



14TH RENCONTRES DU VIETNAM
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Examining Split Window algorithm to Landsat 8 for mapping Sea Surface Temperature

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and
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INTRODUCTION

❖ What is SST?

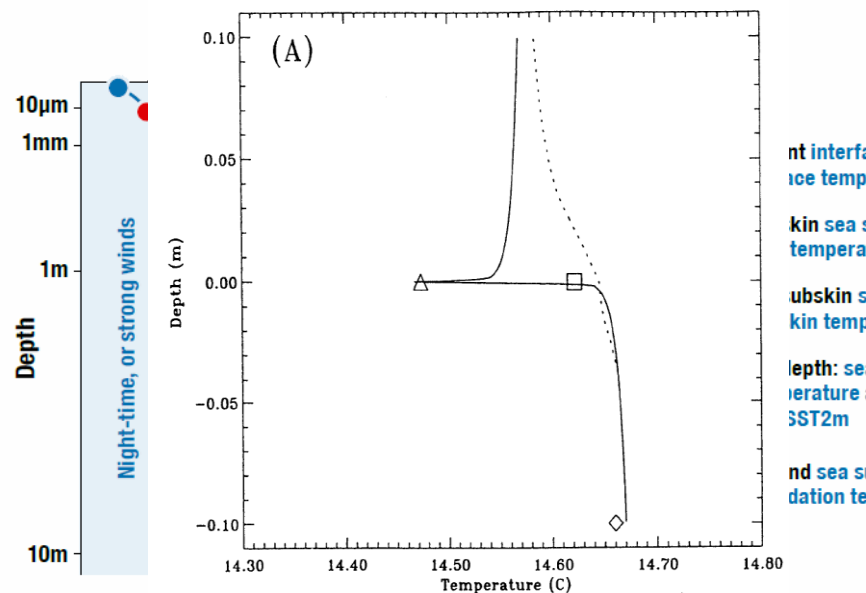
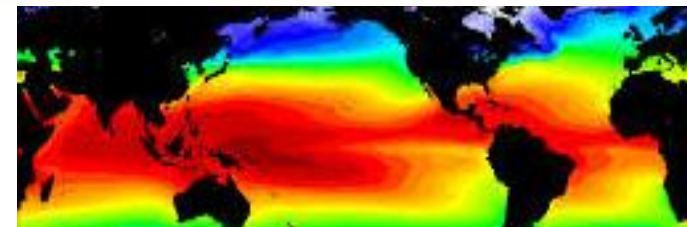
The infrared emission from the ocean originates from the uppermost $<1\text{mm}$ of the ocean – the skin layer.

The atmosphere is in contact with the top of the skin layer.

Ocean-to-atmosphere heat flow through the skin layer is by molecular conduction: this causes, and results from, a temperature gradient through the skin layer.

Conventional measurements of SST are from submerged thermometers – “bulk” temperature.

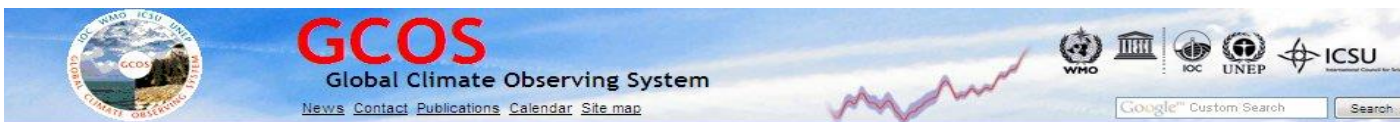
Depth below the influence of diurnal heating is the “foundation”





INTRODUCTION

Essential Climate Variables



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GCOS Essential Climate Variables

The Essential Climate Variables (ECVs;) are required to support the work of the UNFCCC and the IPCC. All ECVs are technically and economically feasible for systematic observation. It is these variables for which international exchange is required for both current and historical observations. Additional variables required for research purposes are not included in this table. It is emphasized that the ordering within the table is simply for convenience and is not an indicator of relative priority. Currently, there are 44 ECVs plus soil moisture recognized as an emerging ECV.

