- Optical satellite pictures –

The up to date source for discharge determination in arid countries

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Lack of discharge data in many arid regions

(missing gage stations or specialists; no information about intensity, duration and frequency)

Water resources are lost…

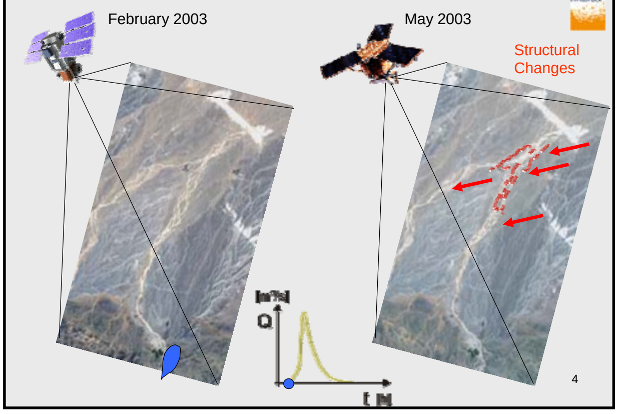
(disappear to the sea, evaporate in basins or get saline or polluted)

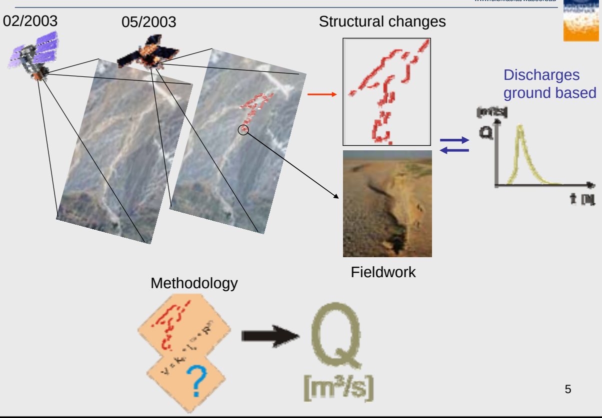
… but they could be used …

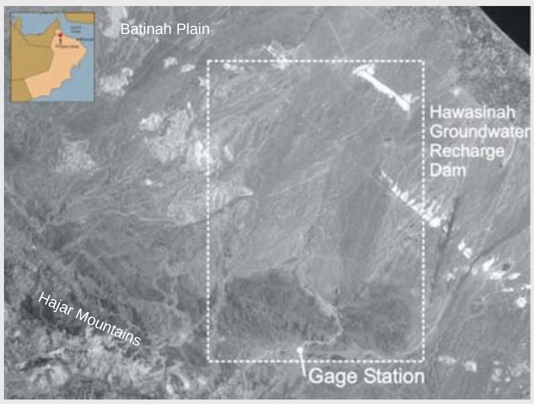
(if discharge data are available

to plan and run infrastructural measures

like artificial groundwater recharge dams)







2. Project area – Field observation

1. Which structures can be observed in the field?


Channels - erosion


Flat basins - deposition

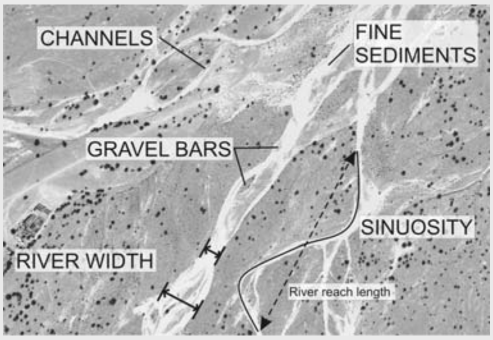

Micro structures - variable

2. Which of these structures can be recognised in satellite data of different spatial solutions?


Main channels can be recognised

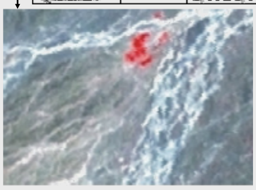
2. Project area – Fluvio morphologic structures

