Synoptic Tactics: Mapping Territorial Transgressions

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The paper introduces theoretical paradigms, computational strategies, and representational techniques to uncover, analyze, and engage cross-boundary, territorial phenomena affecting multi-jurisdictional urban environments. *Jurisdictional boundaries* (between cities, states, regions, and nations) and *urban boundaries* (between zones, neighborhoods, land uses and owners) routinely impose artificial limits on the representation and understanding of *territorial phenomena*. Just as architects often limit site surveys and detailed site investigations near the confines of a given property line, designers and public officials considering transformations of urban neighborhoods, cities, and city regions are often bound to studies that end at the limits of the urban form. These representational limits are not necessarily intentional oversights on the part of the designer; rather, they are practical results of various data regimes, economic constraints, and ownership models which atomize and selectively distribute spatial and environmental information. Simultaneously, there is a growing sensibility toward transboundary conceptions of shared challenges within bio-regions, eco-regions, watersheds, and similar transboundary constructs gaining geopolitical and design currency.[1] Designers seeking to assemble cross-boundary geospatial representations to better assess and intervene within these constructs face challenges in the fragmentation of data sources and incongruous or incomplete data across jurisdictional divides. The paper details a series of novel *synoptic tactics*, computational tools and geospatial data visualization techniques projecting territorial transformations beyond the limits of jurisdictional boundaries.

TRANSBOUNDARY PARADIGMS

Despite the increasing mineralization and securitization of jurisdictional borders around the world,[2] a growing chorus of scholars, health officials, public policymakers, and urban planners are recognizing an urgent need to identify and address transboundary environmental phenomena. Military geographers, like John M. Collins, have long recognized the primacy of cross-border natural resources in shaping the space of peace and conflict. "Geopolitical friction" arises when borders are drawn without respect to environmental concerns.[3] As sovereign national boundaries or other terrestrial jurisdictions are drawn and enforced, they contradict natural environmental flows of air, water, and other resources. The difficulty in delineating and observing these abstract boundaries within transboundary conditions and material flows leads inevitably to confusion and eventually conflict, which Collins describes as "environmental friction." The easy flow of atmospheric pollution across borders and the impact of one territory's water usage on a neighbor's water rights are among the common flashpoints for possible geopolitical conflict.

Beyond the limits of the nation-state or individual jurisdiction, new paradigms for transboundary imaginaries and management strategies are promoted to help identify and relieve these environmental frictions. *Ecoregions* and *bioregions* are common constructs to conceive of these cross-border territories, organized according to shared natural, environmental, and biotic characteristics, across political and administrative lines (Figure 1). Bioregional planners and advocates for bioregional justice encourage a broadened, place-based conception of trans-frontier territories which emphasize the interdependence of human life with the land, water, and life of a bioregion. These frameworks have led to bioregionalist efforts to forge new cooperative efforts across multiple domains along the US-Mexico international border.[4] Leading designers and urban theorists addressing the US-Mexico borderlands commonly cite bioregionalist strategies.[5] Paulina Ochoa Espejo argues beyond what she sees as the limits of the bioregional approach, advocating instead for *a watershed model* of governance in which "place-specific duties" are co-produced in border territories by the inter-relationships of the land, its institutions, its people, and biota.

While these transboundary perspectives offer exciting new pathways for a renewed cross-border planning and spatial practice, these paradigmatic shifts are not adequately supported by current visualization and mapping tools, or by the data regimes that support these tools.[6] The ability to visualize and address contiguous natural phenomena within shared transboundary geographies is limited by the real and virtual boundaries which record territorial data and make it available. We must look beyond the official data sources and standard geospatial visualization techniques if we are to enable impactful transboundary practices.

