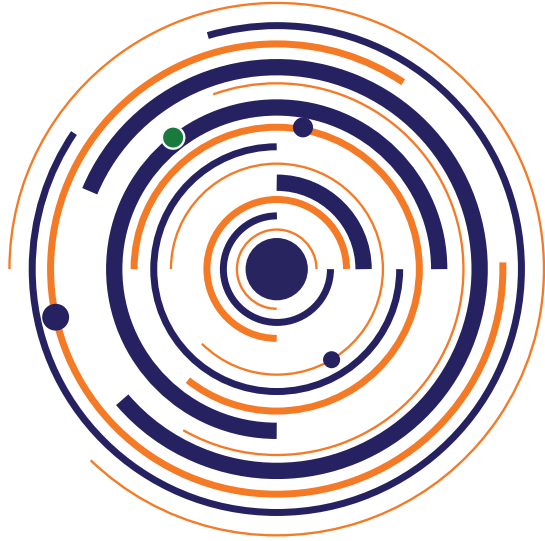




CE²S²

Center of Excellence for
Earth and Space Science

2026



KACST

مدينة الملك عبدالعزيز
للعلوم والتقنية

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Center of Excellence for Earth and Space Science

The Center of Excellence for Earth and Space Science is a new center of the Joint Centers of Excellence Program (JCEP) established in partnership between King Abdulaziz City for Science & Technology (KACST) and the California Institute of Technology (Caltech). This scientific partnership focuses on a collaboration between the Department of Geological and Astronomical Studies in Caltech and the Earth and Space Center in the of Excellence Program at KACST. The center is focused on developing satellite technologies for data interpretation capabilities to enhance our understanding of the following key issues: earth crust deformations and tectonic movements, sand dune movement and its impact, flood pools, and the dynamics of groundwater reservoirs. Another focus of the center is to utilize state of the art visualization tools to present information to both scientists and decision makers on a timely manner.

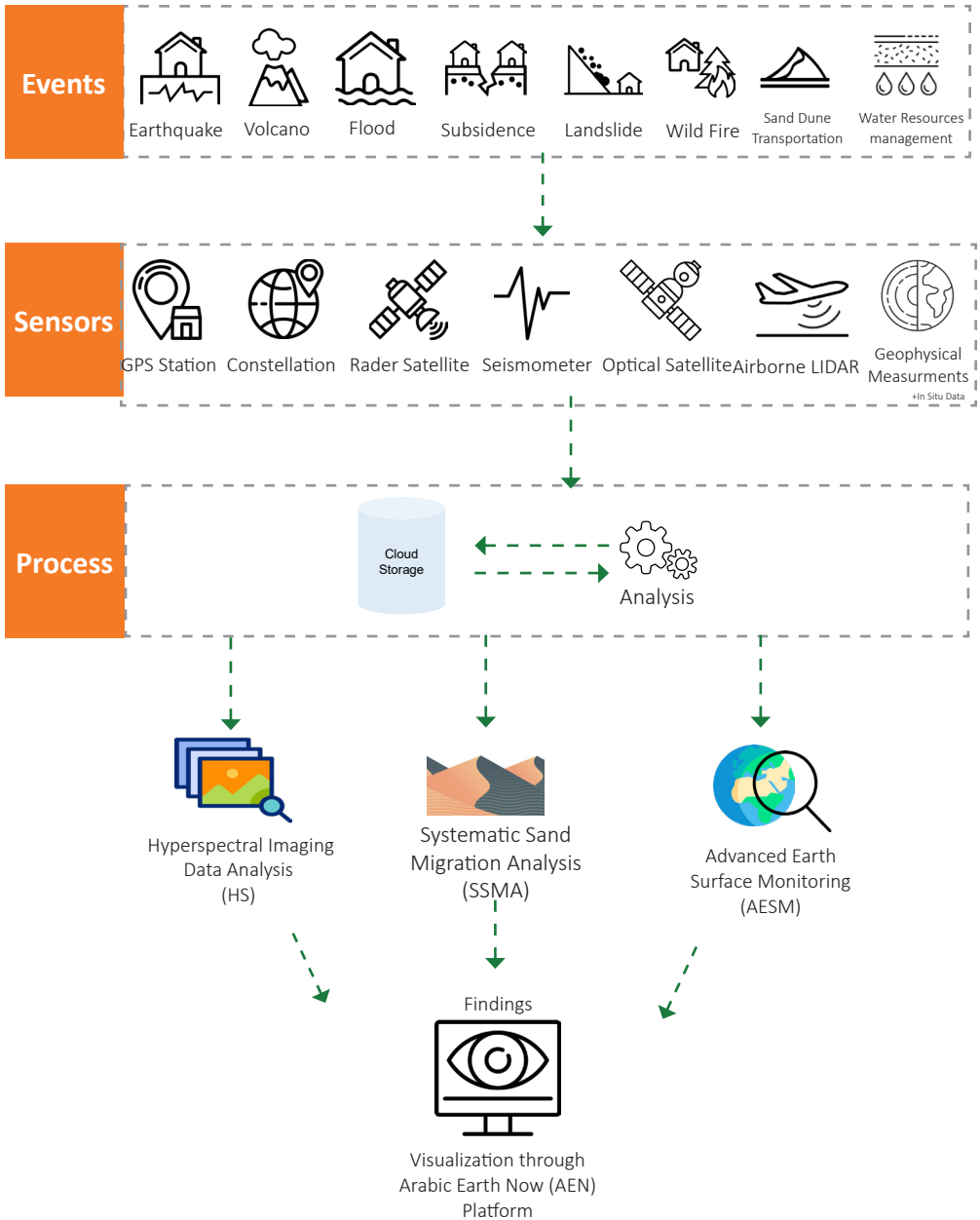
Partner:

