DUST TALES

The story of atmospheric dust and how it affects the Earth's climate.

Dust Tales

Dust Tales is an interactive Google slide deck that tells the story of atmospheric dust, including where the dustiest places on Earth are located, where dust comes from, how it moves around the Earth, how atmospheric dust has changed throughout Earth's history, what times of year are dustier than others, and how atmospheric dust affects Earth's climate. The story is told through a collection of data maps.

The interactive slide deck is designed to have app functionality, allowing visitors to navigate through the story independently or for a facilitator to guide navigation through the story alongside them. *Dust Tales* would work well on a touchscreen display, iPad/Tablet stand, or a laptop cart within an exhibit space.

Dust Tales is best for individuals or small groups and can take between 5-10 minutes to complete, depending on the level of engagement.

Required Materials

- *Dust Tales* Google slidedeck
- iPad/Tablet or laptop

Instructions for Setup

- Make a copy of the *Dust Tales* interactive slide deck for your use.
    - Save your copy of the *Dust Tales* interactive slide deck wherever you keep your educational content. You can edit your copy if desired.
- Set up a tablet, laptop, or touchscreen device to display the *Dust Tales* interactive slide deck.

Instructions for Facilitation

Below are key points for interpretation of the maps and prompts to engage your audience as they explore the interactive slide deck. However, visitors may prefer to explore independently, and the slide deck is set up to work well even without facilitation.

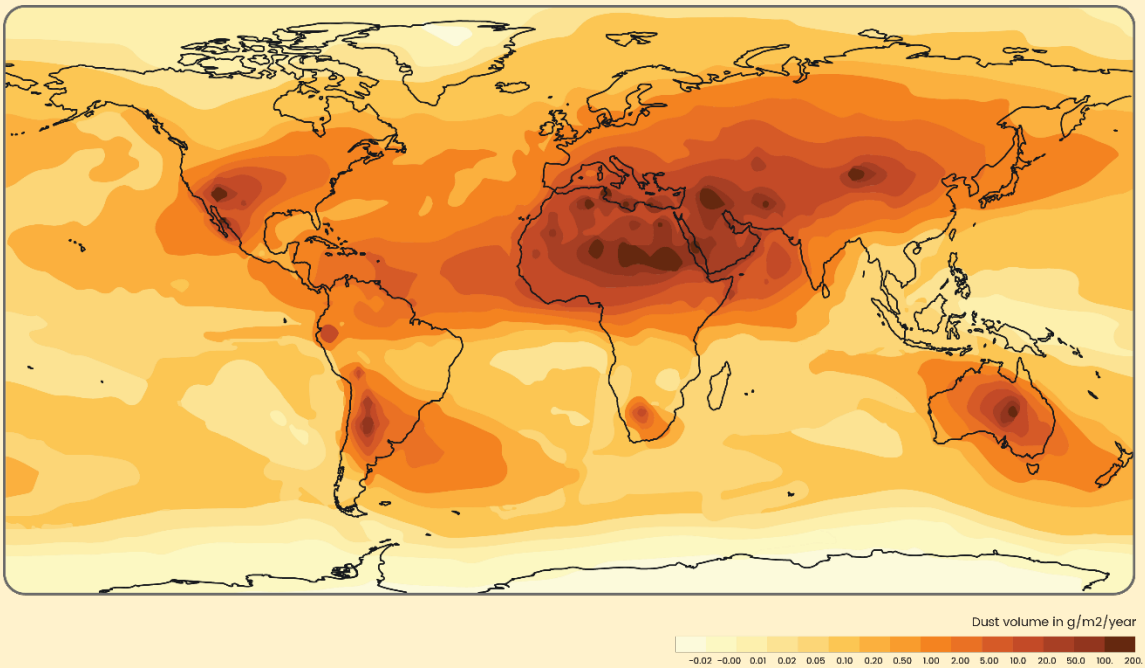
- **Invite visitors to learn about the story of atmospheric dust through the interactive slide deck.**
    - *"The Earth is a dusty place! There is enough dust to affect things like the weather and the climate, and living things, too!*

- Note: You might want to distinguish between dust that is created in the Earth system and household dust - we're not talking about dust bunnies from under the bed! This dust comes from the erosion of rock materials.