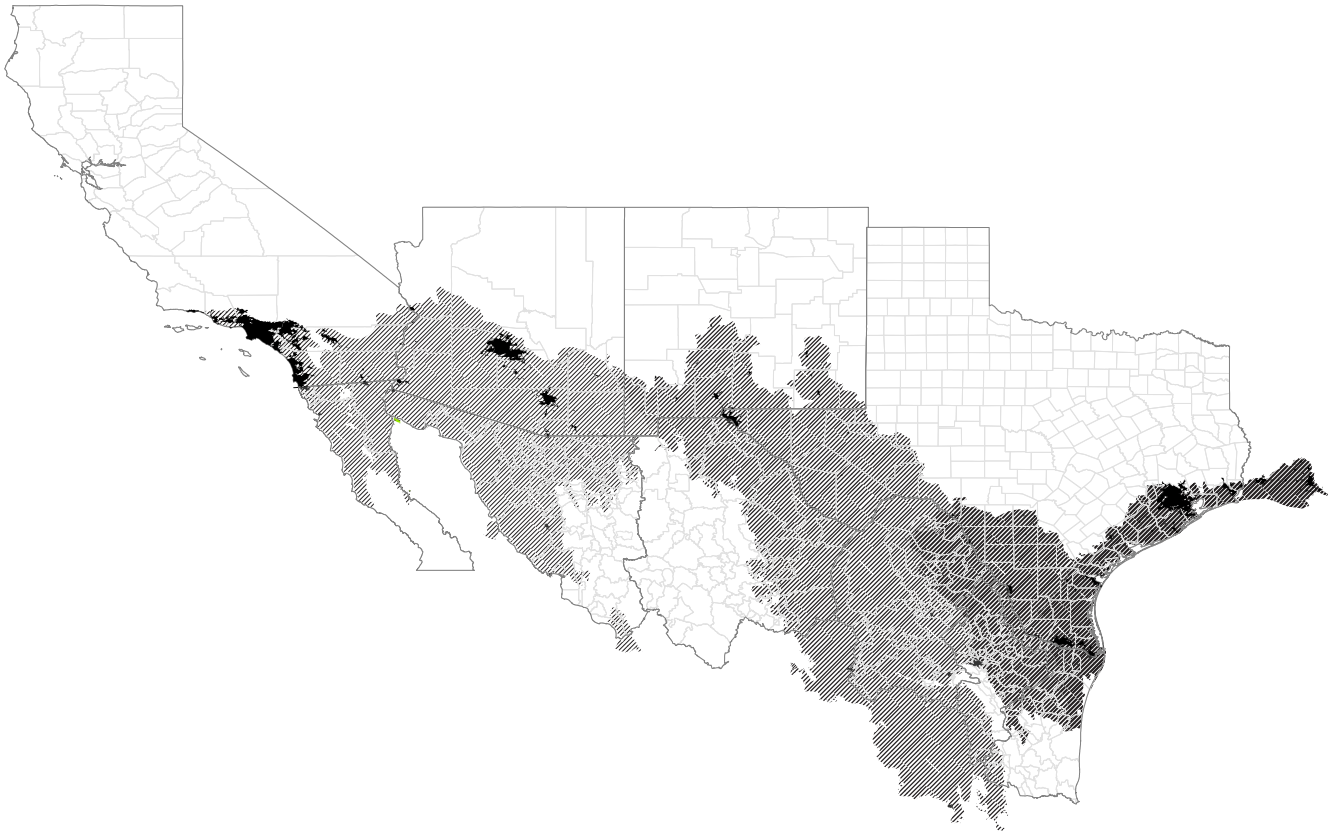

Figure 1.Binational Ecoregions. Image Credit: POST-Project for Operative Spatial Technologies, a Texas Tech College of Architecture (CoA) Research Center.

SYNOPTIC TACTICS

The term "synoptic," borrowed from meteorology,[7] here designates a scale of atmospheric phenomena between the territorial and the planetary, in which anthropogenic activities and climatological events co-produce significant effects on urban populations. The synoptic scale is multi-jurisdictional. It is appropriate to the scale of a transboundary territory, including a bioregion. By looking at the synoptic scale, we are not limited to the atomization of parcelized data, gathered by individual cities, states, counties, or countries. Nor are we subject to predefined delineations of human settlements or jurisdictions. By developing a capacity for an analysis of human settlements at a synoptic scale we can avoid a "metrocentric" bias,[8] mapping and measuring the coproduction of environmental conditions through the combined anthropogenic and biotic activities of an expanded territory, including both urban and rural settlements. We are also not constrained to the arbitrary limits of data as they encounter the abstract boundaries of a jurisdiction. Synoptic data does not end at the international border, or the county line.

