



## **SIMULATION DRIVEN APPROACH FOR SPECTRUM MANAGEMENT AND RADIO PLANNING**

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# ABOUT ALTAIR INDIA

**500+**

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and Developers

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Regional Offices

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Customers

## Industries

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Defence  
Automotive  
Electronics  
Energy  
Healthcare  
Manufacturing  
Marine  
Government Agencies

## Applications

Data Analytics  
EDA  
Electromagnetics  
Fluids & Thermal  
HPC & Cloud  
Industrial Design  
Internet of Things  
Manufacturing  
Multiphysics  
Structures  
Systems Modeling

**Product, Product Engineering, Software Development & Consultancy  
Industrial Design & Training, Enterprise Solutions, Data Analytics**

# Design Challenges

## Defence & Aerospace

Very high-tech industry

In many cases measurements can be extremely challenging

Complexities in:

- **Design & Analysis** – antennas, arrays, radars, radomes
- **Platforms** – small drones to aircrafts to massive warships
- **Environments** – land, sea, air
- **Materials and structures** – composites, RAM, FSS, radomes
- **Technologies** – frequencies, transmitters, co-existence
- **EMC** - with ECUs, systems and cables
- **Propagation** – complex and harsh environments
- **Spectrum** – dynamic allocation of frequencies

Stealth Aircrafts

Unmanned Aerial Systems, Drones

Missile Systems and sub-systems

Radar Systems and sub-systems

Airborne Radio Transmitters / Receivers

Armoured Vehicles

Electronic Warfare Systems

Communication Systems, 5G, TETRA

Electromagnetic Pulses

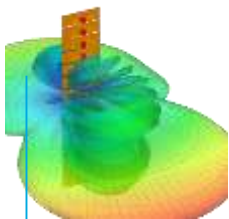
As future conflicts will be fought in a technology intensive environment, high training standards in equipment use would be essential.

...as the Army modernises, UAVs, rotary wing assets and satellite communication will increasingly become essential elements of the coordinated close battle.

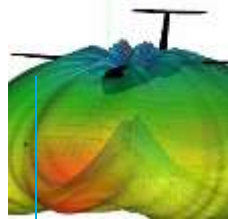
# Simulation Driven Target Applications

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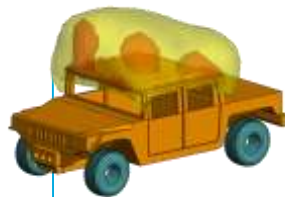
## Defence & Aerospace



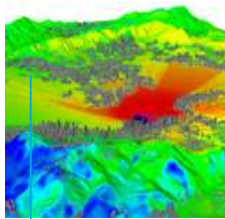
Antenna & Radar Design



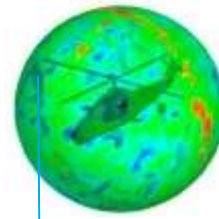
Antenna Placement & Coupling



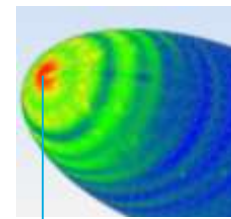
EMI, EMC



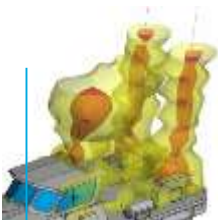
Radio Propagation & Planning



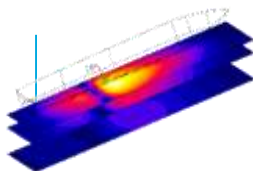
Scattering & RCS



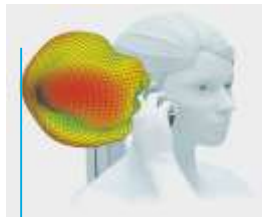
Radomes



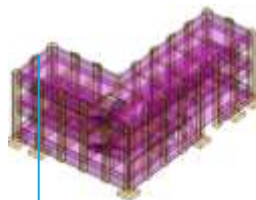
RADHAZ & Bio-Electromagnetics



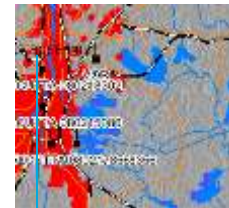
Ship Magnetic Signatures



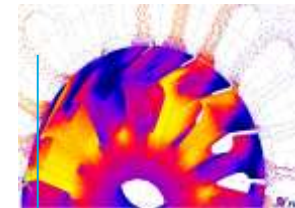
Wireless Equipment, Communication Systems, TETRA, 5G



