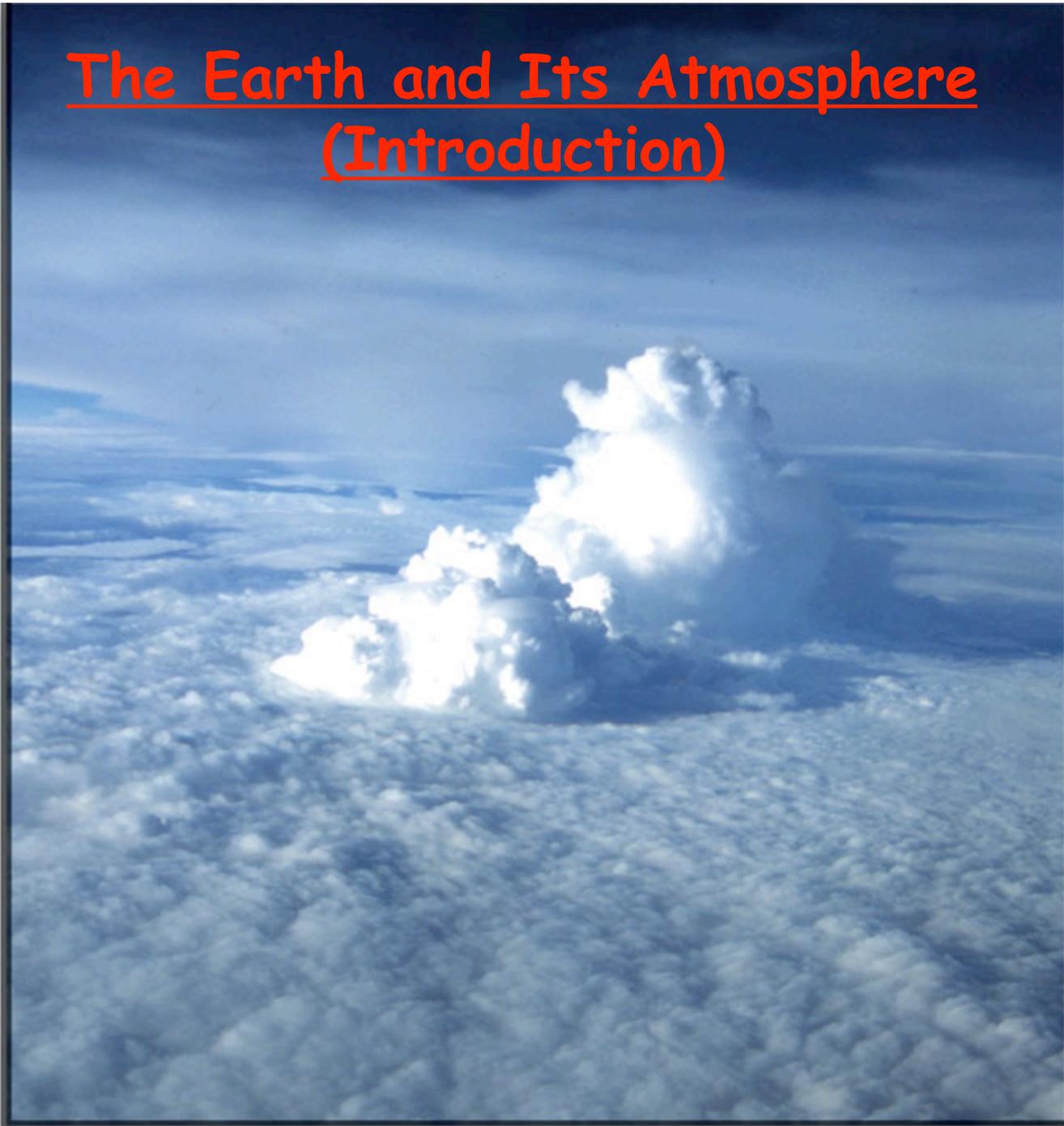


The Earth and Its Atmosphere (Introduction)



What, Why, and How???

