# Session 1: Questions & Answers

Please type your questions in the Question Box. We will try our best to answer all of your questions. If we don't, feel free to email Vivienne Payne Payne, (vivienne.h.payne@jpl.nasa.gov), Junjie Liu (junjie.liu@jpl.nasa.gov), Karen Yuen (karen.yuen@jpl.nasa.gov), David Moroni (david.f.moroni@jpl.nasa.gov), Abhishek Chatterjee (abhishek.chatterjee@jpl.nasa.gov) or Erika Podest (erika.podest@jpl.nasa.gov)

**Question 1: Does anyone have an estimate for massive scaling of kelp farms as sinks?**
Answer 1: A 2016 paper published in Nature Geoscience estimated that seaweed may naturally sequester nearly 175 million tons of carbon per year from the atmosphere. The burning of fossil fuels releases something like 6,000 to 8,000 million tons of carbon per year into the atmosphere. We expect around half of that to be removed by natural sinks (without additional carbon capture efforts). This would suggest that seaweed accounts for something like 2-3% of natural uptake of carbon, which gives some sense of how massive the scaling would have to be.

**Question 2: What happens when we assume dry air for VMR measurements?**
Answer 2: The variations in atmospheric $CO_2$ are small relative to the background. Therefore, it is particularly important to be clear about definitions. Sometimes, you may see trace gas volume mixing ratios defined relative to total air. We report our measurements as volume mixing ratio relative to dry air. This way, the numbers are not impacted by variations in atmospheric moisture (which can vary widely with location and season).

**Question 3: Can we open the OCO-2/3 (XCO) files with Panoply and export them in a format that is compatible with GEE? Has this method been changed in any other way, with direct data repo?**
Answer 3: The files are available from the DAAC as NetCDF files and can be opened with Panoply. You will have to do a file conversion from NetCDF to GeoTIFF if you want to use it within Google Earth Engine. The swaths are also narrow, which is something to keep in mind. We will cover this further in sessions 2 & 3. In the 2nd demo in session 2, David Moroni demonstrates a .png export, which is a supported raster file format in

ArcGIS (please note: GEE and GIS are not within the scope of this training, so we have not tested our output files directly with GEE or GIS software). Here is ESRI's list of supported raster file formats:
https://pro.arcgis.com/en/pro-app/latest/help/data/imagery/supported-raster-dataset-file-formats.htm

**Question 4: The X$CO_2$ data consists of individual data points that can be downloaded in the NC (NetCDF) format. Will this training cover the process of exporting data in raster format? Panoply just visualizes data and displays the coordinates of the data. However, the area is not completely covered.**
Answer 4: The OCO-2 and OCO-3 data do not completely cover the whole planet. As discussed in the training, there are large gaps between the 10 km-wide swaths in the Level-2 data products. This is the nature of the measurements from these particular instruments. Level-3 gridded data products can provide gap-filling, but there is always some assumption needed about how to fill the gaps. This training does not focus on GIS-approved raster formats. However, we will be addressing this in a future training.

**Question 5: Are the OCO-2 and OCO-3 X$CO_2$ data paired with GPS moisture data?**
Answer 5: The OCO-2 and OCO-3 data are not paired with GPS moisture data, although there are water vapor total column values supplied as part of the Level-2 data product. OCO-2 and OCO-3 are also sensitive to variations in total column water vapor via water lines in the spectral range of the instruments.

**Question 6: Why are OCO-3 data in the EarthData platform only available until November 2023? Is it possible to get 2024 OCO-3 data?**
Answer 6: The OCO-3 instrument was installed on the International Space Station (ISS) in May 2019. The ISS has a limited number of slots/locations for science instruments. In November 2023, the OCO-3 instrument was put into storage for a few months in order to allow another instrument to use that slot to complete its mission. We are happy to report that on July 4th, 2024, OCO-3 was re-installed. There were no measurements taken between November 2023 and this re-installation. We are currently performing an in-orbit checkout to make sure that everything is working properly again. OCO-3 measurements will be available again within 90 days.

