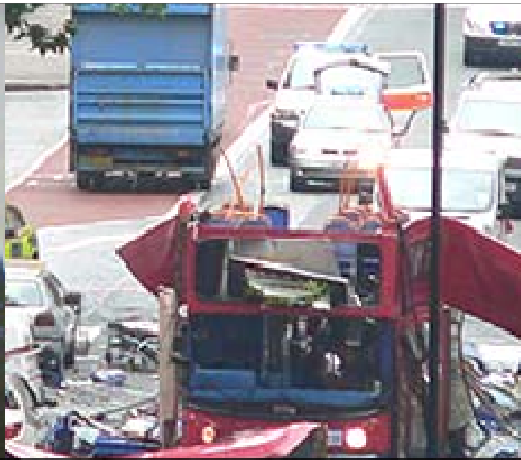


Don't panic!



Saving the world...

...with Ruby and Rails



Who?

**We develop tools for
Homeland Security...**

**We develop tools for
Business Continuity...**

**We develop tools for
Resilience...**

MET Police

SO15 Counter Terrorism Command

Letter Bombs

Polonium Cleanup Operation

European Union

Critical National Infrastructure

What do we use Ruby for?

IRIS

2 years old

Monolithic

116,000 lines of PHP*

*ouch

Enter Rails...

4 months later

Asset Management for the EU

Incident Management and Training

Exercising System for the G8

Geo-messaging

Possible in PHP?

Gas Plumes


Chlorine Gas Tanker Crashed in Leeds

Us <3 SimuCorp*

* not real name

Us < /3 SimuCorp*

* not real name

A man with dark hair and a surprised expression, wearing a dark jacket over a grey t-shirt, looking slightly to the right. The background is a plain wall with a vertical pipe on the right side.

**"woah...
I know Ruby"**

Two main ways to model plumes

Gaussian Plume Model

$$C(x, y, z) = \frac{Q}{2\pi u \sigma_y \sigma_z} \times \left[\exp\left(-\frac{y^2}{2\sigma_y^2}\right) \right] \left\{ \exp\left(\frac{-(z-H)^2}{2\sigma_z^2}\right) + \exp\left(\frac{-(z+H)^2}{2\sigma_z^2}\right) \right\}$$

C = Concentration of the chemical in air. [M/L³]

Q = Rate of chemical emission. [M/T]

u = Wind speed in x direction. [L/T]

σ_y = Standard deviation in y direction. [L]

σ_z = Standard deviation in z direction. [L]

y = Distance along a horizontal axis perpendicular to the wind. [L]

z = Distance along a vertical axis. [L]

H = Effective stack height. [L]

$$\Delta H = 1.6 F_b^{1/3} x^{2/3} / u$$

$$F_b = g \frac{d^2 V}{4} \left(\frac{T_s - T_a}{T_s} \right)$$

ΔH = Plume rise as defined by Briggs equation. [L]

x = Downwind distance. [L]

u = Wind speed in x direction. [L/T]

F_b = Buoyancy flux. [L⁴/T³]

g = Acceleration due to gravity. [L/T²]

