The Role of the Science and Operations Officer (SOO)

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Summary

NWS Science/Operations Teacher
Leader for...

Integrating cutting-edge science/technology into local/regional/national operations:

To enhance NWS’s ability to accomplish its vital mission --

***Life/property protection and enhancing economy***
Summary

How?

A. Publishing as many papers as possible and demanding that everyone follow your way of doing things

A. Developing professional relationships that encourage an embrace for learning, respect, and growth

A. Developing one’s own deep expertise through research, science development, and teaching, and cultivating / leveraging the whole office’s expertises

A. Both B and C
Summary

Leader for...

Integrating cutting-edge science/technology into local/regional/national operations:
To enhance NWS’s ability to accomplish its vital mission --
***Life/property protection and enhancing economy***

⇒ Cultivating/leveraging individual/team expertise &
encouraging POSITIVE/HEALTHY operational culture and professional relationships

⇒ Developing and presenting research with entities internal and external to NWS
  (e.g., universities, research labs, social sciences)

⇒ Working collaboratively with management team and staff to understand partner
  needs and how we can best tailor our products to meeting their needs
Local Operations Focus: Servant Leadership

Serving in whatever role I can to help the team

(Picking up shifts, helping El Techs with the putting the office sign up, jumping in to answer questions, bringing in donuts during stressful times, ...)
Local Operations Focus
Finding The Teaching Moments
Leading Local Training

Weather Event Simulator (WES)

Displaced Real-Time Training / DRILLS -- Train Like We Fight
Some Polygon Goals (Weather-Ready Nation)

Don’t over-do polygon overlap
Leading Local Operations Practice

Warning Strategies

Some Polygon Goals (Weather-Ready Nation)

Considerations

Solution 2

Higher frequency of warnings — mitigated by longer durations

Risk for warnings to linger past severe risk — mitigated by more frequent SVS cancellations

Upgrade to higher-end warning/emergency: CAPTURE STORM

Time to analyze!

Method: Track polygon at longest duration possible, finalize then change time to a shorter time to ensure polygon endpoint is pulled behind trajectory endpoint.

Should be bringing endpoint back anyway, since default buffers beyond trajectory endpoint forcing overlap if we’re trying to get any downstream lead time:

Storm will NEVER leave the default polygon in its duration, forcing multiple warnings for sustained severe risk.

12:59 PM

Storm actually sped up more than anticipated!

Cancel first warning long before 12:59PM!
Leading **Local** Operations Service Enhancements:

MESOANALYSIS -- Science to bridge the watch-warning gap:

Enhance Impact-Based Decision Support Services (IDSS)!!!

Opportunity to provide vital, high-resolution information to partners/customers between outlook/watch and warning scales to support decision making!
Leading Local Operations Service Enhancements:

MESOANALYSIS -- Science to bridge the watch-warning gap: Enhance Impact-Based Decision Support Services (IDSS)!!!

How do we make this work?

A. Demanding cultural change, expecting everyone to adapt to my way
B. Encouraging buy-in to new ideas by respecting a diverse variety of viewpoints, including others, and moving forward with give-and-take / compromise
C. Leveraging expertise across the WHOLE OFFICE as a team, and lead by example (demonstrate actions/procedures I’d like others to consider following)
D. Both B and C
Severe Thunderstorm Outlook
Valid 1:00 pm – 4:00 pm TODAY (July 19, 2018); Issued at 1630Z

Severe storm potential????
Very uncertain

Orange Shading
Greatest severe-storm potential with damaging winds, if storms can be sustained through the day

Yellow Shading
Some severe-storm potential, if storms can be sustained through the day

MESOANALYSIS -- Science to bridge the watch-warning gap: Enhance IDSS!!!
Severe Thunderstorm Outlook
Valid 1:00 pm – 4:00 pm TODAY (July 19, 2018); Issued at 1745Z

