The C5 Approach to Flood Probability Mapping

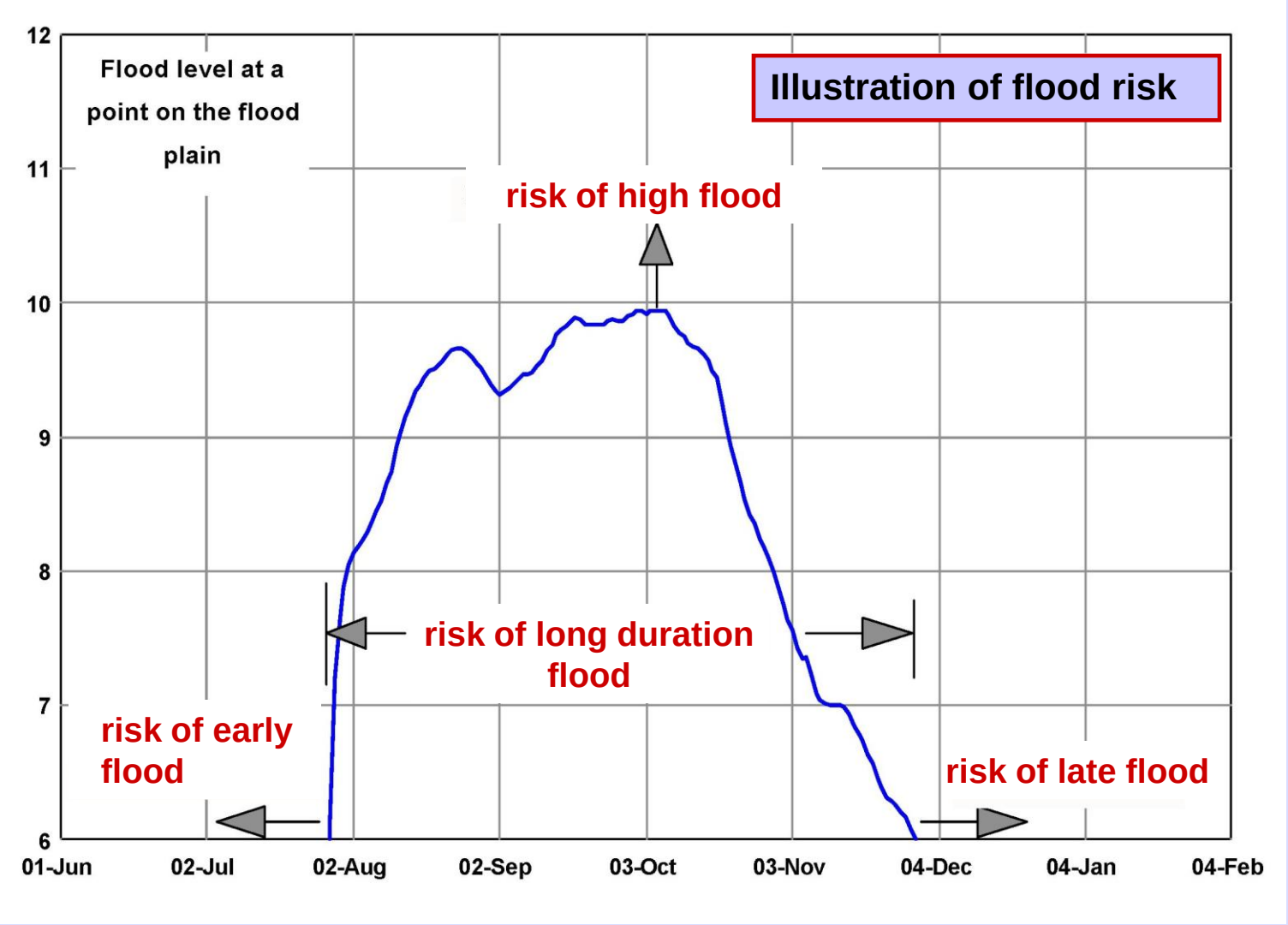
by

Dr. David Plinston

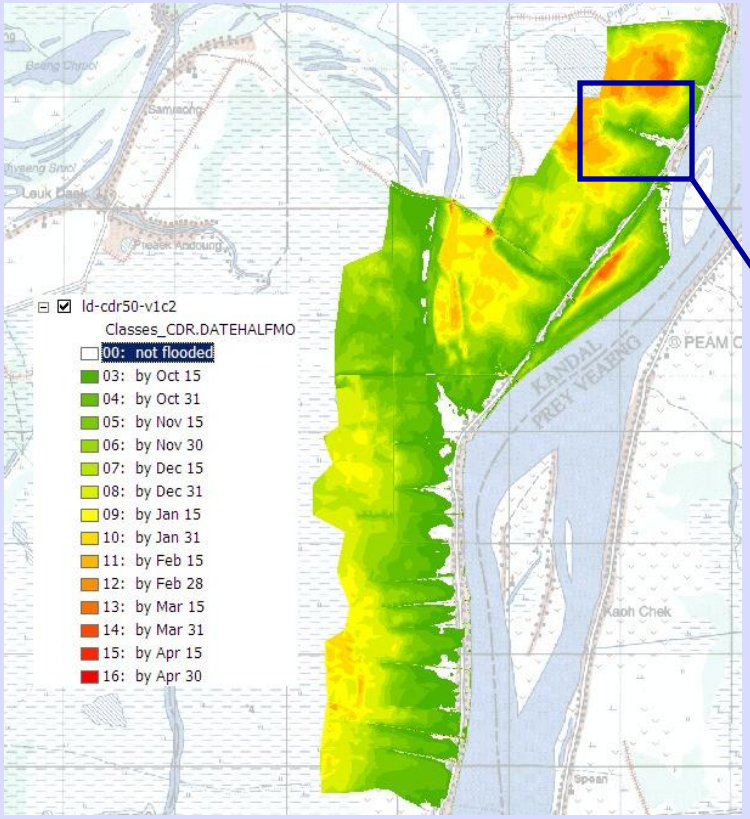
Consultant

MRC Flood Management and Mitigation Programme (FMMP)
Land Management Component (C5)
Regional Flood Management & Mitigation Centre (RFMMC)
Phnom Penh/ Cambodia

Identifying the different risks of flooding

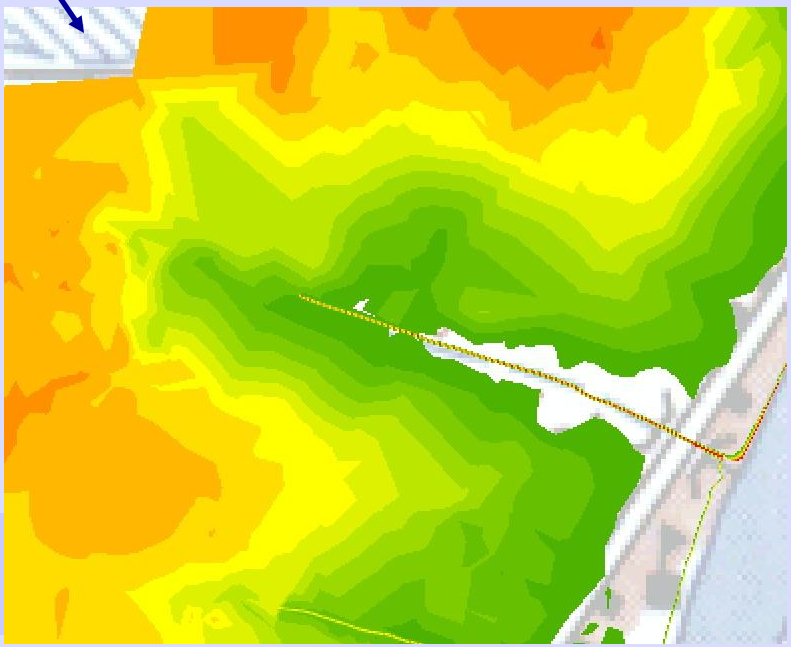


What kind of maps do we want to produce ?



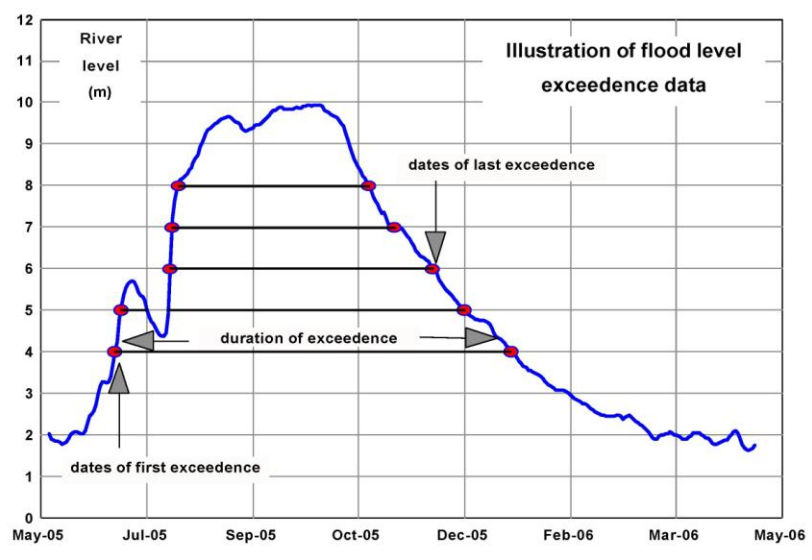
Maps for any selected probability of exceedence

Probability of flooding
Maximum depth of flooding
Start of flooding
Completion of draining
Duration of flooding risk

