

Upper-Level Flow Climatology and Blocking

Atmos 5110/6110

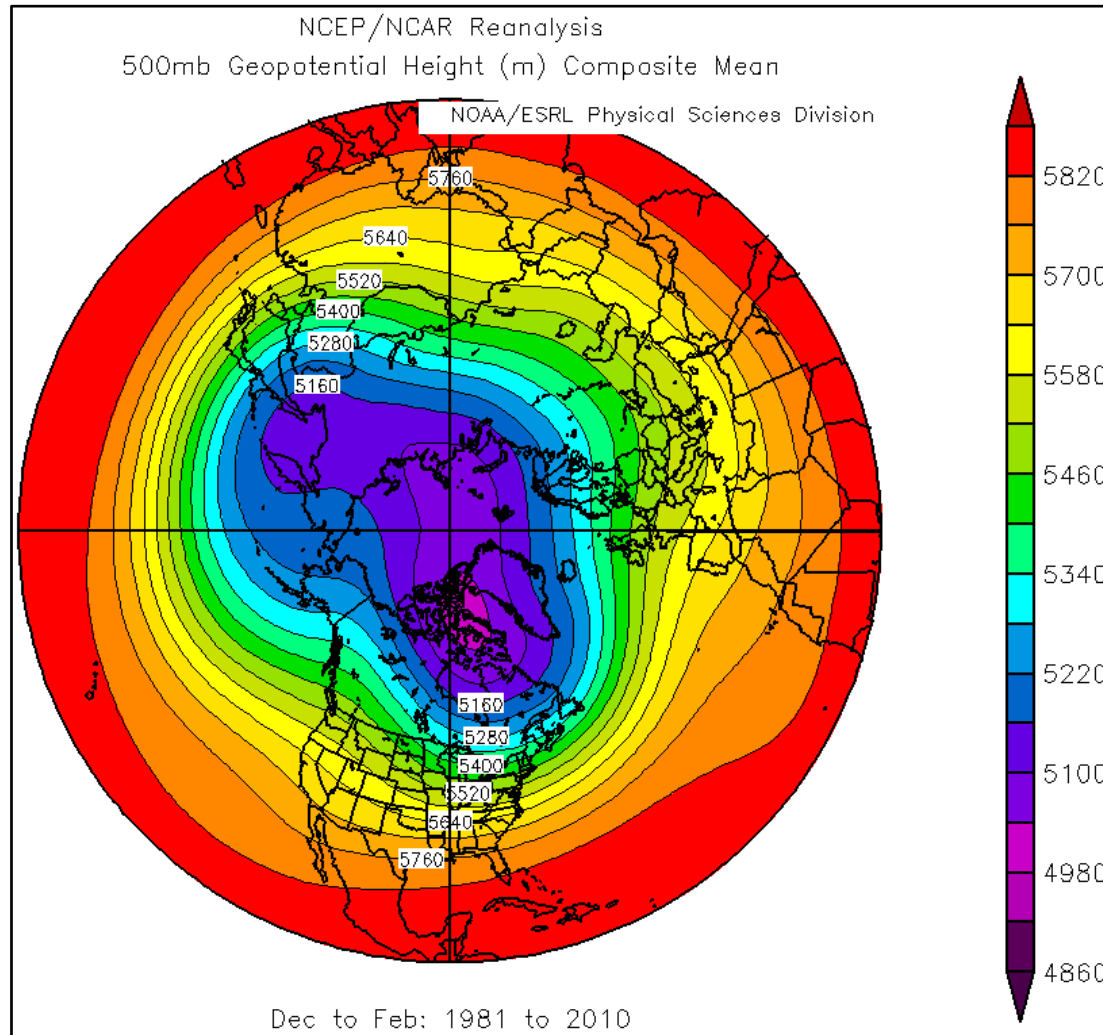
Synoptic–Dynamic Meteorology I

