

Human-Caused Climate Change?

Possible Lessons from Weather Modification Operations During the Vietnam War



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Cruces Atmospheric Sciences Forum

20+ Mar 2021, edited 24 March 2021

Outline:

A Personal Timeline

Geography

A History

Climatology and the Monsoons

Cloud Physics and Cloud Seeding

Cloud Seeding History, some from Newspapers

Sensational Stories

Serious Research led by Dr Joanne Simpson, others

Popeye, 1966, **Compatriot/Intermediary**, 1967-72

1969 In-flight observations: over the Ho Chi Minh Trail

Disclosure, Senate Hearings....

Outline

Puzzlements for me:

1967 State Department memo recommends pursuing cloud seeding

After all these years, the literature is all over the place on details

<https://paleofuture.gizmodo.com/the-secret-weather-manipulation-program-of-the-vietnam-1689249533>

Sidebars:

Aircraft Icing

IGLOO WHITE Sensors, Aircraft relay to Task Force Alpha

Ground-based generators

Meaconing over the Trail

A Personal Timeline

B-52 Forecaster, Operation ARC LIGHT Andersen AFB, Guam, 6 Months

September 1966
- February 1967



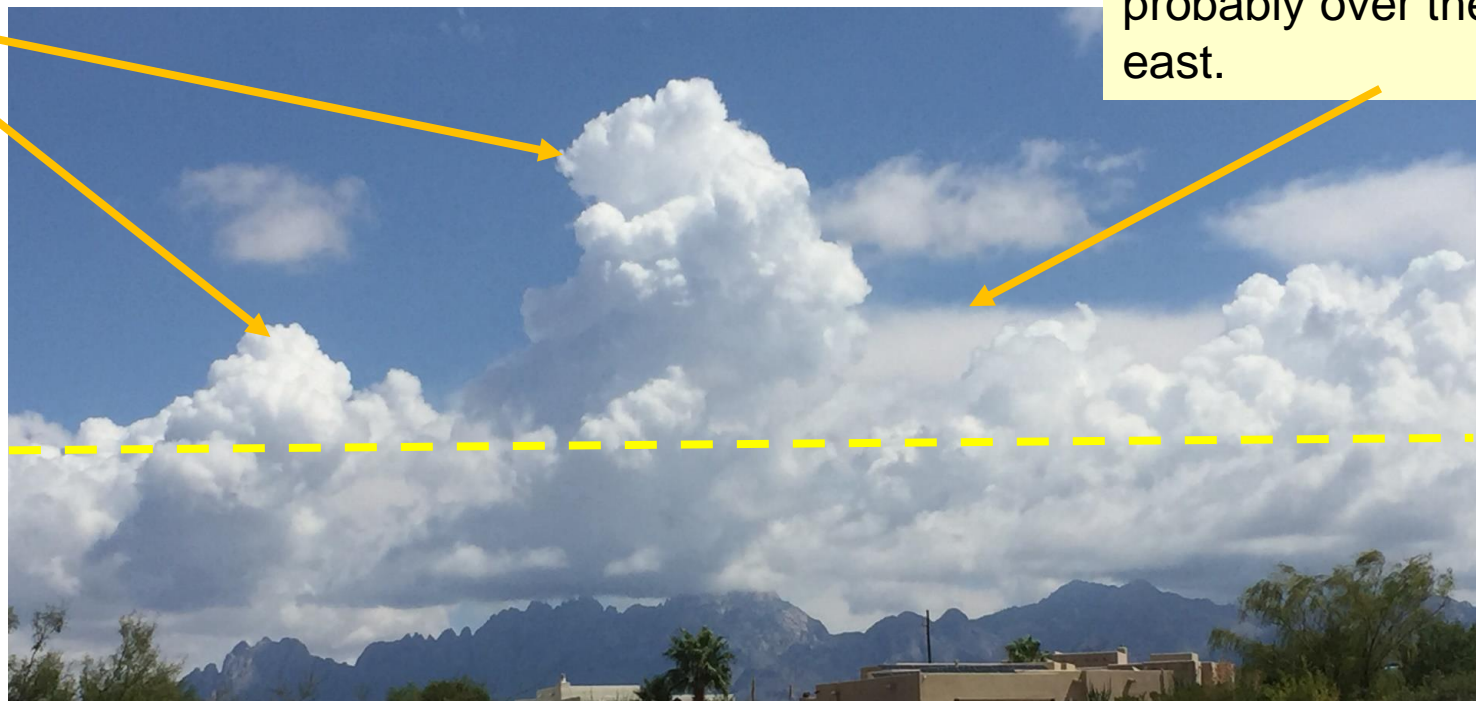
B-52D with Big Belly Mod 108 500# bombs



Supercooled Droplets

Glaciated Tops – Ice Crystal Clouds, probably over the next range to the east.

Freezing Level 13,000 ft

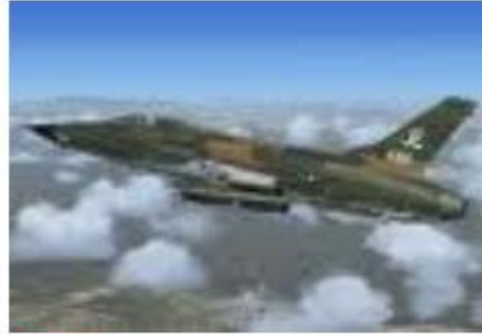


AFIT Grad Student, Penn State, Sept 1967-Feb 1969.

During Cloud Physics class, the instructor, Dr. Larry G. Davis, told us of a recent seeded cloud and control cloud experiment near Flagstaff, AZ, (most probably an early part of Project CLOUDWATER, summer of 1965) where seeding of supercooled droplets with silver iodide was demonstrated unequivocally to produce enhanced cloud growth and enhanced rainfall from the base of the seeded clouds.

Chief Forecaster, Korat RTAFB, Thailand, 4 months

February 1969
- June 1969



388th Tactical Fighter Wing



553d Reconnaissance Wing

WC-130 Cloud Seeding in SEA

Udorn RTAFB & Tan Son Nhut AB 8 Mos

June 1969 –
February 1970



Flight Ops, Udorn, Thailand



Staff Weather Officer Analysis Team, Tan Son Nhut AB, Vietnam

WC-130A Cloud Seeding in SEA

Udorn RTAFB & Tan Son Nhut AB 8 Mos

June 1969 –
February 1970



Flight Ops, Udorn, Thailand

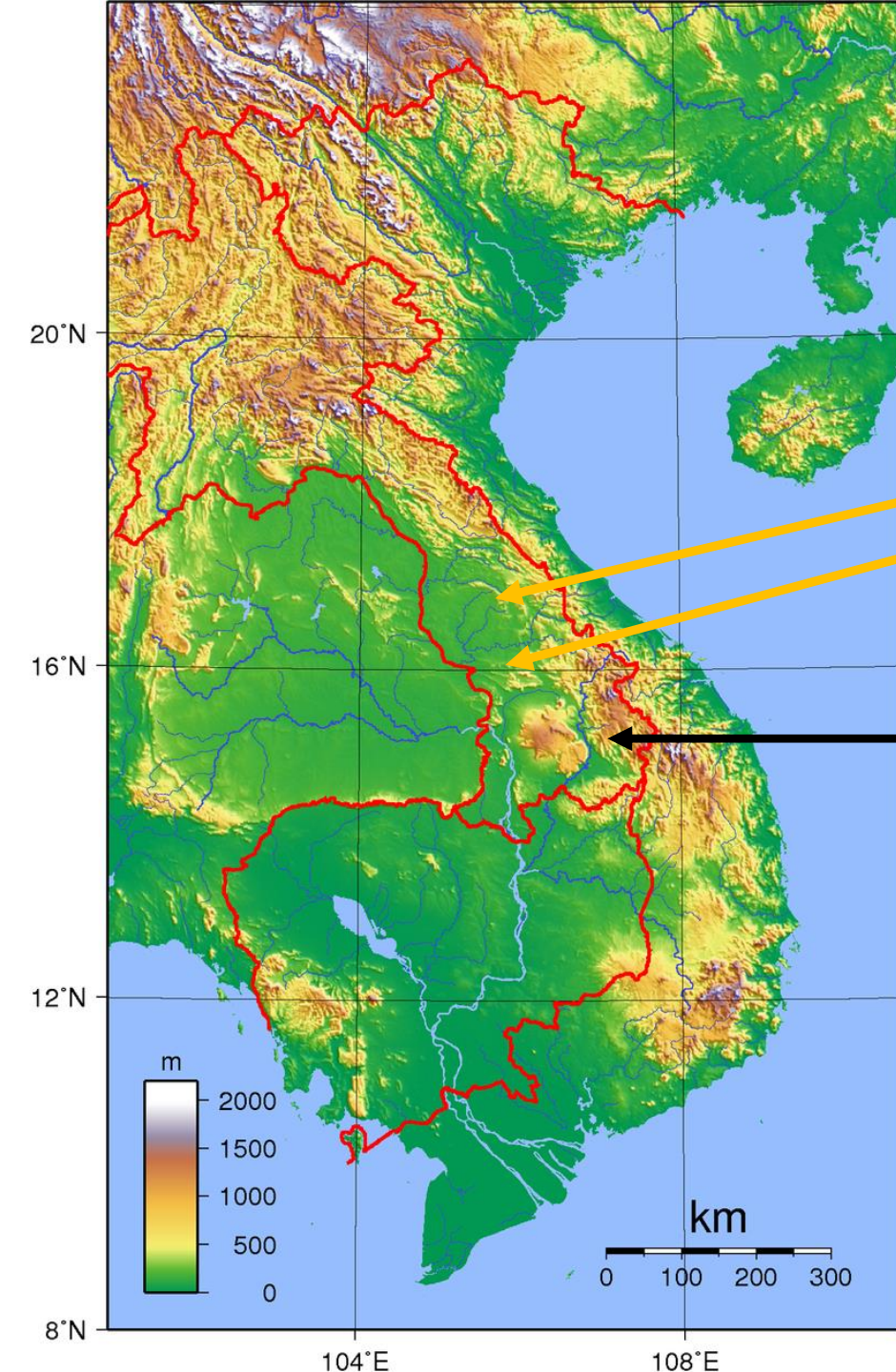




Geography

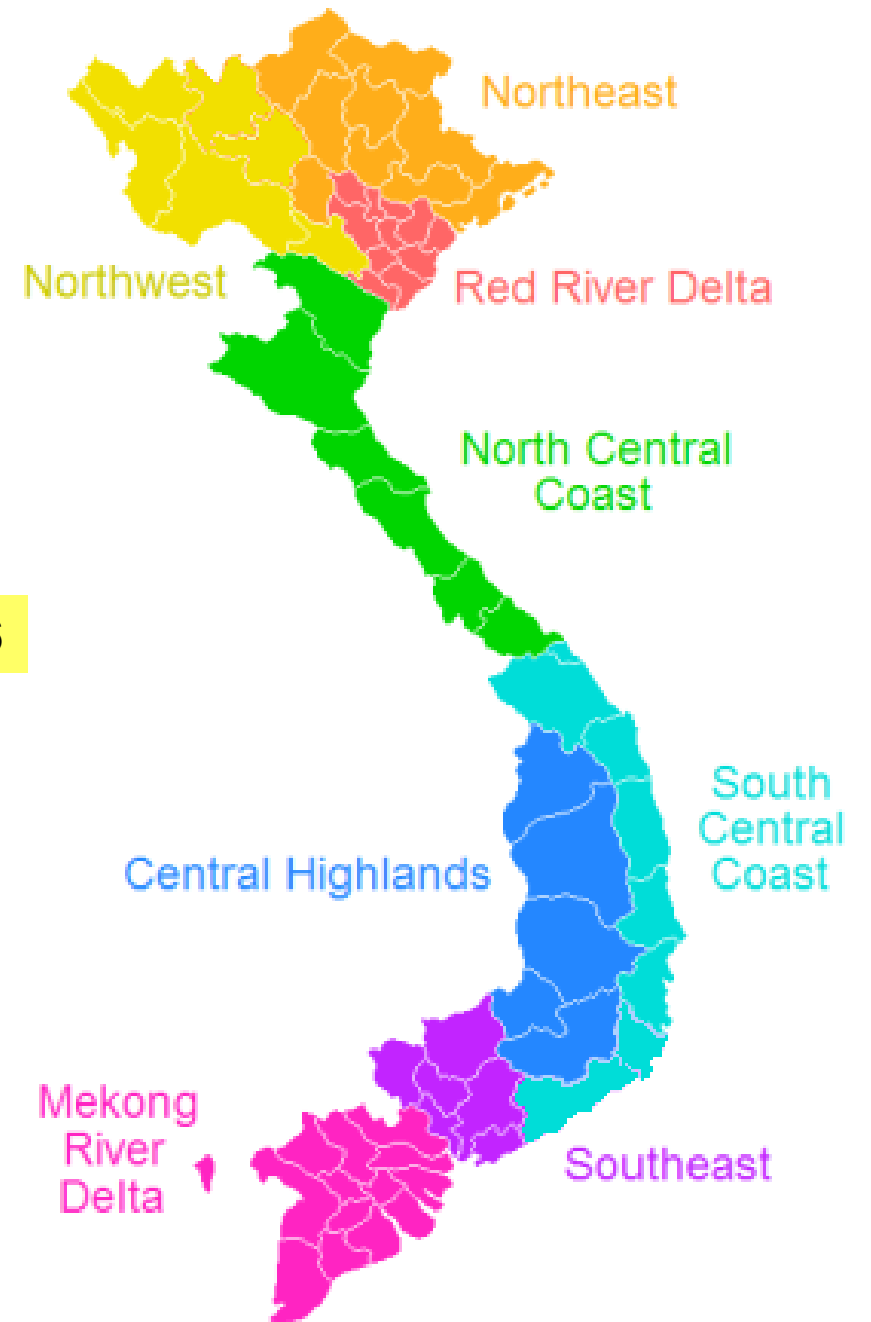






Laos Panhandle

Popeye Ops Area? 1966





Korat Plateau

Annam Mountains







Karst topography in Laos, Dry Season



Rice paddies and Karst topography in Laos, wet season.

<https://thehochiminhtrail.com/tales-from-the-ho-chi-minh-trail-the-mu-gia-pass>

When I was on Guam with my B-52s in 1966-67 our one TOP SECRET mission was our strike on the Mu Gia Pass.

To the right, in Laos:

Red Arrows parallel resupply line of communication from Vinh through Mu Gia Pass into Laos and Route 911 part of Ho Chi Minh Trail.

The area where many of our missions from the 388th Tac Fighter Wing were flown when I was with them, Spring 1969:

Ho Chi Minh trail had many segments, but the targets seemingly that we hit nearly every day were along Route 911 and Route 912.

Ban Laboy or the Ban Laboy Ford, was on our target list frequently.

North Vietnam



Laos

Mu Gia Pass was the main entry point of supplies and troops headed for South Vietnam down the Ho Chi Minh Trail.

Note all the bomb craters, as the military worked it over pretty thoroughly.

This image was taken from a plane flying over Laos, and in the background is North Vietnam.

Plainly seen in the bottom right are CBU canisters on the airplane.
(photo courtesy of Dick Diller)

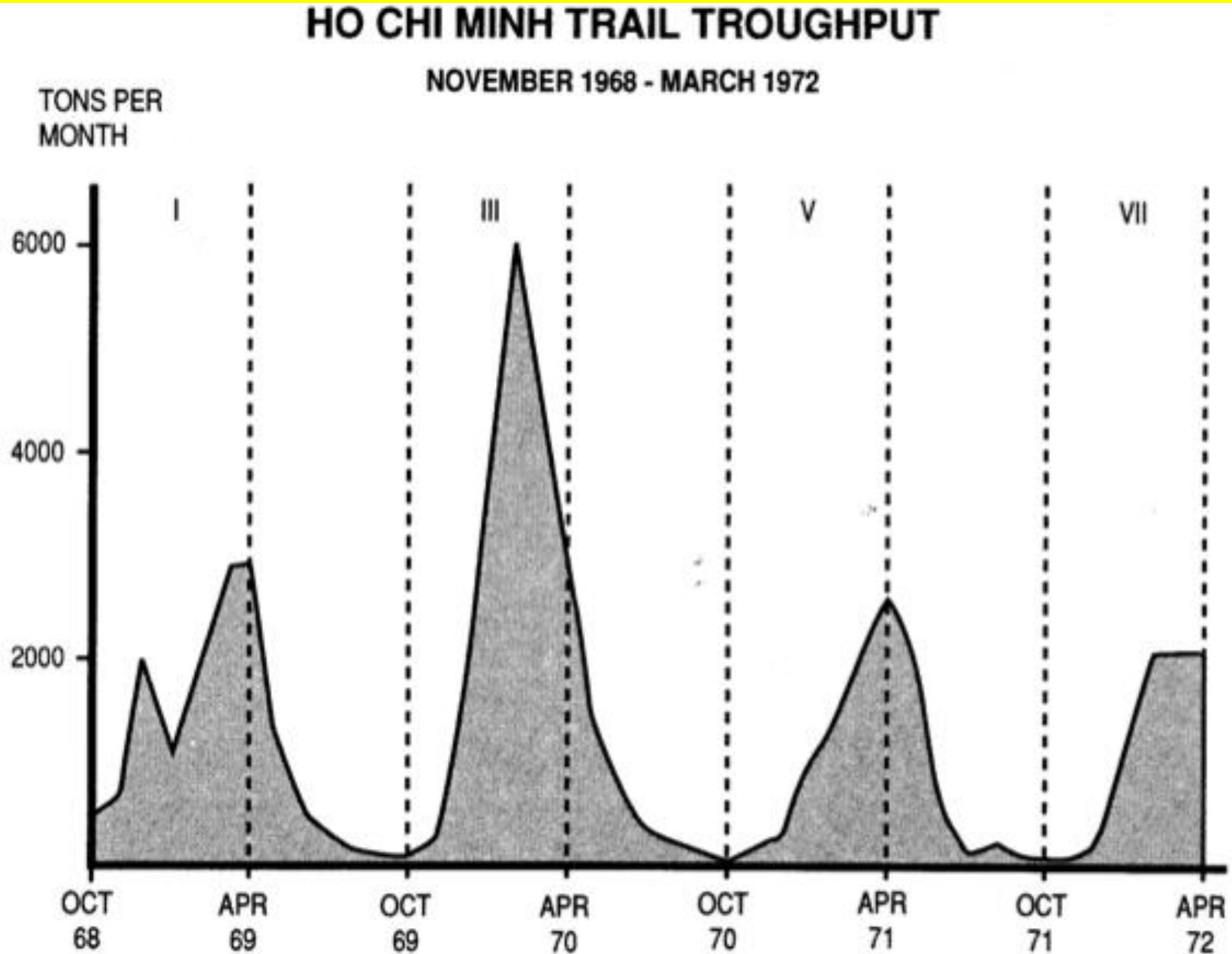
Looking North, Laos foreground,
North Vietnam Mid-field,
Gulf of Tonkin, whitish, distance.





Ban Laboy ford sits astride the Xe Bangfai river and provided a crossing point for people on the Ho Chi Minh trail. It was a very small target in a very big jungle, but being open and not protected by a covering of trees, it made an enticing target for US planners. <http://aircrewremembered.com/sijan-lance.html>

This shows the dry seasons were times of high tonnage transport, the wet season cut the traffic dramatically

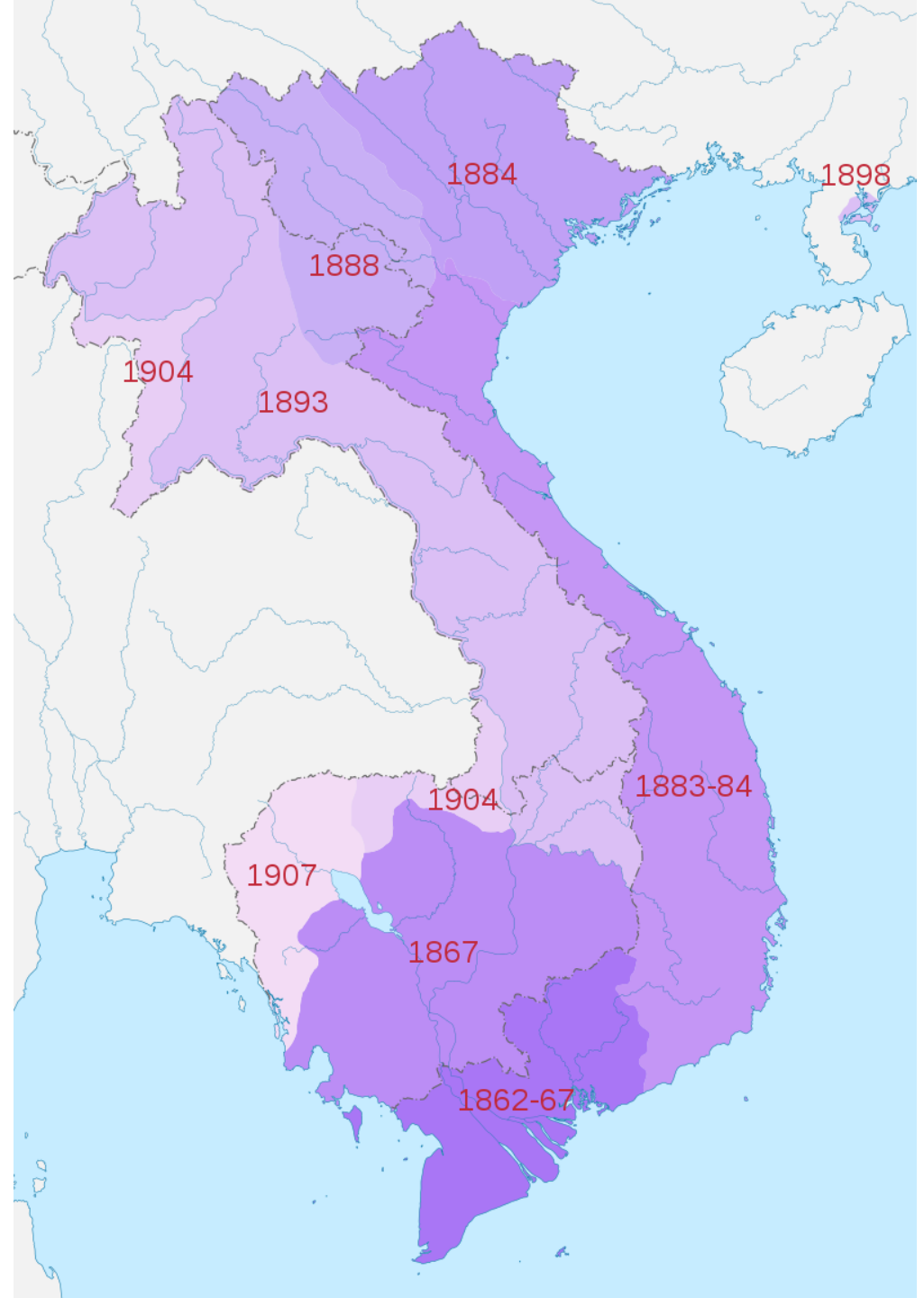


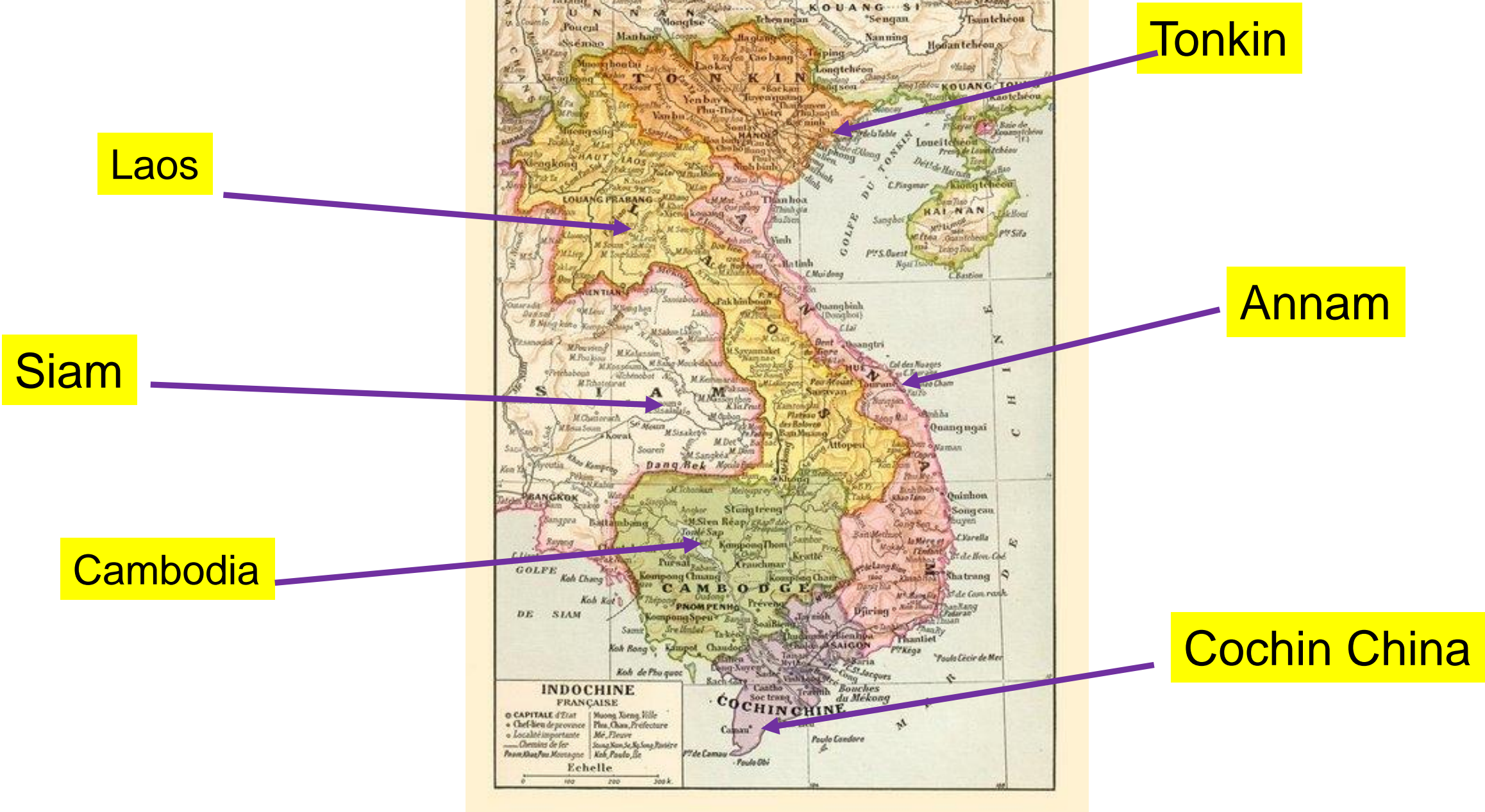


NVA Engineers erect a bridge on the Ho Chi Minh Trail –
Photo, © Tran Phac ~ Vietnam War

A History

Map to the right shows when the French colonized Indochina in phases, over time.





Vietnam confronts Eisenhower

Great consternation within the Eisenhower Administration arose: What to do about the Communist North Vietnamese attacks on the French Garrison at Dien Bien Phu?

USAF Gen Nathan Twining, and later Admiral Arthur Radford wanted to use nuclear weapons to help the French at Dien Bien Phu.

Both Eisenhower and Secretary of State John Foster Dulles pressed the British, other allies, for a joint military operation.

Prime Minister Winston Churchill and Foreign Secretary Anthony Eden refused.

Senate Majority Leader Lyndon Johnson reportedly quashed Eisenhower's request that US unmarked B-29s from the Philippines bomb the Viet Minh at Dien Bien Phu.

Vietnam confronts Eisenhower

Senate Majority Leader Johnson reportedly also refused an Eisenhower request to provide additional support to the French cause at Dien Bien Phu.

<In retrospect, 10 years later, a similar situation developed and was approved, the Tonkin Gulf Resolution of August 1964, giving LBJ a blank check for years >





Operation Castor. French paratroopers jumping over the valley of Dien Bien Phu, November 20-22, 1953.

Planned US Army support for the French at Dien Bien Phu:

My friend, Seale Doss, was with the 11th Airborne Division at Ft. Campbell Kentucky in 1954.

He was a First Lieutenant Paratroop Infantry Officer in the S-3 shop, Assistant S-3 (Air) in the 511th Parachute Regiment.

His unit was alerted in April 1954, and he began planning the Regiment's jump into Dien Bien Phu to relieve the siege of the French by the Viet Minh.

One element of the plan was to use of C-124 Globemasters to fly from Guam direct to the jump area, Dien Bien Phu, in what was North Vietnam.

They were planning to deploy when the mission was pulled.

Knowledge of this plan has been lost except to those who were in on its initial stages.

https://en.wikipedia.org/wiki/Operation_Vulture

Operation Vulture

The French Lose the Battle of Dien Bien Phu, 7 May 1954

Operation Vulture (French: Opération Vautour) was the name of the proposed U.S. operation that would rescue French forces at the Battle of Dien Bien Phu in 1954 via B-29 raids based in the Philippines. The French garrison had been surrounded by the Viet Minh during the First Indochina War. With the British government refusing to give their support (something that Eisenhower required for the operation to proceed), the plan was cancelled and as a result the French Army organised Operation Condor, an attempt to weaken the Viet Minh artillery's assaults against the besieged French Union garrison.

21 July 1954:

Partition of French Indochina resulted from the Geneva Conference.

Three successor states were created: the Kingdom of Cambodia, the Kingdom of Laos and the Democratic Republic of Vietnam, the state led by Ho Chi Minh and the Viet Minh.

The State of Vietnam was reduced to the southern part of Vietnam. The division of Vietnam was intended to be temporary, with elections planned for in 1956 to reunify the country.



Provisions, Geneva Conference of 1954

Accords, made public on 21 July 1954, detailed following terms for Vietnam:

- **"provisional military demarcation line" roughly along the 17th Parallel**
- **both parties' forces to be regrouped on either side of said Parallel after withdrawal**
- **3-mile-wide demilitarized zone on each side of the demarcation line**
- **French Union forces to regroup south, Viet Minh north of said line**
- **population free to move between both zones for three hundred days**
- **neither zone to join any military alliance or seek military reinforcement**
- **International Control Commission created to monitor ceasefire, jointly chaired by Canada, Poland and India**

North Vietnam invades Laos 1958 - 1959

North Vietnamese and Pathet Lao security forces took several villages in Tchepone District near the Demilitarized Zone (DMZ) between North Vietnam and South Vietnam in December 1958.

North Vietnam's Group 959, headquartered at Na Kai, just inside the Houaphan border, began operating in September 1959. Its mission was "serving as specialists for the Military Commission and Supreme Command of the Lao People's Liberation Army and organizing the supplying of Vietnamese matériel to the Laotian revolution and directly commanding the Vietnamese volunteer units operating in Sam Neua, Xiangkhouang, and Vientiane."

These actions were in violation of the obligation Ho Chi Minh's government had assumed as a participant in the 1954 Geneva Conference to refrain from any interference in the internal affairs of Laos.

https://en.wikipedia.org/wiki/North_Vietnamese_invasion_of_Laos

North Vietnam invades Laos 1958 - 1959

The Vietnamese <Communist> party's strategy was... with regard to South Vietnam... a role for the Laos Peoples Party that was supportive of North Vietnam, in addition to the LPP's role as leader of the revolution in Laos.

Hanoi's southern strategy opened the first tracks through the rugged terrain of Xépôn district in mid-1959 of what was to become the Ho Chi Minh Trail.

The Laos Crisis, 1960–1963

The first foreign policy crisis faced by President-elect John F. Kennedy was not centered in Berlin, nor in Cuba, nor in the islands off the Chinese mainland, nor in Vietnam, nor in any of the better-known hot spots of the Cold War, but in landlocked, poverty stricken Laos. This was the major issue Kennedy and his foreign policy team—Secretary of State Dean Rusk, Secretary of Defense Robert S. McNamara, and National Security Advisor McGeorge Bundy—focused on during the days leading up to Kennedy's inauguration on January 20, 1961.

Kennedy faced a choice between two unpromising strategies: pursue a military solution, very likely demanding a unilateral intervention by U.S. forces; or adapt a major shift in policy, seeking a cease-fire and a neutralization of Laos. He rejected the military option, though he encouraged an offensive by Phoumi designed to strengthen his negotiating position. It failed abjectly.

Bob Comment: In reality, there was no military option; we had no allied help; Laos was a 'bridge too far.'

Kennedy opened his press conference on March 23, 1961, with an extended discussion of Laos, calling for an end to hostilities and negotiations leading to a neutralized and independent Laos.

The Pathet Lao accepted the ceasefire offer on May 3.

This delay gave the North Vietnamese Army (NVA) the time to conduct an offensive in southern Laos, capturing the crossroad village of Tchepone and the terrain necessary to extend the Ho Chi Minh Trail to the western side of the Annamite Mountains on the border between Laos and South Vietnam.

