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Development of a model for the forecast El Nino and La Nina events using neural networks

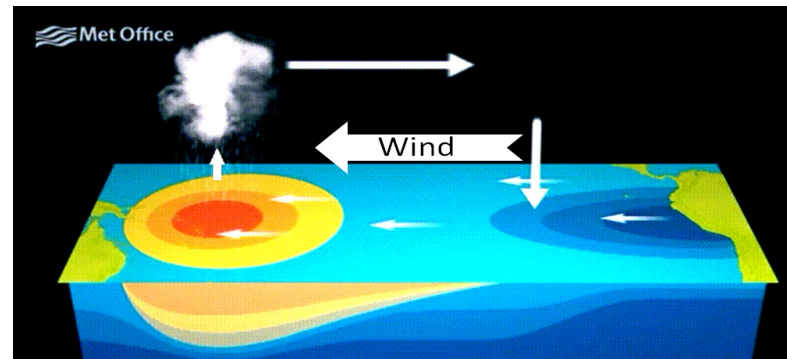
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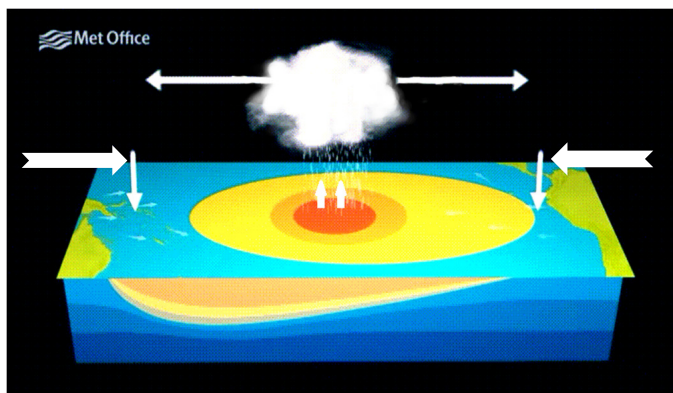
El-Nino – Southern oscillation (ENSO)

Normal conditions

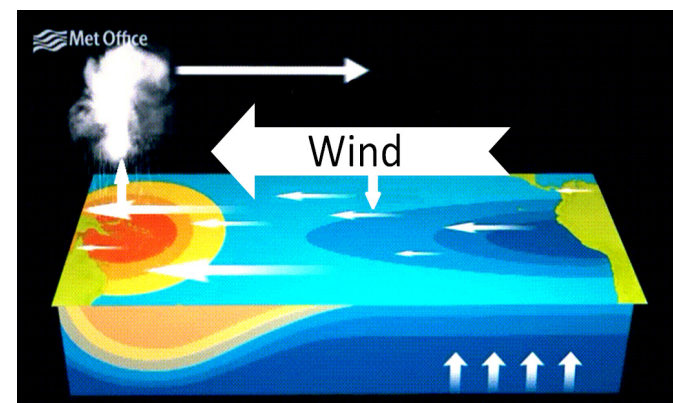


Quasi-periodic oscillation with the 2-7 years period,
observed in the Equatorial Pacific Ocean

