Lagged Hydrospheric Responses to Solar Cycles

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All material a work in progress which may be subject to continuing revision.

Final version of MWA presentation for distribution to attendees of LCAF, Las Cruces, New Mexico. June 2019

Application of lagged correlations between solar cycles and hydrosphere components towards sub-decadal forecasts of streamflows in the Western US

Michael G. Wallace

Hydrological Sciences Journal, Oxford UK Volume 64 Issue 2. doi: 10.1080/02626667.2019.

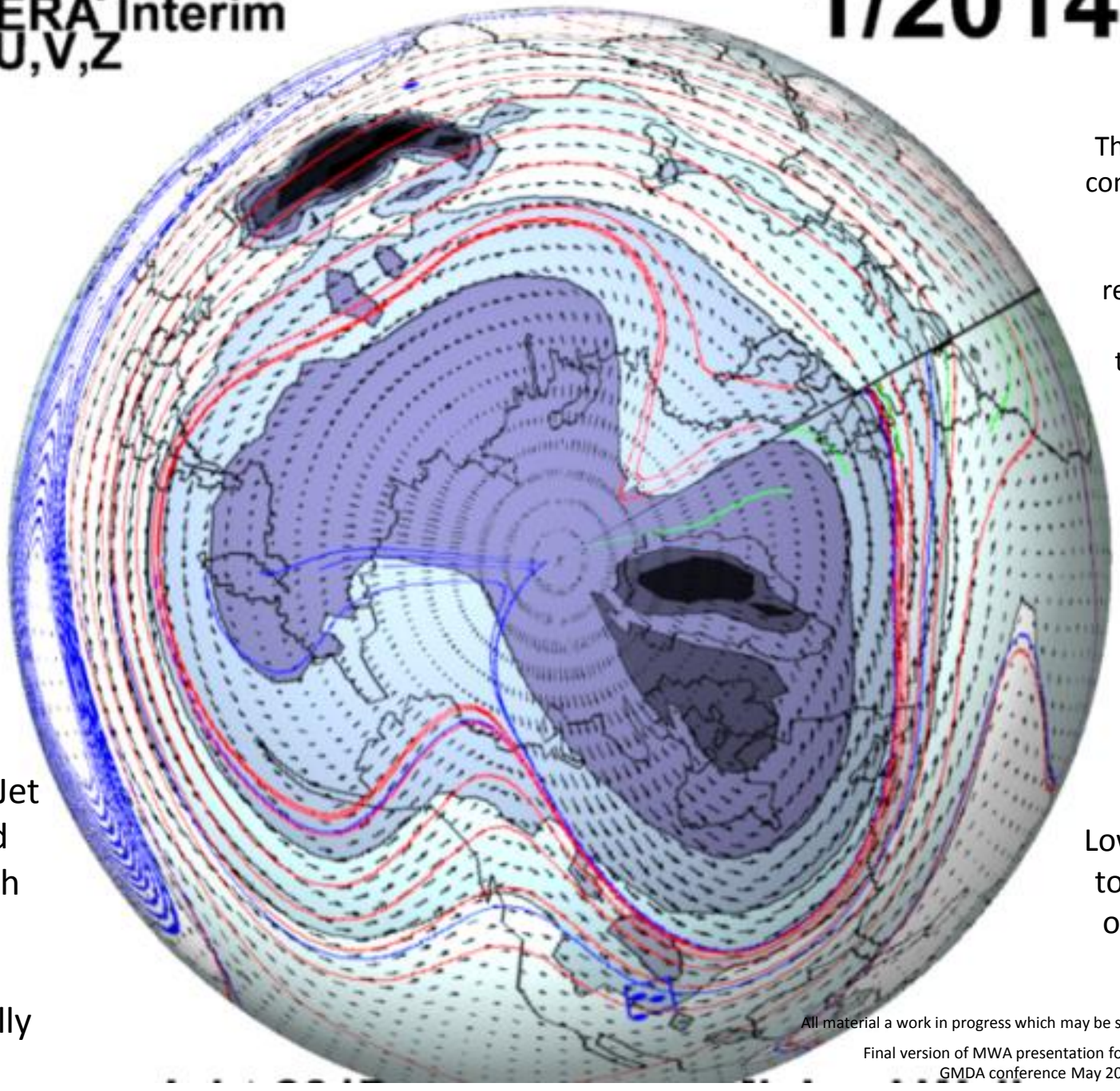
Abstract

Trade winds localized within the western equatorial Pacific express lagged and statistically significant negative correlations to sunspot numbers. Equivalent correlations also exist between those winds and rivers of the Southern Rocky Mountains. Both correlation sets were integrated in a linear regression analysis to produce multi-year streamflow forecasts. Sunspot numbers were utilized to advance the trade wind based 3-year forecasts an additional 3 years into the future. The exercises demonstrate a high fidelity between 3-year and 5-year lead forecasts and the observations when applied to a 5 year moving average. A second set of exercises evaluated a two year forecast of an annual average, with a diminished yet still significant fidelity. A final set demonstrated high fidelity of the observations of the Animas River of south central Colorado (US) to a purely solar based 5-year lead advance forecast of the same moving average.

In comparisons to the auto-correlation technique, the proposed method yielded the highest correlations, the highest goodness-of-fit scores, and the lowest root mean squared errors, for both the 5 year average and the annual average assignments. The highest K-S scores between observation and prediction were found for the single Solar based forecast over the training period.

Adapted from ERA Interim U,V,Z

1/2014

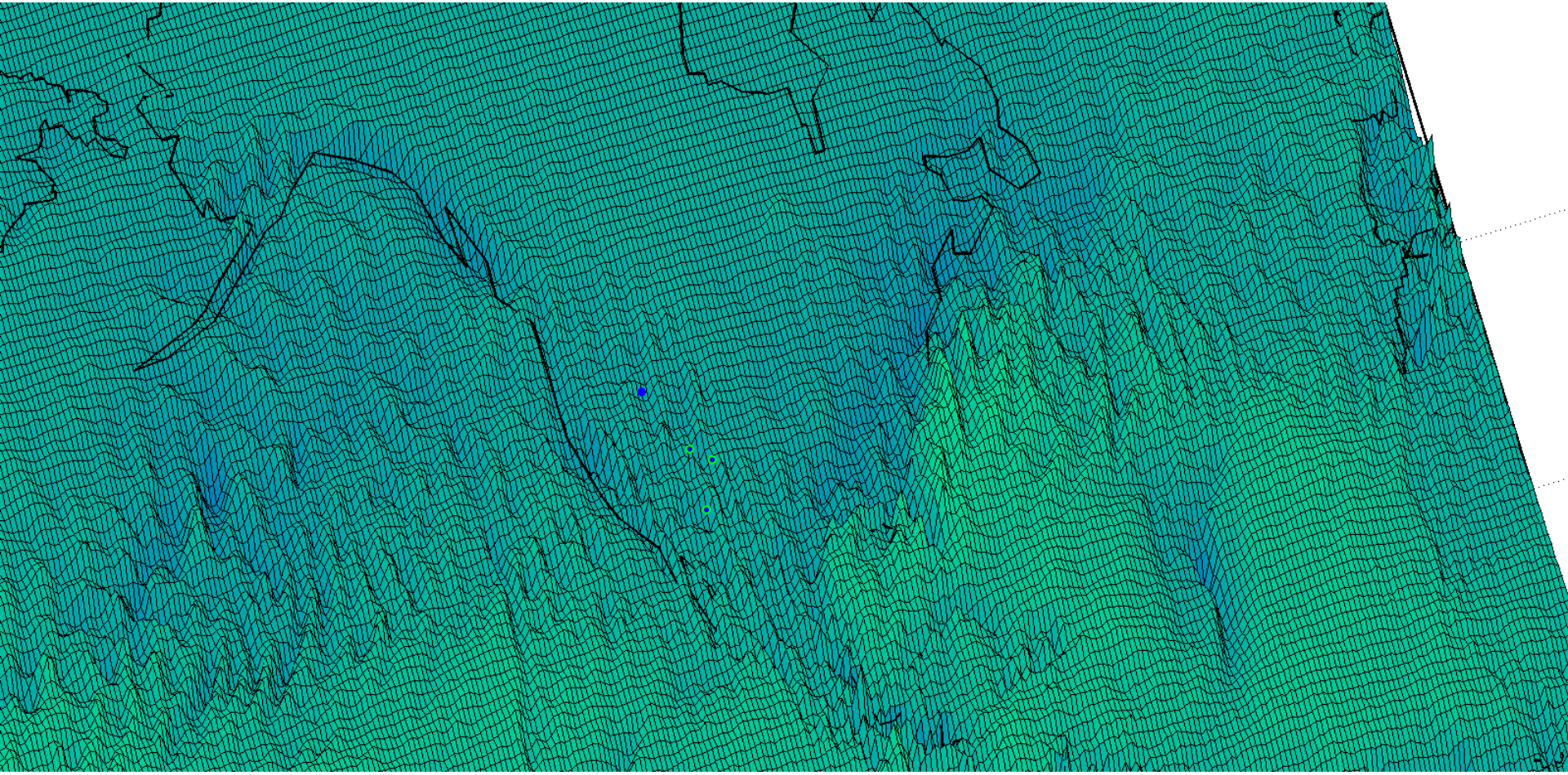


The ERA Interim Z contours resemble the third party independent renderings of the same spatio temporal series.

Noting the Jet Stream and Pacific North Gyre and others, automatically rendered.

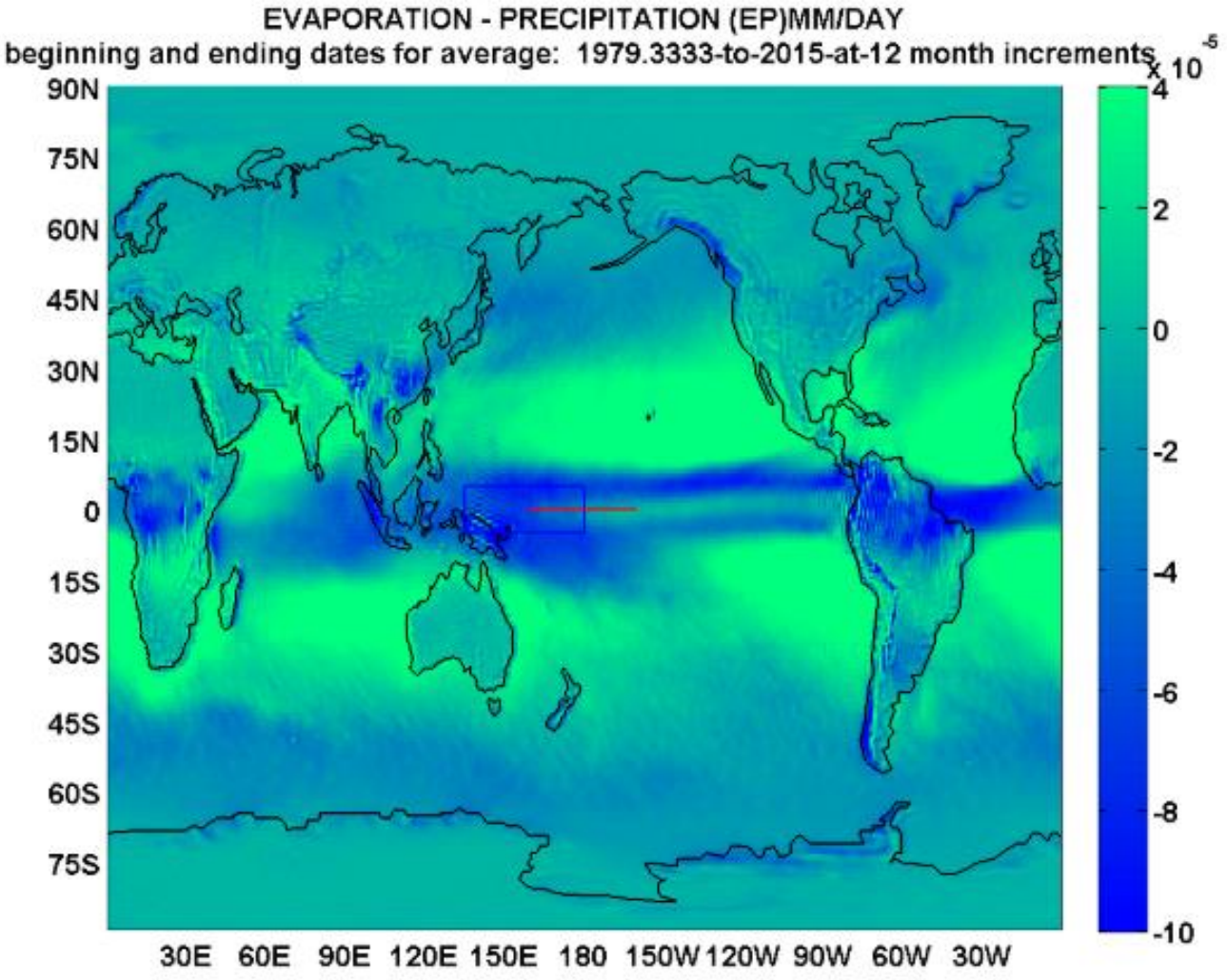
Lowest Z equates to darkest shade of filled contour

Interesting ‘artifact’ of oblique view of EP parameter for full atmosphere



I discussed this multiframe animation of Evaporation – Precipitation (EP)

http://www.abeqas.com/wp-content/uploads/2019/06/EPmonthlyClimatology.gif



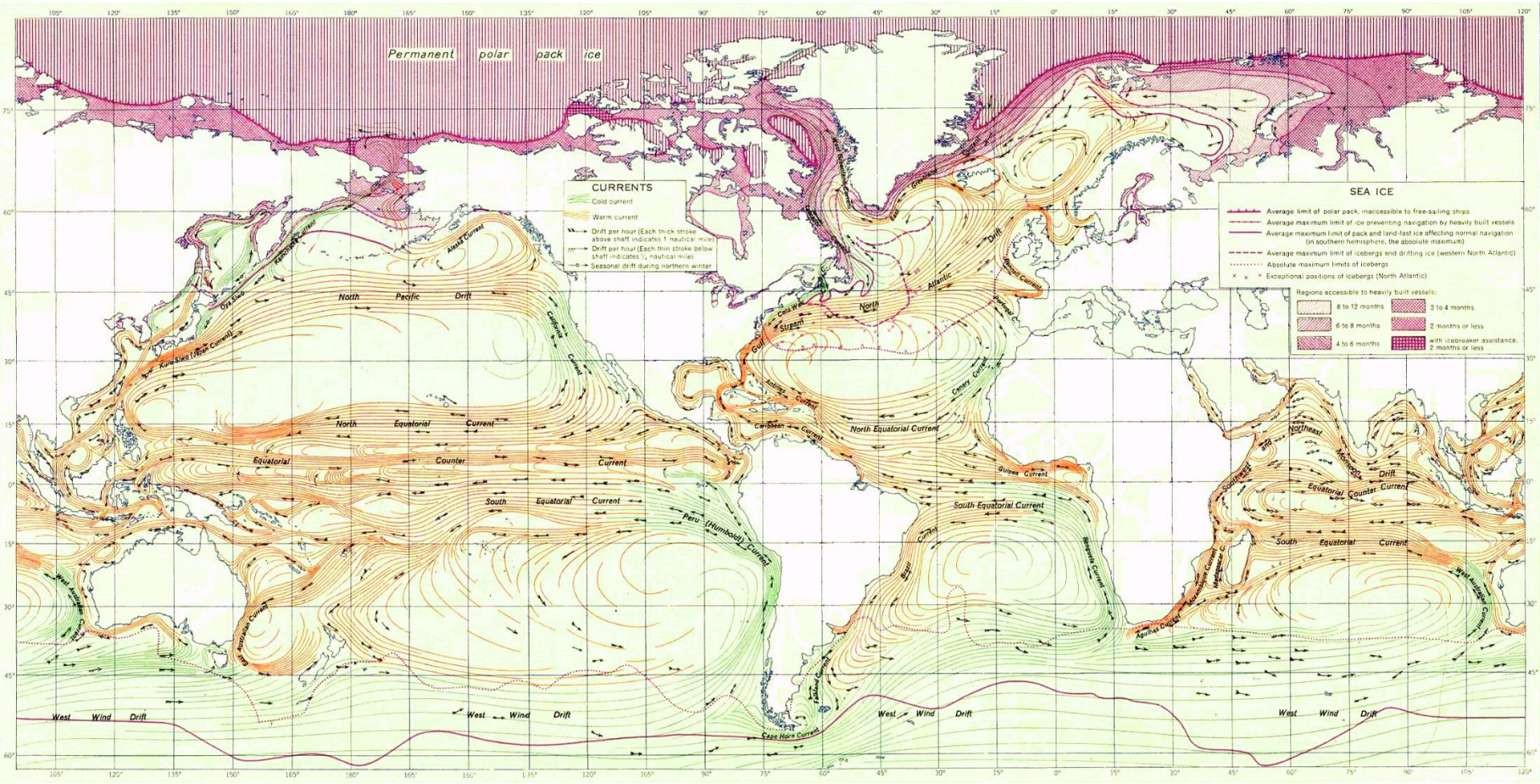
Note units correction here should be Kg / (m^2 s)

Divide any value shown by 86,400 for approximate actual precipitation or evaporation values.

To be corrected soon at web site also.

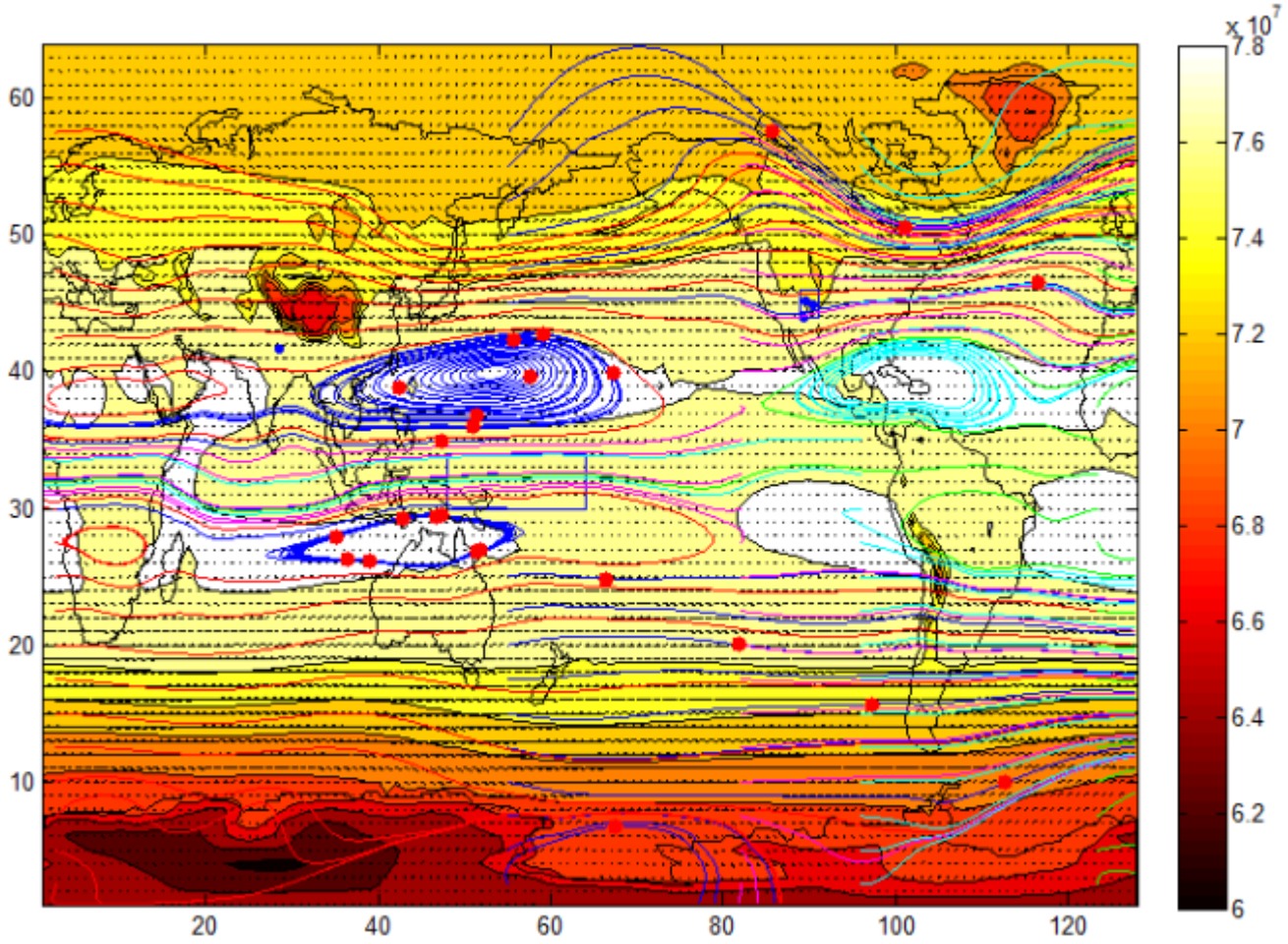
The corresponding post is at: http://www.abeqas.com/geostrophic-monthly-global-moisture/

Does wind really drive ocean circulation, or does Coriolis Force drive both?



