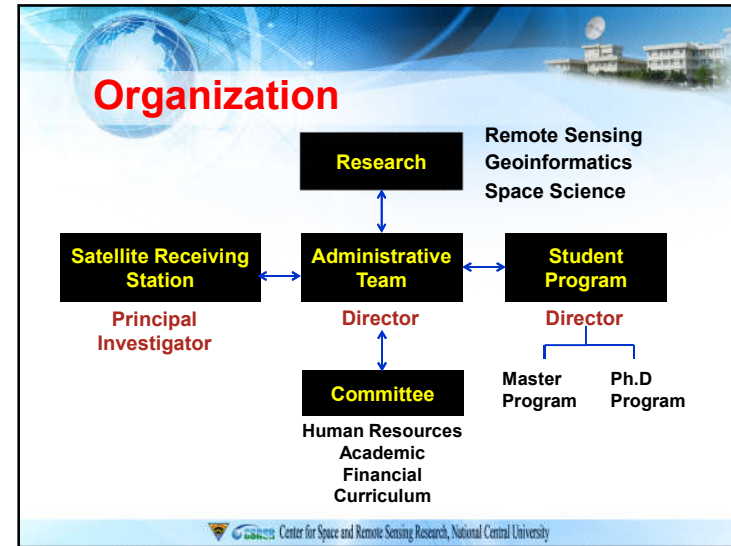


第十五屆地球科學相關領域新進人員及研究推動研討會

Introduction to

Center for Space and Remote Sensing Research
National Central University

Tang-Huang Lin, Prof.
Sep. 7, 2019



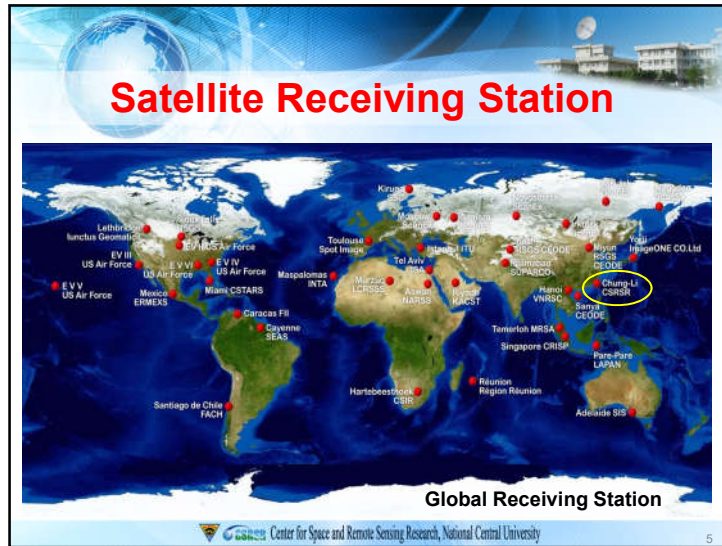
Research Groups

The center is divided into three research groups :

- (1) Remote Sensing Research Group
- (2) Geoinformatics Research Group
- (3) Space Science Research Group

Student Program

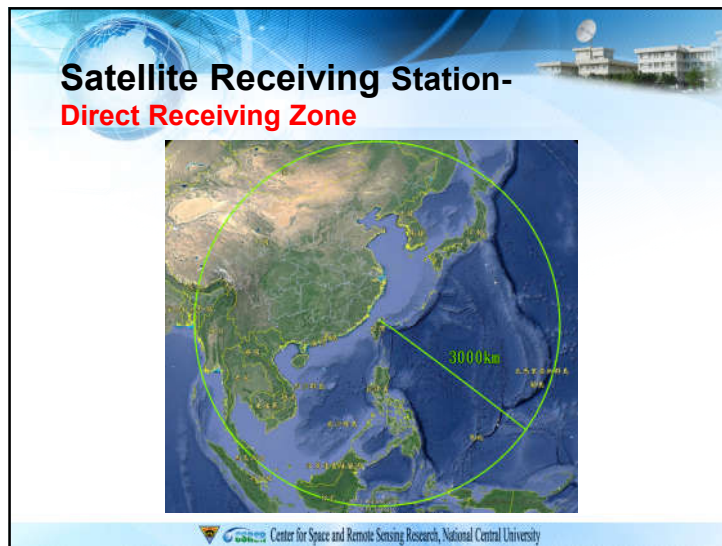
Master Program	Ph.D Program
<ul style="list-style-type: none"> Established in 2008 Degree : Master of Science The first master program specifically designed for Remote Sensing Science and Technology in Taiwan Consists of two groups: Remote Sensing Research Group and Geoinformatics Research Group 18 of 33 courses are given in English; 100% is expected 	<ul style="list-style-type: none"> Established in 2016 International Ph.D Program in Environmental Science and Technology, University System of Taiwan (UST-EST) Foreign students received only, all courses taught in English.
<p>Contact us Tel : +886-3-4227151 ext. 57610 e-mail : degree@csrsr.ncu.edu.tw</p>	



Satellite Receiving Station- Missions

- To provide high quality satellite data and being diligent in transforming research results into practical applications in terms of radiometry, geometry, telemetry and data collection. It is the pioneer of satellite remote sensing research in Taiwan.
- The unique multifunctional “three in one” infrastructure in the world due to its three different functionalities, including **data reception and processing**, **research and development**, and **promotion and education**.

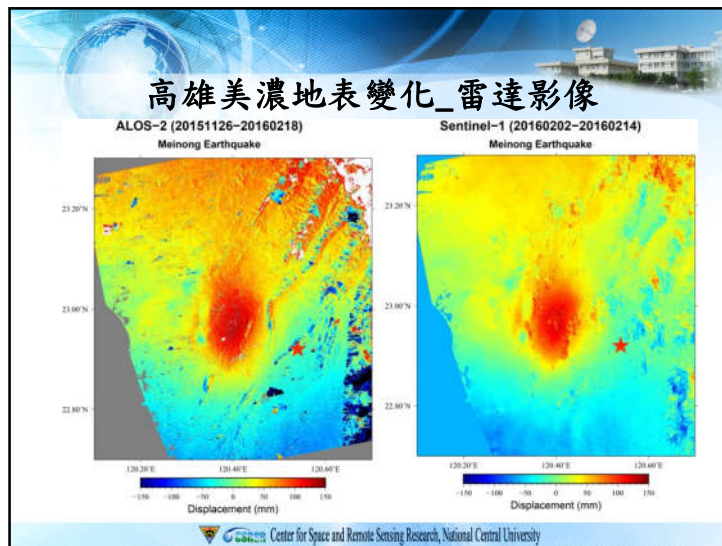
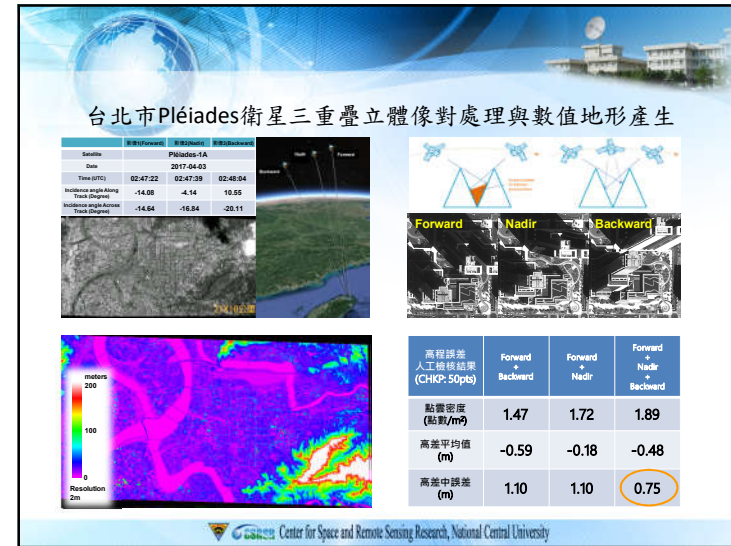
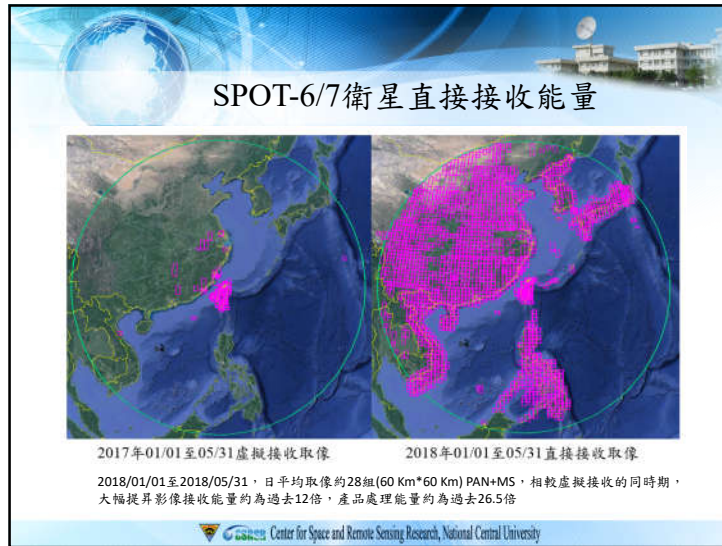
Center for Space and Remote Sensing Research, National Central University



