

WEBINAR

AIR QUALITY MONITORING IN AFRICA

EARTH OBSERVATION TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

20 APRIL 2023 08:00-10:00 & 12:00-14:00 UTC

#EOAfrica



Webinar on Air Quality Monitoring in Africa - Q&A session

- 1. Good day and well done for organizing the webinar. Can we get past/previous data for 3years in many African countries? If yes, please how? Thanks.**
 - a. Hi! I will cover this in my presentation just after Federico, giving some links to the CAMS data available. In short, yes, you can obtain air quality data from here (<http://ads.atmosphere.copernicus.eu>), you can also visualise recent data here (<https://atmosphere.copernicus.eu/charts/packages/cams/>) and see examples of use in the context of Jupyter notebooks here (<https://atmosphere.copernicus.eu/training>). There are also resources and computing capacity available from WEKEO (<https://www.wekeo.eu>). CAMS data covers the period since 2003 up to now (and even the next 5 days with our forecasts). More details to follow in the presentation and happy to follow offline as well.
 - b. Thanks so much for the links provided. Can we get erroneous data from the satellite? If yes, how can this be identified?
- 2. What are the AU air quality policies?**
 - a. The Africa Clean Air Program is supposed to be comprehensive enough and cover the legal framework. At the moment there are no AU specific policies that I am aware of. This will be an area of discussion as we develop further the Clean Air Program.
- 3. What are the financial support the AUC place towards the 37 recommended measures across Africa?**
 - a. This work is ongoing and implementation will require various partnerships. The first partnership forum took place on 16 February 2023 and there are going to be several as we mobilize for resources to implement the measures.
- 4. Quels sont les canaux satellitaire pour nous aider a detecter la pollution de l'air?**
 - a. On utilise des canaux differents - par exemple infrarouge est sensible a NO2 tandis que le UV est sensible a l'ozone. De plus les particules (aerosol) peuvent etre observees dans le visible - mais aussi par exemple dans les UV (comme indice d'aerosol) qui est moins sensible a la presence de nuages.
- 5. Dear Carol. Thanks for your presentation. You talked about tropospheric O3 effects pertaining to Air quality in Africa. Is there any contribution from Stratospheric O3?**
 - a. We just modelled the effects of tropospheric or ground level ozone

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6. **Thanks, Federico, for nice presentation. Kindly share the PPT and the website where I can download the data... and any other materials ...**
 - a. All presentations will be available @ <https://www.eumetsat.int/webinar-air-quality-monitoring-africa>

7. **In terms of capacity building: what is the African Union doing to achieve this? We need funds to train people and most of the funds for these types of workshops are from international orgs but not locally. 2. It will be great to have a board to uses robust evidence for strong AQ limits and find ways to fine governments that will default. 3. We have a fair idea of the causes/ sources of air pollution in Africa - why is the AU not ensuring that these are tackled and new settlements follow structures to ensure a just energy transition? HAP contributed to more than half of air pollution-induced deaths in Africa in 2019 alone.**
 - a. Capacity building is indeed key in air quality management. This is the reason we said, we need input like this as we develop the Africa Clean Air Program

8. **Is data on Africa available to all and in what format?**
 - a. Hi, yes. Data are available for Africa; Julia will do a presentation in the afternoon about how to access these data.

9. **L'utilisation des satellites pour le contrôle de la qualité de l'air a des avantages avérés mais dans le cadre de l'Afrique Centrale et du Cameroun en particulier, nous avons un climat qui montre la présence des nuages pratiquement durant toute l'année. Comment gérez-vous cet obstacle des nuages lors des mesures ? Comment calculer et minimiser les erreurs y afférents pour la fiabilité des données ? Comment valider les résultats obtenus ? Merci. Nasser Nducol, Chercheur/Ministère de la Recherche Scientifique et de l'Innovation, Cameroun.**
 - a. Hi Nasser, there is definitely a need for ground based measurement. Otherwise, the uncertainty will be important. We can collaborate to set a ground base measurement there if you are interested.

