National Renewable Energy Laboratory
Innovation for Our Energy Future

IMAGE Wind Data Manipulation - Update

Snowmass Village – EMF Workshop on Climate Change and Integrated Assessment

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Global Wind Data Update (NREL)

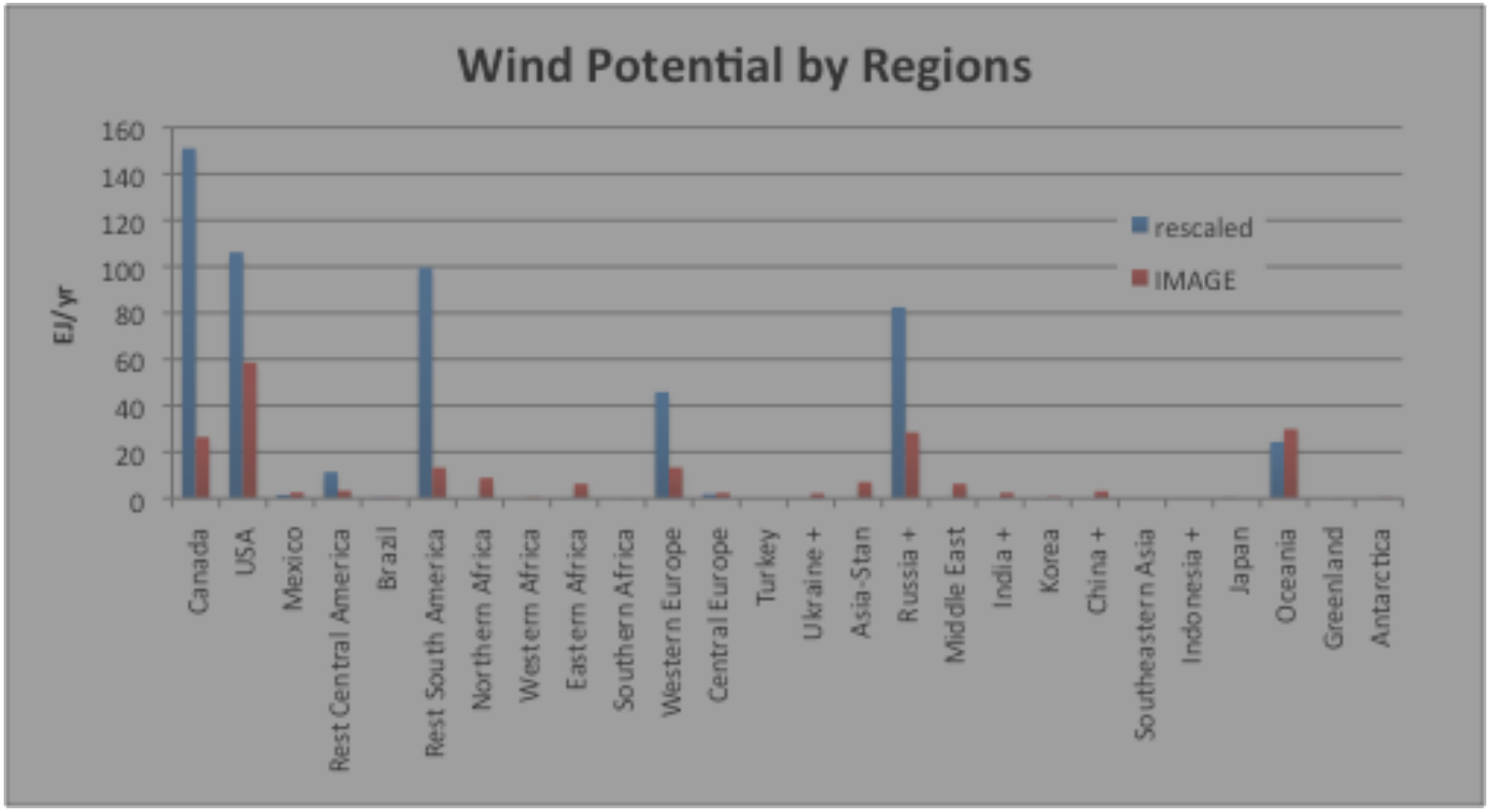
- First attempt – developed statistical distribution to apply to IMAGE data based on high resolution wind data and landform characterization using one sample area
- Second attempt – distributions developed for more regions in U.S. and other countries, and applied regionally to update wind
- Apply some exclusions to the results
  - World Heritage sites excluded
  - Urban areas excluded
  - Elevations > 2000 m excluded

