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Author
Cooper, Danika

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How to draw a dust storm

On the evening of 5 July 2011, a wall of dust barrelled in from the Sierra Madre Occidental in northern Mexico and gathered speed as it moved northwest through the Santa Cruz River Valley into Arizona's Sonoran Desert. The dust storm, over 8,000 feet (2,400 m) high and 100 miles (160 km) wide, raced through the territory at nearly 60 miles (95 km) per hour.[1] Within two hours, it had travelled over 150 miles (240 km), ransacking the landscape of its loose particles before enshrouding the surrounding counties in a haze of dust and debris.[2]

When we try to understand the complexities and implications of such dust storms, the particle and the storm must be contemplated together. Geologically, dust is a measurement unit of sediment, defined as a particle between 2 and 100 micrometres.[3] Dust particles may be rich in mineral nutrients, including phosphor, iron, calcium, magnesium and potassium.[4] As strong wind systems move through drylands, dust particles are lifted from the ground and held high in the air through the aeolian process of suspension. These giant plumes of material charge fiercely across territories. When the wind subsides, the particles are released and fall back to the ground; they accumulate to create new micro-topographies and are stable only until another gust of wind carries them to their next resting place.

The rising frequency and intensity of dust storms demands heightened literacy in representational methods to draw dust as landscape and the storm as landscape process. Drawing dust requires engagement with the soil sciences, climatology and geology to create new readings of dust and overlap knowledge from the natural sciences with the aesthetic, temporal and perceptual qualities of dust. The coupling of analogue and digital techniques aims to address the challenges associated with the dramatic scalar differences between the particle and the storm, and to express the sublime qualities of storms—the threatening scale and speed, the graceful movement through the landscape and the striking palette of tonal hues produced by the accumulation of particles. Drawing the dust is more than simply pointillism; adopting a filmic approach to build a visual narrative of the process of moving dust results in drawings that address the inherent and essential ephemerality of the storm through seriality.

Dust will colonize the planet as regions of aridity spread and urbanization continues to direct our land-use patterns. It is therefore critical to codify dust in the palette of landscape design and imagine it as a land-forming material with which to create and contour the land. Drawing dust—as a particle, as an aggregate and as a process—enables a clearer understanding of the material and provides openings for mitigating its destructive impacts. Expressing the range of scalar, temporal and geological complexities will empower more precise and responsive design in the face of increasingly dynamic ecologies.

Acknowledgments

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1 Ana Vukovic et al., 'Numerical Simulation of "An American Haboob"', *Atmospheric Chemistry and Physics* 14/7 (2014), 3212.

2 NOAA, 'National Weather Service—NWS Phoenix', www.wrh.noaa.gov/psr/pns/2011/July/DustStorm.php, accessed 22 September 2018.

