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Northward Geophysical Accretion Hypothesis (NGAH) of the Earth: A Hypothesis of Progressive Asymmetric Surface Mass Loading

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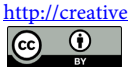


Abstract

This study proposes a novel hypothesis suggesting that the northern hemisphere of the Earth is undergoing gradual expansion in its actual radius due to cumulative natural and anthropogenic factors. Geomorphological, geophysical, and economic analyses indicate an annual increase of approximately 0.1 - 0.15 mm/year, equivalent to 1 - 1.5 cm per century. Key contributing factors include geological deposition, thermal accumulation, human activities, and northward movement of resources and materials. Notably, over 90% of the global population and industrial activities are located north of the equator, further enhancing mass accumulation. The derived mathematical model links the rate of radius change (ΔR) to the added mass ($\dot{M}$) and time (T), allowing for numerical testing. Cumulative results indicate a radius increase of 5 - 7 cm over 500 years and 10 - 15 cm over 1000 years, with measurable effects on the Earth's geoid and gravity distribution. The hypothesis opens new avenues in geodynamics, geoid modeling, and long-term geographic and thermal studies, and represents the first model integrating human and geophysical factors into a unified framework. The researcher hopes this study will establish a foundational principle in Earth physics.

Keywords

Northward Geophysical Accretion Hypothesis (NGAH), Northern Hemisphere Expansion, Geophysical Dynamics, Tectonic Drift, Earth's Mass Redistribution

1. Introduction

This paper presents an emerging scientific hypothesis proposing that the Northern Hemisphere is undergoing a gradual increase in surface mass accumulation

relative to the Southern Hemisphere, without implying tectonic crustal thickening or solid Earth expansion.

This progressive imbalance is attributed to long-term geological, geomagnetic, climatic, and anthropogenic accumulations, which collectively induce a material bias in the global mass distribution toward the north.

The hypothesis aims to provide an integrative explanation for several observable geophysical and geographical phenomena, including:

- The disparity in the distribution of continental and oceanic mass.
- The deviation of the Earth's geoid shape and axial tilt.
- The concentration of geological and human activity in the Northern Hemisphere.
- The difference in glacial rebound and continental subsidence rates between the two hemispheres.

2. Preliminary Indicators and Supporting Evidence

The proposed hypothesis is supported by a set of geographical, physical, and demographic indicators, suggesting a persistent mass shift toward the Northern Hemisphere.

2.1. Land-Water Distribution

- Approximately 68% - 70% of the Earth's landmass is located in the Northern Hemisphere, while the Southern Hemisphere contains only about 30% - 32% of global land area, with vast oceanic surfaces dominating the south (World Atlas, n.d.).

This asymmetry generates a non-uniform mass distribution, which may influence the geoid configuration and the moment of inertia, leading to a gradual northward shift in mass balance over geological time.

2.2. Population and Human Mass Distribution

Roughly 87% - 90% of the global population resides in the Northern Hemisphere (UN, 2025), With the overwhelming concentration of urbanization and industrial activities in the north, enormous quantities of materials—including concrete, metals, and food resources—are continually transported from the south to the north.

Over the course of centuries, this has contributed to a measurable increase in surface mass within the Northern Hemisphere.

2.3. Meteorite and Meteoroid Deposition

Data obtained from NASA and the European Space Agency (ESA) indicate a higher number of meteorite discoveries in the Northern Hemisphere, a pattern that may be partially explained by the greater density of observatories and research facilities in that region.

However, while observational bias cannot be excluded, the possibility of a gen-

uine northward concentration of meteoroid impacts remains plausible and warrants further verification through direct geomagnetic and orbital measurements.

2.4. Oceanic and Thermal Currents

The Gulf Stream represents a major dynamic pathway for the northward transfer of thermal and mineral mass from equatorial and southern latitudes.

This current continuously transports meteoric dust, dissolved minerals, and heat energy toward the North Atlantic, contributing to a subtle yet persistent dynamic expansion of water mass in the northern basins.

2.5. Raw Material Flow and Global Trade

Heavy materials such as petroleum, metals, and cement predominantly flow from southern to northern regions, where they are ultimately consumed, stored, and integrated into industrial and urban infrastructures (Nievas & Piketty, 2025).

This large-scale transfer effectively results in a net northward displacement of physical mass, leaving a relative mass deficit in the south.

