SUPARCO

Pakistan

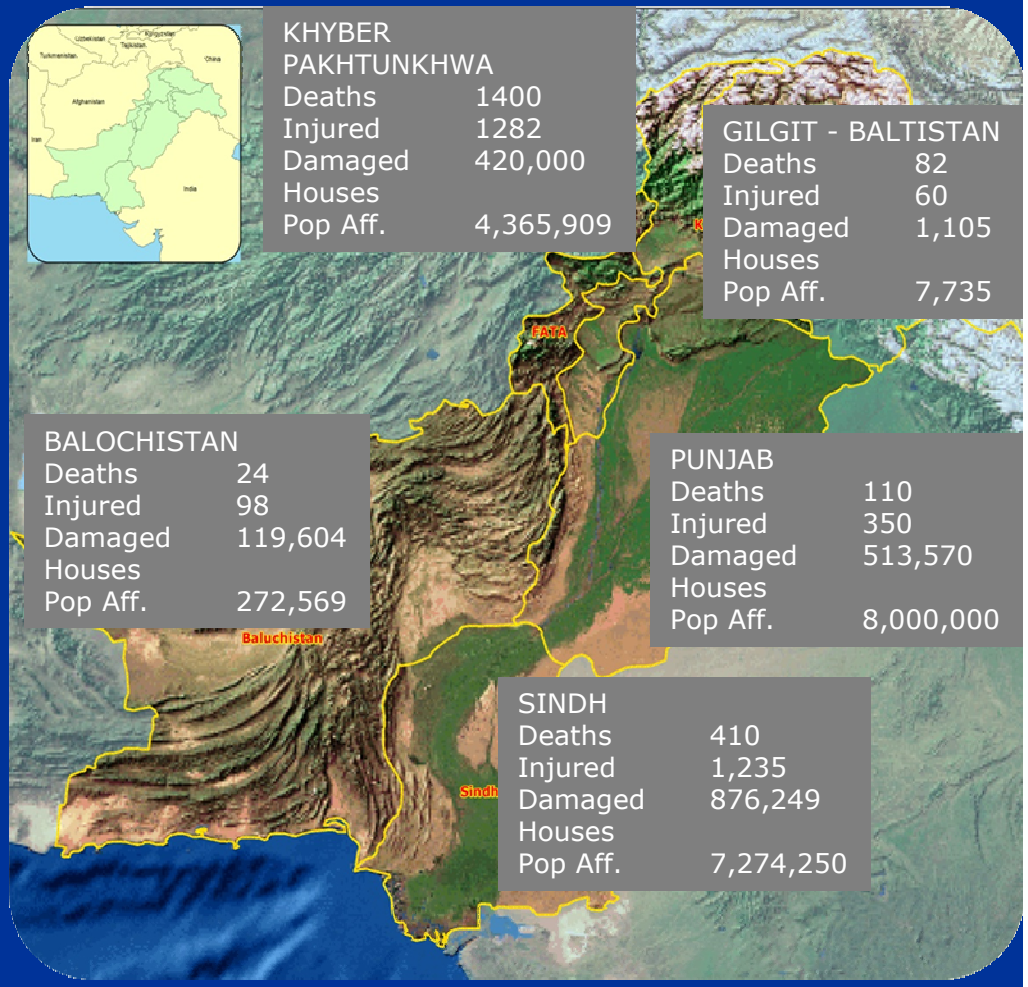
Management of 2010 Floods in Pakistan using Satellite Technology

SUPARCO

Pakistan Floods - 2010

Pakistan

Population Affected	20 million+
Area Affected (Sq km)	150,000+
Deaths	2000+
Injured	3000+
Household Damaged	1,910,439
Damaged Cropped Areas (ha)	2,300,000



" Pakistan floods are a 'slow-motion tsunami' "

Ban Ki-moon, UN Secretary General

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Pakistan Floods - 2010

Pakistan

- Government of Pakistan directed SUPARCO, the national space agency, to comprehensively monitor the flood extent and ensure timely provision of this information to the relevant disaster management agencies for relief and early recovery operations

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Pakistan Floods - 2010

Pakistan

- Necessary infrastructure such as remote sensing satellite ground stations for SPOT-5, SPOT-4, Aqua, and Terra satellites as well as linkage with UN-SPIDER program as regional support office were in place to immediately act on the government directives

SUPARCO

Pakistan Floods - 2010

Pakistan

Spot Receiving Station

Aqua / Terra Receiving Station

SUPARCO

Regional Support Office (RSO), Pakistan

Pakistan

During the 47th session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space (COPUOS) SUPARCO signed an agreement for establishment of the RSO in Pakistan.

Responsibilities

- 24/7 operations to support emergency response
- Technical advisory support to national disaster management agencies
- Awareness / outreach activities for disaster risk management and emergency response
- Capacity building of institutions involved in relief & mitigation efforts in use of space based information

SUPARCO

Pakistan Floods - 2010

Pakistan

Steps Initiated

- A core team was assembled for rapid mapping of affected areas to support relief and early recovery operations utilizing pre and post flood satellite imagery
- Nomination of SUPARCO officials for coordination with National Disaster Management Agency (NDMA), Ministry of Food & Agriculture (MinFA) and other relevant organizations
- Deputation of RS & GIS specialist to NDMA for optimum utilization of space based information
- Requested UN-SPIDER for activation of International Charter Space and Major Disasters

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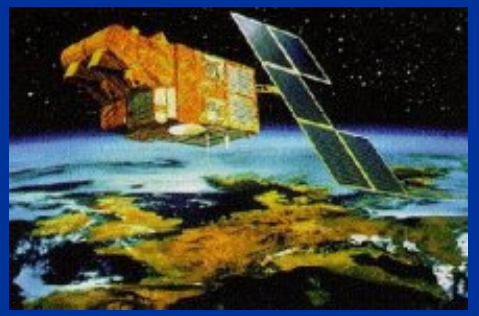
Satellite Tasking / Acquisition

Pakistan

- Spot constellation was programmed through Spot Image for imaging the affected areas and downloading of data at the ground station in Islamabad
- Aqua & Terra satellite data was received and processed at Karachi for daily monitoring of the affected areas on regional scale
- Through the International Charter Space and Major Disasters data was received from Landsat, Geoeye, QuickBird

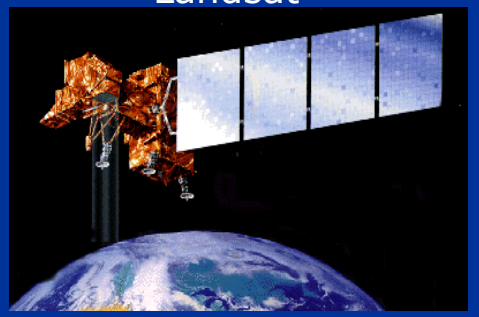
QuickBird

Spot



Aqua

Landsat



Terra

Geoeye

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Pakistan Floods - 2010

Pakistan

Results

- Near real-time flood monitoring on daily basis
- Timely provision of satellite maps to national disaster management agencies
- Regular submission of damage assessment reports both of infrastructure and crops to the concerned ministries

