

**LATITUDE: A RADIOMETRIC AND PSYCHOLOGICAL APPROACH TO
GEOGRAPHIC EMULATION IN COLOR GRADING**

By

Jakob Martinez

A thesis submitted in partial fulfillment of the requirements for the

COLOR GRADING MASTERS DIPLOMA

in

COLOR GRADING MASTERS PROGRAM

COLOUR TRAINING

LOS ANGELES, CALIFORNIA

February, 2026

DECLARATION

I declare that this thesis has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree or diploma. Except where stated otherwise by reference or acknowledgment, the work presented is entirely my own.

Signed:  _____

Date: February 13, 2026

ABSTRACT

As the digital colorist's role evolves from technical correction to creative authorship, the demand for photorealistic look development has grown. Yet current industry workflows often rely on subjective intuition rather than objective environmental data. This thesis proposes a methodology called Geographic Emulation, which argues that the perceived feeling of a location derives from two measurable variables: Solar Radiometry (physics) and Ecological Valence (psychology).

By analyzing the spectral power distributions of Equatorial (12°N) versus Polar (64°N) light, this research establishes a mathematical correlation between latitude and image contrast. Applying the Naka-Rushton equation and the Bezold-Brücke hue shift, I demonstrate how the human visual system biologically compresses dynamic range in high-glare environments — a phenomenon that may help explain why equatorial cultures historically favor saturated color palettes in art and architecture, while Nordic aesthetics tend toward muted restraint.

The methodology operates in a scene-referred logarithmic pipeline (DaVinci Wide Gamut / DaVinci Intermediate) with output transformed to Rec.709 using the BT.1886 display gamma standard. Before applying any geographic emulation, footage is normalized via a CDL correction to establish consistent white balance (D65) and exposure (18% grey at 0.375). This separation ensures consistency across varied source material.

The practical application culminates in the Latitude Tool: a DCTL (DaVinci Color Transform Language) plugin for DaVinci Resolve that calculates color grading parameters from a single scientific input — geographic latitude. The tool derives values using radiometric formulas across three layers: Solar Geometry ([Solar] Pivot, Tonal Contrast, Shadow Density), Atmospheric Scattering ([Atmos] Sun Warmth, Rayleigh Fill, Biogenic), and Perceptual Adaptation ([Psych] Skin Vector, Hunt Saturation). The pipeline extends with Atmospheric Diffusion and Atmospheric Clarity nodes that simulate the physical weight of air between camera and subject.

Test footage uses the official ARRI reference material (ARRI_Helen_John_ALEXA_35_ARRIRAW) under controlled D65 lighting to establish repeatable, verifiable results.

The findings demonstrate that by controlling air mass and solar geometry within an image, a colorist can bypass conscious analysis and trigger a haptic, subconscious emotional response — whether for narrative cinema seeking emotional resonance or documentary work demanding geographic authenticity.

ACKNOWLEDGEMENTS

I would like to thank my mentor, Dado Valentic, for his guidance throughout the Colour Grading Masters Program. His energy, generosity in sharing knowledge, and relentless insistence on understanding the science behind the image have fundamentally shaped how I approach this craft.

I am deeply grateful to my wife, Xiora Martinez, and to my children and family, whose patience and encouragement have sustained me through this process. They continue to push me to grow — not only as a professional, but as a person.

I also want to recognize my fellow classmates in the Colour Grading Masters community. The conversations on Discord — the shared discoveries, the honest feedback, the willingness to help each other solve problems at odd hours — have been invaluable. This thesis is better because of that collective generosity.

Finally, this work is built on the shoulders of researchers and cinematographers who understood that light is not merely technical — it is emotional, geographical, and deeply human. I hope this contribution, however modest, adds something useful to that ongoing conversation.

TABLE OF CONTENTS

1. INTRODUCTION	1
1.1 Background: The Location is the Light	
1.2 The Problem: Geographic Dissonance	
1.3 Methodology	
2. THE PHYSICS OF LIGHT (RADIOMETRY)	5
2.1 Solar Geometry: The Angle of Incidence	
2.2 Atmospheric Scattering: Rayleigh vs. Mie	
2.3 Air Mass and Spectral Power Distribution	
3. PSYCHOLOGY & PERCEPTION	11
3.1 Visual Diets & Ecological Valence	
3.2 Chromatic Adaptation (Dynamic Range)	
3.3 Emotional Mapping	
4. CINEMATIC ANALYSIS (CASE STUDIES)	20
4.1 The Equatorial Aesthetic (<i>City of God</i>)	
4.2 The Polar Aesthetic (<i>The Revenant</i>)	
4.3 Commercial Application: Automotive Advertising	
5. PRACTICAL APPLICATION (THE WORKFLOW)	29
5.1 Tone Mapping for Latitude	
5.2 Managing Memory Colors (Skin)	
5.3 Atmospheric Diffusion and Clarity	
6. THE PRACTICAL PROJECT: THE LATITUDE TOOL	41
6.1 Methodology: The Node Tree	
6.2 The Test: Geographic Emulation	
6.3 Results: Visual Comparison	
7. CONCLUSION	53
REFERENCES	57

1. INTRODUCTION

This thesis examines the relationship between geographic latitude and cinematic color grading. It proposes that the radiometric properties of sunlight — determined by solar geometry, atmospheric scattering, and spectral power distribution — create measurable visual signatures that can be systematically emulated in the digital color grading suite. The practical deliverable is the Latitude Tool, a DCTL for DaVinci Resolve that derives color grading parameters from a single scientific input: geographic latitude. The framework bridges physics and psychology, offering colorists a method for achieving geographic authenticity grounded in science rather than intuition alone.

1.1. BACKGROUND: THE LOCATION IS THE LIGHT

In cinematography, location is not merely a backdrop — it is the primary determinant of the image pipeline. A scene shot in Nicaragua at 12° latitude possesses a fundamentally different radiometric signature than a scene shot in Iceland at 64° latitude. This difference extends beyond color temperature. It is governed by solar geometry, atmospheric density (air mass), and spectral power distribution.

Consider what the camera actually records: not a place, but the light that place produces. The angle of the sun, the depth of atmosphere it travels through, the particles suspended in that atmosphere — these physical variables create the visual fingerprint we associate with a location. When viewers sense that an image feels like Brazil or feels like Scandinavia, they are responding to these radiometric signatures, whether they know it or not.

This connection between light and place runs deeper than cinema. Walk through the streets of Oaxaca or Marrakech and you encounter buildings painted in saturated ochres, magentas, and turquoises. Travel to Copenhagen or Helsinki and the architecture shifts to muted greys, whites, and pale blues. This is not coincidence.

Cultures develop visual languages calibrated to their light. The human eye, adapted to local luminance conditions, normalizes what it sees most frequently. Equatorial populations live under high-intensity light that makes saturated colors appear natural; Nordic populations live under diffuse light where saturation can feel garish. The colorist who understands this can speak the visual dialect of any latitude.

I write this from Nicaragua (12°N), where the physics described in this thesis are not abstractions but daily experience. The hard equatorial shadows, the humid atmospheric diffusion, the saturated palette of Granada's colonial streets and Masaya's markets — these are the visual norms against which I calibrate my eye. This perspective informs the methodology: Geographic Emulation began as an attempt to understand why footage graded in Northern European or North American suites often felt foreign when depicting latitudes I know intimately. The waveforms were balanced, the skin tones were correct, yet something essential had been neutralized.

1.2. THE PROBLEM: GEOGRAPHIC DISSONANCE

With the advent of high-dynamic-range digital sensors and globalized production workflows, color grading often inadvertently sterilizes these geographic nuances. A colorist working in a windowless room in London may technically balance a shot from Brazil to neutral grey, but in doing so, they often neutralize the very physical anomalies — humidity, green cast, hard contrast — that define the location's reality.

This creates what I call Geographic Dissonance: an image that looks technically correct but feels environmentally false. The waveform is balanced, the skin sits on the I-line, the highlights aren't clipped — yet something is wrong. The image has been divorced from its origin.

The problem extends beyond narrative cinema. Documentary filmmakers rely on geographic authenticity to establish credibility; a film about life in the Sahel graded with Nordic contrast undermines its own subject. Commercial work follows similar

logic: travel advertising for Caribbean resorts demands tropical warmth, while luxury automotive campaigns for German engineering favor the cool precision associated with Northern European light. These are not arbitrary aesthetic choices — they are responses to deeply embedded visual expectations shaped by real-world light.

1.3. METHODOLOGY

The objective of this thesis is to develop a Geographic Emulation workflow that restores — or deliberately constructs — these location-specific characteristics. By analyzing the physics of sunlight at different latitudes and the psychology of human perception, I have built a practical tool that allows colorists to dial in the radiometric signature of specific global coordinates.

The methodology operates in a scene-referred logarithmic pipeline using DaVinci Wide Gamut and DaVinci Intermediate, with output transformed to Rec.709 using the BT.1886 display gamma standard. Before applying any geographic emulation, footage is normalized via a CDL correction to establish consistent white balance (D65) and exposure (18% grey at 0.375). This baseline ensures the Latitude Tool operates on predictable input regardless of source camera or lighting conditions.

The practical deliverable is the Latitude Tool: a DCTL (DaVinci Color Transform Language) plugin for DaVinci Resolve that calculates color grading parameters from a single scientific input — geographic latitude. The tool derives values using radiometric formulas: solar geometry determines contrast distribution ([Solar] Pivot, [Solar] Tonal Contrast, [Solar] Shadow Density); atmospheric scattering determines color temperature shifts ([Atmos] Sun Warmth, [Atmos] Rayleigh Fill, [Atmos] Biogenic); and perceptual adaptation determines skin tone and saturation adjustments ([Psych] Skin Vector, [Psych] Hunt Saturation). The DCTL operates within a six-node pipeline that extends the color emulation with Atmospheric Diffusion and Atmospheric Clarity nodes, simulating the physical weight of air between camera and

subject.

Rather than offering fixed presets, the tool allows colorists to position an image anywhere along the latitude continuum, from equatorial intensity to polar diffusion (Figure 1.1).



Figure 1.1: Geographic latitude zones examined in this thesis. The three test positions — Nicaragua (12°N), Los Angeles (34°N), and Iceland (64°N) — represent distinct radiometric environments, with Brazil (Rio de Janeiro, 23°S) included as reference for the City of God case study. The color gradient illustrates the relationship between latitude and perceived color temperature: equatorial latitudes produce warm signatures while polar latitudes produce cool signatures. (Source: Diagram created by author.)

2. THE PHYSICS OF LIGHT (RADIOMETRY)

2.1. SOLAR GEOMETRY: THE ANGLE OF INCIDENCE

The primary driver of geographic mood is the angle at which solar photons strike the Earth — the Solar Zenith Angle. This single variable determines irradiance, shadow character, and the foundational contrast ratio of any exterior image.

At equatorial latitudes (0° – 23.5° , within the astronomically defined Tropics), the sun travels a near-vertical path. Light strikes perpendicular to the surface, minimizing the area the beam must cover and resulting in maximum irradiance. Shadows are short, deep, and hard-edged. The visual result is high contrast with abrupt transitions between highlight and shadow — the look we instinctively associate with tropical intensity. This is the light of Nicaraguan markets, of Brazilian favelas, of Lagos streets at noon: unforgiving, precise, and vivid.

At polar latitudes (60° +), the sun never rises high. Even at solar noon, the angle remains acute. The beam spreads over a larger surface area, reducing intensity significantly. Shadows become elongated and soft, with gradual falloff rather than sharp edges. This is the diffuse, wraparound quality characteristic of Nordic light — lower contrast, fewer true blacks, and a sense of atmospheric depth even on clear days. It is the light of Scandinavian crime dramas, of Icelandic landscapes, of Bergman and Tarkovsky: contemplative, melancholic, and interior.

This relationship follows the Cosine Law of Solar Irradiance: as the angle of incidence decreases from perpendicular, the same quantity of photon energy must spread across a proportionally larger surface area, reducing intensity per unit area (Figure 2.1).

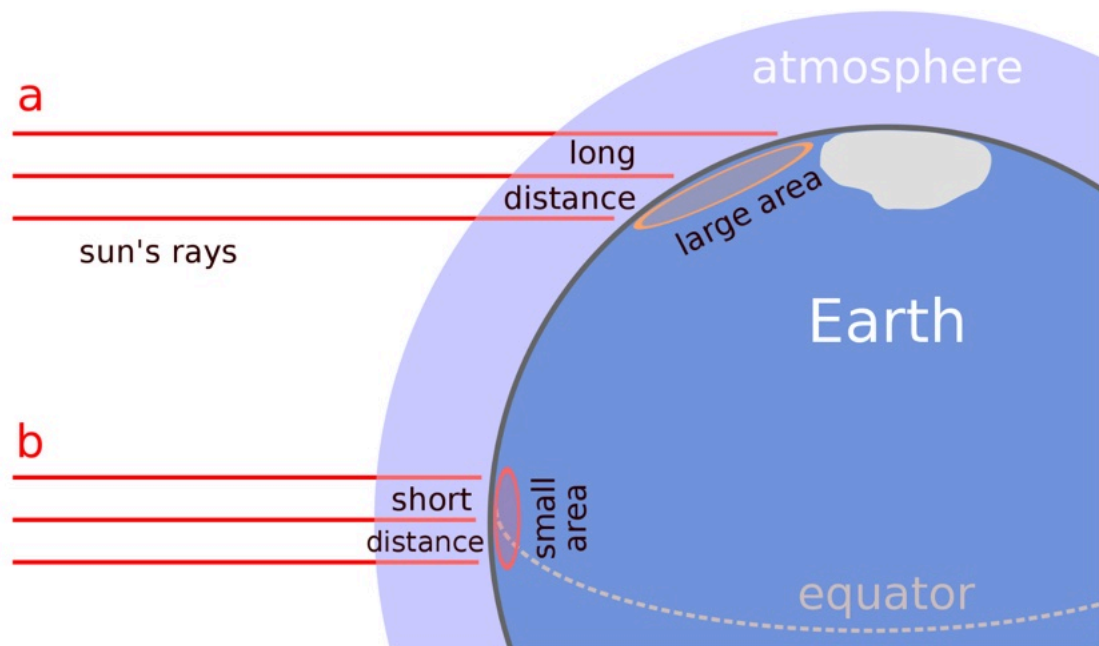


Figure 2.1: *The Cosine Law of Solar Irradiance. At the Equator (0°), the sun strikes at a perpendicular angle (90°), concentrating photon energy into a small surface area (high intensity). At the Poles (60°+ latitude), the oblique angle forces the same quantity of energy to spread over a larger surface area (beam spreading), resulting in significantly lower intensity and softer light. (Source: Halasz, 2007.)*

For the colorist, understanding this geometry is essential: contrast is not merely a creative choice but a physical consequence of latitude. In the Latitude Tool, this relationship is captured by the [Solar] Pivot parameter, which shifts the contrast center point based on solar elevation angle. An image graded to equatorial contrast will feel geographically false if applied to footage shot in Scandinavia, regardless of how technically balanced the exposure appears.

