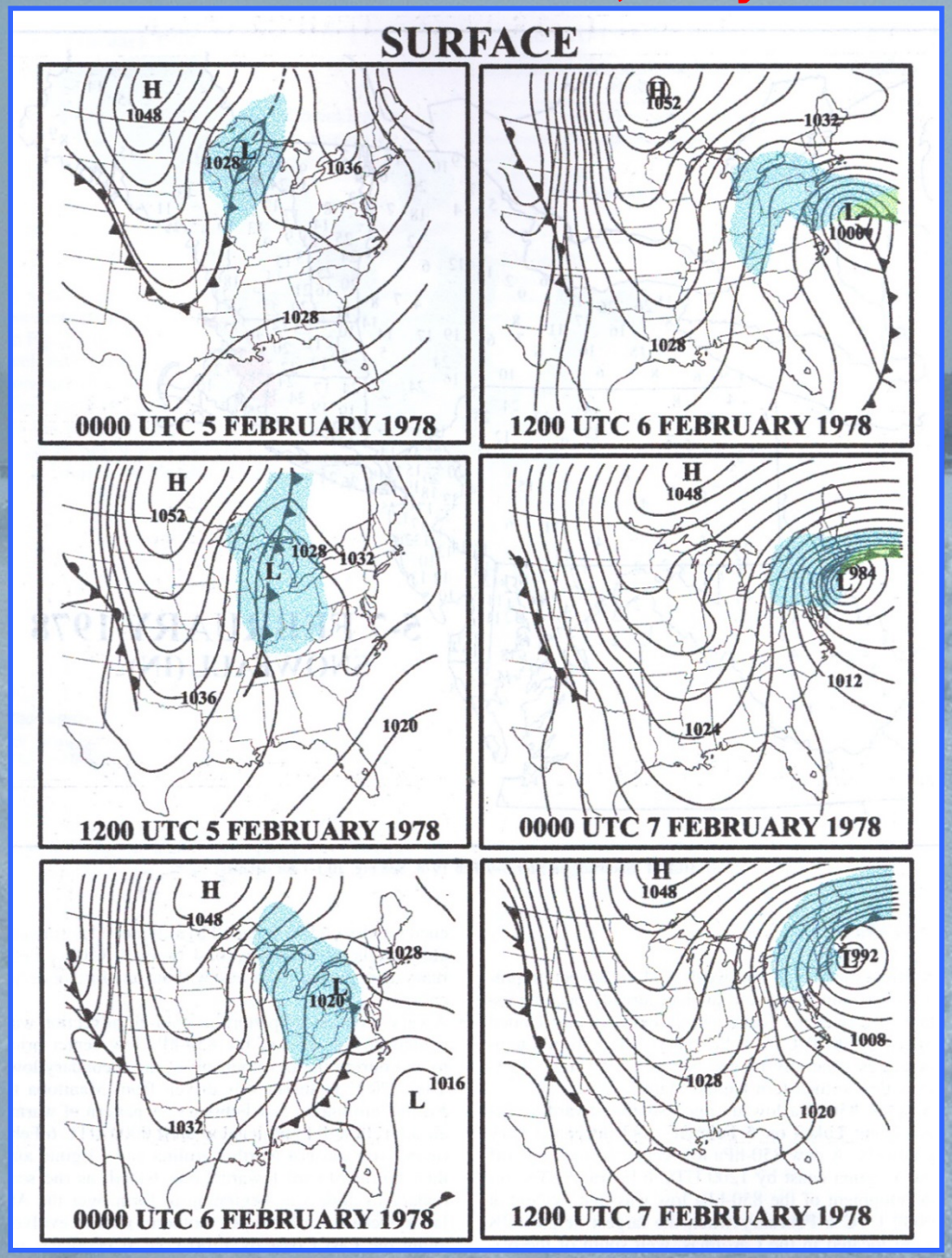
The Presidents Day Snowstorm February 19, 1979: An Overview

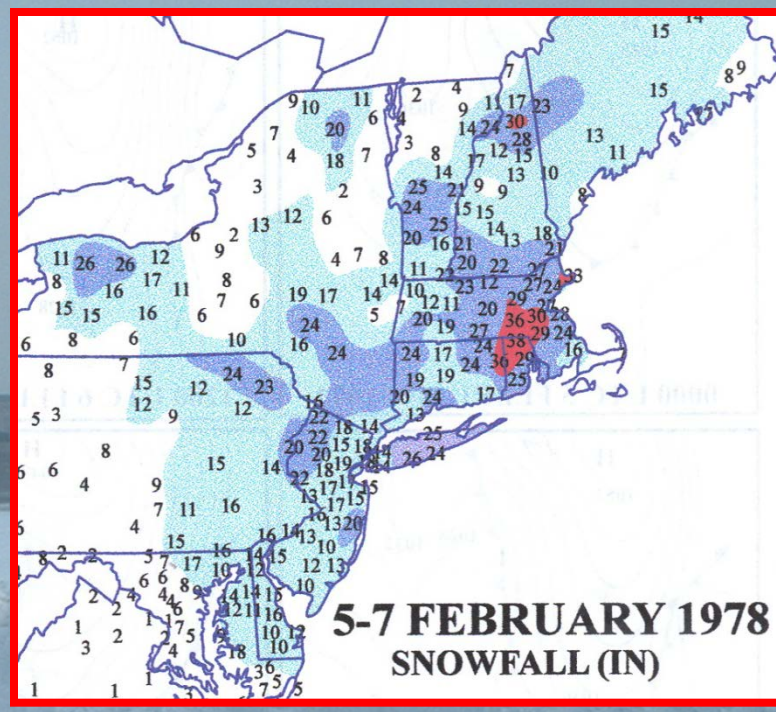
1979


Met-Ed / GPU
THREE MILE ISLAND
NUCLEAR
GENERATING STATION
Authorized Personnel Only
OBSERVATION CENTER
3/4 Mile Ahead


TIME
Coping with Peace
Nuclear Nightmare

Just a year earlier





THE BLIZZARD OF FEBRUARY 1978

The February Blizzard of 1978
3-day forecast

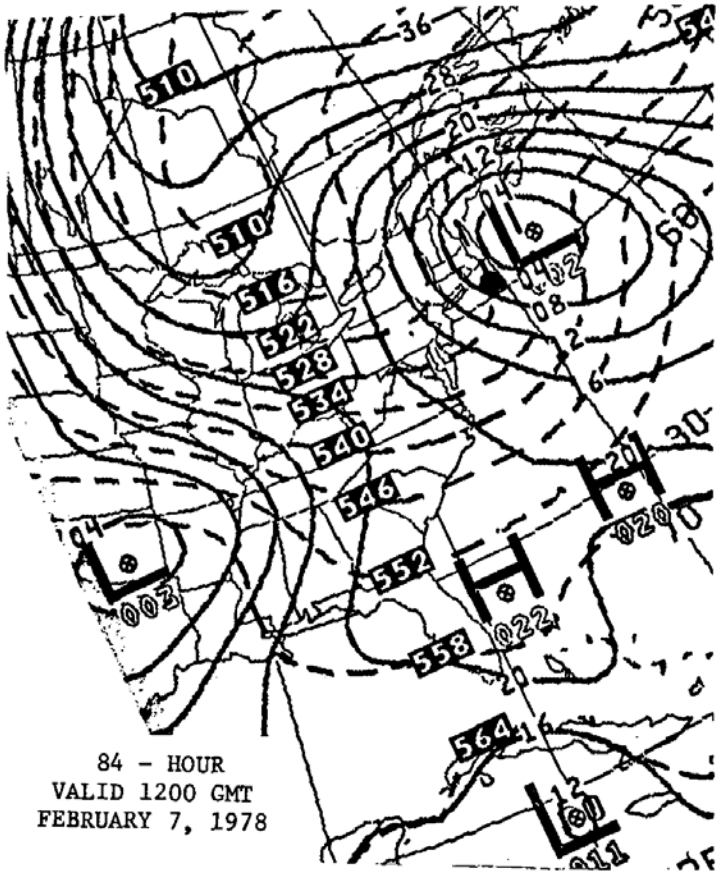


FIG. 10a. 7LPE, 84 h prognostic (from 0000 GMT, 4 February 1978) sea level isobars (in millibars) and 1000–500 mb thickness contours (in dekameters). Verification chart is Fig. 2d.

