

International Network to Encourage the Use of Monitoring and Forecasting Dust Products

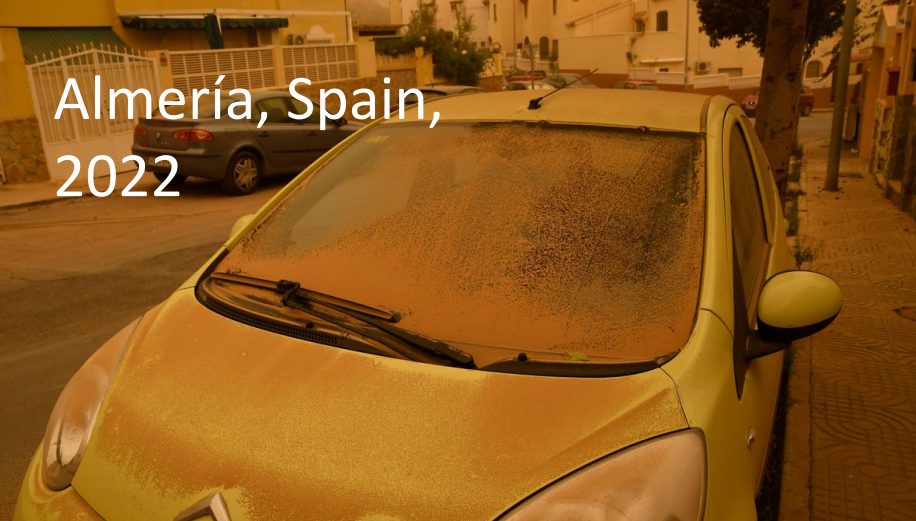
inDust

COST Action CA16202

Sara Basart (~~sara.basart@bsc.es, Spain, BSC~~) on behalf of the inDust

Now at WMO, Switzerland, sbasart@wmo.int

Almería, Spain,
2022



Switzerland, 2022



Türkiye, 2020



Crete, 2018



Paris, 2021

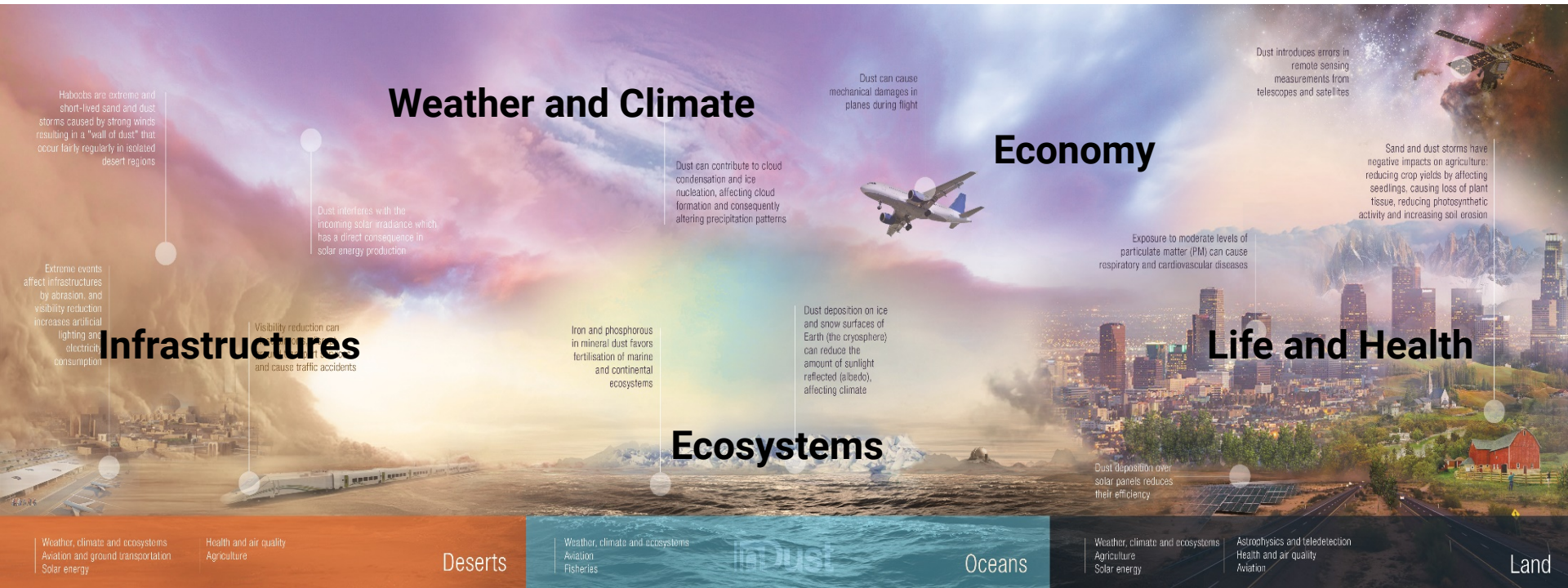


Tenerife 2020



Our Objective

To understand the user's needs in risky sand and dust storm environments for the development of tailored products



