United Nations / South Africa
Symposium on Basic Space Technology
**"Small satellite missions for
scientific and technological advancement'**

HEAD-1 satellite providing in-orbit operational data for maritime services

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HEAD Aerospace Group

- A **Group** of international (private) space companies, headquartered in Beijing
  - Main entity: **China HEAD Aerospace Technology Co**. established in 2007
  - **Offices and Subsidiaries** in China (Hong Kong) and Europe (The Netherlands, France)

- **Main focus**
  - **Space product trading** to/from China
  - Downstream **Applications & Services** based on small satellites

- **Operating principles**
  - Creation of long-term **partnerships**
  - **International** collaboration
 - **Innovation**
  - **Investment**

Through **innovation & international collaboration**, HEAD Aerospace is dedicated

to providing global **space applications & services**

Successful cases – projected-based trading
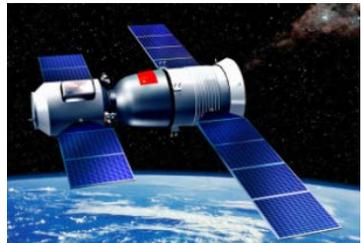
Manned Spaceflight Mission
- Space Mechanisms
- Slip Ring
- Space Power
- Test Facilities
- Harmonic Drive
- Space Radiation Analysis

Lunar Probe Mission
- SSPA
- SADA
- Lunar Rover System Integration
- Harmonic Drive
- Space Radiation Analysis
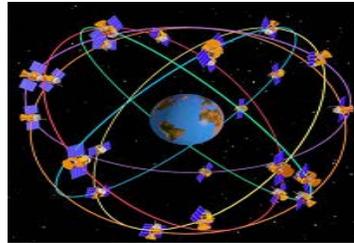
Navigation Satellites Mission
- Space Mechanism
- SADA
- Space Radiation System
- Charge-discharge monitor
- Space Radiation Analysis

Telecommunication Satellite Mission
- Payload antenna
- Optical communication
- Space Radiation
- Hall EP Joint R&D
- EP pointing mechanism
- Communication antenna
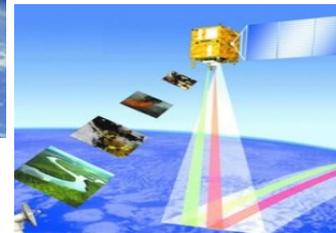
EO Mission
- Calibration system
- SAR technical transfer
- Antenna technical transfer
- Immersed grating
- Space camera

New Tech. Experimental Satellite Mission
- Communication
- Reaction Wheels
- Space environment analysis software
- Electric propulsion system
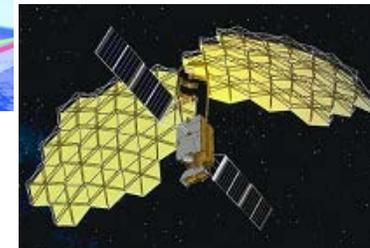
Launcher
- Fairing
- Auto-riveting mechanism
- Simulation software

Participated >100 domestic space missions
HEAD Aerospace has over 10 years experience with space product imports to China

