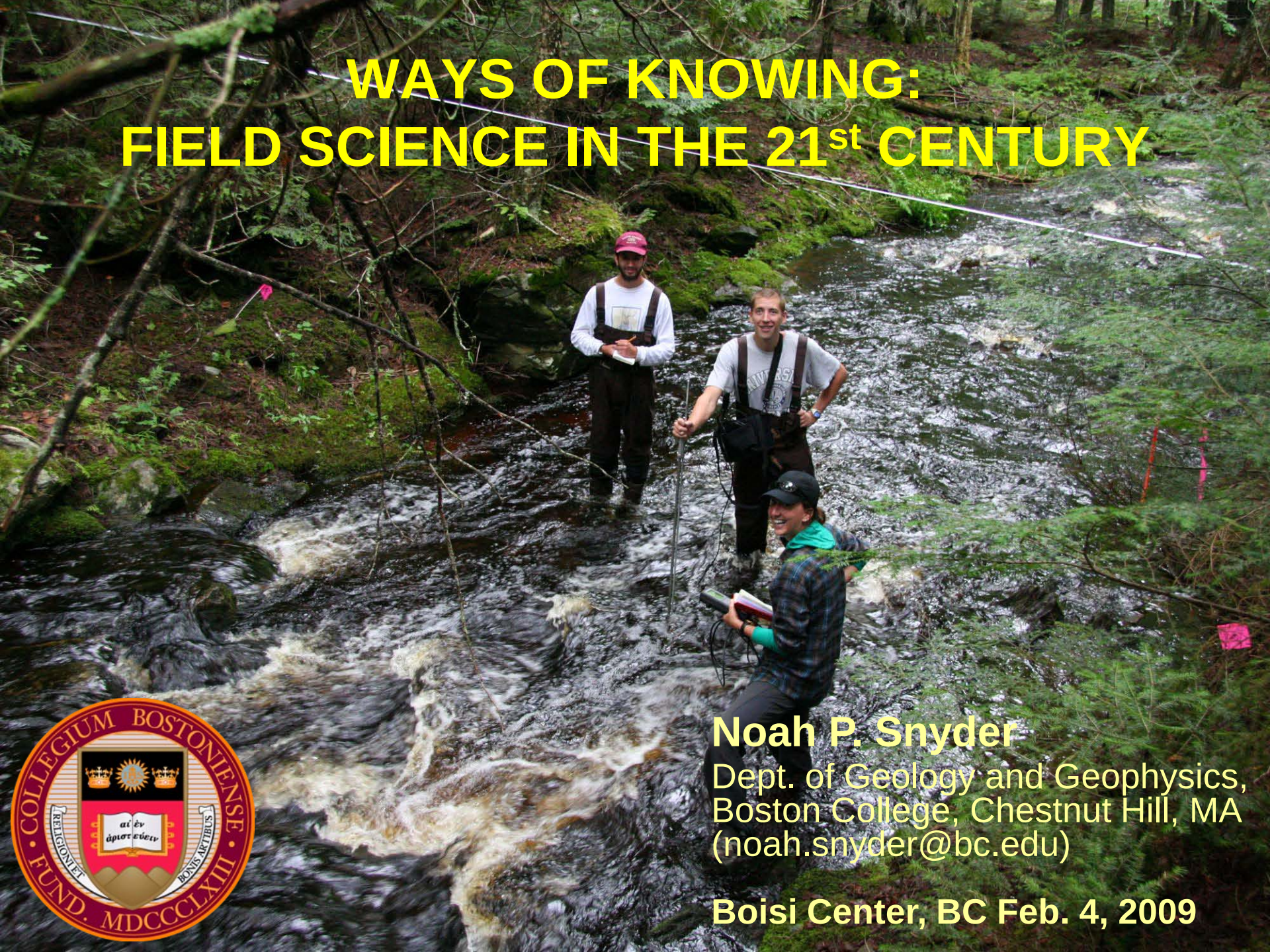
WAYS OF KNOWING: FIELD SCIENCE IN THE 21st CENTURY



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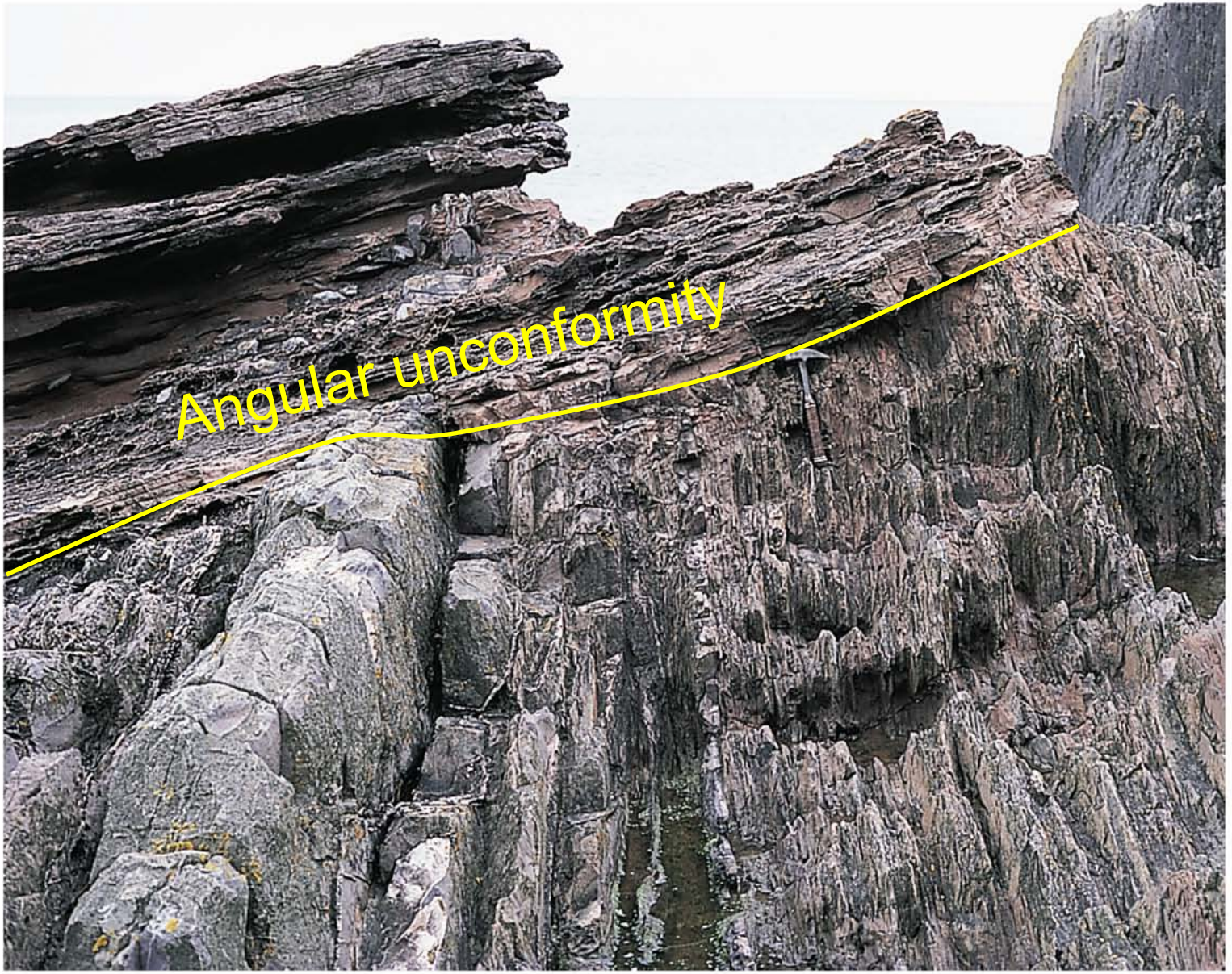
Boisi Center, BC Feb. 4, 2009

Talk outline

1. Classic field observations in geology
2. Scales of topographic mapping
3. Field measurements of channel width in northern California streams
4. Diversion into Gower Gulch, Death Valley, California

The Geologist,

Carl Spitzweg,
19th century



(a)

FIGURE 12.8 Siccar Point, Scotland

Formation of an angular conformity

(James Hutton, *Theory of the Earth*, 1785)

(Raeburn, ca. 1798, Scottish National Portrait Gallery)

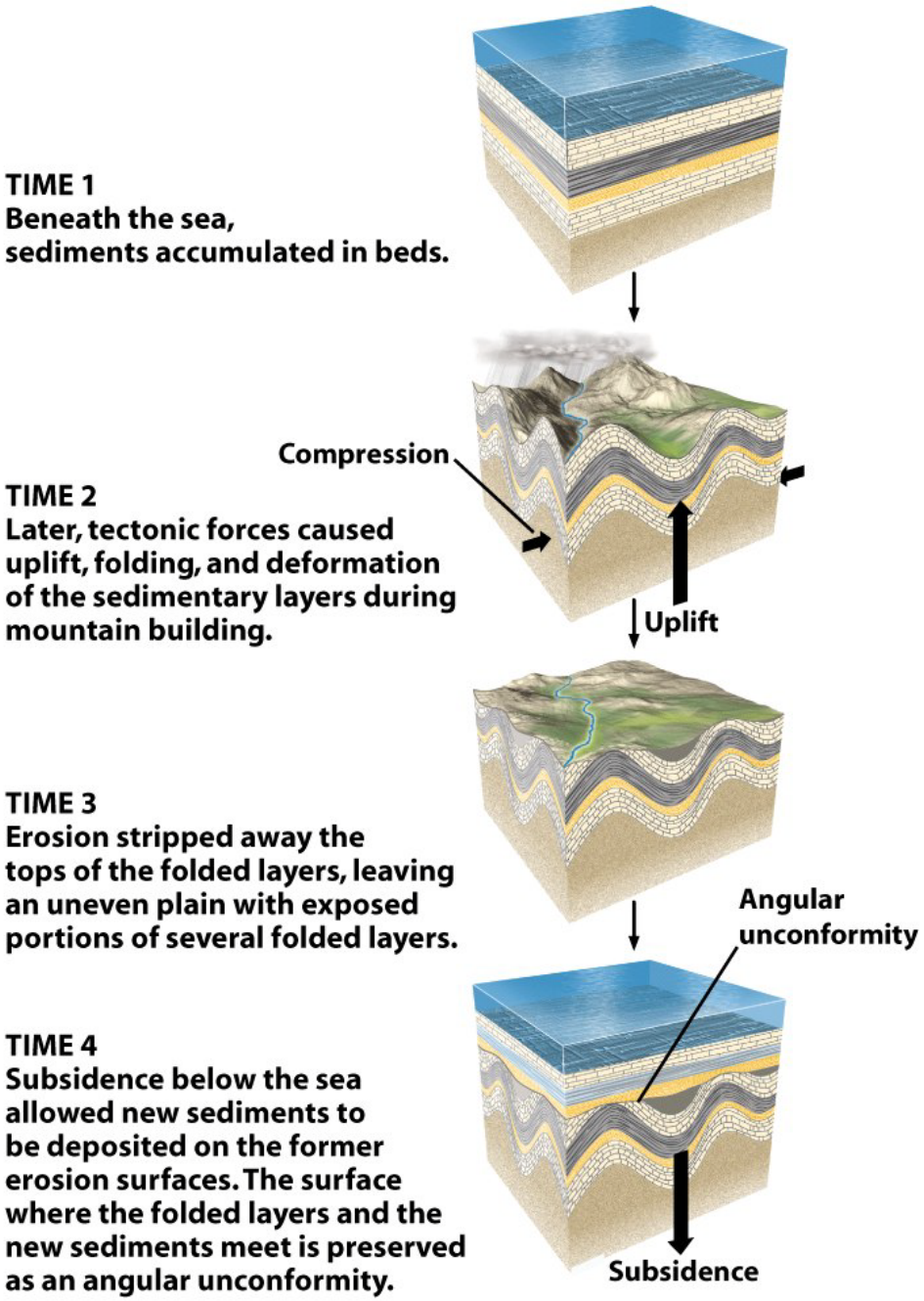


Figure 8-8
Understanding Earth, Fifth Edition


Canyon Diablo Meteorite,
4.55 billion years old
(U-Pb dating by
Patterson, 1956)
(Notkin, 2006)