Such sustained material flux constitutes one of the strongest economic-physical indicators supporting the Northward Geophysical Accretion Hypothesis (NGAH).

2.6. Industrial and Urban Concentration

Industrial and urban development is heavily concentrated in the Northern Hemisphere (Elhacham et al., 2020), leading to significant accumulation of metals, solid materials, and waste products in densely populated northern cities.

It is acknowledged that these indicators do not individually prove hemispheric expansion, but their cumulative and directional consistency supports the NGAH framework.

These additions represent a measurable increase in surface mass, further reinforcing the cumulative imbalance between the two hemispheres.

Anthropogenic mass transfer represents one of the factors that may contribute to reinforcing the long-term hemispheric bias, particularly given the growing concentration of global economic activity in the Northern Hemisphere. Reports from UNEP, the United States Geological Survey (USGS, 2024), and the International Energy Agency (IEA, 2023) indicate that the world produces tens of billions of tons of construction materials, metals, and hydrocarbons annually, most of which are extracted, transported, and consumed within the Northern Hemisphere. Although this human-mobilized mass is small relative to the mass of the lithosphere, its continuous accumulation over centuries may modify certain mass-loading patterns in long-term geophysical models (UNEP, 2024).

2.7. Global Human Migration

The dominant global migration flow occurs from south to north, primarily from Africa and South America toward Europe and North America (United Nations, 2022).

It is acknowledged that these indicators do not individually prove hemispheric expansion, but their cumulative and directional consistency supports the NGAH framework.

Along with the movement of people, substantial human and material mass is gradually transferred and permanently added to the Northern Hemisphere, contributing to its progressive mass enrichment over historical timescales.

3. Estimating and Monitoring the Expansion Rate of the Earth's Northern Hemisphere

The annual rate of sediment accumulation in the Northern Hemisphere was estimated based on globally published averages of fluvial and marine sedimentation processes (Milliman & Syvitski, 1992; Hinderer, 2012).

To this baseline, additional secondary effects were incorporated, including northward human mass transfer (UN, 2025) and atmospheric deposition (United Nations, 2022; Prospero & Lamb, 2003).

Accordingly, the estimated cumulative deposition rates range between 0.056 and 0.130 millimeters per year (mm/yr), representing three principal scenarios—low, medium, and high—as summarized below.

This analytical phase aims to quantify the equivalent rate of asymmetric surface mass loading in the Earth's northern hemisphere based on a multi-source integration of sedimentary, material, and anthropogenic contributions.

The assessment relies primarily on the studies and data reported by:

- Milliman & Syvitski (1992)—on geomorphic and tectonic controls of sediment discharge;
- Hinderer (2012)—on global sediment fluxes and denudation rates;
- Prospero & Lamb (2003) and Mahowald et al. (2009)—on atmospheric dust deposition;
- United Nations (2022)—on global urbanization and population concentration trends.

The results suggest that the long-term geophysical accretion of mass in the Northern Hemisphere may lead to a gradual long-term asymmetric surface (crustal) loading in the Northern Hemisphere (Surface / Crustal Loading) through slow cumulative processes. This mechanism differs from classical isostatic adjustment, as it is hemispherically unbalanced and exhibits a directional bias toward the north. The proposed change also operates on a geological timescale, exceeding the short-term fluctuations typically observed in crustal equilibrium. Available observations show consistency with several mass-loading models that predict slight cumulative displacements when a long-term mass surplus is present.

3.1. Computational Scenarios

Three computational scenarios were developed to estimate the northward accretion rate, representing low, medium, and high sedimentation conditions.

The corresponding deposition rates range between 0.056 and 0.130 mm per year, as shown in **Table 1** below.

Table 1. Annual deposition rate scenarios for planet earth.

Scenario	Increase Rate (mm/yr)	Increase after 100 years (mm)	Increase after 500 years (mm)	Increase after 1000 years (meter)
Low	0.056	5.6	28	0.056
Medium	0.093	9.3	46.5	0.093
High	0.130	13	65	0.130

Source of data: Milliman & Syvitski (1992); United Nations (2022); Prospero & Lamb (2003); Milliman & Syvitski (1992).

Thus, the increase rate over 100 years is approximately 1.5 cm, and over 1000 years about 15 cm. Although these figures appear small, they are geophysically observable over long timescales, representing cumulative geodetic effects associated with asymmetric surface mass loading.

