二零二五 THE KTI VIBE
VOL 4. Aug 2025

TAKING FLIGHT

TABLE OF CONTENTS

Author: Zhiyu Wen

New ChatGPT AI Agent

New ChatGPT AI Agent

Recently, OpenAI revealed its latest creation, ChatGPT Agent. This is far more than a simple update to the language model; it represents a fundamental shift in how AI operates and integrates into our lives. The familiar chatbots we know are now evolving into intelligent and capable of independently controlling a computer to execute tasks.

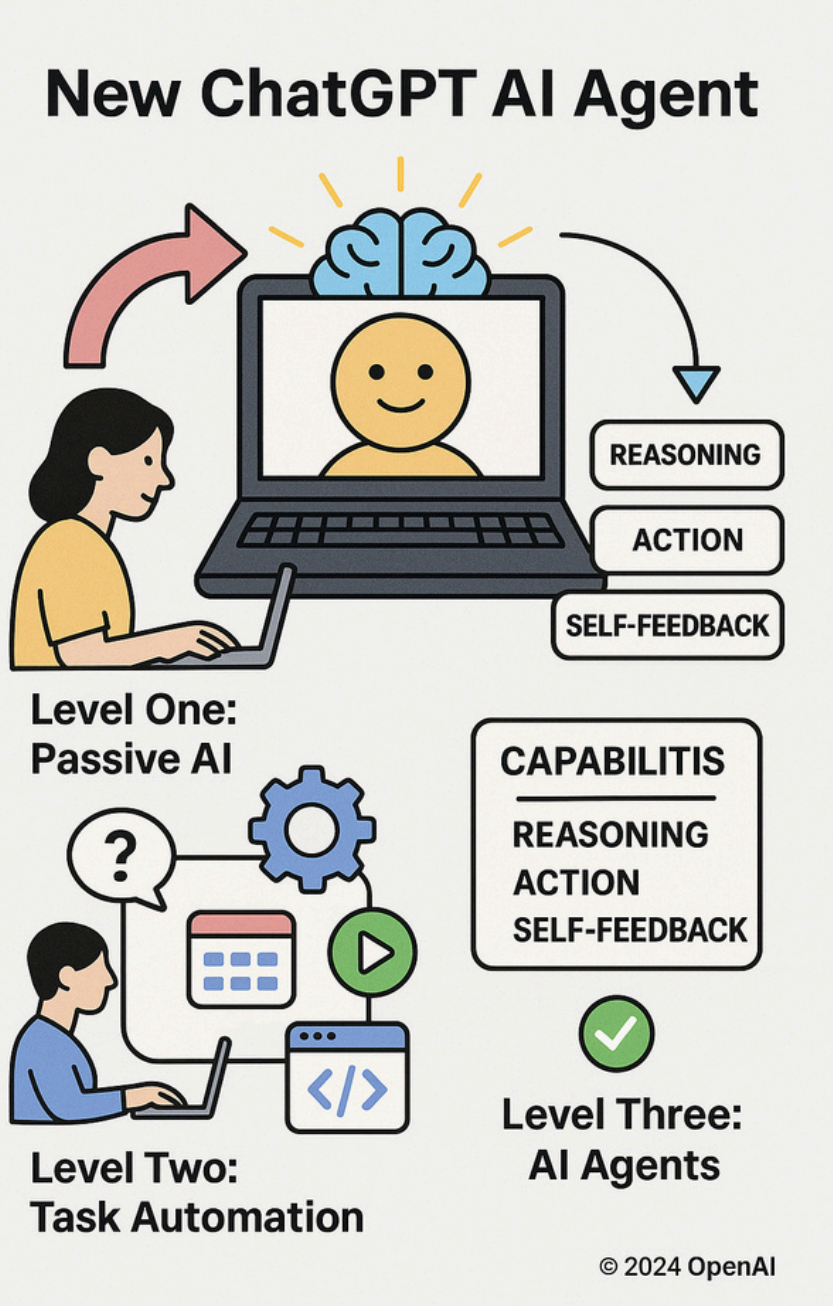
Level One: Large Language Models LLMS

These are the AIs with which we commonly interact, such as ChatGPT, Claude, or Gemini. They execute natural languages and generate human-like responses. Their primary limitation is that they only respond to your prompt. They cannot take initiative and access external tools like calendar, email, or learn from previous steps without instruction.

