These multiple severe pireps reinforce the issuance of the NOVEMBER #1 SIGMET for SEVERE TURBULENCE.

Automated graphics on NWS AWC Twitter. You can follow on Twitter "@NWSAWC"
THE UPCOMING SHEAR TURBULENCE INDICES SUPPORT THE DECISION FOR EXTENDING NOVEMBER #1 SEVERE TURB SIGMET.

Automated graphics on NWS AWC Twitter. You can follow on Twitter “@NWSAWC”
The red oval displays upper level trough and coincides with large swath of shear moving thru the region.

The red oval depicts trapped lee mountain waves throughout the Southwest region.
The Bulk Shear Mag Image in the red oval is showing good potential for severe turb. As well, the streamlines are depicting a trough axis over the region.

The Bulk Shear Mag Image by 28th at 00Z still shows good shear and wind direction for favorable cross-barrier flow.
The Bulk Shear Mag Image depicts weak shear, but the winds are showing a good speed shear zone.

The Bulk Shear Mag Image shows really weak shear on 28th/00Z, but the wind direction remains in good cross-barrier flow.
The Shear Buoy Prod/Dissipation depicts really weak shear, but the Streamlines depict a trough axis over the eastern Utah region. This weak shear in the lower levels will help the vertical wave to propagate upward to upper levels.

The TKE Shear Buoy Prod/Dissipation shows the shear increasing, but still is minimal. This weak shear will continue to enhance the ability for the vertical propagating waves by not tearing the wave apart.
The TKE Shear Buoy Prod/Dissipation depicts marginal shear and streamlines showing trof axis over eastern Utah.

The TKE Shear Buoy Prod/Dissipation shows increasing shear through 21Z. The trof axis has moved over to Utah/Colorado border.
The RAPGTG CATEDR “Clear Air Turbulence (CAT) Eddy Dissipation Rate (EDR)” and RAPGTG “MTNWV” Composite indicate the same strength/vicinity of potential severe turbulence depicted in the red ovals.
The RAPGTG CATEDR Composite continues to indicate potential for severe turb and has slightly stronger indices than the MTNWV Composite. While both RAPGTG Composite’s continue to indicate potential for severe turbulence.
Comparing “RAPGTG CATEDR” vs. “RAPGTG MTNWV to reported SEV TURB PIREP’s…both RAPGTG CATEDR and MTNWV depict excellent potential for severe turbulence.
Comparing RAPGTG CATEDR vs. RAPGTG MTNWV to SEV TURB pireps depicted using “SEV TURB symbols.” Both diagnostics show excellent potential for severe turbulence.
The RAP Vertical Wind Shear Squared images are both indicating good potential for mod-SEV turbulence as the upper level trof moves eastward during this mountain wave event.
The RAP Vertical Wind Shear Squared through 00Z Jan 28th, 2020 depicts hardly any shear.
The red oval depicts strong wind maxima above the ridge top and indicates ridge-top acceleration of the flow. This mountain ridge top flow acceleration is an excellent forcing mechanism for vertically propagating waves.
RAP 250mb winds for both times depict strong northwesterly flow with the nose of a right-front quadrant jetcore approaching the northwest border of the Utah/Arizona region.
RAP 200mb wind depicts weakening westerly flow. Stronger flow by 00Z time-frame southward of the Utah/Arizona border.
The 300mb wind shows strong northwesterly cross-barrier flow and strong nose of jet core moving through northwest Utah.

Red oval depicts RAPGTG CATEDR showing good potential for mod-SEV turbulence where SEV PIREPS are observed.
KSCL sounding from 12Z shows very weak vertical wind shear. By 00Z, the KSCL sounding shows a forward shear turbulence profile. Even though this is not the exact soundings of the cross-sections, it’s still directly upstream with the same dynamic-synoptic regime. The 00Z sounding has several layers of stronger static stability, which leads to trapped waves. The layer between the ridge top and tropopause is characterized by weak shear - this is key in allowing the vertical propagating wave to reach and punch through the tropopause without being torn apart.
Cross-section over the southern Utah region displays the strong up/downward vertical motion and the vertical propagating wave. Where the wave breaks through the tropopause is a good indicator of where to expect SEVERE TURBULENCE.
Comparing the Utah Cross-section from Jan 27th, 2020 at 21Z...to Jan 28th, 2020 at 00Z...the blue ovals are possibly showing the Hydraulic jump.

The white ovals indicate layers of trapped stability between 2 layers of instability. These transitions will potentially have excellent shear zones.

Christa Jacobs did a great job on issuing NOVEMBER SIGMET #1, and then Amy Macpherson issuing NOVEMBER SIGMET #2.
The Upcoming Slides are WRF 3km Model Displaying:

- N-S Topography Cross-Section at “111.6 W” on Jan 27th, 2020
- E-W Topography Cross-Section at “38.3N” on Jan 27th, 2020
- SW-NE Topography Cross-Section from “113.1W-110W” on Jan 27th, 2020
MLF - Milford, Utah “38.39N 113.01W”
HVE - Hanksville, Utah “38.37N 110.7W”
UAL - “36.56N 111.10W”

WRF 3km N-S Topography Cross-Section: “111.6 W” on Jan 27th, 20

WRF 3km N-S Cross-Section: “111.6 W” on Jan 27th, 20 at 1800Z
Positive U winds are from the west.