inDust Leaflet available in www.cost-indust.eu/media-room

<https://www.cost.eu/long-read-indust/>



inDust members - November 2017

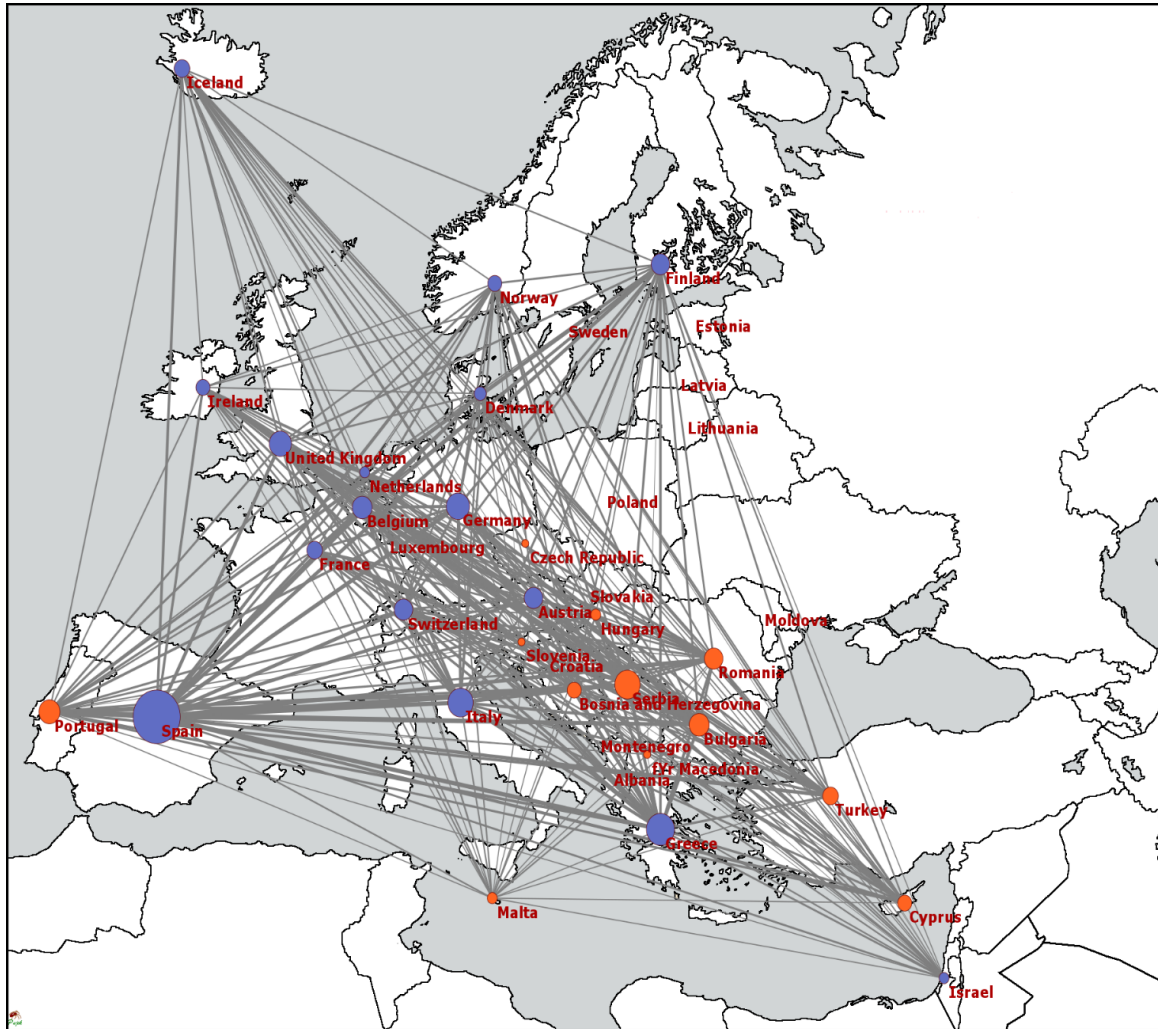




1st inDust MC meeting, Barcelona, Spain, March 2018



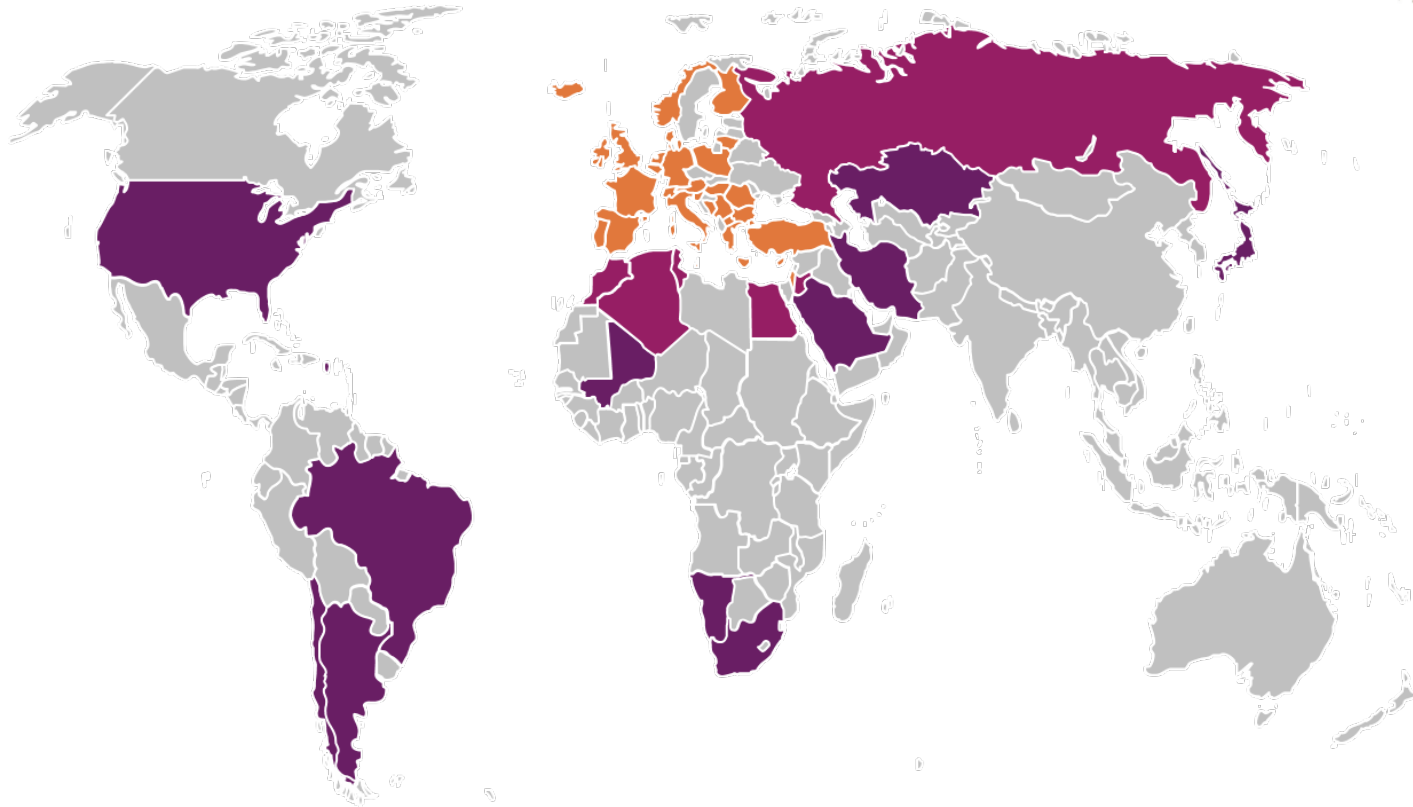
inDust Movements - October 2019



And the COVID appears in our lives...

More than 300 participants at the end

The network extension



- COST countries (29 countries)
 - Near-Neighbour Countries (Algeria, Egypt, Jordan, Lebanon, Morocco, Tunisia and Russia)
 - International Partner Countries
- International Organisations (WMO, ECMWF, WHO)

more than 300 participants around the world

USER ENGAGEMENT: Why?

We **need** potential users to enroll them into the process of the **design** of the tailored product.



Users will help on the identification of **impacts** and in ideas for **risk mitigation**.
This means that we need to understand their needs.

USER ENGAGEMENT: How?

We need to create **interest** in the topic

WORKSHOPS AND MEETINGS

User Workshop on Solar Energy - Soiling (DE)



WG on Modelling Activities (RS)



Meeting on Dataviz and Communication (RO)



User Workshop on products for Aviation (UK)



User Workshop on products for Air Quality (IT)



User Workshop on products for Solar (DE)



Workshop on High Latitude Dust (IS)



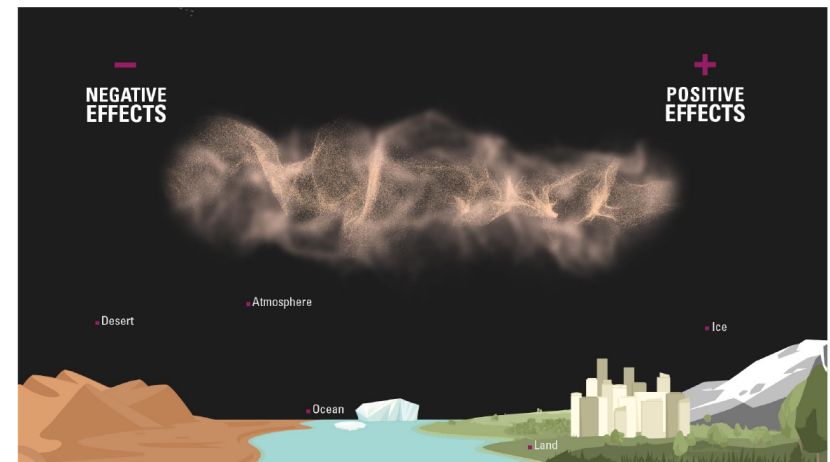
Training School on Dust Products, Aveiro (PT)



