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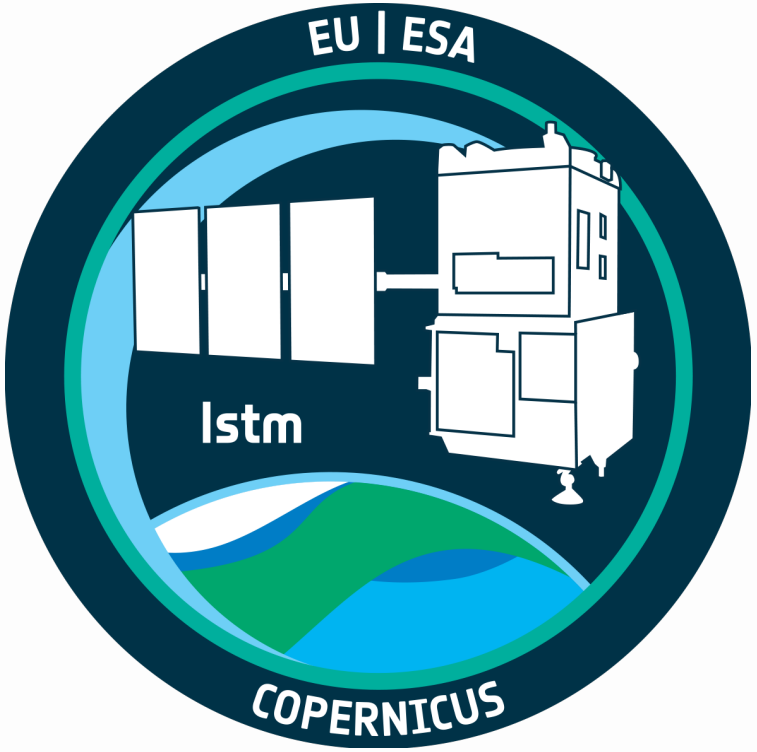
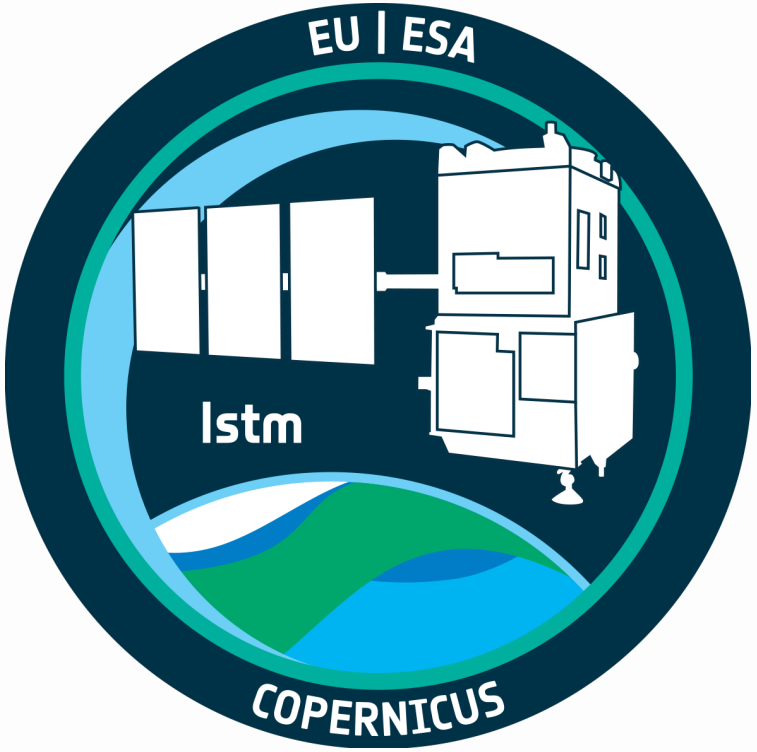
Preparation and algorithm selection for the future high-resolution ESA satellite mission **Land Surface Temperature Monitoring**



Agnieszka Soszynska, Michael Perry, Darren Ghent

LSTM mission in a nutshell

- Support for **agricultural and urban services**
- Mission consists of **2 satellites**
- Imaging in **5 TIR bands and 6 VIS-SWIR bands**
- **Spatial resolution of 50 m**
- **Swath width of ~670 km**
- Global revisit time of **2 days**
- Daily coverage at European latitudes using two satellites
- Observing land and coastal areas