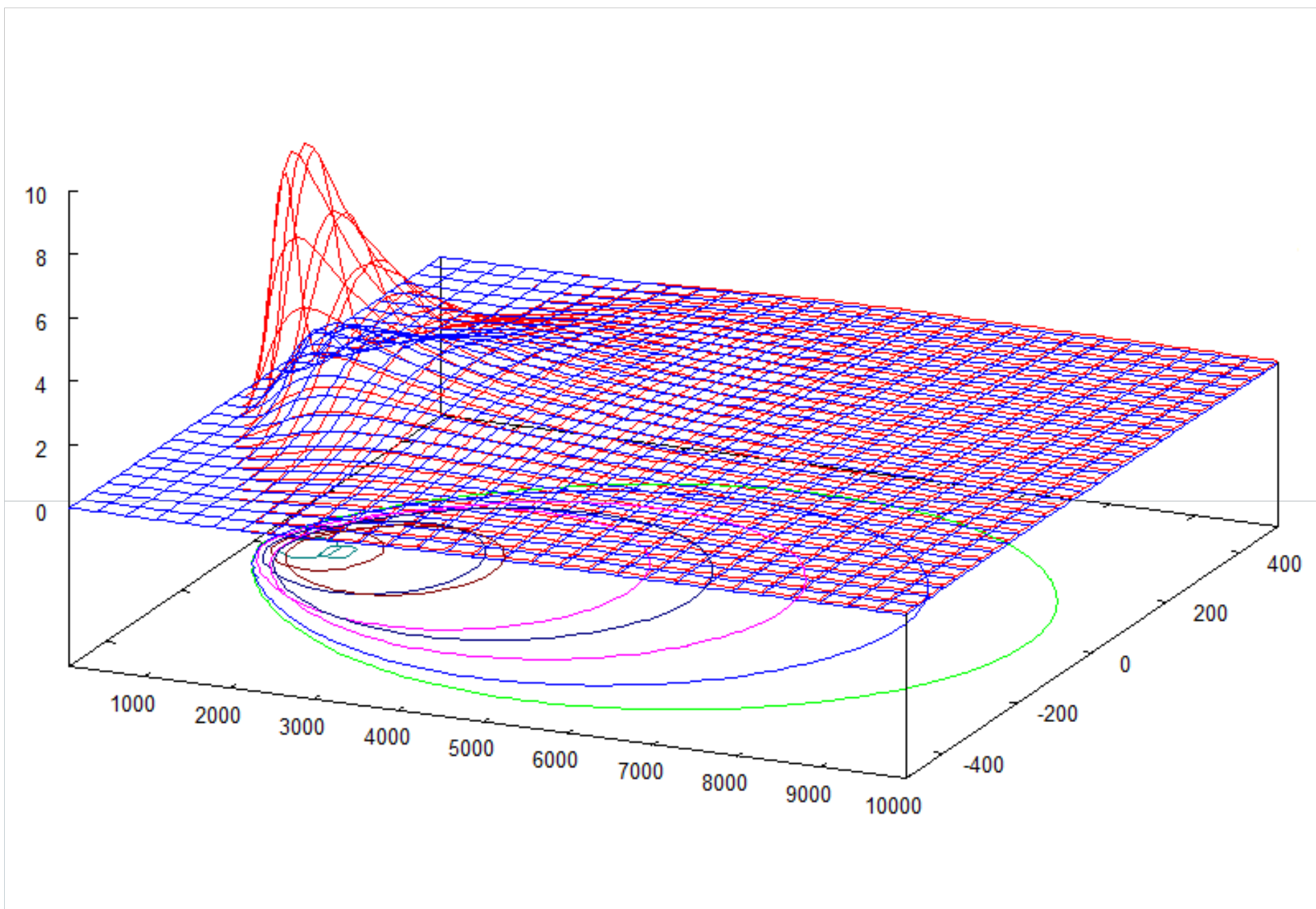
d = Stack diameter. [L]

V = Exit velocity. [L/T]

T_s = Absolute gas temperature. [D]

T_a = Absolute air temperature. [D]

<http://www.rpi.edu/dept/chem-eng/Biotech-Environ/SYSTEMS/plume/gaussian.html>



However...