User Workshop on products for Health (ES)



DISSEMINATION MATERIALS



in which **key stakeholders from different sector (health, transportation, energy, ...)** as well as **EC and National agencies** are taking part

USER ENGAGEMENT: How?

and promote **collaborations** for **deeping** in the topic and **build capacity**



WEBINAR SERIES 2021
cost-indust.eu



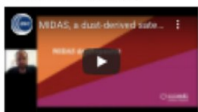
DUST MINERALOGY AND CLIMATE BY C. PÉREZ



InDust webinar by Carlos Pérez García-Pardo (BSC, Spain). The lecture focused on the importance of dust mineralogy in climate. Dr. Pérez García-Pardo is leading the ERC Consolidator Grant FRAGMENT: Frontiers in Dust Mineralogical Composition and its Effects upon Climate, whose goal is to understand and constrain the global mineralogical composition of dust along with its effects upon climate.

Download the webinar slides [here](#).

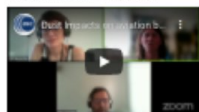
A DUST-DERIVED SATELLITE DATASET BY A.GIKIKAS



InDust webinar by Antonis Gikikas (National Observatory of Athens, Greece). The lecture focused on the presentation of MIDAS, which is a global fine-resolution dust optical depth dataset and its applications for DA.

Download the webinar slides [here](#).

DUST IMPACTS ON AVIATION BY B. SCHERLLIN-PIRSCHER



InDust webinar by Barbara Scherllin-Pirscher (ZAMG, Austria). The lecture focused on an overview of the different aerosol/nuclei sensing databases from ground-based and satellite observations and the challenges associated to perform an accurate aerosol type classification. This topic is part of the [ERA5 reanalysis](#) coordinated by the [ECMWF](#).

Download the webinar slides [here](#).

AEROSOL TYPING FROM OBSERVATIONS BY L. MONA



InDust webinar by Lucia Mona (CNR-IMAA, Italy). The lecture consisted in giving an overview of the different aerosol/nuclei sensing databases from ground-based and satellite observations and the challenges associated to perform an accurate aerosol type classification. This topic is part of the [ERA5 reanalysis](#) coordinated by the [ECMWF](#).

Download the webinar slides [here](#).

MINERAL DUST AND HEALTH EFFECTS BY X. QUEROL



InDust webinar by Xavier Querol (IDAEA-CSIC, Spain). The lecture focused on the characterization of dust intrusions in Europe and the applications of this information on health.

Download the webinar slides [here](#).

HIGH-RESOLUTION GLOBAL DUST MAP BY A. VUKOVIC



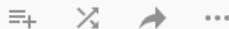
InDust webinar by Ana Vukovic (University of Belgrade, Serbia). The lecture focused on the efforts made to develop a high-resolution global dust map. The work is part of the [Sand and Dust Storm Toolkit](#) coordinated by UNCCD.

Download the webinar slides [here](#).








inDust COST Action

17 videos • 204 views • Updated today



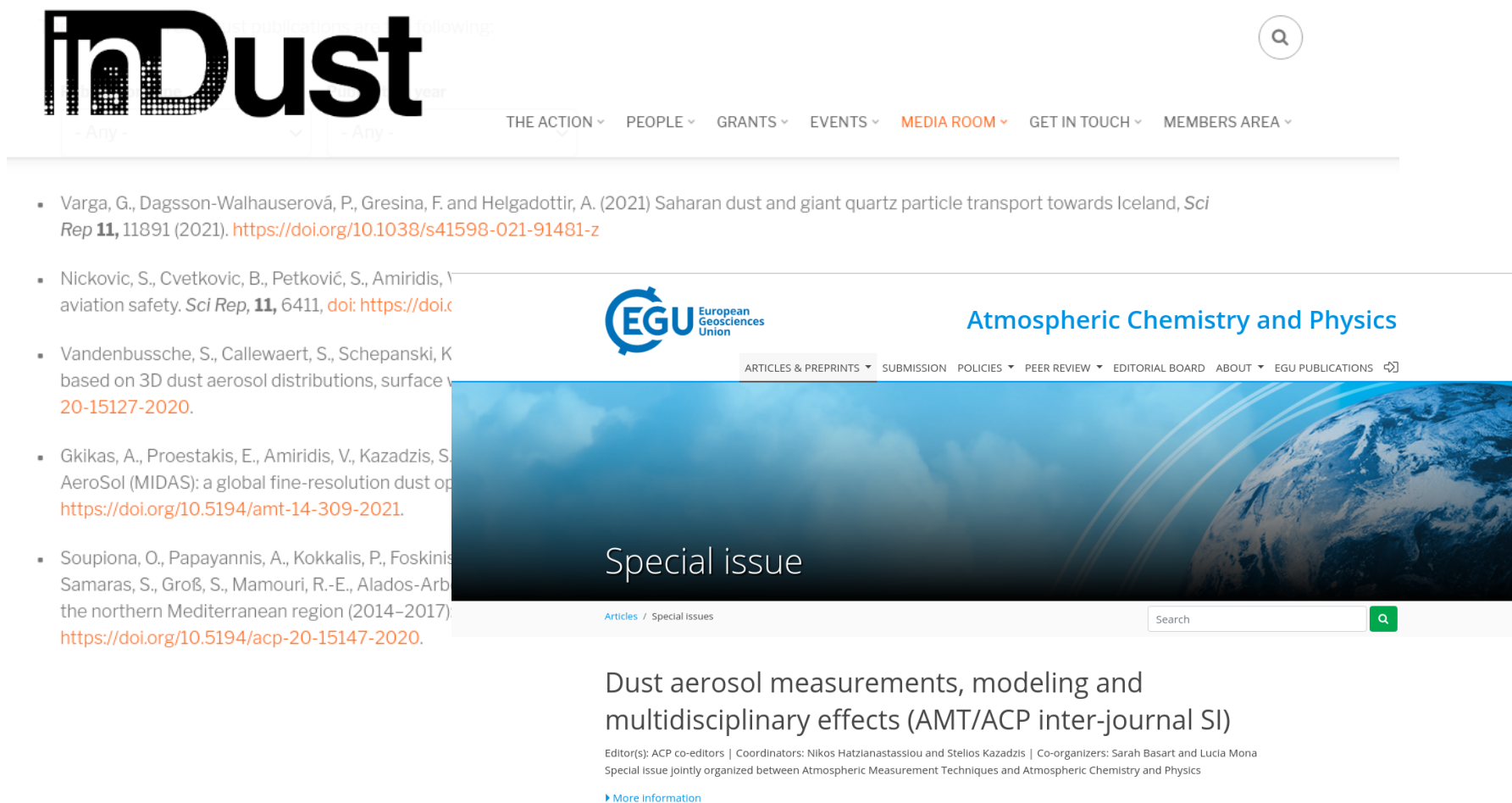
inDust is a COST-funded international network which provides research and assists sectors of society that are affected by airborne mineral dust. The Barcelona Supercomputing Center (BSC) is the Grant Holder of inDust COST Action (CA16202).