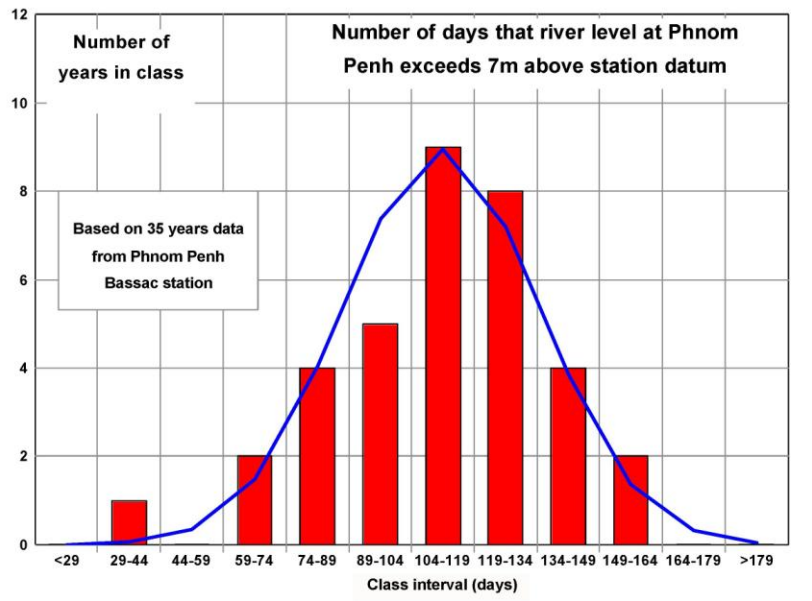


Maps that can be enlarged to 1:10,000 scale to show greater detail

C5 approach: Describing the river statistics



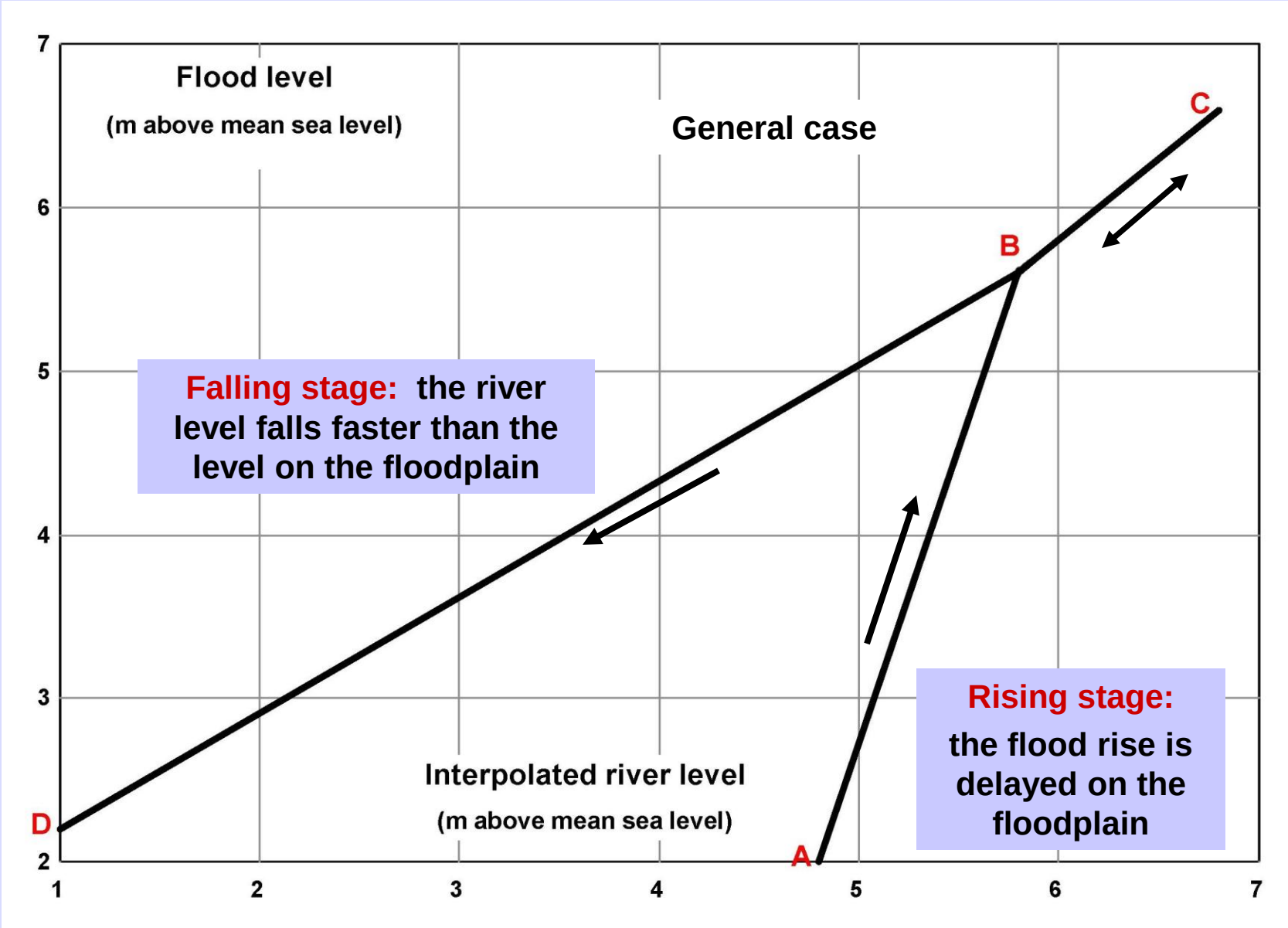
Extract data for flood magnitude, timing and duration from historical flood records at relevant river stations



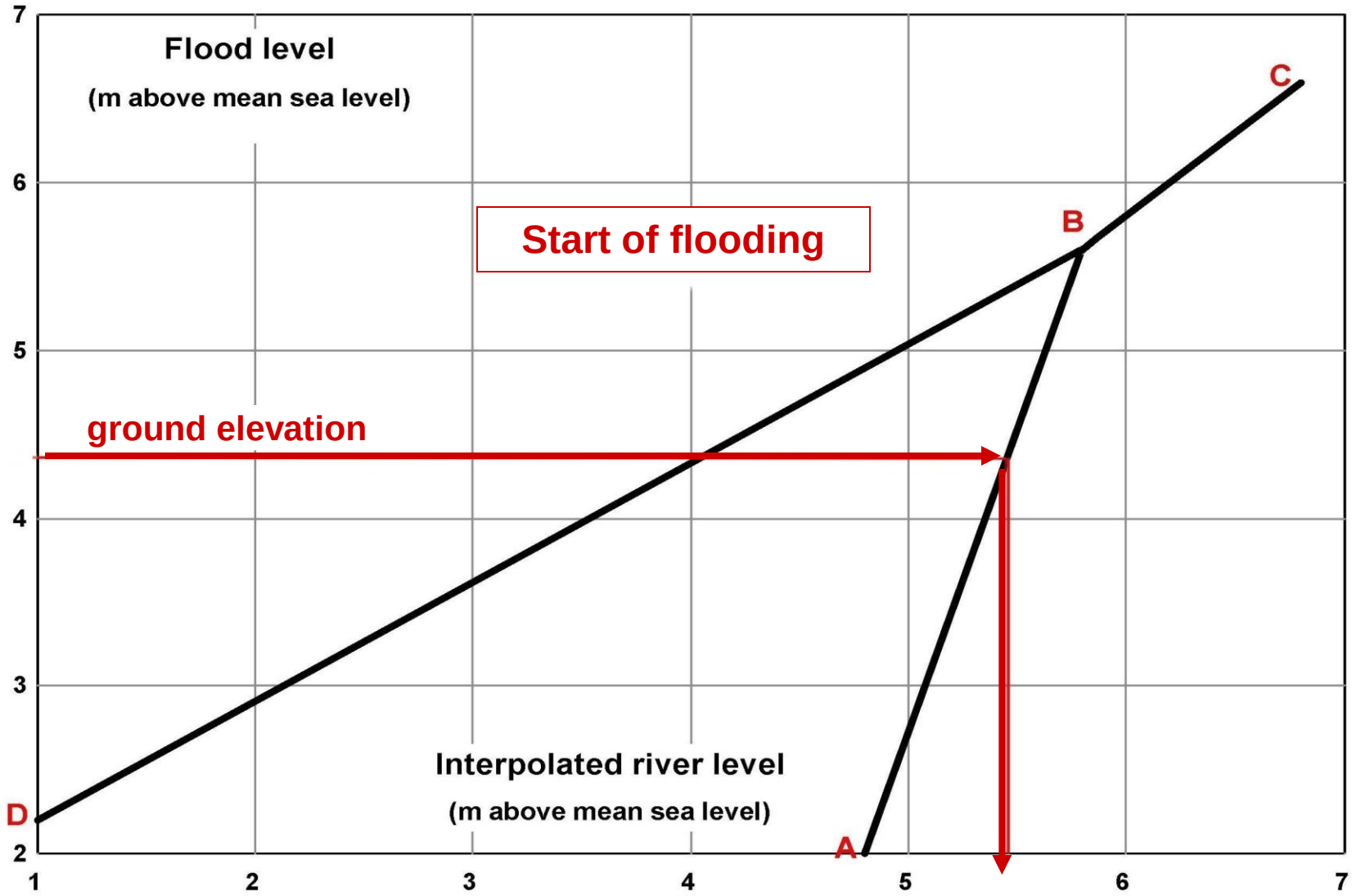
Use standard statistical methods to define parameters that describe the probability distributions

Thus, for any probability of interest, we can compute the magnitude, timing or duration of a river flood

C5 approach: Correlating floods in the river and on the floodplain

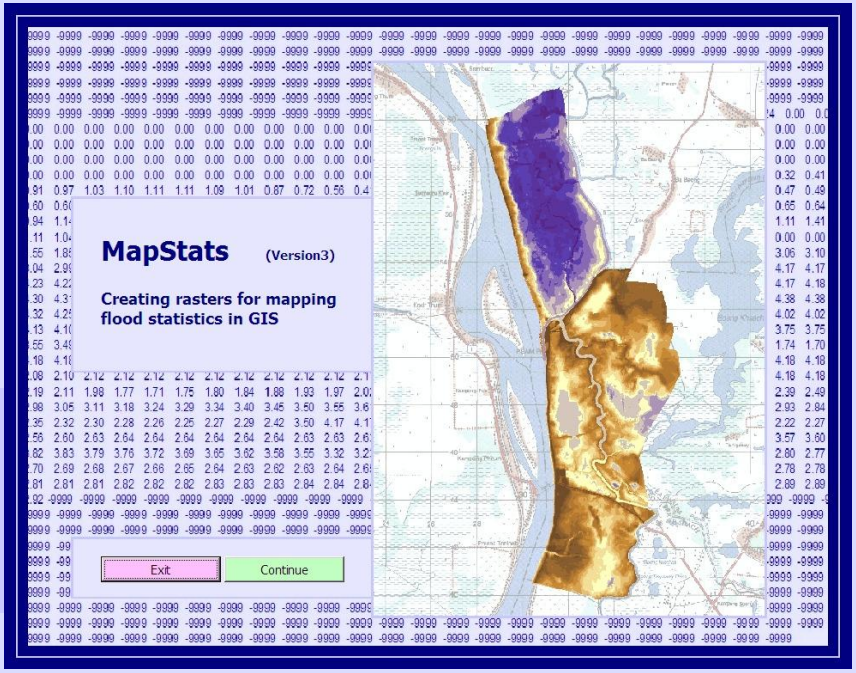


C5 approach: Use of the correlation model



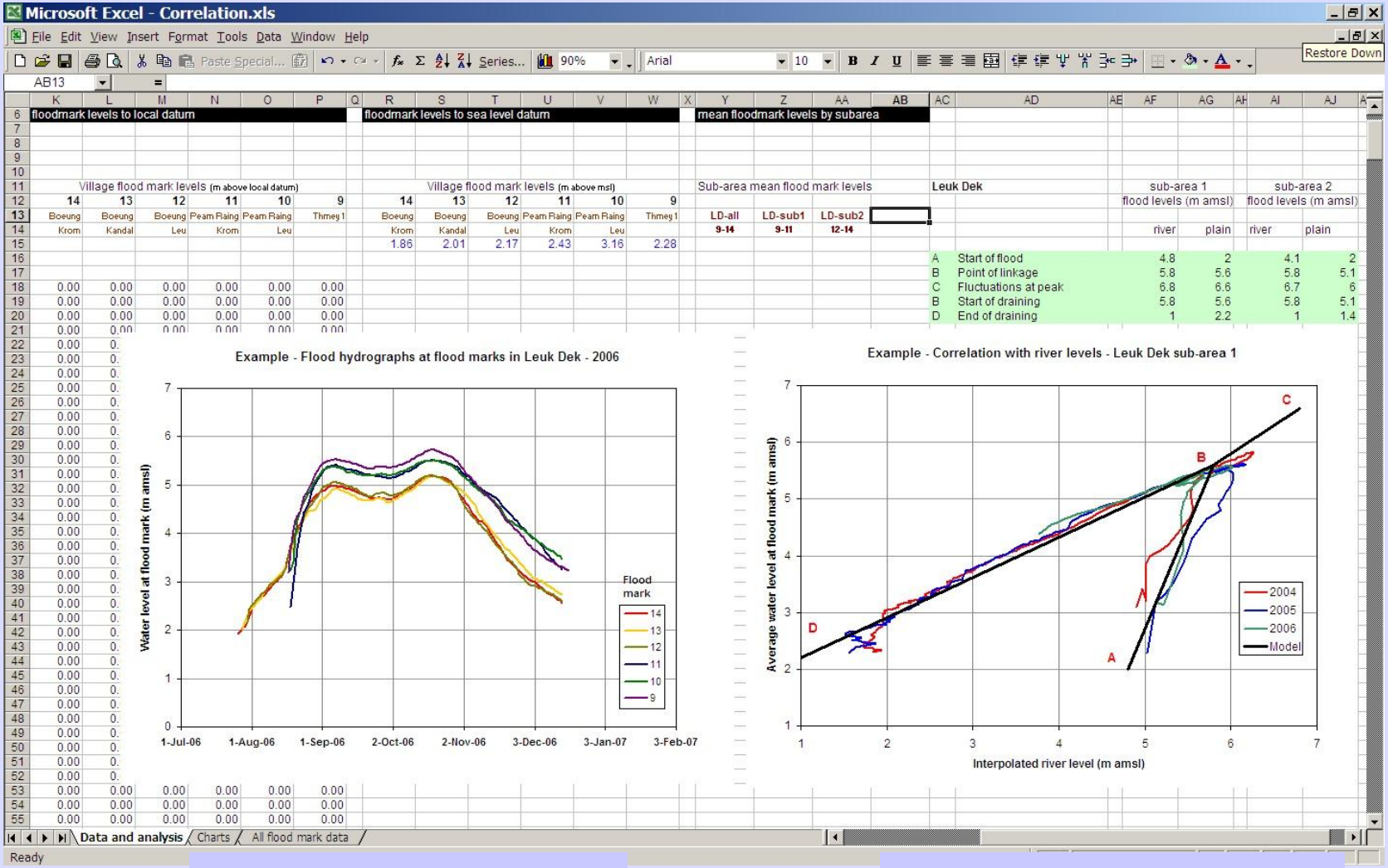
C5 software - programs

MainStem is the program used for statistical analysis of the river data



MapStats uses correlation information, the DTM, and the statistical information for the river to make the digital raster files for the flood probability maps

