Video from Kincaid experiment

Introduction

The Kincaid experiment in 1980 was sponsored by the Electric Power Research Institute (EPRI) in the USA. EPRI has kindly given permission, so the set of video clips here can be freely distributed. The contact person at EPRI is Dr. Charles Hakkarinen.

The video clips were originally on a movie, put together by TRC Environmental Consultants who were contracted to conduct field experiments. The clips have been edited and put in digital format by H.R. Olesen of the National Environmental Research Institute, Denmark.

Most of the video is from time lapse sequences, where a picture was taken every 30 seconds, while the movie was played back at a rate of 9 pictures per second. This corresponds to a rate of 1 "real" hour being played in 13.3 seconds.

The video clips are in MPEG format; you may have to update your Windows Media Player in order to be able to play them,

The video clips can also be compared to experimental tracer data; in particular it is instructive to use the so-called *Data Visualisation Tool* (developed by Alexander Markoski, Bitola University, FYROM) to look at the data in a 3D view.

A field observer from TRC wrote a set of notes on the content of the movie, which is reproduced below:

July 12, 1980 (1930 CDT)

Kincaid12JulyPlant
Close-up of plant. Shows stack and "dirty" plume
0:18

Close-up of Kincaid power plant, stack, & "dirty" plume. This is *not* a time-lapse sequence.
Some data about the power plant:

- 600 ft. stack; 2 650 MW boilers; No scrubber
- 4-5% sulfur coal; 2.4 mil. tons burned per year.
- Baseload plant; Generates 4.3 mil MWH per year.
- SO_2 emissions: 200,000 T/yr, 23 T/hr, 5,700 g/s.
- NO_X emissions: 1/3 SO_2 emissions.
- Particulate emissions: 800 T/yr.

July 14, 1980 (0910-1600 CST)

Kincaid14JulyLooping
Study of plume looping periodicity

Study of plume looping periodicity.

The period of the large eddies affecting the plume appears to be several times the time-lapse interval of 30 seconds.

Meteorology: Class B, wind speed = 5 m/s.

July 15, 1980 (1045-1720 CST)

Kincaid15JulyLooping
Study of plume looping periodicity

Study of plume looping periodicity.

Plume appears to stop or back up. Strobe effect implies that large eddies have a period equal to or multiple of the time-lapse interval of 30 seconds.

Meteorology: Class B, wind speed =5 /s.

July 17, 1980 (1130-1820 CDT)

Kincaid17JulyShear
Strong wind shear
1:43

Plume behavior influenced by strong wind shear.

- North wind aloft initially carries entire plume southward (meanwhile, the surface wind is from the south) .
- During the afternoon, the south winds take over through an increasingly deeper layer.
- By mid-afternoon, wind-shear effect is very apparent. Most of plume continues southward, but chunks are occasionally broken off early in the plume rise by the south wind and are carried northward.
- At 1530 CDT, the bulk of plume is affected alternately by north and south winds. A T-shaped plume results, i.e., two plumes visible at one time going in opposite directions!
- After 1600 CDT, shear is no longer present through plume height. South wind has taken over and entire plume now is carried northward. (Note: clouds aloft still move southward.)

July 23, 1980 1500 CDT

Kincaid23JulyBifurcated
Bifurcated plume

Bifurcated plume often observed at the plant.

July 24, 1980 (0810-1415 CDT)

Kincaid24JulyClassical
Classical morning transition

Classical morning transition fron night: stabIe plume aloft, through inversion break-up fumigation, to the convectively unstable looping plume.

- Initially, a stable, compact plume aloft. No touchdown within 50 km.
- At 1000 CDT, sudden fumigation apparent between plume height and ground.
- By late morning (1150 CDT), strong convective eddies have formed and are propagating through the area in parade fashion.
- As a convective cell passes over the plant area, the plume is rapidly entrained upward into the call. A cumulus cloud then forms in the cell.
- The cloud formation is likely enhanced by added moisture and particulate matter from the plume.

July 25, 1980 (0825-1700 CST)

Kincaid25JulyEntrainment
Plume entrained into convective cells

Plume being entrained into propagating convective cells, with subsequent cumulus development.

- At 1400, bifurcated plume.
- Note: Clock time is wrong.

July 28, 1980 (0820-1530)

Kincaid28JulyCumulus
Plume entrained into convective cells; cumulus formed

Plume producing large, cumulus clouds.

The plume is being entrained into propagating convective cells.

• Note: Clock time is wrong.