Level Three: AI Agents

This marks a significant breakthrough, where ChatGPT stands firm. An AI Agent is a system that combines reasoning, action, and self-feedback to autonomously complete tasks, using LLMs as its core intelligence. The key difference from the workflow is that AI itself decides the next steps and dynamically adjusts based on results. Key capabilities are:

Reasoning: Breaking down complex tasks and determining a step-by-step plan.
Acting: Calling tools, APIs, searching the web, writing, or creating.
Reflection: Checking results, identifying flaws, and revising its steps to provide better outcomes.



Level Two: AI Workflows and Automation

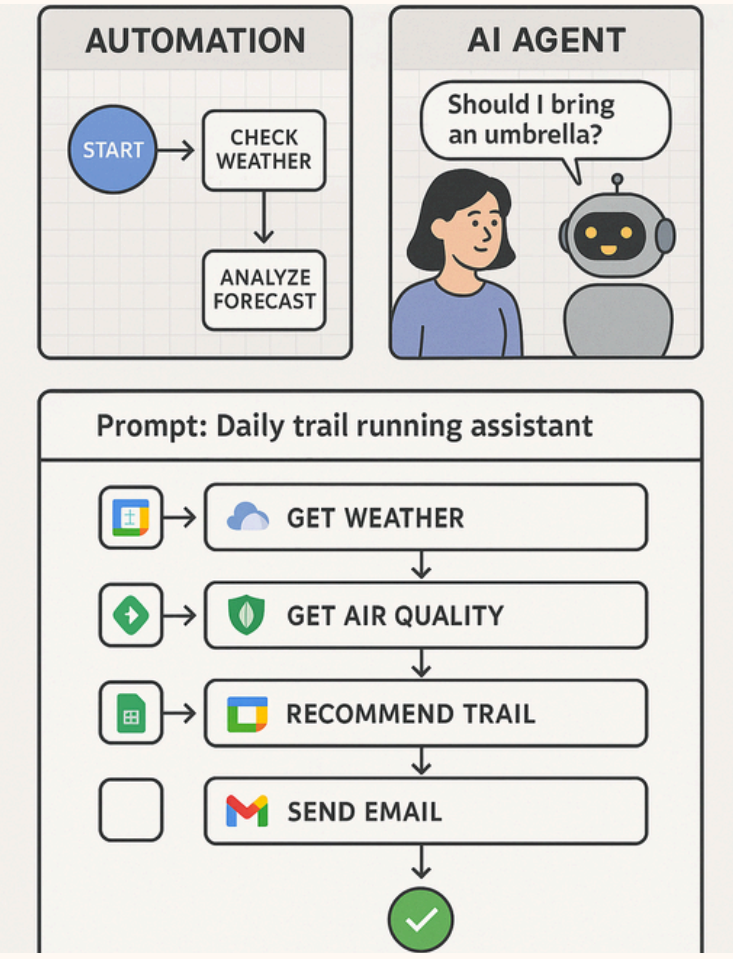
This stage involves combining multiple tools and APIs to perform multi-step tasks. The user or developer creates a flow. For instance, you might design a process to collect news data, summarize it, post it on social media, and then schedule that post. While these workflows are effective for automating predefined sequence.

Pros

Efficiency: It can automate complex workflows from beginning to end, saving large amounts of time and effort.
Capabilities: The Agent performs at the highest level on complex tasks like financial modeling, advanced math, and creative projects, and often does even better than humans.
Operation: It works automatically in the background, freeing users to do other tasks without continuous supervision.

Cons

Data Security Risks: Granting an autonomous agent access to sensitive information like emails or financial accounts has significant risks of data leakage if the agent is being manipulated or makes an error. Ethical Concerns: As these systems gain more independence, new ethical concerns come up, especially if they act in unexpected or harmful ways if not properly controlled. Management Complexity: Users will need time to build trust and learn how to guide it well. Strong safety measures are essential to make sure it only does what it's supposed to do.



