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**Glossary on atmospheric electric field and its biological effects**  
 --Manuscript Draft--

<b>Manuscript Number:</b>	IJBM-D-19-00414
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<b>Article Type:</b>	SI: Atmospheric Electricity and Biometeorology
<b>Keywords:</b>	Electronet; COST Action 15211; Atmospheric Electric Fields; Transdisciplinary; Interdisciplinary
<b>Abstract:</b>	<p>There is an incipient evidence of the interest of studying the interactions between atmospheric electric fields and living organisms at multiple scales. Few studies based focused on natural atmospheric electricity and magnetic field bio-effects have been published. This glossary presents a list of terms used in the studies developed in the European Cooperation in Science and Technology (COST) Action 15211, title Atmospheric Electricity Network: coupling with the Earth system, climate and biological systems. COST is a funding organization for the creation of research networks.</p> <p>The Glossary was edited as an internal Handbook for Working Group IV of the Action, being afterwards extended to the whole COST Action. Its main purpose was facilitating the process of learning and communication among the different working groups and scientific disciplines existing if the Action. Some terms have been obtained from existing sources. Many others concepts have been re-defined according to the specific multidisciplinary and transdisciplinary scientific aims of the COST 15211. The number of terms included is 294 and multiple references are used. Thirty two researchers have worked actively in the selection and definition of the terms.</p>
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## Glossary on atmospheric electric field and its biological effects

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### Abstract

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140  
141 **Keywords:** Electronet; COST Action 15211; Atmospheric electric fields; Transdisciplinary;  
142 Interdisciplinary  
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## 145 Introduction

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According to the Memorandum of Understanding of the COST Action 15211 (MoU), approved by the Committee of Senior Officials through written procedure on 12 February 2016, the study of many environmental processes can benefit substantially by the inclusion of atmospheric electricity. There is emerging evidence that Atmospheric Electric Fields (AEF) variations may interfere with biological processes at multiple scales, from nanomaterial charge range to a global Earth scale such as Schumann Resonances (SR).

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COST Action 15211 is divided into five Working Groups (WG) being WG-IV in charge of studying the biological aspects and effects of the AEF on living organisms.

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158

The Glossary-ELECTRONET is based on a second version of a Handbook that was created for the internal used of members of the Action and it is formed by different sections:

- 159 • The Scientific Conceptual Frame
- 160 • The List of Map Codes assigned to term
- 161 • The Glossary section
- 162 • List of References

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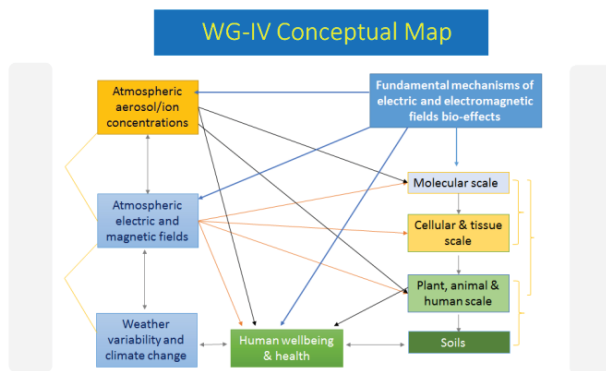
164 One of the main limitations for any COST Action development is, in many cases, the lack of  
 165 normalized conceptualization of terms to confront a complex, diverse and inter and transdisciplinary  
 166 research such as the one proposed by the Cost Action 15211.

167

## 168 The conceptual frame

169

170 The effects of atmospheric electricity on biological organisms refer to the study of complex  
 171 multidimensional systems (physical, biological, environmental, technical, computational, etc.) and  
 172 their mutual interactions. A multidisciplinary and transdisciplinary approach is taken for this purpose,  
 173 and a new conceptual scientific frame is developed in order to organize these interactions. Figure 1  
 174 presents a basic scheme with the existing interactions between different conceptual entities that  
 175 require consideration in the study of bioeffects of electric and electromagnetic fields at multiple  
 176 temporal and spatial scales. In this context, it is important to realize that atmospheric electromagnetic  
 177 phenomena are coupled to other physical, chemical, and biological processes in the lithosphere and  
 178 atmosphere, as well as the solar and cosmic system (Hayakawa et al. 2004; Cifra et al. 2020; Rycroft



179

180 **Fig. 1** Working group IV conceptual frame of the action

181

182

183

184

185

## 186 The conceptual map codes

187

188 Map codes of potential research topics were first defined in order to assign physical terms and  
 189 parameters of relevance. This list of map codes presents a state-of-the-art list of relevant topics that is  
 190 not meant to be complete and should be continuously expanded and improved as new topics may  
 191 emerge, considering in particular that the scientific meaning of many terms can vary substantially  
 192 depending on the academic discipline they refer to. Hence, both the map codes and the glossary itself  
 193 provide open lists to be used as a reference with the possibility of expanding its use. These map codes  
 194 could also play a key role in the future development of a relevant ontology.

195

- 196 1. Atmospheric aerosol/ions concentration and size
- 197 2. Atmospheric electric and magnetic fields
- 198 3. Electric / electromagnetic fields bioeffects at  
molecular scale

199	4. Electric / electromagnetic fields bioeffects at cellular
200	and tissues scale
201	5. Electric and electromagnetic fields and soils
202	6. Electric / electromagnetic fields bioeffects in plants
203	7. Electric / electromagnetic fields bioeffects in animals
204	8. Electric / electromagnetic fields bioeffects in humans
205	9. Space weather
206	10. Bioelectrical indexes
207	11. Radioactivity
208	12. Atmospheric global electric circuit
209	13. Atmospheric electricity - lightning
210	14. Solar, magnetospheric, and ionospheric effects
211	15. Electrical properties of the earth's surface
212	16. Electrical properties of the earth's atmosphere
213	17. Geographic sciences
214	18. Biometeorology and electric/electromagnetic fields
215	19. Electric / electromagnetic fields and public health
216	20. Others

217  
218

## 219 GLOSSARY ELECTRONET COST-15211

220	
221	<b>Absorption</b>
222	
223	

225 The movement of material into blood regardless of mechanism. Generally, applies to dissociation of particles and the uptake into blood of soluble substances and materials dissociated from particles. Includes movement of ultrafine particulate material (ICRP 1994), e.g., nanometer-size particles.

228

### 229 AC Global Electric Circuit

230 Conceptual Map Code: 2,3,4,5,6,7,8,12,15

231

232 Alternating electric and magnetic fields and currents (AC), produced naturally by lightning in the extremely low frequency (ELF) radio range that are observed globally, linked to Schumann resonances (Schumann 1952, Volland 1995).

235

### 236 Action potential

237 Conceptual Map Code: 4,5,6,7,8

238

239 The rapid rise and fall of the membrane potential at a specific location along the cell membrane. This depolarization is propagated in adjacent locations across the axon or muscle membrane. (Hodgkin, 1952)

240

### 241 Acute effect

242 Conceptual Map Code: 1,8

243

244 A health or physiological effect that occurs suddenly over hours or days, for example lung inflammation resulting from inhalation exposure. (WHO, 2017)

245

### 246 Adiabatic process

247 Conceptual Map Code: 0

248

249 The process in which a system does not exchange heat to its surroundings.

250

251



252

### 253 **Aerodynamic diameter**

254 Conceptual Map Code: 1,8

255

256 Aerodynamic diameter is defined as the diameter of a sphere with standard density that settles at the same  
257 terminal velocity as the particle of interest. (ICRP, 1994)

258

### 259 ~~Aerodynamic diameter~~

260 ~~Conceptual Map Code: 1,8~~

261

262 ~~Aerodynamic diameter is defined as the diameter of a sphere with standard density that settles at the same~~  
263 ~~terminal velocity as the particle of interest. (ICRP, 1994)~~

264

### 265 **Aerosol**

266 Conceptual Map Code: 1,5,6,7,8

267

268 A colloidal system of solid or liquid particles in a gas.

269 Aerosols range in sizes from a few nm to about 1 mm and occurs in the atmosphere both naturally and as a  
270 result of anthropogenic processes. Also, a mixture of small particles (solid, liquid or a mixed variety) and  
271 a carrier gas (usually air). (WHO, 2017)

272

### 273 **Aerosol dynamics**

274 Conceptual Map Code: 1

275

276 Dynamical processes modify the number size distributions of atmospheric aerosol particles. These  
277 processes mainly include nucleation, coagulation, condensation, wet and dry scavenging.

278 Transfer of fluids and their physical properties. In relation to meteorology a horizontal air motion.  
279 (Seinfeld & Pandis, 2006)

280

### 281 **Aerosol Formation rate - J**

282 Conceptual Map Code: 1

283

284 The rate at which aerosol particles/clusters of a given size are formed, having units of  $\text{cm}^{-3}\text{s}^{-1}$ . The  
285 determination of this quantity requires a detailed analysis of the relevant aerosol dynamic processes.  
286 (Kulmala and al., 2006)

287

### 288 **Aerosol Growth Rate- GR**

289 Conceptual Map Code: 1

290

291 Describes how fast aerosol particles/clusters grow in size, and is typically given in nm/h. Aerosol  
292 particles in the atmosphere enlarged in size via condensation and coagulation. It is usually difficult to  
293 distinguish between the contributions of these two processes to the particle growth based on ambient  
294 observations; therefore, the growth rate obtained from ambient measurements often represents the overall  
295 growth rate. (Kulmala and al., 2006)

296

### 297 **Agglomerate**

298 Conceptual Map Code: 1,5,6,7,8

299

300 A collection of weakly bound particles or aggregates where the resulting external surface area is similar to  
301 the sum of the surface areas of the individual components. (EC\_GPHSW, 2013)

