FIELD REPORT

Exploratory field visit for potential sea level rise study

Field visit 1: Kannamaly and Chellanam, 26.11.2013 (13:30 – 16:30)

Nansen Environmental Research Centre-India (NERCI): Dr. Harenduprakash, Sachin Pavithran (PhD economics), Ajith (PhD marine biology)

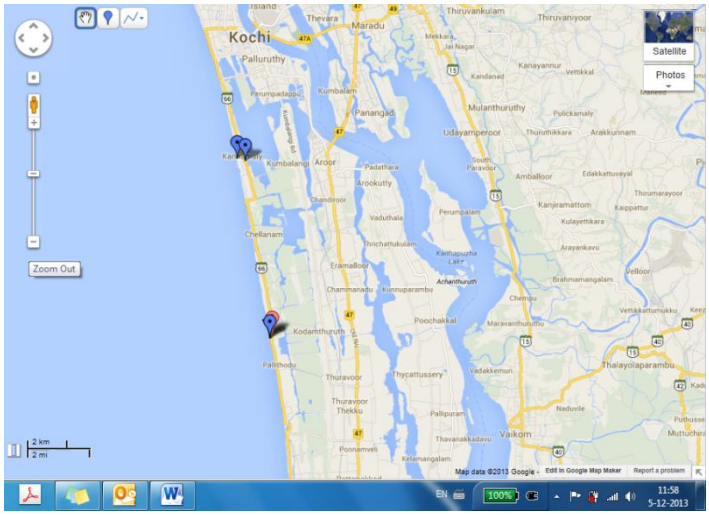
Alterra, WUR: Tanya Singh (researcher, author of this report and photographer)

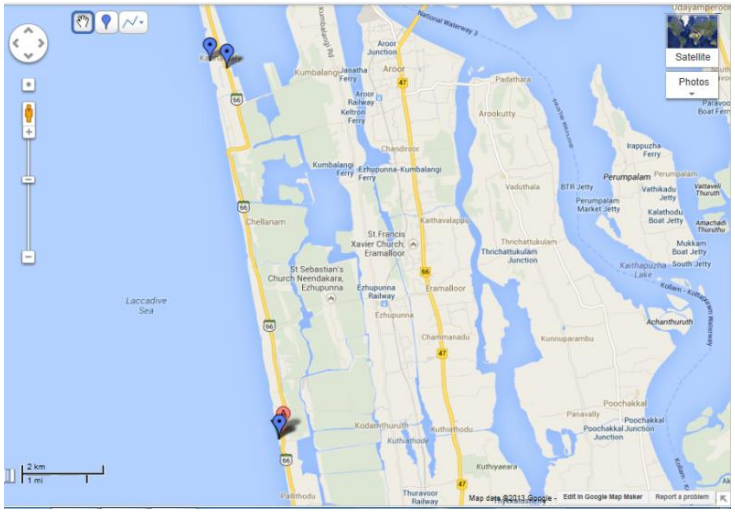
Stop	Area	Coordinates (GPS device, GARMIN)	Coordinates (GPS Status, mobile app)	Google maps (decimal) (just copy paste in google maps)	Altitude (not reliable) (GPS status app)	Comments (see pictures below as well)
1	Kannamaly	9*52'29.9'' N 76*15'40.5'' E	9*52.498' N 76*15.676' E	9.873580, 76.265240	10-13 m	Sea walls. Close to St Marys High School and St Joseph Shrine
2	Kannamaly	9*52'24.9'' N 76*15'54.8'' E	9*52.414' N 76*15.914' E	9.874930, 76.261150	20 m	Street side, very close to first location. Water just directly next to the road, houses and bridge. Roads on the way to Kannamaly not smooth (many little stones and rough)
3	Chelanam South	9*47'27.8'' N 76*16'36.5'' E	9*47.462' N 76*16.609' E	9.791010, 76.276830	3-6 m	Sea walls again. Fisher men were repairing nets. Told us that that during Tsunami water reached until the road. It slowly raised (not big waves). People were scared for three days. But damage was minor (few houses), and nobody got injured

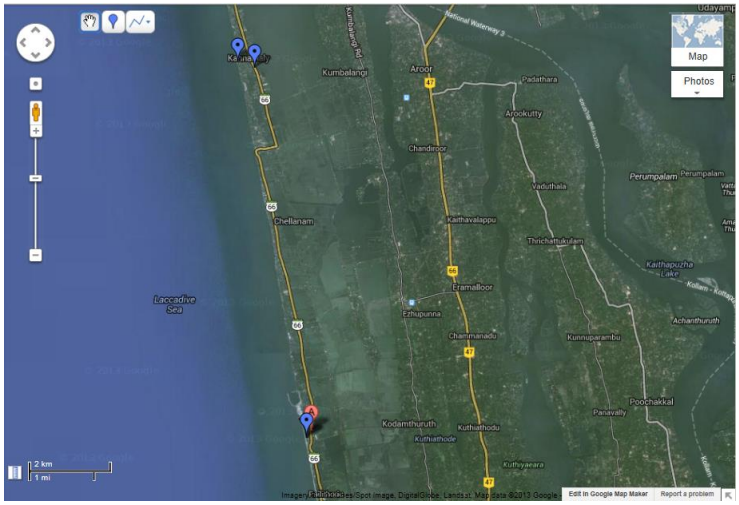
Observations: People did not seem to be 'poor'. Majority had proper stone houses. Some housing areas facing the coast had also had walls around them. Spotted a hospital. Many schools and churches visible.

