10th WindSim User Meeting

24-25 June 2015, Tønsberg

Best Practice

PRESENTED BY: Di Li

windsim

Content

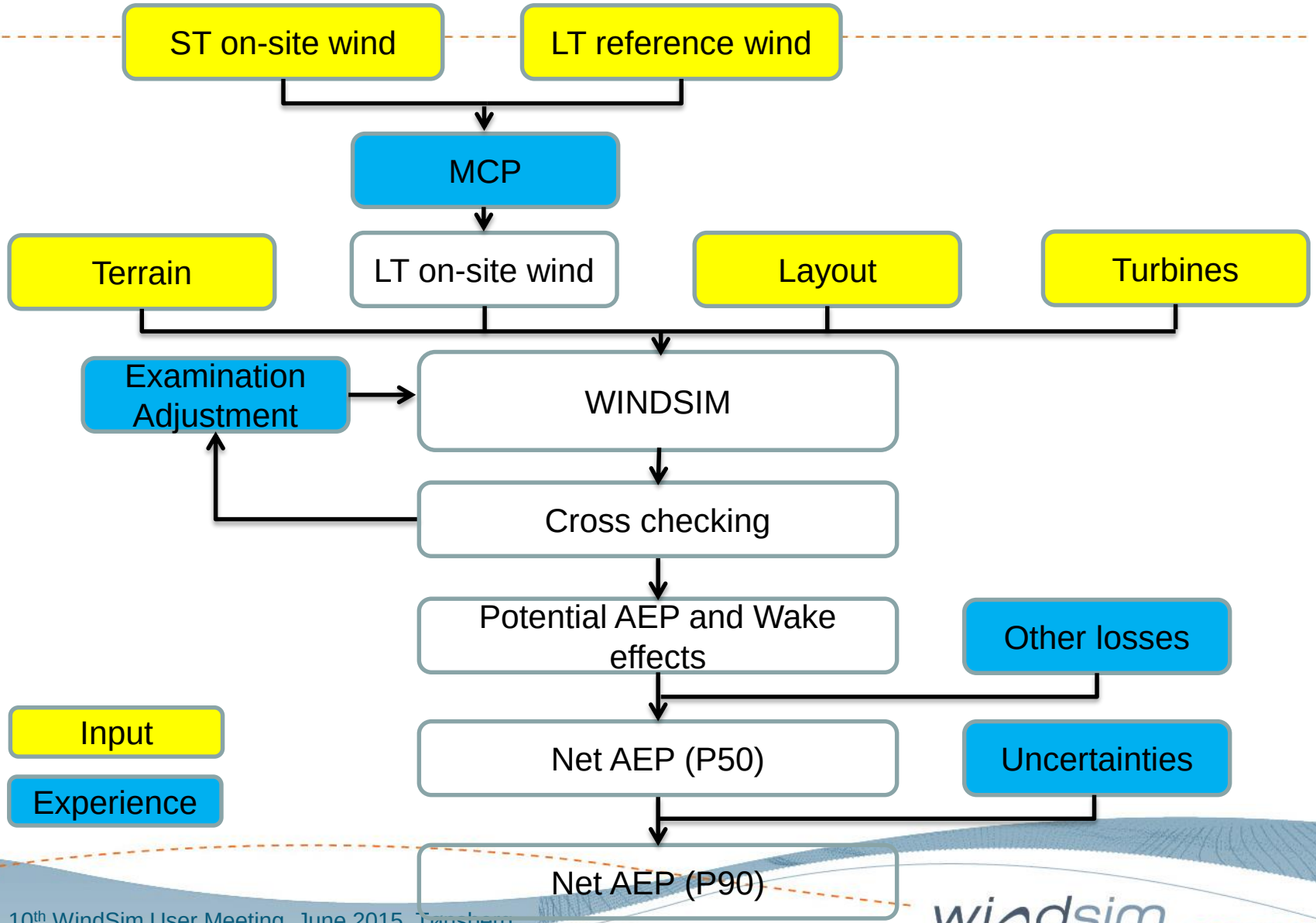
1. Objective:
- Bankable AEP
- Site Suitability

