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COMPARATIVE STUDY OF CLOUD CONCEPT BETWEEN MODERN AND ANCIENT

Dr.G.T.Srikrishnabharadwaja

A cloud is one of the most beautiful and mysterious aspects of nature. And also the transformed form of water that travels through the sky. Due to the heat of the Sun, water from the oceans and rivers evaporates and rises into the atmosphere. There, the water turns into vapour due to temperature conditions , the vapor condenses and becomes visible as clouds. Clouds are not only givers of water, but also givers of beauty. During the rainy season, the thunder of clouds, the flashes of lightning, and their majestic appearance fill the heart with joy. Farmers eagerly await the arrival of clouds, for from them comes the rain that nourishes the earth and produces food.

There are also different types of clouds — white clouds indicate peace, while dark clouds announce the arrival of rain. Poets too have used clouds as metaphors; ***"Meghadūta"*** the famous poem by mahakavi **Kālidāsa** in Sanskrit , is a beautiful example.

Thus, it is clear that a cloud is not merely a holder of water, but also a symbol of joy, beauty, and life itself.

According to modern meteorology Clouds generally take about "three to seven days" to form for the purpose of producing rain.

In the modern era, the subject of clouds is studied from a highly scientific perspective. With the advancement of science, their formation and movement are well understood "through satellites and radar instruments". **S**cientists accurately calculate their movement, shape, and the probability of rainfall. There is

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even a new experiment called "Cloud Seeding," through which "artificial rainfall" can be produced.

Clouds not only provide water but also regulate the Earth's temperature and maintain the balance of the atmosphere. Without clouds, the Earth would become hot and barren.

Thus, clouds remain an "essential part of human life" — not only in poetry, but also in the "field of science".

In ancient times, sages and astronomers described this phenomenon using terms like **"Megha Garbha"** (cloud conception) and **"Meghotpatti"** (cloud formation). However, their explanations were based on "**divine causes**" — considering the Sun, Wind, and Indra (as thunder) responsible for it.

Ancient Method of Understanding Clouds and Rains:

In ancient India, the study of clouds and rainfall was an important part of "**Jyotiṣa(astronomical science)**" and "**puranaas(mythology, history, philosophy, and spiritual information)**".Great sages such as "**Varāhamihira**", "**Parāśara**", "**vallalasena**" and "**Garga**" developed systematic methods to understand how and when rains would occur. They believed that natural elements like the "Sun", "Moon","Wind, "Thunder", and "Lightning"influenced cloud formation. Instead of modern instruments, they relied on **keen observation of nature** — the "color of the sky", the "movement of winds", the "shape and sound of clouds", the behavior of animals, and the position of stars and constellations (Nakṣatras).

Varāhamihira, in his *Bṛhatsaṃhitā*, described the process called **"Megha Garbha"** (the conception of clouds), where he explained that certain combinations of planetary and seasonal conditions lead to the birth of rain-bearing clouds. The sages would note signs such as thunder, lightning, and wind direction to

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determine whether the coming rains would be auspicious or destructive. This traditional system, though expressed in divine or symbolic terms, was actually based on "long-term empirical observation" — a careful study of seasonal patterns repeated over many years.

Thus, the ancient method of understanding clouds was not unscientific; it was an **observational meteorology** in poetic form — "blending spiritual insight with environmental awareness". It connected the "rhythm of the cosmos" with the "rhythm of the earth", showing how deeply the ancients understood the harmony between the sky and the seasons.

The necessity of knowing the knowledge

अन्नं जगतः प्राणाः प्रावृट्कालस्य चान्नमायत्तम्।
यस्मादतः परीक्ष्यः प्रावृट्कालः प्रयत्नेन॥

"Food is the life of the world, and that food itself depends upon the rains of the rainy season. Therefore, the season of rains (Prāvṛṭkāla) should be examined with great effort.."

Varāhamihira connects meteorology with sustenance and cosmic harmony — showing that the study of clouds was a science rooted in ecology and spirituality.

Modern Science Comparison:

This verse establishes the foundation of "agrometeorology" — the science of "how weather and rainfall affect food production". Modern science also asserts:

> **"Rainfall determines soil moisture, crop yield, and overall ecosystem balance."**

Ancient Indian thinkers clearly recognized rainfall is important for food security, much before climatology formalized this

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relation.

In present-day terms, this is equivalent to monitoring monsoon cycles via "IMD"[1], "ENSO"[2], and precipitation indices.