3 Kenneth Pye, *Aeolian Dust and Dust Deposits* (Orlando: Academic Press, 1987) 1.

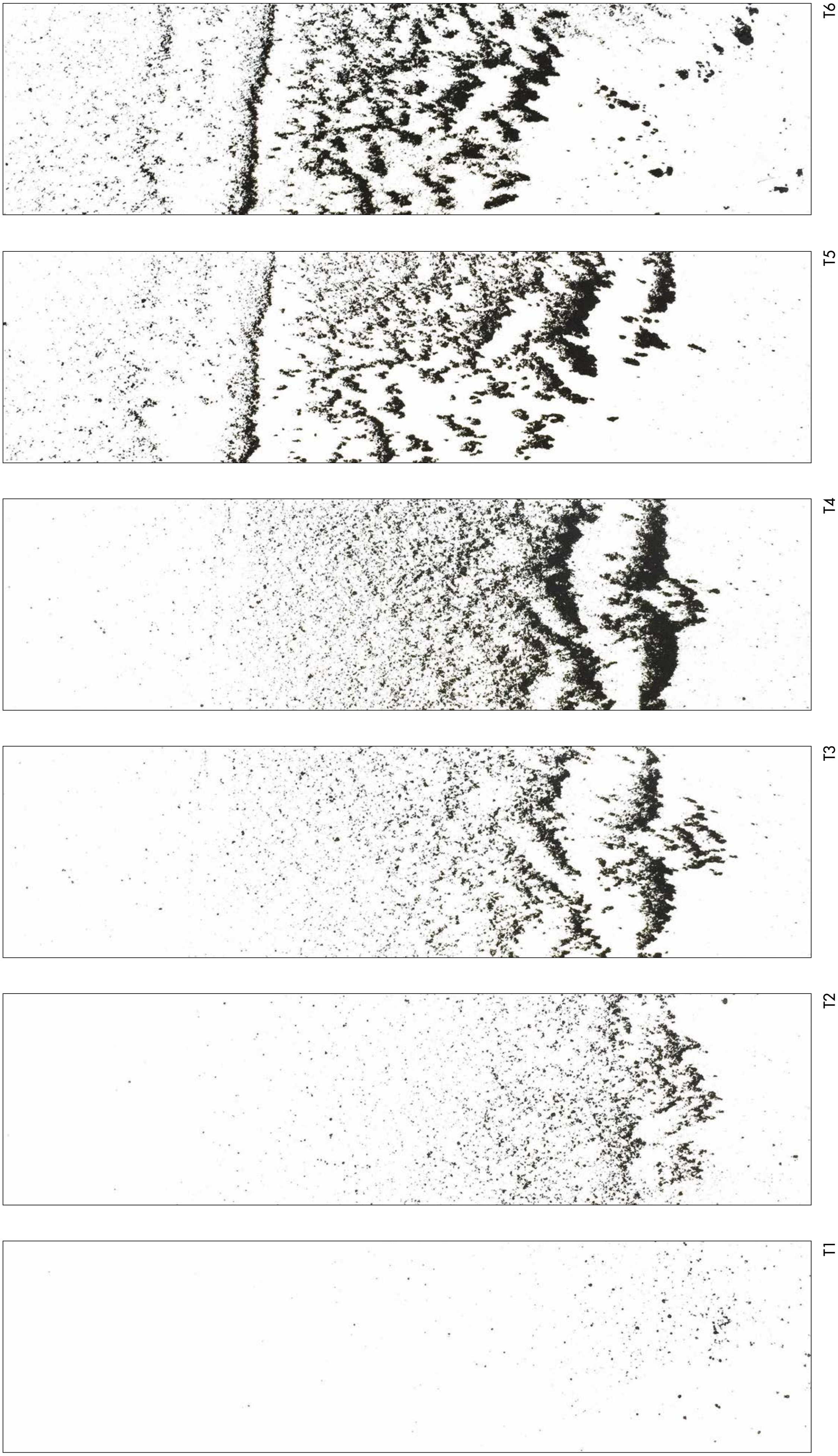
4 Sarah M. Aciego et al., 'Dust Outpaces Bedrock in Nutrient Supply to Montane Forest Ecosystems', *Nature Communications* 8 (2017), 14800.

BIOGRAPHICAL NOTE

Danika Cooper is assistant professor of Landscape Architecture and Environmental Planning at the University of California, Berkeley. Her teaching and research are centred on the geopolitics of scarcity, alternative water ontologies and designing for resiliency in the world's arid regions. She holds degrees in architecture, landscape architecture and design studies, and has practiced in the United States and India.

