

Virtual

The 2020 NOAA Hazardous Weather Testbed Spring Forecasting Experiment

Adam Clark², Israel Jirak¹, Burkely T. Gallo^{1,3}, Andy Dean¹, Kent Knopfmeier^{2,3}, Brett Roberts^{1,2,3}, Louis Wicker², Makenzie Krocak^{3,4}, Patrick Skinner^{2,3}, Pam Heinselman², Katie Wilson^{2,3}, Jake Vancil^{1,3}, Kimberly Hoogewind^{2,3}, Nathan Dahl^{1,3}, Gerry Creager^{2,3}, Thomas Jones^{2,3}, Jidong Gao¹, Yunheng Wang^{2,3}, Eric D. Loken^{2,3,4}, Montgomery Flora^{2,3,4}, Chris Kerr^{2,3}, Nusrat Yussouf^{2,3}, Scott Dembek^{2,3}, William Miller^{2,3}, Joshua Martin^{2,3}, Jorge Guerra^{2,3}, Brian Matilla^{2,3}, David Jahn^{1,3}, David Harrison^{1,3}, and Dave Imy²



- (1) NOAA/NWS/NCEP Storm Prediction Center, Norman, Oklahoma
- (2) NOAA/OAR National Severe Storms Laboratory, Norman, Oklahoma
- (3) Cooperative Institute for Mesoscale Meteorological Studies, University of Oklahoma, Norman, Oklahoma
- (4) School of Meteorology, University of Oklahoma, Norman, Oklahoma



Timeline: In Person -> Virtual Experiment



- **Mid-March**: It became apparent that in-person experiment not possible
 - Option 1 – Cancel experiment
 - Option 2 – Virtual Experiment
 - SFE team unanimously agreed with virtual experiment to maintain momentum in key research areas (SAR-FV3, CAM ensemble, Warn-on-Forecast, etc.)
- **Late-March**: Management approved virtual experiment
- **14 April**: 1st draft of SFE operations plan complete
- **23-24 April**: Experiment “Dry Runs”
- **27 April – 29 May**: Experiment Operations

The SFE team went above and beyond to make this experiment happen. Everybody sacrificed during an unprecedented time in our nation’s history. I am extremely proud to be a part of this team!

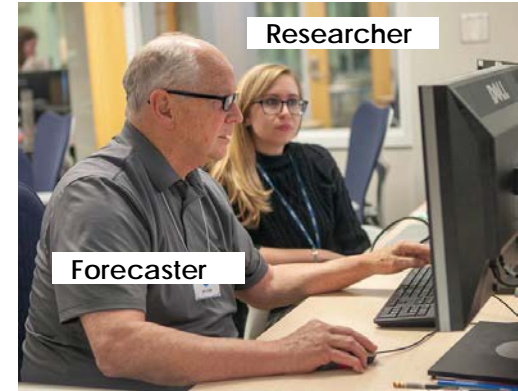
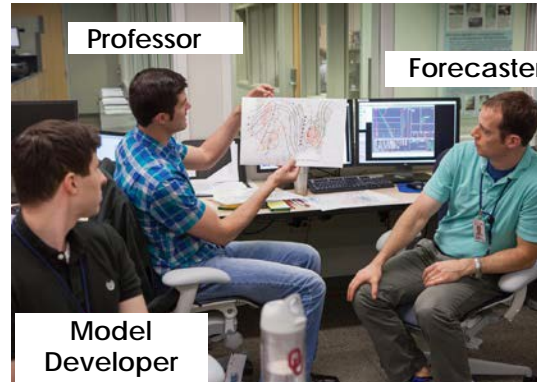


What is it?

- 5-week severe weather forecasting and evaluation experiment
- Emerging concepts and new technologies for improving severe weather prediction are tested to accelerate R2O.
- Document sensitivities and performance of CAMs.