302

### 303 **Aggregate**

304 Conceptual Map Code: 1,5,6,7,8

305  
306 A particle comprising strongly bound or fused smaller particles. (EC\_GPHSW, 2013)  
307  
308  
309  
310 **Air Ion Spectrometer - AIS**  
311 Conceptual Map Code: 1  
312  
313 An apparatus measuring the size distribution of air ions, consisting of two differential mobility analysers,  
314 one for measuring positive ions and the other for measuring negative ions. (Mirme and al., 2007; Laakso  
315 and al., 2004)  
316  
317 **Air-Earth current**  
318 Conceptual Map Code: 1, 2,11,12,15,16  
319  
320 Electric current that flows down through the atmosphere, i.e. the current of the global atmospheric circuit  
321 flowing through the circuit's load. (MacGorman & Rust, 1998)  
322  
323 **Air Pollution**  
324 Conceptual Map Code: 1, 20  
325  
326 Air pollution occurs when gases or particles that might cause harm to health or the ecosystem are  
327 introduced in excessive quantities in the atmosphere.  
328  
329 **Alpha radiation (ionizing radiation)**  
330 Conceptual Map Code:1, 11  
331  
332 Radiation resulting from the radioactive decay of an atom emitting an alpha particle i.e. a helium nucleus  
333 (composed of two protons and two neutrons). The range of alpha particles is very small in air (a few cm),  
334 and they are therefore unable to penetrate directly the human body. However, if inhaled or ingested alpha  
335 particles can cause serious cellular damage. (Sollazzo and al., 2017)  
336  
337 **Alveolar-Interstitial region - AI**  
338 Conceptual Map Code: 1,8  
339  
340 Consists of the respiratory bronchioles, alveolar ducts and sacs with their alveoli, and interstitial  
341 connective tissue; airway generations 16 and beyond. (ICRP, 1994)  
342  
343 **Aragats Space Environment Center - ASEC**  
344 Conceptual Map Code: 20  
345  
346 Armenian research station at an altitude of 3250 m  
347  
348 **Atmosphere**  
349 Conceptual Map Code: 0  
350  
351 The gaseous layer that surrounds the earth or other celestial bodies and is hold in place by gravity.  
352  
353 **Atmospheric discharge**  
354 Conceptual Map Code: 13,16  
355  
356 Lightning (intra-cloud, inter-cloud, cloud-to-cloud or cloud-to-ground discharge). (LPP)  
357

358 **Atmospheric turbidity**

359 Conceptual Map Code: 0,1

360

361 A measure of the amount of atmospheric aerosols that determines the transparency of the atmosphere.  
362 The more aerosols that are present in the atmosphere, the higher the intensity of scattered sunlight and the  
363 higher the turbidity. It expresses the attenuation of the solar radiation that reaches the Earth's surface  
364 under a cloudless sky which describes the optical thickness of the atmosphere. Atmospheric turbidity is a  
365 convenient parameter frequently used to estimate the optical characteristics of aerosols. (Djafer&Irbah,  
366 2013; Guermard, 1998)

367

368

369 **Atmospheric Electric Field – AEF**

370 Conceptual Map Code:0,2,3,4,5,6,7,8,12,16

371

372 A quantitative term denoting the electric field of the atmosphere (AEF) at any specified point in space and  
373 time. In areas of fair weather, the atmospheric electric field near the Earth surface is normally about 130  
374 V/m and this value decreases in magnitude with increasing altitude in the global electric circuit, falling  
375 for example, to about 5 V/m at an altitude of about 10 km. The study of many environmental processes  
376 can benefit substantially by the inclusion of atmospheric electricity as a complementary factor. Such  
377 processes include, but are not limited to, earthquakes, aerosols/clouds and climate, Sun-Earth interactions  
378 (i.e. solar-terrestrial physics), air pollution, lightning, etc. Further, there is some emerging evidence that  
379 AEF variations may interfere with biological processes, including human health and brain function. (MG)

380

381

382

**Atmospheric ions**

Conceptual Map Code: 1

383

384 Atmospheric ions (also called air ions) are charged molecules and molecular clusters suspended in  
385 atmospheric air. If larger than 1.6 nm, they are defined as charged particles [1, 2]. Primary sources of air  
386 ions are gamma radiation, radon decay and cosmic radiation. (Hursikko and al., 2011; Junninen and al.,  
387 2010)

388

389

390

**Atmospheric New Particle Formation – NPF**

Conceptual Map Code: 1

391

392

393

394

395

The production of aerosol particles in the ambient air from gaseous precursors, followed by the  
subsequent growth of these newly formed particles. Photochemical reactions in the gas phase are believed  
to trigger the initial step of atmospheric NPF, (Dal Maso and al., 2005)

396

397

398

**Atmospheric Potential Gradient (APG - PG)**

Conceptual Map Code: 2, 12, 13, 14, 15, 16

399

400

401

Equal in magnitude, but opposite in polarity to the atmospheric electric field (which is sometimes  
ambiguous in terms of sign). Typically is positive in fair weather.

402

403

404

**Aurora**

Conceptual Map Code: 9, 14,16

405

406

407

408

409

410

A colorful, rapidly varying glow in the sky caused by the collision of charged solar wind particles from  
the magnetosphere with gas atoms in the Earth's upper atmosphere, which leads to temporary ionization  
and light emission during the subsequent recombination processes. Auroras are most often observed at  
high latitudes around the magnetic poles (hence also known as polar lights), may appear in different types  
and colors, and are brighter during periods of enhanced geomagnetic activity. (GSFT; Jones, 1974)

411

**Beta radiation (ionising radiation)**

412 Conceptual Map Code: 1, 11  
413  
414 Radiation resulting from radioactive decay of an atom emitting an electron or positron. The range of beta  
415 radiation in air is larger than for alpha particles (up to a few meters) and it is therefore able to penetrate  
416 skin. However, the main risk to human health is associated with internal emission from ingested material.  
417

418 **Binary homogeneous nucleation**  
419 Conceptual Map Code: 1  
420  
421 Homogeneous-heteromolecular nucleation involving two substances. In the Earth's atmosphere, a typical  
422 system is the binary homogeneous nucleation of sulphuric acid and water.  
423

424 **Bioaerosol**  
425 Conceptual Map Code: 1  
426  
427 An aerosol of biological origin including viruses, viable organisms, such as bacteria and fungi, and  
428 products of organisms, such as fungal spores and pollen. (Hinds, 1999)  
429

430 **Bioelectricity**  
431 Conceptual Map Code: 3,4,6,7,8,10  
432  
433 Electric potentials and currents produced by or occurring within living organisms. Bioelectric potentials  
434 are generated by a variety of biological processes and generally range in strength from one to a few  
435 hundred millivolts. (EB)  
436

437 **Bioelectromagnetics**  
438 Conceptual Map Code: 3,4,6,7,8,10  
439  
440 Studies of the interactions of electromagnetic fields with living tissues and organisms. (HBEEF)  
441

442 **Biometeorological data Infrastructure – BDI**  
443 Conceptual Map Code:8  
444  
445 A complex platform formed by a mainframe computer, a biometeorological model, a relational database  
446 management system, data procedures, communication protocols, different software packages, users,  
447 datasets and mobile applications in order to analyse the impact of different atmospheric variables on  
448 living organisms in order to define their specific vulnerability to their variability and change. (Fdez  
449 Arroyabe, 2017)  
450

451 **Biometeorological profile**  
452 Conceptual Map Code: 8,15,17,18  
453  
454 The biological answers, in terms of wellbeing, that a living organism (animal, plant or human being)  
455 experiences through time and space in relation to changes and variability of multiple atmospheric factors  
456 such as temperature, air humidity, solar radiation and atmospheric fields. A specific profile can be defined  
457 for each variable and living organism. It is a graphical characterization of the physical and psychological  
458 reactions of living organisms, including humans, to the variability and change of a specific atmospheric  
459 factor over a period of time. (Fdez Arroyabe, 2017)  
460

461 **Blood pressure**  
462 Conceptual Map Code: 7, 8  
463  
464 The pressure of blood in the arteries of mammals, including humans. The blood pressure has two main  
465 components: an upper value (systolic), and a lower value (diastolic), the background pressure always  
466 present in the artery. The upper value is the pressure caused by the actual heartbeat. KK: Some studies

467 suggest that Schumann resonances can influence blood pressure. (Mitsutake and al., 2005; Palmer and al.,  
468 2006)

469

#### 470 **Blowing dust**

471 Conceptual Map Code: 0

472

473 Dust picked up locally from the surface of the Earth and blown about in clouds, or sheets, causing a hazy  
474 atmosphere. Classed as a lithometeor and is encoded BLDU as an obstruction to vision in an aviation  
475 weather observation (METAR). Blowing dust may completely obscure the sky; in its extreme form it is  
476 called a dust storm. A layer of stable air aloft tends to stop the vertical transport of dust by eddies. There  
477 is then a sharply defined upper limit to the dust layer. (MG)

478

#### 479 **Blue/Gigantic Jet - BJ/GJ**

480 Conceptual Map Code: 2,12,13,16

481

482 Blue jets, gigantic jets (GJ) and other jet-type TLE phenomena shoot up to different heights from the tops  
483 of thunderclouds. These streamer-type discharges are driven by an imbalance of charges in the  
484 thundercloud. Their color is predominantly white and blue close to the thundercloud but becoming red in  
485 higher air regions. The height that a jet can reach depends on the rate the charge imbalance in the top of  
486 the thundercloud. Gigantic jets may reach up to 90-95 km, i.e. to the bottom of the ionospheric E-layer at  
487 night. Jets are the least frequently observed type of TLEs. See also TLE. (Soula and al., 2011)

488

#### 489 **Breakdown**

490 Conceptual Map Code: 2,16

491

492 The process by which electrically stressed **air** is transformed from an insulator into a conductor.  
493 Breakdown involves the acceleration of electrons up to the ionisation potential in the electric field  
494 imposed by the thundercloud, and the subsequent creation of new electrons that avalanche and expand the  
495 scale or enlarge the volume of enhanced conductivity. Breakdown precedes the development of lightning.  
496 The electric field necessary to produce breakdown is called breakdown field. (Soula and al., 2011)

497

#### 498 **Bronchial region - BB**

499 Conceptual Map Code: 1,7,8

500

501 Consists of the trachea and bronchi from which deposited material is cleared by ciliary action; airway  
502 generations 0 through 8. (ICRP)

503

#### 504 **Bronchiolar region - bb**

505 Conceptual Map Code: 1,8,18

506

507 Consists of the bronchioles and terminal bronchioles; airway generations 9 through 15. (ICRP)

508

#### 509 **Bulk material**

510 Conceptual Map Code: 1,8,18

511

512 The larger counterpart of a nanomaterial not confined to the nanoscale in any dimension, e.g., gold as the  
513 bulk material and nano-gold as the nano-form material. (WHO, 2017)

514

#### 515 **Carnegie curve**

516 Conceptual Map Code: 2,12

517

518 Average diurnal variation of the atmospheric electric field at ground level obtained from **measurements**  
519 **on sea** from the research vessel "Carnegie" of the Carnegie Institution of Washington in the first half of  
520 20th century. (Harrison, 2013)

521

## 522 Cellular respiration

523 Conceptual Map Code: 4,5,6,7,8

524

525 Cellular respiration is a process whereby energy from food is captured and stored into a molecule, namely  
526 adenosine triphosphate (ATP). Cellular respiration relies mainly on redox reactions that take place within  
527 cells and their membranes. The reactions involved in respiration are catabolic reactions, which break large  
528 molecules into smaller ones, releasing energy in the process. The final acceptor of electrons during  
529 aerobic respiration is molecular oxygen, which is used by animals, while various bacteria use a variety of  
530 acceptors other than oxygen, for instance nitrates and sulphates, often referred to as anaerobic respiration.  
531 (Rich, 2003)

532

## 533 Charge distribution

534 Conceptual Map Code: 1

535

536 The probability that a charged aerosol (or large ion) of a given mobility has a given charge. For ambient  
537 aerosols this is typically skewed to slightly negative, as negative small ions have higher mobility and  
538 therefore are more likely to attach to atmospheric molecules. Sources of unipolar space charge (e.g., High  
539 Voltage Power Lines) can affect the charge distribution on an aerosol population. (Hinds, 1982;  
540 Wiedensohler, 1988)

541

## 542 Charged clouds

543 Conceptual Map Code: 1,2

544

545 A cloud (or parts of the cloud) with non-zero net total charge. Some highly charged clouds such as  
546 Cumulonimbus create the optimum conditions for lightning discharges to occur during a thunderstorm.  
547 Charged layers exist at the tops and bottoms of stratiform (layer) clouds.