What Makes it Unique

What truly makes ChatGPT Agent apart is its independence. AI models are primarily passive responders or rigid automated sequences. ChatGPT Agent, however, processes true reasoning, action, and self-feedback capabilities. It can understand a complex goal, break it down into a multi-step plan, and then execute that plan by operating its virtual computer. This means it can open web browsers, interact with websites, code, and even connect to your apps like Gmail or Calendar to gather information or perform tasks. Crucially, it dynamically decides on steps based on the goals of the actions, rather than following a rigid, preprogrammed script. This ability to think, act, and reflect makes it a truly unprecedented innovation. AI has reached a new level of independence, changing the way we use technology and get things done. Instead of asking it step-by-step questions, you now set a goal, and the AI Agent figures out how to achieve it.

Conclusion

The new ChatGPT AI Agent signals that AI is no longer only a tool for information, search, or creativity. It becomes an essential executor in our lives. This starts a new massive growth, but it also brings big challenges like keeping data safe, setting ethical limits, and rethinking how humans and AI work together.

Author: Arnav Kheni

The Archaea In Our Body

A Hidden Threat?

By Arnav Kheni

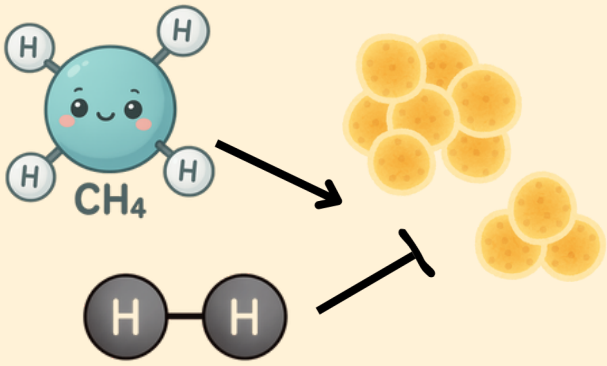
Back in elementary school (far longer than I would like to admit), I remember learning about how our body contains lot of bacteria: some good, some bad, and some that are just hanging out. So does that mean bacteria arethe most unique and complex? Nope.

When it comes to the human body, archaea are a unique, mysterious group that are difficult to study due to the emphasis on bacteria-based extraction methods and difficulty in meeting their nutritional needs when cultivating them. Despite that, some progress has been made.

Author: Arnav Kheni

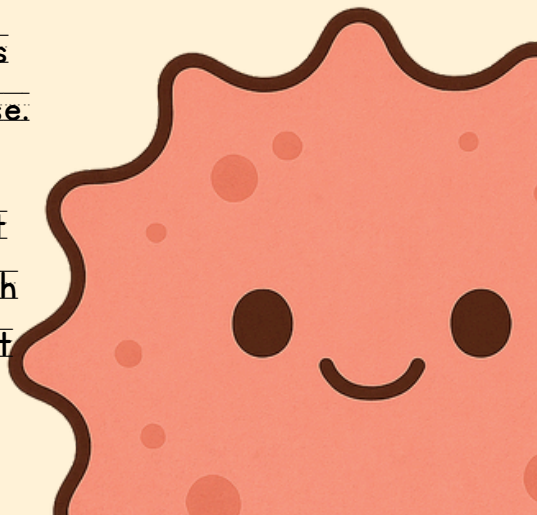
Part of our body's ecosystem

For morethan 30 years, it has been knownthat methanogenic (to be able to produce methane) archaea reside in the gut. Archaea have also been found on our skin, in our oral cavity, and in our urogenital tract. Methanogens like M. smithii and M. stadtmanae produce methane by metabolizing H2 and C02. But mysteriously, archaea have been identified in small amounts in places like feces. And recently, a new order of methogens has been found to be in the colon and oral cavity.



Without even knowing what many of archaea's proteins do and their difficult to observe, it hard to tell if they are pathogenic or not. Studies have shown that higher concentrations of H2 gas hinder pathogenic bacteria, and methanogens like M. smithii create methane gas, which slows intesitinal transit and helps bacteria gather more energy sources.