Electromagnetic Pulse Radiation Analysis



Radio Frequency Interference

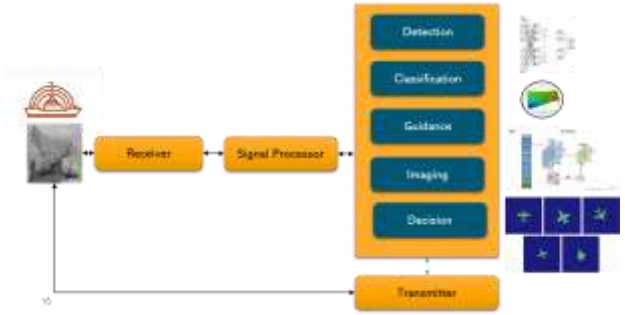


Electromechanical Equipment

# Target Machine Learning Applications For Defence Systems

- Machine Learning and AI techniques are being developed and implemented in defence systems to enhance the accuracy of target recognition in complex combat environments.

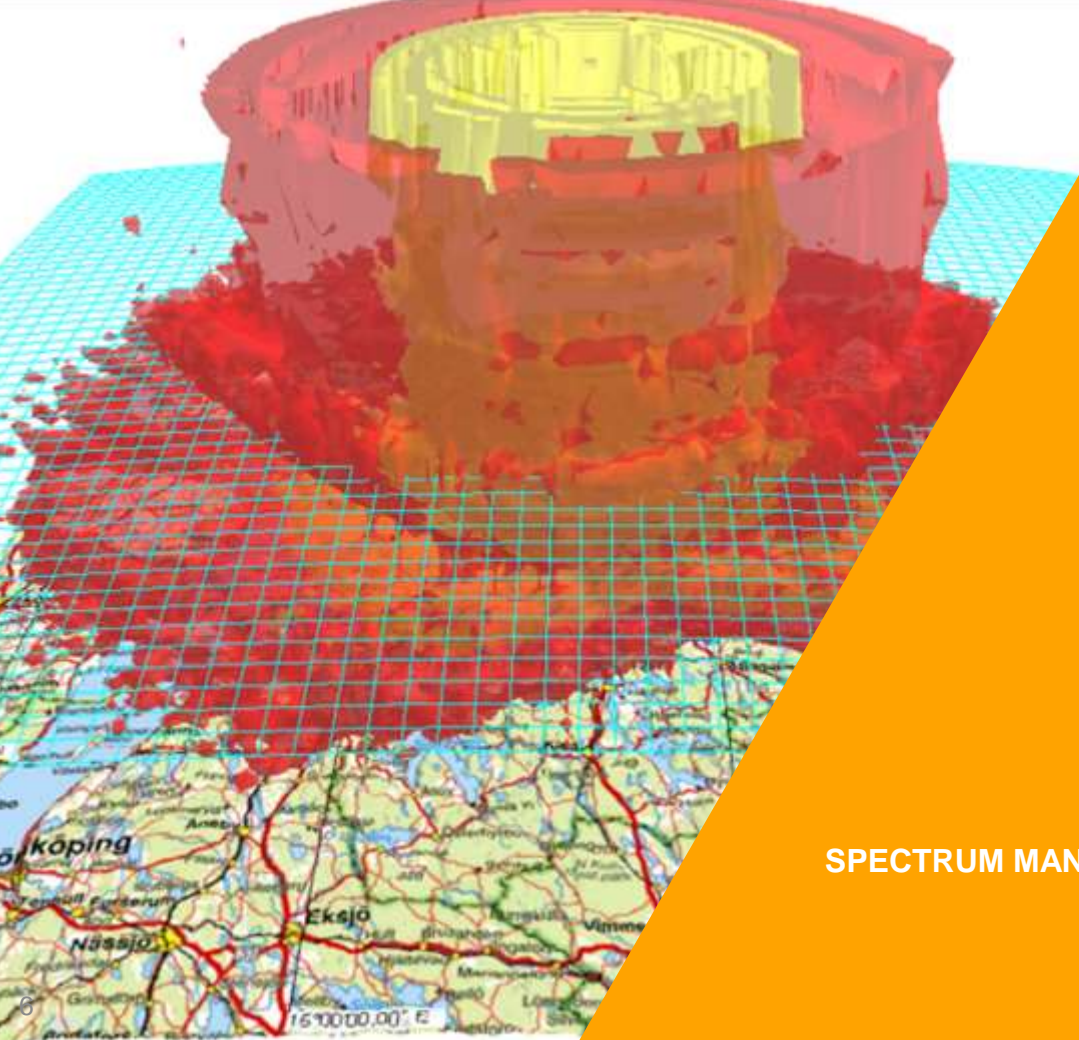
## PREDICTIVE AND PRESCRIPTIVE ANALYTICS