Key successful factor: International collaborations

>30 International Government Agencies & Institutes

> 100 Domestic Goverments & Industries

> 200 Global Partners

Small satellites & Applications
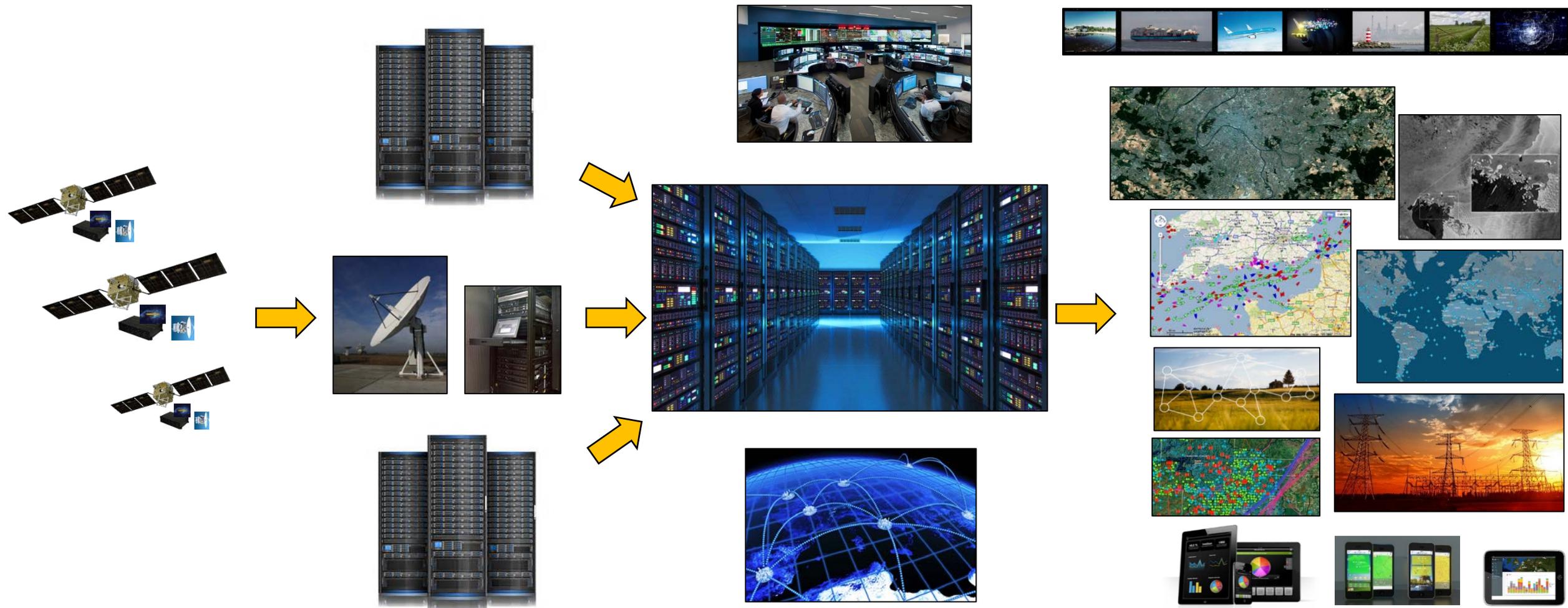
Key economic figures in Africa

Agriculture

- 20% - 30% GDP
- 50% Export
- 60-90% Labor Force

Maritime

- World largest island surrounded by 4 oceans/seas
- 3000km Coastal line
- 39/55 states coastal or island
- 100+ shipping ports, 6% global seaborn trade
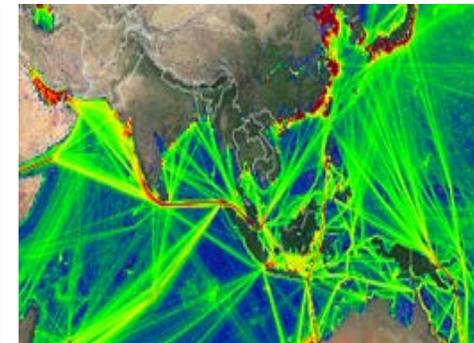
Mining

- 22% - 35% GDP
- Mineral rich: Angola, S.Africa, Egypt, Ghana
- S.Africa + Angola : 60% of region Value added GDP

Commercial Earth Observation satellites to 2024 (>50kg)
Small Satellite <500kg launched & to be launched

 # Sat

Launched and in operation

Future satellites operations
on anticipated lifespan

SAR

OPTICAL CONSTELLATION

OPTICAL

2005 2007 2009 2011 2013 2015F 2017F 2019F 2021F 2023F

Small satellite <500kg
launched & to be launched

180

Satellites launched
(2005-2014)