Keys to success

- Sense of realism and operational urgency
- Diverse participants
- R2O ↔ O2R pathways
- 75+ peer-reviewed publications since 2010





SFE2020 participants (100+)



Week 1 April 27-May 1	Week 2 May 4-8	Week 3 May 11-15	Week 4 May 18-22	Week 5 May 26-29
Lizzie Tirone (ISU)	Lizzie Tirone (ISU)	Lizzie Tirone (ISU)	Lizzie Tirone (ISU)	Lizzie Tirone (ISU)
Jeremiah Pyle (AWC)	Brice Coffey (NCState)	Bill Gallus (ISU)	Lance Bosart (Sunny-Albany)	Kallan Parker (PSU; Hollings)
Victor Gensini (NIU)	Lucia Scaff (U. Sask)	Kyle Hugelback (ISU)	Bruno Ribeiro (Sunny-Albany)	Clark Evans (UWM)
Ryan Sobash (NCAR)	Corey Potvin (NSSL)	Michou Baart de la Faille (KNMI)	Scott Feldman (Sunny-Albany)	Dillon Blount (UWM)
Yongming Wong (OU/MAP)	Becky Adams-Selin (AER)	Tina Kalb (DTC)	Steve Weiss (SPC Ret.)	Craig Schwartz (NCAR)
Amanda Burke (OU)	Alicia Bentley (EMC)	John Allen (CMU)	Harald Richter (BoM)	Ben Blake (EMC)
Jacob Carley (EMC)	Aaron Johnson (MAP)	Glen Romine (NCAR)	Tom Galarnreau (CIMMS/NSSL)	Xiaoyan Zhang (EMC)
Brett Borchardt (WFO LOT)	Andrew McKaughan (WFO PIH)	Paige Crafter (USAF)	Tony Oakley (USAF)	Austin Coleman (TTU)
Matt Anderson (WFO MRX)	Alex Lukinbeal (WFO MSO)	Logan Dawson (EMC)	Gang Zhou (EMC)	Jidong Gao (NSSL)
Alex Krull (WFO DMX)	Hayden Frank (WFO BOX)	Austin Dixon (OU)	Matt Pyle (EMC)	Jamie Wolff (DTC)
David Harrison (CIMMS/SPC)	Patrick Skinner (CIMMS/NSSL)	Austin Coleman (TTU)	Austin Coleman (TTU)	Corey Mead (WFO OAX)
Derek Stratman (CIMMS/NSSL)	Yibing Su (Princeton)	Mike Seaman (WFO SLC)	Jason Godwin (WFO FWD)	Nick Vertz (WFO BYZ)
Joe Pollina (WFO OKX)	Jeff Beck (GSL)	Eric Bunker (WFO TAE)	Tom Hultquist (WFO MPX)	Curtis Alexander (GSL)
Jeff Duda (GSL)	Terra Ladwig (GSL)	Robert Megnia (WFO LCH)	Dan McKerny (WFO LMK)	John Brown (GSL)
Dave Turner (GSL)	Nigel Roberts (UK Met)	Steve Zubrick (WFO LWX)	Mike Evans (WFO ALY)	
Aurore Porson (UK Met)		Geoff Manikin (EMC)	David Dowell (GSL)	
		John Brown (GSL)	Eric James (GSL)	
		Ed Szoke (GSL)	Mike Bush (UK Met)	
		Aurore Porson (UK Met)	Dave Ahijevych (NCAR)	
		Nigel Roberts (UK Met)		
		Bethany Earnest (CIMMS/SPC)		

SFE Facilitators (9)

Adam Clark (NSSL), Israel Jirak (SPC), Burkely Gallo (CIMMS/SPC/NSSL), Dave Imy (retired SPC), Mike Coniglio (NSSL), Kenzie Krocak (CIMMS/NSSL/OU), Brett Roberts (CIMMS/SPC/NSSL), Kent Knopfmeier (CIMMS/NSSL), and Andy Dean (SPC).

Participant Institutions

University: 25
 NWS: 18
 GSL: 10
 EMC: 8
 CIMMS: 5
 UKMET: 5
 NCAR: 4
 NSSL: 2
 DTC: 2
 USAF: 2
 AER: 1
 KNMI: 1
 Retired: 1
 BoM: 1

- Fifth year of the CLUE
- GOAL: Design HWT experiments to provide more controlled datasets that can be better utilized to inform configuration of next-generation operational systems with HREF as the baseline

2020 CLUE components (41 Members)

Driving Model vs. Model Core

- GFS ICs/LBCs driving WRF, UM, FV3-SAR
- UM ICs/LBCs driving WRF, UM, FV3-SAR
- NSSL, NCAR, & UK Met Office

Time lagging strategies

- HRRRE & HRRR (GSL)
- UM (UK Met Office)
- NSSL-WRF (NSSL)