5

## RCS SIGNATURE PREDICTION USING ML





## SPECTRUM MANAGEMENT AND RADAR COVERAGE SIMULATIONS

# Spectrum Management and Monitoring

**A flexible capability to handle technical analysis of coverage, interference and optimisation of the spectrum utilization.**

**Support the defence forces with strategic, long-term spectrum management, design and procurement of new systems and frequency management in consideration of international, national civilian and military frequency allocations.**

**Frequency assignment through simulations, ensuring compatibility with the authorized frequency utilization, band plans and maximum spectrum utilization.**

# Frequency Management

**Radio Network Planning for Analogue and Digital sound and TV Broadcasting, Mobile Services, LTE, 5G Applications, as defined by ITU.**

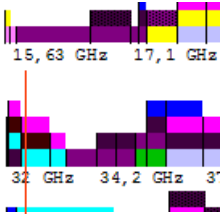
**Radio Network Planning, Electronic Warfare and Radar Planning for Defence (Air Force, Army and Navy) on regional and command unit level.**

**Radio Network Planning, Coverage Calculations, Frequency Assignment to give lowest interference for Public Safety, TETRA, Civil Aviation and Maritime applications as well as radar and navigation systems planning.**

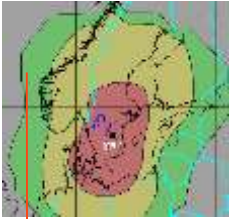


# Target Radio Coverage & Planning Applications

## Defense & Aerospace



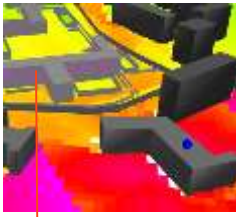
**Spectrum Management**



**Military Radio Planning, including HF**



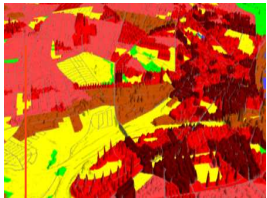
**Radio Network Management**



**Jamming of Cellular & Satellite Signals**



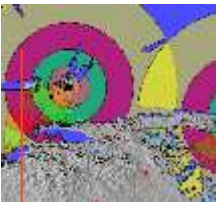
**Virtual Flight Tests**



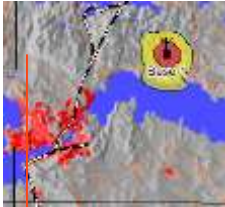
**Map Data Manager**



**Satellite Radio Coverage**



**Radar & Radio Coverage**



**Coverage Optimization For Electronic Warfare**

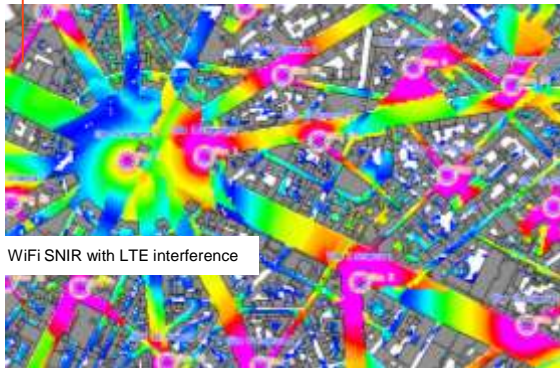


**Communication Equipment Planning**

# Predicting Radio Frequency Interference

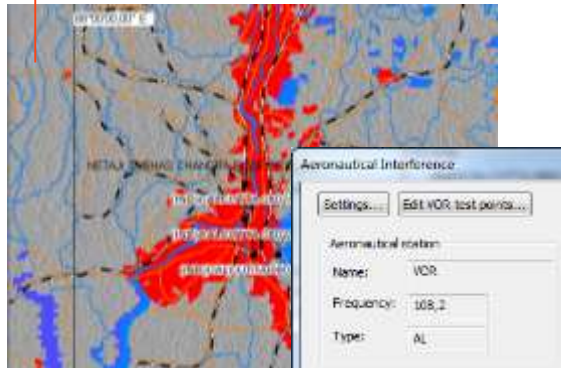
## Scenarios

### Wireless Networks Co-Existence



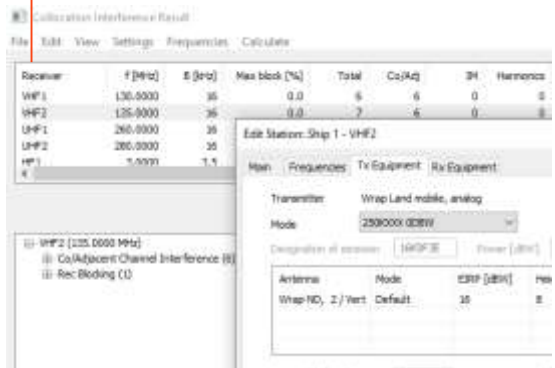
