Temporal Boundaries: Multiscalar Dynamic Modeling Techniques for Climate Change and Design

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Through several design research projects located at the border of the United States and Mexico, the relationship between boundaries, digital design methodologies, and field research techniques are explored to show new alter-disciplinary,[1] multiscalar approaches to the design of the built environment and its pedagogical models. Expanded ecological methods are highlighted with a focus on designing for climate change and the need for more adaptable, responsive, and intelligent research methods in our age of open systems.[2] Future directions for the academy, curricula, and practice are discussed.

ALTER-DISCIPLINARY DESIGN LOGIC FOR CLIMATE CHANGE

Architectural design processes are continuously evolving alongside developments of new tools, digital technologies, and software. In many ways, the influence of tool development upon architectural design, when transposed from other disciplines (i.e. CFD, GIS, LCA, etc.)[3] as opposed to originating within the needs of the discipline (i.e. AutoCAD, BIM, etc.),[4] may at times bring into question the agency of authorship. As we confront emerging challenges in the built environment, our discipline necessarily requires a mode of expansion to address the alternative and unconventional aspects of design that were not traditionally considered in our scope for application. This is partly realized with collective input from data and information gathered through entities and resources outside of architecture and partly with tools and techniques adopted from other disciplines. In assimilating the information and methods from realms beyond architecture, we begin to associate these aspects as inherent to our work and suggest formally identifying these adopted aspects as the alter-discipline in our logic of design. If we provide a framework for situating architectural design that incorporates contemporary theories and interscalar field research, combining information from both empirical and digital methods adopted from other disciplines, then the emerging practices of architecture will incorporate an *alter-disciplinary* approach resulting in an expanded ecology - making apparent otherwise invisible relationships between natural, built, and human environments.

Working from a very broad question - how do we mitigate climate change through built environment design? - the specificity of place is investigated in the Sonoran Desert region of the Mexican and US border to address both technological and cultural outcomes. The topic is complex, and thus constitutes an approach to problem definition and analysis that embeds processes for comprehending various physical, socio-political, and cultural layers simultaneously. The effects of climate change are dynamic and temporal and concurrently impact human and natural entities alike. To position responsiveness of the built environment and architecture through climate change is challenging in part because the phenomena resides at a global scale, which both limits usefulness for local contextual application and creates a dilemma across socio-cultural and political causes. The predominance of approaches to climate change and design are technical in nature with primary aspects addressing carbon dioxide (CO_2) emissions, energy use, and material life-cycles (i.e. biogenic vs. concrete and steel). While these approaches are universal and helpful by means of transforming the chemistry of earth's atmosphere through a shift in technological practices with alternate natural resources and processes, the immediate impacts are less known due to global uncertainties in terms of political alignment and other factors. For example, deforestation for agriculture development is causing approximately 4.8 billion tonnes of CO_2 emissions annually since 2015, which totals about 10% of anthropogenic global emissions.[5] This practice has no direct link to built environment design, yet is a major contributing factor to global climate change. In another example, livestock farming practices produce high amounts of methane and nitrous oxides and account for 7.1 Gigatonnes of CO_2-equivalent emissions annually, which represents 14.5% of global anthropogenic greenhouse gas emissions.[6] Ostensibly, the building industry contributes 40% of CO_2 emissions globally,[7] which can be attributed primarily to operational energy for heating and cooling as well as embodied energy of construction materials. However, the impacts of carbon emissions on climate change and the reciprocal effects, such as increasing temperatures, rising sea levels, unpredictable storm patterns, forest fires, viral outbreaks, climate migration, water scarcity, etc., render much of our existing built environment susceptible to natural disaster and unaccommodating to the adaptation necessary for resiliency to such trends. It is indeed these conditions that require us to advance design

processes that move beyond carbon and energy aspects of architecture and into territories that address the interrelated complex effects, ultimately assimilating an *alter-disciplinary* approach to our practices.

Climate change is linked to the Anthropocene: the blurring of nature, the built environment, and often more invisible digital world. Architecture has its origins in shelter from climate; so what does this mean for the profession and our academy when we acknowledge that climate is changing? How do we address this to make architecture that is appropriate? Surely a knowledge and awareness of adaptability and a deeper knowledge of natural systems are key. Concepts of adaptation and change necessitate a different embedded logic in the design process for outcomes that enable ongoing responsiveness to climate change dynamics. In order to establish outcomes that facilitate processes of adaptation, links between the micro-scale DNA/RNA of systems must be made in corroboration with macro-scale information.

