Recent Experiences with WRF/MMIF

Tom Wickstrom
Surya Ramaswamy

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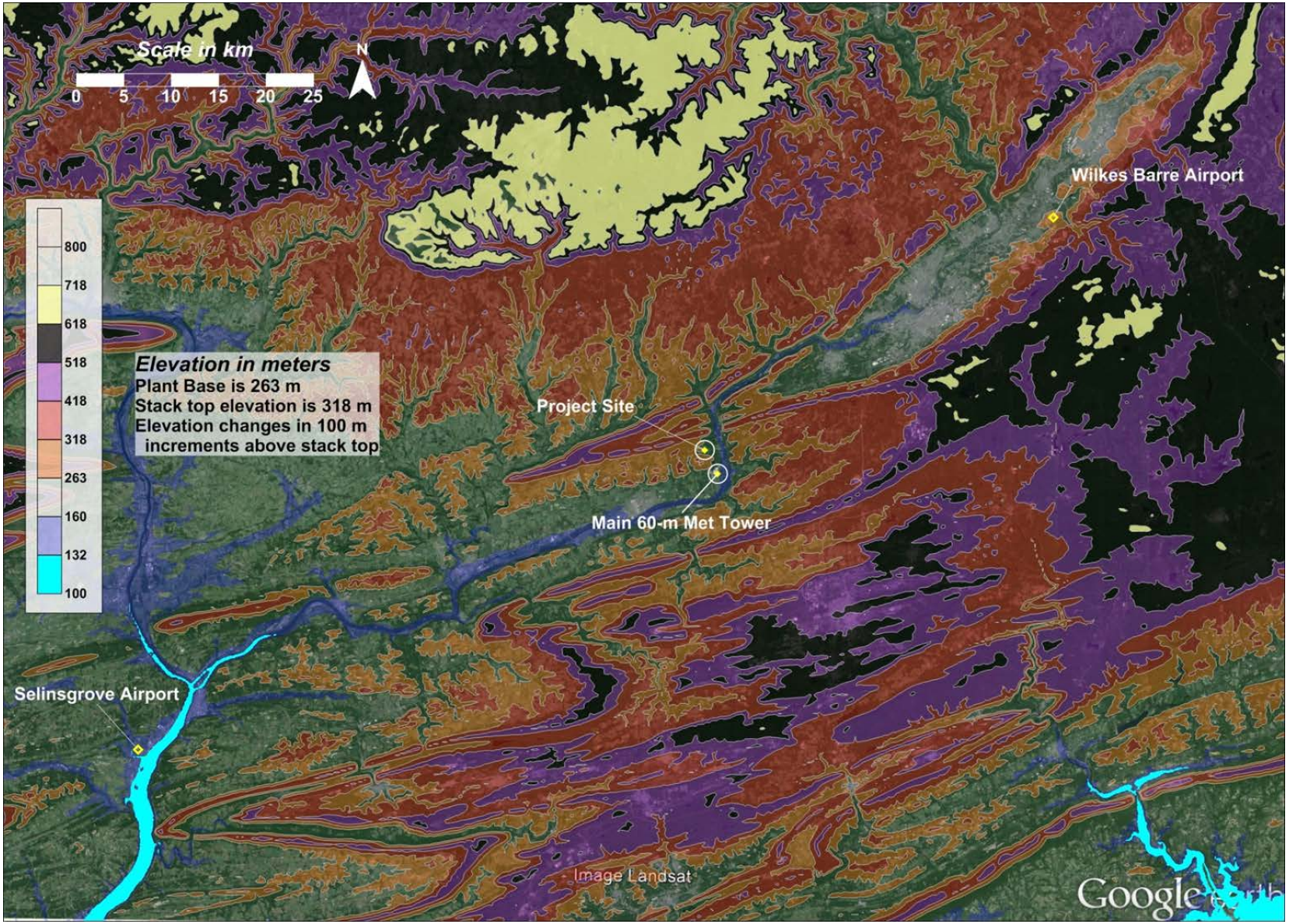
Overview

- Our recent experience has shown that the WRF meteorological model can be useful as an illustrative aide for discussions on meteorological data representativeness
- Example of a recent AERMOD application where the meteorological data representativeness discussion was enhanced by using WRF data
- EPA's proposed changes to Appendix W includes the use of the WRF or MM5 gridded meteorological models as the source of input meteorological data into regulatory air quality modeling analyses
  - Could WRF/MMIF have been used for this application site to arrive at similar model design values compared to observed meteorological data?

