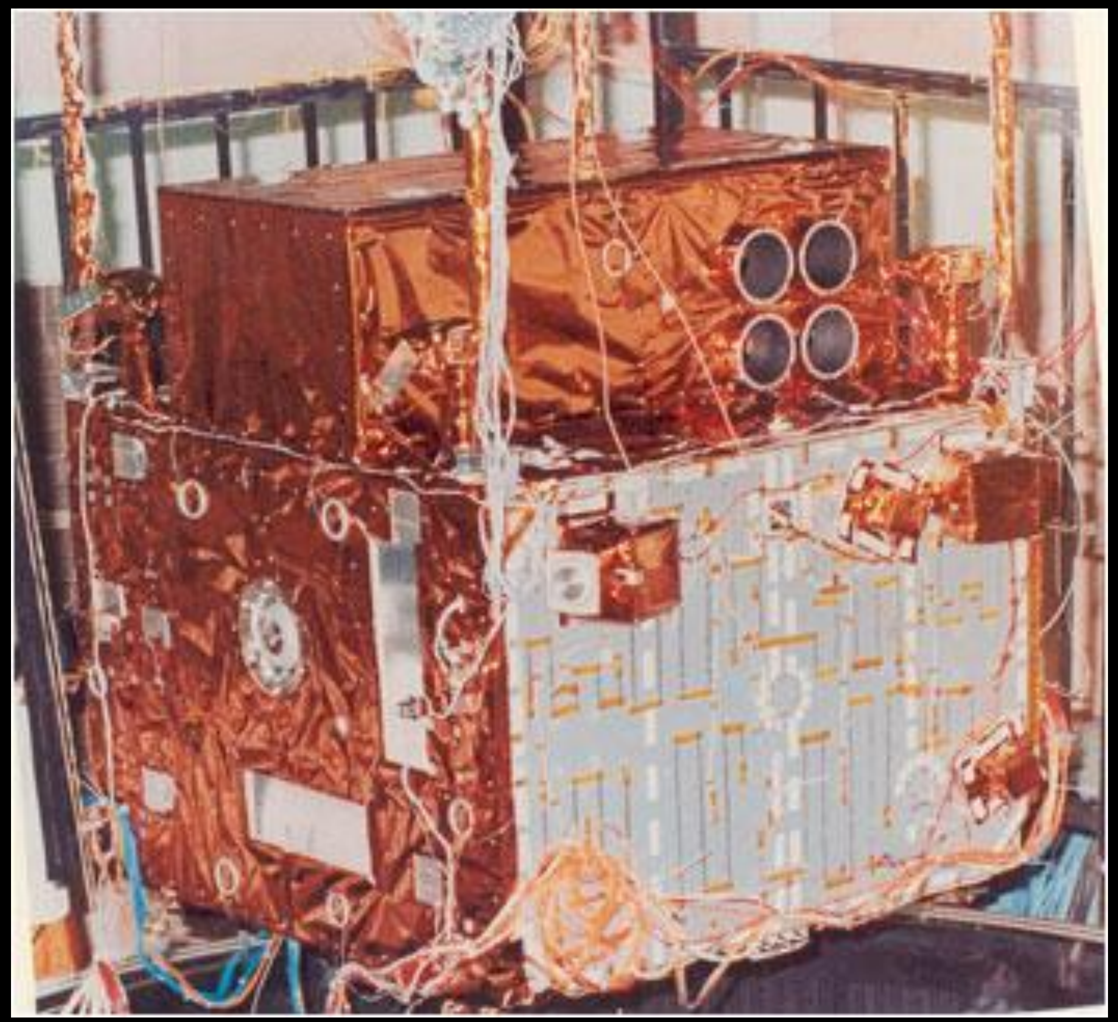
Combining Social, Environmental and Design Models to Support the Sustainable Development Goals