Caltech is the leading institution in the field of geophysics and space science, it has been selected by NASA to operate the Jet Propulsion Laboratory (JPL).

Directors:

Charles Elachi

Majid Albahkali



How CE²S² Projects come together

Advanced Earth Surface Monitoring (AESM)

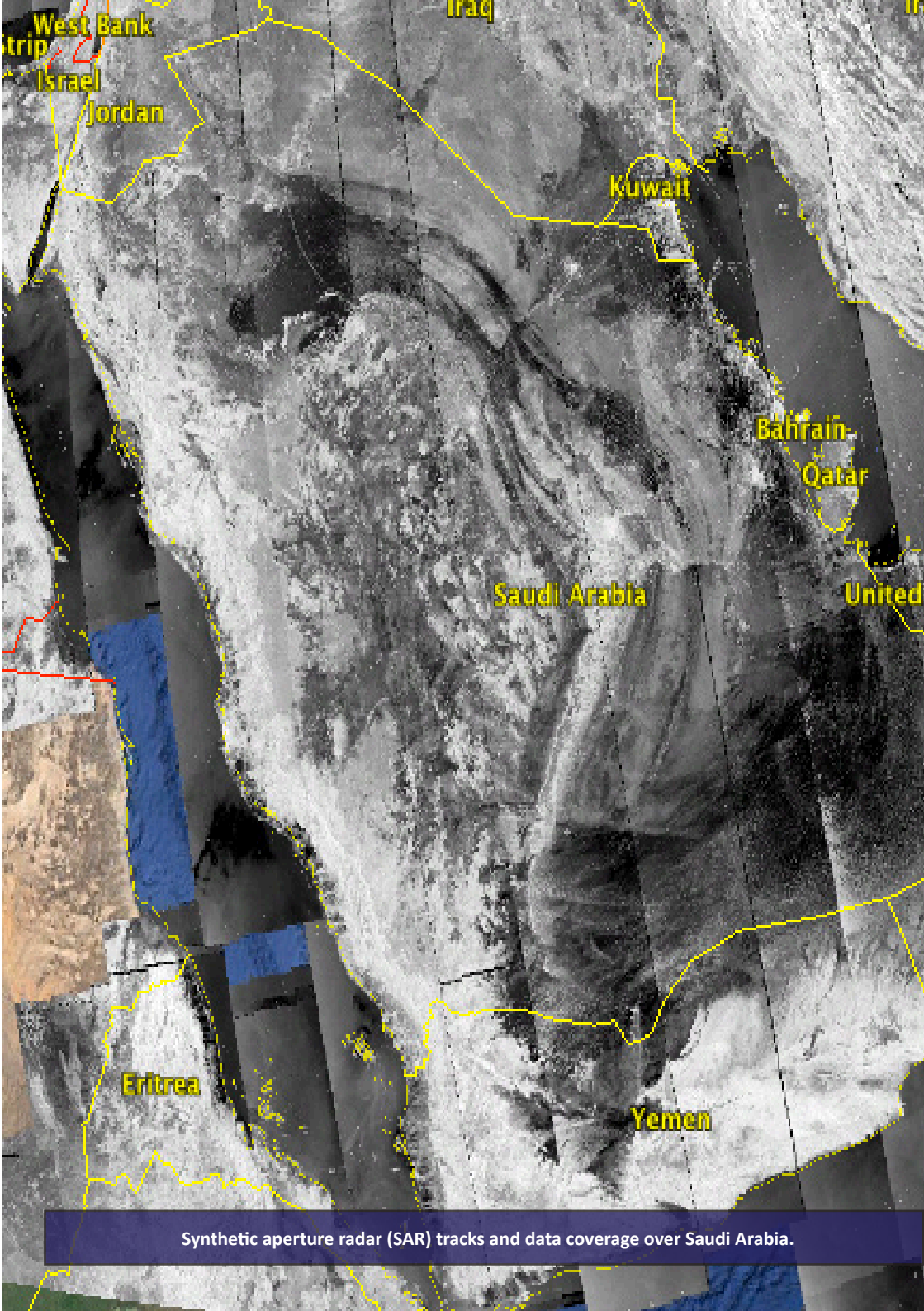
The dramatic expansion in the quantity of available Earth Observation (EO) data combined with advancements on satellite sensors enabled a synoptic and high-resolution perspective on changes at the Earth's surface associated with both natural and anthropogenic processes.

