→ INFRASTRUCTURES PLANNING AND MONITORING
USER CONSULTATION CONFERENCE 2019

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EARTH OBSERVATION – A SUPPORT FOR THE DISTRIBUTED ENERGY SECTOR (MICRO-/ MINI-GRIDS)

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26/02/2019

Corresponding project

INTEGRATED APPLICATIONS FOR MICROGRIDS IN DEVELOPING ECONOMIES

(ESA AO/1-8891/17/UK/AD; category ESA Express Procurement Plus - EXPRO+)
European Centre for Space Applications and Telecommunications (ECSAT)

funded by

project team

TFE Energy

Corresponding project

Integrated Applications for Microgrids in Developing Economies

- Identification of requirements of Microgrid developers
- Initial geographic focus on Indian market, extended to Sub-Saharan countries
- Draft setup of an overall service chain
- User engagement: questionnaire to raise discussion on thematic needs & exchange on present solutions

Micro- or Minigrids are …

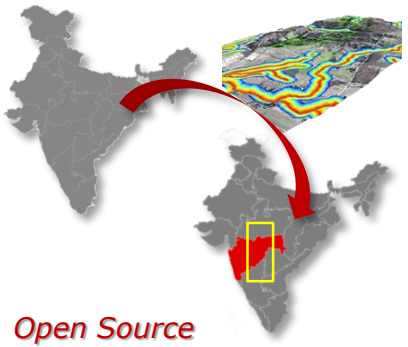
… distributed energy systems, capable of generating

- 1-10kW (Microgrid)
- 10kW – 1MW (Minigrid)

Requirements according to scale

STAGE 1 — National/ Super-regional

draft segmentation



Open Source

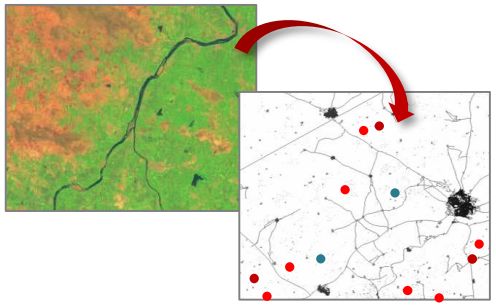
- *GIS data (infrastructure, statistics)*
- *Global layer (thematic classific. (WSF/GUF, LULC …)*
- *Geofactors (climate, terrain, sun irradiance …)*
- *Local Policies*

PLATFORMS, AGGREGATION APPROACHES

Conflict: actuality, scale; thematic detail

STAGE 2 — Regional

up-to-date situation analysis



HR data analysis (Sentinel)

Focus of Services:

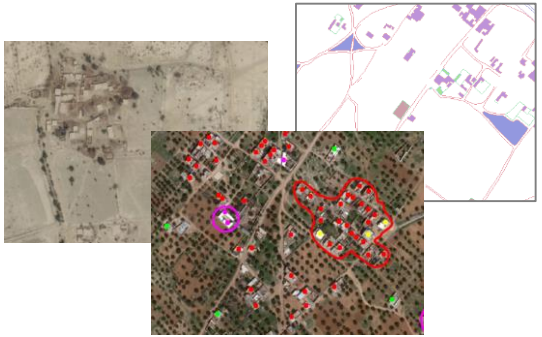
- *up-to-date situation data (infrastructure, urban extent, agricult. productivity, risk exposure, …)*
- *supported by open source if applicable*

UP-TO-DATE LOW-COST INFORMATION, CHARACTER & PRODUCTIVITY PROXY OF WELL-BEING

Conflict: LOD; costs; local survey is necessary

STAGE 3 — Local (Microgrid level)

detailed status analysis



Human (& VHR data analysis)

On-site Survey:

- *up-to-date detailed demand assessment (housing details, economic aspects, risk exposure, …) – VH LOD*
- *wide initial selection – best fit chosen*

LOCAL SOLUTIONS (HUMAN IMPACT), FINAL SITE SPECIFICATION

Finding the right place to act

Region of Interest

general circumstances

Climate

Water situation

Terrain

Hazards

MicroGrid Developer

Interests

Focus

Possibilities

Experience

investors requirements

EO Services

large scale aspects

Landuse/ landcover (LULC)

Settlement extent

Transport infrastructure

Agriculture

Terrain data

Industrial activity

Hydrology data

Annual behaviour of classes

Energy potential map (solar, wind, biomass)

Open source Geo-data

Maps

LULC

status numbers

Census

Statistics

Transport infrastructure

Main GRID

Administration

Settlement extent

Reports

Other infrastructure

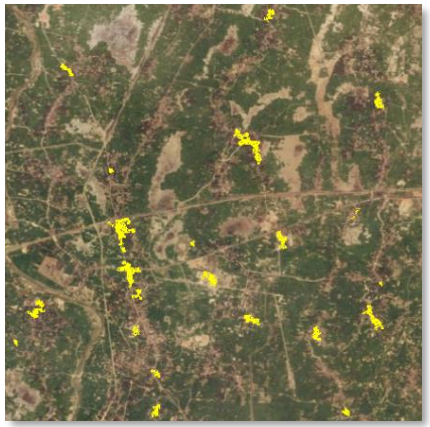
Considering the context

Infrastructure

distribution
(transport, grid)

