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Impact of snow on sound propagating from wind turbines

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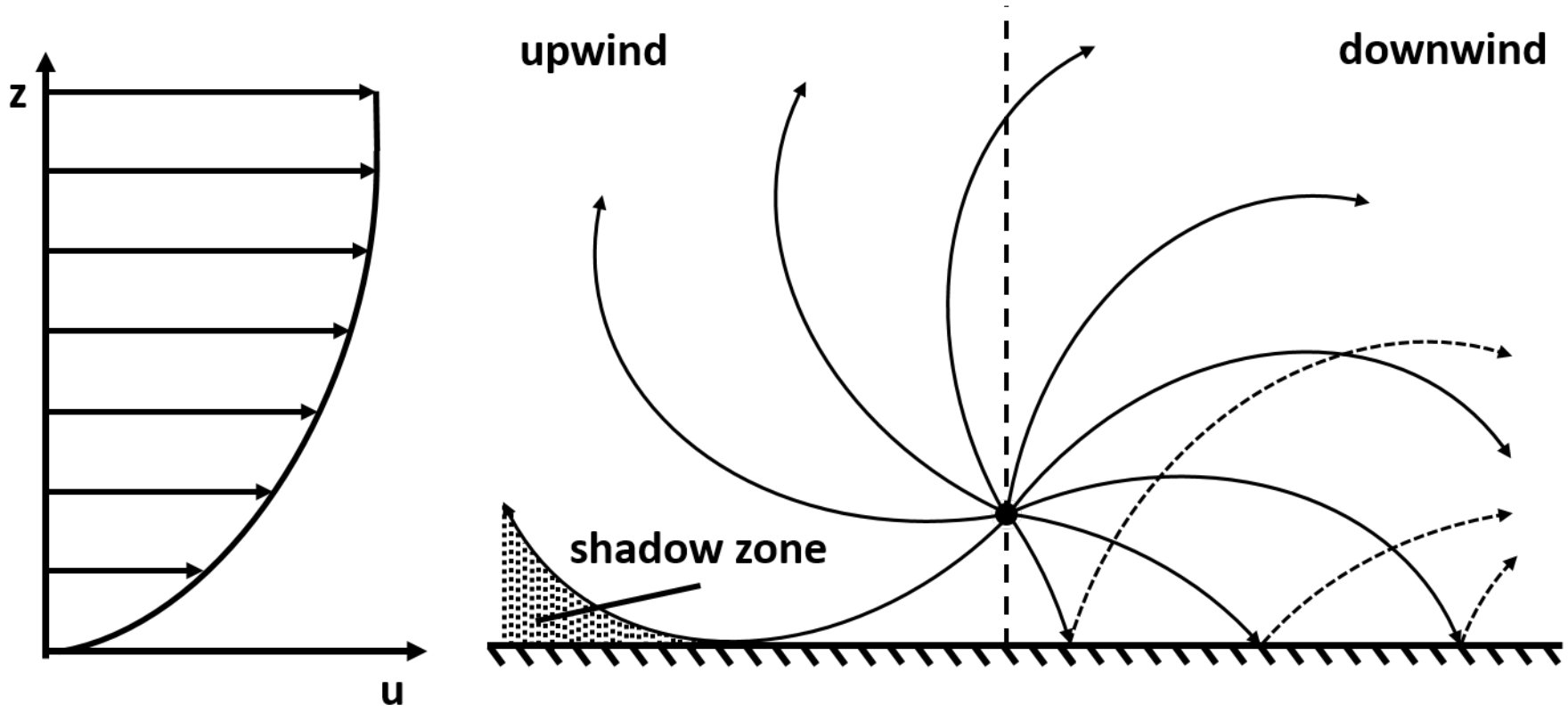
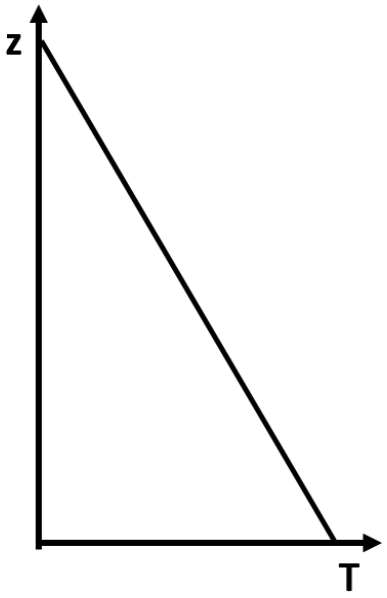
Aim

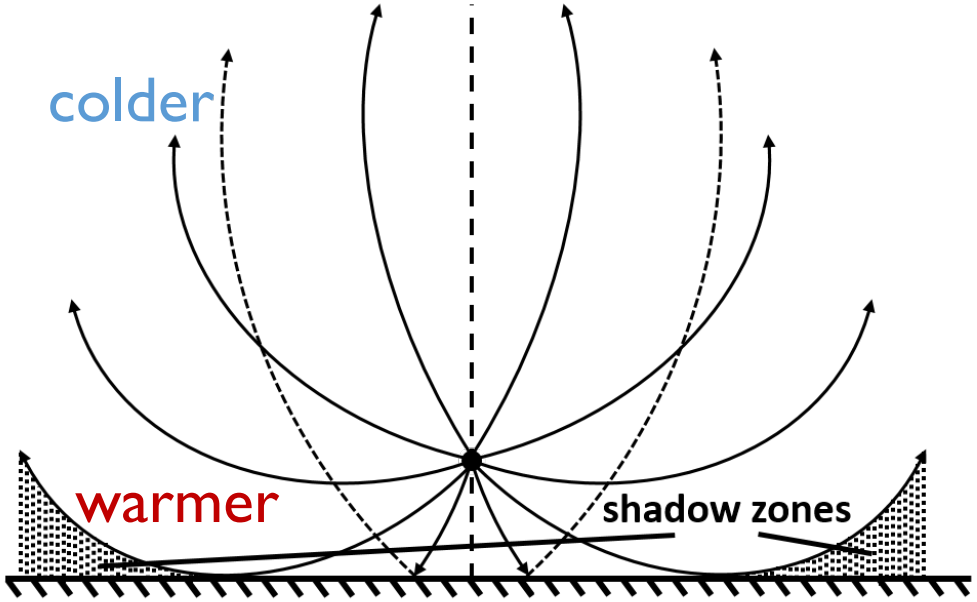
Does snow dampen sound?

Do different snow qualities have different effects?

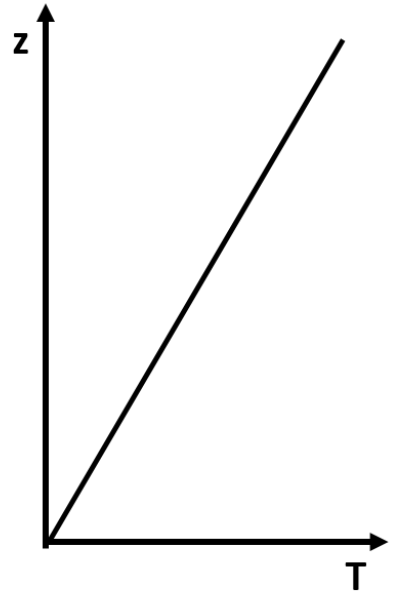
Does upplega affect sound propagation?

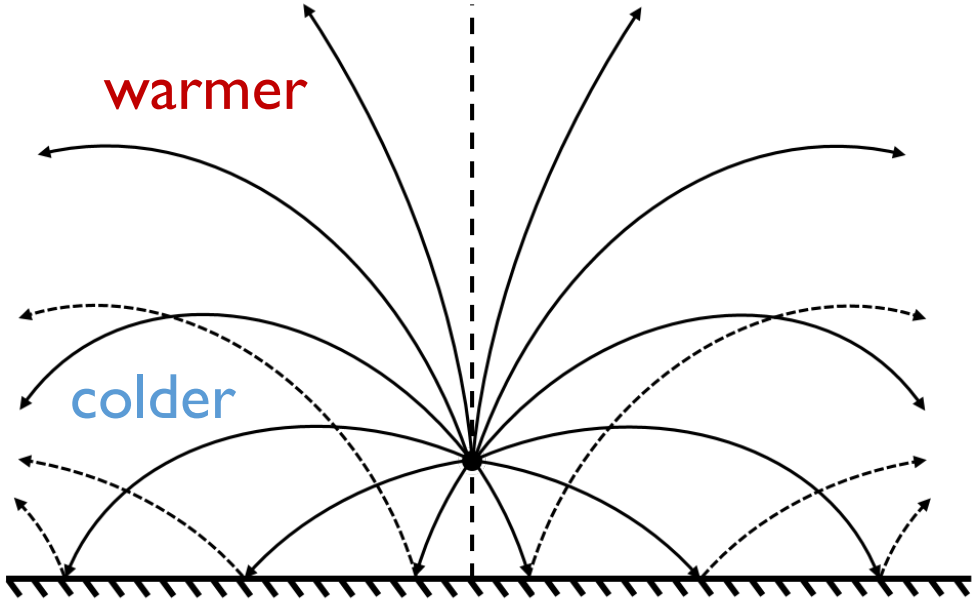

z
u
upwind
downwind
shadow zone





Cold climates!





