

AERSURFACE & AERMOD Sensitivity

Regional/State/Local Modeler's
Workshop

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Contact Information

Karen Wesson

OAQPS/EMAD/AQMG

wesson.karen@epa.gov

Warren Peters

OAQPS/EMAD/AQMG

peters.warren@epa.gov

AERSURFACE Development

Larry Simmons, PE

Energy & Environmental Management, Inc.

Chris Arrington

WV Department of Environmental Protection

Division of Air Quality

What is AERSURFACE?

- *AERSURFACE* is a tool that produces surface characteristics data (Albedo, Bowen Ratio & Surface Roughness) for use in *AERMET/AERMOD*
- Makes use of *CALPUFF* modeling system and USGS Land Use and Land Cover Digital Data (LULC)

Why Use AERSURFACE?

- *AERMOD* seems to be sensitive to the surface characteristics, especially surface roughness
- While *AERMET* User's Guide provides default values, selection is still open to interpretation
- LULC map files, available in 1:250,000 and 1:100,000 scale, provide high resolution land use data [Composite Theme Grid (CTG) <- 30m resolution]
- *AERSURFACE* can provide sector averages for surface characteristics

Applying AERSURFACE

- *CALMET* pre-processors using LULC data
 - USGS LULC data -> land use based on 38 USGS land use categories
 - *CTComp* & *CTProc* -> gridded fractional land use for 38 USGS land use categories
 - *Makegeo* -> gridded albedo, bowen ratio, and surface roughness values based on USGS 38 land use categories (*geo.dat* - *outfile*)

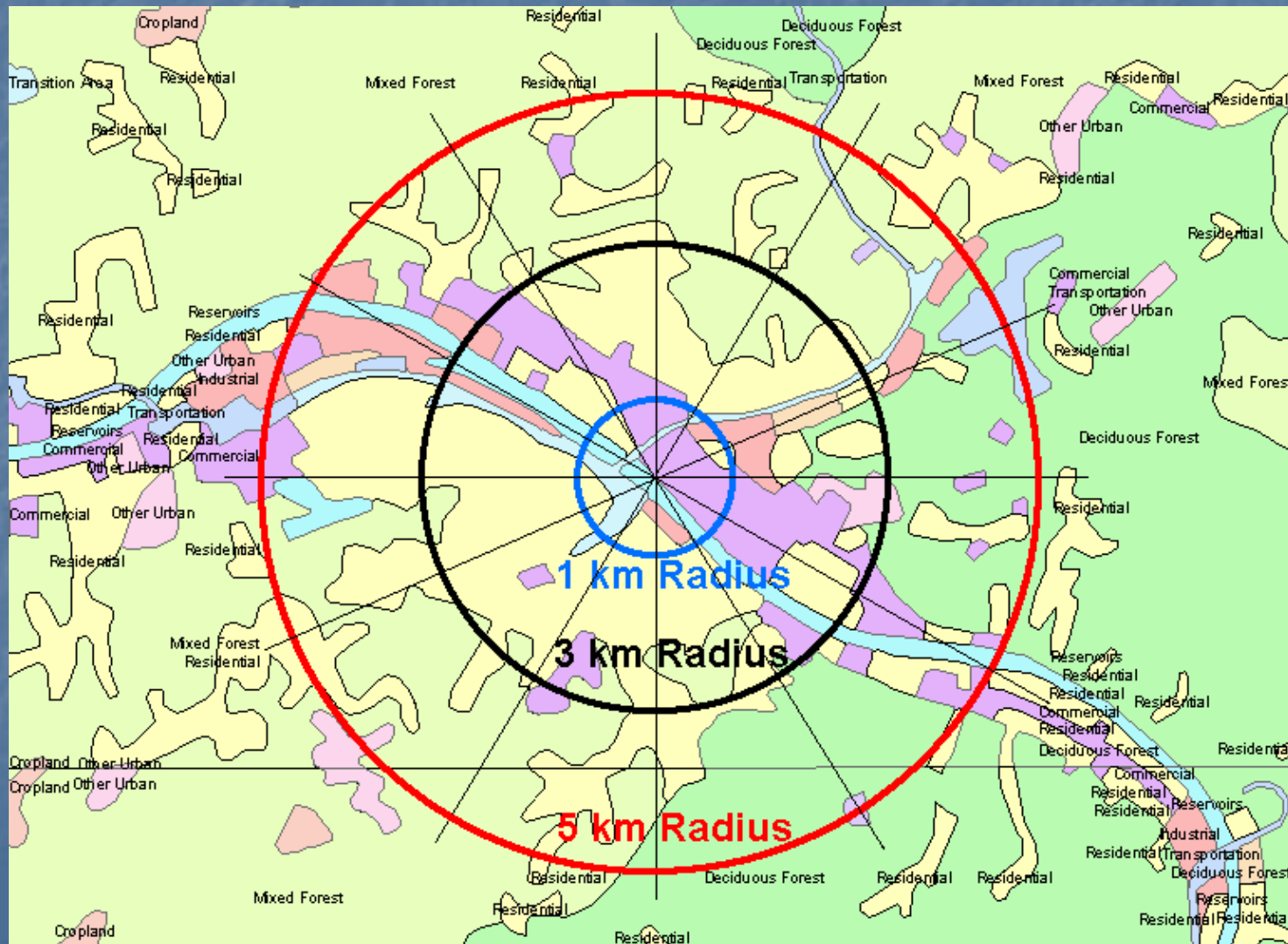
Applying AERSURFACE

- *Geo.dat* is a more manageable in size compared to LULC files
- *Geo.dat* -> gridded file (250m x 250m)
AERMET -> sector averaged file (up to 12)
- Use *AERSURFACE* to transform from gridded field to sector averaged data

Applying AERSURFACE

- *AERSURFACE* is a fortran program that reads *geo.dat* and returns average values of roughness length, albedo, and bowen ratio for 12 sectors
- Specify center location and radius for study area
- Circle parsed into 12 - 30 degree sectors

Applying AERSURFACE



Applying AERSURFACE

- Every 250m x 250m *geo.dat* cell within area is parsed into 625 - 10m x 10m subcells with a radius and angle assigned to each subcell
- Study area and 30 deg sector averages are run on each subcells

