Common Task Framework For a Critical Evaluation of Scientific Machine Learning Algorithms

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No Common Standard

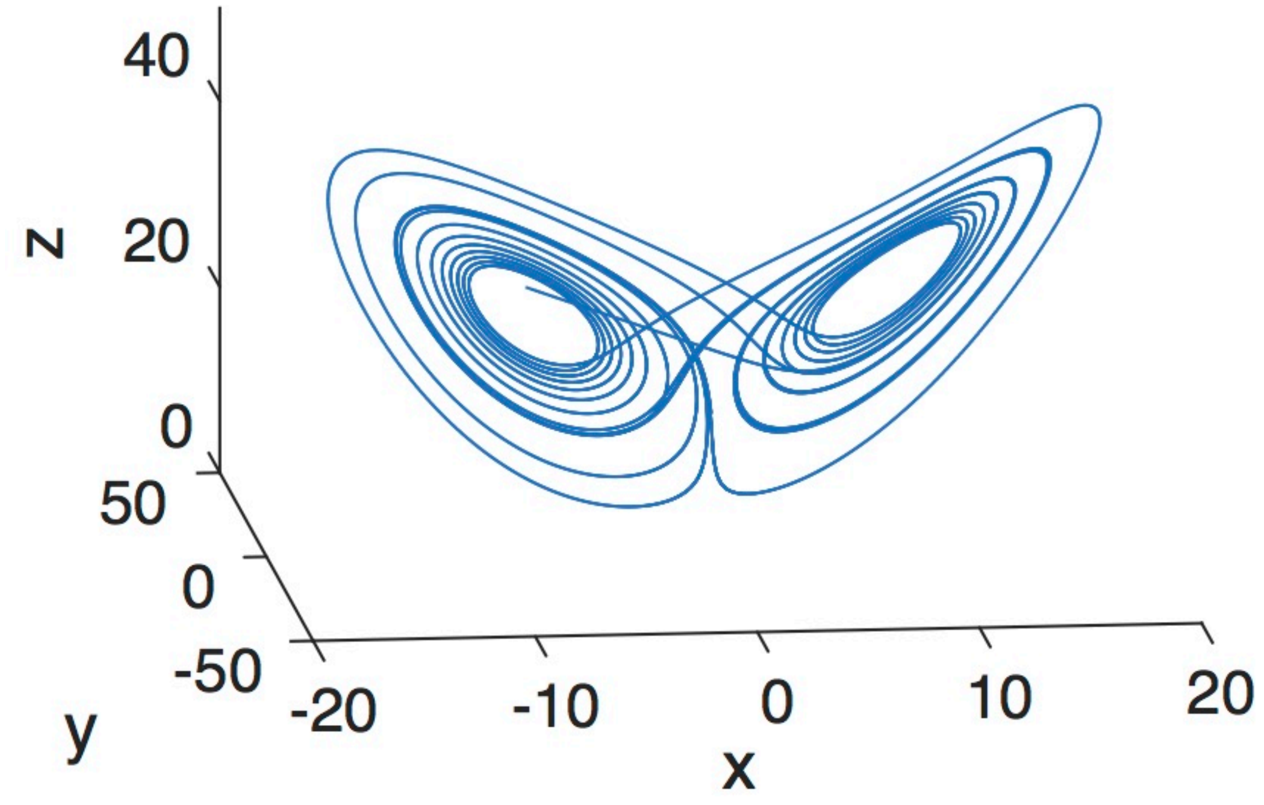
- The field is suffering from:
    - Weak Baselines
    - Reporting Bias
    - Inconsistent Evaluations
    - Lack of *hidden* test sets

Common Task Framework for Science

- We provide:
  - Curated set of datasets
  - Task specific metrics
  - Standardized Evaluation
  - Hidden test set