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Dendrites

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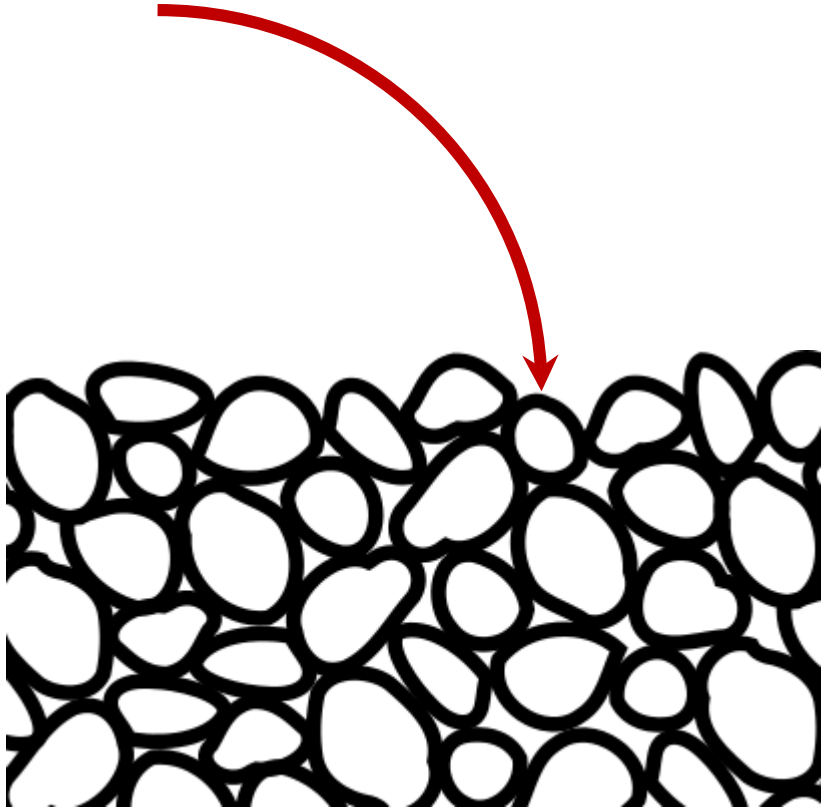
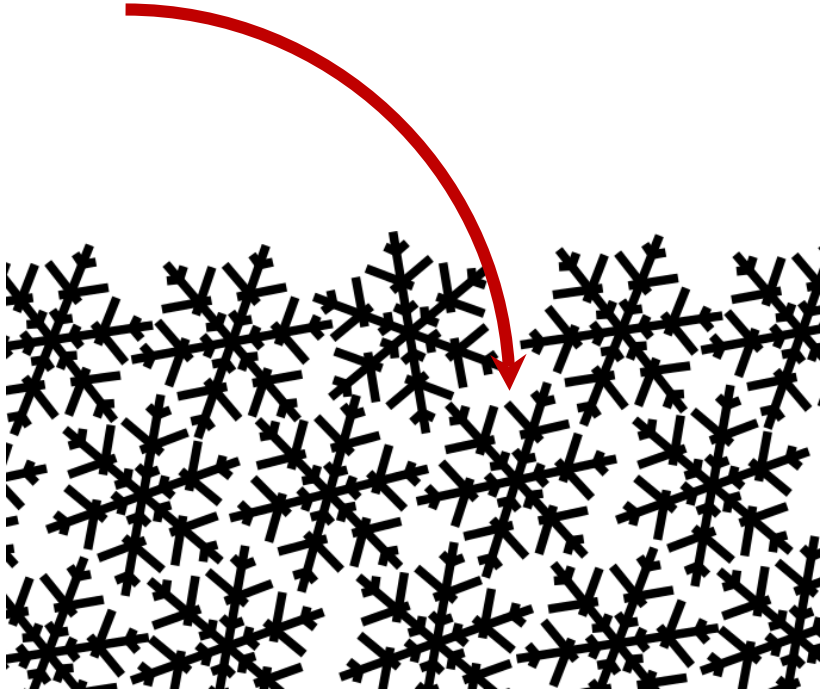
Rounded grains