Satellite Receiving Station- Satellite Receptions

- SPOT 1-5 (July, 1993~March, 2015)
- ERS 1 (Oct., 1993~June, 1996)
- Landsat-5 (June, 1993~1996)
- ERS 2 (June, 1995~ March, 2011)
- EROS-A (Dec., 2000~2003)
- Terra & Aqua (July, 2002~Aug., 2015)
- **Formosat-2 & 5** (Sep., 2004~)
- **SPOT 6-7** (June, 2013 ~)
- **Pleiades** (Feb., 2014 ~)

Center for Space and Remote Sensing Research, National Central University



Satellite Receiving Station- Open Data

- Multi-temporal SPOT images from 1993 of Taiwan area are open to public; new images are continuously updated
- Open Data Service officially commenced on August 17, 2015
- Images can be downloaded unlimited and free of charge for executing research projects of the Ministry of Science and Technology
- Accumulated market value is more than NT\$ 300 millions per year

Center for Space and Remote Sensing Research, National Central University

Satellite Receiving Station- Web Map Tile Service

- Open Web Map Tile Service mosaiced images of Taiwan and Penghu are available from 1996 to 2015
- Data are open to public for non-profit use
- Images are provided conforming to OGC (Open Geospatial Consortium) WMTS (Web Map Tile Service) Standard
- For user convenience , no account or password required

Center for Space and Remote Sensing Research, National Central University

Web Map Tile Service

Adopt National Land Surveying and Mapping Center electronic map

Adopt Open Street Map

Multi-temporal images

Center for Space and Remote Sensing Research, National Central University

Center for Space and Remote Sensing Research, National Central University

多時期台灣SPOT衛星影像比較顯示(1996-2015)

Center for Space and Remote Sensing Research, National Central University

Social Contribution

- Implementation various research projects from government departments and academic institutions
- Disaster Platform Website
- Popular Science Education
 - Remote Sensing Workshop for teachers
 - Remote Sensing Camp for college students
 - Large-scale Exhibition

Social Contribution

- Disaster Platform Website



Research Group & Advance Technology



Remote Sensing Research Group

Objectives and Tasks

- To research **fundamental** remote sensing science and the developments of relevant applications, including the processing and analysis of active and passive remotely sensed data and relevant scientific studies.
- To **integrate** the expertise of each research member, emphasis is laid in the environmental monitoring and mechanisms analysis, including data receiving, collecting, processing, and database constructing; environmental disaster predicting, monitoring and assessing; and construction of relevant data system for disaster reduction.

Remote Sensing Research Group

Members	Research Interests
Prof. Gin-Rong Liu	Remote Sensing · atmospheric radiation · Remote Sensing to Hazard Weather Systems · Atmospheric Sciences · Hydrology, and Environmental Remote Sensing
Prof. Yuei-An Liou	Microwave and Optical Remote Sensing · Atmospheric Science · GPS Meteorology and Methodology · Cryosphere (permafrost, glaciers)
Prof. Chung-Pai Chang	Structural Geology · Geological Data Processing · Geologic Remote Sensing
Prof. Tang-Huang Lin	Environmental Change Detection · Satellite Remote Sensing · Atmospheric Radiation
Assoc. Prof. Hsuan Ren	Image Processing · Target Detection · Pattern Recognition
Assoc. Prof. Chian-Yi Liu	Meteorological Satellite Remote Sensing · Meteorological Satellite Algorithm Application · Atmospheric Radiation · Atmospheric Thermodynamics
Adjunct Prof. Kuo-Chin Fan	Pattern Recognition · Computer Visualization · Data Processing
Adjunct Prof. Chien Hwa	R&D of Instrumentations for Ocean environmental monitoring · Coastal Hydrodynamics and Sedimentation · Surface Wave · Air-Sea Interactions

Research Hydrology (Prof. Yuei-An Liou)

Research Geological (Prof. Chung-Pai Chang)

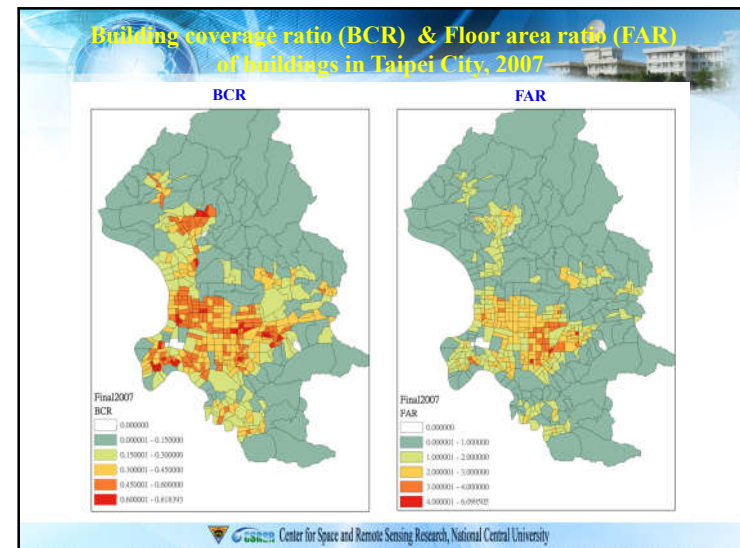
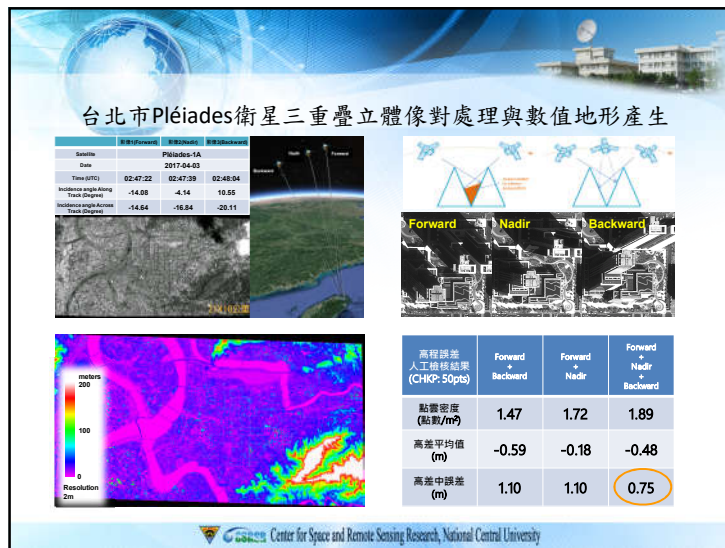
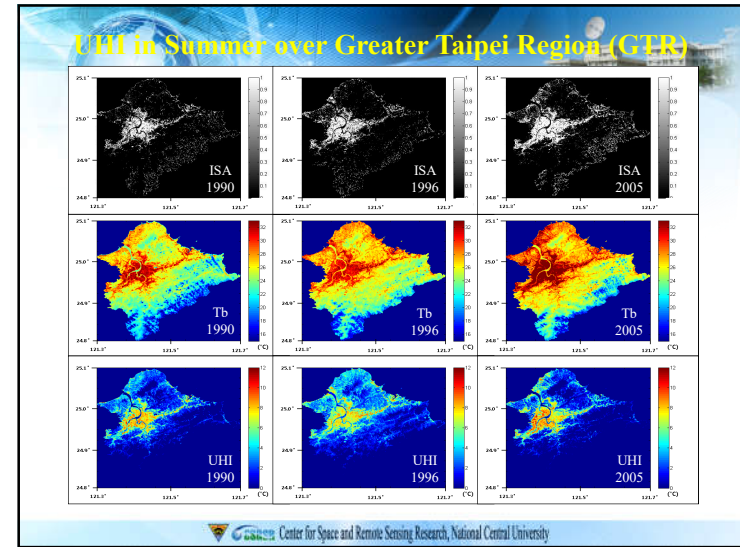
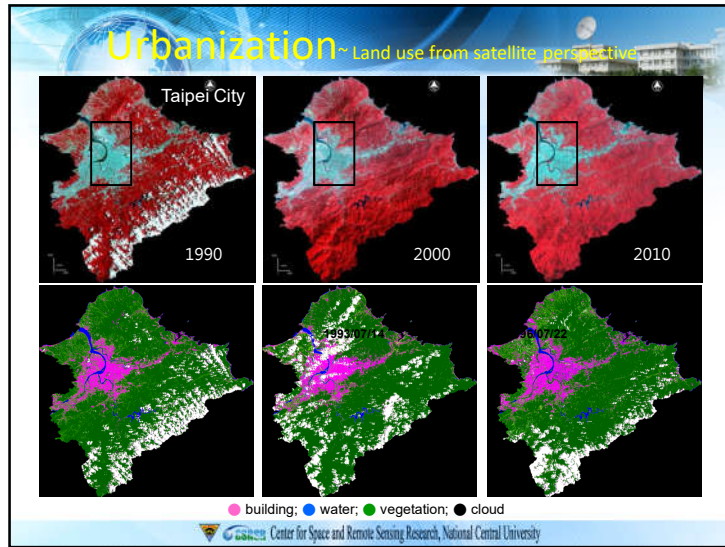
永久散射體雷達差分干涉測量(PSI measurement) Satellite : Sentinel-1A
 Images times : 2015/03/05~2017/08/21
 Master image : 2016/10/01