The sea walls were interrupted at various locations by small openings for fishermen and their boats. According to Dr Harenduprakash, people already seem to adapt to erosion and sea level rise by building these walls. According to his observation fishermen also adjusted as well by 'travelling' to the openings and bringing the nets back close to their houses where they work on them. (**needs to be verified**)

Maps below indicate the locations visited







Pictures of first field trip

Location 1 (Kannamaly)

Sea wall

Behind the sea walls with a gap of around 10/15 meters there are houses. Behind the big empty field there is a school (left pic).

Location 2 (Kannamaly) (houses and road just next to the water. Flooding will have a direct impact on these infrastructures)

Not well maintained road from Kannamaly to Chellanam. On both sided of the road there is water.

Location 3 (Chellanam)

Fishermen mending their nets. Houses behind the sea wall have often walls around them as well.

Fishermen on a fishing trip from a spot where the sea wall is open

Ground covered with sand bags

Field Visit 2

28th Nov 2013, (8:45 am – 5 pm), measures along the coast from Kannamaly to Alleppey beach

Nansen: Dr Harenduprakash, Abdulla (last name? PhD student Oceanography)

Alterra: Tanya Singh

Stops	Area	Coordinates (GPS device, GARMIN)	Coordinates (GPS Status, mobile app)	Google maps (decimal) (just copy paste in google maps)	Comments (see pictures below as well)
1	Chellanam (Alappuzha-Arthunkal-Chellanam - Thoppumpady Road	9*45'05.4'' N 76*17'03.0'' E	9*45.114' N 76*17.038' E	9.751910, 76.283970	Talked to owners of a little shop along the road (one female and one mail, above their 40/50s, later another man joined). During tsunami the area was completely flooded. Water came through Andhakaranazhi. The height was not so much, but it reached the houses. They could not sleep during the night because they were scared. During rainy season (summer monsoon) backwater rises. During Nov/Dec ground becomes very wet without rain. Income from: backwater and sea fishing. (the little shop had hardly anything, few biscuit pieces in a box, some candies and empty bottles) They are not involved in aquaculture, this is done more at the east side of the lagoon. Now they have piped water (not so old, Japan pipeline scheme). Before they had to manage with brackish water. No notice in change in sea level rise (they did not give a very clear answer). During may the water may lower about more than one meter. they experience dry soil during this period Level is the highest around Nov/Dec (back water) If sea level rises they close the shop. And just stay in their house (their house is already on an extra layer of bricks). They can also stay a couple of days with relatives/friends. However, usually water does not rise upto an level that it enters into the home, but it is very difficult to travel from one place to another. Water level will fall within few hours, as the high tide phase completes. They showed the marking at their shop wall up to which level water reaches. Wave action or salt content will destroy the wall due to splashes.
2	On the same road as	9*45'02.6'' N 76*17'09.7'' E	9*45.048' N 76*17.168' E	9.750810, 76.286140	Bridge with a small damn system to control water flow between coast and lagoon/backwater. Coast side was has a small sand island formations with boats on it and a

	above: Andhakaranazhy				lighthouse. On the lagoon side there are many Chinese fishing nets (Andhakaranazhy features a seasonal barrier beach and a tidal inlet. It connects the Vembanad lake withe Lakshadweep sea through two streams mainly from the north and south of the opening. It also serves/served? as an outlet for the flood waters from the vast paddy fields during monsoon)
3	Arthunkal beach	9*39'43.4'' N 76*17'31.4'' E	9*39.667' N 76*17.528' E	9.661130, 76.292150	Beach side with famous Arthunkal church. Road from beach directly leads to church. Pozhi?? Visible (water opening). Lets water from backwaters/lagoon enter coast. Causes lots of sand displacement. Usually only open during monsoon, but during our visit it was open. High tide level marks visible at the beach (natural sand wall next to the coast line) Abdulla: There are two pozhi nearby, namely Arthunkal pozhi and chethi pozhi(also called kattadi pozhi)
4	Beach next to Thumply Kurisadi Road (close to/below Pozhiyoram Beach Resort)	9*31'11.6'' N 76*18'43.1'' E	9*31.196' N 76*18.725' E	9.519950, 76.312090	Old lady sitting together with her grandson in front of the house at a beach. She is living at that place since 15 years. 1-2 a year water reaches house (but does not flood it). Same happened during tsunami. Highest level for coast water: during monsoon and may Lowest level: nov/ dec
5	Alleppey beach, around old habour, peer lane	9*29'31.9'' N 76*19'02.7'' E	9*29.531' N 76*19.049' E	9.492190, 76.317420	From the old peer pole it is visible how high water can get, by looking at the green sea weed on it (was not very high for the pole on the beach, something like 20 cm) 3-5 m mean altitude according to GPS app
6	Close to OG's Beach Bungalow, Kaattur beac	9*34'28.5'' N 76*18'09.5'' E	9*34.481' N 76*18.148' E	9.574700, 76.302470	Gillnet mender. And a group of male labours. Working on a boat and construction of a resort (most likely violating the CRZ). Did not see a change in sea level rise (but he is also an immigrant). Water comes to the depth of the fence during max high tide. Commented that there are many labours at the harbour side from Tamil Nadu.

	h				Sea level is low during December and high in July People have of no feeling of sea level rise
7	Mr Louis in Kannamaly	Coordinates not needed for this spot	9*54.583' N 76*15.323' E	9.909720, 76.255390	Interview on current situation in Kannamaly (changes compared to the past, land value development) See below

1) --> Looks like that the level of the backwaters is high during December season, but in the same period it is low at the coast??? (**This has to be verified**)

2) To a large part the houses built were made of bricks/stone. In between there were small stripes with simpler houses/huts.

3) People seemed to be more affected by backwater rise than coast water (directly at the sea) rise.

--> Side note on 1-3 something to do with the monsoon variability in wind and rainfall, the former driving ocean currents and the latter feeding the rivers.