While the term is borrowed from meteorology it is not intended here to promote only an atmospheric assessment. Since a synoptic study of territory enables an evaluation of the entanglements of human life and settlement with other forms of life, a synoptic gaze is biopolitical by its very nature. The term is positioned to echo, but contrast with the *panoptic* regimes of visual observation and surveillance at the urban and architectural scales, and the well-documented weaponization of architectural and urban vision regimes in the service of biopolitical control.[9] Conscious of the asymmetries promoted by any new visioning and vision-enhancing system, a synoptic strategy for territorial analysis would need to be critical of the tools capable of imaging the territory, and shaping the territory in its image.

The sciences are shifting from the specialization of autonomous fields to the forging of new collectives, convening multiple disciplines to attack shared problems in what Bruno Latour and others have termed the *critical zone*,[10] a description of the thin layer of the earth and the earth's atmosphere including the geophysical and atmospheric conditions capable of supporting life and containing all human activity and human impact. To study complex and critical sites, interdisciplinary teams are creating place-based investigations at "critical zone observatories," which are themselves developing the layered and entangled observations capable of informing a synoptic view. Building on this layered conception of territory, the critical zone imaginary has been translated into new forms of cartography and representation, most extensively by Frédérique Aït-Touati, Alexandra Arènes, and Axelle Grégoire in their *work Terra Forma: Manuelle de Cartographies Potentielles* (2019).[11]

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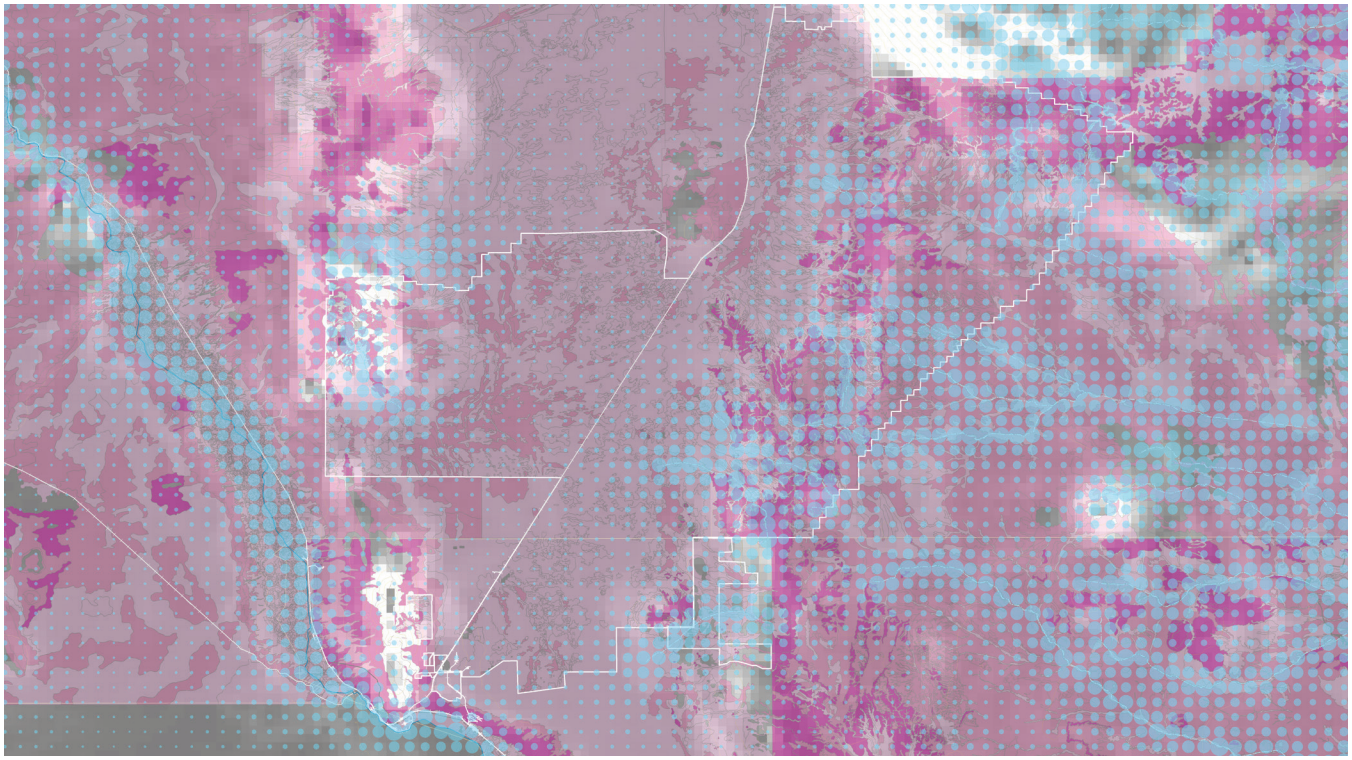