What is an atmosphere?

Why do planets have atmospheres?

**What determines the yearly weather cycle?
Why is the weather different every year?**

What is the structure of the Earth's atmosphere?

How was the Earth's atmosphere formed?

What is the composition of the Earth's atmosphere?

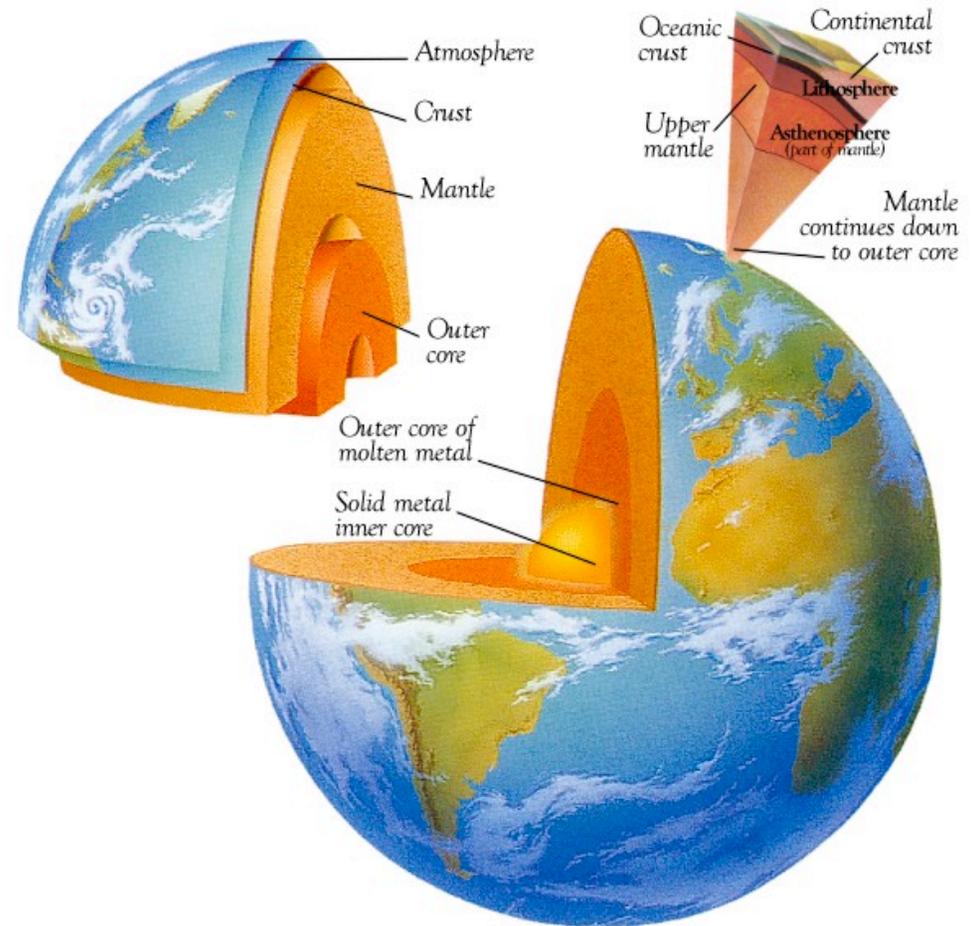
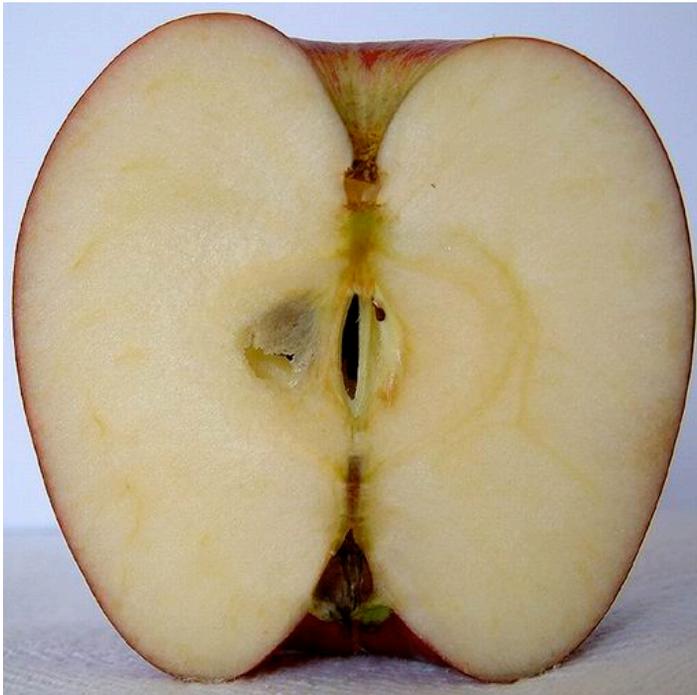
Why do we study the atmosphere?