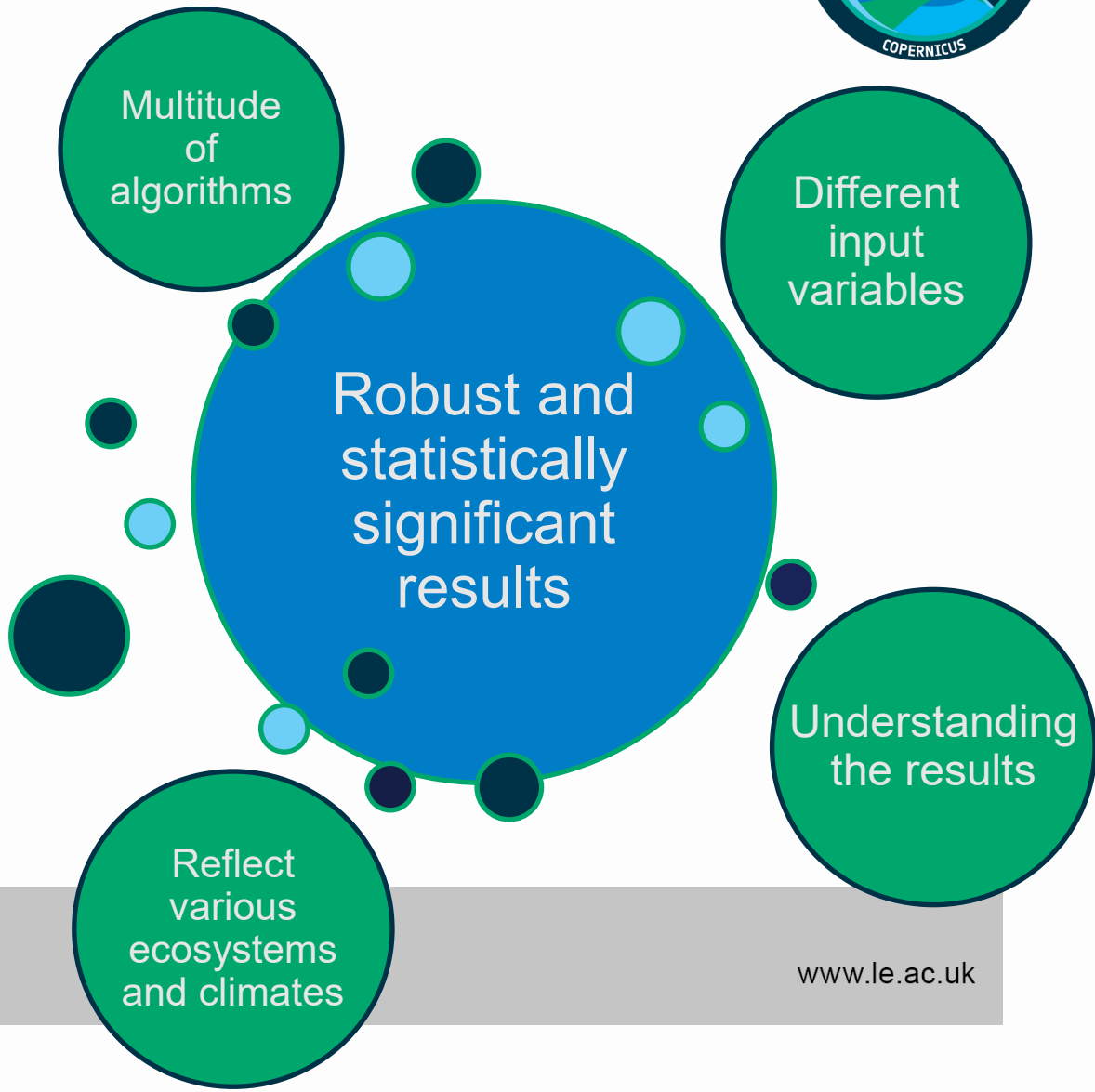


LSTM presentations and posters

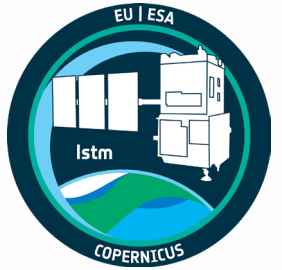
Sandrine Mathieu	Algorithm selections, progress and way forward of LSTM-L2 Processor development and associated calibration and validation project	A.02.01
Itziar Barat, Steffen Dransfeld, Ignacio Fernandez Nunez	LSTM L1 and L2 products and Algorithms	C.03.07
Ignacio Fernandez	Impact of geometric knowledge performance on per pixel uncertainty for non-uniform scenes: the case for CHIME and LSTM missions	C.06.07 - poster
Ben Courtier	The Land Surface Temperature Retrieval Algorithm for LSTM: An Overview and Results	A.02.01
Ana Bolea, Benjamin Koetz, Miguel Such	LSTM mission status	C.03.07
Charlotte Paton	Understanding the Thermal Environment of UK Cities With Satellite Remote Sensing	F.04.13