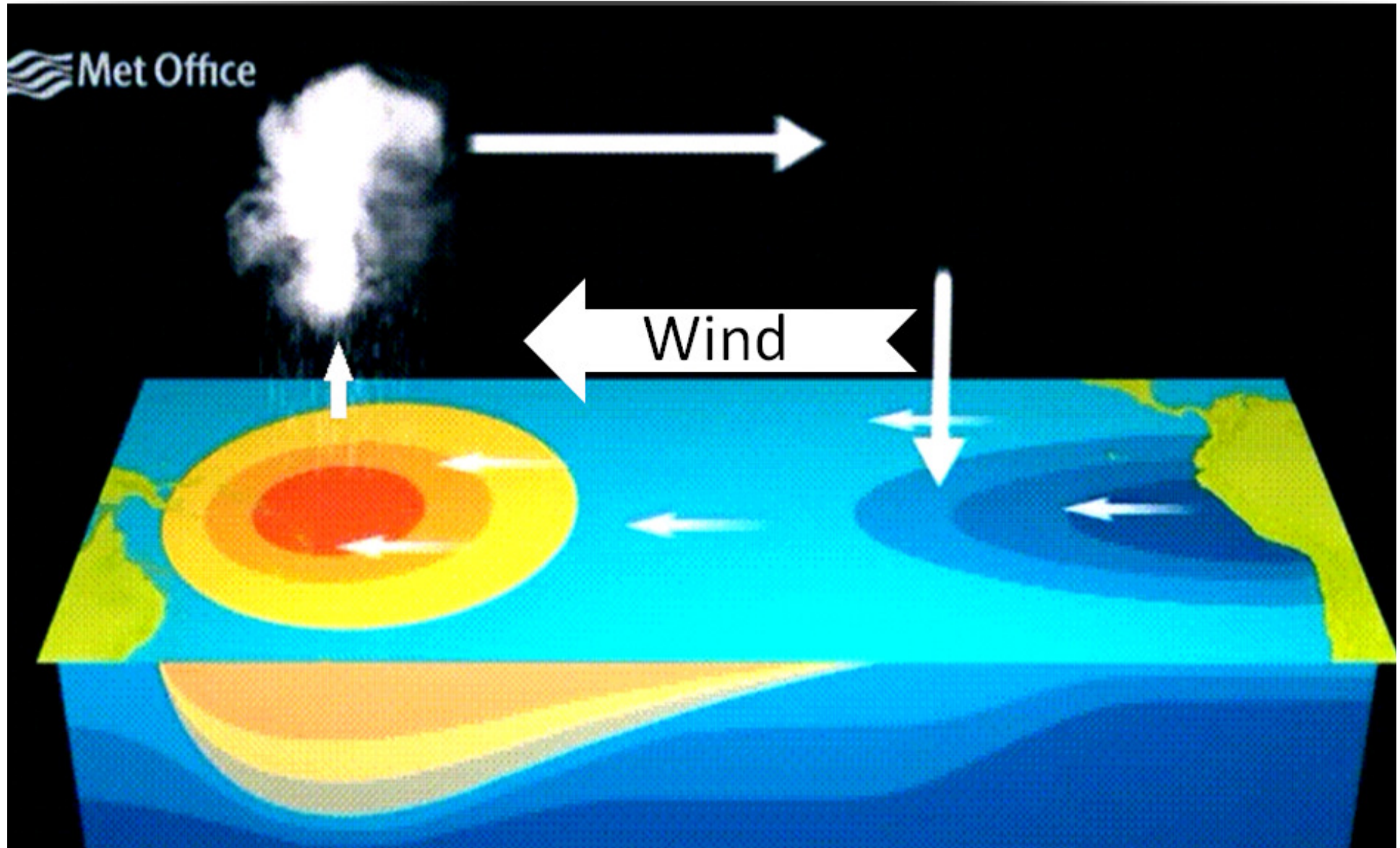
El - Nino



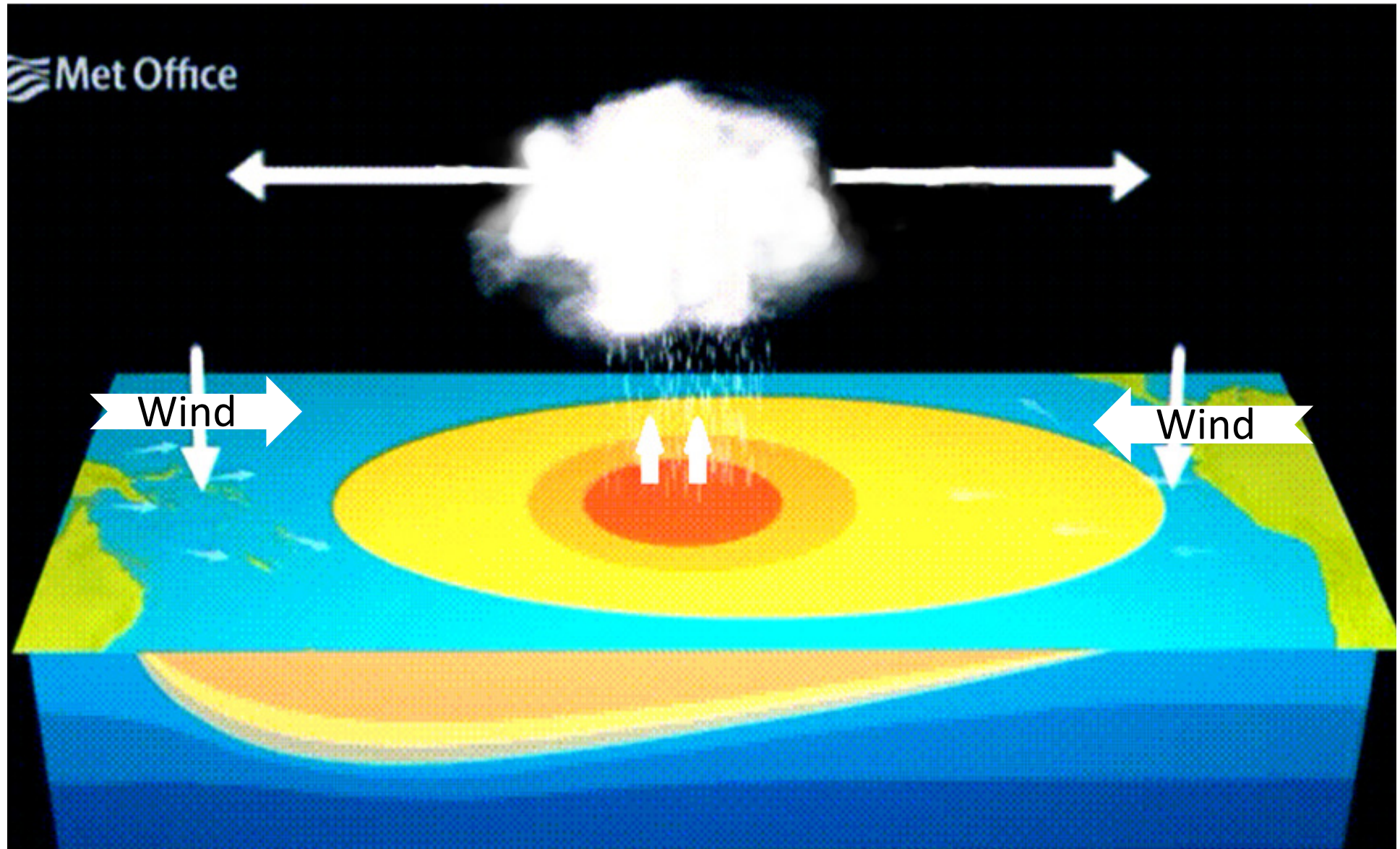
La - Nina



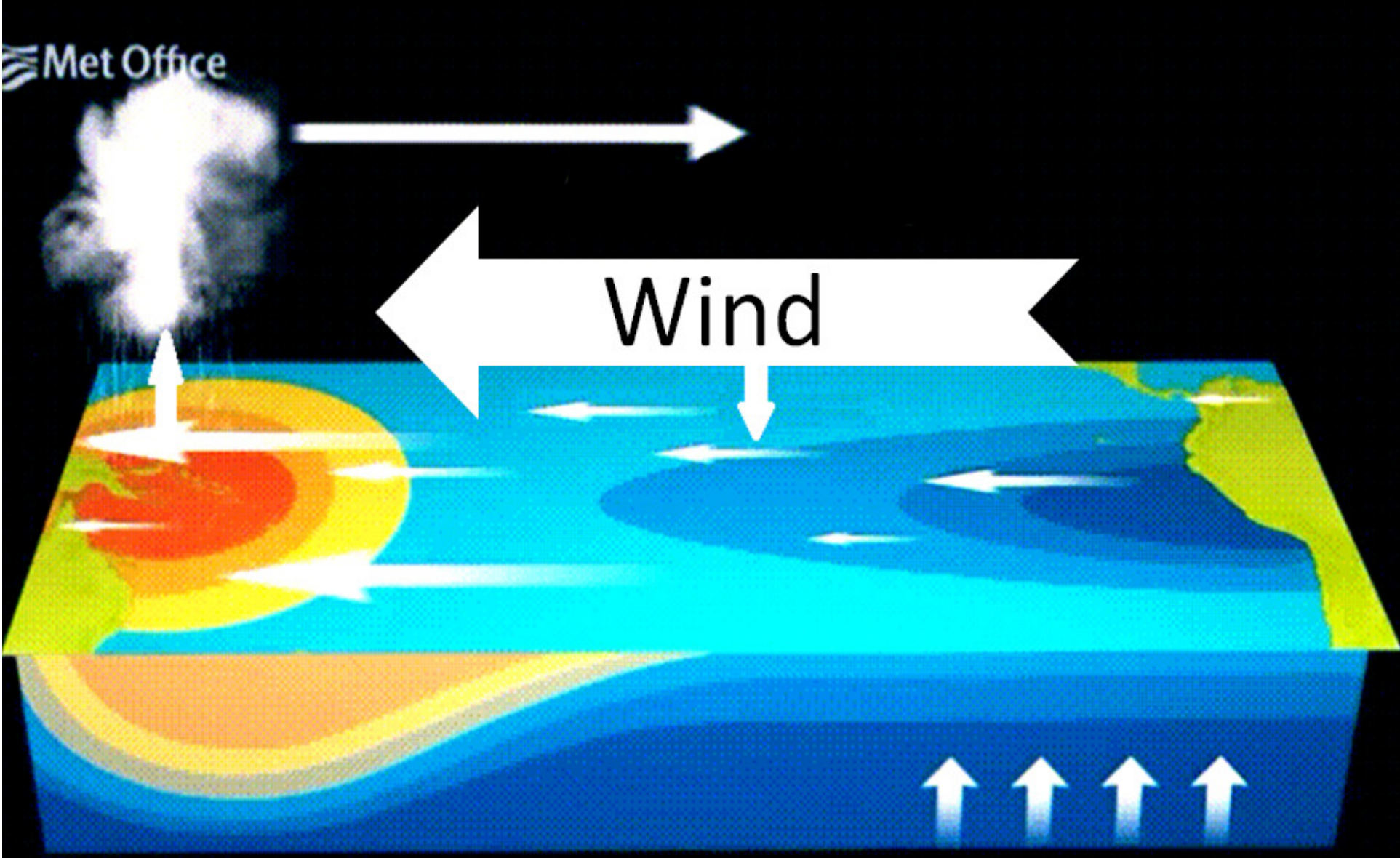
Normal conditions



El Nino



La Nina



ENSO is associated with natural disasters such as
Floods in Peru



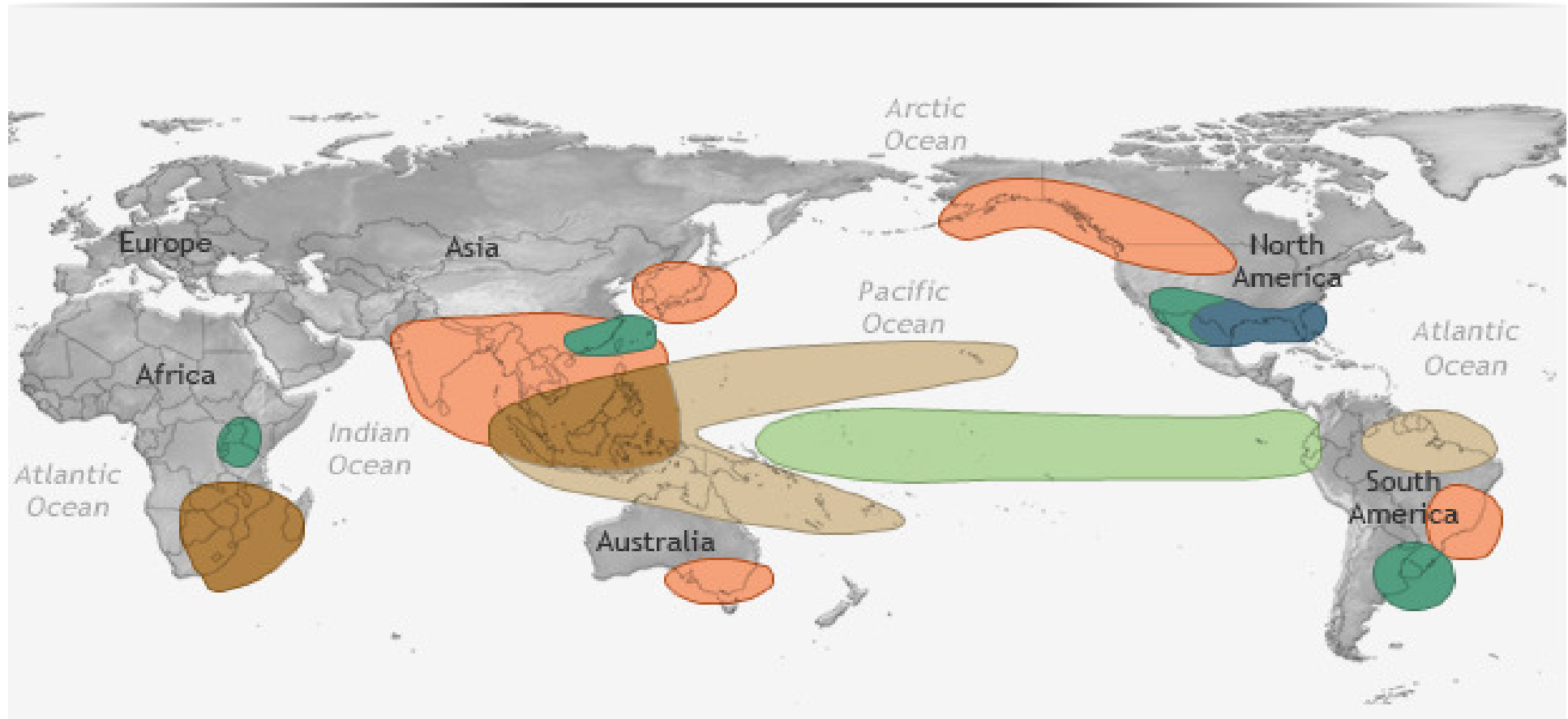
ENSO is associated with natural disasters such as
Fires in Australia



ENSO is associated with natural disasters such as
Blooming flowers in the Atacama Desert



Climate response patterns



El Niño patterns
December-February



Aim of our research...



The forecast
of *Nino 3.4*

Datasets



- HadSST during 1870-2019 used for calculate Nino 3.4 index.



- SLP and geopotential on 500mb was taken from reanalysis 20CR during 1870-1948 and reanalysis NCEP/NCAR during 1948-2019. This database was used for calculate atmospheric indexes



Atmospheric pressure indexes

North Pacific oscillation	NPO
Middle Northern Hemisphere	MNH
Arctic oscillation	AO
North Atlantic oscillation	NAO
East Atlantic oscillation	EA
Mongolia-Scandinavia-East pattern	SCAND
Polar/Eurasia pattern	POL
West pacific oscillation	WP
Europe - Caspian - North China - North America pattern	EA/WR
North Pacific - North America pattern	PNA

Northern
Hemisphere
indexes

Southern
Hemisphere
indexes

MSH	Middle Southern Hemisphere
SIZ	Indian zonal pattern
SIM	Indian meridional pattern
SAO	South Atlantic oscillation
SA/S	South Atlantic max. - South Ocean min. pattern
Pol/Tas	Polynesia-Tasmania pattern
SPO	South Pacific oscillation

