20/11/2017

MedCOF9 & SEECOF18
Annual meeting
Zagreb, Croatia

Seasonal Forecasting SYSTEM 5 (SEAS5) Verification of precipitation for the period DJF 1981/82-2016/17 and in Israel Domain

By: Dr. Itzhak Carmona
Research and Development Department
Israeli Meteorological Service (IMS)
Office: 972-8-9403168
Email Address: carmonai@ims.gov.il

The main differences between ECMWF seasonal forecasting SYSTEM 4 (SEAS4) to SYSTEM5 (SEAS5)

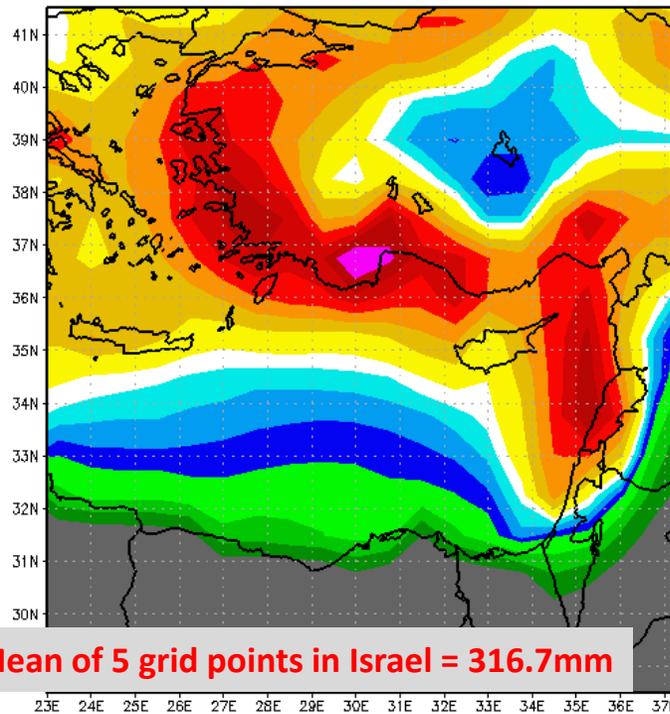| Feature	SYSTEM 4	SYSTEM 5
Period of the climatology data (the initial time in each month is the first day at 00UTC).	January 1981- January 2011	January 1981- December 2016
Number of Ensemble members in the reforecasting	15*	25
DJF number of runs (members) in the total climatology years	450	900**
Number of members in the operative ensemble	51	51
The operative seasonal prediction period	Starts from February 2011 and will ended in December 2017	Starts from January 2017
Resolution	0.703°x0.703° (latitude/longitude) ~75km	0.28°x0.28° (latitude/longitude) ~30km

* In the last year the number of example increased to 51.

** In the ECMWF charts the seasonal prediction is related to the climatology period 1993-2016 or actually 600 member in the ensemble instead of 900 members the period 1981-2016   is related for only verification.

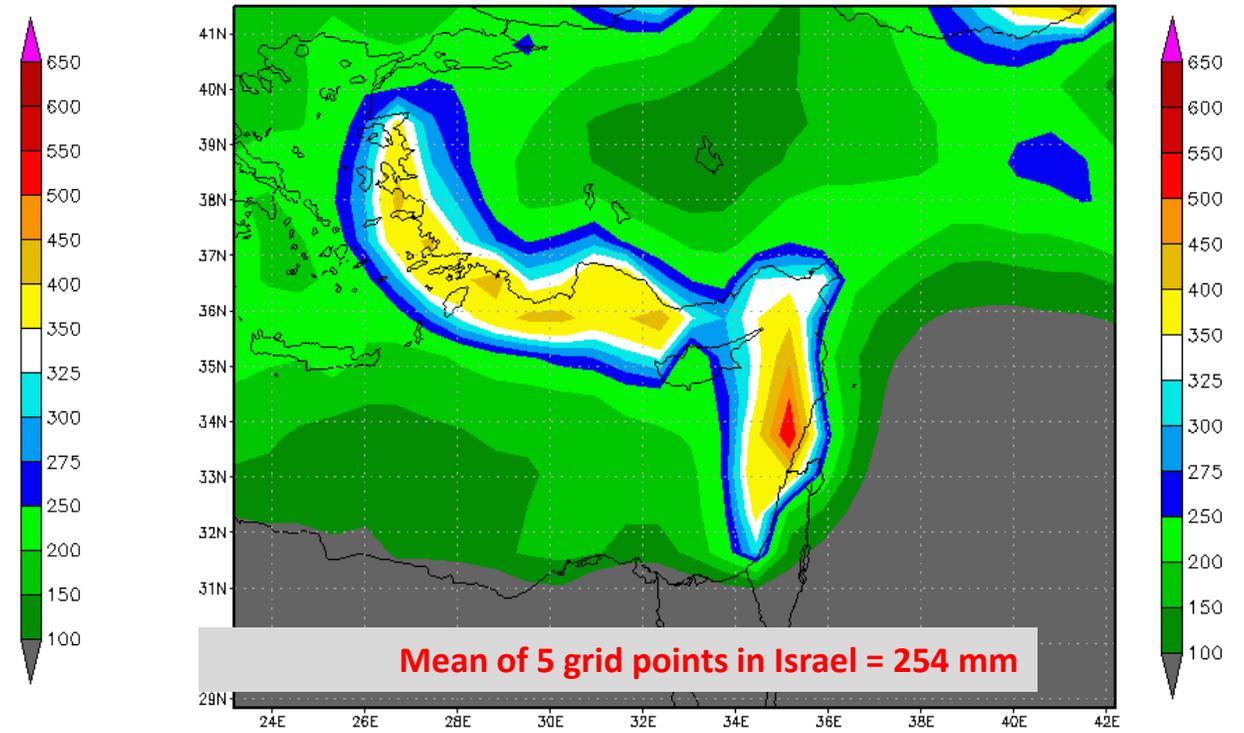# DJF mean precipitation amount difference between ERA interim to SEAS4 (SYSTEM 4)

Mean on Israel (For only regions with Isohyet equal or than 200mm per year) is 332.1 mm

ERA interim Rain [mm]
for DJF 1981/82−2010/11

Mean of 5 grid points in Israel = 316.7mm

Sys4 DJF rain [MM], from NOV model
for 1981−2010, mean on ensmble of 450 members

Mean of 5 grid points in Israel = 254 mm
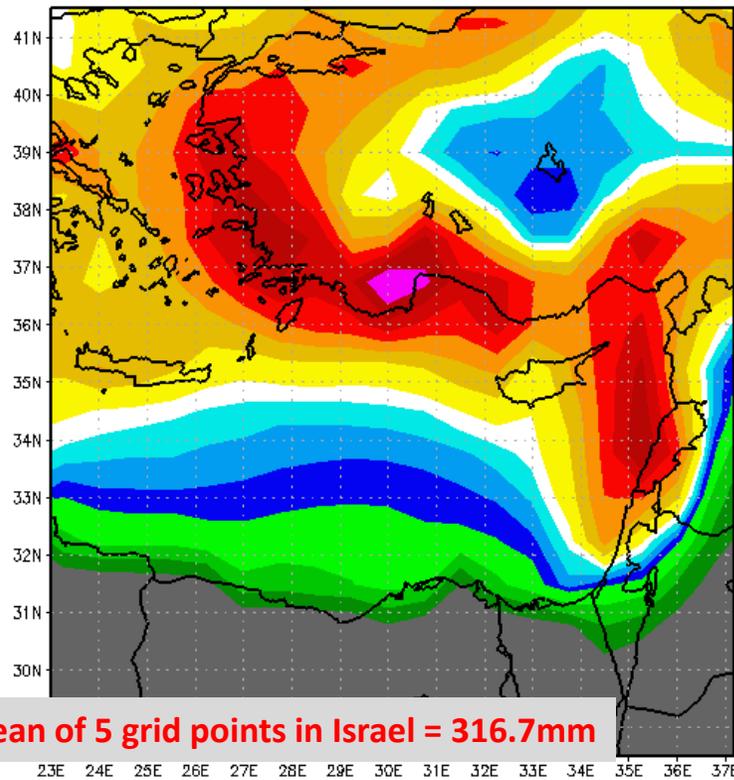
GrADS: COLA/IGES

2016−10−26−18:43

GrADS: COLA/IGES

2017−11−15−18:24

DJF mean precipitation amount difference between ERA interim to SEAS5 (SYSTEM 5)

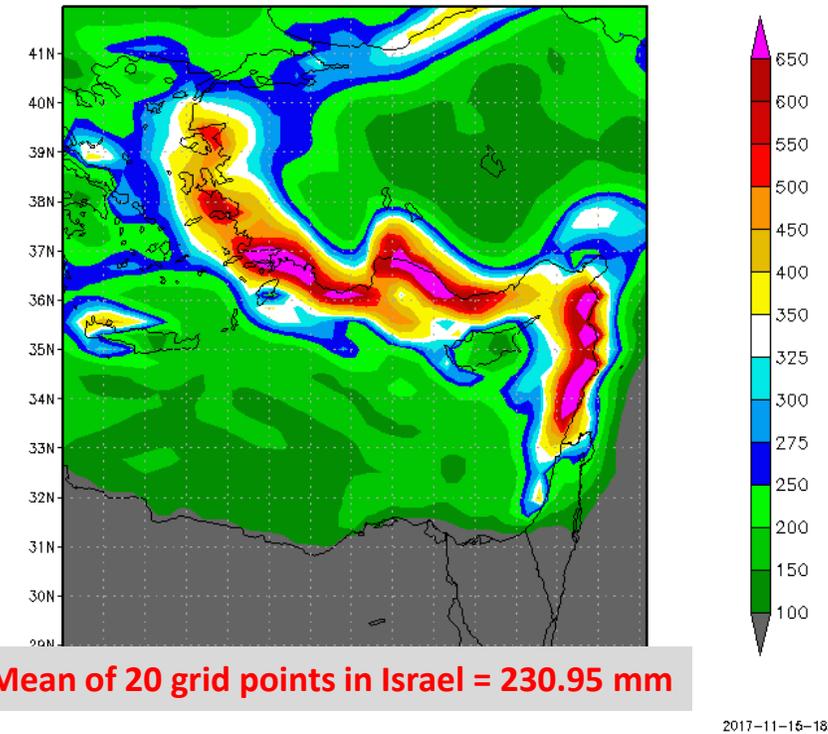## Mean on Israel (For only regions with Isohyet equal or than 200mm per year) is 332.1 mm


ERA interim Rain [mm]
for DJF 1981/82–2010/11

Mean of 5 grid points in Israel = 316.7mm

SEAS 5 DJF rain [MM], from NOV model
for 1981–2010, mean on ensmble of 750 members

Mean of 20 grid points in Israel = 230.95 mm

DJF mean precipitation amount difference between SEAS4 to SEAS5 precipitation mean. Different Climatology period for each system. SYSTEM 4 is from 1981/82-2010/11 and system 5 for 1981/82-2010/16
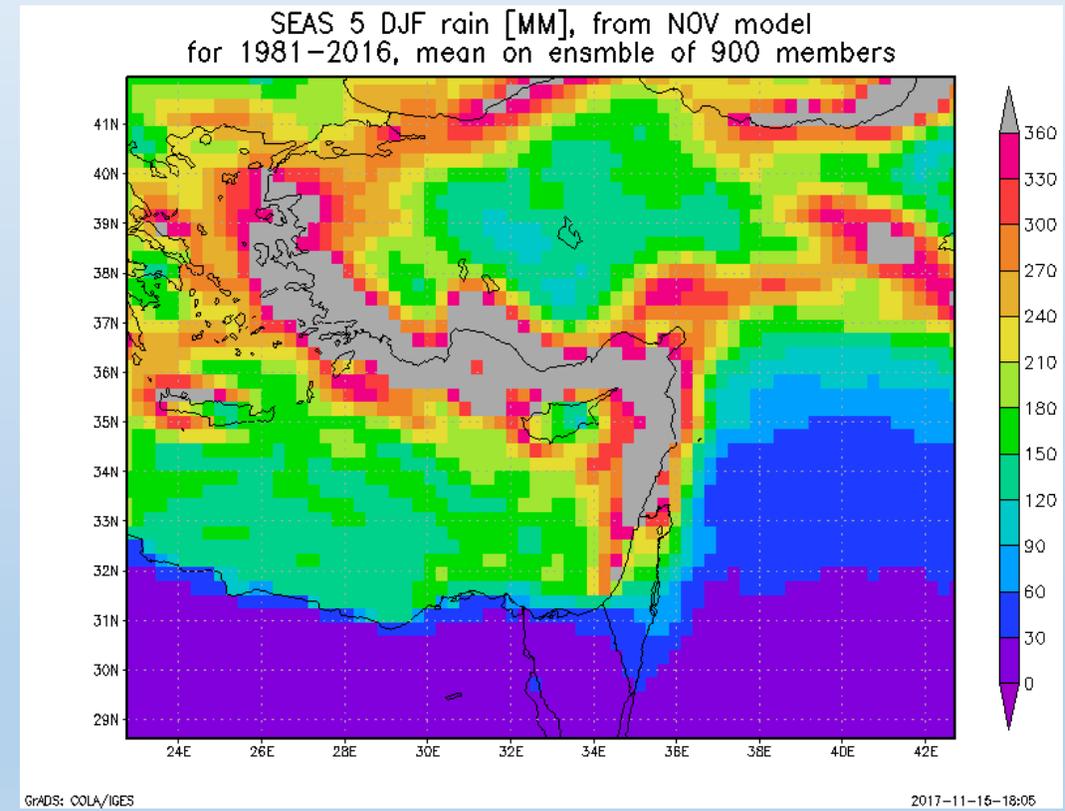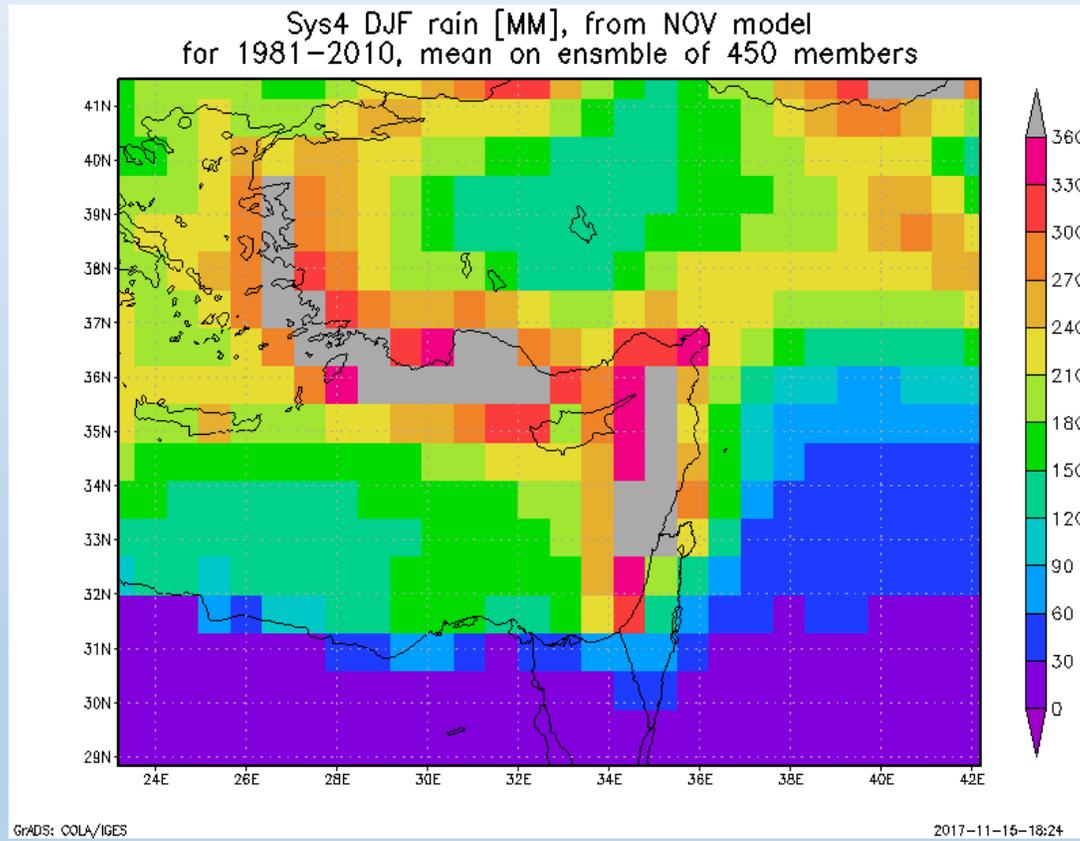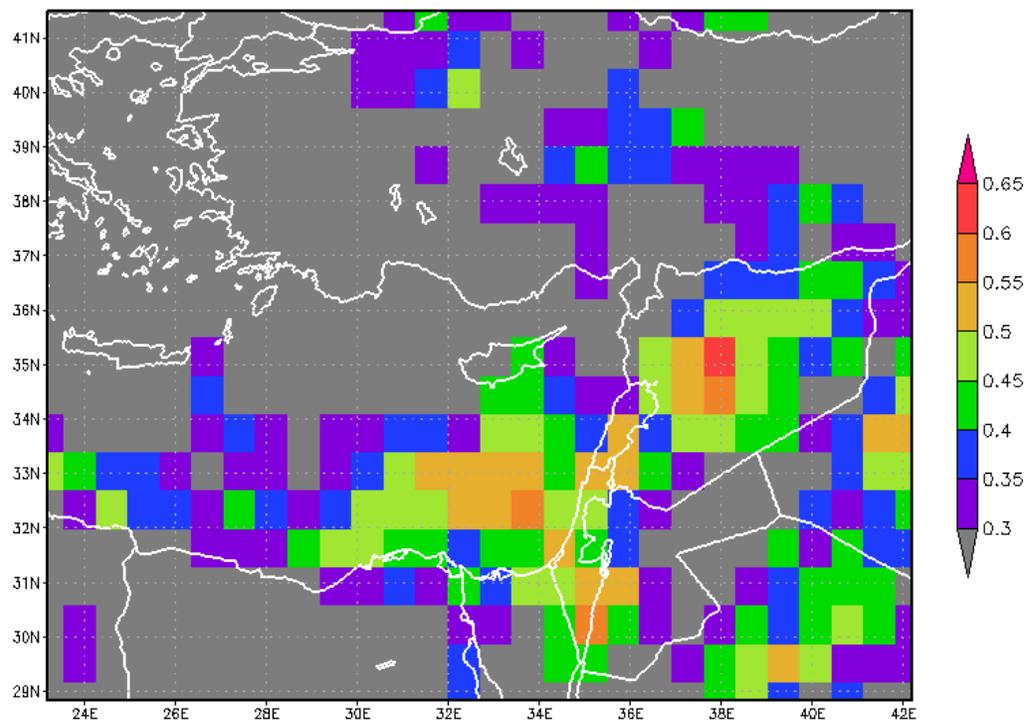
DJF precipitation: Correlation Maps for SEYTEM 4 and SYSTEM 5. Comparison between Rain in Israel (for regions of isohyets above 200mm/year) to precipitation in each model grid points,

By using the Median Ensemble method.

