NOAA Technical Memorandum NWS NHC 39

SATELLITE INTERPRETATION MESSAGES
A USERS' GUIDE

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UNITED STATES
DEPARTMENT OF COMMERCE
C. William Verity, Secretary

National Oceanic and
Atmospheric Administration
J. Curtis Mack, Acting Administrator

National Weather Service
Richard E. Hallgren
Assistant Administrator

TROPICAL SATELLITE AND ANALYSIS CENTER

The Tropical Satellite and Analysis Center (TSAC) is a major component of the National Hurricane Center. This group provides support to the Hurricane Warning Program through: intensity and location estimates of tropical and subtropical cyclones over the Atlantic; quantitative rainfall potential estimates for landfalling tropical cyclones and disturbances within WMO Region IV; surface and upper-air analyses over the tropical and subtropical Western Hemisphere; and running of operational tropical cyclone track models.

In addition to these Hurricane Warning functions, the TSAC prepares routine narrative statements summarizing prominent weather features over the tropical and subtropical Atlantic. The Tropical Weather Discussion (AXCA KMIA) is intended for mariners and laymen, and represents a plain language summary of major features from the latest surface analysis and cloud features depicted in satellite imagery. The Satellite Interpretation Message (TBXX7 KMIA) is a more thorough summary intended for meteorologists and pilot weather briefers.

This document is intended as a Users' Guide to Satellite Interpretation Messages (SIM) prepared by the TSAC. The purpose is not to provide a intensive course in satellite interpretation, synoptic meteorology, or mesoscale analysis. Rather, this Guide is an attempt to provide definitions and a few examples of phenomena commonly used in the SIM. Individuals requiring additional literature are urged to review the reference list at the end of this Guide.

SATELLITE INTERPRETATION MESSAGES - A USERS' GUIDE

James S. Lynch

1. SATELLITE INTERPRETATION MESSAGES - AN INTRODUCTION

The Miami SIM describes and explains prominent cloud features relative to both synoptic and mesoscale dynamic features south of 32N and west of 35W, including the Caribbean, the coastal and offshore waters of the Gulf of Mexico, and the state of Florida.

Trends in the shape, intensity, and movement of meteorological features are normally included in the messages, and locations are frequently referenced to geography and geopolitical boundaries. Whenever possible, the message discusses and compares observed phenomena with those predicted by NMC's numerical guidance packages, including: the Limited Area Fine Mesh Model (LFM), the Nested Grid Model (NGM), and the Spectral Model (SM).

The Miami SIM normally includes two primary sections. The first section summarizes the important synoptic features which specify the dynamics of the troposphere. The second part of the SIM describes the significant cloud patterns and mesoscale dynamic features over the SIM area, with emphasis over/near Florida, the Gulf of Mexico, and Puerto Rico.

The SIM is written using commonly accepted meteorological terminology and abbreviations, consistent with the FAA Contractions Handbook. Important notices to users, such as data availability or major satellite maneuvers, can precede or follow these sections.

TBXX7 KMIA 220244
SATELLITE INTERPRETATION MESSAGE
NATIONAL WEATHER SERVICE...MIAMI FL
11:00 PM EDT OCTOBER 21 1985

GOES/METEOSAT IMAGERY THRU 0200Z AND PRELIM 0000Z SFC ANLYS...

SYNOPTIC FEATURES...
...A LRG MID/UPR-LVL CYC CRCLN INVOF 16N81W HAS RMND NRLY STNRY DURG THE PAST 24 HRS. SHRTWV TROF EXTDG FM THE CRCLN TO 15N77W IS ROTG NNEWD AT 15-20KT ON THE SE END.
...GOES WV DATA INDCS A WK MID-LVL VORTMAX NR 26N65W. THIS VORTMAX IS MOVG E ABT 15KT.
...A LONGWV TROF EXTDS S ALG 50W TO 25N. AN UPR-LVL RIDGE S OF 25N ALG 68W IS GRDLY AMPLIFYING.
...A VORTMAX INVOF 23N42W IS MOVG NE ABT 30KT. A SHRTWV TROF EXTDG SSW TO 16N45W IS MOVG E AT 10-15KT ON THE S END.
...A BACLIN/FNTL ZONE IS ALG A 32N45W-30N55W-30N68W-32N72W LN. THE ZONE IS SHIFTING S AT 5-10KT BTWN 45W AND 75W...AND SHOWS LTL MOVMT W OF 75W. SEE SIMWBC FOR DETAILS N OF 32N.
...SUBTRPCL JTSTR IS ESTABLISHED ALG A 25N88W-15N88W-11N85W-12N80W-22N77W-25N70W-25N65W-19N50W LN. A SPDMAX NR 12N82W IS MOVG ALG THE JET AXIS AT 50KT. ANOTR SPDMAX IS MOVG SWD ARND 40KT INTO THE YUCATAN PEN.
...A TRPCL WV ALG 74W IS MOVG W ARND 15KT.
...A WK TRPCL WV ALG 53W IS MOVG W AT 10-15KT.

MESOSCALE FEATURES...
FL AND ADJ CSTL WTRS...
A BAND OF SHWRS/TSHWRS ALG A GNV-TPA-25.5N83.5W LN IS MOVG W ARND 15KT. STGST TSHWRS ARE LCTD 60NM W FMY WITH CLD TOP TEMPS NR -62C. WDLY SCT TCU AND ISOLD SHWRS CVR THE RMNDR OF THE CSTL WTRS.

GULF OF MEXICO...
A TSTM GUST FRONT EXTDG FM 20NM S BVE TO 27N91W IS MOVG NW ABT 25KT THRU OIL LEASES SP/WD/GI AND TWD LEASES STIM/EC/WC. THE GUST POTENTIAL WITH THIS ARC CLOUD IS 40-50KT. SCT SHWRS/TSHWRS ARE ALG THIS SYS. ELSW...ISOLD SHWRS ARE CLUSTERED OFF THE TX CST 40NM SE PSX.

PUERTO RICO.. U.S. VIRGIN ISL.. AND ADJ CSTL WTRS...
CSDRBL MID/HIGH-LVL CNVTV BEBRIS PVL THRUT THE AREA. MOST SGFNT CNVTN IS 60NM OR MORE FM THE ISLANDS ATTM.

OTR SGFNT FEATURES S OF 32N...
SUBTROPICAL ATLANTIC...
A BAND OF SHWRS/TSHWRS ACPYS THE BACLIN/FNTL ZONE ALG A 32N45W-30N55W-30N68W-32N72W LN. BKN SC/AC PVL N OF THIS BNDRY. MULTILYRD CLDS AND WDLY SCT SHWRS/TSTMS S OF 24N AND W OF 65W ARE ASSOCD WITH AN UPR-LVL CYC CRCLN OVER THE WRN CARIB AND A TRPCL WV ALG 74W.

CARIBBEAN SEA...
MULTILYRD CLDS WITH SCT AND LOCALLY NMRS TSTMS/SHWRS BTWN 65W AND 74W ACPY A MID/UPR-LVL CYC CRCLN AND A TRPCL WV. SCT TSTMS/SHWRS OVER/NR PANAMA ARE ASSOCD WITH THE EPAC ITCZ AND A SPDMAX ALG THE SUBTRPCL JTSTR. WDLY SCT SHWRS/TSHWRS CVR THE RMNDR OF THE CARIB W OF 74W.

TROPICAL ATLANTIC...
MULTILYRD CLDS WITH SCT-NMRS TSTMS/SHRS PVL WITHIN 150NM OF A 4N41W-15N30W LN. THIS ACTVTY IS ASSOCD WITH THE INTERACTION OF A TRPCL WV WITH AN UPR-LVL SHRTWV TROF. SEG OF THE ITCZ CONSISTS OF SCT SHWRS/TSHWRS FM 5N55W THRU 7N43W TO 3N30W.

TBXX7 KMIA 220244
SATELLITE INTERPRETATION MESSAGE
NATIONAL WEATHER SERVICE...MIAMI FL
10 PM EST FEBRUARY 21 1986

GOES/METEOSAT IMAGERY THRU 1900Z AND PRELIM 1800Z SFC ANLYS...

SYNOPTIC FEATURES...
...A 200NM WD BACLIN ZONE EXTDG FM 35N56W TO 20N68W IS MOVG E AT 15-20KT. ACPYG CLDNS OVER THE CARIB IS BCMG DFUS...HWVR SFC ANLYS DEPICTS FNT FM HISPANIOLA TO COSTA RICA...MOVG E ARND 10KT.
...A STG LONGWV TROF EXTDS SSW THRU 30N74W TO 20N81W. OVER THE ERN ATLC...A SCND LONGWV TROF EXTDS SSW THRU 30N22W TO 4N40W. A BLOCKING PAT OVER THE WRN U.S. SHUD KEEP THESE LONGWV PATS ABT STNRY DURG THE NEXT 96-120 HRS ACCORDING TO THE NMC SPECTRAL AND NESTED GRID MODELS.
...A MID-LVL ACYC CRCLN PRSTS OVER THE LESSER ANTILLES. A PROMINENT MID/UPR-LVL RIDGE EXTDS FM THE CRCLN THRU 32N55W.
...GOES WV DATA DEPICTS MULTIPLE JET STREAKS ARND THE WRN ATLC LONGWV TROF. ONE JTSTR BR IS ALG A ILM-29N78W-30N71W-35N65W LN. A SCND JET STREAK IS ALG A BIX-FMY-25N77W-27N70W-35N65W LN. A THIRD JTSTR IS ALG A GLS-21N81W-22N75W-35N65W LN. GENERAL UPR-LVL CNFLNC AND SBSDNC IS EVIDENT BTWN THE JTSTR SEGS FM 85W TO 70W.

MESOSCALE FEATURES...
FL AND ADJ CSTL WTRS...
BKN OCNL SCT CD-AIR SC CVR THE FL CSTL/OFSHR WTRS TO THE RT OF A 27N85W-24N82W-23N78W-31N80W LN. MOST CLD ELEMENTS CONT TO MOVE FM THE NW THRUT THE AREA E OF 85W.

GULF OF MEXICO...
BKN OCNL SCT CD-AIR SCT CVR MOST OF THE GLFMEX SE OF A 26N95W-50NM SE BVE-27N85W-27N85W-24N82W LN. NMC GEOSTROPHIC ANLYS SUGS A LOW-LVL ACYC CRCLN IS LCTD OFF THE MOUTH OF THE MS RIVER. MOSTLY CLEAR SKIES CVR THE TX/LA/MS/AL CSTL WTRS AND OIL LEASES.

PUERTO RICO.. U.S. VIRGIN ISL.. AND ADJ CSTL WTRS...
TCU AND A FEW SHWRS APPR TO BE DVLPG OVER THE HIER ELEVATIONS OF PUERTO RICO. MOST OF THE CLDNS NOTED EARLIER OVER THE VIRGIN ISL IS DSIPTG. THE LEADING EDGE OF BACLIN ZONE CLDNS AND CNVTN...MARKED BY A NNE/SSW ROPE CLD NR ERN HISPANIOLA...IS MOVG E ABT 20KT AND COULD BGN TO AFFECT WRN SXNS OF PUERTO RICO BY 23Z IF PRESENT TRENDS CONT.

OTR SGFNT FEATURES S OF 32N...
CARIBBEAN SEA...
BKN OCNL SCT SC/AC AND WDLY SCT SHWRS CVR MOSTOF THE CARIB W OF 74W. THE FNTL BNDRY IS INDISTINCT IN STLT IMAGERY OVER THE CARIB. SCT-BKN SC/AC AND SVRL SHWRS ARE DVLPG WITHIN 150NM OF 15N70W. A LRG PTCH OF AC/AS AND ISOLD SHWRS IS LCTD OVER THE NRN LEEWARD ISL.

SUBTROPICAL ATLANTIC...
A 200NM WD BAND OF MULTILYRD CLDS WITH EMBDD SHWRS/TSHWRS FM 35N56W TO 20N68W IS ASSOCD WITH THE BACLIN ZONE. OVC SC/AC/AS AND SVRL SHWRS WITHIN 150NM OF 22N70W ARE GDL EXPANDING NEWD. BKN CD-AIR SC CVR THE RMNDR OF THE ATLC W OF THE FNT.

TROPICAL ATLANTIC...
THE WRN TRPCL ATLC RMNS UNORGANIZED. SCT SHWRS/TSHWRS CONT TO INCR WITHIN 200NM OF 3S40W. THE ITCZ IS BTR DEFINED OVER THE GULF OF GUINEA.

TBXX7 KMIA 291935
SATELLITE INTERPRETATION MESSAGE
NATIONAL WEATHER SERVICE...MIAMI FL
4:00 PM EDT AUGUST 29 1985

GOES/METEOSAT IMAGERY THRU 1900Z AND PRELIM 1800Z SFC ANLYS.

SYNOPTIC FEATURES...
...AT 29/1900Z HURCN ELENA IS LCTD NR 26.3N86.3W WITH SUSTAINED WINDS NR 70KT. MOVMT IS NW AT 10-15KT. TWO WELL DEFINED SPIRAL BANDS ARE APRNT ARND THE HURCN. SEE THE LATEST NHC ADVY FOR ADDNL DETAILS.
...A LRG ACYC CRCLN IS EVIDENT OVER HURCN ELENA. THE ACYC CRCLN DOMINATES THE H2 FLOW PAT BTWN 20N AND 32N FM 75W TO 95W.
...A MID/UPR-LVL CYC CRCLN IS LCTD OVER NWRN GUATEMALA. THE SYS IS DRIFTING SLOWLY W. THE CRCLN IS ACTING AS AN ENERGY SINK FOR HURCN ELENA.
...A MID-LVL VORTEX IS APRNT IN GOES WV DATA NR 20N65W. MOVMT IS W AT 10-15KT.
...A SHRTWV TROF ALG 65W IS MOVG ESE AT 15-20KT.
...A JTSTR DIVES SE FM THE NC CST TO 31N65W AND THEN NEWD.
...CLDNS ASSOCD WITH A BACLIN ZONE PVLS BTWN THE JTSTR AXIS AND 30N. SEE SIMWBC FOR ADDNL DETAILS N OF 32N.

MESOSCALE FEATURES...
FL AND ADJ CSTL WTRS...
MULTILYRD CLDS WITH NMRS EMBDD TSTMS/SHWRS ACPY HURCN ELENA. THE ERN EDGE OF THIS CLDNS IS TO THE RT OF A 29N85W-TPA-EYW-23N85W LN. NMRS CLD TOP TEMPS ARE -65C TO -80C WITHIN THIS CLD MASS. WDLY SCT SHWRS/TSHWRS CVR MOST OF THE FL PEN.

GULF OF MEXICO...
SCT-NMRS TSTMS/SHWRS ACPY HURCN ELENA TO THE RT OF A EYW-23N85W-26N87W-29N85W LN...WITH CLD TOP TEMPS OF -65C TO -80C IN THE CNTRL DENSE OVERCAST AND SPIRAL BANDS. MID/UPR-LVL SBSDNC IS SUPPRESSING CNVTN ELSW ACROSS THE RGN.

PUERTO RICO.. U.S. VIRGIN ISL.. AND ADJ CSTL WTRS...
SCT SC ARE APRNT THRUT THE AREA. NO SGFNT CNVTN IS APRNT ATTM.

OTR SGFNT FEATURES S OF 32N...
CARIBBEAN SEA...
SCT TSTMS CVR THE CSTL WTRS OF COSTA RICA AND PANAMA. WDLY SCT SHWRS/TSHWRS PVL BTWN 80W AND 85W. OTRW LTL SGFNT CLDNS IS NOTED.

SUBTROPICAL ATLANTIC...
SCT SHWRS/TSHWRS AND BKN MID CLDS N OF 30N BTWN 55W AND 65W ARE ASSOCD WITH A SHRTWV TROF AND WK BACLIN ZONE. A 120NM WD CLUSTER OF TSTMS IS CENTERED NR 30N75W...JUST S OF THE JTSTR.

TROPICAL ATLANTIC...
THE ITCZ HAS BCM DISORGANIZED. BKN MID CLDS WITH WDLY SCT SHWRS AND A FEW TSTMS ACPY THE ITCZ IN A 270NM WD BAND ALG 13N FM 25W TO 54W.

2. SYNOPTIC FEATURES

Important large scale dynamic processes are summarized at the beginning of the SIM. These phenomena are frequently depicted in one or more forms of satellite imagery: 11um infrared, 6.7um water vapor, or 0.65um visible. In many instances, a pronounced synoptic feature can be detected with a single image; however, animated satellite imagery often provides better definition of the feature. When important dynamic features are missing or obscured in satellite imagery yet are depicted in surface or rawinsonde observations, they will often be included in the SIM.

Most of the synoptic features discussed in the SIM fall into one of five categories:

(1) vorticity centers,
(2) troughs/ridges,
(3) streamflow patterns,
(4) discontinuities, and
(5) tropical features.

Many of these features produce instability and/or lift, which can induce significant weather activity. Others produce subsidence and aid in fair weather activity.

Satellite data does have certain limitations. Low pressure and high pressure centers cannot be directly observed in satellite imagery; circulation centers can be observed, but precise locations can differ by as much as 5deg from the "pressure center". Furthermore, mid/upper tropospheric divergence and convergence cannot be directly observed from satellite imagery since they require mathematical determination; rather, diffluence and confluence can be depicted in satellite imagery, and are often coexistent with their mathematical counterpart.

Interpretation of satellite data is also limited since most
analysis procedures are extremely subjective. Within
example, a "vorticity center" and "trough/ridge" categories, for
plitude of hierarchy exists based on the apparent intensity or am
ORTMAX are the system. A cyclonic circulation, a VORTEX, and a V
ined by the each a form of positive vorticity centers, and are def
ion. subjective determination of intensity and relative mot

SYNOPTIC FEATURES DISCUSSED IN SATELLITE INTERPRETATION MESSAGES

MANDATORY FEATURES

VORTICITY CENTERS
- All Cyclonic Circulations
- Any VORTEX
- Pronounced Vortmax (Mid/Upper Tropospheric)
- Prominent Anticyclonic Circulations (Mid/Upper Level)

TROUGHS/RIDGES
- All Longwave Troughs (>10deg for half wavelength)
- Strong Shortwave Troughs (Mid/Upper Tropospheric)

STREAMFLOW PATTERNS
- All Jetstreams (Upper Tropospheric)
- All Pronounced Diffluent Patterns (Upper Tropospheric)
- All Pronounced Confluent Patterns (Upper Tropospheric)
- Pronounced Cyclonic Shear Axes (Upper Tropospheric)
- Pronounced Anticyclonic Shear Axes (Upper Tropospheric)

DISCONTINUITIES
- Cold Fronts
- Baroclinic Zones (Low/Mid Tropospheric)

TROPICAL FEATURES
- All Tropical Cyclones
- Pronounced Tropical Waves (Low/Mid Tropospheric
- Intertropical Convergent Zone

OPTIONAL FEATURES

VORTICITY CENTERS
- Less Pronounced VORTMAX (Any Level)
- Anticyclonic Circulations (Any Level)

TROUGH/RIDGES
- Less Pronounced Shortwave Trough (Mid/Upper Level)
- Vorticity Lobes (Mid/Upper Tropospheric)
- Impulses (Mid/Upper Tropospheric)
- Ridges (Upper Tropospheric)

STREAMFLOW PATTERNS
- Max Wind Bands (Less Than Jetstream Intensity)
- Speed Maxima Along The Jetstream or Max Wind Band
- Any Diffluent or Confluent Pattern
- Any Cyclonic or Anticyclonic Shear Pattern
- Deformation Patterns (Upper Tropospheric)

ADDITIONAL FEATURES THAT THE ANALYST BELIEVES ARE SIGNIFICANT

FEATURE: Cyclonic Circulation (CYC CRCLN)

DEFINITION: A closed cyclonic circulation, or "closed low". The analyst must be "confident" that the circulation is closed. The circulation may be at any level in the troposphere, but excludes those systems within the category of "tropical cyclones". Circulations are best depicted in animated satellite data, but strong circulations may be apparent in single visible, infrared, and/or water vapor images. Cold core cyclones can be as large or larger than 15deg x 15deg, and can move at speeds in excess of 30kt.

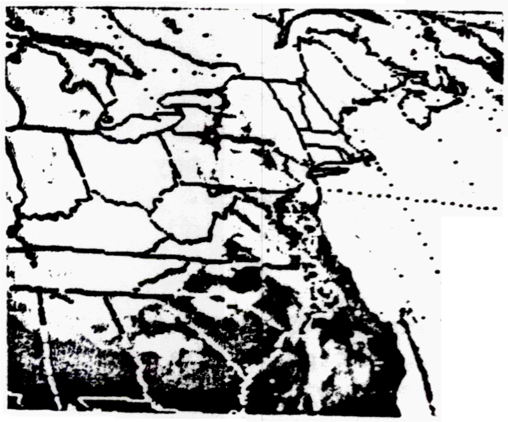
METEOROLOGICAL SIGNIFICANCE: All cyclonic circulations are important features for describing the dynamics and flow characteristics of the atmosphere. In most low-level circulations and many mid/upper-level systems, multilayered clouds and widespread thunderstorms frequently accompany the circulation.

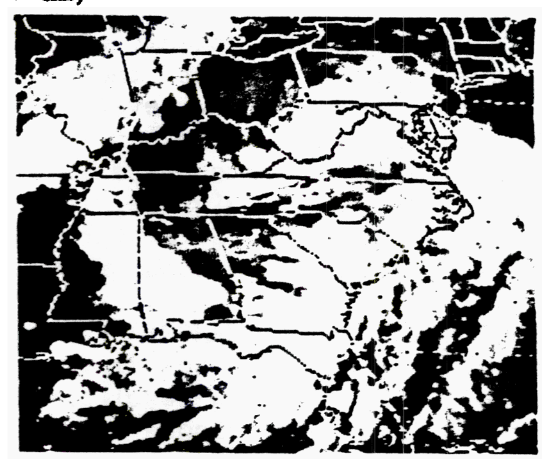
MARINE AND AVIATION SIGNIFICANCE: Widespread multilayered clouds with thunderstorms often accompany the circulation. A cold-core cyclonic circulation at the surface has the potential for producing strong sustained wind speeds (including gale, storm, and hurricane force winds). High altitude turbulence is typical of mid/upper-level circulations.

500mb Streamlines

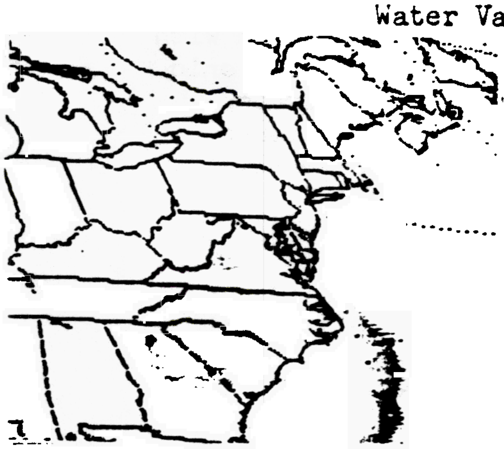
Cyclonic Circulations

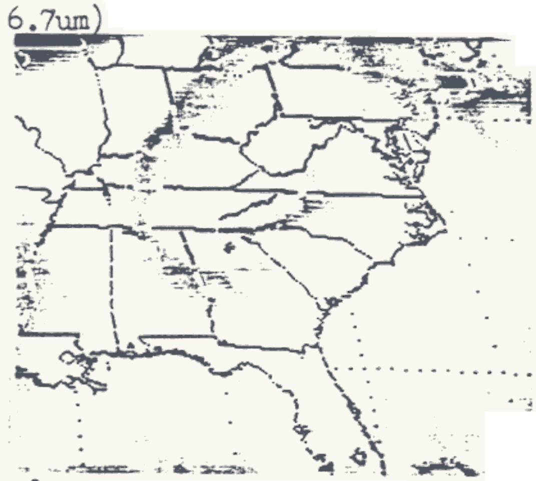
Infrared (IR = 11 um)



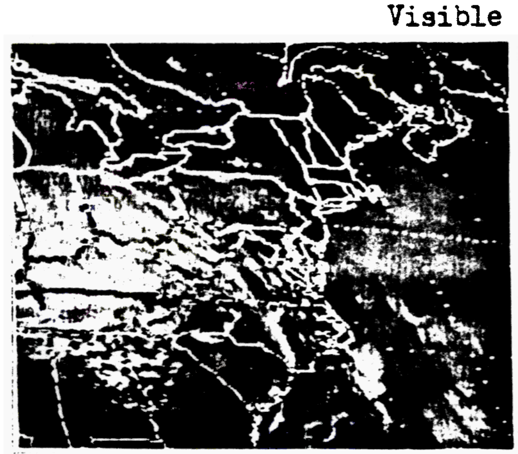


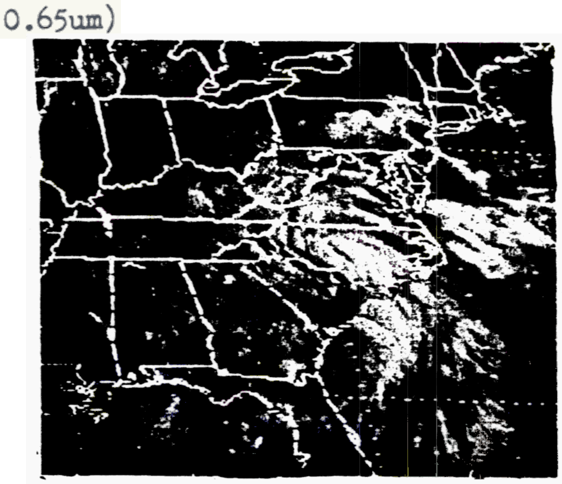
Water Vapor (WV = 6.7um)





Visible (VIS = 0.65um)



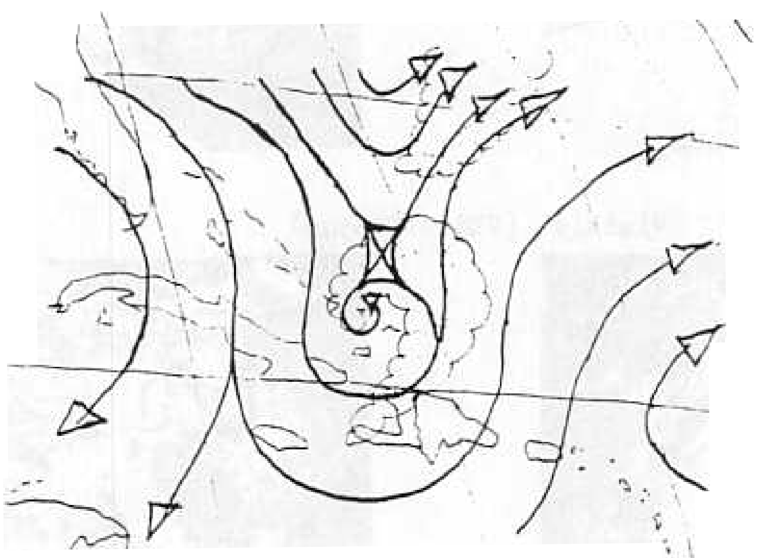


FEATURE: VORTEX

DEFINITION: In its general use, any flow possessing positive relative vorticity is termed a vortex. More often the term refers to a flow with closed streamlines. In satellite applications, a vortex represents a possible cyclonic circulation (analyst is not "absolutely confident" of the existence of a closed circulation) or a very strong "VORTMAX". A vortex is significant at any level of the troposphere. A vortex and its accompanying cloudiness is generally smaller than 5deg x 5deg.

