ZSE Operations Brief



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Ken Wohl
Brad Harris

June 21, 2024

IWAWS 2024 | Salt Lake City, UT

CWSU's came about as a result of an aircraft accident in the state of GA in what year?

A. 2000

B. 1977

C. 1965

D. 2004

Outline

- The Team
- ZSE Airspace Overview
- ZSE Weather
- ZSE CWSU Operations
- Prob-IDSS Mindset
- Wrap-Up

The Team

Who's who of ZSE CWSU

MET  Jim Vasilj [α]

MET  Ken Wohl

MET  Brad Harris

MIC  Doug Stolz

Experiences:

- Commercial airline wx ops
- NWS WFO
- U.S. Department of Transportation
- USAF 21st operational wx squadron
- Atmospheric research
- Private consulting (CCM)

[α] *More than 10 years at ZSE*

“Extracurricular” Efforts

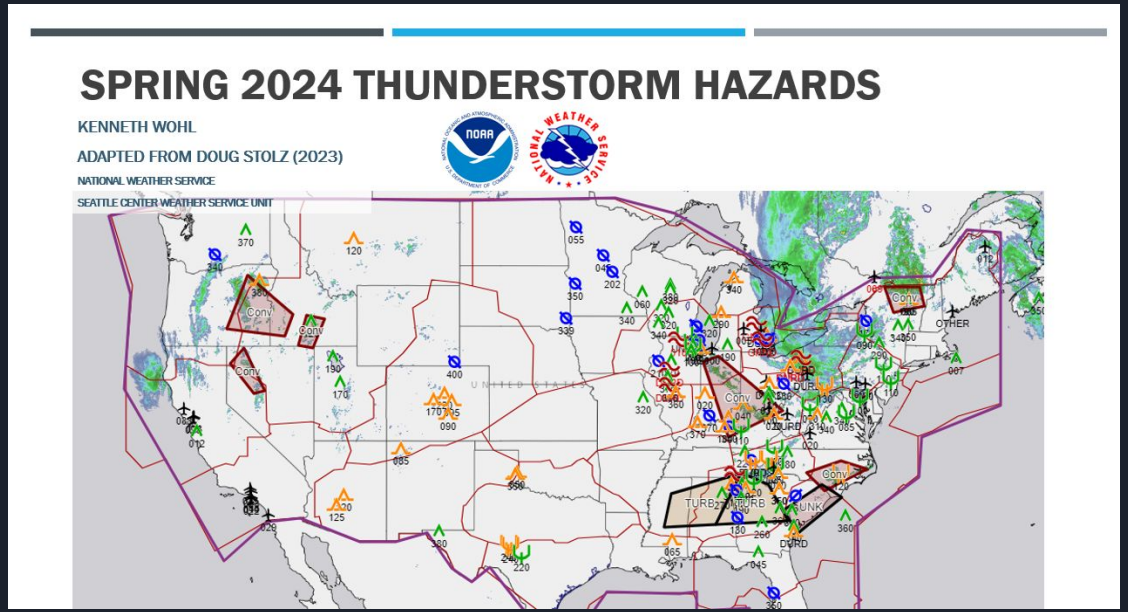
Systems administration tasks

Product development *

Outreach

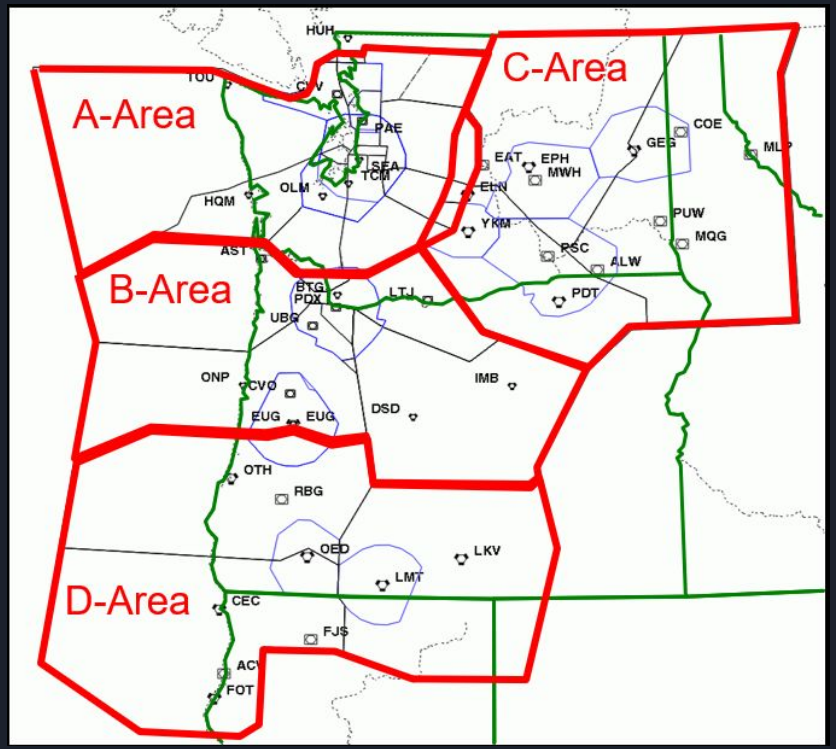
- FAA site visits
- Pilot clubs (GA/local)
- Facility tours
- Student intern programs