Statistical method used

- Goal – use available high resolution wind resource and landform data to create wind resource distributions for low resolution wind data
- Sample area of roughly 2 deg x 2 deg, containing all landform categories
- Extract using highest spatial resolution dataset:
  - High resolution wind resource value
  - IMAGE wind resource value
  - Landform value (16 landform types)
- Develop regression equation for each landform type based on samples
- Apply regression equations to landform and IMAGE resource data to estimate a high resolution wind distribution

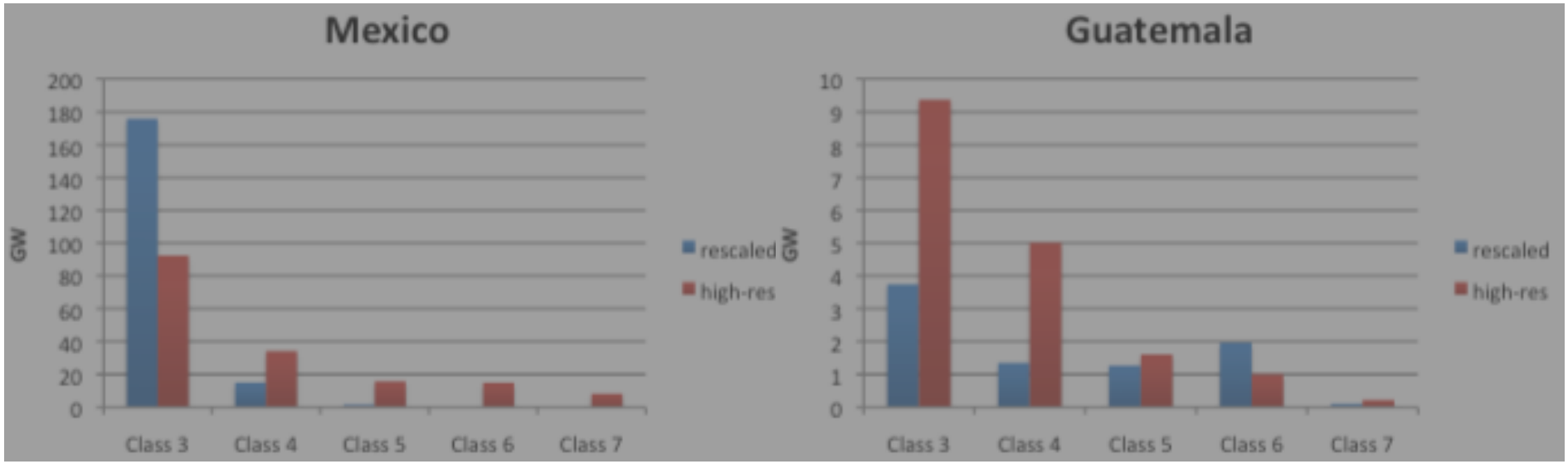
V1 shortcomings

- Re-scaling, in many cases, made the rich richer and the poor poorer



V1 shortcomings

- There is limited agreement between re-scaled curves and independently produced high-res curves
- And, they don't disagree in consistent ways



