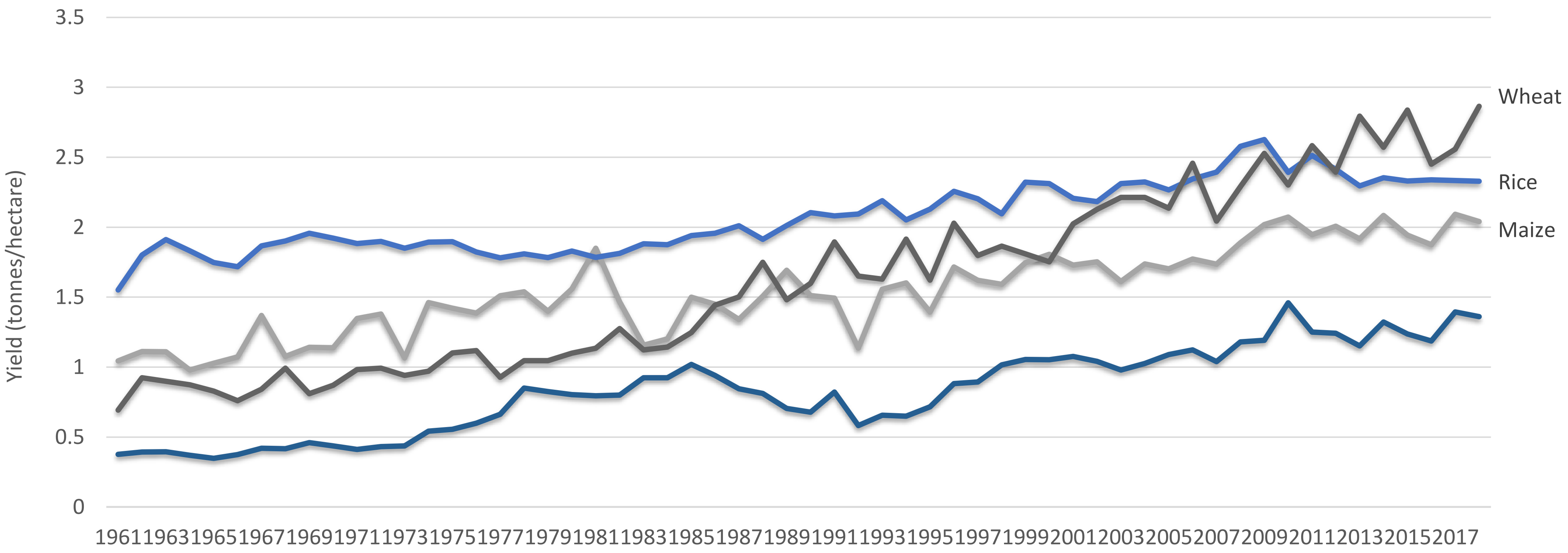
Food and water security major concern

Increasing population and dietary changes put pressure on our food and water resources

Changing climate means unpredictability in the availability of our water resources

Food and water security major concern



More frequent occurrences of extreme weather events causes year to year variations in crop yields. For all these reasons its critical to be able to understand food and water availability for the future

Using global crop models to predict impacts of climate change on crop water productivity across Africa

Presentation during coronavirus, April 2020

VUB
Imeshi WEERASINGHE
Prof. Ann van Griensven
Prof. Wim Bastiaanssen

Water Productivity

YIELD (weight)

CROP WATER PRODUCTIVITY =

WATER CONSUMED (volume)

Outline of paper

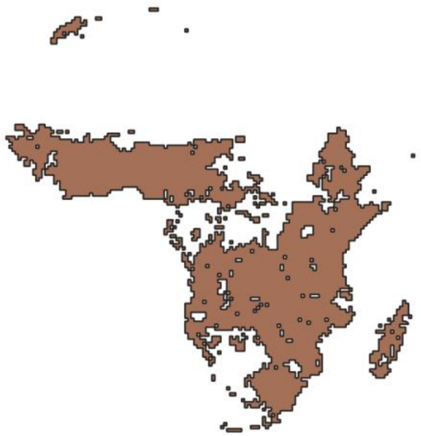
- Open access models with output yield and ET data
- Within the ISIMIP framework 2a and 2b protocols
- Evaluation of 2a model outputs
- Future trends from 2b data

Evaluation

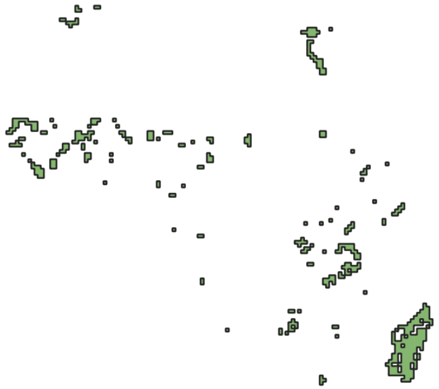
- Based on FAO harvested yield data (annual)
- Based on CMRSET ET data (annual)