METEOROLOGICAL SIGNIFICANCE: A vortex at any level has the potential for developing into a closed cyclonic circulation. Vertical motions are usually strongest in the region downstream of the system in the prevailing flow. A vortex can be accompanied by an extensive cloud shield of multilayered clouds and thunderstorms, especially when the accompanying vertical velocity field taps a moisture source..

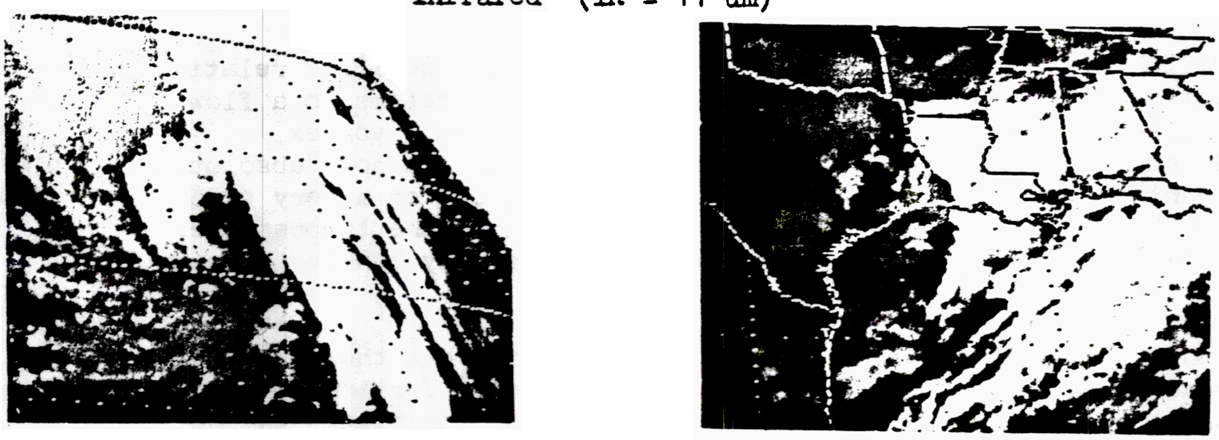
MARINE AND AVIATION SIGNIFICANCE: Multilayered clouds and large areas of thunderstorms often accompany a vortex. High altitude turbulence is frequently present in the vicinity of a vortex.



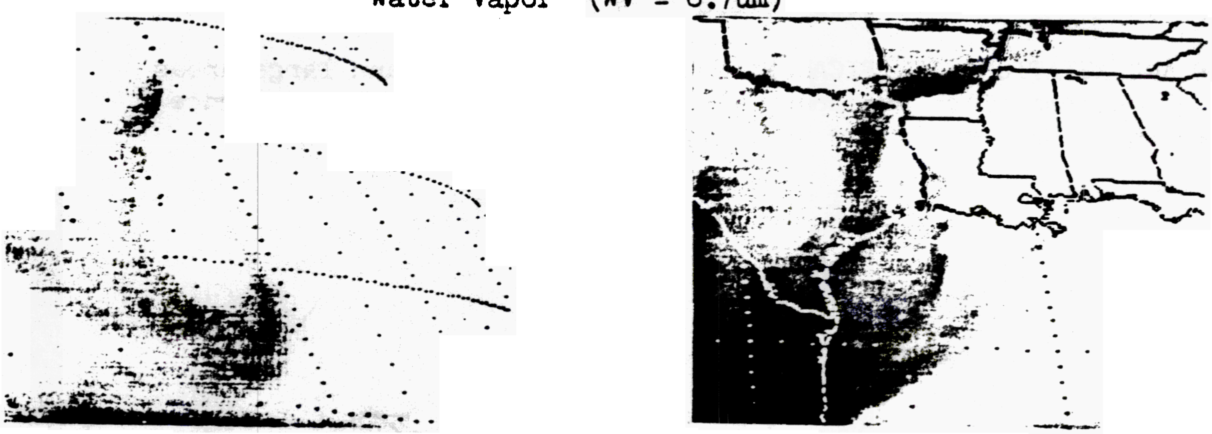
500mb Streamlines

VORTEX

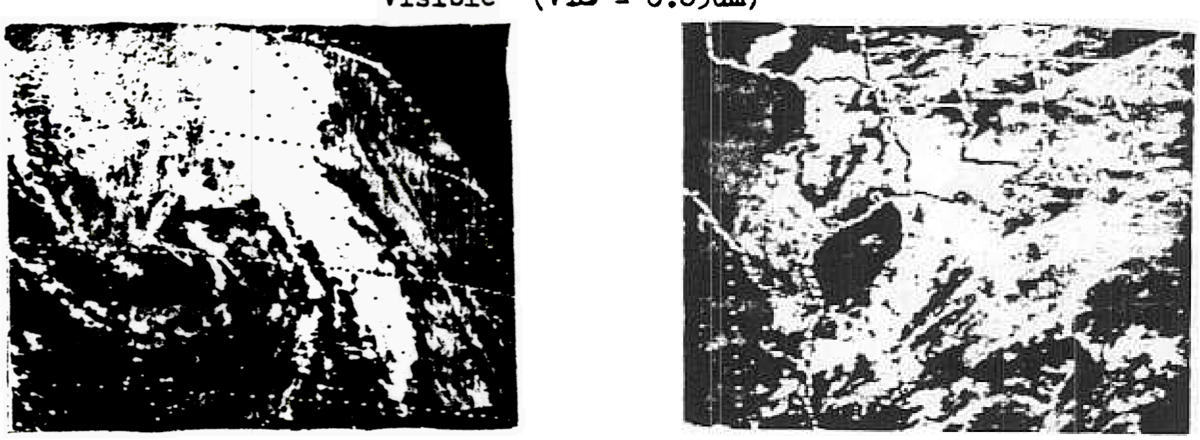
Infrared (IR = 11 um)



Water Vapor (WV = 6.7um)



Visible (VIS = 0.65um)

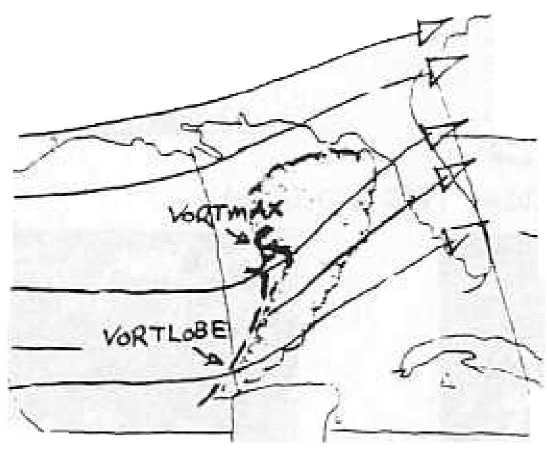


FEATURE: Vorticity Maximum (VORTMAX)

DEFINITION: A maximum of relative vorticity, most significant when located in the middle or upper troposphere. The advection of positive vorticity (PVA), related to upward vertical motion, is the most important factor controlling cloud distribution around the VORTMAX. A well-defined VORTMAX is typically denoted by a cyclonic swirl of clouds ("comma cloud").

METEOROLOGICAL SIGNIFICANCE: Vorticity maxima which are coupled with strong PVA and upward vertical motion can produce significant thunderstorm activity. A pronounced VORTMAX located in close proximity to a "frontal" or "baroclinic" zone will often induce low-level cyclogenesis. Low-level vorticity maxima (sometimes referred to as "screaming eagles") often enhance cumulus and shower activity, but seldom have large scale significance.

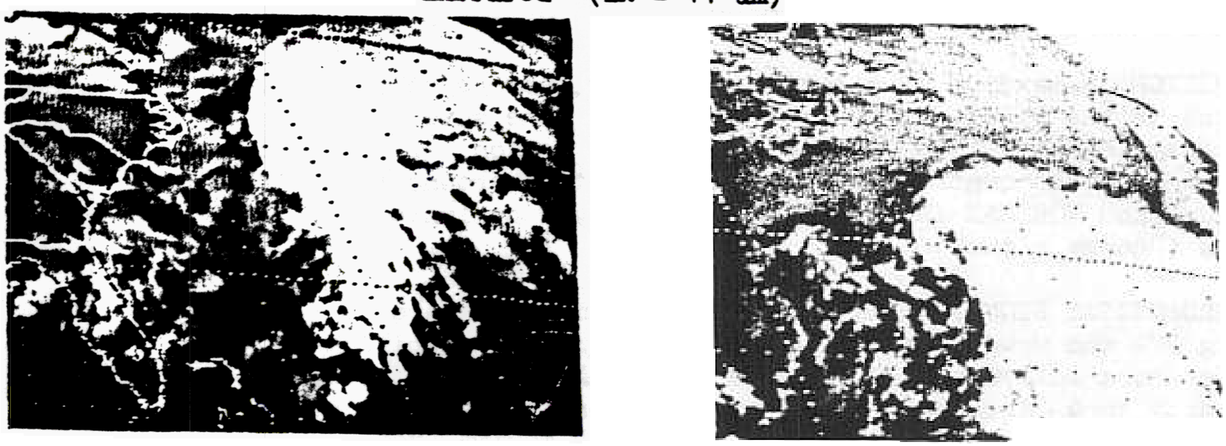
MARINE AND AVIATION SIGNIFICANCE: Widespread multilayered clouds with embedded thunderstorms often prevail downstream and within 5deg of a VORTMAX. High altitude turbulence often accompanies a mid/upper-level VORTMAX.



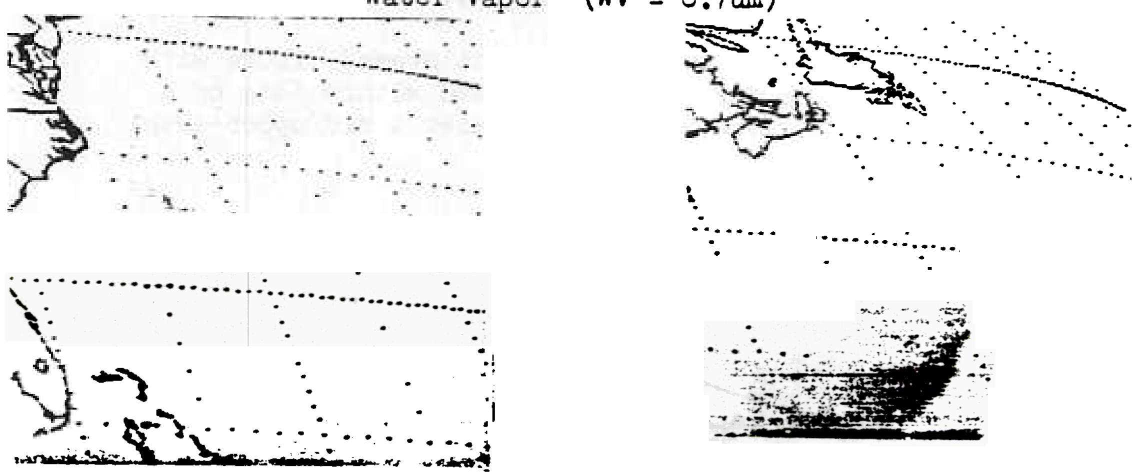
500mb Streamlines

VORTMAX

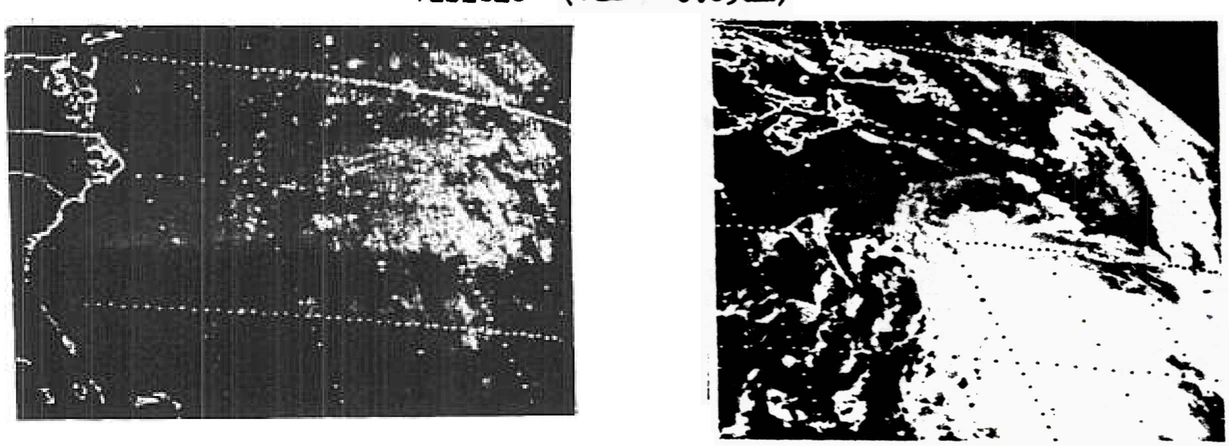
Infrared (IR = 11 um)



Water Vapor (WV = 6.7um)



Visible (VIS = 0.65um)

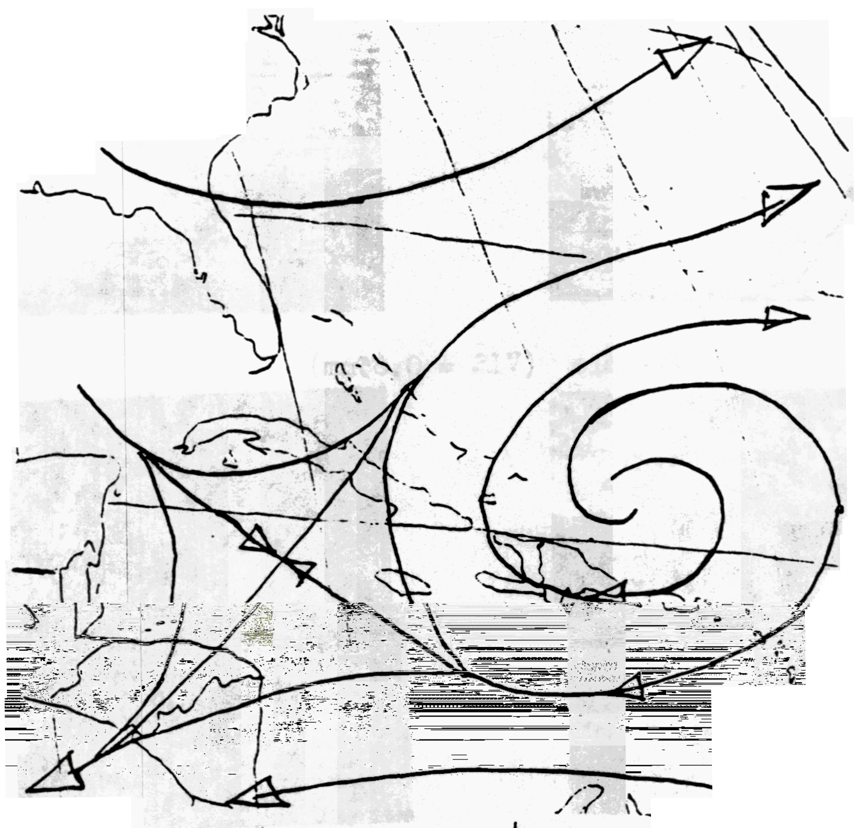


FEATURE: Anticyclonic circulation (ACYC CRCLN)

DEFINITION: A closed anticyclonic circulation, or "closed high". Most apparent in satellite imagery in the upper troposphere. Upper tropospheric anticyclones are often very large, normally larger than 5deg x 5deg. Movement of these systems is usually less than 20kt.

METEOROLOGICAL SIGNIFICANCE: Upper-level anticyclones are significant for describing the upper tropospheric dynamics and flow characteristics. When an upper-level anticyclonic circulation occurs over an area of convection, the circulation often aids in consolidating the areal coverage and enhancing the intensity of the convection.

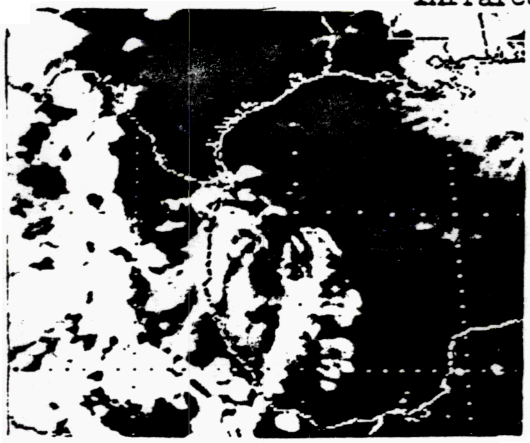
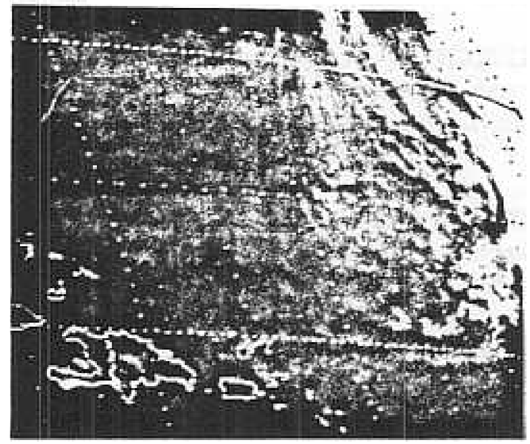
MARINE AND AVIATION SIGNIFICANCE: Of little significance except as an aid to convection.



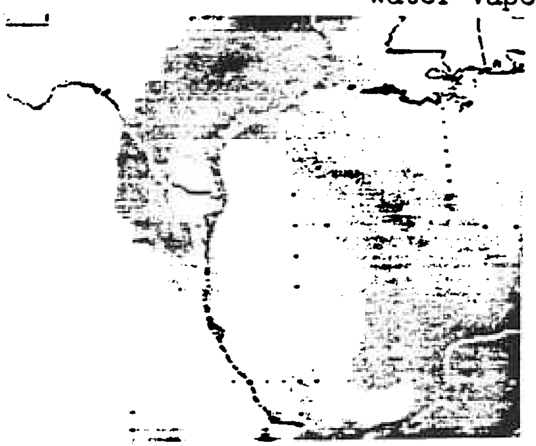
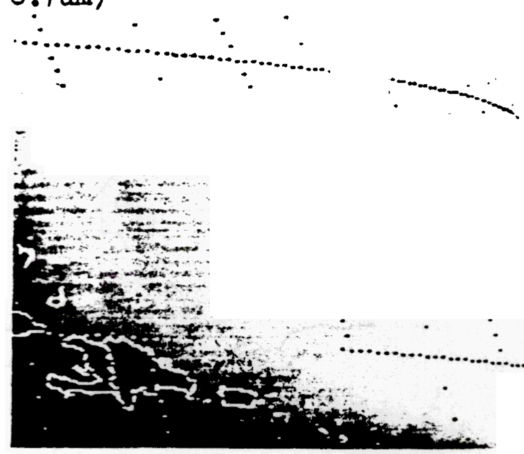
200 mb Streamlines

Anticyclonic Circulation

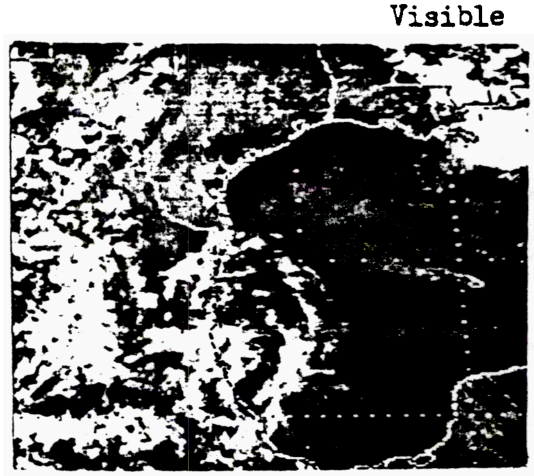
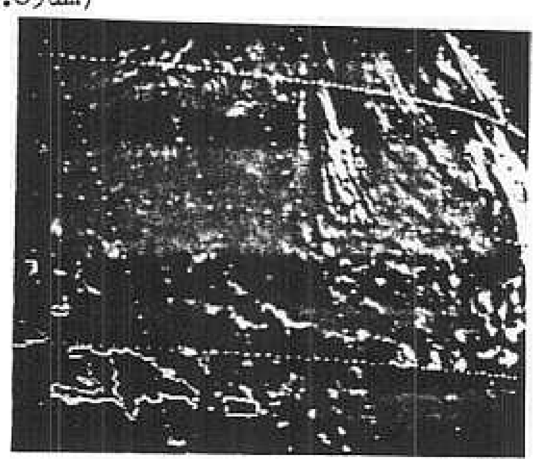
Infrared (IR = 11 um)

Water Vapor (WV = 6.7um)

Visible (VIS = 0.65um)

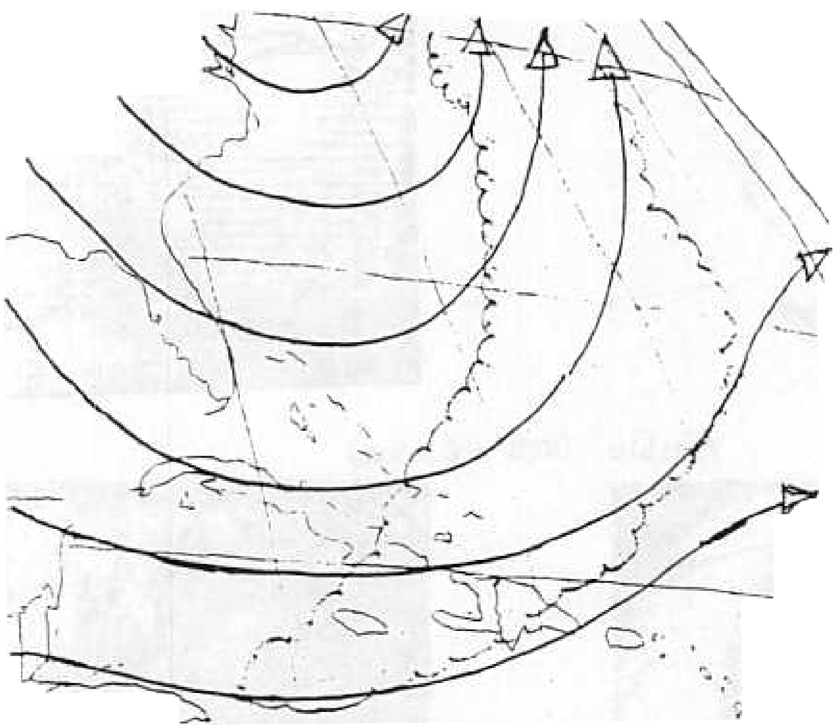



FEATURE: Longwave Trough (LONGWV TROF)

DEFINITION: A wave in the mid/upper tropospheric belt of the westerlies which is characterized by large length and significant amplitude. Longwave troughs have a 1/2 wave-length greater than 10deg (often 20 to 40 deg). Longwave troughs move at speeds of 15kt or less, and can be stationary or retrograde depending on their wavelength.

METEOROLOGICAL SIGNIFICANCE: Longwave troughs are the planetary waves which steer most extratropical and many subtropical disturbances. Longwave troughs have a significant influence on the meridional variation of the polar jetstream.

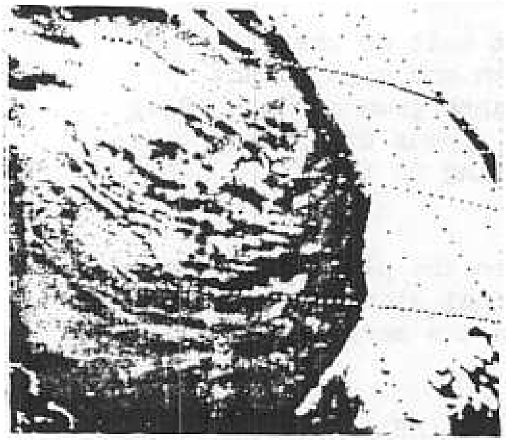
MARINE AND AVIATION SIGNIFICANCE: Of little direct influence.

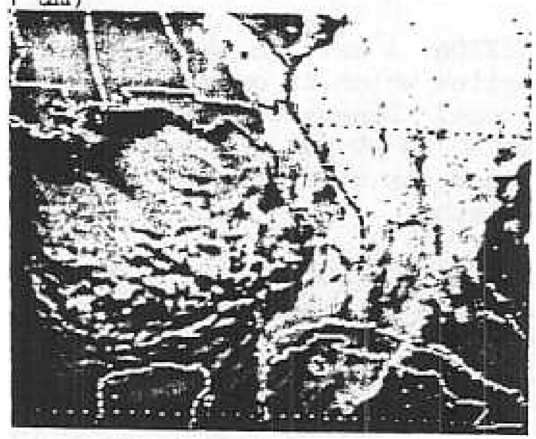


500mb Streaml

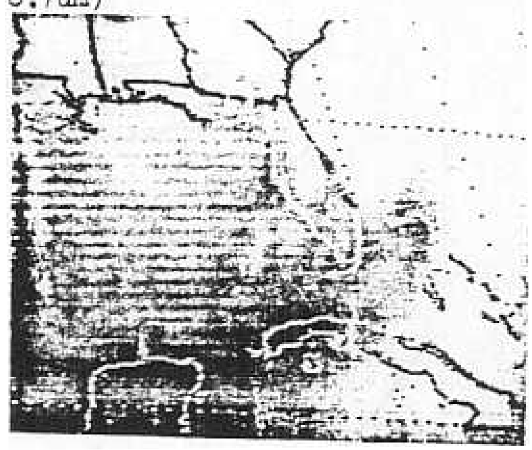
Longwave rough

Infrared (IR 1 um)





Water Vapor (WV 6.7um)



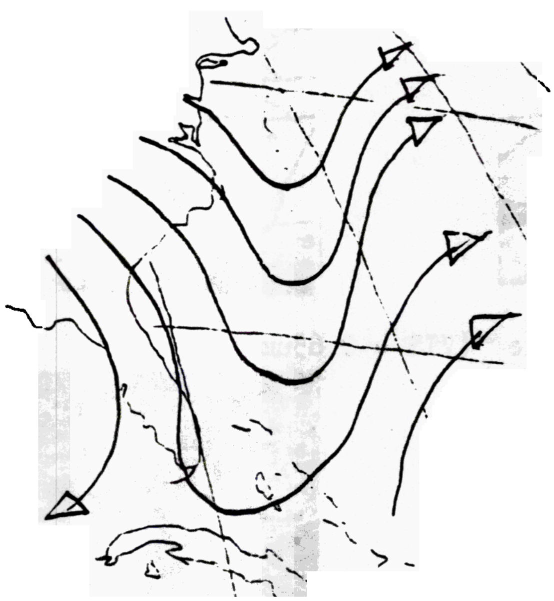
Visible (VIS 0.65um)

FEATURE: Shortwave Trough (SHRTWV TROF)

DEFINITION: A progressive wave in the horizontal pattern of air motion with the dimensions of the cyclonic scale (less than 10deg for 1/2 wavelength). A shortwave moves in the same direction as that of the prevailing current through the troposphere, normally at speeds of 20-40kt.

