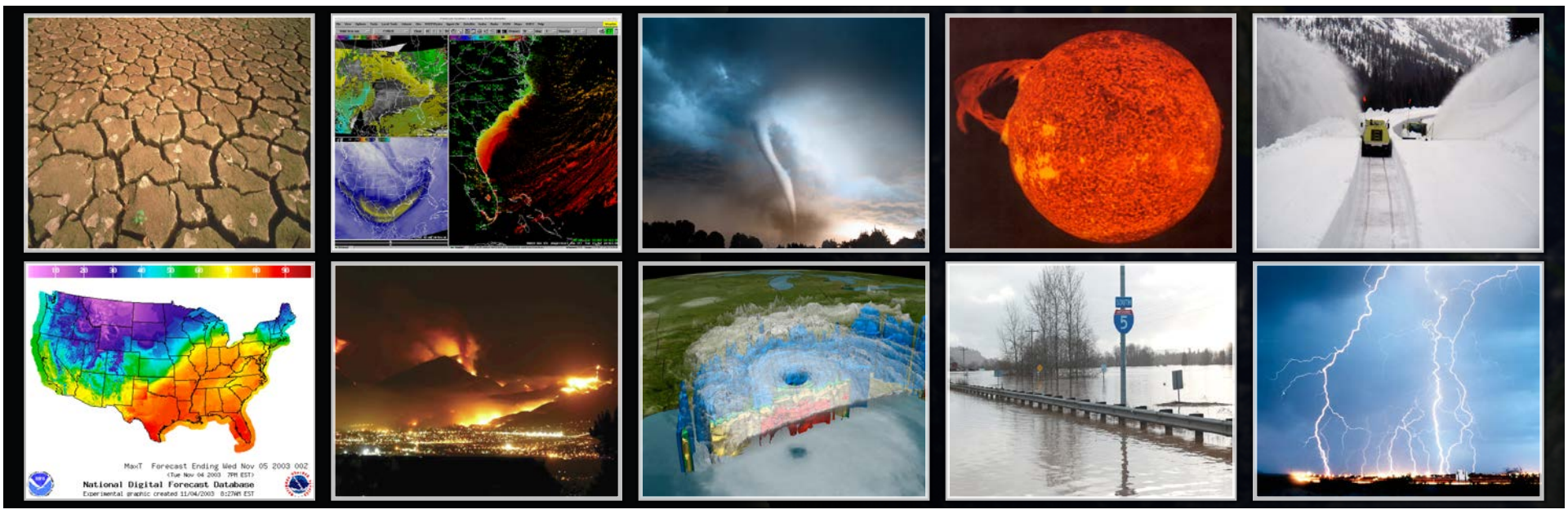
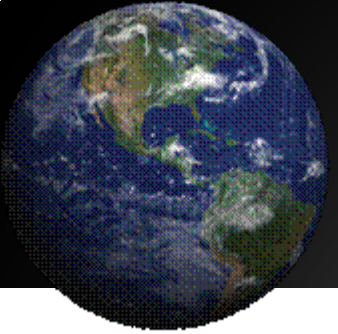
Reflecting on the Presidents Day Storm
18-19 February 1979

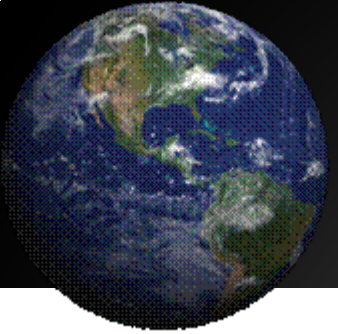


Dr. Louis W. Uccellini
NOAA Assistant Administrator for Weather Services
Director, National Weather Service
College Park, Maryland
May 28, 2014



Outline

- Personal Reflection—Tape from UW Weekly Weather Watch
- Synoptic Review of Presidents Day Storm
- The Operational Model Failure—Enough Is Enough!
- Research Agenda—the Cyclone Workshop Spins into Action
- Visualizing the Research Model Output: Bill Hibbard/UW SSEC Enters the Scene with First Application of VIS 5D
- Since Presidents' Day Storm 1
- Summary



Personal Reflection

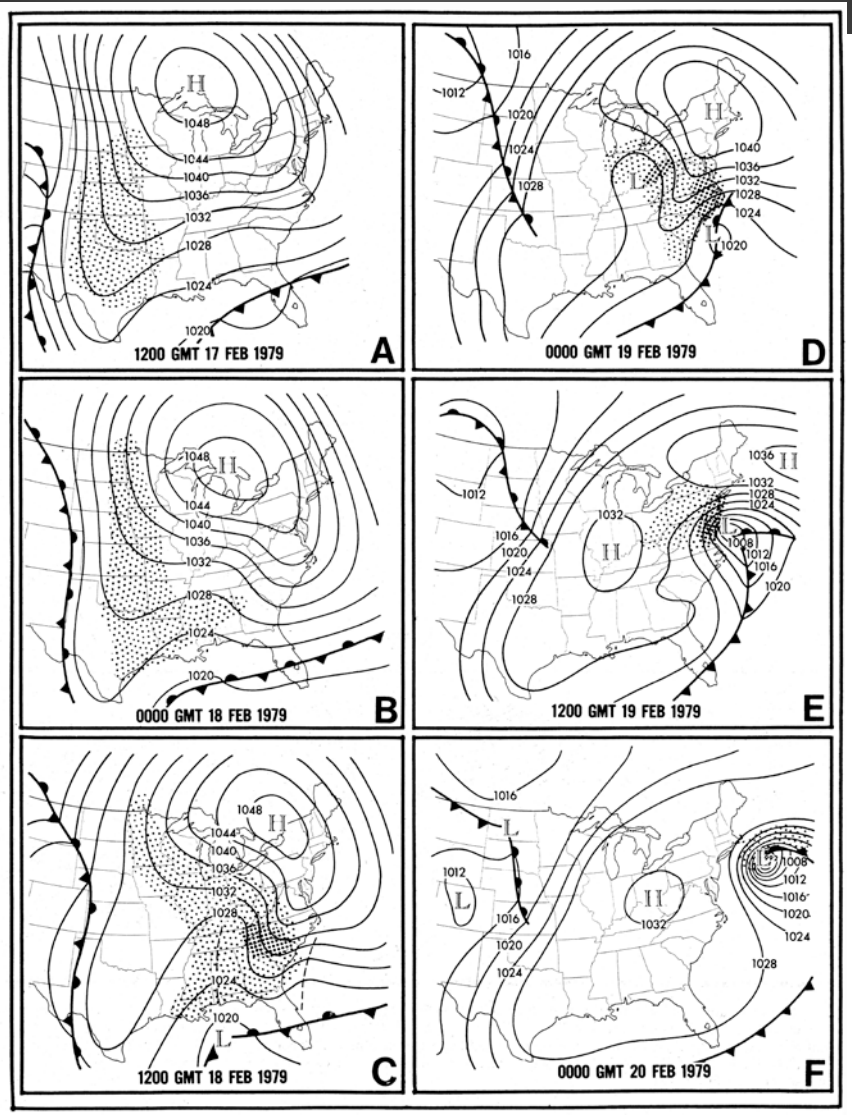
- 1960s-1990s University of Wisconsin, Department of Meteorology: “Weekly Weather Watch”

- I was invited to call in about my experience and observations during the Presidents Day Storm (23 February 1979)

- Phone call arranged by Chuck Wash (who organized the Weekly Weather Watch)

Click to Play Audio

Presidents Day Snowstorm
18-19 February 1979
SFC Maps



Phase 1
18 February 1979
Coastal Front

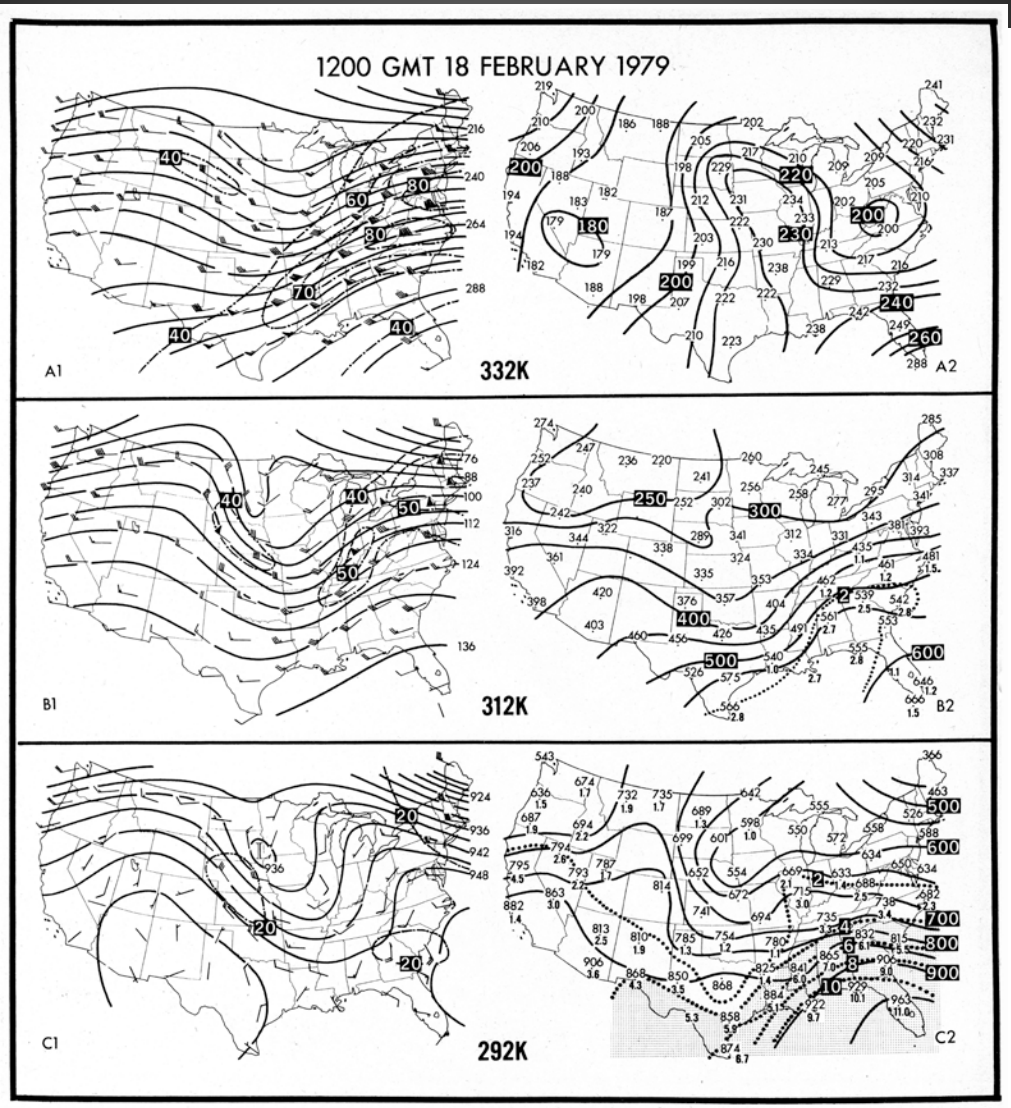
Phase 2
19 February 1979
Rapid Cyclogenesis