2.2. ATMOSPHERIC SCATTERING: RAYLEIGH VS. MIE

Before light reaches the sensor, it must pass through the atmosphere — and the atmosphere is not neutral. Two scattering mechanisms shape the spectral content and directionality of that light, each producing distinct visual signatures that the colorist must understand.

Rayleigh scattering occurs when atmospheric particles — primarily nitrogen and oxygen molecules — are smaller than the wavelength of visible light. This mechanism preferentially scatters short wavelengths (blue and violet) in all directions, creating an omnidirectional distribution. At polar latitudes, where the sun travels through significantly more atmosphere (high air mass), Rayleigh scattering intensifies. Blue wavelengths are redistributed throughout the ambient environment, filling shadows with the cool, cyan-shifted light characteristic of Nordic imagery. In practical terms, Rayleigh scattering functions as a natural fill light, wrapping around subjects and softening contrast. This is why overcast Scandinavian exteriors feel so different from overcast tropical exteriors — even under clouds, the quality of the scattered light differs. In the Latitude Tool, this phenomenon is controlled by the [Atmos] Rayleigh Fill parameter, which increases cyan bias in shadows as latitude increases.

Mie scattering occurs when particles are roughly the same size as the wavelength of light — water vapor, dust, and aerosols. Unlike Rayleigh scattering, Mie scattering affects all wavelengths relatively equally and exhibits strong forward directionality, concentrating scattered light into a pronounced forward lobe. At equatorial latitudes, high humidity produces intense Mie scattering, creating the heavy, diffuse bloom we associate with tropical environments. Highlights bleed into surrounding areas, edges soften, and the air itself becomes visible — dense, humid, almost tactile. This is the visual weight of monsoon season in Mumbai, of midday in Nicaragua, of the Gulf Coast in August. In the pipeline, this effect is simulated by the Atmospheric Diffusion node (Resolve's Glow effect), which adds warm, forward-scattered bloom to

highlights.

The difference in phase function between these two mechanisms is critical (Figure 2.2). Rayleigh produces omnidirectional fill; Mie produces directional glare. The colorist's task is to recognize which mechanism dominates a given environment and emulate its signature accordingly — cool wraparound fill for polar latitudes, warm volumetric bloom for equatorial.

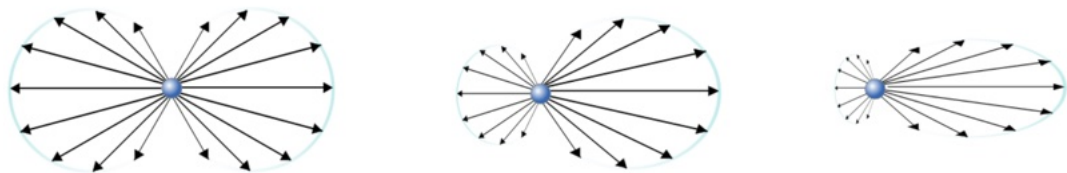


Figure 2.2: Comparison of scattering phase functions. Left: Rayleigh scattering occurs when particles are smaller than the light wavelength ($d < \lambda$), resulting in omnidirectional scattering. This acts as a fill light, redistributing blue wavelengths into the shadows. Right: Mie scattering occurs when particles are similar in size to the wavelength ($d \approx \lambda$), resulting in a strong forward lobe. This directional scattering creates the intense glare and Atmospheric Diffusion seen in high-humidity environments. (Source: Sharayanan, 2007.)

2.3. AIR MASS AND SPECTRAL POWER DISTRIBUTION

Air Mass (AM) quantifies the optical path length that sunlight travels through the atmosphere, expressed as a ratio relative to the shortest possible path (directly overhead).

At the equator under a zenith sun, the path is shortest — AM 1.0. The spectrum reaching the surface remains rich in ultraviolet and blue wavelengths. Direct sunlight is relatively neutral, close to the solar constant. This spectral richness contributes to the intense color rendering of equatorial environments: pigments appear at their most saturated because the illuminant contains the full spectrum needed to excite them.

At polar latitudes, even at solar noon, the air mass value can exceed 2.0 — meaning light travels through twice the atmospheric depth. This extended path produces two simultaneous effects that may seem contradictory but are both physically accurate.

First, short wavelengths (blue) are increasingly scattered out of the direct beam via Rayleigh scattering, causing direct sunlight to shift warmer. Second, those scattered blue wavelengths become the ambient fill light, causing shadows to shift significantly cooler. The Ozone Chappuis absorption band further attenuates wavelengths in the 500–700nm range within the ambient light, deepening the cyan bias in shadows.

This creates the distinctive polar light signature: warm direct light against cool shadow fill, with reduced overall contrast due to the atmospheric softening of the direct beam (Figure 2.3). In the Latitude Tool, this dual behavior is addressed by two opposing parameters. The [Atmos] Sun Warmth parameter controls the warmth contribution of direct sunlight to the overall image — highest at equatorial latitudes where intense, dominant direct sun floods the frame with warm energy, and lowest at polar latitudes where the weak direct beam is overwhelmed by cool Rayleigh-scattered skylight. This works in opposition to [Atmos] Rayleigh Fill (which increases cyan fill as latitude increases). The distinction is important: while the polar direct beam is spectrally warmer due to atmospheric filtering, its low intensity means it contributes less perceived warmth to the image than the powerful equatorial sun at AM 1.0. Understanding air mass allows the colorist to predict — and replicate — the spectral fingerprint of any latitude.

The practical implication is significant: a colorist cannot simply cool down an image to make it feel Nordic or warm it up to make it feel tropical. The relationship between direct light and fill light must shift in opposite directions simultaneously. This is why naive color temperature adjustments often fail — they move the entire image uniformly rather than creating the split characteristic of real geographic light.

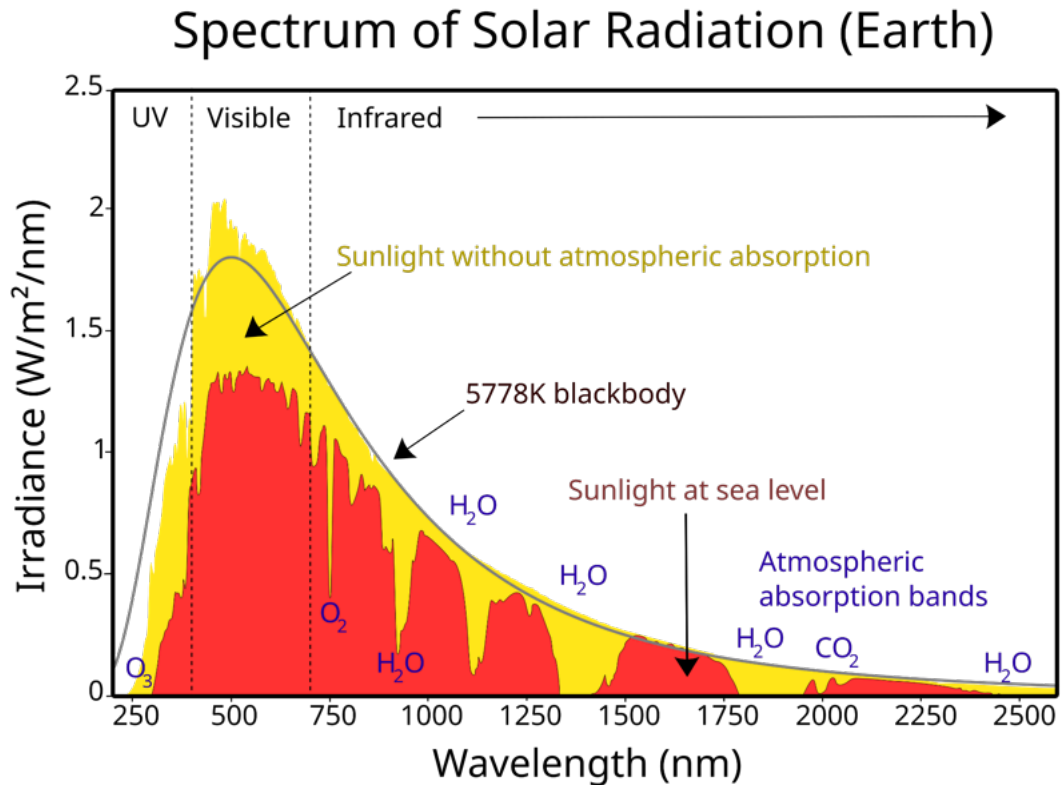


Figure 2.3: Spectral Power Distribution (SPD) and Atmospheric Absorption. The **yellow area** shows sunlight as it exists in space, before entering Earth's atmosphere (Air Mass 0). The **red area** shows what remains after sunlight passes through the atmosphere to reach sea level (Air Mass 1.5). The difference between yellow and red represents energy absorbed or scattered by atmospheric gases — the labeled dips show absorption by O₃ (ozone), H₂O (water vapor), and CO₂ (carbon dioxide). **For colorists, the key insight:** at equatorial latitudes (AM 1.0), sunlight travels a shorter path through the atmosphere, preserving more of the full spectrum. At polar latitudes (AM 2.0+), the longer atmospheric path deepens these absorption bands, filtering out more blue wavelengths from direct sunlight and shifting the color temperature warmer. (Source: Rohde, 2007.)

3. PSYCHOLOGY & PERCEPTION

3.1. VISUAL DIETS & ECOLOGICAL VALENCE

The physics of light explains what reaches the eye. Psychology explains what the brain does with it — and the brain is not a neutral processor. Human color perception is adaptive, shaped by the environment over both evolutionary and individual timescales. A viewer raised in the high-luminance tropics has a fundamentally different visual baseline than one raised under the diffuse skies of Northern Europe.

Ecological Valence Theory, developed by Palmer and Schloss (2010), proposes that humans prefer colors associated with positive experiences within their ecological context. We are drawn to colors that signal health, safety, and resources in our environment. This preference is not universal but adaptive — calibrated to local conditions. A population whose survival depended on reading subtle variations in grey winter light develops different sensitivities than one surrounded by saturated jungle foliage.

This may help explain a pattern observable across cultures: equatorial societies — from the Zapotec weavers of Oaxaca to the textile traditions of Ghana to the temple architecture of Tamil Nadu — historically favor saturated, high-chroma palettes. Nordic cultures, from Scandinavian furniture design to Icelandic architecture to the muted palette of Dutch Golden Age painting, tend toward desaturation and tonal subtlety. These do not appear to be arbitrary aesthetic choices. They are consistent with visual languages calibrated to local light — though the causal relationship between luminance environment and cultural color preference remains an area of active research. What appears vibrant and alive under equatorial sun can appear garish under Nordic overcast; what appears sophisticated and nuanced in Helsinki can appear dull and lifeless in Havana.

Two perceptual phenomena anchor this adaptation scientifically:

The Hunt Effect describes the relationship between luminance and perceived saturation. Under high-luminance conditions, the human visual system perceives colors as more saturated than they would appear under low luminance — even when the chromaticity values are physically identical. This means that populations adapted to high-glare equatorial environments experience saturation differently than those adapted to low-light polar environments. What reads as appropriately vivid at the equator may read as oversaturated to a Nordic eye; what reads as refined and subtle in Scandinavia may read as washed-out to an equatorial viewer (Figure 3.1). In the Latitude Tool, this phenomenon is addressed by the [Psych] Hunt Saturation parameter, which increases saturation at equatorial latitudes and decreases it at polar latitudes to match the perceptual expectations of each environment.

