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science for global insight

Sources and export of nutrients in the Zambezi River basin

Status and future trend

Ting Tang*, Maryna Strokal, Yoshihide Wada, Peter Burek, Barbara Willaarts, Carolien Kroeze, Michelle T.H. van Vliet, Simon Langan

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Nutrient enrichment has been on the rise in African water bodies

Water bodies currently suffer from

- eutrophication at some locations
- water hyacinth invasion

High **population growth**, increasing demand for food & water

How will water quality change in future?

Objective: to analyze the status and future (2050) trends of river export of nitrogen (N)

MARINA model (Strokal et al.,2016)

Model to Assess River Inputs of Nutrients to seAs

Estimate annual river exports of nutrients

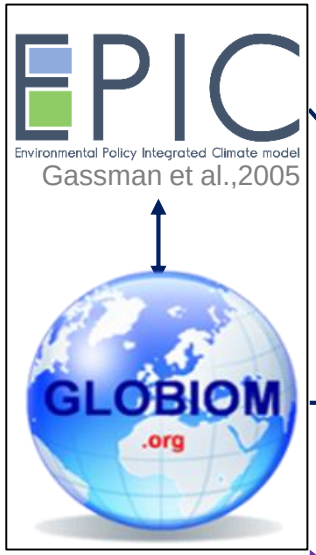
- by source
- at the sub-basin scale

Zambezi river basin

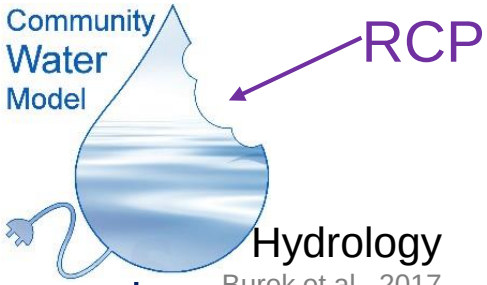
- 1.4 million km^2
- Transboundary (8 countries)
- Inh: 40 mil (2010) → 87 mil (2050)

Linking IIASA models to build up MARINA

Integrated Modeling Framework in IS-WEL project



Land use &
Diffuse sources
(Valin et al., 2013;
Byers et al., 2018)



RCP

Hydrology
Burek et al., 2017

Other data

GDP, Population, Sewer connection
N deposition, N fixation (nat)

RCP & SSP

2010

2050

BAU: SSP2&RCP6.0

RS1:

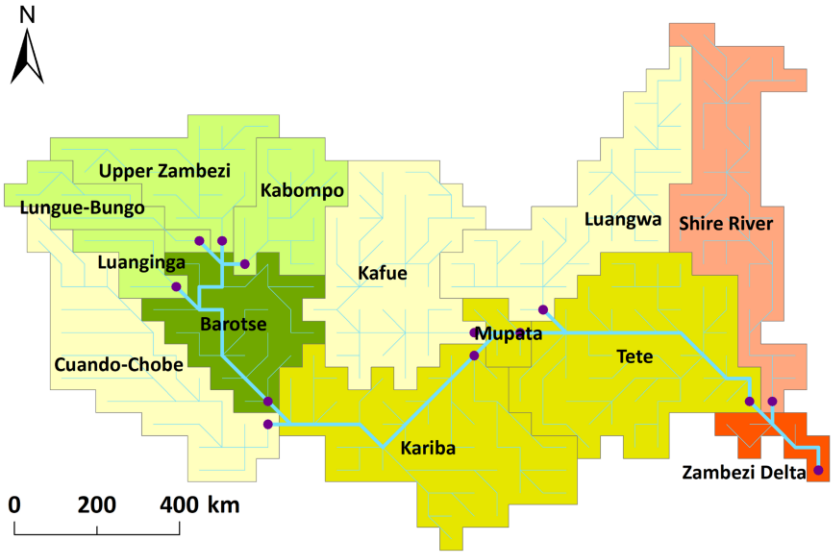
BAU + sustainability

RS2:

BAU + economy

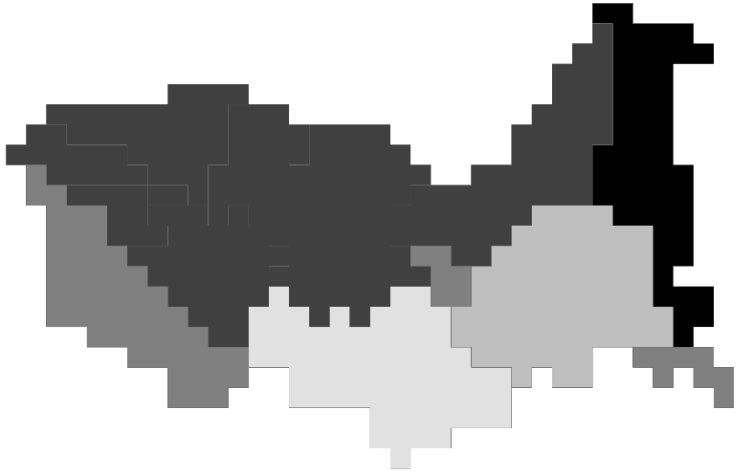
Stakeholder
engagement

Zambezi is delineated into 13 sub-basins.



Sub-basin(j)	Sub-basin with tributary (T)	Sub-basin with main channel (C)
Upstream (ju)	juT	juC
Midstream (jm)	jmT	jmC
Downsteam (jd)	jdT	jdC

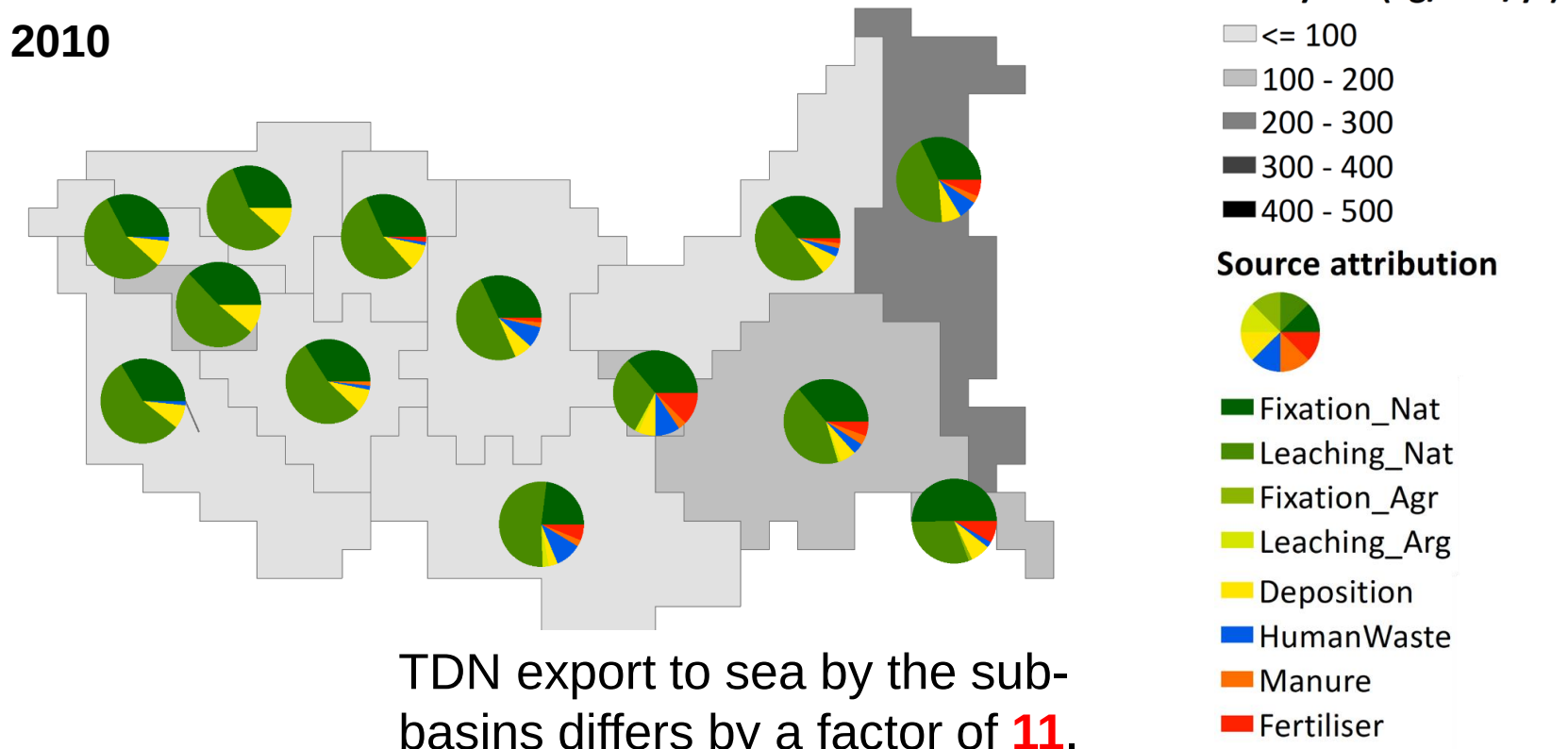
Population growth
between 2010 and 2050 (SSP2)