- **What's the Deal with Dust?** *(dust deposition in current climate conditions map)* Focus on noticing the distribution of dust on Earth through the following question prompts:
  - *What do you notice about dust? Are there patterns in where the dust is?*
  - *Which parts of the world are the dustiest? Which parts are the least dusty? Why might this be?*
  - *Find your location on this map. How dusty is it at your location? Compare where you are to other places on the Earth.*
  - *Is there more dust in the ocean or on the land? Which parts of the ocean seem to have more dust than others?*

Dust Deposition in Current Climate Conditions

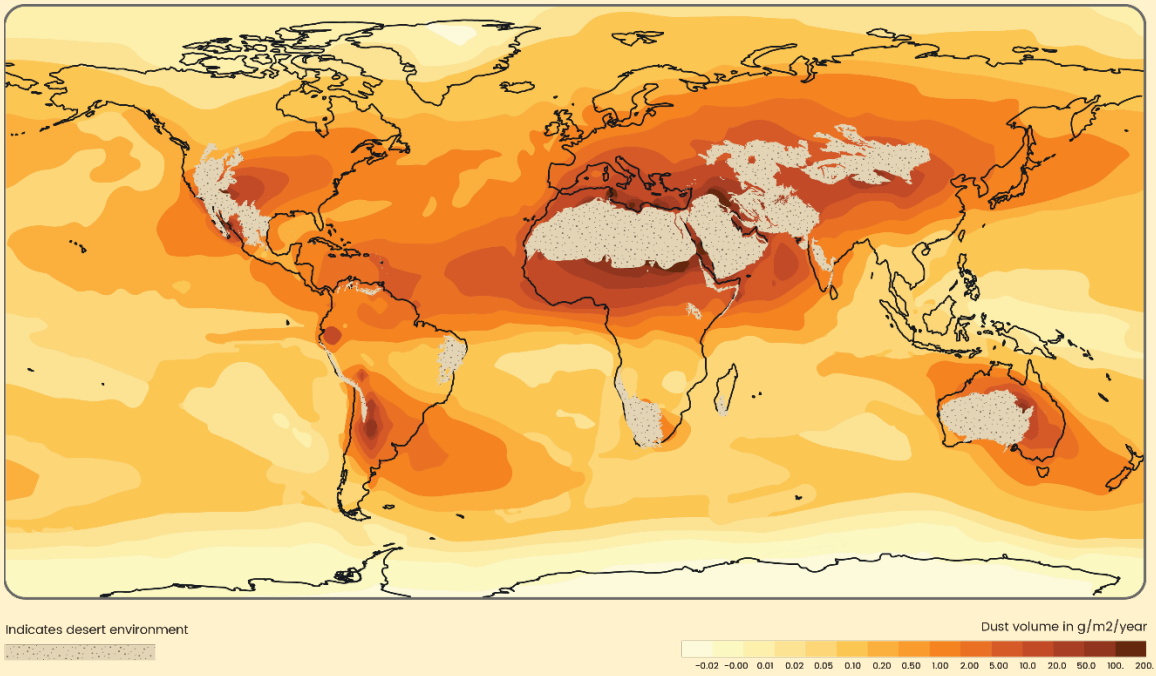
The map below shows where the dust is deposited (area) and the amount of dust deposited in different areas (volume). Warmer colors mean more dust. There appears to be more dust in the tropics and mid-latitudes than in the polar regions. While the dustiest places are over the continents, high volumes of dust are deposited in the ocean. Places with higher amounts of dust in the ocean are adjacent to the places on land with the most dust. For example, North Africa appears to have the most dust, and the Atlantic Ocean also has high amounts of dust.



- **Where does dust come from?** *(deserts of the world map)*
  Focus on the dust source regions of the world, the deserts, with the question prompts:
  - *Where does dust come from?*
  - *What connections do you see between the deserts and the dusty places on Earth?*
  - *Which dust source region is closest to where you live? How might dust from this place affect you?*