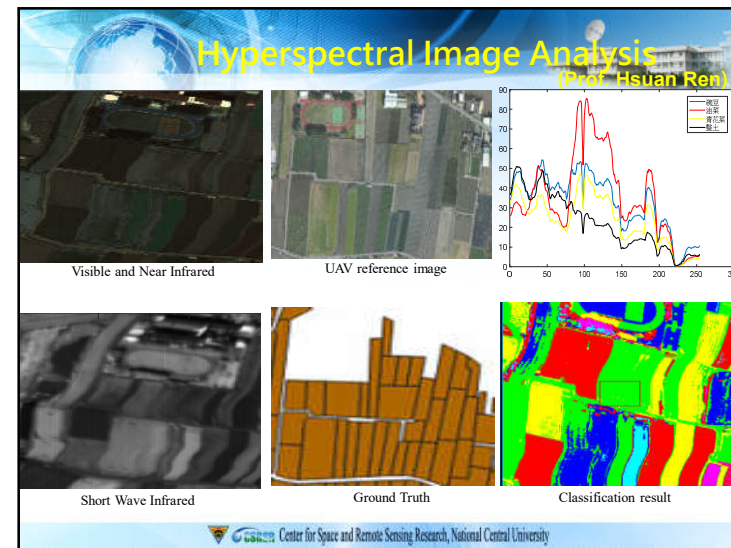
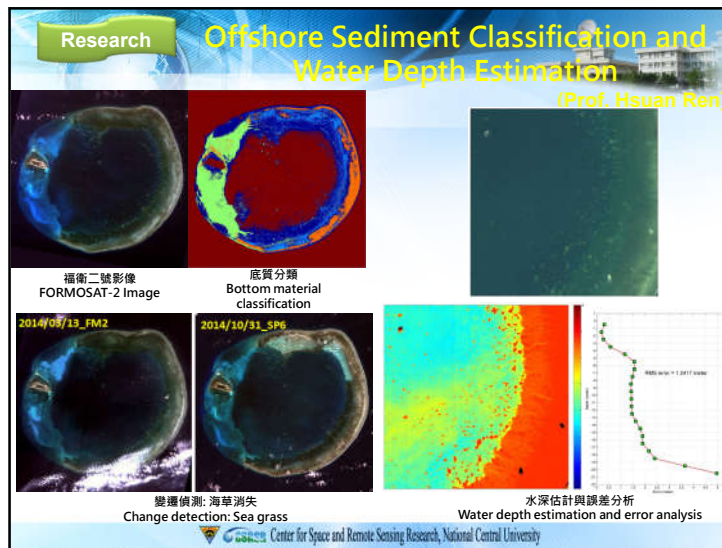
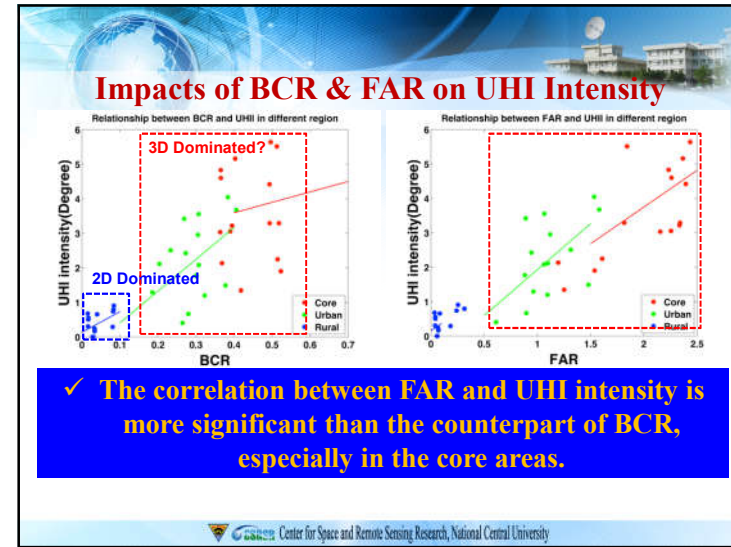
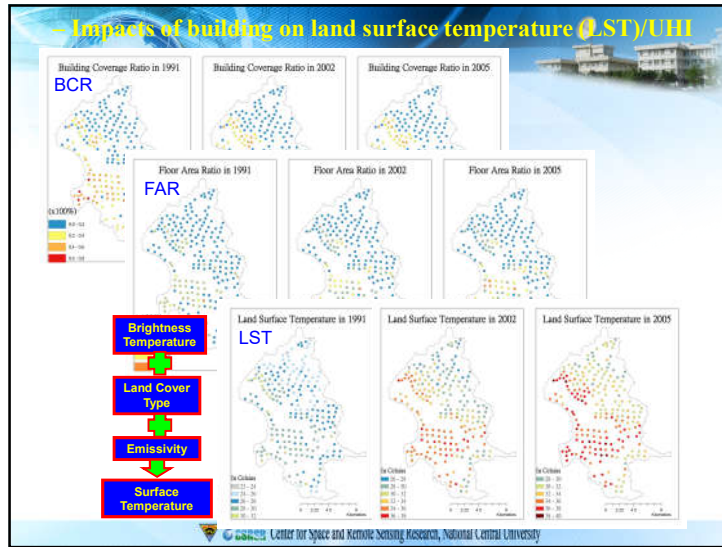
PS mean LOS velocities

Center for Space and Remote Sensing Research, National Central University

地質構造分析 (Analysis of geological structures) (Prof. Chung-Pai Chang)

- 西藏高原東南部的活動構造研究
- 台灣東部利吉泥同層構造分析





Geoinformatics Research Group

Objectives and Tasks

- Applying the 3S, Geographic Information Systems (GIS), Remote Sensing (RS) and Global Positioning System (GPS), as the core technology.
- Research emphases include the acquisition, analysis, visualization, and integration of geospatial data, especially in 3D modeling and spatial information related researches and applications.
- Providing viable and effective solutions to spatial-related problems, such as land-use monitoring, hazard mitigation, land deformation monitoring and the construction and visualization of 3D city models and location-based services (LBS).

