HS2.5.3: EGU25-1051

A Kalman Filter approach for reducing uncertainty in Global Evapotranspiration: Advancing global water budget closure

Shubham Goswami[1], Chirag Ternikar[1], Rajsekhar Kandala[1], Netra S Pillai[2], Vivek Kumar Yadav[3], Abhishek[4], Jisha Joseph[5], Subimal Ghosh[6] and Bramha Dutt Vishwakarma[2,3]

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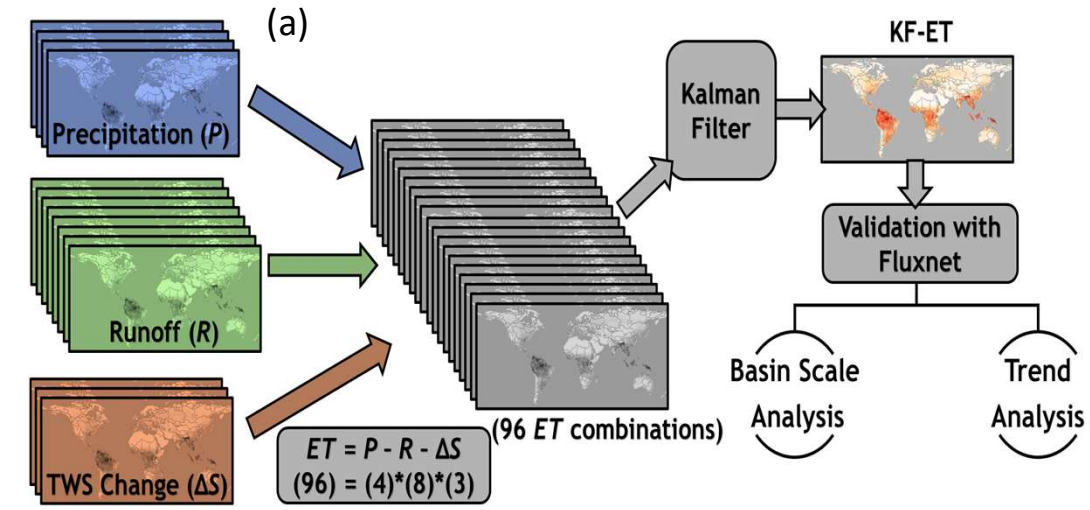
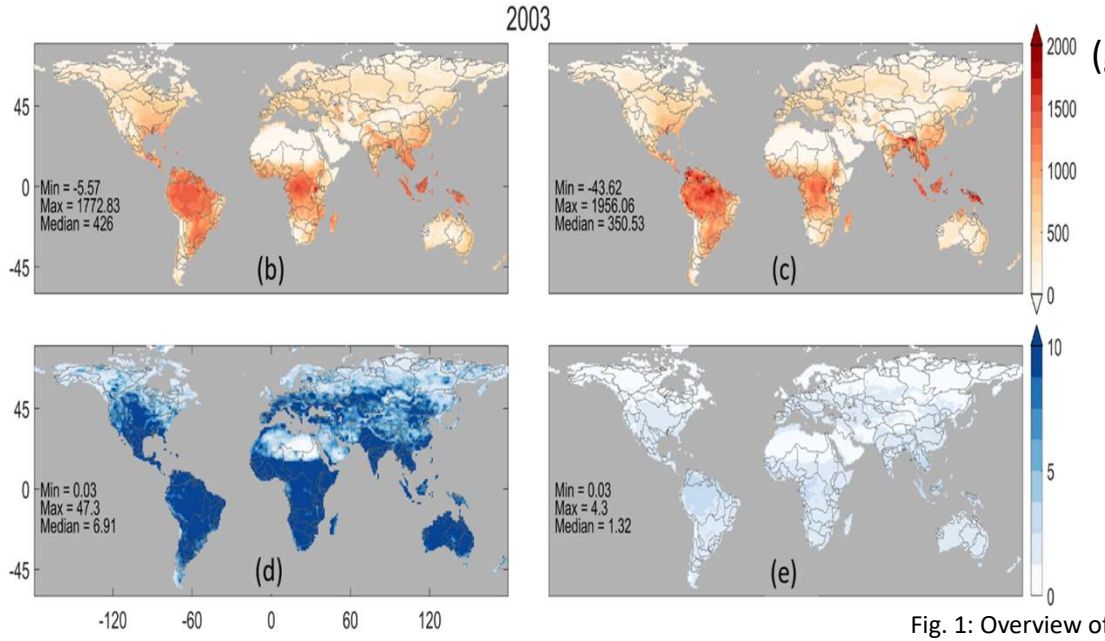
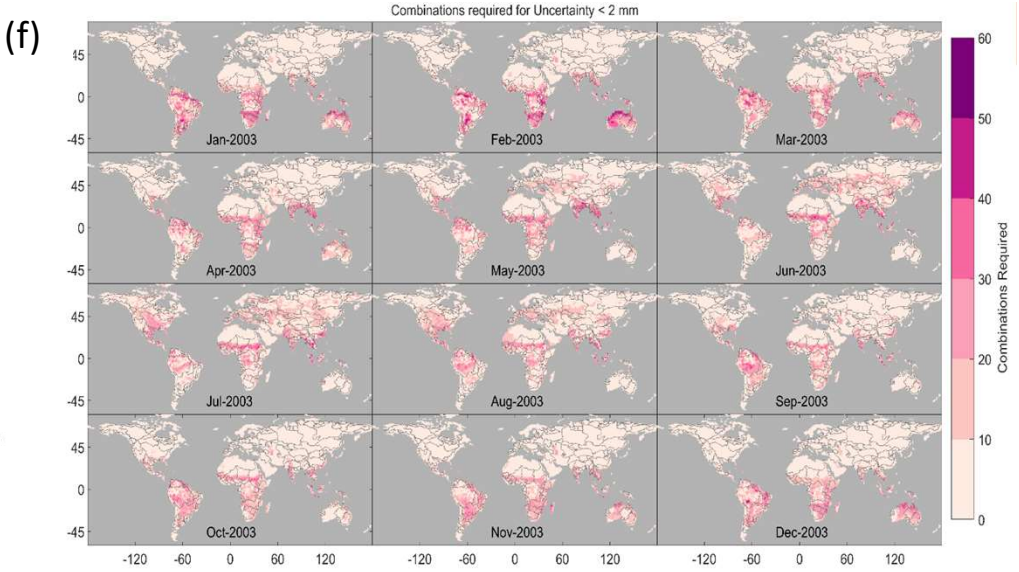
EGU General Assembly 2025







