Using ArcGIS to extrapolate greenhouse gas emissions on the Pengxi River, a tributary of the Three Gorges Reservoir in China

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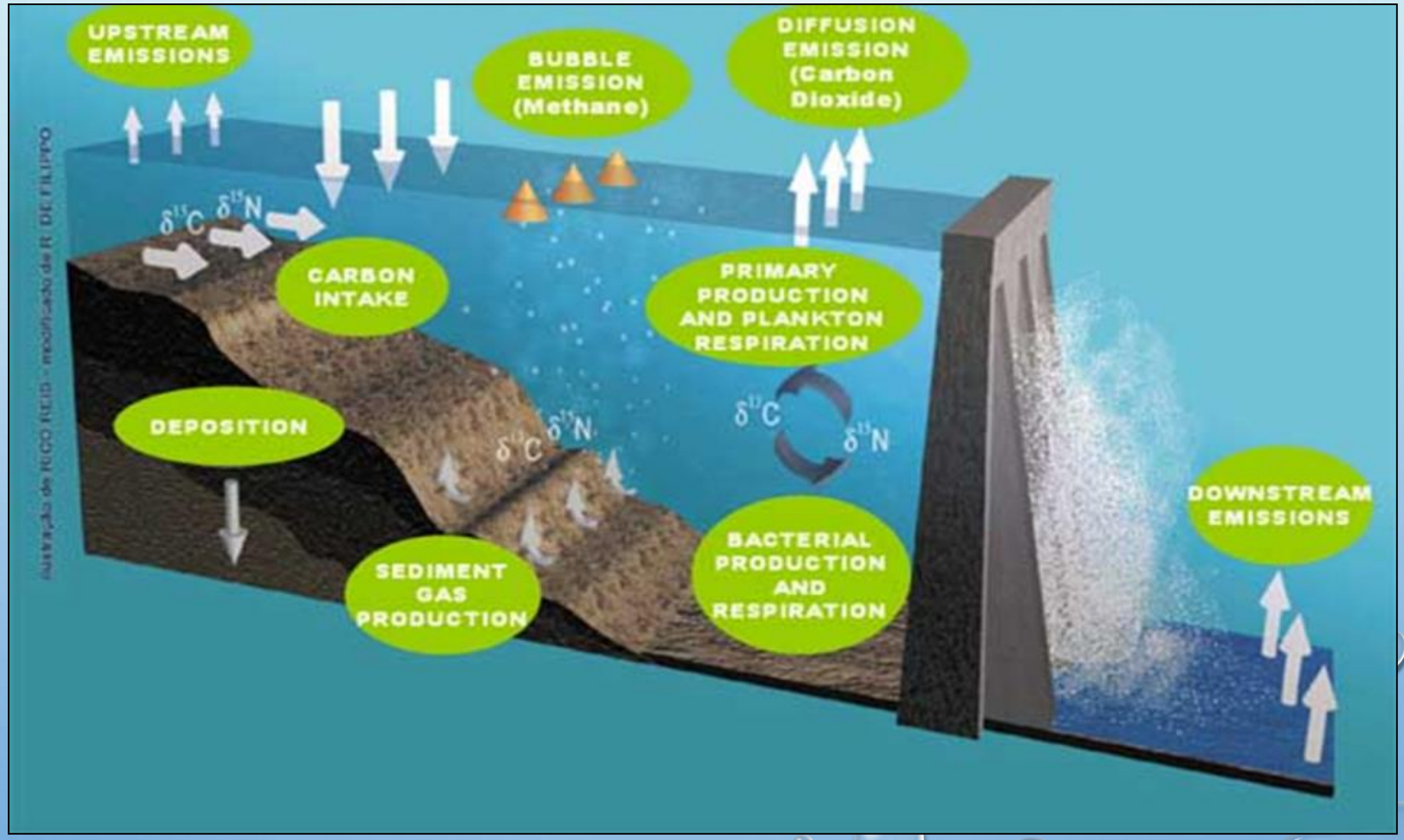
RESERVOIR GREENHOUSE GAS EMISSIONS



(Image from FURNAS www.dsr.inpe.br)

HOW TO SCALE UP GHG EMISSIONS?

PROJECT OBJECTIVE:

Estimate overall greenhouse gas emissions from the Pengxi River Backwater Area (PBA) using ArcGIS geospatial analysis tools.

- Compare geospatial analysis with typical method of extrapolating GHG emissions (i.e. using average value)

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News

Chinese dam may be a methane menace

Wetlands around Three Gorges produce tonnes of the greenhouse gas.