548

## 549 Charged nanoparticles

550 Conceptual Map Code: 1

551

552 Charge carriers that are stable enough under the ambient atmospheric conditions can grow further in size,  
553 provided that the ambient conditions remain unchanged. (Kulmala and al., 2014)

554

## 555 Chronic effect

556 Conceptual Map Code: 1,8

557

558 An effect that occurs or builds up over a long period; for humans over years. For example cardiovascular  
559 disease. (WHO, 2017)

560

## 561 Chronic exposure

562 Conceptual Map Code: 1,8

563

564 Exposure over a long period, for humans over years. (WHO, 2017)

565

## 566 Circadian rhythm

567 Conceptual Map Code: 5,6,7,8

568

569 Circadian rhythm is any biological process that displays an endogenous oscillation of about 24 hours.  
570 These 24-hour rhythms are driven by a circadian clock and they have been widely observed in various  
571 living organisms. Some studies show that they can be affected by natural weak electric fields. (Wever,  
572 1973)

573

## 574 Circular polarization

575 Conceptual Map Code: 5  
576  
577 The polarization state of an electromagnetic wave in which the electric field vector at a point in space  
578 describes a circle. Relative to an observer looking in the direction of signal propagation, the electric fields  
579 of right and left circularly polarized signals rotate clockwise and counterclockwise, respectively. (MG3)  
580 [http://glossary.ametsoc.org/wiki/Circular\\_polarization](http://glossary.ametsoc.org/wiki/Circular_polarization)  
581

**Circulation Weather Types – CWT**  
582  
583 Conceptual Map Code: 1,2,4,9,12,13,15,16  
584  
585 A classification of the synoptic atmospheric situations in a specific region of the world attending to  
586 objective and/or subjective methods based on meteorological data. Types can be obtained from one  
587 specific variable, such as atmospheric pressure, attending to the main component of atmospheric  
588 circulation, or can also be produced using complex multivariate statistical methods based on the physical  
589 properties of the air masses that affect a specific region of the world. (Ramos and al., 2015)  
590

**Clearance**  
591  
592 Conceptual Map Code: 1,8  
593  
594 The removal of material from the respiratory tract by particle transport and by absorption into the blood.  
595 (ICRP)  
596

**Climate**  
597  
598 Conceptual Map Code: 0,12,18  
599  
600 Average weather conditions at some location observed for an extended period of time. The standard  
601 averaging period used here is 30 years.  
602

**Climate Services - ervices – global framework for climate services**  
(GFCS) 603  
604 Conceptual Map Code: 8,15, 17, 18  
605

606 The development and incorporation of science-based climate information and prediction into planning,  
607 policy and practice on the global, regional and national scale. Climate services provide and use climate  
608 and meteorological information in a way that assists decision making by individuals and organizations in  
609 different fields such as water, food, energy, risk and health. Such services require appropriate engagement  
610 along with an effective access mechanism and must respond to user needs. (GFCS)

614

616

**Cloud condensation nuclei (CCN)**  
617  
618 Conceptual Map Code: 1  
619  
620 Aerosol particles (condensation nuclei) that can activate at a given supersaturation and form into cloud  
621 droplets or cloud ice particles. (Seinfeld & Pandis, 20016)  
622

**Cloud generator**  
623  
624 Conceptual Map Code: 12, 15  
625  
626 A single electrically charged cloud or all such clouds which generate an electric current that adds to the  
627 current flowing in the global atmospheric electric circuit. (Wilson, 1921)  
628

**Cloud-to-ground flash/stroke - CG, -CG, +CG**  
629

630 Conceptual Map Code: 13  
631  
632 Lightning flash in which one or more cloud-to-ground return strokes are produced. A stroke is one  
633 impulsive event in which the polarity of the cloud charge transferred to ground determines the stroke (or  
634 flash) polarity.  
635  
636 **Cluster ions**  
637 Conceptual Map Code: 1  
638  
639 Charge carriers composed of two or more monomers, e.g. HSO<sub>4</sub><sup>-</sup>.H<sub>2</sub>SO<sub>4</sub>, HSO<sub>4</sub><sup>-</sup>.(H<sub>2</sub>O)<sub>n</sub> (Harrison &  
640 Tammet, 2008)  
641  
642 **Coagulation sink –CoagS**  
643 Conceptual Map Code: 1  
644  
645 Quantifies the loss rate of particles of a certain size via coagulation with other aerosol particles and via  
646 self-coagulation. It often has units of cm<sup>-3</sup>s<sup>-1</sup>. (Dal Maso and al., 2002)  
647  
648 **Condensation sink-CS**  
649 Conceptual Map Code: 1  
650  
651 Measures the capability of aerosol particles in the atmosphere to accommodate condensable vapours,  
652 which is derivable from the number size distributions of aerosol particles. It is usually expressed in unit of  
653 cm<sup>-3</sup>s<sup>-1</sup>. (Dal Maso and al., 2002)  
654  
655 **Condensational Particle Counter – CPC**  
656 Conceptual Map Code: 1  
657  
658 A type of instrument which detects aerosol particles optically after growing them by vapour condensation.  
659 (Kulkarni and al., 2011)  
660  
661 **Conduction**  
662 Conceptual Map Code: 0  
663  
664 Form of heat or electromagnetic energy transfer through solids from molecule to molecule.  
665  
666 **Conduction current** Conceptual Map Code: 2, 11, 12  
667  
668 Electric current component determined by the conductivity of the air and the electric field according to  
669 Ohm's law.  
670  
671 **Conductivity**  
672 Conceptual Map Code: 0, 2, 12, 13  
673  
674 The ability of a material to conduct. Electrical conductivity refers to the ability of a material to conduct an  
675 electric current.  
676  
677 **Confounder**  
678 Conceptual Map Code: 1,8  
679  
680 A factor in an exposure study that is both related to the exposure and the outcome. The uneven  
681 distribution of the confounder will lead to distorted or spurious results. (WHO, 2017)  
682  
683 **Control banding**  
684 Conceptual Map Code: 1,8  
685



686 A risk management approach to identify and recommend exposure control measures for potentially  
687 hazardous substances for which toxicological information is limited. (WHO, 2017)  
688

689 **Convection current**  
690 Conceptual Map Code: 2,12,16  
691

692 Electric current carried by ions moving due to thermal convection of air.  
693

694 **Convergence**  
695 Conceptual Map Code: 0,19  
696

697 Horizontal inflow of air into an area, leading to the upward motion of air and the generation of clouds and  
698 precipitation (i.e. rain) in a storm, or cyclone.  
699

700 **Corona**  
701 Conceptual Map Code: 2,16  
702

703 Persistent "cloud" of electron avalanches arising from (or moving towards) an object immersed in a  
704 strong electric field.  
705

706 **Corona (Sun)**  
707 Conceptual Map Code: 9, 14,16  
708

709 The outermost layer of the solar atmosphere. The corona consists of a highly rarefied gas with a  
710 temperature greater than one million Kelvin. It is visible to the naked eye only during a solar eclipse.  
711 (SOHO)  
712

713 **Corona current**  
714 Conceptual Map Code: 2,12,15  
715

716 Electric current carried by corona discharge  
717

718 **Corona discharge**  
719 Conceptual Map Code: 16  
720

721 Also called brush discharge. A luminous, and often audible, electric discharge that is intermediate in  
722 nature between a spark discharge (with, usually, its single discharge channel) and a point discharge (with  
723 its diffuse, quiescent, and nonluminous character). It occurs from objects, especially pointed ones, when  
724 the electric field strength near their surfaces attains a value near  $1 \times 10^5$  Vm<sup>-1</sup>. Aircraft flying through  
725 active electrical storms often develop corona discharge streamers from antennas and propellers, and even  
726 from the entire fuselage and wing structure, resulting in so-called precipitation static. It is also seen  
727 during stormy weather, emanating from the yards and the masts of ships at sea. (MG5)  
728

729 **Coronal mass ejection – CME**  
730 Conceptual Map Code: 9, 14,16  
731

732 A huge magnetic bubble of plasma that erupts from the Sun's corona and travels through space at high  
733 speed (~ 1000 kms-1). (SOHO)  
734

735 **Cosmic rays**  
736 Conceptual Map Code: 1, 11  
737

738 High-energy charged particles that reach the Earth from outer space, interact with the nuclei of  
739 atmospheric constituents and generate secondary reaction products in the atmosphere. (UNSCEAR, 2016)  
740

741 **Cosmic ray ionization**  
742 Conceptual Map Code: 1,16  
743

744 The collisional process of converting atmospheric atoms or molecules into ions, or the change of an ion to

745 another ionic form. (Daintith & Gould, 2006)  
746

747 **Cosmogenic radionuclides**  
748 Conceptual Map Code: 1, 11  
749

750 Radioactive nuclei produced by cosmic ray interactions with nuclei of atmospheric constituents.  
751 (UNSCEAR, 2016)  
752

753 **Coulomb force**  
754 Conceptual Map Code: 6,7,8  
755

756 The electric force acting between two charged particles or objects, in our case between atmospheric ions  
757 or between biological organisms. (Stewart, 2001)  
758

759 **Critical frequency of the E layer -foE**  
760 Conceptual Map Code: 9, 14,16  
761

762 The maximum frequency of a radio wave which can be reflected from this layer of the ionosphere.  
763 (DIAS)  
764

765 **Critical frequency of the F2 layer - foF2**  
766 Conceptual Map Code: 9, 14,16  
767

768 The maximum frequency of an ordinary mode radio wave capable of vertical reflection from the F2 of the  
769 ionosphere.  
770

771 **Crust**  
772 Conceptual Map Code: 9, 14,16  
773

774 The outermost major layer of the Earth, ranging from about 10 to 65 km in thickness worldwide. The  
775 uppermost 15-35 km of crust is brittle enough to produce earthquakes. (USGS)  
776

777 **Cumulonimbus**  
778 Conceptual Map Code: 20  
779

780 Heavy and dense, very tall towering clouds. The upper part often spreads out in the form of an anvil.  
781 (ICAtlas)  
782

783 **Cyclone**  
784 Conceptual Map Code: 20  
785

786 A large-scale rotating air mass formed by a low atmospheric pressure system resulting in closed  
787 atmospheric circulation with inwardly spiraling winds. (MG6)  
788

789 **D Region**  
790 Conceptual Map Code: 9, 14,16  
791

792 The lowest layer of the Earth's ionosphere. It is between about 50 and 95 kilometers above Earth's  
793 surface. This is the layer which reflects radio waves of low frequency. Also called the D layer. (SOHO)  
794

795 **DC Global Electric Circuit**  
796 Conceptual Map Code: 2,5  
797

798 Direct currents (DC) and fields that are quasi-static in time produced by global thunderstorm activity and  
799 electrical shower clouds.