Let's look deep into the concept

Ancient sage varahamihira before giving the knowledge of clouds in the below verse sets an perception by giving an instruction to imbibe it

.

दैवविदविहितचित्तो द्युनिशं यो गर्भलक्षणे भवति ।
तस्य मुनेरिव वाणी न भवति मिथ्याम्बुनिर्देशे ॥

Translation :

"He who, with a steady and devoted mind, observes the signs of cloud-conception day and night — his words, like those of a sage, never prove false in predicting rainfall."

Interpretation:

"daivavid" means *one who interprets the signs of nature with wisdom and devotion*. In ancient India, **"Daiva"** did not just mean **"divine"** in a religious sense — it referred to "the *natural order* of the universe", "the laws that govern seasons, winds, and rains". Thus, a "Daivavid" was not a magician or fortune-teller, but "an observer of cosmic and environmental patterns", someone who could read **"The language of the sky"**

The verse draws a parallel between the sage (muni) and the weather observer. Just as the words of a realized sage are never false. Because they arise from inner clarity and truth.

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[1] India Meteorological Department
[2] El Niño-Southern Oscillation

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Similarly, the predictions of a genuine weather observer never fail, because they arise from careful and disciplined observation of the environment.

In modern terms, this ancient idea resembles what we now call meteorology based on long-term observation. Before satellites and radars existed, these wise observers could foresee rains, storms,or droughts purely by studying the atmosphere "knowledge born from centuries of experience and transmitted through tradition".even now we can see in indian "**jyotishya**" hand books like "**panchanga**" where the observers clearly states the actual dates of rain fall,droughts and storms

Understanding rainy clouds

Ancient Indian seers observed 'color' 'height', 'density', and structure of clouds to predict rainfall —this is essentially "**qualitative-meteorology**". Modern science confirms the same principles using quantitative tools. Let's take a sloka as an example- *Description of the Cumulonimbus cloud in the Saṃhitā:* In this verse varahamihira explains how one can find out a rainy cloud

दधिसदृशाग्रे नीलो भानुच्छादी खमध्यगोऽभ्रतरुः
पीतच्छुरिताश्च घना घनमूलास्ते भवन्ति वृष्टिकराः

"That cloud whose front/top is like curd (white), whose middle is blue, which covers the sun, which stands in the middle of the sky like a great tree; and those whose base is thick, whose edges appear yellowish— These indeed are the clouds that cause rain."

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Through meteorological perception :

1.दधिसदृशाग्रे — **"Having a curd-like (white) top**

The upper portions of such clouds contain huge groups of ice crystals. These ice-crystal groups appear white, exactly like curd.This indicates strong updraft of air in the upper troposphere.Modern meteorology considers this feature as a sign of deep convection[3].

2.नीलः घनमूलः — **Dark-blue dense base**

The lower portions of such clouds are deep blue because they contain extremely dense water droplets.Their high moisture load makes them appear dark-blue/blackish. This is the precipitation zone. Cumulonimbus or Nimbostratus cloud bases appear dark due to high liquid water content.

3.भानुच्छादि — **covering the sun**

When such clouds obscure the sun and appear blue–yellow, it means they possess very high optical thickness (optical depth).

4.पीतच्छुरिताः — **tinged with yellow**

means *smeared with yellow* — this yellowish glow around the cloud edges is produced by a combination of:

- Rayleigh scattering
- refraction of sunlight
- optical diffusion through droplets

[3] strong upward movement of warm, moist air from the surface up to the top of the troposphere.

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This yellow color is seen particularly at sunrise/sunset when sunlight is cut slantly and scattered through atmospheric particles.

Rayleigh Scattering Explanation:

When sunlight enters the cloud during morning/evening, the light waves (blue, green, yellow etc.) are scattered by atmospheric molecules. This scattering is called Rayleigh Scattering.

Inside a dense cloud, light does not penetrate deeply because of:

- Water liquidity and density and strong moisture
- critical angle

Hence: the middle part appears blue-black and the edges appear yellow, because of the sunlight scattered at the Outer edge.

Critical Angle :

When the angle of sunlight entering a water droplet exceeds 48.8 degrees, it does not emerge but undergoes **internal reflection**. Therefore only the outer edges of the cloud glow yellow.Modern meteorology calls such a cloud as High Optical Thickness Cloud or Optically Dense Cloud

4. अभ्रतरुः — Cloud-tree

These clouds arise from intense "convective currents"[4].
They grow upward like a towering tree and expand to a large size.Such clouds are the main cause of heavy rainfall, lightning,thunder. Varāhamihira's description exactly matches the modern Cumulonimbus cloud thus his observation is

[4] Very strong upward and downward movements of air caused by heat.

