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Shutting down dust emission during the middle Holocene drought in the Sonoran Desert, Arizona, USA

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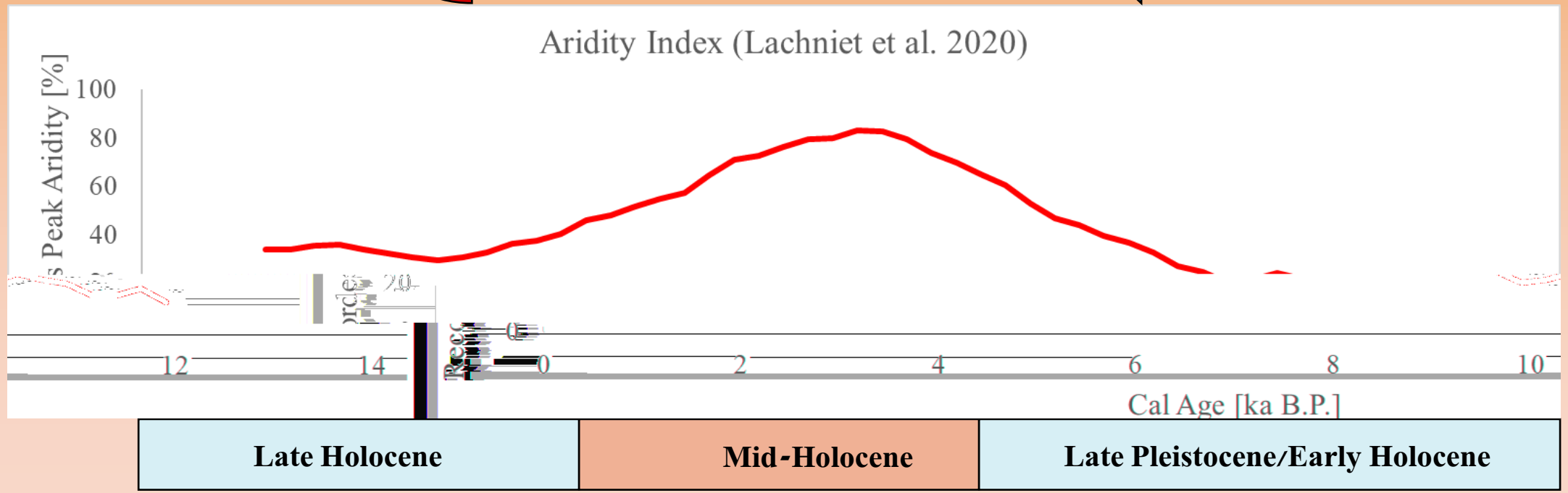
THE UNIVERSITY OF ARIZONA

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

Motivation

?


Aridity Index (Lachniet et al. 2020)
Peak Aridity [%]
100
80
60
40
12
14
0
2
4
6
8
10
Cal Age [ka B.P.]
Late Holocene
Mid-Holocene
Late Pleistocene/Early Holocene
4.2 ka
8.2 ka

Motivation

Late Holocene

Mid-Holocene

Late Pleistocene/Early Holocene

Classification of dust sources

? ?

Transport-limited

Supply-limited

Availability-limited

Hypothesis

Climate changes to an arid phase

Decreasing vegetation coverage exposes available sediments

Increasing Dust flux

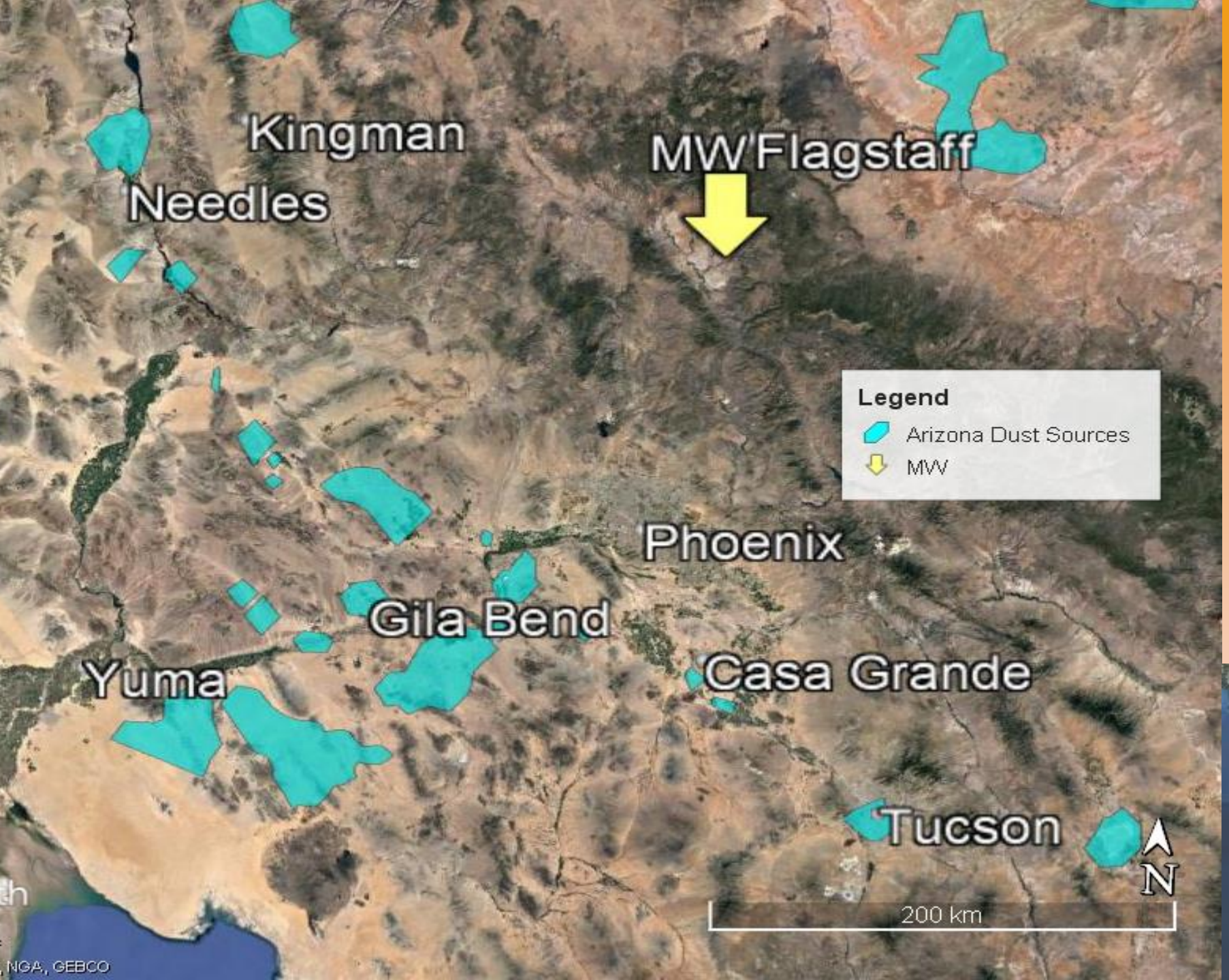
Decreasing storm frequency and magnitude
Decreases dust sources sediment refill