While promoting bacteria's pathogenic activity may harm us, archaea that lower the concentration of H2 help sacchorlytic bacteria to digest complex carbohydrates (which is good for us). But, it can also lead to bacteria breaking polysaccharides into short fatty acid chains, which means increase in calorie intake and increased fat storage. Other bacteria in a state of dybiosis (imbalance in the gut activity) release LPS, which goes into the bloodstream and triggers a pro-inflammatory response. These things can promote obesity. There have also been more archaea found in people with IBS, obesity, cancer, and etc. But conversely to obesity, they have also found more in people with anorexia. However, other research sometimes fails to find that correlation. So with so much unknown about archaea, they do have potential, but nothing can be said without more research.



Author: Rishabh Bansal

ENTREPRENEURIAL EMPOWERMENT

Private Enterprise Powers Urban Economies

Capitalism is a system where private businesses control the means of production, enabling them to shape the economy. Freedom to control all aspects of business empowers entrepreneurs to invest in their ideas and fuel the infrastructure at the heart of our urban economies.

Empowering Entrepreneurial Risk for Growth

Systems which actively promote entrepreneurship encourage individuals to profit from their innovative ideas. Under capitalism, people invest in their ideas and take calculated risks in hopes to profit and improve their quality of life. Daring entrepreneurs who risk their time and capital in pursuit of happiness aspire independence and stability.

The expansion of middle-class entrepreneurship can only occur in capitalist economies with ideal economic conditions such as the following:

- galore opportunities
- access to capital
- legal protections

The United States economy has the largest economy in the world, in part because of its entrepreneurial culture. In a financial system built around freedom, protection of private property, and free market economics, individuals have a high incentive to leverage their resources.

Author: Rishabh Bansal

Entrepreneurial opportunities have enabled individuals to leverage their personal expertise and resources to become self-made entrepreneurs.

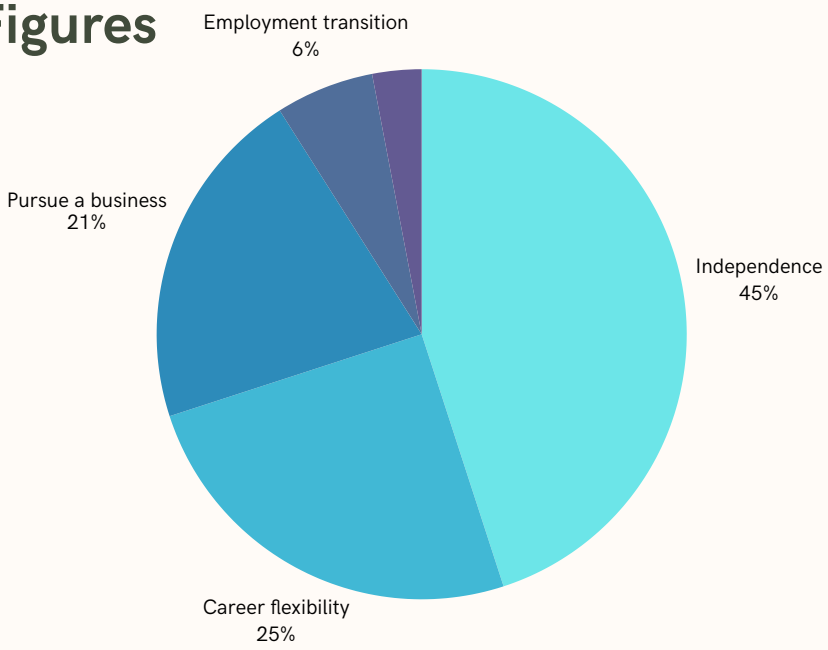
Anyone can become an entrepreneur

For example, former middle school teacher, Vincent Vasquez (aka @thetastebud), left his job to pursue a career as a food influencer on social media during the COVID-19 pandemic, a period in which numerous people lost their jobs and livelihoods. As his entrepreneurial endeavor gained traction, he decided to leave his job in 2022 and become a full-time content creator, showcasing his cooking talent on social media platforms. Entrepreneurial opportunities can arise from a simple pursuit of passion.

Capitalism offers a way for individuals to transform their raw ideas into developing, growing businesses. Risk-taking individuals who ride the entrepreneurial wave have enormous potential to experience success.

Entrepreneurship in Figures

Nearly 70% of entrepreneurs start their own business to gain control over their life. When people are driven to build their own ventures, they reap the benefits from the jobs, innovations, and services they create through economic prosperity.



