SWIBANGLA

Managing Salt Water Impacts in Bangladesh

Deltares
Enabling Delta Life

UNESCO-IHE
Institute for Water Education

Jahangirnagar University
জাহাঙ্গীরনগর বিশ্ববিদ্যালয়

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জনস্বাস্থ্য প্রকৌশল অধিদপ্তর
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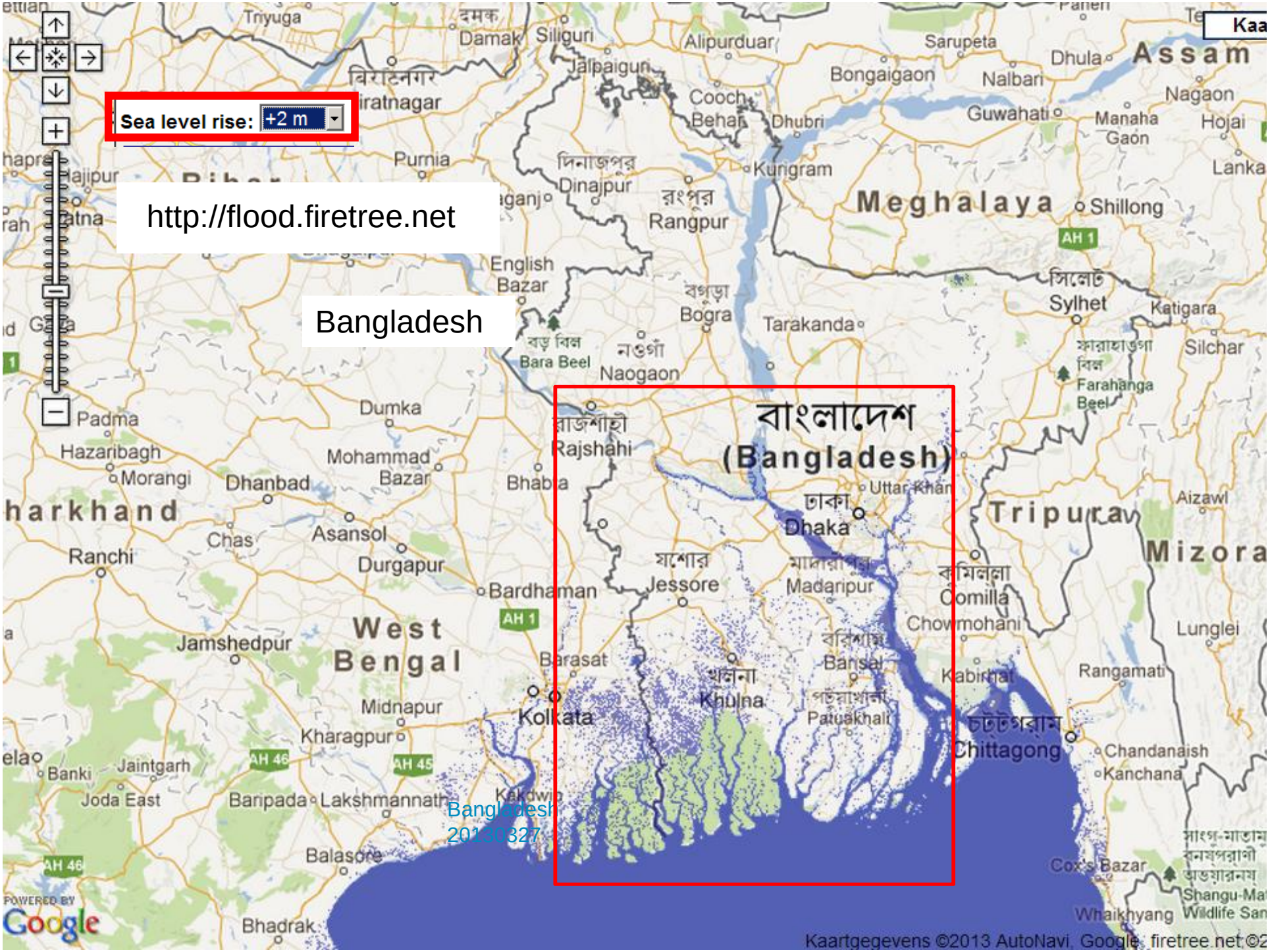
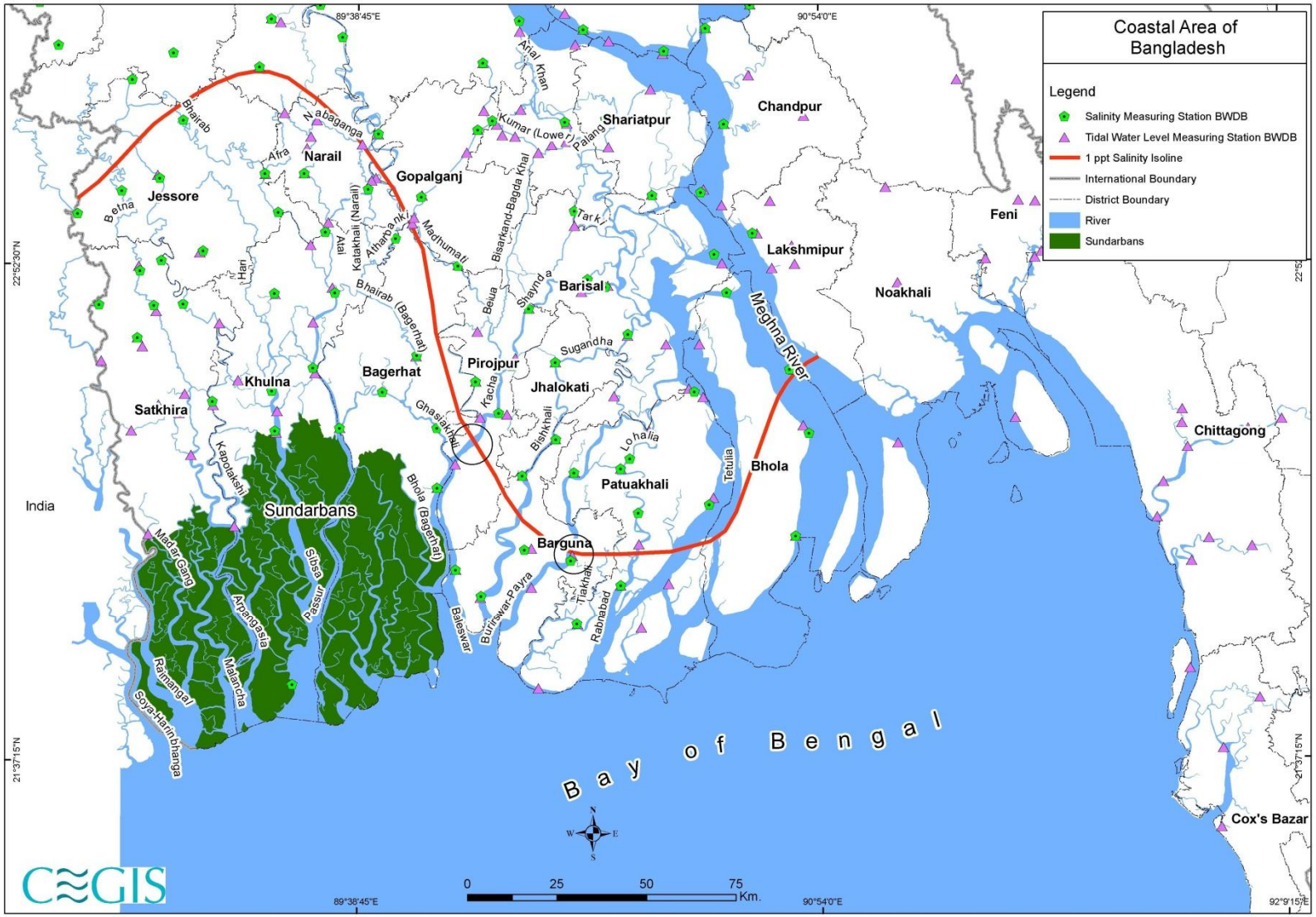
Project duration spring 2013 to winter 2014


