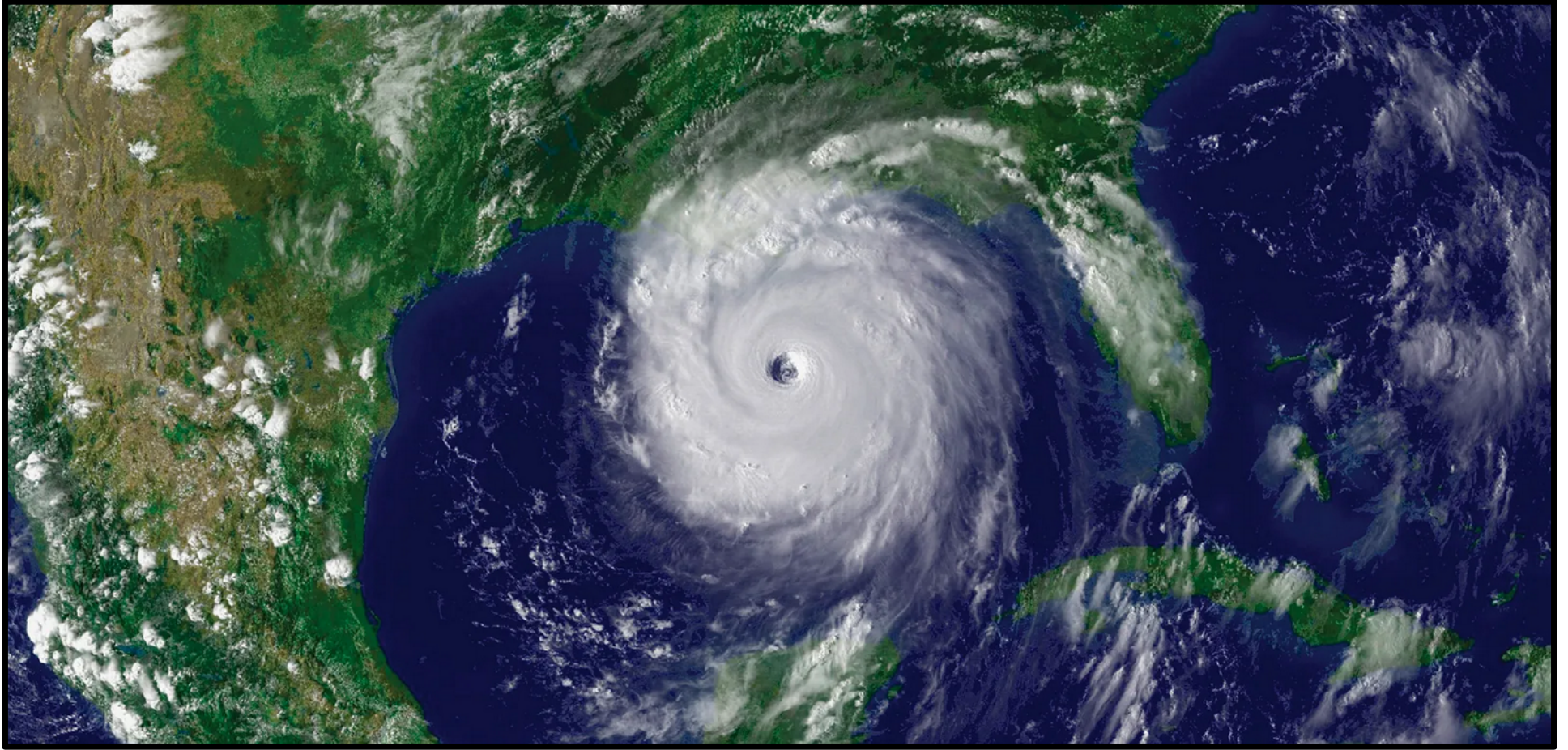


Hurricane Modification



NOAA satellite image of Hurricane Katrina, taken on August 28, 2005

Hurricane Formation

- Hurricanes (called typhoons in the eastern Pacific) form from tropical waves.
- These storms require warm ocean waters.
- Storm energy comes from latent heat of condensation.
- Hurricanes are warm core systems.