10. **To AUC delegate on the air quality assessment. My question is on dataset used to assess the impact of pollution on death and the figure showed is it at continental level?**
 - a. Not to answer, really. However, I thought of interest. The Summary for Decision Makers is available. It has more details. The final technical reports are being finalized with all of the data.
SPM. <https://www.ccacoalition.org/en/resources/summary-decision-makers-integrated-assessment-air-pollution-and-climate-change-sustainable>

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11. Not so sure, how we have sampled those giving the presentation but it would be great to consider African scientists from each of the regions (West, South, North ...) to present what they have been doing in the region re air pollution.

- a. Not sure it is a question or comment: The webinar is structure in 2 sessions: 1st session will inform on the Political framework of Air Pollution monitoring in Africa and Satellite contribution to the monitoring of Air Quality- The 2nd session will inform on existing experience in Africa on the matter. The Webinar includes presentations from Universities and Institutions from South, North, and Eastern Africa.
- b.

12. How did you validate that impact of pollution on health?

- a. I was also wondering the same. If there, are any studies linking these Air Quality measurements to possible adverse health effects? It is worrisome to see increasing levels of Ozone across the continent.
- b. Relate AQ to Health is a quite difficult process - to do this at statistical level, you need reliable epidemic data that also cover a long time range since diseases related to AQ can have long latency - This is becoming quite consolidated in Europe for instance and can be applied to other regions / continents - There are also medical studies that analyse the biological - physiology response to pollutants
- c. The relationships between AQ and health from global burden of disease are generally used. In addition to relationships, it can be difficult to find local baseline mortality data. Here in South Africa, we only can access all-cause mortality on an annual scale. We need more information for these studies.

13. Quelle est la difference qui existe entre les images régénérées par copernicus et météo sat de 3ème génération. La question s'adresse à monsieur Federico.

- a. Copernicus inclut les satellites sentinelle - il y en a deja 2 (3 et 5P) qui sont en train de fournir de donnees. Prochainement Sentinel 4 et 5. MTG va porter Sentinel-4 et fournir des donnees additionnelles (par exemple FCI, l'imageur visible) - donc les donnees sont tres complementaires.

14. Comment avoir accès aux données ou disponibilité des images régénérées par Météosat 3 génération? Question adressée à Mr FIERLI Federico

- a. Bonjour, Meteosat 3 Gen sera disponible apres la premiere phase de validation - access sera avec le Data Store / Eumetcast - plus de details cet apres midi.

15. To EUMETSAT: Do we have an air quality network stations on ground to validate the satellite products?

- a. This was answer live.
- b. Lack of air quality ground station in Africa is indeed an issue for validation.

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- 16. We have an air conditioning station but it is the interpretation of the data that causes us problems. How can air pollution station data be interpreted?**
- There is an upcoming conference that might be of interest. There will be some trainings. <https://asic.aqrc.ucdavis.edu/asic-ghana>
 - Also, we try to advertise such trainings on the ANGA mailing list. You can join here: <https://igacproject.org/working-groups/anga>
- 17. Les mêmes préoccupations se posent pour les poussières désertiques (en particulier du Sahara) ! De plus comment distinguer l'effet écran des nuages et des poussières sahariennes dans le calcul des erreurs ?**
- La question a été répondue en ligne par Federico. Merci.
- 18. will there be English translation from Mr Vincent-Henri presentation?**
- English interpretation is available on-line. Through the interpretation button at bottom of your screen.
- 19. Prof. Vinicent, how do you process the real data? Which modelling tools do you use? Any trainings on them ?**
- Please see: <https://doi.org/10.1175/BAMS-D-21-0314.1> (and references therein). Yes, we do organise regular training between EUMETSAT, ESA and ECMWF.
- 20. Comment pouvons rentrer en contact avec vous?**
- pour eumetsat: ops@eumetsat.int
 - my email: dntwali@space.gov.rw
- 21. A Vincent, l'apport du CAMS sur la capagne de données de terrain, quel serait le soutien de CAMS sur l'installation des réseaux d'observation de terrain**
- Vous pouvez par exemple utiliser les données CAMS sur le passé pour déterminer une première climatologie, afin de vous permettre de choisir un ensemble de sites qui mesureront des conditions suffisamment differentes. Pour les campagnes de mesure et le soutien que nous pouvons apporter, voir ici: <https://atmosphere.copernicus.eu/scientific-field-campaign-support>
- 22. Are the mentioned satellite data also present in other public/private non-European cloud infrastructure (CloudAfrica, etc.)?**
- Part of them are available in commercial cloud infrastructure (eg Amazon) and GoogleEarthLab - inclusion is based on the initiative of the cloud provider...