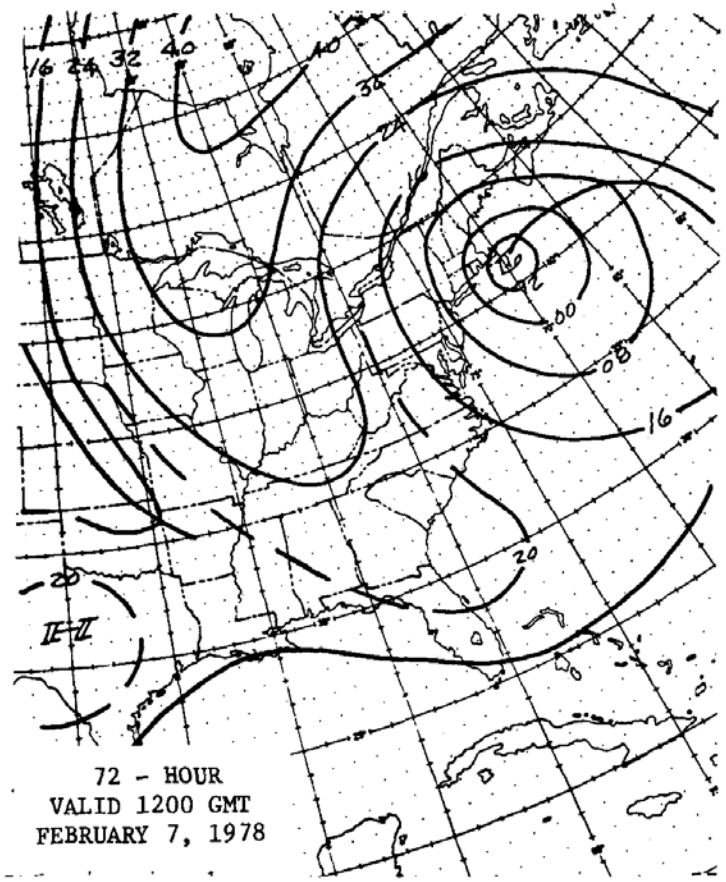
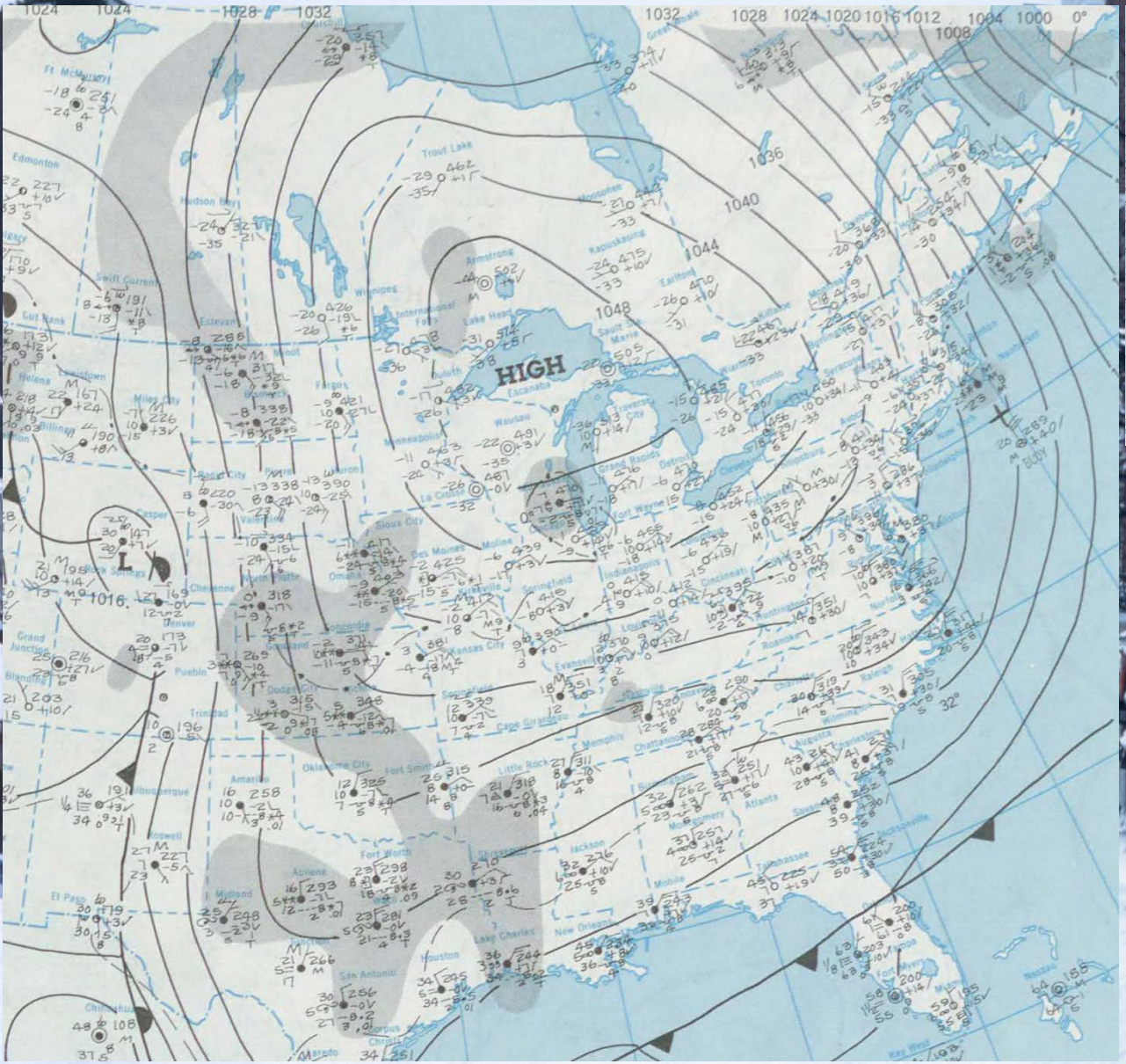
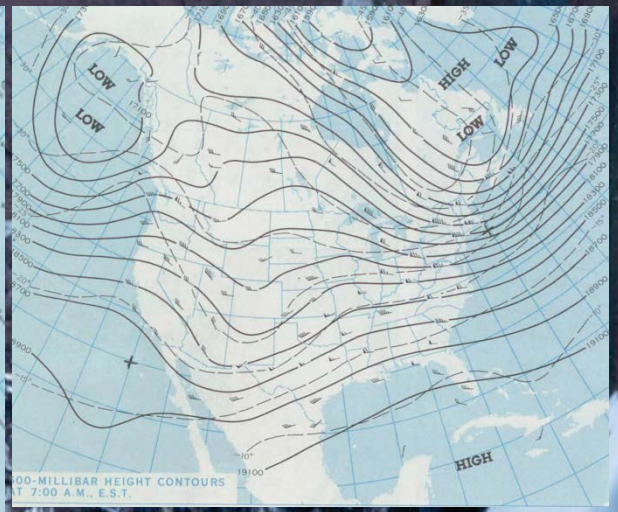


FIG. 10b. Manual 72 h prognostic (from 1200 GMT, 4 February 1978) sea level isobars (in millibars). Verification chart is Fig. 2d.

