Landscapes After The Bifurcation of Nature

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Models for Speculative Landformations

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ABSTRACT

Landformations have not historically been the purview of design production or intervention. Whether it is the spatial extensions in which they emerge, the temporal extensions in which they operate, the complexities of their generative and sustaining processes, or a cultural and institutional deference to a notion of *natural* processes, designers as individuals or design as a discipline has not treated landformation as an area of design inquiry. But the inability to grasp nature fully has not stopped geological-scale manipulation by humans. In fact, anthropogenic activity is responsible for the re-formation of more of the Earth's surface than all other agents combined.

And yet as designers we often disregard this transformation as a design problem, precisely because it eludes the artifices of information visualization employed by designers. This paper examines ongoing research into the generation of *speculative landformations* through an analysis of underlying geological and anthropogenic processes as the quantitative basis for creating generative computational models (figure 1). The Speculative Landformations Project posits human geological-scale activity as a design problem by expanding the operability and agency of environmental design practice through hybrid human/digital computations.

1 3D surface articulation of existing topography from USGS, Digital Elevation Model (DEM).

GEOLOGICAL AGENCY

Anthropogenic by Design

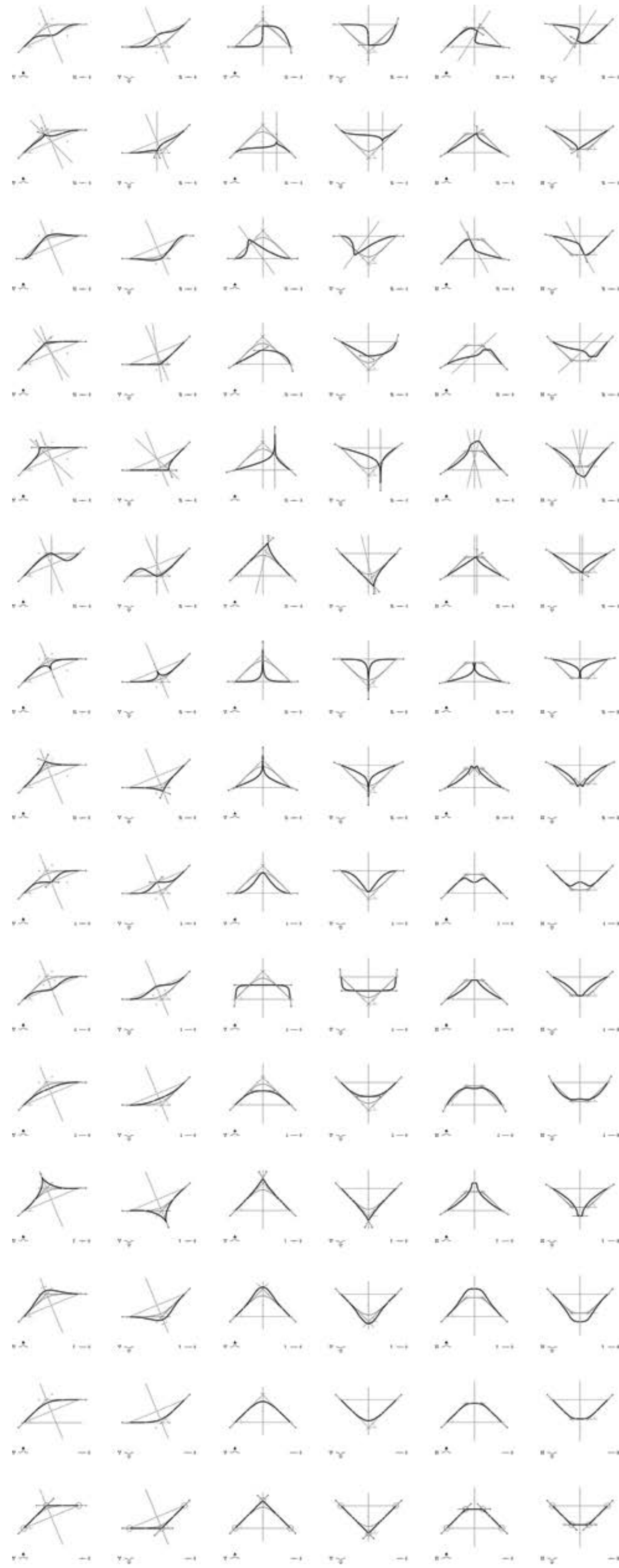
Through a systematic manipulation of the landscape, humans account for the fastest geological transformation of the Earth's surface in its 4.54 billion year history (Wilkinson 2005). Anthropogenic activity is responsible for the re-formation of more of the Earth's surface than all other mechanisms combined. Agricultural and industrial practices impact the majority of this change. When, combined with formations and programs traditionally held within the domain of design and architectural practice—spaces of habitation, occupation, protection, and labor—humans have steadily increased the depth of the Earth's anthropocentric event layer to span over 2,000 meters (Sanderson et al. 2002).

