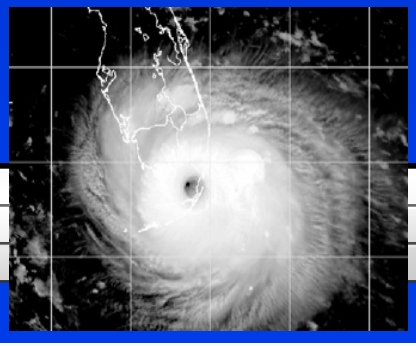
The Ozone Hole

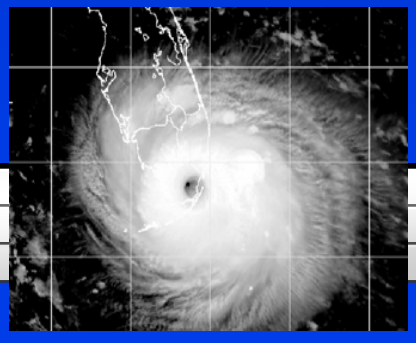


Applied Climatology

The Stratospheric Ozone Hole

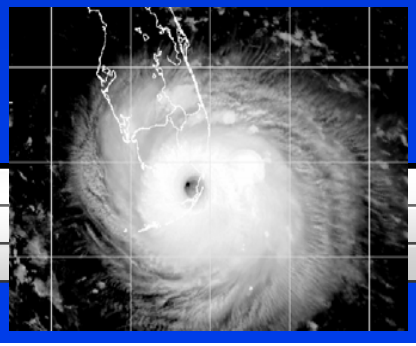
- This Ozone Hole discussion largely follows the material found at “TheOzoneHole.Com”

The Ozone Hole



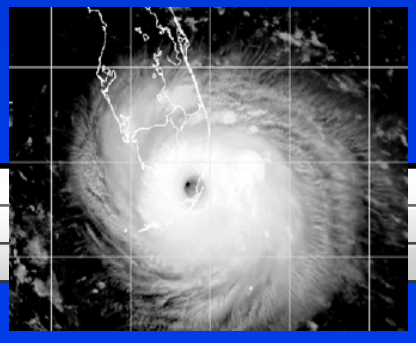
Characteristics of the Antarctic Ozone Hole

- Massive depletion of stratospheric ozone occurs poleward of 45°S.
- This depletion occurs early in the Antarctic spring (September-October time frame)
- Some stratospheric layers incur nearly 100% depletion in some years.



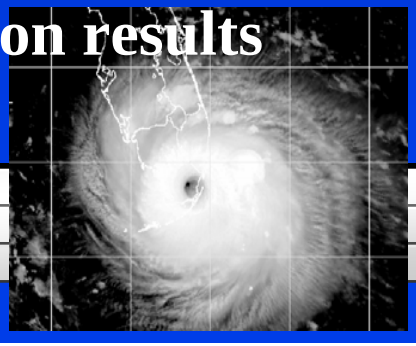
Steps to Development of the Antarctic Ozone Hole

- Winter over Antarctica begins in June
- The sun disappears for several months and stratospheric air becomes ***very*** cold.
- The circumpolar vortex (i.e., the upper-level westerly jet stream) becomes very strong.
- Due to a lack of topography and large mountain ranges in the mid-latitudes of the Southern Hemisphere, the jet stream remains in a fairly zonal pattern.
- This zonal jet stream pattern isolates the Antarctic stratosphere from warmer air intrusions.



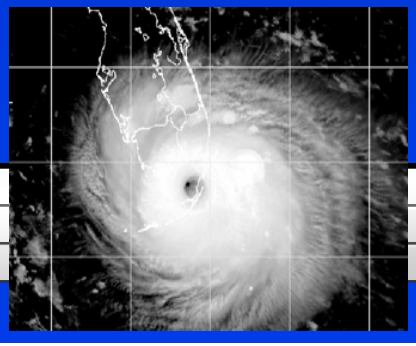
Steps to the Development of the Antarctic Ozone Hole

- Because of the isolation of the Antarctic stratosphere from warmer mid-latitude air, temperatures are allowed to plummet to <-80°C, promoting the development of polar stratospheric clouds.
- These stratospheric clouds act as a platform for ozone destruction.
- When the sun first returns to the Antarctic stratosphere, massive amounts of chlorine are released from the abundant CFC molecules there.
- The ice crystals in the polar stratospheric clouds act as a platform (catalyst) for chlorine to react with ozone. Thus, these clouds greatly enhance the destruction of ozone; massive ozone depletion results



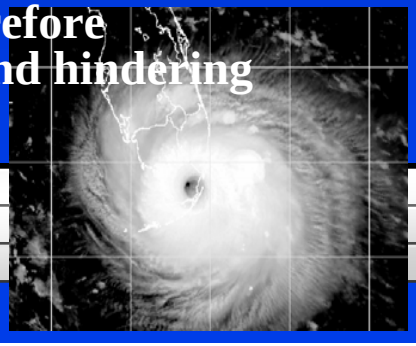
Steps to the Development of the Antarctic Ozone Hole (continued)

- This stratospheric ozone depletion continues until:
  - The sun warms the Antarctic stratosphere sufficiently to dissipate the polar stratospheric clouds.
  - The circumpolar vortex (strong zonal jet stream) weakens and breaks down as summer approaches; thus, ozone-rich air from the tropics and mid-latitudes mixes poleward to replace the ozone-depleted Antarctic regions.
- Overall, this ozone destruction process over Antarctica is reducing the total amount of stratospheric ozone on a global scale.



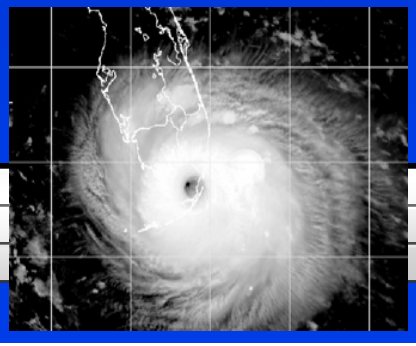
Why No Big Arctic Ozone Hole?

- The stratospheric ozone in the Arctic does not suffer as bad a fate as the Antarctic ozone.
- CFCs and chlorine are very plentiful in the Arctic stratosphere, but there is not a serious ozone hole there.
- Why not?
  - The main reason the Arctic does not suffer a significant ozone hole is due mainly to circulation differences between the circumpolar vortex in the arctic compared to the Antarctic.
  - In the Arctic, the circumpolar vortex develops more meridional amplitude. In other words, the jet stream displays much larger north-south wave undulations in the Northern Hemisphere than in the Southern Hemisphere. These larger wave patterns produce a much greater exchange of air between mid-latitude and polar regions in the Northern Hemisphere, therefore limiting the amount of cooling in the stratosphere and hindering development of polar stratospheric clouds.



Why No Big Arctic Ozone Hole?

- The reason that the Northern Hemisphere circumpolar vortex wave pattern is more amplified has to do with topography.
- There is much more continental landmass area and there are many more mountain ranges in the Northern Hemisphere than in the Southern Hemisphere. Thus, there is much more interference with and “deflection” of the jet stream pattern in the Northern Hemisphere. This deflection helps to keep the Arctic stratosphere less isolated, warmer, and thus more ozone rich.



Paper Assignment: Ozone Hole

- Produce a 3 page paper on the stratospheric ozone hole.
- You may choose topics from one of the 3 areas
  - Human influences on the ozone hole
  - Natural influences on the ozone hole
  - Health/environmental effects of the ozone hole.
- Paper is due Monday, 20 June 2005.