What processes determine the daily variations in the atmosphere? Are they predictable?

How different are the atmospheres of other planets?

What is an atmosphere?

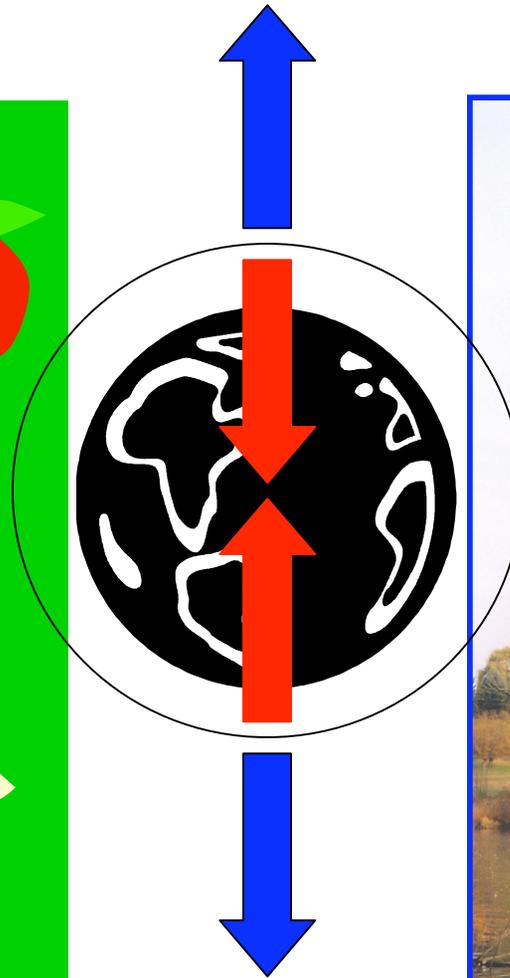
- A gaseous envelope surrounding a planet (satellite, comet...).
- It is very, very thin compared to the size of the planet



