# EVALUATION OF NEW IRRIGATION SCHEME IN CTSM

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29/04/2021, Brussels

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Image from imaggeo.com

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- Evaluation
- Sensitivity test

# CONTENTS

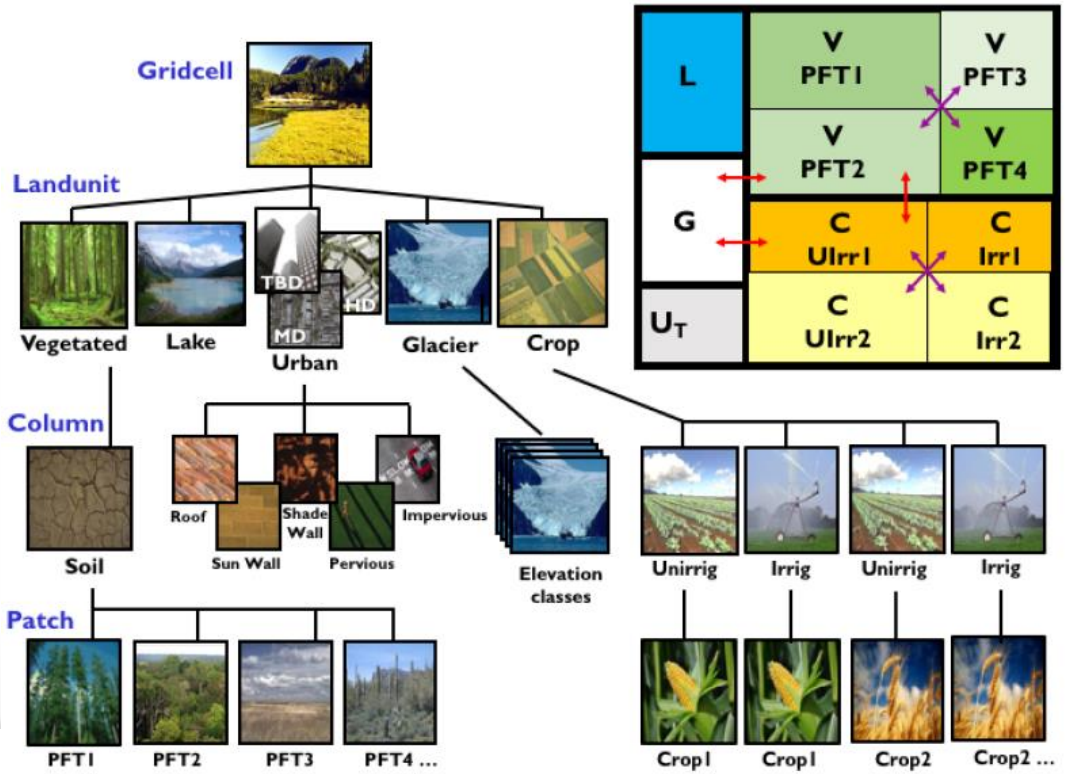
- Implementation

# IRRIGATION DATASET IN CLM5

**Surface dataset:** plant function types (crop): rainfed (pftcon%irrigated(pft_type) = 0)
irrigated (pftcon%irrigated(pft_type) = 1)

if pftcon%irrigated(pft_type) = 0, don't do irrigation:

if pftcon%irrigated(pft_type) = 1, do irrigation.




(CLM5 Documentation, 2020)

# BUILDING NEW SURFACE DATASET

**Surface dataset: add a new variable**

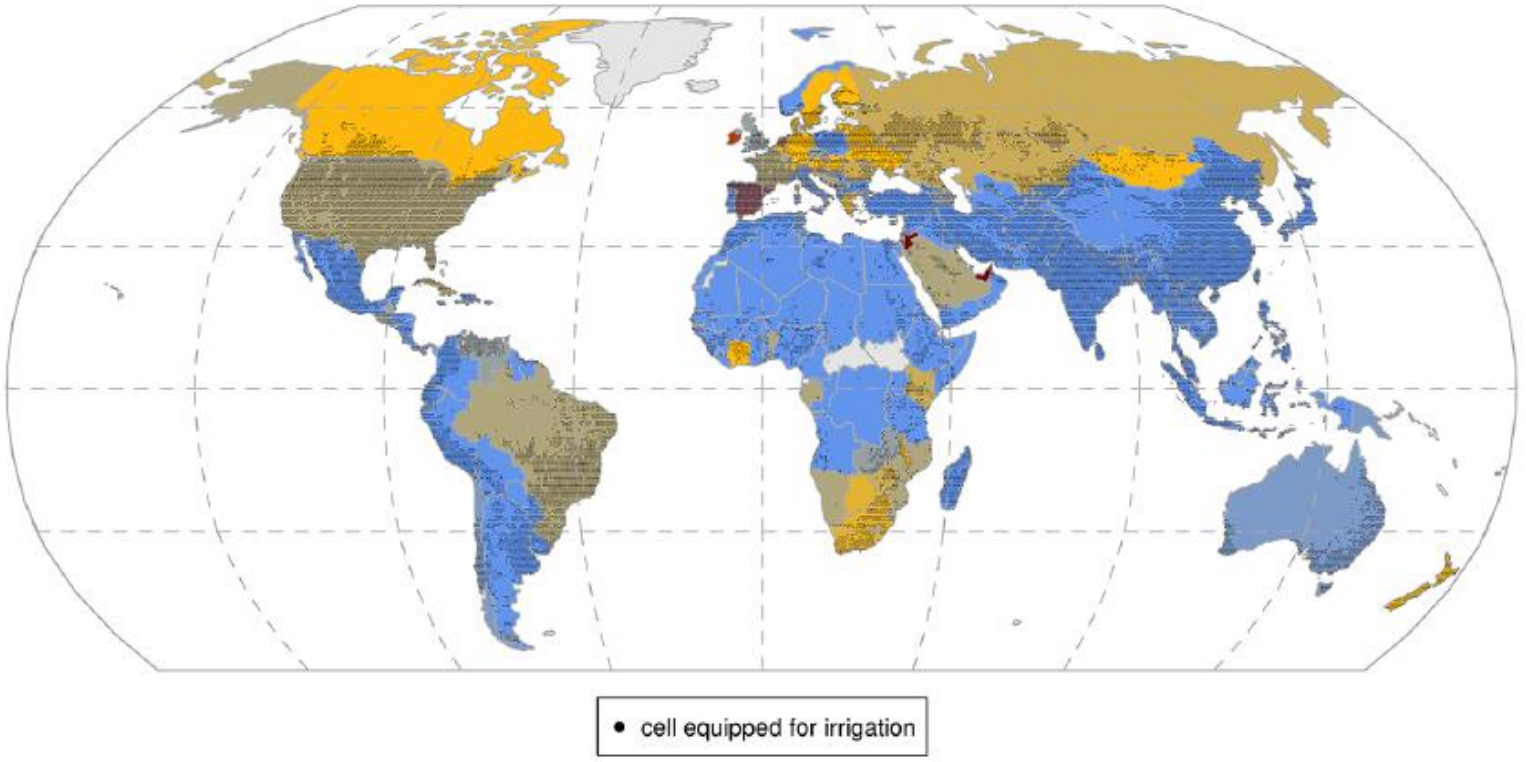
for each irrigated cfts:

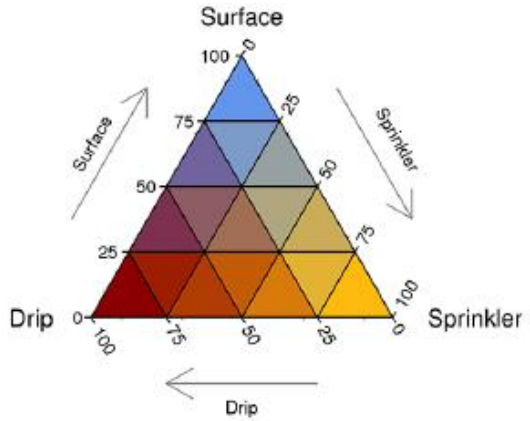
irrigation_method:

| | |
|---|---|
| drip | (irrigation_method = 1) |
| sprinkler | (irrigation_method = 2) |
| flood | (irrigation_method = 3) |

Based on the technique with the most proportion in each pixel

# IRRIGATION DATASETS




Spatial distribution of global area equipped for irrigation (AEI) and the fraction of different irrigation techniques (Jägermeyr et al., 2015)

# IRRIGATION WITH MY DEVELOPMENT

| Technique | Amount | Way |
|---|---|---|
| Drip | Target – actual | Under canopy |
| Sprinkler | Target – actual | Over canopy |
| Flood | Saturate - actual | Under canopy |

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- Evaluation

# EXPERIMENT DESIGN

**Experiments:**

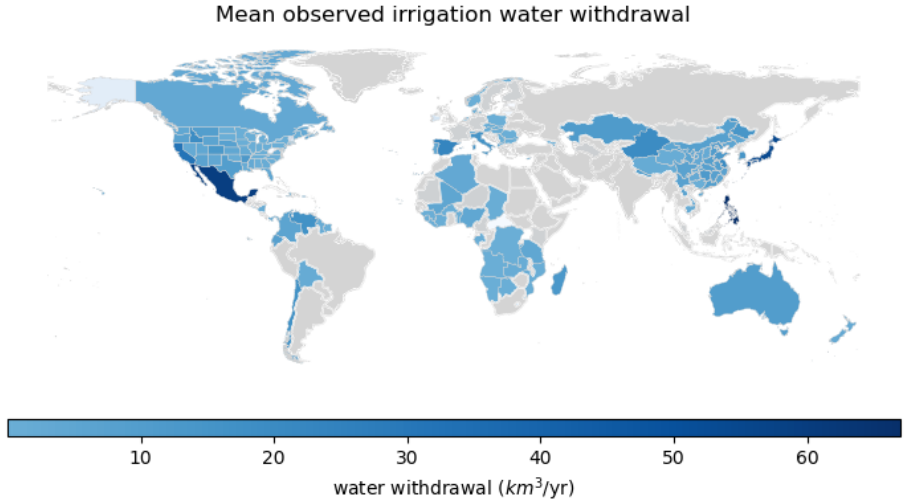
2005 – 2014 (2008 – 2014 for analysis)
NOIRR : Irrigation switched off
CTL : **OLD** irrigation scheme
IRR : **NEW** irrigation scheme