From Uccellini, Kocin, Peterson, Wash, Brill, 1984

Upper Air

Phase 1
18 February 1979

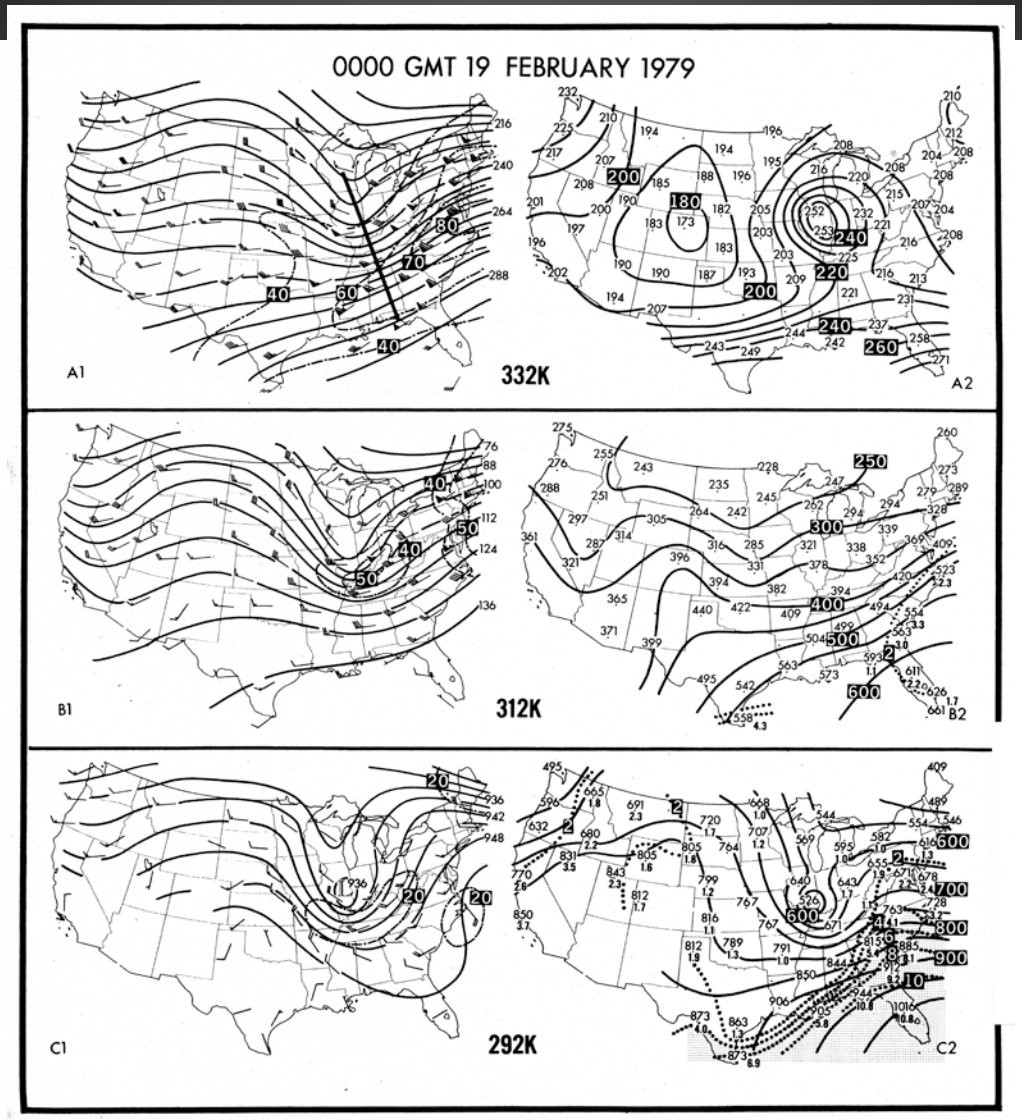
Major upper-level feature: 80 m/s STJ amplifies over East Coast as coastal front/LLJ forms



Upper Air

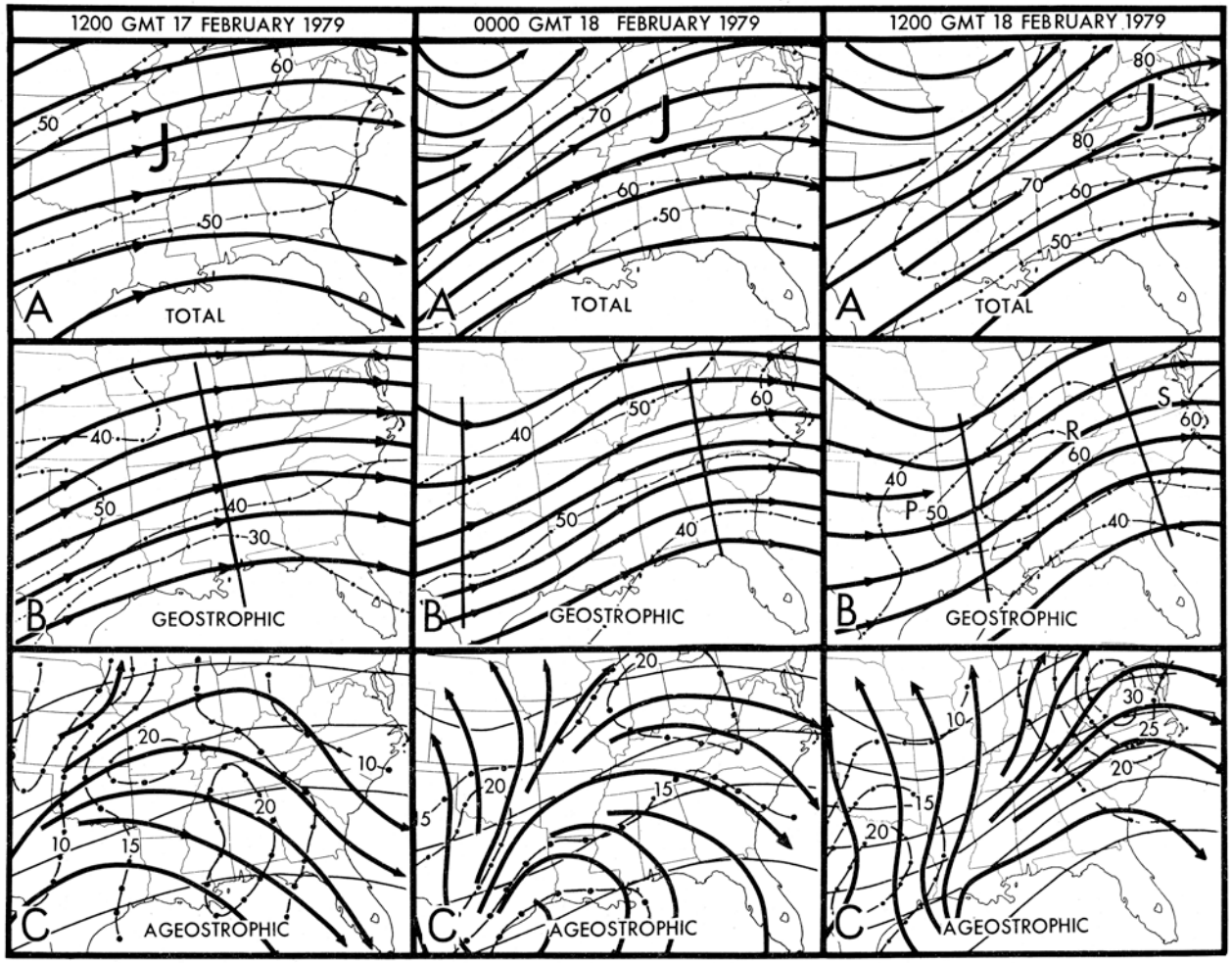
Phase 2
19 February 1979

Major upper-level feature: amplifying trough; PFJ preceding rapid cyclogenesis



Presidents Day Storm
18-19 February 1979 – Phase 1

The STJ—
amplifies to 80 m/s with decreasing wave length between trough-ridge couplet

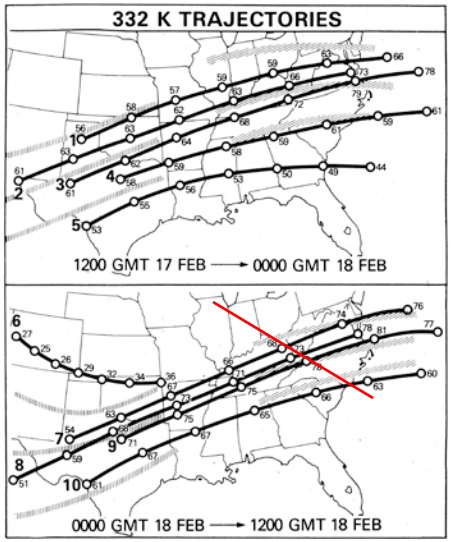


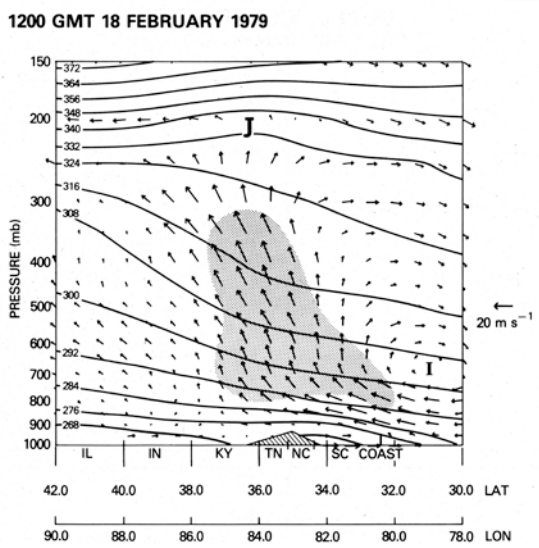
Presidents Day Storm 18-19 February 1979

Precyclogenetic Stage (18 February)

- Inverted trough—coastal front forms along Carolina Coast
- Record-breaking cold in precyclogenetic environment ensured snowfall across wide swath in Mid-Atlantic
- Anticyclonic STJ—coupled LLJ within indirect circulation/above coastal front – Provided divergence aloft/moisture flux for heavy snow

Parcels accelerate through ridge crest along East Coast



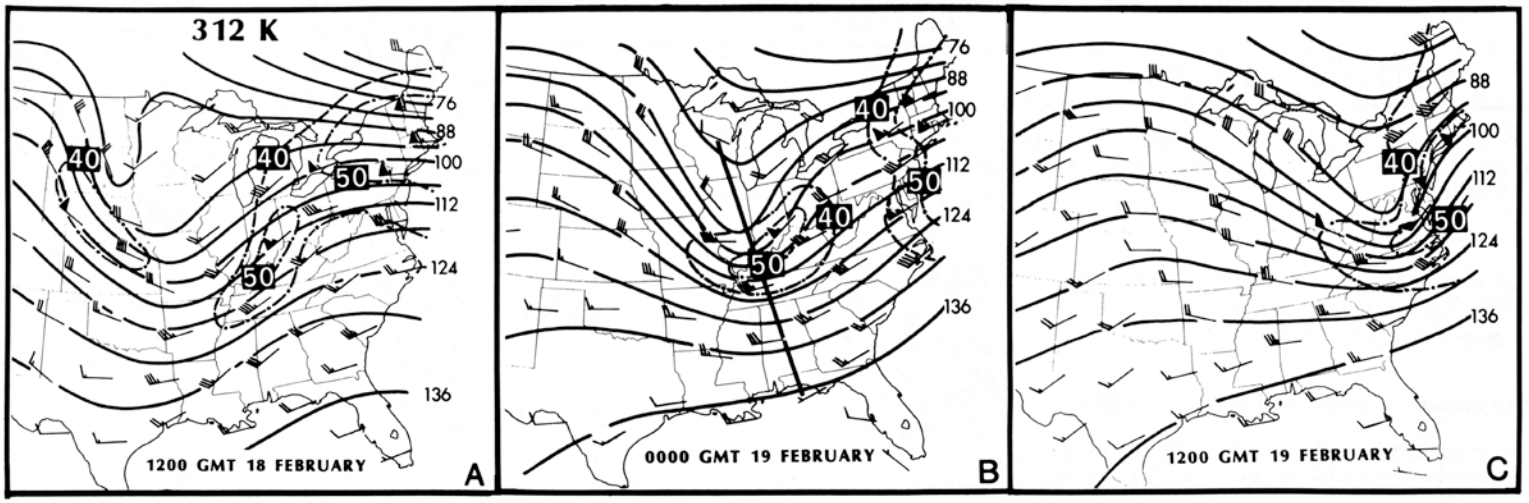


Vertical cross section of potential temperature (contour interval 8 K, solid) at 1200 UTC 18 February 1979 and vector representation of ageostrophic indirect (I) circulation derived from the objective analysis scheme. Cross section derived along rhumb line illustrated in Fig. 2b. shading indicates region where ascent is greater than -6 μb/s. Scale for magnitudes of horizontal component shown on right. J indicates position of core of subtropical jet streak. No inferences should be made from this figure concerning the extent of cross-isentropic flow within the two-dimensional plane of the cross section, given that only the horizontal ageostrophic wind (and not the total wind) is used in this representation of the circulation.