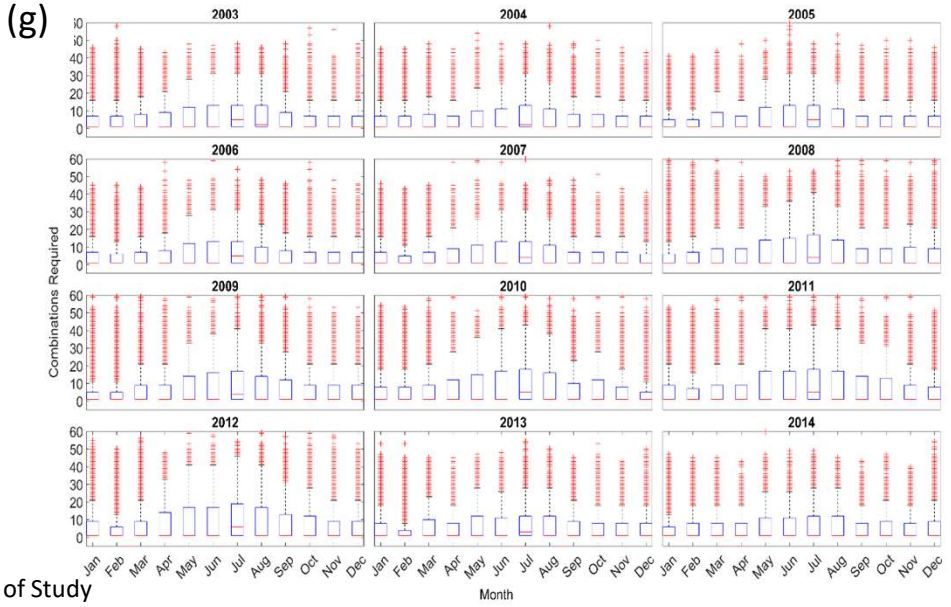


Fig. 1: Overview of Study

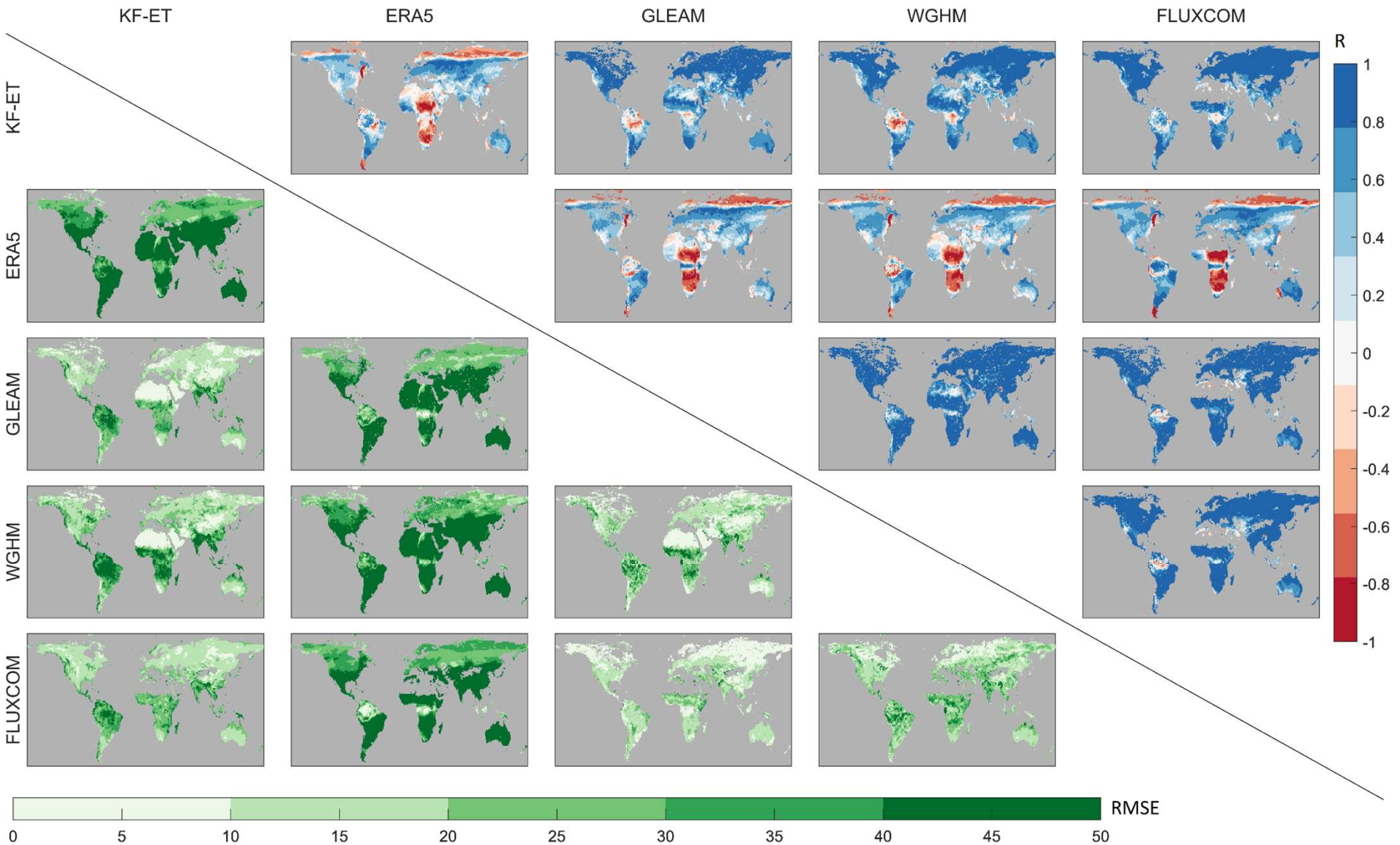


Fig. 2: Comparison of KF-ET with existing products

Outline

- **Importance of Evapotranspiration (ET)**:
  ET is a critical component of the global water cycle
- **Diversity of ET Products**:
  Over 8 approaches and 90+ global ET products available in the literature
- **Challenges**:
  Large uncertainties in global ET estimates
  No single "best" ET product for all conditions
- **Proposed Framework**:
  KF-ET to reduce uncertainties in water-budget-based ET estimates
- **Validation Approaches**:
  ET products assessment using diverse methods

Various ET products

- Numerous ET products exist in literature
- No single best global ET product
- Multiple products for multiple users

ELSEVIER

Remote Sensing of Environment
Volume 304, 1 April 2024, 114066

Review

Spatial-temporal patterns of land surface evapotranspiration from global products

Ronglin Tang [a b], Zhong Peng [a b], Meng Liu [c], Zhao-Liang Li [c a], Yazhen Jiang [a b], Yongxin Hu [b], Lingxiao Huang [a b], Yizhe Wang [a b], Junrui Wang [a b], Li Jia [d], Chaolei Zheng [d], Yongqiang Zhang [e], Ke Zhang [f], Yunjun Yao [g], Xuelong Chen [h], Yujiu Xiong [i], Zhenzhong Zeng [j], Joshua B. Fisher [k]

Water Resources Research

RESEARCH ARTICLE
10.1029/2024WR037608

Key Points:

- Global ET estimates show large discrepancies in magnitude, trends and spatial patterns across 90 state-of-the-art data sets
- There is no single best global ET data set suitable for all applications and locations, the choice depends on the intention and region of study
- Dominant controls on ET differ across categories spatially; constraining estimates via Budyko and novel hybrid modeling can enhance confidence

Reconciling Global Terrestrial Evapotranspiration Estimates From Multi-Product Intercomparison and Evaluation

Yaoting Cai[1], Qingchen Xu[1], Fan Bai[1], Xueqi Cao[1], Zhongwang Wei[1], Xingjie Lu[1], Nan Wei[1], Hua Yuan[1], Shupeng Zhang[1], Shaofeng Liu[1], Yonggen Zhang[2], Xueyan Li[3], and Yongjiu Dai[1]

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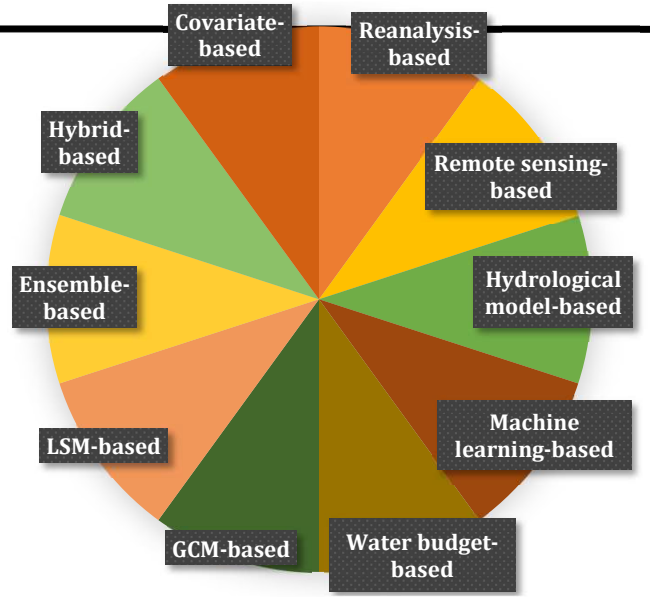