ARCHITECTURE STUDIO DESIGN PEDAGOGY

This essay disseminates select outcomes from a design pedagogy that was executed in an upper level design studio in a state university, land-grant institution in the fall of 2020.[8] The studio co-convened 20 undergraduate and graduate architecture students in accredited programs as well as research-based post-graduate master's students from international backgrounds.[9] The overarching pedagogy followed a 16-week sequence that began with theory readings, digital design methods, micro-macro field work, and culminated with design proposals. The interscalar context for grounded research and climate change impacts was focused on the Sonoran Desert region of Arizona and Sonora, Mexico. Because of the challenging political context at the border of Mexico and the United States (US) and the presence of a physical boundary, migration paths, ecological flows and humanitarian crises are further exacerbated.

The design pedagogy was influenced by the process of thinking and doing (innovation) versus the more traditional architectural studio brief of problem-solving, where students are typically handed a site and program and work within these given constraints. This more emergent, design as research based trans-critical,[10] studio pedagogy makes the students more active participants in the learning process and reflects the dynamic nature of knowledge and life. Design thinking (theory) and doing (practice) are non-linear, so production and reflection are an imperative part of the process. Requiring students to pursue multiscalar inquiry with the macro-scale data mapping and subsequently forcing a close look at micro-scale field conditions is a clear example of engaging the thinking (analyzing correlational spatio-temporal data) and doing (experiencing, measuring, and documenting the micro-environment). Furthermore, the studio was co-taught equally between the two authors, each with their own distinct and shared knowledge (urban design at the macro-scale vs. material science at the micro-scale), providing for consistent conversation of critical inquiry in the teaching and learning process.

The pedagogical goal was to create a scaffolding for the students to develop their skills on multiple levels, where there was not one unified theory or direction, as in certain times of history, but where students were encouraged to innovate in sometimes messy, individual ways and given space to explore, fail and iterate to find more ecological ways of moving forwards addressing some of our wicked problems.

Design intelligence is not about just access to information, but also how it is edited and layered. It is important to realize that this access is not always equitable; the border location was in part selected to heighten awareness of this issue to the students. Students also need to develop ethics and learn how to ask thoughtful research questions, access information, contextualize their sources, and evaluate information from multiple perspectives (picking up on noise and chatter from perhaps less traditional sources). Our buildings and constructed artifacts are not isolated objects, but are connected to global patterns, supply chains, and practices. This glocalized reality means that an awareness of information and contexts at multiple scales is needed.[11] Since multiscalar information is dynamic and constantly changing, using real-time data capture and analysis allows for heuristic and responsive processes. Parametric, relation-based models and simulations are key methods which aid in negotiating the complexity of the real. Digital agility (intelligence), connecting different software platforms, tools, and information, is a crucial trait that architects need today to navigate a consistently changing world.

To enable access to macro-scale data mapping, the studio introduced students to geographic information software (GIS) for the first time with the school's architecture curriculum. A GIS workshop was organized with a faculty colleague from Landscape Architecture. For conceptual links, Geoffrey West's book, Scale, The Universal Laws of Growth, Innovation, Sustainability, and the Pace of Life in Organisms, Cities, Economies, and Companies was introduced to help students explore the power laws and fractal and network geometrical relationships between the macro and micro fabric. "There is a common conceptual framework underlying all these complex phenomena and that the dynamics, growth, and organization of animals, plants, human social behavior, cities, and companies are, in fact, subject to similar generic 'laws.'"[12]

Beyond directed theory readings and inter-disciplinary digital workshops and lectures, field work was also introduced to get students outside to experience additional modes of exploration, information, and possibilities. The more natural parts of the environment tend to be more complex than the

