RON @ NROW25: AI/Machine Learning Notes

AI summaries of responses to discussion questions

How widely is AI currently used in operational weather forecasting? What models are used currently? How do you expect AI usage in operational weather forecasting to change in years to come?

The responses indicate a range of AI usage in operational weather forecasting. Some organizations are actively exploring and incorporating AI models into their workflows, while others have limited or no use of AI. There is also a sentiment that AI is sometimes used for experimentation or "fun" and not yet fully integrated into operational forecasting.

Some specific AI models being used include CIMSS ProbSevere, Nadocast, ECMWF-AI, Pangu, Graphcast, and CSU Machine Learning Convective and Excessive Rainfall Outlooks. Overall, the use of AI in operational weather forecasting is growing, but its adoption and integration vary across different organizations and applications.

Do you think AI will be useful to predict extreme events?

The responses to the question of whether A.I. will be useful to predict extreme events are mixed. Some participants believe that AI could potentially be useful in predicting extreme events, especially if the events are similar to those in the training data. However, others are more skeptical, citing the challenges of predicting unprecedented events and the limitations of AI in thinking outside the box. There is also uncertainty about whether AI can accurately model the tails of probabilistic forecasts.

What are the biggest opportunities for AI in operational forecasting?

The responses highlight several perceived opportunities for AI in operational forecasting:

- ***Improved Forecasting:***
    - ***Downscaling:*** *AI can be used to downscale global models to higher resolutions, providing more detailed and localized forecasts.*
    - ***More accurate predictions:*** *AI can improve the accuracy of forecasts*
    - ***Ensemble forecasting:*** *AI can facilitate the development of larger and more diverse ensembles, improving forecast uncertainty quantification.*
    - ***Probabilistic forecasting:*** *AI can improve the accuracy and reliability of probabilistic forecasts, providing a better understanding of uncertainty.*
    - ***Hurricane track prediction:*** *AI can enhance the accuracy of hurricane cones of uncertainty.*

    - ***Longer lead times:*** *AI can potentially extend the lead time of forecasts, allowing for earlier warnings and preparation.*
- ***Enhanced Decision-Making and Communication:***
    - ***Bridging gaps:*** *AI can help bridge the gap between physical and social sciences, enabling more informed decision-making.*
    - ***Targeted, impact-based forecasting:*** *AI can be used to identify and target specific areas at risk, and tailor forecasts to specific locations and populations, providing more relevant and actionable information.*
- ***Operational Efficiency:***
    - ***Automated tasks:*** *AI can automate routine tasks such as automatically amending aviation forecasts.*
    - ***Data analysis:*** *AI can increase the efficiency of task such as finding climatological data*

What are challenges for integrating AI in operational forecasting?

The responses highlight several challenges in using AI for operational forecasting:

- ***Data and Computational Resources:*** *Acquiring sufficient and high-quality training data, as well as the computational resources (like GPUs) needed to train complex AI models, can be significant hurdles.*
- ***Organizational Infrastructure and Expertise:*** *Building the necessary infrastructure and cultivating the expertise to develop and implement AI models within operational forecasting organizations can be challenging, particularly for organizations that may lack the resources and experience of larger tech companies*
- ***Data Quality and Quantity:*** *The quality and quantity of data used to train AI models can significantly impact their performance. Access to high-quality, diverse, and representative datasets is crucial for developing accurate and reliable models.*

How much do you trust AI models?

The responses to the question "How much do you trust AI models?" indicate a range of opinions, from skepticism to cautious optimism.

Key themes include:

- ***Lack of Trust and Uncertainty:*** *Many participants expressed a lack of trust in AI models due to their perceived lack of understanding of AI models' inner workings. AI models can be complex and difficult to interpret, leading to concerns about their reliability and trustworthiness. This can hinder their adoption in operational settings where understanding the model's decision-making process is crucial.*

- ***Performance and Reliability:*** *Participants highlighted the need for AI models to demonstrate consistent and reliable performance, especially in critical situations, in order to be considered trustworthy.*
- ***Concerns about Verification:*** *There were concerns about the availability and transparency of verification methods for AI models and whether they can be trusted to accurately assess performance.*
- ***Model Interpretability and Trust: Training and Education:*** *There was a strong call for more training and education on AI models, both for meteorologists and the public, to improve understanding and build trust.*

If there is a disagreement between AI models and dynamic models, which do you trust more and why?