space enabled

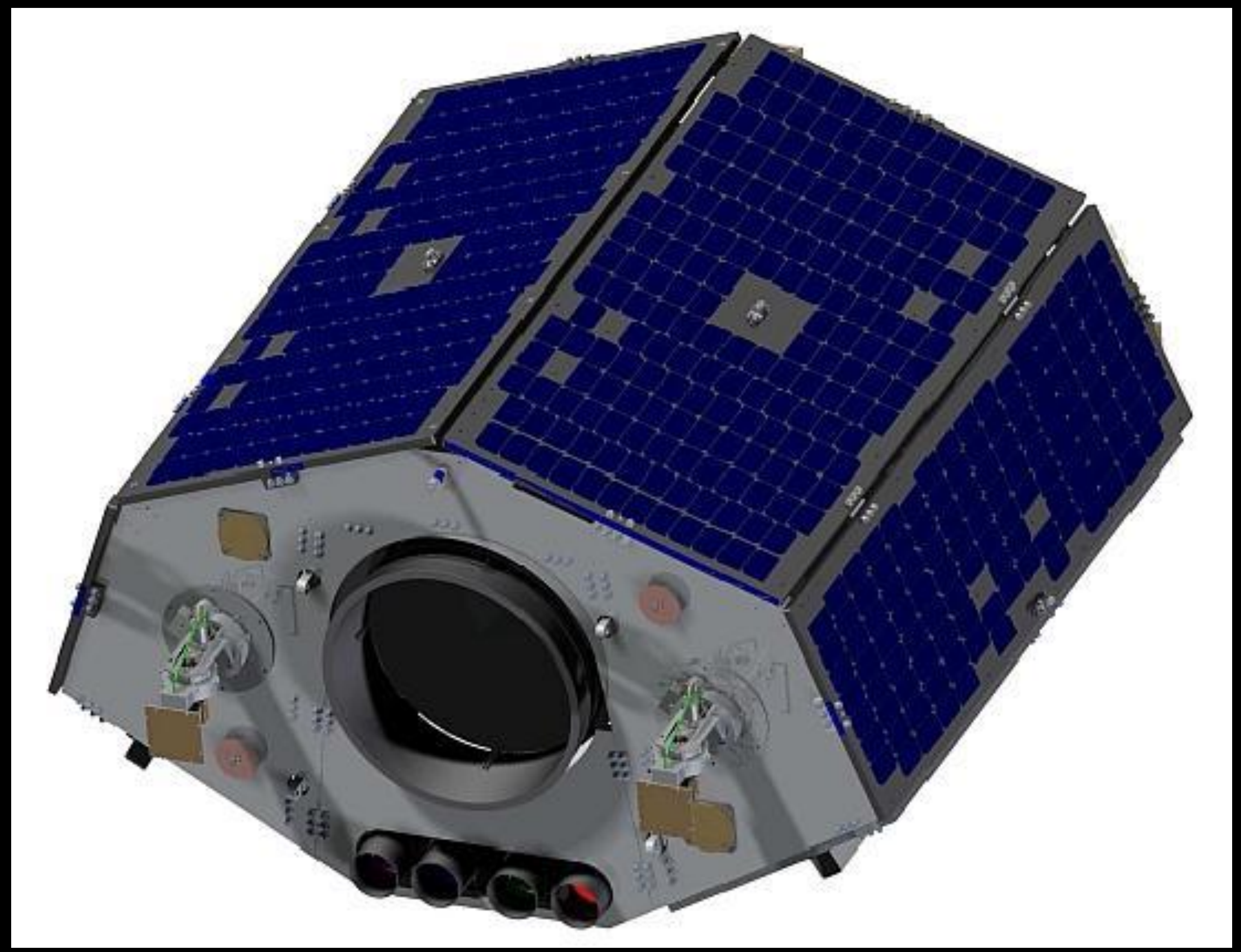

1 NO POVERTY
2 NO HUNGER
3 GOOD HEALTH
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 RENEWABLE ENERGY
8 GOOD JOBS AND ECONOMIC GROWTH
9 INNOVATION AND INFRASTRUCTURE
010
011
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE AND JUSTICE
17 PARTNERSHIPS FOR THE GOALS
THE GLOBAL GOALS
For Sustainable Development

IRS-P2



