

Sky Islands
A time travel of the Andes Mountains

Synthesis

Sky Islands: A time travel of the Andes Mountains is a 3D animation where science, art, and technology converge as a media to explore the visualization of one chapter of the ecological history of the Northern Andes Mountains. In the times we are living today, the anthropogenic global warming is affecting not only our human species but also the whole species and inhabitants of the planet Earth. For this reason this project seeks to envision how the past times in the Andes mountains took more than three million years to create an impressive diversification of ecosystems and species, but the transformation made by humans during the last 500 years and mainly the last hundred years after industrialization, has a magnitude able to extinct unique species that have been evolving and diversifying for the last three million years in the northern Andes of South America. This visualization not only opens a door to travel in a time machine, from the Latest Pliocene to the Anthropocene as a first step toward opening minds and creating awareness of the importance of evolution in the South American Andes ecosystems and its biodiversity, but also to implant a concern and post a question about how we can change the future and our relationship with the Andes and finally with the Earth in a way to mend the disaster our modern human species have been creating.

Introduction

Billions of years of evolution on the Earth have been drastically devastated in a fastest rate in fair one hundred years after industrialization. It is no secret to anyone that currently the alarms of climate change or global warming caused by the human species are affecting life on Earth and it is already a fact that the human footprint is now part of the ice records of the Antarctic Pole, but even in many lakes, lagoons, and rivers around the planet that act as deposits of history on Earth. ***Sky Islands: a time travel of the Andes Mountains*** represents the history of the evolution of the Andes in about around last three million years and its objective is to recover the Earth's memory and make it known. Maybe those who know it, will find the reason and feel the need to protect it in a way to start changing the history of the future of the Andean Páramos and forests but also extended to the ecosystems in the whole Earth.

Sky Islands: a time travel of the Andes Mountains is also an exploration of how to display scientific information using digital art, photography, 3D animation, and data visualization as contemporary tools to imagine ecosystems in the past. The challenge is to find a pathway of telling the dynamic history of the Páramos of the Northern Andes Mountains of South America in a visual and revealing form. This project is a science, art, and technology convergence, integrated into an innovative education model that explores theories from different disciplines with the aim to engage researchers, students, politicians, kids, families or general audiences. The purpose of this visualization is to make them understand the importance of these natural evolution process that took millions of years in the Northern Andes, for our current understanding. In more detail, this project will envision how the shifting elevational distributions of the Andean ecosystems was caused by cold and warm conditions driven by long term climate cycles, called the Milankovitch cycles (Muller et al. 1997) and how the diversification of species increased exponentially as a result of these cycles, but emphatically how these ecosystems which process of evolution spent millions of years is being deteriorated in just hundred years of devastating human activity.

For this travel in a time machine, I am supported by a group of researchers of University of Amsterdam (UvA) and collaborators that has been studying for more than five decades long term climate dynamics and the evolution of the ecosystems in South America Northern Andes. Their studies have been focused on understanding vegetation dynamics in present and past times (see studies from A. Cleef, T. van der Hammen, H. Hooghiemstra and co-workers). After 50 years of studying pollen fossil, aging materials, sedimentation rates, current species of plants, different type of ecosystems and its geographical distribution (among others), they found unique lakes which long fossil pollen and sediment records cover 2.4 million years history of the Andes Mountains (Hooghiemstra 1984; Bogotá et al., 2011; Groot et al., 2011; Torres et al., 2005, 2013). But also found a pathway to make spatial reconstructions through time to generate the most recent explanation of why this top unique ecosystems represent the highest species diversification between the mountains around the world (Van der Hammen,1974, Flantua et al., 2014, Flantua & Hooghiemstra, 2017).

Finally, this paper contains five parts, a geographical and ecological context of Andes Mountains with special focus in the Northern Andes and Páramos ecosystems. A travel in time about the Earth's cycles in a timeline of the last 2.4 million years that includes climate change in large scales and its consequences. A background of the ecological crises we are testifying and negative effects the modern human. A framework about Environmental and Anthropocene Art as an inspiration and finally a description of my personal experience of working between science and arts and how the final piece took form to be expressed.

Part one

Andes mountains and Páramos

Andes Mountains or Cordillera de los Andes

The Andes is a Castilian Aymara name that means "**mountain that lights up**". This name derives from the Aymara terms Qhantir Qullu Qullu used by the Qulläna people to express what happens in the high mountains that, at sunrise, are the first to be illuminated, and the sunset of the sun, the last to receive their rays. The Spanish, unable to pronounce "Qhantir", had just written down "Anti" and then, as it was about several mountains, he pluralized the term "Antis". Today it survives without having any meaning in the Spanish language. It is also said that word Andes comes from Quechua Anti. According to "The Real Commentaries of the Incas" (1609) written by the Inca Garcilaso de la Vega (1539-1616): The Inca Kings divided their empire into four parts that they called Tihuantin-Suyu, which means "The four parts of the World", according to the four main parts of the sky, east, west, north and south. They put the eastern part of Antisuyu, by a province called Anti that is to the east; which also call Anti to all mountain range of Sierra Nevada that passes to the east of Peru.