Shapefiles of used irrigated and rainfed crops

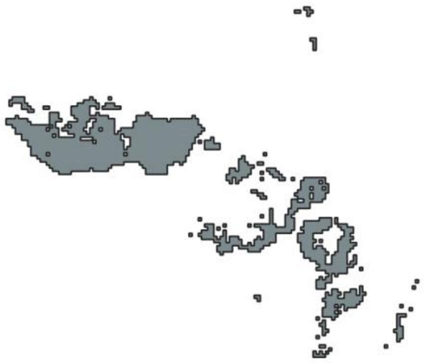
Irrigated maize



Rainfed maize



Irrigated rice



Rainfed rice

ISIMIP 2a

Models

- CGMS-WOFOST
- CLM-Crop
- EPIC-BOKU
- GEPIC
- LPJ-Guess
- LPJmL
- ORCHIDEE-Crop
- PAPSIM
- PDSSAT
- PEPIC

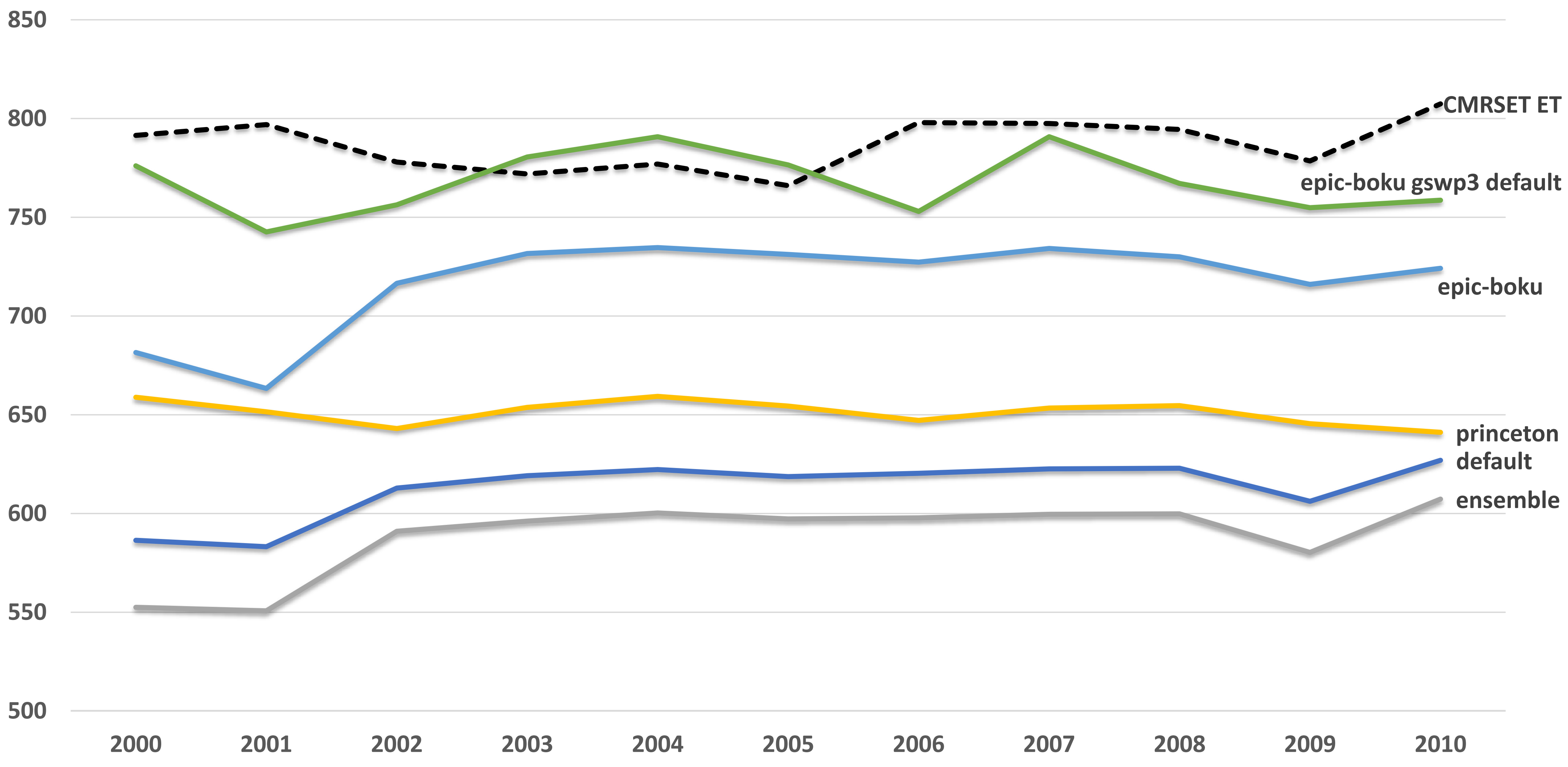
Forcings

- GSWP3