4) Side note: 'People have of no feeling of sea level rise'--> This is likely because there has been very little (yet). Measured relative sea level in Cochin has not risen since the '50s (e.g., Unnikrishnan & Shankar, 2007, Fig.2).

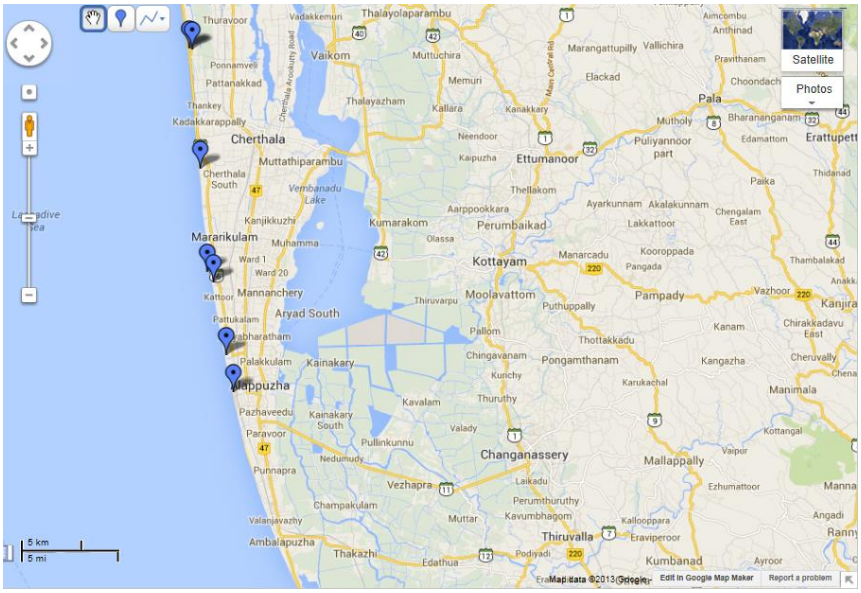
5) Interview with Mr Louis in his house (his second eldest son was also there, and intervened occasionally. Mr Louis is a man in his 60s?. We got the contact from Prof Menon in order to get some idea of the land value in this area). Interview was to a large part in English.

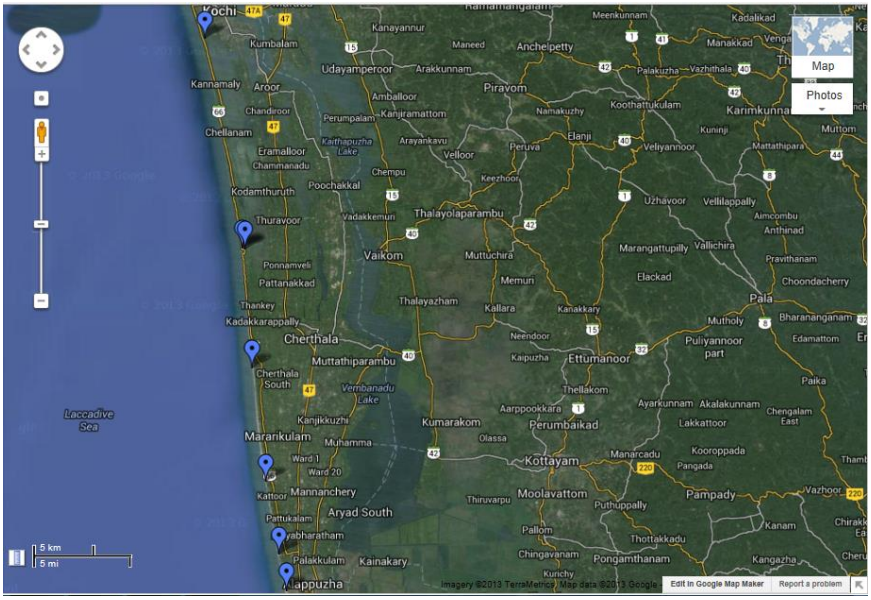
- He is an engineer, but tried to get involved in agricultural activities in the past.
- His father used to be a landlord/land owner in this area.
- About 75 years ago the sea used to be further away (about 1.5 km). **Erosion brought water closer**. Then about 60 years ago sea walls were built. Since then hardly any erosion happens.
- **50 years ago 1 cent land = 50-100 rupees (100 cent = 1 acre) (?!??). Nowadays you pay for same amount of land up to 2 lakhs. (?!) (ask Abdulla about the recorded interview)**
- Kannamaly heavily populated. Because this area is still cheaper than city area, but it is close by. In the city you pay something between 10-20 lakhs (even 50 lakhs). **Population is growing** because native people here are reproducing and more people are moving here because of the location (close to the city and cheaper)
- Because more and more is being built here land value is also increasing. **Nobody here is concerned about sea level rise**. His projection is that land value will further increase in the future. Material for building houses is also getting more expensive. 1 truck of sand used to be 700 rupees (15 years ago). Now it is about 20.000 rupees. Constructing a house nowadays (all costs included, such as labour and material, but not land) costs around 5 lakhs (for 200/300 qm). The main road (road from Kannamaly to Chellanam) close to Mr Louis house was newly constructed after tsunami in 2004. He has no idea about the costs involved.
- After tsunami the prices of land value did not decrease. Nobody seems to be bothered about the risk of sea level rise.
- **Sea walls are maintained every year**. Good protection.
- There is no other major transport way next to roads in this area. The canals are not used for transportation. About every 5 km there is a cross road connected to main road.
- Every **December** there is a **rise of the back water level**. (about 1 feet). High tide level in eastern side is higher he believes. In the mornings the level are the highest. (nov-dec, for 2-3 weeks). Some people do get affected but not all. It was always like that and has not become worse than before. People do not bother too much about that.
- Piped (cooperation) water for drinking. Since many many years (he does not know the exact year)
- Previously backwaters were used for transportation, but this is not the case anymore. Also the area where he is living now used to be backwaters area, but it has been reclaimed for settlement. This was

legal before. Clay from backwaters was used for this. This made the backwaters deeper. During that period the quality of the water was also better, more fresh water and the fishermen were happy because enough and good fish (personal note: I guess a lot of pollution and overfishing came also with population pressure. Not all has to do to with the depth of the backwaters)