METEOROLOGICAL SIGNIFICANCE: Diffluence in the upper tropospheric flow pattern is frequently observed to the east of a trough, with confluence to the west. Mid/upper level shortwave troughs typically have upward vertical motions ahead of their path, thus producing widespread multilayered cloudiness and convection. Subsidence behind shortwave troughs often results in clearing (sometimes only temporary) of multilayered cloudiness.

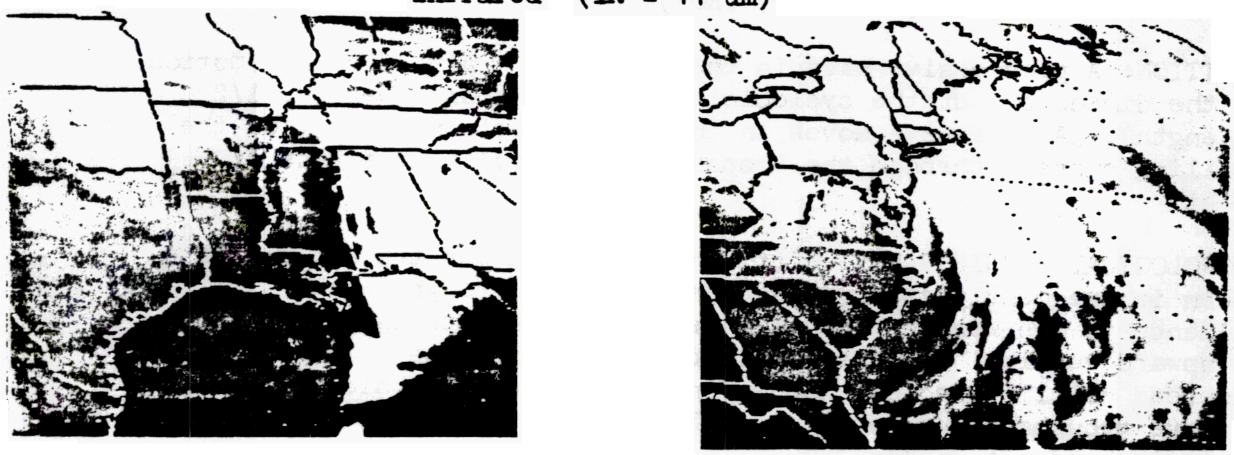
MARINE AND AVIATION SIGNIFICANCE: Widespread multilayered cloudiness and thunderstorms normally prevail ahead of a shortwave trough.



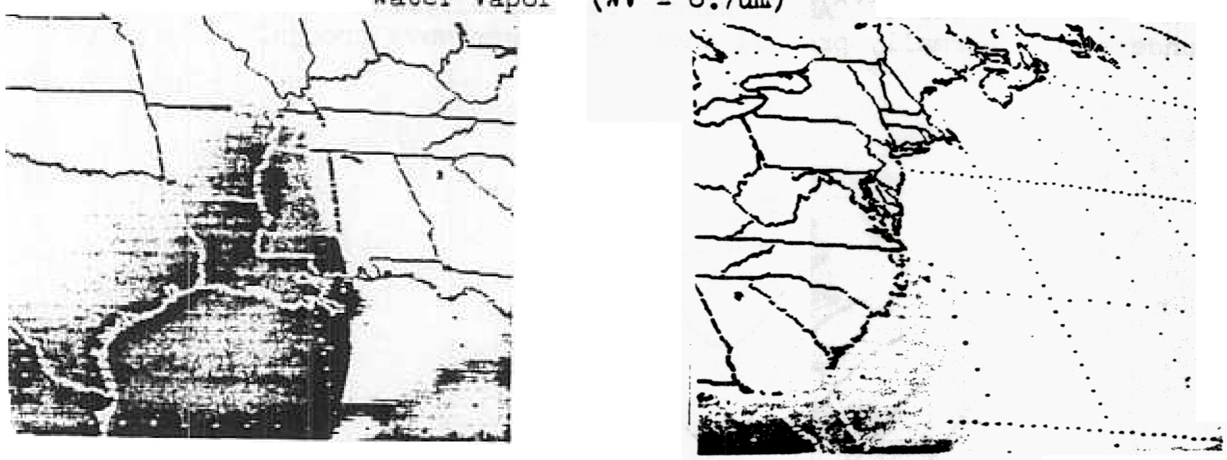
500mb Streamlines

Shortwave Trough

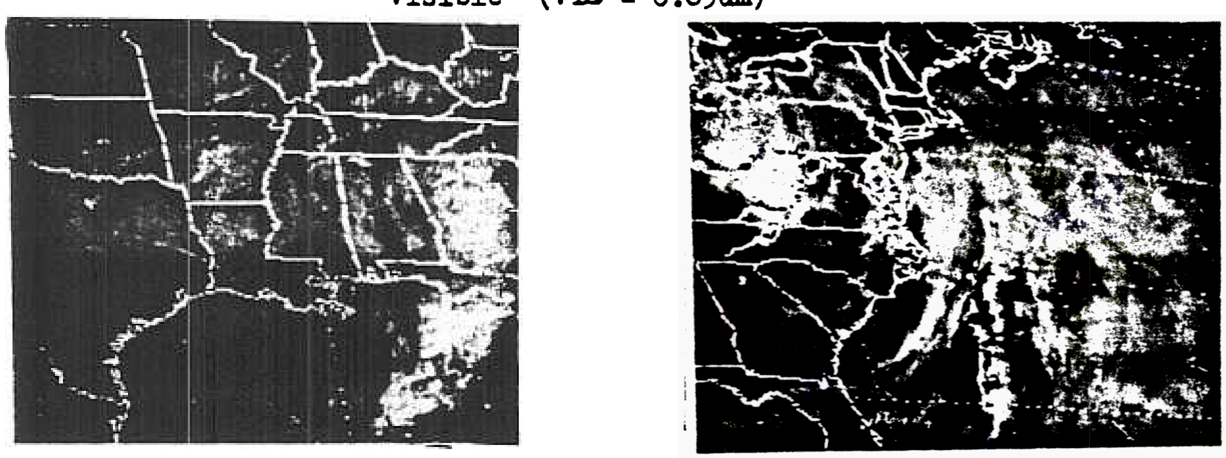
Infrared (IR = 11 um)



Water Vapor (WV = 6.7um)



Visible (VIS = 0.65um)



FEATURE: Vorticity Lobe (VORTLOBE)

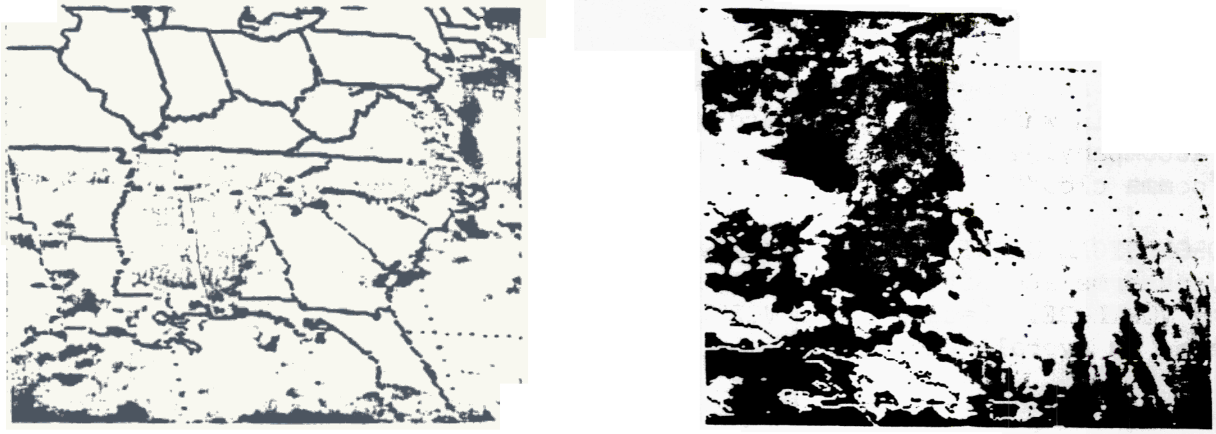
DEFINITION: An elongation of the vorticity pattern (often accompanying a VORTMAX) in which PVA and upward vertical motion are generated. When accompanying a VORTMAX, the VORTLOBE consists of the "tail" of the "comma cloud".

METEOROLOGICAL SIGNIFICANCE: Multilayered cloudiness with embedded thunderstorms are often found in the PVA field immediately downstream of the VORTLOBE. Passage of a VORTLOBE is often accompanied by a decrease in overall cloudiness.

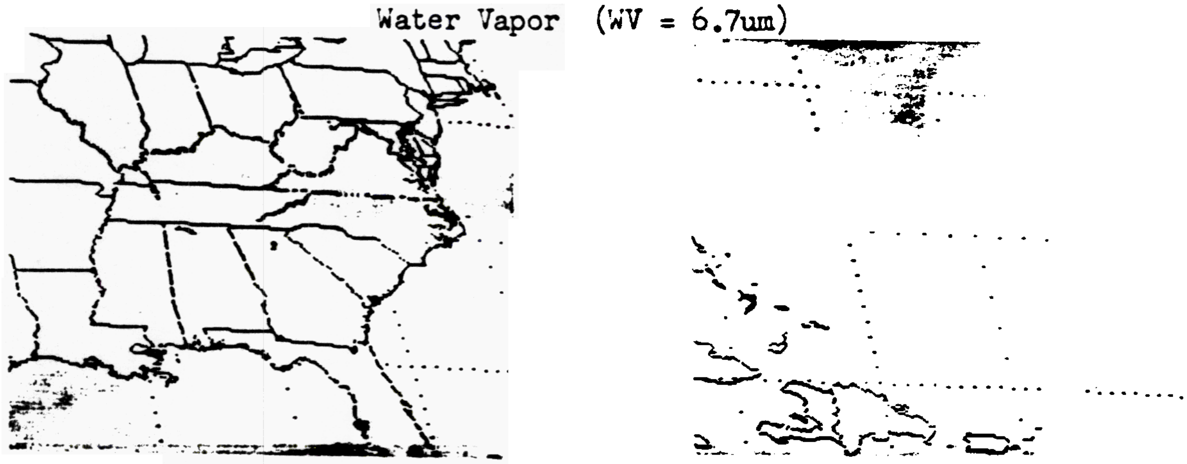
MARINE AND AVIATION SIGNIFICANCE: Multilayered clouds with embedded thunderstorms often precede a VORTLOBE. As a mechanism for generating PVA and vertical motion, high altitude turbulence can accompany VORTLOBEs.

500mb
Streamlines

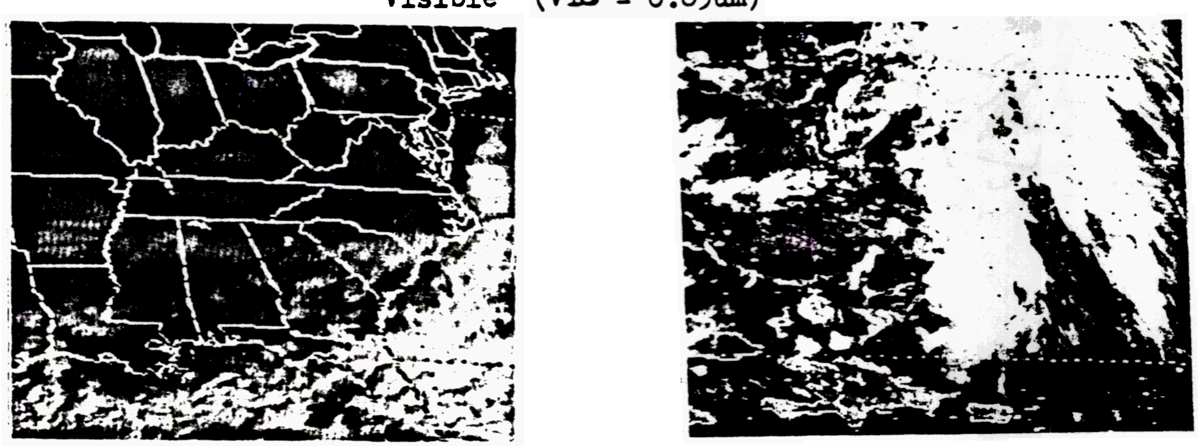
Infrared (IR = 11 um)



Water Vapor (WV = 6.7um)



Visible (VIS = 0.65um)

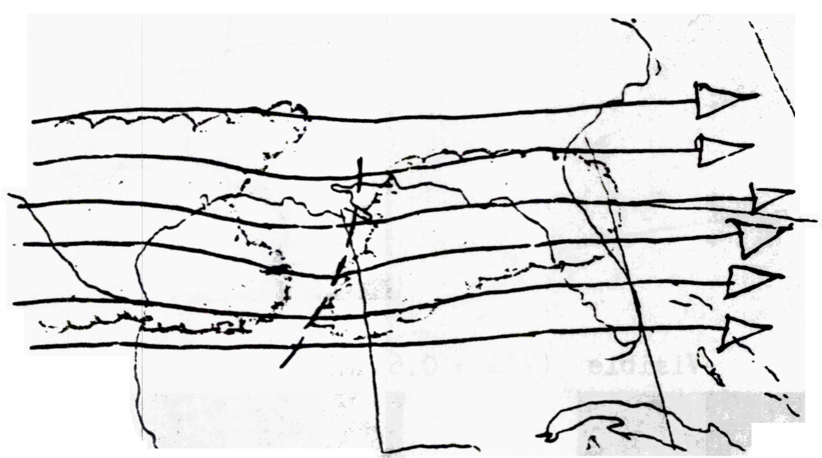


FEATURE: Impulse (IMPL)

DEFINITION: A minor perturbation in the upper-level flow pattern. The system can represent a weak VORTLOBE or a SPEEDMAX. Impulses frequently move at speeds greater than 40kt.

METEOROLOGICAL SIGNIFICANCE: Impulses produce a small area of PVA and upward vertical motion. As such, an impulse can briefly enhance an area of existing convection or layered cloud mass.

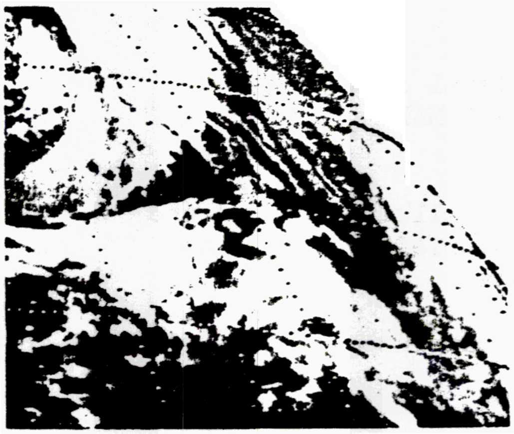
MARINE AND AVIATION SIGNIFICANCE: Thunderstorms can intensify briefly but rapidly with the approach of an impulse.



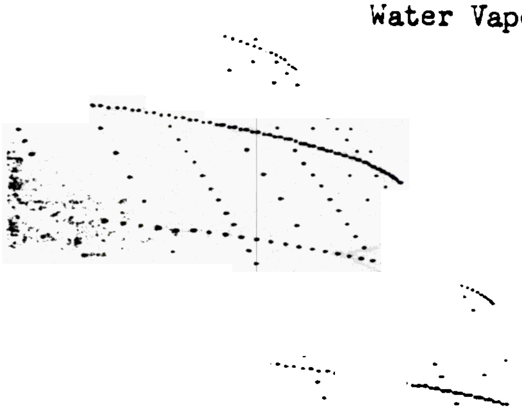
200mb Streamlines

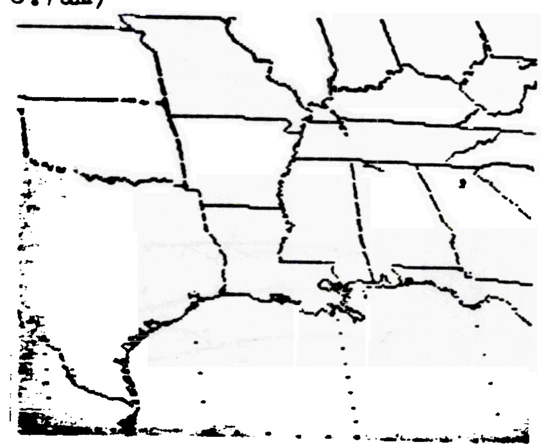
Impulse

Infrared (IR = 11 um)

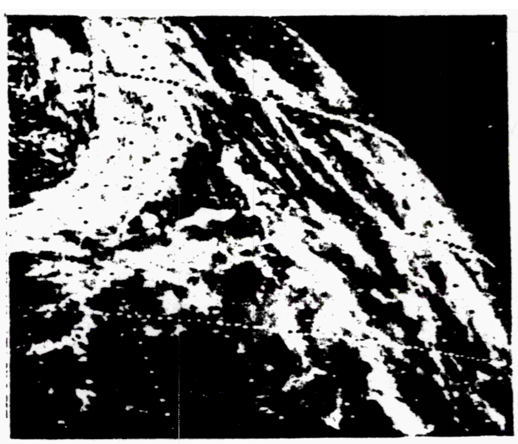


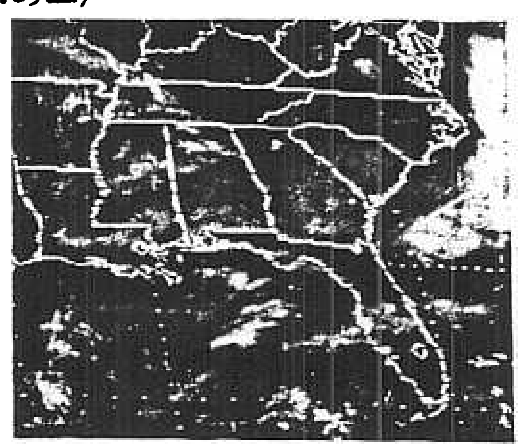
Water Vapor (WV = 6.7um)





Visible (VIS = 0.65um)



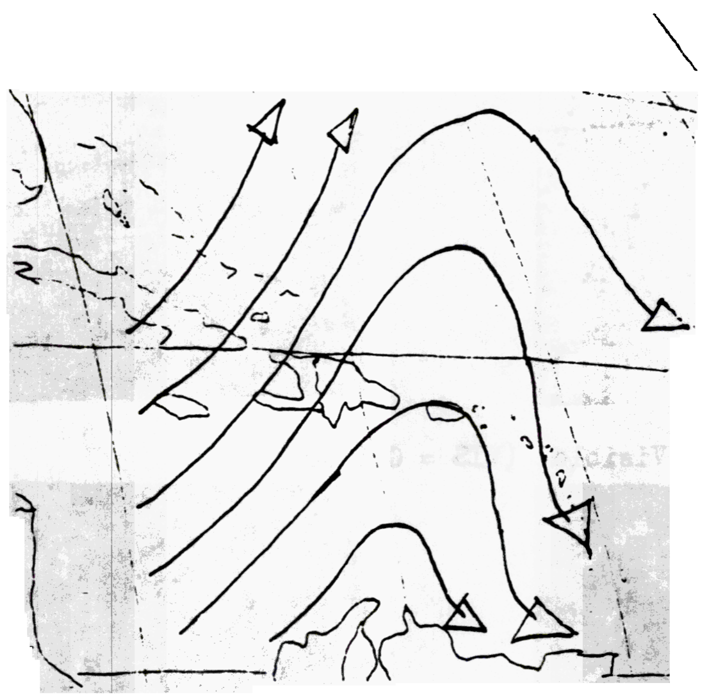


FEATURE: Ridge (RDG)

DEFINITION: An elongated area of maximum anticyclonic curvature of wind flow. Upper-level ridges normally have a north-south component to the axis.

METEOROLOGICAL SIGNIFICANCE: Ridges are significant for describing upper-tropospheric flow characteristics. In the upper-level westerlies, upper-level diffluent patterns typically occur on the upwind side of a ridge axis.

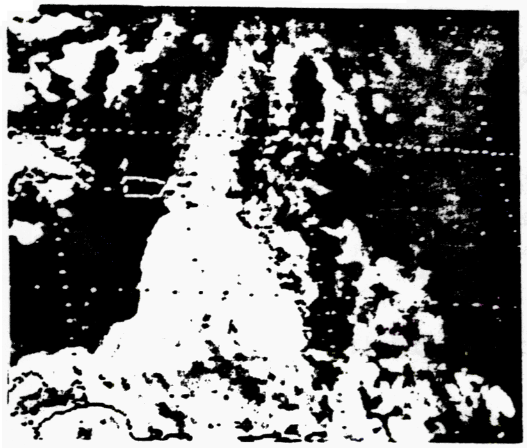
MARINE AND AVIATION SIGNIFICANCE: Of little direct significance.

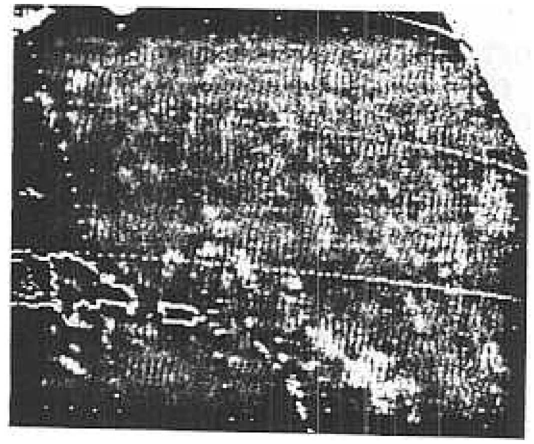


200mb Streamlines

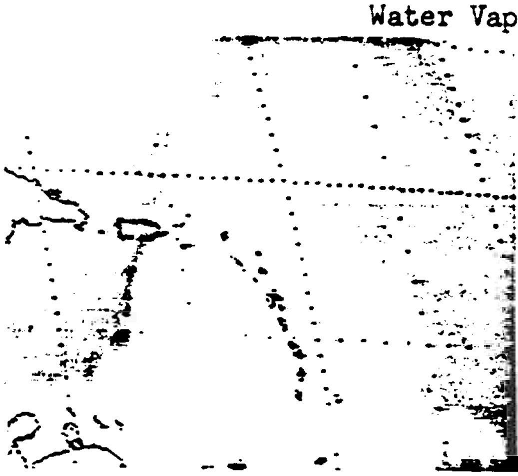
Ridge

Infrared (IR = 11 um)





Water Vapor (WV = 6.7um)



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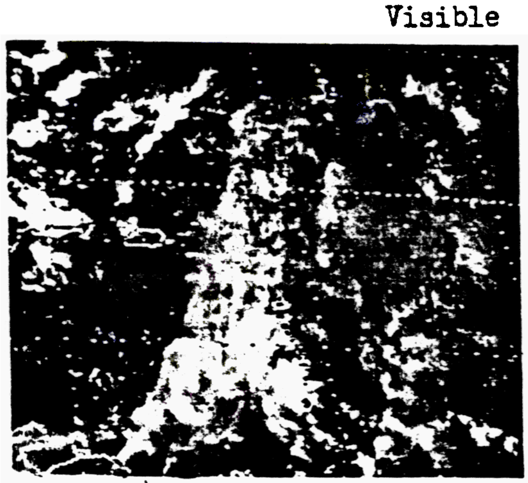
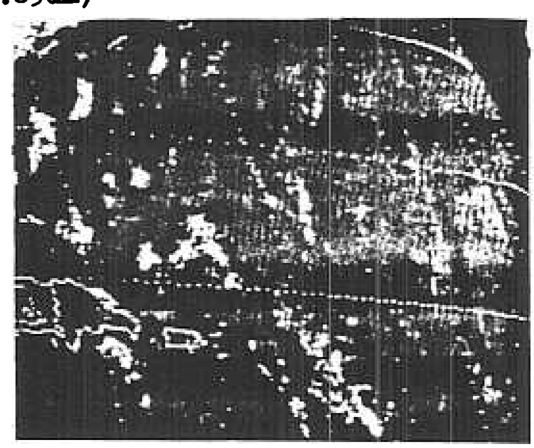


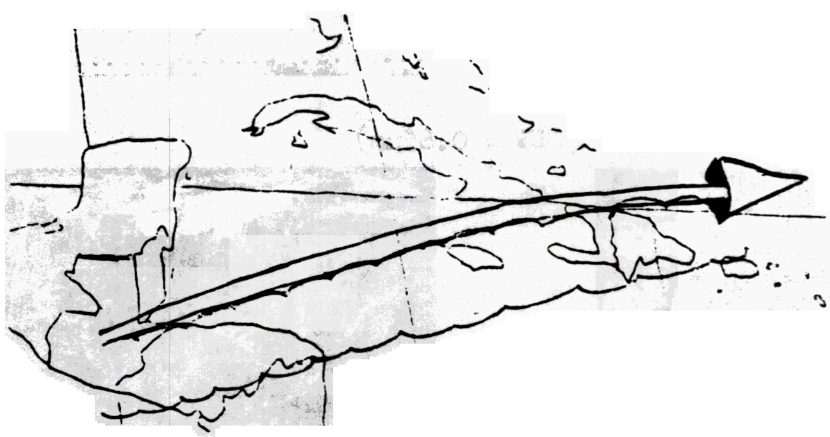


FEATURE: MAX WIND BAND and Jetstream (JTSTR)

DEFINITION: A "MAX WIND BAND" is a band of strong upper-tropospheric winds concentrated into a "core" region. Though the band may be only 1-3 deg wide, the band may extend lengthwise for 20 to 60deg. A jetstream is a "MAX WIND BAND" with wind speeds exceeding 50kt. The "polar jetstream" is found in the upper troposphere normally north of 30N, but occasionally dipping into the subtropics. The "subtropical jet" is an upper tropospheric jetstream normally found between 10N and 35N.

