NOAA Research SCIENCE EDUCATION

A Tale of Ups and Downs

The Earth's atmosphere is a convective fluid heated from below.

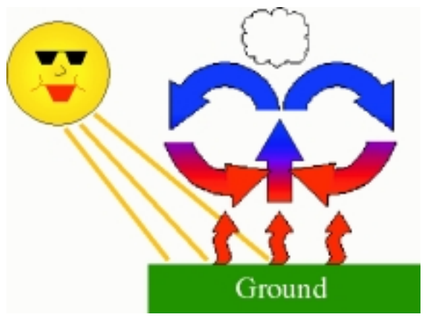
J. Koury, University of Colorado; R. Shin, Bell Middle School, Golden, CO; J.B. McPherson, Ph.D., Spelman College, Atlanta, GA;
T. Schneider, NOAA/ETL; and S. Frisch, CIRA

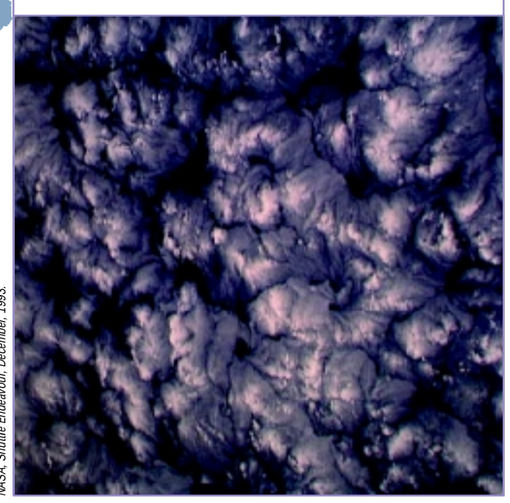
Convection is the process of warm fluids rising and cool fluids sinking. A fluid is any substance that tends to flow, like a liquid (water, oil, etc.) or a gas (air, water vapor, etc.). The simple movement of a fluid through convection can lead to many surprising results! Convection can occur on all scales, whether it's creating patterns in a thin layer of oil, building clouds on a sunny day or even changing global weather patterns. Convection happens all the time in our atmosphere, even when we can't see it. By understanding how convection works, we can gain a better understanding of our climate and our world.

How Convection Works

- A fluid is heated from below. It becomes less dense, so it rises.
- The fluid cools as it rises.
- In the atmosphere, water vapor may condense to form a cloud.
- The cool fluid is more dense, so it sinks back to the bottom.
- A pattern emerges!

Convection in the Sky

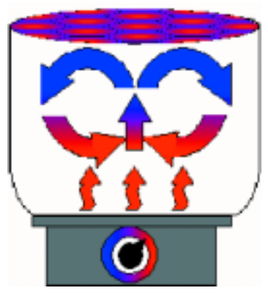


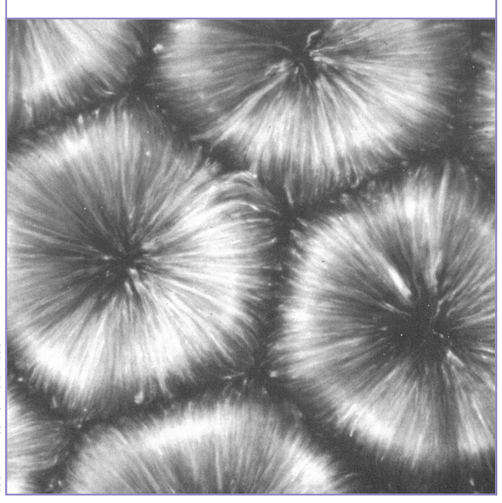


NASA, Shuttle Endeavour, December, 1993.

Shallow Cumulus Convection:
This view of convection in the sky reveals well-defined dark patches where air is sinking around the bright clouds.