800

801 **Denitrification**

802 Conceptual Map Code: 5,6,15

803

804 Denitrification is the unique pathway whereby nitrogen (N) in the terrestrial biosphere is transformed by  
805 denitrifying bacteria into atmospheric N<sub>2</sub>. Denitrification is also significant as the major source of  
806 atmospheric N<sub>2</sub>O, an important greenhouse gas. (Ambus, 2007)

807

808 **Deposition**

809 Conceptual Map Code: 1,8

810

811 Refers to the initial processes determining how much of the material in a human's inspired air remains  
812 behind after expiration. Deposition of material may occur during both inspiration and expiration. (ICRP)

813

814 **Deposition efficiency of region**

815 Conceptual Map Code: 1,7,8

816

817 Deposition efficiency of a region such as the respiratory tract. (ICRP)

818

819 **Deposition in region**

820 Conceptual Map Code: 1,7,8

821

822 Expressed as a fraction of the number or activity of particles of a given size that are present in a volume  
823 of ambient air before inspiration. (ICRP)

824

825 **Depression**

826 Conceptual Map Code: 19

827

828 Common and serious medical illness that negatively affects how a human being feels, thinks and acts. It  
829 causes feelings of sadness and/or a loss of interest in activities once enjoyed and leads to a diversity of  
830 emotional and physical problems; it can decrease a person's ability to function at work and at home.

831

832 **Differential Mobility Analyzer - DMA**

833 Conceptual Map Code: 1

834

835 A type of instrument to classify aerosol particles according to their electric mobility. (Kulkarni and al.,  
836 2011)

837

838 **Differential/Scanning Mobility Particle Sizer - DMPS/SMPS**

839 Conceptual Map Code: 1

840

841 A type of setup to measure the number size distributions of aerosol particles. Aerosol particles are  
842 initially brought to an equilibrium charging state prior to size segregation in a Differential Mobility  
843 Analyser (DMA). Aerosol particles of a certain size selected by the DMA are then grown and counted by  
844 a Condensational Particle Counter. (Wiedensohler and al., 2012)

845

846 **Direct solar radiation**

847 Conceptual Map Code: 6,14

848

849 Electromagnetic radiation from the Sun which reaches the Earth's surface without being diffused,  
850 absorbed, scattered or reflected by aerosols or clouds.

851

852 **Divergence**

853 Conceptual Map Code: 0

854

855 Horizontal outflow of air from an area, leading to downward motion of air in the area and fine weather,  
856 i.e. an anticyclone.

857

### 858 Dosimetry and microdosimetry

859 Conceptual Map Code: 4, 7, 8

860

861 Evaluation of the electromagnetic fields induced in animals, tissues and cells. (HBEEF; Liberti and al.,  
862 2009)

863

### 864 Earth-ionosphere cavity

865 Conceptual Map Code: 2,12,15,17

866

867 The quasi-spherical cavity formed between the Earth and the ionosphere; see Earth-ionosphere  
868 waveguide. (Nickolaenko & Hayakawa, 2002)

869

### 870 Earth-ionosphere waveguide- EIWG

871 Conceptual Map Code: 2,12,13,15,16

872

873 The surface of the Earth and the lower ionosphere are relatively good conductors while the air between  
874 them can be considered as a dielectric layer. This system forms a waveguide for electromagnetic waves  
875 which, depending on their frequency, are reflected from the conductive boundary regions and propagate  
876 laterally away from their source (e.g., lightning).

877 The Earth-ionosphere waveguide forms the closed Earth-ionosphere cavity for low frequency  
878 electromagnetic waves (e.g., VLF and ELF radio waves), which, in principle, cannot propagate through  
879 the conducting boundaries. The quasi-spherical shell geometry of the cavity makes it possible for  
880 electromagnetic resonances to develop. This happens when radio waves propagate all around the Earth  
881 (this is possible only for ELF waves which are not severely damped during their propagation) and when  
882 the wavelength of the waves is an integer multiple of the circumference of the Earth so that constructive  
883 interference can occur (Schumann resonances). (Nickolaenko & Hayakawa, 2002)

884

### 885 Earthquake

886 Conceptual Map Code: 9, 14,16

887

888 Earthquake is a term used to describe both sudden slip on a fault and the resulting ground shaking and  
889 radiated seismic energy caused by the slip, or by volcanic or magmatic activity, or other sudden stress  
890 changes in the Earth. (USGS)

891

### 892 Earthquake hazard

893 Conceptual Map Code: 9, 14,16, 17

894

895 Earthquake hazard is anything associated with an earthquake that may affect the normal activities of  
896 people. This includes surface faulting, ground shaking, landslide, liquefaction, tectonic deformation,  
897 tsunamis, and seiches. (USGS)

898

### 899 Earthquake precursor

900 Conceptual Map Code: 0

901

902 Anomalous statistical or dynamical pattern in the temporal variability electromagnetic, geophysical or  
903 geochemical properties arising from the accumulation and subsequent release of mechanical stress of an  
904 approaching earthquake. Unambiguous association of such observable patterns with particular future  
905 earthquakes is commonly not possible, which poses fundamental restrictions to individual earthquake  
906 predictability. (Ouzounov and al., 2018)

907

### 908 Earthquake risk

909 Conceptual Map Code: 9, 14,16,17

910  
911 Earthquake risk is the probable building damage, and number of people that are expected to be hurt or  
912 killed if a likely earthquake on a particular fault occurs. Earthquake risk and earthquake hazard are  
913 occasionally (and incorrectly) used interchangeably. (USGS)  
914

## 915 Ecology

916 Conceptual Map Code: 6, 7,8

917

918 The study of how organisms interact with each other and with their physical and chemical environment.  
919 (Freeman and al., 2013)

920

## 921 Electric charge

922 Conceptual Map Code: 2-8, 12-16

923

924 Electric charge is the physical property of matter that causes it to experience a force when placed in an  
925 electromagnetic field. There are two types of electric charges: positive and negative (commonly carried  
926 by protons and electrons, respectively). Like charges repel and unlike attract. The electric charge of an  
927 electron is  $-1e$ , while that of a proton is  $+1e$ . The absence of net charge on a particle is referred to as  
928 neutral. An object (e.g., a molecule, or a larger particle) can be negatively charged if it has an excess of  
929 electrons, positively charged if it has a deficiency of electrons, or uncharged.  
930

## 931 Electric charge of biomolecule

932 Conceptual Map Code: 1,3

933

934 Electric charge is the physical property of a piece of matter (here a biomolecule) that causes it to  
935 experience a force when placed in an electromagnetic field. The higher the charge the higher the force on  
936 the biomolecule due to the applied electric field. The amount of charge on the biomolecule and its parts  
937 determines the magnitude of its interaction ("sensitivity") to the electric fields, including the AEF.  
938 (Winzor, 2005; Ruggeri, 2017)

939

## 940 Electric discharge

941 Conceptual Map Code: 0,1

942

943 The atmospheric electric discharge is a fundamental process of nature that converts electrical energy into  
944 ionisation, radiation, chemical products and heat.  
945

## 946 Electric field - EF

947 Conceptual Map Code: 2-8, 12-16

948

949 An electric field is the force field that is created by electric charges. The electric field will affect a charge  
950 placed within the field by repelling or attracting it [1, 2]. Electric fields are created by electric charges and  
951 are also by time-varying magnetic fields. (Purcel and Morin, 2013; Feynman, 1970)  
952

## 953 Electric mobility

954 Conceptual Map Code: 1

955

956 Defined as the drift velocity of an ion in a given electric field, and is dependent on temperature and gas  
957 pressure. (Hinds, 1982)

958

## 959 Electric potential

960 Conceptual Map Code: 1,5,6,7,8,15,16

961

962 An electric potential (also called the electric field potential, or the electrostatic potential) is the amount of  
963 work needed to move a unit positive charge from a reference point to a specific point inside the field  
964 without producing any acceleration. Typically, the reference point is Earth or a point at infinity, although

965 any point beyond the influence of the electric field charge can be used. (Feynman 1970; MacGorman and Rust 1998)  
966  
967

969

973

974 **Electrical conductivity -**

975 Conceptual Map Code: 1,5,6,7,8,15,16

976 The ability of a material, being solid, liquid, gas or plasma, to transmit electricity.

978

979 **Electrical Low Pressure Impactor - ELPI**

980 Conceptual Map Code: 1,8

981

982 ELPI®+ (Electrical Low Pressure Impactor) is an improved version of the widely used and well  
983 characterized ELPI® -system. ELPI®+ enables the measurement of real-time particle size distribution  
984 and concentration in the size range of 6 nm – 10 µm with 10 Hz sampling rate.( Järvinen and al., 2017)

985

986 **Electrical storm**

987 Conceptual Map Code: 0,13,16

988

989 Popular term for thunderstorm. ometimes applied to a relatively rare condition  
of disturbed atmospheric electric field in the lower atmosphere that arises when strong winds are blowing and there  
is much dust in the air, but no thunderstorm activity. Triboelectrification due to the blowing dust may charge  
metallic objects to such an extent that slight shocks are felt when touched (James et al. 2008).