Selection of the operational algorithm

- Algorithm analysis results need to be representative and statistically significant
- Robustness across diverse conditions
- Uncertainty and sensitivity analysis
- Multi-scale validation
- Calibration/validation strategy support
- Scientific credibility trust



Groups of algorithms



Algorithms assuming emissivity

UoL Split Window

Operational for Sentinel-3 SLSTR

Generalised Split Window

Operational for MODIS in LST_cci

Algorithms retrieving emissivity

Temperature-Emissivity Separation (TES)

Operational for ECOSTRESS and MODIS NASA data

DirecTES

Operational for future mission TRISHNA

Optimal Estimation

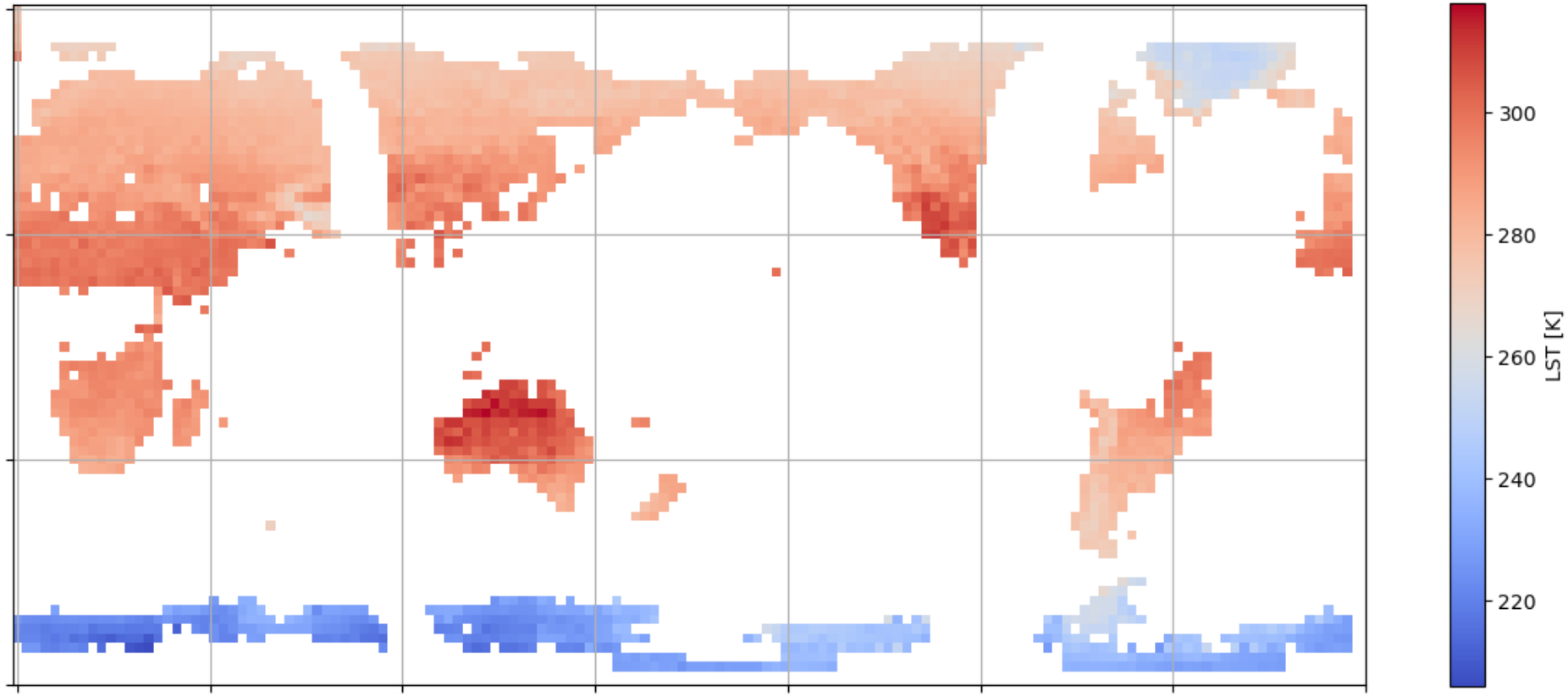
Hybrid Optimal Estimation

Algorithms have different assumptions

And different inputs…

Algorithm	UOL	GSW	OE	TES	DirecTES	HybridOE
Total Column Water Vapour	X	X				X
Fraction of vegetation	X					
Biome	X					
Downwelling				X	X	
Upwelling					X	
BOA radiance				X		
TOA Brightness Temperature	X	X	X			X
First guess emissivity		X	X			X
First guess skin temperature			X			