- However, today the canals and backwaters are getting shallower. This transport possibility is neglected today and not maintained, because of the occurrence of roads. Shallow waters also brought more mosquitos.
- **For detailed information on population, number of household contact panchayat**
- Houses are built of bricks, sand and cement. For building houses fresh water is needed. Salt water is not good for this purpose. Previously people used to live more in huts. People are earning nowadays more. Daily wage for a labourer is about 750 rupees. 15 years ago it was 200 rupees. 20-25 years ago about 50 % of the people used to live in hut type of constructions. Today way less. People also take a lot of loans to build a house.
- Not many immigrants here, so money earned in this area also stays here.
- His father constructed a house 80 years ago for about 10.000 rupees (discussion evolves on that income and prices both are rising.. so perhaps changes are somewhat proportional?)
- Fishery sector here is 'saturated'. Educated people are going away and do not want to get involved in this type of work. Locals do not want to work in this business anymore. So people from Tamil Nadu coming (Personal note: contradictory to a statement of his before)
- No farmers in this area. Agriculture not affordable here. Risk is very high, especially due to unpredictable climate. People perceive other opportunities are better and do not want to take unnecessary risk. There used to be agriculture in this area before but now it disappeared. Because:
    - Shortage of labour
    - Not cost effective (labours cost too much, land is expensive)
    - Too much climate dependent (and climate not predictable, varies extremely)
    - No mechanisation
- Labour charges increased so much, that traditional way not feasible anymore. And there is no government support. The government has done nothing to protect agricultural area. Paddy and coconut plantation used to be here. (personal note: Dr Harenduprakash also noted during our car ride, that the soil is not fertile in this area for agriculture. Land between high mountains and coast is better for agricultural purposes)
- Aquaculture is also not feasible in this part of the lagoon area, as water is too shallow and polluted.
- Critical discussion about how government has negatively changed (no need to report the details here)

Maps of places visited during second trip





Location 1

Shop owners we talked to. On the wall you can see the damage which floods cause. Right image is their house built on a layer of bricks to be higher.

Location 2

Left side of the Andhakaranazhy water gate/bridge a light house and fishing boats on the right side fish landing with Chinese fishing nets

Podhzi (man-made opening, so the lagoon water can enter sea)

Tide level

Road from the beach which leads directly to the church

Location 4

House of old lady. During the peaks water level reaches the stairs. Her house is just next to the opening of the wall

During peaks water reaches the house, but house does not get flooded yet (house of old lady behind the wall)

Location 5

Peer. Sea weed around poles

Location 6

Labours working on the boat and on the resort construction below

Water reaches until here during peak

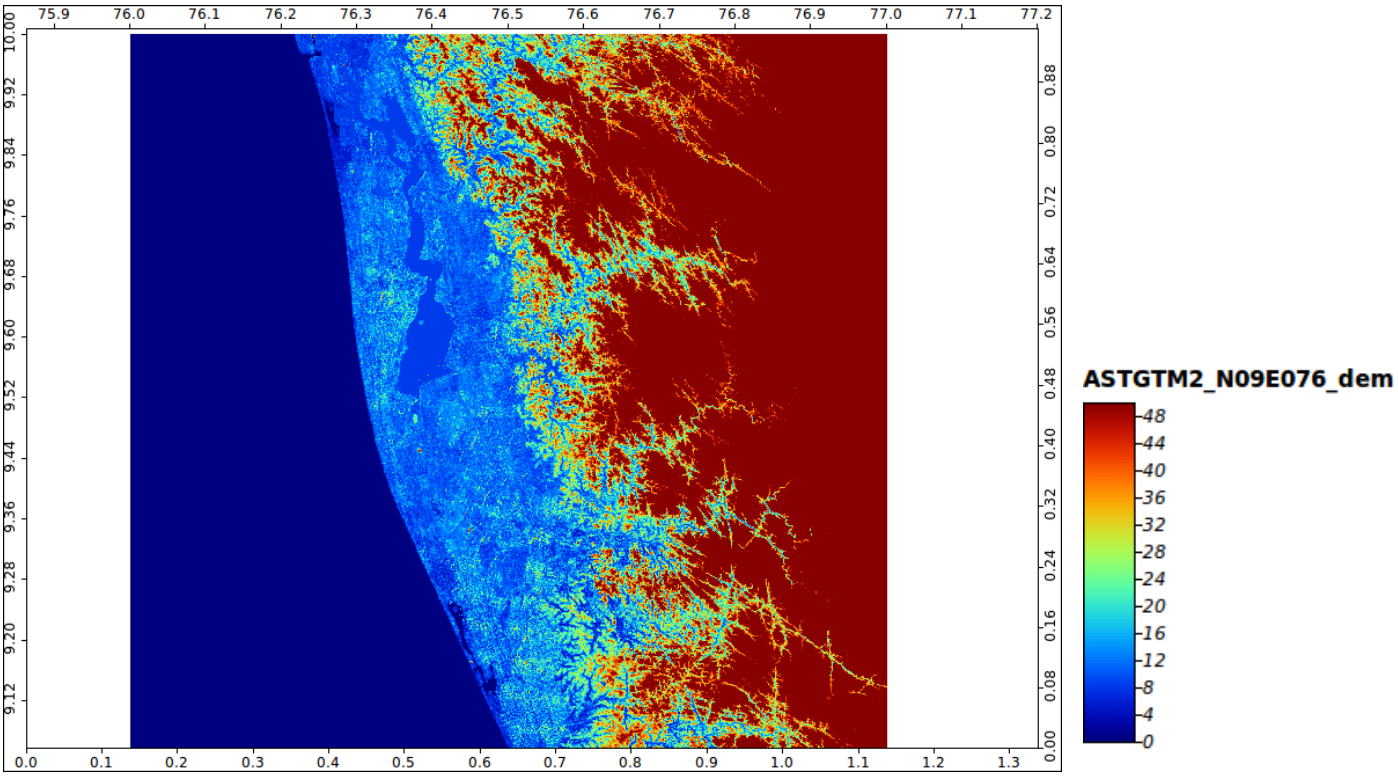
New resort being built behind the wall (not in line with the CRZ)

