Seasonal Prediction of Atmospheric Rivers in the NMME

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*Zhou and Kim, 2017 Climate Dyn. (in review)

Abstract

i. Atmospheric Rivers (ARs)
- Elongated narrow plumes of poleward moisture transport
- Important water resources in the coastal regions

ii. Prediction of SST and circulation
- Underestimated ENSO asymmetry
- Prediction biases in the circulation field

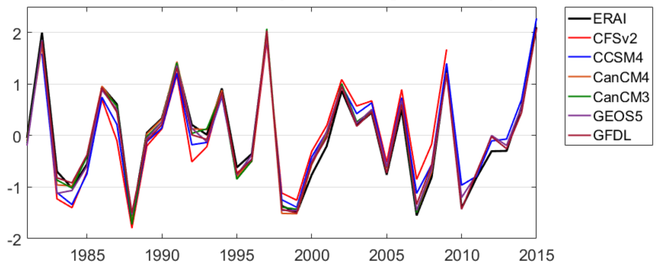
iii. Prediction of moisture flux
- Most of the models have a negative bias in moisture flux magnitude in the northern Pacific
- The overall predicted moisture flux convergence is weaker than the observation

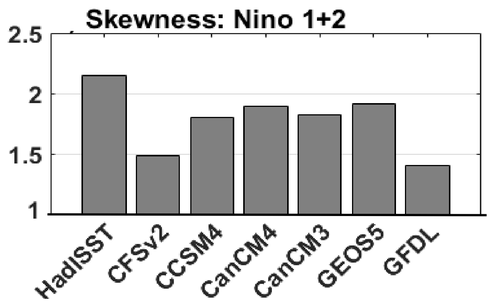
iv. Prediction of ARs
- The gross pattern of the ARs response to ENSO can be predicted in the NMME to some extent, but significant regional biases degrade the overall prediction skill

SST and Circulation

- High correlation of SST in the tropical Pacific
- High correlation of Niño 3.4

DJF Niño 3.4 (IC early Nov.)





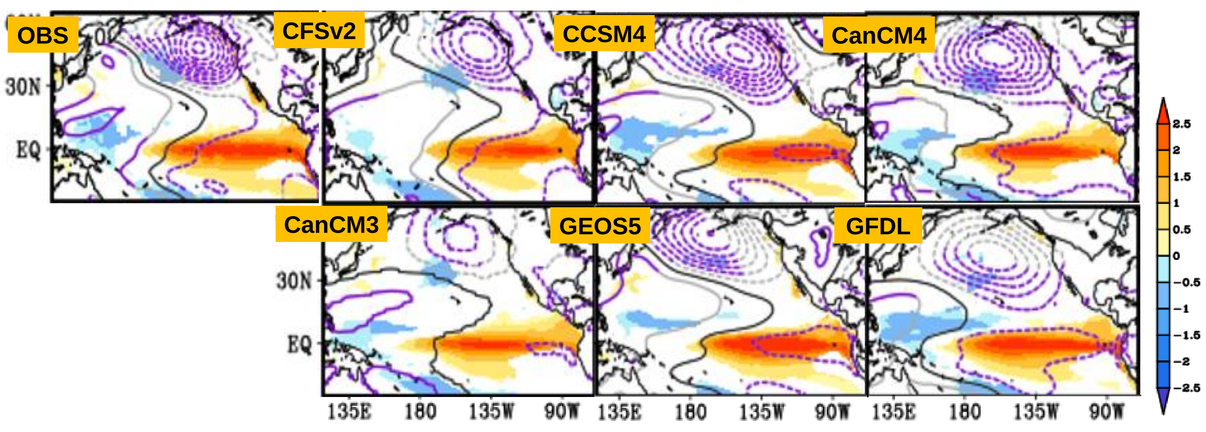
- Underestimated ENSO asymmetry

→ Prediction of weaker El Niño or stronger La Niña

- Biases in the amplitude, shape, and location of the Aleutian Low during El Niño

→ Induce biases in moisture transport prediction

SST (shadings) & SLP (contours) anomaly in El Niño



Data

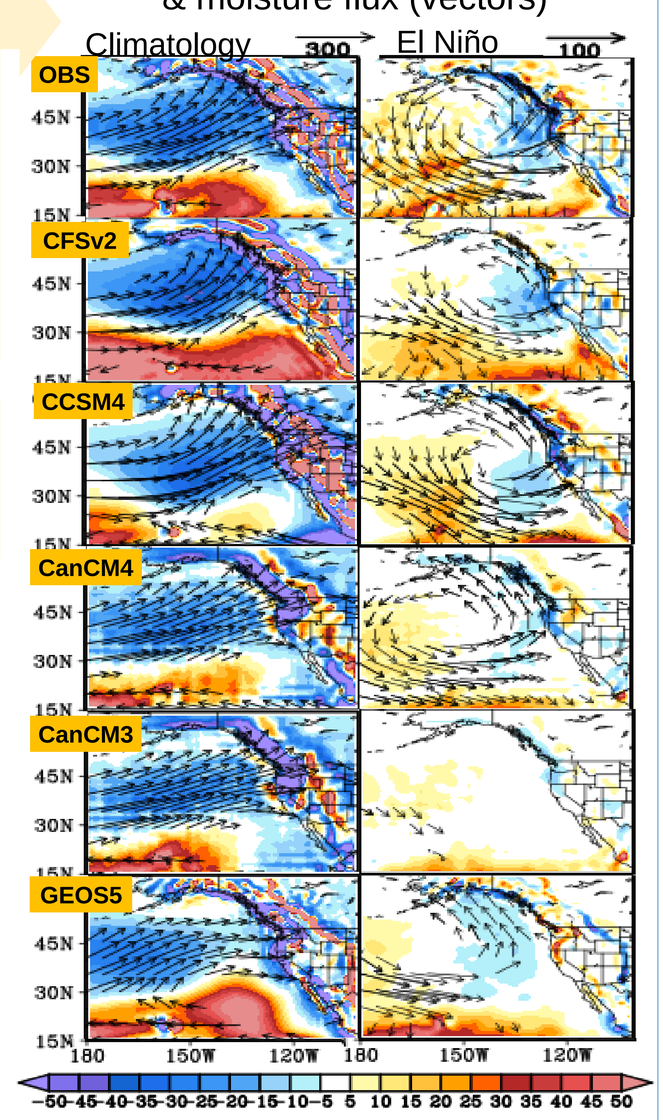
i. ERA-Interim reanalysis, HadISST: 1979-2012 (DJF)