AERSURFACE Output

Mean Albedo = 0.10
Mean Bowen ratio = 0.92
Mean Roughness (m) = 0.8308

	Albedo	Bowen	Rough
sector 01 = 000 to 030 =	0.11	0.89	0.7122
sector 02 = 030 to 060 =	0.10	0.97	0.9448
sector 03 = 060 to 090 =	0.10	0.94	0.9267
sector 04 = 090 to 120 =	0.11	0.89	0.7482
sector 05 = 120 to 150 =	0.11	0.94	0.7436
sector 06 = 150 to 180 =	0.10	0.99	0.9336
sector 07 = 180 to 210 =	0.10	0.99	0.9313
sector 08 = 210 to 240 =	0.10	0.97	0.8699
sector 09 = 240 to 270 =	0.10	0.97	0.8888
sector 10 = 270 to 300 =	0.10	0.94	0.8399
sector 11 = 300 to 330 =	0.10	0.97	0.9241
sector 12 = 330 to 360 =	0.11	0.58	0.5064

AERMET Input from AERSURFACE

FREQ_SECT ANNUAL 12

SECTOR 01 000 030

SECTOR 02 030 060

SECTOR 03 060 090

SECTOR 04 090 120

SECTOR 05 120 150

SECTOR 06 150 180

SECTOR 07 180 210

SECTOR 08 210 240

SECTOR 09 240 270

SECTOR 10 270 300

SECTOR 11 300 330

SECTOR 12 330 360

SITE_CHAR 1 01 0.11 0.89 0.7122

SITE_CHAR 1 02 0.10 0.97 0.9448

SITE_CHAR 1 03 0.10 0.94 0.9267

SITE_CHAR 1 04 0.11 0.89 0.7482

SITE_CHAR 1 05 0.11 0.94 0.7436

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SITE_CHAR 1 10 0.10 0.94 0.8399

SITE_CHAR 1 11 0.10 0.97 0.9241

SITE_CHAR 1 12 0.11 0.58 0.5064

AERSURFACE Conclusions

AERSURFACE is a good tool

BUT

where do we go from here?

AERSURFACE Issues

- *Makegeo* makes use of USGS 38 land use categories & surface characteristic values
 - What land use categories should be used?
 - What surface characteristics values should be used?
 - USGS? *Calmet?* *Aermet?*
 - Seasonal variations?

AERSURFACE Issues

- Surface characteristic values for each land use type must be changed in *makegeo.inp* to produce a *geo.dat* file for each season
- *AERSURFACE* is then run for each of the 4 different *geo.dat* files
- Automation for seasonal variation? What values should be used?

AERSURFACE Issues

- Use of *Calmet* pre-processors
 - Currently use *CTComp*, *CTProc*, & *Makegeo*. Should processors be linked to *AERSURFACE*?
 - *Makegeo* requires terrain data file but it's not used in calculation of surface data. Should we automate to bypass use of terrain data?
- Documentation? Update *CALMET* User's Guide / User's Guide for *AERSURFACE*

AERSURFACE Issues

- LULC data from 1970-80's. Problem?
- What radius should be recommended?
- How many sectors should be used?
- Should surface characteristic data be averaged for the total area or for each sector? How should they be weighted?

AERMOD Sensitivity

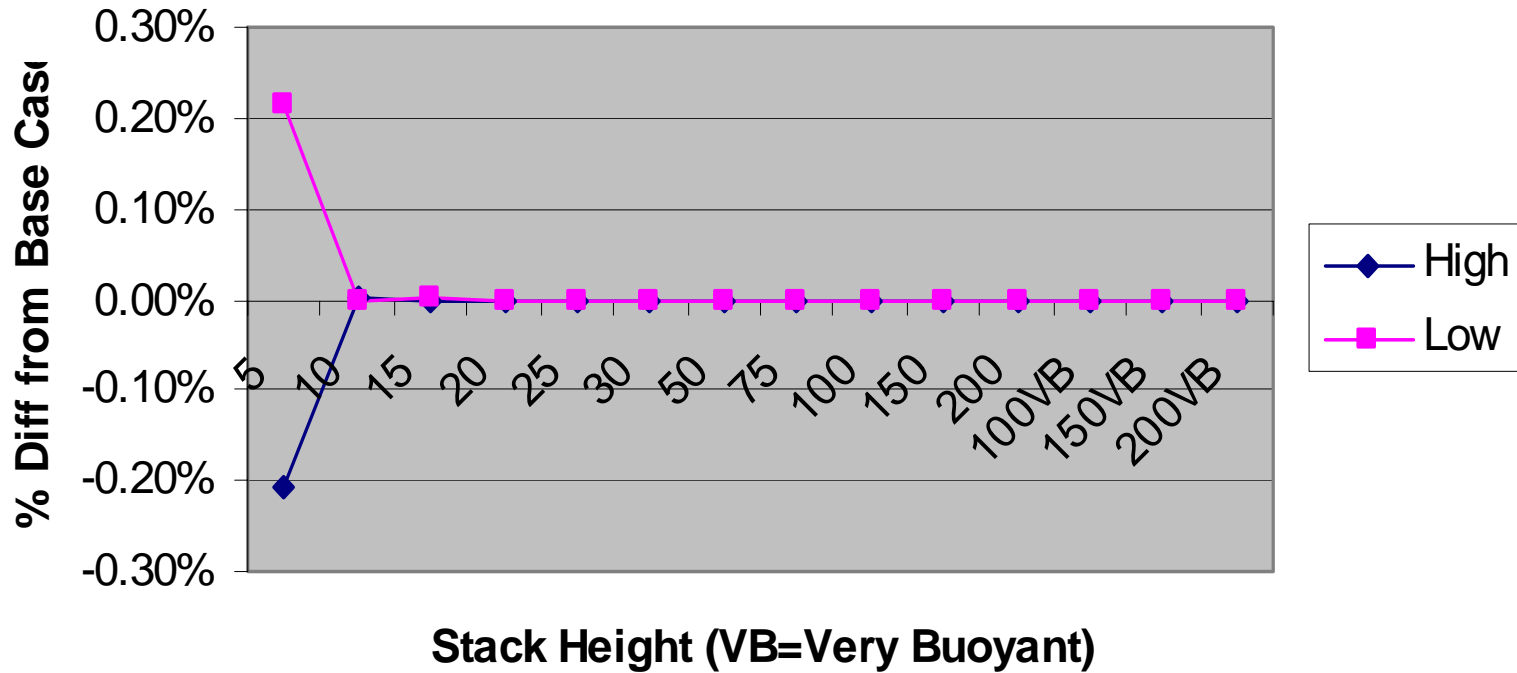
- Many questions could be answered by better understanding the sensitivity of *AERMOD* to variations of surface characteristics.
- Therefore, we have begun a sensitivity study.
 - Using Oklahoma City met data
 - Varying stack height and buoyancy (5-200m)
 - Varying albedo, bowen ratio, surface roughness