- PRINCETON
- WATCH
- WFDEI

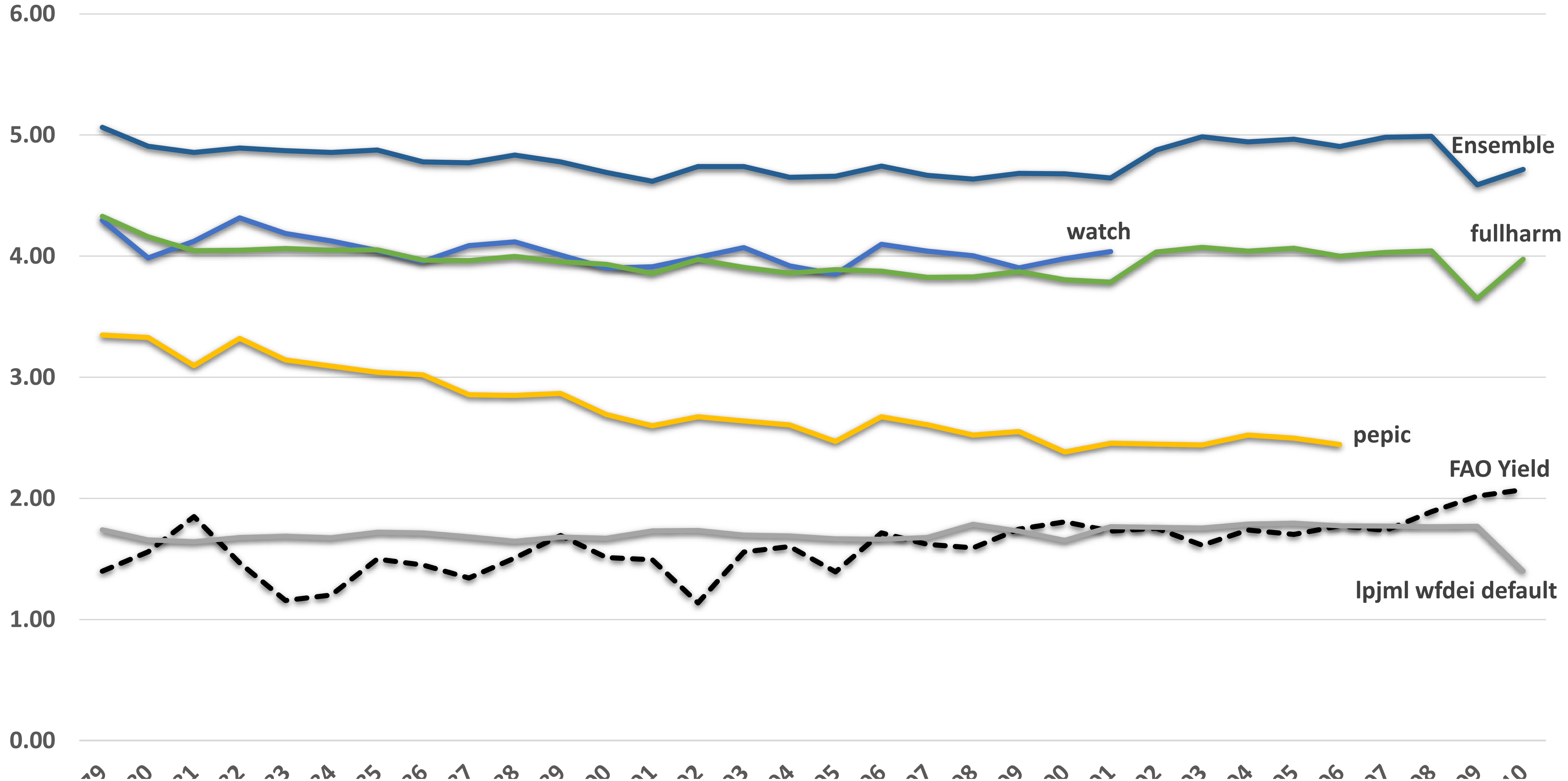
SCENARIOS

- Default
- Fullharm
- Harmnon

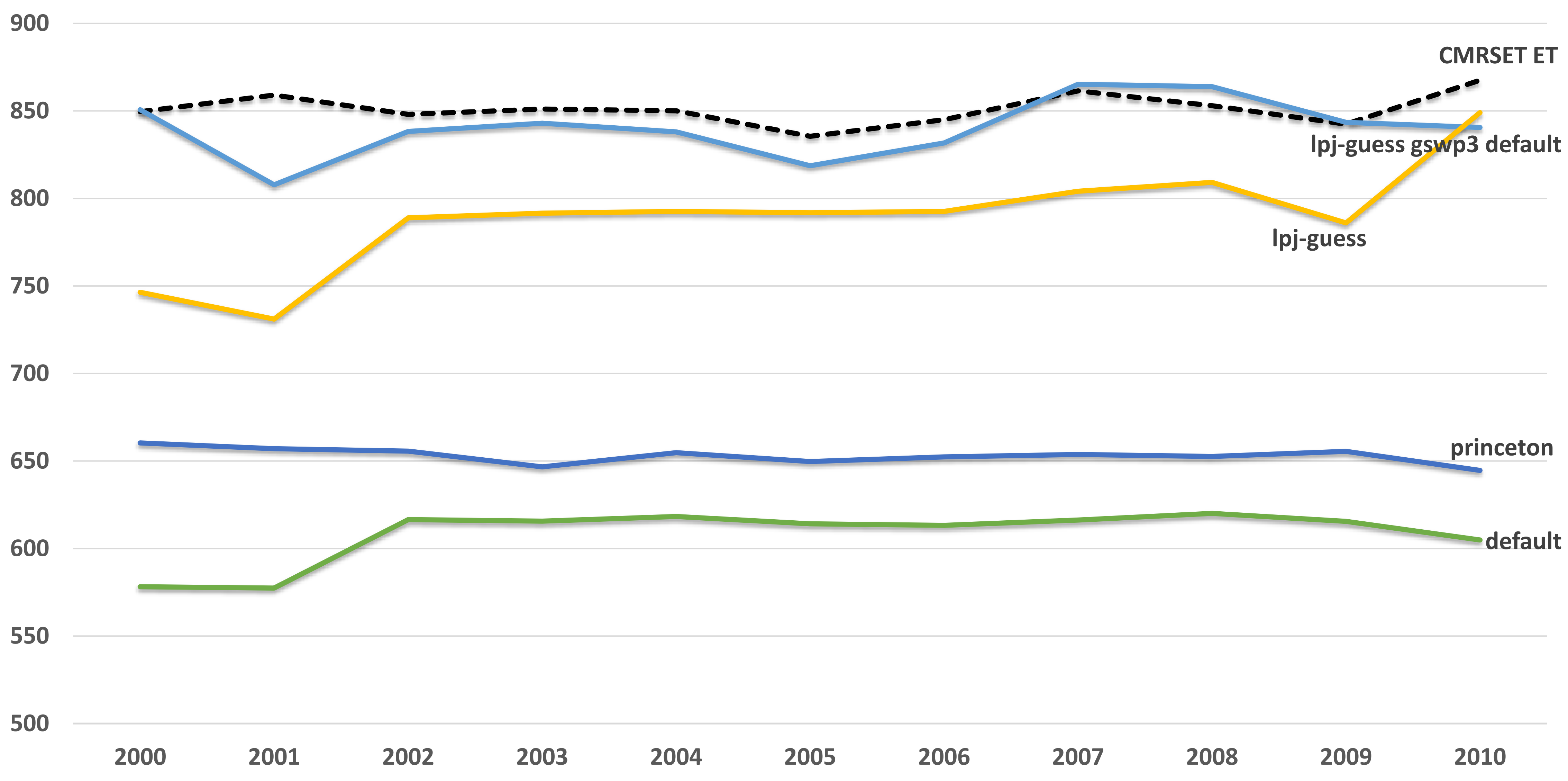
Evaluation – Maize AET (mm/year)



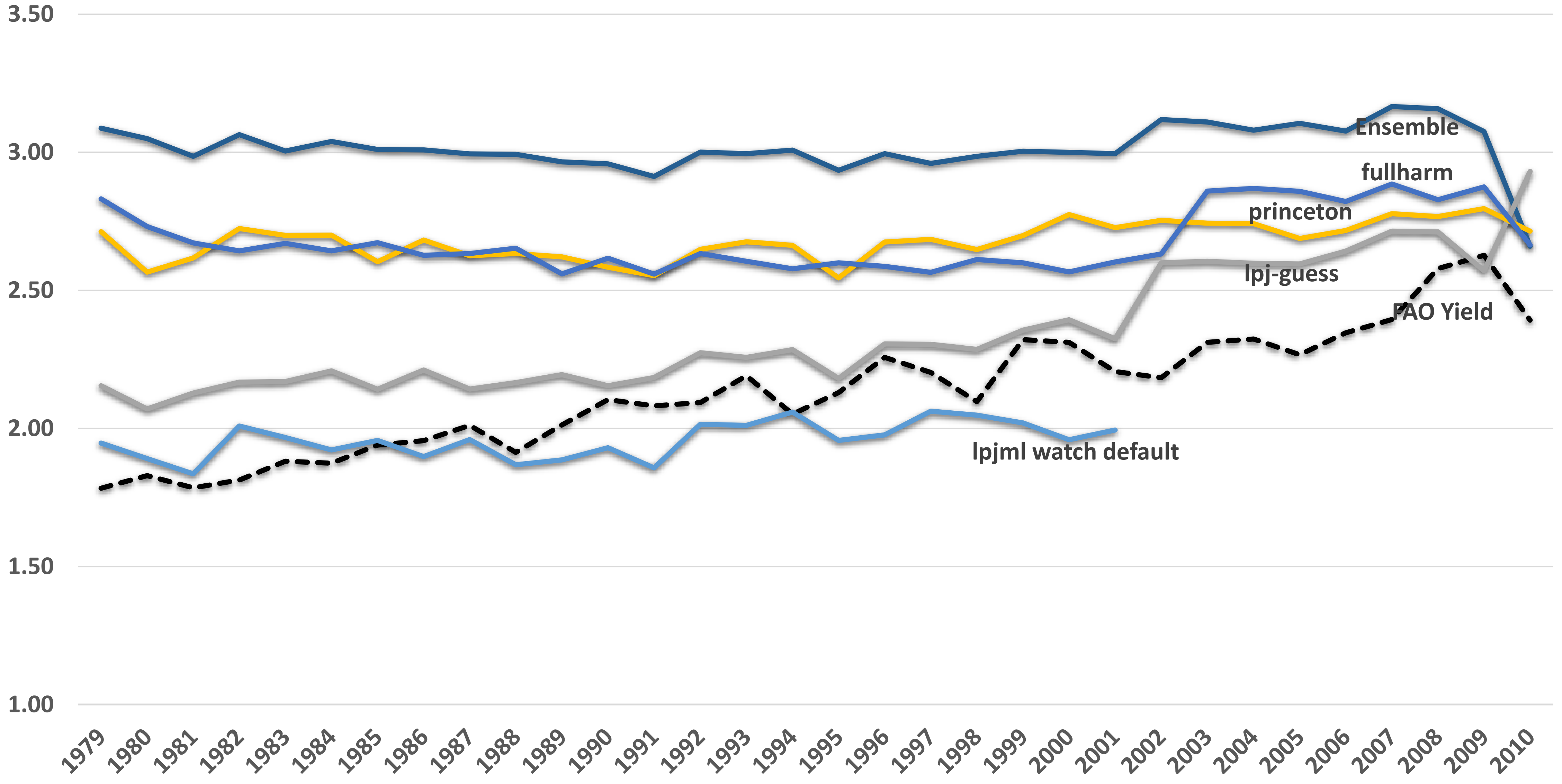
Evaluation – Maize Yield (tonnes/hectare)



Evaluation – Rice AET (mm/year)



Evaluation – Rice Yield (tonnes/hectare)