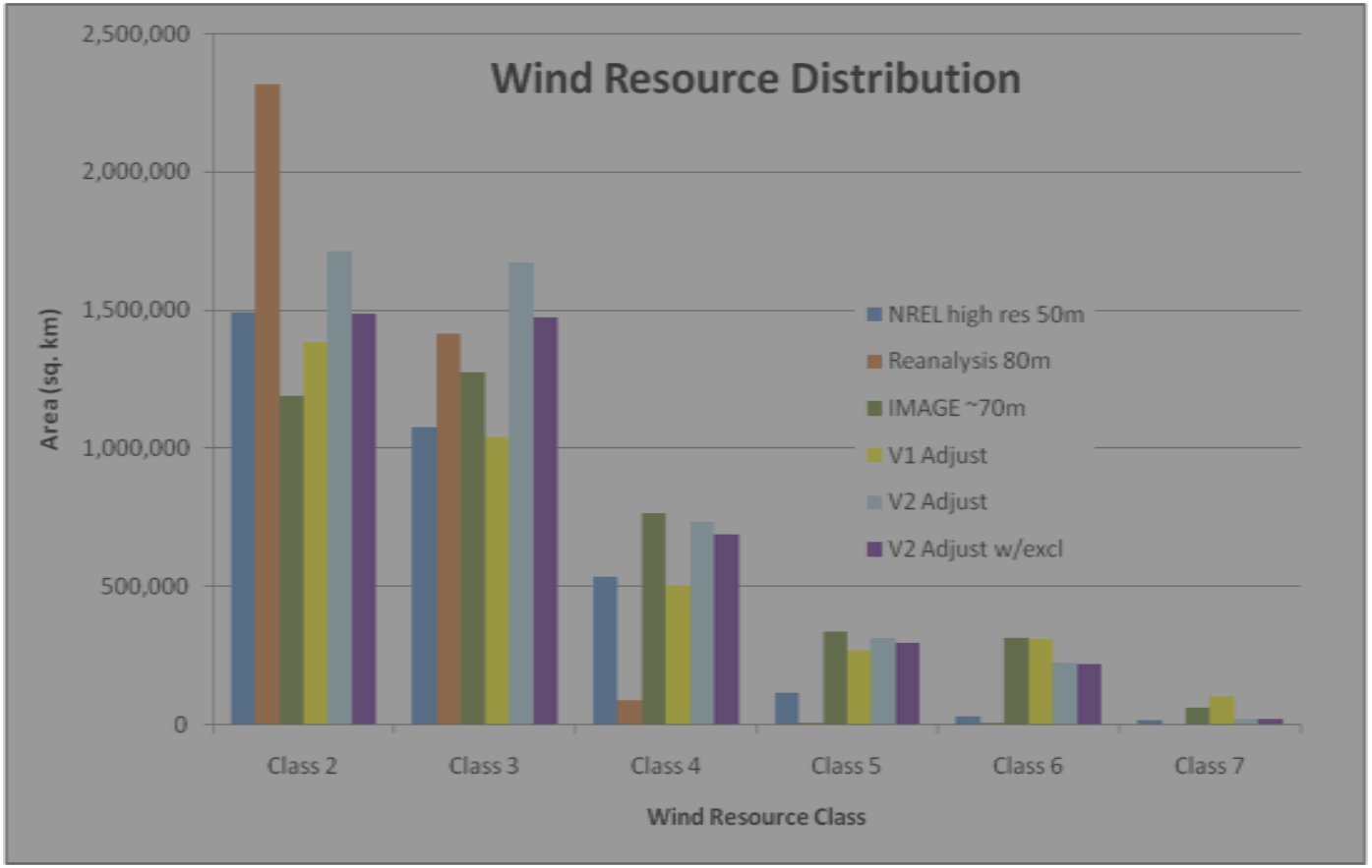
V2 Data Comparison – U.S. by Class

- Comparison of statistical results with source data and reference data