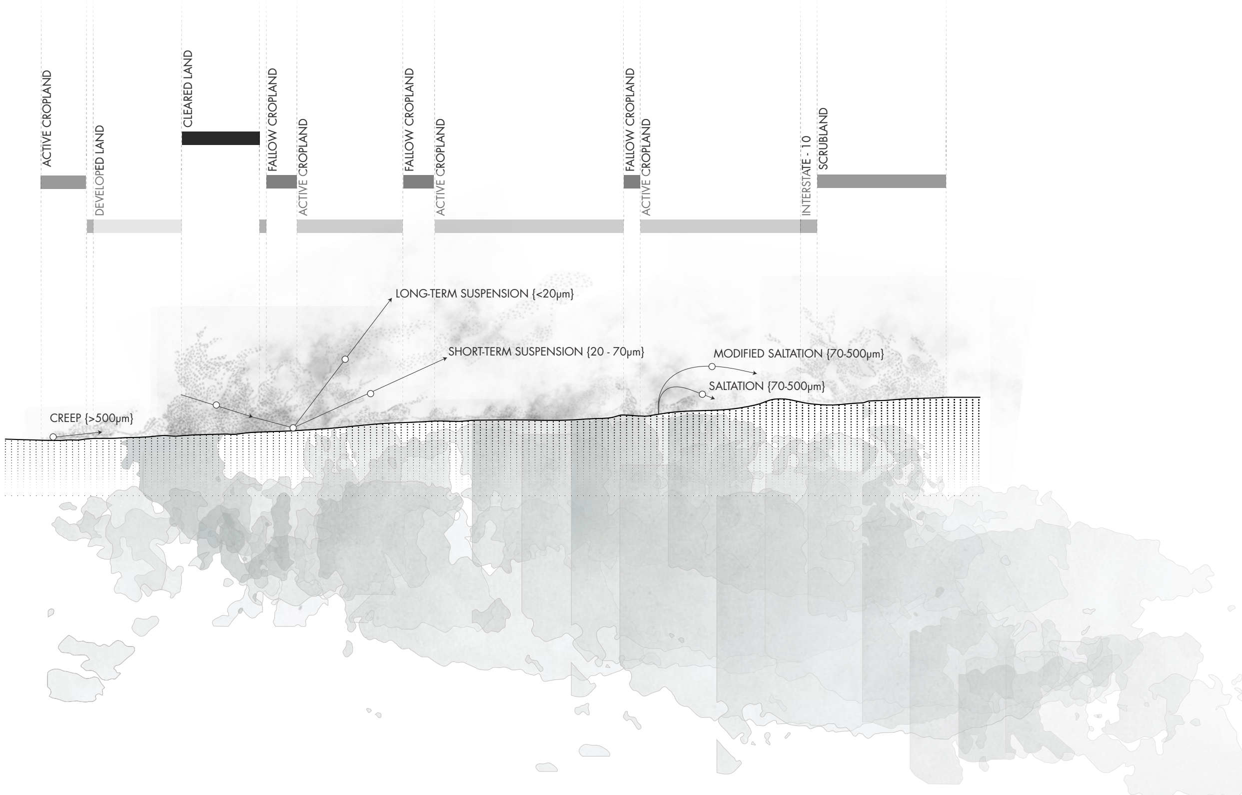
CONTACT

Danika Cooper
Department of Landscape Architecture and Environmental Planning
310 Wurster Hall
University of California, Berkeley
Berkeley, CA 94720
USA
Phone: +1 602 300 3472
danikacooper@berkeley.edu



