

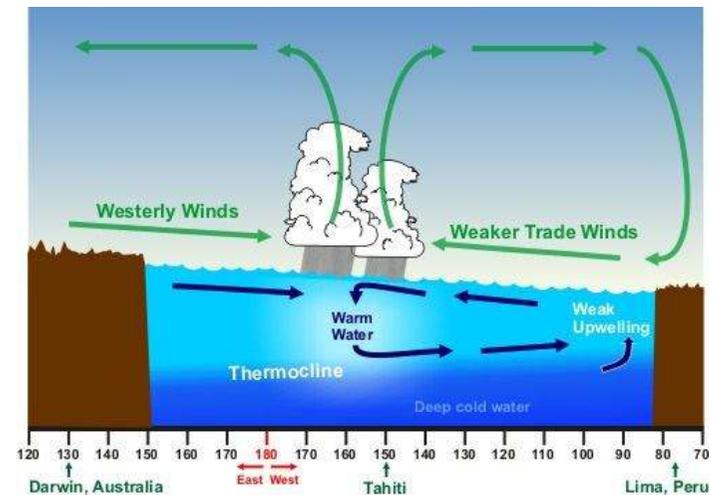
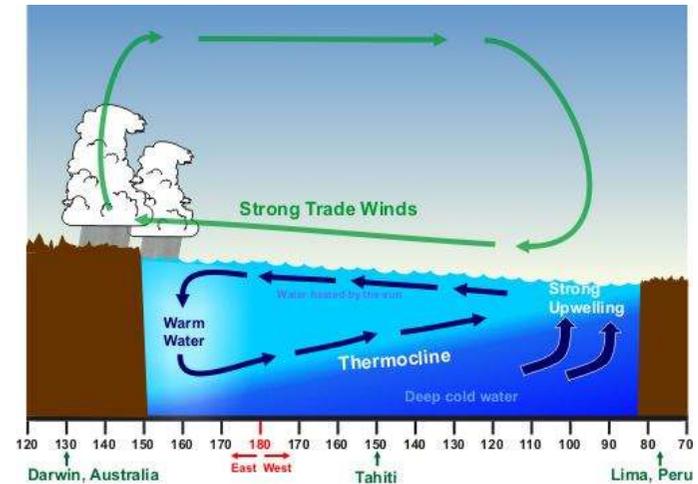
Influence of El Niño– Southern oscillation on Europe in a changing climate

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Challenges in meteorology 3: Extreme weather
and impact on society
November 22nd, 2013.