SYSTEM4
(median of 15 members in Ensembles)

SYSTEM 5
(median of 25 members in Ensembles)1981-2016

SEAS4: CORR of MEDAIN ENS DJF RAIN with Israel GIS RAIN
NOV mdoel with ENS 450 members 1981-2010

GrADS: COLA/IGES   2017-10-31-17:55

SEAS5: CORR of MEDAIN ENS DJF RAIN with Israel GIS RAIN
NOV mdoel with ENS 900 members 1981-2016

GrADS: COLA/IGES   2017-10-31-17:55

DJF precipitation: Correlation Maps for SEYTEM 4 and SYSTEM 5. Comparison between Rain in Israel (for regions of isohyets above 200mm/year) to precipitation in each model grid points,

By using the Mean Ensemble method.
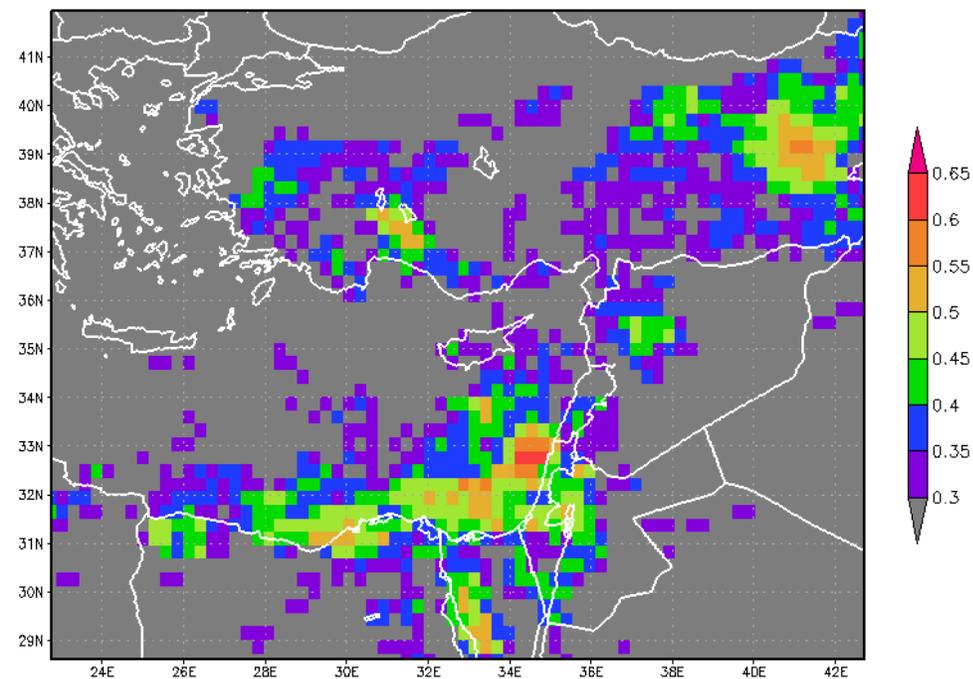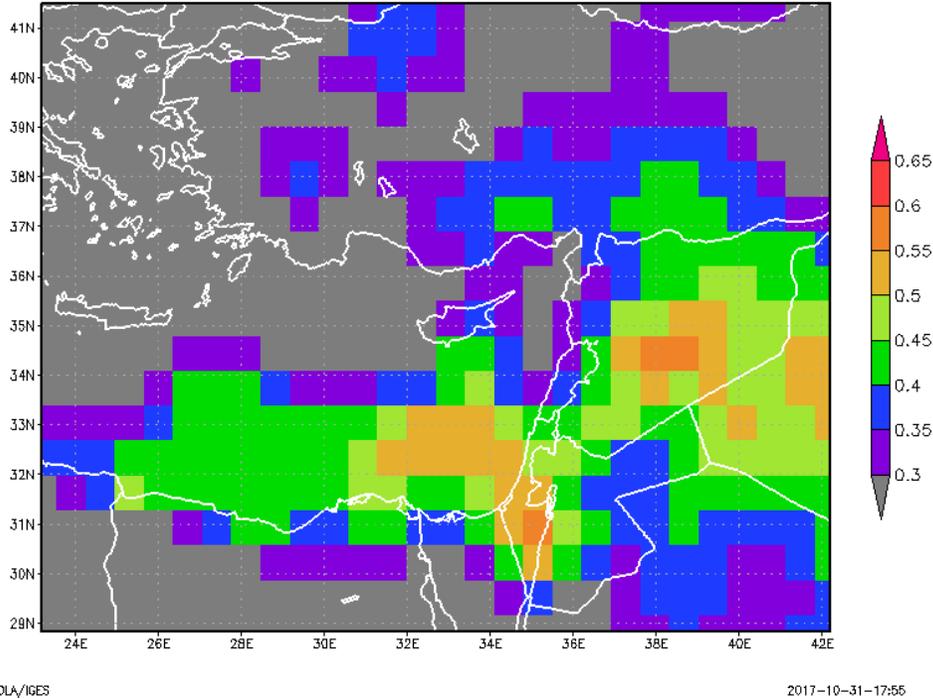
SYSTEM4
(mean of 15 members in Ensemble)

SYSTEM 5
(mean of 25 members in Ensembles)

SEAS4: CORR of MEAN ENS DJF RAIN with Israel GIS RAIN
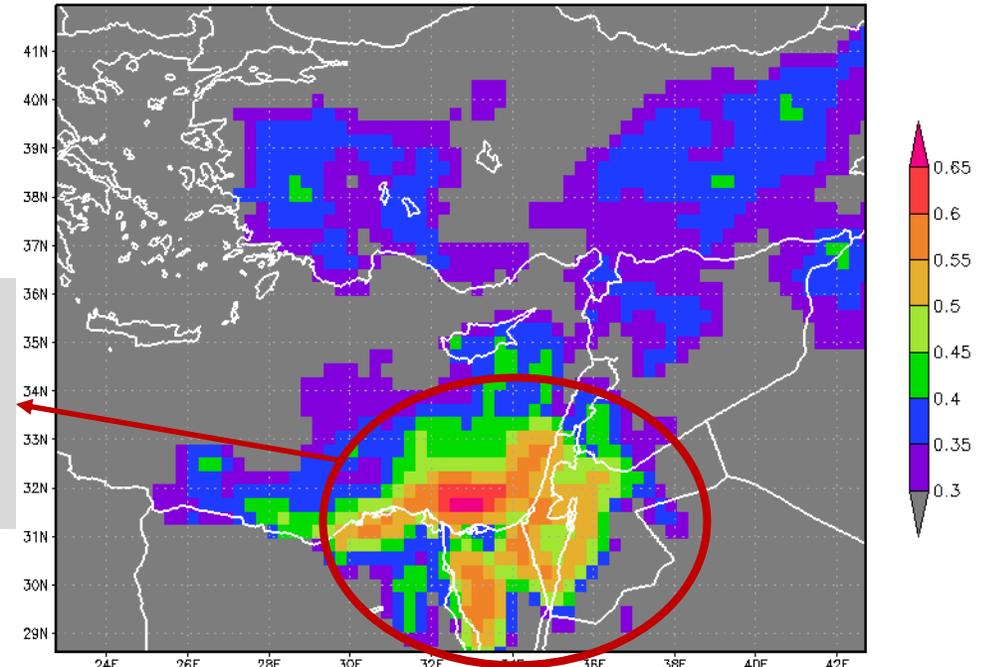NOV mdoel with ENS 450 members 1981−2010

GrADS: COLA/IGES   2017−10−31−17:55

SEAS5: CORR of MEAN ENS DJF RAIN with Israel GIS RAIN
NOV mdoel with ENS 900 members 1981−2016

GrADS: COLA/IGES   2017−10−31−17:55

large Area of correlation equal or above 0.5

HIT SCORE maps.

SYSTEM4
(median of 15 members in Ensembles)
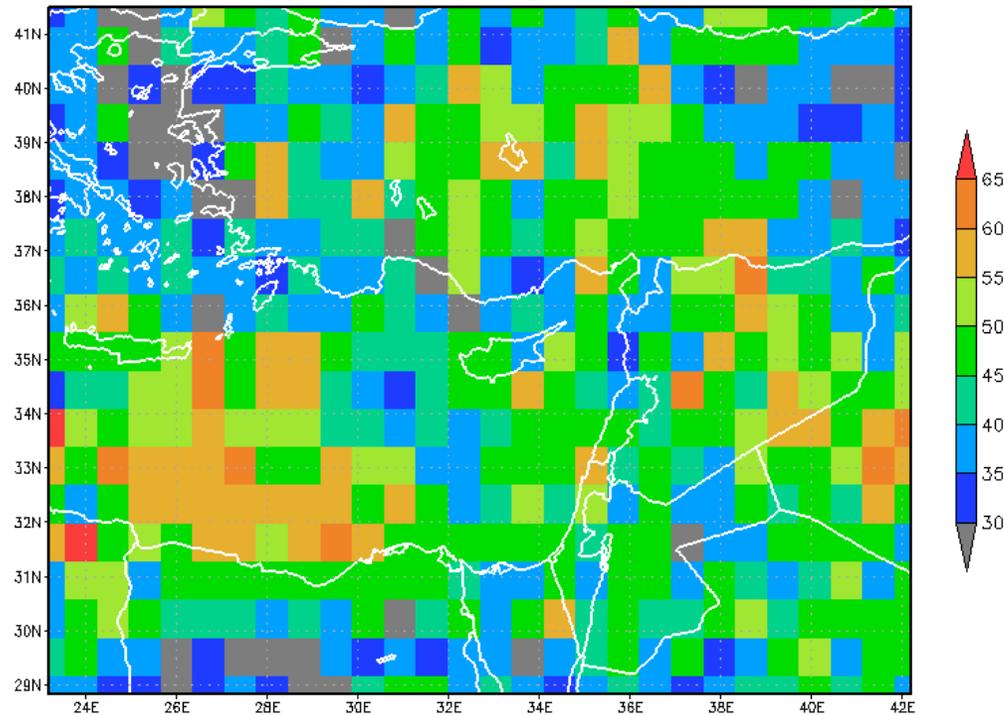
SYSTEM 5
(median of 25 members in Ensembles)1
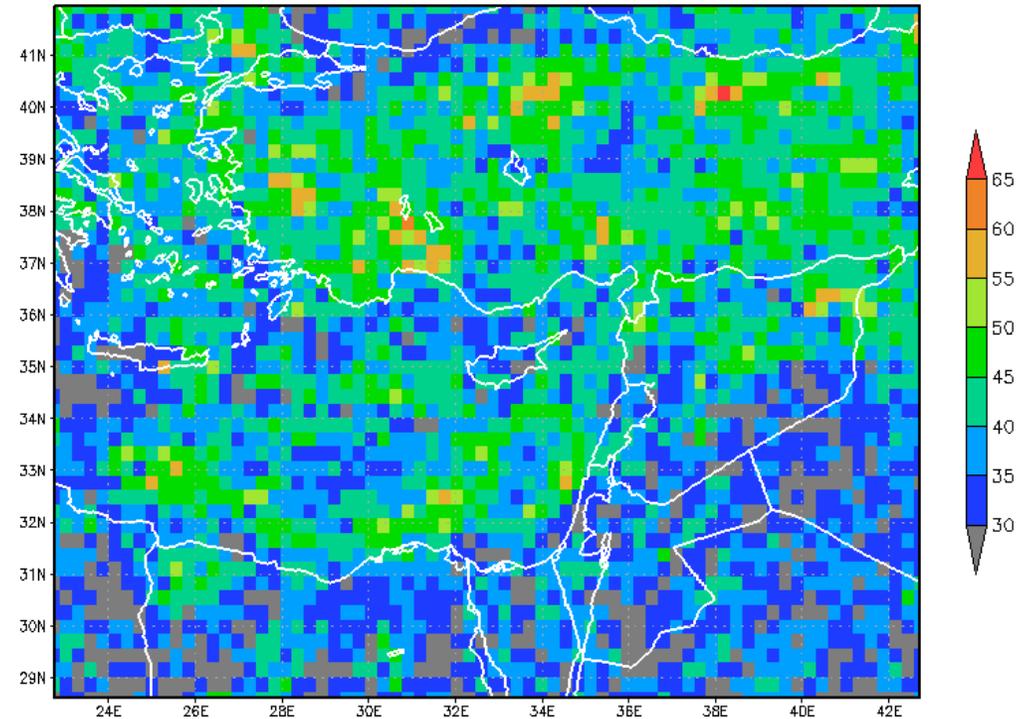
HIT SCORE בין נקודות שריג לבין גשם בישראל. לפי מודל עונתי של נובמבר.

