Extended range verification using economic value

Eva Regnier, Joel Feldmeier, Naval Postgraduate School

46th Climate Diagnostics & Prediction Workshop

28 October 2021

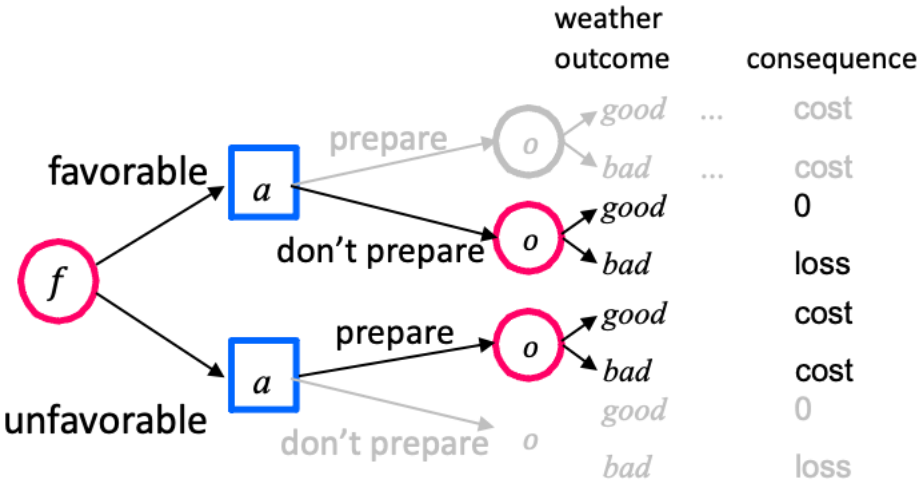
Funded by NPS Naval Research Program

Approaches to forecast performance evaluation

Economic Value, or Value-of-Information (VOI)

(Murphy's Type 3 goodness)

= expected savings decisions made using forecasts, compared to using climatology



Quality-based measures, e.g. RMSE

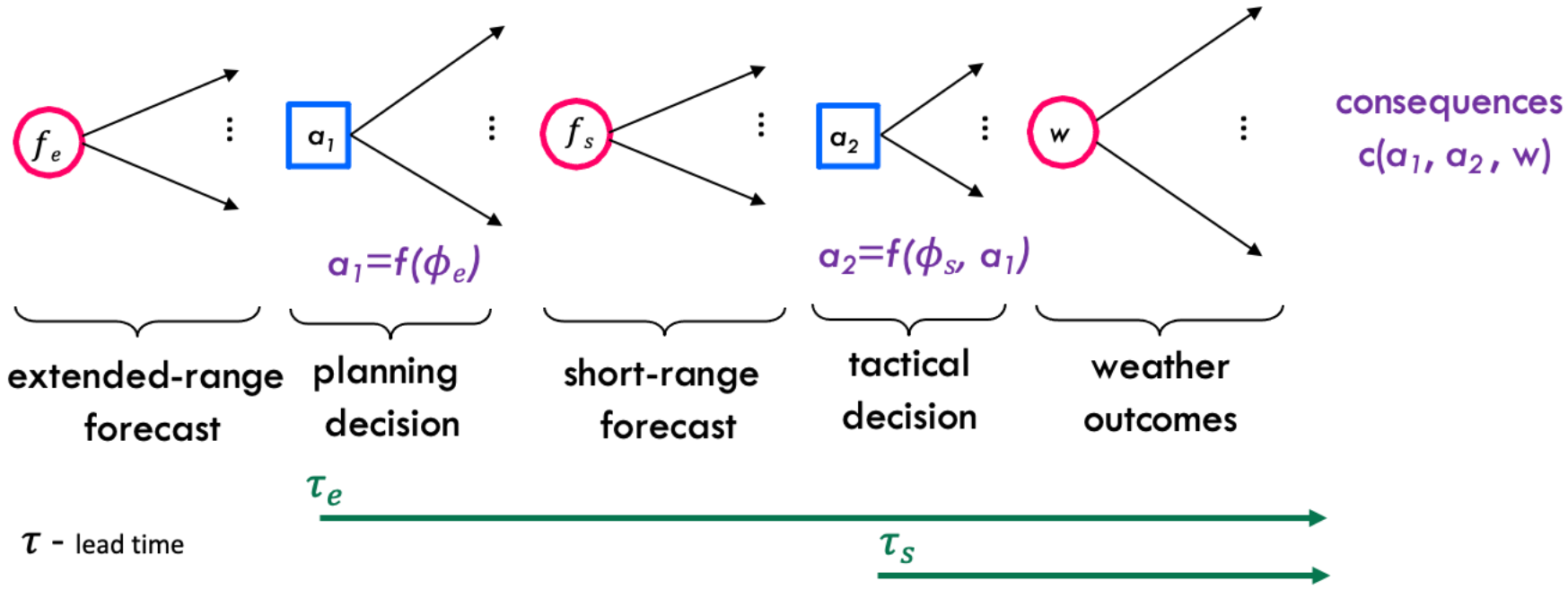
(Murphy's (1993) Type 2 goodness)