C5 software – automated worksheets



Review and comparison of flood level data

Defining the correlation with river levels

C5 approach: Using ArcGIS to display digital FP maps

Digital file from MapStats

File Edit Format View Help

```
ncols        2151
nrows        2083
xllcorner    510579.49415825
yllcorner    1153663.7526998
cellsize     5
NODATA_value -9999
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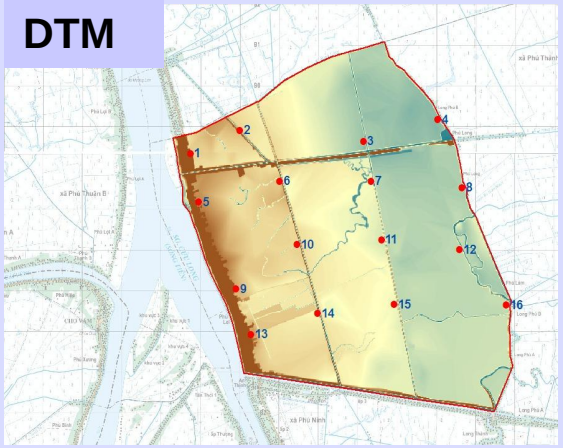
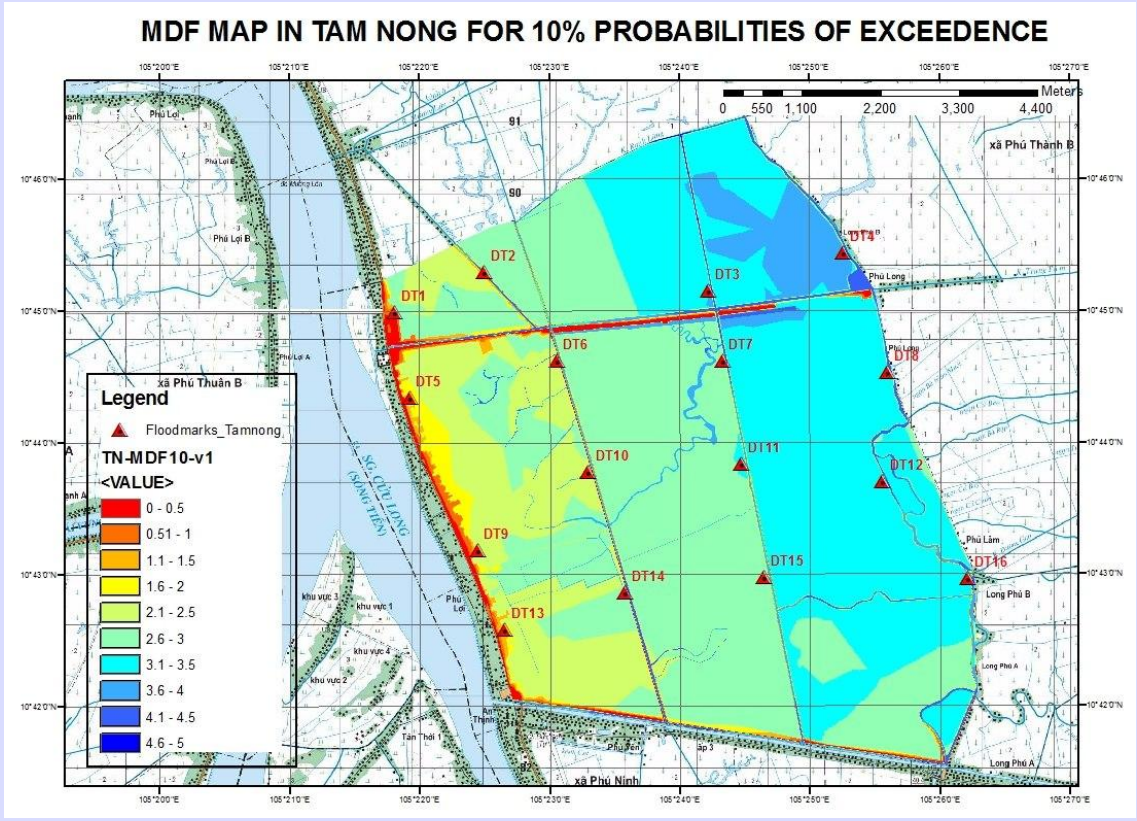
ArcGIS software

DTM





C5: Training

Three 2-week training courses to participants from the 4 member countries in MainStem / MapStats and ArcGIS applications

Including training on the use of FPMs to help solve land management and other questions

Benefits and constraints of different approaches for statistical mapping

C5 Approach	Hydraulic modelling
Can model an area (or any part of an area) of any size	Needs to model the whole of a continuous flooded area and needs a DTM for the whole area
Needs floodmark data only for the selected area	Needs a wide network of flood marks for calibration
Works directly from statistical data	More difficult to express the results in probability terms
Must be recalibrated if there is a significant change in infrastructure that affects the movement of floodwater	Can model the impact of changes in landscape and infrastructure