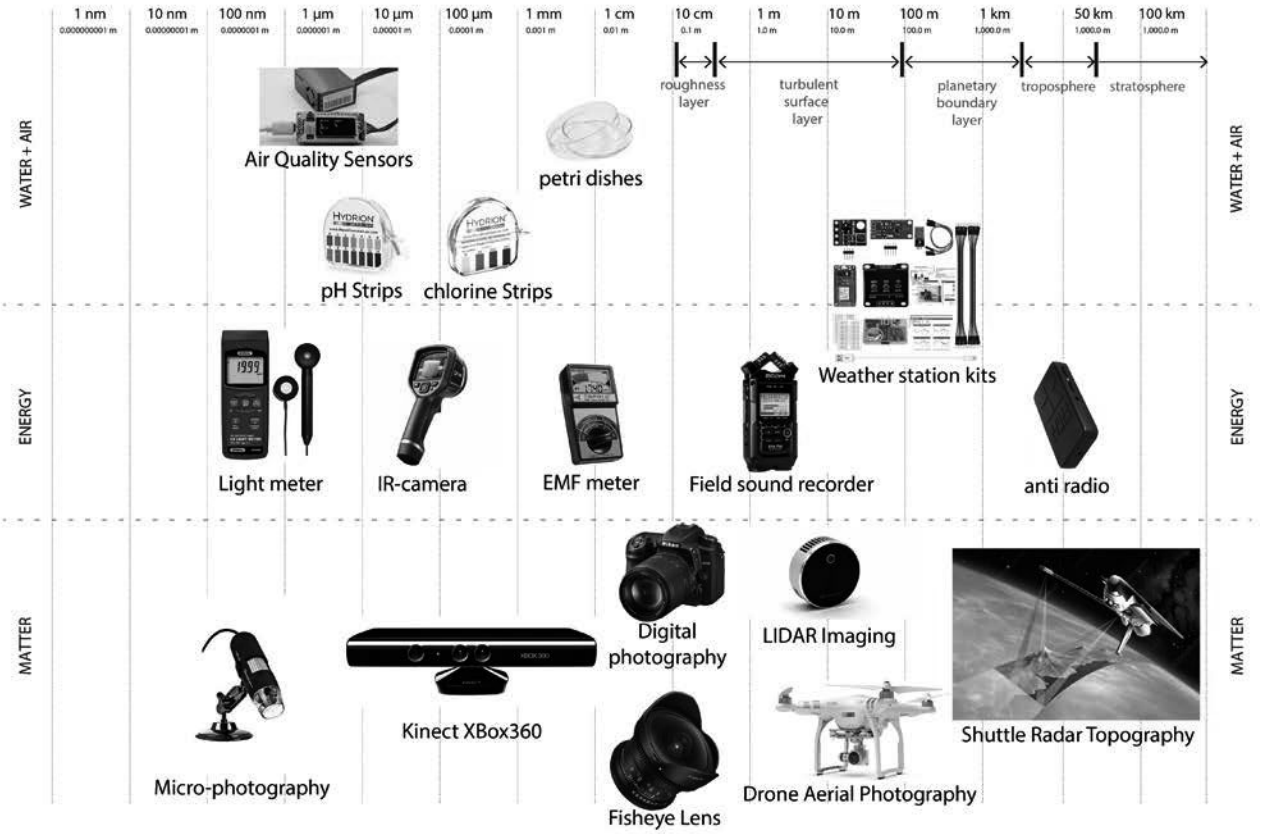

Figure 1. Interscalar field tools for sensing and measuring the environment. Authors (2021).

built environment, so natural phenomena are important for students to learn and experience from, going beyond the traditional, visual observations. To aid in this students were given a list of possible field tools and methods for analyzing the environment (Figure 1). They were also encouraged to research other tools, as these are continually developing too. All individuals' field research was shared with the entire group during the semester as a way of tapping into the collective intelligence that a larger group can provide. An understanding of complexity theory was also disseminated as it is a way of connecting artificial and natural systems at various scales.[13] The field experiments, theory, and data are key to leveraging an emergent design process, i.e. used as a seamless design and knowledge predictor.[14] This iterative, process of making, mapping and/or prototyping, and the dissemination and/or abstraction of what is perceived is imperative. "Mapping differs from 'planning' in that it entails searching, finding, and folding complex and latent forces in the existing milieu rather than imposing a more or less idealized project from on high… whereas the plan leads to an end, the map provides a generative means, a suggestive vehicle that 'points', but does not overly determine."[15] This mapping was encouraged to be as dynamic as possible, incorporating aspects of time and phasing, more aligned with landscape architecture's traditional realm. Benjamin Bratton has written that, "Intelligence can be modeled as a capacity for abstraction, and computation is a technique of intelligence, so computation can model both procedural and aesthetic abstraction," noting also that no single disposition has a monopoly on this.[16]

Encouragement was provided for students to seek out more invisible forces of nature, culture and infrastructure, not for the sake of being avant-garde,[17] but to become more aware of the other. Luce Irigaray has written, "But the invisible takes part in our everyday relations with the world, with the other(s). For example, the air through which we relate to the world and, in some way, with the other(s), remains invisible. The void of the "thing" which allows it to hold – as Heidegger commented –cannot be represented. And our interiority neither. The relations between us and the world, us and the other(s) are not visible. If we can perceive something of our interiority and our relations with the world or the other(s) through their expression or their effects, they remain invisible as such."[18] Her desire to include items like the air, are particularly relevant when we talk about climate change and pollution, which have disproportionate effects on low-income neighborhoods and are often overlooked or invisible.