Mentor: prof. Ivana Herceg Bulić, PhD

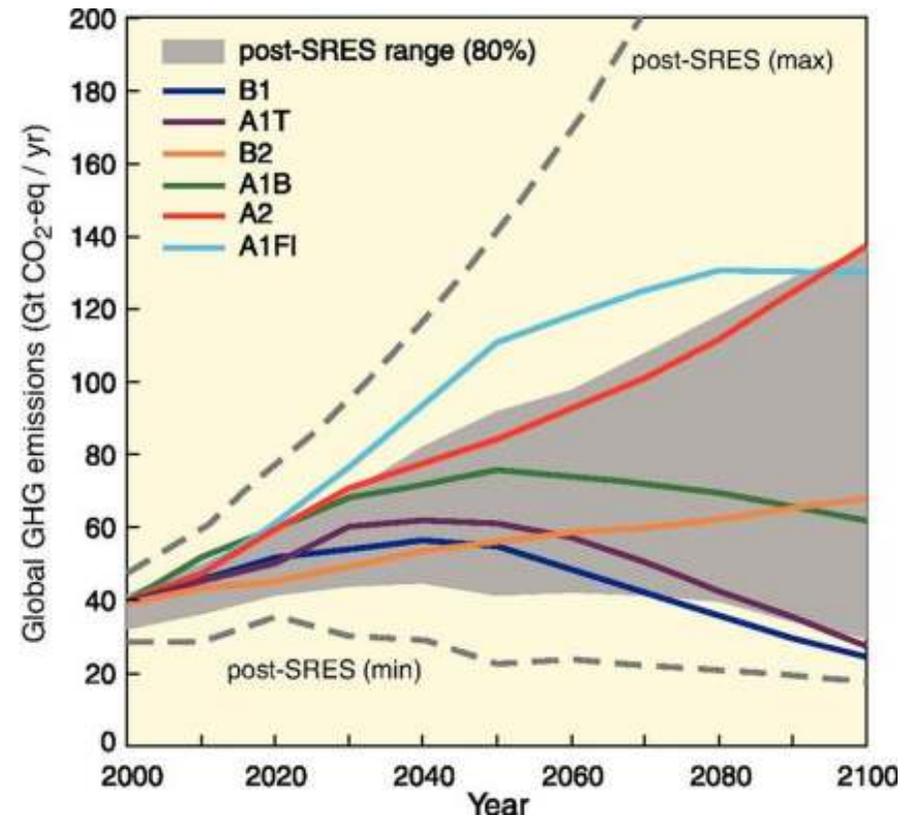
Introduction– ENSO

- Most pronounced mode of climate variability in the tropical Pacific, affects weather globally
- Quasiperiodic (2 – 7 years)
- Two components (Bjerknes, 1969.): atmospheric (Southern Oscillation) and oceanic (El Niño)
- Two phases: warm (El Niño) and cold (La Niña)



Climate change

- ▶ Natural and antropogenic
- ▶ IPCC
 - Fifth report (2014.)
- ▶ Intensive use of fossil fuels, increasing agriculture areas, deforestation, growing cities and areas with asphalt and concrete...
- ▶ ENSO and climate change?
 - Response over Europe?



IPCC's GHG emission scenarios

Data and methods

- **ECHAM5/MPI-OM**: coupled model, CMIP3 dataset
- Simulates well ENSO variability, but with a small overestimation of amplitude (Jungclaus et al., 2005.)
- ▶ Ensemble analysis and composite analysis
- ▶ Periods and scenarios:
 - 1951 – 2000 (20c3m)
 - 2001 – 2050 (A1B, B1)
 - 2051 – 2100 (A1B, B1)
- ▶ t – test for statistical significance (are the anomalies significantly different from zero?)