Author: Zhiyu Wen

https://res.cloudinary.com/jerrick/image/upload/v1753751668/688820747b4d40001d561761.jpg

SEEING THE STORM: THE POWER OF NEXRAD PART I

Early Radar / History

People have always tried to understand and predict the weather, even when the weather is unpredictable. Radar became one of the most essential tools for that. It started during wartime, but now it's part of a complex system that helps scientists see storms more clearly and warn people beforehand. It changed how weather is studied and made a real difference in keeping people safe.

The story of weather radar begins in World War II, where early radar systems were designed to track enemy aircraft. Operators occasionally noticed clutter or noise on their screens during rain or snow, which they initially dismissed as interference. This weather noise was soon recognized as echoes from precipitation itself, and the accident reveals a powerful new application for radar technology.

The basic scientific concepts of modern weather radar are: The Doppler principle. Discovered by Austrian physicist Christian Doppler in 1842, this principle states that the frequency of a wave changes if its source is moving relative to the observer. Imagine a siren: its pitch sounds higher as it approaches and lower as it recedes away. Applied to radar, this meant that by measuring the frequency shift of returning radio waves, meteorologists could determine where precipitation was and how fast it was moving towards or away from the radar. This ability to spot motion was a crucial precursor to identifying dangerous winds and storm rotation. After the war, the US Weather Bureau (now known as the National Weather Service) began experimenting with military radars. The concept of applying Doppler capabilities to weather became a primary research focus. It's known as the NEXRAD program, a multi-agency, multiple-decade effort involving the National Weather Service (NWS), Federal Aviation Administration (FAA), and the US Air Force, with foundational research and development led by institutions like the National Severe Storms Laboratory (NSSL) on Doppler radar technology.

https://upload.wikimedia.org/wikipedia/commons/4/4a/2025-03-04_15_58_38_The_Fort_Dix_WSR-88D_NEXRAD_radar_%28KDIX%29_at_Joint_Base_McGuire%E2%80%93Dix%E2%80%93Lakehurst_in_Manchester_Township%2C_Ocean_County%2C_New_Jersey.jpg

Author: Zhiyu Wen

NEXRAD Era

After decades of research, it peaked in the late 1980s and early 1990s with the development of the NEXRAD (Next-Generation Radar) Doppler weather network, specifically the WSR-88D (Weather Surveillance Radar - 1988 Doppler). This nationwide network has fundamentally changed severe weather forecasting, improved warning times, and saved countless lives across the United States.

https://live.staticflickr.com/65535/52695044521_9112ed08c3_b.jpg

How WSR-88D Works

The WSR-88D is a large, mechanically scanned radar, typically protected inside a spherical dome called a Radome. A large parabolic dish antenna at the inside rotates 360 degrees and tilts through various elevation angles to scan the atmosphere. The radar system contains a powerful transmitter, antenna, receiver, and complex signal processing computers.