The goal of this planetary re-formation project has been to domesticate our environment through the mitigation or exploitation of its material processes and effects. Human intervention, however, has been unable to target specific environmental processes, and cannot generate isolated effects. The interconnectedness of constituent agents, pressures, and materials in any ecological/environmental system undermines the effect of creative and projective spatial design practices such as architecture, landscape architecture, and urban design.

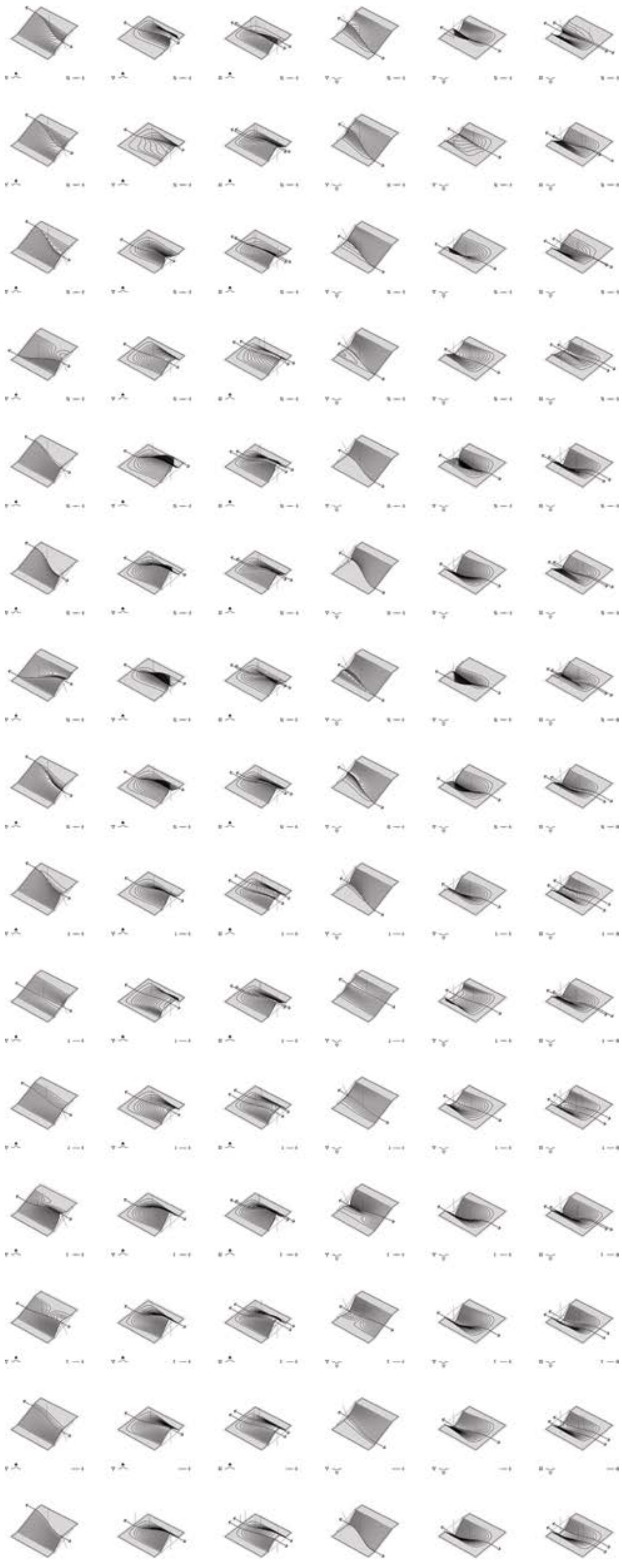
The *Speculative Landformations Project* (SLP) is an ongoing body of research that re-frames the question of anthropogenic landformation as a design problem. Through the creation of a hybrid analytical model which combines human and non-human computational methods, the SLP reverses the predictive goal of analysis to the speculative goal of design. This reversal focuses on two aspects of landformation: *phenomena* —the events that are produced as a result of information exchange—and *artifacts*—the formal results of those events (Beaman & Hong 2016). In this early set of iterations, the SLP is centered on examining landformation morphology (figures 2 & 3) and process typology as vehicles for examining existing ground conditions and generating potential configurations.