Dendrites



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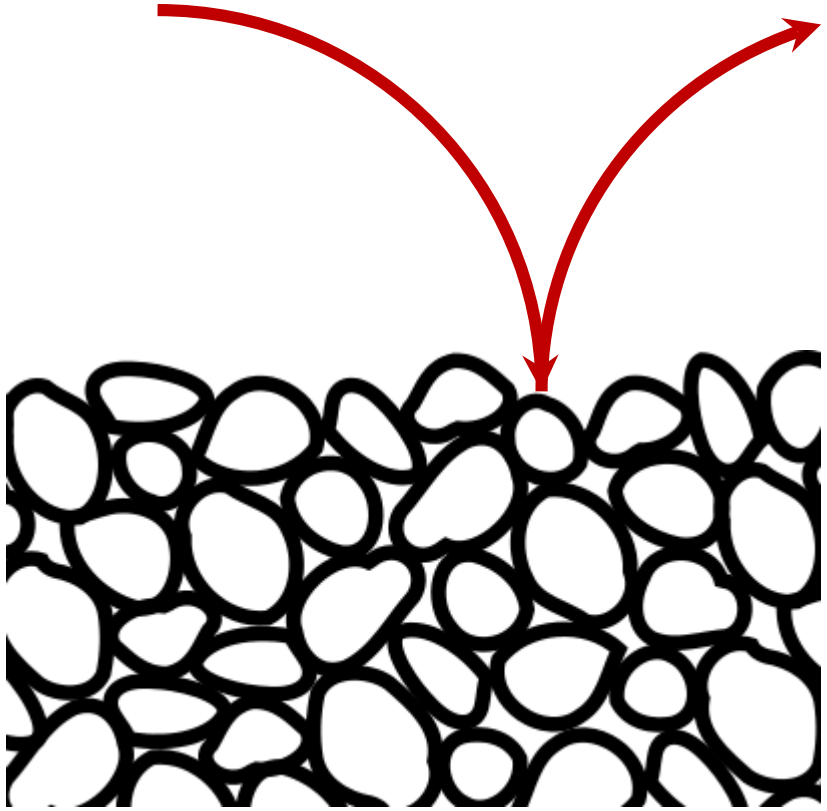
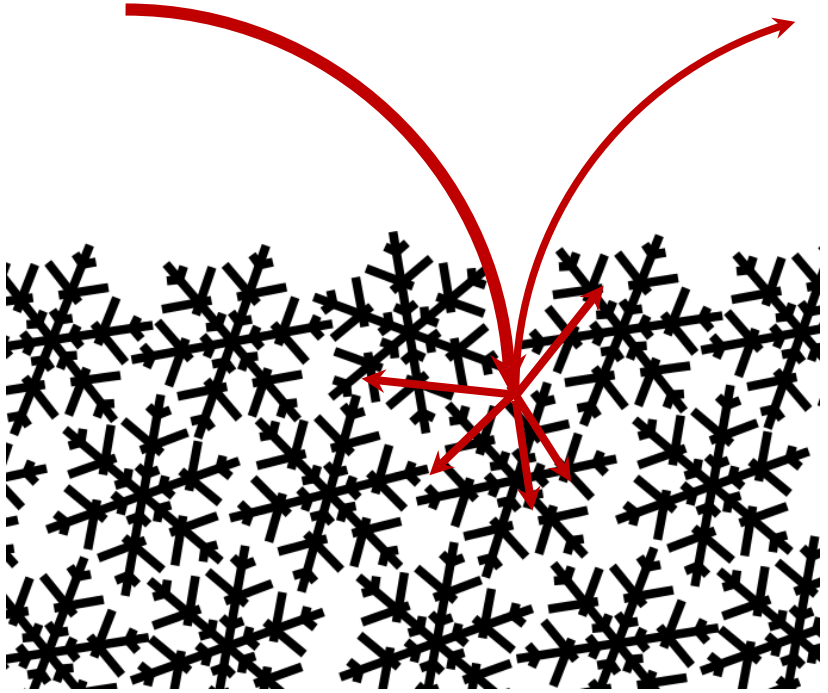
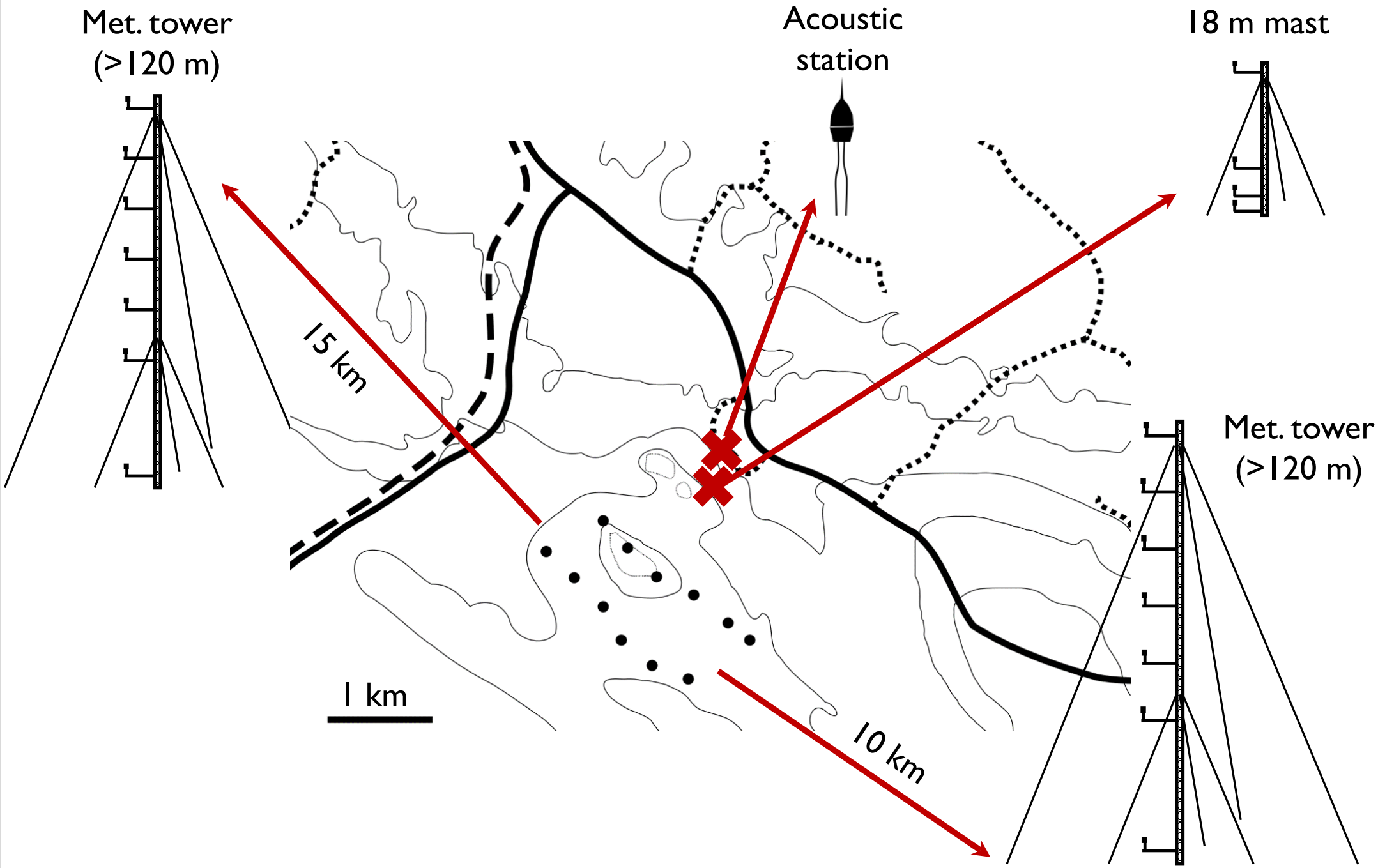
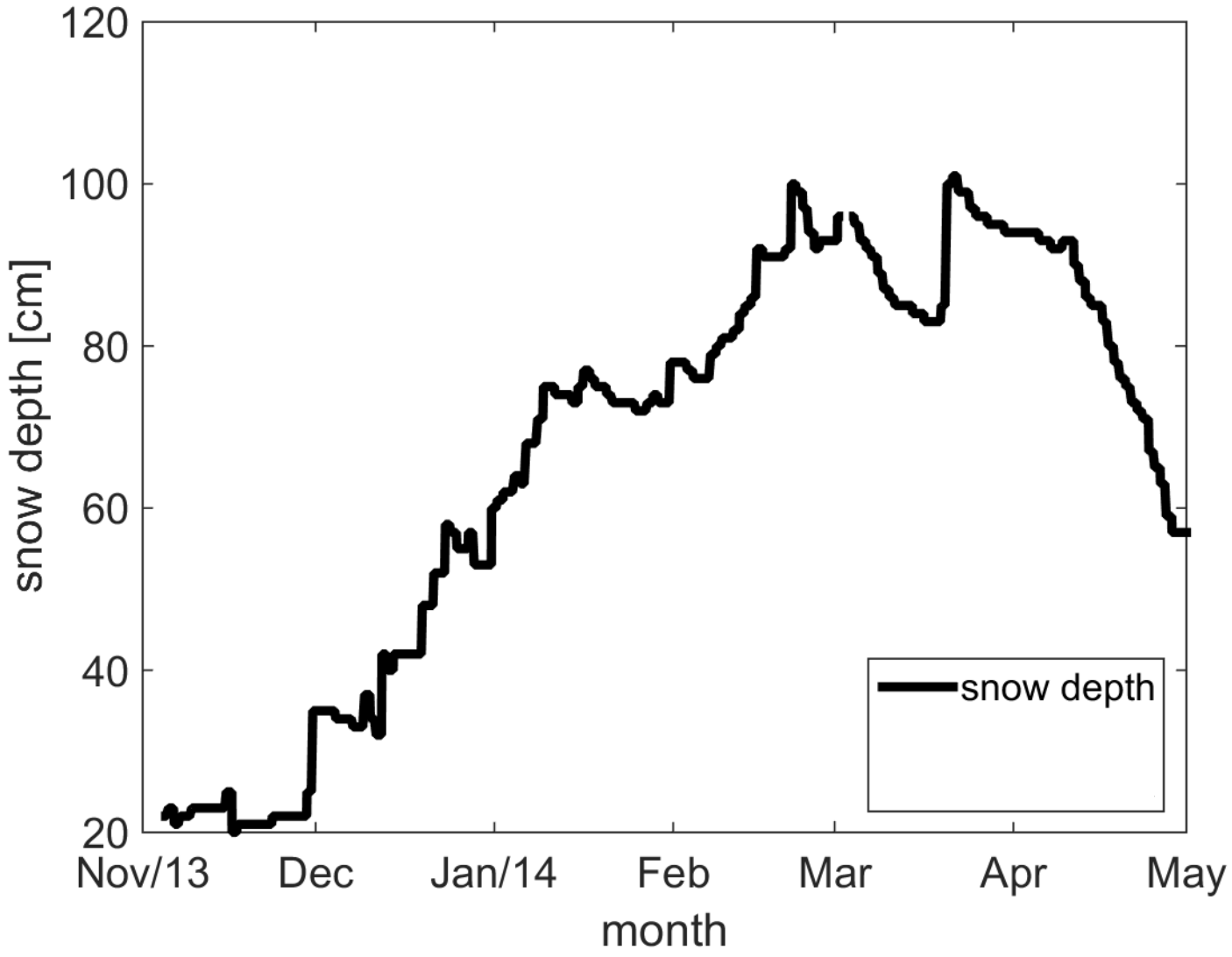
Rounded grains



Dendrites




Met. tower
(>120 m)
Acoustic
station
18 m mast
15 km
1 km
10 km
Met. tower
(>120 m)