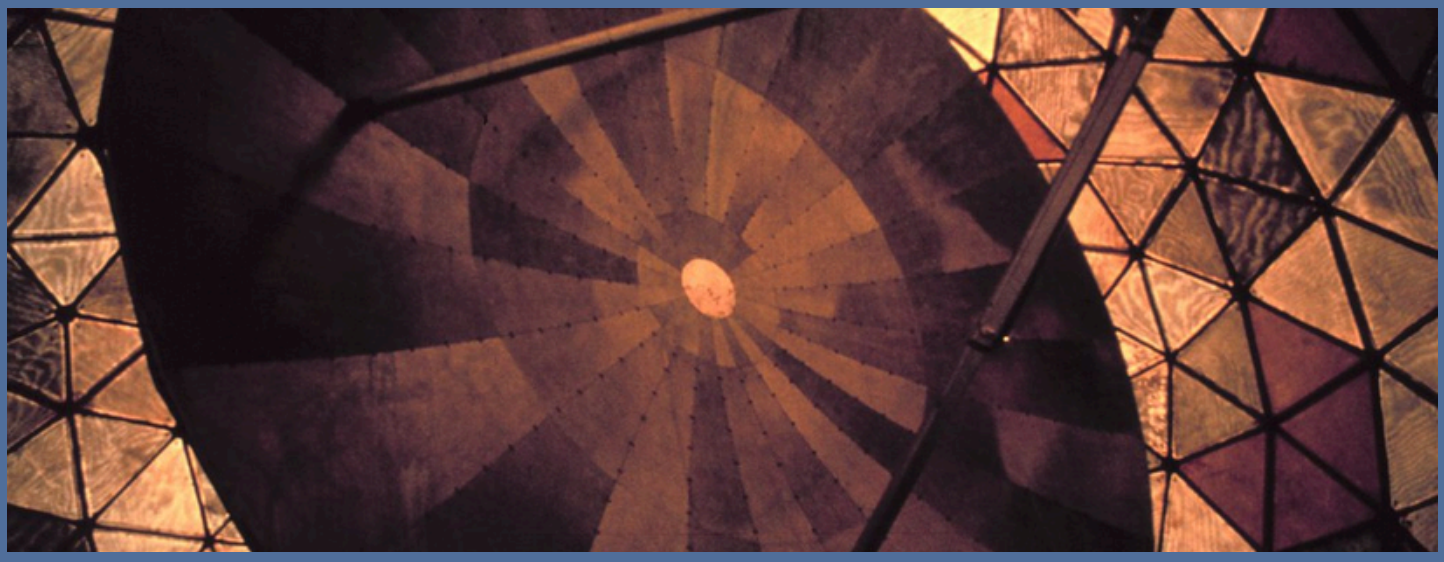
- **Emitting and Receiving Pulses**
  - **The radar transmits extremely short, powerful pulses of radio waves. Each pulse lasts only fractions of a microsecond (0.00000157 seconds) and has immense peak power around 450,000 watts. The radar is only on for 7 seconds per hour, spending the rest of its time listening for echoes. When these pulses encounter targets like raindrops, snowflakes, or hail, a small fraction of the energy is scattered back to the antenna as an echo.**
- **Scanning**
  - **The WSR-88D executes its full scans using pre-programmed Volume Coverage Patterns (VCPs). It systematically rotates through increasing elevation angles to build a three-dimensional image of the atmosphere, typically taking 4-6 minutes in transparent air mode, and 2 minutes for precipitation mode to capture rapidly evolving events.**

Author: Zhiyu Wen

Radar Bands and Their Uses

Radar systems operate across different frequency bands, each has unique characteristics suitable for specific applications.

- S-band (2-4 GHz)
  - S-band radars have long wavelengths, which allow their pulses to penetrate heavy precipitation with minimal attenuation. These make them ideal for wide-area monitoring of severe storms and heavy rains.
- C-band (4-8 GHz)
  - Used by many European weather radars and some US airport radars. C-band offers a good balance between signal attenuation and antenna size. It provides higher resolution than S-band with smaller antennas, but experiences more attenuation in heavy rain.
- X-band (8-12 GHz)
  - This band has a much shorter wavelength. Like many mobile Doppler radars, X-band radars require much smaller antennas for a given beamwidth, making them highly portable. However, their signals are significantly attenuated by heavy rain. Despite this, their high resolution at close range makes them usable for studying fine-scale storm structures and for urban or airport weather monitoring.
- Higher Frequencies Radar (Ka-band, Ku-band 12-40 GHz and above)
  - Even higher frequency bands are used for specialized applications, such as cloud physics research for tiny cloud droplets, or extremely high resolution detection of smaller objects like drones, birds, or people, often with very short ranges due to rapid attenuation. These higher frequencies are less suited for general weather surveillance due to signal loss.