Jane Qiu

Marshland created when China's Three Gorges Reservoir is partially drained during the summer may be a significant source of the powerful greenhouse gas methane, researchers say.

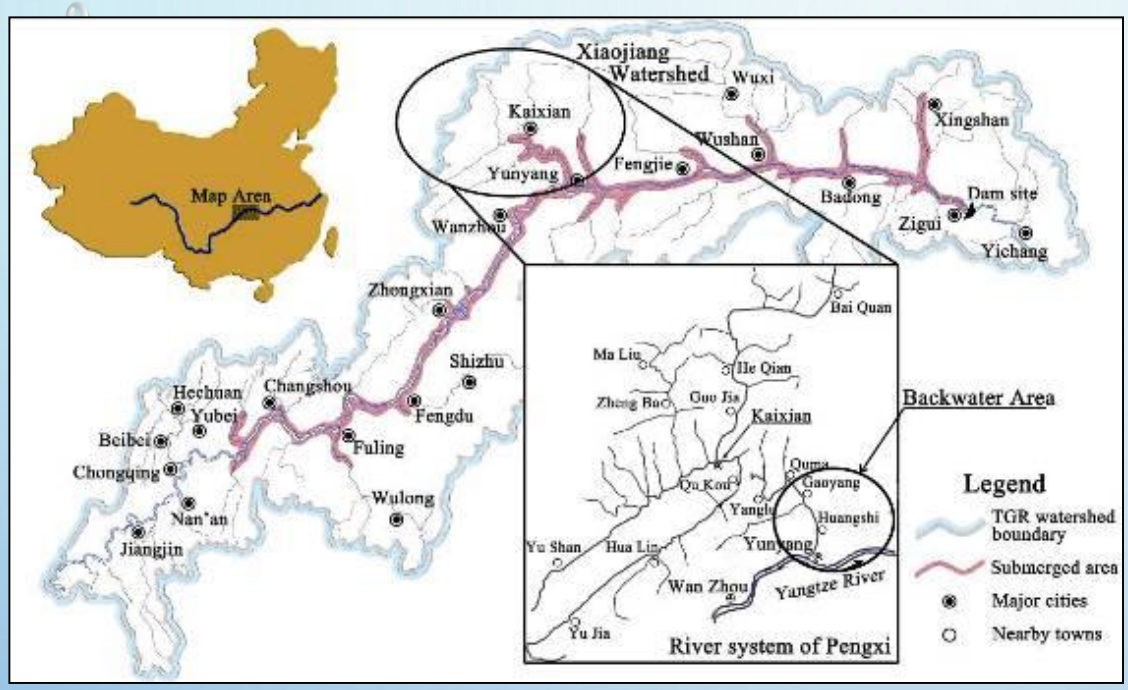
The findings, published in the *Journal of Geophysical Research*[1], are among the latest to raise questions over the green credentials of hydropower.

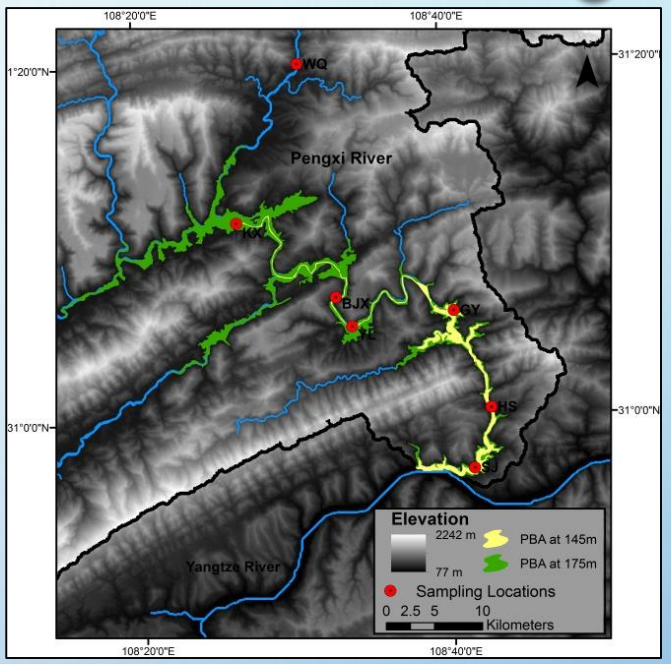
Marshes in the drawdown area of the Three Gorges Reservoir could be a significant source of methane.