Summary 2a evaluation

Variable	Individual Run (bias)	Average Model (bias)	Average Forcing (bias)	Average Scenario (bias)
Maize AET	Epic Boku-GSWP3-Default	Epic Boku	Princeton	Default
Rice AET	Lpj Guess-GSWP3-Default	Lpj Guess	Princeton	Default
Soy AET	Lpj Guess-GSWP3-Defaut	Lpj Guess	Princeton	Default
Wheat AET	Orchidee Crop-Wfdei-Fullharm	Epic Boku	GSWP3	Harmnon
Maize Yield	Lpjml-WFDEI-Default	Pepic	Watch	Fullharm
Rice Yield	Lpjml-Watch-Default	Lpj Guess	Princeton	Fullharm
Soy Yield	Gepic-Watch-Fullharm	Gepic	GSWP3	Fullharm
Wheat Yield	Lpj Guess-Watch-Harmnon	Clm Crop	Watch	Fullharm

ISIMIP 2b

Models

- GEPIC
- LPJmL
- PEPIC

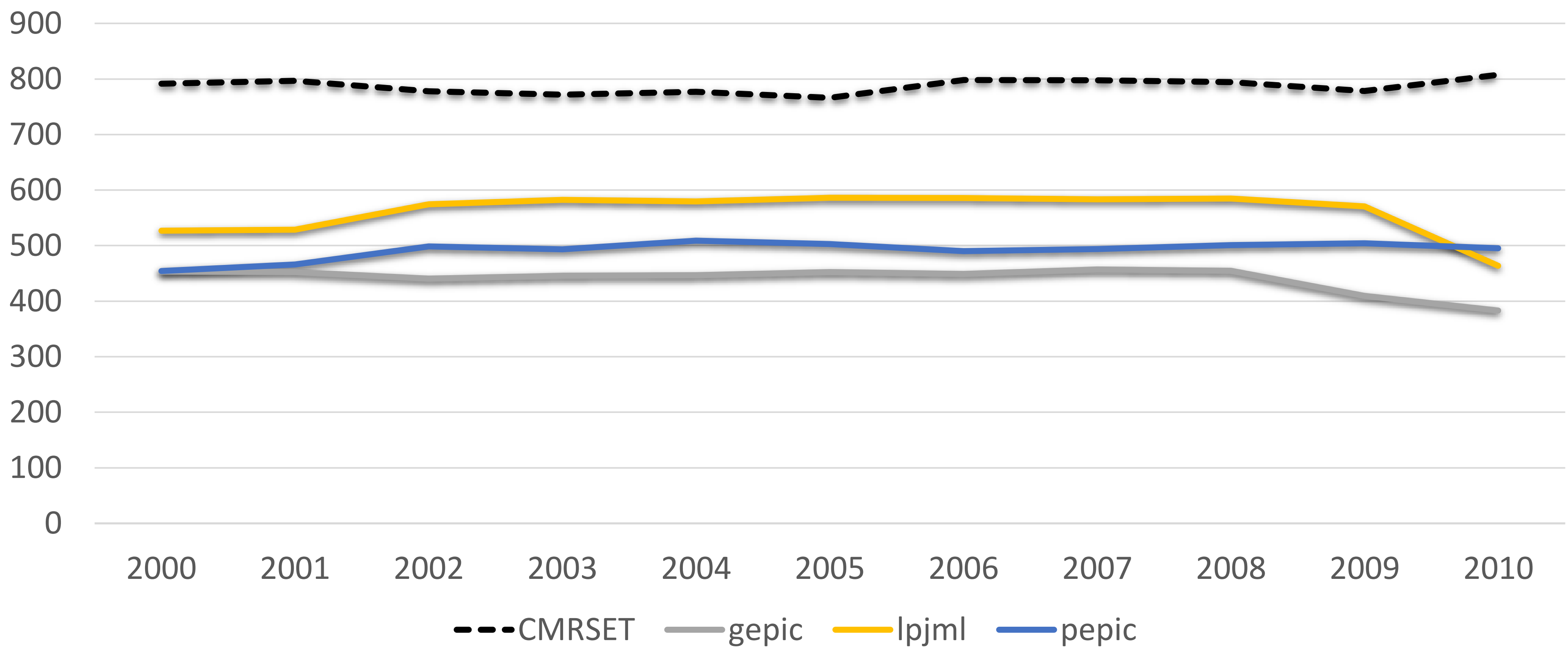
Forcings

- GFDLS-ESM2m
- HADGEM2-ES
- IPSL-CM5a-LR
- MIROC5

SCENARIOS

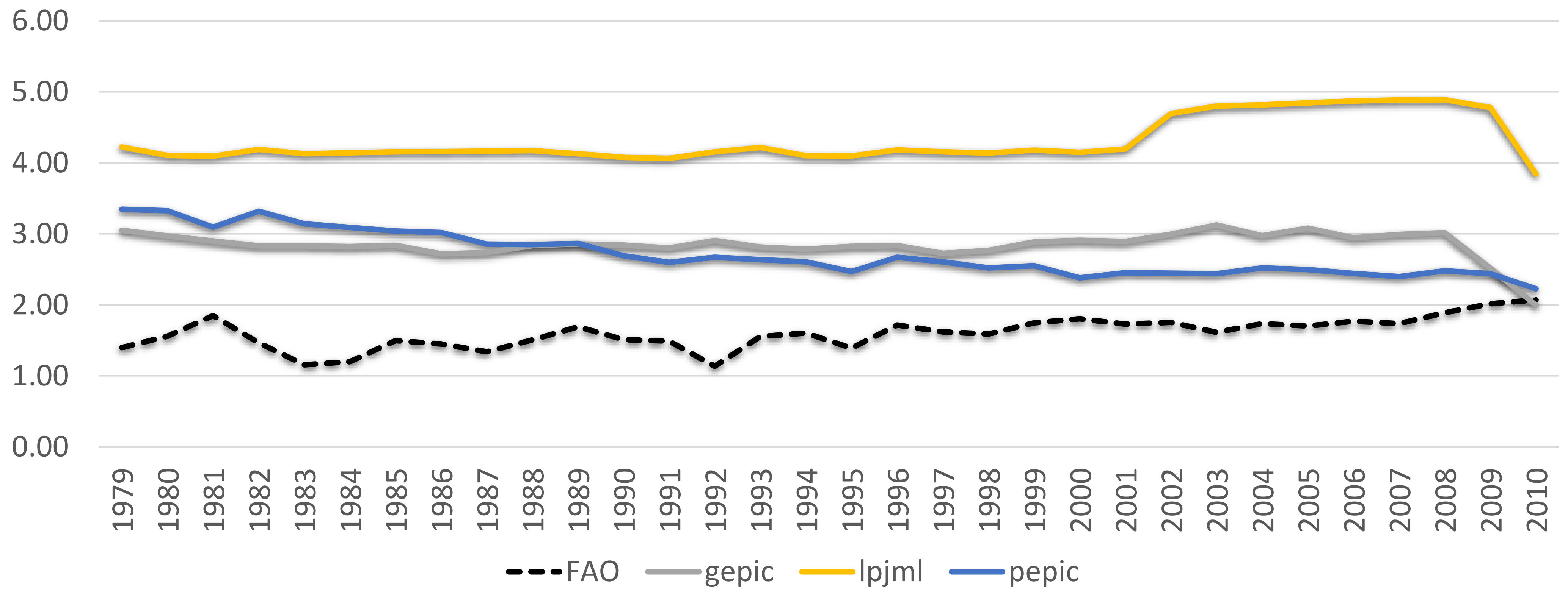
- PICONTROL
- HISTORICAL
- FUTURE

Evaluation – Maize AET (mm/year)



For the three models with output data available in 2b, the above graph shows the AET evaluation on their average performance within the 2a (historical) using all forcings and scenarios.

