

# 测风塔代表性及提高计算精度辩证分析

深圳智润新能源电力勘察设计院有限公司 郑爱玲

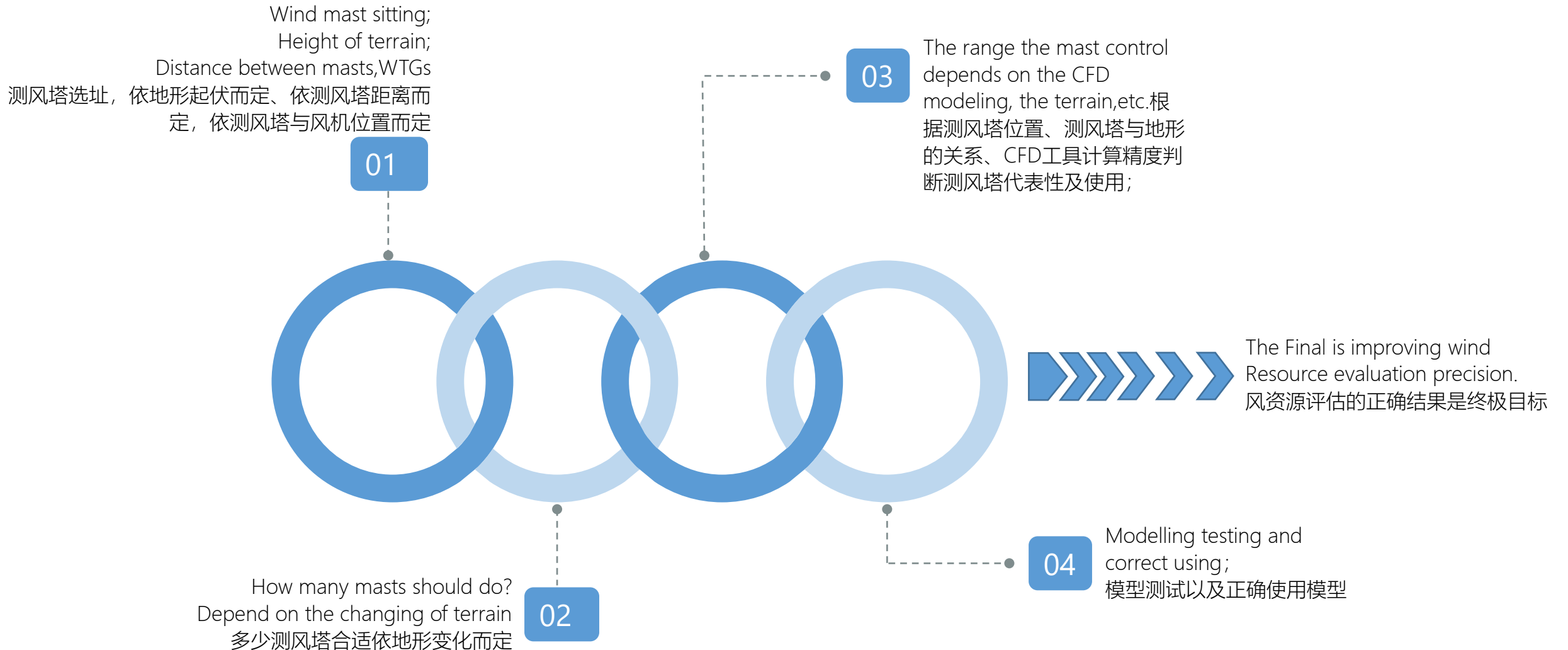
# Content

## 内容

- **Consideration of wind mast building** 树立测风塔应考虑的因素
  - Wind site 风电场的选址范围
  - Wind mast sitting 测风塔选址
  - How many wind mast will be sufficient 多少个测风塔才能满足要求
  - Usage of wind mast 测风塔应如何使用
- **Improving calculation precision using correct modelling and wind masts**  
通过正确的CFD建模以及正确的测风塔使用提高计算精度