Domain	Essential Climate Variables
Atmospheric (over land, sea and ice)	Surface: Air temperature, Precipitation, Air pressure, Surface radiation budget, Wind speed and direction, Water vapour.
	Upper-air: Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), Wind speed and direction, Water vapour, Cloud properties.
	Composition: Carbon dioxide, Methane, Ozone, Other long-lived greenhouse gases ^[1] , Aerosol properties.
Oceanic	Surface: Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Current, Ocean colour (for biological activity), Carbon dioxide partial pressure.
	Sub-surface: Temperature, Salinity, Current, Nutrients, Carbon, Ocean tracers, Phytoplankton.
Terrestrial ^[2]	River discharge, Water use, Ground water, Lake levels, Snow cover, Glaciers and ice caps, Permafrost and seasonally-frozen ground, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (fAPAR), Leaf area index (LAI), Biomass, Fire disturbance, Soil moisture ^[3] .



INTRODUCTION

Essential Climate Variables



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Sea-surface temperature,

plus soil moisture recognized as an emerging ECV.

Essential Climate Variables	
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INTRODUCTION

Measurement of SST

**Field
measurements**

**Remote
sensing**



INTRODUCTION



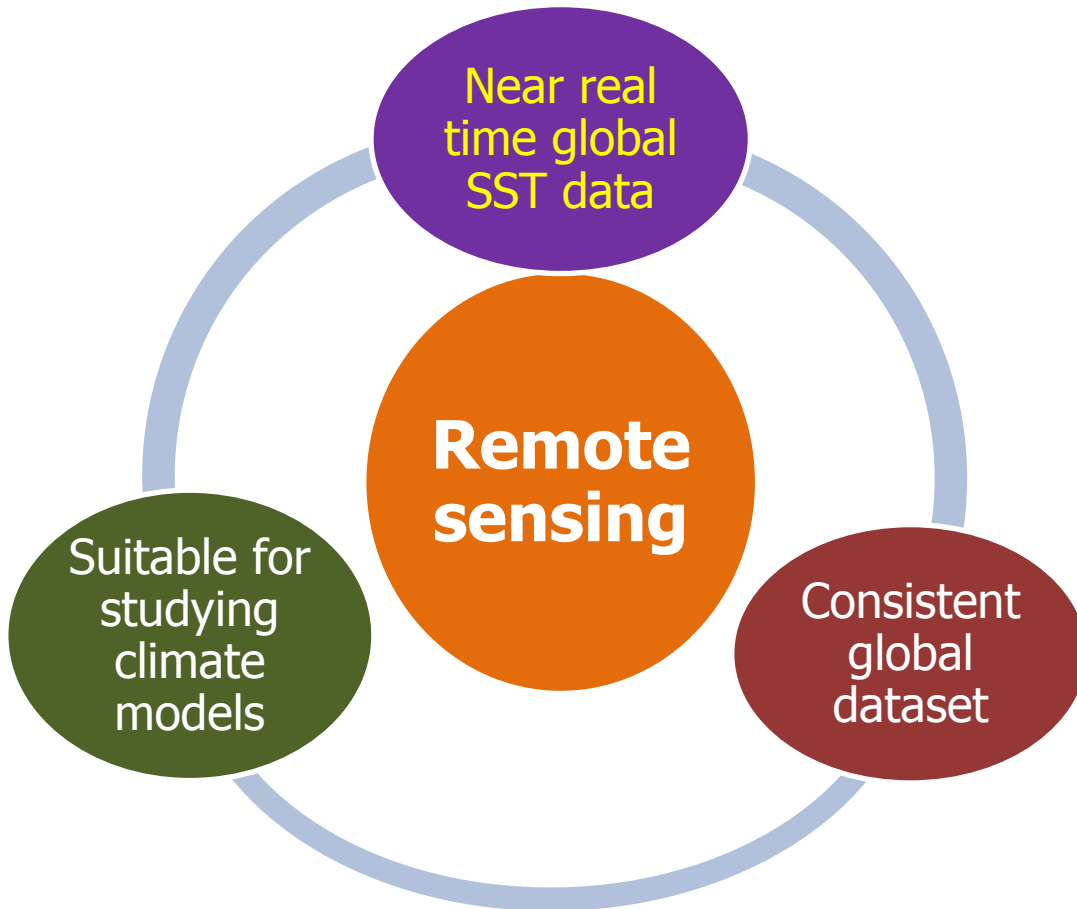
Field measurements

Scarcity of observations

Different measurement methods



INTRODUCTION



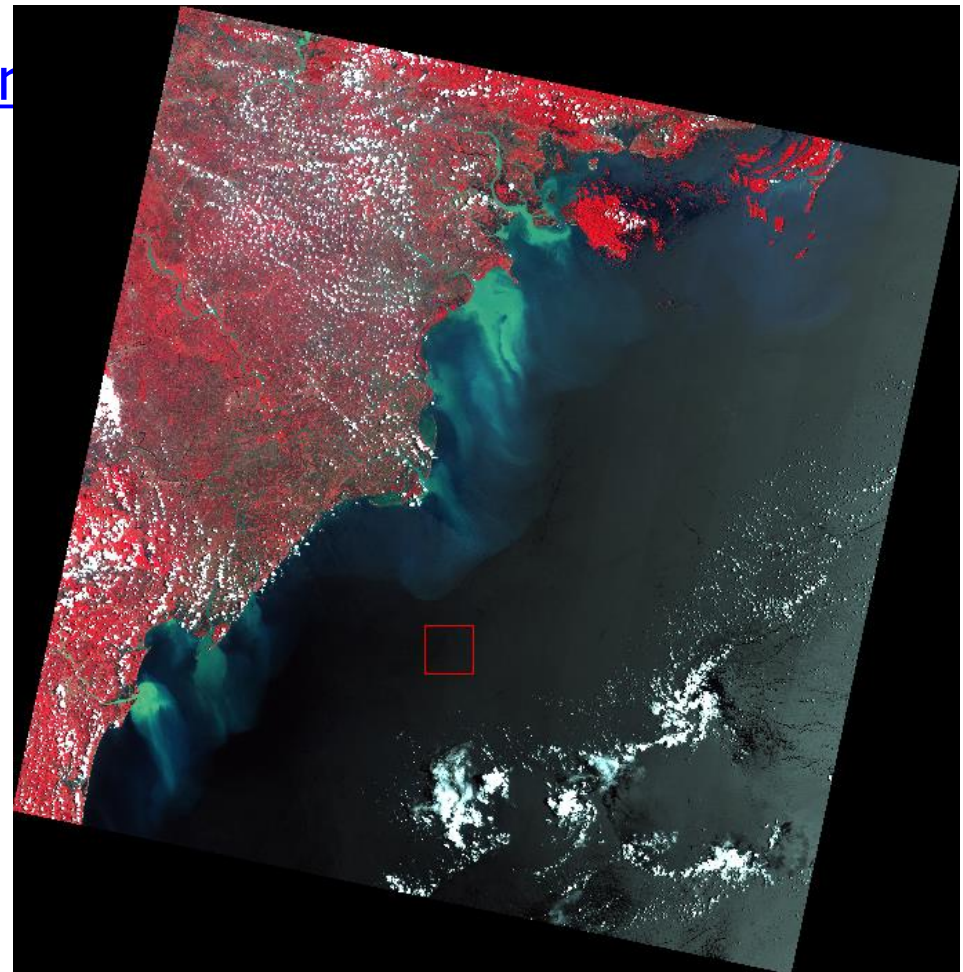


MATERIALS AND METHODS

➤ **Data**

- Landsat 8 (<https://earthexplor>)