… accessibility

People



urban footprint &
type

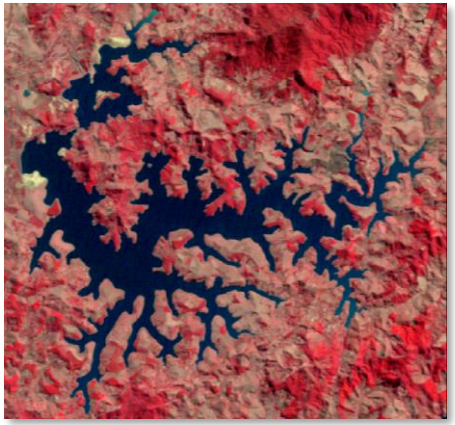
… number of users

Resources

land use &
annual change

… production potential

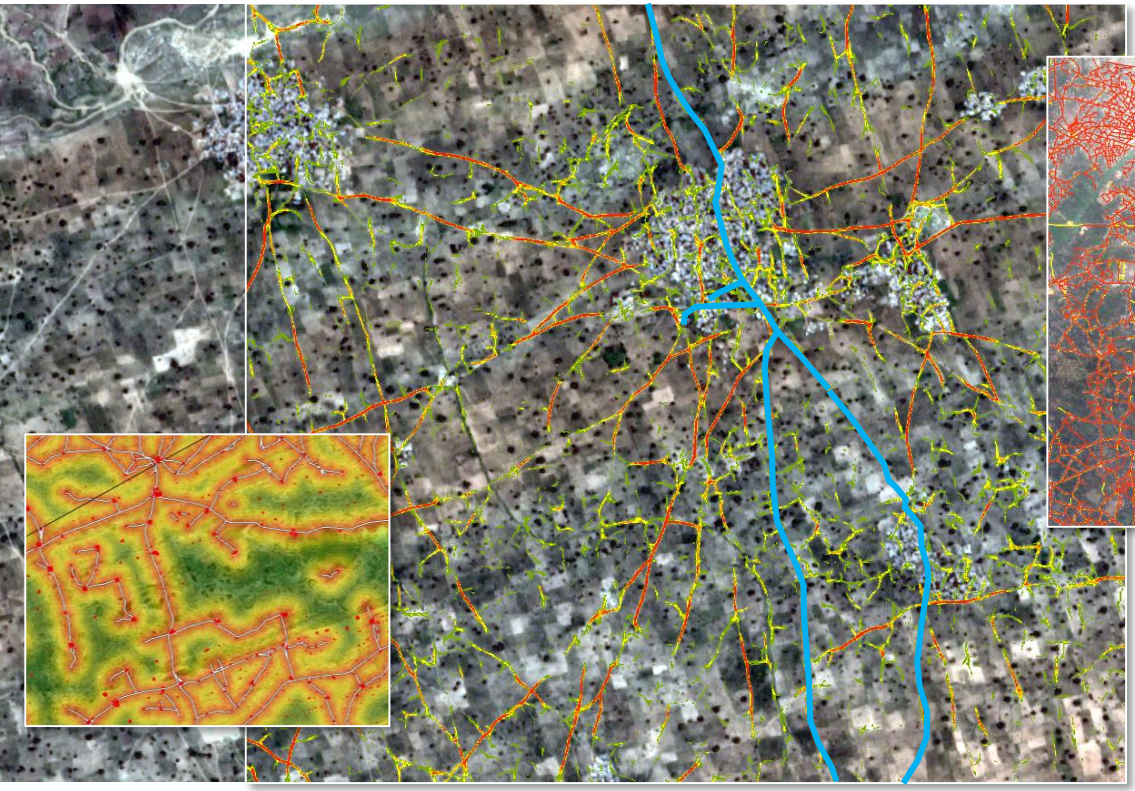
Risk