What
Damaging winds to 60-80 MPH likely, potentially widespread

Where
Most-likely potential in orange shaded area

Action
Move to a sturdy structure before storms arrive

MESOANALYSIS -- Science to bridge the watch-warning gap: Enhance IDSS!!!
Local-scale, tactical threat assessment and messaging to enhance IDSS --

Leverages cutting-edge science tools, conceptual models, observational data, NWP datasets -- MESOANALYSIS

Heterogeneities in threats, various levels of certainty, impact, timing, etc.
To Accomplish This:
Need Strong R2O <-> O2R Leadership!!!!!
Leading Local-Office Research-To-Operations (R2O)
Also Leverages Operations-To-Research (O2R)
Include WHOLE OFFICE STAFF for Science/Technology Integration!

Applying Research to Operations: Mesoscale Patterns Supporting EF3-EF5 Tornadoes across Eastern Kansas and Vicinity

- A need to improve tornado forecasting
- Collect data & conduct statistical analysis
- Formulate a conceptual model
- Construct a formal publication
- Apply the results in real-time
- Enhance forecast services for protection of life & property
Leading Local-Office Research-To-Operations (R2O) Also Leverages Operations-To-Research (O2R)

Include WHOLE OFFICE STAFF for Science/Technology Integration!
Leading Local-Office Research-To-Operations (R2O)
Also Leverages Operations-To-Research (O2R)

Include WHOLE OFFICE STAFF for Science/Technology Integration!

Inspire scientific growth and cultivate an atmosphere where meteorologists develop expertise & build confidence
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**Include WHOLE OFFICE STAFF!**
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**Include WHOLE OFFICE STAFF!**

**High-Resolution Ensemble Forecast (HREF) system**

Newly installed severe weather datasets in CAVE: HREF output and NSEEA Digital Cursor Readout

High Resolution Ensemble Forecast (HREF) System
You can access HREF fields in CAVE by opening the Volume Browser, pulling down the Local menu under Sources, and then clicking on HREF-US.

Then, pulling down the Add-Ons menu under Fields, click on HREF. From there, you can access numerous subclasses of HREF fields, from which you can look at various ensemble output: means, probability-matched means, exceedance probabilities, etc. But in particular, if you click on 1-storms, and then click on Storm Scale, you’ll be able to see storm attribute ensemble fields. Below is a demo for how to pull that up:

Remember that if you go to SPC’s HREF viewer page, you can see a list of analogous information there: [http://www.spc.noaa.gov/exper/href](http://www.spc.noaa.gov/exper/href)
Leading **Local**-Office Research-To-Operations (R2O)
Also Leverages Operations-To-Research (O2R)

**Include WHOLE OFFICE STAFF!**

**Collaborative Event Reviews**

**Reference Guides**
Leading Local-Office Research-To-Operations (R2O)
Also Leverages Operations-To-Research (O2R)

Include WHOLE OFFICE STAFF!

SSCRAM

SSCRAM determines the relative frequency of historical severe weather events occurring within two hours into the future, given environmental parameters.

SSCRAM maps the mesoscale environment to individual-severe-hazard potential (probabilities), based on actual past environments/lightning and associated reports and/or lack of reports occurring into the future.

SSCRAM contextualizes environmental parameter space:
What is the conditional probability of a tornado when there is MLCAPE of 2000 J kg$^{-1}$ combined with effective shear of 45 kt and effective SRH of 200 m$^2$ s$^{-2}$ also when there is lightning?

Eventually, the plan is for the overlay site to take precedence over the main SSCRAM site.
Leading Local-Office Research-To-Operations (R2O)
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Include WHOLE OFFICE STAFF!

*Recall, the hodograph is a curve that connects all wind velocities in the vertical profile at a point. Plotted on the polar coordinate system.

Everything we need to know conceptually (sign) about each term in the $p'$ equation comes right from the hodograph.

SSE 15 kt
SE 15 kt

Resultant shear vector connects the two layer-binding levels, lying tangent to the hodograph!

*So, the bulk shear vector simply connects levels on the hodograph!

⇒ As layer becomes infinitesimal, BOTTOM-TOP is merely is a hodograph tangent!