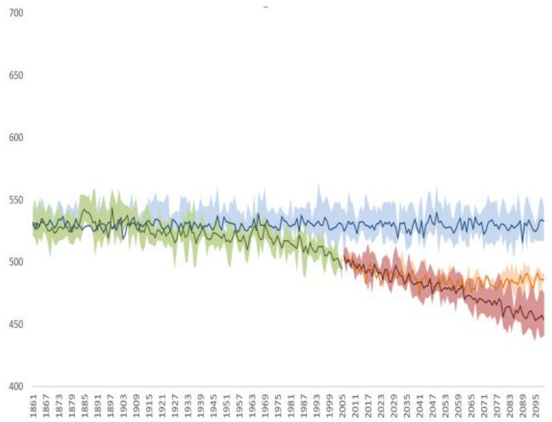
Evaluation – Maize Yield (tonnes/hectare)



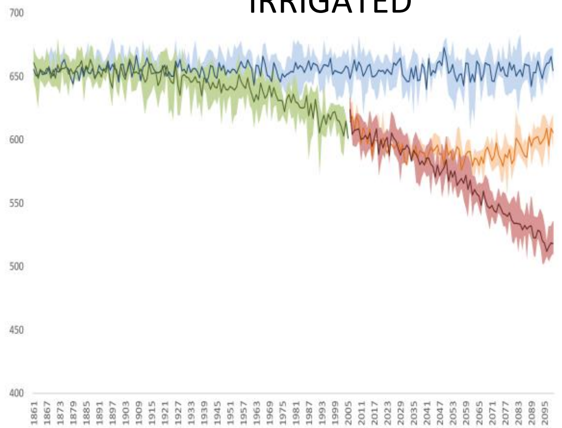
For the three models with output data available in 2b, the above graph shows the Yield evaluation on their average performance within the 2a (historical) using all forcings and scenarios.

Future Projects – Maize AET (mm/year)

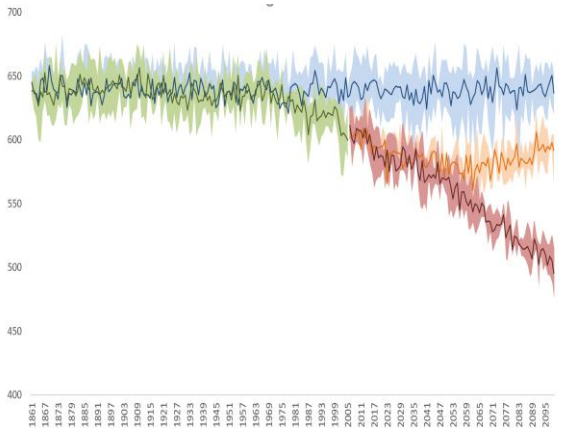
IRRIGATED



GEPIC



LPJML



PEPIC

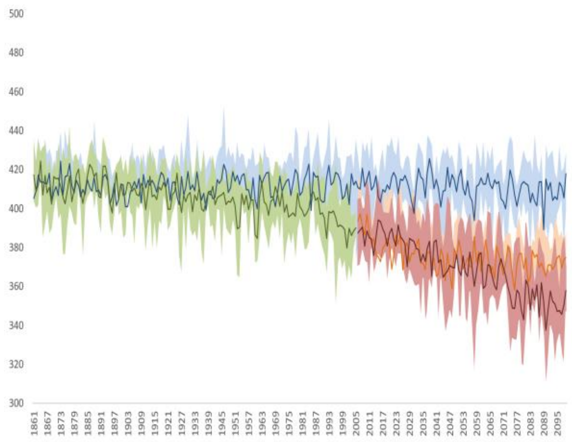
No human influence

Historical

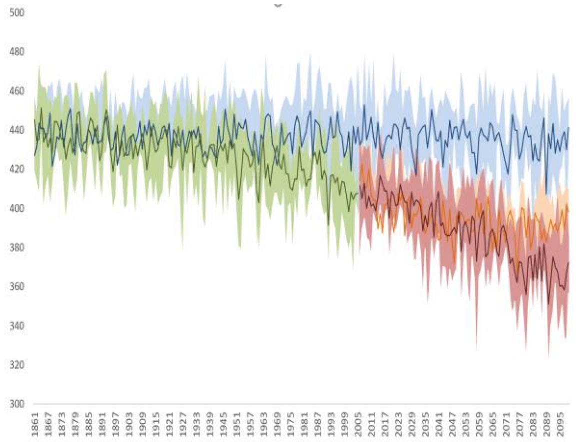
RCP2.6

RCP6.0

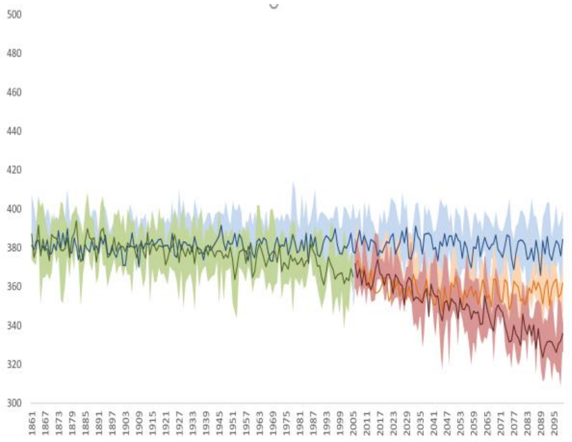
RAINFED



GEPIC



LPJML

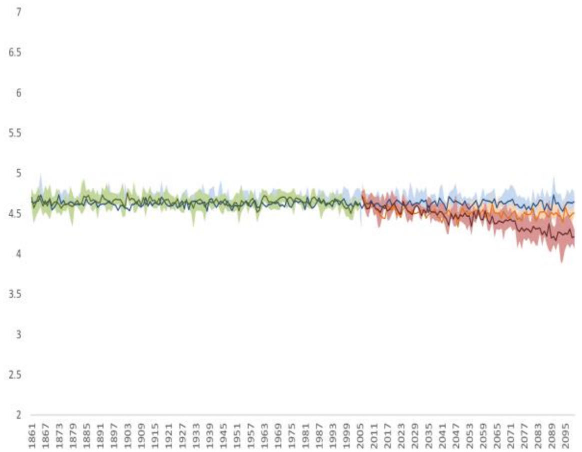


PEPIC

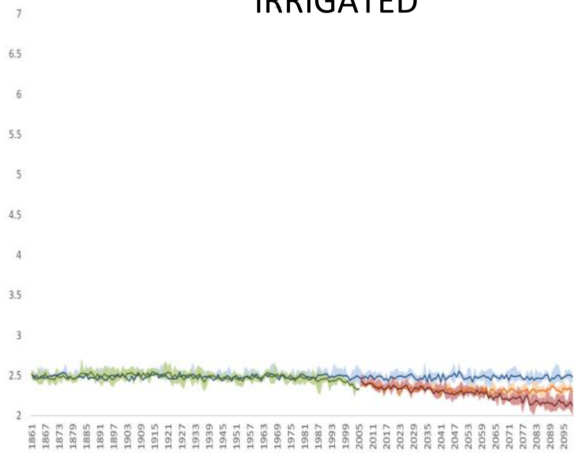
All model averages and both rcp2.6 and rcp6.0 show a downward trend in maize AET

