Ancient Imagery: Digital visualisations of the Auckland isthmus

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Research Question:

What did the Auckland isthmus look like during significant times of its geological history?

Rationale and Aims

To produce a well informed landscape design a landscape architect must understand the varied and complex geological history of the area. This information is found in scientific publications typically presented in a language that is outside the designers knowledge base. This paper describes the process of producing photorealistic images developed through a study of the stratigraphy, paleoecology, climatic, and geological features of the Auckland isthmus. These images represent snapshots of what the region looked like at significant times of its formation from the early Miocene (20 million years ago) through to the eruption of Rangitoto (≈650 years ago). The realism of the images are designed to give the viewer an easy to understand picture of the region as opposed to the current use of rudimentary sketches and diagrams presented alongside scientific descriptions. The process utilises organic modelling and rendering, including the use of conditional ecosystems, procedural textures and digital plant algorithms. The digital workflow will be described and the software packages (esp. e-on software's Vue 7 Infinite) strengths and weaknesses will also be highlighted.

Research Methods

This was achieved through the following steps:

1. Survey of relevant sites through site visits and research.
2. Develop digital terrain models for each of the chosen sites.
3. Develop digital plant algorithms; these will be used to create vegetation for the 3d models.
4. Merge the digital terrain model, vegetation, physical features, textures and climatic conditions for each site to form a 3d digital model that can then be used to produce the required photo realistic renderings.
5. Digitally retouch and enhance the rendered output to exhibition standard.

Site Selection

The first aim of this project was to identify and outline major events in the geological history of the Auckland isthmus (within the last 25million years) and setup a brief for each of these images. These are as follows;

Waitakere Volcano: Once located 15 KM off the west coast of the Auckland isthmus. Over the last 20 Million years it has slowly eroded away now only the eastern flanks and boulders ejected from this massive volcanic vent exist today. As this is one of the only features in the area at the time to put it into scale I intend to use either photography or a digital model to give scale and help the viewer orient themselves.

Lake Pupuke: 140,000 years ago on Aucklands North Shore Lake Pupuke erupted. Lava flowing from the crater engulfed a Kauri forest producing tree moulds that can be seen today on the north end of Takapuna beach.

Rangitoto: The youngest and by far largest volcano in the Auckland volcanic field formed approximately 750 years ago (Ballance & Smith, 1982). Rangitoto is significant both as a landmark and as a reminder of Auckland volcanic origins. This is the only eruption humans have witnessed in Auckland's history, proven by the discovery of footprints in volcanic ash of humans and a dog found on Motutapu Island.

North Head: Approximately 40,000 years ago North head, Mt Victoria and Mt Cambria were active. At the time Sea levels were much lower than today and the Waitemata harbour was a river that flowed through dense forest.

Mapping and Modelling

The next stage of this research required what is commonly termed a 'height-map' (see Fig. 1) of the existing Auckland topography. This involves taking contour lines (vector data) and converting them into a raster terrain model that uses a grey scale symbology to assign the highest point a white pixel value and the lowest point a black pixel at a set size (typically up to 2048 pixels square). This heightmap can then be used to produce a procedural terrain in many 3d applications.

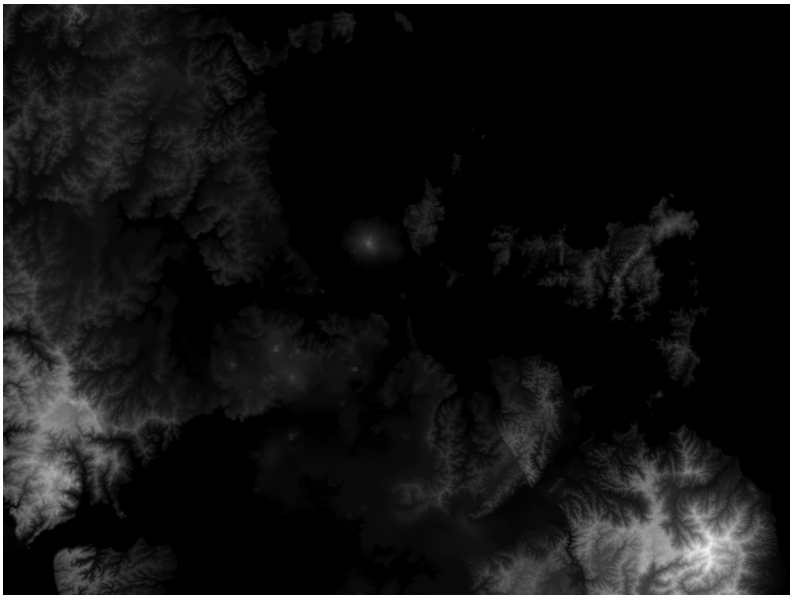

Fig. 1: Height Map of the Auckland Region.