From Brown and Olson 1978 BAMS

Some background to the Pres Day Storm



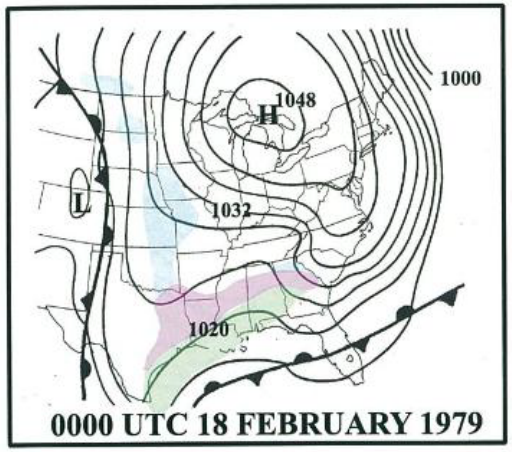


10-day period ending Feb 18
Coldest of 20th century

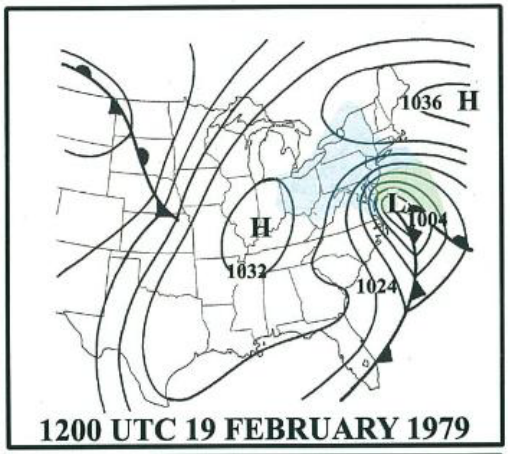
Dulles airport on the 18th
Low -14º High 8º

7 days below zero

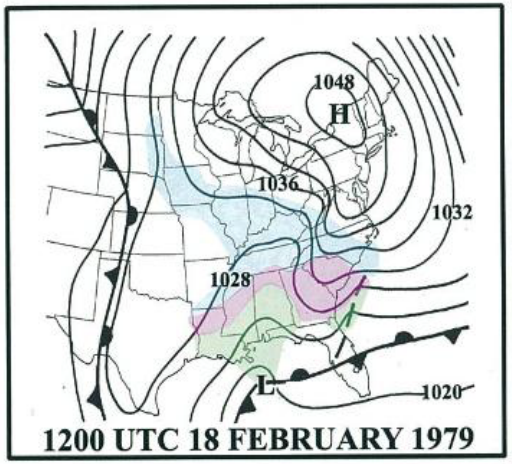
SURFACE



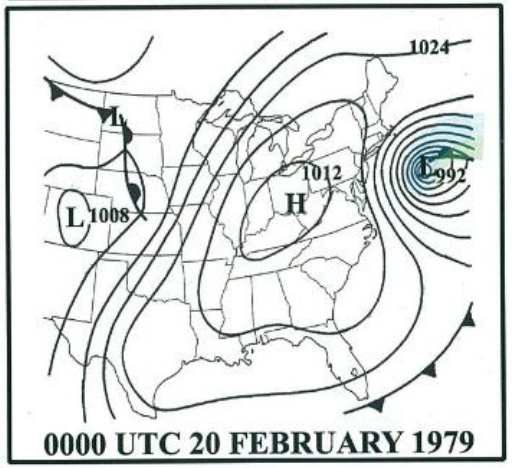
0000 UTC 18 FEBRUARY 1979



1200 UTC 19 FEBRUARY 1979



1200 UTC 18 FEBRUARY 1979



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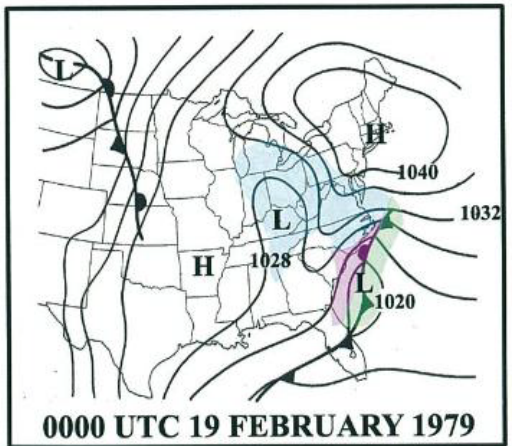

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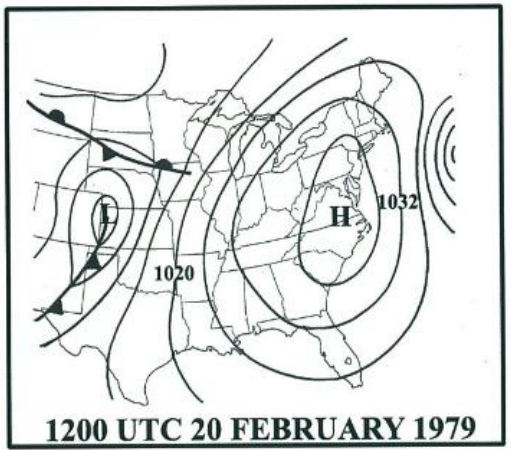

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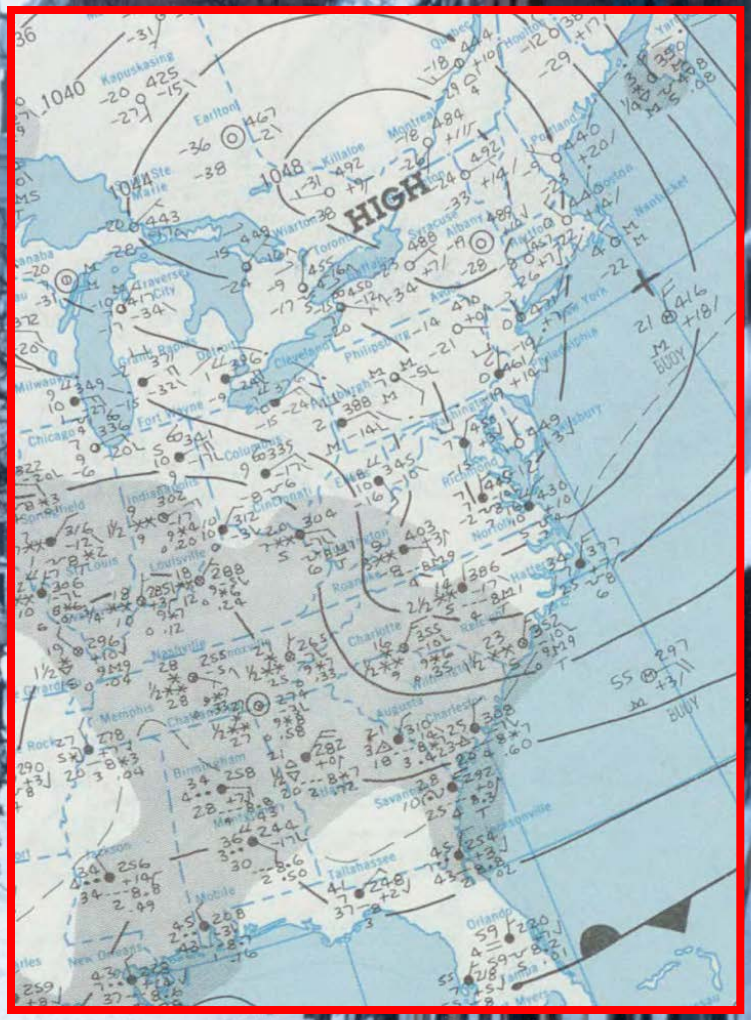
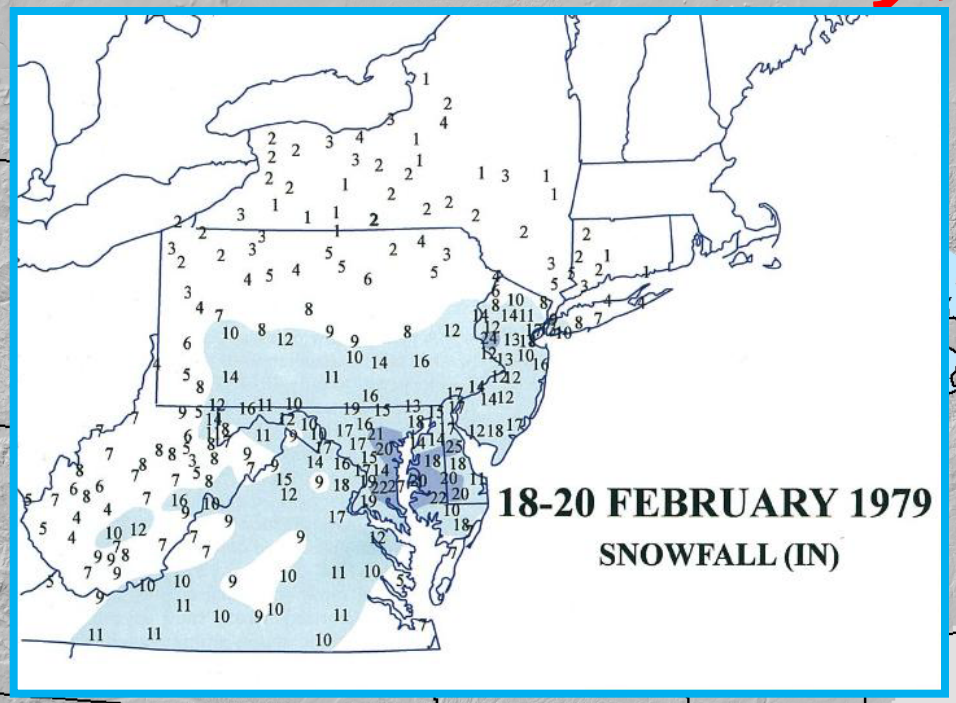