Where can the C5 approach be used ?

- ✔ Areas that are flooded regularly, primarily from a major river
- ✔ Where the floodwaters remain connected to the river system throughout the period of flooding and draining
- ✔ Where the river flooding is seasonal and predictable

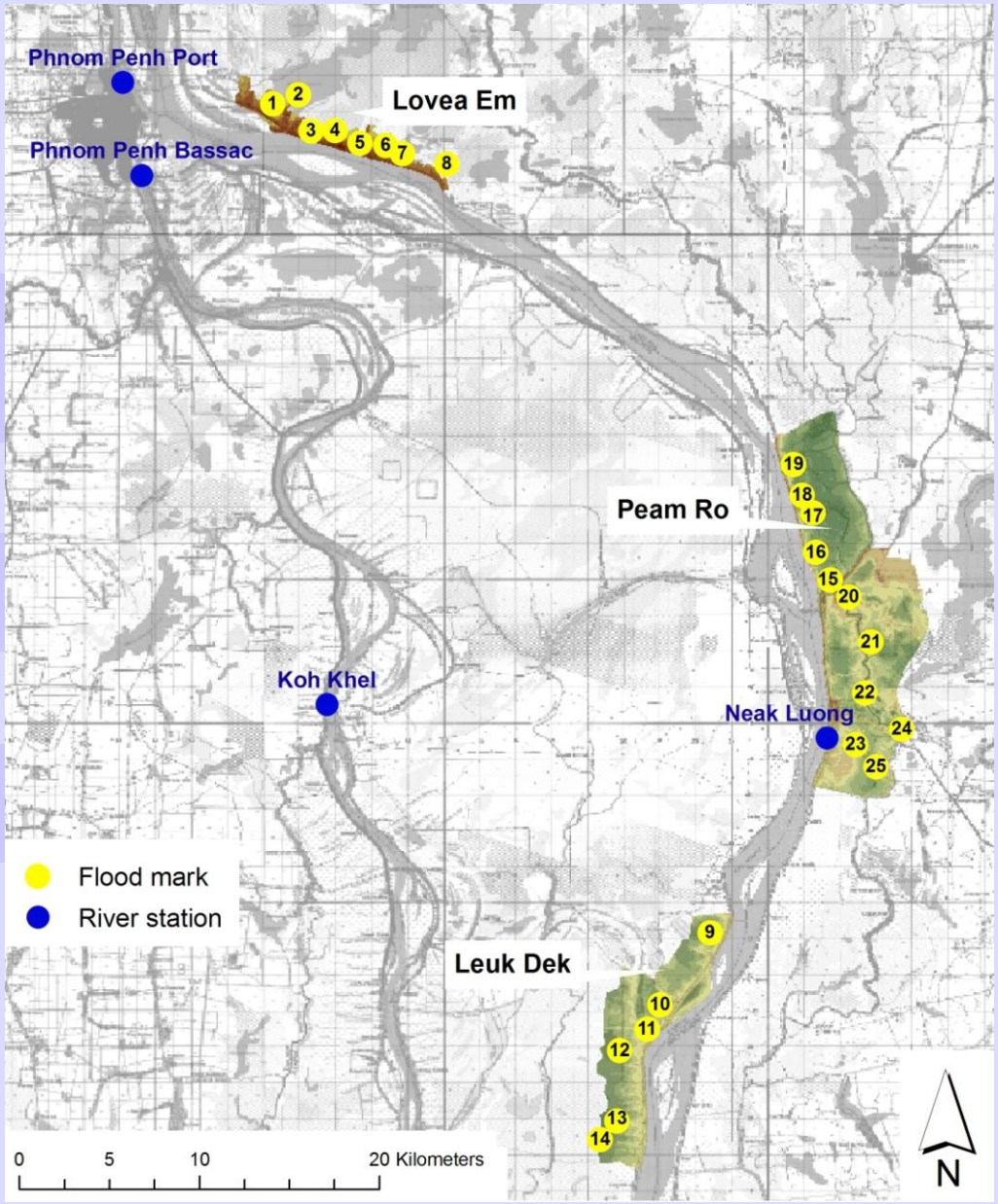
- Areas affected by occasional flooding (eg short tributary floods)
- Areas where water management practices control flooding extent, frequency or depth
- Areas downstream of significant reservoirs that have the capacity for flood control storage

Cambodia: The C5 pilot areas

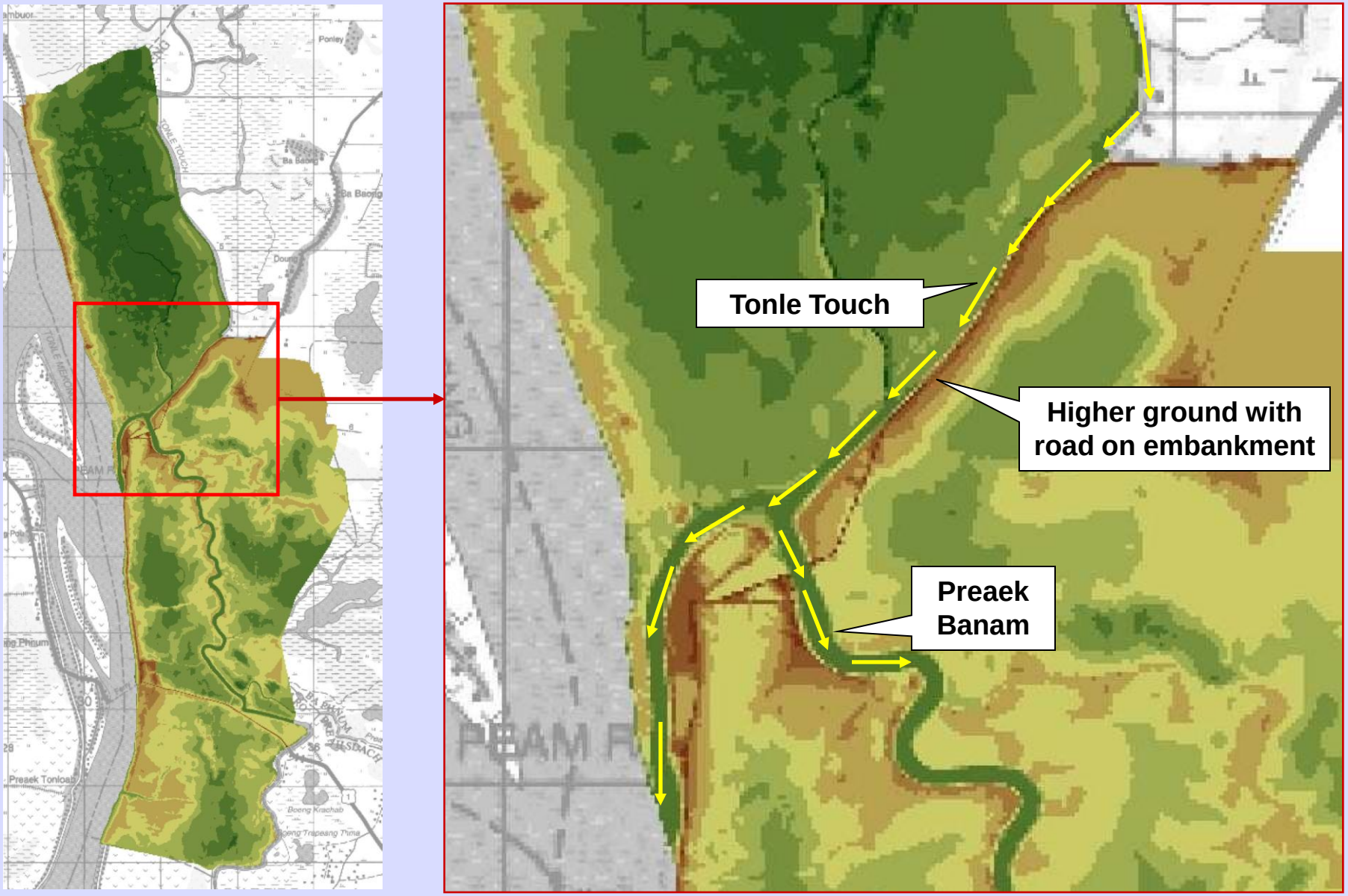
Floodmarks existing for 2003-06 (USAID – OFDA) operated through DHRW

DTMs with 5m cell-size from ground survey (C5 project)

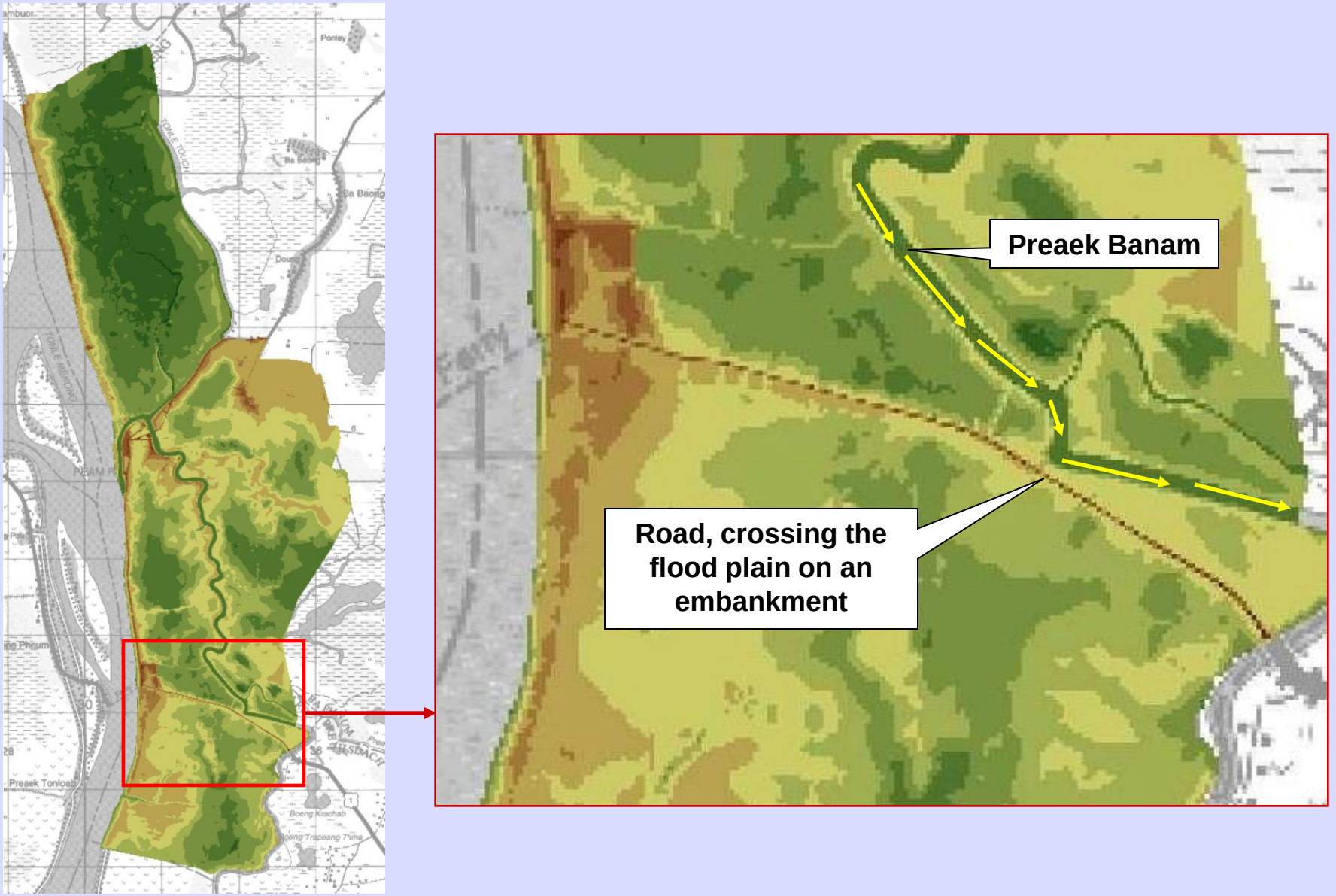
Daily river level from 1960 from the MRC database



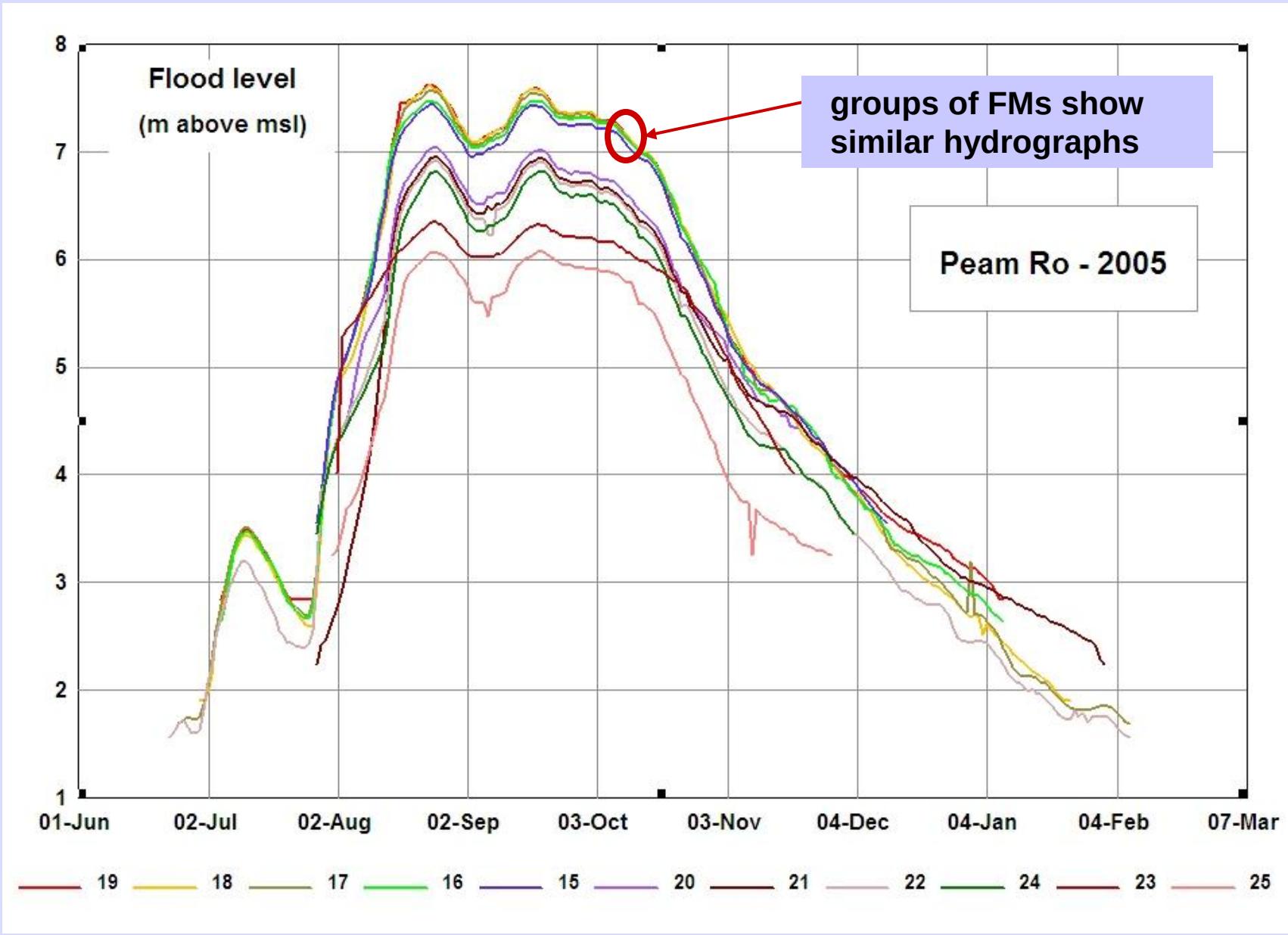
Factors affecting the movement of floodwaters



Factors affecting the movement of floodwaters

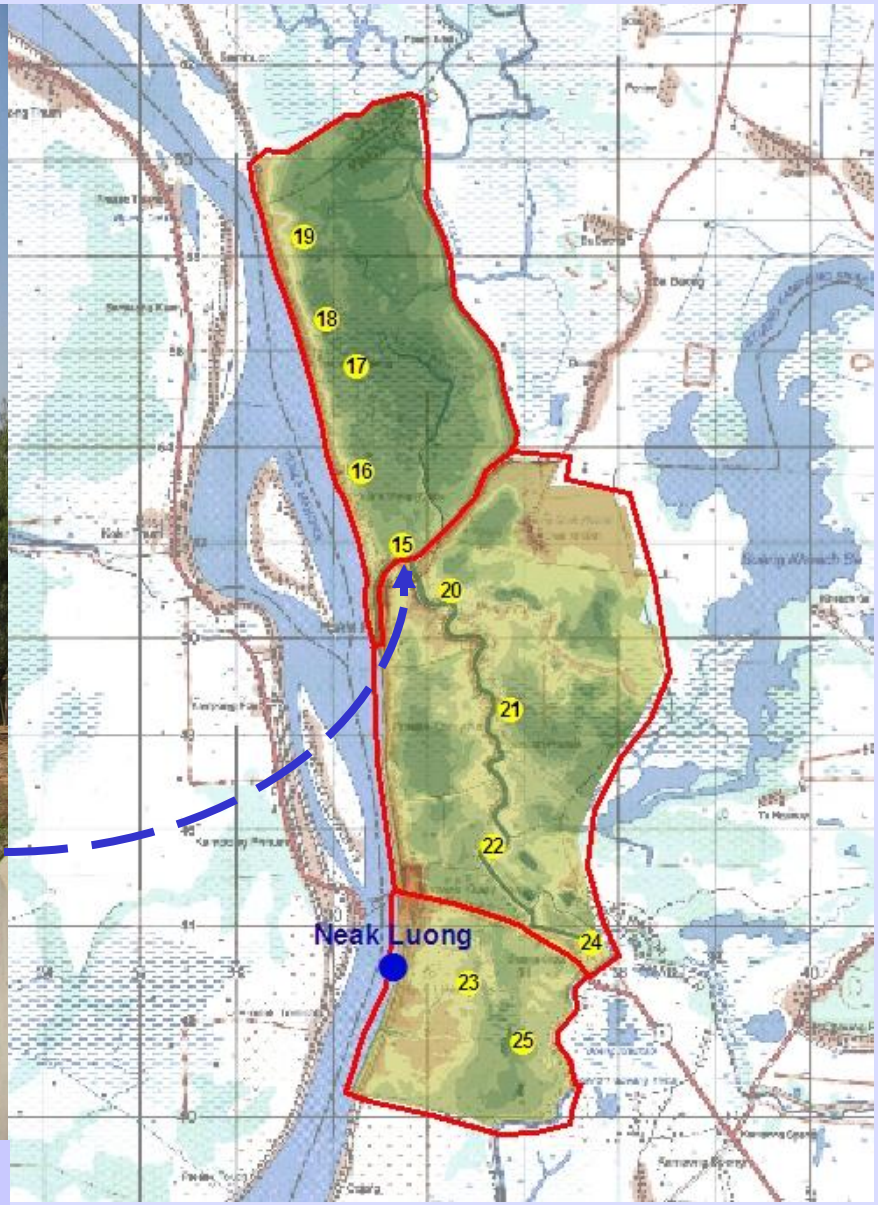


Data from floodmarks – Peam Ro



Peam Ro – Subareas

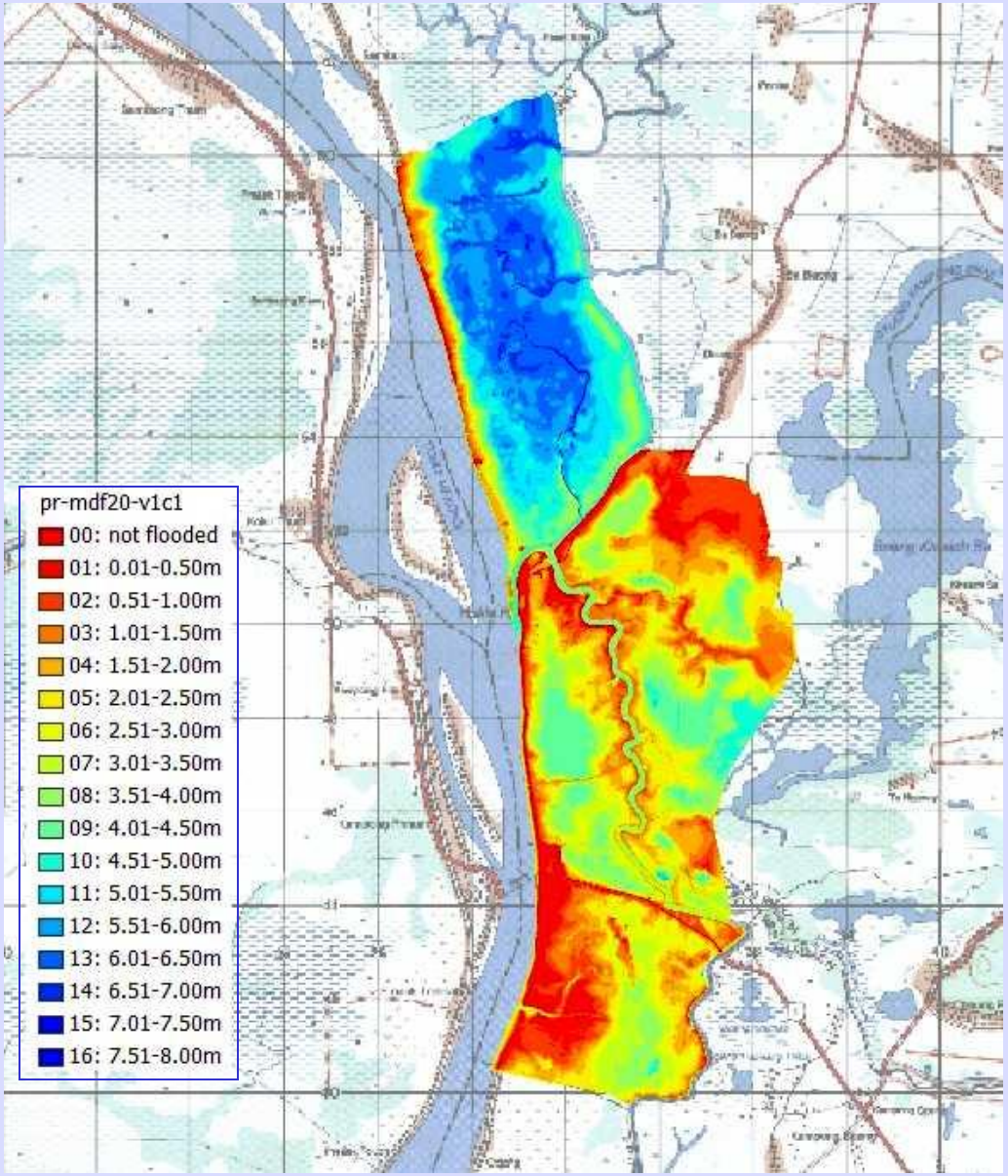
Junction of Tonle Touch and Preaek Banam



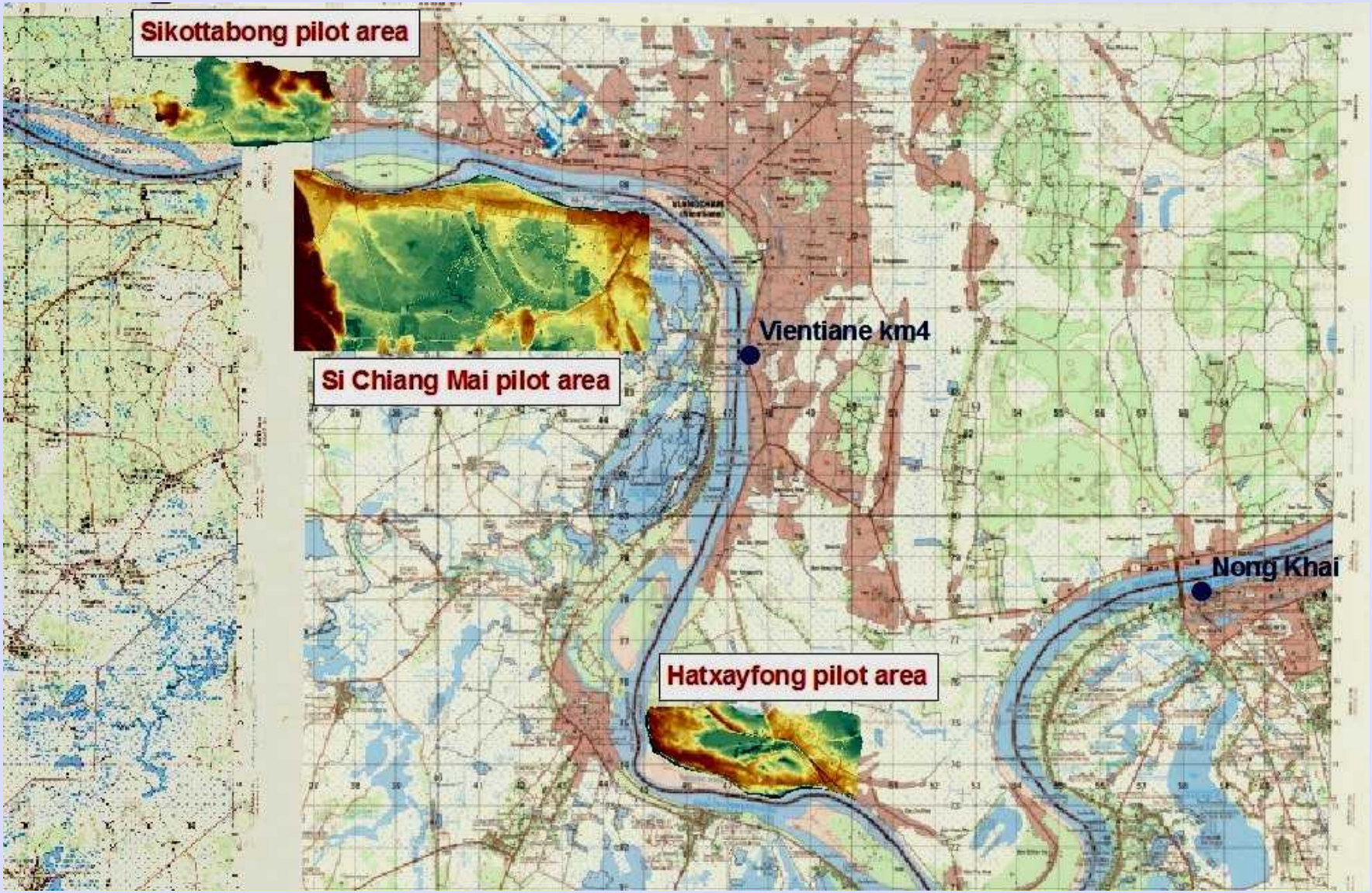
Peam Ro – Maximum depth of flooding at 20% probability of exceedence

Correlation models can be defined for each subarea

