

Preliminary Results

- Archaeological sites along the Colorado River in Grand Canyon National Park are impacted by dam operations.
- Results of monitoring with lidar (Figure 1) show that many sites are eroding (Figure 2), which is counter to the management goal of preserving sites *in situ*.
- Sites that are more connected to windblown river sediment supply (e.g., Type 1 or Type 2 sites in Figures 2 and 4; see also Figure 3) appear to be susceptible to more extreme topographic changes than sites that are less connected (e.g., Type 3 or Type 4 sites in Figures 2 and 4).
- The process of site losing sediment (eroding) or gaining sediment (aggrading) is dependent on sediment supply, time, vegetation cover and distance from the river (Figure 3).
- A continual and regular source of windblown river-sourced sediment supply via frequent High Flow Events (HFEs) is likely necessary to keep sites buried by a protective cover of sediment and preserved *in situ*.

Figure 1. (A) Lidar being conducted as part of a long-term monitoring program to assess effects of flow and non-flow management actions on archaeological sites.

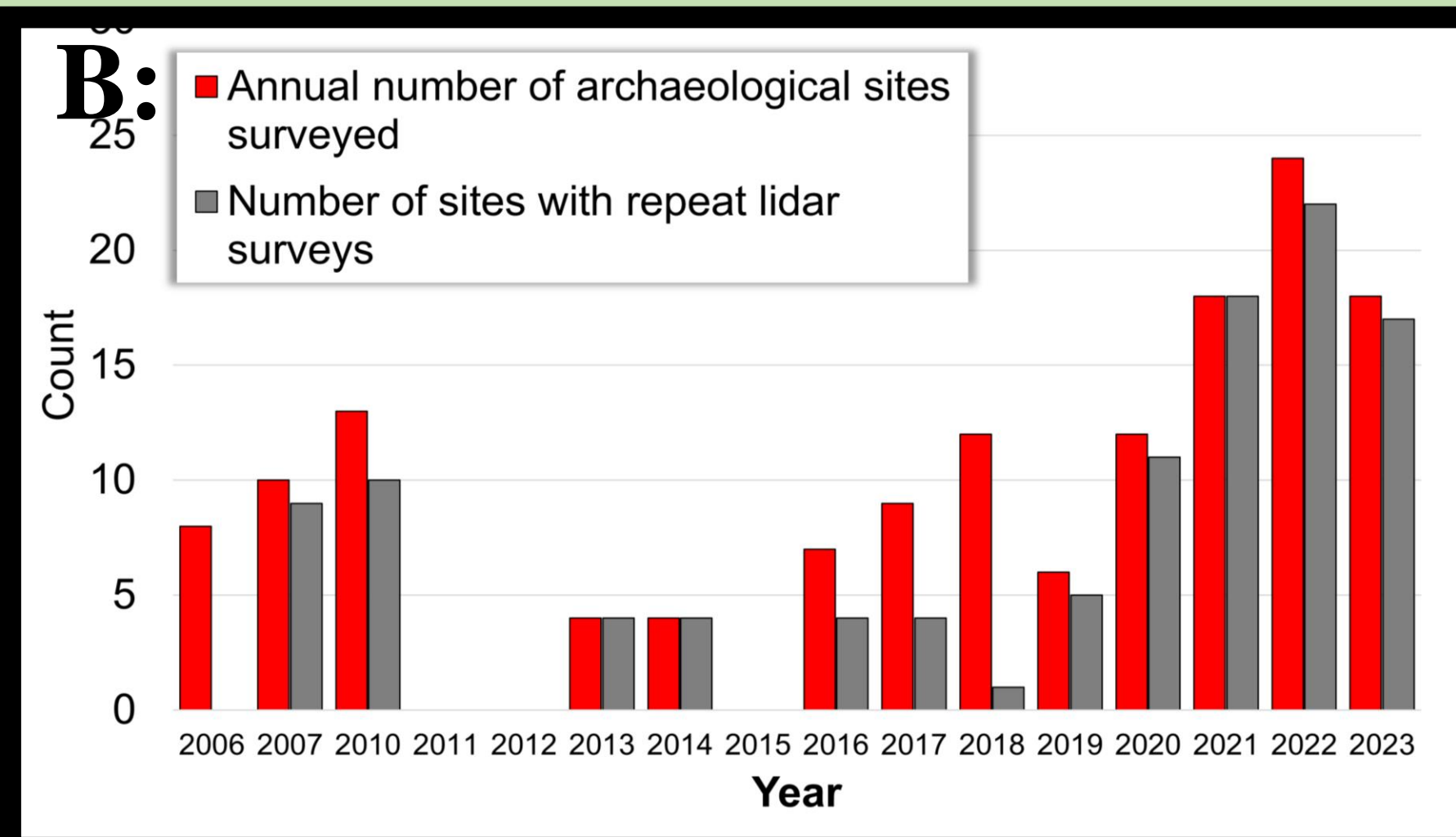
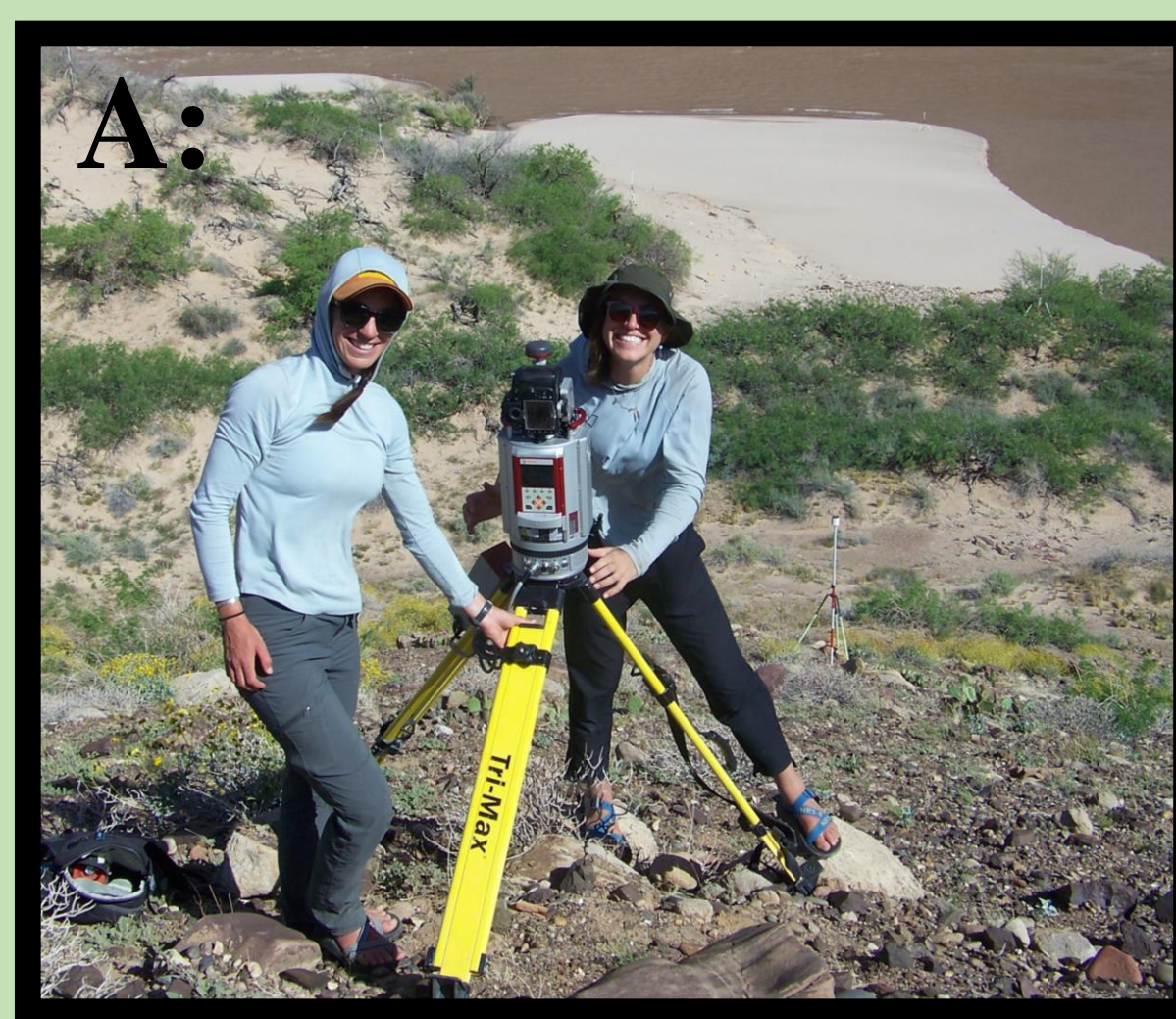


Figure 1. (B) Plot showing the number of archaeological sites surveyed each year since 2006 (red) and the number of those sites that were resurveyed to detect geomorphic changes (grey; fig 2).