Analysis of interferences between radio technologies in multiple scenarios (including indoor, urban and nation-wide)

### Aeronautical Interference



Calculates interferences between sound broadcasting stations (87 – 108 MHz) and the ILS localizer, VOR and the VHF communications equipment in the 108 – 137 MHz frequency band

### Collocation Interference



Analysis and mitigation of interferences in site with multiple transmitters and receivers

# Spectrum Management via Altair WRAP

## Main Applications

- Coordination between national/international military and national/international civilian frequency utilisation
- Central management and coordination distribution of frequency allocations, allotments and assignments for the national defence forces
- Long-term planning of the frequency utilisation within the region/service
- Short-term planning of the frequency utilisation for missions, manoeuvres and large exercises

## Levels of Implementation

- Central defence spectrum management agency
- Regional and service level (Army, Air Force, Navy)
- Local and military unit level
- Single-user and client-server configurations with the possibility to handle several station databases

## Radio Network Design

- Planning and design of radio communication, electronic warfare and radar functions and facilities to achieve required capabilities for coverage, performance and electromagnetic protection.
- Support for all radio systems used in the Army, Air Force and Navy

The screenshot displays the Altair WRAP software interface, which is used for spectrum management and radio network design. It features a central map view with various radio stations and vehicles overlaid. Two windows are open: 'Edit Allotment' and 'Edit Group'.

**Edit Allotment Window:**

Allotment Name: GSM  
 Owner: WRAP User  
 Duplex:  Duplex  
 Band usage at base:  Lower band  U

f [MHz]	f' [MHz]	Tx [MHz]	Rx [MHz]
890	935	935	890
890.2	935.2	935.2	890.2
890.4	935.4	935.4	890.4
890.6	935.6	935.6	890.6
890.8	935.8	935.8	890.8
891	936	936	891
891.2	936.2	936.2	891.2