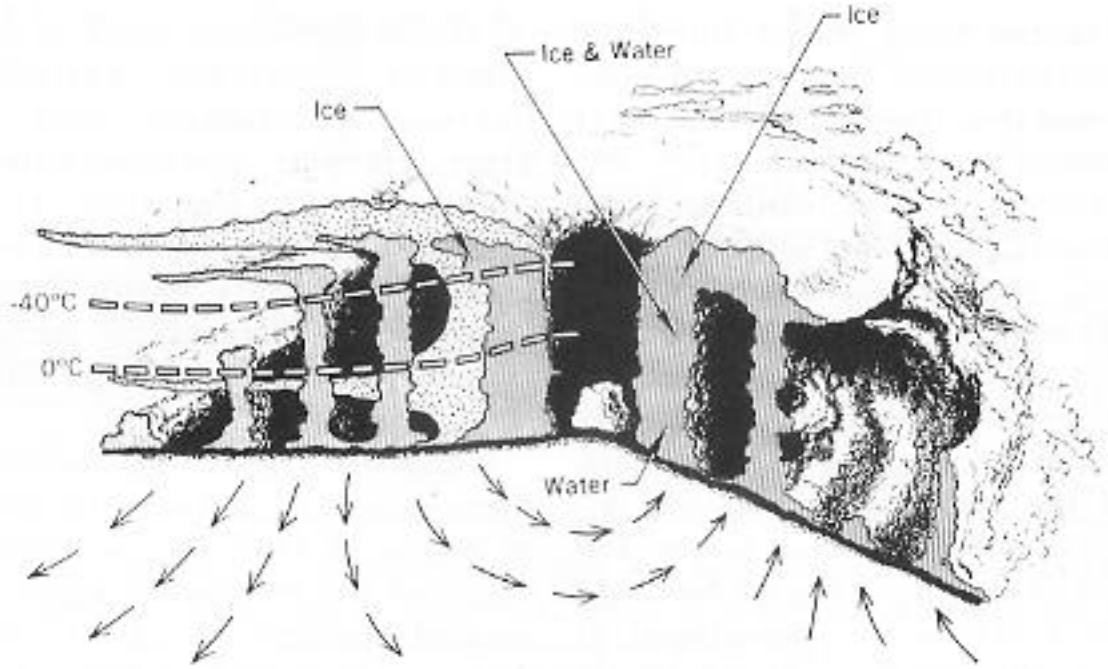
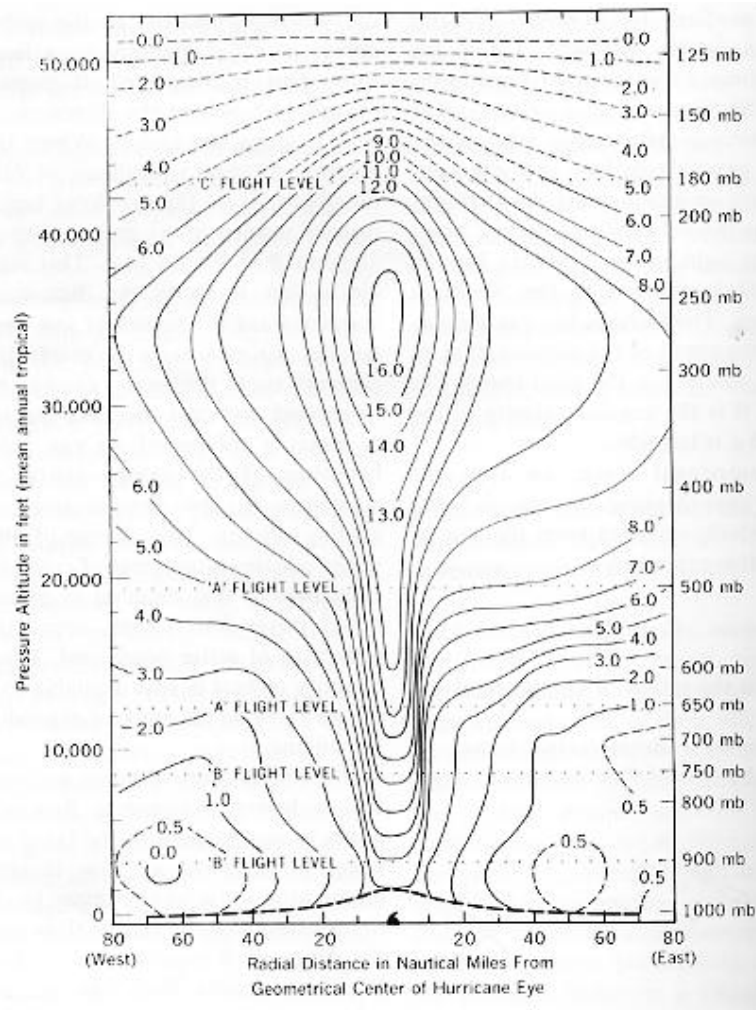