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scientifically exact and corresponds perfectly to thunderstorm clouds described in present-day meteorology.

Anciant Monsoon Forecasting

सार्धैः षड्भिर्मासैर्गर्भनिषेकः स्वनक्षत्रे ॥

Meaning :

Rain falls after 195 days (six and a half months) from the time of conception of the cloud,and generally in the same Nakshatra (stellar region) where it was conceived.

Interpretation:

Varāhamihira and earlier seers states the "cloud embryo" (garbha) idea as part of a "six-and-a-half-month gestation" cloud embryos observed near "Chaitra" (march-april) would "deliver" rain by "Āśvina–Kārtika" (September–October). Here in this sloka rainfall timing and intensity were predicted based on the "*Nakshatra*" in which the clouds first appeared.

If cloud gestation or megha garbha is started in the particular month in modern meteorology it can be understood as the "pre-monsoon convection phase" where high moisture accumulation happens. And the delay is because of ocean and atmosphere system but "the nakshatra" consideration is not acceptable in the modern science but our rishis explains it as the moon making rounds around the earth so they made it in to "twenty seven equal parts" because That is the time taken by the Moon to complete one full orbit around the Earth is approximately "27.3 days". Again each nakshatra orbit is divided as "Thirteen degrees and twenty arch-minutes". So when the moon is in particular degrees of orbit with arch minutes then the cloud formation is happening. After "195 days period" the moon comes to the same orbit i.e. same nakshatra then it rains.

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Hence The term for this idea in modern meteorology is called "Seasonal Predictive Lag Relationship" or "Long-Range Monsoon Forecasting based on atmospheric precursors[5]." This delay and "same nakshatra recurrence" corresponds precisely to energy build-up, atmospheric circulation memory and predictable zonal rainfall bands recognized in climatology and synoptic meteorology.

formation and rainfall mechanism (पञ्चनिमित्तम्)

पवनसलिलविद्युद्गर्जिताभ्रान्वितो यः।
स भवति बहुतोयः पञ्चरूपाभ्युपेतः॥

"A cloud that possesses all these five elements — wind, moisture, lightning, thunder, and condensed form — becomes a rain-bearing cloud, capable of releasing heavy rainfall."

Modern meaning:

In modern meteorology, this indicates the mature stage of a cloud,where all dynamic processes-"updraft","condensation", "electric charge", and "precipitation" are active. Rain occurs when "moisture-laden air" (humidity) rises due to "wind" -"cools" and condenses into clouds, builds "electrical energy" (lightning and thunder), and finally releases "precipitation". It describes mechanisms of rainfall using pre-modern observational language.

This study correlates these descriptions with modern meteorological concepts such as synoptic-scale dynamics, moisture convergence, electrical charge separation, convective instability, and cloud microphysics. The "Five

[5] the early signs that indicate the arrival of weather conditions such as rain, storms, lightning, warm winds, or cold winds.

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Causes" are shown to correspond to key variables in precipitation forecasting and align closely with today's meteorological understanding of convective storms and monsoon rainfall. It demonstrates how early Indian scholars observed nature with remarkable precision, blending poetic expression with scientific accuracy.

Sanskrit Concept	**Modern Scientific Equivalent**	**Explanation**
पवन **(Pavana) – Wind**	Aircurrents/ Atmospheric circulation	Winds lift moist air upward. When air rises, it cools and condenses to form clouds.
सलिल **(Salila) –Water/moisture**	vapour/ Moisture content	Water from oceans, rivers, and plants evaporates into vapour — the base material of clouds.
विद्युत् **(Vidyut) – Lightning**	Electrical discharge within clouds	Electric potential builds up between cloud layers, resulting in lightning.
गर्जित **(Garjita) – Thunder**	Sound waves from lightning discharge	The intense heat of lightning causes air to expand suddenly, producing thunder.
अभ्र **(Abhra)** – Cloud	Condensed water droplets suspended in air	The visible body of condensed vapour — the actual cloud.