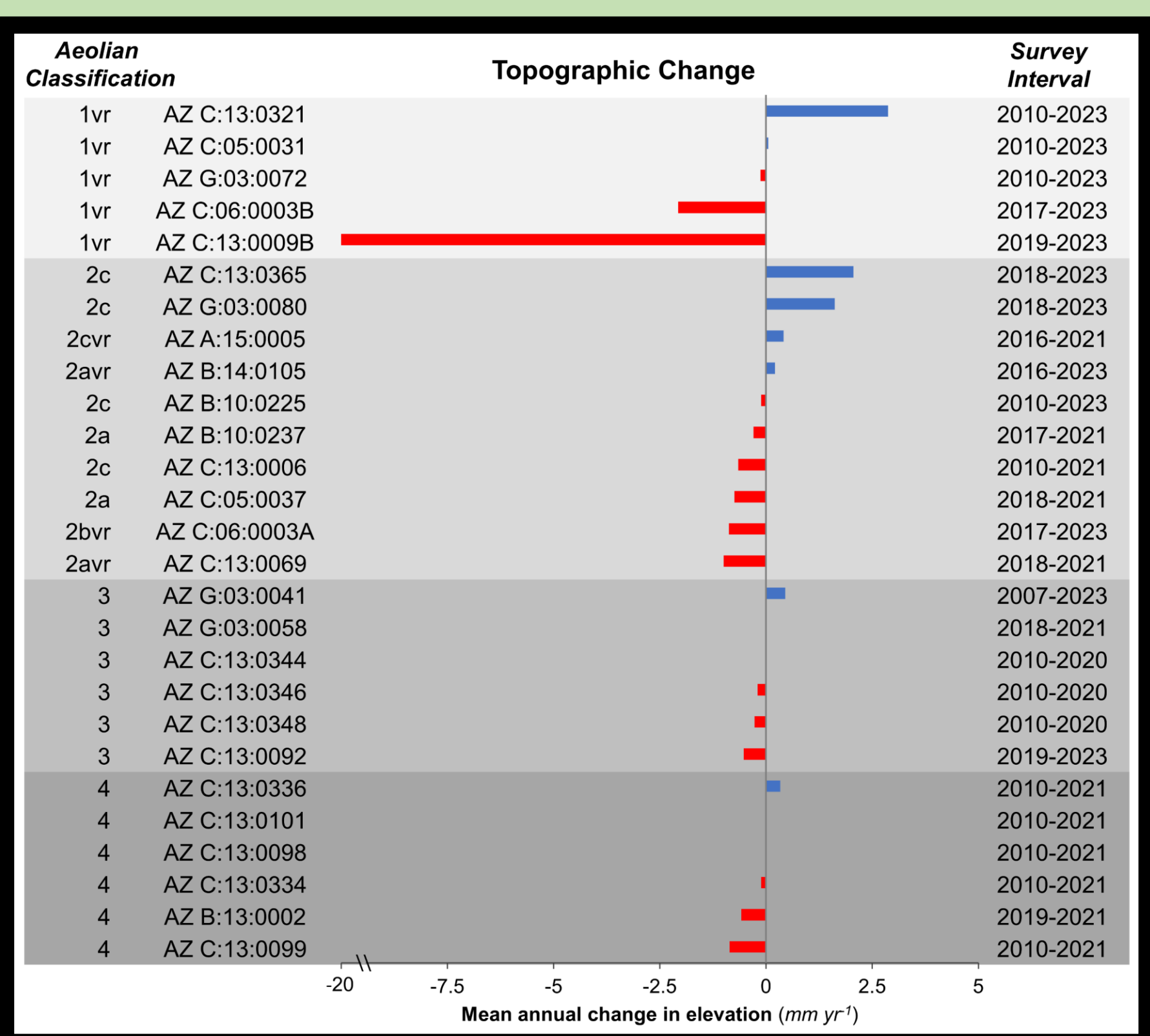


Figure 2: Cumulative topographic changes, measured via lidar monitoring, normalized by area and time. Note larger changes for Type 1 and Type 2 sites indicating greater response to management operations and natural processes.