SYSTEM4
(mean of 15 members in Ensembles)
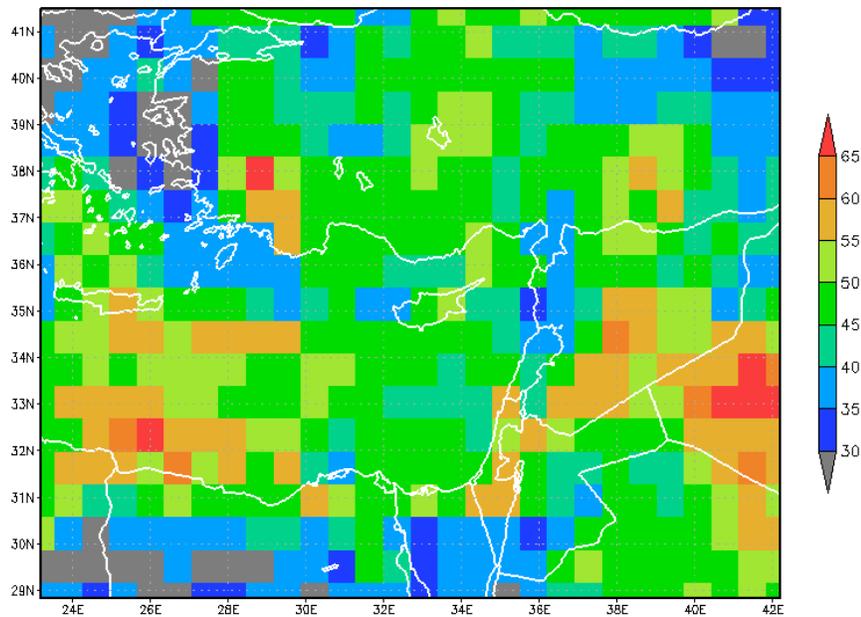
SYSTEM 5
(mean of 25 members in Ensembles)
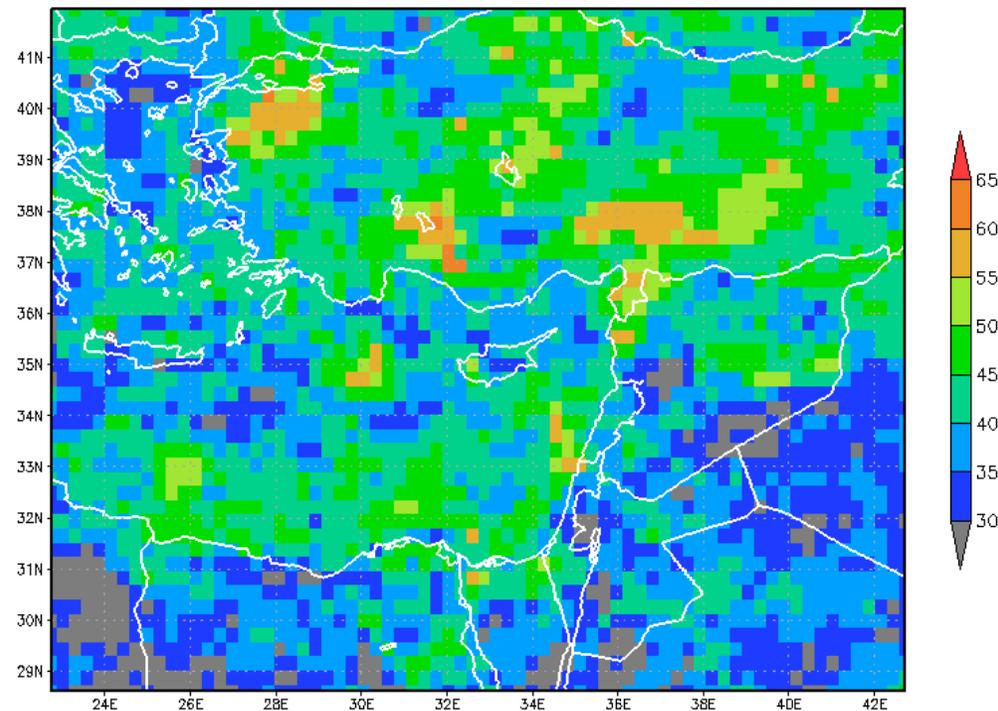
SEAS 5 DJF rain [MM], from NOV model
for 1981–2016, mean on ensmble of 900 members

20 Grid points
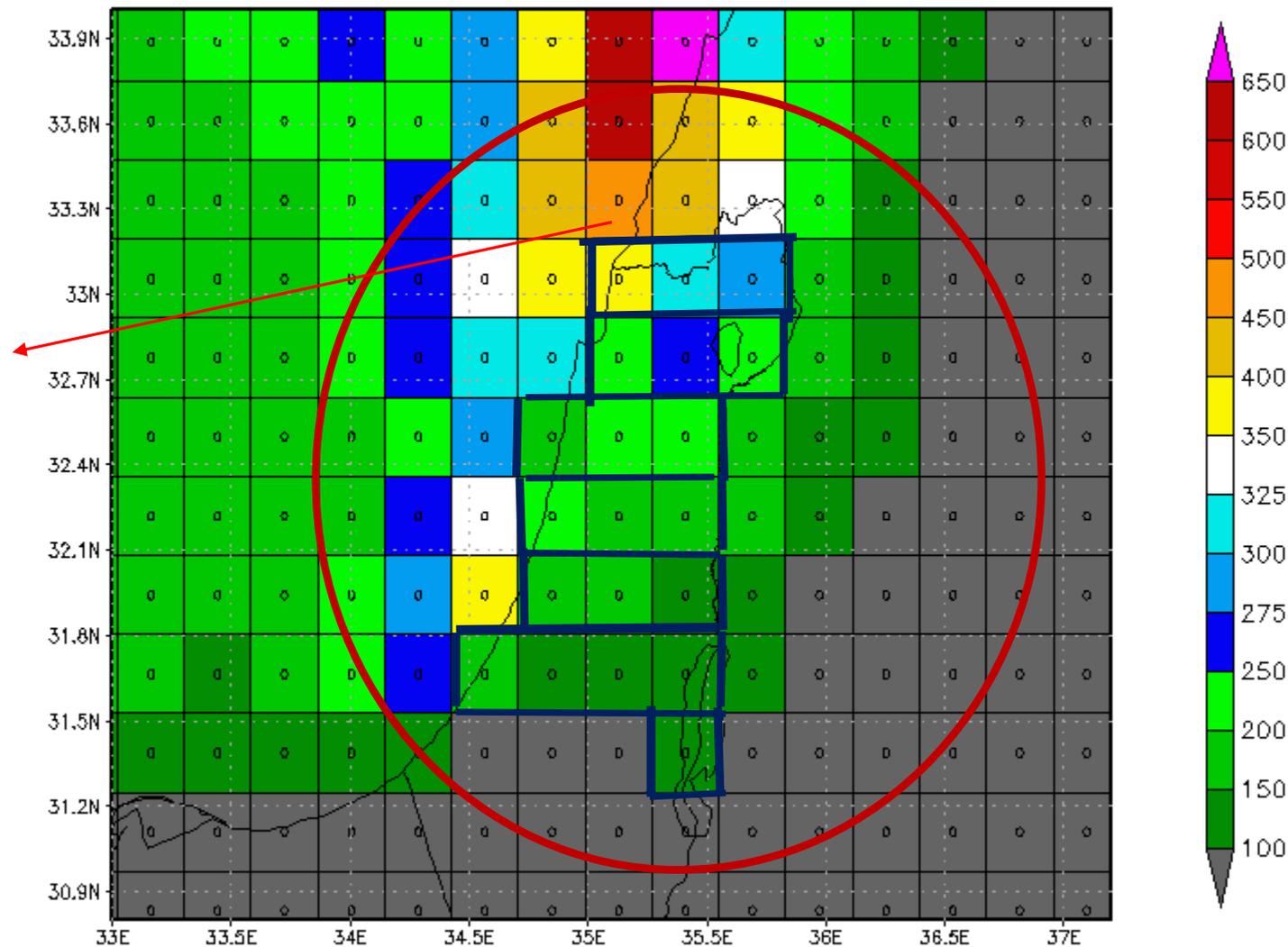
קומבינציה של 15 נקודות שריג (מופיע בצבע כחול הגבולות)

SEAS 5 DJF rain [MM], from NOV model
for 1981–2016, mean on ensmble of 900 members

15
Grid
points

GrADS: COLA/IGES

2017-11-06-16:21

קומבינציה של 15 נקודות שריג (מופיע בצבע כחול הגבולות)

SEAS 5 DJF rain [MM], from NOV model
for 1981−2016, mean on ensmble of 900 members

12 Grid points

GrADS: COLA/IGES

2017−11−06−16:21

SEAS 5 DJF rain [MM], from NOV model
for 1981-2016, mean on ensmble of 900 members

9 Grid points

GrADS: COLA/IGES   2017-11-06-16:21
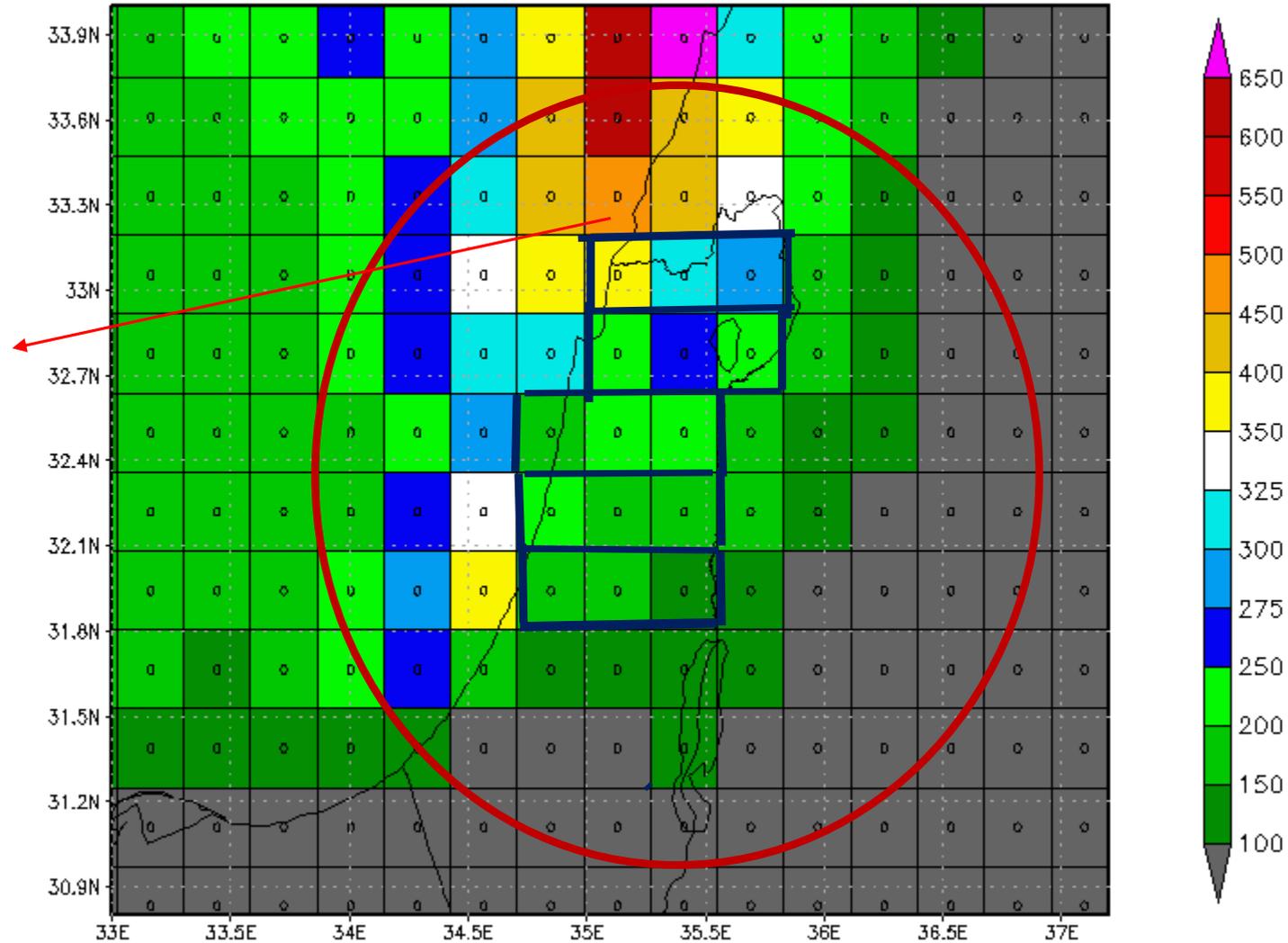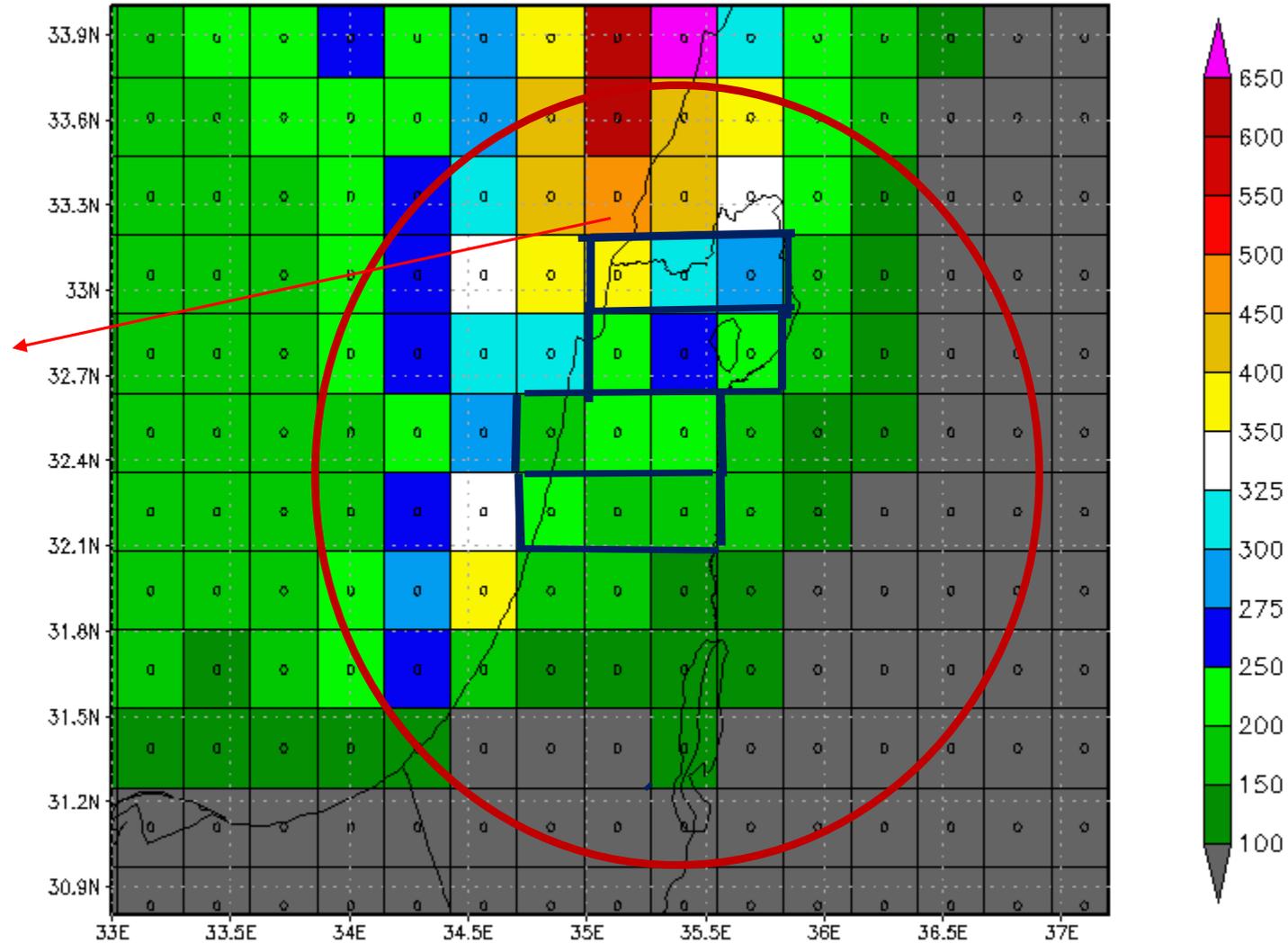
SEAS5: Rain Distribution, 20 grids in Israel, DJF Rain, NOV model, Ense of 25 mem/year 1981-2016

Low Tercile 300 members
Middle Tercile 300 members
High Tercile 300 members
ALL ENSEMBLE of 900 members

For 20 grid points
In Israel
31.39°N-33.04°N

Low Tercile mean rain 223.8 mm/season (std 64.6mm)
Middle Tercile mean rain 235.0 mm/season (std 63.8mm)
High Tercile mean rain 239.7 mm/season (std 71.9mm)
All Ensemble (900 members) 232.8 mm/season (std 67.1 mm)

There is a significant difference between the middle to low tercile (p<0.05, two side tailed and also in one side tailed).
There is no significant difference between the High to middle tercile (p>0.1, two side tailed and also in one side tailed).
There is a significant difference between the high and the low tercile (p<0.05, two side tailed and also in one side tailed).

Distribution (%) of Precipiation for bins of 40mm

Precipiation [mm/season]

SEAS5: Rain Distribution, 9 grids in Israel,DJF Rain,NOV model,Ense of 25 mem/year 1981-2016

For 9 grid points
In Israel
31.39°N-33.04°N

Low Tercile 300 members
Middle Tercile 300 members
High Tercile 300 members
ALL ENSEMBLE of 900 members

The observed mean GIS Israeli rain is
330mm/season (1981-2016)

There is a significant difference between the middle to low tercile (p<1%, two tail side (or p<1% in one tailed side)).
There is no significant difference between the High to middle tercile (p>20%, two tailed side (or p>10% in one tailed side)).
There is a significant difference between the high and the low tercile (p<0.001%, two tailed side (or p<0.1% in one tailed side)).

Low Tercile mean rain 263.8 mm/season (std 78.3mm)
Middle Tercile mean rain 278.4 mm/season (std 75.7mm)
High Tercile mean rain 284.1 mm/season (std 86.6mm)
All Ensemble (900 members) 275.4 mm/season (std 80.7 mm)

Distribution (%) of Precipiation for bins of 40mm

Precipiation [mm/season]

SEAS5: Rain Dist, Corr>=0.55, 54 grids, DJF Rain,NOV model,Ense of 25 mem/year 1981-2016

Low Tercile 300 members
Middle Tercile 300 members
High Tercile 300 members
ALL ENSEMBLE of 900 members

Low Tercile mean rain 121.3mm/season (std 40.0mm)
Middle Tercile mean rain 125.5 mm/season (std 38.1mm)
High Tercile mean rain 131.1 mm/season (std 44.1mm)
All Ensemble (900 members) 125.9 mm/season (std 41.0 mm)

The observed mean GIS Israeli rain is
330mm/season (1981-2016)

There is no significant difference between the middle to low tercile (p=0.09, one sided, p=0.17 two sided).
There is significant difference between the High to middle tercile (p=0.047 one sided, p=0.94 two sided).
There is a significant difference between the high and the low tercile (p<0.01 one sided, p<0.01 two sided).