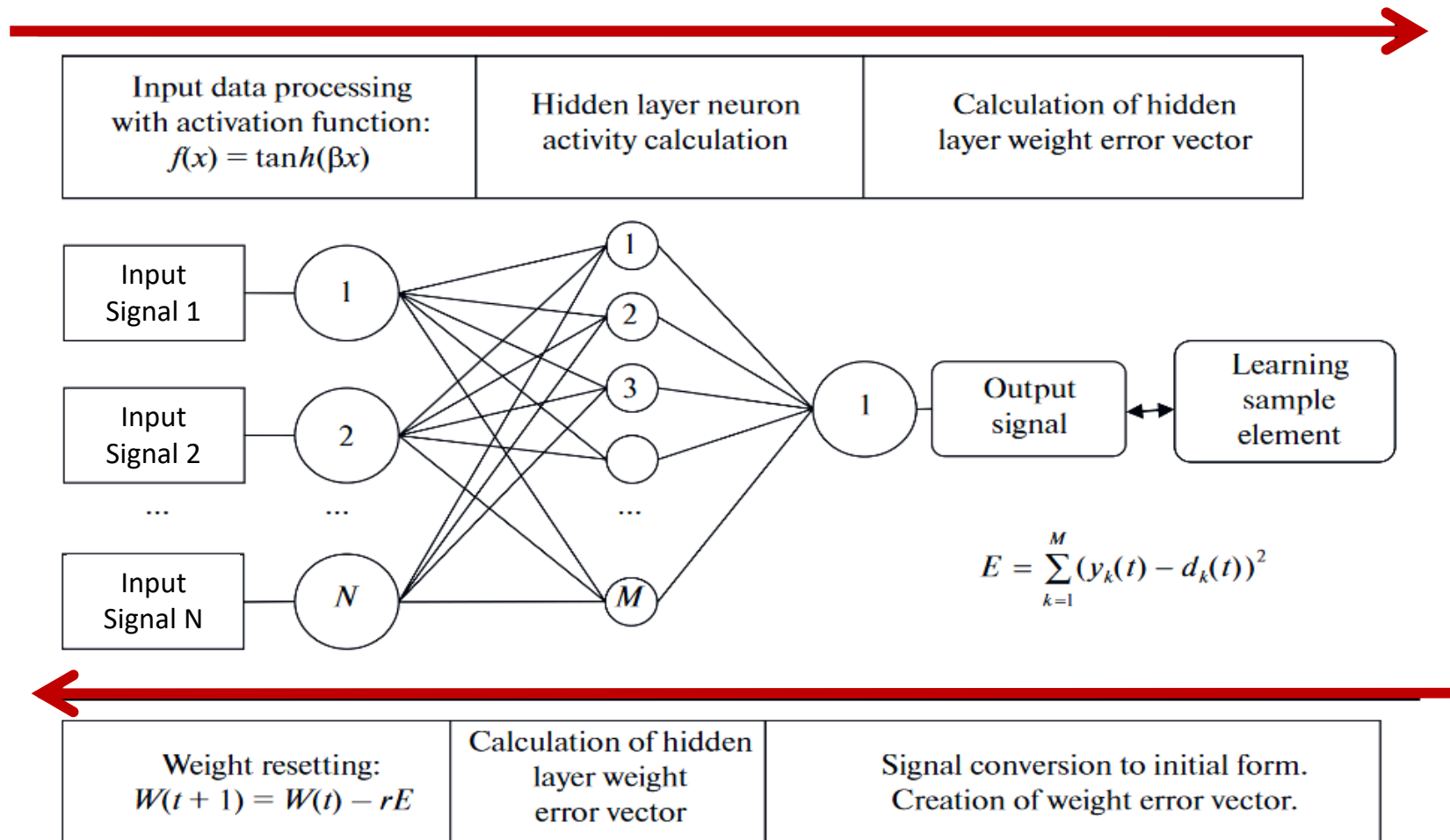
the Pacific Ocean mid-latitudes sum	MNP+MSP
subequatorial latitudes	EqO
Equatorial Pacific - Indonesia	EP/EI
Atlantic – Equatorial Pacific	EA/EP

Equatorial
and other indexes

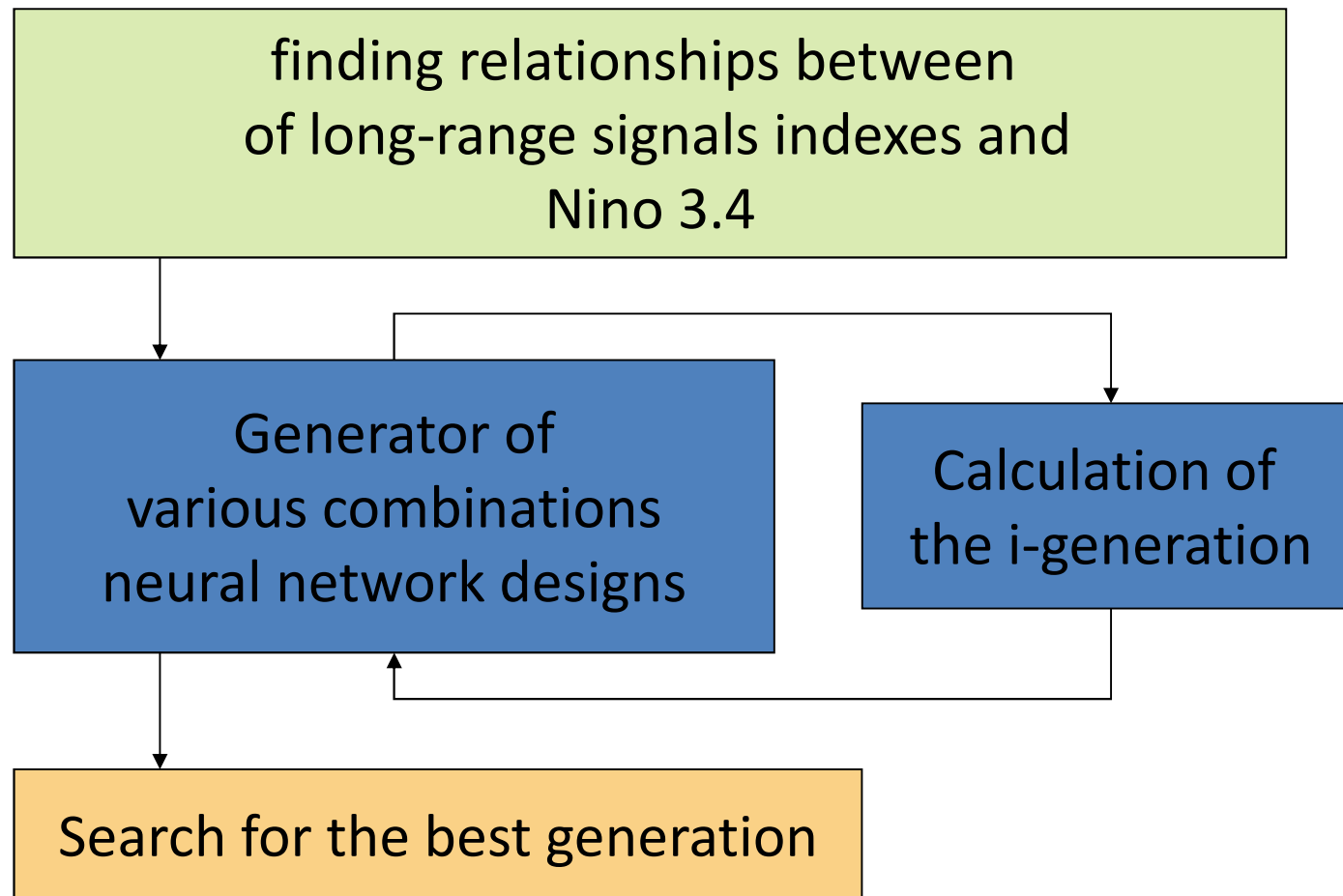


Chart of training the neural network

Here W – is the weight of neural activity; t – is the time step; r – is the coefficient of training rate; E – is the objective function; y_k – is the set of output signals; d_k – is the set of elements of learning sample; N – is the total number of neurons in the input layer; M – is the total number of neurons in the hidden layer; k – is the neuron number in the hidden layer

