Investigating CH_4 emissions from tropical wetlands

A.Klemme

T. Warneke, N. Daskalakis, O. Schneising-Weigel, M. Vrekoussis, J. Notholt

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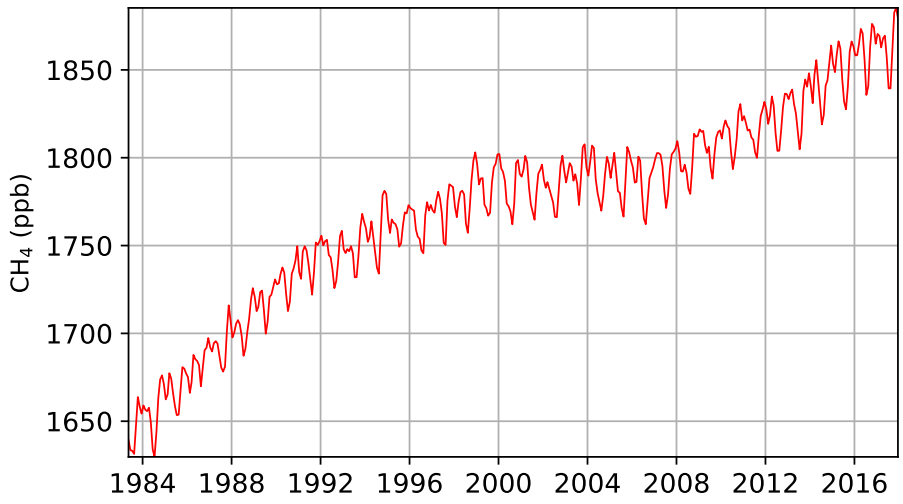
Universität Bremen

Motivation



NOAA, Mauna Loa [Dlugokencky et al., 2017]

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  - **Other**
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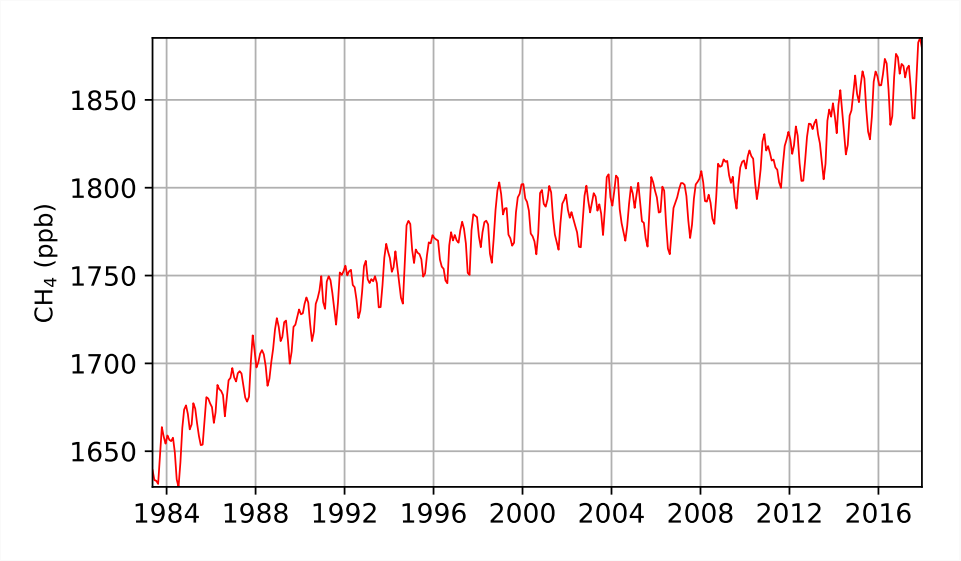
  - Reaction with OH^-



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- Methane Sources:
  - **Wetlands** (216.9 $\mathrm{Tg/yr}$)
  - **Agriculture** (143.6 $\mathrm{Tg/yr}$)
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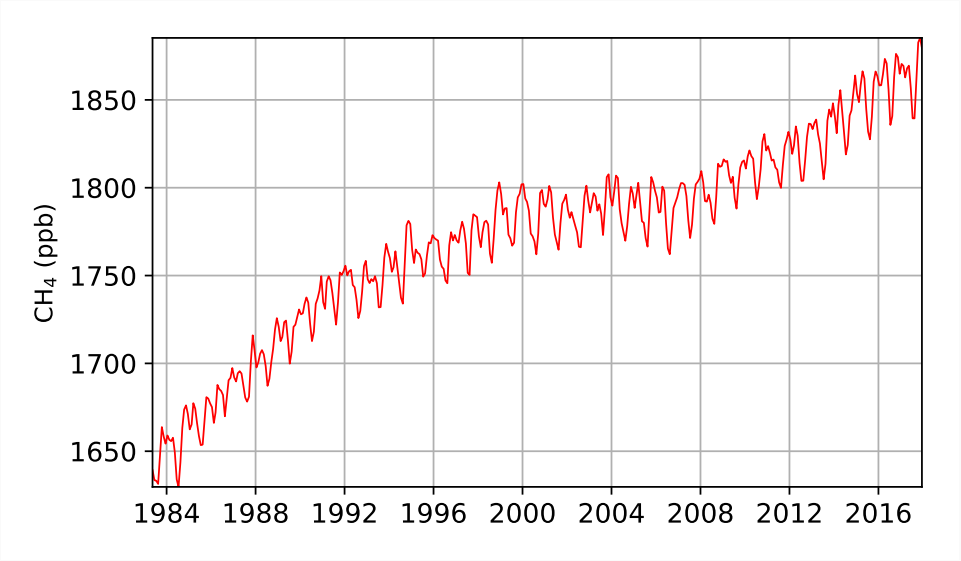

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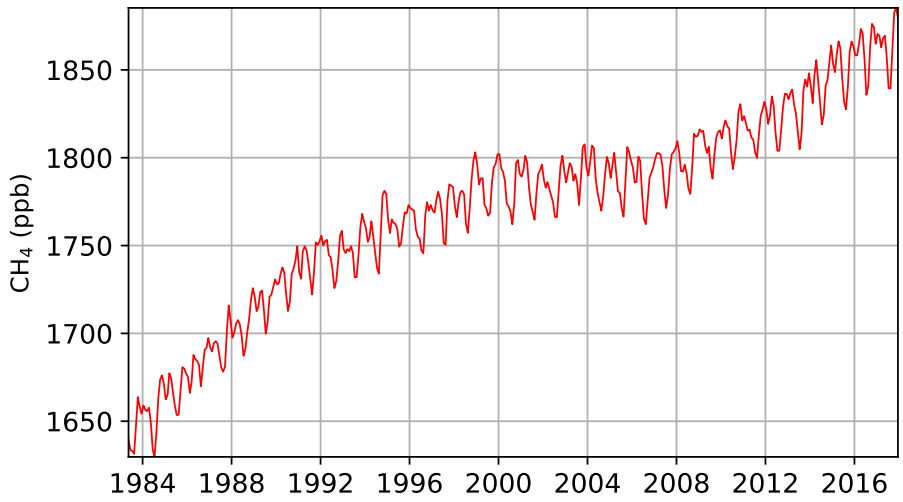

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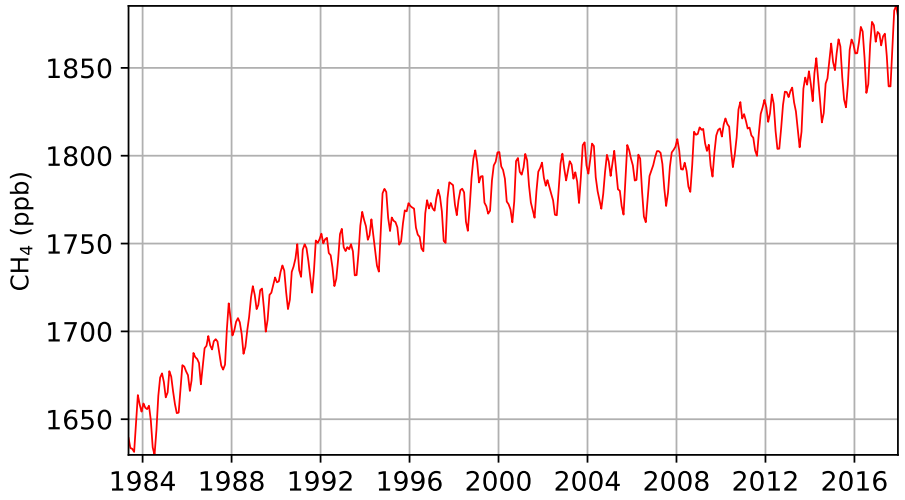

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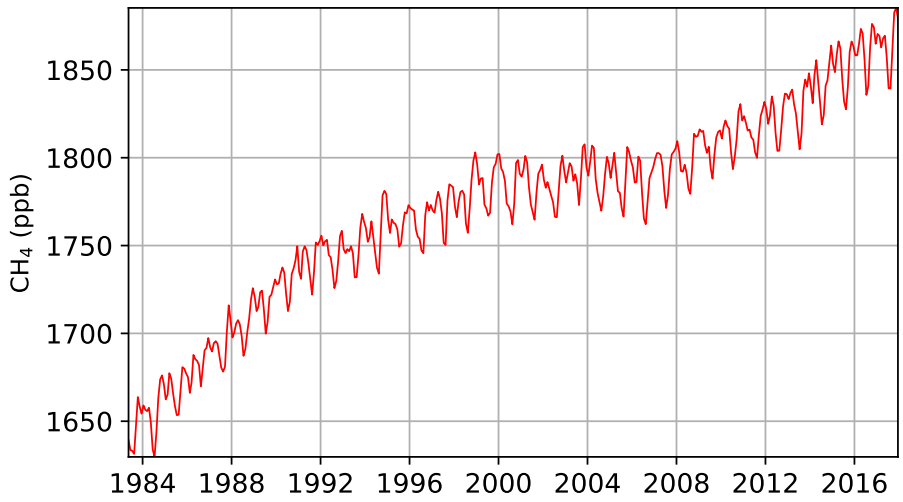

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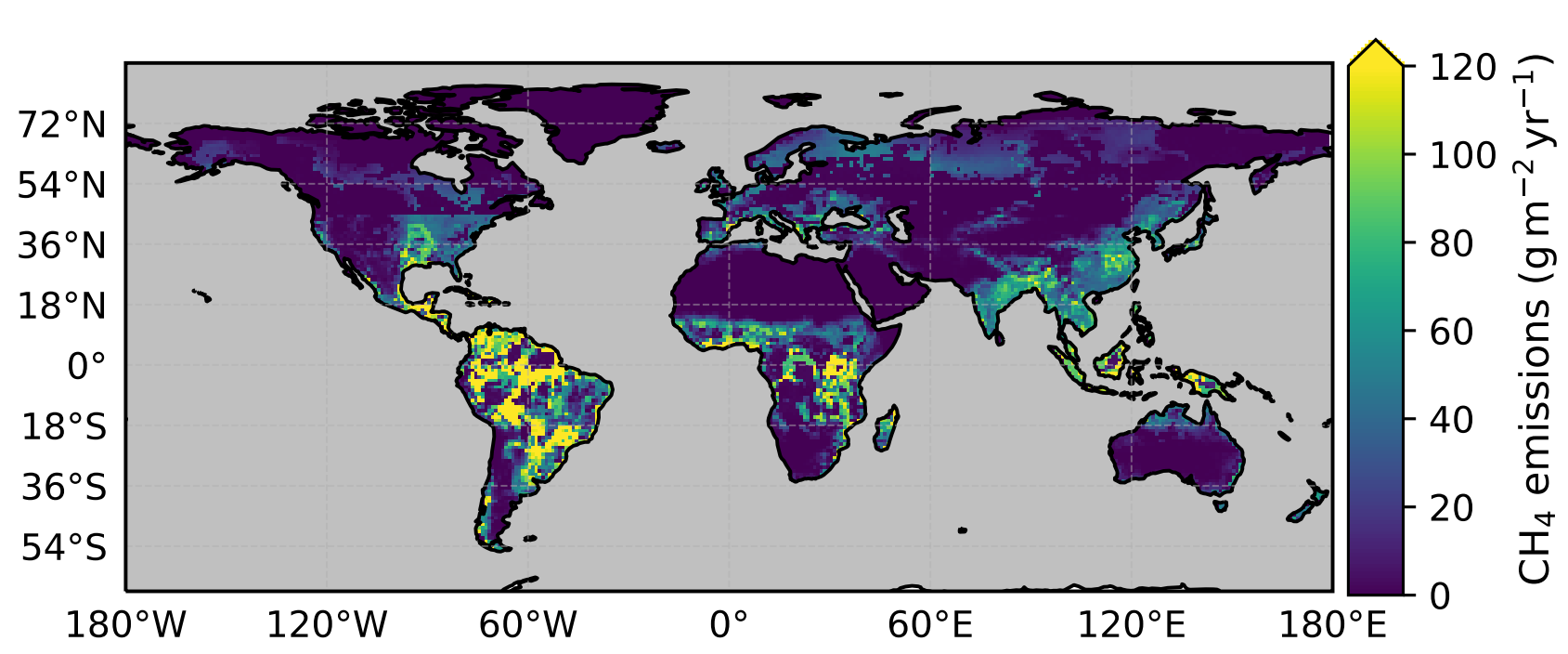
- Natural wetland emissions: 20 to 50 % of global CH_4 emissions
  - waterlogged areas of high carbon content $\rightarrow$ methanogenesis
- $>$ 50 % of wetl. emis. between 25 °N and 25 °S