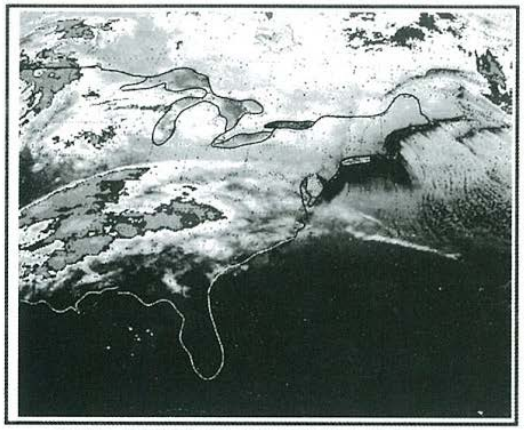
Presidents' Day Snowstorm Snowfall



February 17-19, 1979
Snowfall (inches)
1 - 4 4 - 10 10 - 20 20 - 30 30+

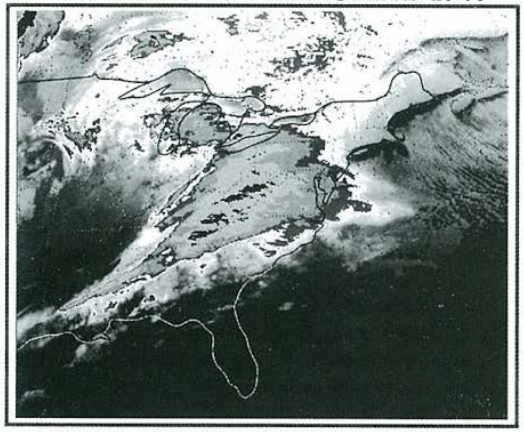
NESIS = 4.77
Category 3

SATELLITE IMAGERY



0001 UTC 18 FEBRUARY 1979

1230 UTC 19 FEBRUARY 1979



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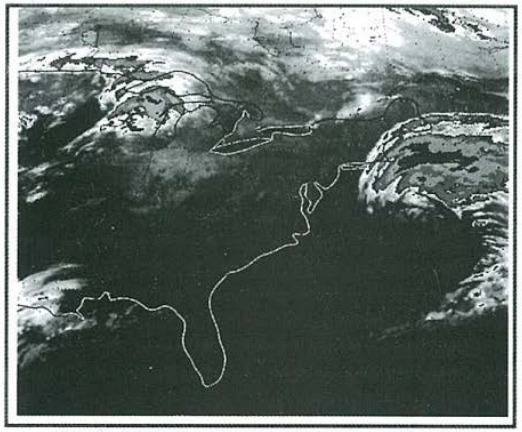
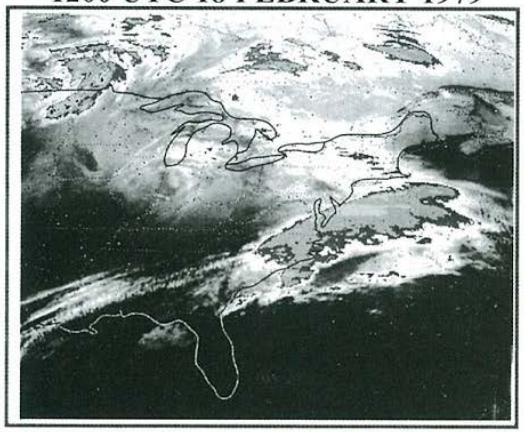
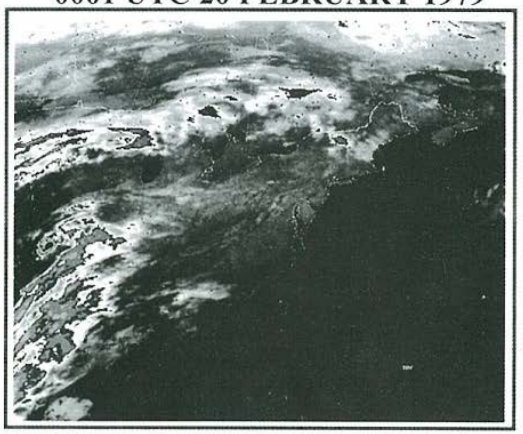