**Edit Group Window:**

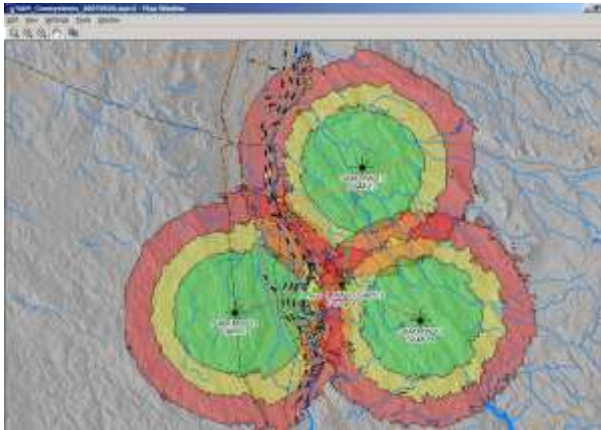
Group/Network	Bat Net	1st Comp Net	2nd Comp Net
Battalion	Battalion st...		
1st Company			
Vehicle 1	Vehicle 1.1		
Vehicle 2		Vehicle 2.1	
Soldier		Portable 1	
2nd Company			
Vehicle 1	Vehicle 1.1		

The map view shows several radio stations and vehicles overlaid on a terrain map. Labels include 'Vehicle 1.1', 'Vehicle 2.1', 'Portable 1', and 'Battalion station'. The interface also includes a menu bar with 'Main', 'Stations', 'Groups', and 'Networks'.

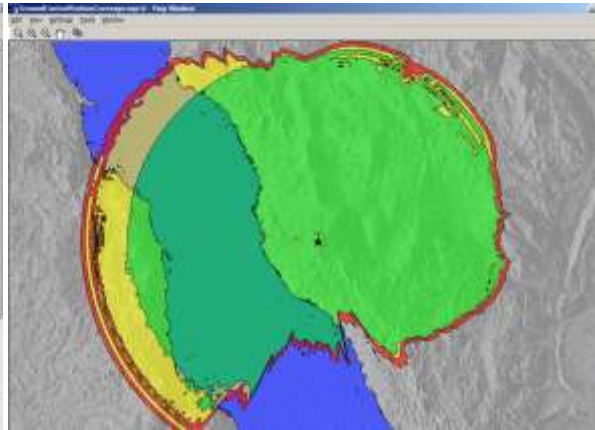
# Radio Coverage via Altair WRAP

## Propagation Models, Air Interfaces and Some Relevant Scenarios

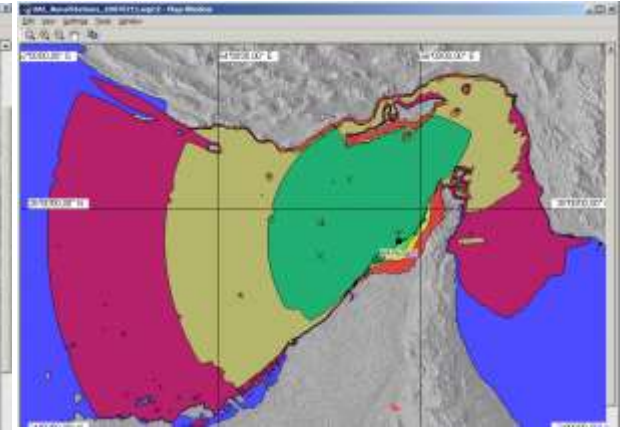
- Comprehensive set of propagation models (empirical, semi-empirical and deterministic ones) (including a wide collection of ITU-based models) for nation-wide, rural, urban and indoor scenarios
- Air interfaces available for all major military and civilian radio systems, from HF through 5G to radar and microwave links



Ground-to-ground coverage of combat net radios

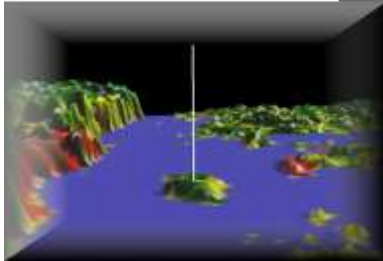
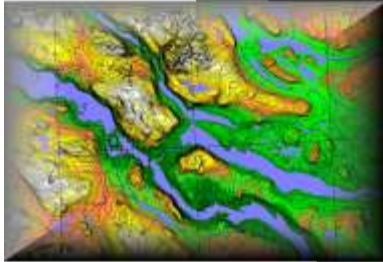
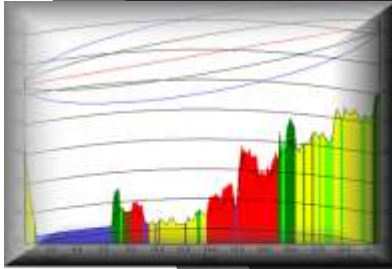