Sea level rise: +2 m
http://flood.firetree.net
Bangladesh
বাংলাদেশ
(Bangladesh)
Assam
Meghalaya
Tripura
Mizora
West
Bengal
harkhand
Kolkata
Dhaka
Chittagong
Rajshahi
Jessore
Khulna
Barisal
Patuakhali
Madaripur
Comilla
Sylhet
Rangpur
Bogra
Naogaon
Bara Beel
Farahanga
Beel
Jamshedpur
Asansol
Durgapur
Dhanbad
Ranchi
Midnapur
Kharagpur
Balasore
Bhadrak
Cox's Bazar
Chittagong
Kaartgegevens ©2013 AutoNavi, Google, firetree.net ©2
Bangladesh
20130327

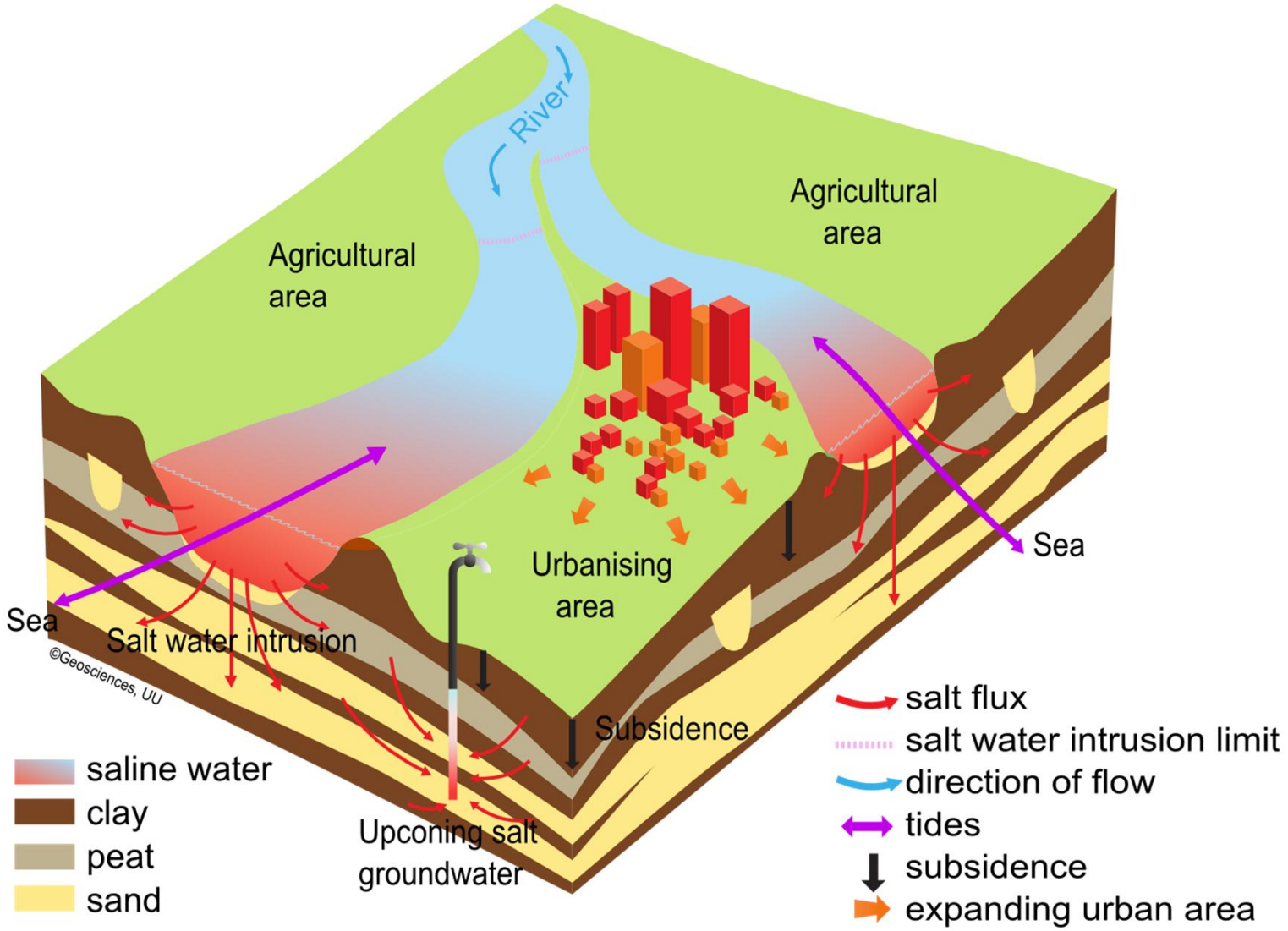
Base: Monsoon

Base: dry season

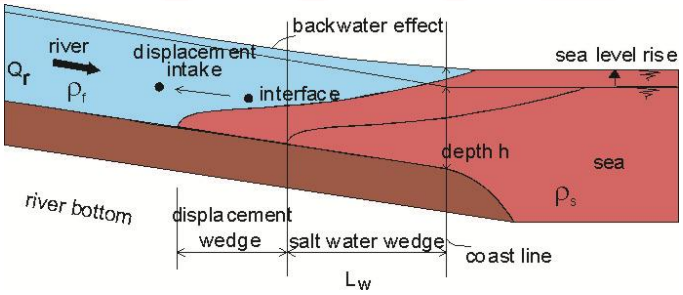
SALINIZATION SURFACE WATER



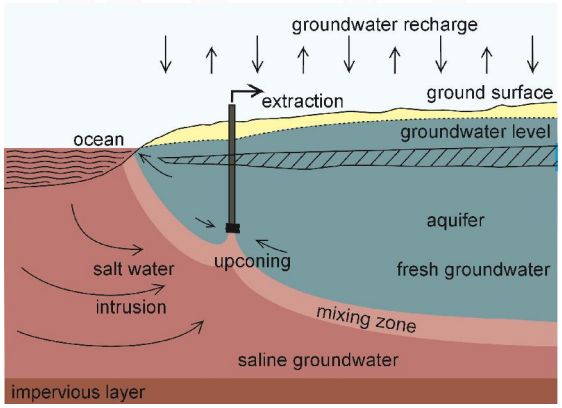
SALINIZATION SURFACE WATER HAS MAJOR IMPACT ON GROUNDWATER



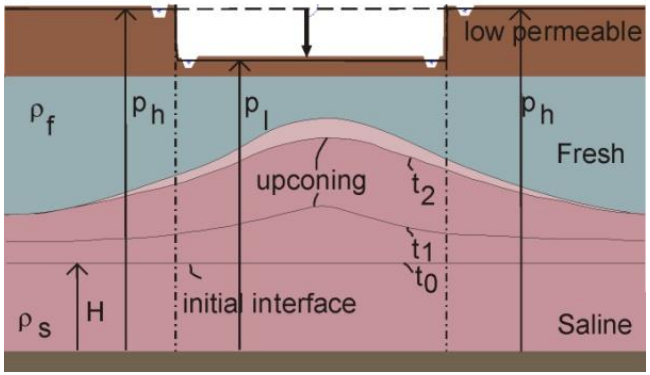
SALINIZATION PROCESSES



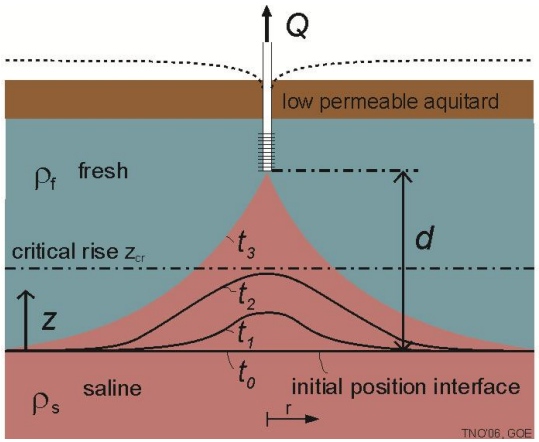
Salt water intrusion surface water



Salt water intrusion groundwater



Upconing low-lying area



Upconing extraction

Climate change hits Barisal agriculture sector

Scanty rain and rise in temperature worsen situation

MURAD AHMED

BARISAL: Shortages in rainfall and changing weather pattern are greatly affecting the agricultural output in Barisal region. Farmers here have become highly frustrated facing the abnormality of the climate as they are facing difficulty in cultivating paddy, winter crops and vegetable.