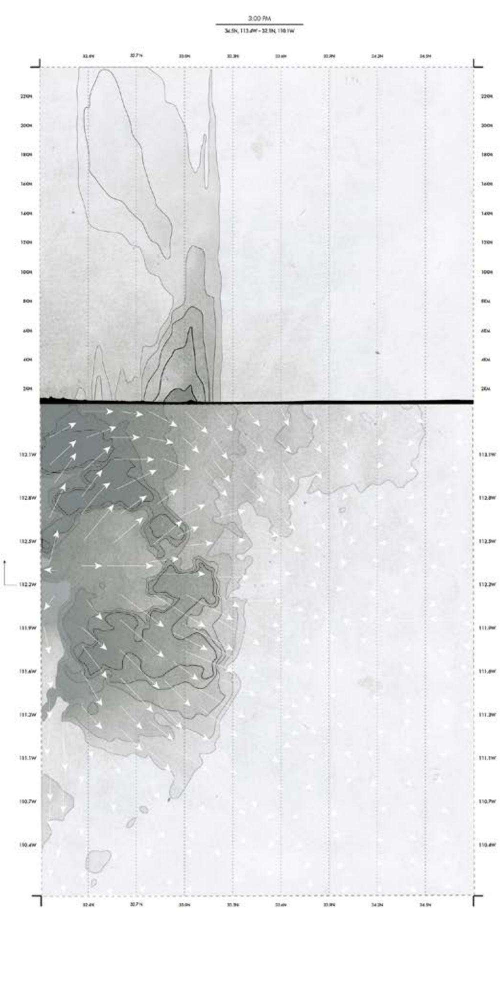
Morphology of dust

The shape and pattern of dust on the ground is an index of wind patterns, moisture regimes, and land-use typologies. When wind sweeps through arid regions where particles are loose and unanchored to the ground by moisture or vegetation, these dust particles are lifted from the surface and carried by the wind. As a result, over time, the movement of dust physically alters the ground. At sites of dust lift-off, the ground loses its topsoil, whereas at sites of dust deposition, new micro-topographies are created. Resultant dust patterns register the direction and strength of wind as well as the characteristics of land cover. These drawings are simulations of how dust might move, accumulate and erode. Charcoal dust is blown across the surface mimicking prevailing wind patterns and fluctuating intensity over time and space.



Classifying movement

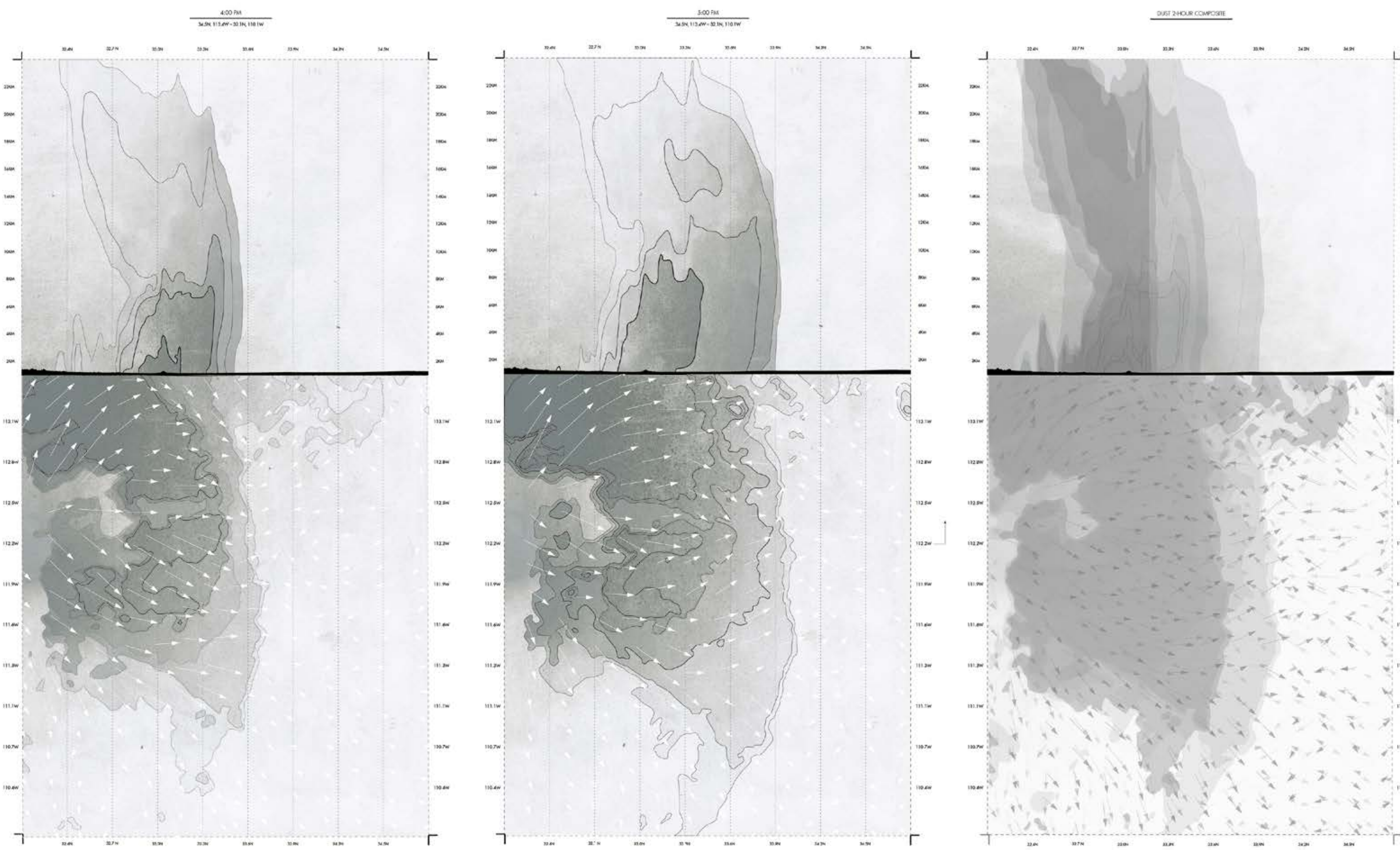
How dust moves and aggregates depends almost exclusively on a particle's size and location. When wind moves through a territory, larger, heavier particles (those more than 70 micrometres) 'creep' across a surface without leaving the ground, while smaller particles are held in the air for short spurts through 'saltation.' Through saltation, particles are lifted, dropped to the ground, then lifted again, and on and on. Soil particles moved through saltation are often responsible for erosion and surface damage. The smallest dust particles, less than 10 micrometres, are transported through 'suspension', a geological process in which particles are carried into wind streams at very high altitudes and transported across extremely long distances. Through these processes, global dust movements are possible. The susceptibility of dust particles to be moved by wind also depends on ground cover. Active croplands—lands that have been planted and therefore have soils stabilized by root systems—are less likely to produce dust particles that are loose and ready to be lifted by winds. On the other hand, fallow croplands—lands that either have been tilled but not yet planted or lands that are purposely left out of production—are likely to have soils that are destabilized, dry and ready to be carried by the wind.

