Names of hurricanes is not as simple as A,B,C

The practice of naming hurricanes and other tropical storms dates back several centuries in the Caribbean where a particular saint's day on which the hurricane occurred was assigned. Of course, hurricanes typically move and affect different areas and islands so the same storm could have different names

Clement Wragge, an eccentric Australian meteorologist gets the credit for assigning a series of names to individual hurricanes (known as cyclones in his part of the world) about 120 years ago. His original idea was to name them after the letters of the Greek alphabet but instead, he used the names of figures from Polynesian mythology, historical figures such as Xerxes and Hannibal and then the names of politicians. He vented his hostility toward public figures by assigned their names to nasty storms. His custom received attention around the world in 1902 when "Conroy", a national politician he despised, became associated with a tropical cyclone that caused considerable damage and hardship in Queensland, Australia.

His funding was reduced soon after. He left the Australian weather service and conducted research on various islands in the South Pacific, then in India and finally in New Zealand.After Wragge's retirement, the practice of naming tropical cyclones would cease for four decades.

Assigning names became popular in World War II in the Pacific Ocean, when meteorologists used names of their girlfriends, mother, or a local character of note. Alphabetical order was commonly used by the end of this war. The first storm of the season began with the letter A, the second with B, and so on. This avoided confusion if two or more tropical storms were present at the same time.

In 1949 a Category 4 hurricane named #2 struck Florida when President Harry Truman was on a visit there. It was christened "Hurricane Harry".

In the early 1950s, it became accepted that some order was desirable and in 1953 it was agreed internationally to give hurricanes female names in alphabetical order from the beginning of each year. These names for hurricanes were chosen under the aegis of the World Meteorological Organisation by local representative committees, whose members are from countries in the regions usually affected by tropical storms.

In 1979, this rather chauvinist approach was changed to allow hurricanes to be alternately male and female names. Six semi-permanent lists of names are now used; each set is repeated six years. The current list for 2015 was used in 2009 and will appear again in 2021. The list for each year allows for 21 storms, the letters Q, U, X, Y and Z being omitted because the choice of names would be limited. And if a season is particularly stormy, with more than 21 named storms (tropical storms and hurricanes, then the Greek alphabet - Alpha, Beta, Gamma and so on - could be used to name extra storms.

When a hurricane has had major impacts its name may be "retired" which, strictly speaking, means that it will not be re-used for at least 10 years. This is intended to facilitate historical references, legal actions, insurance claims and perhaps to avoid bad memories. Hurricane Gilbert (1988), Hugo (1989) and Mitch, which caused such havoc in Central America in 1998, have all been superannuated. Hazel, responsible for 1200 fatalities in the Caribbean, North Carolina and Toronto (81 deaths) in 1954, has never been reassigned.

The 2005 Atlantic hurricane season

Hurricane season in the Atlantic officially begins on June 1 and ends on November 30. These dates almost always contain the Atlantic hurricane season. Occasionally late May will feature an eager tropical storm and rarely a late hurricane will persist into December.

This hurricane season a decade ago is remembered for Hurricane Katrina, which devastated New Orleans and the Gulf Coast, killing at least 1,833 people. (Several hundred persons were still reported missing in association with Katrina two years later.) But Katrina was only one of a record-breaking 28 named tropical storms in this disastrous year. In all, these storms caused 4,000 deaths and almost $200 billion in damage in the United States, Mexico, Central America and the Caribbean.

It began with tropical storms (TS) in June, continued with major hurricanes Dennis and Emily in July, five more TS and a hurricane and then Katrina which destroyed large parts of New Orleans in late August. Five more hurricanes took place in September and October featured two TS and three hurricanes. These included Rita a few weeks after Katrina, which prompted massive evacuation of the Houston area and contributed directly and indirectly to about 100 deaths. In early October, Stan was associated with disastrous inland flooding in areas of Guatemala and Mexico. Some estimates of the death toll were as high as 2000.

Wilma exhausted the available alphabet and, more important, set a record for the lowest central pressure ever recorded in a western hemisphere hurricane.

The Greek alphabet, first suggested by Clement Wragge, came into play. Alpha was first Atlantic tropical storm ever to be named from the Greek alphabet. It was followed by Beta, Gamma, Delta and Epsilon which ushered in December. Beta qualified as a major hurricane and did damage to Nicaragua. Tropical Storm Zeta literally finished the year and persisted until January 6, 2006.