4 regional samples of different wind climates

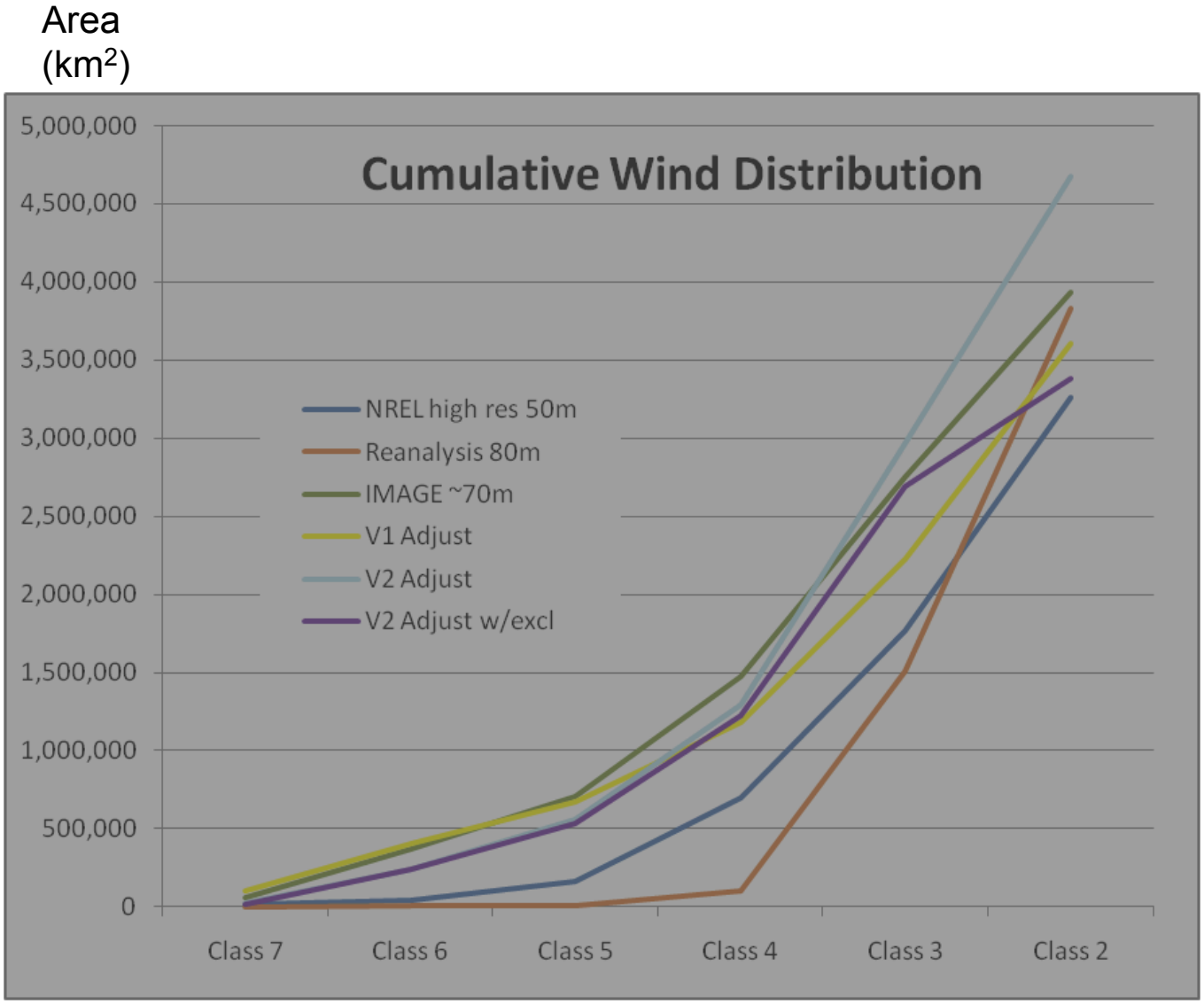
U.S. divided into rough regions to represent the wind climates