Figure 2. Boundary Transgression Mapping: Erosive Landscape / Fort Bliss. Image Credit: Aurea Lopez (Student), Texas Tech University.

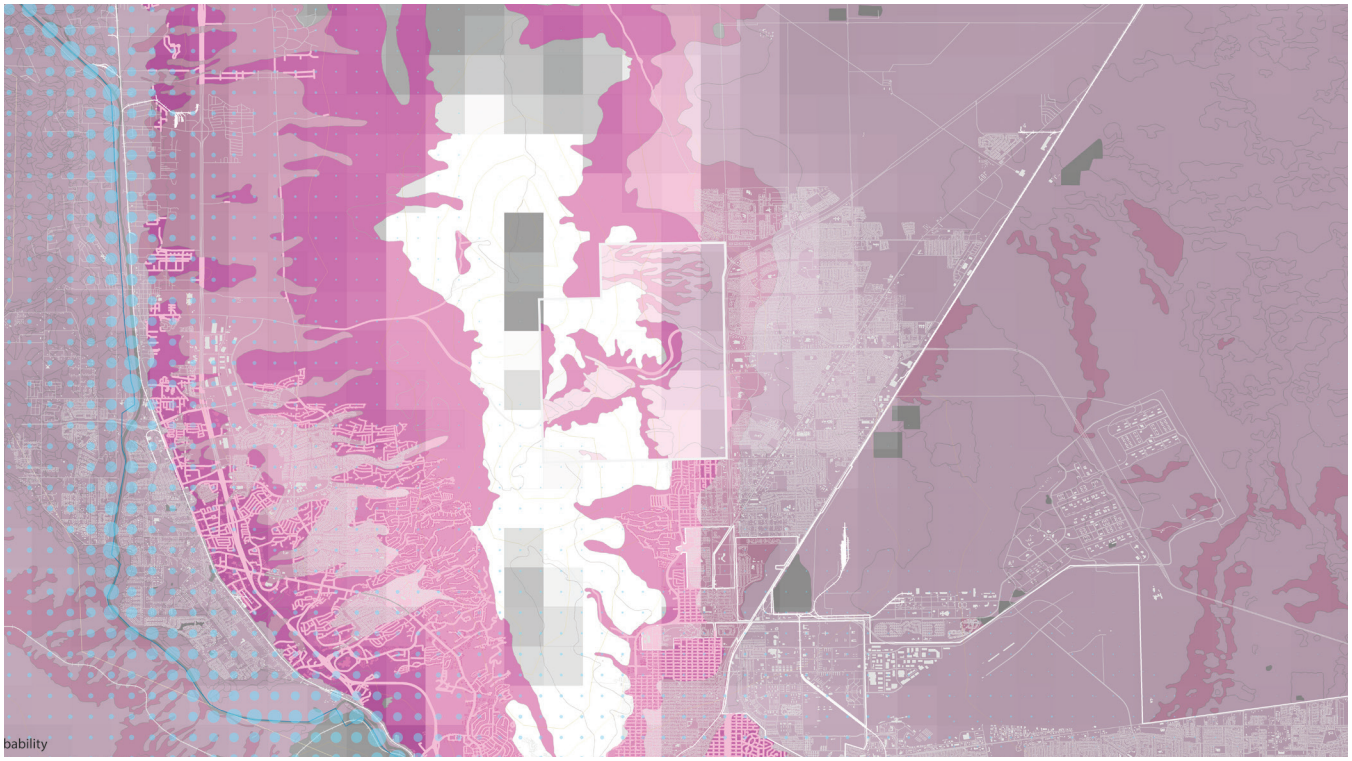

Figure 3. Boundary Transgression Mapping: Erosive Landscape / Castner Range. Image Credit: Aurea Lopez (Student), Texas Tech University.