Application Setting



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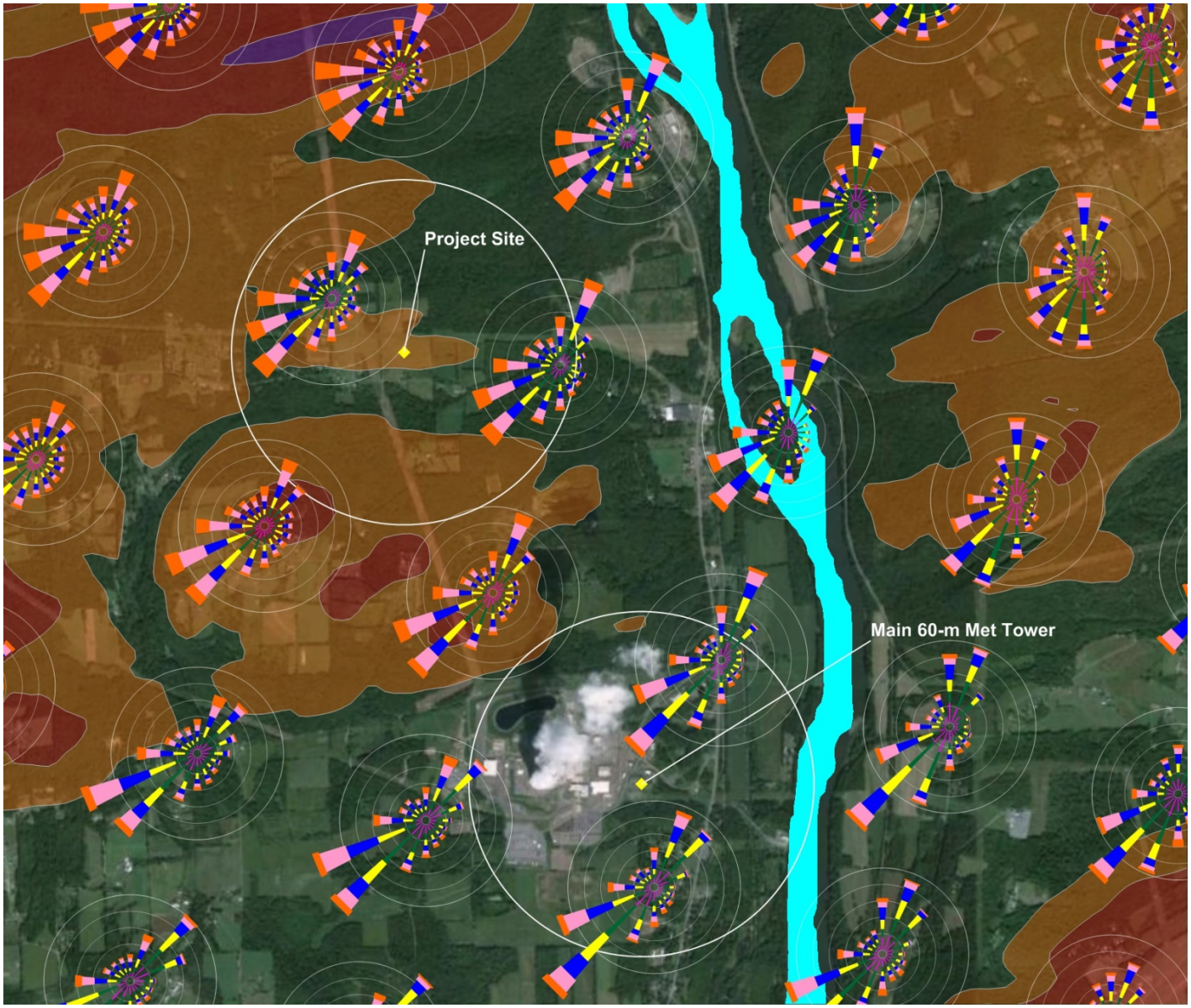
