Forecast Evaluation and Uncertainty Communication

--introduction of a useful tool

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Cooperative Research Units Run Forecasting workshop

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Washington Department of FISH and WILDLIFE

Challenges we face as forecasters:

- Our forecast is not accurate.
- We don’t think our model is wrong, but data are messy.
- It’s hard to compare our forecast with others because we are using different models.
- The uncertainty is so high that the forecast is not helpful.
- Folks are questioning about our forecast, it’s hard to explain to them.

Introduction

- A tool that can help:
  - Diagnose data/model issues
  - Compare all models for a single stock
  - Compare models across different stocks
  - Demonstrate uncertainties
  - Communicate to non-experts

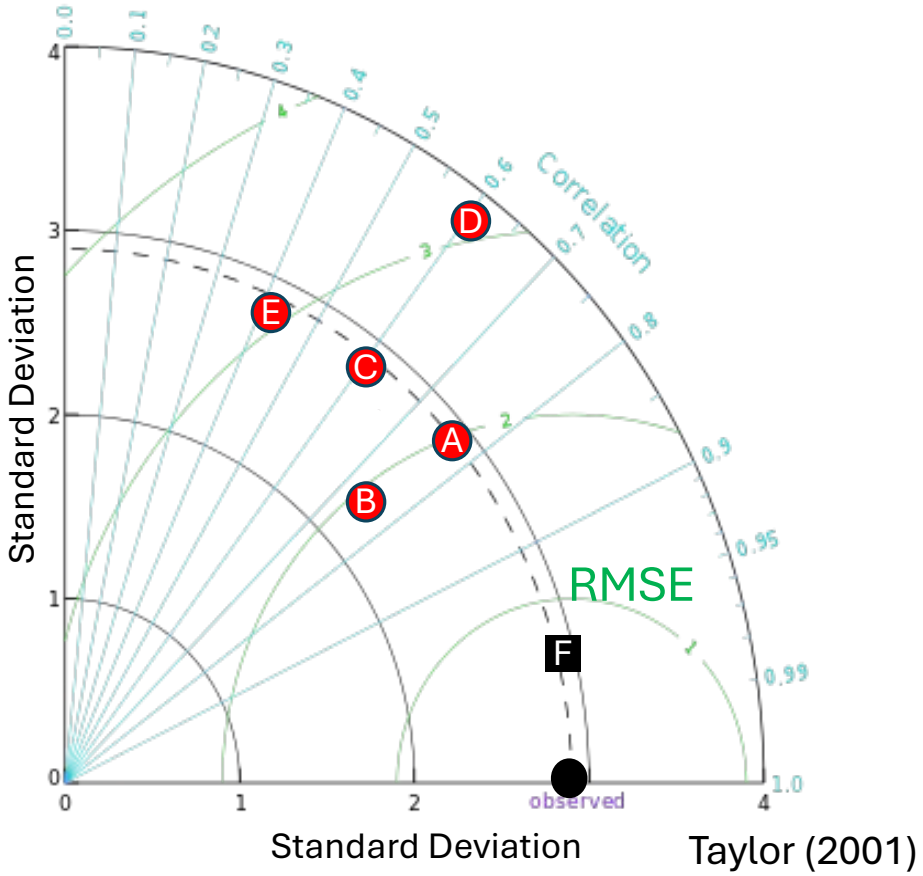
Taylor Diagram

- Taylor (2001)
  Google citations: 7,808 (last checked, 2024/9/6)

- Be widely used by many science communities (weather, oceanography, other fisheries)

- Ready to use in multiple languages
  R (plotrix), Python (VCS), Matlab (taylordiag)

Taylor Diagram



Taylor (2001)

