Subseasonal Potential Predictability of Horizontal Water Vapor Transport and Precipitation Extremes over the North Pacific

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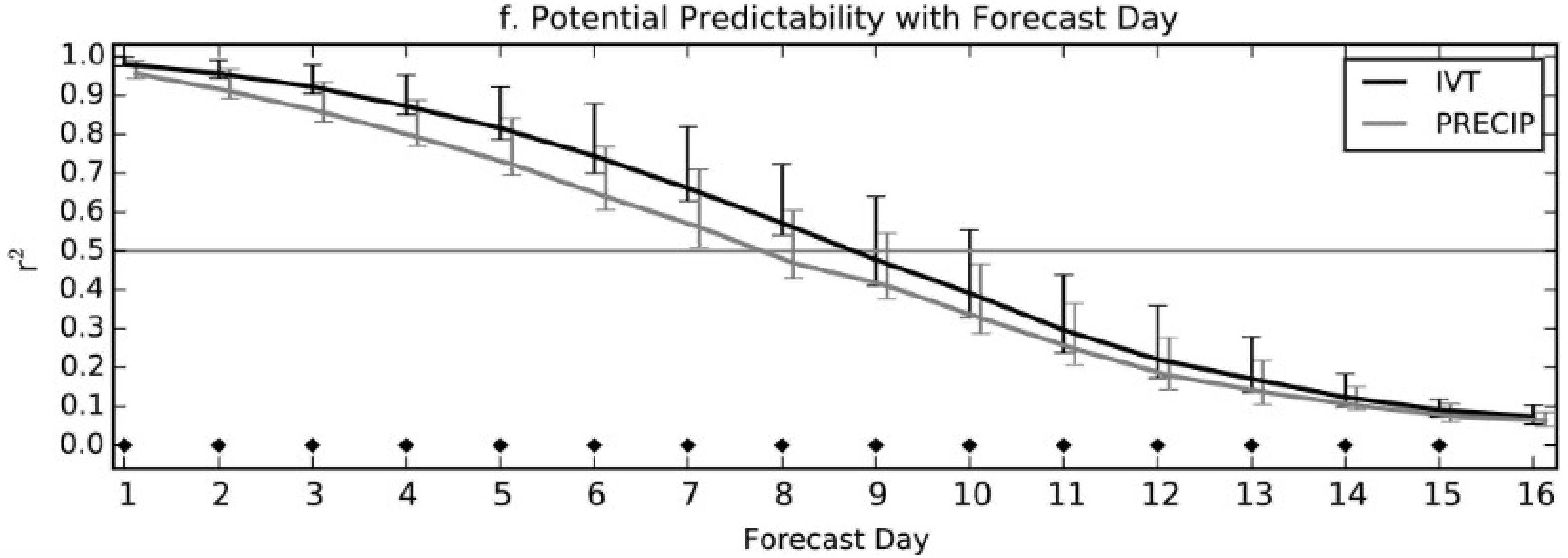
S2S Potential Predictability – Differences between IVT and Precipitation

Lavers et al. 2016 demonstrated these differences on the medium range, but these differences are still yet to be shown in the S2S range



Source: Lavers et al. (2016)

Project Goal

Determine whether differences between the predictability of IVT and precipitation exist in the subseasonal range and physically explain any potential differences

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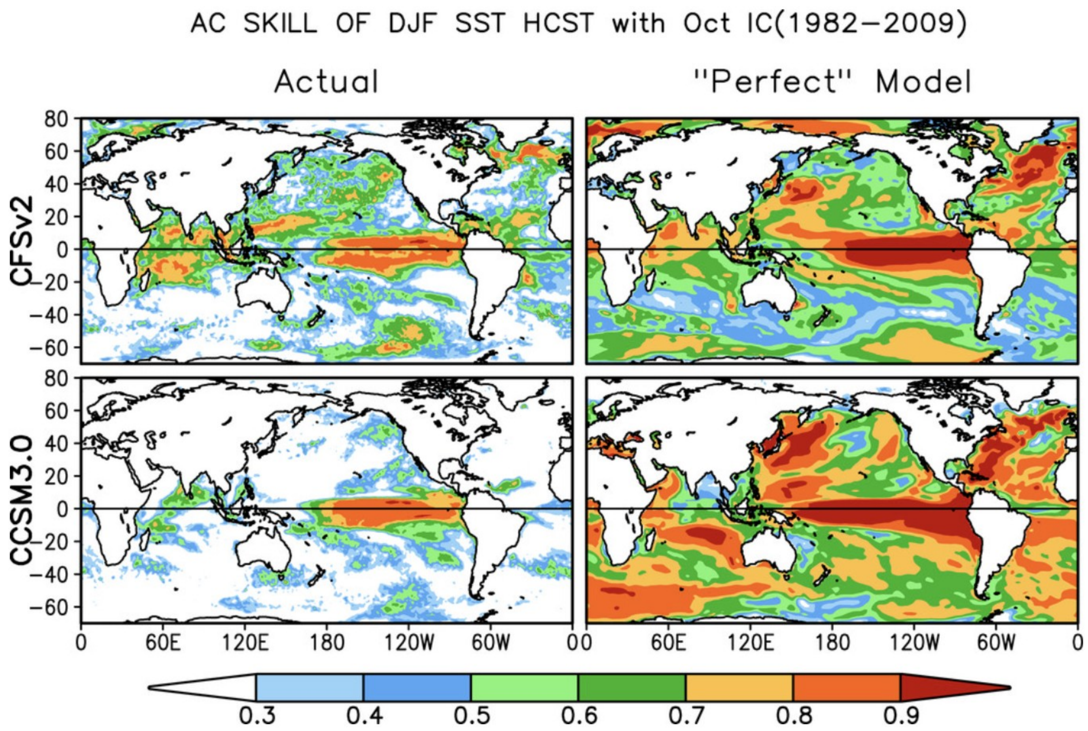
Our Approach

ECMWF reforecasts

Skill metric: ROC scores

Lead times: Week 3 and Week 4

Target threshold: 90th Percentile conditions



Source: Kumar et al. 2014

Traditional Predictability

= reanalysis

= ensemble member

t = 0

t = n

Skill = Function , mean((n)))

Potential Predictability

= ”model-observation” ensemble member = forecast ensemble member

t = 0 t = n

Skill(ens) = Functio (n), m n((n)))

