

Long-term El Niño forecasting

Josef Ludescher



POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH



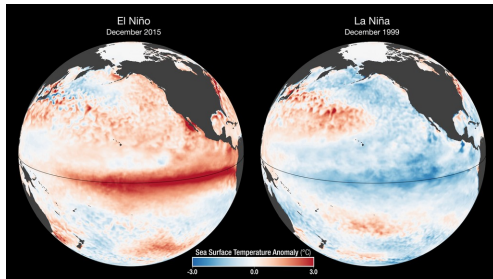
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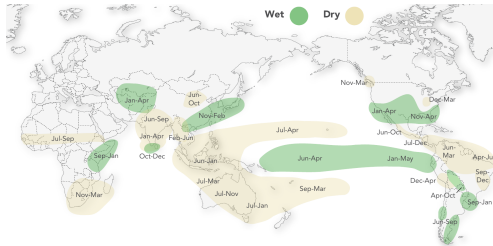
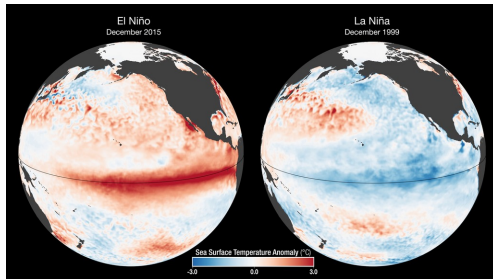
on the basis of a decision
by the German Bundestag



El Niño Southern Oscillation



El Niño Southern Oscillation



Social and economic consequences



Floodings



Agriculture



Fresh Water & Power



Fisheries



Infrastructure



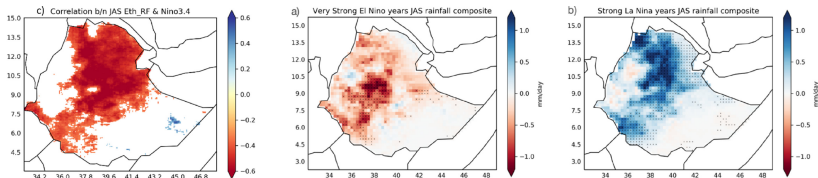
Wildfires



Public health

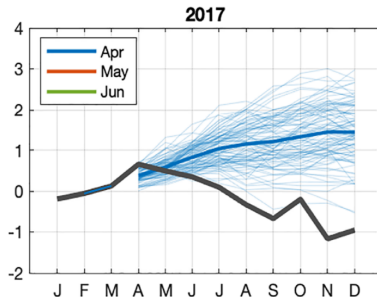
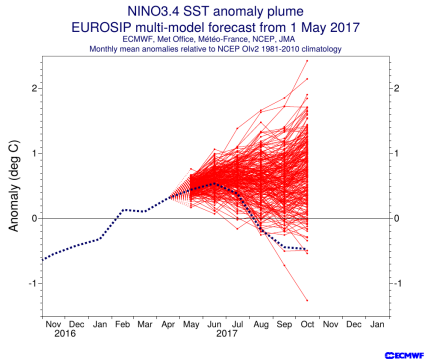
Biodiversity

Impact of El Niño on Kiremt



- Single main rain season (June-September) for central and northwestern Ethiopia
- Accounts for 65% to 95% of all Ethiopian annual rainfall
- Up to 50% of variability due to ENSO [Gleixner et al. (2017)]

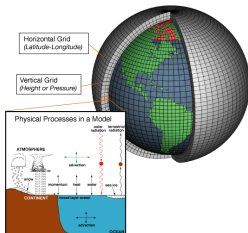
Spring predictability barrier



El Niño predictions before or during the boreal spring are particularly challenging

Two kinds of El Niño prediction models

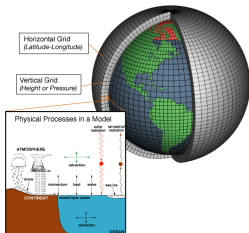
Dynamical models



- are initialized by observations
- simulate directly the development of physical quantities

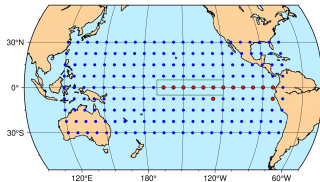
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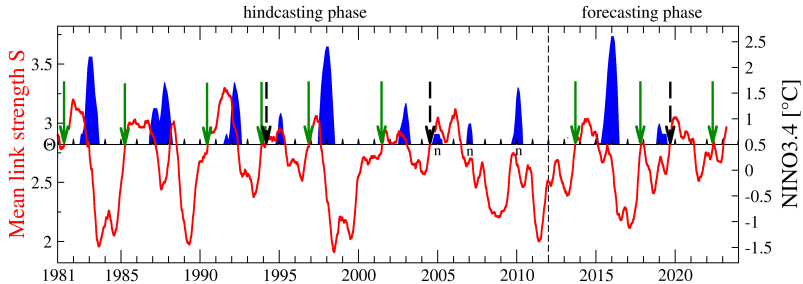
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Statistical models