0001 UTC 20 FEBRUARY 1979

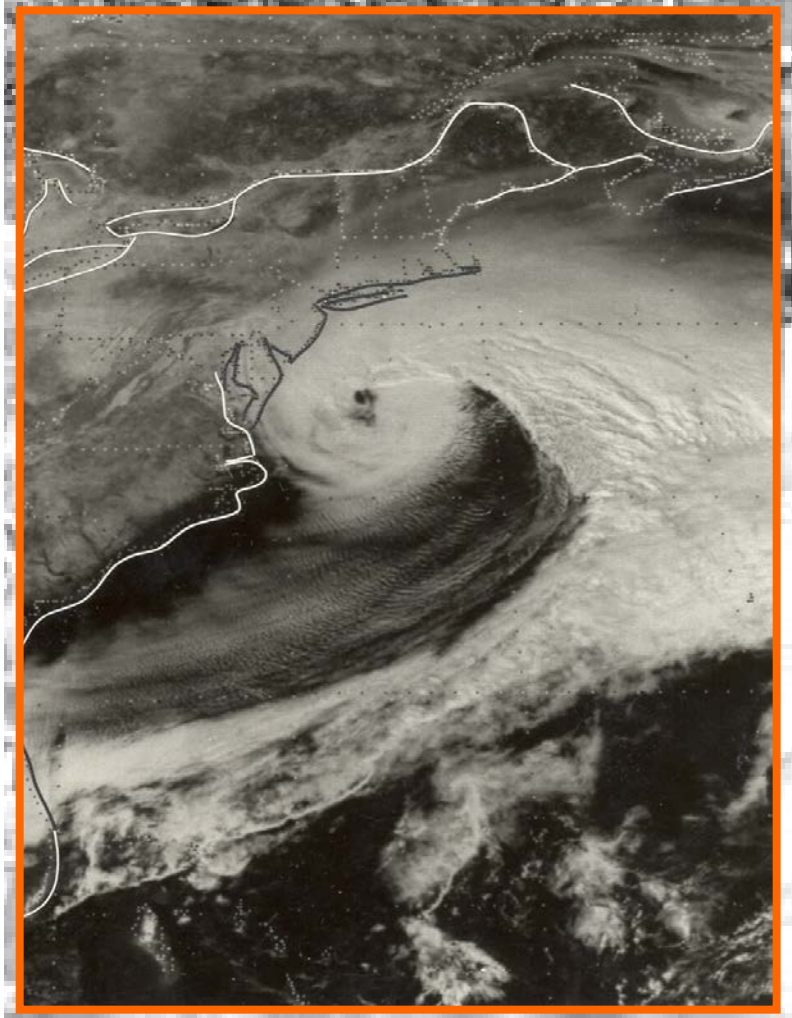


2330 UTC 18 FEBRUARY 1979



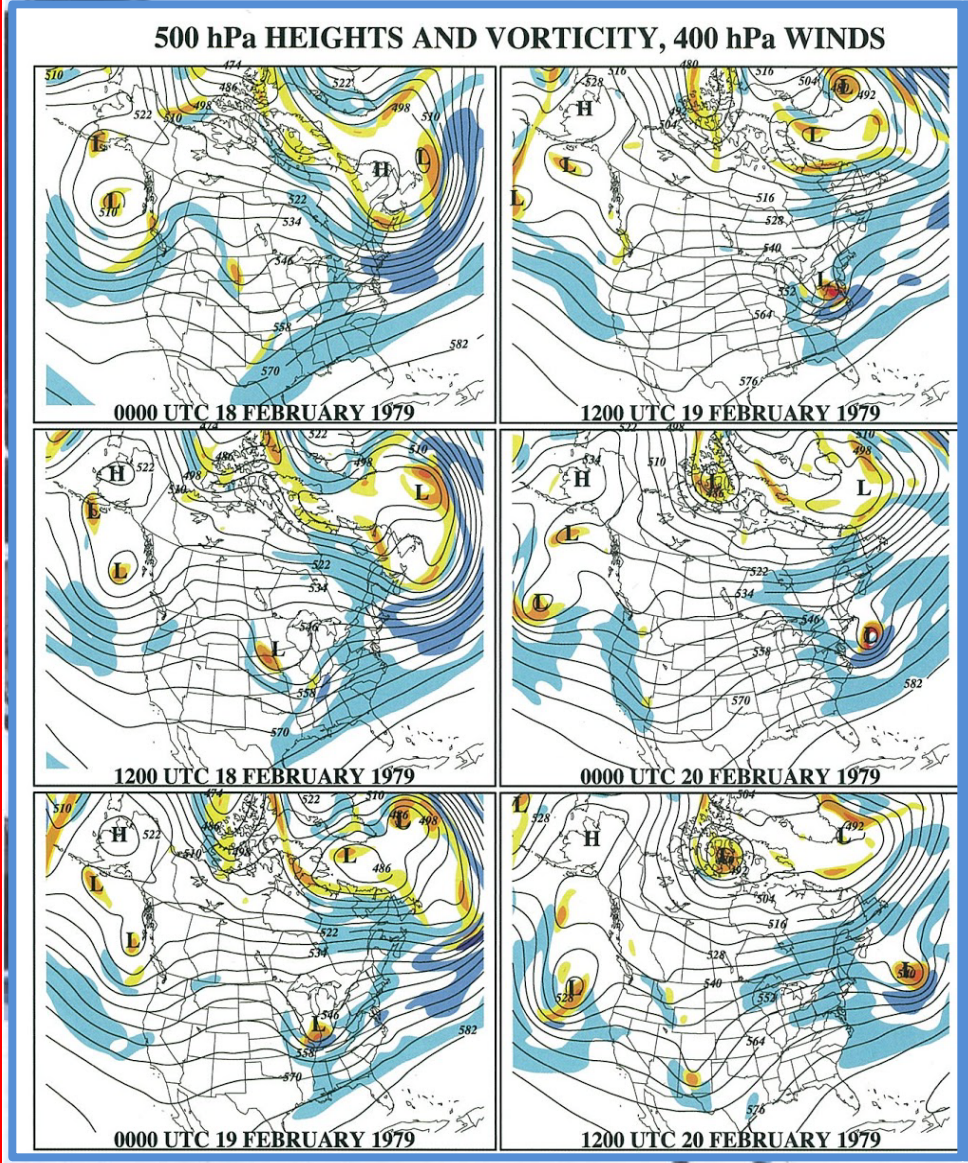
1200 UTC 20 FEBRUARY 1979

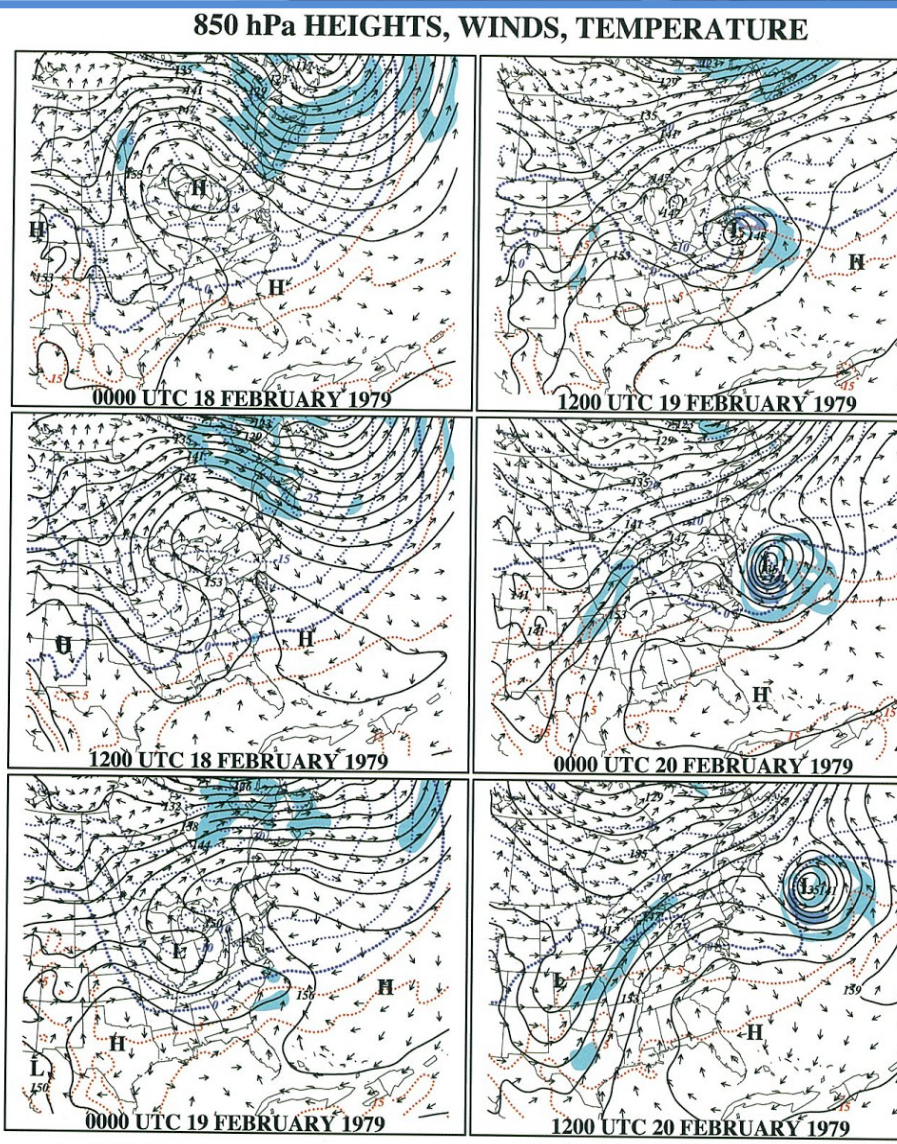
February 19, 1979



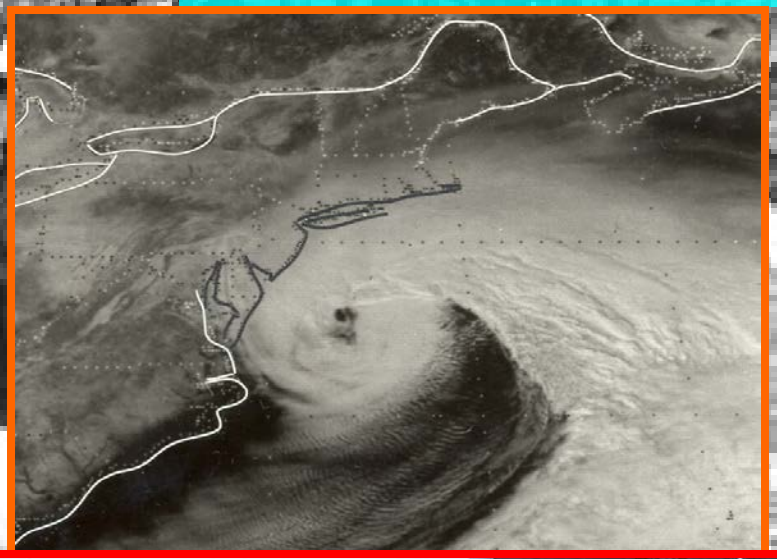
500 hPa Sequence

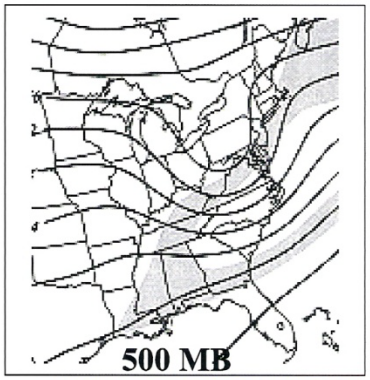
850 hPa Sequence

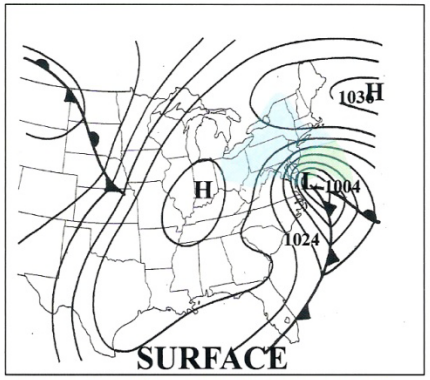




Presidents Day Storm Forecast
The LFM "Ensemble of One"....