Potential Predictability

= ”model-observation” ensemble member

= forecast ensemble member

t = 0

t = n

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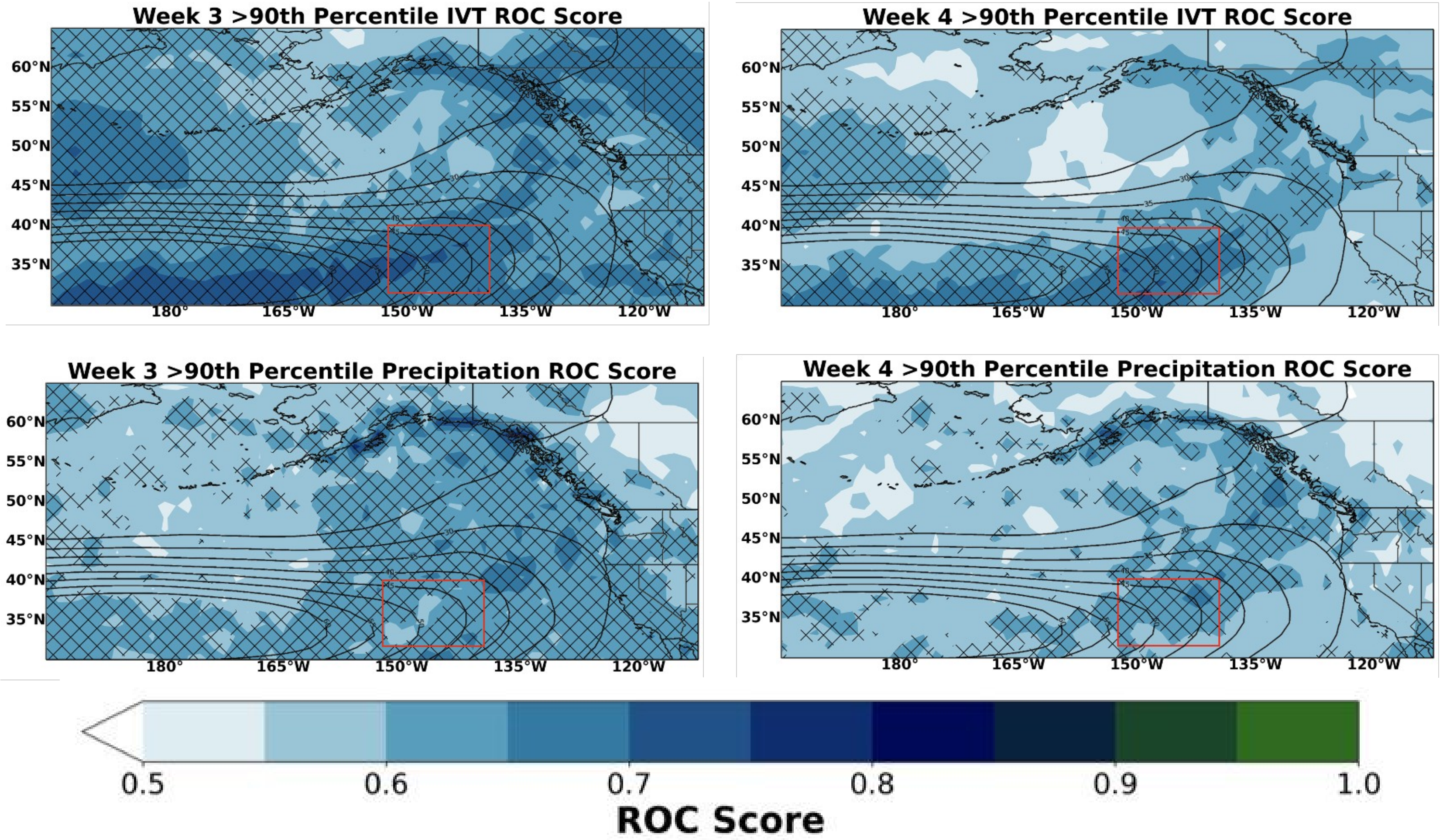
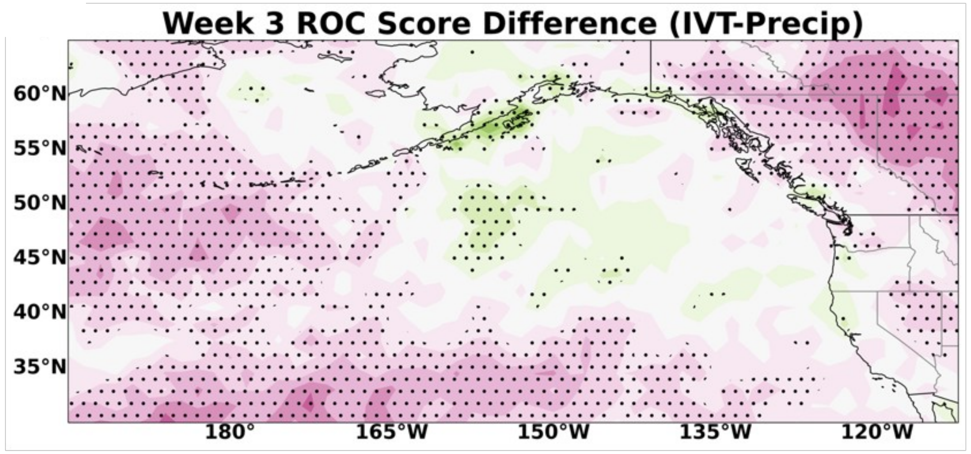
ROC Scores

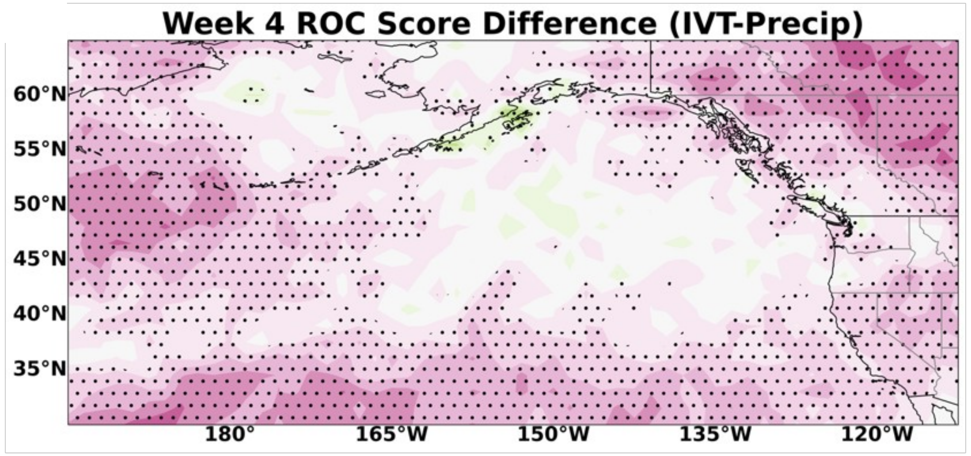


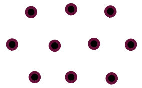
 =

Skillful using Mann-Whitney U test (Mason and Graham 2002)