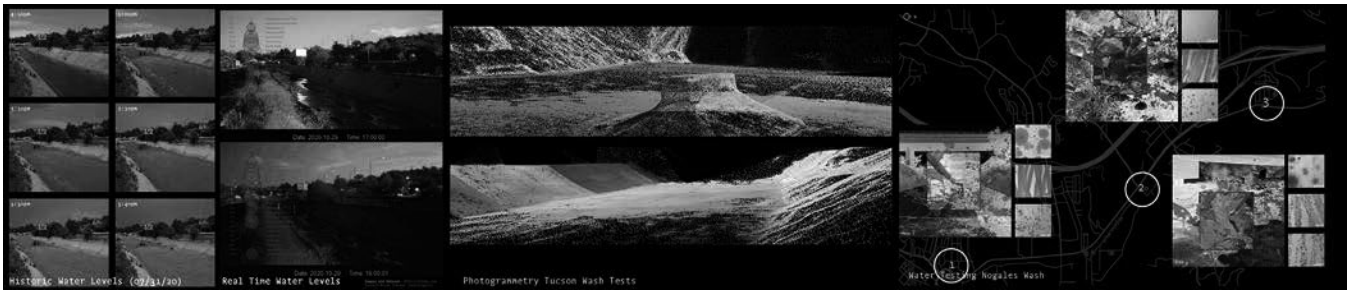

Figure 2. Nogales Wash field documentation: flash flood and wash water levels (left), photogrammetry (center), and water quality sampling (right). Athena Myers (2020).

PROPOSITIONS OF THE ARTIFICIAL AND NATURAL

This essay focuses on two of the semester outcomes to highlight the pedagogy and methods more clearly: 1) Athena Myers' *Kinetic Wave*, and 2) Andrew Puppos' *Hospedajes*. Each project depicts the interrelationship between often unnoticed and invisible conditions of natural and human contexts, which demonstrate aspects of both cause and effects of climate change, through manifestation into physical architectural works that heighten societal awareness and engagement with such conditions.

In the *Kinetic Wave* project, Athena began her research with geographical mappings of human migrant deaths due to dehydration and hyperthermia correlated with groundwater well locations near the Arizona-Mexico border. Using Groundwater Site Inventory (GWSI) data with shape-files and ArcGIS, she applied the dataset time scale intervals to animate both the water well changes and migrant death rates occurring between 2012 to 2020. The study reveals that the majority of deaths occurred in areas without water wells and a scattering of deaths in areas of southern Arizona where water well levels are extremely low. In addition, Athena began to study this data in a three-dimensional way, first applying the National Agriculture Imagery Program (NAIP) data to develop 3D topography with point clouds, and then using the Quela agent-based design plugin for Grasshopper to activate water level depths in response to migrant deaths over time - providing a correlational tool that depicts groundwater volumes with point clouds, which disappear in locations where corpses are present. Her interests with the dematerialization of boundaries inspired her to work with point cloud visualization through much of her work. She initiated a study with the Kinect Xbox360 device to obtain human gesture recognition through a combination of RGB, infrared projection, and depth mapping, which she then visualized in real-time on Processing.

Working from these original studies, as Athena embarked on field work she focused on the water conditions closely surrounding and within the Nogales, Arizona border region. She visited and documented the water conditions of the Nogales Wash, which weaves back and forth across the Arizona-Mexico border. Accessing both recorded video footage and water level datasets for the Nogales Wash,[19] the information revealed long periods of low water level coupled with sudden and immediate short-term flash-flood water levels of the wash. Athena prepared a method for photogrammetry of wash infrastructure, using Autodesk Recap software and conducted tests to convert the imaging capture into point cloud topography. She also collected water, soil, and plant samples from the Nogales Wash at three sites along its north-south length and used microphotography to visually depict the microbiological comparisons (Figure 2). The water quality varies along the flow of the wash, which initiates to the east at the base of Arizona's Bisbee Lavender Pit copper mine and moves briefly south and west through Nogales, Mexico, then heads north into Arizona and towards Tucson. The water treatment plant does not occur until a bit north of the wash's re-entry point into Arizona, where water quality begins to improve. The movement of fine metals and particulate trace elements from mining activities in the US are carried directly into Mexico via the Nogales Wash, settling into groundwater and soils as environmental contaminants.

