Global prediction skill of atmospheric rivers: seasonal comparison and relationship to ENSO phase

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Data and methodology

- ECMWF 1996-2014 hindcasts, compare to ERA-I data
  - Calculate IVT and detect ARs at leads ranging from 1 week to 1 month
  - Compute prediction skill as a function of lead time and ”threshold” distance between modeled and observed AR centroids

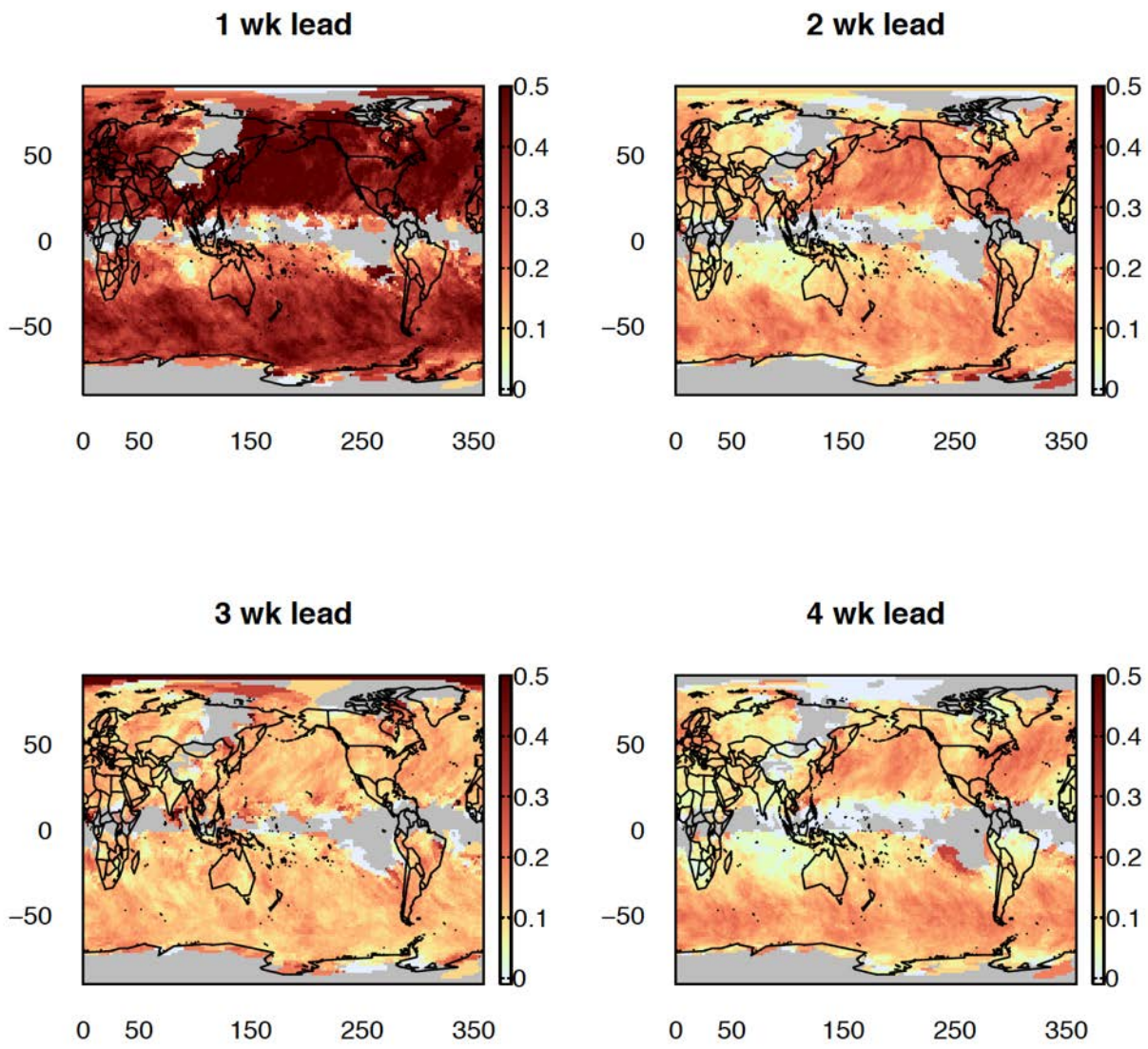
”1000km” AR hit threshold

Input parameters for Prediction Skill Algorithm

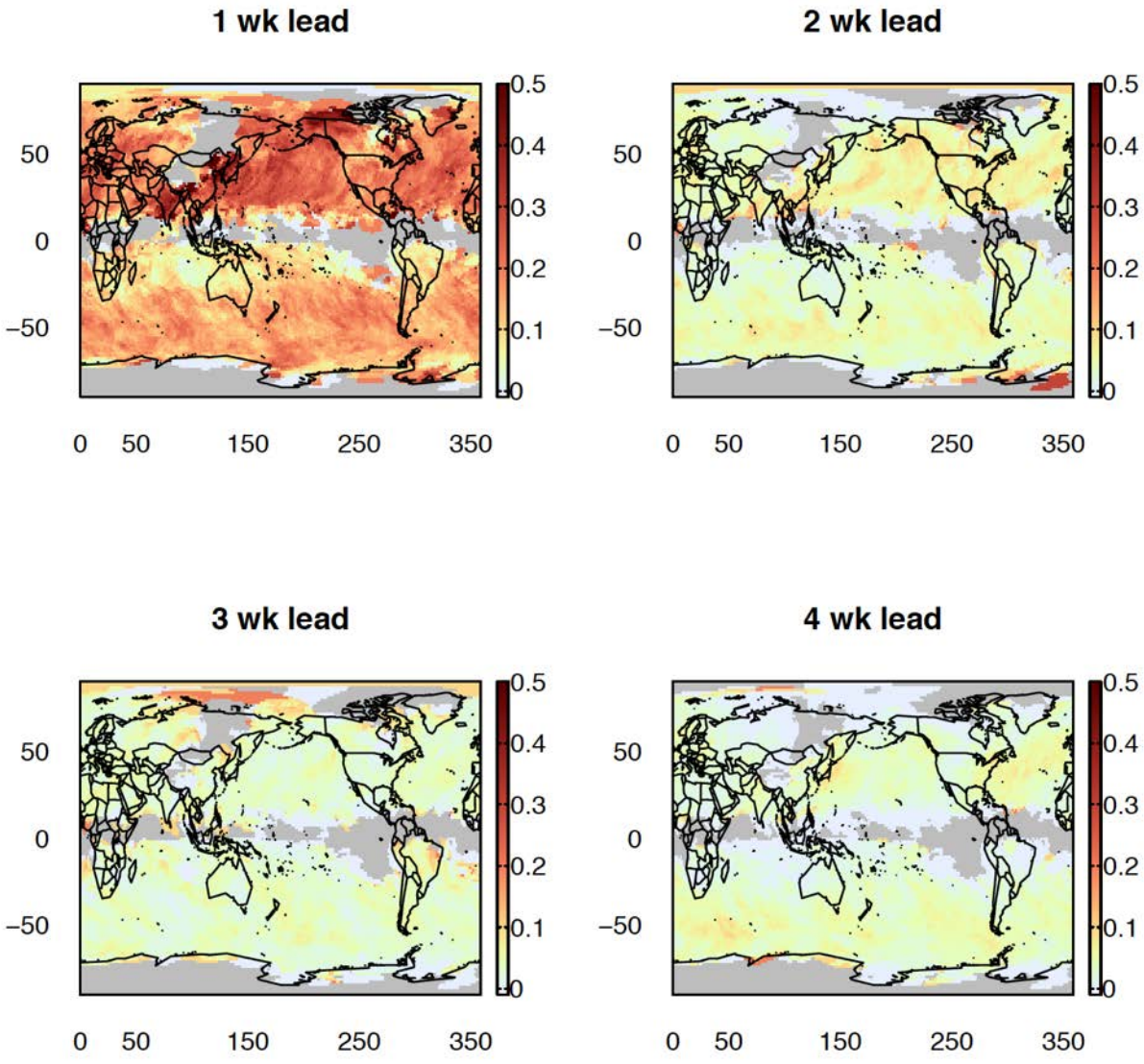
```
# ---------------------------------------------------------
# CALCULATE AR PREDICTION SKILL FROM S2S HINDCAST DATA
# ---------------------------------------------------------
# created: 16 May 2016

library(ncdf4)

##########################################
############### FILE I/O ################
##########################################

            file_dir = "/global/cscratch1/sd/mdeflori/s2s/ecmwf_all_leads/AR_detection/1207/txt_files/"
            hmonth_start = 12
            hdate = 7
            hyear_start = 1995
            hyear_end    = 2013    # note: for hindcasts 0104 thru 0505, use 1996-2014... for hindcasts 0515 thru 1231, use 1995-2014

            year_vector = c(1995,1996,1997,1998,1999,2000,2001,2002,2003,2004,2005,2006,2007,2008,2009,2010,2011,2012,2013,2014)

            hmonth_lead_1wk = 12
            hdate_lead_1wk  = 14

            hmonth_lead_2wk = 12
            hdate_lead_2wk = 21

            hmonth_lead_3wk = 12
            hdate_lead_3wk = 28

            hmonth_lead_4wk = 1
            hdate_lead_4wk = 4

            distance_threshold = 1000      # IN KM
```