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Drizzling-short span of cloud life according to the ancient sages

विसृजन्ति यदि तोयं गर्भकालेऽतिभूरि ।
प्रसवसमयमित्वा शीकराम्भः करोति । ।

"If a cloud matures too early and discharges water before the right time, it will not yield heavy rain later — only light drizzle."When clouds, during their formation stage (called *"garbhakāla"* — the period of conception), gather and release excessive moisture prematurely, they lose the capacity to produce heavy rainfall later. Thus, when the time for rain (*prasava-samaya*, i.e., the period of delivery) arrives, they are able to release only fine drizzle or dew-like moisture (*śīkarāmbha*).

Modern Meteorological Interpretation :

- The "conception period"(garbhakāla) refers to the *cloud formation stage* — when water vapor condenses into droplets.
- The "delivery period" (prasava-samaya) refers to *precipitation* — when droplets combine and fall as rain.
- If too much "condensation"[6] happens too soon, the cloud becomes unstable or "prematurely saturated"[7], leading to small droplets that can't merge into larger raindrops.
- As a result, the cloud only produces mist, dew, or drizzle instead of heavy rainfall.

[6] Condensation is the process in which water vapor in the air cools down and changes into tiny liquid water droplets, forming clouds, dew, or fog.
[7] "Prematurely saturated" means the air becomes full of moisture faster than usual, reaching its maximum capacity to hold water vapor earlier than expected, leading to quicker cloud or fog formation.

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Scientific Parallels

Ancient meteorologists like "Varāhamihira" and "vallalasena" and "parashara" observed that When clouds develop prematurely with excessive internal moisture they instantly release huge water, "they fail to yield full rainfall later in prescribed month" —a concept strikingly similar to modern "cloud microphysics", which explains why certain clouds only produce "drizzle".

scale-based rainfall model.

पञ्चनिमित्तैः शतयोजनं तदर्धार्धमेकहान्यतः।
वर्षति पञ्चनिमित्ताद्भूपेणैकेन यो गर्भः॥

Meaning :

"A cloud-embryo (garbha) endowed with one of these five causes gives rain for 100 yojanas; "When it is said 'with the five omens' (pañca-nimittaiḥ), it refers to a cloud that possesses all five signs—wind (pavana), moisture (salila), lightning (vidyut), thunder (garjita), and cloud mass (abhra). Such a cloud pours rain over a distance of one hundred yojanas on all sides. The phrase tad-ardhārdham means 'half of that, and again half', and the word tad refers back to that same hundred yojanas.

Explanation:

If one of the five omens is absent, then by a general rule following the same order of diminishing signs, the rainfall distance becomes half of that measure: — with four omens, the cloud rains for half of a hundred, that is fifty yojanas; — with three omens, half of that again, that is twenty-five yojanas; — with two omens, half of that amount, which is twelve-and-a-half yojanas.

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Let's take one yojana as ≈ 0.26 km[8]

Aspect	Ancient Concept (Varāhamihira)	Modern Meteorological Concept
Five Causes	1. Pavana (Wind) 2. Salila (Moisture) 3. Vidyut (Lightning) 4. Garjita (Thunder) 5. Abhra (Cloud)	Wind shear, humidity, microphysics, electrical activity, cloud structure & instability[9]
If all 5 are active	100 yojana spread ≈ 26 km	Severe Thunderstorm / Multi-cell Cluster; 40–120 mm/hr, spread 5–15 km
If 4 are active	50 yojana spread ≈ 13 km	Moderate / Localized Thunderstorm; 15–40 mm/hr, spread 5–10 km
If 3 are active	25 yojana spread ≈ 6.5 km	Light, localized rain; 2–15 mm/hr, spread 1–5 km
If 1–2 are active	Very small/brief rainfall ("eka-hānyaḥ")	Isolated showers / weak single-cell convection

[8] According to the description of sampathi from kishkindhakanda explanation in the last page
[9] *How strongly the air is rising* (energy in the atmosphere)

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This quantitative **rainfall intensity model** shows that rainfall magnitude depends on the **number of active atmospheric forces.**

Scientific equivalence:

"Precipitation intensity $\propto$ convective energy × moisture × instability".