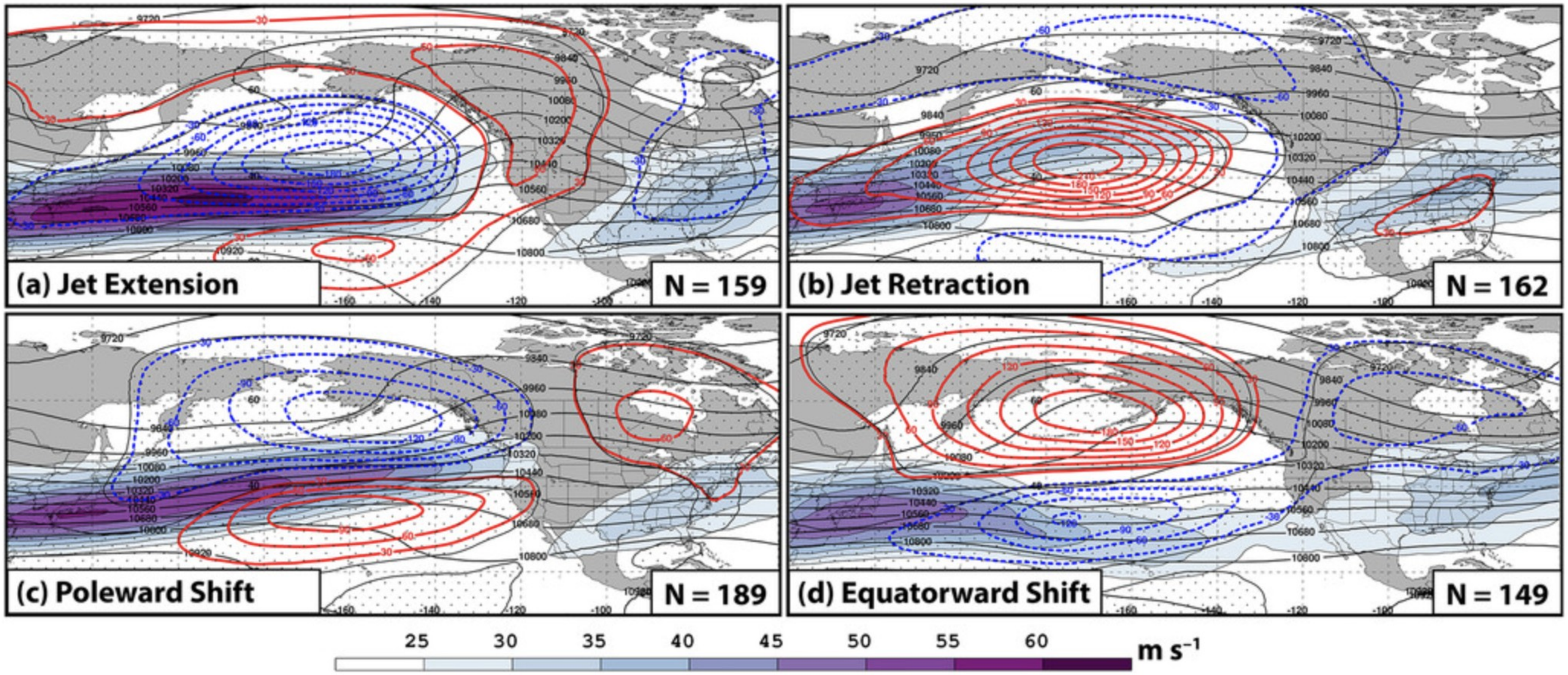
Differences in ROC Scores



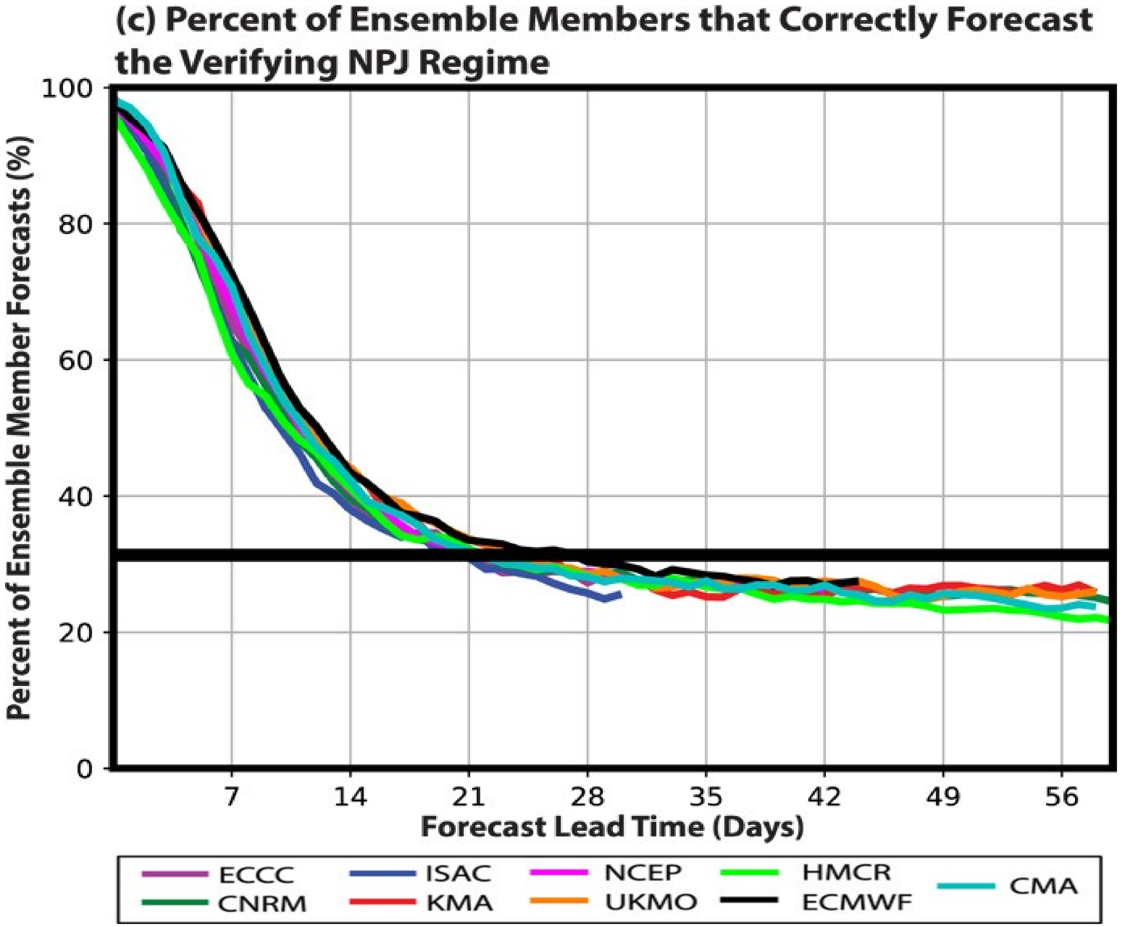


 = Difference is significant at the 95% level using student t-test

NPJ EOFs (Winters, Keyser, and Bosart 2019)

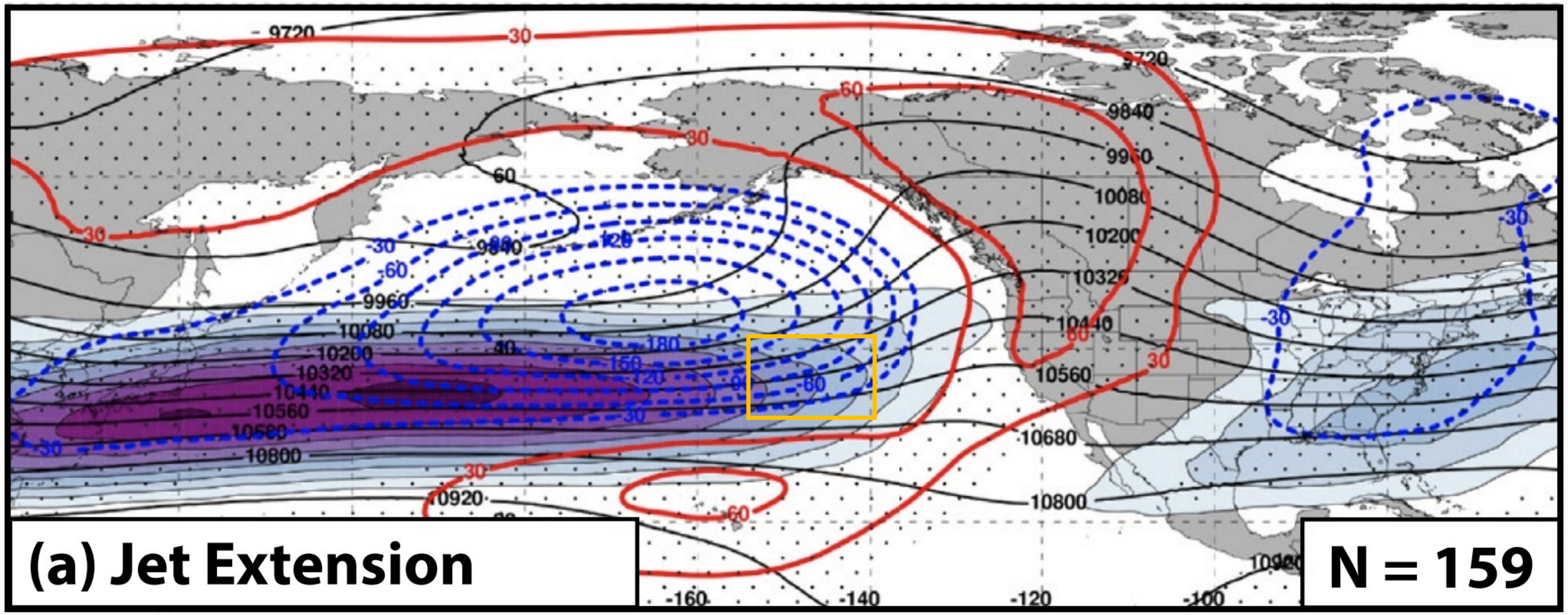


Subseasonal Forecast Skill of Jet Extension (Winters 2021)



