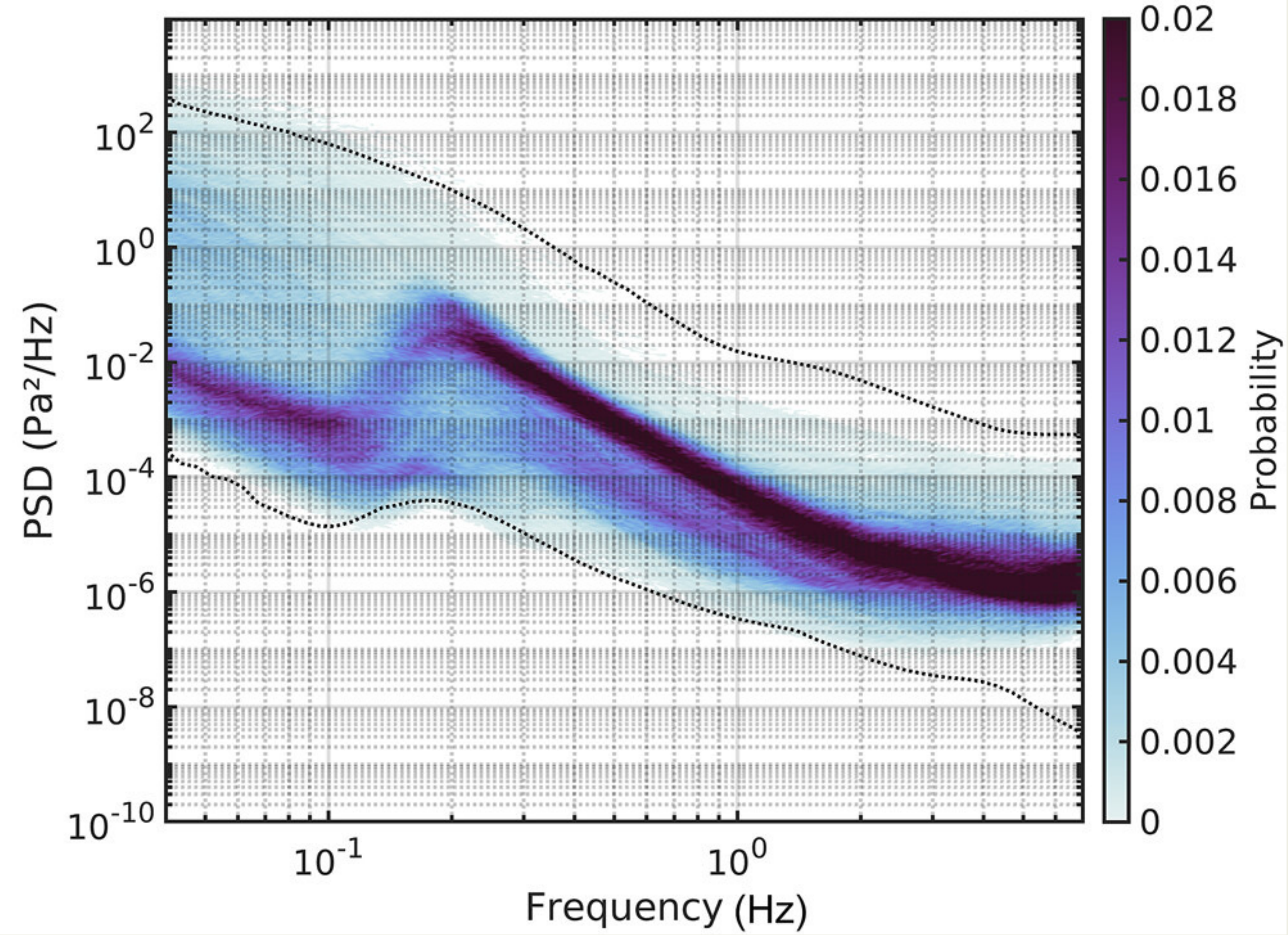
Microbaroms



Modified from Letournel et al. (2024)

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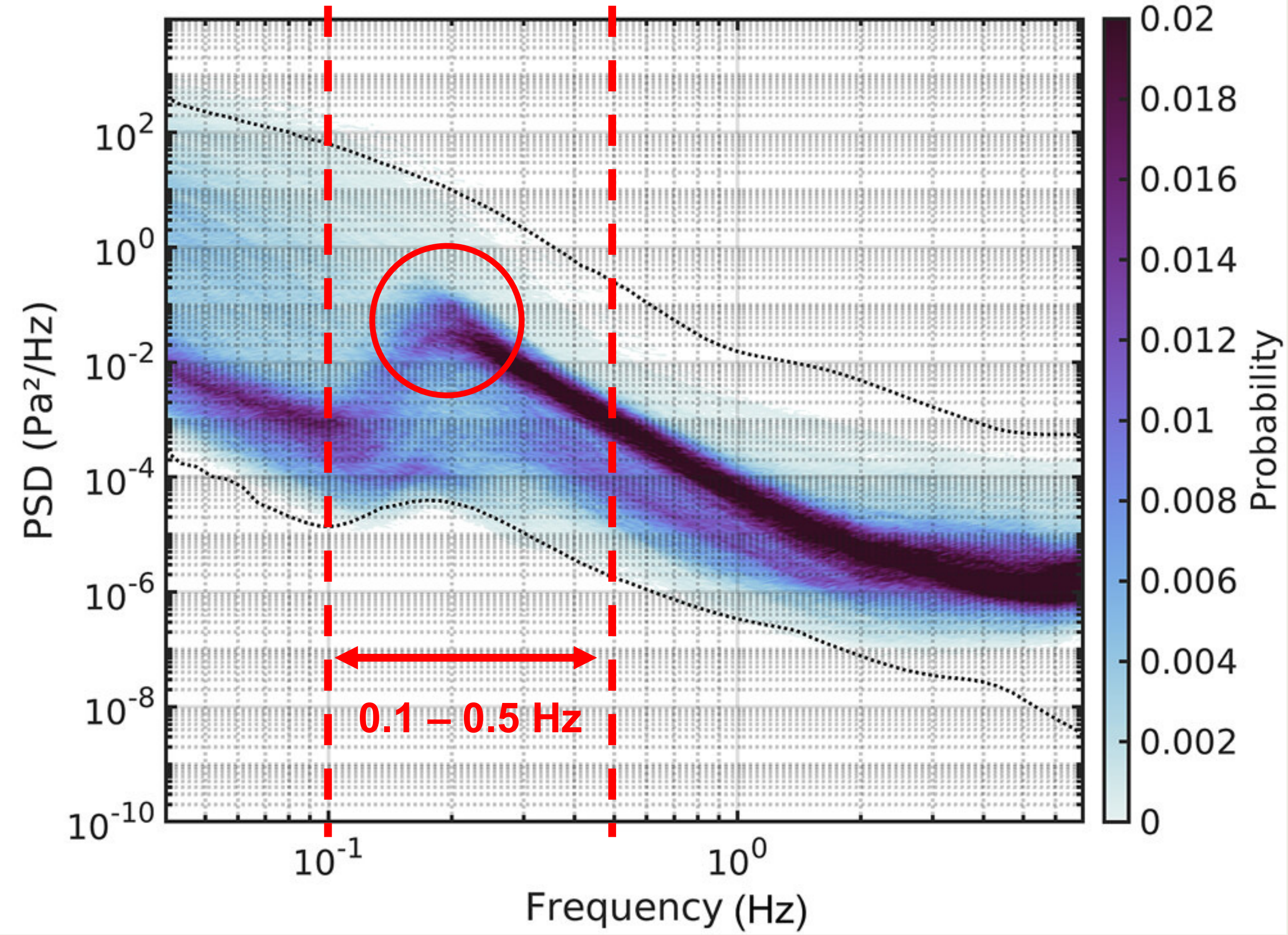
Microbaroms