-  inDust Research Visits 2018-2021
BSC CNS
-  Slobodan Nickovic | inDust Research Visits 2018-2021
BSC CNS
-  Michael Russo | inDust Research Visits 2018-2021
BSC CNS
-  Clarissa Baldo | inDust Research Visits 2018-2021
BSC CNS
-  Michael Pikridas | inDust Research Visits 2018-2021
BSC CNS

USER ENGAGEMENT: How?

and promote **collaborations** for **deeping** in the topic and **build capacity**

More than **20 publications** and
launch of an **Special Issue in ATM/ACP**



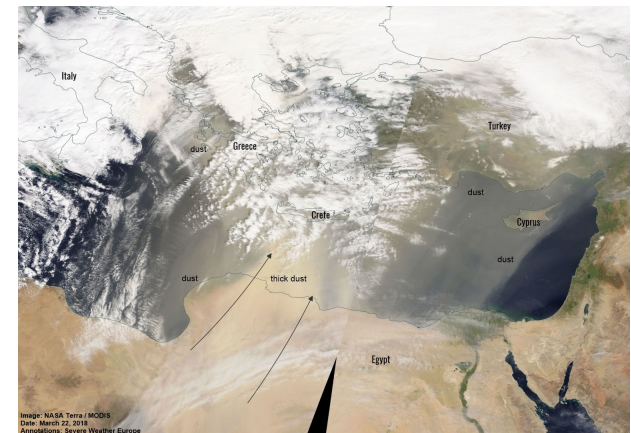
The image shows a screenshot of the inDust website. The top navigation bar includes the inDust logo, a search icon, and a menu with items: THE ACTION, PEOPLE, GRANTS, EVENTS, MEDIA ROOM, GET IN TOUCH, and MEMBERS AREA. Below the navigation bar, there is a list of publications:

- Varga, G., Dagsson-Walhauserová, P., Gresina, F. and Helgadottir, A. (2021) Saharan dust and giant quartz particle transport towards Iceland, *Sci Rep* **11**, 11891 (2021). <https://doi.org/10.1038/s41598-021-91481-z>
- Nickovic, S., Cvetkovic, B., Petković, S., Amiridis, V. et al. (2021) The impact of Saharan dust on aviation safety. *Sci Rep*, **11**, 6411, doi: <https://doi.org/10.1038/s41598-021-91481-z>
- Vandenbussche, S., Callewaert, S., Schepanski, K. et al. (2020) Dust aerosol distributions based on 3D dust aerosol distributions, surface fluxes and radiative forcing. *Atmospheric Chemistry and Physics*, **20**, 15127–2020.
- Gkikas, A., Proestakis, E., Amiridis, V., Kazadzis, S. et al. (2021) AeroSol (MIDAS): a global fine-resolution dust optical properties dataset. *Atmospheric Chemistry and Physics*, **21**, 1039–1054. <https://doi.org/10.5194/amt-14-309-2021>
- Soupliona, O., Papayannis, A., Kokkalis, P., Foskinis, S., Samaras, S., Groß, S., Mamouri, R.-E., Alados-Arboleda, J. L. et al. (2017) Dust aerosol measurements, modeling and multidisciplinary effects (AMT/ACP inter-journal SI) in the northern Mediterranean region (2014–2017). *Atmospheric Chemistry and Physics*, **17**, 1039–1054. <https://doi.org/10.5194/acp-20-15147-2020>

The bottom part of the screenshot shows a special issue announcement for "Dust aerosol measurements, modeling and multidisciplinary effects (AMT/ACP inter-journal SI)". The announcement includes the title, the journal name "Atmospheric Chemistry and Physics", and the date "15 November 2020". It also lists the editor(s) as ACP co-editors, coordinators as Nikos Hatzianastassiou and Stellos Kazadzis, and co-organizers as Sarah Basart and Lucia Mona. The announcement is jointly organized between Atmospheric Measurement Techniques and Atmospheric Chemistry and Physics. A link for "More information" is provided.

IMPACTS OF A STRONG DUST EPISODE OVER SOUTHEASTERN EUROPE

On 22nd March 2018, a large part of the Mediterranean Eastern countries experienced a very intense episode of African dust, **one of the most important of recent years.** (Monteiro et al., STOTEN, 2022)



- Increase (3 times) of emergencies responses and hospital admissions.
- Reduction of visibility caused aircraft traffic disruptions in Crete.
- Reduction of solar energy production is estimated on ~10 MW.
- Lower bounded cost in Crete about **3.4-3.8 million EUR**

Dust catalogue

Interactive dust information catalogue that includes observations and forecast

The screenshot displays the inDust web application interface. At the top, the 'inDust' logo is on the left, and navigation links for 'Satellites', 'Ground-based', 'Campaigns', 'Dust Models', 'Marine Environments', and 'About' are in the center. A 'Logout' button is on the right. Below the navigation is a 'Filters' sidebar on the left with sections for 'Parameter', 'Satellites', 'Instrument', 'Spectral range', 'Unit', 'Active/Passive', and 'Temporal Resolution'. A 'Contribute' button is located at the top of the filters. The main content area is a table with columns: Parameter, Satellites, Instrument, Data Availability (From, To), Spectral range, Unit, Active/Passive, Temporal Resolution, Spatial Resolution, Vertical Resolution, Coverage, and Open Data. The table lists various dust observations from satellites like Terra, Aqua, and Aura, and instruments like MODIS, OMI, and CALIOP. At the bottom right, there is a pagination control showing page 1 of 20.