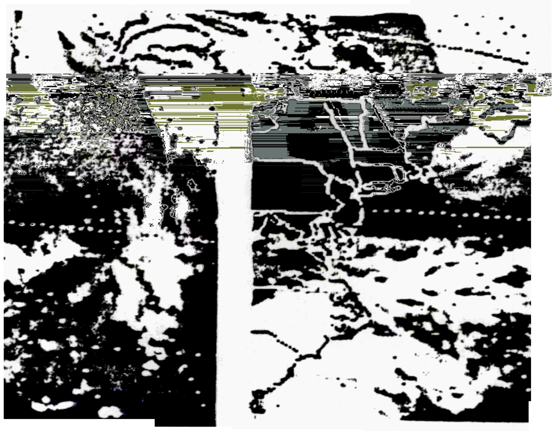
METEOROLOGICAL SIGNIFICANCE: The polar jetstream is an integral part of the longwave trough/ridge pattern steering most extratropical and many subtropical disturbances. Multilayered cloudiness is often observed on the southern side of the "MAX WIND BAND" or jetstream axis.

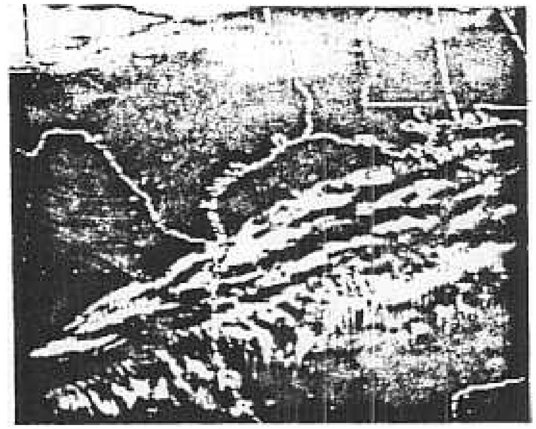
MARINE AND AVIATION SIGNIFICANCE: MAX WIND BANDS and jetstreams often mark the edge of multilayered cloudiness. As a narrow tube of strong winds, the location of these phenomena is important to the aviation industry in determining optimum flight routes. High altitude turbulence can accompany the jetstream.



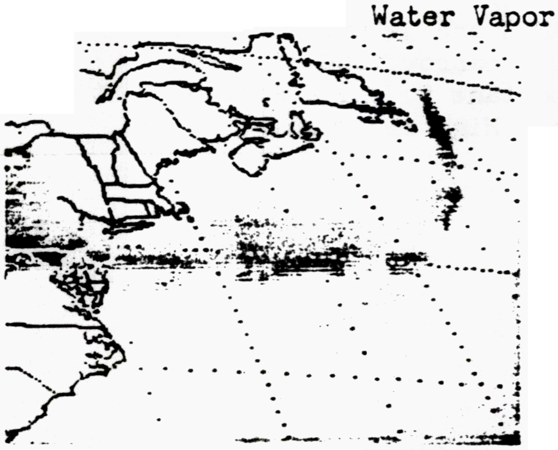
Max Wind Band or Jetstream

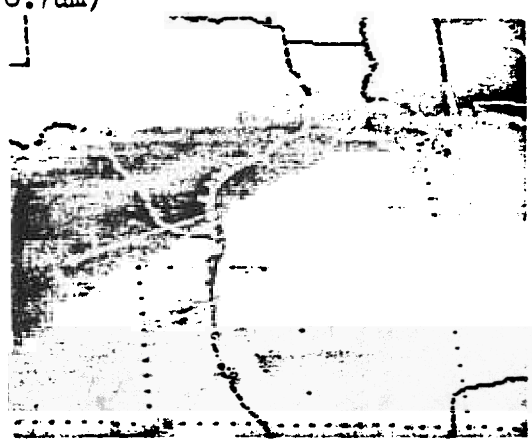
Infrared (IR = 11 um)



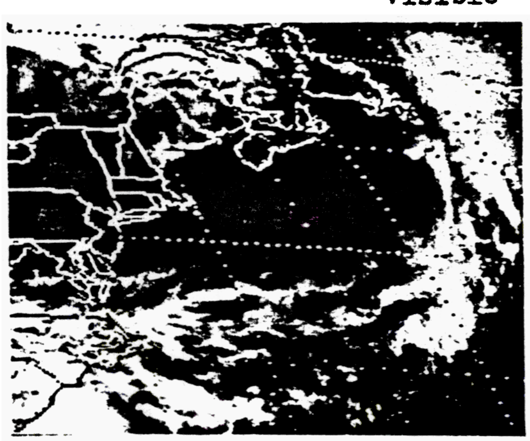


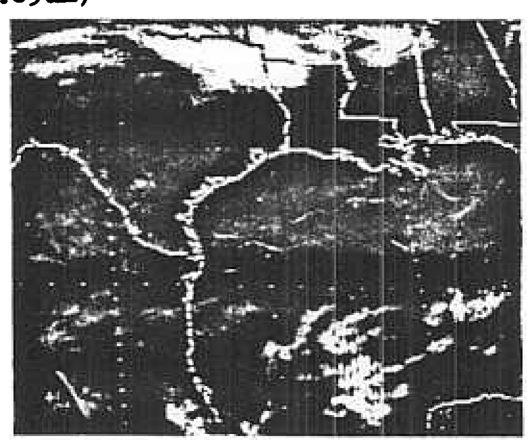
Water Vapor (WV = 6.7um)





Visible (VIS = 0.65um)



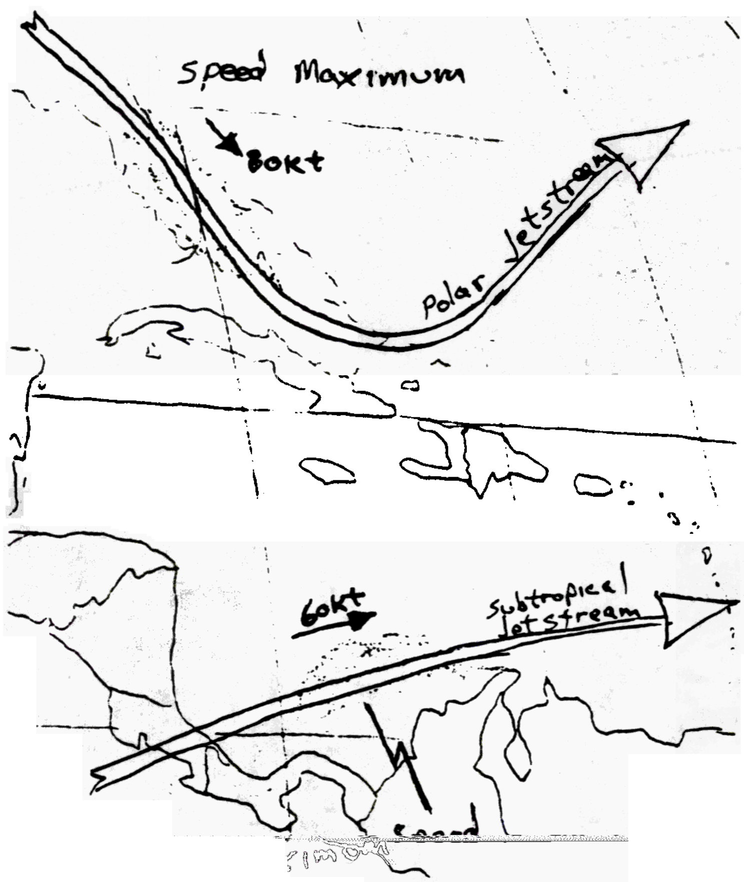


FEATURE: Speed Maximum (SPDMAX)

DEFINITION: A SPDMAX is a small region of higher winds traveling along a jetstream or "max wind band". In satellite data, a speed max appears as a slight anticyclonic bulge or bright cirrus cloud moving at speeds generally greater than 50kt.

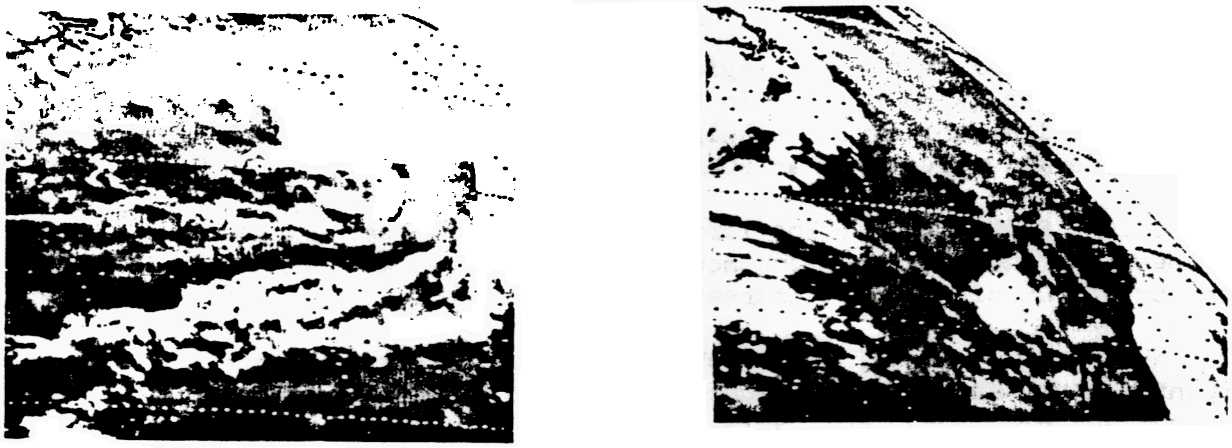
METEOROLOGICAL SIGNIFICANCE: The left-front and right-rear quadrants of a "speed max" are areas of enhanced upward vertical motion, and can produce brief but significant increases of convection.

MARINE AND AVIATION SIGNIFICANCE: Severe high altitude turbulence can accompany a speed max. Severe thunderstorms can develop in the left-front and right-rear quadrants.



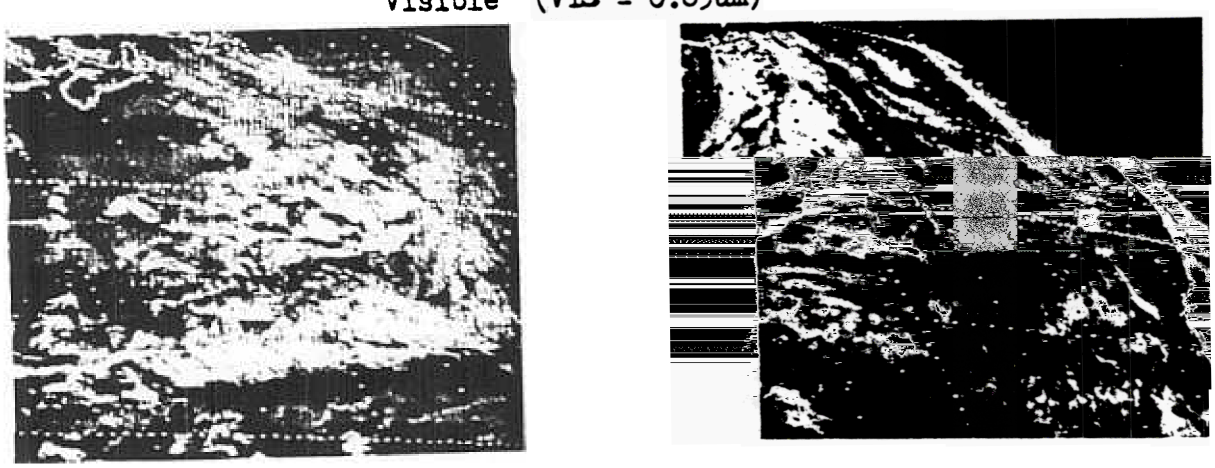
Speed Maximum

Infrared (IR = 11 um)



Water Vapor (WV = 6.7um)

Visible (VIS = 0.65um)

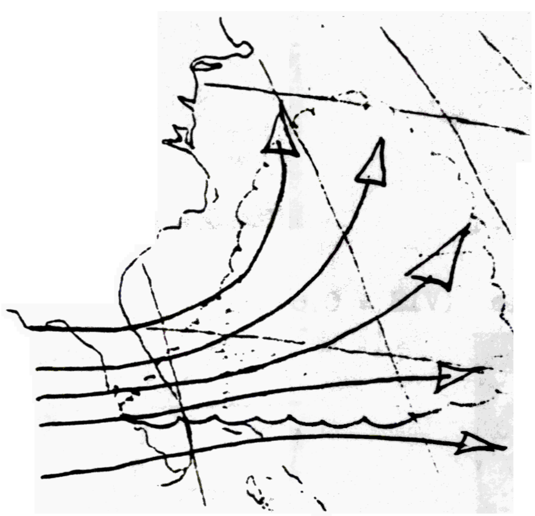


FEATURE: Diffluent Pattern (DFLNT PAT)

DEFINITION: A fanning out of the horizontal winds (not to be confused with mathematical divergence, though they often coexist).

METEOROLOGICAL SIGNIFICANCE: Since diffluence and divergence often coexist, diffluence is often referred to as the "poor man's" divergence indicator. Since upper-level divergence produces upward vertical motions, cloudiness and thunderstorms are frequently enhanced areas of diffluence.

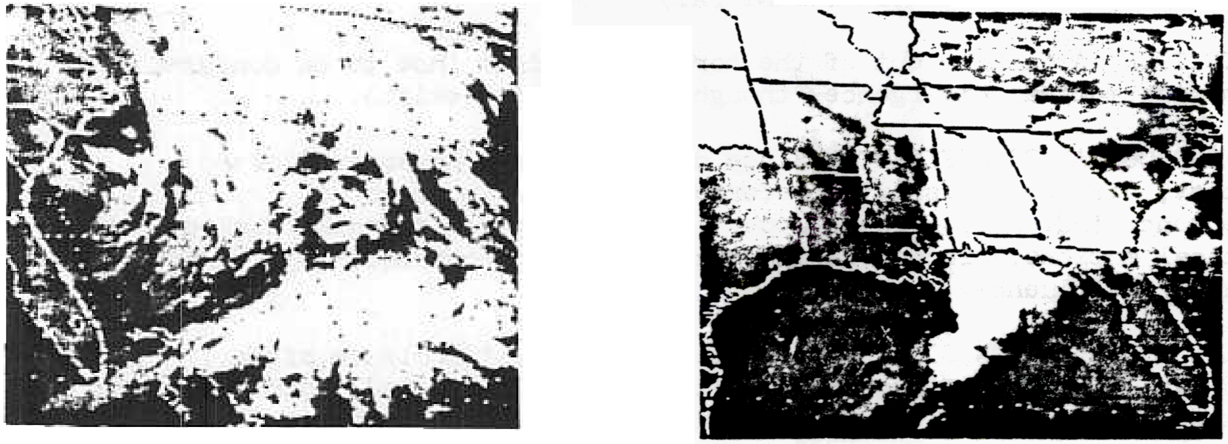
MARINE AND AVIATION SIGNIFICANCE: High altitude turbulence often accompanies upper tropospheric diffluence. Multilayered cloudiness and thunderstorms are often observed near upper-level diffluent patterns.



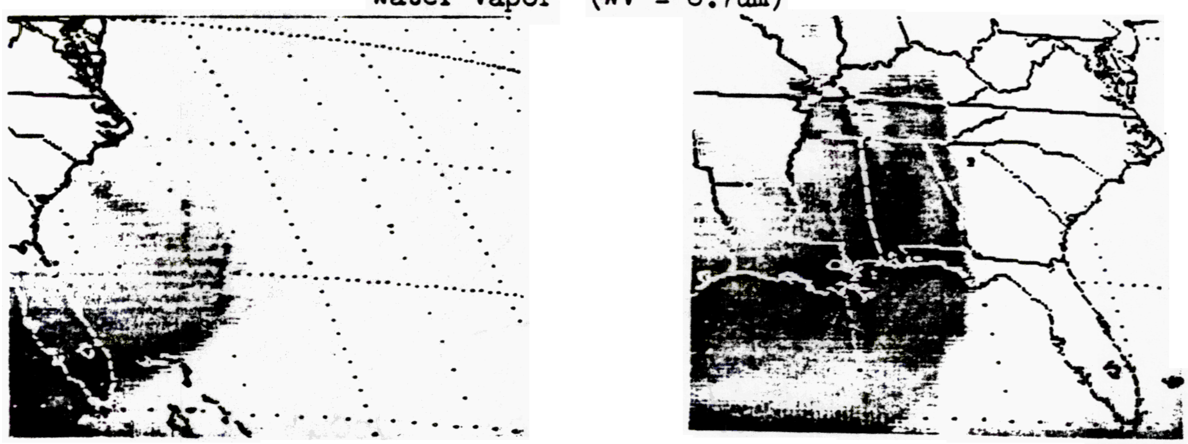
200mb
Streamlines

Diffluent Pattern

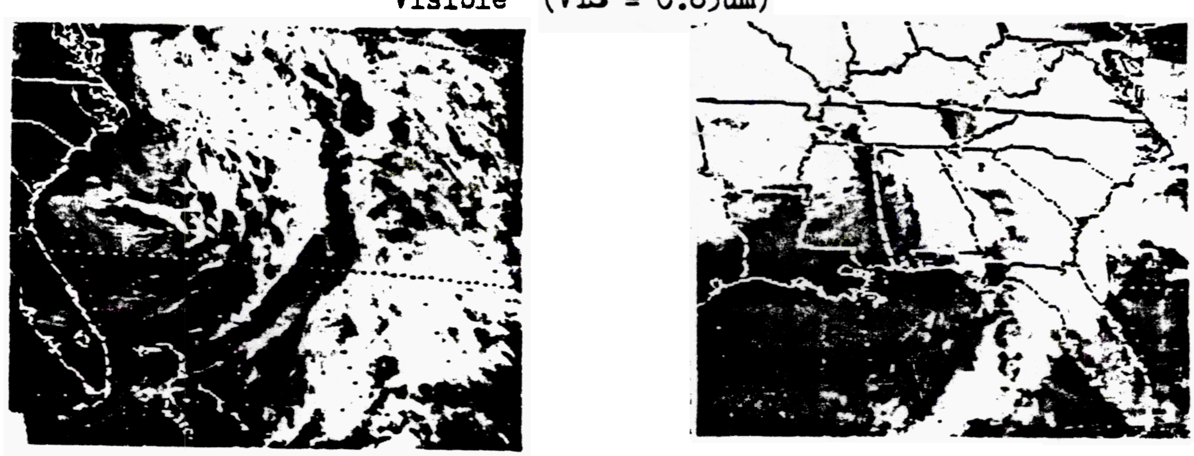
Infrared (IR = 11 um)



Water Vapor (WV = 6.7um)



Visible (VIS = 0.65um)

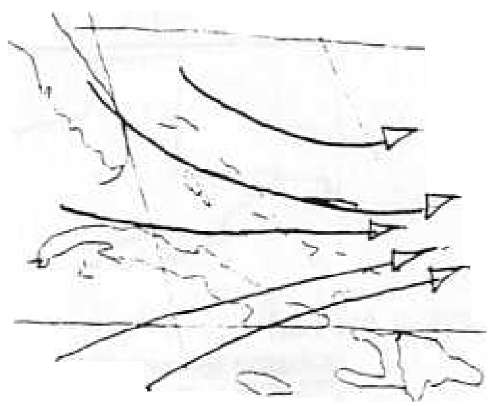


FEATURE: Confluent Pattern (CNFLNT PAT)

DEFINITION: A coming together of the horizontal winds (not to be confused with mathematical convergence, though they often coexist).

METEOROLOGICAL SIGNIFICANCE: Since confluence and convergence often coexist, confluence is often referred to as the "poor man's" convergence indicator. Since upper-level convergence produces downward vertical motions, cloudiness and thunderstorms are frequently suppressed in areas of confluence.

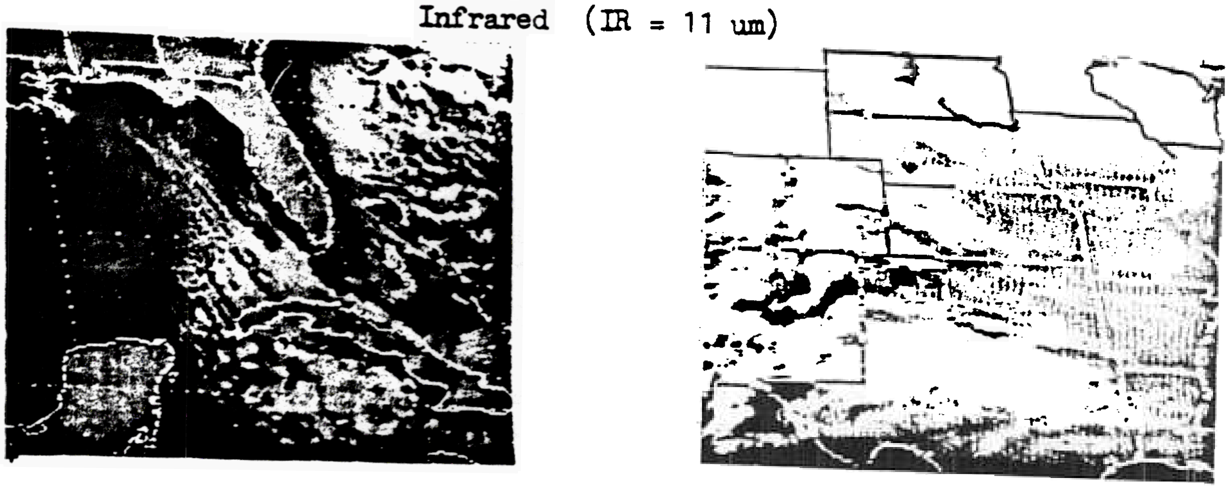
MARINE AND AVIATION SIGNIFICANCE: High altitude turbulence often accompanies upper tropospheric confluence. Cloudiness is often suppressed near upper-level confluent patterns.



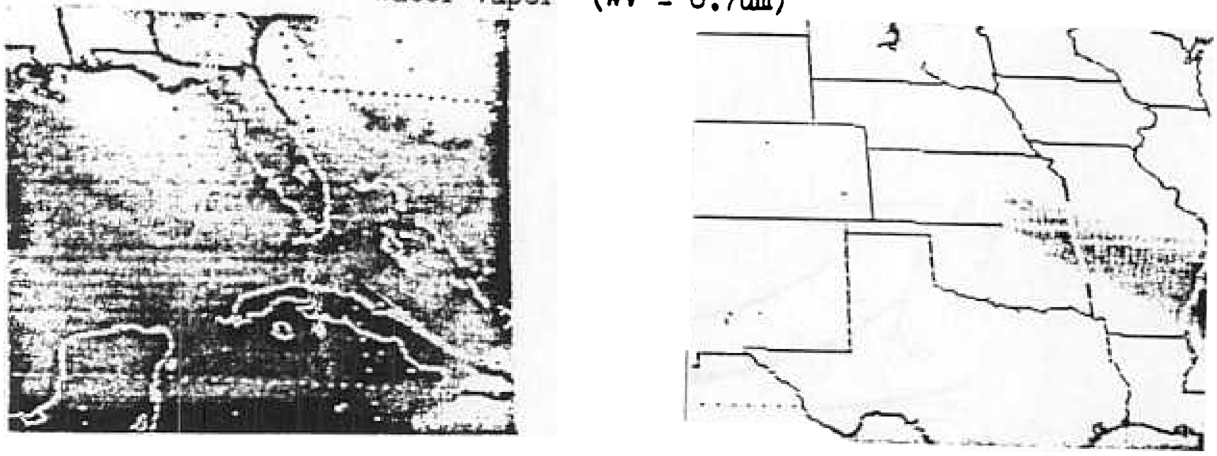
200mb
Streamlines

Confluent Pattern

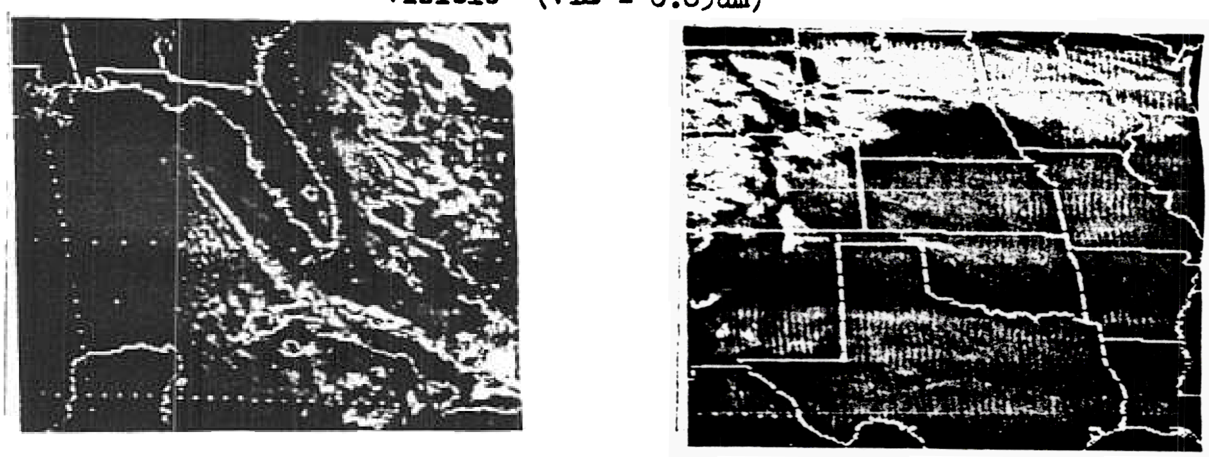
Infrared (IR = 11 um)



Water Vapor (WV = 6.7um)



Visible (VIS = 0.65um)

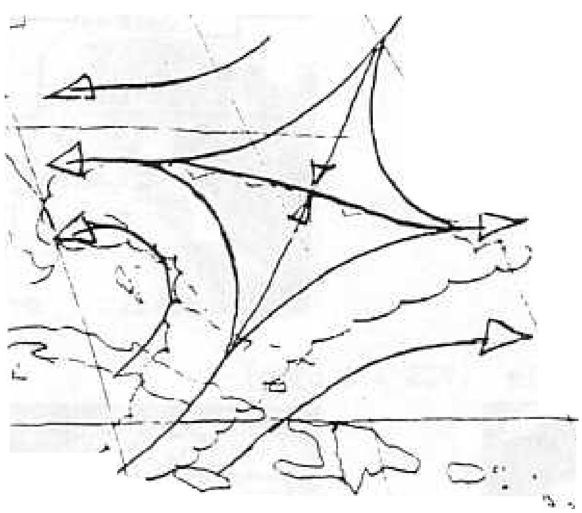


Deformation Pattern (DEFORMATION PAT)

DEFINITION: The change in shape of a cloud mass by horizontal stretching and shearing. Deformation patterns are maximized near col points.