Controller training (seasonal)



ZSE Airspace

ZSE ARTCC Areas



Areas: A, B, C, D

Approach Area Boundaries

Sector Boundaries

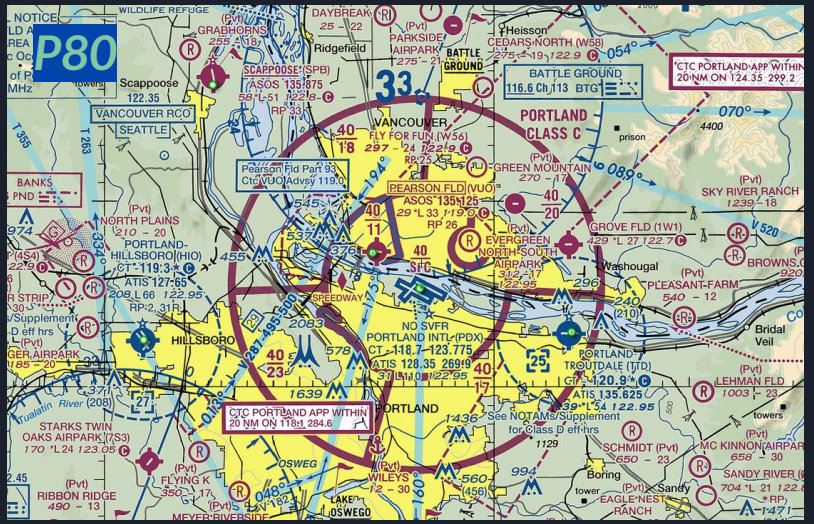
State Borders

S46/P80 TRACON Areas



Both major terminals have satellite airports with local VFR/IFR traffic demand…

…yielding considerable operations sensitivity.



SEA/BFI Terminal View

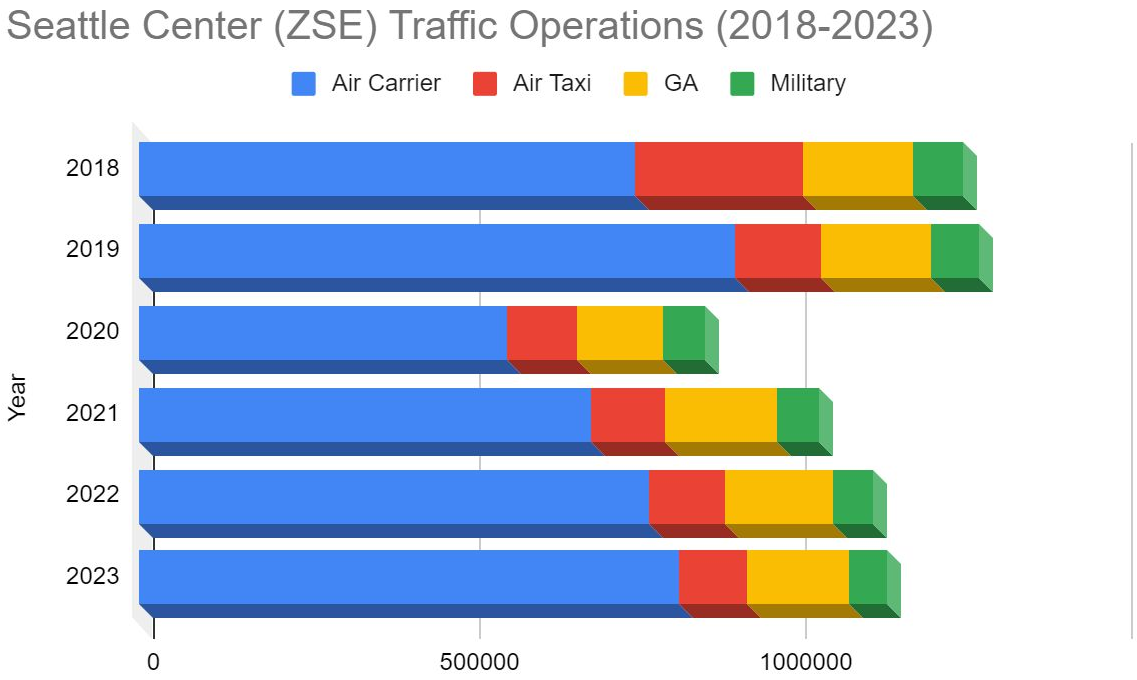


"Plan A" (S | Split Flow) - Visual Separation

"Plan B" (N | Split Flow) - SEA and BFI can provide visual separation between arrivals and departures

"Plan C" (N Flow)*** - Visual separation not possible; greater aircraft separation, reduced AAR