**Question 7: Is developing a TCCON project something that can be done by a university? Do you have an idea about its wavelength coverage, and how much the instrument costs?**
Answer 7: Many of the TCCON sites are run by universities. The TCCON spectrometers are Bruker 125HR instruments (estimated cost of around $500,000 USD). The minimum spectral range is 4,000-9,000 cm-1, although many of the sites have instruments with coverage that extends to a lower wavenumber. There are stringent requirements for participation in the TCCON network. See: https://tccon-wiki.caltech.edu/Main/TCCONRequirements.
There is also a range of smaller, more portable, less expensive spectrometers that are increasingly being used for ground-based remote sensing of greenhouse gasses. Examples include the Bruker EM27/SUN instruments and the Bruker Vertex70. Certain areas of the world are covered better than others, such as North America and Europe, and areas such as the tropics are less so.

**Question 8: Why does AIRS have the peak at 6 km/500 hPa? What physics do we see here?**
Answer 8: Thermal infrared sounding of the atmosphere relies on variation in the temperature profile. The thermal infrared remote sensing of CO2 relies on a sufficiently strong temperature lapse rate and a sufficiently strong contrast between the temperature of the surface and the temperature at altitude. Therefore, thermal IR spaceborne measurements are not sensitive to variations in CO2 in the lowermost atmosphere.

**Question 9: What is the accuracy of measurements in comparison to TES $CO_2$ measurements?**
Answer 9: TES $CO_2$ are thermal infrared measurements and are sensitive to variations in CO2 in the upper troposphere (see above), while OCO-2 and OCO-3 measure in the shortwave infrared and are sensitive to variations in CO2 throughout the atmospheric column. The predicted error on TES 500 hPa CO2 for a monthly average in a 15 by 15 degree latitude/longitude box (around 80 TES soundings) is 2.2 ppmv (see Kulawik et al., 2010 - https://acp.copernicus.org/articles/10/5601/2010/acp-10-5601-2010.pdf). The estimated error on OCO-2 XCO2 for a single sounding is 0.8 ppmv (see Taylor et al., 2023 - https://amt.copernicus.org/articles/16/3173/2023/amt-16-3173-2023.pdf).

**Question 10: Is "the column" measurement a 3-D volume or is it a 1 [or 2] D "length?" In either case, how do you get from a measurement to a concentration: m / L**3?**

Answer 10: In practice, the instrument views a 3D chunk of the atmosphere, but conceptually, let's think of it as a 2D pencil beam. The column average volume mixing ratio is the pressure-weighted vertical average of the CO2 volume mixing ratio.
The instrument measures a radiance spectrum. We apply an algorithm to iteratively fit the CO2 profile (plus temperature, water vapor, aerosol and surface parameters). We then calculate a column average XCO2 value from the fitted CO2 profile. Further details of the algorithm that is applied to OCO-2 and OCO-3 radiances can be found in O'Dell et al. (2018) - https://amt.copernicus.org/articles/11/6539/2018/amt-11-6539-2018.pdf.
Further details on how to calculate and apply the pressure weighting to calculate the column average XCO2 value from a profile of CO2 volume mixing ratio can be found in Connor et al. (2008) - https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2006JD008336

**Question 11: Are the product files publicly accessible?**

Answer 11: Yes, they are! There are links to the locations of these data products in the presentation. You may also reference the Jupyter notebooks (top markdown cell) for direct links to the publicly accessible data products that are utilized in the Jupyter notebook portions of the training. Here's the github repository to retrieve those notebooks: https://github.com/NASAARSET/ARSET_CO2_Measurements_Climate

**Question 12: How can we access $CO_2$ plume data for specific regions?**

Answer 12: OCO-3 snapshot area map (SAM) observations are great if your interests lie in plumes. More information on the available SAMs can be found here: https://ocov3.jpl.nasa.gov/sams/.

**Question 13: If the gaps are 10 km, what does it mean that the spatial resolution is 1.29–2.25km?**

Answer 13: Across the swath (the swath being 10 km), there are 8 footprints.

**Question 14: How long are OCO-2 and OCO-3 expected to last?**
Answer 14: Both instruments are in excellent health. Since OCO-3 is on the ISS, it is cleared to operate on the ISS until the end of the decade. OCO-2 could potentially go on for longer.

**Question 15: Is there an agreed-upon model for the Paris Accord?**
Answer 15: The UNFCCC has a framework for each country to do emissions reporting. As part of the Accord, there are carbon stocktakes that are reported in order to further meet the agreed upon climate goals. There are more details on this presented in session 3 of this webinar series.

