

Thermal Infrared Remote Sensing

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Sensors, Methods, Applications

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Foreword



Temperature is one of the most important physical environmental variables monitored by Earth observing remote sensing systems. Be it land surface temperature, sea surface temperature, or air temperature, temperature ranges define the boundaries of habitats on our planet. Already thousands of years ago, temperature defined where we humans can settle and survive. Which plant resources are available? What wildlife is present? Which crops can be grown? Which diseases are prevalent? Which water surfaces will freeze, which will remain ice-free? Where do frequent wildfires occur? Temperature boundaries contribute largely to the answers to all these questions.

Nowadays, in an era of technological progress but also concern about climate change, the above questions still remain important. But new ones have arisen as well. On the local scale, we are interested in a variety of phenomena, such as urban microclimate dynamics, urban heat island effects, industry-related thermal water pollution, and burning oil and gas wells, to give only some examples. On the regional scale, we need reliable information on where forest fires flare up, where geothermal fields hold the potential for energy generation, or where coal is wastefully consumed by underground coal fires. On the global scale, our interest lies in global dynamics and the consequences of global warming and climate change. We need to understand ocean current temperature changes, need to know if the freeze-and-thaw behaviour of coastal waters, rivers, and lakes is changing, and how altered evaporation patterns impact our water resources.

Temperature information with good spatial and temporal coverage is a key to addressing most of these challenges. Consequently, thermal infrared Earth observation data and derived products are a crucial source of valuable information. Sensors for thermal infrared observations can be ground-based, airborne, or space-borne. Ground-based remote observation performed with novel handheld thermal camera systems enables the detection of energy leaks in buildings,

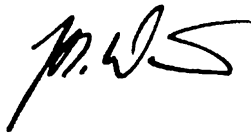
performance monitoring of machines in industry, and a survey of local geothermal phenomena. Airborne thermal infrared surveys support city planning, precision agriculture, and mineral mapping. With space-borne Earth observation technology we can monitor phenomena at all scales. For this task a variety of thermal infrared sensors are flown on an international fleet of Earth observing satellites.

The famous NOAA-AVHRR sensor family has been enabling thermal mapping at 1 km spatial resolution since 1979. At the same resolution, the MODIS sensor has also mapped the temperature state of Earth in 16 thermal bands since the year 2000. At the higher resolution of 120–60 m, all the well-known Landsat sensors (MSS-3 onwards, TM, ETM+) monitored our planet in the thermal domain – allowing a view into our past from their launch up until 1978. The new Landsat Data Continuity Mission, LCDM, launched in 2013, also includes a thermal band.

The German Aerospace Center, DLR, designed and operated the BIRD (2001–2004) and TET-1 missions (launched in 2012), which contributed and still contributes to thermal observations of the Earth's surface. This is only an incomplete snapshot of available resources, and numerous future sensor missions are planned.

The thermal infrared community is growing day by day. Many international scientists active in thermal infrared remote sensing have contributed to this book, providing an introduction to this important domain and describing selected sensors, analysis methods, and applications. I am convinced that it will be a milestone on the pathway of thermal infrared remote sensing and will trigger scientific discussion about advances and remaining gaps and also spark the excitement of scientists new to this field.

I hope that I have awakened your interest in thermal infrared remote sensing as one important tool to assess the state of our environment.
May you enjoy your reading!



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