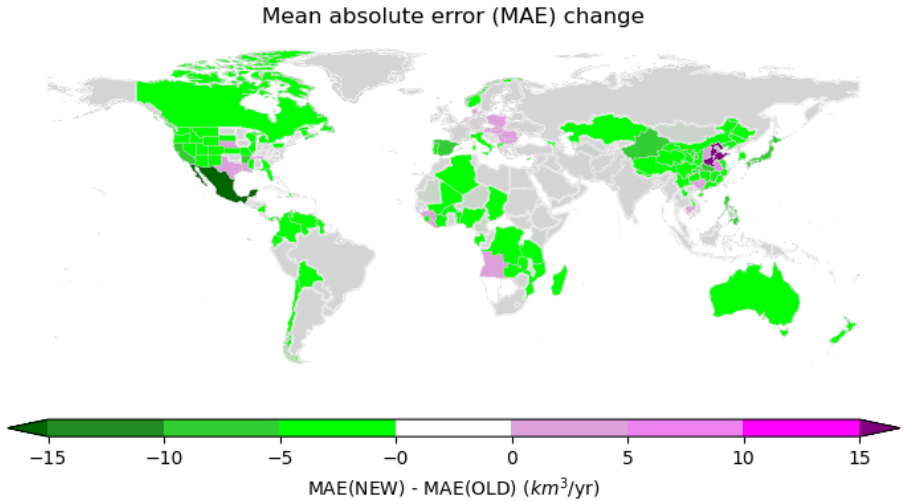
Analyse only the irrigated pixels (irrigated area >= 10%)

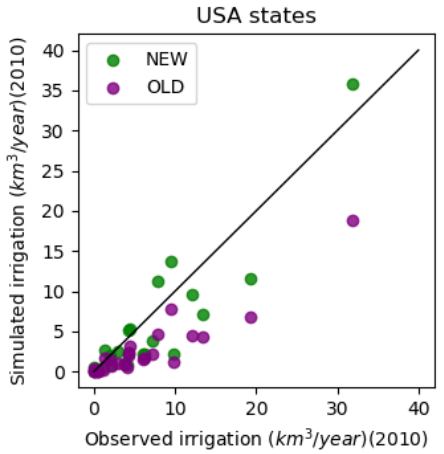
# IRRIGATION WATER WITHDRAWAL

**Data source:**

USA: USGS (Only 2010 in this study)
China: (Zhou et al., 2020) (2008 – 2013 in this study)
Other countries: Aquastat (Only 2012 in this study)