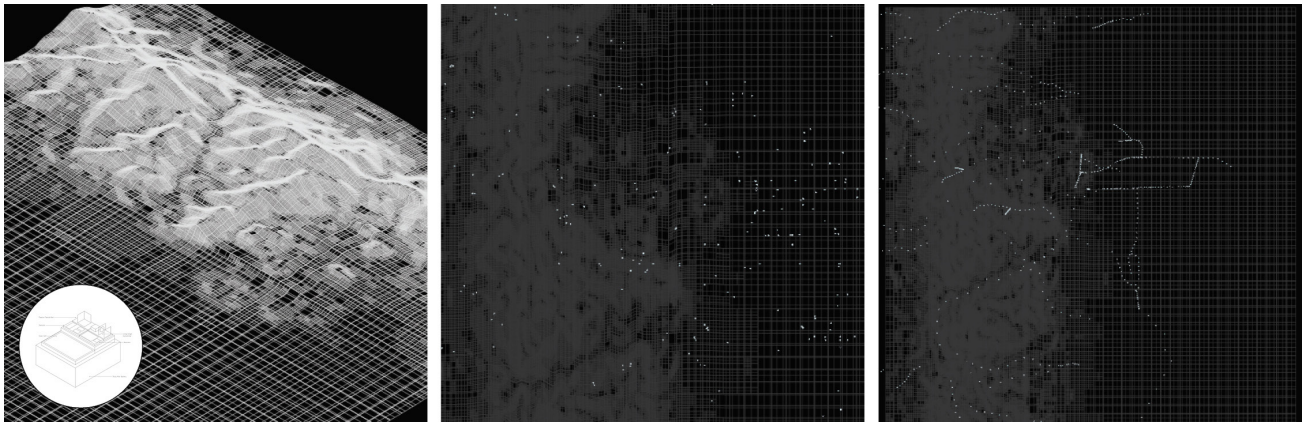

Figure 4.Territorial Vision Mapping: Virtual Smart Dust and Natural Watercourses. Image Credit: Aurea Lopez (Student), Texas Tech University.

The techniques presented successfully collapse and calibrate the complex interchange of multiscalar territorial knowledge with concentric sections through geologic, terrestrial, and atmospheric layers comprising the critical zone. The sectional conceit of the territorial map captures and emphasizes multiple 'sheds' affecting any given site by intentionally denying the planimetric or satellite view. A synoptic view of a territory would complement these representational experiments by attempting to capture the layered reality of the critical zone while contending with the planimetric inscriptions, and re-inscriptions, of territory.

In order to fill these gaps, and develop synoptic assessments appropriate to the study of entangled urban and environmental phenomena at the extraterritorial scale, we must develop *synoptic tactics.* While there exist a suite of tools and data sources for atmospheric assessments at the synoptic scale, the range of phenomena we seek to capture in our synoptic studies demand other strategies. Through a process of translation, we might view available synoptic data as proxies or stand-ins to provide evidence of anthropogenic activities and other conditions of the entangled territory difficult to observe otherwise. But the availability of applicable data, and the application of available data both have their limits, constraining synoptic studies and knowledge they produce. A robust synoptic investigation would need to look to new models of *territorial vision*, and *territorial image-making*, to assist in further breaking these disciplinary barriers.

TERRITORIAL VISION MACHINES

A series of investigations with graduate students in an advanced architectural design studio at Texas Tech University conducted online in Summer 2020 leveraged the advances in a collection of *territorial vision machines*—emerging sensing technologies capable of capturing and visualizing atmospheric, surficial, and geophysical activities—to enable new protocols for computational mapping and representation strategies at the extra-territorial scale. Prior work by investigators considered the environmental and atmospheric boundary transgressions across the multiple jurisdictional boundaries within the US-Mexico borderland, especially the militarized international border wall in and around the binational metroplex of El Paso and Ciudad Juarez.[12] This investigation considered a militarized boundary within the urban construct-the boundary between the land holdings of Fort Bliss and the City of El Paso.