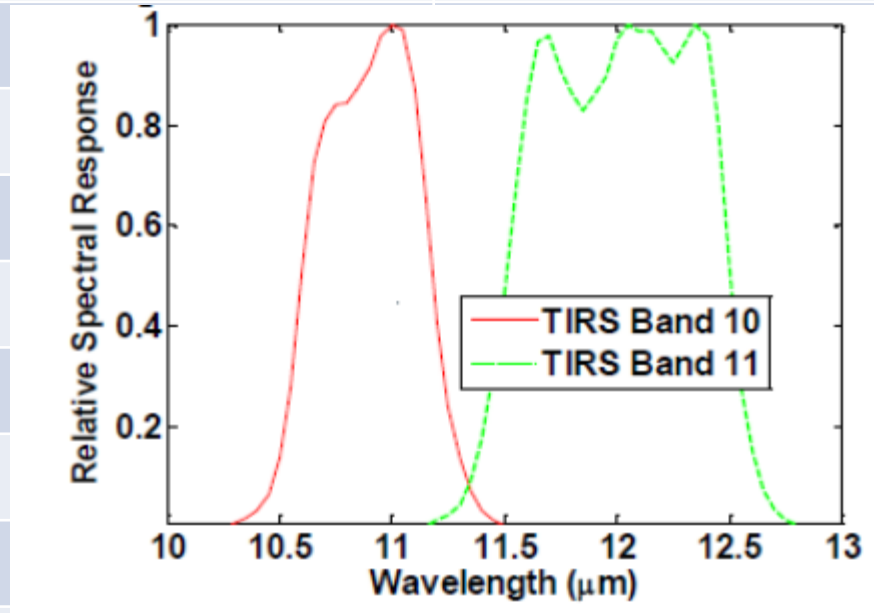
ID of Data	LC81260462016 204LGN00
Path	126
Row	046
Acquisition date	23/07/2016
Cloud coverage	6.72%





MATERIALS AND METHODS

Spectral Bands	Wavelength(μm)	Spatial Res.(m)
Band 1- Coastal aerosol	0.43- 0.45	30
Band 2- Blue	0.45- 0.51	30
Band 3- Green		
Band 4- Red		
Band 5- Near Infrared		
Band 6- SWIR 1		
Band 7- SWIR 2		
Band 8- Panchromatic		
Band 9: Cirrus		
Band 10- Thermal Infrared	10.6- 11.19	100
Band 11- Thermal Infrared	11.50- 12.51	100





MATERIALS AND METHODS

- LST _ MODIS product by NASA freely download:

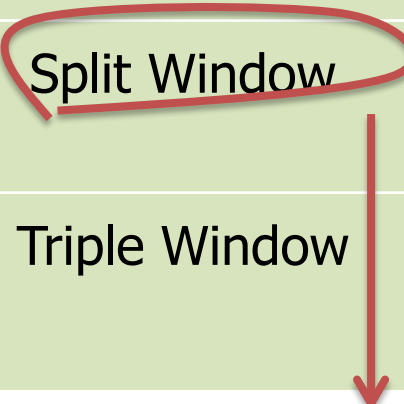
<https://ladsweb.nascom.nasa.gov>.

MYD11A1.A2016204.mosaic.006.2017207023616.mcrp_000
501161679.LST_Day_
(3436378)



➤ Algorithms

Algorithms	Wave length (μm)	Usage
Dual Window	3,7 and 11	Day
Split Window	11 and 12	Day & Night
Triple Window	3.7, 11 and 12	Day