Post-Human Propositions

Landformations have not historically been the purview of design production or intervention. Whether it is the spatial extensions in which they emerge, the temporal extensions in which they operate, the complexities of their generative and sustaining processes, or a cultural and institutional deference to a notion of natural processes, neither designers as individuals nor design as a discipline has treated landformation as an area of design inquiry (Smith 1994).[1] This perception of a distinction between what exists and what is within human capacity to know, and thus intervene in—what Alfred North Whitehead called the " bifurcation of nature"



2 Landformation Morphology—*abridged*: Profile Analysis.



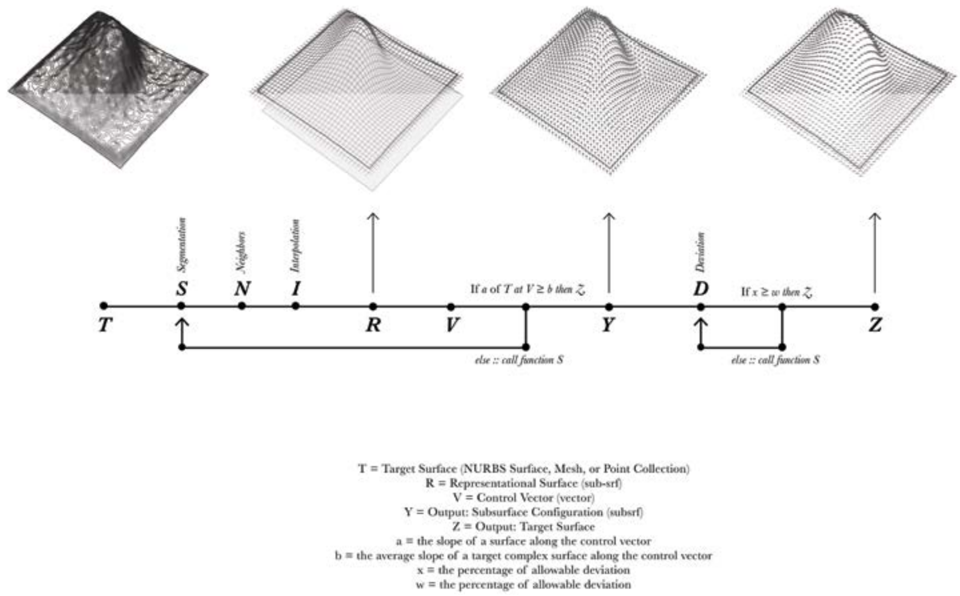
3 Landformation Morphology — *abridged:* Surface Analysis.