GIS MAPS to identify our case study areas

Maps below show that parts of Kannamaly and the area around Chellanam (the area we also visited based on the recommendation of Prof Menon) and Thrikkunnapuzha, Kuttikad, Pallana might be interesting case studies. Thease areas might be the most vulnerable to sea level rise due to their low elevation and proximity to the sea and lagoon waters

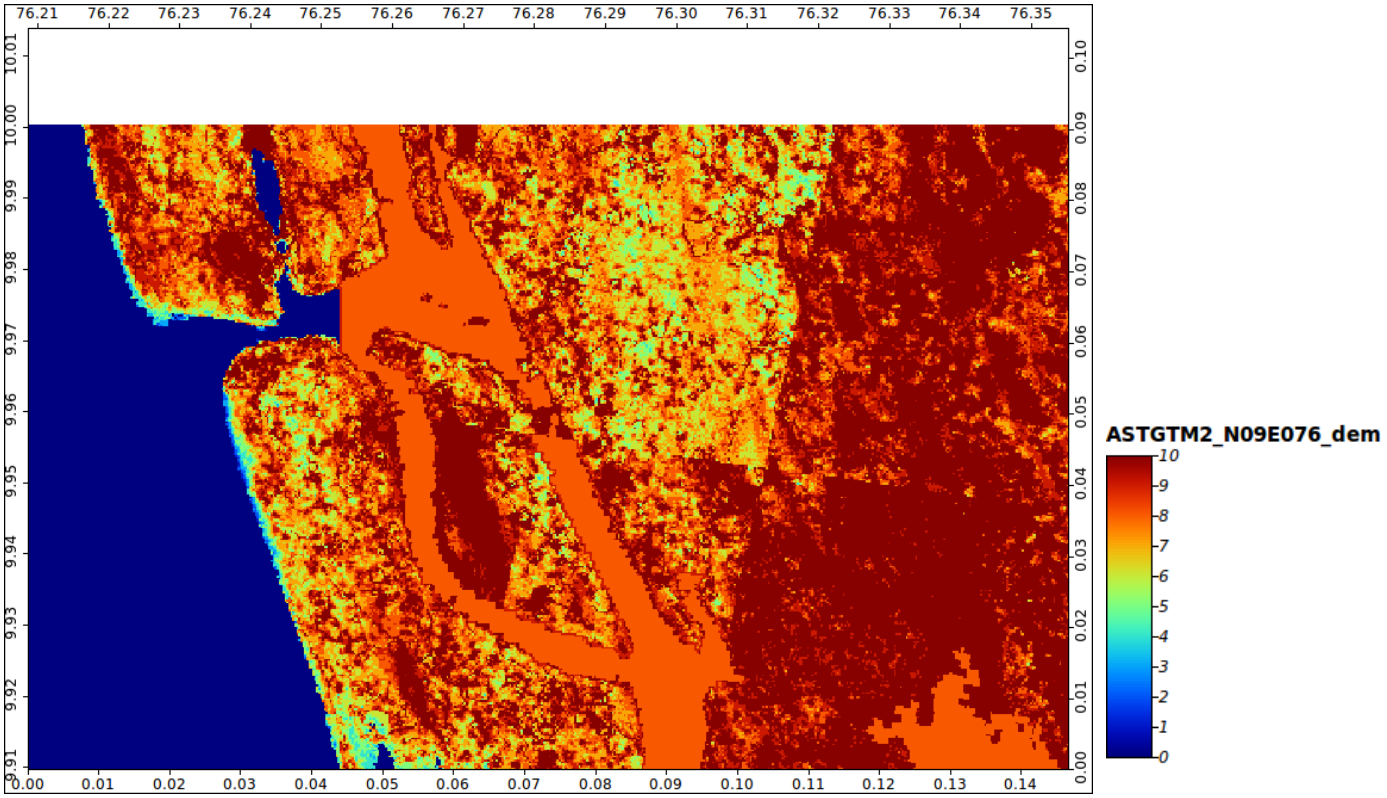
Based on Aster 30 m resolution data (elevation 0-50m)

Kerala map (Cochin and stretch south of it)