Global distribution of rice & wetland emissions



HYMN [Spahni et al., 2011]

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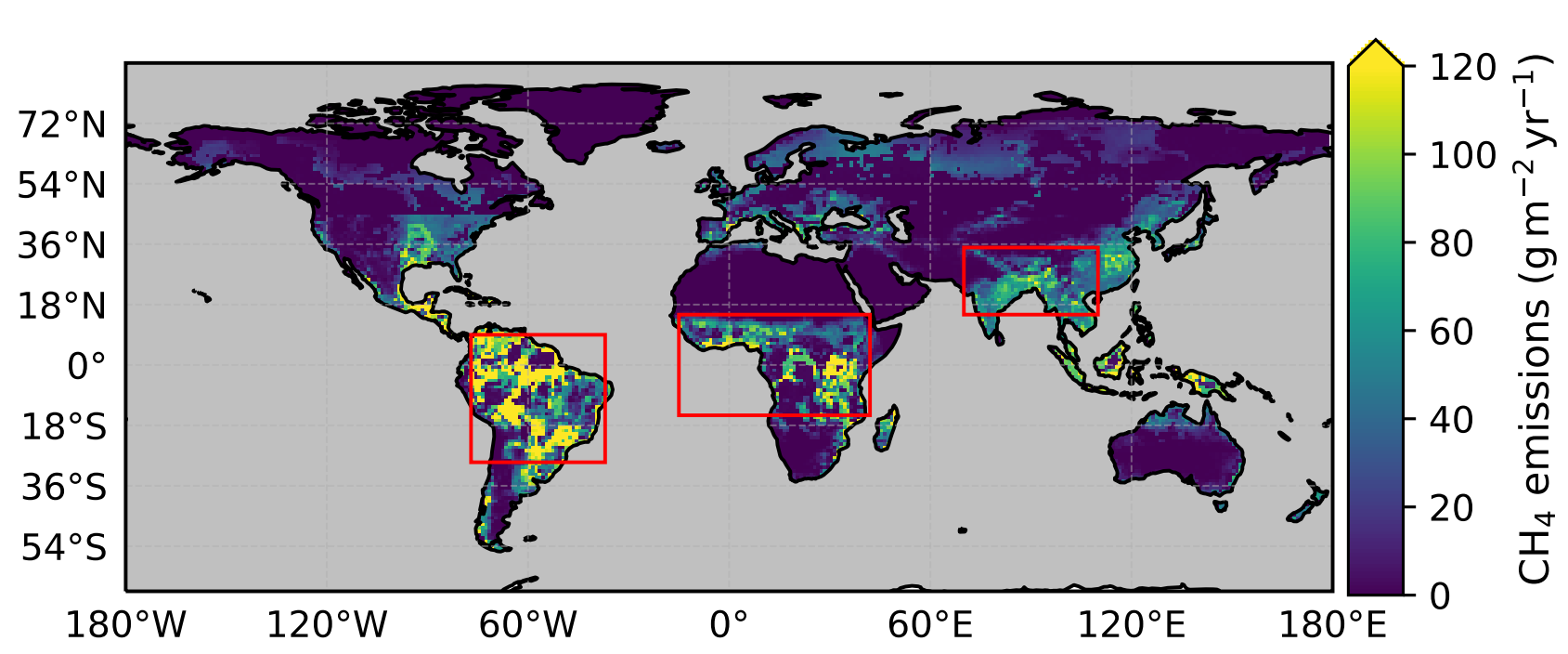

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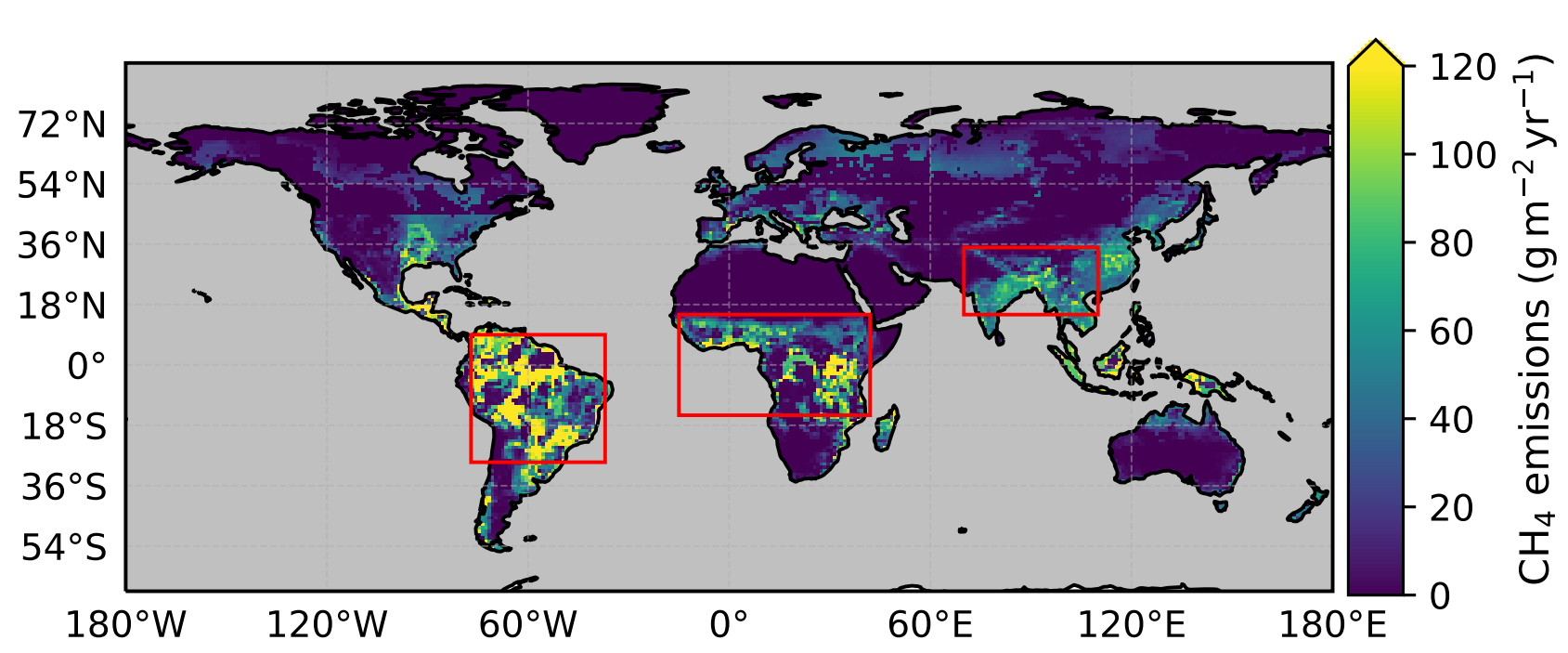
Interesting emission regions:

- Amazon river basin
- Congo river basin
- Ganges-Brahmaputra-Meghna river basin

Impact of local emissions on atmospheric CH_4 concentrations



Two model runs for atmospheric methane:

1. calculated with full emission product
2. calculated excluding local emissions

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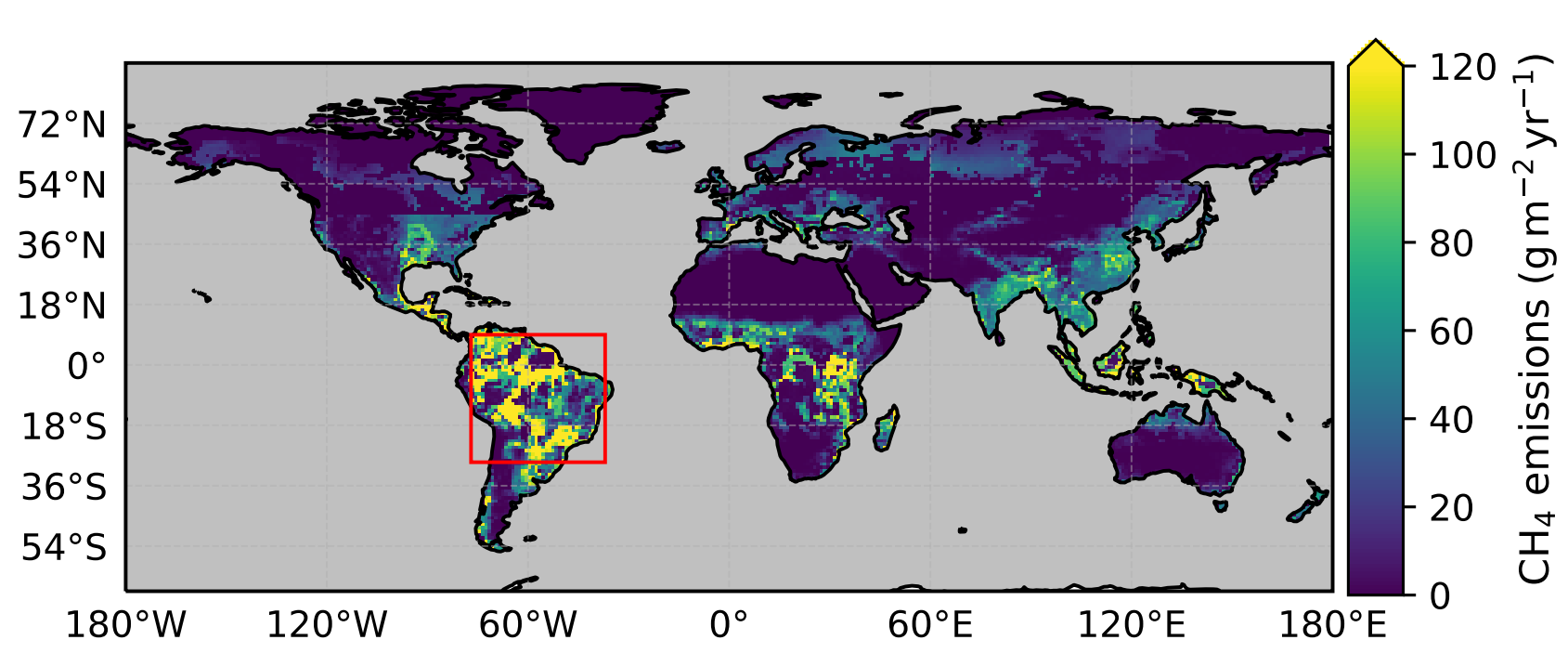