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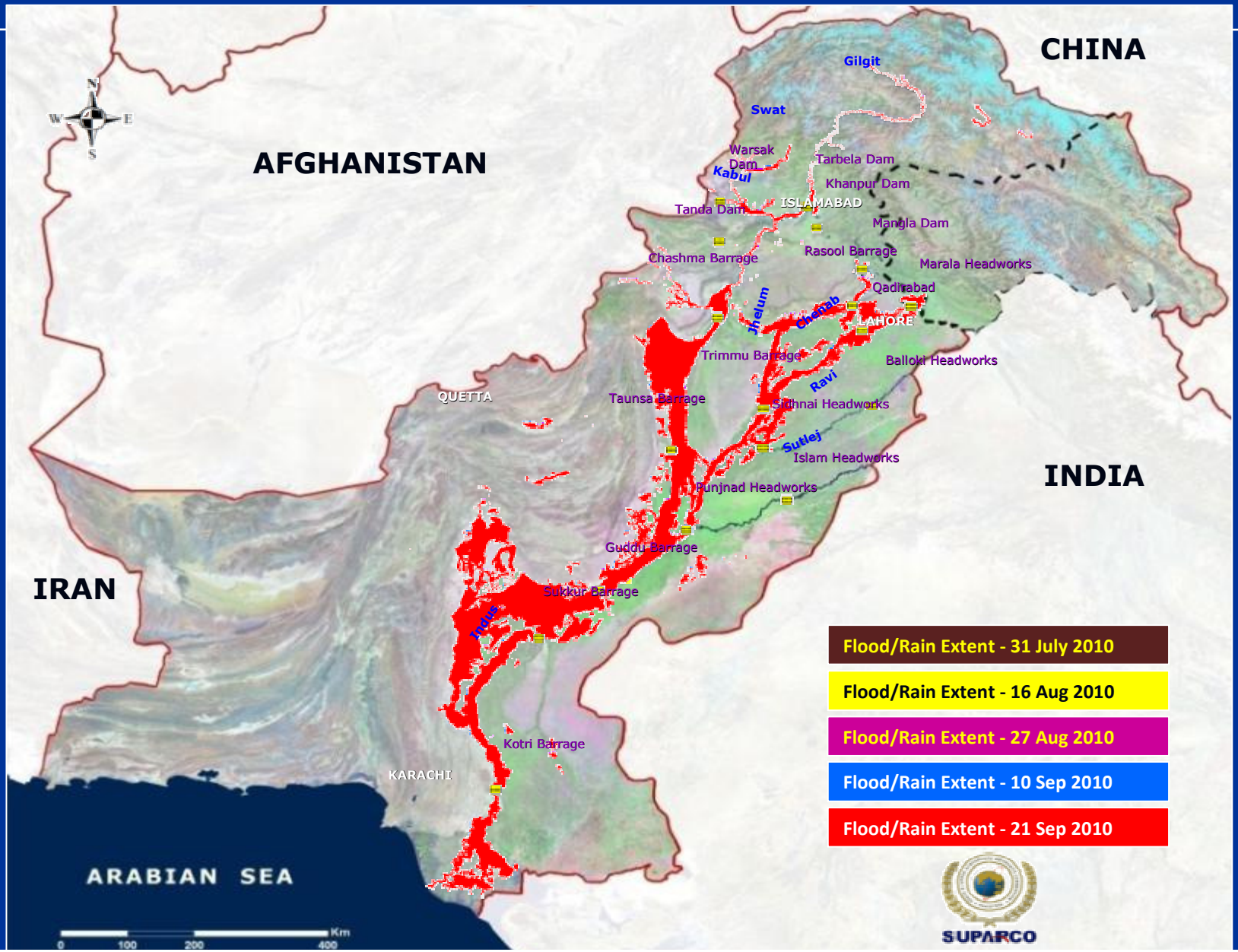
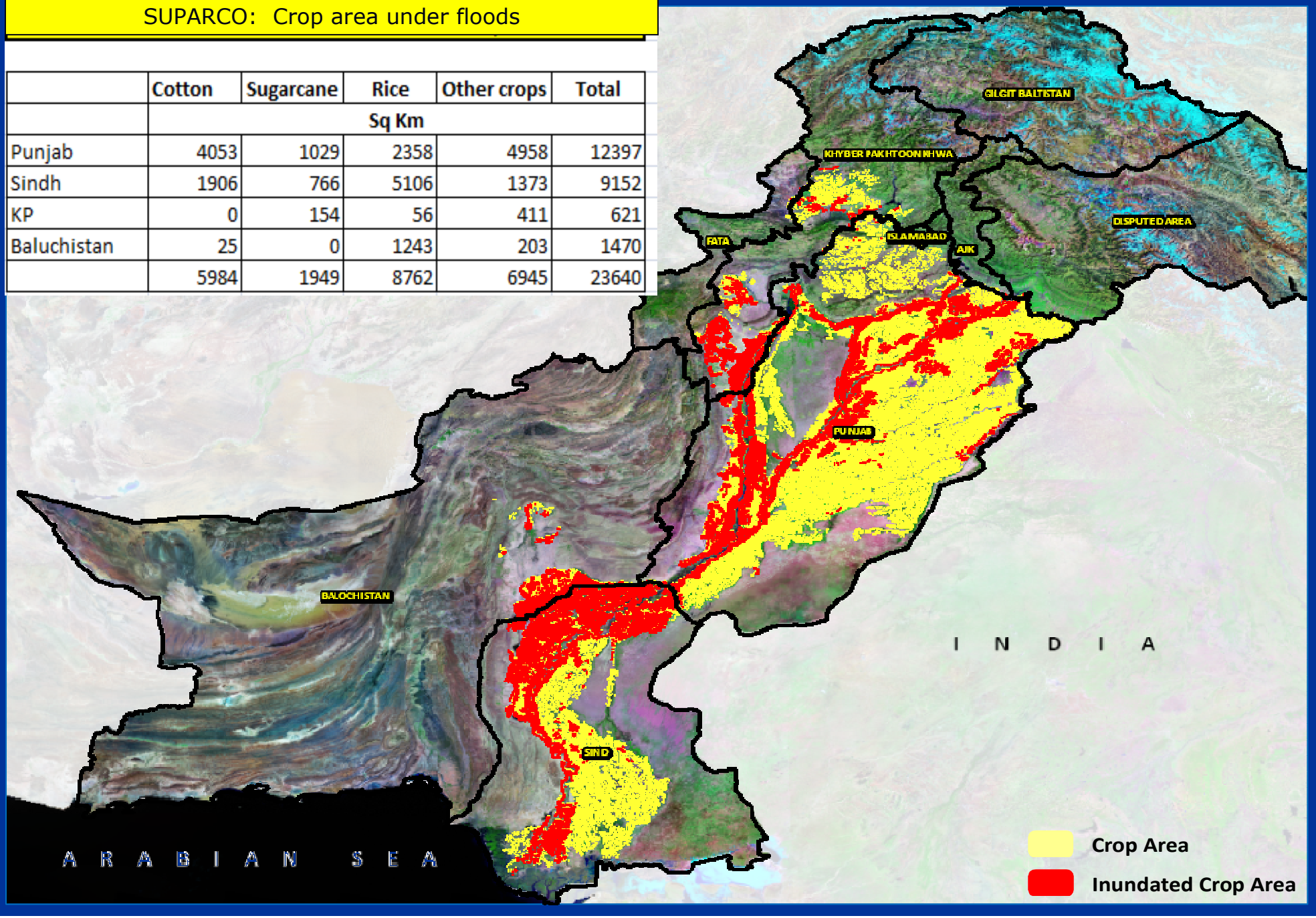
Pakistan Floods - 2010

Pakistan



SUPARCO: Crop area under floods

	Cotton	Sugarcane	Rice	Other crops	Total
	Sq Km				
Punjab	4053	1029	2358	4958	12397
Sindh	1906	766	5106	1373	9152
KP	0	154	56	411	621
Baluchistan	25	0	1243	203	1470
	5984	1949	8762	6945	23640



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Rapid Damage Assessment

Pakistan

S. No.	DISTRICT	Total Area (Sq km)	Inundated Area (Sq km)	%age Inundated
1	MUZAFFARGARH	8411.5	6854.6	81.5
2	JHANG	6188.6	2087	33.7
3	MANDI BAHAUDDIN	2832.4	846	29.9
4	MIANWALI	5875.1	1338.3	22.8
5	CHINIOT	2801.4	625	22.3
6	RAJANPUR	12372.3	2394.3	19.4
7	HAFIZABAD	2454.9	465.2	18.9
8	GUJRAT	2925.1	542.7	18.6
9	LEIAH	6238	933.4	15
10	KHUSHAB	6633.5	980.6	14.8
11	JHELUM	3751.3	510.6	13.6
12	SARGODHA	6082.3	777.9	12.8
13	DERA GHAZI KHAN	11762.6	1489.9	12.7
14	SIALKOT	2592.5	313.4	12.1

SUPARCO

Rapid Damage Assessment

Pakistan

Damage to Sugarcane Crop

Punjab				
Districts	Area Damaged ('000' ha)	Yield Loss (tons/ha)	Damage Factor	Projected Production Loss (million tons)
Bhakkar	2.6	42.1	0.8	0.1
D.G.Khan	1.1	51.7	0.8	0.0
Gujranwala	0.2	37.8	0.0	0.0
Gujrat	0.7	39.0	0.0	0.0
Hafizabad	0.7	37.8	0.0	0.0
Jhang	17.3	48.4	0.2	0.2
Khanewal	0.9	50.8	0.0	0.0
Khushab	3.3	43.4	0.0	0.0
Layyah	4.4	51.5	0.8	0.2
M.B.Din	9.8	41.9	0.0	0.0
Mianwali	1.4	46.4	0.8	0.1
Multan	0.5	41.5	0.0	0.0
Muzaffargarh	22.5	50.9	0.8	0.9
Rahim Yar Khan	7.5	30.0	0.8	0.2
Rajanpur	9.8	63.1	0.8	0.5
Sargodha	13.7	45.9	0.0	0.0
Sialkot	0.2	29.9	0.0	0.0
T.T.Singh	6.4	50.7	0.0	0.0
Total	**102.8**	**47.9**	**0.4**	**2.2**