Methodology

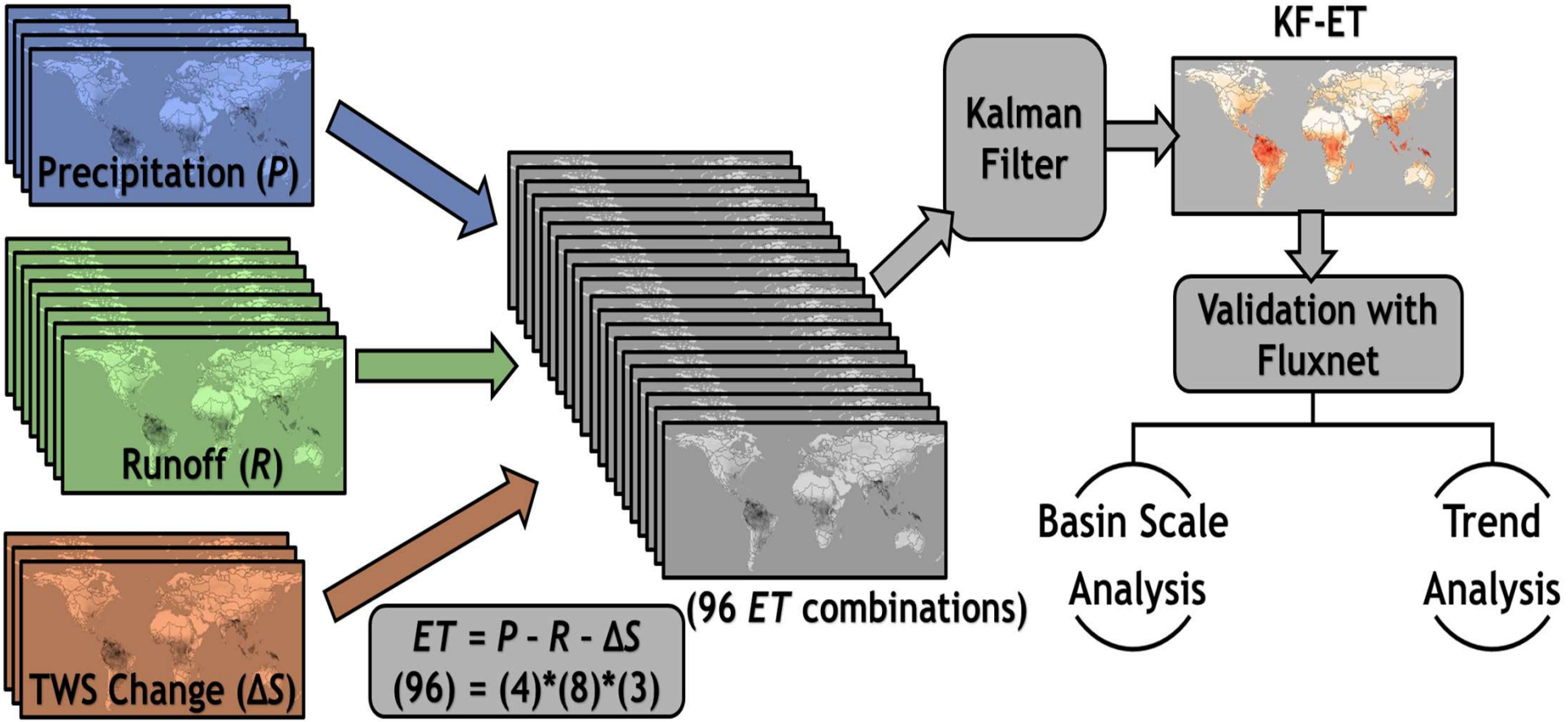


Fig. 3: Flow Chart of Methodology

Methodology

Table 1: Stepwise process for KF-ET

Iter. No	ET	UET	KG	ET^u	UET^u
				ET_0 (Initialization)	UET_0 (Initialization)
1	ET_1	UET_1	$KG_1 = UET_0/(UET_0 + UET_1)$	$ET_1^u = ET_0 + KG_1 \times (ET_1\text{-}ET_0)$	$UET_1^u = (1 - KG_1) \times UET_0)$
2	ET_2	UET_2	$KG_2 = UET_1^u/(UET_1^u + UET_2)$	$ET_2^u = ET_1^u + KG_2 \times (ET_2\text{-}ET_1^u)$	$UET_2^u = (1\text{-}KG_2) \times UET_1^u)$
3	ET_3	UET_3	$KG_3 = UET_2^u/(UET_2^u + UET_3)$	$ET_3^u = ET_2^u + KG_3 \times (ET_3\text{-}ET_2^u)$	$UET_3^u = (1\text{-}KG_3) \times UET_2^u)$
…	…	…	…	…	…
…	…	…	…	…	…
…	…	…	…	…	…
94	ET_{94}	UET_{94}	$KG_{94} = UET_{93}^u/(UET_{93}^u + UET_{94})$	$ET_{94}^u = ET_{93}^u + KG_{94} \times (ET_{94}\text{-}ET_{93}^u)$	$UET_{94}^u = (1\text{-}KG_{94}) \times UET_{93}^u)$
95	ET_{95}	UET_{95}	$KG_{95} = UET_{94}^u/(UET_{94}^u + UET_{95})$	$ET_{95}^u = ET_{94}^u + KG_{95} \times (ET_{95}\text{-}ET_{94}^u)$	$UET_{95}^u = (1\text{-}KG_{95}) \times UET_{94}^u)$
96	ET_{96}	UET_{96}	$KG_{96} = UET_{95}^u/(UET_{95}^u + UET_{96})$	$ET_{96}^u = ET_{95}^u + KG_{96} \times (ET_{96}\text{-}ET_{95}^u)$	$UET_{96}^u = (1\text{-}KG_{96}) \times UET_{95}^u)$