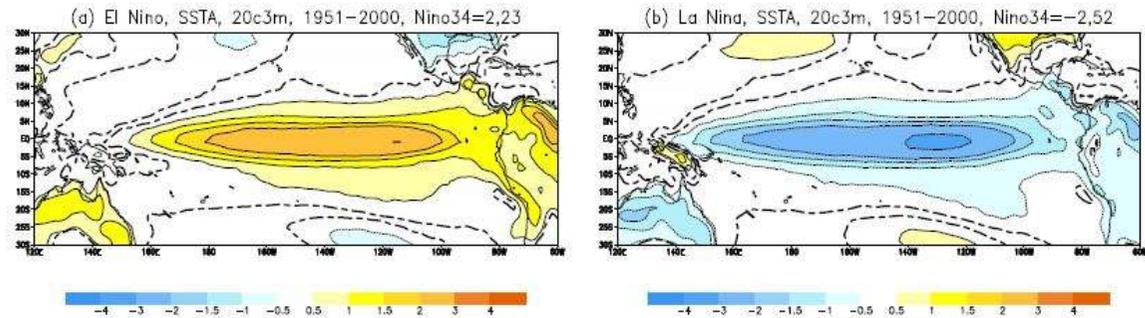
Results



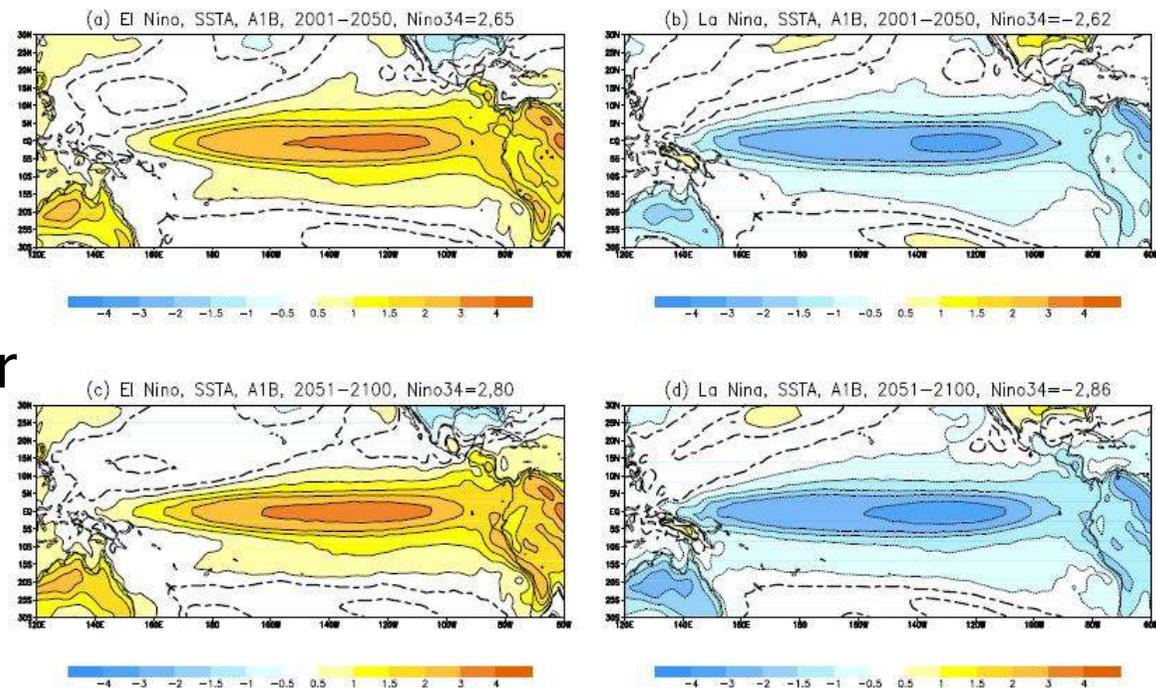
Tropical Pacific

- Stronger amplitude comparing to 20th century
- Will it result with a stronger response?
- Amplitudes of La Niña events stronger than for El Niño