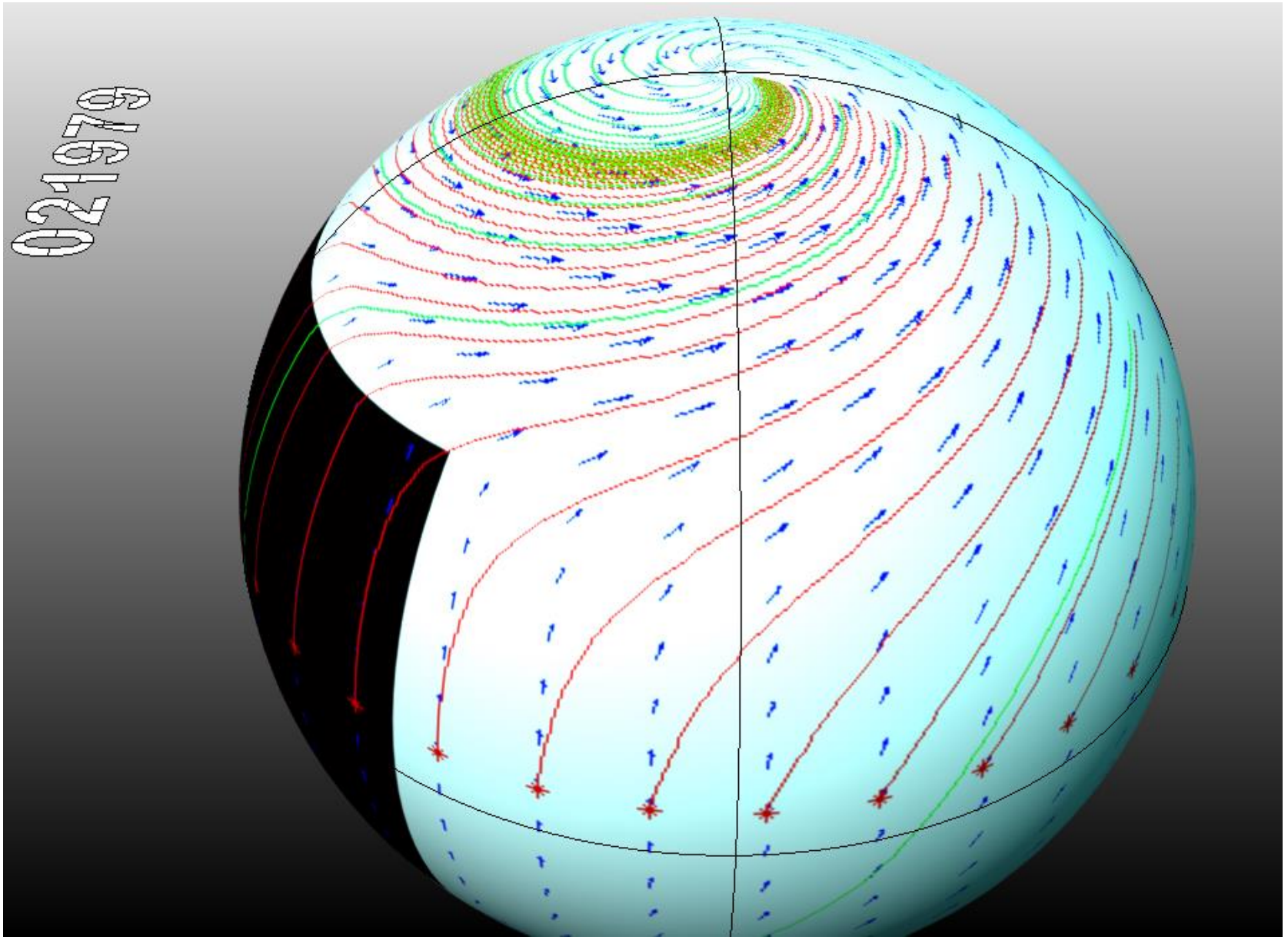
from Image:Ocean currents 1943 (borderless).png, Public Domain, https://commons.wikimedia.org/w/index.php?curid=3841905

I discussed this multiframe animation of particle tracking of geostrophic flows along streamlines. The animation is at: http://www.abeqas.com/wp-content/uploads/2017/05/GyreFlowExMWAfromERAIUV1979through2014.gif

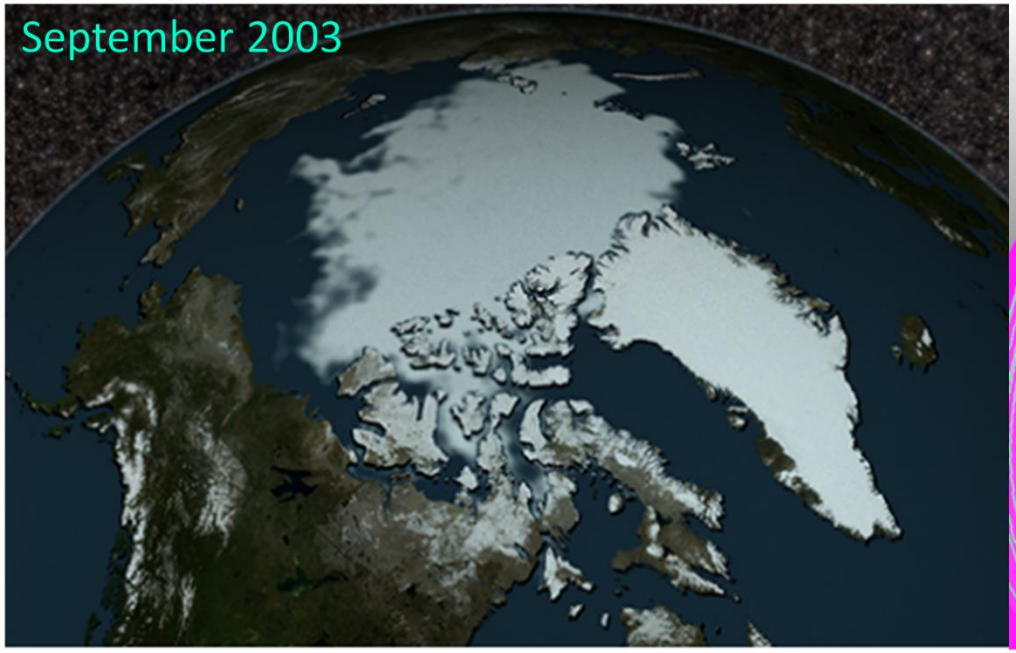


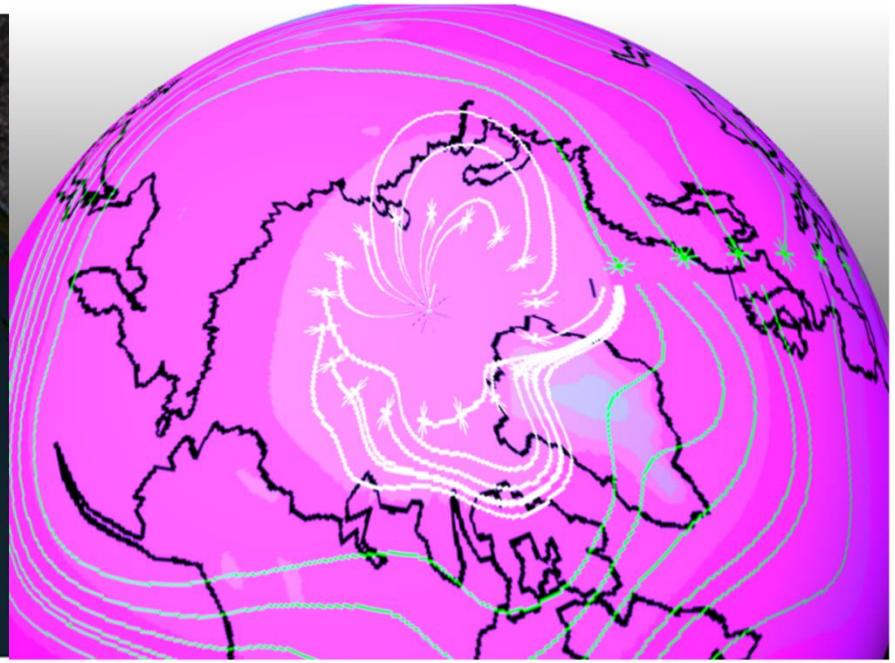
A related post is at: http://www.abeqas.com/hurricanes-gyres-and-forecasting-performance/

I described how an LB simulator might be employed to model global circulation
See: http://www.abeqas.com/lattice-boltzmann-and-a-new-way-to-simulate-earths-hydroclimate/



Polar ice extents and winds are explored. Latest post at:
http://www.abeqas.com/geostrophic-winds-tied-to-polar-ice-retreats-and-expansions/





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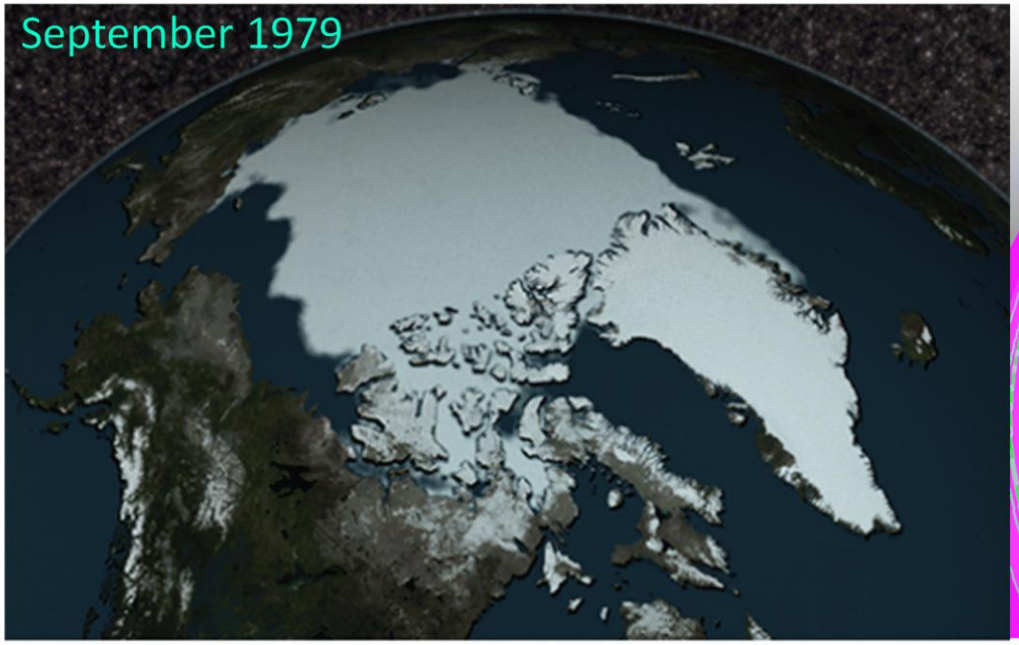
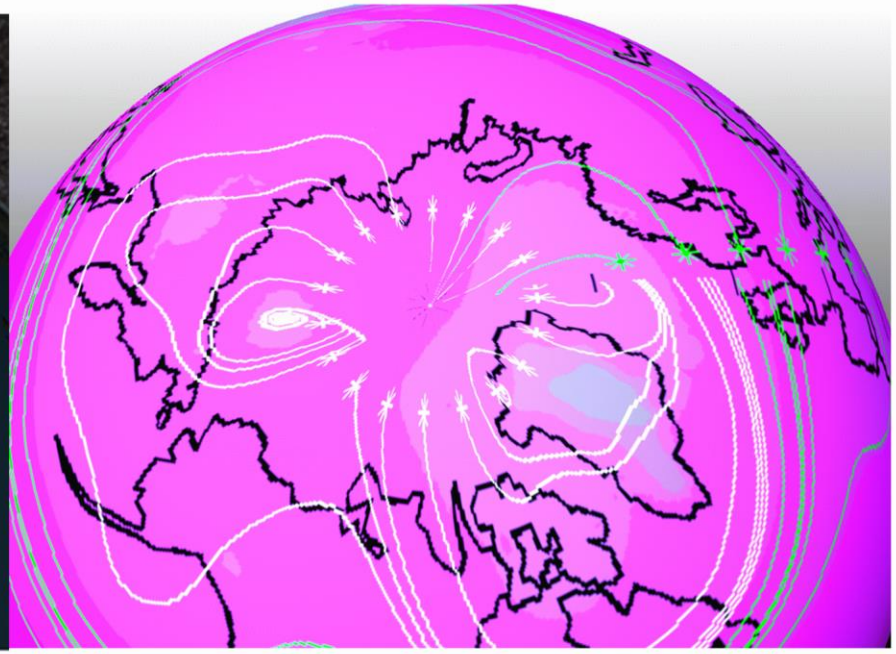
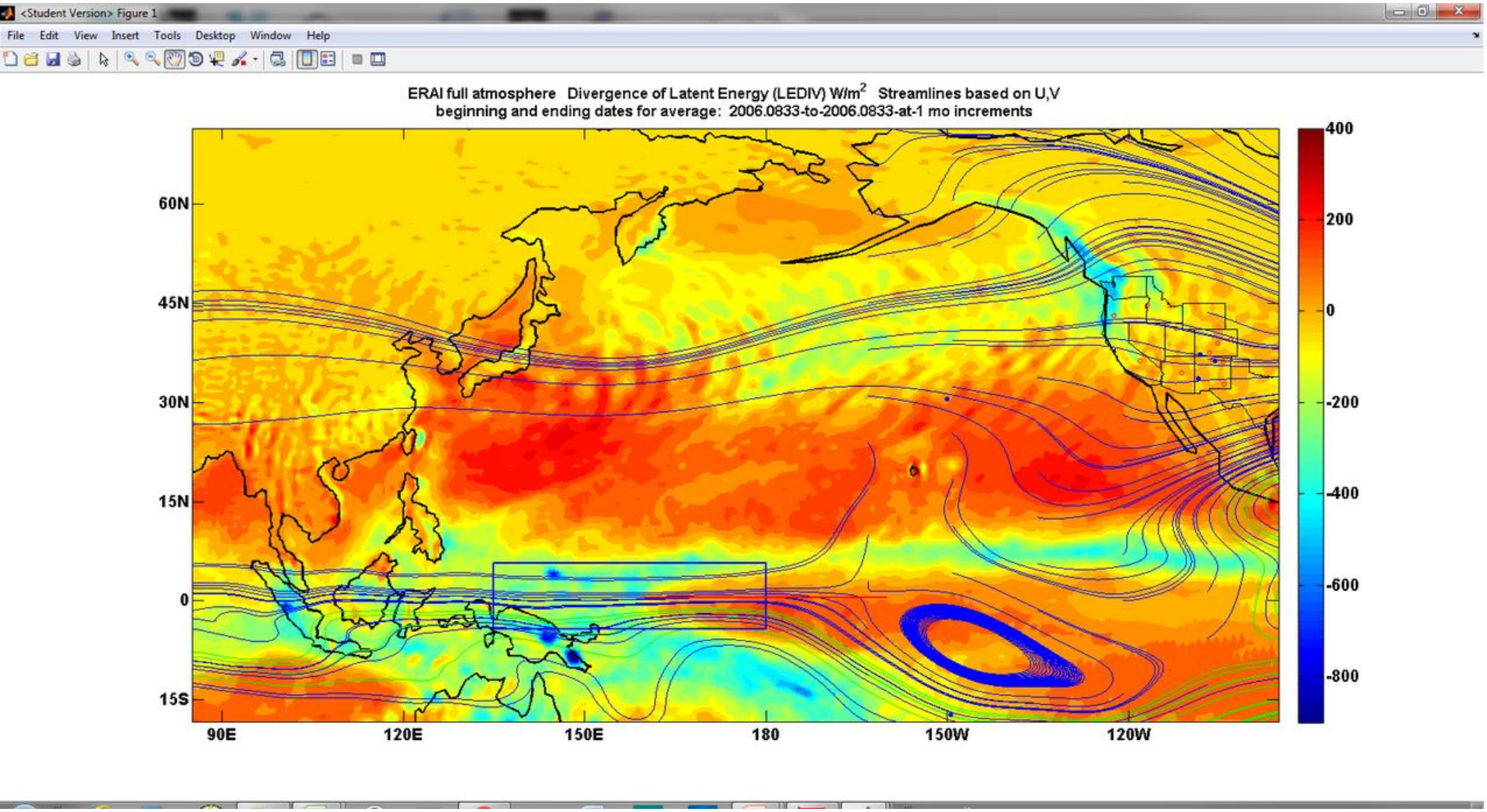
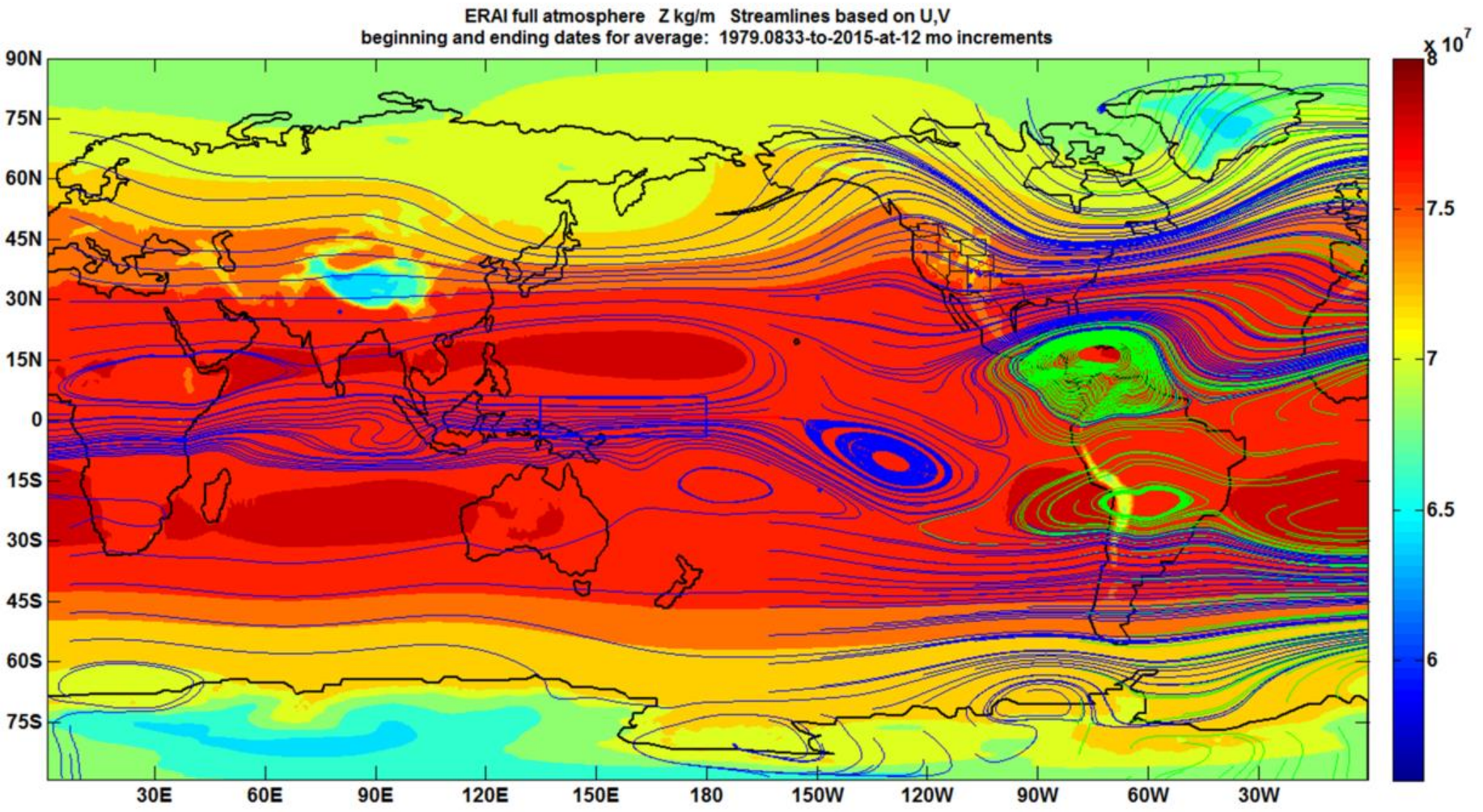