ii. NMME hindcasts:
- Initial condition: early November;
- Target season: DJF
- CFSv2, CCSM4, CanCM4, CanCM3, GEOS5, GFDL

Moisture Flux and ARs

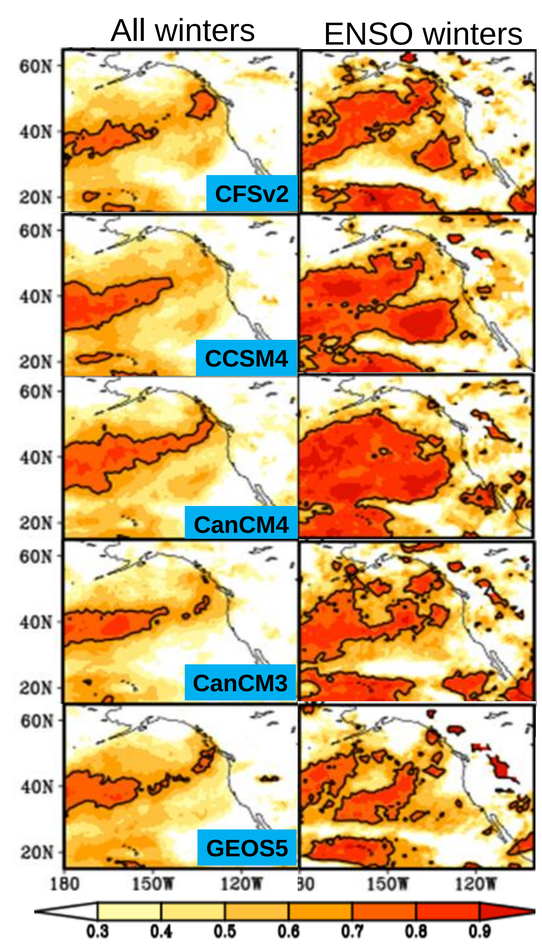
- Most models roughly predict the climatological moisture flux
- Due to the circulation prediction bias, the predicted moisture flux convergence shifts southward with weaker amplitude

Moisture flux divergence (shadings) & moisture flux (vectors)

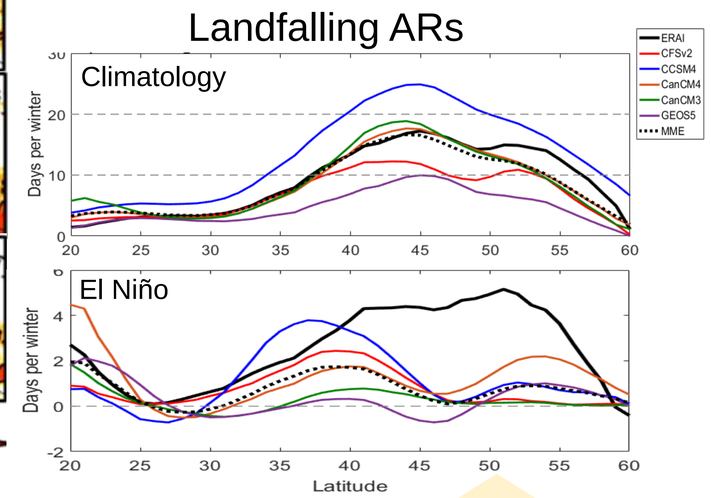


- The seasonal AR prediction is largely improved corresponding with ENSO

Correlation of AR frequency



Landfalling ARs



- Multi-model ensemble shows the best prediction of landfalling ARs over the Northeast Pacific
- Large regional biases in the prediction of landfall location related to ENSO

AR Definition

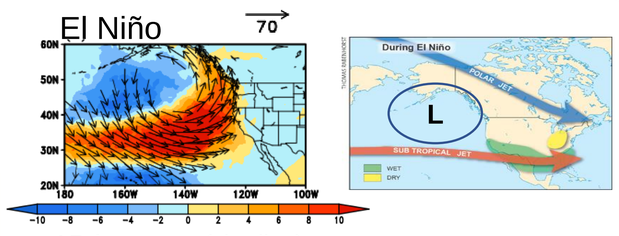
- Define AR:

$$\vec{Q} = \frac{1}{g}\int_{850}^{100} q\vec{V}\, dP$$

Ps: surface pressure
V: horizontal wind
q: specific humidity

- During El Niño:

→ Intensified Aleutian Low
→ Subtropical jet shifts equatorward
→ More ARs in the US west coast



- AR frequency (shading)
- Moisture flux (vectors)
- Data: ERA-Interim

❖ This study was supported by NOAA MAPP grant NA15OAR4310078

❖ Zhou, Y. and H. M. Kim*: Prediction of atmospheric rivers over the North Pacific and its connection to ENSO in the North American Multi-Model Ensembles (NMME), *Climate Dynamics (in review)*