Laotian groups reached agreement on composition of the coalition government on 12 June 1962, ...Geneva Conference... **Declaration on the Neutrality of Laos on 23 July 1962** .

The **Declaration on the Neutrality of Laos** and its associated protocols... withdrawal of all “foreign regular and irregular troops, foreign para-military formations and foreign military personnel”supervision of the International Commission for Supervision and Control in Laos (ICC), ... representatives of India, Poland, and Canada.

Agreements broke down quickly, with lasting consequences for Laos and its neighbors.

NVA conducted a symbolic withdrawal of 15 troops on August 27...on October 9 North Vietnam notified Laotian foreign ministry their troops...withdrawn in accordance with Geneva agreement.

However, North Vietnam continued its advisory, logistics, and combat in support of the Pathet Lao in violation of the accords. <Bob Comment: “ with ~6,000 troops remaining in Laos” >

The United States withdrew its military advisory teams in compliance with the Geneva agreement, but in its aftermath responded to the North Vietnamese violation by supporting Meo and Thai forces, and by providing economic and military support to the Phouma government and its army.



THE PRESIDENCY | IN-DEPTH EXHIBITS

THE TONKIN GULF

The August 1964 passage of the Tonkin Gulf resolution was a pivotal moment in the escalation of the Vietnam War

Photo: North Vietnamese torpedo boat, from the USS Maddox, August 2, 1964

VIETNAM - THE PATH TO WAR

The Gulf of Tonkin Incident

Prefabricated to Start the Vietnam War

Flawed Intelligence and the Decision for War in Vietnam



USS Maddox (DD-731)
Involved
In the Gulf of Tonkin Incident



USS Turner Joy (DD-951)
Involved
In the Gulf of Tonkin Incident

President Lyndon B. Johnson signing the Tonkin Gulf Resolution in the East Room of the White House

On Aug. 7, 1964, Congress passed the Gulf of Tonkin Resolution Authorizing the Vietnam War based on what is now widely believed to be faulty intelligence, plunging the United States into the Vietnam War

The Gulf of Tonkin incident allowed President Johnson to expand the Vietnam War through the Gulf of Tonkin Resolution without a Congressional Declaration of War

https://en.wikipedia.org/wiki/Operation_Rolling_Thunder

Operation Rolling Thunder was the title of a gradual and sustained aerial bombardment campaign conducted by the United States (U.S.) 2nd Air Division (later Seventh Air Force), U.S. Navy, and Republic of Vietnam Air Force (RVNAF) against the Democratic Republic of Vietnam (North Vietnam) from 2 March 1965 until 2 November 1968, during the Vietnam War.

Bob Comment: Rolling Thunder failed because the President chose the targets and SECDEF McNamara refused Military pleas to attack strategic targets in Hanoi and Haiphong to cripple North Vietnam's logistics push into South Vietnam. "Sustained" is Wikipedia's deception for deliberately not writing that LBJ was continually trying to "send messages" with his "bombing pauses," playing politics with the military.

Rolling Thunder was ended just days before the 1968 Presidential Election ... when Nixon beat Humphrey

Disclosure (of the secret war in Laos)

Soon after the Nixon Administration took office in 1969, the secret war in Laos—which had been under way for the past four years—became a political issue.

That summer, the Senate Foreign Relations Subcommittee on US Security Agreements and Commitments Abroad began hearings. By the end of the year, a growing list of Senators was complaining about Administration secrecy in Laos, and national newspapers had joined the fray.

“This was the culmination of a campaign extending over many months in the Senate and in the media to get at the ‘truth’ in Laos,” said Henry Kissinger in 1979. “The issue was not to obtain the facts—they were widely known—but to induce the government to confirm them publicly, which was quite a different matter.”

US involvement in Laos was publicly acknowledged for the first time in a statement by President Nixon on March 6, 1970.

I’m pretty sure that President Nixon said the US was “conducting armed reconnaissance and taking other actions in Laos,” in 1969

Barrel Roll

By John T. Correll, Air Force Magazine

Aug. 1, 2006

In early 1961, the hot spot of leading concern in Southeast Asia was not Vietnam but Laos.

“The ground war *<in Laos>* waxed and waned with the weather.

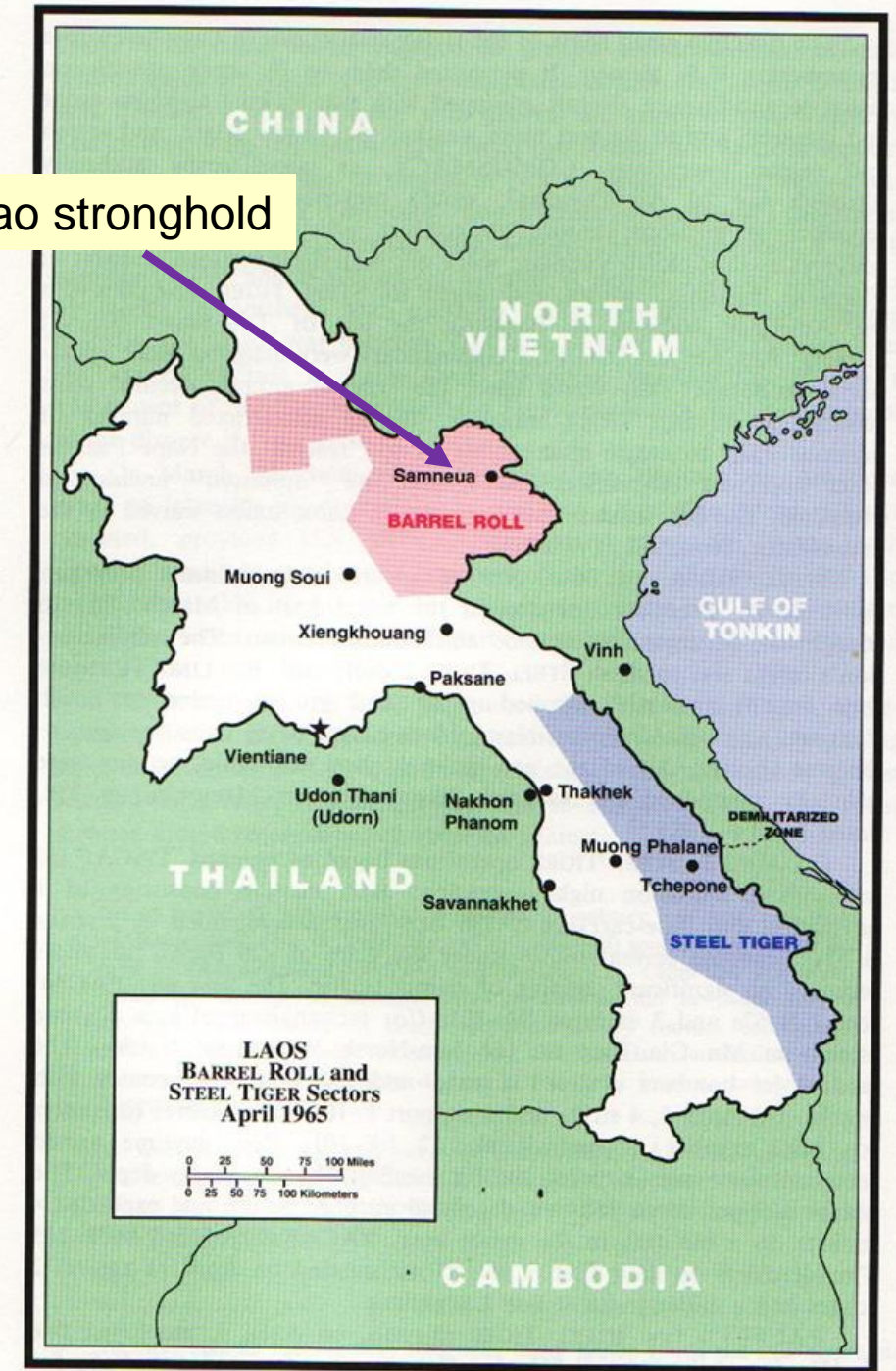
During the annual dry season, from September to May, the Pathet Lao advanced. When the wet season came, the monsoon rains turned the roads to mud. The advantage shifted to the weaker government forces, which had the advantage of air support and mobility.

Neither side was strong enough to decisively defeat the other.”

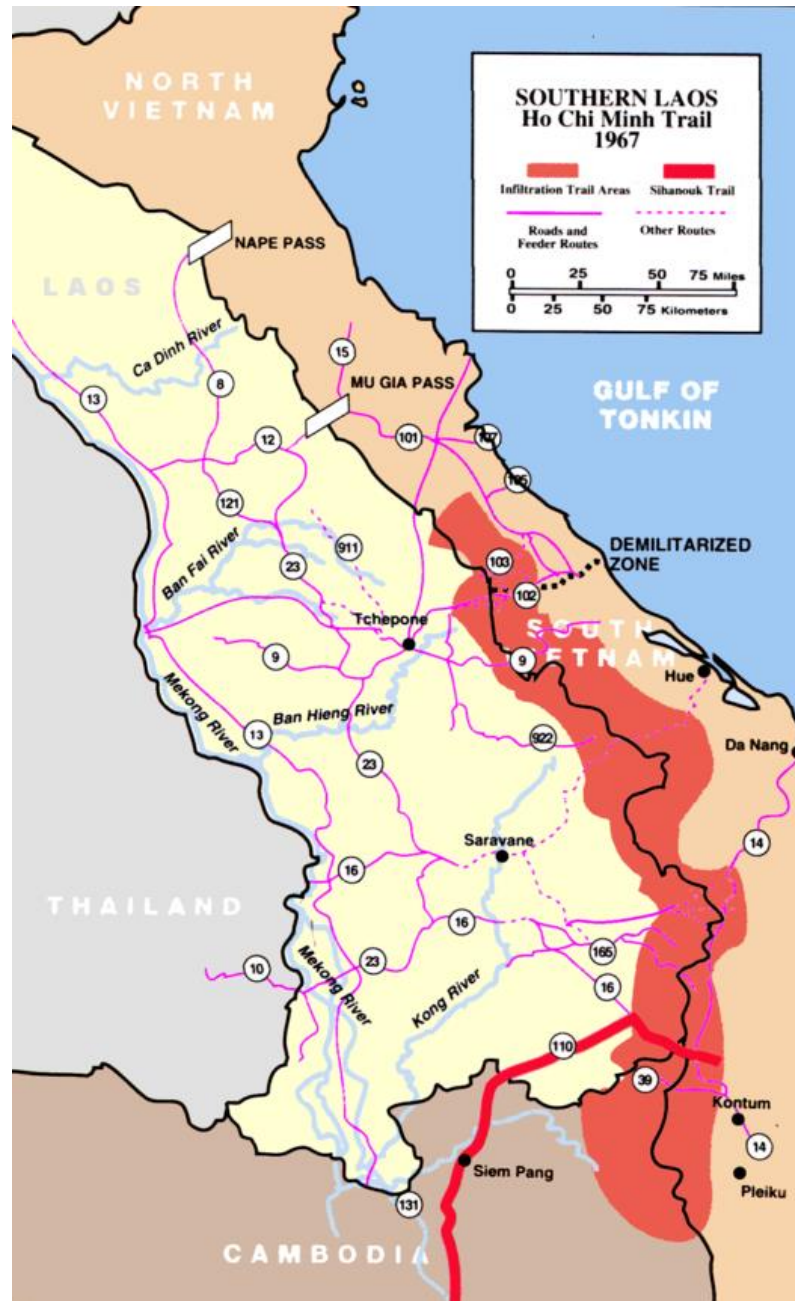
<https://www.airforcemag.com/article/0806roll/>



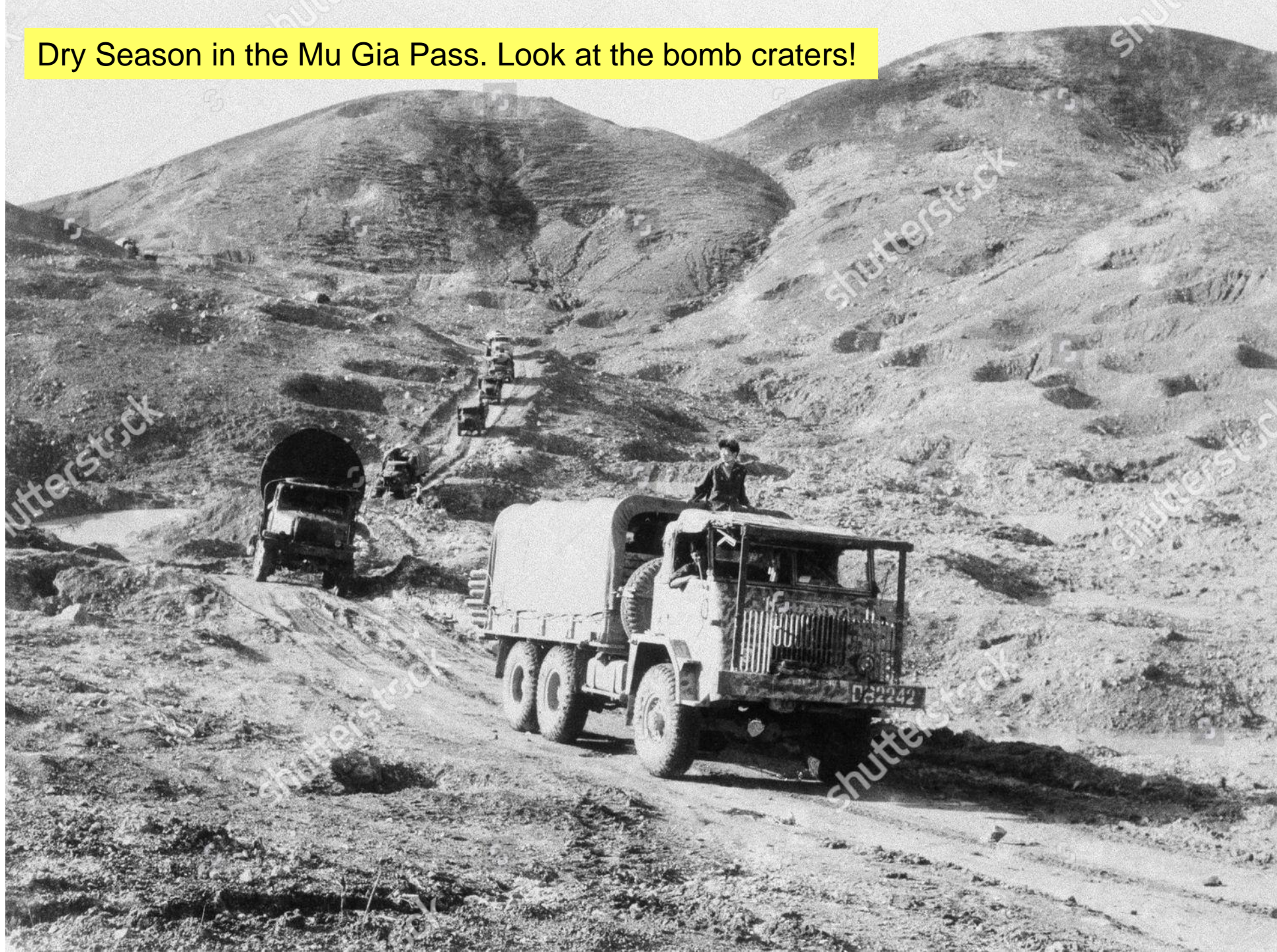
Pathet Lao stronghold







Dry Season in the Mu Gia Pass. Look at the bomb craters!



Wet Season along the Ho Chi Minh Trail. The trucks are carrying tree limbs for camouflage.



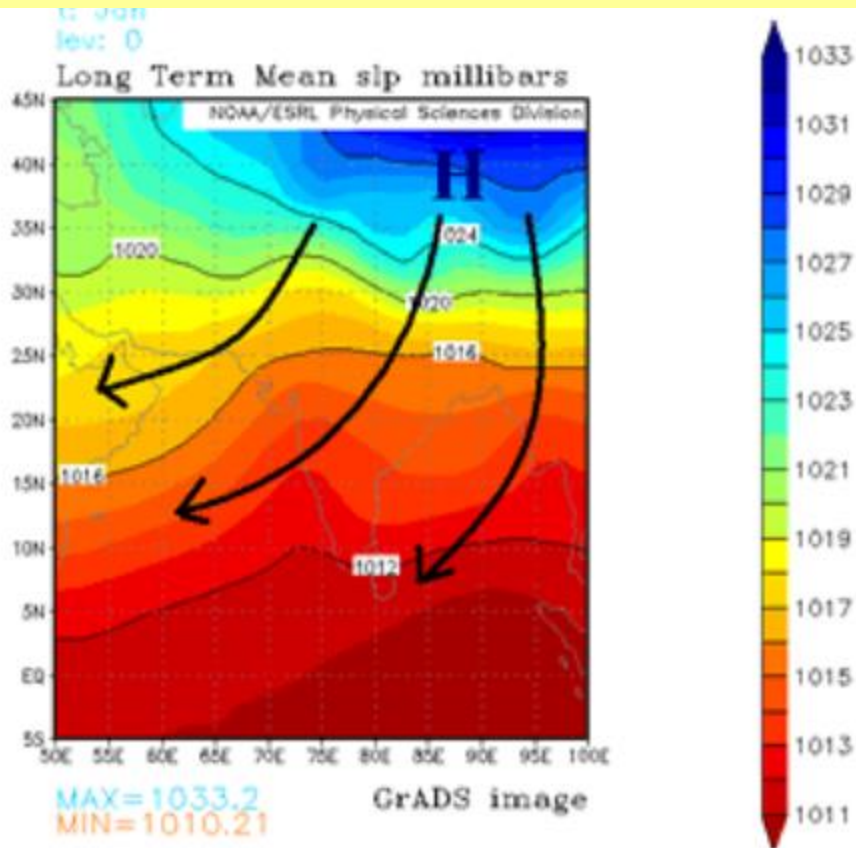
450 × 300

Climatology and the Monsoons

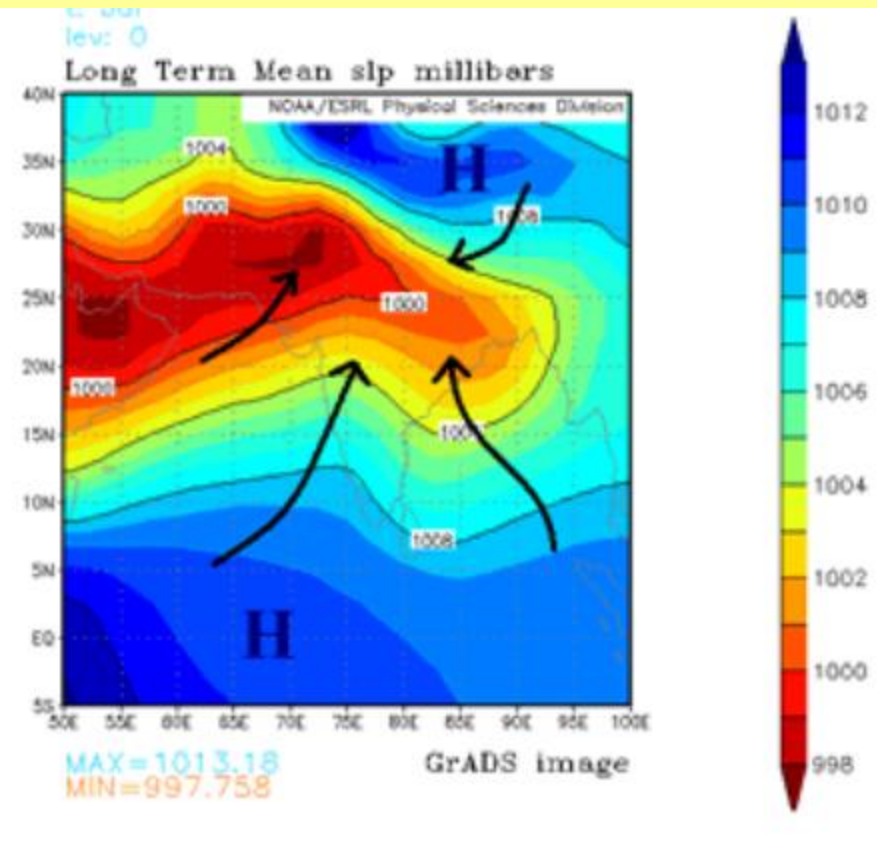
Classic definition of “monsoon” from Arabic, meaning “season,” or “seasonal wind” at the surface.

WINTER : Cold High Pressure over Asia

SUMMER: Land Heating => Low pressure over Asia:



Graphic 1: Mean sea level pressure and near surface flow over India, January (dry season)



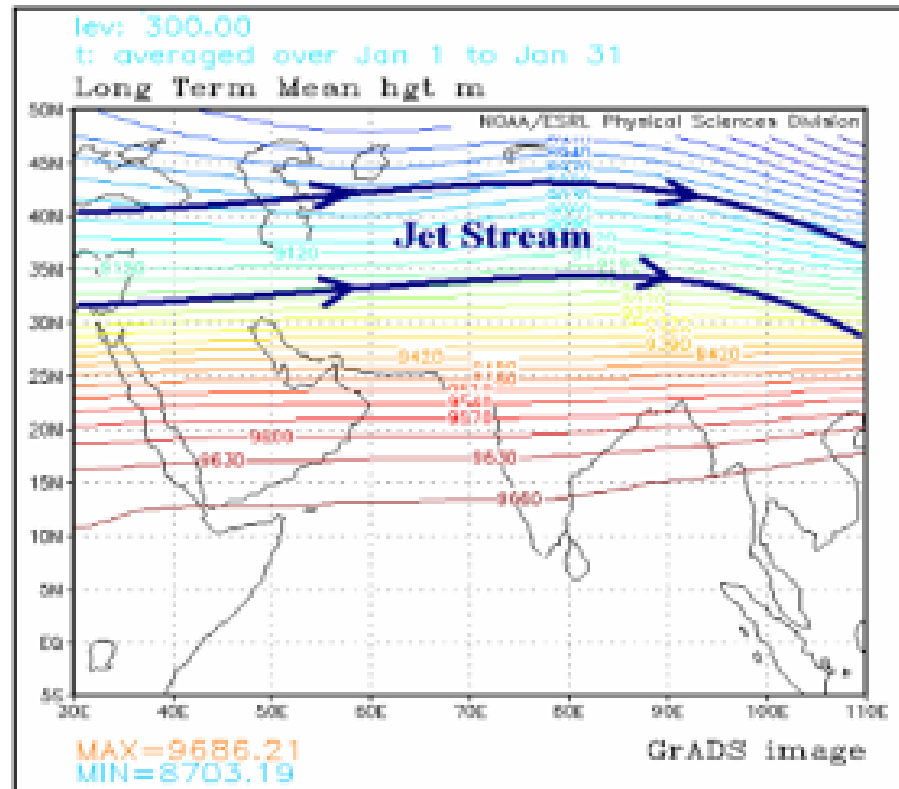
Graphic 2: Mean sea level pressure and near surface flow over India, July (monsoon season)

Classic definition of “monsoon” from Arabic, meaning “season” or “seasonal wind” in the upper air.

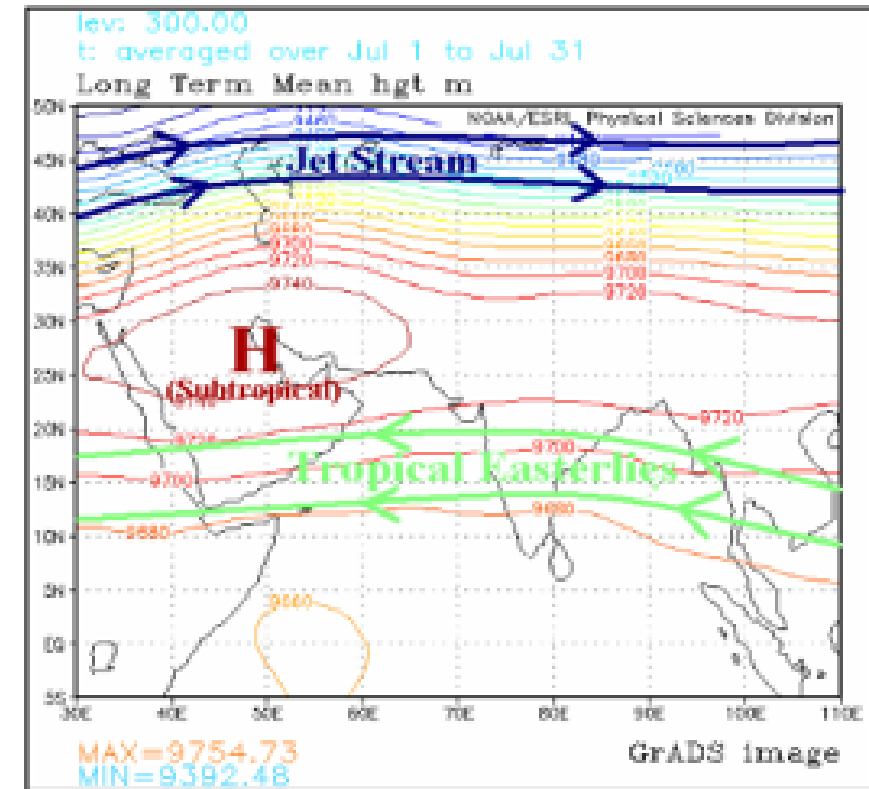
WINTER: Jet Stream over Asia
Westerly winds dominate

Bay of Bengal

SUMMER: Subtropical Ridge moves over SWA
Jet Stream has migrated to north; weakened.
Easterly winds (Green) dominate SEA, India,
Vietnam, Arabian Sea



Graphic 3: 300mb (jet stream level) flow over south Asia, January (winter)



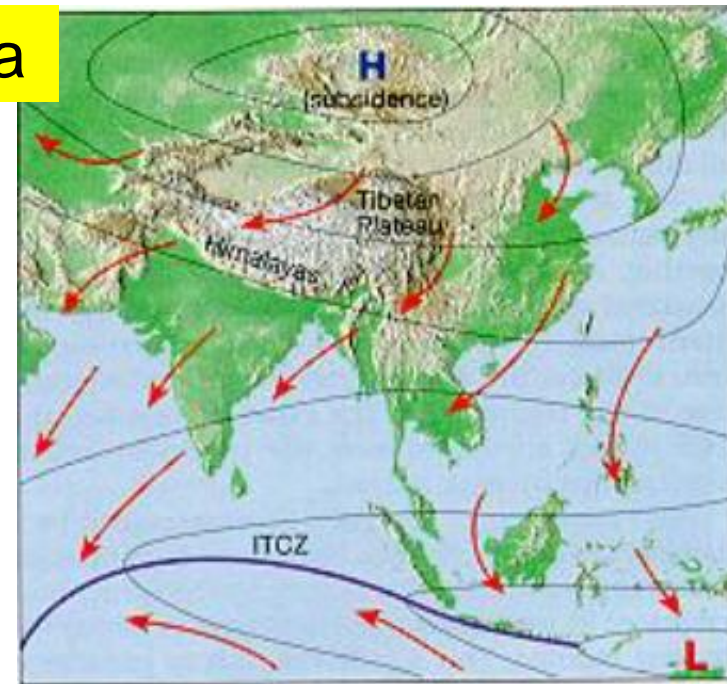
Graphic 4: 300mb (jet stream level) flow over south Asia, July (monsoon season)

Surface Circulation Patterns in Southeast Asia

Top: Winter Monsoon.

Huge High Pressure over Asia

Called the Northeast Monsoon in Vietnam, winds from the Northeast.

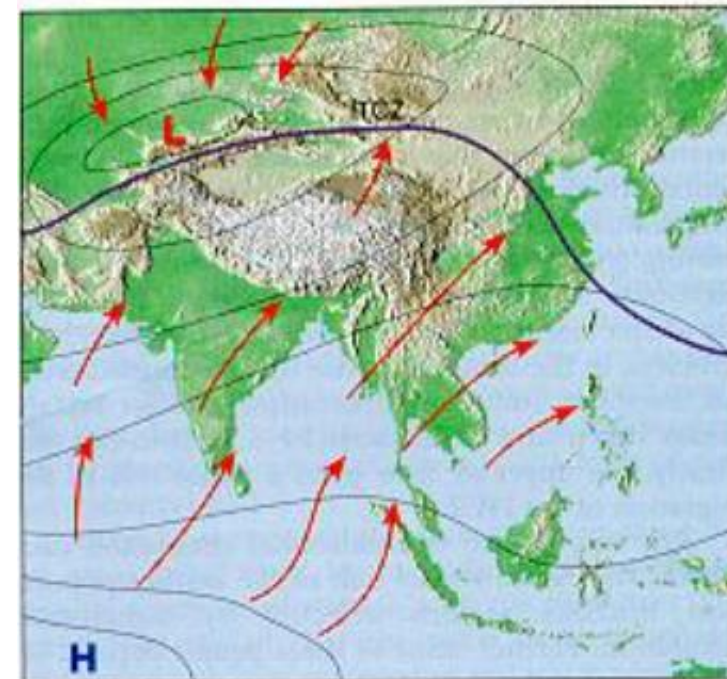


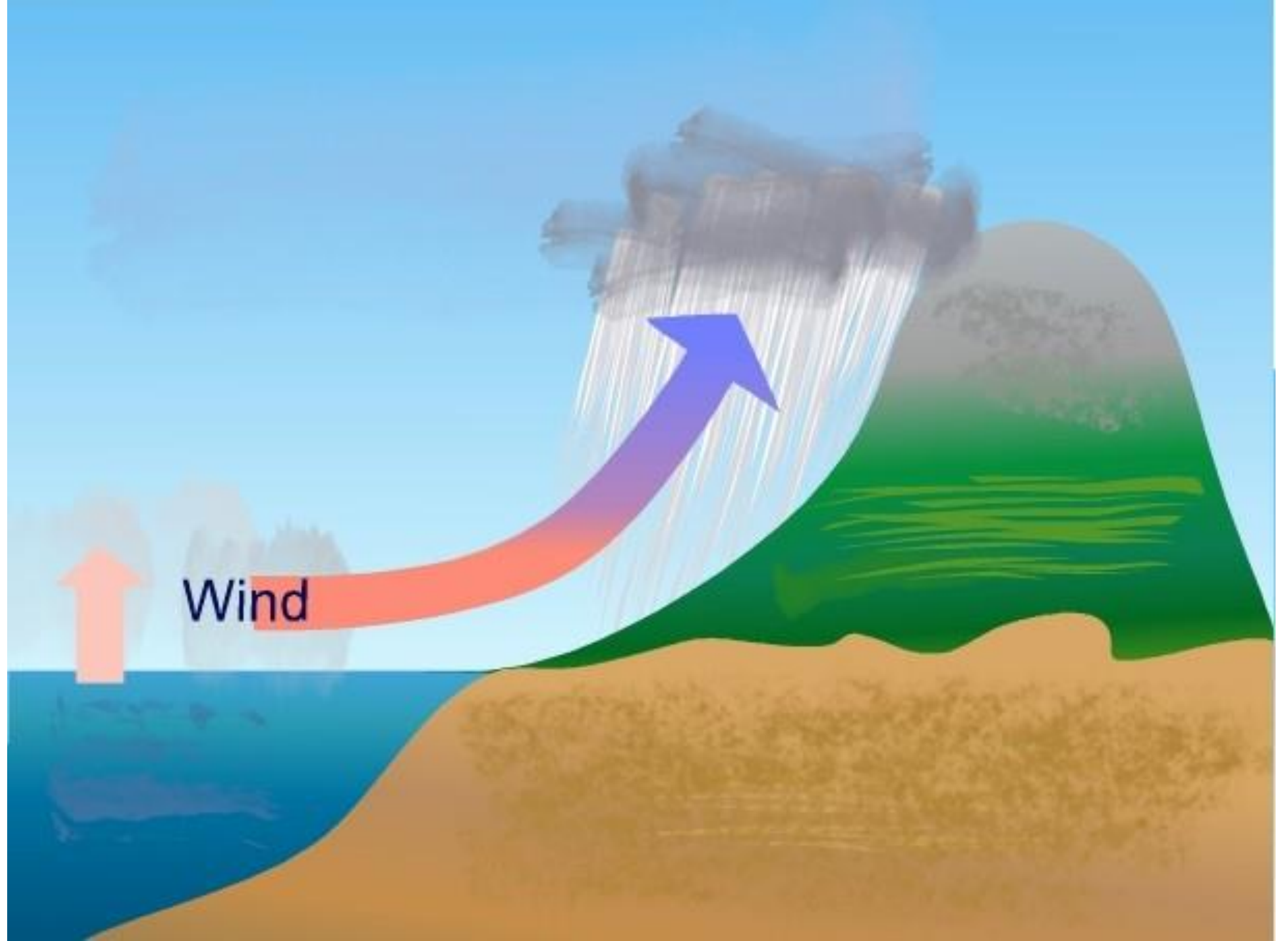
(a) Winter monsoon

Bottom: Summer Monsoon

Low and heat Low over Asia

Called the Southwest Monsoon in Vietnam, because winds are from the Southwest.