Distribution (%) of Precipiation for bins of 20mm

Precipiation [mm/season]

Number of grid points in the averaged area	The correlation for the median method	The correlation for the mean method	The HIT SCORE for the median method	The HIT SCORE for the mean method	The south latitude in area of the average	The mean precipitation (Ensemble mean of 900 members for DJF 1981/82-2010/11)
20	0.481	0.522	36.11%	38.89%	31.39°N	232.8mm*
15	0.433	0.508	41.67%	**47.22%**	31.94°N	255.8mm
12	0.404	0.505	36.11%	**47.22%**	32.22°N	271.4mm
9	0.405	0.503 **(excluding 1991/92 , correlation reduces to 0.180)**	38.89%	**47.22 (excluding 1991/92 , hit score reduces to 42.9%)**	32.50°N	275.4mm
54 For correlation above or equal 0.55 all of the grid points in South Israel sea.	0.551	**0.632 (excluding 1991/92 , correlation reduces to 0.313)**	41.7%	**52.8% (excluding 1991/92 , hit score reduces to 48.6%)**	--------------------	125.9mm
11 For correlation above or equal 0.55 Most of the grid points in South Israel sea.	0.481	**0.643 excluding 1991/92 , correlation reduces to 0.309)**	36.11%	**44.44%**	----------------------	159.4 mm

SEAS5 HIT SCORE Results: For Israeli DJF precipitation 1981/82-2016/17

For the period DJF 1981/82-2016/17

Tercile	True	False	Bust
Lower	58.3%	33.3%	8.4%
Middle	33.3%	66.7%	---------------
Upper	50.0%	33.3%	16.7%
All	**47.2%**	44.4%	8.5%

SEAS5 HIT SCORE Results: For Israeli DJF precipitation excluding data of winter 1991/1992 from the refered period 1981/82-2016/17

Tercile	True	False	Bust
Lower	58.3%	33.3%	8.3%
Middle	25.0%	75.0%	---------------
Upper	53.0%	46.2%	18.8%
All	**42.8%**	48.6%	8.6%

SEAS5: DJF Rain from NOV MODEL.
Time CORSS SECTION FOR 54 grid point in the sea with correlation above or equal 0.55.

Observation mean = 330mm (STD 112.2mm)
Model mean = 125.9mm (STD 12.8mm)
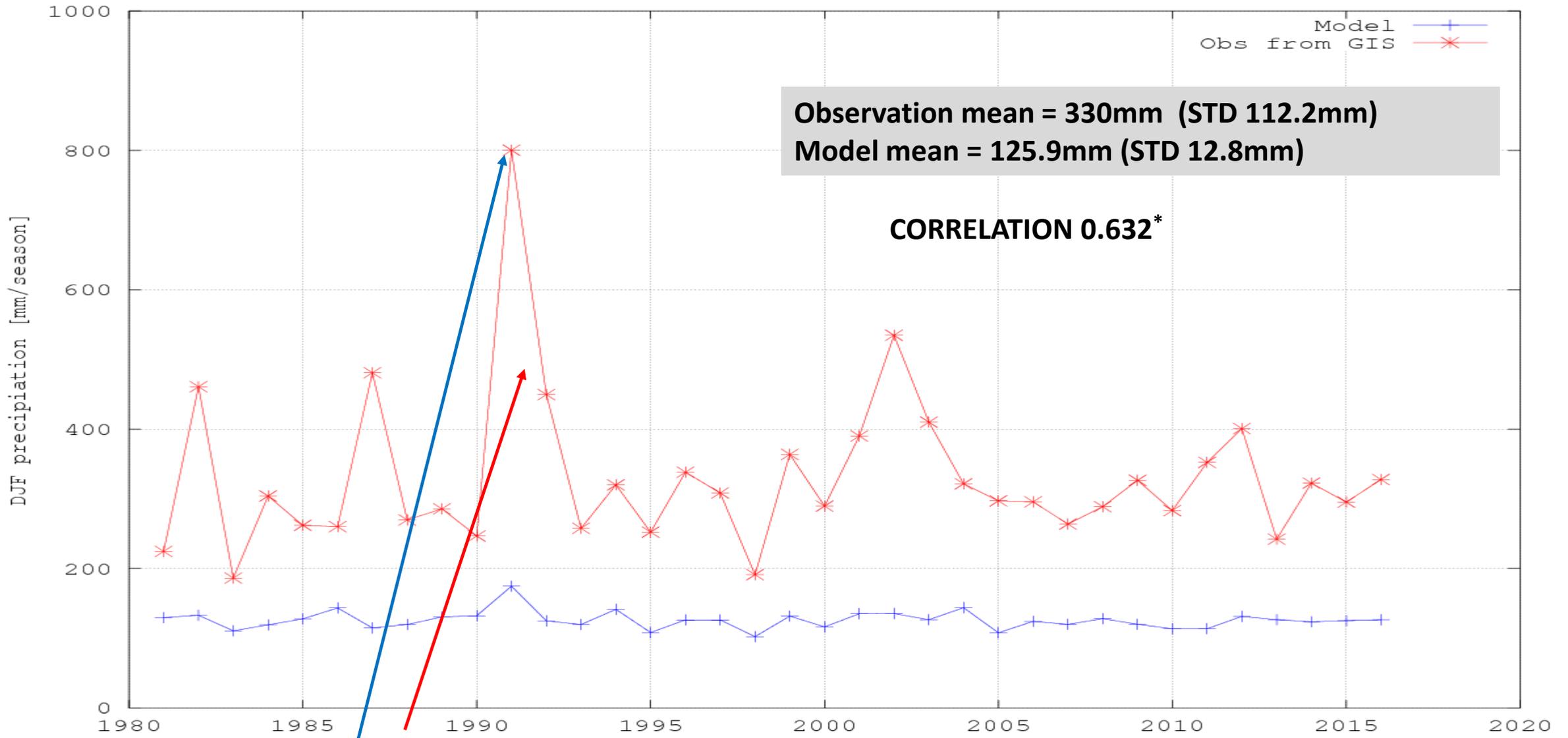
CORRELATION 0.632*

*Omitting year 1991/92 from the calculation reduces correlation to 0.313

DJF Rain Israel: Model and Obs for NOV model and median of 25 ensemble (9 grids VER2)
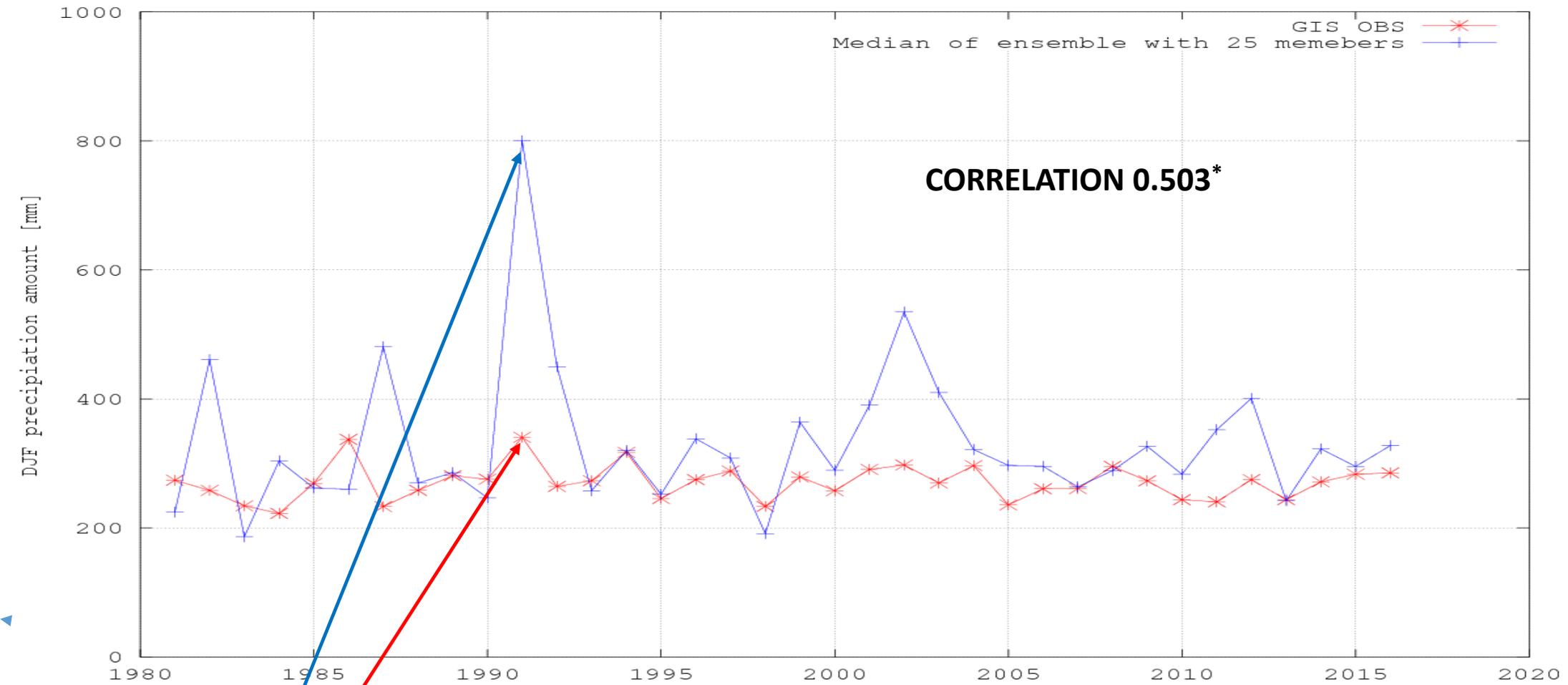
CORRELATION 0.503*

*Omitting year 1991/92 from the calculation reduces correlation to 0.180

SEAS5: DJF Rain STD 1981-2016 [mm]
from NOV model

GrADS: COLA/IGES

2017-11-12-12:12
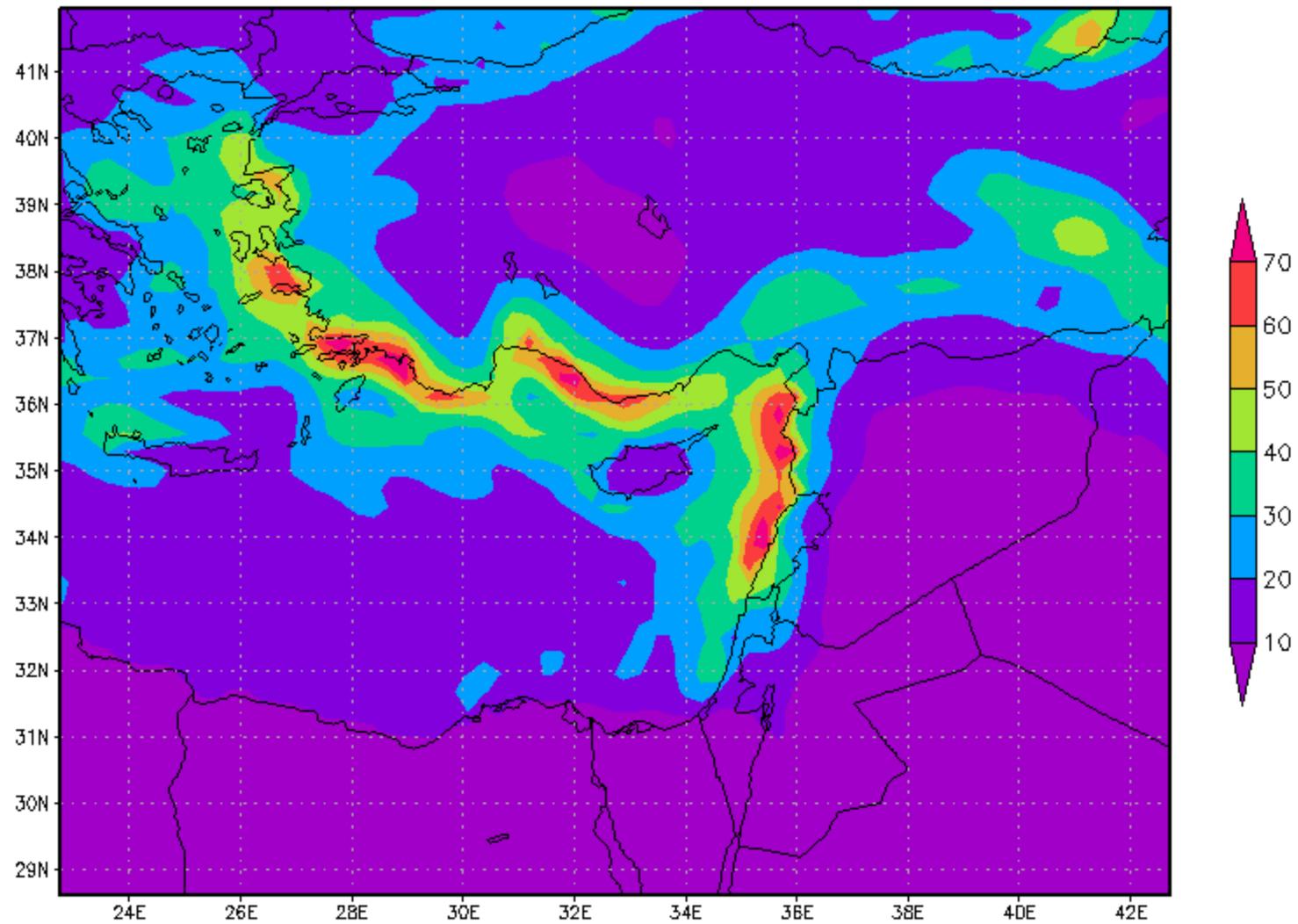
SYSTEM 4: 5 grid points for predicting precipitation in the Israeli winter (DJF)

gxout 15 Ensembles mean winter (DJF) Rain 1982-2011 [mm]
From November (one month ahead)

