

PRIME building wake scheme

questionable results in light wind
stable conditions

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Source – test case related to a gas turbine at an LNG plant

Building dimensions: L 270m, W 20m, H 22m
Stack situated next to building at 0.5 L
Hs 40 m, Ts 523C, Ws: 26.3 m/s, Diam 3.74 m
i.e. very high buoyancy and momentum.
NOx emission: 15.5 g/s

receptor 4.7 km downwind, flow vector cases:
90 degrees (across building) and 45 degrees.

Ausplume Metsamp.met, converted for ISC3P
24 hours, all Hmix = 9999.

ISC3P: PRIME off, flow 90 deg

Rank	Conc.	Time Recorded mddhh	speed m/s	stab
1.	3.89218	(10210)	20.0	D
2.	3.75651	(10209)	17.0	D
3.	3.45708	(10118)	6.0	C
4.	3.43717	(10119)	7.0	C
5.	3.36491	(10208)	14.0	D
6.	3.30015	(10117)	5.0	C
7.	2.98328	(10207)	12.0	D
8.	2.82777	(10116)	4.0	C
9.	2.53743	(10111)	3.0	B
10.	2.40765	(10206)	10.0	D
40.	0.52402	(10221)	1.5	F

ISC3P: PRIME on, flow 90 deg

Rank	Conc.	Time Recorded mddhh	speed m/s	stab
1.	7.22903	(10218)	5.0	E
2.	6.83558	(10208)	14.0	D
3.	6.61114	(10209)	17.0	D
4.	6.59806	(10217)	4.0	E
5.	6.56371	(10207)	12.0	D
6.	6.23269	(10117)	5.0	C
7.	6.11538	(10210)	20.0	D
8.	5.62088	(10206)	10.0	D
9.	5.04187	(10224)	3.0	F
10.	4.90409	(10223)	2.5	F
39.	0.03589	(10221)	1.5	F

ISC3P: PRIME on, flow 45 deg

Rank	Conc.	Time Recorded mddhh	speed m/s	stab
1.	21.75722	(10222)	2.0	F
2.	21.45429	(10221)	1.5	F
3.	19.95199	(10223)	2.5	F
4.	19.56282	(10224)	3.0	F
5.	19.17402	(10215)	2.5	E
6.	15.77936	(10216)	3.0	E
7.	15.07965	(10214)	2.0	E
8.	13.62135	(10217)	4.0	E
9.	13.13327	(10218)	5.0	E
10.	7.31106	(10201)	4.0	D

Questions

- Change in angle has tripled concentration. What mechanism?
- Can significant wake effects occur at 1.5 to 2 m/s F, such that concentrations at 5 to 10 km under these conditions become annual maxima, ~ 40 times higher than at 1.5 to 2 m/s F without building effects? Wouldn't the momentum and buoyancy of the source dominate? Could there be enough energy in the air flow distortion at such a low wind speeds to significantly affect a high buoyancy / momentum plume?
- Note Calpuff ignores building effects in Calms Processing.
- Further runs of Ausplume/Prime show that the angle becomes less important as buoyancy/momentum decrease. Wake effects decrease as building length decreases (from the large 270 metres) and this appears to be true regardless of buoyancy/momentum.