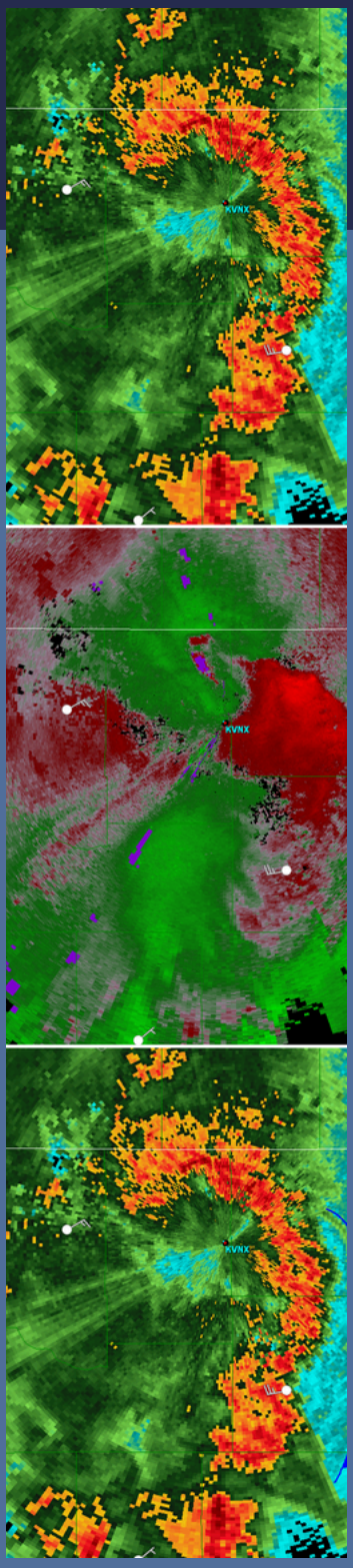
https://live.staticflickr.com/4128/5054524088_bd6d62edbb_b.jpg

Author: Zhiyu Wen

Detection and Display Weather

The WSR-88D generates a wealth of data. Displayed as visual graphics that meteorologists interpret or understand weather phenomena. These products have evolved significantly.

- Base Reflectivity
  - How it Works: The intensity of the returning echo, known as the reflectivity (Z), is measured in decibels relative to Z (dBZ). Higher dBZ values mean more energy is returned, indicating a higher concentration or larger size of precipitation particles.
  - Displayed: Blues and greens indicate light rain and snow. Yellows, oranges, reds, and purples indicate moderate to heavy precipitation.
  - This is the most common radar image, providing a fundamental precipitation map and the overall storm structure. Crucial for general forecasts indicating heavy rainfall, floods, and hail.
- Base Velocity
  - How it Works: By precisely measuring the change in frequency (Doppler shift) of the returning pulse, the radar determines the radial velocity (V), the speed of targets directly towards or away from the radar.
  - Displayed: Greens represent motion towards the radar, while reds represent motion away from the radar.
  - This radar image allows meteorologists to: estimate wind speed and direction within storms, locate the edges of outflow from thunderstorms, identify severe weather like mesocyclones (rotating updrafts within thunderstorms), and lastly identify areas of turbulence for aviation.
- Storm Relative Velocity
  - How it Works: Measures the dispersion or variability of velocities within the radar volume. High values indicate significant turbulence.
  - Display: uses a color similar to the base velocity, but the patterns reflect internal rotation more clearly.
  - Forecasters can more easily and confidently identify mesocyclones that could lead to tornadoes, further enhancing warning accuracy and lead times.



https://upload.wikimedia.org/wikipedia/commons/3/3d/Outflow_bndry.png

Those are just the common ones researchers use every day. There's way more than that, and they all help show what is going on in a storm, like rain, wind, rotation, etc, that helps track storms and keeps people safe.

What is a Mesocyclone?

A mesocyclone is a large, rotating column of air found within a powerful thunderstorm; it is a type of supercell. It forms when wind at different altitudes blows at different speeds or directions, creating a horizontal spinning effect tilted vertically by the storm's strong updrafts. A mesocyclone often appears as a dark cloud structure with a broad rotating base. The cloud base looks low, circular, or funnel-shaped, hanging beneath the main storm.

https://live.staticflickr.com/8381/8634239155_e7dbea64cb_b.jpg

From accidental wartime discoveries to today's cutting-edge systems, weather radar has changed our ability to understand and respond to the atmosphere. NEXRAD has been the trusted eye on the sky, revolutionizing how we track storms and issue warnings. But what if we could see even more, like the actual precipitation type? In part 2, we'll uncover the upgrades that enhanced radar's vision and explore the future of weather surveillance.

I READ
I TRAVEL
I BECOME

知识树月刊

$5/Month (1 Issue)
$36/Year (12 issues)
订阅或捐款via Zelle 至:
office@knowledgetreeinstitute.com

Knowledge Tree Institute
Where we grow together

杂志广告请接洽

(510)328-6688

Email:
office@knowledgetreeinstitute.com