The Andes mountains emerge in South America as the longest in the Earth, and the major mountain system running the length of the Pacific coast from Argentina, Chile, Perú, Colombia, Ecuador to Venezuela. By a range of about 7.000 km from the sea level to the highest peak which rises to a height of 6.960 meters, called Aconcagua. The majesty of Andes reflect the snow in the summit and its streams and pathways in the boundary of abysses lead down to the valleys and canyons to become the giant rivers which waters run to deese in the Pacific and Atlantic oceans. This astonishing mountains harbor the riches assemblage of plants and animals in the Neotropics and perhaps in the world .

To conceive an image of Andean ecosystems from the highest to the bottom, there is a perennial snow line in the highest peak immersed by amazing Páramos, which distribution goes from 5.000 and 3.000 meters above the sea level. Then, under 3.000 to 1.000 meters the Andean Forest take the scene with different structure and composition of colorful trees, lianas, epiphytes and fauna which beauty's cloaked in foggy mist. The mountain under 1.000 meters downwards, a tropical jungle appeared to extend their roots to the sea level where the Pacific and the Atlantic oceans hit the mountains or where the Amazon Jungles and Eastern plains continue to meet the other side of south America.

I want to depict the Páramos, because they are the main character of this venture. After Spanish arrived to Americas, the name Páramos started to be used for this high, open and chilly areas in northern Andes. As a restricted and ecologically fragile areas of northern Andes of south America and adjacent southern central America, Páramos represent a high biological diversity and rich endemism or unique species with limited geographical distribution in our Planet. They has the riches high-mountain flora in the world and are characterized by tussock grasses, large rosette plants, shrub with evergreen, coriaceous and sclerophyllous leaves, and cushion plants (Luteyn 1999; Cleef, 1981).

In the present day, the Páramos resemble an archipelago of isolated islands or our **sky islands**. However, in the past they dominated large surface areas throughout the northern Andes. Driven by large scale cycles of climate change, the **sky islands** shifted altitudinally along the mountain slopes, influenced also by the topography that causes a complex spatial mosaic of fragmented (small) and connected (large) Páramo areas. During cold conditions, the low elevational position of the páramos cause the many isolated Páramo

islands to fuse, while during warmer conditions the páramos formed isolated archipelagos, as a long connectivity-disconnectivity dance or a mechanism described as the *flickering connectivity system* (Flantua & Hooghiemstra, 2017). For Páramos, the glacial-interglacial cycles drive fauna and flora species rhythmically along the slopes, opening temporary dispersal pathways or dividing populations of plants and animals into isolated remnants. This opportunity of connection and disconnection of plants and animals populations, created the flickering connectivity system that impulse species to evolve or disappear.

We are very fortunate to witness the existence of Páramos, not only because they are ancestral sacred places, and to stand up on their earths creates a peaceful sense of being part of the nature and planet, but also because they act as a sponge absorbing moisture from rain and fog for subsequent use by plants, animals, and humans. Páramo is the mother that give birth to the water to run downwards and sustain the live and the Earth for being essential to sustain and reproduce life on the planet.

Part two

Earth Cycles

The Earth is an alive organism that has been walking around the sun closer or further, grading the axes up and down and experiencing different glacial and interglacial periods of climate that have left signature or records of CO₂, water, plants and animals fossil prints, amongst others. As well, the modern human history has their own record already written on the Earth's surface. The Earth is 4.54 billion (4'500.000.000) years old, since then she has been evolving and many changes on her surface and oceans have been sculpting to create the current shape she has. On her surfaces have hosted different climates, landscapes, species of plants and animals and other life forms. Between all of these species, we the "homo sapiens" are one of the most successful species with a history of just about 200.000 years, but our last civilization has emerged from industrialization to be almost completely separated from the natural systems of the planet in fair hundred years.

The Quaternary

For this story, I want to focus in the the last geological Earth's era called **Quaternary** that is about 2.6 million (2'600.000) years ago to the present days, and it has separated in two periods of time the **Pleistocene** and **Holocene**. The Pleistocene happened between 2.6 million years and 10.000 years before present. It recorded different climate cycles with marked periodicity for glacial (cold ice-age) and interglacial (warm-age), ages that transformed the face of the Earth, causing extinction and speciation (generation of new species), as well as geographical changes of distribution for plants and animals that has strong evidences in the Andes ecosystems (Van der Hammen, 1974). While the **Holocene** was extended 10.000 years ago until 1.950 of our days and it is the most recent and modern interglacial. Recently, and after many discussions, the **Anthropocene** has been accepted as the contemporary geological period which sediment records are evident since 1950 (Waters et. al, 2016).

