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S589: Venting

Original material developed by Mike Pistilli
Planning and Information Coordinator, Northwest Region
Aviation, Forest Fire, and Emergency Service, Ontario

Adapted for the 2022 WFBS Course, S589 Module
Richard Carr, Natural Resources Canada – Canadian Forest Service

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Heading: Arial 32pt centred, vertical=0.5cm

Section Title: Corbel 40pt centred hor.

Text: Level 1 = Calibri 28 pt

Text level 2 = Calibri 24pt

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Objectives

- **Describe venting and its effects on fire behaviour**
- **Calculate the venting index by calculating the atmosphere's mixing height and winds**

Venting

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- The ability of the lower atmosphere to mix and transport smoke through the boundary layer (normally considered to extend up to 3000', or 1000m AGL)
  - Can be higher, especially in unstable air masses
  - During a surface inversion the ability of the atmosphere to disperse smoke is virtually zero

Ventilation Index

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- What is it?
  - It is a crude estimate of how well smoke released into the atmosphere will be carried away from the surface during the afternoon –i.e. will the valley be cleaned up quickly?
- How is it calculated?
  - Using the mixed layer depth (m) multiplied by the wind speed (m/s).

Ventilation Index

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CAUTION!

- It is not related to calculation of the Air Quality Index
- It was not designed for small fires in cold valleys, it was designed for large fires on level ground.
- Clear and cold winter days are usually poor venting days.
- It has little to do with the way a plume behaves near the ground.

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- Low mix
  smoke t
  surface:
  - Poor
  - Poor
  - Firin

Ventilation Index

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- High mixing heights usually allow for the dispersion of smoke through a deeper part of the atmosphere
- Burn operations are more successful when dispersion is good
- Categorized as Poor, Fair, or Good

Mixing Height

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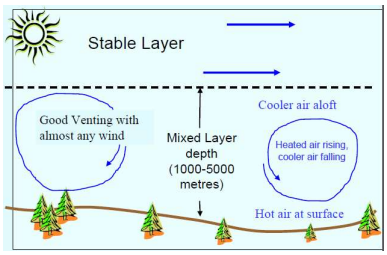
- The top of the surface layer where a parcel of air (smoke) stops rising
- This layer is turbulent and well mixed together



Mixing Height

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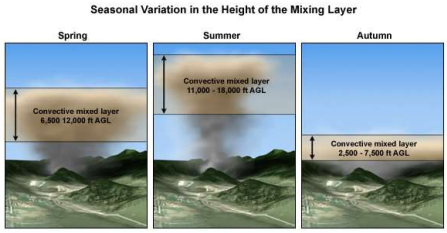

Mixing Height

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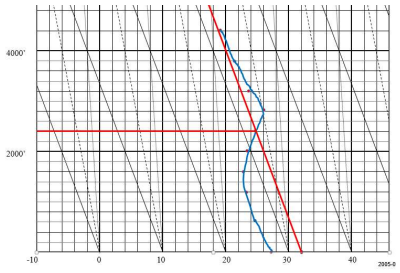
- Calculating the afternoon mixing height
  - Using the 00 UTC sounding if available
  - Extend the temp profile to the max temp for the day (use forecast if earlier in the day)
  - Follow a line using the dry adiabatic lapse rate until it intersects the temperature profile



Mixing Height

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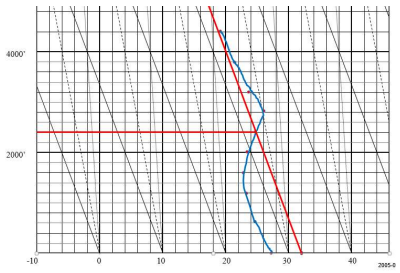
- Estimating the afternoon mixing height
  - Extend the temp profile to the forecast maximum temp for the day, or
  - Using the 00 UTC sounding if available
  - Follow a line using the dry adiabatic lapse rate until it intersects the temperature profile (assuming air is dry throughout this layer)



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Transport Winds

- Important factor in smoke management forecasts
- The average speed and direction of all winds in the mixing layer
- Used to predict horizontal smoke dispersion

The higher the wind speed, the lower the concentration of smoke, and the better the venting.