—undoubtedly colors the tendency to address landformations as entities which lie outside design practice (Whitehead 1920, passim). But the inability to grasp nature fully has not stopped geological-scale manipulation by humans.

This was first achieved through direct manipulation, relying on heuristic knowledge bases such as cultural traditions and practices (Goudie 2009). The scale of intervention widened as representational models of landformation systems developed. These "interpretive structures" allowed scientists and engineers to investigate both exogenic and endogenic land forming processes by mitigating the amount of information needed to describe an observed process or condition (Weisberg 2013, 15).[2] Computational models operate much in the same way as conventional representational models in that they reduce the complexity of an actual environment by creating a corollary between it and a computational model in an effort to study actual phenomena and artifacts through abstracted ones contingent on less information .[3]

Computational methodologies in landscape design, much like their counterparts in architectural design, assist in the design process by magnifying the ability to test a set of procedures carried out within a domain of variables, generating multiple solutions through an iterative process. Solutions are constrained to the structure of the model which means that the methodology and evaluation of model-to-target correlations determine the validity of computational (and indeed all) models (Weisberg 2013). However, for design, correlation to actual environments is only half the problem. The other half includes the creation of future configurations of current environments or wholly new ones that replace, or exist parallel to those problematized. This marks a departure from the analytical or predictive capacity needed in the sciences to the projective or speculative capacity required in design. How can these two capabilities be bridged?

Whitehead again offers an alternative framework through his use of the term "propositions"—a way of suspending the desire toward judgment of truth in favor of opening up discovery. (Shaviro 2009, 3). All representational models have latent biases which preclude certain sets of information in an effort to affect others. While these have come to be known in part as a "simple fictions" (Weisberg 2013), "purely fictional entities are not constituents of propositions" (Walton 1990, 32).[4] Proposition leverages the strengths of the logical (model structure), and the strengths of the analogical (intuitions, resemblances, or affinities assigned or imbued within the model). The combination resides somewhere between the fictional and the factual. Its advantages become apparent in computational models where both analogical and logical structures combined can exceed the representational capacity of either alone. It is in this hybridized position that speculation is viable.



4 Landformation Analysis-to-Proposition Procedure (simplified).

It is within this conceptual framework that the SLP examines how propositional structures within computational models might open up design inquiry in a way that bridges analysis and projection (figure 4).

SPECULATIVE LANDFORMATIONS

Analysis to Projection

Computational proposition can open landformation to design inquiry. The SLP seeks a process for landform exploration and production that extends the ability of designers to understand and communicate the operational, material, and technological history of constructed landscapes as well as their potential material, phenomenological, and technological futures. To build a model that worked in this way, we looked toward other disciplines that explore this general approach. Though there is a long history of analytical and predictive modeling of landforms and formation processes , only those instrumental to the SLP's early stages are covered here.

We began by understanding topographic characteristics as formal manifestations of dynamic systems in either stable or perturbed states. But to be able to utilize these formations in a design process, the ability to project them as discrete properties of future conditions was needed. In geomorphology, the practice of delimitation is a question defining morphometric properties. Landformations that exhibit similar formal features or geometric qualities are delimited in similar ways (Jasiewicz & Stepinski 2013). Within this regime, cycles and periods, end conditions, aspect transitions, material and geometric discontinuities, and qualitative thresholds are used to establish a provisional landformation ontology. The classification procedure can be described computationally and performed recursively or serially.