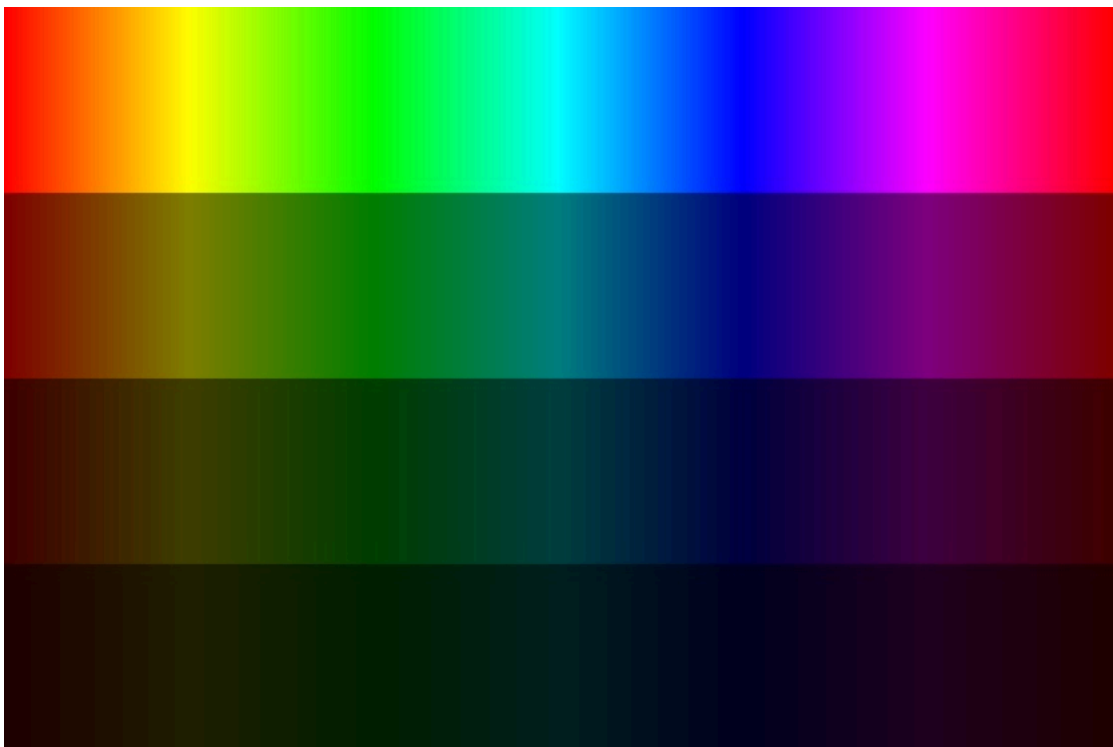


Figure 3.1: Visualization of the Hunt Effect. The four horizontal bands contain identical chromaticity values (hue and saturation); only luminance varies between them. The human visual system perceives the brighter bands (top) as significantly more saturated than the darker bands (bottom). This illustrates why high-glare environments (equatorial) are perceived as vibrant while low-light environments (polar) are perceived as monochromatic, even when physical surface reflectance is identical. Additionally, as intensity peaks, the Bezold-Brücke Shift causes hues to warp, pushing reds and greens toward the invariant yellow (575nm), contributing to the perceived warmth of **equatorial** sun. (Source: Axford, 2022.)

The Bezold-Brücke Shift describes how hue perception itself changes with luminance. As intensity increases, most hues drift toward perceptual anchors: reds shift toward yellow, greens shift toward yellow, blues shift toward cyan. Only a few invariant wavelengths — approximately 478nm (blue), 503nm (green), and 575nm (yellow) — remain stable across luminance changes. Under the high-intensity light of equatorial noon, the visual system experiences a world shifted toward warmth — not because the light source is warmer, but because the eye perceives it that way (Figure 3.2).

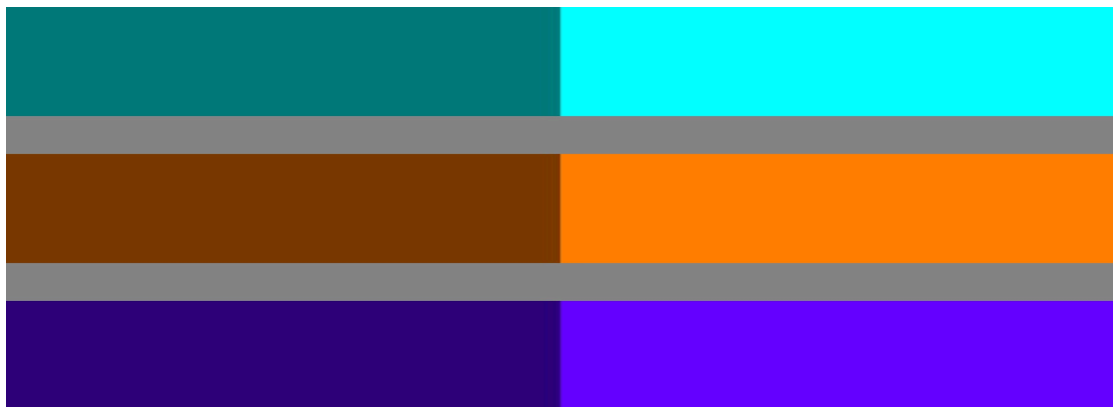


Figure 3.2: *The Bezold-Brücke Hue Shift. This phenomenon demonstrates that hue perception is non-linear relative to luminance. The patches on the left and right of each pair share identical chromaticity (wavelength ratio); they differ only in brightness. As luminance increases (right), perception distorts: long wavelengths (red/orange) shift toward the invariant yellow (575nm), while short wavelengths (violet) shift toward the invariant blue (478nm). In the context of the Latitude Tool, this validates why the high-glare environment of the equator naturally pushes skin tones toward a dominant golden/ochre vector — a shift captured by the [Psych] Skin Vector parameter. (Source: Wikimedia Commons, 2025.)*

This validates the golden, ochre-dominant palette of tropical cinema as perceptually authentic, not merely stylistic convention. When cinematographers like César Charlone push skin tones toward bronze in *City of God*, they are not imposing an aesthetic — they are replicating what the eye actually perceives under Brazilian sun.

For the colorist, these phenomena have direct practical implications. A grade intended for global audiences must account for the fact that viewers bring different visual baselines to the screen. More importantly, when emulating a specific latitude, the colorist must consider not just the physics of the light but the perceptual experience of

someone adapted to that light. Geographic Emulation is not just about matching spectral power distributions — it is about triggering the appropriate perceptual response.

3.2. CHROMATIC ADAPTATION (DYNAMIC RANGE)

The human visual system does not function like a digital sensor with a fixed ISO. It is a dynamic, non-linear system that continuously adapts to luminance conditions — and this adaptation fundamentally shapes how we perceive contrast, color, and detail at different latitudes.

At equatorial latitudes under direct sun, the eye operates in the high-photopic regime, processing luminance levels exceeding 10,000 nits. Under these conditions, the retina engages protective compression mechanisms described by the Naka-Rushton equation: a sigmoidal response function that aggressively rolls off highlights to prevent neural saturation. While the equation itself is not directly computed in the Latitude Tool, its shape informs the tonal strategy. In practical terms, the eye creates its own hard knee in the highlights — a biological tone mapping that preserves shadow detail while accepting highlight clipping as the cost of operating in extreme brightness.

This is why equatorial cinema often features crushed highlights and deep blacks: the grade is replicating how the eye actually experiences high-glare environments. When César Charlone speaks of the bleached, blown-out aesthetic of *City of God*, he is describing not just a stylistic choice but a perceptual reality. The favela residents in that film live under light that forces the eye into constant highlight compression. To grade that footage with gentle highlight roll-off and open shadows would be technically possible but perceptually false — it would depict a luminance experience no one standing in that location would recognize.

At polar latitudes, the situation inverts. Even at midday, luminance levels remain modest. The eye operates primarily in the mesopic regime — the transitional zone between photopic (cone-driven, color-sensitive) and scotopic (rod-driven, monochromatic) vision (Figure 3.3). In this regime, contrast sensitivity drops. The eye struggles to resolve deep blacks because it is adapted to a lower overall luminance baseline. Shadows that would read as rich and detailed under equatorial adaptation become muddy and indistinct.

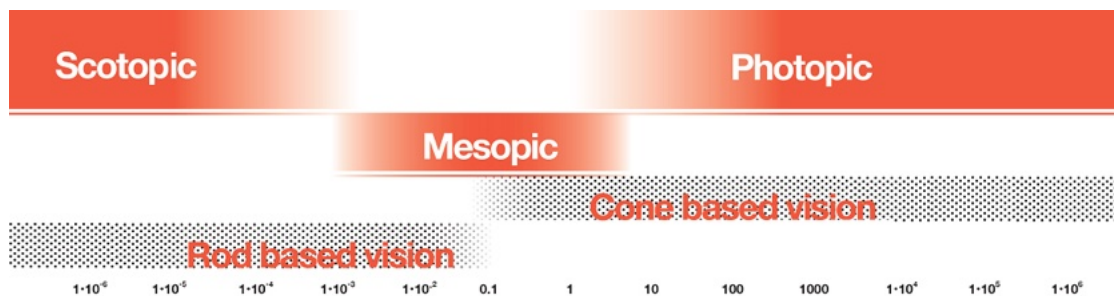


Figure 3.3: Human eye luminance level range and types of vision. The diagram illustrates the three regimes of human visual adaptation: scotopic (rod-driven, below 10^{-3} cd/m^2), mesopic (mixed rod/cone, 10^{-3} to $10^{0.5} \text{ cd/m}^2$), and photopic (cone-driven, above 10 cd/m^2). At equatorial latitudes, the eye operates in the high-photopic regime under luminance levels exceeding $10,000 \text{ cd/m}^2$, engaging aggressive highlight compression via the Naka-Rushton response. At polar latitudes, the eye operates primarily in the mesopic regime, with reduced contrast sensitivity and difficulty resolving deep blacks. (Source: Admesy, 2024.)

This is why Nordic cinema often features lifted blacks. Films like *Let the Right One In* or the work of cinematographer Hoyte van Hoytema maintain shadow detail not through technical limitation but through perceptual accuracy — they are simulating the reduced contrast sensitivity of an eye adapted to low-light conditions. To crush the blacks in a Scandinavian winter scene would impose an equatorial perceptual regime onto a polar environment. The image would gain contrast but lose authenticity.

For the colorist, the Naka-Rushton equation offers a conceptual analogy rather than a direct computational model: the eye's response to luminance is not linear but sigmoidal, with a variable inflection point that shifts based on adaptation state. The

grading parameters derived in the Latitude Tool are informed by this principle but are not mathematically computed from the equation itself. At the equator, that inflection point sits high — the eye tolerates extreme highlights before compressing. At the poles, it sits lower — the eye begins compressing earlier, in a gentler curve.

The Latitude Tool accounts for this through the [Solar] Pivot and [Solar] Tonal Contrast parameters. Equatorial emulation sets a high [Solar] Pivot (0.6–0.65) with positive [Solar] Tonal Contrast, creating aggressive highlight roll-off and deep shadows. Polar emulation sets a lower [Solar] Pivot (0.35–0.40) with negative [Solar] Tonal Contrast, lifting shadows via the [Solar] Shadow Density parameter and creating gentle tonal transitions. The tool is not merely adjusting contrast — it is simulating the adaptation state of an eye calibrated to a specific luminance environment.

3.3. EMOTIONAL MAPPING

The connection between light and emotion is not metaphorical — it is measurable. Psychologists have long used Russell's **Circumplex Model of Affect** to quantify emotional responses to environmental stimuli, and light is among the most powerful of those stimuli. For the colorist, this model provides a framework for understanding why certain grades feel tense, serene, oppressive, or liberating.

The Circumplex Model maps emotional states across two dimensions: **Valence** (positive to negative pleasure) and **Arousal** (high to low activation). Light characteristics — intensity, contrast, color temperature, and directionality — directly influence where a viewer lands on these axes.

Equatorial light (0°–15° latitude) is defined by high contrast, hard shadows, and intense luminance. These characteristics correlate with high arousal states: tension, vitality, alertness, and danger. The body responds to high-glare environments with increased cortisol and heightened alertness — an evolutionary response to conditions that demand vigilance. This is why the favela sequences in *City of God* feel so viscerally tense, why the cartel violence in *Sicario* feels immediate and threatening,

why travel advertisements for adventure tourism favor hard desert light. The light itself activates the nervous system (Figure 3.4).

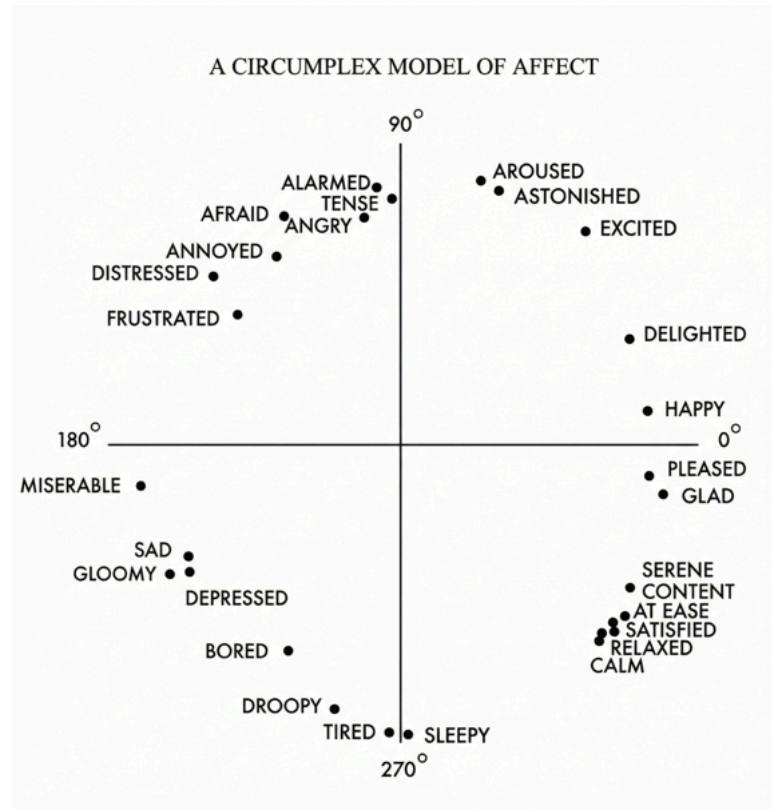


Figure 3.4: The Circumplex Model of Affect, mapping emotional states along axes of arousal (activation) and valence (pleasure). High-contrast, high-luminance equatorial light correlates with high-arousal states in the upper portion of the model (tense, alert, excited), while low-contrast, diffuse polar light correlates with low-arousal states in the lower portion (calm, serene, melancholic). This framework allows colorists to predict the emotional response a grade will evoke. (Source: Adapted from Russell's Circumplex Model, 1980.)