*So, the hodograph sketches out – is parallel to – the vertical shear profile $\frac{\partial u_h}{\partial z}$, and horizontal vorticity $\omega_h = \hat{k} \times \frac{\partial u_h}{\partial z}$ which is perpendicular and to the left of the hodograph sketch!
Discussion:

How do we best go about encouraging a culture of proactive messaging and warning, for complex/high-impact, low-confidence/isolated flash-flood events (reasonable worst-case scenario / 10-percent exceedance)?
Corfidi Vectors: Convective motion explained by ADVECTION & PROPAGATION (from LLJ and cold-pool dynamics)

LLJ flow forces preferential convective development where inflow is most moist/unstable (southern part of cold pool, as convective processing precludes convective development on north side)

Driving, forward-propagating, progressive, downshear-propagating, downwind-propagating (include cold-pool scooping)!

LLJ

Cloud-layer mean wind

FASTER

Trailing/training; backward-propagating, back-building, upshear propagating, upwind-propagating (slower moving and more sensitive to LLJ; no cold-pool inertia)

Cloud-layer mean wind

SLOWER

With backed low-level flow, we get enhanced warm advection over trailing isentrope gradient.

When we see a convective cluster start to follow these vectors, we know that the convection is becoming cold-pool-influenced as the cold pool’s vertical circulation becomes established.
As described by C. F. Chappell and cited by Doswell et al. (1996): "the heaviest precipitation occurs where the rainfall rate is the highest for the longest time."

Rainfall Rate: large PW, low LCL, deep warm cloud (collision-coalescence), some convective instability (narrow MUCAPE profile), enhanced lowest-100-mb mean mixing ratio
ALL Soundings for TOP

03 Sep 12 UTC

Daily Min (Thin Line): 0.42
Min Moving Average: 0.48
10% Moving Average: 0.71
25% Moving Average: 0.88
Median Moving Average: 1.14
Daily Mean (Thin Line): 1.21

75% Moving Average: 1.42
90% Moving Average: 1.60
Max Moving Average: 1.98
Daily Max (Thin Line): 1.96

Period of Record
TOP (1955/09/30-2014/10/26; 42185 soundings)
Think of this as a little MCS!

Forward propagating: Fastest

Backbuilding/trailing: Slowest

Dissipated -- weaker cold-pool circulation

Backbuilding section experiences very little motion. Continuously reinforced zone of isentropic ascent of warm/moist inflow from the south. Also, major loss of cold-pool expansion component since cold pool is weak (low DCAPE).
Repository of Reference Documents:  
SOO Site
Developing Local Office Partnerships: NWS-Academia

Collage courtesy of Bryan Baerg and Audra Hennecke (WFO Topeka)
Developing Local Office Partnerships: NWS-Academia

Bridging Operational Meteorology and Academia through Experiential Education
The Storm Prediction Center in the University of Oklahoma Classroom


RESEARCH TO OPERATIONS AND THE NATIONAL WEATHER CENTER. The challenge of infusing research findings and theoretical principles into operational practice is no simple feat. The phrase “valley of death” (NRC 2001) has been linked to the repeated failure of meteorological research to become instilled within the practitioner’s toolbox. It has been used to describe the gap between the academic and research communities in meteorology, and refers to cases where applied research fails to become implemented operationally (e.g., Hossain et al. 2014; Wolff et al. 2016). Alternatively, effective communication between research and operational communities is critical for creating scientifically relevant work, by which mutual missions are satisfied through collaboration. Strong relationships between research and operations entities can be considered a “bridge” to accomplish successful research-to-operations (R2O) initiatives, lessening the likelihood of research results falling into the valley of death.