2. Management:
- Balance on accuracy, timeline and resource
- File management

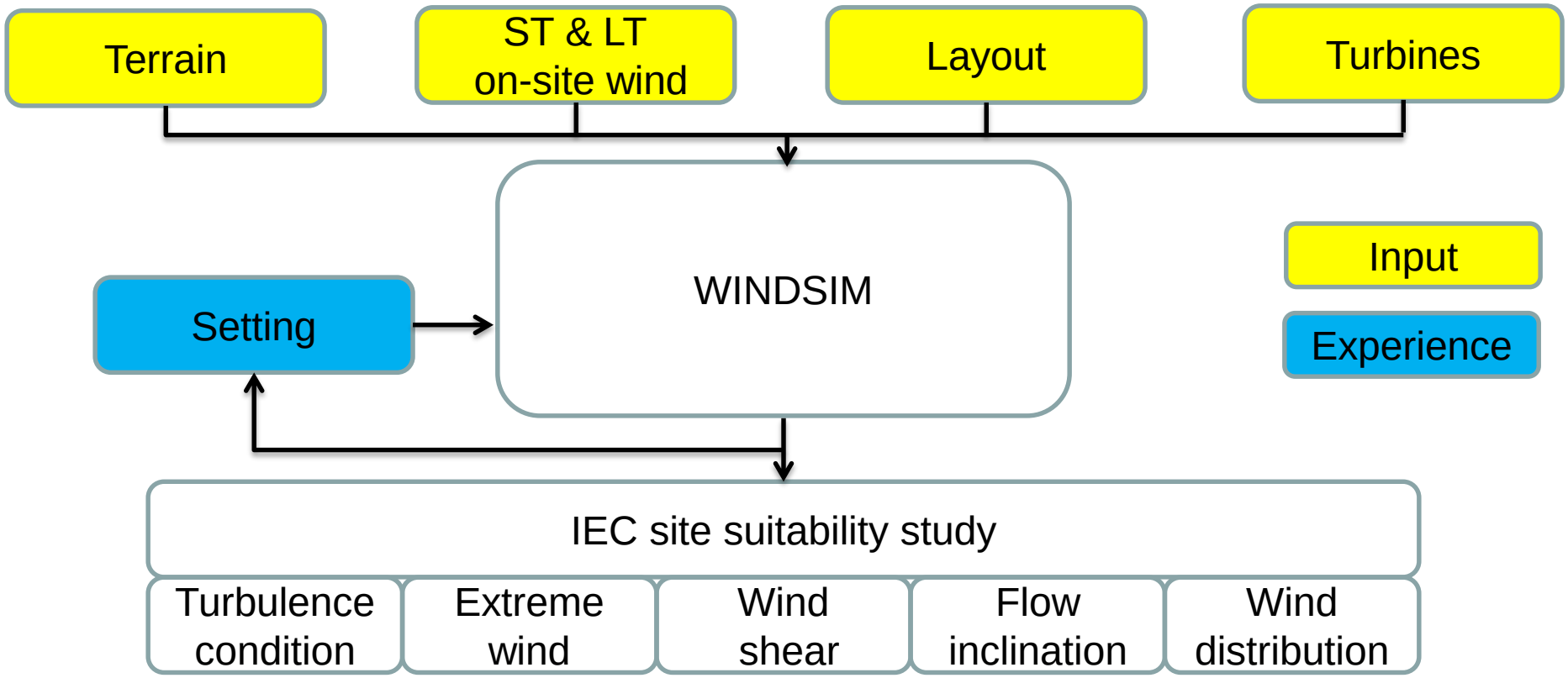
3. Parameter:
- Gridding
- Boundary conditions
- Atmospheric stability

4. Technique:
- MCP
- NTF
- Sector Management

Objective


ST on-site wind
LT reference wind
MCP
Terrain
LT on-site wind
Layout
Turbines
Examination Adjustment
WINDSIM
Cross checking
Potential AEP and Wake effects
Other losses
Input
Net AEP (P50)
Uncertainties
Experience
Net AEP (P90)

