Evaluating the Presence of the Endocrine Disruptor 4-Nonylphenol in California Glaciers

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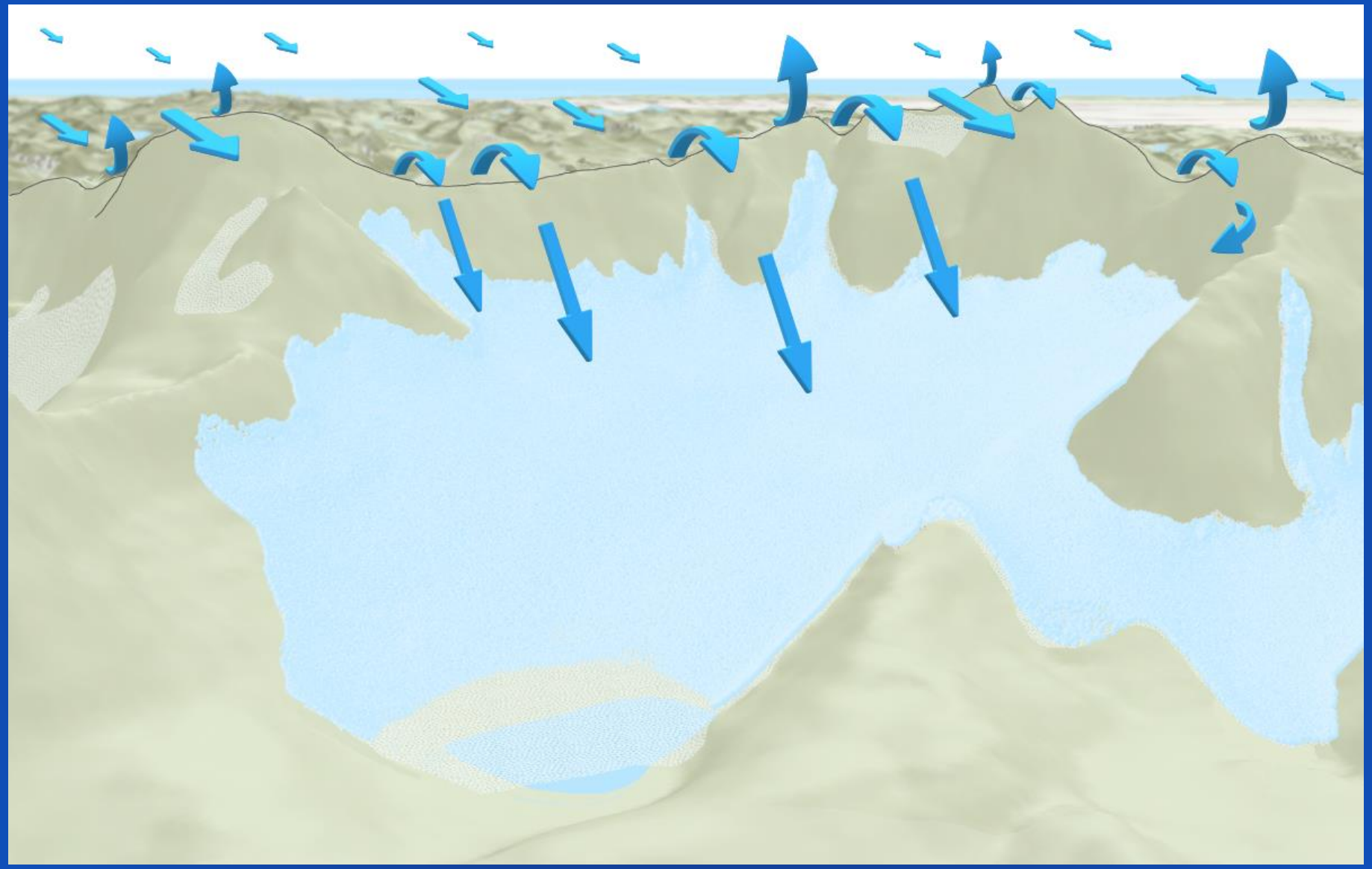
Sierra Nevada
San Francisco
San Joaquin Valley
Source: NASA

Topographic Shielding



Palisade Glacier (July 2018)

Image: Scott Weavil

4-Nonylphenol (4NP)

- *Surfactant* used in:
  Plastics, detergents, personal care products, and pesticides
- Endocrine disruptor
- Risk of ovarian and prostate cancer