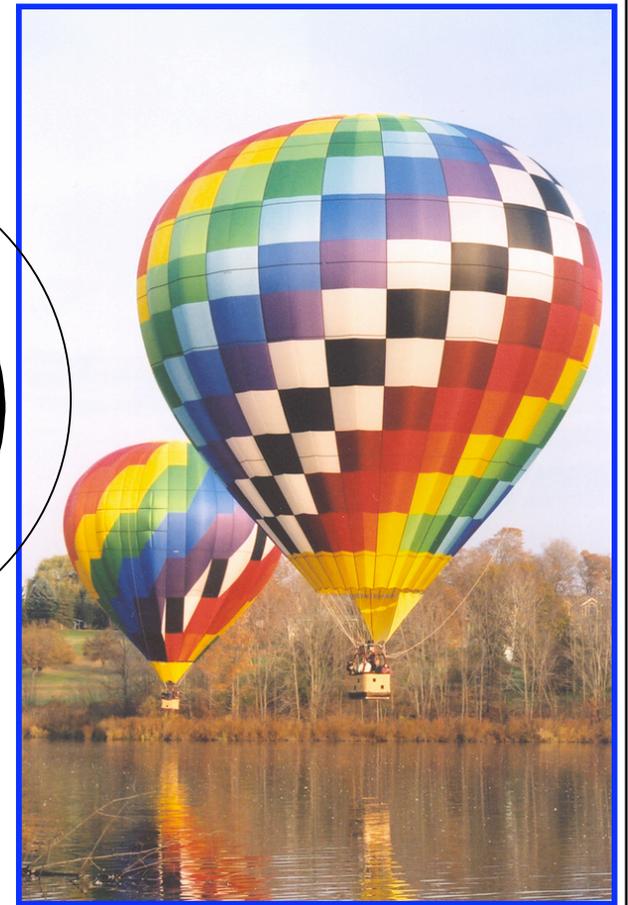


Why do planets have atmospheres?

Gravity !!!



Pressure !!!



Origin of the Atmosphere (How is an atmosphere formed?)

- The early atmosphere of the Earth was **very different** from the atmosphere today!
- **Stage I** (Primordial Atmosphere):
 - ◆ Acquired by gravitational attraction of volatile gases from the proto planetary nebula of the Sun
 - ◆ Consisted mostly of **H₂ and He**
 - ◆ **Small and warm planets** (Earth, Mars, Venus, Mercury) lost this atmosphere because the gravity is not strong enough to keep the light hot gases from escaping the planet.
 - ◆ The composition of the atmosphere of the **giant planets** (Jupiter, Saturn, Uranus and Neptune) today is very close to their primordial atmosphere (**why?**).