The Great Unconformity, Grand Canyon (May 2003)

Bora Bora atoll, South Pacific Ocean

Un figure pg 124
Understanding Earth, Fifth Edition

HMS Beagle (Stanley, 1841)

Formation of coral atolls

(Charles Darwin, *The Structure and Distribution of Coral Reefs*, 1842)

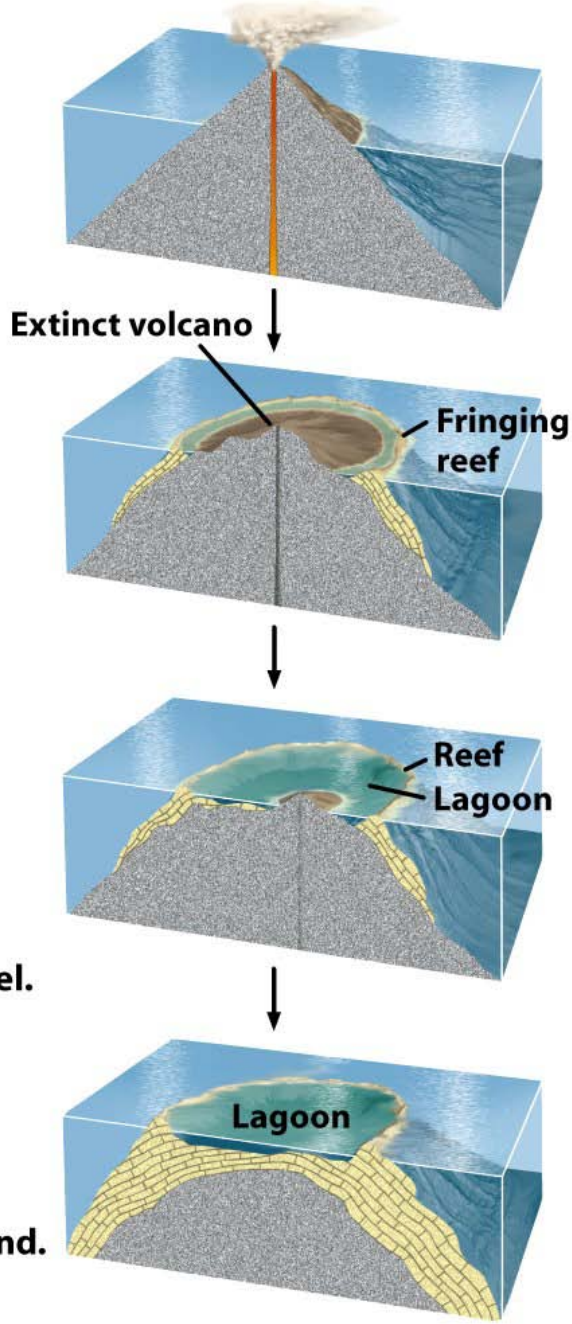
(Richmond, 1830s)

STAGE 1
A volcano rises from ocean floor.

STAGE 2
The volcano becomes extinct and erodes. A fringing reef forms.

STAGE 3
The oceanic plate subsides, carrying the volcanic island with it. The reef builds up, keeping pace with rising sea level.

STAGE 4
As subsidence continues, the reef completely covers the buried volcanic island.



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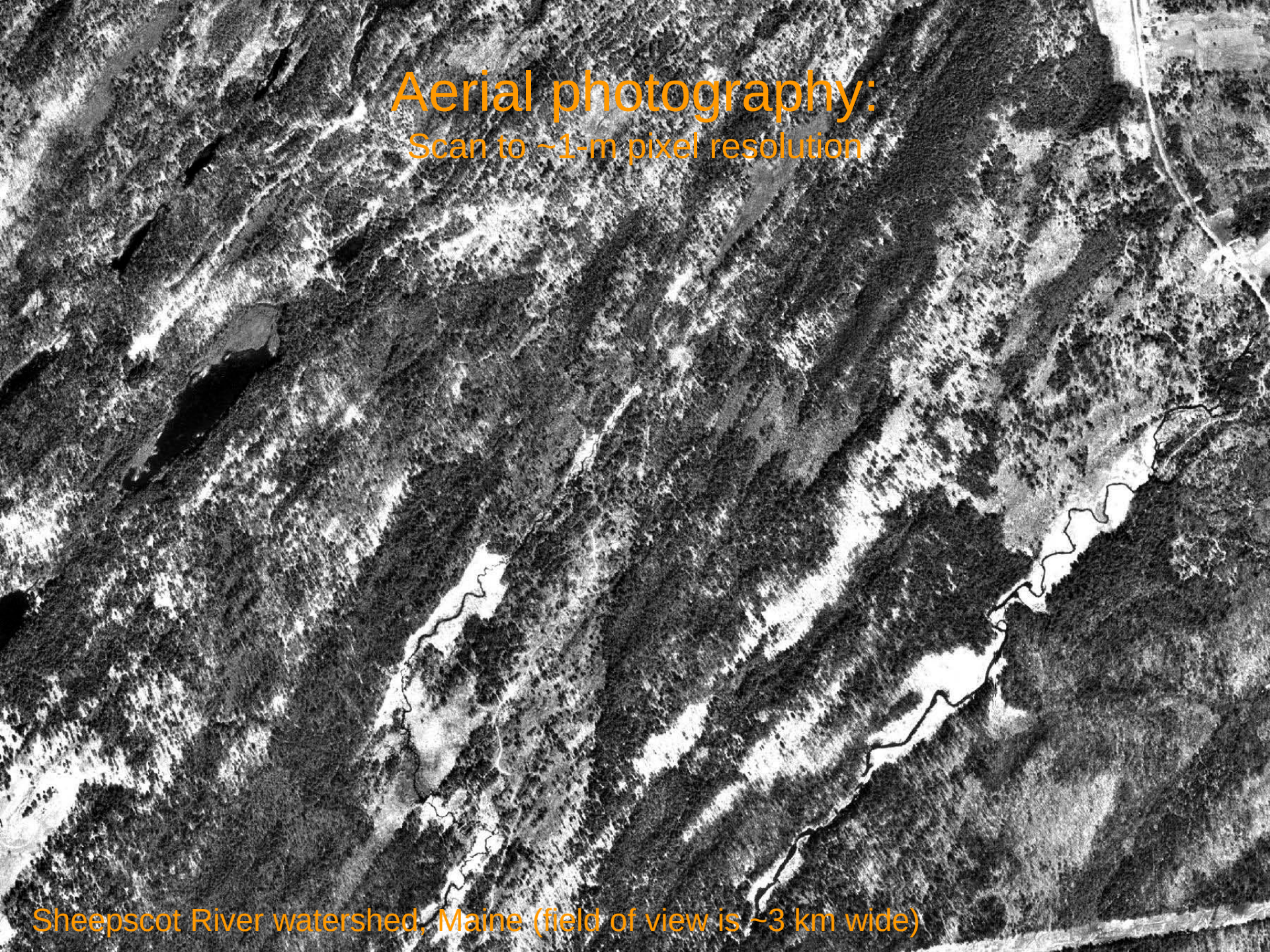
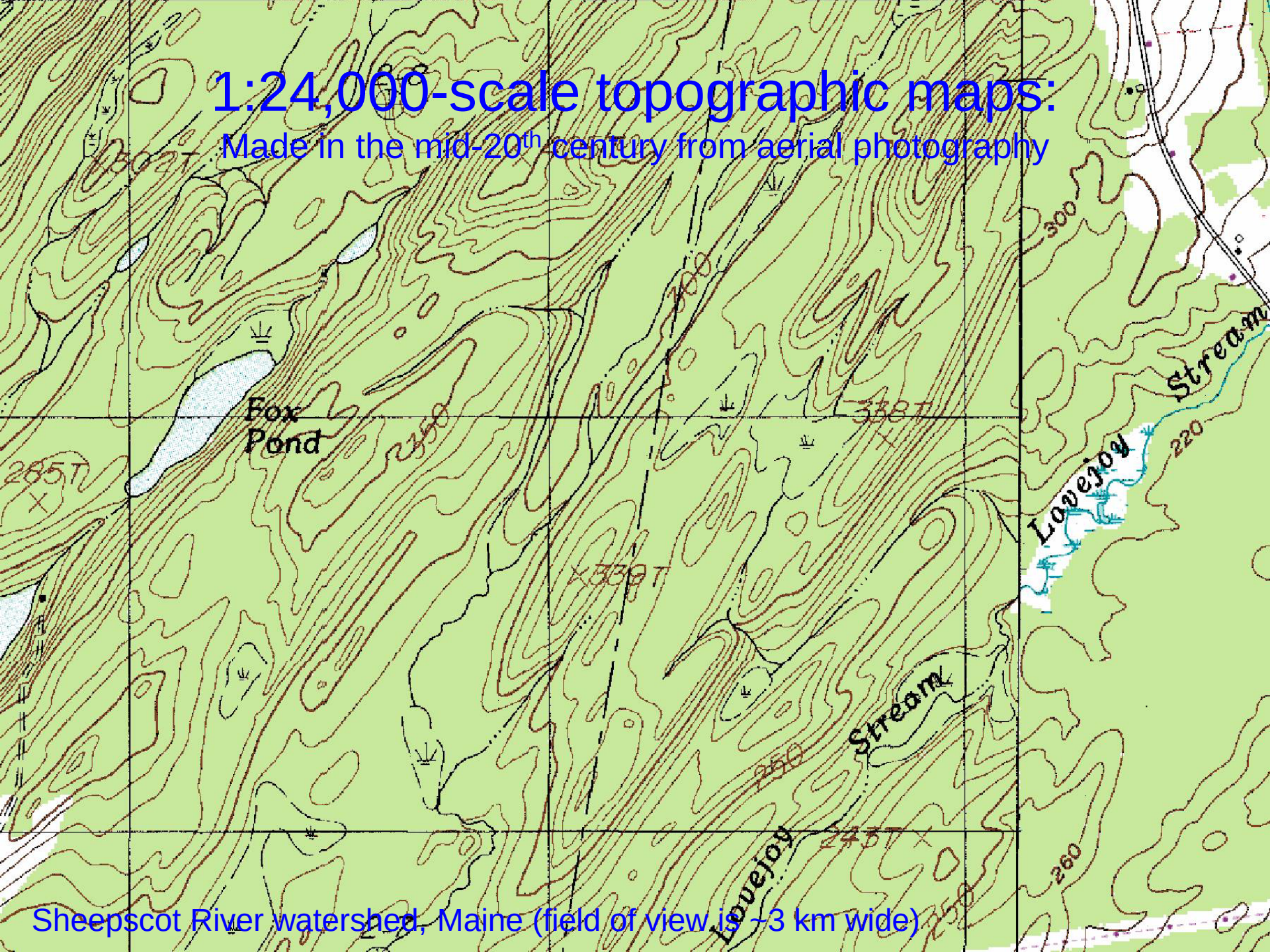
Understanding Earth, Fifth Edition