Udorn Thailand during
the Northeast Monsoon.

Slash-and-burn Agriculture
dominates rural areas.

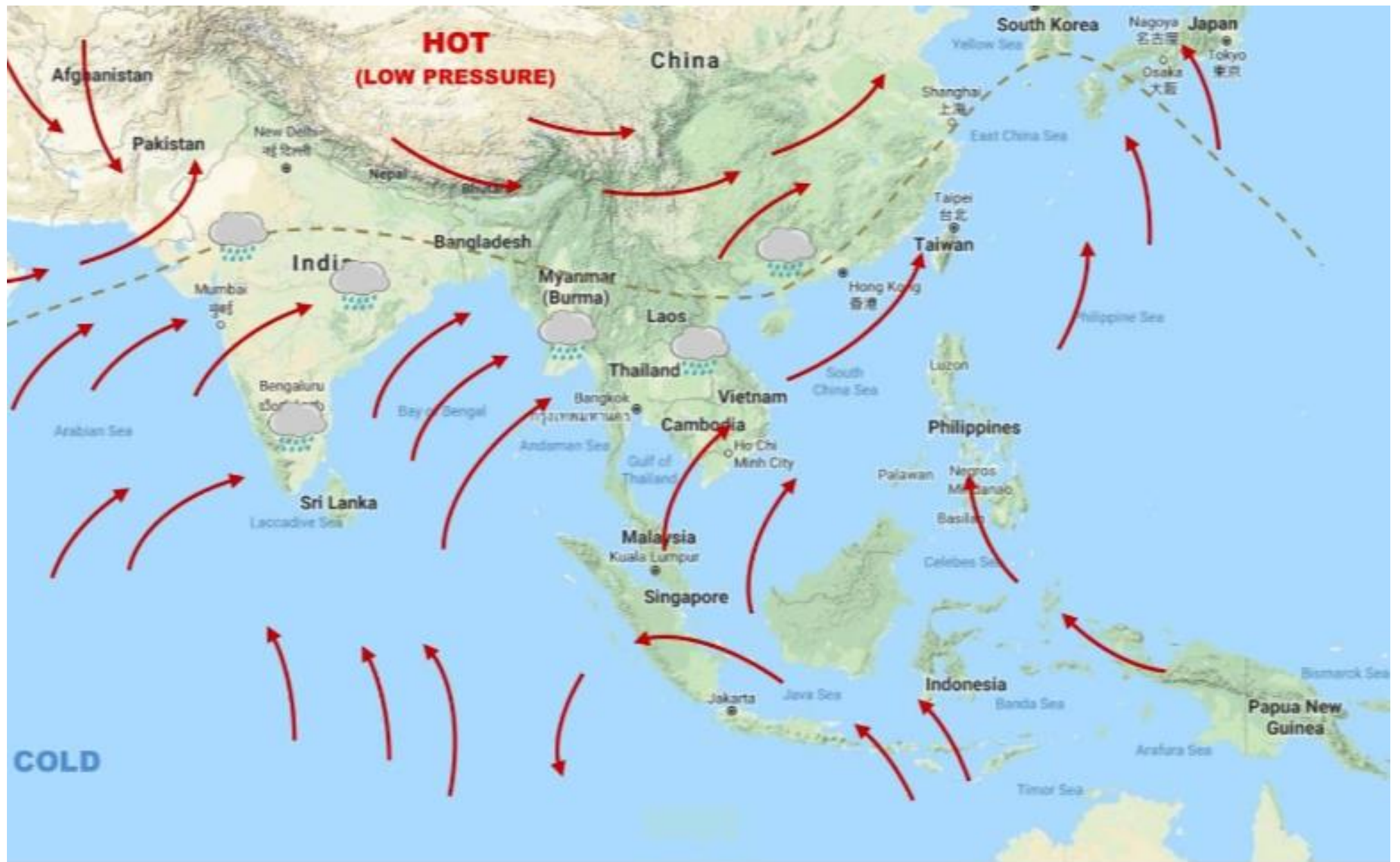
Previous year's crops
are cut, allowed to dry,
then burned, "poor man's
fertilizer."

Smoke accumulates
under sustained high
pressure.

There is no precipitation
to scrub the smoke and dust

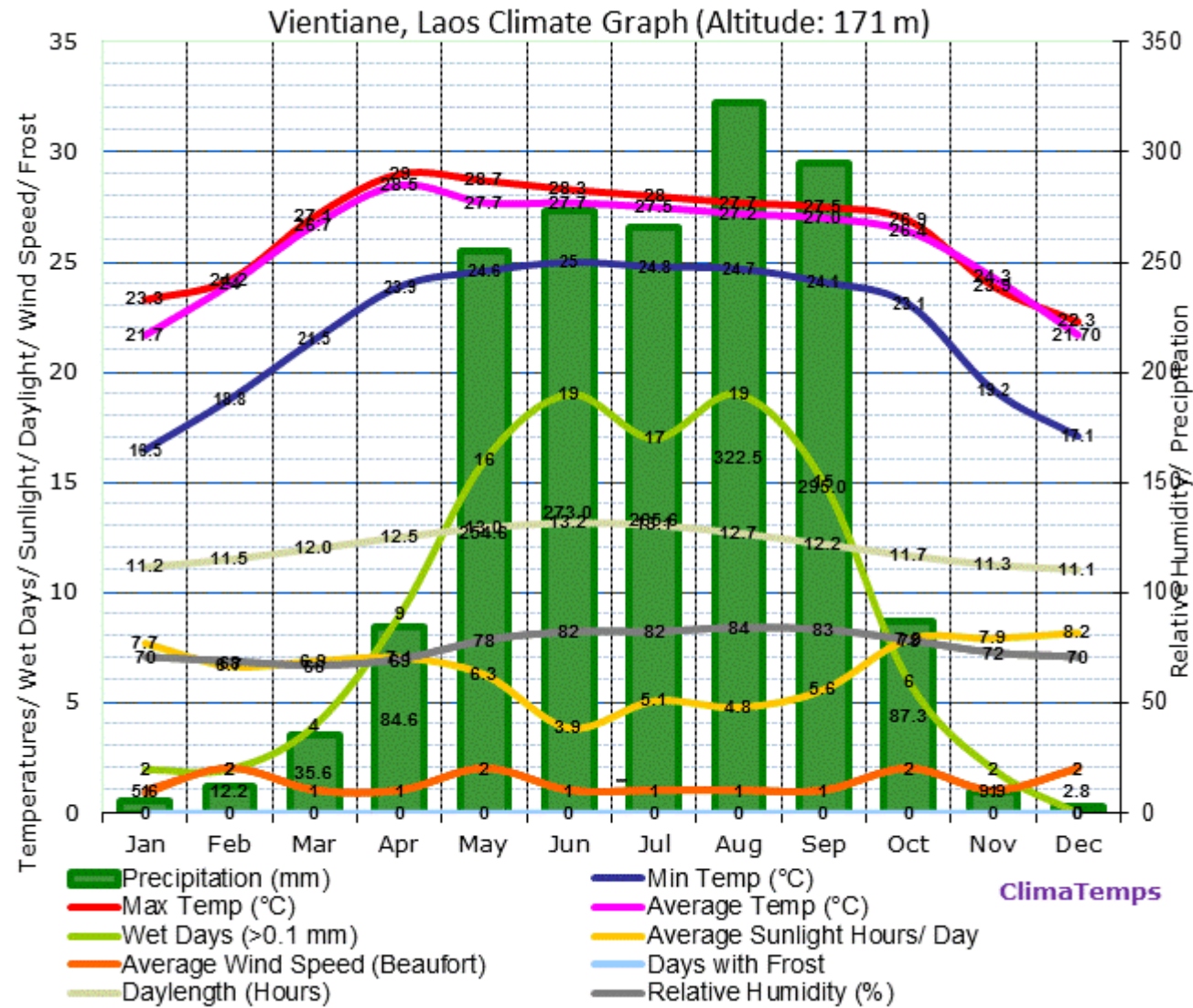
It is like flying in chocolate
milk.



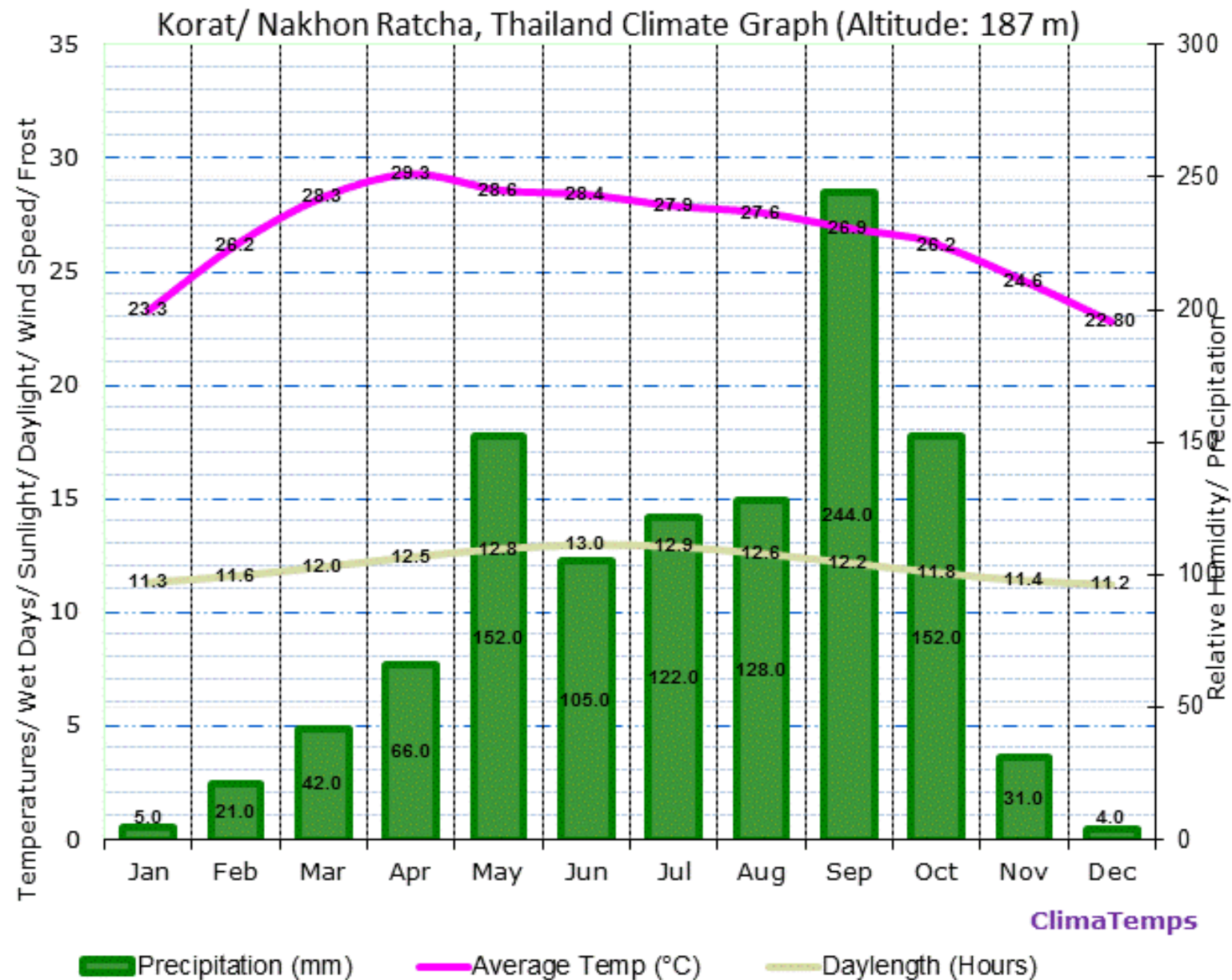


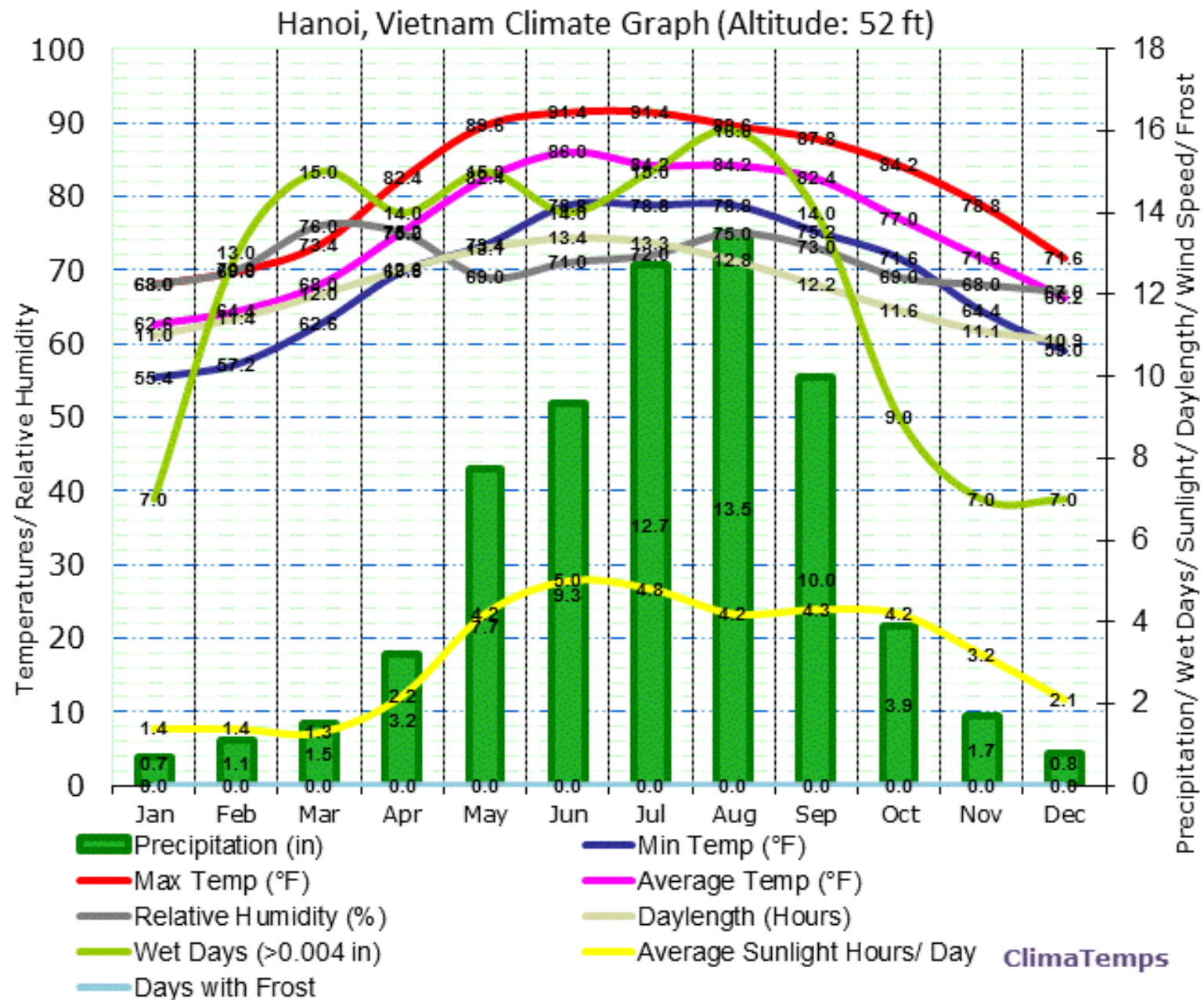
SUMMER, WET MONSOON

Note the pronounced wet season, May through September, the southwest monsoon.

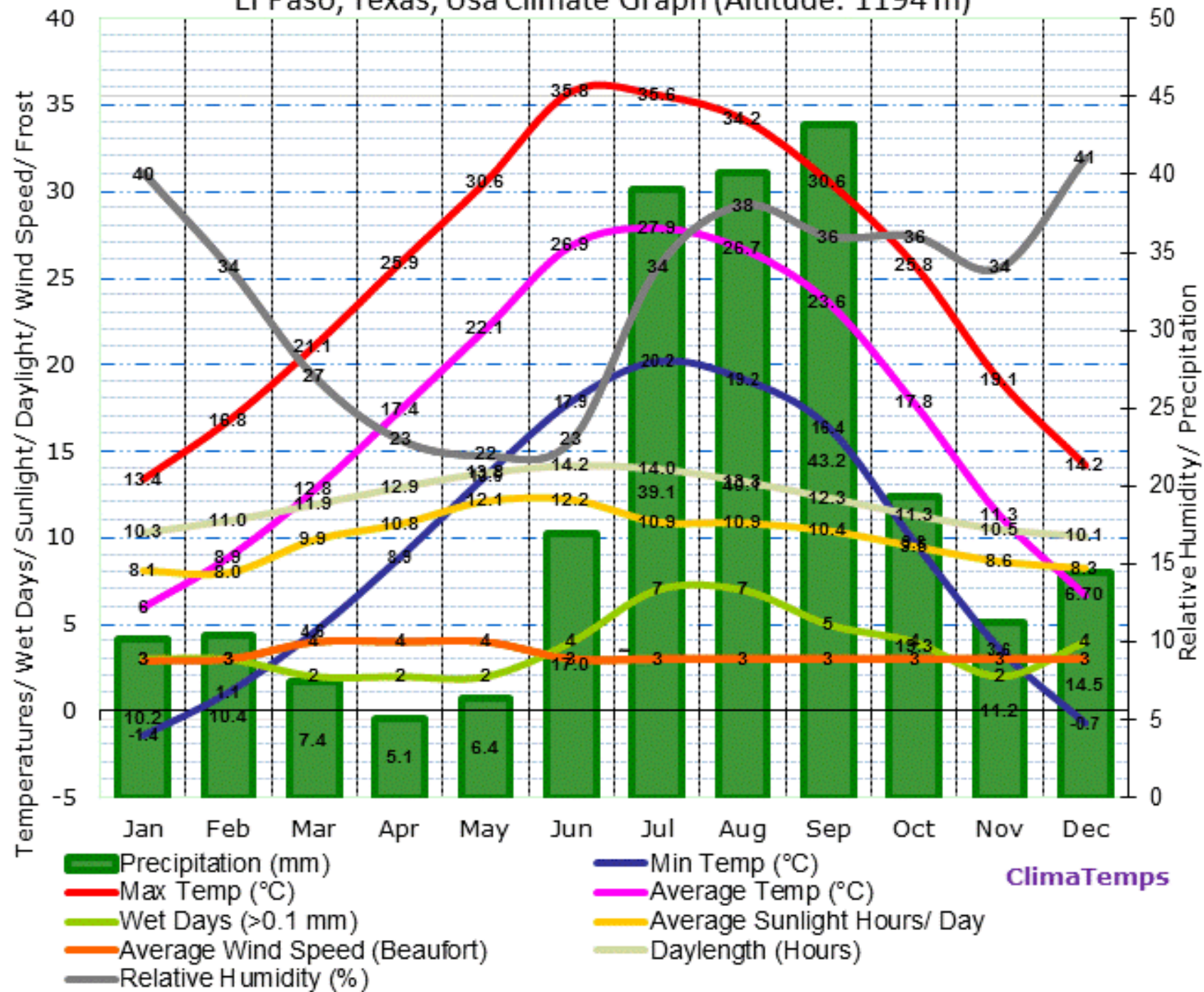


Hottest temperatures are in April, before the winds shift and bring moisture-laden air from the Gulf of Thailand



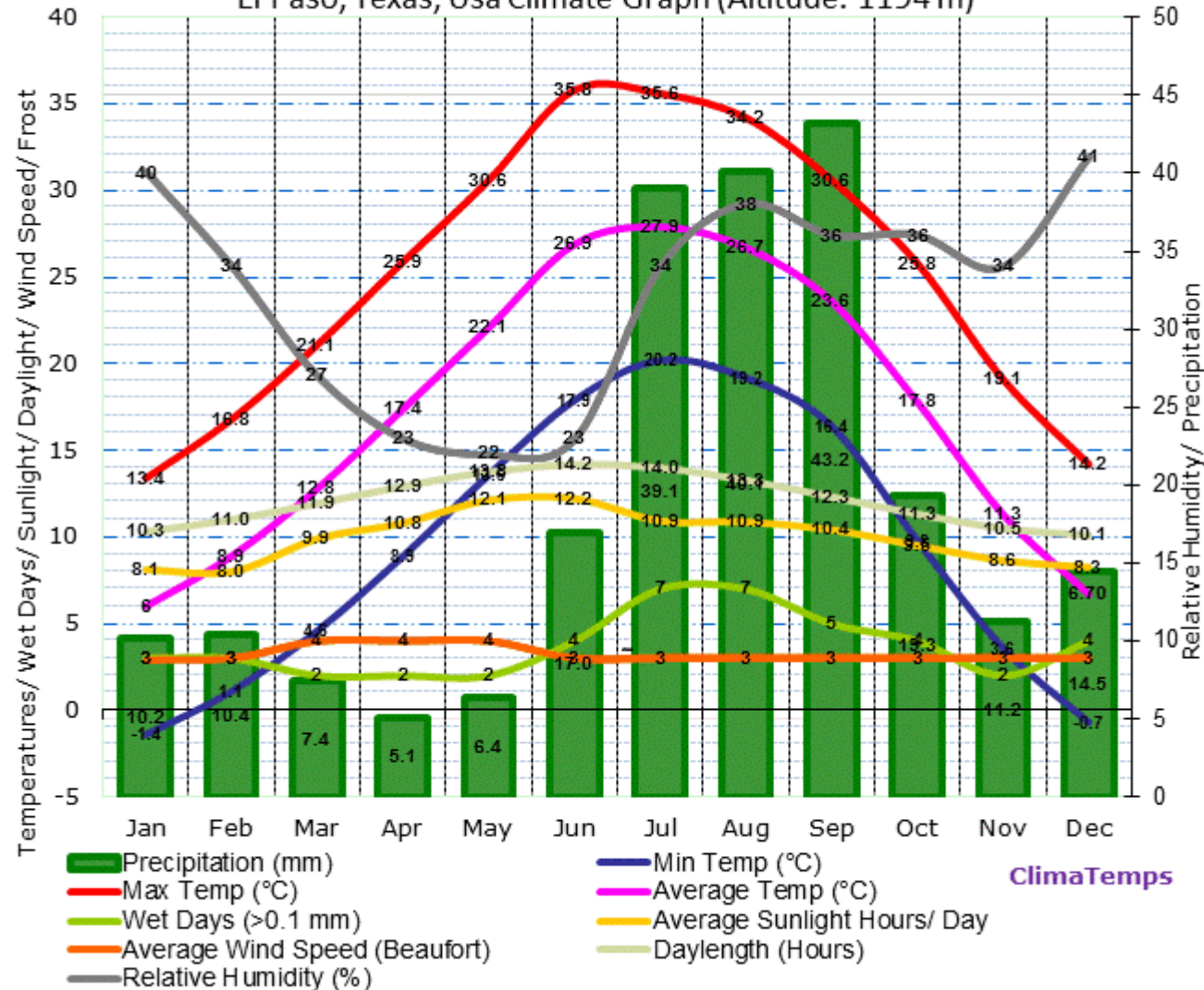


El Paso, Texas, Usa Climate Graph (Altitude: 1194 m)

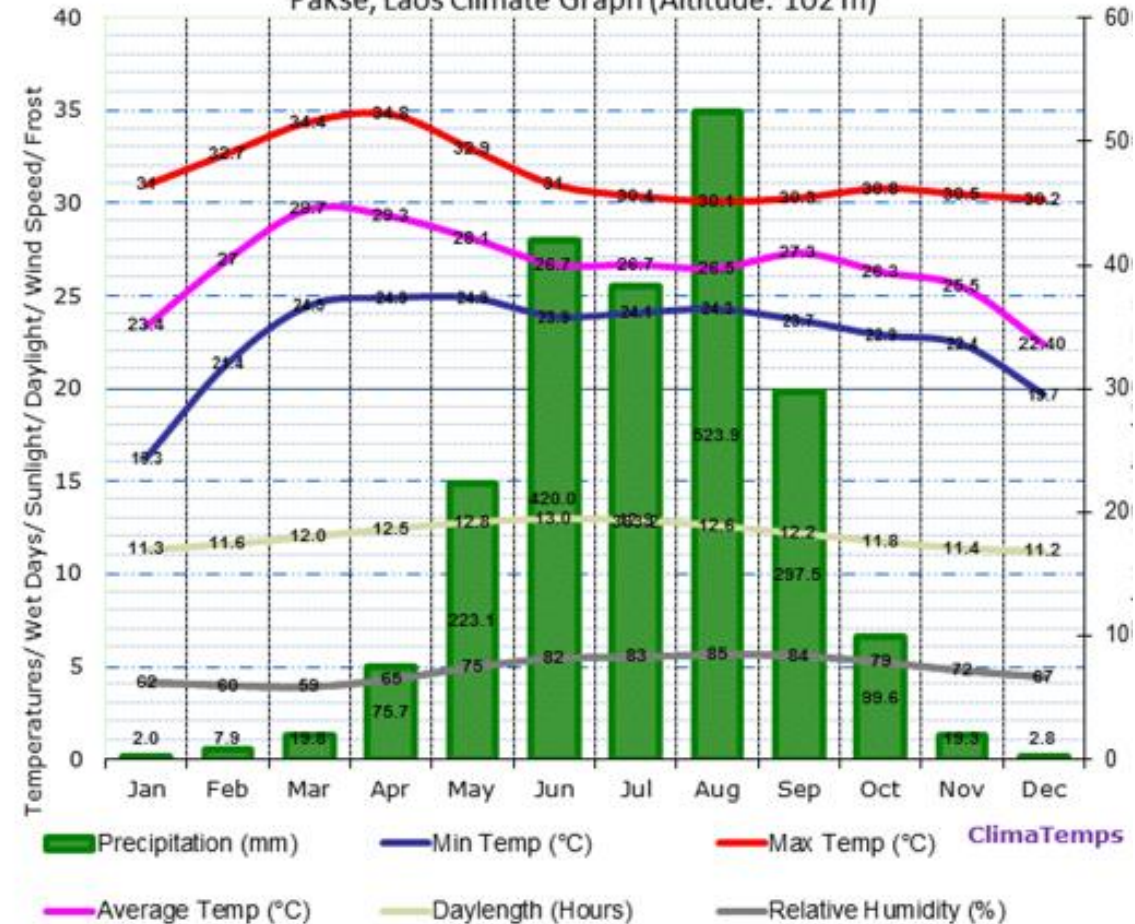


Both have a summer warm and wet season. We have a “winter wet” season, but this does not happen in Laos

El Paso, Texas, Usa Climate Graph (Altitude: 1194 m)



Pakse, Laos Climate Graph (Altitude: 102 m)





Western Ghats, Maharashtra on 28 May in dry season



Western Ghats, Maharashtra on 28 August in rainy season



Cloud Physics and Cloud Seeding

Cloud Physics Basics

Observations in the atmosphere and in the laboratory show cloud water droplets remain unfrozen at temperatures well below freezing, down to -40 Degrees in clean air.

....called supercooled droplets

The phrase “supercooled liquid water” coined to refer to the presence of such water droplets in a cloud.

For water droplets to freeze at temperatures between 30.2F (-1C) and -38.2F (-39C) they must contact a foreign particle to cause freezing

These particles are called freezing nuclei.

Cloud Physics - Freezing Nuclei



Snowflakes have hexagonal crystal form.

Aerosols of hexagonal crystal form become freezing nuclei and help convert supercooled water droplets and drops into snowflakes.

Silver Iodide has a hexagonal crystal form, and so is an effective nucleus to initiate freezing of supercooled droplets into snowflakes.

“Smokes” of silver iodide contain millions of silver iodide crystals, which, when introduced into supercooled droplet clouds, become freezing nuclei.

Our WC-130As and RF-4Cs flew directly into towering cumulus clouds and ejected flares spewing Silver Iodide smoke directly into the cloud towers.

Latent Heat

<https://www.britannica.com/science/latent-heat>



Melting Ice Cubes

Ice cubes melting as heat is added...during melting, the ice absorbs latent heat, which changes the state of the water from ice to liquid water.

While the ice is absorbing latent heat, its temperature does not change from 0°C

Latent Heat



Latent heat arises from the work required to overcome the forces that hold atoms or molecules in a material together. The regular structure of a crystalline solid is maintained by forces of attraction among its individual atoms, which oscillate slightly about their average positions in the crystal lattice.

As the temperature increases, these motions become increasingly violent until, at the melting point, the attractive forces are no longer sufficient to maintain the stability of the crystal lattice.

However, additional heat (the latent heat of fusion) must be added (at constant temperature) in order to accomplish the transition to the even more-disordered liquid state, in which the individual particles are no longer held in fixed lattice positions but are free to move about through the liquid.

Latent Heat of Fusion (adapted from Britannica)

<https://www.britannica.com/science/latent-heat>

Melting of this mass of solid requires the addition (to the ice phase of this water substance) of a characteristic amount of heat, **the latent heat of fusion** (to melt the ice or snow). For water, this latent heat is about 80 calories per gram of water.

In the reverse process, the freezing of the liquid (supercooled water droplets) to form the solid, **the same quantity of heat is given off by the forming snow crystals.**

When snow forms, this heat gives buoyancy to the clouds.



In the atmosphere, the vapor pressure difference between water droplets and nascent snow crystals gives impetus to rapid snow crystal growth. Snow grows rapidly at the expense of supercooled droplets, giving off the latent heat of fusion and adding buoyancy to the clouds.

Sidebar on Supercooled Liquid Water—Icing formation on Aircraft

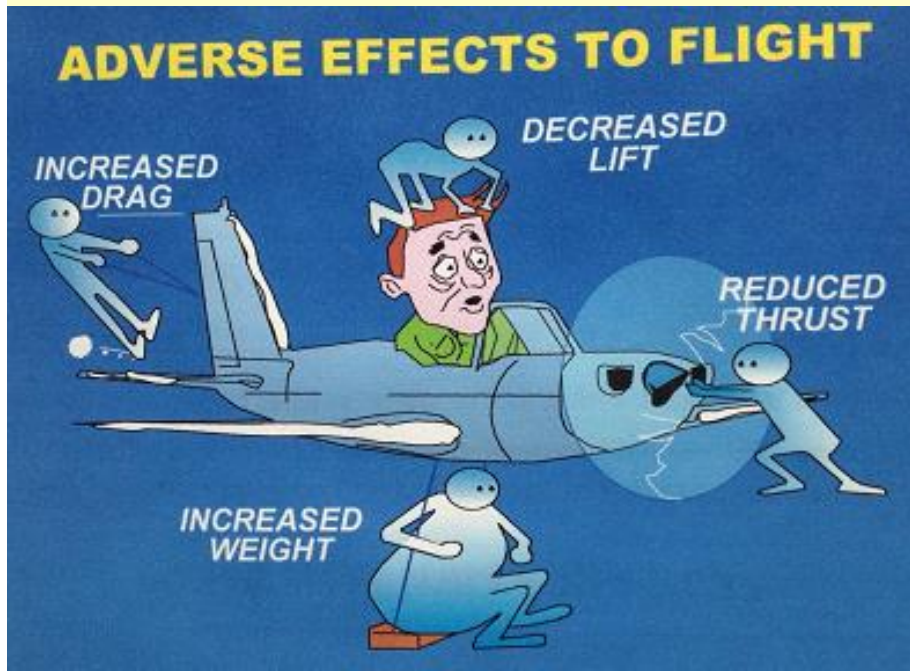
Applied Cloud Physics-- Aircraft Icing

As air rises, it cools dry adiabatically...losing the ability to keep water in the vapor phase... water vapor in the air cools also....and condenses into supercooled droplets in the rising air.

Depending on the “synoptic” weather conditions, the rising air might be widespread, with widespread cloudiness, and large numbers of supercooled droplets.