Population increase

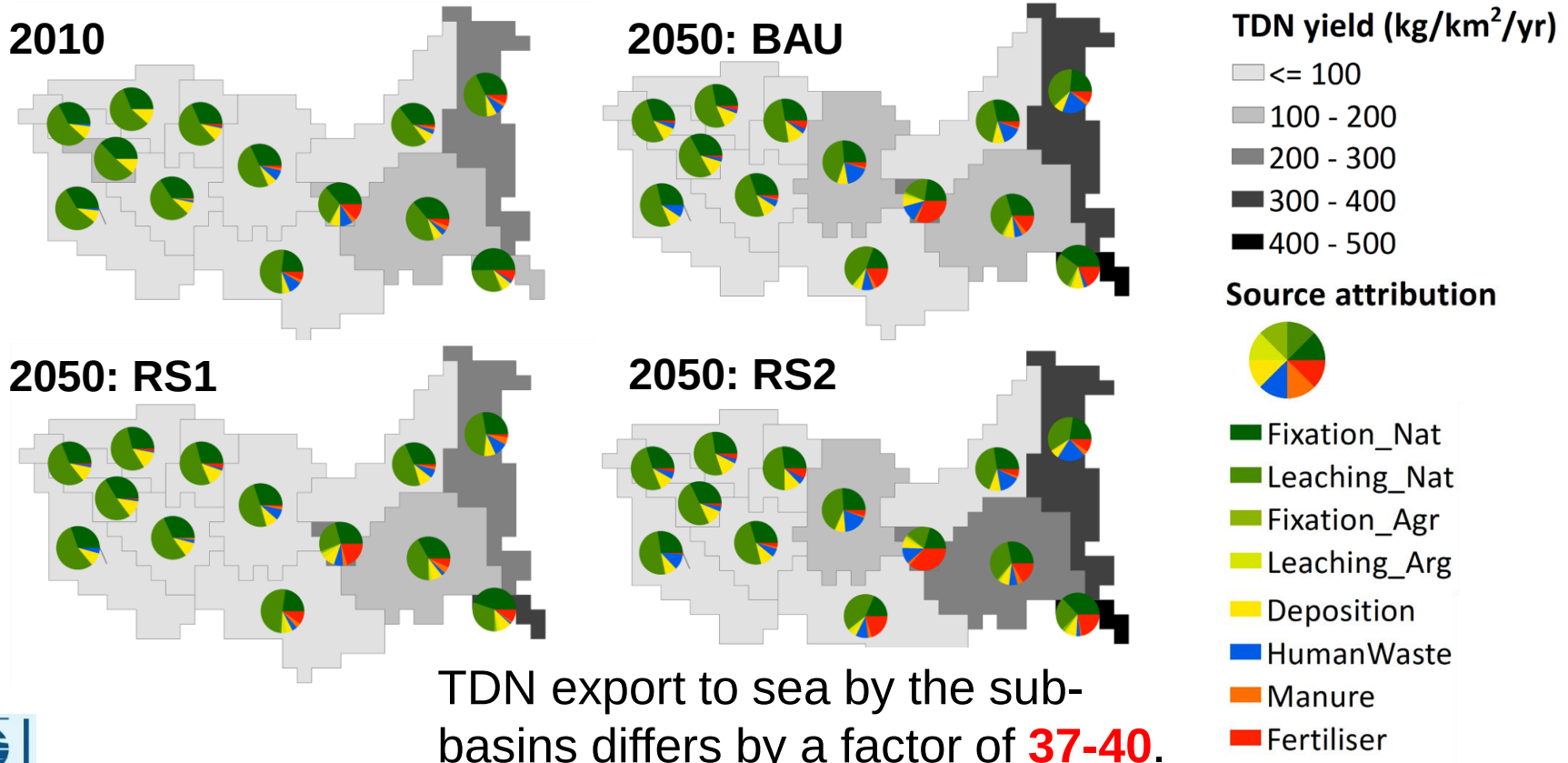
- <=40%
- 40% - 80%
- 80% - 120%
- 120% - 160%
- 160% - 200%

