


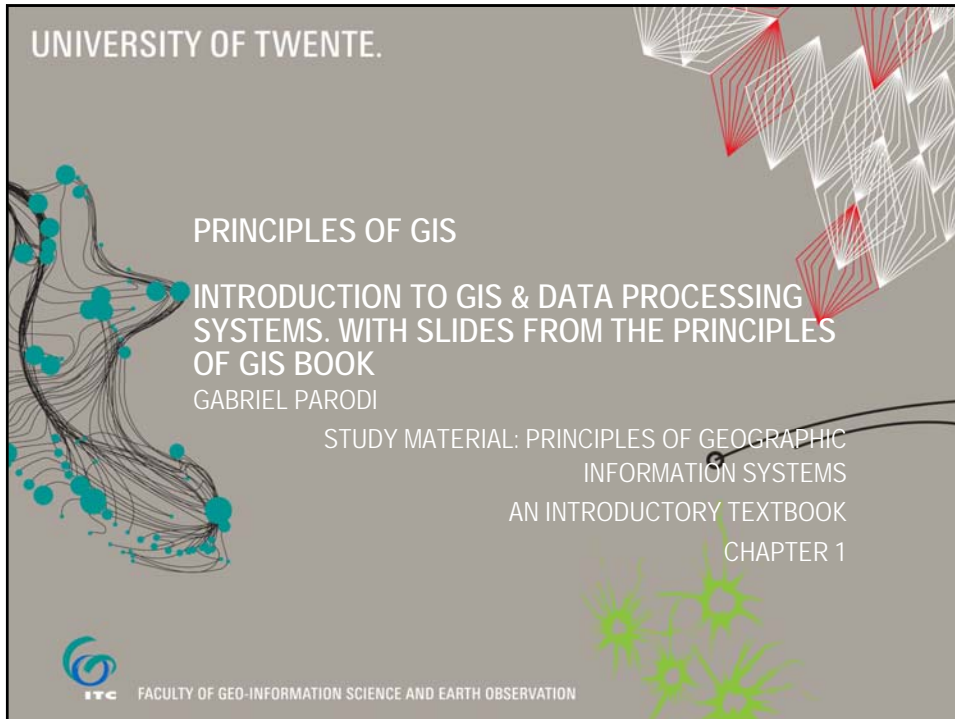
UNIVERSITY OF TWENTE.

PRINCIPLES OF GIS

INTRODUCTION TO GIS & DATA PROCESSING SYSTEMS. WITH SLIDES FROM THE PRINCIPLES OF GIS BOOK  
GABRIEL PARODI

STUDY MATERIAL: PRINCIPLES OF GEOGRAPHIC INFORMATION SYSTEMS  
AN INTRODUCTORY TEXTBOOK  
CHAPTER 1

 ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION



## Purpose of GIS

---

- The purpose of geographic information systems is to maintain and process georeferenced data
- It always has to answer the spatially (and temporally) related questions of the users.

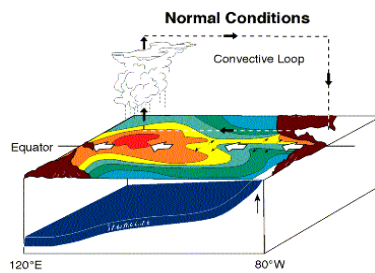
## Content of GIS book

- Gentle introduction
- Spatial data types
- Data processing systems
- Determining and mapping position
- Data entry and preparation
- Spatial data analysis
- Data visualization

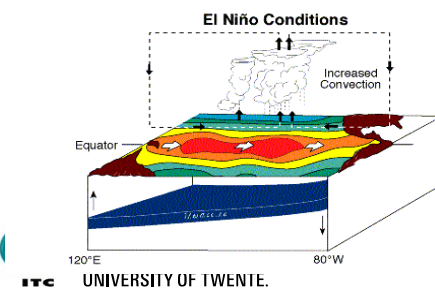


UNIVERSITY OF TWENTE.

## A spatio-temporal problem: El Niño



**El Niño: Weaker westerly winds along the equator, less upwelling cold waters in the ocean, increased convection**



UNIVERSITY OF TWENTE.