To address these intricately linked areas of study, Athena's work culminates with the Kinetic Wave - an installation of interactive membrane structures at two existing bridge crossings (one in Arizona and one in Mexico) of the Nogales Wash (Figure 3). The membrane structures serve both as projection screens for transborder human interaction and as flood alert systems by kinetically reacting to water levels in the wash. The anticlastic membranes are designed with PVC fabric wrapped around steel frame components that have intermittent rods which behave like pistons, pushing up and down on the membrane with servo-motors linked to water-level hydraulic sensors that connect into the wash through the foundation footings. Athena used the physics-based Kangaroo plugin to assist with the dynamic membrane modeling and design. Low water levels allow for pedestrians to pass under the structures, where the human movements and gestures are simultaneously projected onto the membrane fabric of the opposite structure (i.e. Arizona pedestrian activity maps onto the Mexico membrane fabric). High water conditions will

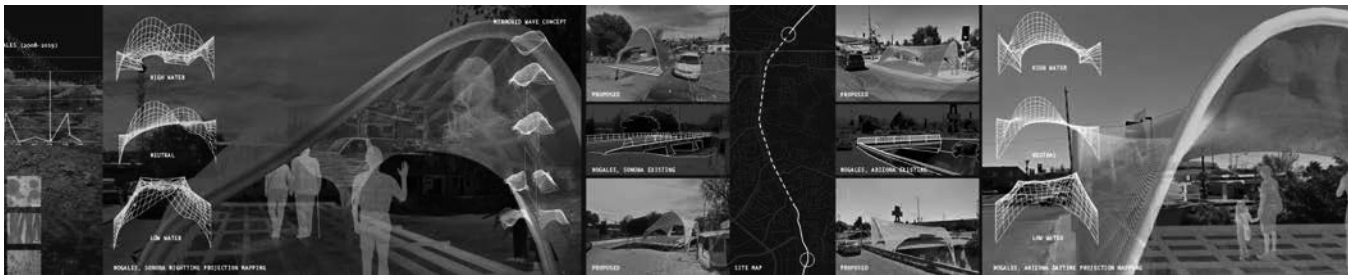

Figure 3. Interactive anticlastic membrane structures located on two existing pedestrian bridges for transborder communication - one in Nogales, Sonora (left) and one in Nogales, AZ (right). Athena Myers (2020).

cause the membranes to close down, prohibiting pedestrians from crossing the wash and serving as temporary flood warnings by this visual cue within the city.

Hospedajes, the Spanish term for 'guest-house,' is a project that addresses a humanitarian need for transitory housing of climate migrants and asylum seekers at the Mexico-Arizona border. Andrew embarked on his study of climate change through climate migration mapping, identifying relocation trends of populations from places that are experiencing greater climate change impacts to other locations that are currently less impacted (i.e. minimal natural disasters, adequate temperatures, etc.). One example of a climate migration population is affected by reduction in agricultural production viability, thus a loss of livelihood, occurring more frequently in Central and South America with increasing temperatures due to climate change.[20] The people migrate north to the Mexico border to apply for asylum in the US, which at times results in population influx without housing, services, and resources to properly support the people during the asylum waiting period. As waiting periods can occur anywhere from three days to ten months or more,[21] the infrastructure to sustain the transitory populations is identified as a need in Nogales, Mexico and Arizona.

Utilizing a GIS mapping technique, Andrew investigated relationships between land use and community resources to identify potential sites for migrant housing in Nogales, Mexico. He also mapped regional soil conditions to determine locations of high-clay content soils that could potentially be utilized for local construction materials. The emphasis in this project was on the construction technique and design for housing units that engage the migrant community both in the process of construction and through the dwelling arrangement and inhabitation of space. Taking cues from historic and traditional regional building techniques utilizing earthen materials for adobe, Andrew advances the soil-based constructions with 3D printing to enable more complex geometries for site-specific environmental performance and to reduce on-site trades to expedite construction, enabling designs that are simultaneously forward thinking and primitive. Furthermore, the project intends to engage migrant populations with the construction process, whether in the gathering and mixing of soils or skill development with the printing and extrusion technologies (Figure 4).