Simulation database for comparison



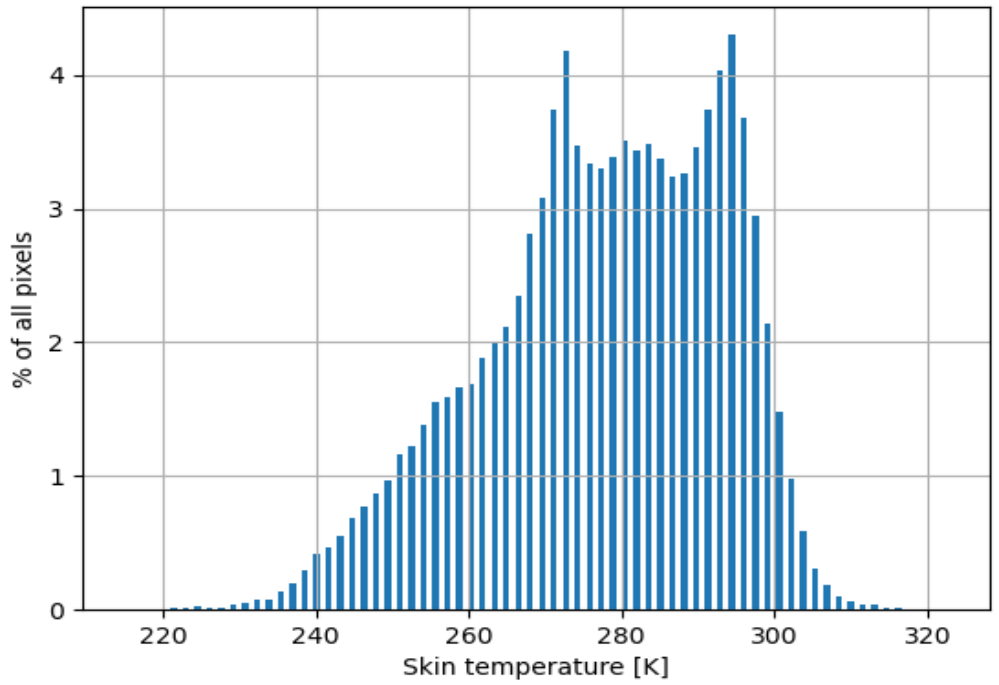
Database comprises
20 years
12 months
1 day a month
144*72 pixels

altogether
157 478 pixels
(excluding cloudy pixels)