NASA – Hurricane Dorian

Conditions for Hurricane Formation

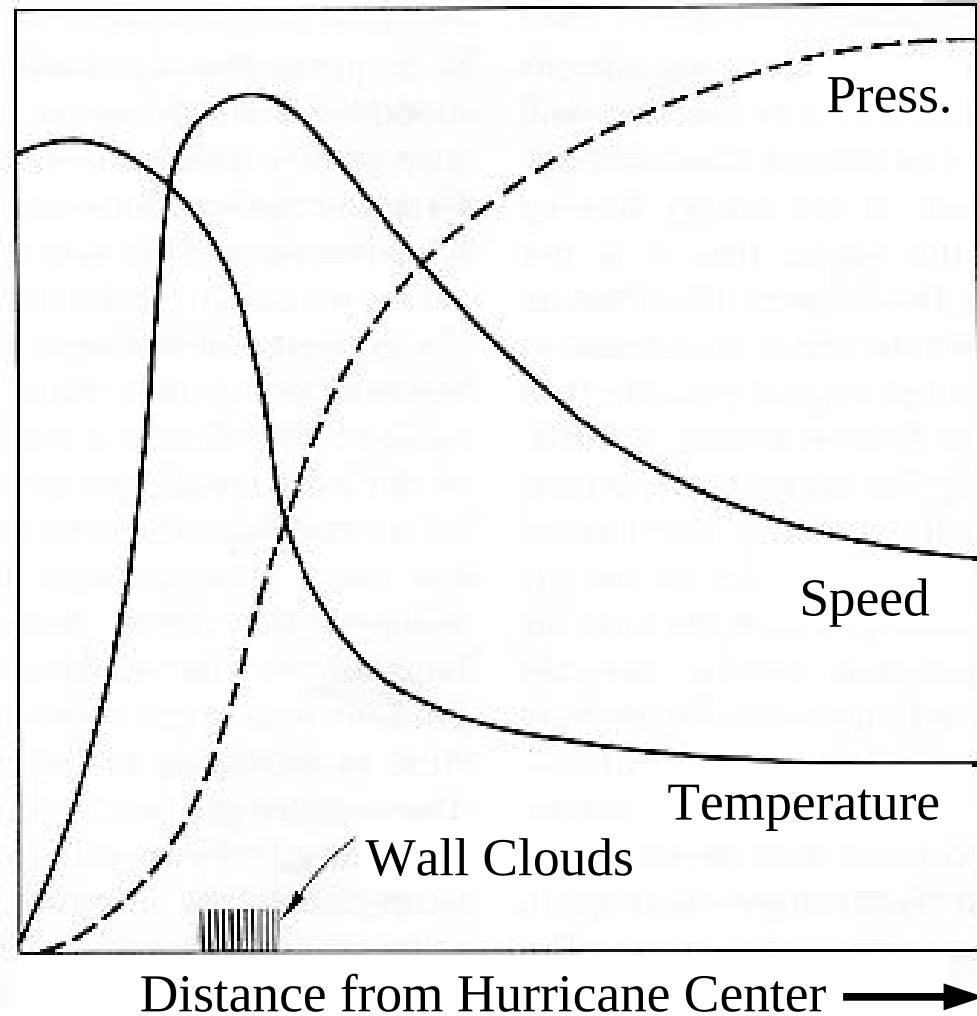
- Ocean waters above 26 °C (79 °F).
- Close to the equator.
 - Spin Earth → Coriolis Force
- Saturated lapse rate gradient near the rotation center of the storm.
 - Latent heat will be released at a maximum rate.
- Low vertical wind shear, especially in the upper level.
 - Strong upper level winds destroy the storms structure.
- High relative humidity in the lower part of the atmosphere.
 - Dry mid level air impedes hurricane development.
- A tropical wave.
 - Thunderstorm complex that moves off Africa coast.