Divergence of Latent Heat corresponds closely with limits of TSI and a related post: http://www.abeqas.com/your-winter-your-summer/



More on geostrophic flows, here shown across a geopotential height coverage



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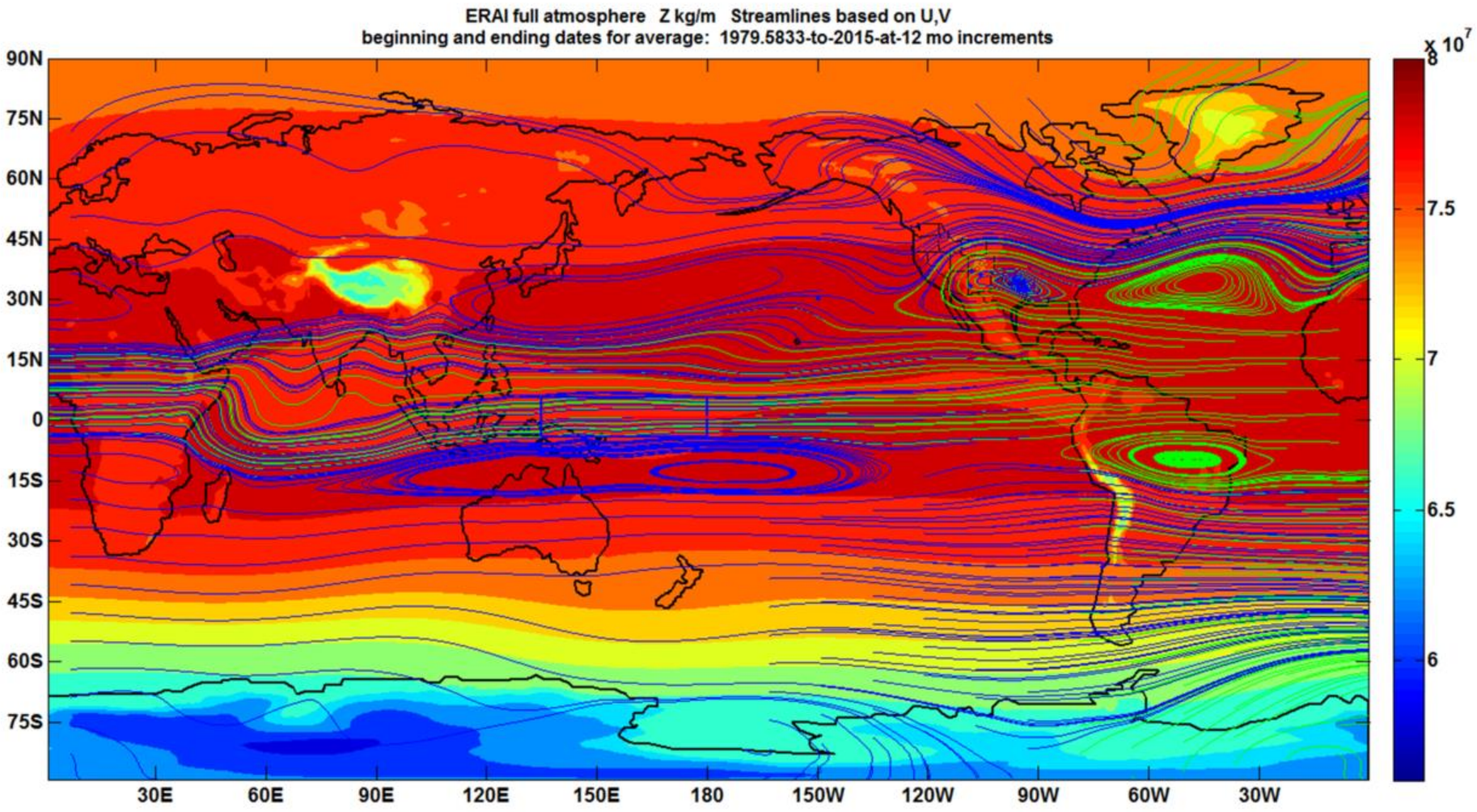
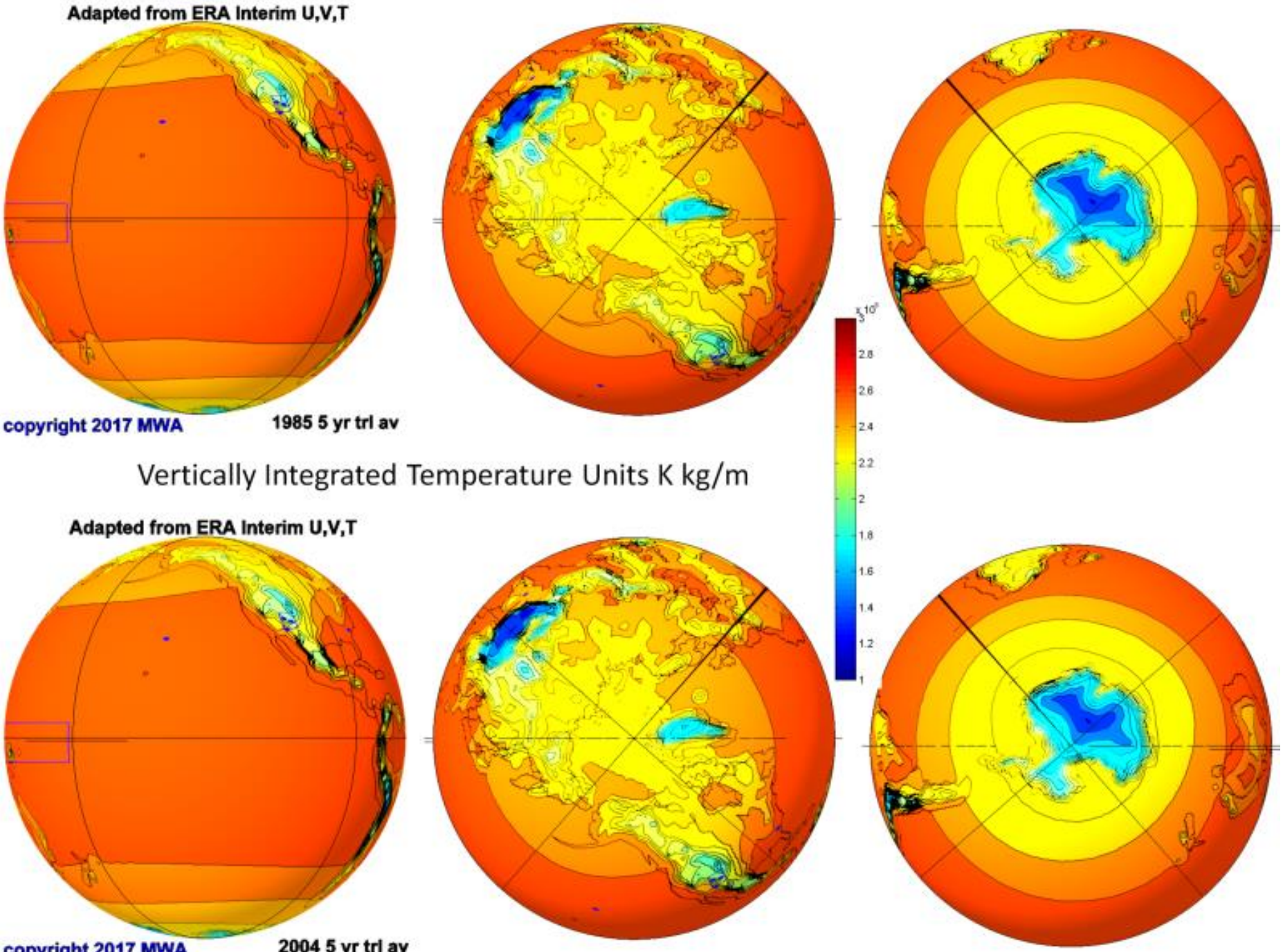


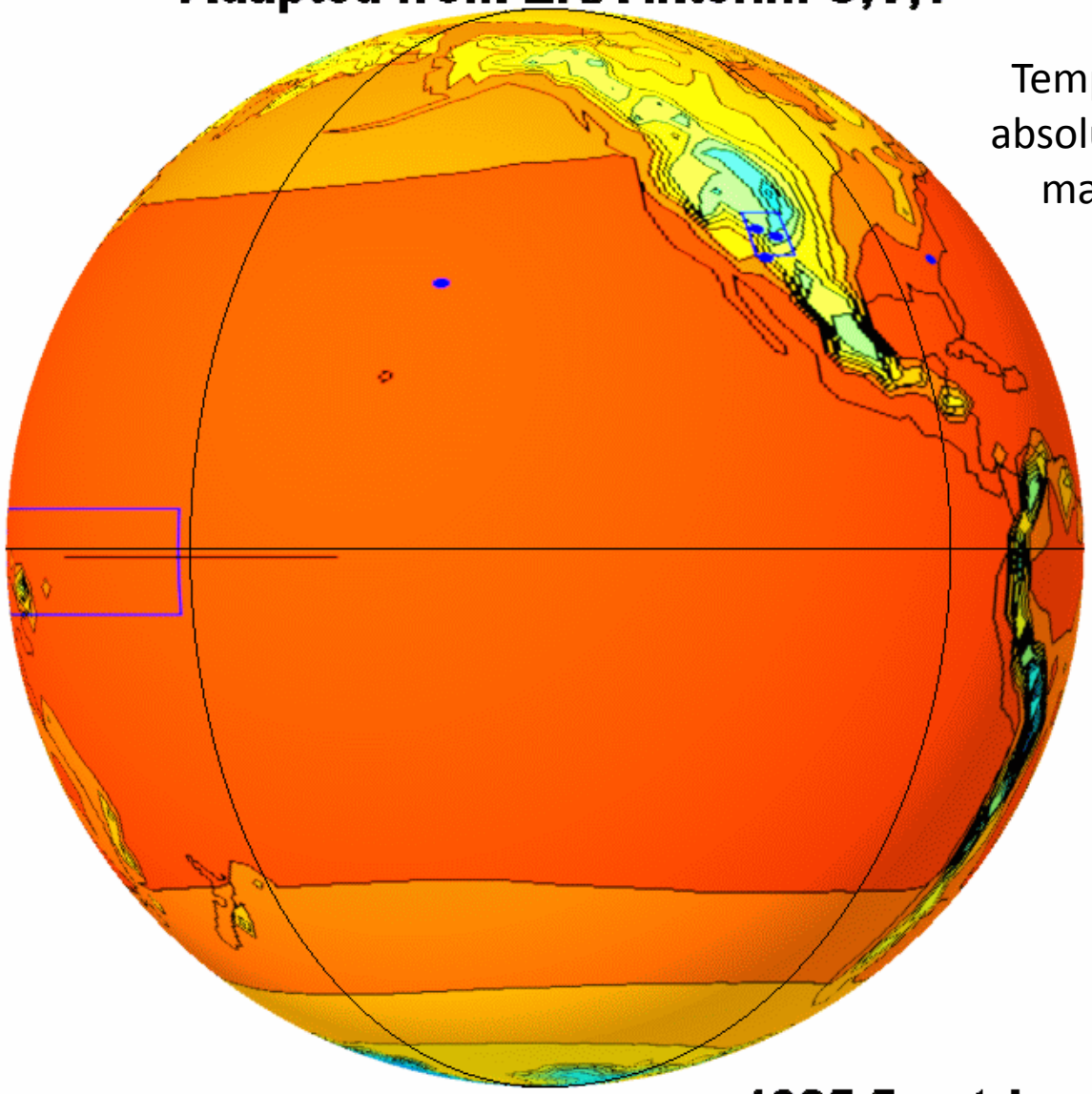

Adapted from ERA Interim U,V,T
copyright 2017 MWA
1985 5 yr trl av
Vertically Integrated Temperature Units K kg/m
x10^3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
Adapted from ERA Interim U,V,T
copyright 2017 MWA
2004 5 yr trl av

Much of the atmosphere is geostrophically stationary over 60 month averages. However from the scale and variable perspective below, the vast middle oceanic latitudes are featureless

Adapted from ERA Interim U,V,T

Charleston Temperature continues to track with AMO

Temperature contours absolute from min and max over years 1979 through 2014



Southern Rockies only area shown to change at this scale.

At 1985 and 1995, a tongue of blue reaches into Southern Rockies

Gyres are not visible through this scalar coverage

1985 5 yr trl av

Final version of MWA presentation for distribution to attendees of GMDA conference May 2017 Albuquerque New Mexico

Some Gyre Centers are as stationary as any mountain range

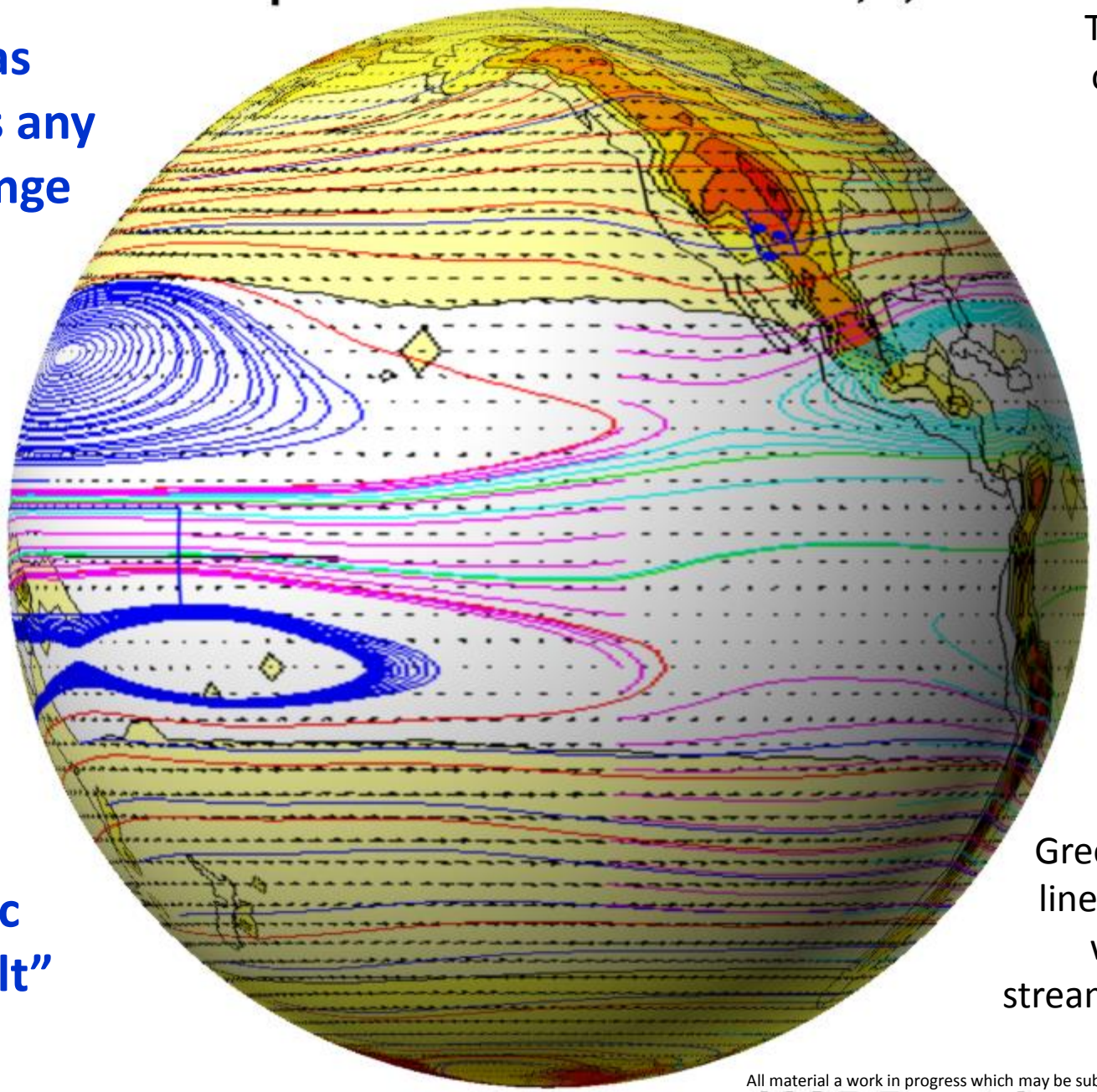
Adapted from ERA Interim U,V,T

Charleston Temperature continues to track with AMO.

Temperature contours are relative from lowest (dark red) to highest (white)

Mass Flux of Equatorial Easterlies increases in 1985

The Hawaii Diamond Dimple



The "Atmospheric Conveyor Belt"

Green and Cyan lines associated with eastern streamline origins

Final version of MWA presentation for distribution to attendees of GMDA conference May 2017 Albuquerque New Mexico

All material a work in progress which may be subject to continuing revision.

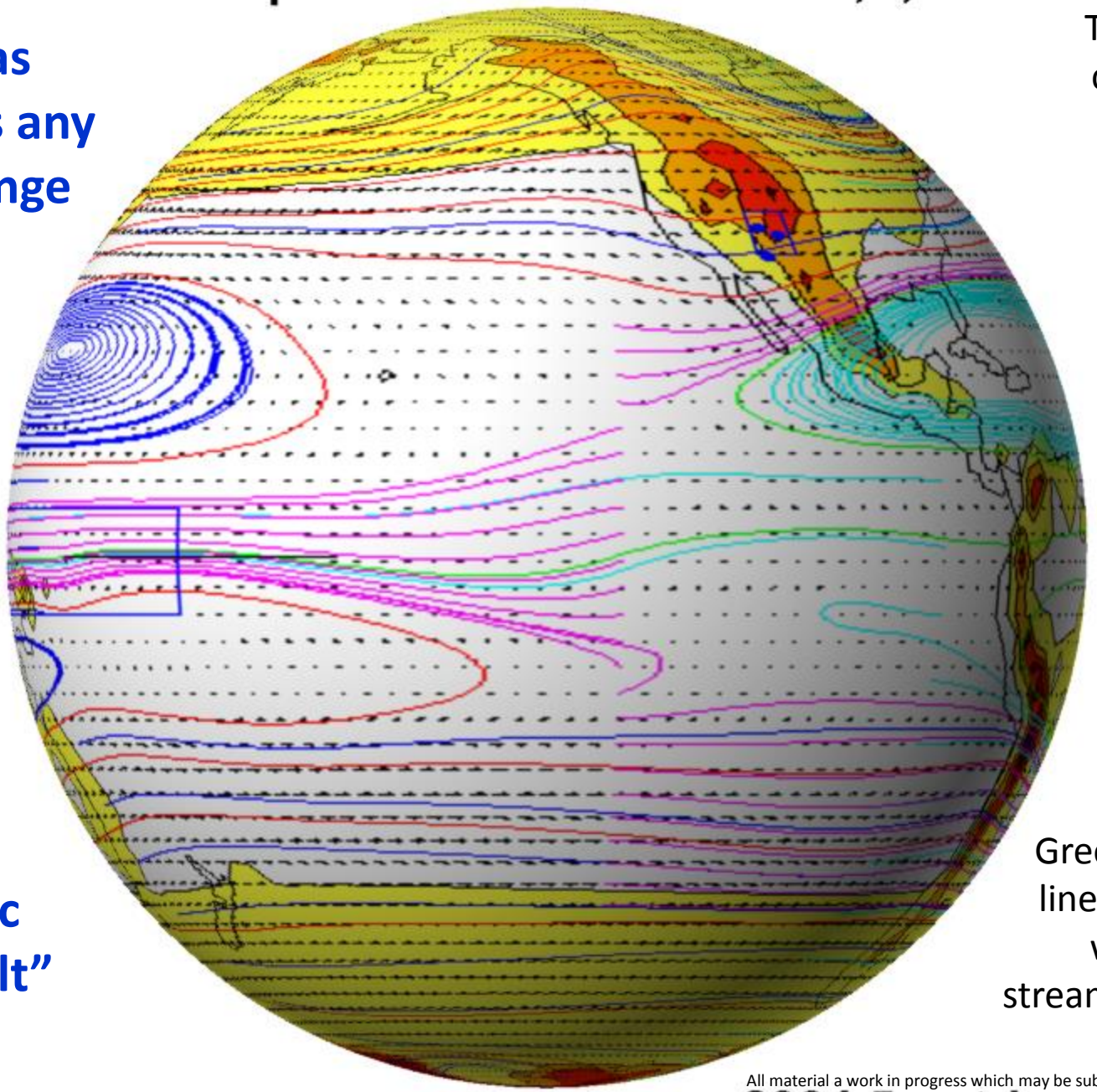
1985 5 yr trl av

Some Gyre Centers are as stationary as any mountain range

Mass Flux of Equatorial Easterlies increases in 1985

The "Atmospheric Conveyor Belt"

Adapted from ERA Interim U,V,T



Charleston Temperature continues to track with AMO.