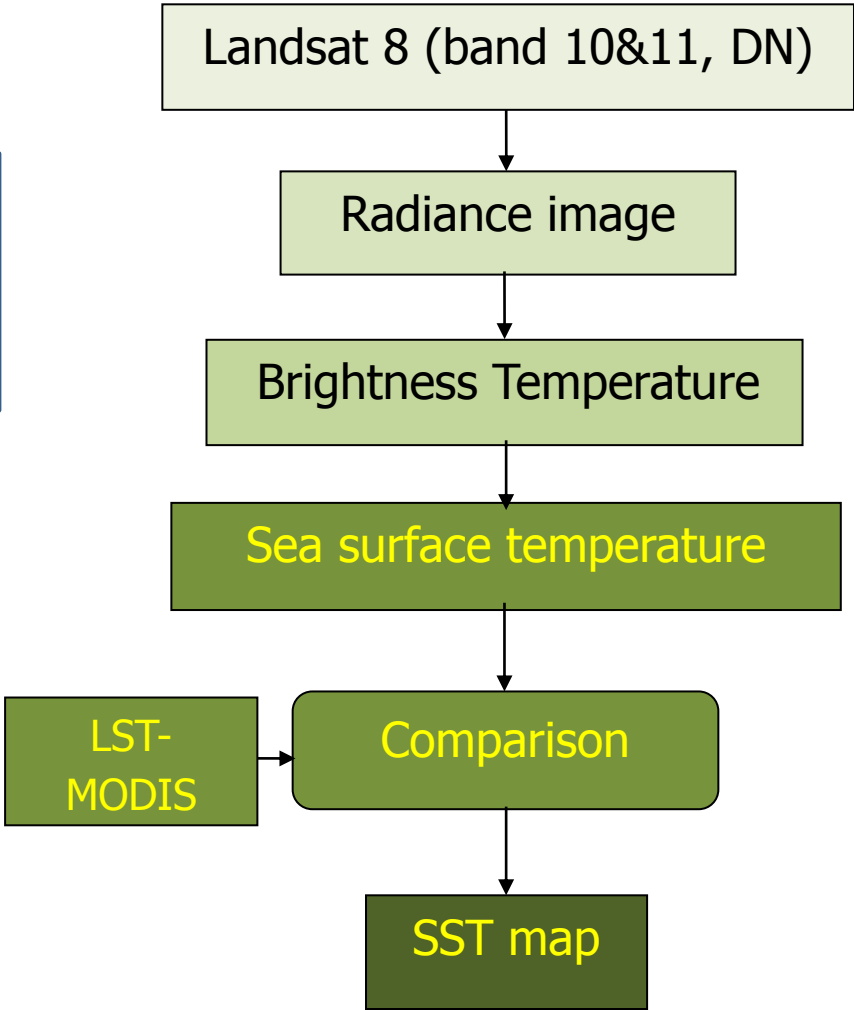


$$\text{MCSST} = a_0 + a_1 T_i + a_2 (T_i - T_j)$$

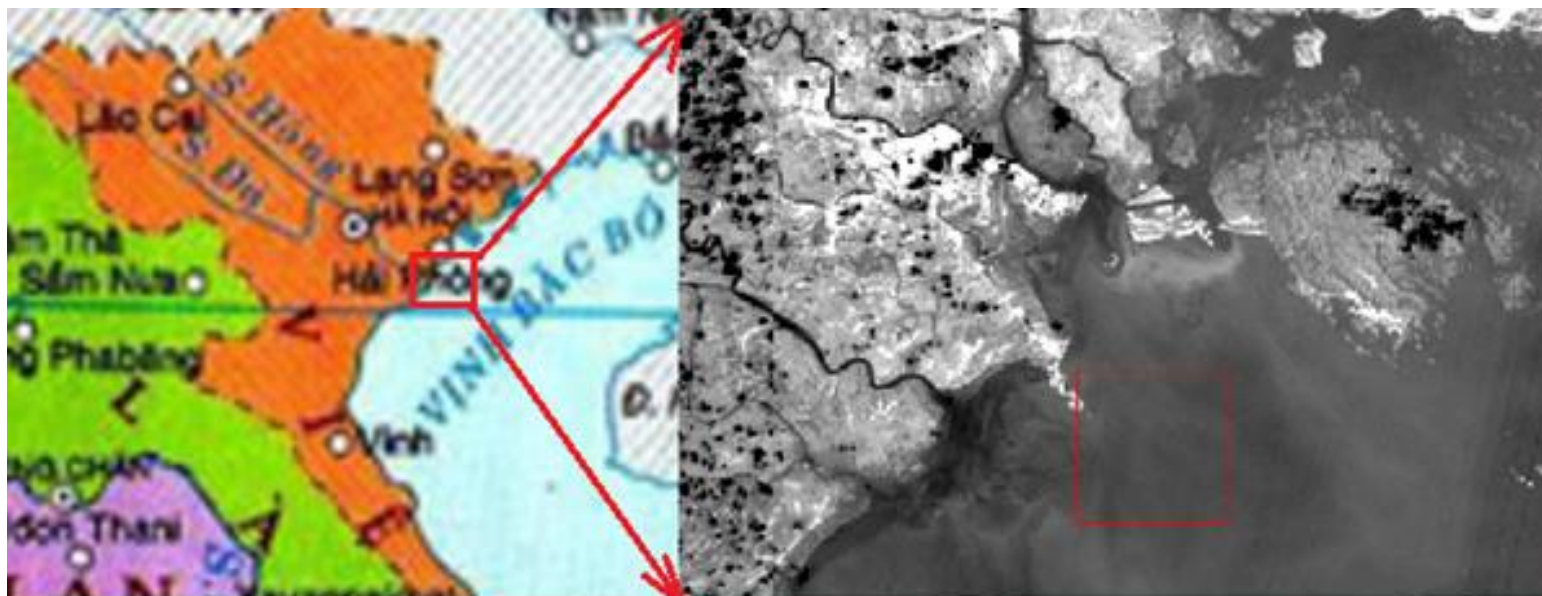


MATERIALS AND METHODS