~1,700

Satellites expected
(2015-2024)
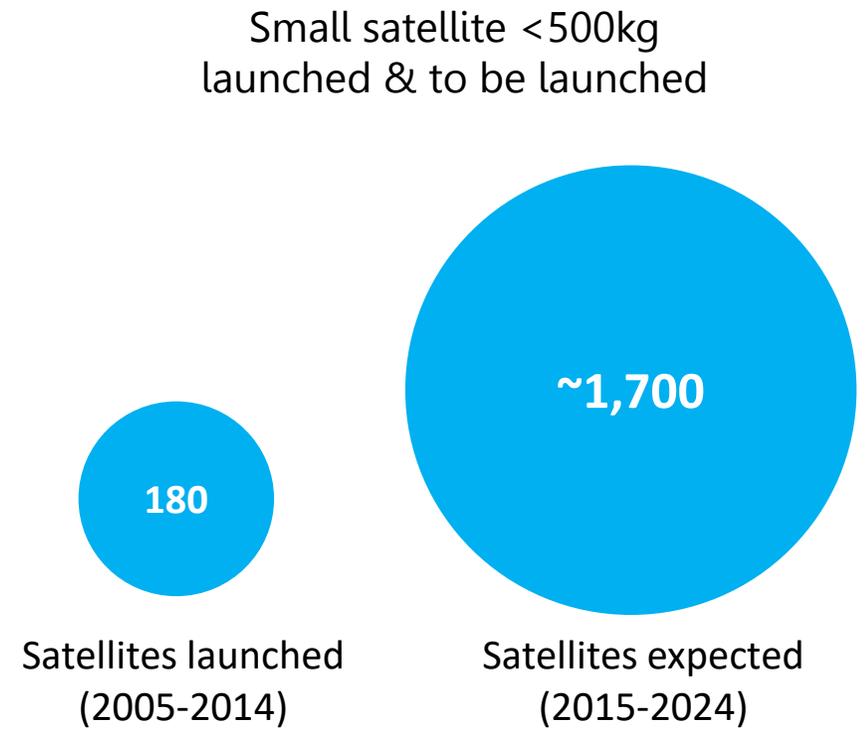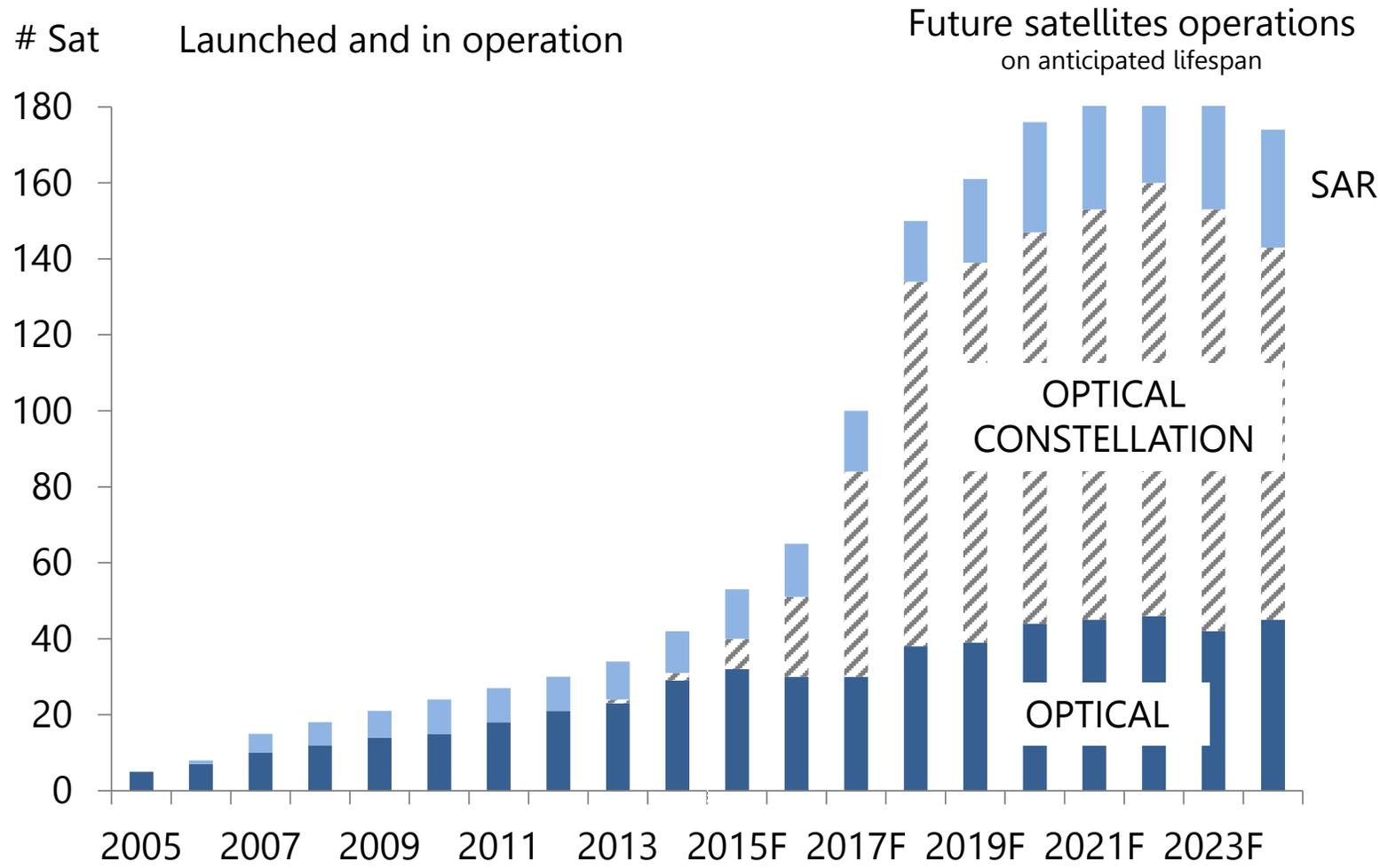
Building towards HEAD's Commercial Satellite Constellation : SkyWalker