Temperature contours are relative from lowest (dark red) to highest (white)

The Hawaii Diamond Dimple Disappears

Green and Cyan lines associated with eastern streamline origins

Final version of MWA presentation for distribution to attendees of GMDA conference May 2017 Albuquerque New Mexico

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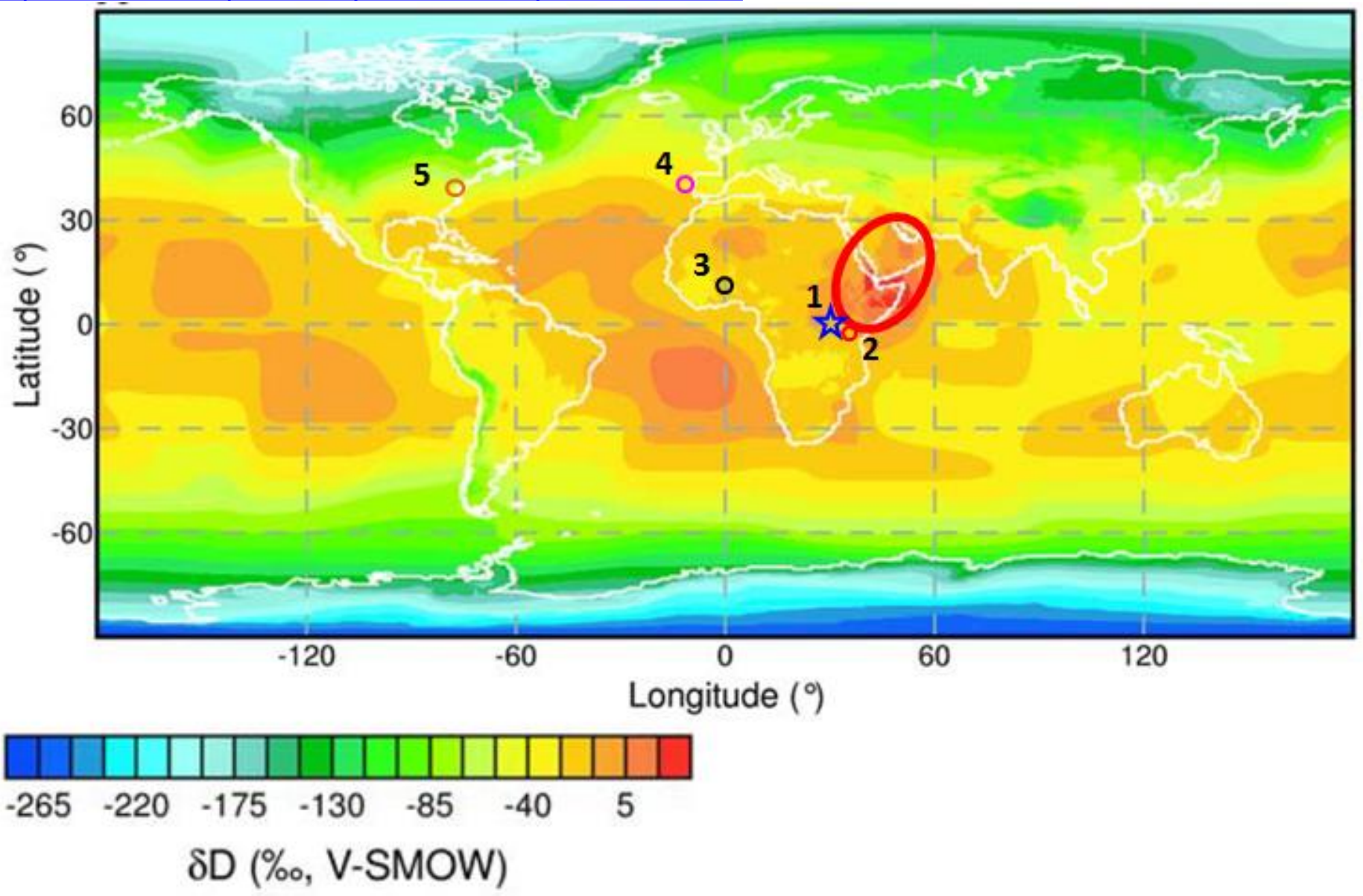
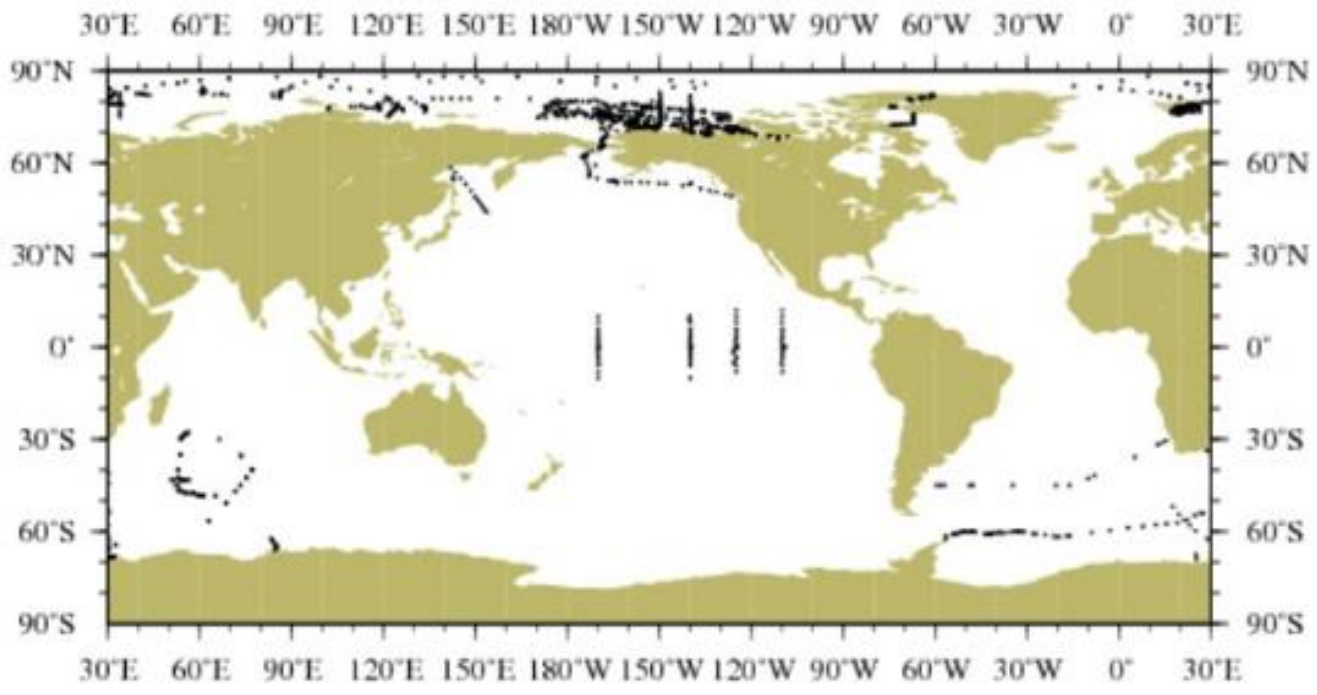
2004 5 yr trl av

Stable Isotopes of O and H correspond to latent heat distributions. See a related post: http://www.abeqas.com/your-winter-your-summer/



After Schmidt 2003

A coverage of fall of NOAA's WOD 18 O records…



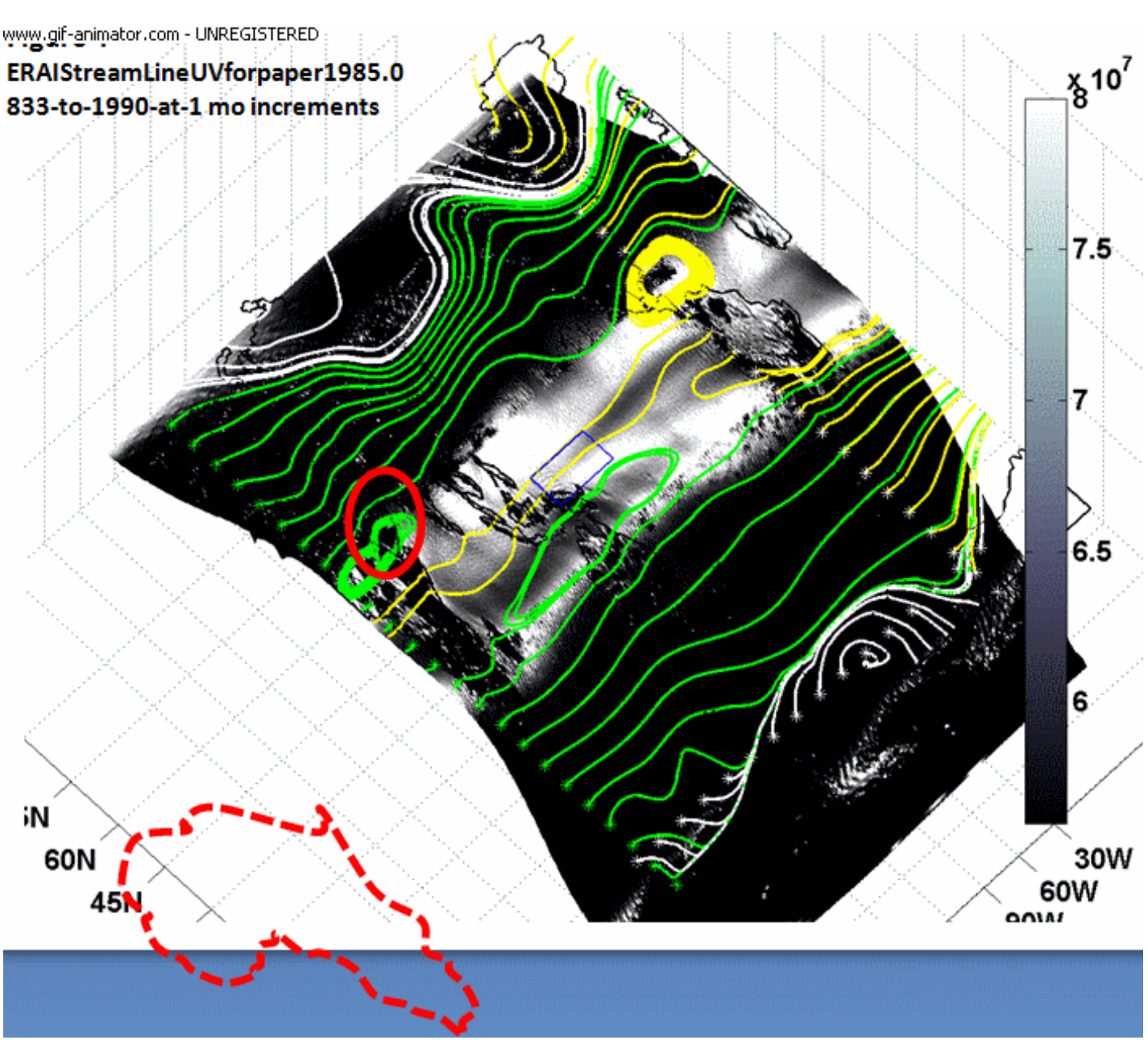
Geographic distribution of casts (1461 casts)

NOAA NODC Ocean Climate Laboratory
http://www.nodc.noaa.gov/OCL/

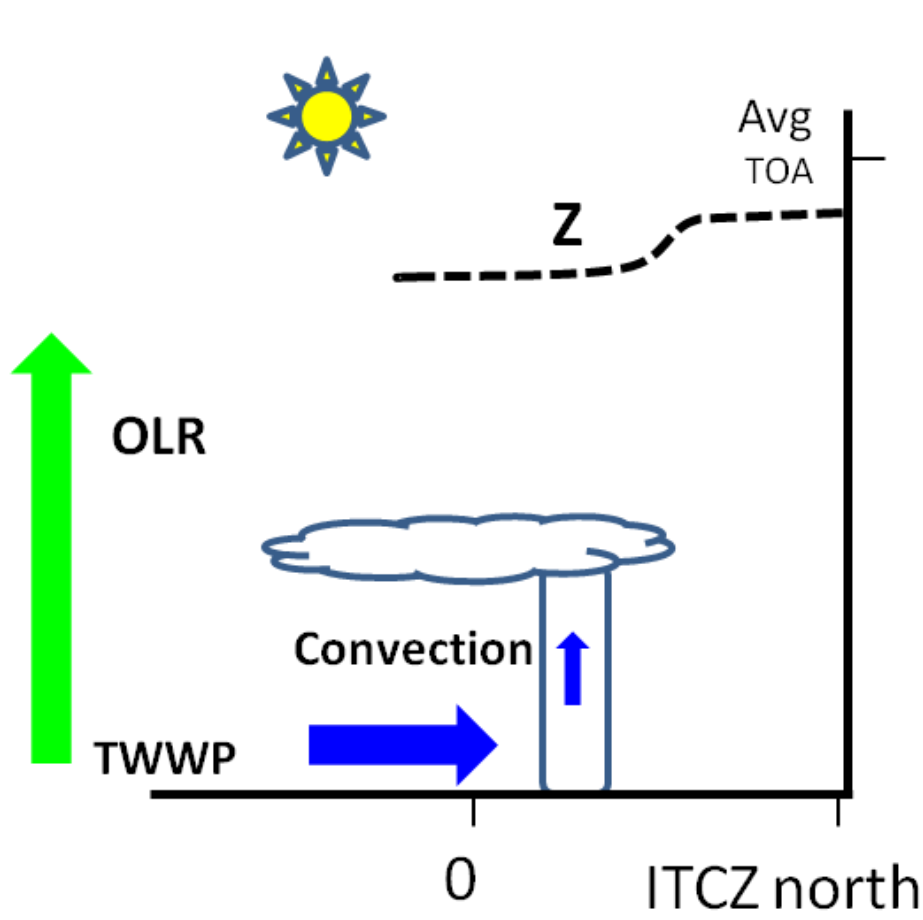
COPY OF YOUR SEARCH CRITERIA:

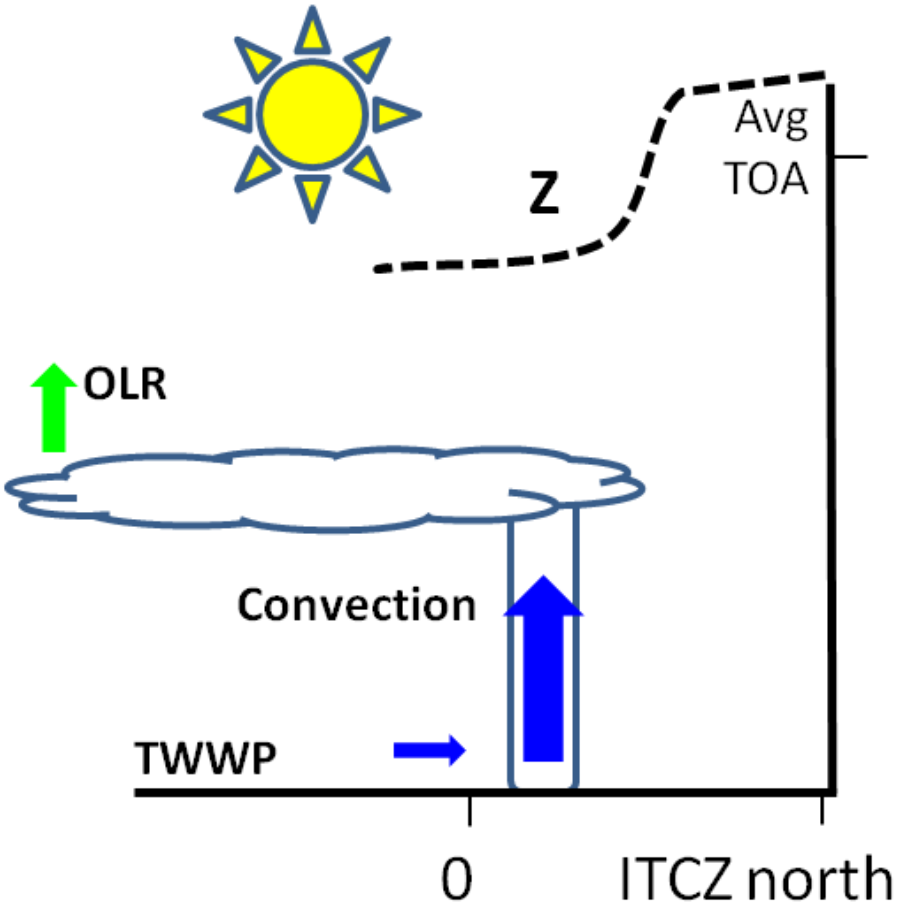
OBSERVATION DATES:	**Year** from 1960 to 2017; **Month** from 1 to 12; **Day** from 1 to 31
GEOGRAPHIC COORDINATES:	Entire World Ocean
DATASET:	OSD,CTD,XBT,MBT,PFL,DRB,MRB,APB,UOR,SUR,GLD
MEASURED VARIABLES (must):	Delta Oxygen-18
DATA ADDITIONS:	from Beginning to WOD18+Aug2018

Geopotential height, some key gyres, and a related post:
http://www.abeqas.com/atmospheric-isotopic-hot-spots-and-the-great-gyres/