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23. How can we convert your spatial data to csv or netcdf formats or access your data in other formats?

- a. You can try using the Data Tailor to change formats. <https://www.eumetsat.int/data-tailor>

24. Question à Vincent comment pouvons rentrer en contact avec vous concernant la coopération? je en Côte d'Ivoire

- a. Vous pouvez me contacter à: Vincent-Henri.Peuch@ecmwf.int ! Très content d'interagir.

25. Merci vincent pour la présentation, je voudrais savoir si les pays du golfe de guinée ont un accès facile aux produits de CAMS

- a. Les produits CAMS sont accessible via les interfaces mentionnées ici: <https://atmosphere.copernicus.eu/data>. Le Cloud WEKEO offre aussi un acces à ces données, avec des capacités de calcul pour faire des opérations sur les donnée via Cloud. <https://www.wekeo.eu/>

26. In recommending ground instruments, which products are recommended as reliable and cheap for measuring Air quality to validate satellite data

- a. Suggest bringing the question to Priscilla Adong - She will talk later on.

27. Hi thank you for your different presentations. Are there mechanisms at the EU or UMETSAT or Copernicus level to support ground-based measurement in Africa? Who can we contact to hear more about it?

- a. Hi, EUMESAT and Copernicus (ECMWF) generally don't support ground based measurement, but for calibration / verification. The EU run some capacity building programme which could consider ground based measurement. WMO is also supporting ground based measurement (networking, etc.)

28. Quelles sont les particules fines les plus dangereuses et qui dégradent le plus la qualité de l'air dans l'atmosphère. Question pour monsieur Vincent-Henri.

- a. Brièvement, il y a deux aspects principaux: la taille des particules et la nature chimique des particules. Sans rentrer trop dans le detail, plus les particules sont fines, plus leur impact sur la santé est potentiellement important. Sur la dimension chimique, il y a beaucoup de travaux en cours chez les epidemiologistes pour determiner les effets sanitaires particuliers des poussières Sahariennes, des particules de combustion, etc...

29. Vincent je voudrai savoir s'il ya des opportunités de partenariat du programme CAMS avec les services météo de l'Afrique. Au Niger, nous sommes confrontés à ce phénomène de pollution malheureusement nous n'avons pas de station de mesure

- a. Bonjour Nafissa, nous vous recommandons de contacter CAMS directement pour les possibilite de cooperation. Mais le mieux et de commencer a vous familiariser avec les

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donnees et produits de CAMS, qui sont disponible pour le Niger. how real is the observed satellite data from the forecasted data for all air quality parameters

30. How real is the observed satellite data from the forecasted data for all air quality parameters

- a. Observations are "real" - but are representative of a limited part of the atmosphere, The presentation from Ranjeet (now) is showing the importance of validation of the forecast models - satellite are crucial for this ... Together with ground-based data

31. M. Federico, je voudrais savoir si avec l'avenement de MTG, il y'aura une revolution en terme de produits satellitaires relatif au suivi de la qualité de l'air.

- a. Bonjour, la capabilite d'observer en orbite geostationnaire est tres important pour un suivi continu. Mais le grand pas sera aussi avec la disponibilite de different instruments sur differentes satellites ... cela pourra fournir une couverture plus dense dans espace temps et typologie de polluant

32. How can we download reanalyse data from CAMs for air quality?

- a. From here: <https://ads.atmosphere.copernicus.eu/cdsapp#!/dataset/cams-global-reanalysis-eac4?tab=overview> or here (already calculated monthly averages): <https://ads.atmosphere.copernicus.eu/cdsapp#!/dataset/cams-global-reanalysis-eac4-monthly?tab=overview>

33. Stp pouvons nous avoir les scripts python qui permettent de tracer les différentes cartes sur la qualité de l'air?

- a. Surement - Julia Wagemann va presenter cela cet apres-midi ... il y a des outils qui sont fournis par EUMETSAT et ECMWF ici <https://catalog.trainhub.eumetsat.int/>

34. In Using the Copernicus data from windy.com, I discovered the unit of CO is in ppbv while WHO standard threshold is in mg/m3. How do we convert ppbv to mg/m3. Is it true that 1ppbv=1mg/m3 or 1ppbv=1/1000ppm =1.15mg/m3 ?