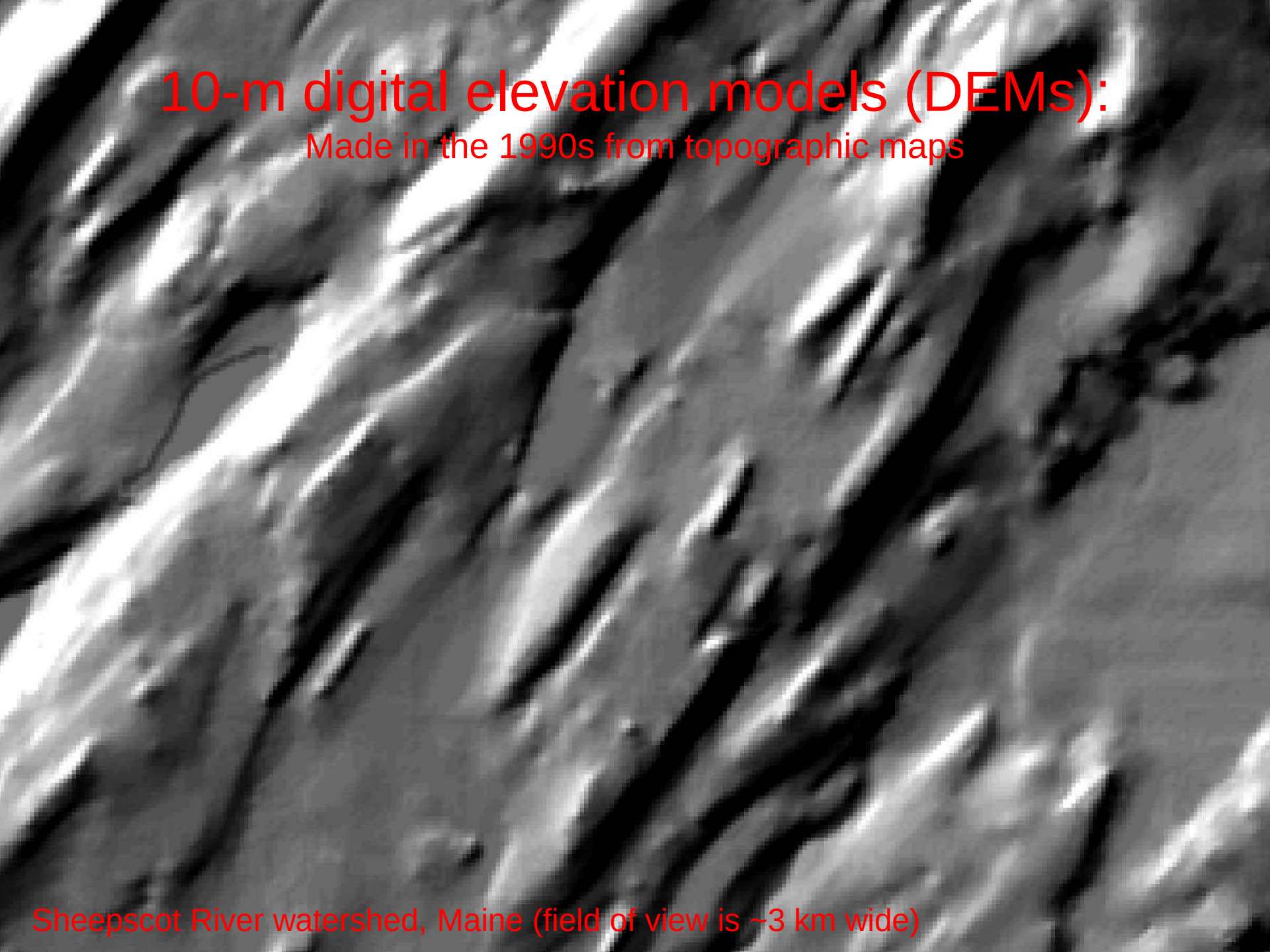
Aerial photography:

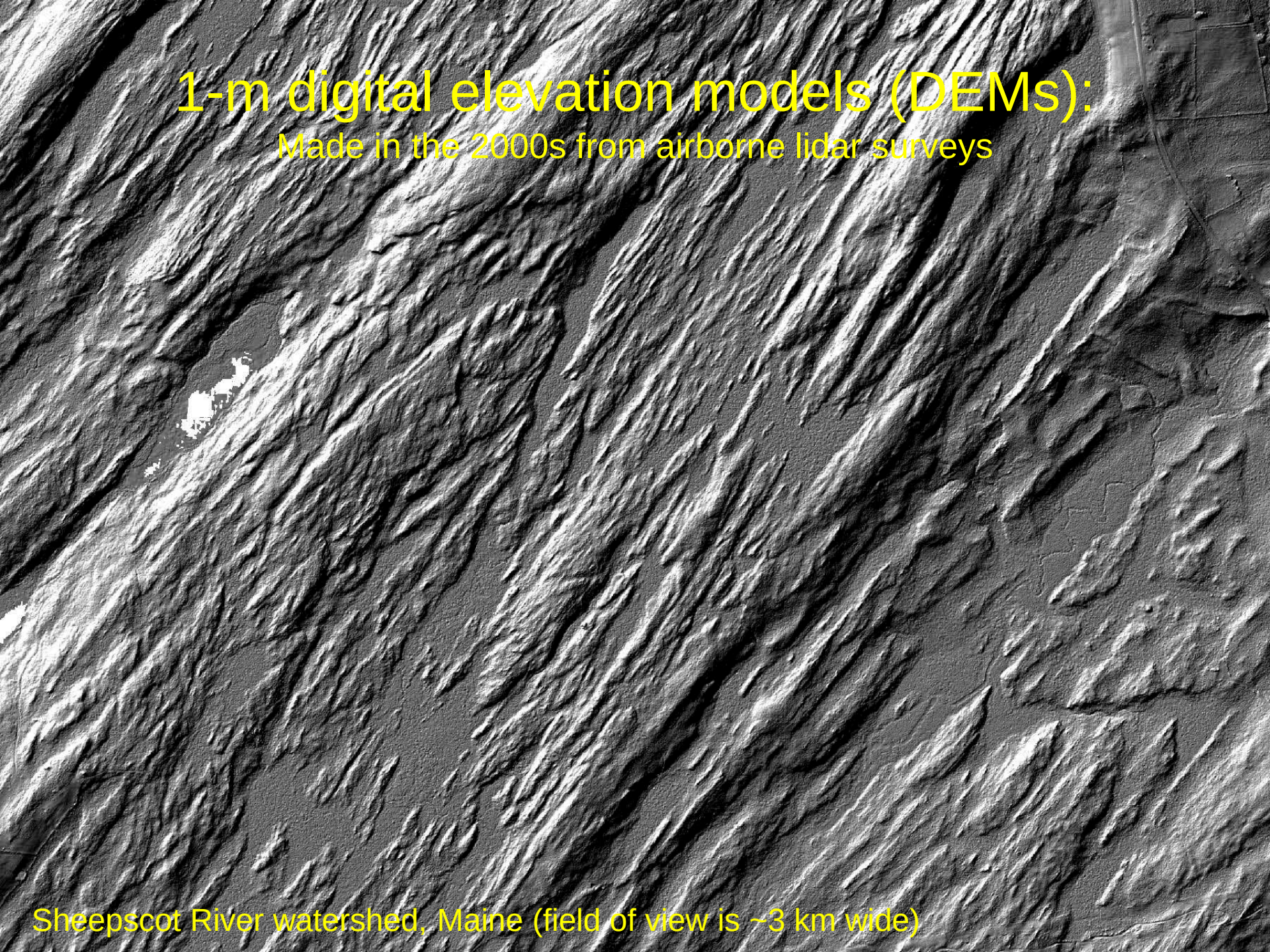
Scan to ~1-m pixel resolution



Sheepscot River watershed, Maine (field of view is ~3 km wide)


1:24,000-scale topographic maps:
Made in the mid-20th century from aerial photography
Fox Pond
Lovejoy Stream
Lovejoy Stream
Sheepscot River watershed, Maine (field of view is ~3 km wide)


10-m digital elevation models (DEMs):
Made in the 1990s from topographic maps
Sheepscot River watershed, Maine (field of view is ~3 km wide)