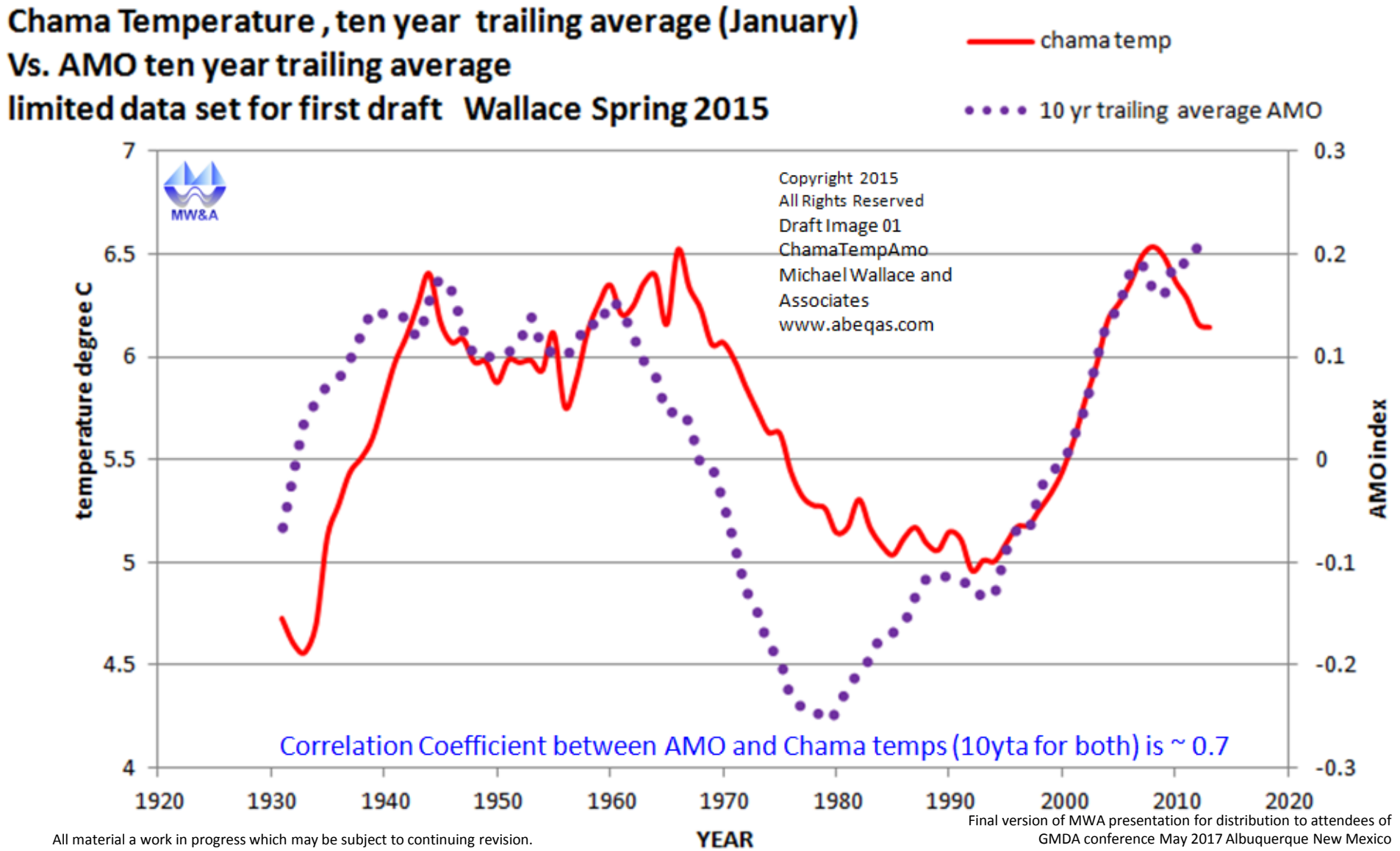


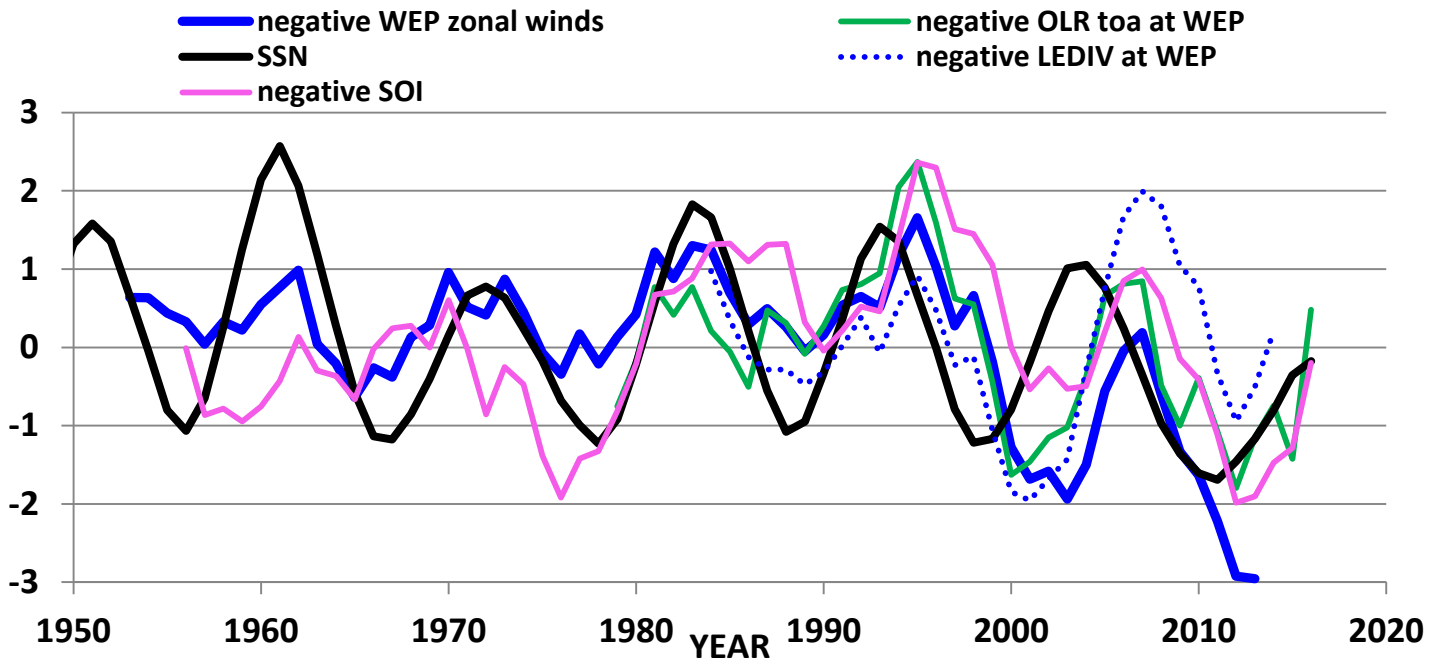
From my paper:
http://www.abeqas.com/publication-of-a-solar-hydrospheric-causation-and-application-study/

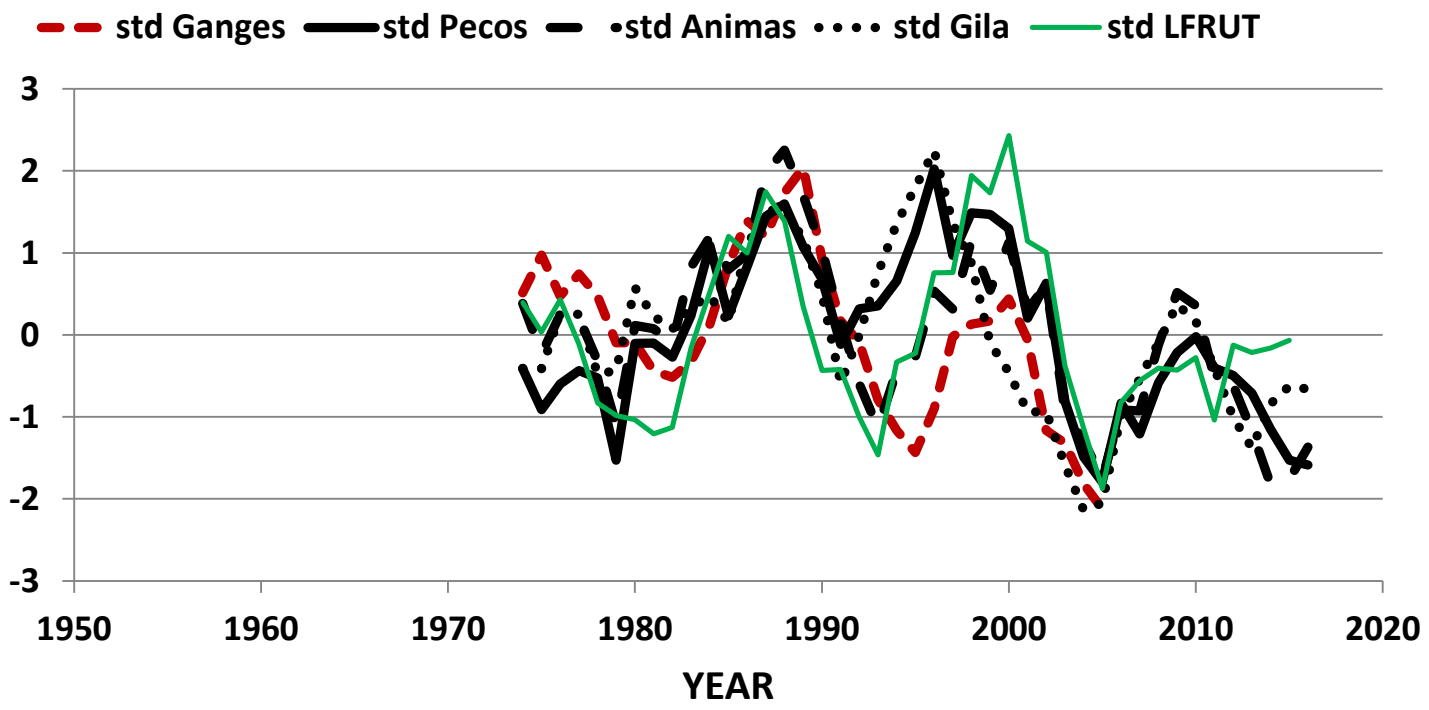


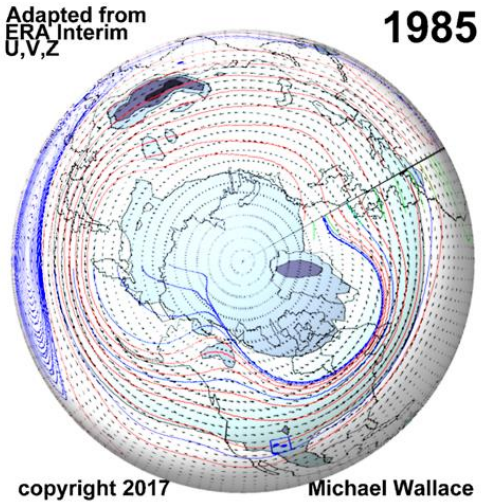


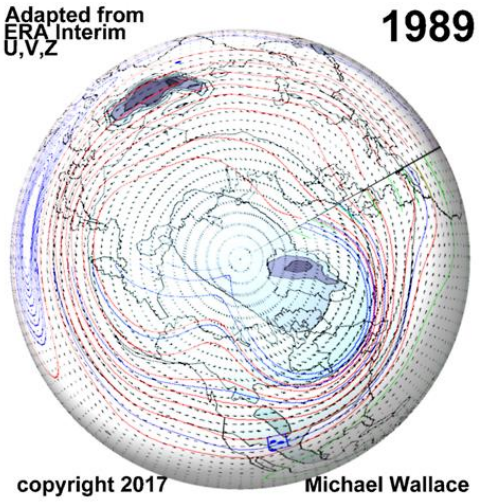
Correlations of temperature to these ocean and other drivers, particularly the Atlantic Multidecadal Oscillation (AMO) were examined.



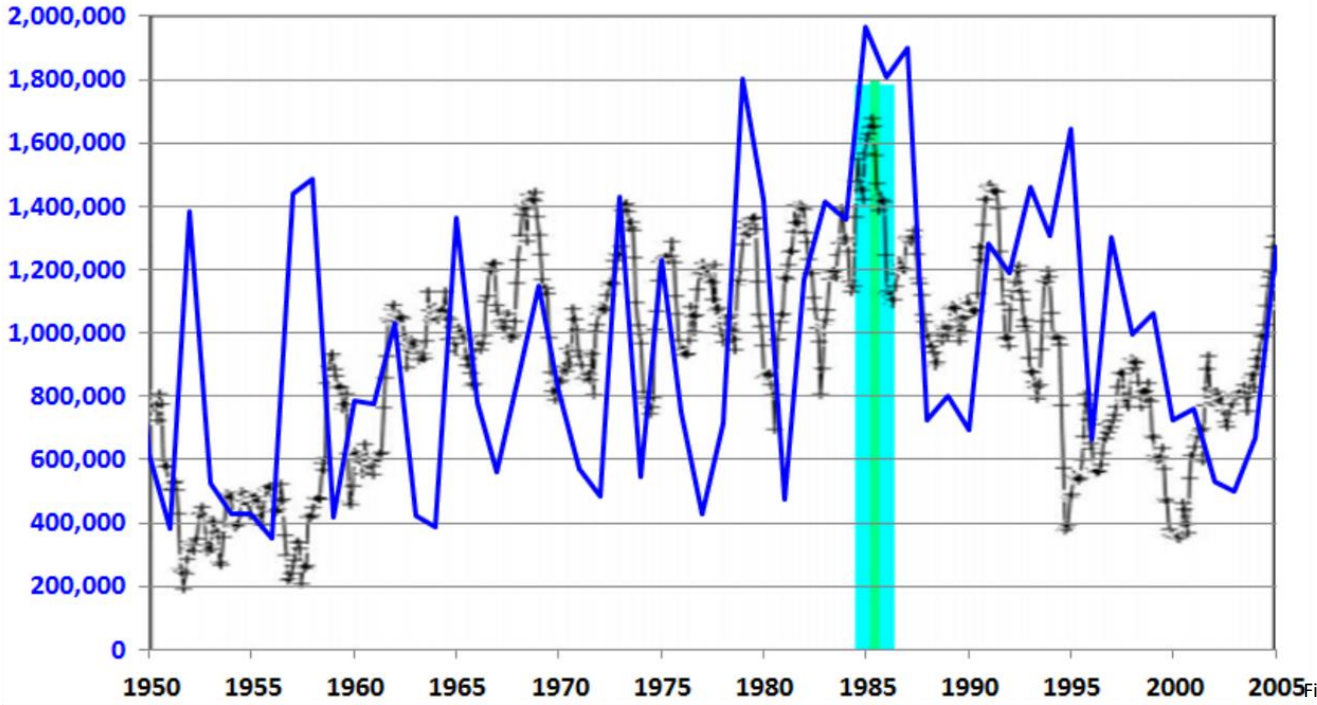

negative WEP zonal winds
SSN
negative SOI
negative OLR toa at WEP
negative LEDIV at WEP
3
2
1
0
-1
-2
-3
1950
1960
1970
1980
YEAR
1990
2000
2010
2020


std Ganges
std Pecos
std Animas
std Gila
std LFRUT
3
2
1
0
-1
-2
-3
1950
1960
1970
1980
1990
2000
2010
2020
YEAR





Otowi Gage on Rio Grande annual acre ft. *background image from Mo and Schemm, 2008 of SST of North Pacific.* Over the common time frame shown, the 1985 samples are both at maxima

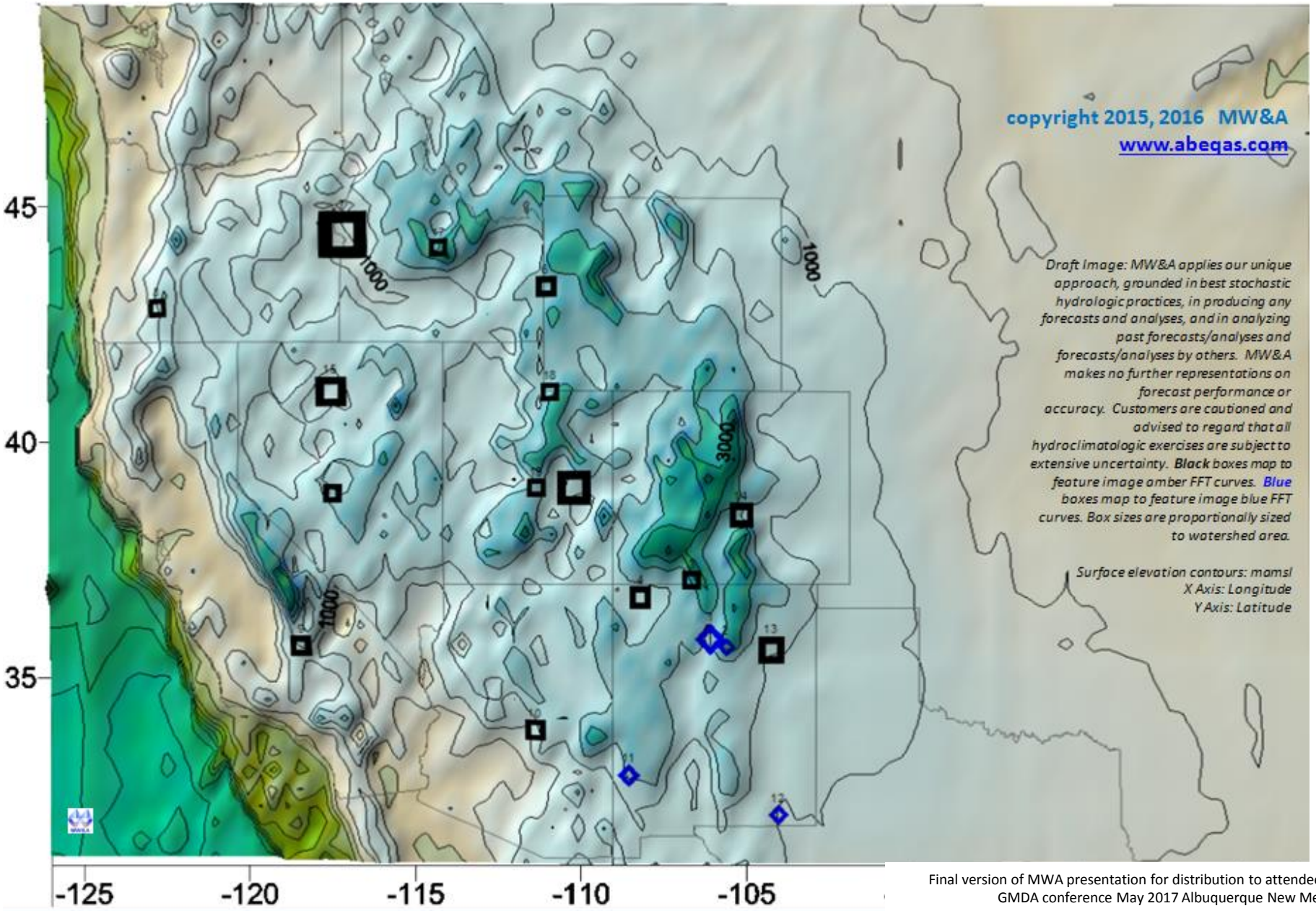


Because of similarities to other maxima, I made 1985 an "anchor year", and the annual and the five year trailing average (5yta) my "anchor span" for some more detailed auto chart investigations.

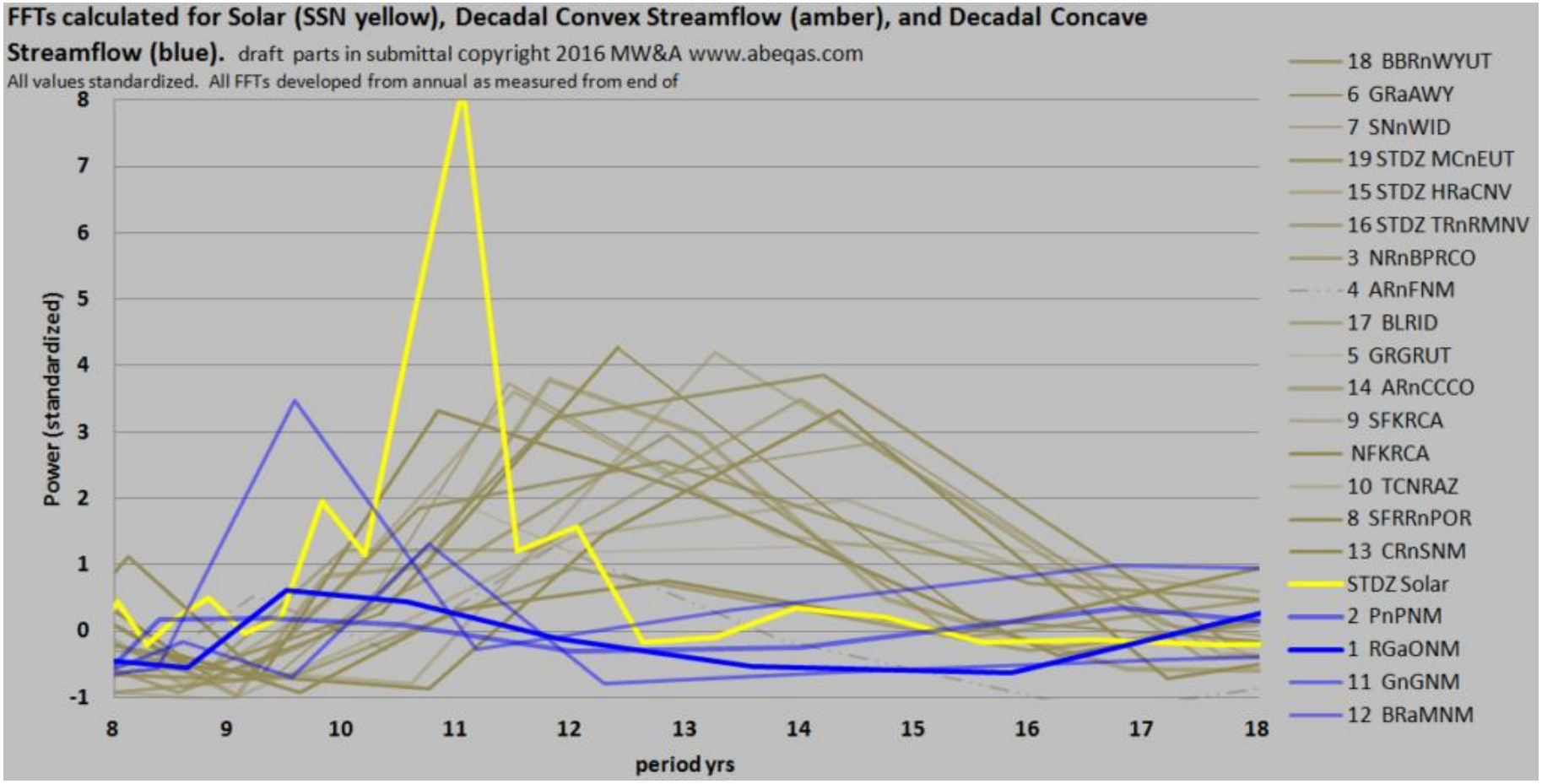
Later I narrowed further to a monthly resolution.