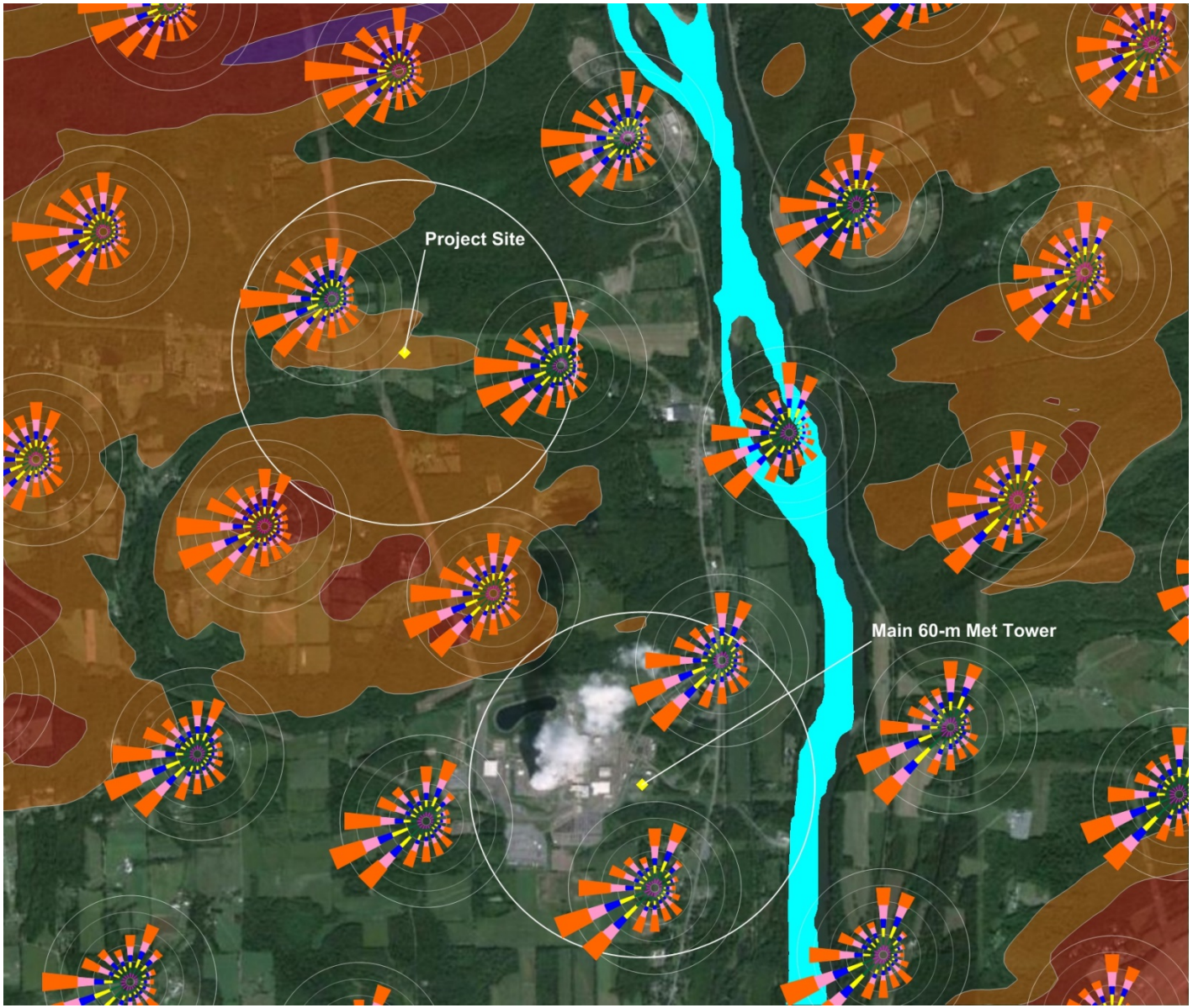
Meteorological Data Representativeness