Skywalker Constellation: 30 satellites

- Planned: 30 satellites in different classes: **15-150 kg**
- Different Applications: multi-sensor : **AIS + Hyperspectral**
- Deployed in SSO / LEO orbits
- Instruments from international partners as well as jointly developed
- Modern ICT infrastructure for data processing, machine learning, automation and data access

Launch and Deployment：

- First Satellite: HEAD-1, launched: Nov. 15th, 2017
- Full Constellation Operation: 2022

Multiple Applications:

- Narrow band communication : AIS/VDES, ADS-B, DCS, IoT
- Earth Observation: Hyperspectral, MW-IR
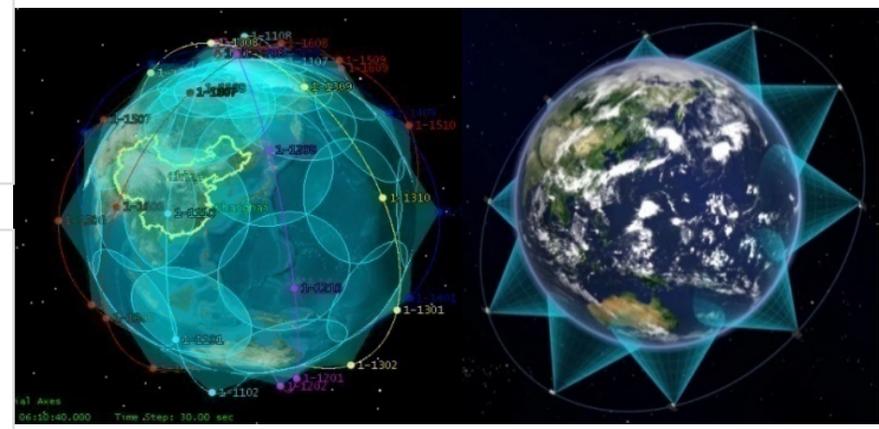
First step: The HEAD-1 Satellite

- **AIS Technology demonstrator with operational capability**

- **808 km Sun-Synchronous Orbit (SSO)**

- **4th Generation AIS : receive 2 million short message, identify 60 000 ships/ 24 hours**

- **HEAD Data Processing Centre**
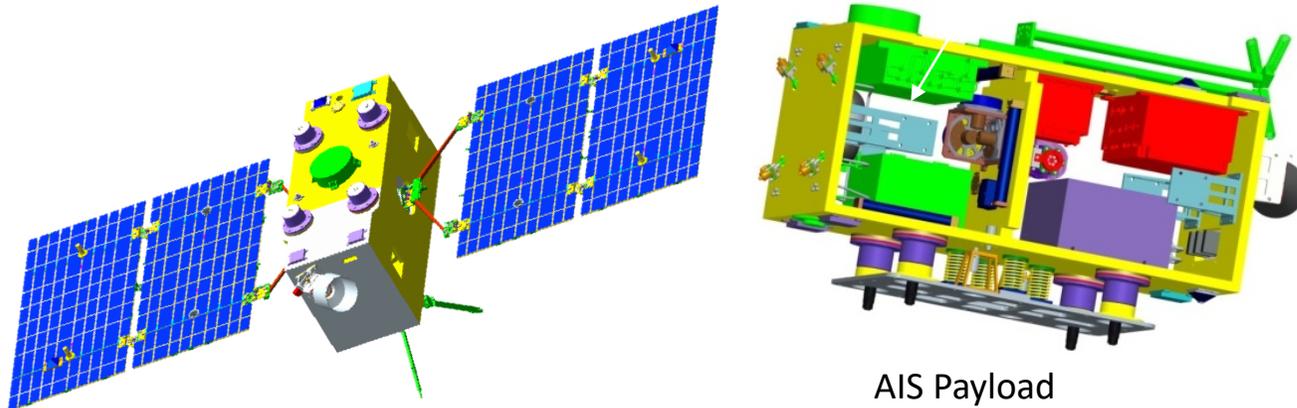
AIS Payload