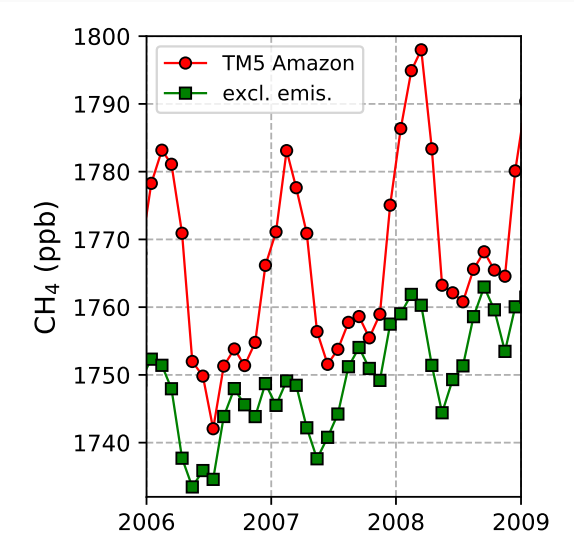

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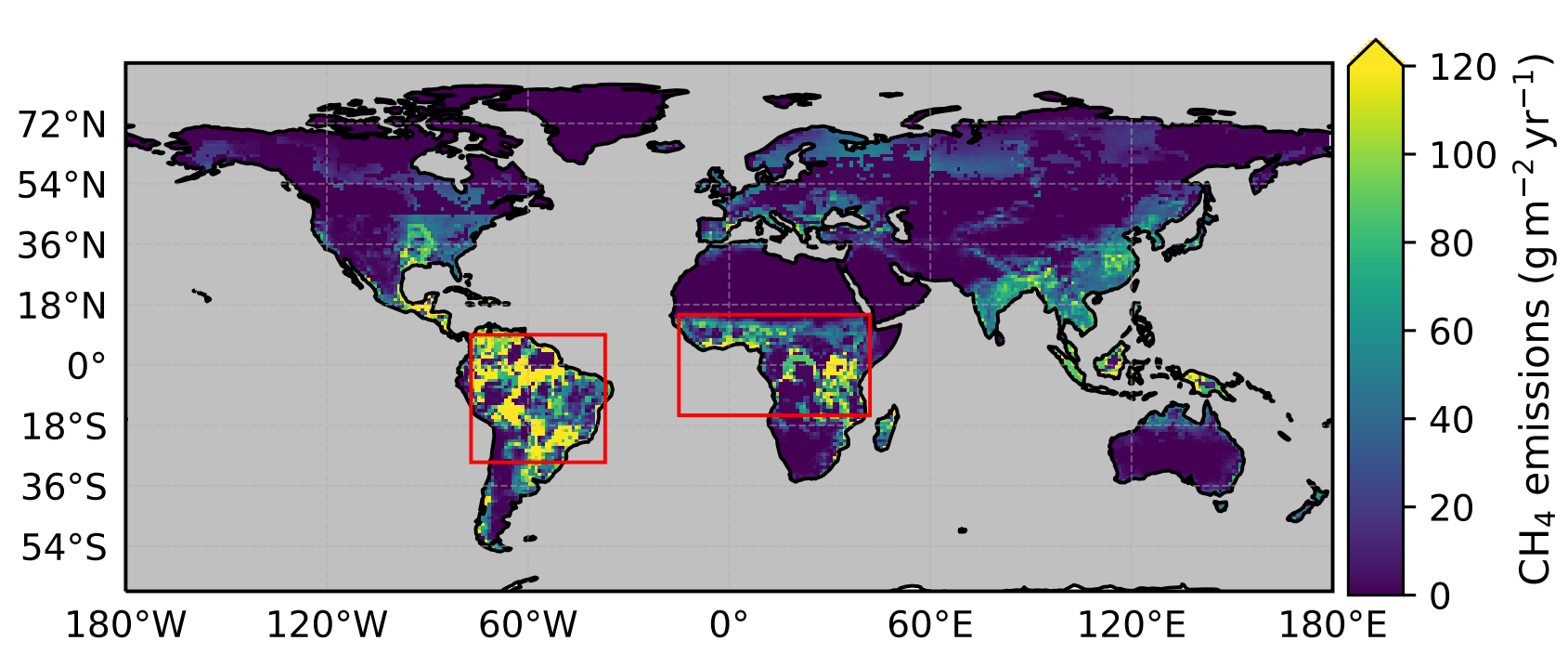

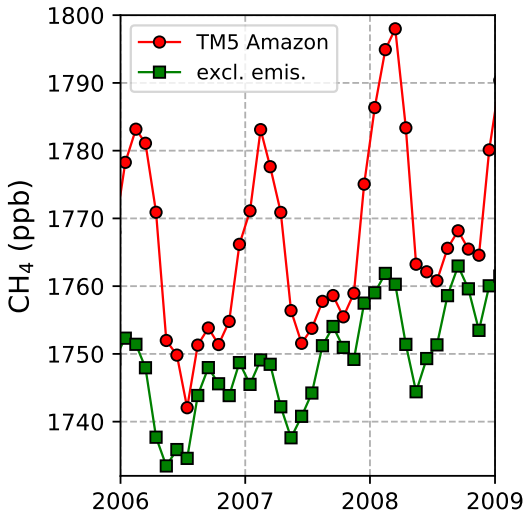

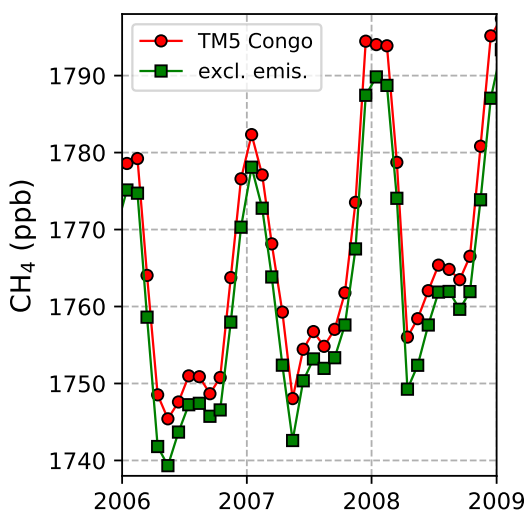

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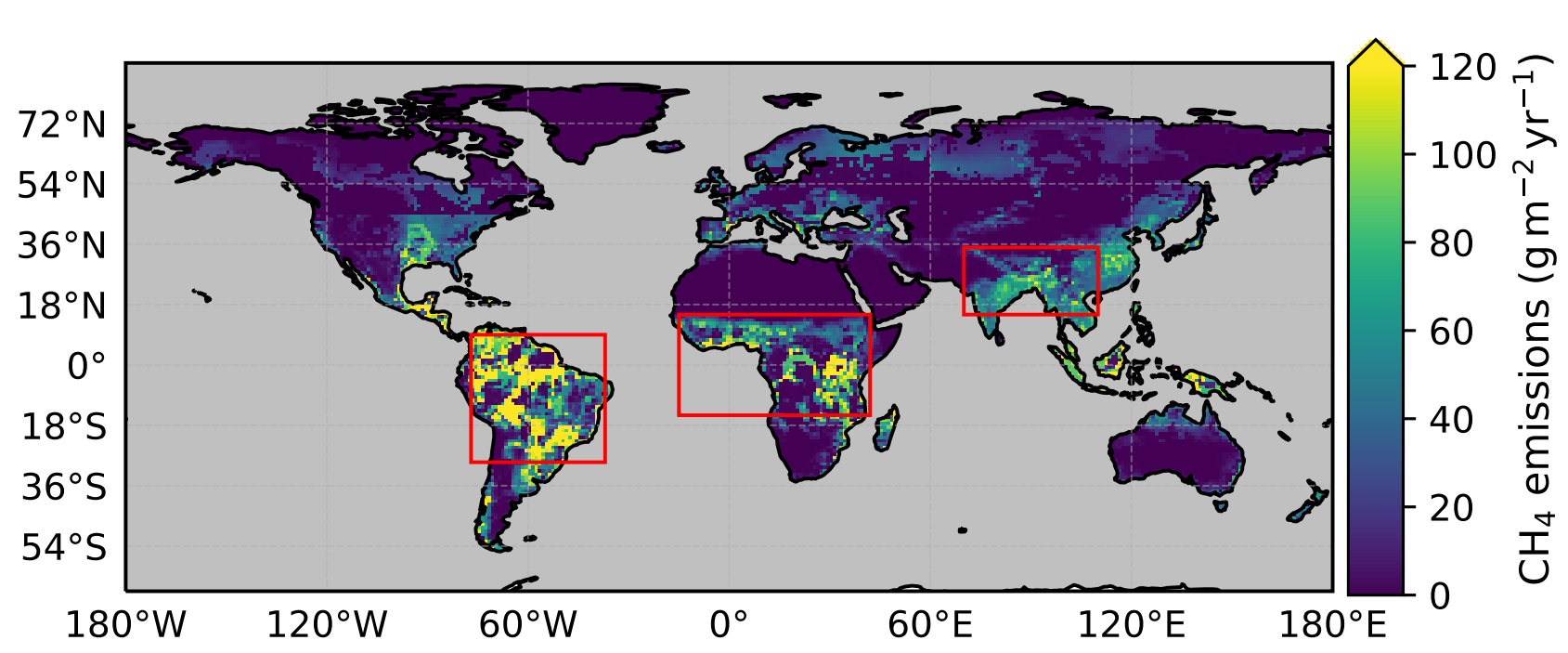
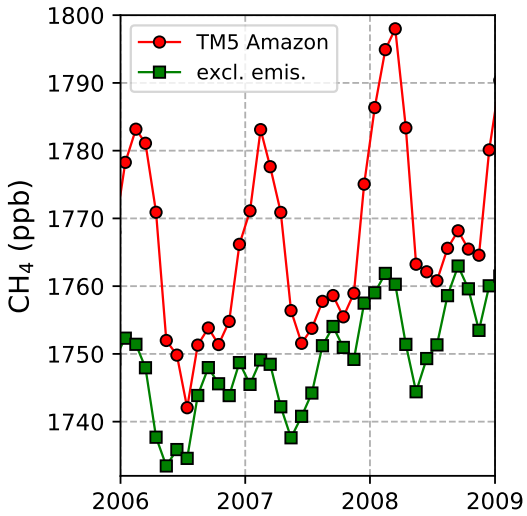
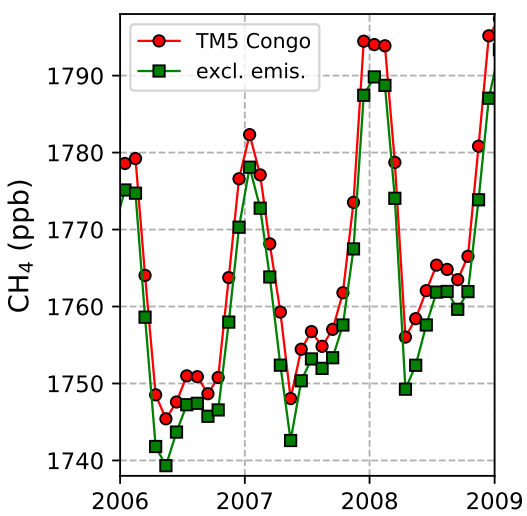
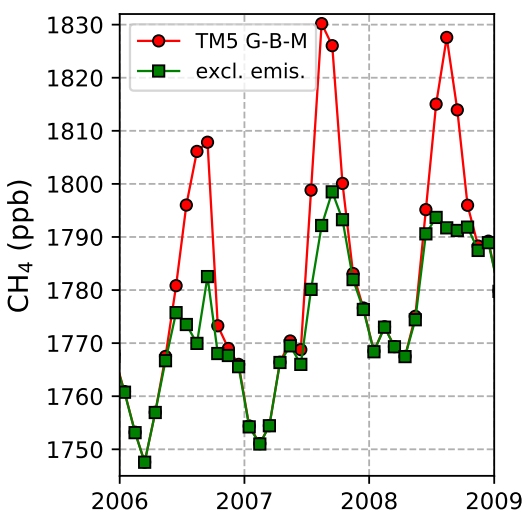
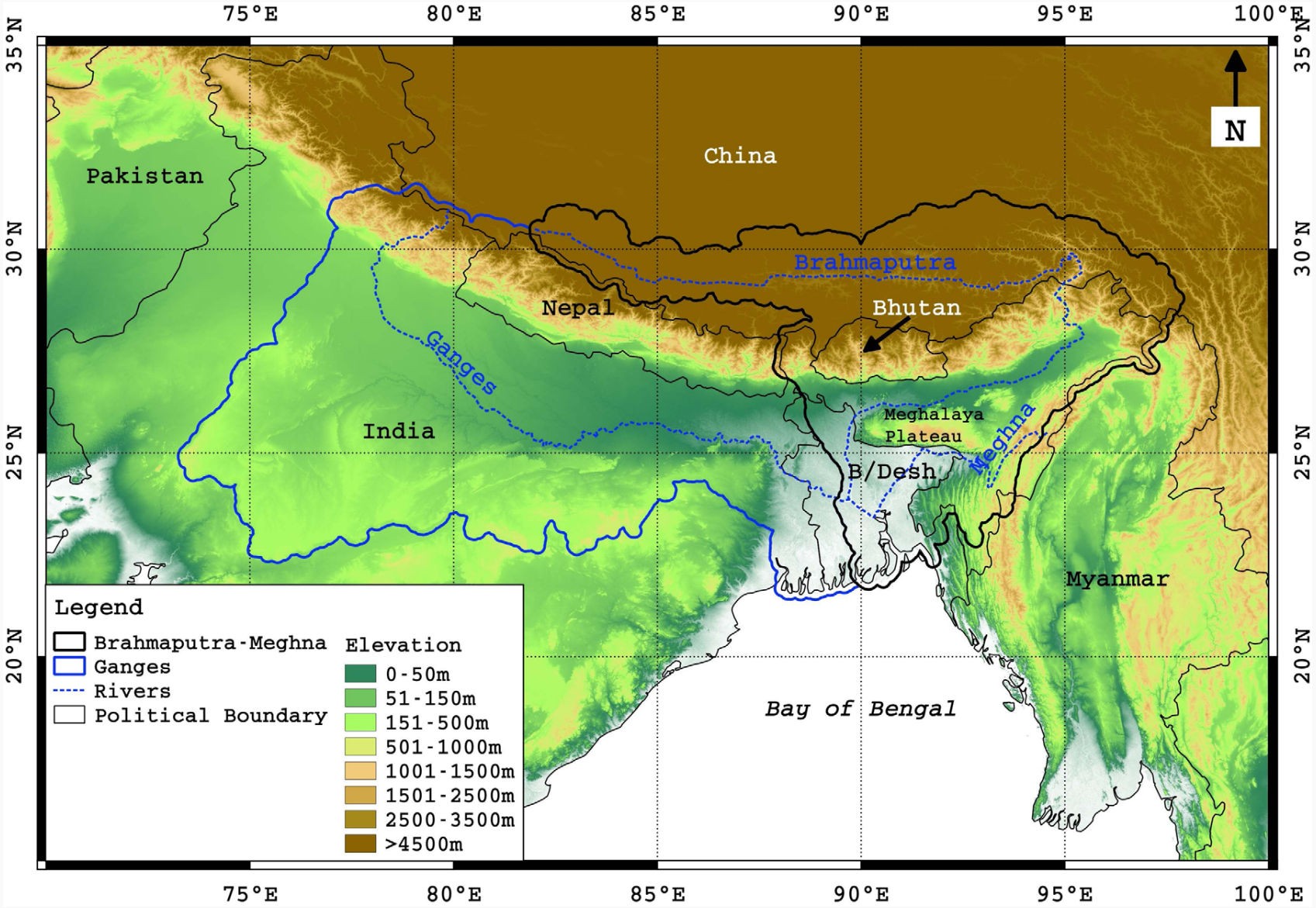