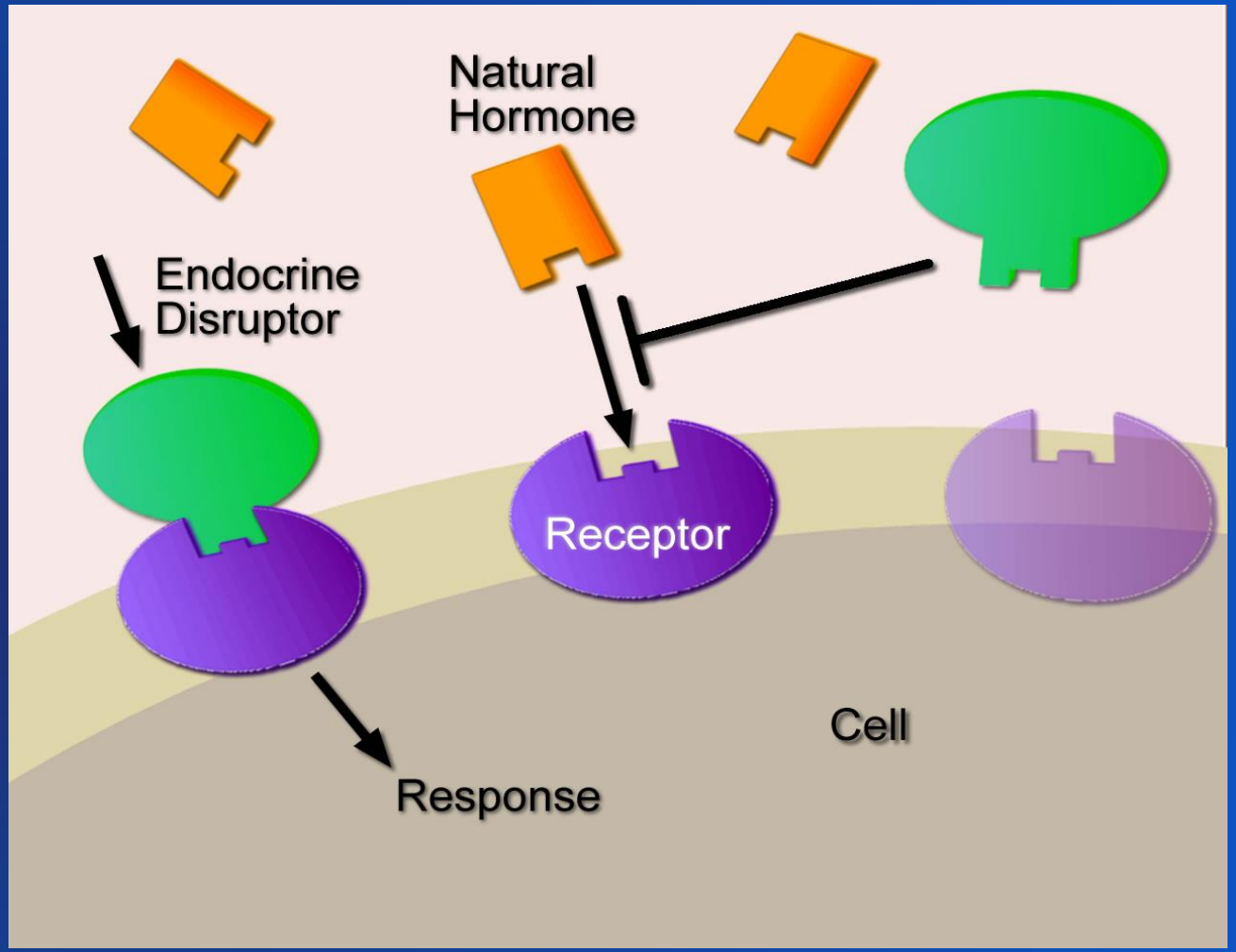


Image: European Parliamentary Research Service

From previous studies…

“[There is an increase in] concentrations of 4NP in snow at greater distances from the headwall with less topographical shielding.”