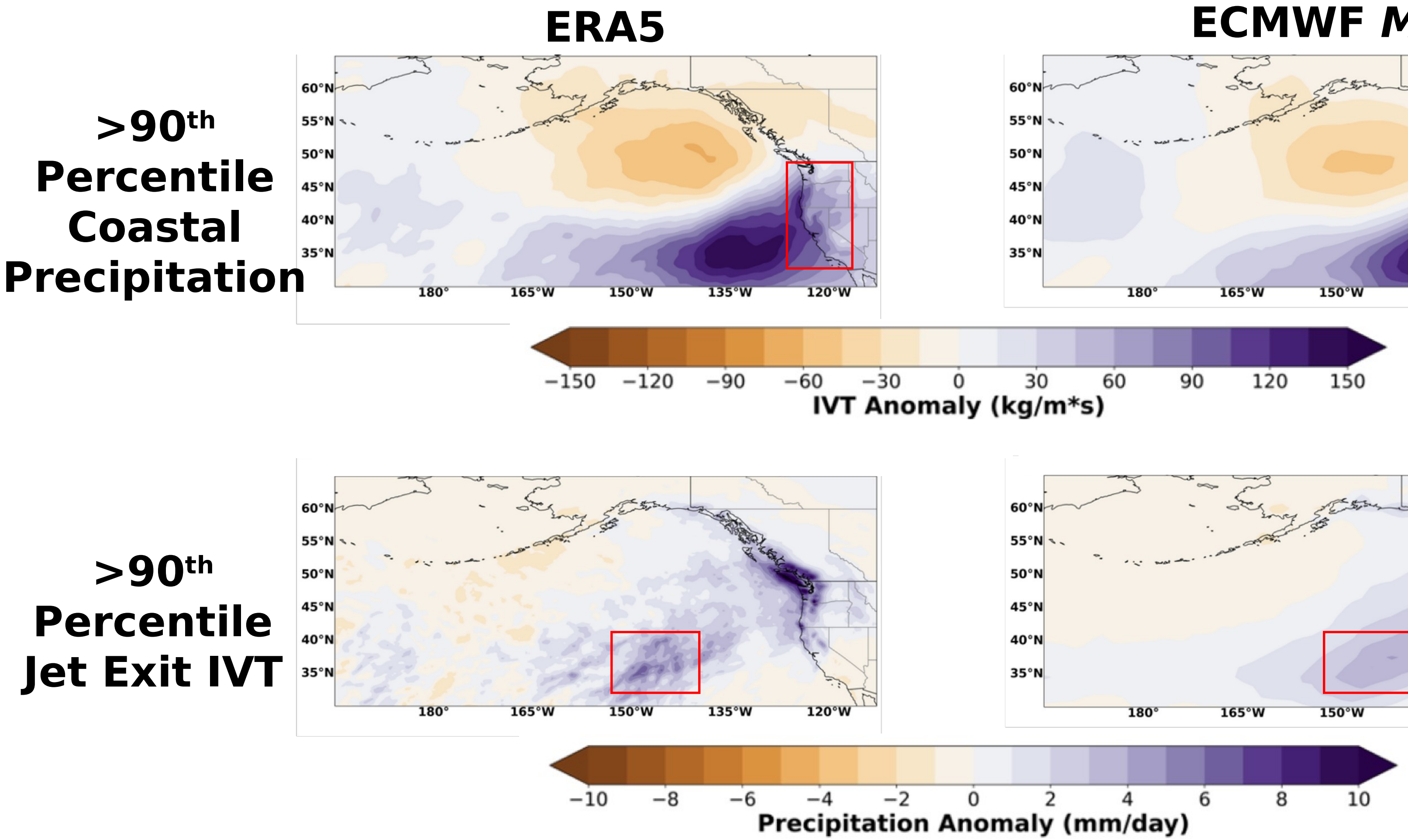
Jet Exit Region

Source: Winters, Keyser, Bosart (2019)



250 hPa geopotential heights – black contours
250 hPa geopotential height anomalies – colored contours: red (positive), blue (negative)
Wind speed – shaded

