SUNSPOTS

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“Mankind will not remain on Earth forever, but in its quest for light and space will at first timidly penetrate beyond the confines of the atmosphere, and later will conquer for itself all the space near the Sun.”

-Konstantin E. Tsiolkovsky
THE SUN’S LAYERS

- Solar Winds
- Solar Corona
- Chromosphere
- Photosphere
- Interior
- Core
ACTIVE REGIONS

- Combination of plasma and magnetic field that is constantly undergoing structural change.
- Variety of features including sunspots, solar flares, coronal mass ejections & coronal arches.
- Sept. 20, 2000: largest observed sunspot group
- Estimated size: 12x the area of Earth’s surface
WHAT IS A SUNSPOT?

- magnetic regions on the Sun
  - 1000x stronger than Earth’s magnetic field
- appear as dark spots on surface of Sun.
- come in groups with two sets of spots.
  - One positive or north magnetic field, one negative or south magnetic field
- Manifestations of magnetically disturbed conditions at the Sun’s visible surface
MAGNETISM

- Sun magnetism is produced by flow of electrically charged ions and electrons.
- The sun spot cycle is caused by the recycling of magnetic fields and by flow of materials in the interiors of the sun.
- Sun spots come in pairs and are each other’s polar opposites.
SUNSPOT CYCLE

- Average 11 year cycle (9.5-12 years)
- Maunder Minimum
  - 1645-1715
- Currently in a solar maximum
  - Period of large sunspot numbers
PREDICTED SUNSPOT CYCLE

Cycle 23 Sunspot Number Prediction (October 2000)
BUTTERFLY DIAGRAM

DAILY SUNSPOT AREA AVERAGED OVER INDIVIDUAL SOLAR ROTATIONS

SUNSPOT AREA IN EQUAL AREA LATITUDE STRIPS (% OF STRIP AREA)

DATE


AVERAGE DAILY SUNSPOT AREA (% OF VISIBLE HEMISPHERE)

DATE

OBSERVATION HISTORY

- Galileo, Scheiner, Fabricus
  - Independently observed sunspots in 1610’s
- Schwabe, Wolf
  - Eleven year cycle
- Hale
  - Discovered magnetic fields, theorized on origin
<table>
<thead>
<tr>
<th>Observation Date</th>
<th># of Sunspots</th>
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**TABLE #2: SIZE OF SUNSPOTS**

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<thead>
<tr>
<th>Sunspot #</th>
<th>Size</th>
<th>Umbra / Penumbra (y/n)</th>
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TABLE #3: SUNSPOT LOCATION

Hemisphere’s of sun