METEOROLOGICAL SIGNIFICANCE: Deformation patterns are significant for describing the upper tropospheric flow characteristics.

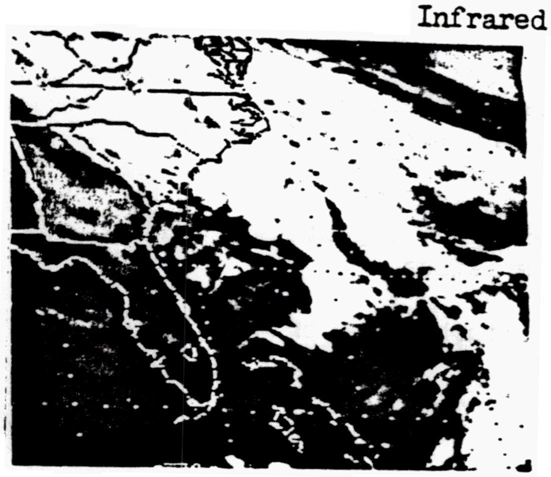
MARINE AND AVIATION SIGNIFICANCE: High altitude turbulence often accompanies deformation patterns.

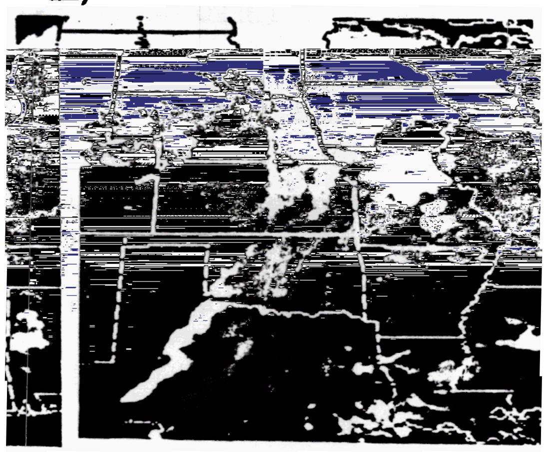


200mb Streamlines

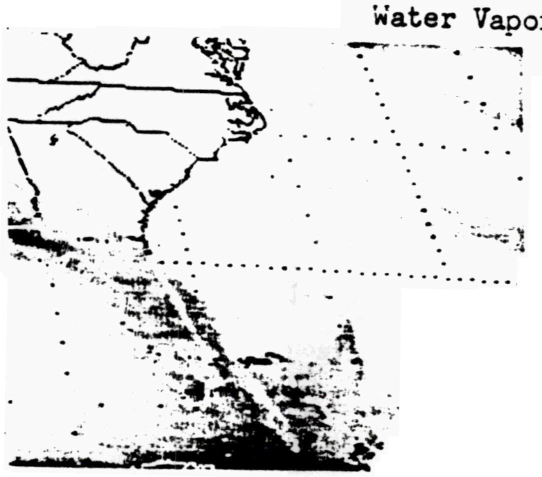
Deformation Pattern

Infrared (IR = 11 um)

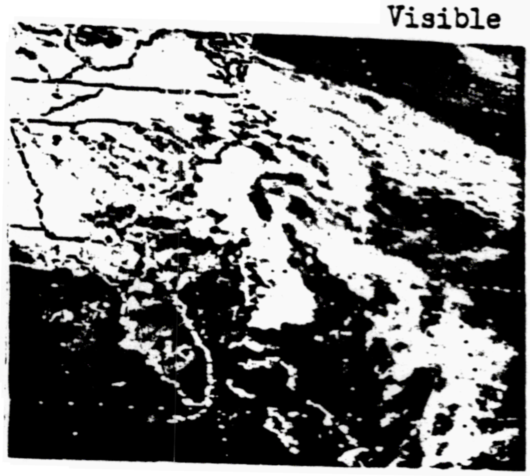


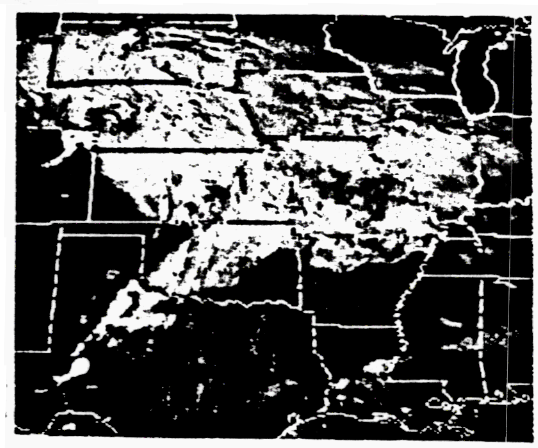


Water Vapor (WV = 6.7um)



Visible (VIS = 0.65um)





FEATURE: Cyclonic Shear Axis (CYC SHEAR AXIS)

DEFINITION: Horizontal directional and/or speed shear of such a nature that it contributes to the cyclonic vorticity of the flow. The axis of cyclonic shear zones is normally oriented east/west. The shear is usually concentrated in a narrow zone less than 5deg across, but the axis can extend up to 20deg in length.

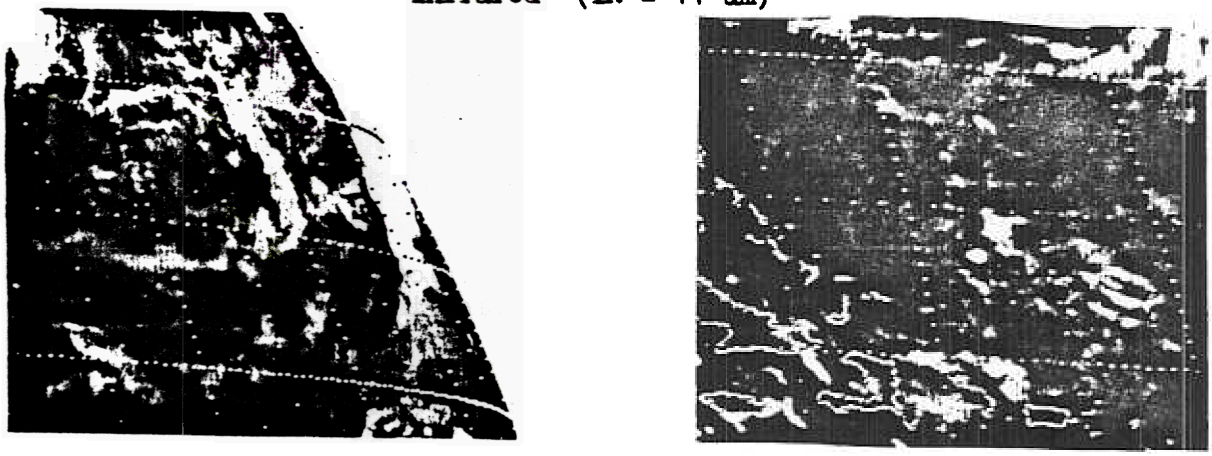
METEOROLOGICAL SIGNIFICANCE: Upper tropospheric cyclonic wind shear contributes to downward vertical motions, thus clearing cloudiness in close proximity.

MARINE AND AVIATION SIGNIFICANCE: High altitude turbulence often accompanies cyclonic wind shear.

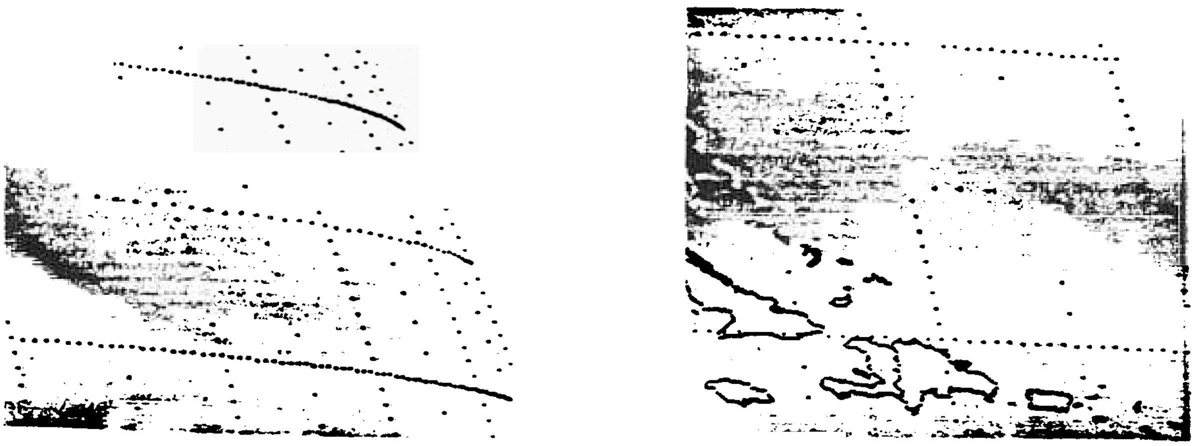
200mb streamlines

Cyclonic Shear Axis

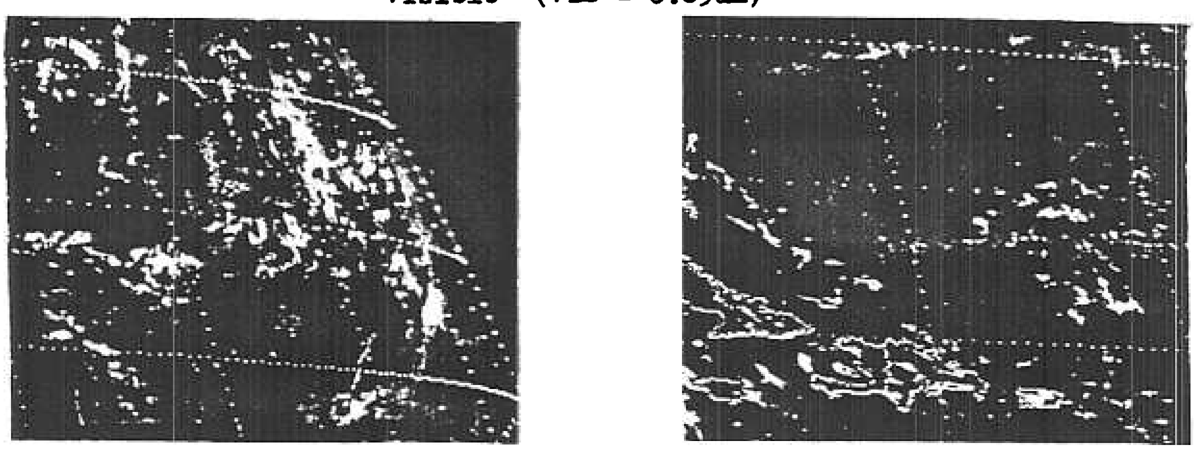
Infrared (IR = 11 um)



Water Vapor (WV = 6.7um)



Visible (VIS = 0.65um)

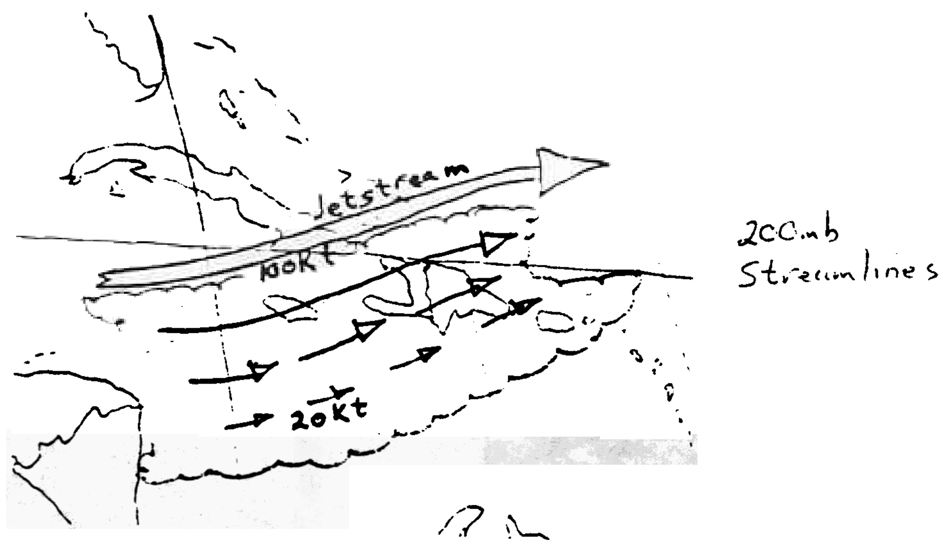


FEATURE: Anticyclonic Shear Axis (ACYC SHEAR AXIS)

DEFINITION: Horizontal directional and/or speed shear of such a nature that it contributes to the anticyclonic vorticity of the flow. Anticyclonic wind shear is significant only when the shear is pronounced at upper levels. The axis of anticyclonic shear zones is normally oriented east/west. The shear is usually concentrated in a narrow zone less than 5deg across, but the axis can extend up to 20deg in length.

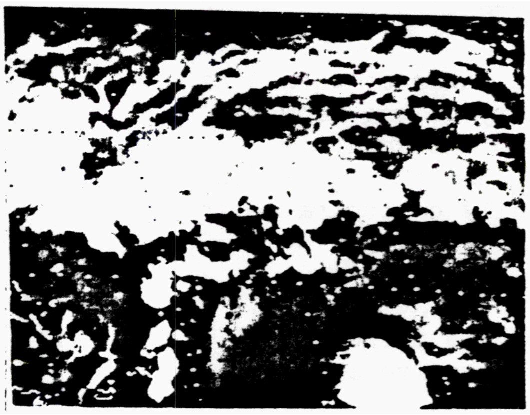
METEOROLOGICAL SIGNIFICANCE: Vertical motion can be increased in areas of strong anticyclonic shear, thus enhancing convective activity.

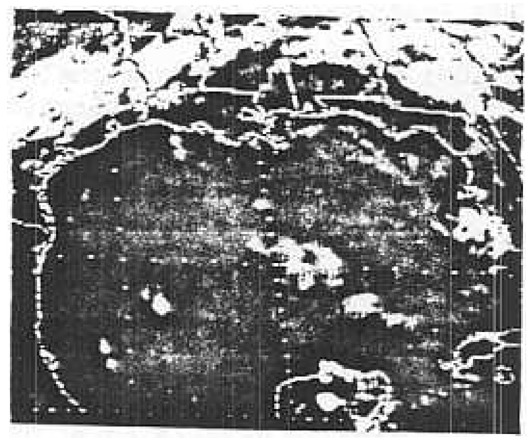
MARINE AND AVIATION SIGNIFICANCE: High altitude turbulence frequently accompanies areas of strong anticyclonic shear.



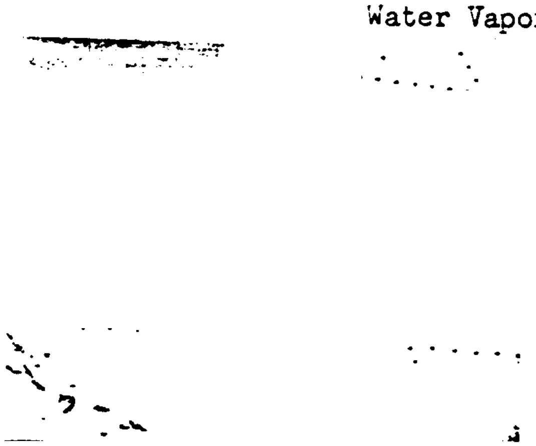
Anticyclonic Shear Axis

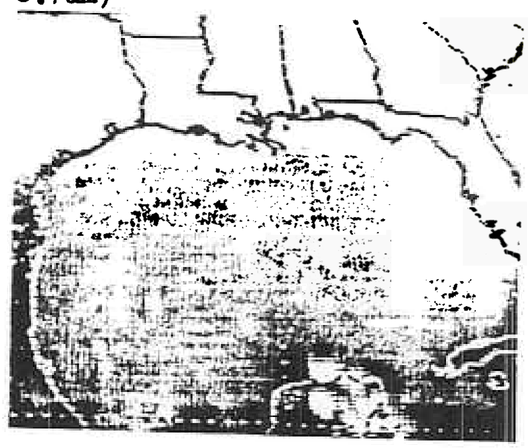
Infrared (IR = 11 um)



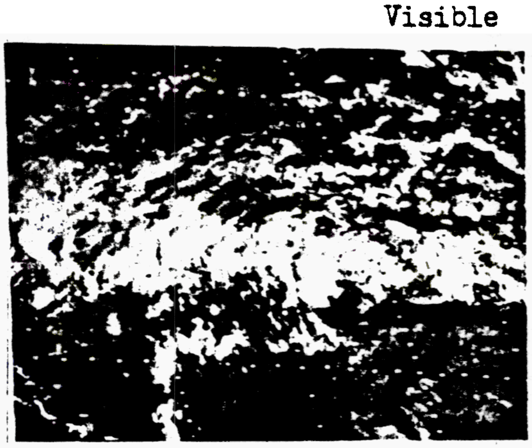


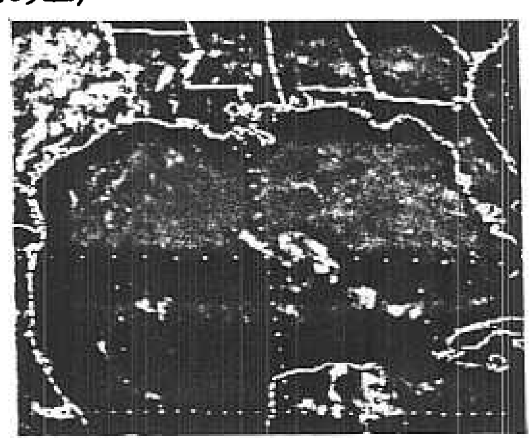
Water Vapor (WV = 6.7um)





Visible (VIS = 0.65um)





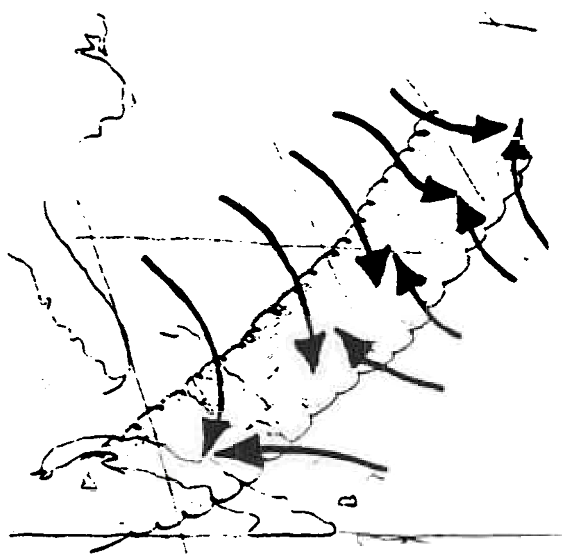
FEATURE: Baroclinic Zone (BACLIN ZONE) and
Frontal Boundary (FNTL BNDRY)

DEFINITION: A band of multilayered cloudiness often associated with a frontal zone or surface trough. The baroclinic zone or frontal boundary represents a thermal and/or moisture discontinuity. The Term BACLIN ZONE is often used to describe this discontinuity, especially when the system is accompanied by multilayered cloudiness in a band 3 to 10 deg wide and 20 to 30 deg long.

The term cold front (CDFNT) is used to describe the system when a "rope cloud" (a narrow, <1deg wide, low-level cloud line) representing a wind shift line is observed, and the air mass with lower potential temperature is moving into and displacing the air mass of warmer properties. When a frontal boundary is nearly stationary (moving at speeds of less than 10kt) and is accompanied by a band of low clouds, the term quasistationary front (QSTNRY FNT) is often used. Warm fronts (WRMFNT) are rarely detectable in satellite imagery.

METEOROLOGICAL SIGNIFICANCE: A windshift may or may not accompany the baroclinic zone. Baroclinic zones and frontal boundaries often accompanied by a band of multilayered cloudiness and thunderstorms.

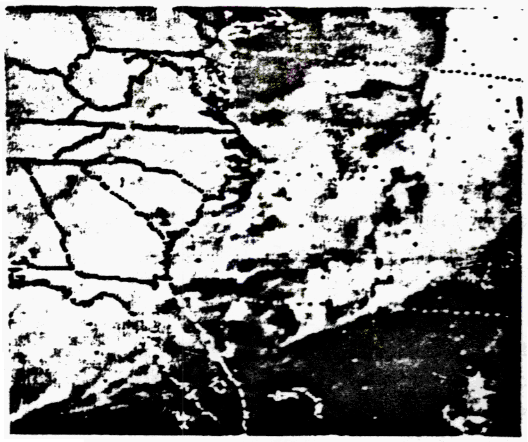
MARINE AND AVIATION SIGNIFICANCE: Multilayered cloudiness and thunderstorms often accompany the zone. A low-level windshift can also prevail along or within the zone.

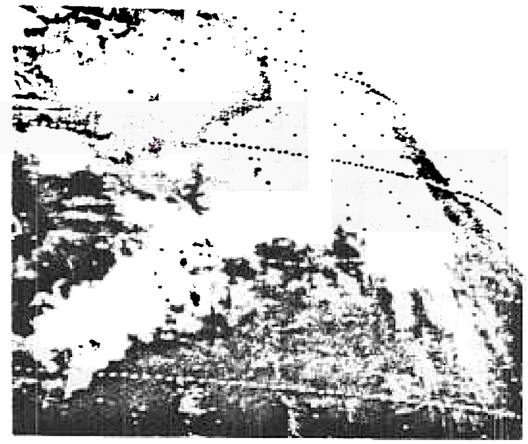


Low-Level Streamlines

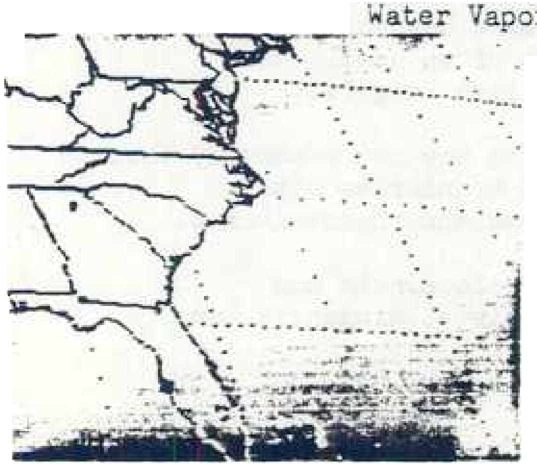
Baroclinic Zone or Cold Front

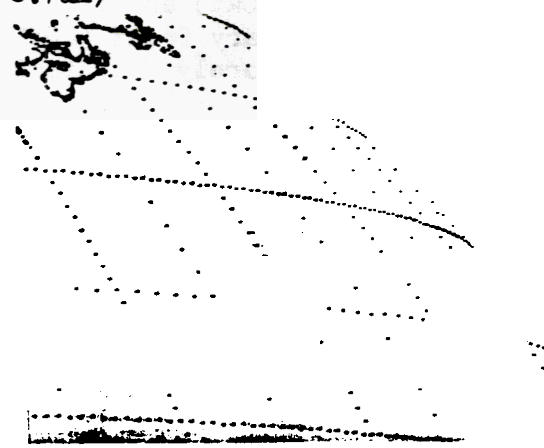
Infrared (IR = 11 um)



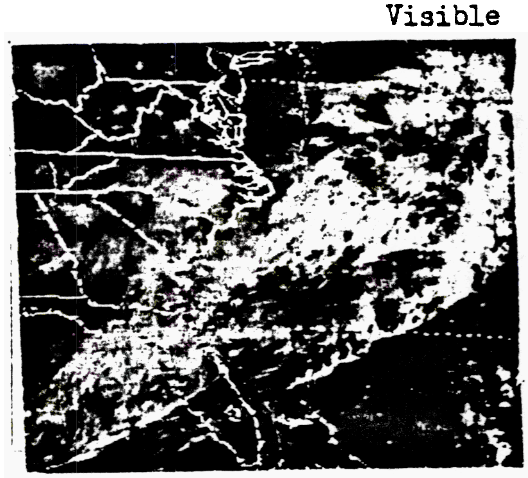


Water Vapor (WV = 6.7um)





Visible (VIS = 0.65um)



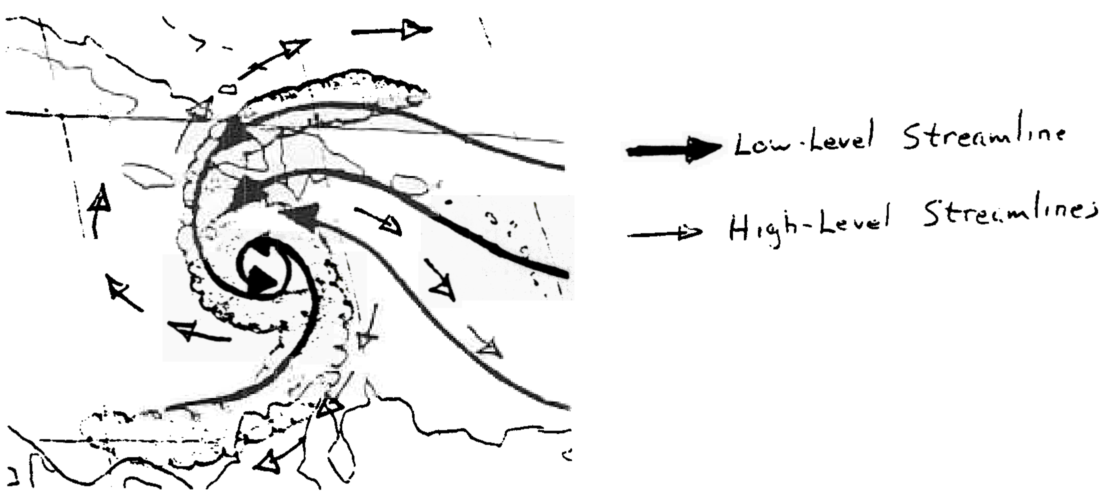
FEATURE: Tropical Cyclone (TRPCL CYCLONE)

DEFINITION: A tropical cyclone is a cyclonic circulation which (1) forms over the tropical or subtropical oceanic areas, (2) normally has a warm central core region, (3) has significant convection near the circulation center, and (4) has been declared a tropical cyclone by the National Hurricane Center hurricane specialist. A tropical cyclone is termed a "tropical depression" (TRPCL DEPRESSION) when a closed cyclonic circulation produces maximum sustained winds of 33 knots or less, a "tropical storm" (TRPCL STM) when winds are 34 to 63 knots, and a "hurricane" (HURCN) when winds are 64 knots or greater.