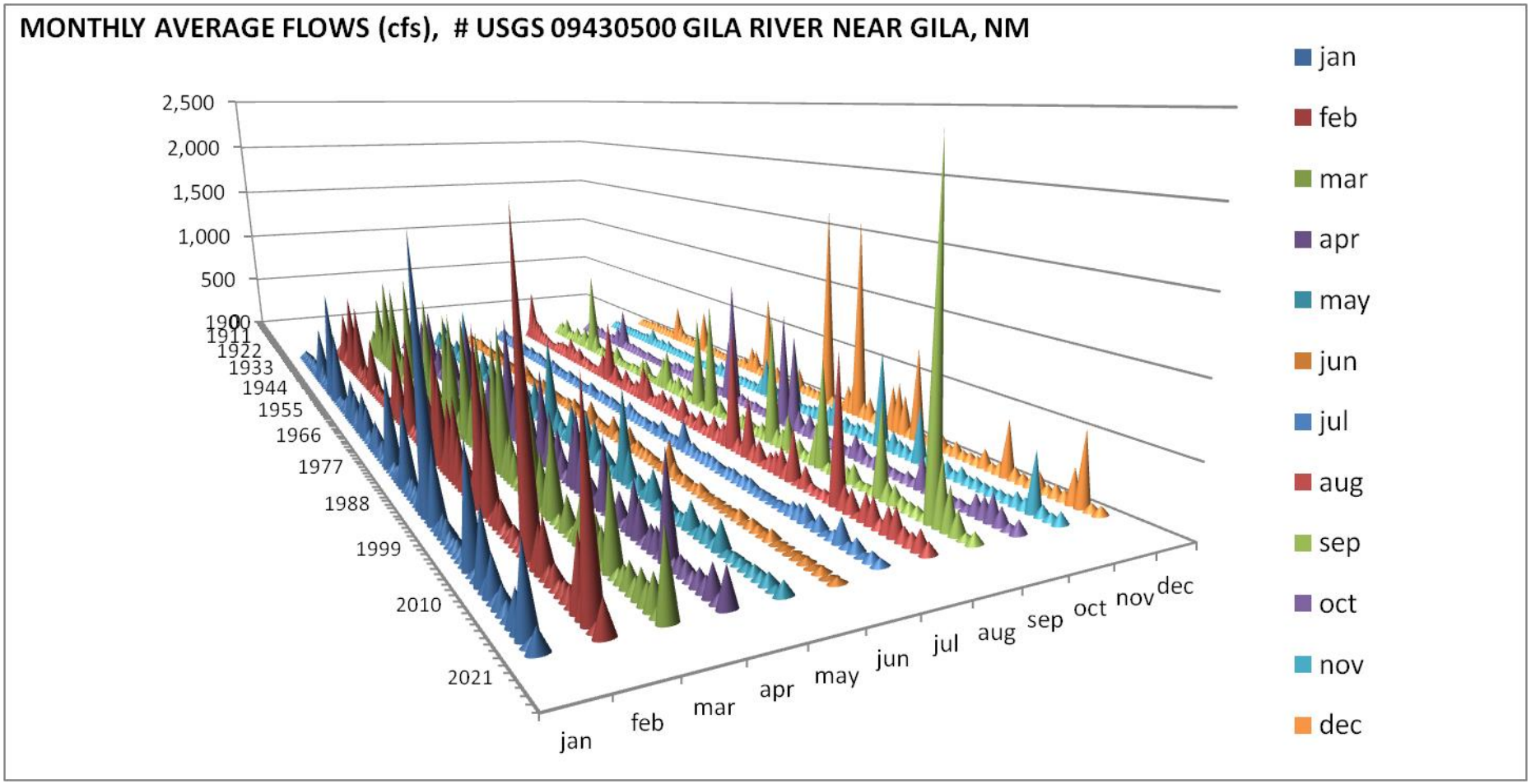
I looked in detail at streamflow and temperature associated with a variety of western watersheds

All material a work in progress which may be subject to continuing revision.



By late 2015 many of my lines of investigation converged to a solar related approach to forecasting streamflows and temperatures further in advance in certain areas such as high altitude watersheds of the Western US.




MONTHLY AVERAGE FLOWS (cfs), # USGS 09430500 GILA RIVER NEAR GILA, NM
2,500
2,000
1,500
1,000
500
1900
1911
1922
1933
1944
1955
1966
1977
1988
1999
2010
2021
jan
feb
mar
apr
may
jun
jul
aug
sep
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nov
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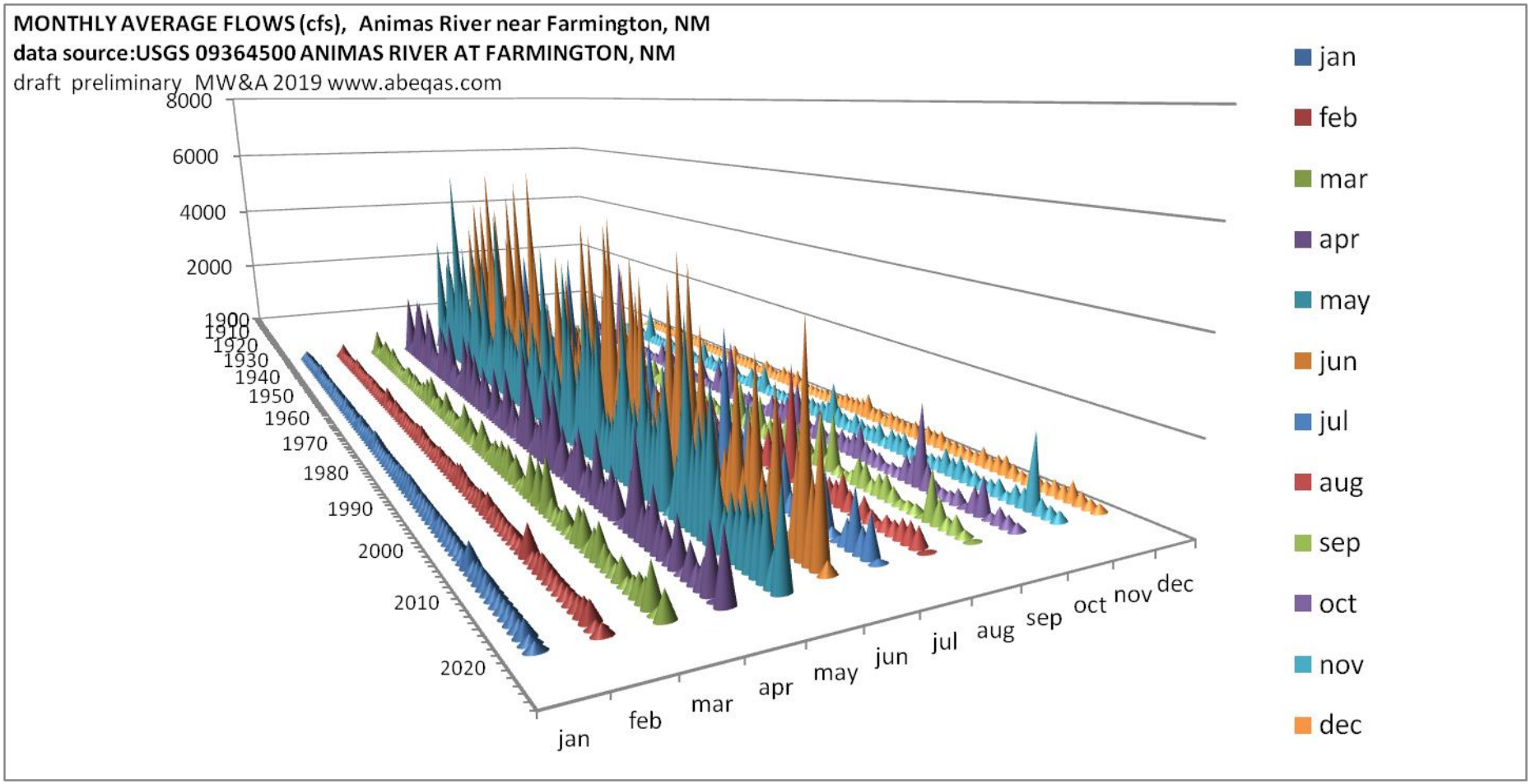
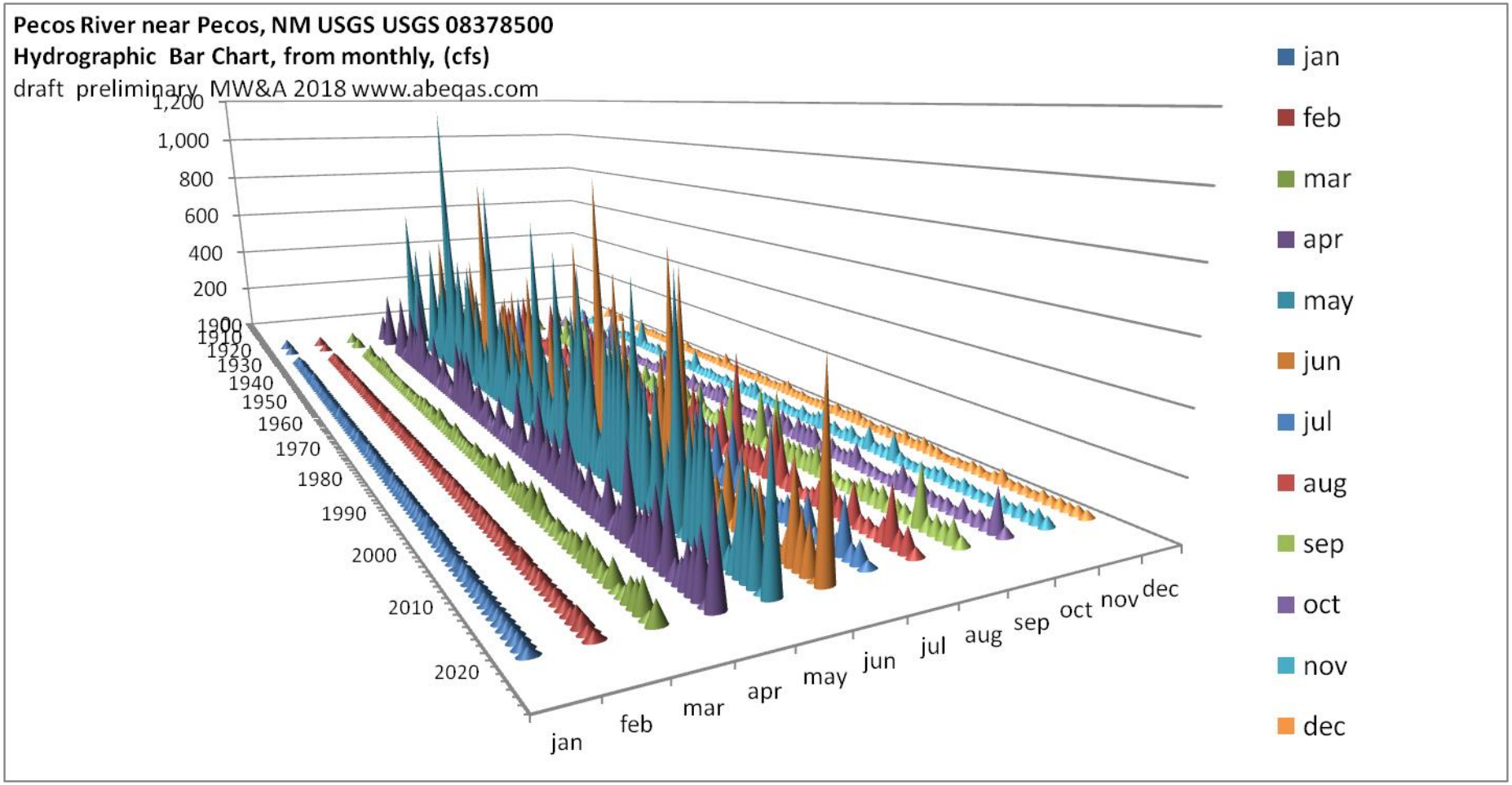

MONTHLY AVERAGE FLOWS (cfs), Animas River near Farmington, NM
data source:USGS 09364500 ANIMAS RIVER AT FARMINGTON, NM
draft preliminary MW&A 2019 www.abeqas.com
8000
6000
4000
2000
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
jan
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec

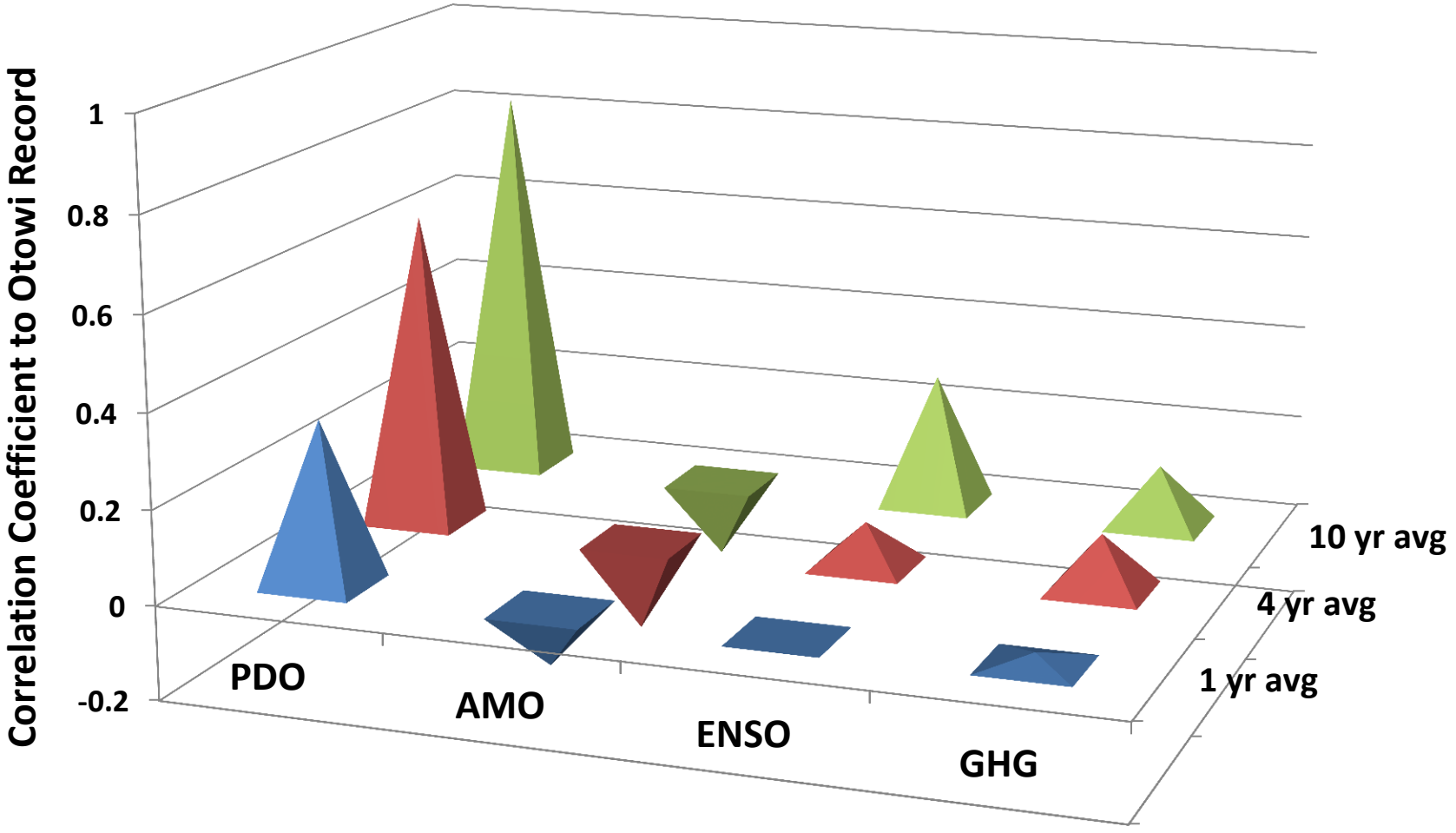
Pecos River near Pecos, NM USGS USGS 08378500

Hydrographic Bar Chart, from monthly, (cfs)

draft preliminary MW&A 2018 www.abeqas.com

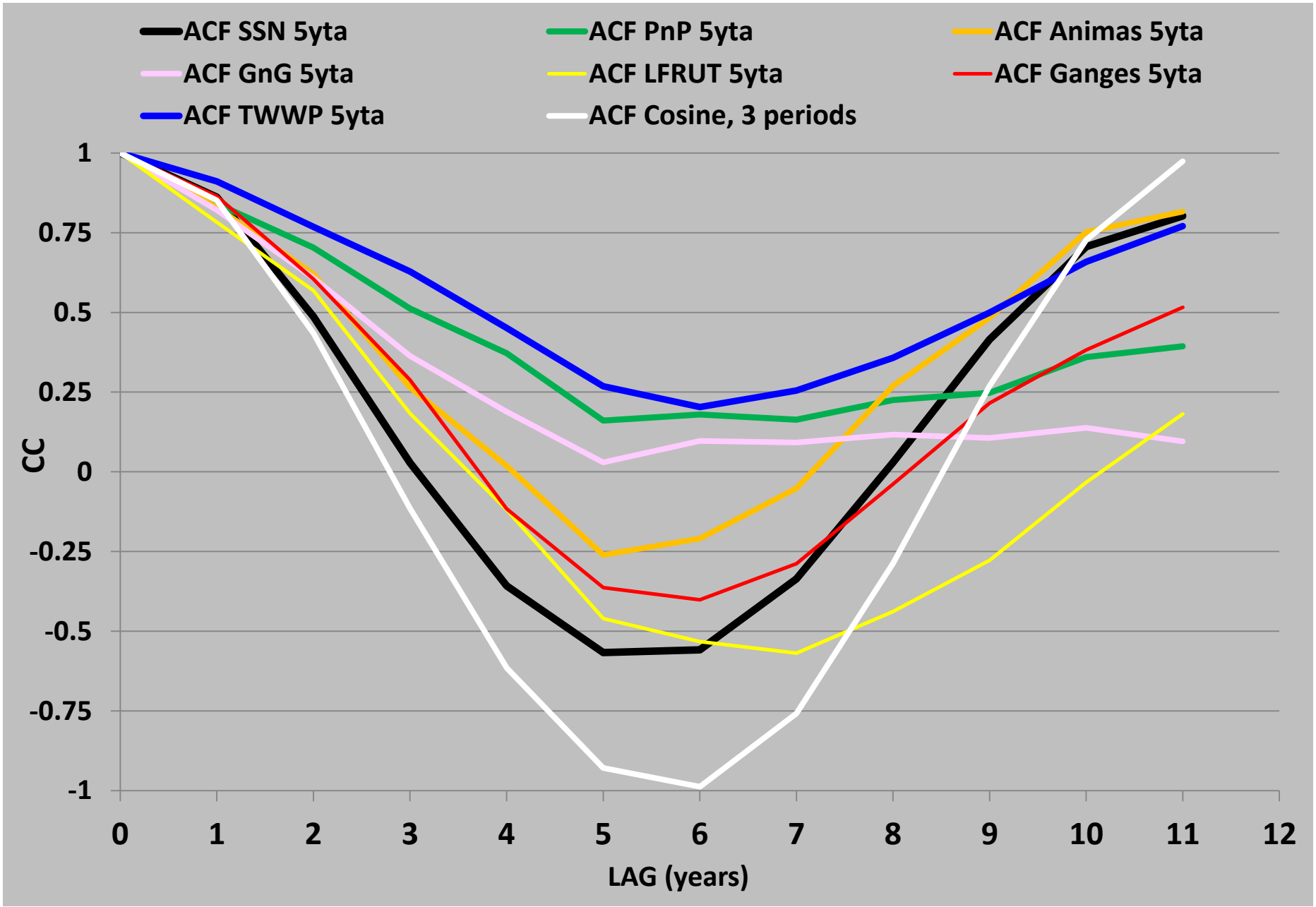


Also, correlations of **streamflow** to ocean and other drivers were examined.