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Rapid Damage Assessment

Pakistan

INUNDATION DURATION STATISTICS

Sr. No.	Provincce		District	Total District Area (Sq. km)	Total Affected Area (sq. km)	31-jul	5-Aug	10-Aug	15-Aug	20-Aug	25-Aug	30-Aug	5-Sep	10-Sep	15-Sep	20-Sep	25-Sep	30-SSep	Inundation Duration	Status as on 30 September
1	AJK	1	MIRPUR	765	167		↑ 100%	↑ 100%											05 Days	100 % Receded
2		2	BHIMBER	1652	105		↑ 100%	↑ 51%	↑ 100%										10 Days	100 % Receded
3	BALOCHISTAN	1	BOLAN	8546	3034			↑ 100%	↓ 19%		↓ 60%	↓ 4%	↓ 13%	↓ 2%					40 Days	2 % Still Inundated
4		2	JAFARABAD	2487	1926			↑ 73%	↓ 58%	↑ 42%	↑ 12%	↑ 3%	↓ 4%	↓ 7%		↓ 4%	↑ 12%	↓ 12%	45 Days	45 % Still Inundated
5		3	NASIRABAD	3222	1264			↑ 85%	↑ 58%	↑ 15%	↑ 15%	↓ 3%	↓ 3%	↓ 4%		→ 7%	↓ 2%	↓ 2%	45 Days	8 % Still Inundated
6		4	JHAL MAGSI	3859	929			↑ 60%	↑ 14%	↑ 6%	↓ 32%	↑ 20%		↓ 19%		↓ 10%	↓ 11%	↓ 11%	45 Days	28 % Still Inundated
7		5	LORALAI	9955	286			↑ 100%	↑ 100%										05 Days	100 % Receded
8		6	SIBI	4963	250			↑ 100%	↑ 100%										05 Days	100 % Receded
9		7	DERA BUGTI	10286	229			↑ 99%		↑ 1%		↑ 100%							20 Days	100 % Receded
10		8	QILLA SAIFULLAH	12446	229			↑ 100%	↑ 100%										05 Days	100 % Receded
11	FATA	1	SOUTH WAZIRISTAN AGENCY	5034	84			↑ 100%	↑ 100%										05 Days	100 % Receded
12		2	MOHAMAD AGENCY	2280	47		↑ 100%	↑ 100%											05 Days	100 % Receded
13		3	BAJAUR AGENCY	1502	31		↑ 100%	↑ 100%											05 Days	100 % Receded
14		4	KURRAM AGENCY	3469	20		↑ 100%	↑ 100%											05 Days	100 % Receded
15	KHYBER PAKHTOON KHWA	1	D. I. KHAN	9466	6014	↑ 66%	↓ 43%	↑ 100%	↓ 44%	↑ 2%	↓ 6%	↓ 25%	↓ 8%	↓ 1%					50 Days	9 % Still Inundated
16		2	TANK	3167	1108	↑ 58%	↓ 15%	↑ 100%	↑ 20%	↓ 5%	↓ 21%	↓ 28%	↓ 7%	↓ 2%					50 Days	2 % Still Inundated
17		3	LAKKI MARWAT	3126	316		↑ 100%	↑ 100%											05 Days	100 % Receded
18		4	NOWSHERA	1806	287	↑ 78%	↑ 22%			↑ 82%	↓ 3%	↑ 100%							30 Days	100 % Receded
19		5	SWABI	1474	241	↑ 75%	↑ 25%		↓ 37%		↓ 16%	↑ 100%							30 Days	100 % Receded
20		6	HARIPUR	2113	220		↑ 100%		↑ 100%										10 Days	100 % Receded
21		7	CHARSADDA	1091	215	↑ 57%	↑ 43%	↑ 100%											10 Days	100 % Receded
22		8	LOWER DIR	1697	149		↑ 100%	↑ 100%											05 Days	100 % Receded
23		9	KOHAT	3495	147	↑ 78%			↓ 47%	↑ 22%	↓ 9%	↑ 100%							30 Days	100 % Receded
24		10	BANNU	2299	138		↑ 100%	↑ 100%											05 Days	100 % Receded
25		11	SWAT	5087	130		↑ 100%	↑ 100%											05 Days	100 % Receded
26		12	MANSEHRA	4310	62		↑ 100%	↑ 100%											05 Days	100 % Receded
27		13	MARDAN	1617	59		↑ 100%	↑ 100%											05 Days	100 % Receded
28		14	KOHISTAN	7628	43		↑ 100%	↑ 100%											05 Days	100 % Receded
29		15	PESHAWAR	1410	29	↑ 55%	↑ 44%	↑ 100%											10 Days	100 % Receded
30		16	SHANGLA	1278	11		↑ 100%	↑ 100%											05 Days	100 % Receded
31		1	MUZAFFARGARH	8412	4783	↑ 16%	↑ 11%	↑ 64%	↓ 31%	↓ 9%		↓ 15%	↓ 11%	↓ 5%		↓ 8%	↑ 14%	↓ 14%	55 Days	16 % Still Inundated
32		2	RAJANPUR	12372	3772	↑ 10%	↓ 3%	↑ 83%	↓ 32%	↑ 9%	↓ 7%	↓ 1%	↓ 1%	↓ 10%	↑ 4%	↓ 18%	↓ 16%	↓ 16%	55 Days	28 % Still Inundated
33		3	JHANG	6189	3003	↑ 20%	↑ 31%	↑ 49%	↓ 54%	↓ 5%		↓ 5%	↓ 21%	↓ 1%			↓ 3%	↓ 3%	55 Days	11 % Still Inundated
34		4	DERA GHAZI KHAN	11763	2840	↑ 49%	↑ 26%	↑ 25%	↓ 38%	↓ 5%	↓ 3%	↓ 16%	↓ 20%	↓ 1%	↑ 1%		↓ 6%	↓ 6%	55 Days	12 % Still Inundated
35		5	KHUSHAB	6634	1460	↑ 100%	↓ 55%	↓ 10%	↓ 35%	↑ 5%	↓ 5%	↑ 11%	↓ 6%						50 Days	5 % Still Inundated

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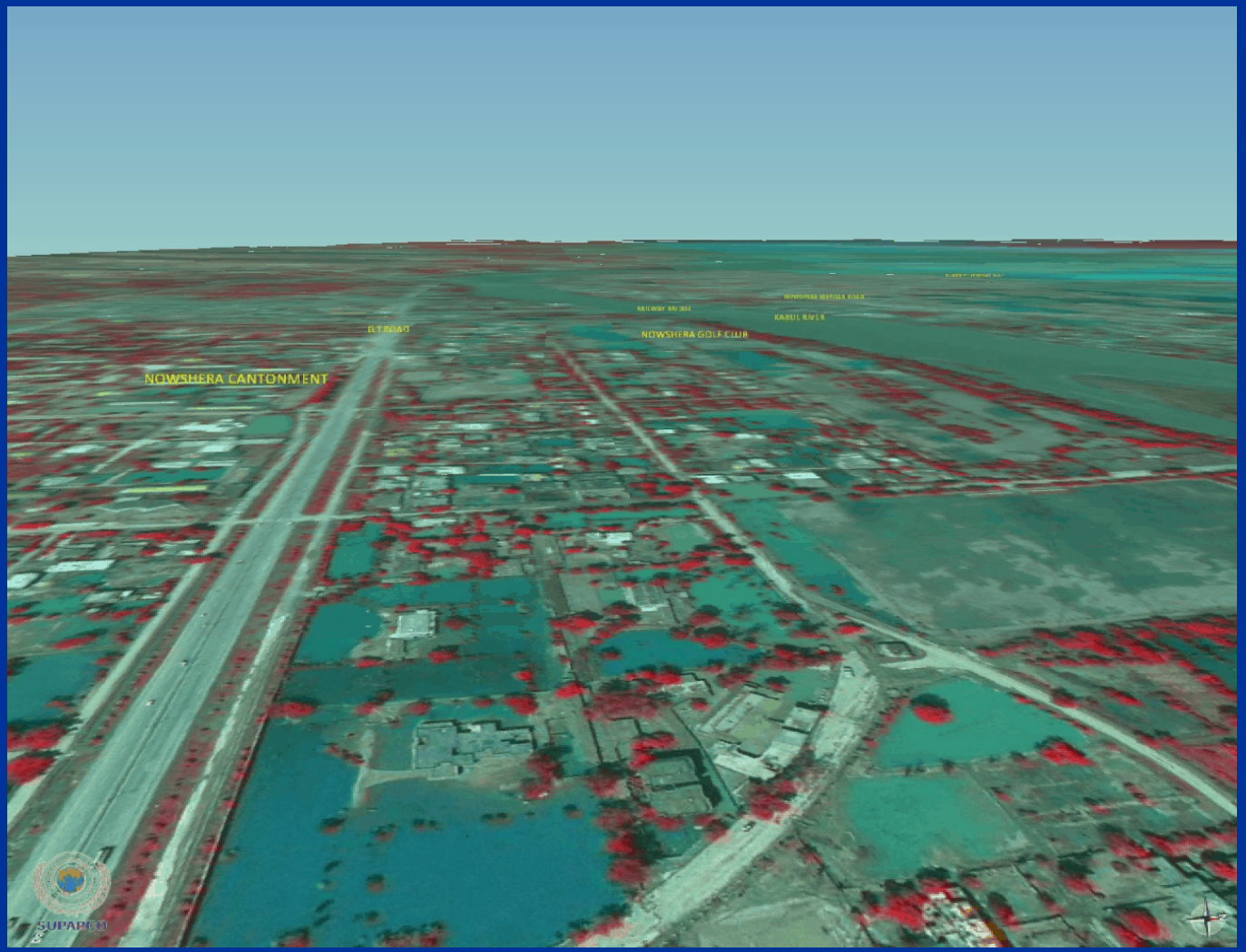
Fly through (Nowshera)