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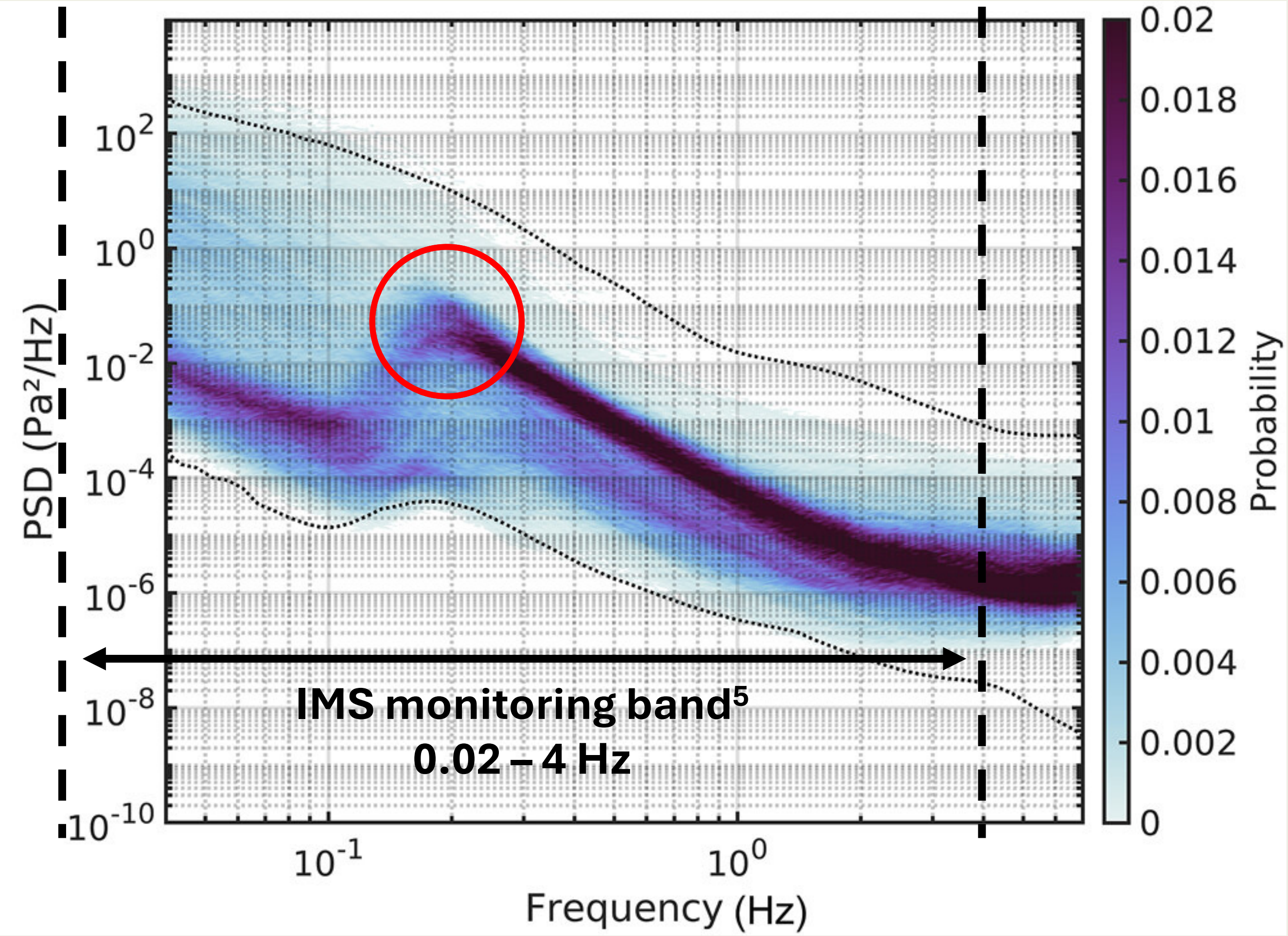
Microbaroms

- Dominates part of band important to global nuclear monitoring

- Substantial obstacle to the IMS infrasound network's explosion monitoring goals[6,7,8]