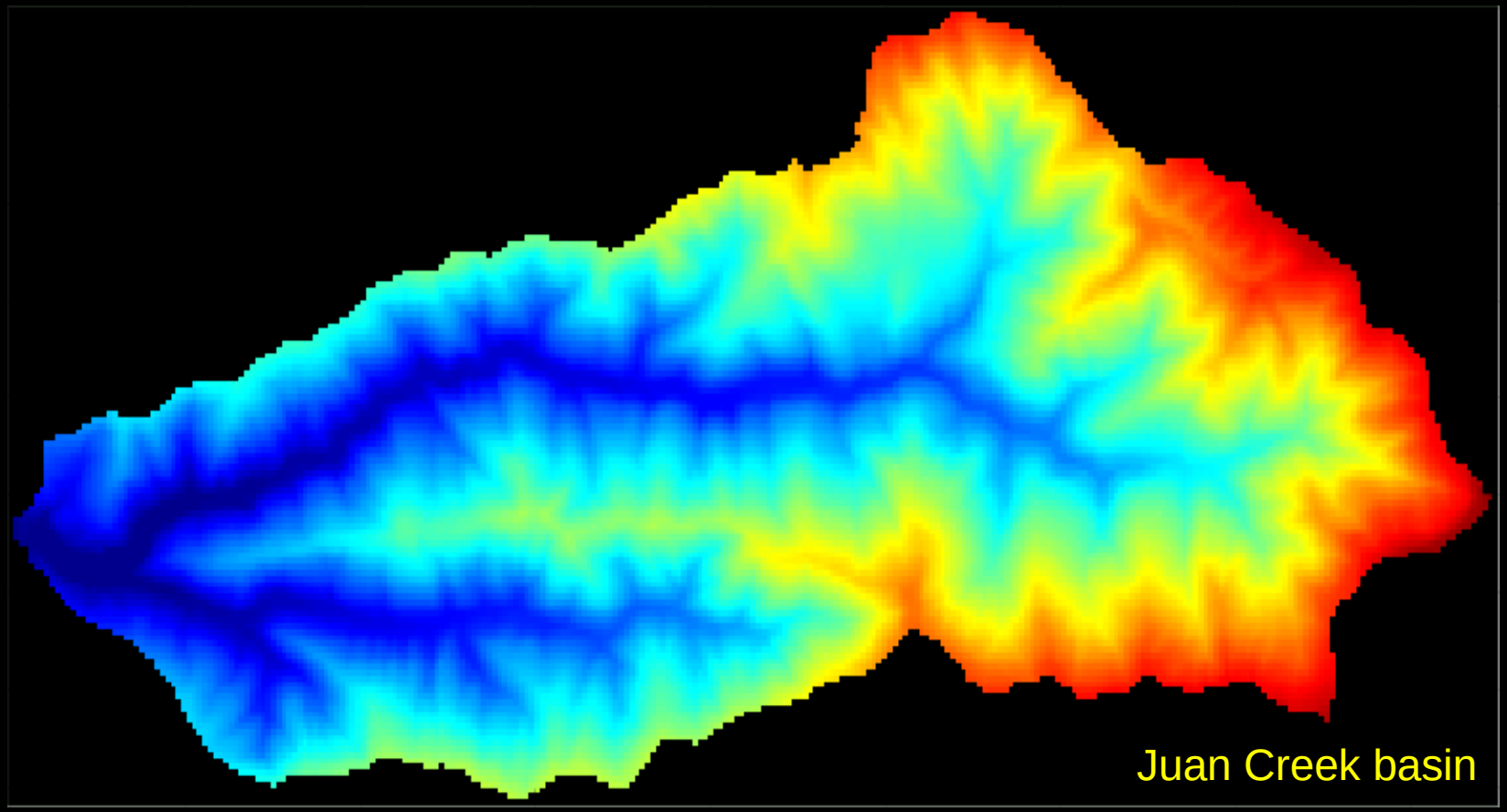

1-m digital elevation models (DEMs):
Made in the 2000s from airborne lidar surveys
Sheepscot River watershed, Maine (field of view is ~3 km wide)

PhD thesis research: Northern California, 1997-2001

Kinsey Creek basin, King Range, northern California (1998)

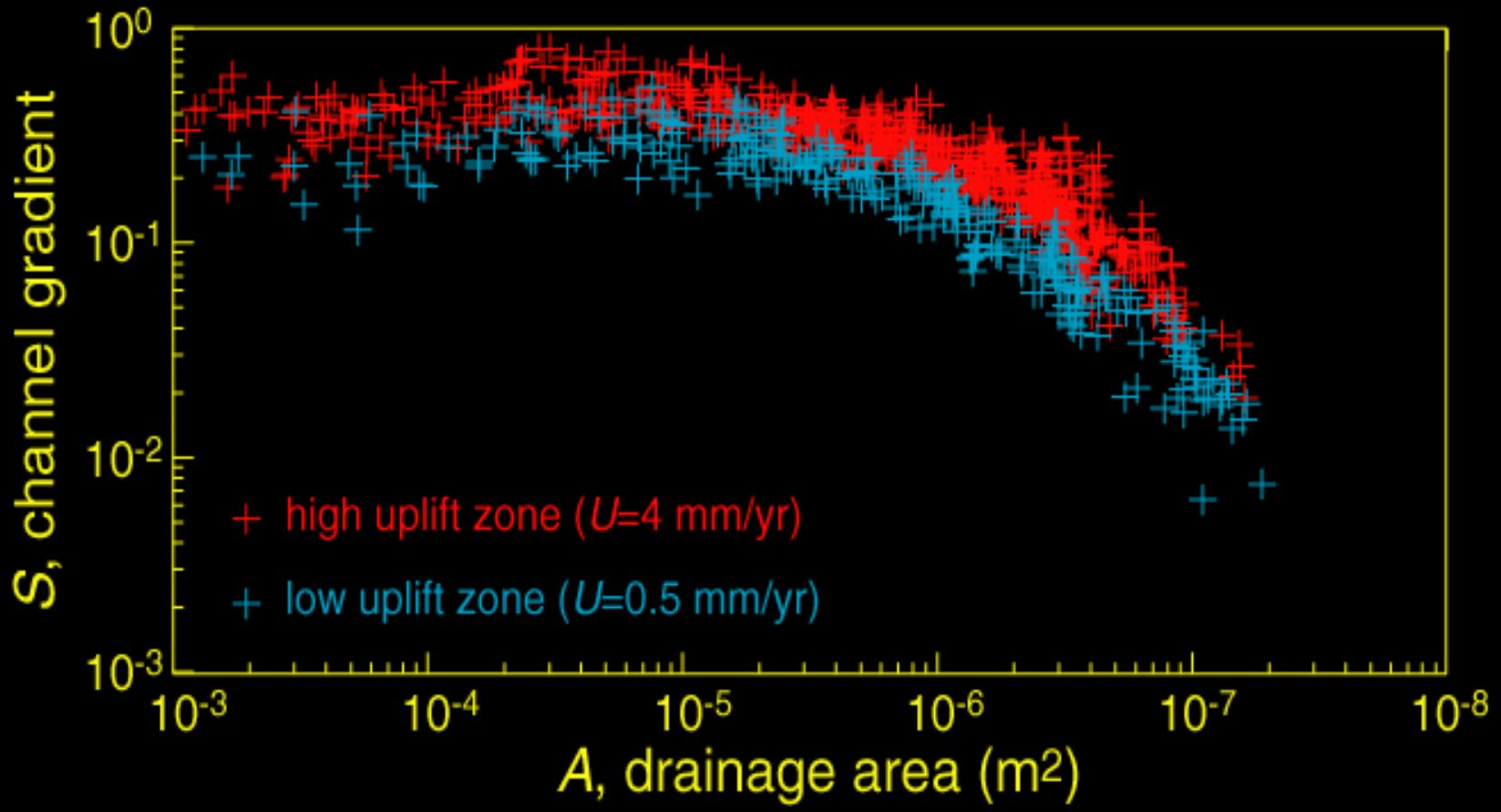
Mendocino triple junction region, northern California

Watershed DEM (30-m pixels)



⇨ **20th-century technology**

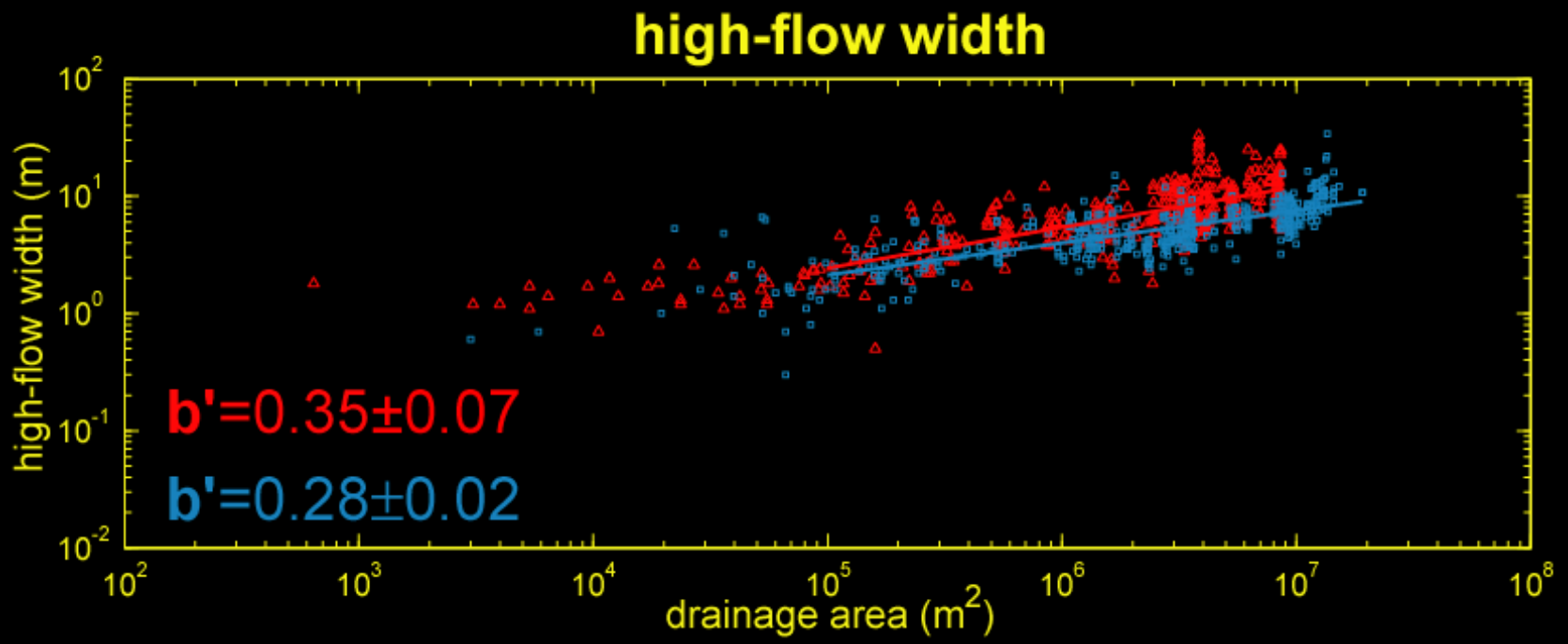
Observation: Streams are twice as steep in response to ~8x difference in uplift rate



Measuring channel width every 50 m along the channel (1999)

High-flow channel width results:

Wider in the high uplift zone!