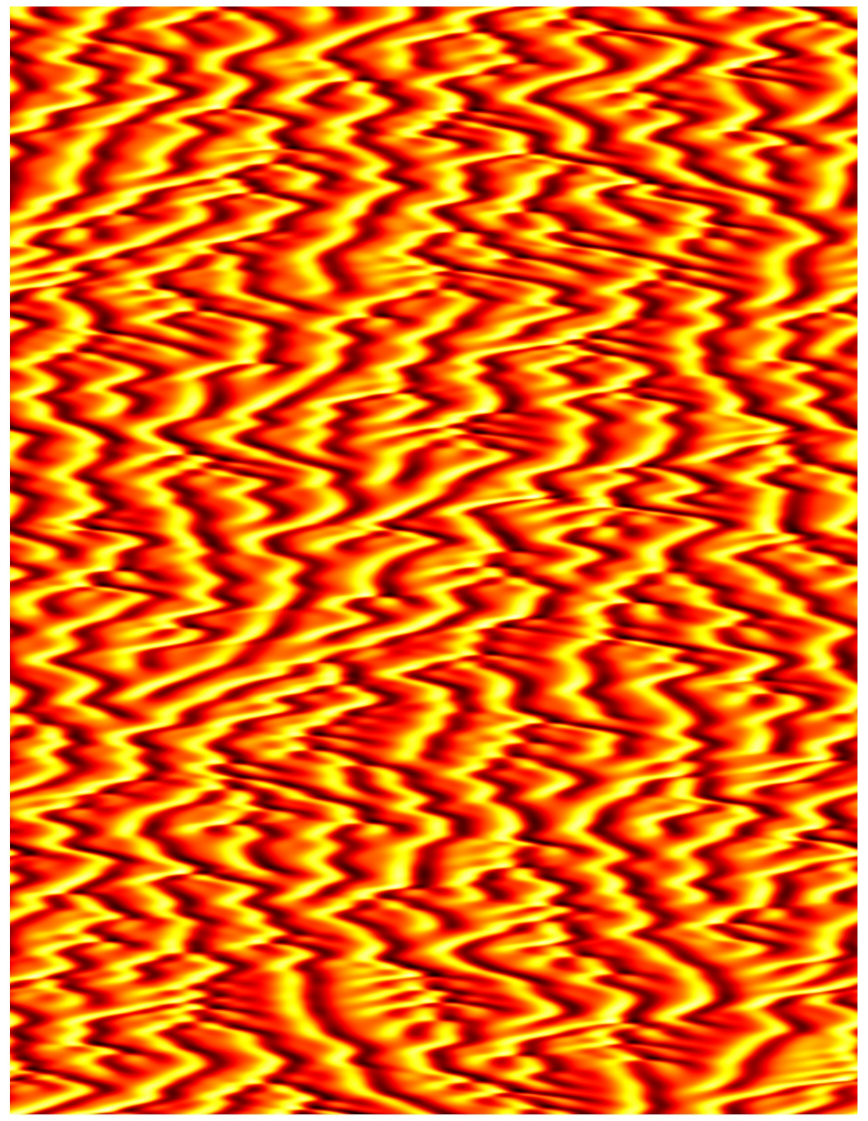
Datasets

Lorenz



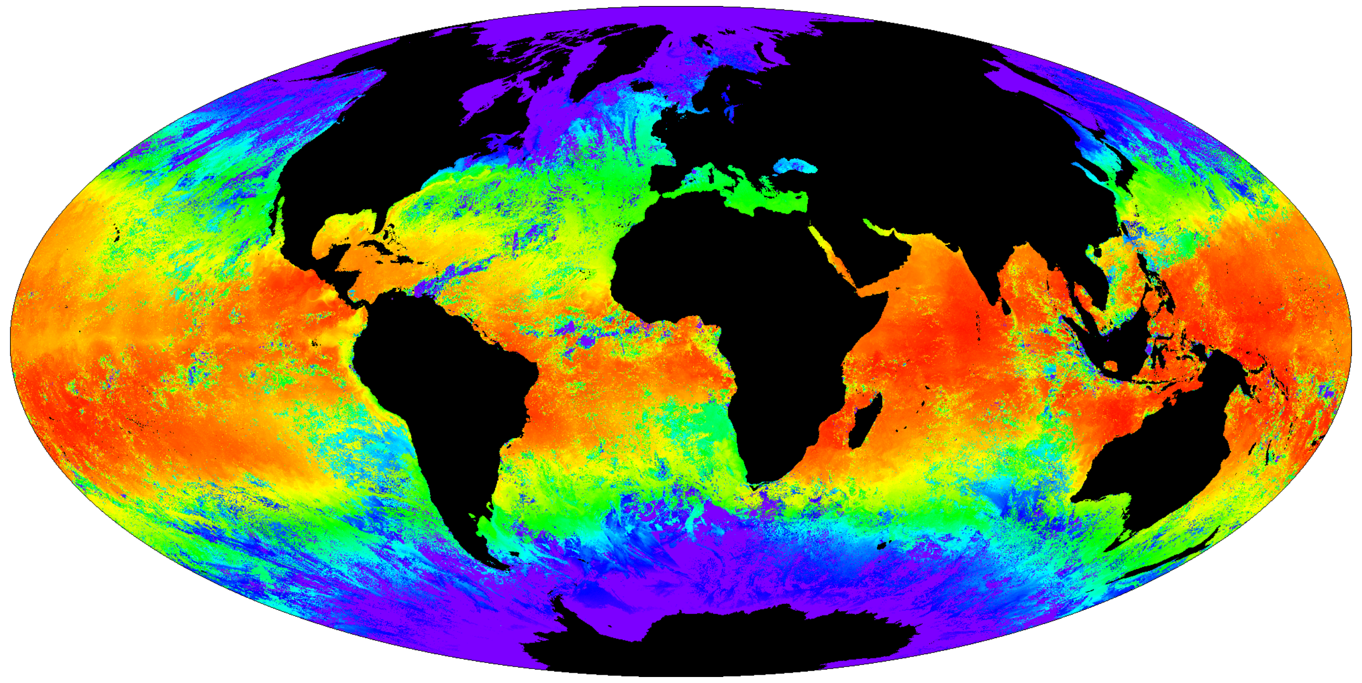
$$\mathbf{x}_j = \mathbf{x}(t_j) = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