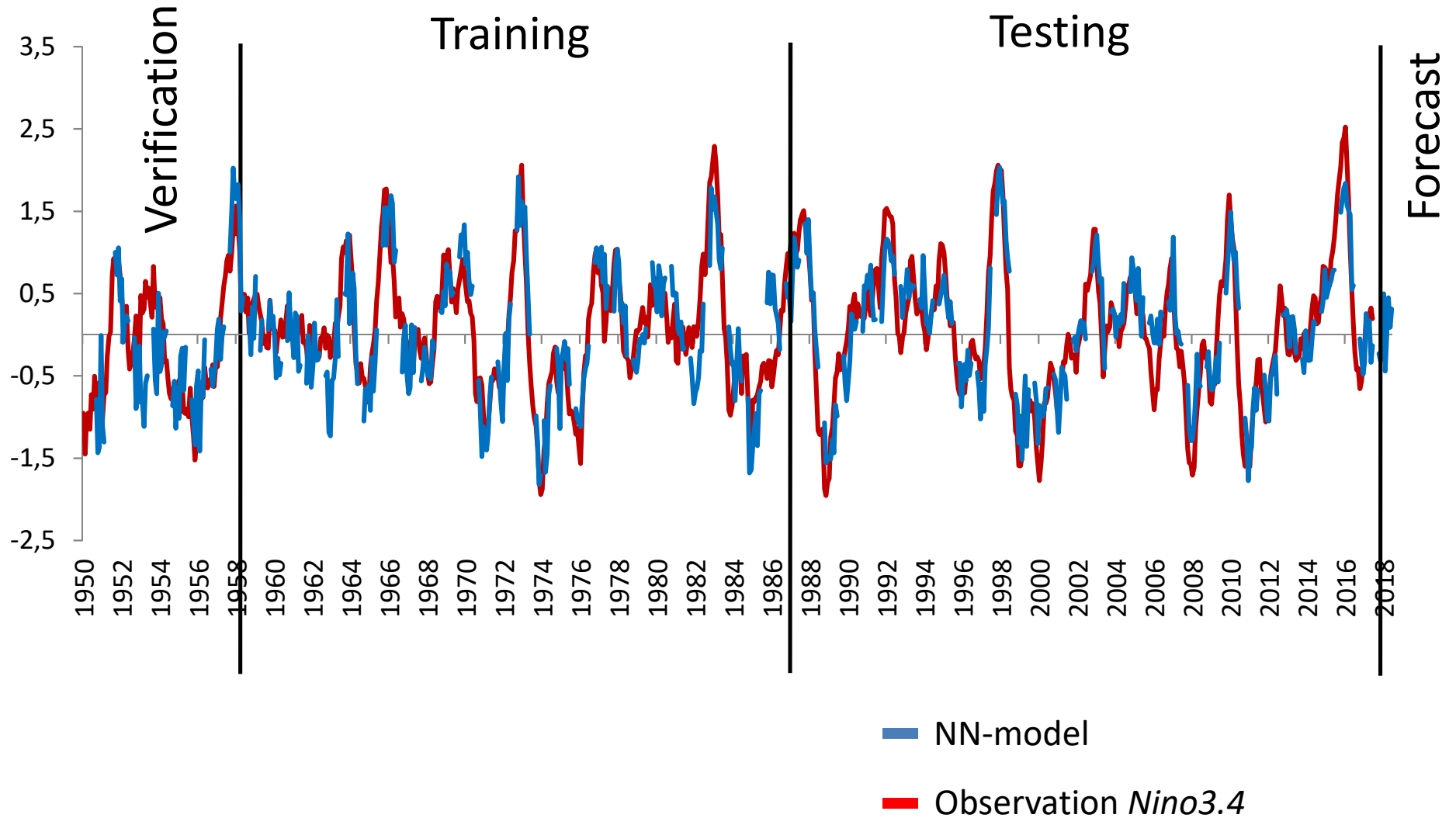


This model includes 3 stages...



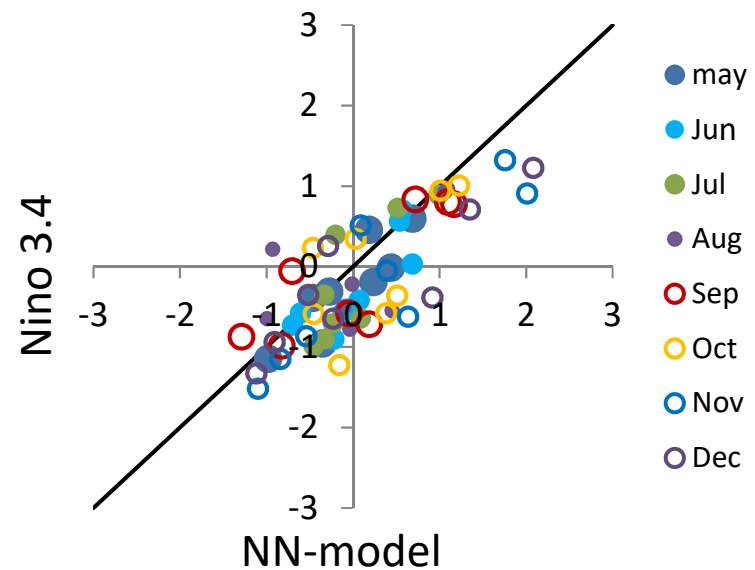
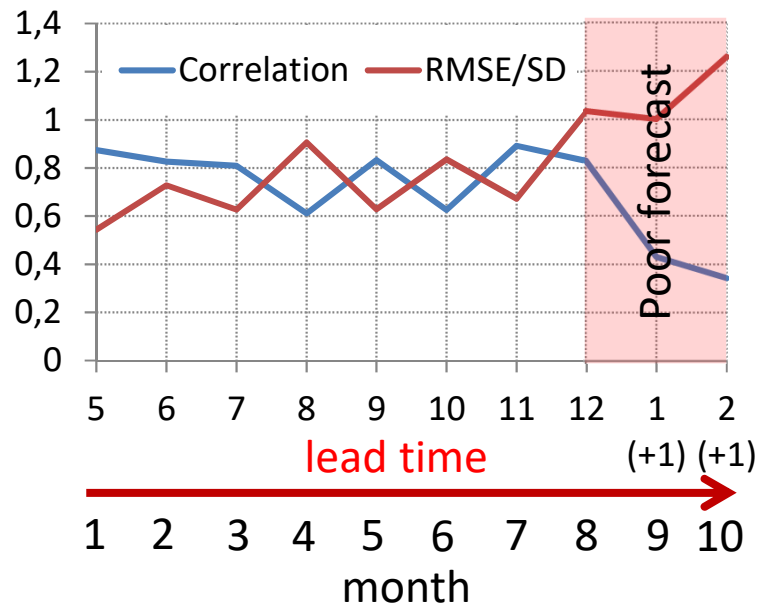
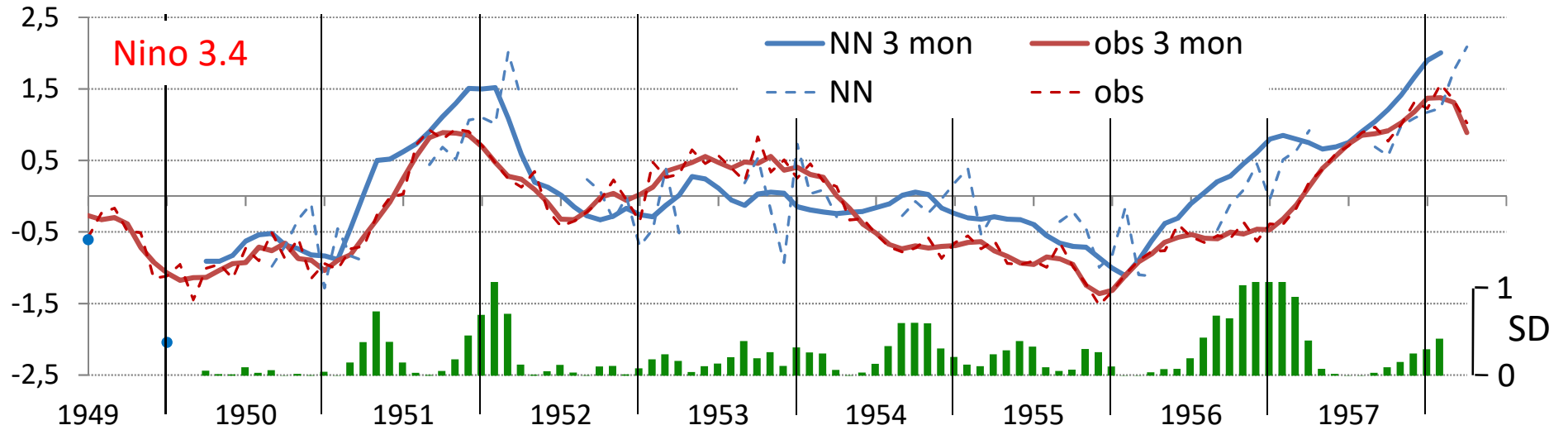
Results