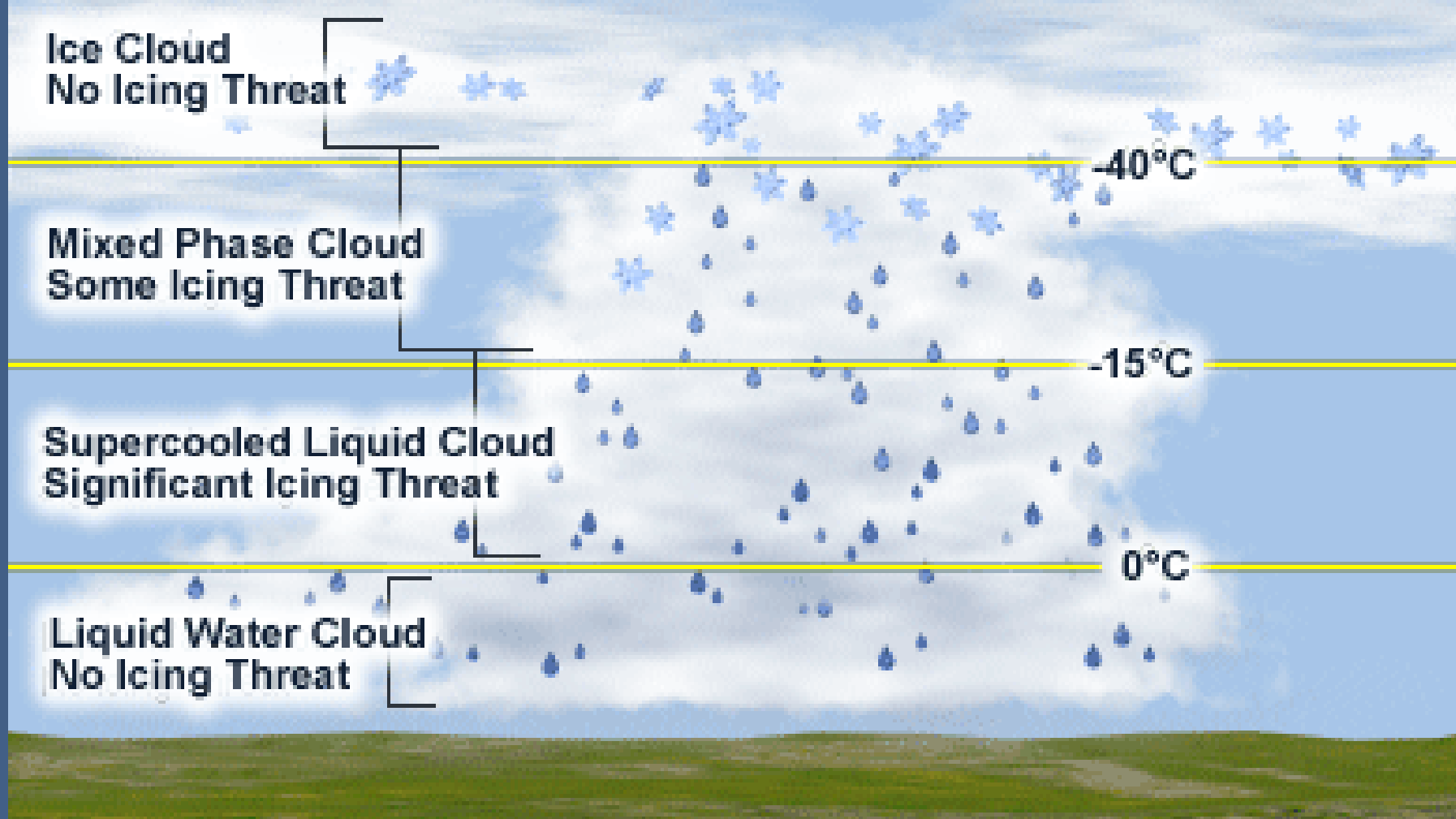
Aircraft flying in such conditions will encounter inlet icing, airframe icing, and propeller icing.

If there are no or insufficient anti-icing equipment, the pilot must promptly get the aircraft out of this situation or risk losing control of the aircraft



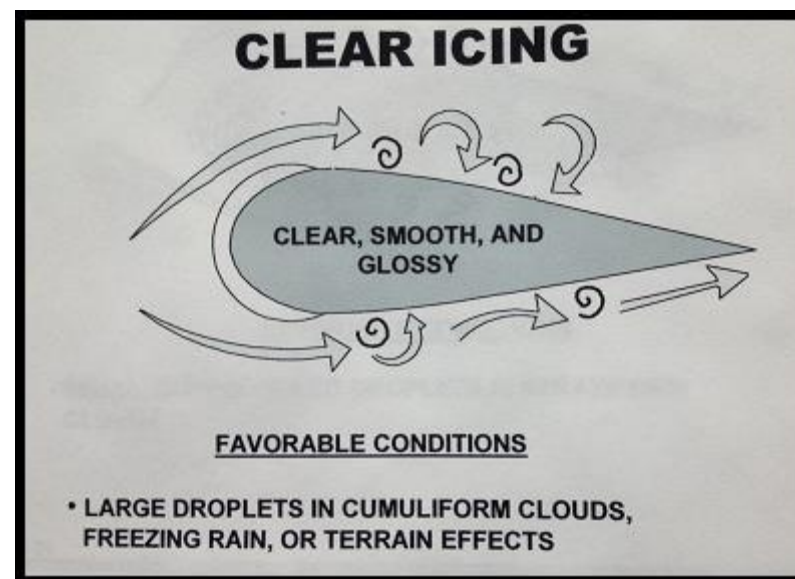
Idealized Cloud Phase and Potential Icing Threat

The COMET Program

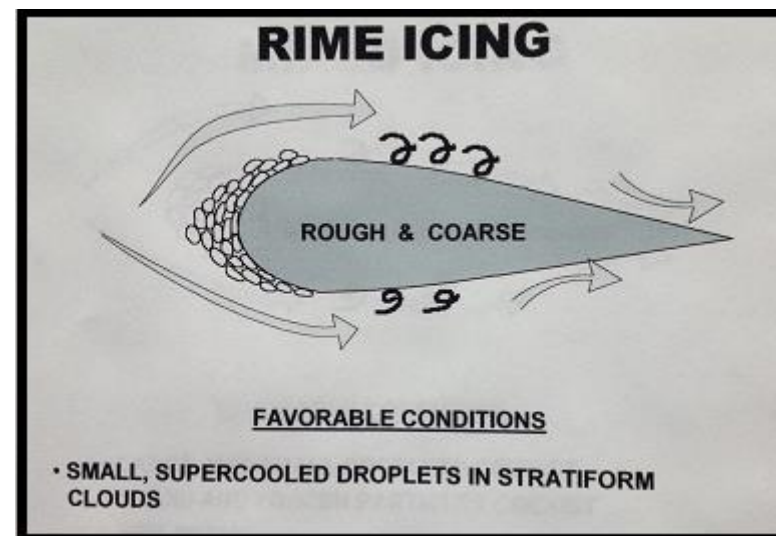




Clear Ice



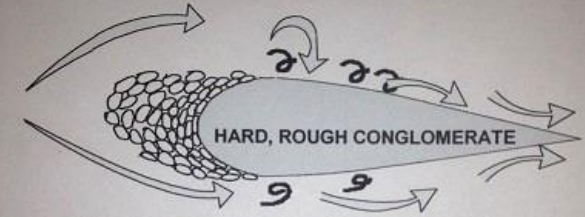
Rime Ice



Mixed Ice Formation on Wing Leading Edge



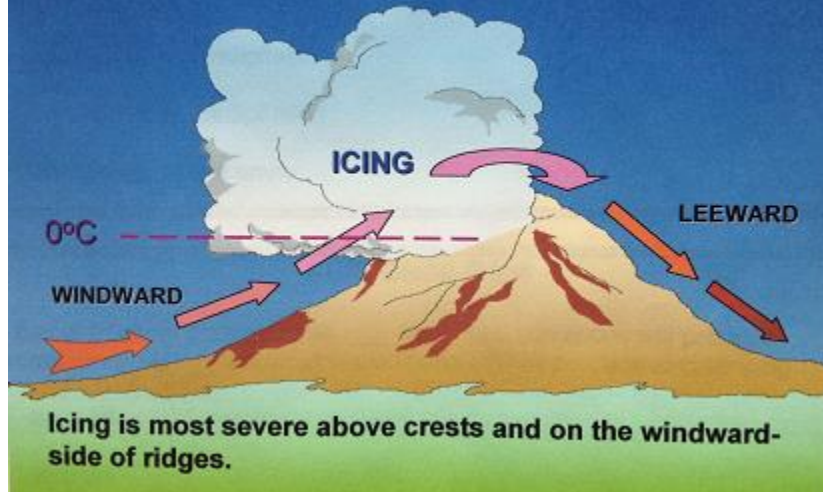
MIXED ICING



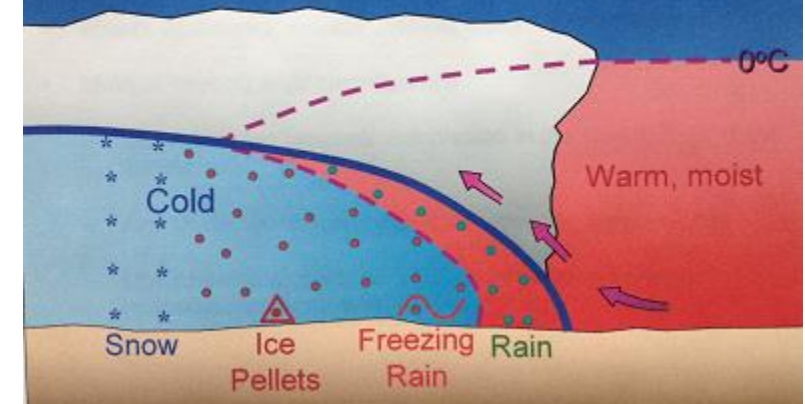
FAVORABLE CONDITIONS

- LARGE AND SMALL DROPLETS COEXIST
- LIQUID AND FROZEN PARTICLES COEXIST
- WET SNOW

ICING WITH UPSLOPE FLOW



ICING WITH FRONTS



End Sidebar on aircraft icing

History of Cloud Seeding...and it's use in the Vietnam War

History of Cloud Seeding...and it's use in the Vietnam War

Cloud Seeding--Wild Speculation Phase 1946-1958

--Serious Science Phase 1958-1980

Dep't of Commerce and DOD cooperate in developing operational cloud seeding which culminates in numerous STORMFURY successes by 1965

Cloud Seeding in Vietnam approved by LBJ after Rolling Thunder disappointments
Operation **Popeye** Risk Reduction experiment, Philippines? Laos? 1966

Operation **Compatriot/Intermediary** 1967-1972 Ho Chi Minh Trail



Compromised in Jack Anderson Column 1971

Seymour Hersh New York Times 4 July 1972

“Outrage” in the Press/Senate; Senate hearings 1972

Story remains muddled even today (Gizmodo, Wikipedia)

Cloud Seeding History from Newspapers

Cloud Seeding History beginning in 1946

Graphics from:

<https://weathermodificationhistory.com/newspapers/>

1946-1958: Period of Wild Speculation and Sensationalism

Even later, the speculation continued and was un-skeptically reported upon.

Charlatans abounded.

Public became skeptical.

Dr Irving Langmuir

Vincent J Schaefer

One hot and humid 14 July 1946, Vincent J. Schaefer wanted to try a few experiments at GE's Schenectady Research Lab

He was dismayed to find that the deep freezer was not cold enough to produce a "cloud" using breath air.

He decided to move the process along by adding a chunk of dry ice to lower the temperature of his experimental chamber.

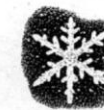
To his astonishment, as soon as he breathed into the deep freezer, he noted a bluish haze, followed by an eye-popping display of millions of microscopic ice crystals, reflecting the strong light rays from the lamp illuminating a cross-section of the chamber.

He instantly realized that he had discovered a way to change super-cooled water into ice crystals. The experiment was easily replicated, and he explored the temperature to establish the -40°C limit for liquid water.



Vince Schaefer, with Dr. Irving Langmuir (left), makes snow in his laboratory cold-chamber.

What it takes to make a G-E scientist



Vincent J. Schaefer is the man who discovered how to seed supercooled clouds with dry ice and make them produce snow and rain . . . who has developed a number of meteorological instruments, including a "cloud meter" which automatically measures the amounts of water in a cloud . . . who, during the war, helped develop smoke generators, gas-mask filters, submarine detectors.

By any standards, he ranks as a true scientist. But if you have formed stereotyped ideas of what it takes to rise to the top in a scientific organization like that of General Electric—if you think the chances are good of capable men becoming "lost" here—consider Vince Schaefer more closely.

He had to end his formal education and go to work

after two years in high school.

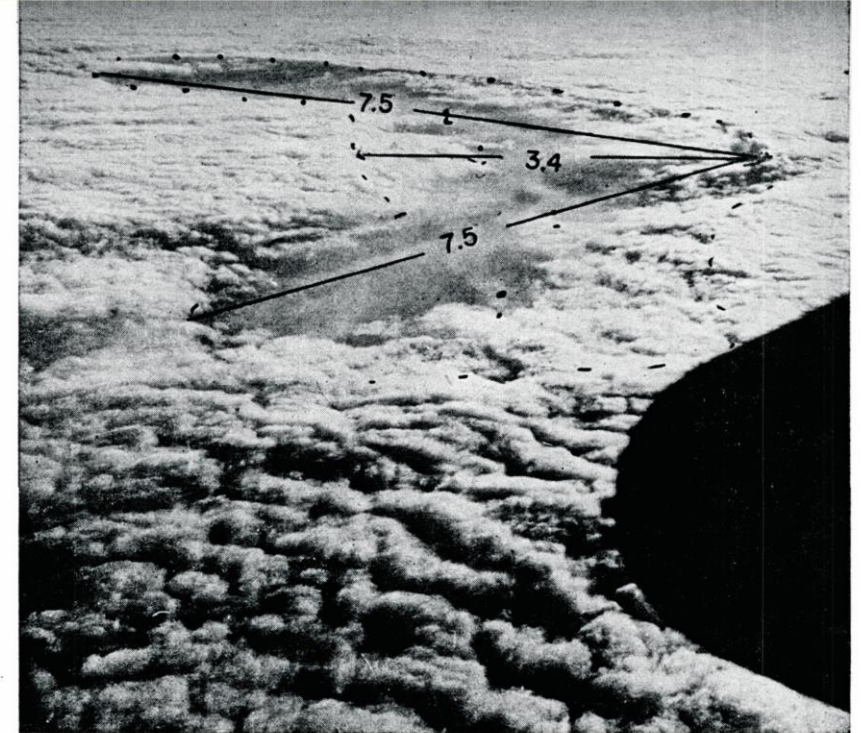
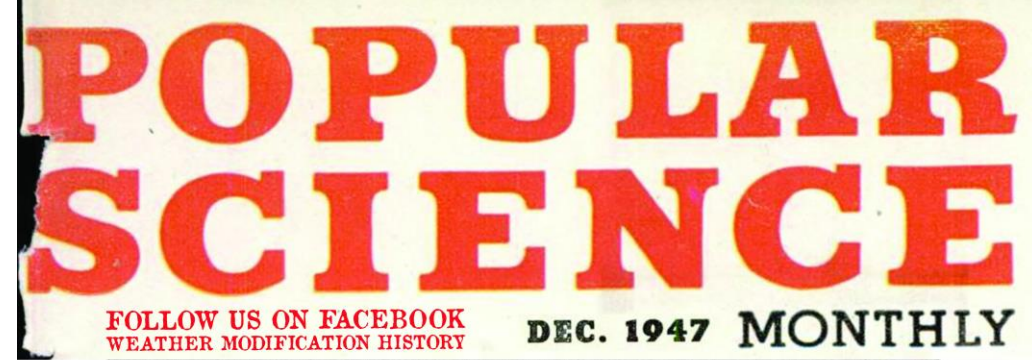
His first General Electric job was as a drill-press operator. When he first got into the G-E Research Laboratory, it was as a machinist.

But he had the scientist's intense curiosity, the desire to pierce beneath the easy surfaces of knowledge, the imagination to conceive new approaches to nature's mysteries. General Electric men like Dr. Irving Langmuir, associate director of the Laboratory and a Nobel Prize winner, recognized these qualities and saw to it that he got his chance.

Stories like this of Vincent Schaefer are possible where emphasis on research and incentives for creative thinking are the tradition. By "finding" men of high caliber, General Electric stays in the forefront of scientific and engineering development.

The first attempt to modify natural clouds in the field through "cloud seeding" began during a flight that began in upstate New York on 13 November 1946.

Schaefer was able to cause snow to fall near Mount Greylock in western Massachusetts, after he dumped six pounds of dry ice into the target cloud from a plane after a 60-mile easterly chase from the Schenectady County Airport.



Chopping a hole in a cloud. A few pounds of dry ice were enough to clear this rift in an ice-forming cloud. It is 15 miles long and three miles wide—twice the size of Manhattan Island. An airplane can drop into the opening without collecting ice on its wings or control surfaces.

“Sanding Roads” for Planes

SCIENCE'S snow makers are crossing ice off the list of flying dangers by removing the supercooled clouds that cause the ice to form on wings and control surfaces. They “sand” the clouds with ordinary dry ice—and in 15 minutes there is a hole big enough for a plane to land through.

Capt. Clarence N. Chamberlain, Jr., pilot

rain to drought-struck areas in Illinois and Arizona, and Dr. Langmuir believes it can be adapted to change the entire winter climate of large sections of the country. It may also prevent costly hailstorms.

Schaefer is now working on a gun to shoot dry-ice bullets straight ahead from the nose of an airplane flying inside an ice-forming

1950--
Wild Speculation and
Sensationalism of the time

The Horsham Times

(WITH WHICH IS INCORPORATED "THE WIMMERA STAR")

THE OLDEST ESTABLISHED AND LEADING JOURNAL IN THE VAST WIMMERA TERRITORY
CIRCULATING THROUGHOUT THE WIMMERA AND WESTERN DISTRICT

TWELVE PAGES

HORSHAM, FRIDAY, MARCH 31, 1950

Printed at the General Post Office, Melbourne.
For transmission by post as a newspaper.

Planes Control Weather

Meteorologists in the United States are experimenting with cloud-seeding techniques to prevent violent storms that can cause severe damage.

Success of these artificial weather controls, says Dr. Vincent J. Schaefer, noted U.S. scientist, may some day be of great value in the conservation of the world's natural resources.

Planes "seed" clouds by dispensing into them such materials as dry ice, silver iodine, or or-

dinary water. Continuous seeding can cause an entire cloud, or a large part of it, to dissipate, says Dr. Schaefer, who is a pioneer in the search for artificial rain-producing methods.

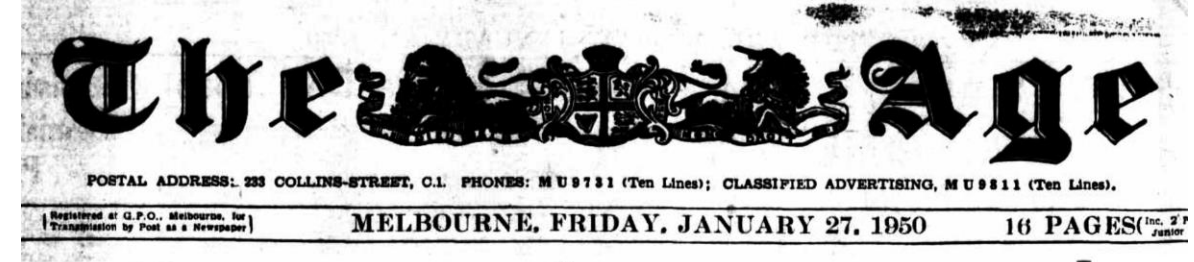
Dr. Schaefer points out that by using this technique scientists may help prevent loss of timber caused by fires started by lightning; devastation resulting from high winds; the bruising and smashing of fruit and vegetables by hail; and muddied streams and eroded farm lands left by torrential rains.

**FOLLOW US ON FACEBOOK
WEATHER MODIFICATION HISTORY**

1950--
Wild Speculation and
Sensationalism

...that surface silver-iodide
generator cloud drift can be
targeted to reach supercooled
towering cumulus clouds.

That cloud seeding can
convert Chihuahuan and
Sonoran Deserts to "rich
crop-growing areas."



Success Announced in Rain Making

NEW YORK, Jan. 26 (A.A.P.).—A rain-making experiment in New Mexico last year produced 320,000,000,000 gallons of water.

Dr. Irving Langmuir, Nobel Prize-winning scientist, told a meeting of the American Meteorological Society that the technique of generating silver iodide smoke from a machine on the ground and allowing it to drift into super-cooled cumulus clouds produced a heavy rain storm.

The smoke generator was kept going 13 hours, using two-thirds of a pound of silver iodide costing only 20 dollars.

A similar experiment, which was conducted in 1948, produced rainfall of 160,000,000,000 gallons.

Dr. Langmuir said he had proof that these rains were the direct result of the experiments. **FOLLOW US ON FACEBOOK**

Weather stations in the States had said rain could not have fallen naturally in the area at the time.

Dr. Langmuir emphasised that cumulus clouds must be present for the experiment. There must be sufficient moisture and wind to carry it to the place where the cloud is growing.

There also must be sufficient concentration of minute ice particles, or other foreign particles, to generate heat within the cloud to overcome the stability of the atmosphere and cause clouds to grow rapidly and produce the turbulence needed.

He said such clouds and conditions were found in New Mexico and Arizona, where desert lands ultimately might be converted into rich crop-producing areas.

29 March 1950

No idea who the Rainmakers were.

But they bragged before they knew what they were doing

...and ended up looking silly!

The Evening Independent

AP Wirephoto--NEA Telemata

ST. PETERSBURG, FLORIDA, WEDNESDAY, MARCH 29, 1950

Price 5 Cents

25 Cents a Week by
Carrier, Home Edition

Rainmakers In New York Foiled Again

NEW YORK — (AP) — New York city's rainmakers were foiled by the weather again today.

They decided against a second attempt to "milk the clouds" after weather reports indicated conditions over the city's watershed to the north continued unfavorable.

The rainmakers planned to renew their efforts later this week — or whenever big, billowy clouds seem likely to be in the right place at the right time.

So far, they've been bested in their duel with nature to stir up artificial rains to replenish the city's critically low water supply.

The rainmakers went cloud-hunting for the first time yesterday. But because fog delayed their plane's takeoff, all the good clouds had made a getaway before the rainmakers got started.

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WEATHER MODIFICATION HISTORY

1954. Wild Speculation and Sensationalism
“...cause torrents of rain over Russia....”

“...cause destructive droughts which would dry up food crops by “overseeding” these same clouds.”

“increase precipitation almost at will, using favorable situations”

“Stuff Happens” when they don’t understand “The Science.”

USWB’s Wexler:

“...if rainfall increases claimed by commercial rain-making firms were real, “they would stand out like a sore thumb -- and as such have not been revealed...”

THE RAIN MAKERS -- III

Cloud Seeding May Someday Be Useful, Powerful Weapon of War

• By FRANK CAREY
WASHINGTON (AP) — It may someday be possible to cause torrents of rain over Russia by seeding clouds moving toward the Soviet Union.

Or it may be possible — if an opposite effect is desired — to cause destructive droughts which would dry up food crops by “overseeding” those same clouds.

And fortunately for the United States, Russia could do little to retaliate because most weather moves from west to east.

EXPERT AT HELM

The possibility such a spectacular device as this might be used in some future total war “should not be discounted,” according to the man who heads a group set up by Congress to advise it on the chances for success of plans to control the weather.

Capt. Howard Orville, USN, Ret., who charted the weather for Doolittle’s raid on Tokyo and helped prepare the forecasts for the North African and Normandy invasions, is chairman of an 11-member advisory committee charged by Congress with seeing that current efforts at rain making and rain suppression don’t get out of hand.

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WEATHER MODIFICATION HISTORY

It is Orville’s personal view that if the United States would devote the same effort and money to weather experiments that it does to atomic development it could, in about 40 years, “increase precipitation over any area almost at will, using favorable situations.”

NOT FOR GRANTED

However, he emphasizes that the advisory committee does not take it for granted weather control will or will not work.

In the law setting up the advisory group, Congress said application of scientific advances to the problem of weather “appears to be practical.”

Primarily, Congress wants the committee to determine whether experiments, public and private, strengthen possibilities of large-scale weather control.

But the committee has a corollary job: to determine whether federal legislation is necessary to be sure that attempts at weather modification don’t result in disaster, such as “catastrophic droughts, storms, floods and other phenomena. . . .”

And finally, Congress wants the committee to recommend to what extent the government should experiment with or engage in weather control activities.

Some federal work already is under way. Army, Navy, Air Force and Weather Bureau have research projects.

EXTENSIVE TESTS

The Weather Bureau has been conducting extensive cloud-seeding tests in the Seattle area. Meteorologist Ferguson Hall, the man in charge, says results still are being evaluated. He adds, however, that as of now he does not think weather control on any kind of worthwhile scale will be worked out.

This opinion is echoed by one of the top scientists in the bureau, Dr. Harry Wexler, who maintains that if rainfall increases claimed by commercial rain-making firms were real “they would stand out like a sore thumb — and such has not been revealed, at least in the cases we have studied.”

Orville sums up the work of his investigators this way:

“If the advisory committee finds that weather modification projects cannot produce important results, it will so report — and thus deter farmers and ranchers from spending their money unwisely. . . .”

OTHER POSSIBILITY

“If the committee finds out it can confirm the results claimed by reputable and scientifically competent operators — claims of rainfall increases of from 7 to 50 per cent and more — then, the dollar benefits to agriculture, industry and government will be so great as to be incalculable.”

January 1955



Radar truck tracks cloud formations and radio direction-finding truck records lightning 1000 miles away

"Import rain for Texas from Mexico's Yucatan"

Let's Import Rain for the Dust Bowl

New Mexico scientists pursuing the rain-making project turn up a strange discovery: Water changing into ice generates electricity

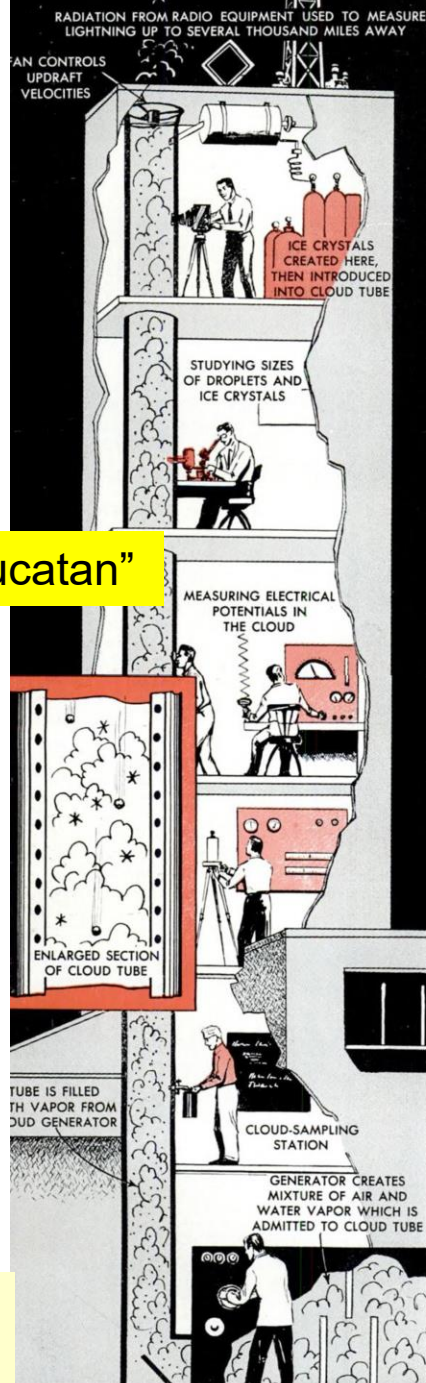
By Thomas E. Stimson, Jr.

YUCATAN? This is Dust Bowl. We'd like about 800,000,000 tons of rain next week. Start your ground generators!" Fantastic instructions like this may not seem farfetched a few years from now. There's a possibility that dry Texas and much of the drought area can be changed into a vast garden spot simply by seeding rain clouds over the Yucatan peninsula in Mexico.

The idea of controlling the weather from a distance stems in part from a striking relationship that has been observed between periodic cloud-seeding activities in New Mexico and subsequent heavy rainstorms as far away as the Ohio valley. The air masses that were seeded in New Mexico were on their way east toward the Ohio.

To test the long-range idea, a proposal to seed the Yucatan clouds is advanced by

Two thunderstorm scientists, Doctors Workman and Reynolds, diagram some electric fields inside a cloud



Dr. E. J. Workman, president of the New Mexico Institute of Mining and Technology. The Socorro campus of the institute has been headquarters for much of the rain-making research conducted in the United States.

"Summer winds frequently sweep north from the Gulf of Mexico after leaving much moisture in the Yucatan area," Doctor Workman states. "It would be a worthwhile experiment to seed the Yucatan area in an effort to reduce rainfall in that wet region and thus force the air masses to transport their moisture farther north."

"Quite possibly all of northeastern Mexico, Texas and parts of New Mexico and Oklahoma would benefit."

"Usually when you seed clouds with silver iodide or other nuclei you are trying to increase the rainfall in the immediate area. But the same method can actually reduce precipitation. If an immature cloud is seeded, for instance, the cloud-building mechanism is disrupted and the cloud vanishes."

"Similarly, overseeding can put a mature cloud right down on the ground and end its life, bringing a relatively quick end to its rain production."

"Either or both of these methods should be tried off Yucatan in efforts to increase the rainfall where we need it."

Modern research on rain making (actually rain augmentation) has been going on continuously ever since Dr. Irving Langmuir and Dr. Vincent J. Schaefer of General Electric developed their seeding techniques in 1946. Yet the subject is so broad that it is still far from being an exact science, although about a dozen groups in the United States and abroad are actively studying it.

To learn more about how to make it rain, the cloud physicists at the New Mexico institute go aloft in aircraft studded with research instruments. They bore through thunderstorms, tag air masses with fluorescent aerosols and then trace the air masses for hundreds of miles to observe the mixing of the atmosphere. Today they

Thunderstorm laboratory, below, has tower in which scientists can simulate most cloud conditions. Drawing shows cloud formed in big tube for close study



120

POPULAR MECHANICS

are preparing to create artificial thunderstorms and other rain clouds inside a huge test tube at Socorro, and to use radio direction-finding apparatus on a continental scale (with stations in Minnesota, Florida and New Mexico) for tracing thunderstorms by their electrical discharges.

Already, working with zero-freeze boxes and other apparatus in their thunderstorm laboratory, the Socorro scientists have learned a number of brand-new facts about nature. One of their milestones was the discovery of what probably causes lightning. Doctors Workman and S. E. Reynolds found that an electric charge is created when water freezes into the solid state, no matter whether the freezing occurs in a cloud or in your refrigerator at home.

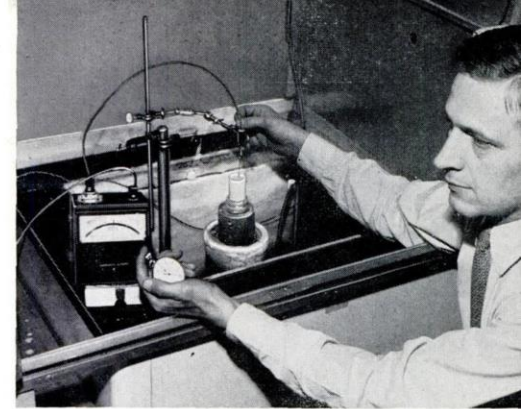
A sample no larger than an ordinary ice cube, they discovered, may generate as much as 250 volts while changing from water to ice. The amperage is extremely small, usually less than 100 microamperes, but enough to be significant in thunderstorm electrification.

At Socorro this Workman-Reynolds effect is demonstrated by inserting one lead from an electrostatic voltmeter into water contained in a plastic cup with a platinum base placed on a freezing unit. The base of the cup is grounded to the unit. The voltmeter needle remains at zero until freezing begins, then slowly swings over to 40, 50 or 150 volts, depending on the impurities in the water. The voltmeter needle returns to zero when all the water has frozen.

In a thunderstorm, Doctor Workman theorizes, water that is shed from growing ice generates enough voltage to produce a lightning stroke, apparently a logical theory.

The step-by-step sequence is something like this: The thunderstorm has its beginning as an updraft of air from the heated surface of the ground, or as a breeze that is deflected upward by a mountainside. In either event, the warm air travels upward until it encounters sub-zero temperatures.

The moisture in the air freezes into ice crystals and becomes electrified in doing so. Soon the ice crystals become heavy enough to begin falling through the ascending column of air or in the region alongside it, and it is at this point that the separation of the electric charges begins. Water droplets in the ascending air column rob the ice and



Doctor Reynolds measures the time that water, freezing in cup, generates electricity as indicated on the dial of the voltmeter



Generator on car creates clouds of silver-iodide smoke, seeding cloud formations in experiments to increase the rainfall

hail pellets of their positive charge and thus a region of positive charge is built up high in the cloud.

As the pellets continue to fall, they encounter warmer temperatures and begin to melt, yielding their negative charge to the water vapor low in the cloud.

The result of this process, extremely simplified here, is that a region of positive charge builds up high in the cloud and a negatively charged center gathers in the lower portion of the cloud. These centers may discharge together as sheet lightning, or the discharge may occur between the ground and the low negative center in the

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Jan 1955

NMIMT President Dr. Workman was

involved in cloud seeding and cloud electrification research

THE SPENCER DAILY REPORTER

THE ASSOCIATED PRESS

The Spencer News-Herald

LEASED WIRE SERVICE

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WEATHER MODIFICATION HISTORY

COUNTY NEWSPAPER

SPENCER, IOWA, FRIDAY, APRIL 29, 1955

Blames Air Force for Floods

ALBUQUERQUE, N.M.— The man who fathered the science of making rain said Thurs. he believes armed forces experiments may have caused the disastrous Missouri Valley floods of June 1952.