Preliminary Results

- Started with a “base case”
 - Albedo = 0.20
 - Bowen Ratio = 1.0
 - Surface Roughness = 0.10
- Used surface characteristics' extremes
(Extreme values based on T. Grosch and R. Lee, “Sensitivity of the AERMOD Air Quality Model to the Selection of Land Use Parameters”)
 - High/Low Albedo = 0.45/0.1
 - High/Low Bowen Ratio = 0.10/10.0
 - High/Low Surface Roughness = 1.3/.0001

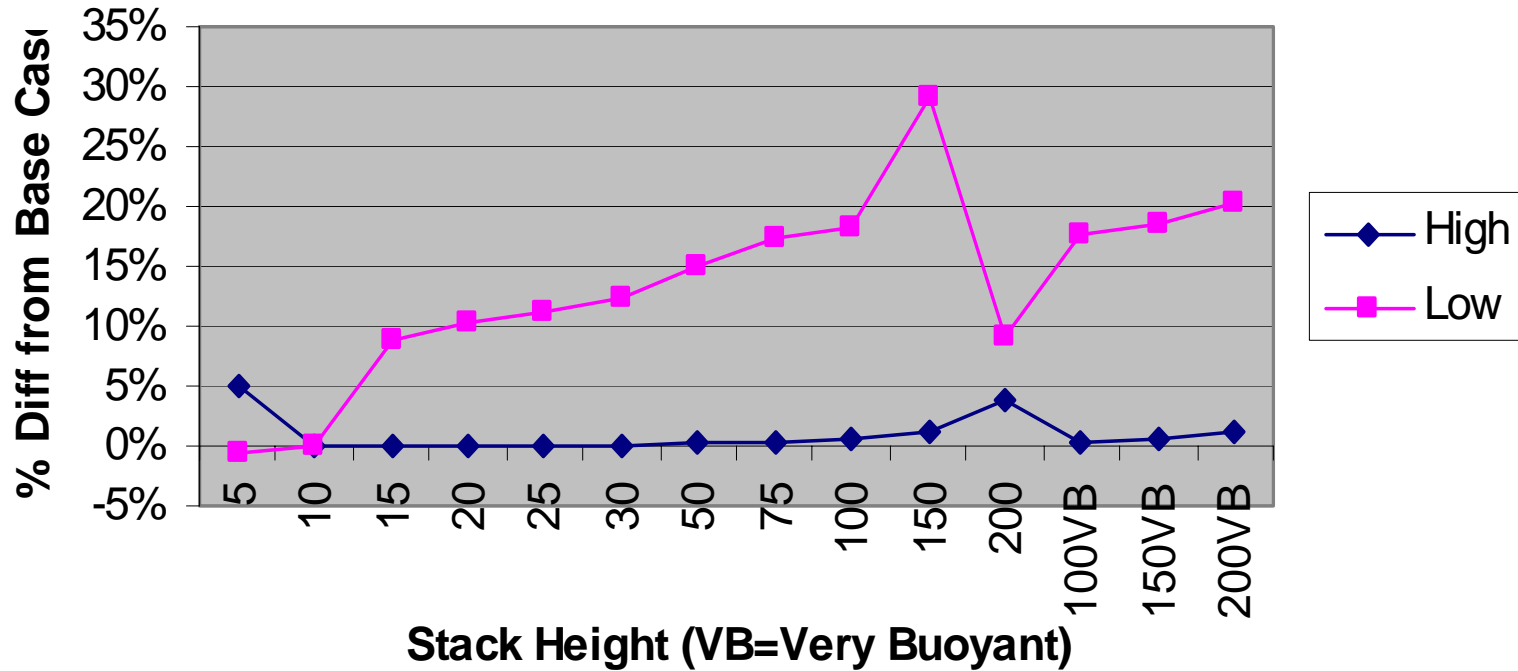
Sensitivity – Bowen Ratio

Bowen Ratio (24-hr)