Bottom line up front:

- VOI specific to enduser characteristics,
- BUT VOI can reveal value when RMSE doesn't show skill – and vice versa (e.g. Dorrington et al, 2020)
- AND for extended-range forecasts, we can narrow down enduser characteristics

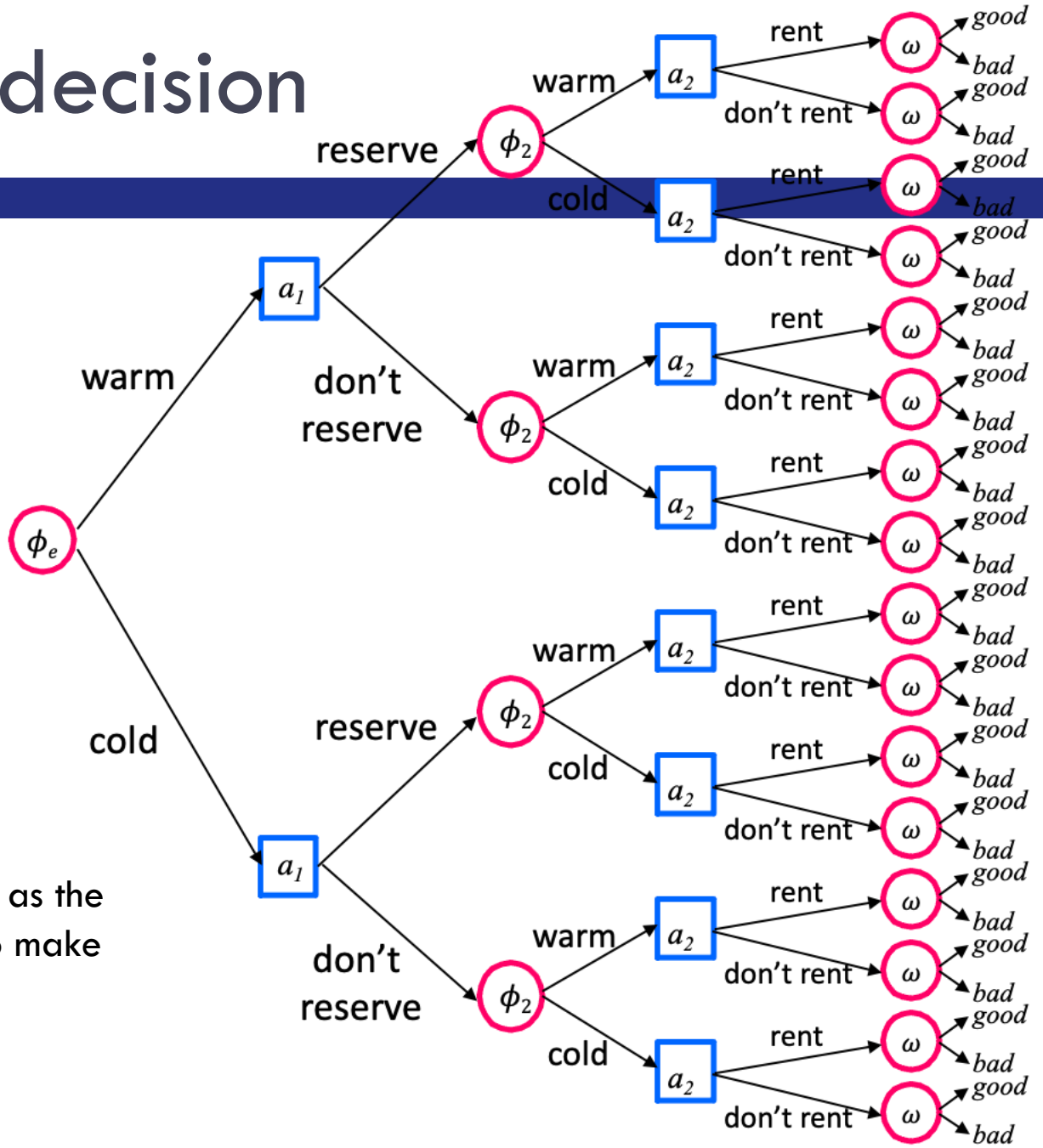
Extended range forecasting – What decision contexts are relevant?