Procedure to estimate SST



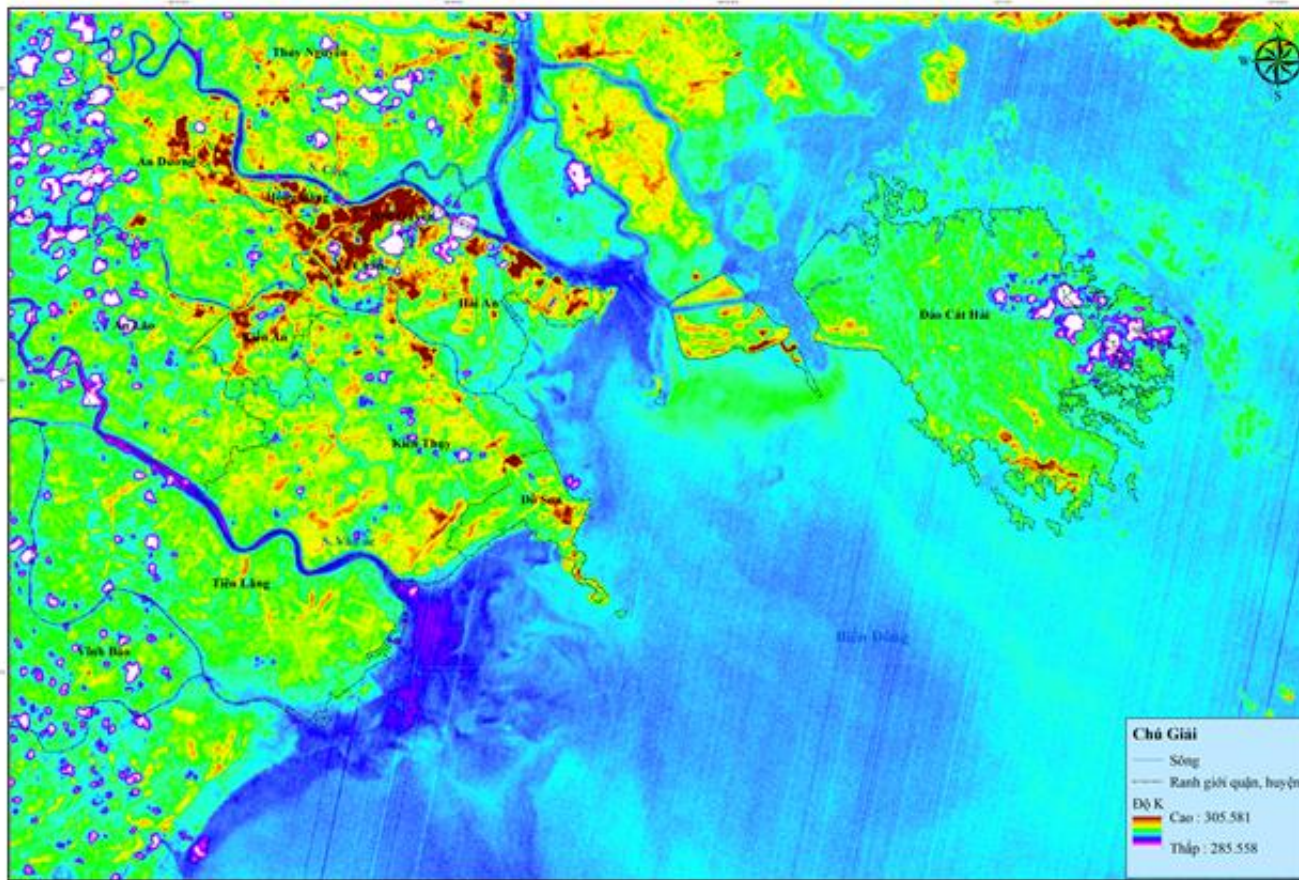
RESULTS AND DISCUSSIONS



Location of area interested

RESULTS AND DISCUSSIONS