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Venting Exercise

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Venting Exercise

- Required
  - WFBS spreadsheet
  - Blank Thermodynamic diagram

WFBS Spreadsheet

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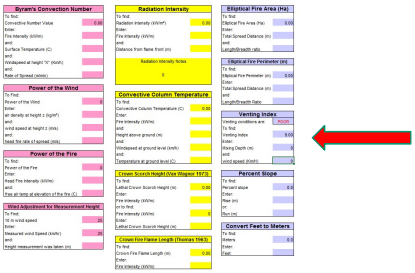

WFBS Spreadsheet

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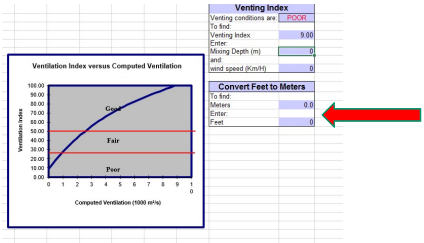

Thermodynamic (Stuve) diagram

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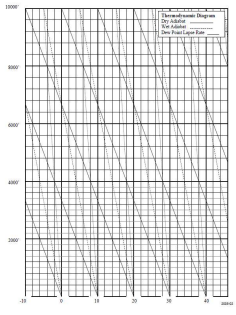
- **Electronic versions of this are available in the course material (*ThermodynamicDiagram.pdf*, *StuveDiagram.png*).**
- **Be sure you have this on your computer.**
- **It is probably easiest to load into a Word or Powerpoint document and annotate the diagrams there.**



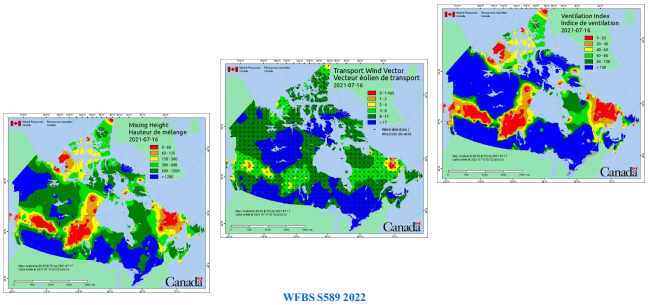
Calculate Venting

- Plot the temperature profile on the diagram
- Max temperature for the day was 24C
- Calculate the mixing height by following the dry adiabatic from the max temp until it crosses the temp profile
- Calculate the average winds within the mixing layer

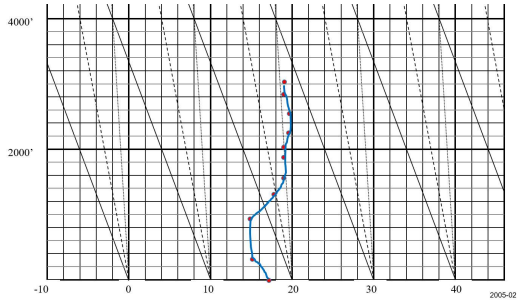
Minisonde sounding for Oct 20, 2017 at 17 UTC

Time[min:sec]	P[hPa]	T[C]	RH[%]	Wsp[km/h]	Wdir[Grd]	Lon [-]	Lat [-]	Altitude[ft]	GeoPot[ft']
0:00	956.2	17.4	57	6	113	-93.0004	49.0539	0	0
0:16	944	15.3	58.8	14.8	115.8	-93.001	49.0546	358.9	357.3
0:40	926.5	15.1	61.5	22	161.6	-93.0015	49.0558	881.9	874
1:04	914	18.6	53.9	32.3	174.8	-93.0015	49.0576	1260.9	1254
1:28	903.9	18.9	47.8	38.1	175.6	-93.0017	49.0599	1570.3	1562.4
1:52	895.2	18.8	48	43.5	182.8	-93.0018	49.0626	1845.8	1836.2
2:08	889.5	19	47.2	47.1	190.2	-93.0014	49.0644	2025.9	2015.6
2:32	881.2	19.9	43.2	50.3	202.8	-93.0001	49.0673	2287.7	2277.5
2:56	872.8	19.8	41.7	55	209.3	-92.9979	49.0703	2560.1	2548
3:20	864.3	19.3	42	59.9	211.5	-92.9951	49.0734	2836.3	2823.5
3:36	858.8	19	42.1	63.1	211.7	-92.9931	49.0756	3014.6	3001.1