Gaussian = static

Wind speed, direction & emission rate

Puff dispersion model

Particle system

Particle

- position
- velocity
- volume

Emitter

- position
- volume
- rate
- particles

World

- wind velocity
- emitters

```
# let there be light!
world = World.instance

world.wind = Vector2D.new(0, 15)

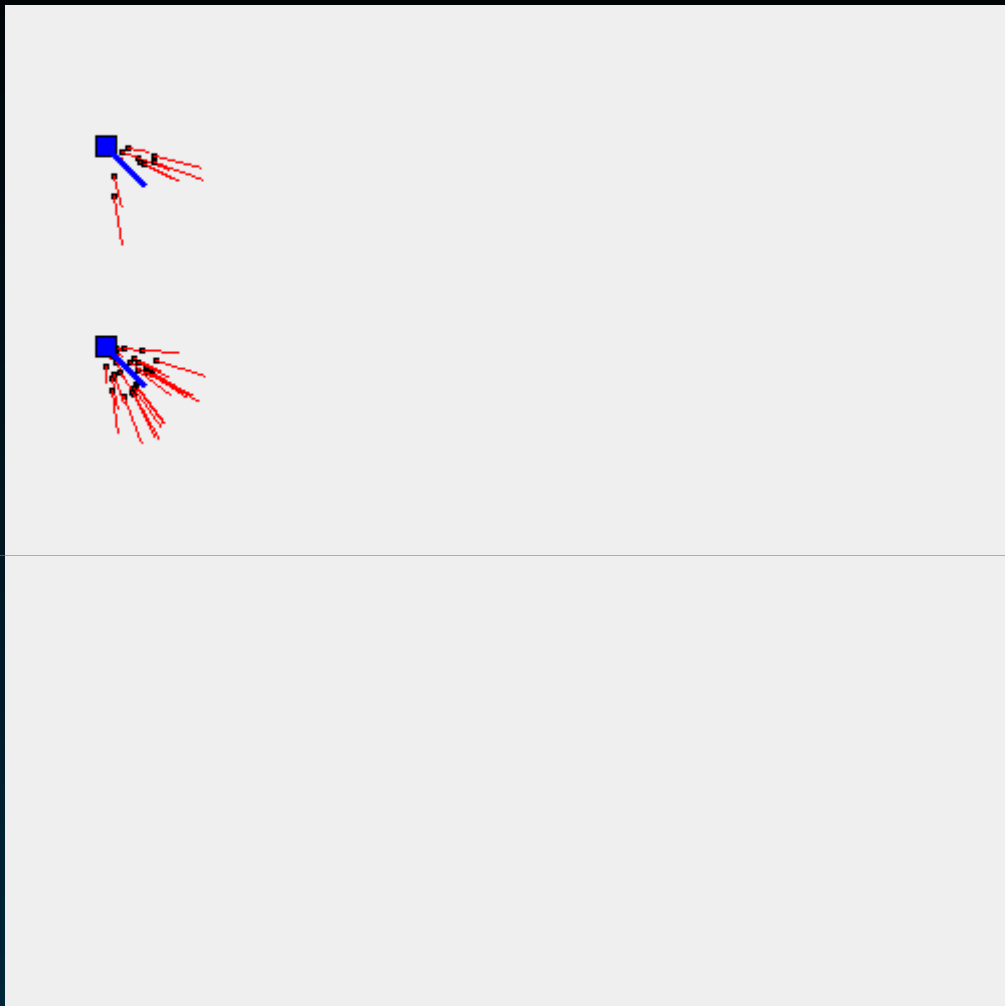
# add an emitter
emitter = Emitter.new(:position => Position.new(10, 20),
                    :volume    => 100,
                    :rate      => 1)

world.emitters << emitter

10.times { world.tick }

# change the wind
world.wind.rotate! Math.deg2rad(25)

10.times { world.tick }
```



Changes

```
emitter = Emitter.new(:position => Position.new(10, 20),
                    :volume   => 100,
                    :rate     => 1)

# setup rate changes
emitter.changes << EmitterChange.new(:after => 5.hours,
                                     :rate   => 5)

emitter.changes << EmitterChange.new(:after => 8.hours,
                                     :rate   => 30)

# setup wind changes
world.changes << WindChange.new(:after => 6.hours,
                              :velocity =>
                                Vector2D.new(10, 20))
```

Making it real*

* ish

Ficks Law

Combined Gas Laws

Molecular Weight
Cl₂ = 70.906

Temperature and pressure gradients

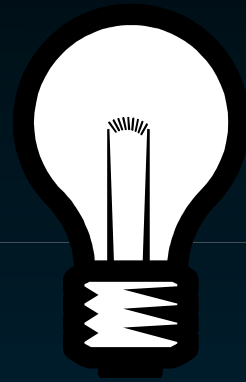
“Screw it”

me, Jan 2007, after working
about 36 hours straight and
ending up back where I started!

Credible Reality

Ruby is slow*

* /me makes run for the door...