- a. yes, the "native" parameter is ppbv (part per billion in volume). The conversion to mass concentration is: 1 ppb = 1.15 microg/m3.

35. Thanks for the presentation. Please, do we have data covering the African continent?

- a. Les produits CAMS sont accessible via les interfaces mentionnées ici: <https://atmosphere.copernicus.eu/data>
- b. Le Cloud WEKEO offre aussi un acces à ces données, avec des capacités de calcul pour faire des opérations sur les donnée via Cloud. <https://www.wekeo.eu/>

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- 36. We already have an operational air quality monitoring and prediction in NiMet Nigeria using CAMS data, how can we access long term data for comparison with current data and obtain capacity building for our personel from CAMS**
- Excellent. Maybe we can discuss offline? my contact is Vincent-Henri.Peuch@ecmwf.int
- 37. How can we scale down modelling locally to enhance better output on modelling? also can we configure local models for both forecast and validation**
- The CAMS outputs have a horizontal resolution of 40km x 40km, so there is indeed scope for downscaling if the interest is for a specific region or city. Different types of models can be used, from simple statistical approaches (which work very well if there are some surface observations available in the area of interest) to mesoscale limited area models that will use CAMS data for boundary conditions (so that the plumes of dust, pollution, smoke that come from outside the domain of interest are covered) and will refine forecasts thanks to e.g. local information on emissions.
- 38. Can the nuclear pollution is detected by satellite?**
- To my knowledge, no. Detection of radioactivity is based on ground measurements.
- 39. My question is to the first presenter. In the nearest future, is there a possibility that the impact of air pollution on other environmental media will be considered?**
- Hi Elizabeth. I will answer privately so it doesn't get marked as answered (I worry AUC will miss it). The Assessment does look at ozone impacts on crop yield in addition to human health.
- 40. Comment faire pour avoir les données fiables ? il faut utiliser les capteurs ? soit les données du programme CAMS ? Question pour Mr Vincent Henri**
- Les donness les plus fiables sont celle dites " de reference" tel que presente par Madame Khomsi
- 41. Est ce que avec la station mesa nous pouvons observe les particules fines dans l'atmosphère**
- A priori non, mais avec la ClimSA station oui : des données de Qualité de l'Air et aussi des données de poussière du CAMS seront accessibles
 - pour le compte de la DGM gabon nous avons pas cette station comment faire pour que notre direction puisse avoir sa merci beaucoup
 - si non, avec quelle station c'est possible de faire une observation
 - surtout pour le compte de la forêt de l'afrique centrale on doit normalement avoir sa pour la surveillance de la polution de l'air.

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42. Rebecca, How did you develop the emission inventory, did you use satellite data or data from sources. Did you develop your own emission factors? If not, which factors work best for Africa?

- a. Hi Paul. Local emission factors are very limited. This is a key gap that needs focus. We use if we have them, but we often do not have them. For the emission inventories I showed, we did not use satellites directly for emissions. We used local information as we could (e.g. local information on road networks, traffic counts, number of households using domestic fuels, etc). We do have a project now with @Terrence in this call to use satellites to estimate emissions. We want to see how the different approaches compare. Please do contact me for any specific questions. Mogesh Naidoo at CSIR is the expert and part of GEIA African Working group.

43. SHALL WE HAVE ACCESS TO THESE PRESENTATIONS AFTER THE MEETING?

- a. Yes. All presentation will be available here for download, after the Webinar: <https://www.eumetsat.int/webinar-air-quality-monitoring-africa>.

44. Mr Vincent, les données CAMS nous déterminera l'ensemble des mesures et conditions pour l'analyse de la qualité de l'air en Afrique ?

- a. Pas directment. elles y contribuent, mais il est necessaire d' avoir des references au sol.

45. S. Tome dans les mois de janvier, nous sommes frappés par la poussière venant d'Afrique du Nord. pourra-t-on observer ces particules et prédire leur intensité de pollution de l'air et même dans le cas d'une baisse importante de la visibilité dans l'atmosphère avec la table station ? Cette question s'adresse à vous pour Vincent-Henri.