# Consideration of wind mast building

## 树立测风塔应考虑的因素



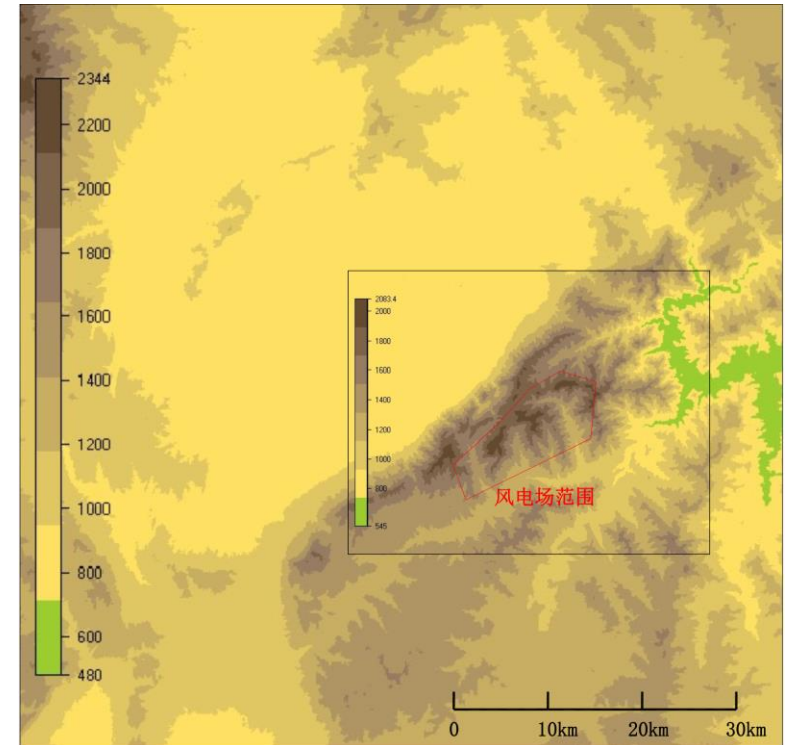
# Consideration of wind mast building-Case1

## 树立测风塔应考虑的因素-案例

- The wind site locates at north China, a part of a NE~WS mountain with 1200m~2080m height terrain.

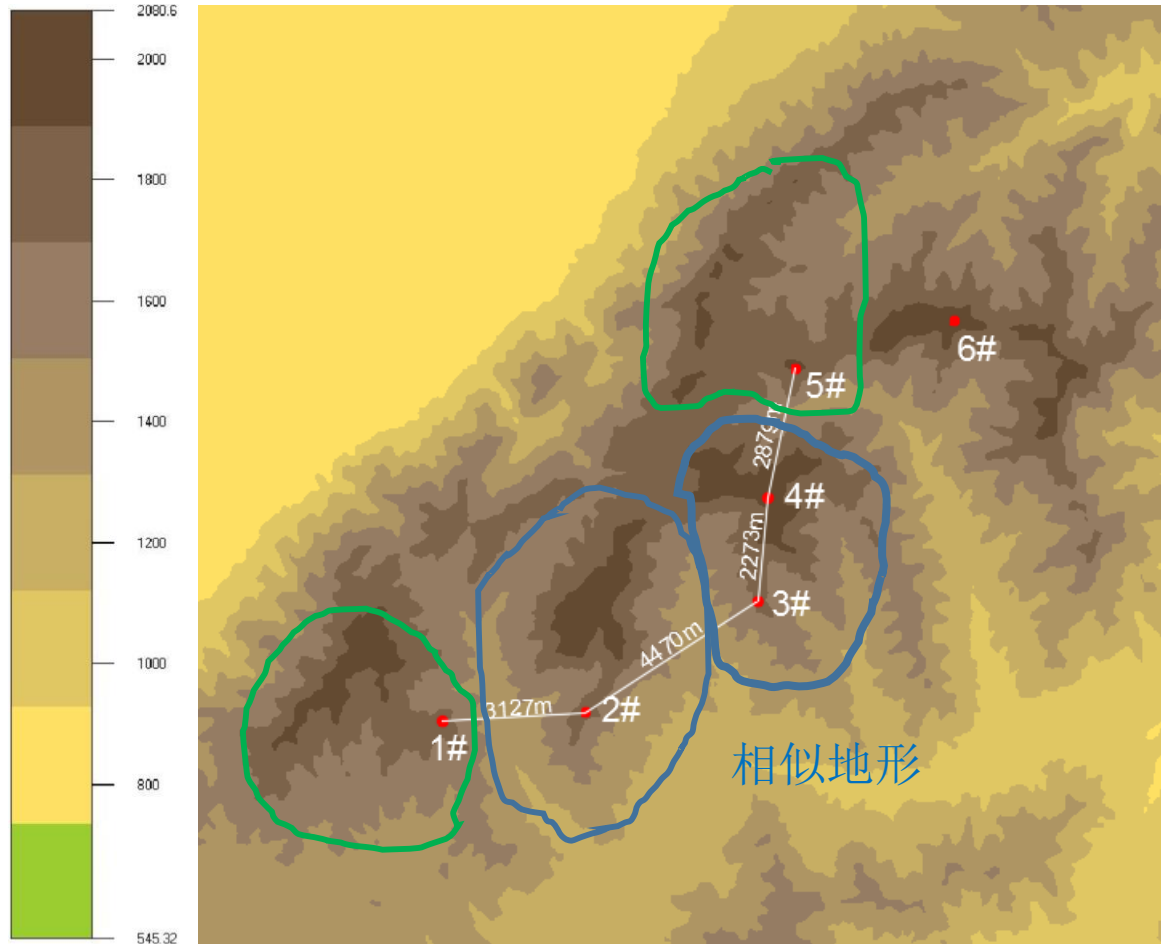
风电场位于中国北方，一道东北~西南走向的山脊的一部分，高程为1200m~2080m。