The responses indicate a variety of perspectives on trusting AI models versus dynamic models in case of disagreement. Some participants expressed a preference for dynamic models due to their interpretability, as they can be explained and understood. Others leaned towards AI models, citing their better verification performance. However, there was also recognition that the choice of which model to trust can depend on the specific scenario and the nature of the disagreement.

Do you think there will be problems communicating forecasts that incorporate AI approaches? What is the public perception of these approaches?

There are concerns about how to communicate forecasts that incorporate AI approaches, particularly regarding the interpretability of AI models. One participant expressed concern that meteorologists may not be able to fully explain the output of AI models, which could lead to trust issues with the public.

The public's perception of AI in forecasting is uncertain. While one participant indicated that the public may not care about the methods used as long as the information is accurate and trustworthy, another noted that the public's opinion on AI in forecasting is unknown.

Raw Notes

How widely is AI currently used in operational weather forecasting? What models are used currently? How do you expect AI usage in operational weather forecasting to change in years to come?

- AI usage is exploding
- We looking at "whatever A.I. we can get our hands on" as an extra opinion
- We look at A.I. for "funsies" but it is not going into the actual NWS forecast
- "Entertainment purposes only"
- It is used everyday
- Limited to non-existent usage
- We look at whatever A.I. models we can
- Specific AI models that are being used include: CIMSS ProbSevere, Nadocast, ECMWF-AI, Pangu, Graphcast, CSU Machine Learning Convective and Excessive Rainfall Outlooks
- AI being used for translating products
- We include A.I. output in event reviews but this is qualitative not quantitative assessment of AI performance

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- Opportunity for longer lead time watches
- Hurricane track cone improvement from A.I.
- Downscaling guidance
- produce more robust probabilistic guidance
- The ability to develop large ensembles quickly
- AI being used to identify potential impacts based on the forecast/impact modeling
    - Your cell phone tailoring weather impacts specific to you
- Anything traditional models struggle with is an opportunity for A.I.
- AI techniques to improve the NBM guidance
- A.I. for finding climatological data / analogs
- Believe there is an opportunity for A.I. to develop probabilistic guidance
- Hazard visualization from A.I.
- More targeted warnings/preparedness by A.I./M.L. identifying hazards impacting more vulnerable locations
- A.I. can help bridge the gaps between physical guidance & social science decision making, social vulnerability
- Opportunities for updating aviation forecasts
- Opportunity to develop larger ensembles

What are challenges for integrating AI in operational forecasting?

- training dataset size and time to have the ability to build a robust A.I. model
- NOAA lags on architecture to build an AI model
- Training is expensive
- Need to be able to train the model which requires more reforecasts need to be done
- concerned that NOAA cannot keep up with private sector leadership in AI model development
- Even private sector does not have infrastructure outside of large tech companies
- Access to GPUs
- Large mesoscale ensembles can also be overwhelming to extract the signal from the noise

Do you think AI will be useful to predict extreme events?

- Maybe using different ways of building the models. It will be very difficult to predict an unprecedented event.

- Maybe if the extreme event is in the training dataset, probably not extreme events
- Uncertainty as to whether AI can accurately model the tails of a probabilistic forecast
- I am pessimistic because an extreme event is not in the model it would have a challenge forecasting it, but it still may be possible
- A.I. is not good at thinking outside the box so it will have a hard time predicting it if it is not in the training dataset
- It's possible that it could produce an unprecedented event
- Uncertaint if A.I. "creates" new events or just reproduces what it has seen

How much do you trust AI models?

- Not sure about confidence/how much to trust AI models because they are unproven
- can we trust the verification?
- More transparency with verification of AI models is needed for increased trust
- Uncertainty as to whether verification is available and if so where is it available
- All A.I. output can be conveyed with a high level of confidence but is not necessarily correct
- Operational Meteorologist: I want to know how an A.I. models perform before I will begin to trust & use it
- How much does an operational meteorologist need to know about how a model works in order to trust it?
- Need for more NWS training on AI models: what they are capable of/trade-offs/how they are developed
- We will need more training on the A.I. models
- It's just another model but it does verify better

If there is a disagreement between AI models and dynamic models, which do you trust more and why?

- Dynamic, because I can explain it.
- I would generally lean more towards the A.I. model because it verifies better
- For me it depends on the scenario if we lean towards A.I. or not

Do you think there will be problems communicating forecasts that incorporate AI approaches? What is the public perception of these approaches?

- Concern that a meteorologist cannot explain an A.I. model's output
- No clue what public thinks of A.I. mentioned in AFD
- As a member of the public, I hope the information is correct. If it is, I don't care how it is made. I would hope I can trust the communicator.