SSTA [°C], 20th century



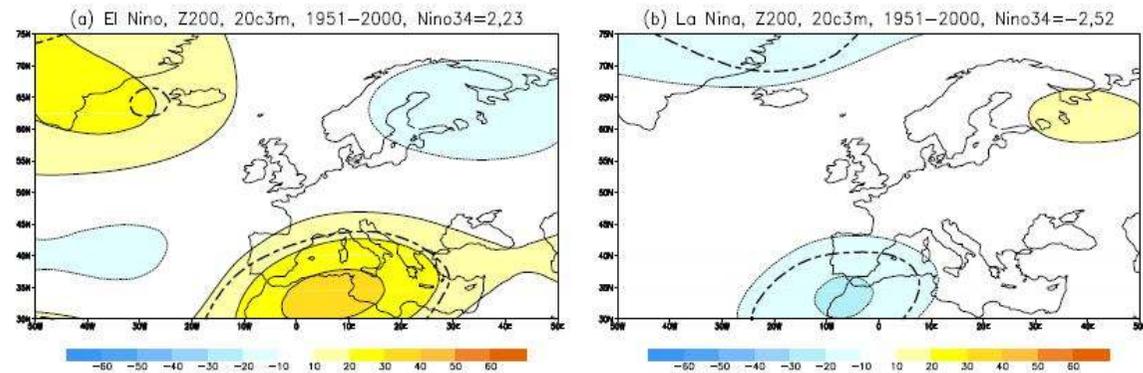
SSTA [°C], A1B scenario



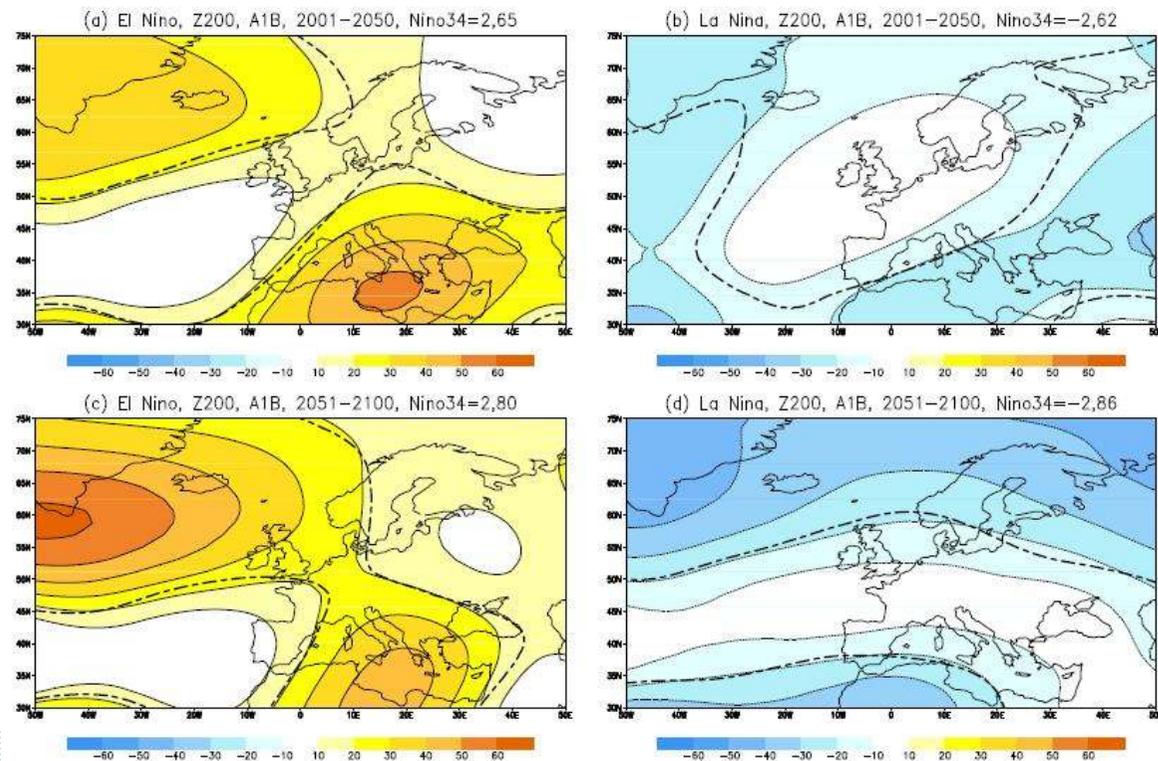
Geopotential [gpm], Z200

- Stronger amplitude in future climate (especially over the Atlantic)
- Slight space shift

20th century



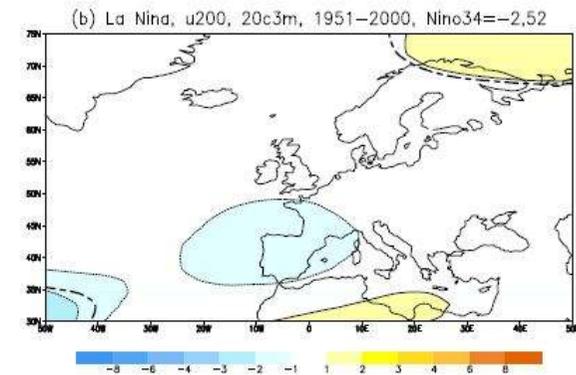
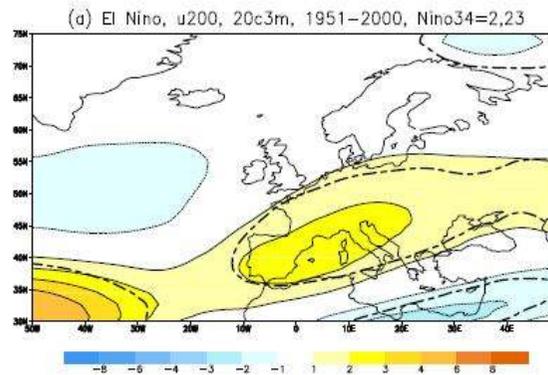
A1B scenario



