

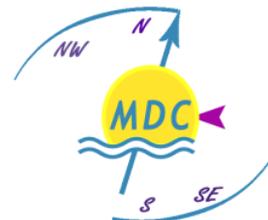
Benefits of Satellite Imagery

Dr. Albert Martis
Vice President
WMO Regional Association IV



Meteorological Department Curaçao

*Protecting life and property against
natural hazards*





Overview

- **World Meteorological Organization**
- **Before the Satellite Era**
 - Only Analyzed Surface and Upper-air Maps
- **The late 1960s through the 1980s**
 - Satellite Images through Direct Reception and NAMFAX (printed)
- **Since 1990**
 - Direct Reception through Computer
- **The Future?**



World Meteorological Organization

- United Nations Specialized Agency
- Established in Washington on 11 October 1947
- Headquarters in Geneva, Switzerland





WMO Mission

- (a) Protection of life and property,
- (b) Safeguarding the environment,
- (c) Contributing to sustainable development,
- (d) Promoting long-term observation and collection of meteorological, hydrological and climatological data, including related environmental data,
- (e) Promotion of endogenous capacity-building,
- (f) Meeting international commitments,
- (g) Contributing to international cooperation,



WMO Regional Associations

RAIV:

North America

Central America

Caribbean



President:

Juan Carlos Fallas Sojos, Costa Rica

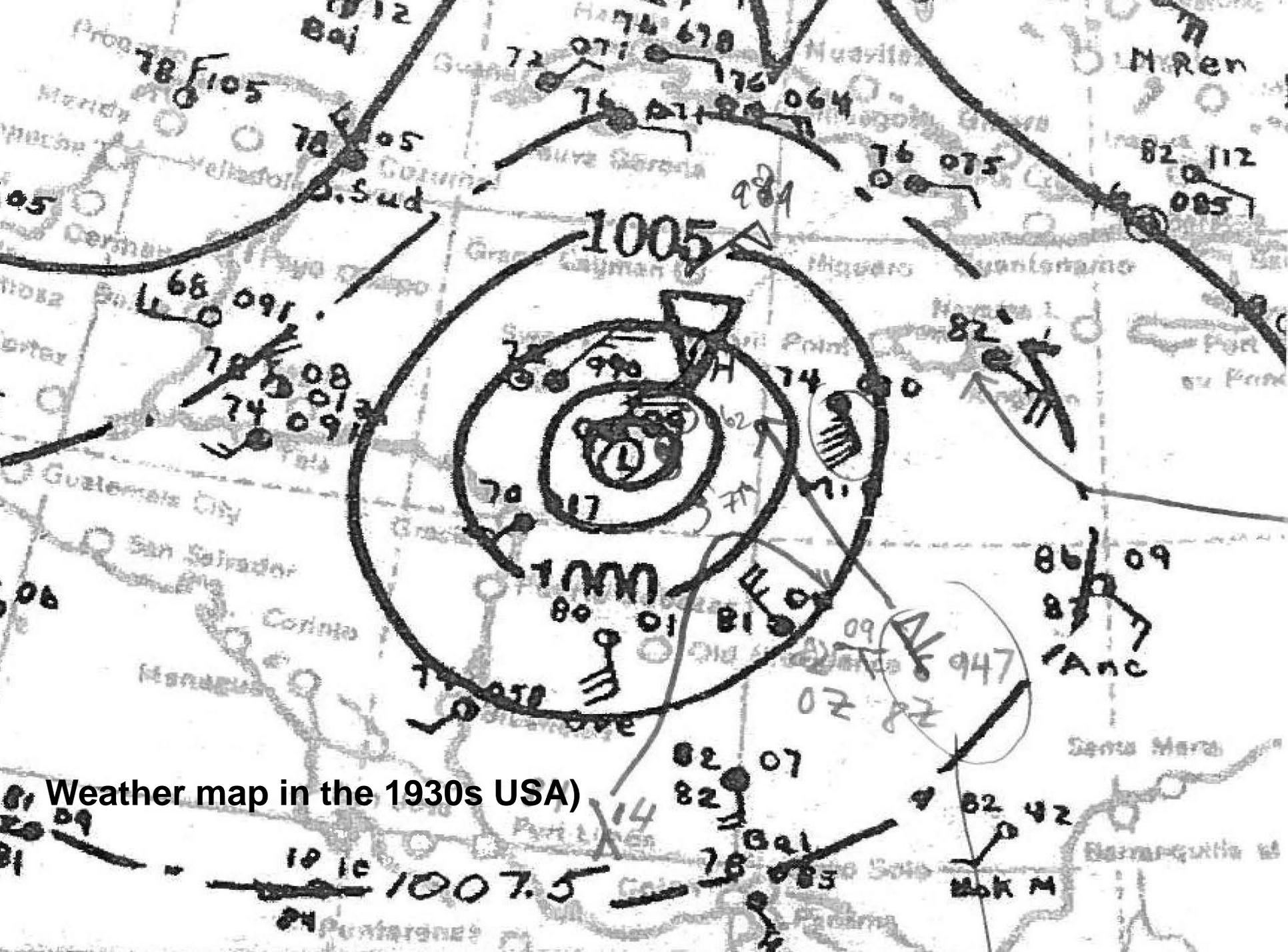
Vice-president:

Albert Martis, Curaçao

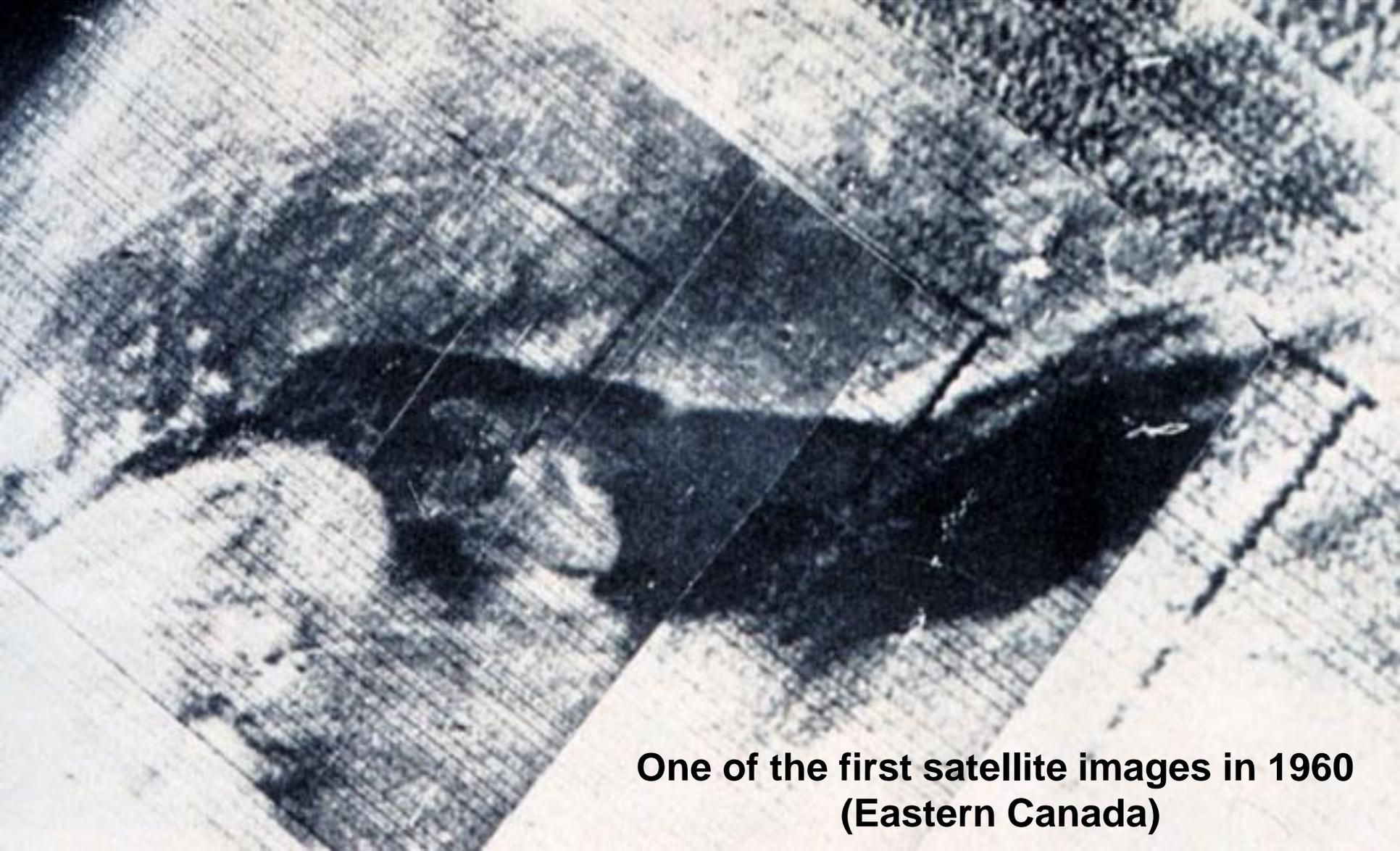


Before the Satellite Era

- We had only analyzed surface and upper-air maps
- Surface and upper-air maps hand-plotted
- No satellite imagery until late 1960s
- In the beginning reception of imagery (by facsimile) arrived 1- 2 hours late



Weather map in the 1930s USA)



**One of the first satellite images in 1960
(Eastern Canada)**

Weather facsimile machine (1970s)