"National Natural Resources Management system - an integrated resource management system aimed at optimal utilisation of country's natural resources by a proper and systematic inventory of the resource availability using remote sensing data in conjunction with conventional techniques"

NigeriaSat-2



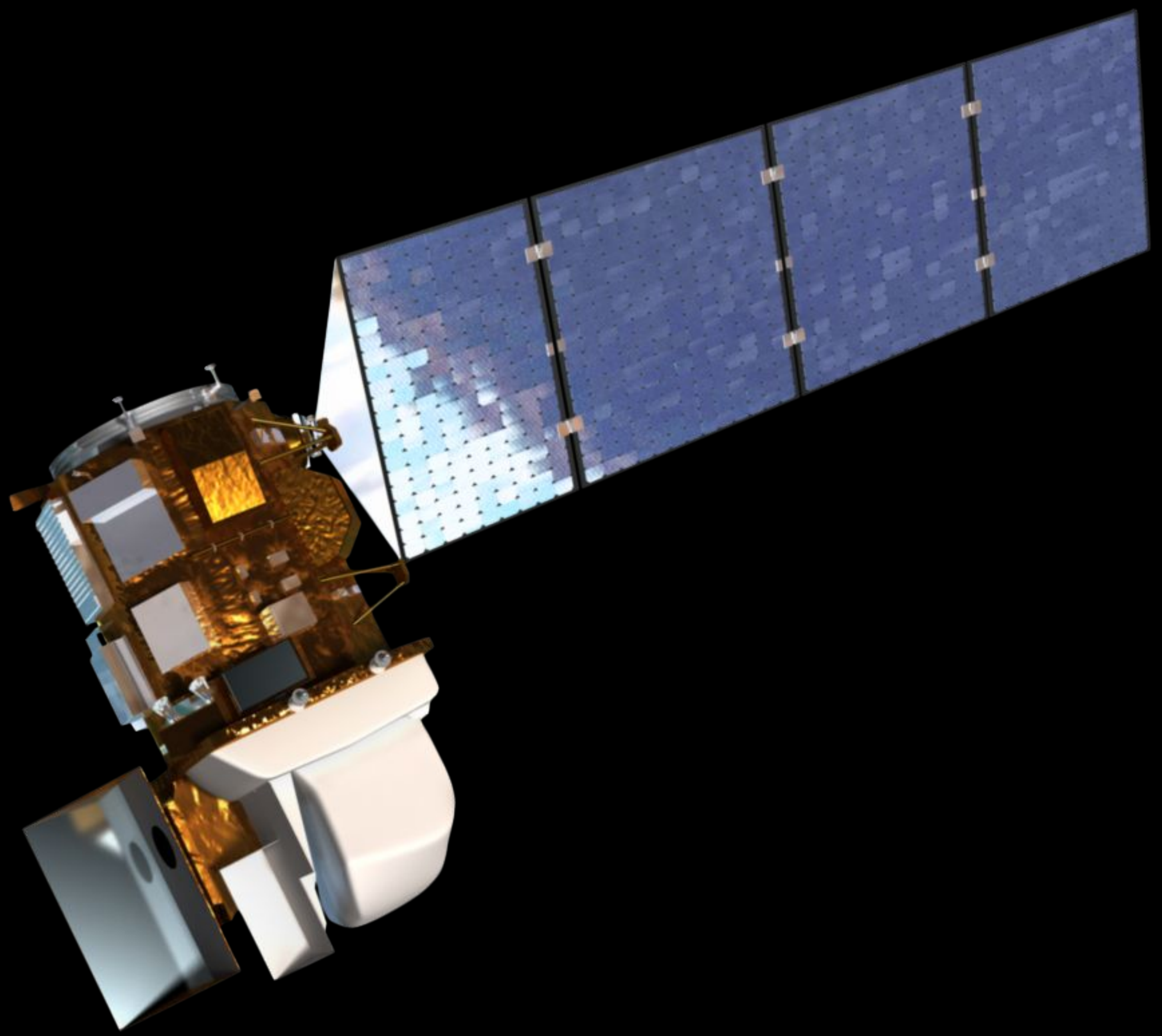
"Nigeria Sat-2 is designed with some key Nigerian objectives in mind:

- To support food supply security, agricultural and geology applications
- To support mapping and security applications
- To provide continuity and compatibility with the existing NigeriaSat-1 system"

Kasturirangan, K. (1995). *Remote Sensing in India-Present Scenario and Future Thrusts*. *Photonirvachak Journal of the Indian Society of Remote Sensing* (Vol. 23).

Da, A., Curiel, S., Carrel, A., Cawthorne, A., Gomes, L., Sweeting, M., & Chizea, F. (2012). Commissioning of the NigeriaSat-2 High Resolution Imaging Mission. In *Small Satellite Conference*. Logan, UT: AIAA/Utah State University .

Landsat 8



- Pixel Size: 15m/30m/100m (panchromatic/multispectral/thermal)
- Scenes/Day: 700
- Scene Width: 185 km (pushbroom)
- Overpass Frequency: Every 16 Days (8 with Landsat 7)
- Spectral Frequencies: Visual and Infrared (Both Short and Long)

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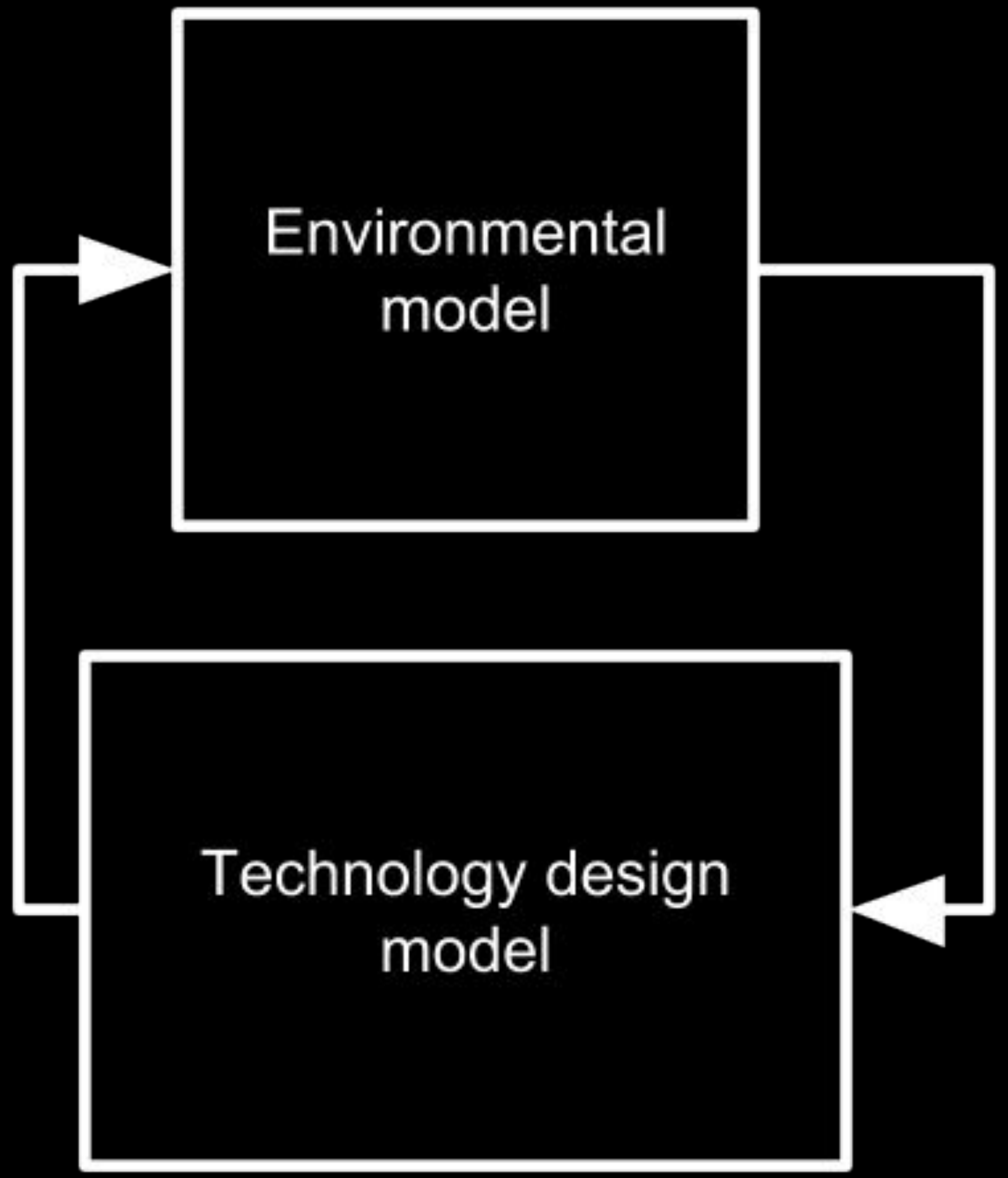