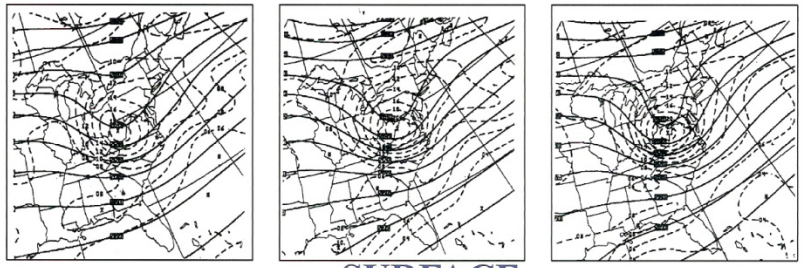




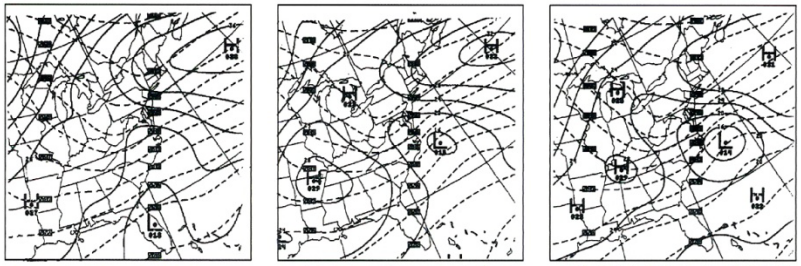


ANALYSES VALID 1200 UTC 19 FEB 1979

500 hPa



SURFACE



36 HOUR FCST | 24 HOUR FCST | 12 HOUR FCST

FORECASTS VALID 1200 UTC 19 FEB 1979

One Paper.....

The Presidents' Day Snowstorm of 18–19 February 1979: A Subsynoptic-Scale Event

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(Manuscript received 4 September 1980, in final form 20 March 1981)

ABSTRACT

On 18–19 February 1979 a major east coast cyclone deposited a record-breaking snowfall on the Middle Atlantic States. The storm is noteworthy because of the failure of the operational prediction models to signal the intensity of the event. The life cycle of the cyclone is reviewed with emphasis on the synoptic and mesoscale features and their possible linkage.

Prior to cyclogenesis the synoptic pattern features a massive cold anticyclone near the Great Lakes with a broad baroclinic zone extending from Texas eastward to the Atlantic coast. A region of enhanced lower tropospheric baroclinicity develops along the Carolina coastal strip in response to significant oceanic sensible and latent heat fluxes which warm, moisten and destabilize the boundary layer. Cyclogenesis is initiated along the coastal front as the result of lower tropospheric warm advection. The importance of the coastal front is that it effectively steers the cyclone north-northeastward parallel to the coast such that it eventually acquires a favorable phase relationship for deepening with respect to a vigorous short-wave trough moving eastward from the Ohio Valley by 1200 GMT 19 February.

Explosive deepening takes place in the ensuing 6 h coincident with the outbreak of convection near the storm center. By 1800 GMT, satellite pictures reveal a closed, clear storm eye while surface ship and drilling rig data disclose the presence of minimal hurricane force winds, primarily in the northern semicircle of the storm. Unlike a hurricane, however, the convection is asymmetric with respect to the vortex, being concentrated in the region of strongest surface winds.

The major operational model errors stem from poor sea level pressure and quantitative precipitation prognoses. Evidence is presented that initial analysis deficiencies coupled with inadequate boundary-layer and convective precipitation physics precluded a successful model forecast in this case.

1. Introduction

This is a paper about the memorable snowstorm of 18–19 February 1979 in the Middle Atlantic States. Storm snowfalls totaled in the vicinity of 60 cm in portions of eastern Virginia, Maryland and Delaware with a number of localities reporting record 24 h snowfalls and total amount on the ground. Additional details and a description of the larger scale circulation regimes are found in Dickson (1979).

An equally interesting facet of this cyclonic event was the failure of the operational Limited Fine Mesh (LFM-II) and Seven-Layer Primitive Equation (7LPE) models in use at the National Meteorological Center (NMC) to adequately predict the cyclogenesis. Numerical weather prediction has made tremendous strides in the last 25 years, a point eloquently made by Reed (1977), and confirmed by the spectacular success of the LFM model in providing early warning of the famous Boston blizzard of February 1978 (Brown and Olson, 1978). Consequently, the failure of the LFM-II to predict major cyclogenesis over the conterminous United States and vicinity must be viewed as a rather rare event that is worthy of research.

Cyclogenesis was initiated along a Carolina coastal front of the type described by Bosart *et al.* (1972) and Bosart (1975). Cyclogenesis then proceeded at a more rapid rate in response to the approach of a short wave from the Ohio Valley. The explosive deepening phase of the cyclone coincided with the outbreak of convection near the storm center, a situation not unlike the development of a major oceanic cyclone which battered the *Queen Elizabeth II* in September 1978 as described by Gyakum (1980).[2]

This paper will describe the cyclone development in detail with emphasis on some important mesoscale features. Sections 2 and 3 contain a synoptic overview and quasi-geostrophic diagnosis, respectively. A mesoscale description of the coastal front is contained in Section 4 with supporting radar observations given in Section 5. Coastal frontogenesis is described in Section 6. Evidence for convective

[1]Work initiated while the author was on sabbatical leave at the Massachusetts Institute of Technology for the 1978–79 academic year.

[2] Gyakum, J. R., 1980: On the evolution of the QE II storm. *Preprints Eighth Conf. Weather Forecasting and Analysis*, Denver, Amer. Meteor. Soc., 23–28.

0027-0644/81/071542-25$10.25

Led to Another.....

The Presidents' Day Cyclone of 18–19 February 1979: Synoptic Overview and Analysis of the Subtropical Jet Streak Influencing the Pre-Cyclogenetic Period

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(Manuscript received 9 September 1982, in final form 8 August 1983)

ABSTRACT

The Presidents' Day cyclone of 18–19 February 1979 was an intense and rapidly developing storm which produced heavy snowfall along the East Coast of the United States. An analysis of the cyclone is presented which isolates three jet streaks that appear to have played important roles in the development of two separate areas of heavy snow. One area of heavy snow developed prior to cyclogenesis and is linked, in part, to an increasingly unbalanced subtropical jet streak (STJ) and a noticeably ageostrophic low-level jet. The second area of heavy snow developed in conjunction with the explosive cyclogenesis off the East Coast as a polar jet streak and midtropospheric trough propagated toward the coastal region from the north-central United States.

This paper examines the STJ in detail. The maximum wind speeds associated with the STJ increased by 15 to 20 m s^{-1} between 1200 GMT 17 and 1200 GMT 18 February 1979 as the jet propagated from the south-central toward the eastern United States. During the 24 h period, the flow in the STJ became increasingly supergeostrophic and apparently unbalanced. Ageostrophic wind speeds increased to greater than 30 m s^{-1}, with a significant cross-contour component directed toward lower values of the Montgomery streamfunction, as the flow along the STJ became increasingly divergent with time. The increased wind speed, ageostrophic flow, and divergence along the axis of the STJ are linked to the increasing confluence in the entrance region of the jet streak and the decreasing wavelength of the trough–ridge system in which the jet streak was embedded. The upper level divergence and upward vertical motion near the axis of the STJ along with the moisture transport associated with the LLJ are found to be important factors in the development of the first area of heavy snow.

1. Introduction

On 18–19 February 1979, a very intense cyclone developed along the Middle Atlantic Coast which produced 45 to 60 cm of snow from Virginia to southern New Jersey, including the greatest 24 h snowfall accumulation in Washington, D.C., in over 50 years (Foster and Leffler, 1979). The storm, referred to as the Presidents' Day cyclone, is of particular interest because of its intensity, the apparent contribution of many physical processes to its rapid development on 19 February 1979, and the failure of the National Meteorological Center's (NMC) operational Limited Area Fine Mesh model (LFM-II) to forecast accurately the cyclogenesis and heavy snowfall.