MOTOR
START

D-649-D/AB
18" MUFAX RECORDER
PATENTS PENDING
SERIALIZED & DATED BY 80-22338

24V
18V
OFF

REV/MIN
50 100 200

REUX
START

PHASE SIGNAL
BLACK WHITE

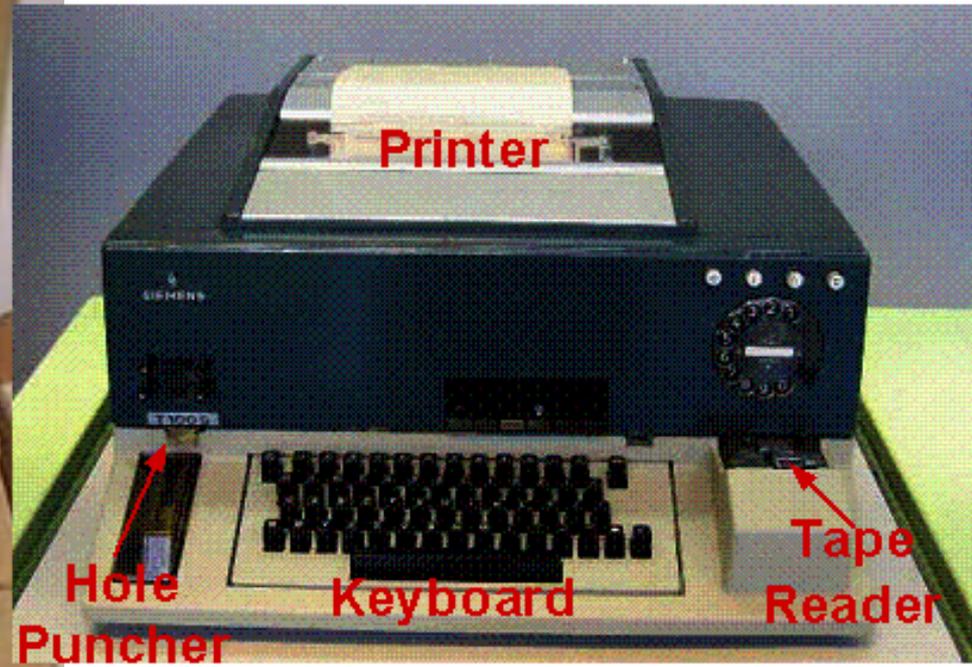
GAIN

Mifax

F 12



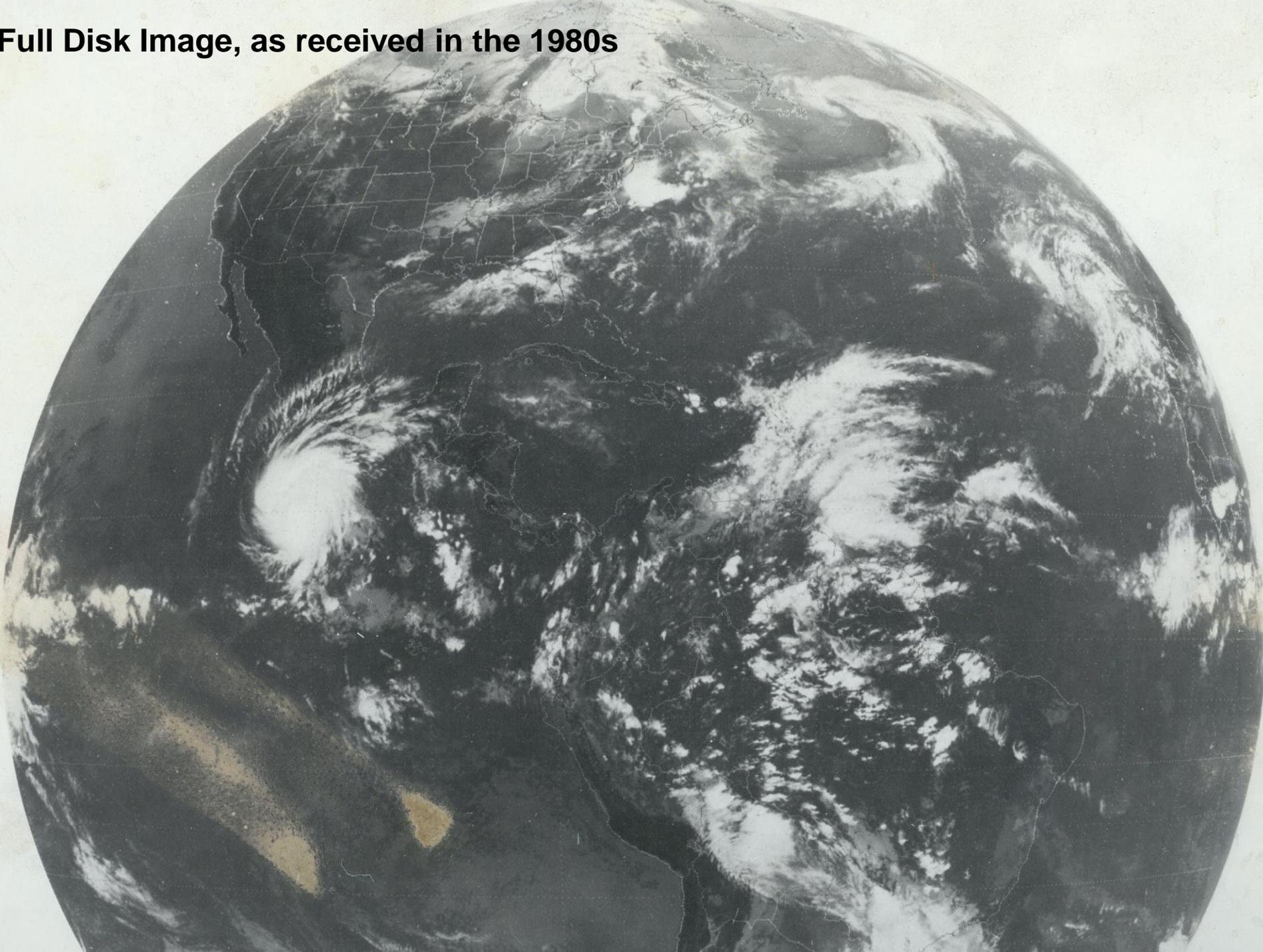
Teletype Machines were used in the 1980s and earlier to receive messages, including NOAA Polar Weather Satellite orbit predictions.