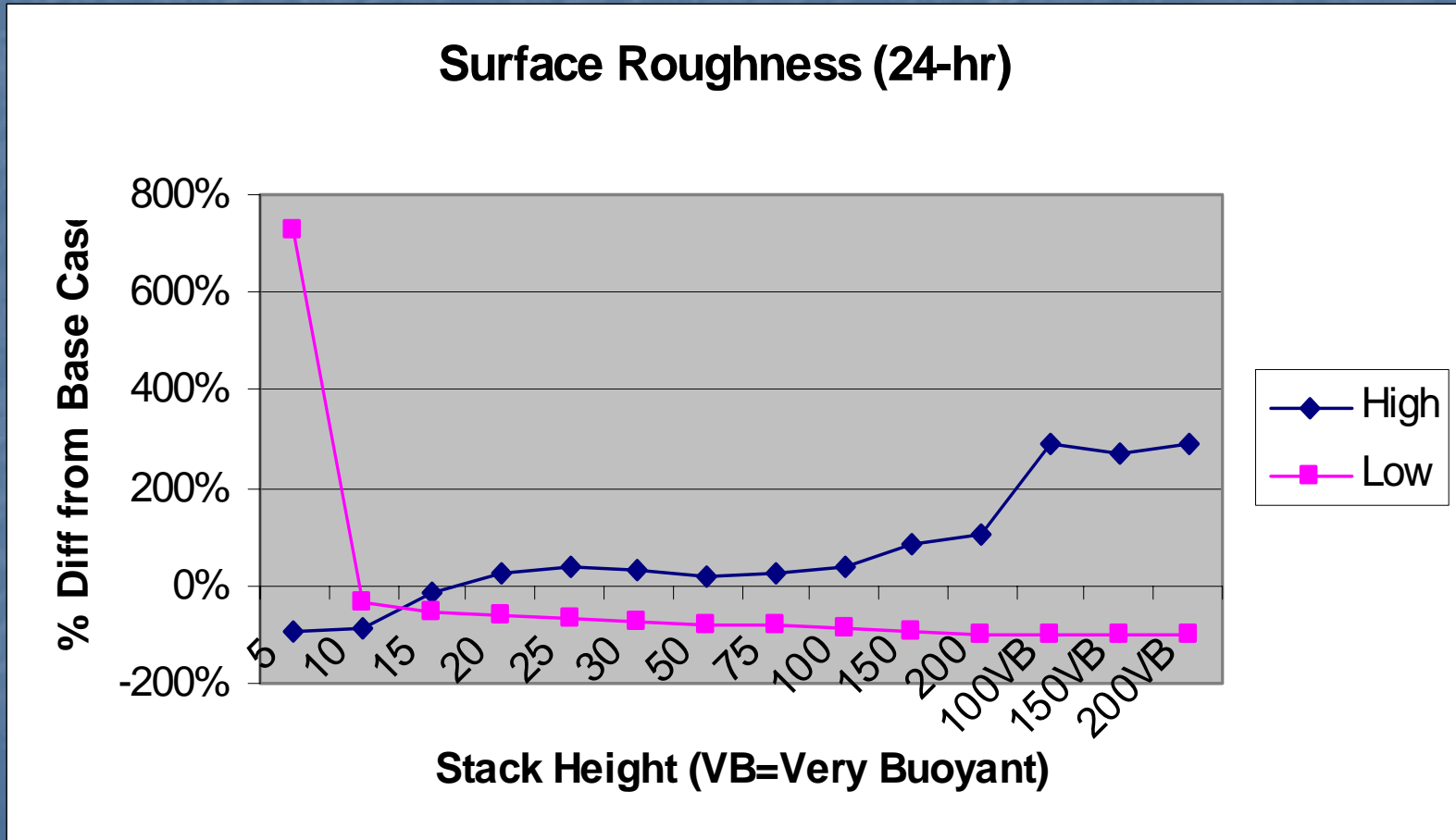


Sensitivity - Albedo

Albedo (24-hr)



Sensitivity – Surface Roughness

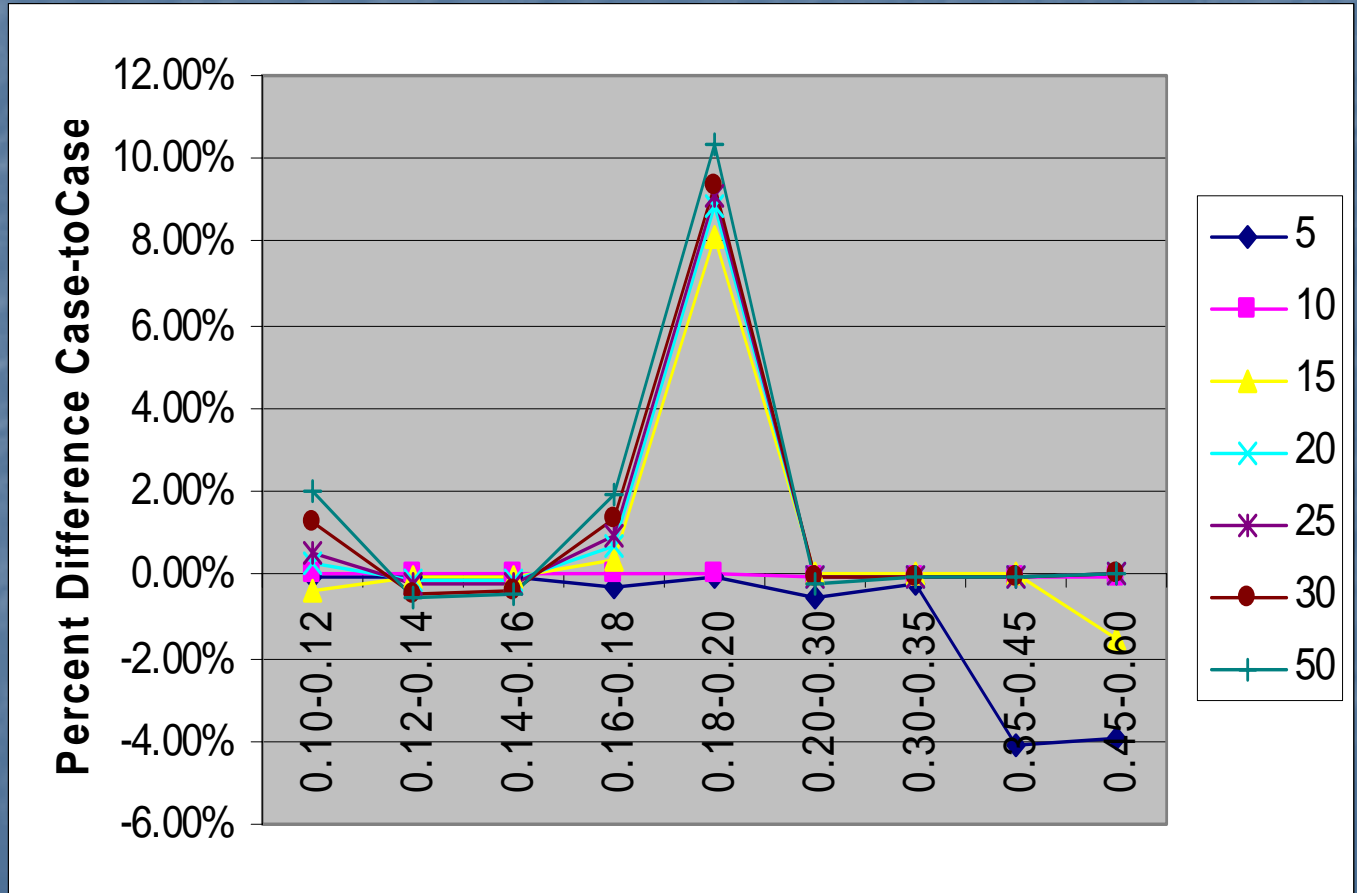


Preliminary Conclusions

- For any stack height, very little sensitivity to changes in Bowen Ratio
- Definite sensitivity to changes in surface roughness – greater sensitivity for shorter, less buoyant stacks
- Some sensitivity to changes in albedo