Barisal met office recorded 700 mm rain fall here in the month of May last year. On the other hand, it was only 235mm this year and only 107mm in 2012. It is a record that only 235mm rain fall has been reported here in first five months of the current year compared to 769mm in same period last.

According to sources, abnormality of the rainfall has started to be felt here in last eight years.

Abdul Alim, working at Barisal Met office for last seven years said he never saw such abnormal pattern of weather. He said that temperature in the region is increasing at a rate of 0.05 degree Celsius every year. It climbed up to 39.2C in the month of May this year breaking all past records.

Climate Change in the region is not only affecting agricultural production, but also creating tornadoes like Sidr, Reshmi, Aila in this part of the country.

Agriculturalist Nitta Ranjan Biswas, training officer of AED Barisal said that over 28 varieties of local Aman and Aush paddy have become extinct from Barisal region facing the shortage of rain and rise in temperature in last 10 years.

The AED official said, Aman cultivation depends on weather mainly rain. But delay of monsoon rain caused Aman plantation started three weeks late all over the region again. At the same time abnormal rain fall makes situation out of control day by day here. AED Barisal source said that change of the climate said us to change the mode of agri season as soon as possible.

Increase of salinity is another big problem which has affected all the 53 upazilas of Barisal Agri region.

According their recent survey report of Barisal soil resource development institute, highly shortage of rainfall increased the salinity almost everywhere of Barisal region. Crop production must be decreased over 4,03570 tones by the affect of salinity according the report, source adds.

Md. Liaquat Ali, principal Scientific Officer of Barisal Soil Resource Development Institute (SRDI) said that shortage of rainfall and increasing salinity particularly in the thousands of acres of croplands in the southern Barisal region may cause the food production to decrease drastically.

A survey report of the department revealed that 53 upazilas of seven districts under Barisal Agri region salinity in the soil is increasing alarmingly. It said that over 5 lakh hectares of land here have been found to be saline affected.

Crop production may decrease by 5 lakh tones due to this reason.

OUR GOAL

To set up an approach based on salinity monitoring, modelling and stakeholder participation to improve water safety plans in Bangladesh

UNESCO-IHE Institute for Water Education

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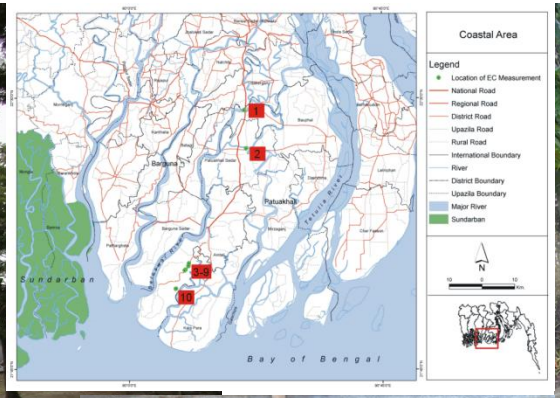
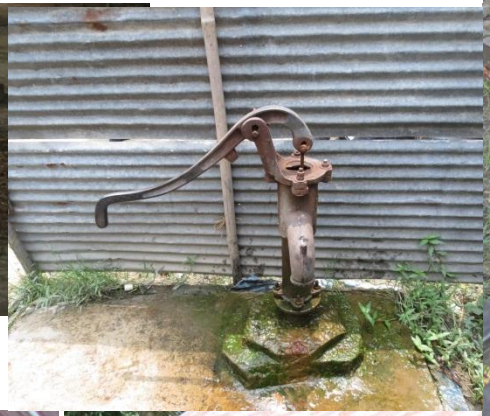
WHAT ARE WATER SAFETY PLANS?

- Describe all steps in water supply from catchment to consumer
- Meant to organize and systematise the water management practices applied to drinking-water
- Should be developed for each water and sanitation technology





Focus on drinking water

TIP: KNOW IN TIME ABOUT THE RELATION BETWEEN LOCAL PARTNERS

Relation stakeholder BRAC (Bangladesh Rural Advancement Committee, world largest ngo) and former partner CEGIS (Center for Environmental and Geographic Information Services) appeared to be not optimal, to put it mildly…

So we changed partners, and we had to shift to:

DPHE (Department of Public Health Engineering) and professor of local university as mediator to continue with project

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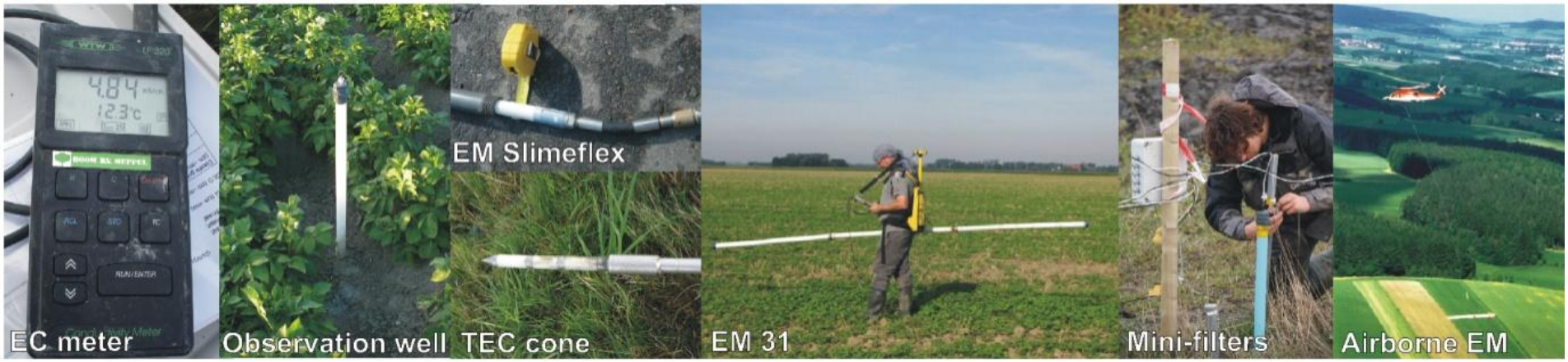
OUR OBJECTIVES

1. Create a better understanding of the process of salinization of drinking water resources in Bangladesh
2. Provide recommendations for monitoring
3. Provide recommendations for adaptation and mitigation
4. Achieve an effective, tailored knowledge transfer between the Netherlands and Bangladesh
5. Advise on the integration of the salinization issue in Water Safety Planning