Mixed results – lower classes worse; higher classes better



V2 Data Comparison – U.S. Cumulative

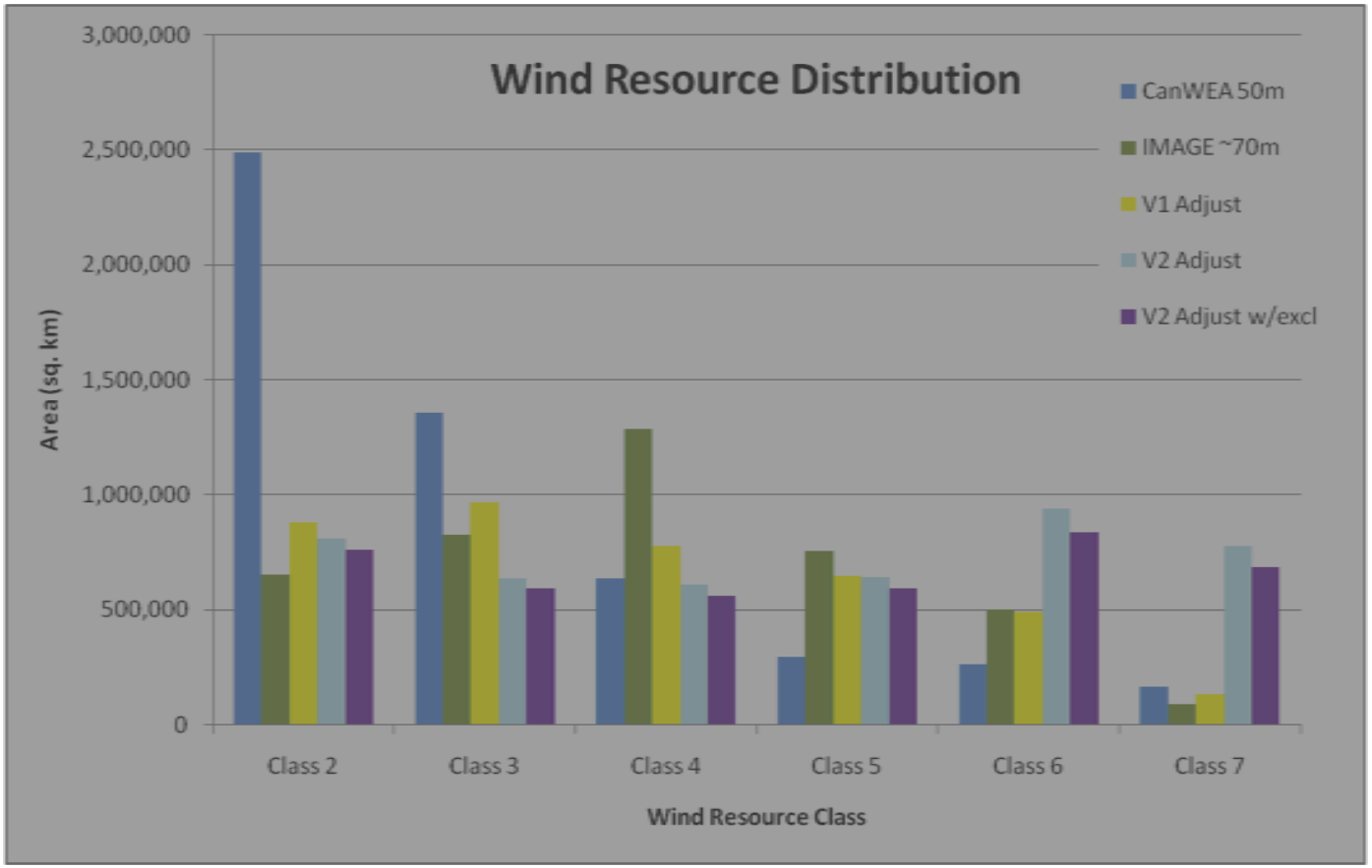
IMAGE, and adjusted datasets are similar, but higher than NREL 50 m data