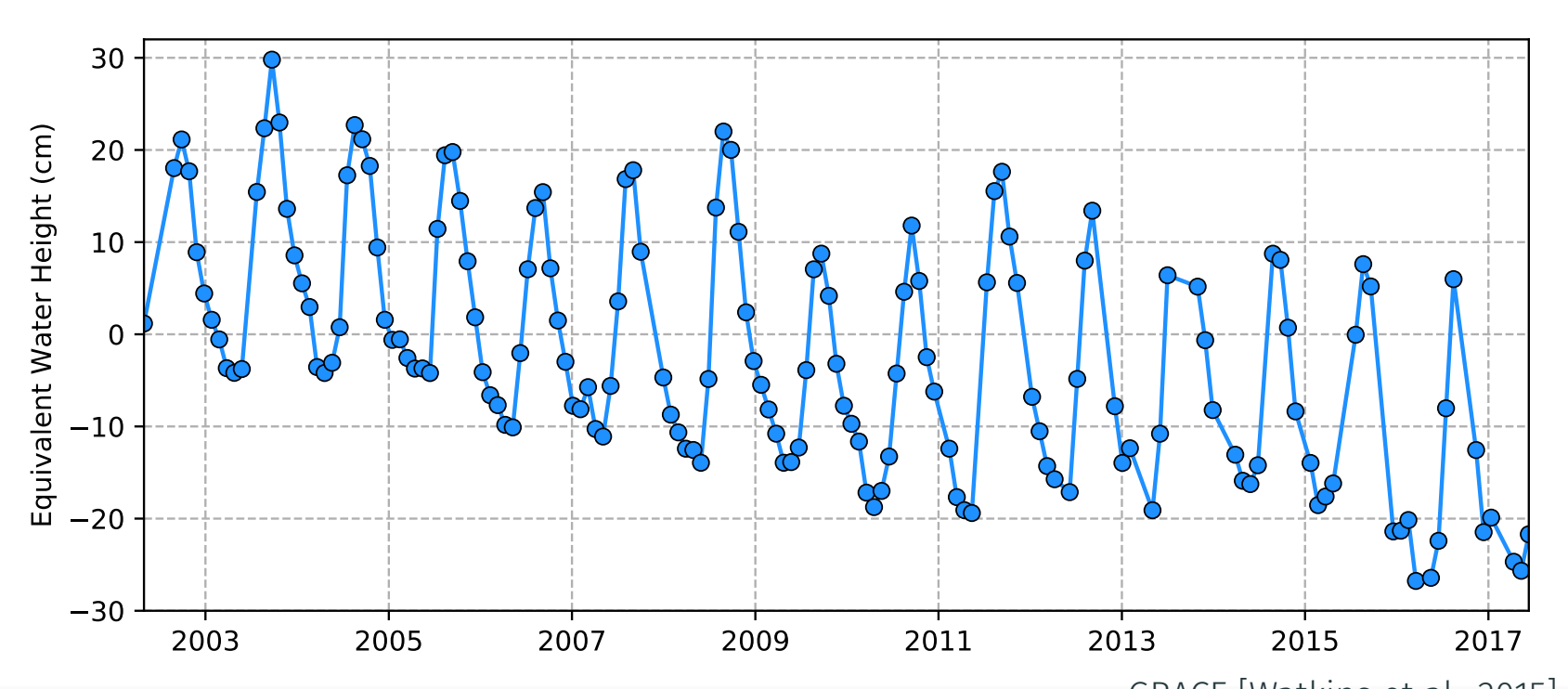


Ganges-Brahmaputra-Meghna (G-B-M) River Basin



[Khandu et al., 2016]

G-B-M: Decline of total water storage



GRACE [Watkins et al., 2015]

- decline in EWH over G-B-M delta

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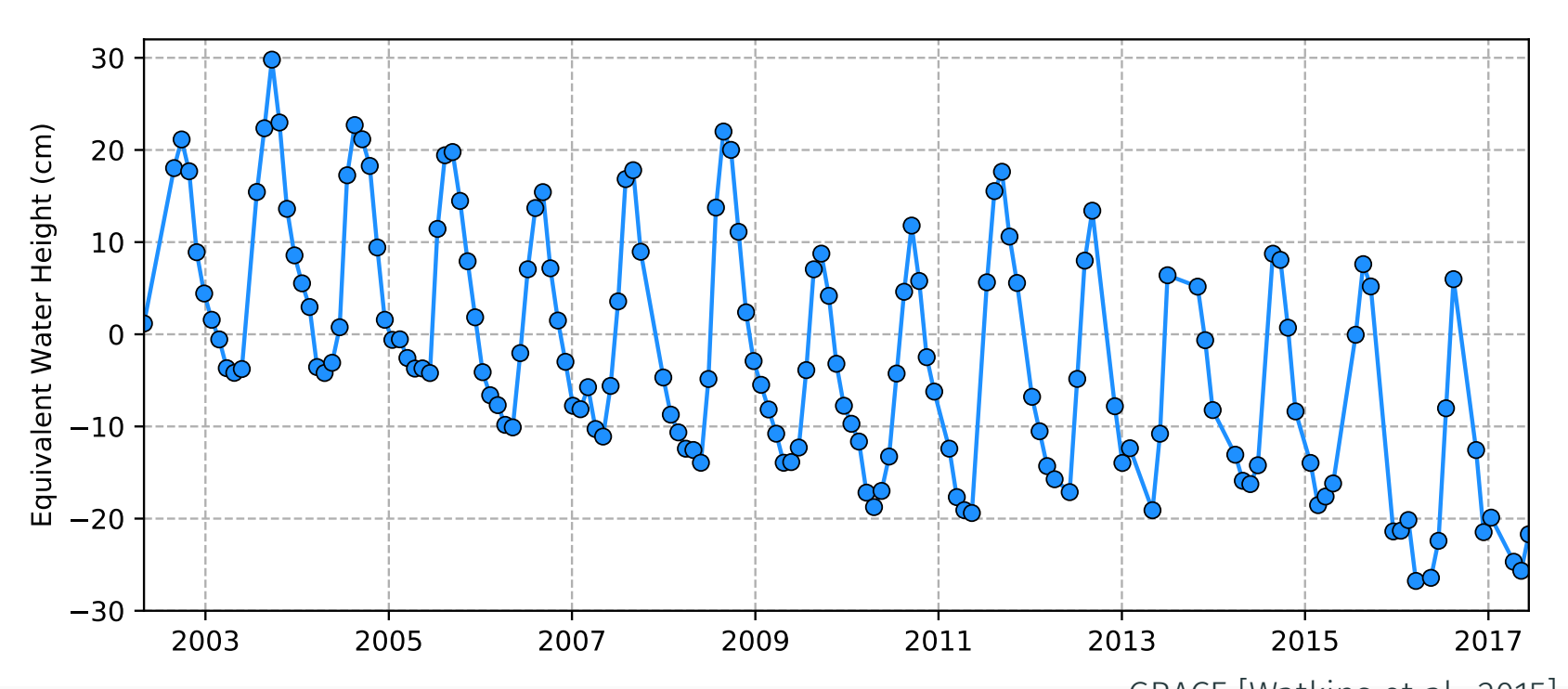