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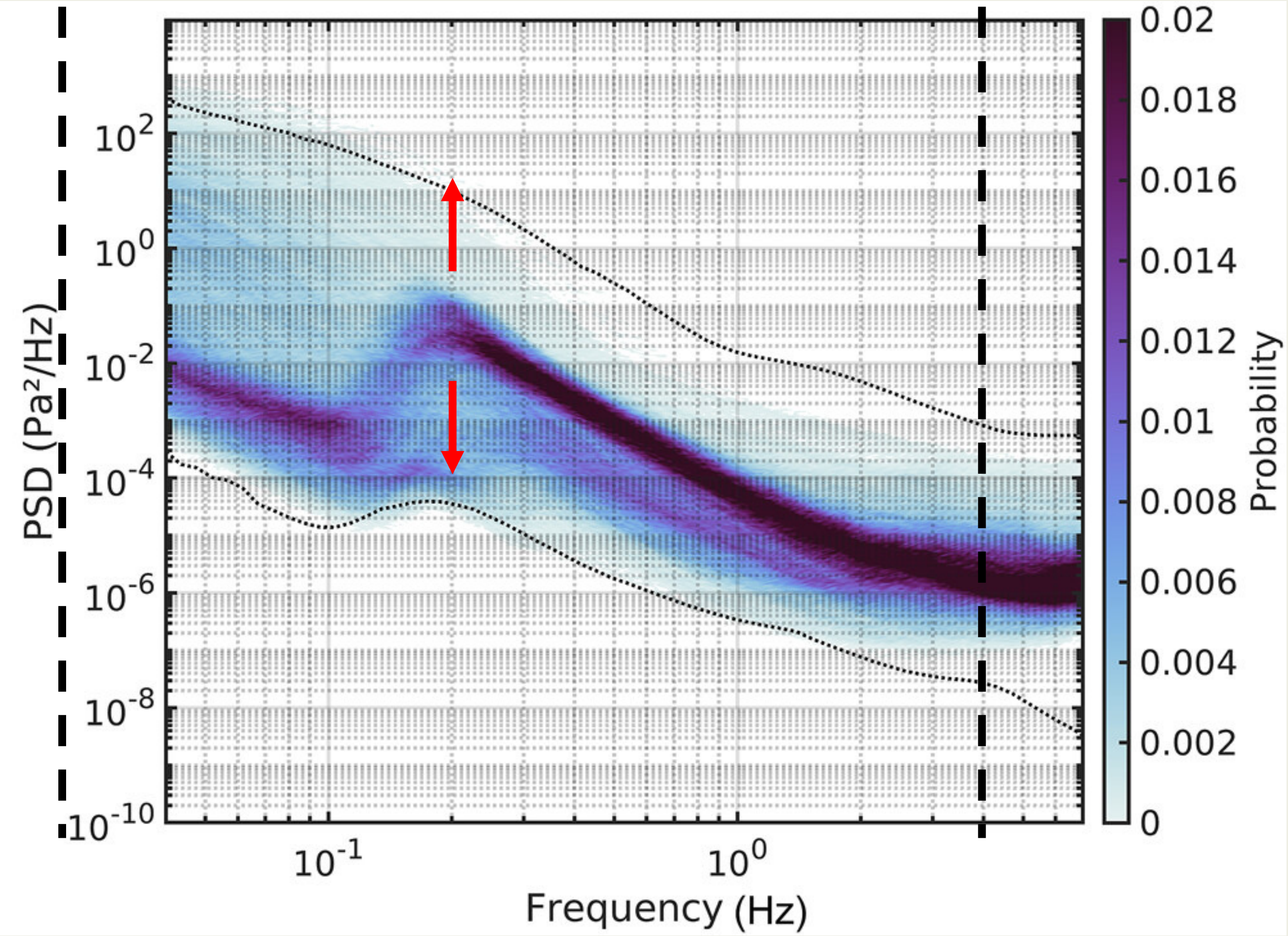
Microbaroms

- Dominates part of band important to global nuclear monitoring

- Substantial obstacle to the IMS infrasound network's explosion monitoring goals[6,7,8]

→ **Problem: Variation in microbarom amplitudes could affect monitoring.**



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Schaible, L. P., S. Albert, E. Roesler, J. Frederick, and M. G. L. Brown

Question #1: Does the microbarom exhibit any secular trend?