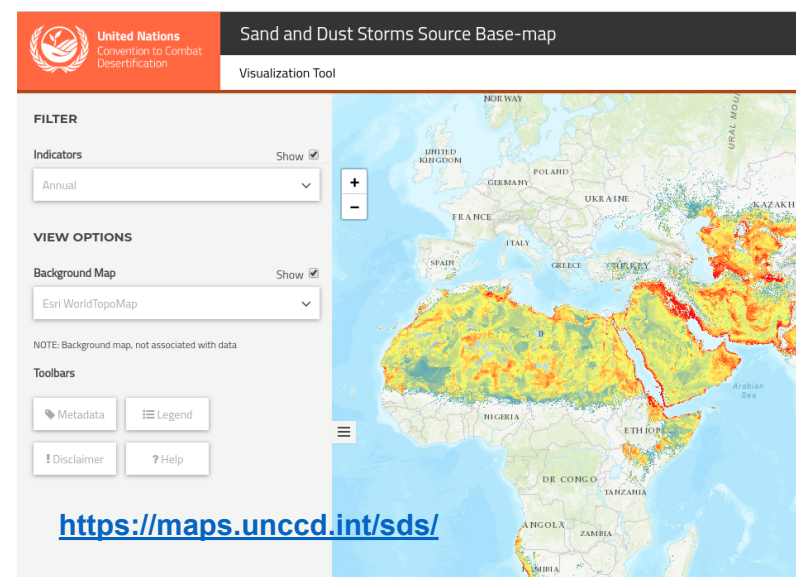
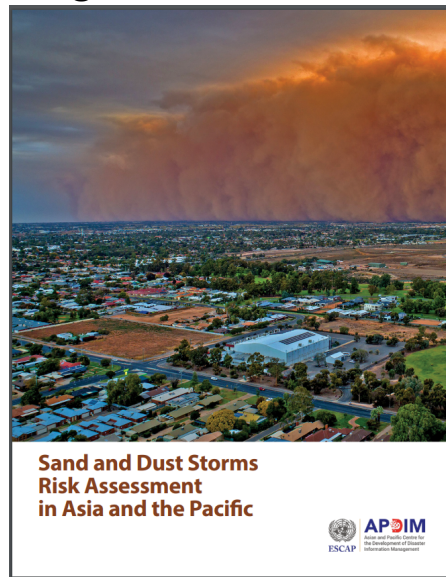
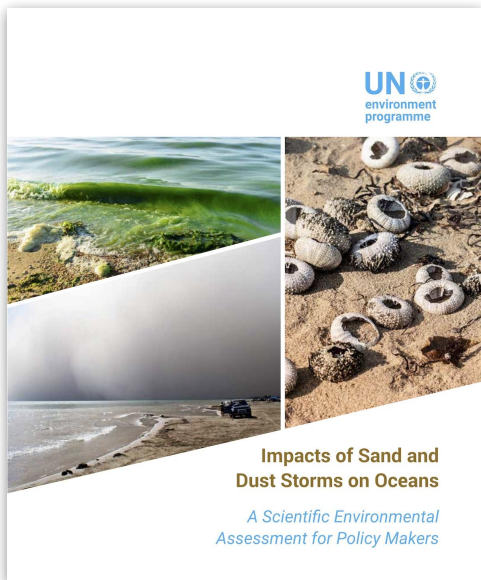
Parameter	Satellites	Instrument	Data Availability		Spectral range	Unit	Active/Passive	Temporal Resolution	Spatial Resolution	Vertical Resolution	Coverage	Open Data
			From	To								
Aerosol Optical Depth	Terra	MODIS	2000-02-24	Present	550	Unitless	Passive	Daily	1 deg x 1 deg	Columnar	Global	Yes
Aerosol Optical Depth	Aqua	MODIS	2002-07-04	Present	550	Unitless	Passive	Daily	1 deg x 1 deg	Columnar	Global	Yes
Aerosol Optical Depth	Terra	MODIS	2000-02-24	Present	550	Unitless	Passive	5-min	10 km x 10 km	Columnar	Global	Yes
Aerosol Optical Depth	Terra	MODIS	2000-02-24	Present	550	Unitless	Passive	5-min	3 km x 3 km	Columnar	Global (abov...)	Yes
Aerosol Optical Depth	Aura	OMI	2004-10-01	Present	354, 388, 500	Unitless	Passive	Sub-daily	13 km x 24 km	Columnar	Global	Yes
Aerosol Index	Aura	OMI	2004-10-01	Present	354 - 388	Unitless	Passive	Sub-daily	13 km x 24 km	Columnar	Global	Yes
Absorption Coefficient	Aura	OMI	2004-10-01	Present	354, 388, 500	Unitless	Passive	Sub-daily	13 km x 24 km	Columnar	Global	Yes
Backscatter Coefficient	CALIPSO	CALIOP	2006-06-12	Present	532, 1064	km ⁻¹ sr ⁻¹	Active	Daily	5 km x 70 m	30, 60, 180	Global	Yes
Particulate Matter	CALIPSO	CALIOP	2006-06-12	Present	532	Unitless	Active	Daily	5 km x 70 m	30, 60, 180	Global	Yes
Extinction Coefficient	CALIPSO	CALIOP	2006-06-12	Present	532, 1064	km ⁻¹	Active	Daily	5 km x 70 m	30, 60, 180	Global	Yes
Aerosol Optical Depth	Aqua	MODIS	2002-07-04	Present	470, 550, 660	Unitless	Passive	Daily	1 deg x 1 deg	Columnar	Oceans	Yes
Angstrom Exponent	Aqua	MODIS	2002-07-04	Present	550-860	Unitless	Passive	Daily	1 deg x 1 deg	Columnar	Oceans	Yes
Angstrom Exponent	Aqua	MODIS	2002-07-04	Present	860-2130	Unitless	Passive	Daily	1 deg x 1 deg	Columnar	Oceans	Yes
Asymmetry Factor	Aqua	MODIS	2002-07-04	Present	550	Unitless	Passive	Daily	1 deg x 1 deg	Columnar	Oceans	Yes
Aerosol Optical Depth	Aqua	MODIS	2002-07-04	Present	470, 550, 660	Unitless	Passive	Daily	1 deg x 1 deg	Columnar	Land	Yes

ATTENTION: It will be available in the Barcelona Dust Regional Center website.

Policy Impact

inDust members are part of scientific expert committees of several **UN and EC agencies and initiatives**

- FAIRMODE (European Commission)
 - Running National projects in Bulgaria, Iceland and Turkey
- ADPIM/ESCAP
- UNEP
- UNCCD
- WHO (AQ Guidelines 2021 incorporates a sections on mineral dust)
- WMO (through the SDS-WAS)
- UN Coalition for Combating Sand and Dust Storms



inDust finishes on 30th October 2021

But this was not the end, we are still promoting **tailored dust information** through



 *@Dust_Barcelona*
<https://dust.aemet.es/>

This WMO Regional Center is coordinating the efforts of the **SDS-WAS Regional Node for Northern Africa, Middle East and Europe** that considers a large contribution of researchers, data providers and (*thanks to inDust*) **user communities**

WMO Barcelona Dust Regional Center is coordinating the WMO SDS-WAS activities Northern Africa, the Middle East and Europe



The WMO Barcelona Dust Regional Center
is managed by AEMET and BSC

<https://dust.aemet.es/>
@Dust_Barcelona

More than 10,000
visits per month in
the website

and more than 500
new Twitter followers
in the last year (at
present 4,072
followers in total)

Dust Products



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Regional Center

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Overview

The WMO Barcelona Dust Regional Center provides access to high-quality dust information for the benefit of society. This information is useful to predict the occurrence of Sand and Dust Storms (SDS), as well as to manage their effects and impacts. In this context, the Center offers a wide range of dust products, both models and observations, that serve the need for detailed dust information on a regional scale. A detailed description of all the products offered on the Center's website can be found in the User Guide.

USER GUIDE



Daily Dust Products

Dust forecasts and dust-related observational products

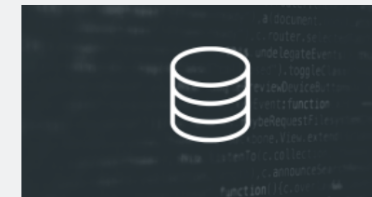
[EXPLORE PRODUCT](#)



Dust Products Catalogue

Inventory of available dust observational and modelling products

[EXPLORE PRODUCT](#)