Results: Uncertainty Analysis

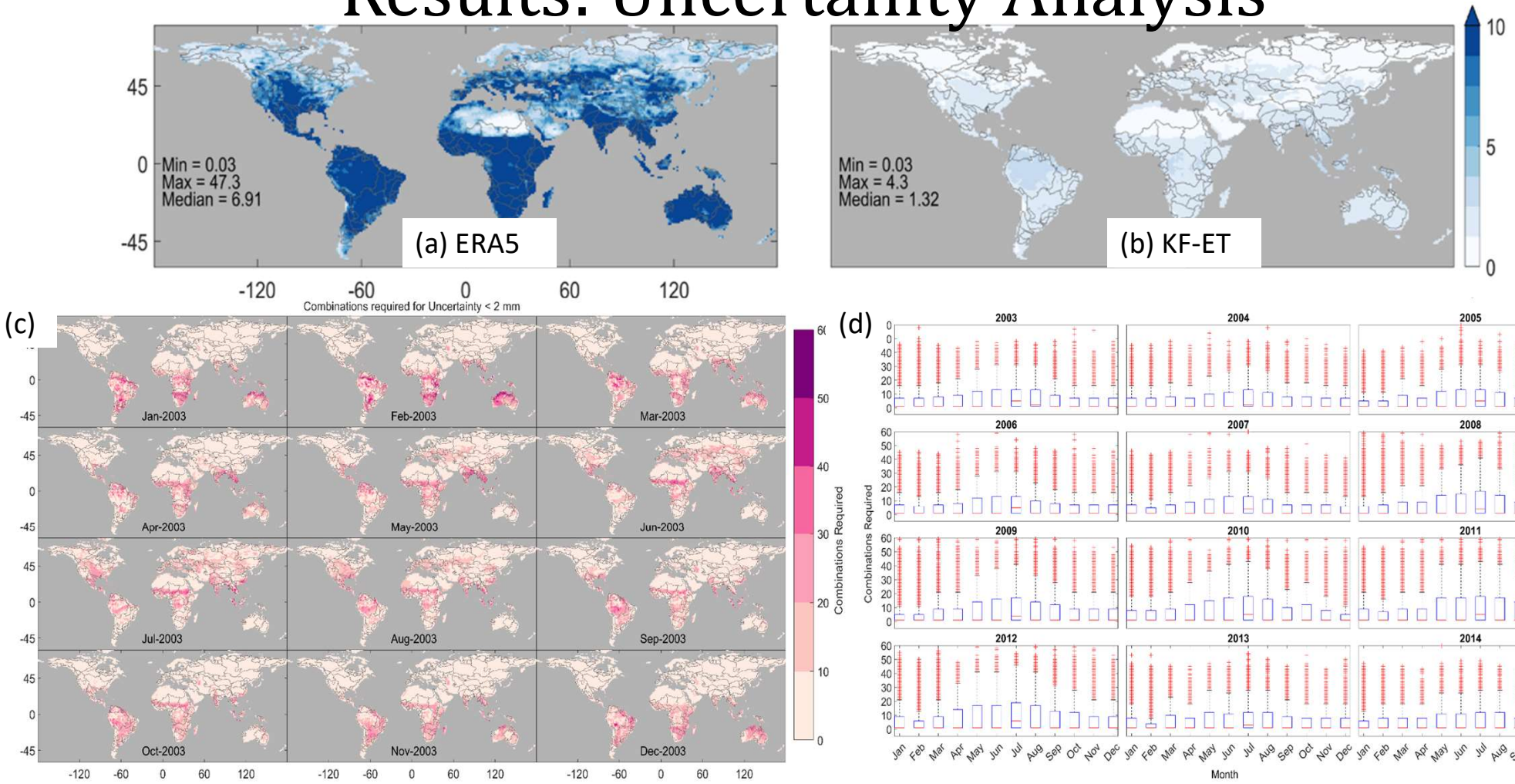


Fig. 4: (a) and (b) Uncertainty in ERA5 and KF-ET based ET; (c) and (d) number of combinations required to bring KF-ET uncertainty <2mm/month