Hand-plotted and hand-analyzed surface map in the 1980s

Full Disk Image, as received in the 1980s



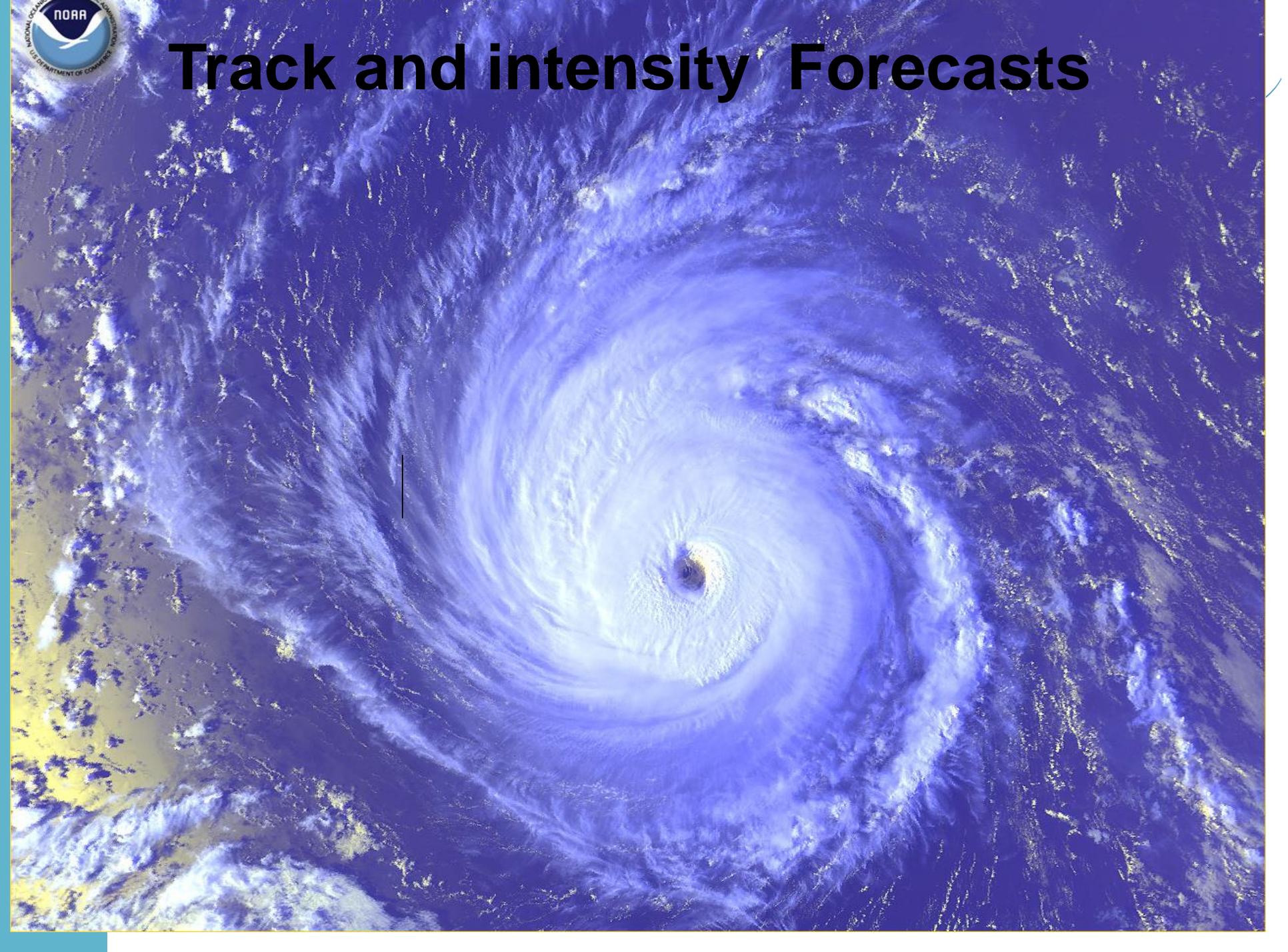


WMO Tropical Cyclone Program

- **1972:** WMO establishes the Tropical Cyclone Project in response to a call for international action to mitigate the harmful effects of tropical cyclones brought about by the disastrous 1970 Bangladesh storm.
- **1978:** A second working group, that of WMO's Regional Association for North, Central America and the Caribbean, (RA IV) - the Hurricane Committee - was established.