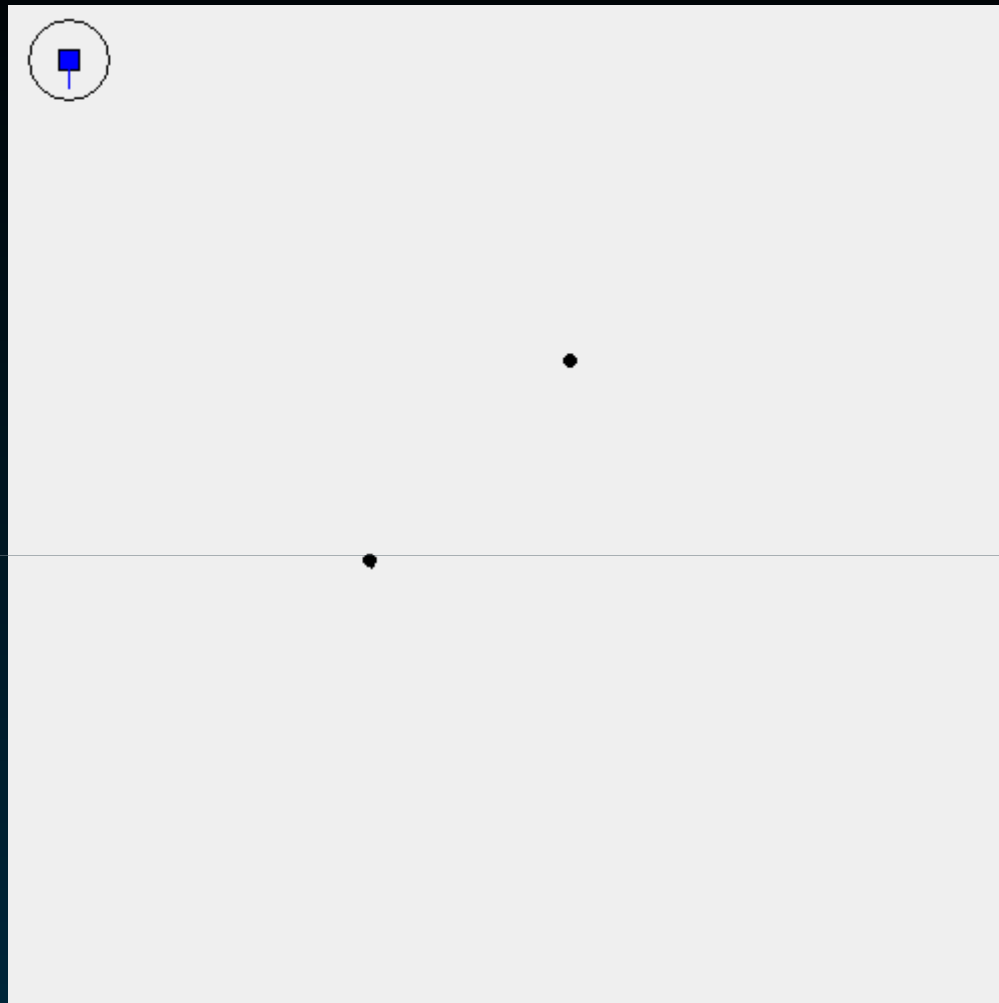


**Don't need real-time
so why bother?**

Ballistic trajectory

srand(XXX)

Final model



Mapping

Pretend to be a map-server

Convert Coordinates

Output image

Gas Plume - Particle Model

Time Select

20 : 30 12 February 2007

display simulation

Emitters

Quantity

in kg of liquid gas



Enter a quantity and drag the emitter onto the map

Set Rate (2)