3. Crucial question: Which of these recognizable structures will change during a runoff event?



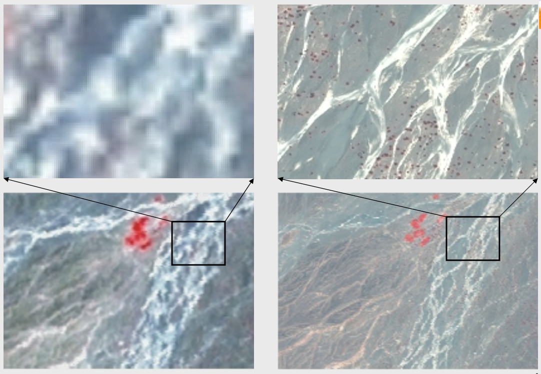
3. Satellite data

Satellite	Sensor	Resolution [m/pixel]		Bands	Launch
		multispectral	panchromatic		
Landsat 1	MSS	57 x 79	-	4	1972
Landsat 5	TM	30 x 30	-	7	1984
Landsat 7	ETM+	30 x 30	15 x 15	7	1999
JERS	OPS	18 x 18	-	3	1992
Terra	ASTER	15 x 15	-	14	1999
SPOT 3	HRV	20 x 20	10 x 10	4	1993
IKONOS	-	3,28 x 3,28	0,82 x 0,82	4	1999
Quickbird	-	2,44 x 2,44	0,61 x 0,61	4	2001


LANDSAT 5 (30x30m)


IKONOS (3,3x3,3m)

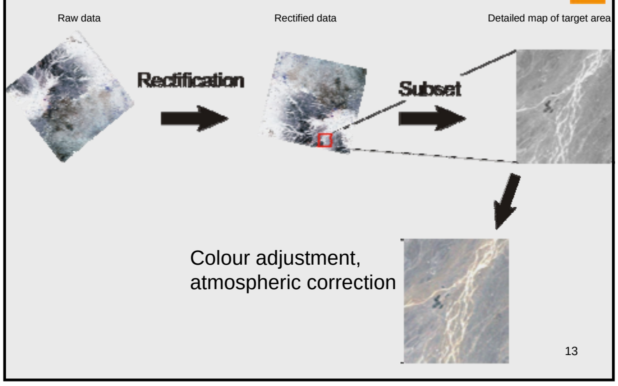
3. Satellite data – Comparison of resolution


LANDSAT 5 (30x30m) IKONOS (3,3x3,3m)

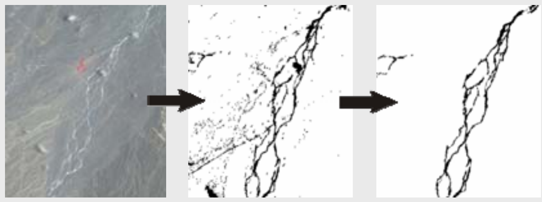
4. Workflow - Image processing

Raw data, without orientation

Rectified data
(fit in coordinate systems)



Spectral classification “Cleaning” of the classified picture

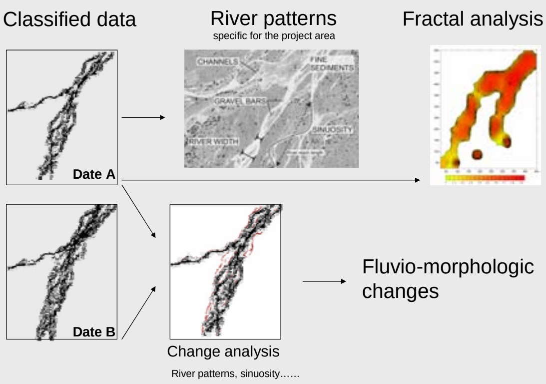


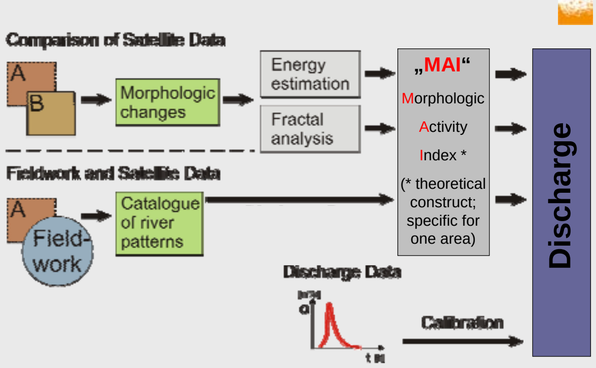
Subset of the project area

Classified data
(based on spectral reflectivity
of the pixels)

Cleaned data
(removal of wrongly classified pixels,
clouds, surface materials)

Structures of the river network





Main goal:

Fast and economical determination of water resources management data in arid river basins.

Secondary goals:

Context between flood events and morphological changes.