Pakistan



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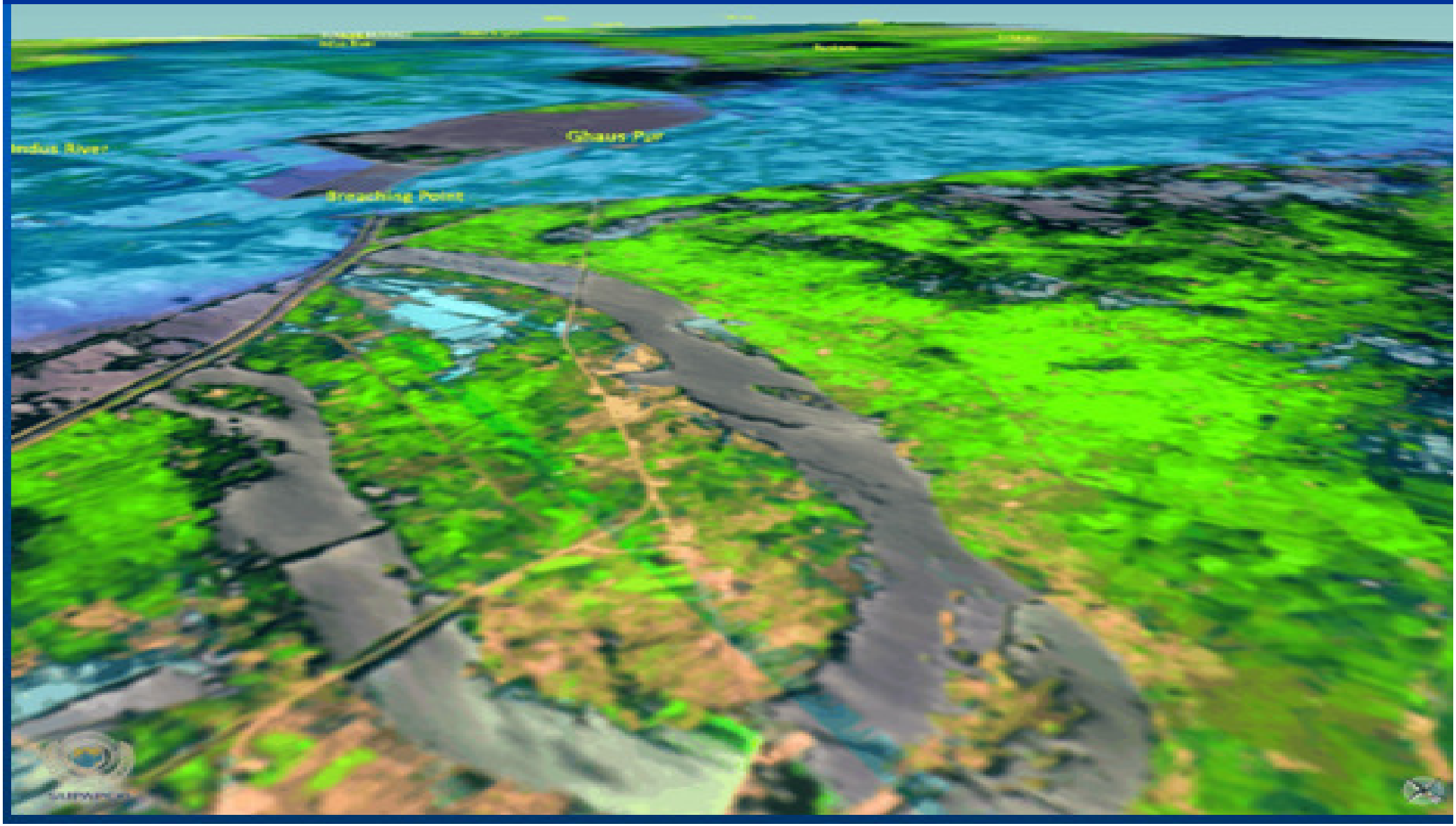
Fly through (Sukker)

Pakistan



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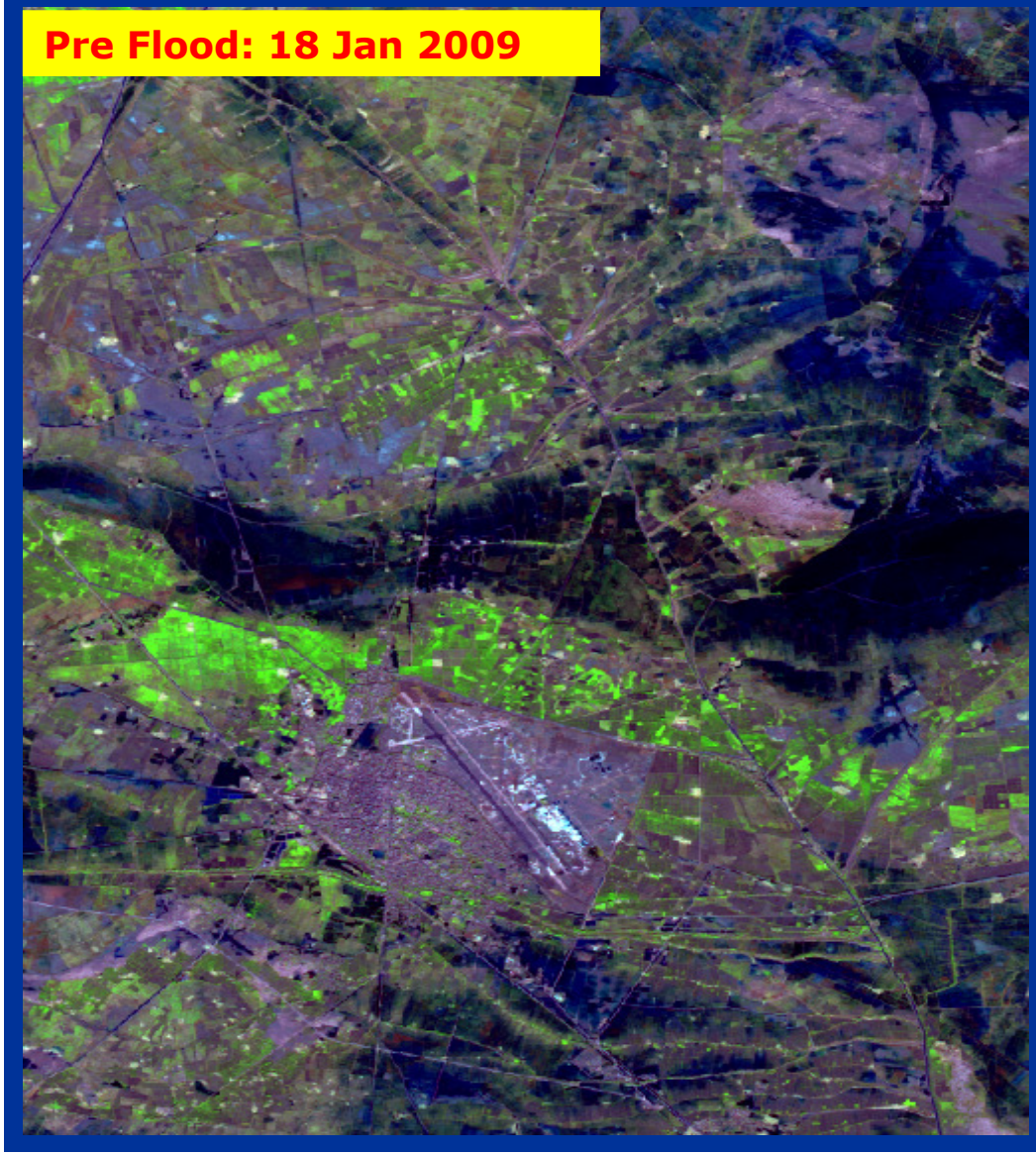
Jacobabad