- Two models are built, meso and nesting.  
分两个模型进行设置，中尺度及嵌套模型。
  - Meso:60km\*60km with grid size 80\*80\*10(Z)
  - Nesting:30km\*30km with grid size 35\*35\*8(Z)
- 6 masts are built;6座测风塔;
- 5 masts have some measuring period.5座同期;

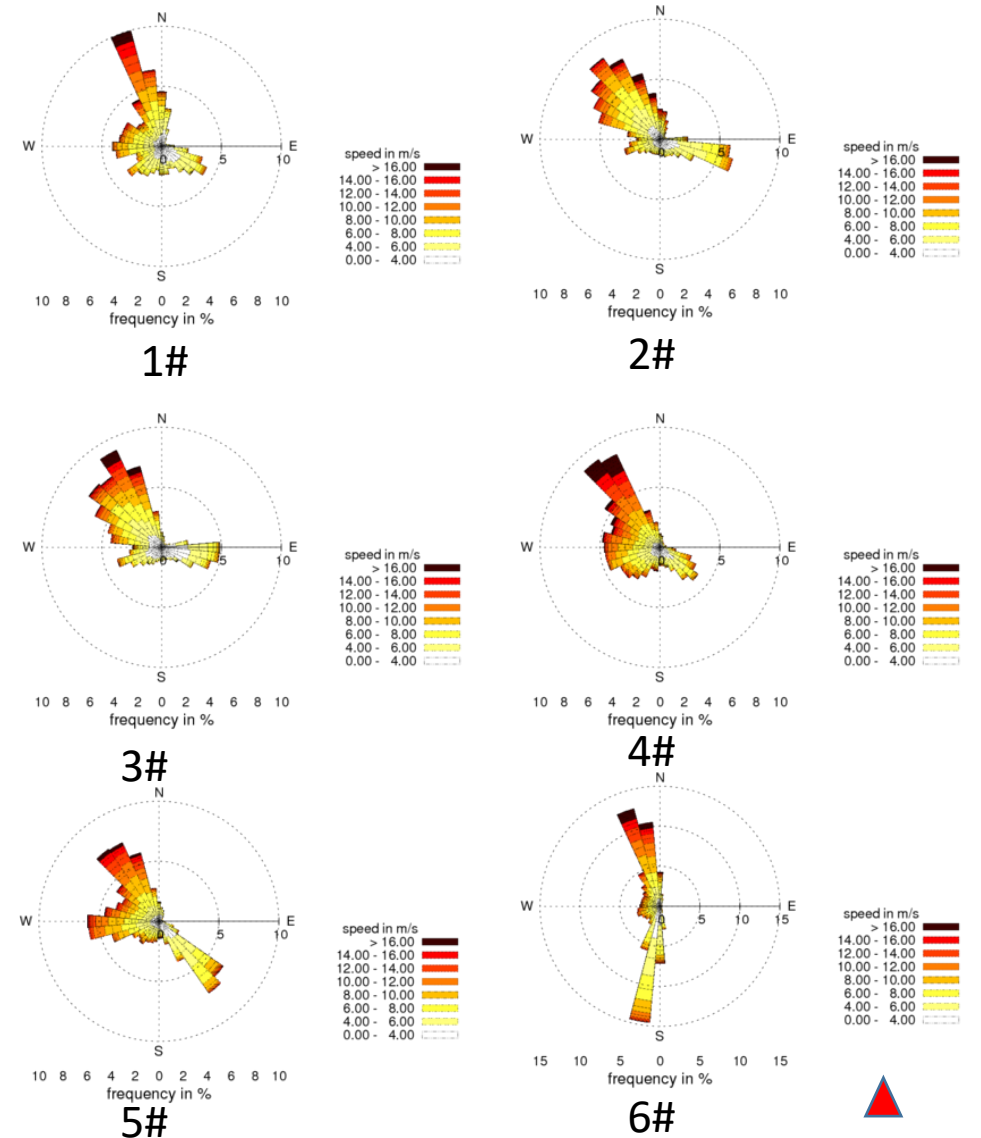


# Consideration of wind mast building-Case1

## 树立测风塔应考虑的因素-案例



Mast	1#	2#	3#	4#	5#
Height (m)	1790	1828	1771	2043	1933
V(m/s)	5.83	6.14	5.57	7.37	6.79



# Consideration of wind mast building-Case1

树立测风塔应考虑的因素-案例-地形相似度高，测风塔代表性强

12sectors		1#	2#	3#	4#	5#
1#	5.83		5.15	4.77	6.09	5.95
2#	6.14	7.15		5.93	7.39	7.17
3#	5.57	6.78	5.83		7	6.75
4#	7.37	7.29	6.38	6.1		7.1
5#	6.79	6.63	5.84	5.61	7.03	

12sectors		1#	2#	3#	4#	5#
1#	5.83		-11.7%	-18.2%	4.5%	2.1%
2#	6.14	16.4%		-3.4%	20.4%	16.8%
3#	5.57	21.7%	4.7%		25.7%	21.2%
4#	7.37	-1.1%	-13.4%	-17.2%		-3.7%
5#	6.79	-2.4%	-14.0%	-17.4%	3.5%	

36sectors		1#	2#	3#	4#	5#
1#	5.83		5.59	5.71	6.6	6.07
2#	6.14	6.51		6.43	7.42	6.82
3#	5.57	5.72	5.39		6.55	5.96
4#	7.37	6.46	6.28	6.49		6.7
5#	6.79	6.48	6.07	6.28	7.35	

36sectors		1#	2#	3#	4#	5#
1#	5.83		-4.1%	-2.1%	13.2%	4.1%
2#	6.14	6.0%		4.7%	20.8%	11.1%
3#	5.57	2.7%	-3.2%		17.6%	7.0%