The Quaternary and its glacial–interglacial cycles have been engraved in marine and terrestrial paleo-climate and paleo-ecological records around the world. Projects like EPICA-VOSTOC in Greenland and Antarctica and FUQUENE-FUNZA in Colombia, amongst others, have focused efforts drilling ice and sediment cores to understand the global climate history. This fossil records showed that intensive ice-age glacial took place followed by warm interglacial periods and the last million years ten ice-age have occurred. In the same way, its results coincided with Milankovitch’s theory about cycles of *eccentricity* (every 100.000 years), *obliquity* (every 41.000) and *precession* (every 26.000 years), cycles that caused a cyclical variation in the solar radiation reaching the Earth, which strongly influenced climatic patterns around the globe (figures). (NOOA 2017; Flantua & Hoghiemstra 2017; Hoogiemstra et.al. 2006; Scientific America 2005; Van der Hammen 1974).

The Anthropocene

It describes how the modern human which actions have had drastic effect on the Earth like the current global warming (Crutzen & Stoermer 2000). The Anthropocene is functionally and stratigraphically distinct from the Holocene. Waters et. al. (2016) reviewed anthropogenic markers of functional changes in the Earth system through the stratigraphic record. The appearance of manufactured materials in sediments, including aluminum, plastics, and concrete, coincides with global spikes in fallout radionuclides and particulates from fossil fuel combustion. Carbon, nitrogen, and phosphorus cycles have been substantially modified over the past century. Rates of sea-level rise and the extent of human perturbation of the climate system exceed Late Holocene changes. Biotic changes include species invasions worldwide and accelerating rates of plants and animals extinction. Since 1970, there has already been a 58% overall decline in the numbers of fish, mammals, birds and reptiles worldwide, according to the WWF's latest bi-annual Living Planet Index, what means that we are already losing species at a rate consistent with a sixth mass extinction event. These combined signals render the Anthropocene stratigraphically distinct from the Holocene and earlier epochs (WWF, 2016).

Furthermore, opposed to changes in climate that may have resulted as part of earth's natural processes, global warming in the Anthropocene is a result of destroying natural landscapes, nature forests and releasing ancient stores of carbon. These alterations are causing changes in temperature, sea ice extent and carbon dioxide concentrations that can be quickly visualized in the climate time machine (NASA 2017). The oil extraction, hydroelectric construction, mono-agriculture and modern cities or jungle’s cement, can be seen as contributing factors, and a means towards our modern mutant creation.

The global warming is not only a consequence of changes in the Earth’s long-range planetary motions but also a result of the land use transformations that we have been strongly accelerating in just a hundred years post-industrialization. As modern humans, our behaviors and habits have contributed to global warming through the carbon footprints, and this process is alerting us in ways that will make us change our habits to return to a balance with the earth and to remember our origins as one more species. As Davis et al. (2015) described: Critical Climate Change is oriented, in this general manner, toward the epistemopolitical mutations that correspond to the temporalities of terrestrial mutation. As well, I believe that our civilization is crossing the line between the end of one era and the beginning of a new one. Perhaps, we are already living the ‘Quinary’, a new geological era after Quaternary starting with the Anthropocene, with our fingerprints already made on the layers of history deposited and eroded for millions of years. In the Dickinson (2015) words: "Anthropocene is both a metaphysical concept and concrete reality:

tomorrow's fossil record will reveal one story only, that on the rise and demise of the human race". In that way, the last years transdisciplinary research with its cross-pollination of art, science, design, media, ecology and different cultural disciplines are developing a critical discussion about the Anthropocene, where the arts and design are playing an active role as agents of communication and change (Anthropocene Agents 2017). As well as Alonso (2015) says: experimental artistic practice emphasizes a new combination of aesthetics and ethics and the ecological and the social can provide interesting models in helping societies adapt to this new territory of the Anthropocene. A question that follows now "it is how to write a new history with the knowledge and the need to change we have now but also the faster development of technologies to mend this broken balance between the earth and us?".

Part three

Biophilia, Solastalgia and the age of Ecological crises

Nowadays, we are facing the age of Ecological crises led by current global warming or anthropogenic climate change. The last few years we have been testifying extreme seasonal weather and increment of hurricanes and tsunamis, to name just a few of the most evident environmental changes. However, the last years some authors have been leading changes to direct our civilization for a more sustainable future society.

Today, there are evidences about how the modern human has been negative affected for being disconnected of nature. We as one more of the species on Earth have forget the origin and this forgetfulness have brought negative consequences on our psyches and of course in our planet. Here, I will introduce some of the concepts related this dis-connection and the need of being rounded by nature.

In 1984 the American Biologist and Entomologist, Edward Wilson, coined the term **Biophilia** a hypothesis about how humankind, as a part of our species evolutionary heritage, has an innate need to be around living things and how we are naturally drawn to those places that in our pre-historic past, have best facilitated survival. Although Biophilia was first used in 1973 by the philosopher and social psychoanalyst Erich Fromm, who described it as "the passionate love of life and of all that is alive", Wilson described and popularized the hypothesis as "the connections that human beings subconsciously seek with the rest of life." Since then, many other researchers of different disciplines have been using the concept to design urban planning as well as to find psychological health benefits and well being for our society. Thus, Biophilia invites to incorporate and cultivate nature connection among urban communities to enhance psychological wellbeing through the cultivation of nature connection among urban populations (Cleary et al., 2017).