We modeled index *Nino 3.4* using neural network...



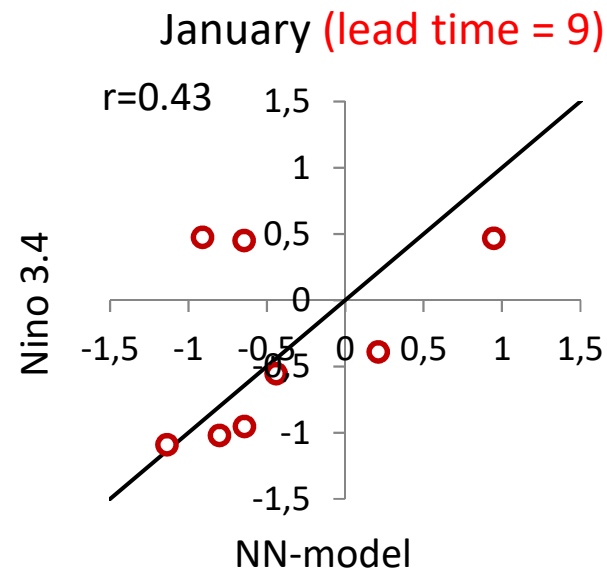
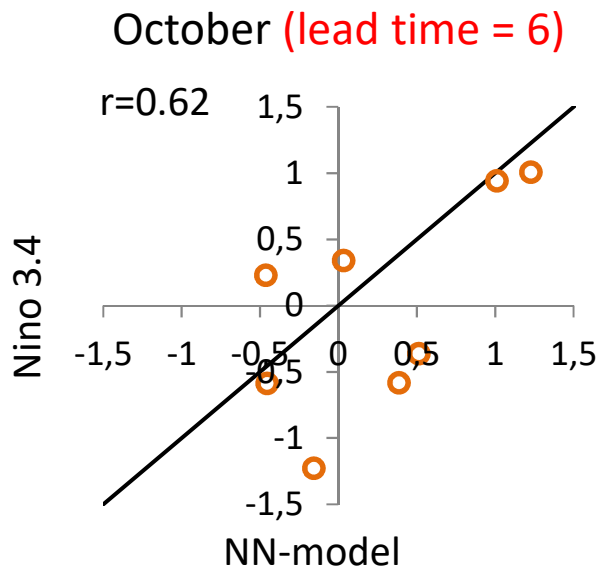
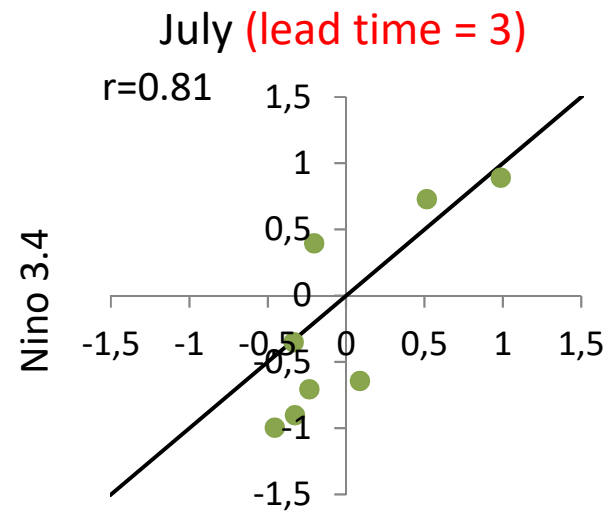
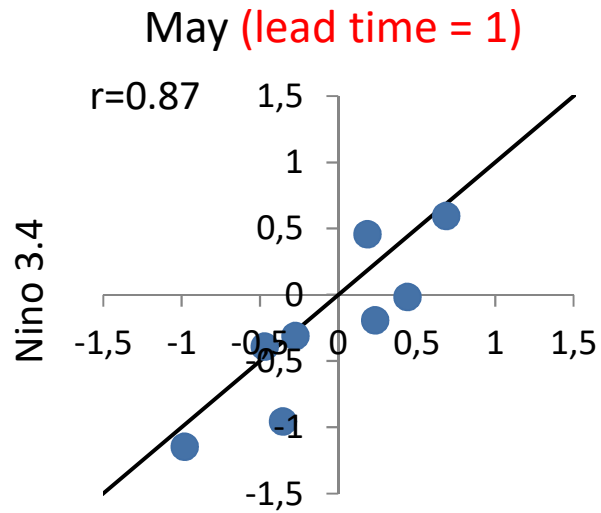
Verification

The verification of NN-model is provided based on the control dataset at the period 1949-1958