Data Download

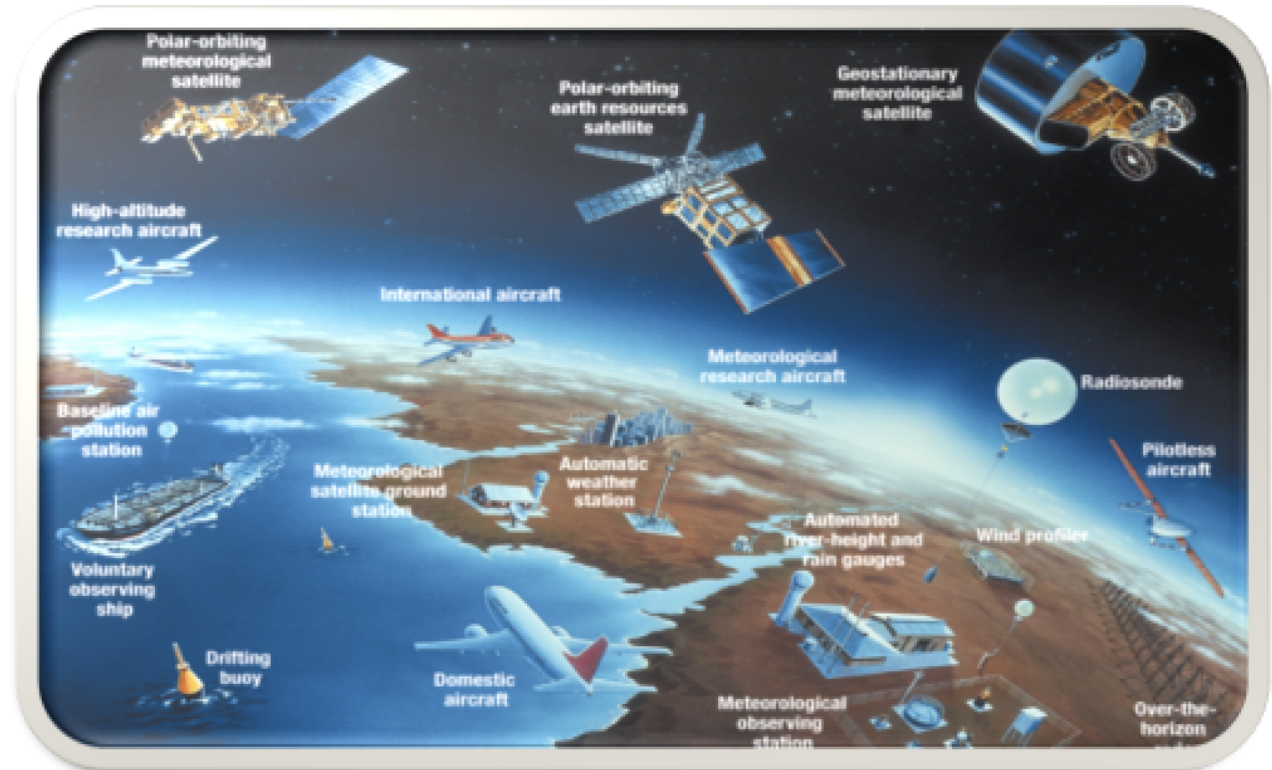
Access and download the numerical data of dust forecasts

[EXPLORE PRODUCT](#)

<https://dust.aemet.es/>

World Meteorological Organization (WMO)

- UN specialized agency on weather, climate and water.
- It's supported by 193 Members and the headquarters is in Geneva (Switzerland).
- Coordinates work of > 300,000 national experts from meteorological and hydrological services, academia and private sector.
- Co-Founder and host agency of IPCC.





Global Atmosphere Watch (GAW)

Research Enabling Atmospheric Composition Services

*Advance and enhance **science, services and infrastructure** related to atmospheric composition, and support policies for society through applied research aimed at improving the understanding of the roles of aerosols, reactive gases, stratospheric ozone and greenhouse gases and their interactions in the Earth System.*

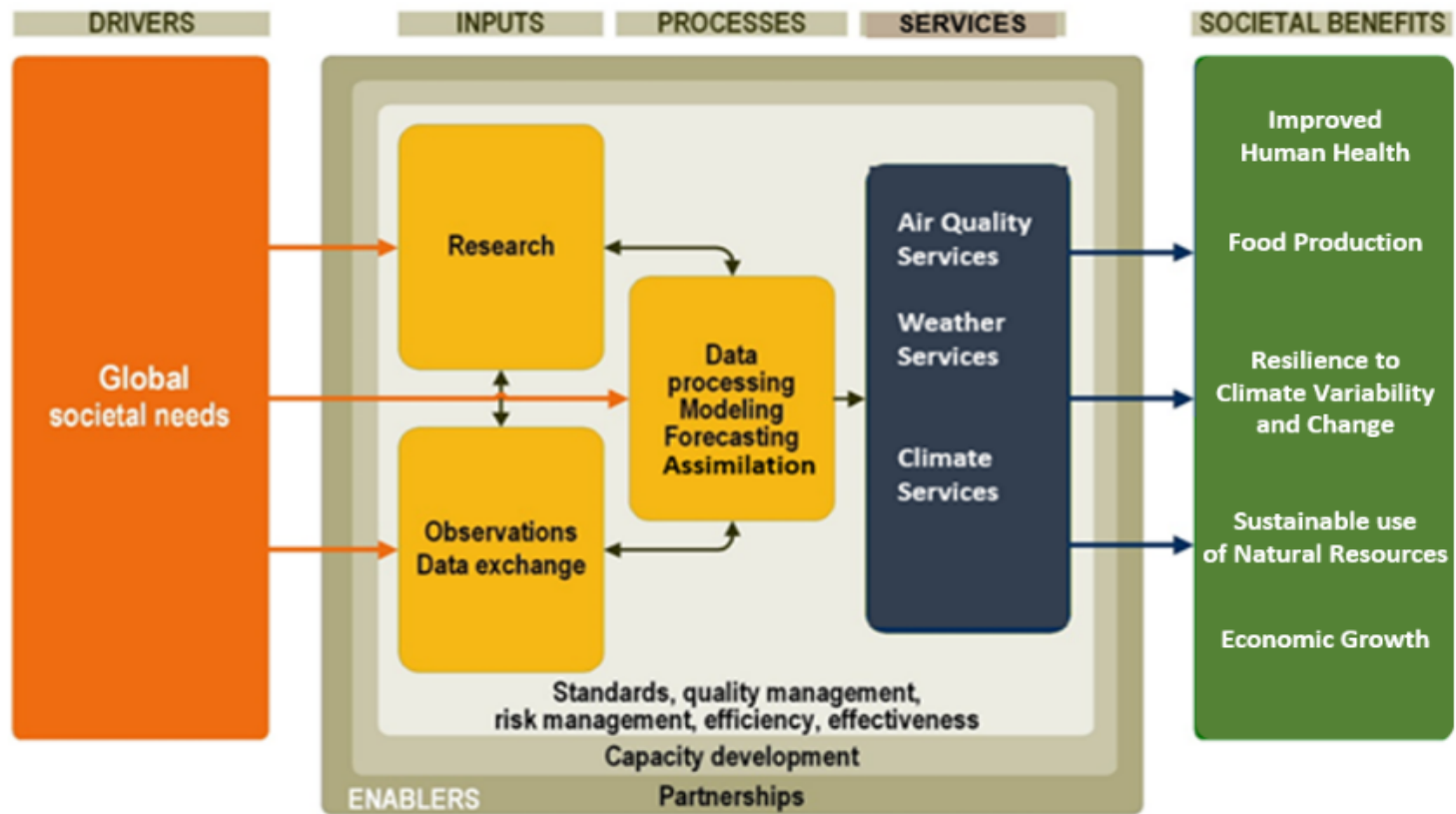
Drivers: Global societal needs





Global Atmosphere Watch (GAW)

Achieving a comprehensive atmospheric composition observing and analysis infrastructure by closely linking operations and research