Dr. Irving Langmuir, a Nobel Prize winner and consultant for General Electric Co. experiments with rainmaking, also declared:

1. An Air Force test on a tornado off the eastern coast Oct. 17, 1947,, may have turned the twister off its course and pushed it into Savannah, Ga., with damage of five million dollars.

2. There is evidence that rainmaking in some areas may create drought in others.

Langmuir was interviewed while

attending the International Arid Lands Symposium, where scientists from 18 nations are seeking answers to the rapidly growing arid regions which already cover a third of the earth's land surface.

Steady Downpour

He declared that he thinks now—and insisted at the time—that a single silver iodide generator operating at Alamogordo, N. M., under Project Cirrus caused the steady downpours which drowned the Missouri Valley three years ago.

"We had been seeding for some time, and the storms kept getting bigger and better. I told them

(the armed forces heads administering the project) that I felt we ought to stop seeding as the rains in the Missouri Valley kept falling.

"But the administrator of the project was on vacation at the time. No one would take responsibility for ordering the seeding stopped.

"Finally, I told them we must stop, things were getting serious.

"We stopped on July 2. On July 7 the flood just about devastated Omaha.

"If we had stopped our generator two weeks earlier," Langmuir said, "the Missouri Valley floods would not have happened."

Hurricane, not
Tornado

Later data shows
this not to be the
case.

This is wild speculation

LIFE 1964 story talks both about possible “hurricane control” and “inexplicable variations in hurricane wind speeds.”

BOMBS IN THE 'EYE' MAY BRING HURRICANE CONTROL

As Dora waned over Florida, several sisterly successors were on the move—Ethel off Bermuda, Florence off Africa, Gladys off the West Indies. “This is a good season for hurricanes,” says Dr. Herbert Riehl, one of the world’s leading hurricane experts. “There has been a reduction in the normal amount of air rising near the equator. This may breed hurricanes. So I think we’ll have some more.”

Dr. Riehl is one of a group of scientists working with the U.S. Weather Bureau and the Navy to study hurricanes and find ways to control them. During 1963’s hurricane season Drs. Robert Simpson and Joanne Malkus carried out the extraordinary experiment shown in this drawing. They “bombed” a hurricane with silver iodide—a chemical with the property of turning cold drops of water into ice. They hoped that by freezing droplets in hurricane clouds they could disrupt the storm processes.

The hurricane they tried to thwart was called Beulah and is

shown in cross section above. It was a coiling expanse of towering clouds, 200 miles across. In the center was an eye and around the eye the cloud wall (area in blue square) was up to nine miles high. Winds there spiraled at 115 mph.

Here most of the storm’s energy was being generated. Moisture-laden air from the warm sea was sucked up. As the clouds lifted and cooled the air the droplets of water condensed and in this process gave off heat. The warm light air rushed upward even faster, sucking up still more sea air. Though the temperature in the upper parts of the clouds was below freezing, the droplets failed to freeze.

A Navy plane carrying 50 bomb-like capsules filled with silver iodide flew into the eye of the storm north of Puerto Rico. It dropped its bombs one by one (as in drawing at upper right) into the clouds around the eye. There the process shown in detail at right was set off.

The capsules released a 20-mile swath of particles (dark specks).

When the cold droplets of water hit or came near them, ice and snow crystals formed. This process gave off heat. This heat, the scientists hoped, would upset the air circulation and slow down the winds.

That is exactly what happened. Suddenly Beulah’s 20-mile eye appeared to fade and reform into one 30 miles across. The spiraling winds, traversing a larger circle, fell from 115 mph to 75 mph. Other planes following the bomber through the hurricane found that this effect lasted for several hours.

Though they temporarily slowed Beulah, which regained some of its fury and later died out over the Atlantic, the scientists were not certain that the changes in wind speed were caused by seeding. They plan more extensive experiments in 1965 and Dr. Riehl has been studying this year’s hurricanes. He spent five days chasing Dora and found big, inexplicable fluctuations in her winds. “Hurricanes are quite properly named for women,” he remarks. “They are so variable.”



LIFE

SEPTEMBER 25 • 1964 • 25¢

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WEATHER MODIFICATION HISTORY

Some of this is pretty wild,
as seen 56 years later.
Smagorinsky headed GFDL

“Controlling the Weather”

Computer simulations and
forecasts accurate, “to
within a tiny degree”

This was during the ongoing
cooling, since 1940...

“laying down carbon soot...
to expedite melting (of Polar
Ice)

“Diverting the Gulf Stream,”
“explosion of hundreds of nuclear
devices” in Florida Strait.

Computers used to assess
inadvertent climate modification
from addition of CO2

READING EAGLE

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WEATHER MODIFICATION HISTORY

READING, PA., WEDNESDAY, NOVEMBER 17, 1965

Man Still Goes On Dreaming Of Controlling the Weather

Washington, Nov. 17 (UPI)—One morning in 500,000 BC, John Doe Pithecanthropine grumbled at the rain, struck a spark to warm his cave and dreamed of being able to control the weather.

This morning his grandson, countless times removed, woke in an air conditioned room, drove to work in an air conditioned car, entered his air conditioned office, and dreamed of being able to control the weather.

It has been one of mankind's most persistent—and, so far, most illusory—dreams.

Modern man can control his environment to a considerable extent. Pithecanthropine's great grandson is rarely subject to the elements unless he wants to be—and even then in a sense he controls his environment through the expertly engineered fabrics he wears.

He seeds clouds to bring rain to parched fields; he shields his tobacco crops or his coffee beans from the sun to let them ripen more slowly, and he lights smudge pots in his fruit orchards to guard against freeze. He even sends Tyros satellites into space to warn him of storms.

His buildings are temperature-controlled. Even his fishing camp is likely to have a portable electric fan to stir up a breeze.

But a vast portion of his land area remains unarable desert and his polar ice caps represent thousands of miles of frozen wastes.

So man wonders: Why can't some of the moisture from the Antarctic ice caps be diverted to rainfall over the desert? And wouldn't the warming up of the ice caps also serve to moderate the climate of Greenland, and the Yukon territory of Canada, and Russia's Siberia to become more hospitable to a mankind fast running out of living room?

Dr. Joseph Smagorinsky, acting director of the institute for atmospheric sciences in the Environmental Science Services Administration (ESSA), told UPI in an interview that serious proposals for diverting the polar ice were made as recently as three or four years ago, but do not now have a priority among weather modification scientists.

But he said possible new avenues of research currently are being studied by a panel under the sponsorship of the National Academy of Science.

The panel has been at work for two years and will be ready with its final report within the next two or three months. The report, he said, will contain recommendations for basic lines of research on both small and massive ways of tampering with the weather.

At the same time, Smagorinsky said the entire field of

weather modification is being changed by the rapid perfection of computers.

Within the next 5 to 10 years, he predicted, it will be possible to simulate the actual natural circulation of the atmosphere to such an extent that proposals for massive tampering can be tested so accurately that results can be predicted to within a tiny degree.

Some of the long-standing ideas for altering climate include:

Melting the polar ice by laying down a carbon-soot covering on the ice to absorb the sun's rays and expedite melting. Drawback: The world's coastal cities would be devastated by the resulting increase in the ocean level.

Exploding a number of nuclear devices in the Arctic Ocean at a precise depth to create a mist so fine it would remain as fog overlaying the ice, thus acting as a blanket to prevent heat escape and create melting. Same drawback.

Joint Project

Building a dam across the Bering Straits so warm Pacific water could be fed into the Arctic Ocean and warm up the north. A Russian scientist estimated the cost at \$17.5 billion, to be shared jointly by the United States and Russia.

Diverting the Gulf stream, perhaps through the explosion of hundreds of nuclear devices in the straits between Florida and Cuba. Obvious drawbacks:

You'd create so much radioactivity you'd off-set all you had accomplished.

But once the computer models are perfected, Smagorinsky said, these proposals could easily be tested. It also would be possible to ask purely hypothetical questions scientists would like to know the answers to: Like what would happen if you removed the Rocky Mountains; or what would be the result of cutting down all the trees in the United States.

Already the scientists are using the computers for a greater and greater degree of fidelity in reproducing the natural properties of the atmosphere.

This is helpful, Smagorinsky said, in assessing the long-range results of “inadvertent modification” such as the increase of carbon dioxide in the earth's atmosphere from the automobile and industrial pollution; the growth of cities with their very real warming effects; whether the imminent use of super-sonic transports in the stratosphere will affect the atmosphere.

Smagorinsky expects the answers to most or all of these within a year or two. It is essential to know these answers, he says, before it is possible to extrapolate results of the “purposeful modifications” which are man's deliberate attempts to alter the weather.

Right or Else

It is pretty well agreed that once man starts tampering with his atmosphere, he'd better be right. Disaster could result from an error that started small and magnified.

If, for instance, man managed to warm up his climate enough to melt the ice caps altogether, it might result in a dislocation of water-weight which could tilt the earth on its axis and establish an entirely new configuration of land areas and oceans.

This would bring about the end of all of mankind's worries about the H-bomb because it would bring about the end of mankind period.

But one thing is probable: Whatever thinking creature inherited the earth as man's successor would have one great dream:

Being able to control the weather.

DAYTONA BEACH MORNING JOURNAL

DAYTONA BEACH, FLORIDA, WEDNESDAY, DECEMBER 29, 1965

☆☆☆☆

PRICE T

1965: Exaggerated claim by Dr Charles Hosler, Dean of Penn State's College of Earth and Mineral Sciences

All It Takes Is Cash And Incentive

FOLLOW US ON FACBOOK
WEATHER MODIFICATION HISTORY

'Man Can Control The Rainfall'

BERKELEY, Calif. (AP) — All that men need to control the world's rainfall is money and incentive, a weather expert said Tuesday.

The Weather Dr. Charles L. Hosler of Pennsylvania State University told the annual meeting of the American Association for the Advancement of Science his group had achieved 100 per cent accuracy in predicting when cloud seeding would bring rain.

Expansion of the technique, which involves detailed analysis of the temperature and moisture of clouds to pick the right time for seeding, could hasten the day when scientists will be able to modify weather. Hosler said.

"A lot of engineering will be needed," he said, "and with the limited funds meteorologists now have to spend it may

not come in my lifetime—but I am convinced that weather modification eventually will be an important factor in the economy of the world."

Dr. Morris Nelburger of the University of California at Los Angeles, who appeared with Hosler at a news conference on weather control, suggested meteorologists start "thinking big."

"If we were to make it a matter of national prestige to beat the Russians in modifying the weather," he said, "we might get some of the money now going into the space programs."

Archie Kahan of the U.S. Bureau of Reclamation at Denver, Colo., said the bureau's 1965 budget for weather modification was less than \$3 million, compared with \$5 billion for space exploration.

"If we had just a small fraction of the

space budget," Hosler said, "we could make a great plunge forward in weather control."

He based his belief on seven tests over the past three years in Pennsylvania. He said his group each time was able to forecast accurately whether clouds could be made to release rain.

In most rainmaking attempts, clouds are seeded with particles of silver iodide around which raindrops form. Occasionally these particles may be lifted from the surface back into the atmosphere by evaporation and cause rain by accident. Hosler said he used rapidly dissolving dry ice pellets to avoid any possible holdover effect.

The reason rainmaking has been so unpredictable and, therefore controversial, Hosler said, is that not enough has been known about any particular cloud prior to seeding.

After the sensationalism, more moderate views, 1958-1980
Serious work uncovered conditions where reliable seeding could work

March 1958 CIA survey showed DOD, USWB, National Science Foundation...

“(the) present known capabilities for ‘controlling the weather’ are quite modest.”

“...fundamental knowledge is seriously lacking over almost all areas of cloud physics and meteorology related to weather control.”

“Production of precipitation by seeding requires specific conditions”

Next graphic shows the declassified CIA document

In general, the present known capabilities for controlling the weather are quite modest.

Present Government Sponsorship of R&D:

A number of Federal Government organizations have been and presently are engaged in activities in the field of weather modifications and cloud physics. The most active groups are the Army, the Navy, the Air Force,


SECRET

Declassified and Approved For Release 2013/08/06 : CIA-RDP78-03425A002100020023-2

. Declassified and Approved For Release 2013/08/06 : CIA-RDP78-03425A002100020023-2

I became aware of this work unit in 1966. In 1969, it became part of the Army Atmospheric Sciences Lab, WSMR, where I worked 1984-2001.

the U. S. Weather Bureau, and the National Science Foundation.



The Army work on cloud physics and weather modification is centered at the Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey. They have studied the effectiveness of various seeding materials and the dissipation of supercooled stratus by seeding. In addition, laboratory work at Fort Monmouth covers a range of basic experimentation on cloud particles and environmental effects. Large cold chambers are utilized in this work. In Volume 5 (Geophysical Sciences and Engineering) of the 1958 Annual Research Task Summary (U. S. Army), the Army projects are listed as being under the direction of D. Deisinger, Chief, Physical Sciences Division, ESL, with the principal internal investigator being

Weathermen Plan To Bomb a Storm

By JOHN TROAN

Scripps-Howard Newspapers

WASHINGTON, Nov. 28—The Weather Bureau is aiming to explore a hurricane next year.

If the experiment works, it will open the way to taming one of man's most dangerous natural enemies.

Tentative plans call for the all-out bombing of a hurricane with silver iodide, a chemical which artificial rainmakers use to milk clouds of moisture.

The Weather Bureau has tried similar experiments three times before, but on a very limited scale.

Plan Bombings

This time, scientists plan to send Navy planes aloft to strike the same storm five or six times, bombing it every few hours with silver-iodide "seeds" designed to make the walls of a hurricane's eye grow outward so it will collapse before reaching land.

The plans will be disclosed

in next month's Scientific American by Dr. R. H. Simpson and Dr. Joanne S. Malkus, who are associated with the Weather Bureau's Project Stormfury.

The researchers contend such an approach is needed "if hurricane modification is to become more than a vague hope." Even if the experiment fails to produce a hurricane killer, they maintain it will yield results that will greatly improve forecasting of such storms.

'A Monstrous Thing'

The meteorologists point out a hurricane is a monstrous thing. In a single day, for example, "A medium-sized hurricane" releases as much energy as 400,000 atom bombs of the Hiroshima size.

"Obviously," they explain, "no human resource is capable of competing with such a formidable enemy in any head-on confrontation."

"Instead, one must search these storms for an Achilles' heel, some internal instability than can be triggered in such a way as to set off a predictable chain of events leading to a reduction in the storm's intensity."

'Notoriously Erratic'

The scientists say that "the notoriously erratic behavior" of hurricane indicates they have such an Achilles' heel.

Small-scale tests in 1961 and last year, they report, suggest that the swirling winds which form the eye of a hurricane can be reduced by bombing them with silver iodide. But apparently this must be done over and over to prevent the hurricane from "regaining its equilibrium."

Simpson and Dr. Malkus said individual clouds outside of hurricanes have been exploded by bombing them with silver iodide. They think hurricanes likewise can be exploded—and hope to prove it next summer.

Catchy Headline....1964

Describes USWB – Navy work on Project Stormfury.

Seeding Hurricanes with Silver Iodide.

Dr Robert Simpson and Dr Joanne Malkus, who would soon become Dr Joanne Simpson



Dr. Joanne Simpson, Director of Stormfury Project and Commander Ronald V. Himelick, Commanding Officer of the study weather data aboard aircraft.

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WEATHER MODIFICATION HISTORY

Cdr. J. W. Kidd is Assistant Director of Project Stormfury and also serves as the project's operation officer.



Original from
UNIVERSITY OF MICHIGAN

1966 Puff piece on Dr Simpson, but no wild speculation.

Her collaborators were from VW-4, Flying WC-121N Super Constellations.

Navy Heavy Weather Recon Squadron FOUR out of Navy Jacksonville.

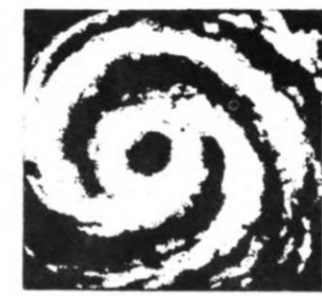
In 1966 VW-1 was flying out of NAS Agana, Guam, also flying WC-121N Super Constellations.

Navy Heavy Weather Recon Squadron ONE.
This is when I was stationed at Andersen AFB Guam

JULY 1966

essaWorld

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION



U.S. NAVY Hurricane Hunters

Their official title is Airborne Early Warning Squadron FOUR, or in naval jargon, VW-4. But the world knows them as the famous Navy Hurricane Hunters. While they have taken a vital and active part in Project Stormfury, their prime mission is reconnaissance—early warning of the approach of tropical storms.

The Navy has performed aerial reconnaissance in support of the joint U. S. hurricane warning service since 1943. VW-4, the seventh naval aircraft squadron assigned this mission, has been in operation since 1953. Hurricane reconnaissance techniques have improved greatly during recent years. The aircraft perform at altitudes of 500 to 1000 feet including hurricane eye penetrations. This is thought by many to be the most dangerous type of flying in the world, but time tested procedures and highly trained flight crews have reduced the danger to a minimum. In more than 23 years of Navy hurricane flights in the Atlantic, Caribbean, and Gulf of Mexico, only one plane has been lost. That occurred in 1955 when a VW-4 aircraft, a P2V Neptune, was lost with all hands in the Caribbean while penetrating the eye of Hurricane Janet.

With the advent of powerful long-range airborne radars, a new aircraft was

added to the long list of planes making storm flights. In 1955 the Navy Hurricane Hunters received the first of the WC-121N Lockheed Super Constellations. New techniques were devised and weather reconnaissance underwent a radical change. Weather information which once took days to acquire can now be gathered on one meteorological flight. Conditions in an area of 200,000 square miles can be observed with one sweep of the powerful airborne radar. One Navy weather flight can provide information of an area encompassing 1,500,000 square miles.

Based at Naval Air Station, Jacksonville, Fla., the squadron also maintains a detachment in Puerto Rico to provide better year-round weather reconnaissance in the Caribbean and Atlantic waters.

Since aerial hurricane reconnaissance began, more than 350 hurricanes and tropical storms have been probed by Navy Hurricane Hunters. They have a record of 50,000 accident free flying hours with 10,000 of these in actual hurricane reconnaissance. They have made about 800 penetrations into the "eye" of the hurricanes. Experts at the low-level penetration technique, the Hurricane Hunters, in their 70-ton "Connies", encounter winds as high as 150 miles per hour.

The men of VW-4 can be justly proud of the traditions and accomplishments of the Navy Hurricane Hunters. The Nation is. □

July 1966.

Dr Joanne Simpson...directing
STORMFURY:

Better understanding of hurricanes

Let's investigate modifying them.

Task Force Aircraft consist of

Navy WC-121Ns

ESSA DC-6

Navy A3B Skywarrior (seeder)



JULY 1966
essaworld U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION

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WEATHER MODIFICATION HISTORY

CLOUD PHOTOS from a weather satellite indicate a tropical depression at 15°N and 45°W—a tiny point in the Atlantic between Africa and South America more than 1000 miles from any land area. Of no concern to most people. Just a suspicious area now. Later, possibly a hurricane. No one can tell yet.

At ESSA's National Hurricane Center in Miami, Florida, the world's best trained hurricane eyes keep a constant vigil from this moment on. Ships, satellites, planes, and radars will track, measure, and report on the storm's progress. When a land mass is threatened, the public is warned. It's almost routine now.

But other eyes are also watching this low pressure area. They include atmospheric physicists, meteorologists, engineers, technicians and flight crews of instrument-crammed aircraft. They are on 72-hour alert to "stage" from Roosevelt Roads Naval Station in Puerto Rico. From there they will fly into the hurricane—if it's the right kind of hurricane—and in the right place.

They come from Jacksonville and Miami, Florida; from Edwards Air Force Base and China Lake, California; from Norfolk, Va.; and from Washington, D. C. They wear the insignia of ESSA, or U. S. Navy, or Air Force, but at Roosevelt Roads, they are one team. On any one operation, as many as 200 scientists, technicians, and flight crews will fly

Project Stormfury is an inter-agency program of the Department of Commerce (ESSA) and Department of Defense (NAVY). It was established in 1962 as a program of scientific experiments designed to explore the structure and dynamics of hurricanes. The Project's objectives are to achieve better understanding, improve prediction, and investigate the possibility of modifying some aspects of these destructive storms.

The Director of Project Stormfury is Dr. Joanne Simpson, Chief of the Experimental Meteorology Branch of ESSA's Institute for Atmospheric Sciences.

Commander J. W. Kidd, Officer in Charge of the U. S. Navy Fleet Weather Facility at Jacksonville, (Fla.) Naval Air Station is Assistant Director Operations Officer. Dr. R. C. Gentry, Director of ESSA's National Hurricane Research Laboratory, is the Alternate Director of the Project. Dr. J. R. Stinson, Chief of the Research Division, U. S. Navy Weather Research Facility, Norfolk, Va., is the scientific advisor to the Assistant Director.

The seeding materials have been developed under the supervision of Dr. Pierre St. Amant. He and other scientists of the Naval Ordnance Test Station at China Lake, California have perfected the generator used to disperse the silver iodide crystals and have participated extensively in the field programs, with their research aircraft as one of the seeding planes.

Pioneering work of Dr. Joanne Simpson brought nine years of leadership into this subject area, 1965-1974.

Started earlier with a 1958 study with Riehl, where they developed the “Hot Tower hypothesis” to account for enough moist static energy aloft found in measurements. The Hot Towers were thunderstorms.

These efforts were helped enormously by Dr Robert White, Director of the US Weather Bureau.

Partial list of Dr Simpson’s publications, part of her life-long interest in tropical clouds:

“Photographic and Radar Study of the 5 Aug 1965 STORMFURY Seeded Cloud.” Jour Applied Met, Feb 1967 Concept of “dynamic seeding:” rapidly releasing the latent heat of fusion by AgI seeding at -10C level

“An Airborne Pyrotechnic Cloud Seeding System and its Use” Journal of Applied Meteorology, Feb 1970: 14 seeded clouds; 13 grew explosively. Seeded clouds grew 11,400 ft higher than control clouds. Statistically significant rainfall increases.

“Precipitation Results of Two Random Pyrotechnic Cumulus Seeding Experiments,” Journal Applied Meteorology, Jun 1971: 1968 and 1970: Seeding results in >300% increase in precipitation, >6200 ft higher clouds; statistically significant

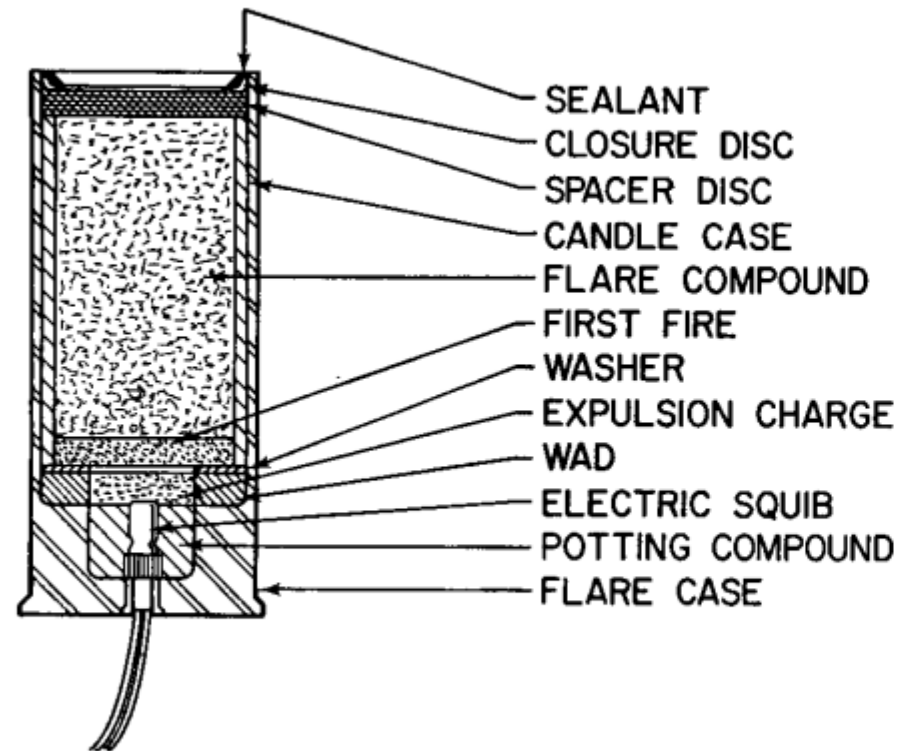


FIG. 2. Diagram of flare cartridge used with mix X1055 in 1968 Florida program; 1-20M-45A cartridges had the same case and were similar in construction.

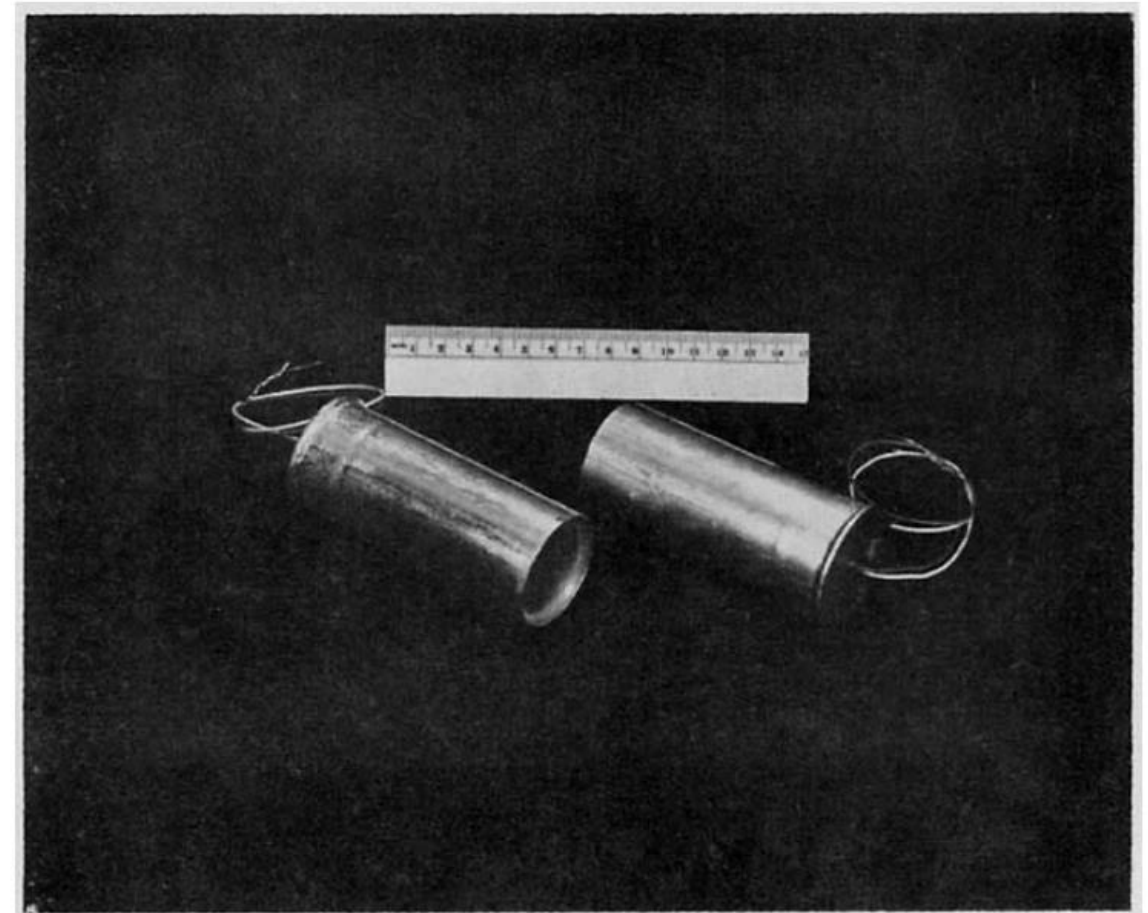


FIG. 3. Photograph of two flares used in Florida 1968 experiment (centimeter scale).

Dr Joanne Simpson of the ESSA Experimental Lab worked with Industry <Olin Matheson and Atlantic Research Corporation> also Dr Pierre St Amand of China Lake Naval Ordnance Test Station to develop, test and manufacture flares which could be launched from A3B, B-57, DC-6, WC-121, and WC-130 aircraft.

Testing the Silver Iodide Flares in Florida

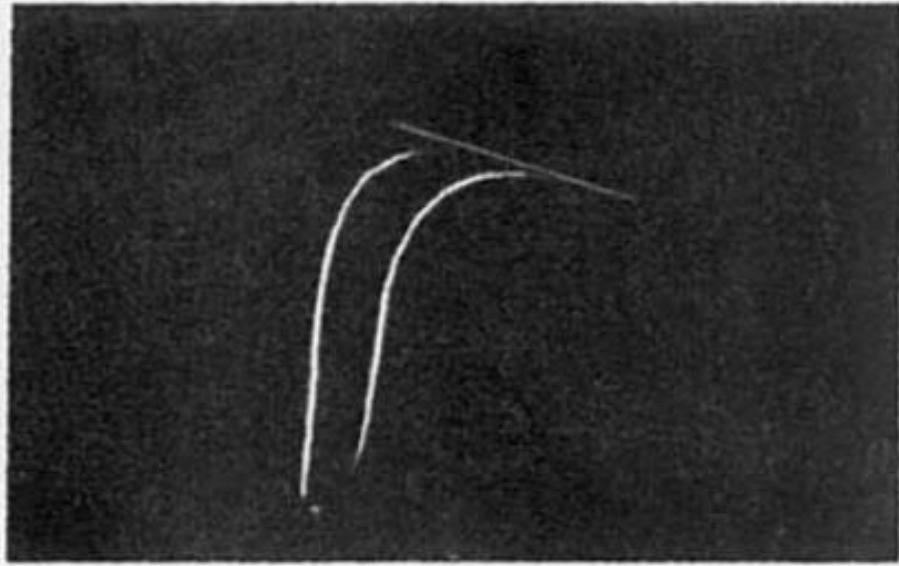


FIG. 8. Time exposure photograph of nighttime release of two ARC 1-20M-45A flares ejected at 20,000 ft.

Time exposures were used to test both the Atlantic Research Corporation flares, Above, left and the Olin Matheson flares, right.

Simpson, Joanne, et al., "An Airborne Pyrotechnic Cloud Seeding System and its Use" *Journal of Applied Meteorology*, Feb 1970, pp. 109-122.

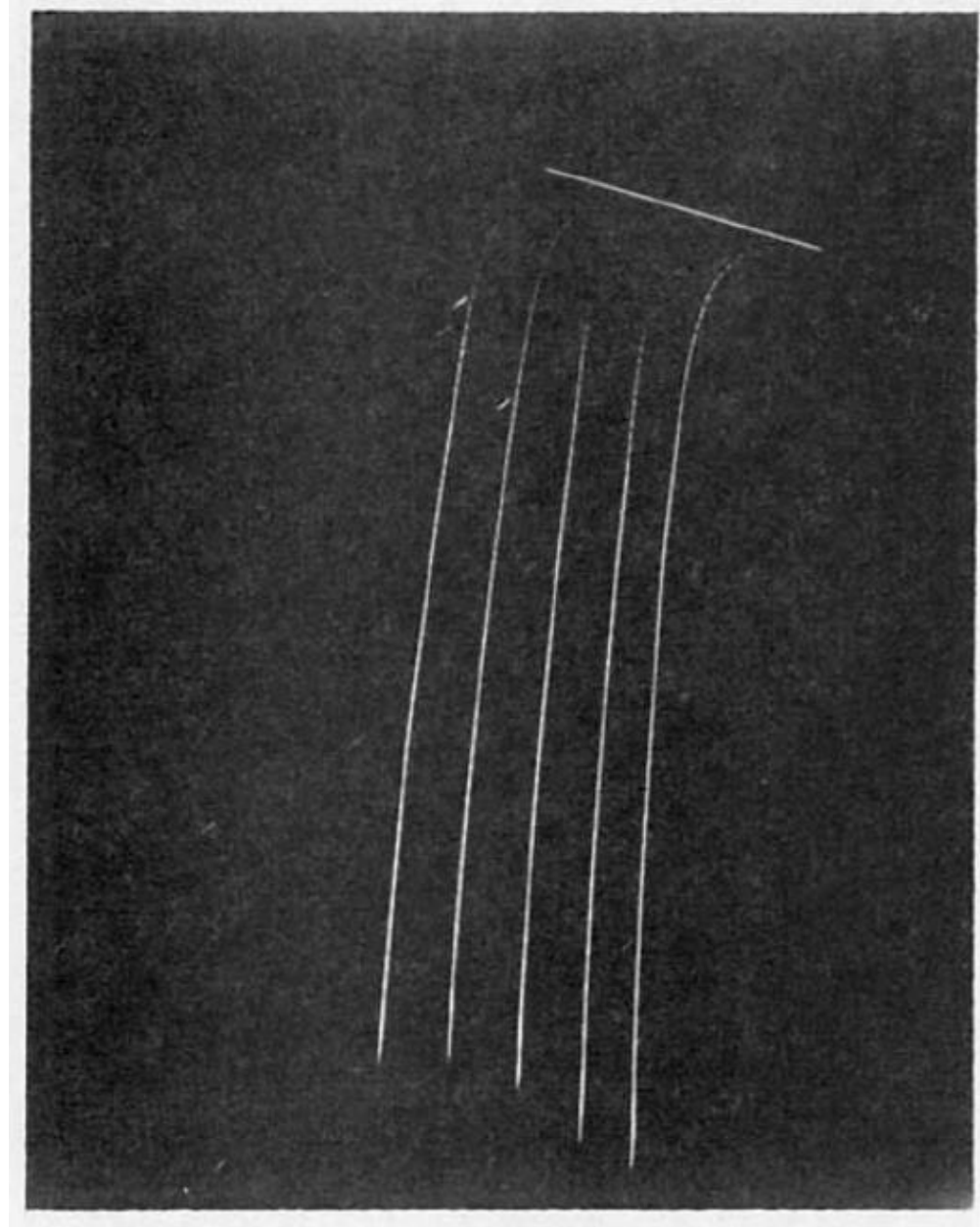


FIG. 9. Time exposure photograph of nighttime release of five Olin X1055 flares ejected at 20,000 ft. Streak on top is aircraft's landing light, on for exactly 10 sec. Aircraft's true airspeed is 400 ft sec^{-1} .