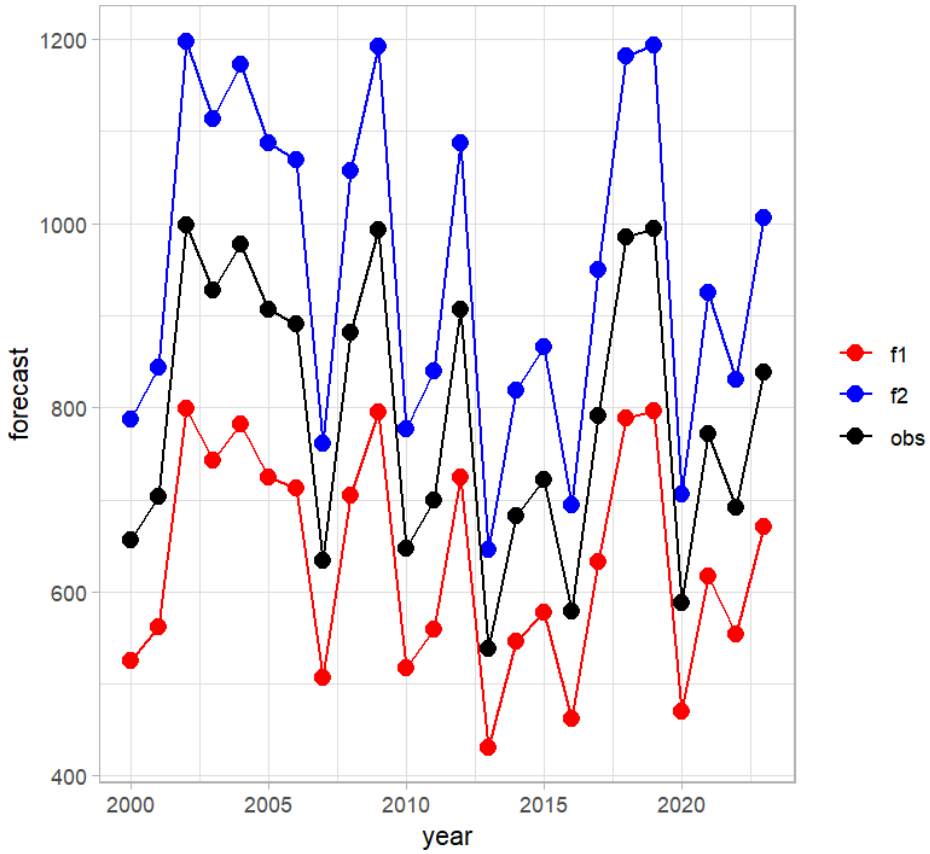
Inputs:

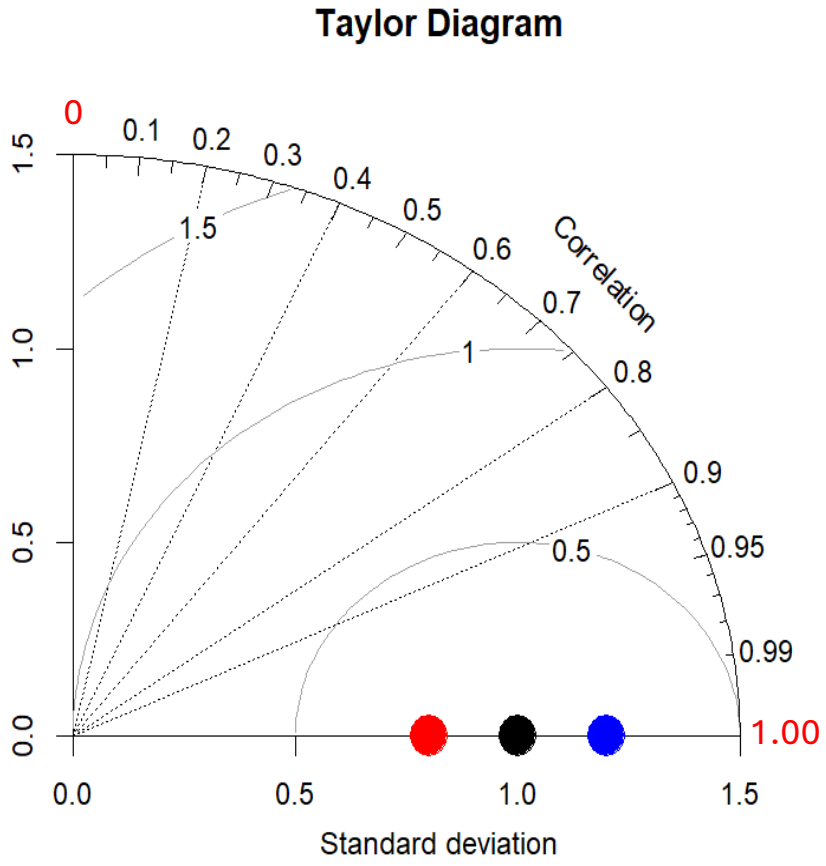
- Observation
- Prediction

3-metrics-in-1

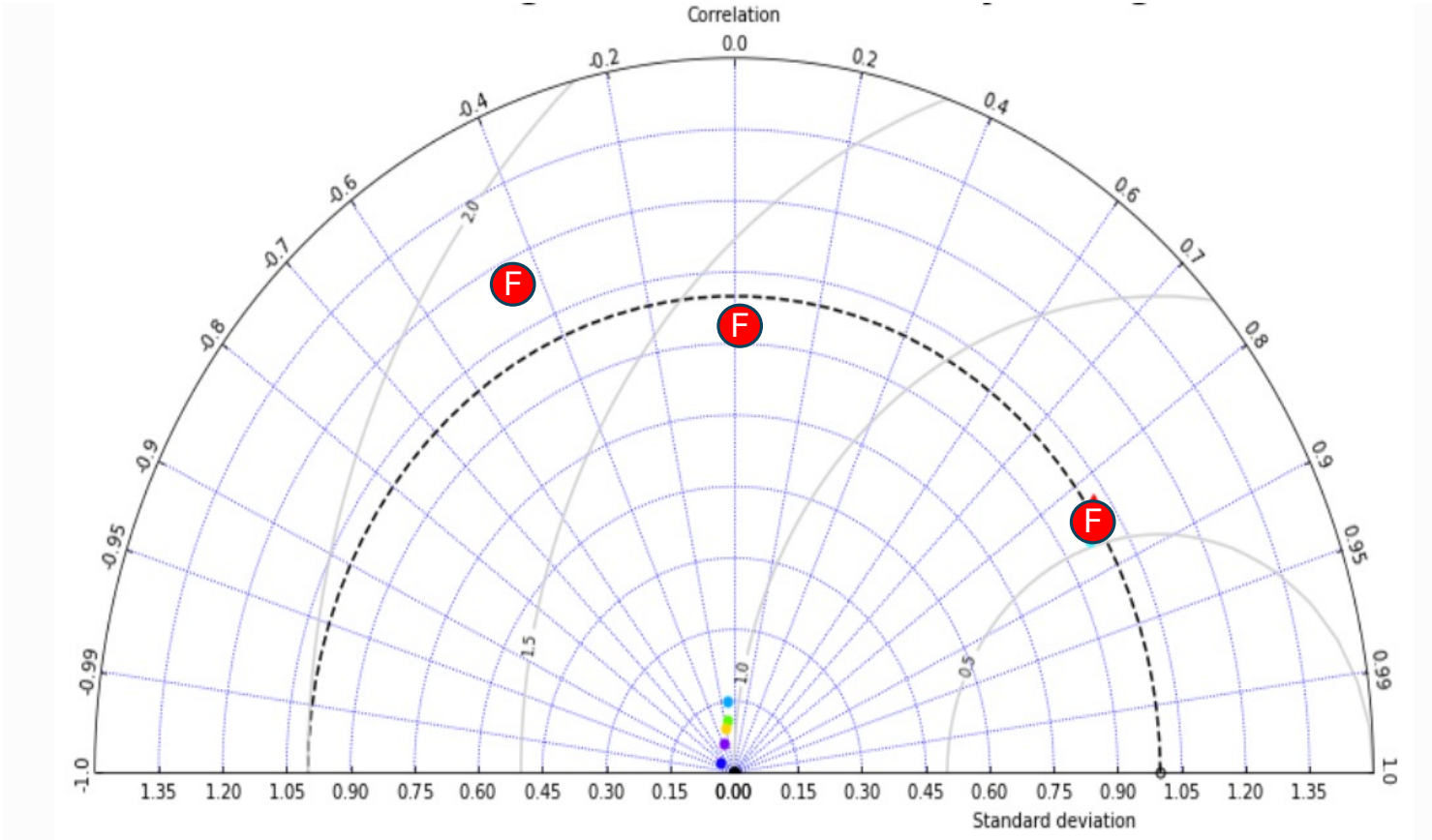
- Correlation
- SD
- RMSE

Taylor Diagram - correlation

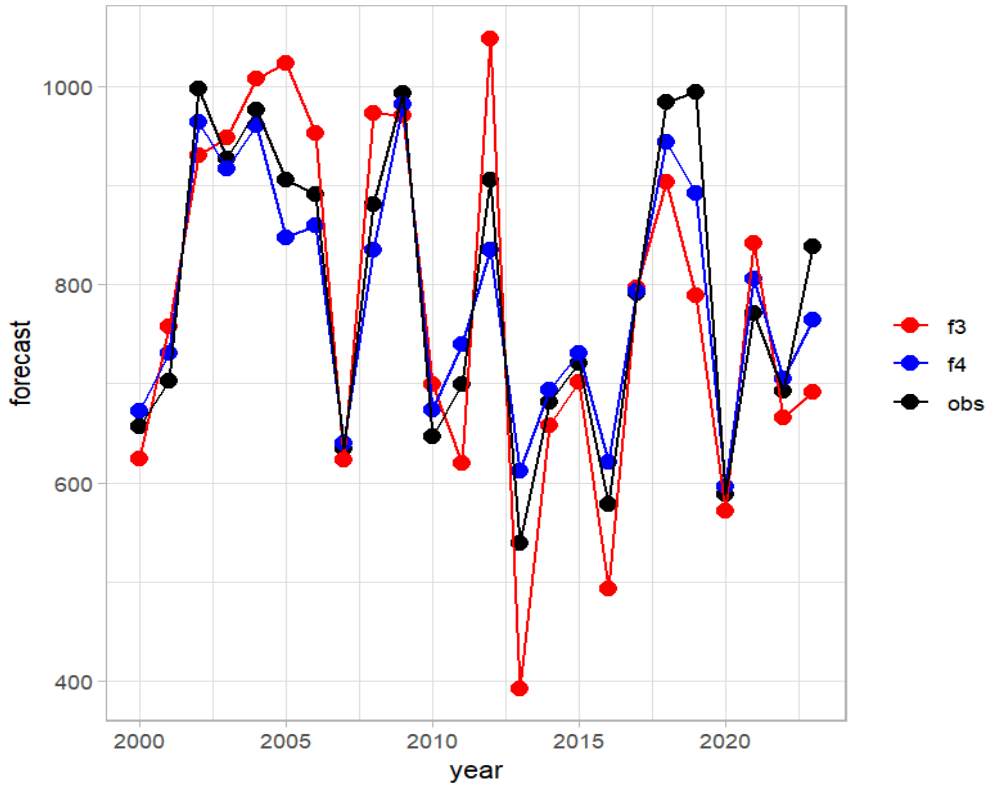


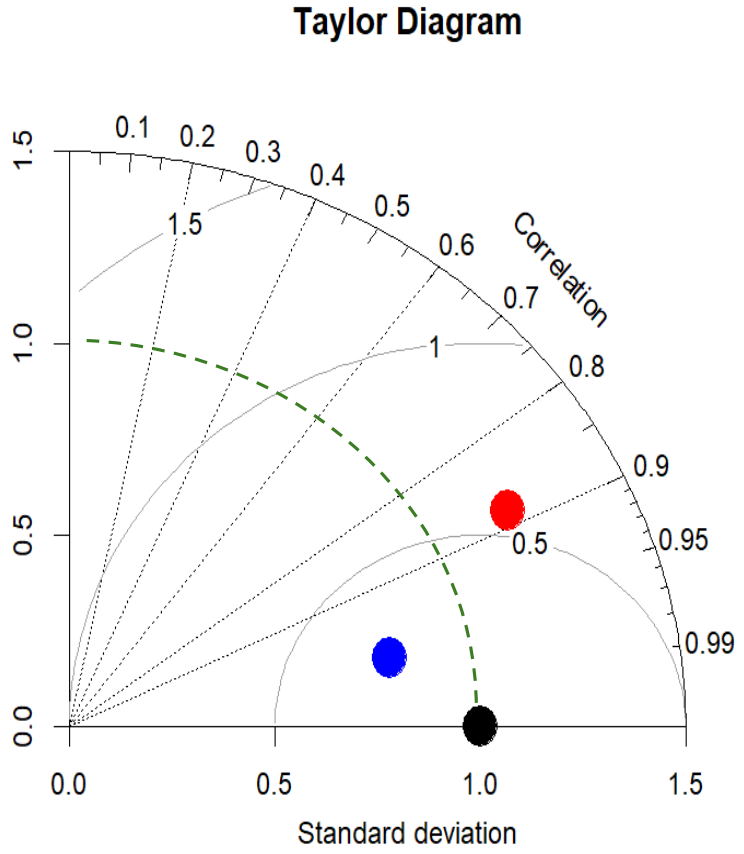