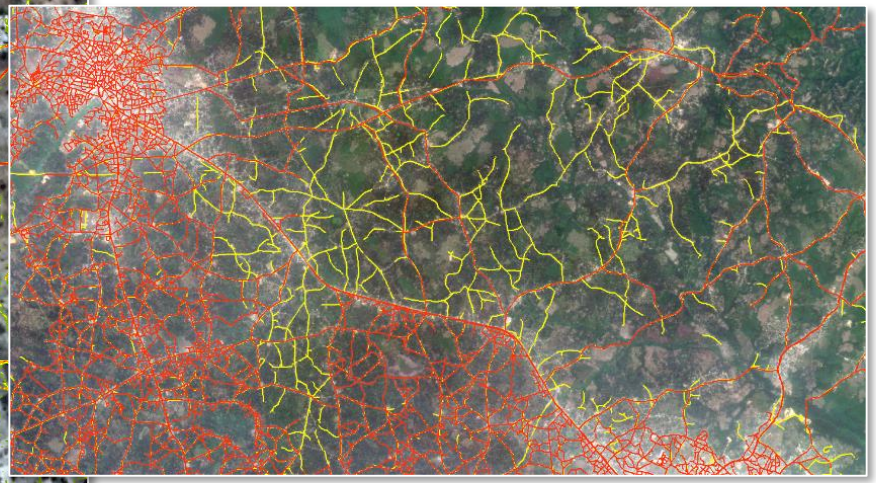
hazard type &
long-term tendencies

… temporal change

Considering the context



Infrastructure



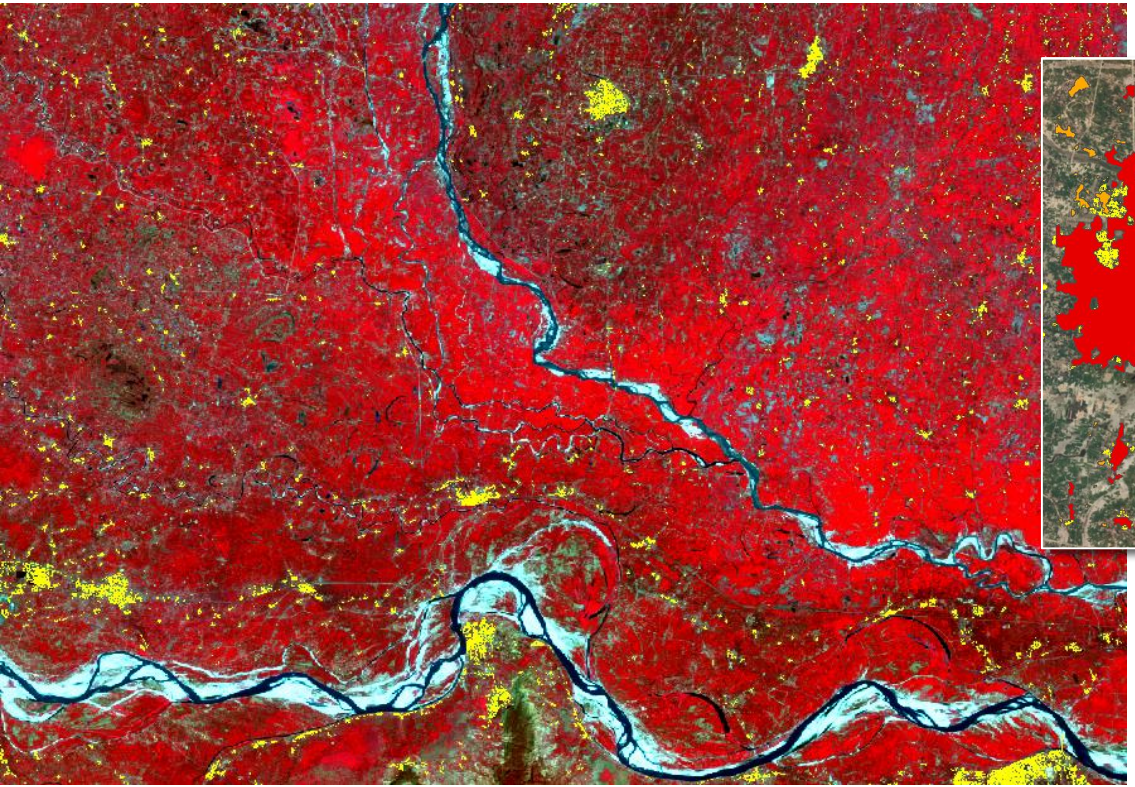
Open source GIS
(transportation network)

Machine Learning
(road network)