HEAD-1 Specification

Satellite Mass	45kg
Power Consumption	82W
Attitude Control	Three-axis Stabilization
Pointing Accuracy	≤0.3° (3σ)
Attitude Stability	≤0.05° (3σ)
TT&C System	USB
TM&TC Rate	8192bps
Data Transmission Rate	2Mbps
Accumulator Capacity	20Ah
Solar Array	Two Wings, 0.96m^2
Dimension	876mm(x)×410mm(y)×436 mm(z)
Lifetime	2~3 years

Data Fusion——VTS , AIS, ground radar, satellite radar imagery
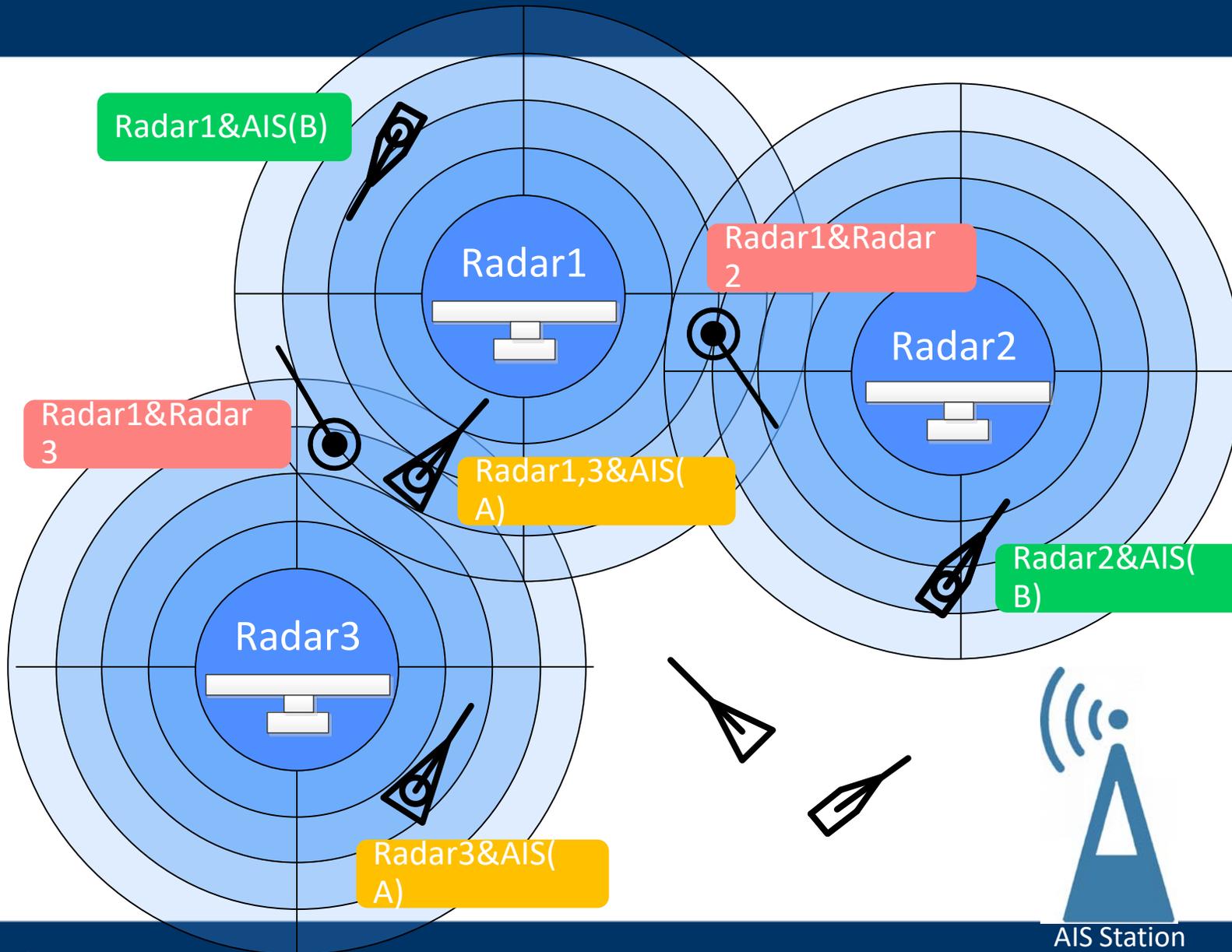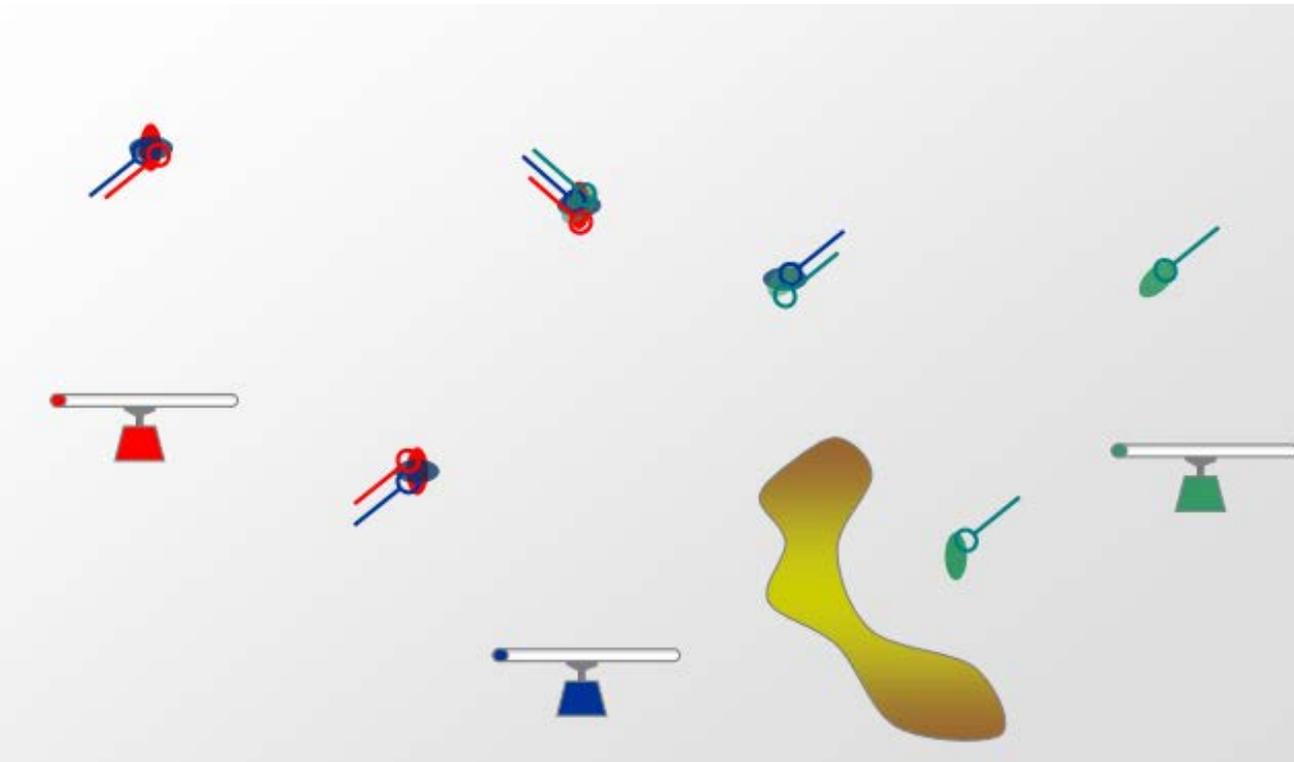
Fusion of Multi-Radar Data