Trends in Traffic



Data: FAA OpsNet, ASPM

Overall traffic dip (-33%) due to COVID, resuming normal by 2023

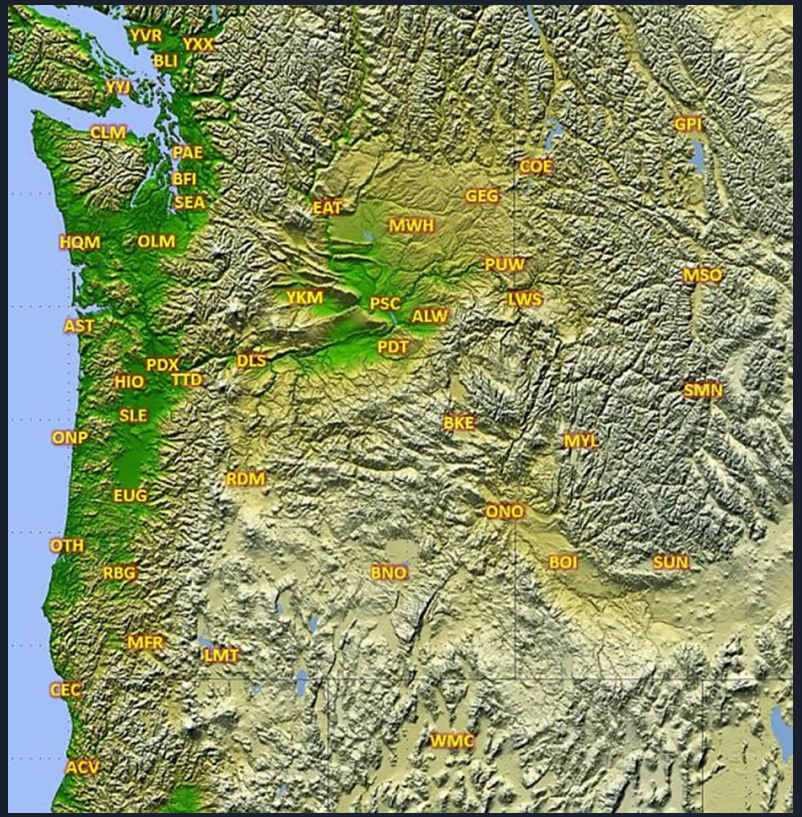
KSEA AAR: 46 N RWY34, 50 S RWY16

Peaks in arrival demand: Thurs/10,20LT

ZSE Weather

“It’s a good day to be a chameleon”
- B. Harris, ZSE Meteorologist

Seattle Geography



Modified maritime air masses (W) & arid/alpine-desert (E)

Occasional excessive moisture (e.g., AR's)

Abrupt terrain rises (>080-100)

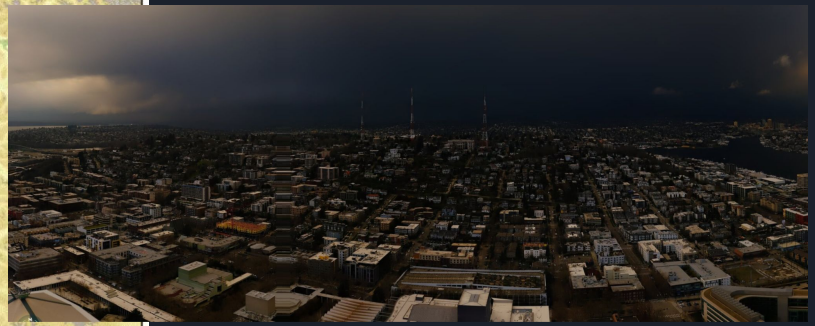
N-S mountain barriers; gaps in terrain imply localized impacts to winds, p-type, C&V

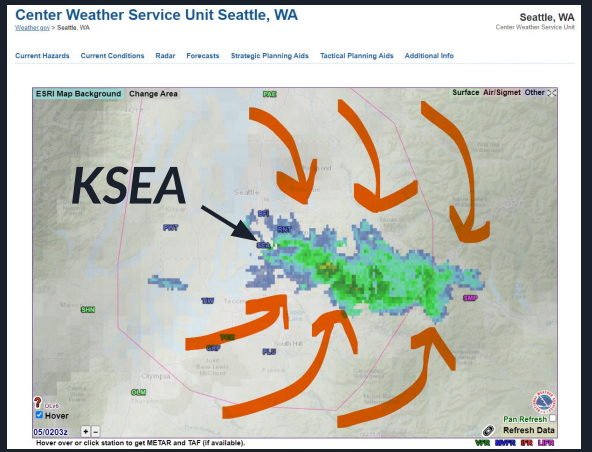
Puget Sound CZ

Develops with moderate to strong onshore low-level wind (BLW 700 hPa)