Future Projects – Maize Yield (hg/ha)

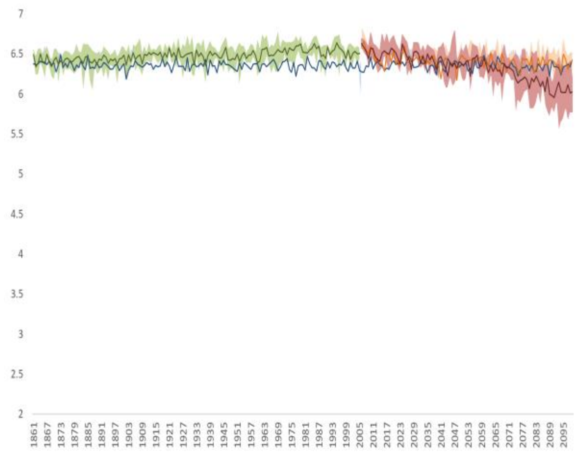
IRRIGATED



GEPIC



LPJML



PEPIC

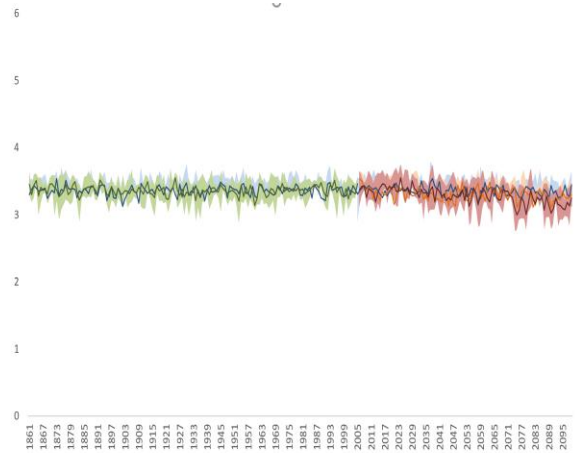
No human influence

Historical

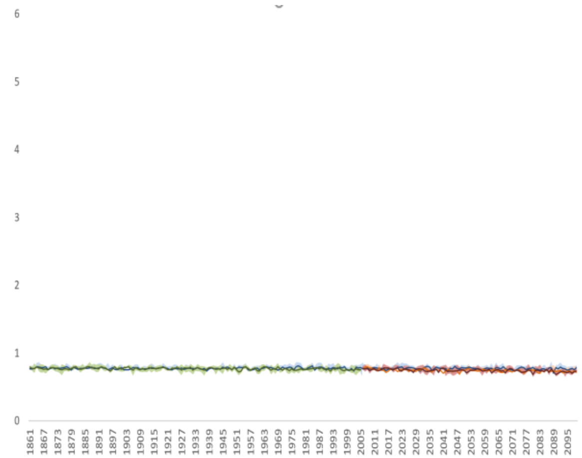
RCP2.6

RCP6.0

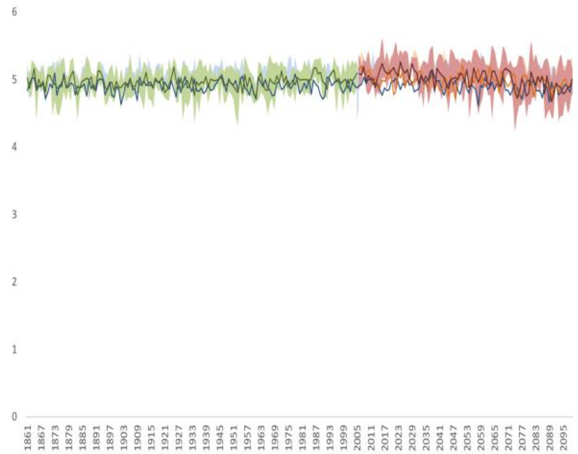
RAINFED



GEPIC



LPJML

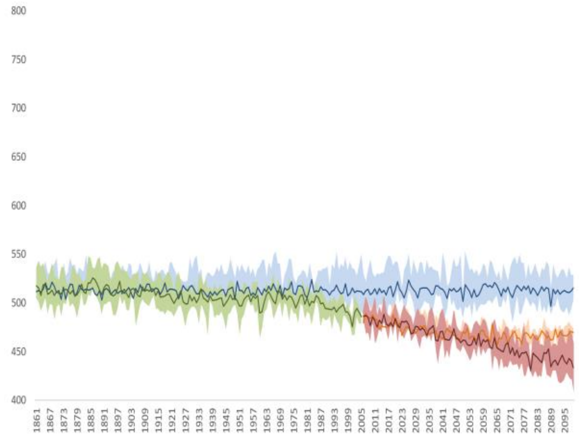


PEPIC

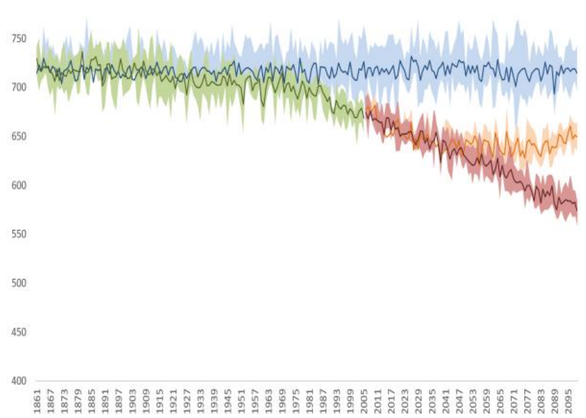
Most model averages and both rcp2.6 and rcp6.0 show a downward trend in maize Yield

Future Projects – Rice AET (mm/year)