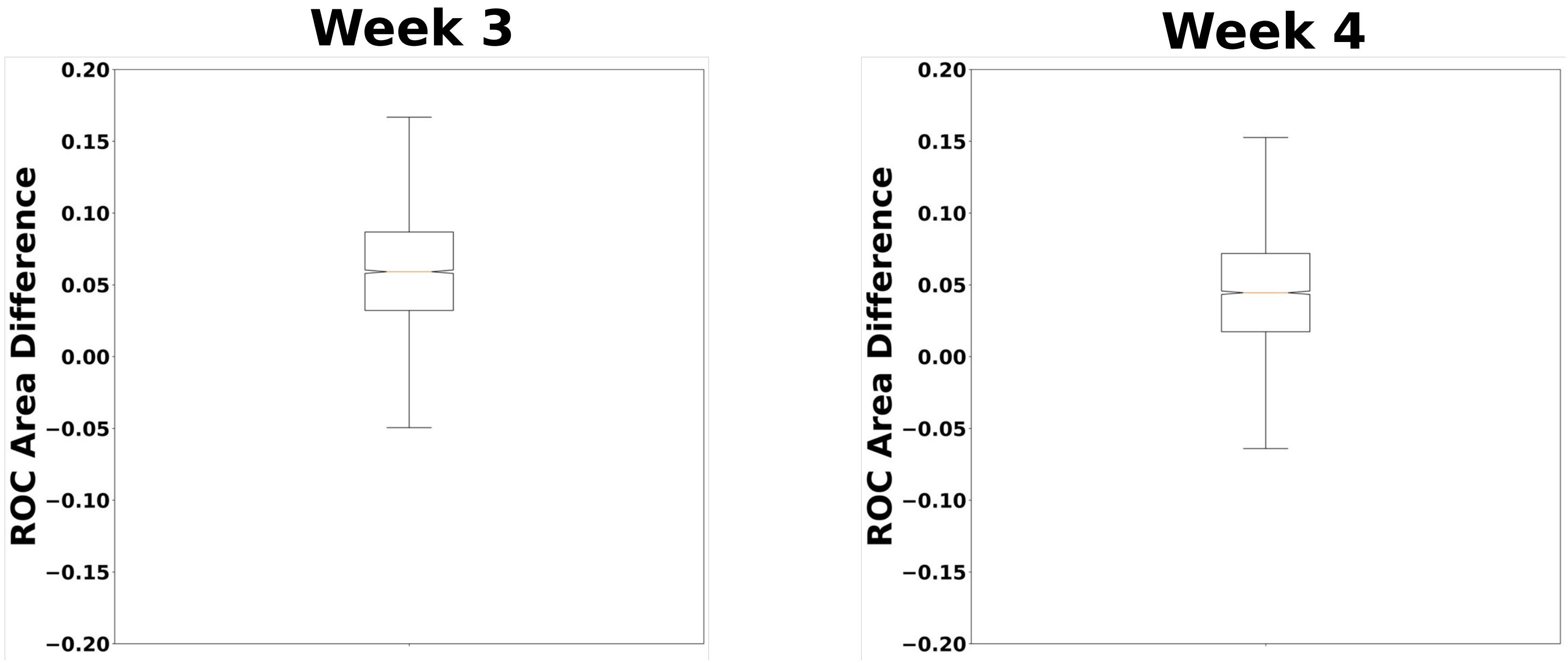
Importance of Predicting Jet Exit



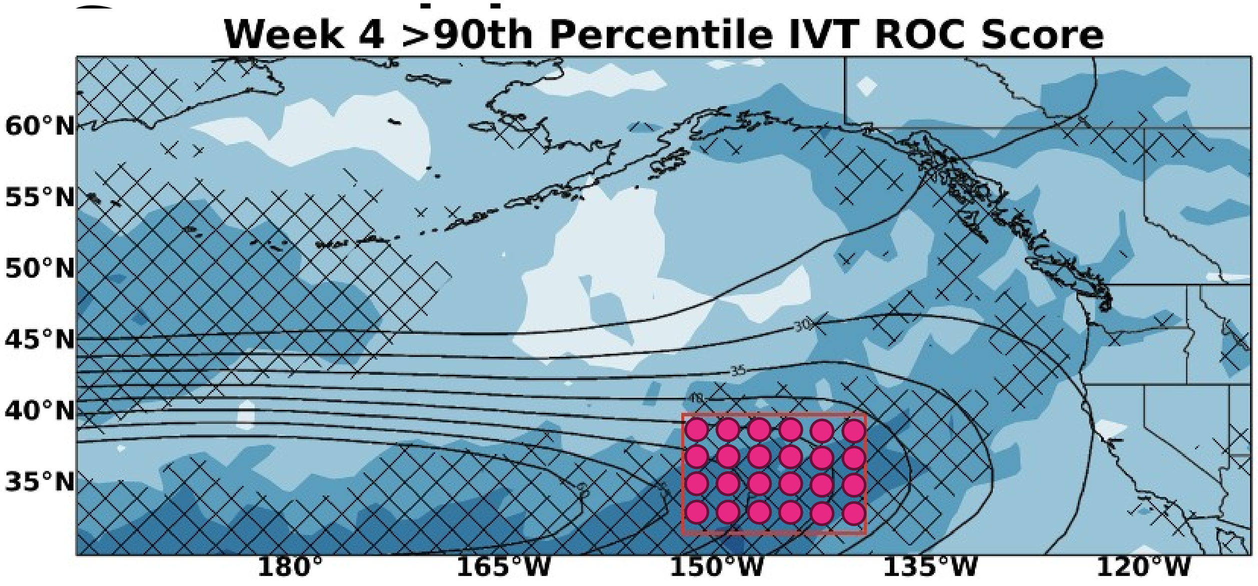
Change in Jet Exit ROC Scores (IVT-Precip)

