AI Weather Quest ECMWF

Enhancing sub-seasonal predictions with AI/ML: A competition by ECMWF

Pre-Competition Webinars

Get ready for the Competition Phase

ECMWF

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Agenda

- **Presentation (30 minutes)**
  - ✓ The AI Weather Quest in a nutshell
  - ✓ Registrations and Testing Period participation overview
  - ✓ First Competition Period timeline
  - ✓ Evaluation and results display
  - ✓ Competition outputs transparency
- **Q&A (30 minutes)**

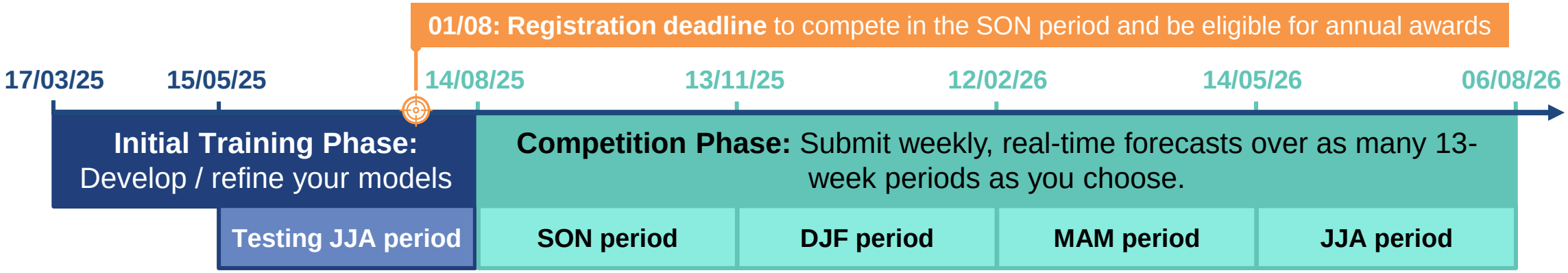
This session is being recorded.
The recording will be made available online after the webinar. If you do not wish to appear, please turn off your camera.

Please mute your microphone.
Please keep yourselves muted during presentations. You are welcome to take the floor or ask questions in the chat during the Q&A.

The AI Weather Quest in a nutshell

A **global competition,** organised by ECMWF and endorsed by WMO, for the **best-performing AI/ML models for sub-seasonal weather predictions**.

Participants are tasked with producing global weekly forecasts of **near-surface (2-metre) temperature**, **precipitation**, and **mean sea level pressure**. Forecasts must provide quintile probabilities at a **1.5-degree** latitude/longitude resolution, covering one of two lead times: **Days 19 to 25** or **Days 26 to 32**.



Access detailed submission guidelines, explore the AI Weather Quest Python package (with ReadtheDocs documentation), and watch the step-by-step usage guide recording - all available on the Quest website.

Registrations and Testing Period participation overview

AI Weather Quest ECMWF

The registrations in numbers

300+
Participants registered

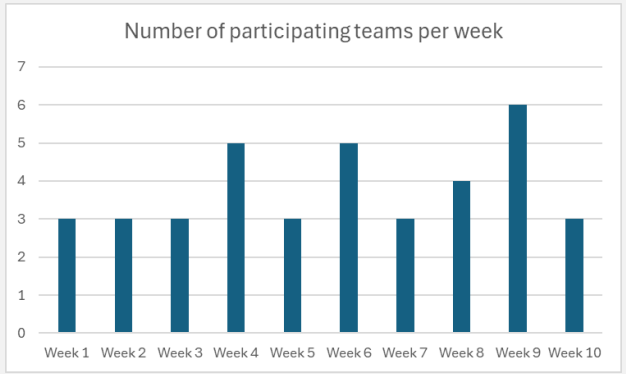
100+
Teams registered

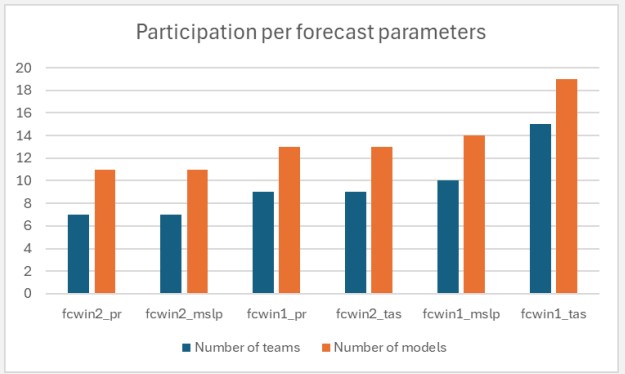
140+
Models registered

The Testing Period participation

16
Teams

20
models





3 weeks to go: **Submit a test forecast** to ensure everything runs smoothly on your side!