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Emergency	Phase	Spatial Resolution	Time Resolution
Floods	Monitoring	30–100 *m*	12 *h*
	Management	10–100 *m*	3–12 *h*
Landslides	Monitoring	30–250 *m*	1 *d*
	Management	10–100 *m*	3–12 *h*
Earthquakes	Management	1–100 *m*	3–12 *h*
Volcanoes	Monitoring	30 *m*	1 *d*
	Management	10–30 *m*	6 *h*–1 *d*
Fires	Monitoring	100 *m*	1–3 *h*
	Management	30 *m*	0.25 *h*
Sea pollution	Monitoring	1 *km*	1 *d*
	Management	100 *m*	6–12 *h*
Border monitoring	Monitoring	1–10 *m*	3 *h*
Humanitarian Emergencies	Management	1–10 *m*	1–3 *h*

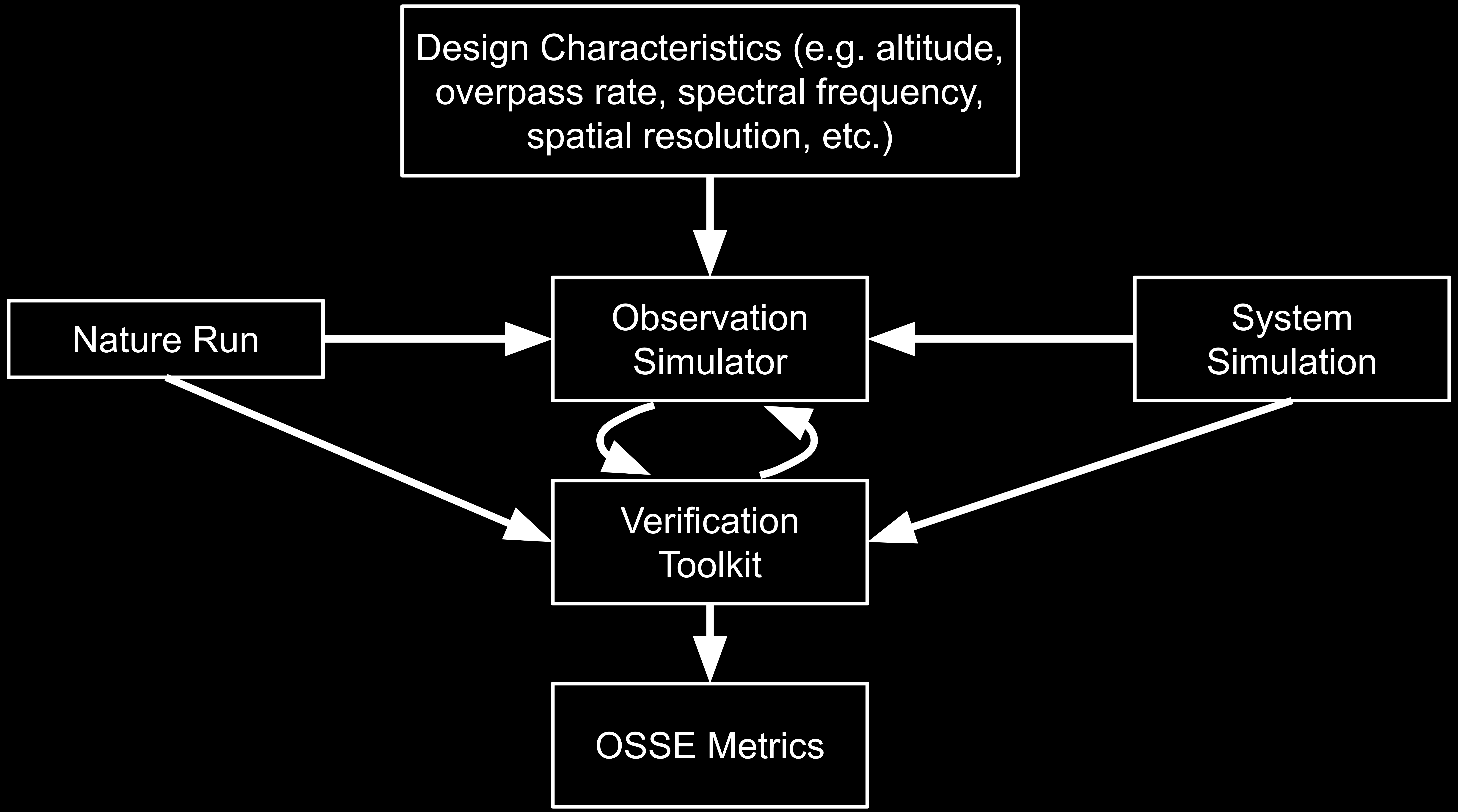
#	User requirements	Sensor requirements		
		Spatial resolution	Spectral resolution	Temporal resolution
1	Agriculture, climate, environ.	3–5 m	Multi-spectral	Montly, summer/winter
2	Environmental Impact Assessment, Farmer Settlement, housing, planning and urban planning, Border Monitoring	0.6–1 m	PAN, RGB	p.a., every 1–2 yr
3	Disaster monitoring	1–250 m	Pan, VIS, NIR, MIR, TIR	2 per day (night and day)
4	Land use/cover mapping	0.5–5 m	Pan	1 per 2 days
5	Water management, Land use and Land care	10 m	Multi-spectral	bi-annual, quarterly
6	Managed Agriculture	< 3 m/ < 40 m	VIS, NIR/-SWIR	1 day–2 weeks/1 weeks–6 months
7	Map food vulnerability	10 m	VIS, NIR	1 month
8	Water quality monitoring	Unsure	Hyperspedctra	Bi-annual, summer/winter
9	Water resources assessment	1–10 m	VIS, NIR	1 per week
10	Drought status, disaster, global	250 m–1 km	Multi-spectral, IR	1 h daily
11	Land use and land care, water management, food security	20–30 m	Multi-spectral, IR	Quarterly, summer/winter
12	Mineral, oil and gas exploration	1–30 m/60 m	Pan, VIS, NIR, SWIR, TIR	1 per 6 month
13	Fishing	10 m/60 m	VIS, NIR, MIR/TIR	1–3 days/1–3 days
14	Peace keeping missions	< 1 m	Pan, VIS, NIR, TIR	1 per day