Decreasing Dust flux

MODIS deep blue aerosol

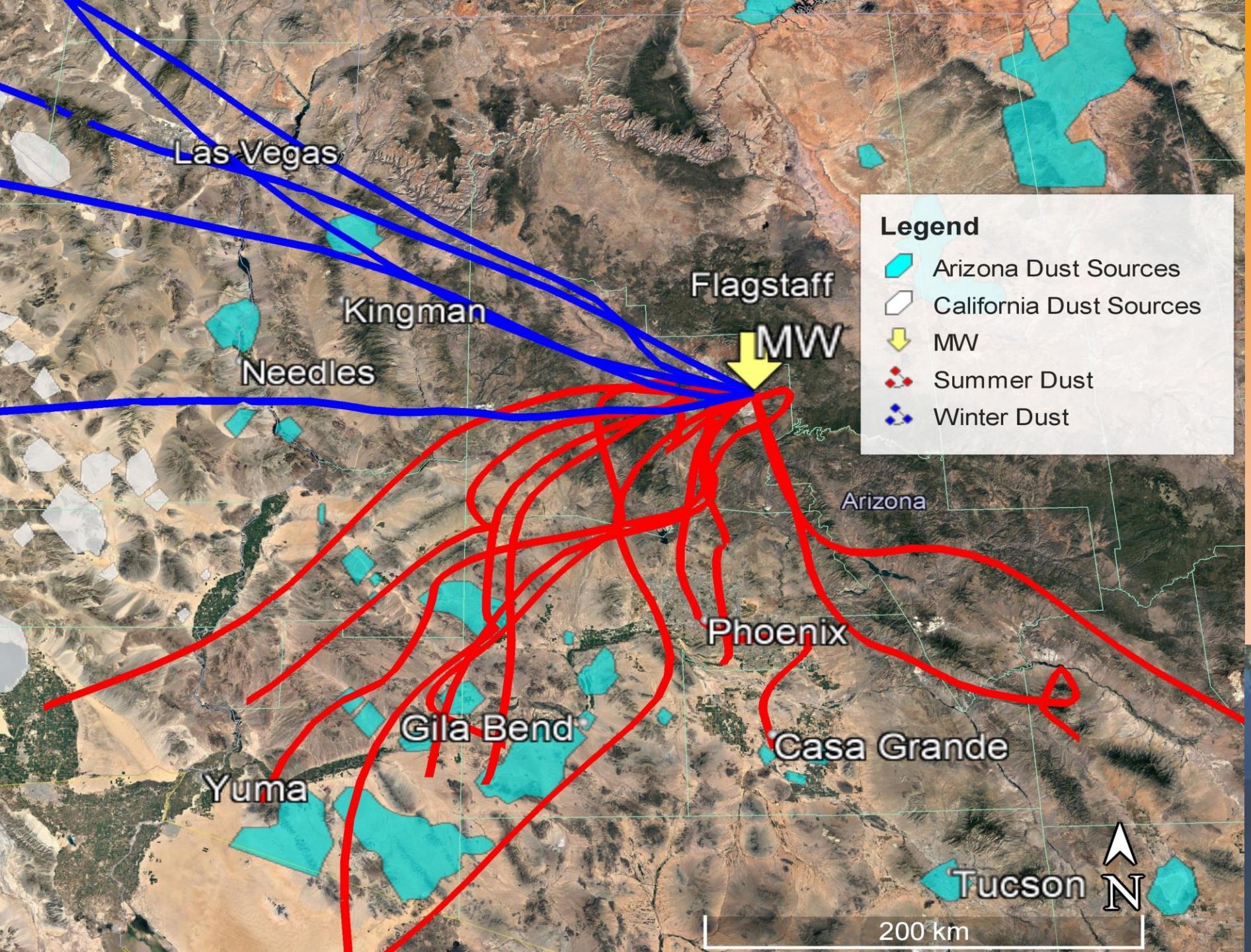
Results

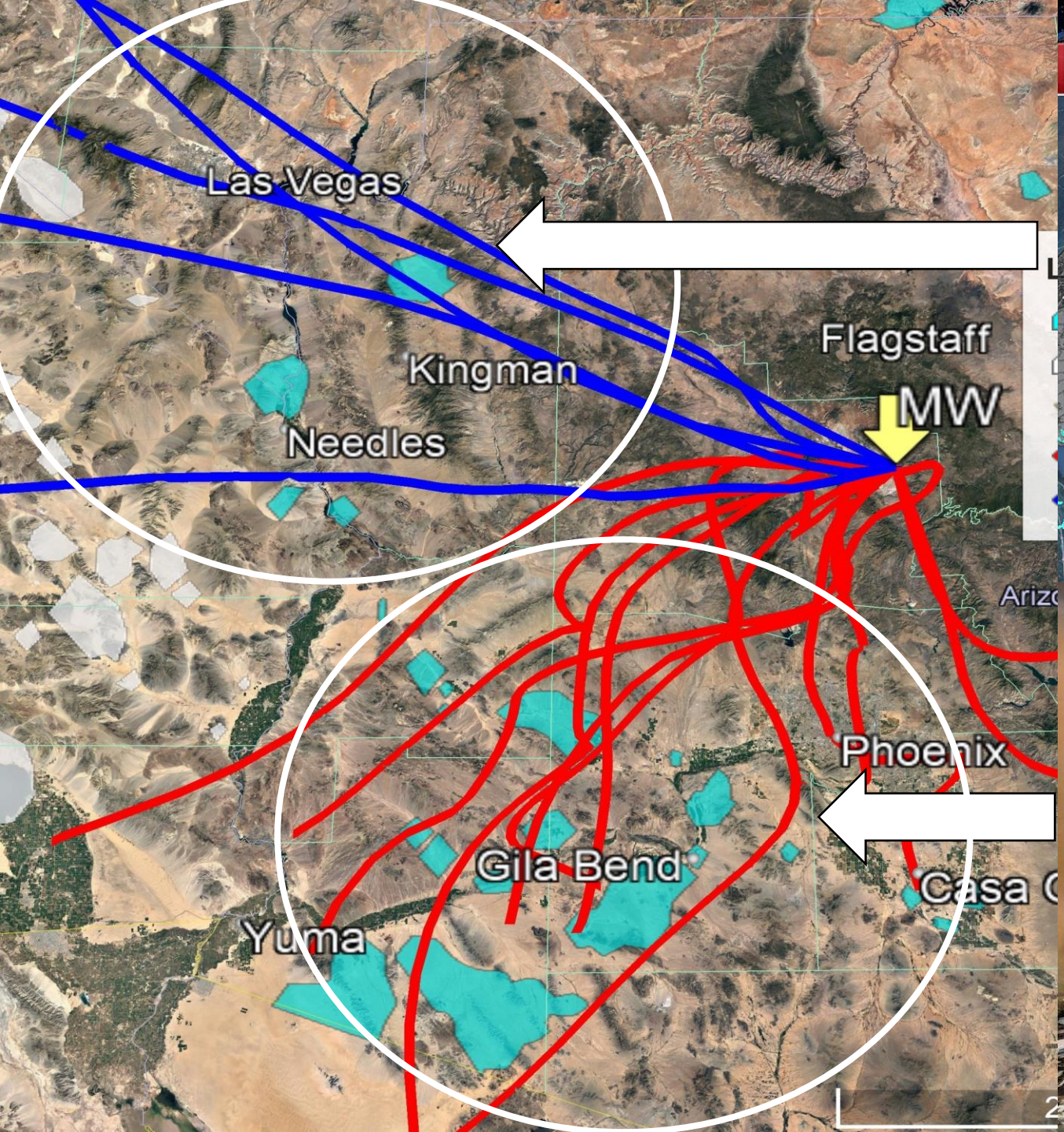
Potential dust sources



Results

Active dust sources



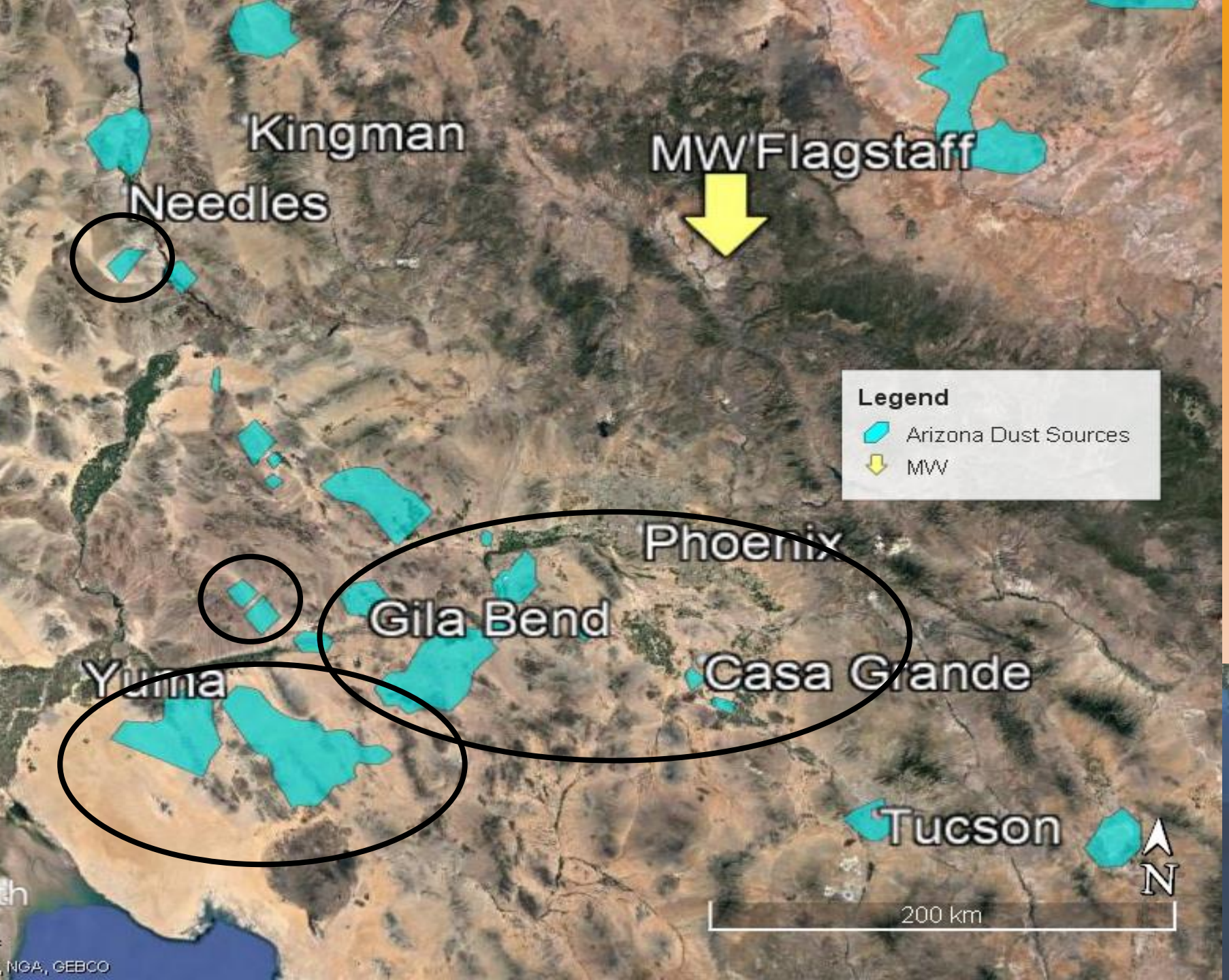

Las Vegas
Kingman
Needles
Flagstaff
MW
Phoenix
Gila Bend
Yuma


abc NEWS
TRACKING THE STORM
RADAR AND ADVISORIES
WINTER WEATHER ADVISORY
WINTER STORM WARNING
L
WIND ADVISORY

Results

Active dust sources

Alluvial Fan




Alluvial Fan
Gila River
Flood Plain
Google Earth
© 2020 Google
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N
8 km