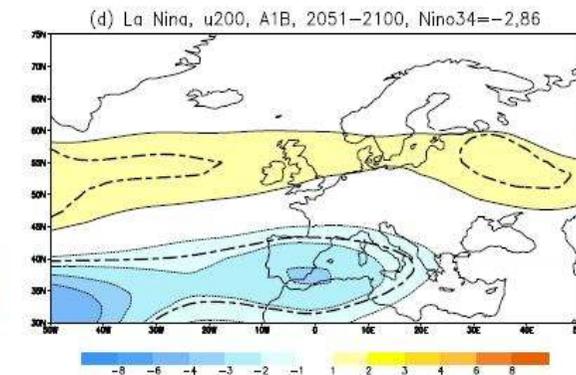
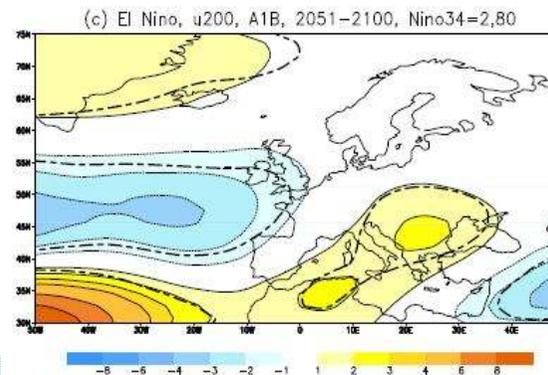
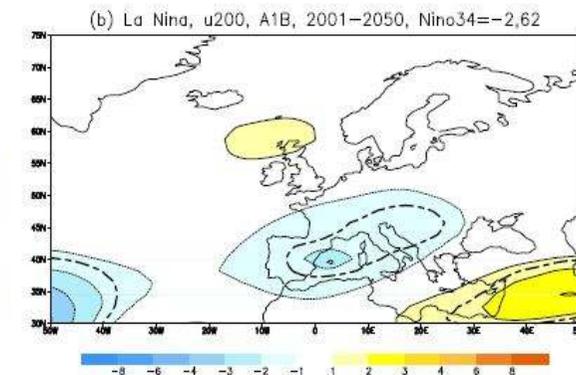
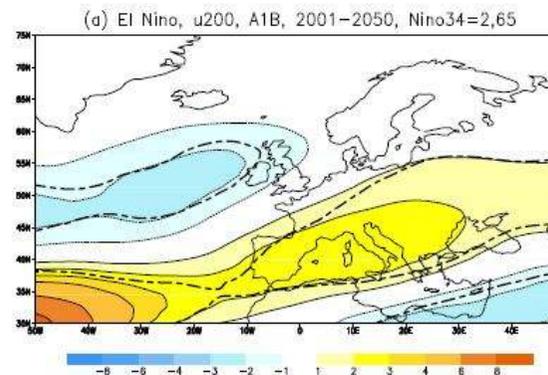
Zonal wind [m/s], u200

- Important for weather type of a certain area
- Strengthening of the subtropical jet stream for El Niño events
- Weak response for La Niña events