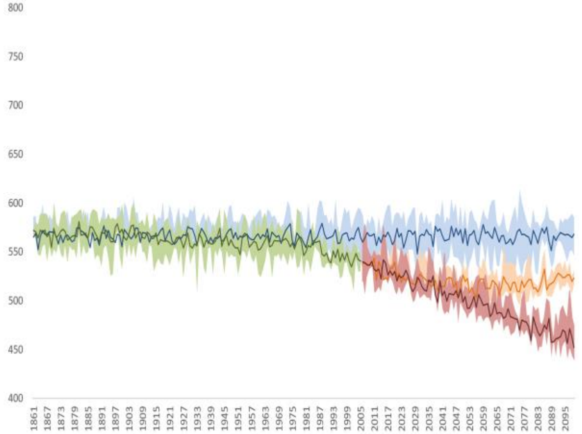
IRRIGATED



GEPIC



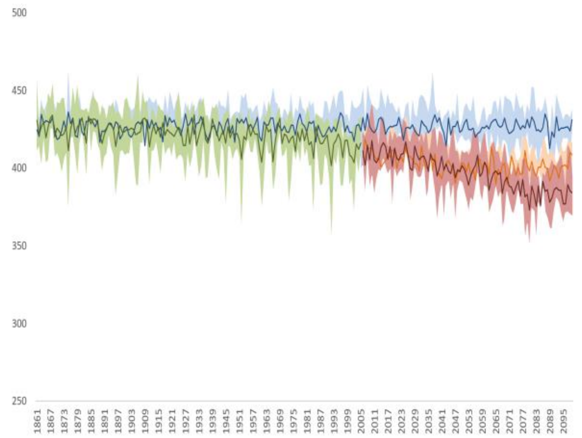
LPJML



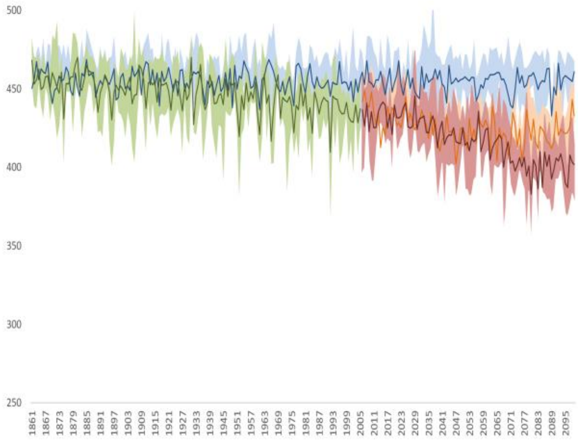
PEPIC

- No human influence
- Historical
- RCP2.6
- RCP6.0

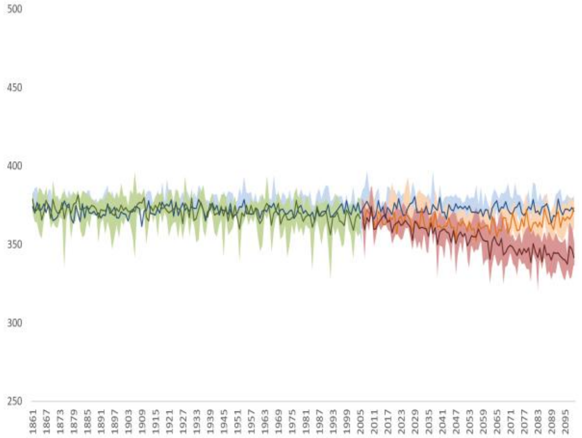
RAINFED



GEPIC



LPJML

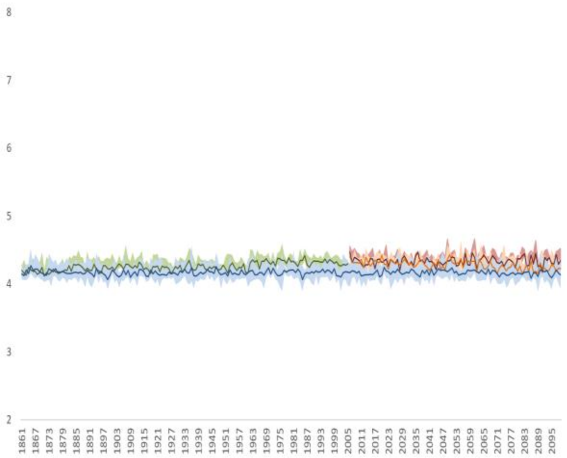


PEPIC

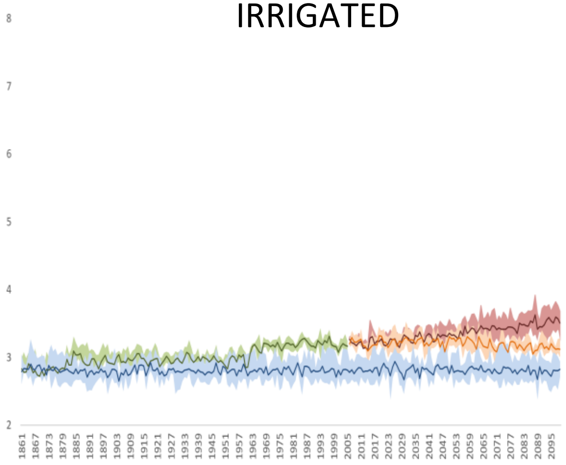
All model averages and both rcp2.6 and rcp6.0 show a downward trend in rice AET

Future Projects – Rice Yield (hg/ha)