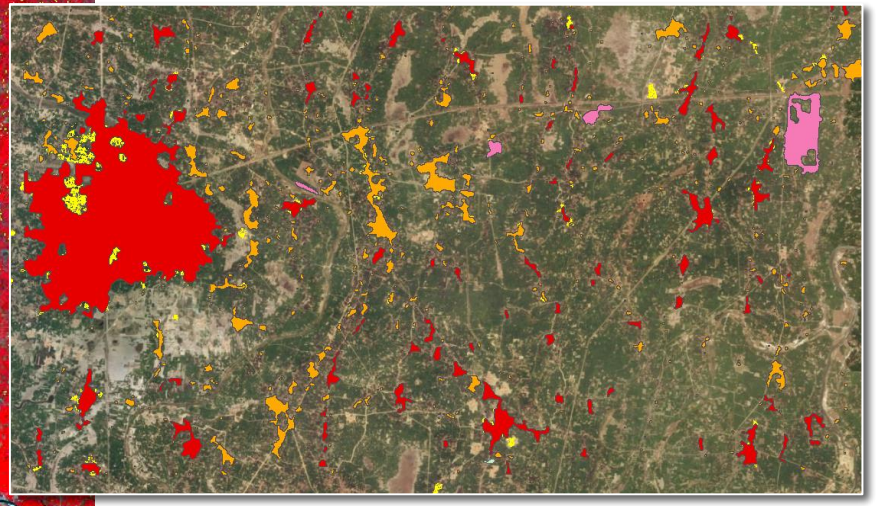
Distance analysis

© Planet Scope

Considering the context



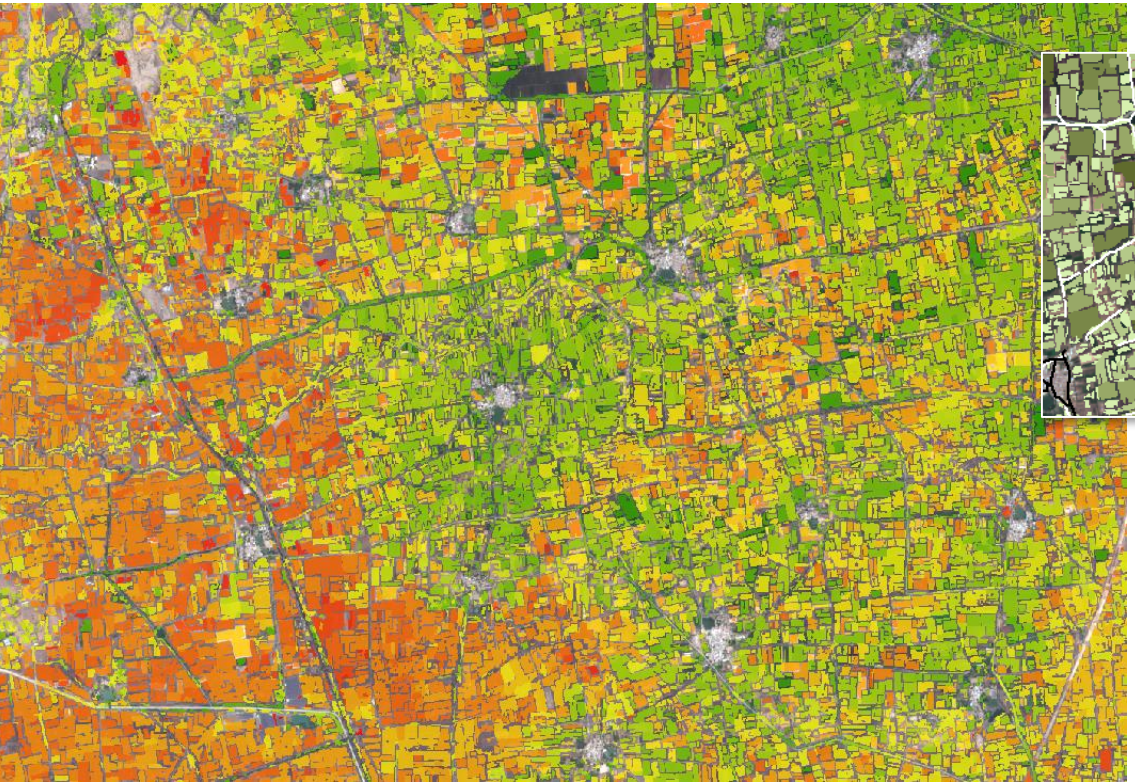
People



Global Layer

Urban (dense)
Urban (sparse)
Industrial construction

Considering the context



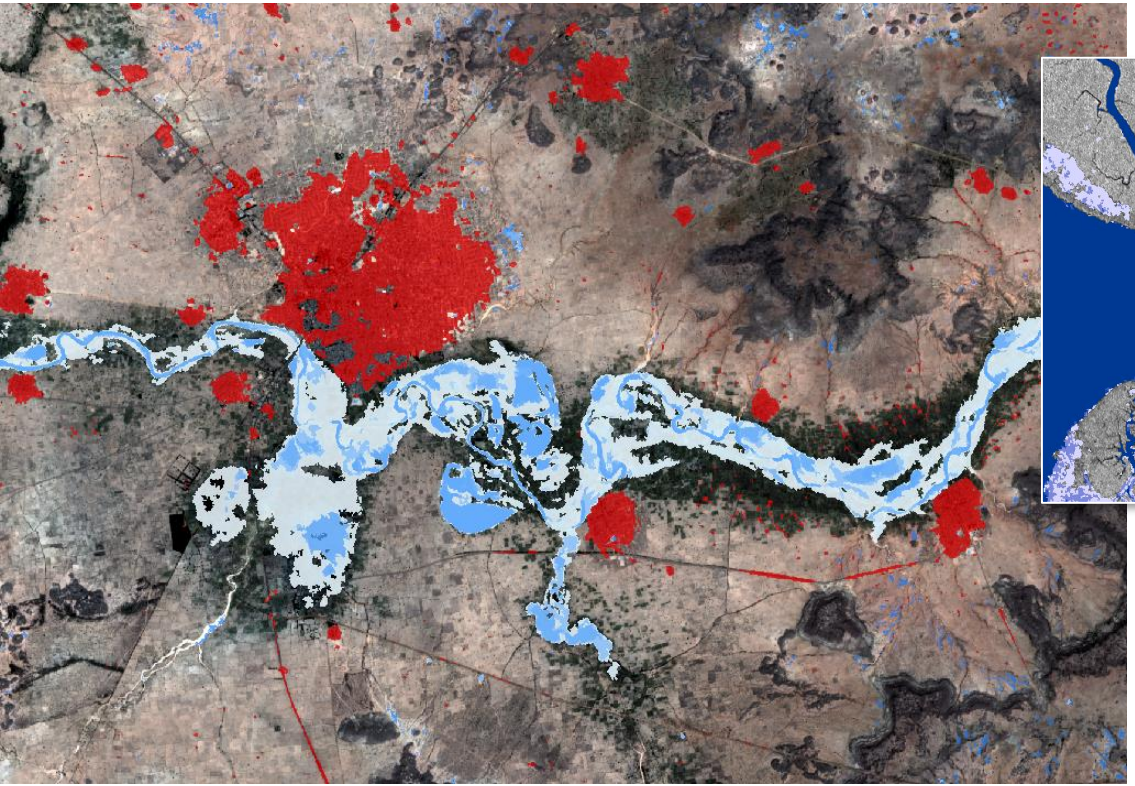
Resources

Characterisation of agricultural use, e.g.