BẢN ĐỒ NHIỆT ĐỘ BỀ MẶT BIỂN KHU VỰC ĐÔNG BẮC BỘ



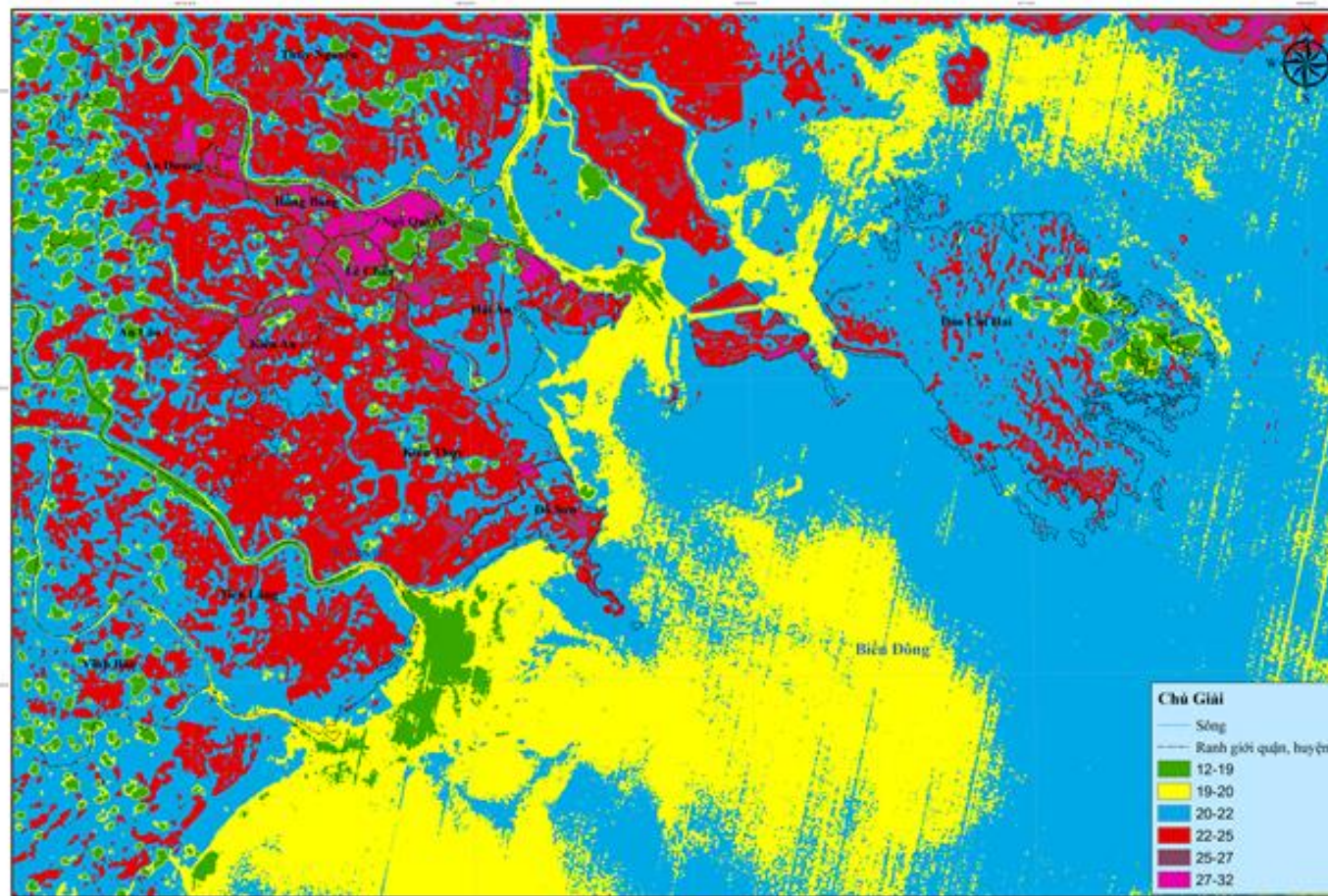
Nguồn: Ảnh vệ tinh Landsat 8 chụp ngày 23/7/2016