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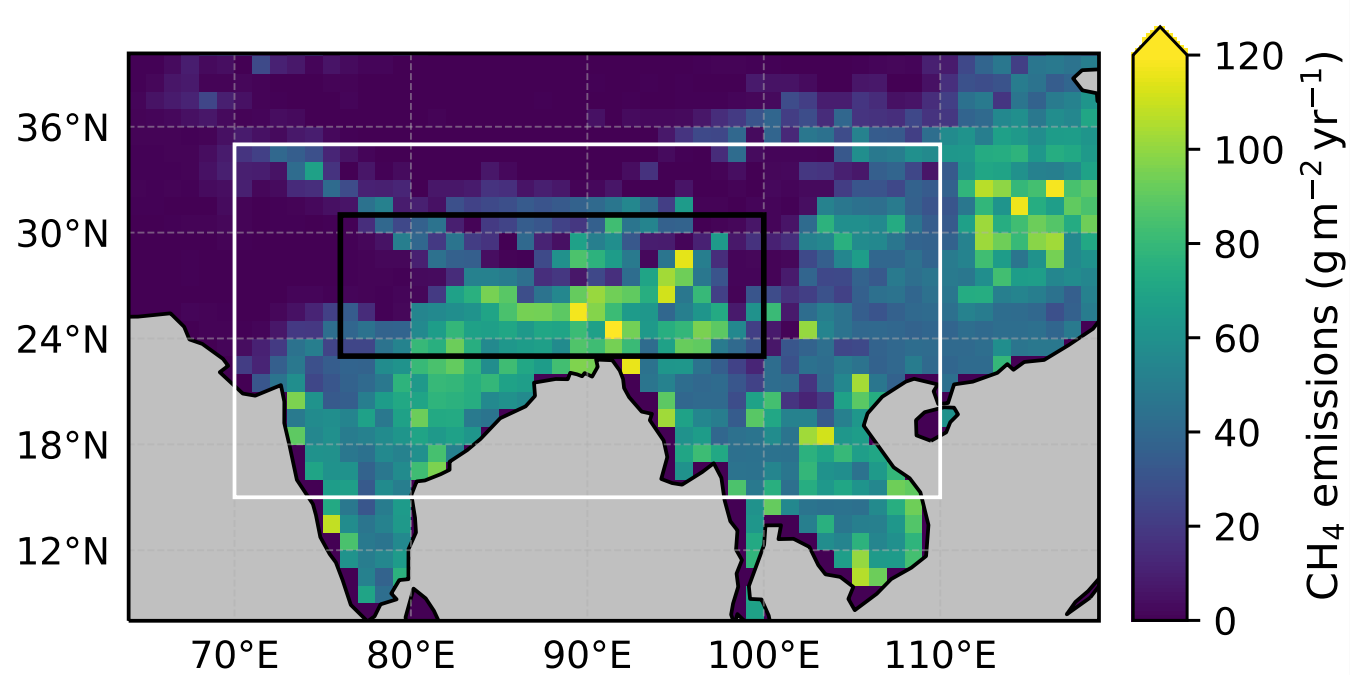
- decline in EWH over G-B-M delta
- water used to flood rice plantations

G-B-M: Local CH_4 emissions



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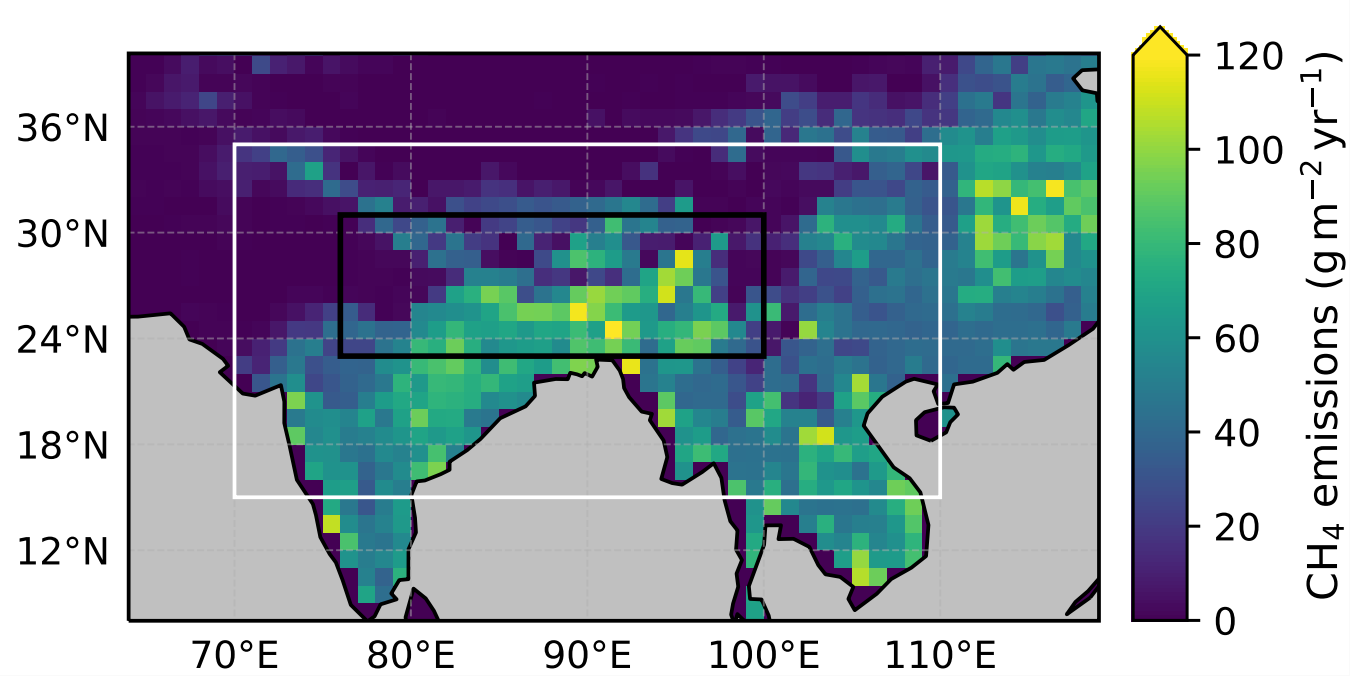

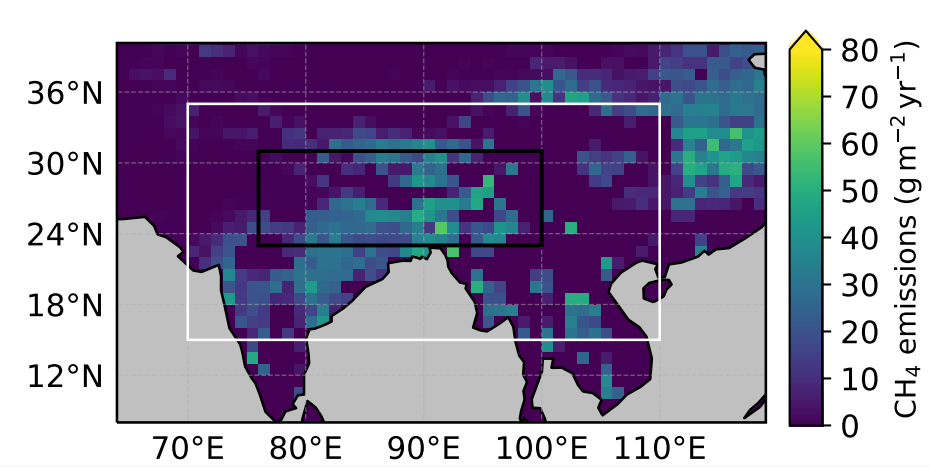

wetland emissions

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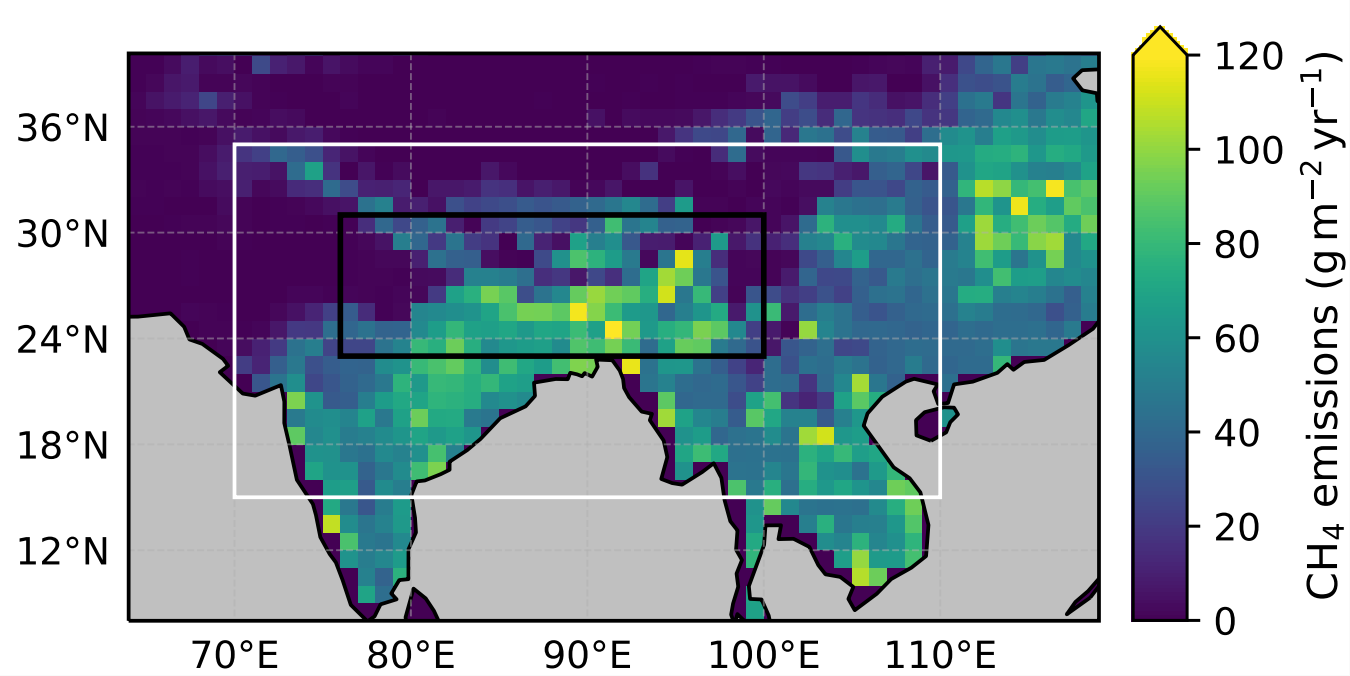
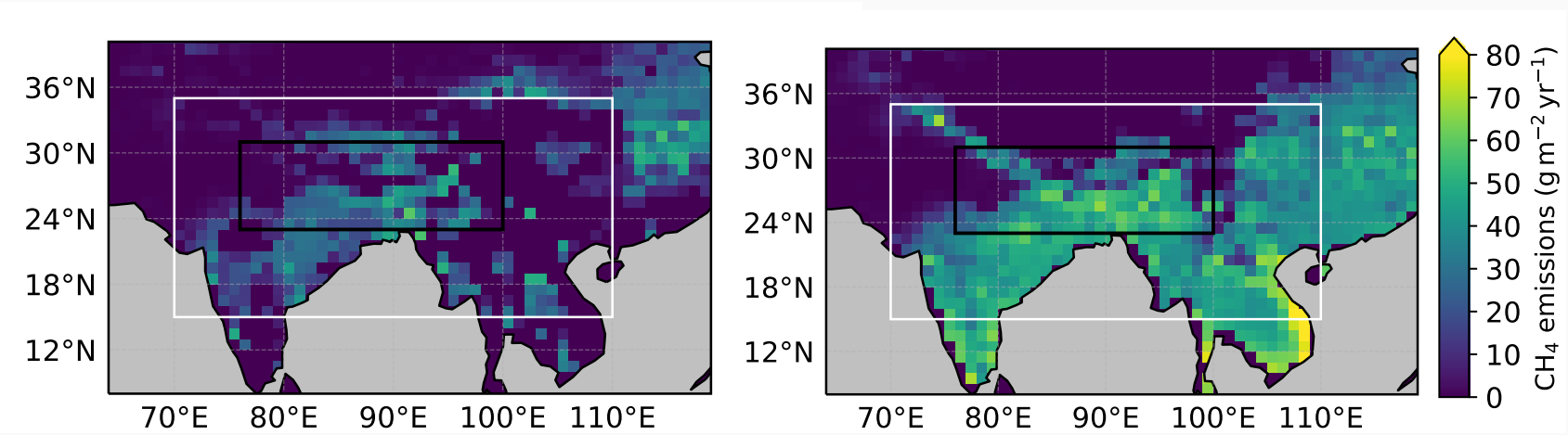
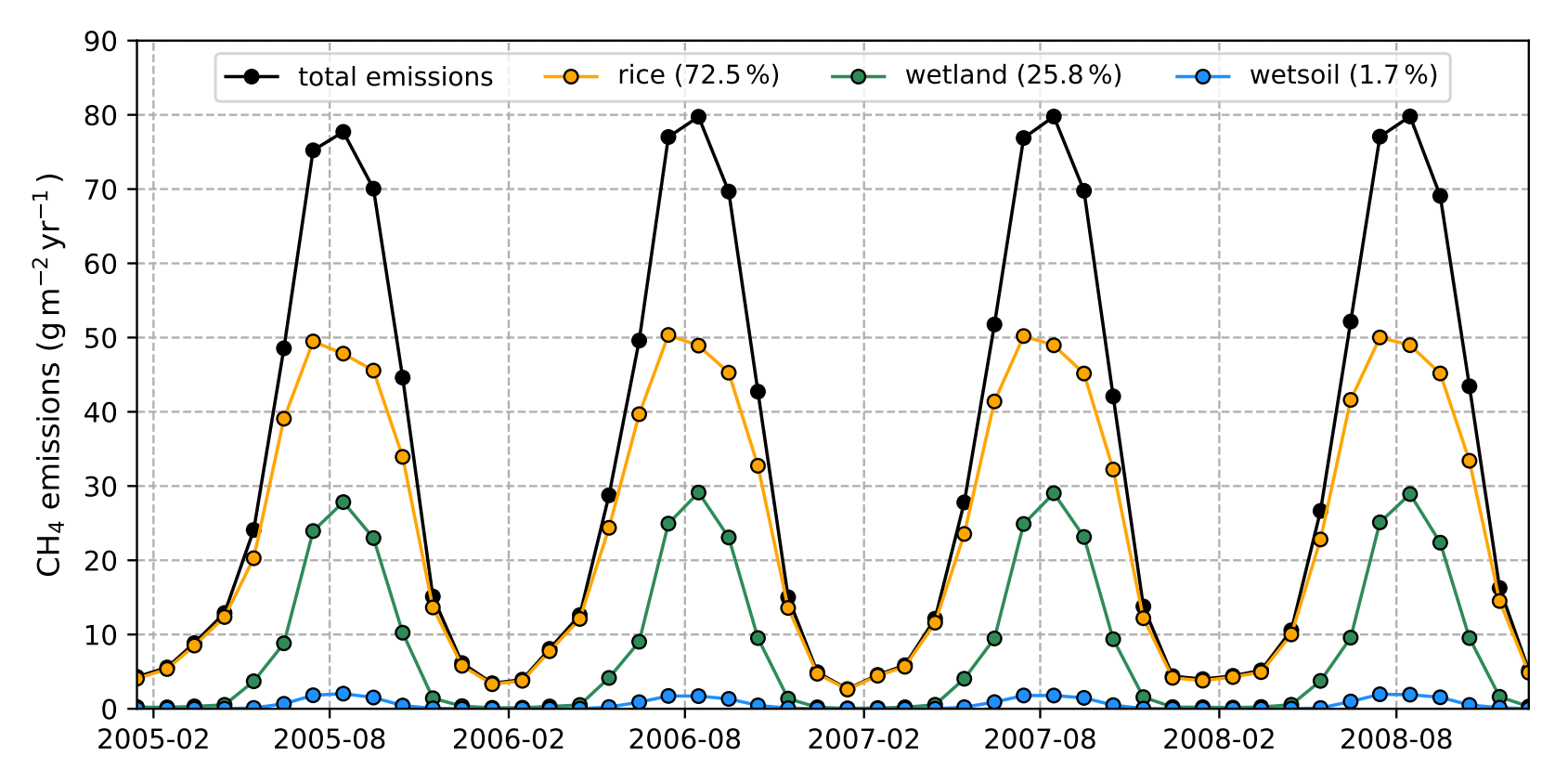