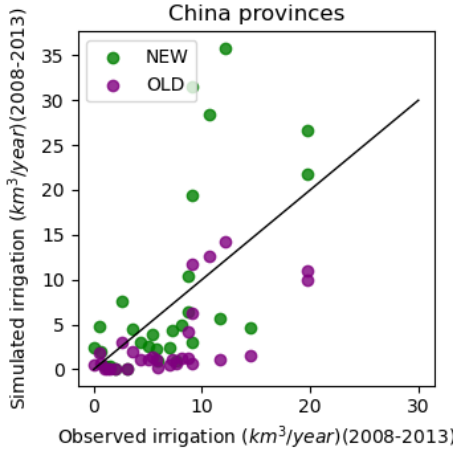


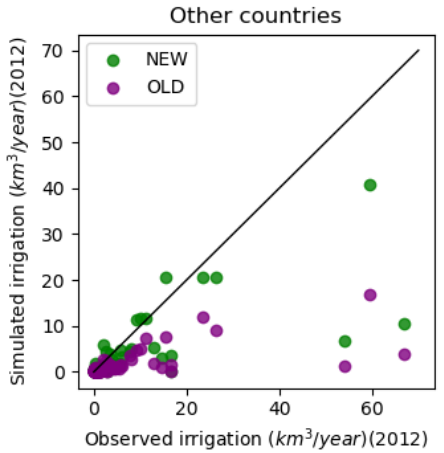

$Bias_{NEW}$ = -1.51
$Bias_{OLD}$ = -4.28

$RMSE_{NEW}$ = 3.74
$RMSE_{OLD}$ = 6.10




$Bias_{NEW}$ = 1.31
$Bias_{OLD}$ = -3.82

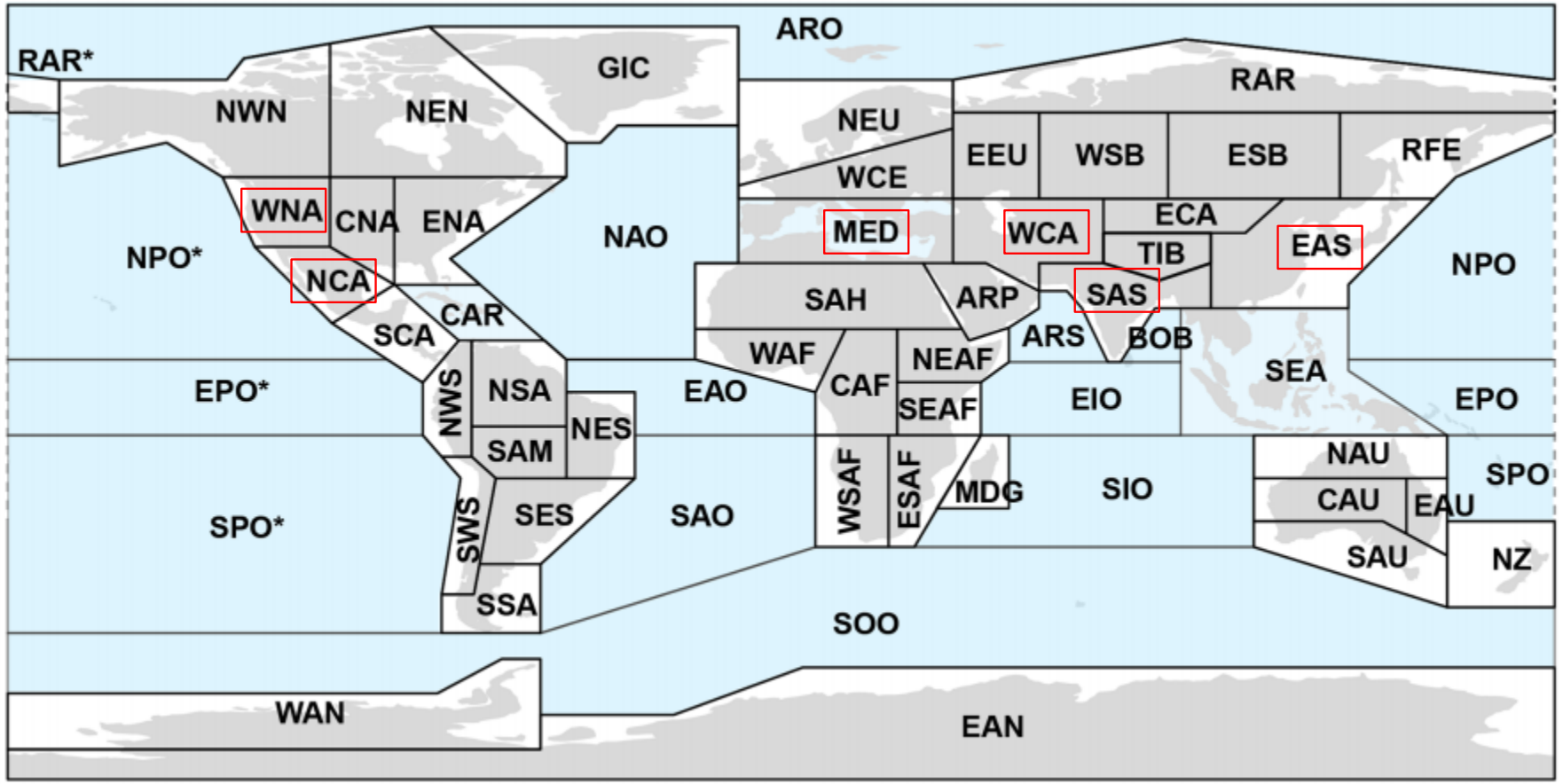
$RMSE_{NEW}$ = 8.25
$RMSE_{OLD}$ = 5.66




$Bias_{NEW}$ = -2.79
$Bias_{OLD}$ = -4.78

$RMSE_{NEW}$ = 9.70
$RMSE_{OLD}$ = 14.90

# IPCC REGIONS




Maialen Iturbide et al., 2020

# SOIL MOISTURE

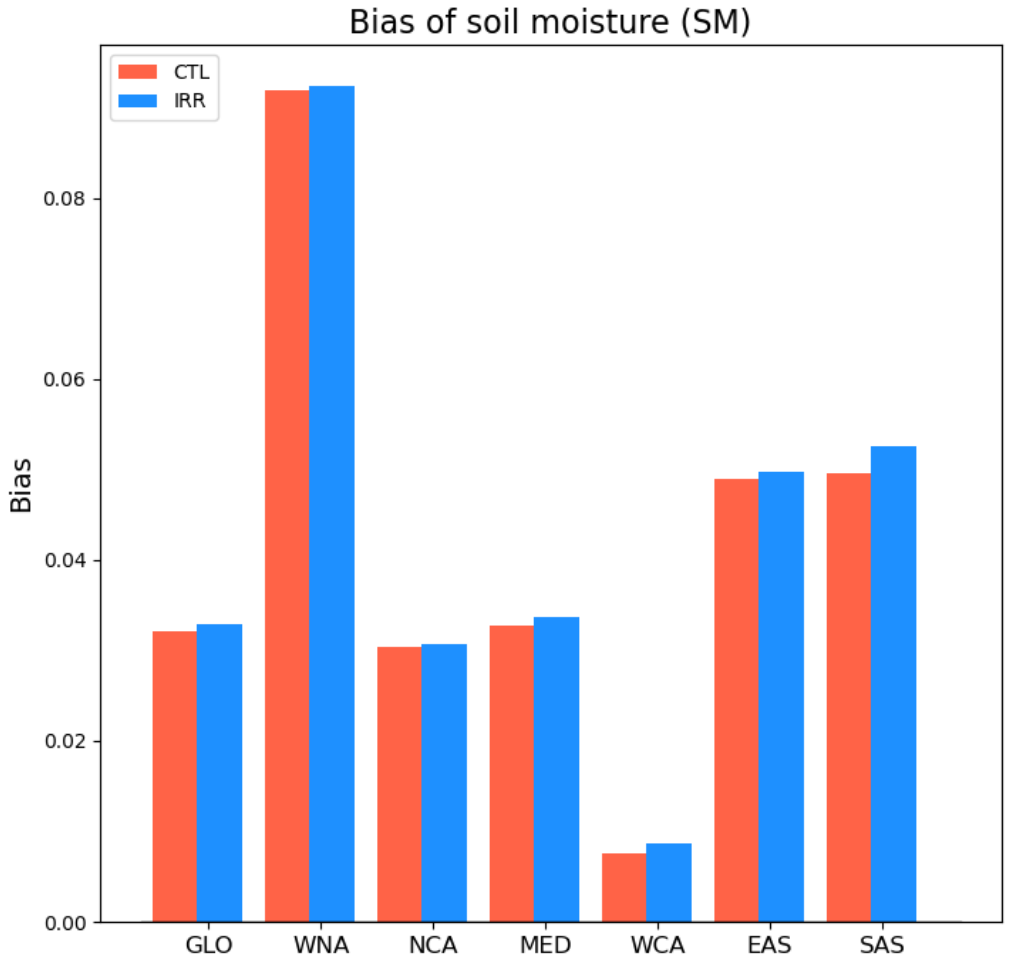
**Data source:**

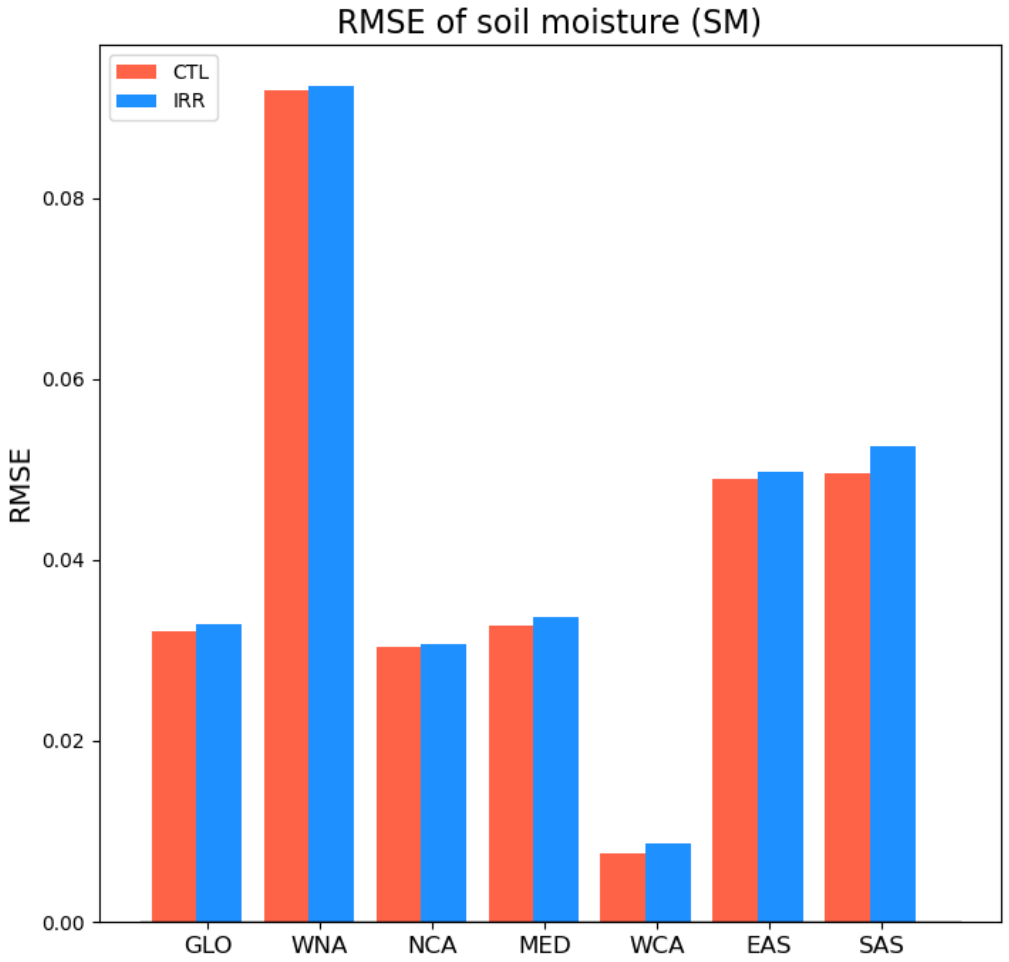
C3S (ESA CCI): surface soil (2 – 5 cm) moisture, including Active, Passive and **Combined**

**Processing of model output:**

Average value of the first two layers (0 - 2 cm and 2 – 6 cm)