Figure 3: Photo series showing the progression of aeolian processes transporting sediment from the sandbar deposited during April 2023 HFE filling in a downwind scarp created by the April 2023 HFE. Photo credit: Sankey, Tango, Palmquist

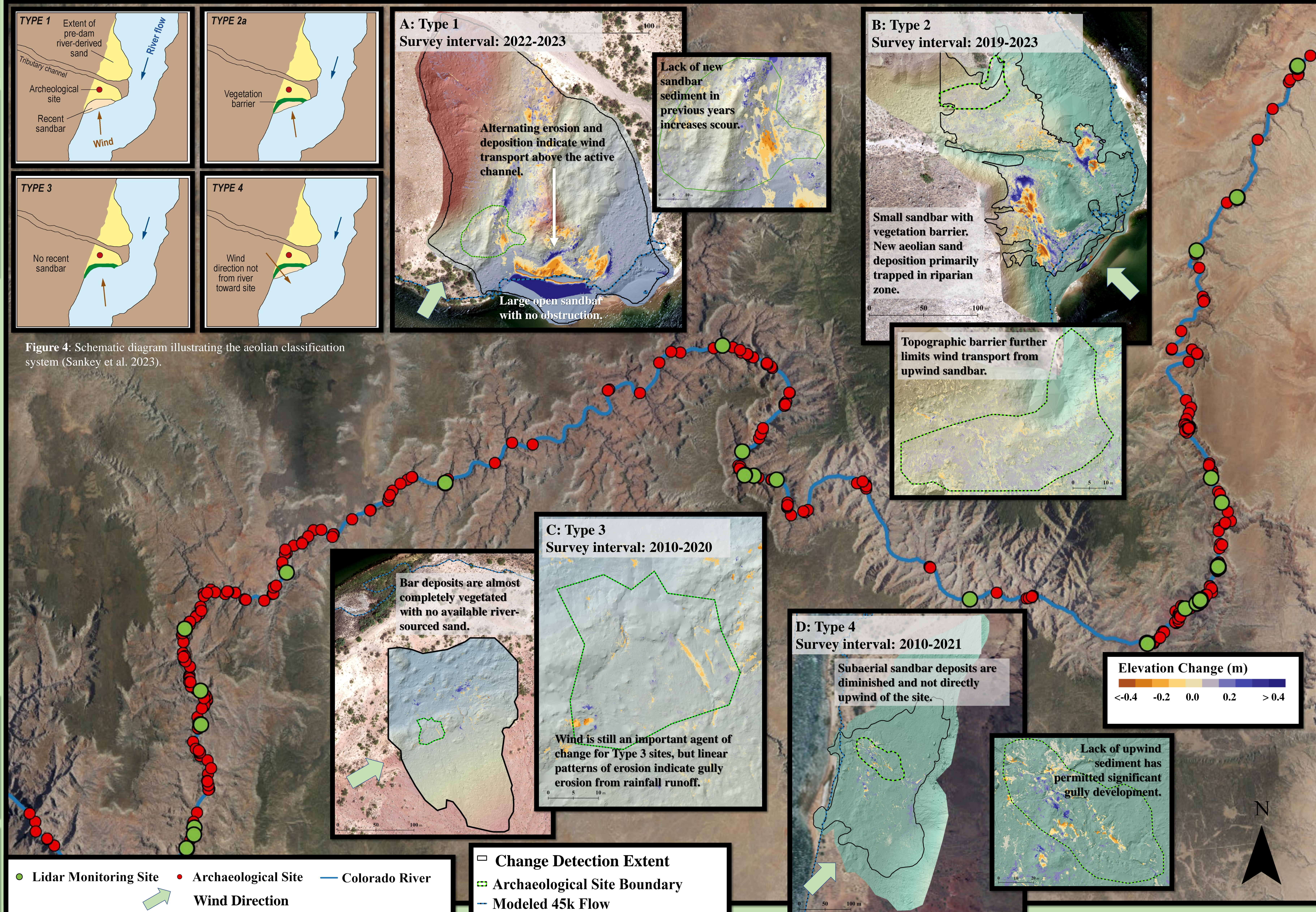


Figure 4: Schematic diagram illustrating the aeolian classification system (Sankey et al. 2023).

Figure 5: Overview map of the Colorado River running through the Grand Canyon. Red dots represent monitored cultural sites and green dots represent sites that Project D is monitoring with terrestrial lidar. Terrestrial lidar monitoring sites were selected based on distribution across the Colorado River Corridor as well as their geomorphic position with regards to presence of an upwind sandbar and encroaching riparian vegetation. A-D show lidar-derived topographic changes at sites AZ:C:13:0321, AZ:C:13:0365, AZ:C:13:0348, and AZ:C:13:0099, respectively. Dates represent the survey interval for the represented topographic change.