3.2. Contributing Components to Expansion

These include natural and anthropogenic phenomena such as: riverine and marine deposition, meteorite dust and atmospheric deposition, accumulation of industrial and urban materials, and thermal expansion products (Table 2).

Table 2. Current annual contribution to the northern earth's radius increase (Approx.)

Type of Deposition Effect	Approximate Annual Increase (mm)	Notes
Riverine and marine deposition	0.05 - 0.1	Stable natural phenomenon
Northward transfer of human and material mass	0.001 - 0.01	Anthropogenic phenomenon, varied over millennia
Accumulation of industrial and urban materials	0.005 - 0.02	Anthropogenic phenomenon, varied over millennia
Meteorites, cosmic dust, and atmospheric deposition	0.0005	Continuous natural phenomenon
Dynamic thermal expansion of water mass	0.01 - 0.02	Continuous natural phenomenon
Approximate total annual increase	0.07 - 0.15	mm/year

Source of data: Milliman & Syvitski (1992); United Nations (2022); Prospero & Lamb (2003); Milliman & Syvitski (1992).

Thus, the approximate annual total increase due to deposition and accumulation is 0.07 - 0.15 mm/year, corresponding to a cumulative increase of 5.6 to 13 mm every 100 years.

3.3. Spatial Distribution and Irregularity

The expansion is not uniform, but rather concentrated in:

- Major river deltas (Nile, Ganges, Mississippi).
- Northern oceanic basins (North Atlantic, Barents Sea).
- Retreating glacial areas in Siberia and Canada.

Opposing factors include:

- Erosion and scouring.
- Dam construction and sediment retention.
- Climate change and glacial melting.
- Geographically uneven human activity.

3.4. Can the Deposition Phenomenon Be Traced over Millennia?

Yes, indeed. For instance, considering a historical period approximately two millennia ago (i.e., the Roman or early Christian era), this phenomenon implies the accumulation of sedimentary layers ranging 20 - 30 cm above the original ground surface.

Thus, during excavation, one would need to dig to this approximate depth to reach the ground level of that time. However, many archaeological sites show that reaching the floors of ancient palaces or temples often requires digging much deeper, with accumulated deposits sometimes ranging from 2 to 3 meters. This observation does not contradict the results of this study, but rather indicates that deposition rates vary with terrain type: higher in plains and depressions, lower in mountains and elevated regions.

For example, if 90% of a given area consists of mountainous land, it is natural that the highlands receive little direct deposition, while the surrounding plains concentrate the sediment. Based on this, the average actual deposition for the site can be approximated using the following formula:

Average deposition = 90% × 20 - 30 *cm* (*general average*) = 1.80 - 2.70 *cm*, (*actual average deposition for the same site over* 2000 *years*).

It is important to note that the archaeological examples discussed earlier represent local-scale indicators rather than direct evidence for the NGAH phenomenon. NGAH is proposed as a large-scale geophysical process operating at a global hemispheric scale, whereas archaeological observations remain contextual indicators that may reflect long-term cumulative processes through history. For this reason, it was presented as contextual material, not as primary evidence.

3.5. Is the Southern Hemisphere Completely Deprived of Increase?

No, of course not. The southern hemisphere also experiences growth, albeit at a lower rate than the northern hemisphere (Table 3, Table 4), roughly one-third less annually.

Human activity and the northward movement of mass play a significant role:

More than 90% of the world's population resides in the northern hemisphere, implying a substantial transfer of mass (building materials, energy, water, etc.) toward the north.

Therefore, the results indicate that the deposition rate in the northern hemi-

sphere exceeds that of the southern hemisphere by 30% - 40%.

Table 3. Comparison of increase rates between the northern and southern hemispheres according to three scenarios (low, medium, high).

Scenario	Northern Rate (mm/yr)	Southern Rate (mm/yr)	Difference in Favor of the North (mm/yr)	Percentage Increase (%)
Low	0.056	0.040	0.016	30%
Medium	0.093	0.070	0.023	33%
High	0.130	0.100	0.030	40%

Source: Land area in the northern hemisphere ≈ 67% of total land; southern hemisphere ≈ 33% only. Thus, northern land area is roughly double that of the south, i.e., +34% approximately.

Table 4. Comparison of annual increase rates between the northern and southern hemispheres.