Flow splits around Olympic Mtns W of Seattle…convergence over Puget Sound





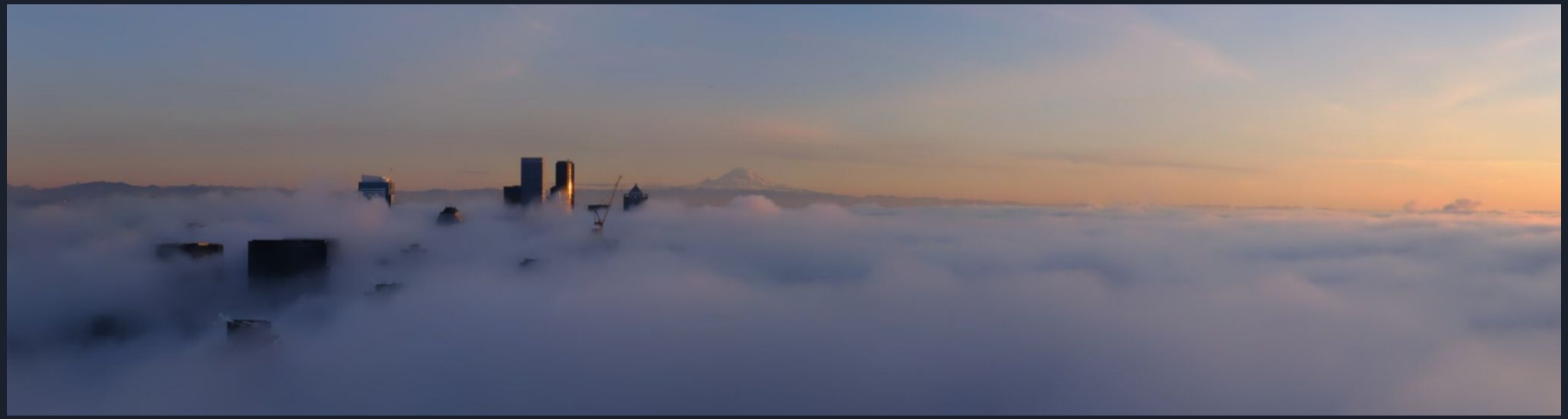


Marine Push

Relatively cool ocean nearby moderates regional temperature and stability

Fog and low ceilings are persistent features of PNW climatology

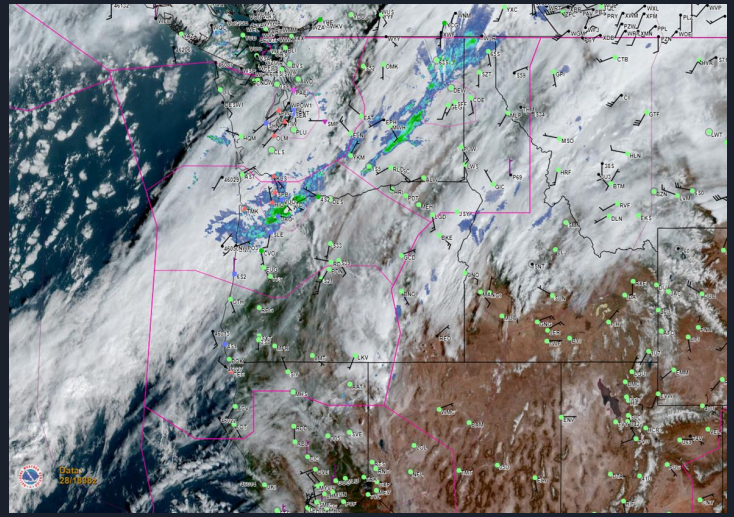
Rapid changes from VFR to IFR (and back again?)

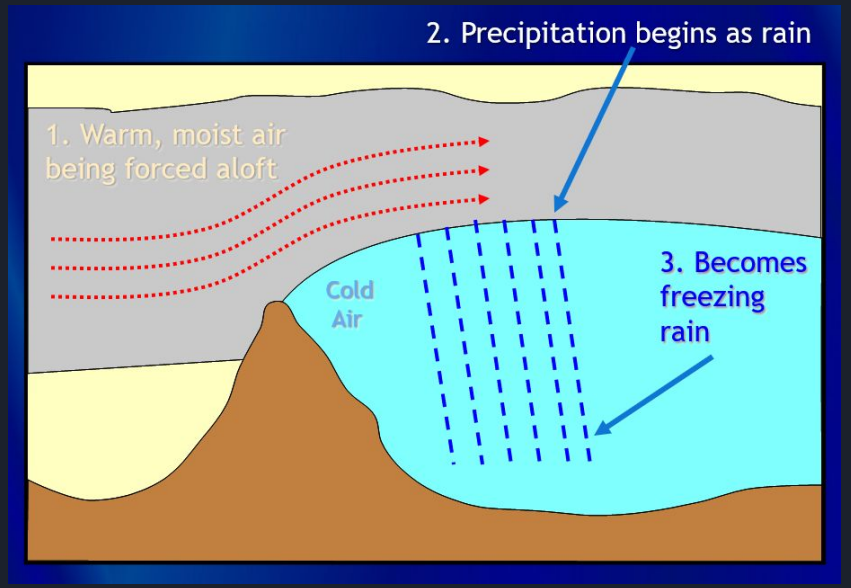


PNW “Ice Machine”

Moisture convergence and strong lift in AR’s

Overrunning events (Fraser/Columbia River outflows)