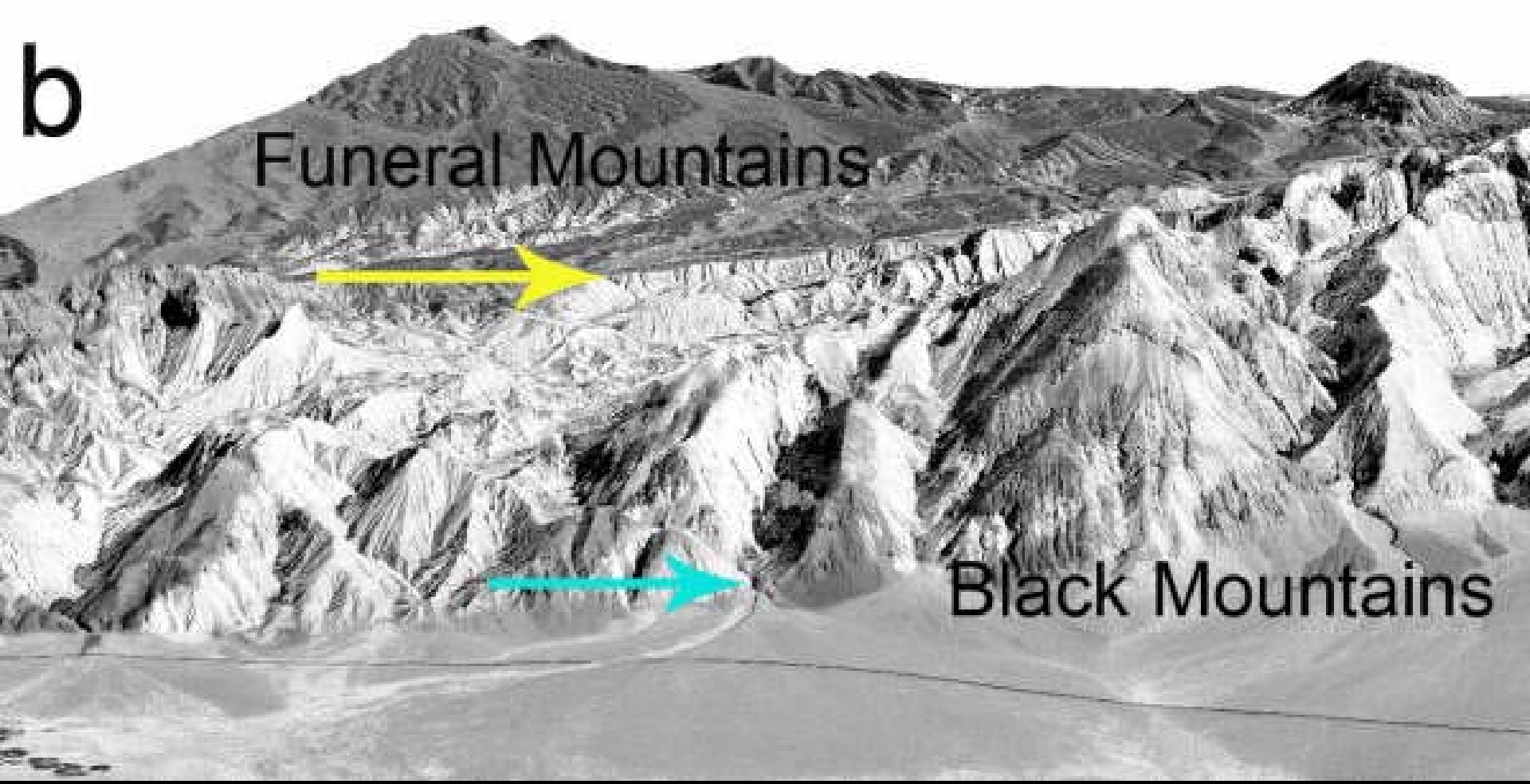
Fill terrace burying logging-cut stump

Juan Creek, northern California (1999)

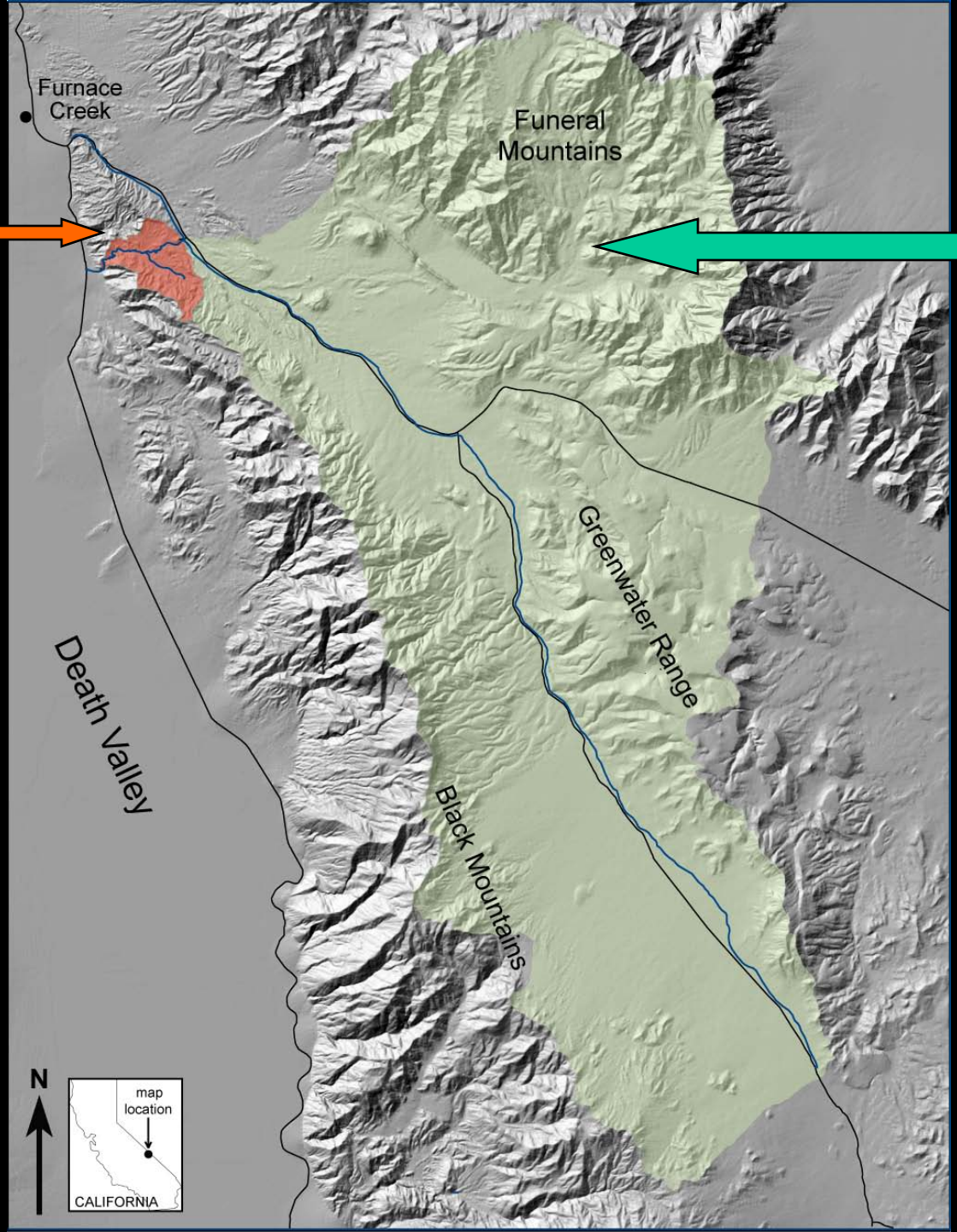
Juan Creek watershed, northern California (1999)

Gower Gulch, Death Valley National Park, CA

(Snyder and Kammer, *Geology*, 2008)



Digital orthrophotograph of eastern Death Valley draped on a digital elevation model

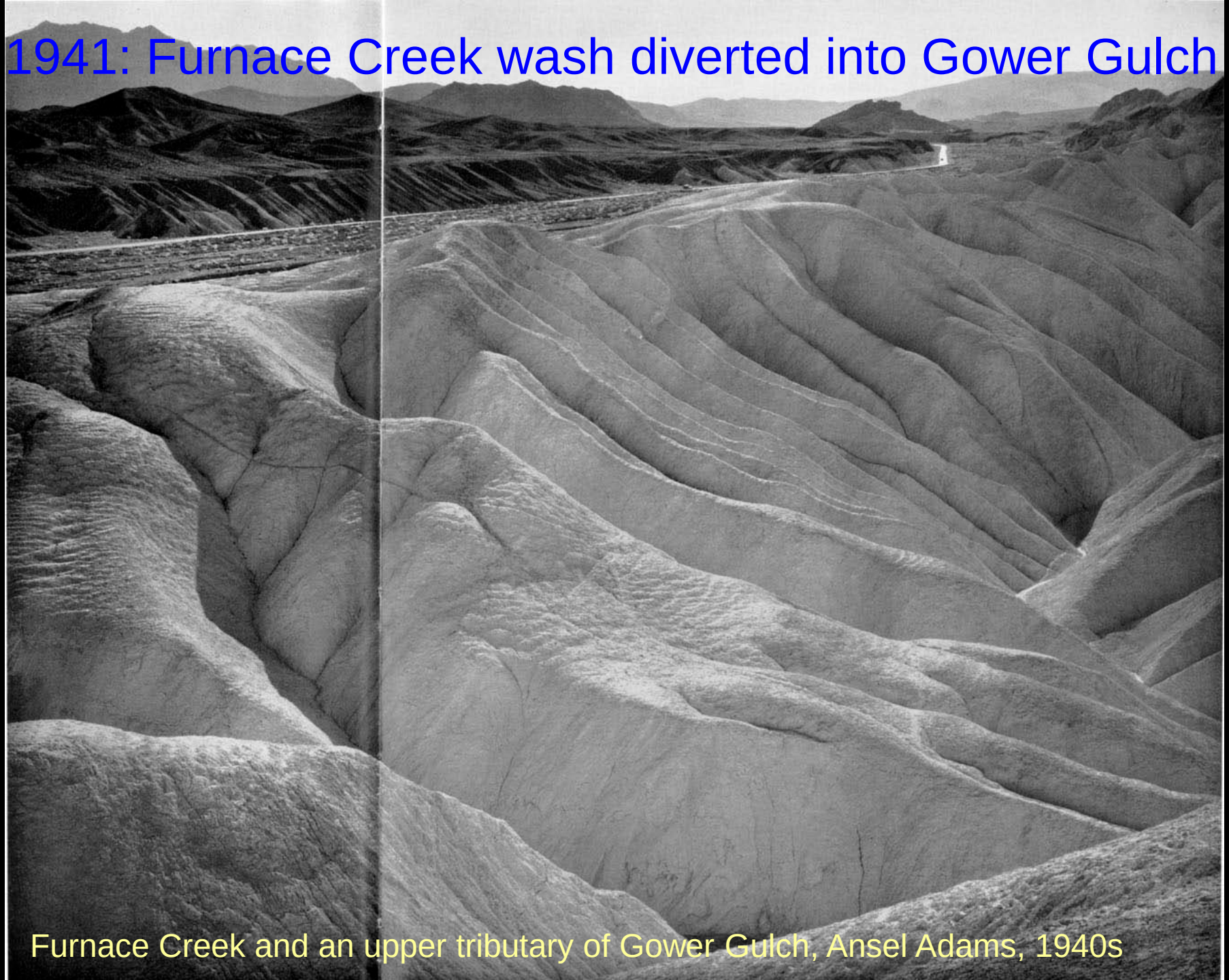


Gower Gulch
(5.8 km^2)

Furnace Creek
(445 km^2)

