1. Flood monitoring
2. Disaster assessment
3. Monitoring on water project for flood control
4. Flood forecasting and risk map
China is suffered from flood disaster for a long history. So Chinese government pays more attention to flood control. Remote sensing technology has been used for flood monitoring since 1980, then disaster assessment, water project monitoring, risk map making, and establishment of professional system were made step by step.
1. Flood monitoring

Image Data Sources

1. Space satellite: Landsat 8, SPOT, Radarsat 2, Envisat, Sentinel-1, GF-1, GF-2, GF-3, GF-4, GF-5, GF-6, ZY3-01, ZY3-02, ZY1-02C, ZY-04, BJ-2, JL-1

2. Air-born SAR: 10,000~13,000m (all weather)

helicopter, unmanned plan

Real-time monitoring mainly depends on radar image

Background data from visible image
1. Flood monitoring

Appropriateness evaluation for remote sensing data usually used

<table>
<thead>
<tr>
<th>Data</th>
<th>Landsat 8</th>
<th>SPOT</th>
<th>NOAA/AVHRR</th>
<th>GF-3 (domestic)</th>
<th>EOS/MODIS</th>
<th>Sentinel-1</th>
<th>Air-born SAR</th>
<th>Unmanned plan</th>
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<tr>
<td>Revisit (d)</td>
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<td>26</td>
<td>0.5</td>
<td>29</td>
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<td>×</td>
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<td>√✓</td>
<td>×</td>
<td>√✓</td>
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<tr>
<td>Data obtain</td>
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<td>√</td>
<td>√✓</td>
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<td>√✓</td>
<td>×</td>
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</tr>
<tr>
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<td>√</td>
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<td>√</td>
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<tr>
<td>Duration</td>
<td>×</td>
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<td>—</td>
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<tr>
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<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: ✓✓ very suitable ✓ general suitable × not suitable
Real-time transmission system of air-born SAR
Inundated oil-well at Daqing in 1998 by this system
Factors for monitoring:

Extent of inundation

Duration of inundation (successive monitoring)

Water depth and its spacial distribution with the aid of DEM
Flood monitoring & assessment system (software)
系统总界面
雷达影像水体自动提取界面
淹没范围提取界面
Dynamic Monitoring for Monwa Detention Basin

Water level: 28.82m

2003.7.5 17:22

Montou Water level: 28.23m

2003.7.7 6:11

Montou Water level: 28.69m

2003.7.12 18:18
Dynamic Monitoring for Jinshanhu Flooding Basin

2003年7月7日6时11分

2003年7月12日18时18分
Dynamic Monitoring for the Chendonghu Detention Basin

2003年7月7日6时11分

2003年7月12日18时18分
Heilong River in August, 2013
Wuhan City in 2016
Hubei and Anhui in 2016
14 times monitoring for downstream of Yangtze River in 2016
Shouguang, Shangdong in 2018
Dammed lake of the Jinsha River in 2017 & 2018
1. Flood monitoring
2. Disaster assessment
3. Security of Water Project for flood control
4. Flood forecasting and risk map
2. Disaster assessment

Depending on water depth, duration and inundated objects from social & economic data base, the most difficult factor is loss rate.
Disaster loss evaluation model

Economic loss estimation is performed on the basis of grid which is common for flood routing and social-economic database.

On the basis of water depth, inundation duration, inundation object and corresponding loss rate, the capital loss is calculated.

\[
R_{\text{capital}} = \sum_{i} \sum_{j} \sum_{k} \sum_{m} \sum_{n} A_{ij} \eta_{jkm} Y_{jn} (1 + e_{j})^N
\]
According to the inundation duration, the loss due to stoppage of business is calculated.

\[ R_{busi} = \sum_i \sum_j L_j B_{ij} (1 + e_j)^N \times \text{Days} / 365 \]
\[ R_{\text{indirect}} = \sum_i \sum_j R_{ij\text{direct}} \times K_j \]

\[ R_{\text{relief}} = R_{\text{historical}} (1 + e_j)^N \]
\[ R_{benefit} = \sum_i U_i \times \int_0^T a e^{-bt} \, dt \]

\[ W_{total} = R_{capital} + R_{busi} + R_{indirect} + R_{relief} - R_{benefit} \]
Relation curve between loss rate and water depth for different sector
Relation curve between loss rate and inundation duration for different crops
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Variation of river regime due to scour and filling of sedimentation, also sand dredging may cause the change of flow direction, and threat the security of dyke.
Variation of river course

River course variation of the Yalouzhanbu River from 1980 to 2013
Monitoring of river regulation

2008年12月30日

图示内容未翻译。
Monitoring of river regulation
Monitoring on water project for flood control

Displacement and transformation of dam by INSAR

Three Gorge Dam
Monitoring on water project for flood control

Stability of dam
Revise of relation curve between Water level and Storage of reservoir by means of remote sensing images

Shuifeng Reservoir (80m~131m)
1. Flood monitoring
2. Disaster assessment
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4. Flood forecasting and risk map
Flood forecasting and risk map

1) Input of flood forecasting system, including precipitation, initial soil moisture content. Doppler radar, TRMM, GPM, GPS-RS
2) Parameter determination according to underlying conditions from remote sensing.
3) Watershed hydrological model on the basis of both water balance and energy balance, which is significant for ungagged basin.
Risk maps reveal the flood risk degree and distribution characteristics under different flood scenarios in key flood control areas of China.

Risk map which has been made covers 496000 km$^2$, being occupied 48% of the risk region of whole country.

All basic data needed for making risk map are from remote sensing.
198 rivers with the total length of 2700 km, 45 important cities
78 Detention basins with the total area of 29000 km²
26 flood plains with the total area of 8800 km²
227 important area for flood detention with the total area of 408100 km²
Thanks for Attention

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