Hierarchy of Atmospheric Scales

Scale	Range (km)	Duration	Examples
Microscale	< 1 km	Seconds–minutes	Dust devil, small turbulence
Mesoscale	1 – 100 km	Minutes–hours	Local thunderstorm, sea breeze
Synoptic Scale	100 – 3000 km	Days–a week	Cyclone, monsoon low
Planetary (Global) Scale	> 3000 km	Weeks–months	Jet streams, ENSO, monsoon circulation

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Standardized Rain-Gauge Dimension

समे विंशाङ्गुलानाहे द्विचतुष्काङ्गुलोच्छ्रिते।
भाण्डे वर्षति सम्पूर्णं ज्ञेयमाढक वर्षणम्॥

"If one wishes to measure the amount of rainfall, then — in a vessel that is 20 aṅgulas wide and 8 aṅgulas high, if the rainwater fills it completely, it should be known as 'one āḍhaka of rainfall.'"

Varāhamihira and other ancient scholars measured rainfall using a calibrated vessel. They specify a container with:

- **Diameter: 20 aṅgulas (≈ 50.8 cm)**
- **Height: 8 aṅgulas (≈ 20.54 cm)**

If the rainwater fills this container completely, it is considered "one **Āḍhaka of rainfall**", which corresponds to approximately **1.6 cm of rainfall depth**. This ratio **(2.5)** matches closely with the **Indian Meteorological Department (IMD)** standard rain gauge:

- **Diameter = 200 mm = 20 cm**
- **Depth = 80 mm = 8 cm**
- **Ratio (Diameter : Height) = 20 : 8 = 2.5 : 1**

demonstrating methodological continuity across millennia. The underlying measurement principle reflects a deliberate sequence—**rainwater weight → collected volume → rainfall depth**—showing that early Indian hydrologists applied a calibrated weight–volume conversion to quantify precipitation. Thus, Varāhamihira's description is not metaphorical but represents a **scientifically coherent prototype of the modern rain-gauge**, illustrating the evolution of precipitation science from ancient India to contemporary meteorology.

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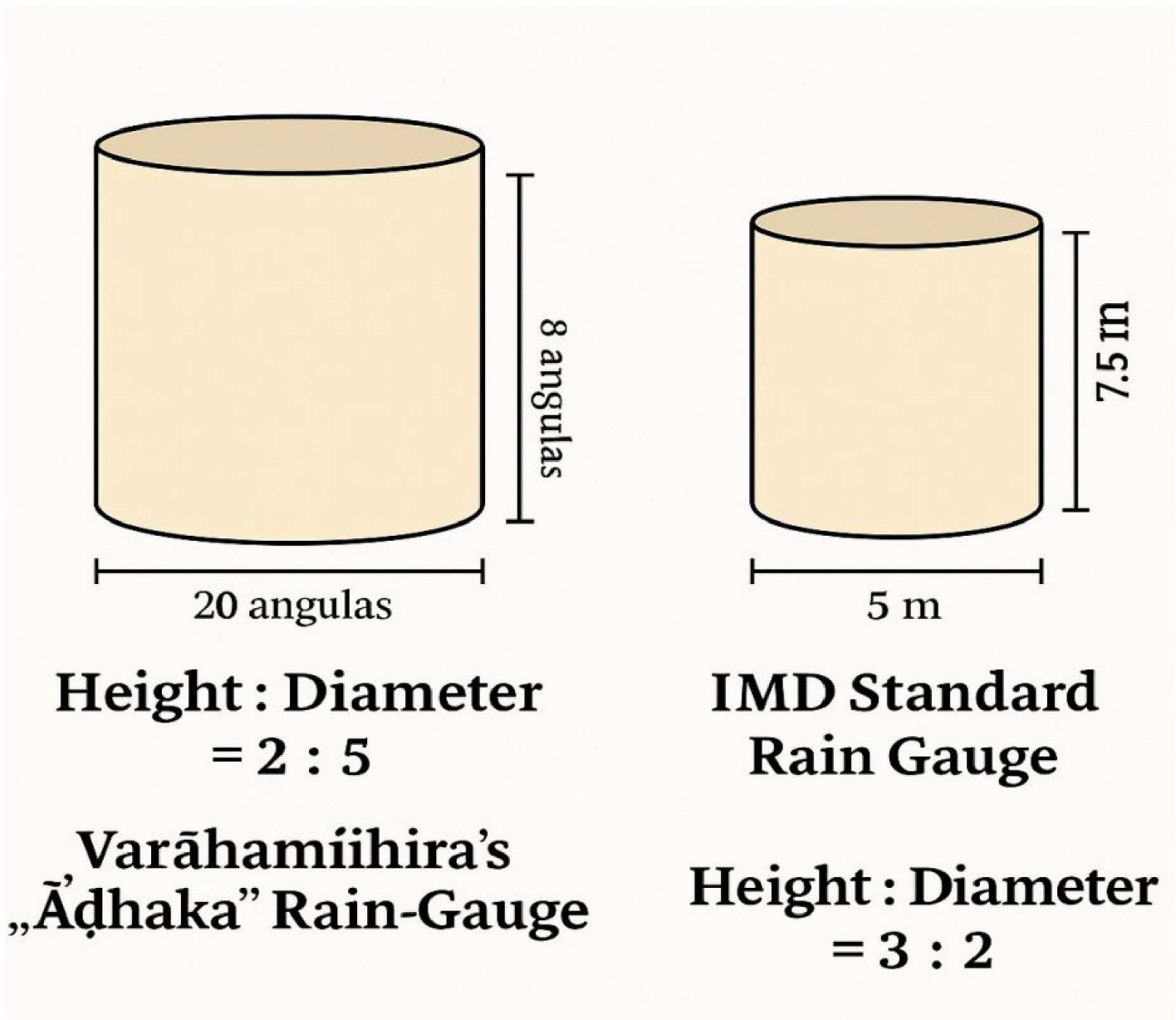