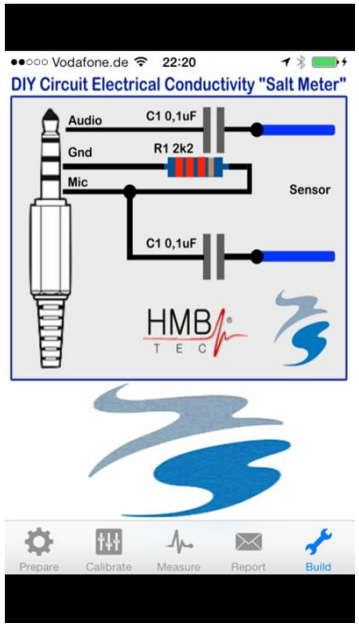


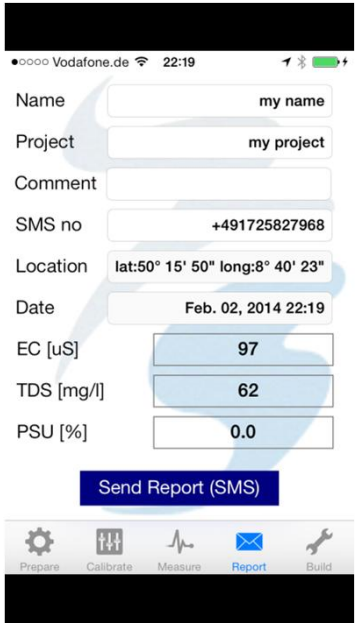
MAIN COMPONENTS OF OUR PROJECT

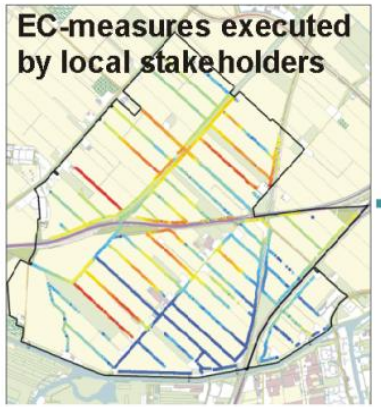
- Literature review & Data acquisition
- Monitoring
- Contribution to Water Safety Plans
- 3D Variable-density Groundwater Model
- Knowledge transfer: Training & Dissemination

Low-profile monitoring being part as a public awareness

AND high-end monitoring: cheap Salt Water Smart Phone App







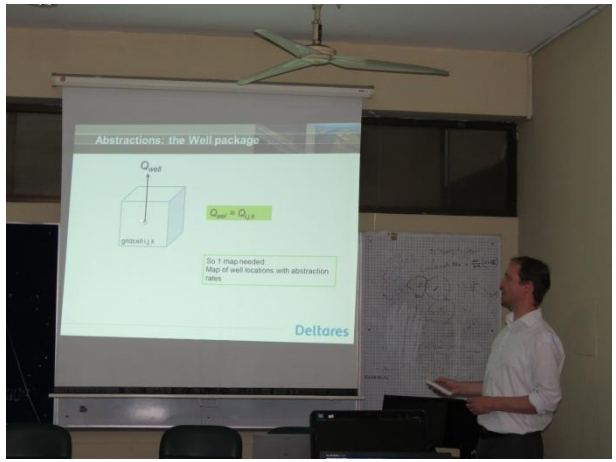
Water system analysis

Solutions

Desktop Knowledge Transfer

- Meetings

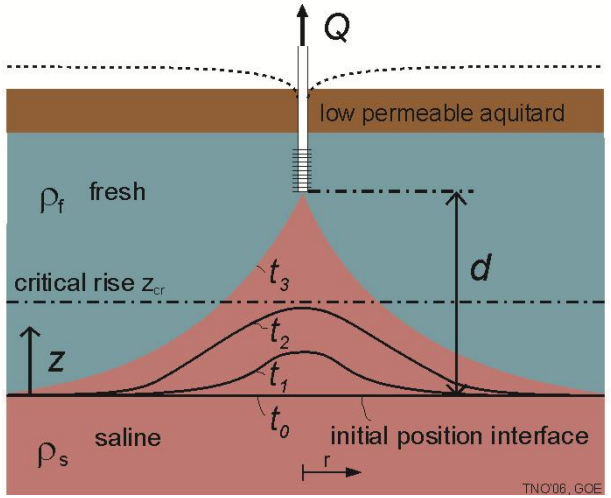
- Modelling Course



GROUPING WATER AND SANITATION TECHNOLOGIES

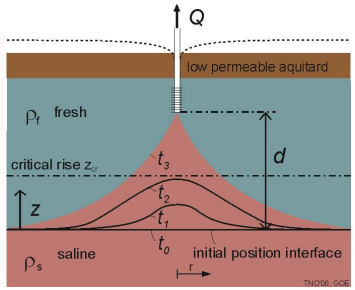
Shallow wells:
Shallow Tubewells
Tara Tubewells
Ring wells
Dug Well
Hand Pump Tubewells
Shrouded Tubewell (SST)
Very Shallow Schrouded Tubewell (VSST)

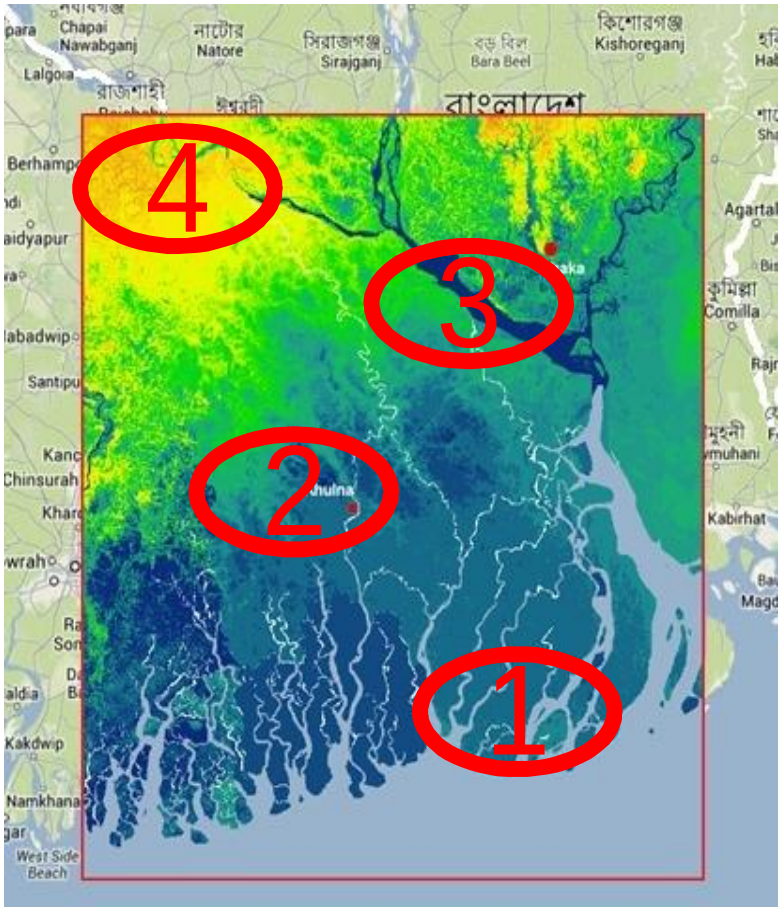
Deep wells (up to 300m):
Deep Tubewells
Tara Tubewells
Hand Pump Tubewells



Rain harvesting and artificial recharge:
Pond Sand Filters
Rainwater Harvesters
Infiltration galleries