Wikimedia Commons

Scientists have become increasingly concerned about the greenhouse gases released by submerged grass and trees when land is flooded to create dams. When such organic matter decays, it releases methane and carbon dioxide, which contribute to global warming. Methane is particularly troublesome as it has more than 20 times the warming impact of CO_2.

STUDY AREA





Samples were collected from seven sampling spots along the 80 km backwater area: (1) Wenquan (WQ), an unaltered river location; (2) Kaixian (KX), the terminal backwater region at a high water level; (3) Baijiaxi (BJX), the terminal backwater area in the discharge period; (4) Yanglu (YL), the terminus of low water operation; (5-7) Gaoyang (GY), Huangshi (HS), and Shuangjiang (SJ), three permanent backwater regions.

METHODS COMPARISON: EXTRAPOLATING CO_2 AND CH_4 EMISSIONS

Inverse Distance Weight (IDW) Interpolation

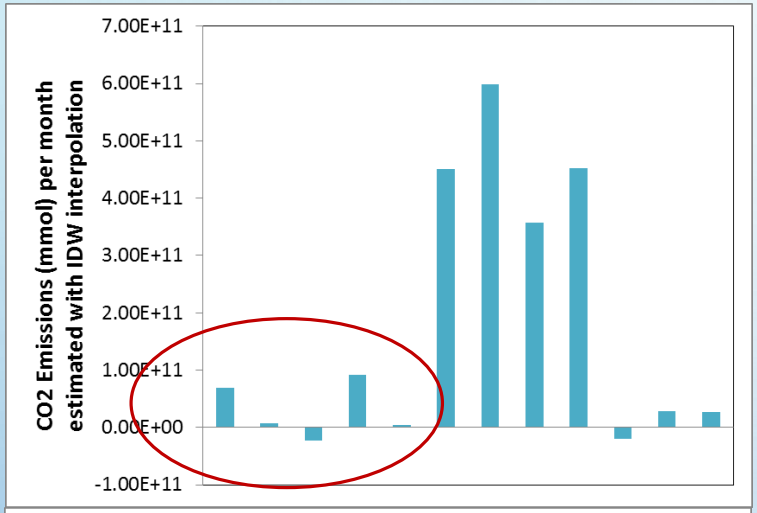
- Point data representing monthly emissions at each location
- Create raster surface using IDW interpolation
- Sample raster for zonal statistics with respective water level shapefile
- Total emissions per month

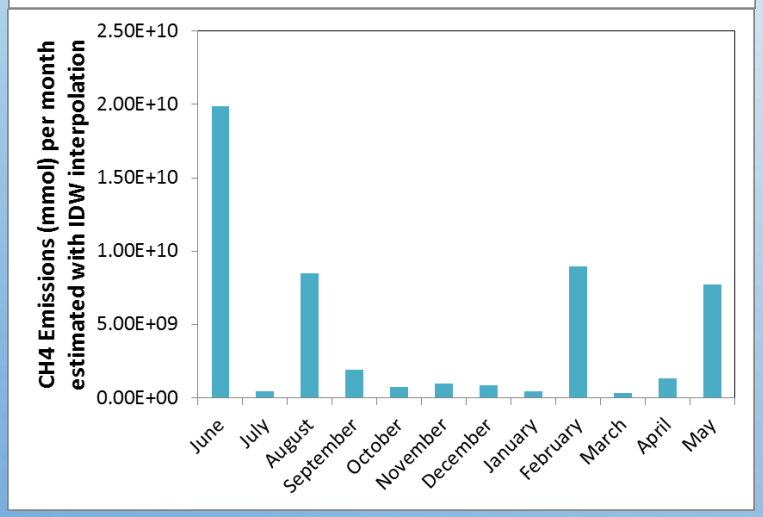
Mean Flux and Spatial Average

- Average all locations to calculate mean flux per month for entire PBA
- Calculate average area at time of sampling based on regression of water level at dam and PBA area
- Multiply mean flux by average area to get total emissions per month