Results: KF-ET

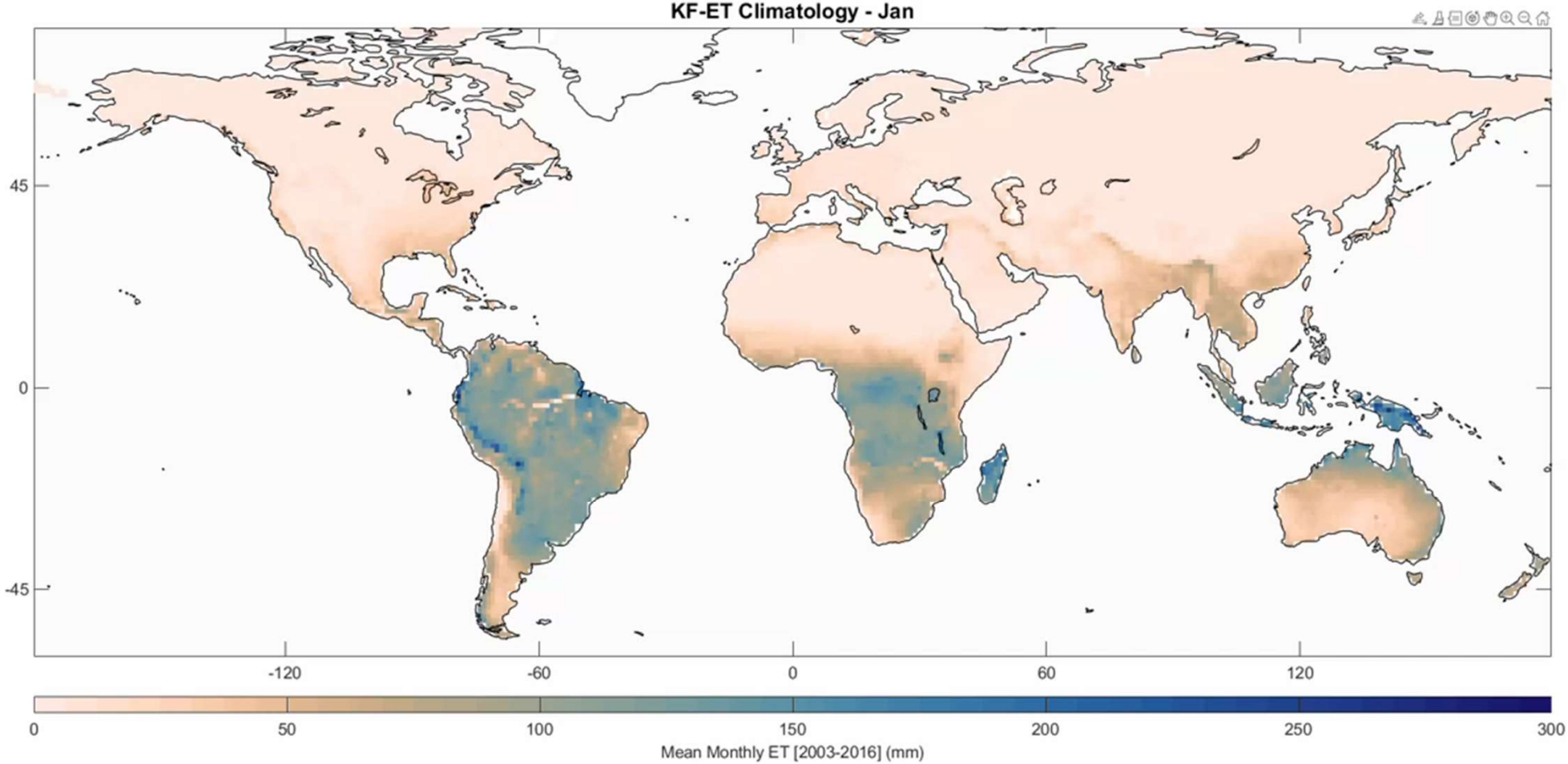


Fig. 5: Monthly Climatology Variation of KF-ET