Total dissolved N (TDN) export to sea and its future changes are highly variable in space



TDN export to sea by the sub-basins differs by a factor of **11**.

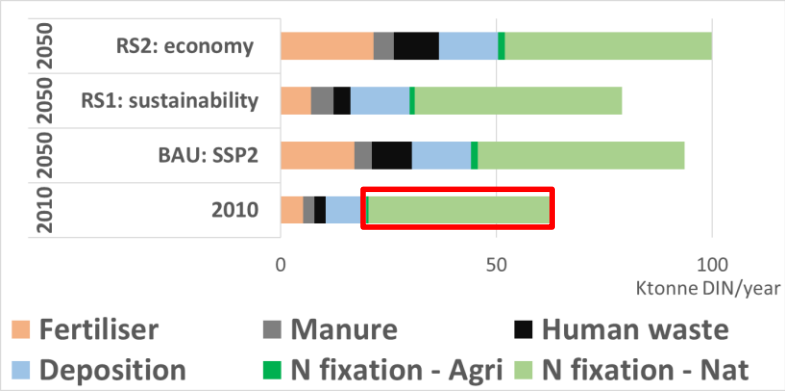
Total dissolved N (TDN) export to sea and its future changes are highly variable in space



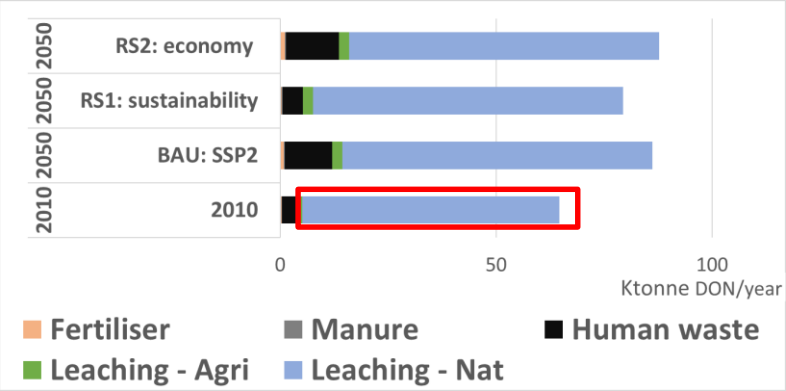
TDN export to sea by the sub-basins differs by a factor of **37-40**.

N export is dominated by natural sources with increasing contribution from human activities.

