

Abstract

Brief luminous phenomena are observed since at least 25 years in the low atmosphere above the Hessdalen valley. The valley is located in the middle of Norway, 120 km southeast of Trondheim at latitude 62°41' North and longitude 11°11'22" East between two mountain ranges, at an altitude of 600 m. This phenomenon, still unexplained, appears like a glowing light ball with dimensions ranging from decimetres up to 30 m. The glow is brighter than high magnitude stars. It may be localised in a single point and lasts less than one second or may move inside the valley during several seconds or even tens of seconds. Since the mid of 1980's, camera observations and radar measurements have given qualitative and quantitative observations which complement the observations reported by Hessdalen Valley inhabitants. Each year, since 2000, a Science camp took place in Hessdalen in the beginning of September. During the last camp, from 6th to 13th,

September 2010, different instruments were installed by Norwegian, Italian and French institutes. CEA participated for the first time to this camp with electric field and infrasound measurements. Such experiment was motivated by previous echoes related to camera observations, demonstrating the presence of ionisation inside the luminous ball. Electric field or infrasound are then expected, as other transient luminous events, like sprites inside the middle atmosphere, are sources of such emissions. Two different experiments were thus installed by CEA: an infrasound array and a wideband (1 kHz – 5 MHz) electric-field antenna. During the week, a fish-eye camera, operated by Østfold University College, on the top of a mountain, caught several events including a long one (~2km length). We show, in the paper, first results obtained at the same time.

A. 2010 Science Camp and observations

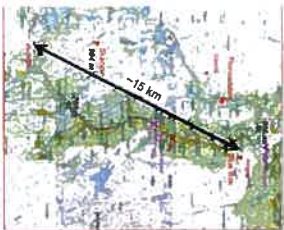
Science camp instruments

Scientists from Norway, Italy and France have participated to the Hessdalen Science Camp, which occurred from Sept. 6th to 13th, 2010. About 30 school students from Norway and Sweden and their teachers participated to the observations (www.sciencecamp.no)

Previous observation campaigns and a full description of the phenomenon are presented in the following EGU associated posters:

- XY 481: The Hessdalen Phenomenon by Erling Strand
- XY 481: Optical spectroscopy of the transient luminous phenomena in the low atmosphere over the Hessdalen valley, NORWAY by Bjørn G. Hauge

Cameras	Dyungen, Rogre
Survey cameras	Blau Box
Fish-eye camera	Schwabert
UV camera	Dyungen
VLF recording	Dyungen
Magnetic field measurement	Dyungen at Frinsdalen
Seismometer	Head Quarter (HK)
Infrasound electric field	Blau Box
Wideband electric field	Blau Box



Fish-eye camera (Østfold University College)



Observations during the Science Camp

- 7 events observed with the fish-eye camera (30 s exposure time)
 - 08 Sept. at 22:00:00 (LT)
 - 09 Sept. at 22:36:04, 23:20:04, 23:44:04, 23:52:04, 23:59:04 (LT)
 - 10 Sept. at 00:45:58 (LT)
- and 3 others by witnesses:
 - 07 Sept. at 20:35 (LT) lasting 8 minutes !!
 - 13 Sept. at 14:50 (LT)
 - 14 Sept. at 20:45 (LT)



Location of the events



- 08/09/2010 at 22:00:00
- 09/09/2010 at 22:36:04
- 09/09/2010 at 23:20:04
- 09/09/2010 at 23:44:04
- 09/09/2010 at 23:52:04
- 09/09/2010 at 23:59:04
- 09/09/2010 at 00:45:58

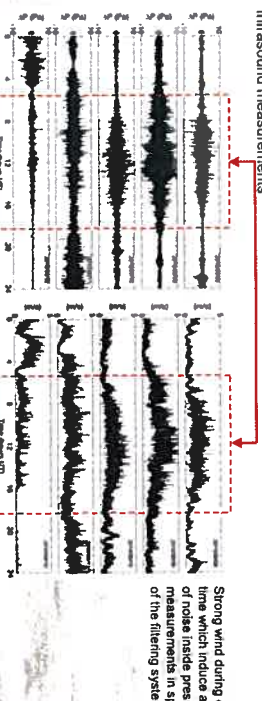
The event is clearly inside the valley. Most of events are like a flash but one is moving at a speed which can be from 250 to 7000 km/h (depending on its duration which is unknown).