Results: Point scale evaluation

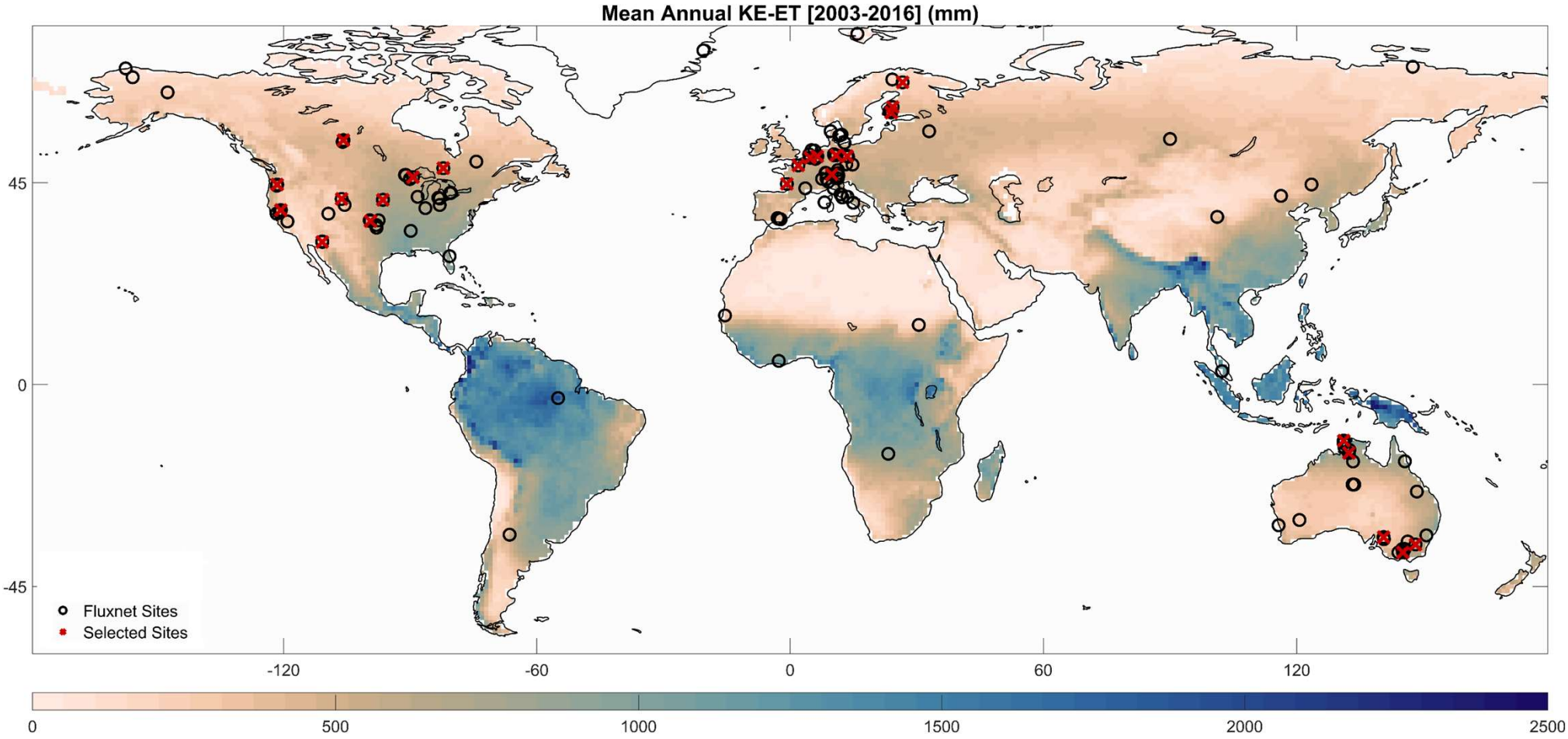
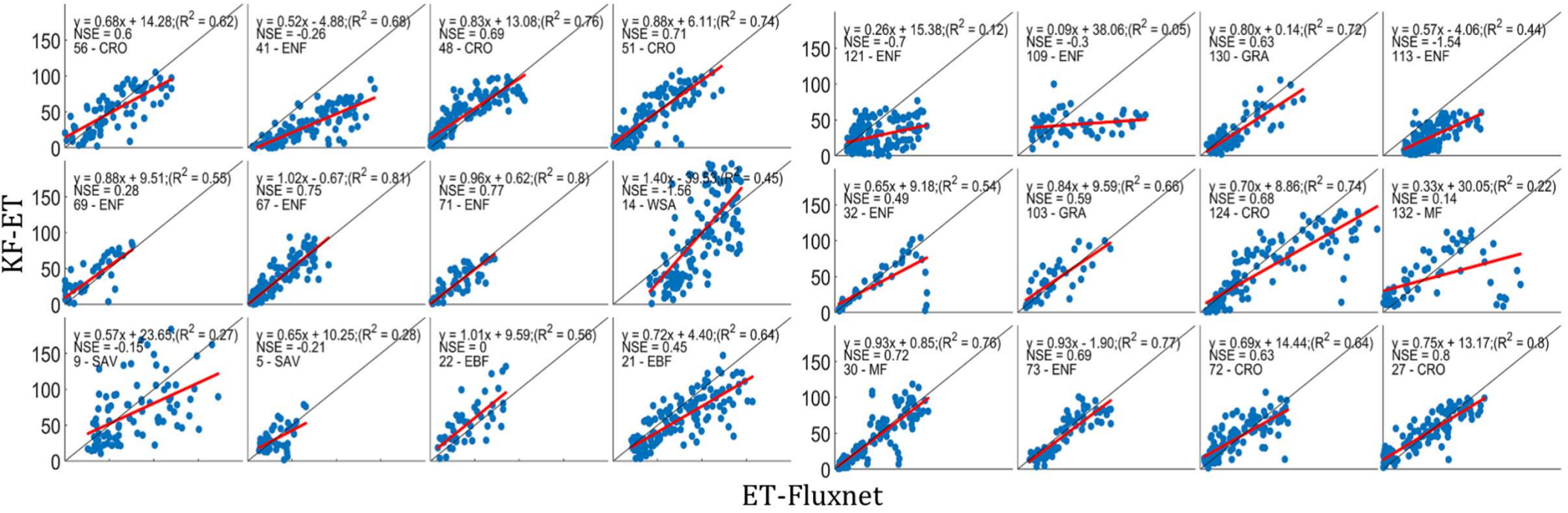