Presidents Day Storm 18-19 February 1979

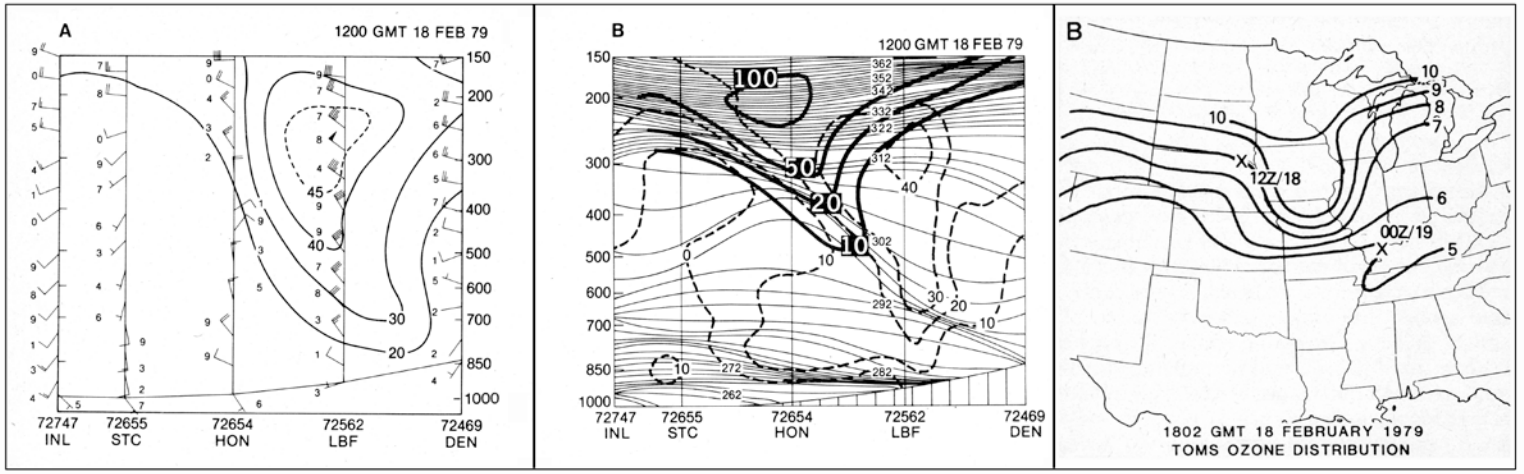
Rapid Development Phase (19 February)

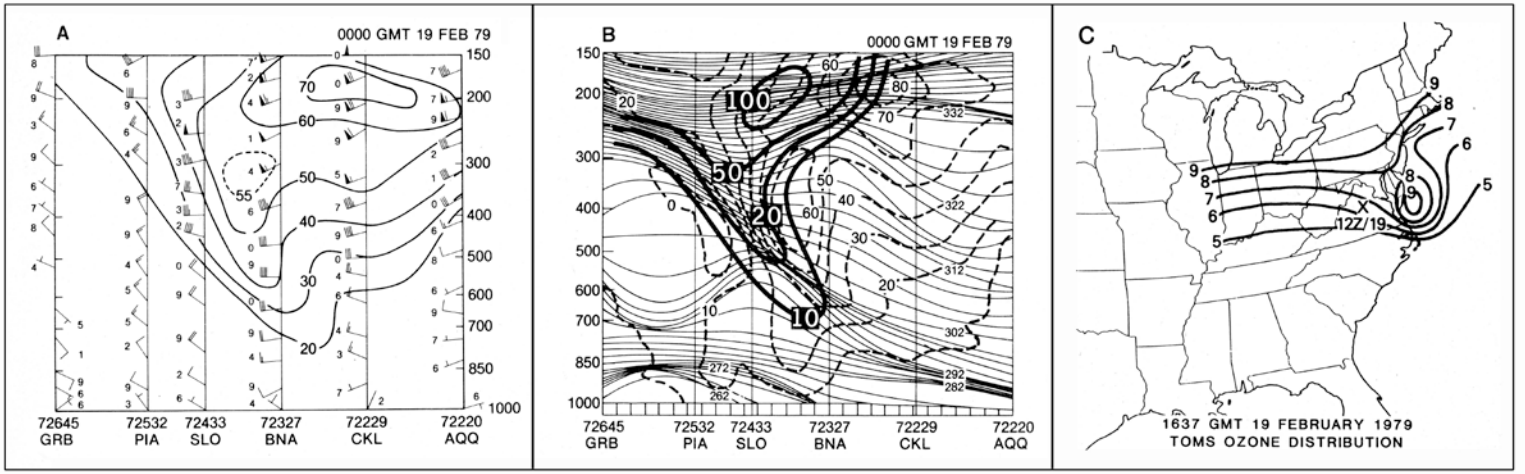
- PFJ/Digging Trough approaches East Coast/coastal front
- Tropopause fold prior to and upstream of rapid cyclogenesis
- Heaviest snow fell in Mid-Atlantic Region, associated with rapid cyclogenesis 4"-5"/hr
- Heavy snow on 19 February occurred AFTER warnings were dropped late on 18 February; rapid cyclogenesis not predicted!



Presidents Day Storm
18-19 February 1979 Phase 2

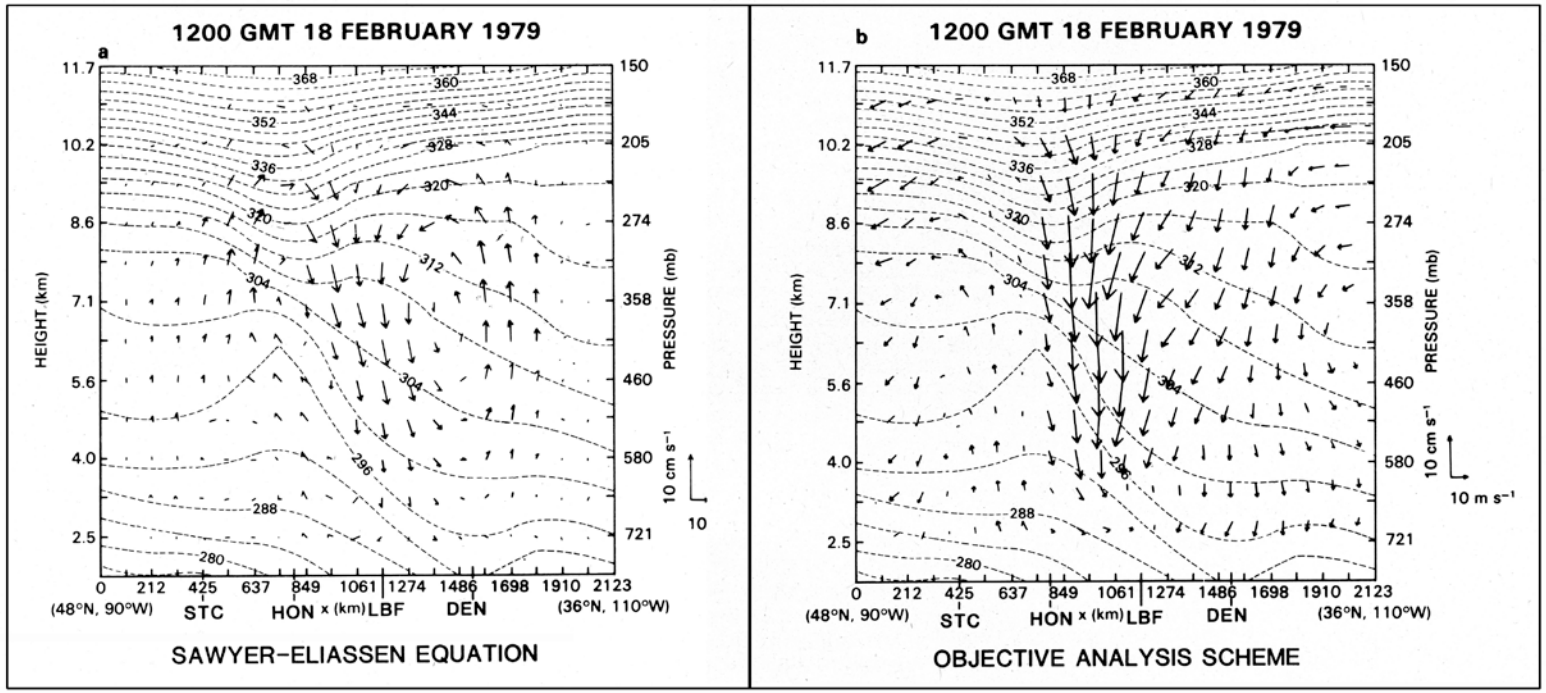
Tropopause fold upstream and preceding rapid cyclogenesis

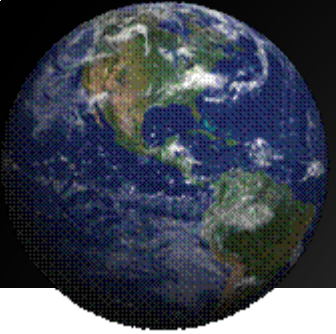




Presidents Day Storm
18-19 February 1979 Phase 2

Application of Sawyer-Eliassen Equation for diagnosing transverse circulation/tropopause fold prior to cyclogenesis





Operation Model Failure

Models failed to predict the rapid cyclogenesis on 19 Feb.

MRF/LFM	PE	LFM
Horizontal Resolution	190.5km	127 km
Vertical Levels	7	7
Essentially no boundary layer	✓	✓

- Primary data Source: RAOB data/SFC data
  - No significant level data; no satellite data

- Research Community Reaction
  - Enough Is Enough!
  - Cyclone Workshop energized

Research Results from the GSFC Team (Uccellini, Kocin, Keyser, Brill, Whittaker, Petersen, Wash)

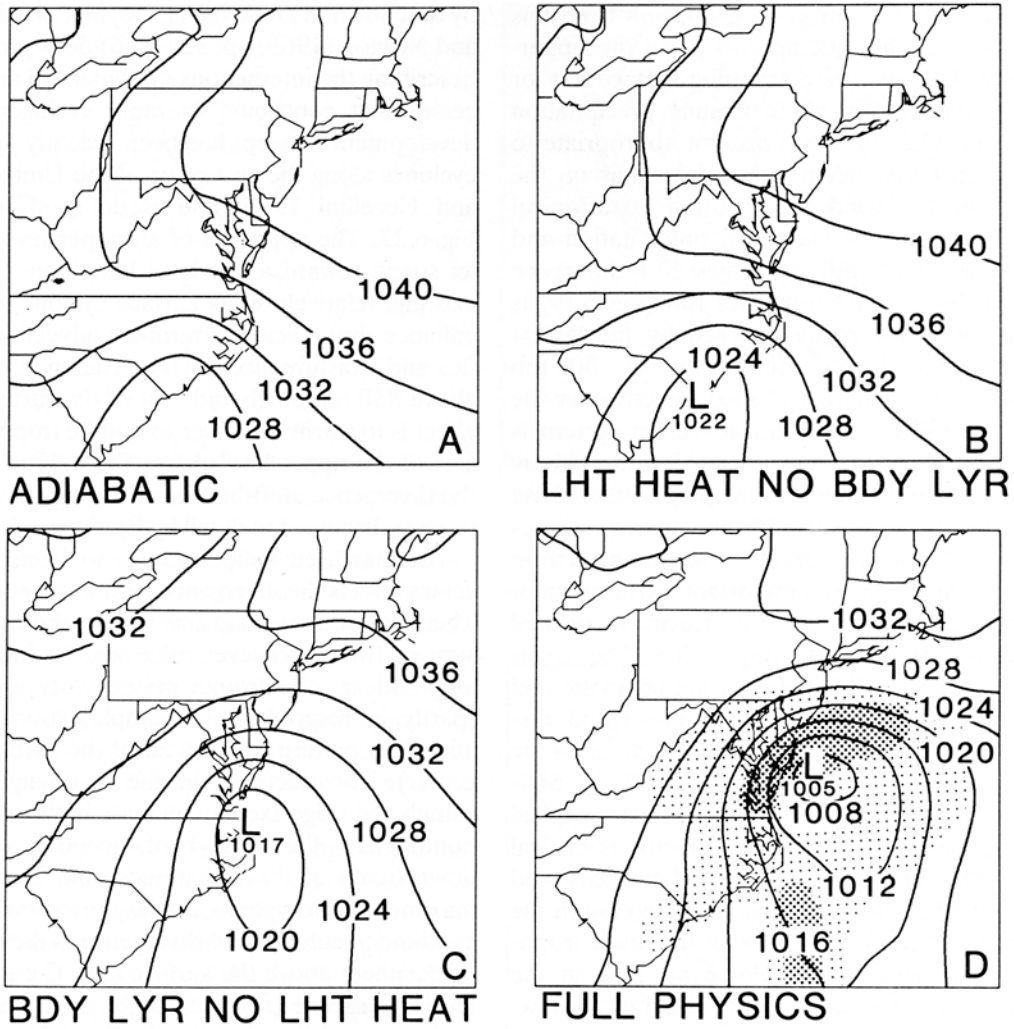
- Unbalanced flow through STJ provided vertical circulation pattern for first phase of heavy snowfall
- LLJ developed rapidly above coastal front/within indirect circulation (related to unbalanced STJ) provided moisture flux for heavy snow
- LLJ development within 6 hr related to vertical parcel displacement within indirect circulation
- Tropopause Fold preceded and contributed to rapid cyclogenesis