DJF AR prediction skill: ECMWF 1995-2014

1000 km threshold

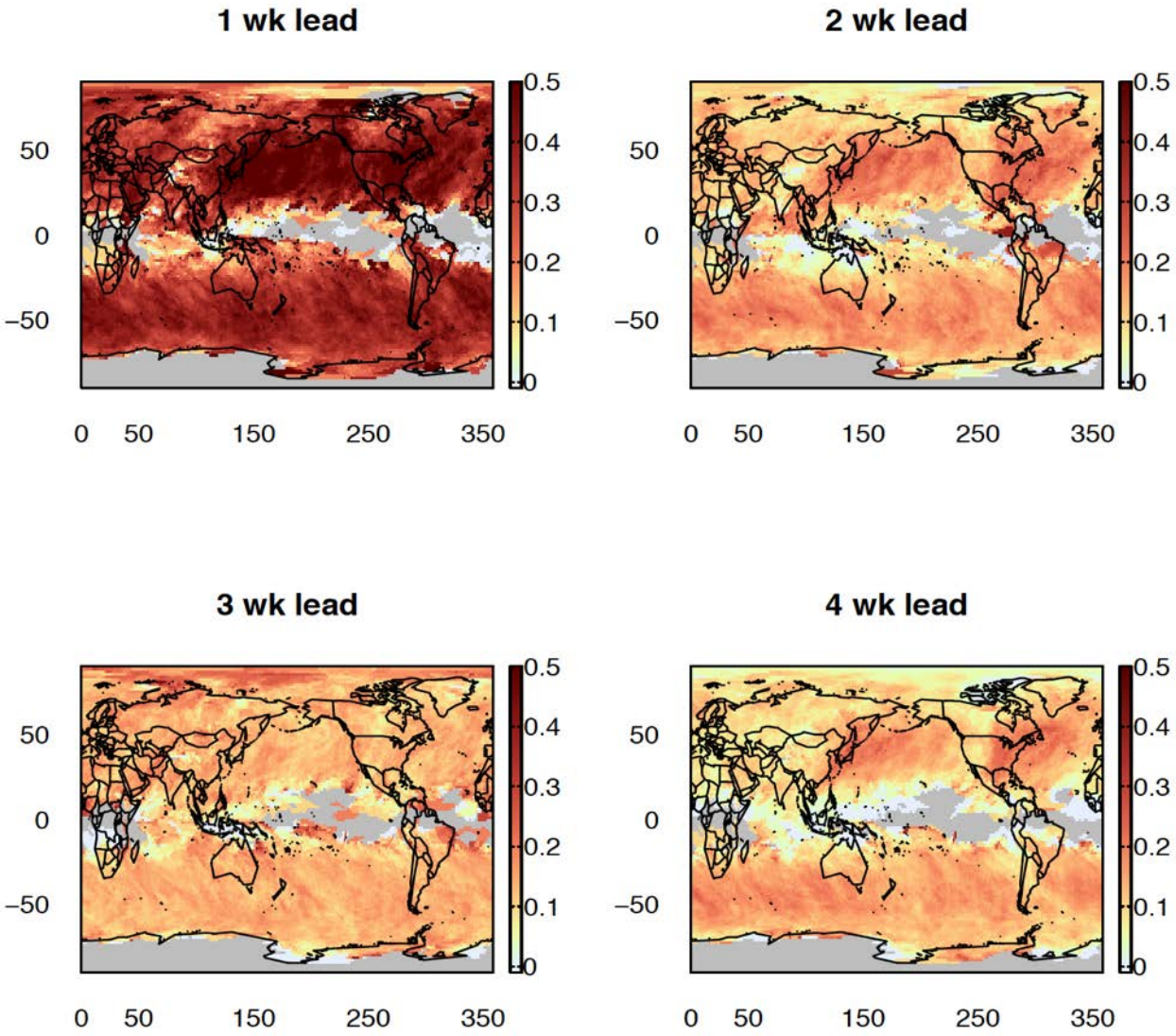