*Israel Jirak
2:40pm Mon.*

FV3 Experiments

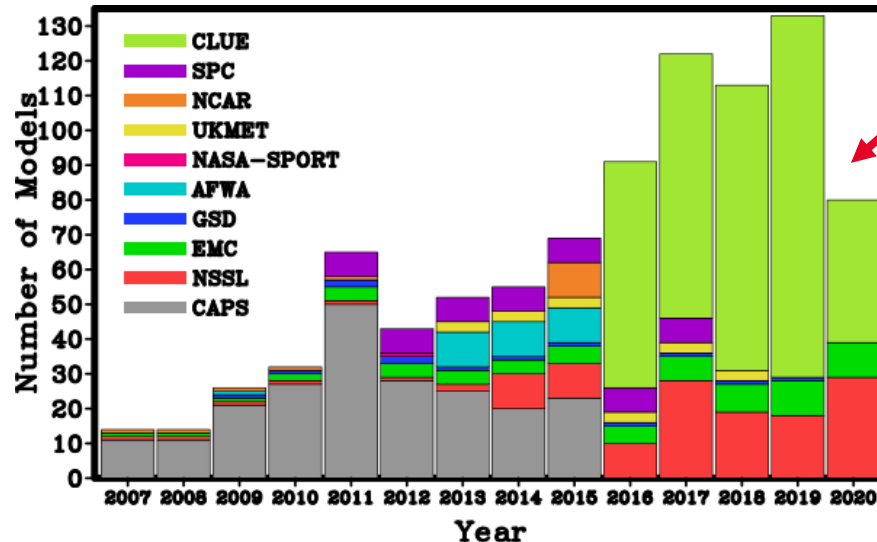
- FV3-SAR (EMC, NSSL, & GSL)
- FV3 global w/ nest (GFDL)

*Burkely Gallo
4:30pm Wed.*

Total Lightning Data Assimilation

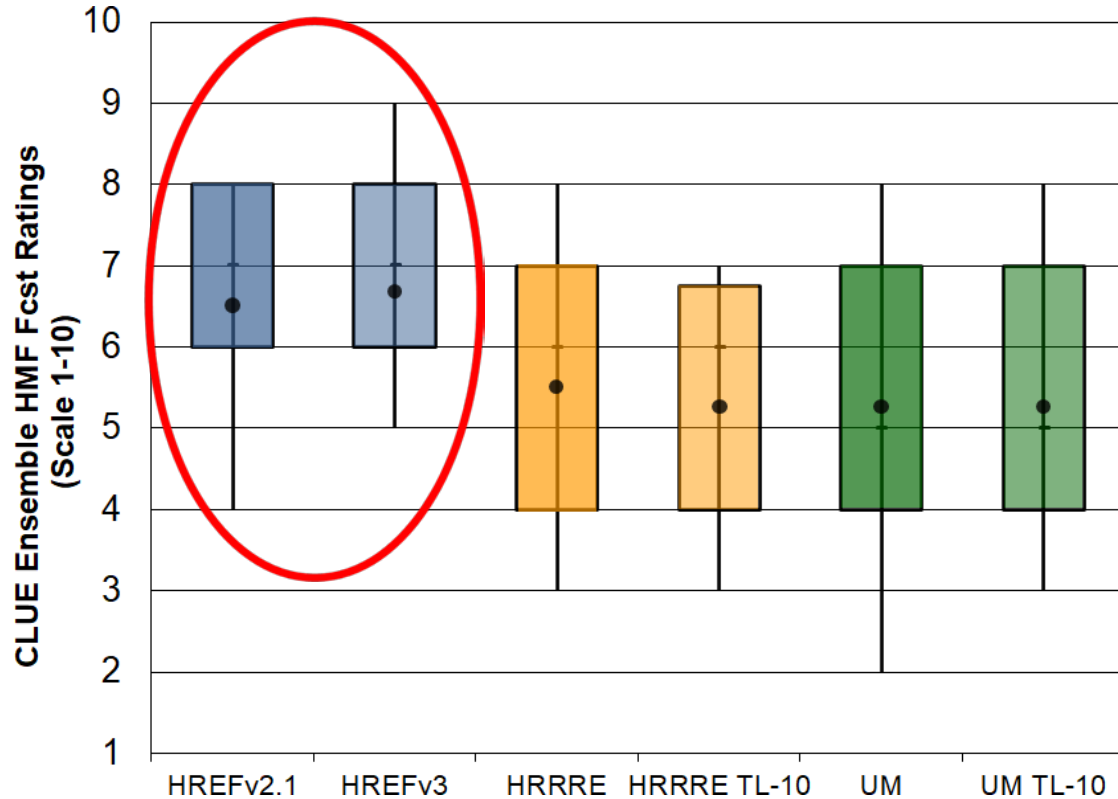
- WRF w/ Radar DA – no lightning (NSSL)
- WRF w/ Radar DA – lightning (NSSL)