Polar light (60°+ latitude) produces the inverse response. Low contrast, diffuse illumination, and cool color temperatures correlate with low arousal states: calm, introspection, melancholy, and isolation. The body downregulates in low-light environments — a response that conserves energy during long winters. This is the emotional register of Nordic noir: the quiet dread of *The Girl with the Dragon Tattoo*, the contemplative stillness of Bergman's *Persona*, the isolated vulnerability of *Fortitude*. The viewer's nervous system settles into a slower rhythm, more receptive to psychological tension than visceral shock.

For the colorist, emotional mapping provides a practical tool: before grading, define the target emotional state. A thriller set in Managua requires high arousal — push [Solar] Tonal Contrast positive, set a high [Solar] Pivot, let the shadows crush with minimal [Solar] Shadow Density. A meditation on grief set in Reykjavik requires low arousal — increase [Solar] Shadow Density, lower the [Solar] Pivot, soften the roll-off with negative [Solar] Tonal Contrast. The Latitude Tool encodes these relationships: as the latitude slider moves from equatorial to polar, arousal decreases and the emotional register shifts from visceral to contemplative.

This is not manipulation — it is communication. Filmmakers have always understood that light carries emotional information. Geographic Emulation simply makes that understanding systematic and repeatable.

4. CINEMATIC ANALYSIS (CASE STUDIES)

The theoretical framework established in the previous sections — solar geometry, atmospheric scattering, chromatic adaptation, and emotional mapping — can be observed in practice across decades of cinematography. The following case studies examine how master cinematographers have intuitively or deliberately employed Geographic Emulation to create images that feel rooted in specific latitudes. These are not merely aesthetic choices; they are applications of the same radiometric and psychological principles this thesis seeks to systematize.

4.1. THE EQUATORIAL AESTHETIC: CITY OF GOD (2002)

Fernando Meirelles' *City of God*, photographed by César Charlone, remains one of the most visceral depictions of equatorial light in cinema. Set in the favelas of Rio de Janeiro (22°S latitude — near the boundary of the tropical band defined in Section 2.1, but exhibiting the high solar elevation angles and equatorial light characteristics described throughout this thesis), the film's visual language is inseparable from its geography. Charlone did not simply photograph Brazil; he made the audience feel the heat, humidity, and relentless intensity of life under tropical sun.

The look is defined by what I term Radiometric Excess: the visual consequence of Air Mass 1.0 (hard, perpendicular light), high humidity (intense Mie scattering), and biogenic reflectance (light bouncing off dense vegetation and weathered concrete). Every frame carries the weight of equatorial physics.

Charlone achieved the film's signature contrast through a hybrid photochemical approach. He shot primarily on 16mm reversal stock (Kodak Ektachrome) rather than negative film, then processed the footage through a digital intermediate pipeline that emulated cross-processing — the technique of developing reversal film in negative chemistry, or vice versa. This chemical mismatch produces a characteristic response curve: crushed blacks, clipped highlights, and elevated midtone contrast. The result is

an image that feels overexposed and underexposed simultaneously — precisely how the human eye experiences high-glare environments where the retina compresses both ends of the dynamic range to protect itself (Figure 4.1).



Figure 4.1: Stills from *City of God* (2002) demonstrating the equatorial aesthetic. Note the crushed highlights, deep shadows, and the characteristic warmth of the sunlit areas contrasted against cyan-shifted ambient shadows. Cinematographer César Charlone achieved this look through a combination of 16mm reversal stock and digital cross-processing emulation, replicating the perceptual experience of the human eye under high-glare tropical conditions. (Source: *City of God*, dir. Fernando Meirelles, DP César Charlone, 2002.)

The color palette reveals equally deliberate physics. Charlone created a separation between two chromatic zones: skin tones pushed toward ochre and bronze, while ambient shadows carry a distinct green-cyan tint. This is not arbitrary stylization — it is an emulation of biogenic reflectance. In the favelas, light bounces off dense vegetation, weathered painted surfaces, and the surrounding hills. This bounced light

carries the spectral signature of its source: chlorophyll-heavy foliage reflects strongly in the green spectrum, filling shadows with that characteristic tint. Meanwhile, direct sunlight on skin — uncontaminated by this bounce — renders in the warm golden tones associated with high-luminance photopic perception.

This chromatic separation is a hallmark of authentic equatorial imagery. When colorists grade tropical footage without understanding this physics, they often neutralize the green fill, creating images that are technically balanced but geographically false. Charlone understood — intuitively or deliberately — that the green shadows were not a flaw to correct but a signature to preserve. In the Latitude Tool, this phenomenon is captured by the [Atmos] Biogenic parameter, which introduces green reflection in shadows at equatorial latitudes.

The *City of God* grade also demonstrates the emotional mapping principles discussed in Section 3.3. The high contrast and hard light place viewers in a high-arousal state: tense, alert, and viscerally engaged. This is not merely a creative choice but a radiometric one — the grade replicates the perceptual and physiological state of someone standing in that favela under that sun. When we watch *City of God*, our nervous systems respond to the light before our minds process the narrative.

For the colorist seeking to emulate equatorial light, *City of God* provides a template: push the [Solar] Pivot high, allow highlights to clip into a hard knee, let shadows crush with minimal [Solar] Shadow Density, introduce warm bias in direct light via [Atmos] Sun Warmth and green-cyan bias in ambient fill via [Atmos] Biogenic, increase [Psych] Hunt Saturation, and add Atmospheric Diffusion to simulate the visual weight of humid, particulate-heavy air. The Latitude Tool encodes these relationships: as the latitude slider approaches 0°, these characteristics intensify.

4.2. THE POLAR AESTHETIC: THE REVENANT (2015)

If *City of God* represents the equatorial extreme, Alejandro González Iñárritu's *The Revenant*, photographed by Emmanuel Lubezki, represents its polar counterpart. Shot primarily in Alberta, Canada (51°N latitude) and later in Ushuaia, Argentina (54°S — the southern equivalent), the film is a masterclass in high-latitude light. Lubezki's commitment to natural illumination was absolute: no artificial lighting was used for exterior scenes. The result is an image defined entirely by the physics of polar radiometry.

The look is defined by what I term Radiometric Restraint: the visual consequence of Air Mass 2.0+ (oblique, diffused light), low humidity (minimal Mie scattering), and extended twilight (the sun hovering near or below the horizon for much of the day). Where *City of God* assaults the viewer with intensity, *The Revenant* envelops them in atmospheric depth.

Lubezki achieved the film's signature tonal structure through a digital emulation of ENR (silver retention) processing. In traditional photochemical workflows, ENR involved skipping the bleach bath during printing, leaving metallic silver in the emulsion alongside the color dyes. The result was denser blacks, reduced saturation, and increased apparent sharpness. For *The Revenant*, this process was emulated digitally in the grade: shadows gain density and texture without losing detail, while colors shift toward desaturation without becoming monochromatic. The blacks feel substantial — what colorists sometimes call "crunchy" — while the highlights remain soft and diffused (Figure 4.2).



Figure 4.2: A still from *The Revenant* (2015) demonstrating the polar aesthetic. Cinematographer Emmanuel Lubezki used exclusively natural light, capturing the diffuse, omnidirectional quality of high-latitude illumination. Note the dense, textured shadows, desaturated palette, and soft highlight roll-off characteristic of ENR emulation. The cyan-blue bias in the shadows results from Rayleigh scattering — at high latitudes, the sky itself becomes the dominant fill light. (Source: *The Revenant*, dir. Alejandro González Iñárritu, DP Emmanuel Lubezki, 2015.)

The color palette demonstrates Rayleigh scattering in its purest cinematic form. At 51°N latitude during winter, the sun barely rises above the horizon. For much of the day, the primary illuminant is not direct sunlight but the sky itself — a vast hemisphere of scattered blue wavelengths. This creates the characteristic cyan-blue bias in shadows that defines Nordic light. In *The Revenant*, shadows are never neutral grey; they are deep cyan, sometimes pushing toward teal. This is not a creative choice imposed in the grade — it is the physics of the location captured faithfully. In the Latitude Tool, this phenomenon is captured by the [Atmos] Rayleigh Fill parameter, which increases cyan bias in shadows as latitude increases.

Lubezki's insistence on shooting during "magic hour" (the extended twilight periods at high latitudes) further emphasized this quality. At these times, the sun's rays travel through maximum atmosphere (high air mass), scattering virtually all blue wavelengths out of the direct beam. What remains is warm, golden light — but this light is weak, and the dominant illumination remains the blue sky. The result is the distinctive polar signature: warm direct highlights against cool shadow fill, with

reduced overall contrast due to the atmospheric softening of the direct beam.

This is the inverse of equatorial light. Where *City of God* features hard contrast with warm shadows, *The Revenant* features soft contrast with cool shadows. Where Charlone pushed saturation and allowed highlights to clip, Lubezki pulled saturation and protected highlights with gentle roll-off. The two films sit at opposite ends of the latitude spectrum, and their visual languages reflect this with scientific precision.

The emotional register follows accordingly. The low contrast and cool tones place viewers in a low-arousal state: contemplative, isolated, melancholic. The body downregulates in response to this light, just as it would in an actual high-latitude environment during winter. This is the emotional territory of Nordic noir — the quiet dread of survival rather than the visceral shock of violence. When Hugh Glass crawls across frozen landscapes, we feel the cold not because of narrative context but because the light itself signals it to our nervous systems.

For the colorist seeking to emulate polar light, *The Revenant* provides a template: lower the [Solar] Pivot, protect highlights with soft roll-off via negative [Solar] Tonal Contrast, lift the blacks via [Solar] Shadow Density while adding density and texture, introduce cool cyan bias in shadows via [Atmos] Rayleigh Fill while reducing [Atmos] Sun Warmth (which tracks the perceived warmth contribution of direct sun to the overall image — not the spectral color temperature of the direct beam, which is paradoxically warmer at polar latitudes; see Section 2.3), reduce overall [Psych] Hunt Saturation, and minimize Atmospheric Diffusion while holding Atmospheric Clarity at neutral. The Latitude Tool encodes these relationships: as the latitude slider approaches 64°N, these characteristics intensify.

4.3. COMMERCIAL APPLICATION: AUTOMOTIVE ADVERTISING

The principles of Geographic Emulation extend beyond narrative cinema into one of the most lucrative sectors of moving image production: automotive advertising. In this

arena, the connection between latitude, light, and emotional response is not merely artistic — it is strategic. Every frame is engineered to trigger specific consumer psychology, and the grade is a primary tool in that engineering. Two dominant paradigms illustrate this application: the Adventure Grade and the Luxury Grade. Each employs a distinct geographic light signature to evoke a target emotional state.

The Adventure Grade: Desert and Wilderness (Equatorial Light Emulation)

When selling a rugged SUV or off-road vehicle, advertisers consistently favor locations like Utah, Namibia, or the Australian Outback — environments defined by low-latitude light characteristics even when not technically equatorial. The grade leans heavily into a golden-red vector, often pushing color temperature toward 3200K or warmer. Shadows take on amber and ochre tones. Highlights blow out into white-gold.

This is not arbitrary. The warm palette triggers associations with adventure, vitality, and freedom — high-arousal states aligned with the product's intended identity. Colorists working on these campaigns often push Atmospheric Clarity aggressively, enhancing the visibility of airborne particulate matter: dust, dirt, sand kicked up by the vehicle. This particulate haze serves a dual function. Physically, it demonstrates the vehicle's capability — it is doing something, going somewhere, conquering terrain. Perceptually, it amplifies the Mie scattering signature of high-glare environments, adding Atmospheric Diffusion to the air (Figure 4.3).

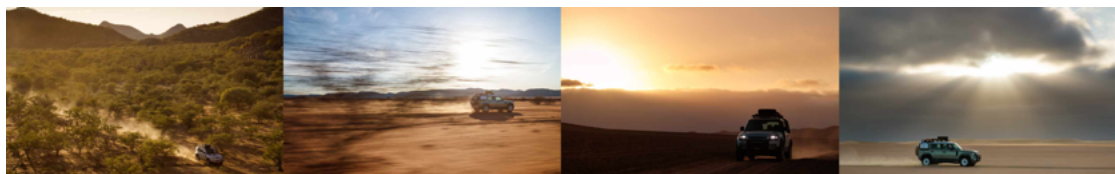


Figure 4.3: A Land Rover advertisement demonstrating the Adventure Grade aesthetic. The golden-amber color temperature (approximately 3200K), visible airborne particulate (dust), and warm shadow bias create a high-arousal visual environment associated with capability, freedom, and rugged vitality. This grade emulates equatorial light characteristics: high contrast, warm direct light, and Atmospheric Diffusion from suspended particles. (Source: Land Rover promotional imagery.)

The Luxury Grade: Urban and Nordic (Polar Light Emulation)

When selling a luxury sedan — Mercedes-Benz, BMW, Audi, or Lexus — the visual language inverts entirely. These campaigns favor locations like London, Berlin, Stockholm, or abstract studio environments designed to emulate high-latitude light. The grade shifts toward silver, steel, and cyan, often pushing color temperature to 6500K or cooler. Shadows take on blue-grey tones. Highlights remain controlled, never clipping, with soft specular roll-off.