HEAD Application portal: Real-time maritime surveillance services
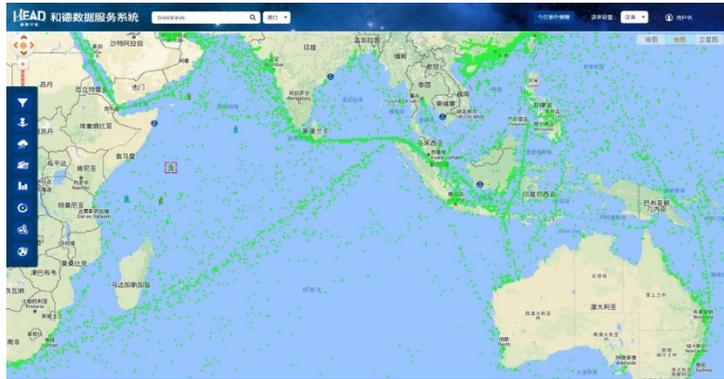
Illegal activity analysis : Illegal immigrants, illegal fishing, illegal drugs…
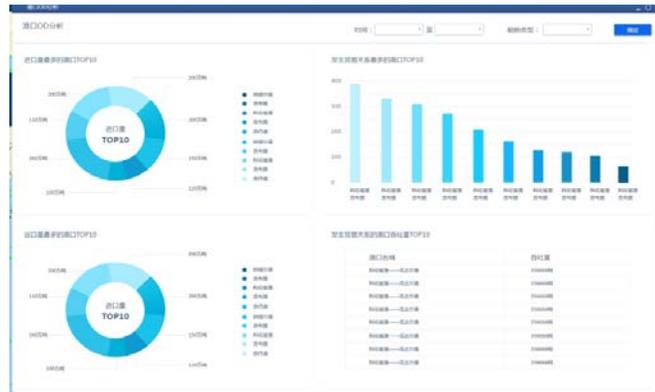
Vessel density mapping Traffic density mapping AIS density mapping Statistical analysis custom area

Real-time vessel tracking analysis: Vessel location, arrival & departure time, port info, archive data, weather, in-situ data

Key Applications with Hyperspectral (HS) Data

AGRICULTURE, FORESTRY, WATER, MINING

- **Agriculture:** corps classification, health, resources management

- **Forest Monitoring:** inventory, health, illegal activity

- **Water Management:** pollution, resource; quality management

- **Mining:** mineral classification, & idenfication, inventory,

RIVER WATER POLLUTION
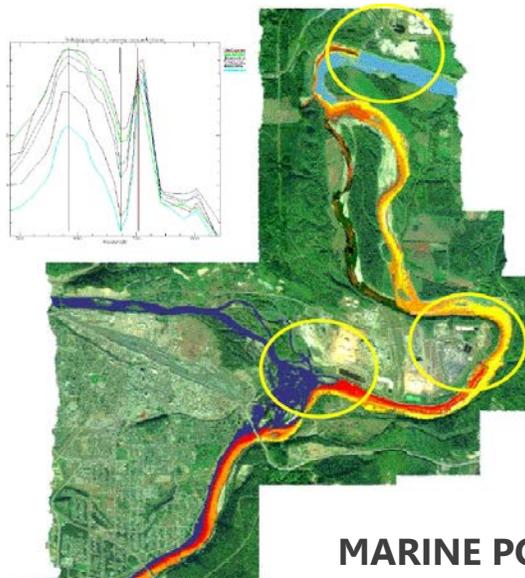
FOREST SPECIES CLASSIFICATION IN SOUTH AFRICA BASED ON VNIR BANDS
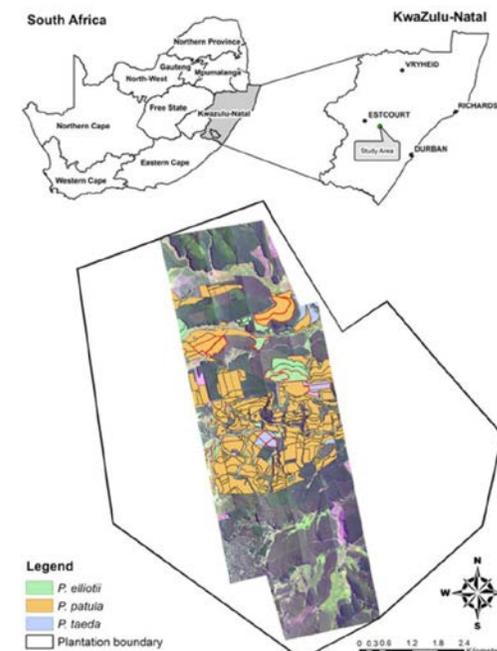
MARINE POLLUTION
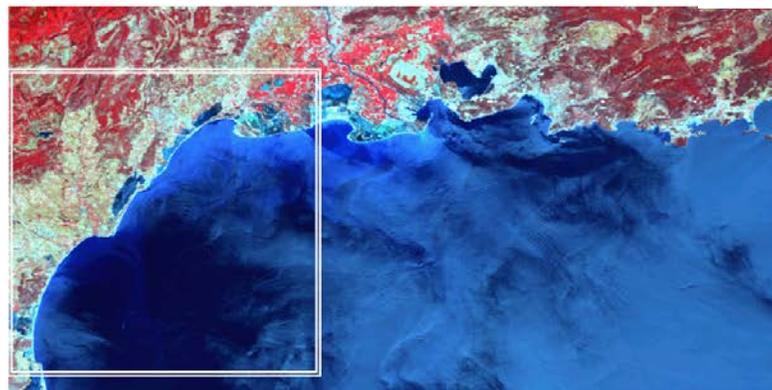
Landsat: invisible