**Question 16: Can these products be used to report the NDC commitment of countries? Is the efficiency of these products reliable enough to inform emission values that are being reported for countries?**
Answer 16: OCO-2 measurements have been used, together with ground-based in situ measurements, to estimate country-level carbon emissions and removals as part of the Global Stocktake under the Paris Agreement. For more on this study, see here: https://www.jpl.nasa.gov/news/nasa-space-mission-takes-stock-of-carbon-dioxide-emissions-by-countries

**Question 17: OCO-2 and OCO-3 were shown to be in agreement within 0.5 ppm. How well do OCO and GOSAT measurements agree with one another? With TCCON?**
Answer 17: There have been studies that have compared OCO and GOSAT measurements against each other and with TCCON. A few select studies are mentioned here and we refer the reader to look at other references that may be mentioned in these studies -

1. Liang, A.; Gong, W.; Han, G.; Xiang, C. Comparison of Satellite-Observed $XCO_2$ from GOSAT, OCO-2, and Ground-Based TCCON. *Remote Sens.* 2017, *9*, 1033. https://doi.org/10.3390/rs9101033
2. Chen Y, Cheng J, Song X, Liu S, Sun Y, Yu D, Fang S. Global-Scale Evaluation of $XCO_2$ Products from GOSAT, OCO-2 and CarbonTracker Using Direct Comparison and Triple Collocation Method. *Remote Sensing*. 2022; 14(22):5635. https://doi.org/10.3390/rs14225635

3. Yang, H., Li, T., Wu, J., & Zhang, L. (2023). Inter-comparison and evaluation of global satellite XCO2 products. *Geo-Spatial Information Science*, 1–14. https://doi.org/10.1080/10095020.2023.2252017
4. Taylor, T. E., O'Dell, C. W., Baker, D., Bruegge, C., Chang, A., Chapsky, L., Chatterjee, A., Cheng, C., Chevallier, F., Crisp, D., Dang, L., Drouin, B., Eldering, A., Feng, L., Fisher, B., Fu, D., Gunson, M., Haemmerle, V., Keller, G. R., Kiel, M., Kuai, L., Kurosu, T., Lambert, A., Laughner, J., Lee, R., Liu, J., Mandrake, L., Marchetti, Y., McGarragh, G., Merrelli, A., Nelson, R. R., Osterman, G., Oyafuso, F., Palmer, P. I., Payne, V. H., Rosenberg, R., Somkuti, P., Spiers, G., To, C., Weir, B., Wennberg, P. O., Yu, S., and Zong, J.: Evaluating the consistency between OCO-2 and OCO-3 XCO2 estimates derived from the NASA ACOS version 10 retrieval algorithm, Atmos. Meas. Tech., 16, 3173–3209, https://doi.org/10.5194/amt-16-3173-2023, 2023.

It is important to remember though that depending on when a study was conducted, different data versions of GOSAT or OCO-2 or OCO-3 could have been used. As mentioned during the webinar, the data versions are continually being improved. Hence results that have been published in 2023 with newer data versions may look very different from results published in 2017 with older data versions.

**Question 18: At the policy level, we usually analyze emissions from all anthropogenic sources, including methane. In this case, do OCO-2 or OCO-3 have capabilities to collect methane and other ozone depleting data? If not, can you recommend how to fill this data gap?**
Answer 18: OCO-2 and OCO-3 are targeted specifically at carbon dioxide and are not sensitive to methane, ozone or ozone-depleting substances. TROPOMI does measure atmospheric methane with global coverage and has been used extensively to quantify methane emissions.

**Question 19: How can we ensure that the data from these missions is accessible and usable for researchers in developing countries?**
Answer 19: The data is publicly accessible through the GES-DISC, https://disc.gsfc.nasa.gov/datasets?keywords=oco&page=1.
You can choose between OCO-2 and OCO-3 and the different data products available.

**Question 20: Will the homework include the analysis of data and graphs?**

Answer 20: The homework will include questions from each session and the demonstrations in future sessions.