Interferometric synthetic aperture radar (InSAR) technology has been used to identify and monitor sources of deformation and mass change associated with a range of processes. These maps enable monitoring surface changes periodically as function of time, by which they benefit diverse government and industrial sectors.

For instance, the Ministry of Interior can benefit from Damage Proxy Maps (DMPs) developed from this project which will provide the ability to quickly assess devastation from large natural disasters such as earthquakes, floods or volcanos for first responders enabling effective disaster management strategies. Furthermore, monitoring subsidence along pipeline routes for critical urban infrastructure such as water or oil pipelines and in performing operational hazard assessment on mining induced activities.

KACST-PI:

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Arabic Earth Now (AEN)

Arabic Earth Now (AEN) is an interactive Arabic geo-visualization platform developed in collaboration with NASA and Caltech. The project has progressed through multiple releases and continues to evolve with ongoing enhancements in features, datasets, and research integration.

AEN displays the current and projected locations of NASA's Earth-observing satellite fleet and visualizes their data in near real-time and from historical archives. Users can monitor key Earth indicators such as global surface temperature and atmospheric carbon dioxide, and explore major environmental events including sandstorms and hurricanes through geo-located satellite imagery. The platform also presents three-dimensional visualizations of Earth-observing satellites, including SaudiSat-4.

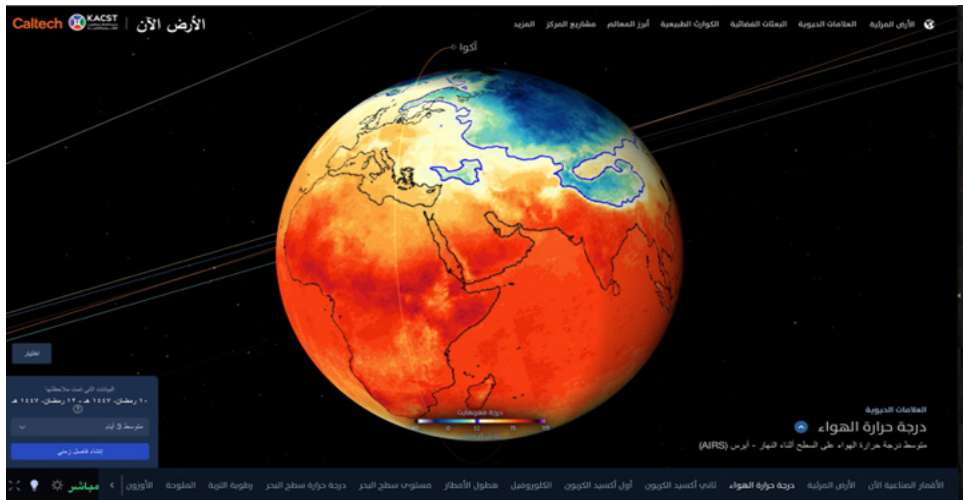
Beyond global datasets, AEN integrates national and research-focused components. It includes Points of Interest (POIs) featuring satellite images captured by KACST across Saudi Arabia and visualizes outputs from Center projects (AESM, SSMA, and HS), including methane emissions time-series analysis, topography maps, sand dune movement models, and an earthquake catalog with magnitude and depth information.