Ground control station coverage to aircraft



Coast station ground wave coverage

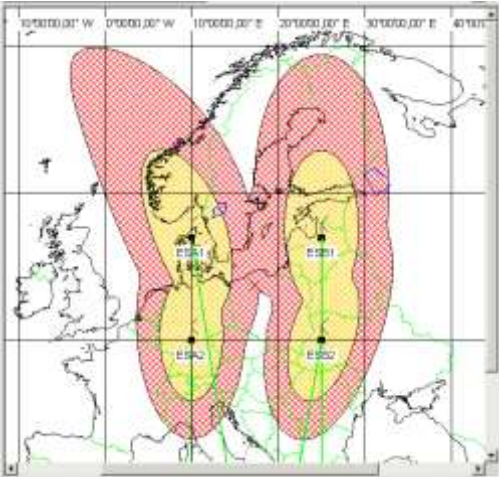
# Radio Systems Supported



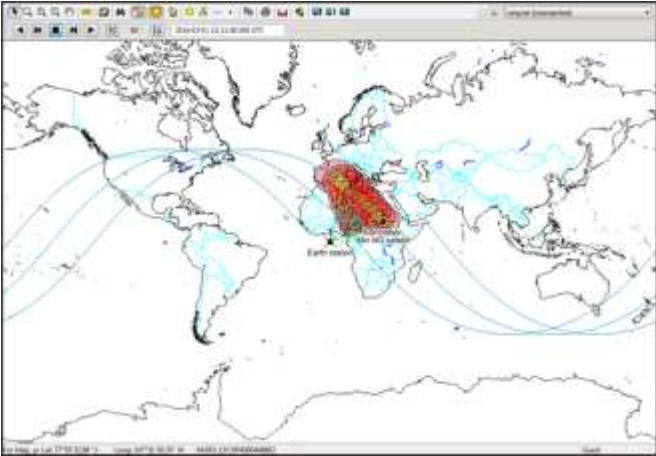
- HF/VHF/UHF radio communication
- VLF/LF navigation and communication systems
- Microwave links
- Air defence radars, airborne radars, ship borne radars, air and coast surveillance radars
- Ground traffic control radars
- Distress systems: 121.5, 243, 406, 1646 MHz
- NDB, VOR, ILS, DME, MLS navigation systems
- AIS navigation systems (160 MHz)
- Surveillance sensors
- Electronic warfare systems