120
100
80
60
40
20
snow depth [cm]
Nov/13
Dec
Jan/14
Feb
Mar
Apr
May
month
snow depth

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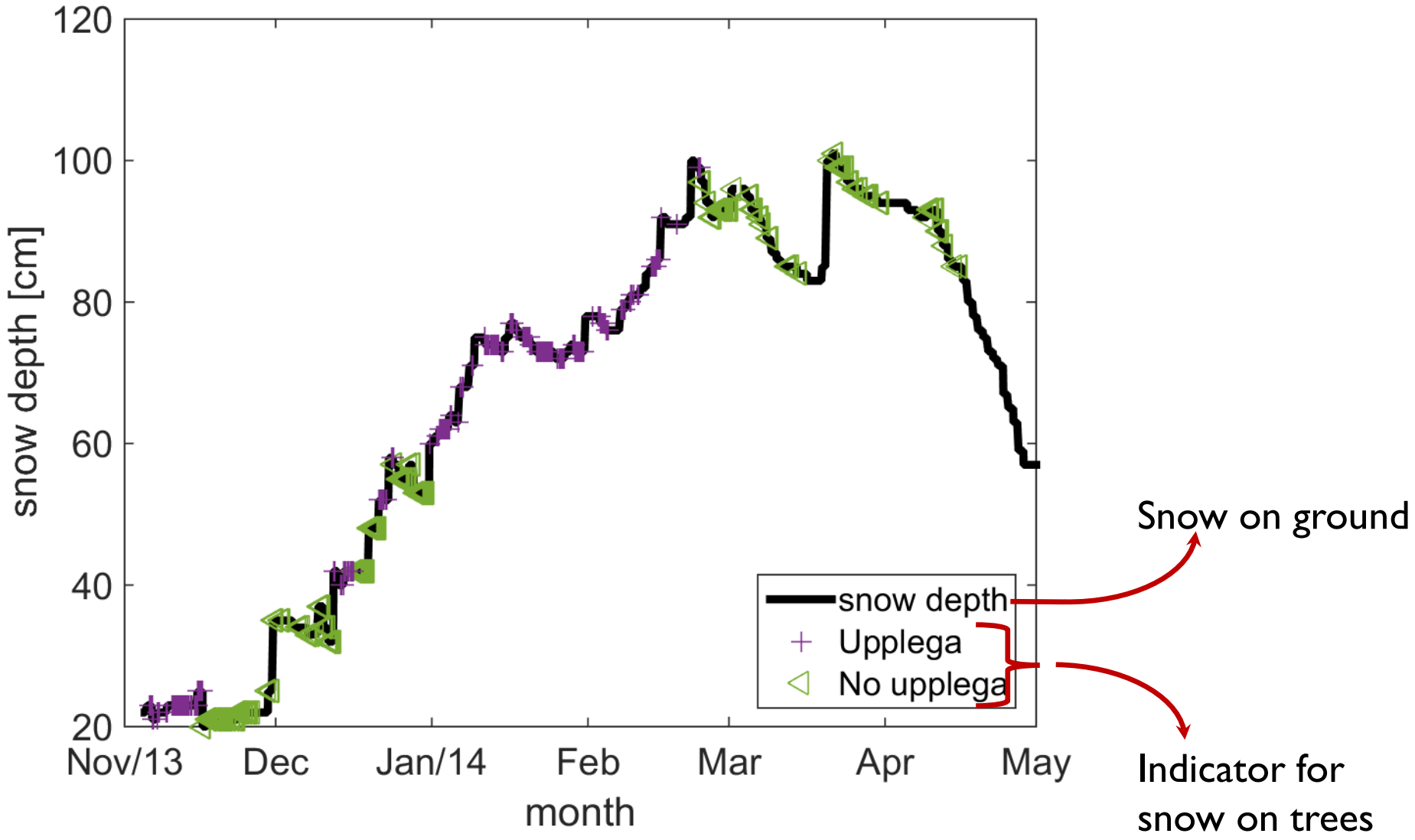

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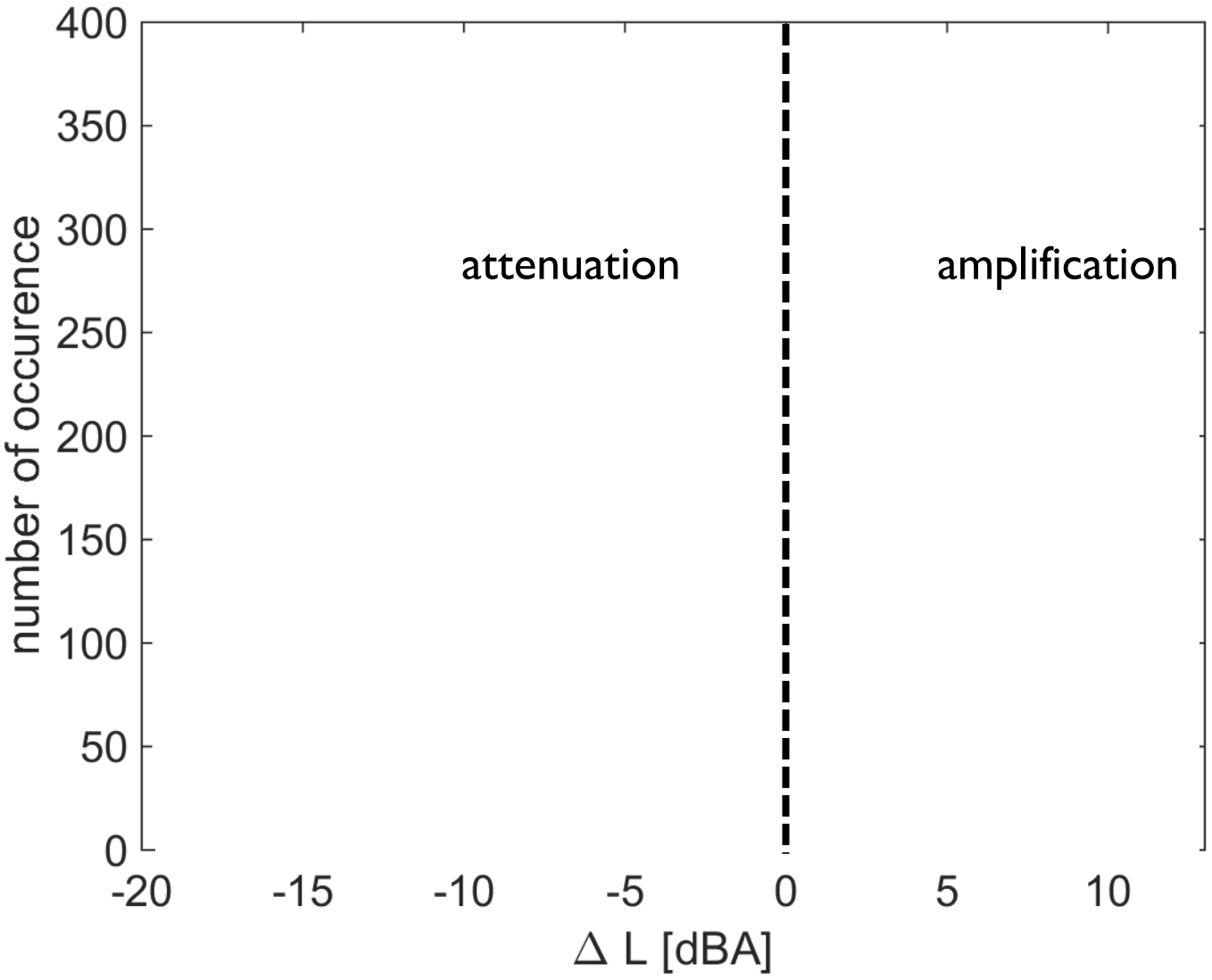