For the design development, Andrew integrated solar radiation analysis with the Ladybug plugin to inform different geometries of the dwelling unit forms and then optimized the extrusion topologies for self-shading effects based on intense zones of radiation. Since Andrew was working remotely from Ohio with his own custom printing bed, but unable to conduct field visits in Arizona, he focused on developing both the g-Code for the extrusion toolpath and the printing nozzle setup for the clay-based soils. The embedded intelligence in the design and printing process for the clay structures provides one example of climate adaptive design, both in its formal and micro-logic and in the material life-cycle process. Without the tools and techniques that allow for computational integration of spatio-temporal climate information, the resolution of design outcomes would be limited and lack accessible links between the macro-geometry and micro-topology of the construction. Design processes that inherently streamline the architectural and material conditions with the production and fabrication methods are lending to emerging practice models which seamlessly integrate these activities that historically reside amidst different trades and disciplines.

EXPANDING ECOLOGIES

The project examples represent select outcomes, though not comprehensive to the entire course, which utilized the methodological framework in different ways.

Each project captures an essence of the multiscalar inquiry, starting from broad information mapping and then diving into the micro-conditions of biology and physics in the field or of material conditions in the design. One of the issues that became apparent in the transborder context between Mexico and the US was the limitation to Mexico's information and datasets that otherwise are accessible for the US (i.e. air quality data, weather station data, etc.). In addition, each project incorporated parametric digital tools in the design process to enable an optimal morphological relation to the physical environment - from structural kinetics optimization in the *Kinetic*

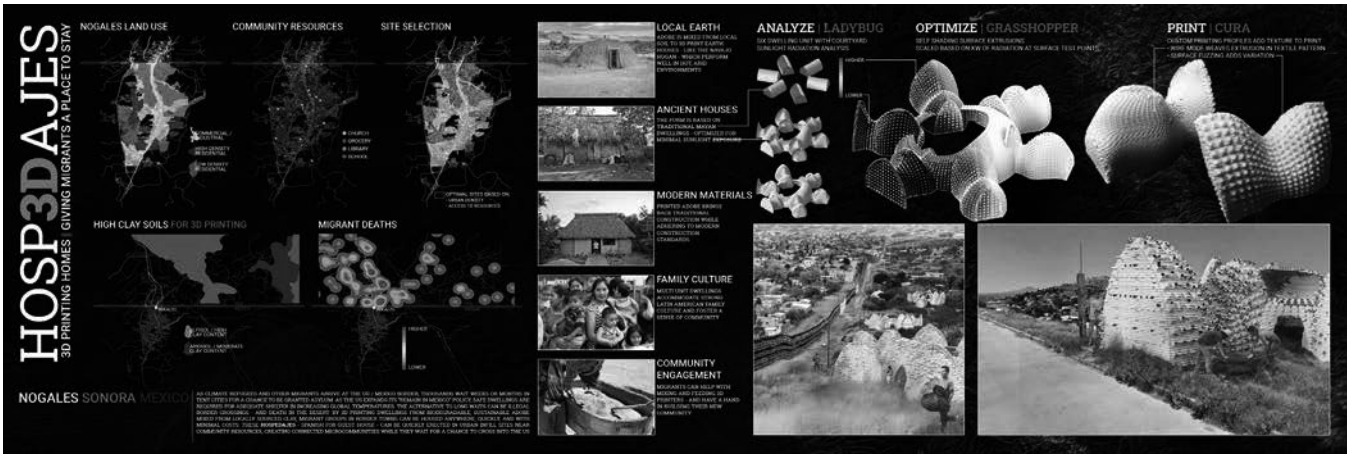

Figure 4. Regional GIS mapping for migration and soil analysis (left) and proposed 3D-printed earthed dwellings (right). Andrew Puppos (2020).

Wave membrane, to the solar radiation optimization in the *Hospedajes* structures and material topologies. Furthermore, each project incorporated interactive relations between humans and machines in the resulting proposed works - from the human-gesture projection mapping in *Kinetic Wave,* or the hands-on collaboration with migrants and soil printers proposed for construction of *Hospedajes'* units. In the Information Age, it is important to embrace our cyborg self, mixing artificial intelligence (AI), but also using our bodies, being physically alive and active.[22] Each project demonstrates this intention in the work, capturing the awareness of individuals who are confronted with opportunities to engage with the built and natural environment, which eventually can make shifts in socio-cultural practices - a significant part of addressing climate change through action. Finally, though not prescribed in the methodology, the selected projects also depict the significance of historical research (data over time) to inform the proposed technological artifacts - from the historic water levels of groundwater and washes in *Kinetic Wave*, to the historic material techniques with regional soils that inform *Hospedajes* construction.