# SOIL MOISTURE



# TOTAL WATER STORAGE

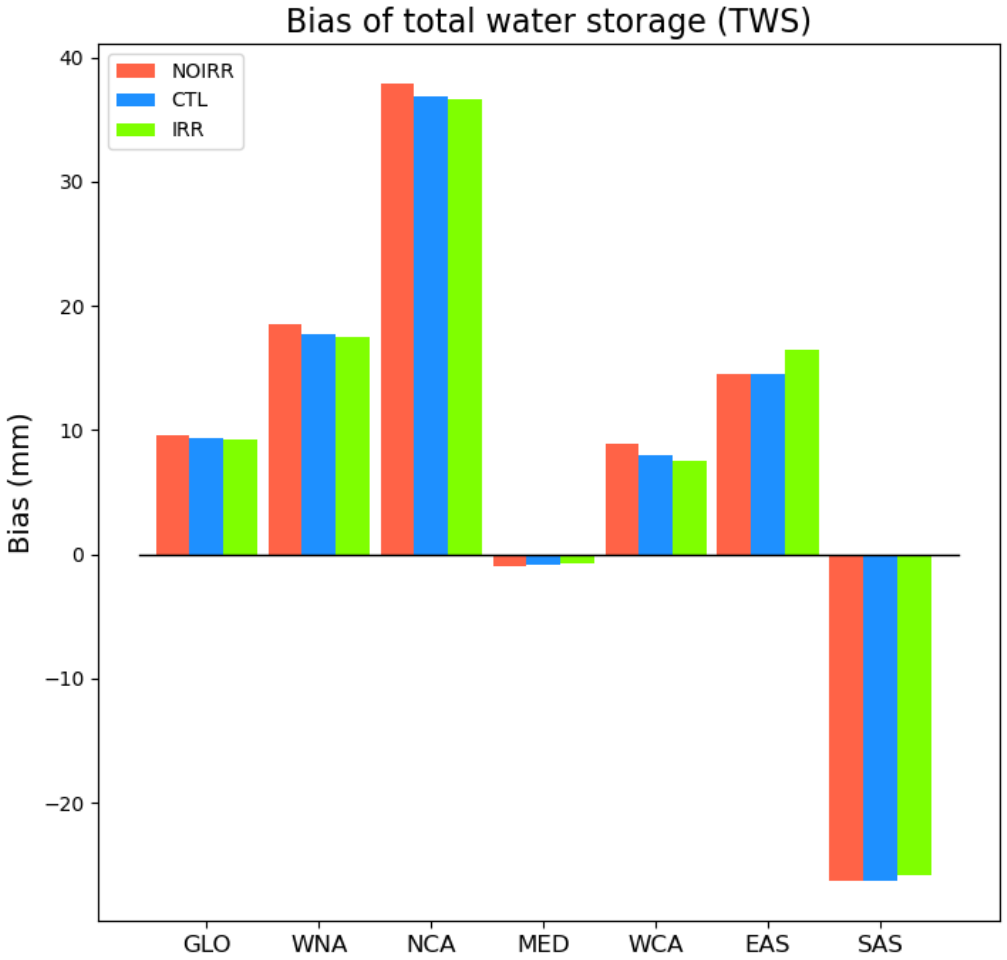
**Data source:**

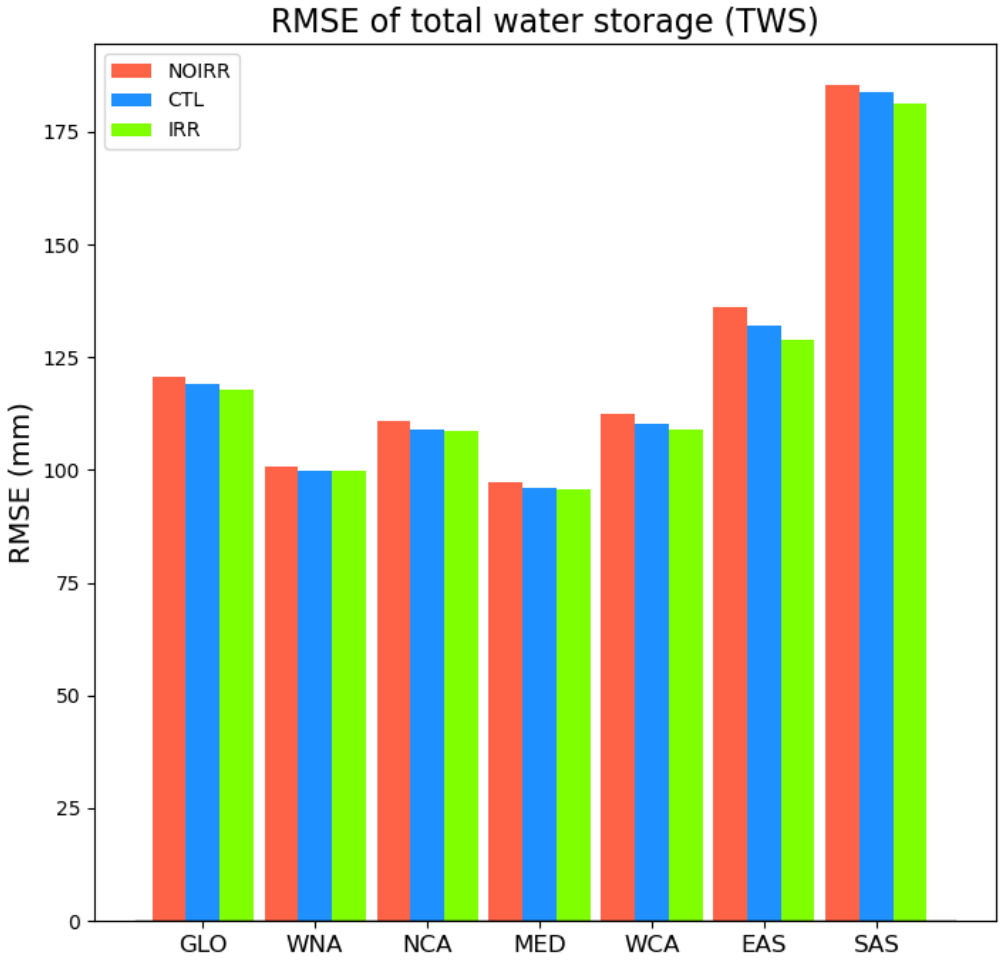
GRACE: 2008 - 2014

**Processing :**

Calculate the anonym based on the mean value in 2008

# TOTAL WATER STORAGE



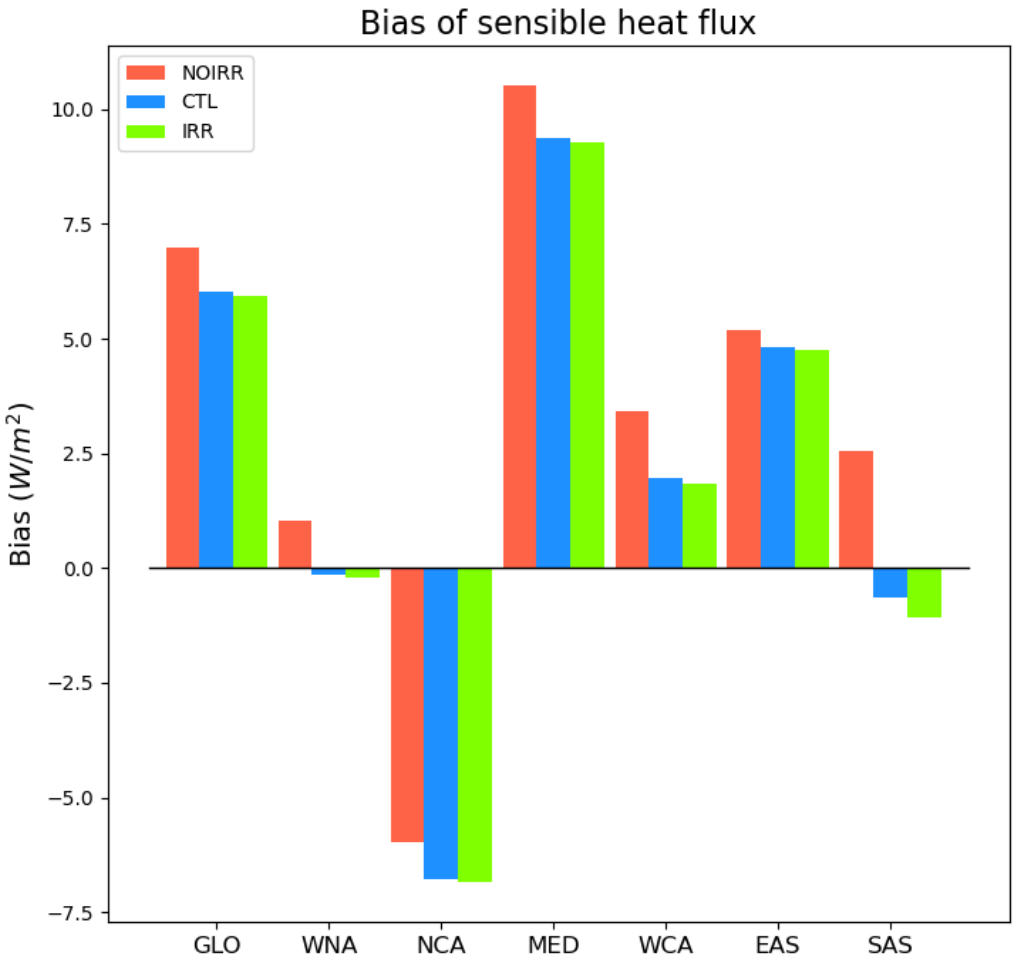



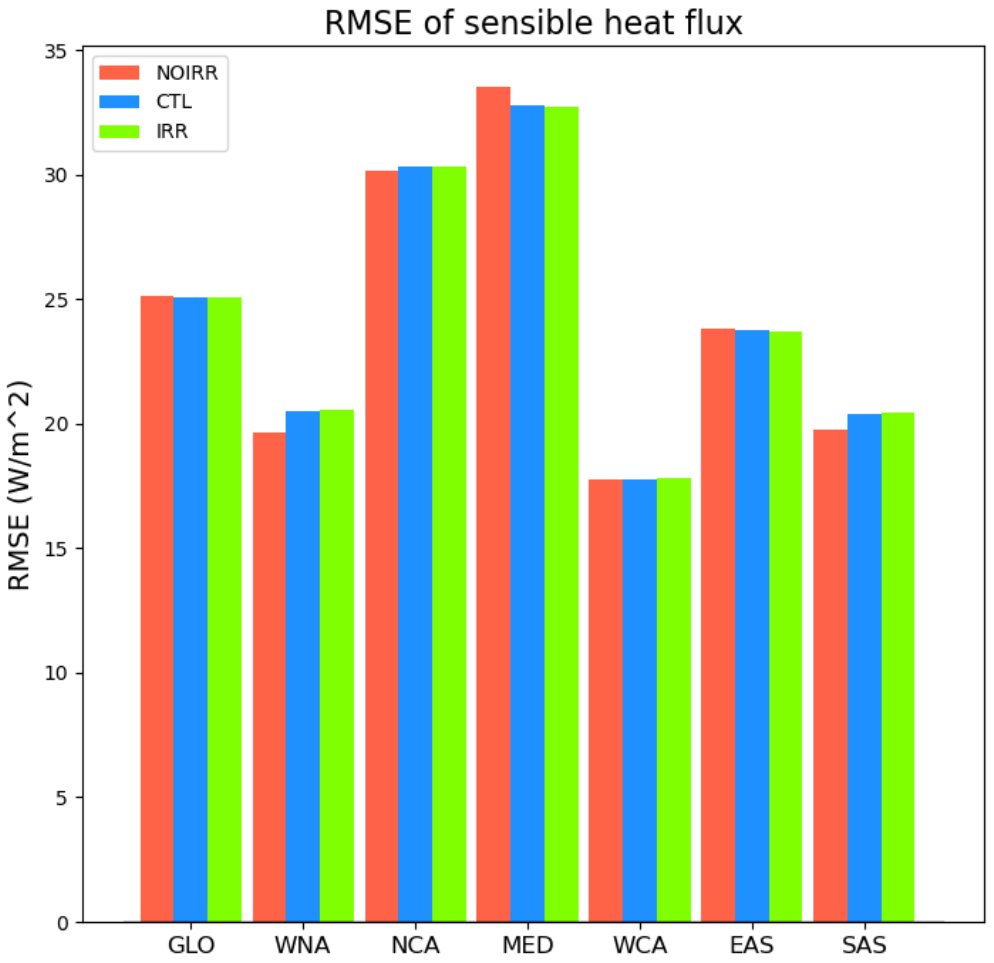