33

Geoinformatics Research Group

Members	Research Interests
Prof. Chi-Farn Chen	Remote Sensing · GIS, Image Processing · Digital Photogrammetry · Environmental Monitoring
Prof. & Director Fuan Tsai	Remote Sensing · Image Analysis · Geoinformatics · Scientific Visualization
Asst. Prof. Kuo-Hsin Tseng	Satellite Altimetry · Satellite Geodesy · Remote Sensing for Health-Related Application · Multispectral Analysis
Asst. Prof. Chih-Yuan Huang	Web-based Geographic Information System · Geospatial Cyberinfrastructure · Geospatial Web, World-Wide Sensor Web · Internet of Things
Asst. Prof. Shou-Hao Chiang	Spatial Modeling · Physical Geography · Hillslope Hydrological Processes · Landslide Modeling
Adjunct Prof. Ray-Shyan Wu	Nonpoint source pollution and the impact of land development · Physical-based watershed models incorporating Geographical Information Systems · hydrology under climate changes

34

Geographic Information Systems

(Prof. Chi-Farn Chen)

Remote Sensing Technology on Agriculture

Rice mapping analysis and assessment in Mekong Delta, Vietnam.

Drought risk analysis and assessment on crops in Central America.

Promotions of International Cooperation

RS/GIS Training Program in Central America

Analysis of insect pest infection in Honduras.

Forest fire monitoring in Nicaraguan natural reserves.

Center for Space and Remote Sensing Research, National Central University

Research

高光譜影像三維紋理分析 (入侵性植物監測應用)
(3D Texture Analysis for Hyperspectral Images)

GeoComputing

(Prof. Fuan-Tsai)

全波形光達分析(Full-waveform LiDAR Analysis)

3D空間分析崩塌潛勢分析
(3D Spatial Analysis for Landslide Assessment)

3D Level of Detail for Visualization

Center for Space and Remote Sensing Research, National Central University

室內3D環景重建及AR導航導覽
Indoor 3D Panorama and AR Navigation

非典型攝影測量三維模型重建(Unconventional 3D Reconstruction)

3D數位城市建置應用(3D Digital City Modeling)

遙感影像自動化修補(Façade Texture Inpainting)

Research Web-based Geographic Information System (Prof. Chih-Yuan Huang)

地理網路搜尋引擎 GeoWeb Search Engine

地理網路爬蟲 GeoWeb Crawler

World-Wide-Web

Web Page (seed) → Hyperlinks → NTP GET → Download document → Parse URLs → Catalogue Service? → Yes/No → Link to Catalogue / Geo-Resource? → Yes/No → DB

地理網路搜尋引擎架構 GeoWeb Search Engine Architecture

PubSub Engine, Recommendation Engine, SIN DB, Search Engine, Index DB, Analyzer, Feeder, Cache, GeoWeb Browser, Social Network, Search Engine, User Portal, User

時間與空間遙測影像融合 Spatial and temporal remote sensing imagery fusion

應用時空影像融合於空氣品質監測 Apply spatial-temporal image fusion on air quality monitoring

Remote Sensing Research, National Central University

感測物聯網之開放式基礎建設 An Open Infrastructure for the Sensor Web & Internet of Things

Applications

Services

Gateways & Devices

國際開放式感測物聯網標準制定 International Open Standard for the Sensor Web & Internet of Things

感測物聯網之開放式基礎建設 An Open Infrastructure for the Sensor Web & Internet of Things

感測物聯網補即用流程 SW-IoT Plug-and-Play

感測物聯網資料模型與通訊協定 Data models and protocols for the Sensor Web & Internet of Things

Center for Space and Remote Sensing Research, National Central University

Space Science Research Group

Objectives and Tasks

- To study the ionosphere and mid-upper levels of the atmosphere, along with the observations regarding the space environment and space weather.
- To provide large-scale 3D global ionospheric density distribution, and low latitude area small-scale 2D tomographic scans, the basic ionospheric parameters over Taiwan, vertical electron density distribution, earthquake precursor alerts, etc.

Center for Space and Remote Sensing Research, National Central University

Space Science Research Group

Members	Research Interests
Prof. Lung-Chih Tsai	Ionospheric Physics · Radar Signal Processing
Adjunct Prof. Yen-Hsyang Chu	Radar Remote Sensing of the Atmosphere and Space · Ionospheric Physics · Signal Analysis and Processing · Radio Wave Propagation
Adjunct Prof. Jann-Yeng Liu	Ionospheric Physics · Space Physics

Center for Space and Remote Sensing Research, National Central University

Research Ionospheric (Prof. Lung-Chih Tsai)

福爾摩沙衛星三號、七號電離層觀測

全球三維電離層電子密度分佈圖

全球電離層閃爍現象發生頻率分佈圖

South Korea issues warning over suspected North Korean GPS disruption

海軍敦睦巡航高頻通訊頻率與路徑預測

電離層垂直電子密度分佈圖

Center for Space and Remote Sensing Research, National Central University 台灣自主定位系統開發

Scientific Investigation and Sustainable Development Research

Center for Space and Remote Sensing Research, National Central University


Environmental monitoring

- Land use/Land cover change
- Water resource
- Coastal zone

Center for Space and Remote Sensing Research, National Central University

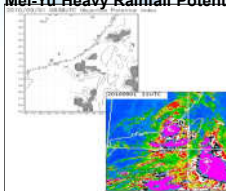
Disaster assessment

- Heavy rainfall
- Landslide
- Flooding/Drought




Research Meteorological (Prof. Gin-Rong Liu)


梅雨期豪大雨預測 Mei-Yu Heavy Rainfall Potential



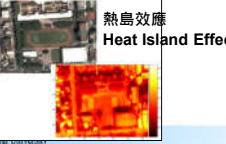
數位颱風監測系統 Digital Typhoon Monitoring System



環境監測 Environmental Change

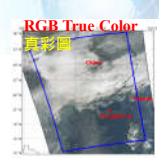


熱島效應 Heat Island Effect

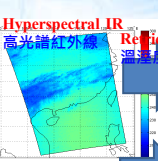


Research Atmospheric Radiation (Prof. Chian-Mi Liu)

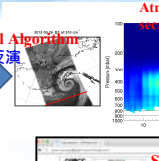
RGB True Color 真彩圖



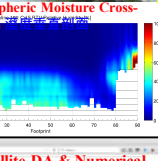
Hyperspectral IR 高光谱紅外線



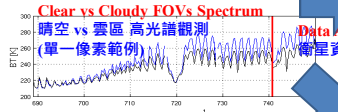
Retrieval Algorithm 溫濕度反演



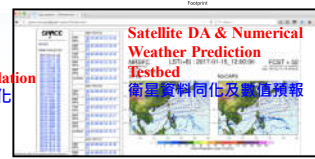
Atmospheric Moisture Cross-section 大氣濕度剖面



Clear vs Cloudy FOVs Spectrum 晴空 vs 雲區 高光譜觀測 (單一像素範例)