7. First results of the Florida 1968 seeding program

A total of 19 experimental clouds was selected from the command control aircraft. Fourteen were seeded and five were used as controls. The dates and locations of all experimental clouds are shown in Fig. 11. A cloud summary for each cloud is given in Table 8. The cloud top heights were first measured by the B-57 and then checked by photogrammetry. Heights are given in pressure altitude.

The average growth following the seeding run was 12,500 ft for the 14 seeded clouds and 1100 ft for the five control clouds. The difference is 11,400 ft, which is significant to better than 0.5% based on a two-sided "t" test. The average maximum top of the seeded clouds was 35,800 ft, and the corresponding figure for the controls was 25,800 ft. Thirteen of the 14 seeded clouds underwent explosive growth; one died without growth. Of the 13 explosive growths, 10 occurred soon after seeding and involved the actual tower seeded, while three were delayed or "hesitation" growths, where a newer tower than the one originally selected for seeding appeared and grew.

Test area, right, and results, above. Simpson and her colleagues had isolated the conditions when cloud seeding was effective.

"Thirteen of the fourteen seeded clouds underwent explosive growth"

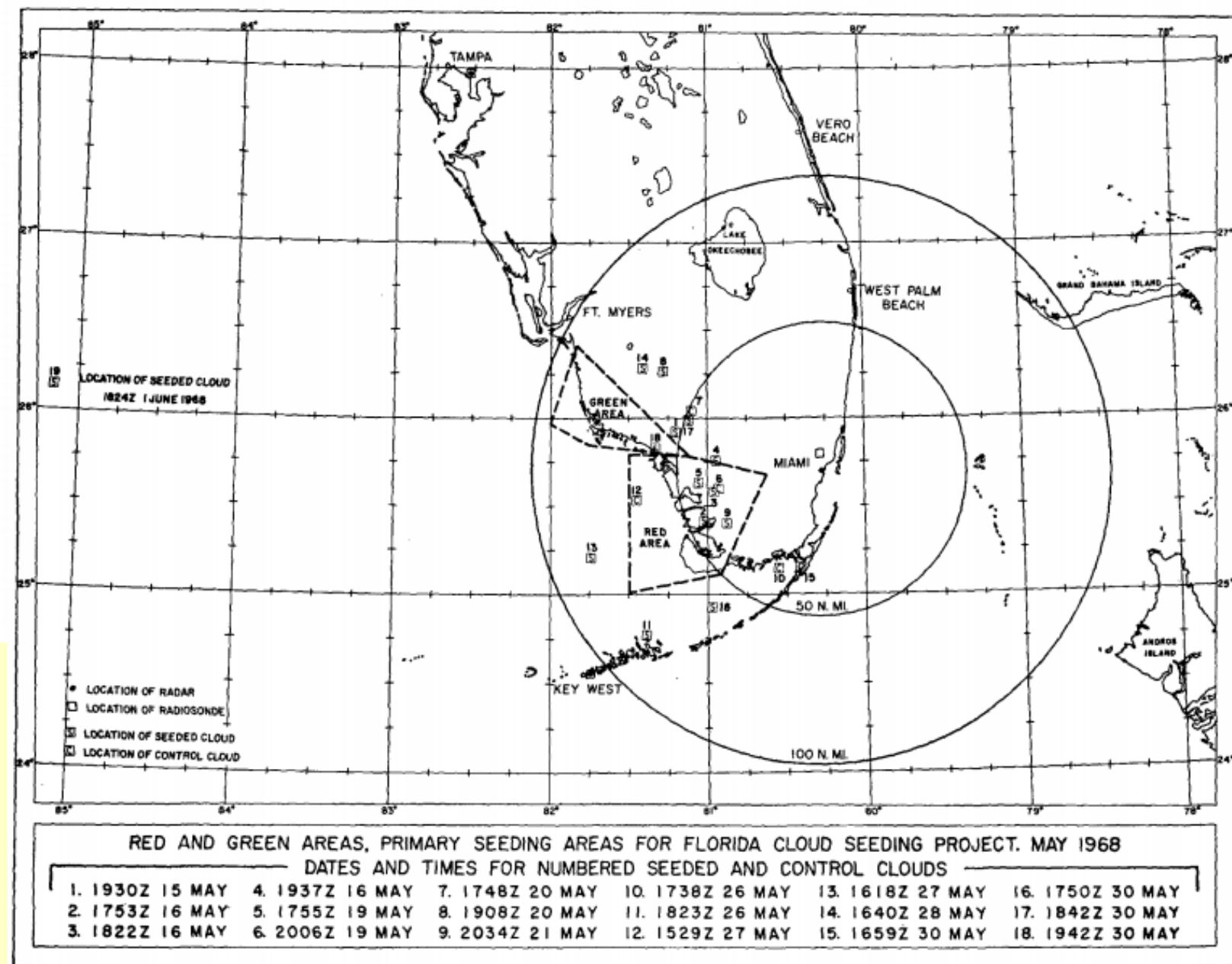


FIG. 11. Location of seeded (S) and control (C) clouds in Florida 1968 cumulus experiment. Dash-outlined areas are so-called "red" and "green" areas, set aside by the Federal Aviation Administration as the main land areas to be used in the experiment.

**Photographic and Radar Study of the Stormfury
5 August 1965 Seeded Cloud**

JOANNE SIMPSON

Environmental Science Services Administration, Silver Spring, Md.

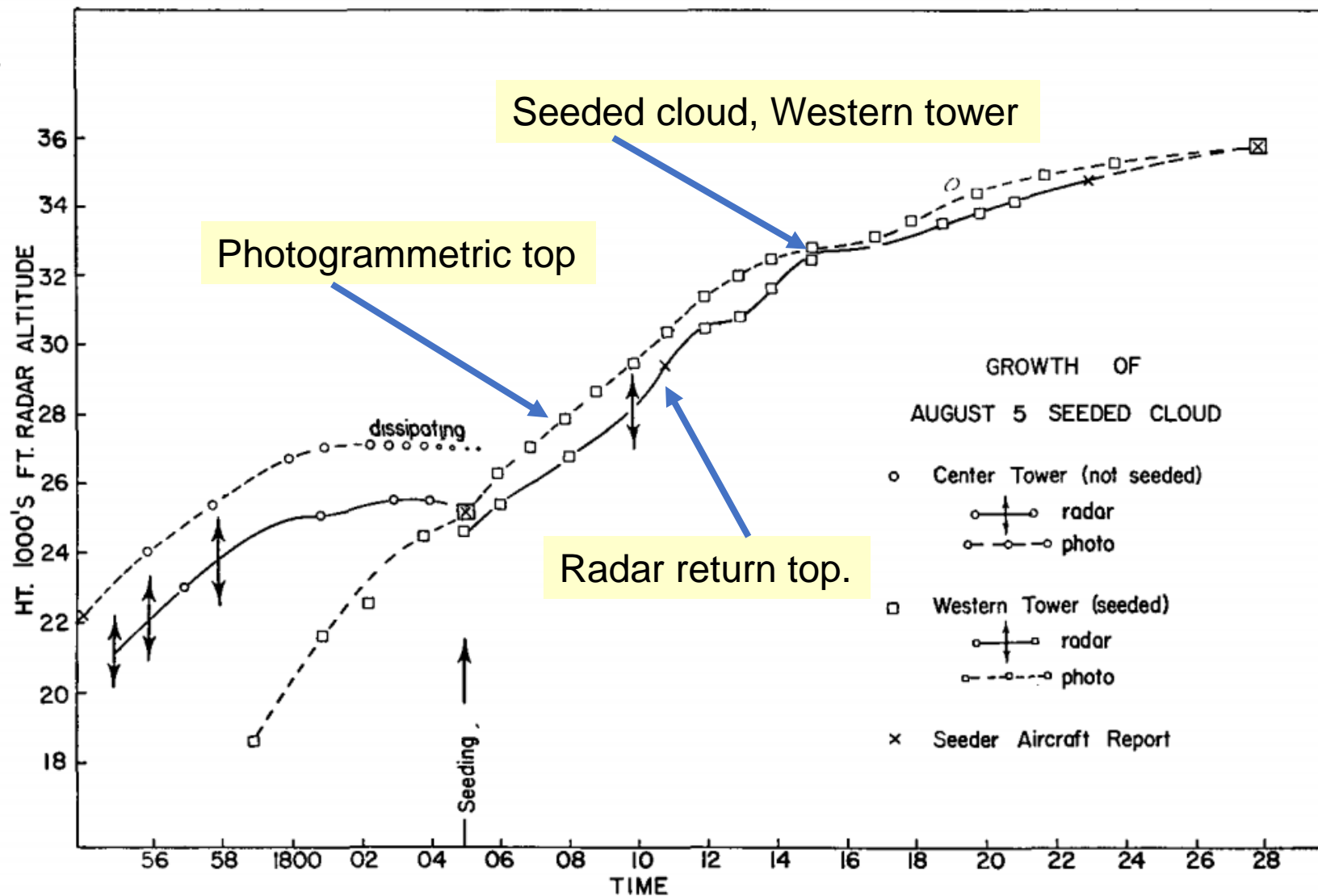


FIG. 1. Vertical growth of seeded cloud, 5 August 1965, as a function of time. Heights have been converted to absolute altitude (1000's ft) above the sea surface. Solid curves are APS-45 measurements. Double-ended arrows appear where latitude in top definition was indicated. Dashed curves are photogrammetric measurements. Seeded aircraft measurements are shown by X's. Circles denote center (older) tower. Boxes denote western (seeded) tower. The photographic measurements were unambiguous regarding which tower was being measured. On the radar, the top of the tallest tower was always selected for measurement.

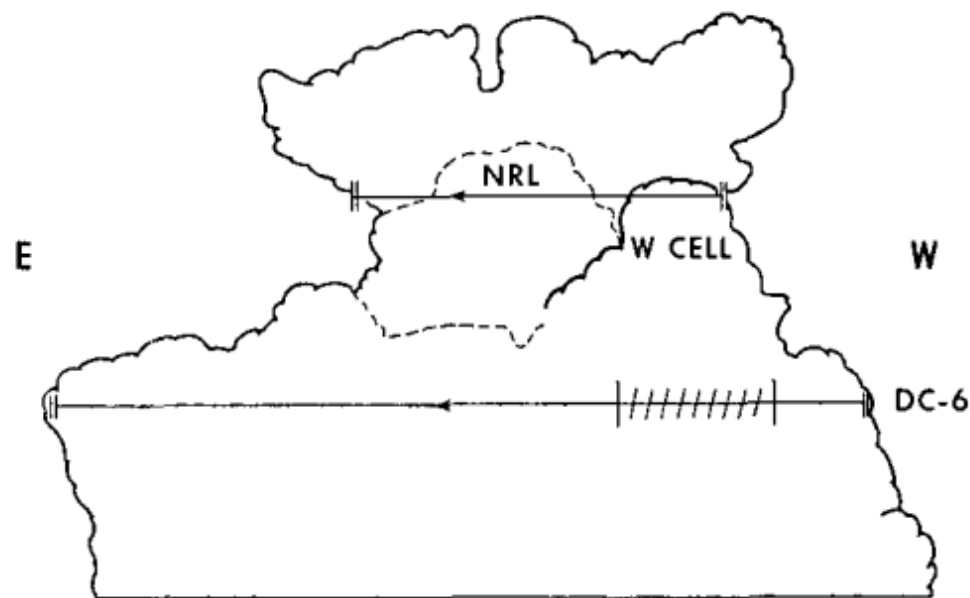


FIG. 8. Pre-seeding profile of 5 August 1965 seeded cloud. Profile made at time of first monitoring run at 1759 GCT. Constructed to scale from projection of 35-mm slide made from Command Control aircraft, looking due south, plane of picture east-west. N. R. L. aircraft's west to east traverse through cloud is shown, double vertical lines indicating entrance and exit. "W cell" is western cell, later seeded, measured as 1.25 km across on both this construction and N. R. L. record [see Ruskin (1967)]. A vertically stacked "pack" of four monitoring aircraft penetrated this cloud. A DC-6 at 10,000 ft (pressure altitude) measured a "warm core" beneath the west cell, its extent denoted by the hatching. The DC-6 traverse is delineated between the lower double vertical lines.

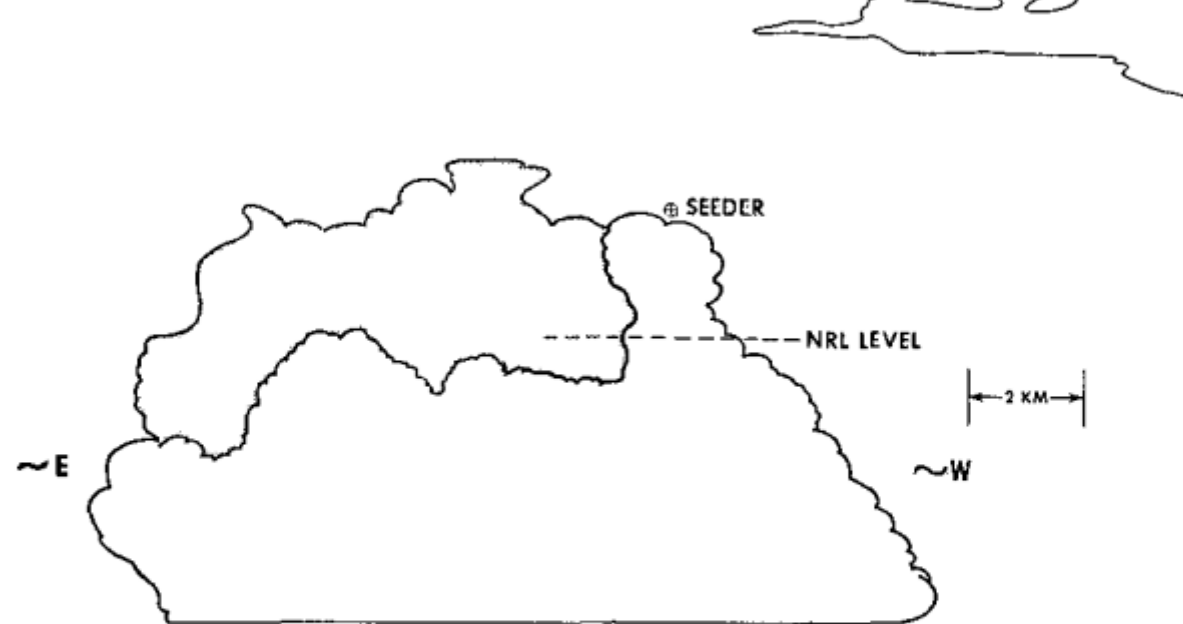


FIG. 9. Profile of 5 August 1965 cloud at seeding time 1805 GCT made from Command Control aircraft photograph looking 20 deg west of south. Sixteen pyrotechnic silver iodide generators (Alecto units) were dropped into the western tower from seeder aircraft flying toward north (into the diagram, as indicated by the encircled X) just above tower top. Scale diagram reconstructed from 35-mm slide in same manner as Fig. 8.

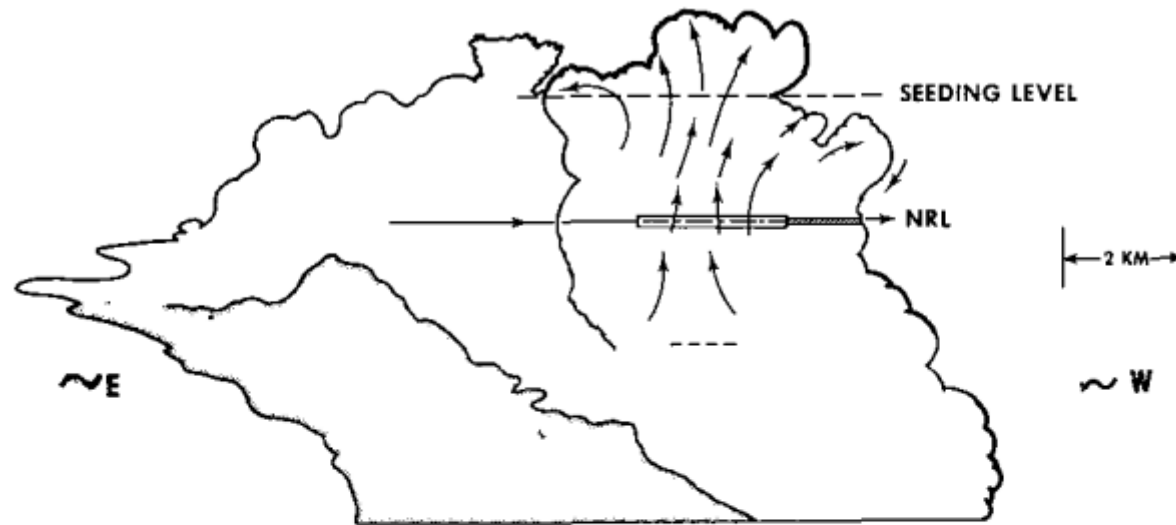








FIG. 10. Post-seeding profile of 5 August 1965 cloud. Profile made at time of second monitoring run at 1810 GCT made from Command Control aircraft photograph looking approximately southwest. Constructed to scale in same manner as Figs. 8 and 9. N.R.L. aircraft's east-west traverse through cloud is shown, double vertical lines indicating entrance and exit. Darkened portion is western 1.25 km. Thickened white portion is central region where about 2C warming, relative to previous run, was observed.

Warm core is from the release of latent heat of fusion, as snow grows at the expense of supercooled droplets.

	CLOUD AT 1805 G.C.T.	RA 25,000
	1806 G.C.T.	26,200
	1807 G.C.T.	26,900
	1808 G.C.T.	27,800
	1809 G.C.T.	28,500
	1810 G.C.T.	29,400

Seeded West Tower grew to 36,000 ft MSL

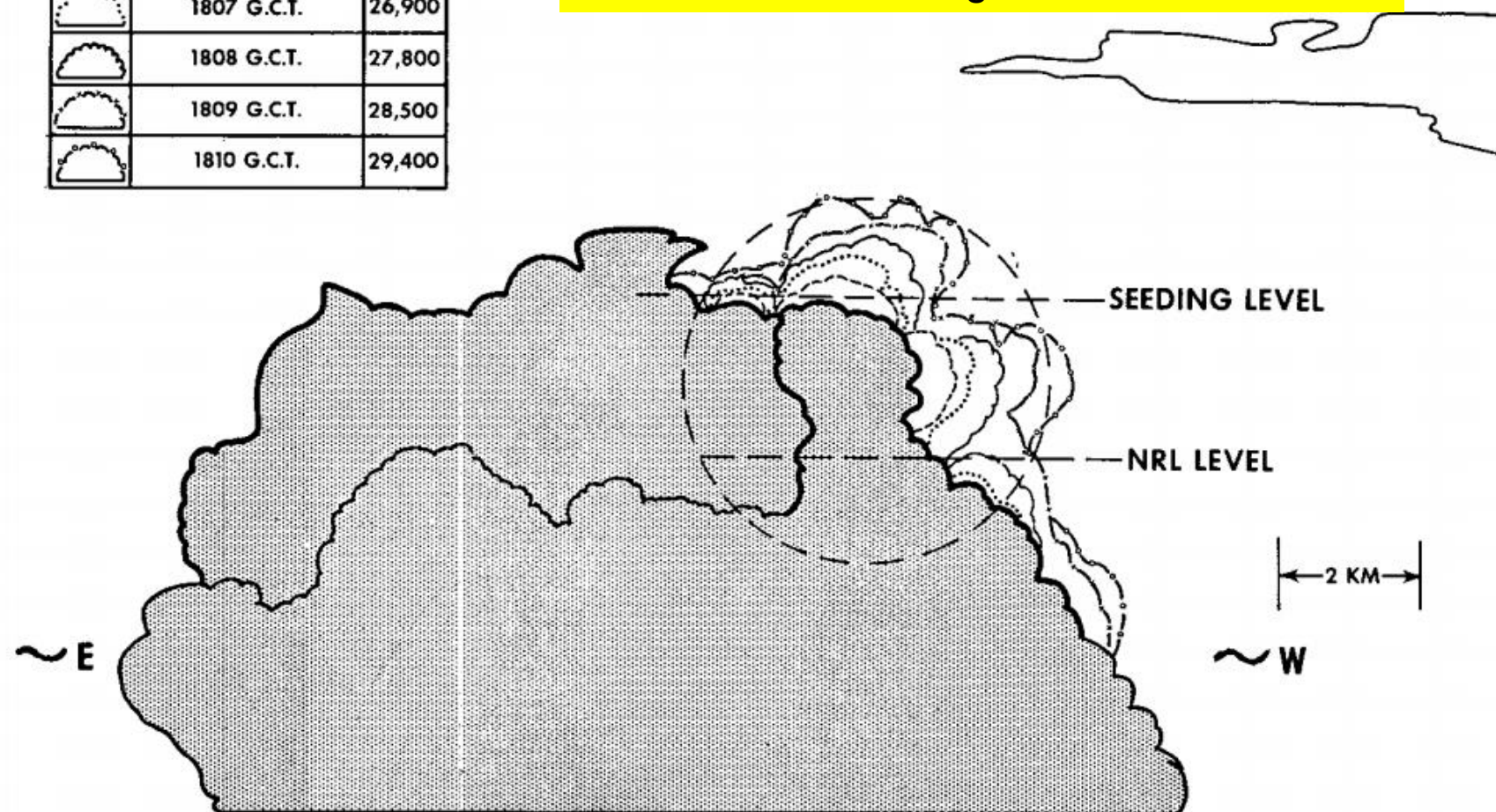
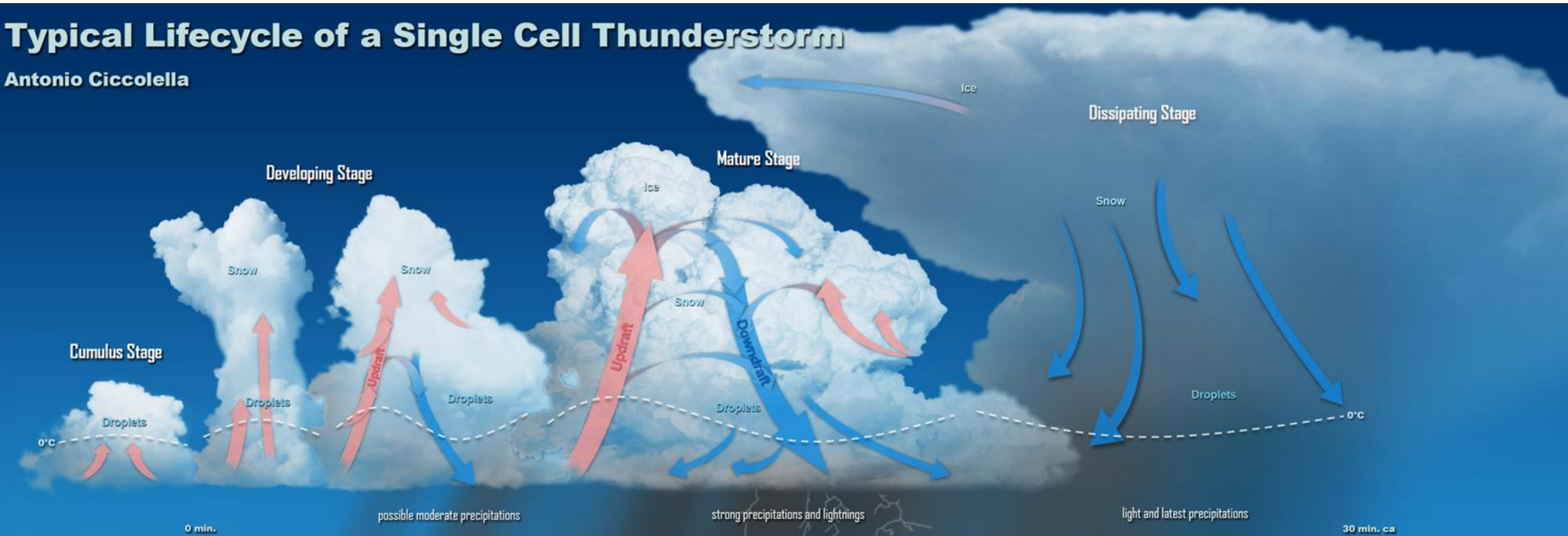


FIG. 11. Composite after-seeding profile of 5 August 1965 cloud. Growth outline shown at 1-min intervals from 1805 to 1810 GCT. Dashed circle with 5 km diameter roughly denotes portion of cloud "activated" following seeding. These dimensions are comparable to those of vortical circulations computed after 5 min following heat input in such numerical model studies as that by Murray and Anderson (see footnote 3).

Typical Lifecycle of a Single Cell Thunderstorm

Antonio Ciccolella



MARCH 1971 60 CENTS

Popular Science

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WEATHER MODIFICATION HISTORY

Rainmakers score success

After five years of theorizing and experimenting with cloud-seeding techniques, a team of scientists at the National Oceanographic and Atmospheric Administration has carried out what is probably the most successful rainmaking venture to date. Drs. Joanne Simpson and William L. Woodley increased rainfall from individual cumulus clouds as much as sevenfold over normal by seeding them with silver-iodide crystals via flares dropped through the cloud.

In the experiment—conducted over southern Florida between April and July of 1970—the NOAA scientists seeded 13 clouds and compared their rainfall with 16 unseeded clouds used as controls. They are now working on a technique to promote cloud mergers by seeding.



“Cloud seeding unit mounted to the side of a WC-130A Hercules via Historic Wings.”

<https://paleofuture.gizmodo.com/the-secret-weather-manipulation-program-of-the-vietnam-1689249533>

Timeline around my direct involvement

Popeye, Philippines? 1966: Risk Reduction phase. (Ken Kaiser)
State Dept reports area west of Bolevans Plateau, Laos

Compatriot/Intermediary flew from 1967-1972

WC-130As (and RF-4Cs) out of Udorn RTAFB

TOP SECRET SPECAT LIMDIS NOFORN EYES ONLY

Assigned Tan Son Nhut AB, Vietnam, SWOAT, June 1969-Feb 1970

TDY to Udorn AB at least three separate occasions.

I flew with the aircrews, probably seven missions.

My in-flight observations on seeding missions:

Once we seeded a narrow towering cumulus cloud.

The latent heat was released, but the acceleration entrained dry air from the side of the cloud.

It dissipated.

Obvious: we killed it.

This matches the “K-parameter” for computer modeling, the $1/\text{cloud radius in meters}$ parameter, it means that seeding works when the cloud towers are “fat clouds;” conversely.

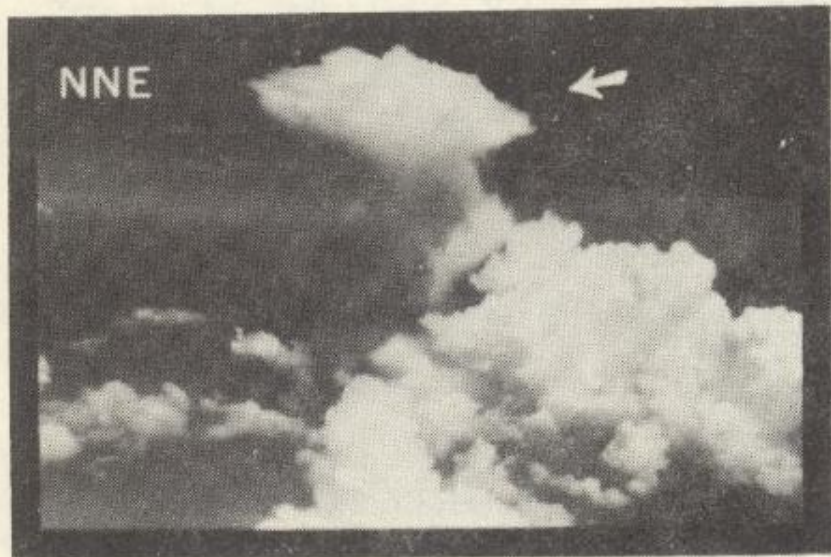
This is what NOAA published. They called it “Cutoff Tower Growth:”

ftp://ftp.library.noaa.gov/noaa_documents.lib/NOAA_historic_documents/ESSA/ESSA_ERLTM_AOML/TM_AOML_10.pdf

Woodley, W. L., et al, Some Results of Single Cloud Pyrotechnic Seeding in Florida, 1970, NOAA Technical Memorandum ERLTM-AOML 10. US Department of Commerce, NOAA, Environmental Research Laboratories

Cutoff Tower Growth

Fig 17C Cloud 27 T+27 minutes. P 62



c.

1852 GMT

T+27

(fig. 17e). This picture shows a truly classic example of what is meant by cutoff tower growth. The cloud top was continuing to rise almost completely cut off from the cloud body below. A dry layer in the middle levels (700 to 500 mb) in the environment of a cloud is apparently one of the prerequisites for this growth regime. Entrainment of this dry environmental air by the cloud weakens its mid-section and natural or artificially induced buoyancy near cloud top serves to sever the connection of the top of the cloud with its body below.

My in-flight observations on cloud seeding missions:

On numerous occasions, when the area was working nicely, we could “hit” one cumulus, and hit another one, then come back to the first one to see whether hitting it again would result in more cloud growth.

We could be hitting three clouds over a 15-minute period to achieve excellent cloud growth over an extended area, and we could see the results in copious rainfall emerging from the cloud base, which further aided our decisions on the seeding sequence.

It was not unusual for us to encourage two seeded growing clouds to join, a “merger” which became a larger two-cell, even a multi-cellular complex

More in-flight observations from those missions:

One “good” day, we were busy working a good number of clouds over the Ho Chi Minh Trail of Laos; we were east of Nakon Phanom RTAFB, Thailand, and west of the Mu Gia Pass.

The clouds were working so well that we had four pairs of clouds we were working in a group, then found another two pairs, each of which became a two-cell merged complex, and repeated.

After working these second two pairs, we turned, and, looking back where we had started, **the sky was black with a Mesoscale Convective Complex, MCC, of heavy rain.**

There is no doubt in my mind that **we created that MCC** where none would have existed, because an inversion about 22,000 ft MSL was inhibiting convection. But by adding the latent heat by flying directly into the towering cumulus and seeding them directly, we had converted the supercooled droplets to ice.

We liberated the latent heat of fusion within those supercooled clouds, we caused cloud buoyancy in the complex to punch through that inversion, and merge with the other towering cumulus clouds we were working.

More of my observations, after flying those missions:

After I returned to Tan Son Nhut, in my APO mail, there was an article in the Journal of Applied Meteorology written by Dr. Joanne Simpson, saying that she and her NOAA group found similar results, creating Mesoscale Convection Complexes from their cloud seeding operations in Florida.

It made perfect sense, seeding supercooled droplets in towering cumulus clouds over a peninsula on the southeast side of a large continent in the warm season; the analog is almost perfect.

Below is a paragraph extract, a screen capture from a 31 May 1972 Comptroller General letter report to Senator Schweiker, from the GAO, which specifically addresses this phenomenon:

The results of these experiments, according to NOAA, indicate that seeded clouds, on the average, yield more than three times as much rain as unseeded clouds. NOAA has estimated that seeding individual clouds yields 100 to 250 acre-feet of additional water for each cloud and that seeding two single clouds which merge can yield approximately 20 times as much water as two singly seeded clouds which do not merge.

I am sure, almost positive, that this part of the letter report to Senator Schweiker was derived from the cloud seeding experiences of Joanne Simpson and her group, part of NOAA's National Cumulus Modification Project.