FOCUS ON 4 REGION TYPES





Region 1: Eastern coastal Belt

Deep wells, rain harvesting and artificial recharge

Region 2: Urban and rural areas far from big rivers

Deep wells (and shallow wells), rain harvesting and artificial recharge

Region 3: Urban and rural areas close to big rivers

Shallow wells (and deep wells), rain harvesting and artificial recharge

Region 4: High infiltration areas

Shallow wells (and deep wells), rain harvesting and artificial recharge

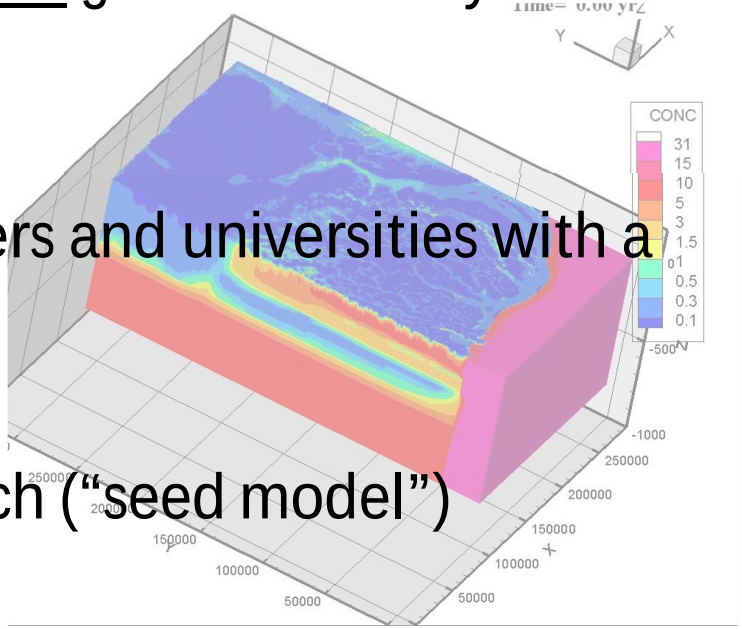
REGION 1 – DEEP TUBE WELLS – CONTROL MEASURES AND MONITORING

Wells with arsenic in water are painted red. Wells with measured electrical conductivity could also be marked depending on the EC.

	mS/cm	TDS mg/l	Purpose	Symbol indication
Non-saline	<0.7	<500	Drinking and irrigation water	blue filled circle (RGB Blue 255)
Slightly saline	0.7 - 2	500-1500	Irrigation water	green filled circle (RGB green 255)
Moderately saline	2-10	1500-7000	Primary drainage water and groundwater	black/red cross
Highly saline	10-25	7000-15 000	Secondary drainage water and groundwater	black/red cross
Very highly saline	25 - 45	1 5 000-35 000	Very saline groundwater	black /red cross
Brine	>45	>45 000	(more than) Seawater	black/red cross

3D VARIABLE-DENSITY GROUNDWATER MODEL: WHY?

- To understand and visualize the regional groundwater dynamics and the salinity processes



- To provide Bangladeshi water managers and universities with a instrument for their mandates

- To stimulate and assist further research ("seed model")

- To fill the void: there is no regional groundwater model in Bangladesh that includes density effects

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USE OF A 3D DENSITY DEPENDENT GROUNDWATER MODEL?

Questions that can be answered:

- Where are the present fresh-saline interfaces?
- How will these interfaces evolve in the following years?
- What is the effect of the extractions in the vertical distribution of the salinity?
- Guiding the positioning of monitoring and data collection
- Guiding the positioning of extraction wells

DATA COLLECTION IS A CONTINEOUS PROCESS

Sharing data is not common practice for institutes in Bangladesh

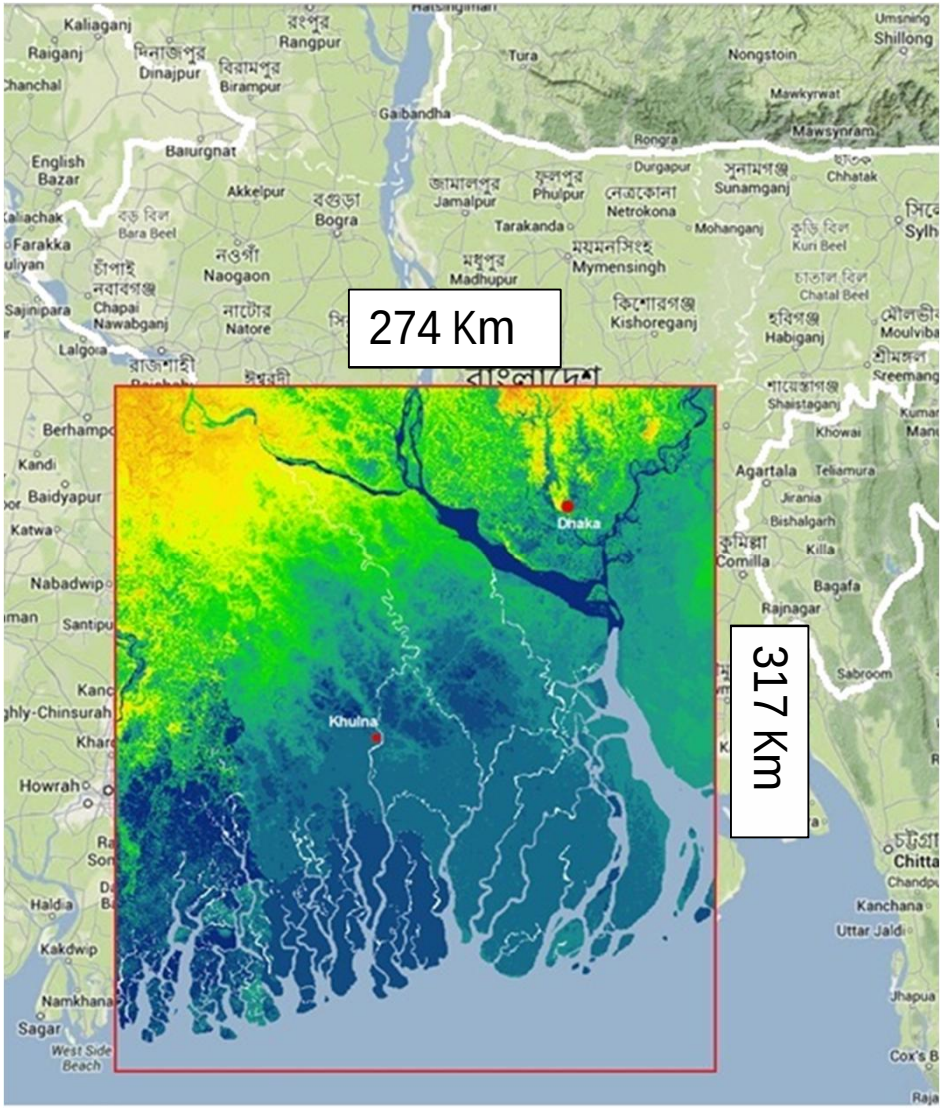
Convincing institutes to share data takes time, but is an important activity towards a successful data collection

Let local partners collect the data (to avoid payments for data)