Santilli, G., Gessini, P., & Vendittozzi, C. (2018). Remote Sensing based on CubeSats: is there any added value? In *United Nations/Brazil Symposium on Basic Space Technology: "Creating Novel Opportunities with Small Satellite Space Missions"*. United National Office of Outer Space Affairs.

Santilli, G., Vendittozzi, C., Cappelletti, C., Battistini, S., & Gessini, P. (2018). CubeSat constellations for disaster management in remote areas. *Acta Astronautica*, *145*, 11–17. https://doi.org/10.1016/J.ACTAASTRO.2017.12.050

Mostert, S., & Jacobs, M. (2008). ARM constellation—Establishing a regional remote sensing asset. *Acta Astronautica*, *63*, 221–227. https://doi.org/10.1016/j.actaastro.2007.12.030

Observing System Simulation Experiment



S. V. Kumar et al., “Land information system: An interoperable framework for high resolution land surface modeling,” *Environ. Model. Softw.*, vol. 21, no. 10, pp. 1402–1415, 2006.

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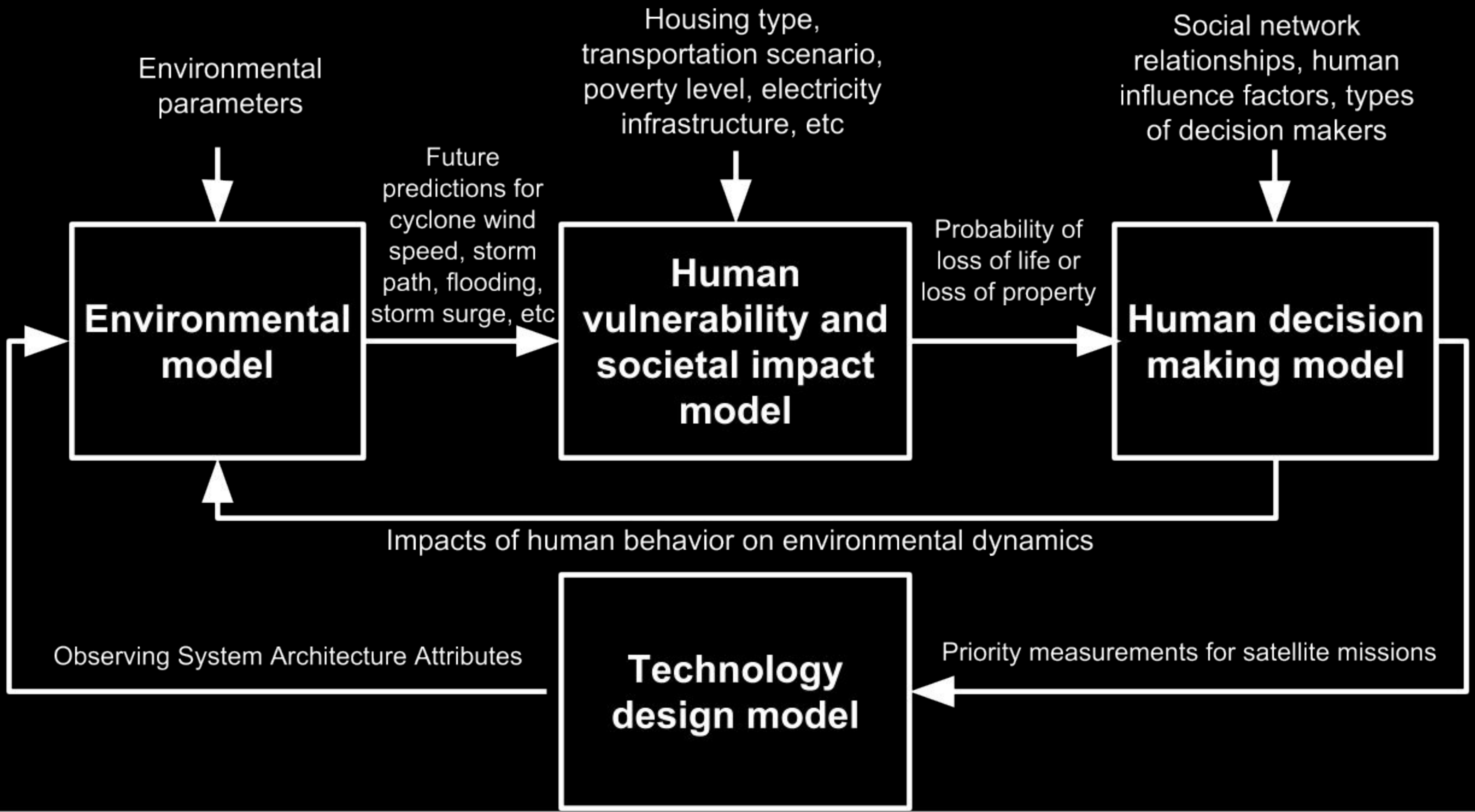
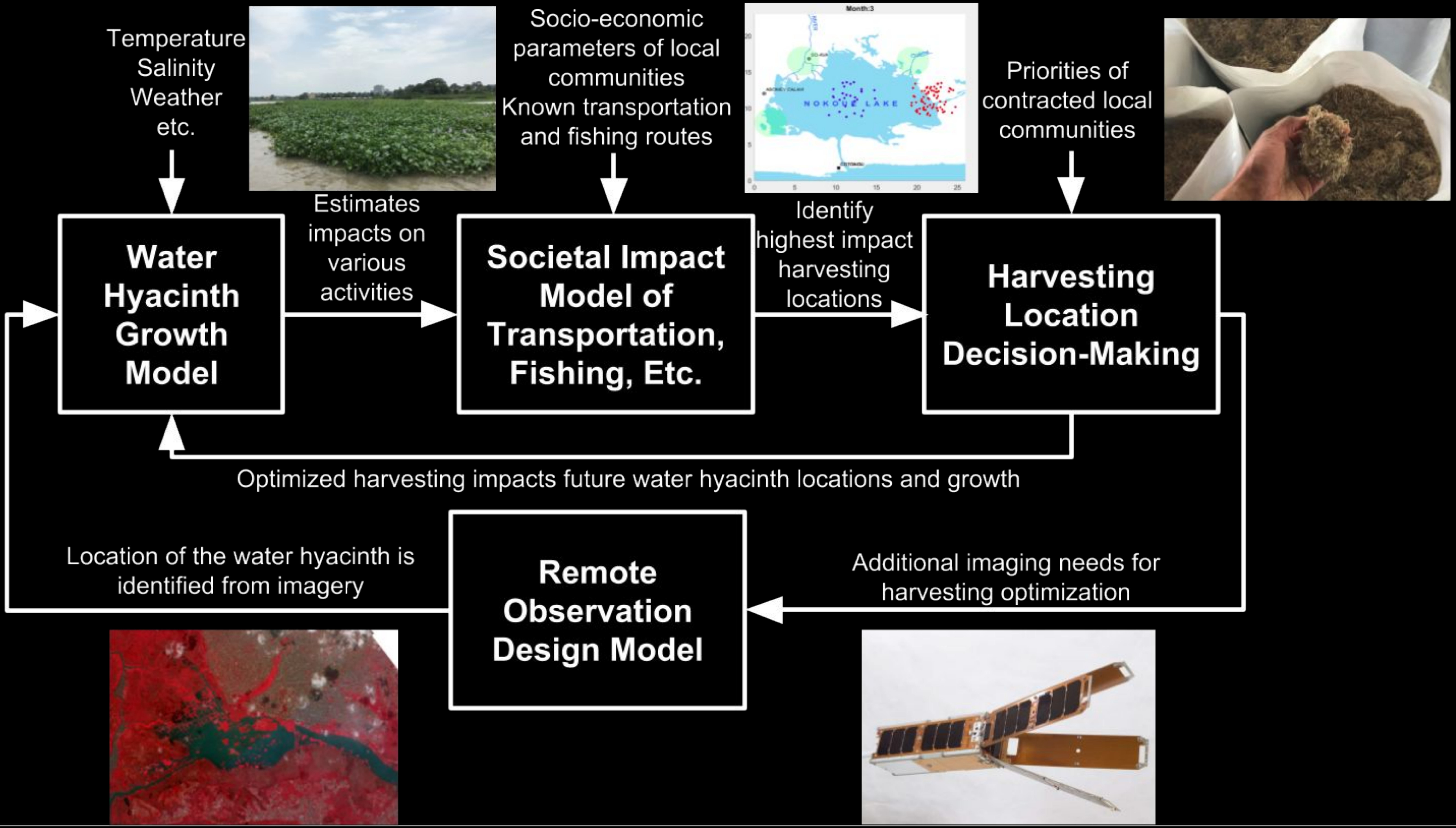
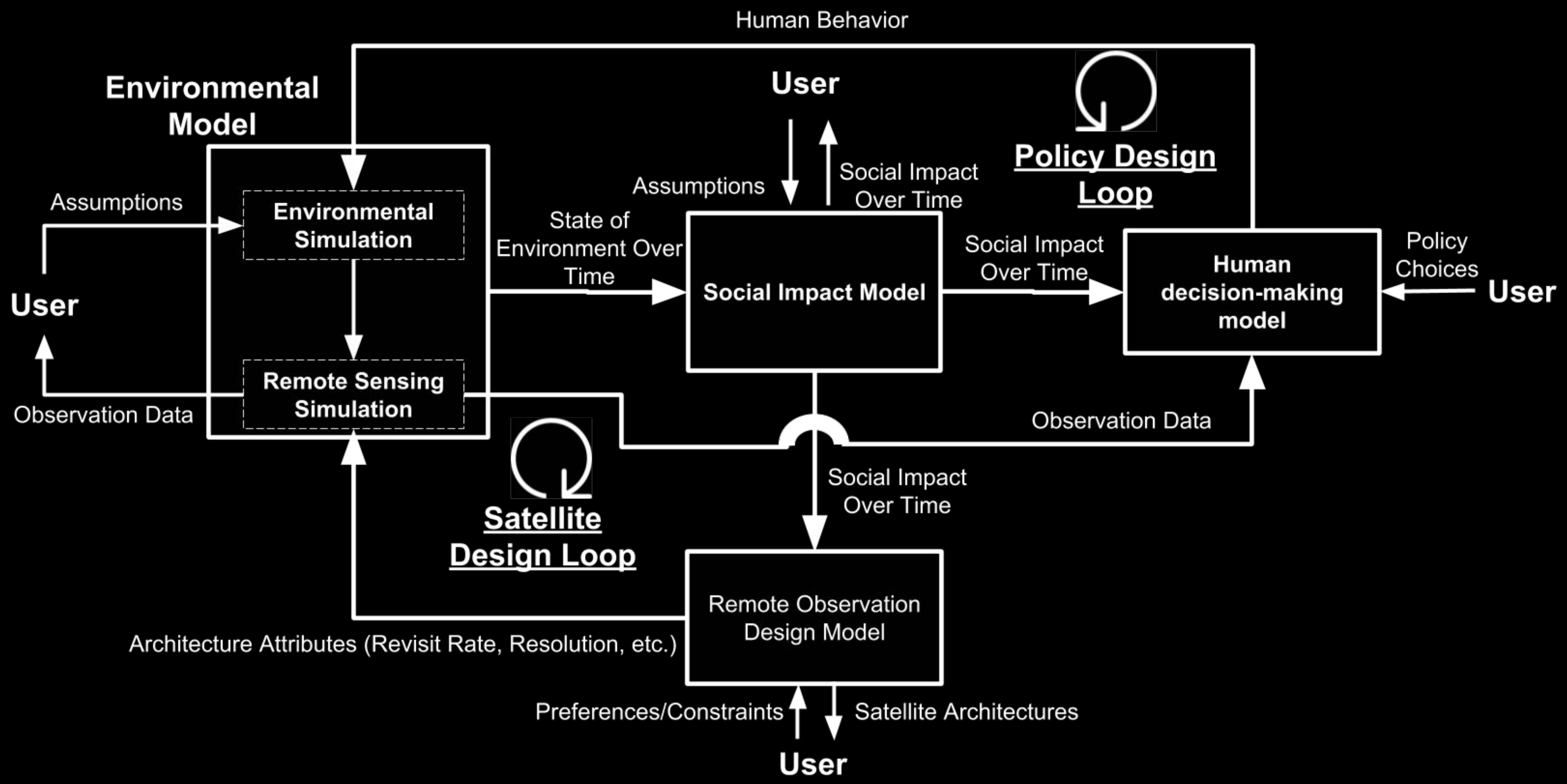