Kuramoto-Sivashinsky



$$\mathbf{x}_j = \mathbf{x}(t_j) = \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{bmatrix}$$

Sea Surface Temperature



More to come!

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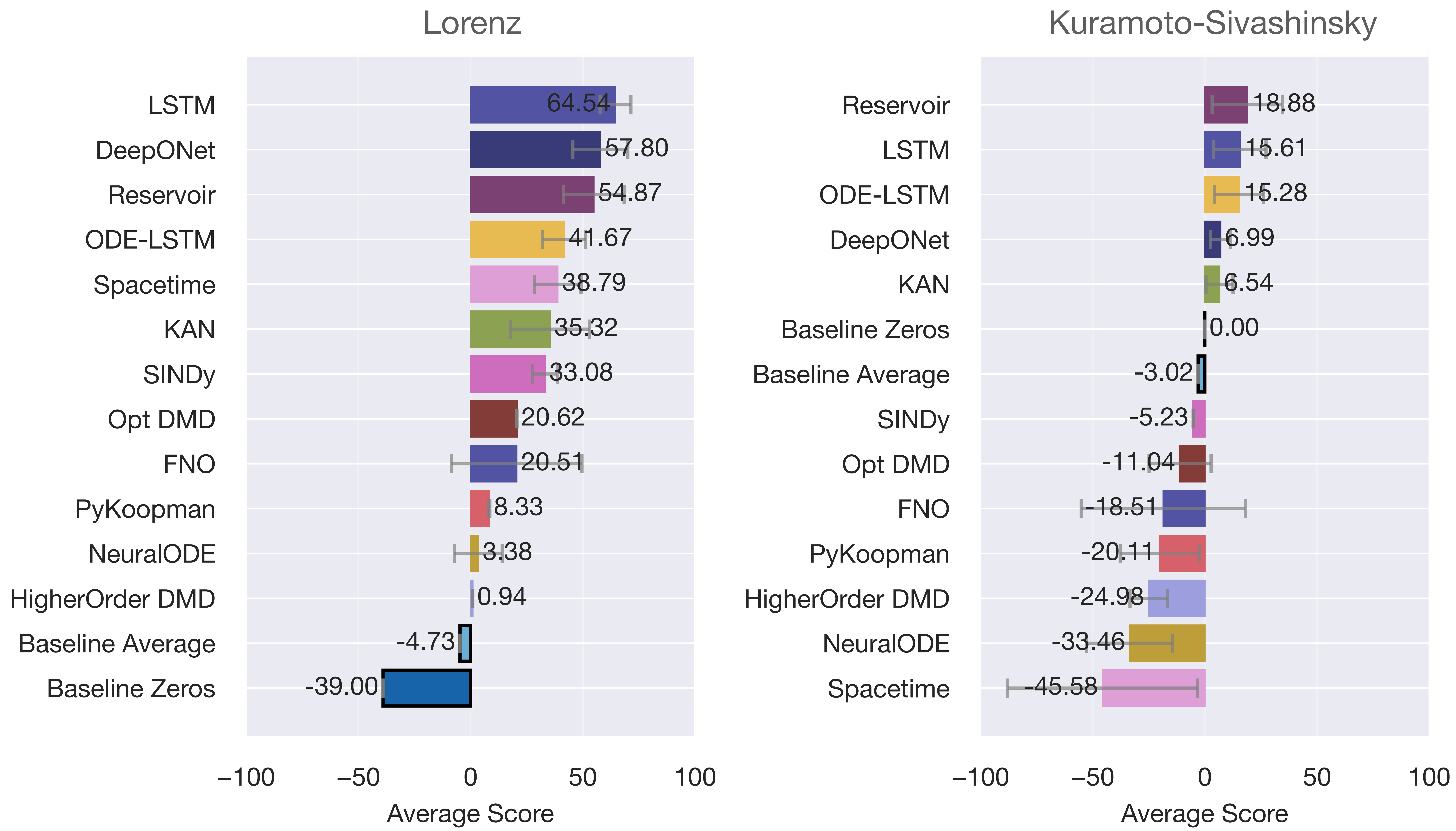
Average Scores