Deserts of the World

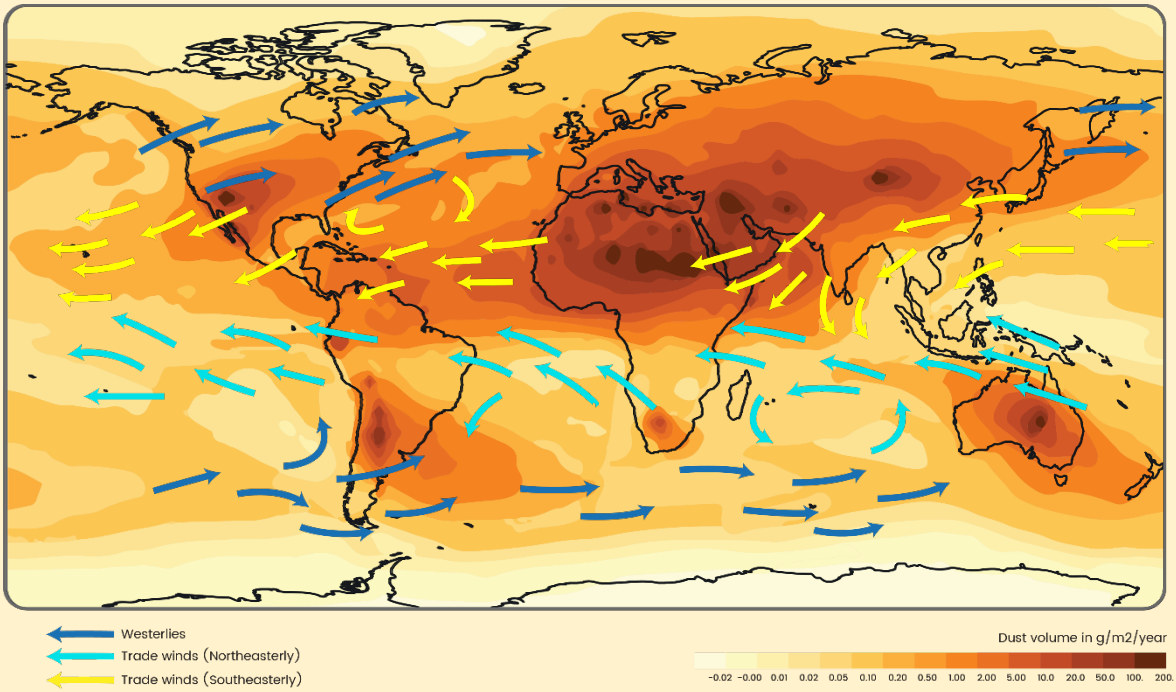
Dust comes from desert areas with arid, windy climates. The areas with the highest dust deposition correlate with the locations of Earth's major deserts. The Sahara Desert is the largest dust source region on Earth. Dust from the Sahara causes massive summer dust storms over North Africa and can impact air quality in the Caribbean and US.



- **What moves the dust around?** *(wind patterns map)*
  Now focus on how dust is carried from the source regions to where it is deposited. Use the following prompts:
  - *How does the dust get from the deserts to the ocean?"*
  - *Choose a desert on the map and follow the arrows to find out where dust from there might end up.*
  - *Where does the dust that ends up in North America come from?*
  - *Where does the dust that ends up in the Pacific Ocean come from?*

Wind Patterns

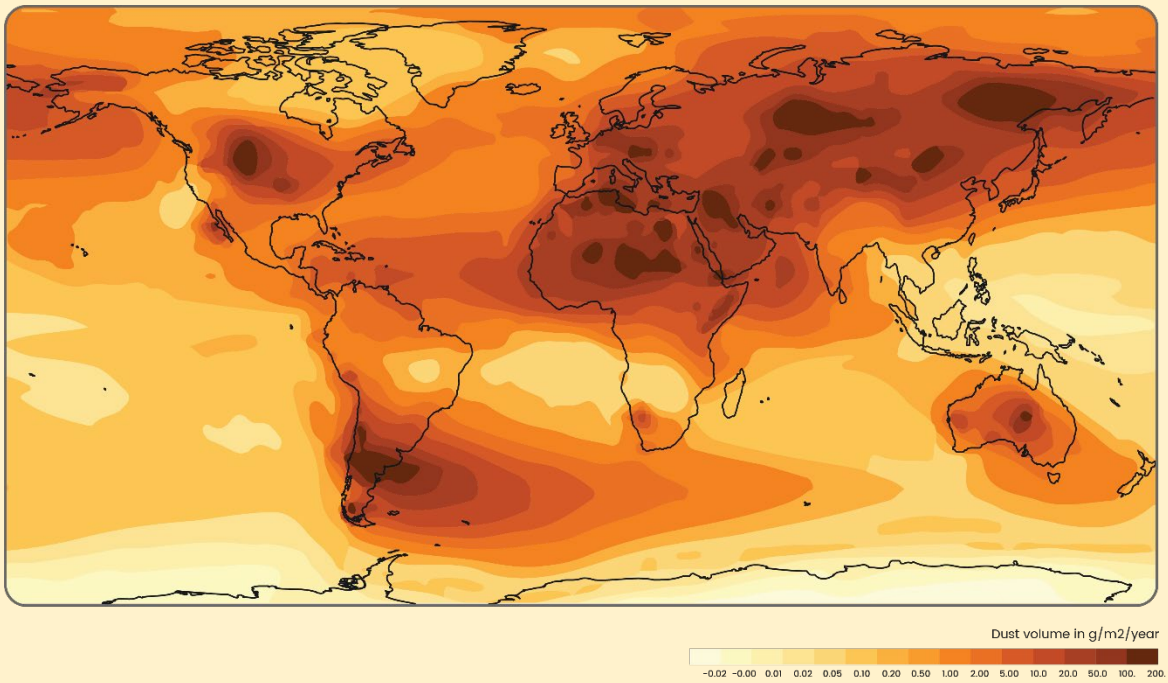
The arrows indicate the direction of air movement across the Earth's surface due to prevailing winds. The prevailing winds are influenced by global convection and the Earth's rotation (the Coriolis effect). Dust is carried by winds from the deserts and deposited along the path of the blowing winds. Thus, dust originating in North Africa is carried west across the Atlantic Ocean by the trade winds and deposited in Central and North America. Dust from Northern Asia is carried east by the westerlies and deposited in the North Pacific Ocean.