MLF - Milford, Utah “38.39N 113.01W”
HVE - Hanksville, Utah “38.37N 110.7W”
UAL - “36.56N 111.10W”
WRF 1km E-W Cross-Section: “38.3N” on Jan 27th, 20 at 1500Z

WRF 3km E-W Cross-Section: “38.3N” on Jan 27th, 20 at 1800Z
Positive U winds are from the west.

Hydraulic jumps

MLF - Milford, Utah “38.39N 113.01W”
HVE - Hanksville, Utah “38.37N 110.7W”
UAL - “36.56N 111.10W”
MLF - Milford, Utah “38.39N 113.01W”
HVE - Hanksville, Utah “38.37N 110.7W”
UAL - “36.56N 111.10W”

Positive V winds are from the south.
MLF - Milford, Utah “38.39N 113.01W”
HVE - Hanksville, Utah “38.37N 110.7W”
UAL - “36.56N 111.10W”

“Y-Wind Comp.” Positive V winds are from the south.
HVE - Hanksville, Utah  “38.37N 110.7W”

UAL - “36.56N 111.10W”

Hydraulic jumps

Positive V winds are from the south.

“Y-Wind Comp.”

MLF - Milford, Utah  “38.39N 113.01W”

WRF 3km E-W Cross-Section: “38.3N” on Jan 27th, 20 at 1800Z

WRF 3km E-W Cross-Section: “38.3N” on Jan 27th, 20 at 1500Z
MLF - Milford, Utah “38.39N 113.01W”
HVE - Hanksville, Utah “38.37N 110.7W”
UAL - “36.56N 111.10W”

Positive V winds are from the south.

Hydraulic jumps

“Y-Wind Comp.”
Positive U winds are from the west.

Positive V winds are from the south.

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WRF 3km E-W Cross-Section: “38.3N” on JAN 27th, 20 at 1800Z

WRF 3km N-S Cross-Section: “38.3N” on Jan 27th, 20 at 1800Z

Positive V winds are from the south.

“Y-Wind Comp.”
Positive V winds are from the south.

“Y-Wind Comp.”
Positive V winds are from the south.

MLF - Milford, Utah “38.39N 113.01W”
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“X-Wind Comp.”
Positive U winds are from the west.

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Positive U winds are from the west.
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HVE - Hanksville, Utah “38.37N 110.7W”
UAL - “36.56N 111.10W”

Positive V winds are from the south.

“X-Wind Comp.”

“Y-Wind Comp.”
The start of first hydraulic jump begins by 12Z and major hydraulic jump occurs at 15Z. This coincides with the moderate-to-severe turb pirep at “FL310” at 1455Z over UAL.

The next two moderate-severe turb pireps occur over MLF & HVE at 1750Z & 1736Z.
WRF “3km” N-S OMEGA & POTENTIAL TEMPS LOOP
cross-section: at “111.6 W”
times: times: 01/27/20 from 0600Z - 01/28/20 at 0000Z.

MLF - Milford, Utah “38.39N 113.01W”
HVE - Hanksville, Utah “38.37N 110.7W”
UAL - “36.56N 111.10W”
WRF "3km" N-S "Y-WIND COMPONENT & POTENTIAL TEMP LOOP
Cross-Section: at "111.6 W"
TIMES: 01/27/20 from 0600Z - 01/28/20 at 0000Z.
WRF “3km” E-W Cross-Section at 38.2N Jan 28th, 20 at 0000Z

WRF shows excellent hydraulic jumps or breaking gravity waves.

NAM12 “4-5km” Resolution Cross-Section Jan 28th, 20 at 0000Z

NAM12 struggles with showing hydraulic jumps but instead just shows areas of instability.

Vertical Propagating Wave Potential Hydraulic Jump

Areas of instability

Hydraulic jumps

Hydraulic jumps
CONCLUSION:

● Good cross-barrier flow in northwesterly flow. Typically prefer to see perpendicular flow across the mountain ridges.

● Forward Wind Shear as the wind increased with height.

● Several strong stability layers between instability layers displayed in cross-section - indicated trapped waves (as observed on the visible satellite imagery), and the 1.6 rule of thumb with 200mb winds 1.6 greater than ridge-top winds.

● Shear between the ridge top and tropopause was weak. Allowed the vertically propagating wave to eventually punch through the tropopause.

● Northwesterly orientated 250 & 300 hPa jet-core with right-front quadrant moving over Utah from the west. Provided:
  ○ Highly favorable area for subsidence
  ○ Mountain-waves
  ○ Downslope winds, and downward vertical motion

● Cross-section using Omega, Potential Temperature, wind speed, and depicted:
  ○ Rise/fall couplets
  ○ Stable layers aloft
  ○ Vertically propagating waves
  ○ Near 300mb is where the wave punched through the Tropopause, and indicates where you would expect severe turbulence to occur.

● Thanks for those who helped complete this mountain-wave research:
  ○ Ryan Solomon, Brian Pettegrew, Jesse Sparks, Jonathan Leffler, Emily Neibuhr, Steven Silberberg

● Questions?