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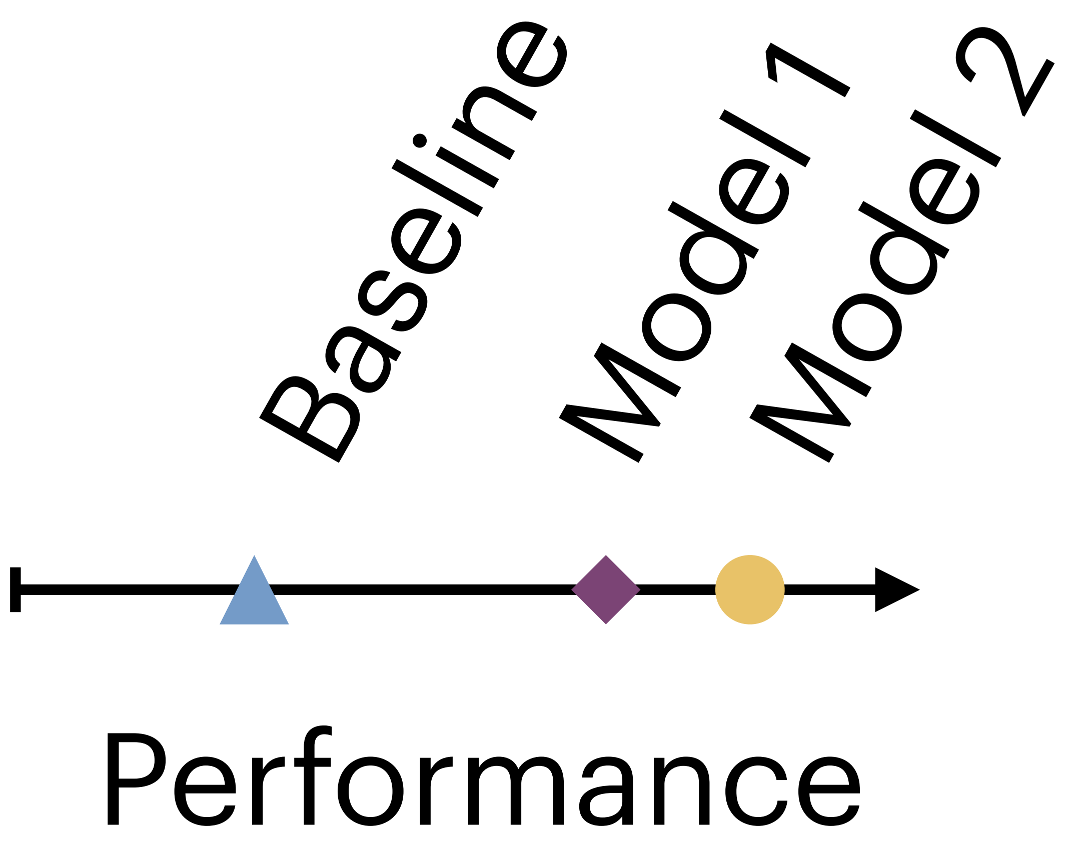
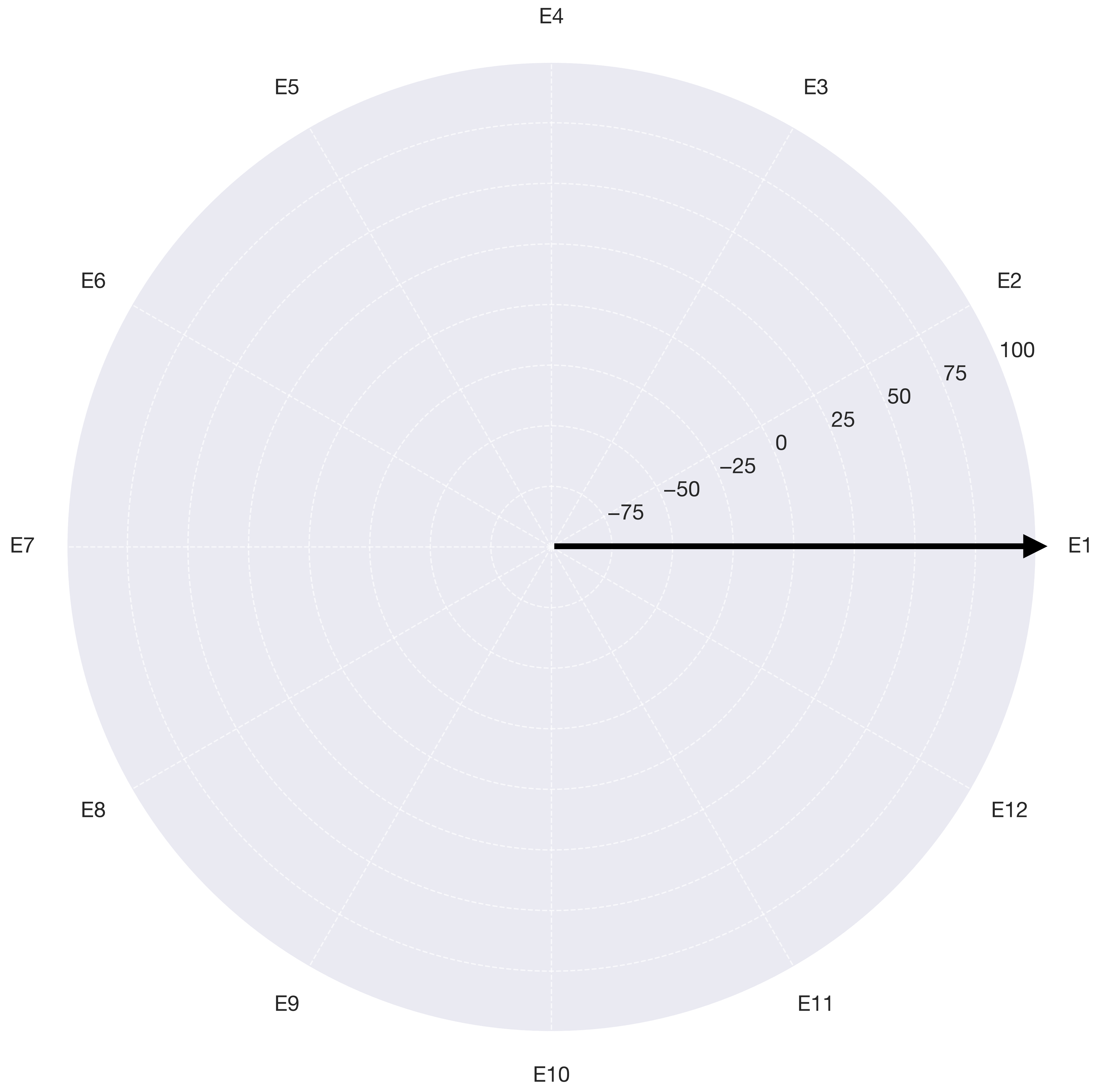