More than 300 experts from MetServices, universities and research centres



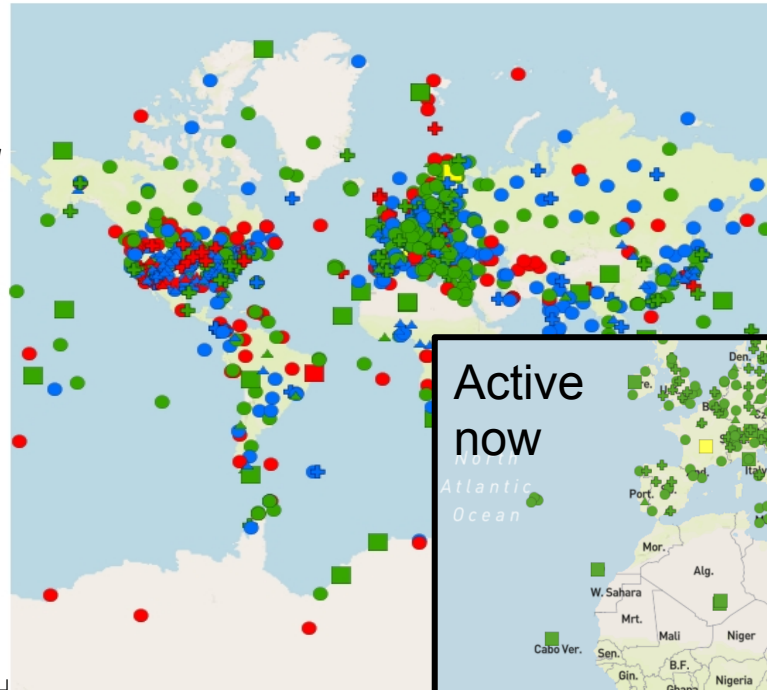
Global Atmosphere Watch (GAW)

Observational (research) Infrastructure

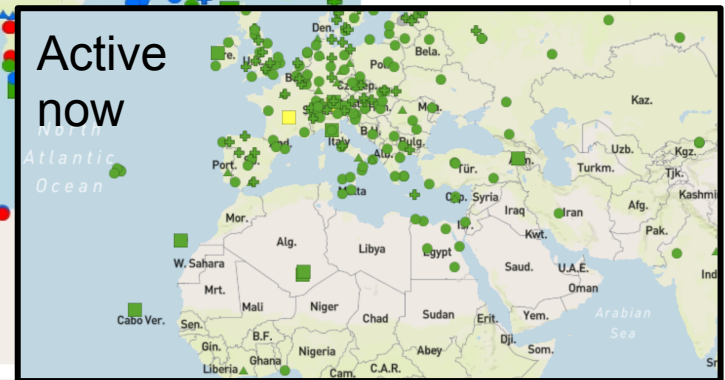
*Strengthen the atmospheric composition measurement and data infrastructure and contribute to **understanding trends and variability and extremes.***

- More than 200 parameters
- Intercomparisons
- Measurement guidelines
- World Data Centers

13,000 Km




Filling gaps:
National AQ networks, LCS and satellites recommendations



Open access



 Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation
Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

- | | | |
|-----------------------|--------------------|--|
| Global | Operational | |
| Regional | Partly operational | |
| Contributing networks | Non-reporting | |
| Local | Closed | |
| Other networks | Planned | |
| | Pre-operational | |
| | Stand-by | |

GAW Station Information System (**GAWSIS**) part of OSCAR <https://gawsis.meteoswiss.ch/GAWSIS/#/>



Global Atmosphere Watch (GAW)

Activities World map

Model Intercomparisons

Sand and Dust Storms

Wildfires

Air Quality

Monitoring

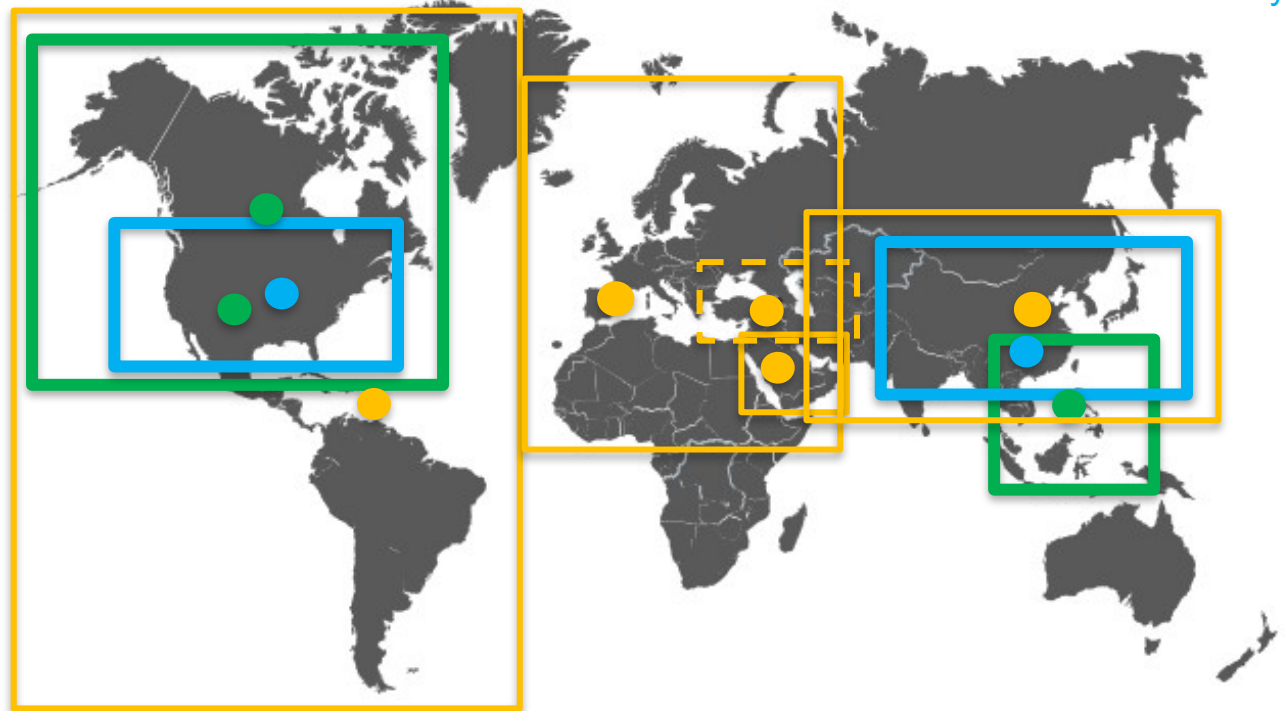
746 active
global/regional/urban/
stations in 112 countries

Central Facilities

13 countries are hosting
GAW central facilities

Forecasting

21 countries providing daily
forecasts



WMO INFRASTRUCTURE - GDPFS

Regional Specialized Meteorological Center with activity specialization on
Atmospheric Sand and Dust Forecast (RSMC-ASDF)