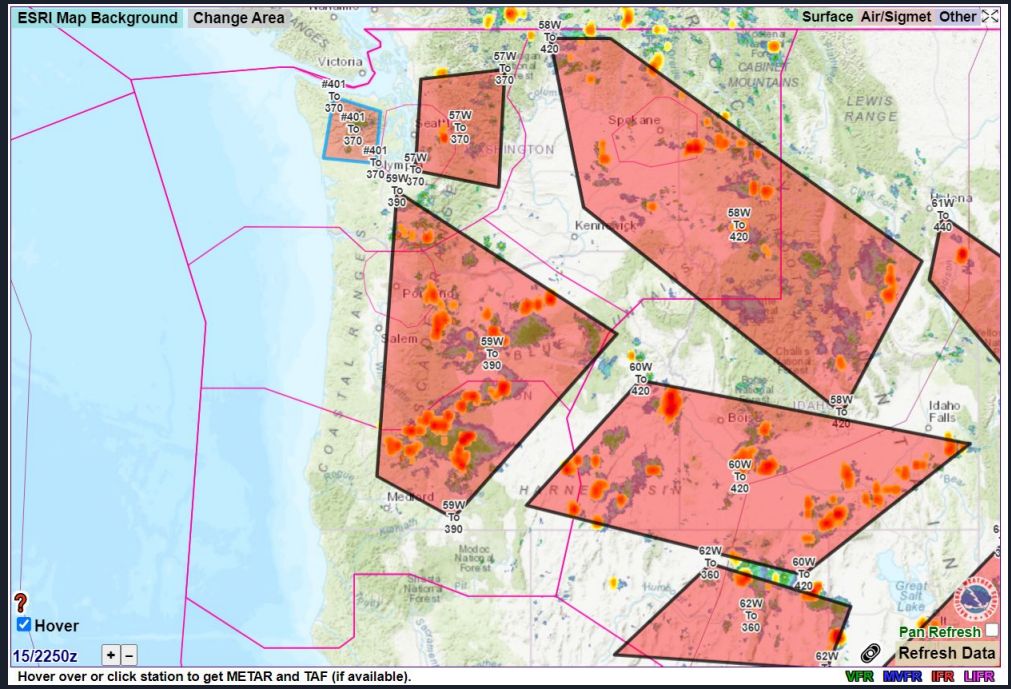




Convective Events

Post-frontal, low-topped convection frequent in winter

Terrain-assisted development in the warm season



ZSE CWSU Operations

Rotation

9-week shift rotation

16 hours per day, 7 days per week, 365 days per year

- D: 0500-1300 LT
- E: 1300-2100 LT
- R: Supernumerary

“Flex” minutes during shift change

MIC provides operations coverage for AL/SL, training, etc.

Situational telework agreements in place

Partner Briefings (LT)

0530: Morning PDWB

0600: S46 Telecon (ZSE TMU, SEA/BFI ATCT, TRACON)

0800: AM Stand-up (ZSE OMIC, TMU, Area Supervisors)

1230: Afternoon PDWB

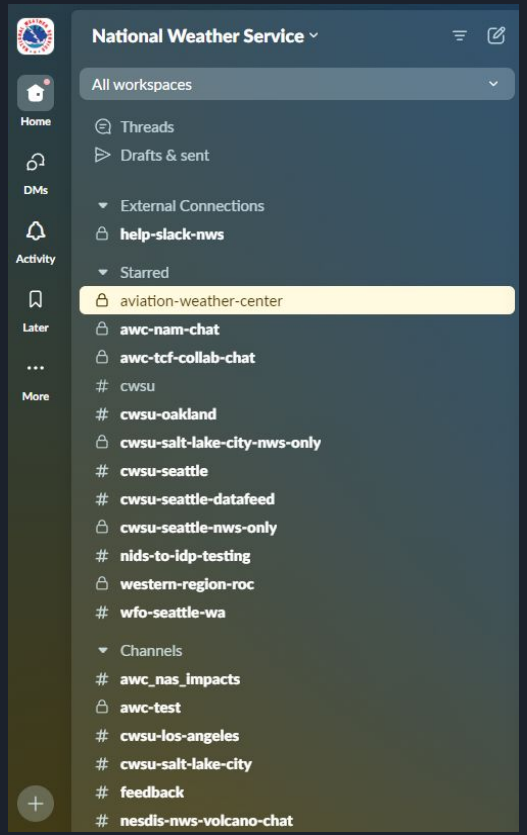
1430: S46 TRACON, day ahead/0000-2000Z TAF update

1500: PM Stand-up

1800: S46 Telecon (as needed)

2030: Evening PDWB

NWS Collaboration



Shift briefings during changeover

National Aviation Meteorologist (NAM) updates

TAF collaboration with WFO's

Aviation Weather Center (AWC) SIGMET/advisory coordination

NWS Collaboration

Collaboration scenarios between WFO SEW and ZSE

“Check list” for TAF writers

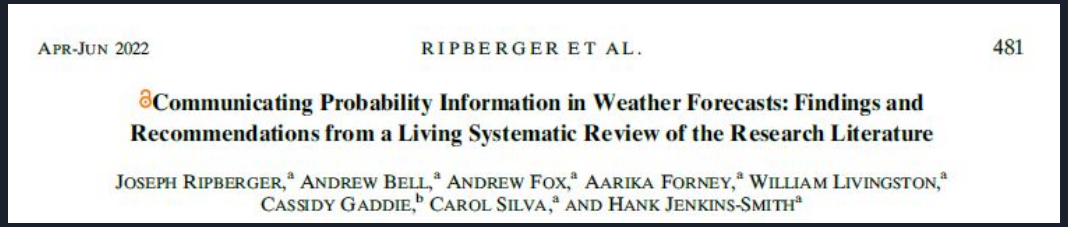
Not designed to be exhaustive, rather strategically prioritized