The goal here is fundamentally different: maximizing the anisotropy of the vehicle's surface. Anisotropy refers to directional reflectance — the way light bounces off a surface differently depending on viewing angle. High-end automotive paint, with its multiple clear-coat layers and metallic flake, exhibits extreme anisotropy. This quality is best revealed under diffuse, omnidirectional illumination — exactly what high-latitude Rayleigh scattering provides. The soft, cool light wraps around the vehicle's curves, revealing form and surface quality in ways that hard equatorial light would obscure with harsh specular highlights (Figure 4.4).

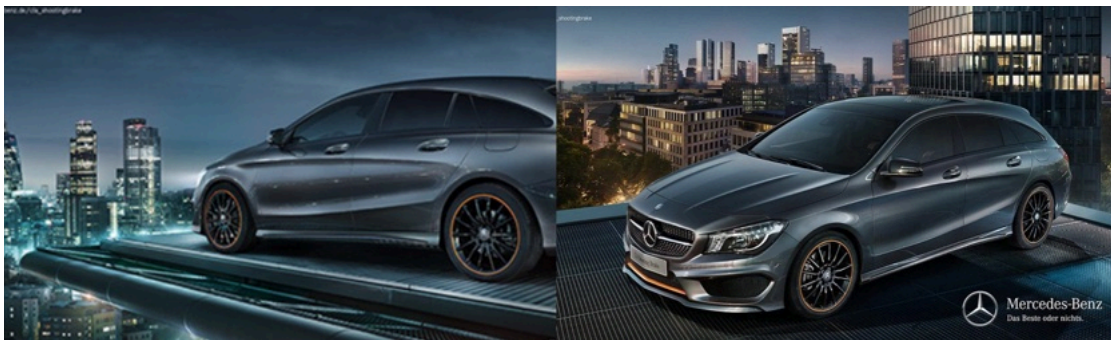


Figure 4.4: A Mercedes-Benz advertisement demonstrating the Luxury Grade aesthetic. The cool color temperature (6500K+), silver-blue tonality, and controlled specular highlights create a low-arousal visual environment associated with precision, sophistication, and technological excellence. This grade emulates polar light characteristics: soft contrast, omnidirectional fill, and Rayleigh-scattered blue bias. The diffuse illumination maximizes anisotropic reflectance, revealing the sculptural quality of the vehicle's surface. (Source: Mercedes-Benz promotional imagery.)

The emotional mapping is precise. The Adventure Grade places viewers in high-arousal states: excitement, energy, the thrill of possibility. The Luxury Grade

places viewers in low-arousal states: calm, confidence, the assurance of quality. Neither is superior — they are calibrated to different consumer psychology and different product identities.

What makes this relevant to Geographic Emulation is the underlying physics. Automotive advertisers discovered these palettes not through arbitrary aesthetic preference but through decades of testing what works — and what works aligns precisely with the radiometric signatures of real latitudes. The Adventure Grade is equatorial light; the Luxury Grade is polar light. The industry arrived at these conventions empirically; this thesis provides the scientific framework explaining why they work.

For the colorist, automotive advertising offers a controlled laboratory for studying Geographic Emulation. The products are consistent (cars), the budgets are high (allowing precise execution), and the emotional targets are explicit (sell rugged capability or refined luxury). Studying these conventions reveals the latitude-emotion mapping in its most commercially distilled form.

5. PRACTICAL APPLICATION: THE WORKFLOW

The Latitude Tool operates within a Fixed Node Structure in DaVinci Resolve. The pipeline processes the image in the order that light physically behaves:

- **Node 01: IDT** — Converts camera footage to DaVinci Wide Gamut
- **Node 02: CDL** — Normalizes to D65 white balance, 18% grey at 0.375
- **Node 03: Latitude Tool** — Applies geographic color emulation (DCTL)
- **Node 04: Atmospheric Diffusion** — Atmospheric glow effect (Resolve's Glow)
- **Node 05: Atmospheric Clarity** — Edge definition (Resolve's Texture Pop)
- **Node 06: ODT** — Converts to delivery format (Rec.709)

This sequence ensures physically coherent processing: normalization first, then color, then atmospheric effects. The complete node structure is illustrated in Figure 5.1.



Figure 5.1: The Latitude Tool pipeline in DaVinci Resolve. The Fixed Node Structure processes footage in physically coherent order: input transformation, normalization, geographic color emulation, atmospheric effects, and output conversion. (Source: Screenshot by author.)

For testing and demonstration purposes, this thesis uses the official ARRI reference footage (ARRI_Helen_John_ALEXA_35_ARRIRAW) available from ARRI's website. This controlled studio environment provides a neutral baseline with known

lighting conditions (D65), standard skin tones, and consistent exposure — ideal for isolating the effects of geographic emulation without variables introduced by location shooting.

5.1. TONE MAPPING FOR LATITUDE

The foundational layer of Geographic Emulation is tone mapping — shaping the contrast curve to replicate the luminance signature of a specific latitude. This is achieved through custom curves and HDR zone controls, manipulating what I call the hardness of light: the rate at which the image transitions from shadow to highlight.

Two parameters govern this transition: the [Solar] Pivot (the luminance value around which contrast is distributed) and the [Solar] Tonal Contrast (the shape of the sigmoid curve as it approaches black and white). Different latitudes produce different combinations of these parameters, and replicating them is the first step in geographic authenticity.

The Equatorial Tone Map (0° – 23.5° Latitude)

Equatorial light is defined by intensity. The sun strikes perpendicular to the surface, delivering maximum irradiance. The human eye responds by compressing dynamic range aggressively — the Naka-Rushton response curve shifts to accommodate high luminance, creating a hard knee in the highlights.

To emulate this in the grade:

Set the [Solar] Pivot high, at **0.620**. This places the point of maximum contrast in the upper midtones, allowing shadows to fall away steeply while concentrating tonal separation in the brighter regions of the image.

Use a positive [Solar] Tonal Contrast of **+0.240**. Rather than allowing highlights to roll off gradually, let them clip relatively abruptly. This simulates the sensation of

blinding glare — the perceptual experience of looking into equatorial sun where the eye simply cannot resolve detail above a certain luminance threshold.

Minimize [Solar] Shadow Density to **0.00 IRE**. Equatorial shadows are deep and dense. The ambient fill is dominated by Mie scattering (warm and directional) rather than Rayleigh scattering (cool and omnidirectional), so shadows do not receive the same wraparound fill characteristic of polar environments. Let them crush.

The result is an image with high overall contrast, abrupt highlight clipping, dense shadows, and maximum tonal separation in the upper midtones. This is the *City of God* curve — visceral, intense, and unforgiving (Figure 5.2).

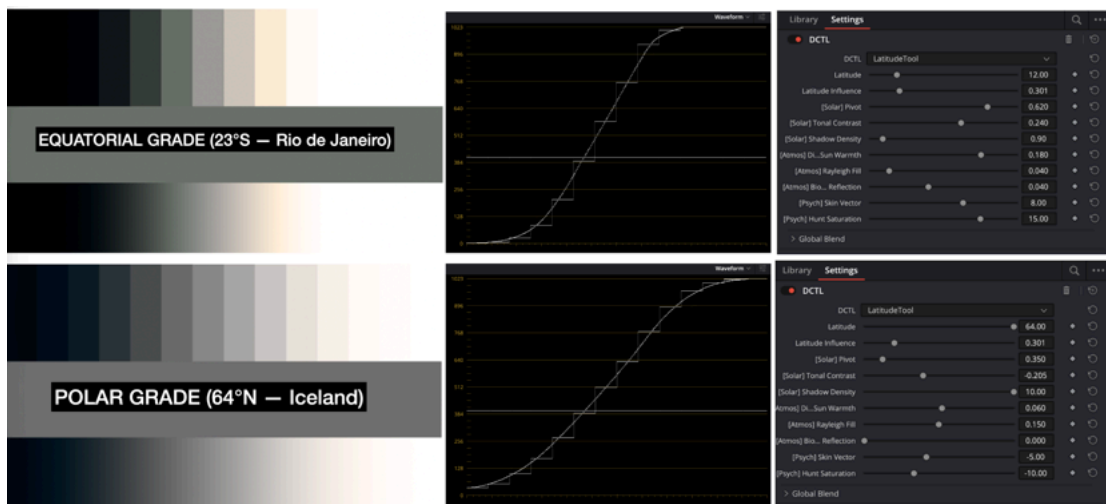


Figure 5.2: Tone mapping comparison using the Latitude Tool applied to a grayscale tonemap test image. **Top:** Equatorial settings (23°S, Rio de Janeiro) produce a high [Solar] Pivot (0.620), positive [Solar] Tonal Contrast (+0.240), and minimal Shadow Density (0.00 IRE)—visible in the waveform as a steep S-curve with blacks crushed to 0 IRE. **Bottom:** Polar settings (64°N, Iceland) produce a low [Solar] Pivot (0.350), negative [Solar] Tonal Contrast (-0.205), and elevated Shadow Density (10.00 IRE)—visible in the waveform as a gentler curve with lifted blacks. The grayscale test image isolates tonal response from color, demonstrating the pure contrast signature of each latitude. (Source: Screenshot by author using Latitude Tool v3.2 and Dado's LOOK DESIGNER tonemap test image.)

The Polar Tone Map (50° – 70° Latitude)

Polar light is defined by diffusion. The sun travels at an oblique angle, spreading its energy across greater surface area and passing through more atmosphere. The human

eye operates in the mesopic regime, with reduced contrast sensitivity and difficulty resolving deep shadows.

To emulate this in the grade:

Set the [Solar] Pivot low, at **0.350**. This places the point of maximum contrast in the lower midtones, allowing highlights to extend upward gradually while concentrating tonal separation in the shadow-to-midtone transition.

Use a negative [Solar] Tonal Contrast of **-0.205**. The curve should begin to flatten well before reaching white, ensuring that clouds, snow, skin highlights, and atmospheric haze retain maximum detail. This is the soft, gentle roll-off characteristic of Scandinavian cinematography — highlights that glow rather than clip.

Increase [Solar] Shadow Density to **10.00 IRE**. Polar shadows are never truly black. The omnidirectional fill from Rayleigh-scattered blue light wraps into every crevice. Crushing the blacks in a polar grade creates an equatorial perceptual signature that contradicts the geographic reality. Instead, allow shadows to retain density and texture while lifting the absolute black point.

The result is an image with reduced overall contrast, gentle highlight roll-off, lifted but textured shadows, and maximum tonal separation in the lower midtones. This is *The Revenant* curve — contemplative, atmospheric, and enveloping.

5.2. MANAGING MEMORY COLORS (SKIN)

Skin tone is the most scrutinized element in any graded image. Human beings are exquisitely sensitive to skin — we evolved to read faces for health, emotion, and social information. A skin tone that deviates even slightly from expectation registers as wrong, even if the viewer cannot articulate why. This makes skin the most critical memory color in Geographic Emulation.

The conventional wisdom in color grading is to place skin on the I-line (the warm diagonal extending from the center of the vectorscope toward orange-yellow, approximately 117° on most scopes). This guideline exists because skin, regardless of ethnicity, shares a common underlying chromatic signature derived from melanin and hemoglobin — both of which reflect in the warm spectrum. However, the I-line represents a neutral baseline, not a universal target. Real skin under real light deviates from this line in predictable ways based on latitude, and authentic Geographic Emulation requires honoring those deviations rather than correcting them away.

Tropical Skin Strategy (Equatorial Latitudes)

Under equatorial light, skin is bathed in high-intensity, warm-spectrum illumination. The Hunt Effect increases perceived saturation; the Bezold-Brücke shift pushes hues toward yellow. Simultaneously, tropical environments trigger physiological responses: increased melanin production, perspiration, and surface oil — all of which affect how skin reflects and scatters light.

To emulate tropical skin authentically:

Set the [Psych] Skin Vector to a positive value (e.g., **+8.00°**), rotating skin tones counter-clockwise on the vectorscope, drifting from the I-line toward yellow-orange. Do not force correction back to the textbook position. This rotation reflects the actual spectral signature of skin under high-glare conditions — the golden, ochre-bronze tonality we associate with sun exposure. In *City of God*, Charlone allowed skin to push well into this territory, creating the distinctive favela complexion that reads as authentically Brazilian.

Increase [Psych] Hunt Saturation to a positive value (e.g., **+15.00%**). The Hunt Effect means that viewers adapted to high-luminance environments expect higher saturation. Desaturated skin in an equatorial grade reads as sickly or washed-out, even if technically correct by temperate standards.

The [Atmos] Biogenic Reflection parameter (up to 0.040 at 0° latitude; 0.030 at

Nicaragua's 12°N) adds subtle green reflectance in the midtones, simulating the environmental bounce from tropical vegetation that influences skin tonality in jungle and rainforest environments (Figure 5.3).



Figure 5.3: Skin tone analysis using the ARRI color reference chart and vectorscope. The vectorscope trace shows skin tones falling along the I-line (skin tone line) extending toward the warm quadrant between yellow and red. Regardless of ethnicity, healthy skin tones cluster along this vector due to the consistent spectral properties of melanin and hemoglobin. The [Psych] Skin Vector parameter in the Latitude Tool rotates hues along this axis—positive values push skin toward golden/ochre (equatorial adaptation), while negative values shift toward pink/magenta (polar adaptation). (Source: Screenshot by author using ARRI test footage.)

Arctic Skin Strategy (Polar Latitudes)

Under polar light, skin receives diffuse, low-intensity, cool-spectrum illumination. The reduced luminance means lower perceived saturation (the inverse of the Hunt Effect). The cool ambient fill shifts overall skin tone toward the underlying blood flow — hemoglobin, which reflects in the red-magenta spectrum — rather than the melanin-dominant warmth of sun-exposed skin.