Platform link:

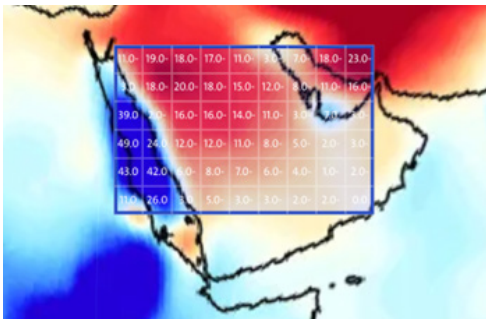
<https://ce2s2.caltech.edu/earthnow-ar/#/>

KACST-PI:

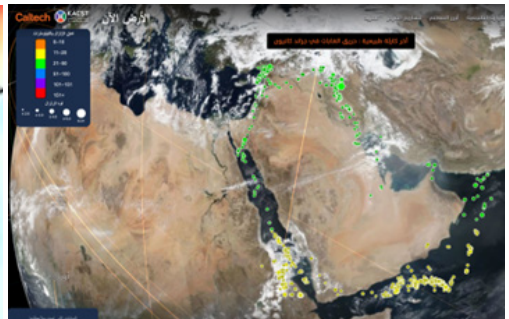
Nouf A. Alsinan (nalsinan@kacst.gov.sa)



Arabic Earth Now interface



Data Extraction feature



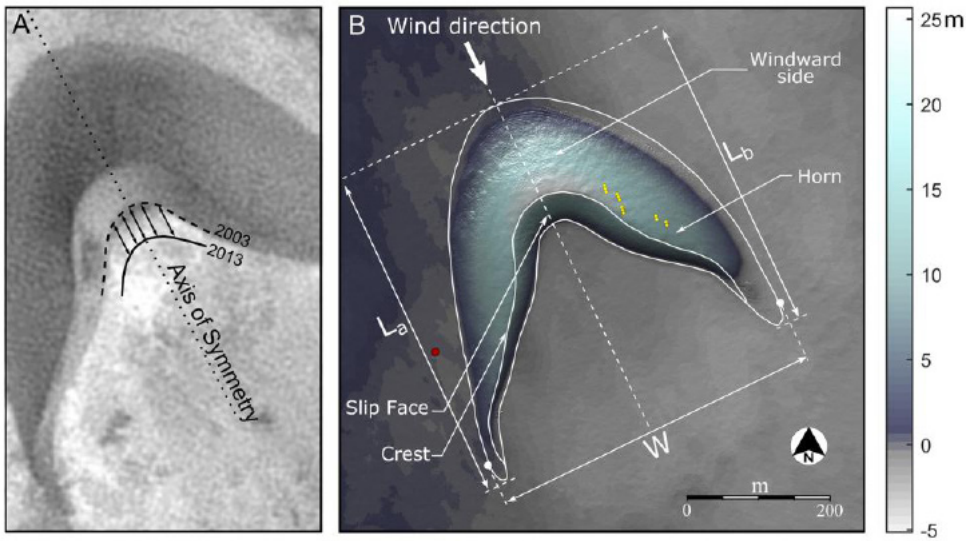
Earthquake catalog

Systematic Sand Migration Analysis (SSMA)

The study of dynamic processes of sand dunes is of a prime importance to the kingdom of Saudi Arabia. The landscape of the Arabian Peninsula has mostly evolved under the action of Aeolian processes since the end of the early Holocene wet period. This has resulted in the development of extensive dune systems across the peninsula (source areas, transport pathways, sand seas and dune fields). These areas of sand activity are also the source area of atmospheric dust leading to some feedback between sand system dynamics and seasonal climate in the region. Understanding the sand transportation phenomenon will facilitate creating a local model for determining the migration of smaller scale (ripples) and larger scale bedforms (megadunes) to accurately track and predict the sand dunes migration process. These studies would benefit environmental sciences to identify and model the relationship between dust emission and sand transportation and of great benefit to planetary as dune systems are common in the Solar system.