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Conclusion:

In ancient India, cloud and rainfall science was not merely a branch of astrology or religious speculation; it was, in essence, an "empirical environmental science". Observers like Varāhamihira explored the secrets of nature through long-standing observational traditions and articulated scientific principles grounded in direct experience. What modern meteorology describes as the "**convection–organization–precipitation cycle**" had already been conceptually planted by the ancient seers. Their analysis of the five indicators—"**wind, cloud, lightning, thunder, and rainfall**"—corresponds remarkably with present-day atmospheric diagnostics. So Varāhamihira's "**Daiva-vidyā**" (skill in interpreting natural signs) is nothing other than what we now call "**atmospheric observation**", Thus, it may be concluded that the essence of ancient Knowledge evolved into the scientific framework of "modern seasonal climatology". Hence it becomes clear that the cloud is not merely a bearer of rain, but a bridge uniting science, poetry, and life, revealing the mysterious heart of nature.Moreover, the methodology of ancient Indian cloud science should not be dismissed as unscientific. It was, in fact, a deeply ecological and observational meteorology—blending natural insight, environmental sensitivity, and empirical reasoning. It sought to harmonize the rhythms of sky and Earth, demonstrating the profound understanding ancient seers possessed about the balance of the natural world.As scholar i just only interpreted fewer elements of the samhitas and other ancient books which dedicated to cloud science **"any correction and criticism are welcomed".**

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WHY ONE YOJANA IS EQUAL TO 0.26 KMS ACCORDING TO SAMPATI IN RAMAYANA AS HE STATES?

Ślokas 4.58.20-25 Meaning in English:

"From here, across the ocean, at a distance of a full hundred yojanas, lies the beautiful city of Laṅkā, constructed by the divine architect Viśvakarmā."

"O monkeys! The city of Laṅkā, protected on all sides by the ocean, lies across a full hundred yojanas of the sea. On reaching the southern end of the ocean, you will see it in its entirety."

"On reaching the southern coast, you will behold Ravana. Now, swiftly, O monkeys, cross the sea and display your valour!"

Explanation: This verse gives a geographical estimation of the distance of "Laṅkā" from the point "Sampāti" observed — traditionally "100 yojanas" according to Valmīki.

"Laṅkā" is described as a fortified and well-protected city.Its natural fortification is the sea surrounding it.(protected on all sides by the ocean) The ocean acts like a moat, making it extremely difficult for enemies to reach the city. On reaching the end of the ocean Sugrīva directs the monkeys to travel southward, until they reach the southern edge of the Indian coastline and They must cross a distance of 100 yojanas of ocean—traditionally interpreted as the distance between the Indian coast and Laṅkā. Once they reach the far end of the sea, the city of Laṅkā will be visible in all its vastness as he said."**Sampāti"** is giving instructions to the vanaras about the location of Laṅkā. He mentions: The distance of Laṅkā **"100 yojanas across the ocean"** That it is protected all around by the sea They should reach the southern coast and then see Ravana and the city He urges them to proceed swiftly and courageously. So current distance from rameshwaram to mannar islands approximately 26 k.m.s by this if we speculate one yojana as 0.26 kms then 100 yojanas as 26 kms because as sampathi mentioned vanaras **"in a distance of 100 yojanas and covered with ocean on all sides"**