Temperature and Storm Structure



- Key Features:
- Eye, Eye Wall, Spiral Bands, and Outflow Cirrus

Radial Profiles of Temp., Pressure, and Wind



Causes of Hurricane Damage Sources

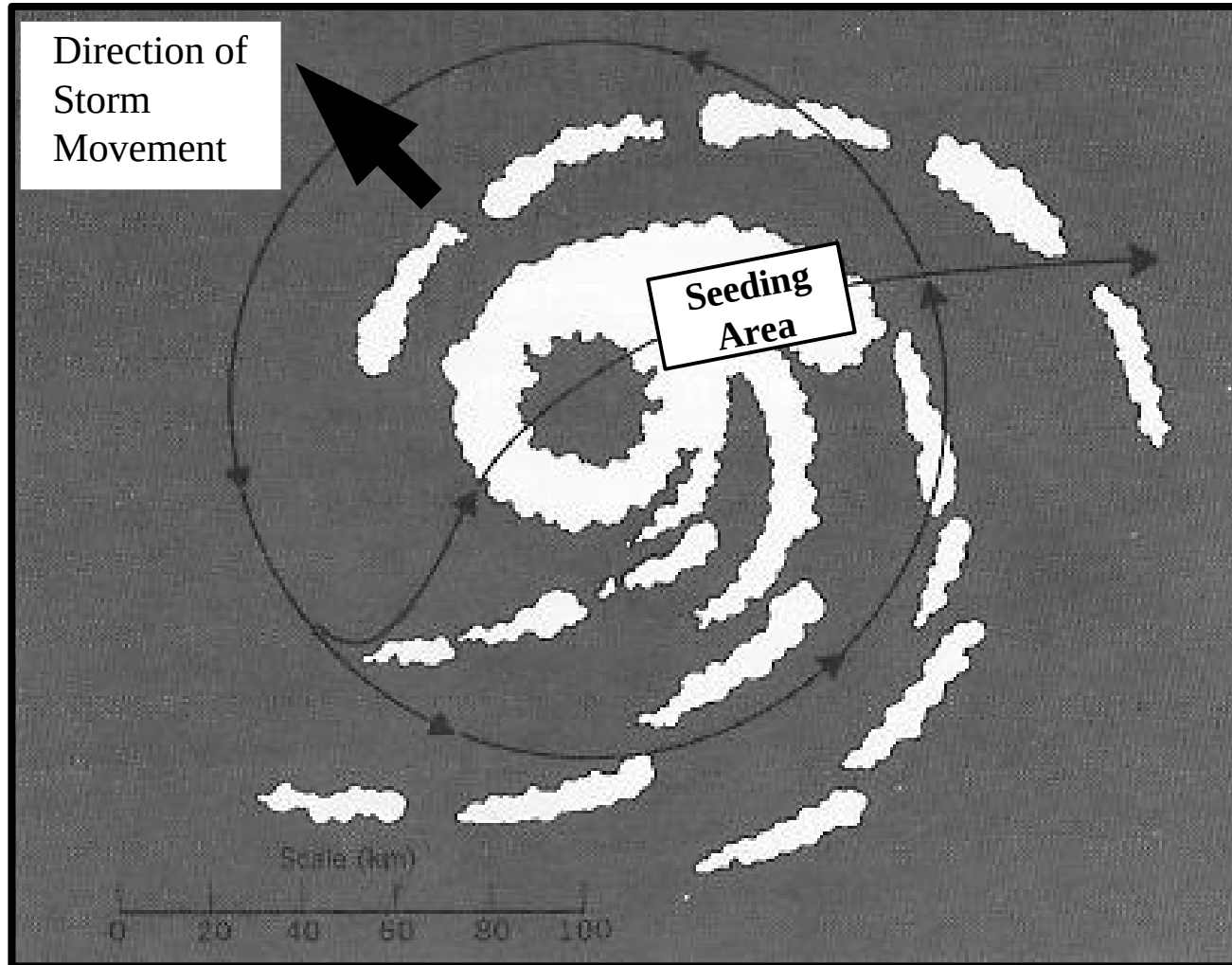
- Wind
- Storm Surge
- Rain
- Tornadoes



Hurricane Modification Hypothesis