5000 Bootstraps

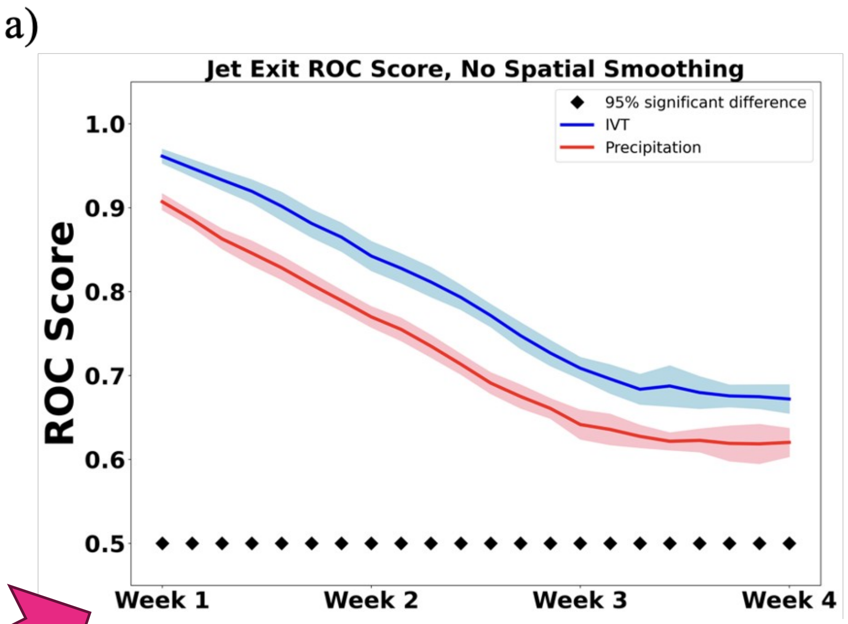
1000 Samples



No Spatial

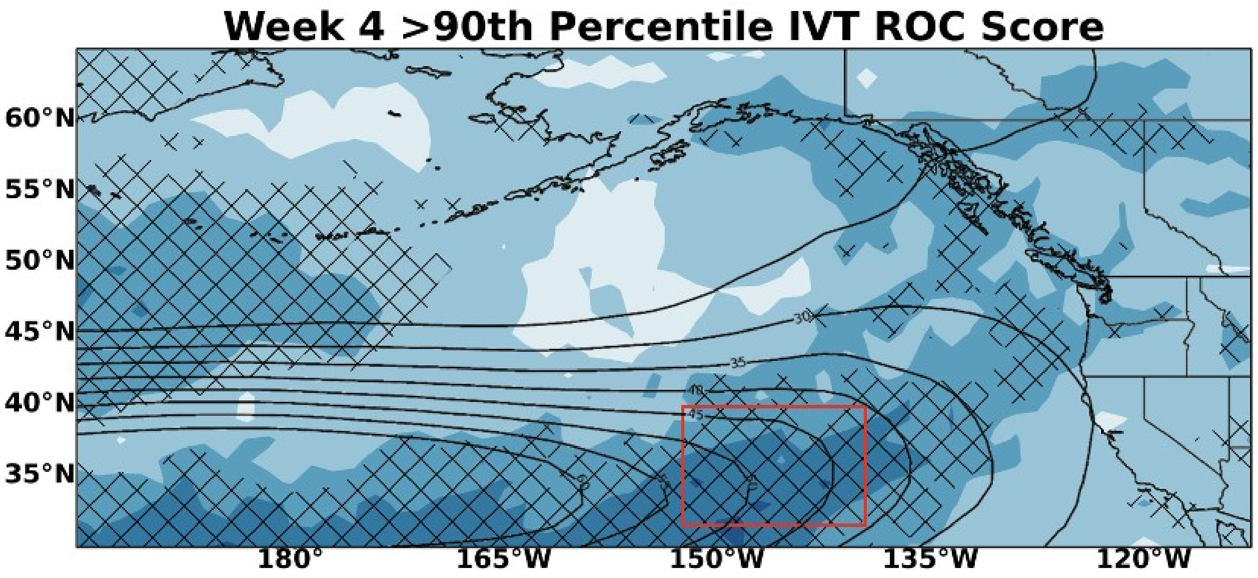


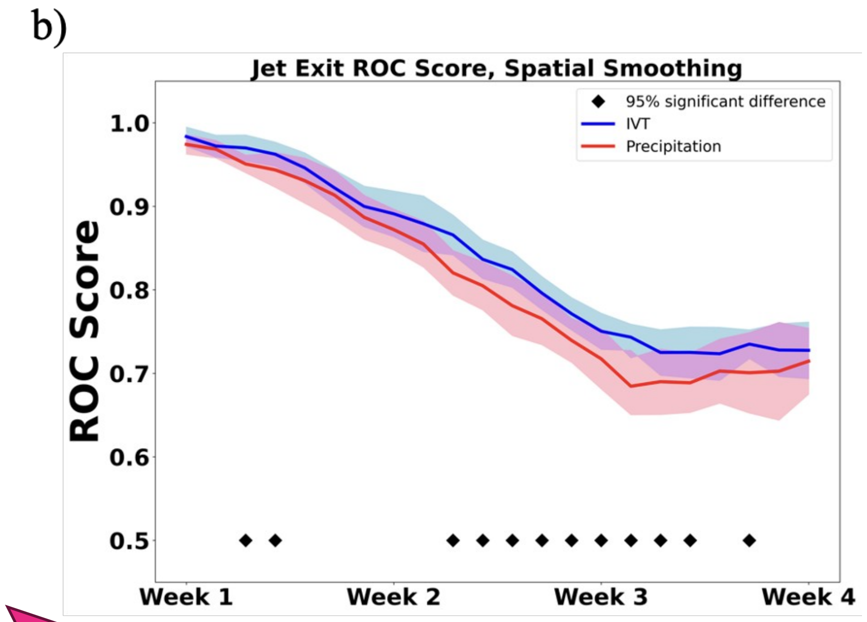
Compute ROC scores at each point



Compute Mean ROC score

Spatial Smoothing



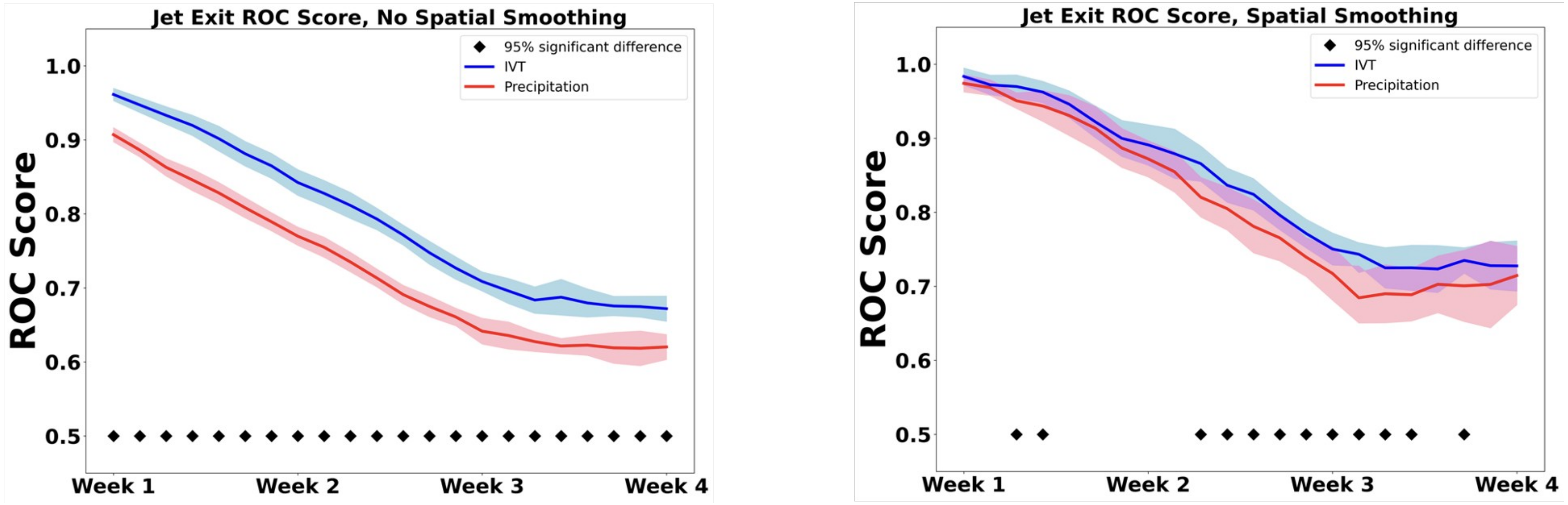


Compute mean of
conditions over
the entire area

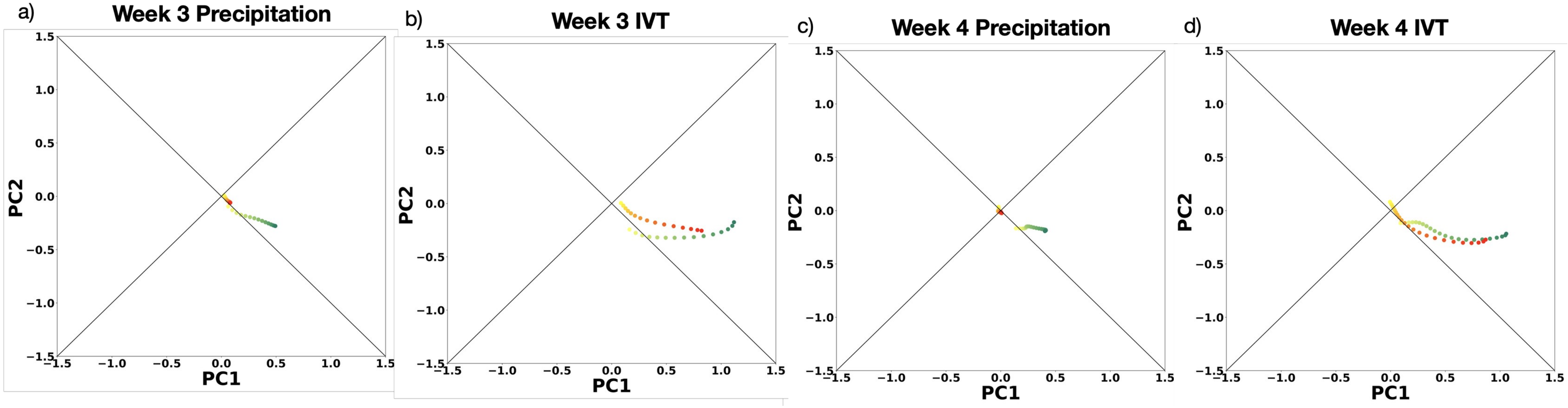
Compute ROC
score from
averaged area

Impact of Smoothing Spatially

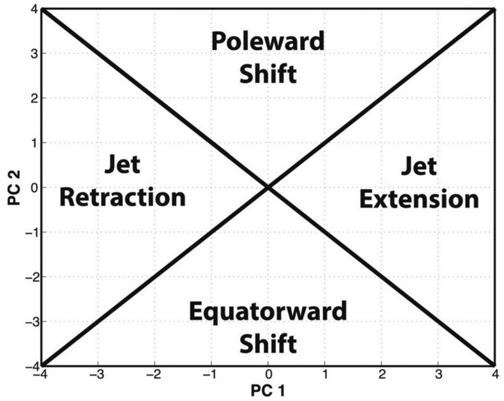
a) b)