~ Dr. Rebecca Lyons, University of Redlands

Snow Volume

Snow Density

4NP Concentration

$$M = \frac{V * \rho_g * [4\mathrm{NP}]}{\rho_w}$$

Water Density

Calculating Snow Volume with LiDAR

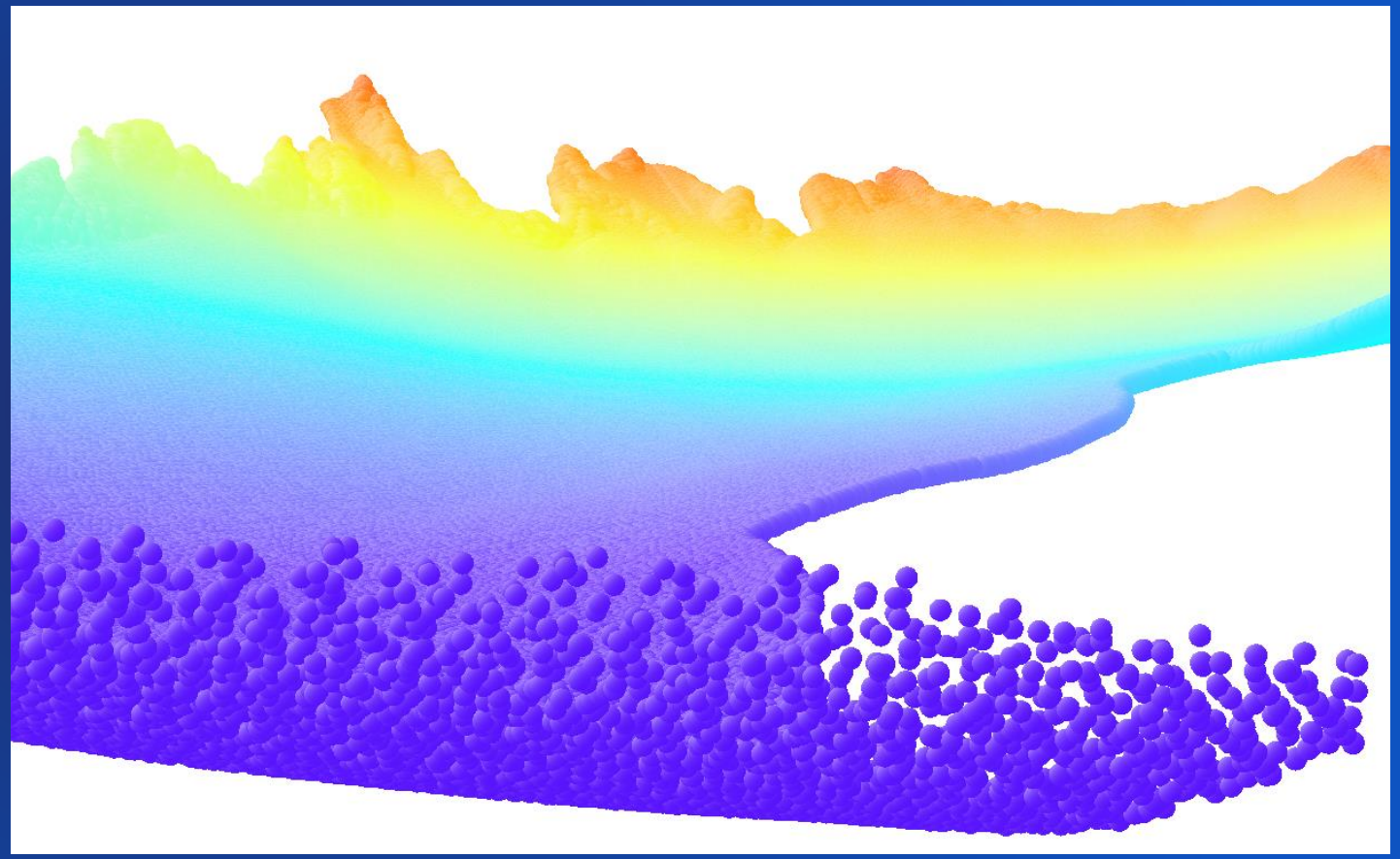
Calculating Snow Volume with LiDAR