# SENSIBLE HEAT FLUX

**Data source:**

ERA5 2008 - 2014

# SENSIBLE HEAT FLUX



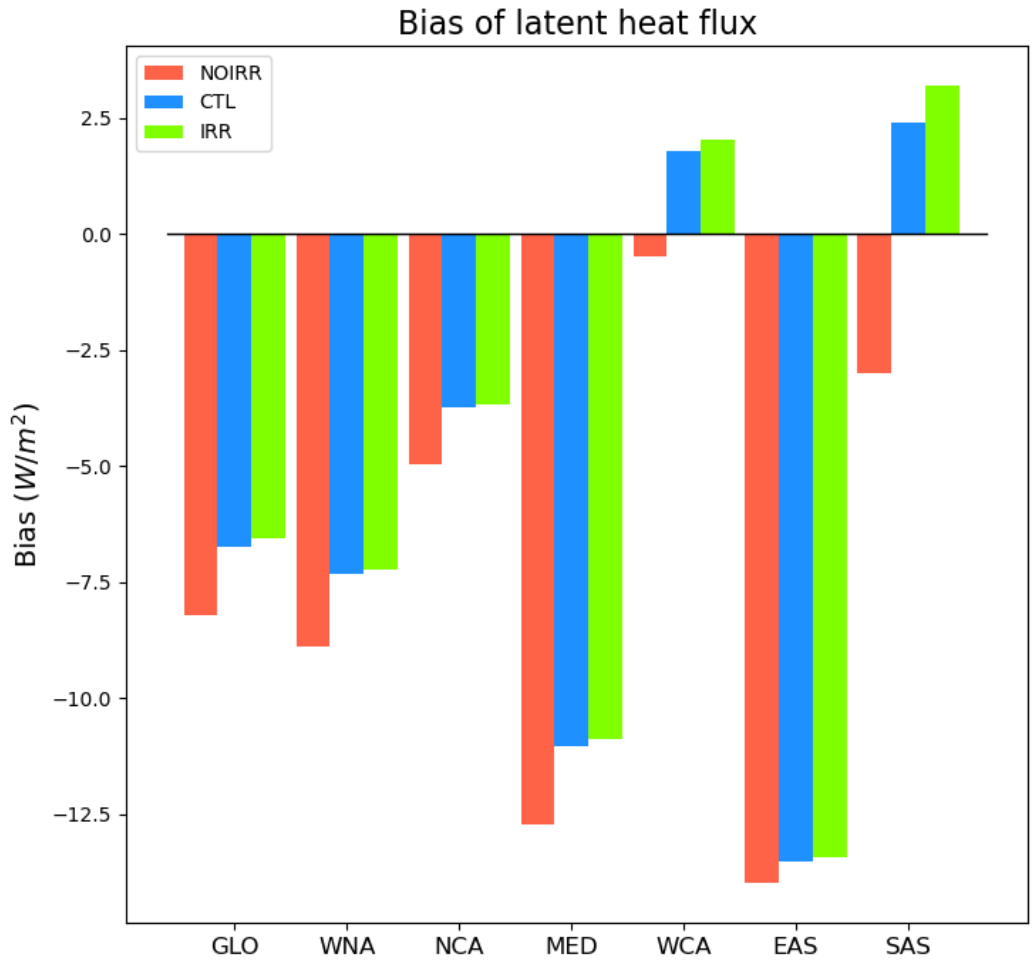



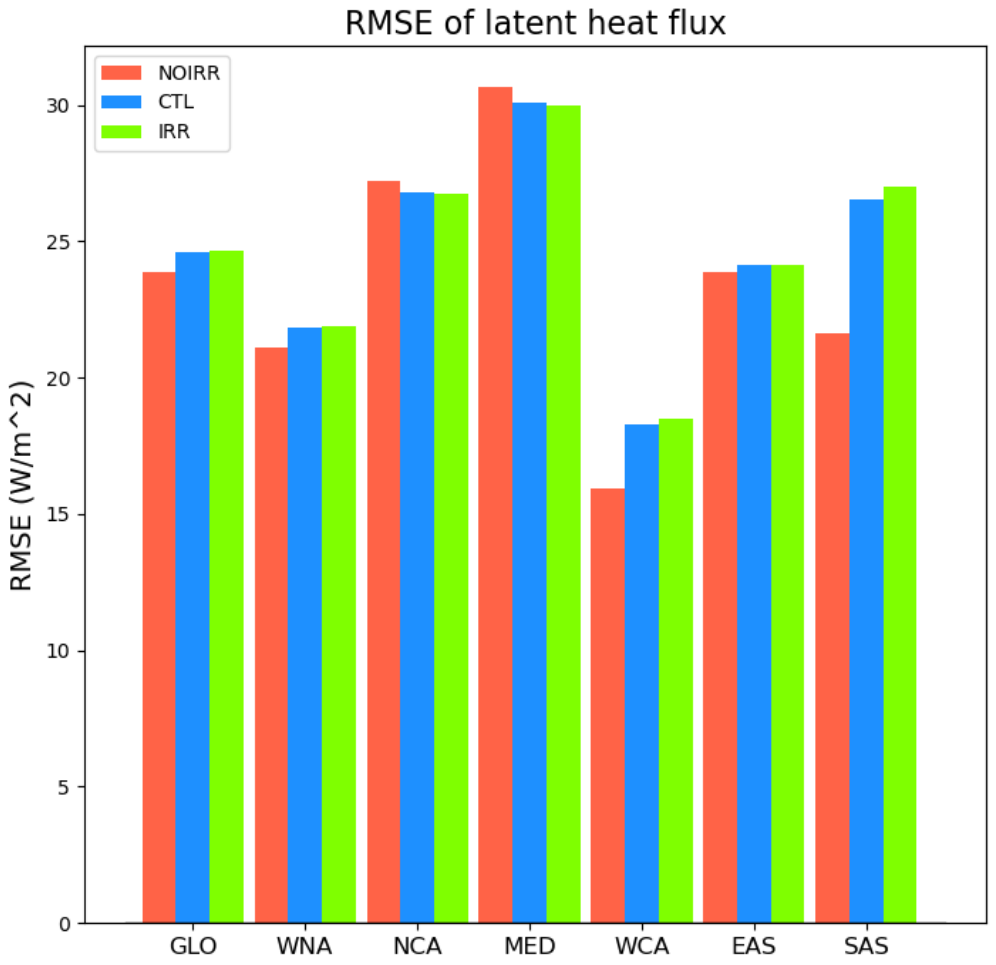
# LATENT HEAT FLUX

**Data source:**

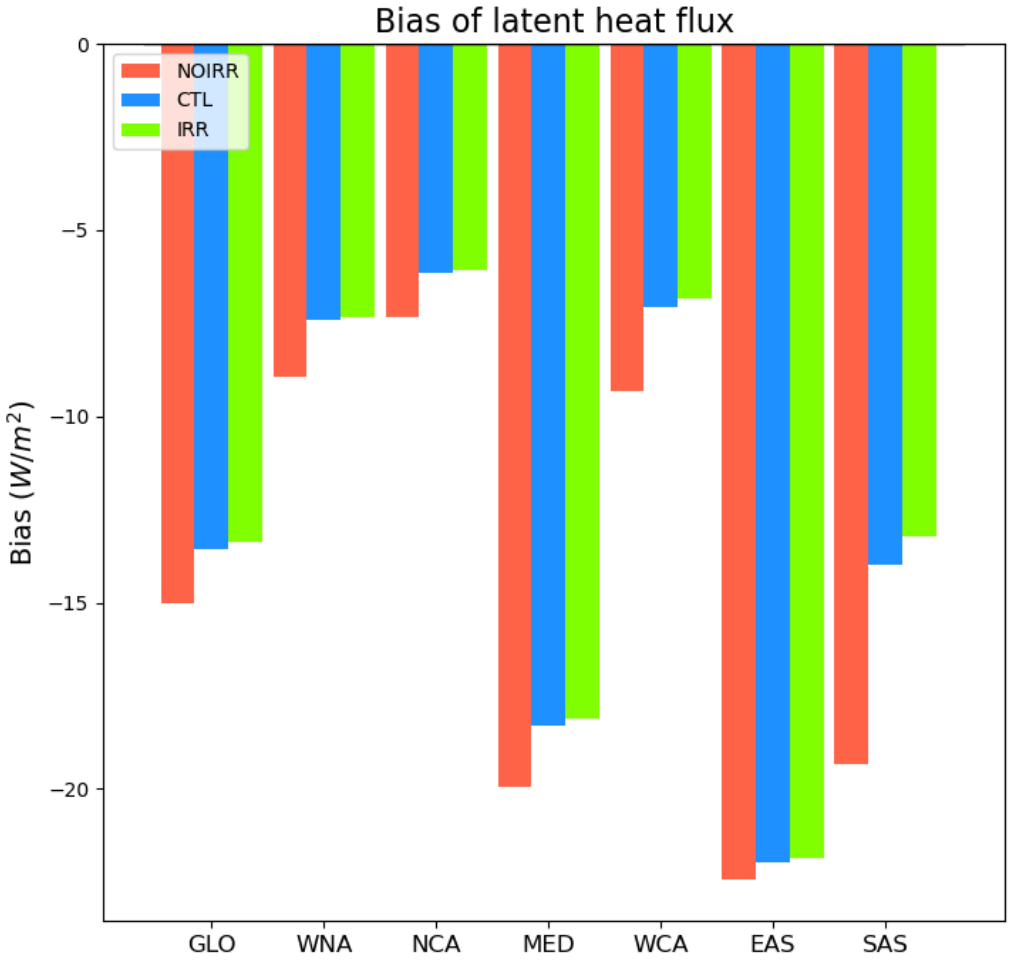
GLEAM 2008 -2014
ERA5 2008 - 2014

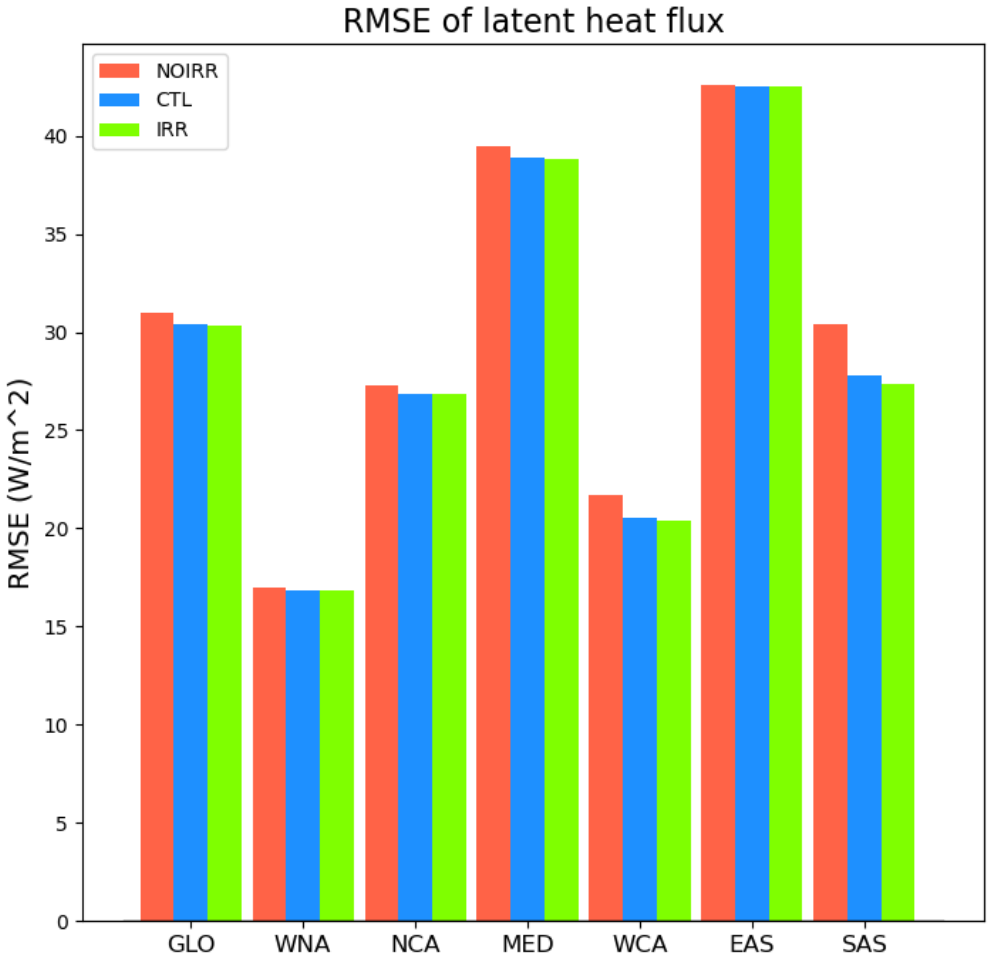
# LATENT HEAT FLUX GLEAM



# LATENT HEAT FLUX ERA5



# TAKE HOME POINTS

**New irrigation scheme can improve greatly the performance on simulating the water used for irrigation**

**The impacts on other variables are less significant. New scheme do not always perform better than the old one on simulating other variables.**