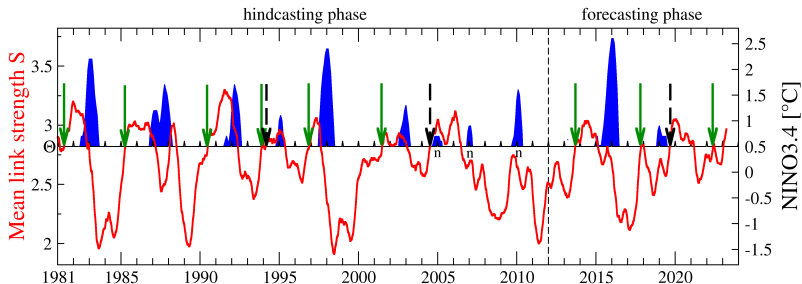


- use statistical relationships within the observational data
- In our case: regard data as a network

Climate network forecasting performance



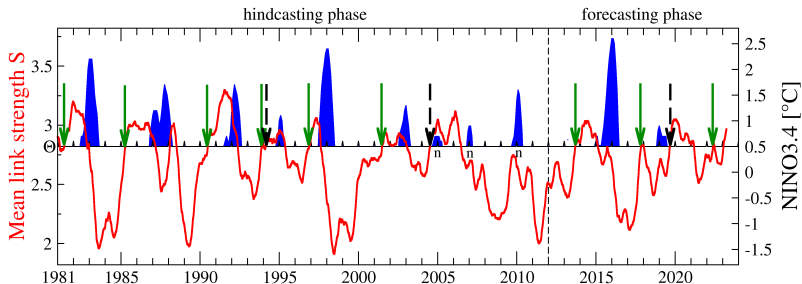
Climate network forecasting performance



In total, 10 out of our 11 forecasts were correct ($p = 0.017$)

p-value (hindcast + forecast) = $3.5 \cdot 10^{-5}$

Climate network forecasting performance

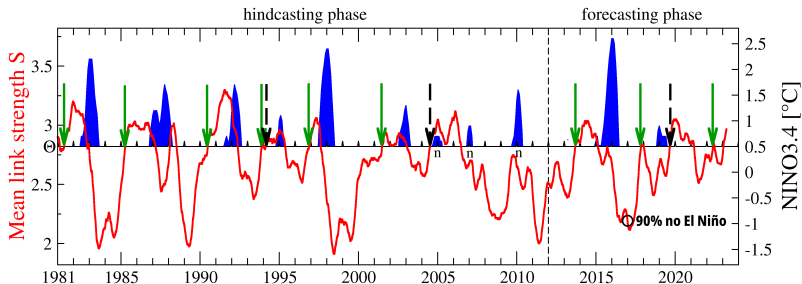


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In June 2022, the method forecasted the onset of an El Niño in 2023

Climate network forecasting performance



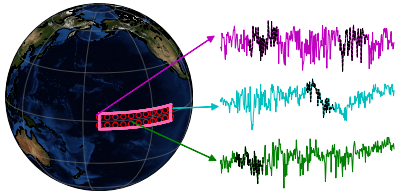
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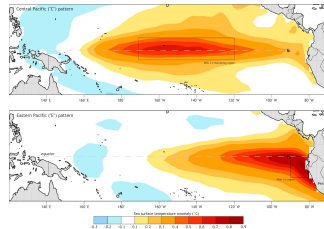
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Forecasts before the spring barrier also possible for:

- El Niño **magnitude**



- El Niño **type**



Forecast for 2023:

Very early warning of a moderate-to-strong El Niño in 2023

Josef Ludescher¹, Jun Meng², Jingfang Fan³, Armin Bunde⁴, and Hans Joachim Schellnhuber¹

¹Potsdam Institute for Climate Impact Research, 14412 Potsdam, Germany



Our forecast, data until Nov 2022:

- El Niño onset with 89% probability
- Moderate-to-strong ($1.49 \pm 0.37^\circ\text{C}$)
- Eastern Pacific type 86% prob.

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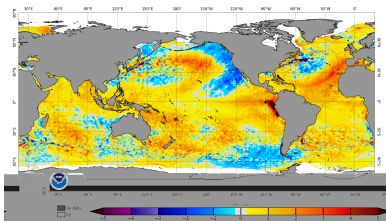
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NOAA Coral Reef Watch Daily 5km SST Anomalies (v3.1) 1 May 2023



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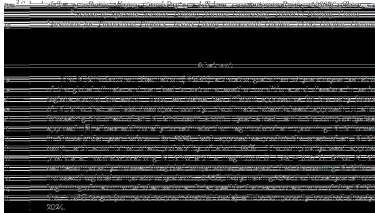
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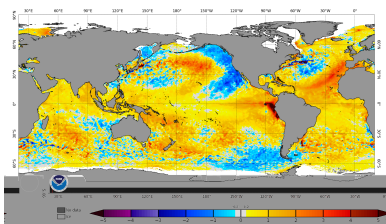
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WMO, “Prepare for El Niño“, May 2023:

- “80% between July and September”
- “At this stage there is no indication of the strength”

Skillful probabilistic El Niño forecasts across the spring barrier are possible:

- The climate network approach can forecast the **onset** of an El Niño event or its absence about 1 year in advance
- Forecasting the **magnitude** and **type** are also possible in the calendar year before onset