Since they normally involve no air mass discontinuities, tropical cyclones are more nearly symmetric than frontal cyclones. Fully mature tropical cyclones range in size from 60 miles in diameter to well over 1000 miles in diameter. The low-level winds spiral inward cyclonically, becoming more circular near the center of the tropical cyclone. The upper-level flow over the cyclone is typically anticyclonic outflow. Mesoscale features associated with tropical cyclones may include: an eye, a central dense overcast, one or more spiral convective bands, one or more upper-level outflow jetlets, and a wall cloud.

METEOROLOGICAL SIGNIFICANCE: All tropical cyclones are important features for describing the dynamics and flow characteristics of tropical/subtropical atmosphere. Winds, seas, and tides are significantly affected by the proximity of tropical cyclones. Multilayered cloudiness and widespread thunderstorms accompany tropical cyclones. Rainfall can be excessive, particularly for moving tropical cyclones.

MARINE AND AVIATION SIGNIFICANCE: At maturity, the tropical cyclone is one of the most intense and feared storm systems of the world. Winds exceeding 175 knots have been measured with some intense hurricanes. The accompanying storm tide of a landfalling hurricane can be catastrophic. Locally numerous thunderstorms and potential excessive rainfall typify tropical cyclones.



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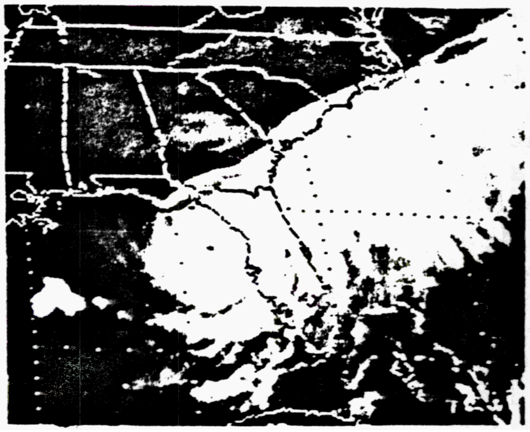
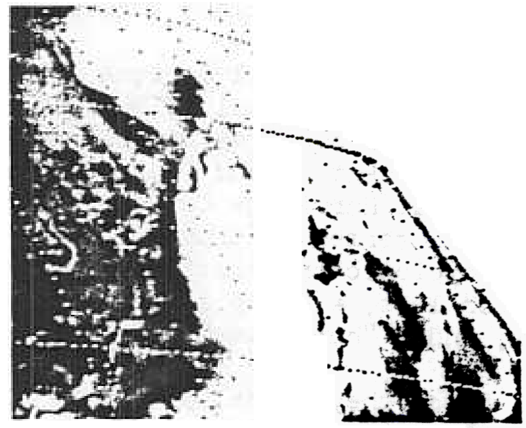
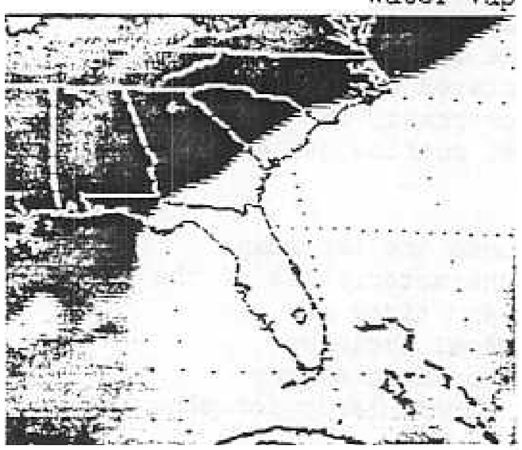
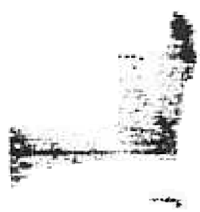
Infrared IR



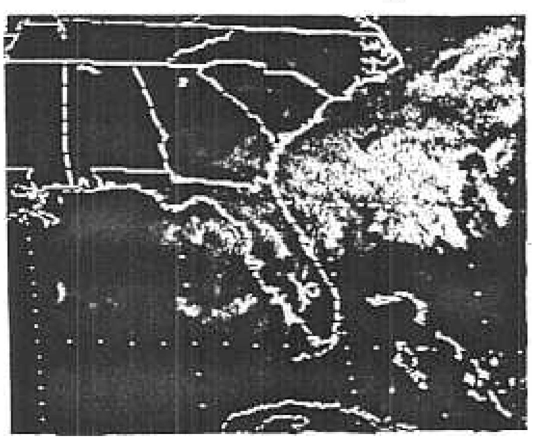


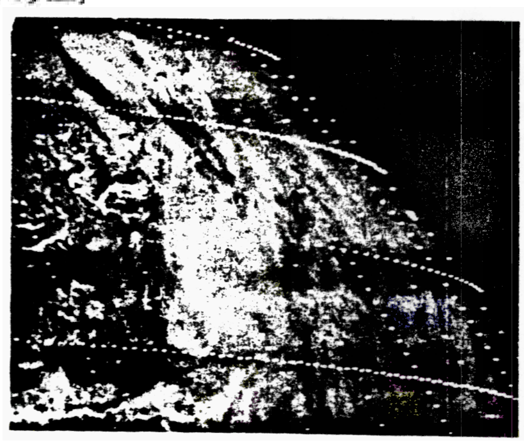
Water Vap WV 6.7um





Vis bl VIS 0.65um,



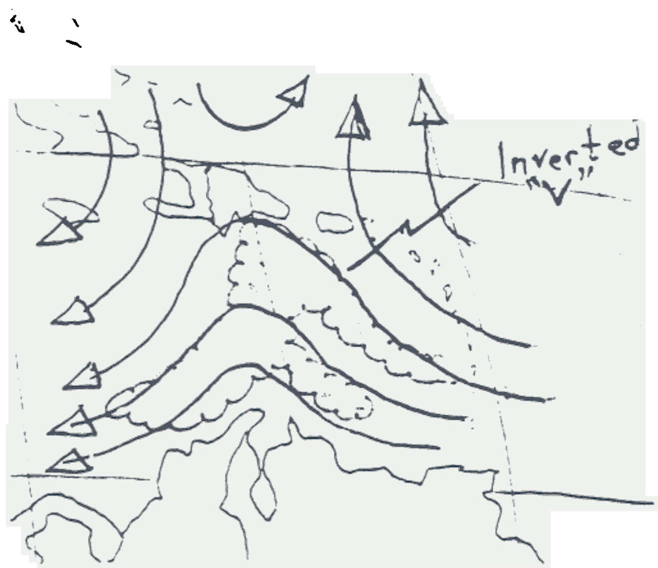


FEATURE: Tropical Wave (TRPCL WV)

DEFINITION: A low and/or middle tropospheric inverted trough or discontinuity in the easterly current. The system typically has a maximum effect near 700mb, and may or may not be represented at the surface. Tropical waves can represent any of three phenomena: African waves, a reflection of a mid/upper-level low pressure system, or a surge in the low-level easterly flow. Tropical waves typically propagate westward at 10-20kt, but may move as fast as 40kt when associated with a surge in the easterly flow.

METEOROLOGICAL SIGNIFICANCE: Tropical waves are often accompanied by scattered showers and thunderstorms, occasionally producing locally heavy rainfall. In some instances, the convective cloud pattern can represent an "inverted-V" in satellite imagery. Occasionally, tropical cyclones develop from tropical waves.

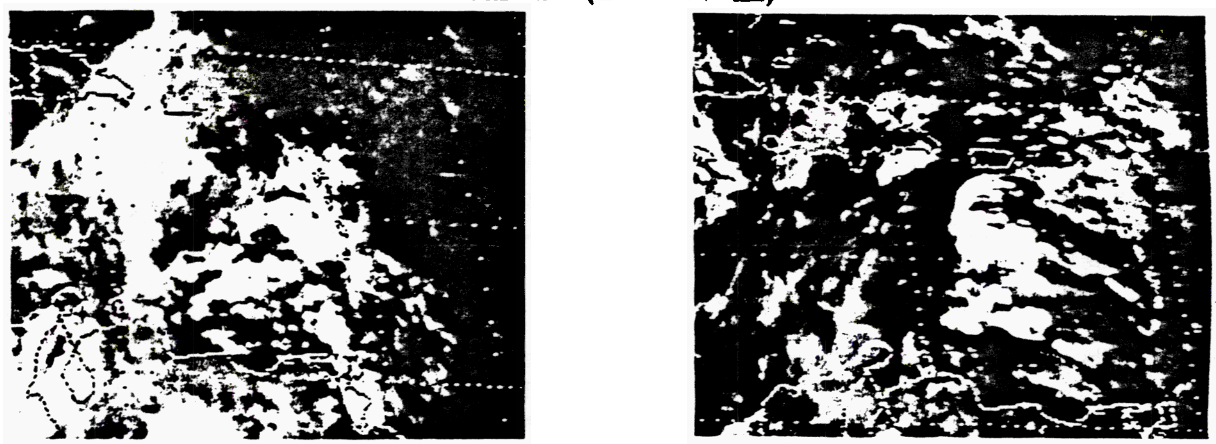
MARINE AND AVIATION SIGNIFICANCE: Scattered thunderstorms typically accompany tropical waves. Thunderstorm squalls can be generated with these systems, especially with surges in the easterly current. African dust plumes often encompass tropical waves, and can restrict visibilities at altitudes at and below 20 thousand feet.



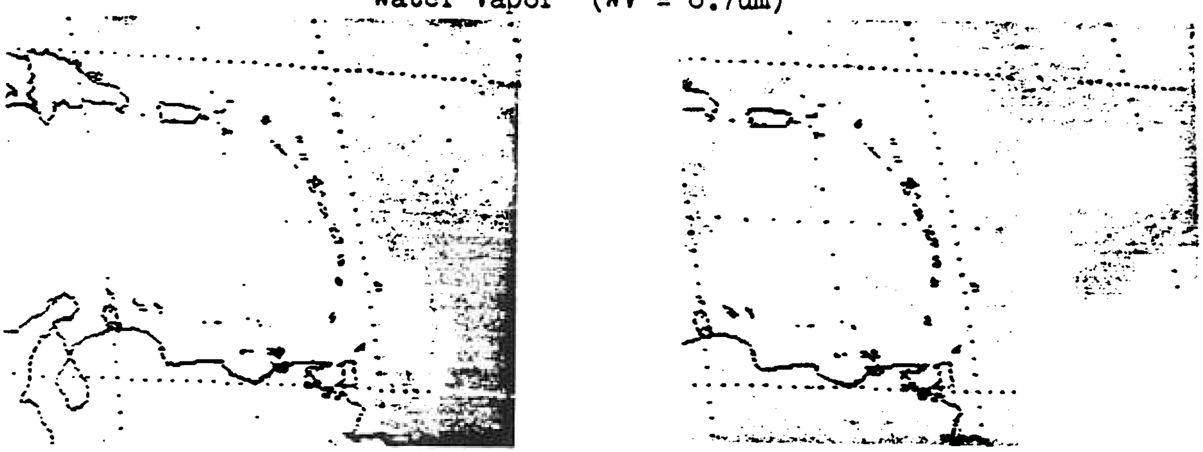
700mb Streamlines

Tropical Wave

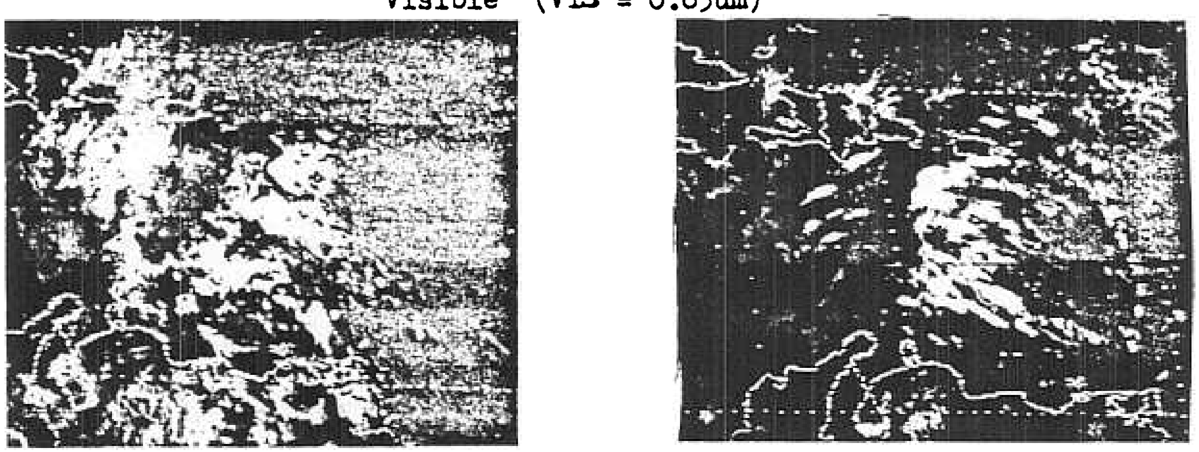
Infrared (IR = 11 um)



Water Vapor (WV = 6.7um)



Visible (VIS = 0.65um)

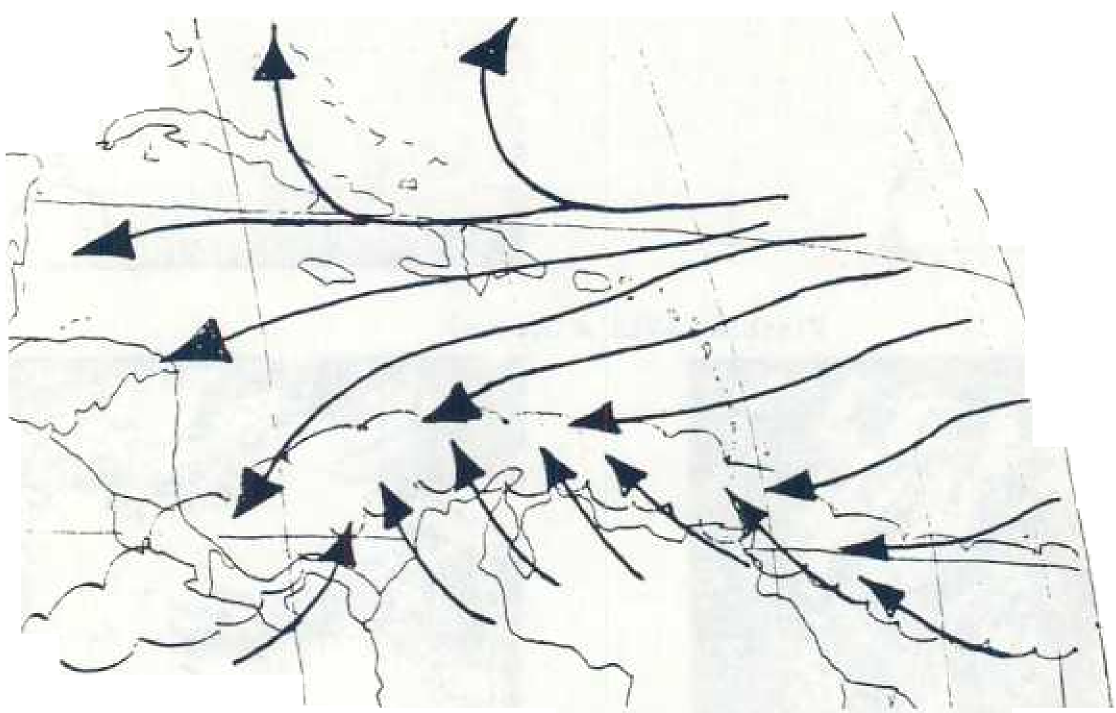


FEATURE: Intertropical Convergence Zone (ITCZ)

DEFINITION: The axis, or portion thereof, of the broad trade-wind current in the tropics, separating the circulation of the Northern Hemisphere from that of the Southern Hemisphere. The system is often accompanied by a quasicontinuous belt of low pressure in the equatorial region, occasionally extending as far north as 15N over the western Atlantic and Caribbean Sea.

METEOROLOGICAL SIGNIFICANCE: The entire ITCZ region is one of very homogeneous air; yet, humidity is so high that slight variations in stability or lift can cause major variations in cloudiness. The region is typified by layered mid-level cloudiness and widely scattered showers/thunderstorms. During active periods, the ITCZ can consist of locally numerous intense thunderstorms.

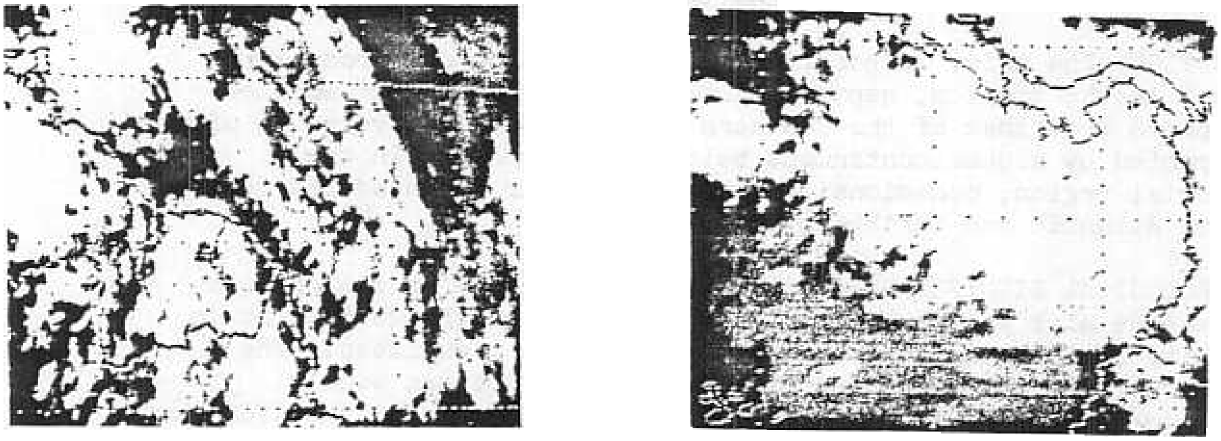
MARINE AND AVIATION SIGNIFICANCE: Thunderstorms and squalls typify an active ITCZ. Layered cloudiness can also affect aviation interests.



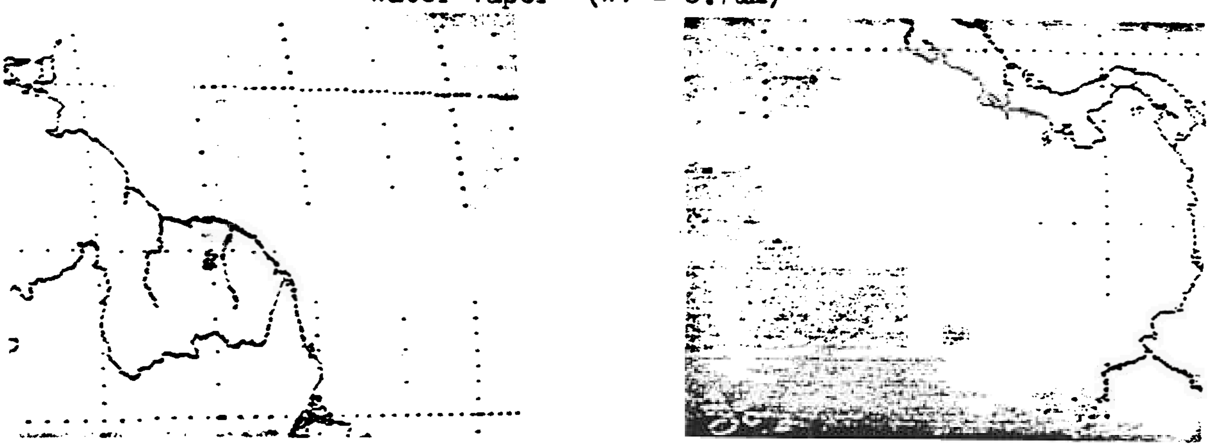
LOW-LEVEL STREAMLINES

Intertropical Convergence Zone (ITCZ)

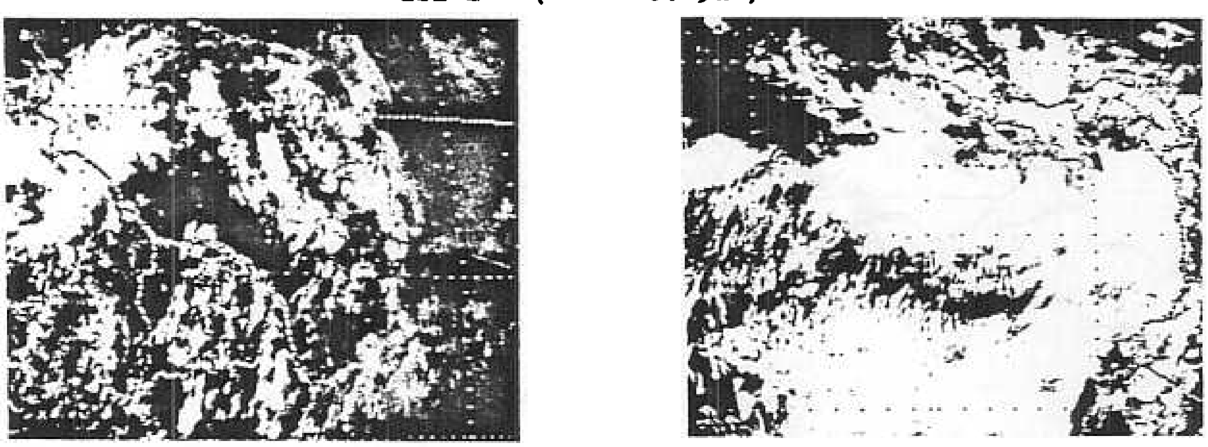
Infrared (IR = 11 um)



Water Vapor (WV = 6.7um)



Visible (VIS = 0.65um)



3. MESOSCALE AND OTHER FEATURES

The section on mesoscale and other features describes cloud and convective phenomena. When applicable, synoptic features are related to organized cloud features. As appropriate, nowcasts based on movement of a system or the intensification of convection are included in this section. SIM updates may be issued when major changes occur which are significantly different from those described in the previous SIM.

Mesoscale dynamic features and cloudiness patterns are routinely described for three geographic areas: Florida and adjacent coastal waters; the coastal/offshore waters of the Gulf of Mexico beyond the Florida coastal waters; and Puerto Rico, the U.S. Virgin Islands, and adjacent coastal waters. These three areas are normally monitored closely, as time and workload permits, and updated SIMs are issued when:

(1) cloud features suggest the onset of severe convection;
(2) the issuance supports, explains, or adds information to a severe weather watch/warning or a satellite precipitation estimate issued by the NESDIS Synoptic Analysis Branch; or
(3) recent imagery indicates unexpected changes or conditions which are significantly different from those described in the previous SIM, NMC guidance package, or an NWS forecast product.

Major cloud systems are discussed over the remainder of the Caribbean Sea and sections of the Atlantic south of 32N and west of 35W.

MESOSCALE FEATURE: Thunderstorm Gust Fronts

A gust front is a thunderstorm-induced feature, sometimes referred to as an outflow boundary or arc cloud, which is potentially hazardous to marine and aviation interests. Gust fronts can cause strong surface winds, wind shifts, and/or low-level wind shear.

Outflow boundaries serve as mechanisms for rapid thunderstorm development and intensification. Development is maximized near the intersection of two gust fronts, or near the intersection of a gust front and sea breeze front, or at the intersection of a gust front and a cold front. Thunderstorms may rapidly intensify as a gust front moves into a pre-existing convective cluster. In the air mass behind the outflow boundary, convection is normally suppressed by stability and subsidence.

Gust fronts propagating with the prevailing flow are often fast moving (producing strong or severe wind gusts), but are usually short lived phenomena. Outflow boundaries propagating into the prevailing flow are usually slower moving, resulting in lower wind gusts but more drastic wind shifts and wind shears; and are longer lasting due to increased low-level convergence.

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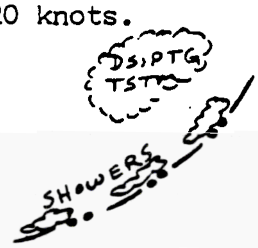
Gurka, J.J., 1976: Satellite and surface observations of strong wind zones accompanying thunderstorms. Preprints, 6th Conf. on Wea. Forecasting and Analysis, Amer. Meteor. Soc., 499-502.

Purdom, J.F.W., 1979: The development and evolution of deep convection. Preprints, 11th Conf. on Severe Local Storms, Amer. Meteor. Soc., 143-150.

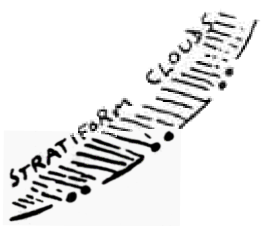
Four categories of gust fronts include:

Type I: Strong Outflow Boundary. A gust front is appendant to an active and mature thunderstorm. Over water, the gust potential is approximately twice the speed of propagation. Severe weather (including tornadoes, hail, and damaging winds) is potentially located near the intersection of the gust front with the parent thunderstorm.

Type II: Active Outflow Boundary. A gust front is moving away from its parent cell, or the parent thunderstorm has dissipated leaving only the arc cloud. Towering cumulus and showers are along or just behind the gust front, but deep convection is absent. The gust potential is about 20 knots.



Type III: Inactive Outflow Boundary. The arc cloud is composed mostly of stratiform low clouds, with no active convection. Minimal wind gusts are present.



Type IV: Propagating Convective Boundary. This boundary represents a gravity wave above the surface. Though not clearly visible except in animated imagery, the boundary moves through a convective area, enhancing local convection with its approach. Minimal wind gusts occur near developing convection.

MESOSCALE FEATURE: Enhanced-V Signature

Severe thunderstorms are often accompanied by convective tops "overshooting" the tropopause. These overshooting tops are depicted in visible imagery as scalloped or terreted tops through a cirrus shield (anvil), and in infrared imagery as a cold core surrounded by warmer cirrus. The colder the overshooting top, the more intense the updraft in the core of the thunderstorm (and potentially the more severe weather likely to be reported from the storm).