V2 Data Comparison - Canada

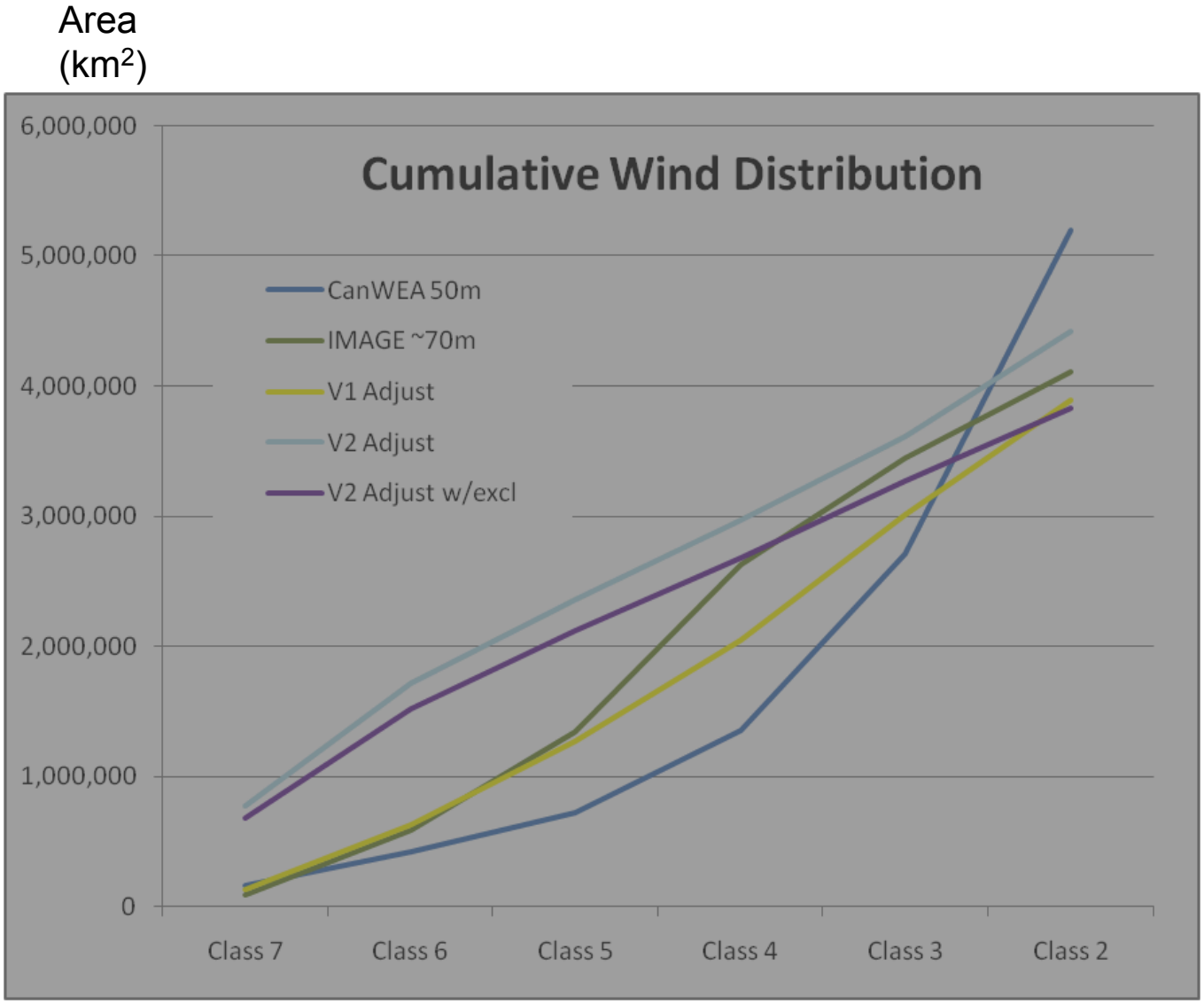
- Comparison of results, apply regional algorithms from U.S. analysis to regions in Canada