---

- Research Model Studies
  - Confirming synergistic interaction among latent, sensible, adiabatic/dynamic is essential
  - Trajectories: complex forcing/yet coherent flow through developing cyclone

Model Sensitivity Studies: Synergistic Interactions (dynamics, LHT, BDY layer) required for rapid cyclogenesis

Process contributing to the rapid development of extratropical cyclones



Low Level Trajectories

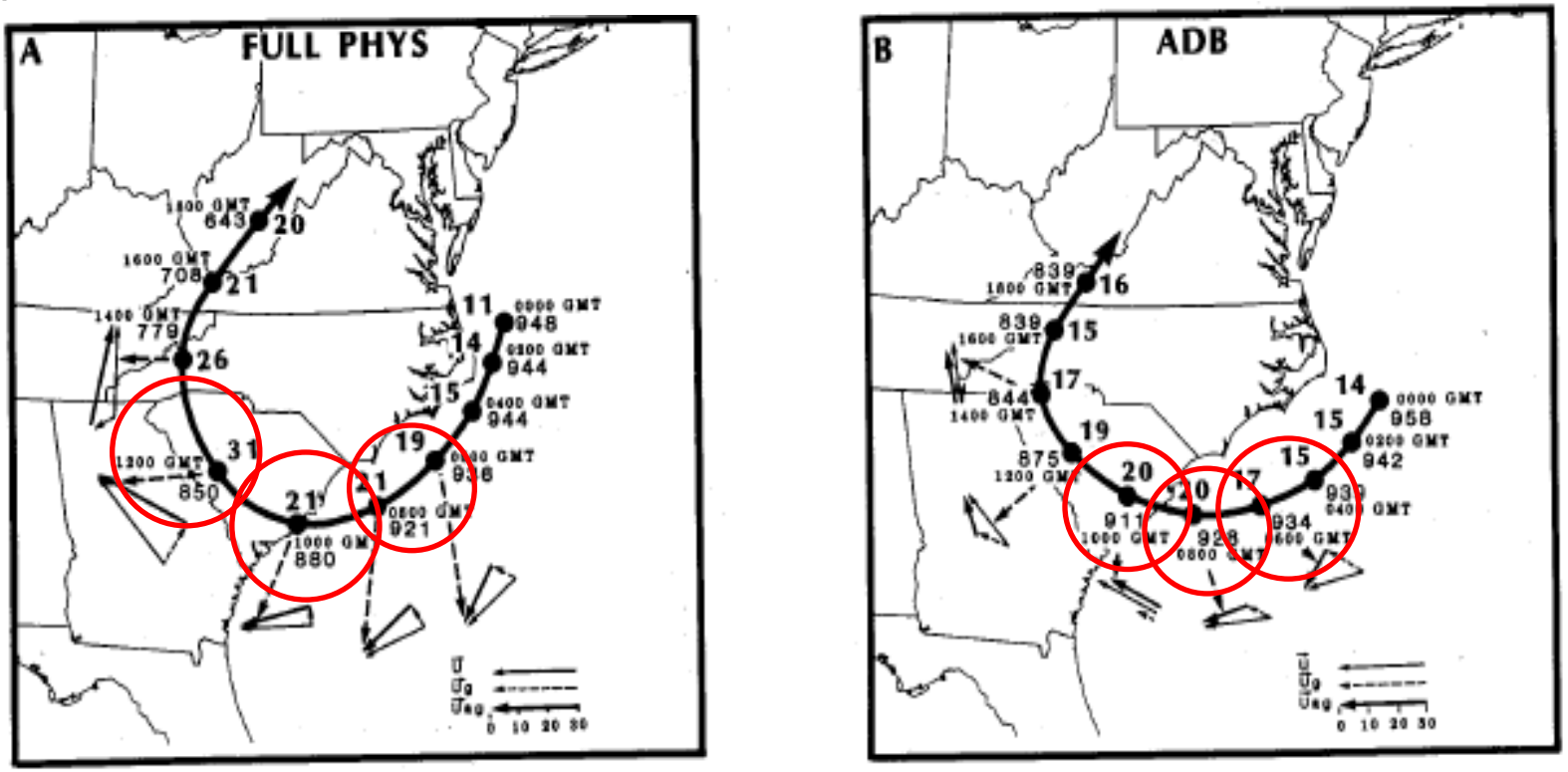


FIG. 19. Low-level trajectory from the (a) full physics simulation (FULL PHYS) and (b) adiabatic simulation (ADB) initialized as described in section 5. Two-hourly positions, total wind speed (m s^{-1}), and pressure (mb) indicated. Vector representation for total wind (U), geostrophic wind (U_g), and ageostrophic wind (U_{ag}) presented at 2 h intervals from 0600 through 1400 UTC. Vectors defined and lengths scaled (m s^{-1}) in bottom right corner.

Uccellini et al., 1987

Low Level Trajectories
Rapid Development of LLJ & Associated Ageostrophic Component

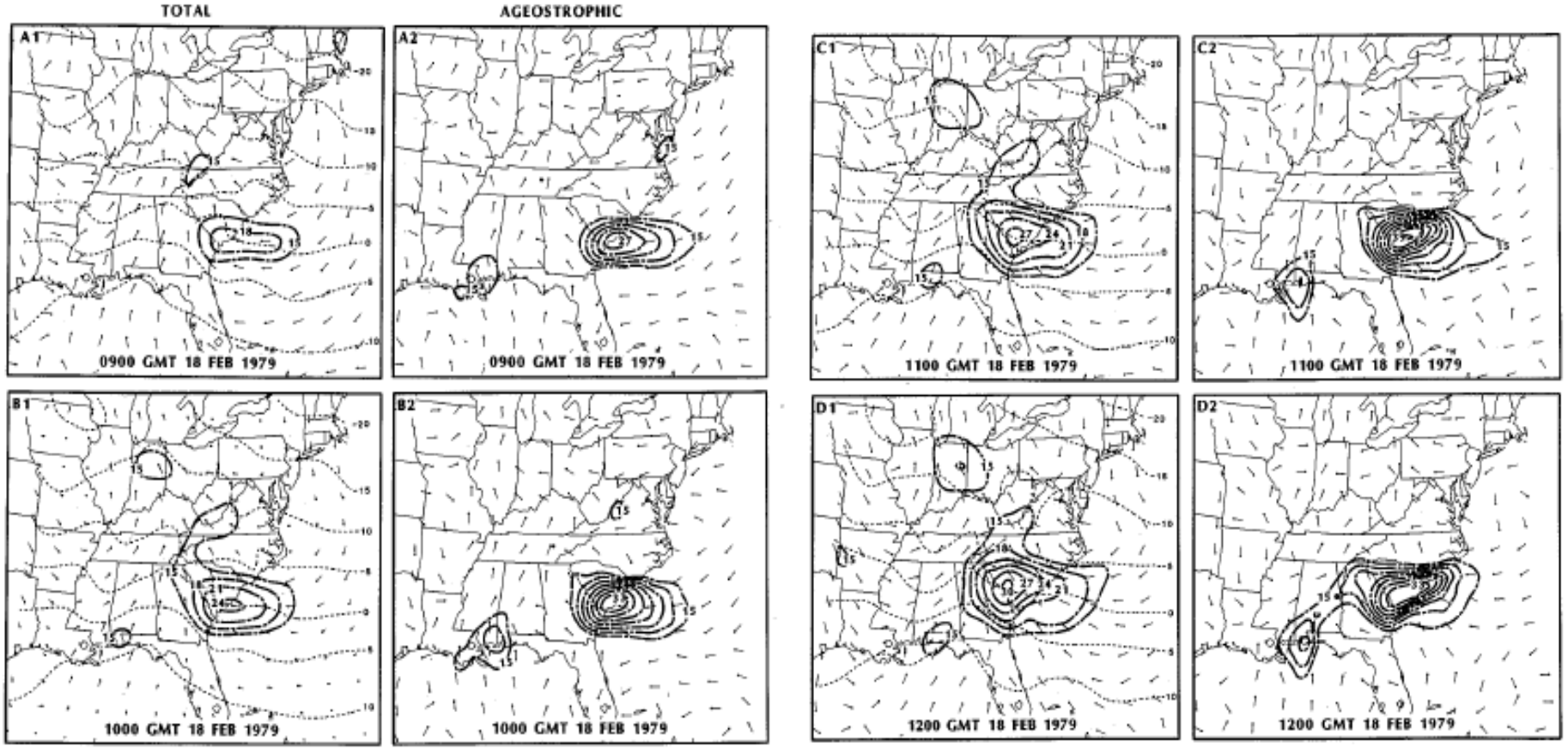


FIG. 18. Hourly sequence of 850 mb wind direction (arrows) and isotachs (dot-dashed, m s^{-1}), total wind (left column; a1, b1, c1, d1) with isotherms included (dashed, °C), and for ageostrophic wind (right column; a2, b2, c2, d2) from the full physics simulation (FULL PHYS).