This remarkable season featured 28 tropical storms and 15 of these became hurricanes (maximum 1-minute winds of at least 64 knots/119 km/h) breaking the record of 12 set in 1969. Seven hurricanes became major hurricanes (winds at least 96 knots/178 km/h). Four of these hurricanes reached category 5 strength (maximum winds greater than 135 knots/249 km/h), the first time this has been observed in one season.
A record 11 storms formed that year in the Gulf of Mexico.

Katrina made landfall as a Category 3 hurricane near New Orleans. More than 1,800 people died in New Orleans and areas of the Gulf Coast. Katrina was the costliest natural disaster in US. (Source: NOAA)

Some of the information for the article comes from **ANNUAL SUMMARY:Atlantic Hurricane Season of 2005** JOHN L. BEVEN II, LIXION A. AVILA, ERIC S. BLAKE, DANIEL P. BROWN, JAMES L. FRANKLIN, RICHARD D. KNABB, RICHARD J. PASCH, JAMIE R. RHOME, AND STACY R. STEWART (2008) http://www.aoml.noaa.gov/hrd/hurdat/mwr_pdf/2005.pdf

Lecture 7
Newton’s second law of motion: if there is an unbalanced force on an object, it will accelerate in the direction of that force.
What’s important here is the net force – several forces can act in different directions

Ideal Gas Law
Pressure is a function of density and temperature; that is, the density and temperature of a gas will determine its pressure
Ahrens use R instead of C; same thing
Example: Enclosed air molecules move about continual and exert pressure on the interior walls of the chamber
- pressure proportional to the rate of collision

Pressure can be increased by adding more molecules
Or by heating up the molecules
If denser air is outside container Whoosh like a vacuum seal
If less dense outside - like opening a can of pop
In either case, the pressure is equalized and thus air is constantly moving to establish equilibrium

Horizontal pressure gradient force
Isobars on the map are at intervals of 4 hPa

Vertical Changes in Pressure
Always decrease with height as opposed to temperature, moisture and density
Typically falls 50% for each 5.5 km
Fig. 2 – exponential decay; pressure does not decrease at a uniform rate (Compressibility)
There is a vertical pressure gradient force

Upper air
H is large and on the right H is small
3D drawing of a pressure ‘surface’ – 500 mb level
Colder temperatures have lower pressure heights (elevations)
Higher latitudes have lower pressure elevations

Isobaric charts
Upper air pressure gradients are best determined through the heights of constant pressure due to density considerations
Height contours indicate the pressure gradient
Twice daily, heights are drawn at 60 m intervals for the 850, 700, 500, and 300 hPa levels
Note troughs and ridges

The Coriolis Effect
Kids on a merry-go-round.
Now this is just a start, but the Coriolis effect is hard to visualize, so I want to leave you with this image and then come back to it next lecture

Lecture 6

A small fringe group of scientists who denied the science that climate change human-caused. One is reminded of the famous Upton Sinclair quote “It is difficult to get a man to understand something, when his salary depends on his not understanding it.”

Shortwave Radiation
Numbers are not exact; disagree from source to source.

Gives a ballpark idea of the relative quantities +/- 5 units.
30 units lost out to space: 19+6+5.

Earth-atmosphere energy balance
7 units of sensible heat, 23 units of latent heat, 111 units of IR go to atmosphere
Returned are 96 units of IR back to the surface; the rest of it is IR emitted by the atmosphere to space
Note that cloud tops are colder than cloud bottoms

Convection
Conservation of mass; if air is flowing up somewhere, it must be flowing down somewhere else.
Net effect is to transfer heat away from the surface.
Called a “sensible” heat transfer – could use a thermometer to “sense” the movement of heat.
Will come back to this kind of circulation.

Thermal Storage and phase change
Ice cannot be warmer (nor water colder) than 0C
Note that water can evaporate at less than 100C

Latent heat
The energy isn’t lost; it’s hidden.
Condensation (cloud formation) releases that heat
Net heat transfer from the surface to the atmosphere.

Global coordinate system
Lines of latitude are evenly spaced: 0-90 degrees in either direction
Lines of longitude converge at the poles: 0-180 degrees in either direction
N and E positive, S and W negative

Less energy per unit surface area (Wm-2) – even at the hottest time of year in the Arctic
Inevitable because the Earth is a sphere

Intensity of Radiation
Depends on the time of year, and latitude
Also depends on time of day!