**Question 21: What are the main sources of uncertainty in $XCO_2$ measurements from OCO-2 and OCO-3, and how are these uncertainties quantified and minimized?**

Answer 21: One of the big sources of uncertainty from these instruments are aerosols. We can screen out soundings with optically thick aerosols, but cannot mask out all aerosol influence. Characterization of the surface is also a source of uncertainty in the XCO2 products. We can attempt to characterize these uncertainties using comparisons to TCCON measurements. Since the TCCON spectrometers take direct solar measurements (rather than reflected solar like OCO-2 and OCO-3), the scattering from aerosols is much less of an issue. Since the TCCON spectrometers are ground-level instruments pointing up, surface characterization is not an issue.

Another significant outstanding source of uncertainty is the modeling of molecular absorption for CO2 and O2. The accuracy requirement on the spaceborne XCO2 measurement presents a challenge to our current understanding of the fundamental spectroscopy (modeling of molecular line shapes).There are efforts underway from lab studies from the spectroscopy point of view.

**Question 22: What is the margin of error of the measurements?**

Answer 22: The requirement for accuracy and precision is 1 ppm, but we have met and exceeded that requirement.

**Question 23: Are there any plans to make the data available in Google Earth Engine (GEE)?**

Answer 23: Not right now due to formatting issues.

**Question 24: It was mentioned that OCO-3 has a snapshot mode that focuses on an 80x80 km region for a brief time. How are these target locations tasked? Is there a fixed schedule or is tasking dynamic allowing response to current events (e.g., wildfires)?**

Answer 24: There is a schedule that is decided in advance due to how our mission operations work. Being that the instrument is on the ISS, control on our end is limited. Session 3 discusses all of this in more detail.

**Question 25: How do the temporal coverage and revisit frequency of OCO-2 and OCO-3 impact their ability to monitor seasonal and interannual variations in $CO_2$?**
Answer 25: OCO-2 has a 16-day repeat cycle, which is good for monitoring seasonal variations for latitudes where good coverage is obtained throughout the year. However, there can be sampling challenges due to seasonal variation in cloud cover in some locations. Since the measurement relies on reflected sunlight, there are also challenges at high latitudes due to winter measurements being limited.
The seasonal coverage for OCO-3 is variable and cannot be predicted far in advance, which presents challenges in monitoring seasonal variations. However, OCO-3 has advantages in other areas such as looking at changes during different times of the day.

**Question 26: How can we convert the volume mixing ratio like ppmv at different layers to column averaged vmr?**
Answer 26: See Appendix A in Connor et al. (2008): [https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2006JD008336](https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2006JD008336)

**Question 27: What are potential technological or methodological advancements for future satellite missions to overcome the current limitations of OCO-2 and OCO-3? Their applicability is a bit confusing for me.**
Answer 27: Spatial coverage (narrow swath) is one limitation of OCO-2 and OCO-3. This can be remedied by expanding the width of the swath in a future mission. JAXA is sending up GOSAT-GW, which will have a wider swath. ESA will be launching CO2M on 3 platforms, which will offer increased spatial coverage relative to OCO-2 and OCO-3.
Cloud cover is also a limitation, which can be problematic over areas such as the Amazon rainforest. Smaller spatial footprints could allow an instrument to view between clouds. OCO-2 already has small spatial footprints compared to GOSAT and the planned GOSAT-GW and CO2M missions.

**Question 28: Regarding the averaging kernel, is it necessary that the column averaging kernel should sum up to 1? I am using some products that don't add up to 1. What does this actually mean?**
Answer 28: The averaging kernel is the sensitivity of the remote sensing measurement to the true atmosphere at any given altitude. It shows us where the remotely sensed measurement is sensitive to variations in atmospheric CO2 and where it is not. There is no expectation that the column averaging kernel should add up to 1. On one of the

slides, we showed examples of column averaging kernels. There is one for an OCO type measurement where you can see that the function is relatively constant with altitude and it drops off at higher altitude. That means that the OCO-2 and OCO-3 measurements are sensitive to variations in CO2 throughout that altitude range. If there was a measurement that was equally sensitive to CO2 at all altitude ranges then that averaging kernel would be 1 all the way from the surface to the top of the atmosphere. In the other extreme, if there was a measurement that was only sensitive to say CO2 at 900 hectopascals then that averaging kernel would be a delta function with a peak at 900 hectopascals.