GrADS: COLA/IGES

2012-10-25-09:09
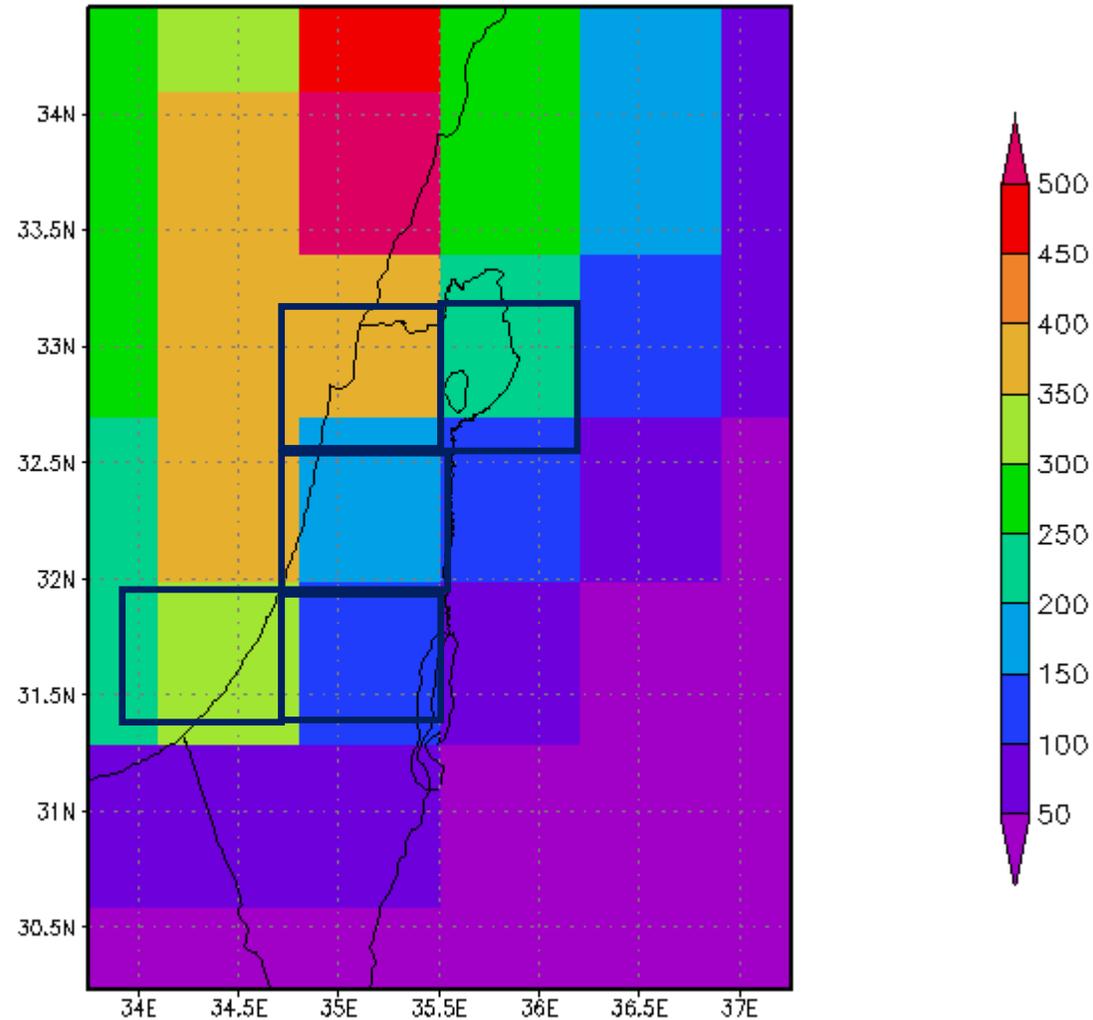
SYSTEM 4 HIT SCORE

ECMWF Predictied DJF Rain from November (1 months lead) from 5 grids method. The data Based on Noam rain maps from 5 areas. Winters 1981/1982 - 2010/2011
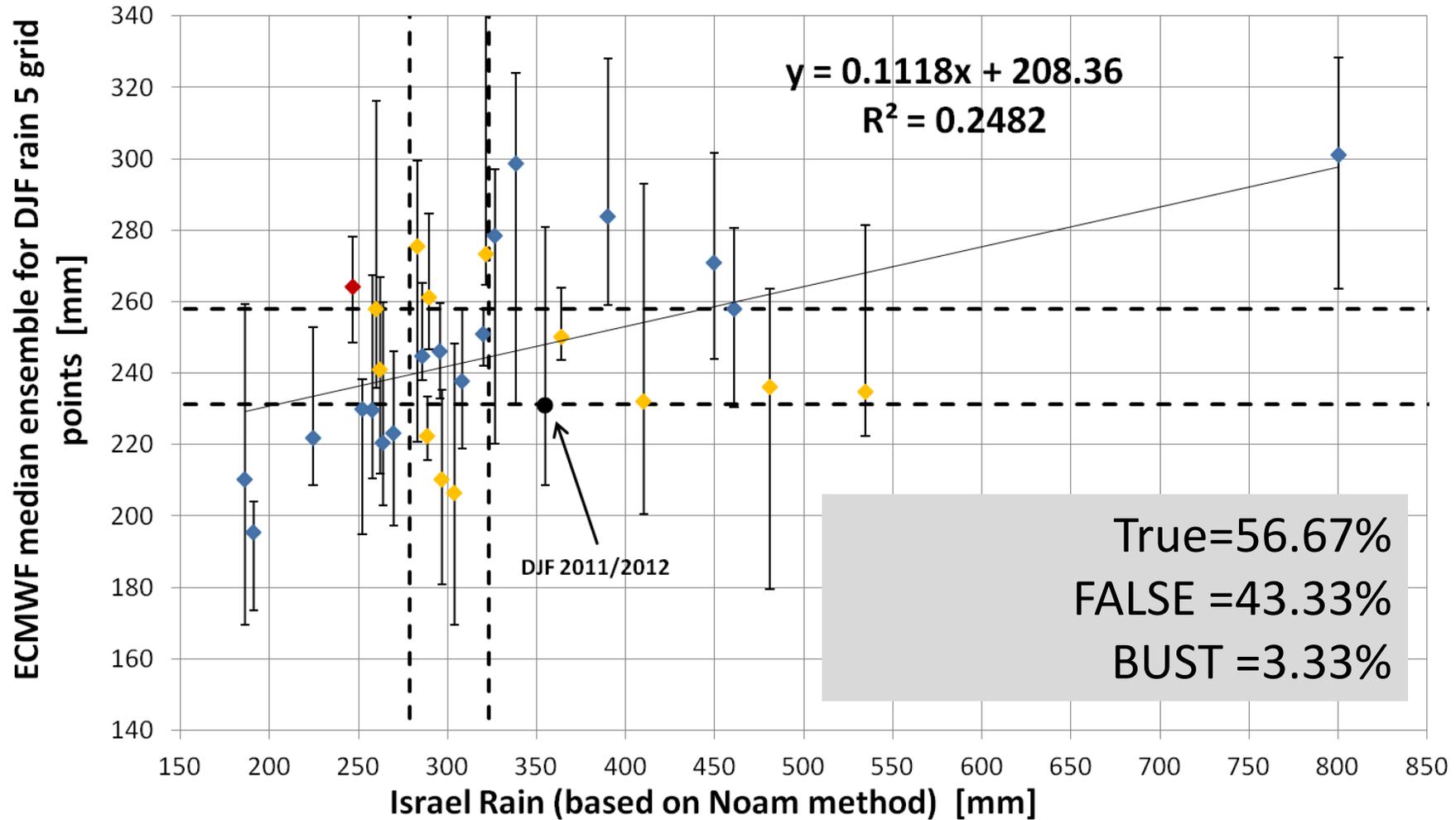
DJF 2017/18 Rain prediction for other global models than IFS (ECMWF)

CFSv2 seasonal Prec anomalies (mm/day)

Nov-Dec-Jan 2017/2018

Initial conditions: 27Oct2017-5Nov2017

-1 -0.8 -0.6 -0.4 -0.2 0.2 0.4 0.6 0.8 1
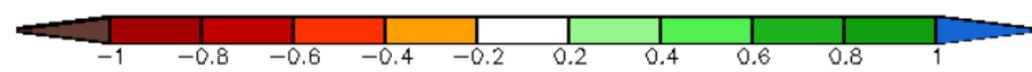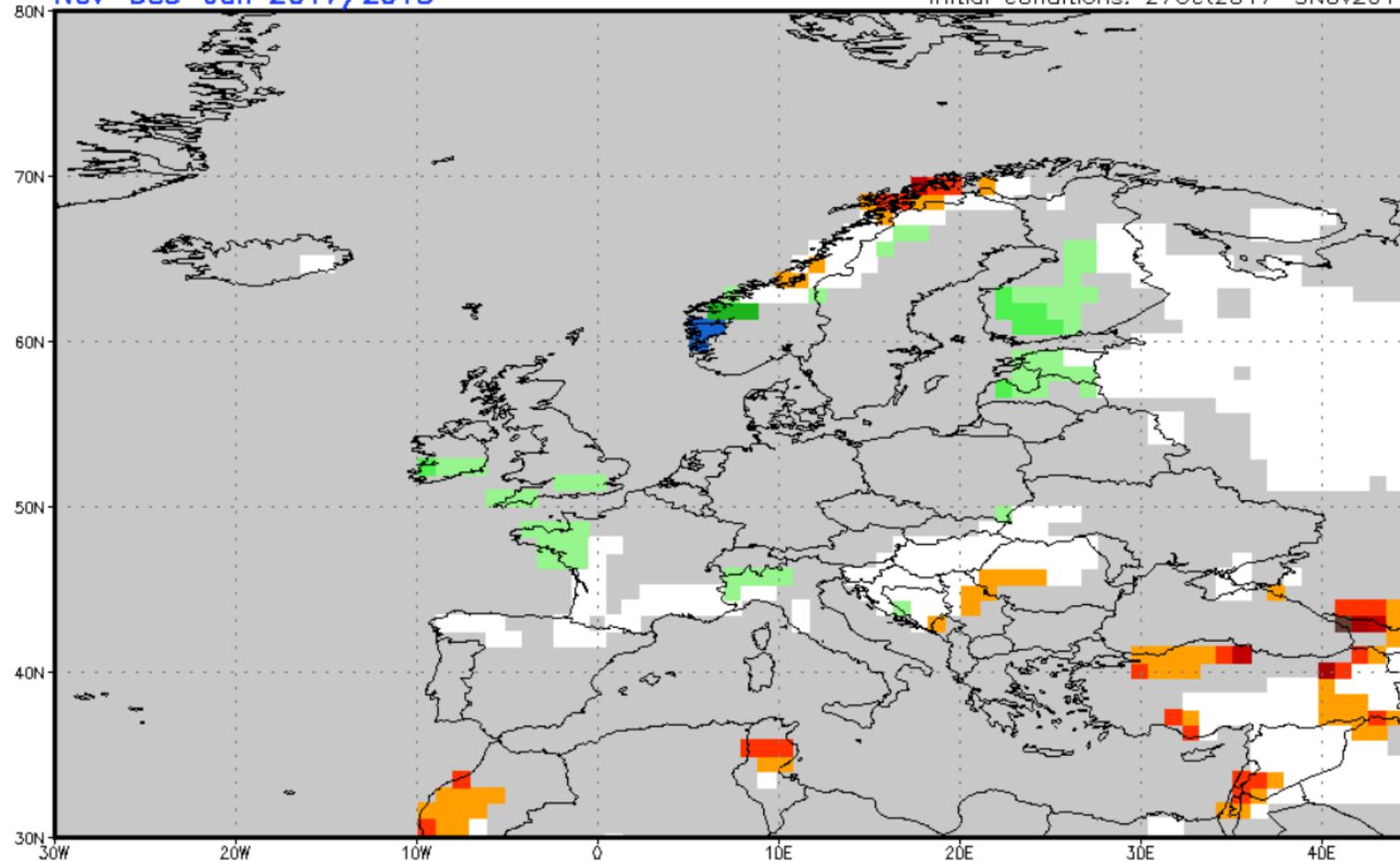
(Areas of expected skill less

North American 12 model Ensemble for DJF precipitation

NMME Forecast of Prate Anom (mm/day) IC=201711 for 2017DJF
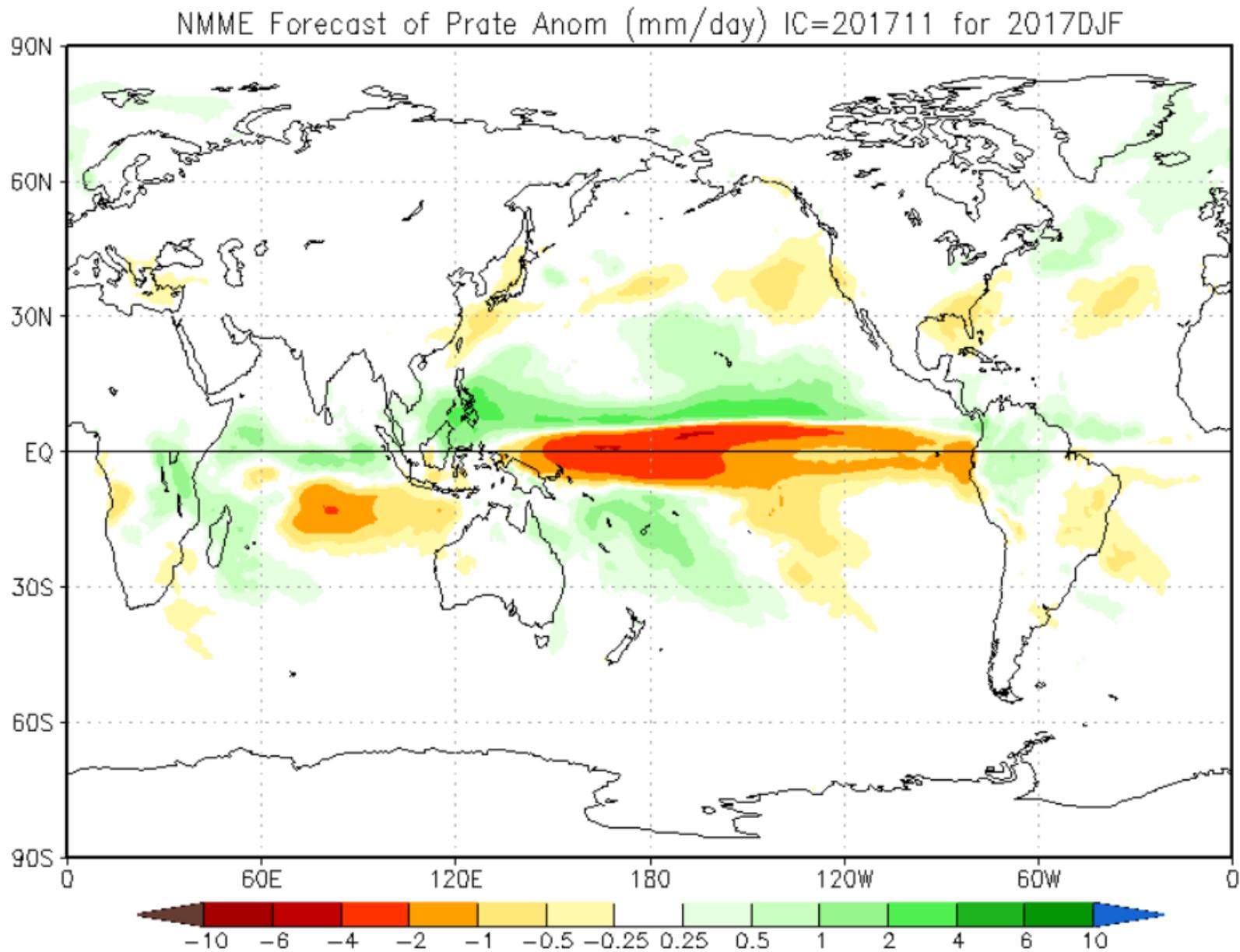
UKMO Precipitation Seasonal Forecasting

DJF 2017/18 From OCTOBER MODEL

DJF 2017/18 Rain from Oct 2017 UKMO model
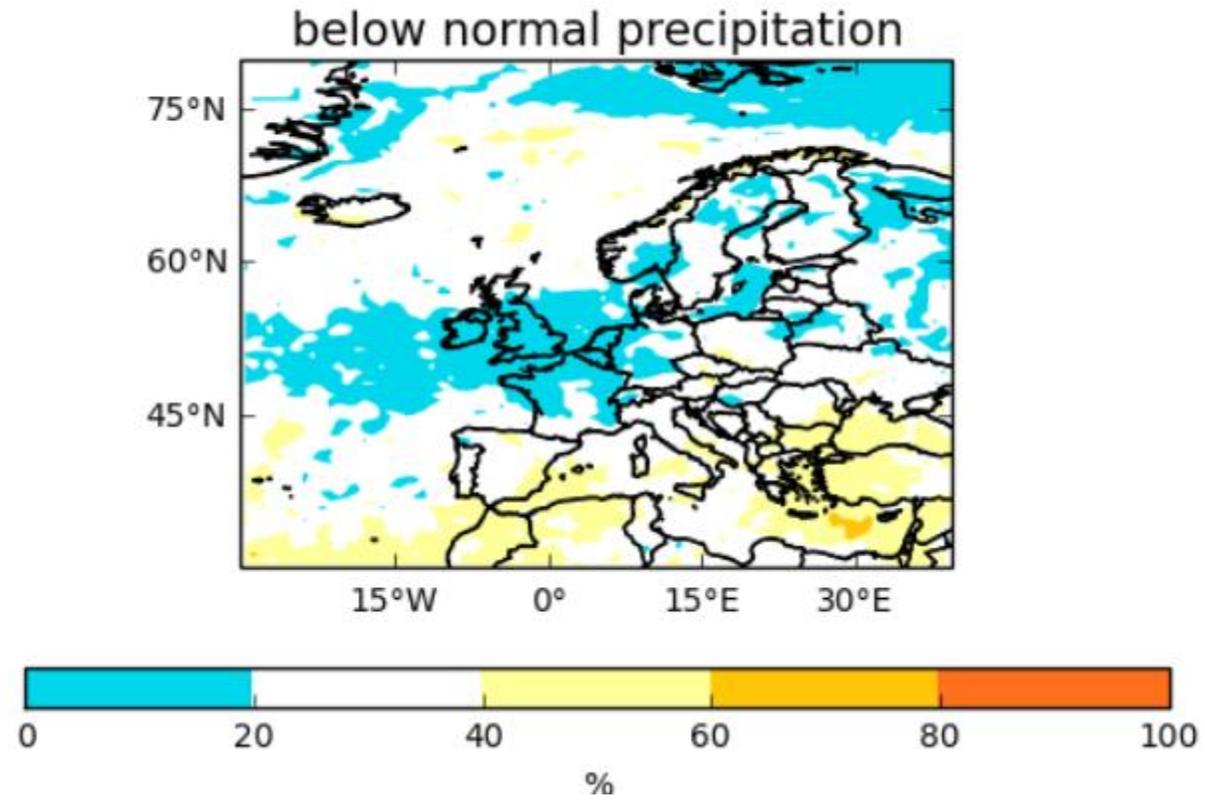
below normal precipitation