Version 1, with one U.S. regional algorithm, more closely tracks CANWEA data



V2 Data Comparison – Canada

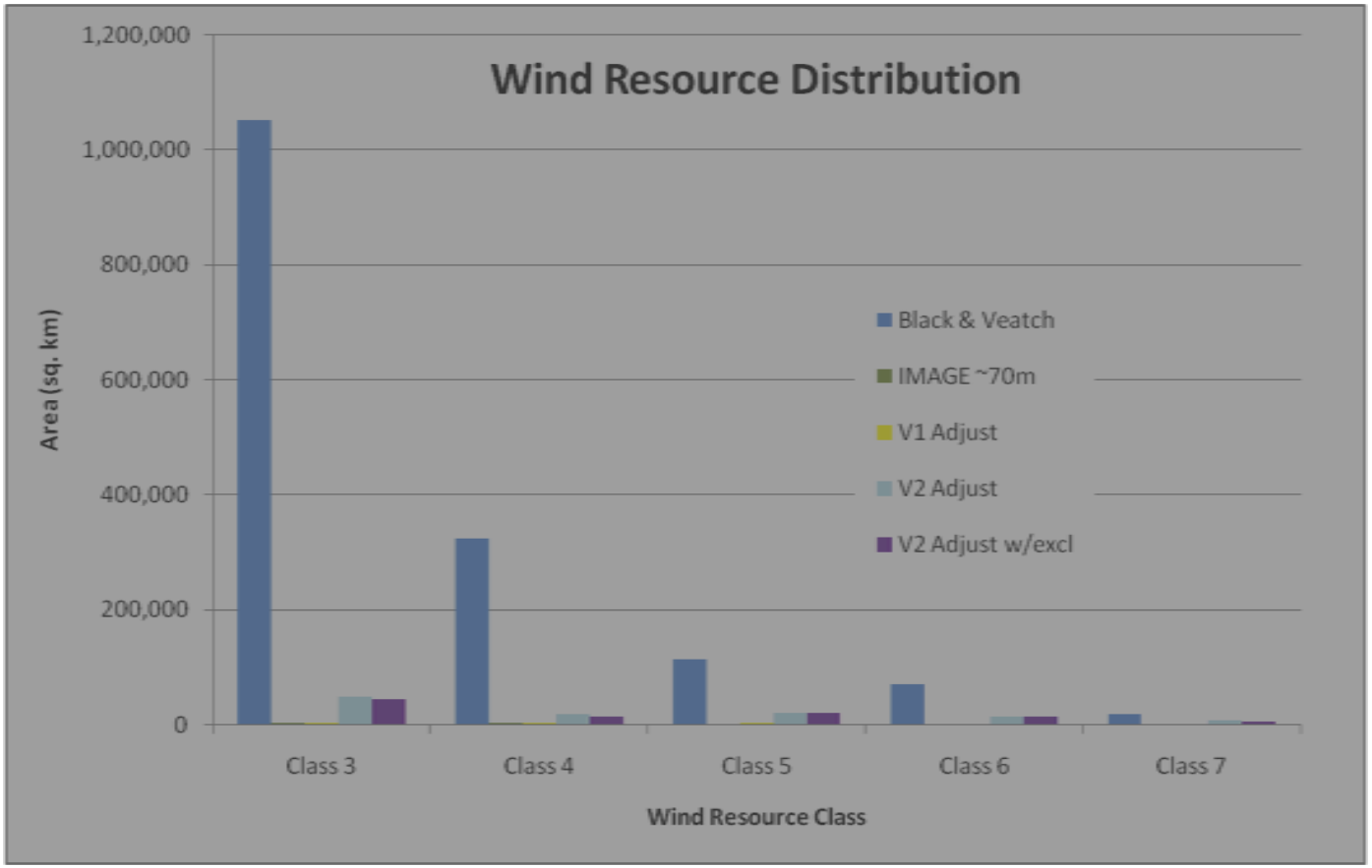
Again, Version 1 tracks best with CanWEA data. Version 2 significantly over-predicts