Meris: clearly visible, bith image took same day

Key Applications with Hyperspectral (HS) Data

Hidden vehicle

Panchromatic

Object detected with hyperspectral data

Detect chemicals based on their spectral signiture, to distinguish a camouflaged vehicles from surrounding undergrowth, through the two might appear extremly similar in visual imagery

DEFENSE HS APPLICATIONS

- **Monitoring Activities**
- **Mission Planning**
- **Border Monitoring:** illegal activity monitoring, cross-border surveillance
- **Coastal Security:** vessel and suspicious activitity monitoring

- HS image :

- Determine the composition of material visible in imagery

- Identify buried roadside bombs, improvised explosive devices (IEDs), certain chemical attacks

Source: Federation of American Scientists Intelligence resource program

HEAD is partner of Chinese civilian Earth observation satellites

Through the strategic partnerships, HEAD offers a wide portfolio data & services based on AIS, optical, radar, video data

HEAD-1
Powerful micro-satellite for AIS

Superview – 0.5m

GF 2 – 0.8m

ZJ – 2.1m

Orbita OVS-1 & 2: video

HJ – 30m

China African collaboration in Space Technology Development
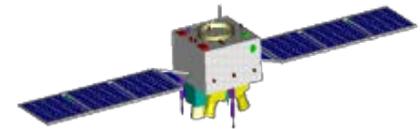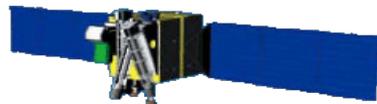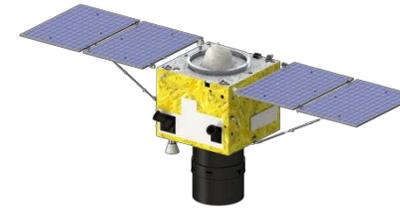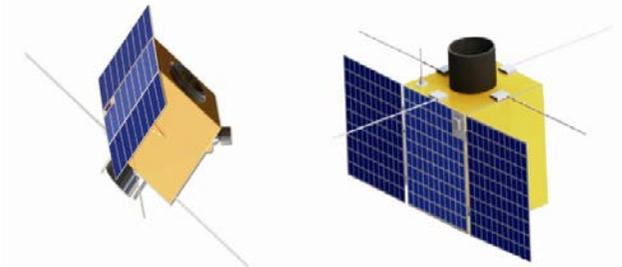
- **Investment in the African region to help human capacity building in African region** : China '**The Belt The Road'** national project to help African region by Chinese financial and human resources

- "**Satellite as a Service**", "**Cloud Data Provider**", **invest & develop a data-fusion centre in Africa** through partnerships

- Invest & develop in a **one-stop-shop spaceport** in the African region:
    - **Data sharing :** free data sample HEAD-1 AIS data & low-cost high resolution Chinese EO data
    - **Value added services :** maritime, agriculture, mining, disaster management (forest fire), infrastructure (electricity)
    - **Smallsat platform & AIT**
    - **Access to space for smallsat :** piggy-back launch opportunity, scientific payloads hosting/in-orbit validation
    - **Ground Segment** TTC & Data acquisition

Your Business Partner in Space