# Satellite Communication

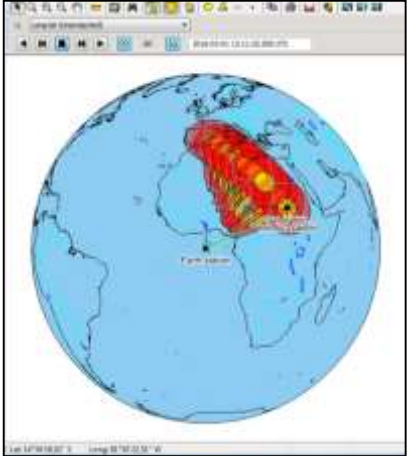
## Space



Space Satellite Coverage,  
Time Dynamic Analysis



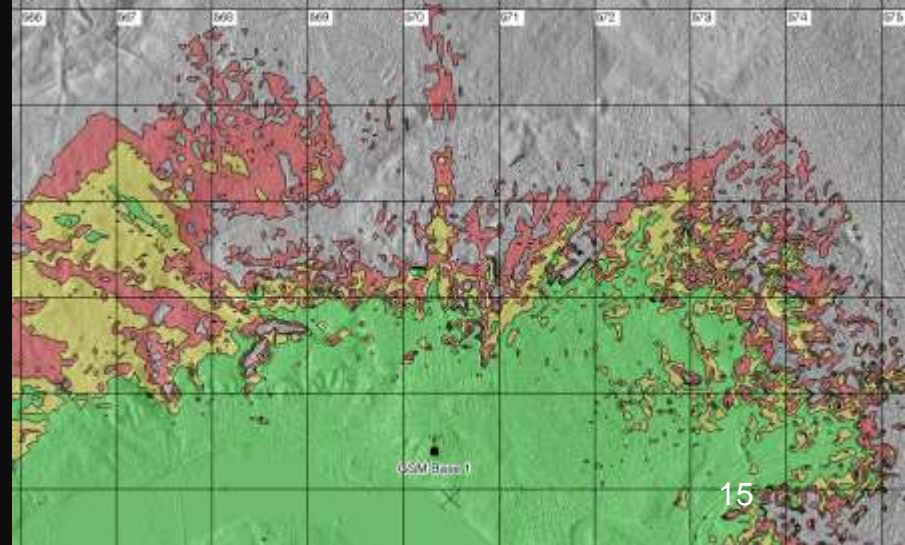
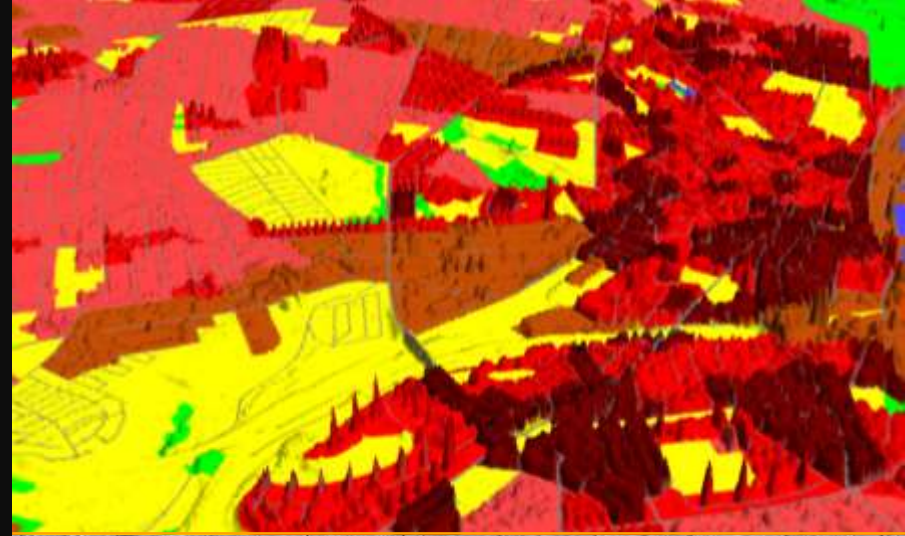
Dynamic Satellite Calculations



# Geographical data in WRAP

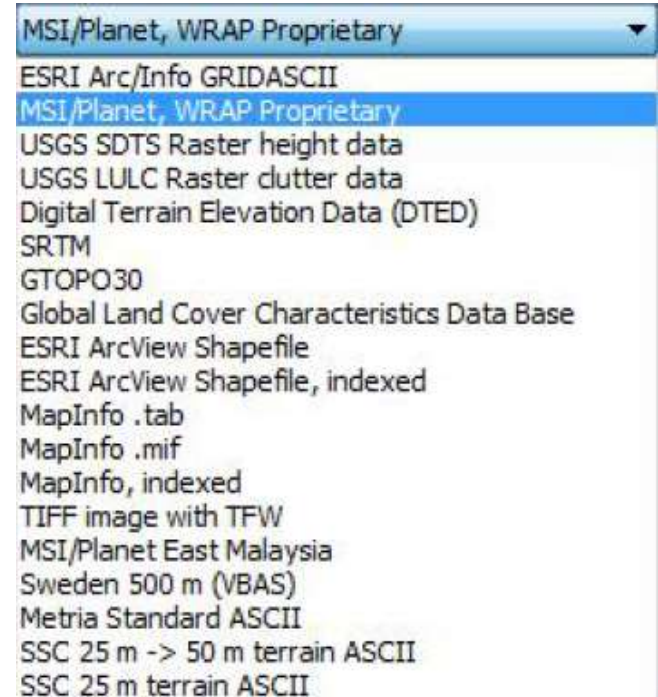
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- WRAP uses clutter map data with height and terrain code, in raster format, for its calculations.
  - Building data in standard ESRI Shapefile vector format may be created inside WRAP or imported from some GIS software.
- 