- Difficult to justify the use of distant airports for this site
- Continuously operating and maintained tall meteorological tower located approximately 2.8 km from the application site
- Need to justify the use of the tall tower, despite close proximity, due to terrain influences
- WRF was used to get a better understanding of wind patterns due to complex terrain
  - 1.3 km resolution, one year of data (2005)

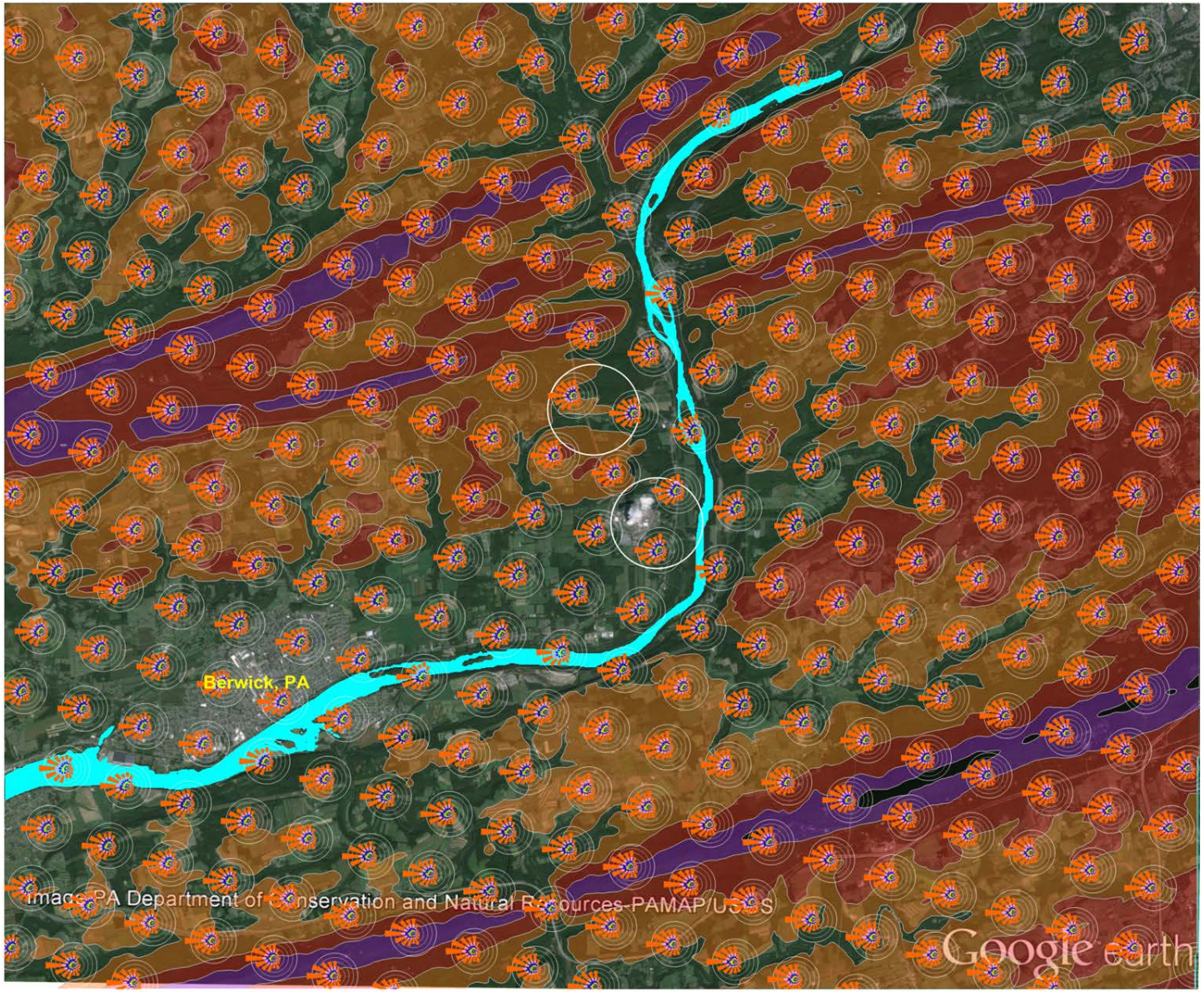
WRF - 60-m Level



WRF – 240-m Level



WRF – 480-m Level (Wide View)