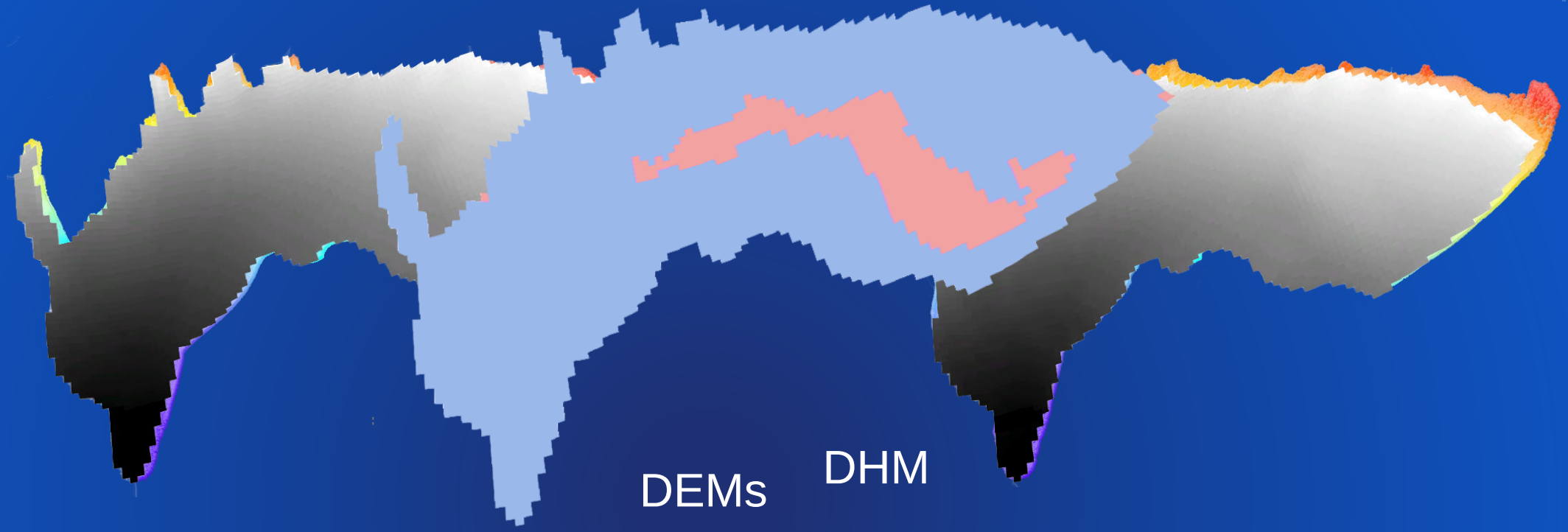
Snow-on points

Kings Basin: *585,018,157*

Palisade Glacier: *1,579,465*

Middle Palisade Glacier: *760,464*



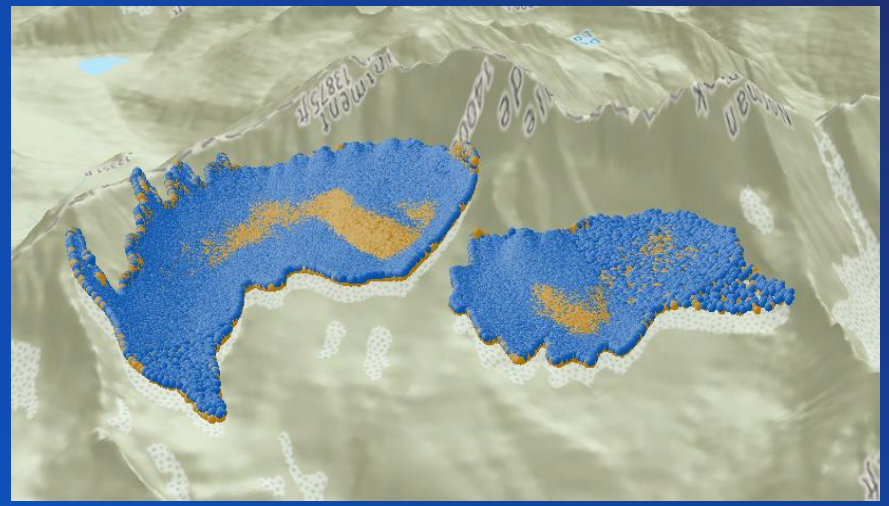


DEMs

DHM

Snow-On
(April 2018)

Snow-Off
(August 2014)