Base: shaded relief image from 10-m NED DEM

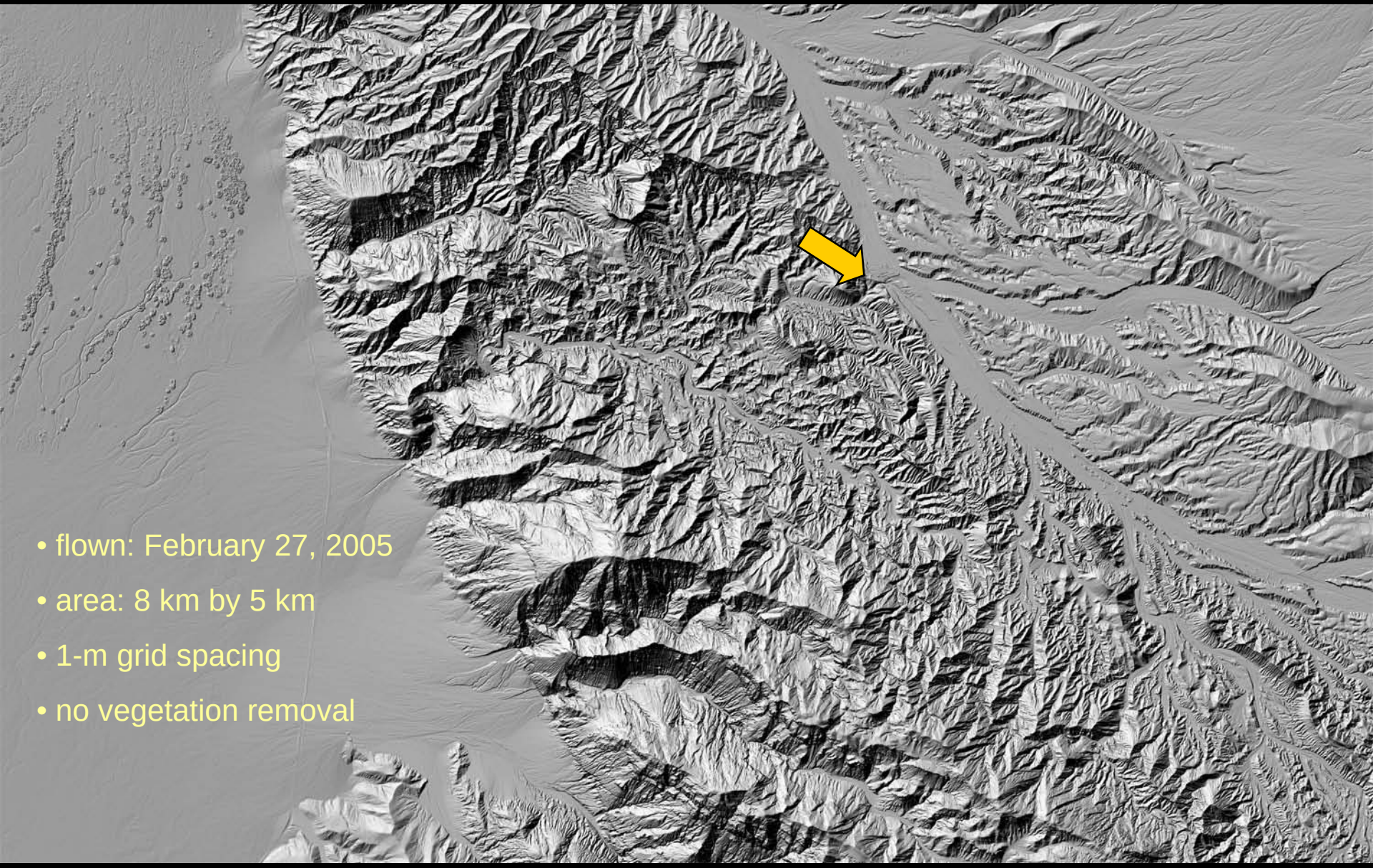
1941: Furnace Creek wash diverted into Gower Gulch



Furnace Creek and an upper tributary of Gower Gulch, Ansel Adams, 1940s

The diversion point (January 2005)

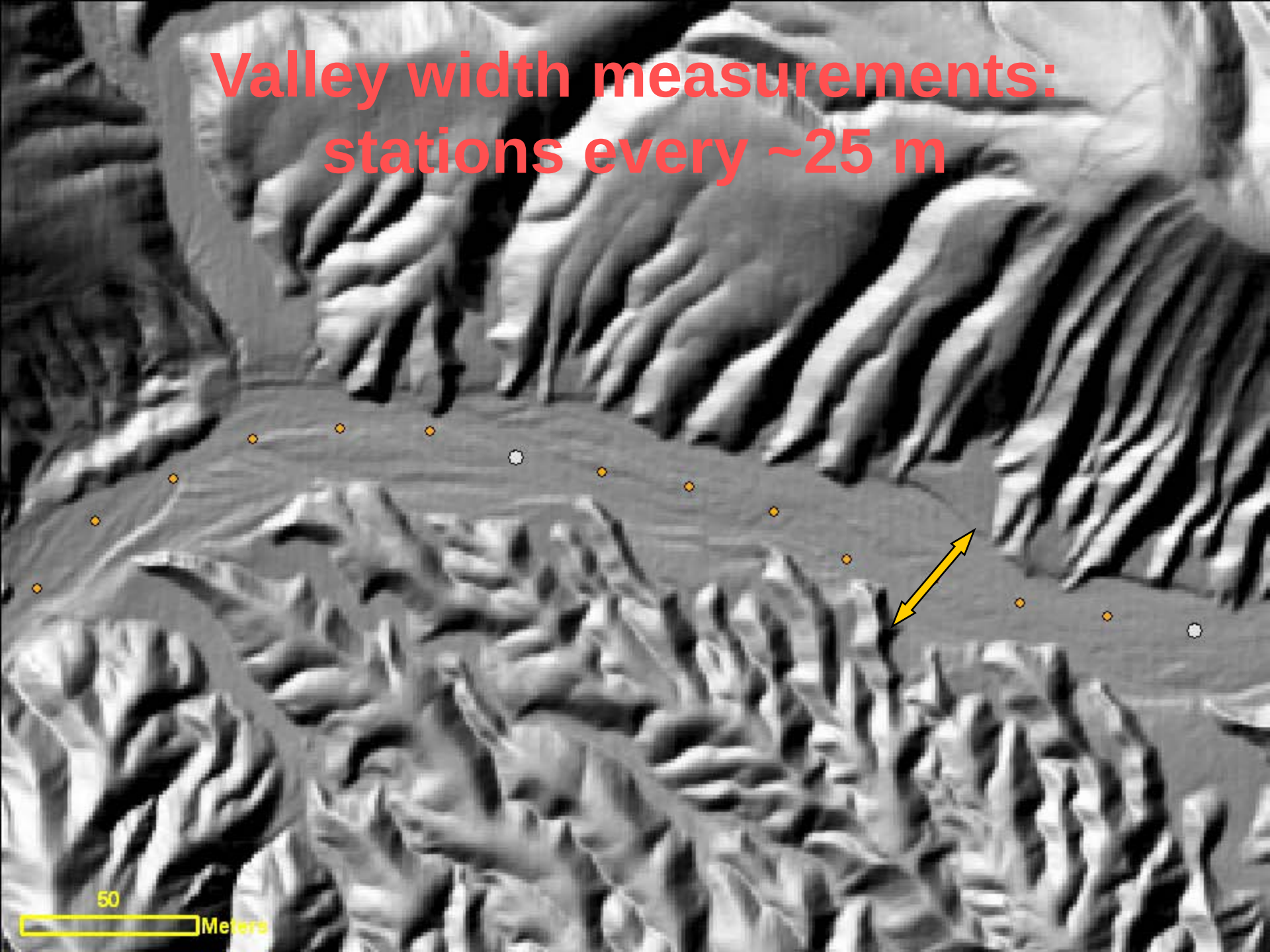
Lidar imagery of Gower Gulch, Death Valley National Park

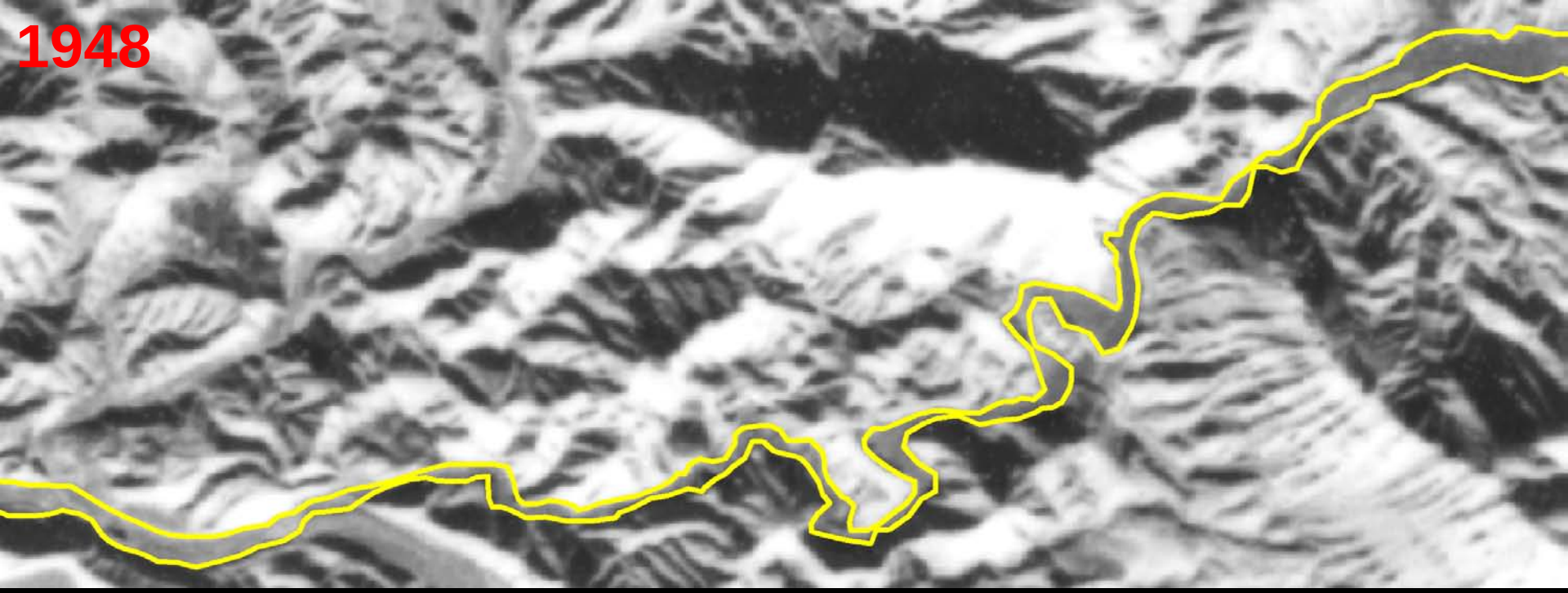


- flown: February 27, 2005
- area: 8 km by 5 km
- 1-m grid spacing
- no vegetation removal