Environmental parameters
Housing type, transportation scenario, poverty level, electricity infrastructure, etc
Social network relationships, human influence factors, types of decision makers
Future predictions for cyclone wind speed, storm path, flooding, storm surge, etc
Probability of loss of life or loss of property
Environmental model
Human vulnerability and societal impact model
Human decision making model
Impacts of human behavior on environmental dynamics
Observing System Architecture Attributes
Technology design model
Priority measurements for satellite missions


Temperature
Salinity
Weather
etc.
Socio-economic parameters of local communities
Known transportation and fishing routes
Priorities of contracted local communities
Water Hyacinth Growth Model
Estimates impacts on various activities
Societal Impact Model of Transportation, Fishing, Etc.
Identify highest impact harvesting locations
Harvesting Location Decision-Making
Optimized harvesting impacts future water hyacinth locations and growth
Location of the water hyacinth is identified from imagery
Remote Observation Design Model
Additional imaging needs for harvesting optimization



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Why?

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Direct Benefits

- Improve decision-making
- Facilitate quantification of remote sensing value
- Assist design of satellites

Indirect Benefits

- Reduce burden-of-entry
- Allow end-users to specify and vocalize “gaps”
- Raise awareness of value of remote sensing data

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Challenges / Limitations

- Requires models from multiple fields
- Limited computationally and by scope
- Lack the precision of OSSEs

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Longer term…

We would like there to be a *standard* and a *library of submodels*

- Develop a few case study models
- Develop a standard set of APIs
- Develop a library of submodels
- Expand to other technologies

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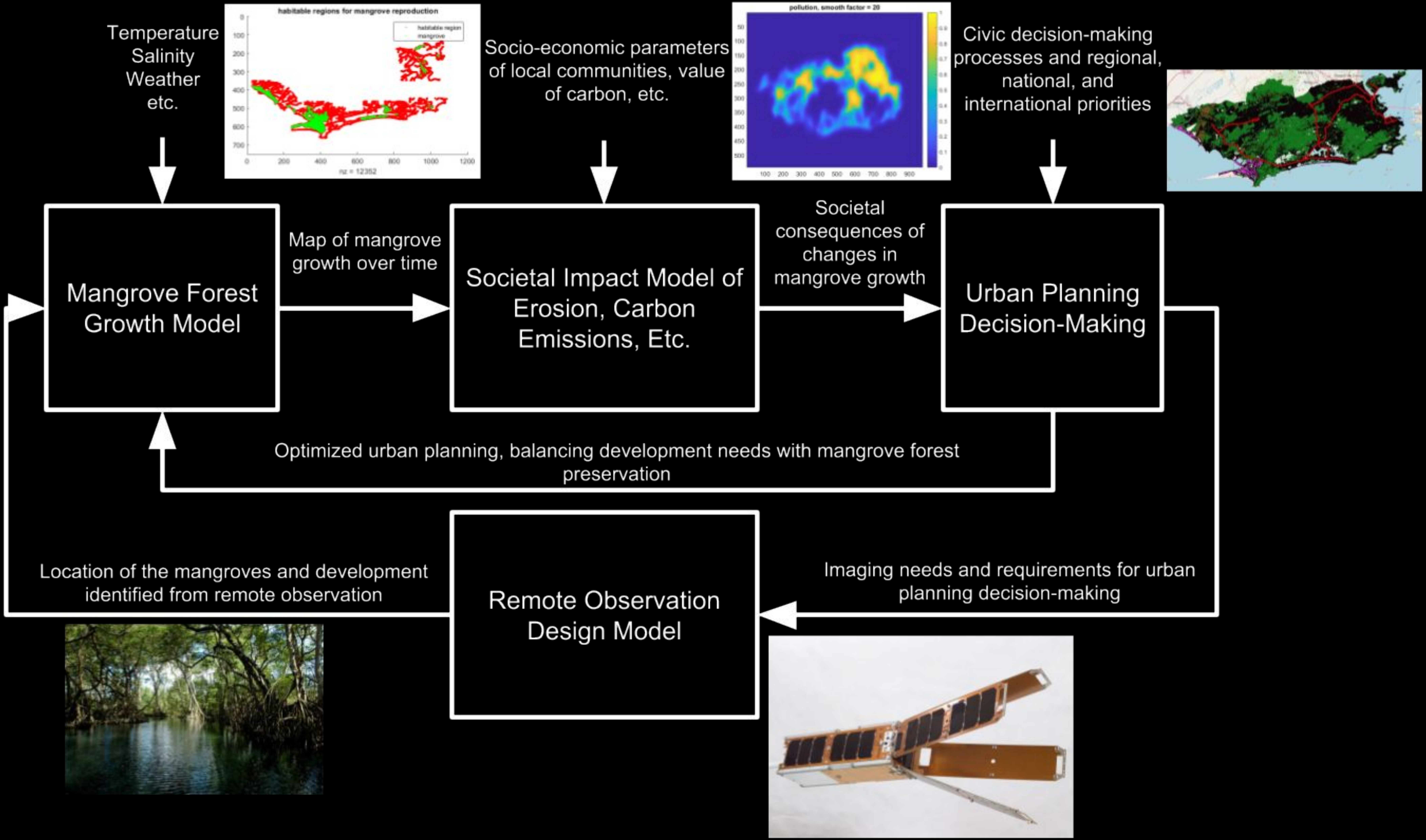

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Earth Observation Data Application Levels

1. Earth Observation (EO) System Design & Implementation
2. EO System Operation, Data Retrieval, Calibration, & Validation
3. EO Data Correction and Processing
4. Earth Science Modeling & Assimilation of Earth Observations
5. EO Data Discovery & Visualization
6. EO Data Transformation
7. Knowledge Integration
8. Decision Support