- **Has it always been this dusty?** *(dust deposition during the Last Glacial Maximum)* Explain that this map shows dust deposition during the height of the last ice age. This is called the Last Glacial Maximum (LGM), and it occurred approximately 22,000 years ago when it was much cooler on the Earth. Compare the dust map with current conditions to the LGM dust map:
    - *What is different between the maps?*
    - *Why might certain times in Earth's past be dustier than others?*
    - *How might a cooler climate (such as during an ice age) cause more dust?*

Dust deposition during the Last Glacial Maximum

The LGM map shows more dust, in both area and volume of dust deposition, than the map of current climate conditions. When Earth's climate is cooler, there is more ice at the poles and at continental and oceanic ice sheets. The movement of glaciers grinds against the rock, creating dust. Colder weather also produces higher wind speeds due to higher temperature gradients. Thus, increased erosion due to glacial movement and increased winds due to cold temperatures suggest that cooler climates make the Earth a dustier place. Observations of the thickness of dust layers in the geologic record also support that cooler climates correlate with increased dust deposition.



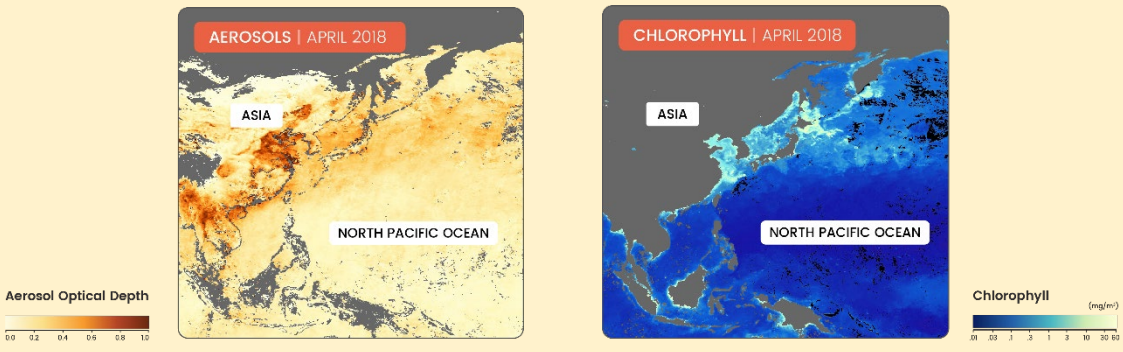
- **How does dust affect Earth's Climate?** *(aerosols and chlorophyll)*
  Focus on what happens when dust gets in the ocean and how this can affect the global climate.
    - Point out that measuring aerosols is a way to measure dust in the atmosphere. And measuring chlorophyll is a way to measure phytoplankton.
    - It may be of interest to distinguish between how dust entering the ocean affects climate and how dust in the atmosphere affects climate. Dust in the atmosphere influences the climate by scattering light and absorbing energy from the Sun. These maps instead focus on how dust in the ocean affects climate.
        - For younger audiences, you may want to make sure they understand what climate is.
    - Question prompts:
        - *How could dust change the climate?*
        - *What is the connection between the aerosols map and the chlorophyll map?*
        - *The dust contains lots of iron, which helps phytoplankton to grow. What kinds of changes could result from lots of dust entering the ocean?*

Aerosols and chlorophyll

More dust (aerosol) from Asia enters the North Pacific Ocean during April and May. Areas in the North Pacific Ocean where the most dust is deposited also show the highest concentration of chlorophyll, which indicates that phytoplankton are abundant. An increase of phytoplankton also means that more CO_2 is drawn out of the atmosphere via photosynthesis. Thus the addition of dust to the North Pacific and subsequent decrease in atmospheric CO_2 concentration can result in a cooling effect on the climate.