Simpson's colleague, William L Woodley, in NOAA's Technical Memorandum ERLTM-AOML 10, "Some Results of Single Cloud Pyrotechnic Seeding in Florida, 1970," p 70,

, "...on fair days, the rainfall increases due to seeding are in the range of 350-400 acre-ft, or *on the order of 400 percent of the unseeded clouds' precipitation.* The differences are significant at the 0.5 percent level."

and p 81,

"We believe that with the 1970 experiment the growth and rainfall aspects of individual Florida cumulus clouds have been fairly conclusively established. Conditions have been specified quantitatively under which *it is possible to greatly enhance vertical growth, consequently producing precipitation of more than 100 per cent* or several hundred acre-feet." <underlining, and bolding emphasis added>

Project was leaked to the press. Press story was accurate.

Details of US, specifically the USAF, Weather Modification efforts in the Vietnam War including the code-word names, were revealed.

18 March 1971 Jack Anderson Column, Washington Post

4 July 1972 Seymour Hersh Column, New York Times

Proverbial crap hit the fan.

There was outrage, some appears feigned to me, in the Senate, and in the press.

Some of this was political posturing on the part of the Senate Democrats.

Eventually, this led to us signing a treaty that we would not modify the environment for military purposes.

Pentagon Upset Over News Leaks

PERIODICALLY, the Pentagon tries to scare off our news sources by unleashing its bloodhounds to find out where we get our information.

The bloodhounds are now loose again, searching up and down Pentagon corridors for our trail, growling at anyone who might have been seen talking to us.

The brass hats want to know how we found out that Air Force rainmakers have been seeding the clouds over the Ho Chi Minh trail network during the wet seasons.

This novel attempt to produce cloud-bursts to wash out the trails, we reported, was known by the secret code name: "Intermediary-Compatriot." Only a few insiders were supposed to know that, and the brass would dearly like to find out who blabbed.

The New York Times

NYTimes MAR 9 1973
Nixon Asked if U.S.

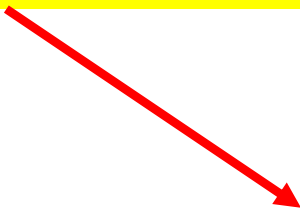
Used Rainmaking in War

WASHINGTON, March 8 (AP)—A scientific group said today that the time had come for President Nixon to disclose whether the United States used artificial rainmaking as a weapon in the Vietnam war.

"We see geophysical warfare as a Pandora's box to which the seemingly inoffensive weather modification may be the disastrous key," the Federation of American Scientists told the President in a letter.

The group, which speaks for 4,500 scientists said: "The use of weather modification as a weapon of war is an opening wedge to the use of climate modification, the inducement of earthquakes, and other still more terrible methods."

Inducement of
Earthquakes!



Weather Modification Alarmism

Eugene Register-Guard

LANE COUNTY'S HOME NEWSPAPER

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WEATHER MODIFICATION HISTORY

2 SECTIONS

EUGENE, OREGON, SATURDAY, MAY 20, 1972

34 PAGES

Weather warfare

Science News' April 15 issue carried a most interesting article: "Weather modification as a future weapon."

Among other things, the piece mentioned Senator Claiborne Pell's fears that the United States may already have put weather modification expertise to use as a weapon of war in Southeast Asia.

The Rhode Island Democrat and others in Washington have heard "unofficial and unconfirmed" reports suggesting that U.S. planes have been seeding clouds over the Ho Chi Minh Trail country to increase rainfall and make it more difficult for infiltrating North Vietnamese troops to use.

Other unofficial and unsubstantiated reports have even suggested that catastrophic floods which caused an estimated one million North Vietnamese to lose their lives last year were triggered by such techniques as cloud seeding.

Senator Pell and 13 other senators have been sufficiently disturbed by these reports and by expressions of expert opinion concerning the feasibility of "meteorological warfare" that they have introduced a draft treaty for the international banning of any such military action.

Some may scoff and rhetorically ask, "Aren't raindrops to be less dreaded than bullets or bombs?"

Maybe yes, maybe no, Science News writer Louise A. Purrel seems to have disclosed. She has noted that after extended efforts to get reassuring information from Secretary of Defense Melvin Laird and other government officials, Sen. Pell said:

The use of rainmaking as a weapon of war can only lead to the development of vastly more dangerous environmental techniques whose consequences may be unknown and may cause irreparable damage to our global environment.

Does make you shiver a bit, doesn't it, when you think that some day an enemy might use satellites to drop "rain seed" throughout the entire Mississippi drainage basin? Or that enemy rockets might be used to stir huge cyclones and tornadoes all across the U.S.?

The land would not be contaminated as it would be by nuclear weapons attacks. But the military effects might be equally great, or greater.

Really stupid.! Senator Pell could NOT have passed even high school physics.

Using a **satellite** to drop "rain seed" throughout the entire Mississippi River Basin?

Use rockets to stir huge cyclones and tornadoes across the US?

<You don't "drop" stuff from satellites>

It requires a "de-orbit burn," firing propellants!

Rockets don't cause cyclones and tornadoes, it's the temperature difference between equator and pole.

1973 Fearmongering by Sen. Claiborne Pell, D-RI:

"Before its too late!" Tipping point!

Stimulation of Earthquakes....

Controlling of Ocean Currents

"Creation of Tidal Waves!"

"may have created a part in the (1971) floods that devastated the dikes ricelands of North Vietnam."

Bob Comment:

There were devastating floods in the Red River Valley of North Vietnam in 1971.

But flooding is very common in these rice fields.

The dikes are up to 2700 years old.

But the US was seeding in the Ho Chi Trail, on the other side of the Annam Mountain Chain!

SEN. PELL URGES

FOLLOW US ON FACEBOOK
WEATHER MODIFICATION HISTORY

L.A. TIMES OCT, 8 1973

End Weather Warfare Before It's Too Late

BY CLAIBORNE PELL

The threat of devastation from a whole new kind of warfare—environmental warfare—is moving all too rapidly from the realm of science fiction toward reality.

That is why, in my view, it is imperative that the U.S. government take the leadership among the nations of the world in an effort to lock the Pandora's box of environmental warfare before it is too late.

The reality of the threat, and the need for action to forestall it, has already been recognized by the Senate. By an overwhelming vote of 82 to 10, the Senate on July 11 adopted my resolution urging the government to seek an international agreement prohibiting the use or development of any environmental or geophysical warfare techniques.

The prospective range of such warfare is awesome—from simple rainmaking to possible earthquake stimulation, to the controlling of ocean currents or the creation of tidal waves. In addition to the direct destructive effects of such activities, there is the danger of unforeseeable repercussions from tampering with complex and not fully understood forces.

My own concern over the prospects of environmental warfare, I regret to say, was aroused by reports that our government was using weather-modification techniques in the war in Southeast Asia.

Unofficial reports in the press indicated that the United States was utilizing rainmaking techniques in an apparent effort to muddy the Ho Chi Minh Trail, to bog down the "other side" in a sea of mud. There were similar reports that these rainmaking efforts, in the monsoon climate of Southeast Asia, may have played a part in the floods that devastated the diked ricelands of North Vietnam. And there were reports that a refinement of this weather warfare was a method of precipitating a corrosive rain that would rust the trucks, radar and equipment of the enemy.

These reports were, to me, disturbing. More disturbing was the reaction of our Defense Department when I requested

more specific information. The department refused to provide information, even on a classified basis, to the Foreign Relations Committee, stating that the information requested was "closely related to national security." I had always thought national security to be a proper concern of the Foreign Relations Committee.

I reluctantly reached the conclusion that the U.S. forces did, indeed, conduct weather-modification activities in Southeast Asia. I would not be surprised if other countries have taken steps to develop their own offensive military weather modification capabilities.

I have not been alone in my concern about the prospect that environmental warfare might become a part of the arsenal of future wars. Within the past year these distinguished organizations have appealed for caution:

Claiborne Pell, the junior senator from Rhode Island, is a member of the Foreign Relations Committee. He is a Democrat.

—The National Academy of Science's review panel on Weather and Climate Modification recommended that the United States take international leadership through the United Nations to dedicate all weather modification to peaceful purposes.

—The National Advisory Committee on Oceans and Atmosphere—a presidentially appointed body—in its first annual report to the President and the Congress recommended that the United States "dedicate all weather-modification efforts to peaceful purposes."

—The Federation of American Scientists urged the President to make a full public disclosure of any offensive military weather-modification activities in Southeast Asia. That appeal, like my own earlier requests, was met with a nonsubstantive response.

—The North Atlantic Assembly, composed of members of Parliament from NATO nations, adopted a resolution recommending a treaty to ban environmental

modification except for peaceful purposes.

With this background, the Senate Foreign Relations Committee and the Senate in July adopted my resolution.

I am hopeful that the President will heed these voices of concern—the voices of the National Academy of Sciences, the North Atlantic Assembly, the American Federation of Scientists, the National Advisory Committee on Oceans and Atmosphere and the U.S. Senate.

If these words go unheard, perhaps recent natural events should speak loudly to the Administration of the potential horror of environmental warfare:

—A disastrous crop failure in the Soviet Union placed that nation in a state of dependency on American agriculture.

—A cyclical change in ocean currents off Peru devastated that nation's anchovy harvest, one of the principal world sources of protein, with worldwide economic repercussions.

—A drought in West Africa is threatening the lives of millions.

These were natural events. They demonstrate man's increasing dependence on the whims of nature. God forbid that such events should ever depend on the strategic planning and technological capabilities of any nation.

We have learned through the SALT talks the immense difficulty involved in controlling arms, once they are in the arsenals of the superpowers. In the case of environmental warfare, could we not take the easier course of banning a horror before it is demonstrated to the world? Do we really need an environmental equivalent of Hiroshima before we decide that this genie must remain in its bottle?

The war in Vietnam is behind us. We are looking now toward an era of increased international harmony and cooperation. Within our country, the Administration is talking of a new spirit of bipartisanship and consultation with Congress. The climate should be right for action to ban environmental modification as a weapon of war.

Weather war outcry

CONGRESSMEN QUERY AMERICAN RAINMAKING PROJECTS

From PETER BERNSTEIN
in Washington

IT SOUNDS straight out of Buck Rogers, but at least a score of prominent scientists and congressmen suspect environmental warfare is already under way.

"There's no doubt in my mind that it's going on in Vietnam," says Representative Gilbert Gude.

"Such activities could very well lead to another international weapons race," warns Senator Claiborne Pell.

The Pentagon, they suspect, is secretly augmenting rainfall in South-East Asia for military purposes.

Although Pentagon officials have thrown a security blanket over all aspects of geophysical warfare, meteorologists agree that they are searching for ways to harness such "weapons" as earthquakes, tidal waves and tropical hurricanes.

For the first time in the history of warfare, the Air Force is reportedly seeding clouds over the Ho Chi Minh trail in North Vietnam. Last summer the monsoon fell with unprecedented fury and washed out railways and highways and crippled the electric generating capacity of North Vietnam. Similar floods in 1945 took a million lives.

In an exchange of letters made public last week, a group of congressmen asked for information last June about the Air Force's rain-making project, known by the code-name of "Intermediary-Compatriot."

Acting on behalf of a contingent of 130 senators and representatives called Members of Congress for Peace Through Law, they also asked for details about other instances of weather manipulation for military purposes.

The "Intermediary-Compatriot" project for seeding clouds during the monsoon was revealed on March 18 last year by the columnist Jack Anderson.

His report, based on a secret document, said the rain-making was started in 1967. Defence Department sources subsequently acknowledged the contents.

The Pentagon's chief scientist, Dr John Foster, jun, told the congressmen in a two-paragraph letter last December 8 that the information they sought was "classified."

He added: "I find it necessary to respectfully and regretfully decline to make a public disclosure of the details of these activities at this time."

In effect, he seemed to confirm that some form of weather modification activity was under way against the North Vietnamese, the congressmen said.

Their suspicions became even more pronounced when the Defence Secretary, Melvin Laird, informed them in a subsequent letter on March 18 that "some aspects of our work in this area (weather modification) have a definite relationship to national security and are classified accordingly."

He claimed information

concerning the classified work, had been provided in briefings with chairmen of the House and Senate armed services and appropriations committees.

But since then Congressional concern over military weather modification has grown. Three weeks ago, Senator Pell introduced a resolution setting forth a draft treaty to prohibit geophysical and environmental warfare.

And in a letter this week to President Nixon, Congressman Gude, who heads a special committee within the congressional peace group, urged the President to adopt a "no first use" policy regarding offensive employment of environmental weapons.

Congressional concern has even spread to an unclassified Pentagon project known as "Nile Blue."

Under this project, a large and very powerful computer called the Illiac IV simulates

atmospheric changes in order to predict the effects of modifications man might make in the environment.

The computer's military value was made clear in testimony last year before the Senate appropriations committee.

A witness, Stephen Lukasik, director of the Pentagon's Advanced Research Projects Agency, said in a prepared statement: "Since it now appears likely that major world powers have the ability to create modifications of climate that might be seriously detrimental to the security of this country, Nile Blue sub-project was established in fiscal 1970 to achieve a US capability."

"The idea that this might be used as a military weapon is a very frightening thing," Congressman Gude said in an interview. "Using weather modification as a military tool opens the door to a vast new category of warfare."

He added that with evidence now that the merging of clouds could produce more than 30 times as much rain, it was possible to foresee the steering of tropical hurricanes and cyclones and the triggering of earthquakes in certain areas.

At the present rate of technological progress, geophysical warfare was a real possibility, said Gordon J. F. Macdonald, who first openly discussed the subject in a collection, "Unless Peace Comes," published in 1968.



Senator Claiborne Pell.
Weapons race warning.

Now a member of President Nixon's Council on Environmental Quality, Macdonald believes steps should be taken to prohibit destructive manipulation of the weather.

"Let's start discussing it now at an early stage," he said, "so we don't repeat the mistakes we made with biological weapons, the production of something that turned out to be a wasted effort."

The National Academy of Sciences has also pressed for a ban against geophysical warfare.

Thomas Malone, dean of the graduate school at the University of Connecticut and chairman of the National Academy's special panel on weather modification, said that of all the fields of science, none had produced greater international co-operation than meteorology.

"What a tragic reversal it would be if we started using our knowledge to beat one another over the head."

Newhouse News Service through AAP



Mr Melvin Laird. National
security involved.

This is very ill-informed.

The rainfall that crippled railways and highways and crippled electrical generating capacity in North Vietnam was in the Red River Valley

Rainfall from Compatriot/Intermediary was over the Ho Chi Minh Trail in Laos, not in the area north of Hanoi, North Vietnam.

The Ho Chi Minh trail was not and was never in North Vietnam.

Pentagon Admits Using Rainmaking in Vietnam

Clandestine Program of 1967-72 Falsified in Reports, Senate Testimony Reveals

BY JOHN H. AVERILL

Times Staff Writer

WASHINGTON — The U.S. Air Force conducted clandestine rainmaking operations over Indochina from 1967 to 1972 and falsified reports about it as it did in the secret 1969-70 bombing of Cambodia, a Senate committee said Saturday.

The Senate Foreign Relations Committee released the transcript of a closed-door hearing on March 20 at which the Defense Department officially acknowledged for the first time that it had used rainmaking as an offensive weapon in the Vietnam war.

The Pentagon, which had classified the rainmaking program as "top secret," refused at the time to let the transcript be made public. But it later relented under prodding from Sen. Claiborne Pell (D-R.I.), chairman of the foreign relations subcommittee on oceans and international environment, which conducted the hearings.

In a statement accompanying the transcript, the subcommittee said the rainmaking was conducted over North and South Vietnam, Laos and Cambodia.

The cost of the six-year program was estimated by the subcommittee at \$21.6 million. It involved 2,602 cloud-seeding flights, the bulk of them in 1968.

Pentagon witnesses testified at the March 20 hearing that the objective of the rainmaking was to



Sen. Claiborne Pell
(AP photo)

disrupt enemy forces by softening road surfaces, causing landslides along roadways, washing out river crossings and keeping soil saturated.

There was uncertainty among the witnesses, however, about the program's effectiveness.

"The results of the project cannot be precisely quantified," Army Lt. Col. Ed Soyster of the office of the Joint Chiefs of Staff told the subcommittee.

He said some experts "estimated that rainfall was increased in limited areas up to 30%."

To maintain secrecy, the Pentagon handled the rainmaking program in a manner similar to the Cambodian bombing, in which reports to lower echelons were falsified and accurate accounts were submitted only to top authorities.

"Because the program was considered sensitive, reporting procedures were instituted to limit knowledge of the program," Soyster testified. He said the cloud-seeding flights were "reported through normal channels" as either weather reconnaissance flights or straight reconnaissance missions.

The cloud-seeding, involving the dropping of silver and lead iodide chemicals, was conducted by 7th Air Force planes stationed in Thailand.

Expressing puzzlement over the secrecy surrounding the operation, Pell told one witness:

"I am reminded of the old maxim—'An elephant labored and a mouse came forth.' What was the reason for this great secrecy?"

Air Force Maj. Gen. Ray Furlong, a deputy assistant secretary of defense, agreed.

"Your observation—the elephant laboring and bringing forth a mouse—I think reflects in large measure our current perception of the classification," he said.

Included in the hearing transcript was a letter from former Defense Secretary Melvin R. Laird apologizing for having told the Foreign Relations Committee on April 18, 1972, that the United States had never engaged in weather modification over North Vietnam.

In the letter, dated last Jan. 28, Laird said he had "just been informed that such activities were conducted over North Vietnam in 1967 and again in 1968."

Using national security to lie for political advantage is not new.

Point in case:

Nixon's Secret War in Cambodia! →

Daniel Schorr whined about it for years when he was on NPR.

Conveniently omits the fact that we were sending ARC LIGHT B-52 strikes into Cambodia on a daily basis from when I arrived on Guam on 8 Sept 1966, until I redeployed in Feb 1967!

LBJ was the President who escalated our involvement in Vietnam, and was President when I deployed with my B-52 unit to Guam.

Laird: Cloud Seeding in North Vietnam

During the Johnson Administration! →



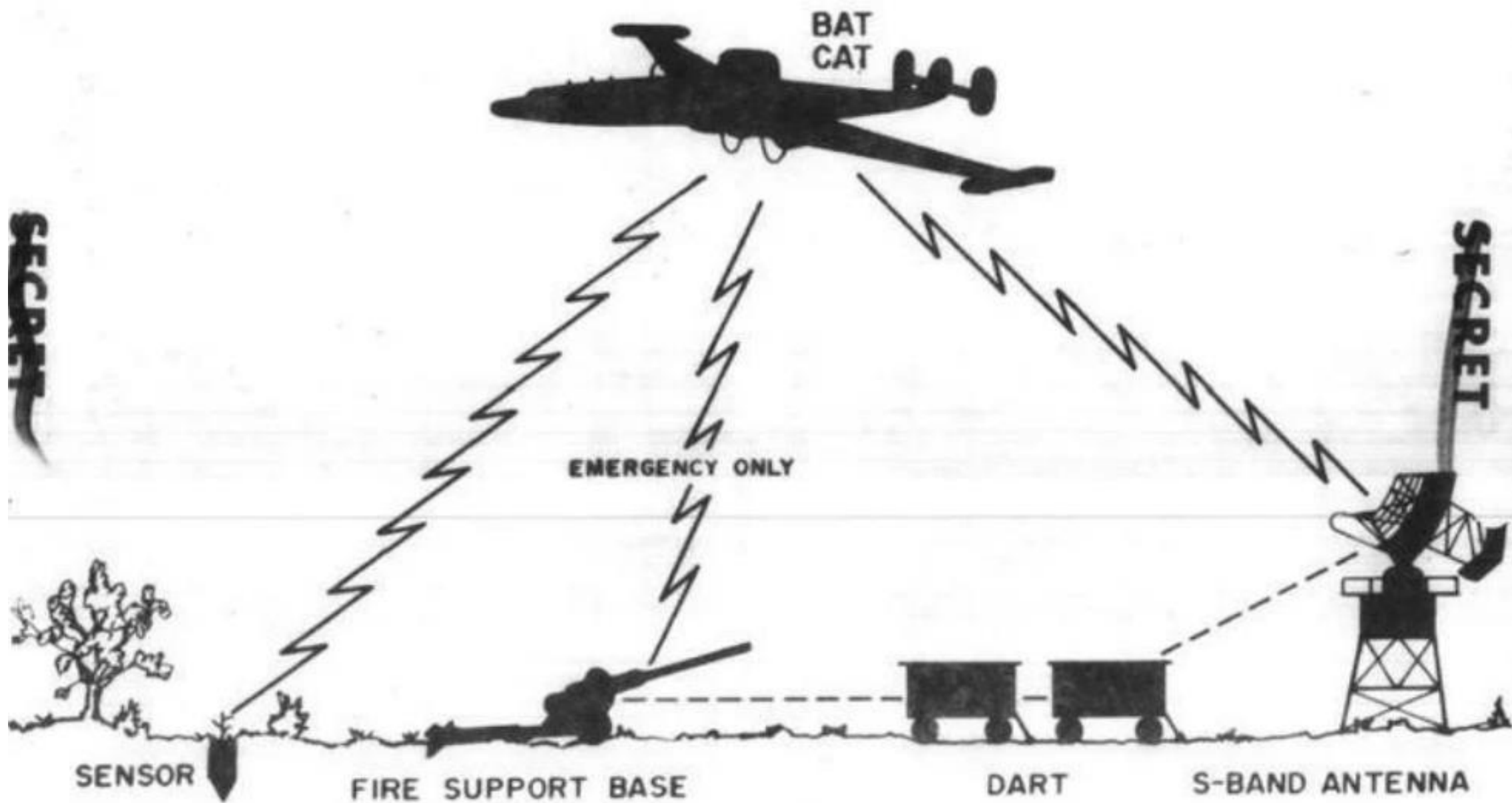
NIXON'S SECRET AIR WAR

THE U.S. PRESIDENT AUTHORIZED COVERT
CROSS-BORDER B-52 STRIKES TARGETING
NORTH VIETNAMESE FORCES STAGING
IN CAMBODIAN SANCTUARIES BY ROBERT O. HARDER

BOMBS AWAY A Boeing B-52
Stratofortress unleashes its
massive payload during an
Operation Arc Light raid.

Sidebar on IGLOO WHITE Sensors, aircraft relay to Task Force Alpha

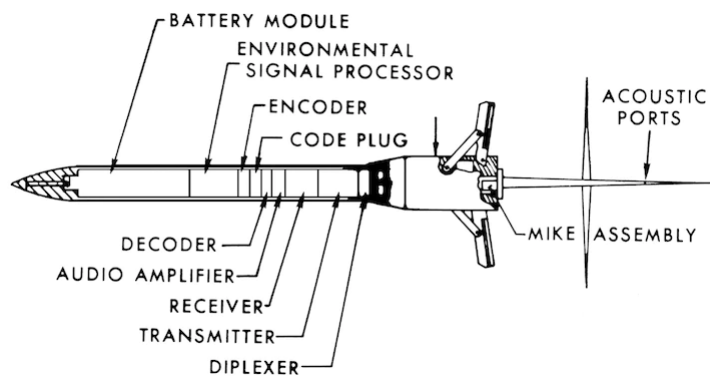
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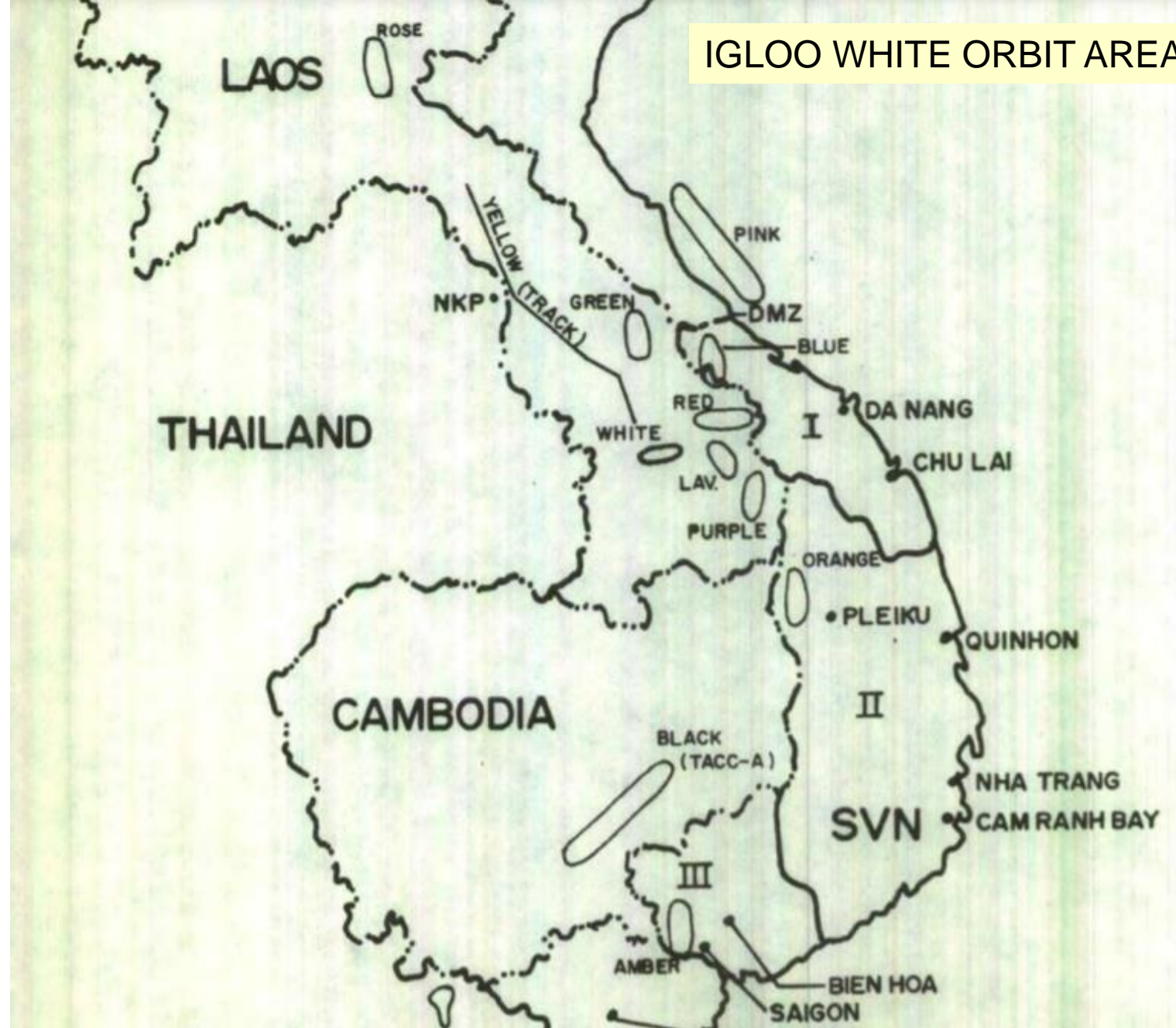
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An EC-121R "Batcat" orbiting above the Ho Chi Minh Trail. The aircraft receives sensor signals and transmits the signals to Task Force Alpha's Information Surveillance Center, Nakhon Phanom, Thailand. (National Museum of the U.S. Air Force)



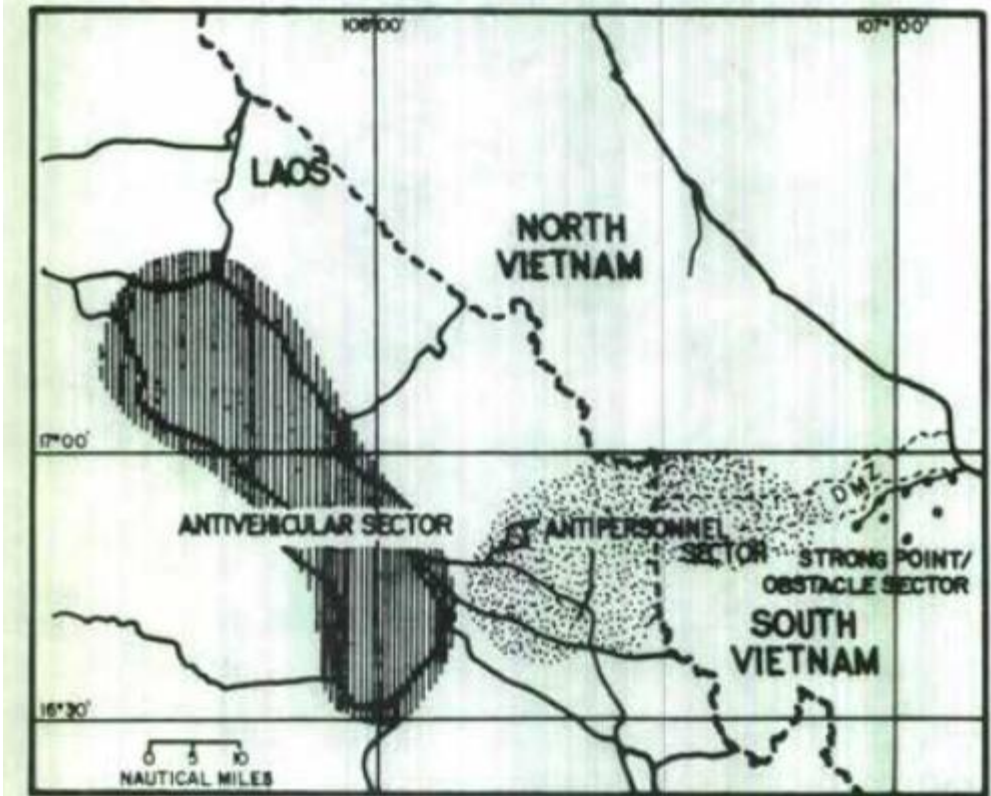
IGLOO WHITE ORBIT AREAS







The Ho Chi Minh Trail originated in North Vietnam and wound through Laos and Cambodia into South Vietnam. (Office of the Secretary of Defense Graphics)



ANTI INFILTRATION
SUBSYSTEMS

FIGURE 1

~~SECRET~~

The Ho Chi Minh Trail originated in North Vietnam and wound through Laos and Cambodia into South Vietnam. (Office of the Secretary of Defense Graphics)

Combat Information Monitor, CIM, aboard an EC-121R Super Constellation of the 553d Reconnaissance Wing, Korat AB, Thailand.



An Air Force sergeant decodes sensor signals aboard a C-121 aircraft in support of Operation IGLOO WHITE, April 10, 1968. (National Archives)

Climate change and Human Climate Modification stories

FOLLOW US ON FACEBOOK
WEATHER MODIFICATION HISTORY

In 1966 Reid Bryson noted that as <CO2> increases dramatically, the temperature has been falling... for at least 15 years.

Weather Patterns Altered

Dust May Spell Mankind's Doom

WASHINGTON (UPI) — With-
out at all meaning to, man may
be sentencing himself to dusty
death.

It lies within his power—per-
haps—to suspend or remit the
sentence. But will he?

The threat of dust and other
atmospheric pollutants, includ-
ing jet vapor trails and the
smoke of cities, was aired at a
symposium here for science
writers on atmospheric physics.

Effect Pointed

Dr. Reid A. Bryson of the
University of Wisconsin said that
dirty air, by reflecting sunlight
back into space before it can do
its normal work, alters the at-
mospheric heat flow which
drives the weather.

It thus may make deserts
more desert-like and cold climates
colder.

Carbon dioxide from burning
fuels tends to warm the planet
because this gas blocks radiation
of heat back to space. So you
would think that as man burns
more and more fuel in his in-
dustries, cities and automo-

biles, his climate would get
warmer and warmer and warm-
er.

The average world tem-
perature did, indeed, rise some-
thing like half a degree between
1850 and 1950, a period in which
the carbon dioxide content of the
atmosphere rose about 30 per
cent.

Readings Decline

But an odd thing has hap-
pened. In the past 15 years, with
the carbon dioxide level still ris-
ing, the world temperature has
gone down as much as it had
risen in the previous 100 years.
Why?

Between 1950 and 1965, Bryson
said, the dirtiness of the at-
mosphere (in the United States,
at least), practically doubled.
Dirt particles, it may be rea-
soned, are turning back more
solar heat than carbon dioxide
is trapping.

Where does the dust come
from which may be affecting
climate? Jet aircraft produce
vapor droplet contrails ("dust"
for meteorological purposes)

which reflect sunlight.

Bryson has studied the great
Rajputana desert in northwest
India and found that dust as-
cending to 35,000 feet from the
surface was helping to keep the
desert a desert.

In ancient times, up to 3500
B.C., the Rajputana supported a
rich farming civilization. By
700-800 A.D. it was a region of
blinding dust storms, having
been "brutally overused" for ag-
riculture.

New technological methods —
brainy computers, satellite sys-
tems capable of making weath-
er observations in the 90 per
cent of the globe not now cov-
ered, a brand new system of
round - the - world atmosphere-
studying balloons — may im-
prove weather forecasting and
pave the way to intelligent cli-
mate modification.