The military base/city boundary was identified as both fixed and fluid. The securitized boundary between base and city was viewed as evidence of a mineralized jurisdictional boundary—a hard limit to populations, as well as land management and environmental data. But the military base boundary also registered, promoted, and reinforced a series of transboundary transgressions with implications for territorial transformations within larger conceptions of territory surrounding the base, including a binational desert bioregion, transnational watershed, and multi-jurisdictional airshed. The studio explored this dual condition, documenting the ways in which the base participates as an active agent in the *critical zone* of the region. While the entwined futures of the base and city are co-produced by shared populations, there are limited cross-boundary studies and planning initiatives conducted in the region. The base operates largely as if it were a regulatory, political, and environmental *island* within the larger territory. Access to the base is limited, and planning efforts focus either within the base boundary, or beyond it. Despite these divided planning imaginaries, the environmental impact of the city on the base, and the base on the city is irrefutable. But the entanglements of base and city are difficult to ascertain. Representations of the coproduction of environmental and urban phenomena have been historically limited by the military/civilian divide.

The studio was tasked with developing tools for *synoptic observation* capable of spanning the base/city boundary, engaging atmospheric events and territorial anthropogenic shifts enacted by activities on and around the base. To begin, students interrogated and extrapolated the optical logics of emerging *territorial vision machines* to extract and project architectural and territorial intelligence. The resolution and range of advanced imaging and sensing technologies have advanced substantially in the past several decades, with a