MapStats combines these with the DTM and the river statistics to produce a single, consistent, map for the whole pilot area



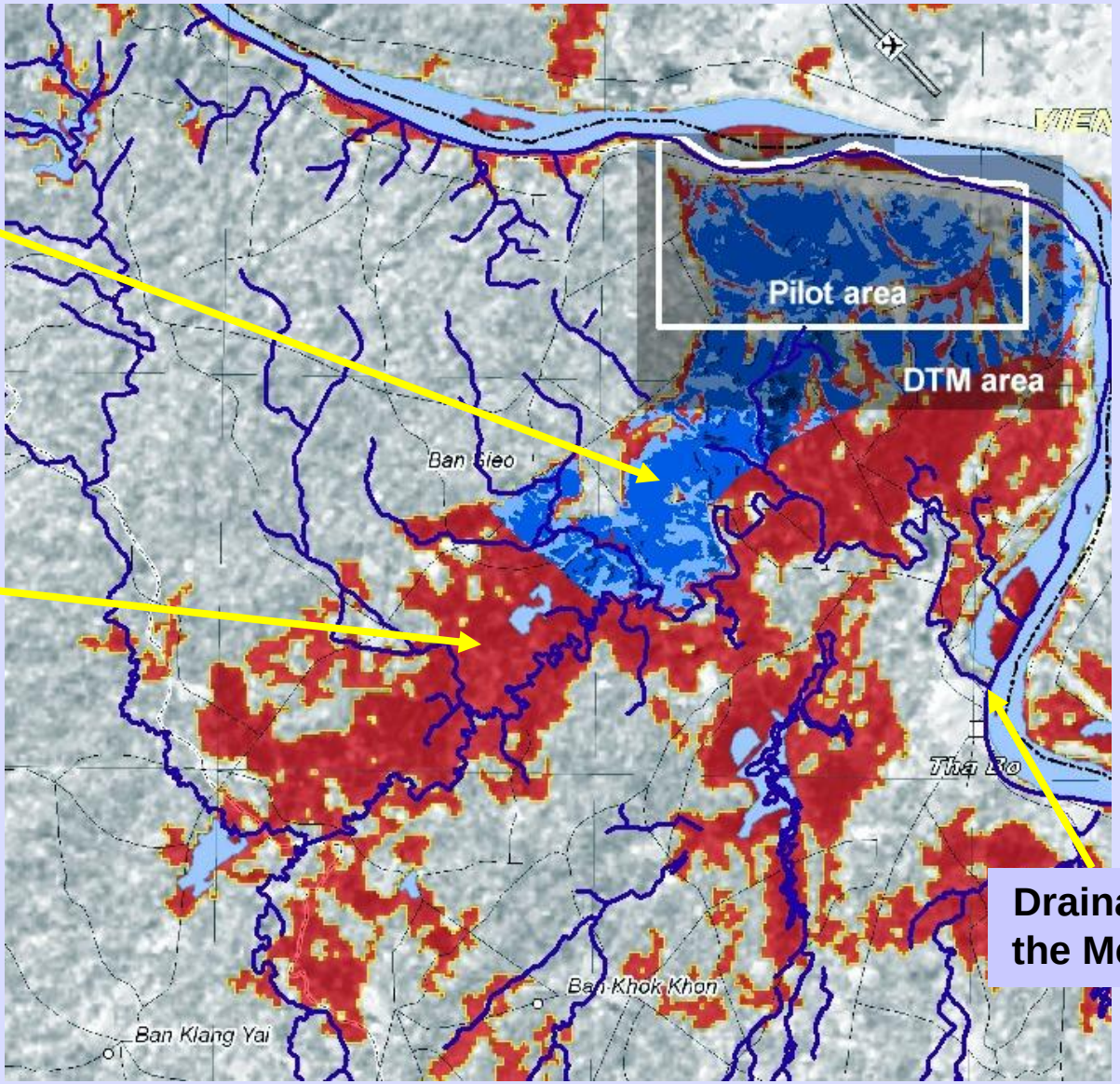
Lao PDR and Thailand: Location of the pilot areas



Flood extent in Si Chiang Mai district 2008

In blue: detailed satellite flood extent data for the four week period of the flood in August 2008

In red: Flood extent from the ASAR VT image on 20 Aug 2008



Drainage to the Mekong

Why is the C5 approach inappropriate in Si Chiang Mai ?

When over-bank flooding ceases, the flooding level in the pilot area is no longer related to Mekong river level and a correlation model cannot be used effectively

The statistical description of river floods in the Mekong is not stable because levees are continually raised around Vientiane and other major urban areas

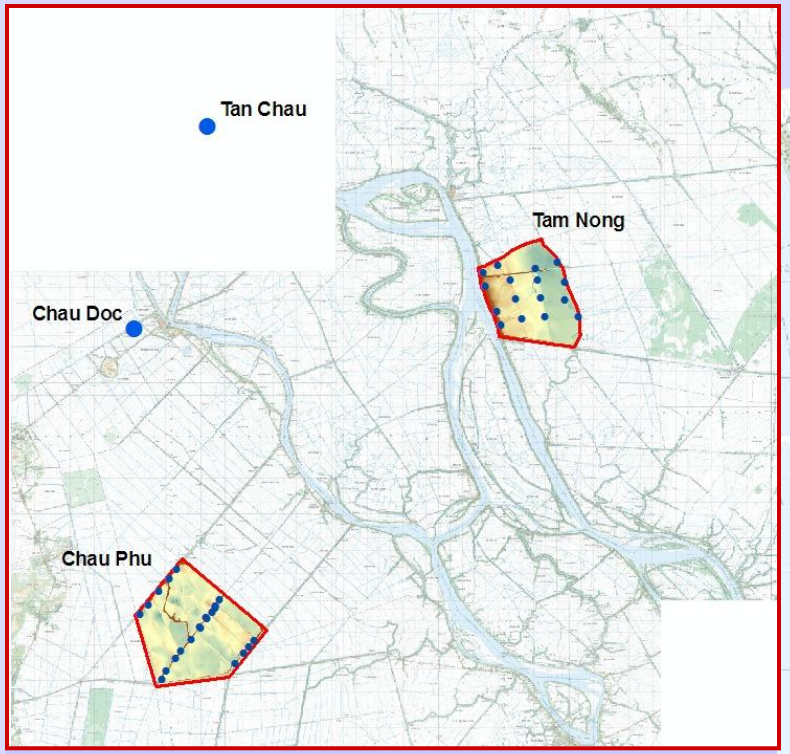
It is not possible to analyse the flooding in a small pilot area in isolation

Flood events of this kind are not a frequent or regular occurrence

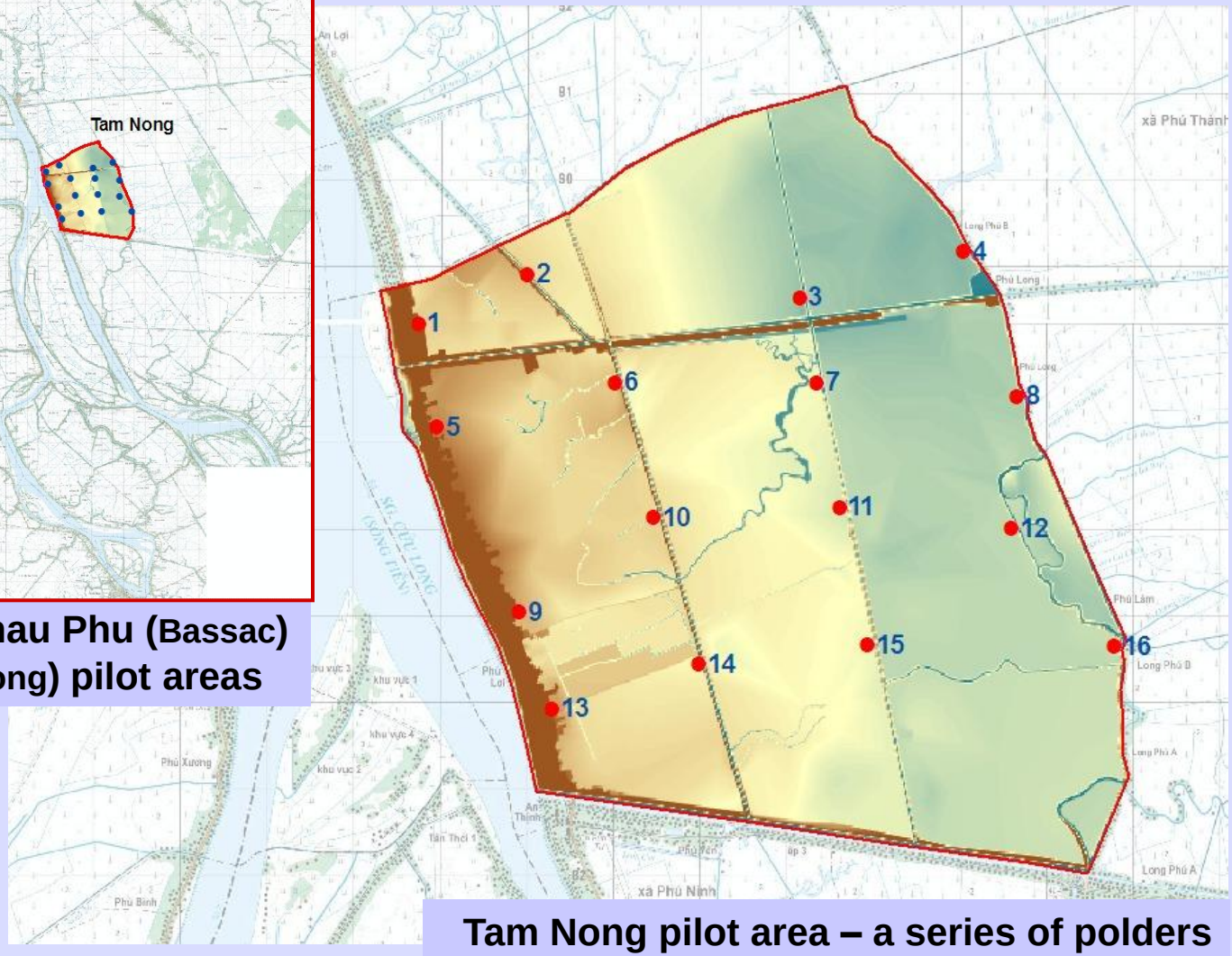
The volume of over-bank flooding is difficult to estimate accurately

✔ A hydraulic model could be used to carry out a ‘flood event’ analysis to provide information for land-use and infrastructure planning. The network of floodmarks should extend over the whole flooded area for model-building and calibration