MO NPJ Regimes during *MO* >90th Percentile Conditions

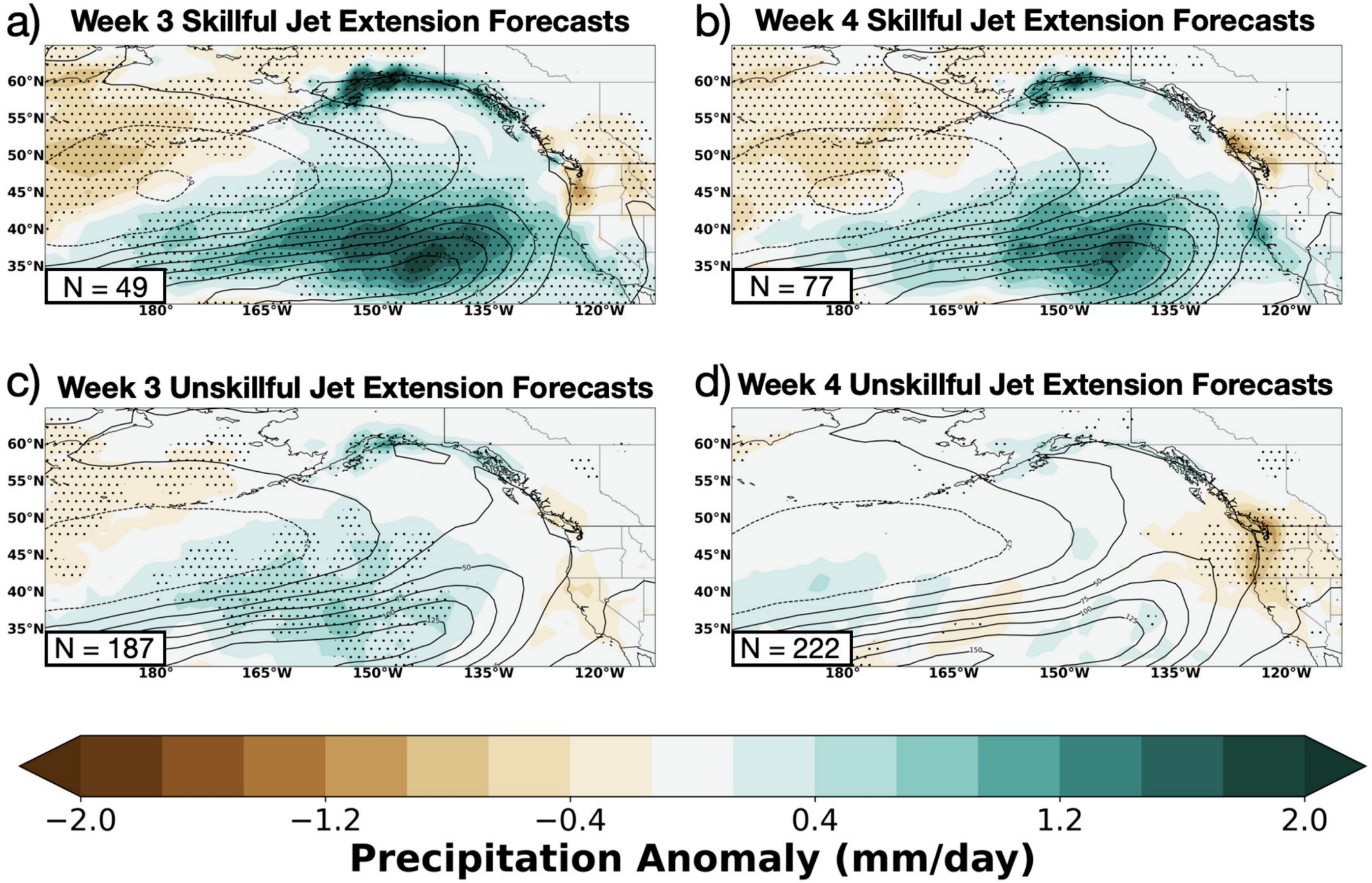


Red = unskillful forecasts
Green = skillful forecasts
Darker shades = longer lead times



MO Conditions during *MO* 90th Percentile Jet Extension

= Precipitation difference is significant at the 95% level using student t-test



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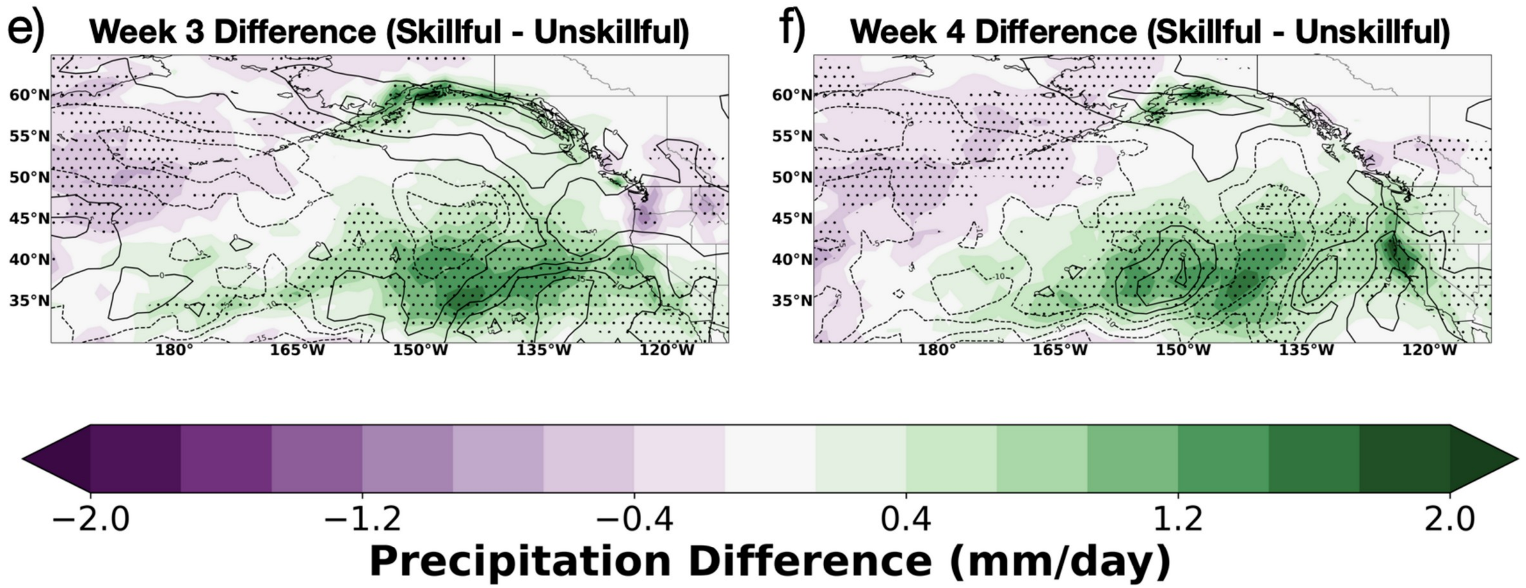
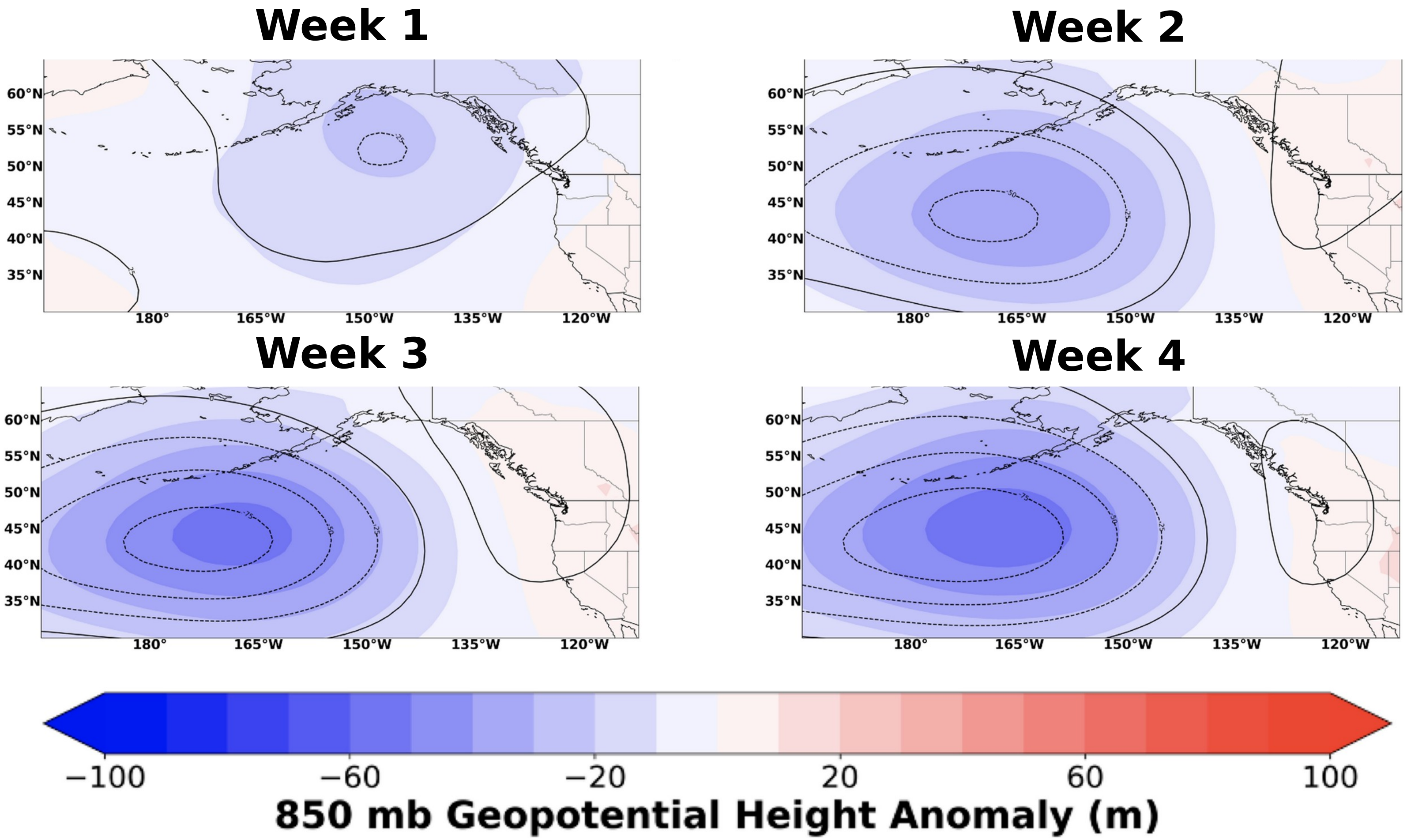