994

995 **Electrical resistance**

996 Conceptual Map Code: 4,6,7,8,15,16

997

998 The electrical resistance of an object is a measure of its opposition to the flow of electric current.  
999 (Clayton, 2006)

1000

1001 **Electrojets**

1002 Conceptual Map Code: 16

1003

1004 Strong concentrated electric currents flowing in the lower ionosphere. The equatorial electrojet flows  
1005 along the Earth's magnetic dip equator and is present at all times, while the auroralelectrojet is a more  
1006 sporadic phenomenon occurring in association with auroral displays at high magnetic latitudes. (MG7)

1014 **Electromagnetic radiation**

1015 Conceptual Map Code: 2,3,4,5,6,7,8,15,16

1016

1017 It refers to the waves (or their quanta, photons) of the electromagnetic field propagating (radiating)  
through a medium, carrying electromagnetic radiant energy. It includes a broad variety of waves covering a broad  
spectrum, for example, extremely low and very low frequency waves, radio waves, microwaves, infrared, visible  
waves (light), ultraviolet, X-rays, and gamma rays. In space and approximately the atmosphere, EM radiation  
propagates approximately with the speed of light.

1020  
1021

1025  
1026  
1027

1029

1033

1034 **Electrometeor**

1035 Conceptual Map Code: 2,13,16

1036

1037 A visible or audible manifestation of atmospheric electricity, principally due to lightning and thunder.  
1038 (but also aurora and St. Elmo's fire (WMO 2017)

1039

1040 **Electromigration**

1041 Conceptual Map Code: 5

1042

1043 The movement of charged particles in the form of ions due to the presence of an electric or magnetic  
1044 field. Electrokinetic flows can occur at low current densities, ranging from 0.025–5 Am<sup>-2</sup>. These electric  
1045 fields occur in soils and sediments due to natural potential gradients, but are also increasingly applied to  
1046 remove contaminants from soils and sediments in a process called electro-remediation. The effective  
1047 ionic mobility by electromigration of a specific ion in a soil is a function of its molecular diffusion  
1048 coefficient, soil porosity, tortuosity factor and charge. (Probstaein & Hicks, 1993)

1054

1055 **Electron Transport Chain/System - ETC (S)**

1056 Conceptual Map Code: 4,5,6,7,8

1057

1058 An electron transport chain (ETC) is a series of molecules within cells, their membranes, or in the  
1059 extracellular matrix, that transfers electrons from electron donors to electron acceptors via redox (both  
1060 reduction and oxidation occurring simultaneously) reactions. This electron transfer results in the transfer  
1061 of protons (H<sup>+</sup> ions) across a membrane, which creates an electrochemical proton gradient that drives the  
1062 synthesis of adenosine triphosphate (ATP), a molecule used to store energy. Electron transport chains are  
1063 used for extracting energy via redox reactions from sunlight in photosynthesis or, such as in the case of  
1064 the oxidation of sugars, cellular respiration. (White, 1999)

1074

1075

1076 Elves

1077 Conceptual Map Code: 2, 12, 13, 16

1086 Elves is a generic name given for a transient luminous event (TLE) in the upper atmosphere  
1087 occurring between about 85 and 105 km. This is a donut-like shaped emission produced by the  
red-light emissions of molecular nitrogen, excited by the electromagnetic pulse transmitted  
upwards by an intense cloud to ground lightning stroke in a thunderstorm. Elves live for about  
1 ms and extend out horizontally up to a few hundred kilometers (Pasko et al. 2012).

1095

1096 **Endogenous biological chemiluminescence - UPE**

1097 Conceptual Map Code: 3,4,5,6,7,8

1098

1099 Emission of light from biological systems due to oxidative chemical reactions taking place within them.

1100 This luminescence is also called ultra-weak photon emission - UPE. Since electric fields applied to

1101 biosystems can induce oxidative and hence biological effects, monitoring oxidation due to an electric

1102 field or electrode potential is important and can be achieved via monitoring UPE. (Cifra & Pospíšil, 2014;

1103 Bonnafous et al., 1999; Maccarrone et al. 1998)

1122

1123 **Extraterrestrial radiation**

1124 Conceptual Map Code: 9,11,16

Extraterrestrial radiation is the sun's EM radiation at the top of the Earth's atmosphere falling on a plane normal to the sun rays. It is expressed in irradiance units (Watts per square meter) and takes a value of 1360 W/m<sup>2</sup>, which is called "solar constant" (Liu 2002; Gueymard 1998).



1139

1140 **Extremely Low Frequency - ELF**

1141 Conceptual Map Code: 2

1142

1143 ELF refers to very long wavelength electromagnetic waves falling in the 3–3000 Hz band of the EM spectrum. ELF waves are produced naturally in the atmosphere by lightning and can travel around the Earth in the so-called Earth-ionosphere waveguide, or inside the Earth-ionosphere cavity. Please keep only one reference, for example (Price 2016).

1144

1145 F and E regions of the ionosphere

1146 Conceptual Map Code: 9, 14,16

The ionospheric F region is produced by photoionization caused by the incident extreme ultraviolet (EUV) solar radiation. It extends from about 160 km to more than 600 km, having its peak electron density located between 250 and 350 km. It is usually comprised two layers, a secondary one below 200 km (F1 layer) and its main layer centered about its maximum electron density height (F2 layer). The F region is taken to be a weakly ionized plasma imbedded into the much denser neutral atmosphere, called at the F region heights, the thermosphere.

The E region, or E layer, is situated below the F region between 90 and 160 km, having its ionization maximum at 110 km. The dominant ions are the molecular NO<sup>+</sup> and O<sub>2</sub><sup>+</sup> ions generated by photochemical reactions driven by the sun's UV radiation. The strongest ionospheric currents are flown near the E region peak, called electrojets, e.g., the auroral and equatorial electrojets (Rishbeth and Garriot 1969).

1150

1151 **Fair weather - FW**

1152 Conceptual Map Code: 1,12,14

1153

1154 Weather conditions of low cloudiness, low wind speed, lack of fog and precipitation, which permit the study of parameters of the global atmospheric electric circuit at a particular location. (Harrison & Nicoll, 2018)

1155

1156

1157

1158 **Field mill**

1159 Conceptual Map Code: 2,12,13

1160

1161 A device measuring the electric field, based on the principle of electrostatic induction, consisting of electrodes periodically exposed (using, e.g., rotating discs) to the electric field. (Wahlin, 1986)

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**Forecast**

Conceptual Map Code: 0

A prediction of future events, conditions and occurrences, based on the available information from past experiences along with observations of a present situation, either based on statistical relationships or simulations of a dynamical model. One typically distinguished between deterministic and probabilistic forecasts, the latter focusing on predicting the probability of occurrence of a specific type of event at a given time. (WIKI3)

**Forbush decrease**

Conceptual Map Code:0

A Forbush decrease is a rapid decrease in the observed galactic cosmic ray intensity following a coronal

- 1182 mass ejection. (CME). (WIKI4)  
1183
- 1184 **Galactic cosmic radiation - GCR**  
1185 Conceptual Map Code: 1, 11  
1186
- 1187 Cosmic rays originating from sources outside the solar system, i.e. coming from deep space. The  
1188 nucleonic component is due primarily to protons and alpha particles with energy from 108 eV to more  
1189 than 1020 eV. (UNSCSAR, 2016)  
1190
- 1191 **Gamma radiation**  
1192 Conceptual Map Code:1, 11  
1193
- 1194 Radiation resulting from the radioactive decay of an atom emitting a high-energy photon (typically with  
1195 energy above 100 keV). Since gamma radiation has no mass or charge, gamma rays have a much larger  
1196 range than alpha or beta radiation and can only be stopped by a dense material such as lead.  
1197
- 1198 **Gaseous precursor**  
1199 Conceptual Map Code:2,12,17  
1200
- 1201 A gas that participates in a reaction that leads to formation of aerosols.  
1202
- 1203 **Geoelectric field**  
1204 Conceptual Map Code:14  
1205
- 1206 Electric field induced in the Earth's electrically conducting crust, mantle, and ocean by natural time-  
1207 dependent geomagnetic field variation generated by dynamic processes in the Earth's geospace  
1208 environment. (Love&Bedrosian, 2019)
- 1223
- 1224 **Geomagnetic field**  
1225 Conceptual Map Code: 2,9,12,14  
1226
- 1227 The magnetic field that originates from the Earth's interior and extends out into space where its pattern  
1228 can be modified by the solar wind. The magnitude of the geomagnetic field at the Earth's surface ranges  
1229 from ~ 25 microTeslas at the geomagnetic equator to ~ 65 microTeslas at the magnetic poles (0.25 to 0.65  
1230 gauss). (Finlay, 2010)  
1231
- 1232 **Geomagnetic indices**  
1233 Conceptual Map Code:0, 14  
1234
- 1235 Integrated variables describing the time variations of the geomagnetic field strength at the Earth's surface  
1236 and near-Earth space environment at different spatial and temporal scales. (ref.)

- 1237
- 1238 **Geomagnetic pole**
- 1239 Conceptual Map Code: 0,2,14
- 1240
- 1241 Positions on the Earth's surface where the geomagnetic field is vertical (i.e. perpendicular) to the
- 1242 ellipsoid. Those two points are the north and south poles of the Earth's magnetic field. (NOAA)
- 1243
- 1244 **Geomagnetic storm**
- 1245 Conceptual Map Code: 14
- 1246
- 1247 A geomagnetic storm is a temporary disturbance of the Earth's magnetosphere and magnetic field caused
- 1248 by a more intense than usual solar wind (i.e. larger speed and density). It is commonly based on the
- 1249 geomagnetic index Dst approaching values below -50 nT. Severe geomagnetic storms may have
- 1250 devastating effects on power generation and transmission lines as well as satellite infrastructures.
- 1251 (Gonzalez et al. 1994; Kivelson and Russel 1995; Runge et al. 2018).
- 1252 **Geophysics**
- 1253 Conceptual Map Code: 5
- 1254
- 1255 The natural science concerned with the physical processes and physical properties of the Earth, and how
- 1256 these are influenced
- 1257 by its surrounding space environment. Biogeophysics is a sub-discipline concerned with the geophysical
- 1258 signatures of biotic interactions with geological/geophysical media, and spans disciplines such as
- 1259 geomicrobiology, biogeoscience and biogeochemistry.
- 1260
- 1261 **Gerdien cylinder/condenser**
- 1262 Conceptual Map Code: 1, 16
- 1263
- 1264 A device measuring the atmospheric ion concentration or air conductivity, consisting of two coaxial
- 1265 cylinder electrodes, the centre one being connected to an electrometer. (Wahlin, 1986)
- 1266
- 1267 **Global Electric Circuit - GEC**
- 1268 Conceptual Map Code: 1,2
- 1269
- 1270 The totality of electric currents flowing in a planet's atmosphere which form a closed electrical circuit
- 1271 from the sources (e.g., thunderstorms which act as batteries) to the fair weather atmosphere (which acts as
- 1272 a load).
- 1273
- 1274 **Global radiation**
- 1275 Conceptual Map Code: 2,11
- 1276
- 1277 The total short-wave radiation from the sky falling onto a horizontal surface on the ground. It includes
- 1278 both the direct solar radiation and the diffuse radiation resulting from reflected or scattered
- 1279 sunlight.(PIFCIR)
- 1280
- 1281 **Granular biopersistent particles**
- 1282 Conceptual Map Code: 1,8
- 1283
- 1284 Particles that are characterized as respirable granular and biopersistent but not fibrous.Also known as
- 1285 “poorly soluble particles” or as “poorly soluble, low-toxicity particles”. (WHO, 2017)
- 1286
- 1287 **Health Hazard**
- 1288 Conceptual Map Code: 1,8
- 1289
- 1290 The inherent potential of a situation to cause physical or psychological harm to the health of people.
- 1291 (WHO, 2017)