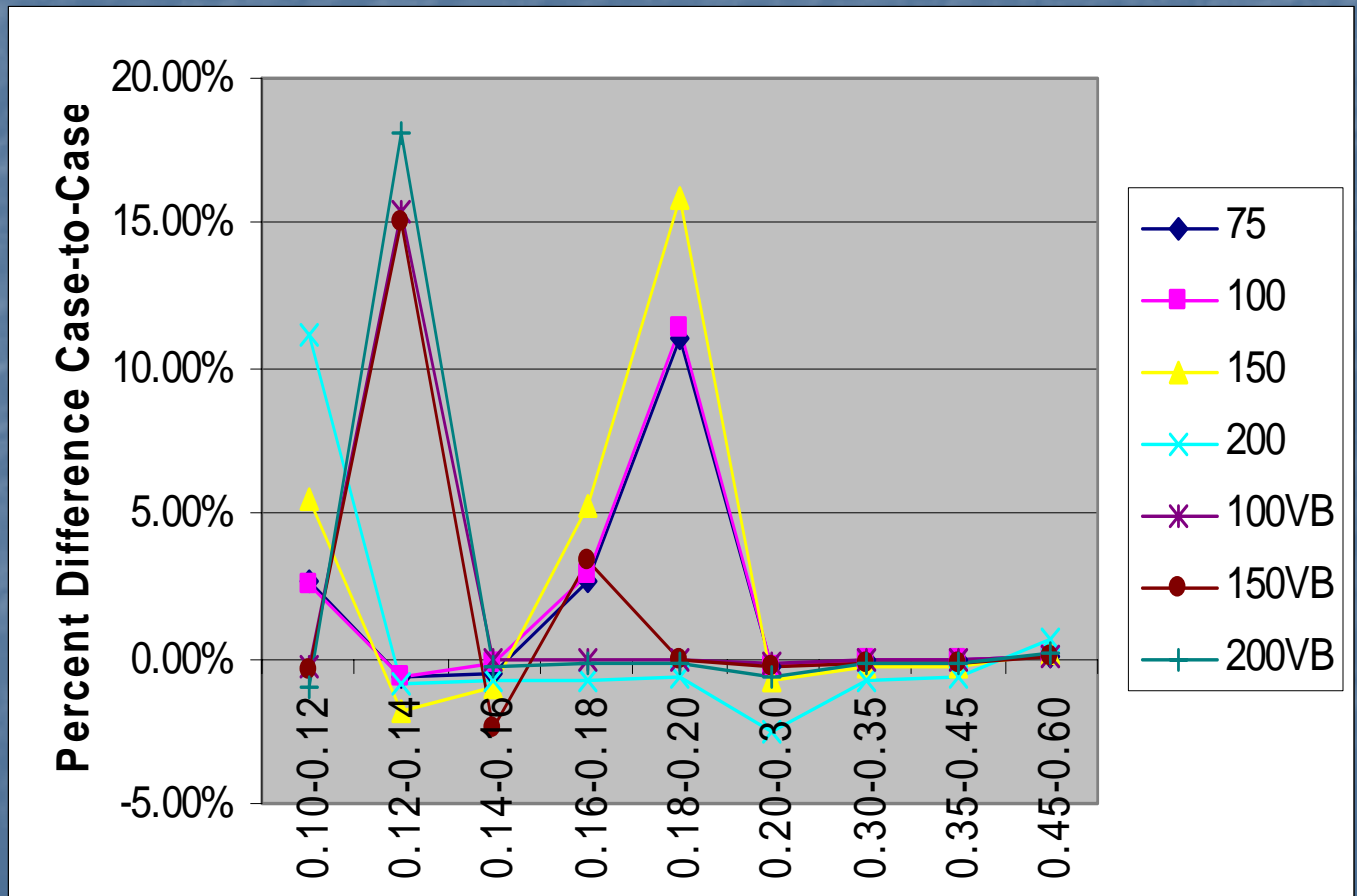
Preliminary Results (Albedo)