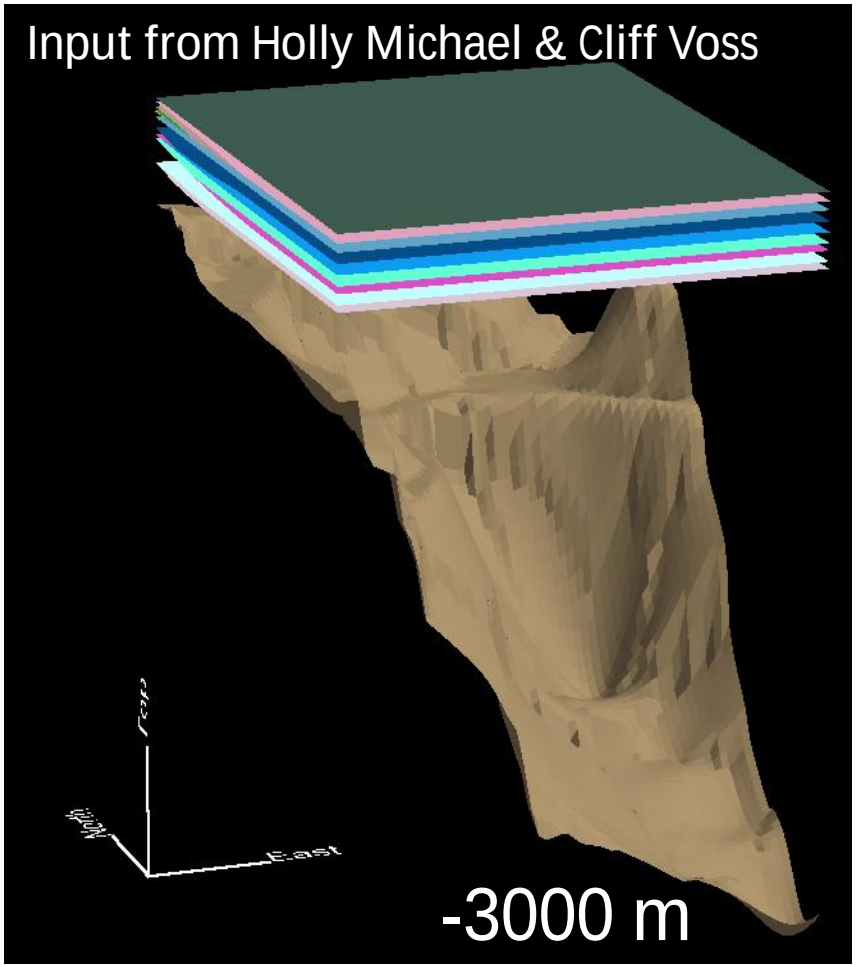
Show consistent what you do with the data. Suggesting you are using it as numerical model input helps

Tip: be flexible enough in model construction: new data is often available just before the ending of the modelling work package…

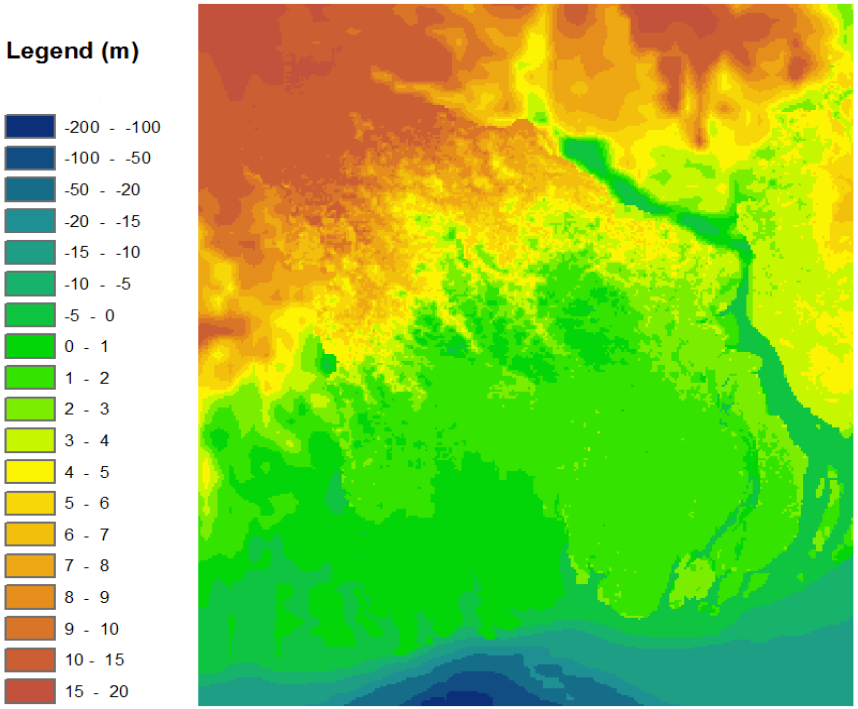
Model Geometry: model extent



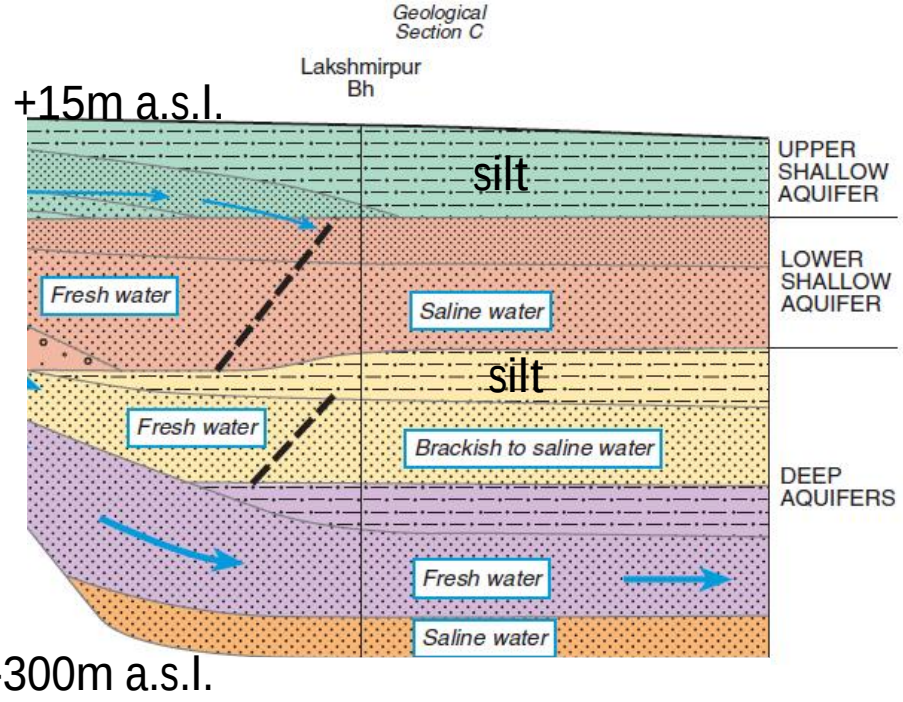
Bottom boundary: Boka Bil formation hydrological base (no flow)

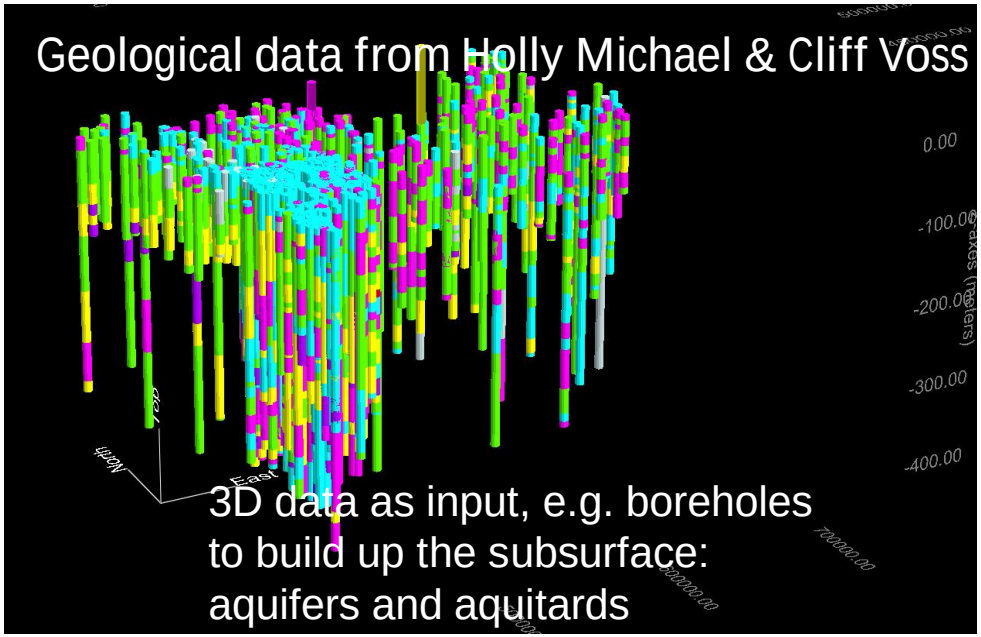


surface level (DEM)