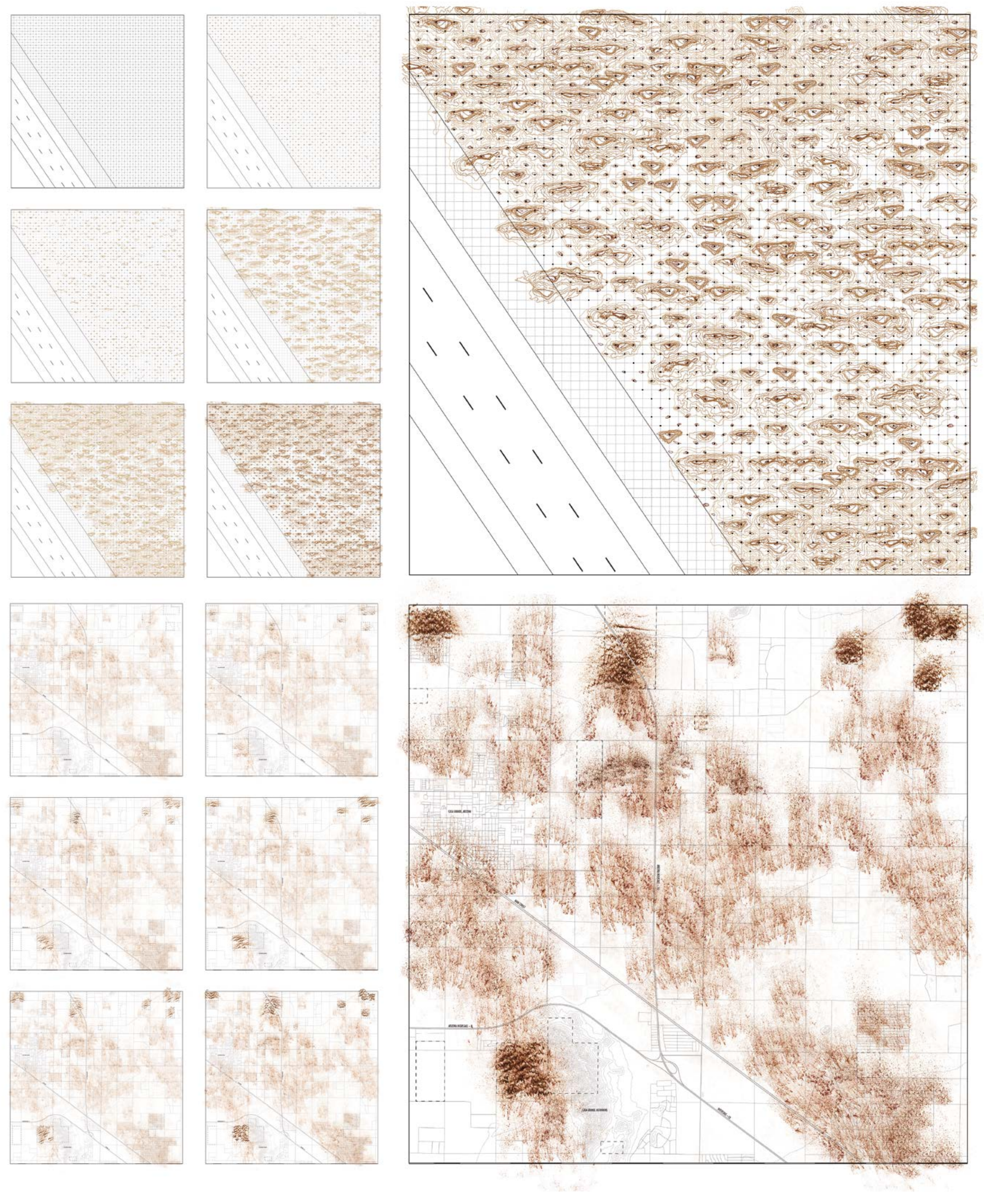


Territorial occupation

Along the motorway corridor between Phoenix and Tucson, Arizona, the topography and land cover make the presence of these dust storms ever more intense. Huge tracts of land were primed for a housing development and cleared of vegetation. However, a lack of finances has prevented completion of the construction. As a result, the soil is dry, destabilized and ready for lift-off. In the dust storm that hit Arizona in 2011, the monumental cloud of dust was 8,000 feet (2,400 m) tall and over 100 miles (160 km) wide, and it travelled nearly 150 miles (240 km) before dissipating. These sequential plans and sections describe the storm at three specific moments by illustrating wind direction, air density and spatial distribution. The final image reveals the evolving intensity of the storm.