DJF 2017/18 Rain from Oct 2017 UKMO model
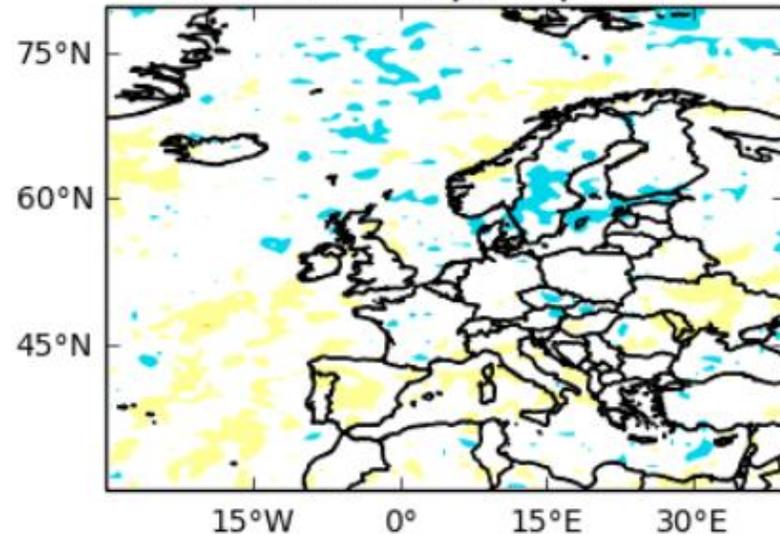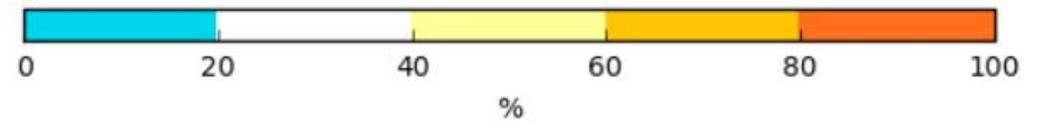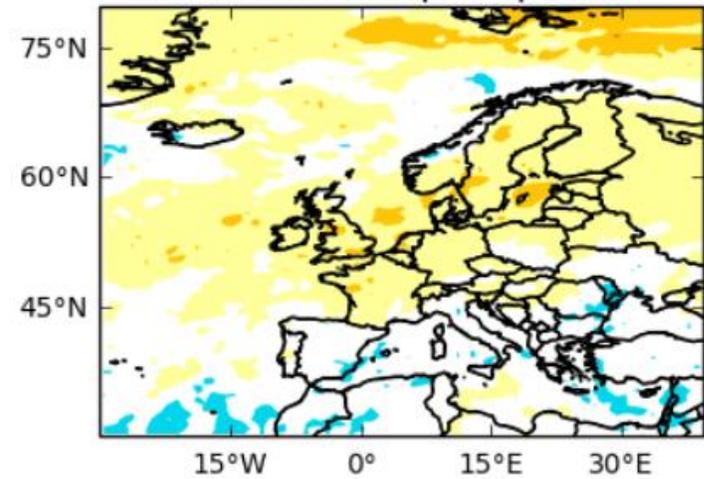
ECMWF SEAS5:   DJF 2017/18 Prediction
                maps for DJF 2017/18 Precipiation:
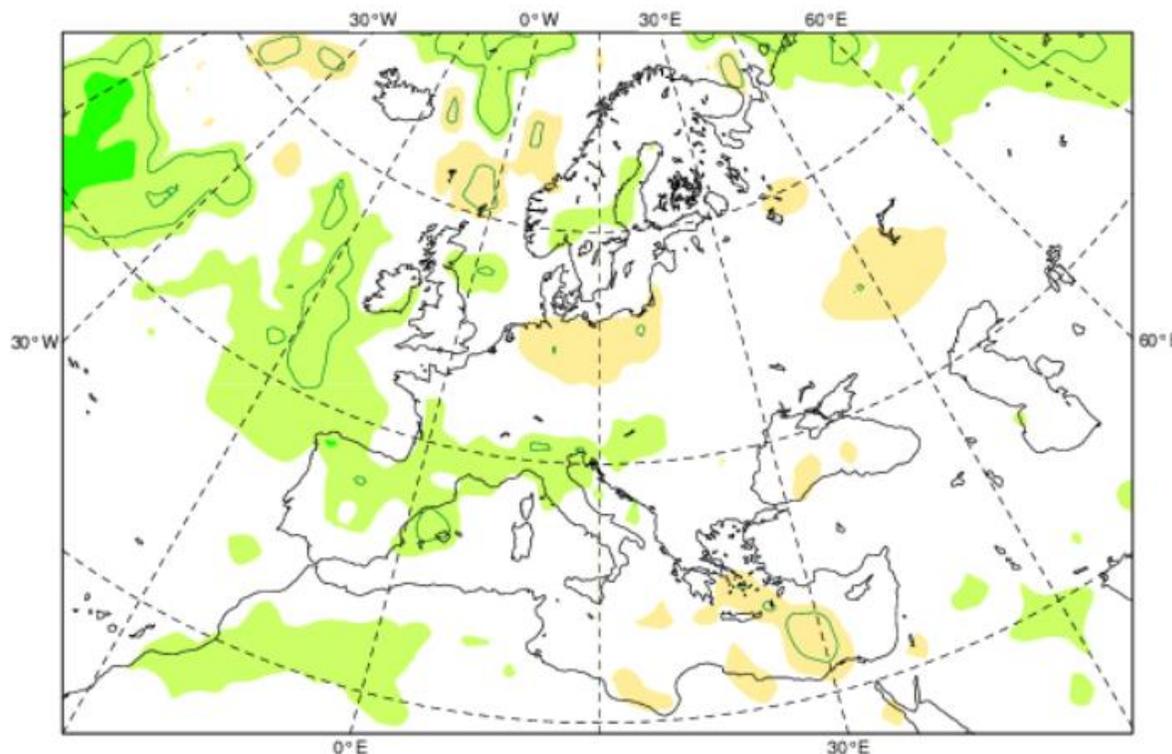
תחזית גשם לחודשים DJF 2017/18. ממודל נובמבר 2017   של (SEAS5) SYSTEM 5

נא לשים לב ב- charts התחזית היא של 51 חברים עבור DJF 2017/18 כאשר משווים אותם ביחס לאקלים המודל של 1993-2016 כאשר בכל שנה יש 25 חברים או סה"כ 600 חברים בכל התקופה 1993-2016. בכל ההרצאה ההשוואות האקלימיות היו מבוססות על התקופה 2016-1981. יש להם גם שנים 1981-1992 אבל הם משתמשים בתקופה 2016-1981 רק בשביל ורפקציה, בשביל לקבל SKIL של מודל ובשביל SCORES שונים. את התחזית האופרטיבית הם קובעים לפי השוואה לתקופה 1993-2016. אנחנו בשמ"ט נעשה ביחס ל- 2016-1981 כי כבר הכנתי סקריפטים של 2016-1981.

SYSTEM 5
Mean Precipitation
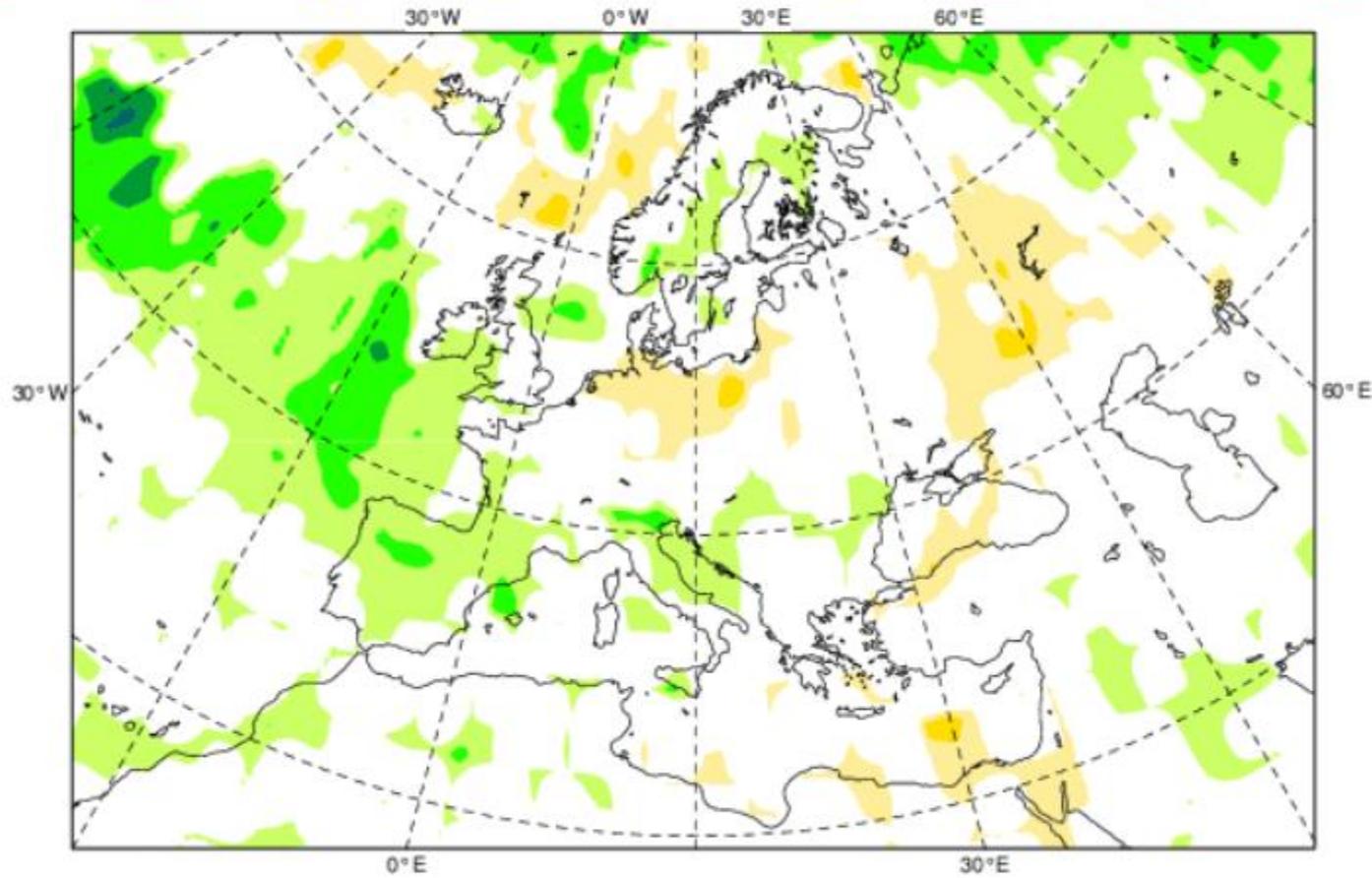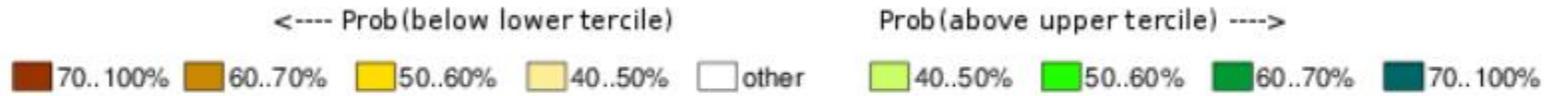anomaly (mm/season)

ECMWF Seasonal Forecast

Prob(most likely category of precipitation)

Forecast start is 01/11/17, climate period is 1993-2016

Ensemble size = 51, climate size = 600

System 5
DJF 2017/18

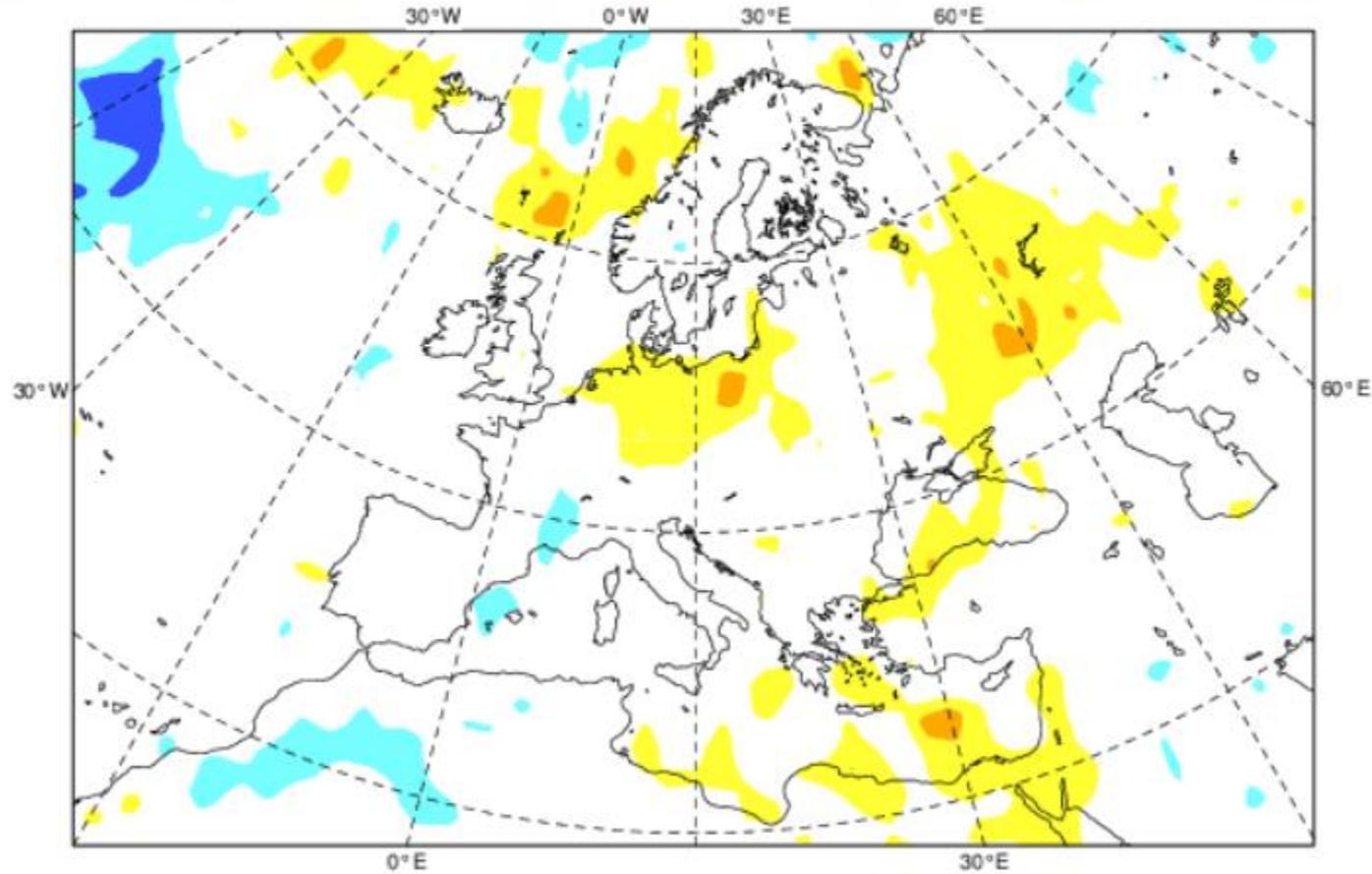SYSTEM 5
Tercile Summary (%)

ECMWF Seasonal Forecast
Prob(precipitation < lower tercile)
Forecast start is 01/11/17, climate period is 1993-2016
Ensemble size = 51, climate size = 600

SYSTEM 5
Lower Tercile [%]