In reality with remote sensing measurements we always have something in between. The OCO averaging kernels are not equal to 1 everywhere from the surface to the top of the atmosphere but are somewhere approximate to that. On slide 25 there is also an averaging kernel for AIRS, which is a thermal infrared measurement. These measurements have sensitivity that peaks in the mid-troposphere. You can see that the averaging kernel drops off as you near the surface, which means that those measurements are not really sensitive to variations in CO2 near the surface. In that case you are seeing CO2 in the region where the averaging kernel has the higher values.

For in-depth explanation of averaging kernels, see Rodgers, 2000, Inverse Methods for Atmospheric Sounding. Theory and Practice, World Scientific, https://doi.org/10.1142/3171

**Question 29: Does biochar have a substantial potential for mitigating $CO_2$ emissions?**

Answer 29: This question is somewhat outside the scope of this training team, but there is considerable interest in biochar as a means for soil carbon sequestration. This special report from the Intergovernmental Panel on Climate Change does suggest that biochar offers potential for carbon sequestration: https://www.ipcc.ch/sr15/

**Question 30: Can OCO-3 data be used for forest fire-based emissions?**

Answer 30: Using OCO-3 for forest fire emissions can be done, but does require some care. Both OCO-2 and OCO-3 can be used to look at the large-scale impact of sustained fire events on atmospheric CO2. However, in fresh plumes, the aerosol loading is high and that interferes with the accuracy of the XCO2 measurement in those conditions.

In addition, see also answer to question 24. It is not currently possible for our OCO-3 mission operations team to shift the observation plan on short notice to observe rapidly-evolving events.

**Question 31: What is "Truth" Atmosphere?**
Answer 31: We rely on TCCON estimates of XCO2 as our “truth” and compare the OCO-2 and OCO-3 satellite measurements against those. The TCCON spectrometers view the full atmospheric column with extremely high spectral resolution and are carefully calibrated. However, as with any measurement, there is also some uncertainty in the TCCON XCO2 estimates. Estimated uncertainty in the TCCON XCO2 is of the order of 0.4 ppm. The TCCON sites are also only available for certain locations. The NOAA AirCore balloon-based profile measurements can be used to calculate XCO2 values that are accurate to 0.2 ppm, but those measurements are even more sparse.

**Question 32: How useful is the OCO-2 and OCO-3 column (most sensitive at the surface) data in subtropical regions with decoupled troposphere by stable layers? My previous study from TES $CO_2$ profile data showed that some regions may have higher $CO_2$ values (from transported air) at about 700-500 hpa altitude than at the surface.**
Answer 32: It is true that the interpretation of the measurements requires care. We will go into further detail in Session 2.

**Question 33: As the OCO-2 and OCO-3 data are comparable based on the publicly available data, has any city utilized this dataset for climate mitigation management? If any illustration exists it would be great to hear.**
Answer 33: A group at The World Bank used OCO data to measure the impact of transit construction for 192 cities. See Dasgupta et al. (2023) -
https://www.sciencedirect.com/science/article/pii/S0048969723023124?dgcid=author
Also an associated blog post:
https://blogs.worldbank.org/en/developmenttalk/subways-connect-people-opportunity-and-they-slash-carbon-emissions-half.
A number of cities across the US are currently working towards using OCO measurements.

**Question 34: In the case of solar radiation modification through stratospheric aerosol injection, is there any chance that we will need to modify the atmospheric**

**correction for most satellite sensors? How do you separate different chemical signatures coming from different altitudes?**
Answer 34: We changed the algorithm following a volcanic eruption event in the Southern hemisphere and accounted for events such as these that affect the stratosphere.

**Question 35: Which instrument do you prefer for inverse modeling of $CO_2$ fluxes: OCO-2 or OCO-3?**
Answer 35: It depends on your application. It is possible to use both together.

**Question 36: Who/which agency recognizes the results from your methods?**
Answer 36: NASA, NOAA, WMO, UNFCCC. Also, with the US Environmental Protection Agency, we tested the feasibility of OCO products.

**Question 37: What are the ranges of OCO-2 attitude in the atmosphere? Is it consistent worldwide, such as in flatlands and mountainous regions?**
Answer 37: The OCO-2 and OCO-3 instruments provide measurements of the column average CO2 volume mixing ratio. We account for variations in surface pressure when deriving the XCO2 values from the radiance spectra. Therefore, the XCO2 product is available over both flatlands and mountainous regions, although the characterization of surface pressure over mountainous regions is more challenging than over flatlands and some caution is required in use of products over mountainous terrain.