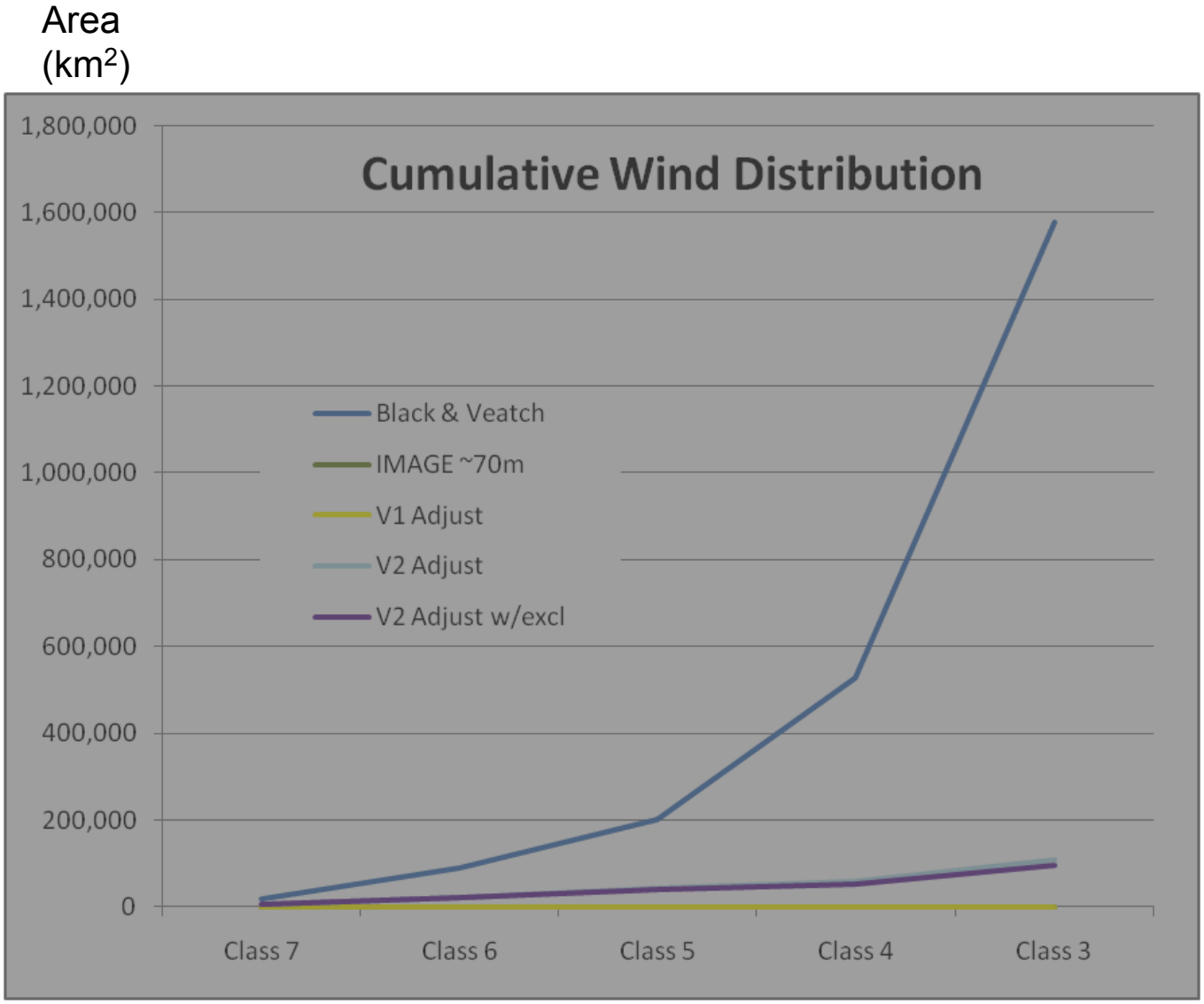
V2 Data Comparison - China

- Statistics developed using NREL high resolution data, but compared here to Black & Veatch reported values

Version 2 does yield more wind resource, though nowhere near values reported



V2 Data Comparison – China



Data Questions

- Does this method produce good results?
  - Better representation of higher class wind resources in some cases
  - Is it going into the right areas? What is the impact of over-estimation of resource or under-representation of high class resource?
- Issues with this approach
  - This approach assumes that the overall pattern in the low-resolution data is accurate (at least an accurate predictor)
  - If low resolution resource is extremely low, there is limited capacity to scale resource estimates upward
  - This approach doesn't reflect how wind behaves

Data Questions

- Properly using IMAGE data?
  - IMAGE data used here includes resource exclusions (wind speed >4 m/s at 10m) and estimate full wind load hours using power curves
  - Statistics built against raw resource data, treating IMAGE data as the same

- Minimally, our analysis should start with raw resource data – upstream of any processing

Datasets: Global data options?

- Mix and match – supplement low resolution data with high resolution datasets where available
- Statistical adjustment – develop distribution functions by comparing low and high resolution data, incorporating more predictor variables (land cover, coast, relative elevation, etc.)
- Adopt other global dataset as base
- Develop consistent wind energy dataset at high enough resolution to pick up significant wind features?