1292

### 1293 **Heat lightning**

1294 Conceptual Map Code: 12

1295

1296 The luminosity observed from ordinary lightning too far away for its thunder to be heard. Since such  
1297 observations have often been made with clear skies overhead, and since hot summer evenings particularly  
1298 favour this type of observation, there has arisen a popular misconception that the presence of diffuse  
1299 flashes in the apparent absence of thunderclouds implies that lightning is somehow occurring in the  
1300 atmosphere merely as a result of excessive heat. (MG9)

1301

### 1302 **Heterogeneous nucleation**

1303 Conceptual Map Code: 1

1304

1305 Nucleation from the gas phase on a foreign surface or substance. The nucleation can be from a single  
1306 species on a foreign substance (heterogeneous - homomolecular) or nucleation of two or more species on  
1307 a foreign substance (heterogeneous-heteromolecular(Seinfeld and Pandis 2016)).  
1308

### 1309 **High Aspect Ratio Nanoparticles - HARNs**

1310 Conceptual Map Code: 1,8

1311

1312 Particles with one or two dimensions in the nanoscale that are much smaller than in the other dimensions  
1313 (HSE, 2013). Besides nanofibres, nanoplatelets (that present only one dimension in the nanoscale) are  
1314 considered to be HARNs. (EC\_GPHSW, 2013)  
1315

### 1316 **Homogeneous nucleation**

1317 Conceptual Map Code: 1

1318

1319 Nucleation from the gas phase without a surface or a pre-existing foreign nuclei. Nucleation can be from a  
1320 single species (homogeneous-homomolecular) or can be the nucleation of two or more species  
1321 (homogeneous-heteromolecular)(Seinfeld and Pandis 2016)..  
1322

### 1323 **Human bioclimatology**

1324 Conceptual Map Code: 9,17,18

1325

1326 The scientific discipline which seeks to understand the influence of climate and weather upon  
1327 humans.(Munn, 1987)

1328

### 1329 **Human Respiratory Tract Model - HRTM**

1330 Conceptual Map Code: 1,8

1331

1332 The model used to estimate pulmonary deposition, retention and biokinetic clearance to blood.(ICRP,  
1333 1994)

1357

1358 **Inhalable fraction**

1359 Conceptual Map Code: 1,8

1360

1361 The mass fraction of total airborne particles inhaled through the nose and mouth. (ECS1, 1993)

1369

1370 **Intermediate ions**

1371 Conceptual Map Code: 1

1372

1373 Atmospheric ion of sizes between the sizes of small and large ions (typically 1.6 to 7.4 nm). Mobility

1374 between 0.034 and 0.5 cm<sup>2</sup> V<sup>-1</sup> s<sup>-1</sup>. (Hörrak et al., 2000)

1386

1387 **Ion balance equation**

1388 Conceptual Map Code: 1

1389

1390 An equation describing the processes of ion production rate, ion-ion recombination, ion-aerosol

1391 attachment and ion induced nucleation rates, thereby describing the number of atmospheric ions present

1392 in a system. (Harrison, 2000)

1393

1394 **Ion recombination**

1395 Conceptual Map Code: 1

1396

1397 The process by which ions of opposite polarities recombine and neutralise, thereby destroying both ions.

1398 The ion recombination coefficient is usually denoted by alpha. (Hoppel, 1969)

1399

1400 **Ion-aerosol attachment**

1401 Conceptual Map Code: 1

1402

1403 The process by which aerosols gain charge from ions. The rate at which ions attach to aerosol particles is  
1404 dependent on the size of the aerosol present, the charges present on the aerosol, and the number of ions  
1405 and aerosol particles. (Gun, 1954)

1406

1407 **Ion-induced nucleation**

1408 Conceptual Map Code: 1

1409

1410 Nucleation, e.g., of water in the gas phase in a cloud into the liquid phase or solid phase (ice), involving  
1411 an ion. The presence of an ion often lowers the energy barrier between particles and so encourages  
1412 nucleation (Kirkby et al. 2016)..

1443

1444 **Ionosphere**

1445 Conceptual Map Code: 9,12,13,14,16

1446

1447 A region in the atmosphere characterized by a high concentration of free electrons and ions. Around the  
1448 Earth, the ionosphere occupies roughly 60 - 1000 km height range where ionizing radiation from the Sun  
1449 (and, to a lesser extent, galactic cosmic rays and energetic charged particles from the magnetosphere)  
1450 produce free electrons and ions in a significant concentration. Generally, the ionosphere is thicker and its  
1451 lower boundary is closer to the Earth during the day while it is thinner and its lower boundary is higher at  
1452 night. The ionosphere is electrically conductive and has layers (D,E,F) in which the electron density has a  
1453 local maximum. The layering of the ionosphere varies, being characteristically different during daytime  
1454 and nighttime, and can be significantly affected by space weather events. The ionosphere is that part of

1455 the atmosphere in which the density of ionisation is sufficient to deflect HF radio waves in the 2–30 MHz  
1456 range. See also: 'lower ionosphere'. (Zolesi & Cander, 2014)

1457

### 1458 **Ionospheric Potential**

1459 Conceptual Map Code: 2,12

1460

1461 Thunderstorms and electrified clouds act as a meteorological generator of electric potential differences  
1462 which causes the ionospheric potential to be about  $\approx +250$  kV with respect to the Earth's surface.  
1463 (Lukianova et al., 2011)

1464

### 1465 **Ionospheric storm**

1466 Conceptual Map Code: 9, 14,16

1467

1468 Large-scale disturbances in the F region ionosphere driven by highly variable solar energetic particle and  
electromagnetic wave energy inputs incident upon the Earth during periods of very intense solar activity, this is, during  
solar flares and coronal mass injection events. These disturbances, which represent large deviations from the “quiet-  
time” ionosphere, affect the ionospheric energy and particle distributions, the total electron content, and the ionospheric  
electric fields and current systems (Buonsanto 1999).netic storms. (DIAS)

1475

### 1476 **Isoceraunic**

1477 Conceptual Map Code: 2,9

1478

1479 A line on a map connecting points of equal frequency (or intensity) or simultaneous occurrence of  
1480 thunderstorms (lightning discharges).

1481

### 1482 **Isochasm**

1483 Conceptual Map Code: 2,9,12,14,16

1484

1485 A line on a map connecting points of equal frequency of auroral occurrence.

1486

### 1487 **Isoclinic line**

1488 Conceptual Map Code: 2,14

1489

1490 A line on a map connecting points of equal inclination of the Earth's magnetic field.

1491

### 1492 **Large ion**

1493 Conceptual Map Code: 1

1494

1495 Sometimes referred to as Langevin ions (discovered by him in 1905). These are atmospheric aerosols that  
1496 have gained charge, typically by ion-aerosol attachment. Mobility of 0.0004 to 0.03 cm<sup>2</sup> V<sup>-1</sup> s<sup>-1</sup> (size  
1497 typically 5 - 80 nm). (Hörrik et al., 2000)

1498

### 1499 **Leader**

1500 Conceptual Map Code: 9,14

1501

1502 A hot, conducting plasma channel in a lightning flash which is electrically polarised having oppositely  
1503 charged ends. The negative leader end propagates into the direction of the positive cloud charge, and vice  
1504 versa. A bidirectional leader tree has a zero net charge.

1505

### 1506 **Lightning current**

1507 Conceptual Map Code: 2,12, 15

1508

1509 Electric current carried by a lightning discharge.

1510

1511 **Lightning flash**

1512 Conceptual Map Code: 12,13

1513

1514 An electric discharge event, separated from other flashes by space and time criteria. In one flash, all processes from the initial breakdown to leader growth and any strikes to ground are included.

1515

1516

1517 **Long wave radiation -**

1518 Conceptual Map Code: 2

1519

1520 Electromagnetic radiation in the atmosphere confined in the infrared spectral band, having wavelengths between about 4.0 and 100  $\mu\text{m}$ . Although there is a small part of this radiation coming from the sun, most originates from the Earth's surface which radiates as a black body at a temperature of 255 K. Long wave (LW) radiation plays a key role in the greenhouse effect because it is absorbed strongly in the atmosphere by water vapor and carbon dioxide.

1526

1542

1543 **Lower positive charge region - LPCR**

1544 Conceptual Map Code: 9,12,14

1545

1546 Short lived positive charge region just below the main negative layer in the model of the tripole structure of the thundercloud.

1547

1554

1555 **Magnetosphere**

1556 Conceptual Map Code: 9, 14

1557

1558 The region surrounding the Earth or another astronomical or planetary body in which charged particles are heavily affected by the magnetic field generated from this body (Hargreaves 1992; Kivelson and Russel 1995).

1559

1560

1561

1562 **Mechanoreceptor hairs**



1563 Conceptual Map Code: 6, 7, 8  
1564  
1565 Hairs on the surface of most terrestrial arthropods (such as insects and spiders) that are sensitive to small,  
1566 sometimes nanoscale, mechanical forces.(McIver, 1985)  
1567  
1568 **Membrane potential** Conceptual  
1569 Map Code: 6, 7  
1570  
1571 The difference in electric potential between the interior and the exterior of a biological cell. With respect  
1572 to the exterior of the cell, typical values of membrane potential range from  $-40$  mV to  $-80$  mV.(Alberts  
2014).