The Secondary Atmosphere



Stage II

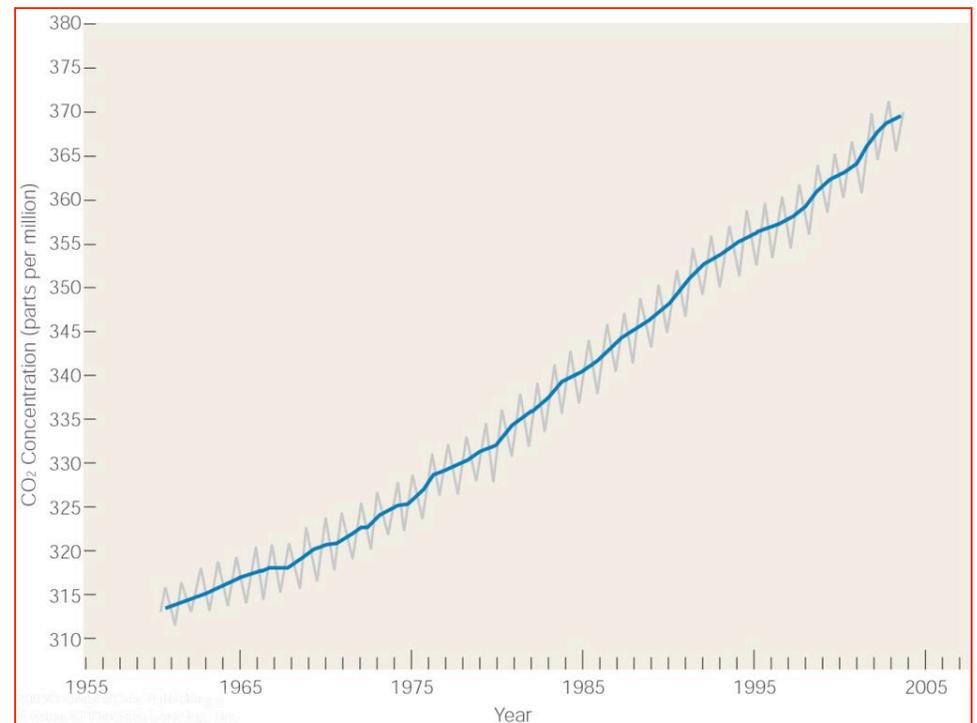
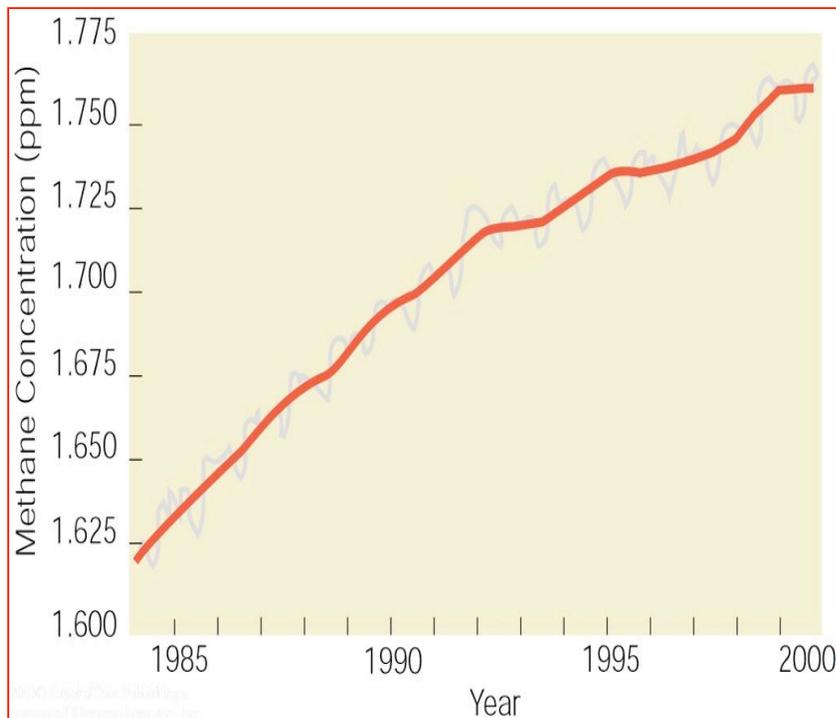
- ◆ **Outgassing** of the terrestrial type planets during the early stages of their geological history. Volcanoes, geysers, cracks, ...
- ◆ Most abundant gasses: H_2O , CO_2 , SO_2 , H_2S , CO
- ◆ **Recall: radon mitigation**
- ◆ On the Earth H_2O condensed, formed clouds and rained out to form oceans.
- ◆ On the Earth most of the abundant gasses then dissolved in the ocean, leaving N_2 as the dominant gas.
- ◆ The dominant gas for Mars and Venus is CO_2 (why?).
- ◆ Other gas sources:
 - influx of material from **meteorites and comets**;
 - sputtering of material of the planetary surface by **cosmic rays and energetic particles**.



The Final Stage...

● Stage III

- ◆ The Earth atmosphere has been greatly modified by the presence of life.
- ◆ The Earth's atmosphere was enriched in O_2 as a result of the photosynthesis by plants.
- ◆ The composition of the Earth's atmosphere is evolving even now as a result of human activity (industry, deforestation ...).