wetland emissions

rice emissions

G-B-M: Seasonality of emissions



- high emissions during wet season

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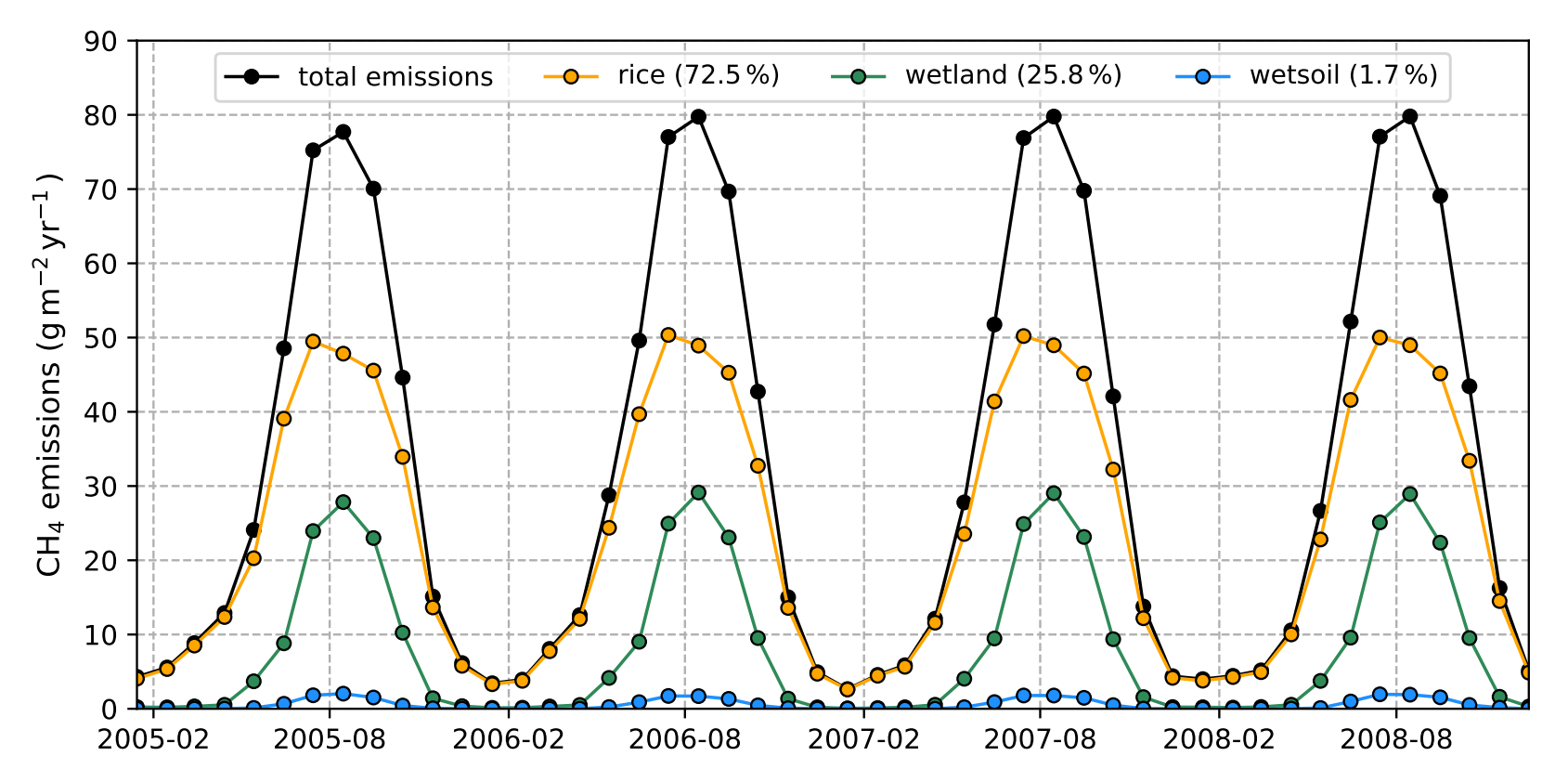

- high emissions during wet season
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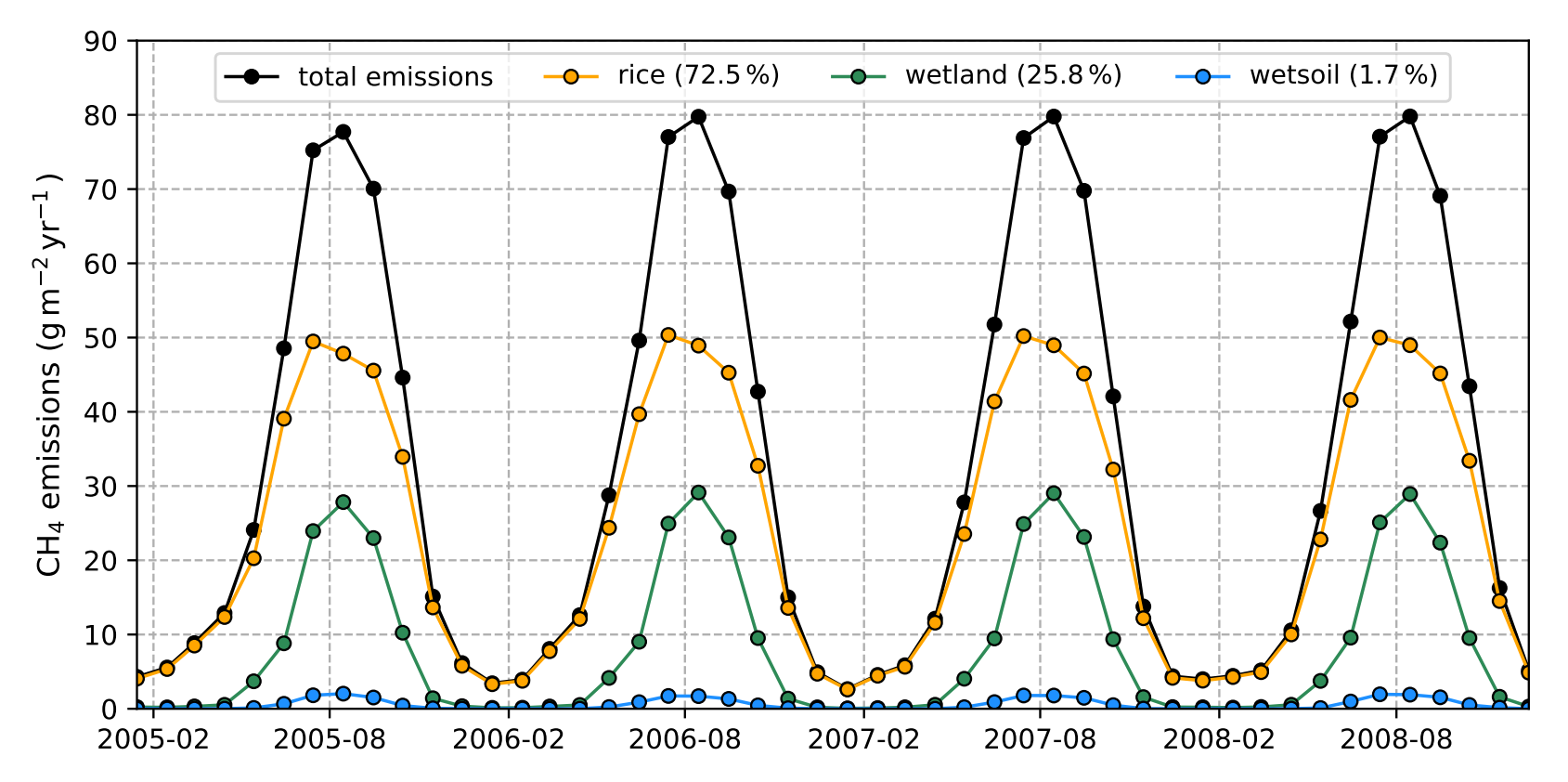