1579  
1580 **Mesosphere**  
1581 Conceptual Map Code: 0, 20  
1582  
1583 The mesosphere is the layer of the earth's atmosphere that lies above the stratosphere. Temperature  
1584 declines with altitude within the mesosphere and this decline is used to define the limits of the  
1585 mesosphere. The lower limit is when the temperature starts to decline with altitude above the stratosphere  
1586 and the upper limit is when the temperature stops to decline with altitude. These limits are at 50-65 km  
1587 and 85-100 km height respectively.(Wallace and Hobbs 2006).

1594  
1595 **Mobility distribution**  
1596 Conceptual Map Code: 1  
1597  
1598 The number of ions of a given mobility in a sample of ions, as measured by an air-ion spectrometer.  
1599 (Hinds, 1982)  
1600  
1601 **Modification of the energy spectra (MOS)**  
1602 Conceptual Map Code: 2,12,14  
1603  
1604 Peaks and dips, which arise in time series of count rates of surface particle detectors due to the asymmetry  
1605 of positive-to-negative fluxes of secondary cosmic rays in the terrestrial atmosphere.  
1606  
1607 **Molecular ions**  
1608 Conceptual Map Code: 1  
1609  
1610 Charge carriers in the form of monomers, e.g.,  $\text{HSO}_4^-$ ,  $\text{NO}_3^-$ ,  $\text{H}_3\text{O}^+$ . (Shuman at al., 2015)

- 1621
- 1622 **Nano-object and nanoparticle**
- 1623 Conceptual Map Code: 1,8

A nano-object is a discrete piece of material with one or more external dimensions in the nanoscale, 1–100 nm (Lidén 2011). A nanoparticle is a nano-object with all three external dimensions in the nanoscale, from 1 to 100 nm. If the length of the longest and shortest axes of the nano-object differs significantly (typically by more than three times), the terms nano rod or nano plate can be used (EC-GPHSW 2013). The biological effects of atmospheric charged nanoparticles remain to be discovered.

- 1661
- 1662 **Nanosecond pulsed electric fields -nsPEF**
- 1663 Conceptual Map Code: 4,8
- 1664
- 1665 Ultrashort electric pulses, of a duration similar to that of a streamer propagating in lightnings, and used in
- 1666 some laboratories to analyze electric field interactions with biological objects (cells, tissues, ...)
- 1667
- 1668 **Natural radioactivity**
- 1669 Conceptual Map Code: 1, 11
- 1670
- 1671 Radioactivity arising from natural sources including both primordial radionuclides in the Earth's crust,
- 1672 and radionuclides being formed from the interaction of cosmic rays with the atmosphere and during

Radioactivity arising from natural sources, including both primordial radionuclides in the Earth's crust and radionuclides formed from the interaction of cosmic rays with the atmosphere and during thunderstorms and lightning conditions (Reiter 1985, Kathren, 1998).

1693

1694 **Nucleation**

1695 Conceptual Map Code: 1

1696

1697 The formation of new aerosol particles from gaseous precursors.

1698

1699 **Nucleation barrier**

1700 Conceptual Map Code: 1

1701

1702 An effective energy barrier that prevents the gas from nucleation although it is supersaturated in the gas phase.

1703



1805  
1806

**Primaryatmospheric ions**

1807 Conceptual Map Code: 1

1808

1809The atmospheric ions resulting from solar photoionization of the atmospheric constituents, e.g., N<sup>+</sup>, N<sub>2</sub><sup>+</sup>, O<sup>+</sup>, and O<sub>2</sub><sup>+</sup>, where the atomic ions here follow after the photo-dissociation of molecular ions (Shuman et al. 2015).

1816

**Protein**

1818 Conceptual Map Code: 3

1819

1820 Proteins are large bio-molecules consisting of one or more long chains of amino acids. Proteins have a  
1821 spatially complex distribution of electric charges in their structure. The charge distribution of proteins  
1822 determines the nature and magnitude of the protein sensitivity to electric fields. Since proteins are  
1823 molecules which determine life processes, one mechanism of how an electric field can act on a molecular  
1824 scale is through influencing the protein dynamics and structure. (Hekstra at al., 2015; Marracino at al.,  
1825 2019; Chafai at al, 2019)

1826

**Q-burst**

1828 Conceptual Map Code: 2,13,16

1829

1830 Exceptionally powerful lightning discharges produce ELF radio waves whose amplitude can exceed that  
1831 of the natural ELF background noise by several times. These waves cause characteristic transient signals,  
1832 Q-bursts, in the recorded time series at ELF monitoring stations. The most powerful waves can travel a  
1833 few times around the Earth and may excite the lowest Schumann resonance modes for a fraction of a  
1834 second. (Nickolaenko at al., 2010)

1842

1843 **Radioactive collector**

1844 Conceptual Map Code: 2, 12

1845

1846 A device measuring the potential gradient, consisting of an electrometer connected to a conducting  
1847 antenna and an alpha radiation source in the vicinity of the antenna in order to speed up the equalisation  
1848 of the potential of the antenna and the surrounding air. (Wahlin, 1986)

1849

1850 **Radon -<sup>222</sup>Rn**

1851 Conceptual Map Code: 10,11

1852

1853 Radon is a chemical element with symbol Rn; it is a radioactive gas. It occurs naturally as an intermediate  
1854 step in the normal radioactive decay chains through which thorium and uranium slowly decay into lead;  
1855 radon itself is a decay product of radium. Its most stable isotope, <sup>222</sup>Rn, has a half-life of 3.8 days.  
1856 Unlike all the other intermediate elements in these decay chains, radon is gaseous and easily inhaled.  
1857 Radon gas is a health hazard. It is often the single largest contributor to an individual's background  
1858 radiation dose, but due to local differences in geology, the level of radon gas hazard differs from location  
1859 to location. Despite its short lifetime, radon gas from natural sources can accumulate in buildings,  
1860 especially, due to its high density, in low areas such as basements and crawl spaces. Radon can also occur  
1861 in ground water in some spring waters and hot springs.

1862

1863

1864 **Radon progeny**

1865 Conceptual Map Code: 1,11

1866

1867 Short-lived radioactive elements <sup>218</sup>Po, <sup>214</sup>Pb, <sup>214</sup>Bi and <sup>214</sup>Po which result from the radioactive decay  
1868 of Radon (<sup>222</sup>Rn).

1869

1870 **Read across**

1871 Conceptual Map Code: 1,8

1872

1873 Transfer of hazard information from one material to another based on similarities between the materials.  
1874 (WHO, 2017)

1875

1876 **Red Sprite**

1877 Conceptual Map Code: 2,12,13,16

1878

1879 Red sprites are optical flashes produced by streamer type electric discharges in the mesosphere. These  
1880 occur due to the quasi-static electric field which can build up in the mesosphere after an extremely  
1881 powerful lightning discharge for a few milliseconds. Most often, several sprite entities show up quasi-  
1882 simultaneously, sometimes in a rapid sequence (so-called 'dancing sprites'). There is a great variety of  
1883 shapes of red sprites depending on the paths that the heads of streamer discharges explore during their  
1884 development of the event. Sprite entities are mostly vertical structures of length 20-50 km, while those in  
1885 a sprite cluster may be scattered over an area of up to several hundred square km. The colour of the  
1886 emission is predominantly red at high altitudes while it contains more blue when produced in lower air  
1887 regions. See also TLE. (Bór, 2013)

1888

1889 **Reduction Oxidation Potential – Redox**

1890 Conceptual Map Code: 5

1891

1892 Measure of the tendency of a medium such as soil or water to acquire or release electrons.  
1893 The quantity of redox potential is labeled as Eh and has units of mV. (Vorenhout at al., 2004)  
1894  
1895 **Remote sensing**  
1896 Conceptual Map Code: 0  
1897  
1898 Gathering information about an object or area from a distance without making direct physical contact  
1899 with the surface. The term is mostly used for Earth observation by satellites, airplanes or drones carrying  
1900 electromagnetic sensors.  
1901  
1902 **Respirable fraction**  
1903 Conceptual Map Code: 1,8  
1904  
1905 The mass fraction of inhaled particles penetrating to the nonciliated airways. (ECS1, 1993)

1920  
1921 **Risk of bias**  
1922 Conceptual Map Code: 1,8  
1923  
1924 The risk that the results of a study can be distorted due to methodological limitations such as the presence  
1925 of confounders. (WHO, 2017)

1932  
1933 **Schumann resonances - SR**  
1934 Conceptual Map Code: 2  
1935  
1936 The Schumann resonances are the set of spectral peaks in the extremely low frequency (ELF) portion of  
1937 the Earth's electromagnetic field spectrum. Schumann resonances are global electromagnetic resonances,  
1938 generated and excited by lightning discharges in the spherical shell cavity formed by the Earth's surface  
1939 and the ionosphere. Schumann resonances are the principal background signal in the ELF part of the  
1940 electromagnetic spectrum and appear as distinct peaks at ELF around 7.8 Hz (fundamental), 14.3, 20.8,  
1941 27.3 and 33.8 Hz. (Sentman, 1995)  
1942  
1943 **Schumann resonance transient**  
1944 Conceptual Map Code: 2,13,17  
1945 See Q-burst.  
1946