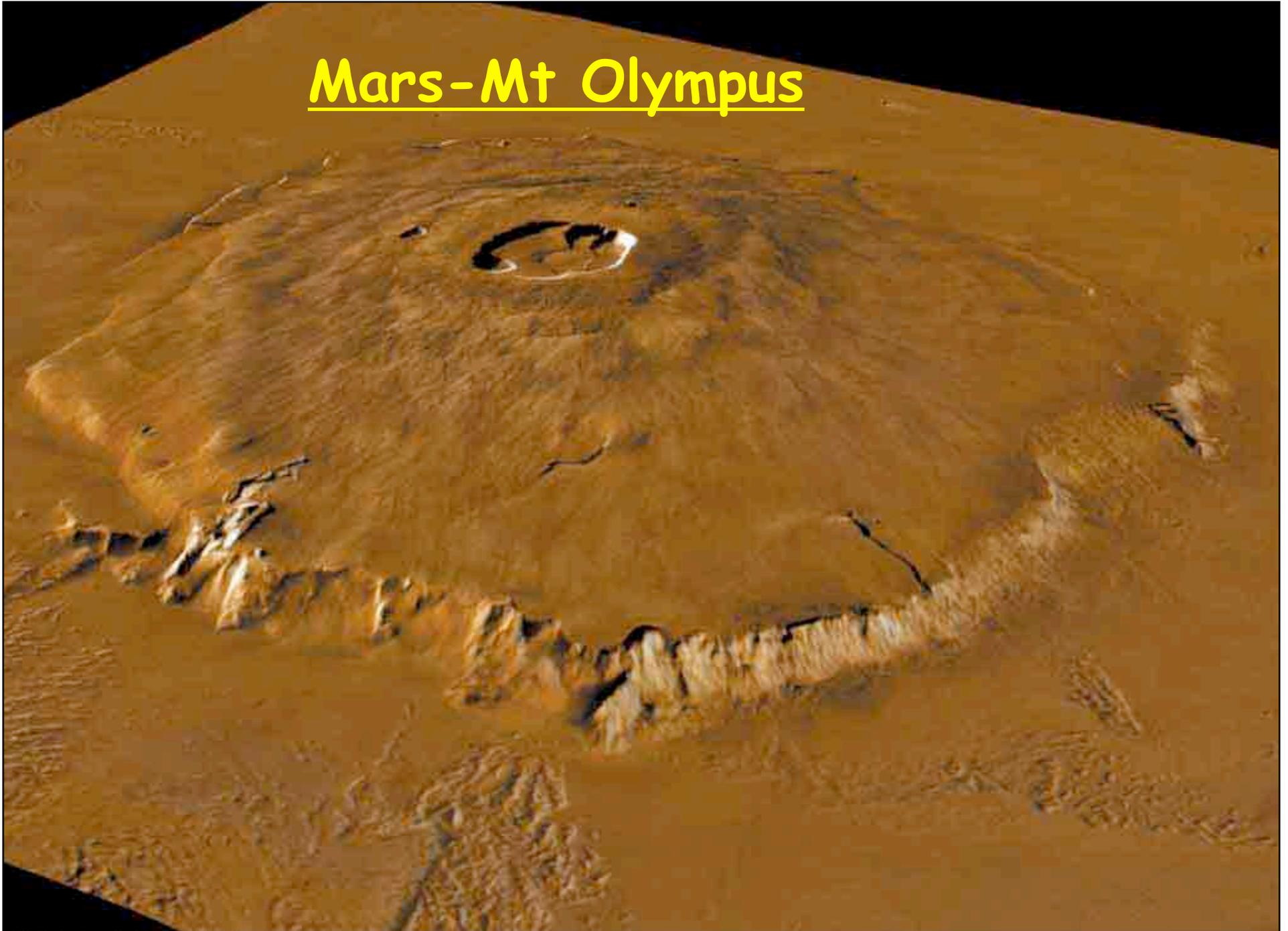
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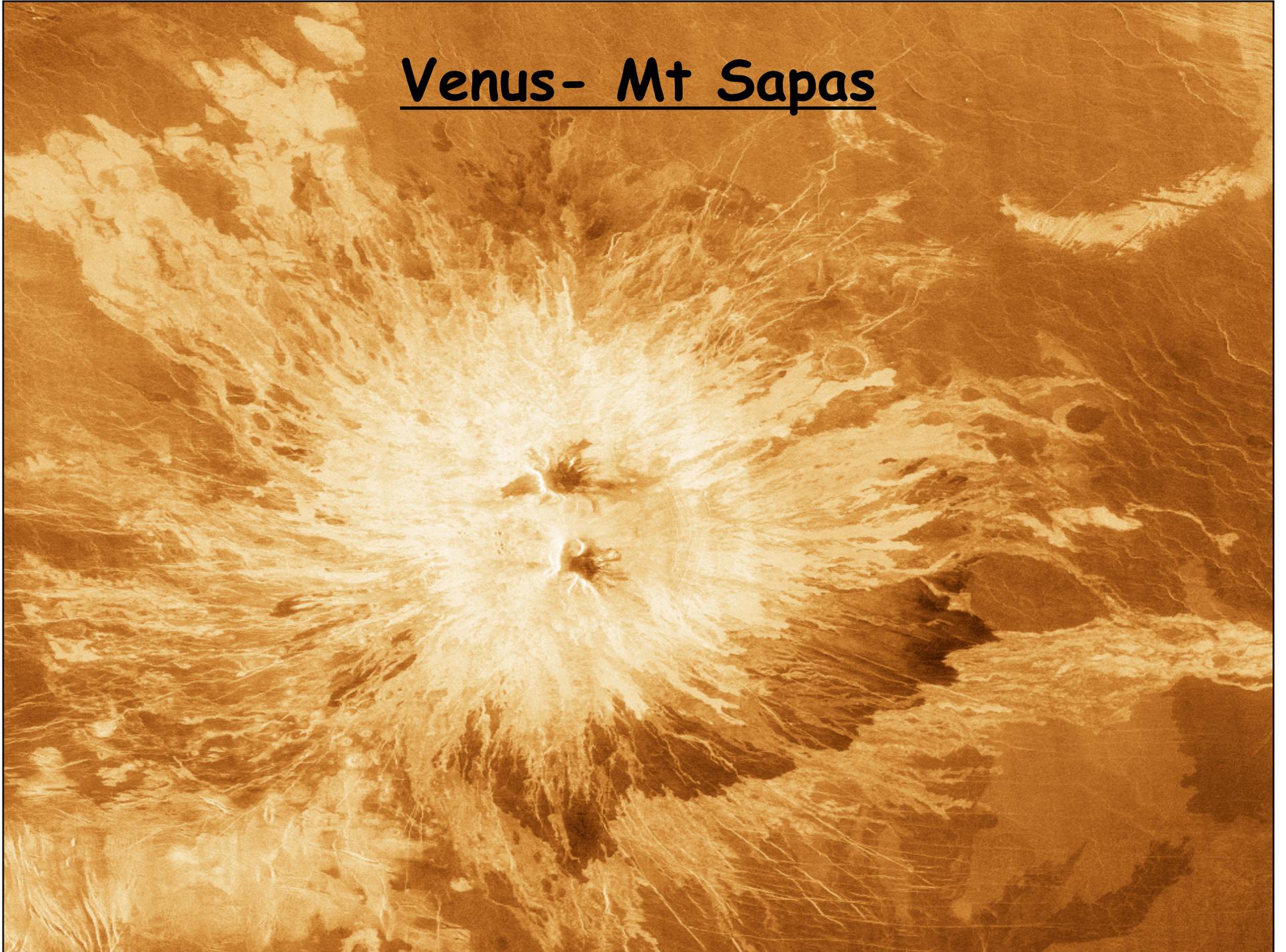
- We learn about the formation and the evolution of the Earth's atmosphere from the Earth's geological records and by studying other planets.



Mars - Mt Olympus



Venus - Mt Sapas



Why do we need to study the atmosphere?

- **The scientist's view:** How does nature work?
- **The consumer's view:** What is the weather tomorrow? Will the hurricane pass through Gainesville? How clean is the air we breathe? How harmful is the sun radiation for my skin? Should I turn off the sprinklers tonight?
- **The impact on the economy:** agriculture, air-traffic, radio-communications (satellites, radio stations, wireless phones), long term planning...
- **The human survival:** prediction of the impact of catastrophic events (volcano eruption, meteorite strike ...) and global climate change, control of the air pollution, irreversible global processes (ozone depletion), colonization of other planets.