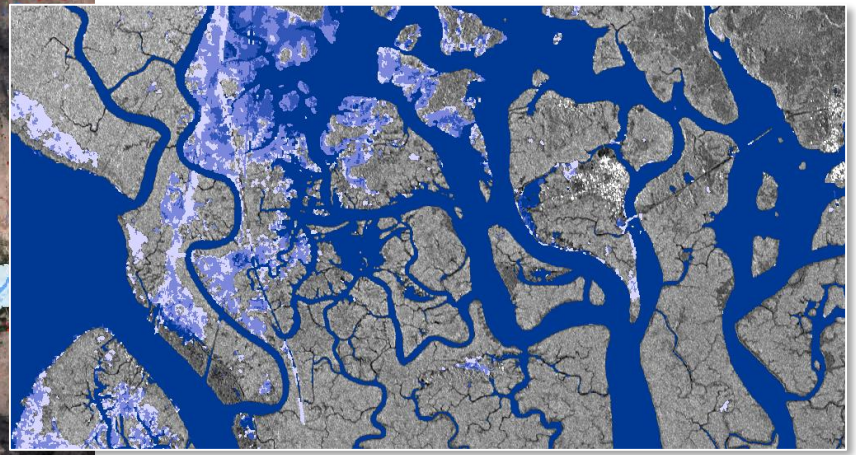
According to vitality (biomass, productivity)
→ Biomass? Ability to pay?

According to management (size)
→ Production characteristics, ownership

Considering the context



Risk



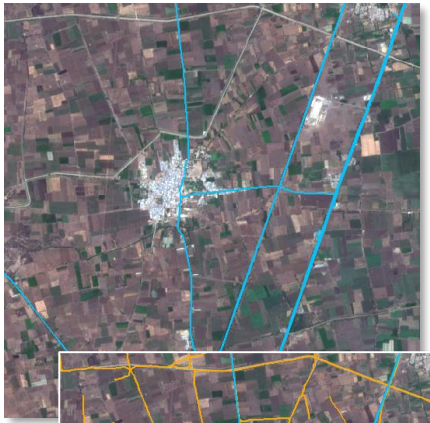
e.g. availability and exposure to water

… other aspects (terrain, …)

Water body (recent flooding)