Bryson thinks that what man
has done, as in Rajputana, he
can somehow undo. But not all
experts are convinced current
ideas of climate control can
stave off disaster.

Major Shift in World's Weather

WASHINGTON — There is mounting evidence around the world that a major shift in the earth's weather is under way but what is causing it is still one of nature's most baffling mysteries.

Freakish droughts, floods, and violent storms all over the globe — coupled with less perceptible long-term changes in temperature and rainfall — all are part of the shifting weather picture according to government weather experts studying the changes.

A graphic illustration of changing patterns is the semiarid region that lies just below Africa's Sahara desert. Millions of people in that region have been threatened with starvation during the past two years in one of the worst droughts on record. The edge of the parched desert is creeping south at the rate of 30 to 100 miles per year, burning out grazing land, farms, and towns.

Here in the U.S. deadly tornadoes have been striking in record numbers and far outside their normal paths. Many of these violent storms in recent weeks have followed a path to the north and east of the usual spring "tornado roadway" — running from Texas through Nebraska. More than 70 tornadoes were reported in one day on April 3. In addition to the violent storms, high winds have caused some of the worst dust storms since the 1930s in sections of Texas.

While government weather experts have no definite answers for the changing weather patterns in the U.S., one possible reason being investigated is a shift in so-called jet stream wind patterns of the upper atmosphere.

This shift has been detected by the National Severe Storms Forecast Center in Kansas City. Its officials are forecasting that if these jet stream changes continue that there will be a greater frequency of tornadoes in the Great Lakes States, the Gulf States, and on the East Coast.

Government meteorologists are now trying to determine if the shift of the jet streams crossing the U.S. and the change in upper atmospheric winds in the Caribbean area have had anything to do with the fact that the U.S. has not been hit by a major hurricane for the past two years.

Unseasonably cold weather in Japan — with predictions that the cooling trend will continue — is being studied by U.S. weather experts to see what is causing it and the impact that this change might have on jet streams coming this way.

Since the weather developed over Communist China and Russia affects these jet streams, American officials are gathering as much information as they can about conditions in those regions.

The Russians and Chinese are

exchanging some weather data with the U.S., but none of their officials will discuss any of their government's secret weather-changing experiments.

The Russians are known to be spending millions of dollars to try to control the weather but American intelligence authorities have been unable to obtain any hard information on how successful they have been or details of their experiments.

Opening Pandora's Box

The secrecy and importance of weather modification experiments was highlighted recently during a closed door appearance of Secretary James R. Schlesinger before the Senate Foreign Relations Committee.

Although the meeting concerned the Strategic Arms Limitations Talks now underway with Russia, Senator Claiborne Pell (D. R.I.) raised the subject of weather control and the progress being made in this field, stating:

"It opens up the Pandora's box so that the next step is the development and pointing of typhoons."

Reluctant to discuss the matter, Schlesinger replied:

"I think the Pandora's box element is a point well taken."

When pressed further, Schlesinger admitted that both the U.S. and Russia were conducting experiments to control storms and change the weather but balked at going into any details.

This is in 1974, near the coldest in the post-1940 cooling period.

1974 had several severe tornado outbreaks including the tornado that struck Xenia Ohio.

1974 also was when Arctic Ice was at a maximum.

This is when many seal pups were unable to breathe through polynyas in the ice.

As a result, Polar Bear Cubs, which feed on seal pups, died by the thousands!

That's right, the data show that it is extreme cold and ice that kills Polar Bear Cubs, and reduces Polar Bear populations.

9 June 1972

Rapid City Flood

WINNIPEG TRIBUNE

FOLLOW US ON FACEBOOK
WEATHER MODIFICATION HISTORY

Thursday, June 5, 1975 ★ ★

Experiment killed 238, suit says

RAPID CITY, S.D. (Reuter) — Relatives of five persons killed in a flood here three years ago are suing the U.S. government, charging that rain-making experiments caused the tragedy in which a total of 238 persons died.

The four plaintiffs each seek \$250,000 damaged for loss of life and \$75,000 for loss of property.

The complaint states that the U.S. interior department contracted with South Dakota School of Mines and Technology on July 1, 1969, to

conduct random cloud-seeding experiments.

On the day of the floods, a seeding experiment was carried out by the school in the Black Hills area near here. About 14 inches of rain fell later that day and the next night, but a federal government report absolved the school of blame.

But the lawyer for the plaintiffs said that in the three years since the flood, scientists have begun to question the report's conclusions.



Rapid City man says 1972 flood was not caused by cloud seeding study

June 9, 2020 by NewsCenter1 Staff

RAPID CITY, S.D. — A day many will never forget in Rapid City — 48 years ago. Rapid City saw life change in an instant as flood waters rushed through town, devastating homes, businesses, and lives.

At the time, NewsCenter1's Chief Meteorologist Bob Riggio was a graduate student at the South Dakota School of Mines and Technology. One of his advisors was Dr. Arnett Dennis, who was working on a research study called "Project Cloud Catcher." The focus of the study was looking at seeding clouds to hasten the onset of rainfall from a particular cloud. The project drew questions nationwide about the cloud seeding connection to the 1972 flood.

Months ago, Dennis sat down with us to recount his day on June 9th, 1972 and say why he says the two events were not related.

South Dakota Governor Richard Kneip called for a three-person panel to investigate and answer the question, "Did cloud seeding cause the flood?"

"They said if there had been no cloud seeding, the flood would have been the same," said Dennis.

Dennis said some people chose to not believe the panel and said there was no way to prove that cloud seeding did not cause the flood. In response, Dennis asked those people to provide a hypothesis to show how seeding could have caused the flood.

"Never got an answer," said Dennis. "The salt seeding we did not increase the amount of condensed water, it just changed the size distribution of the cloud droplets a little bit."

Rapid City man says 1972 flood was not caused by cloud seeding study

June 9, 2020 by NewsCenter1 Staff

He adds, the clouds seeded on June 9 did not rain out over Pactola Reservoir or Rapid Creek.

A lawsuit filed in 1975 claimed the cloud seeding project was dangerous and done recklessly. **The attempt to set a legal precedent connecting the flood and project failed on legal grounds in the 8th Circuit Court of Appeals less than a decade later.**

The “issue of causation of the flood was never argued and decided in court.”

Years later, Dennis says some people still believe Project Cloud Catcher and the 1972 flood are related but 48 years later, nothing has been proven one way or the other.

“We had winds aloft up to 70 miles per hour from the southeast over the southern part of our area,” said Dennis. “The 70 mph winds was something unheard of.”

They decided to take to the skies with sights set to seed near a shower in the northern Black Hills.

“A test case, as we called it, on some little showers up in the northwest of us near Sturgis but they did their thing and moved on,” said Dennis.

Nothing remarkable came from that shower. A second flight that same day led a crew just east of Fairburn.

“Around 5:30 p.m., the cloud was almost into Fairburn and then as the cloud group came over the first of the rising ground in the Black Hills, it just intensified a lot,” said Dennis. “Strongest one we had ever seen in Project Cloud Catcher.”

Brief Sidebar:

Ground-Based Dispensers:

Systems for Seeding Orographic Clouds to enhance
wintertime storms' snowfall

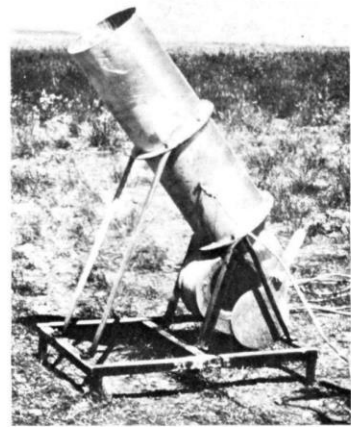
Anti-fog thermal systems

Cold Fog Dissipation Systems

Ground-based generators

Ft Lewis College is in Durango, Colorado

This started in the early 1970s, EG&G.



A silver iodide generator, a prime tool of the weather modifier's trade, is raised vertically by EG&G Company employee at Fort Lewis College.

Ground-based silver iodide in acetone solution burner, top. Below, a pyrotechnic hygroscopic generator burns brightly from ground at night.

Cloud seeding of orographic clouds.



The Bureau of Reclamation, BOR, has used surface-based silver iodide facilities to enhance “orographic” clouds --wintertime clouds over the Western Mountains of the USA.

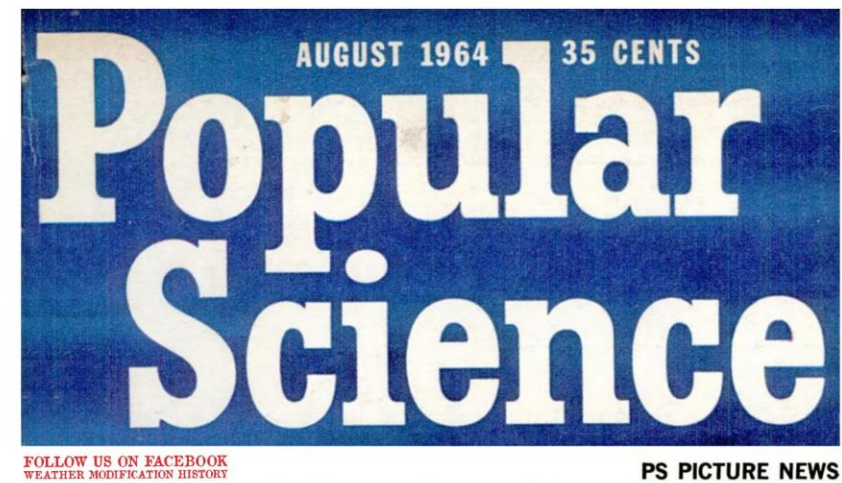
BOR’s 1968 Project Cloudwater reported 54% increases in snowfall when stratiform clouds were -12 to -20C, at 500 mb, less increases (12%) when 500 mb clouds were -21 to -23C and snowfall decreases when 500mb cloud tops were colder than -24C.

Same Cloudwater report showed that precipitation increases extended 100 miles downwind.

Same Cloudwater report showed study in Australia with Project Whitetop with similar increases in downwind precipitation, and, based on radar studies, echo intensity increased, decreased some, and then increased again. This suggests that cloud seeding activities do not result in extensive downwind precipitation deficits from cloud seeding.

Kahan, Archie, “A PROGRESS REPORT ON PROJECT SKYWATER, THE BUREAU OF RECLAMATION'S ATMOSPHERIC WATER RESOURCES PROGRAM,” Las Vegas, Nevada, December 12-13, 1968.

The French used hydrocarbon burners for a number of years to clear fog from airport runways.



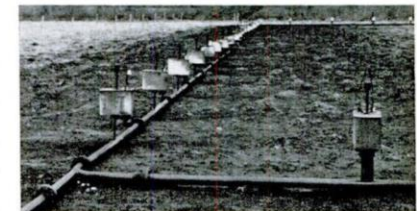
Lighted by glow of oil burners, Henri Dessens watches as heated air rises to form rain cloud.

Firing up a rainstorm

The trouble with chemical seeding of clouds is that you have to have clouds. Henri Dessens, French meteorologist, gets clouds by making his own—with heat.

Using a 400-by-400-foot square of oil burners he calls a meteotron, he sets off a roaring furnace that boosts a column of hot air into the atmosphere where it cools, collects condensation, and in 15 minutes becomes so heavy with water droplets that it bursts for a rain of several hours.

The meteotron can also, Dessens claims, create wind, scatter fog, prevent night frost, and occasionally—so far unpredictably—whip



Meteotron furnace has 125 burners fed by oil pipeline. It burns a ton of fuel a minute.

up the meteotron's unleashed power to control rainfall and hailstorms, clear up air pollution, dissipate radioactive fallout, and

This is "cold fog dissipation."

Supercooled droplets at the surface can be seeded, and the snow crystals form.

Water is removed when the snow crystals precipitate out of the fog.

Can be done with Silver Iodide and propane.

Seven Cities To Bomb Airports To Evaporate Fog For Aircraft

WASHINGTON (UPI) — At least seven cities will "bomb" their airports this winter with dry ice in an effort to keep air traffic moving even in thick fog.

The program is an aftermath of experiments by United Air Lines last December at Salt Lake City. UAL hired a cloud-seeding company to drop dry ice into fog on 14 separate occasions. The pellets evaporated the fog sufficiently to allow 30 flights carrying more than 700 passengers to take off or land.

This summer United went

to airport managers and city officials at seven other western cities particularly affected by a type of fog known as "super-cooled," which forms in below-freezing temperatures. To these communities — Seattle-Tacoma, Portland, Spokane, Reno, Pendleton, Medford and Boise — UAL in effect gave this argument:

"Try the experiment at your own airports. Fog seeding costs money (\$65 per flight in the Salt Lake tests). But you'll get it back and maybe more through landing fees. If planes don't land,

you don't collect. At airports like Medford and Pendleton, where landing fees are based on scheduled landings, we and other carriers will underwrite the cost."

All seven cities have agreed. Salt Lake City probably will join the program, too.

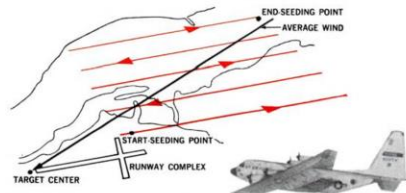
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WEATHER MODIFICATION HISTORY

How Science Wages the Fight Against Fog

New techniques can clear airports for safer landings, and some day may make highway driving easier



Before-and-after shots show results of airborne seeding with crushed dry ice to clear cold fog at Elmendorf AFB, Alaska. The Air Force now uses newer on-ground liquid-propane dispensers.



Airmen pulverize blocks of dry ice for fog seeding inside cargo hold of C-130. Drawing above shows pattern flown by planes upwind of airstrip so that the cleared area drifts over it.

By BEN KOCIVAR / PS Consulting Editor, Flying

If you encounter fog while traveling, it may be bad news. Despite today's sophisticated landing and radar systems, fog can still shut down airports, delaying or diverting your plane flight, costing the airlines millions of dollars each year. And travel along a crowded, fog-bound highway can be a deadly, nerve-wracking experience. A persistent fog can even trap pollutants.

We've had a grab bag of fog-clearing techniques for years. But the most common method, airborne seeding, is costly, and until recently worked with only one type of fog. Other fog-dispersal methods may create undesirable side effects.

Now, after extensive research by government and industry, important new progress in fog cutting has been achieved. The new techniques involve both airborne and ground-installation dispersal, and suggest an attack on fog may be economically feasible in geographic locations once subject to the whims of nature. One expert believes improved fog-dispersal techniques may one day be applied in non-aviation settings: to clear a dangerous stretch of heavily used highway for example, or perhaps just to dissipate the gloom a persistent fog can cast over a town. Among the new weapons in use, and under development and study:

- Ground seeding, achieved with colorless, odorless liquid propane gas sprayed as a mist into fog masses.
- Hydroscopic—moisture-removing—airborne seeding with microencapsulated chemicals that evaporate fog.
- Generating heat plumes (by burning smokeless liquid propane) which burn away the toughest fog.
- Spraying electrified water droplets that attract fog particles like magnets.

- Evaporating fog by mixing it with clear air, using helicopters, a technique proven in Viet Nam.

To learn how science is gearing up for a full-scale attack on fog, I recently visited Hanscom Field at Bedford, Mass., and rapped with weather-expert Dr. Bernard Silverman at the U.S. Air Force Electronic Systems Division. Then I spoke with Capt. Larry Menderhall and Ted Cress at Scott AFB, Ill. Cress and Menderhall have been testing fog-dispersal concepts in Alaska, the West Coast, Europe, and elsewhere.

Three types of fog. One of the first things I learned is that a three-way attack is required. Three basic fog types—ice fog, supercooled or cold fog, and warm fog—require different techniques to make them disappear. Fog is simply a cloud of microscopic water particles that restrict visibility to 3280 feet or less. Fog forms when moist air is cooled; when humidity reaches the saturation point, tiny water droplets form.

These droplets become ice crystals in extremely cold climates. This is ice fog, a rarity. In Alaska and Greenland, where ice fogs can be a problem, it's wise to locate airports upwind from the moist heat of public housing. One way to reduce ice-fog formation is to include moisture suppressors, such as heat exchangers, on exhaust pipes. To disperse small ice-fog clouds, large fans have been used.

When air temperature is just below freezing, there are no suitable ice embryos in the atmosphere, and water droplets form in a semistable physical state. Supercooled or cold fog results. Much of the success in fog dispersal has been with this variety. On a worldwide basis, however, cold fog represents only a tiny part of the problem. About 95 percent of the fog you'll encounter in the U.S. is the warm variety (water droplets above the freezing point). Warm fog is a stable suspension of droplets in air, and Dr. Silverman says "brute force" must be used to disperse it.

Fogs are further classified by the conditions under which they form (see drawings, next page). *Radiation* fog forms when moist air is cooled by heat escaping a surface via radiation; *upslope* fog occurs where moist air moves to higher elevations and decreased pressure; and *advection* fog develops when moist air passes over a cold surface. Also, *warm-rain* fog develops when water falls into a layer of cold air. *Warm-water* fog is produced by water vapor rising into a colder air mass.

Fighting fog from the air. Let's look first at what's been going on with seeding from aircraft. Strangely enough, while early experiments in snow making and fog clearing took place in the U.S., it was the Russians who picked up the idea and did something with it.

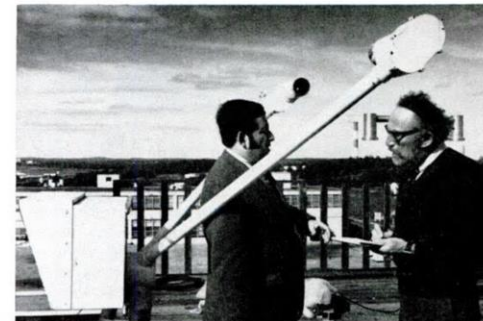
In 1946, General Electric scientist Vince Schaefer first demonstrated that dropping dry ice into clouds emptied them of moisture and created snow. In the 1950s, the Army proved it could make holes in fog. By 1957 the Air Force Cambridge Research Lab developed a "cloud buster" by carrying liquid CO₂ in an aircraft, pouring out snow-like expanded CO₂ into cold clouds.

It worked, but unfortunately the idea wasn't hotly pursued. Dr. Silverman learned from scientific reports that by the early 1960s the Russians were already using dry-ice operationally to clear airports of fog.

Here's why the airborne-seeding technique works:



Liquid-propane burners heat air in fog-clearing tests. Natural gas can also be used. Future installations will be underground.



Dr. Silverman gives explanation of fog-measuring gear to author Kocivar (right). Unit measures fog density across 1.5 cubic feet.

Since water droplets in cold fog are not physically stable, they can easily be converted to another state: ice. The introduction of ice-forming nuclei such as CO₂ particles creates ice crystals. The crystals fall as snow and open a clearing.

Dropping out at minus-five degrees. Ice crystals can also be produced by dropping silver iodide particles to form the nuclei. Capt. Cress of the Air Weather Service points out some major problems, however. Much supercooled fog exists in the temperature range from zero to minus-five degrees centigrade, and silver iodide is not an active ice nucleant above minus-five degrees. Also, the Air Weather Service found its big four-engine turboprop Lockheed Hercules transports had to fly within 250 feet of the top of fog banks for silver iodide seeding to be effective. In hilly terrain, that's not conducive to the longevity of pilots.

Dry ice creates problems, too. In the temperature range of zero to minus-one degree centigrade, ice-crystal growth is very slow. However, the dry ice does fall quickly through the fog, creating an ice-crystal curtain, which is practical and usable.

By the mid-sixties, United Airlines got impatient with government foot-dragging in fog dispersal and started its own air-seeding operations in northwestern airports. After that the Air Weather Service began using the techniques for military bases. (Today, using various methods, 13 civilian airports in the U.S. and 11 military fields here and abroad disperse fog.)

Why did it take us from 1946 to the sixties to start using the information on hand? Dr. Silverman, a physicist at the AF Cambridge Research Laboratory, believes it was because research money was aimed primarily at development of instrument-landing systems to make bad-weather landings safe. It seemed more promising to concentrate on radio, radar, and automatic flight-control systems.

Continued

End Sidebar on Ground-Based Systems.

Puzzlements after doing the research

State Department memo recommends pursuing cloud seeding in 1967

<https://history.state.gov/historicaldocuments/frus1964-68v28/d24>

Washington, 13 January 1967.

These are claims from the State Department document:

“(a) 82% of the clouds seeded produced rain within a brief period after seeding—a percentage appreciably higher than normal expectation in the absence of seeding.

(b) The amount of rainfall inducedrendering vehicular routes in this area inoperable. Since the end of the rainy season, the communists have failed to undertake route repairs and there has been no vehicular traffic.

(c) **In one instance**, the rainfall continued as the cloud moved eastward across the Vietnam border and inundated a **U.S. Special Forces camp with nine inches of rain in four hours.**

(d) DOD scientists...demonstrated a capacity to raise and maintain rainfall under controlled conditions ...the land is saturated over a sustained period, slowing movement on foot and rendering the operation of vehicles impracticable. <Edited for clarity, emphasis>

State Department memo recommends pursuing cloud seeding in 1967

<https://history.state.gov/historicaldocuments/frus1964-68v28/d24>

Washington, 13 January 1967.

“The objective of the program is to produce sufficient rainfall along these lines of communication to interdict or at least interfere with truck traffic between North and South Vietnam.

Recently improved cloud seeding techniques would be applied on a sustained basis, in a non-publicized effort to induce continued rainfall through the months of the normal dry season. “ (!) Bob edit.

The target areas in Laos, by contrast, are characterized by relatively low population density, but the proposed program would drastically change the weather patterns over the next few months—creating to some extent rainy season conditions during normal dry weather periods.

Secondly, the possibility of a US seeding aircraft being downed cannot be discounted.

Thirdly, there is virtually no aspect of military operations in Southeast Asia which has not over time become the subject of leaks or at least of speculation in the press.

State Department memo recommends pursuing cloud seeding in 1967

<https://history.state.gov/historicaldocuments/frus1964-68v28/d24>

Washington, 13 January 1967.

Outcome:

Kohler wrote the following note on the first page of the memorandum:

“I have serious doubts—may I discuss this with you.”

According to a February 7 memorandum from Kohler to Unger, Rusk also had reservations and, after consultations with Kohler, agreed to approve the operation “on a strictly experimental basis” in the five limited areas.

Rusk wished to be kept informed of the progress of the project and wanted it to be understood that **his approval was not a commitment** to approve further steps in the project or broader application of it.

JCS recommended for this operation.

McNamara recommended against this operation.

It is my understanding that LBJ went ahead with the recommendation, “the highest authority approved.”

After all these years, the literature is all over the place on details

Explicable, in part, by the TOP SECRET nature of the project when I was directly involved.

Declassified in 1974, couple of years after it was compromised in the press, after Senate hearings.

State said Popeye test missions were conducted in Laos. USAF/SWOAT said it was Philippines.

State continued to use POPEYE.

Air Force called it COMPATRIOT/INTERMEDIARY

<https://woodstockwhisperer.info/2018/07/20/vietnam-operation-popeye-weather-control/>

- Offers a timeline with background of cold war enmity US vs USSR.
- “Although some claimed that [Operation Popeye] induced from 1 to 7 inches of additional rainfall annually along the Ho Chi Minh Trail, no scientific data were collected to verify the claim. “

How to collect “scientific data,” when Ho Chi Minh trail of Laos was denied territory?

Lack of critical thinking skills by this author, and others. No interviews with aircrews who flew.

Article by Matt Novak.

One of his primary sources is a global warming alarmist.

Repeats this notion from Fleming, “Although some claimed that [Operation Popeye] induced from 1 to 7 inches of additional rainfall annually along the Ho Chi Minh Trail, no scientific data were collected to verify the claim.”

Agrees with Fleming that there was “very little” success.

Nixon’s Secretary of Defense, Melvin Laird, testified at a Senate hearing on April 18, 1972:

“we have never engaged in that type of activity over Northern Vietnam.”

That was a baldfaced lie.”

Agrees with Fleming that there was “very little” success, but then he shows this photo.

This photo shows the success of the mission, if you know how to read it.

The arrow points to an RF-4C of the 432d Tactical Fighter Wing, modified to carry silver iodide flares.

This RF-4C was scrambled on a day when cloud seeding conditions were excellent, and the WC-130A called STAGECOACH to scramble the RF-4C to augment seeding and increase rainfall.

Executing this mission was the highest priority of the Udorn Command Post



Photo taken during an Operation Popeye mission on 31 July 1968 via the Air Weather Reconnaissance Association

Agrees with Fleming that there was “very little” success.

Does not mention the successes of cloud seeding published by Dr. Joanne Simpson, William Woodley, and other authors claiming successes in Caribbean and Florida, published in the Journal of Applied Meteorology, referenced here.

Does not understand that USAF aircrews and Commanders executed this mission enthusiastically.

(above photo of RF-4C augmenting MOTORPOOL mission.)

Unaware of Technical Literature focused on statistical significance of positive cloud seeding research published “in the peer-reviewed literature.”

Obviously has not read,

“Weather Modification, a.k.a Cloud Seeding, a Technology Whose Time Has Come,”

University of Arizona Water Resources Research Center, Spring 2010 Newsletter,

<https://wrrc.arizona.edu/awr/sp10/clouds>

“Nixon's secretary of Defense, Melvin Laird testified at a Senate hearing on April 18, 1972 that, “we have never engaged in that type of activity over Northern Vietnam.” That was a baldfaced lie.”

There was no seeding over North Vietnam during the Nixon Administration, when Laird was Defense Secretary

When I was on the project, there was no mention of seeding in other than the Ho Chi Minh Trail areas of Laos.

CAROLINA MOON, a C-130 mission to take out the Than Hoa Bridge, dropping pancake shaped floating munitions, resulted in the loss of an unarmed C-130 in May 1966. Flying C-130s in North Vietnam was dangerous!

Reade, <http://p-3publications.com/PDF/TheUnrealizedHistoryofWeaponizedWeather2015.pdf> p. 49

“Although some public record references suggest seeding flights were flown over North Vietnam, this is not exactly the case. In actuality, US DoD and Congressional (Popeye) records show that seeding flights into areas of North Vietnam only occurred for a few short weeks in 1967 and a 5-6 week period between September and early November 1968. Other than these very short periods in 1967-68, there are no other archival records or evidence that indicates Popeye ever flew over North Vietnam again.”

Meaconing over the Trail
...by North Vietnam

<https://en.wikipedia.org/wiki/Meaconing#:~:text=Meaconing%20is%20the%20interception%20and,stations%20are%20given%20inaccurate%20bearings>

Successful meaconing can cause aircraft to be lured into "hot" (ambush-ready) landing zones or enemy airspace, ships to be diverted from their intended routes, bombers to expend ordnance on false targets, or ground stations to receive inaccurate bearings or position locations.



Co-Pilot TACAN
display

During one of my cloud seeding missions...

Suddenly, the co-pilot and engineer both exclaimed, “TACAN! Break Lock!” and pointed to the TACAN displays on the instrument panel.

Sure enough, the arrows on both TACAN displays broke from pointing west, to Mukdahan, Thailand on the muddy Mekong, and were turning to the northeast, towards one of the air bases near Hanoi, maybe it was Gia Lam, maybe Kep.

It was clear that the North Vietnamese were meaconing the airspace over Laos and hoping that a shot-up fighter or another aircrew in distress would follow the TACAN signal across Laos and into North Vietnam where it would promptly be attacked, and probably shot down.

A few minutes later a USAF F-100 was attacked by groundfire. We heard the call on Guard that he’d ejected.

In a steep turn, we could see the smoke and dust as his aircraft hit the ground, 18,000 ft below us.

Possible Lessons from Weather Modification Operations During the Vietnam War

Many, including, and especially, political leaders make unfounded, unscientific and wild extrapolations from the experimental data:

Senator Pell (D-RI): “Will lead to, “using a satellite to drop “rain seed” throughout the entire Mississippi River Basin.”

“Will lead to the use of “rockets to stir huge cyclones and tornadoes across the US.””

“may have created a part in the (1971) floods that devastated the dikes ricelands of North Vietnam.”

Federation of American Scientists: Cloud seeding will evolve into “inducement of earthquakes, and other more terrible methods.”

Possible Lessons from Weather Modification Operations During the Vietnam War

Bob Comments: Underlined

“Will lead to, “using a satellite to drop “rain seed” throughout the entire Mississippi River Basin.”

Satellites don’t “drop stuff.” This requires a de-orbit burn, typically planned days ahead of time

“rockets to stir huge cyclones and tornadoes across the US.”

Cyclones, extratropical winter storms, draw their strength from the equator to pole temperature difference, not rockets.

“may have created a part in the (1971) floods that devastated the dikes ricelands of North Vietnam.”

There were devastating floods in the Red River Valley of North Vietnam in 1971.

Flooding is very common in these rice fields, and the dikes are up to 2700 years old.

But the US was seeding in the Ho Chi Trail, on the other side of the Annam Mountain chain, in the Mekong River drainage.

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The Unrealized History of the Military's Utilization of Weather as a Weapon, the "Real" Father of Weaponized Weather and the Secret Hurricane Modification Program Nobody Has Ever Heard Of.

By David Reade

Article Disclaimer: This article seeks to disclose the unrealized history of the weaponization of weather (1961-72) which is currently misunderstood and not correctly represented within the Universal Record. The information contained in these pages does not address any perceived weather waponization efforts that may have been developed since 1972, when the designed checks and balances of a modern democracy evaluated the issue raised at the time, conducted public hearings and subsequently recommended a halt to any and all militarized weather modification practices from continuing. Any suggestions to continued weaponized weather operations by the US Military, under ultra-secured programs, are not addressed here.



Dr. Pierre Saint-Amand

THE ROCKETEER

THURSDAY, DECEMBER 10, 1992

NAVAL AIR WEAPONS STATION, CHINA LAKE

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WEATHER MODIFICATION HISTORY

THE ROCKETEER

December 10, 1992

An Interview With PIERRE SAINT-AMAND

By Kristine L. Roquemore
Technical Information Department

Editor's note: Last week we began the story of Pierre Saint-Amand with an overview of his career. This week continues with his reflections on NOTS and NWC.

ROCKETEER: Let's switch gears to the past. What is one vivid memory you have of your days at NWC?

SAINT-AMAND: The snakes. I'm referring to the reptilian kind. We had a cage full of them out at the old Earth and Planetary Sciences building. Kids used to go out, catch rattlesnakes and take them home in a paper sack to their mommies. The kids loved it. The mothers freaked. They'd call the security people, who didn't know what to do with them, so they brought them to us. Finally, we built a cage and kept adding more and more snakes to it. Then, once a year we'd take them down to the University of Southern California where they used them to make antivenin. So, we struck a deal. We'd supply the snakes, if they'd supply the antivenin free to anyone in the Ridgcrest area that got bit. It worked out beautifully.

ROCKETEER: Weather modification techniques, and in particular, Project Popeye, was your baby, so to speak. What can you tell us about it?

SAINT-AMAND: In the middle of August 1966, the Department of Defense asked if I could get enough peo-

ple and material together to go to Vietnam. They wanted us to make it rain on the Ho Chi Minh Trail. For the next ten years the program was highly effective in limiting traffic on the trails because of the rain. We were able to extend a monsoon three months on either side of its normal season. There was a lot of rain. We went from having 1,000 infiltrators a month to less than 50. Finally, they surfaced the road from Hanoi to Saigon. But, this made it easier for the Marines to blow up the road. Plus, it was a lot easier than trying to find individuals crawling around in the bushes.

ROCKETEER: And nobody knew this was going on?



SEISMIC STUDIES —In July 1957, Dr. Pierre Saint-Amand and Gerry Malloy bury a geophone at Mono Lake to record shock waves.

SAINT-AMAND: For over ten years nobody knew! I was very pleased we never had one leak in all that time. Looking back, I was also pleased we never had a loss-time accident, and considering the dynamic research we conducted it's a wonder we never did. We had a mountain of certificates for conducting research without anybody getting hurt. When I think of some of the things we were doing, it's a wonder we all didn't get killed.

ROCKETEER: What was your opinion of Congress putting a halt to the Navy conducting all weather modification research?

SAINT-AMAND: It was unfortunate and unnecessary. We used weather modification techniques to make rain and to clear fog. We helped relieve the Marines who were stuck on the hill at Khesahn when we got rid of the fog trapping them. And, as I said before, we made it rain on the Viet Cong. But, a bunch of senators in Congress got it in their heads that we were treating the Viet Cong unusually cruel. Treating them unusually cruel because we made it rain on them? They lumped it with chemical and biological warfare. We, on the other hand, thought it was more humane than dropping bombs on them. So, yes, a treaty was formed stating the U.S. and Russian civilian scientists would stop conducting such activity. The Russians happily signed the treaty. And a few weeks later, they put all their weather modification work under a three-star general. Suddenly all of their civilian scientists were dressed in Army uniforms. I can't imagine why. The excuse for their attire was—it was cheaper. Right!