Pakistan

Pre Flood: 18 Jan 2009

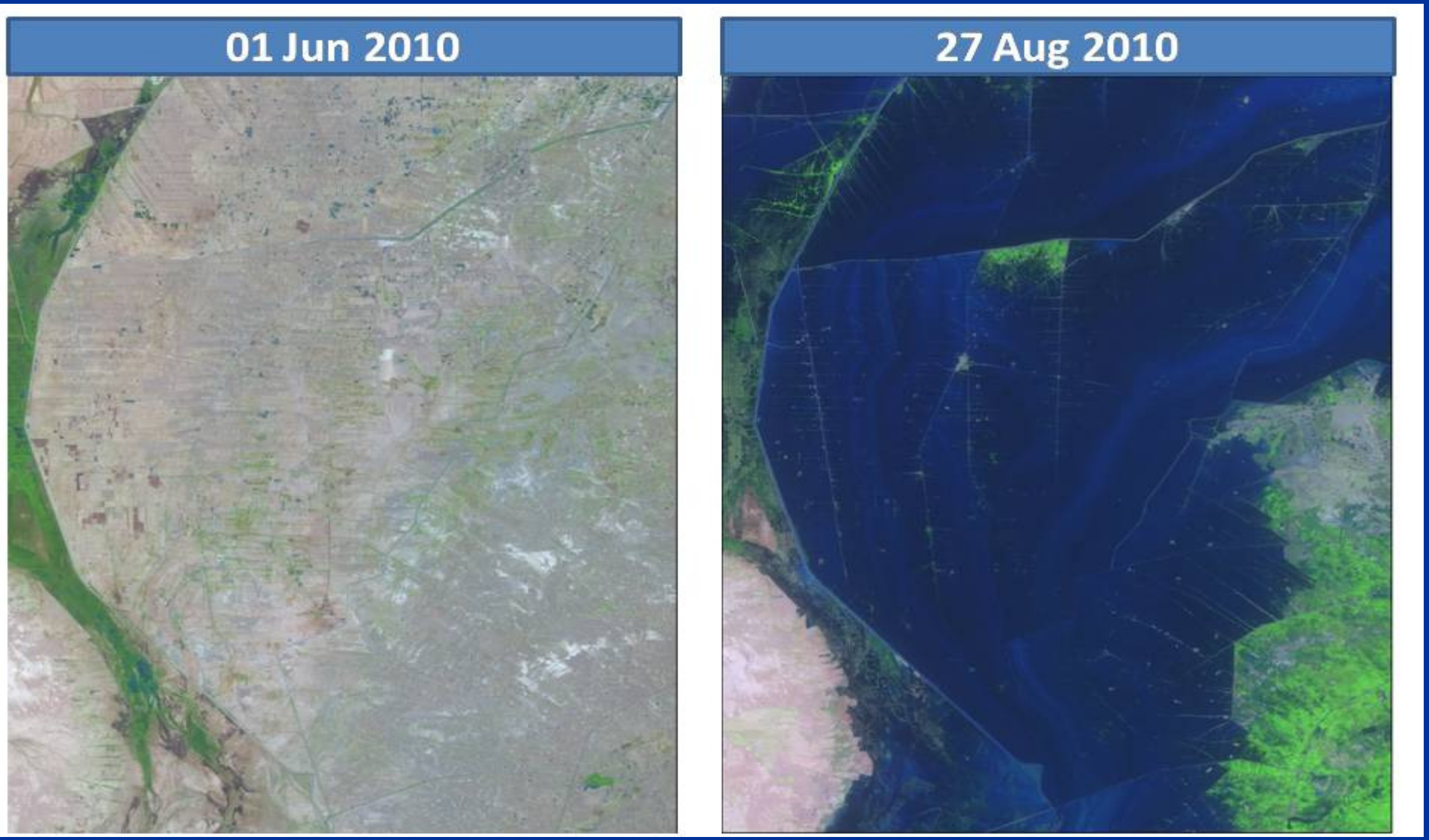


Post Flood: 03 Sep 2010

SUPARCO

Qambar Shahdadkot

Pakistan



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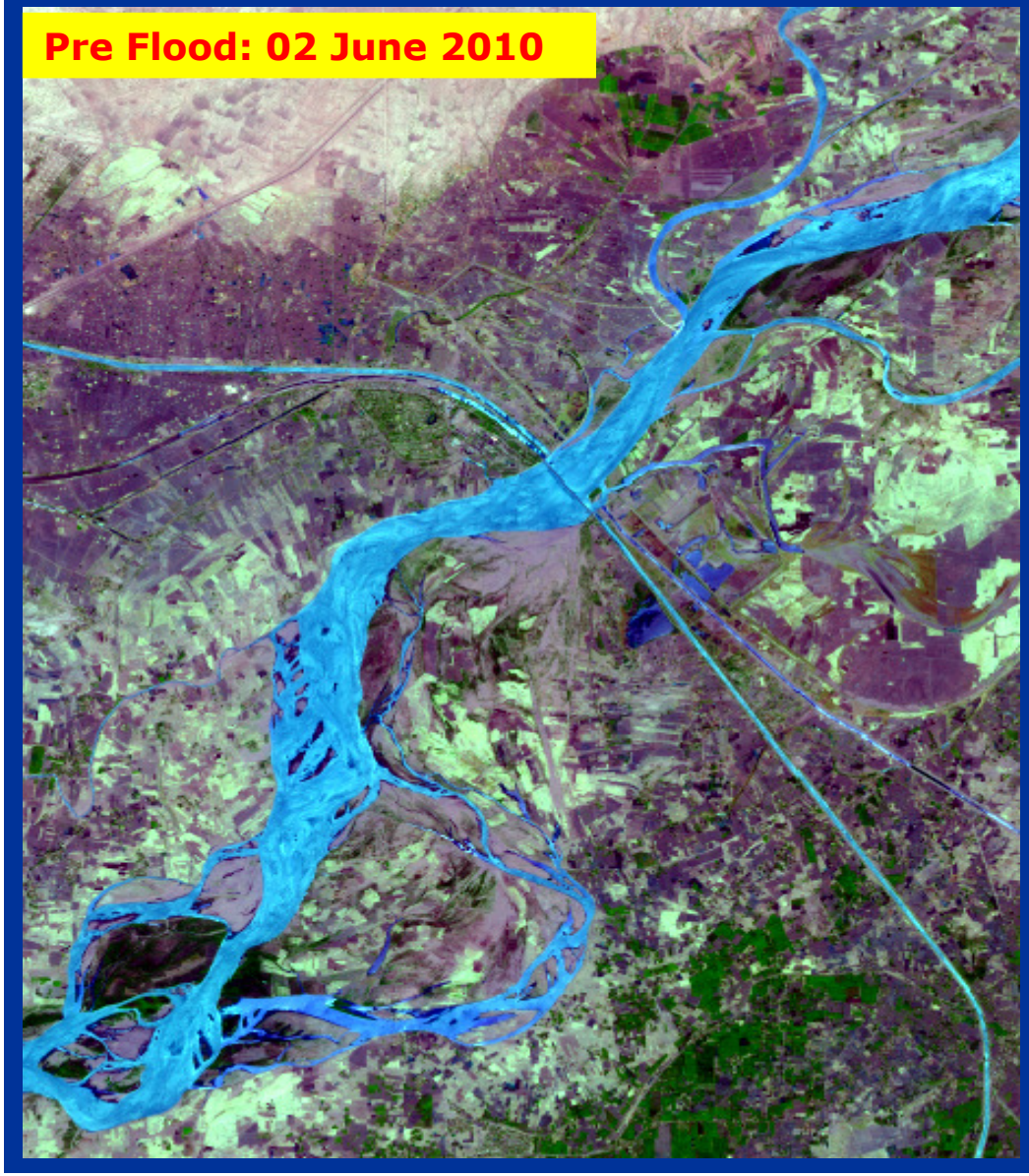
Gudu Barrage