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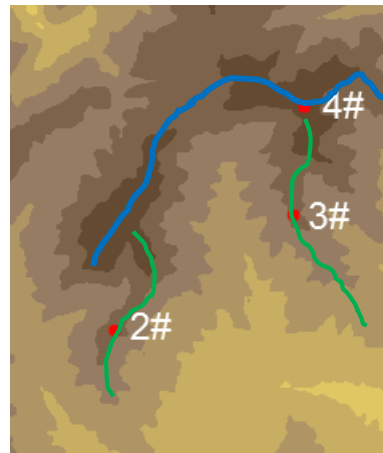
36sectors-部分1:2000地图		1#	2#	3#	4#	5#
1#	5.83		5.44	5.66	6.41	5.85
2#	6.14	6.59		6.65	7.46	6.8
3#	5.57	5.65	5.25		6.4	5.77
4#	7.37	6.75	6.38	6.85		6.62
5#	6.79	6.67	6.16	6.65	7.46	

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2#	6.14	7.3%		8.3%	21.5%	10.7%
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# Consideration of wind mast building-Case1

树立测风塔应考虑的因素-案例-**地形相似度高，测风塔代表性强**

- **Wind direction, trend of terrain** between 3# and 2# are quite similar, result of climate transfer is good, even 12 sectors simulation.  
2#和3#的地形相似、高程接近、距离近，测风塔转移的结果也比较好，  
尽管只采用 12扇区计算；
- **Wind direction, trend of terrain** between 5# and 1# are quite similar, result of climate transfer is good, even 12 sectors simulation.  
5#和1#的地形相似、高程相差150m、距离超过10km，测风塔转移的结果也比较好，  
尽管只采用12扇区计算；



- The representative scope is effected by the shape of the terrain.  
**这证明了测风塔的代表范围与地形的相似程度密切相关。**

# Consideration of wind mast building-Case1

树立测风塔应考虑的因素-案例-36扇区计算提高了1#的代表性

12sectors		1#	2#	3#	4#	5#
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# Consideration of wind mast building-Case1