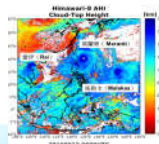


Satellite DA & Numerical Weather Prediction Testbed 衛星資料同化及數值預報

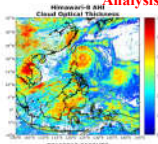


High-Impact Weather Analysis 高災害天氣分析

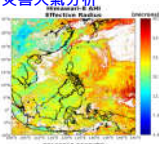
High-Impact Weather Analysis 高災害天氣分析



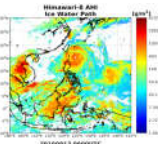
High-Impact Weather Analysis 高災害天氣分析



High-Impact Weather Analysis 高災害天氣分析



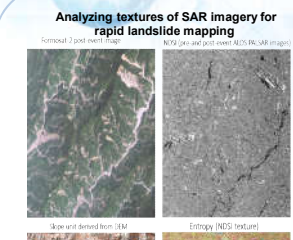
High-Impact Weather Analysis 高災害天氣分析



(Prof. Shou-Hao Chiang)

Application of Synthetic Aperture Radar (SAR) for Event Landslide Detection

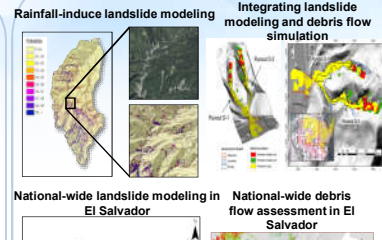
Analyzing textures of SAR imagery for rapid landslide mapping



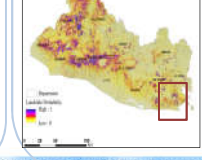
Landslide and Debris flow modeling and Susceptibility Assessment

Rainfall-induced landslide modeling

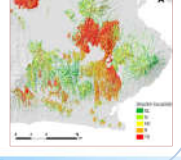
Integrating landslide modeling and debris flow simulation




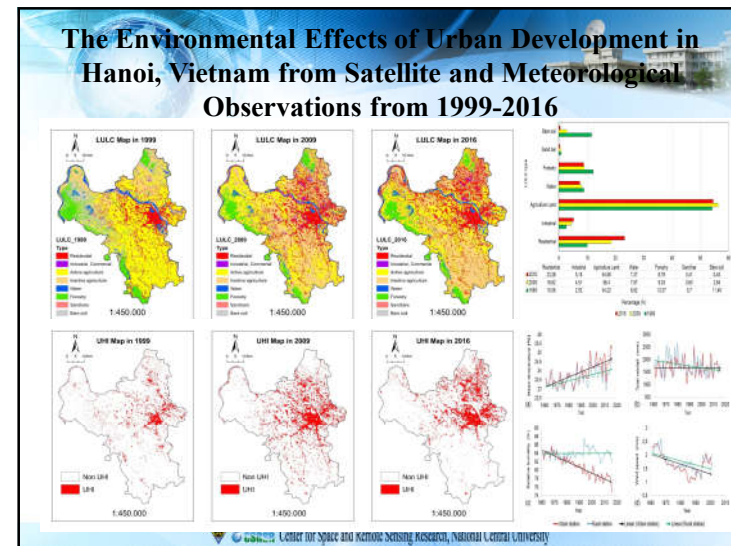
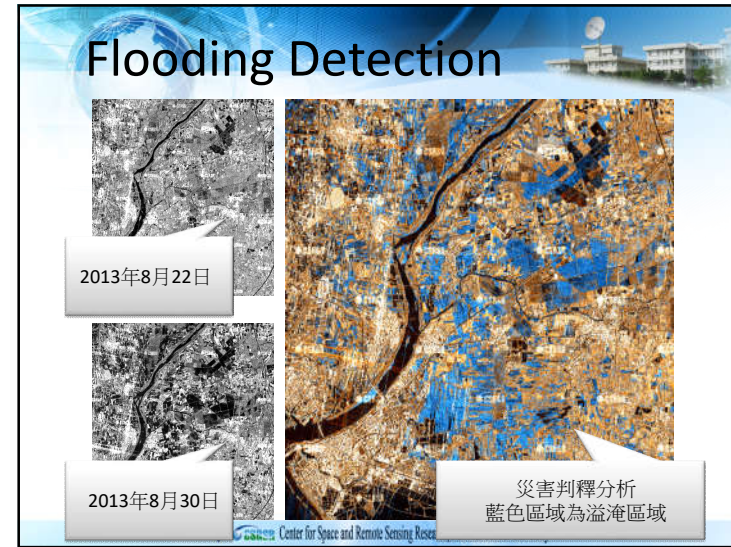
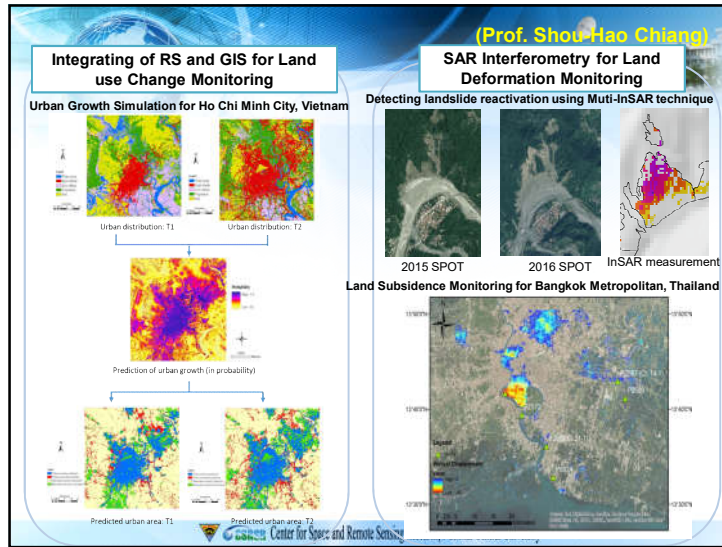
National-wide landslide modeling in El Salvador