The enhanced-V pattern is a severe weather signature, much as the "hook echo" is a severe weather indicator in radar. The pattern appears in infrared imagery with the "point of the V" at the upwind side of the thunderstorm anvil. Severe weather reports (including tornadoes, hail, and damaging winds) occur near the coldest tops on the V. The enhanced-V pattern often develops just prior to the onset of severe weather, and can last for several hours.

REFERENCES

McCann, D.W., 1981: The enhanced-V — a satellite observable severe storm signature. NOAA Technical Memorandum, NWS NSSFC-4, Kansas City, MO, 31pp.

Fujita, T.T., 1982: Infrared stereo-height cloud motion, and radar-echo analysis of SESAME-day thunderstorms. Preprints, 12th Conf. on Severe Local Storms, Amer. Meteor. Soc., 213-216.

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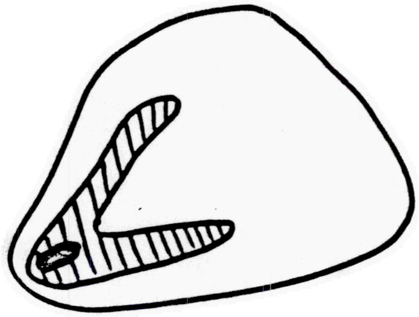


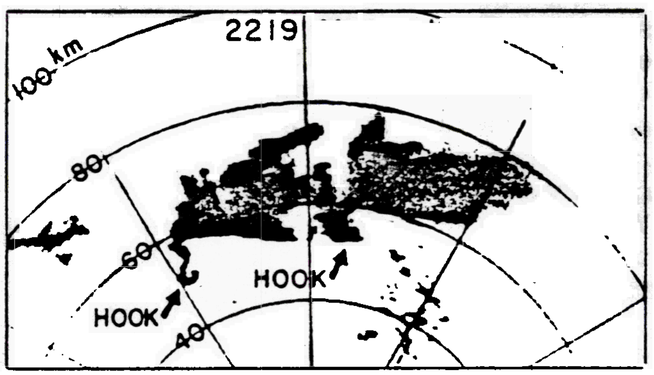


Fig.6 Reflectivity of two hook-echo thunderstorms depicted by NCAR's CP-3. At this time, the Orienta tornado, inside the western hook, was developing in form of a sequence of suction vortices while the Lahoma tornado had touched down a few minutes earlier inside the eastern hook which was approaching to the north of Ringwood.

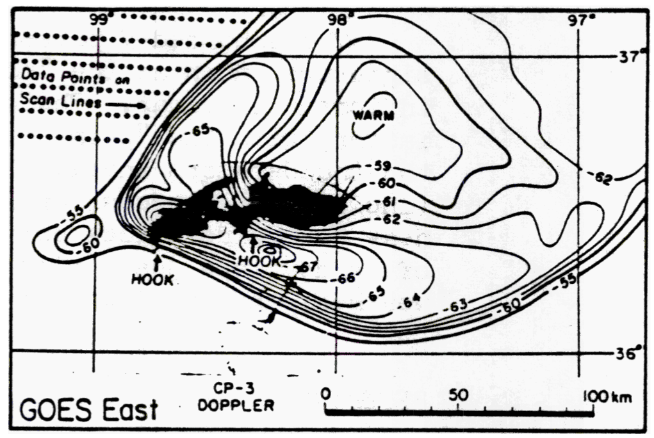


Fig.7 Rectified isotherms of IR temperature from GOES East at 2217GMT (1617CST). The western thunderstorm is located where the IR temperature is coldest while the western thunderstorm, where the gradient of the IR temperature is largest.

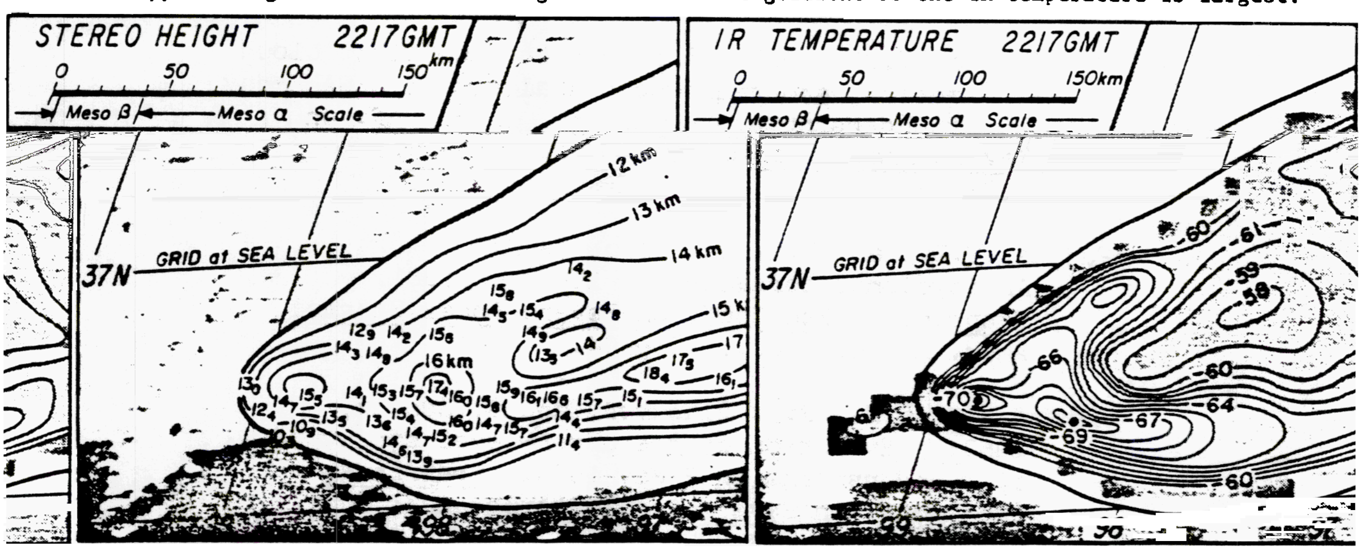


Fig.8 LEFT: Stereo height (in km) superimposed upon the visible imagery at 2217GMT 2 May 1979. RIGHT: IR isotherms (in °C) superimposed upon the enhanced IR imagery at the same time. These pictures reveal that the IR temperatures are warm and stereo heights are high inside the horseshoe wake. On the upwind side of the wake, however, the higher the stereo height, the cloder the IR temperature.

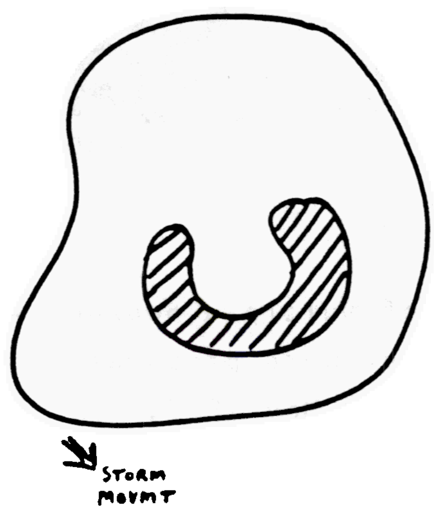
MESOSCALE FEATURE: Bounded Warm Core Region

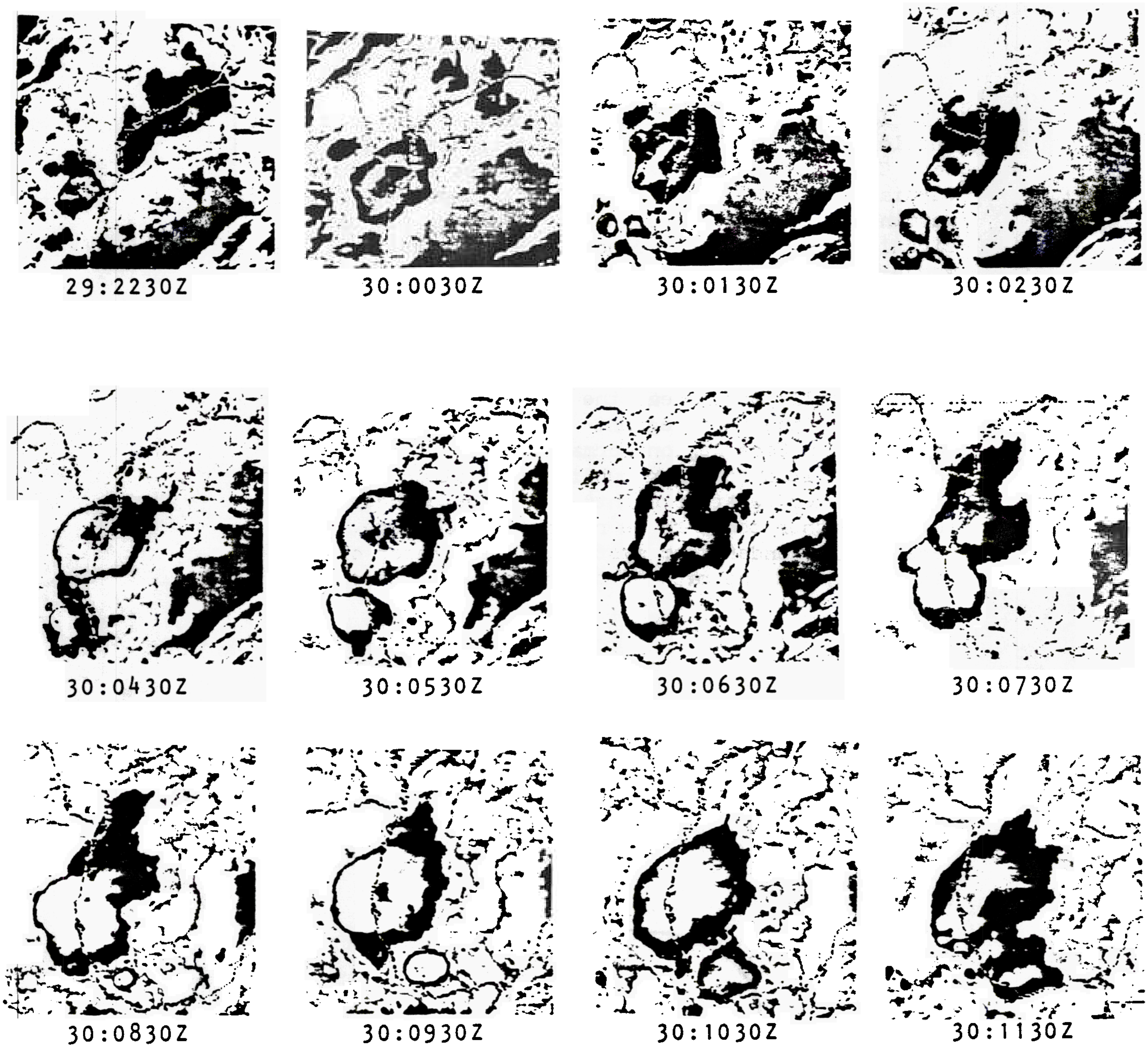
In long-lived convective complexes, the cold cirrus shield can become quite cold and extensive. The Bounded Warm Core Region appears as a warm area enclosed or partially enclosed by a ring of cold tops. Two types of warming patterns are frequently observed: (1) small, circular dark areas embedded within the anvil; and (2) a wedge-shaped darkening area near the upwind portion of the anvil.

The Bounded Warm Core Region represents an area of downdraft (possible downburst). Surface wind damage and hail typically occur near the interface of the coldest IR tops and the warm region. Identification of the Bounded Warm Core Region normally does not provide sufficient lead time for public or aviation warning for initial severe weather events. However, since the severe weather tends to be recurrent for large persistent thunderstorm systems, an indicator of further wind damage in the path of the storm would be provided.

REFERENCE

Ellrod, G., 1985: Dramatic examples of thunderstorm top warming related to downbursts. Natl. Wea., Digest, 10, 7-13.





The evolution of multiple Bounded Warm Core Regions in a southward propagating thunderstorm complex ---- 29-30 May 1987.

MESOSCALE FEATURE: Mesoscale Convective Complex

A Mesoscale Convective Complex (MCC) is a vast and long-lived convective system. An MCC is defined, based in enhanced infrared satellite imagery, as an organized convective system consisting of a cirrus canopy with continuously low IR temperature $\leq$ -32C over an area $\geq$ 100,000 sq. km., and an interior cold cloud region with temperature $\leq$ -52c over an area $\geq$ 50,000 sq. km.

Mesoscale Convective Complexes frequently occur over the central United States, and occasionally develop over Mexico and the Gulf of Mexico. MCCs are triggered by a shortwave trough moving through an upper-level ridge, are focused by low-level axis of maximum winds overriding a low-level boundary, and develop a circular or oval anticyclonic outflow. In addition to the tremendous areal extent, MCCs often persist for more than 12h. The systems have a strong diurnal maximum from early evening to early morning, and typically begin to weaken around daybreak.

Mesoscale Convective Complexes interact and modify their large-scale environment, often affecting the future evolution of weather systems within the region. MCCs are organized in a distinctly nonrandom manner. The phenomena and effects attending MCC weather systems are not forecast by operational numerical models, whose physics are not completely understood.

In addition to widespread beneficial rains, a wide variety of severe convective weather phenomena attends these systems, including local excessive rainfall accumulations, tornadoes, hail, and damaging winds. Cold tops, overshooting tops, and numerous cell mergers are commonly observed in satellite and/or radar data. Thunderstorms within the MCC are most efficient precipitation producers 4-10h after initial convection develops.

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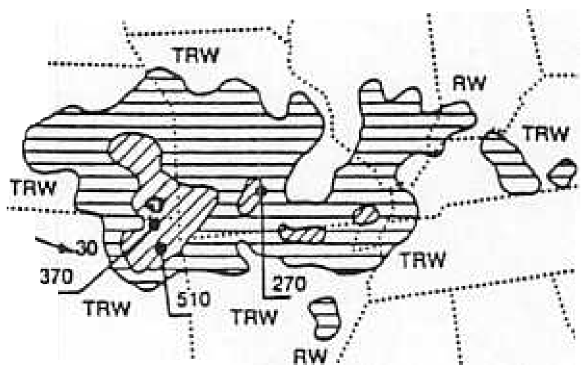
Leary, C.A., and E.N. Rappaport, 1983: Internal structure of a mesoscale convective complex. Preprints, 21st Conf. on Radar Meteor., Amer Meteor. Soc., 70-77



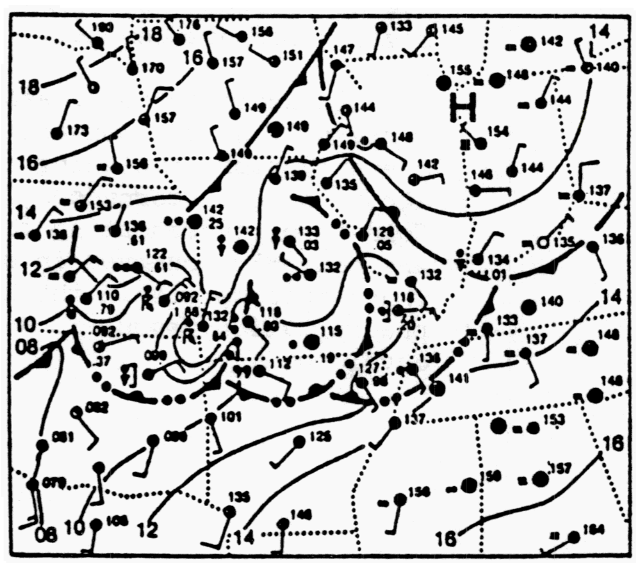


FIG. 4. a) Enhanced infrared satellite image for 1200 GMT 20 May 1979. b) Radar summary chart for 1135 GMT 20 May 1979. c) Surface analysis for 1200 GMT 20 May 1979. Surface features are indicated, along with 2 mb isobars. Winds are in kt (full barb = 10 kt) and squall symbols with frontal barbs indicate positions and movements of cold-air outflow boundaries. Three-hourly precipitation amounts, in inches, are also shown.

MESOSCALE FEATURE: The "Freight Train" Pattern

Excessive rainfall can accumulate when thunderstorms repeatedly cross a small area. This repeated passage of thunderstorms is often referred to as a "freight train" pattern. The pattern can develop in a multitude of ways, but two common causes are the LARGE SCALE WEDGE and REGENERATIVE DEVELOPMENT.

The LARGE SCALE WEDGE is a linear pattern with a large 50-90deg angle pointing into the mid/upper-tropospheric wind, where the polar jetstream and subtropical jetstream separate. Shortwave troughs rotating around a longwave trough concentrate convective outbreaks. Due to persistent low-level inflow, convection redevelops over the same area or upwind after weak shortwaves pass, and thunderstorms become increasingly efficient rainfall producers. No distinct diurnal tendencies are associated with this pattern.

In REGENERATIVE DEVELOPMENT, single-clustered or multi-clustered convective systems develop along the upwind portion of a low-level boundary (outflow boundary or convergence boundary) and traverse the same path downwind along the boundary. Inflow perpendicular to the boundary may be focused by a mesolow, resulting in extremely high moisture convergence values. Outflow from new cells may continually reinforce an existing quasistationary outflow boundary. If regeneration of cells is very rapid, the system may resemble a small wedge. The system often weakens when a triggering shortwave trough overtakes the low-level boundary. A diurnal maximum occurs in the late afternoon through mid-evening.

REFERENCES

Scofield, R.A., 1985: Satellite convective categories associated with heavy precipitation. Preprints, 6th Conf. on Hydrometeor., Amer. Meteor. Soc., 42-51.

Scofield, R.A., 1981: Satellite-derived rainfall estimates for the Bradys Bend, Pennsylvania, flash flood. Preprints, 4th Conf. on Hydrometeor., Amer. Meteor. Soc., 188-193.

Belville, J.B., and N.O. Stewart, 1983: Extreme rainfall events in Louisiana — the "New Orleans" type. Preprints, 5th Conf. on Hydrometeor., Amer. Meteor. Soc., 284-290.

Figure 12. Enhanced IR imagery (mb curve), 1400 GMT, May 3, 1978.

Figure 13. Enhanced IR imagery (mb curve), 1445 GMT, May 3, 1978.

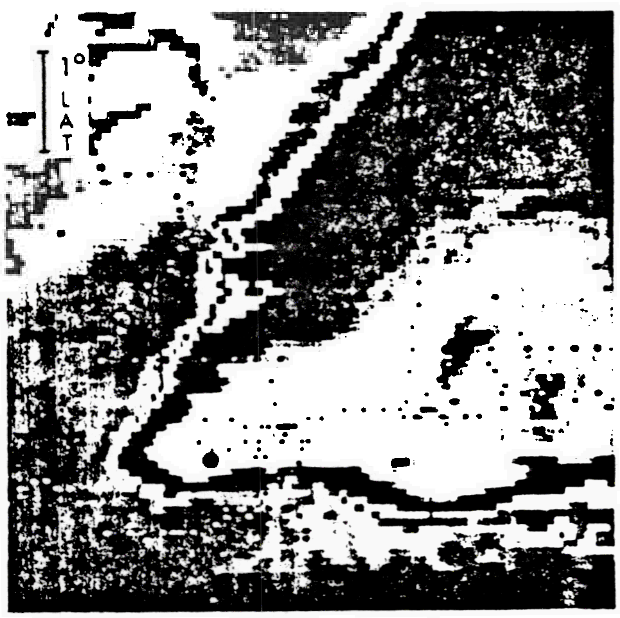


Figure 14. Enhanced IR imagery (mb curve), 1500 GMT, May 3, 1978.

Figure 15. Enhanced IR imagery (mb curve), 1515 GMT, May 3, 1978.

MESOSCALE FEATURE: Stratus and Advection/Radiation Fog

Advection-Radiation fog, which occurs most frequently during the cooler months of the year in the coastal plains along the southeast Atlantic coast and the Gulf coastal regions, generally appears "warmer" than the land on nighttime infrared satellite imagery. Thus the fog appears as a darker gray shade than the land, leading to the terms "Black Stratus" and "Black Fog". Animated infrared imagery is also a valuable aid for locating and tracking fog where minimal land/fog top temperature contrasts occur.

Fog and stratus are frequently observed to erode inward from the edges. The ground surrounding the fog is heated more rapidly than that beneath the fog. The temperature gradient thus produced along the fog boundary sets up a circulation, similar to a sea breeze which erodes the fog along the edges by sinking and mixing of warmer, drier air into the fog. The thicker and/or denser the fog area, the "brighter" it will appear in visible imagery, and the "slower" it will dissipate.

REFERENCES:

Gurka, J.J., 1980: Observations of advection-radiation fog formation from enhanced IR satellite imagery. Preprints, 8th Conf. on Weather Forecasting and Analysis, Amer Meteor. Soc., 108-114.

Gurka, J.J., 1978: The role of inward mixing in the dissipation of fog and stratus. Mon. Wea. Rev., 106, 1633-1635.

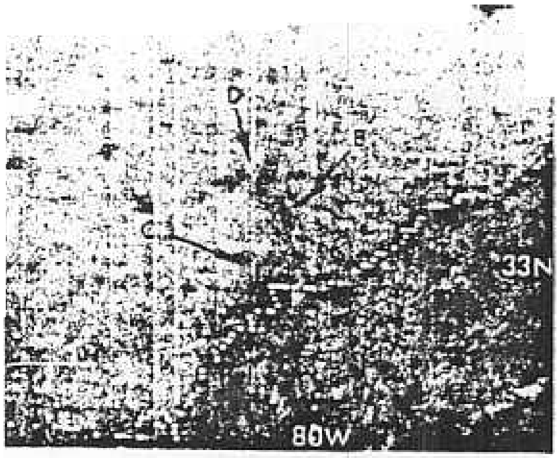


Figure 13. GOES-East, 8-km enhanced infrared (Mb curve), 1200 GMT, 15 Oct 76.

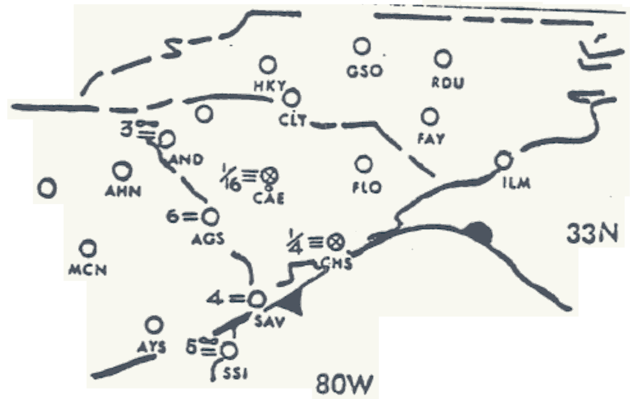


Figure 15. Ceiling and visibility, 1200 GMT, 15 Oct 76.

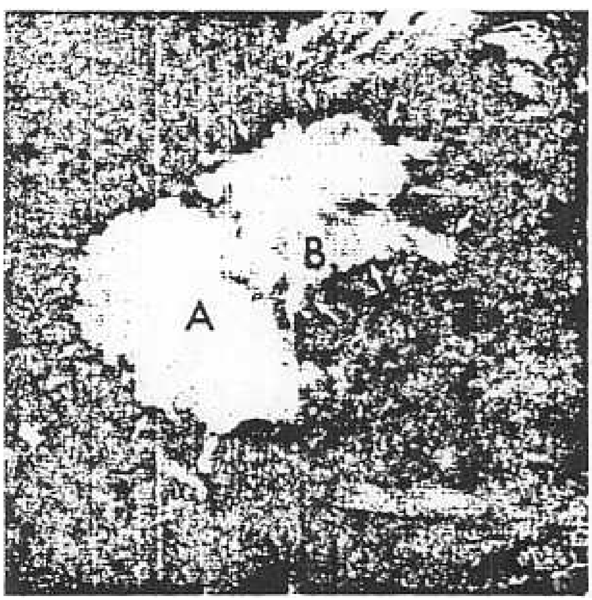


FIG. 1. SMS-1 visible 2 km data, 1600 GMT 7 January 1975.

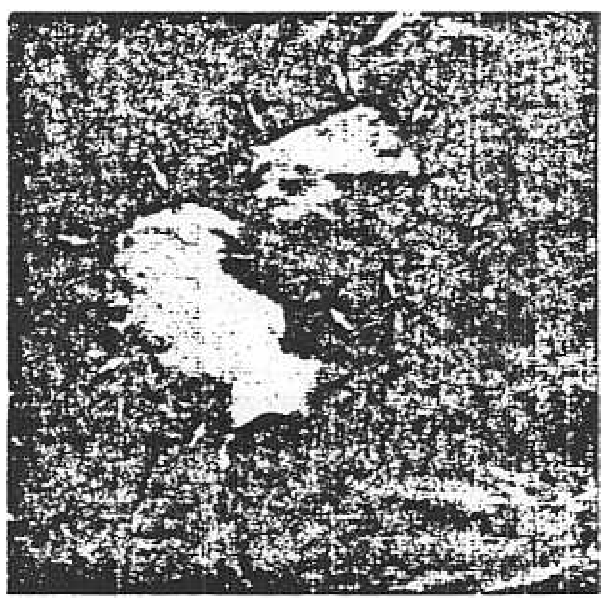


FIG. 2. SMS-1 visible 2 km data, 1700 GMT 7 January 1975.

MESOSCALE FEATURE: Sea Fog

One of the most difficult meteorlogical forecasting problems is predicting the formation, dissipation, and movement of sea fog. Sea fog, sometimes referred to a tropical air fog, is formed in maritime tropical air moving over a cold water surface. In general, the coastal waters of the Gulf of Mexico (Brownsville, TX to Sarasota, FL) and the southeast Atlantic coast (north of Vero Beach, FL) are cold enough only from mid-Winter (January) through mid-Spring (April); at other times the water is too warm for the production of sea fog.

As the fog moves progressively over colder water, its speed will generally increase due to growth, providing the growth is not suppressed by synoptic scale influence. Sea fog moving from warm to cold water can reach speeds in excess of twice the surface wind. The speed of fog moving toward warmer water, on the other hand, will generally decrease with time. During the day, sea fog rarely moves inland more than a few miles, but upon hitting the coast tends to spread out parallel to the coastline, often at a rate faster than the original speed.

Sea fog is extremely difficult to observe in infrared imagery, since the cloud tops and ocean surface have virtually identical temperatures. The subtle differences, when they occur, are best depicted in animated enhanced infrared data as ocean features are obscured by transitory fog patches.