- a. Oui. CAMS fournit des previsions de poussieres pour Sao Tome. Il est possible que le centre regional WMO de Barcelone fournisse egalement ces informations (limite a afrique de l' ouest).

46. Pourrions-nous avoir des tutoriels permettant la manière de télécharger les images par Copernicus CAMS? Mr. Vincent-Henri PEUCH à vous

- a. Je vous suggère de rechercher dans la section support du Atmospheric data store: <https://ads.atmosphere.copernicus.eu/cdsapp#!/usersupport>

47. Comment pouvons nous tellement mesurer la qualité de l'air quand même nos gouvernements peinent à déployer les outils de mesure de la qualité de l'air. Les solutions satellites sont envisageables mais combien arriveront? Certaines organisations de la société civile emboîtent le pas mais les moyens techniques et financiers font barrières, certaines organisations développement des outils mais beaucoup restent encore à faire

- a. Merci pour votre remarques. Beaucoup reste a faire, effectivement.

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- 48. Comment telecharger les parametres de qualité de l'air données de series chronologique au format csv..?**
- Il y aura une session cet apres-midi - les donnees sont en general en format ncdf - toutefois il est possible d'utiliser des outils de conversion et d'extraction (par exemple en python).
- 49. Thank you to organizers and Presenters of this webinar**
- 50. "Avec copernicus nous aurons encore besoin des capteurs sur terrain ? Ou bien nous aurons déjà les informations sur la qualité de l'air en Afrique avec copernicus. Nous savons bien que pour la surveillance atmosphérique nous pouvons utiliser les capteurs. Bref explication sur les capteurs et données CAMS. A Mr Vincent"**
- Bonjour. Oui, des capteurs de reference sont necessaires pour completer les donnees satellitaires.
- 51. I work with Nigerian Meteorological Agency Air quality monitoring unit, we basically use CAMS forecast for our local forecast, but we are thinking if we can configure our local model using CAMS initial boudary conditions data for modeling and forecasting, also hands-on traning on modelling will also be required for better output, how can we achieve all this through collaboration?**
- Hi, you are welcome to contact CAMS for further cooperation. the Barcelona Regional Dust Centre.
- 52. Les données sentinel 5P nous fournira quel type d'image en Afrique ?**
- Aerosol Index, NO₂, CO, O₃, SO₂, HCHO, CH₄, cloud optical depth, cloud top height, cloud fraction, cloud base height... I have found sentinel 5P very important ... sauf qu' il mesure seulement juste 1 fois par journée
- 53. Hi how to calibrate your sensors?**
- Yes we do, we using machine learning. Here is a paper with detailed information. <https://onlinelibrary.wiley.com/doi/epdf/10.1002/ail2.76>
- 54. Can you show us how to download CAMS data, and how to visualise these data using carthopy or basemap for example?**
- This was presented by Julia and Vincent-Henri. Please refer to their presentations.
- 55. Hello Adong, Thanks for the good presentation. I wish to find out about accuracy of your system plus how can we partner in order to learn from your experinces**
- Hello Paul, please send me an email: priscilla@airqo.net cc. baino@airqo.net and dokure@airqo.net

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**56. Comment nous pouvons avoir les données en Afrique central ?**

- a. En suivant les liens fournis dans la présentation de Julia. Merci pour votre participation.

57. Thank you for the presentation. Please, the last time I checked the Copernicus data, no data was available for Africa. Please, are there data available for Africa now?

- a. A lot of Copernicus data are available for Africa. See this link, or Julia's presentation.

<https://www.copernicus.eu/en/access-data>

58. pourriez vous nous nommer les appareils de mesures in situ de la concentration de l'air en ces polluants ? ainsi que quelques fabricants ? si possible nous indiquer comment faire pour entrer en possession de ces appareils chez nous. Merci

- a. Hello Issa, We use custom made AirQo lowcost monitors that measure PM2.5 and PM10. For gaseous pollutants, we use satellite data Link to our website: airqo.net My email: priscilla@airqo.net

59. comment avoir les données CAMS de la qualité de l'air de l'Afrique central

- a. Merci de suivre les liens indiqués dans la présentation de Julia.

60. This is a question from all speakers. Regarding the comparison of satellite recording with ground-based measurements, do we allow to compare columnar recording with ground-based in situ measurements ? for example TROPOMI with in situ ! and for this special case, is there any satellite or combination of different satellite to retrieve vertical structure of gaseous species in the atmosphere.?

