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Indirect Mapping of Methane Seeps Using Satellite Remote Sensing

Methane is a potent greenhouse gas that plays a major role in shaping the global climate. The total accumulation of methane in the atmosphere is the balance between sources that emit methane to the atmosphere and sinks that remove methane from atmosphere. Methane can be produced as a direct result of human activities and natural processes. Of the natural sources is the geological seepage which considered as the second largest natural source of methane after wetlands. It is estimated to contribute to about 54 million ton per year. Soil in drylands is known to withdraw methane from the atmosphere, however drylands which are part of petroleum basins may not consume methane but instead produce it. Hydrocarbon in subsurface and due to high pressure at depth and weakness areas in geological structure can escape to surface in the form of visible oil or invisible gases. The invisible gases are composed of methane as the most predominant gas seep and it is termed as microseepage. The relative contribution of methane from microseepage to the atmosphere is highly uncertain. This uncertainty in data is one of the primary scientific challenges in today climate model.

Uncertainties arise due to incomplete knowledge of the actual area of microseepage. Accurate and more reliable estimates can be obtained by performing as many as possible ground measurements from many different petroleum basins, an exercise that pose lots of challenges at regional or global scales. Motivated by the incomplete knowledge of the actual area of microseepage and therefore uncertainty over the magnitude of global methane source and sink. And as it is hard to measure every drylands, satellite remote sensing imagery was used to investigation areas affected by natural hydrocarbon microseepage. Mapping the boundary of a microseepage can then facilitates for more accurate predictions.

The gases that leaked out of petroleum traps and rose towards the surface and interacted with soil and rocks create alterations in surface. Possible alterations include development of different minerals, formation of carbonates, development of vegetation anomalies and surface temperature variations. Satellite sensors have the ability to see more than just red, green and blue and therefore can recognize a particular minerals, or mineral families. Through the recognition of mineralogical and biological changes in soils, sediments, rocks and vegetation using satellite remote sensing the boundary of microseepage was mapped. The methodologies used are suitable for the detection and visualization of overall spatial distribution of minerals surface anomalies. The work demonstrated the potential of satellite remote sensing and its analysis in mapping hydrocarbons microseepage extent on regional or even global scale.

Keywords: Geography, Geographical Information Systems, Hydrocarbon Microseepage, Atmospheric Methane, Remote Sensing, Satellite Image Classification.

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