Pakistan



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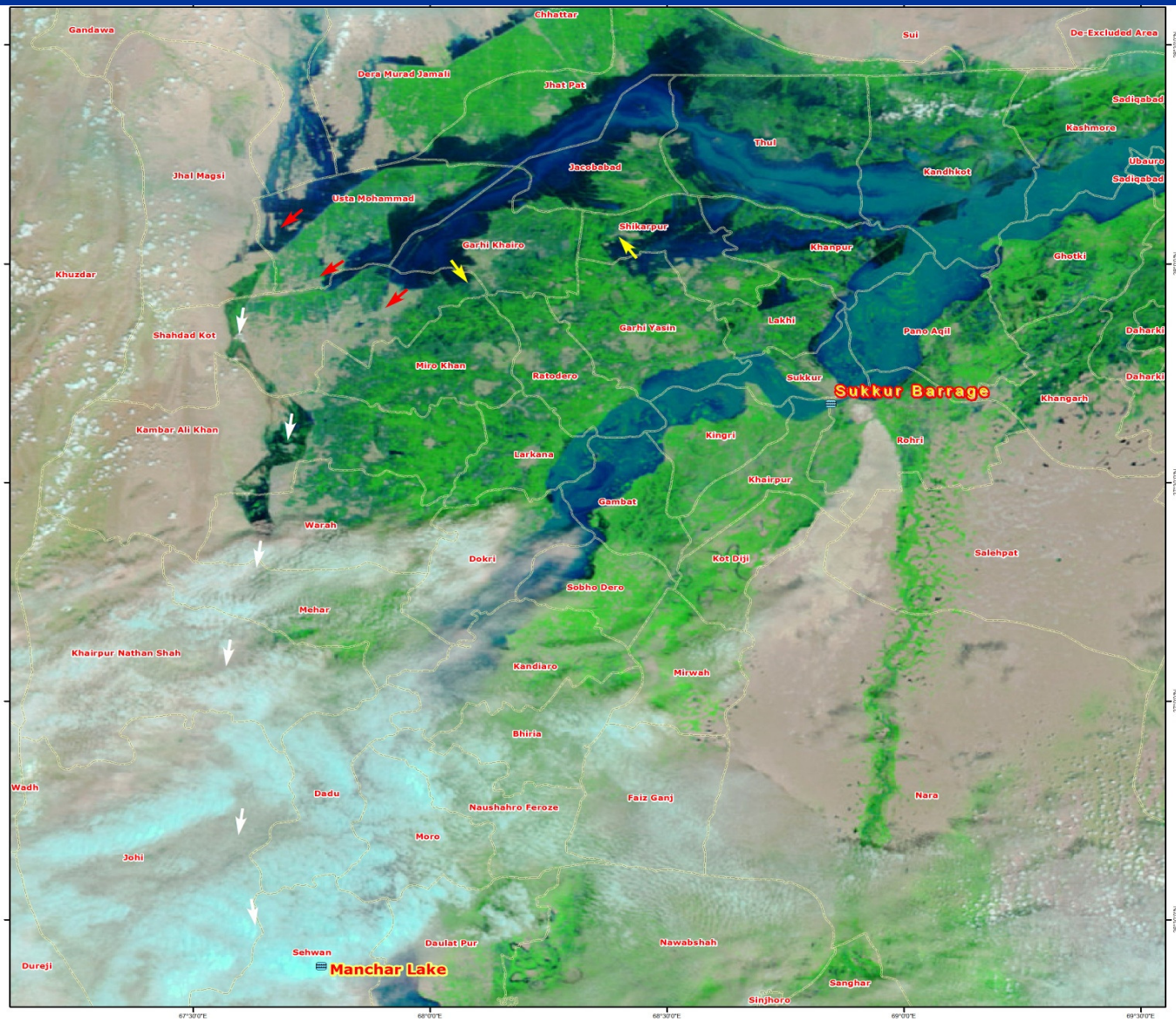
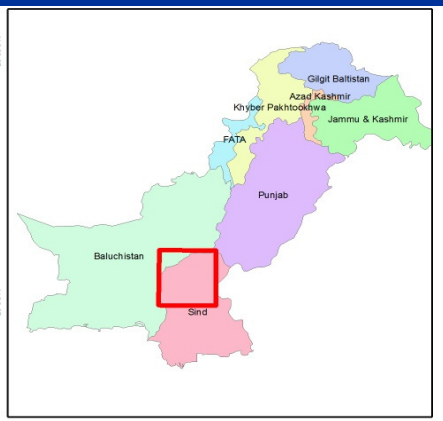
Monitoring of Flood Flow

Pakistan





Legend

- Dam / Barrage
- Tehsil Boundary
- Fast Movement
- Slow Movement
- Potential Movement

PRODUCED ON 20 AUGUST 2010

N
W E
S

0 20 40 80

Kilometers

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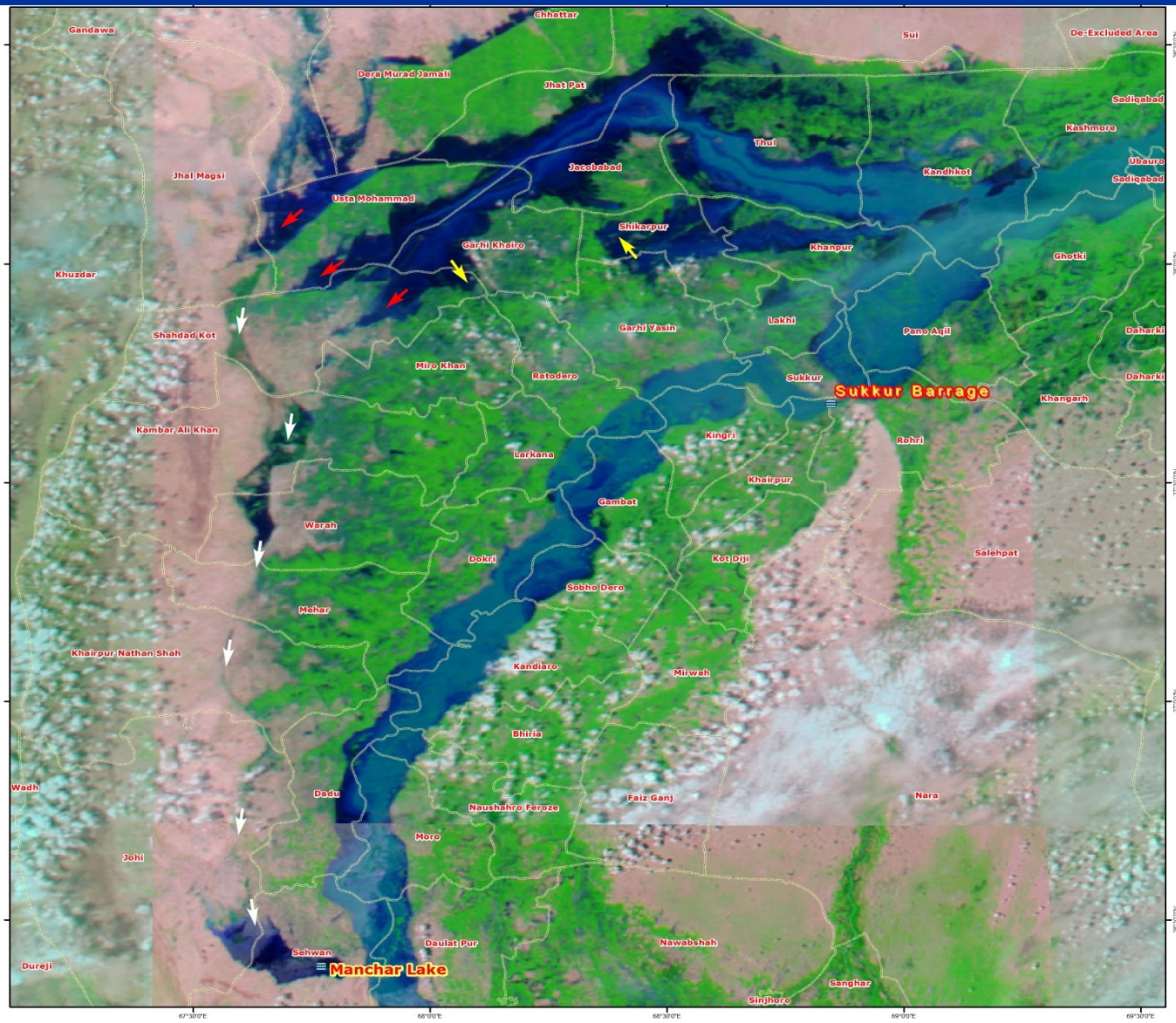
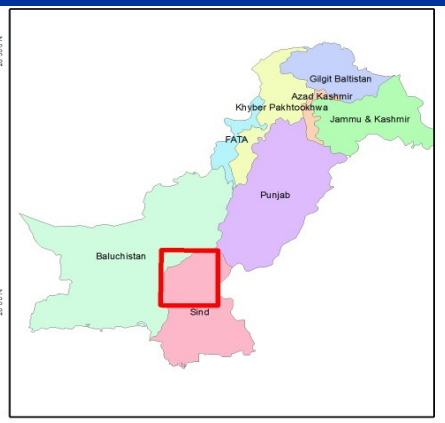
Monitoring of Flood Flow

Pakistan





Legend

- Dam / Barrage
- Tehsil Boundary
- Fast Movement
- Slow Movement
- Potential Movement