## Where to obtain the GIS and topographical databases?

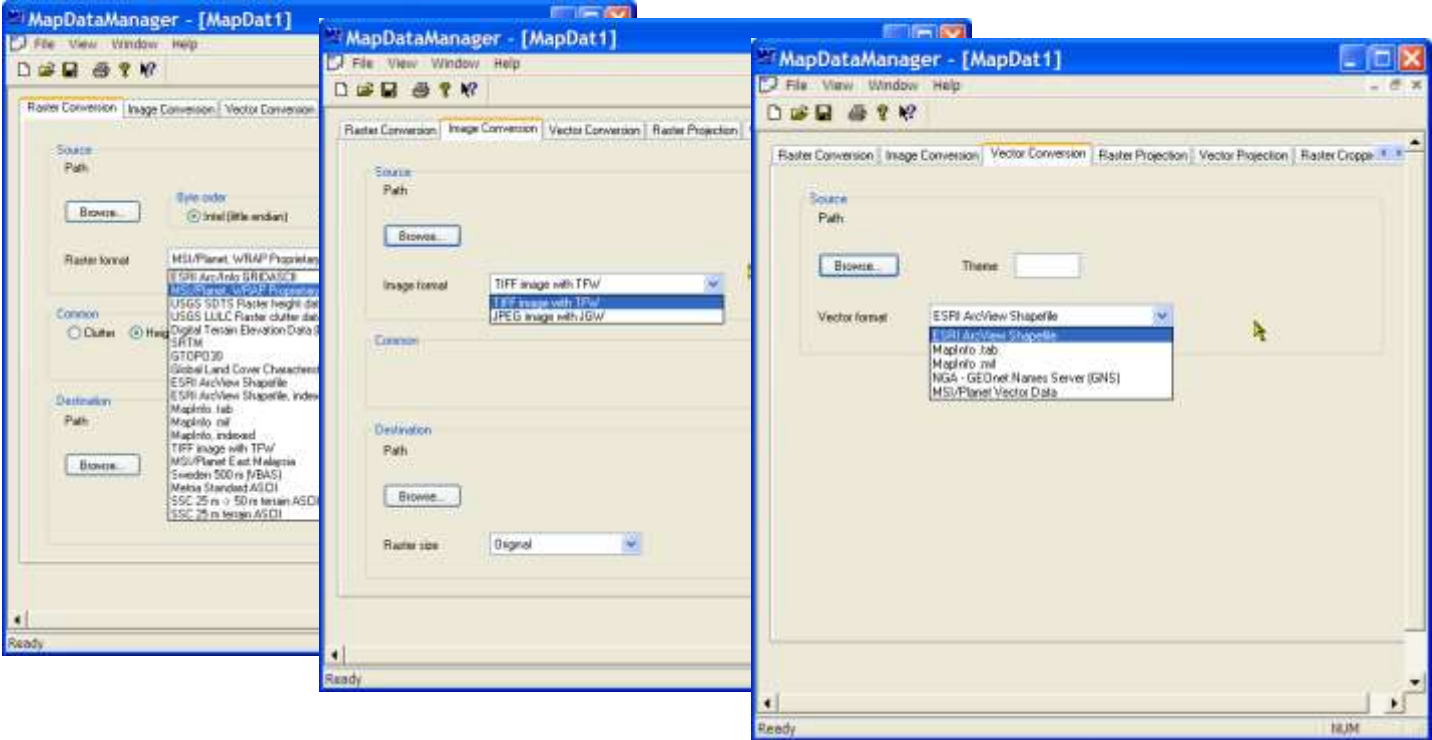
- Many suppliers of geodata for radio planning exist.
- There are also government suppliers such as Bharat Maps, USGS. It has become more common that government organizations provide data for free or at low cost.
- Open Street Map is another source of free data.





# Data Formats

- The WRAP Map Data Manager is used for converting geographical data in different formats into those formats that WRAP uses internally.





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