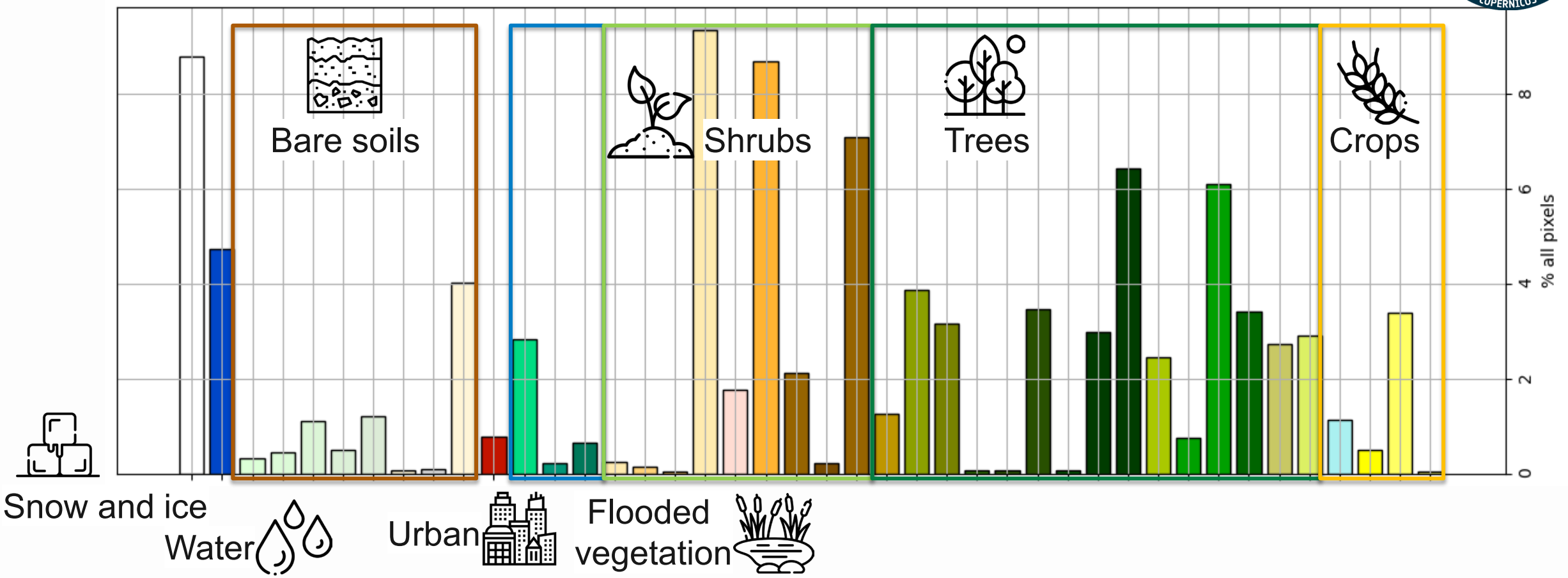
Simulation database for comparison

True variables and perturbed variables

- Vegetation fraction
- Biome
- Elevation
- Skin temperature
- Total column water vapour
- Upwelling irradiance
- Downwelling irradiance
- TOA BT (or L)
- BOA BT (or L)
- Transmissivity
- Emissivity



Simulation database for comparison



Algorithm selection criteria

- **Bias**
- **Precision**
- **Sensitivity**
  (towards biomes and atmospheric parameters)
- **Complementarity**
  (channel combinations, usage in other missions)
- **Mission compliance** (retrieve LST and ε)
- **Improvability**
- **Difficulty of implementation**