Specific to TAF sites in S46 TRACON area

What?	V	V	FG	TS	CZ	Action	Coord?
Scenarios	WIND @ SEA	WIND @ BFI	FG & Low CIGS	TS @ BFI/SEA	PSCZ between SEA/BFI	SEW ACTION	COORDINATION
Scenario A	South	South	No	No	No	Ideal situation. Monitor and update TAF for any windshifts > 30 degrees.	Plan on typical amount of coordination with ZSE. Let them know of any expected wind shifts.
Scenario B	North	North	No	No	No	-Make sure the TAF is reflective of how long the N winds will persist, especially in the 6-8 kt range.	Coordinate with ZSE if you expect the N winds to jump up in speed for any length of time or whether the increase will be sustained. Watch for increases up to 10-12 kt sustained.
Scenario C	South	North	Yes	No	Yes	-Split flow interaction. Timing of PSCZ impacts at both terminals/TAFs is critical. -Watch for wind shifts, strength changes. -Ceilings also critical as visuals will be severely impacted. One may not allow departures while another arrives, and vice versa.	Coordinate with ZSE on incoming PSCZ with as much notice as possible. > 2 hours if possible. Let ZSE know of TAF updates and amendments.
Scenario D	North	North	Yes	No	No	-Monitor for any incoming fog and/or mid to low level clouds affecting one or both terminals as it could affect visuals between the two.	-Coordinate more frequently with ZSE on fog timing and updates. **If on midshift, ask ZSE before 6AM to get a report from the tower on where the fog is**. Can be useful in identifying trends.

Prob-IDSS Mindset

Motivation



APR-JUN 2022 RIPBERGER ET AL. 481

Communicating Probability Information in Weather Forecasts: Findings and Recommendations from a Living Systematic Review of the Research Literature

JOSEPH RIPBERGER,[a] ANDREW BELL,[a] ANDREW FOX,[a] AARIKA FORNEY,[a] WILLIAM LIVINGSTON,[a] CASSIDY GADDIE,[b] CAROL SILVA,[a] AND HANK JENKINS-SMITH[a]

New Operations Model (announced NOAA-wide in mid-FY2024)

- Embracing power of probabilities
- *Not "How can we help?" >>> rather "what decisions do you need to make?"*

From systematic literature review (*Ripberger et al.*, 2022):

1. Partners DO effectively comprehend probabilistic messaging
2. Using appropriate communications techniques, probabilities help decision makers

Methods

Automation to record hourly obs at KSEA with the set of (f00,f03,f06,f09,f12,f18) NBM v 4.X forecasts

Scripting routines executed regularly to correlate forecast with corresponding forecast lead-times

Verification – running archive of Forecast-Observation pairs:

- Surface wind vectors
- Ceiling
- Visibility
- Deterministic forecasts (CIGs & VIS)
- Forecast probabilities (MVC, IFC, LIC, MVV, IFV, LIV)

“Real-time” to subset/composite for various events as needed.

F-O Pair Statistics

Using 2x2 contingency table approach, document “Y” vs. “N” events for flight categories at KSEA

Scalar performance measures like PC, FAR, CSI, etc.

CIG: VFR

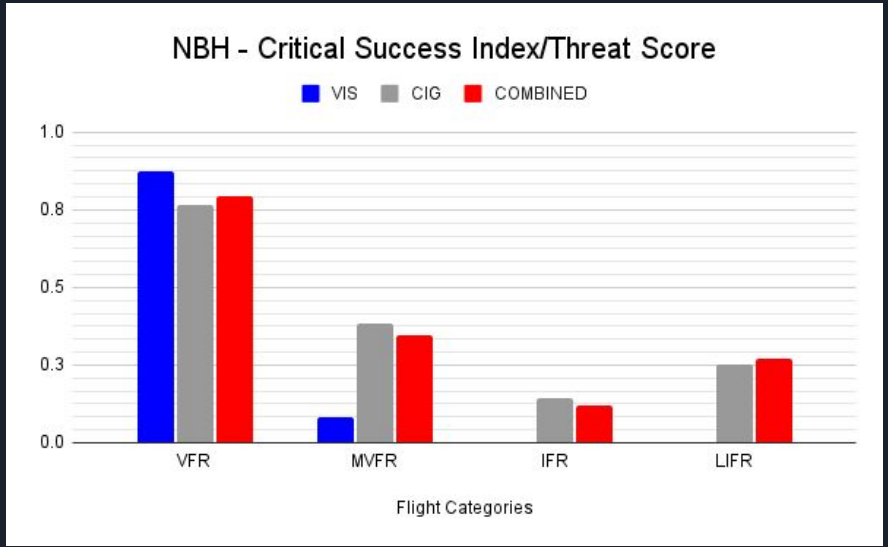
			Observed		
HSS=	0.6298				
PC =	0.8289	Forecast	126	22	148
CSI =	0.7636		17	63	80
B =	1.0350		143	85	228
FAR =	0.1486				

CIG: MVFR

			Observed		
HSS=	0.1417				
PC =	0.5714	Forecast	28	23	51
CSI =	0.3836		22	32	54
B =	1.0200		50	55	105
FAR =	0.4510				

CIG: IFR

			Observed		
HSS=	0.1570				
PC =	0.8235	Forecast	2	4	6
CSI =	0.1429		8	54	62
B =	0.6000		10	58	68
FAR =	0.6667				