- Consequences depend on location of something slow – e.g. ships
- Stage-setting, e.g. prepositioning, reserving assets



A two-stage decision

Reserve and rent a tent for a garden party



Consequences can depend on decisions made based on extended-range forecasts and later decisions made based on short-range forecasts.

User characteristics include consequence function…as well as the lead times at which user has to make each decision.

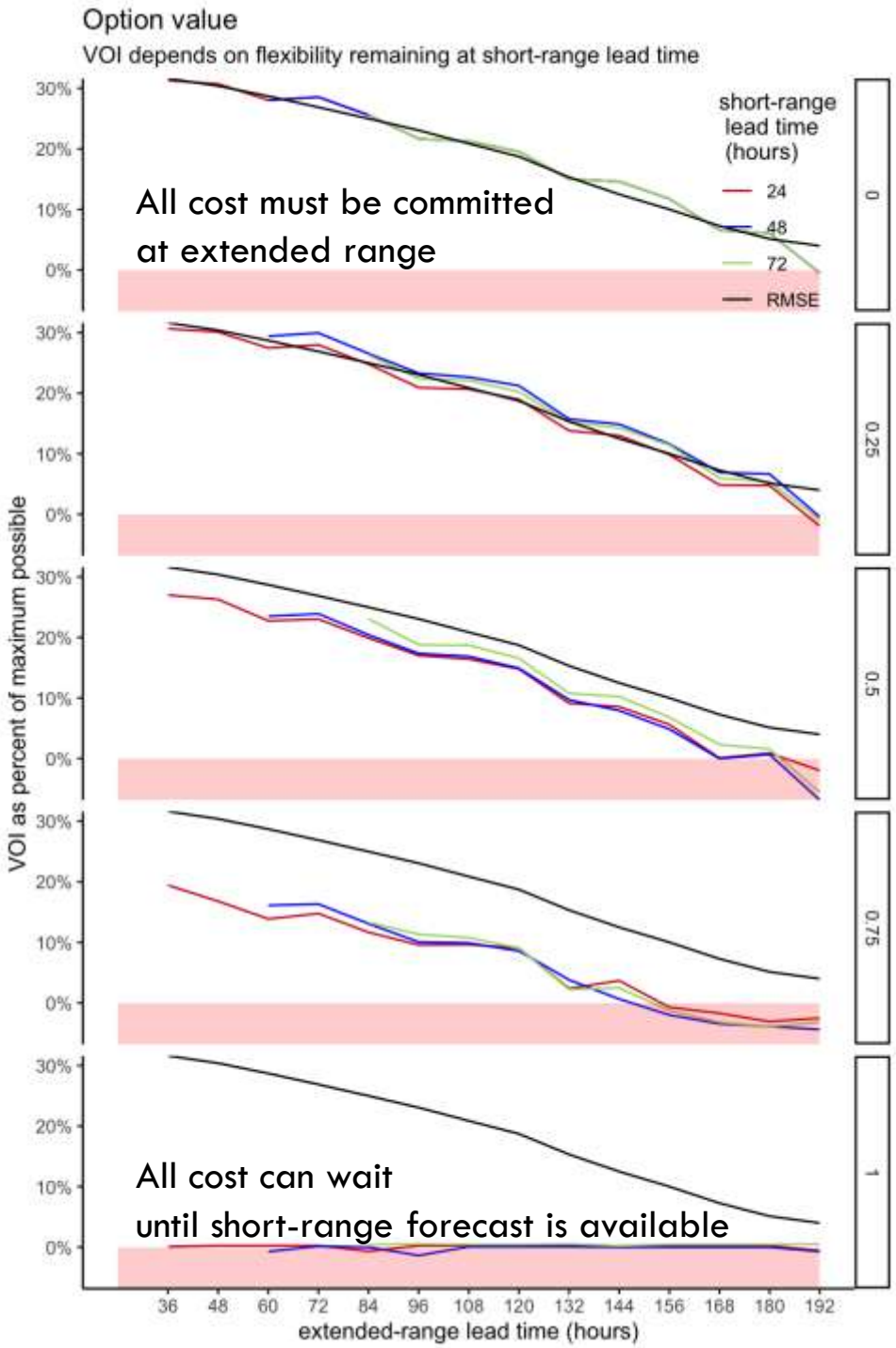
Data

We use data for all days in April and May, 2015-2019, all valid at 1800 UTC, at the following twenty stations:

- Cheyenne, WY: KCYS
- Detroit, MI (Wayne): KDTW
- New Orleans, LA INTL: KMSY
- Phoenix, AZ Sky Harbor: KPHX
- Seattle-Tacoma, WA: KSEA
- Washington D.C. Reagan National: KDCA,
- KBLV, KDAY, KELP, KJAX, KMCN, KBOI, KOKC, KOMA, KORF, KPSM, KPUB, KSAN, KSAT, and KVCB.

In particular, we use:

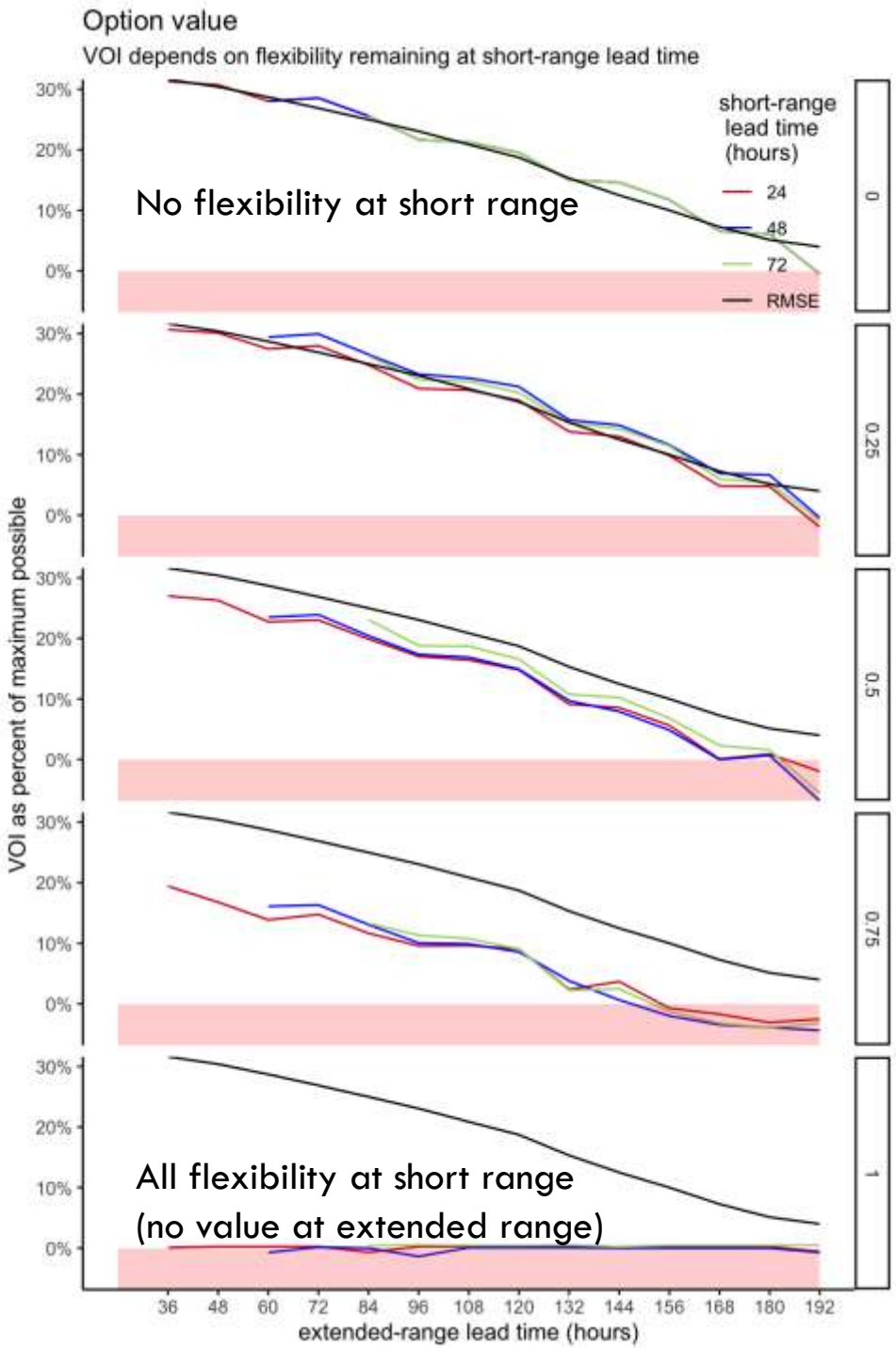
- for ground truth, hourly data from NCEP ISD.
- for extended-range forecasts, MDLs GFSMEX MOS forecasts,
- for short-range forecasts, short term MOS (MAV) forecasts, and
- for climatology, max average daily temperatures by day of the month average from 1981-2010. Since the available climatology gives daily maximum temperature, and actuals are for 1800Z, we estimated the bias of using the daily maximum as a prediction of the 1800Z temperature, and removed this bias of 5.1 to estimate a climatological temperature for the valid time.