KACST-PI:

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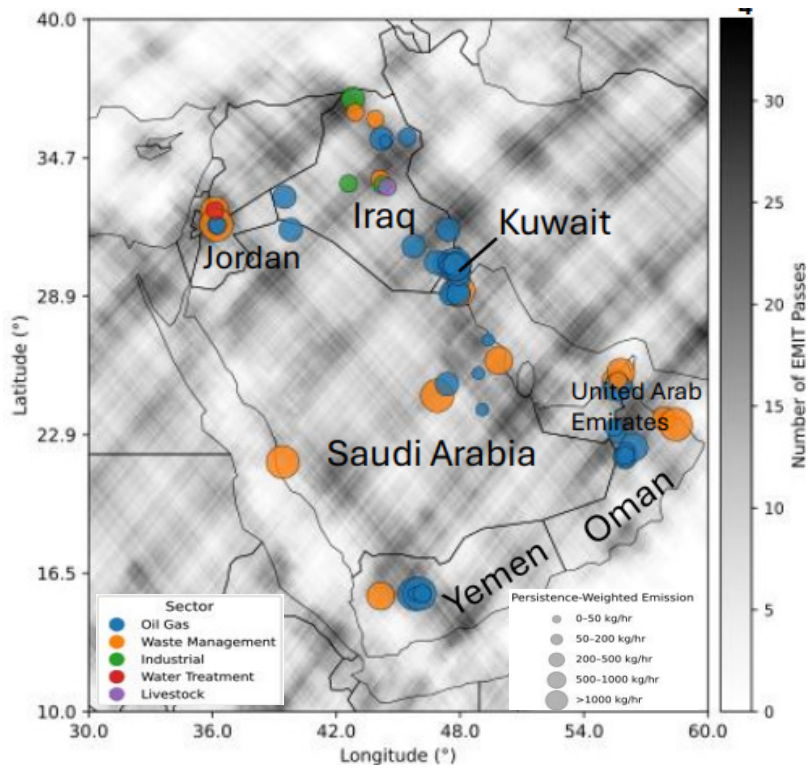
Modeling of Aeolian Sand Transport

Hyperspectral Imaging Data Analysis (HS)

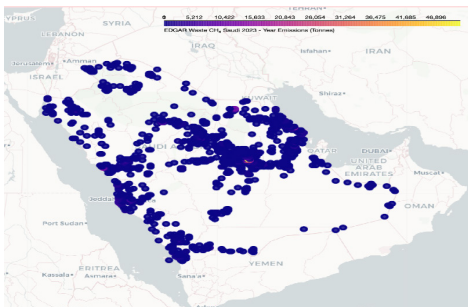
Saudi Arabia faces significant challenges resulting from climate change, placing increasing pressure on environmental sustainability and natural resources. This project employs hyperspectral remote sensing based on satellite Earth observation data to identify high-emission areas, assess seasonal variability, and analyze surface mineral composition, supporting efforts to reduce the negative impacts of greenhouse gas emissions while also contributing to improved understanding of mineral distribution relevant to sustainable mining activities. Advanced analytical techniques are applied to enhance the spatial detail and reliability of emission assessments. By mapping emission patterns, identifying key sources such as waste sites and hydrocarbon-related activities, and providing insights into surface mineral characteristics, the project supports emission reduction initiatives, sustainable mineral resource management, and informed environmental policy development.

KACST-PI:

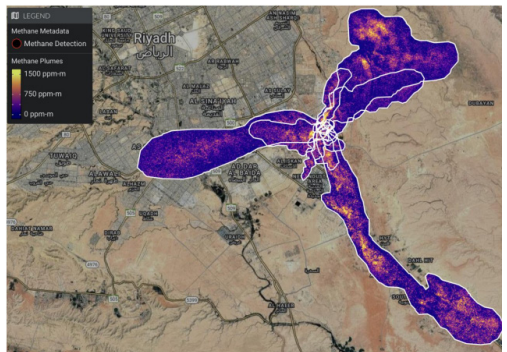
Dr.Abdullah W. Taher (ataher@kacst.gov.sa)



Emission Rates from Detected EMIT CH₄ Plumes



GFEI – EDGAR | Methane Emission Areas in the Arabian Peninsula



Riyadh, Saudi Arabia Landfill

For any further inquiries about the projects please contact the kacst-PI's or the center's co-director
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