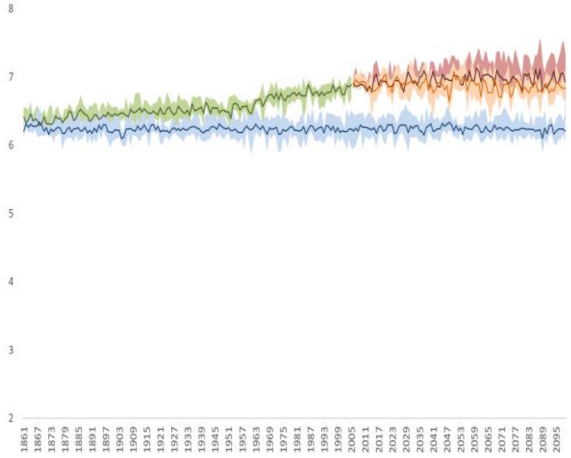
IRRIGATED



GEPIC



LPJML



PEPIC

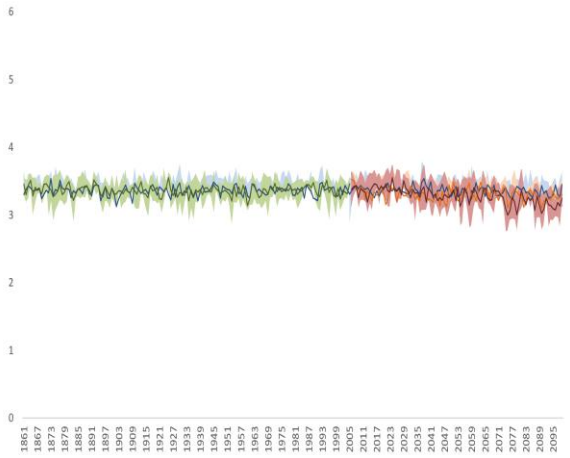
No human influence

Historical

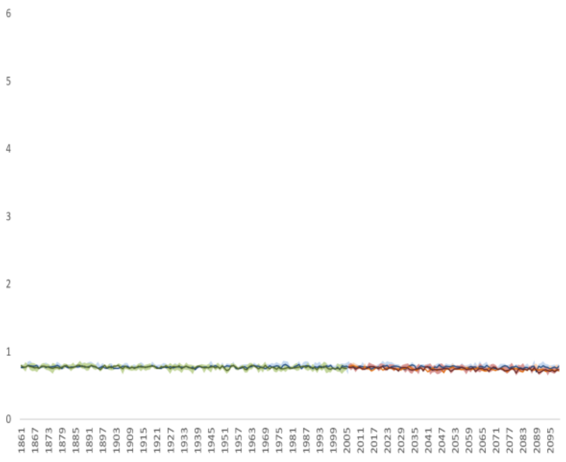
RCP2.6

RCP6.0

RAINFED



GEPIC



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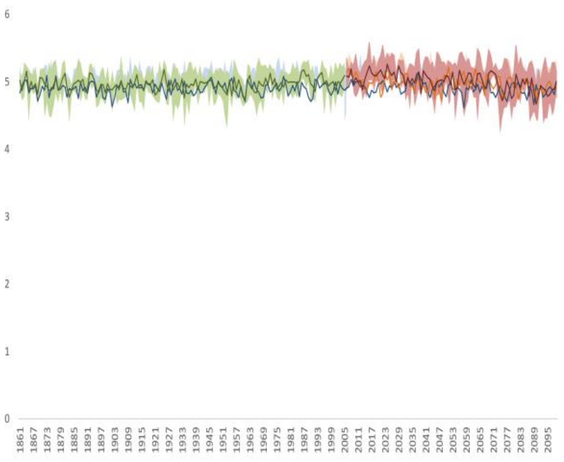
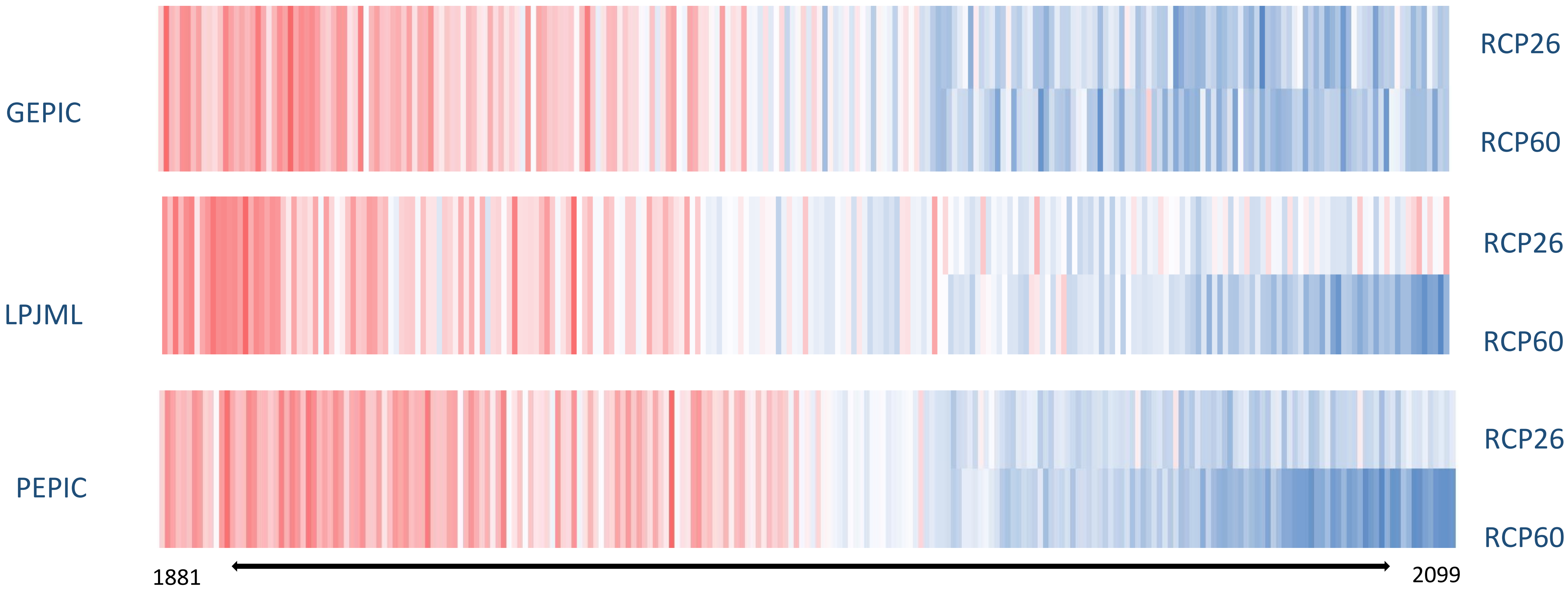


PEPIC

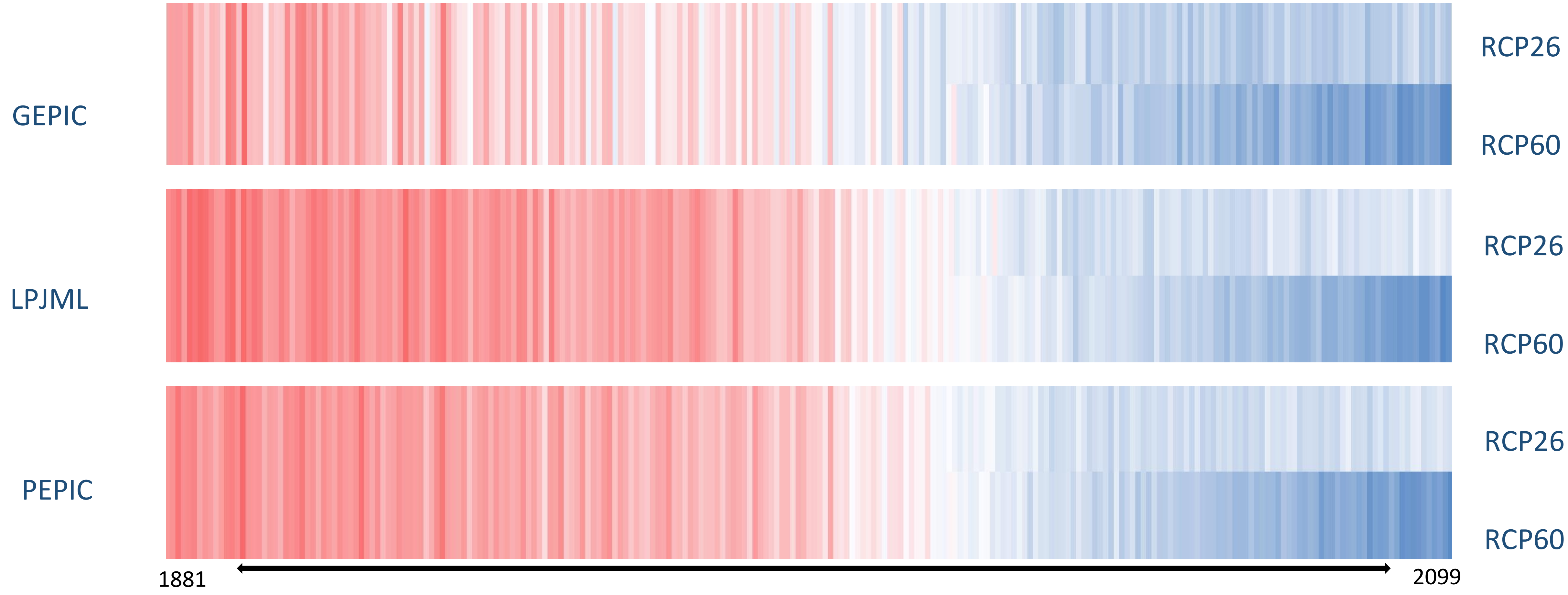
Most model averages and both rcp2.6 and rcp6.0 show an upward trend in rice Yield

Future Projects – WP Irrigated Maize anomaly (kg/km^3)



An increasing trend in Maize Water Productivity can be seen. This is most likely due to the fact that there is a larger decrease in maize AET than maize Yields.

Future Projects – WP Irrigated Rice anomaly (kg/km³)



An increasing trend in Rice Water Productivity can be seen. An increase in rice yield and a decrease in aet ensures this trend.

Current Conclusions – 2a

- no clear consensus in predicting yield or ET
- Ensemble product generally goes in the same trend however there is a large bias
- EPIC-BOKU and LPJ-GUESS, Princeton and default better at predicting AET
- Fullharm scenario better at predicting yield

Current Conclusions – 2b

- Most models predict downward trend in maize yields and aet
- All models predict downward trend in rice aet
- All models predict upward trend in irrigated rice yields
- No clear trend in rainfed rice yields
- Magnitudes are very different amongst models

Further work

- Calculation of WP anomaly graphs

- Same analysis for African countries

THANK YOU

QUESTIONS