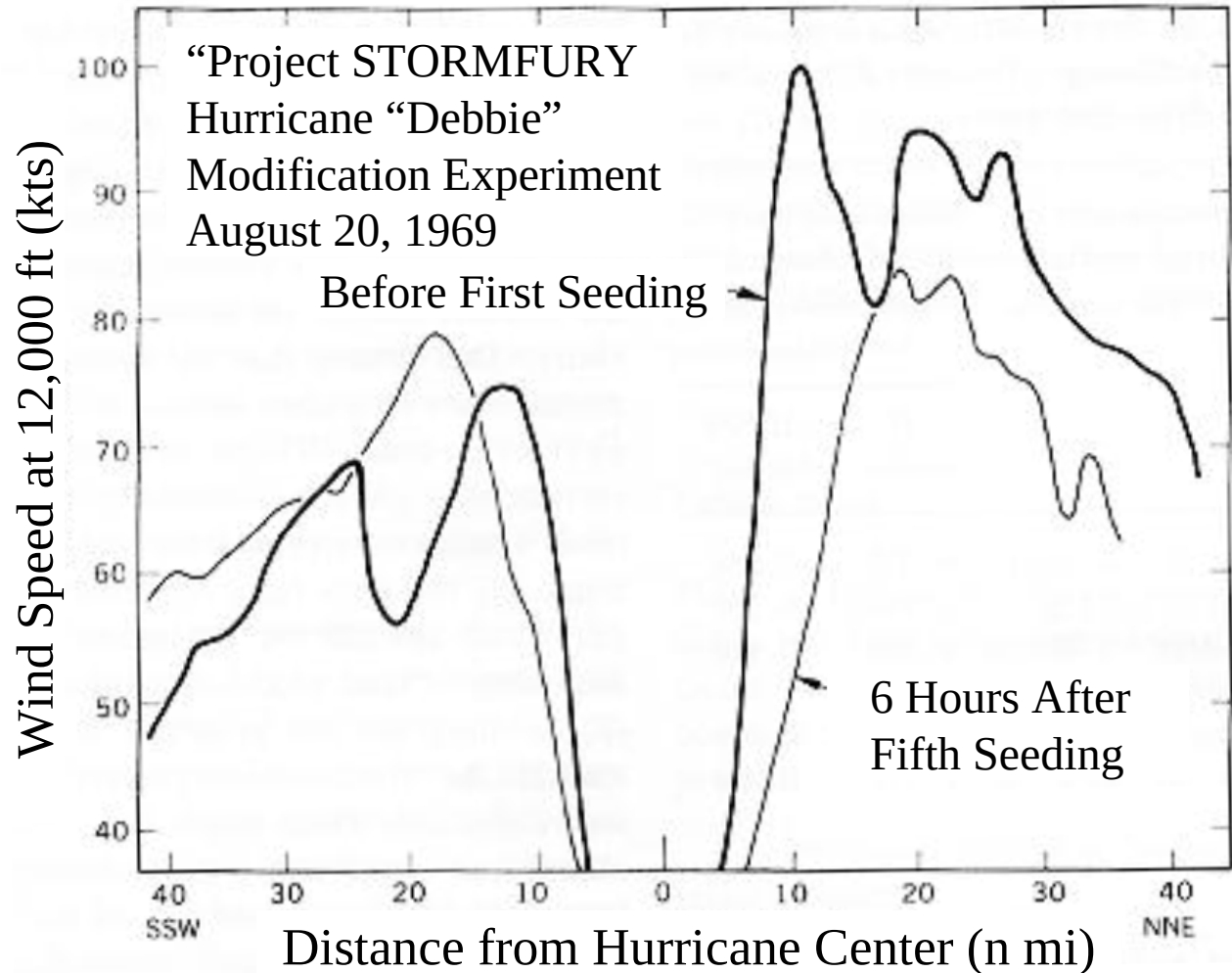
- Primary release of latent heat is in eye wall.
- If energy is released outside of eye, will result in less energy available to lower pressure.
- Eye wall will expand and maximum winds will decrease.
- Seeding with glaciogenic material in spiral bands, releasing latent heat of fusion.