ESTIMATES OF CO_2 AND CH_4 EMISSIONS

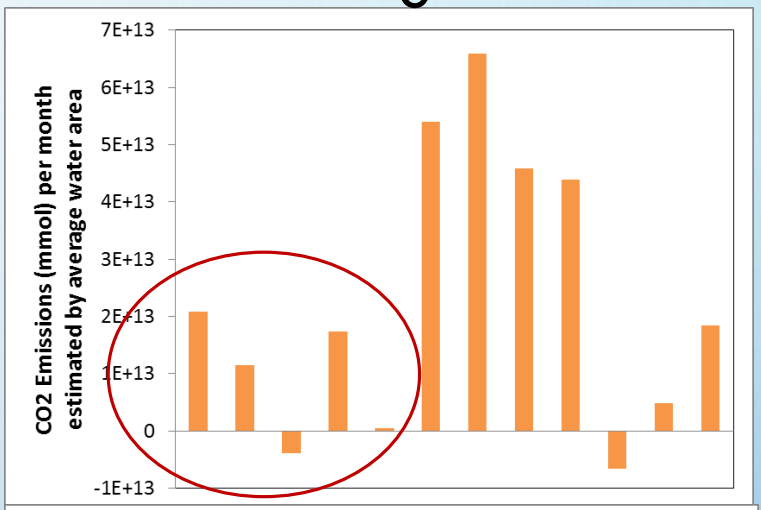
IDW interpolation

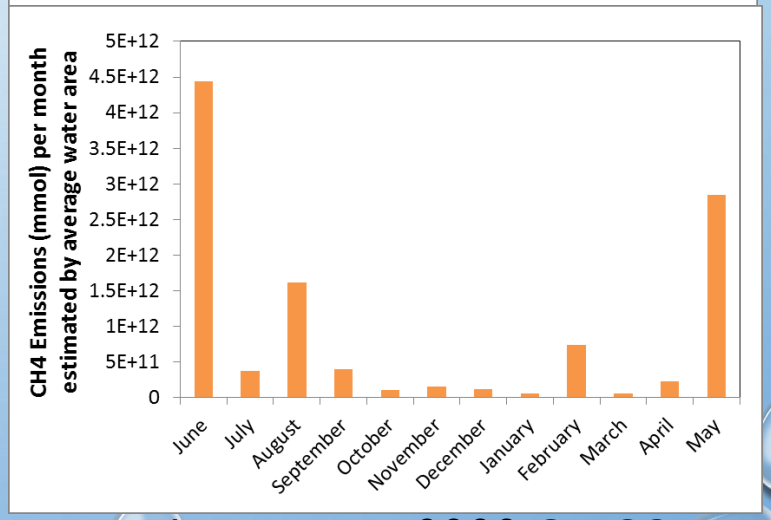




Gross annual emissions: 90 Gg CO_2
0.84 Gg CH_4

Using spatial and temporal averages





Gross annual emissions: 12000 Gg CO_2
180 Gg CH_4

CO_2

CH_4

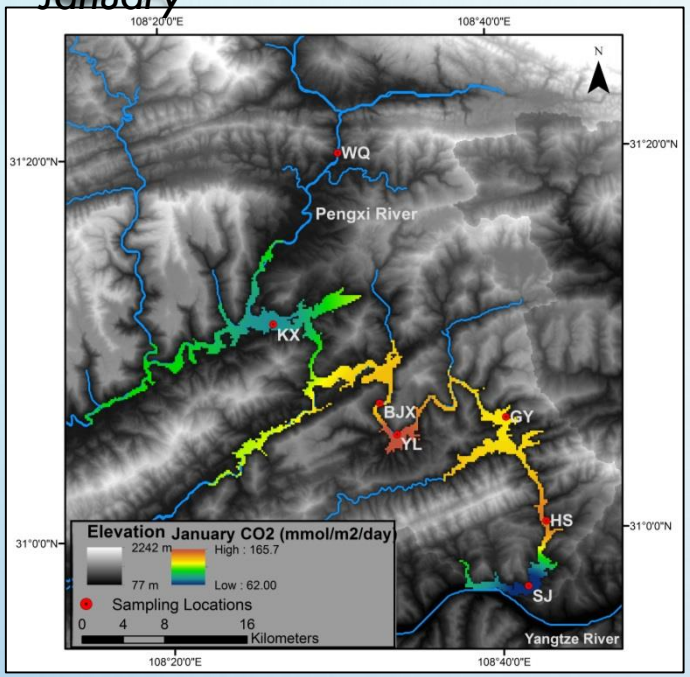
Examples of IDW Interpolation Results

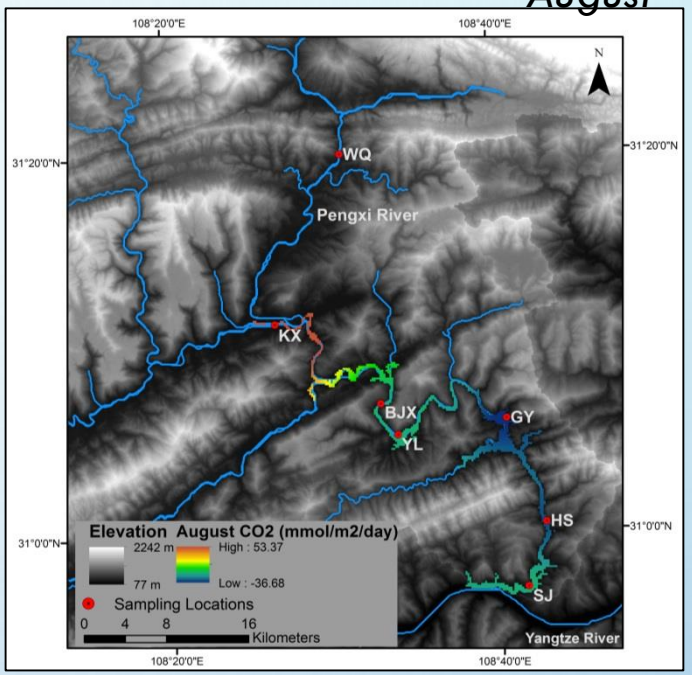
January

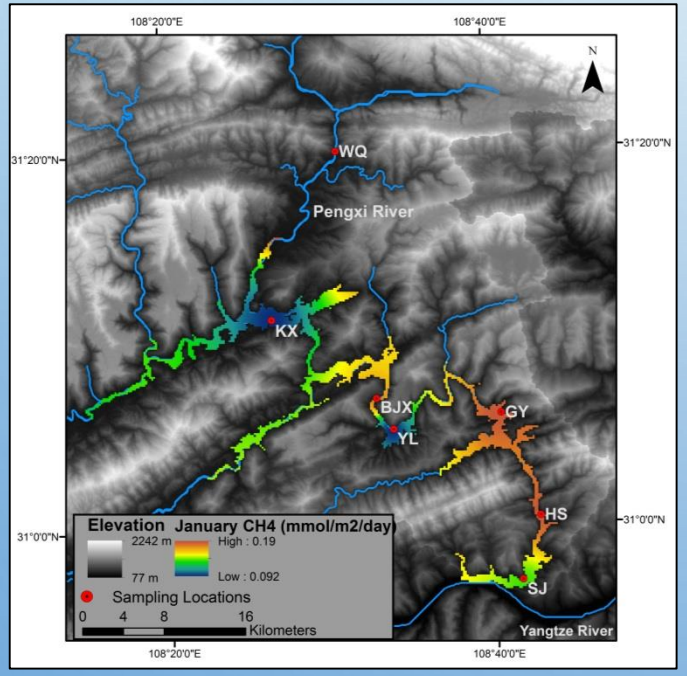