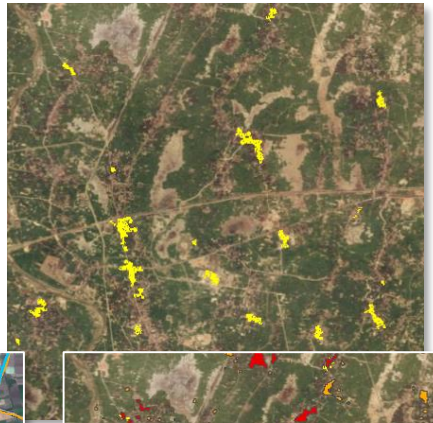
Considering the context

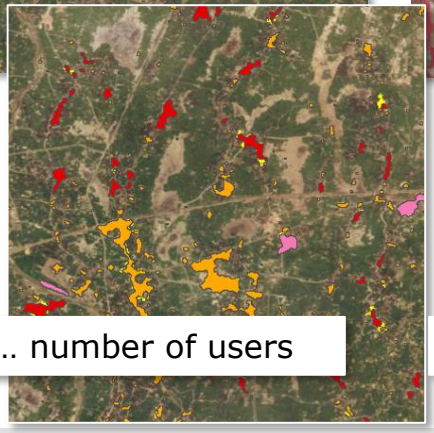
Infrastructure



… accessibility

People



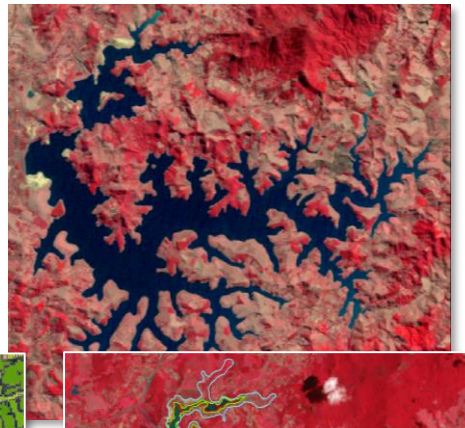


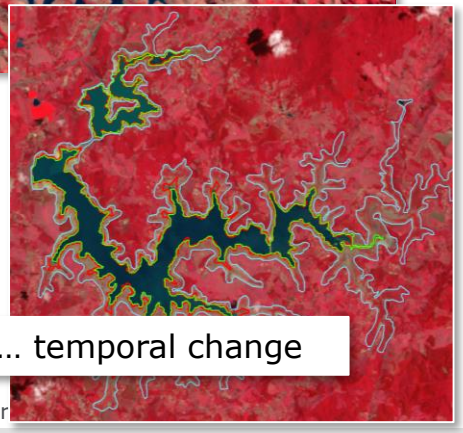
… number of users

Resources

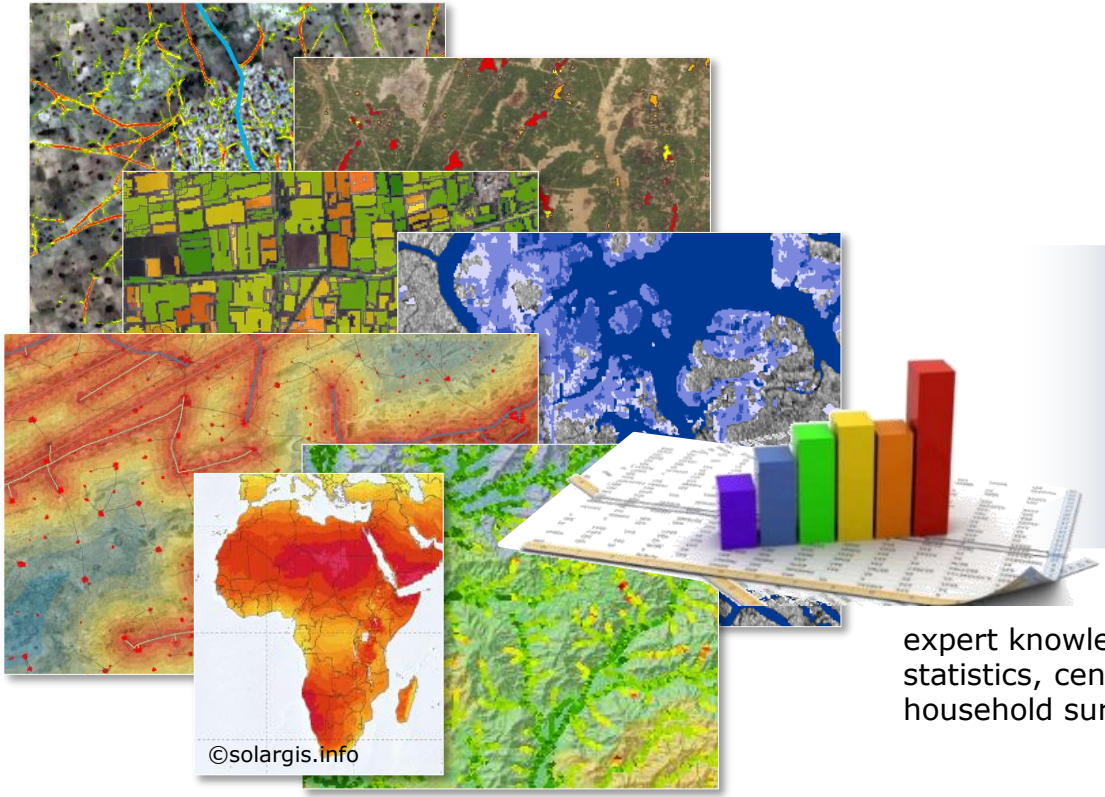
… production potential

Risk





… temporal change



expert knowledge,
statistics, census,
household survey, ..

Requirements **DEVELOPER**
Interests
Experience **Possibilities**

Village Data Analytics

Site Identification as a function of

Village size
hamlet … city

Accessibility
infrastructure distance

Resources
dominant size of fields
potential crop type, …

Risk
natural flooding
drought

Other aspects

Energy demand modelling

Village Data Analytics (ViDA) …

… analyzes resources and energy demand of each village

… lead to ranking of villages (scoring of the modelling tool)

… includes ground-truth & survey-data
to continuously improve the prediction model (AI, feedback loop)

→ support the decision making process

→ tailored to developers requirements

from hearsay to data-driven decisions

AI powered energy demand modelling

Approach (ViDA) …

… **combines** common image analysis methods (object/ pixel-based) with AI algorithms for EO analysis & ViDA energy modelling

… **supports** cost projections for Microgrid Management (Setup, Operation and Maintenance)