Fig. 6: Fluxnet Site location for Validation of KF-ET

Results: Point scale evaluation



Red line (best fit line), black line (1:1 line), $R2$, NSE, site-id and the IGBP LULC class are reported

Fig. 7: Scatter plots of Fluxnet-based *ET* data from 24 Fluxnet sites with respect to KF-ET gridded dataset

Results: Cross Comparison - Climatology

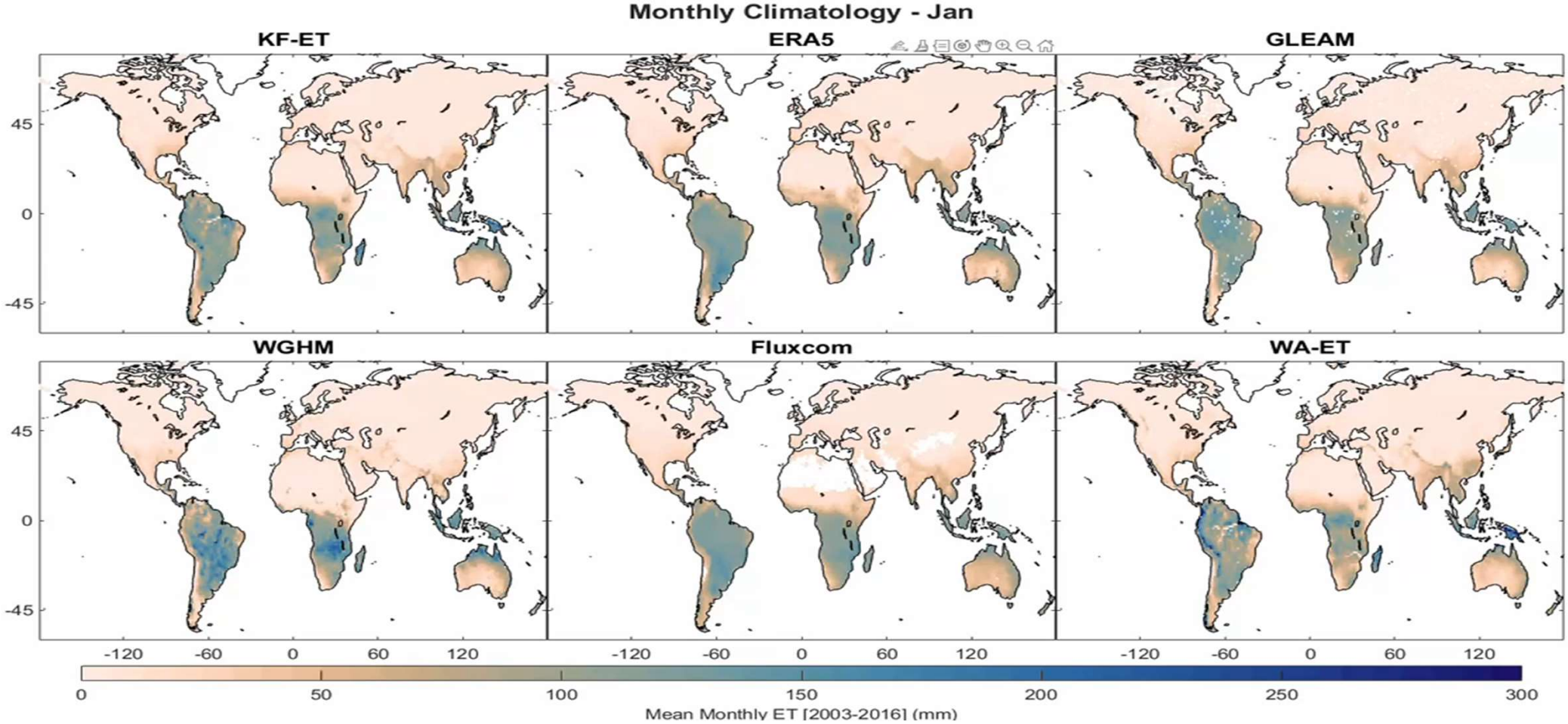


Fig. 8: Monthly Climatology of 6 ET products

Results: Cross Comparison

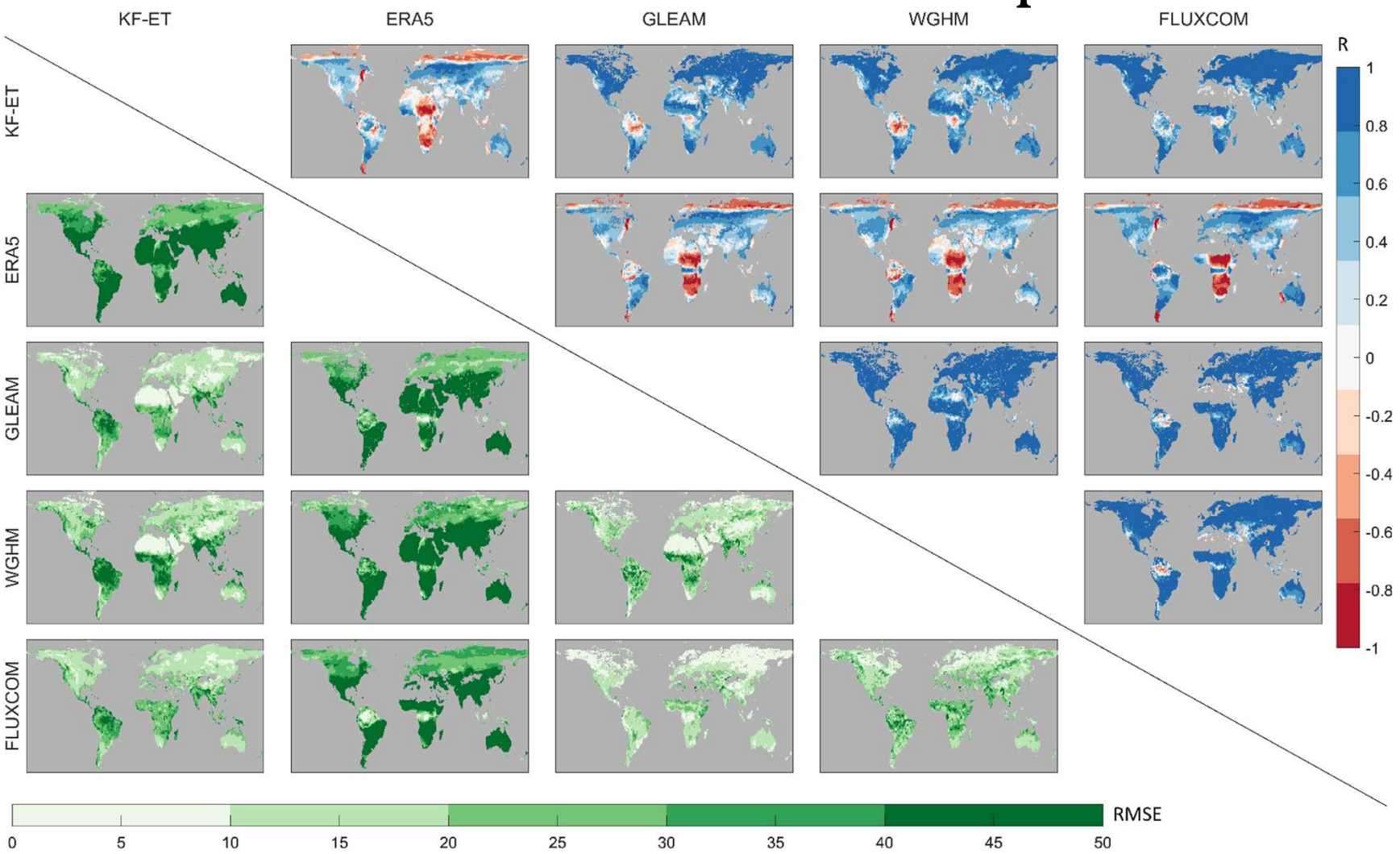


Fig. 9: Comparison of 6 ET products

- Large regional discrepancies among ET products
- Key regions: Amazon, Southern Africa, Eastern India, and Southern China.
- KF-ET closely matches Fluxcom in most regions.
- Fluxcom performs well in data-dense regions but has limitations in sparse areas.

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Publication and blogposts

ENVIRONMENTAL RESEARCH
LETTERS

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Water budget-based evapotranspiration product captures natural and human-caused variability

Shubham Goswami, Chirag Rajendra Ternikar, Rajsekhar Kandala, Netra S Pillai, Vivek Kumar Yadav, Abhishek, Jisha Joseph, Subimal Ghosh and Bramha Dutt Vishwakarma*

Challenges in Validating Large-Scale ET Estimates: A Comparative Study of Six Global Products

AGRICULTURAL | ATMOSPHERIC SCIENCES | CLIMATOLOGY (GLOBAL CHANGE) | ENVIRONMENTAL SCIENCES | GEODESY | HYDROLOGY

Chirag Ternikar, Shubham Goswami, Rajsekhar Kandala, Netra S Pillai, Vivek Kumar Yadav, Abhishek ., Jisha Joseph, Subimal Ghosh, Bramha Vishwakarma

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Combining GRACE and Kalman filter to get superior evapotranspiration estimates

Ternikar Chirag Rajendra, Shubham Goswami and Bramha Dutt Vishwakarma · October 25, 2024 · ECS, Guest post, Papers · No Comments