⇨ 21st-century technology

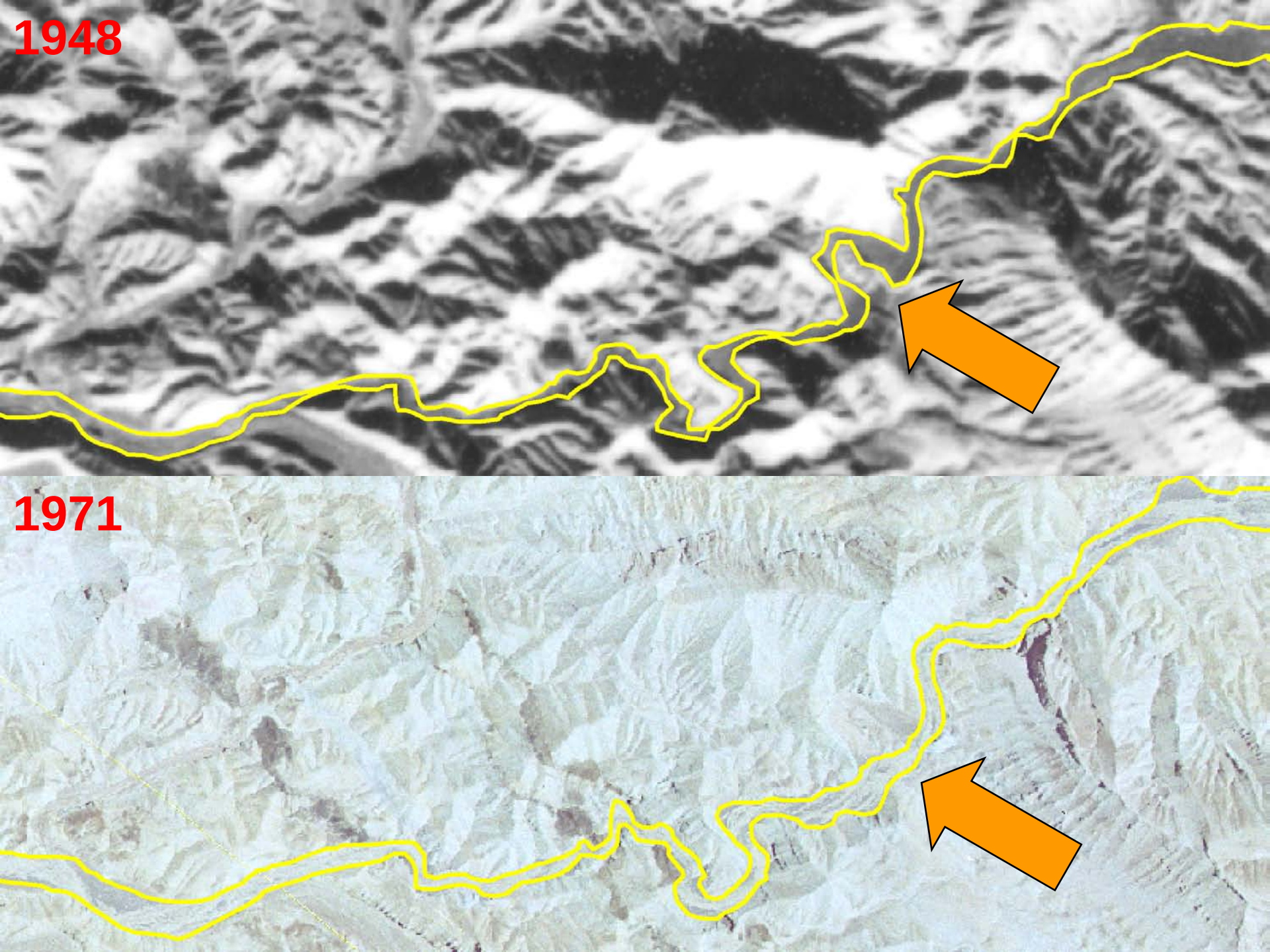
Flood damage, Zabriskie Point parking lot (January 2005)