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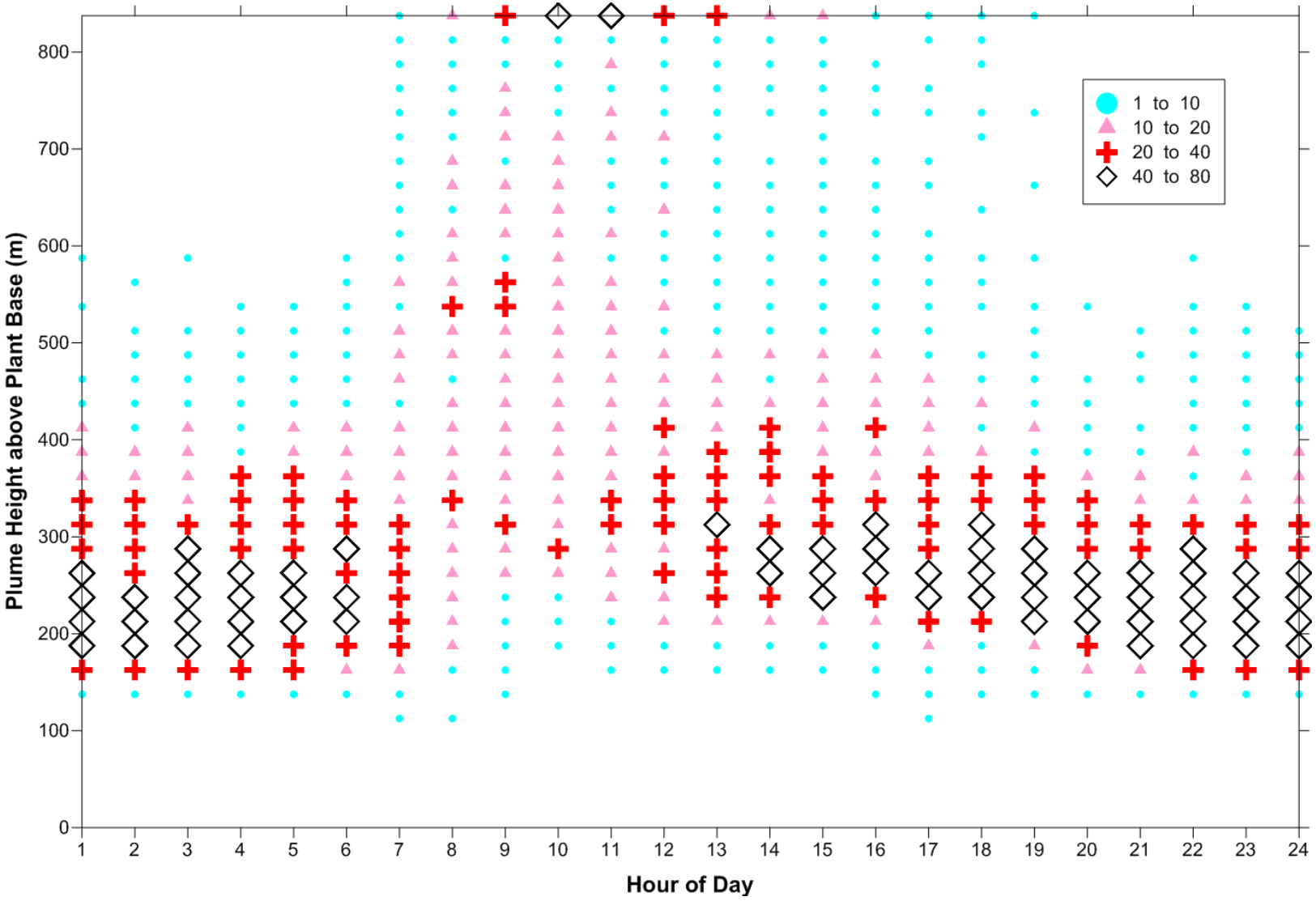