Dissolved inorganic nitrogen (DIN)



Dissolved organic nitrogen (DON)



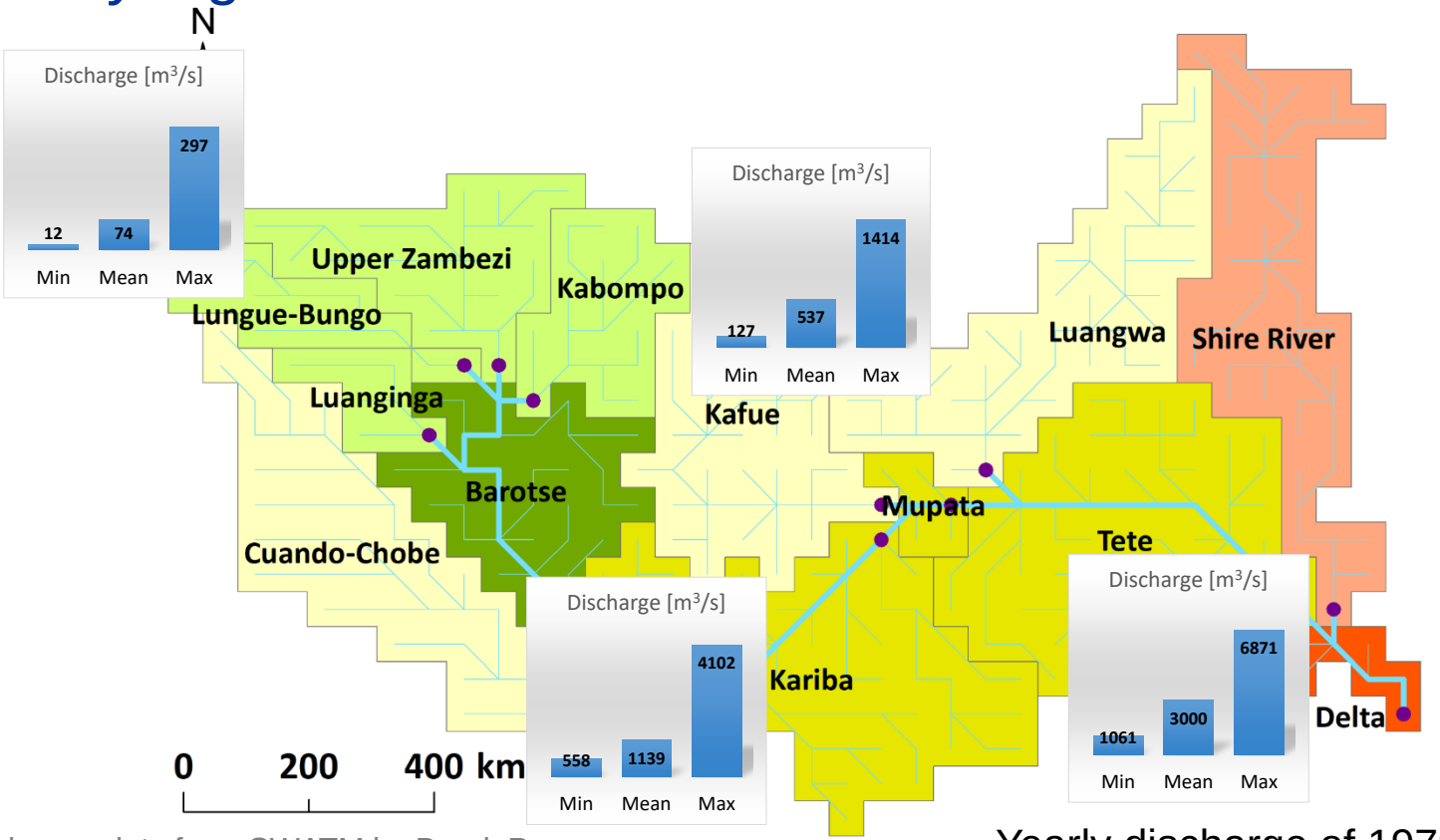
Dominate sources

- Fixation
- Leaching

25-50% increase of TDN export

- Mainly due to human activities
- Wetting climate projection also plays a role.