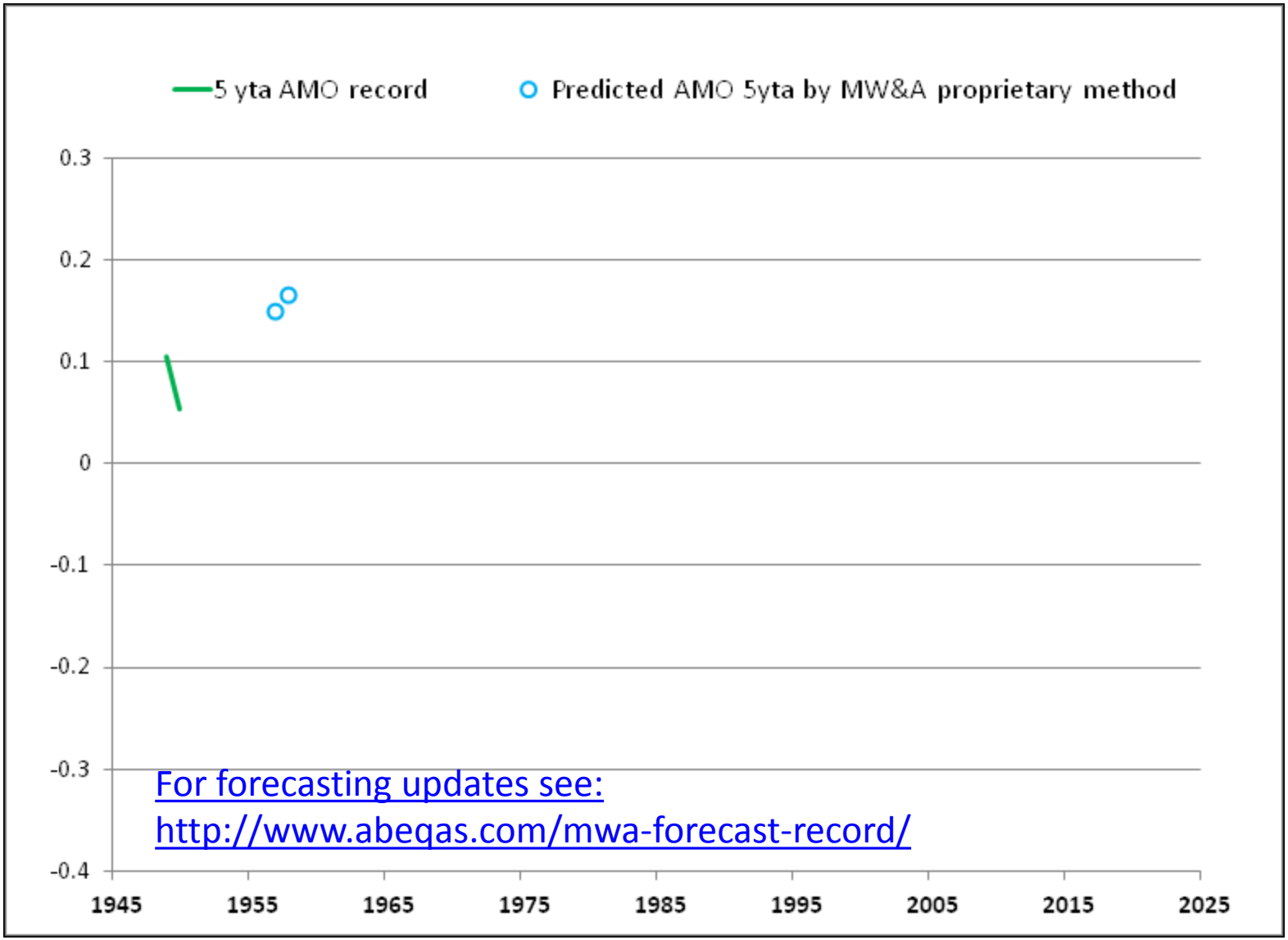


PDO scored high and Emissions scored low in simple correlation comparisons

Autocorrelations were examined. From my paper:
http://www.abeqas.com/publication-of-a-solar-hydrospheric-causation-and-application-study/

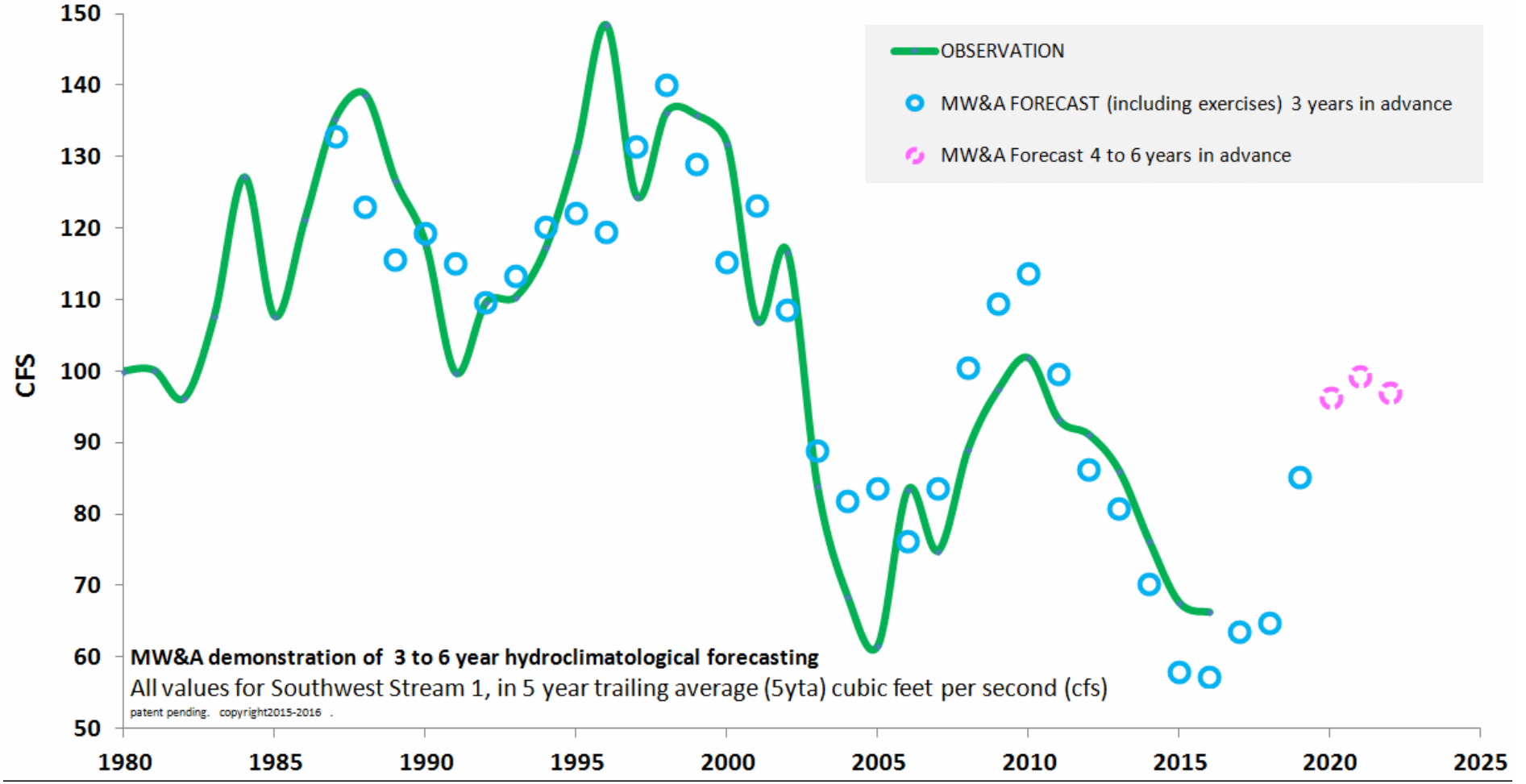


Given that the AMO is somewhat synonymous with much of the temperature regime of Eastern North America, then forecasting the AMO 8 years in advance is equivalent in some respects to forecasting temperatures accordingly.



At the end of 2015, I forecast the five year trailing average of streamflows for the Upper Pecos River, near Pecos, NM . I based the exercise forecasts upon Solar based precursor data from three years prior. For the forecast portion, I included three additional years of span.

[For forecasting updates see:
http://www.abeqas.com/mwa-forecast-record/](http://www.abeqas.com/mwa-forecast-record/)



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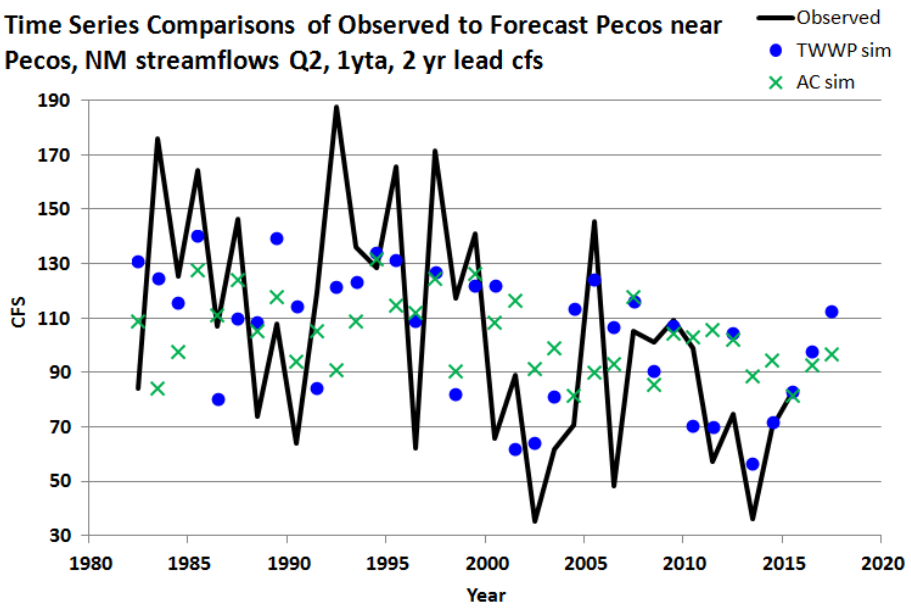
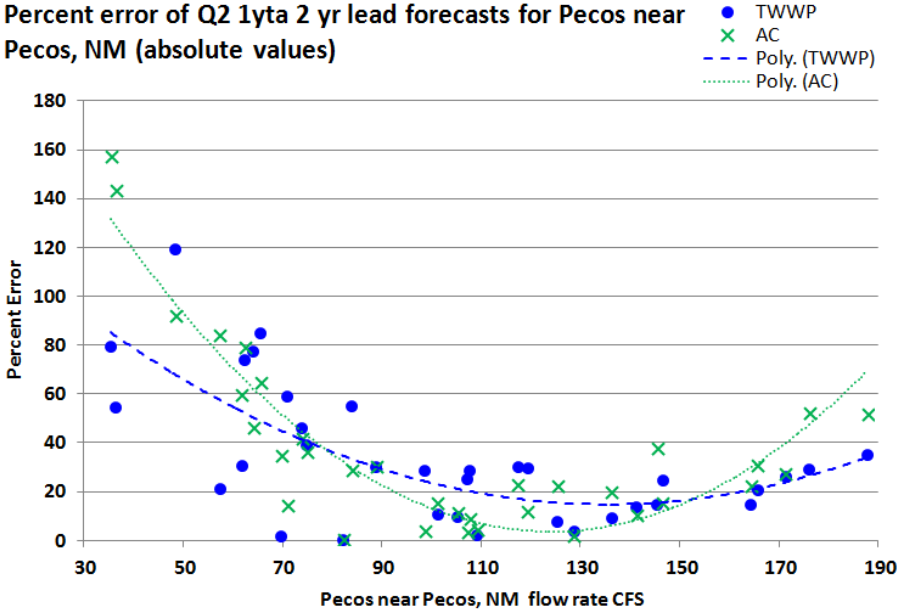
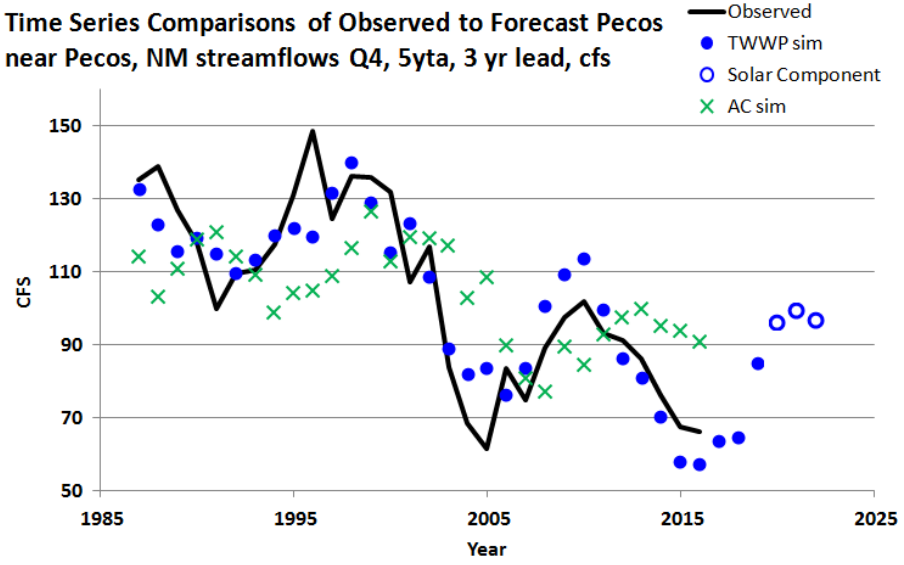
(a)



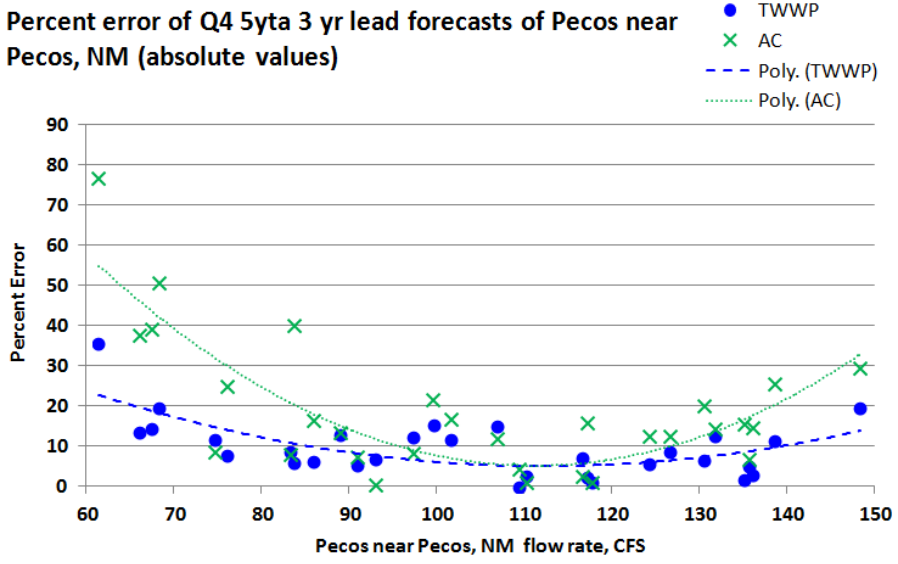
(b)



(c)



(d)



From my paper:
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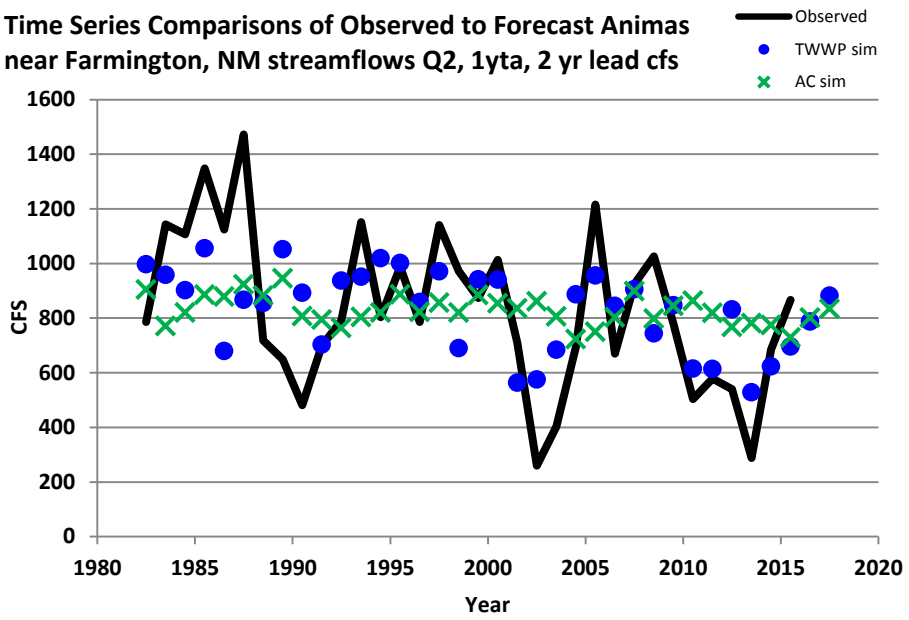
(a)



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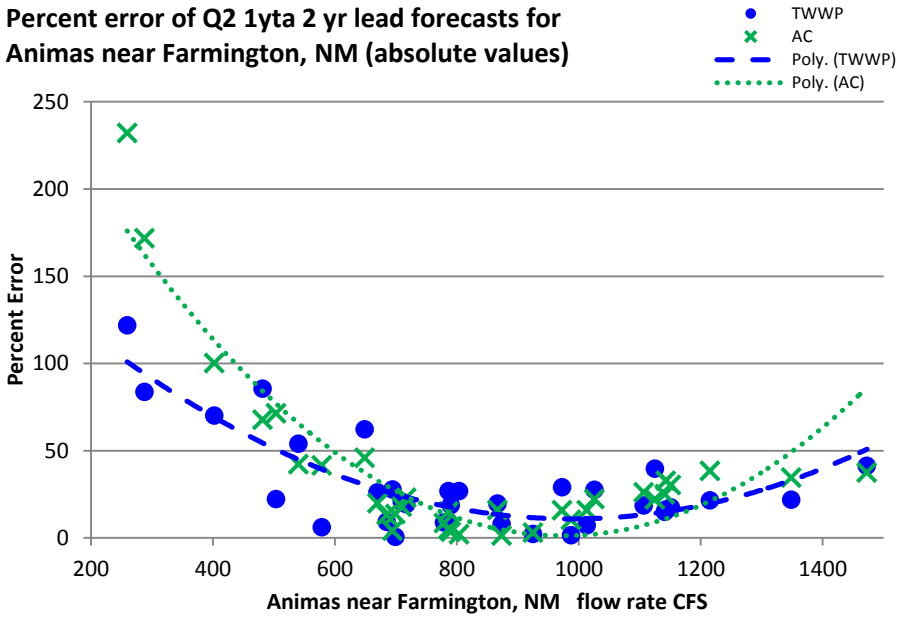

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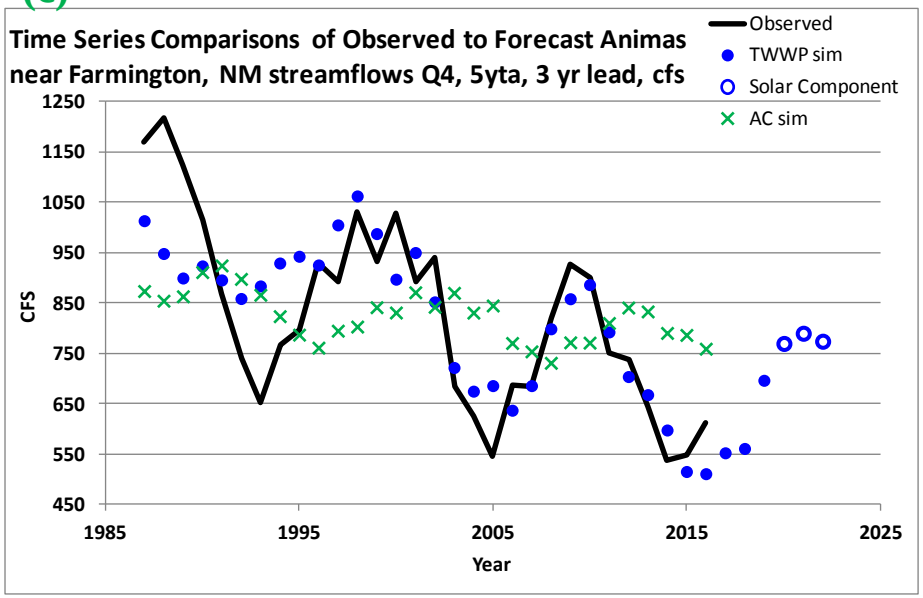