Submission validation on the Forum

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First Competition Period timeline

Week	Forecast initialisation date = submission open	Submission close	Forecast week 3 start date	Forecast week 3 end date	Forecast week 4 start date	Forecast week 4 end date	Publication of weekly results on the website
1	Thursday 14-Aug-2025 00:00	Sunday 17-Aug-2025 23:59	Monday 1-Sep-2025 00:00	Sunday 7-Sep-2025 18:00	Monday 8-Sep-2025 00:00	Sunday 14-Sep-2025 18:00	Friday 19-Sep-2025 00:00
2	Thursday 21-Aug-2025 00:00	Sunday 24-Aug-2025 23:59	Monday 8-Sep-2025 00:00	Sunday 14-Sep-2025 18:00	Monday 15-Sep-2025 00:00	Sunday 21-Sep-2025 18:00	Friday 26-Sep-2025 00:00
3	Thursday 28-Aug-2025 00:00	Sunday 31-Aug-2025 23:59	Monday 15-Sep-2025 00:00	Sunday 21-Sep-2025 18:00	Monday 22-Sep-2025 00:00	Sunday 28-Sep-2025 18:00	Friday 3-Oct-2025 00:00
...							
13	Thursday 6-Nov-2025 00:00	Sunday 9-Nov-2025 23:59	Monday 24-Nov-2025 00:00	Sunday 30-Nov-2025 18:00	Monday 1-Dec-2025 00:00	Sunday 7-Dec-2025 18:00	Friday 12-Dec-2025 00:00

Week number	Day of week						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0				1	2	3	4
1	5	6	7	8	9	10	11
2	12	13	14	15	16	17	18
3	19	20	21	22	23	24	25
4	26	27	28	29	30	31	32
5	33	34	35	36	37	38	39
6	40	41	42	43	44	45	46

Forecast submission window | First forecast period | Second forecast period | Publication of evaluation results

Forecast evaluation

After the two forecasting windows have passed, forecasts will be **evaluated against ERA5T**.

By **Day 37**, the latest ranked probability skill scores (RPSSs) will be published online.

Evaluation and results display

Weekly RPSS associated with the latest forecasts

Every week we will compute the RPSS associated with the latest set of forecasts.

$$RPSS = 1 - \frac{RPS}{RPS_{clim}} \; where \; RPS = \sum_{k=1}^{K}(Y_k - O_k)^2 \; and \; RPS_{clim} = \sum_{k=1}^{K}(P_k - O_k)^2$$

Period-aggregated RPSS across all previous weeks within the competitive period

In addition, we will compute period-aggregated RPSSs through comparing ranked probability scores (RPS) at every temporal and spatial point.

$$\mathrm{RPSS}^*(F) = 1 - \frac{\frac{1}{T}\frac{1}{L}\sum_{\ell=1}^{L}\sum_{t=1}^{T}\mathrm{RPS}(F_{\ell,t}, y_{\ell,t})}{\frac{1}{T}\frac{1}{L}\sum_{\ell=1}^{L}\sum_{t=1}^{T}\mathrm{RPS}(F_{\ell,t}^{\mathrm{clim}}, y_{\ell,t})},$$

To be ranked on the Period-aggregated leaderboard, you must **submit forecasts every week** with a given model across the entire 13-week period and **complete a model questionnaire**.

At the end of the period, during the Awards Webinar on 18 December, teams with the **top-performing models,** based on the **highest variable-averaged, period-aggregated RPSS**, will be spotlighted and invited to present.

Outstanding teams from diverse organisations or operating with limited resources will also be recognised.