Metrics are weighted

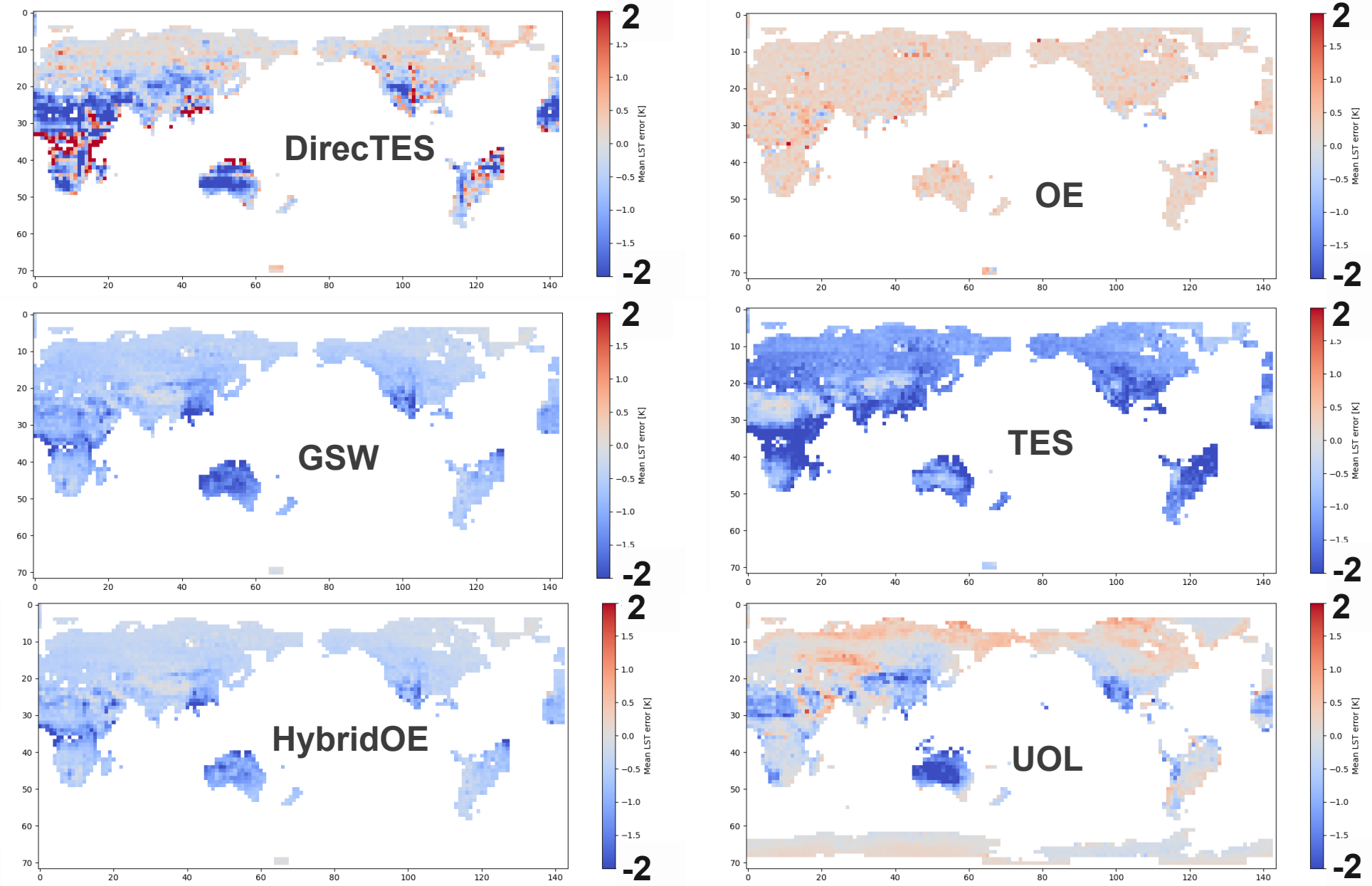
Results are ranked

Overall result takes the weighted score over all metrics

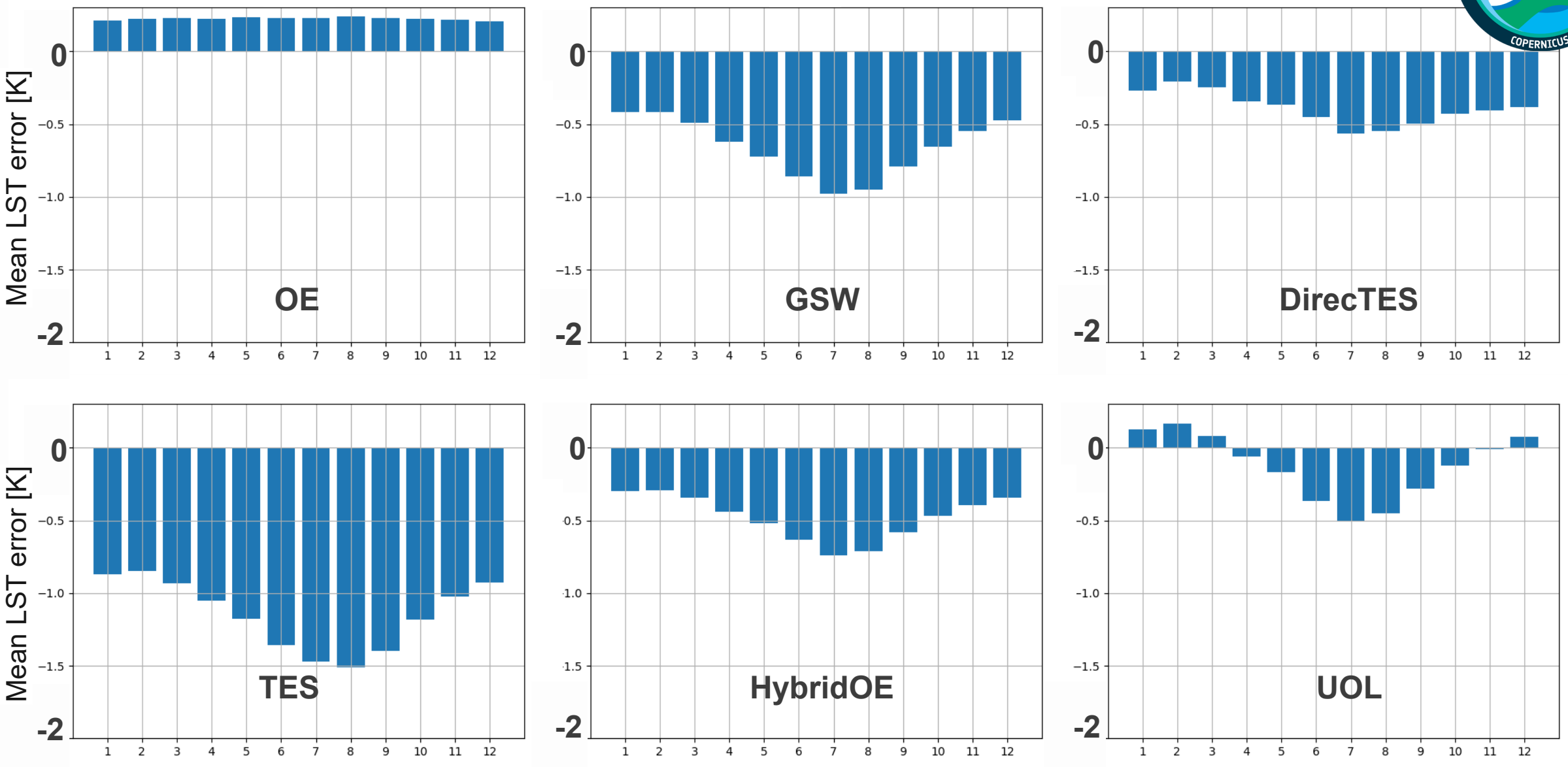
Results: Bias and precision

	UOL	GSW	OE	TES	direcTES	HybridOE
Bias (mean absolute discrepancy) [K]	0.69	0.69	0.42	1.22	1.04	0.52
Bias (median absolute discrepancy) [K]	0.53	0.56	0.36	1.05	0.54	0.38
Precision (st. dev.) [K]	0.93	0.59	0.53	0.88	1.66	0.52
Precision (mean of cell st. dev.) [K]	0.88	0.56	0.53	0.84	1.63	0.50
Precision (median of cell st. dev.) [K]	0.87	0.56	0.53	0.84	1.61	0.50