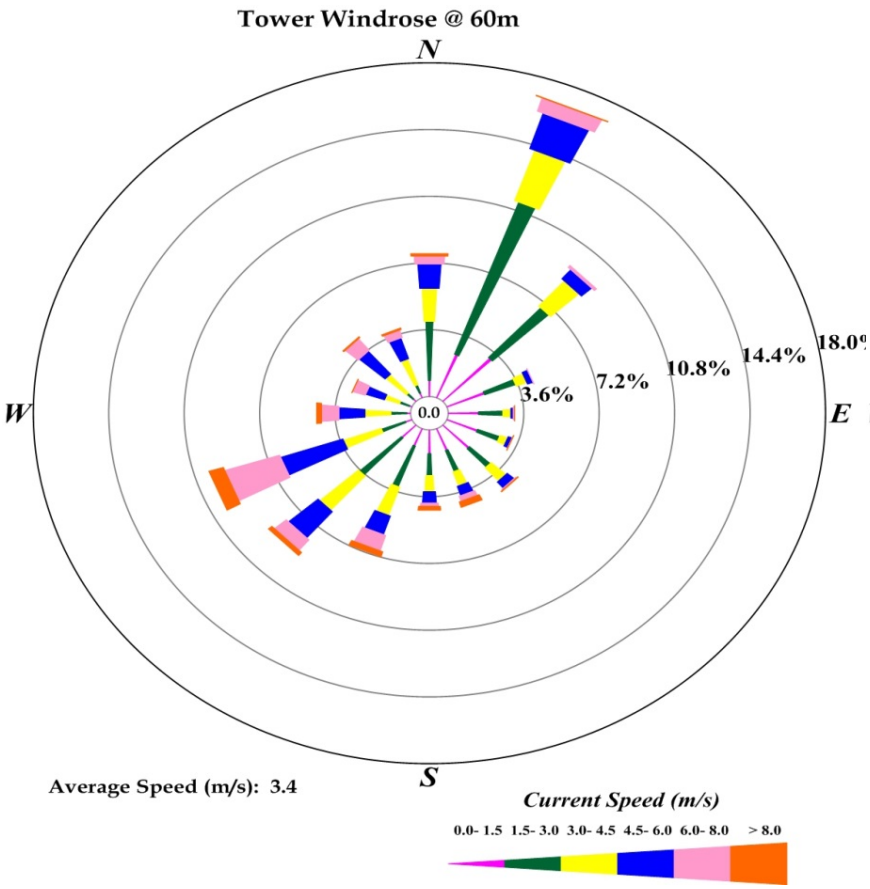
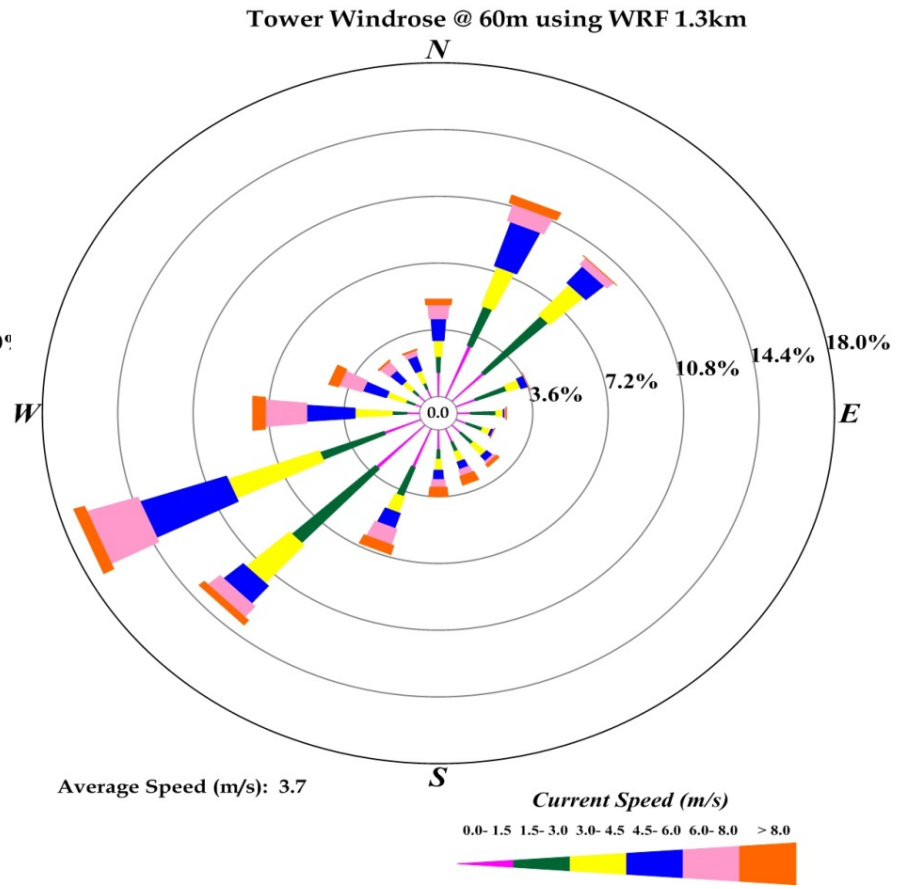
Plume Height Distribution