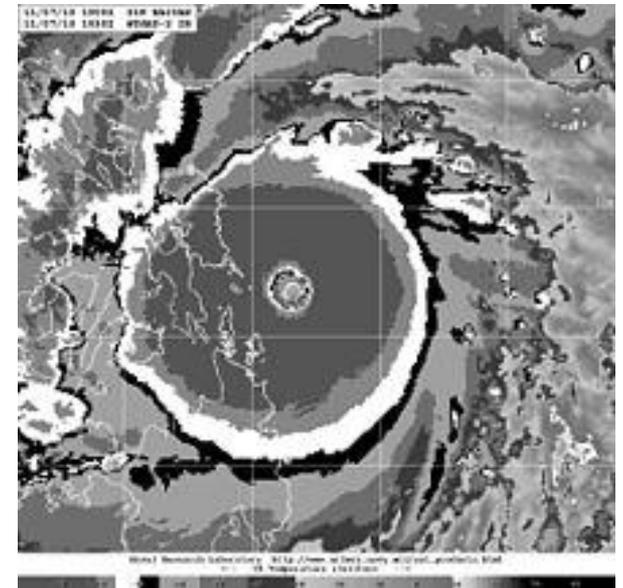
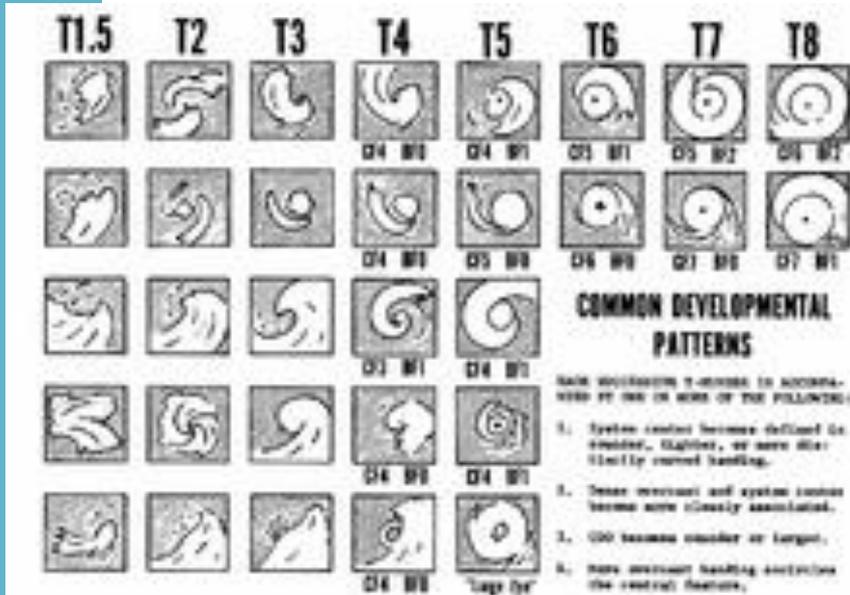
Track and intensity Forecasts





Dvorak technique

The Dvorak technique (developed between 1969 and 1984 by Vernon Dvorak) is a method using