Objective


Terrain
ST & LT
on-site wind
Layout
Turbines
WINDSIM
Setting
Input
Experience
IEC site suitability study
Turbulence
condition
Extreme
wind
Wind
shear
Flow
inclination
Wind
distribution

Management

Free space for *.wrg generation:

T= 20*n*X/l*Y/l/10^6

T - Total free space needed (GB)

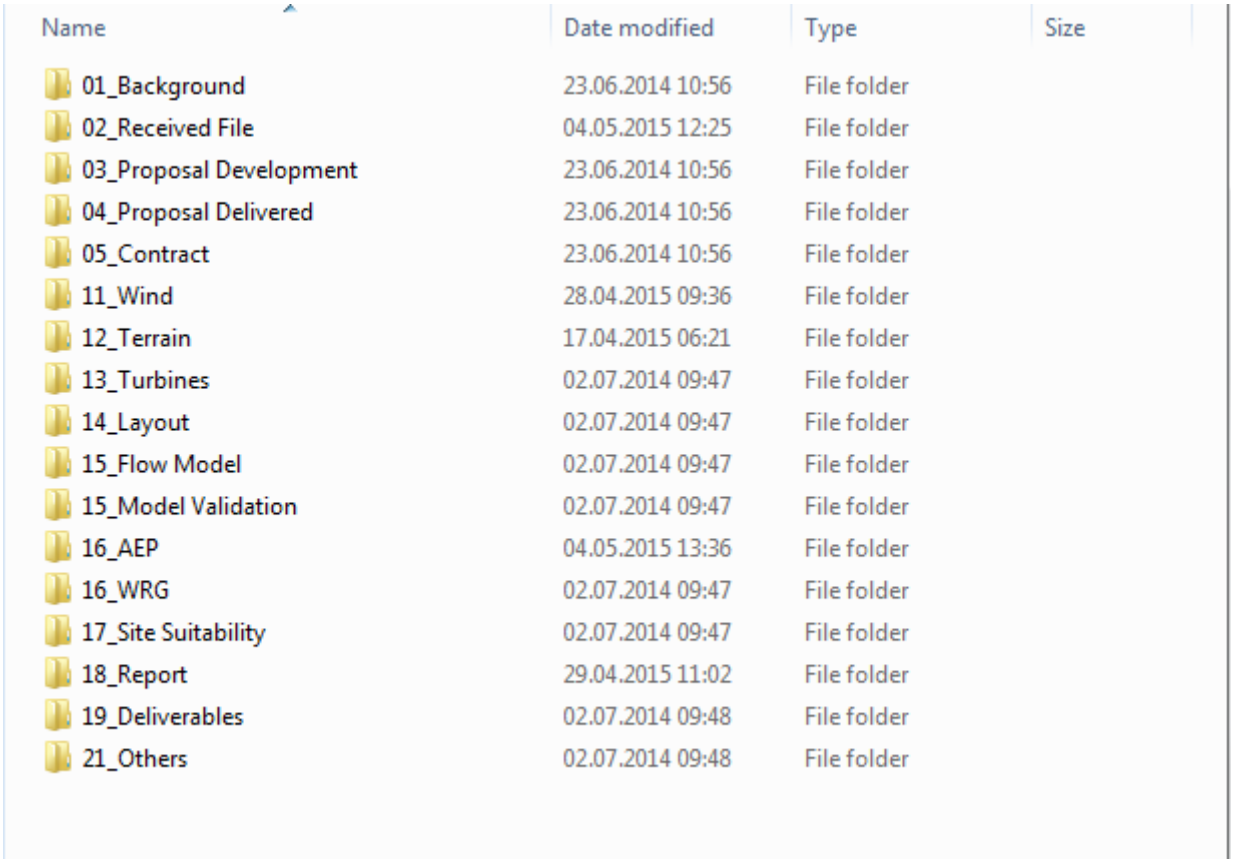
n - number of climatologies

X - x-extension of digital terrain model/refinement (m)

