



A key goal in the search for life elsewhere in the universe is to detect liquid water, which is generally agreed to be the most essential ingredient for living systems that we know about.

The image to the left is a false-color synthetic radar map of a northern region of Titan taken during a flyby of the cloudy moon by the robotic Cassini spacecraft in July, 2006. On this map, which spans about 150 kilometers across, dark regions reflect relatively little of the broadcast radar signal. Images like this show Titan to be only the second body in the solar system to possess liquids on the surface. In this case, the liquid is not water but methane!

Future observations from Cassini during Titan flybys will further test the methane lake hypothesis, as comparative wind effects on the regions are studied.

Problem 1 – From the information provided, what is the scale of this image in kilometers per millimeter?

Problem 2 – What is the approximate total surface area of the lakes in this radar image?

Problem 3 - Assume that the lakes have an average depth of about 20 meters. How many cubic kilometers of methane are implied by the radar image?

Problem 4 – The volume of Lake Tahoe on Earth is about 150 km^3 . How many Lake Tahoes-worth of methane are covered by the Cassini radar image?

Problem 1 – From the information provided, what is the scale of this image in kilometers per millimeter?

Answer: $150 \text{ km} / 77 \text{ millimeters} = \mathbf{1.9 \text{ km/mm}}$.

Problem 2 – What is the approximate total surface area of the lakes in this radar image?

Answer: Combining the areas over the rectangular field of view gives about 1/4 of the area covered. The field of view measures 77 mm x 130mm or 150 km x 247 km or an area of $37,000 \text{ km}^2$. The dark areas therefore cover about $1/4 \times 37,000 \text{ km}^2$ or $\mathbf{9,300 \text{ km}^2}$.

Problem 3 - Assume that the lakes have an average depth of about 20 meters. How many cubic kilometers of methane are implied by the radar image?

Answer: Volume = area x height = $9,300 \text{ km}^2 \times (0.02 \text{ km}) = \mathbf{190 \text{ km}^3}$.

Problem 4 – The volume of Lake Tahoe on Earth is about 150 km^3 . How many Lake Tahoes-worth of methane are covered by the Cassini radar image?

Answer: $190 \text{ km}^3 / 150 \text{ km}^3 = \mathbf{1.3 \text{ Lake Tahoes}}$.