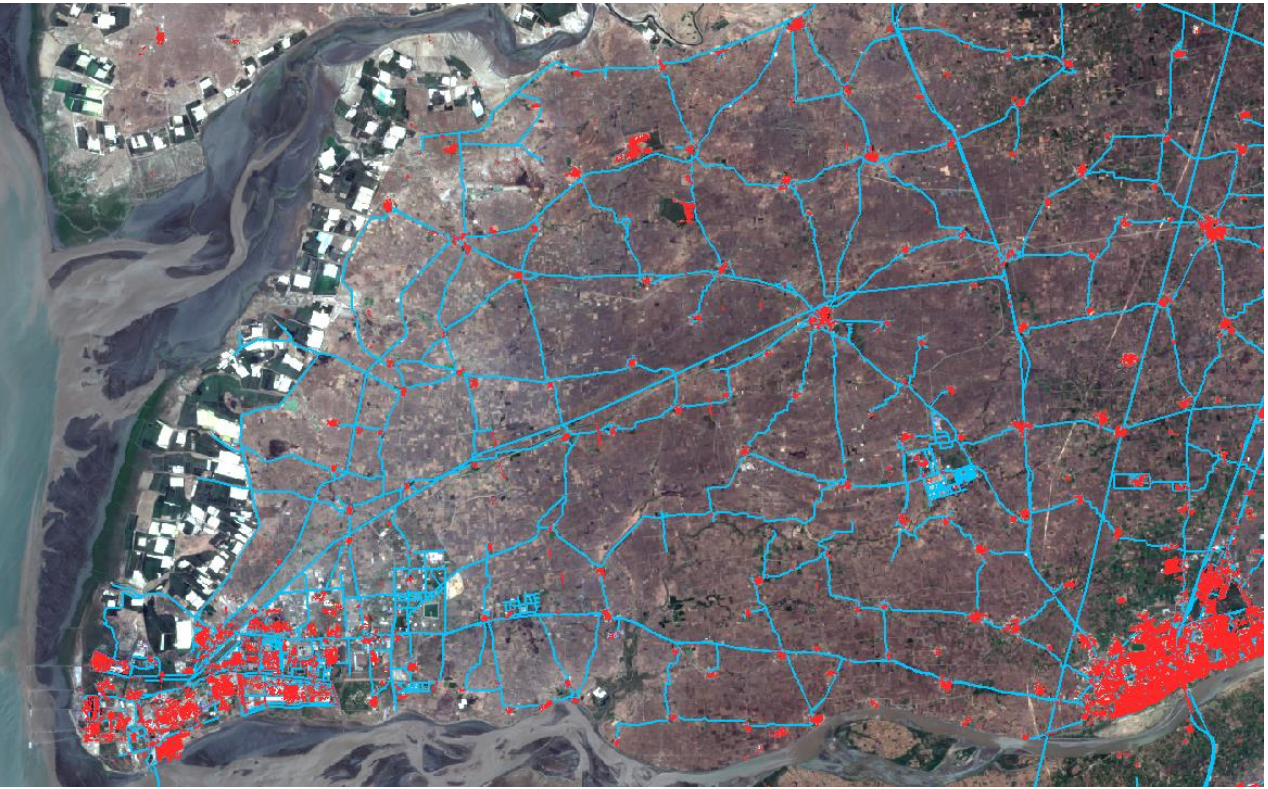
Consortium …

… **able to support** telecommunication issues (IABG runs SatCom Environment)

providing internet (tele-health/-education) if needed

to contribute to monitoring Microgrids

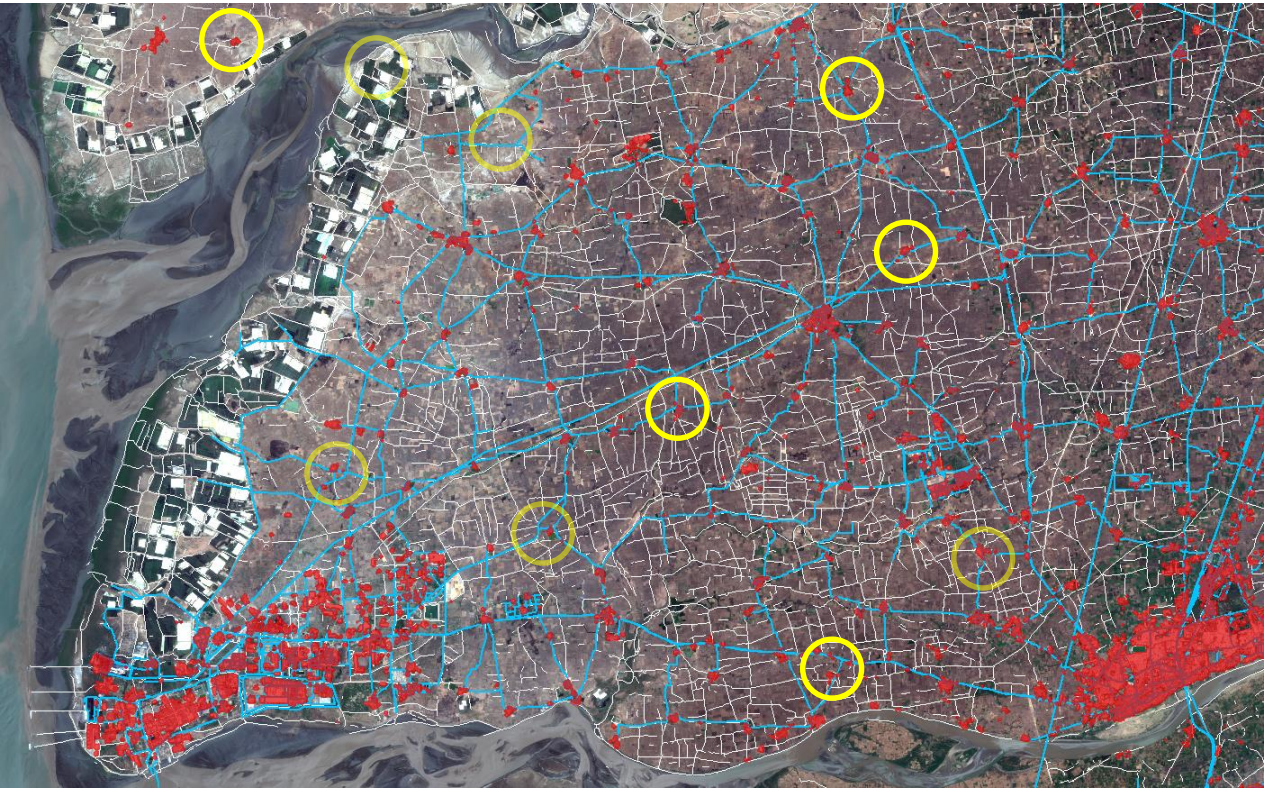
Village Data Analytics – open data



→ Open Source Data

© Open Streep Map
© Global Urban Footprint

Village Data Analytics – update using Sentinel



Sentinel & other spatial data

+ open Data
+ Analysis
  (example urban, infrastructure)