To emulate polar skin authentically:

Allow the [Psych] Skin Vector to rotate clockwise on the vectorscope, drifting from the I-line toward red-magenta. This removes the golden cast associated with sun exposure and reveals the cooler, pinker undertones of skin that rarely sees direct sunlight. In *The Revenant*, Lubezki's natural-light approach captured this

automatically — Hugh Glass's skin reads as raw, wind-chapped, and blood-flushed rather than bronzed.

Reduce [Psych] Hunt Saturation slightly in skin tones. Polar viewers are adapted to lower saturation environments. Highly saturated skin in a Nordic grade reads as artificial or over-processed. Allow skin to sit closer to neutral, with just enough chroma to read as healthy.

Use negative or neutral Atmospheric Clarity in skin regions. Polar skin, protected from intense UV exposure and lacking the perspiration of tropical climates, presents a smoother, more uniform surface. The aggressive texture enhancement appropriate for equatorial grades would look harsh and unflattering in a polar context. Allow skin to retain its natural softness under diffuse light.

The emotional implications are significant. Warm, saturated, textured skin reads as vital, active, and present — appropriate for the high-arousal environments of equatorial cinema. Cool, desaturated, smooth skin reads as vulnerable, introspective, and exposed — appropriate for the low-arousal environments of Nordic noir. The skin grade is not merely cosmetic; it is part of the emotional architecture of the image.



Figure 5.4: Comparison of equatorial versus polar skin tone treatment. Left: A still from *City of God* (2002) showing tropical skin — the vector rotates counter-clockwise toward yellow-orange, with elevated saturation and enhanced texture (perspiration, pores visible under hard equatorial light). Right: A still from *The Revenant* (2015) showing polar skin — the vector rotates clockwise toward red-magenta, revealing underlying hemoglobin in skin that rarely sees direct sun, with reduced saturation and smoother texture under diffuse arctic light. (Sources: *City of God*, dir. Fernando Meirelles, 2002; *The Revenant*, dir. Alejandro González Iñárritu, 2015.)

5.3. ATMOSPHERIC DIFFUSION AND CLARITY

The atmosphere is not empty space — it is a medium through which light travels, and that medium has visual weight. The density of air, its moisture content, and its particulate load all affect how light behaves between the subject and the lens. This is the third layer of Geographic Emulation: simulating the atmospheric volume that separates the viewer from the scene.

At equatorial latitudes, air is dense with water vapor. Humidity can exceed 80% in tropical environments, and that moisture scatters light in ways that fundamentally alter the image. At polar latitudes, air is cold and dry. Moisture freezes out, particulates settle, and light travels with minimal interference. These differences are visible — the heavy, glowing air of the Amazon versus the crystalline clarity of an Icelandic glacier — and they must be addressed in the grade.

Equatorial Density: Wet Air

Tropical atmospheres are defined by Mie scattering from water vapor. Unlike Rayleigh scattering (which affects short wavelengths directionally), Mie scattering affects all wavelengths and exhibits strong forward directionality. The practical result is diffusion: high-luminance areas bleed into surrounding regions, edges soften, and the air itself becomes visible as a dense, humid medium.

To emulate equatorial atmospheric density:

Apply Atmospheric Diffusion with high spread and warm tint. In DaVinci Resolve, this is achieved through the Glow effect (Node 04 in the pipeline). The spread should be aggressive — light should leak well beyond its source boundaries. The tint should be warm, shifting toward amber or gold, reflecting the spectral bias of Mie-scattered light in humid environments.

Allow highlights to bloom into surrounding shadows. In tropical environments, the boundary between highlight and shadow is never sharp. Water vapor in the air catches

and redistributes light, filling the space between bright and dark regions with a luminous haze. This is the visual weight of monsoon air, the dense glow of midday in Managua, the heavy bloom that makes tropical footage feel humid even on a dry screen.

Reduce Atmospheric Clarity in highlight regions. The scattering that causes diffusion also reduces the micro-contrast within bright areas. Facial highlights, sky gradients, and specular reflections should feel soft and diffused rather than crisp. In DaVinci Resolve, this is achieved through the Texture Pop effect (Node 05 in the pipeline), set to moderate positive values to enhance tactile texture while allowing the diffusion to soften overall edge definition (Figure 5.5).

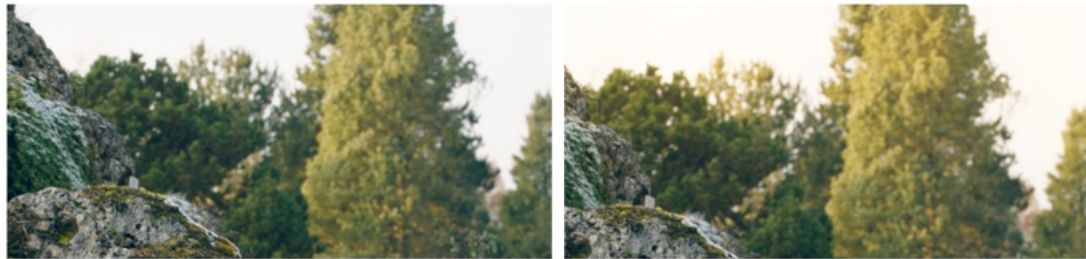


Figure 5.5: *Equatorial atmospheric density emulation. Left: Original ARRI footage. Right: After applying Glow (Node 04) and Texture Pop (Node 05). The Glow effect creates warm Mie-scattered bloom, visible in how the bright foliage bleeds into the sky and surrounding shadows. Note the softened edge transitions between the trees and sky, the luminous haze in the highlight regions, and the warm amber tint that simulates humid tropical air. (Source: Screenshot by author using ARRI test footage in DaVinci Resolve.)*

The cumulative effect is an image that feels thick. The viewer senses humidity not through narrative or performance but through the behavior of light itself. This is the *City of God* atmosphere, the *Sicario* border sequences, the tropical passages of *Apocalypse Now* — images where the air is a character.

Polar Clarity: Dry Air

Arctic atmospheres are defined by absence. Cold air holds minimal moisture; what water exists has frozen into ice crystals that settle rather than suspend. Particulate matter is sparse. The result is extraordinary clarity: light travels from subject to lens with almost no interference, edges remain sharp across great distances, and the image possesses a crystalline, almost hyperreal quality.

To emulate polar atmospheric clarity:

Reduce or eliminate Atmospheric Diffusion. Where equatorial grades add glow, polar grades subtract it. Highlights should remain contained within their boundaries, with minimal bleed into surrounding areas. If your footage has inherent lens bloom or sensor characteristics that add warmth to highlights, these should be countered or removed.

Rely on natural atmospheric clarity rather than artificial enhancement. Cold, dry air produces what psychophysicists call the Mach band effect: an enhancement of perceived contrast at luminance boundaries caused by lateral inhibition in the retina (Livingstone, 2002). In clear atmospheric conditions, this effect is pronounced because there is no scattering to soften edges. Rather than amplifying this with aggressive sharpening, set Atmospheric Clarity (Texture Pop) to neutral or slightly negative values — preserving the smooth, soft quality of polar light rather than adding artificial texture.

Hold Atmospheric Clarity between 0 and -5. This preserves the soft, diffuse quality of arctic light. Polar skin and landscapes should not exhibit the aggressive texture of equatorial grades. The clarity comes from the absence of atmospheric interference, not from enhanced sharpening. Excessive texture enhancement contradicts the gentle, enveloping quality of high-latitude illumination (Figure 5.6).



Figure 5.6: An Icelandic landscape demonstrating polar atmospheric clarity. Note the crisp edge definition, lack of atmospheric haze, and crystalline quality of the light — characteristics of cold, dry air with minimal Mie scattering. This clarity allows the eye to resolve fine texture detail across great distances, creating the hyperreal sharpness associated with high-latitude environments (64°N). The absence of suspended moisture produces images that feel thin and cold through the behavior of light alone. (Source: Iceland landscape photography.)

Allow cool tones to dominate the atmospheric layer. Where equatorial haze glows warm, polar clarity tints cool. The minimal scattering that does occur favors short wavelengths (Rayleigh scattering), so any atmospheric effect should shift toward blue-cyan rather than amber-gold. This is controlled through the [Atmos] Rayleigh Fill parameter in the Latitude Tool, which increases cyan bias in shadows as latitude increases.

The cumulative effect is an image that feels thin. The viewer senses cold not through snow or breath vapor but through the behavior of light itself. This is *The Revenant* atmosphere, the opening of *Fargo*, the landscape passages of *Insomnia* — images where clarity itself communicates temperature.

The Pipeline Implementation

In the Latitude Tool pipeline, atmospheric effects are controlled through two dedicated nodes following the DCTL:

Node 04: Atmospheric Diffusion (Resolve's Glow effect) controls the spread and warmth of highlight bloom. At equatorial latitudes, increase spread (0.3–0.4), intensity (0.2–0.3), and warm tint (+10 to +15 orange). At polar latitudes, reduce to minimal values or bypass entirely.

Node 05: Atmospheric Clarity (Resolve's Texture Pop effect) controls edge definition and surface texture. At equatorial latitudes, use moderate positive values (+12 to +15) to enhance the tactile reality of humid environments. At polar latitudes, hold at neutral to slightly negative values (0 to -5) to preserve the soft quality of diffuse arctic light.

Latitude	Atmospheric Diffusion	Atmospheric Clarity
0° (Equatorial)	High spread, warm tint	+12 to +15 (Resolve UI value)
34° (Mediterranean)	Moderate spread, golden tint	+5 to +8 (Resolve UI value)
64° (Polar)	Minimal or none	0 to -5 (Resolve UI value)

Note: The Atmospheric Clarity values listed above refer to the Texture Pop slider values within DaVinci Resolve's interface. In the Latitude Tool test (Section 6.2), Atmospheric Clarity is expressed as a normalized 0–1.0 scale used by the DCTL pipeline. The approximate correspondence is: 0.20 = +15 (Resolve UI), 0.10 = +8 (Resolve UI), 0.00 = 0 (Resolve UI). Negative Resolve UI values correspond to the same scale extended below zero.

Together, these two nodes complete the atmospheric simulation that the Latitude Tool DCTL initiates. The DCTL handles color — [Atmos] Sun Warmth, [Atmos] Rayleigh Fill, [Atmos] Biogenic — while the Atmospheric Diffusion and Atmospheric Clarity nodes handle the physical weight of air between camera and subject.

6. THE PRACTICAL PROJECT: THE LATITUDE TOOL

The theoretical framework established in previous sections — solar geometry, atmospheric scattering, and perceptual adaptation — translates into a working tool for DaVinci Resolve. The Latitude Tool is a custom DCTL (DaVinci Color Transform Language) plugin that calculates color grading parameters from a single scientific input: geographic latitude. Rather than requiring colorists to manually adjust dozens of parameters based on intuition, the tool derives radiometrically accurate values using the formulas described in Sections 2 and 3, then applies them through the perceptual framework described in Sections 4 and 5. The result is a starting point for geographic emulation that is grounded in physics, informed by psychology, and practical to implement.

6.1. METHODOLOGY: THE NODE TREE

The Latitude Tool operates within a Fixed Node Structure (FNS) designed for the DaVinci Wide Gamut / DaVinci Intermediate color pipeline. This structure separates the emulation process into discrete, logical layers that process the image in the order that light physically behaves — from capture through atmospheric interaction to perceptual interpretation.

Node 01: IDT (Input Device Transform)

The first node transforms camera-native footage into the working color space (DaVinci Wide Gamut). This ensures consistent behavior regardless of source camera — whether ARRI, RED, Sony, or Blackmagic, all footage enters the pipeline in a unified color space with known characteristics.

Node 02: CDL (Normalization)

The second node establishes the baseline from which all geographic emulation

operates. Using CDL (Color Decision List) controls, footage is normalized to:

- White balance: D65 (6500K)
- Exposure: 18% grey at approximately 0.375 code value in DWG Intermediate
- Primary balance: Neutral, with no color cast in grey tones

This normalization is critical. The Latitude Tool's formulas assume consistent input; without proper normalization, the geographic emulation will produce unpredictable results. When a ColorChecker is present in the shot, normalization is objective and precise. When no reference is available, the colorist normalizes by eye to perceptual neutral — skin on the I-line, mid-grey at target exposure, no obvious cast in highlights or shadows.

Node 03: Latitude Tool (DCTL)

The third node is the core of the geographic emulation — a custom DCTL that calculates all color parameters from a single input: latitude. The tool derives values using radiometric formulas:

Solar Geometry Parameters:

- **[Solar] Pivot** — Contrast pivot derived from solar elevation angle. Higher latitudes produce lower pivot values (0.35 at 64°N) while equatorial latitudes produce higher values (0.65 at 0°).
- **[Solar] Tonal Contrast** — Sigmoid tonal contrast that increases at equatorial latitudes and decreases at polar latitudes, implemented as a logit/sigmoid function that never clips.
- **[Solar] Shadow Density** — Shadow lift derived from atmospheric fill. Polar latitudes lift shadows (10.00 IRE at 64°N) due to omnidirectional Rayleigh fill; equatorial latitudes crush shadows (0 IRE at 0°).

Atmospheric Scattering Parameters:

- **[Atmos] Sun Warmth** — Perceived warmth contribution of direct sunlight to

the overall image, derived from Air Mass using the Kasten-Young formula. Highest at equatorial latitudes where intense direct sun dominates the frame; lowest at polar latitudes where the weak direct beam is overwhelmed by Rayleigh-scattered skylight. This does not track the spectral color temperature of the direct beam, which is paradoxically warmer at polar latitudes due to atmospheric filtering (see Section 2.3).

- **[Atmos] Rayleigh Fill** — Cyan bias in shadows that increases with latitude, emulating the blue-cyan fill from Rayleigh-scattered skylight.
- **[Atmos] Biogenic** — Green reflection from vegetation that decreases with latitude. Tropical environments exhibit strong biogenic reflection; polar environments exhibit none.