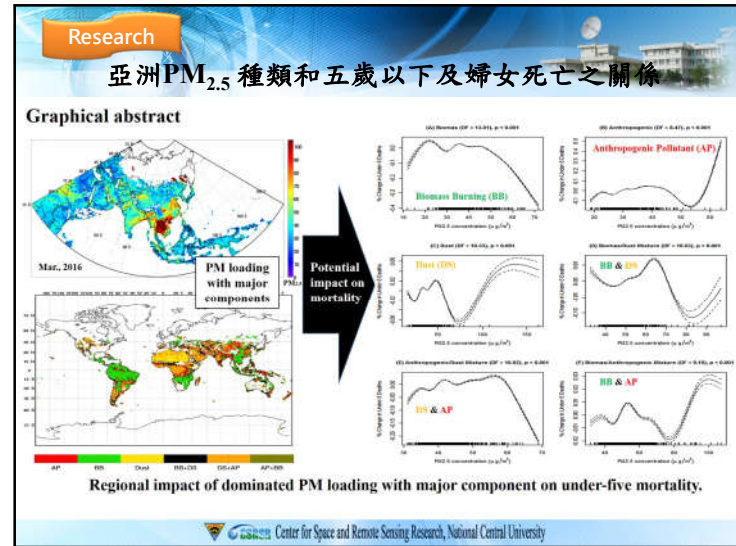
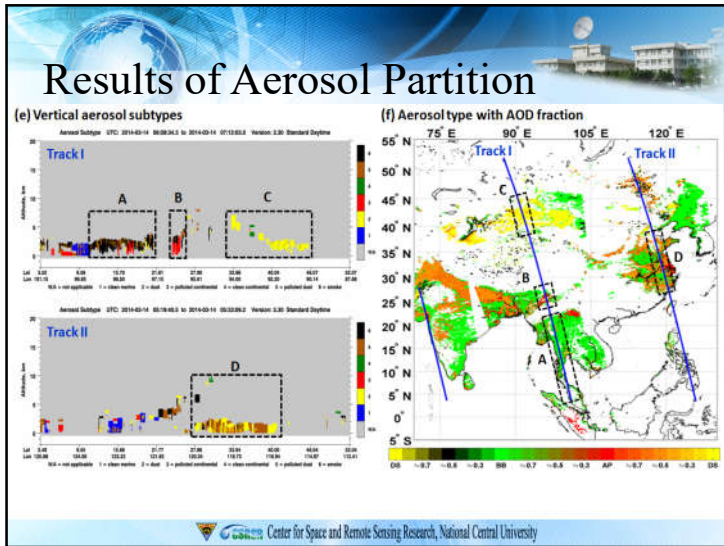
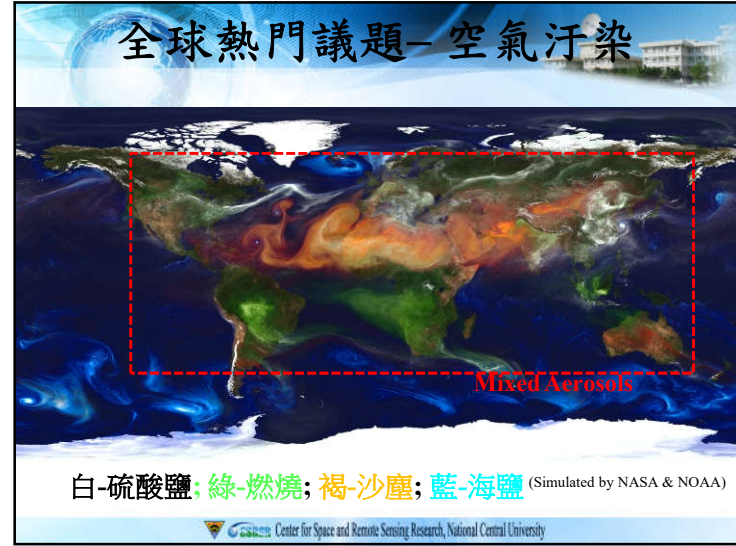
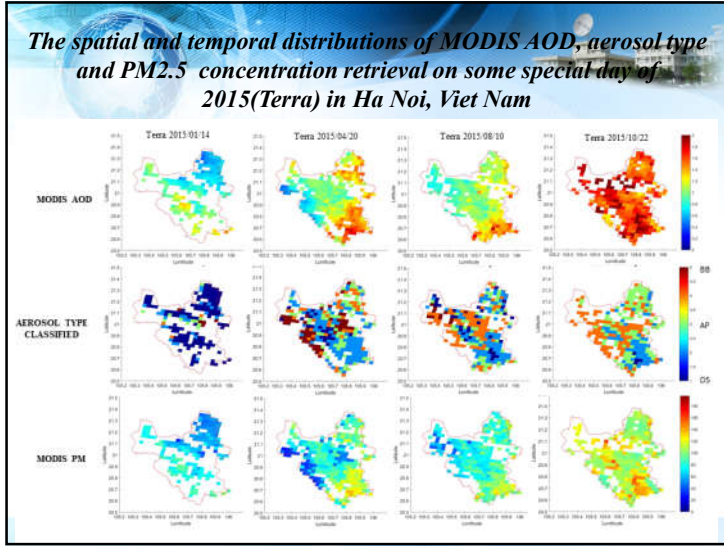


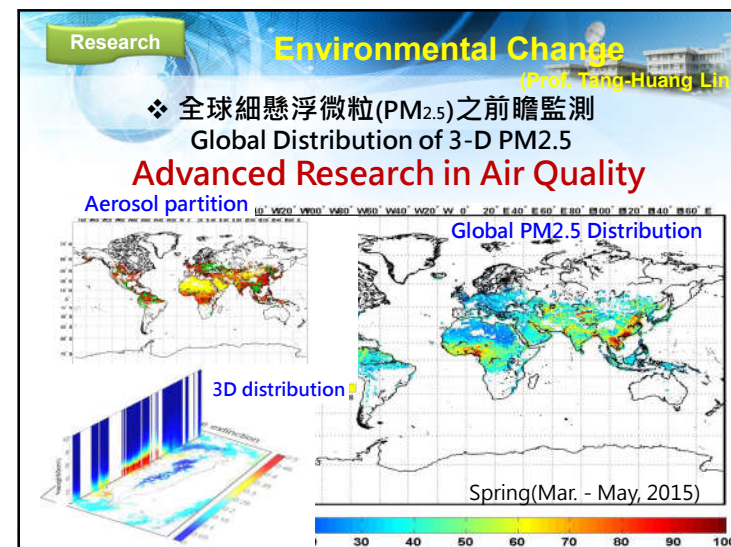
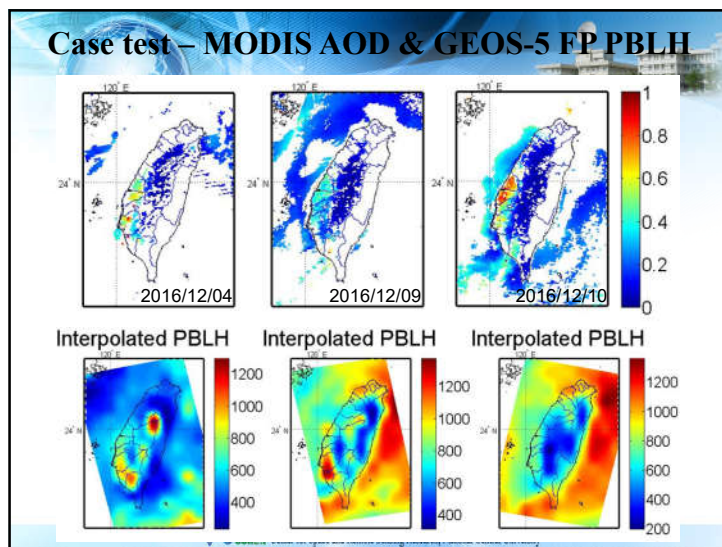
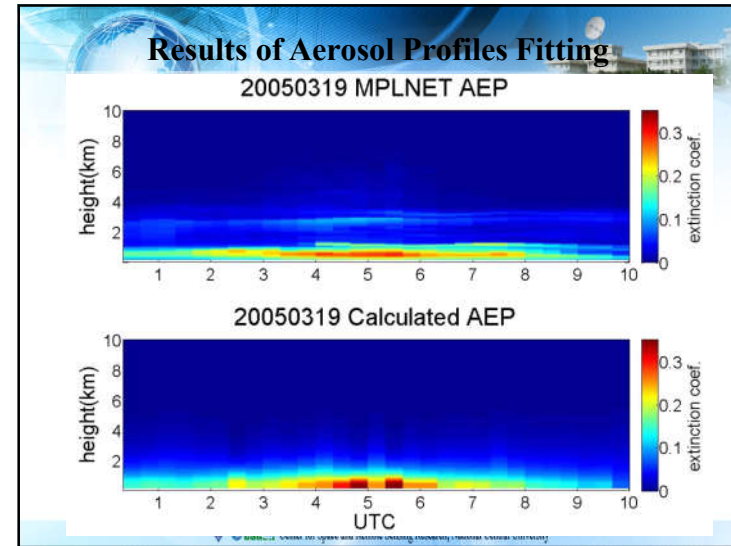
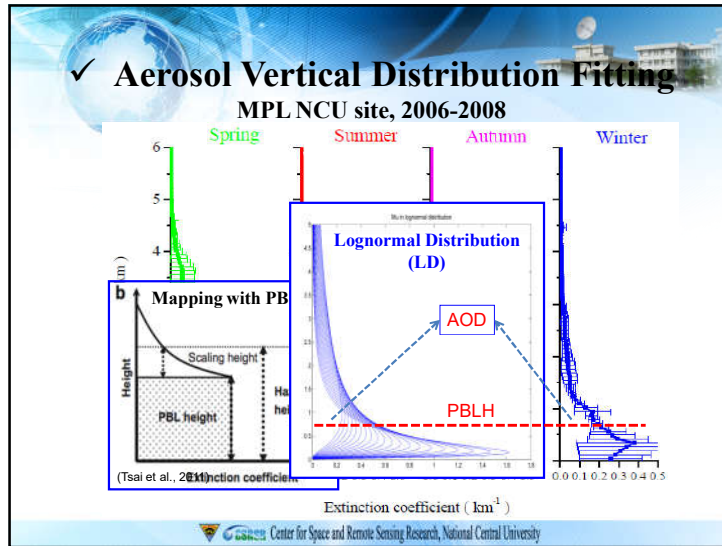
National-wide debris flow assessment in El Salvador