0 5 10 20 km

1:100,000

RESULTS AND DISCUSSIONS

BẢN ĐỒ NHIỆT ĐỘ BỀ MẶT BIÊN KHU VỰC ĐÔNG BẮC BỘ

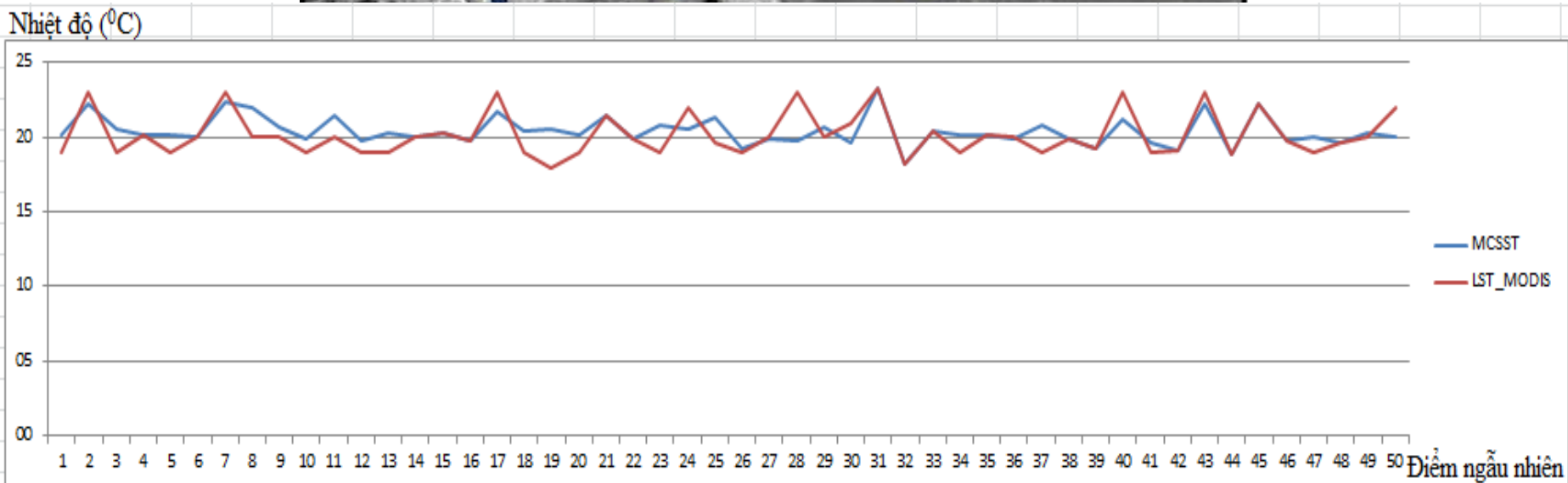
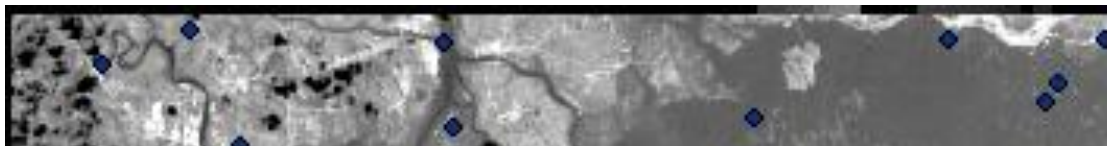


Nguồn: Ảnh vệ tinh Landsat 8 chụp ngày 23/7/2016

0 5 10 20 km

1:100,000

RESULTS AND DISCUSSIONS



50 random points for comparison

Comparison SST-Landsat 8 to LST MODIS



CONCLUSIONS

The study produced SST map by employing Split Window algorithm to band 10 and band 11 of Landsat 8. As shown on the map, the farther coastal, the lower value of SST.

Comparison SST-Landsat and LST-MODIS showed that differences are around 0-3.2 °C and average difference is 0.73 °C. This suggests that Split Window algorithm have quite good fit to estimate SST from Landsat 8 data in the study area.



CONCLUSIONS

- ✓ Landsat 8 imagery can be used to study SST at a higher scale than previous satellite generations: NOAA and MODIS, etc. but Landsat 8 has lower temporal resolution.
- ✓ Further studies could utilize Landsat 8 to monitor STT change.

Limitation: The study lacked of in situ data to validate the results.



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THANK YOU!

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