PRODUCED ON 21 AUGUST 2010

N
W E
S

0 20 40 80

Kilometers

SUPARCO

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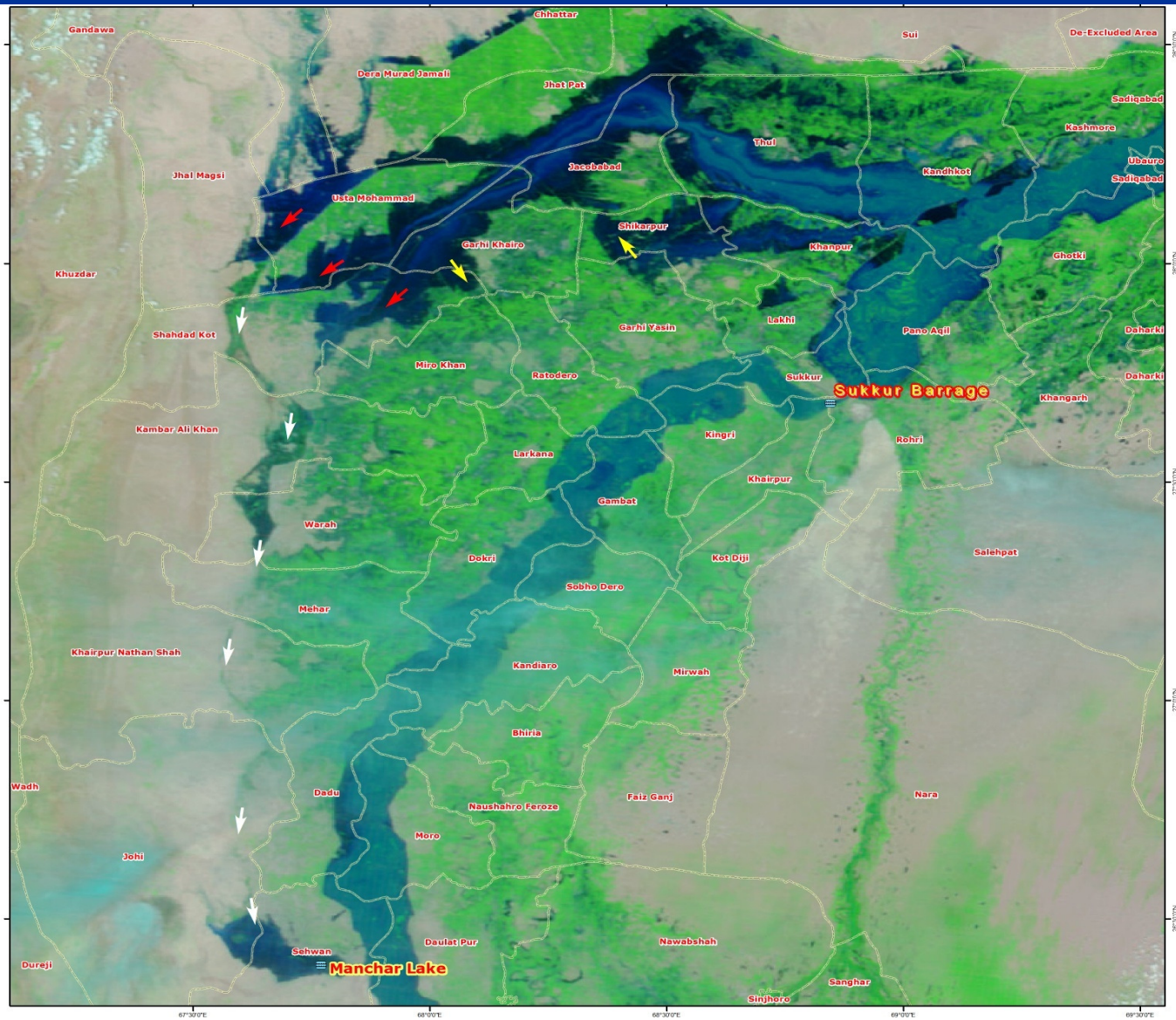
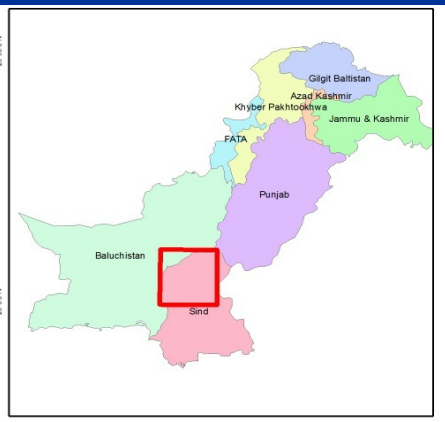
Monitoring of Flood Flow

Pakistan





Legend

- Dam / Barrage
- Tehsil Boundary
- Fast Movement
- Slow Movement
- Potential Movement

PRODUCED ON 22 AUGUST 2010

N
W E
S

0 20 40 80

Kilometers

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SUPARCO

Ponded Water in Sindh
(Floods – 2010)

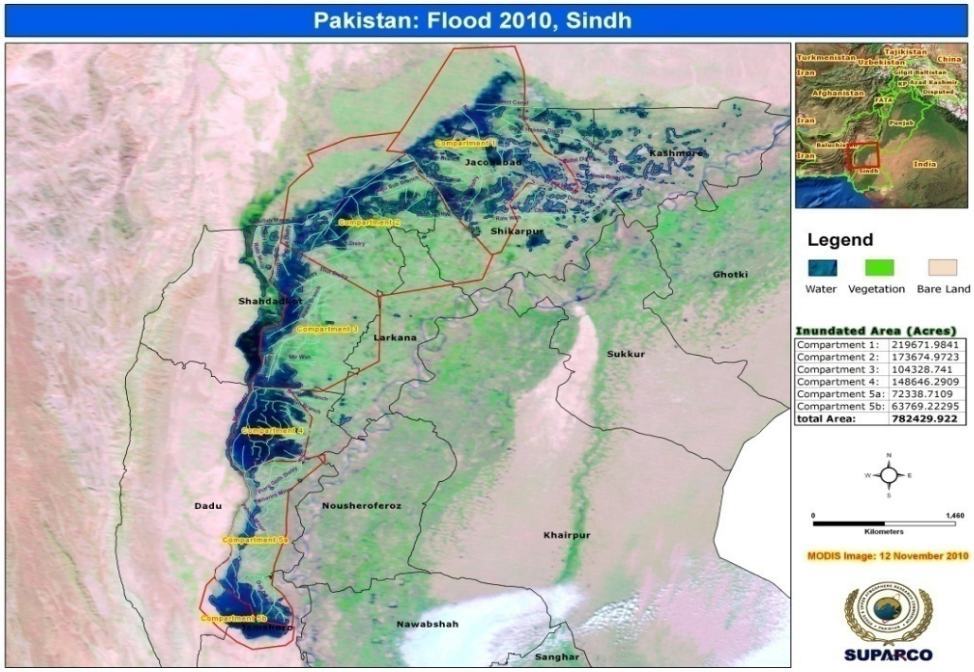
Pakistan

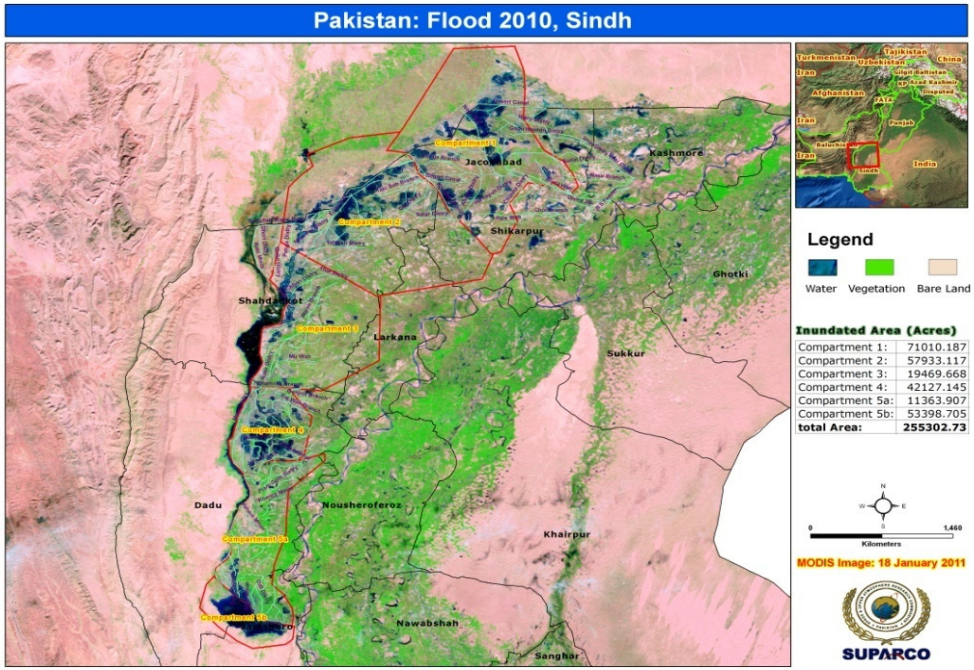
Assessment of ponded water in Sindh was provided to the President Secretariat on daily basis from 12 November 2010 to 03 January 2011