树立测风塔应考虑的因素-案例—**地形相似度高、计算模型细化、测风塔代表性强**

- 1# has good relationship with 2#/3# although not as good as 2# and 3#,but by using 36 sectors simulation, the result is also not bad.  
1#的地形、风向也与2#、3#类似，但相似度没有2#、3#本身那么吻合，采用 36扇区的计算的转移效果较好。
- By using 36 sectors simulation, 1#,2# and 3# have simulate terrain, with simulate wind rose, good transfer result. That means 1#,2#,3# can control the simulate terrain.  
采用36扇区的模型计算，1#、2#、3#基本上可以互相代表其所在的分支山脊。
- The representative scope is effected by the shape of the terrain and the modelling.  
测风塔的代表范围与地形的**相似程度**、计算**模型的设置**密切相关。

# Consideration of wind mast building-Case1

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# Consideration of wind mast building-Case1

树立测风塔应考虑的因素-案例-地形相似性差，无论距离多近，测风塔代表性差

- But 1#/2#/3#cannot control the high main ridge such as 4#, the high main hill such as 4# cannot give a true result of sub ridge no matter distance.  
但1#、2#、3#代表不了附近的主山脊（比如4#）；主山脊（比如4#）也代表不了分支山梁，*无论距离有多近*；



*撇开地形相似性以及高程差，单纯地用距离来讨论测风塔的代表性是没有多大意义的。*

# Consideration of wind mast building-Case1

树立测风塔应考虑的因素-案例-地形精度的提高有利于提高测风塔的代表性

- Improving: higher than 1600m use 1:2000 map, other use SRTM;  
改进措施: 1600m以上采用1:2000地形图, 1600以下采用SRTM地形图;
- The relationship between 4# and other are better. 4#对其他位置的代表性有所提高;
- 3# improve obviously.距其最近的3#测风塔位置改进最大;

