Remote sensing: the acquisition of information about an object/surface without being in contact physical contact with it.

Dolphin - echolocation

Sound waves that "bounce" off objects - and then receives these waves and interprets them.

Information is acquired by detecting and measuring changes that the object imposes on the surrounding field, be it an electromagnetic, acoustic, or a potential field, gravity, magnetic.

Microwaves: wavelengths from mm to m
Frequency from 100's MHz to 100's GHz
Uses: radar, ovens, communication

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Wavelength and frequency:

\[ c = \text{speed of light} = 3 \times 10^8 \text{ m/s} = \lambda f \]

\( \lambda = \text{wavelength} \)

\( f = \text{frequency} \)

\[ \lambda = \frac{c}{f} = \frac{3 \times 10^8 \text{ m/s}}{1 \times 10^9 \text{ s}^{-1}} = 3 \times 10^{-1} = 0.3 \text{ m} = 30 \text{ cm} \]

\[ \lambda = \frac{c}{f} = \frac{3 \times 10^8 \text{ m/s}}{10^8 \times 10^6 \text{ s}^{-1}} = 3 \times 10^{-3} \text{ m} = 0.3 \text{ mm} \]

L band = 1 – 2 6 GHz
C band = 4 – 8 6 GHz
X band = 8 – 12 6 GHz
K band = 18 – 27 6 GHz

There are two types of microwave remote sensing, active (radar = radio detection and ranging).

An electromagnetic wave is launched at an object (target) and the quality of the radiation scattered by the target is analyzed to obtain information about the object.
quality of radiation; magnitude of scattered radiation, phase, polarization, frequency content

passive remote sensing (radiometry): we measure the radiation that is naturally emitted by an object. This information is analyzed to obtain qualities of the object/surface/target.

Why microwaves?

The electrical properties of most natural surfaces do not vary greatly at IR wavelengths. Visible remote sensing depends on illumination by the Sun - so we can't use it at night. At microwave wavelengths, liquid water has distinct electrical properties. Water vapor and other gases also have electrical properties that vary in the microwave region.

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Microwaves can also penetrate through clouds, and to some extent rain. Microwaves also penetrate into objects/surfaces so that properties within an object can be inferred. So we can find out about inner structure, water & content, etc.