Taylor Diagram - correlation

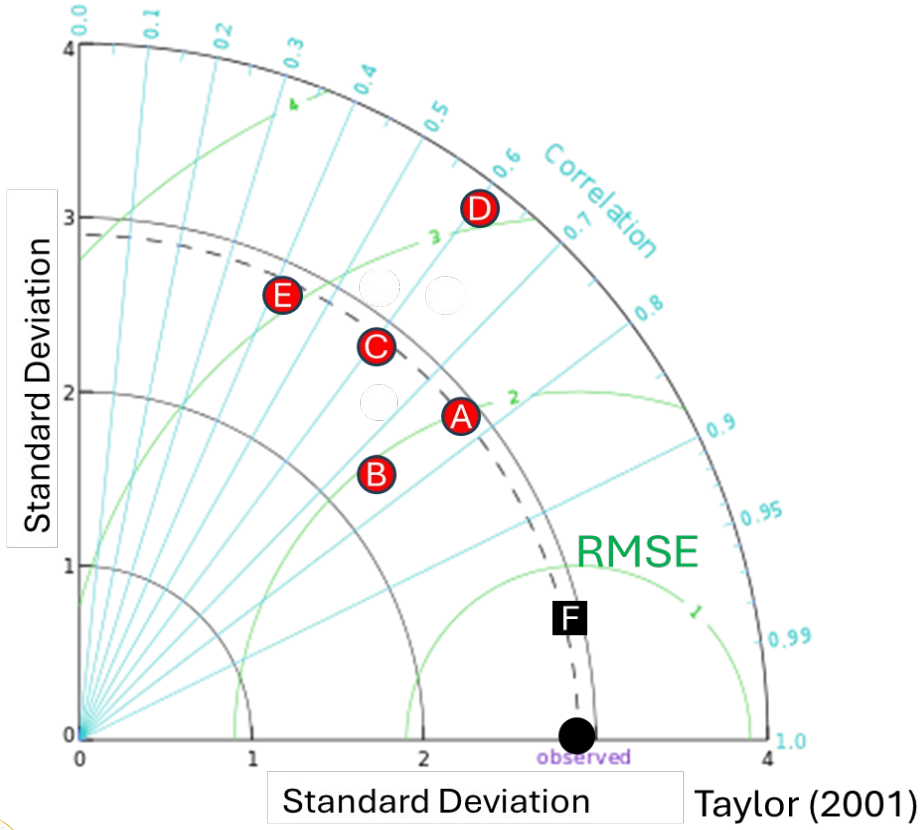


Taylor Diagram – standard deviation





Taylor Diagram - RMSE



Taylor (2001)

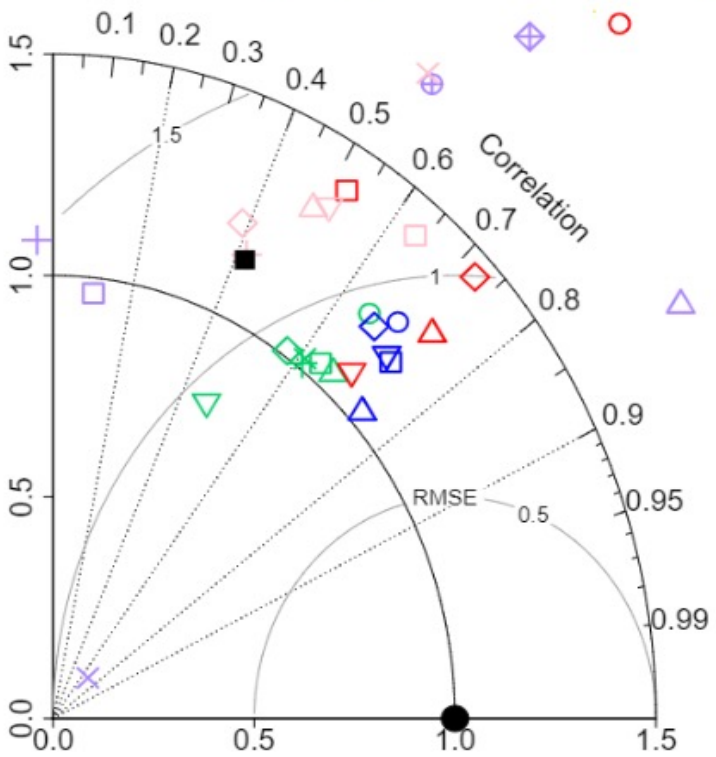
- Other metrics:
  - MAE
  - MRE
  - MAPE

- Good model:
  - High correlation
  - Similar SD
  - Small RMSE

  => Close to observation

Case study: Fraser sockeye

Fennell (Upper Barriere)



- PowerGOA.SST
- PowerSockeye
- PowerChum
- PowerPink
- PowerSalmon.Total
- Larkin
- LarkinCyc
- Sibling
- LLY
- R1C
- R2C
- RAC
- TSA
- RS1
- RS2
- RSC
- MRS
- RS4yr
- RS8yr