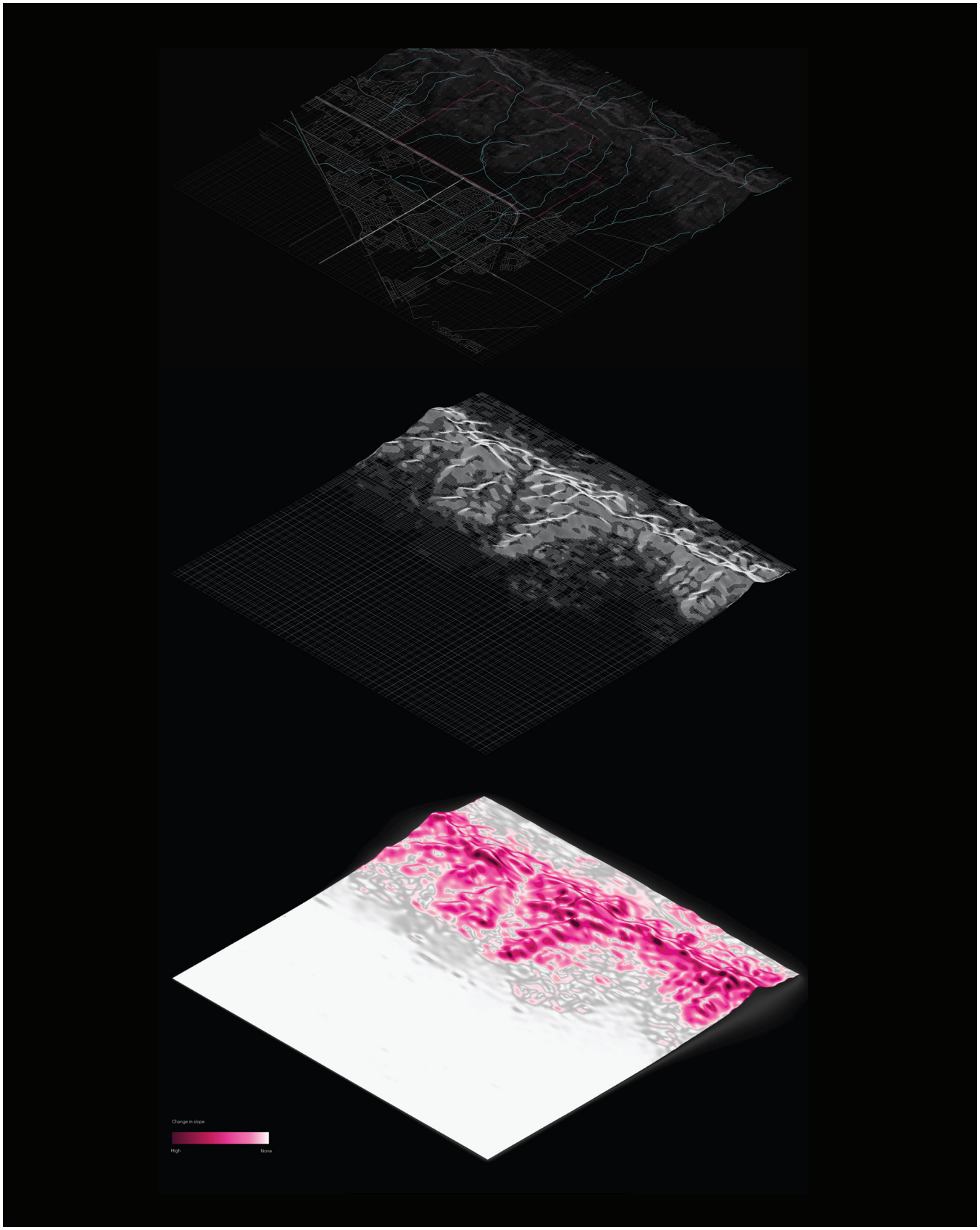

Figure 5. Territorial Vision Mapping: Virtual Smart Dust and Erosive Potential. Image Credit: Aurea Lopez (Student), Texas Tech University.

range of devices and applications developed across both military and civilian sectors increasing capabilities to detect and track changes in environmental phenomena.

Vision machines investigated in the studio included: Flash LiDAR (light detection and ranging) equipment, Tactical Unattended Ground Sensors (T-UGS), VADER (Vehicle and Dismount Exploitation Radar), Mobile Ground Penetrating Radar (MGPR), and Microelectromechanical Systems (MEMS, or *smart dust*). These technologies are used for a range of applications, across multiple military and civilian domains, and were selected for the studio to speculate on their yet-untapped capabilities to sense and image geophysical and atmospheric phenomena at synoptic scales. Special attention was paid to the possibilities of the technologies being sensitive to boundary transgressions otherwise unobservable by more common or traditional imaging capabilities.

Flash LiDAR is an imaging technology in which pulsing lasers record the depth from the sensor to nearby environmental features, including buildings, landforms, and vehicles. The technology has largely been developed to augment the responsiveness of unmanned vehicles to changing physical characteristics to their surroundings. The system has documented applications in terrain mapping, obstacle avoidance, aerospace applications for landing and airport surveillance. T-UGS are an increasingly common military technology in which unmanned sensors capable of registering vibrational disturbances in a landscape provide persistent surveillance capable of human and animal detection, identification, and tracking. Private security firms and border security applications have adopted this system as well, and it may have additional utility in monitoring geophysical and seismic shifts. VADER is an advanced aerial imaging technology used currently by border security agents to identify and tracking moving vehicles and subjects. MGPR is capable of imaging subsurface conditions through its sensitivity to different material densities. The mobile radar has recently been enlisted in border security operations to speed and facilitate the discovery of illicit tunnels, including at the US-Mexico border and within occupied Palestine.

Smart dust is a system of distributed low-cost microscopic sensing technologies in development for the last two decades with implications for innovations in the pervasive, unmanned monitoring of large territories. The systems can integrate with a range of electromechanical, optical sensing, and microprocessing technologies, allowing swarms of sensors distributed throughout a landscape to gather information on a range of territorial characteristics and behaviors. Applications for this technology have been developed and proposed to track environmental conditions like humidity, temperature, and moisture, as well as the tracking and recording of animal and human movement through miniaturized cameras, infrared lenses, and motion or pressure sensors. Smart dust developers have tuned the technology in recent years for a range of applications in agricultural and air quality monitoring, facility monitoring, border security and other military surveillance operations.

Students developed mapping and procedural drawing techniques, informed by their vision machine, to develop a critical representation of the territory and a method for design. The mapping and drawing techniques translated: the mechanisms and components of the vision machine, including auxiliary equipment/vehicles, the process of image-making, and the resulting image compared to the reality. Drawings described what each vision machine rendered visible or invisible, as well as what was emphasized, exaggerated, distorted.

BOUNDARY TRANSGRESSION MAPPING

The investigation focused on understanding previously unobservable geophysical and atmospheric transgressions across the boundary of Fort Bliss, leveraging the sensory logics of the territorial vision machines to document the findings. Fort Bliss is the largest installation under US Army Forces Command (FORSCOM), extending over one million acres across areas of Texas and New Mexico. This vast territorial boundary is secured by a hypermanagerial infrastructure, but it is also a boundary transgressed and traversed routinely by several terrestrial and atmospheric systems.