Modification Aircraft Operations



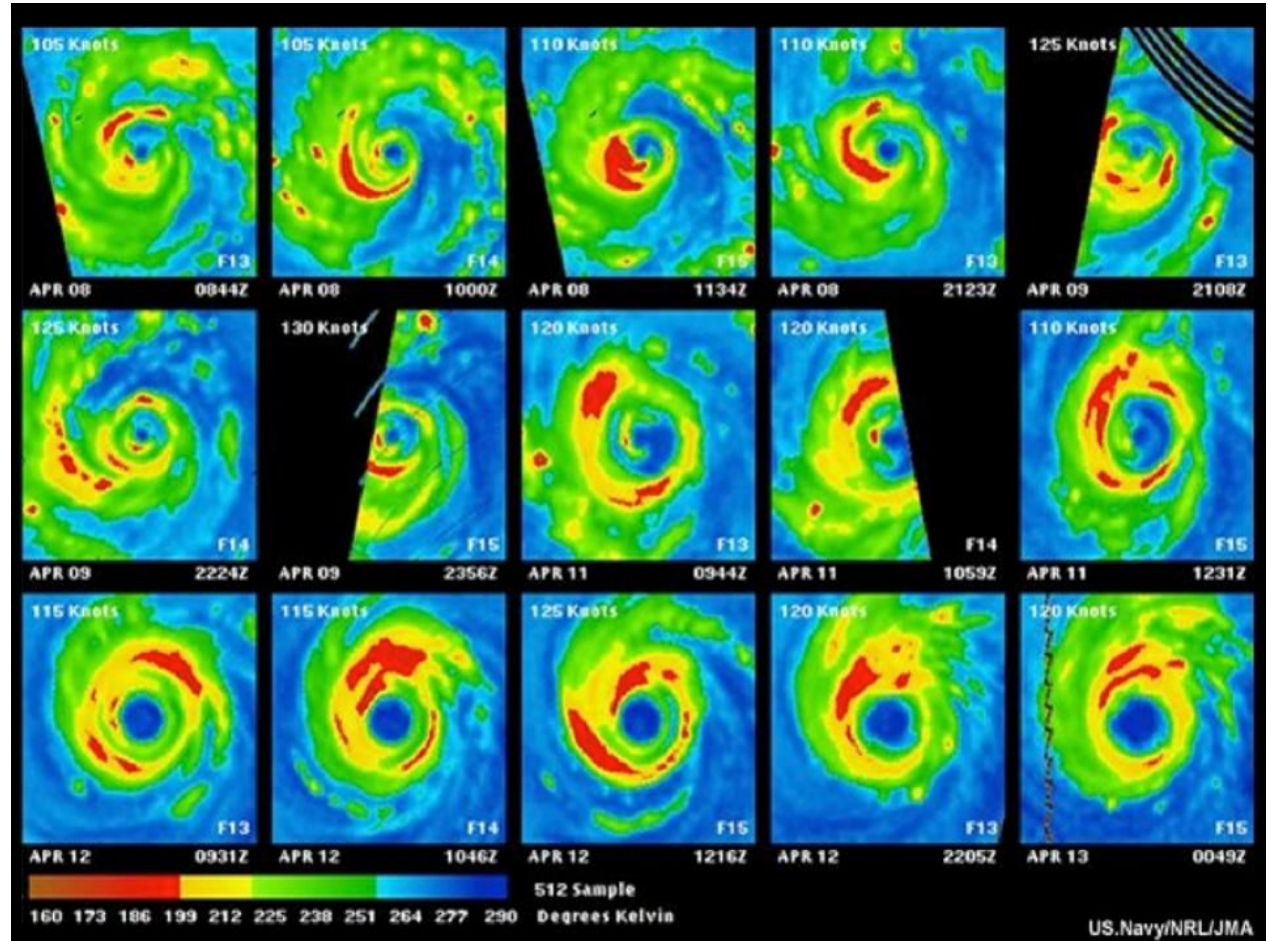
Weather Modification Project Stormfury

- Conducted in 1960s.
- Actually seeded several hurricanes.
- Possible results noted.



Project Stormfury Problems and Issues

- Hurricanes don't really contain much supercooled water.
- Hurricanes naturally go through life cycle changes like those observed in seeded storms.