In an analysis of the Presidents' Day storm, Bosart (1981) places particular emphasis on describing the coastal frontogenesis observed prior to cyclone development and the extent to which boundary-layer processes and diabatic processes contributed to the rapid cyclogenesis. Nevertheless, other studies have shown that jet streaks[1] often play an important role in the development of cyclones (e.g., Newton, 1956; Reiter, 1969; Hovanec and Horn, 1975). The intent of this paper is to determine the role of upper- and lower-tropospheric jets before and during the period of rapid cyclogenesis.

The specific purposes of this paper are: 1) to present a synoptic overview of the Presidents' Day cyclone that isolates two distinct periods of heavy snow, 2) to identify the subtropical, polar, and low-level jet streaks which appear to have influenced the development of the cyclone, and 3) to focus on the subtropical jet streak (STJ) and its role in the development of the first area of heavy snow in the southeastern United States during the pre-cyclogenetic period. In Section

[1] Palmén and Newton (1969, p. 199) define jet streaks as the regions of isotach maxima embedded within the jet stream.

From the internet…….. Eric Rogers……..

On the anniversary of Lance's 30 years of teachings…..A reminiscence on Lance's use of cliches……

"….For the record, I counted 108 cliches in that class, with a daily record of 12 in the last class of the semester,

***in which Lance was dissecting the Uccellini President's Day Storm papers with a* meat cleaver. "**

AH….a fond memory!!!!!

Which led to another and another and another.....

A Diagnostic Analysis of the Pre

LANCE F. BOSAR

State University of New Yo

(Manuscript received 22 Augu

AB

A diagnostic analysis of the Presidents' Day ston findings of Bosart. The initial growth of cyclonic convergence along the Carolina coastal front. Rap midtropospheric short wave trough from the Ohio cyclone spinup is enhanced by the vertical advec environment along the coast as the upper level extension of high semigeostrophic potential vortic cyclone and prior to the rapid cyclogenesis stage, c potential vorticity is poorly conserved, however, an potential vorticity growth below 800 mb near the Boundary layer warming and moistening appr waters of the precyclogenetic environment. Cos moistening in conjunction with sensible heating o southern Appalachian Mountains. The observed whereas the large-scale geostrophic flow contributes to frontolysis.

A comparison of kinematic, quasi-geostrophic and semigeostrophic vertical motions reveals that the kinematic method best captures the structure in the lower troposphere, indicative of the importance of boundary layer convergence. The semigeostrophic vertical motions are superior to the quasi-geostrophic vertical motions in depicting a sloping updraft and a closer separation of the ascent–descent dipole. Solution of the semigeostrophic vertical circulation equation from Hoskins and Draghici lends some support to the finding of Uccellini and others that the flow around the subtropical jet streak was unbalanced.

Finally, kinetic energy export from the storm environment is balanced by a positive residual and generation by both the divergent and nondivergent components of the wind in a manner suggestive of an anticyclone region.

1. Introduction

Bosart (1981) described the meteorology of the memorable Presidents' Day snowstorm of 18–19 February 1979 in the Middle Atlantic States. Evidence was presented, based on the analysis of surface observations, which suggested that the incipient cyclone was a shallow, baroclinic boundary layer disturbance that formed along a Carolina coastal front. Differential heating, moistening and roughness between land and sea in conjunction with cold air damning to the east of the Appalachian Mountains were implicated as important physical mechanisms that sustained the incipient cyclogenesis and allowed significant precipitation to develop along the coastal plain. The shallow cyclone then tracked north-northeastward parallel to the coast. Rapid deepening ensued when this cyclone came under the favorable southwesterly flow ahead of a prominent upper tropospheric trough moving eastward from the Ohio Valley. Convection occurred in the vicinity, and to the north, of the rapidly intensifying storm. Whether this convection (e.g., see Sanders and Gyakum, 1980; Gyakum, 1983a,b) had a direct bearing on the storm deepening rate h been ascertained and will not be discussed here

Ucellini *et al.* (1984) have shown that pr rapid cyclogenesis, the upper troposphere was acterized by an amplifying, unbalanced subtr jet streak. They hypothesized that the therma direct circulation associated with the propagati streak resulted in a more favorable environme coastal cyclogenesis through enhanced dive aloft. In their view, the lower level ageostrophi was embedded in the indirect circulation asso with the subtropical jet and influenced by bou layer and diabatic processes.

The purpose of this paper is to extend and qu the earlier work of Bosart (1981). Boundary processes relevant to coastal frontogenesis and genesis will be emphasized. The cyclone spinu cess is investigated through a kinetic energy, vo potential vorticity and vertical motion diagnos

2. Synoptic overview and vertical motion analy

Objective analyses of temperature, height and are presented for the surface, 700 and 300 mb

The Presidents' Day Cyclone of 18–19 February 1979: Influence of Upstream Trough Amplification and Associated Tropopause Folding on Rapid Cyclogenesis

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(Manuscript received 2 April 1984, in final form 31 January 1985)

ABSTRACT

A diagnostic analysis of an amplifying polar jet-trough system and associated tropopause fold which preceded the 19 February 1979 Presidents' Day cyclone is presented. The analysis is based on conventional radiosonde data, infrared and visible satellite imagery, 6.7 μm water vapor measurements from the Temperature-Humidity Infrared Radiometer (THIR), and ozone measurements from the Total Ozone Mapping Spectrometer (TOMS). The case study indicates that dynamically forced meso-α scale vertical circulations played an important role in the extrusion of stratospheric air along the axis of a polar jet and the subsequent development of the storm system. Specific findings include: 1) Tropopause folding accompanying an amplifying polar jet-trough system occurred along the axis of the intensifying polar jet in response to subsidence forced by geostrophic deformation patterns associated with the jet streak. 2) The folding process extruded dry stratospheric air marked by high values of potential vorticity down toward the 700 mb level, 1500 km upstream of the East Coast, 12 to 24 h prior to the explosive development phase of the cyclone. This result differs from previous case studies which have emphasized the concurrent development of a folded tropopause and cyclogenesis. 3) During the 12 h preceding rapid cyclogenesis, the stratospheric air descended toward the 800 mb level and moved toward the East Coast to a position just upstream of the area in which rapid cyclogenesis occurred. Even though potential vorticity was not strictly conserved, the absolute vorticity increased in the lower to middle troposphere in association with adiabatic mass convergence, vertical stretching, and the related decrease of static stability of the air mass originating in the stratosphere. 4) As was inferred from the infrared and visible satellite imagery and the ozone measurements, the stratospheric air mass was nearly colocated with the storm center as explosive deepening and vortex development occurred, suggesting that the explosive development of the cyclone was likely influenced by the stratospheric air mass as it descended toward a deep oceanic planetary boundary layer immediately off the East Coast.

1. Introduction

On 18–19 February 1979, a major snowstorm developed along the Middle Atlantic Coast, producing heavy snow from North Carolina to southeastern New York and extreme southern New England. Various aspects of this storm, known as the Presidents' Day cyclone, have been described by Bosart (1981), Uccellini *et al.* (1983, 1984) and Bosart and Lin (1984). Bosart's (1981) study provides a detailed analysis of the coastal frontogenesis that played an important role in concentrating low-level baroclinicity along the coast during the precyclogenetic period on 18 February. Bosart also emphasizes a possible connection between a line of convection near the center of the storm and the onset of explosive cyclogenesis which began after 1200 GMT 19 February. The Uccellini *et al.* (1984) study describes the increase in upper-level divergence associated with a significantly ageostrophic subtropical jet streak (STJ) and an intense and highly ageostrophic low-level jet (LLJ), both of which considerably influenced the development of heavy snow during the precyclogenetic period. The synoptic overviews by Bosart (1981) and Uccellini *et al.* (1984) also indicate that the explosive development phase of the Presidents' Day cyclone commenced as an eastward propagating polar jet (PJ)–trough system moved across the central United States and overtook the coastal front on 19 February. Uccellini *et al.* (1984) briefly note that a tropopause fold (Reed, 1955; Reed and Danielsen, 1959) developed in the central United States on 18 February 1979, 1500 to 2000 km upstream of the East Coast and 12

A Model-Based Diagnostic Study of the Rapid Development Phase of the Presidents' Day Cyclone

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(Manuscript received 18 August 1987, in final form 4 May 1988)

ABSTRACT

A model simulation of the rapid development phase of the Presidents' Day cyclone of 19 February 1979 is analyzed in an effort to complement and extend a diagnostic analysis based only on 12-h radiosonde data over the contiguous United States, with a large data-void area over the Atlantic Ocean (Uccellini et al. 1985). As indicated by the SLP and 850 mb absolute vorticity tendencies, rapid cyclogenesis commences between 0300 and 0600 UTC 19 February and proceeds through the remaining 18 h of the simulation. This rapid development phase occurs as stratospheric air [marked by high values of potential vorticity (PV)] approaches and subsequently overlies a separate, lower-tropospheric PV maximum confined to the East Coast, or during the period when the advection of PV increases in the middle to upper troposphere over the East Coast. The onset of rapid deepening is marked by 1) the transition in the mass divergence profiles over the surface low from a diffuse pattern with two or three divergence maxima to a two-layer structure, with maximum divergence located near 500 mb and the level of nondivergence located near 700 mb; 2) the intensification of precipitation just north of the surface low pressure system; and 3) an abrupt increase in the low-level vorticity.