B. Infrasound measurements

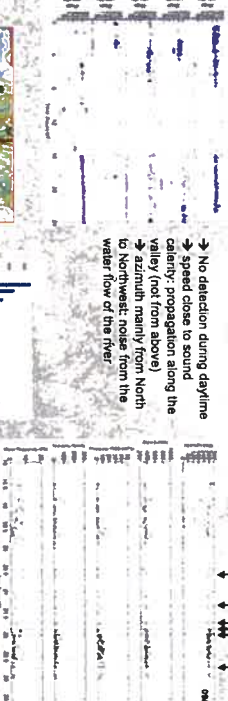
Objective: recording acoustic radiation from Hessdalen phenomenon, if any



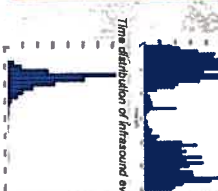
An infrasound station, composed of 4 microphones (MBR2005 organized as an equilateral triangle of ~250 m side) has been installed close to the Head Quarter. The sampling frequency was 100 Hz. A filtering system composed of pipes has been used to reduce the noise due to wind.



PMCC results (autocorrelation analysis) in 0.1 – 20 Hz band



No detection during daytime
 → Speed close to sound
 → cavity, propagation along the valley (not from above)
 → azimuth mainly from the North
 → Northwest noise from the water flow of the river



No detection in correlation with any optical events recorded during that night
 → azimuth of all optical events is from South to Southwest while infrasound detection give azimuths from Northwest to North

Probably no acoustic wave is produced by the Hessdalen phenomenon.

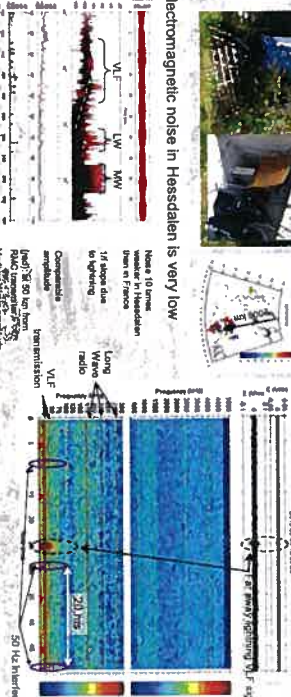
C. Wide band electric field measurements

Objective: recording electric field radiation from Hessdalen phenomenon, if any

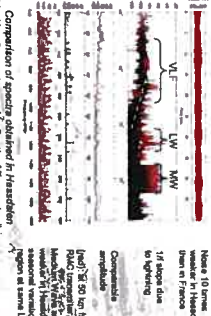


Using the same instrument used for lightning and sprite observations:
 • vertical electric field measurements using a vertical dipole
 • wideband: 1 kHz – 5 MHz
 • event duration: 50 ms
 • acquisition card: 100 Meamples/s, 14 bits
 • recurrence: every 5 seconds (more than 17 000 events/day) in lightning and sprite research, triggering over a determined threshold is used, but here the threshold is unknown.
 • data storage on a removable hard disk (1 TB ~ 3 month of data). The instrument has been left operational during the winter.

Example of recorded signal



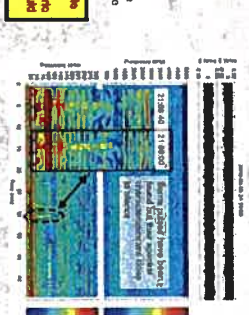
Electromagnetic noise in Hessdalen is very low



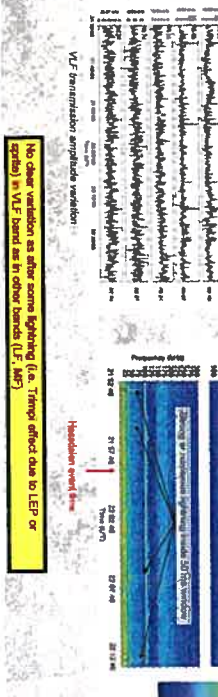
Research of impulsive radiation

Impulsive radiations for each optical events has been looking for inside a time window of the CDA before the image and 30 s after the end of the 30 s exposure time).

No definitive conclusion can be given because the appearance principle (five samples of 80 ms each 5 μs) gives a relative observation time of only 1%. Possible impulsive radiation can be then measured. Phenomena can, giving the precise time and duration of optical phenomena, should be very useful for the three engines and eventually for lightning.



Research of long term perturbations



No clear variation as after some lightning (i.e. Things effect due to LEP or sprites) in VLF band as in other bands (LW, MW)