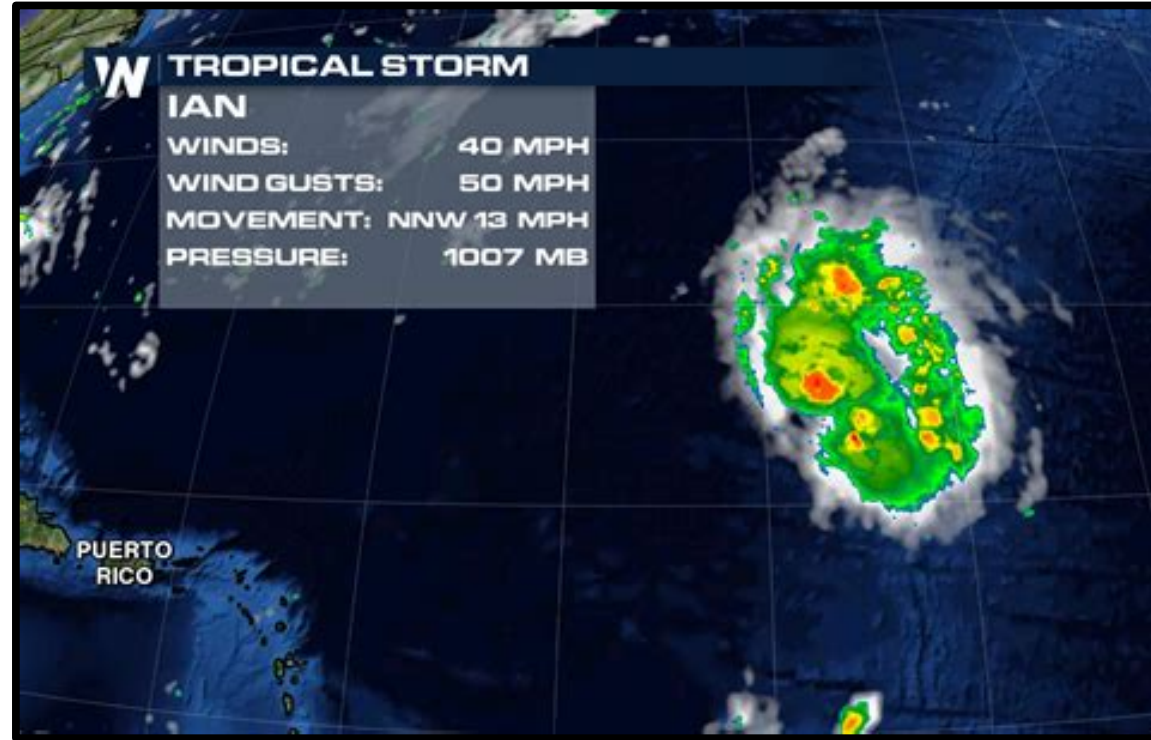
Hurricane Matthew Completing an Eyewall Replacement Cycle.

Other Hurricane Modification Hypotheses

- Cooling the ocean with cryogenic material or icebergs.
- Retardation of surface evaporation with monomolecular films.
- Changing the radiation balance in the hurricane environment by absorption of sunlight with carbon black.
- Blowing the hurricane apart with hydrogen bombs.
- Releasing huge quantities of moisture-absorbing gel (Dyn-O-Gel) into the storm to remove water.

Issues with Hurricane Modification


- Delivery of seeding material.
- Storms occur far from land.
- Lots of material required.
- Liability.
- Possible test cases limited.
- Hurricane rains are also beneficial.



Tropical Storm Ian Forms in Atlantic


Hurricane Modification and Myths

NOAA Hurricane Research Division: Tropical Cyclone Modification and Myths



Hurricane Research Division
Atlantic Oceanographic
& Meteorological Laboratory
National Oceanic & Atmospheric Administration

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version 4.11
June 1, 2018

C : TROPICAL CYCLONE MODIFICATION AND MYTHS

Text version of TROPICAL CYCLONE MODIFICATION AND MYTHS

- C1) Doesn't the low pressure in the tropical cyclone center cause the storm surge?

TC FAQ

- [Basic Definitions](#)
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- [Cyclone Forecasting](#)
- [Cyclone Climatology](#)
- [Cyclone Observation](#)
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- [Cyclone Prep](#)
- [Hurr. vs Tornado](#)

Hurricane Irma ([Radar Loop](#))