Loam
Terrace
Coarse
active wash


Loam
Terrace
Coarse
active
wash

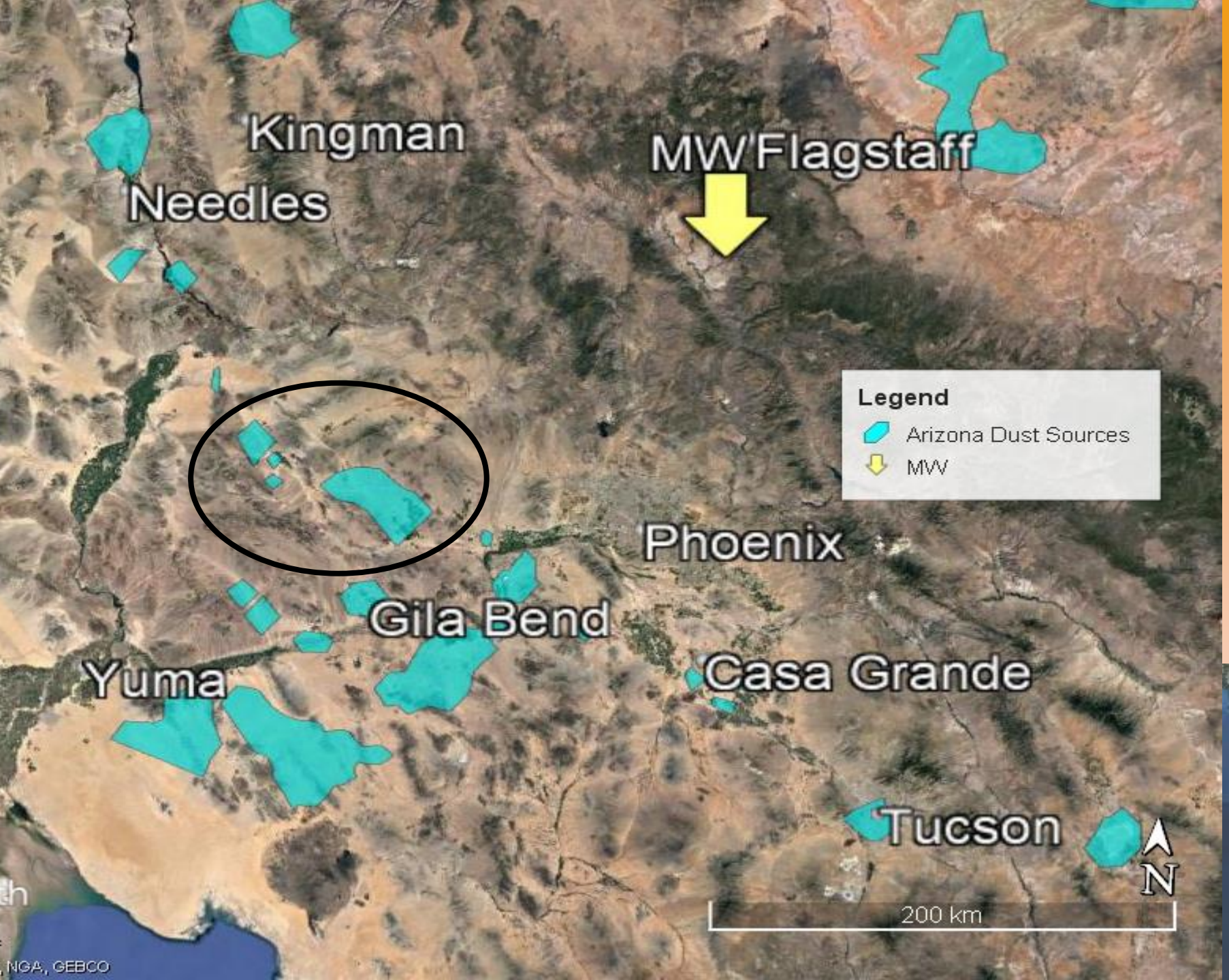

HY-01

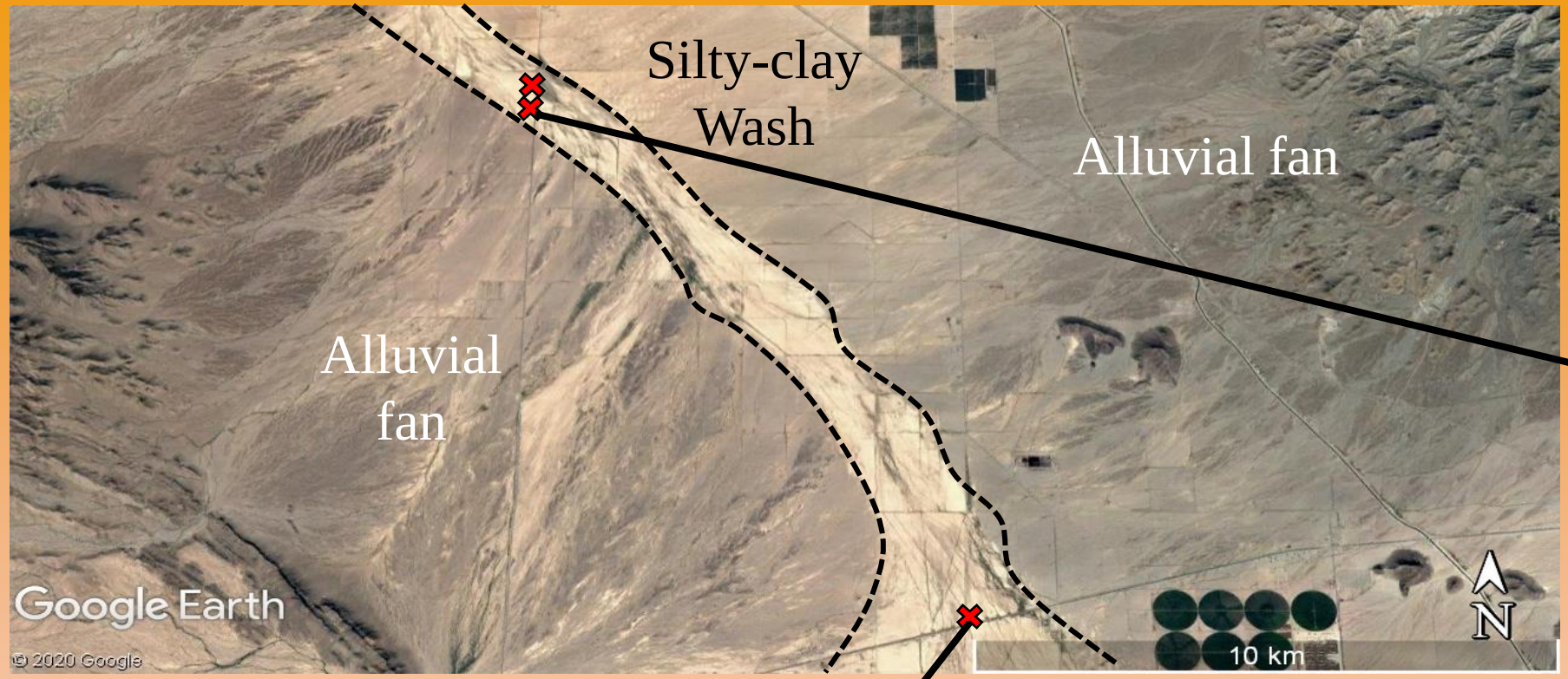

GR-03

Results

Active dust sources

Silty-clay wash




Silty-clay
Wash
Alluvial fan
Alluvial
fan
Google Earth
© 2020 Google
10 km
N

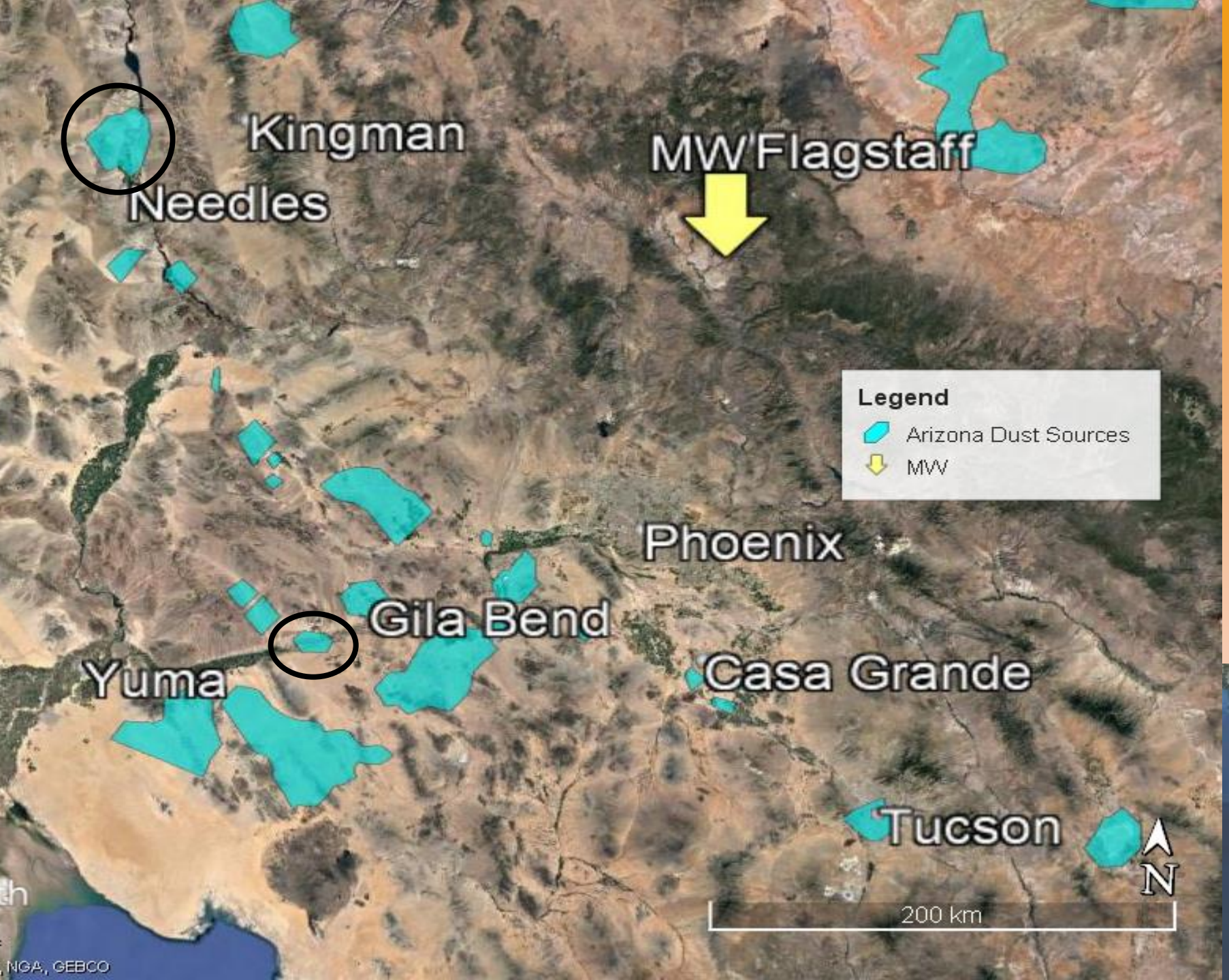