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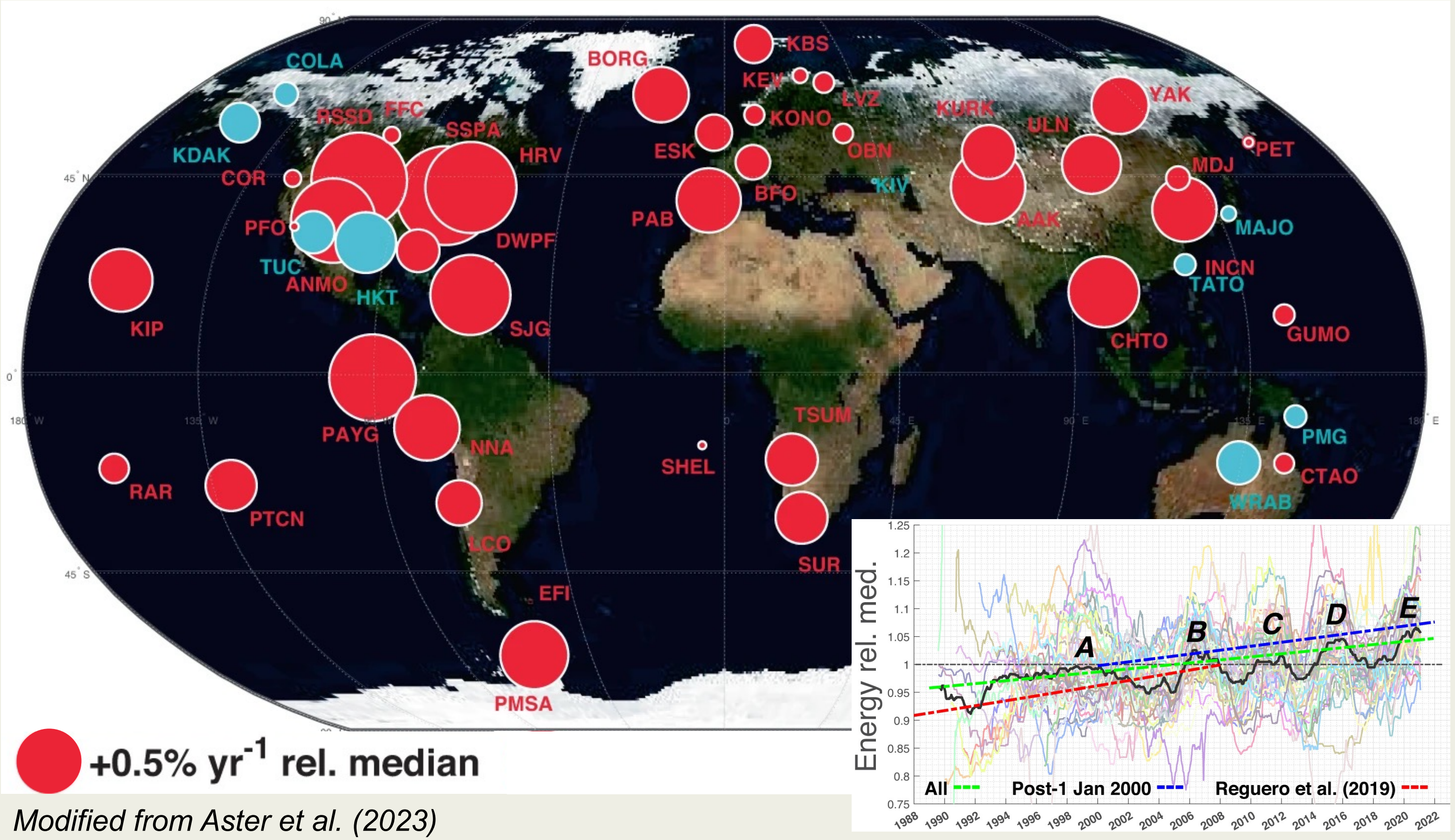
Question #1: Does the microbarom exhibit any secular trend?

- Microseism trending upwards[9]
  - +0.27 ± 0.03 % y^{-1} since 1988
  - +0.35 ± 0.04 % y^{-1} since 2000

- Attributed to increasingly energetic oceans



Modified from Aster et al. (2023)

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Question #2: Does hemispheric scale sea ice extent affect microbarom amplitudes?

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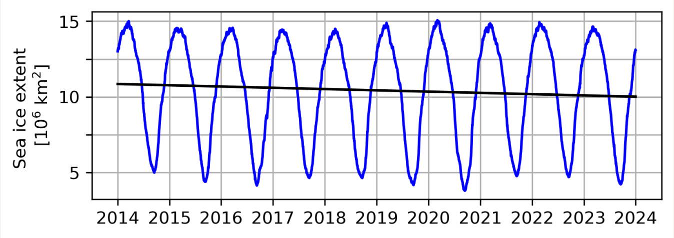
Question #2: Does hemispheric scale sea ice extent affect microbarom amplitudes?

- Strong sea ice can inhibit waves, thereby diminishing microseism and microbarom amplitudes[10,11,12]

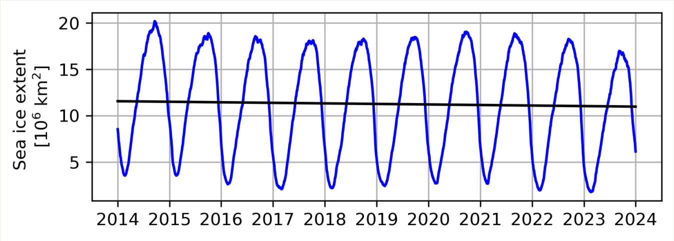
- Enormous annual variation in sea ice extent over course of the year