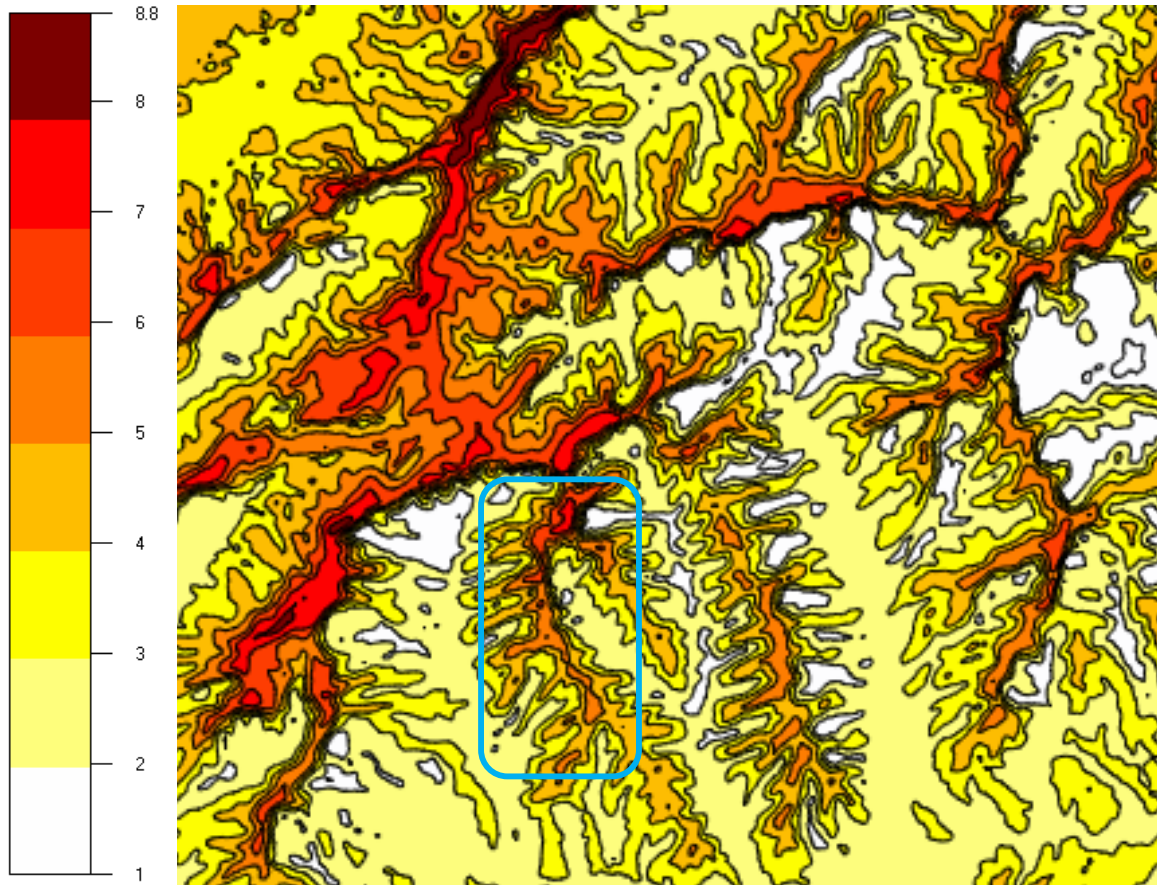
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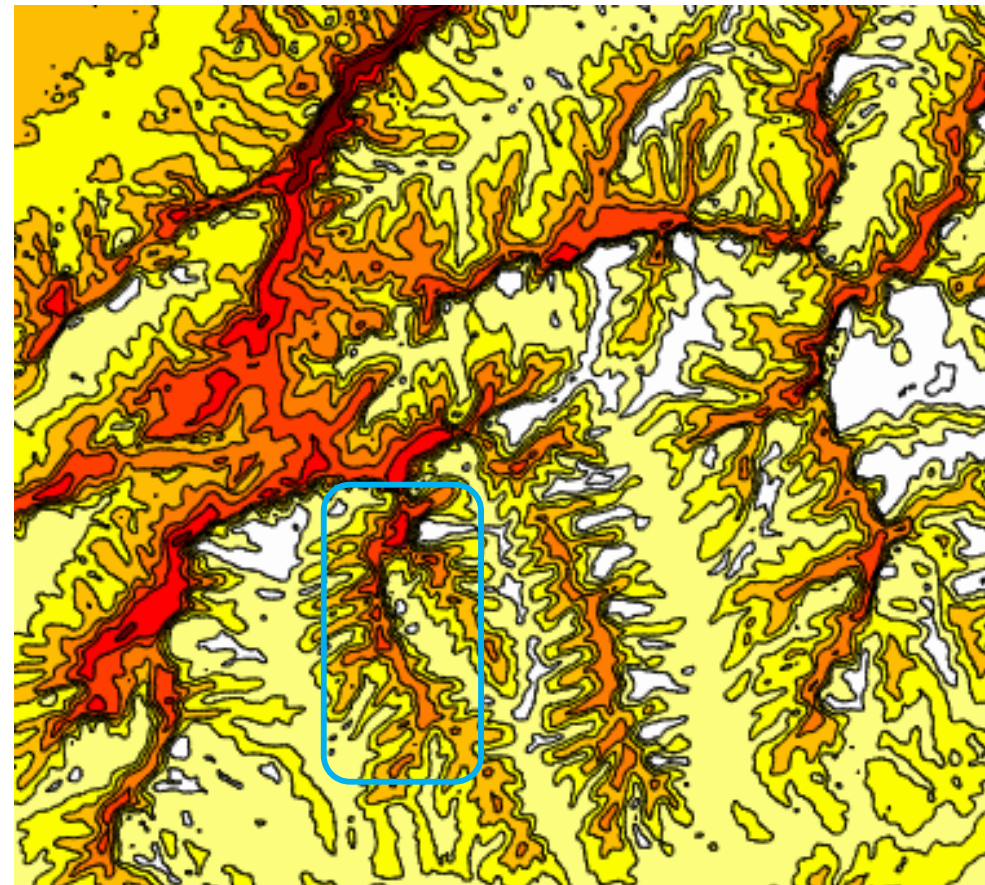


# Consideration of wind mast building-Case1

树立测风塔应考虑的因素-案例-测风塔的简化方案



五塔



四塔

# Consideration of wind mast building-Case1

## 树立测风塔应考虑的因素-案例-总结

- 地形的相似性
  - 周围地形的起伏变化状况；
  - 周围地形的陡峭度等；
- 地形的相似程度越高，测风塔的代表性越好，代表范围越大；
  - 地形的相似程度越高，即使相距10km以上，其代表性仍然很好，对模型的精度要求不高；
  - 地形的相似程度越差，即使相距2km，其代表性仍然很差，对模型的精度要求不高；
  - 模型的精度（正确的模型设置、高精度地形图使用）可以提高测风塔的代表范围。
- 测风塔的代表范围与之有关的因素
  - 地形的相似性
  - 测风塔处所在高程
  - 与测风塔距离
  - 采用的模型的精度（模型设置、高精度地形图）
- 思考：测风塔综合发电量计算时只考虑距离、距离的加权合适吗？  
应该做的改进和修正...

谢谢！