Solastalgia instead is a concept developed by the philosopher Glenn Albrecht and first introduced at the Ecohealth Conference in Montreal in May 2003 to give greater meaning and clarity to environmentally induced distress. "As opposed to nostalgia, the melancholy or homesickness experienced by individuals when separated from a loved home, solastalgia is the distress that is produced by environmental change impacting people while they are directly connected to their home environment". Albrecht explains Solastalgia as a combination of the Latin word solascium: comfort, and the Greek word algia: pain.

Solastalgia is related to somaterratic illnesses (soma: body, terratic: earth-related) that threaten physical wellbeing and are caused mainly by living in ecosystems that have been destroyed, transformed, and contaminated by pollutants and toxins generated by over-exploitation of natural and conserved ecosystems. The alteration is a consequence of human activity as exploitation and transformation in massive scales because of mining, oil extraction, hydroelectric construction, mono-agriculture, cattle raising and modern-day cities, among others (Albrecht, 2006; 2007). modern cities etc. As a new concept Albrecht says: "I found that many traditional cultures and their indigenous languages have words for home-heart-environment relationships, however, it is interesting to note that modern English has very few. I created the concept of 'solastalgia' to fill this void and to give expression in the English language to a fundamentally important relationship between people, communities and their home environment. I also feel that we need many more new concepts that recapture the closeness that human animals have with their support environment or habitat. The realm of the 'psychoterratic' or positive and negative relationships between human mental health (psyche) and the earth (terra) has to be re-created in the twenty first century (Albrecht 2016).

Kim Donehower (2009) writes about migration and cultural loss and identity, explains: "solastalgia captures the interrelationship between environmental degradation and the disruption of families and communities. The resulting symptoms of this human distress of dislocation and habitat destruction is – depression, alcohol and drug abuse, high rates of suicide, diabetes, and heart disease; and the breakdown of family and community culture- coupled with ecological distress are embraced in the notion of solastalgia".

Alike, "psychoterratic illness is defined as Earth-related mental illness where people's mental wellbeing (psyche) is threatened by the severing of healthy links between themselves and their home/territory" (Albrecht 2007). Preliminary research by Albrecht on mining and drought has produced promising new insights into psychoterratic illness. There are many more environmental contexts where chronic environmental stressors negatively affect human health and wellbeing. Likewise, psychoterratic illness has been also named by many other psychologists working on this subject after Albrecht like "Nature Deficit Disorder, Ecoanxiety and Ecoparalysis". For this reason, this age is recognized as the age of ecological crises (Smith 2010).

"Climate change for one might, unfortunately, be a globally significant source of psychoterratic distress expressed as nostalgia and solastalgia" (Albrecht 2006). The age of ecological crises is the current climate change or global warming, that is not only a consequence of changes in the sun activity and earth cycles at galaxy scales, it is also a consequence of the transformation of land use that we have been accelerating for the last hundred years after industrialization and overpopulation. As modern humans, our behaviors and habits have contributed massively to a global warming. Then, the global warming is not only alerting us to the fact that we must change our habits to re-establish balance with the Earth but also to remember our origins.

In fact, there is a recent report by the American Psychological Association (APA) entitled "Psychology and Global Climate Change: Addressing a Multi-faceted Phenomenon and Set of Challenges," the aim of which is to examine the role of psychology in understanding and addressing global climate change, including efforts to adapt to and mitigate climate change. In this paper researchers describe the contributions of psychological research to an understanding of psychological dimensions of global climate change, provide research recommendations, and propose policies for APA to assist psychologists' engagement with this

issue (Swim et al., 6). For me this means that the psychological community is now aware of the consequences of global warming for the human psyche and of the vital role of the environment for a healthy life.

“Ecopsychology” appeared in the same way and is defined by John Davis as the story of “the home of the soul”. It is concerned with healing the relationship between the human soul and the “soul of the world” - Anima Mundi-. It acts as a bridge between the fields of ecology and psychology to address the psychological and spiritual roots of the ecological and human crisis that we are experiencing. During the past approximately sixty years, the focus of psychiatry’s attention has gradually become enlarged, from an early preoccupation with intra-psychic [interior] processes to include interpersonal and broad sociological-anthropological factors. It would seem that a natural next phase would consist of broadening our focus still further, to include man’s relationship with his nonhuman environment.” Four decades later, this next phase in the broadening of psychologies’ focus—call it “ecopsychology”—is finally beginning to take shape (Davis).