North

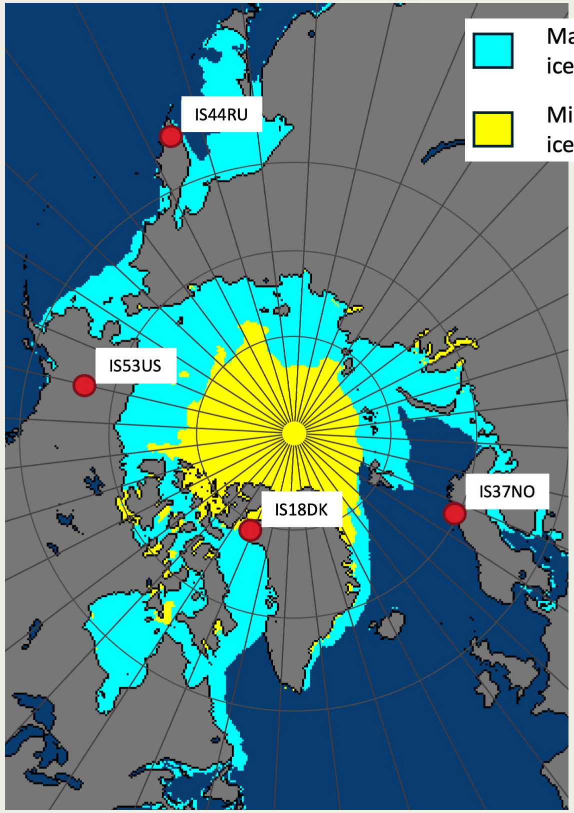


~1.0x10^6 km^2

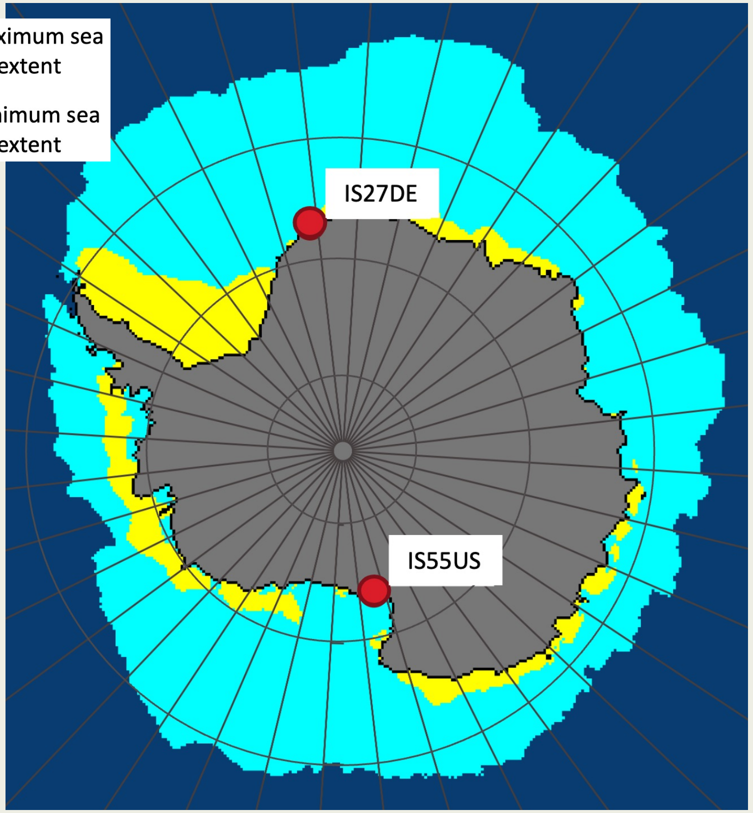
South



~1.5x10^6 km^2



-0.74 ± 0.18 % y^{-1}
(-84 ± 20 10^3 km^2 y^{-1})



-0.49 ± 0.27 % y^{-1}
(-58 ± 33 10^3 km^2 y^{-1})

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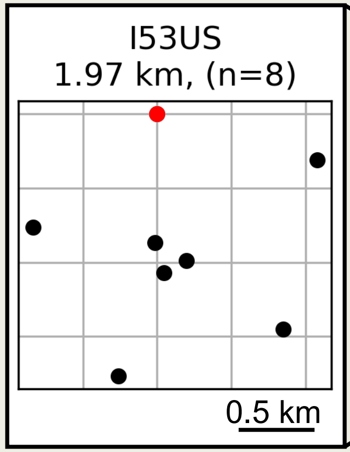
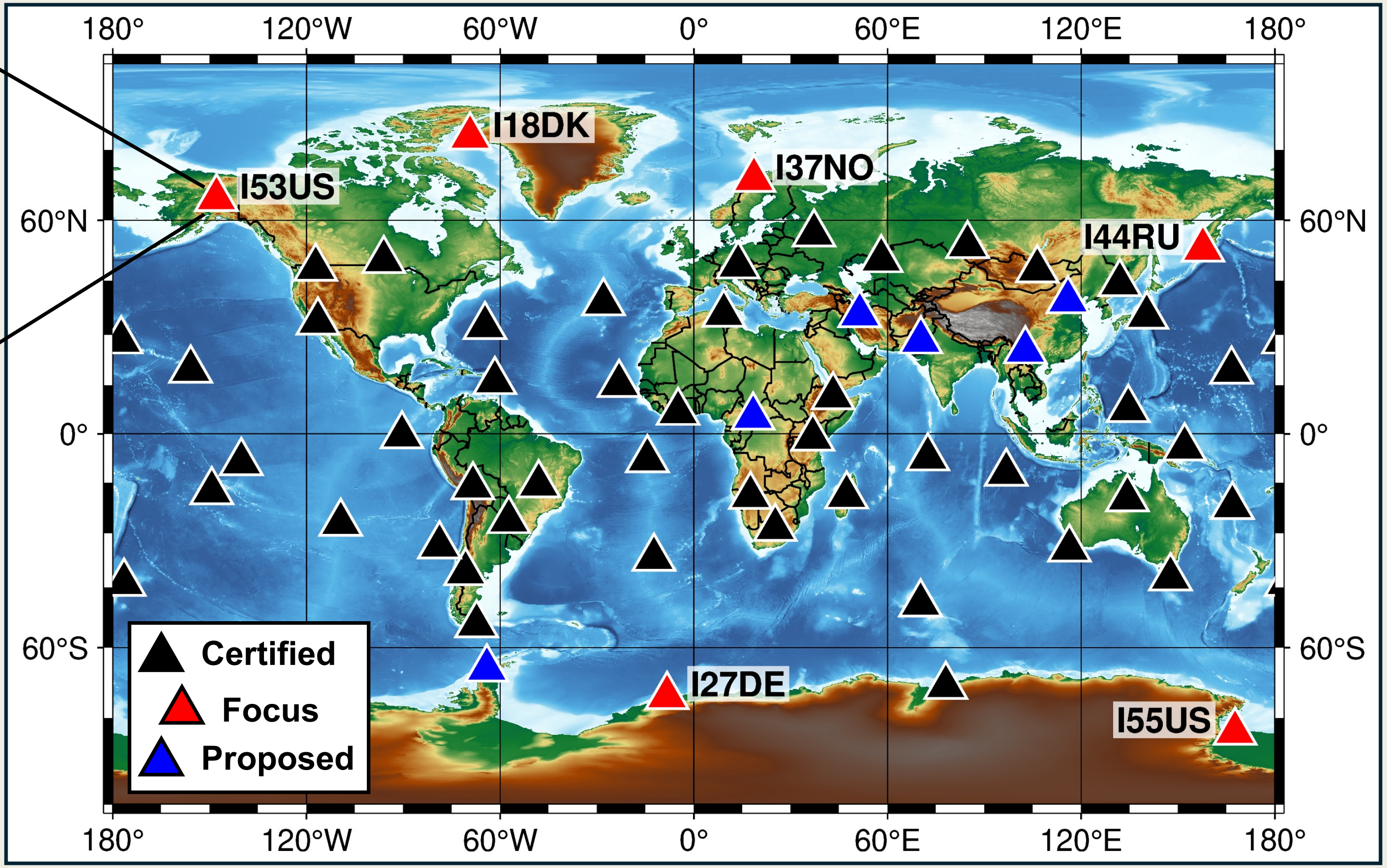
Station and data selection