Y - y-extension of digital terrain model/refinement (m)

l - Minimal grid spacing (m)

Management



Name	Date modified	Type	Size
01_Background	23.06.2014 10:56	File folder	
02_Received File	04.05.2015 12:25	File folder	
03_Proposal Development	23.06.2014 10:56	File folder	
04_Proposal Delivered	23.06.2014 10:56	File folder	
05_Contract	23.06.2014 10:56	File folder	
11_Wind	28.04.2015 09:36	File folder	
12_Terrain	17.04.2015 06:21	File folder	
13_Turbines	02.07.2014 09:47	File folder	
14_Layout	02.07.2014 09:47	File folder	
15_Flow Model	02.07.2014 09:47	File folder	
15_Model Validation	02.07.2014 09:47	File folder	
16_AEP	04.05.2015 13:36	File folder	
16_WRG	02.07.2014 09:47	File folder	
17_Site Suitability	02.07.2014 09:47	File folder	
18_Report	29.04.2015 11:02	File folder	
19_Deliverables	02.07.2014 09:48	File folder	
21_Others	02.07.2014 09:48	File folder	

Parameter

1: Terrain extension	
Coordinate system	Global
X-range	**746500; 758000**
Y-range	**1586500; 1598500**
2: Roughness	
Roughness height	Read from grid.gws
3: Numerical model	
Automatic gridding	False
Refinement type	**Refinement area**
Refinement area, X-range	**751000; 753500**
Refinement area, Y-range	**1591000; 1593000**
Height above terrain	**6000**
Horizontal griding	**Horizontal resolution**
Horizontal resolution	20
Ratio additive length to resoluti	0,5
Height distribution factor	**0,05**
Orthogonalize 3-D grid	False
Number of cells in Z direction	**35**
4: Smoothing	
Smoothing type	No smoothing
5: Forest	
Forest	**Base on roughness height**
Forest setup	**(Collection)**

1: Boundary and initial conditions	
Do Nesting	Disregard nesting
Sector input type	Uniform distribution of the sector angles
Number of sectors	**16**
Sectors for next run	0;22;45;67;90;112;135;157;180;202;225
Height of boundary layer	500
Speed above boundary layer he	10
Use previous run as input	**True**
Boundary condition at top	Fixed pressure
2: Physical models	
Potential temperature	Disregard temperature
Air density	1,225
Turbulence model	**RNG k-epsilon**
3: Calculation parameters	
Solver	GCV
Number of simultaneous sector	**3**
Number of iterations	**400**
Convergence wizard	False
Convergence criteria	**1E-05**
4: Convergence monitoring	
Coordinate system	**Global**
Spot value X position	**752131**
Spot value Y position	**1592051**
Field value to monitor	Speed scalar XYZ
5: Output	
Height of reduced wind databas	300
Run in batch mode	**True**

Parameter

Size:

Refinement: larger than wind farm area

Edge: c.a. 10km away from the wind farm area

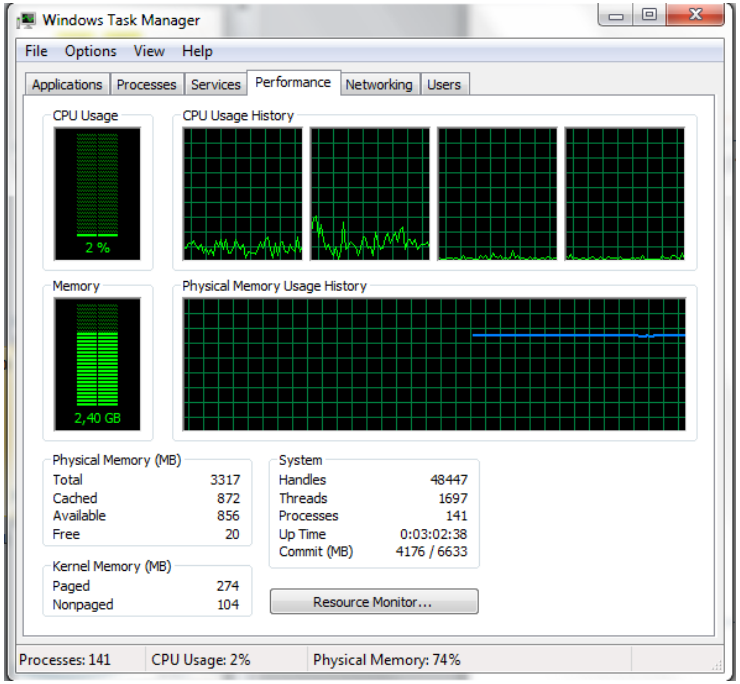
Total number of cells: resources

Cell Aspect Ratio: over 20

Management

Computer capacity:

- Free memory
- CPU core
- Free space in Hard Disk Drives



Management

GCV solver:

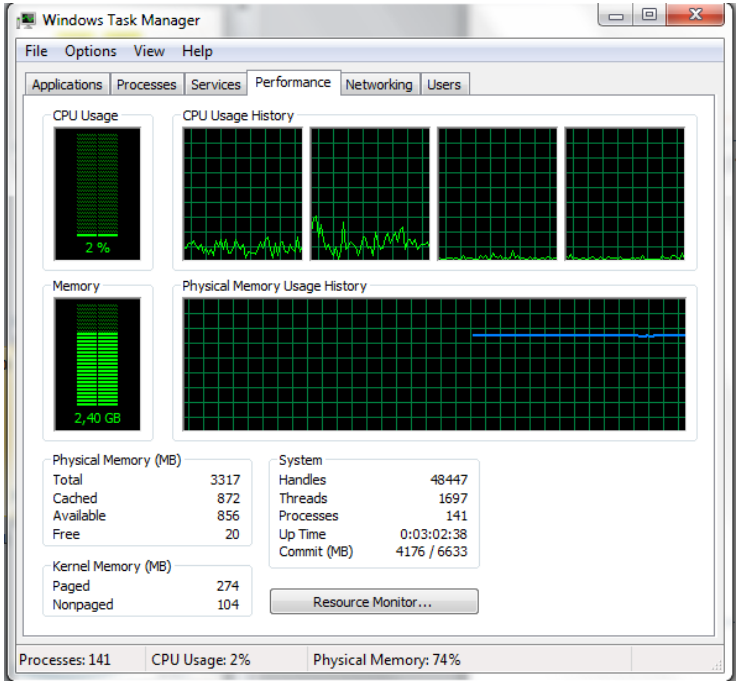
- T = m*i/200
- R = 1.0*m

T - computational time per sector (hr)

R - RAM per sector required (GB)

m - cell number (m)

i - iteration



Parameter

						cell	
			bottom	mid	upper	half heigh	size
l1	1	1	0	3.3	6.6	3.3	6.6
	2	2	6.6	10.9	15.2	4.3	8.6
	3	3	15.2	20.3	25.4	5.1	10.2
	4	4	25.4	31.5	37.6	6.1	12.2
	5	5	37.6	44.5	51.4	6.9	13.8
	6	6	51.4	59.4	67.4	8	16
	7	7	67.4	76.1	84.8	8.7	17.4
	8	8	84.8	94.5	104.2	9.7	19.4
	9	9	104.2	114.8	125.4	10.6	21.2
	10	10	125.4	137	148.6	11.6	23.2
	11	11	148.6	161	173.4	12.4	24.8
	12	12	173.4	186.7	200	13.3	26.6
l2	1	13	200	216.4	232.8	16.4	32.8
	2	14	232.8	265.5	298.2	32.7	65.4
	3	15	298.2	347.3	396.4	49.1	98.2
	4	16	396.4	461.8	527.2	65.4	130.8
	5	17	527.2	609.1	691	81.9	163.8
	6	18	691	789.1	887.2	98.1	196.2
	7	19	887.2	1001.8	1116.4	114.6	229.2
	8	20	1116.4	1247.3	1378.2	130.9	261.8
	9	21	1378.2	1525.5	1672.8	147.3	294.6
	10	22	1672.8	1836.4	2000	163.6	327.2
l3	1	23	2000	2200	2400	200	400
	2	24	2400	2600	2800	200	400
	3	25	2800	3000	3200	200	400
	4	26	3200	3400	3600	200	400
	5	27	3600	3800	4000	200	400