UT-05


CE-03

Results

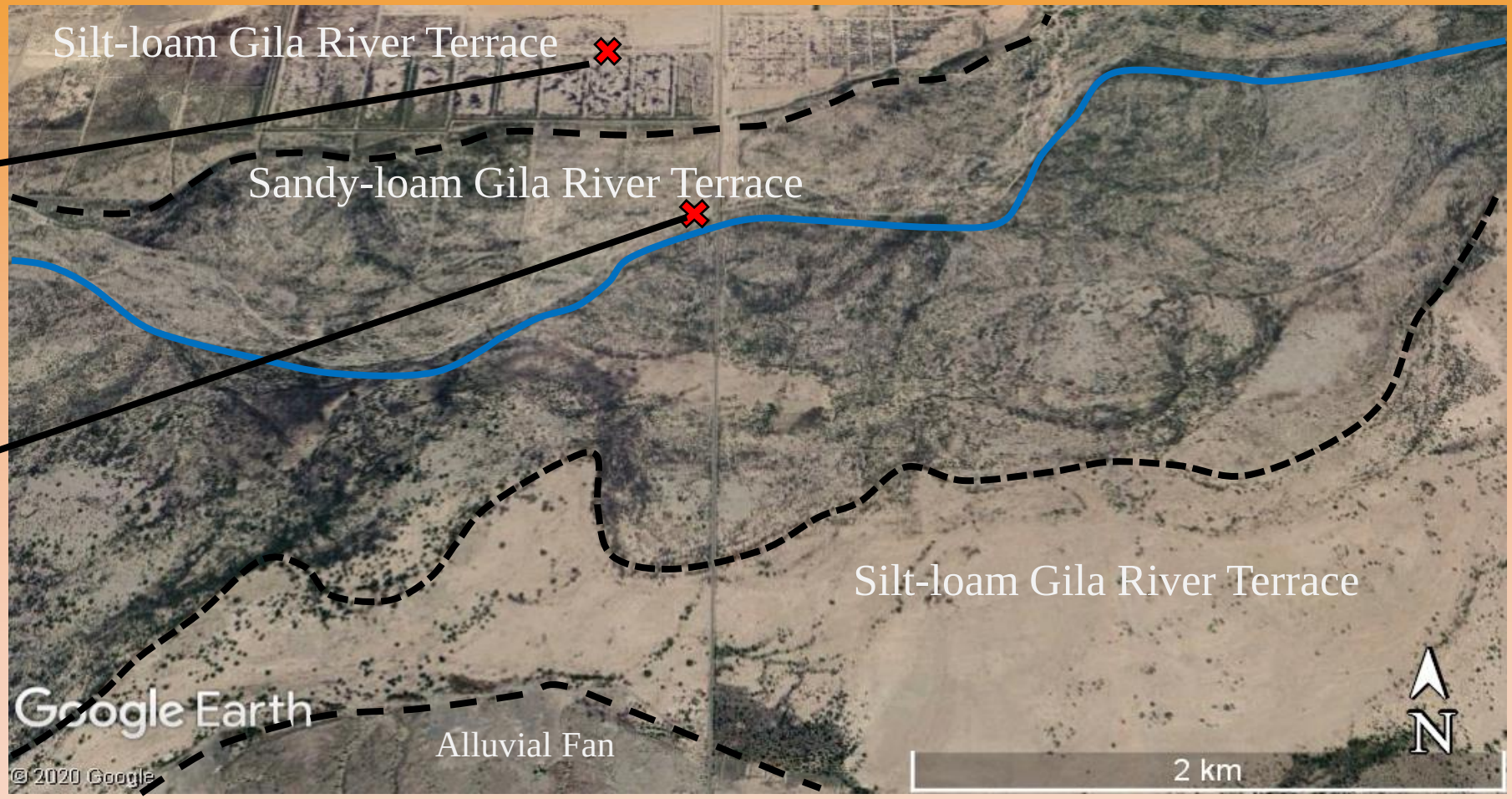
Active dust sources

Colorado and Gila River Flood Plains




PL-04

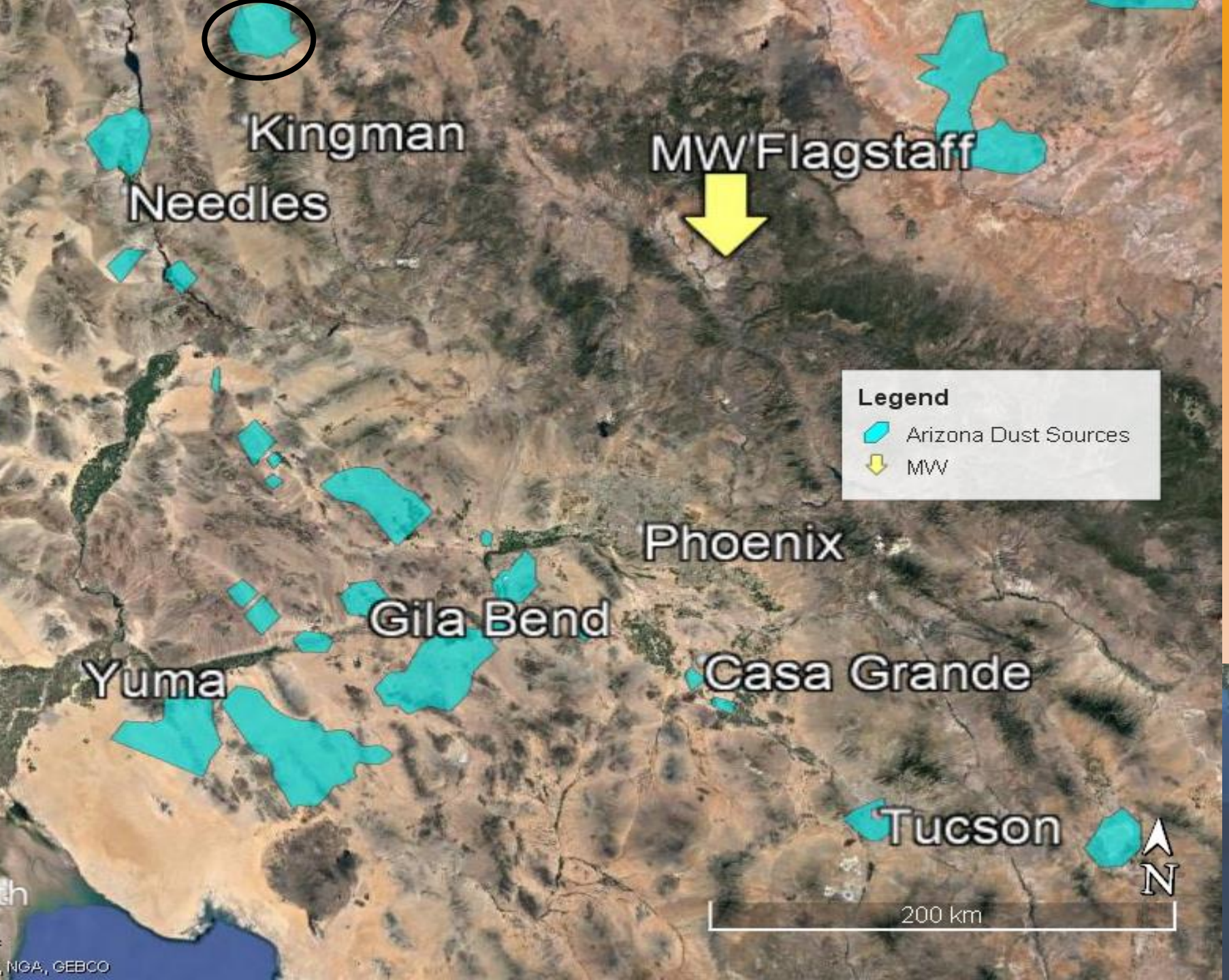

PL-03


Silt-loam Gila River Terrace
Sandy-loam Gila River Terrace
Silt-loam Gila River Terrace
Alluvial Fan
Google Earth
© 2020 Google
2 km
N