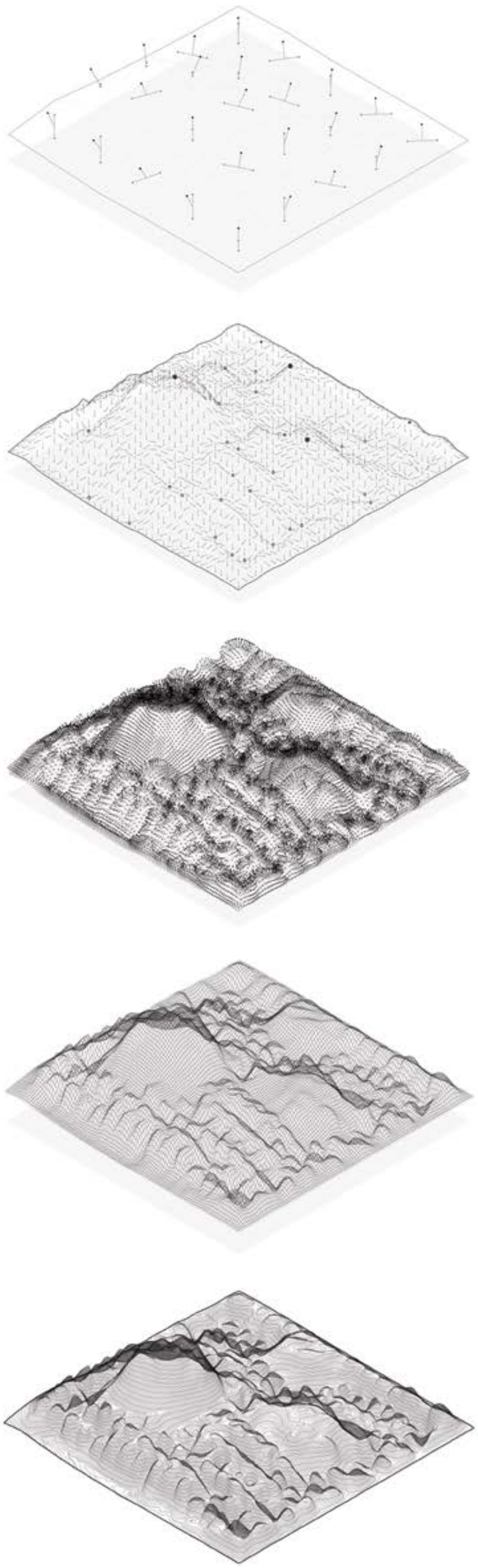
Landforms are differentiations in the Earth's surface. The process of identifying individual landformations within this continuous surface field, spanning both subaerial and subaqueous environments, falls into two approaches: 1) differentiation by formal analysis (paradigmatic), or 2) differentiation by process analysis (syntagmatic). Categorization by form relies on identifying surface features as having unique yet iterative physical qualities. Categorization by process focuses on the relationship between formation process and formal results. In both cases, landform differentiation can emerge at different scales and with varying degrees of consistency.

The SLP began with an analysis of landformations in two categories: *Morphologies* and *Process Typologies*. Within these categories we then identified boundary conditions which elicited two formation tendencies in relation to Earth's surface features: *protrusions* and *depressions*. Delineation of these two can be further determined by the pattern of field qualities (material intensity and distribution) and flow qualities (movement, direction, and speed) that each formation establishes.

- *Morphologies:* A morphometric analysis of landformations examines surface attributes at face-Value with no regard for how they have come to be. These were developed through point-based global variances within two contexts: slopes and inflections. Variances include elevational differences, slope angle, concavity/convexity, and curvature. Profile derivatives were generated through localized variations to global forms through push-pull operations applied either symmetrically or asymmetrically. These profiles correspond to both anthropogenic and non-anthropogenic physiographic features.

- *Process Typologies:* A process analysis of landformations examines patterns of material fields and flows, and form ontogeny. This analysis approach defines landformations as belonging to a linear program of activity: coastal, eolian, fluvial, glacial, igneous, lacustrine, and tectonic and in what ontogenetic state of ablation or superposition each surface is defined. Processes can be analyzed through scalar recursion, identifying features at various scales.