500 km threshold

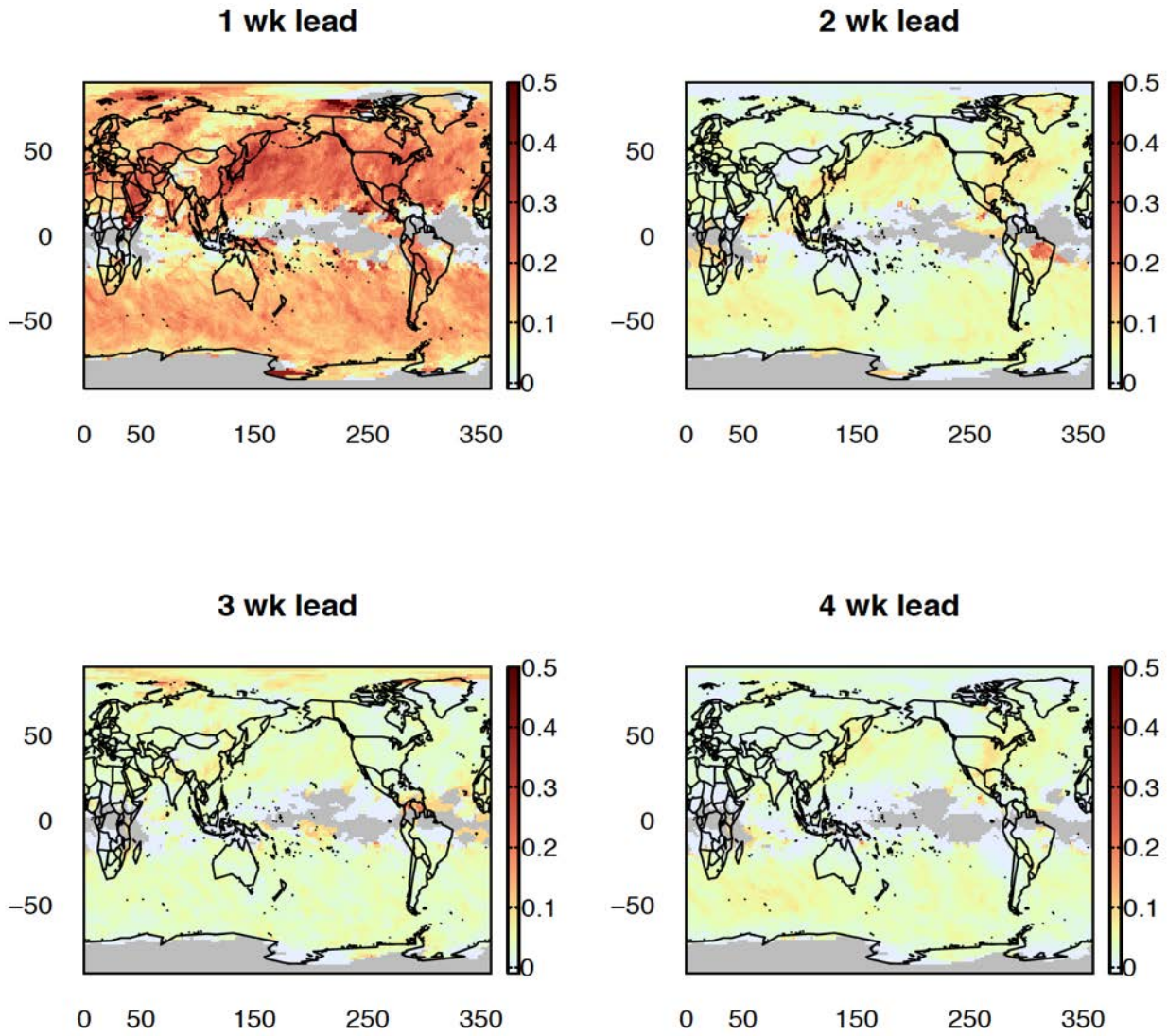


MAM AR prediction skill: ECMWF 1995-2014