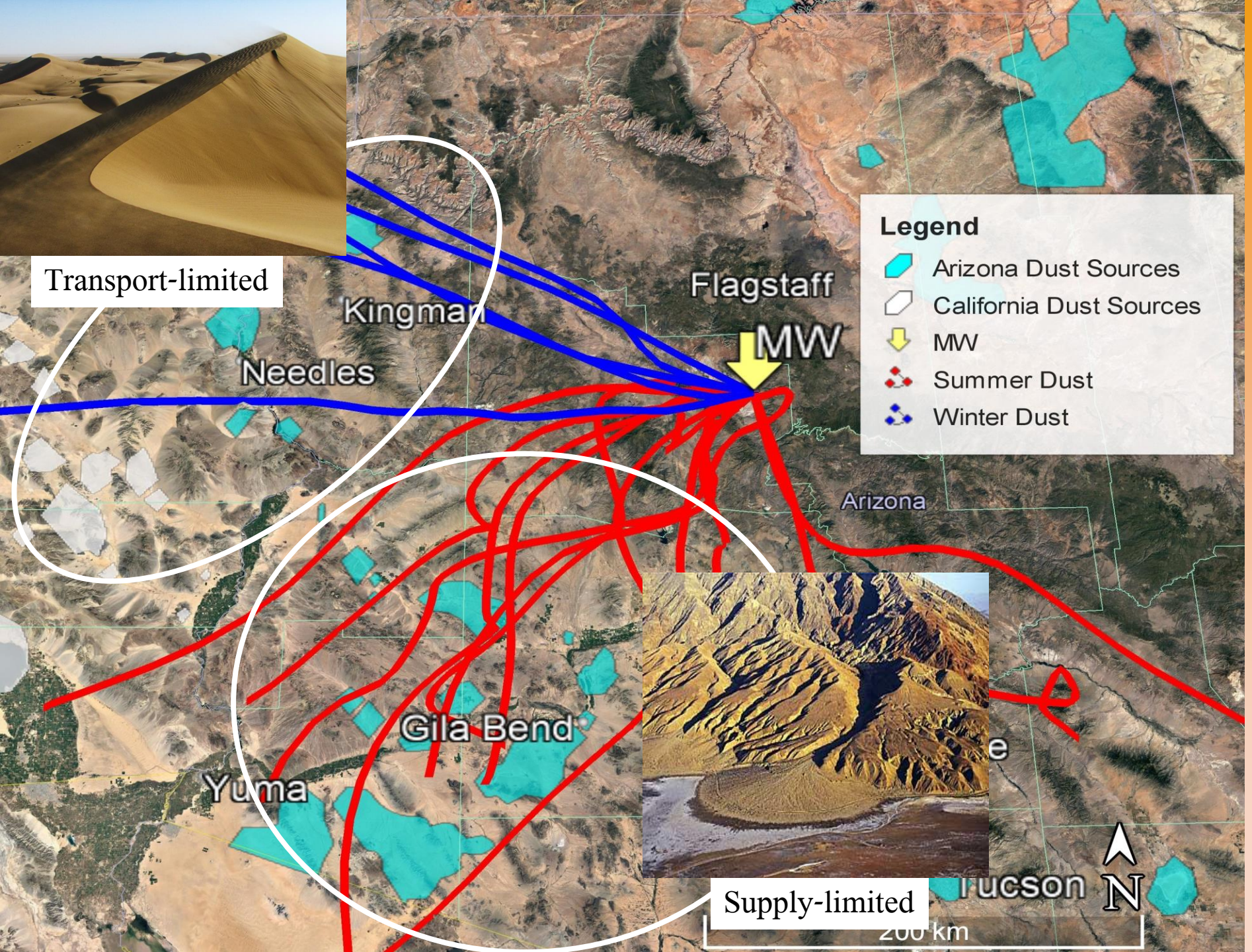
Results

Active dust sources

Playa




Google Earth
© 2020 Google
10 km
N



Results

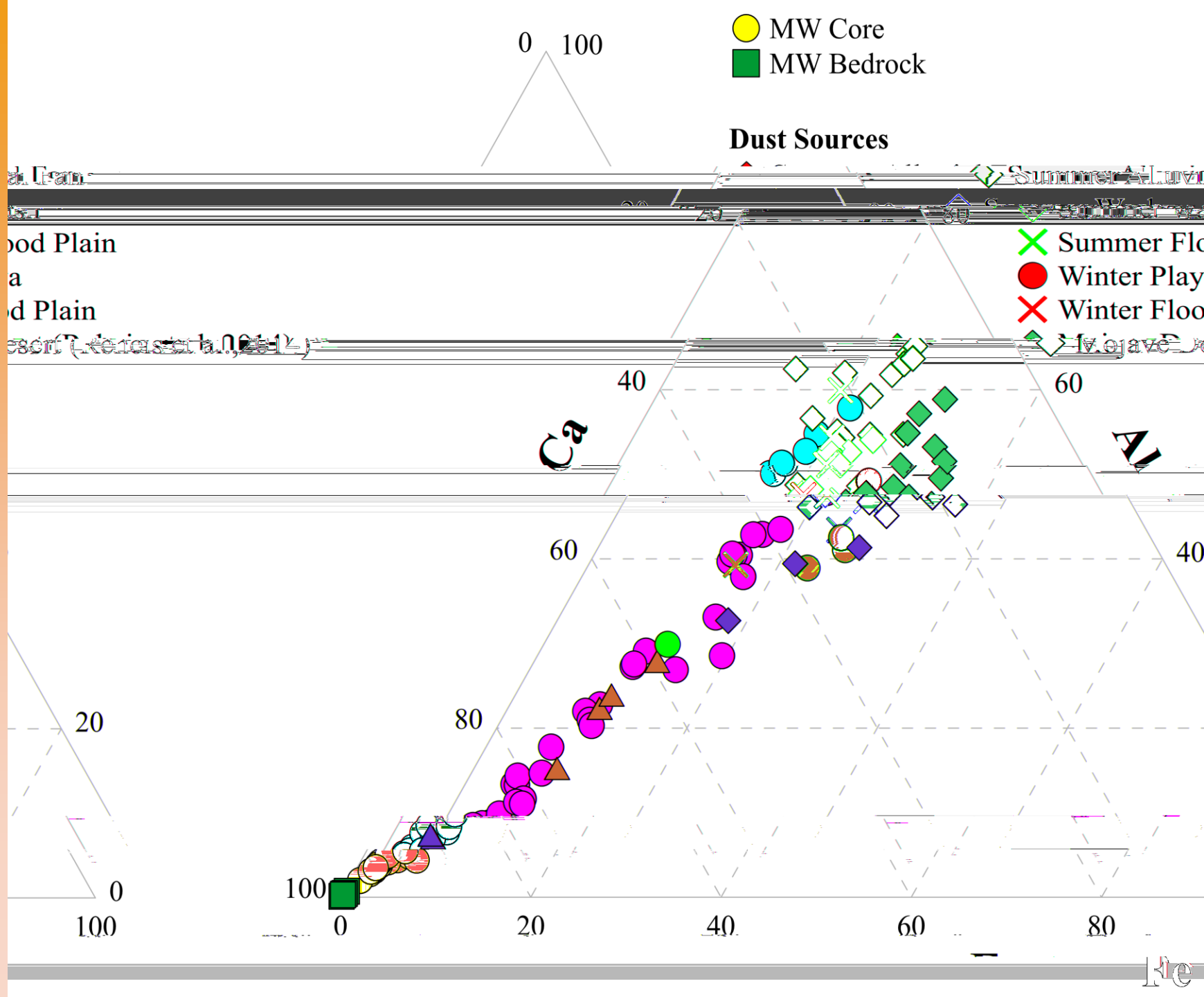
Potential dust sources

Results

Major Elements

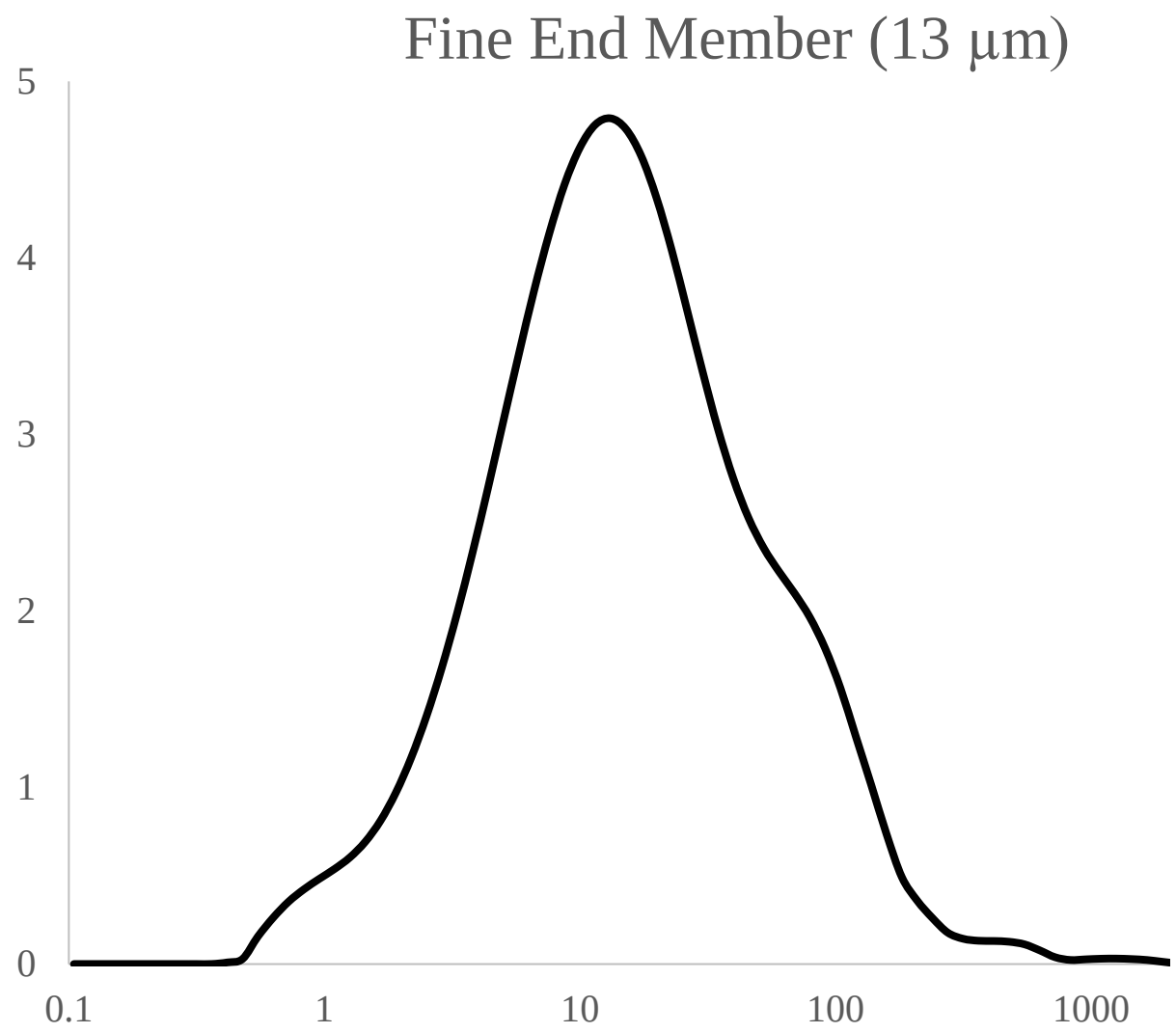