Total Mass Divergence

LLJ → focused area of low-level mass divergence in area of inverted trough

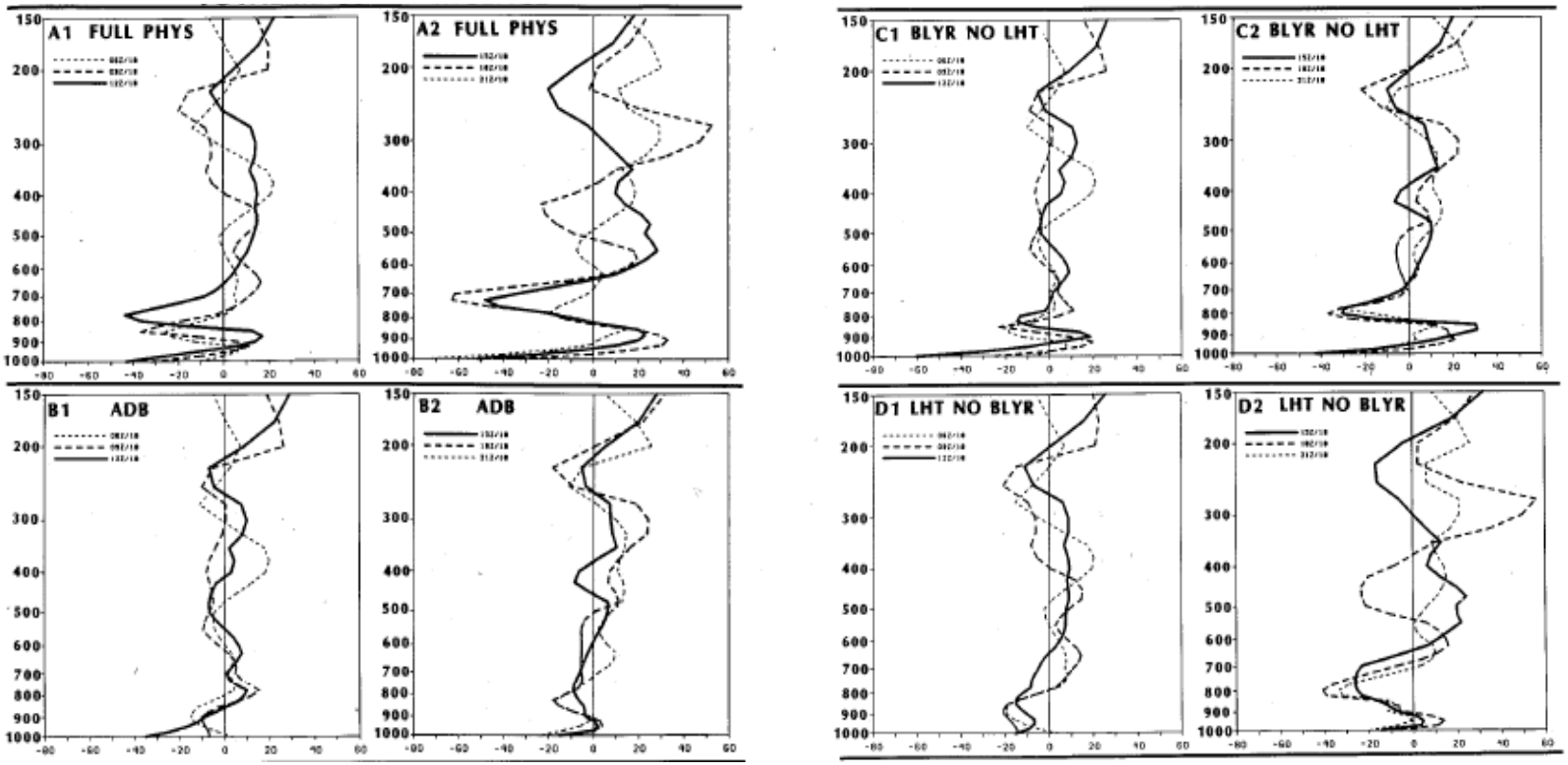
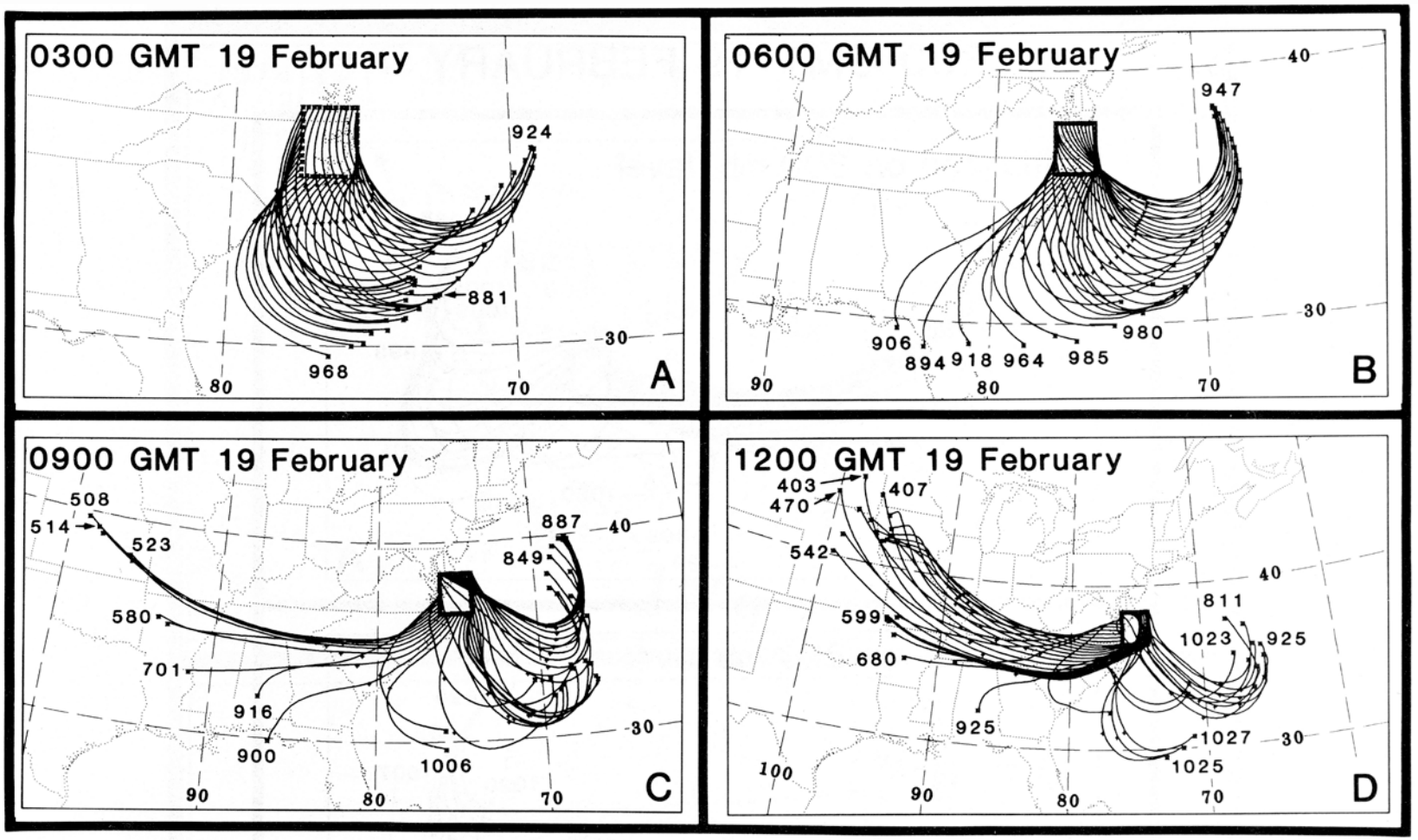


FIG. 20. Vertical profiles of area-averaged mass flux divergence ($10 = 10 \times 10^{-3}$ mb s^{-1}) computed for 0600 (thin dashed), 0900 (thick dashed), and 1200 UTC (solid) in the left column and 1500 (solid), 1800 (thick dashed), and 2100 UTC (thin dashed) in the right column. (a) Profiles from full physics simulation (FULL PHYS); (b) profiles from adiabatic simulation (ADB); (c) profiles from boundary layer simulation with no latent heat (BLYR NO LHT); and (d) profiles from latent heat simulation with no boundary layer (LHT NO BLYR). The profiles are computed for the areas along the Georgia to Middle Atlantic coasts depicted on map inset for times shown in Fig. 21.

Uccellini, et al., 1987

Flow through cyclone, Whittaker et al.



Mass Divergence Profiles

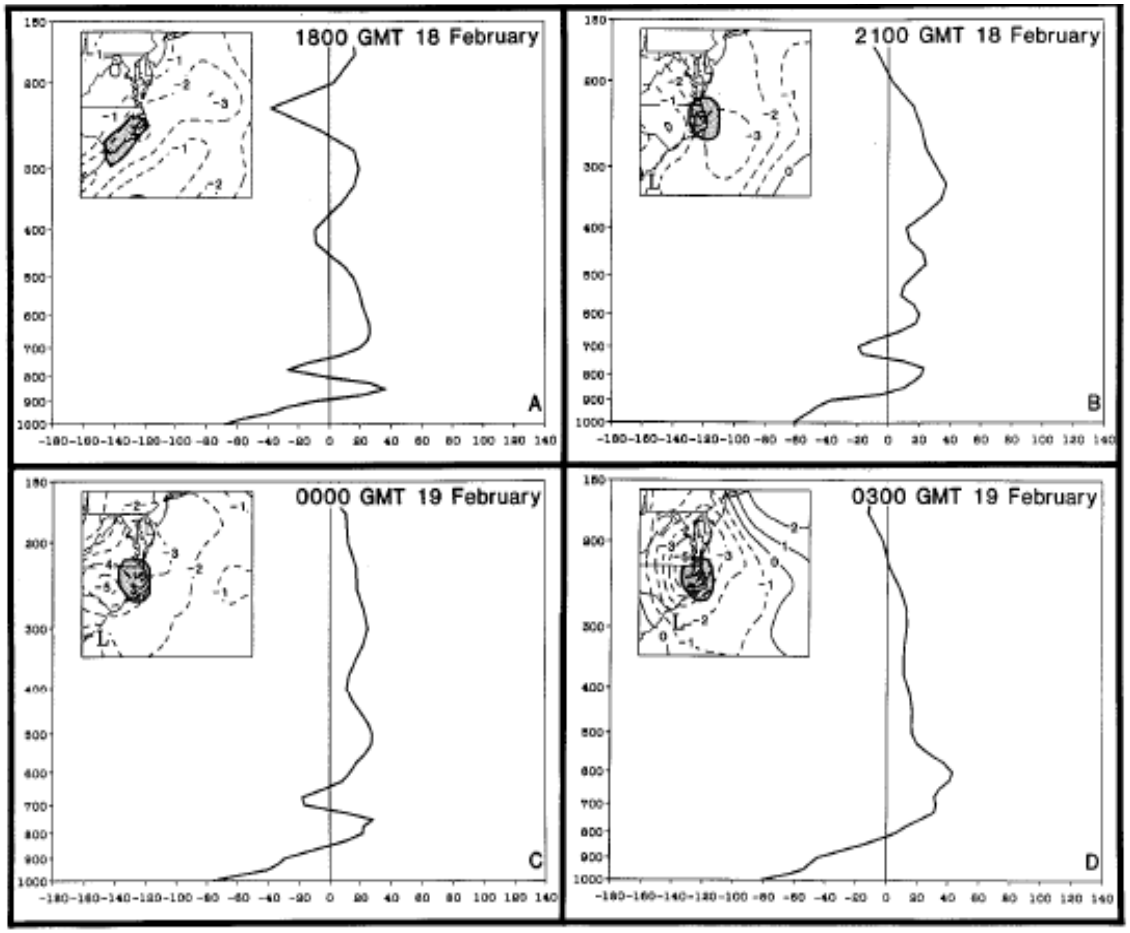
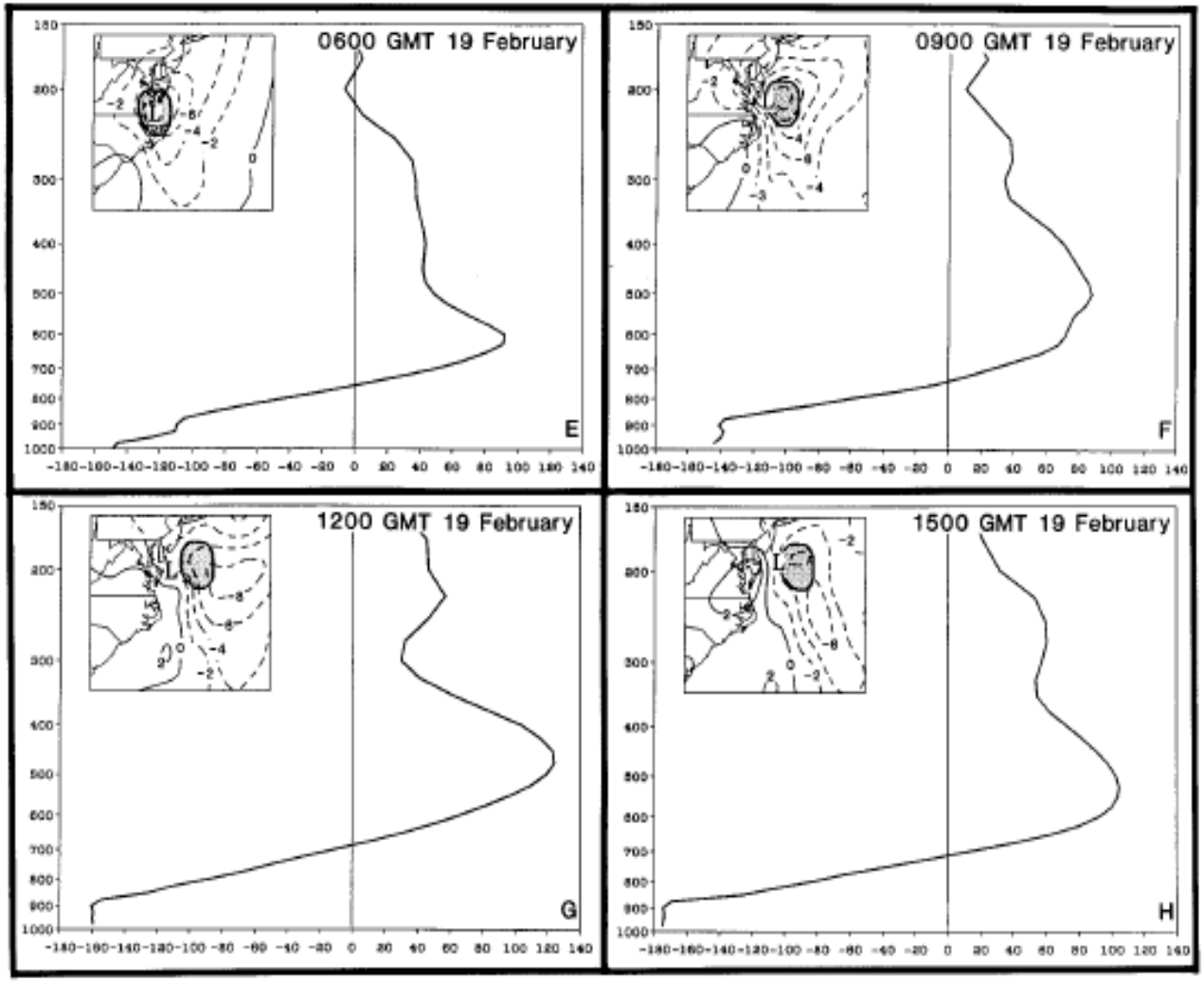


FIG. 7. Area-averaged vertical profiles of mass divergence ($10 = 10 \times 10^{-5}$ mb s^{-1}) computed for (a) 6 h (1800 UTC 18 February), (b) 9 h (2100 UTC 18 February), (c) 12 h (0000 UTC 19 February), (d) 15 h (0300 UTC 19 February), (e) 18 h (0600 UTC 19 February), (f) 21 h (0900 UTC 19 February), (g) 24 h (1200 UTC 19 February), and (h) 27 h (1500 UTC 19 February) before and during the rapid deepening phase. The profiles are computed for shaded regions depicted on map inset for each time. The 3-h pressure changes (mb) and locations of the surface low center are depicted on each map inset.