- Observation
- Forecast
- Ricker
- RickerCyc
- RickerEi.SST
- RickerPi.SST
- RickerFRD.mean
- RickerFRD.peak
- RickerPDO
- RickerGOA.SST
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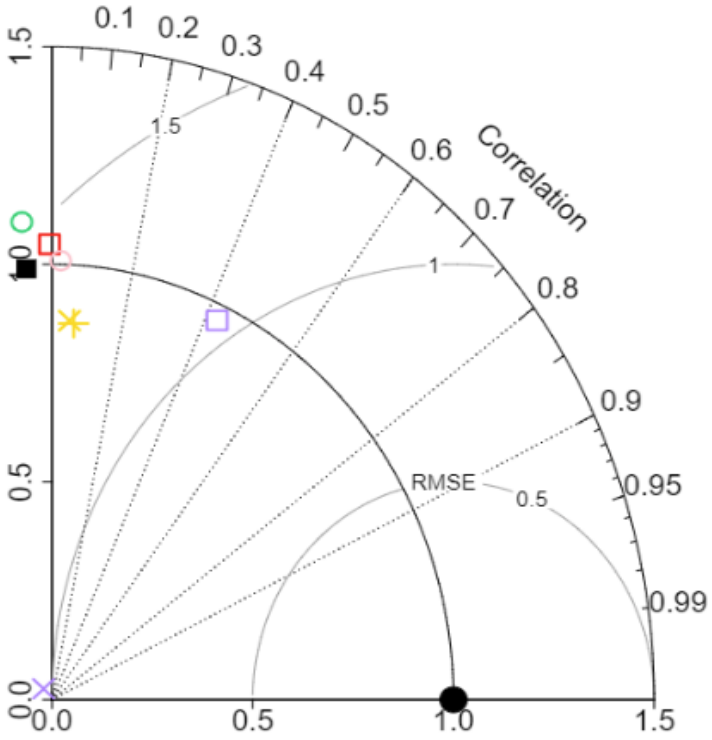
Case study: Fraser sockeye

Gates



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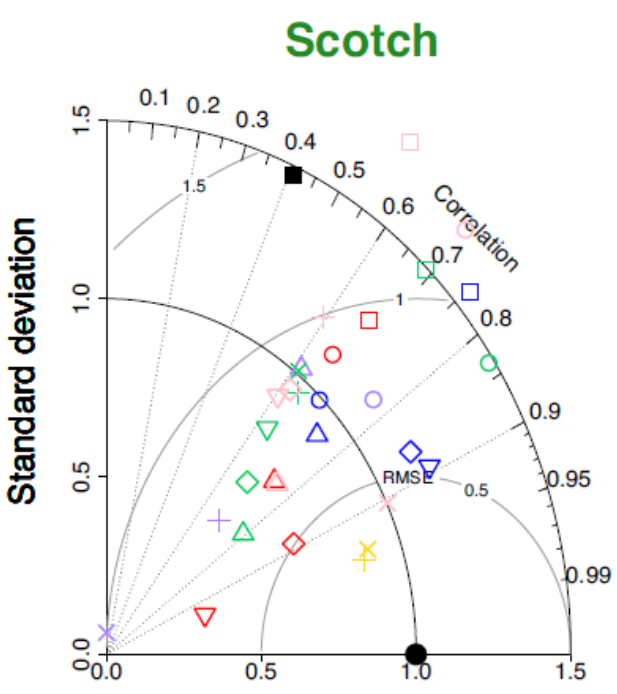
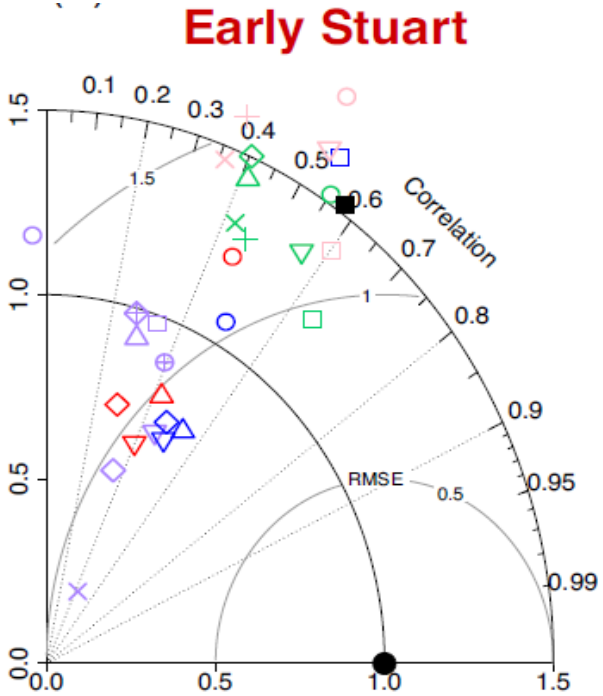
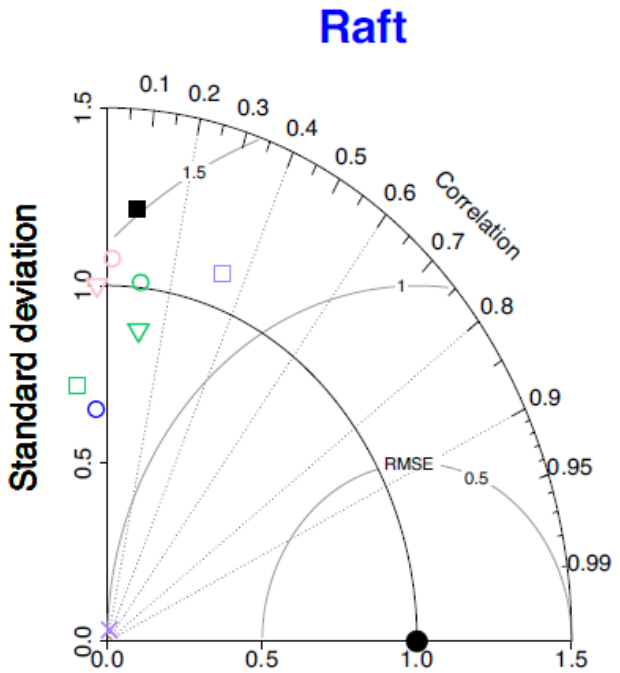
Identify work priorities