- Major elements triangle diagram reveals that MZW samples are mixed between two end members, the local bedrock and Arizona dust sources. Dust sources have high Al values; thus, Al-based dust flux was calculated.

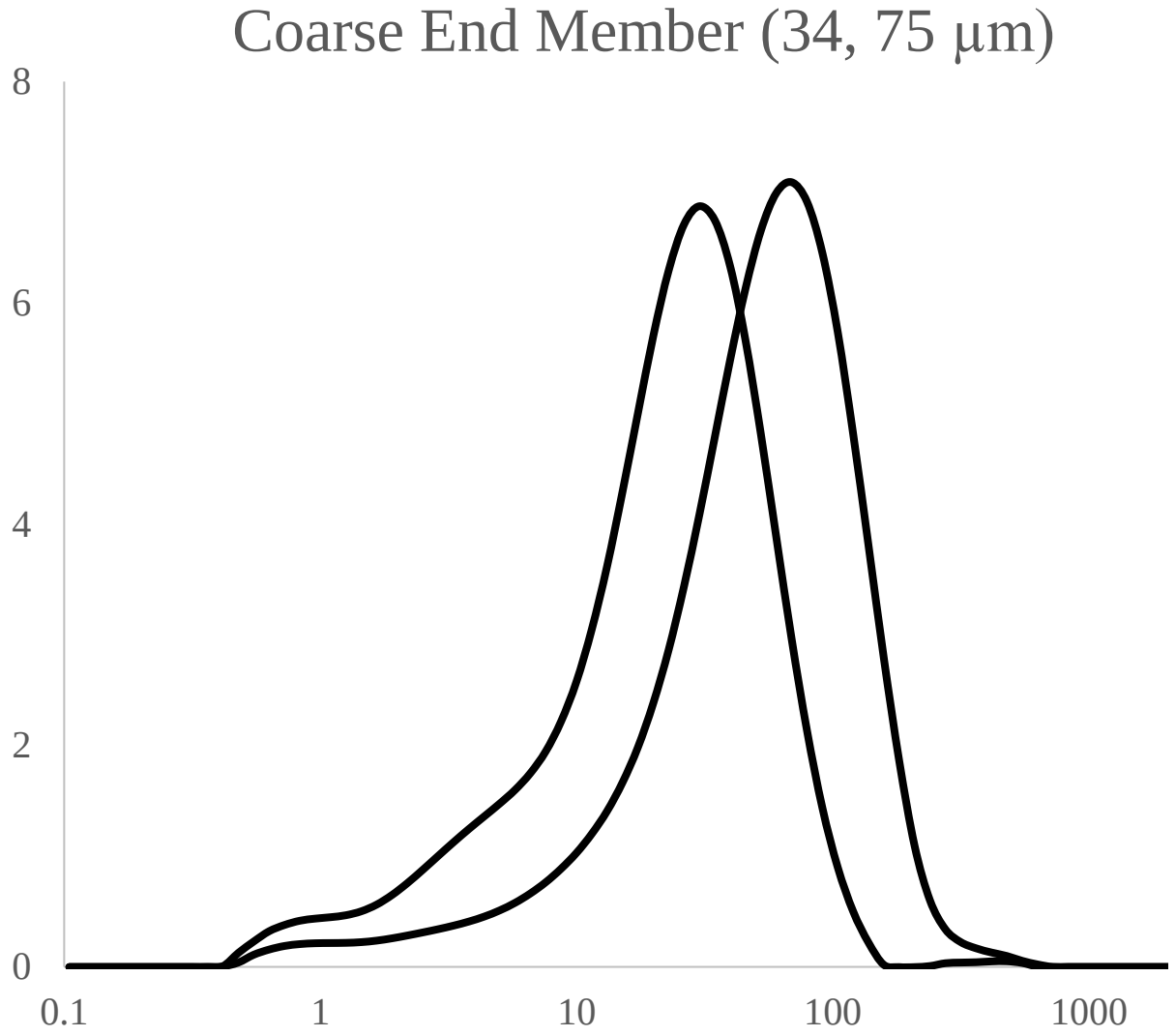
- Mojave Desert values were taken from Reheis et al., 2009.