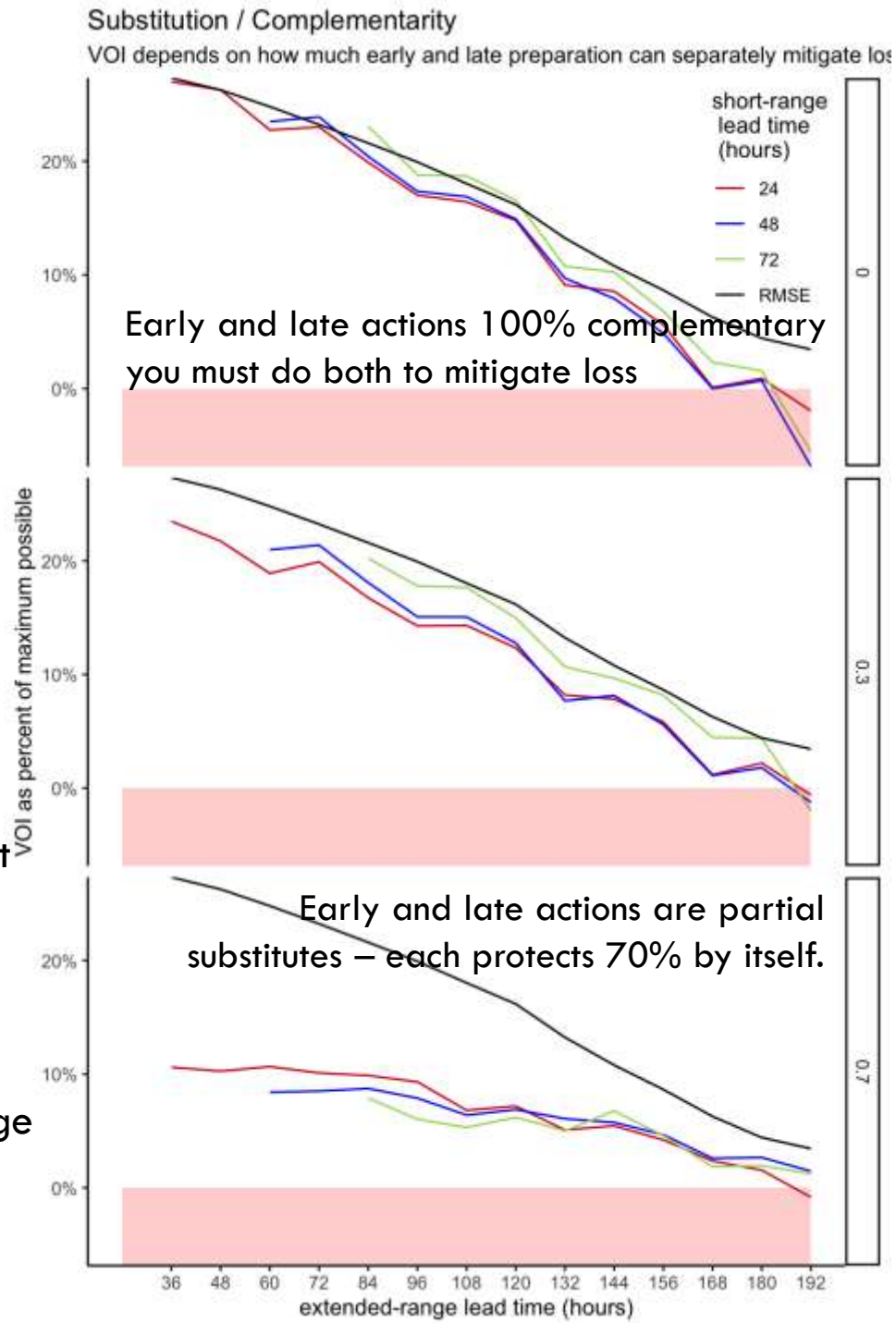
VOI is here shown as a percent of the maximum achievable with perfect forecasts. The climatology reference decision still includes the short-range forecasts – in other words, the extended-range decision is made using climatology, but the short-range decision is made using the short-range forecast.

Values in the red are worse than climatology.

RMSE (in black) is included as a reference. Its scale is reversed (low values are bad) to align with VOI and its units aren't shown.



Some enduser parameters matter a lot – e.g. complementarity of early and later actions.
Some matter less – e.g. lead time for short-range decisions.



References

Murphy, A. H. (1993). What is a good forecast? An essay on the nature of goodness in weather forecasting. *Weather and forecasting*, *8*(2), 281-293.

Dorrington, Joshua, Isla Finney, Tim Palmer, and Antje Weisheimer. "Beyond skill scores: exploring sub-seasonal forecast value through a case-study of French month-ahead energy prediction." *Quarterly Journal of the Royal Meteorological Society* 146, no. 733 (2020): 3623-3637.

Pegion, Kathy, Ben P. Kirtman, Emily Becker, Dan C. Collins, Emerson LaJoie, Robert Burgman, Ray Bell et al. "The Subseasonal Experiment (SubX): A multimodel subseasonal prediction experiment." Bulletin of the American Meteorological Society 100, no. 10 (2019): 2043-2060.
Harvard

Also see Johnson, S. R., & Holt, M. T. (1997). The value of weather information . Chapter 3 (pp. 75-107) in Katz, R.W. & Murphy, A.H., eds. *Economic Value of Weather and Climate Forecasts*. Cambridge: Cambridge University Press.

Regnier, E.D. (2008) Decision Modeling for Smart Climatology. NPS Technical Report NPS-64-08-001.