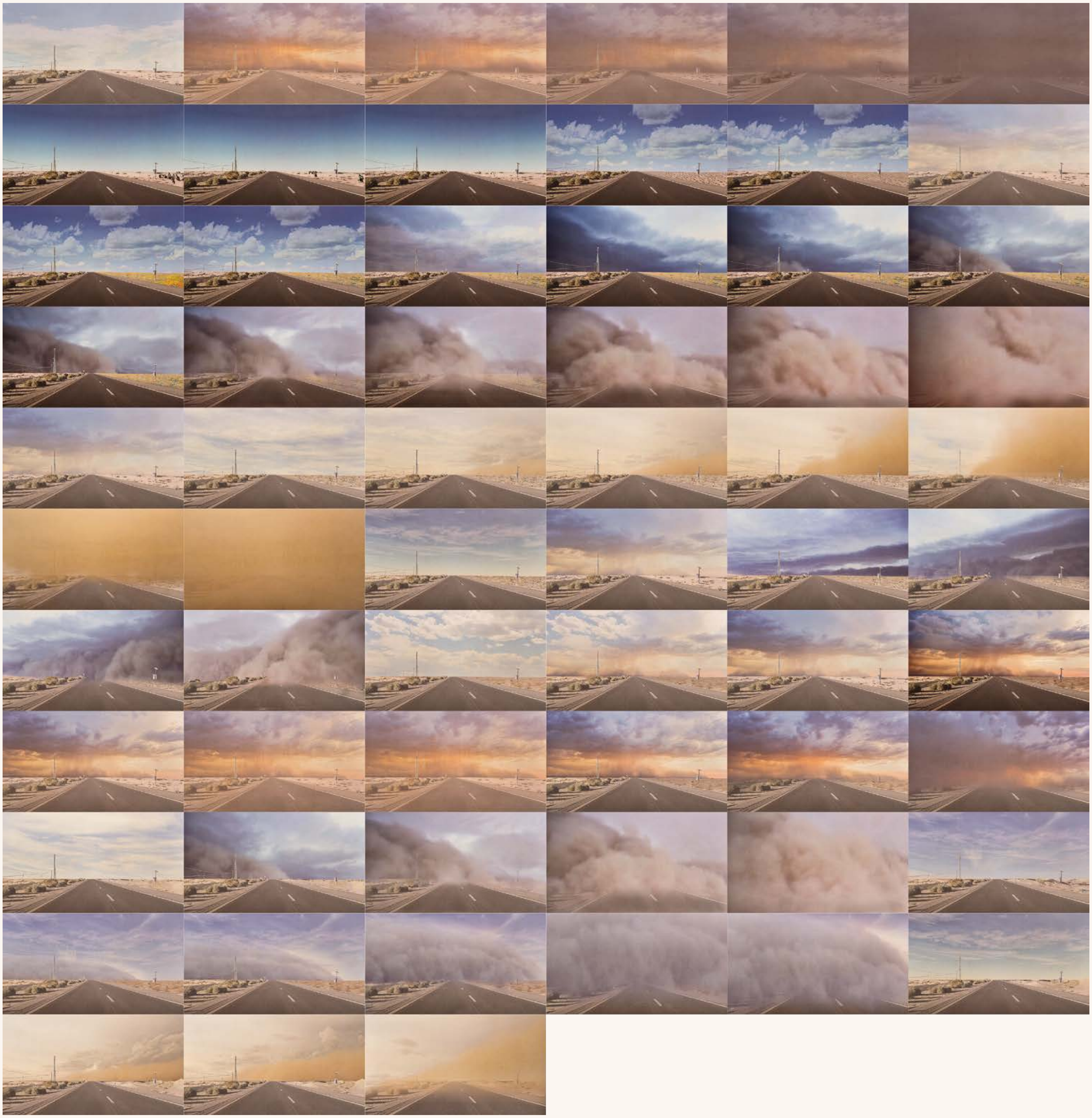
Data gathered from Ana Vukovic et al., 'Numerical Simulation of "An American Haboob"', *Atmospheric Chemistry and Physics* 14/7 (2014), 3211–3230.





Temporary accumulations

In a highly-speculative intervention, the planting of psammophile fields (desert dune plants) on destabilized, dust-prone lands encourages the settlement of wind-carried dust by hindering the movement of wind and stabilizing the ground. Tolerant of soil inundation, such seedlings can emerge from 14 cm deep. Over time, the plants create a dust sink, accumulating so much material that dunes begin to form. Regardless of rain patterns, the dunes increase in size and quantity and the ground becomes relatively stable. Throughout the territory, ephemeral topographies are continually created and eroded by the wind over time and space. Shown here is the Arizona landscape as it is changed over time through the movement of wind and dust across the region. The direction of the wind is registered by the direction of the dunescape.



Emergent dust terrain
A new terrain emerges from the accumulated dust. These serial images imagine topographic changes on the site over forty years as dust is lifted into the air, released back to the ground, settled and eroded through patterns of wind, water and human movement.