1000 km threshold

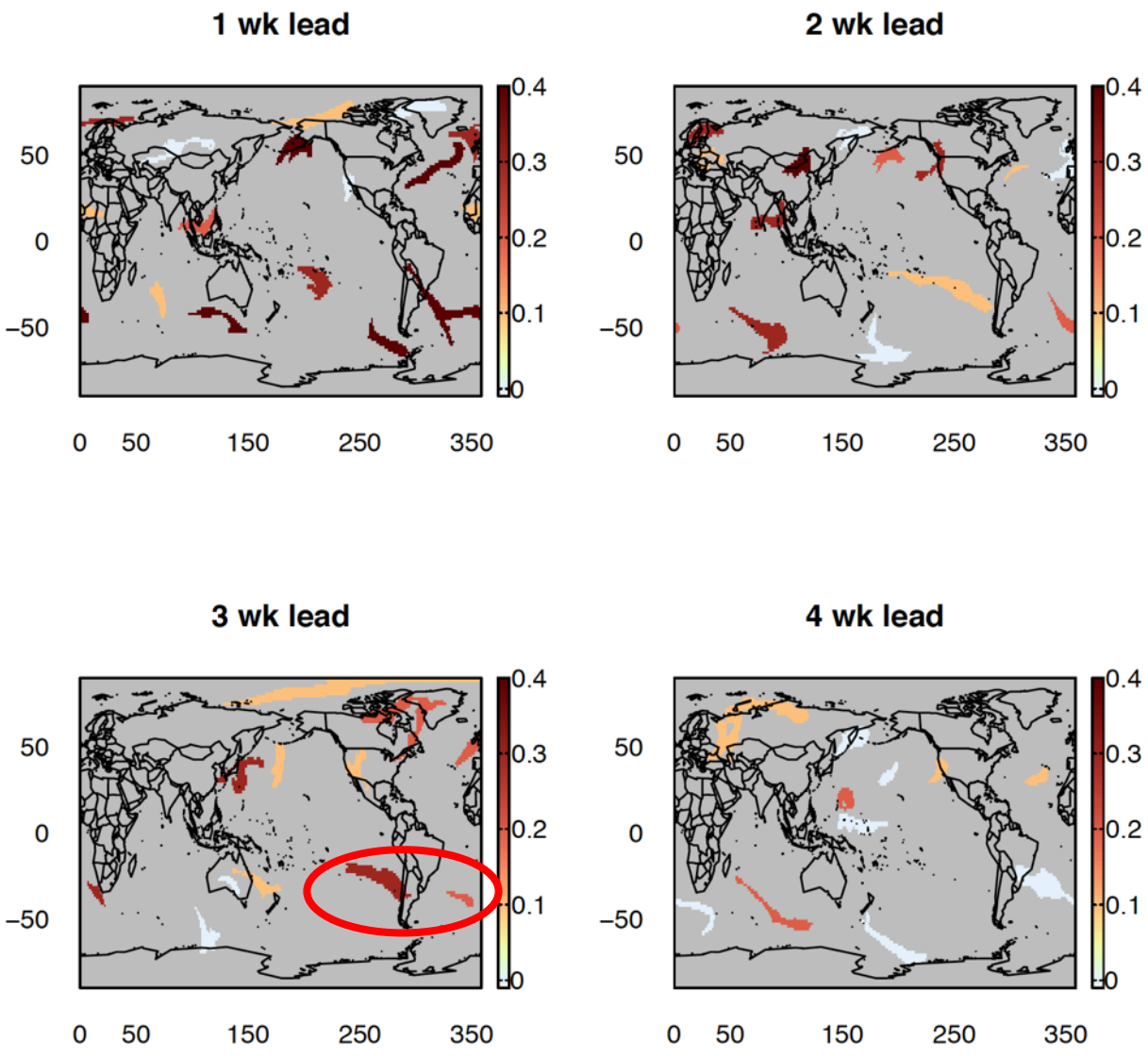


500 km threshold

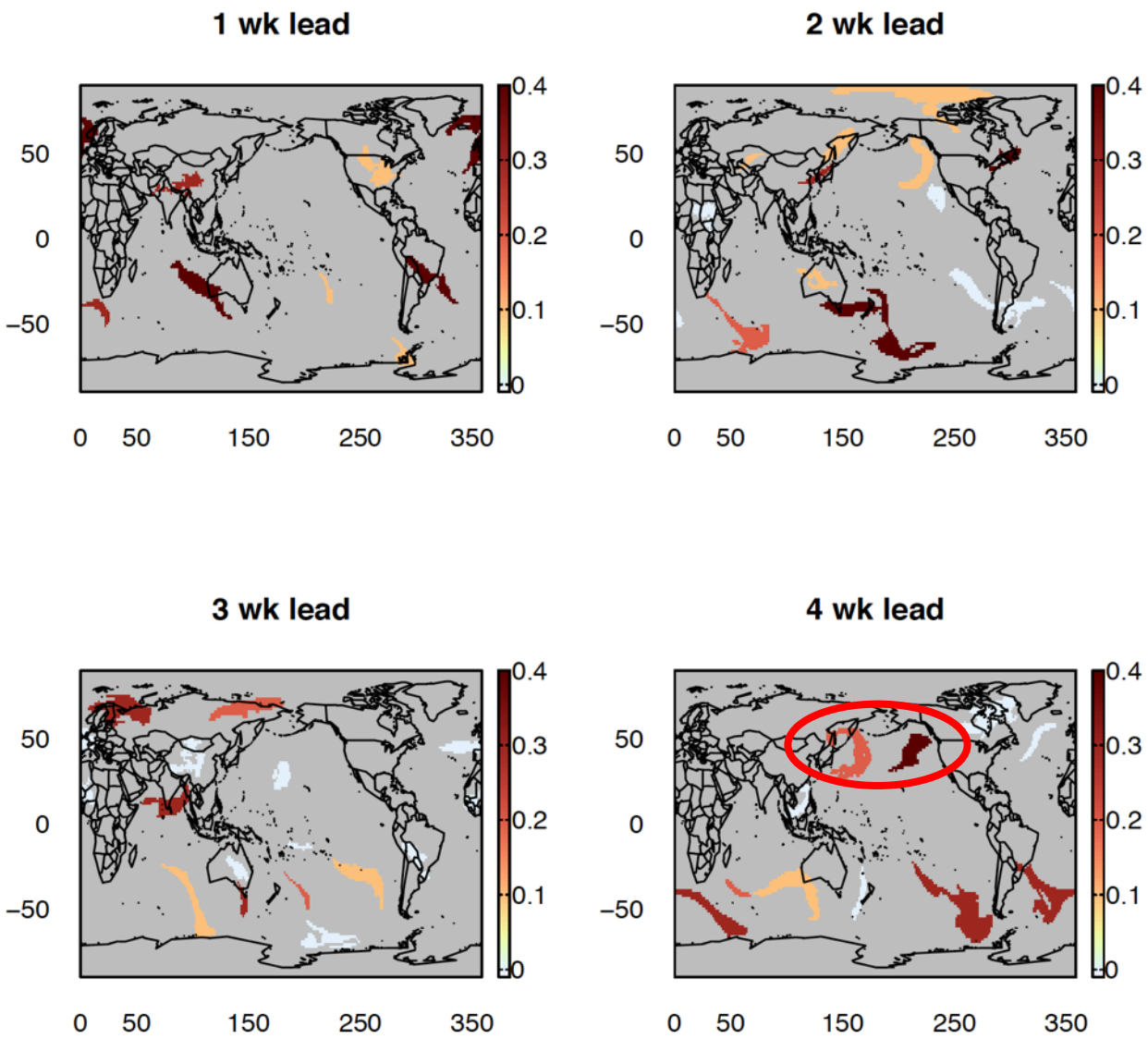


Strong El Niño vs. Strong La Niña skill example

El Niño (13 Aug 1997 hindcast)

