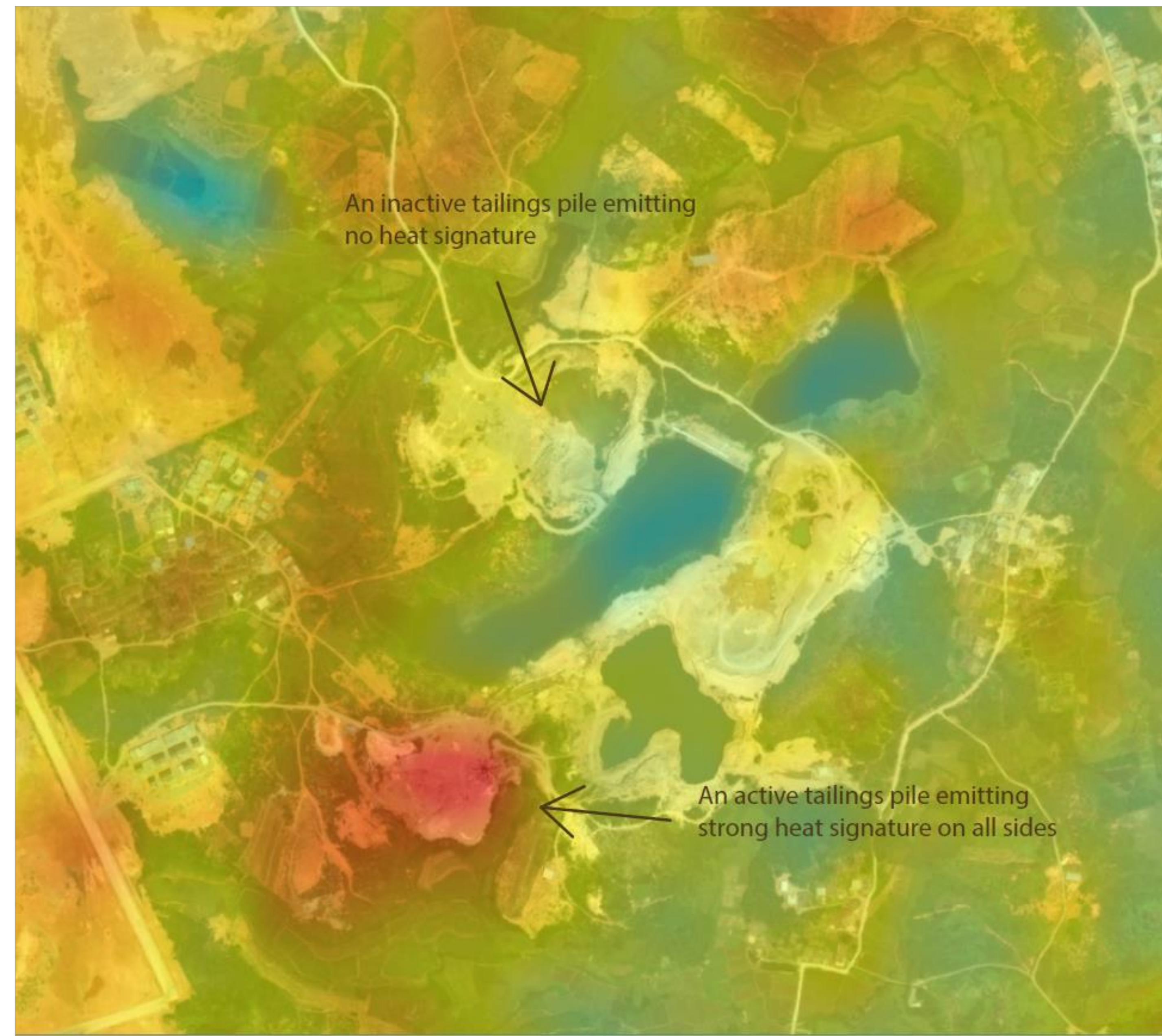




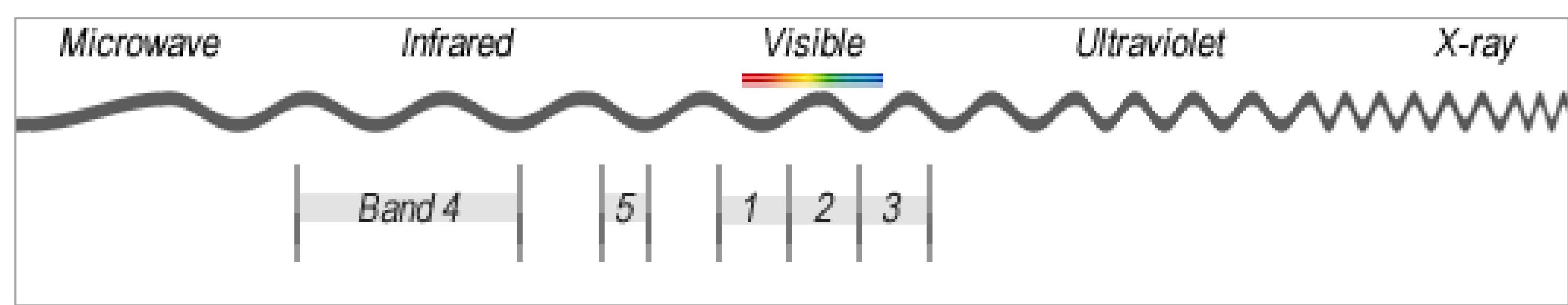
## Abstract

Information uniquely derivable from multispectral and hyperspectral satellite images can provide deeper insights into uranium mining and milling activities, shedding light on key stages of the nuclear fuel cycle that are covert and poorly documented. These operations can span large distances, which present challenges for on-site inspections, necessitating more efficient methods to monitor such sites.



## Multispectral Imagery

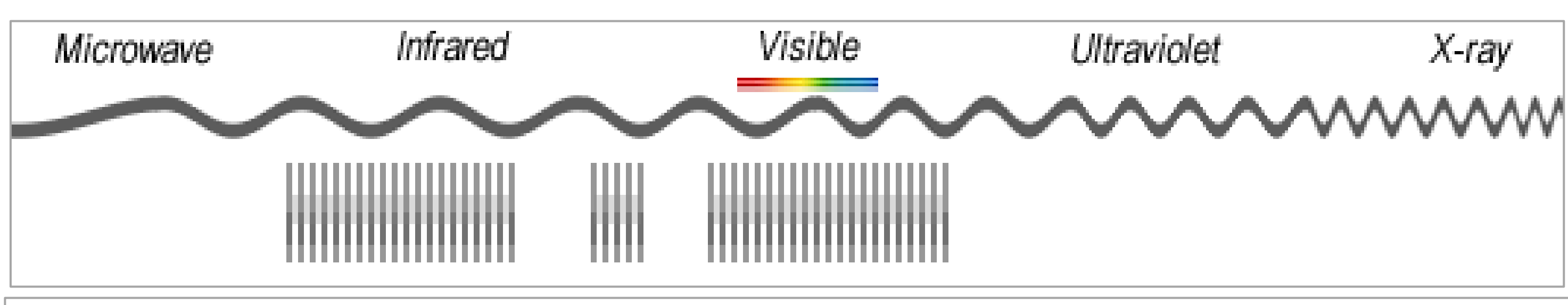
Multispectral (MS) and hyperspectral (HS) sensors capture wavelengths outside the visible spectrum. MS sensors collect on a small number of bands in addition to the red, green, and blue optical bands. These bands are optimized and processed to show specific types of information. For example, thermal bands show relative heat, which indicate the tailings piles which were most recently active. This can cue further collection efforts on a specific area.



**Above:** An example of bands collected by a multispectral sensor.  
**Left:** Thermal imagery overlaid on optical satellite imagery.

## Hyperspectral Imagery

The number and density of bands HS sensors collect differentiate it from MS. HS senses hundreds of bands, which produces continuous or nearly continuous spectral profiles. These profiles integrate data from all of the bands simultaneously, which delivers a level of nuance that characterizes various ground compositions. This could distinguish uranium operations from others such as copper or coal. HS imagery is limited in the open-source, so further availability of imagery is needed to develop proof of concept.



**Above:** An example of bands collected by a hyperspectral sensor.  
**Left:** Comparison of Spectral Profiles from MS vs HS imagery.

## Satellite Imagery

Satellite imagery is already widely used for monitoring and safeguards. Advancements in satellite and sensor technology and a growing commercial industry are producing higher resolution images at a higher frequency than ever before. Imagery analysts can often reliably derive the types, levels, and recency of activity around sites of interest using optical imagery alone. However, using bands outside of the visible spectrum can further confirm optical signatures or fill in gaps that are simply not visible in optical images.