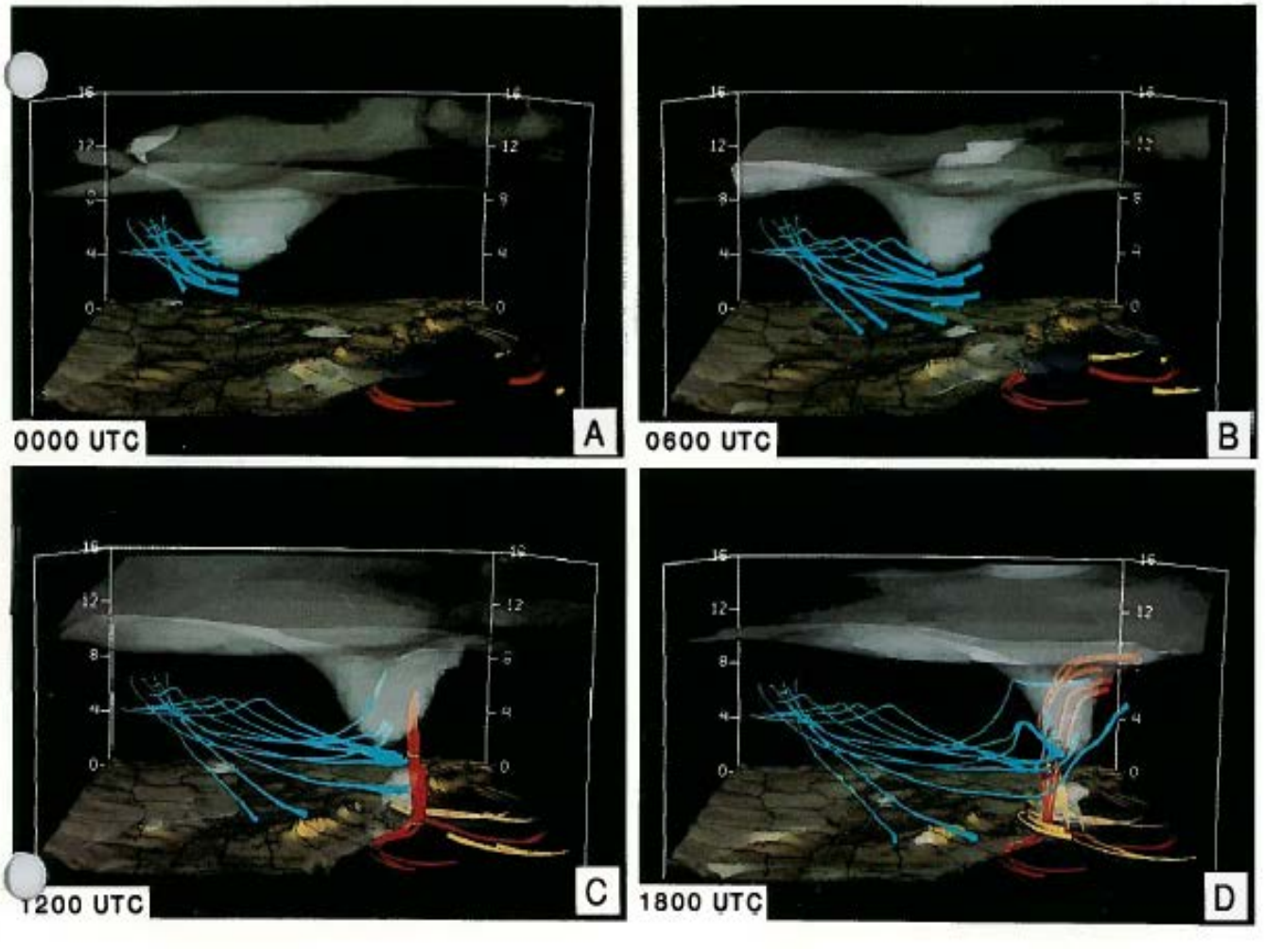
Whittaker, et al., 1988

Mass Divergence Profiles



Whittaker, et al., 1988

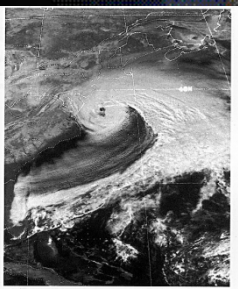
3D Perspective of the Presidents' Day Storm: 18-19 February



Hibbard, et al., 1989

Mesoscale-Tropopause Fold (cont.)

Comparison 1979 and 2003 Storms



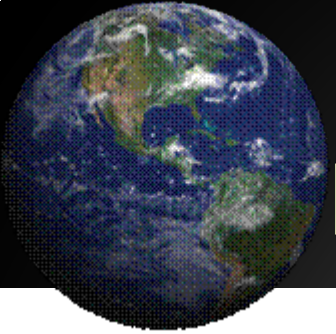
Presidents' Day Storm I
February 18-19, 1979

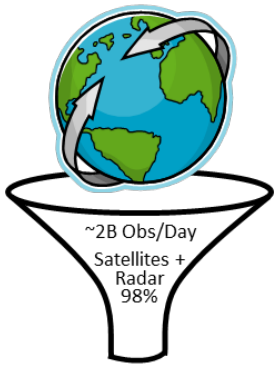
- Heavy snow with rapid cyclogenesis
- Major amplifying trough – moisture feed from Atlantic
- Not forecast even 6 hours in advance; major data feed into models → RAOB – standard levels only, no satellite data
- Major effort by research community; synoptic-mesoscale studies, model enhancements
- "Bosart vs Uccellini" "Low level vs Upper level"
- Years spent collecting, plotting, analyzing data

Presidents' Day Storm II
February 16-17, 2003

- Heavy snow preceded cyclogenesis
- Near constant trough amplitude - moisture feed directly from the tropics
- Forecast 5,4,3 days in advance – AMS conference attendees change plans to get back home in time for this event
- Very little research; neither case studies nor model enhancements
- "Data" related to this analysis/model put together in weeks (Grumm)

Where We Are Now: NOAA's Model Production Suite





Global Data Assimilation

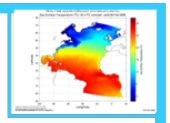
Global Forecast System

Climate Forecast System
GFS MOM4
NOAH Sea Ice

Hurricane
GFDL
HWRF

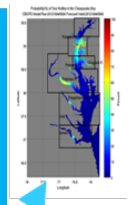
Coupled

Oceans
HYCOM
WaveWatch III



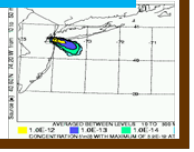
NOS – OFS
- Great Lakes
- Northern Gulf of Mex
- Columbia R.

Bays
- Chesapeake
- Tampa
- Delaware
- San Francisco

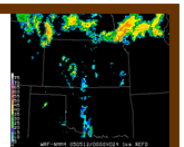


Regional DA | **Regional NAM**
WRF NMMB

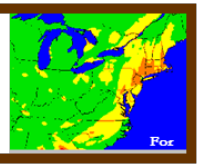
Dispersion
ARL/HYSPLIT



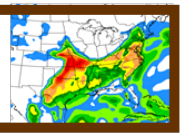
Severe Weather
WRF NMM/ARW
Workstation WRF



Air Quality
NAM/CMAQ



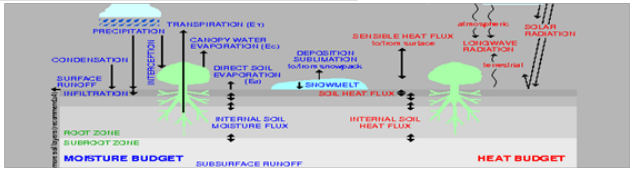
Rapid Refresh for Aviation



Space Weather
ENLIL

North American Ensemble Forecast System
GFS, Canadian Global Model

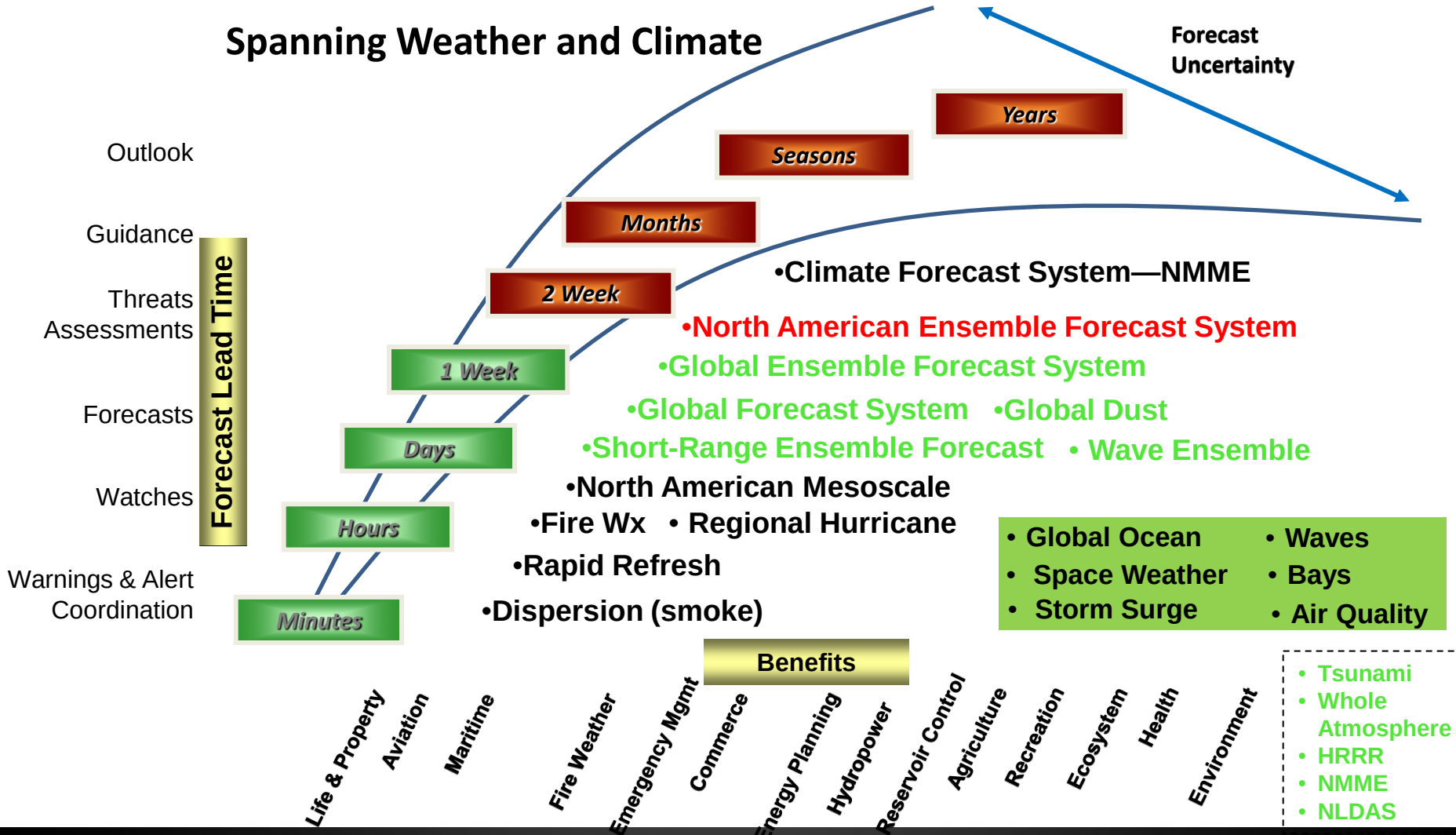
Regional DA | **Short-Range Ensemble Forecast**
WRF: ARW, NMM
NMMB



NOAH Land Surface Model

1

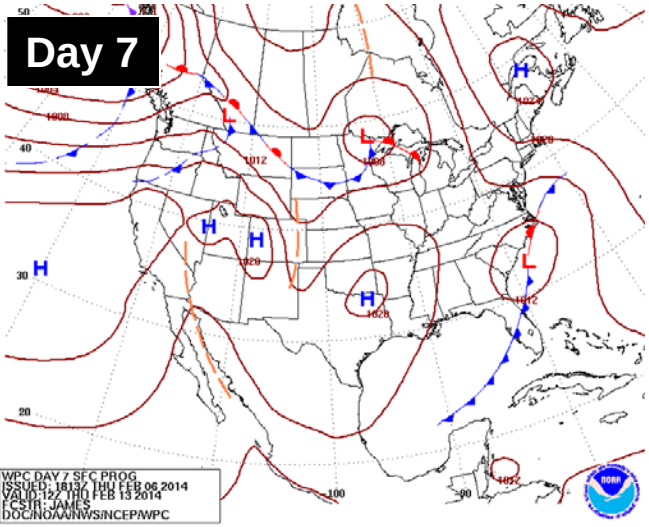
Forecasts Increasingly Based on Multi-Model Ensembles