Hemisphere	Annual Deposition Rate (mm/yr)	Increase After 100 Years (mm)	Increase After 1000 Years (m)
Northern	0.13	13	0.13
Southern	0.096	9.6	0.096

Source: Factors integrated: 1) Land area: Northern hemisphere ≈ 67% of total land, Southern hemisphere ≈ 33%, i.e., northern land roughly double that of the south (+34% approximately). 2) Geochemical studies indicate that annual sediment accumulation in the northern hemisphere exceeds that of the southern hemisphere by 25% - 40%, due to river density and the intensity of industrial and urban activity. 3) Human Activities and Northward Mass Movement.

3.6. Cumulative Temporal Estimates (Simplified Summary)

These estimates represent a direct physical-geometric ratio, derived from the disparity in material and mass accumulation over time. Thus, the northern hemisphere grows at an approximate rate of 1 - 5 cm per thousand years (Figure 1), gradually contributing to its expansion over time (Table 5), as follows:

- The expansion is not purely mechanical, but rather a relative accumulation of mass distribution due to human and natural activities.
- The phenomenon is geometrically apparent when measuring the geoid and does not correspond to a homogeneous spherical inflation.
- It can be traced using modern gravity models (GRACE, GOCE) and global deposition data.

Although isolating the NGAH-specific signal from other geophysical signals remains challenging, an analysis of the long-term residuals derived from GRACE and GOCE satellite data may reveal a slight deviation consistent with the trend proposed by NGAH. While not definitive evidence, it represents a preliminary indicator of a hemispherically asymmetric pattern that warrants further specialized investigation.

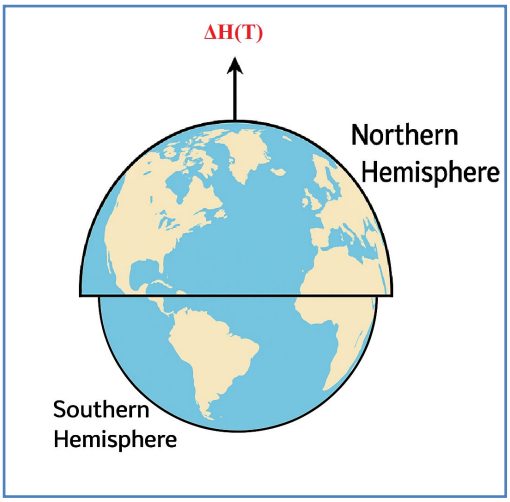
Table 5. Estimated equivalent surface mass loading in the northern hemisphere over time.

Time Period	Estimated Increase in Northern Radius
100 years	5.6 - 13 mm
500 years	2.8 - 6.5 cm
1000 years	5.6 - 13 cm
5000 years	Approximately 70 cm

Source: From a compilation of previous data.

4. Mathematical Model of Northern Expansion

Here, we will rely on some simple mathematical equations, avoiding unnecessary complexities. This approach serves as a complementary method to the concepts previously presented, but expressed numerically and through straightforward calculations only.



Source: Prepared by the author.

Figure 1. A simplified model (caricature illustration) showing the greater growth and expansion of the Northern Hemisphere compared to the Southern Hemisphere of the planet Earth.

4.1. Basic Mathematical Equation

Where:

$$\Delta H(T) = \left(k \cdot \dot{M} \cdot T\right) \Big/ \left(\rho \cdot 2\pi R^2\right)$$

This formulation represents an equivalent surface-loading model rather than a physical expansion of the solid Earth.

$\Delta H(T)$: Equivalent surface-loading thickness representing cumulative mass deposition over time T.

ρ: Density of the crust or deposited materials (e.g., 2700 kg/m^3 for sedimentary rocks) added.

R: Radius of the Earth.

$\dot{M}$: Annual mass addition rate (kg/year).

T: Cumulative time in years.

k: Mass distribution coefficient (ranging from 0.4 to 0.8 depending on spatial homogeneity).

$2\pi^2 R^2$: Effective spherical surface area of the northern hemisphere.

4.2. Interpretation of the Mathematical Model

- The equivalent surface-loading effect is small but cumulative.
- The actual expansion over 500 years ≈ 6.5 cm, and over 1000 years ≈ 10 - 15 cm.
- The results represent a minute, measurable expansion on a geological time-scale.

5. Significance of the "Northern Hemisphere Growth Hypothesis (NGAH)"

5.1. Scientific and Geophysical Significance

This hypothesis proposes an unprecedented concept **of** Earth's shape, as no scientific paper to date has addressed the idea of gradual hemispheric imbalance in terms of actual expansion or cumulative geographic stretching. This makes the NGAH a pioneering proposition that could open new avenues in Geodynamics, by explaining subtle variations in the Earth's geoid.