Direct Comparison of Tower Observations vs. WRF





Meteorological Representativeness Conclusions

- At 240-m level, WRF shows consistent windrose patterns across the study area
  - 240-m level is important to the application due to expected modeled plume heights
- Wind pattern in the immediate vicinity of the tower and application site is similar at 60-m
  - Average wind speed slightly less at tower site
  - Tower observed wind speed generally biased slightly lower than WRF
- Conclusion: Acceptable directional representativeness, slightly lower tower wind speeds will be conservative when extrapolated to plume height by AERMOD
- Five years of 60-m tower data
- Successful air quality modeling analysis

Use of MMIF/WRF in AERMET/AERMOD

- Use of prognostic meteorological data for regulatory applications – included in the July 2015 Appendix W proposal

- "For some modeling applications, there may not be a representative NWS or comparable meteorological station available (e.g., complex terrain), and it may be cost prohibitive or infeasible to collect adequately representative site-specific data. For these cases, it may be necessary to use prognostic meteorological data in a regulatory modeling application."

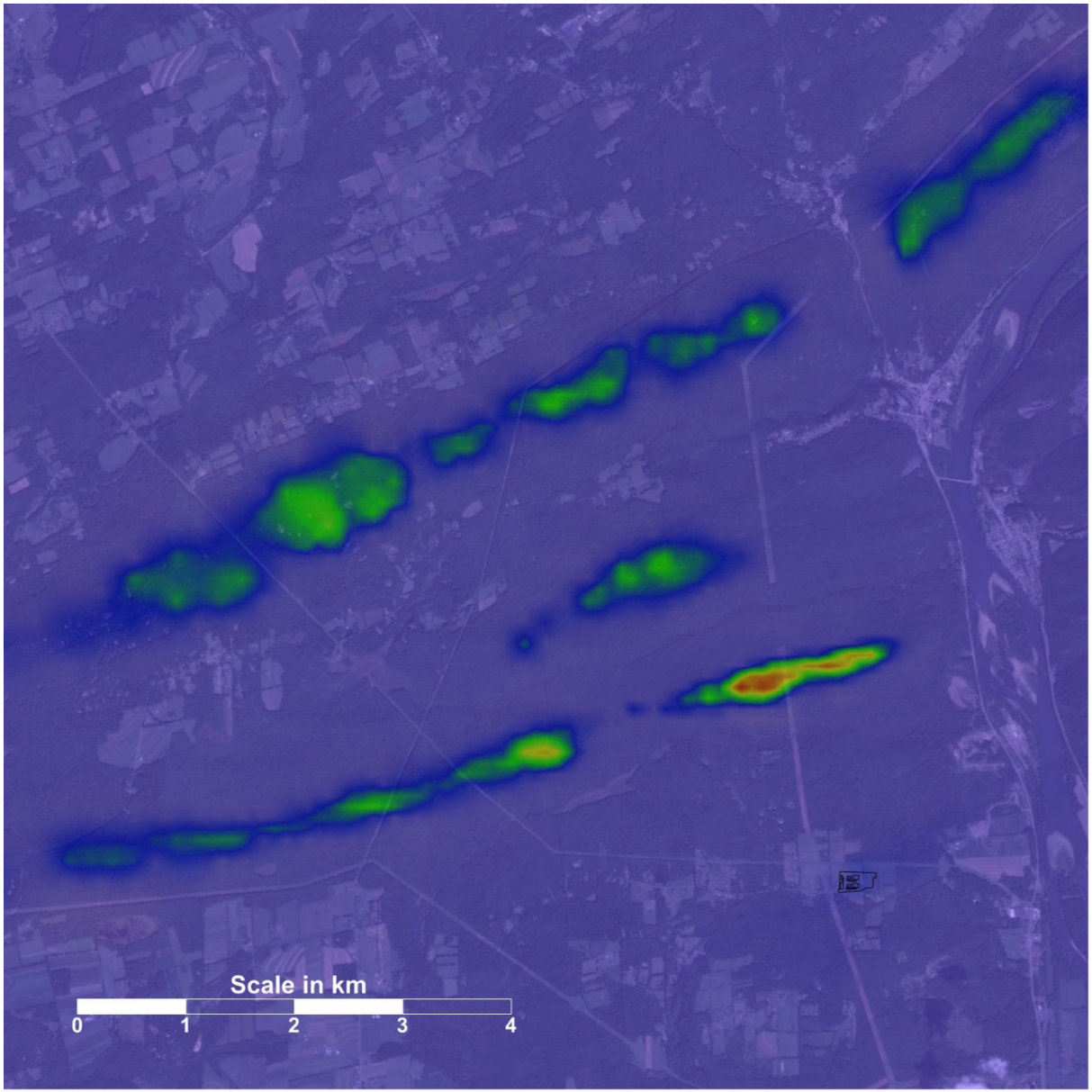
Use of MMIF/WRF in AERMET/AERMOD

- If nearby tower data were not available for the application described previously, could MMIF/WRF have been used to generate meteorological data for AERMOD?
  - Questionable representativeness of distant airport meteorological data
  - Project development likely could not have accepted minimum 16 month delay for meteorological monitoring
- Site-specific meteorological monitoring may have included:
  - Tall tower
  - SODAR
  - Time to acquire instrumentation, construction
  - Monitoring protocol
  - Minimum 12 months of meteorological data required

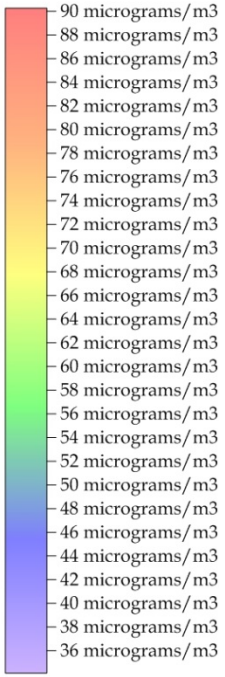
MMIF Version 3.2 – AERMET - AERMOD

- Execute MMIF 3.2 following EPA July 2015 guidance
- Quick Look: How would modeled results compare?
  - The tower data used in the application isn't "site-specific", but it is high quality multi-level meteorological data
  - Higher degree of resolution compared to NWS airport data
- Consider 1 year for comparison – 2005 tower observations vs. 2005 WRF
- Model results presented are for a theoretical project