Student drawings uncovered the atmospheric, surficial, and sub-surface transgressions across the base boundary. Students began by assembling disjointed cross-boundary data, including urban-scale data from the city and the base, as well as larger territorial datasets documenting geophysical and environmental conditions across the multiple counties and jurisdictions the base neighbors and crosses. Using Geographic Information Systems (GIS) software, students were challenged to resample the available data to create more contiguous, complete, and finer-scale analyses synthesizing the disparate sources. In one analysis, a fine-scale assessment of the erosive potential of the territory was established by assembling and interpolating large-scale geologic, topographic, and hydrologic data (Figures 2 and 3). Erosion on base impacts the city and region as military training activities disturb and suspend soil, increasing atmospheric pollution and causing dangerous conditions for visibility and public health. After compiling and resampling the transboundary data, the student developed an overlay analysis, comparing areas of high slope, presence of dry watercourses, and soils with high emissive potential to identify the most impactful areas with high erosive potential in and around the base.

Students then developed algorithmic and computational mapping techniques to simulate the deployment of their selected *territorial vision machine* to sample, sense, and visualize the boundary transgressions. In one example, a student studying smart dust developed a dispersal algorithm which generated thousands of potential sample points, representing smart dust monitors, deployed along the boundary territory (Figure

4). The algorithm accounted for the mobility of the sensors within the dynamic landscape once deployed from selected aerial dispersal points, and tracked the sensors' projected movement as the sensors would encounter and be swept by watercourses on site.

From the overall analysis of the base/city boundary, students then conducted more detailed analyses of transgression in two particular sites. The first site is a former maneuver area on the southeastern edge of Fort Bliss (Figure 5). The site is defined by a number of territorial islands within this former militarized zone, including a state park (Hueco Tanks State Park and Historic Site), native lands (Ysleta del Sur off-reservation trust lands), and an unincorporated community (Montana Vista "colonia"). Peaks on the site have views to base activities. The site is near Cerro Alto, the highest peak of Hueco mountains. Site is embedded with layers of military ordnance and traces of military activity. An illegal dump site, and sites of historic training villages are nearby. The second site, dubbed Castner Range, is a decommissioned training range at the foothills of the Franklin Mountains, bisected by a mountain pass. The site is defined as an island of military land within the city fabric, bound by sprawling neighborhoods to the east, and nearby development to the north and south, with public programs including the National Border Patrol Museum, El Paso Museum of Archaeology, and the site of the annual poppies festival within its footprint.

CONCLUSION

The experimental pedagogical approach of the studio encouraged students to develop attitudes, positions, and proposals engaging aspects of contemporary urbanism, ecology, and critical theory as outlined above. Students developed sensitivities to transgressions of atmospheres, geologies, and populations across real and imagined borders and boundaries, applicable to a variety of contexts and scales of architectural endeavor. Through the critical engagement with the territorial vision machines, students were able to describe and leverage opportunities for technological transfer, engage emerging technologies from adjacent disciplines and industries, and apply their logics to architectural design methods, analytical methods, and construction methods.

The studio advanced experimental modes of representation capable of uncovering and communicating complex phenomena while projecting speculative architectural strategies capable of intervening ethically within urgent territorial transformations. Students developed procedural and computational drawing strategies to embed territorial representations with quantifiable data as well as embodied qualities, and developed unique modes of mapping addressing the synoptic scale. The sensory and visual logics of emerging and transformative territorial vision machines was translated through strategies of simulation and computation to create complete and contiguous visualizations of shared geophysical and atmospheric qualities of entangled, but jurisdictionally independent entities.

The studio attempted to "expand" the disciplinary "view" both in developing the capacity of architectural thinking to engage territorial phenomena, and the ability of architecture students to engage methods, workflows, and representational techniques from other disciplines—including geosciences, atmospheric sciences, and military sciences—driving the advancement of such studies. The tools and methods explored in the studio opened new possibilities for architects and other spatial practitioners to detect and act to engage transboundary phenomena to promote environmental and spatial justice in multijurisdictional territories.

ENDNOTES

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