One element per station array





10 years of continuous data
Beginning of 2014 → End of 2024

NAME	LOCATION	COV [%]
I18H1	Qaanaaq, Greenland, Denmark	97.3
I27L1	Georg von Neumayer, Antarctica, Germany	96.8
I37H1	Bardufoss, Norway	93.0
I44H1	Petropavlovsk-Kamchatskiy, Russia	94.8
I53H1	Fairbanks, Alaska, USA	95.6
I55H1	Windless Bight, Antarctica, USA	96.6

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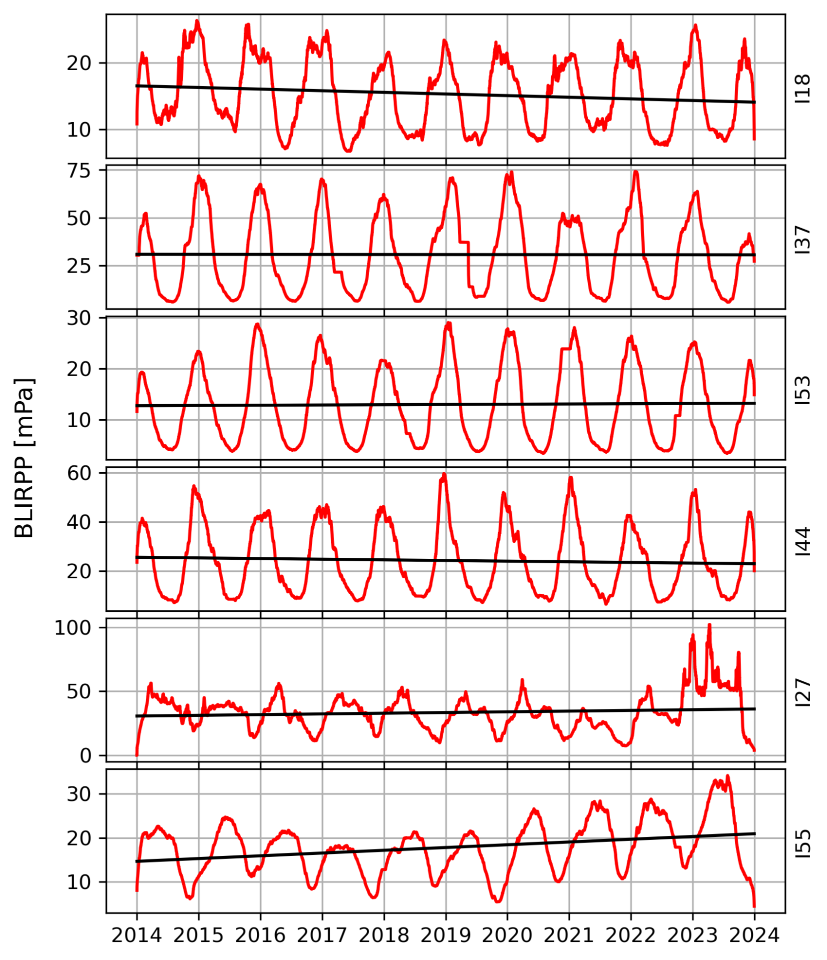
Question #1: Does the microbarom exhibit any secular trend?

- Calculate 0.2–2 Hz band-limited integrated root power[9] pressure for each hour in 10-year duration

- Seasonal variation, consistent with previous work

→ Three positive trends, two negative, one near zero



Station	Microbarom	Microseism[9]
I18	-1.60 ± 0.04 % y^{-1}	
I37	-0.10 ± 0.09 % y^{-1}	
I53	$+0.43 \pm 0.08$ % y^{-1}	$+1.54 \pm 0.08$ % y^{-1}
I44	-1.30 ± 0.08 % y^{-1}	$+0.67 \pm 0.07$ % y^{-1}
I27	$+1.70 \pm 0.51$ % y^{-1}	
I55	$+3.5 \pm 0.04$ % y^{-1}	$+1.96 \pm 0.11$ % y^{-1}

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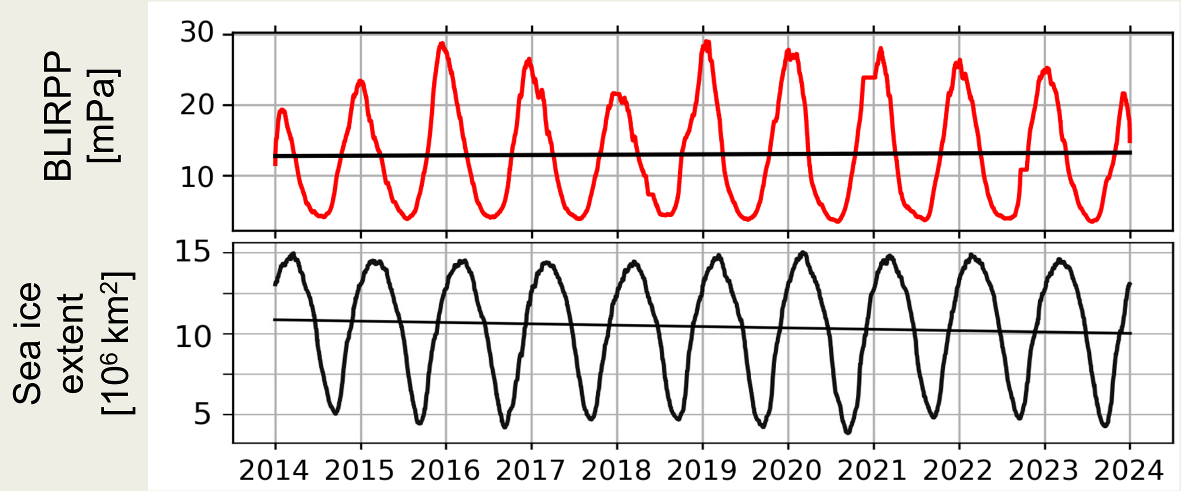
Question #2: Does hemispheric scale sea ice extent affect microbarom amplitudes?