- Model Selection
- Develop new models
- QA/QC data

Shiny app

Taylor Diagram

A Salmon Forecast Model Evaluation Tool

Select stock

Late Shuswap

Select age

all

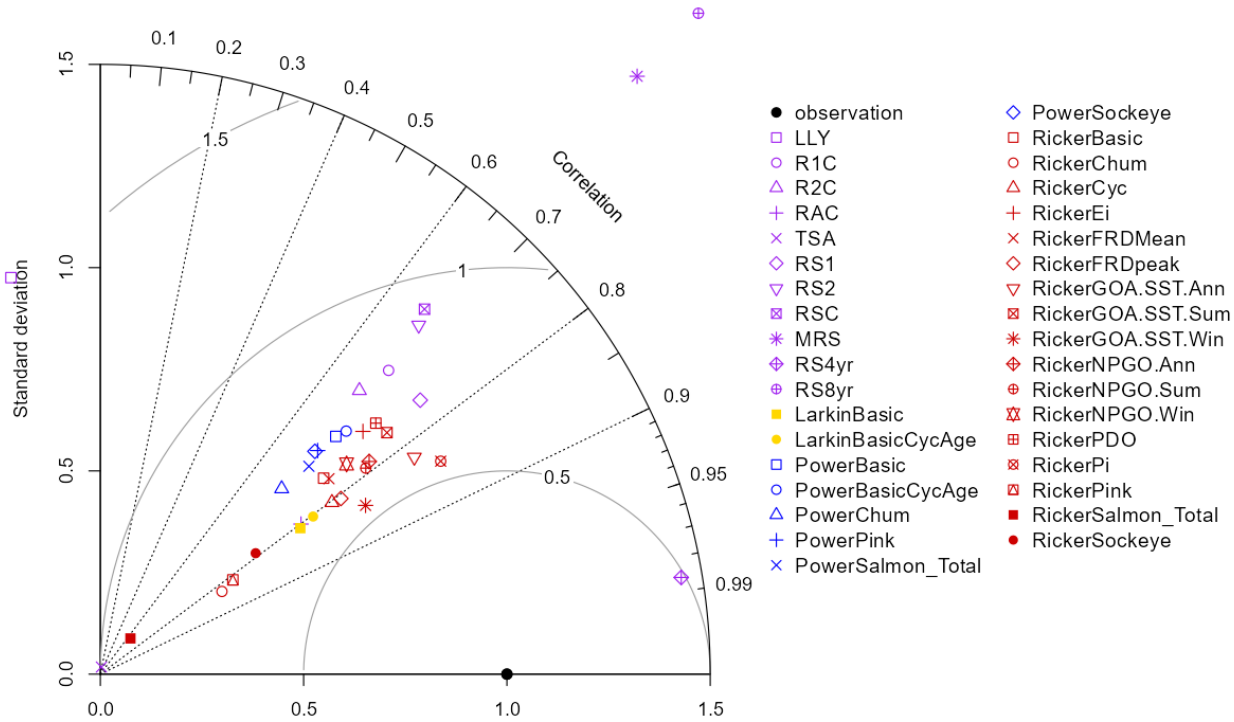
Evaluation Year Range

2009 2020

2009 2011 2013 2015 2017 2019 2020

Developed by Yi Xu
yi.xu@dfw.wa.gov
Last update 2024.8.8.
Method in Xu et al. 2024 CJFAS

We are evaluating from 2009 to 2020.