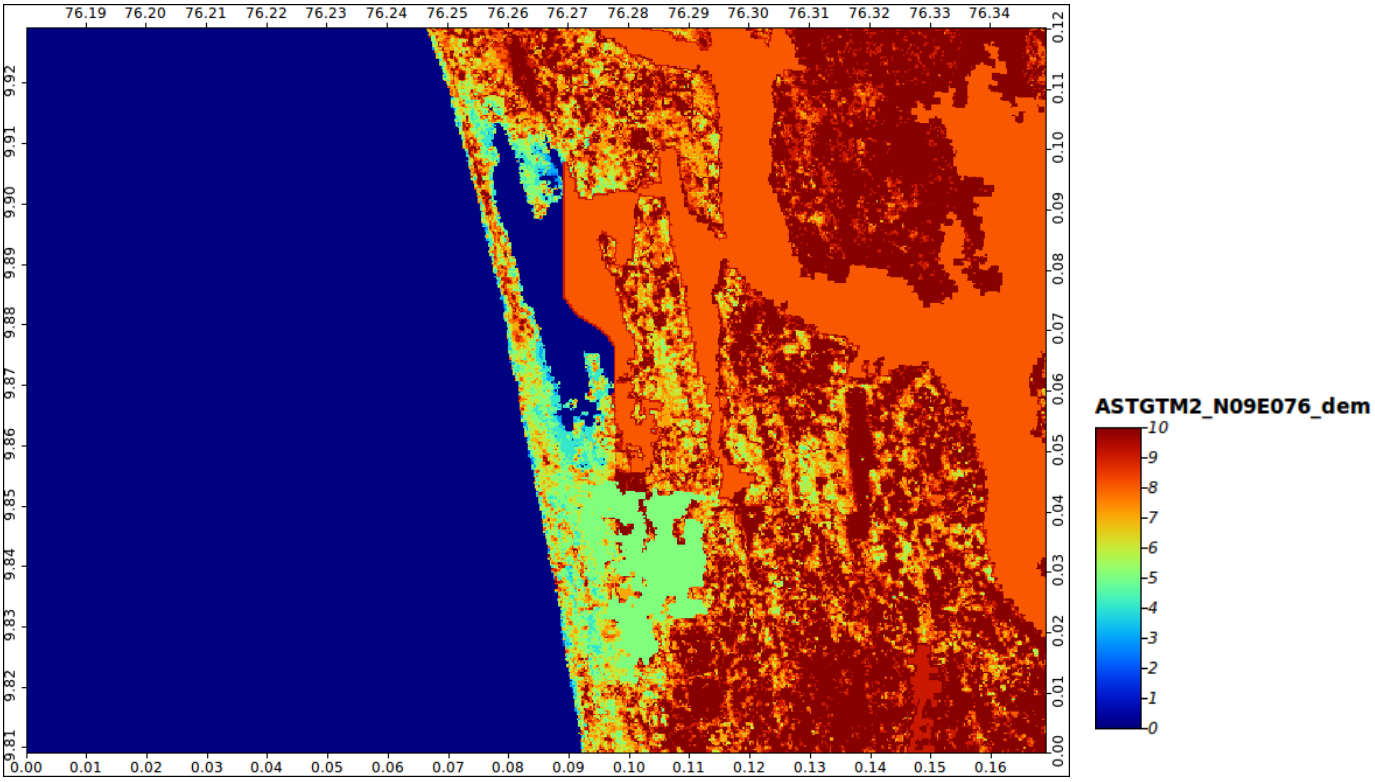


All maps below based on Aster 30 m resolution data (elevation 0- at least 10m)