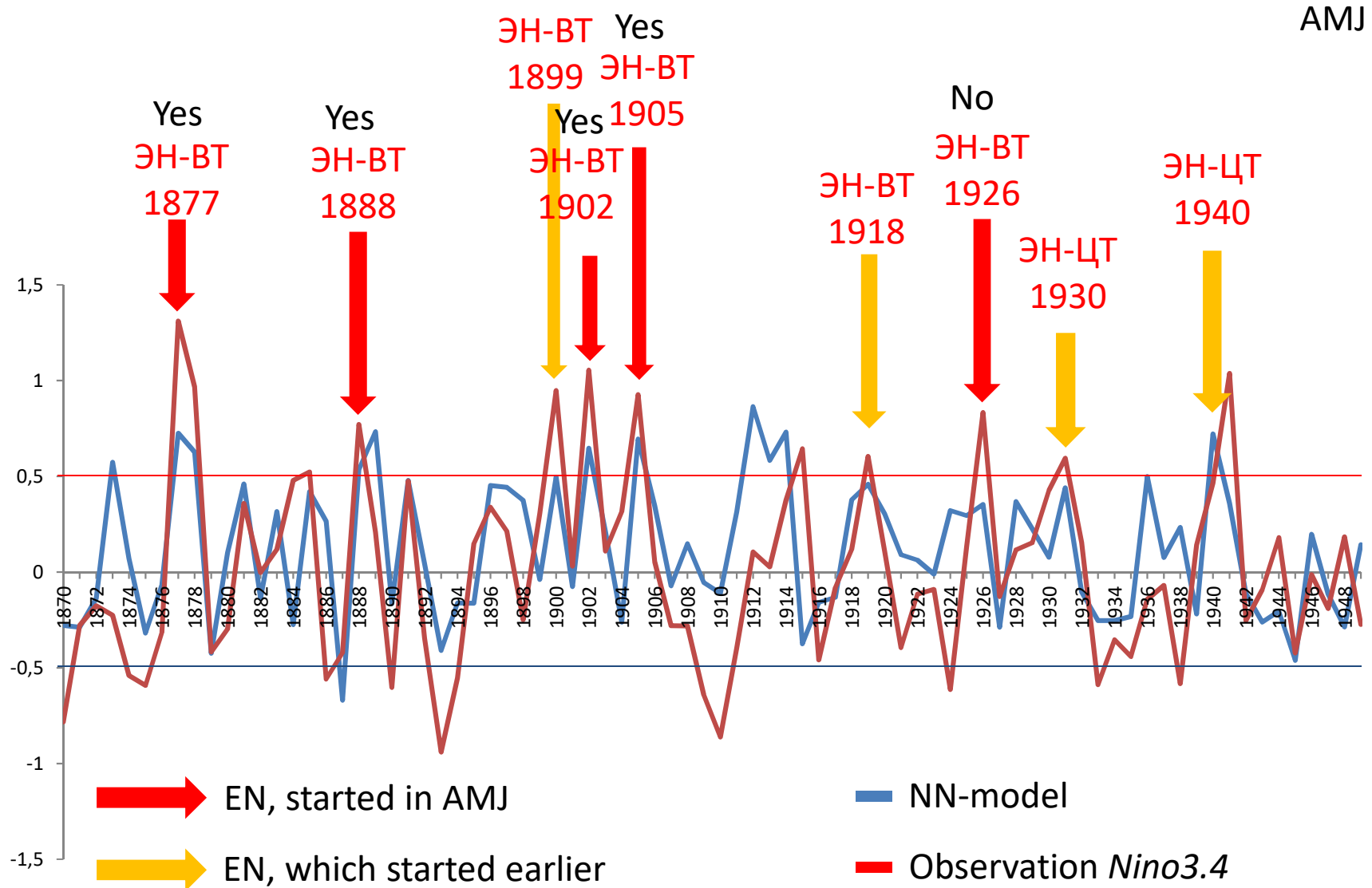
Comparative analysis

for May, July, November and January



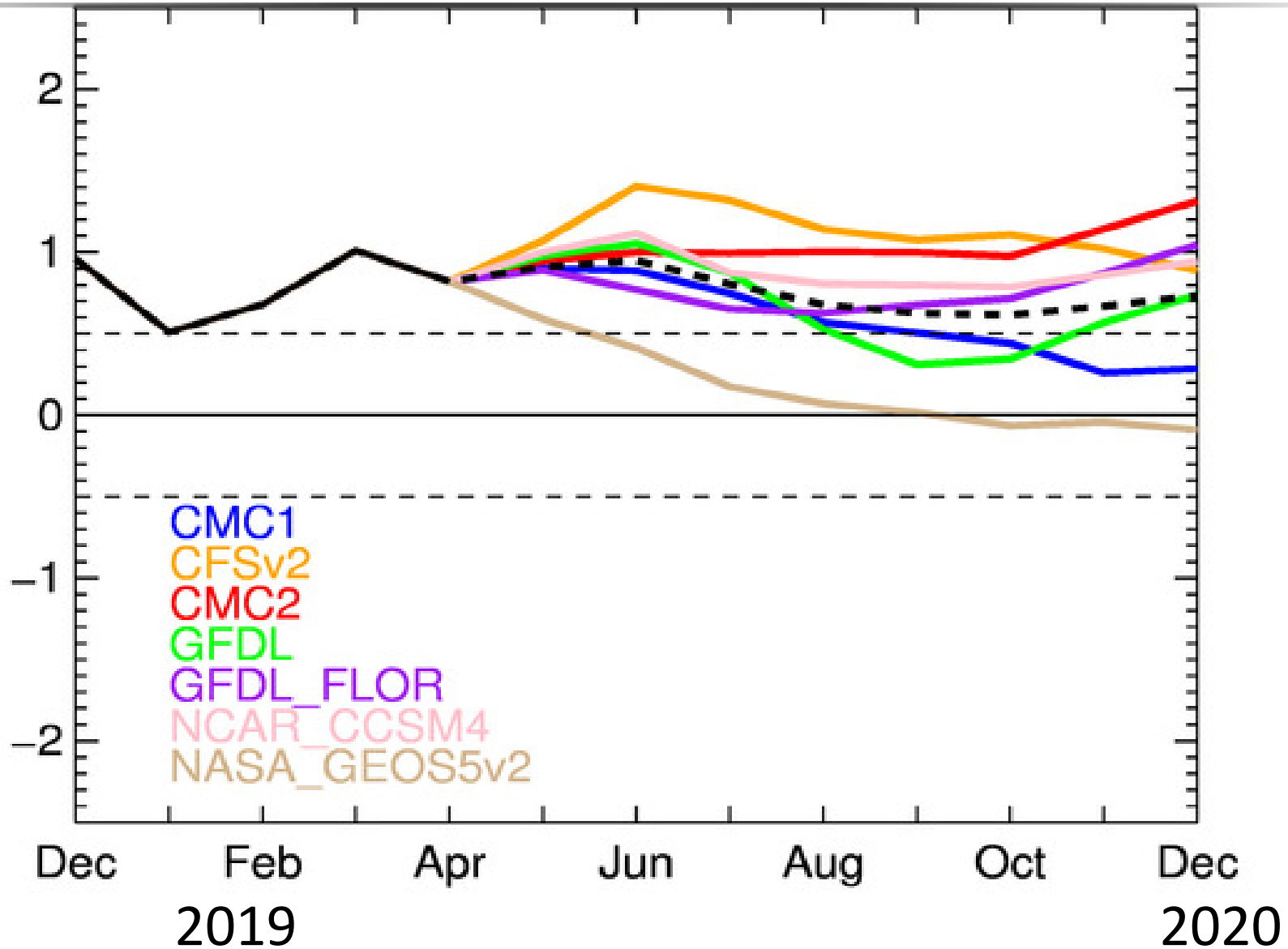
Retrospective Forecast

Can a NN-model predict the start of El Nino events?
 We used 20CR for test (lead time in this experiment = 3)