Results

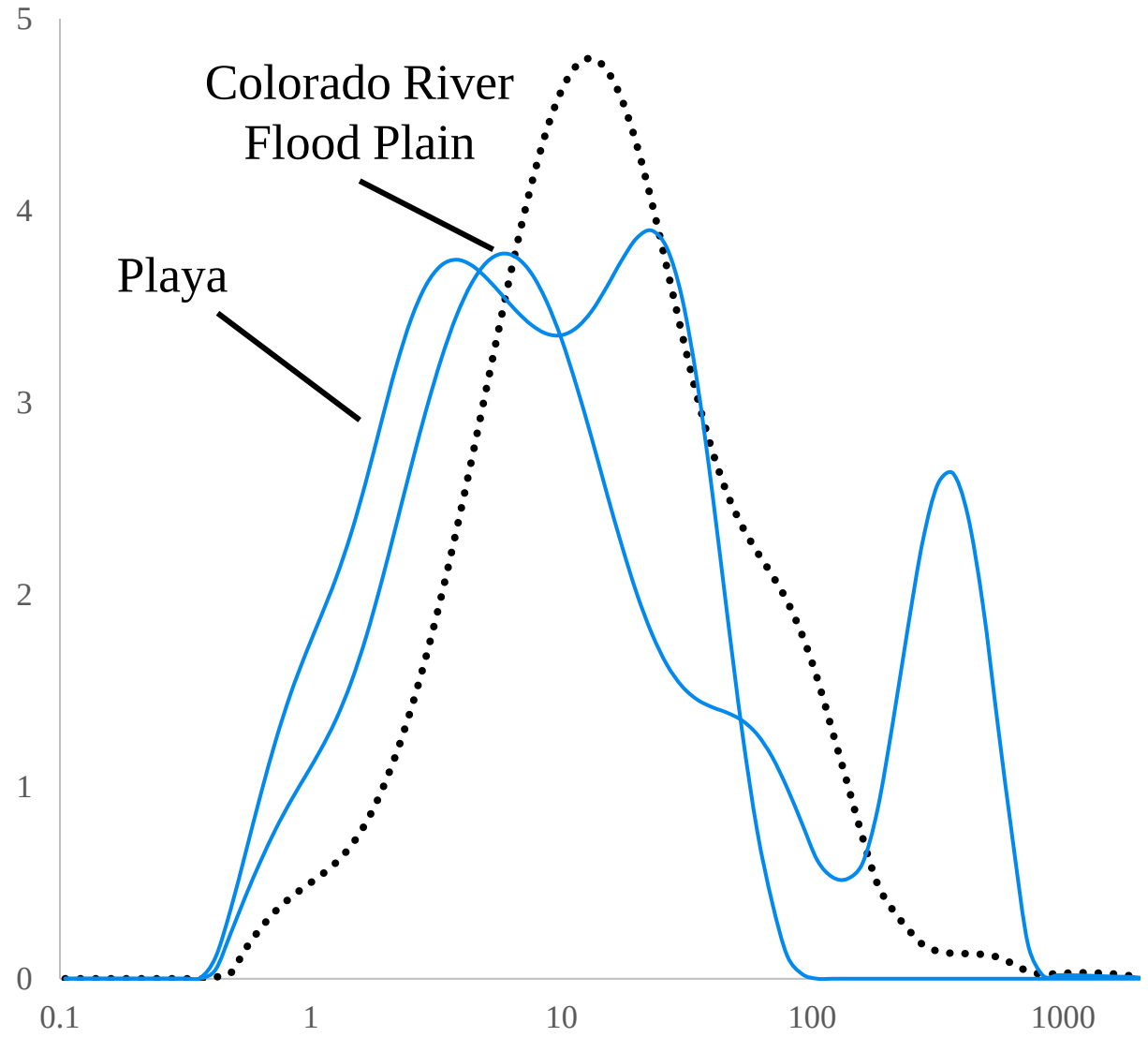
Grain Size End Member (EM) Modeling Analysis