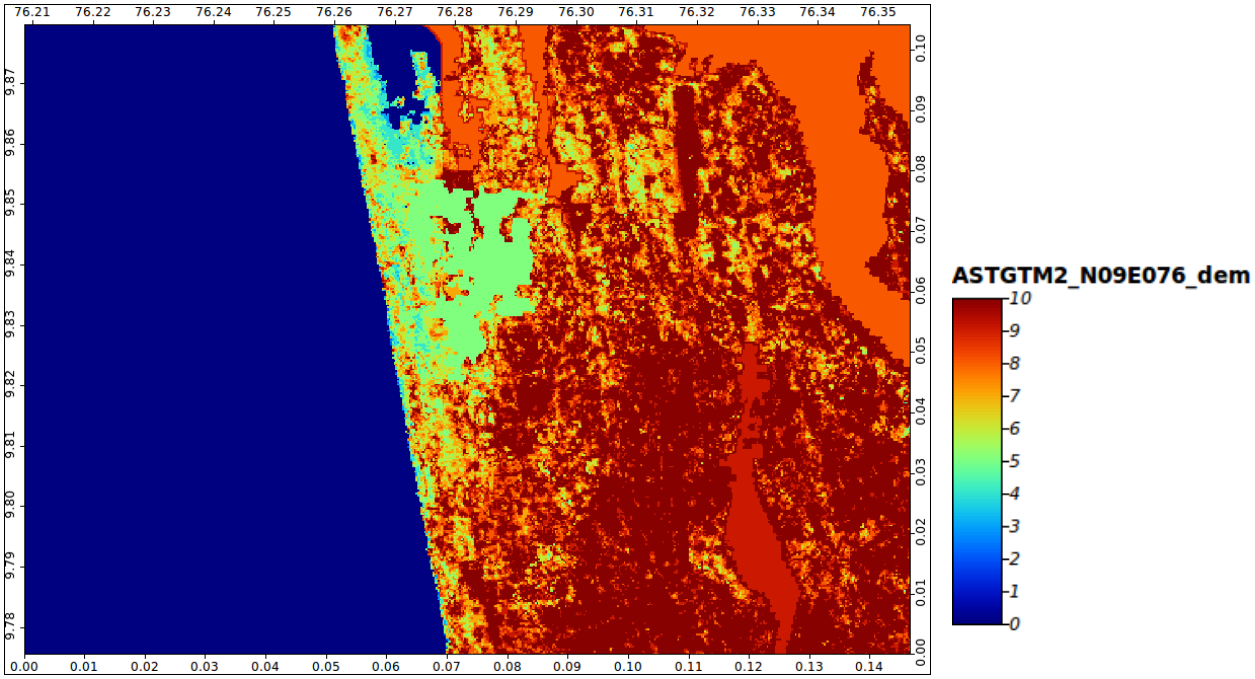
Area around Kochin



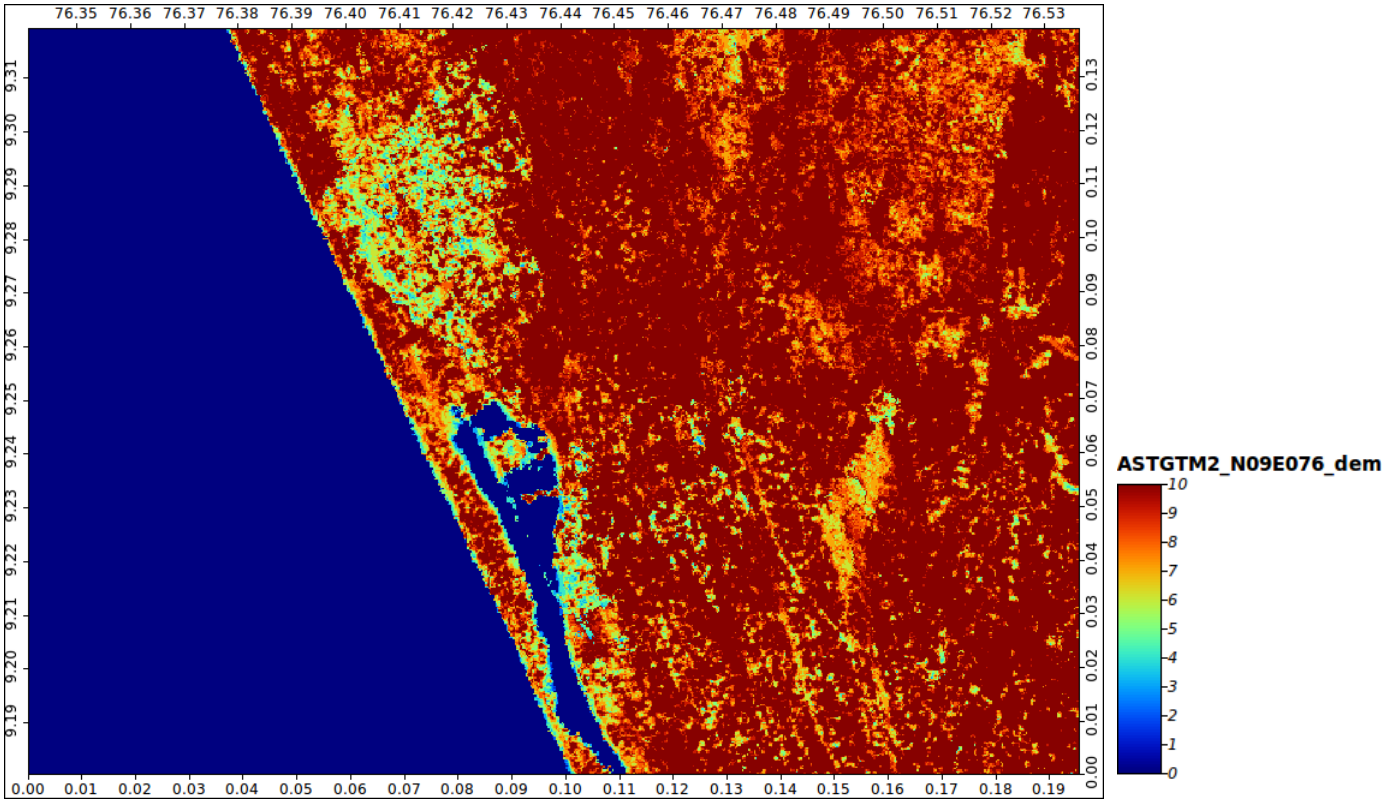
Chellanam

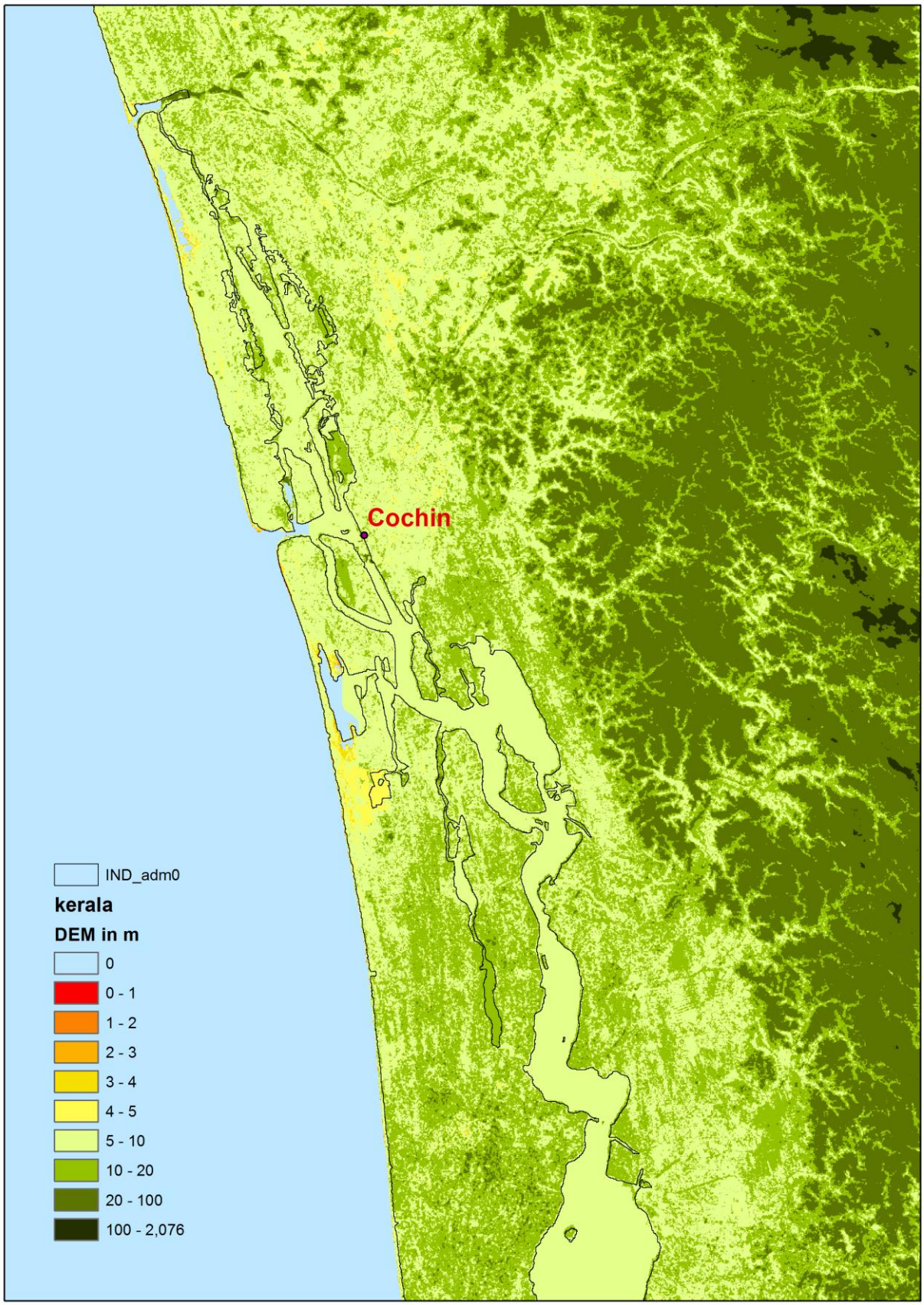


Chellanam South



Thrikkunnapuzha, Kuttikad, Pallana

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Conclusion/Discussion/Further research:

Further research needs to be done. As it is visible from the GIS image there would hardly be any area affected by a sea level rise of 1 m (conclusion only based on images. Reality might be different, as our exploratory field trip showed. Chellanam seems to be the most interesting area to focus on because many parts have an elevation of 2-4 m (lowest elevation along the coast).

It could be worthwhile as a next step to get finer DEM maps (15 m resolution) and to see if areas based on these maps might suffer from inundation because of future sea level rise.

From report above:

'*1) --> Looks like that the level of the backwaters is high during December season, but in the same period it is low at the coast??? (**This has to be verified**)*

2) To a large part the houses built were made of bricks/stone. In between there were small stripes with simpler houses/huts.

3) People seemed to be more affected by backwater rise than coast water (directly at the sea) rise. '

--> Side note on 1-3 could have something to do with the monsoon variability in wind and rainfall, the former driving ocean currents and the latter feeding the rivers?

- How much are the canals influenced in the backwaters by sea level (tides?) as opposed to the river outflow. If they are part of the river delta outflow, at some point from the shore, the sea level will not matter since we will be upstream (thus at higher altitude) in a river system. Question is, where? Or, are most of the backwater canals at sea level or not at all?

People with their simple houses and ocean front barriers, seem capable of adapting. Question: whether there is a limit to this; what are the main limitations; and at which rate and level of changes their capabilities will be put to the test.

Input from Dr Harenduprakash: Systematic data is missing on various basic aspects of the Vembanad Lake and the sea coast. Works and data are patchy and are in the custody of different departments. I don't think it is possible to study the whole region unless we ourselves collect, collate and augment the physical data, which is beyond the scope of the present project. Therefore we can confine ourselves to Kannamaly-Chellanam strip but go deeper into different aspects of the problem.