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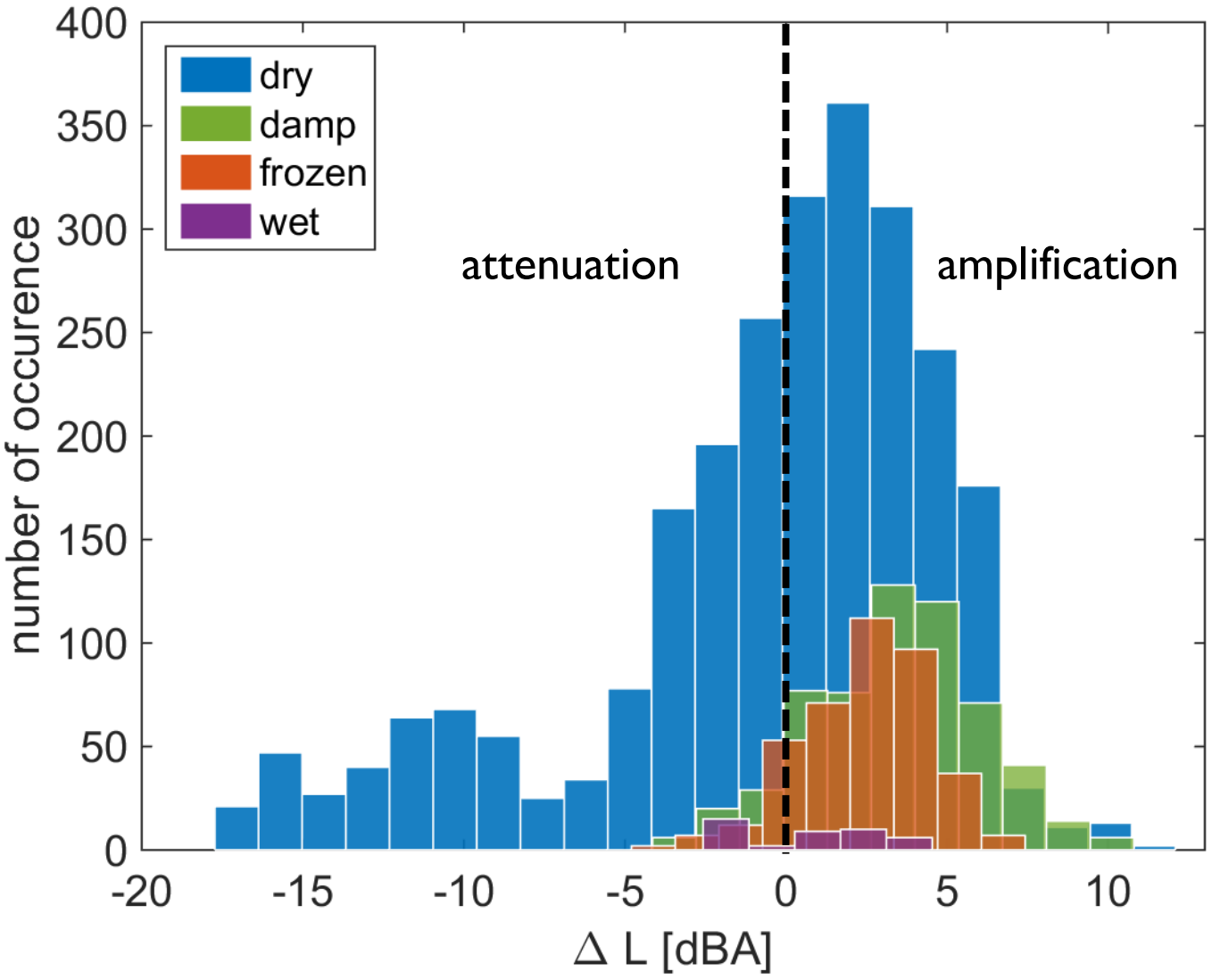