The methodology established for this design studio demonstrates a range of potential outcomes that were stimulated by the intellectual synergies for critical and theoretical inquiry within the process of design. Process evolves amidst a continuum of technological shifts, and technology itself becomes the basis upon which history and nature intersect to facilitate critical cultural artifacts.[23] Cultural theorist Peter Sloterdijk posits that contemporary thinking necessitates abandoning polemic dualisms, which result in hybrid reality technological advancements, and is convinced that thinking must engage the 'hyper-complexities' of elastic horizons.[24,25] Science encourages transparent cross-sections through multiscalar correlations, seeking demystification of divergent magnitudes; the Eames' "Powers of Ten" dissection reaffirms this fascination for design disciplines.[26] Alter-disciplinary contextual analyses are a translation of the interscalar cross-section as genesis for making sense out of life's complexities, as is a historian's cross section through time. Navigating each of these dimensional transects in turn provides the groundwork for emergent discovery and innovation, an approach that is called for in times of uncertainties and change if only to reveal the unknown relations between living, non-living, and hybrid systems. Alternative logics in our design processes are necessary beyond individual courses and institutions, i.e. across the entire curricula and working with others in the region and beyond, in order to comprehend contemporary dynamic forces, complexity theory, and interscalar relations pertinent to regional socio-cultural, ecological and political perspectives.[27]

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We would like to thank the College of Architecture, Planning, and Landscape Architecture at the University of Arizona, which gave us an in-house Grassroots Teaching Innovation Grant, which helped fund guest lectures, field tools, and various other items. As participants in the summer 2020 ACSA Border Consortium Workshop, the authors were inspired by the presentations and discourse around US-Mexico border issues. Precedents such as this, as well as guest lectures and/or review input in our studio provided by Chris Lasch, Kiel Moe, Ronald Rael, and Kathy Velikov further inspired the students to think outside of traditional architectural design boundaries, the importance of field work, the potentials of digital simulation tools to inform dynamic processes, and also eliminated a priori intimidation of working around and directly with the border wall infrastructure and border politics. We would also like to thank our faculty peers at the University of Arizona who gave lectures and/or workshops from their disciplines: Professor Diane Austin, Director of Anthropology, Professor David Taylor, School of Art, Associate Professor Shujuan Li, School of Landscape Architecture, and Associate Professor Kamel Didan, Biosystems Engineering.