**Question 38: What is the plan to continue OCO-3 measurements after the ISS is decommissioned?**
Answer 38: While the OCO-2 and OCO-3 teams would love to see a follow-on mission, that will depend on NASA programmatic considerations and budgets. Both the OCO-2 and OCO-3 instruments remain in excellent health for now.

**Question 39: When producing spatially-uniform, gridded $XCO_2$ through averaging, how large a grid (in degrees) can be reliably constructed? Since the gap between two swaths seems to be very large compared to the swath width of 0.1 degrees (10km). Can a grid of 0.5x0.5 degrees be constructed with sufficient reliability?**
Answer 39: The answer will depend on the latitude range of interest and also the temporal scale that you are interested in. Here is a paper, based solely on measurement data, that may help you in thinking about this question:
https://www.tandfonline.com/doi/full/10.1080/20964471.2022.2033149

The OCO-2 GEOS Level 3 XCO2 daily and monthly products, available at the GES DISC, are supplied on a 0.5 by 0.625 degree grid, although these represent a model that assimilates the OCO-2 data (rather than solely using the OCO-2 data).
https://disc.gsfc.nasa.gov/datasets/OCO2_GEOS_L3CO2_DAY_10r/summary?keywords=oco-2%20geos%20l3
https://disc.gsfc.nasa.gov/datasets/OCO2_GEOS_L3CO2_MONTH_10r/summary?keywords=oco-2%20geos%20l3

**Question 40: Do we combine the OCO-2 data with methane data from other satellites before processing?**
Answer 40: No. We don't combine the OCO-2 data with methane data before processing.

**Question 41: How should we preserve the ozone layer depletion during this era of the 20th century given that our technology depends on $CO_2$ vehicles? How should we permanently prevent this in the upcoming years?**
Answer 41: The ozone layer shields us from harmful UV radiation. The depletion of the ozone layer was tied to the presence of chlorofluorocarbons in the stratosphere. Since the enactment of the Montreal Protocol, the levels of these chemicals have been decreasing, and long-term monitoring of the ozone layer indicates that this has been successful in terms of stopping the ozone depletion from getting worse.
CO2 presents a different problem. CO2 is a greenhouse gas. It traps heat in our atmosphere, meaning that increasing levels of CO2 in our atmosphere result in warming of our planet. In order to prevent that, countries around the world must either dramatically reduce CO2 emissions, or find ways to increase the uptake of CO2 from the atmosphere, or both.

**Question 42: In India, there is no TCCON site, right? In this case, is it reliable to use the $XCO_2$ data for finding regional hotspots here with no TCCON sites? How do I validate the data in this case?**
Answer 42: There is currently no TCCON site in India. There are efforts underway to work with teams making EM27/SUN and Vertex70 measurements in sites in India. Ideally, we would have greater coverage of reference validation measurements. However, that is not a reason to avoid using OCO-2 and OCO-3 data over India. The

data can be used in any region of the world. The agreement between OCO-2, OCO-3 and TCCON in regions where the ground-based measurements are available provides us with confidence that the satellite data can be used in regions where the ground-based data measurements are not available.

**Question 43: The "vertical column" assumes isotropy and homogeneity, right? So how far from reality is that? Can stratification be modeled?**
Answer 43: We know that there is vertical structure in the true atmospheric profile of CO2. Some example profiles over Sodankyla in Finland were shown in one of the slides. The OCO-2 and OCO-3 measurements are not able to resolve the vertical structure in the CO2 profiles, but are sensitive to the total number of molecules in the atmospheric column. We can see the impact of sources, such as urban areas, or sinks, such as uptake by plants on the total column average XCO2. We might see an impact of a layer of enhanced CO2 on the total column average XCO2, but the spaceborne measurement would not provide information about where that enhancement is vertically placed.

**Question 44: How do we access the data to use in Nigeria?**
Answer 44: As long as you have access to the internet, you can access the data here: https://disc.gsfc.nasa.gov/datasets/OCO2_L2_Lite_FP_11.1r/summary?keywords=OCO-2%20L2%20Lite