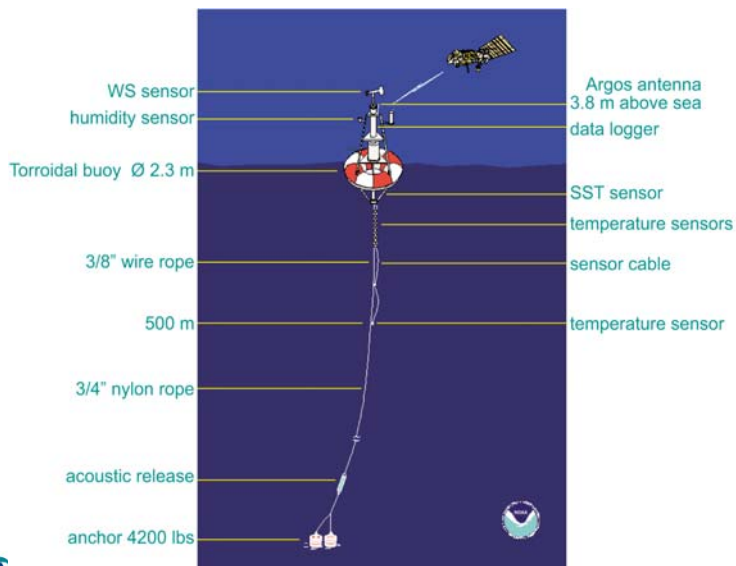
## Steps of spatio-temporal analysis

- Data collection/preparation
- Data analysis
- Data presentation
- (in general for georeferenced data)



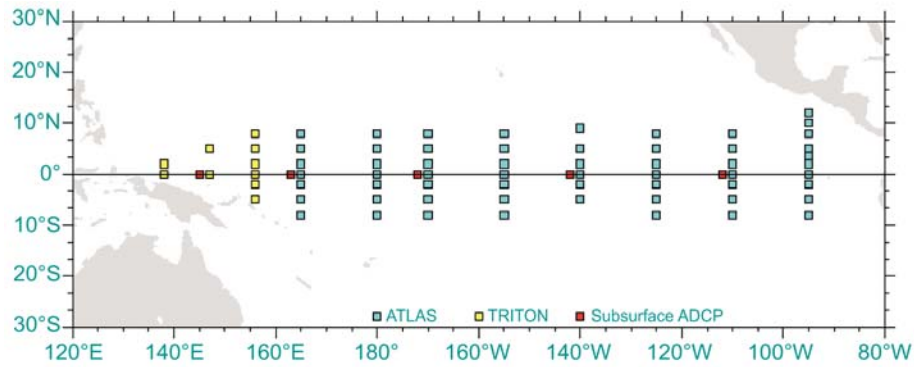
UNIVERSITY OF TWENTE.

## Data collection unit: a buoy in the ocean



UNIVERSITY OF TWENTE.

## Locations of buoys



UNIVERSITY OF TWENTE.

## Daily data from the buoys

### DAYMEASUREMENTS

Buoy	Date	SST	WS	Humid	Temp10	...
B0749	1997/12/03	28.2° C	NNW 4.2	72%	22.2°	...
B9204	1997/12/03	26.5° C	NW 4.6	63%	20.8°	...
B1686	1997/12/03	27.8° C	NNW 3.8	78%	22.8°	...
B0988	1997/12/03	27.4° C	N 1.6	82%	23.8°	...
B3821	1997/12/03	27.5° C	W 3.2	51%	20.8°	...
B6202	1997/12/03	26.5° C	SW 4.3	67%	20.5°	...
B1536	1997/12/03	27.7° C	SSW 4.8	58%	21.4°	...
B0138	1997/12/03	26.2° C	W 1.9	62%	21.8°	...
B6823	1997/12/03	23.2° C	S 3.6	61%	22.2°	...
...	...	...	...	...	...	...



UNIVERSITY OF TWENTE.

Monthly data are calculated

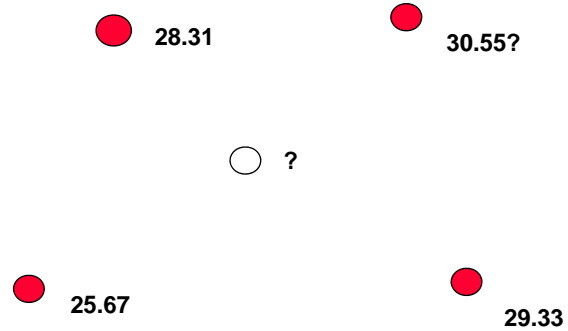
<i>Buoy</i>	<i>Geographic position</i>	<i>Dec. 1997 avg. SST</i>
B0789	(165° E, 5° N)	28.02° C
B7504	(180°, 0°)	27.34° C
B1882	(110° W, 7°30' S)	25.28° C
...	...	...