Albedo
0.10
0.12
0.14
0.16
0.18
0.2
0.3
0.35
0.45
0.6



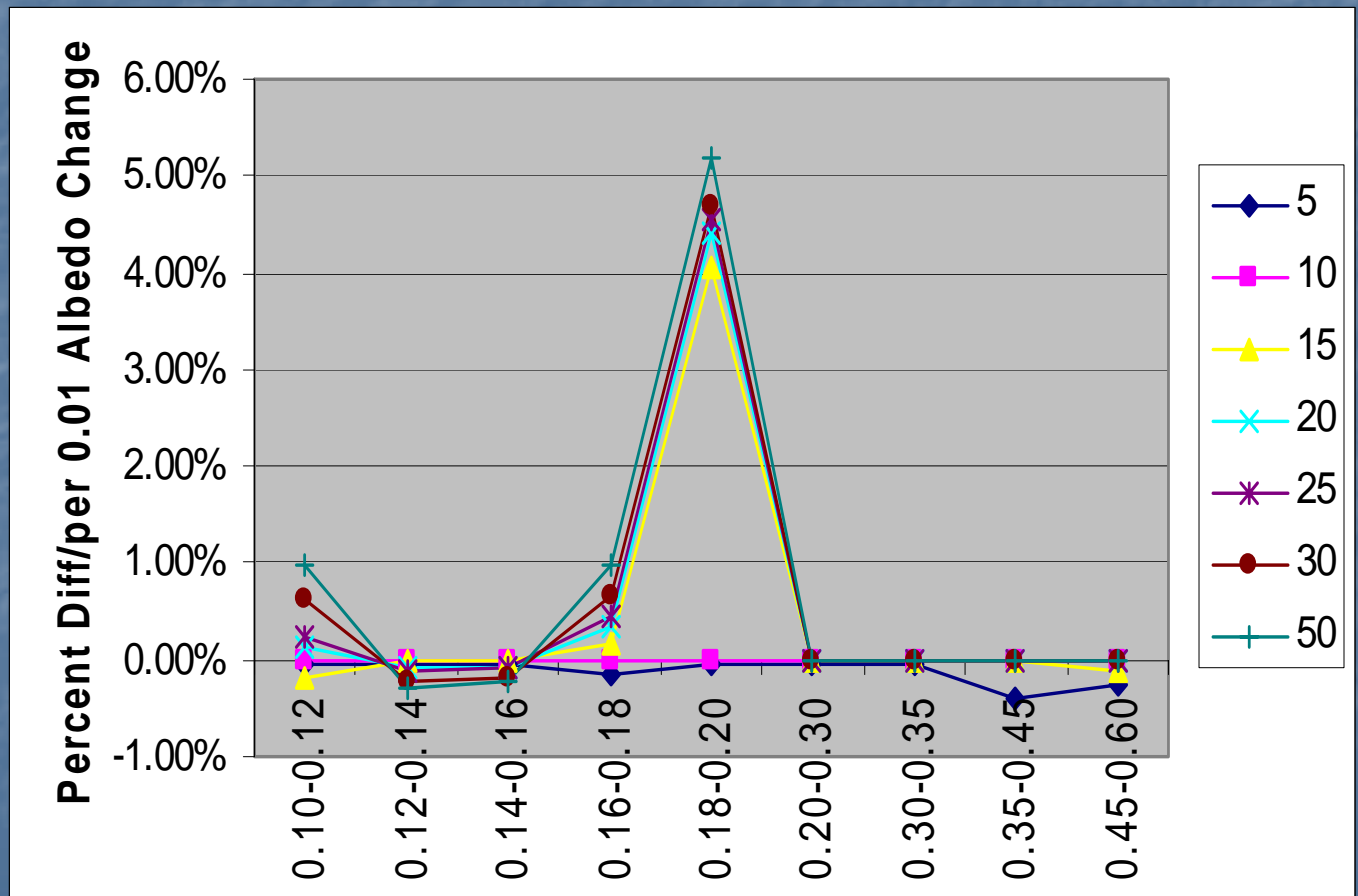
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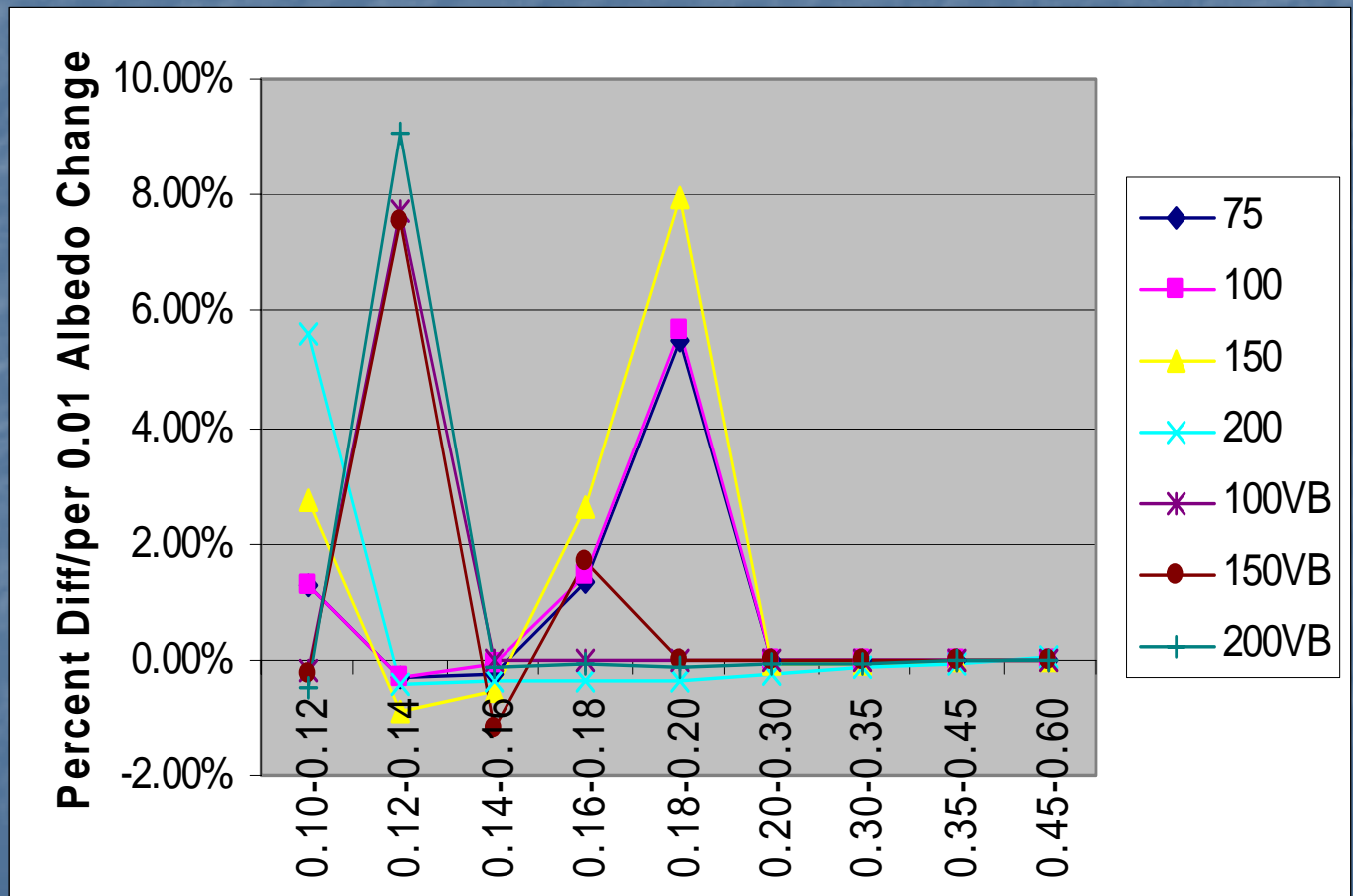
Preliminary Results (Albedo)