If Solastalgia is the pain for a lost home and the nostalgia and melancholy for the peace instilled by living in a natural or aboriginal family and community surrounded by wilderness, perhaps, our hurts or pains are coming from ancestral memories. We lost our connection with the Earth, with “Mother Earth,” something referred to by many aborigines or native cultures around the world like Hopis from North America, or Mapuches and Koguis from South America or aborigines from Australia and New Zealand, amongst others. How many thousands of years of Solastalgia have we have been experiencing? These peoples still perceive and feel Earth as a Mother and Goddess, as a live spirit with emotions and perceptions. For those native and original cultures still with ancestral memories, “She, the Earth” is a common personification of nature that focuses on the life giving and nurturing aspects of nature by embodying them in the form of a mother. For instance, in Inca mythology, “Mama Pacha” or “Pachamama” is a fertility goddess who presides over planting and harvesting and causes earthquakes. There are many images of women representing Mother Earth or Mother Nature, and they are timeless. In prehistoric times, goddesses were worshipped for their association with fertility, fecundity, and agricultural bounty. Priestesses held dominion over aspects of Incan, Algonquian, Assyrian, Babylonian, Slavonic, Germanic, Roman, Greek, Indian, and Iroquoian religions in the millennia prior to the inception of patriarchal religions.

Therefore, if Solastalgia as a concept coined after seeing how a current and aboriginal Australian community is suffering distress after scarcely 20 years of experimenting destruction of their territory or land, then thinking of our genealogical tree and assuming that we are connected with our ancestors through the genes and many generations of DNA replication and information, it follows that every person on this planet is suffering from Solastalgia. After many generations, we are still not more conscious connected with “our house”, and when I say “our house” I refer specifically to our planet, our Earth. The Earth is the only house we have, and I feel sadness everyday and a pain in my heart, when observing all the destruction we have created in the original paradise that this planet was some time ago. Over generations we have forgotten how respect and feel gratitude and love for being part of the same ecosystem, it is like an organelle inside the cell forgetting that is part of the cell, or an organ forgetting it is part of the body. It is because we forget that we are the children of the Earth and the Earth is the big mother who feeds not only our bodies but also our souls.

In the spirit of Albrecht when he coined the other term Soliphilia, meaning the solidarity needed between all of us and the need to be responsible for a place and the unity of interrelated interest within it.

Solastalgia will be overcome only when sufficient numbers of us act in solidarity to defeat the forces of desolation (Albrecht, 2010). Or, as Albert Schweitzer said, "ethics is nothing else than reverence for life." In all aspects of life - social, cultural, psychological, political, scientific and economic – we as humans need to redirect our energy and intelligence to an ethically inspired, urgent, practical response to overcoming the causes of solastalgia (Albrecht, 2007).

Part four

Earth, Arts, Science and Technology Context

In a larger context sense, the piece would be outlined inside the conceptual movement of artists exploring the metaphorical language of Planet Earth which started in the 1970's, like "Planet Earth in Contemporary Electronic Artworks" and "Environmental Art", which expression coined as an umbrella term to encompass Eco-Art/Ecological Art, Ecoventions, Land Art, Earth Art, Earthworks, and Art in Nature (Knebusch, 2004; Bower, 2010). To bring some examples for Environmental Art, there are over 150 artists, and close to 22 scientists and Science & Arts collaborative projects, organizations, programs, and residencies focused on this Eco-Art movement around the world (The Greenmuseum, 2010). A number that has been increasing with the current 'Art in the Anthropocene', a massive trans-disciplinary movement of artists, designers and scholars exploring the symbolic language of the Anthropocene (Anthropocene Agents, 2017; Dickinson, 2015; Alonso, 2015; Bourriaud, 2014).

To bring some of the most recent examples of events created to engage audiences for environmental issues in the framework of Anthropocene are:

1) 'The Great Acceleration: Art in the Anthropocene' at Taipei Biennale (2014) with the participation of 52 artists (<http://www.taipeibiennial.org:8080/index.php/en/>).

As Bourriaud described (2014), the exhibition addressed the cross-overs appearing in the art of the Anthropocene; it was focused on artists for whom objects, products, computers, screens, chemistry, natural elements or living organisms are interconnected with humans, and can be used by them for a critical analysis of contemporary world. The exhibition highlighted the way artists focus on links, chaining, connections and mutations: how they envision planet earth as a huge network, where new states of matter and new forms of relations appear (Dickinson, 2015; Lin, 2015).

2) '7 MIL MILLONES' (<http://www.eacc.es/7-000-000-000/info/>) referred to the total human population inhabiting Earth and was hosted at EACC in Valencia, Spain (Alonso, 2015).

3) 'Dark Ecology project' (2014, 2015, 2016) inspired by Timothy Morton's concept of 'Dark Ecology' and his philosophy of 'Ecology without Nature'. Morton offers a radical criticism of the modernist way of thinking about nature as something outside of us and instead proposes an interconnected "mesh" of all living and non-living objects (<http://www.darkecology.net/about>).