Vietnam: Location of the pilot areas



Location map for Chau Phu (Bassac) and Tam Nong (Mekong) pilot areas



Tam Nong pilot area – a series of polders defined by the river and canal system

Direct linkage between river/canals and flooded areas

As the polders are linked directly to the river / canal system, we expect to see a direct correlation between river level and flood level on the fields

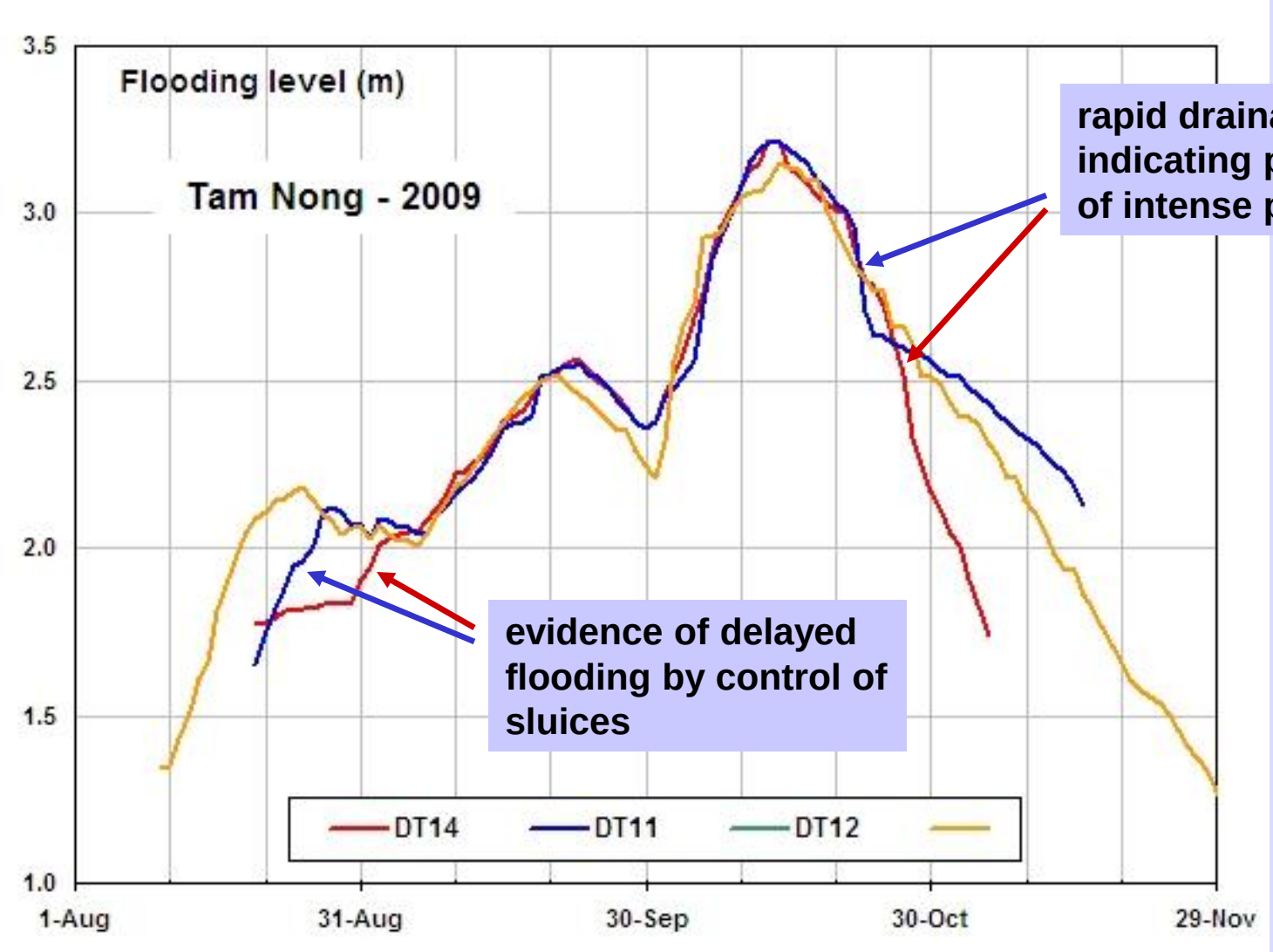
Water management practices in Tam Nong

Flooding of the polders can be delayed by control of sluices

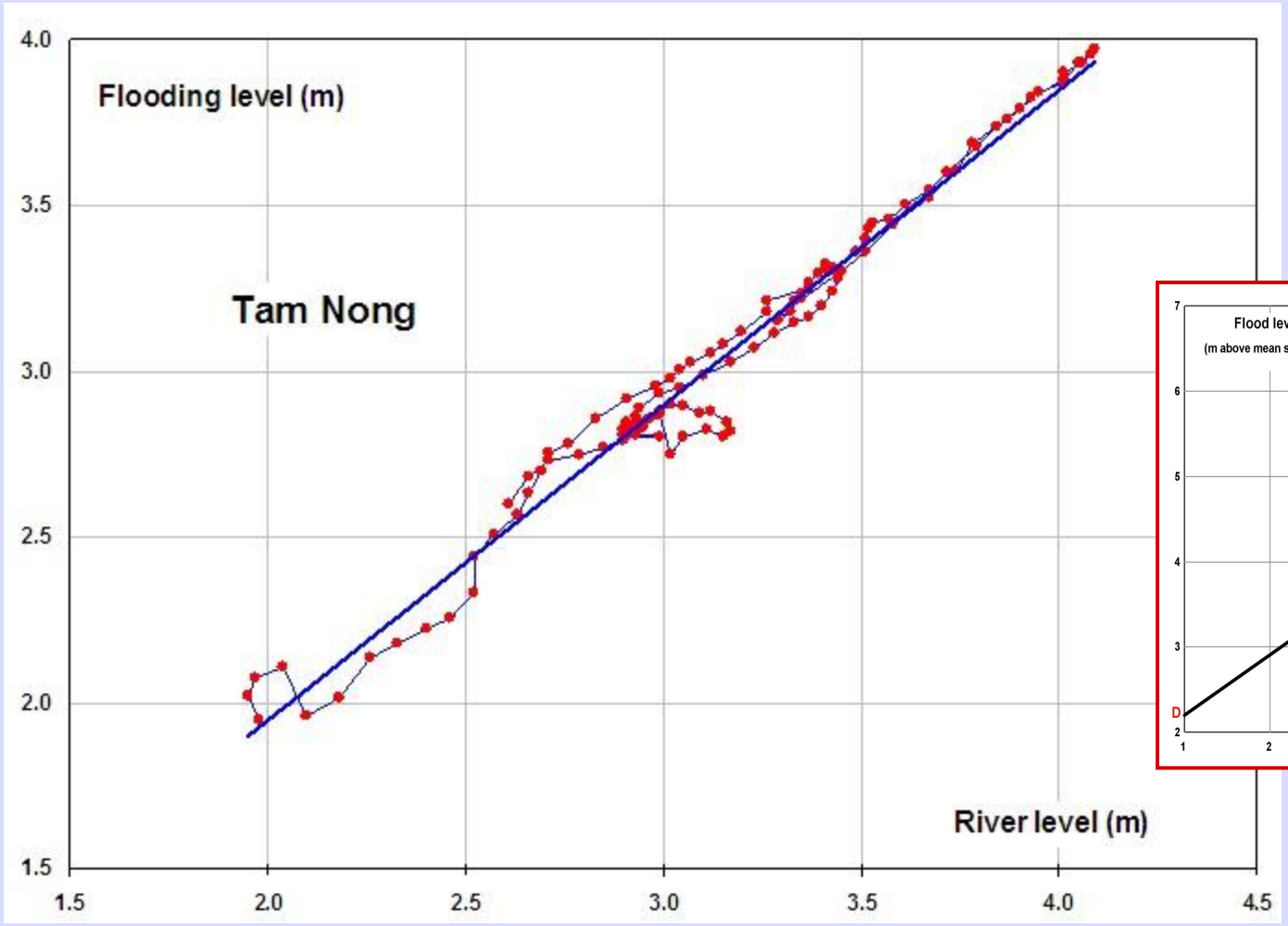
and

draining of the polders can be brought forward by intensive pumping of floodwater into an adjacent canal

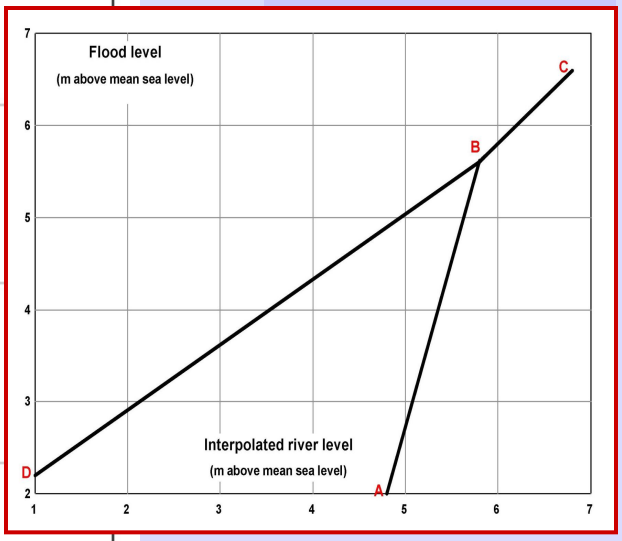
The effects of water management at the floodmarks



Correlation model for Tam Nong / Tan Chau



general model



2 days delay travel time between Tan Chau and Tam Nong

Summary of potential for the C5 approach

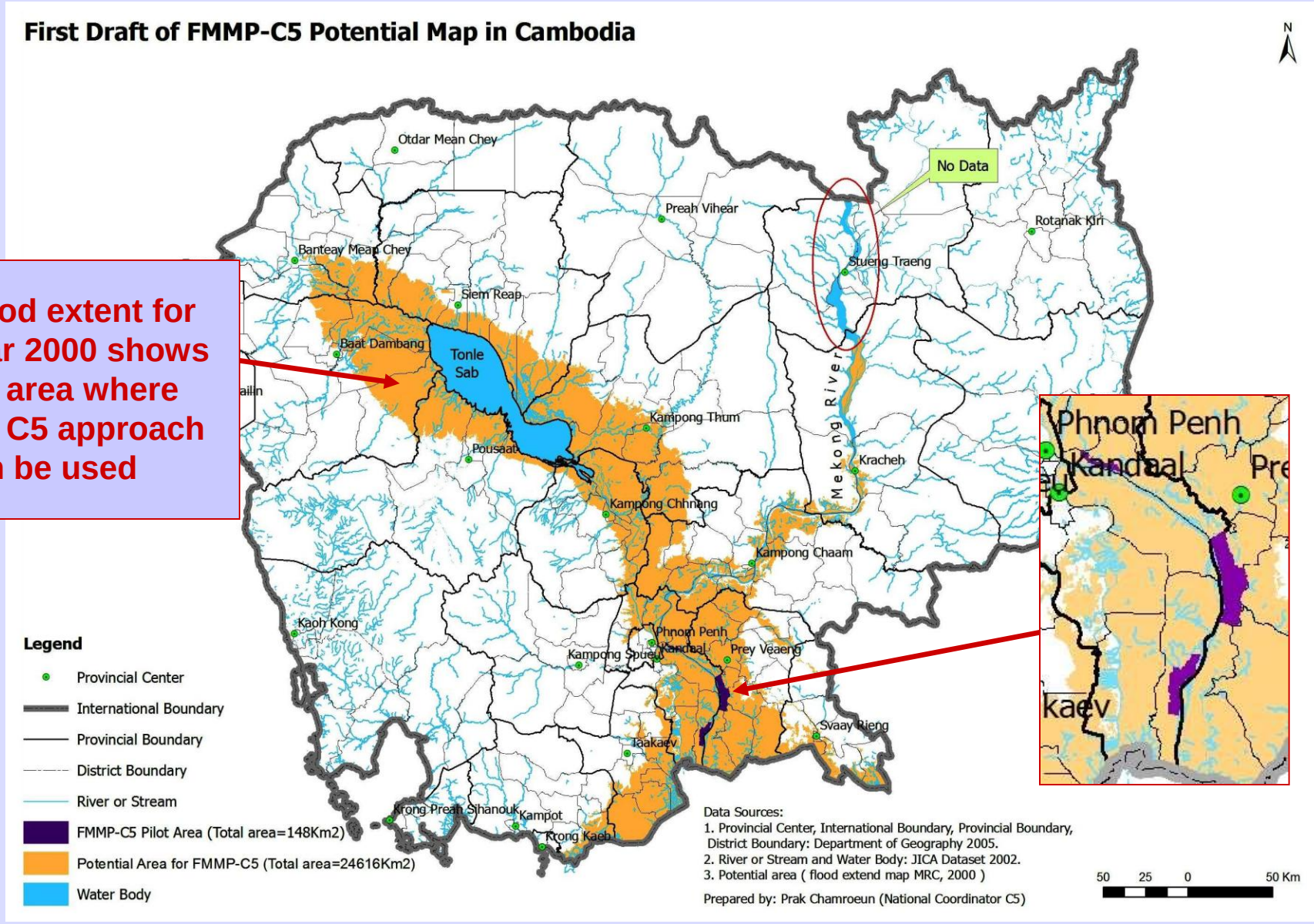
Laos / Thailand - development of flood event maps + location of possible areas where the C5 approach could apply

Cambodia - extend existing pilot areas and add new districts where flooding is a major component of land management

Vietnam - extension of coverage limited by importance of water management

Potential coverage of C5 approach in Cambodia