August

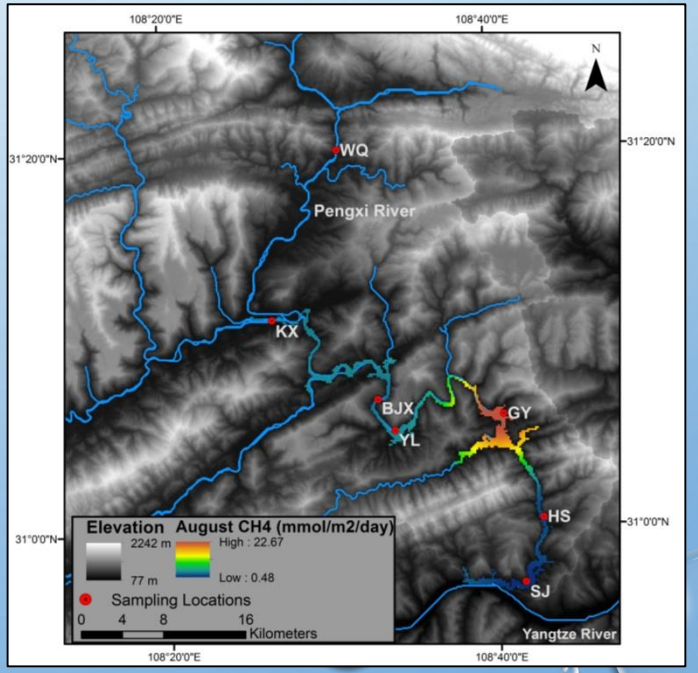
CO_2

CH_4









CONCLUSIONS:

- The interpolation method produced much lower estimates of gross emissions from Pengxi backwater area.
- Further work is needed test this method in other areas of the reservoir and to determine reliability.
- ArcGIS is useful for visualizing variations in emissions by season and location within the tributary

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