enhanced Infrared and/or visible satellite imagery to quantitatively estimate the intensity of a Tropical Cyclones





Intensity Forecast

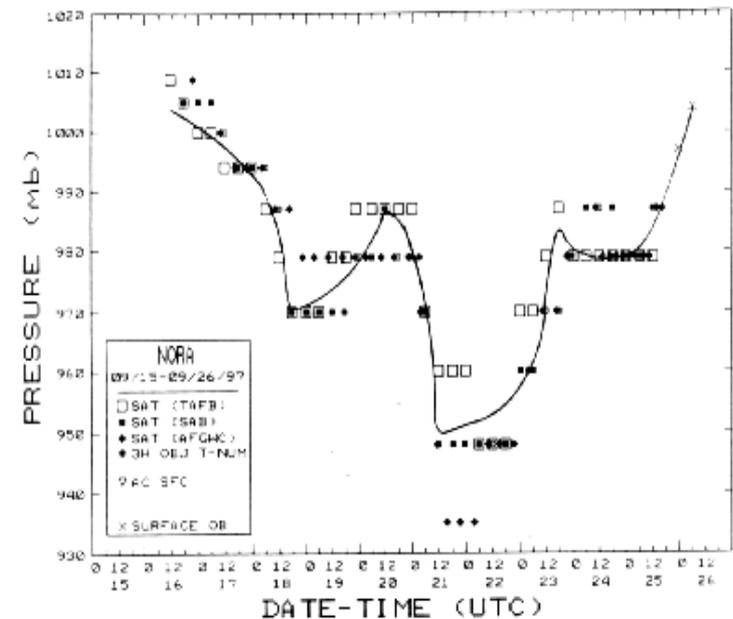
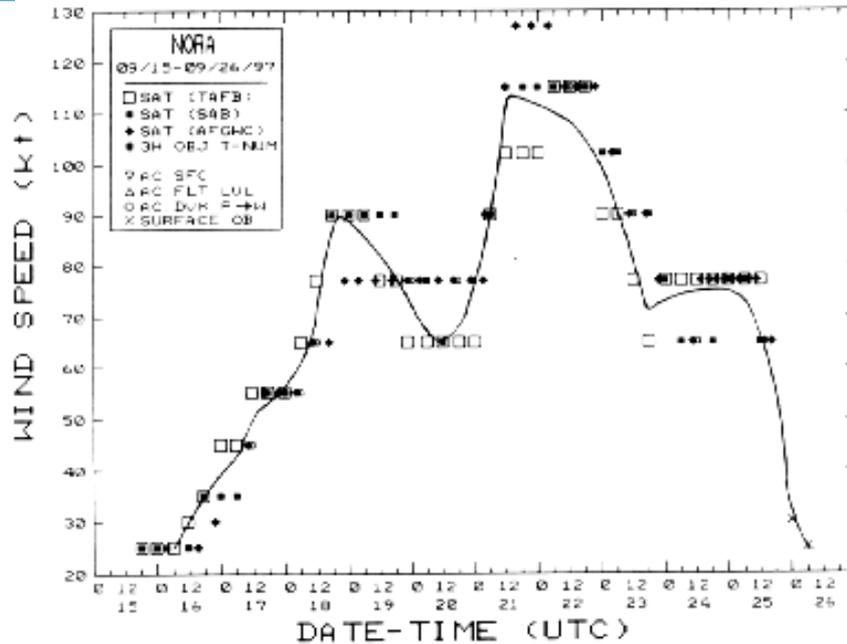