For this project I'm using e-on Vue 7 Infinite, a 3D modelling and rendering package. The software's ability to simulate organic plant species, terrain modelling and physical environments (lighting, clouds, fog, haze, etc.) as well as an advance procedural texture engine can produce imagery of outstanding detail well beyond that of CAD software. Typical cad packages choke once they reach one million polygons, in this project I've produced images with well over 30 billion polygons with little hassle.

Vue is capable of producing ecosystems that can be controlled by manual manipulation or procedurally (eg placing certain types of plants on steep surfaces at high altitude, or controlling the density and size of rocks to predefined areas). GIS data can be used to produce raster images that dictate the placement of objects (eg areas with trees) and textures as long as the terrain model and other layers align with each other. Although the workflow isn't obvious and can become technically challenging at the best of times the ability to visualise GIS data in a photo realistic manor is awe-inspiring.

Fig. 2: A Vue 7 Ecosystem applied to a small terrain

A good deal of the time has been spent learning the software (e-on Vue) and developing a strong workflow (GIS Data -> Vue -> Photoshop/Shake). I've also spent time creating procedural textures for Lava flows, burning foliage, snow capped mountains, and other general surfaces.

Rendered Images

The first image I worked on was that of the Waitakere volcano. The most interesting aspect about this volcano was it's size and position however the Auckland isthmus at the time was no more than a seabed with a mountain range to the west (Coromandel up through Great Barrier island). An image of a volcano surrounded by ocean would give little understanding its size or position, therefore I decided to use a false sense of time and space to allow the viewer to understand it better. To do this I used a terrain model of the Auckland Isthmus and placed a volcano that matched the geological description of the Waitakere Volcano (see Fig. 3 on page 3). I actually revisited this site and reworked the volcano and Atmosphere towards the end of the project using the knowledge I'd gathered by working on other Vue projects.

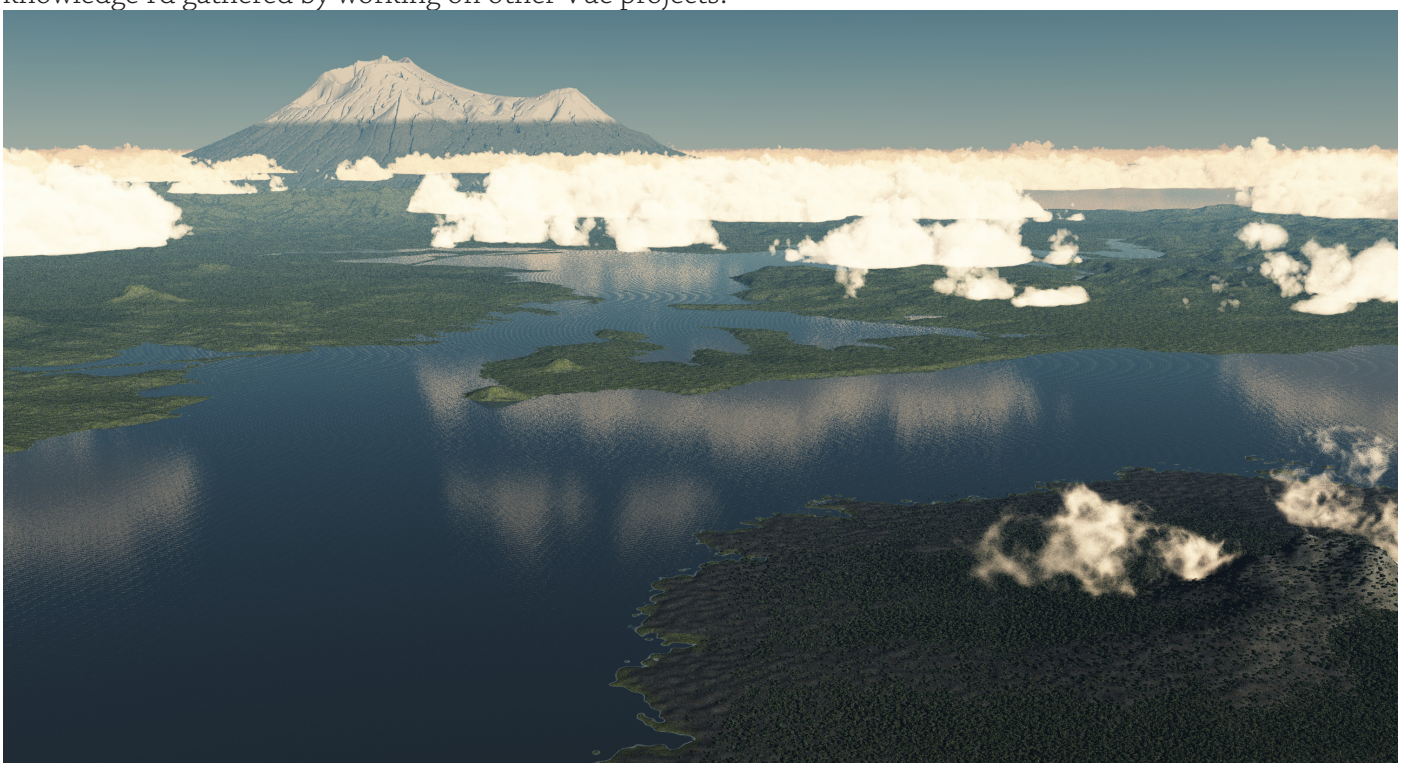

Fig. 3: Render looking over a present day Auckland shoreline with Rangitoto in the foreground and showing the scale and placement of the Watakere volcano. This image is made up using over 30 billion polygons!

