Everyone has seen a landscape reflected in the surface of a lake. Everyone has been also wondering, why does the object in water change its shape, size and position. Those phenomena are caused by refraction of the light beam passing through media with different densities (like air and water). Those intriguing and even artistic effects are results of light slowdown in denser media.

Figure 1: Light refracted by the glass of water. Source: https://commons.wikimedia.org

But everyone, who has ever tried to take an amazing photo of a landscape doubled by a reflection, knows how hard it is to catch a proper moment – water surface is usually disrupted by all kinds of wavelets and waves, that ruins potentially excellent picture. Similar event can be observed also on the sky at night. Air temperature and density irregularities in the atmosphere cause well-known star twinkling effect.

Figure 2: A building reflection in the water. Source: https://www.pexels.com

The same phenomenon also occurs in the radio waves domain, however the more important refractive medium for radio waves are clouds of electrons and free ions located few hundreds of kilometers above the ground. Because of high ionization level that area is called the ionosphere. The mechanism is the same – just like wavelets on the water disrupt reflection, irregularities in ionospheric plasma density causes fluctuations of the radio signal reflected by the ionosphere or passing through it (transmitted for instance by an artificial satellite). In the results, radio images ‘twinkle’ like stars in the night sky.

Such irregularities monitoring and studying is very important issue – like motorboat’s wake may completely ruin the water reflection, strong turbulence in the ionosphere can terminate communication between satellite and earthbound receiver or seriously degrade the quality of radio astronomical observations.

Ionospheric irregularities studying approach is based on a very simple assumption – if we know, how does the reflected in the water building look like in reality, we can easily say, what is the shape of the mirroring surface. In case of ionosphere monitoring, if we know theoretical radio signal parameters, transmitter and receiver positions, we can reproduce irregularities structure from the actual disrupted signal.

In the ionospheric disturbances study, we search for answer not only for question ‘how do they look like?’, but also ‘what caused them?’. Thus, parallel monitoring of other possible triggers – both space-based (like solar flares) and earthbound is a crucial issue .