Time-Lag Ensembles

Raw hourly tables can be useful…

Wind

QPF/TS

PoPs + TS Probs

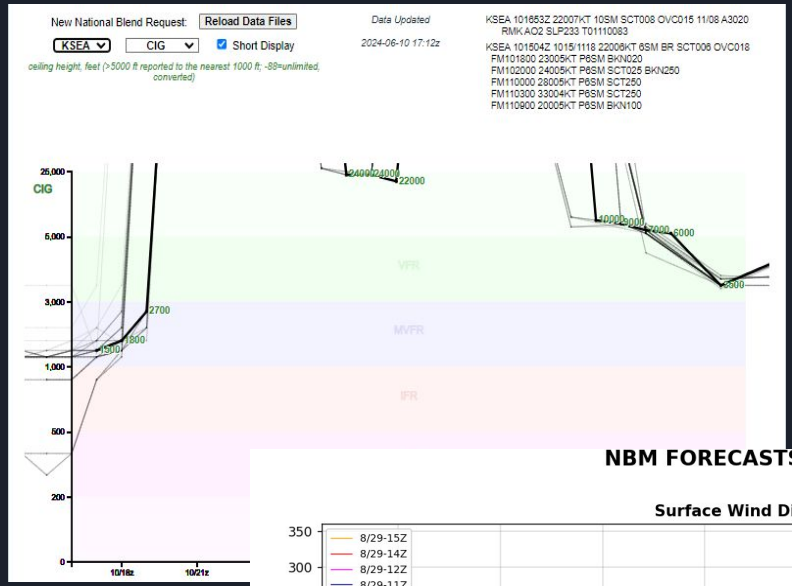
C&V +Probs

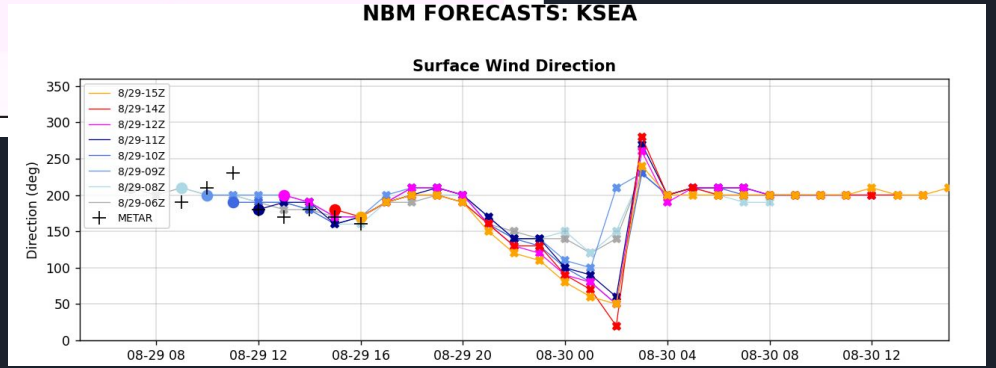
KSEA	NBM V4.2 NBH GUIDANCE								6/10/2024	1500 UTC													
UTC	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
TMP	54	56	58	61	63	65	67	69	70	70	69	68	65	63	62	61	59	57	56	56	55	55	55	56	57
TSD	2	2	2	2	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
DPT	46	46	47	47	48	48	47	47	46	46	46	46	46	46	47	47	47	47	47	48	47	47	46	46	46
DSD	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SKY	76	63	53	27	35	37	39	39	37	44	50	66	64	57	42	44	36	41	25	37	46	45	64	87	88
SSD	19	33	38	29	36	36	36	32	33	31	26	18	26	27	30	33	37	26	24	27	36	36	35	21	7
WDR	21	21	21	22	23	24	25	27	28	29	30	32	33	35	1	29	22	21	20	19	19	19	20	21	21
WSP	6	5	5	4	4	3	4	4	4	4	4	4	4	3	3	4	5	6	7	7	8	9	10	11	11
WSD	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
GST	7	6	6	6	5	5	5	5	6	5	5	5	4	4	4	5	6	7	8	9	10	12	13	15	16
GSD	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	4	4	4	3	3
P01	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	2	3	4	8	9	8	22
P06									0						1						4				
Q01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
T01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PZR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PSN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PPL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	3	32
S01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SLV	72	72	73	74	76	79	82	84	87	88	89	91	92	94	97	100	100	110	110	100	100	98	97	92	
I01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CIG	13	13	18	27	-88	-88	-88	-88	-88	-88	-88	240	240	-88	-88	-88	-88	-88	-88	-88	-88	90	60	60	
MVC	93	88	71	39	27	16	13	9	6	5	2	2	2	3	4	3	5	6	6	8	9	8	6	5	13
IFC	9	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
LIC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LCB	13	13	18	27	11	10	12	20	22	20	26	20	26	20	25	022	019	018	010	012	015	011	010	010	0
VIS	60	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
MVV	25	18	12	9	7	7	4	4	4	6	3	4	3	2	2	1	1	4	5	6	6	9	11	6	5
IFV	8	5	3	1	1	1	1	1	1	1	1	1	0	0	1	1	1	2	2	2	3	5	5	2	1
LIV	3	2	1	1	0	1	0	0	0	0	0	0	0	0	1	1	1	2	1	2	2	3	3	2	0
MHT	22	24	25	26	28	32	32	32	32	31	26	8	5	4	4	4	4	4	4	4	6	11	12	13	
TWD	21	21	22	21	21	30	30	32	34	35	36	2	2	1	2	1	18	20	20	20	20	20	20	22	22
TWS	6	5	5	4	4	3	4	4	4	4	4	4	4	4	3	4	5	6	7	7	8	10	13	14	15
HID									5						5						4				
SOL	28	46	59	84	89	91	83	69	60	38	26	12	4	4	3	0	0	0	0	0	0	4	13	14	5

Time-Lag Ensembles

"Trend in the Blend"

1. Choose station
2. Choose parameter
3. Observe trend in runs from prior 24 hours
4. Compare to available TAF





Time-Lag Ensembles

...continued...