Fig. 4: Eruption of lake Pupuke (approx 140k years ago) engulfing trees as the lava finds its way to a stream leading to the Waitamata river.

The next image I wanted to do was working at a different scale. I decided to try and capture the drama and destruction of a lava flow running from Lake Pupuke through a Kauri forest (evidence of this is visible at the north end of Takapuna beach). An alteria motive for this image was working with elements that traditionally have been difficult to produce digitally like fire, water, smoke, atmosphere, and foliage. The resulting image took about 20-30 hours to create in Vue and the final model took 8 x Mac pros (each with dual 4 core Xeon processors) 3 days to render one still image (see Fig. 4).

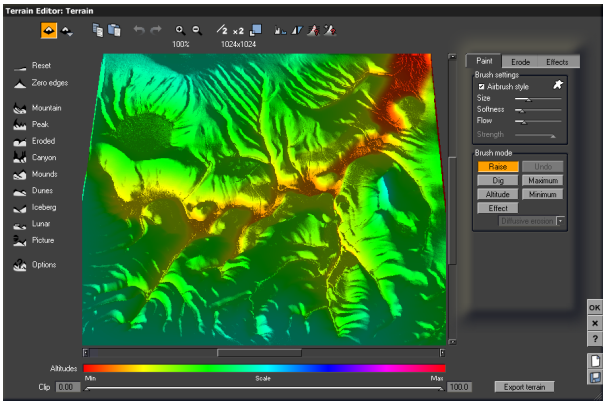

Fig. 5: Terrain editor within Vue.

After completing Large scale and small scale scenes it was time to tackle a mid sized site; the eruption of north head as seen from the south. For this model I would have to recreate a section of the Waitamata river, which has become the Waitamata harbour as the sea level rose flooding the river valleys. For this I used Vue's terrain modelling tools (see Fig. 5) as there was no GIS data for the area 40,000 years ago. This process involves manipulating a terrain with a handful

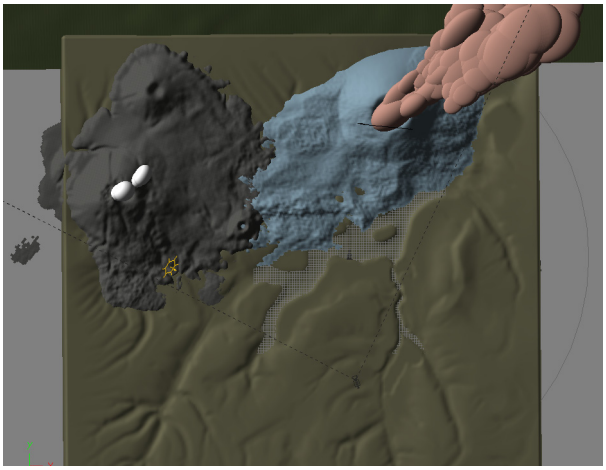

Fig. 6: Plan view of completed river valley and Volcanic vents.

Fig. 7: Eruption of North head approximately 40,000 years ago.

Fig. 8: Eruption of Rangitoto approximately 750 years ago.

of tools to erode and shape it into something that fits the criteria however these tools are highly creative but difficult to achieve any accuracy with.

After the initial terrain has been created the volcanoes of Mt Cambria, Mt Victoria, Dudders hill and North head needed to be created in a similar way. The scene was then populated with an ecosystem made up of foliage reassembling what would have been present at the time and textures that where designed to look like cooling lava. I spent some time designing a procedural cloud texture that looked volcanic and an atmosphere similar to one that would be seen today. Another less detailed terrain was created to represent the rolling terrain in the background.

The last image I produced (Fig. 8) was of a young Rangitoto days after it had begun erupting. This was an exercise that pulled together all of the techniques I'd developed with the other images. Here I wanted to give a sense of scale and atmosphere that would allow the viewer to engage with a sight similar to that which the Maori people of the time witnessed first hand. The most significant development with this image was creating a method to simulate moulten lava flowing down the slopes. The texture of this flow is brightest around the edges of the flow and near the top where is still very hot. The atmosphere to the north is thick with smoke and in the foreground the morning light illuminates a familiar foliage.