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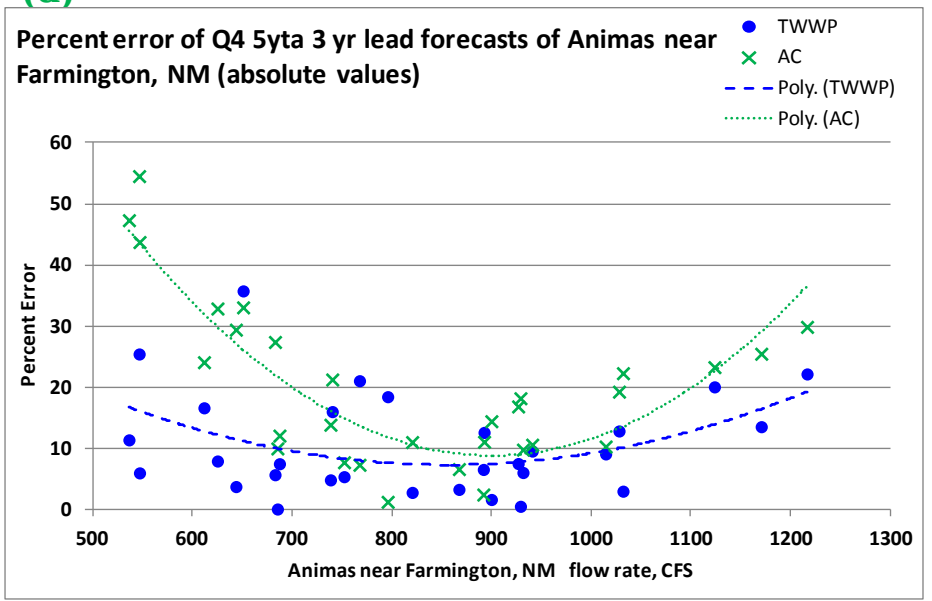

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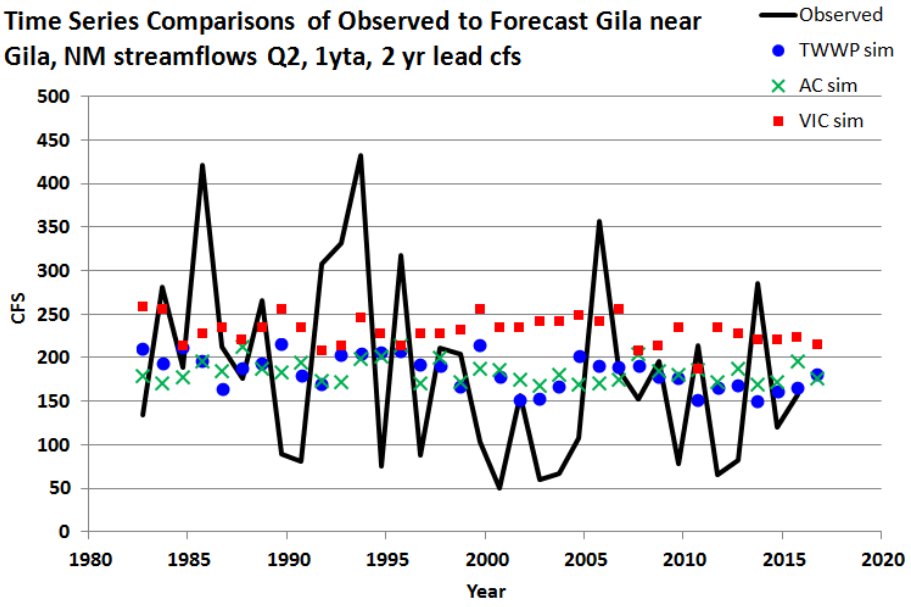
(a)



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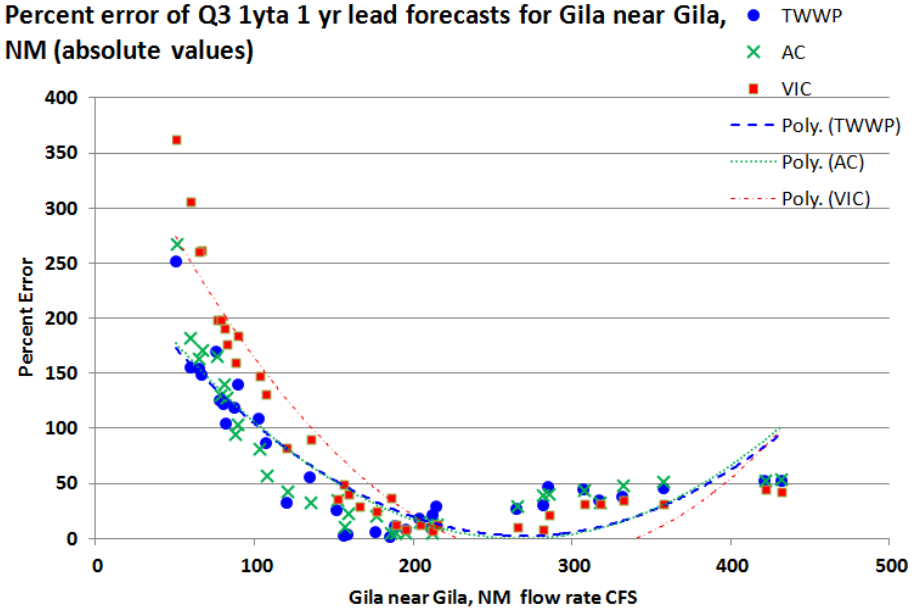

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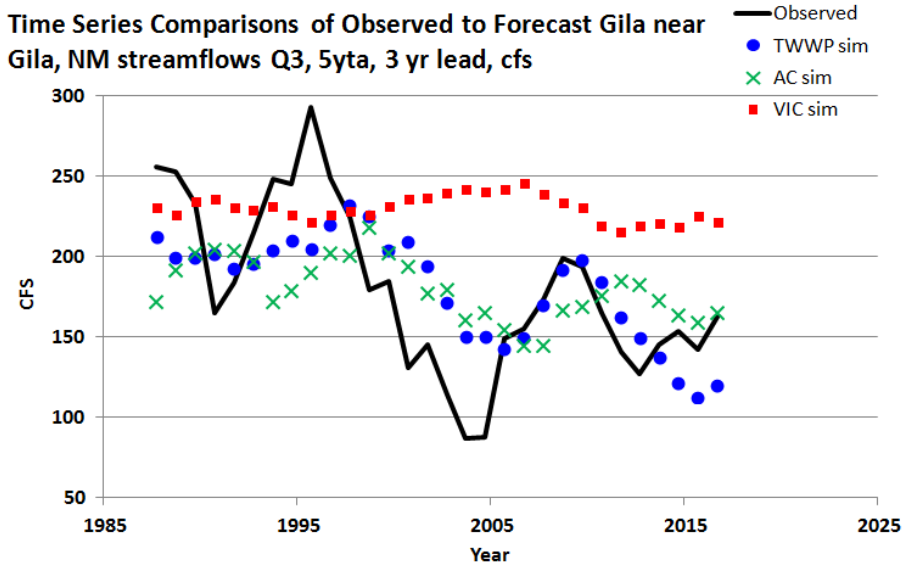

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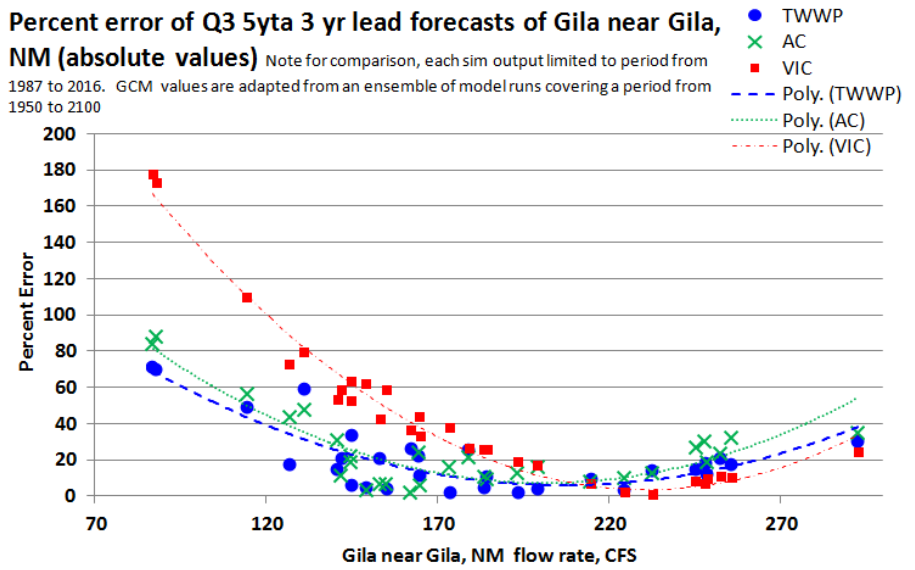

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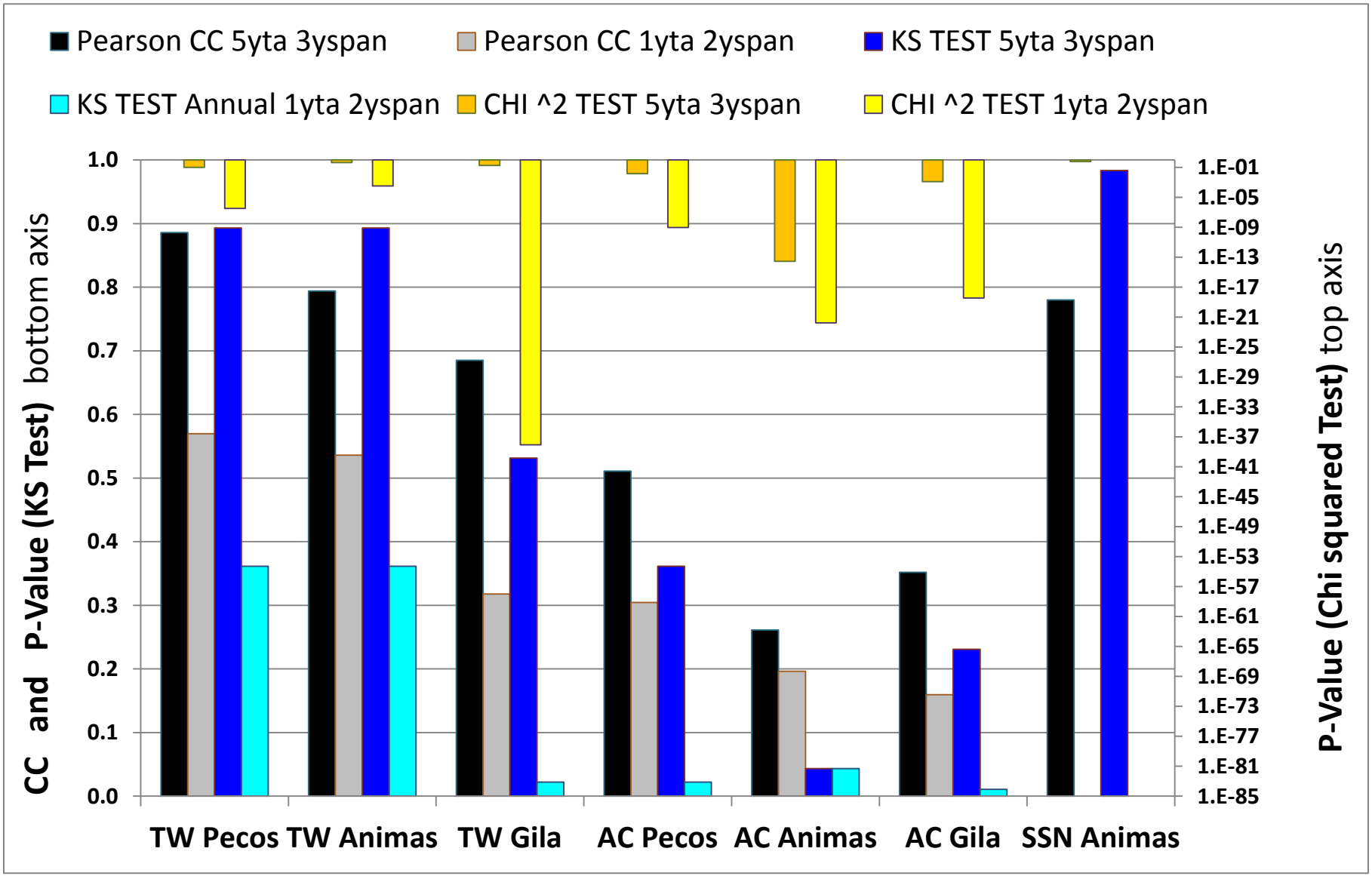

For forecasting updates see:
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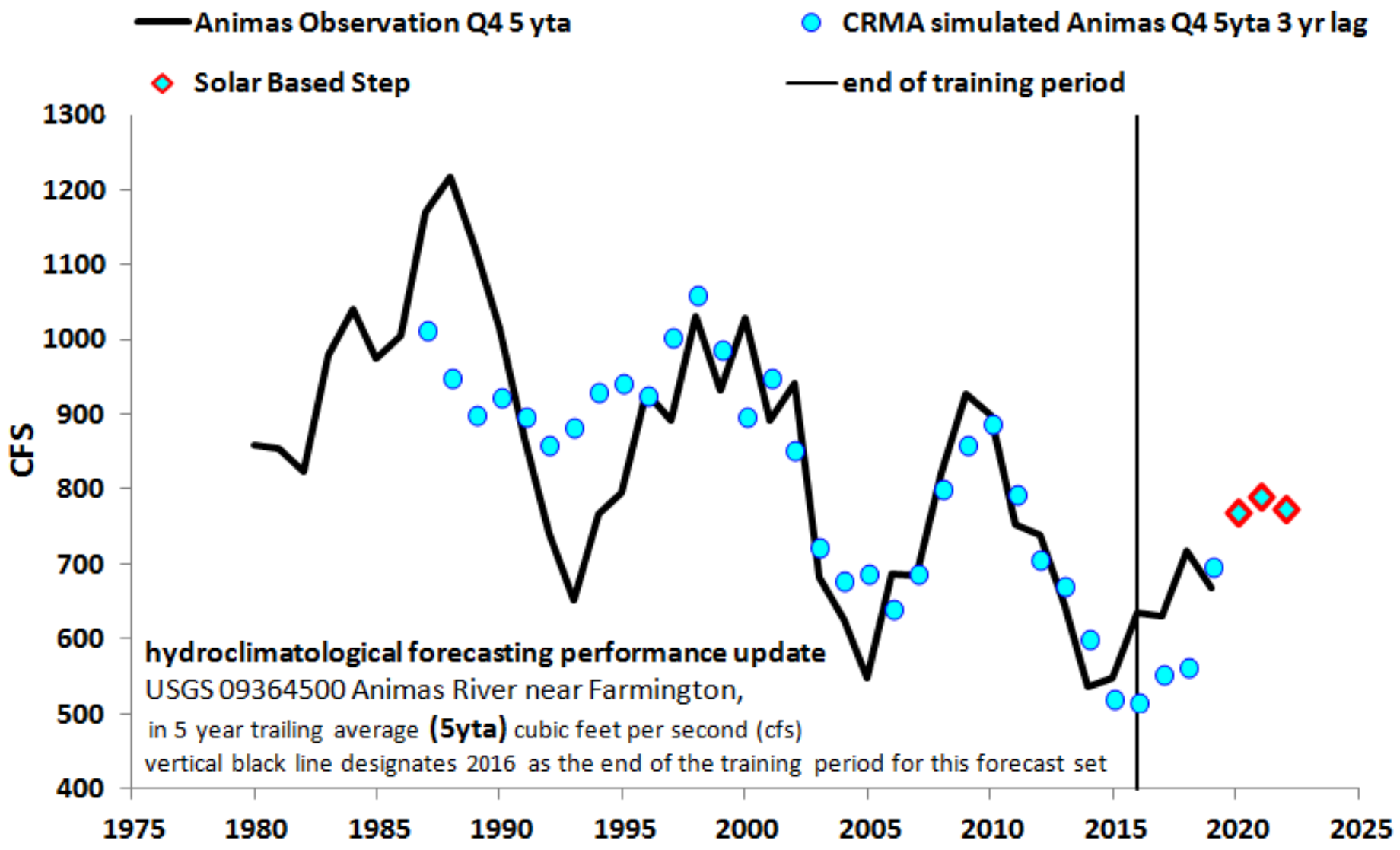

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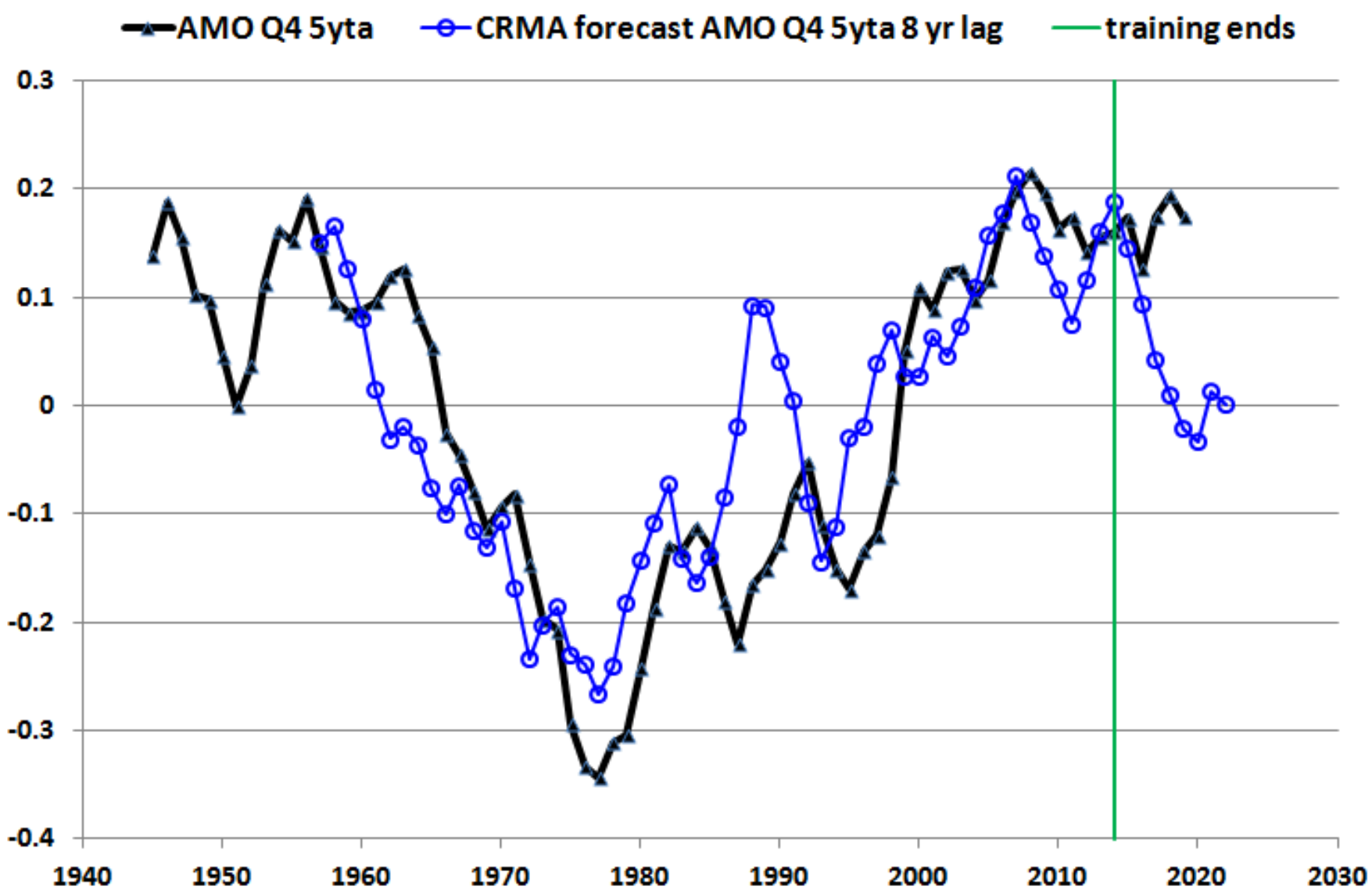

Bonus slides

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