Proxy data for past climates indicate that during times of increased dust, there was also a decrease in atmospheric CO_2, which suggests that the ocean's biological pump (how marine organisms influence the global carbon cycle) could have been responsible for cooling the climate in the past.

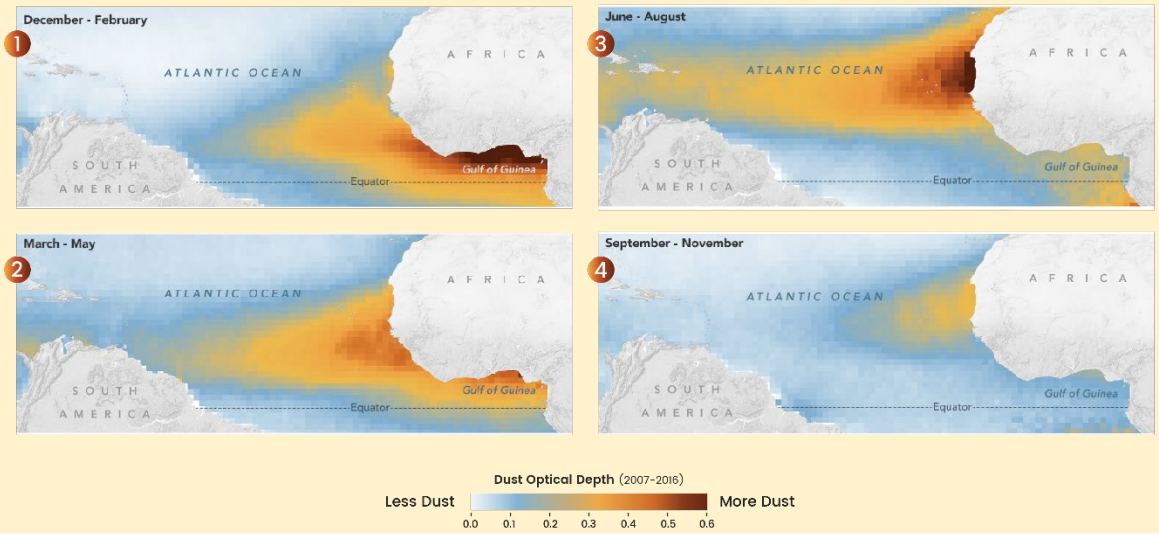
Note: Dust influences the larger climate system but is by no means the only factor responsible for cycles of ice ages and interglacials. The role of dust is a more recent area of scientific research.



- **Are certain times of the year dustier than others?** *(dust off the Sahara throughout the year)*
  Help visitors see that the amount of dust in the atmosphere changes throughout the year.
  - *What time of year does the most dust get into the ocean from the Sahara Desert?*
  - *How does the dust from the Sahara end up in the Atlantic Ocean?*
  - *Why might the amount of dust change throughout the year?*

Dust off the Sahara throughout the year

Changing weather patterns throughout the year are causing some months to be dustier than others. Air pressure and wind patterns, coupled with hot, dry conditions, lead to an increase in dust over the Sahara during the summer months. Strong convective systems create massive dust storms and a layer of hot, dry, dusty air, also known as the Saharan Air Layer (SAL). This dust cloud moves out over the Atlantic every few days and can even reach as far west as the US. In the fall months, changes in sea surface temperatures cause the trade winds to weaken, which results in less dust blowing west from the Sahara.



- **How do we know so much about dust?** *(image of geologist in the field)*
  - The geologist is in Junggar Basin, Xinjiang Province, China, a major dust-producing area in Asia, studying the rocks that erode into dust.
    - *How could studying rocks and fossils help to understand the Earth's climate?*
  - This image provides an opportunity to mention the *DUST PIRE* research project, where scientists from China and the US worked together to discover clues about Earth's climate in the past and how it was affected by dust. (See introduction for more information about the project.)