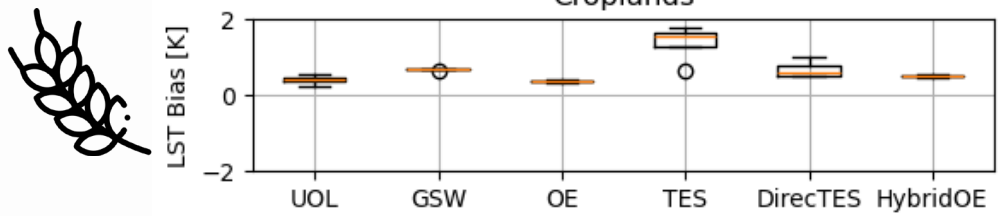
Results: Bias and precision

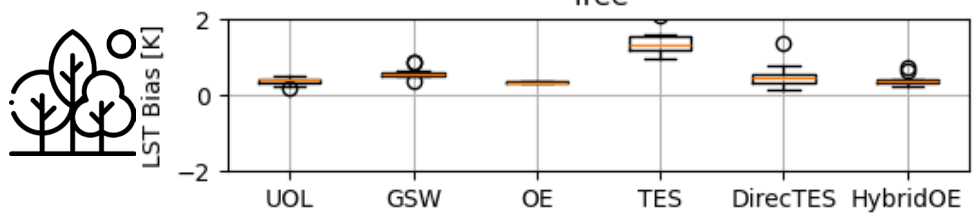


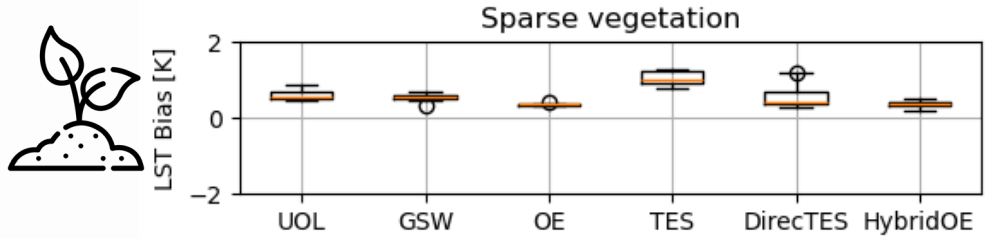
Results: Seasonality

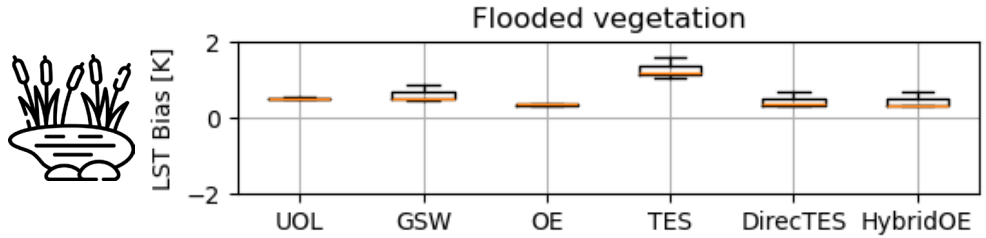


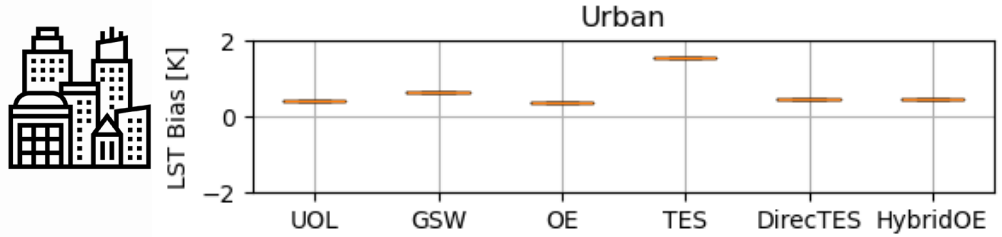
Results: Sensitivity to biomes

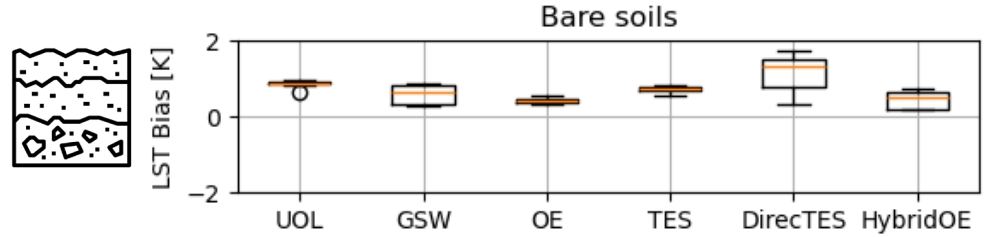


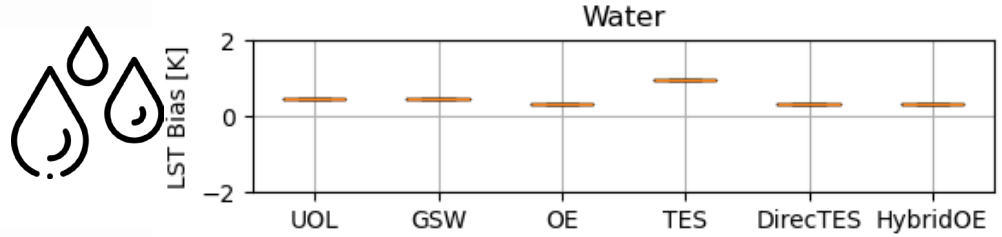


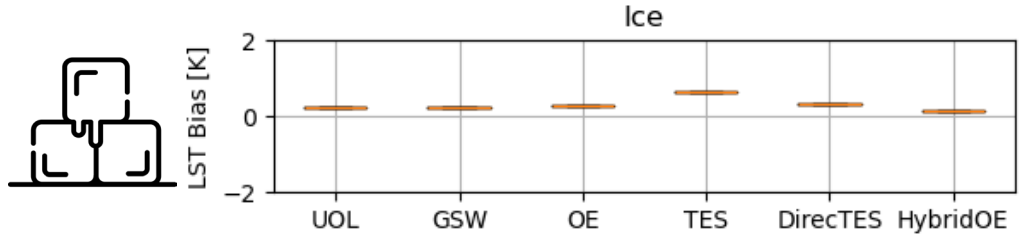






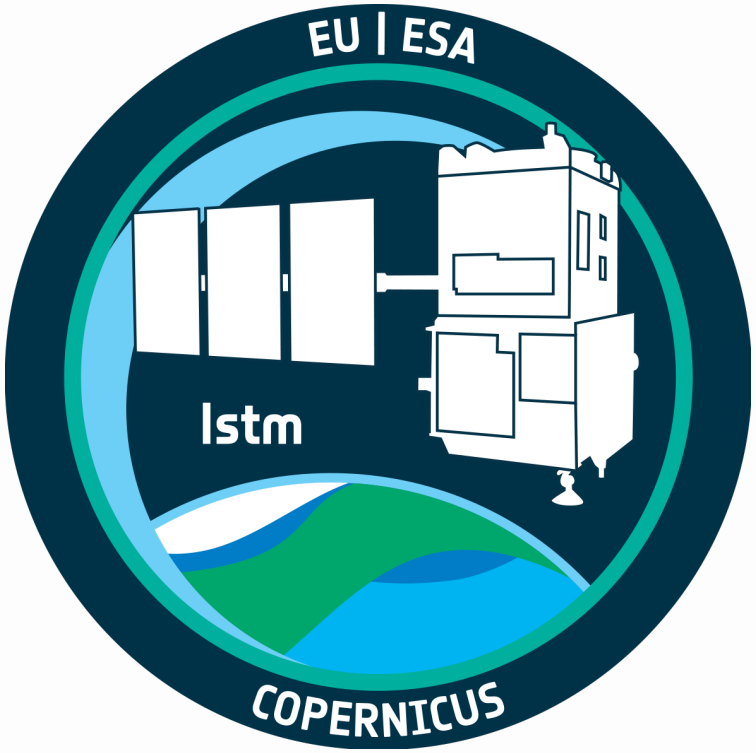






Results and selected algorithms

Place	Algorithm	
1	Optimal Estimation	**First choice**
2	HybridOE	
3	Generalised Split-Window	
4	University of Leicester	
5	DirecTES	**Second choice**
6	Temperature-Emissivity Separation	



Round robin report is available from ESA upon request

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Special Interest Group on Thermal Remote Sensing

- **Organising events, workshops, special sessions**
  Thermal Remote Sensing Workshop and thermal meetup at LPS
- **Website**
  Knowledge base and news: lectures from the workshop, articles on relevant matters, news relevant to the community
- **Thermal Lens podcast**
  Special series of Those Space People podcast on all things thermal remote sensing
- **Newsletter**
  News and updates relevant for the community
- **Would you like to engage? Let us know!**

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