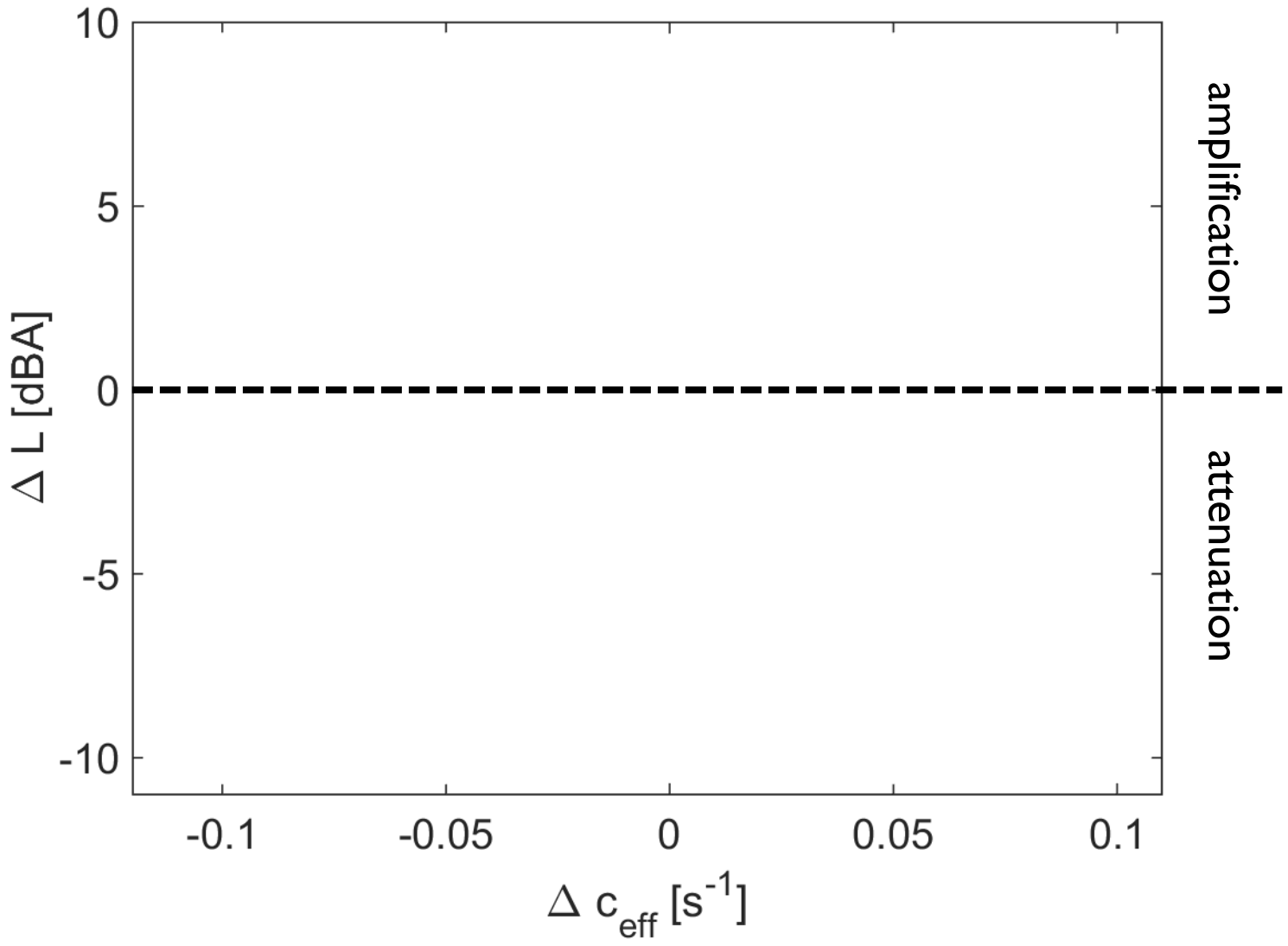
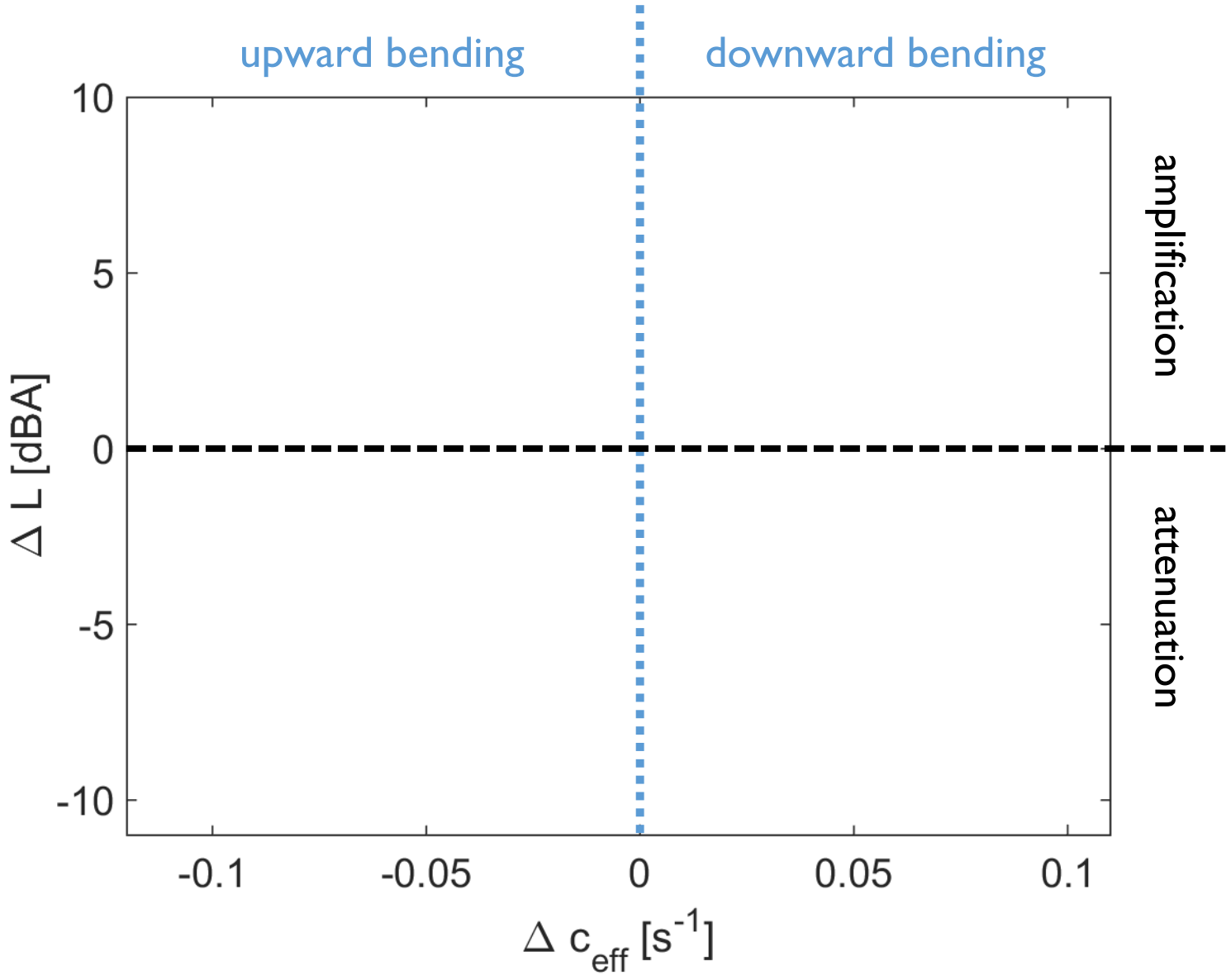
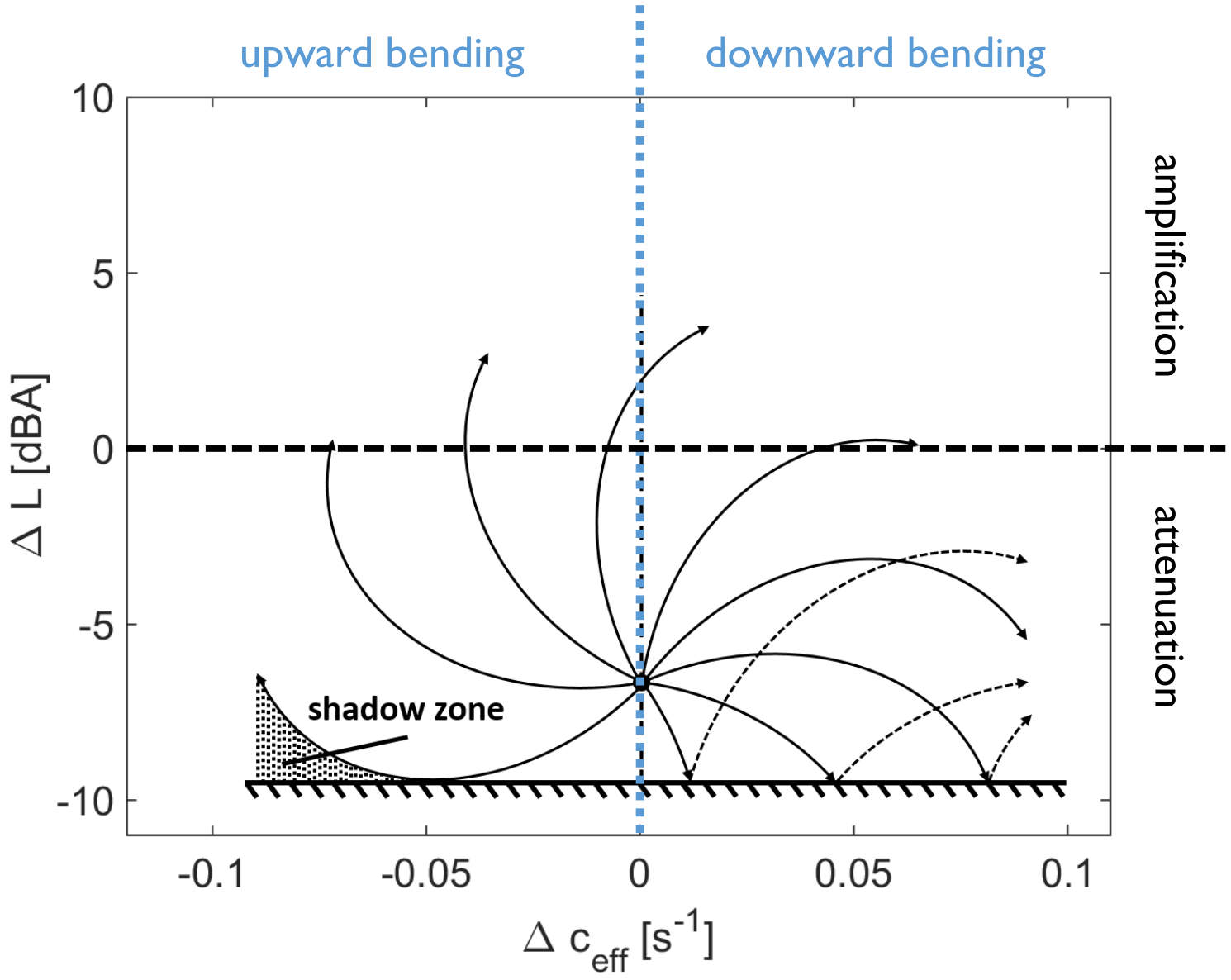