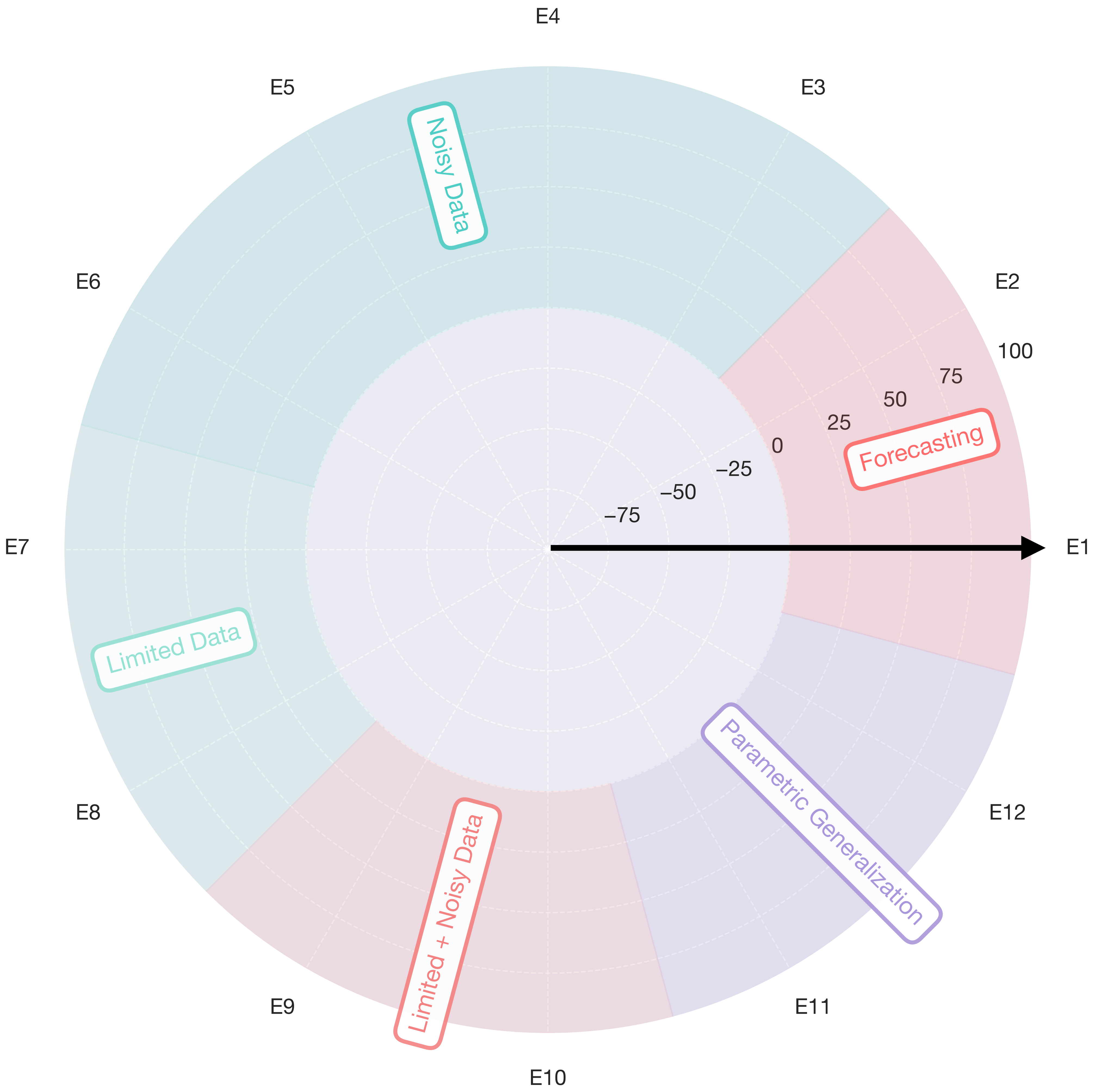
Characterizing Model Performance