As an integral member of the weather enterprise, academia not only lays the foundation for learning within the university classroom, but also plays a
Outreach / Enhancing Partnerships: **Science Sharing**

**Media Interview:**

Severe Weather Awareness

Thomas Worthington High School
Convection during the North American Monsoon across Central and Southern Arizona: Applications to Operational Meteorology

JARET W. ROGERS AND ARIEL E. COHEN
NOAA/NWS/NCEP/Storm Prediction Center, Norman, Oklahoma

LEE B. CARLAW
National Weather Service Forecast Office, Tucson, Arizona

(Manuscript received 5 August 2015, in final form 15 July 2016)

ABSTRACT

This comprehensive analysis of convective environments associated with thunderstorms affecting portions of central and southern Arizona during the North American monsoon focuses on both observed soundings and mesoscale parameters relative to lightning flash counts and severe-thunderstorm reports. Analysis of observed sounding data from Phoenix and Tucson, Arizona, highlights several moisture and instability parameters exhibiting moderate correlations with 24-h, domain-total lightning and severe thunderstorm counts, with accompanying plots of the precipitable water, surface-based lifted index, and 0–3-km layer mixing ratio highlighting the relationship to the domain-total lightning count. Statistical techniques, including stepwise, multiple linear regression and logistic regression, are applied to sounding and grid-box mesoscale data to predict the domain-total lightning count and individual gridbox 3-h-long lightning probability, respectively. Applications of these forecast models to an independent dataset from 2013 suggest some utility in probabilistic lightning forecasts from the regression analyses. Implementation of this technique into an operational forecast setting to supplement short-term lightning forecast guidance is discussed and demonstrated. Severe-thunderstorm report predictive models are found to be less skillful, which may partially be due to substantial population biases noted in storm reports over central and southern Arizona.
Leading **Regional** Research-To-Operations (R2O)
Also Leverages Operations-To-Research (O2R)

Central Region Grid Methodology Advisory Team

Overview: A Simplified Approach to Forecasting the Probability of Thunderstorms in the ForecastBuilder Era

Prepared by Chauncey Schultz (NOAA/NWS Bismarck) with a few adjustments by Ariel

This new method for creating PotThunder grids should help alleviate some of the low bias we’ve seen with thunder from ForecastBuilder, especially in the long term. You’ll notice a new PotThunder option available when you run ForecastBuilder through the non-precipitating weather types: “Combo of Pop and Models” (experimental):

This option relies on a blend of lapse rates from all models and our official forecast dewpoints to determine PotThunder based on the table below:

<table>
<thead>
<tr>
<th>Surface Dewpoint (°F) from the Forecast Database</th>
<th>&gt; 8</th>
<th>7 to 8</th>
<th>6 to 7</th>
<th>&lt; 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>700-500 mb Lapse Rate (°C/km) from a Multi-Model Convective</td>
<td>PotThunder + Pop</td>
<td>PotThunder + Pop</td>
<td>PopThunder + Pop</td>
<td>PotThunder = 15</td>
</tr>
<tr>
<td>60 to 65</td>
<td>PotThunder + Pop</td>
<td>PotThunder + Pop</td>
<td>PotThunder = 15</td>
<td>PotThunder = 15</td>
</tr>
<tr>
<td>50 to 60</td>
<td>PotThunder + Pop</td>
<td>PotThunder + Pop</td>
<td>PotThunder = 15</td>
<td>PotThunder = 15</td>
</tr>
<tr>
<td>40 to 50</td>
<td>PotThunder + Pop</td>
<td>PotThunder + Pop</td>
<td>PotThunder = 15</td>
<td>PotThunder = 15</td>
</tr>
<tr>
<td>30 to 40</td>
<td>PotThunder + Pop</td>
<td>PotThunder + Pop</td>
<td>PotThunder = 15</td>
<td>PotThunder = 15</td>
</tr>
<tr>
<td>&lt; 30</td>
<td>PotThunder + Pop</td>
<td>PotThunder + Pop</td>
<td>PotThunder = 15</td>
<td>PotThunder = 15</td>
</tr>
</tbody>
</table>

*If the SREF or gridded MOS value exceeds the table value, PotThunder will be set to the SREF or gridded MOS value.*

You’ll note that this “combo” still uses the old model-based “Blend of Model Probabilities” (SREF and GFS) method when and where those model probabilities exceed those from the table. This is admittedly a relatively simple approach, but since we don’t get many hits from models in GFS that are correlated to lightning production, mid-level lapse rates and forecast dewpoints are solid choices. We have been working on this project with the GMAF, and if you want to know all of the details, click here.