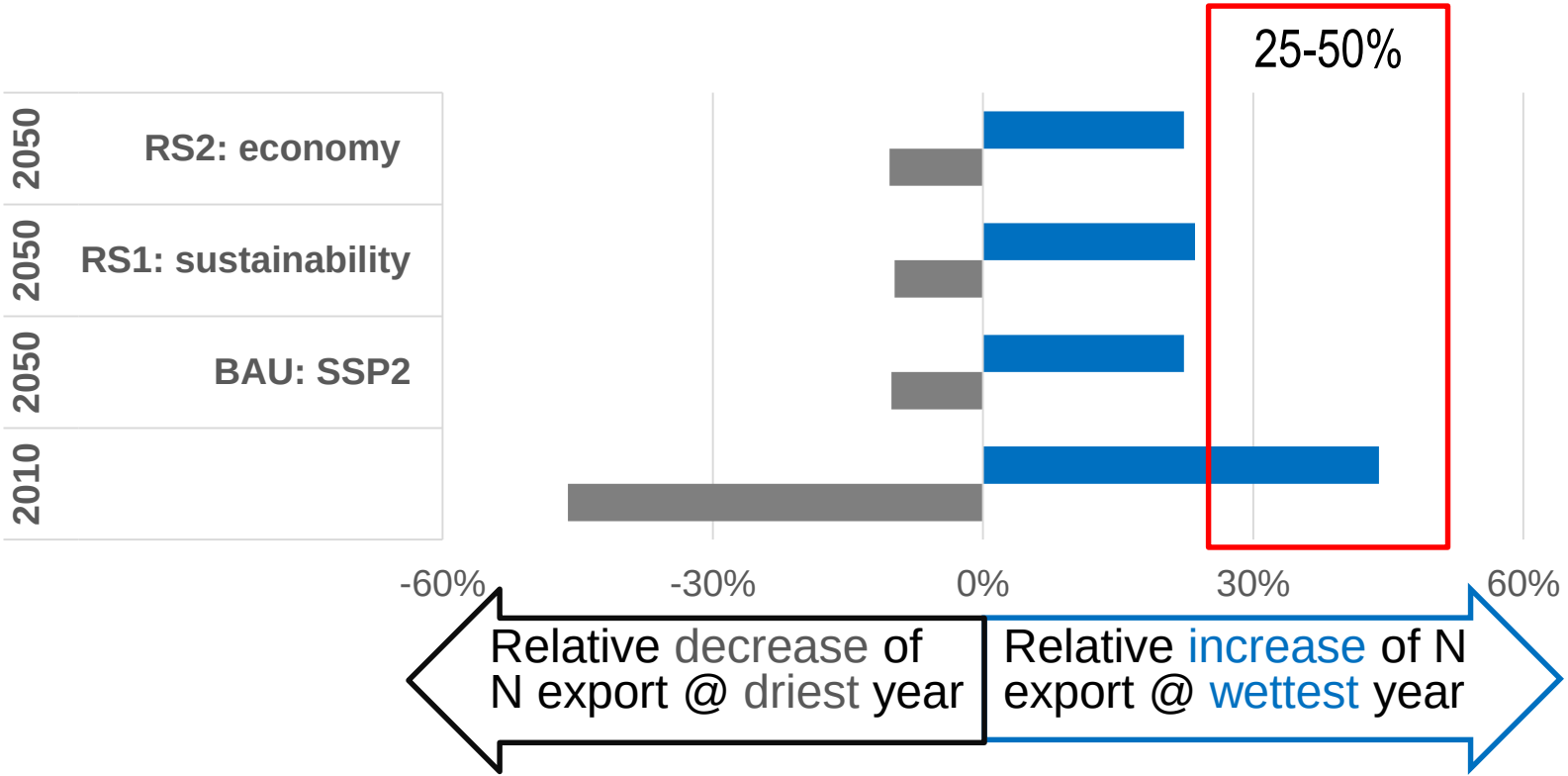
Inter-annual variabilities of rainfall and discharge are very high in the basin.



Discharge plots from CWATM by Burek P.

Yearly discharge of 1979-2013

Influence of **climate variability** on N export is at similar level to that of increasing human activities.



Take home messages

N export is dominated by **natural sources** with increasing contribution from **human activities** in Zambezi.

Climate variability is an important factor in N export.

N export in the Zambezi basin is **highly variable in space.**

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