subsurface model





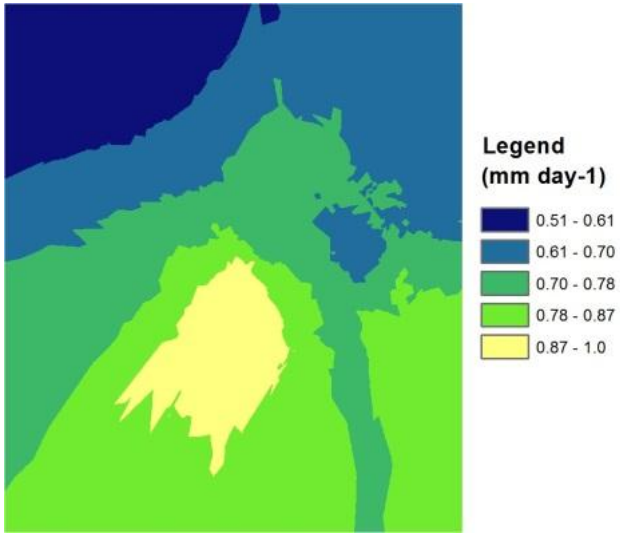
Sources:
CEGIS, BGS and DPHE, 2001

Net gw recharge

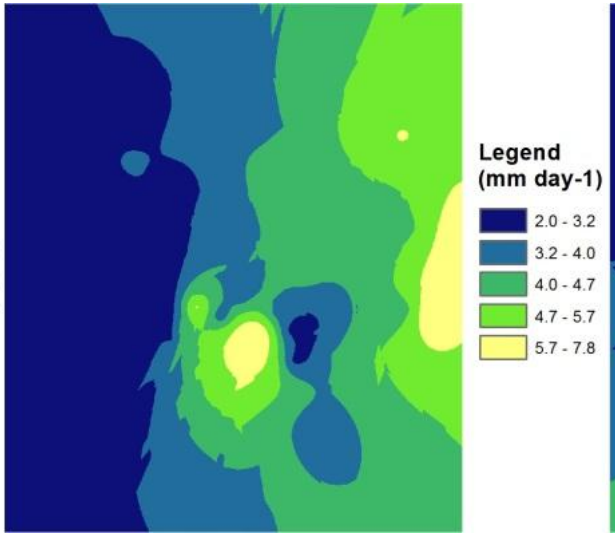
- Interpolation measured data (source CEGIS):
- 4 monitoring stations for evapotranspiration
- 96 monitoring stations for precipitation
- ±1990 – 2011

Data averaged per stress period:

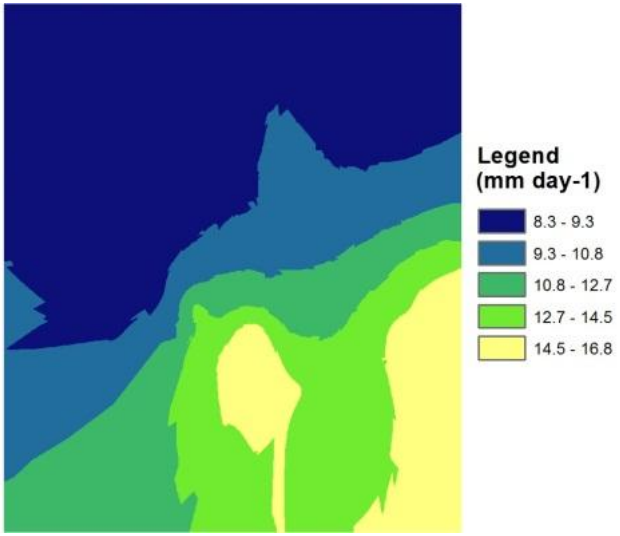
1. Cold and dry
Nov - Feb



2. Hot and humid
Mar - May



3. Monsoon season
June - October

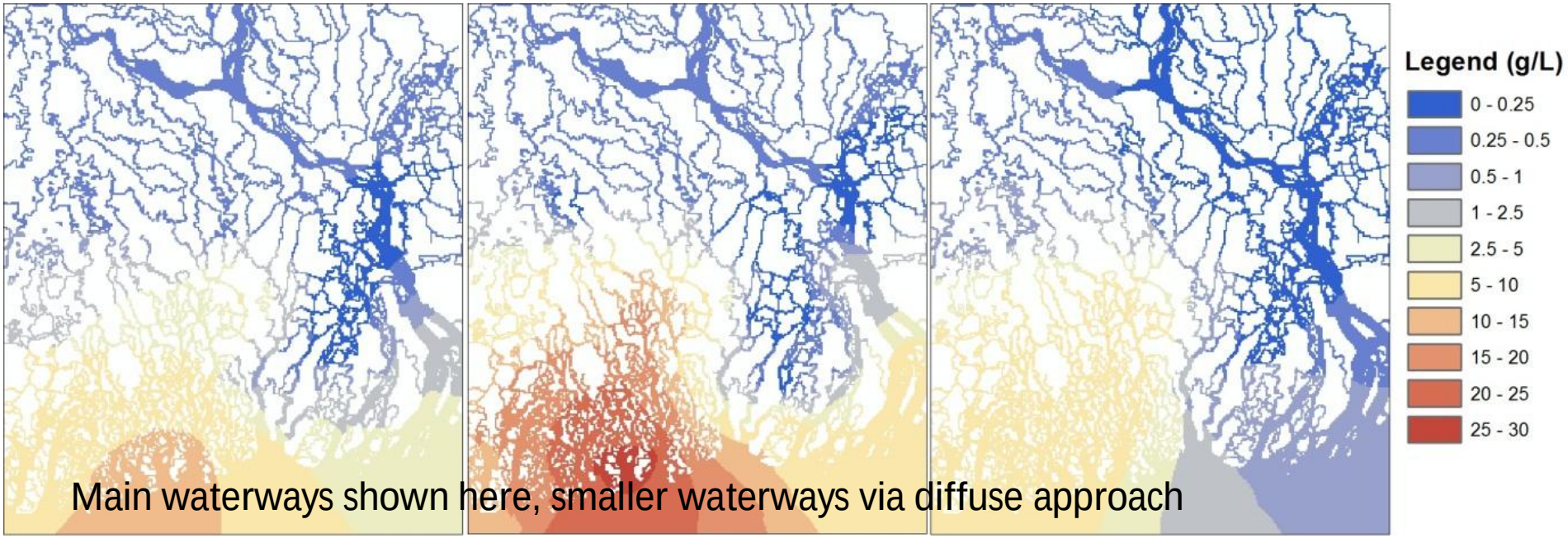


Surface water: Salinity levels in river package

1. Cold and dry
Nov - Feb

2. Hot and humid
Mar - May

3. Monsoon season
Jun - Oct

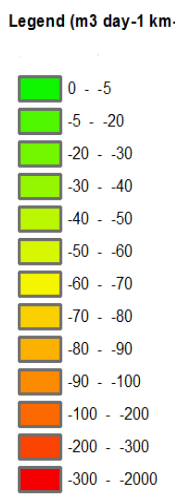


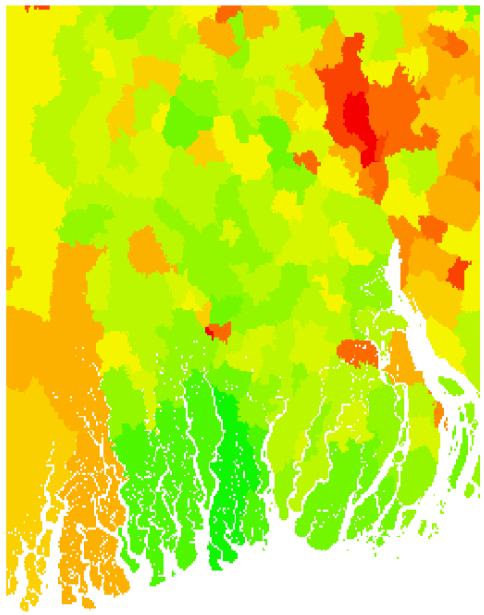
Main waterways shown here, smaller waterways via diffuse approach