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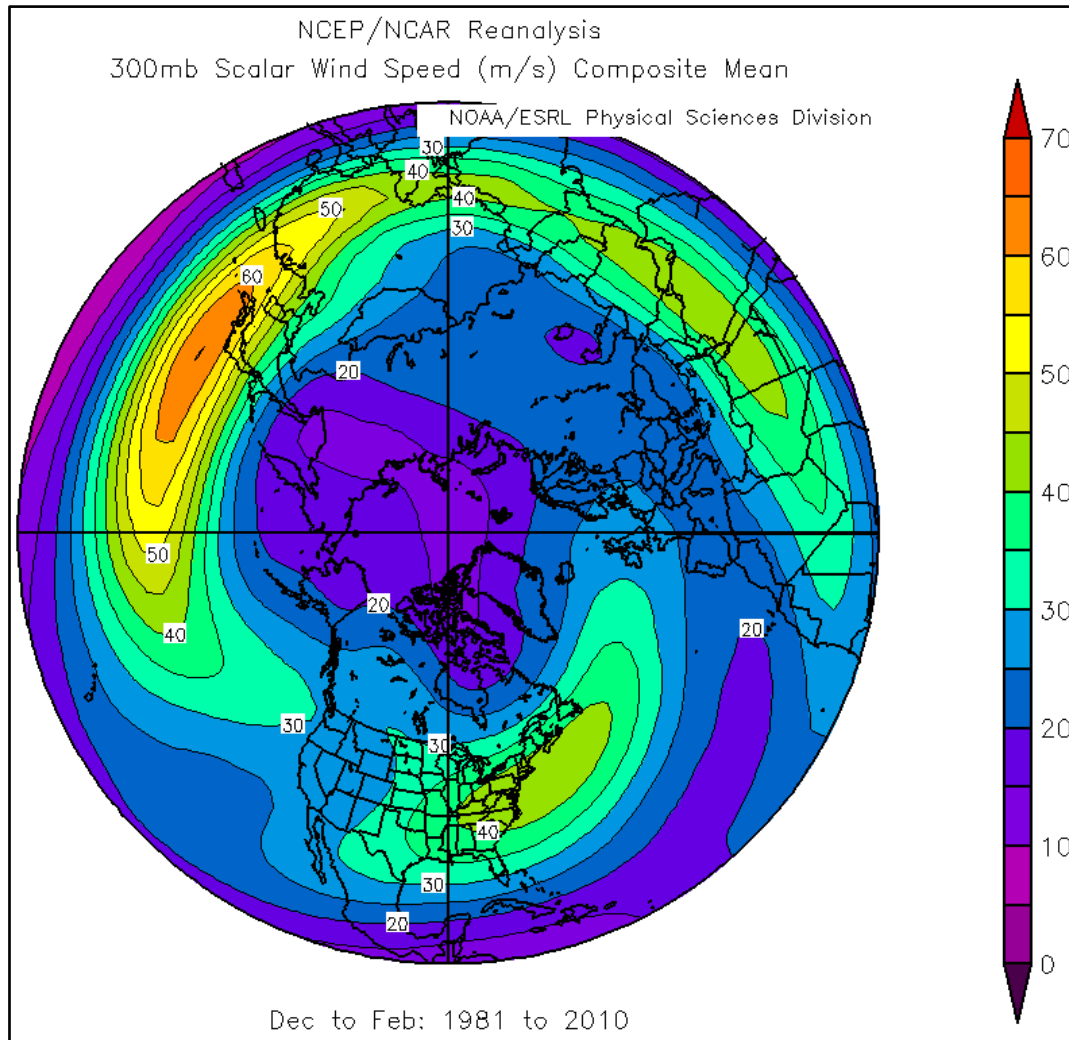
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Northern Hemisphere Winter