SFE model contributions since 2007



Drop? No contributions from CAPS, OU-MAP, & fewer from NCAR – vagaries of funding cycles.

CLUE Subjective Evaluations



HREF "baseline"
continues to be hard to
beat.

Daily Activities Schedule

Monday		
Time (CDT)	Topic	Moderator
10:00 a.m.	Welcome and Introductions	Israel
10:20 a.m.	Overview of SFE Scientific Goals	Israel and Adam
11:00 a.m.	Preview of the Evaluations (Science Questions, Examples)	Group A: Israel & David J. Group B: Burkely & Adam
Tuesday-Friday		
9:45 a.m.	Overview of Yesterday's Severe Weather (David Imy)	
10:00 a.m.	Independent Evaluations (with moderators available for questions)	
11:00 a.m.	Discussion of Group A Evaluations: A1. ISU ML Severe Wind Probs A2. NCAR ML Hazard Guidance A3. CLUE: 00Z CAM TL-Ensemble A4. CLUE: TTU Ensemble Subsetting A5. CLUE: Ens. Hail Guidance (Fri) A6. CLUE: FV3-SAR Physics/DA/VL A7. CLUE: FV3-SAR IC/Hord/LSM A8. Mesoscale Analyses A9. CLUE: Lightning DA	Discussion of Group B Evaluations: B1(a-f). HREF Calibrated Guidance B2. CLUE: 00Z CAM Multi-Model Ensemble B3. CLUE: 12Z CAM TL-Ensemble B4. CLUE: Deterministic Flagships B5. CLUE: Core and ICs B6(a-f). WoFS Configurations

- ML-based and other calibration strategies
- CLUE experiments
- Warn-on-Forecast
- Analyses

Daily Activities Schedule

Short-Term Forecasting: Monday-Friday

1:30 p.m.	Overview of Today's Severe Weather Threat (David Imy) Break into Virtual Groups (R2O & Innovation)	
	R2O (<i>Israel Jirak & Burkely Gallo</i>)	Innovation (<i>David Imy, Mike Coniglio, & Adam Clark</i>)
1:40 p.m.	Overview of SFE Drawing Tool (M); Evaluation of Yesterday's Forecasts (T-F)	Overview of WoFS Drawing Tool (M); Evaluation of Yesterday's Forecasts (T-F)
2:00 p.m.	Day 1 Outlook Generation* Full period (20-12Z) coverage and conditional intensity forecasts of tornado, hail, and wind using available 12Z CAM ensemble guidance (not WoFS) and observations.	Short-Term Outlook Generation*^ 1-h (21-22Z) and 4-h (21-01Z) probabilistic forecasts of tornado, hail, and wind. Some forecasters with access to WoFS^ and some without*.
3:00 p.m.	Day 1 Outlook Update* Update full period (21-12Z) coverage and conditional intensity forecasts of tornado, hail, and wind using WoFS and observations.	Short-Term Outlook Update*^ 1-h (21-22Z) and 4-h (21-01Z) probabilistic forecasts of tornado, hail, and wind. Same forecasters with access to WoFS^ and same without*.

**Warn-on-Forecast
Activities**



Warn-On-Forecast Demonstration



Example
WoFS-based
outlook



Conclusions & what's next?

- We learned a lot from a virtual experiment, but there is no replacement for the personal interactions that occur in-person.
- We'll be planning for in-person 2021, but we'll be ready for anything!
- Contributions to the final report from colleagues and collaborators are due 31 July. Adam will compile final report by 31 August.

- Significant progress has been made w/ SAR-FV3.
- Very positive feedback for WoFS.
- ML-based forecasting methods maturing and showing promise.
- HREF is still the "king", but time-lagging + mixed physics with single model very promising.