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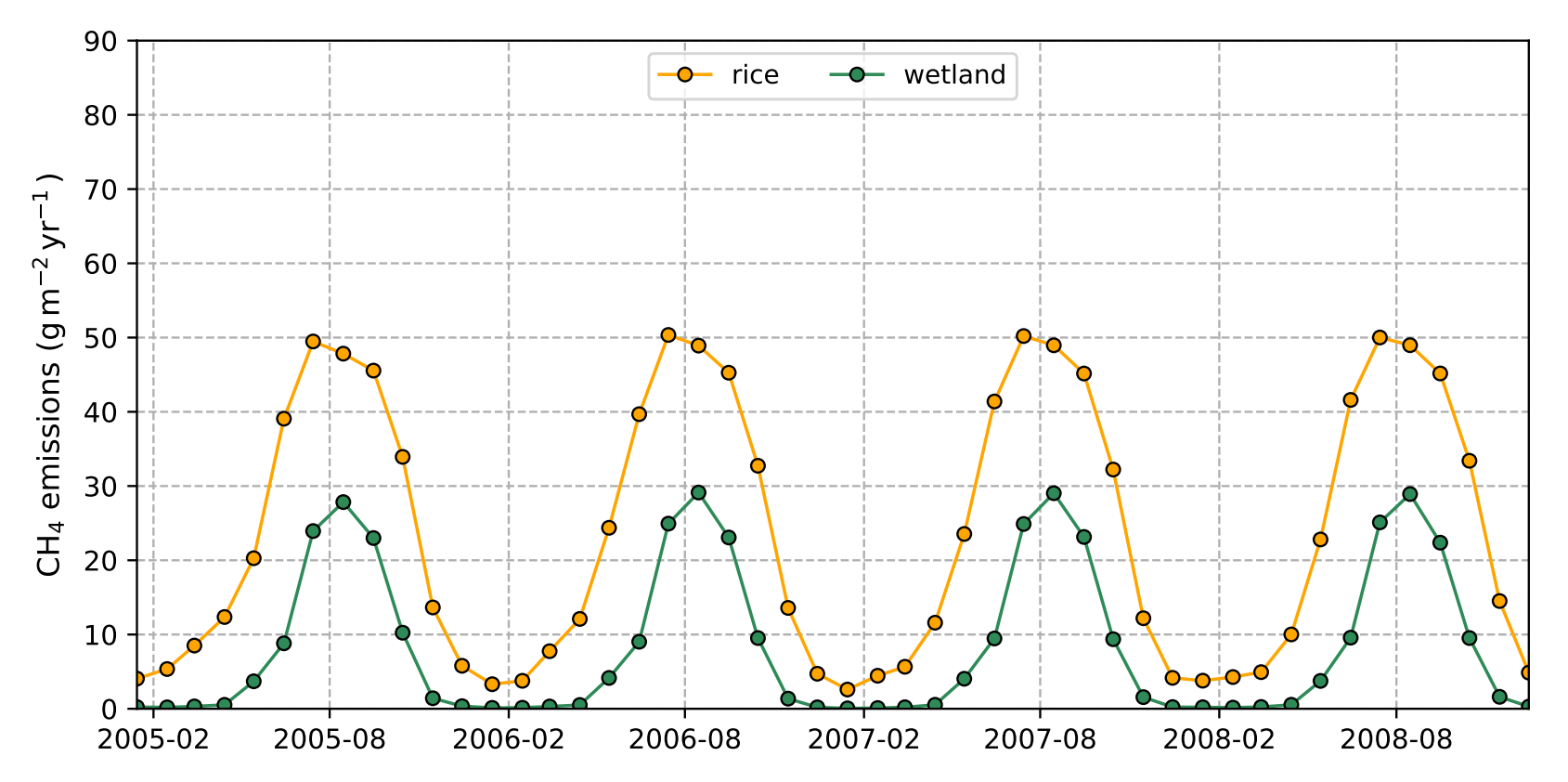

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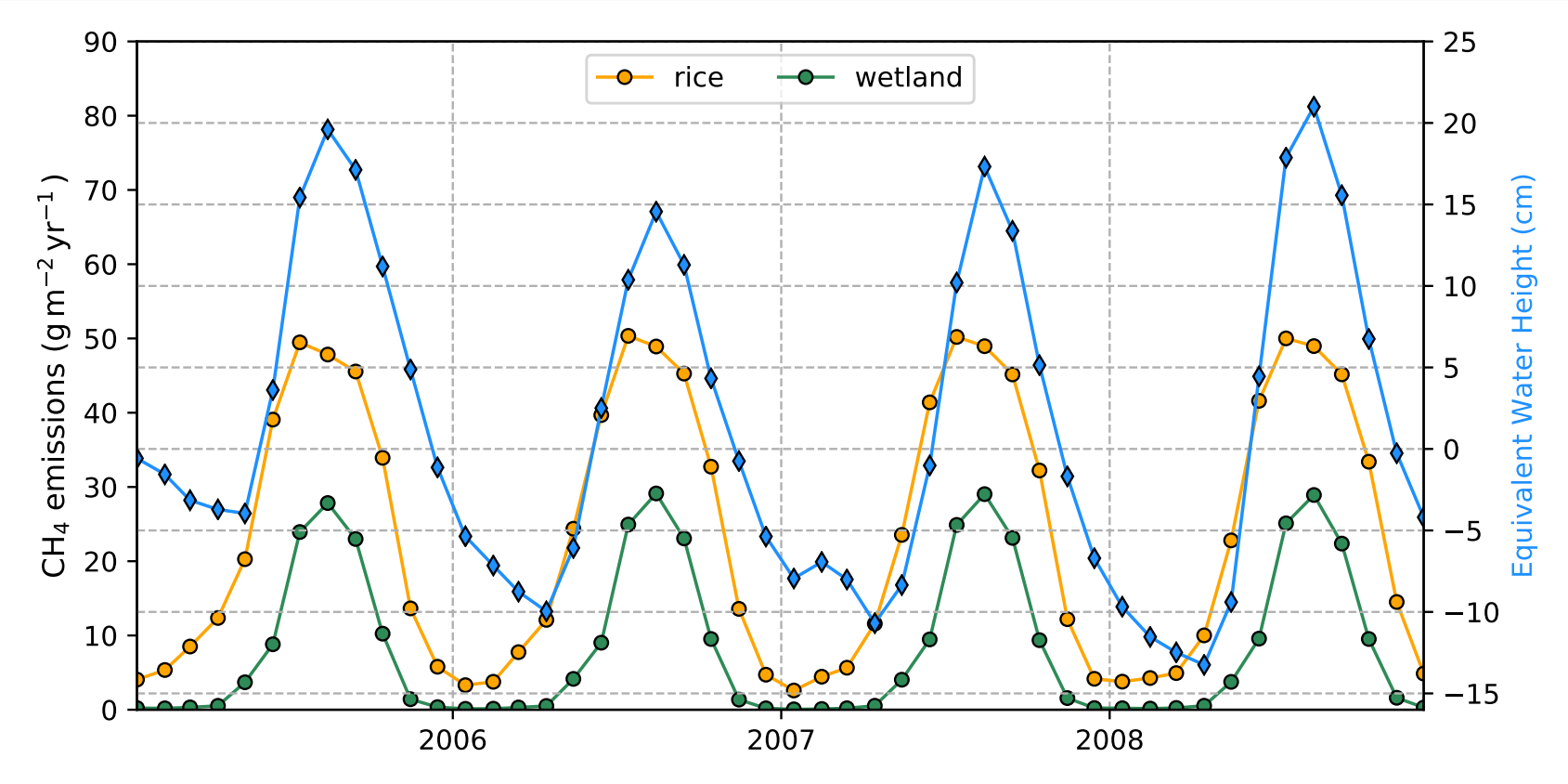
G-B-M: Correlation of CH_4 emissions with water storage



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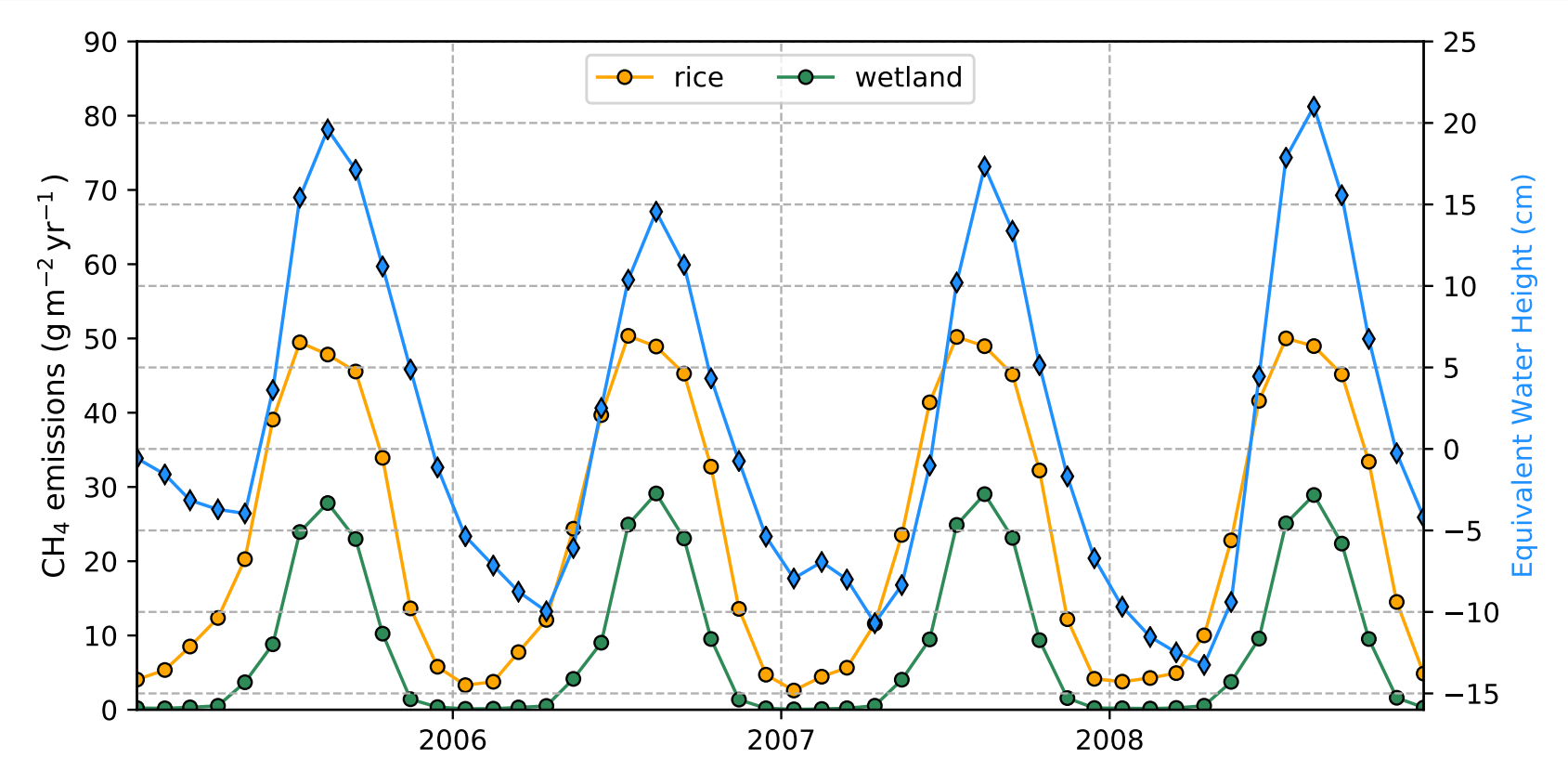