2005 Eighth Highest Daily Maximum 1-hr – WRF/MMIF Met Data



2005 Model Design Value: 89.5 μg/m³



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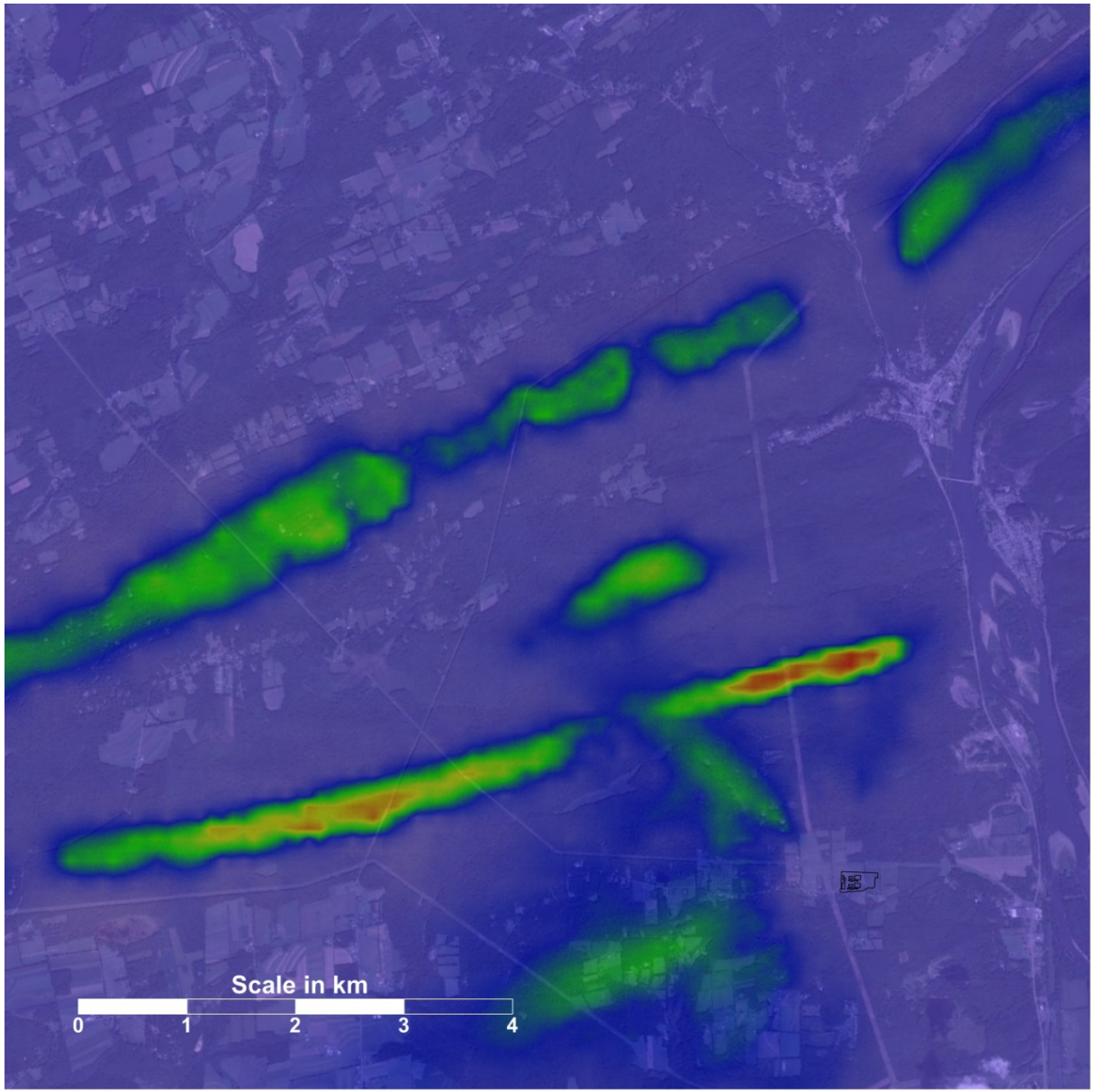
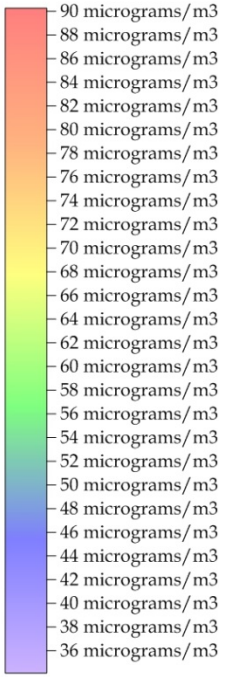
2005 Eighth Highest Daily Maximum 1-hr – Tower Met Data



2005 Model Design Value: 91.75 μg/m³



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Direct Comparison of Modeled Concentrations – 2005 AERMET MMIF vs. Tower Data

	Maximum 1-hr		H8H Daily Maximum				
Source	**AERMET 2005 MMIF Data**	**AERMET 2005 Tower Data**	**AERMET 2005 MMIF Data**	**AERMET 2005 Tower Data**	Stack Height	Stack Temperature	Stack Flowrate
	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	*ft*	*°F*	*acfm*
1	**131.9**	**90.3**	**32.0**	**35.8**	180	163	1,217,159
2	**5.0**	**4.9**	**4.5**	**4.3**	40	260	15,368
3	**4.1**	**4.1**	**3.5**	**3.5**	25	350	5,210
4	**1.2**	**1.2**	**1.1**	**1.0**	10	820	2,636
5	**3.1**	**2.5**	**2.4**	**1.6**	10	890	8,069

Both meteorological inputs result in episodic high modeled concentrations from the main source in complex terrain

Initial observations seem to suggest reasonable comparability between model results using the two meteorological data sets

Initial Conclusions, Comments

- Utilizing WRF/MMIF as the source of meteorological data for AERMOD for this application shows similar model results compared to representative multi-level observational meteorological data
- If no nearby observational meteorological data were available, finding representative airport data would have been challenging
- The use of WRF/MMIF as suggested by the new Appendix W proposal could have possibly saved the project in that case
- Strongly support the proposal in Appendix W to allow the use of WRF or MM5 through MMIF to generate meteorological data for regulatory applications