REFERENCE:

Gurka, J.J., V.J. Oliver, and E.M. Marturi, 1982: The use of geostationary satellite imagery for observing and forecasting New England sea fog. Preprints, 9th Conf. on Weather Forecasting and Analysis, Amer. Meteor. Soc., 143-151

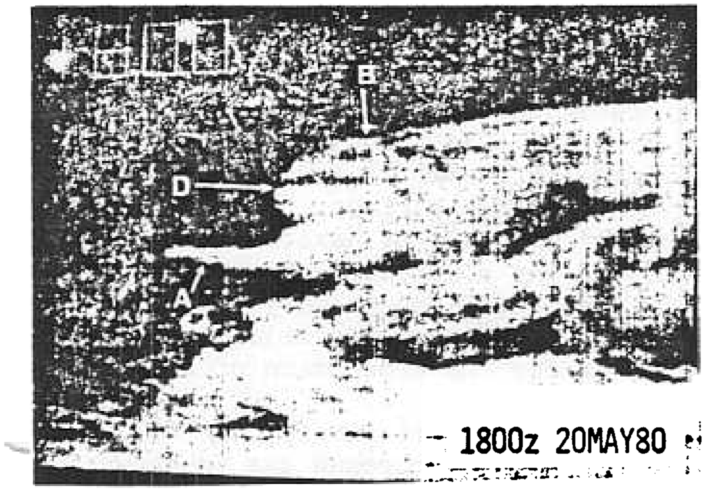


Fig. 17. *GOES-East 1-km VIS 20 May 1980, 1800 GMT.*

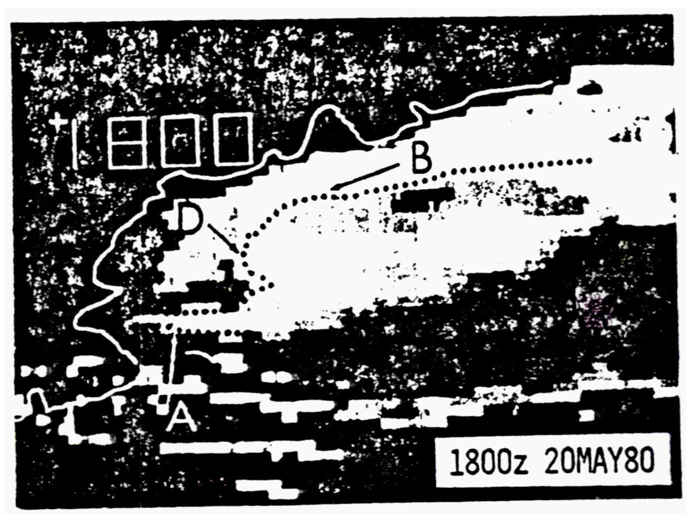


Fig. 16. *GOES-East IR 20 May 1980, 1800 GMT.*

4. MOST COMMONLY USED ABBREVIATIONS

The Satellite Interpretation Message is written using commonly accepted U.S. meteorological terminology and abbreviations, consistent with the FAA Contractions Handbook. The abbreviations are intended to save space on telegraphic circuits, tabulating and computer equipment, charts, drawings, and reports.

Some of the rules in forming or using contractions include:

a) signs and symbols included as part of a contraction are limited to those available on FAA communications equipment;

b) contractions composed of both upper and lower case letters cannot be used in telegraphic communications;

c) in some cases, a contraction may include numbers;

d) a contraction should retain an alphabetical similarity to the longer word or phrase;

e) excessively long contractions will not be adopted;

f) prepositions, conjunctions, and articles should be omitted in forming contractions;

g) a pronounceable word should be attained, if possible, when contracting a phrase; and

h) a contraction should have only one meaning.

The contractions may normally be used for any derivation or tense of the root word. If confusion would otherwise result, variations may be shown by adding the following letters to the contraction of the root word:

able	BL	ive	V
al	L	iest,est	ST
ally,erly,ly	LY	iness,ness	NS
ary,ery,ory	RY	ing	G
ance,ence	NC	ity	TY
der	DR	ment	MT
ed,ied	D	ous	US
ening	NG	s,es,ies	S
er,ier,or	R	tion,ation	N
ern	RN	ward	WD
ically	CLY		

ABBREVIATIONS
COMMONLY USED IN THE
MIAMI SATELLITE INTERPRETATION MESSAGE

ABNDT	Abundant
ABT	About
ABV	Above
AC	Altocumulus
ACLT	Accelerate
ACRS	Across
ACTV	Active
ACTVTY	Activity
ACYC	Anticyclone
ADDNL	Additional
ADJ	Adjacent
ADVCTN	Advection
ADVY	Advisory
AFCT	Affect
AFT	After
AFTN	Afternoon
AGN	Again
AGRMT	Agreement
AL	Alabama
ALG	Along
ALQDS	All Quadrants
ALT	Altitude
AMP	Amplitude
AMS	Air Mass
AMT	Amount
ANLYS	Analysis
APCH	Approach
APPR	Appear
APRNT	Apparent
APRX	Approximate
ARND	Around
AS	Altostratus
ASSOCD	Associated
ATLC	Atlantic
ATTM	At This Time
AVBL	Available
AVG	Average
BACLIN	Baroclinic
BCM	Become
BDR	Border
BFR	Before
BGN	Begin
BHND	Behind
BINOVC	Breaks in Overcast
BLD	Build
BLO	Below
BKN	Broken
BND	Bound
BNDRY	Boundary
BR	Branch
BTR	Better
BTWN	Between
BYD	Beyond
CARIB	Caribbean
CB	Cumulonimbus
CC	Cirrocumulus
CDFNT	Cold Front
CHC	Chance
CHG	Change
CI	Cirrus
CIG	Ceiling
CLD	Cloud
CLDNS	Cloudiness
CLR	Clear
CLSD	Closed
CMA	Comma
CMPLX	Complex
CNFLNC	Confluence
CNTR	Center
CNTRL	Central
CNVG	Converge

CNVGNC	Convergence
CNVTN	Convection
CNVTV	Convective
CPD	Coupled
CRCLN	Circulation
CS	Cirrostratus
CSDRBL	Considerable
CST	Coast
CU	Cumulus
CVR	Cover
CVRG	Coverage
CYC	Cyclonic
CYCLGN	Cyclogenesis

DCLRT	Decelerate
DCR	Decrease
DEG	Degree
DFCLT	Difficult
DFUS	Diffuse
DIAM	Diameter
DIFLNC	Diffluence
DMSH	Diminish
DNS	Dense
DRFT	Drift
DRZL	Drizzle
DTRM	Determine
DTRT	Deteriorate
DSIPT	Dissipate
DSPLC	Displace
DURG	During
DVLP	Develop
DVRG	Diverge
DVRGNC	Divergence

E	East
EFCT	Effect
ELSW	Elsewhere
EMBDD	Embedded
ENE	East Northeast
ENHNCD	Enhanced
ENHNCMT	Enhancement
ENTR	Enter
EPAC	East Pacific
ESE	East Southeast
EST	Estimate
EVE	Evening
EXCP	Except
EXTD	Extend
EXTRM	Extreme
EXTV	Extensive

FCST	Forecast
FL	Florida
FM	From
FNT	Front
FNTGNS	Frontogenesis
FNTLYS	Frontolysis
FQT	Frequent
FRM	Form
FRMN	Formation
FRST	Frost
FRZ	Freeze
FT	Feet
FTHR	Further

GA	Georgia
GEN	General
GLF	Gulf
GLFMEX	Gulf of Mexico
GNDFG	Ground Fog
GRAD	Gradient
GRDL	Gradual
GTR	Greater

H2	200mb
H3	300mb
H5	500mb
H7	700mb
H8	850mb
HI	High
HIER	Higher
HLF	Half
HND	Hundred
HR	Hour
HV	Have
HVY	Heavy
HWVR	However

IDENT	Identify
IMPL	Impulse
IMPT	Important
INCL	Include
INCR	Increase
INDC	Indicate
INLD	Inland
INSTBY	Instability
INTCP	Intercept
INTS	Intense
INTSFY	Intensify
INTXN	Intersection
INVOF	In The Vicinity Of
IPV	Improve
ISOLD	Isolated

JCTN	Junction
JTSTR	Jetstream

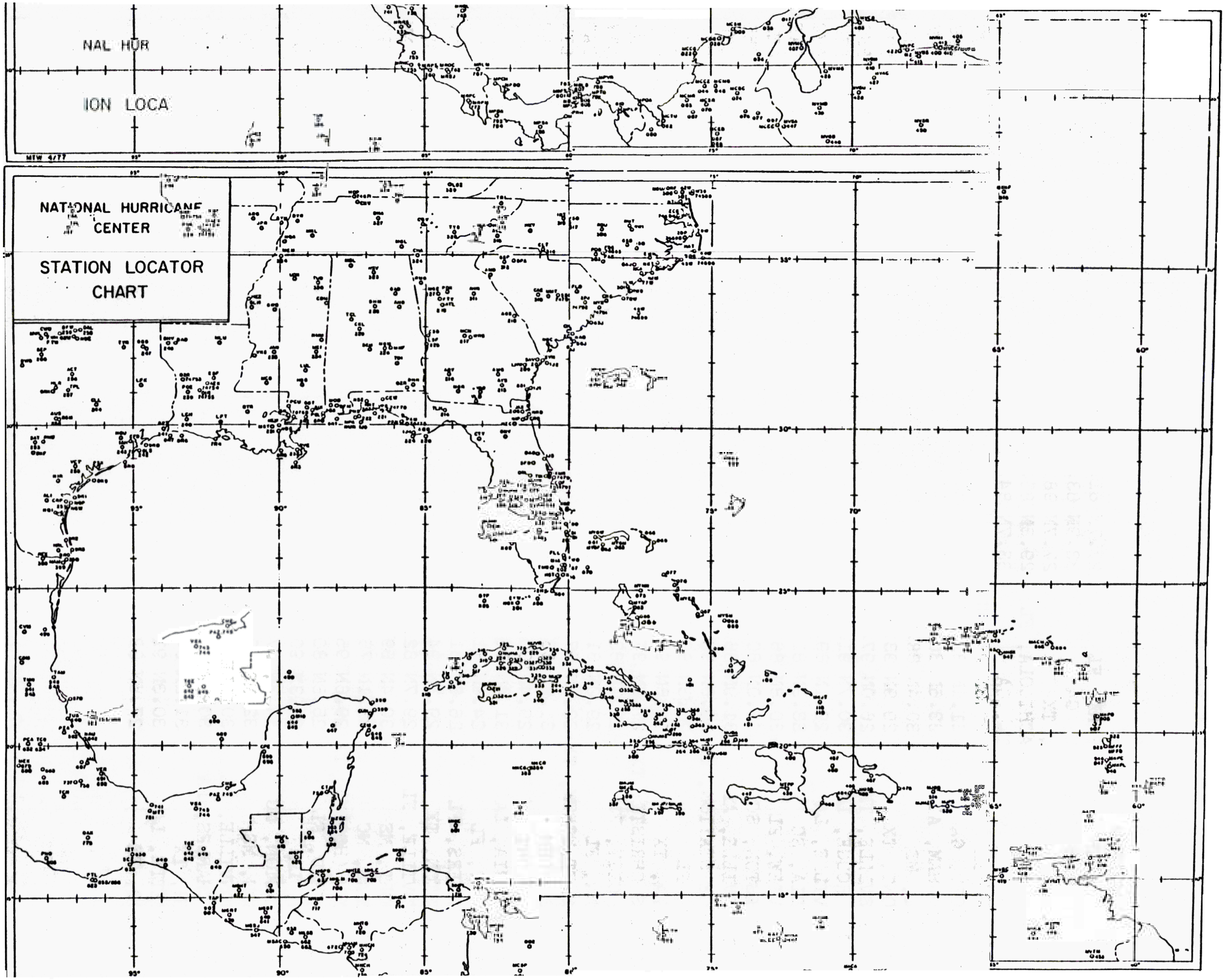
KT	Knot

LA	Louisiana
LAT	Latitude
LGT	Light
LKLY	Likely
LMT	Limit
LN	Line
LND	Land
LON	Longitude
LONGWV	Longwave
LRG	Large
LTL	Little
LTLCG	Little Change
LVL	Level
LWR	Lower
LYR	Layer

MAX	Maximum
MB	Millibar
MDT	Moderate
MEGG	Merging
MEX	Mexico
MID	Middle
MIN	Minimum
MRNG	Morning
MS	Mississippi
MSG	Message
MSTR	Moisture
MTN	Mountain
MULTILYRD	Multilayered
MXD	Mixed

N	North
NC	North Carolina
NE	Northeast
NHC	Natl Hurricane Center
NM	Nautical Miles
NMC	Natl Meteorological Center
NMRS	Numerous
NNE	North Northeast
NNW	North Northwest
NR	Near
NRW	Narrow
NW	Northwest
NWS	Natl Weather Service
NXT	Next
OBSC	Obscure
OCFNT	Occluded Front
OCNL	Occasional
OCR	Occur
OFSHR	Offshore
OMTN	Over Mountains
ONSHR	Onshore
ORGPHC	Orographic
OTR	Other
OTRW	Otherwise
OVC	Overcast
OVRN	Overrun
PAT	Pattern
PCPN	Precipitation
PEN	Peninsula
PNHDL	Panhandle
PRIM	Primary
PROG	Prognosis, Progress
PRST	Persist
PSBL	Possible
PTCHY	Patchy
PTLY	Partly
PVA	Positive Vorticity Advection
PVL	Prevail
PVLT	Prevalent
QUAD	Quadrant
QSTNRY	Quasistationary
RAOB	Rawinsonde Data
RDG	Ridge
RGD	Ragged
RGN	Region
RLTV	Relative
RMN	Remain
RMNDR	Remainder
RPD	Rapid
RUF	Rough
S	South
SBSD	Subside
SBSDNC	Subsidence
SC	Stratocumuli
SCND	Second
SCT	Scattered
SE	Southeast
SFC	Surface
SGFNT	Significant
SHFT	Shift
SHLW	Shallow
SHRTLY	Shortly
SHRTWV	Shortwave
SHWR	Shower
SIM	Satellite Interpretation Message
SLD	Solid
SLGT	Slight
SML	Small
SMRY	Summary
SPD	Speed
SPDMAX	Speedmaximum
SPRD	Spread
SQLN	Squall Line
SRND	Surround
SSE	South Southeast
SSW	South Southwest
ST	Stratus
STBL	Stable
STDY	Steady

STG	Strong
STLT	Satellite
STM	Storm
STNRY	Stationary
SUG	Suggest
SVR	Severe
SVRL	Several
SW	Southwest
SXN	Section
SYNOP	Synoptic
SYNS	Synopsis
SYS	System
TCU	Towering Cumulus
TDA	Today
THK	Thick
THN	Thin
THRU	Through
THRUT	Through Out
THSD	Thousand
TNGT	Tonight
TRK	Track
TROF	Trough
TROP	Tropopause
TRPCL	Tropical
TSHWR	Thundershower
TSTM	Thunderstorm
TURBC	Turbulence
TWD	Toward
TWRG	Towering
TX	Texas
UNAVBL	Unavailable
UNRELBL	Unreliable
UNSTBL	Unstable
UPR	Upper
UPSLP	Upslope
UPSTRM	Upstream
USBL	Useable
VCNTY	Vicinity
VLY	Valley
VORT	Vorticity
VORTMAX	Vorticity Maximum
VORTLOBE	Vorticity Lobe
VRBL	Variable
VSBY	Visibility
W	West
WD	Wide
WDLY	Widely
WK	Weak
WKN	Weaken
WND	Wind
WNW	West Northwest
WRM	Warm
WRMFNT	Warm Front
WSHFT	Wind Shift
WSW	West Southwest
WTR	Water
WV	Wave, Water Vapor
XCP	Except
YDA	Yesterday
Z	Universal Coordinated Time


NATIONAL HURRICANE CENTER
STATION LOCATOR CHART
NAL HUR
ION LOCA
MTW 4/77

UNITED STATES

AGR	AVON PARK, FL	27.7N	81.5W
AHN	ATHENS, GA	33.9N	83.2W
ALI	ALICE, TX	27.7N	98.0W
AQQ	APPALACHICOLA, FL	29.8N	85.0W
ATL	ATLANTA, GA	33.7N	84.4W
AUS	AUSTIN, TX	30.3N	94.2W
AYS	WAYCROSS, GA	31.1N	82.1W
BHM	BIRMINGHAM, AL	33.6N	86.8W
BIX	BILOXI, MS	30.4N	88.9W
BPT	BEAUMONT, TX	29.9N	93.9W
BRO	BROWNSVILLE, TX	26.0N	97.5W
BTR	BATON ROUGE, LA	30.7N	91.2W
BVE	BOOTHVILLE, LA	29.1N	89.2W
CAE	COLOMBIA, SC	33.9N	81.1W
CEW	CRESTVIEW, FL	30.8N	86.6W
CHS	CHARLESTON, SC	33.0N	80.0W
CKL	CENTERVILLE, AL	31.9N	86.9W
CLL	COLLEGE STATION, TX	30.6N	96.4W
COF	COCOA, FL	28.3N	80.6W
COT	COTULLA, TX	28.5N	99.1W
CRP	CORPUS CHRISTI, TX	27.8N	97.3W
CTY	CROSS CITY, FL	29.7N	83.0W
DAB	DAYTONA, FL	29.0N	81.0W
DFW	DALLAS-FT WORTH, TX	33.0N	97.0W
DHN	DOTHAN, AL	31.2N	85.3W
DRT	DEL RIO, TX	29.4N	100.9W
ESF	ALEXANDRIA, LA	31.4N	92.3W
EYW	KEY WEST, FL	24.6N	81.8W
FMY	FORT MYERS, FL	26.6N	81.9W
GLS	GALVESTON, TX	29.3N	94.8W
GNV	GAINESVILLE, FL	29.7N	82.2W
GPT	GULFPORT, MS	30.4N	89.1W
HAT	HATTERAS, NC	35.1N	75.6W
HOU	HOUSTON (HOBBY), TX	29.6N	95.3W
HST	HOMESTEAD, FL	25.5N	80.3W
HUM	HOUMA, LA	29.3N	90.9W
ILM	WILMINGTON, NC	34.3N	77.9W
JAN	JACKSON, MS	32.4N	90.1W
JAX	JACKSONVILLE, FL	30.5N	81.6W
LCH	LAKE CHARLES, LA	30.1N	93.0W
LFK	LUFKIN, TX	31.2N	94.7W
LFT	LAFAYETTE, LA	30.3N	91.9W
LRD	LAREDO, TX	27.5N	99.5W

MCN	MACON, GA	31.9N	83.7W
MEI	MERIDIAN, MS	31.4N	88.8W
MGM	MONTGOMERY, AL	31.2N	86.2W
MIA	MIAMI, FL	25.8N	80.2W
MLB	MELBOURNE, FL	28.1N	80.5W
MOB	MOBILE, AL	30.7N	88.0W
MSY	NEW ORLEANS, LA	30.0N	90.3W
NEW	NEW ORLEANS, LA	30.0N	90.0W
ORL	ORLANDO, FL	28.5N	81.2W
PAM	PANAMA CITY, FL	30.1N	85.6W
PBI	WEST PALM BEACH, FL	26.7N	80.1W
PIE	ST. PETERSBURG, FL	27.9N	82.8W
PNS	PENSACOLA, FL	30.3N	87.2W
POE	FT. POLK, LA	30.8N	93.4W
PSX	PALACIOS, TX	28.7N	96.3W
SAT	SAN ANTONIO, TX	29.6N	98.6W
SAV	SAVANNA, GA	32.1N	81.1W
SRQ	SARASOTA, FL	27.5N	82.6W
SSI	BRUNSWICK, GA	31.2N	81.5W
TIX	TITUSVILLE, FL	28.5N	80.6W
TLH	TALLAHASSEE, FL	30.5N	84.4W
TPA	TAMPA, FL	27.9N	82.6W
VCT	VICTORIA, TX	28.9N	97.0W
VLD	VALDOSTA, GA	30.9N	83.2W
VPS	VALPARAISO, FL	30.3N	86.6W
VRB	VERO BEACH, FL	27.7N	80.4W

BAHAMA ISLANDS AND BERMUDA

TXKF	BERMUDA	32.4N 64.7W
MYER	ELEUTHERA ISLAND	24.8N 76.1W
MYGF	FREEPORT	26.5N 78.7W
MYGM	WEST END, G. BAHAMA	26.8N 79.1W
MYNN	NASSAU	25.0N 77.4W
MYSM	COCKBURN TOWN	24.1N 74.6W

MEXICO

CME	CIUDAD DEL CARMEN	18.7N 91.9W
CPE	CAMPECHE	19.9N 90.5W
CTM	CHETUMAL	18.5N 88.3W
CUN	CANCUN	21.0N 86.8W
CVM	CIUDAD DEL CARMEN	23.7N 99.1W
CZM	COZUMEL	20.5N 86.9W
MEX	MEXICO CITY	19.4N 99.1W
MID	MERIDA	21.0N 89.6W
MTT	MINATITLAN	17.8N 94.5W
MTY	MONTERREY	23.8N104.5W
NAU	NAUTLAS	20.2N 96.7W
SCZ	SALMA CRUZ	16.2N 95.2W
TAM	TAMPICO	22.2N 97.8W
TAP	TAPACHULA	14.9N 92.3W
TUX	TUXPAN	21.0N 97.4W
VER	VERACRUZ	19.2N 96.1W
VSA	VILLAHERMOSA	18.0N 92.9W

GUATEMALA

MGFL	FLORES	16.9N 89.9W
MGGT	GUATEMALA CITY	14.6N 90.5W
MGHT	HUEHUETENANGO	15.3N 91.5W
MGPB	PUERTO BARRIOS	15.7N 88.6W
MGPP	POPTUN	16.3N 89.4W
MGRT	RETALHULEU	14.5N 91.7W

BELIZE

MZBZ	BELIZE CITY	17.5N 88.2W

HONDURAS

MHCA	CATACAMOS	14.9N 85.9W
MHLC	LA CEIBA	15.7N 86.9W
MHLM	LA MESA	15.5N 87.9W
MHNG	GUANAJA	16.5N 85.9W
MHPL	PUERTO LEMPIRA	15.2N 83.6W
MHTG	TEGUCIGALPA	14.0N 87.2W

NICARAGUA

MNCH	CHINANDEGA	12.6N 87.2W
MNMG	MANAGUA	12.1N 86.2W
MNPC	PUERTO CABEZAS	14.0N 83.4W
MNPL	BLUEFIELDS	12.0N 83.8W
MNRS	GRANADA	11.4N 85.8W

COSTA RICA

MRLM	PUERTO LIMON	10.0N 83.0W
MRNC	NICOYA	10.2N 85.5W
MROC	JUAN SANTAMARIA	10.0N 84.2W
MRPM	PALMAR SUR	9.0N 83.5W

PANAMA

MPBO	BOCAS DEL TORO	9.2N 82.1W
MPFS	COLON	9.0N 80.0W
MPHO	PANAMA/BALBOA	8.9N 79.7W
MPOA	PUERTO OBALDIA	8.8N 77.6W
MPSA	SANTIAGO	8.1N 80.9W
MPTO	TOCUMEN	9.1N 79.4W
MPVR	EL PORVENIR	9.3N 79.0W

COLOMBIA

SKBC	EL BANCO	9.1N 74.0W
SKBQ	BARRANQUILLA	10.9N 74.8W
SKCC	CUCUTA	7.9N 72.5W
SKCG	CARTAGENA	10.5N 75.5W
SKMR	MONTERIA	8.8N 75.9W
SKSM	SANTA MARTA	11.1N 74.2W
SKTU	TURBO	8.1N 76.7W

VENEZUELA

SVBC	BARCELONA	10.1N 64.7W
SVCB	CIUDAD BOLIVAR	8.1N 63.6W
SVCR	CORO	11.4N 69.7W
SVGI	GUIRIA	10.6N 62.3W
SVMB	BARQUISIMETO	10.1N 69.3W
SVMC	MARACAIBO	10.6N 71.7W
SVMD	MERIDA	8.6N 71.2W
SVMG	MENE GRANDE	9.8N 70.8W
SVMI	CARACAS	10.6N 67.0W
SVPC	PUERTO CABELLO	10.5N 68.0W
SVPQ	PORLAMAR	10.9N 64.0W
SVTM	TUMEREMO	7.3N 61.5W

CUBA

MUBA	BARACOA	20.2N 74.2W
MUCF	CIENFUEGOS	22.1N 80.4W
MUCM	CAMAGUEY	21.4N 77.9W
MUCU	SANTIAGO DE CUBA	20.0N 75.8W
MUGM	GUANTANAMO	19.8N 75.1W
MUHA	HAVANNA	23.1N 82.3W
MUMZ	MANZANILLO	20.3N 77.2W
MUNG	NUEVO GERONA	21.8N 82.7W
MUVR	VARADERO	23.2N 81.3W

JAMAICA

MKJK	KINGSTON	17.9N	76.8W
MKJM	MONTEGO BAY	18.5N	77.9W

HAITI

MTPP	PORT-AU-PRINCE	18.5N	72.3W

DOMINICAN REPUBLIC

MDPP	PUERTO PLATA	19.8N	70.7W
MDSD	SANTA DOMINGO	18.5N	69.9W

PUERTO RICO AND U.S. VIRGIN ISLANDS

TIST	ST. THOMAS	18.3N	65.0W
TISX	ST. CROIX	17.8N	64.9W
TJBQ	SAN ANTONIO	18.5N	67.1W
TJMZ	MAYAGUEZ	18.2N	67.2W
TJNR	CEIBA	18.3N	65.6W
TJPS	PONCE	18.0N	66.6W
TJSJ	SAN JUAN	18.4N	66.0W

LESSER ANTILLES AND OTHER CARIBBEAN ISLANDS

TNCA	ARUBA	12.5N	70.0W
TNCB	BONAIRE	12.1N	68.3W
TNCC	CURACAO	12.2N	69.0W
TNCE	ST. EUSTATIUS	17.5N	63.0W
TNCM	ST. MAARTIN	18.1N	63.1W
SKSP	SAN ANDRES	12.6N	81.7W
TFFF	MARTINIQUE	14.7N	61.0W
TFFR	GUADELOUPE	16.3N	61.5W
MHIC	SWAN ISLAND	17.4N	83.9W
MWCG	GRAND CAYMAN	19.2N	81.4W
MKJT	TURKS ISLAND	21.6N	71.2W
TAPA	ANTIGUA	17.1N	61.8W
TBPB	BARBADOS	13.1N	59.5W
TLPC	ST. LUCIA	14.0N	61.0W
TDPD	DOMINICA	15.5N	61.3W
TDPE	GRENADA	12.1N	61.6W
TTPP	TRINIDAD	10.6N	61.4W
TTPT	TOBAGO	11.2N	60.8W
TVSV	SAINT VINCENT	13.1N	61.2W

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