Below is the PotThunder output for a past Tuesday evening from the new method, which is a period where we have forecast MCAPE on the order of 3,000 J/kg:

Compare this with the old “Blend of Model Probabilities” method, and you’ll notice a marked difference with much lower PotThunder values despite the strong instability:

This should greatly improve our first-guess thunder probabilities, especially in the long term, but that doesn’t mean you cannot or should not still manually intervene to adjust them at times if you need to. You still may need to collaborate more on PotThunder while we are exploring the various options.
Leadership in **National Team Initiatives: Science / Technology Integration**

**To Enhance Services (IDSS) Promoting Weather-Ready Nation**

**MESOANALYSIS BOOTCAMP**

These experiments evaluate capabilities to leverage observed meteorological data, science-based conceptual models, and cutting-edge numerical weather prediction datasets to enhance precise, targeted impact-based decision support services (IDSS) associated with high-impact convective weather events.

These immersive experiences are comprised of job-relevant exercises involving real weather events, instruction from subject matter experts, facilitated group discussions, and feedback from participating core partners.

This initiative represents a strong collaboration between the OPG, the Storm Prediction Center, Weather Forecast Offices across the NWS, the Office of the Chief Learning Officer, and the National Severe Storms Laboratory.

Ultimately, these experiments are expected to identify avenues for the NWS to enhance its services pertaining to high-impact convective weather using an understanding of the deep physical sciences.
Front row from left to right: Brian Caricone (NWS Huntsville, AL), Kim Runk (NWS OPG), Katie Crandall Vigil (NWS OPG), Chauncy Schultz (NWS Bismarck, ND), and Corey Mead (NWS Omaha, NE)

Back row from left to right: Matthew Foster (NWS OPG), Ariel Cohen (NWS Topeka, KS), Seth Binau (NWS Wilmington, OH), Daniel Hawblitzel (NWS Nashville, TN), and Chad Gravelle (NWS OPG)
Front Row: Bill Bunting, SPC; Ariel Cohen, TOP; Corey Mead, OAX; Chauncy Schultz, BIS

Second Row: Seth Binau, ILN; Chad Gravelle, OPG; Brian Carcione, HUN; Katie Vigil, OPG

Back Row: Matt Foster, OPG; Kim Runk, OPG; Jenni Laflin, EAX; Jim LaDue, WDTD; Dan Hawblitzel, OHX
Front Row: Ariel Cohen (WFO Miami, FL); Chauncy Schultz (WFO Bismarck, ND); Brittany Peterson (WFO Grand Forks, ND); Brian Haines (WFO Raleigh, NC); Kristen Cassady (WFO Wilmington, OH); Chad Gravelle (Southern Region Headquarters)

Middle Row: Kim Runk (Operations Proving Ground); Nate McGinnis (WFO Jacksonville, FL); Timothy Humphrey (WFO Lake Charles, LA); Michael Evans (WFO Albany, NY); Matthew Foster (Operations Proving Ground)

Back Row: Andrew Loconto (WFO Blacksburg, VA); Jenni Pittman (WFO Kansas City/Pleasant Hill, MO); Jared Allen (WFO Cheyenne, WY); Alex Edwards (WFO Bismarck, ND); Eric Wise (WFO Springfield, MO); Rich Thompson (Storm Prediction Center)
Leadership in **National** Team Initiatives:
**Mesoanalysis Bootcamp**
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Mesoanalysis Bootcamp
Vital component: Feedback from partners, including Emergency Managers -- bringing people together.
Development of National Training
NWS Representation at Conferences
Leadership in National Team Initiatives:
SOO Development Course

Pictures courtesy of
Kevin Scharfenberg
(Forecast Decision Training Division)
The Role of the Science and Operations Officer (SOO)

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