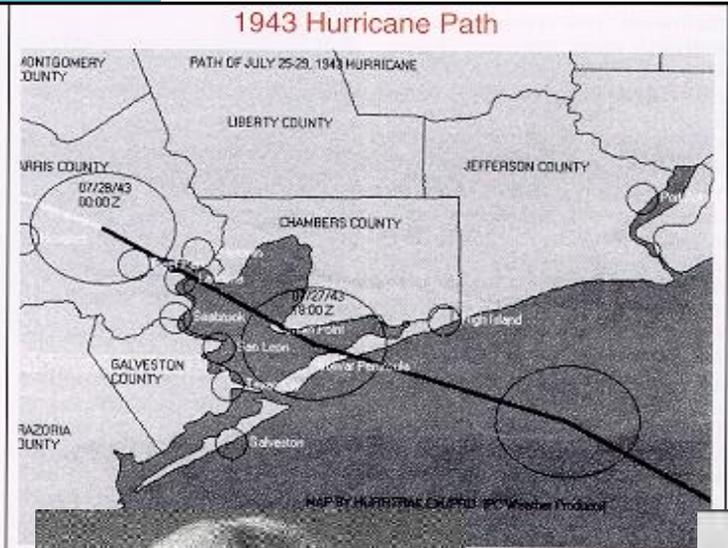
Figure 2. Best track central pressure curve for Hurricane Nora, 16-26 September 1997.

Figure 3. As in Fig. 2, except for maximum wind speed.



Pilot Joe Duckworth, Nav Ralph O' Hair, and Wx Ofcr William Jones-Burdick Bryan TX, Jul '43

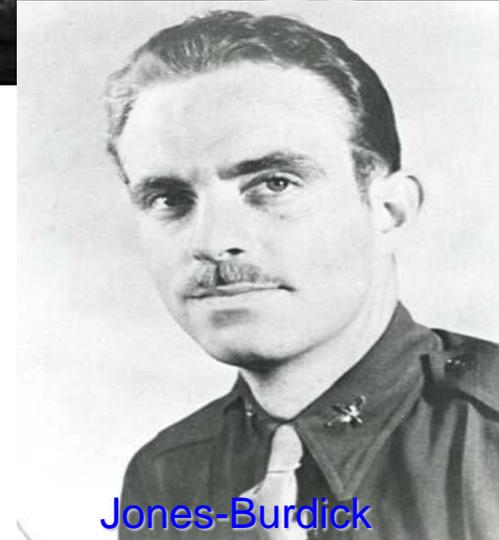
72yrs ago



Duckworth



O' Hair



Jones-Burdick



SEMR



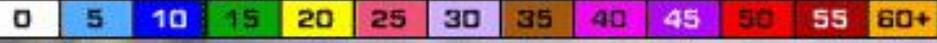
Stepped Frequency Microwave Radiometer
Airborne Mapping of Surface Wind Speed
Deployed on NOAA WP-3D Hurricane Research Aircraft &
US Air Force Reserves WC-130J Hurricane Hunter Aircraft



- The Stepped Frequency Microwave Radiometer (SFMR), which detects wind speed on the surface



Average Flight Level Wind Over 30 Seconds (knots)