# CONTENTS

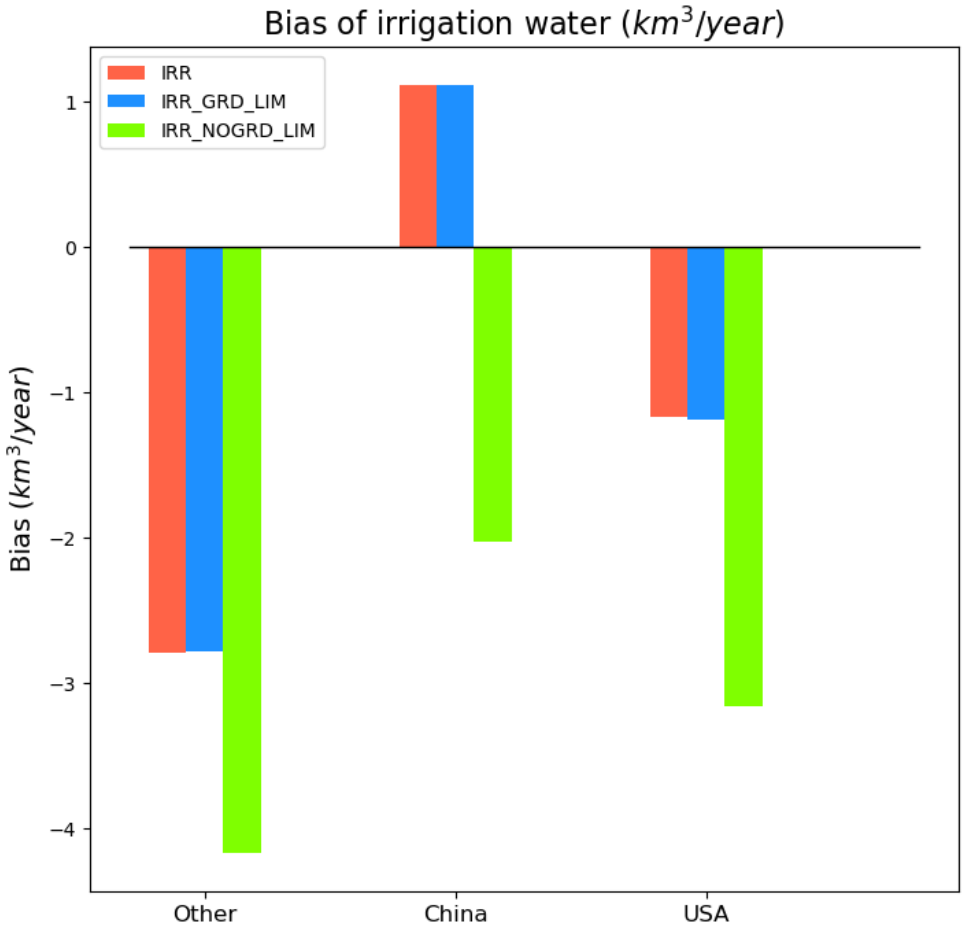
- Sensitivity test

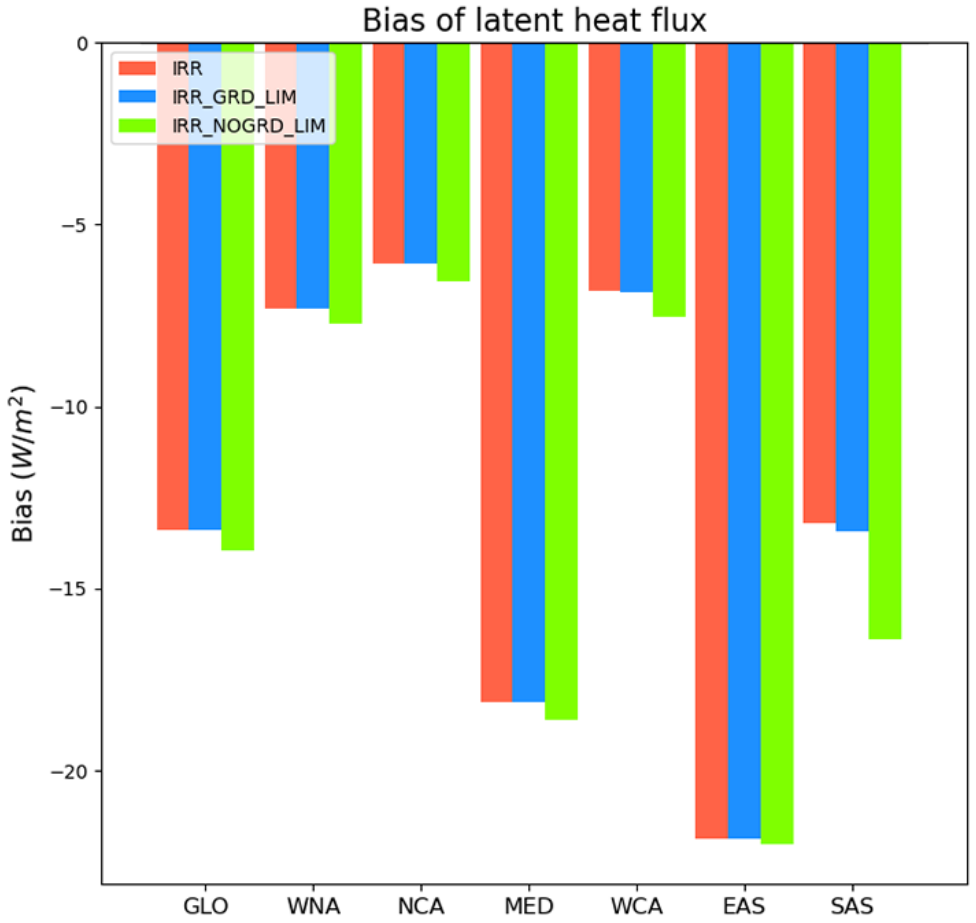
# EXPERIMENT DESIGN

## Experiments:

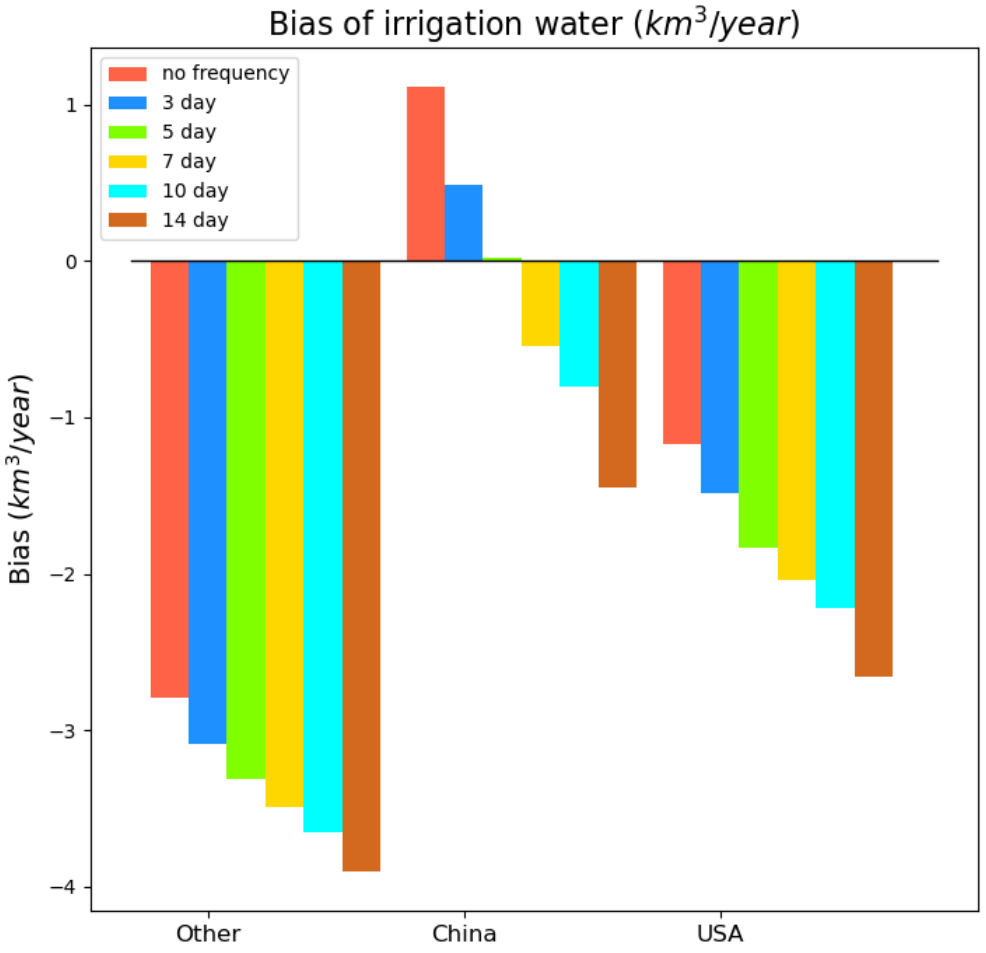
| | |
|---|---|
| **Limitation & groundwater:** | IRR – no limitation and no groundwater<br>IRR_GRD_LIM – limit the water and use groundwater<br>IRR_NOGRD_LIM – limit the water and don't use groundwater |
| **Frequency:** | Once per 3, 5, 7, 10, 14 day, check whether do irrigation (if soil water less than threshold)<br>default: no frequency |
| **Frequency_no_threshold:** | Once per 3, 5, 7, 10, 14 day, check whether do irrigation (if soil water less than target)<br>default: no frequency |
| **Length and start_time:** | Irrigation length as 1h, 2h, 12h, 24h (default: 4h), and start time at 0h, 12h and 18h (default: 6h) |