ENDNOTES

1. Alter-disciplinary aspects of architecture are those borrowed from other disciplines that have assimilated into our practice over time. This is a distinction from inter-disciplinary (working collaboratively with experts from other fields), trans-disciplinary (an individual authoring expertise in more than one discipline embodied in the work). The alter-disciplinary aspects of architecture emerge from the multi-disciplinary (combining several disciplines in the approach to a topic) but carry forwards, and are repeatedly used, in ways that transform to become embedded in the regular practice.
2. Relates to Kiel Moe's 2018 call in his essay "Architectural Research in an Age of Open Systems" in Technology|Architecture + Design, (TAD) 2:1, p.8-10.
3. Computational Fluid Dynamics (CFD); Geographic Information Systems (GIS); and Life Cycle Analysis (LCA).
4. Computer Aided Design (CAD); and Building Information Modeling (BIM).
5. World Resource Institute. Annual Report 2018-19. https://www.wri.org/annualreport/2018-19/
6. Food and Agriculture Organization of the United Nations, "Key facts and findings." Accessed Jan 2020. http://www.fao.org/news/story/en/item/197623/icode/
7. International Energy Agency, "World Energy Outlook 2020." Accessed Jan 2020. https://www.iea.org/reports/world-energy-outlook-2020.
8. The University of Arizona was established as a land-grant university in accordance with the Morrill Act of 1862, which endowed federally-controlled land to the state for the use of higher education whose purpose would be "[…] to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life" (Congress of the United States of America, 1862). In particular the Morrill Act was in response to the industrial revolution and emerging social classes in contrast to the preceding practices of higher education emphasizing primarily the liberal arts.
9. At the time this studio course was developed, the COVID-19 outbreak and global pandemic occurred, resulting in shifting implications for built environment design (i.e. spatial, material, and technological reformations) and pedagogy (i.e. remote learning formats). Early speculations by factions of the scientific community indicate that the genomic sequencing of emerging viruses and pathogens may be directly linked to climate change (see Harvard's T.H. Chan School of Public Health "Coronavirus, Climate Change, and the Environment" https://www.hsph.harvard.edu/c-change/subtopics/coronavirus-and-climate-change/). Integration of these relevant discussions were implemented within the Climate Change and Design studio course. The course was also adapted for hybrid learning environments (online and in-person formats), which provides further enhancement and emphasis on the use of digital tools and how the digital design methods might facilitate the connection of designers to remote locations and robust information without opportunities for direct phenomenological experience.
10. Ashraf M. Salama has argued that this direction in pedagogy is needed today in part to be a more adaptable, evidence-based design studio and he encourages a less hierarchical relationship between educators and students, where both learn, ideally in trans-disciplinary contexts in Spatial Design Education: New Directions for Pedagogy in Architecture and Beyond. Farnham, UK: Ashgate Publishing, Ltd, 2015.
11. Neil Leach in his essay, "Parametrics Explained" in Next Generation Building, Vol 1, No. 01/2014 edited by Kas Oosterhuis, Baltzer Science Publishers (2014) pp 33-42, p. 41, is where he points out that the hybrid term, glocalization, which denotes a mix of the global and local, has gained prominence in recent years.
12. Geoffrey West. 2017. Scale – The Universal Laws of Life, Growth and Death in Organisms, Cities and Companies: New York: Penguin Books, p.5
13. Relates to pedagogy built up over time by the author, most recently disseminated in the essay, "The complexity of the natural and built environment" in the Conference Proceedings (2021) of the conference, The City and Complexity: Life, Design and Commerce in the Built Environment, by City University of London, AMPS, Architecture_MPS, 17-19 June, 2020.
14. Relating to John Holland's work, Emergence: from Chaos to Order, Oxford University Press (Oxford), 1998 and also that of Michael Hensel, Achim Menges and Michael Weinstock, "Morphogenesis and Emergence" (2004), initially seen in architecture related to geometric complexity, but now seen as inclusive of socio-cultural, economic and ecological conditions.
15. James Corner, "The Agency of Mapping: Speculation, Critique and Invention" in ed. Denis Cosgrove, Mappings. London: Reaktion Books, 1999, pp188-225.
16. Benjamin Bratton, "Geographies of Sensitive Matter: On Artificial Intelligence at Urban Scale" in New Geographies 09: Posthumanism, edited by Mariano Gomez-Luque and Ghazal Jafari. Cambridge, MA: Harvard University and Actar D, 2017, p.29.
17. Michael Speaks in his 2002 A+U text and beyond, talks of the avant-garde as seeking unusual ideas or experiments for the sake of being different.
18. From Luce Irigaray's 2004 essay, "To paint the invisible", in The Continental Philosophy Review (2004) 37: 389-405, p. 395, Springer, 2005, translated by Helen A. Fielding. Similarly Juhani Pallasmaa's The Eyes of the Skin, 2005 seeks to move beyond the modernist tradition of privileging vision to include a more expanded field of senses and promoting an active user and their respective body.
19. J.E. Fuller Hydrology, https://www.jefuller.com/
20. Amanda Cady Hallett. "How climate change is driving emigrants from Central America," PBS World News, Sep. 18, 2019. https://www.pbs.org/newshour/world/how-climate-change-is-driving-emigration-from-central-america
21. American Immigration Council. "Policies Affecting Asylum Seekers at the Border." January 2020.
22. Donna J. Haraway, "A Cyborg Manifesto", in the Socialist Review, no. 80 (1985): 65–108, Center for Social Research and Education, (San Francisco: CA).
23. Hannah Arendt. Between Past and Future. New York, NY: Penguin Books, (2006): p.61.
24. Peter Sloterdijk. What Happened in the 20th Century? Christopher Turner, trans. Cambridge, UK: Polity Press, 2018.
25. Elastic horizon: a notion of conceptualizing presented by Steven Holl in collaboration with Alberto Perez-Gomez, which enables the humanist imagination to extend into global, cosmological awareness.
26. Eames, C. and Eames, R. Powers of Ten. Video documentary, (1968). https://www.eamesoffice.com/education/powers-of-ten-2/
27. Ersela Kripa and Stephen Mueller are working on a Border Consortium Network that we hope to contribute to, which we learned about at the ACSA Border Consortium Workshop. https://www.acsa-arch.org/conference/acsa108-virtual-conference/border-workshop/