Parameter

Vertically: (typical)

Mutiple layers

Layer 1: 7-10 below 100 meter

Layer 1: not too low for the first cell height

Layer 2: Smooth expended

Example:

```
k-logical          :    line_k  points   distribution  z_upper
                             1      11     0.2500        200.0
                             2       9     0.1000        2000.0
                             3       5     1.0000        4500.0
```

Parameter

1. Hortizontal gridding, resolution, refinement area, size: GUI
2. Vertical gridding, *.bws

Parameter

Forest:

Range:

Vertical: 3 – 5 tree height

Horizontal: 10 – 20 tree height

Tree height: field trip

C1=0

C2= xxx

Cells= 3 – 5

Turbulence term

Parameter

Convergence cretira:

0.00001

Height of the boundary layer:

Norway 500

Higher closer to equater

Parameter

Stability:

Stable:

MOL 100

Ref H: 300

U at Ref. H: 10

H BL: 30

Unstable:

MOL -100

Ref H: 1000

U at Ref. H: 10

H BL: 1000

0

Parameter

Making *.ows

1. Copy sample file to excel
2. Modify add xxxx in front
3. Copy to Notepad++, replace xxxx with a lot of space
4. Copy *.pws to project folder
5. Apply *.ows

Parameter

Making *.ows

1. **Copy sample file to excel**
2. **Modify add xxxx in front**
3. **Copy to Notepad++, replace xxxx with a lot of space**
4. **Copy *.pws to project folder**
5. **Apply *.ows**

Cross checking

ref 3 – 25

Target 3- 25

Wake sub cycle:

30

Parameter

WAT

1. ST wind for TI, then repalce NA in extreme wind from GUI

Making *.pws

Copy from Excel, keep the title

Parameter

Better picture scale

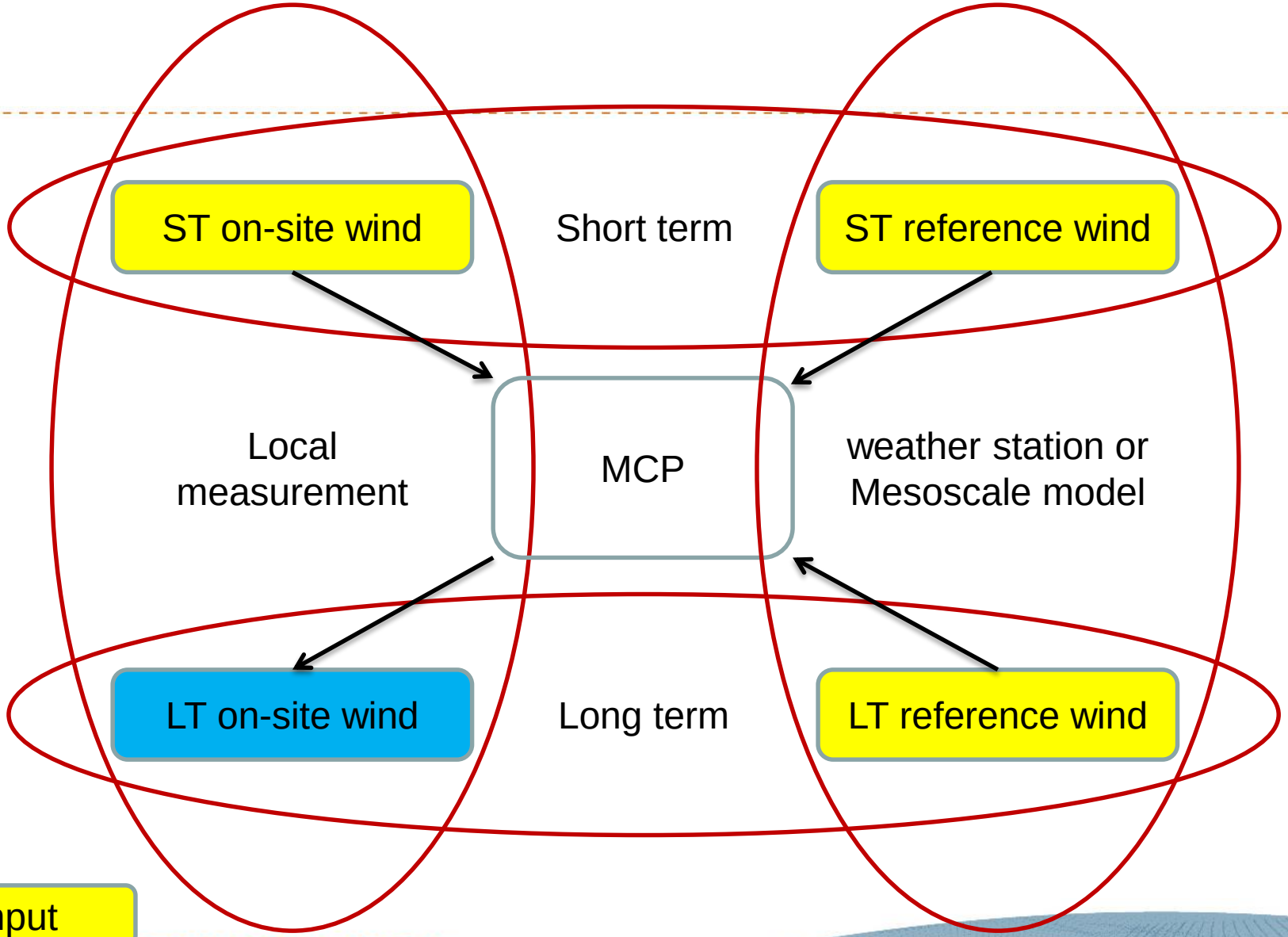
1. GLViewer, Scalar – Scalar setting

Visual and quick pick

1. Special – node picking, ctrl + mouse

Visualize layout + roughness

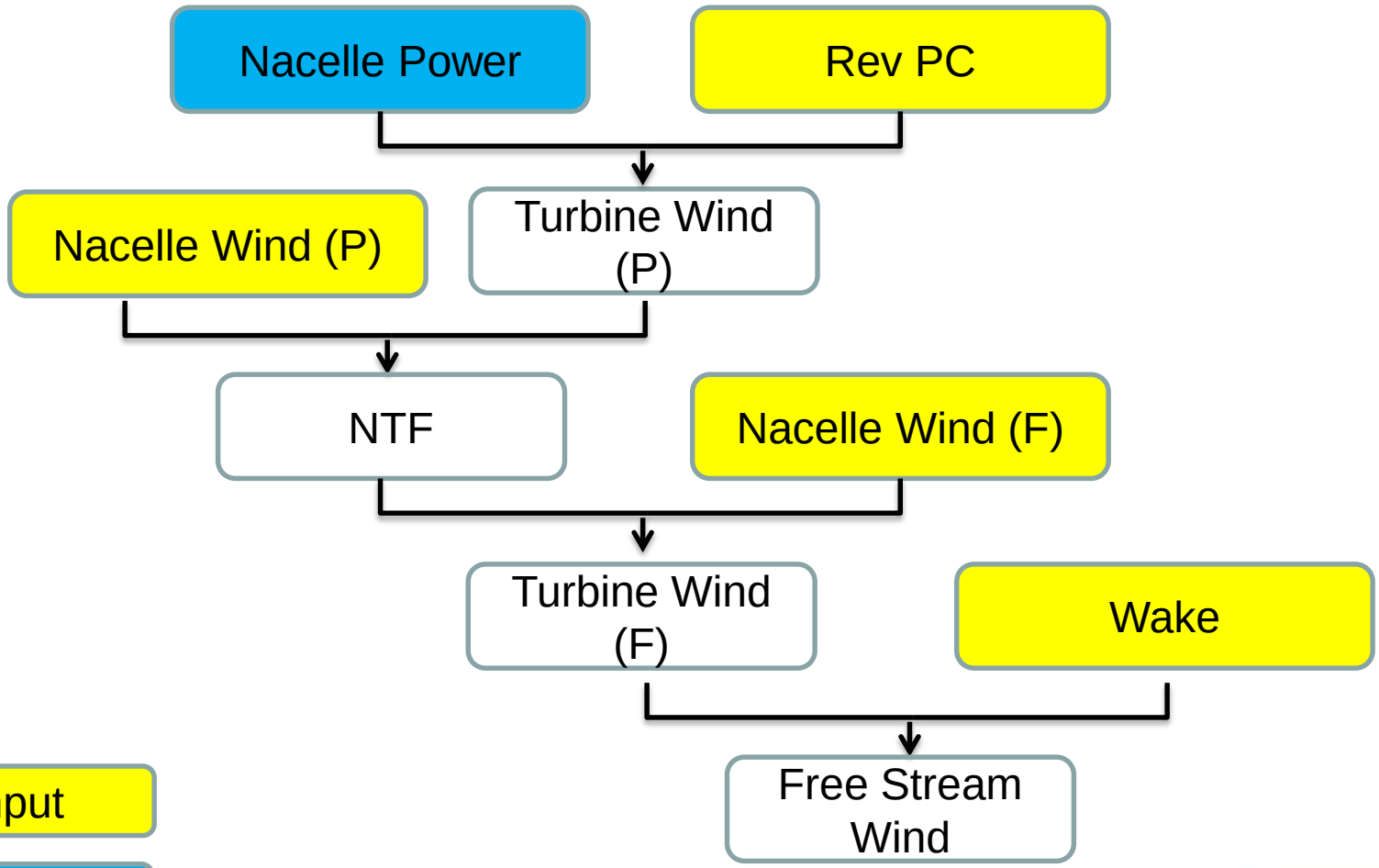
1. Open terrain_roughness,
2. Open secondary file add_3Dobjects_to_vtf



Input

Output

Technique - NTF



Technique - Sector Management

				T1	T2	T3	T4	T5	T6	T7
energy				frequency	energy	frequency	frequency	frequency	frequency	frequency
				(MWh/y)	(MWh/y)	(MWh/y)	(MWh/y)	(MWh/y)	(MWh/y)	(MWh/y)
	From	center	to							
1	-11.25	0	11.25	547.5	552.7	550.9	548.2	522.4	505.1	465.7
2	11.25	22.5	33.75	8907.7	9018.4	9053.4	8842.9	8310.3	8284.8	7929.2
3	33.75	45	56.25	1078.7	1135.2	1151	1056		935.3	928.1
4	56.25	67.5	78.75	282.2				230.4		203.2
5	78.75	90	101.25				139	116.6		
6	101.25	112.5	123.75				133.3	119.9		
7	123.75	135	146.25	65.4			107.2	94.6		89.5
8	146.25	157.5	168.75	92.4		104.9	130.3	107.6	101.4	89.7
9	168.75	180	191.25	207.4	173.8	147.8	165.7	138.7	126	116.9
10	191.25	202.5	213.75	150.9	148.8	127.4	102.5	82.8	117.3	132.4
11	213.75	225	236.25	34.6	37.1	38.8	34.7		17.8	16.7
12	236.25	247.5	258.75	17.3		19.9				
13	258.75	270	281.25							7
14	281.25	292.5	303.75				2.6			5.8
15	303.75	315	326.25		1.4		2.3	2.6		2.9
16	326.25	337.5	348.75		11.4		13.4	13	13.9	13.2