- 4-year difference
- Landform changes
- Subglacial melt


Snow

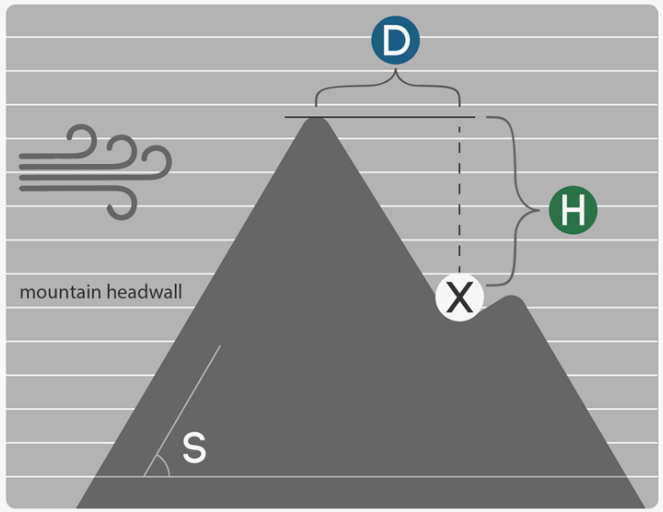
Snow Volume Raster

Predicting 4NP Concentrations

DEPOSITION DETERMINING FACTORS

CORRELATION BETWEEN SIZE OF CANYON HEADWALLS AND THE AMOUNT OF NP FOUND IN THEM

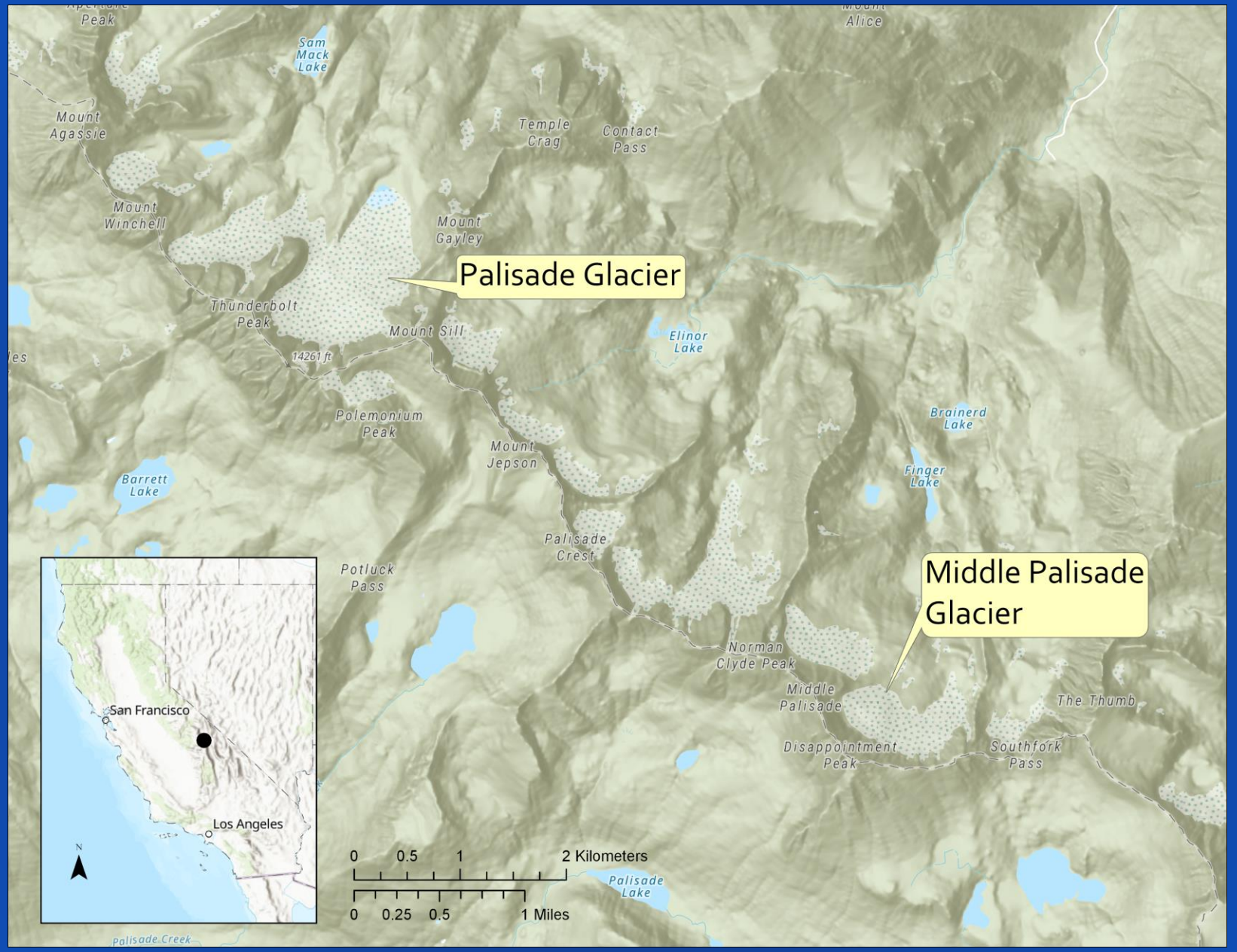
TOPOGRAPHICAL SHIELDING (T)