Model trajectories and Eulerian analyses indicate that three airstreams converge into the cyclogenetic region during the rapid development phase. One of these airstreams descends within a tropopause fold on the west side of an upper-level trough over the north-central United States on 18 from the west-southwest as the rapid development commences. A seco lower-tropospheric subsidence within the cold anticyclone north of the sto path at low levels over the ocean, and then ascends as it enters the st approaches the storm from the south at low levels and also ascends as the airstreams pass through the low-level PV maximum as they appr increase following a parcel related to the vertical distribution of θ due coastal region.

A vorticity analysis shows that absolute vorticity associated with the through vortex stretching associated with the convergence of the airstrea the maximum vorticity is initially confined below the 700 mb level, the is shown to be directly related to dynamic and physical processes that exte Finally, the divergence of these airstreams within the 700 to 500 mb laye divergence just north and east of the storm center and thus enhances the measured by the decreasing sea level pressure.

1. Introduction

On 18–19 February 1979, a very intense cyclone developed along the Middle Atlantic coast, producing heavy snow and high winds from North Carolina to southeastern New York and extreme southern New England. This storm, known as the Presidents' Day storm, is a classic case of a rapidly developing coastal cyclone and is of particular interest because of its rapid intensification and heavy snowfall, which were poorly forecast by operational models.

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Stratospheric–Tropospheric Mass Exchange during the Presidents' Day Storm

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(Manuscript received 23 February 1993, in final form 10 September 1993)

ABSTRACT

Using data generated from a model simulation, the exchange of mass between the stratosphere and the troposphere is estimated for the Presidents' Day storm during a 24-h period beginning at 1500 UTC 18 February 1979. This 24-h interval coincided with a strongly developed tropopause depression and the onset of explosive surface cyclogenesis. The initial part of the study consists of identifying a surface of isentropic potential vorticity (IPV) to represent the tropopause. The 3.0-IPV-unit surface is chosen since the pressure distribution on this surface closely matches the tropopause pressures reported by radiosonde stations. The IPV surface portrays the depression of the tropopause associated with the polar-front jet and trough system accompanying the baroclinic amplification of the Presidents' Day storm.

Using a quasi-Lagrangian transport model, stratospheric–tropospheric mass exchange is estimated for the region including and immediately adjacent to the tropopause depression. The estimated mass transport from the stratosphere to the troposphere for the 24-h period is 5×10^{14} kg. The transport from the troposphere to the stratosphere is 2×10^{14} kg yielding a net transport across the tropopause of 3×10^{14} kg from the stratosphere to the troposphere. These results are confirmed by a second, independent model simulation.

The mass transport from stratosphere to troposphere across the 3.0-IPV surface coincides with descending air, often referred to as the "dry airstream," arcing counterclockwise around the polar-front jet and trough system from northwest to east. Reverse transport from the troposphere to the stratosphere occurs northeast of the depression and agrees with trajectories of air parcels within the end region of rising "conveyer belts."

e East Coast Cyclogenesis: Numerical Experimentation and Model-Based Diagnostics

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(Manuscript received 7 November 1988, in final form 5 May 1989)

ABSTRACT

mentation of explosive East Coast cyclogenesis is performed using the Florida State University del (FSUGSM). The three cases examined here are the Presidents' Day storm of 18–19 the North Atlantic and Pacific bombs of 18–20 January 1979 which formed off the east States and Japan respectively. The use of a global model provides a framework for studying

Synergistic Interactions between an Upper-Level Jet Streak and Diabatic Processes that Influence the Development of a Low-Level Jet and a Secondary Coastal Cyclone

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(Manuscript received 26 February 1986, in final form 14 March 1987)

ABSTRACT

A series of numerical simulations is presented for the February 1979 Presidents' Day cyclone in order to understand more fully the roles played by upper-level jet streaks, the oceanic planetary boundary layer (PBL), and latent heat release in the development of a low-level jet (LLJ) and secondary cyclogenesis along the East Coast of the United States. Mesoscale model simulations with and without sensible and latent heating show that the diabatic processes, along with the jet streak circulation patterns, contribute to the enhancement of the low-level winds and the initial development of the coastal cyclone. However, *none of the mechanisms acting alone* is sufficient to yield a satisfactory simulation of the LLJ and secondary cyclogenesis. Furthermore, the model-based diagnostic analyses indicate that a synergistic interaction must exist among these processes to account for the substantial increase in the magnitude of the low-level winds and the decrease in the sea level pressure that mark the secondary cyclogenesis for this case.

The following sequence is derived from the model diagnostic study: 1) Temporally increasing divergence along the axis of an upper-tropospheric jet streak located near the crest of an upper-level ridge is associated with the development of an indirect circulation that spans the entire depth of the troposphere and is displaced to the anticyclonic side of the jet. The lower branch of the indirect circulation appears to extend northwestward from the oceanic PBL up sloping isentropic surfaces toward 700 mb over the Appalachian Mountains. 2) Sensible heating and associated moisture flux within the oceanic PBL warm and moisten the lower branch of the indirect circulation, enhancing precipitation rates and latent heat release west of the coastline. 3) The combination of a shallow direct circulation associated with a developing coastal front, sloping lower-tropospheric isentropic surfaces just to the west of the coastline, and latent heat release contributes to a vertical displacement of parcels within the lower branch of the indirect circulation as they cross the coastline. 4) The vertical displacement of the parcels in a baroclinic environment (in which the pressure gradient force changes with height) results in the rapid increase in the magnitude of the ageostrophic wind and associated unbalanced flow. This imbalance contributes to parcel acceleration, resulting in the formation of a LLJ in the lower branch of the indirect circulation over a 2 to 4 h period. 5) The increasing wind speed associated with the developing LLJ is, in turn, responsible for an increase in the horizontal mass flux divergence in the entrance region of the LLJ. The increase in the mass flux divergence in the lower troposphere just above the boundary layer makes a significant contribution to the decreasing sea-level pressure that constitutes the initial development phase of the secondary cyclone along the coast.

1. Introduction

In a recent study of major snowstorms along the East Coast of the United States, Kocin and Uccellini (1985a,b) find that a significant number of the coastal snowstorms are associated with secondary cyclogenesis near the coastline as a primary system weakens west of the Appalachian Mountains. The forecast problems associated with secondary cyclogenesis (labeled a type B cyclone by Miller, 1946) are well known and include specifying the timing and location of the redevelopment of the surface low along the coast. Kocin and Uccellini also show that the coastal cyclogenesis is often marked by an enhancement of the 850 mb wind field, which usually takes the form of a low-level jet (LLJ). The LLJ develops either as secondary cyclogenesis commences or as a coastal front/inverted trough forms prior to cyclogenesis. Maximum wind speeds can exceed 30 m s^{-1} in the core of the LLJ and are typically directed from the south, southeast, or east toward the area of heavy precipitation associated with the cyclone. The LLJ acts to increase the moisture transport toward the region of heavy precipitation. The strong warm air advection associated with large wind speeds and thermal gradients along the coast may also be an important factor in the occurrence of secondary cyclogenesis.

In the analyses of the Presidents' Day cyclone of 18 and 19 February 1979, Uccellini et al. (1984) describe the development of an intense and highly ageostrophic LLJ on 18 February, during the period in which a coastal front and inverted trough formed along the Southeast Coast. The decreasing sea-level pressure as-


And this is where I will step aside to leave it to the main protagonists....
COLD FACTORY