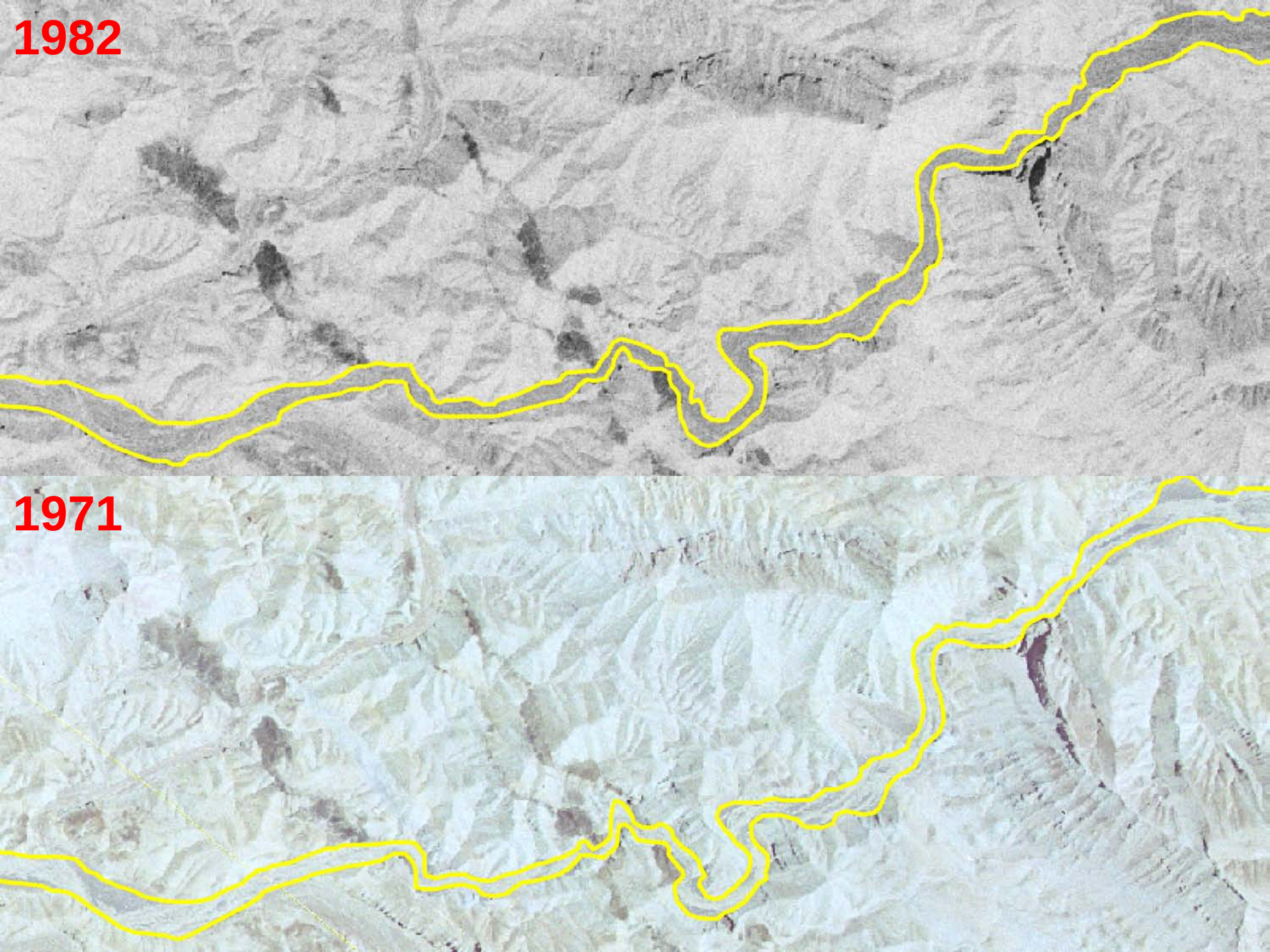

Valley width measurements:
stations every ~25 m
50
Meters

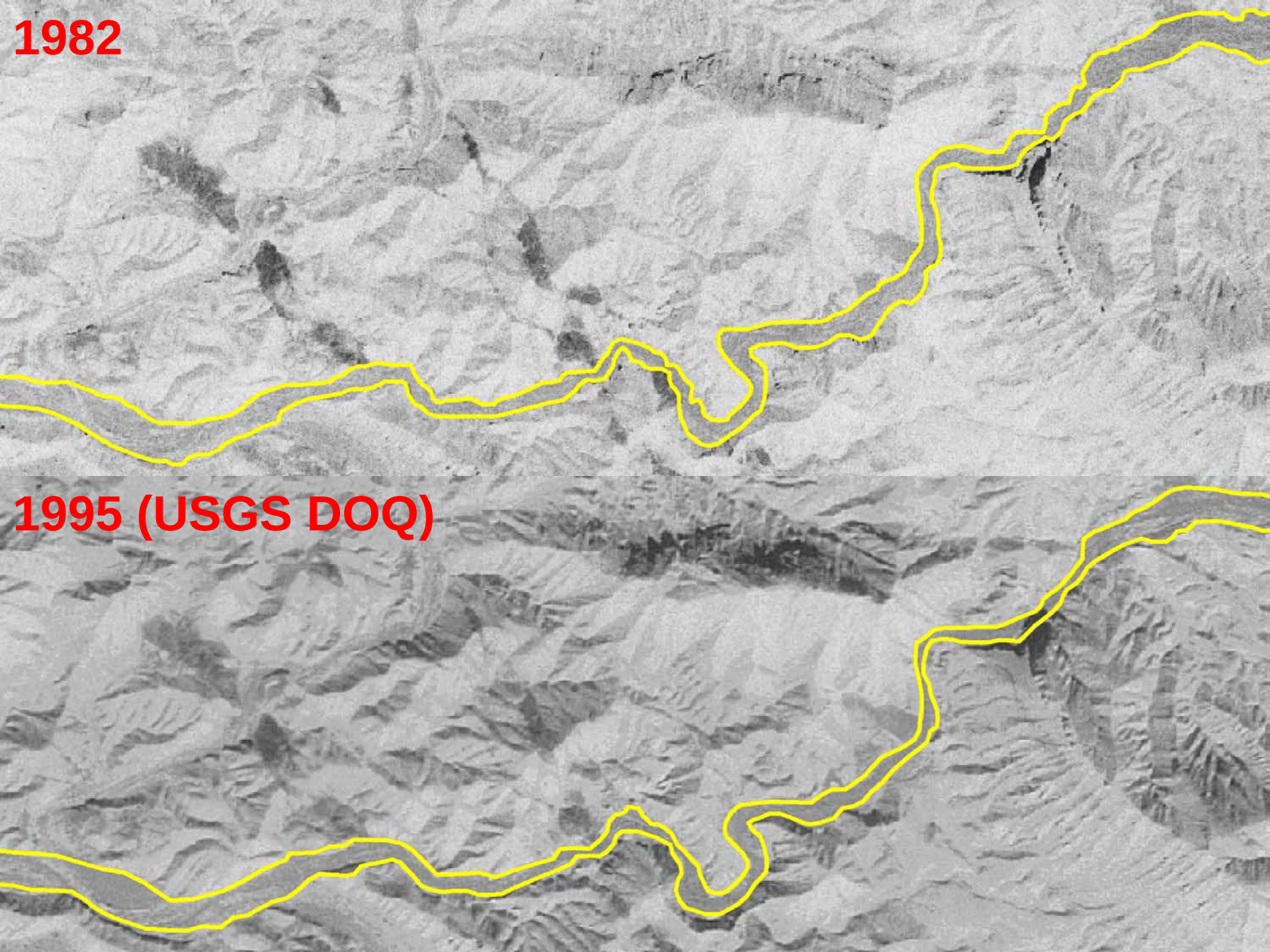


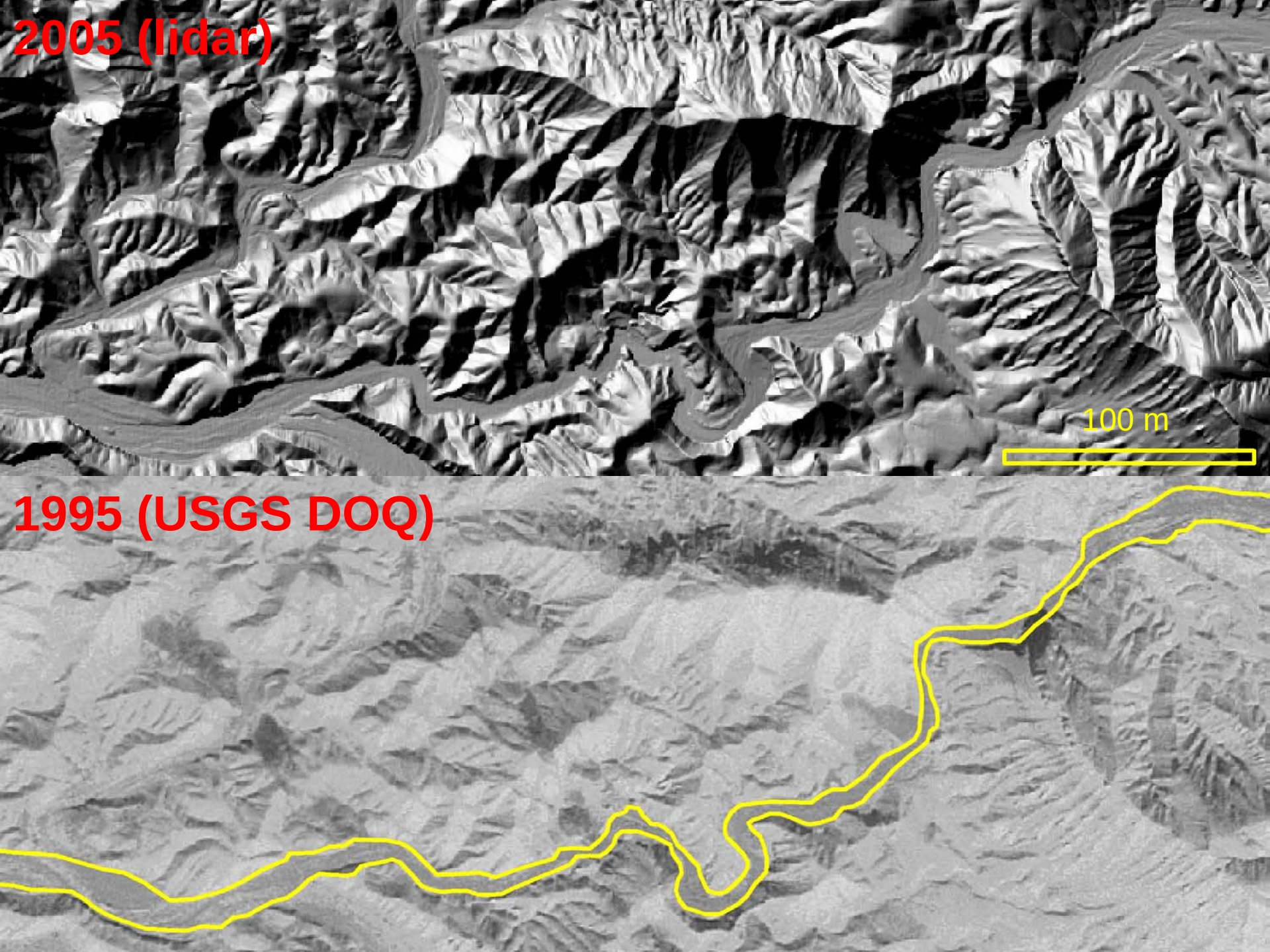
Orthorectified and georeferenced historical aerial photographs: 1948-1982

(1-m pixels)

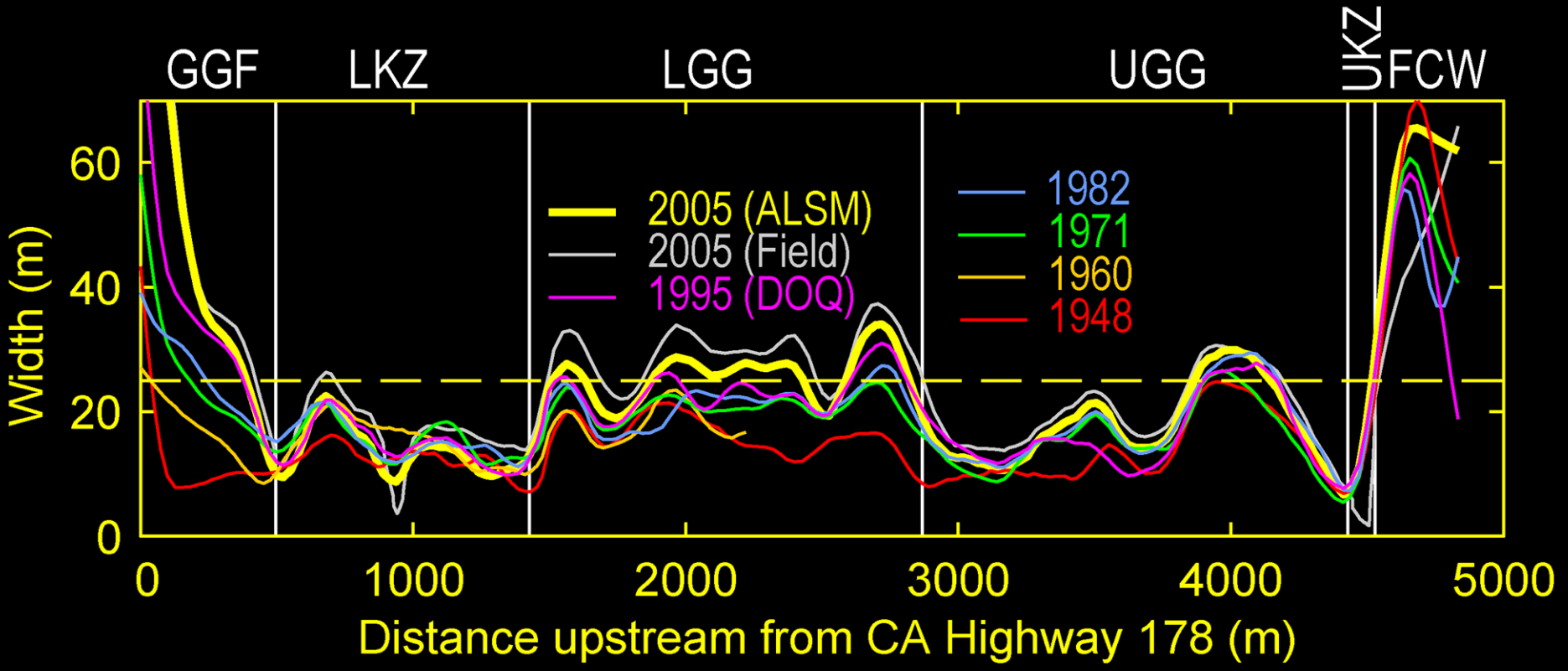

1948
1971


1982
1971

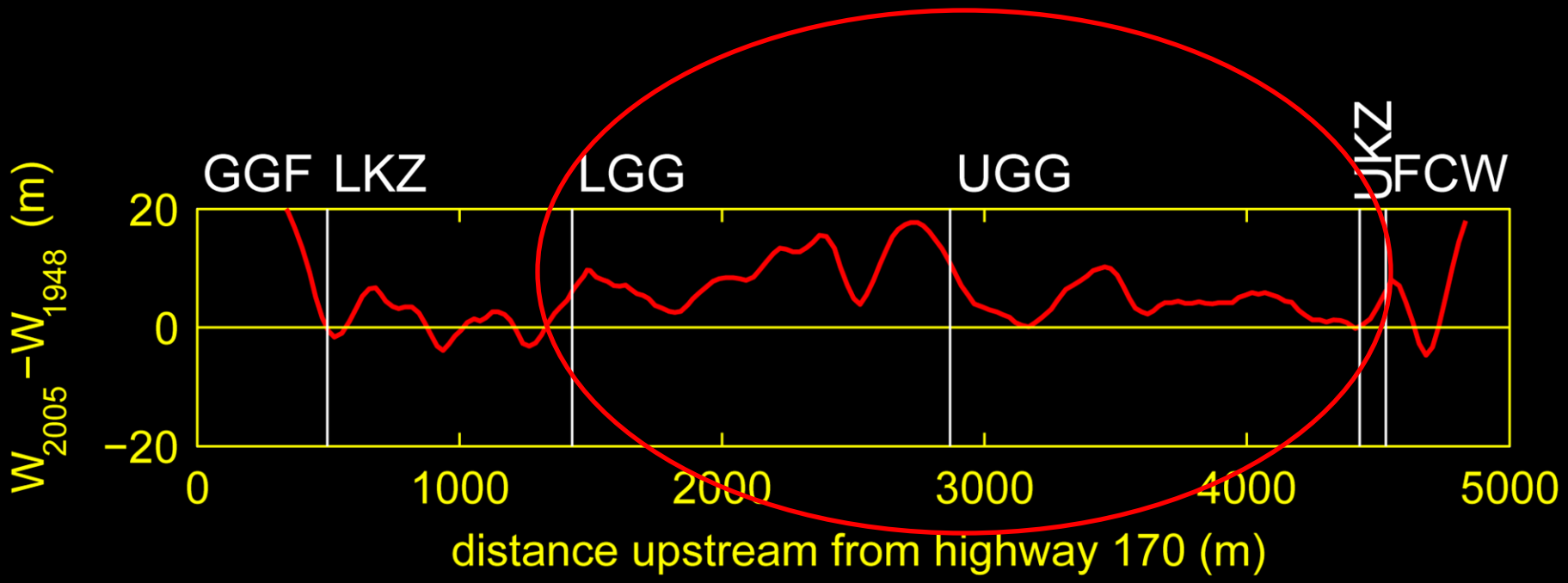

1982
1995 (USGS DOQ)


2005 (lidar)
100 m
1995 (USGS DOQ)

Valley width: 1948-2005



Change in valley width: 2005 minus 1948



Lisa Kammer at field survey station 110R (January 2005)

Field survey station 132 (January 2005)

Flood debris on a fill terrace just upstream of the lower knickzone (January 2005)

Gower Gulch, Death Valley and the Panamint Mountains (January 2005)