Characterizing Model Performance



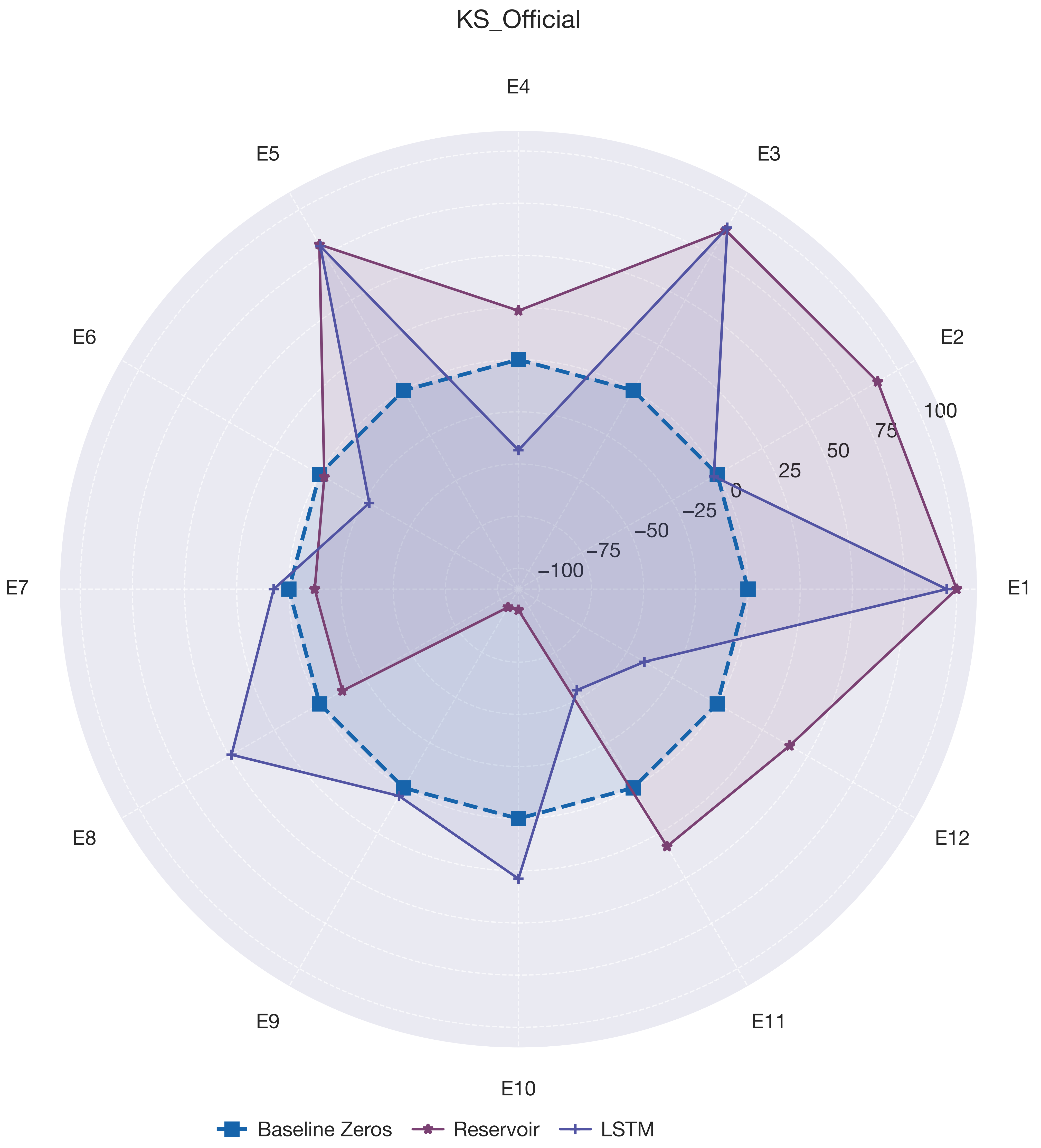
Characterizing Model Performance



Scoring Dimensions

Score	Test	Task
E1	Forecasting	Short-time
E2	Forecasting	Long-time
E3	Noisy (medium)	Reconstruction (denoising)
E4	Noisy (medium)	Forecast (long-time)
E5	Noisy (high)	Reconstruction (denoising)
E6	Noisy (high)	Forecast (long-time)
E7	Limited Data (clean)	Forecast (short-time)
E8	Limited Data (clean)	Forecast (long-time)
E9	Limited Data (noisy)	Forecast (short-time)
E10	Limited Data (noisy)	Forecast (long-time)
E11	Parametric Generalization	Interpolation forecast
E12	Parametric Generalization	Extrapolation forecast

Model Fingerprint



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CTF4Science on GitHub

- Modular code with diverse functionality
  - Data loading and model evaluation API
  - Easy hyper-parameter tuning
- Pre-configured models
  - 18 models implemented, tuned, and evaluated
- Visit https://github.com/CTF-for-Science/ctf4science

CTF for Science on Kaggle

- Let the broader community score their models
- Truly withheld test-set for fair comparison
- Display submissions per team to prevent p-hacking
- Custom website to show spider plots and detailed metrics

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