System 5
DJF 2017/18

ECMWF Seasonal Forecast
Prob(lower tercile < precipitation < upper tercile)
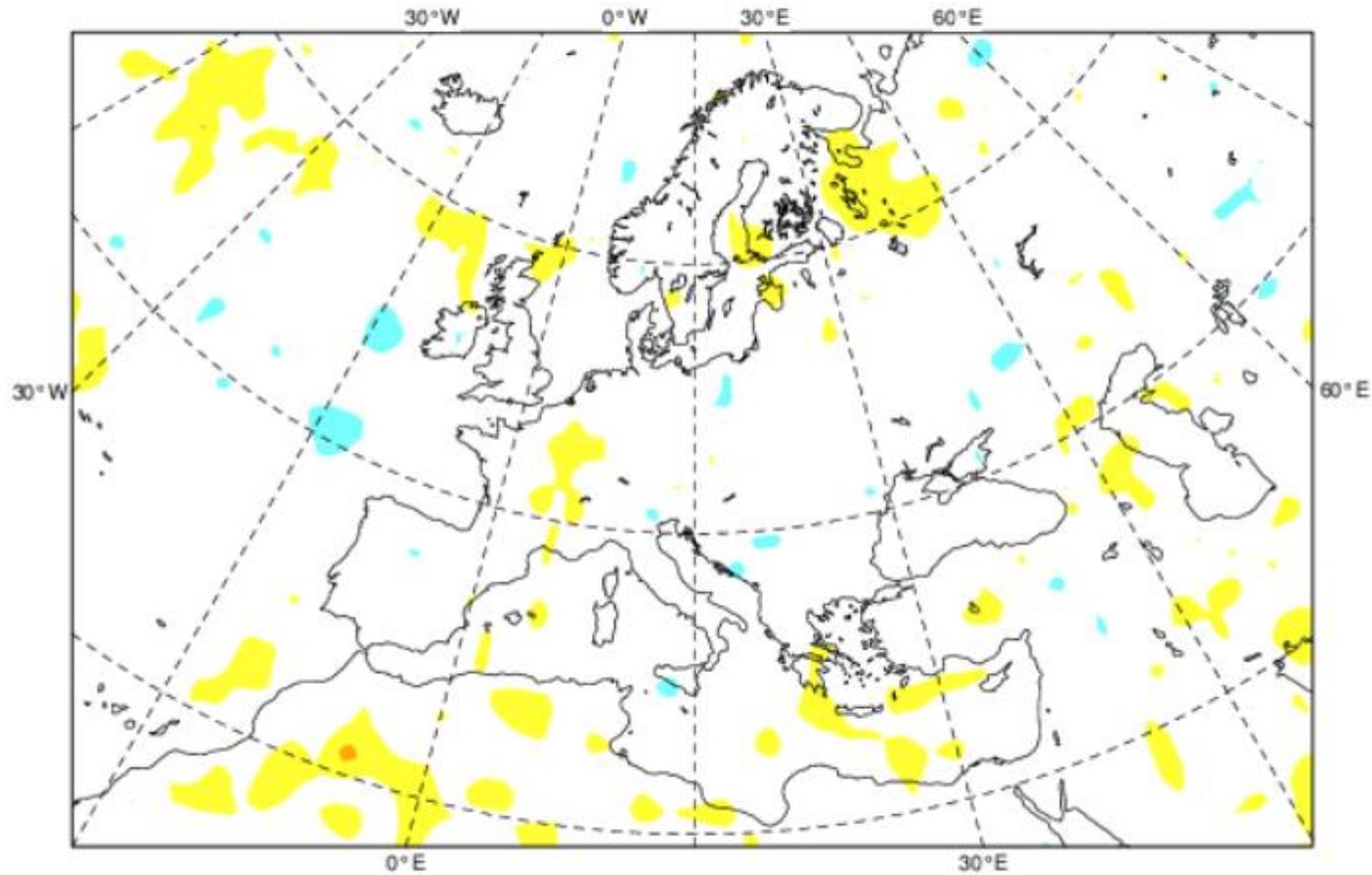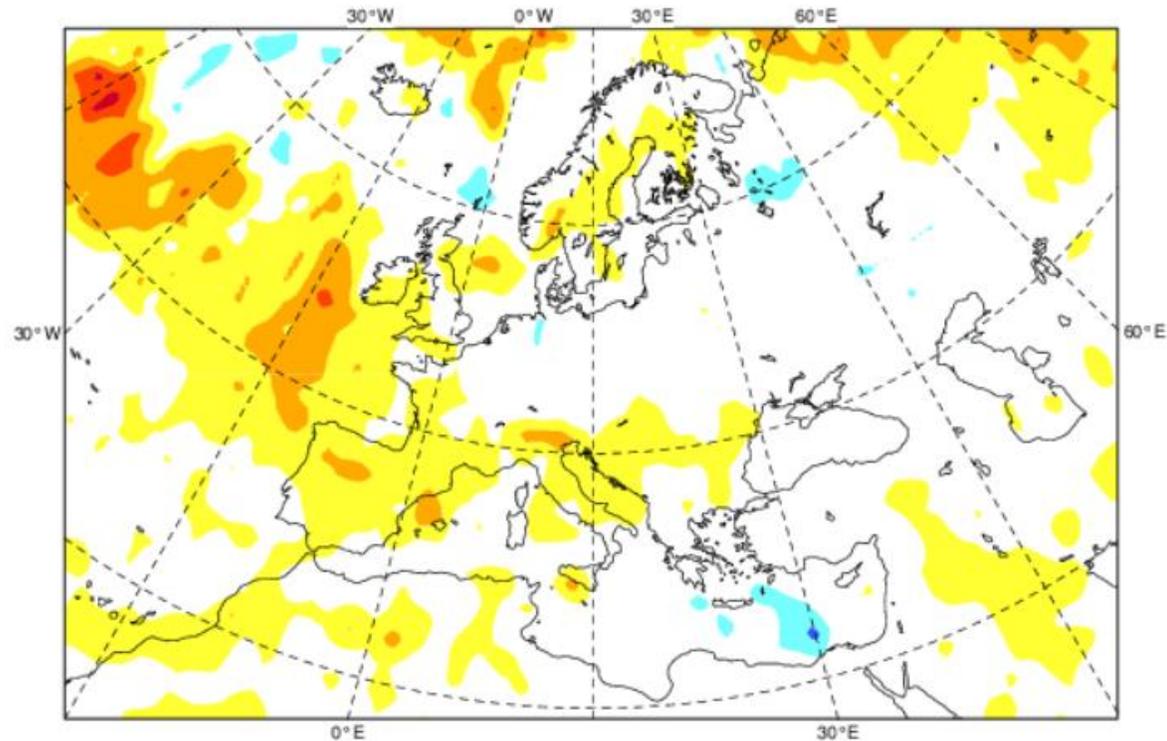Forecast start is 01/11/17, climate period is 1993-2016
Ensemble size = 51, climate size = 600

SYSTEM 5
Middle Tercile [%]

System 5
DJF 2017/18

SYSTEM 5
Upper Tercile [%]
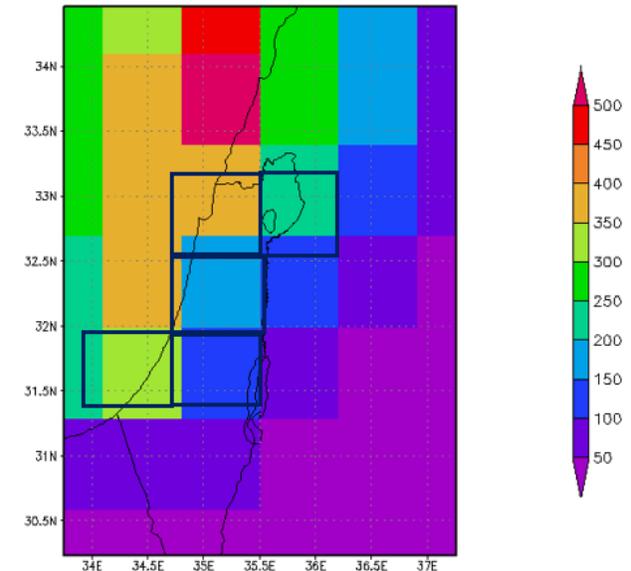
Prediction of DJF Rain in Israel from November 2017 model SYSTEM 4 by using 5 grid points in Israel

1. **Lower tercile ("drought winter") probability: 25.5%.**

2. **Middle tercile ("Normal winter) probability: 47.1%.**

3. **upper tercile ("wet winter") probability: 27.4%.**

Conclusion : According to ECMWF Ensemble prediction from SYSTEM 4, We except to have "Normal" winter (Normal amount of   precipitation). The preferred category is "normal wet" due to the face that it is the only category with probability equal or above 40%.

The final precipitation prediction for DJF 2017/18 in Israel

Prediction of DJF Rain in Israel from November 2017 model SYSTEM 5 by using 9 grid points in North Israel (domain 32.5N-33.04N) grid points in the seas

SEAS 5 DJF rain [MM], from NOV model
for 1981-2016, mean on ensmble of 900 members

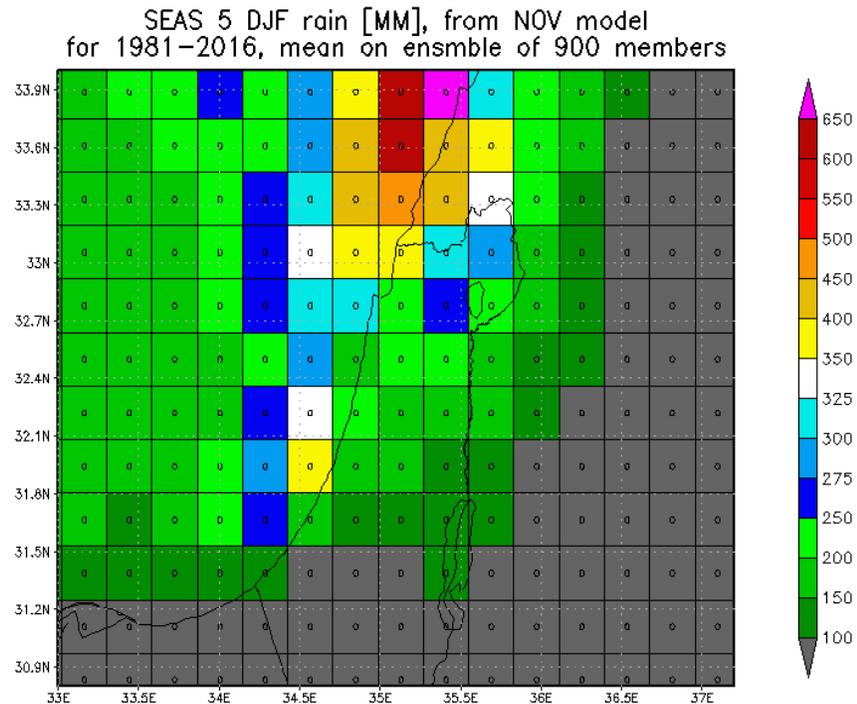GrADS: COLA/IGES   2017-11-06-16:21

1. **Lower tercile ("drought winter") probability: 47.1%.**

2. **Middle tercile ("Normal winter) probability: 17.6%.**

3. **upper tercile ("wet winter") probability: 35.3%.**

Final Conclusion : According to ECMWF Ensemble prediction from SYSTEM 4, there is not signal and preferred category hence, there is no category probability which equal 40% or above.
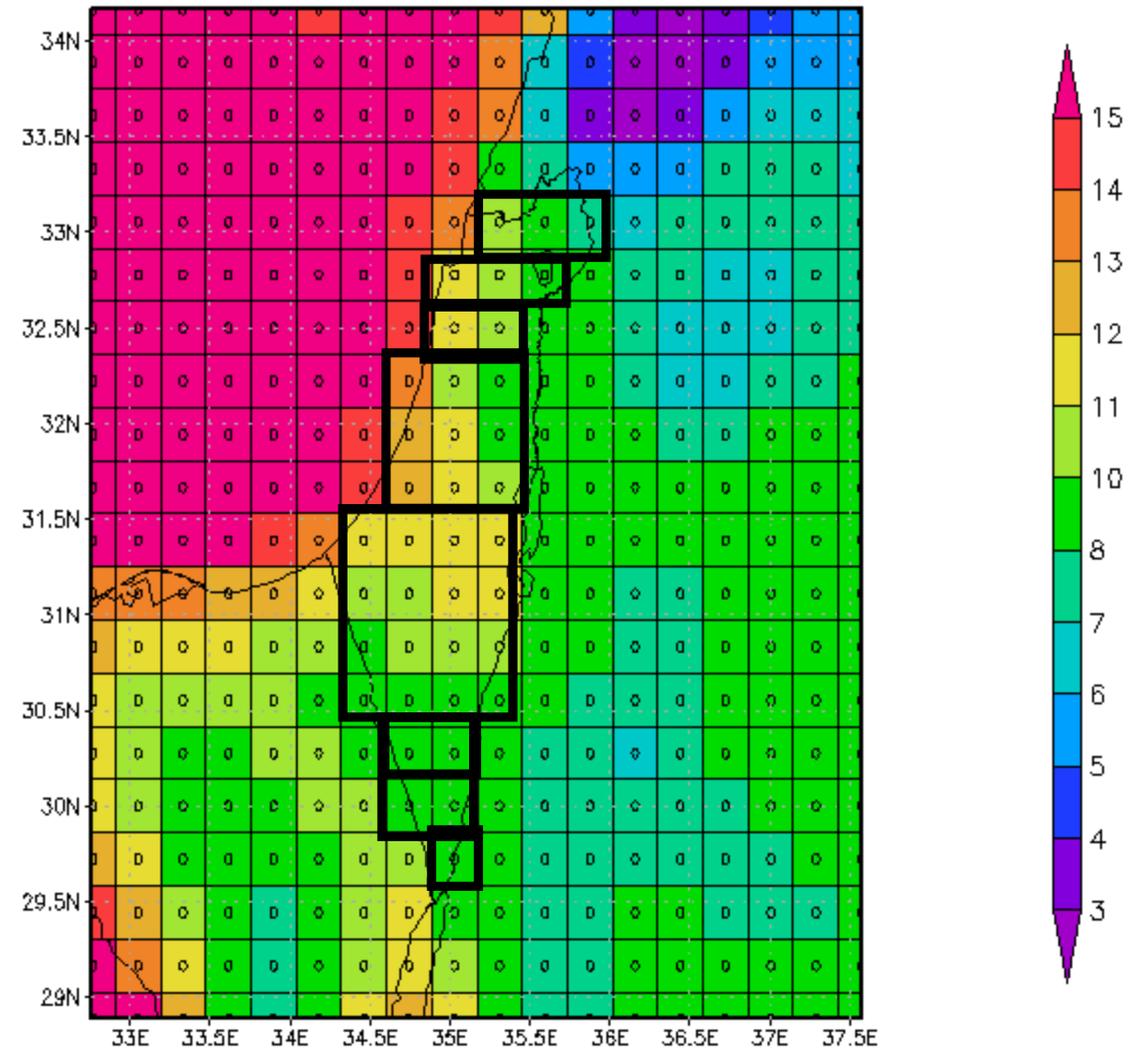
The final Surface temperature (T2m) prediction for DJF 2017/18 in Israel

SEAS 5 DJF T2m [c], from NOV model
for 1981-2010, mean on ensmble of 750 members

GrADS: COLA/IGES

2017-11-15-17:59
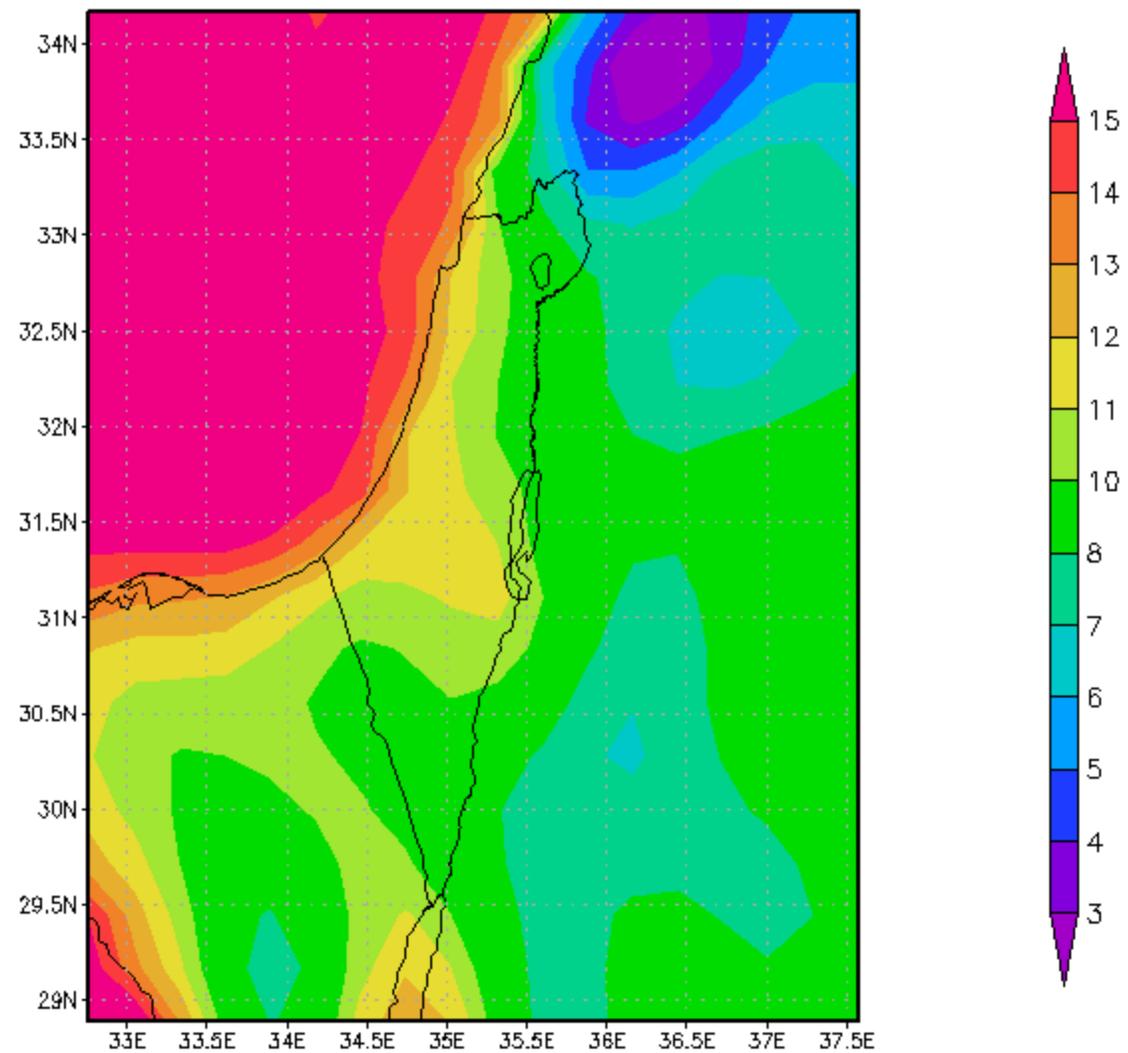
T2m Seasonal Forecasting by SEAS5 : 37 Grid points cover Israel