Forecasts and evaluation display

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Filtering

Competitive period and competition week (forecast initialisation date)

MAM 2025 ▾ | Competition week 1 (Thu 13-Feb-2025) ▾

Forecast window

- **First forecast window: Days 19 to 25**
- Second forecast window: Days 26 to 32

Variable

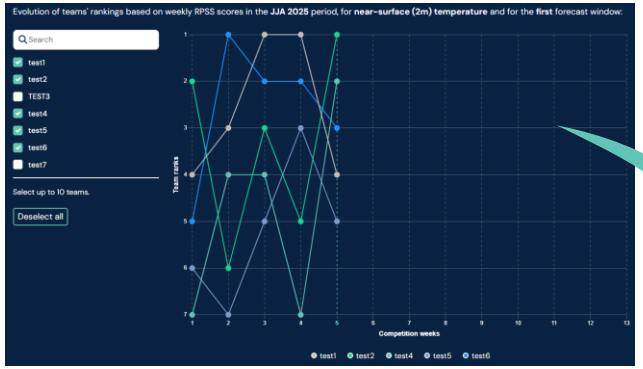
- Variable-averaged (tas, mslp, pr)
- **Near-surface (2m) temperature (tas)**
- Mean sea level pressure (mslp)
- Precipitation (pr)

Period-aggregated + Weekly

Access to team's page

Team Rank	Model Rank	Team name / Model name	Weekly RPSSs: tas
1		test2	
	1	testfc	0.840
	6	aimltestfc	0.458
	12	clim_fc	−0.139
2		test4	
	2	sfcmodel2	0.809
3		test6	
	3	fctest12	0.758
	10	webinartest7	−0.057
	13	aifc4	−0.204

Forecasts visualisations portal



Evolution graphs over the period's 13 weeks for teams ranking & scores

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Open access to forecast data

Forecast data will be made available in two phases: (1) at the end of each 13-week competition period, and (2) after the conclusion of the AI Weather Quest.

End of each competitive period

Following a webinar recognising the top performing models, all submitted forecast data will be made available on **ECMWF's Open Data Store**. We will provide Python-based tools to simplify forecast download.

After the AI Weather Quest

All submitted forecast data, along with evaluation datasets, will be stored on ECMWF's Cross Data Store. This platform is designed to host public datasets developed by ECMWF's Research Department.

Competition outputs transparency – Model summaries

In mid-October

4 weeks before the end of the first competition period, an empty **model summary questionnaire** will appear in the *Models* section of each participant's dashboard. The teams will have 4 weeks to complete the form.

After each competition period ends and awards are granted

The submitted model summary questionnaire becomes **visible on the team's public profile page**.

During the final four weeks of future competition periods

Teams will be able to **update the questionnaire** for any previously registered models that has not since been withdrawn / complete the questionnaire for any new models added during the period.

1. Which of the following descriptions best represent the overarching design of your forecasting model? *(Select all that apply – multiple choices allowed)*:
    a. Post-processing of numerical weather prediction (NWP) data.
    b. Machine learning-based weather prediction.
    c. Statistical model focused on generating quintile probabilities.
    d. Hybrid model that integrates physical simulations with machine learning or statistical techniques
    e. An empirical model that utilises historical weather patterns.
    f. Ensemble-based model, aggregating multiple predictions to assess uncertainty and variability.
    g. Other (please specify).
2. What types of datasets were used for model training? *(For example: observational datasets, reanalysis data, NWP outputs or satellite data.)*
3. Please provide an overview of your final ML/AI model architecture? *(For example: key design features, specific algorithms or frameworks used, and any pre- or post-processing steps.)*
4. Have you published or presented any work related to this forecasting model? If yes, could you share references or links?
5. Before submitting your forecasts to the AI Weather Quest, did you validate your model against observational or independent datasets? If so, how?
6. Did you face any challenges during model development, and how did you address them?
7. Are there any limitations to your current model that you aim to address in future iterations?
8. Are there any other AI/ML model components or innovations that you wish to highlight?
9. Who contributed to the development of this model? *(Optional) Please list all individuals who contributed to this model, along with their specific roles (e.g., data preparation, model architecture, model validation, etc.) to acknowledge individual contributions.*

Q&A

Feel free to ask your questions!

- *Raise your hand to speak*
- *Type your questions in the chat*

Thanks!

To everyone involved in the organisation of the AI Weather Quest.

See you for the next webinar!

The SON Awards webinar will take place on December 18th.