Forecast Lead Time →

Run Time ↓

Run	10/16	10/17	10/18	10/19	10/20	10/21	10/22	10/23	11/00	11/01	11/02	11/03	11/04	11/05	11/06	11/07	11/08	11/09	11/10	11/11	11/12	11/13	11/14	11/15	11/16	11/17	11/18	Run
0		1500	1800	2700	~	~	~	~	~	~	~	24000	24000	22000	~	~	~	~	~	~	~	10000	9000	7000	6000		3500	0
-1	1300	1300	1800	2700	~	~	~	~	~	~	~	24000	24000	~	~	~	~	~	~	~	~	~	9000	6000			3500	-1
-2	900	1300	1500	2700	~	~	~	~	~	~	26000	24000	24000	~	~	~	~	~	~	~	~	~	9000	6000			3500	-2
-3	400	900	1500	~	~	~	~	~	~	~	26000	25000	24000	~	~	~	~	~	~	~	~	~		7000			3500	-3
-4	400	900	1300	~	~	~	~	~	~	~	~	24000	24000	~	~	~	~	~	~	~	~			7000			3500	-4
-5	900	1300	1500	2200	~	~	~	~	~	~	~	25000	24000	~	~	~	~	~	~	~	~			7000			3500	-5
-6	1300	1800	1800	~	~	~	~	~	~	~	26000	24000	24000	~	~	~	~	~	~		~			6000			3500	-6
-7	1300	1500	2200	~	~	~	~	~	~	~	~	24000	24000	~	~	~	~	~			~			4500			3500	-7
-8	1500	1500	2200	~	~	~	~	~	~	~	~	~	~	~	~	~	~	~			~			6000			3500	-8
-9	1300	1500	1800	2700	~	~	~	~	~	~	~	~	~	~	~	~		~			~			6000			3500	-9
-10	1500	1500	1800	2700	~	~	~	~	~	~	~	~	~	~	~			~			~			6000			3500	-10
-11	1300	1500	1800	2700	~	~	~	~	~	~	~	~	~	~	~			~			~			6000			3400	-11
-12	1300	1300	1500	2200	~	~	~	~	~	~	~	~	~		~			~			~			7000			3700	-12
-13	1500	1500	1800	1800	~	~	~	~	~	~	~	~			~			~			11000			6000			3700	-13
-14	1500	1500	1800	2200	~	~	~	~	~	~	~	~			~			~			11000			8000			3700	-14
-15	1500	1800	2700	~	~	~	~	~	~	~		~			~			~			11000			8000			3700	-15
-16	1800	1800	2700	~	~	~	~	~	~			~			~			~			11000			8000			3700	-16
-17	1500	2200	1700	~	~	~	~	~	~			~			~			~			8000			8000			3700	-17
-18	1500	1800	2700	~	~	~	~		~			~			~			~			8000			9000			3800	-18
-19	1800	2200	3500	~	~	~			~			~			~			~			8000			9000			3800	-19
-20	2200	3500	~	~	~	~			~			~			~			~			8000			9000			3800	-20
-21	3500	1400	~	~		~			~			~			~			~			8000			9000			3800	-21
-22	3500	1400	~			~			~			~			~			~			8000			9000			3800	-22
-23																												-23

"For 2-3 hours ahead, we have seen guidance trending toward MVFR, ceilings 015-018..."

Probabilistic Calibration

Sharpness Diagrams

- *How often does the model forecast produce probability-of-occurrence at XX%?*

Discrimination Curves

- *Given the occurrence of YES vs. NO events, what are the relative frequencies of binned forecast probabilities?*

Attributes Diagrams

- *If the forecast probability is XX% chance in a given hour, how often does that actually occur?*

Wrap-Up

Summary

Turnover/short-staffing in 2023, now back to full-force

Good to be humble…"OK, it's here, now when's it going away?"

ZSE shifts feature numerous routine/ad-hoc briefings to partners via multiple methods

Considerable internal collaboration between NWS teams

ZSE will work to incorporate ProbIDSS strategy in operations

Additional effort to be put toward revamping forecast verification (e.g., NBM, TS)

Thank you!



We'd love to hear from you!

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US National Weather Service Seattle Center Weather Service Unit

Revisiting Operational Decision Criteria

Mountain Wave Intensity		
Wave Intensity	Vertical Speed	IAS Change
Light	<=200 fpm	+/- 10kts
Light/Moderate	201-400 fpm	+/-15 kts
Moderate	401-550 fpm	+/- 20 kts
Moderate/Strong	551-650 fpm	+/- 25 kts
Severe	>650 fpm	> +/- 25 kts

These rates greatly exceed the climb performance of most light aircraft, particularly at the higher altitudes encountered in the west.

Note: In still air at 7,000 ft, the typical climb performance of small aircraft is 300-500 fpm.

Revisiting Operational Decision Criteria

Wind shear layers and proper inclusion in TAFs

Thunderstorm impacts at main terminals vs. en-route/in STARs

Ceilings within critical TRACON areas