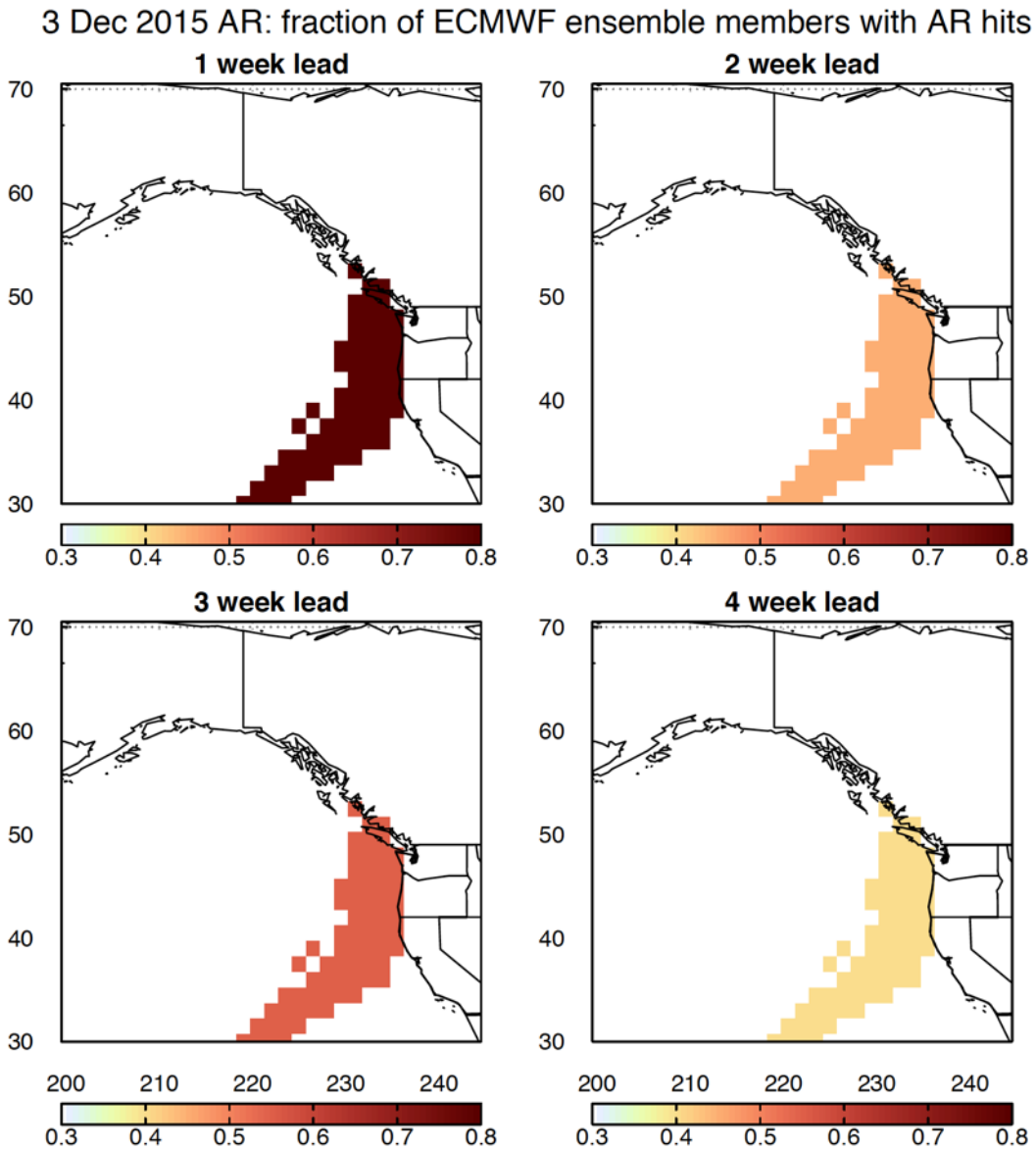


La Niña (13 Aug 2009 hindcast)



Regional application: landfalling AR during winter 2015 El Niño event

- Previous examples use fixed ECMWF hindcast date
  - here, we fix observed date (to focus on a particular AR event) and assess skill of 1 week, 2 week, 3 week, and 4 week lead hindcasts



Summary

- developed an AR prediction skill methodology and flexible algorithm
- prediction skill in ECMWF generally decreases with more stringent AR distance threshold
- moderate-to-high prediction skill at 1 week lead even with reduced 500-km distance threshold, especially over climatologically active AR regions (e.g. N. Pacific)
- generally higher prediction skill at 1-2 week leads in DJF relative to MAM
- potential increase of 3-4 week skill relative to climatology during strong El Niño and La Niña events
  - will add more ENSO events and examine phase locking of different climate modes to try to exploit predictability and prediction skill at longer leads
- our global methodology allows for targeted regional prediction skill and predictability estimates of particular observed AR events
- currently expanding methodology to utilize a dozen S2S operational models, and to quantify predictability limits of ARs