Flood extent for year 2000 shows the area where the C5 approach can be used



Adding a new district - reconnaissance

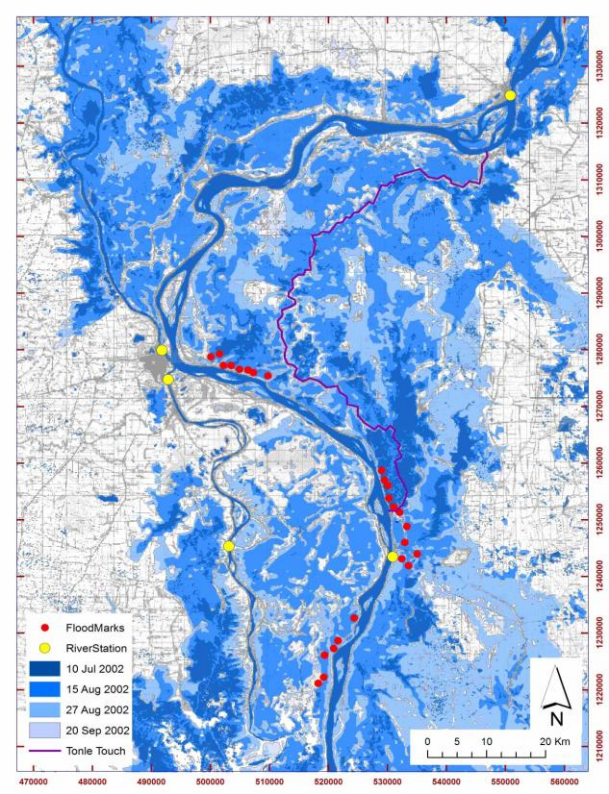
Visit the area during the flood season – discuss the flood behaviour with local representatives and farmers to get the benefit of local knowledge

Focus on points where there is a direct connection to the river, and where embankments or roads control the flow of floodwater

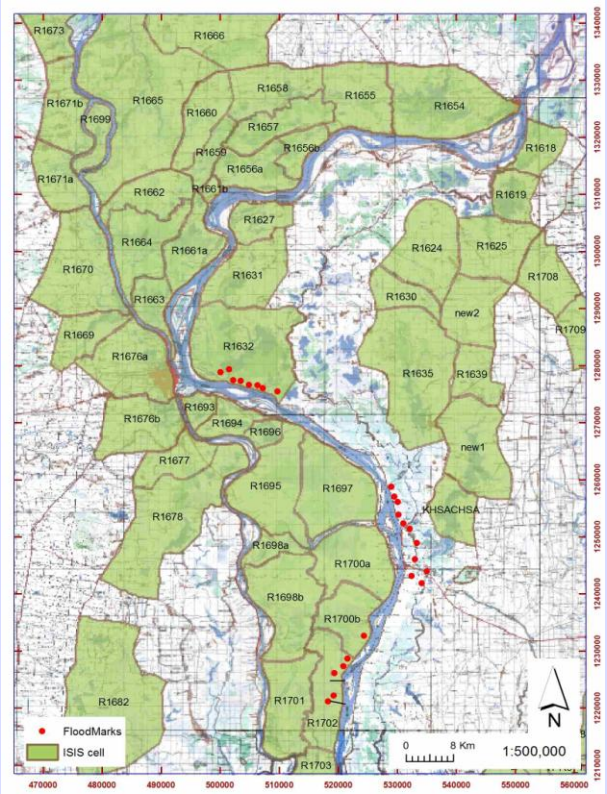
Adding a new district – collect information

Review all relevant existing data

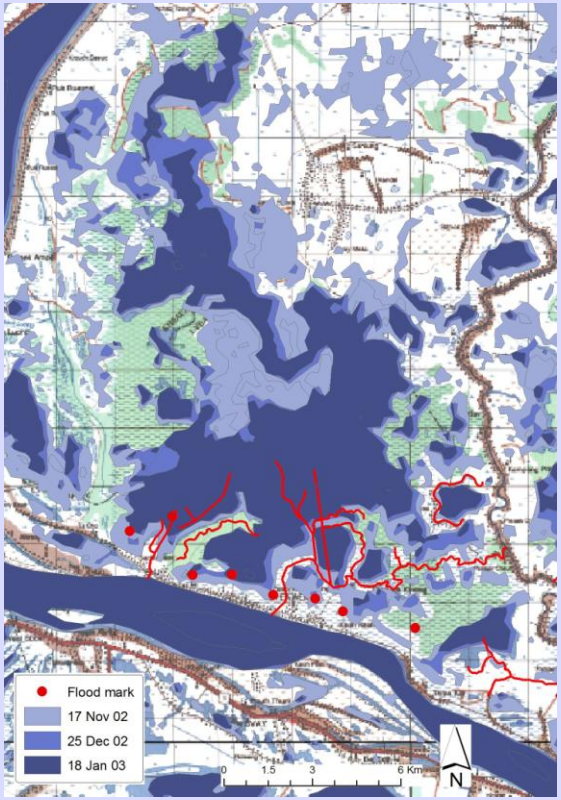
flood extent mapping



hydraulic modelling

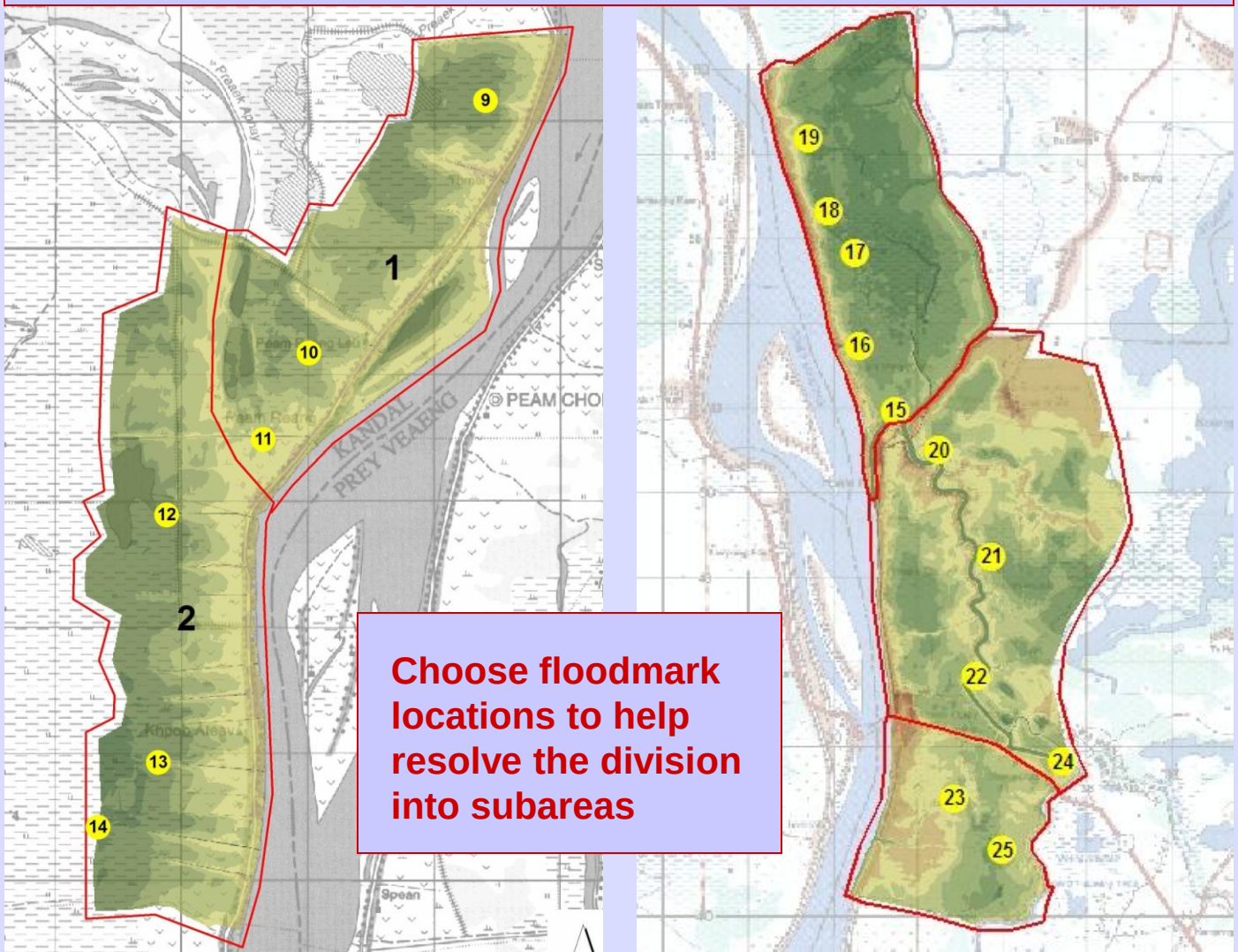


feature mapping



Adding a new district - planning

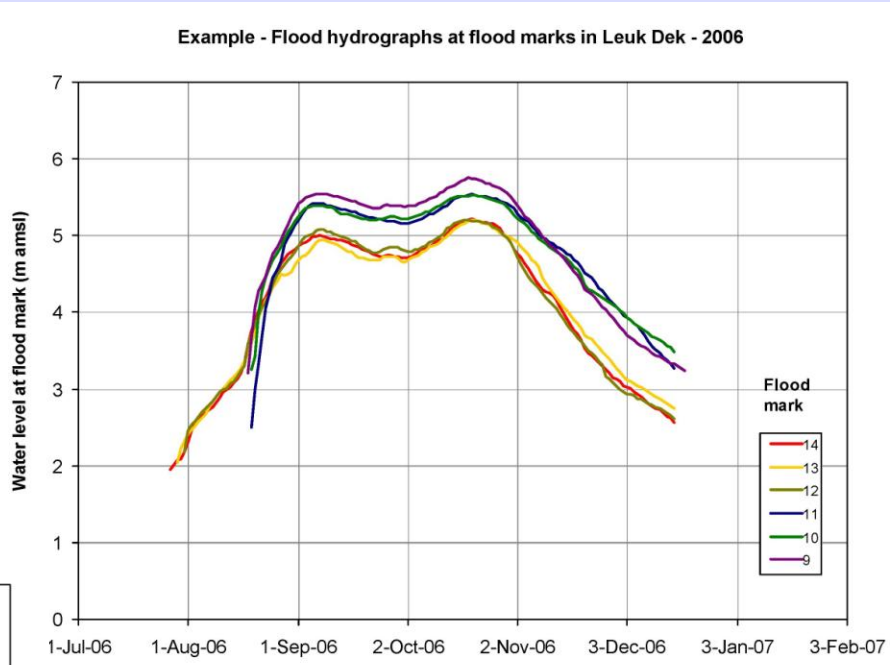
Try to identify ‘subareas’ that might behave differently because of topography, drainage or infrastructure

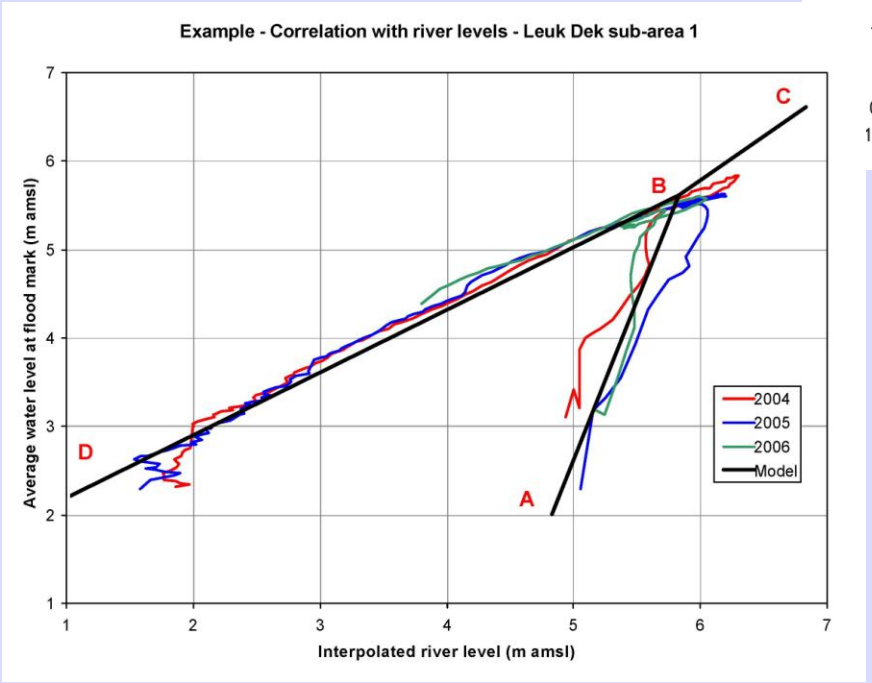


Choose floodmark locations to help resolve the division into subareas

Adding a new district - review

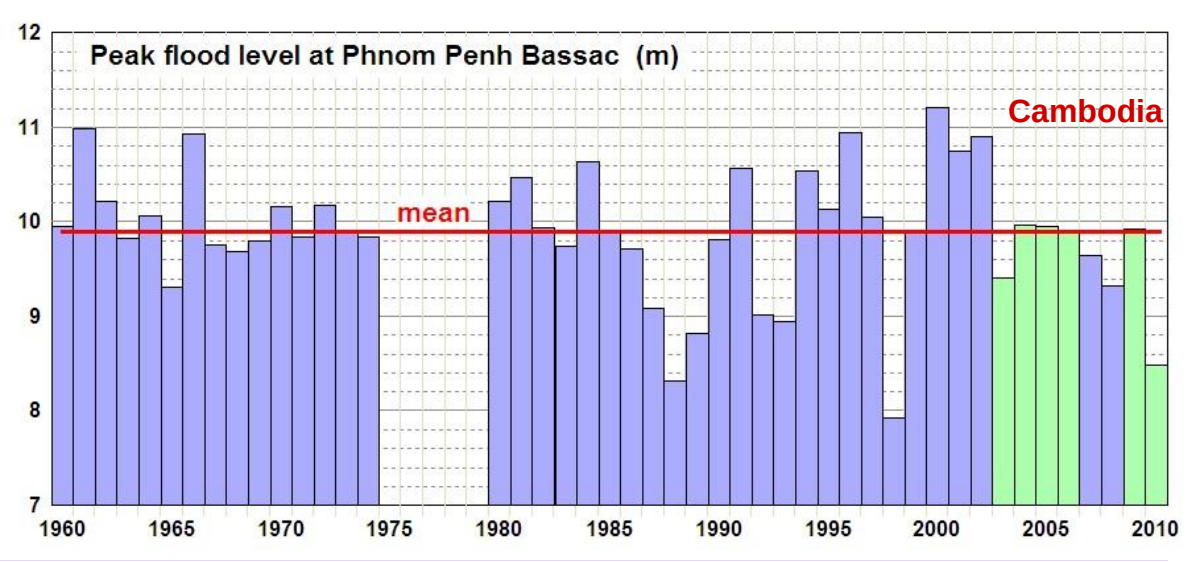
After the first flood season, review the data from the flood marks, make provisional correlations and a set of flood maps, and change the network if necessary

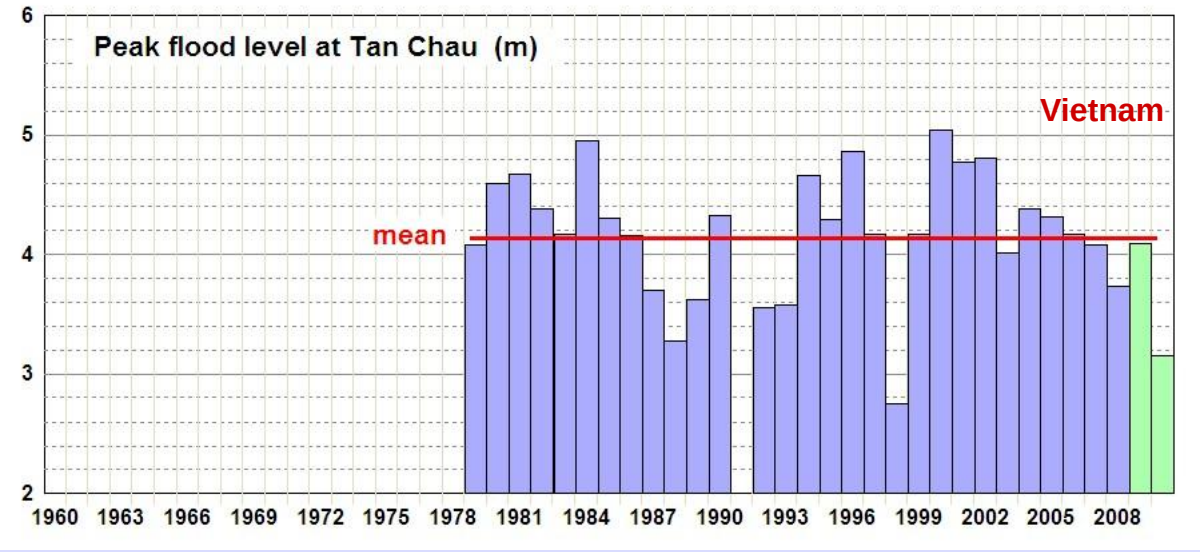




In the longer term, the FM network can be reduced to a sustainable minimum

A strategic networks of floodmarks should be maintained





None of the data used to create FPMs in Cambodia or Vietnam is yet from a year with a high flood

The green bars indicate years with floodmark data

The accuracy of the flood probability maps can be assessed fully only when we have observed a range of flood conditions

Conclusions

The C5 approach works well on the pilot areas in the flood plains of Cambodia and Vietnam. It is less successful in areas with the different flooding conditions such as those discussed for Lao PDR and Thailand

The flood probability maps can contribute essential information to land management and infrastructure planning, particularly in Cambodia where quantitative information on flood risk was not previously available

Each year the new information adds to the reliability of the maps, and present networks of floodmarks should be maintained

We believe that there are considerable benefits to be gained from extending coverage of the maps to other areas within the potential areas of seasonal flooding

In this context, extension of a high-quality DTM over the whole of the flood plain in Cambodia should be supported by continuing MRC programs – it would be of general benefit to many potential users

Thank you very much for your attention !

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