The first iteration of morphological analysis was generated from USGS Digital Elevation Models (DEM) of existing land surfaces, which could be reduced to a simple point cloud. To further reduce the amount of information used to describe each landform, and to evaluate it within a computational analysis schema, each target landformation was described using a representational surface with lower resolution. This was done using three steps: segmentation, neighbor finding, and interpolation (Agarwal, et.al. 2006). Next, a set of if/then questions were posed between a "representational surface" and a target surfaces to test the representational surface's fidelity through geometric similarity. [5]



5 Global Surface Geometry-to-Local Surface Features: Speculative Landformations Series 02.

Once a catalogue of surface morphological attributes was established, the evaluative process could be reversed so that any set of new attributes applied to an existing or constructed base surface generated a new singular or collection of formations. When produced in series, secondary evaluative processes such as landformation programming can be either assessed or applied using a similar reversible methodology as outlined above (figure 5).

Similarly, process analysis yielded residual patterns which could be reversed to create new landformation features. These can generally be subdivided into either additive or subtractive formation processes—features could be classified as being in a state of material subtraction (e.g. erosion or deposition) or addition (e.g. accretion of sedimentation). Since land forms are in a persistent state of formation, process analysis allows for a visualizations of past and future configurations.

To test the viability of this process, six propositional landformation hybrids were created: Cryostatic Buttes, Parasitic Pyroclastic Cones, Trellised Escarpments, River Ridges, Branched Basins, and Thermokarstic Ranges. From these models, one instantiation was printed (figure 6—11). For each series, landformations were generated by selecting attributes, defining their relative influence in the computational assemblage, and assigning them to a randomly

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6 Branched Basins | Speculative Landformation Series 01.

7 Cryostatic Buttes | Speculative Landformation Series 01.

8 Parasitic Pyroclastic Cones | Speculative Landformation Series 01.

9 Thermokarstic Ranges | Speculative Landformation Series 01.

10 River Ridges | Speculative Landformation Series 01.

11 Trellised Escarpments | Speculative Landformation Series 01.

selected initiation surface. Each instantiated landform was defined through point locations at two scales (global and local) along with an articulation resolution, inverting the analytical process.

Since the primary concern was establishing representational fidelity within a highly restrictive scope as a means of revealing affinities, and subsequently categories, of landformations, dynamical fidelity (the match between modeled and actual forms) was initially downplayed. Representational fidelity was determined by how speculative surfaces compared against known and modeled phenomena with special interest to geometric similarity—its surface structure and articulation as much as it surface affect or resemblance.