This table is the basis for spatial interpolation



ITC UNIVERSITY OF TWENTE.

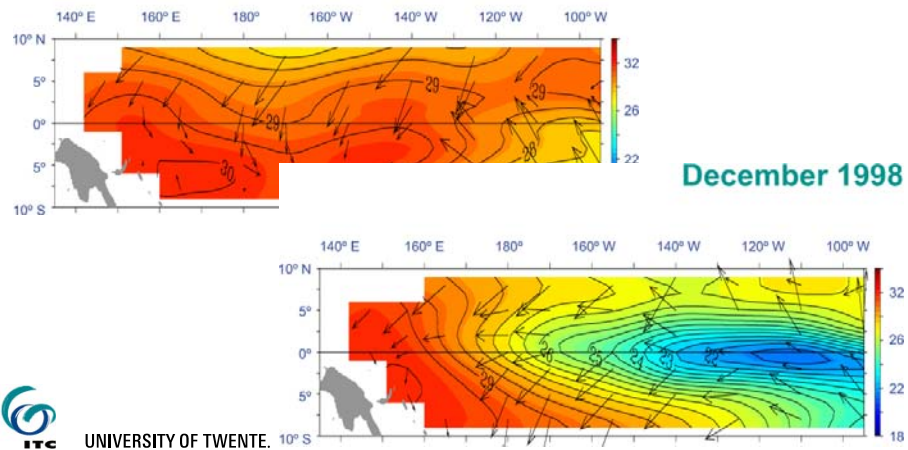
Spatial interpolation (ch 5)



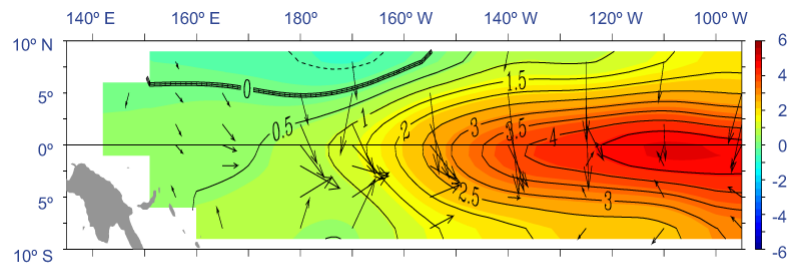
ITC UNIVERSITY OF TWENTE.

## Results of interpolation

**December 1997**  
Monthly SST [ °C] and WS [m/s]



## Results of change (difference) analysis



Computed differences in average SST, WS and WD between December 1997 and December 1998

Real world: natural phenomena



 ITC UNIVERSITY OF TWENTE.

Real world: man-made phenomena (objects)



 ITC UNIVERSITY OF TWENTE.

## Representation of the real world (modelling)

---

- Maps
  - graphical representation
  - scale
  - abstraction/simplification
  - static
- Databases
  - quantitative/qualitative data
  - data model is the language to define the database
  - query
  - storage optimization
  - spatial aspects (x,y,z)
- Dynamic (simulation) models
  - representation of processes
  - simplification/abstraction of processes



UNIVERSITY OF TWENTE.

## Computer representation of spatio-temporal data

---

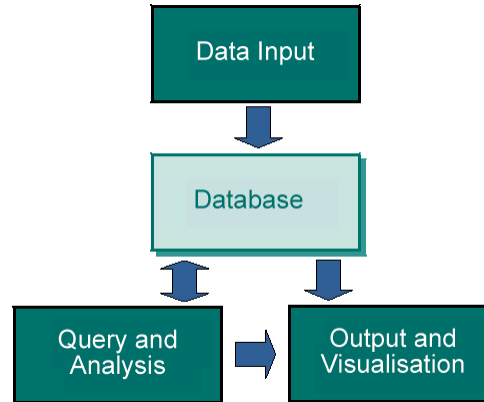
- A geographic information system (GIS) is used to enter, store and maintain, process, analyze and display spatial data.



UNIVERSITY OF TWENTE.