1. One metre rise of mean sea level is definitely going to have serious consequences. However the major effect(s) may not be the flooding of present day land areas brought about by the rise in the mean sea level.

The following comments are about the Kannamali-Chellanam strip where the height above water lavel is less than one metre in large stretches (as we saw during the visits).

2. One obvious area we have to look into is the impact of such rise on existing problems that the people face.

a. On the sea ward side it is the surface waves and their action on the coast (coastal erosion and sea water overflowing across sea walls, etc.).

b. On the eastern side (back water side) the major problem is aggravation of regular rise in sea level due to tides (and occasional rise due to rain and river inflow, release of water from dams). This already manifests as swelling up of ground water and also floods during the rainy season.

Already the population is complaining and concerned about these, as we had heard from them.

3. He believes, it will be of real significance if we concentrate only on this strip and only on these phenomena and estimate the socio-economic impacts.

4. As far as the physical aspects are concerned, we have to scientifically describe the environment and also its evolution during the last 50 (or 100 years). As of now the location specific information in our possession is qualitative. We have to make it as quantitative and accurate as possible. Perhaps we have to interview more people, look for insitu physical evidences or artifacts that may provide quantitative information. In addition to it we have to collect all accessible records and remote sensed data. This activity itself will be of use because as of now such systematic description is not available. These data should be made into a GIS data base.

5. We also have to project the expected sea level rise in terms of its impact on the two aspects mentioned in Para 2 above. The socio-economic study has to utilise the physical aspects as brought out in this scientific description.

6. A work of wider scope or covering a larger region is too difficult to carry out at present because basic data like bathymetry of the backwaters; tidal and seasonal variation of water level, etc. are presently not available to us.

7. He thinks the problem before us is well defined and doable and the work is of relevance and use.