Perceptual Adaptation Parameters:

- **[Psych] Skin Vector** — Hue rotation for skin tones based on the Hunt Effect. Positive values rotate counter-clockwise on the vectorscope toward yellow-orange (+10° at 0°); negative values rotate clockwise toward red-magenta (-5° at 64°N).
- **[Psych] Hunt Saturation** — Overall saturation adjustment based on the Hunt Effect. High-luminance equatorial environments increase perceived saturation (+18% at 0°); low-luminance polar environments decrease it (-10% at 64°N).

The Latitude Tool includes two master controls:

- **Latitude (0°–64°)** — The upper limit of 64° corresponds to Reykjavik, Iceland — the highest-latitude major population center used as a test position in this thesis. Beyond this latitude, solar geometry enters extreme seasonal regimes (including polar night) that the current solar-noon model does not address.
- **Latitude Influence (0.0–1.5)** — Controls the intensity of geographic emulation. At 1.0, the tool applies full calculated values from the radiometric formulas; below 1.0, the effect is attenuated for subtlety; above 1.0,

exaggerated for stylistic emphasis. Default is 0.3 for subtle initial application. The tool uses absolute latitude values — southern hemisphere coordinates are entered as their positive equivalent (e.g., Rio de Janeiro at 23°S is entered as 23°), since radiometric properties of light are symmetrical across the equator. All calculations assume solar noon conditions at each latitude. Time-of-day variations (golden hour, overcast, twilight) are not addressed by the current version and represent a potential axis for future development.

Node 04: Atmospheric Diffusion (Glow)

The fourth node simulates Mie scattering — the forward-scattered diffusion caused by water vapor and particulates suspended in air. In DaVinci Resolve, this is achieved through the Glow effect.

At equatorial latitudes, Atmospheric Diffusion is applied with high spread (0.3–0.4), moderate intensity (0.2–0.3), and warm tint (+10 to +15 orange) — replicating the dense, humid atmosphere of tropical environments.

At polar latitudes, Atmospheric Diffusion is reduced to minimal values or bypassed entirely — replicating the thin, dry air that produces crystalline clarity.

Node 05: Atmospheric Clarity (Texture Pop)

The fifth node controls edge definition and surface texture based on atmospheric density. In DaVinci Resolve, this is achieved through the Texture Pop effect.

At equatorial latitudes, Atmospheric Clarity is set to moderate positive values (+12 to +15) — emphasizing the tactile texture of perspiration, pores, and surface detail under hard tropical light.

At polar latitudes, Atmospheric Clarity is held at neutral to slightly negative values (0 to -5) — preserving the smooth, soft quality of skin and landscape under diffuse arctic light.

Node 06: ODT (Output Device Transform)

The final node transforms from the working space to the delivery specification — Rec.709 with BT.1886 gamma for standard HD delivery. This node remains constant regardless of latitude setting; the geographic emulation exists entirely in the scene-referred domain. The complete node structure is illustrated in Figure 6.1.

Node	Name	Function
01	IDT	Camera to DaVinci Wide Gamut
02	CDL	Normalization (D65, 18% grey)
03	Latitude Tool	Geographic color emulation (DCTL)
04	Atmospheric Diffusion	Mie scattering simulation (Glow)
05	Atmospheric Clarity	Edge definition (Texture Pop)
06	ODT	Working space to delivery format

Figure 6.1: The Latitude Tool pipeline in DaVinci Resolve. The Fixed Node Structure processes footage in physically coherent order: input transformation, normalization, geographic color emulation, atmospheric effects, and output conversion. This six-node structure consolidates all color parameters into a single DCTL that calculates values from latitude input. (Source: Screenshot by author from DaVinci Resolve.)

6.2. THE TEST: GEOGRAPHIC EMULATION

To validate the Latitude Tool's effectiveness, a controlled test was conducted using the official ARRI reference footage (ARRI_Helen_John_ALEXA_35_ARRIRAW) available from ARRI's website. This controlled studio environment provides a neutral baseline with known lighting conditions, standard skin tones, and consistent exposure — ideal for isolating the effects of geographic emulation without variables introduced by location shooting.

Test Footage Specifications:

Parameter	Specification
Camera	ARRI ALEXA 35 (ARRIRAW)
Lighting	Controlled studio environment, D65 reference
Subject	Two human subjects (Helen and John) with neutral wardrobe
White Balance	D65 reference
Color Space	ARRI LogC4 / AWG4, transformed to DaVinci Wide Gamut

This setup provides a neutral baseline — footage with no inherent geographic character, balanced to standard illuminant, with professional studio conditions. Any geographic signature that appears in the graded output is attributable to the Latitude Tool rather than capture conditions. For this test, the Latitude Influence was set to 0.228 rather than the default 0.3 to demonstrate that geographic signatures remain visually and measurably distinct even at reduced intensity. All parameter values in the following tables reflect this 0.228 setting; to reproduce these exact results, the Latitude Influence must be matched to 0.228, as the default 0.3 will produce proportionally stronger derived values across all parameters.

A note on equatorial reference points: Sections 4.1 and 5.1 use Rio de Janeiro (23°S) as the equatorial example because it anchors the *City of God* case study. For the controlled test, Nicaragua (12°N) was selected instead, as it sits deeper within the equatorial band (0°–23.5°) and produces a more pronounced radiometric signature. Both latitudes share the same fundamental light characteristics — high solar elevation, short air mass, dominant Mie scattering — but Nicaragua's lower latitude intensifies these properties, providing clearer contrast against the polar test position (Iceland, 64°N). The parameter values in the following tables reflect Nicaragua's 12°N position; Rio at 23°S would produce intermediate values between Nicaragua and Los Angeles.

Control and Test Variables:

Control (Normalized Baseline):

Parameter	Value
Latitude Tool	Bypassed
CDL Normalization	D65, 18% grey at 0.375
Skin Vector	Standard I-line (117°)
Contrast	Linear, no creative curve
Saturation	Unity (no adjustment)
Atmospheric Effects	None

Test Variables:

Parameter	Nicaragua (12°N)	Los Angeles (34°N)	Iceland (64°N)
Latitude Influence	0.228	0.228	0.228
[Solar] Pivot	0.62	0.51	0.35
[Solar] Tonal Contrast	+0.24	+0.09	-0.205
[Solar] Shadow Density	0 IRE	2.7 IRE	10.00 IRE
[Atmos] Sun Warmth	+0.18	+0.12	+0.06
[Atmos] Rayleigh Fill	0	0.09	0.15
[Atmos] Biogenic	0.03	0.02	0.00
[Psych] Skin Vector	+8°	+5°	-5°
[Psych] Hunt Saturation	+15%	+3%	-10%
Atmospheric Diffusion	High / Warm	Moderate / Golden	Minimal / Neutral
Atmospheric Clarity	0.2	0.1	0

6.3. RESULTS: VISUAL COMPARISON

The following images present the control footage processed through each latitude setting. Figure 6.2 establishes the normalized baseline; Figures 6.3–6.5 demonstrate the geographic emulation at Nicaragua (12°N), Los Angeles (34°N), and Iceland (64°N) respectively. Accompanying waveform and vectorscope analysis demonstrates the measurable differences in tonal distribution and color signature.



Figure 6.2: Control image — normalized baseline with no geographic emulation applied. The waveform displays a linear tonemap response curve generated using Dado's LOOK DESIGNER OFX plugin (Input Profile: Select Camera; Output Profile: Select Output; Test Images: Tonemap) inserted after the IDT for analysis purposes. The vectorscope shows skin positioned at the standard I-line (117°). This serves as the reference point against which all latitude variations are measured. (Source: ARRI reference footage, processed by author.)

A. THE EQUATORIAL GRADE (12°N — Nicaragua)



Figure 6.3: Equatorial grade (12°N latitude — Nicaragua) with all pipeline nodes enabled (IDT, CDL, Latitude Tool, Atmospheric Diffusion, Atmospheric Clarity, ODT). The waveform displays a characteristic S-curve with elevated contrast: crushed blacks, controlled highlights, and maximum separation in upper midtones. The [Solar] Pivot at 0.620 concentrates tonal energy in the upper range, while [Solar] Contrast at +0.240 creates the punchy, aggressive curve characteristic of equatorial light. [Solar] Shadow Density at 0.00 IRE crushes blacks completely. The vectorscope (displayed at 2x zoom for clarity) shows [Psych] Skin Vector rotated counter-clockwise toward yellow-orange (+8°) with elevated [Psych] Saturation (+15%), and a warm bias in highlights from [Atmos] Sun Warmth (+0.180). [Atmos] Biogenic reflection (0.030) adds subtle green in the midtones, simulating tropical vegetation bounce. The tonemap curve (right panel, generated via Dado's LOOK DESIGNER) shows the Atmospheric Diffusion effect in the highlighted region (dotted circle) — the soft shoulder in the upper midtones where the Glow effect redistributes highlight energy into surrounding tonal regions. Visually, the subject appears vital and sun-exposed. (Source: ARRI reference footage, processed by author with Latitude Tool.)

B. THE MID-LATITUDE GRADE (34°N — Los Angeles)



Figure 6.4: Mid-latitude grade (34°N latitude — Los Angeles) with all pipeline nodes enabled. The waveform displays a classic S-curve: controlled shadows, open midtones, and gentle highlight roll-off. The [Solar] Pivot at 0.51 centers contrast in the midtones, while [Solar] Contrast at +0.09 provides moderate punch without the aggression of equatorial settings. [Solar] Shadow Density at 2.7 IRE allows shadows to retain texture while remaining grounded. The vectorscope (displayed at 2x zoom for clarity) shows [Psych] Skin Vector slightly counter-clockwise (+5°) with moderate [Psych] Saturation (+3%), and a characteristic orange-teal complementary axis created by the balance of [Atmos] Sun Warmth (+0.12) in highlights against [Atmos] Rayleigh Fill (0.09) in shadows. The tonemap curve (right panel, generated via Dado's LOOK DESIGNER) shows the Atmospheric Diffusion effect in the highlighted region (dotted circle) — a gentler shoulder than the equatorial grade, with less highlight redistribution. Visually, the subject appears healthy and bronzed — the idealized warmth of Southern California light. This is the most commercially familiar latitude — the look of travel advertising, romantic comedy, and lifestyle content. (Source: ARRI reference footage, processed by author with Latitude Tool.)

C. THE POLAR GRADE (64°N — Iceland)



Figure 6.5: Polar grade (64°N latitude — Iceland) with all pipeline nodes enabled. The waveform shows compressed dynamic range with lifted blacks ([Solar] Shadow Density at 10.00 IRE) and soft highlight roll-off from [Solar] Contrast at -0.205. The [Solar] Pivot at 0.350 shifts tonal separation into the lower midtones, allowing highlights to extend gradually without clipping. The vectorscope (displayed at 2x zoom for clarity) shows [Psych] Skin Vector rotated clockwise toward red-magenta (-5°) with reduced [Psych] Saturation (-10%), and a pronounced cyan bias throughout the shadows from [Atmos] Rayleigh Fill (0.15) — the maximum value, reflecting the long atmospheric path of oblique polar light. [Atmos] Biogenic is absent (0.00), eliminating the green vegetation reflection characteristic of lower latitudes. The tonemap curve (right panel, generated via Dado's LOOK DESIGNER) shows minimal Atmospheric Diffusion effect — a nearly linear shoulder with no highlight redistribution, reflecting the thin, dry polar air. Visually, the subject appears cold and exposed — the pallid complexion of skin under diffuse northern light, with underlying hemoglobin visible rather than sun-induced melanin warmth. This is the Nordic noir palette — contemplative, isolated, and psychologically tense. (Source: ARRI reference footage, processed by author with Latitude Tool.)

QUANTITATIVE SUMMARY

Parameter	Control	Nicaragua (12°N)	Los Angeles (34°N)	Iceland (64°N)
[Solar] Pivot	0.50	0.620	0.51	0.350
[Solar] Tonal Contrast	0.00	+0.240	+0.09	-0.205
[Solar] Shadow Density	0 IRE	0.00 IRE	2.7 IRE	10.00 IRE
[Atmos] Sun Warmth	0.00	+0.180	+0.12	+0.06
[Atmos] Rayleigh Fill	0.00	0.000	0.09	0.15
[Atmos] Biogenic	0.00	0.030	0.02	0.00
[Psych] Skin Vector	0°	+8°	+5°	-5°
[Psych] Hunt Saturation	0%	+15%	+3%	-10%
Atmospheric Diffusion	None	High / Warm	Moderate / Golden	Minimal / Neutral
Atmospheric Clarity	0	0.2	0.10	0

7. CONCLUSION

This thesis began with a question that emerged from personal frustration: why does footage from my home — from Granada's colonial streets and Masaya's volcanic highlands — so often feel wrong when graded in facilities calibrated to Northern light? The answer, as this investigation has demonstrated, lies not in technical error but in perceptual mismatch. Geographic Dissonance occurs when the physics of light contradicts the psychology of place.

The framework developed here confirms that geographic authenticity is physically quantifiable. The color signature of any location on Earth derives from measurable radiometric properties: solar elevation angle determines contrast distribution through the cosine law of irradiance ([Solar] Pivot); atmospheric composition determines spectral power distribution through Rayleigh and Mie scattering ([Atmos] Rayleigh Fill, [Atmos] Biogenic); air mass determines the warmth of direct illumination ([Atmos] Sun Warmth). These are not aesthetic preferences but optical facts, and they can be mapped to specific grading parameters.