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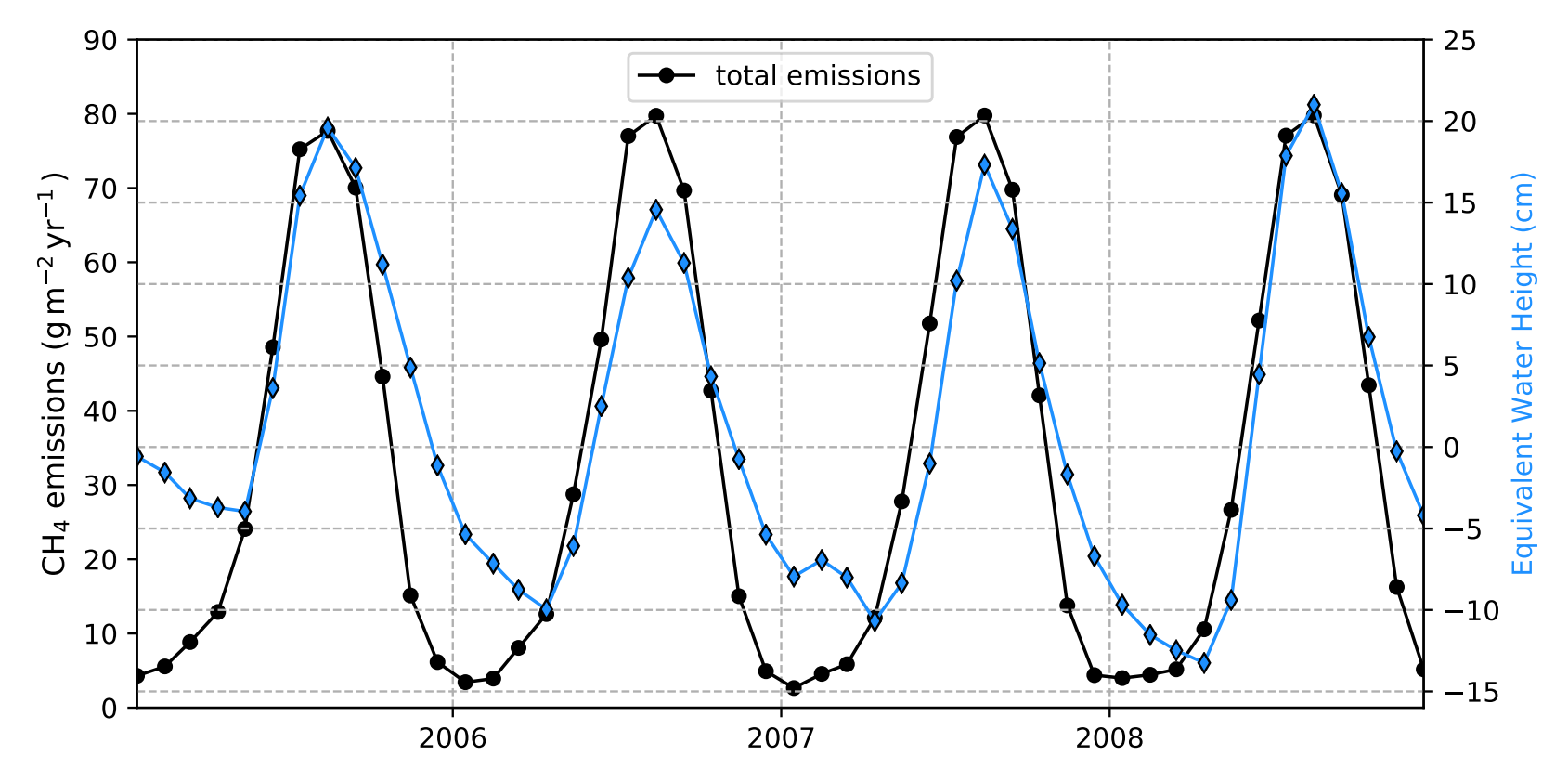
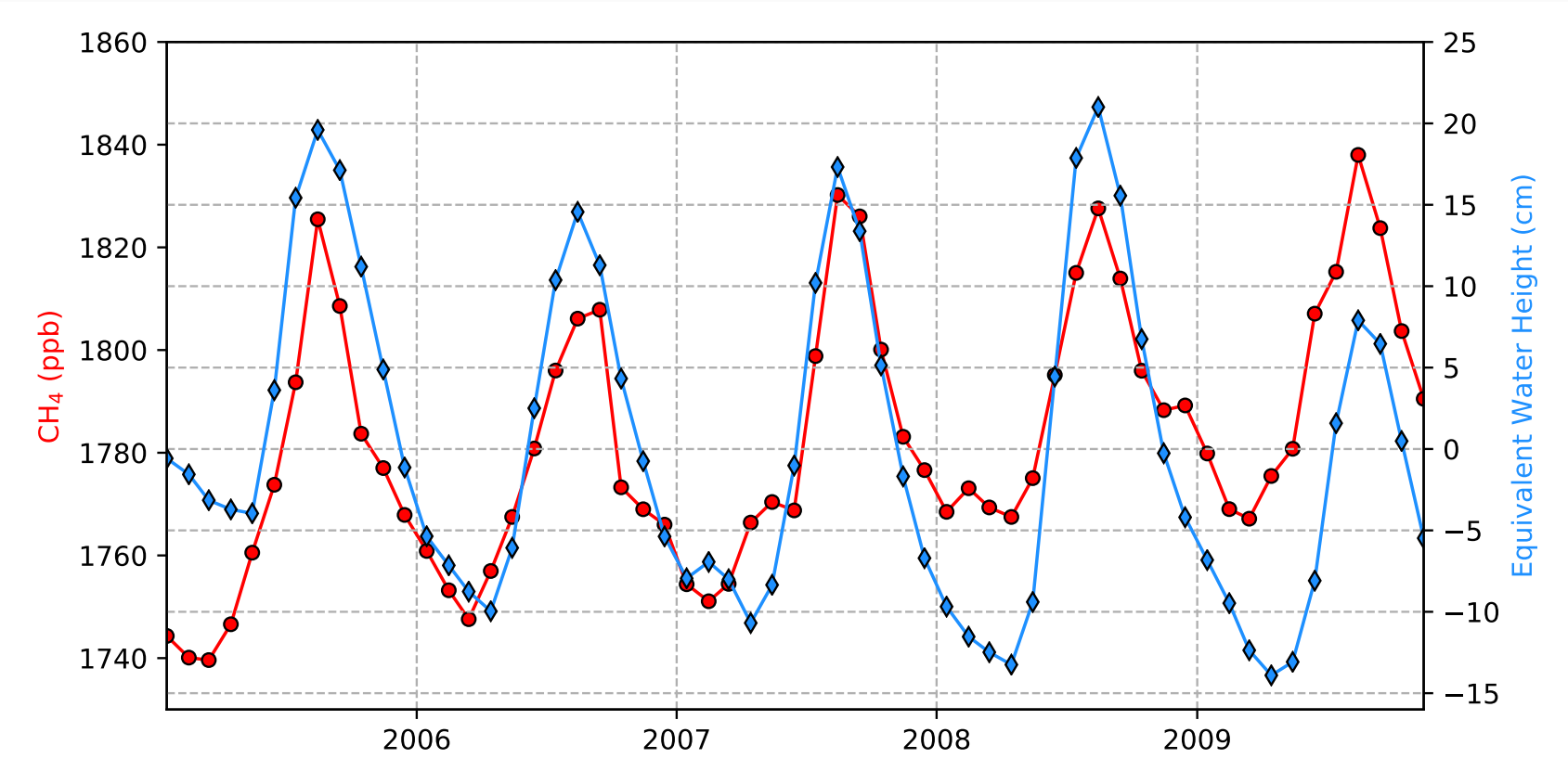


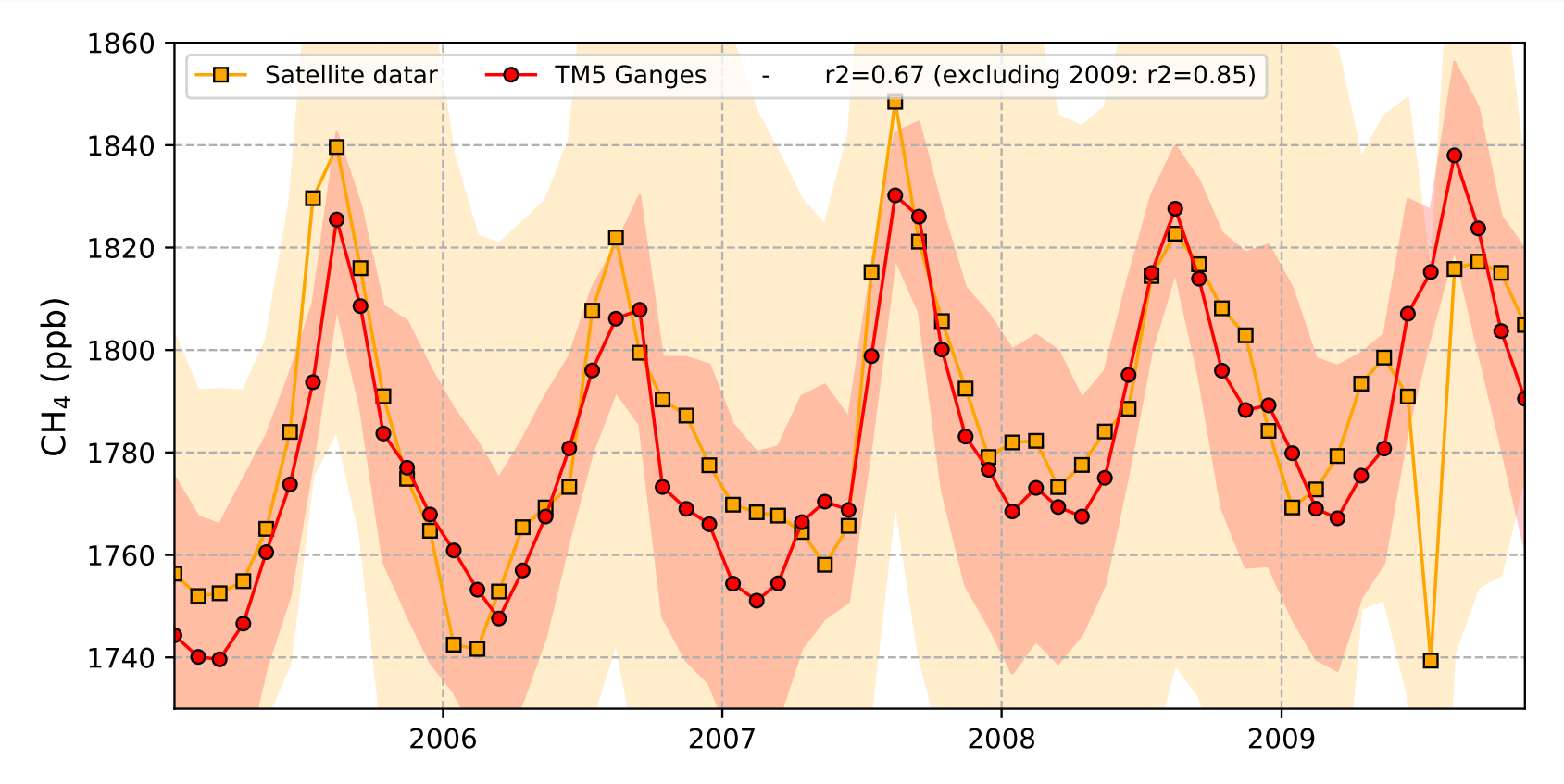
- No wetland emissions in November - April
- Rice emissions start in March
- CH_4 emissions start to rise before Equivalent Water Height

G-B-M: Correlation of atmospheric CH_4 with water storage



- CH_4 concentration rises before eq. water height

G-B-M: Correlation with satellite data



SCIAMACHY & GOSAT (EMMA [Reuter et al, 2013])

Conclusion

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  - Shift between atmospheric CH_4 & water storage [Bloom, 2010]
  - No shift between HYMN emission data and water storage

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- **Ganges-Brahmaputra-Meghna basin**
  - Decline in equvalent water height
  - High fraction of rice emissions
  - CH_4 concentration rises before Equivalent Water Height

Outlook

- Better temporal and spatial resolution
  - New satellite data:
  - GRACE-FO (Oct. 2018 - ..) $\rightarrow$ EWH data
  - Sentinel-5P (Oct. 2017 - ..) $\rightarrow$ CH_4 data

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- investigate different soil models for CH_4 emissions