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0.12
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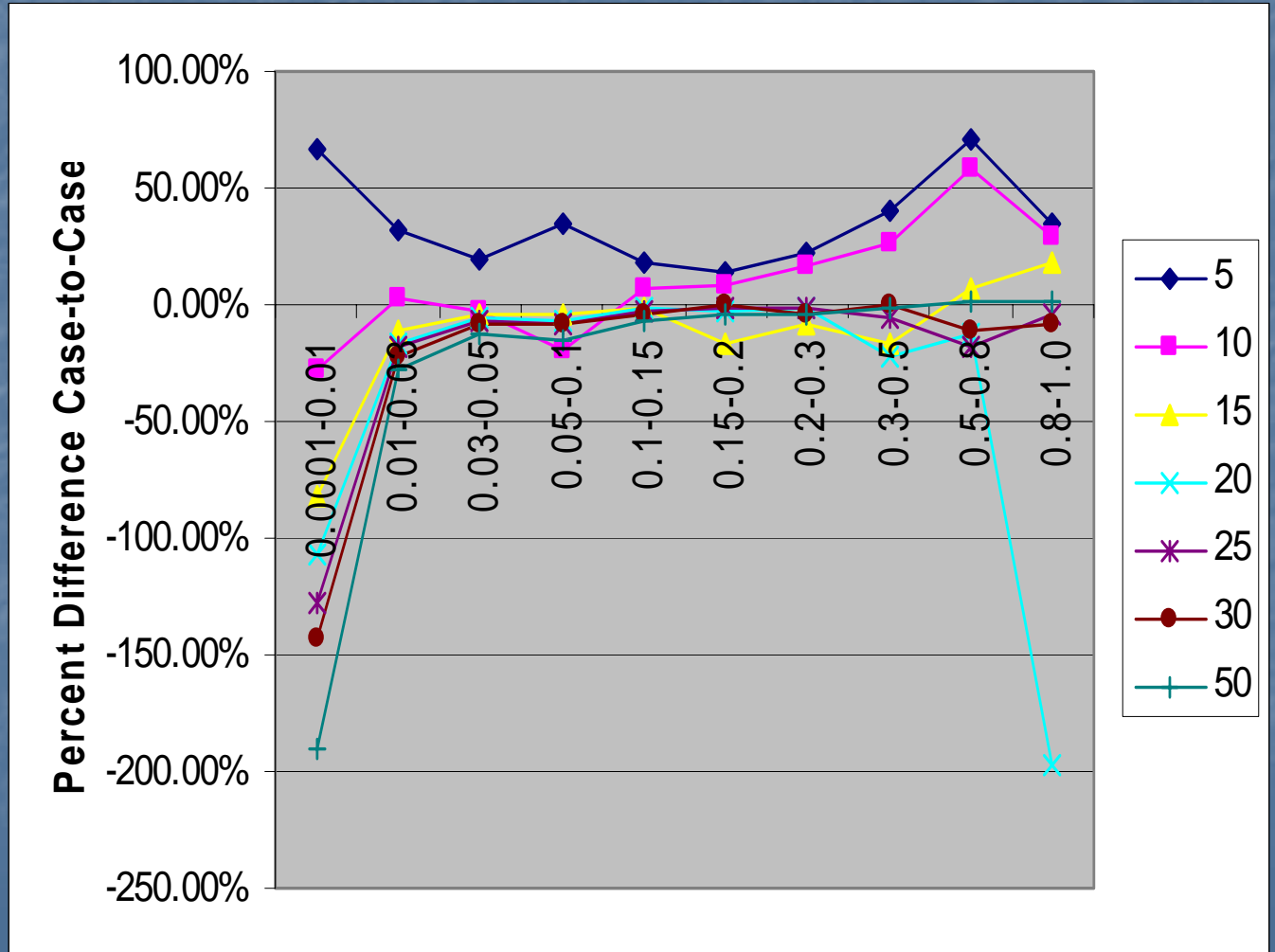
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0.6



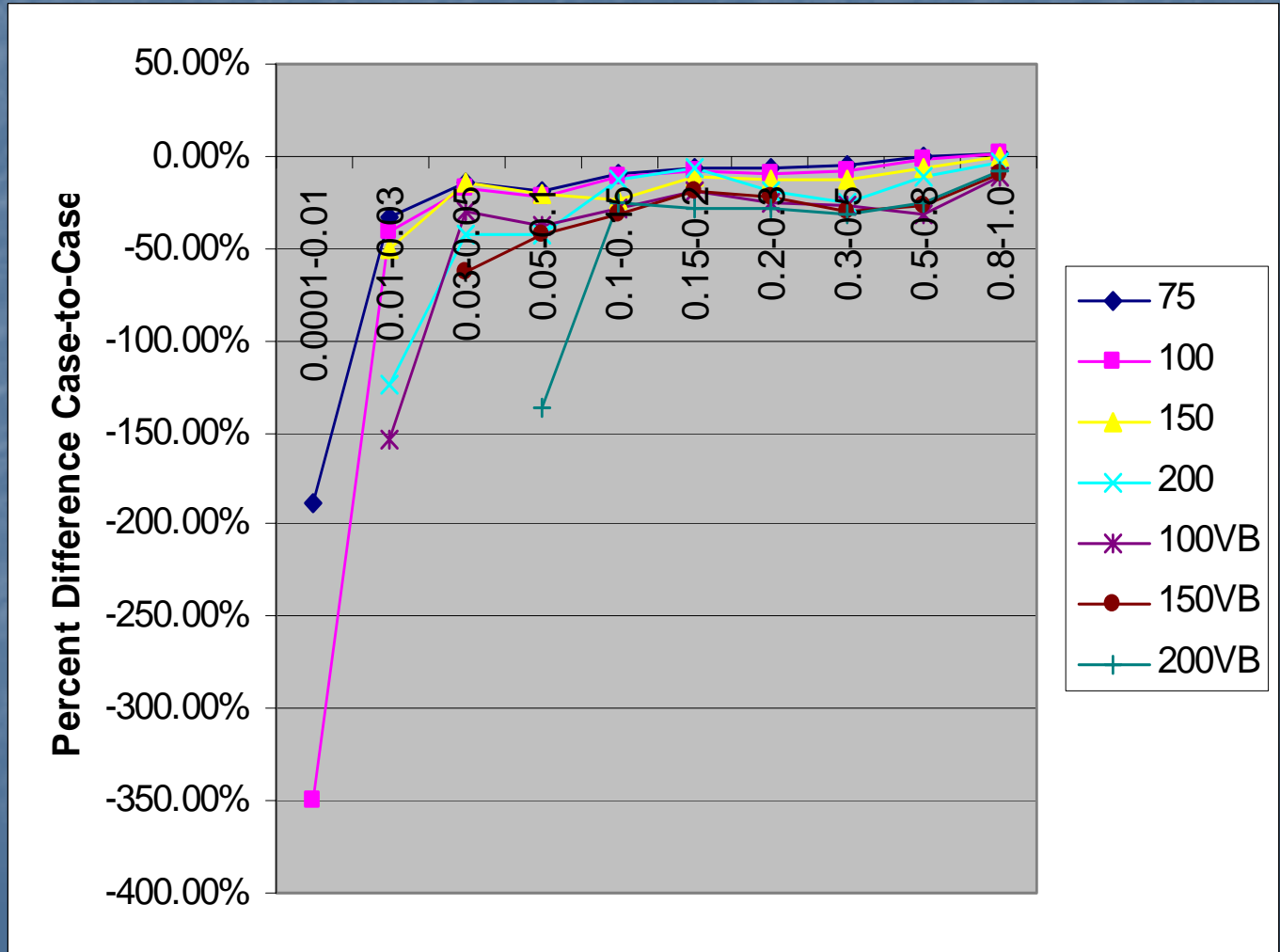
Preliminary Results (Surf. Rough.)