## Data processing systems ch 3



UNIVERSITY OF TWENTE.

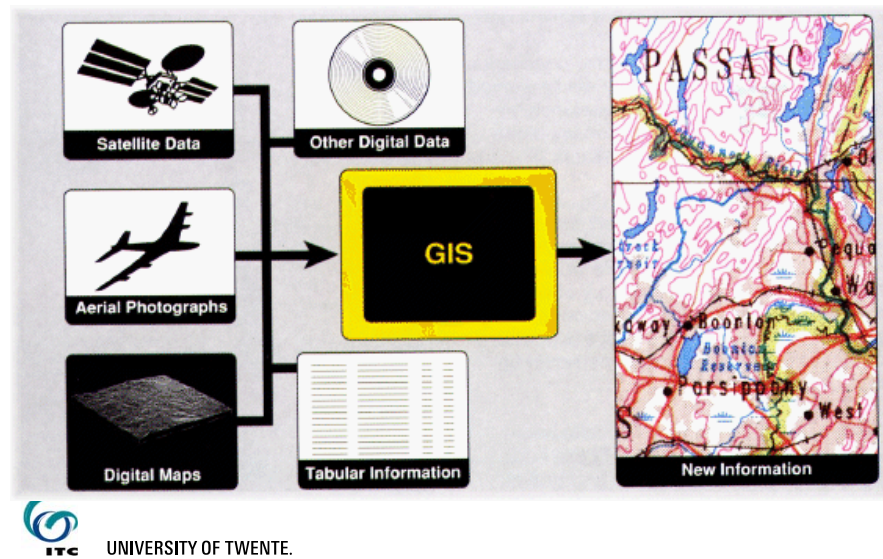
## Data input (ch5)

<i>Method</i>	<i>Devices</i>
Manual digitizing	<ul style="list-style-type: none"> <li>• coordinate entry via keyboard</li> <li>• digitizing tablet with cursor</li> <li>• mouse cursor on the computer monitor (heads-up digitizing)</li> <li>• (digital) photogrammetry</li> </ul>
Automatic digitizing	<ul style="list-style-type: none"> <li>• scanner</li> </ul>
Semi-automatic digitizing	<ul style="list-style-type: none"> <li>• line following devices</li> </ul>
Input of available digital data	<ul style="list-style-type: none"> <li>• magnetic tape or CD-ROM</li> <li>• via computer network</li> </ul>



UNIVERSITY OF TWENTE.

## External digital sources (ch 5)



## Database ch3.4

- Data storage
- Query
- Maintenance

## Types of queries ch6

<i>Questions</i>	<i>Answers</i>	<i>GIS functions</i>
What is ... ?	Display of data as maps, reports and tables, e.g., "What are the name and the address of the owner of that land parcel?"	Storage and query functions
What pattern ... ?	Patterns in the data, e.g., all parcels with an area size greater than 2000.	Query functions with constraints
What ... if ... ?	A prediction about the data at a certain time or at a certain location.	Modelling functions



UNIVERSITY OF TWENTE.

## Data analysis ch 6

- Retrieval, classification and measurement functions
  - Retrieval (selection, without modification)
  - Classification (new entities)
  - Generalization (new entities)
  - Measurements (characteristic of objects)
- Overlay functions
- Neighborhood functions
  - Search functions (within window)
  - Line-in-polygon or point-in-polygon
  - Proximity (buffer zone)
  - Topographic functions (slope, aspect etc.)
  - Interpolation
- Connectivity functions
  - Network analysis



UNIVERSITY OF TWENTE.

## Data output ch 7

<i>Method</i>	<i>Devices</i>
Hard copy	<ul style="list-style-type: none"> <li>• printer</li> <li>• plotter (pen plotter, ink-jet printer, thermal transfer printer, electrostatic plotter)</li> <li>• film writer</li> </ul>
Soft copy	<ul style="list-style-type: none"> <li>• computer screen (CRT)</li> </ul>
Output of digital data sets	<ul style="list-style-type: none"> <li>• magnetic tape</li> <li>• CD-ROM</li> <li>• computer networks</li> </ul>



UNIVERSITY OF TWENTE.

## Output devices ch7



Printers, plotters



Internet



UNIVERSITY OF TWENTE.

---

Lecture is over

Questions?



ITC UNIVERSITY OF TWENTE.