SEAS 5 DJF T2m [c], from NOV model
for 1981-2010, mean on ensmble of 750 members

GrADS: COLA/IGES

2017-11-15-17:59

T2m DJF Forecast for Israel by using the 37 grid points in Israel
**And climatological years of reference 1981/82-2010/11**

Using ECMWF Seasonal forecast SYSTEM 5 (SEAS5) from November 2017model (initial time 1/1/2017 00UTC)
and all 51 members of ensemble

1. warmer than the average (upper tercile) = 70.6%

2. "Normal" temperature (middle tercile) = 21.6

3. Colder than the average (bottom tercile) = 7.8%

The END

DJF mean precipitation amount difference between ERA interim to SEAS5 (SYSTEM 5)

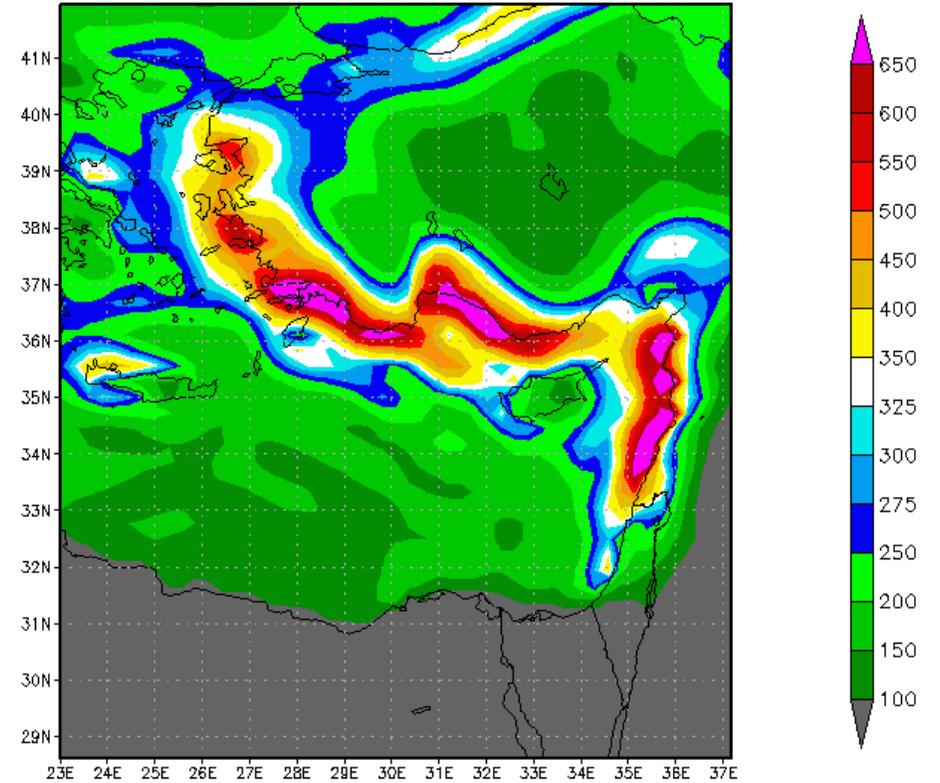

Sys4 DJF rain [MM], from NOV model
for 1981-2010, mean on ensmble of 450 members
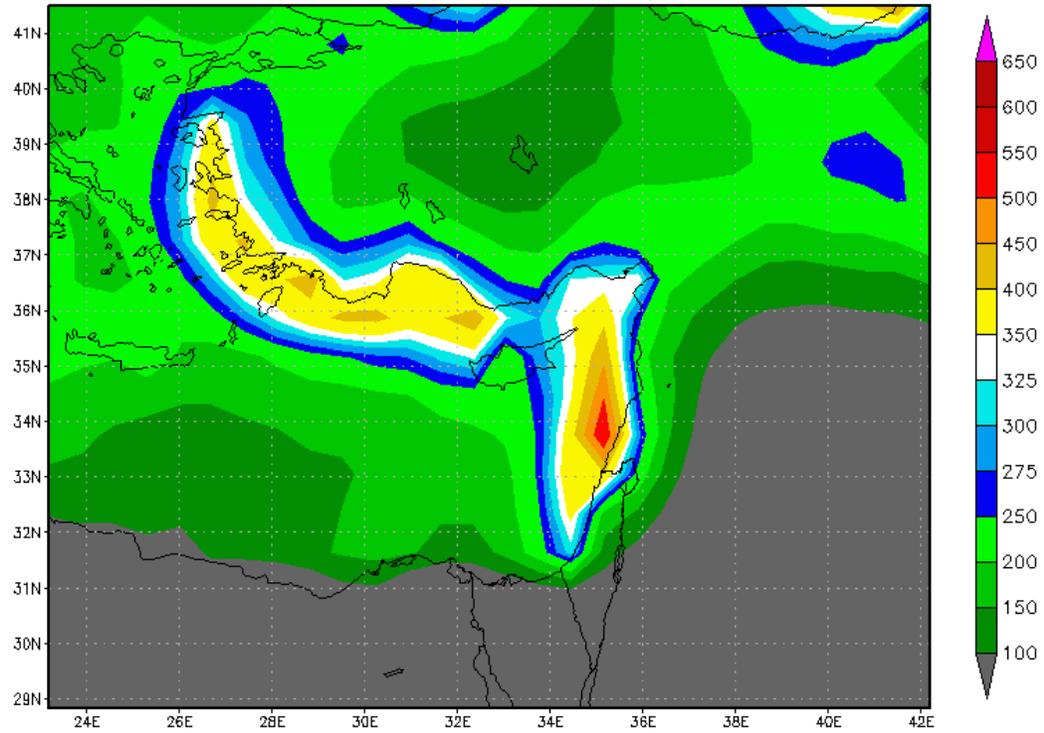
SEAS 5 DJF rain [MM], from NOV model
for 1981-2010, mean on ensmble of 750 members

SYSTEM 4, 5 grid points in Israel . NOV model
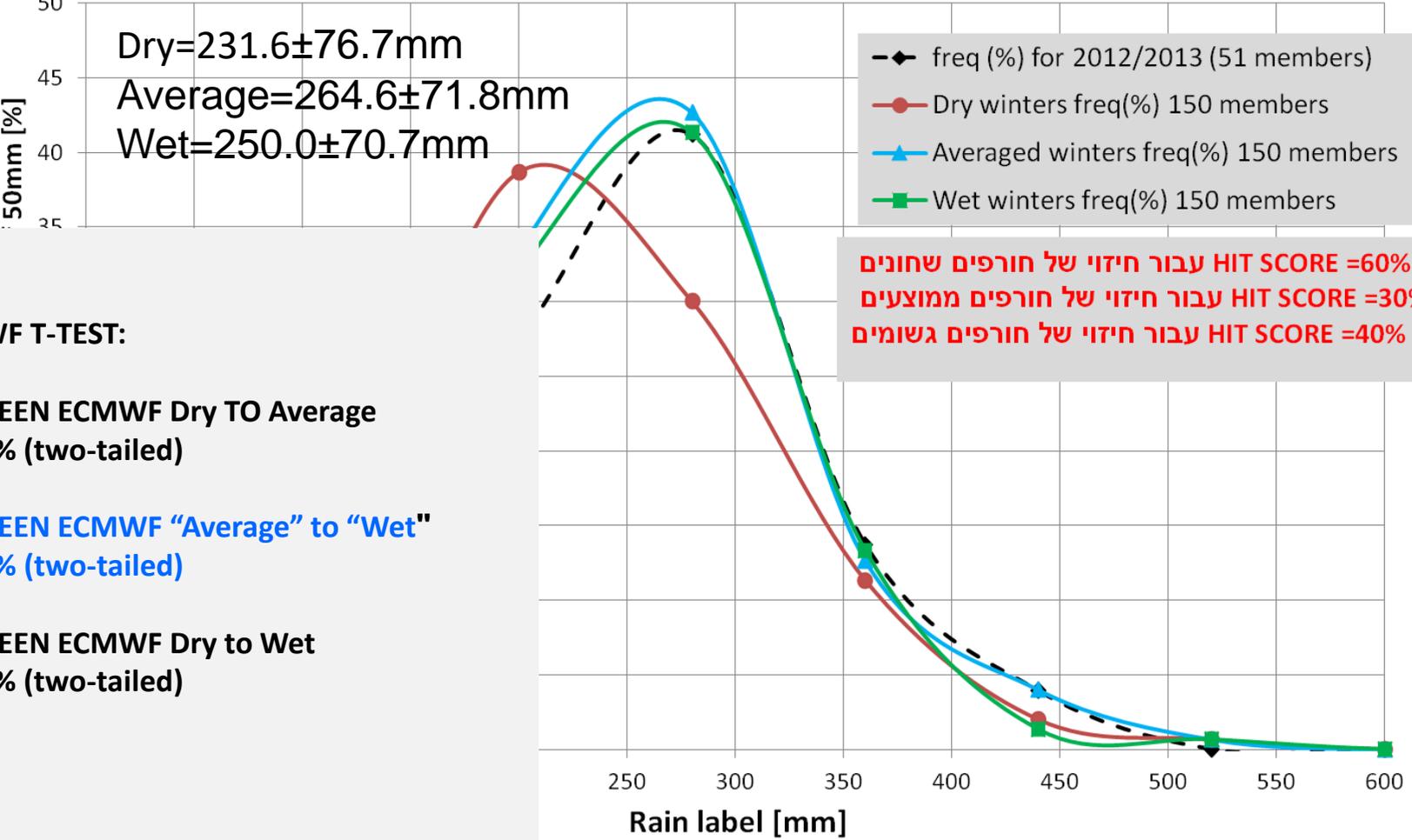Rain DJF 1981-2010 (450 ensemble)

SEAS5: Rain Distribution, 20 grids in Israel,DJF Rain,NOV model,Ense of 25 mem/year 1981-2016

The Highest sixth (6 years out of 36years, 150 members ✳
The Lowest sixth (6 years out of 36years, 150 members +
The middle sixth (24 years out of 36years, 600 members △

The Mean of the lowest 6 years out of 36 years is: 218.3mm (STD=61.5mm).
The Mean of the highest 6 years out of 36 years is: 241.4mm (STD=74.0mm).
The mean of the middle 24 years out of 36 years is: 234.3mm (STD=66.2mm).

Conclusions:
1. There is a significant difference between the highst 6 years to the lowest 6 years distribution (p<0.05).
2. There is a significant difference between the 6 lowest years to the 24 years in the middle (p<0.05).
3. There is NOT a significant difference between the 6 highst years to the 24 years in the middle (p>0.1).
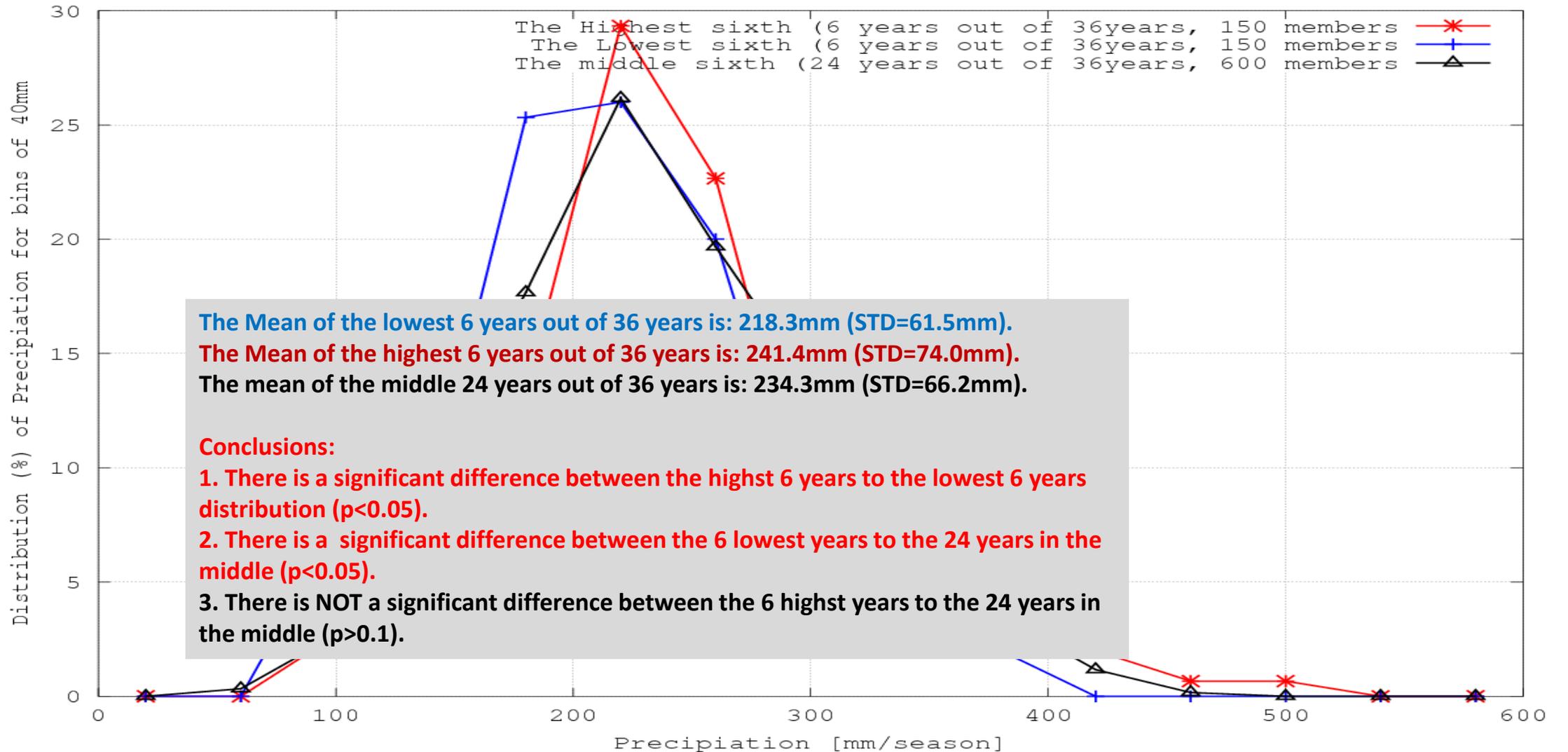
Prediction of DJF Rain in Israel from November 2017 model SYSTEM 5 by using 54 correlative (correlation>0.55) grid points in the seas

SEAS5: CORR of MEAN ENS DJF RAIN with Israel GIS RAIN
NOV mdoel with ENS 900 members 1981–2016

עבור האזורים בהם הקורלציה שווה או מעל 0.55
ה- HIT SCORE שיוצא (מיצוע כל נקודות השריג) הוא
44.44% (לפי חציון אנסמבל).   יש 54 נקודות שריג כאלו.
והקורלציה לאחר מיצוע 54 נקודות שריג היא 0.48 (לפי
חציון אנסמבל)

GRADS: COLA/IGES   2017-10-31-17:55
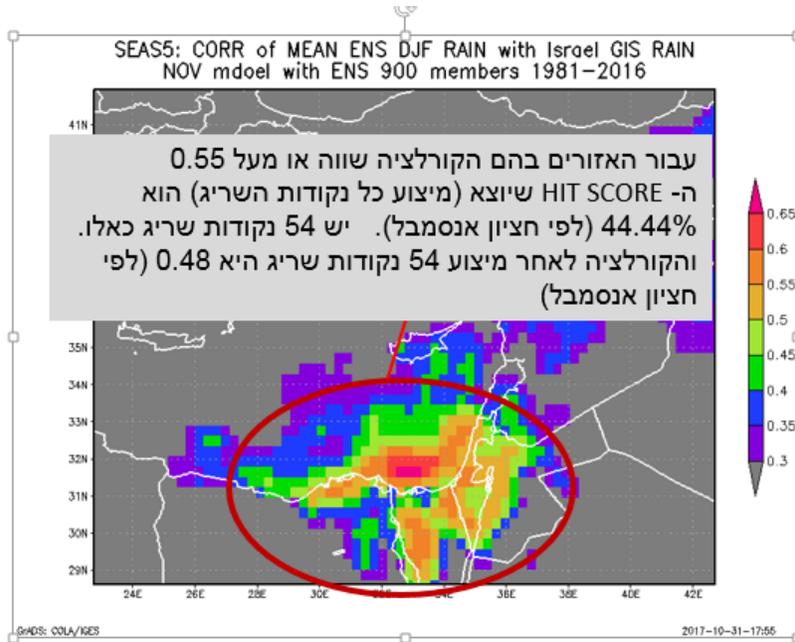
1. **Lower tercile ("drought winter") probability: 35.3%.**

2. **Middle tercile ("Normal winter) probability: 35.3%.**

3. **upper tercile ("wet winter") probability: 29.4%.**

Conclusion : According to ECMWF Ensemble prediction from SYSTEM 4, there is not signal and preferred category hence, there is no category probability which equal 40% or above.