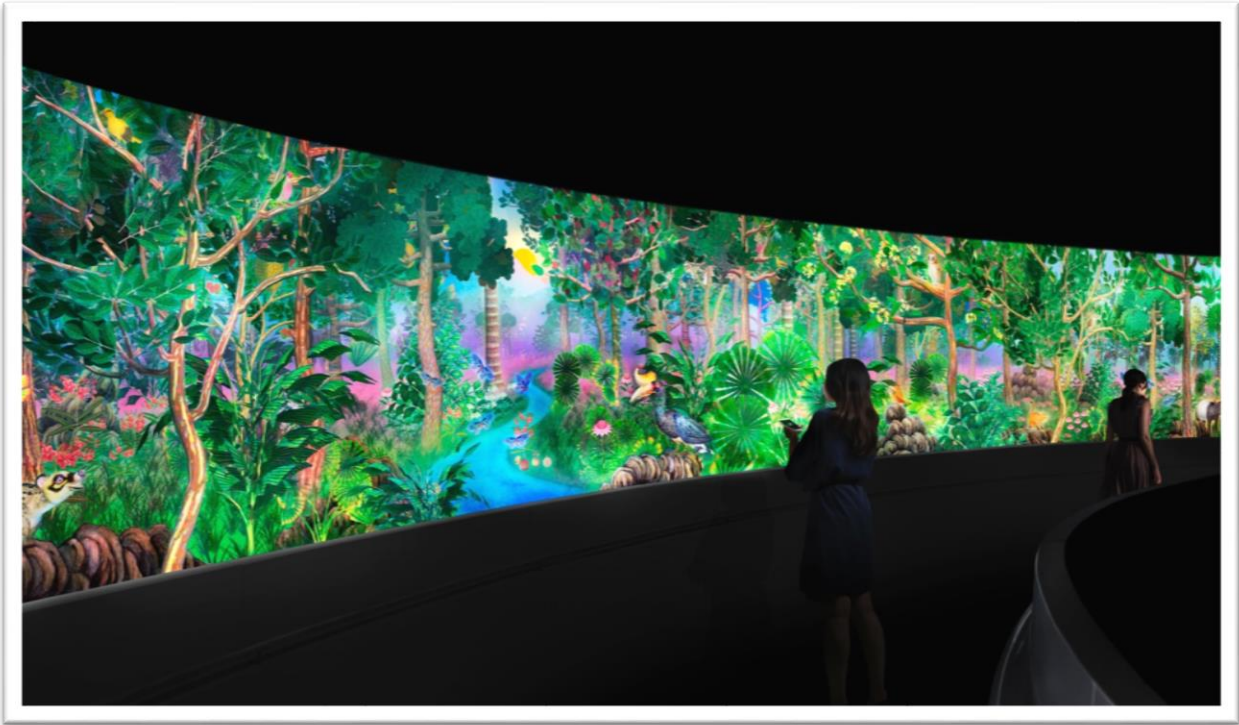
As inspirational artists since the 1970s that have been engaging audiences for climate change, restoration of ecosystems and protection of watersheds using models for sustainable restoration are Newton & Helen

Mayer Harrison, AMD&ART/T., Allan Comp, Jean Paul Ganem, Tim Collins & Reiko Goto, Yolanda Gutiérrez, Patricia Johanson, Lynne Hull, Ichi Ikeda, and Aviva Rahmani.

One of my close conceptual inspirers are **Newton & Helen Mayer Harrison**, they have developed since 1969 “visionary projects often led to changes in governmental policy and have expanded the dialogue around previously unexplored issues leading to practical implementations throughout the United States and Europe”. Nowadays, their project The Force Majeure “expresses a co-evolving set of circumstances, initially brought on or exacerbated by the processes of civilization, and increasing dramatically from the industrial revolution to the present”. (<http://theharrisonstudio.net/the-force-majeure-works-2008-2009-2>).



Likewise, another contemporary inspiration is the collective, interdisciplinary and creative group based in Japan. The **teamLab** which aims to achieve a balance between art, science, technology and creativity. I like the their concept of being able to manipulate and use much larger spaces, then viewers are able to experience the artwork more directly. One of my favourite pieces are the Story of the Forest (more info at: <https://www.teamlab.art/press/thestraitstimes161207>)



Part five

Animation process, editing, and installation

After exploring and playing with microscopes, analog and digital cameras, and beamers as media objects, I started recently to learn 3D animation software as Cinema 4D, Vue and After Effects. In this part, I will describe how I found a way to use them to make possible this 3D animation and how the technical process and final result took shape.

The complete process includes pre-production, production, and post-production following the next steps.

