Coastal Remote Sensing
Supporting Ocean Accounting

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[China]
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Why do we need remote sensing data

• Area: How much?

• Distribution: Where? What do they look like?

• Landscape types: Seagrass beds, Mangrove, Seaweeds, Coral reefs, salt marshes, even migrating marine organisms large individual/groups (Sonar)…..

• Biomass evaluation based on in-situ survey
1.1 Characteristics of coastal areas
1.2 Remote sensing data list

<table>
<thead>
<tr>
<th>Satellites</th>
<th>Launch Time</th>
<th>Nation</th>
<th>Spatial Resolution(m)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>WorldView-3/4</td>
<td>2014/2016</td>
<td>US</td>
<td>Pan: 0.31; MS: 1.24</td>
</tr>
<tr>
<td>WorldView-1/2</td>
<td>2007/2009</td>
<td>US</td>
<td>Pan: 0.46; MS: 1.84</td>
</tr>
<tr>
<td>GeoEye-1</td>
<td>2008</td>
<td>US</td>
<td>Pan: 0.46; MS: 1.84</td>
</tr>
<tr>
<td>Pleiades</td>
<td>2011</td>
<td>France</td>
<td>Pan: 0.5; MS: 2</td>
</tr>
<tr>
<td>SuperView-1</td>
<td>2016</td>
<td>China</td>
<td>Pan: 0.5; MS: 2</td>
</tr>
<tr>
<td>KOMPSAT-3A</td>
<td>2015</td>
<td>Korea</td>
<td>Pan: 0.55; MS: 2.2</td>
</tr>
<tr>
<td>Quickbird**</td>
<td>2001</td>
<td>US</td>
<td>Pan: 0.65; MS: 2.62</td>
</tr>
<tr>
<td>KOMPSAT-3</td>
<td>2012</td>
<td>Korea</td>
<td>Pan: 0.7; MS: 2.8</td>
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<tr>
<td>Gaofen-2</td>
<td>2014</td>
<td>China</td>
<td>Pan: 0.8; MS: 2.44</td>
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<tr>
<td>TripleSat</td>
<td>2015</td>
<td>India</td>
<td>Pan: 0.8; MS: 3.2</td>
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<tr>
<td>IKONOS***</td>
<td>1999</td>
<td>US</td>
<td>Pan: 0.82; MS: 3.28</td>
</tr>
<tr>
<td>SkySat-1/2</td>
<td>2013/2014</td>
<td>US</td>
<td>Pan: 0.9; MS: 2</td>
</tr>
</tbody>
</table>
Other data sources in recent years: land-based

- unmanned aerial vehicle (UAV)
- Lidar
- Glider
Other data sources in recent years: ocean-based Autonomous Underwater Vehicle (AUV)/sonar
2.1 Marine ecosystems: Mangrove
2.1 Marine ecosystems: Salt marshes
2.1 Marine ecosystems: Seagrasses

(Zhou, et al. 2019)
2.1 Marine ecosystems: Seagrasses

(Zhao, et al. 2015)
Survey the underwater ecosystems
2.1 Marine ecosystems: Seaweeds
2.1 Marine ecosystems: Coral reefs

(Zhang, et al. 2019)
2.1 Marine ecosystems: Biodiversity

Traditional in-situ survey for small individuals

Rethinking the marine carbon cycle: Factoring in the multifarious lifestyles of microbes

Worden et al. Science 13 February 2015, DOI: 10.1126/science.1257594
The most complicated ecosystem in the world

A comparison of the size range (maximum linear dimension) of phytoplankton relative to macroscopic objects

Cyanobacteria

2.1 Marine ecosystems: Biodiversity and food web
2.1 Marine ecosystems: YSLME foodweb

Ecopath model
SIA analysis

(Wang, et al. 2019)
2.1 Marine ecosystems: Biodiversity
Rapid, long distance, no intervention for large individuals

\[
W = l \cdot \tan \left( \frac{\alpha}{2} \right)
\]

\[
r = \frac{W_s}{W_p}
\]

\[
w_s = l \cdot \tan \left( \frac{\alpha}{2} \right) \cdot \frac{W_s}{W_p}
\]

**M1: Ranging telescope**

\[
L_s = L_s' \times \left( \frac{d_0}{d_0'} \right)
\]

**M2: Parallel laser beam**
2.1 Marine ecosystems: Intertidal flats

Hyperspectral remote sensing
2.1 Marine ecosystems: Islands

(Dong, et al. 2019)
2.2 Data acquisition connecting natural ecosystem and ocean accounts

National ocean accounts

- Indicators classification
- Data normalization
- Original data

Union of national economic-environmental statistics

Macro-statistics

Ecosystem services

Economic data

National SEEA - Ocean

Marine ecosystems level

Ecosystems (the same type) level

Pilot sites

Ecosystems & the Ocean

http://www.unescap.org/our-work/statistics
3. joining local ecosystem knowledge to higher levels (economic+eco-environmental benefits)

- Ecosystem services (Costanza et al., 1997): Goods + indirect economic outputs from nature benefits;

- Emergy analysis (Odum, H. T., 2003. 《Emergy Accounting》)

- Green GDP

- Green National Accounting System
(Lu, et al. 2007)
4. What we have done: basic data

- Liaohe Estuary
- Yellow River Estuary
- Yancheng Salt marsh
- Seagrass beds in Hebai, Shangdong
- Coral reefs in the South China Sea
- Dongzhaihang Mangrove
- Baihai Mangrove
- Weizhou Island Corel Reefs
- Yangtze River Estuary
- Pearl River Estuary
- Yangtze River Estuary
- Yellow River Estuary
- Liaohe Estuary
- Seagrass beds in Hebai, Shangdong
- Coral reefs in the South China Sea
- Dongzhaihang Mangrove
- Baihai Mangrove
- Weizhou Island Corel Reefs
- Yangtze River Estuary
4. What we will do: Building Accounts system in spatio-temporal scale

• Support Dr. Zhao Peng’s accounting system

• Combination with related statistics
  • National Social-economic Bulletin (since 2000)
  • National Environmental Bulletin (since 2000)
  • National Natural Resources Assets
  • National Statistics (since 1980)
  • National Fishery Statistics (since 1980)
  • Ocean Governance Assessment relating to management
  • Fishery Performance Indicator system based on SES
(He, et al. 2014)
4. Thematic maps: overlay analysis, krigging analysis, etc.
Thank you!