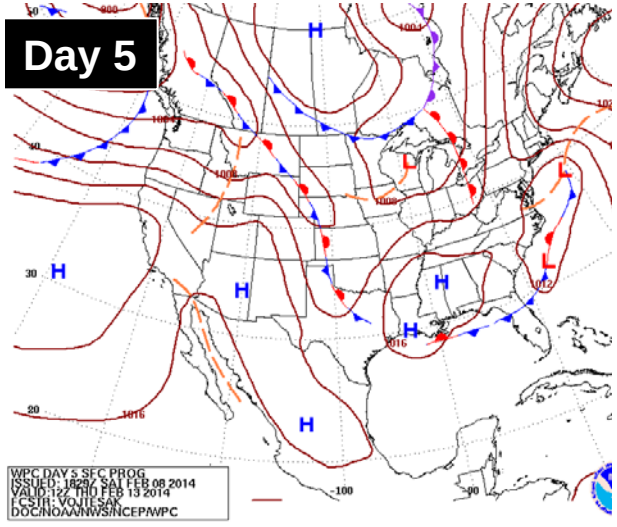
WPC Forecasts for 13 Feb 2014

Issued Feb 6th – 12th

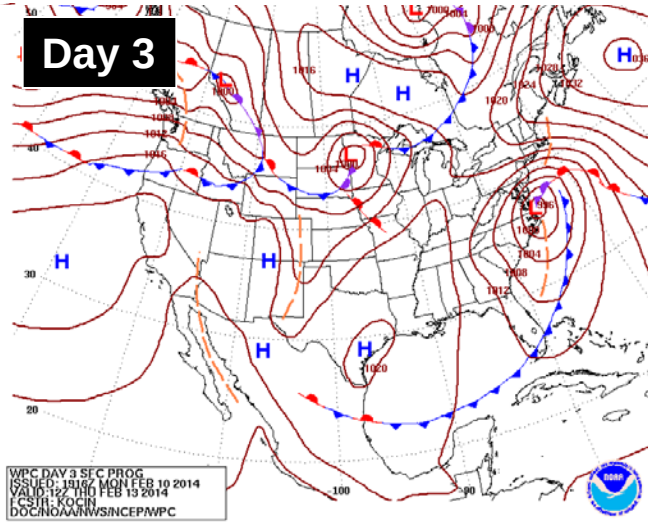
Day 7



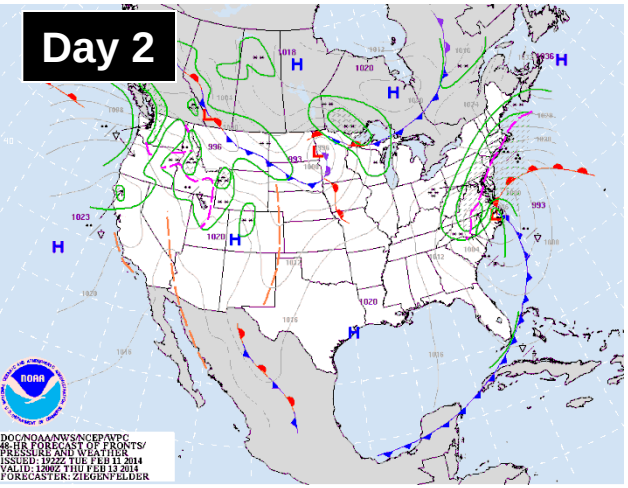
Day 5



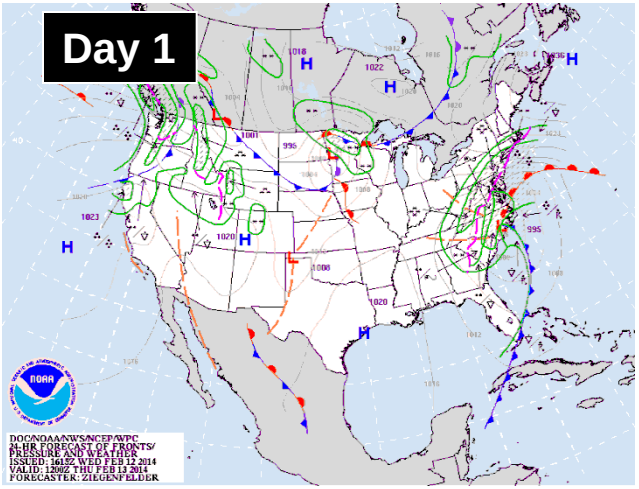
Day 3



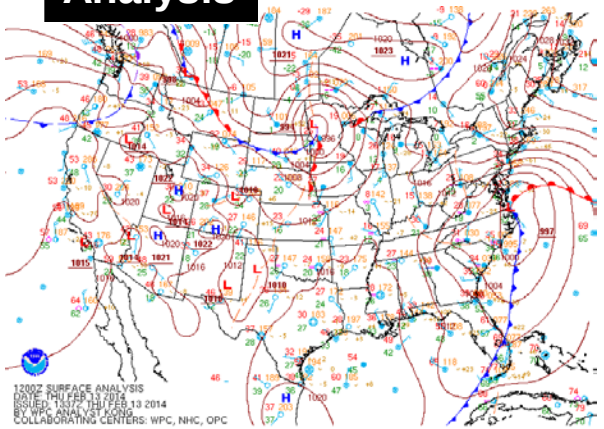
Day 2



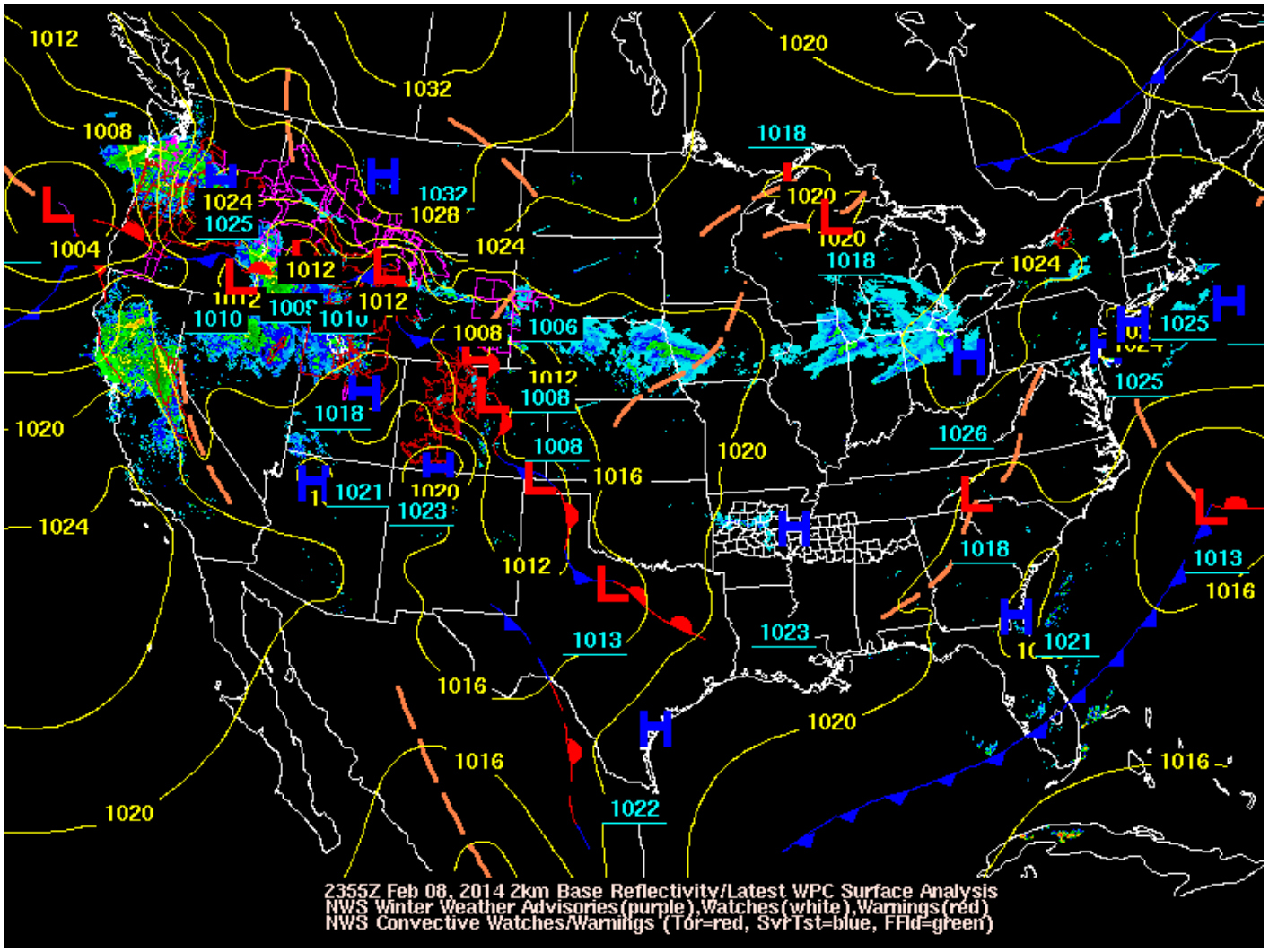
Day 1



Analysis



NWS Watches/Warnings and Radar

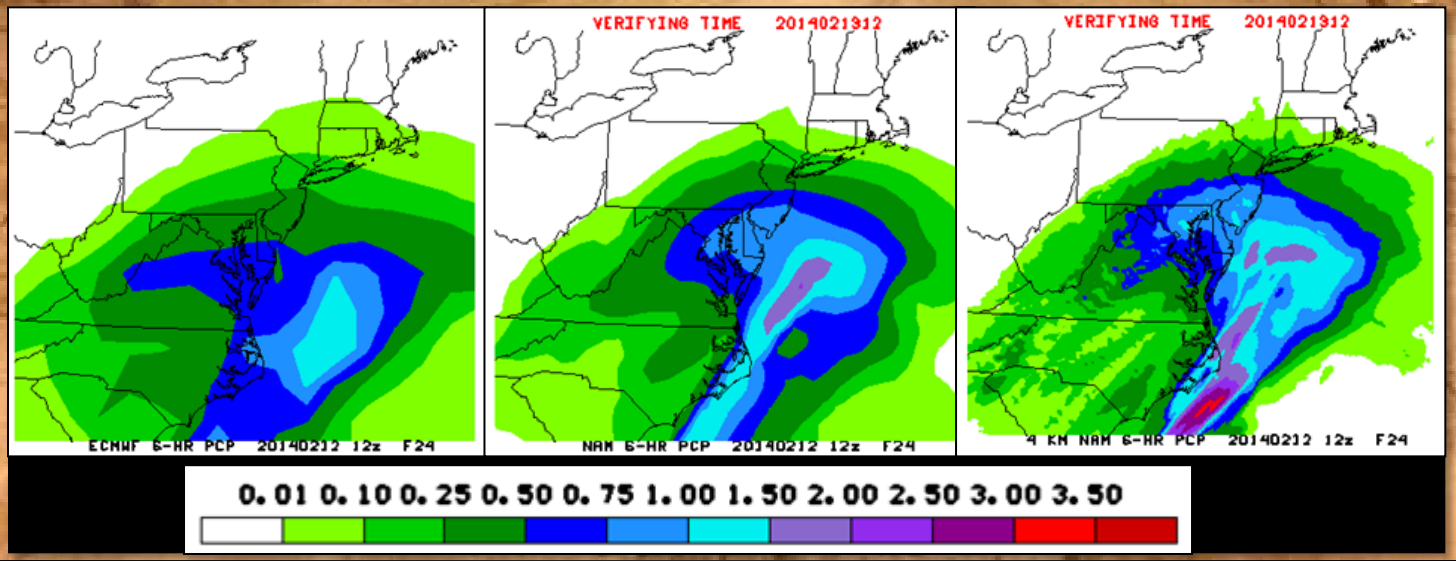


13 Feb 2014 DC Snowstorm

Overnight snowfall rates of 2-3 inches per hour

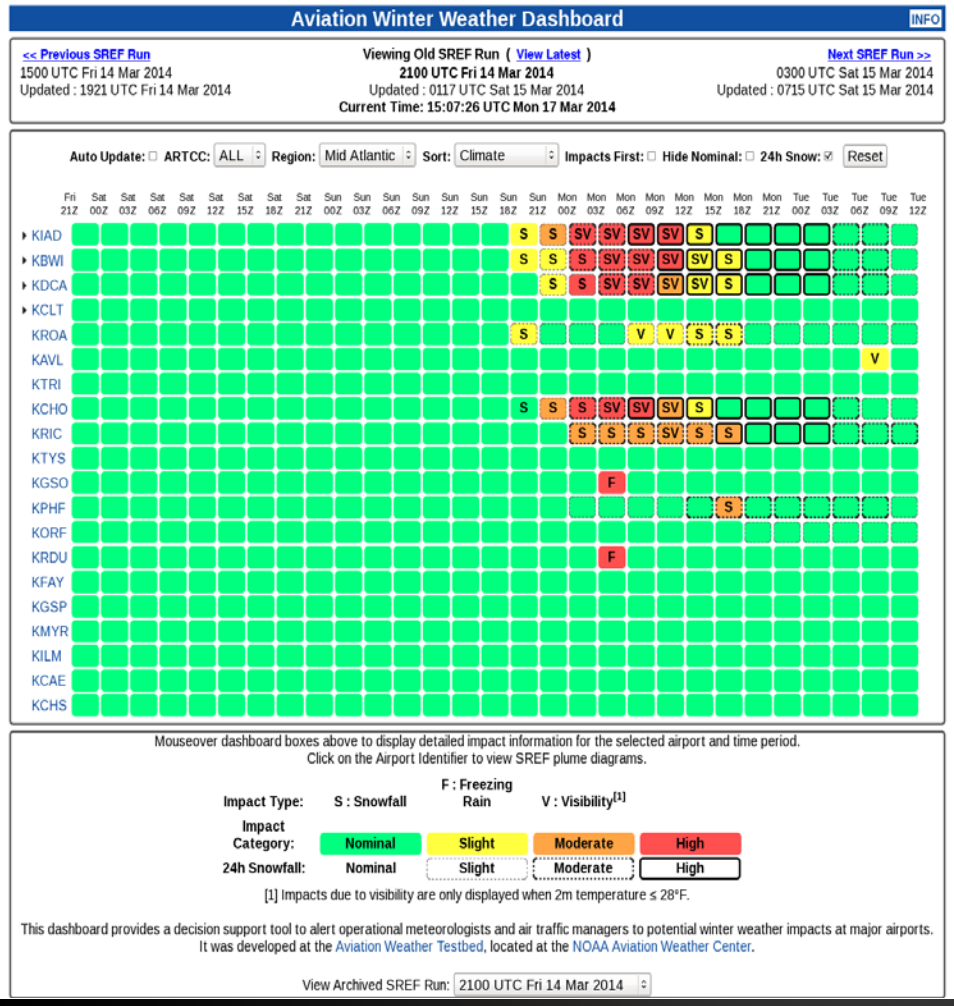
1-7 am liquid-equivalent totals

DCA	ECMWF	NAM	NAMnest
0.93”	0.40”	0.75”	0.80”



Communicating Impact (Aviation)

3 Days Before

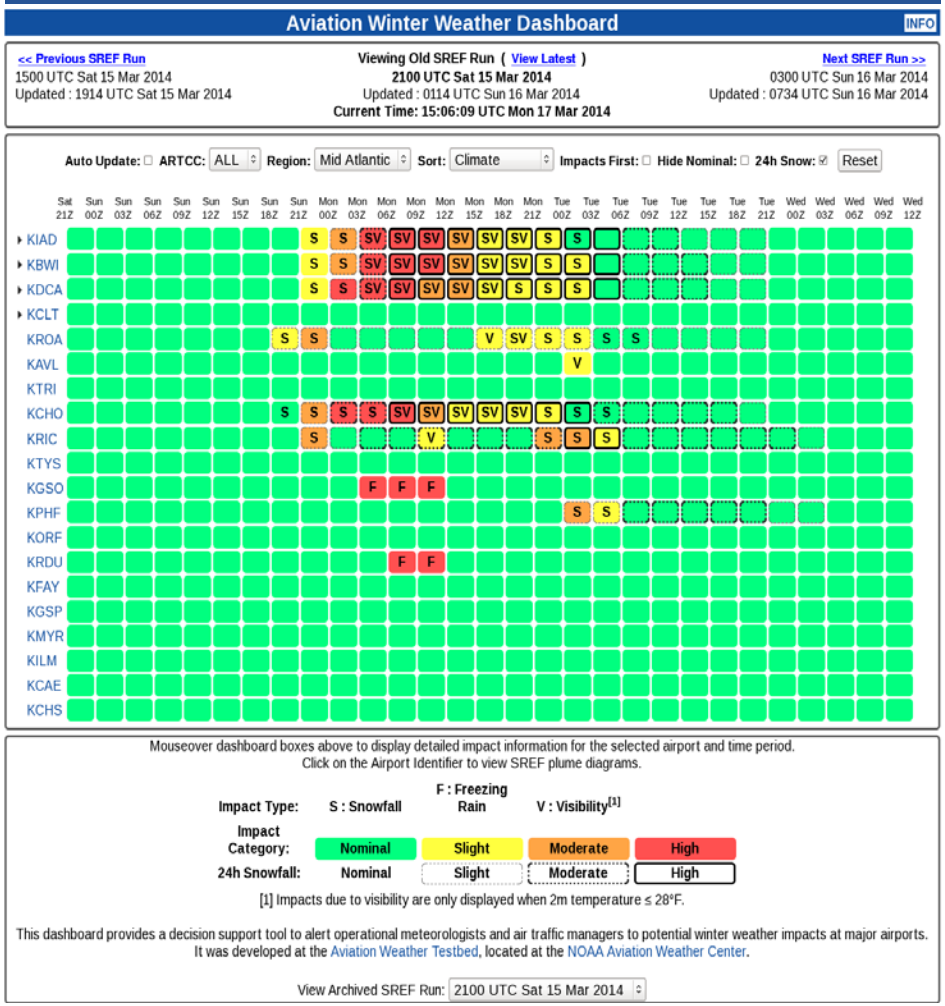


Criteria for DCA

Event	Slight Prob >40%	Modt Prob >40%	High Prob > 40%
3-h Snow	> 0.2”	> 0.75”	> 1.5”
24-h Snow	> 1”	> 2”	>6”
3-h Fz Rain		> 0.01”	> 0.05”
Visibility	< 3 mi	< 1 mi	< ½ mi

Communicating Impact (Aviation)

2 Days Before

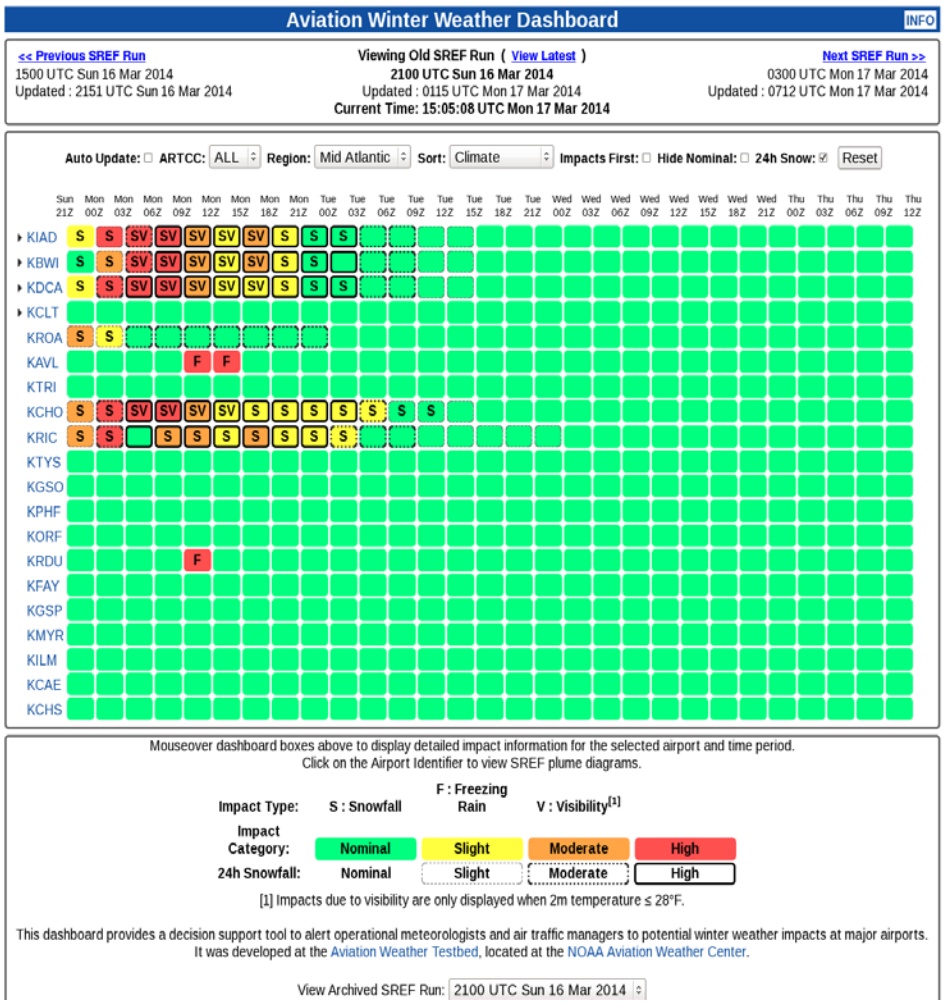


Criteria for DCA

Event	Slight Prob >40%	Modt Prob >40%	High Prob > 40%
3-h Snow	> 0.2”	> 0.75”	> 1.5”
24-h Snow	> 1”	> 2”	>6”
3-h Fz Rain		> 0.01”	> 0.05”
Visibility	< 3 mi	< 1 mi	< ½ mi

Communicating Impact (Aviation)

1 Day Before



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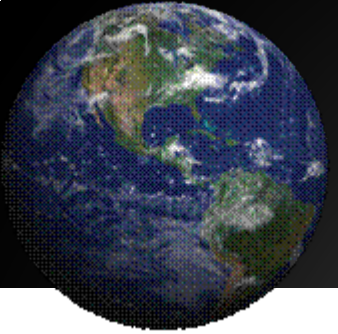
1/3 of flights canceled at DCA



Summary

- Presidents Day Cyclone represented a turning point for the research and operational communities

- Research:
  - Focus on a case study/use of model data to conduct synoptic diagnostic studies
  - Launched the Cyclone Workshop, bringing the top people/experts together annually
  - The drive to improve the operational models raised interest in R2O
  - Visualization opens the eyes
  - Cyclogenesis/snowstorms are fundamentally a mesoscale problem marked by synoptic scale lore

- Operations:
  - Operational models clearly became a focus of the research community
  - Increased interest in running real-time mesoscale/limited-area models at research institutions