set - x

Wind

Wind Speed

in meters per second

around 2 is a light breeze, with a near gale at 15 and violent storm at 30m/s

Wind Direction

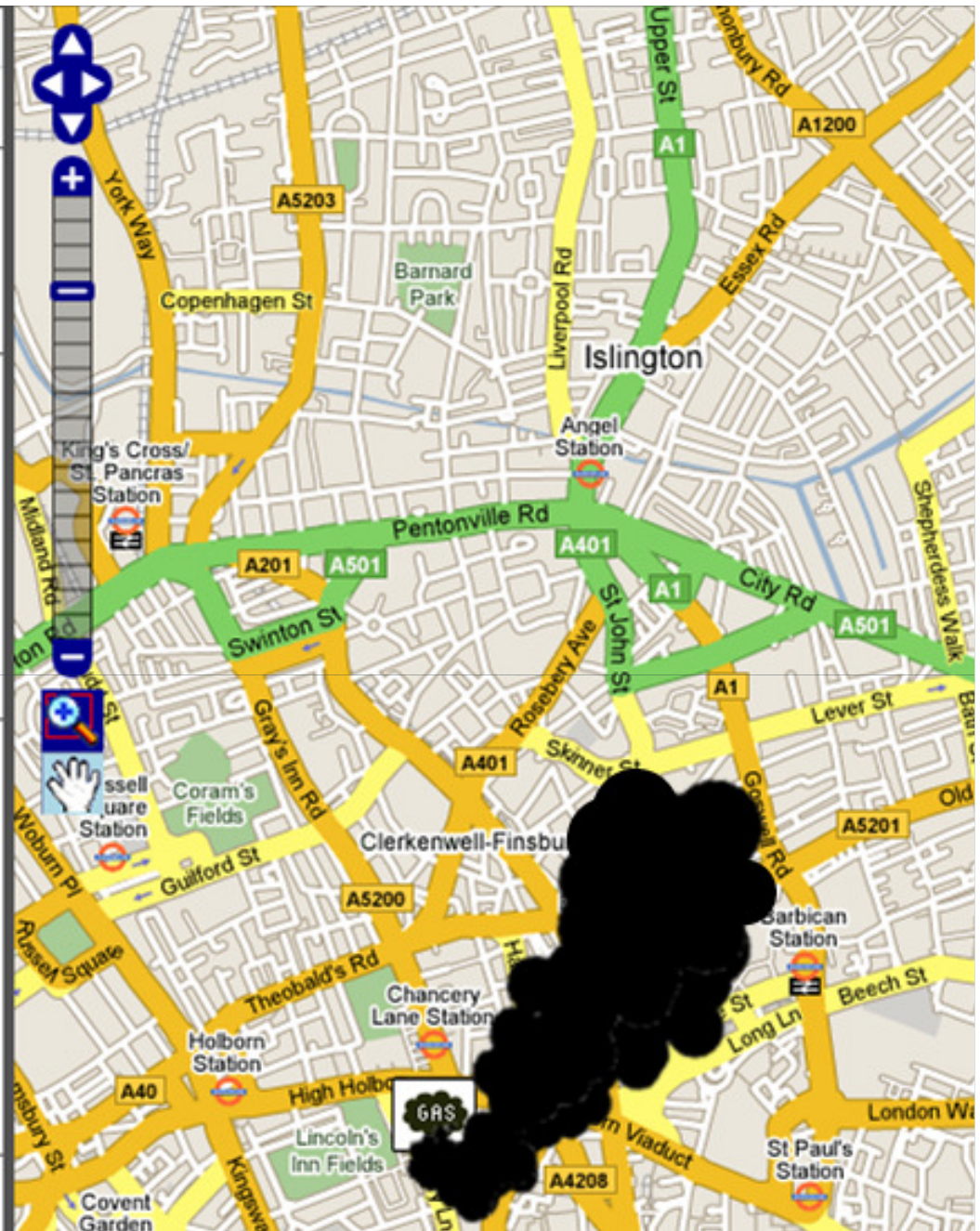
in degrees

0° is north, 180° is south, 90° and 270° are east and west respectively.

set

Action Queue

Add emitter (2) - 18:30 12/02/2007 → 1000kg - x



plugins

acts_as_branch

exercise_time

```
function sit_reps_url(incident_id, params){
  return '/incidents/'+incident_id+'/sit_reps/'+route_params(params);
}
```

```
function new_sit_rep_url(incident_id, params){
  return '/incidents/'+incident_id+'/sit_reps/new/'+route_params(params);
}
```

```
function new_inject_url(incident_id, params){
  return '/incidents/'+incident_id+'/injects/new/'+route_params(params);
}
```

```
function sort_audiences_url(params){
  return '/admin/audiences;sort/'+route_params(params);
}
```

```
function asset_types_url(params){
  return '/admin/asset_types/'+route_params(params);
}
```

```
function attachments_url(incident_id, params){
  return '/incidents/'+incident_id+'/attachments/'+route_params(params);
}
```

```
function new_incident_url(params){
  return '/incidents/new/'+route_params(params);
}
```

```
function edit_expected_outcome_url(incident_id, inject_id, id, params){
  return '/incidents/'+incident_id+'/injects/'+inject_id+'/expected_outcomes/'+id+';edit/'+route_params(params);
}
```

```
function account_audit_trails_url(params){
  return '/admin/audit_trails/'+route_params(params);
}
```

js_routes

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<http://code.livsey.org>
<http://code.citysafe.org>

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