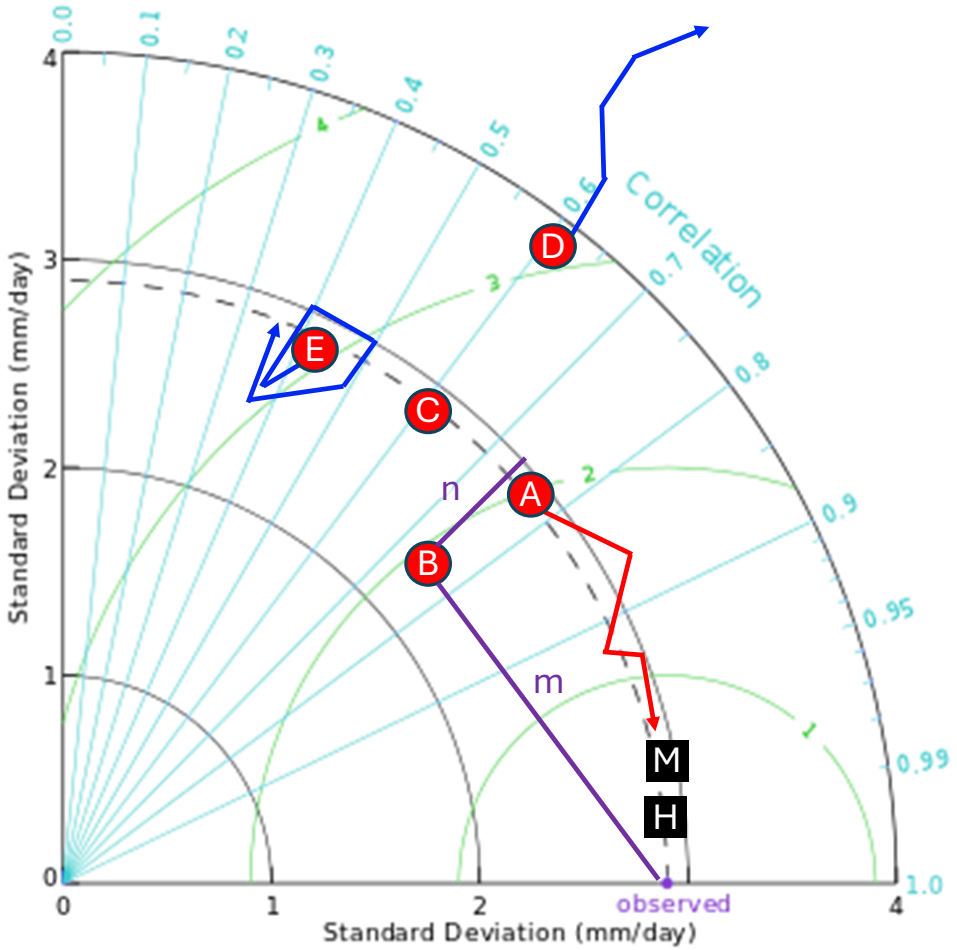


Fraser forecast vs return in recent years

Year	Forecast	Return	Percentage	Source
2021	1,330,000	2,549,000	+92%	(DFO,2022)
2022	9,775,000	6,777,000	-31%	(PSC,2022)
2023	1,564,000	1,670,000	+7%	(PSC,2023)
2024	567,000			(DFO,2024)

Future development

- Dynamic Taylor
- Automated process
- Forecast Evaluation



Summary

- Introduce a tool that can potentially help:
  - forecasters to improve their forecast by identify data/model issues, evaluate model performance more effectively within and across stocks
  - managers to identify work priorities, better communicate results to non-experts

- All data/method are published and accessible.
  - Data weblink: https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41227153.pdf
  - Analyses weblink: https://github.com/yi-xu/Sockeye_paper (Xu et al., 2024, CJFAS)
  - Paper weblink: https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2000JD900719
  - Shiny app weblink: https://github.com/yi-xu-dfw/ForecastEvaluation

- This tool can be further developed and may become a more powerful standard tool for the salmon fisheries/forecast society.

Acknowledgements

Questions? Contact Yi
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