20th century



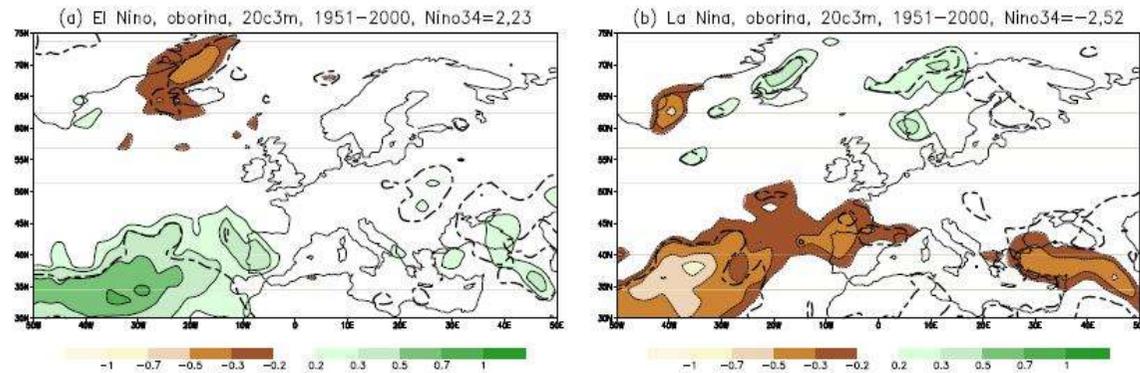
A1B scenario



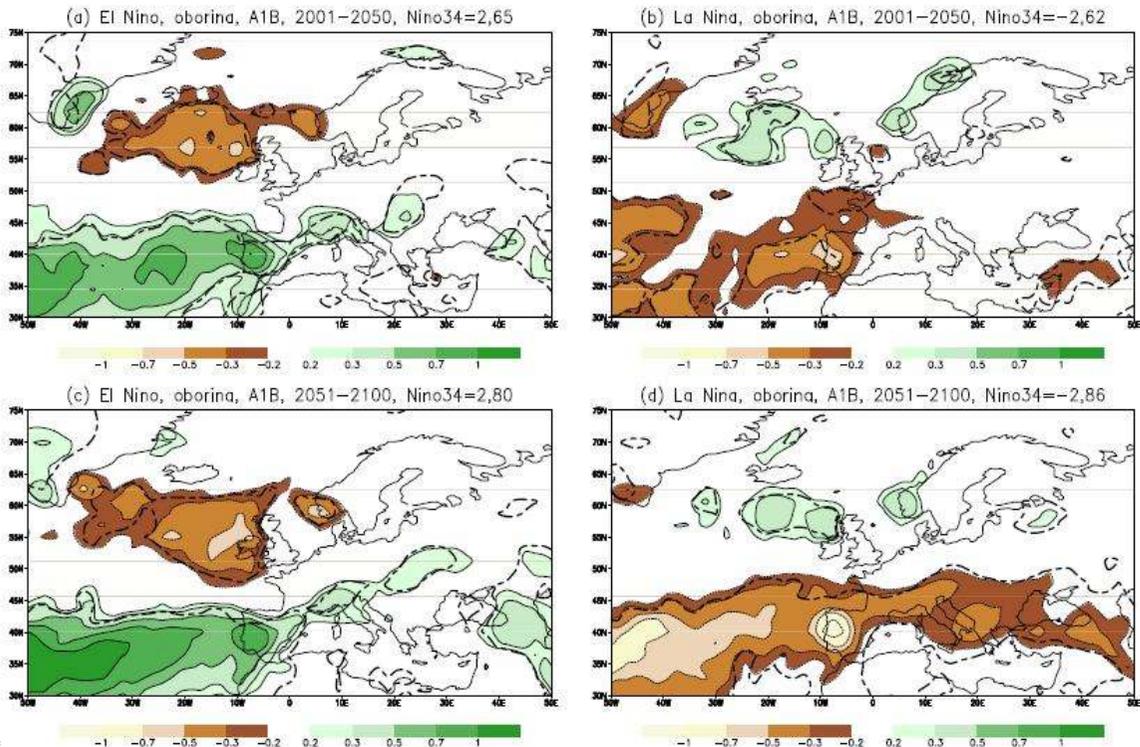
Precipitation [mm/day]

- Majority of the anomalies over the Atlantic (Herceg Bulić et al., 2012)
- Spreading over mainland in future climate
- Southeastward spatial shift near Iceland
- Maxima over sea?

20th century



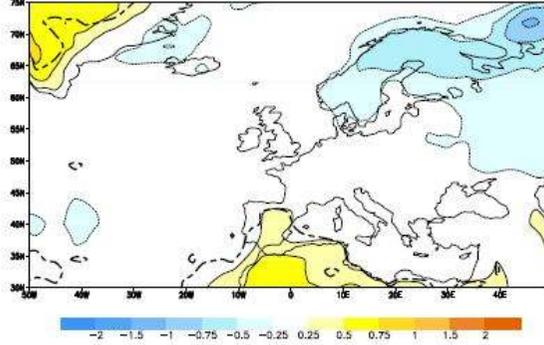
A1B scenario



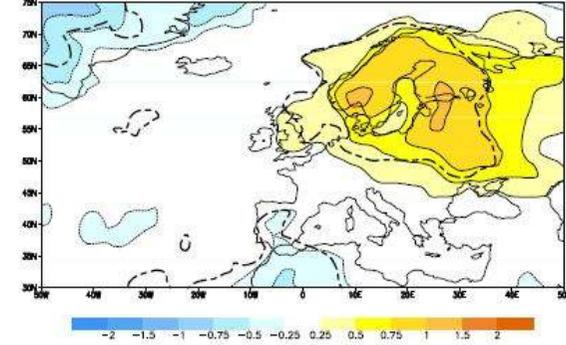
Temperature [°C]

20th century

(a) El Nino, prizemna temp., 20c3m, 1951–2000, Nino34=2,23



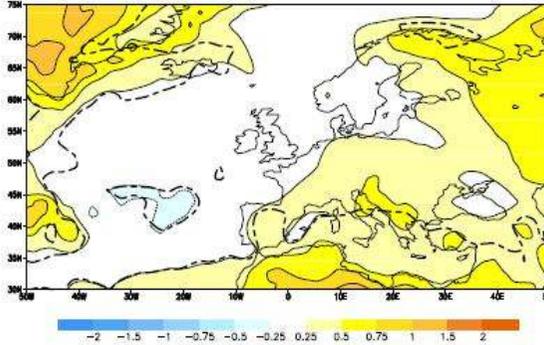
(b) La Nina, prizemna temp., 20c3m, 1951–2000, Nino34=-2,52