Surf. Rough.
0.0001
0.01
0.03
0.05
0.10
0.15
0.2
0.3
0.5
0.8
1.0
1.3



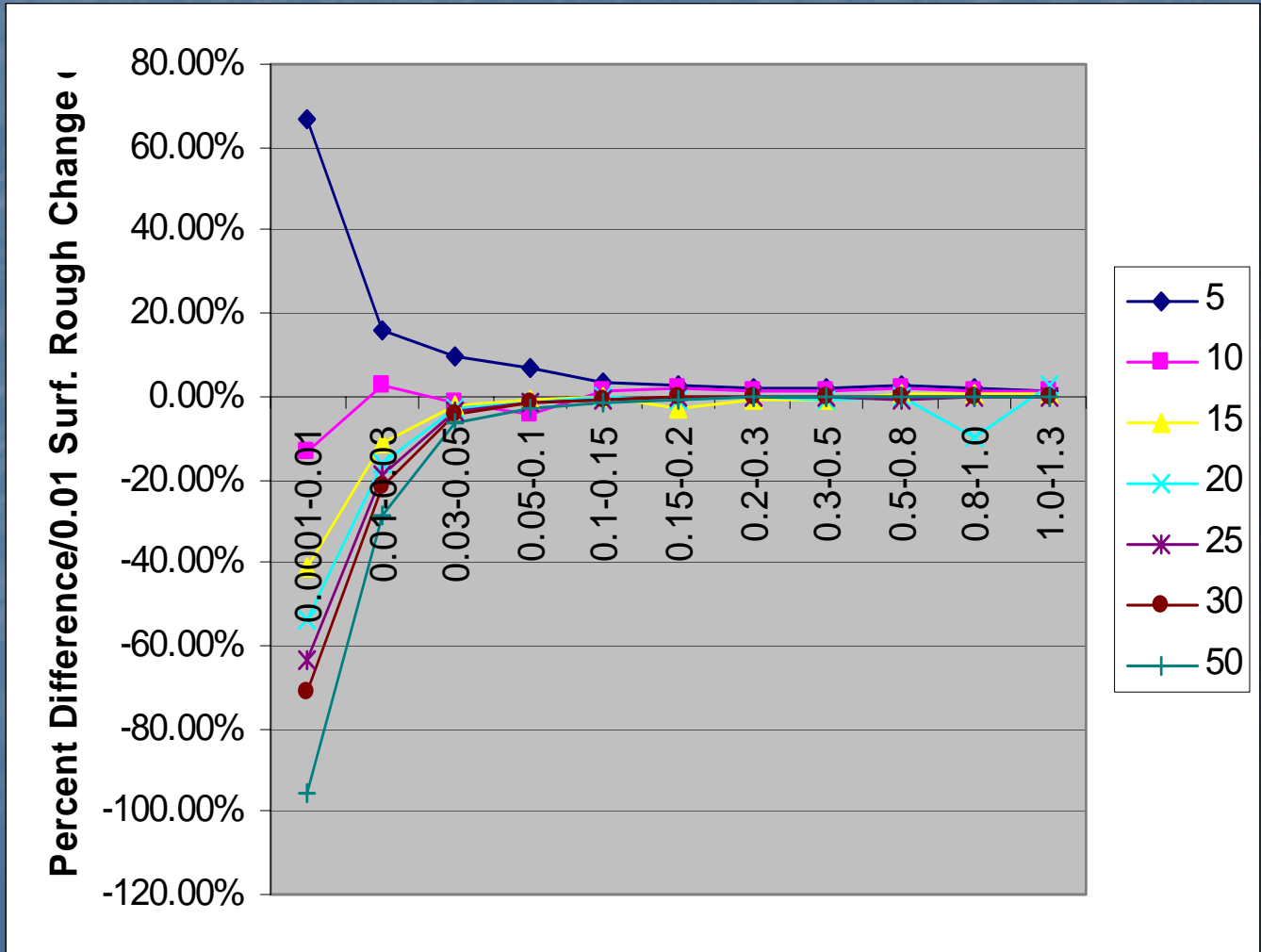
Preliminary Results (Surf. Rough.)

Surf. Rough.
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0.01
0.03
0.05
0.10
0.15
0.2
0.3
0.5
0.8
1.0
1.3



Preliminary Results (Surf. Rough.)

Surf. Rough.
0.0001
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0.05
0.10
0.15
0.2
0.3
0.5
0.8
1.0
1.3



Preliminary Conclusions

- More analyses needed for sensitivity study
 - Vary surface parameters incrementally – independently & in combination (e.g. Bowen Ratio)
 - Examine *AERMOD* sensitivity using other met data
- These results and other analyses will be used to make decisions & recommendations for *AERSURFACE*
- Workgroup to be formed – goal: beta version released in near future

AERSURFACE

Questions? Comments?
Suggestions?