Some CWFIS Examples



Venting Exercise – Temperature Profile



Calculate Wind

- Sum of all wind values to 1600'
- 113.2 / 5 = 22.6 km/h

Minisonde sounding for Oct 20, 2017 at 17 UTC

Time[min:sec]	P[hPa]	T[C]	RH[%]	Wsp[km/h]	Wdir[Grd]	Lon [~]	Lat [~]	Altitude[ft]	GeoPot[ft]
0:00	956.2	17.4	57	6	113	-93.0004	49.0539	0	0
0:16	944	15.3	58.8	14.8	115.8	-93.001	49.0546	358.9	357.3
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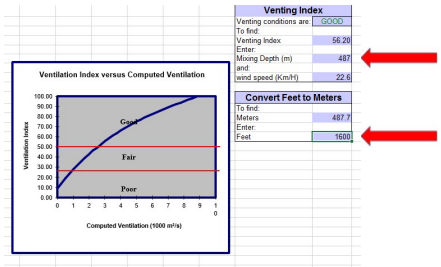
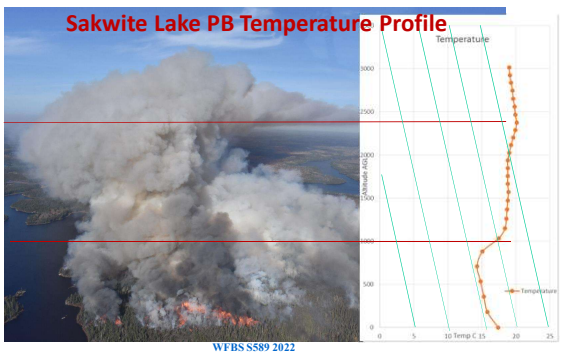
Spreadsheet Inputs



Venting Index	
Venting conditions are:	GOOD
To find:	
Venting Index	56.29
Enter:	
Mixing Depth (m)	487
and:	
wind speed (Km/H)	22.6

Convert Feet to Meters	
To find:	
Meters	487.7
Enter:	
Feet	1600

Sakwite Lake PB Temperature Profile



Sakwite Lake PB Wind Profile

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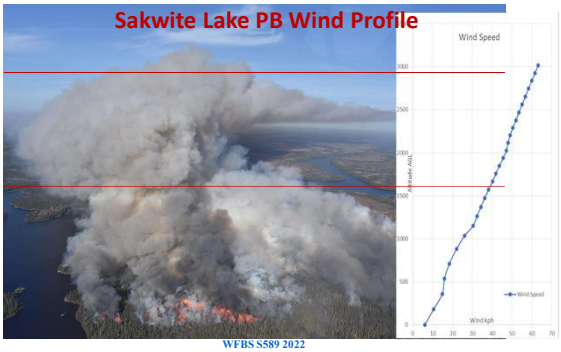

Summary

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- Venting, or the Ventilation Index, is a crude estimate of how well smoke released into the atmosphere will be carried away from the surface during the afternoon
- Uses the mixed layer depth multiplied by the wind speed.

Contact Information

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Contact:
Richard Carr
Wildland Fire Research Analyst

Richard.Carr@NRCan-RNCan.gc.ca

5320 122 Street NW
Edmonton, AB, Canada
T6H 3S5

~~825-510-1265~~ 780-710-3147

Mike Pistilli
Planning and Information Coordinator, Northwest Region
Aviation, Forest Fire, and Emergency Service
Ontario
Mobile: 807-275-6767
mike.pistilli@ontario.ca