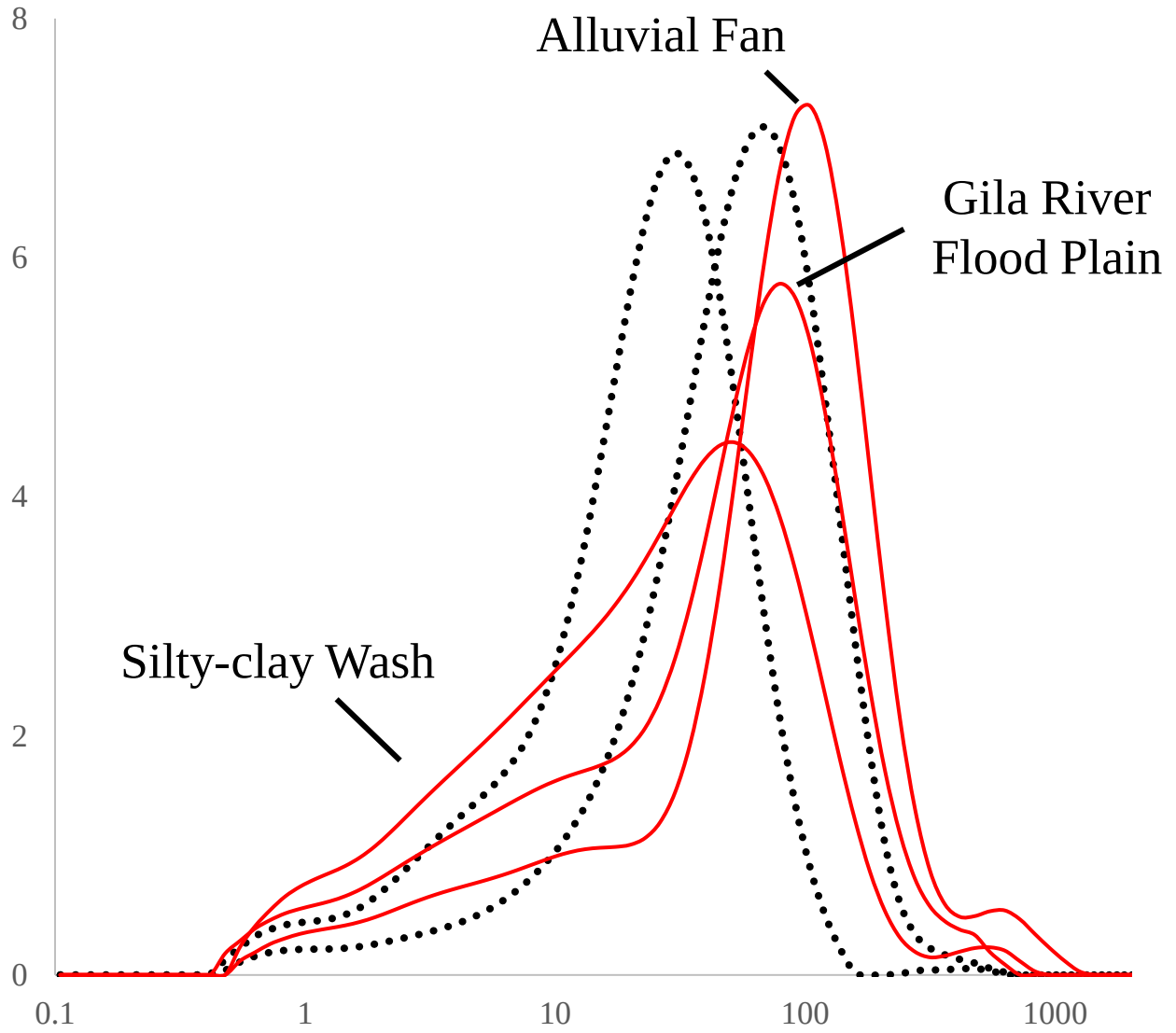


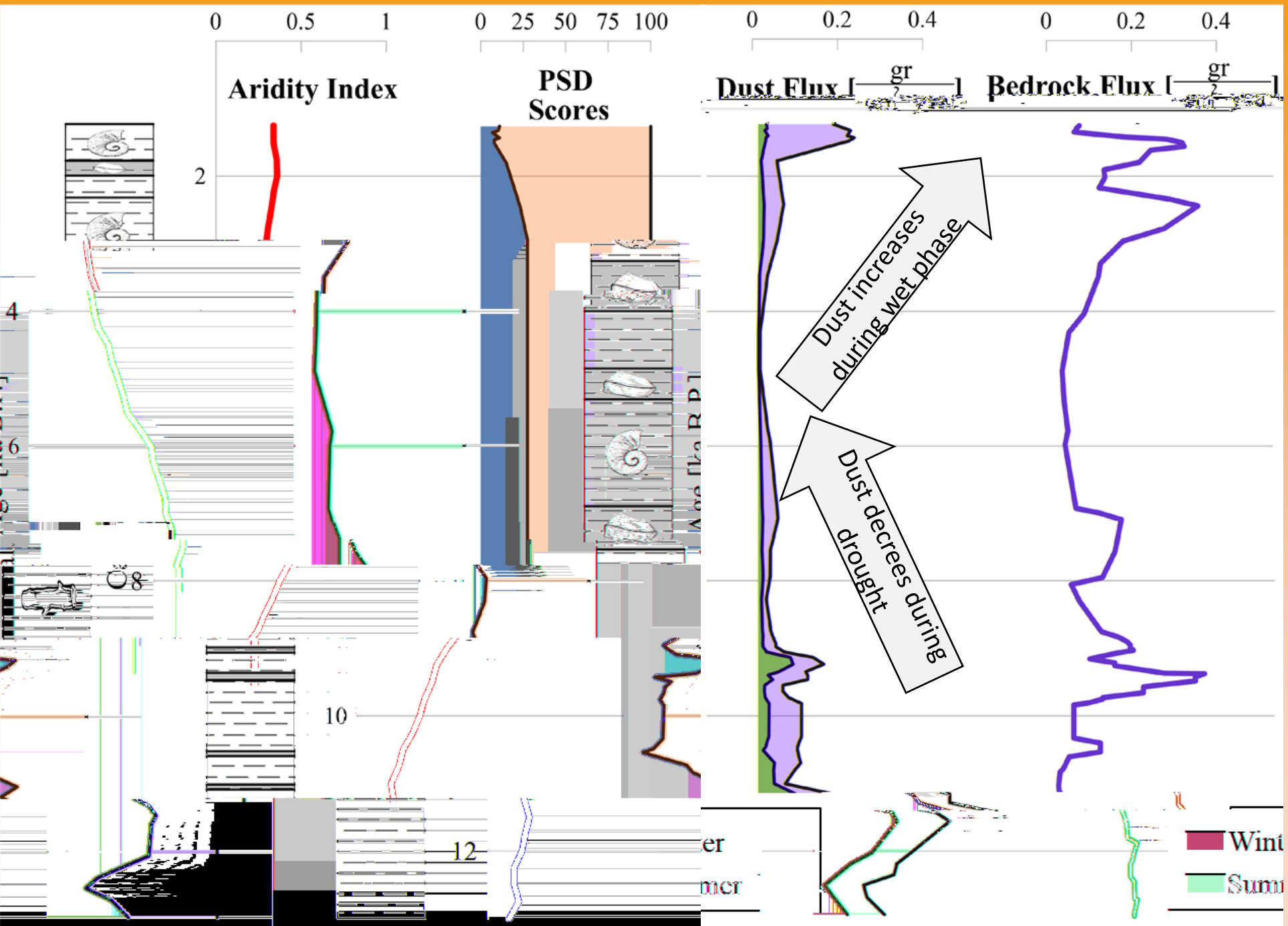


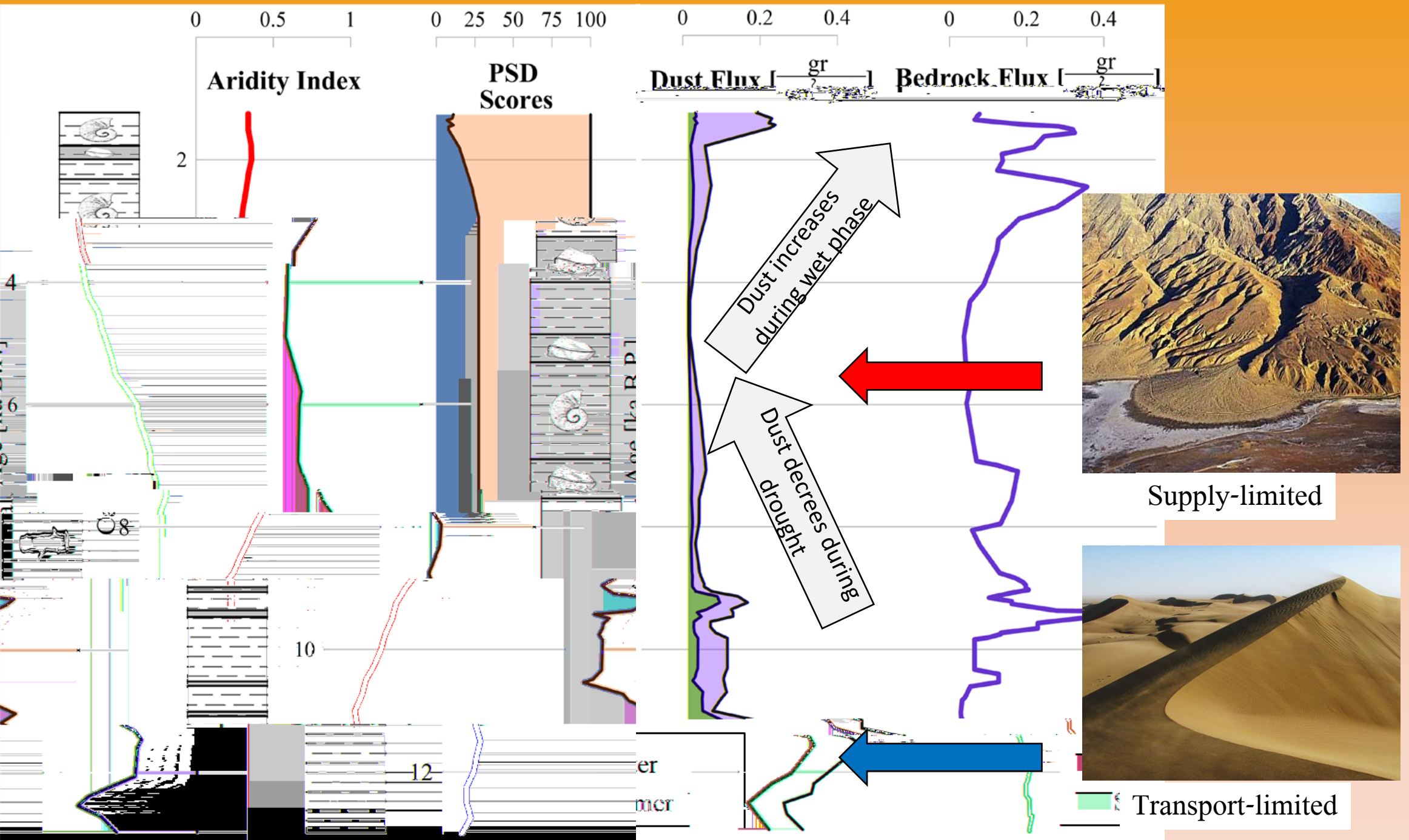
Results

Grain Size End Member (EM) Modeling Analysis






0
0.5
1
Aridity Index
0
25
50
75
100
PSD
Scores
0
0.2
0.4
Dust Flux [gr/m²]
0
0.2
0.4
Bedrock Flux [gr/m²]
2
4
6
8
10
12
Dust increases during wet phase
Dust decrees during drought
Wint
Sum


0
0.5
1
Aridity Index
0
25
50
75
100
PSD Scores
0
0.2
0.4
Dust Flux [gr/m²]
0
0.2
0.4
Bedrock Flux [gr/m²]
2
4
6
8
10
12
Dust increases during wet phase
Dust decrees during drought
Supply-limited
Transport-limited

Conclusions

- The current dust sources of Arizona were identified and studied, reviling summer coarse dust arriving from the Sonoran Desert and fine winter dust from the Mojave Desert.

- Arizona's dust-cycle is controlled by the characteristics of dust sources (i.e., supply-limited and transport-limited) and climate change (humid/drought).

- Dust flux was found to be minimal during arid periods of the Holocene


Questions?