- a. Yes, it is possible. I am working on it. I compared the data of the total NO2 and SO2 column of TROPOMI with those of Pandora solar photometer.

61. Jusque là pas d'intervention pour l'Afrique Central. Est-ce que nous aurons l'exposé de l'Afrique Central ? A Eumetsat

- a. Bonjour, comme indiqué par Federico, ce séminaire sert aussi à mieux connaître les actions en cours en Afrique dans ce domaine. Lors du 14e Forum des usagers d'EUM en Afrique, un représentant de votre région est intervenu dans une session dédiée à la Qualité de l'Air. Dans tous les cas n'hésitez pas à témoigner de vos activités dans ce domaine.

62. We have difficulty in accessing the eumetsat data from January this year until date. Who do we go about that? thanks.

- a. Dear Malami, the best is to contact our EUMETSAT Help Desk and raise question directly to them. email: ops@eumetsat.int Thanks

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63. I found that Sentinel 5P cannot measure CH₄ (methane) in Equatorial region including my country Rwanda. I saw a paper reporting that it is because equatorial region is often cloudy. Please do you plan to adjust the Tropomi sensor so that it can measure CH₄ in cloudy events?

- a. Hi Didier, it is not easy ... methane can be observed in the infrared domain - here clouds dominate the signal - there is also a spectral region in the short waves but here there is a big overlap with water vapour and then doesn't solve the issue ...
- b. Thanks Federico. So please what will be the solution for that sensor's limitation?

64. I wish the visiting time could be more than 1 time! We could have more information of air quality if we could have more data than only 1 data per day

- a. Sure - one good approach is to make use of different satellites that observe at different times - it is quite complex but feasible ...

65. Les données de CH₄ (méthane) en Afrique équatoriale manquent à cause de beaucoup de nuages! Il y a un plan de fixer ce problème

- a. Hi Didier, it is not easy ... methane can be observed in the infrared domain - here clouds dominate the signal - there is also a spectral region in the short waves but here there is a big overlap with water vapor and then doesn't solve the issue ...

66. l'orthographe des fabricants, des noms cités,

- a. Bonjour Issa, il serait souhaitable que vous donniez un peu plus de précision. Que voulez-vous mesurer? Et pour quelle application ou quel service? Merci
- b. il ya par exemple Les capteurs clarity nodes qui le No₂ et les pm_{2.5} et les capteurs low cost purpleair qui mesurent pm₁₀ pm_{2.5} et pm₁

67. Even though it is not in the line with today's theme, please could you next time prepare a workshop on weather forecasting using MSG satellites ... I wish to use the new MTG satellites data that will be launched ...

- a. Dear Didier, we ran a webinar on MTG for Africa. You can see the link here:
- b. <https://www.eumetsat.int/webinar-meteosat-third-generation-africa>
- c. there was also a webinar on Nowcasting in Africa, which refer a lot to MTG:
- d. <https://www.eumetsat.int/webinar-nowcasting-africa>
- e. MTG was also the focus of the last two EUMETSAT User Forum in Africa, in 2021 (on-line) and 2022 (in Dar es Saalam).
- f. See: https://www-cdn.eumetsat.int/files/2022-07/UFA14_Report_EN.pdf the report of the 15th Forum will be available soon.

68. @Federico, Are the Sentinel 7 CO₂ data already available? If yes what will be the revisit time and what is its spatial resolution?

- a. Hi Didier - We hope to have data ready in 2027 ... spatial resolution few km revisit time as for Sentinel-5P ... daily

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- b. Not easy in fact - one method is to use co-emissions like NO₂ - and check where you have enhancement in both species - moreover CO₂ is assimilated in a service similar to CAMS to identify emissions -
<https://www.sciencedirect.com/science/article/pii/S2590162121000101>

69. Have you also use WRF-Chem model? If yes are there some agreements with Sentinel 5P and WRF-Chem model?

- a. As far as we know, there is no agreement. But Sentinel 5P data are freely available and can be use by WRF_Chem. There is also numerous scientific publication on model comparison with satellite observation. Tools in the ESA Atmospheric toolbox to process Sentinel 5P and use it with the model.