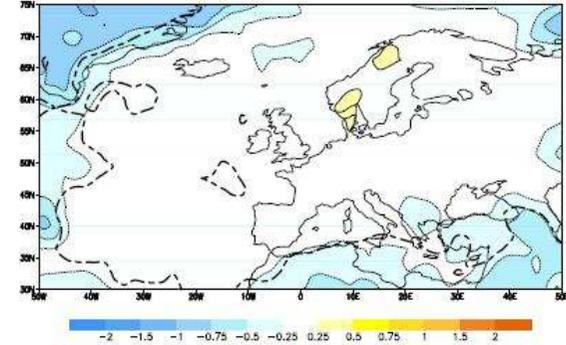
- Anomalies spreading over south Europe
- Increase in temperature during El Niño

A1B scenario

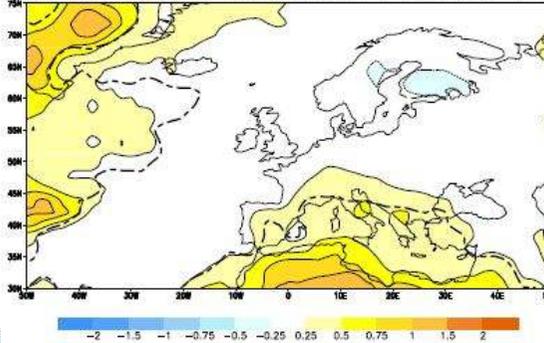
(a) El Nino, prizemna temp., A1B, 2001–2050, Nino34=2,65



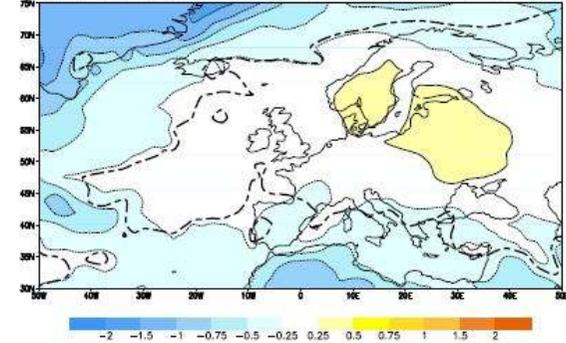
(b) La Nina, prizemna temp., A1B, 2001–2050, Nino34=-2,62



(c) El Nino, prizemna temp., A1B, 2051–2100, Nino34=2,80

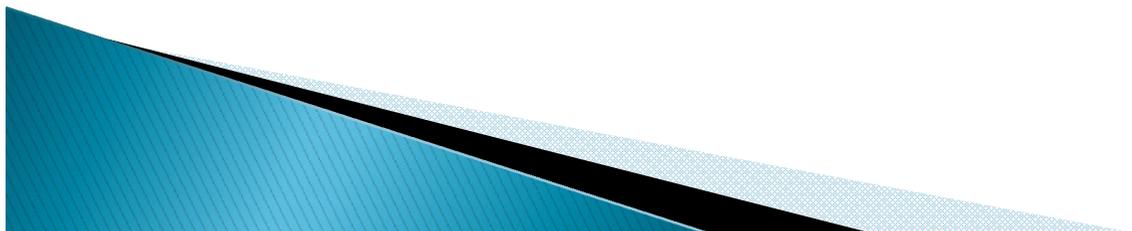


(d) La Nina, prizemna temp., A1B, 2051–2100, Nino34=-2,86



Conclusion

- ▶ Prominent mode of climate variability
- ▶ Change in amplitude of ENSO in the Pacific
- ▶ Change in response over Europe
- ▶ 2051. – 2100., A1B, strongest forcing and strongest response



- Observed:
 - Space shift of geopotential field
 - Stronger jet stream over south Europe and weaker over north Europe during El Niño
 - Wetter and warmer winters over south Europe, response for northern Europe weaker



Thank you!