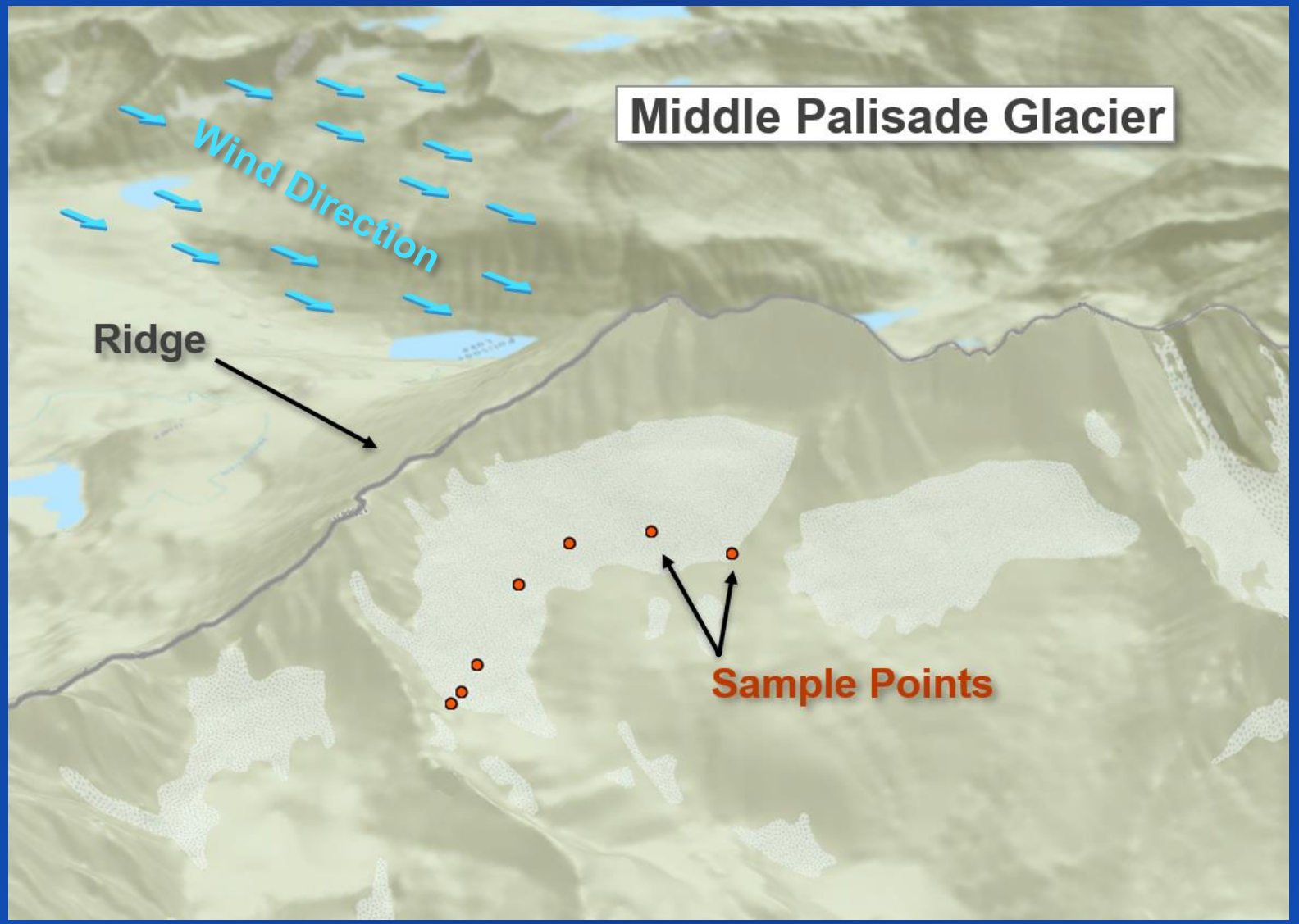
$$T = \frac{S \times H}{D}$$

S = rise/run of headwall slope
D = horizontal apex to sample site
H = vertical apex to sample site
X = sample site

Graphic by Austin Koons


Palisade Glacier
Middle Palisade Glacier
Sam Mack Lake
Mount Agassie
Temple Crag
Contact Pass
Mount Winchell
Mount Gayley
Thunderbolt Peak
Mount Sill
14261 ft
Elinor Lake
Polemonium Peak
Mount Jepson
Brainerd Lake
Finger Lake
Barrett Lake
Palisade Crest
Potluck Pass
Norman Clyde Peak
Middle Palisade
Disappointment Peak
Southfork Pass
The Thumb
Palisade Lake
Palisade Creek
San Francisco
Los Angeles
N
0 0.5 1 2 Kilometers
0 0.25 0.5 1 Miles