  - Today's research and operational model suites owe their existence to the reaction to the Presidents Day Storm

Things to Toss: Presidents' Day

wp OPINIONS

Trending Topics Calif. shooting rampage Ukraine Colo. mudslide Herb Jeffries 'Mad Men' finale

Outlook's Sixth Annual Spring Cleaning

With spring weather finally here to stay, Outlook asked 10 writers to nominate something — an idea, a tradition, a technology, a hashtag, anything — we're better off without. Here are their picks.

Presidents' Day

By Ramesh Ponnuru

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Presidents' Day is more than a little bizarre. Why would a country founded on the rejection of monarchy devote a day to the celebration of the office of the presidency and those who have occupied it?

The president was never meant to run the country. There's a reason he doesn't get pride of place in the Constitution: Article II deals with the presidency, right after Article I establishes Congress. Of course, we have expanded presidential authority pretty far since the founding. As Gene Healy, author of "The Cult of the Presidency," writes: "The modern president is America's shrink, a social worker, our very own national talk show host. He's also the Supreme Warlord of the Earth." Discarding Presidents' Day would not undo that deplorable trend, but at least we'd no longer be cheerleaders for it.

Getting rid of Presidents' Day would not be difficult. All we would have to do is start calling the third Monday of February by its proper name under federal law: George Washington's Birthday.* The father of our country is worth a holiday, not least because he adopted the title "Mr. President" rather than "Your Majesty" or some other exalted term. Presidents' Day undercuts that republican modesty.

And making the shift would have one other advantage: eliminating a perennial punctuation problem. Where does that apostrophe go?

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