Stove Top Convection

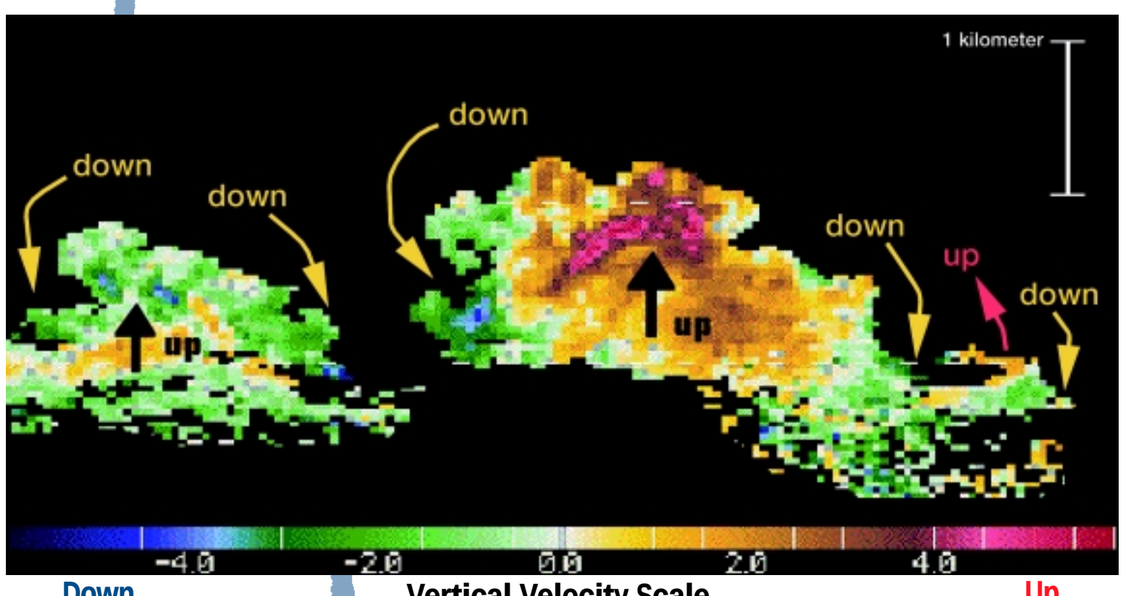




Used with permission of The Parabolic Press. Van Dyke, M., 1982: An Album of Fluid Motion.

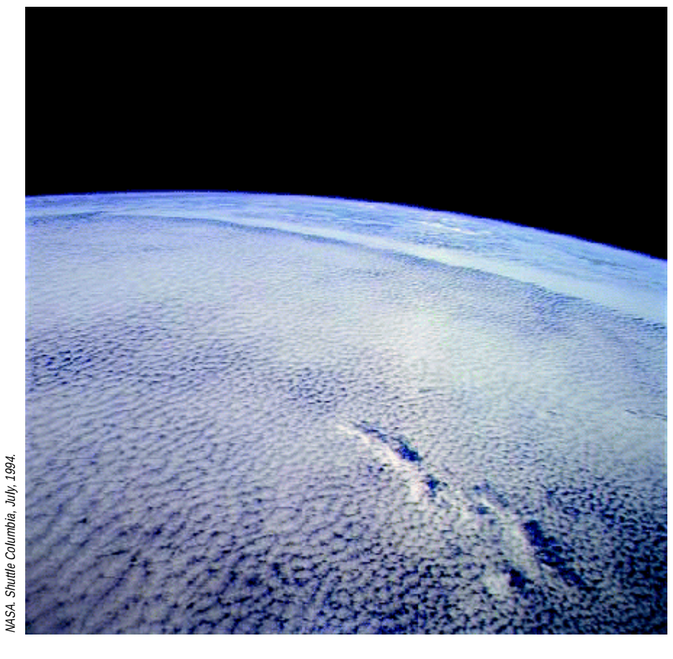
Convection in a Petri Dish:
These convection cells were created by heating silicone oil. The streaks are the paths of aluminum flakes which make it possible to visualize the flow.

Doppler Radar Measurements of Shallow Cumulus Clouds



Down — Vertical Velocity Scale in Meters per Second — Up

A Peek Inside of a Cloud:
Here at the NOAA Environmental Technology Laboratory, we use radars to probe inside of clouds. The radar can "see" the motions of cloud droplets, and even determine whether they are moving up or down. In this image, the cloud particles are moving up in the middle of the clouds and down on the sides – this is what convection looks like inside of a cloud.



NASA, Shuttle Columbia, July, 1994.

Clouds and Climate:
Convection often forms sprawling "cloud decks" like this one covering a huge portion of the Atlantic Ocean. The bright cloud tops reflect a lot of sunlight back into space, preventing the ocean from soaking up very much energy. These convective cloud decks greatly affect the global climate by changing the amount of sunlight that reaches the surface of the earth.

ENVIRONMENTAL TECHNOLOGY LABORATORY • NOAA • ETL

For further information, visit our website: www.etl.noaa.gov