10
5
0
-5
-10
Δ L [dBA]
-0.1
-0.05
0
0.05
0.1
Δ c_eff [s^-1]
amplification
attenuation


upward bending
downward bending
amplification
attenuation
10
5
0
-5
-10
Δ L [dBA]
-0.1
-0.05
0
0.05
0.1
Δ c_eff [s^-1]


upward bending
downward bending
amplification
attenuation
shadow zone
10
5
0
-5
-10
Δ L [dBA]
-0.1
-0.05
0
0.05
0.1
Δ c_eff [s^-1]

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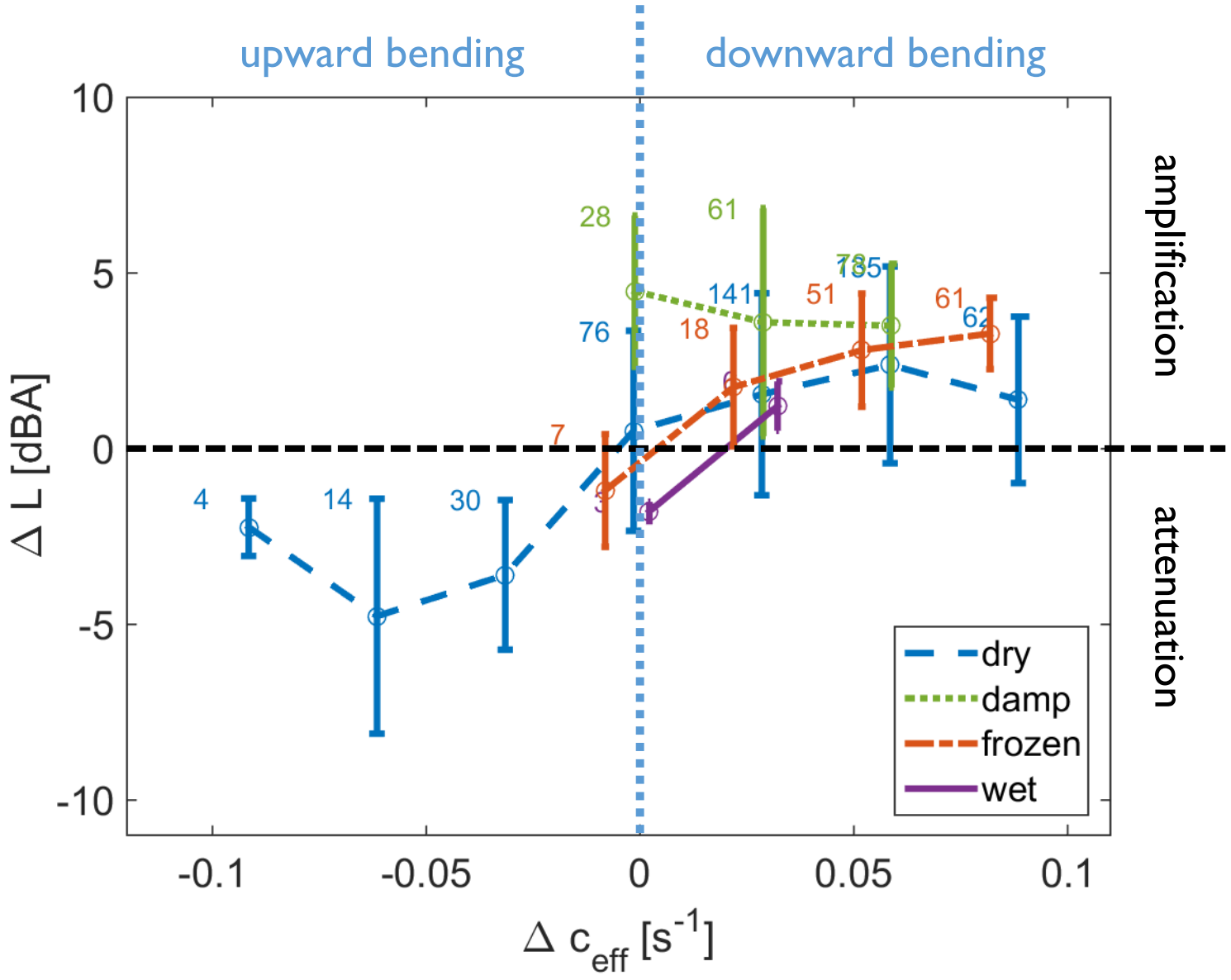

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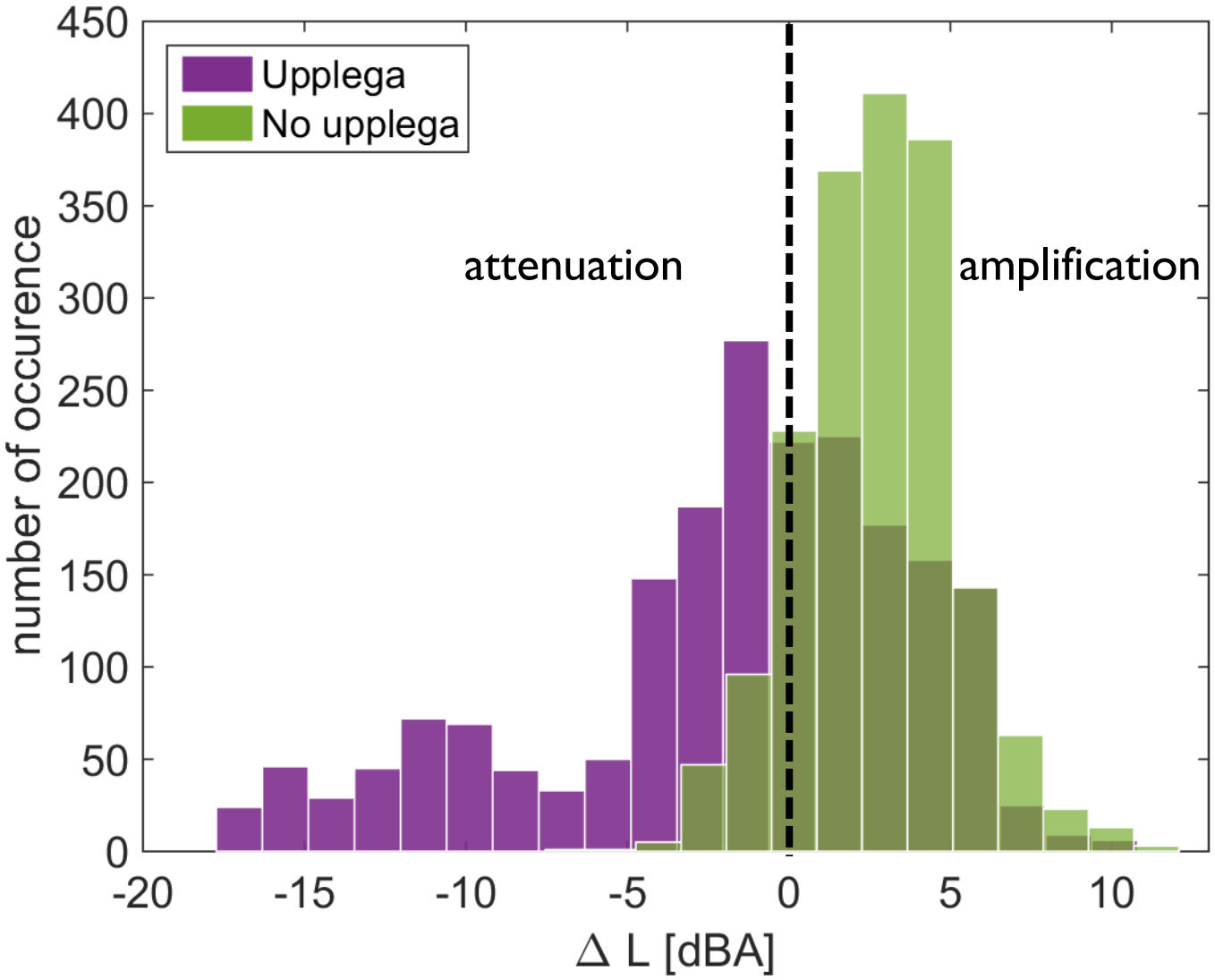

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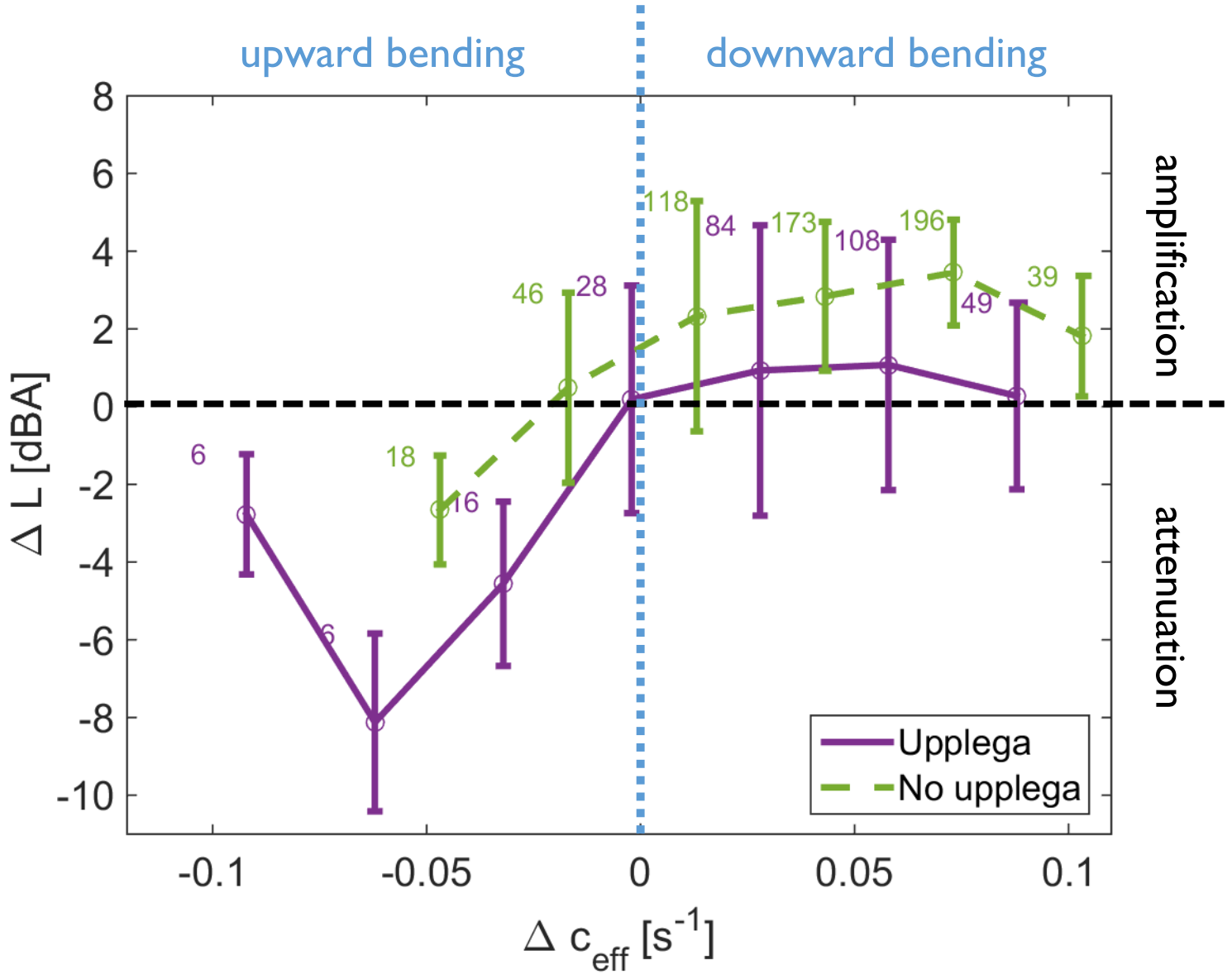