At the equator, the sun travels a near-vertical path that produces hard shadows, compressed dynamic range in the shadows, and maximum luminance in the highlights. The short atmospheric path preserves warm spectral content while biogenic aerosols scatter yellow-green into the ambient fill. At the poles, oblique solar angles compress the luminance range, extend golden hour across the day, and allow Rayleigh scattering to dominate — filling shadows with the cool cyan of scattered sky. These signatures are consistent, predictable, and reproducible in the grading suite.

But physics alone cannot explain why certain grades feel authentic while others feel false. The psychological dimension — the way human perception adapts to local light through chromatic adaptation, the Hunt Effect, and the Bezold-Brücke shift — determines how audiences read color emotionally. A viewer raised under equatorial light has a different visual diet than one raised under Nordic overcast. Their

ecological valence, the learned associations between color and meaning, shapes their response to every frame. The Latitude Tool addresses both dimensions: physics through [Solar] Pivot, [Solar] Tonal Contrast, and [Solar] Shadow Density; atmosphere through [Atmos] Sun Warmth, [Atmos] Rayleigh Fill, and [Atmos] Biogenic; psychology through [Psych] Skin Vector and [Psych] Hunt Saturation. The pipeline extends these parameters with Atmospheric Diffusion and Atmospheric Clarity nodes that simulate the physical weight of air itself.

The case studies confirm that master cinematographers have always understood these principles intuitively. César Charlone's work on *City of God* exploits equatorial physics to create images that feel humid and vital. Emmanuel Lubezki's work on *The Revenant* exploits polar physics to create images that feel cold and unforgiving. Neither cinematographer needed the theoretical framework presented here — their craft emerged from observation and experimentation. But the framework allows these intuitions to be systematized, taught, and applied consistently across projects and colorists.

The practical test validates the approach. Neutral studio footage, processed through the Latitude Tool at Nicaragua (12°N), Los Angeles (34°N), and Iceland (64°N) settings, produces measurably different images with distinct emotional signatures. The equatorial grade triggers warmth, density, and vitality. The polar grade triggers cold, clarity, and isolation. The Mediterranean grade occupies comfortable middle ground — the golden familiarity of commercial content. These responses are not arbitrary; they are the predictable result of aligning grading parameters with the physics of geographic light and the psychology of human perception.

The implications extend beyond technical workflow. This thesis argues for a reconceptualization of the colorist's role: not as a technician who balances shots and matches scenes, but as an environmental architect who constructs the atmospheric reality of the film. Every grading decision shapes the audience's haptic experience of the image — their sensation of temperature, humidity, air quality, and physical

presence within the frame.

This is subconscious storytelling. When a thriller set in Managua is graded with the cool desaturation of Scandinavian noir, audiences feel the contradiction before they can articulate it. The narrative says tropical; the light says arctic. The dissonance undermines immersion at a level beneath conscious awareness. Conversely, when the grade reinforces the geographic reality of the story, audiences accept the world without question. They feel the heat of the favela, the chill of the tundra, the golden dust of the Mediterranean afternoon. The colorist has made them believe.

This power carries responsibility. Geographic Emulation is not about imposing Northern aesthetics on Southern stories or vice versa — it is about honoring the light of each place on its own terms. The framework developed here provides tools for authenticity, but the artistic intent must guide their application. A film set in Lagos should feel like Lagos, not like a Lagos filtered through the visual expectations of audiences who have never experienced equatorial light. The colorist who understands the physics of place can advocate for geographic truth in the grading suite.

Future workflows will likely integrate computational tools that automate aspects of this process. AI-driven depth maps could enable per-pixel atmospheric density simulation, automatically varying Atmospheric Diffusion based on distance from the camera. Machine learning models trained on geographic image databases could suggest latitude-appropriate palettes. Real-time color transforms could adapt footage to target geographic signatures with minimal colorist intervention. The Latitude Tool represents a first step in this direction — a single slider that derives an entire color signature from geographic coordinates. The current limitations are acknowledged: the tool assumes solar noon conditions, does not account for time-of-day variation, and treats latitude as symmetrical across hemispheres. A natural next step would be incorporating time-of-day as a second input axis, allowing the tool to account for the significant radiometric differences between solar noon, golden hour, and twilight at any given latitude.

But automation without understanding produces homogenization. The value of the framework presented here is not merely procedural — it is conceptual. A colorist who understands why equatorial shadows carry green-cyan bias ([Atmos] Biogenic), who knows that the Hunt Effect increases saturation perception under bright adaptation ([Psych] Hunt Saturation), who recognizes that skin tone placement on the vectorscope carries emotional meaning beyond technical correctness ([Psych] Skin Vector) — this colorist can make informed creative decisions that no algorithm can replicate. The physics grounds the art; the psychology humanizes it; the craft synthesizes both into images that feel true.

Geographic Emulation is, ultimately, an act of cultural respect. It acknowledges that light is not neutral, that place shapes perception, and that audiences from Managua and Minneapolis experience color differently because they have lived under different skies. The Latitude Tool offers a practical method for honoring these differences. But the deeper contribution of this thesis is the argument itself: that color grading is not merely technical, that geographic authenticity matters, and that the colorist who masters the relationship between physics and psychology becomes something more than a technician — they become a colorist who doesn't just balance an image but locates it.

REFERENCES:

Admesy. (2024). How Does the Human Eye Perceive Light? Photopic and Scotopic Vision. *AZoM*. Available at: <https://www.azom.com/article.aspx?ArticleID=14971> [Accessed: February 2026].

Anderson, C. A. (2001). Heat and violence. *Current Directions in Psychological Science*, 10(1).

Angelopoulou, E. (2001). The reflectance spectrum of human skin. *Technical Reports (GRASP Lab)*, University of Pennsylvania. [Online]. Available at: https://repository.upenn.edu/cis_reports/315/ [Accessed: 01 June 2024].

ASTM International. (2020). *Standard Tables for Reference Solar Spectral Irradiances (ASTM G173-03)*. [Online]. Available at: <https://www.nrel.gov/grid/solar-resource/spectra.html> [Accessed: 01 June 2024].

Axford, T. (2022). *The Hunt Effect: Appearance of colorfulness increases with luminance*. [Digital Image]. Wikimedia Commons. Available at: https://commons.wikimedia.org/wiki/File:Hunt_Effect_-_the_appearance_of_colourfulness_increases_with_luminance.png [Accessed: 01 June 2024].

Bankston, D. (2008). Blood and Snow: Let the Right One In. *American Cinematographer*. [Online]. Available at: <https://theasc.com/blog/the-film-book/blood-and-snow-let-the-right-one-in> [Accessed: 01 June 2024].

Bartleson, C. J., & Breneman, E. J. (1967). Brightness perception in complex fields. *Journal of the Optical Society of America*.

Bellantoni, P. (2005). *If It's Purple, Someone's Gonna Die: The Power of Color in Visual Storytelling*. Focal Press.

Charlone, C. (2003). City of God: Post-Processing and The Look. *American Cinematographer*, 84(2). [Online]. Available at: <https://theasc.com/magazine/feb03/city/> [Accessed: 01 June 2024].

EBU R 103. (2017). *Video Signal Tolerance in Digital Television Systems*. European Broadcasting Union. [Online]. Available at: <https://tech.ebu.ch/docs/r/r103.pdf> [Accessed: 01 June 2024].

Fukunaga, C. J. (2015). Restless Heart, Roving Camera: Cary Fukunaga on Beasts of No Nation. *MovieMaker Magazine*. [Online]. Available at: <https://www.moviemaker.com/restless-heart-roving-camera-beasts-of-no-nation/> [Accessed: 01 June 2024].

Gueymard, C. A. (2001). Parameterized transmittance model for direct beam and circumsolar spectral irradiance. *Solar Energy*, 71(5).

Grobar, M. (2015). Emmanuel Lubezki on Shooting 'The Revenant' with Natural Light. *Deadline Hollywood*. Available at: <https://deadline.com/2015/12/the-revenant-emmanuel-lubezki-cinematography-natural-light-1201670285/> [Accessed: February 2026].

Halasz, P. (2007). *Oblique Rays: Effect of Sun Angle on Climate*. [Diagram]. Wikimedia Commons. Available at: https://commons.wikimedia.org/wiki/File:Oblique_rays_04_Pengo.svg [Accessed: 01 June 2024].

Iñárritu, A. G. (Director), & Lubezki, E. (Cinematographer). (2015). *The Revenant* [Film]. Regency Enterprises / New Regency / RatPac Entertainment / 20th Century Fox.

ITU-R BT.2408-4. (2021). *Guidance for operational practices in HDR television production*. International Telecommunication Union. [Online]. Available at: https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-BT.2408-4-2021-PDF-E.pdf [Accessed: 01 June 2024].

Kasten, F., & Young, A. T. (1989). Revised optical air mass tables and approximation formula. *Applied Optics*, 28(22).

Koschmieder, H. (1924). *Theorie der horizontalen Sichtweite*. (Theory of the Horizontal Visual Range). [Online]. Available at: <https://en.wikipedia.org/wiki/Visibility> [Accessed: 01 June 2024].

Labrecque, L. I., & Milne, G. R. (2012). Exciting red and competent blue: the importance of color in marketing. *Journal of the Academy of Marketing Science*. [Online]. Available at: <https://link.springer.com/article/10.1007/s11747-010-0245-y> [Accessed: 01 June 2024].

Lee, R. L., & Hernández-Andrés, J. (2005). Virtual and natural twilights: The role of Chappuis absorption. *Applied Optics*, 44(27).

Livingstone, M. (2002). *Vision and Art: The Biology of Seeing*. Harry N. Abrams.

McCamy, C. S., Marcus, H., & Davidson, J. G. (1976). A Color-Rendition Chart. *Journal of Applied Photographic Engineering*. [Online]. Available at: <https://www.google.com/search?q=McCamy+Marcus+Davidson+A+Color-Rendition+Chart> [Accessed: 01 June 2024].

Meirelles, F. (Director), & Charlone, C. (Cinematographer). (2002). *City of God* [Film]. O2 Filmes / Miramax Films.

Mosse, R. (2013). *The Enclave*. (Aerochrome Photography). [Online]. Available at: <https://www.richardmosse.com/projects/the-enclave> [Accessed: 01 June 2024].

Naka, K. I., & Rushton, W. A. (1966). S-potentials from colour units in the retina of fish. *The Journal of Physiology*, 185(3).

Narasimhan, S. G., & Nayar, S. K. (2002). Vision and the Atmosphere. *International Journal of Computer Vision*. [Online]. Available at: https://www.cs.columbia.edu/CAVE/publications/pdfs/Narasimhan_IJCV02.pdf [Accessed: 01 June 2024].

Palmer, S. E., & Schloss, K. B. (2010). An ecological valence theory of human color preference. *Proceedings of the National Academy of Sciences*.

Pascale, D. (2006). *RGB coordinates of the Macbeth ColorChecker*. The BabelColor Company. [Online]. Available at: http://www.babelcolor.com/index_htm_files/RGB%20Coordinates%20of%20the%20Macbeth%20ColorChecker.pdf [Accessed: 01 June 2024].

Poynton, C. (2012). *Digital Video and HD: Algorithms and Interfaces*. Morgan Kaufmann.

Preetham, A. J., Shirley, P., & Smits, B. (1999). A Practical Analytic Model for Daylight. *Proceedings of SIGGRAPH*.

Purdy, D. M. (1931). Spectral hue as a function of intensity. *The American Journal of Psychology*, 43(4), pp. 541–559.

Reinhard, E., et al. (2002). Photographic Tone Reproduction for Digital Images. *ACM Transactions on Graphics*. [Online]. Available at: <https://www.cs.utah.edu/~reinhard/cdrom/tonemap.pdf> [Accessed: 01 June 2024].

Rohde, R. A. (2007). *Solar Spectrum and Atmospheric Absorption (ASTM G173-03 Standards)*. [Graph]. Wikimedia Commons. Available at: https://commons.wikimedia.org/wiki/File:Solar_spectrum_en.svg [Accessed: 01 June 2024].

Russell, J. A. (1980). A Circumplex Model of Affect. *Journal of Personality and Social Psychology*, 39(6), 1161–1178.

Sharayanan. (2007). *Depiction of Mie scattering on a spherical particle*. [Diagram]. Wikimedia Commons. Available at: https://commons.wikimedia.org/wiki/File:Mie_scattering.svg [Accessed: 01 June 2024].

Storaro, V. (2013). *Writing with Light*. *Aperture*.

Tektronix. (2018). *Waveform Monitor and Vectorscope: Reading the Display*. Tektronix Technical Guides. [Online]. Available at: https://download.tek.com/document/25W_22264_1.pdf [Accessed: 01 June 2024].

Thomson, P. (2016). Braving the Cold: The Revenant. *American Cinematographer*, 97(1). [Online]. Available at: https://theasc.com/ac_reviews/the-revenant [Accessed: 01 June 2024].

Valdez, P., & Mehrabian, A. (1994). Effects of color on emotions. *Journal of Experimental Psychology: General*, 123(4).

Van Hurkman, A. (2013). *Color Correction Handbook: Professional Techniques for Video and Cinema*. Peachpit Press. [Online]. Available at: <https://www.peachpit.com/store/color-correction-handbook-professional-techniques-for-9780321929662> [Accessed: 01 June 2024].

Wikimedia Commons. (2025). *Bezold–Brücke hue shift examples*. [Digital Image]. Available at: https://commons.wikimedia.org/wiki/File:Bezold%E2%80%93Br%C3%BCcke_hue_shift_examples.png [Accessed: 01 June 2024].

X-Rite Photo. (2020). *ColorChecker Passport Video Manual*. X-Rite Incorporated. [Online]. Available at: <https://www.xrite.com/service-support/product-support/formulation-and-gc-software/colorchecker-passport-video> [Accessed: 01 June 2024].