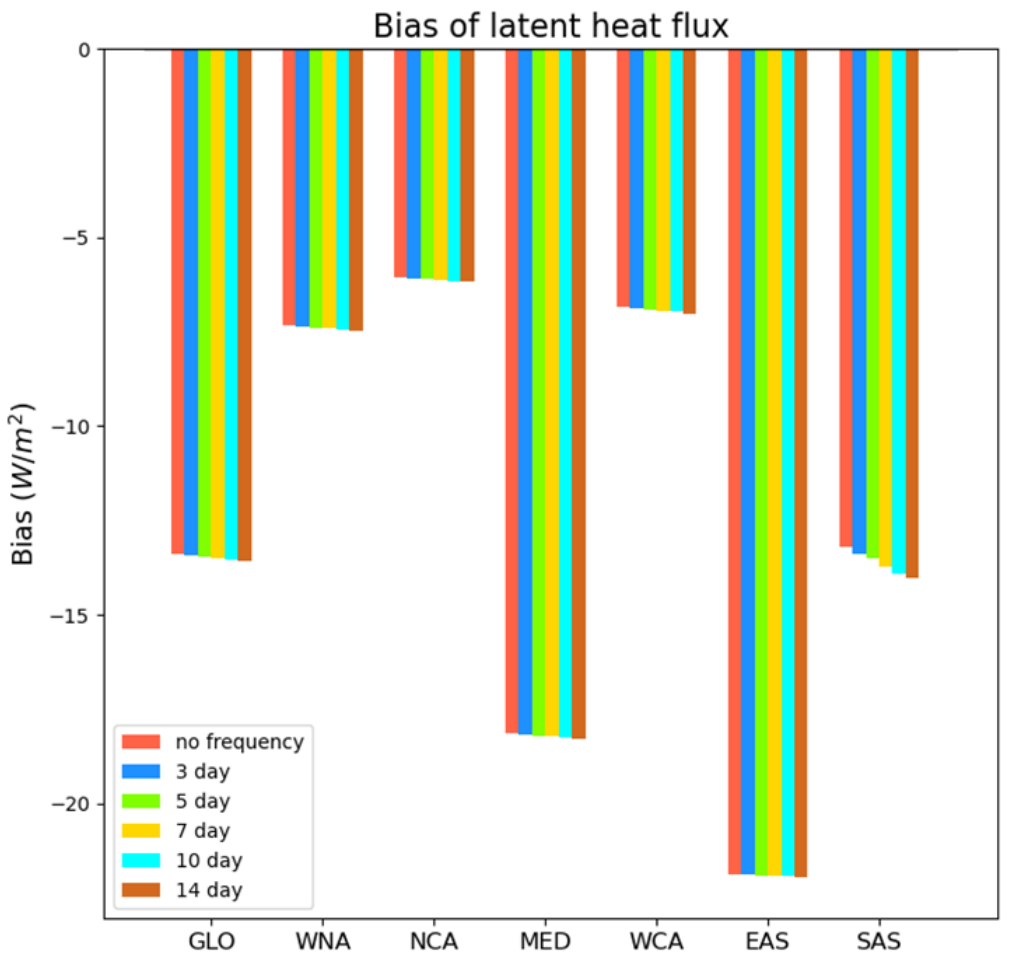
# LIMITATION AND GROUNDWATER



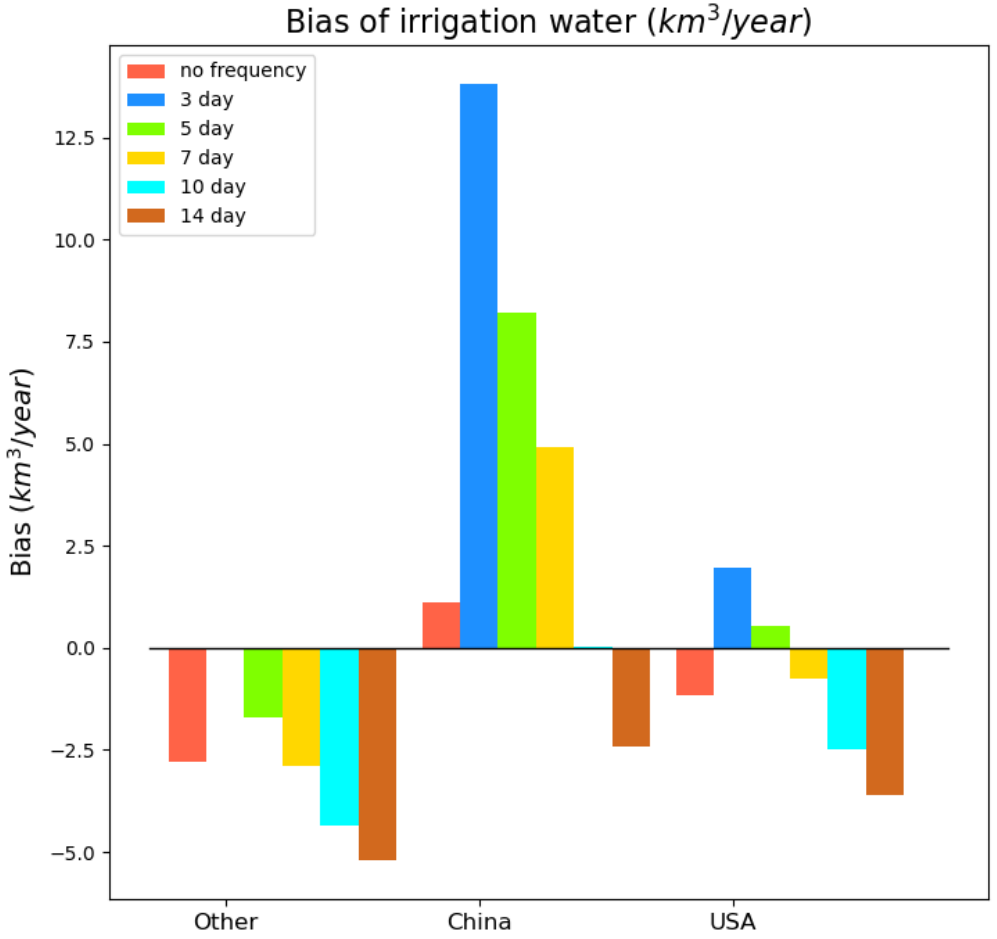



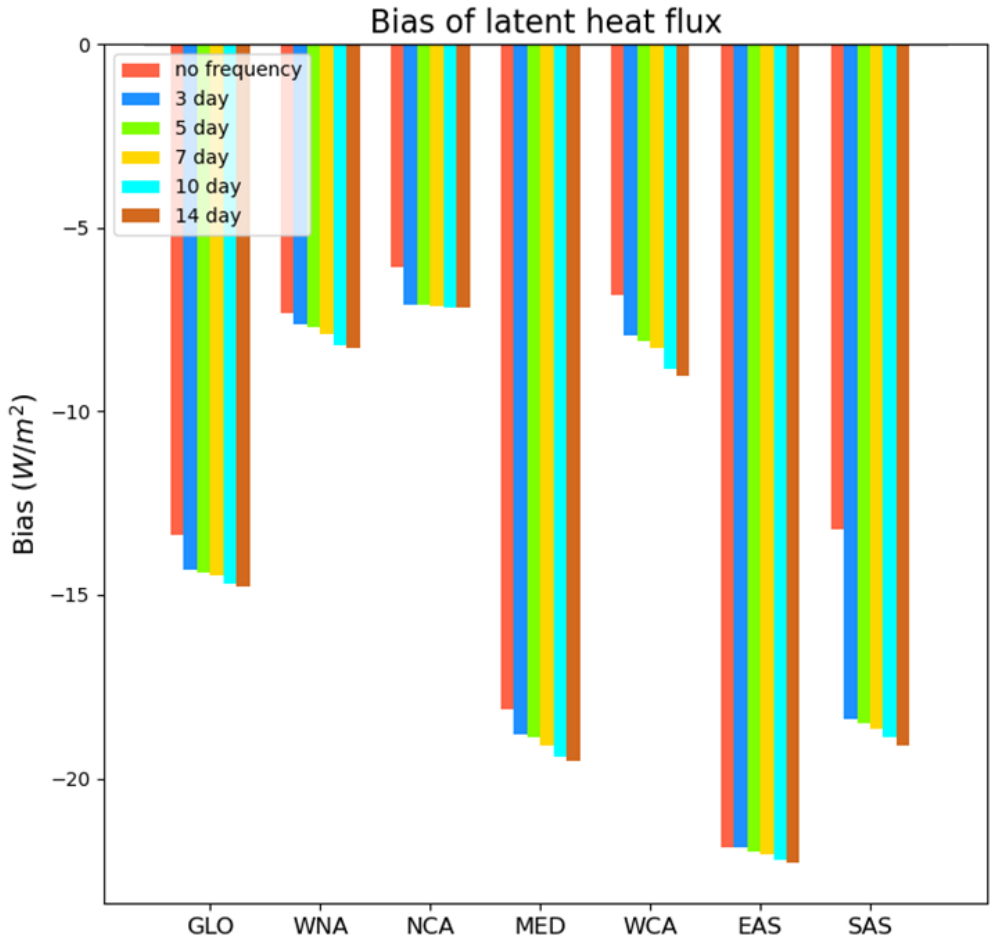
# FREQUENCY


Bias of irrigation water ($km^3/year$)
no frequency
3 day
5 day
7 day
10 day
14 day
Bias ($km^3/year$)
1
0
−1
−2
−3
−4
Other
China
USA

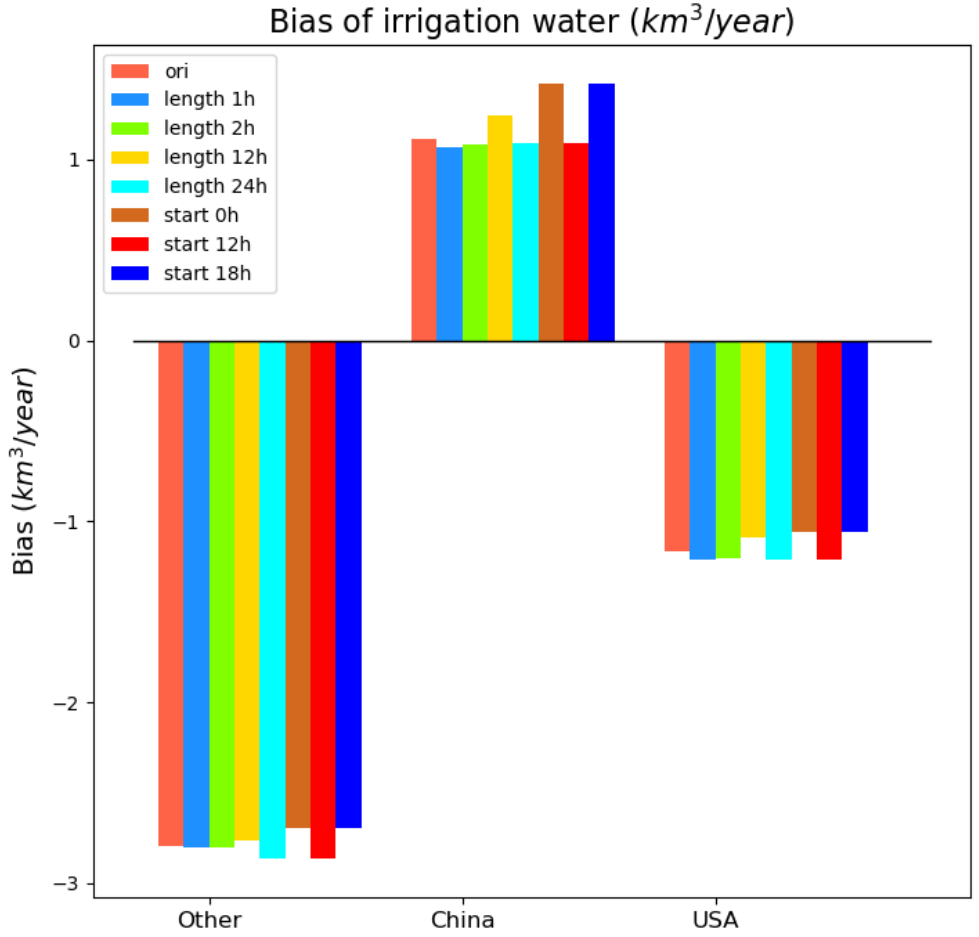

Bias of latent heat flux
Bias ($W/m^2$)
0
−5
−10
−15
−20
no frequency
3 day
5 day
7 day
10 day
14 day
GLO
WNA
NCA
MED
WCA
EAS
SAS

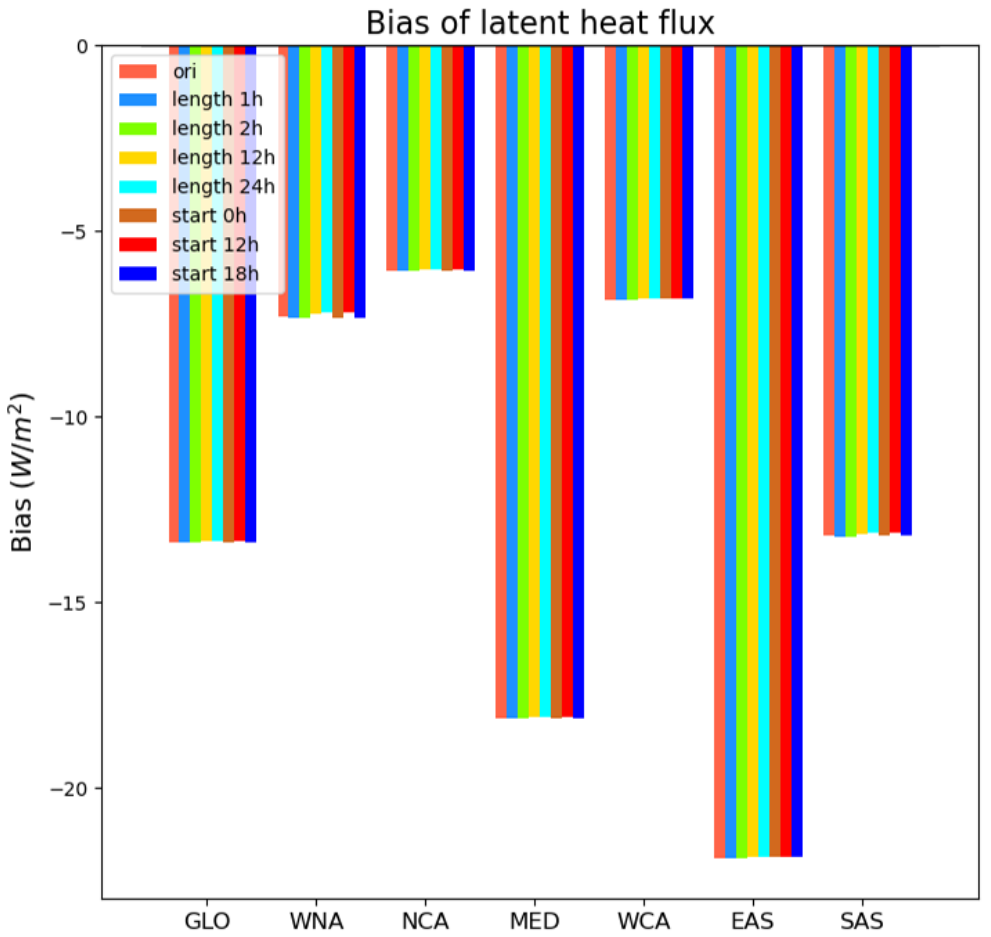
# FREQUENCY_NO_THRESHOLD



# LENGTH AND START_TIME(IRRIGATION WATER WITHDRAWAL)



# TAKE HOME POINTS

**Switch on both limitation and ground water have nearly no impacts on irrigation water and latent heat flux, but switch on limitation and switch off groundwater may result in big changes**

**Frequency (with and without threshold) affects the irrigation water significantly, but the impacts on latent heat flux can be subtle. Normally less the frequency, bigger the difference**

**The effects on irrigation length and start_time are negligible**

# THANKS!

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Image from imaggeo.com