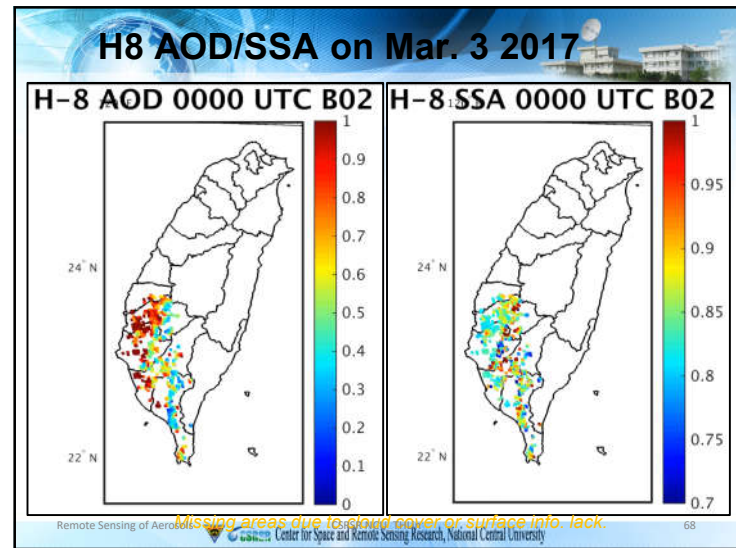
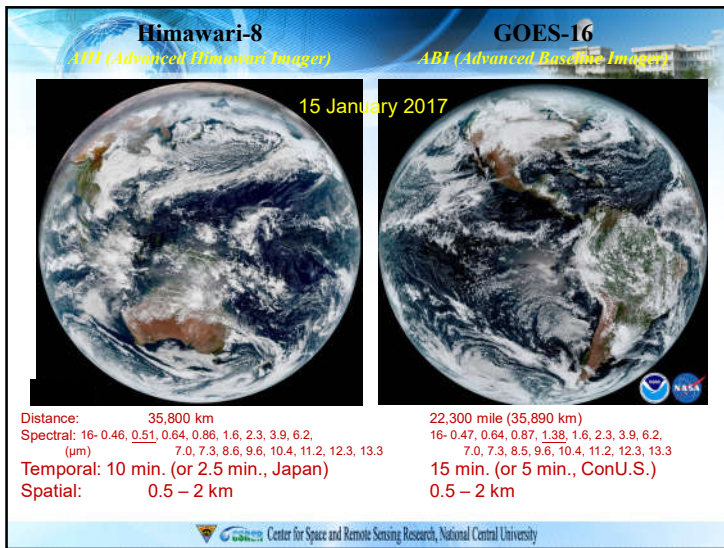
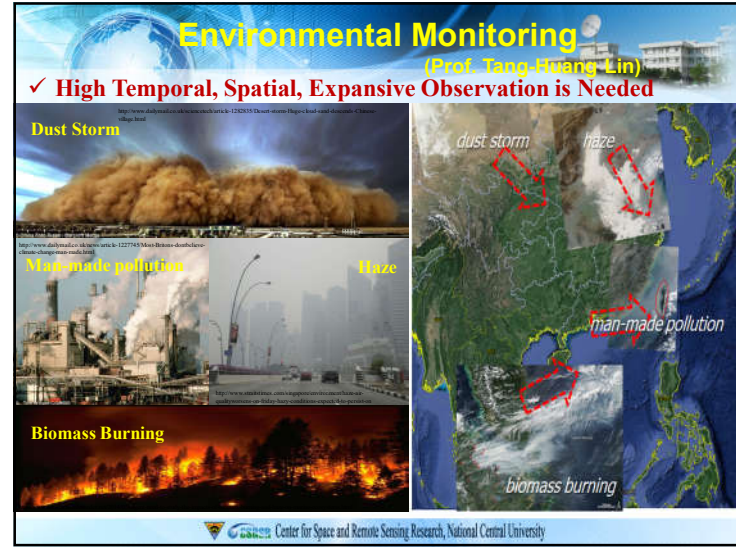
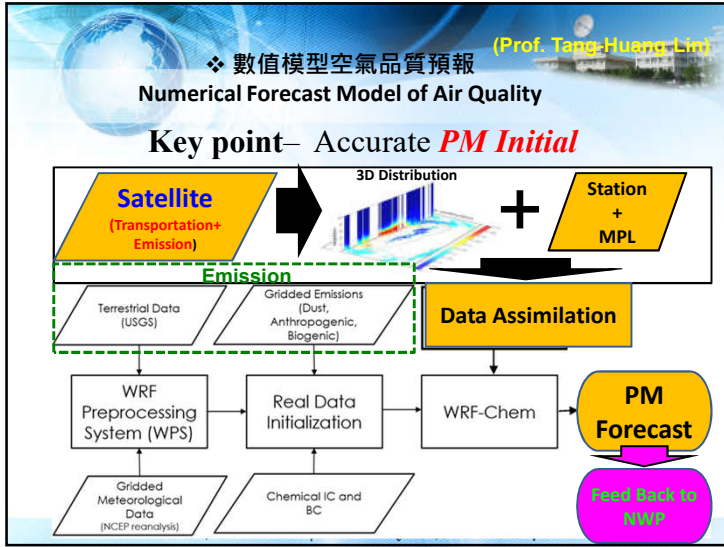


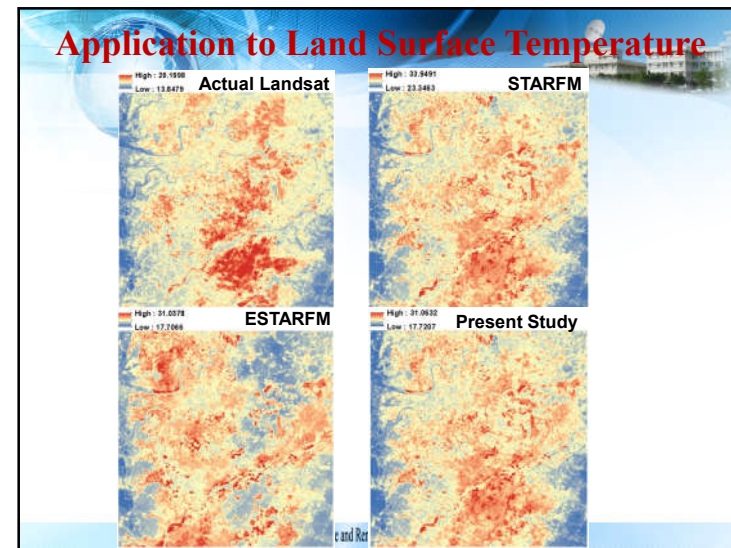
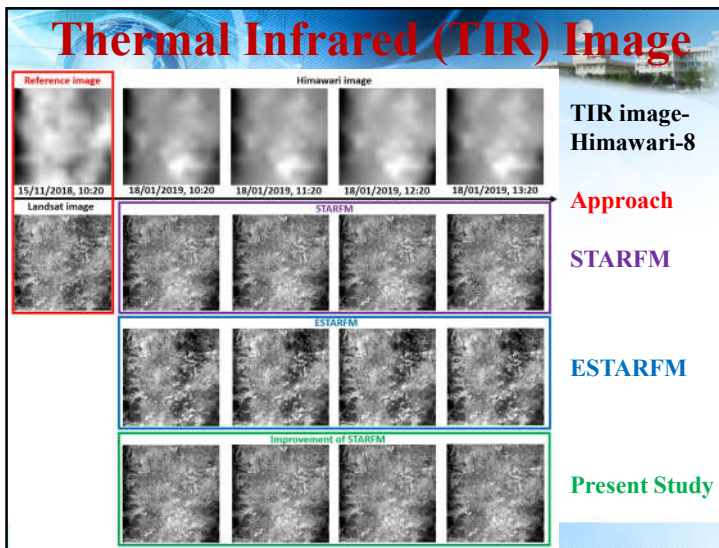
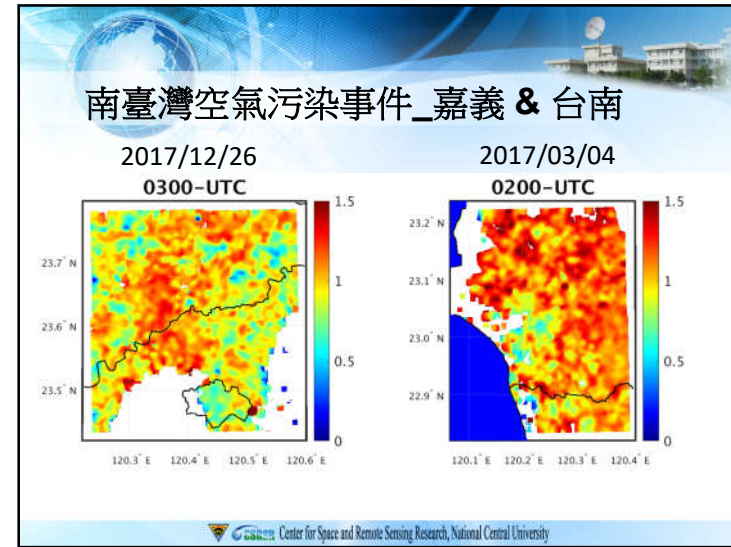
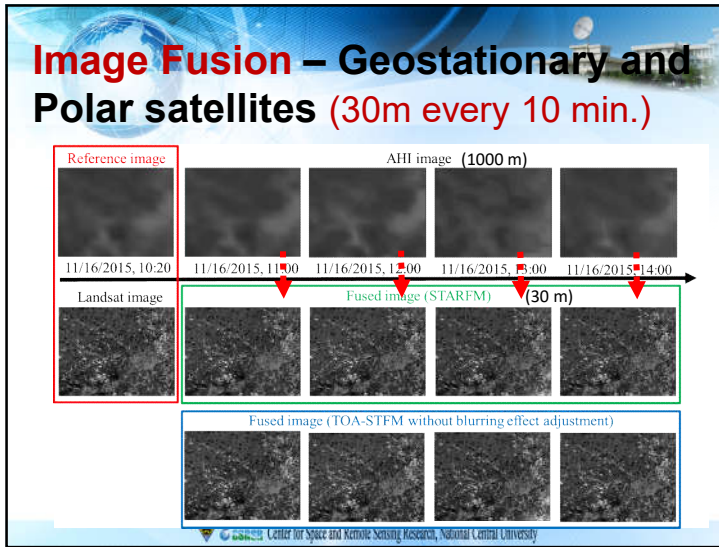