Examine phase relationship of two timeseries



10 years of data vs calendar date

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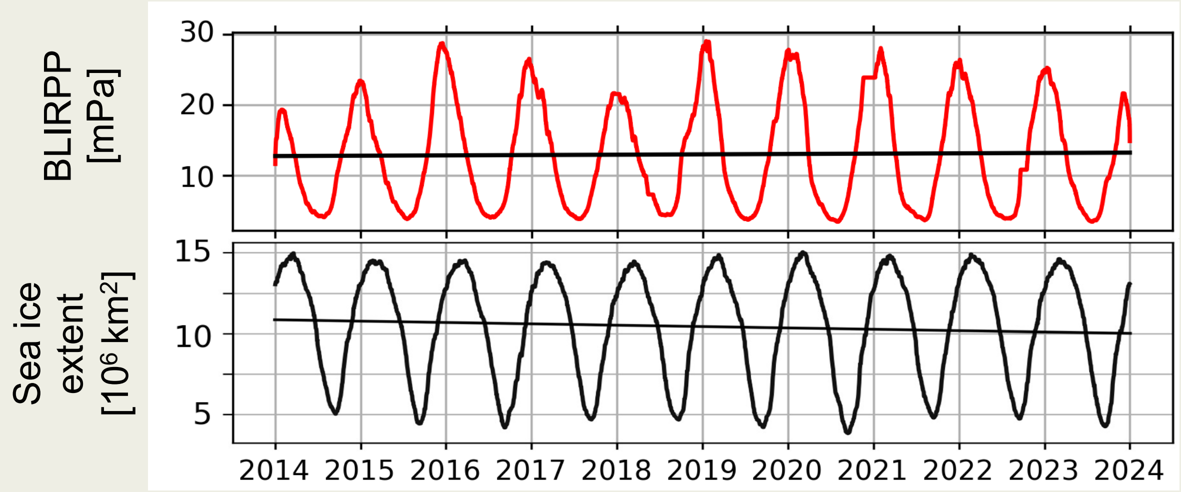
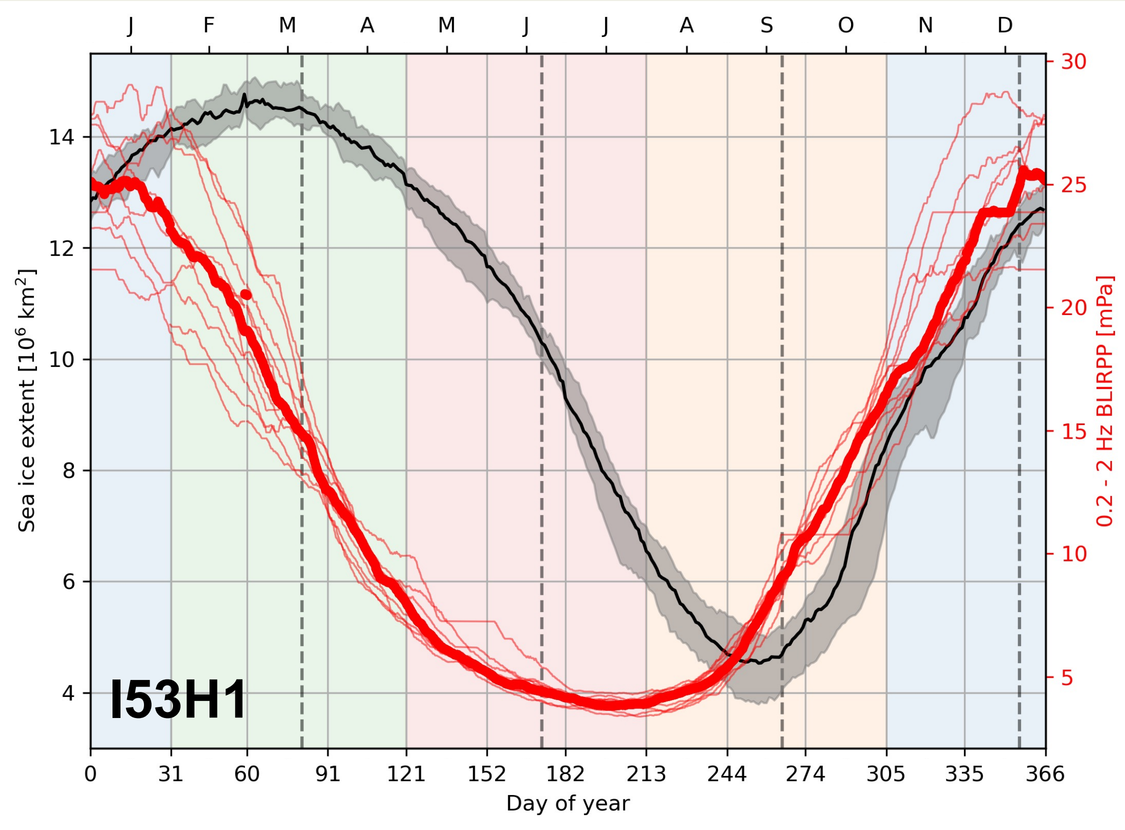