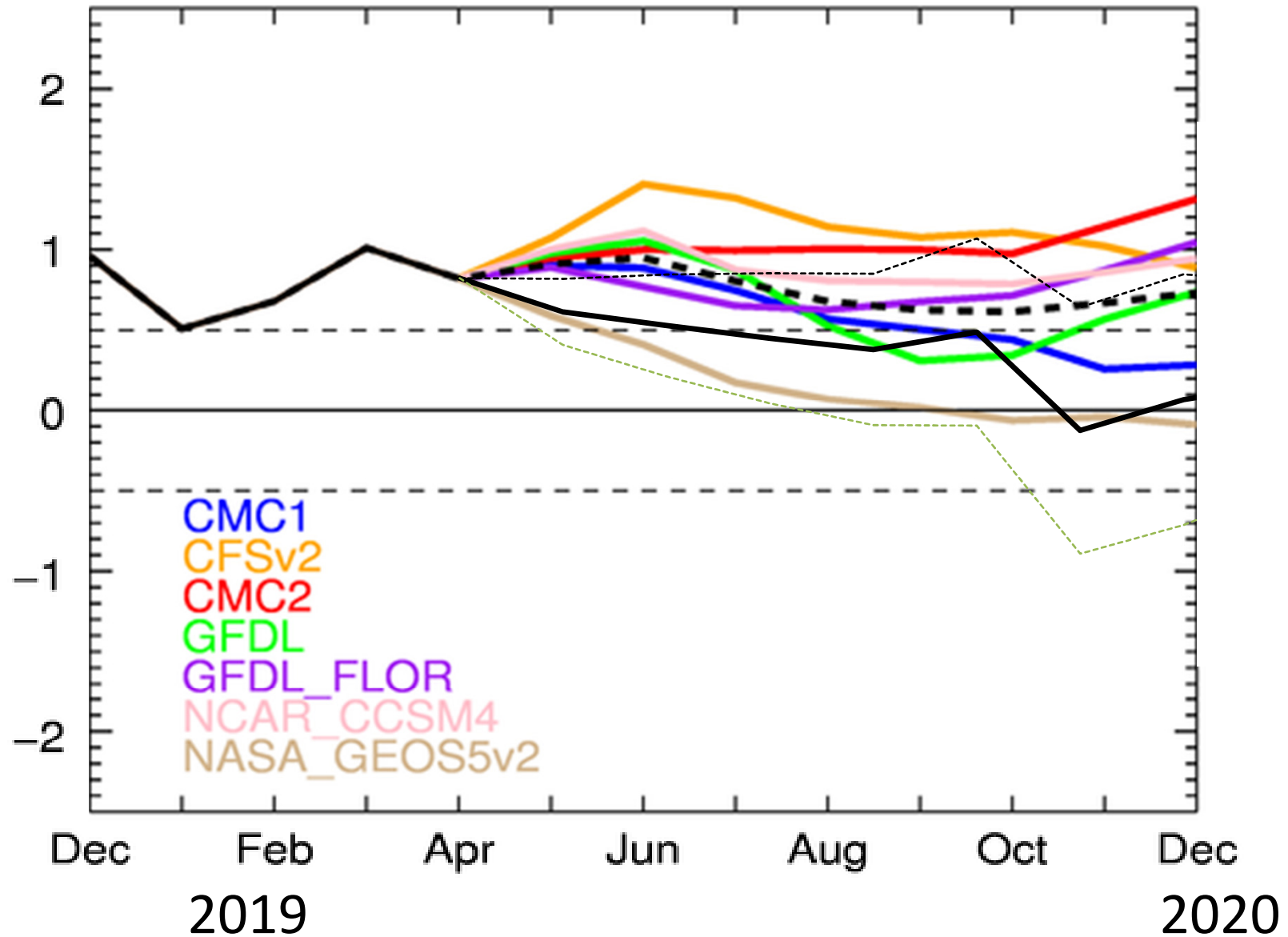
Ensemble Mean

NMME Nino3.4 Fcst, IC=201905

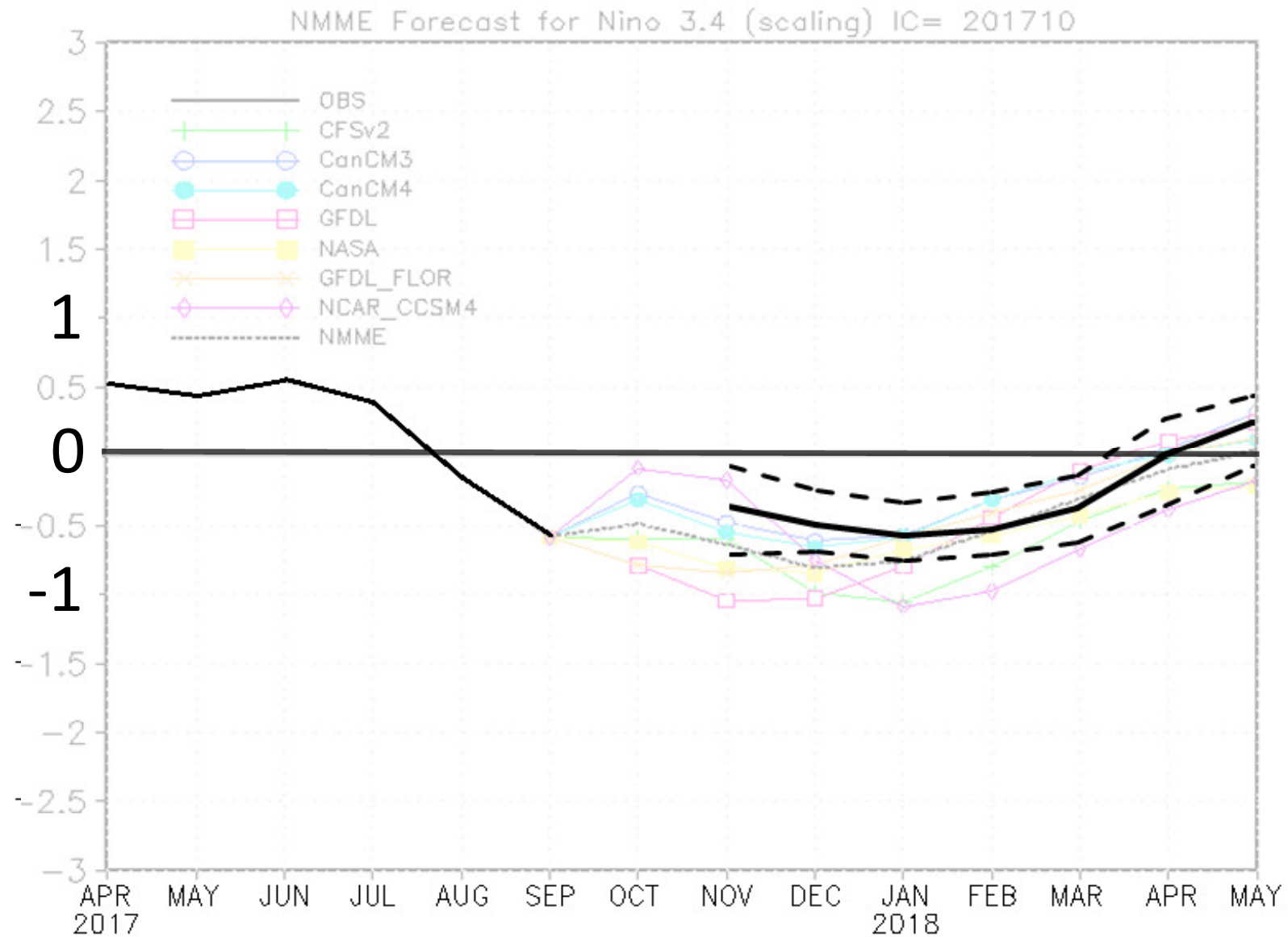




Forecast using NN-model for 2019



Forecast La-Nina for 2017





*Thanks for your
attention!*

Contact Information

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