Demands on satellite data to recognize morphological changes

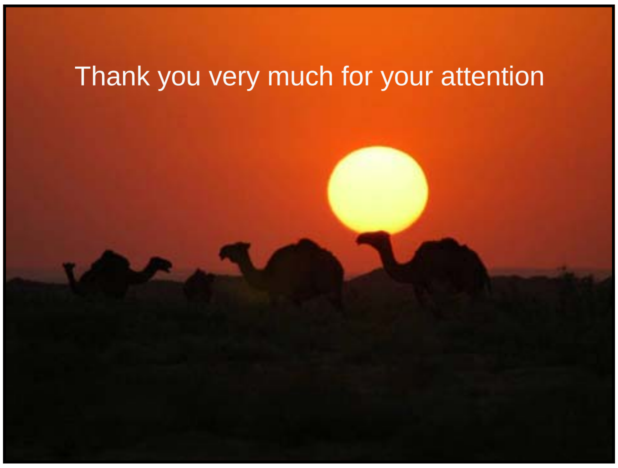
Acquisition and compilation of presently available and adequate satellite data

Demands on future satellite sensors

- Optical satellite pictures –

The up to date source for discharge determination

in arid countries ?



Appendix – River features

River dimensions: Observed river width is displayed by sedimentation of fine material (clay, silt) during the maximum stage of the flood event. Also the total area of wadi streams and length gives evidence about the flow behaviour of the river system.

River sinuosity: Sinuosity is defined as the length of the river divided by the length of the floodplain. River sinuosity is already used by Smith et al. (1996) to estimate discharges in flowing braided rivers in alpine regions and offers promising potential for this research application in arid areas without water.

River patterns: Erosion and deposition processes can be observed by studying sand bars and gravel bars. Deep channels occur in river reaches of high fluid energy, whereas deposition of fine material displays low stream energy.

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Appendix – Fractal analysis

Fractal analysis: Fractal analysis exhibits great potential to describe structural patterns. Fractal geometry is based on the self similarity of patterns and allows to (1) characterize structures quantitatively, (2) gather information about anisotropy of pattern and (3) to derive information about pattern forming processes (Kruhl et al., 2004).

The preferred technique for fractal analysis within the research project is the “box counting method” which can be applied easily to the extracted river patterns

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Appendix – Energy estimation

Energy estimation: Geomorphologic changes depend on river energy. For energy estimation basic information about river patterns, slope conditions and approximated water levels can be derived from satellite data.

With the observation of erosion and deposition processes a valuation of bed load transport (= river energy) is possible.

In this context works of Zarn (2003) and Hunzinger (1998) about the relation between river extension, river slope and water depths deliver valuable approaches for the project.

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Appendix – Discharge estimation

Alsdorf et al. (2000) observed interferrometric radar measurements to monitor water levels in reaches of the Amazon basin. Combined with information about river bed geometry and flow velocity the discharge can be estimated.

Meinel et al. (2003) derived information about maximum flow depth and flow width from optical sensors of high resolution to calculate discharge of the river Elbe whilst the flood.

Radar altimeter data were used to monitor sea level height by Birkett (1998). Attempts to derive discharge information from structural components of the river and fluviomorphologic changes due to changing flow regimes are in the focus of recent research.

For example Smith et al. (1996) used Synthetic Aperture Radar (SAR) data to estimate discharge in braided river systems. They used effective river width.

Bjerklie et al. (2005) estimated discharge in rivers by using remotely sensed hydraulic information like river width from air photos and airborne SAR imagery.

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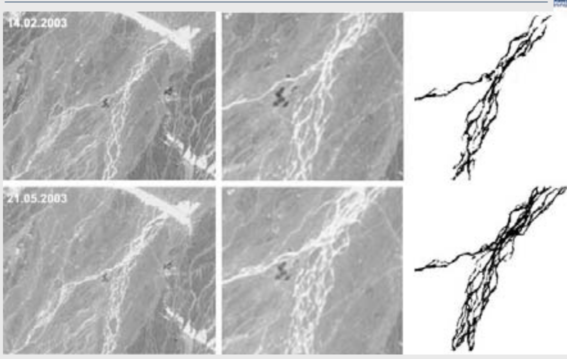
Appendix – First results



⑥ Zusammenfassung: Arbeitsteam multinational & interdisziplinär

Österreich

Arbeitsbereich Wasserbau der Universität Innsbruck
(Prof. Aufleger)

Arbeitsbereich Vermessung und Geoinformation
der Universität Innsbruck (Prof. Hanke)

Deutschland

Lehrstuhl und Versuchsanstalt für Wasserbau und
Wasserwirtschaft (Prof. Strobl)

Deutsches Fernerkundungsdatenzentrum
DFD (Prof. Strunz)

Lehrstuhl für Methodik der Fernerkundung der TUM
(Prof. Bamler)

Fachgebiet Tektonik und Gefügekunde
(Prof. Kruhl)

Jordanien

Jordan University of Science and Technology
(Prof. Malkawi)

Oman

Ministry of Regional Municipalities,
Environment and Water Resources
(Ali al-Abri)