A. Pre-Production: Storytelling and timeline

The storytelling of Sky Islands: a time machine of the Andes Mountains is based on publications and meetings with UvA's researchers to understand and transform their results into a storytelling which follows a timeline of the last 3 million years (latest Pliocene, Pleistocene, Holocene, and Anthropocene geological periods). This will be composed of three parts:

1. There is a macro-scene from outside the Earth showing the glacial (the coldest periods) and interglacial (the warmest periods) Milankovitch's cycles: eccentricity, obliquity and precession.
2. There are two close-ups in the Andes mountains:

a. A general scene from the Northern Andes to visualize and understand the main vegetation dynamics. This mechanism is called Flickering Connectivity System and shows how the Andean ecosystems (páramos and Andean forests) shifted up and down along the slopes. Also, the páramos expanded and contracted to form archipelagos of isolated islands, also called 'sky islands'. This camera point of view is mirroring the macro-scene from outside the Earth but shows the same process in more detail within the mountains. There will be a clock showing the time-machine, and extra information about the altitude of the main three Andean ecosystems and a legend that explains the used colors (temperature and ecosystems).

b. A close-up at the central mountain chain in Colombia to show changes in more detailed perspective on how the páramo archipelago changed over the last 2.4 million years, the Quaternary. For this part, we chose six scenarios as the most representative snapshots of the whole storyline. These scenarios will be repeated in similar conditions of glacial and interglacial periods but in different moments of time during the last 2.4 million years.

- Scenario 1: Pliocene. The páramo biome had evolved during the previous millions of years when climate had only fluctuated little; the páramo was poor in species
- Scenario 2: Pleistocene. Interglacial (Warm conditions). 1 million years before present, Alnus tree entered into the northern Andes.
- Scenario 3: Pleistocene. Glacial (cool stadial conditions). 480.000 years before present. The tree Quercus enters into the Northern Andes.
- Scenario 4: Pleistocene. Glacial (mild interstadial conditions). X, Y, Z years
- Scenario 5: Holocene. Interglacial (warm conditions). X, Y, Z y years
- Scenario 6: Interglacial in the Anthropocene, deforestation, actual conditions, today.

B. Production: Illustration Design + Revision and Animation + Revisions

I am making a 3D animation using Cinema 4D and VUE Xtreme. For final renders, I am using After Effects and Adobe Premier. To generate the real landscapes of Andes mountains in Cinema 4D and Vue Xtreme, I am using high-resolution Digital Elevation Models (DEM at 30m and 90 m of resolution). To design plants, I will use VUE-Plant Factory. General and technical steps are modeling, texturing, lighting, animating, camera animating and rendering.

C. Post-Production: Rendering + Revisions and Final editing + Revisions

This final step is dedicated to make the final renders and edit the composition, effects and color correction.

D. Installation

The final outcome will depend on facilities for materials, but I am currently preparing the following three options:

1. Immersive 360 degrees' video installation, the half screen will display the cycles outside of the Earth and the second half, the process happening in the mountains as a mirroring or a reflection of the Sun-Earth cycles.

Inspirations

<http://jessieboylan.com/ngurini-searching/>

<http://www.tamschick.com/en/projects/time-machine/>

https://www.youtube.com/watch?time_continue=6&v=hyzoQ8jagwI

2. A video installation using two confronted screens, but in this case, one screen will display the cycles outside of the Earth and the second screen the process happening in the mountains as a mirroring or a reflection of the Sun-Earth cycles.

3. A five minutes editing for film and screening. Additionally, the visualization will be integrated with additional explanations provided by researcher's interviews. The results will be available in an open access domain, e.g. on the IBED server, and will also be part of the Installation.

Conclusion

"Sky Islands: A time machine of the Andes Mountains" is not more than the result of a wish I dreamt many years ago when I was part of a group of researchers and traveler of the time machine. Watching the hidden worlds living under the soils, under the water and inside of any living and apparently no living organisms with microscopes but also traveling for new research adventures in the forest and mountains with my camera as a witness. Since then, I saw beyond imaginable, invisible worlds that came up visible to my eyes as the augmented realities. Micro-worlds that revealed macro-worlds from other times.