Concentration Samples

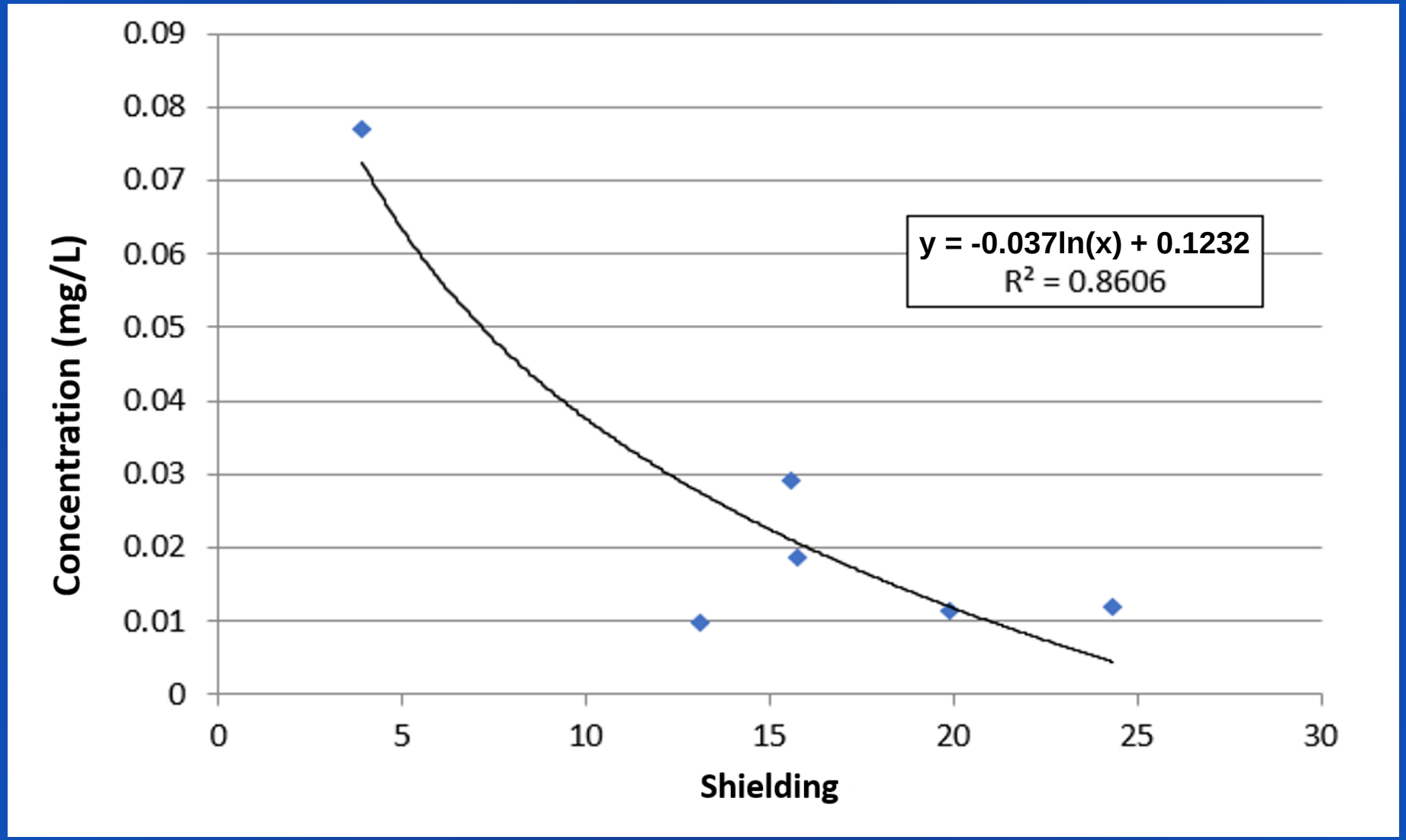


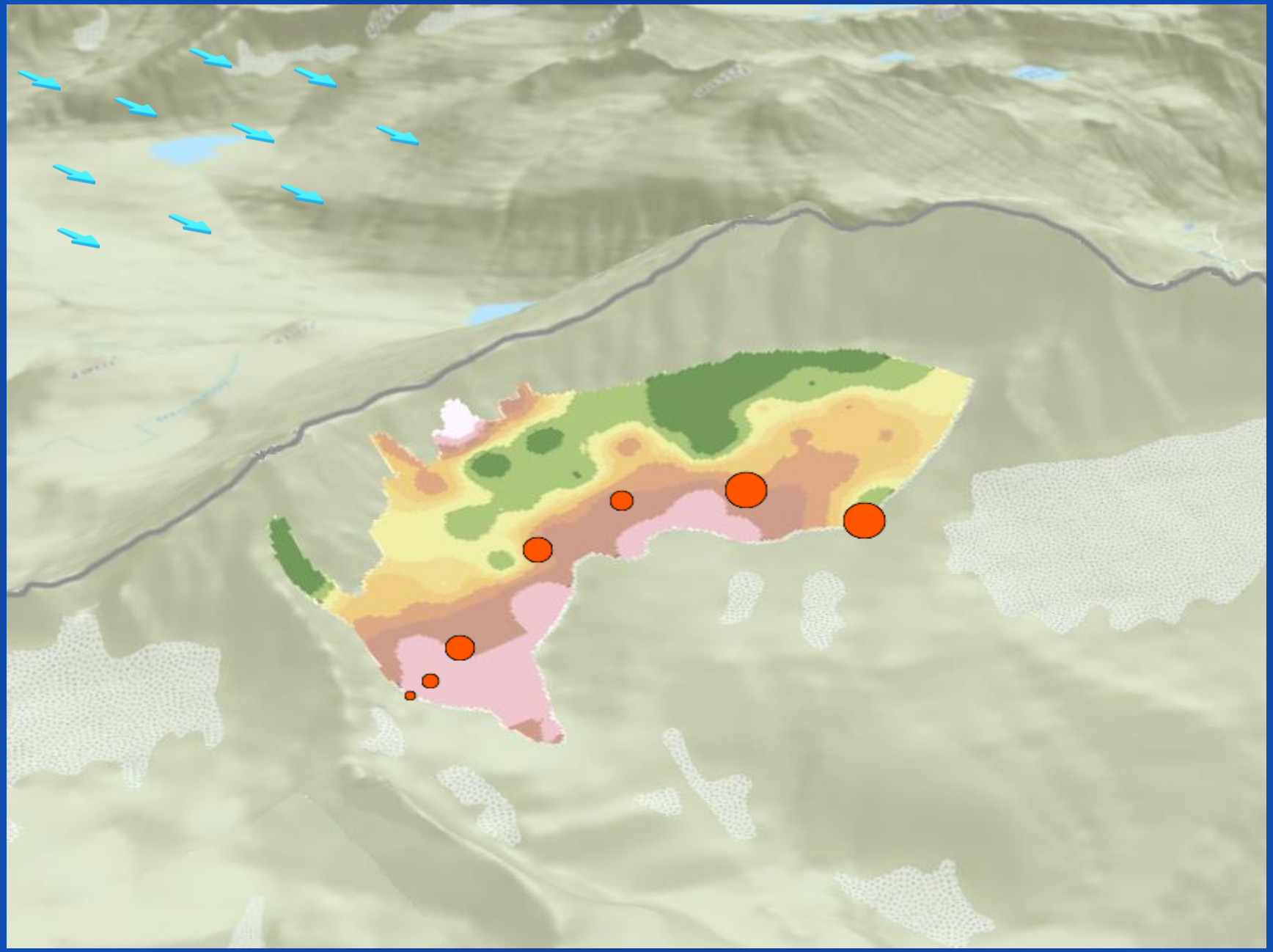
Middle Palisade Glacier (September 2015)

