Reflecting on the Presidents Day Storm
18-19 February 1979

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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)
Phase 1
18 February 1979
Coastal Front

Phase 2
19 February 1979
Rapid Cyclogenesis

From Uccellini, Kocin, Peterson, Wash, Brill, 1984
Phase 1
18 February 1979

Major upper-level feature: 80 m/s STJ amplifies over East Coast as coastal front/LLJ forms
Phase 2
19 February 1979

Major upper-level feature: amplifying trough; PFJ preceding rapid cyclogenesis
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.
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
Application of Sawyer-Eliassen Equation for diagnosing transverse circulation/tropopause fold prior to cyclogenesis
Models failed to predict the rapid cyclogenesis on 19 Feb.

- **MRF/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 (Uₚ), and ageostrophic wind (Uₐ) 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 \rightarrow \text{focused area of low-level mass divergence in area of inverted trough}

Fig. 20. Vertical profiles of area-averaged mass flux divergence ($10 = 10 \times 10^{-3} \text{ mb s}^{-1}$) 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

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

<table>
<thead>
<tr>
<th>Presidents’ Day Storm I</th>
<th>Presidents’ Day Storm II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>February 18-19, 1979</strong></td>
<td><strong>February 16-17, 2003</strong></td>
</tr>
<tr>
<td>Heavy snow with rapid cyclogenesis</td>
<td>Heavy snow preceded cyclogenesis</td>
</tr>
<tr>
<td>Major amplifying trough – moisture feed from Atlantic</td>
<td>Near constant trough amplitude - moisture feed directly from the tropics</td>
</tr>
<tr>
<td>Not forecast even 6 hours in advance; major data feed into models → RAOB – standard levels only, no satellite data</td>
<td>Forecast 5,4,3 days in advance – AMS conference attendees change plans to get back home in time for this event</td>
</tr>
<tr>
<td>Major effort by research community; synoptic-mesoscale studies, model enhancements</td>
<td>Very little research; neither case studies nor model enhancements</td>
</tr>
<tr>
<td>“Bosart vs Uccellini” “Low level vs Upper level”</td>
<td>“Data” related to this analysis/model put together in weeks (Grumm)</td>
</tr>
<tr>
<td>Years spent collecting, plotting, analyzing data</td>
<td></td>
</tr>
</tbody>
</table>
Where We Are Now: NOAA’s Model Production Suite

Climate Forecast System
- GFS
- MOM4
- NOAH
- Sea Ice

Global Forecast System
- ~28 Obs/Day Satellites + Radar 98%

Global Data Assimilation

North American Ensemble Forecast System
- GFS, Canadian Global Model

Space Weather
- ENLIL

Hurricane
- GFDL
- HWRF

Oceans
- HYCOM
- WaveWatch III

Coupled

Regional DA

Regional NAM
- WRF NMMB

Short-Range Ensemble Forecast
- WRF: ARW, NMM, NMMB

Regional DA

Dispersion
- ARL/HYSPLIT

Severe Weather
- WRF NMM/ARW Workstation WRF

Air Quality
- NAM/CMAQ

Rapid Refresh for Aviation

NOS – OFS
- Great Lakes
- Northern Gulf of Mex
- Columbia R. Bays
- Chesapeake
- Tampa
- Delaware
- San Francisco

NOAA Land Surface Model
Forecasts Increasingly Based on Multi-Model Ensembles

Spanning Weather and Climate

- Outlook
- Guidance
- Threats
- Assessments
- Forecasts
- Watches
- Warnings & Alert Coordination

Forecast Lead Time

- Minutes
- Hours
- Days
- 1 Week
- 2 Week
- Months
- Seasons
- Years

Forecast Uncertainty

Benefits

- • North American Ensemble Forecast System
- • Climate Forecast System—NMME
- • Global Ensemble Forecast System
- • Global Forecast System
- • Global Dust
- • Short-Range Ensemble Forecast
- • Wave Ensemble
- • North American Mesoscale
- • Fire Wx
- • Regional Hurricane
- • Rapid Refresh
- • Dispersion (smoke)
- • Global Ocean
- • Space Weather
- • Storm Surge
- • Waves
- • Bays
- • Air Quality
- • Tsunami
- • Whole Atmosphere
- • HRRR
- • NMME
- • NLDAS

Life & Property
Aviation
Maritime
Fire Weather
Emergency Mgmt
Commerce
Energy Planning
Hydropower
Reservoir Control
Agriculture
Recreation
Ecosystem
Health
Environment
WPC Forecasts for 13 Feb 2014
Issued Feb 6th – 12th
### 13 Feb 2014 DC Snowstorm

**Overnight snowfall rates of 2-3 inches per hour**

1-7 am liquid-equivalent totals

<table>
<thead>
<tr>
<th></th>
<th>DCA</th>
<th>ECMWF</th>
<th>NAM</th>
<th>NAMnest</th>
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<tr>
<td></td>
<td>0.93”</td>
<td>0.40”</td>
<td>0.75”</td>
<td>0.80”</td>
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![Weather Maps](image-url)
Communicating Impact (Aviation)

3 Days Before

Aviation Winter Weather Dashboard

Criteria for DCA

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<th>Modt Prob &gt;40%</th>
<th>High Prob &gt; 40%</th>
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<tr>
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<td>&gt; 0.2”</td>
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<td>&gt; 1.5”</td>
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<tr>
<td>24-h Snow</td>
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<td>&gt; 6”</td>
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<tr>
<td>3-h Fz Rain</td>
<td></td>
<td>&gt; 0.01”</td>
<td>&gt; 0.05”</td>
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<tr>
<td>Visibility</td>
<td>&lt; 3 mi</td>
<td>&lt; 1 mi</td>
<td>&lt; ½ mi</td>
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This dashboard provides a decision support tool to alert operational meteorologists and air traffic managers to potential winter weather impacts at major airports. It was developed at the Aviation Weather Testbed, located at the NOAA Aviation Weather Center.
Communicating Impact (Aviation)

2 Days Before

Aviation Winter Weather Dashboard

Criteria for DCA

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This dashboard provides a decision support tool to alert operational meteorologists and air traffic managers to potential winter weather impacts at major airports. It was developed at the Aviation Weather Testbed, located at the NOAA Aviation Weather Center.
1 Day Before

Aviation Winter Weather Dashboard

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

Criteria for DCA

1/3 of flights canceled at DCA
• 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
Outlook’s Sixth Annual Spring Cleaning

TEN THINGS TO Toss

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

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 Supremes 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?
References