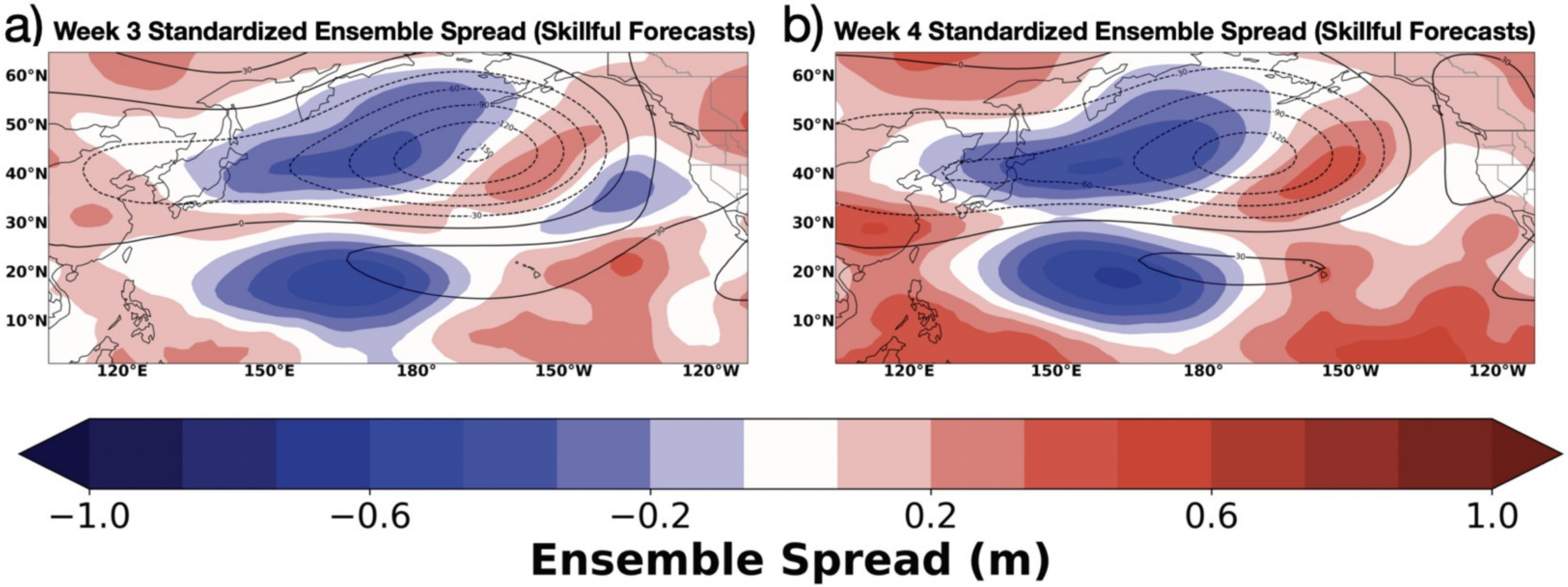
Forecasted Geopotential Height Anomalies during *MO* >90^{th} Percentile IVT in Week 4

Line contours:
300 mb
geopotential heigh
anomaly

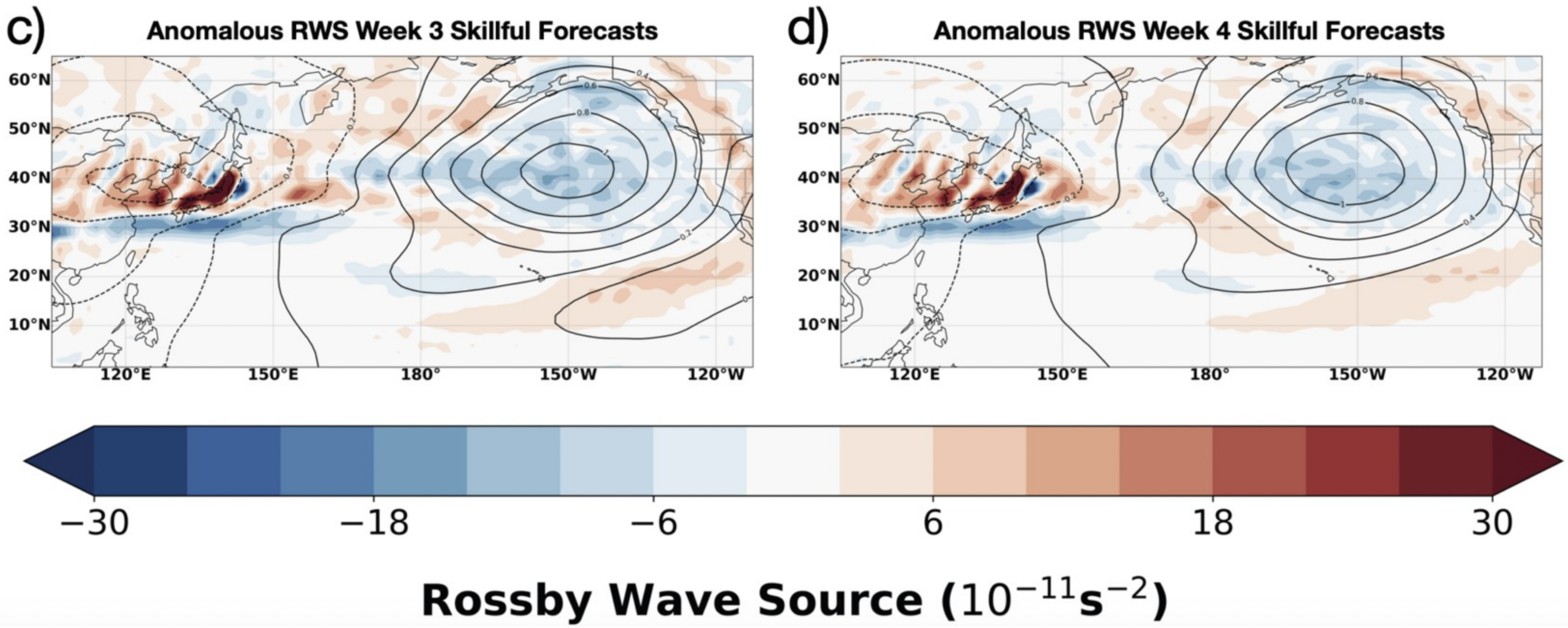
Shaded contours:
850 mb
geopotential height
anomaly



Standardized Ensemble Spread during Skillful Forecasts



Rossby Wave Source during Skillful Forecasts



Main Conclusions

There is some potential predictability of both >90^{th} percentile IVT and precipitation weeks that exists out to week 4 in the jet exit region

IVT generally has more forecast skill than precipitation does over the North Pacific at subseasonal lead times

Local variability cannot fully explain differences in forecast skill

The strength of the NPJ can have a significant impact on the predictability of both IVT and precipitation in the subseasonal range

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