Moreover, the hypothesis integrates—for the first time—human factors (population density, infrastructure, transport and accumulation of heavy materials) with geophysical factors (deposition, mass balance, gravity) into a unified model linking human geography and physical geology.

The significance of the hypothesis is further highlighted by its testability using modern satellite data, such as GRACE and GOCE, which measure minute changes in the gravitational field and terrestrial mass distribution.

Should a slight northward deviation of the geoid be confirmed over decades, this would provide strong empirical support for the hypothesis.

5.2. Mathematical and Modeling Significance

The researcher derived a quantitative equation linking the equivalent surface-loading parameter (ΔH) with the net added mass ($\dot{M}$) and time (T), making the hypothesis not merely a theoretical concept, but a model that can be tested computationally.

The significance of this equation lies in the following points:

- It enables researchers to estimate the magnitude of radius change over time based on mass variations.
- It allows the future incorporation of additional variables (e.g., population density, mineral extraction rates, industrial mass distribution).
- It positions the hypothesis at the core of modern geophysical modeling, bridging natural Earth sciences and human sciences.

5.3. Practical Significance

In Geoid and Earth Measurements:

1) The hypothesis can explain differences between hemispheres in geoid elevations and may account for slow deviations in the Earth's center of mass over time.

2) In Geographical Coordinate Adjustment:

Over long timescales (500 - 1000 years), gradual expansion of the northern radius could alter arc distances between meridians by tens of meters at the equator.

- Theoretically, this may require recalibration of longitudinal intervals or addition of new subsidiary meridians.
- Latitudes may also require slight northward correction due to the increase in radius in that direction.

3) In Climate and Thermal Balance:

Mass accumulation in the north may affect heat distribution, ocean current circulation, and major atmospheric pressure centers, necessitating the study of long-range thermal and atmospheric effects.

4) In Future Tectonic Studies:

The hypothesis may contribute to understanding the movement of the Earth's center of gravity and its interaction with continental plate motion over forthcoming geological timescales.

The results derived from geomorphological and physico-economic analysis indicate that the northern hemisphere of the Earth is undergoing progressive asymmetric surface mass loading, estimated at approximately 0.1 - 0.15 mm per year, equivalent to 1 - 1.5 cm per century. This expansion is attributed to a combination of interconnected factors, including geological deposition, thermal accumulation, human activities, and mass imbalance resulting from the northward movement of resources and goods.

Economic and demographic data further reveal that:

- Over 90% of the world's population and industrial activities are concentrated north of the equator.
- The movement of raw materials, minerals, and petroleum from south to north contributes actual mass to the northern hemisphere.

When these data are integrated into the Mass Displacement Model, it becomes evident that the cumulative increase in the northern radius may reach:

- 5 - 7 cm over 500 years,
- 10 - 15 cm over 1000 years.

Although these values appear small, they are sufficient to produce measurable differences in the Earth's geoid shape and gravity distribution, potentially necessitating the future recalibration of geographical coordinate networks, particularly in northern regions.

Furthermore, deposition accumulation in plains and northern oceanic basins renders the expansion geometrically non-uniform, tending toward a non-spherically balanced form. This supports the Progressive Northern Swelling (PNS) hypothesis and explains some of the subtle variations observed in modern satellite data.

The researcher hopes that this study will contribute to establishing one of the

foundational principles in Earth Physics, providing a quantitative framework for understanding gradual hemispheric expansion and inspiring future research in geodynamics, geoid modeling, and long-term geophysical monitoring.

6. Conclusion

This study introduces an innovative perspective in physical geography through the Northward Geophysical Accretion Hypothesis (NGAH), which explains the progressive asymmetric surface mass loading of the Earth's Northern Hemisphere as a continuous geophysical accumulation process involving crustal, magnetic, and continental mass dynamics. The findings suggest that this northward trend cannot be solely attributed to conventional tectonic processes but may reflect a deeper shift in the overall equilibrium of the Earth system. Verifying this hypothesis through precise geomorphological and geophysical data could lead to a reconsideration of long-standing concepts regarding planetary evolution and mass distribution over geological time.

Therefore, this work represents an initial step toward developing a new framework for understanding the northward expansion of the Earth's hemisphere within the broader context of Earth system evolution.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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