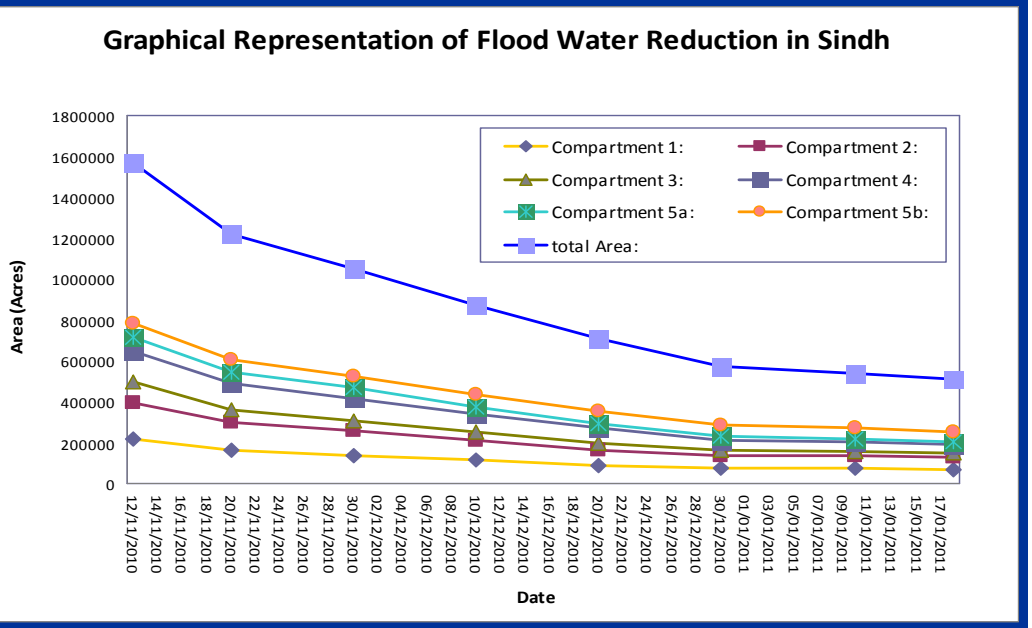
The ponded water on November 12 was 312,972 ha and 03 January 2011 was 107,899 ha respectively. Satellite maps of the ponded areas provided by SUPARCO were also used for planning of dewatering activities by Sindh Government

Sindh Dewatering Program

Daily flood extent maps were produced by utilizing data from remote sensing satellites







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Field Survey on 17th Jan 2011

Pakistan

SUPARCO

Damage and Need Assessment

Pakistan

- In the wake of floods, the World Bank and Asian Development Bank led the Damage and Need Assessment (DNA) exercise
- SUPARCO was requested by the World Bank for providing an analysis of flood related damages using satellite imagery and mapping of affected regions
- The time period was from July 24 to 30 Oct 2010
- Sectors covered were housing, roads, bridges, rail and airports, agriculture and irrigation

SUPARCO

Collaboration with Food & Agriculture Organization, FAO, UN

Pakistan

FAO, UN in collaboration with SUPARCO undertook rapid crop damage assessment in the flood affected districts. This included:

- Flooded area breakdown by crop and district
- Date of inundation of affected districts and recession
- Displaced population in the affected districts and food needs
- Flooded area cumulative and latest by affected districts vs total area of these districts

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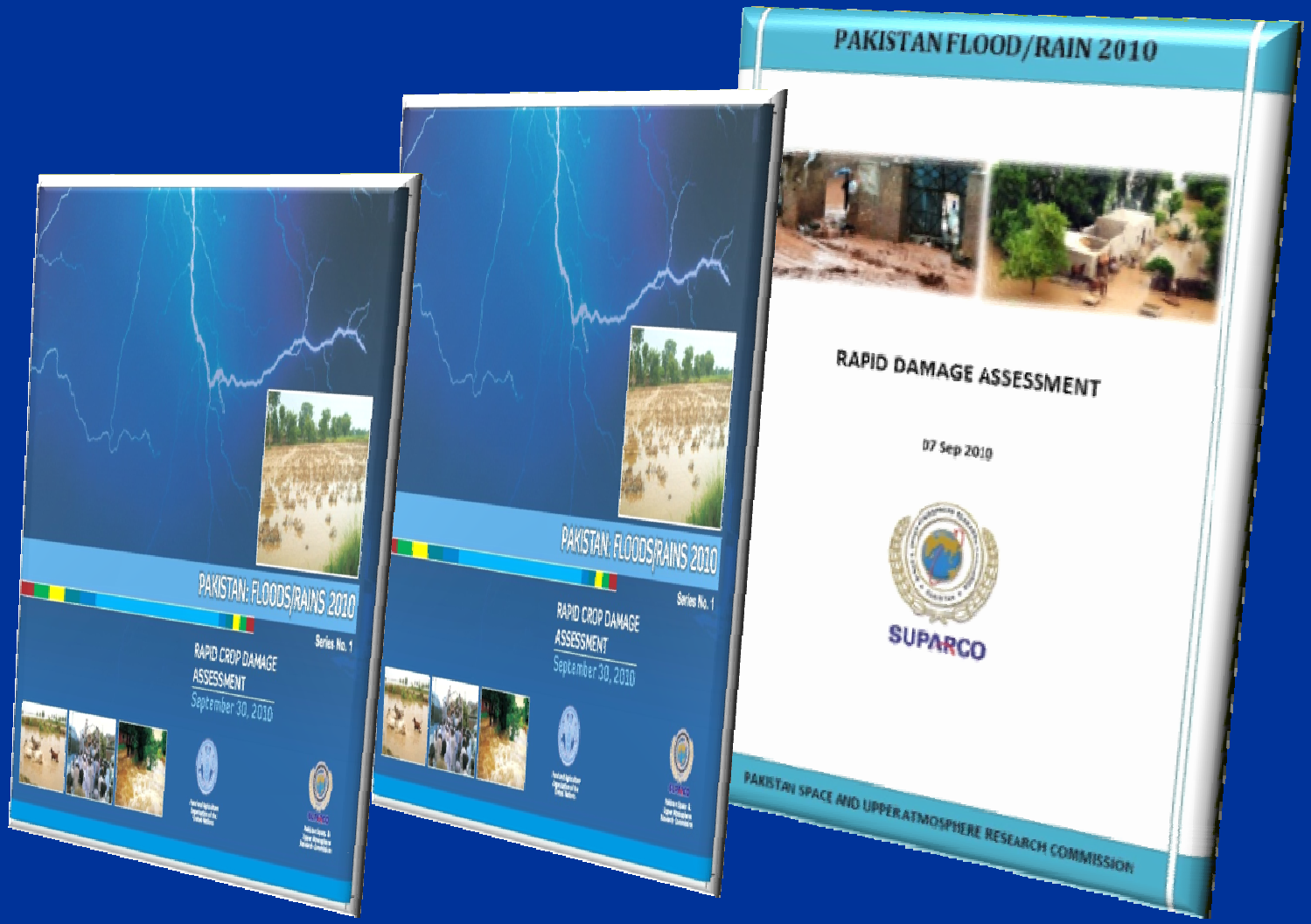
Publications

Pakistan



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Conclusions

Pakistan

- Availability of train manpower, satellite receiving stations and linkages with international bodies assisted in provision of information to the disaster management agencies and other relevant organisations for taking timely decisions

- Better coordination by the Meteorological Department would have contributed towards prompt mobilization, preparedness and ultimately reduced losses

- Availability of high resolution synthetic aperture radar data would have increased the accuracy of assessment in view of the overcast conditions

- Closer cooperation among international and national agencies would have optimized early response and relief operations

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Recommendations

Pakistan

- International cooperation to be further strengthened
- Regional support offices to be provide further training in dealing with various types of disasters

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Acknowledgment

Pakistan

Pakistan is indebted to International Charter Space and Major Disaster, UN-SPIDER, UNITAR, UNOSAT, USGS, ICIMOD, JAXA, Safer and Sentinel Asia for extending support during the floods

UNOSAT

JAXA Japan Aerospace Exploration Agency

Sentinel Asia

USGS science for a changing world

ICIMOD

UN-SPIDER

UNITAR

SUPARCO

Pakistan