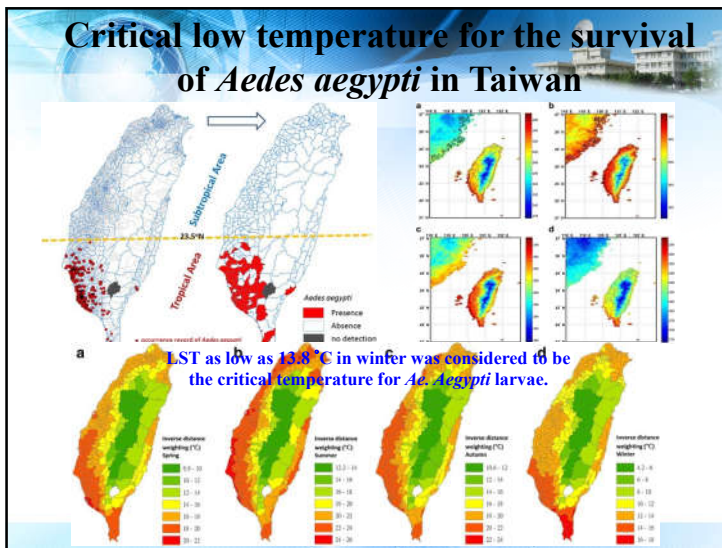
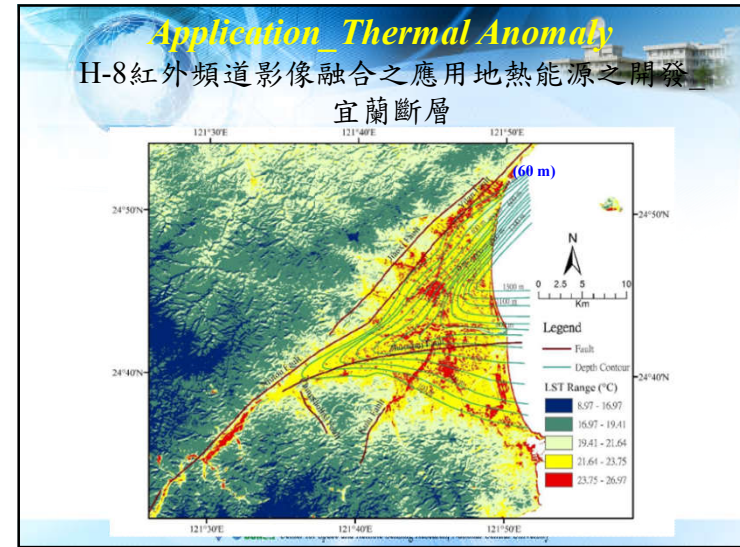
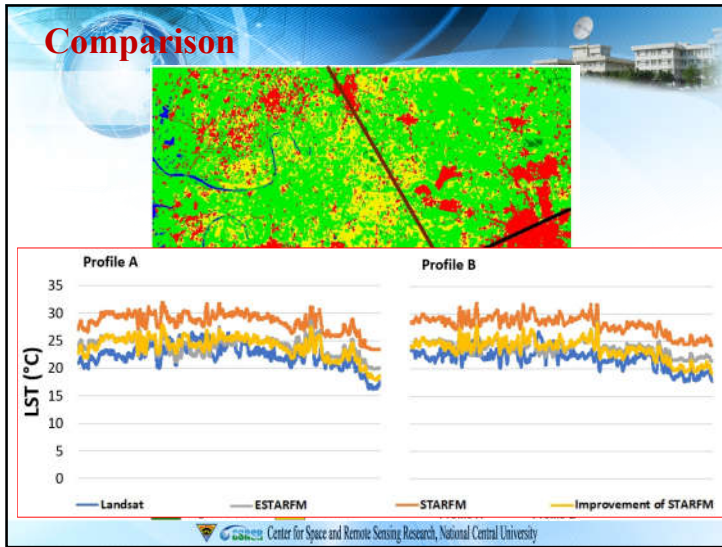












Advanced Research – Multi-Sensor System

Multi-Sensor Geocoded Production System (MSGPS)

Open Data

1996-2016共21年度 SPOT全台灣影像圖庫免費開放服務

Center for Space and Remote Sensing Research, National Central University

系統架構

空間資料流管理系統

模組連結(建立資料流處理流程)

後端基礎建設將需要包含多元遙測空間資料流彙整、巨量時空資料儲存管理、資料流處理系統的最佳化

資料流: SPOT, 福衛, Himawari, ...

指標運算元: 植生指標, 水體指標, ...

影像融合運算元: 時空融合, ...

分析及辨識運算元: ...

整合預報

流程一 (舉例): 訓練資料, SPOT, Himawari-8 (以高時間大範圍同步衛星為基底, 配合高空間資料), 時空融合, 空氣品質指標, 門檻值過濾, 高時空資料庫, 訊息(圖層)提供, 各項預報模式 (災害天氣、空氣品質、潛勢崩塌), 評估與決策系統 (人工智慧)

Center for Space and Remote Sensing Research, National Central University

Conclusion

- Strong remote sensing fundamental research capability and advanced application technology development
- Integrating satellite resources and promoting the remote sensing imagery, value-added data and services
- Contributing to global environmental issues with remote sensing and geo-spatial technologies
- Commitment to global services and international collaborations

We are ready to collaborate with you!

Center for Space and Remote Sensing Research, National Central University

79

敬請支持

Thank You

Prof. Tang-Huang Lin
thlin@carsr.ncu.edu.tw