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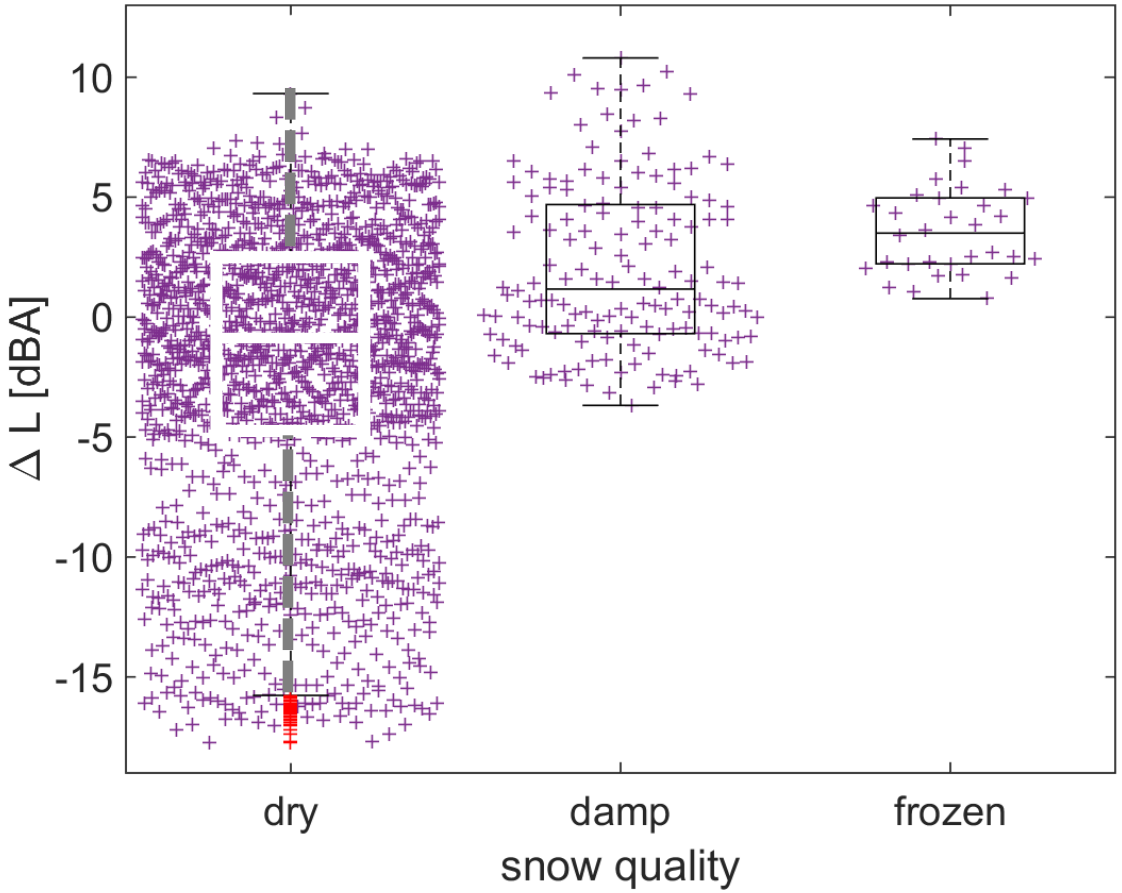
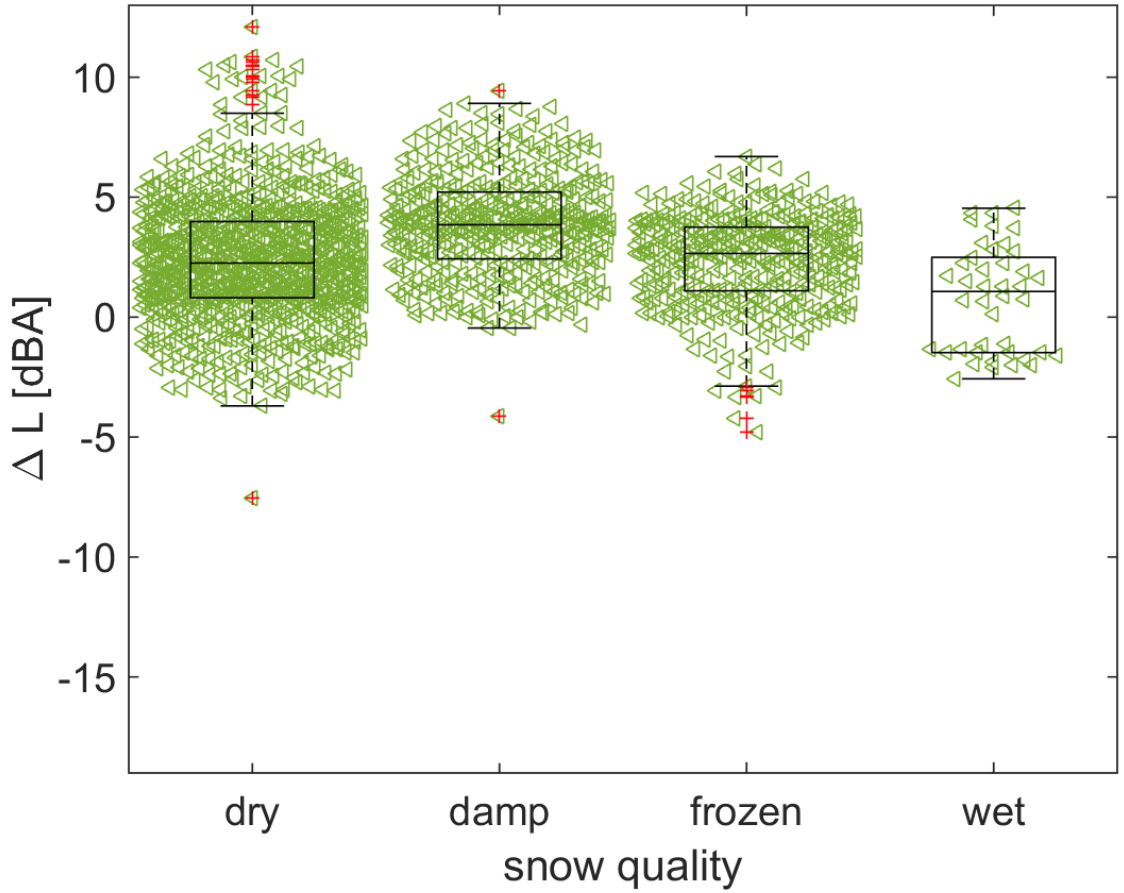
With upplega



Without upplega



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Conclusions

Does snow dampen sound?

Yes, snow dampens sound **but** can also amplify sound.

Do different snow qualities have different effects?

Dry, damp, wet and frozen snow affect sound differently.

Does upplega affect sound propagation?

Yes, it does – dependent on the snow quality and frequency.