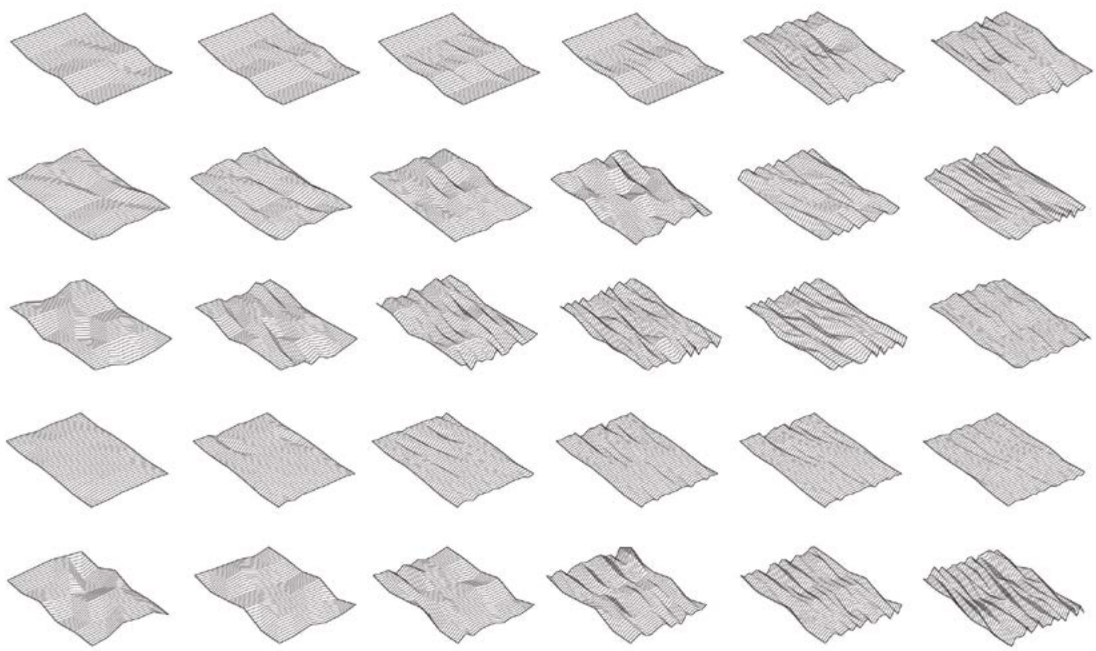
FICTIONAL FACTUALS

Conclusion

While results to this point have been limited to abstract artifacts (Weisberg, 2013), landformations generated as fictional, instantiated surface conditions, future explorations will focus on speculations that correspond to existing historically defined typologies and established systems of *artificial* landform production. This phase will examine relationships of scale, shape, resolution, and occurrence of speculative formation typologies, the expectations associated with each typology, and the operative techniques used to produce them at full-scale.

In reversing the analytical function of landformation computational models to projective ones, discrepancies, incongruencies, and infidelities inherent in representational frameworks become characteristics of the actual geometric composition of the speculative formations. Correspondence between the subject of the model and the model itself can be reinterpreted as the foundational compositional logic of a now generative process (figure 12).

Both architecture and landscape architecture commonly relies on the well-established techniques of abstraction and substitution (the removal or displacement of specific information to adhere and/or conform to a representational system) to reduce the complexity and data-scale of a given condition to a discrete and edited set of information. This effort equalizes the disparate types of information contained in an environment into a common vision-based, effects-oriented framework. This framework in turn has become ingrained in how designers work within the design disciplines. These systems are highly coded and ripe for procedural exploration. The connection between representations that focus on analysis and those that are projective, or rather the designer's transition from one area of focus to another, invites a high degree of interpretation. And, while this can not be avoided, considering computational models as being both inside



12 Sample Landformation Families.

and outside of factuality (i.e. propositions) helps intertwine both domains in ways that ground speculation and expand agency.

ACKNOWLEDGEMENTS

Speculative Landformations Project:

- Research + Design Team: Michael Leighton Beaman and Zaneta Hong.
- Student Assistants: Joshua Jow and Foad Vahidi

NOTES

1. Barry Smith defines objects as "extended in space" and processes as "extended in time".
2. See Weisberg on the definition of models in science which have here been extended into design.
3. In this case I am using the term "abstract" in the general sense, but I would argue that this applies to the specific use of abstract, as in "abstract artifacts" or "abstract structures" just as well. See Weisberg 2013, 18—19.
4. Kendal Walton offers a view of propositions as a type of constructive and ruled "fiction" . See also Godfrey-Smith 2009.
5. For more on geometric similarity and model-to-target fidelity, see Weisberg 2013, 40—45.

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IMAGE CREDITS

Figure 1: Surface Articulations (© Beaman & Hong, 2016).
Figure 2: Landformation Profile Morphology — *abridged* (© Beaman & Hong, 2016).
Figure 3: Landformation Surface Morphology — *abridged* (© Beaman & Hong, 2016).
Figure 4: Landform Propositions 01 — *abridged* (© Beaman & Hong, 2016).
Figure 5: Landformation Global Geometry & Local Features (© Beaman & Hong, 2016).
Figures 6—11: Speculative Landformations: Series 01 — *various* (© Beaman & Hong, 2016).
Figure 12 : Sample Landformation Families (© Beaman & Hong, 2016).

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