Source:
Daily water level data from BWBD (126 locations on river levels)
CEGIS, completed by data from DIVA-GIS (84 monitoring stations on salinity values)

Abstractions

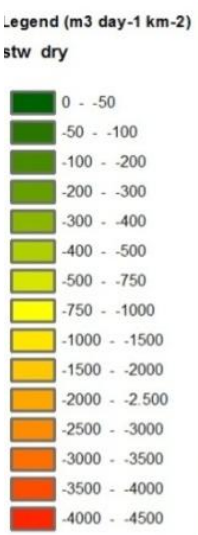
Q_{well}

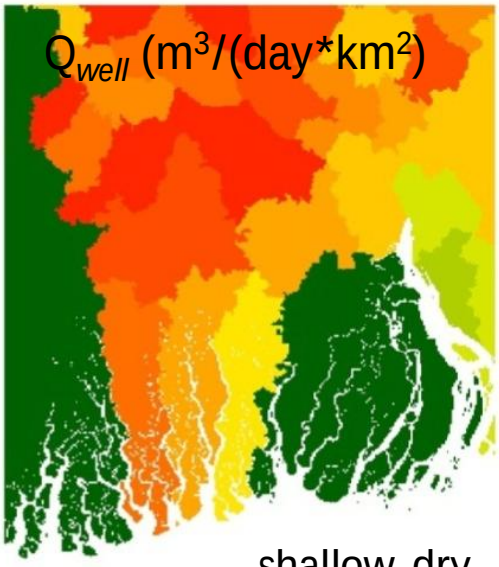




Domestic&Industrial

- based on population size (cf Michael and Voss, 2009)
- total (domestic + industrial) demand 50 L/day per capita (WARPO, 2000)
- assumed constant throughout the year





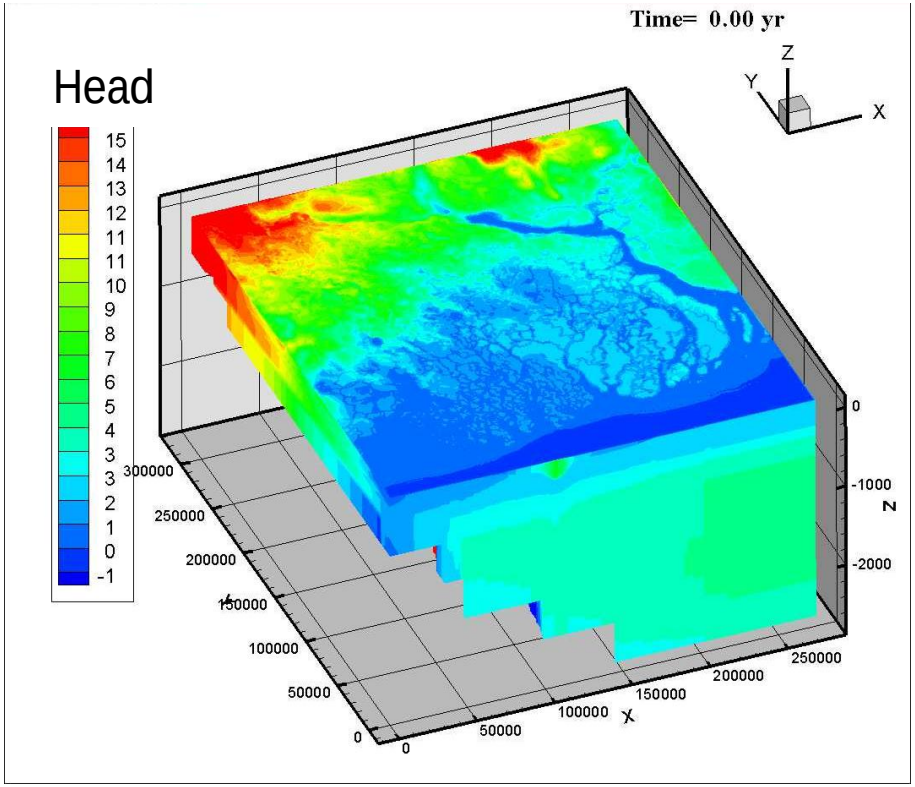
shallow, dry

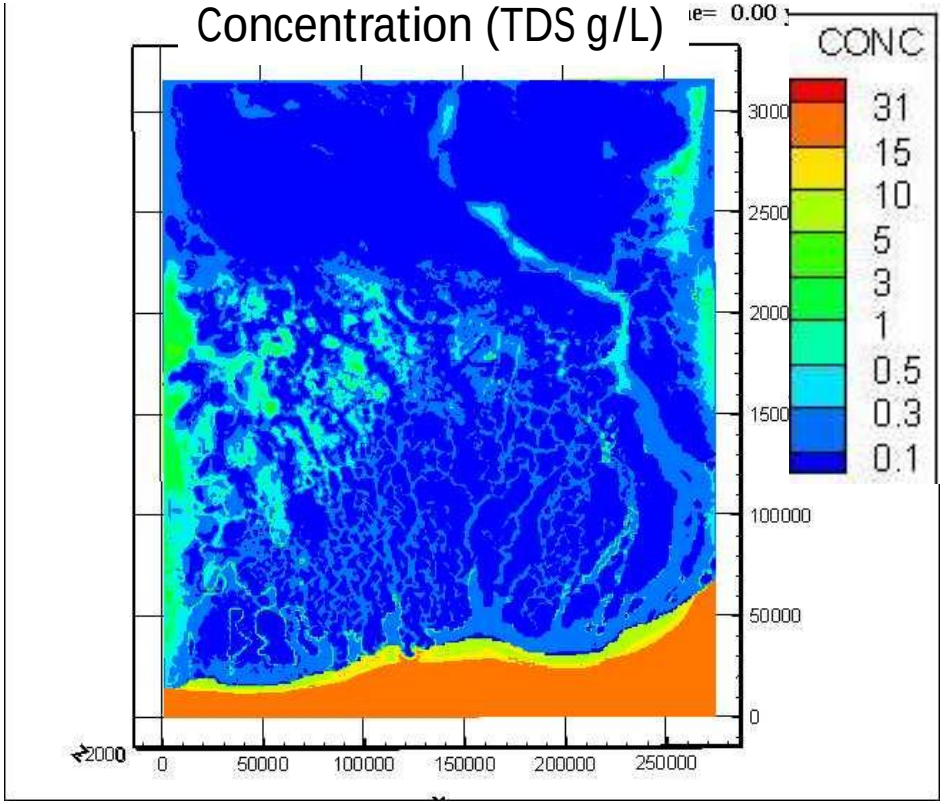
Irrigation for agricultural purposes

- known is area per irrigation type, on district level
- distinction between wet season and dry season
- irrigation Shallow Tube Well : 10-60m depth
- irrigation Deep Tube Well: 60-100m depth

Source: depth based on the well data of DPHE

Some preliminary model results





New data gets available and will be implemented:

- on geology
- on EC

Conclusions

- Good personal relations between local partners essential for success project
- Listen to demands local partners but be stubborn enough in striving your own goals
- Relatively low-profile monitoring techniques can be sufficient for now in data-poor areas
- Use numerical model:
  - just as communication tool
  - just as a database
  - Not yet as an accurate presentation of the complex reality

Questions?