Diurnal heat budget
Temperature (green) – note that peak is not at noon! Warming continues as long as energy gained is greater than energy lost

Energy lost is greater under clear skies; more likely to have frost
Starting at the same temperature, a cloudy night will be much warmer than a clear night

Diurnal surface air temperature
Surface is the most efficient radiator
Profile is strongly influenced by winds, which cause turbulence and forced convection (vertical mixing)
Profile shown is only for the first few metres; at a few km above the surface T is generally constant on a diurnal scale

Text P78 and 80

NOTES – Lecture 5
Total Solar Irradiance (S)
Consider a light bulb in a room – all of the light hits the walls (OK, assume a vacuum in the room)
If the room were bigger, same amount of light spread over a larger surface area

Surface area of the walls gets bigger in proportion to the square of the distance

This sphere is larger than the previous one, so the energy emitted must be distributed over a greater area.

First Law of Thermodynamics
Simple - Joules (watts) per second in must equal joules per second out

Earth radius 6,353 km to 6,384 km the surface area – of the Earth. (4pi*r2) Little e refers to the Earth. (509 million square km). About 71 percent is covered by water and 29 percent by land.

Energy Balance
Incoming should equal outgoing Treat the Earth is a blackbody so epsilon = 1
Pi-r-e-squareds cancel out, therefore

Exchange with the atmosphere
Radiation goes out from the atmosphere to space, BUT some is radiated back down to Earth.

These three variables that are expressed over the entire surface of the Earth
Whatever doesn't get absorbed gets transmitted

Greenhouse calculation
We know that I is equal to 242 Solution will be demonstrated in the lab

The atmosphere is colder than the Earth, but the Earth is warmer than it was without the atmosphere 288 K is better estimate; but this is pretty darn close considering how crude our model is
Let's consider some other energy transfers

The Greenhouse Effect

A planet's climate is decided by:
- its distance from the Sun
- its albedo
- the composition of its atmosphere.

Mars's atmosphere is quite small, Earth's is a hundred times thicker.
Remember that, for Earth, water vapour is the most important greenhouse gas
Greenhouse effects: Earth 33C, Venus 500C, Mars 20C
Venus has an albedo of 77% - should be colder than Earth

The Earth's climate has been relatively stable for the past 12,000 years. These conditions have enabled humans to develop agriculture, domesticate animals,

Early history of research into the greenhouse effect

The following provides a brief chronology of climate science.

Jean-Baptiste Joseph Fourier is perhaps best known for his contributions to mathematics but physics and history were also well within his domain. In the 1820s, Joseph Fourier calculated that the Earth at its distance from the Sun should be considerably colder if warmed by only solar radiation. He speculated on possible sources of the additional observed heat in articles and proposed that interstellar radiation might be responsible for some of this additional warmth.

He also considered that the Earth's atmosphere might act as a kind of insulator. More precisely, Fourier proposed that gases in the atmosphere could form barriers like glass panes in a greenhouse. This has become known as the “greenhouse effect”. Fourier also wrote about processes in the atmosphere that determine and changed temperatures within the atmosphere, including convection.

Louis Agassiz, Swiss-born biologist and geologist, discussed In 1837 that the Earth had been subject to a past ice age: "[G]reat sheets of ice, resembling those now existing in Greenland, once covered all the countries in which unstratified gravel is found . . .” (Etudes sur les glaciers ("Studies on Glaciers"), published in 1840. Lake Agassiz, the vast glacial lake that covered a considerable part of middle North America that existed at the end of the most recent glacial period is named after him.

Irish chemist John Tyndall demonstrated in a laboratory experiment in 1861 that carbon dioxide and water vapour intercepted energy in the form of heat (Figure 2.1). Tyndall promptly recognized that this meant that changes in the atmospheric concentrations of these greenhouse gases could change the climate.

Swedish chemist Svante Arrhenius in 1896 did the first calculations of how much the world would warm if the content of carbon dioxide in the atmosphere was increased. His work suggested that doubling the amount of carbon dioxide (2 x CO2) in the atmosphere would increase the Earth’s average temperature by 3 to 4° C. He also detailed the distribution of temperature rise. The most warming would take place in the high latitudes, medium warming in the mid-latitudes and less in the tropics. These details in part were based on the likely reduction of albedo because of less ice and snow cover in the higher latitudes.

When did global warming cease being merely a computer simulation? It must have been at some point between the 1970s, when the world experienced 660 natural catastrophes, and the last decade, with its 3,322 storms, heat waves and flooding. It came quietly, and most of us were looking away.