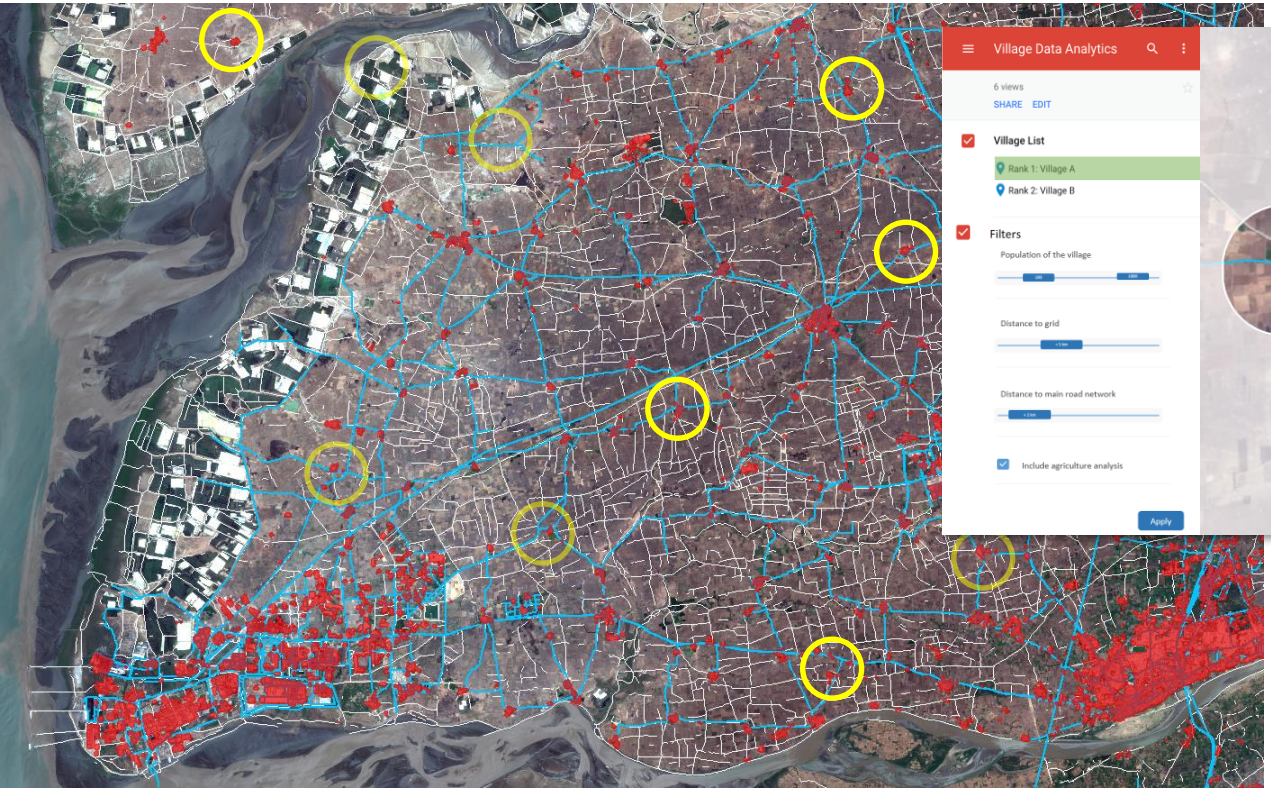
→ Ranking …

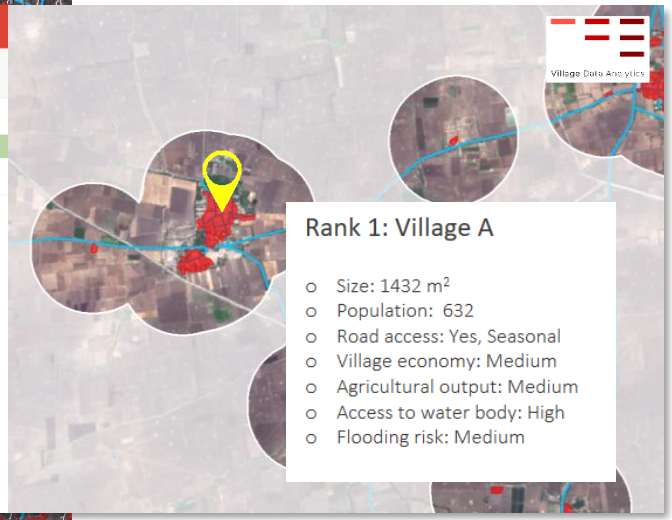
… represents the estimated energy demand,

… considers up-to-date contextual situation (EO based),

… assumes general ability to pay, development potential

Village Data Analytics - Analysis





Decision support for Microgrid developer

→ More precise than Stage 1 (national level)

→ Input for Stage 3
(on-ground survey/ dialogue)
will reduce on-site effort needed

Project to be continued …

- user needs are identified/ sketched to high degree
  → converted to a draft processing chain
- Energy demand assessment can be reviewed with the new information layer
  → different information layer available (Sentinels, new technologies)
- Working on automation of the image analysis elements
  → scalable services → continue with extended case studies
- Continue dialogue with the distributed energy sector → feedback

THE GLOBAL GOALS
For Sustainable Development

SDG 7: affordable and clean energy

→ energy = essential need for economic & social well-being

→ electrification Tanzania 15%, Kenya 23%, Nigeria 55%
[Global Energy Architecture Performance index report 2017]

Thank You!

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