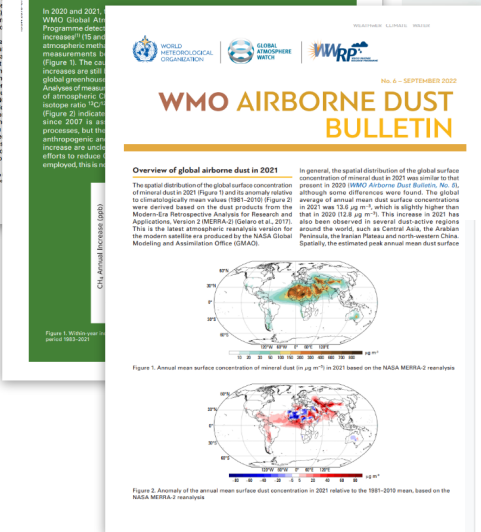
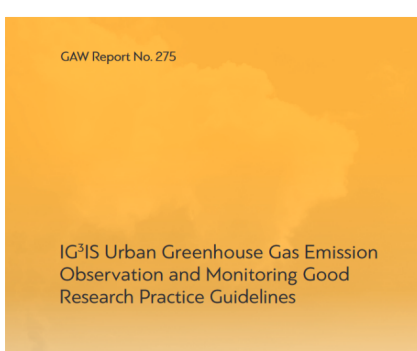
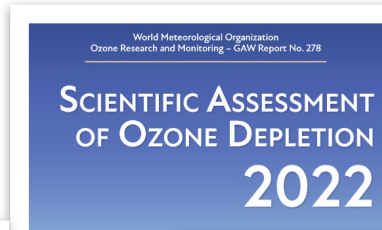


WMO OMM



Global Atmosphere Watch (GAW)

Achievements



Atmos. Chem. Phys., 22, 4615–4703, 2022
 https://doi.org/10.5194/acp-22-4615-2022
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Atmospheric Chemistry and Physics
 Open Access EGU

Review article

Advances in air quality research – current and emerging challenges

Ranjeet S. Sokhi¹, Nicolas Moussiopoulos², Alexander Baklanov³, John Bartzis⁴, Isabelle Coll⁵, Sandro Finardi⁶, Rainer Friedrich⁷, Camilla Geels⁸, Tiia Grönholm⁹, Tomas Halenka¹⁰, Matthias Ketzel⁸, Androniki Maragkidou⁹, Volker Matthias¹¹, Jana Moldanova¹², Leonidas Ntziachristos², Klaus Schäfer¹³, Peter Suppan¹⁴, George Tsegas², Greg Carmichael¹⁵, te Franco¹⁶, Steve Hanna¹⁷, Jukka-Pekka Jalankinen², Gous J. M. Velders^{18,19}, and Jaakko Kukkonen^{9,1}



Improving Estimates of Sulfur, Nitrogen, and Ozone Total Deposition through Multi-Model and Measurement-Model Fusion Approaches

Joshua S. Fu,^{*} Gregory R. Carmichael,^{*} Frank Dentener,^{*} Wenche Aas, Camilla Andersson, Leonard A. Barrie, Amanda Cole, Corinne Galy-Lacaux, Jeffrey Geddes, Syuichi Itahashi, Maria Kanakidou, Lorenzo Labrador, Fabien Paulot, Donna Schwede, Jiani Tan, and Robert Vet

Cite This: *Environ. Sci. Technol.* 2022, 56, 2134–2142

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ACCESS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 | 540 | 541 | 542 | 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 | 560 | 561 | 562 | 563 | 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 | 575 | 576 | 577 | 578 | 579 | 580 | 581 | 582 | 583 | 584 | 585 | 586 | 587 | 588 | 589 | 590 | 591 | 592 | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 | 601 | 602 | 603 | 604 | 605 | 606 | 607 | 608 | 609 | 610 | 611 | 612 | 613 | 614 | 615 | 616 | 617 | 618 | 619 | 620 | 621 | 622 | 623 | 624 | 625 | 626 | 627 | 628 | 629 | 630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 | 640 | 641 | 642 | 643 | 644 | 645 | 646 | 647 | 648 | 649 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659 | 660 | 661 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 | 673 | 674 | 675 | 676 | 677 | 678 | 679 | 680 | 681 | 682 | 683 | 684 | 685 | 686 | 687 | 688 | 689 | 690 | 691 | 692 | 693 | 694 | 695 | 696 | 697 | 698 | 699 | 700 | 701 | 702 | 703 | 704 | 705 | 706 | 707 | 708 | 709 | 710 | 711 | 712 | 713 | 714 | 715 | 716 | 717 | 718 | 719 | 720 | 721 | 722 | 723 | 724 | 725 | 726 | 727 | 728 | 729 | 730 | 731 | 732 | 733 | 734 | 735 | 736 | 737 | 738 | 739 | 740 | 741 | 742 | 743 | 744 | 745 | 746 | 747 | 748 | 749 | 750 | 751 | 752 | 753 | 754 | 755 | 756 | 757 | 758 | 759 | 760 | 761 | 762 | 763 | 764 | 765 | 766 | 767 | 768 | 769 | 770 | 771 | 772 | 773 | 774 | 775 | 776 | 777 | 778 | 779 | 780 | 781 | 782 | 783 | 784 | 785 | 786 | 787 | 788 | 789 | 790 | 791 | 792 | 793 | 794 | 795 | 796 | 797 | 798 | 799 | 800 | 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 | 809 | 810 | 811 | 812 | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821 | 822 | 823 | 824 | 825 | 826 | 827 | 828 | 829 | 830 | 831 | 832 | 833 | 834 | 835 | 836 | 837 | 838 | 839 | 840 | 841 | 842 | 843 | 844 | 845 | 846 | 847 | 848 | 849 | 850 | 851 | 852 | 853 | 854 | 855 | 856 | 857 | 858 | 859 | 860 | 861 | 862 | 863 | 864 | 865 | 866 | 867 | 868 | 869 | 870 | 871 | 872 | 873 | 874 | 875 | 876 | 877 | 878 | 879 | 880 | 881 | 882 | 883 | 884 | 885 | 886 | 887 | 888 | 889 | 890 | 891 | 892 | 893 | 894 | 895 | 896 | 897 | 898 | 899 | 900 | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 | 909 | 910 | 911 | 912 | 913 | 914 | 915 | 916 | 917 | 918 | 919 | 920 | 921 | 922 | 923 | 924 | 925 | 926 | 927 | 928 | 929 | 930 | 931 | 932 | 933 | 934 | 935 | 936 | 937 | 938 | 939 | 940 | 941 | 942 | 943 | 944 | 945 | 946 | 947 | 948 | 949 | 950 | 951 | 952 | 953 | 954 | 955 | 956 | 957 | 958 | 959 | 960 | 961 | 962 | 963 | 964 | 965 | 966 | 967 | 968 | 969 | 970 | 971 | 972 | 973 | 974 | 975 | 976 | 977 | 978 | 979 | 980 | 981 | 982 | 983 | 984 | 985 | 986 | 987 | 988 | 989 | 990 | 991 | 992 | 993 | 994 | 995 | 996 | 997 | 998 | 999 | 1000

Article Type: Research Article

Global Atmospheric Composition Observations: The Heart of Vital Climate and Environmental Action

Gregory R. Carmichael, Oksana Tarasova, Øystein Hov, Leonard Barrie, and James H. Butler

imp within precipitation, or dry deposition on vegetation, soil, crop production. Current global scale maps of atmospheric deposition are mostly based on chemical transport model



Final remarks

- Sand and Dust Storms (SDS) play a significant role in different aspects of weather, climate and atmospheric chemistry and represent a **serious hazard** for life, health, property, environment and economy.
- Understanding, managing and mitigating **SDS risks** and effects requires fundamental and cross-disciplinary knowledge.
- **inDust** focused to build a community of researchers and users that support the design of the strategy to develop **dust services**.
 - *WMO Barcelona Dust Regional Center is supporting this downstream service platforms.*



Tehran, Iran, June 2014

Thanks a for you attention

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