References

- Albrecht, Glenn. Environmental Distress as Solastalgia. *Alternatives*, 32 (4/5) pp. 34-35. 2006.
- Albrecht Glenn, Gina Meree Sartore. Solastalgia: the distress caused by environmental change. *Australasian Psychiatry*. Vol 15 Supplement S97. 2007.
- Alonso C. (2015). Artistic practices, discursive contexts and environmental humanities in the Age of the Anthropocene. *Artnodes* 15, | ISSN 1695-5951.
- Bardin, J. - 1918. *El Reino de los Incas del Perú – Based on texts written by Inca Garcilaso de la Vega*.
- Bourriaud, N. (2014). The great acceleration. Art in the Anthropocene. <http://www.taipeibiennial.org:8080/index.php/en/tb2014?phpMyAdmin=ef6946252cea3105a72033fb2f279321>. (accessed 18-04-2017).
- Bower, S. (2010). A Profusion of Terms. *Greenmuseum.org*. URL: http://greenmuseum.org/generic_content.php?ct_id=306. (accessed 06-04-2017).
- Cleef, A. M. (1981). The vegetation of the páramos of the Colombian cordillera Oriental. *Dissertationes Botanicae* 61: 321 pp. J. Cramer. Vaduz. Liechtenstein.
- Dark Ecology Project. (2014, 2015, 2016). <http://www.darkecology.net/about>. (accessed 04-18-2017).
- Dewey John. "Having an Experience," (Ch. 3 of *Art as Experience*). 1934
- Dickinson, B. (2015). Pleistocene, Holocene, Anthropocene. *Features* 02, ART MONTHLY, Sep 15, 389 pg.
- Donehower, K. Migration and education in a multicultural world: Culture, loss, and identity. *Journal of Research in Rural Education*, 24 (13). 2009. Retrieved [date] from <http://jrre.psu.edu/articles/24-13.pdf>
- Flantua, S.G.A., Hooghiemstra, H., Van Boxel, J.H., Cabrera, M., González-Carranza, Z., González-Arango, C., 2014. Connectivity dynamics since the Last Glacial Maximum in the northern Andes; a pollen-driven framework to assess potential migration, in: Stevens, W.D., Montiel, O.M., Raven, P.H. (Eds.), *Paleobotany and Biogeography: A Festschrift for Alan Graham in His 80th Year*. Missouri Botanical Garden, St. Louis, pp. 98–123.
- Flantua, S.G.A. & Hooghiemstra, H. (2017) Historical connectivity and mountain biodiversity. In: Hoorn, C., Perrigo, A., Antonelli, A. (eds). *Mountains, Climate and Biodiversity*. Wiley, Oxford, UK.
- Francoeur, E. (1997). The Forgotten Tool: The Design and Use of Molecular Models. *Social Studies of Science*. 27(1), 7-40.
- Groot M.H.M. (2012). "Solving a Piece of the puzzle". Reconstruction of millennial-scale environmental and climatic change in the northern Andes during the last glacial cycle: An integration of biotic and abiotic proxy-information. Ph.D. Thesis. University of Amsterdam.
- Knebusch, J. (2004). Planet Earth in Contemporary Electronic Artworks. *Leonardo* 37 (1), 18-24. URL: <http://muse.jhu.edu/journals/len/summary/v037/37.1knebusch.html> (accessed 06-04-2017).

Lin, A. (2015). Taipei Biennial: The Great Acceleration. Art Review Issue. Taipei Fine Arts Museum. Jan & Feb 2015. URL: https://artreview.com/reviews/jan_feb_2015_review_taipei_biennial/ (accessed 06-04-2017).

Luteyn, J. (1999). Páramos: A Checklist of Plant Diversity, Geographical Distribution, and Botanical Literature (Memoirs of the New York Botanical Garden, vol. 84). The New York Botanical Garden Press, New York.

Muller R. A. & MacDonald G. (1997). Glacial Cycles and Astronomical Forcing. *Science* 277 (5323): 215–8.

NASA, 2017. NASA's Global Climate Change website. Design and programming by Moore Boeck. Concept and Research by Randal Jackson and Holly Shaftel. Animations by Goddard Scientific Visualization Studio, Moore Boeck, CREsis. Web. Feb 21 2017.

<https://climate.nasa.gov/interactives/climate-time-machine>

NOAA, 2017 <https://www.ncdc.noaa.gov/abrupt-climate-change/Glacial-Interglacial%20Cycles>. Web. Feb 21 2017.

Smith, Daniel B. "Is There an Ecological Unconscious?." *New York Times* 31 Jan. 2010: Print. http://www.nytimes.com/2010/01/31/magazine/31ecopsych-t.html?pagewanted=all&_r=0

Scientific American 2005. Fossil Reanalysis Pushes Back Origin of Homo sapiens. *Scientific American*, a division of Nature America, Inc. Feb 17, 2005. Web. Feb 21 2017.

<https://www.scientificamerican.com/article/fossil-reanalysis-pushes/#>

Symposium Agents in the Anthropocene: Trans/disciplinary practices in art and design education today. (2017). Piet Zwart Institute / Willem de Kooning Academy, Rotterdam. January 27-28, 2017. <https://www.anthropoceneagents.nl> (accessed 04-18-2017).

The Greenmuseum (2010). URL: <http://www.greenmuseum.org/>. (accessed 06-04-2017).

Torres, V., Vandenberghe, J., Hooghiemstra, H. (2005). An environmental reconstruction of the sediment infill of the Bogotá basin (Colombia) during the last 3 million years from abiotic and biotic proxies. *Palaeogeography, Palaeoclimatology, Palaeoecology* 226, 127–148. doi:10.1016/j.palaeo.2005.05.005

Torres, V., Hooghiemstra, H., Lourens, L., Tzedakis, P.C. (2013). Astronomical tuning of long pollen records reveals the dynamic history of montane biomes and lake levels in the tropical high Andes during the Quaternary. *Quaternary Science Reviews* 63, 59–72. doi:10.1016/j.quascirev.2012.11.004

Van der Hammen, T. (1974) The Pleistocene changes of vegetation and climate in tropical South America. *Journal of Biogeography* 1, 3-26.

Van der Hammen, T. (1974) The Pleistocene changes of vegetation and climate in tropical South America. *Journal of Biogeography* 1, 3-26.

World Wildlife Fund. 2016. Living Planet Report. Risk and resilience in a new era. Web. Feb 21 2017.