10 years of data vs calendar date
vs numerical day of year



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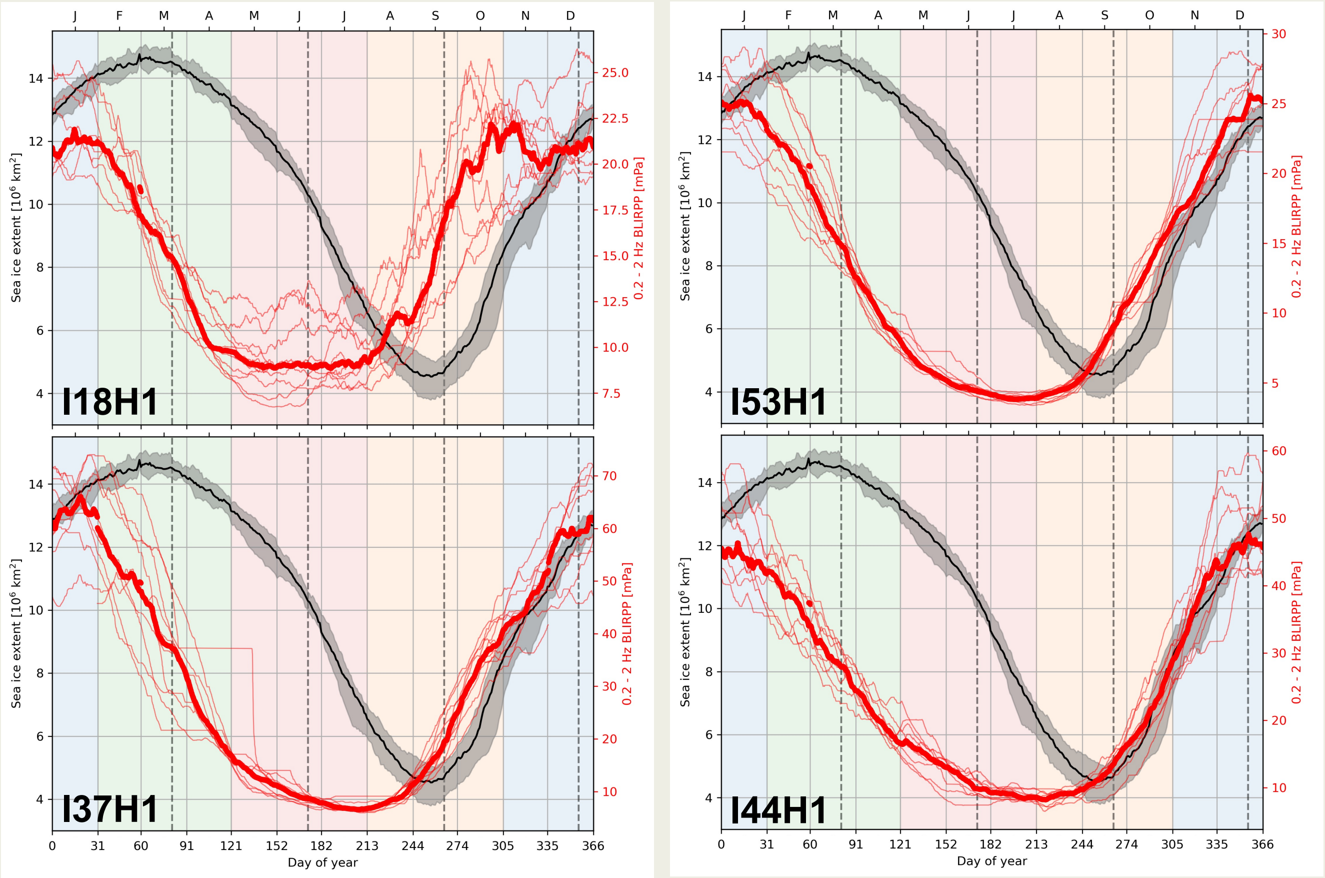
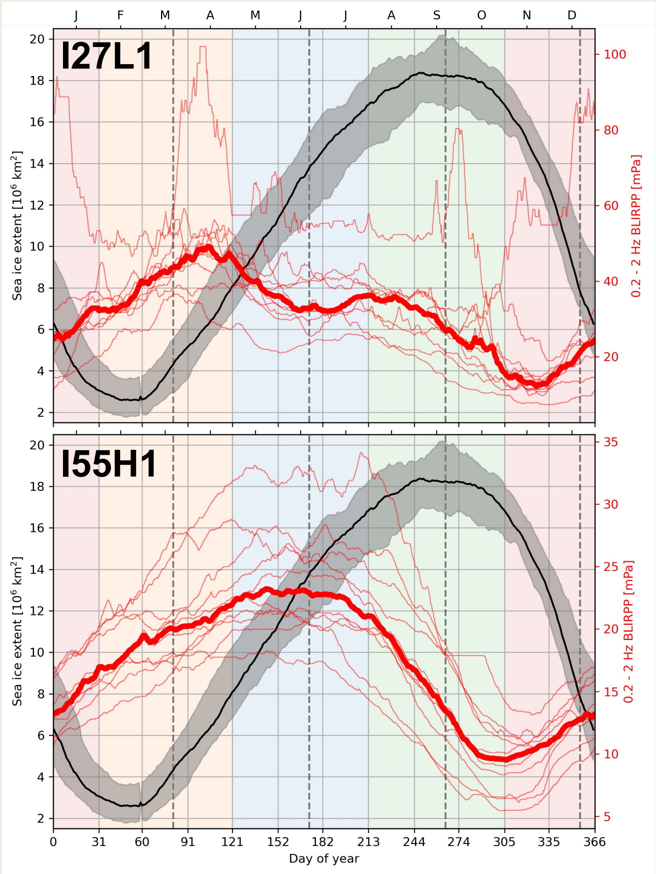
North



South



- 2 – 4 month phase difference

→ Sea ice not primary driver

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Preliminary conclusions and future work

Question #1: Does the microbarom exhibit any secular trend?

→ Inconclusive: three sites with positive trends, two negative, one near zero

Question #2: Does hemispheric scale sea ice extent affect microbarom amplitudes?

→ Sea ice is not dominant driver of microbarom amplitude

Future work

- Analyze more IMS infrasound stations (53 active)
- Analyze longer durations – earliest records back to 2001
- Consider narrower passband (e.g. 0.1 – 0.5 Hz)

Thank you very much!
Questions?

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