Image: Jesse Felten

Image: Dr. Rebecca Lyons

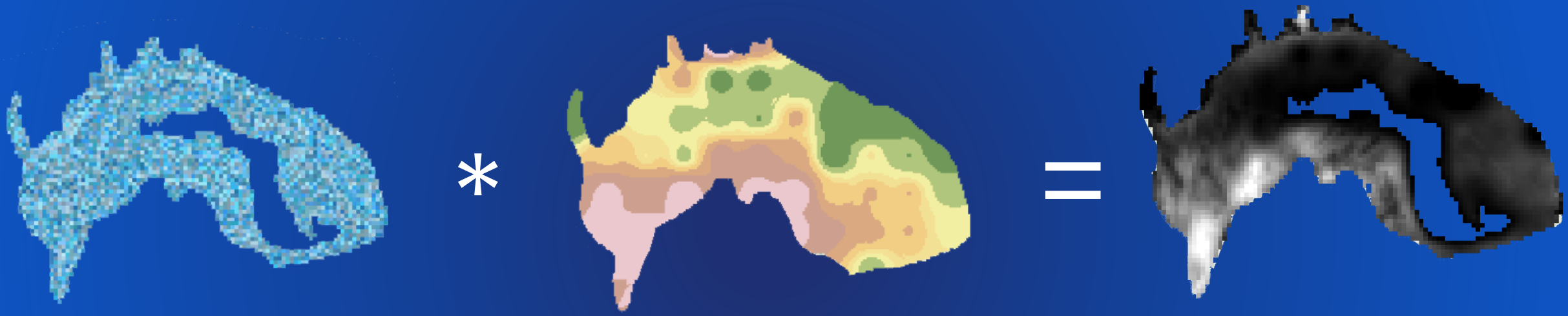
- **Hormonal changes in fish and amphibians reported at 0.02 mg/L 4NP in water concentrations (Vazque-Duhalt et al., 2006)**
- **Concentrations in snow are greater than water concentrations**


0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Concentration (mg/L)
0
5
10
15
20
25
30
Shielding
y = -0.037ln(x) + 0.1232
R² = 0.8606



Background | Methods | Results | Summary

Calculating 4NP Mass



Study Area	4NP Mass
Palisade Glacier	41.03 kg
South Middle Palisade Glacier	15.55 kg

Concentration
ppm
≤ 0.01
≤ 0.02
≤ 0.03
≤ 0.04
≤ 0.05
≤ 0.08
Thunderbolt Peak
Mount Gayley
Mount Sill
14261 ft
13951 ft
12800 ft

- LiDAR is an effective snow surveying technique
- Estimating concentration and mass removes guesswork
- Exposure risk application
- GIS work supports research

THANK YOU

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Dr. Kathryn Bormann,
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