1947 **Secondary aerosols**  
1948 Conceptual Map Code: 1  
1949  
1950 Aerosols that form through gas-to-particle conversion in the atmosphere. (Sienfeld & Pandis, 2016)  
1951  
1952 **Self-potential - SP**  
1953 Conceptual Map Code: 5  
1954  
1955 Self-potential, or spontaneous potential, is a naturally occurring electric potential difference in the Earth,  
1956 measured by an electrode relative to a fixed reference electrode. SPs are usually caused by charge  
1957 separation in clay or other minerals, due to the presence of a semi-permeable interface impeding the  
1958 diffusion of ions through the pore space of rocks, or by the natural flow of a conducting fluid, e.g.,  
1959 (contaminated) groundwater flows. (Revil et al., 2003)  
1960  
1961 **Sensory Ecology**  
1962 Conceptual Map Code: 6,7,8  
1963  
1964 The study of how and why organisms acquire information from their environment. (Dusenbary, 1992)  
1965  
1966 **Shortwave radiation - SW**  
1967 Conceptual Map Code: 2  
1968  
1969 Radiative energy in the visible, near-ultraviolet and near-infrared parts of the spectrum, in the wavelength  
1970 interval 0.4 – 1.0  $\mu\text{m}$ . It is a solar radiation.  
1971  
1972 **Small atmospheric ion**  
1973 Conceptual Map Code: 1  
1974  
1975 Atmospheric ions created by natural or anthropogenic processes. They rapidly undergo clustering to form  
hydrates and can break apart. Their mobility ranges from 0.5 to 3.2  $\text{cm}^2\text{V}^{-1}\text{s}^{-1}$  (diameter 0.36–1.6 nm) (Israël  
1971; Hörrak et al. 2000). These are the ions contributing to the atmospheric conductivity.  
1978  
1979 **Solar cosmic radiation**  
1980 Conceptual Map Code: 1, 11  
1981  
1982 Cosmic rays generated near the surface of the Sun by magnetic disturbances. These solar particles are  
1983 comprised mostly of protons with energies generally below 100 MeV and only rarely above 10 GeV.  
1984 (UNSCEAR, 2016)  
1985  
1986 **Solar Flare**  
1987 Conceptual Map Code: 9, 14,16  
1988  
1989 Rapid release of energy from a localized region on the Sun in the form of electromagnetic radiation,  
1990 energetic charged particles, and mass motions. Powerful flares are often accompanied by coronal mass  
1991 ejections. (GSFT)  
1992  
1993 **Solar storm**  
1994 Conceptual Map Code: 9,14  
1995  
1996 A major disturbance in the Earth's magnetosphere resulting from the arrival of a very disturbed solar  
1997 wind and propagating down through the atmosphere. The effects cause the disturbances of the  
1998 geomagnetic field, changes of the atmospheric electric field and currents, movement of the auroral  
1999 regions to lower latitudes, and charged particle precipitation into the atmosphere.  
2000  
2001



2002 **Solar wind**

2003 Conceptual Map Code: 9, 14

2004

2005 A stream of charged particles, mostly electrons, protons and alpha particles, coming from the upper  
2006 atmosphere of the Sun (the solar corona) and blowing through interplanetary space, typically at ~ 400  
2007 kms-1 (Hargreaves 1992, Hundhausen 1995).. (WIKI7)

2008

2009 **Solubility**

2010 Conceptual Map Code: 1,8

2011

2012 The ability of a material to release ions in water or another liquid. Solubility may be expressed by the  
2013 dissolution rate of the material and may also be described using words such as insoluble, very soluble or  
2014 poorly soluble. (WHO, 2017)

2015

2016 **Space Weather**

2017 Conceptual Map Code: 9

2018

2019 Variability in the near-Earth space environment which can potentially affect human technologies and life.  
2020 Compared to the longer-term average variability of the radiation output of the Sun referred to as space  
2021 climate, significant variations can occur on shorter time-scales (e.g., due to eruptions of the Sun or solar  
2022 flares) which cause geomagnetic storms and significant changes in the ionospheric conditions.  
2023 (Messerotti, 2004; SWC)

2024

2025 **Sporadic E layer - Es**

2026 Conceptual Map Code: 14,16

2027

2028 A relatively thin yet dense ionospheric layer which sometimes appears between 90 and 140 km heights  
2029 independently of the regular E layer. The attribute 'sporadic' refers to the variability of the layer in terms  
2030 of its altitude, duration, and lateral extension. Es layers can have different patterns at high, middle and  
2031 low latitudes caused by different production mechanisms. The most widely accepted production  
2032 mechanism is based on wind shear, where heavy ions dragged by high altitude winds of opposite  
2033 directions are forced by the geomagnetic field to be concentrated in the layer of wind reversal. (Zolesi &  
2034 Cander, 2014)

2035

2036 **Sprite**

2037 Conceptual Map Code:

2038

2039 Link to existing entry: Red Sprite

2040

2041 **Sprite Halo**

2042 Conceptual Map Code: 2,12,13,16

2043

2044 Sprite halos are diffuse glow discharges extending over a circular area with a diameter of few tens of km.  
2045 These red emissions occur when the background electric field in the mesosphere becomes very strong in a  
2046 very short time, usually after a powerful lightning stroke having a very strong lightning current. Their  
2047 optical lifetime is only a few milliseconds. See also TLE. (Williams et al., 2012)

2048

2049 **St. Elmo's fire**

2050 Conceptual Map Code: 6, 7, 16

2051

2052 Corona or point discharges that occur when the environmental electric field is high, typically at the tips of  
2053 sharp conductors (e.g., needles of coniferous trees, or ship masts) that enhance the electric field. This  
2054 name was given to the phenomenon by Mediterranean sailors who regarded it as a visitation of their  
2055 patron saint, Elmo (Erasmus). The appearance of St. Elmo's fire was regarded as a good omen, for it tends  
2056 to occur in those latter phases of a violent thunderstorm when most of the surface wind and wave

2057 disturbance is over. (Schonland, 1950)

2058

2059 **Stratosphere** 2060

Conceptual Map Code: 20

2061

2062 The stratosphere is the layer of the earth's atmosphere that lies above the troposphere and below the  
2063 mesosphere. Temperature increases with altitude within the stratosphere and this increase is used to define  
2064 the limits of the stratosphere. The lower limit is when the temperature starts to increase with altitude  
2065 above the troposphere (called tropopause) and the upper limit is when the temperature stops to increase  
2066 with altitude (called stratopause). This limits are at 6-16 km and 50-65-100 km height respectively,  
2067 depending on latitude, season and other factors.

2068

2069 **Streak lightning**

2070 Conceptual Map Code: 13

2071

2072 A single lightning channel in an electric cloud-to-ground discharge.

2073

2074 **Streamer**

2075 Conceptual Map Code: 1,16

2076

2077 A relatively cool, quasi-neutral plasma channel with a moving tip formed by electron avalanches.

2078

2079 **Substorm**

2080 Conceptual Map Code: 13

2081

2082 Short-term perturbation of the Earth's magnetosphere that causes energy to be injected into the high  
2083 latitude ionosphere. Often accompanied by sudden brightening and increased movement of auroral arcs.  
2084 Distinct from geomagnetic storms, while possible linkages between both phenomena are a matter of  
2085 ongoing scientific research. (WIKI8; Runge et al., 2018))

2086

2087 **Sun-Earth connection**

2088 Conceptual Map Code: 20

2089

2090 Physical processes relating solar variability with changes in the Earth and its geospace environment. A  
2091 main part is described by electromagnetic interactions, specifically effects linking the magnetic fields of  
2092 the Sun, the solar wind, and the Earth, relating to space weather and climate as well as geomagnetic  
2093 activity. (SSC)

2094

2095 **Sunspot**

2096 Conceptual Map Code: 9, 14,16

2097

2098 A temporary disturbed area in the solar photosphere that appears dark because it is cooler than the surroundings. There,  
the magnetic field flux is particularly strong which causes energetic particles to be trapped which reduces free vertical convection;  
therefore, part of the internal heat is prevented from reaching the surface. Typical sunspot sizes compare with the size of the Earth.  
They usually occur in pairs or in groups of opposite magnetic field polarity that move in unison across the face of the sun as it  
rotates. The sunspot number activity changes periodically with an average period of 11 years, known as the "11-year solar cycle".  
The highest point of sunspot occurrence during a cycle is known as solar maximum, and the lowest sunspot occurrence point as  
solar minimum (Priest 1995).

2101

2102 **Tectonic plates**

2103 Conceptual Map Code: 9, 14,16

2104

2105 The tectonic plates are the large, thin, relatively rigid plates that move relative to one another on the outer

2106 surface of the Earth. (USGS)

2108

2108 **Ternary homogeneous nucleation**

2109

2109 Conceptual Map Code: 1

2110

2111 Homogeneous-heteromolecular nucleation with three substances. In the Earth's atmosphere, a typical

2112 system is the homogeneous nucleation of sulphuric acid, water and ammonia.

2113

### 2114 Terrestrial Gamma Flashes

2115 Conceptual Map Code: 14

2116

2117 A burst of gamma rays produced in the Earth's atmosphere, typically lasting 0.2 to 3.5 milliseconds, and  
2118 having energies of up to 20 MeV (million electron Volts). It is speculated that TGFs are caused by intense  
2119 electric fields produced above or inside thunderstorms; they may be associated with sprites. (ref.)

2136

### 2137 Thoracic fraction

2138 Conceptual Map Code: 1,8

2139

2140 The mass fraction of inhaled particles penetrating beyond the larynx. (ECS1, 1993)

2141

2142 Thundercloud

2143 Conceptual Map Code: 12,13

2144

2145 An electrified cloud, of cumulonimbus type, in which at least one lightning discharge is produced. A rain-bearing cloud that also produces lightning. The convective cell of a cumulonimbus cloud that generates lightning and thunder is a thunderstorm cell (Magono 1980; MacGorman and Rust 1998; Rakov and Uman 2002).

2152

### 2153 Thunderstorm Ground Enhancement -

2154 Conceptual Map Code: 12,13

Enhanced fluxes of high-energy electrons, gamma rays, and neutrons associated with lightning discharges (Chilingarian et al. 2019).

2167

2168 **Transient Luminous Event - TLE**

2169 Conceptual Map Code: 2,12,13,16

2170

2171 The collective name for various optical phenomena which occur within the altitude range of 15–110 km as a consequence of the rapid redistribution of electric charge in an underlying active thunderstorm. These brief flashes with optical duration much less than a fraction of a second can occur in many forms and are believed to have different production mechanisms. TLEs in the mesosphere (sprites, sprite halos, and gigantic jets) can perturb the propagation of VLF waves propagating in the Earth-ionosphere waveguide while TLEs at high altitudes (sprites, gigantic jets, ELVES) perturb (i.e., heat or otherwise influence) the lower ionosphere, and can cause secondary effects on radio signals propagating in the Earth-ionosphere waveguide (Rodger 1999, Rakov and Uman 2002, Fullekrug et al. 2006, Pasko et al. 2012). See “red sprite” and “blue/gigantic jets”.

2179

2180 **Translocation**

2181 Conceptual Map Code: 1,8

2182

2183 The transfer of material absorbed from the respiratory tract to other tissues in the body. (ICRP, 1994)

2184

2185 **Triboelectrification/triboelectricity**

2186 Conceptual Map Code: 2,3,6,7,8

2187

2188 A process of charge separation that involves the rubbing together of material surfaces. The detailed physical mechanism in triboelectrification is a long unsolved problem. Triboelectrification in the atmosphere can result in fields produced inside dust clouds. Triboelectricity is static electricity generated during the contact or friction between the surfaces of dissimilar materials. When separated, each material acquires a charge of opposite polarity, hence undergoing triboelectric charging. It is a synonym of contact electrification. The triboelectric series is a classification scheme for the ordering of the tendency for positive charge acquisition in rubbing (Diaz and Felix-Navarro 2004).

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