Hurricane Bill
2009

WC-130J
Current
position

HDOBs

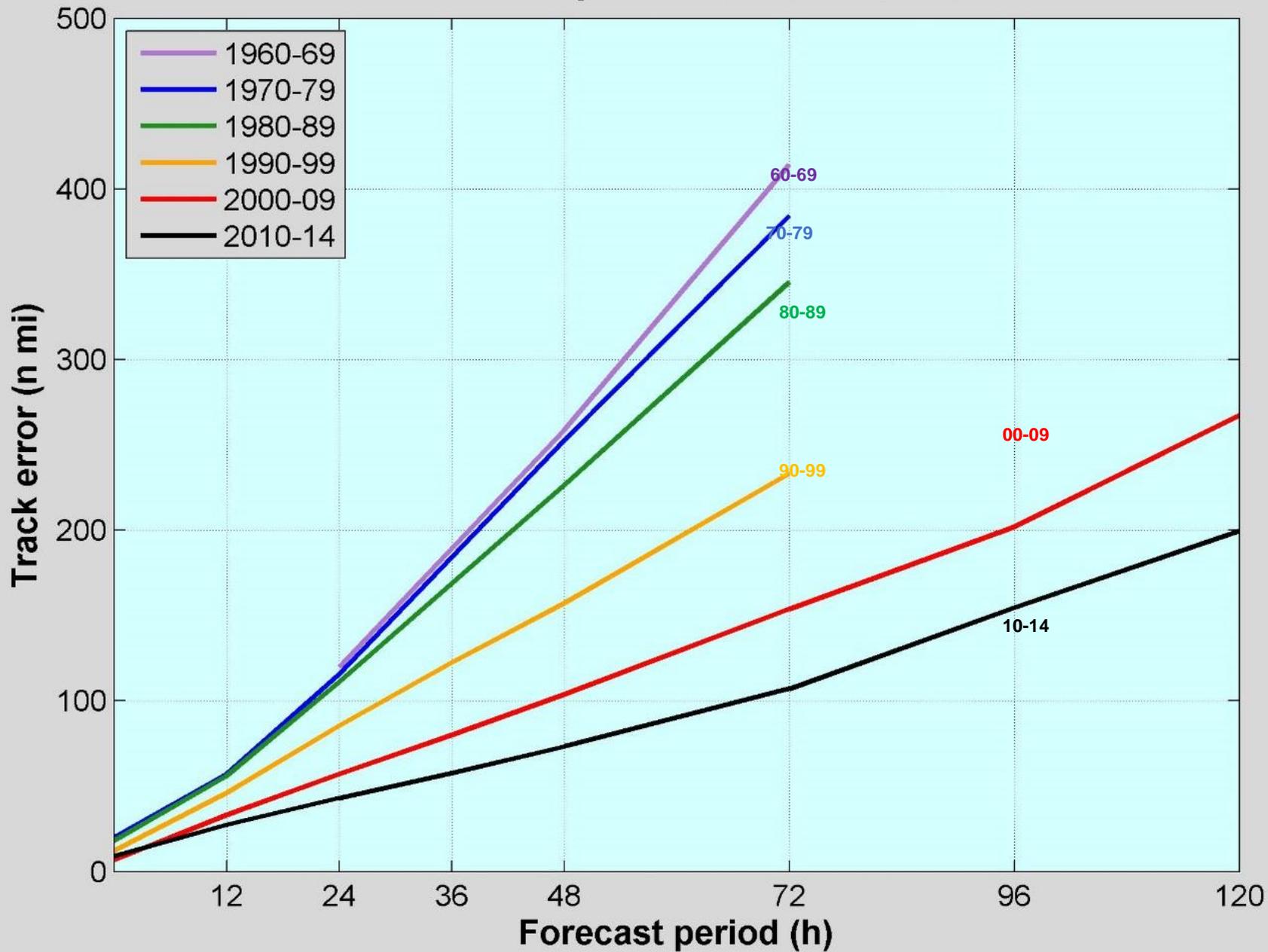
Vortex Msg

Dropsonde
Observation

RECCO

Plots aircraft position and data every 30 sec via HDOBs
Plots manual observations (RECCOs, Drops, Vortex)

NHC Official Average Track Errors Atlantic Basin Tropical Storms and Hurricanes





RA-IV Hurricane Committee , Costa Rica 2015



Summary

- Exchange of weather information to make regional synoptic charts.
- Establishment of the World Meteorological Organization to further coordinate the exchange of weather information and capacity building
- Satellite Images became available in the 1960s
- Hurricane Hunter missions became Hurricane Reconnaissance missions
- Techniques to analyze satellite images
- Enhancement of the Early Warning System

Preparedness and EWS: Caribbean Hurricane Awareness Tour



*At the end of the day,
It is about saving lives and property*