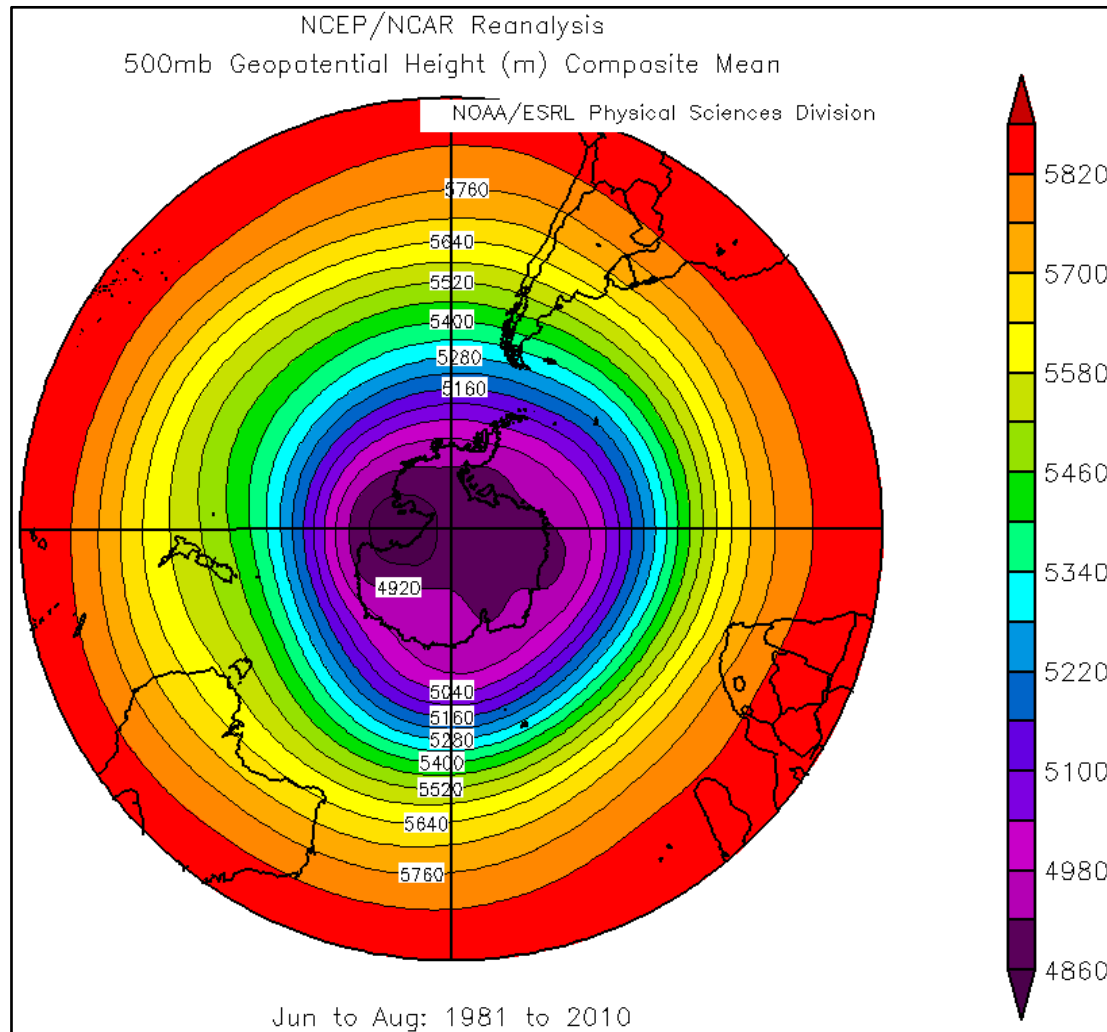
- Circumpolar vortex
 - Lowest heights over pole
- 3 major troughs/ridges (wave #3)
- Enhanced height gradient over west Pacific and west Atlantic
 - Pacific and Atlantic jets/storm track
- Weaker heights over Eurasia

Northern Hemisphere Winter



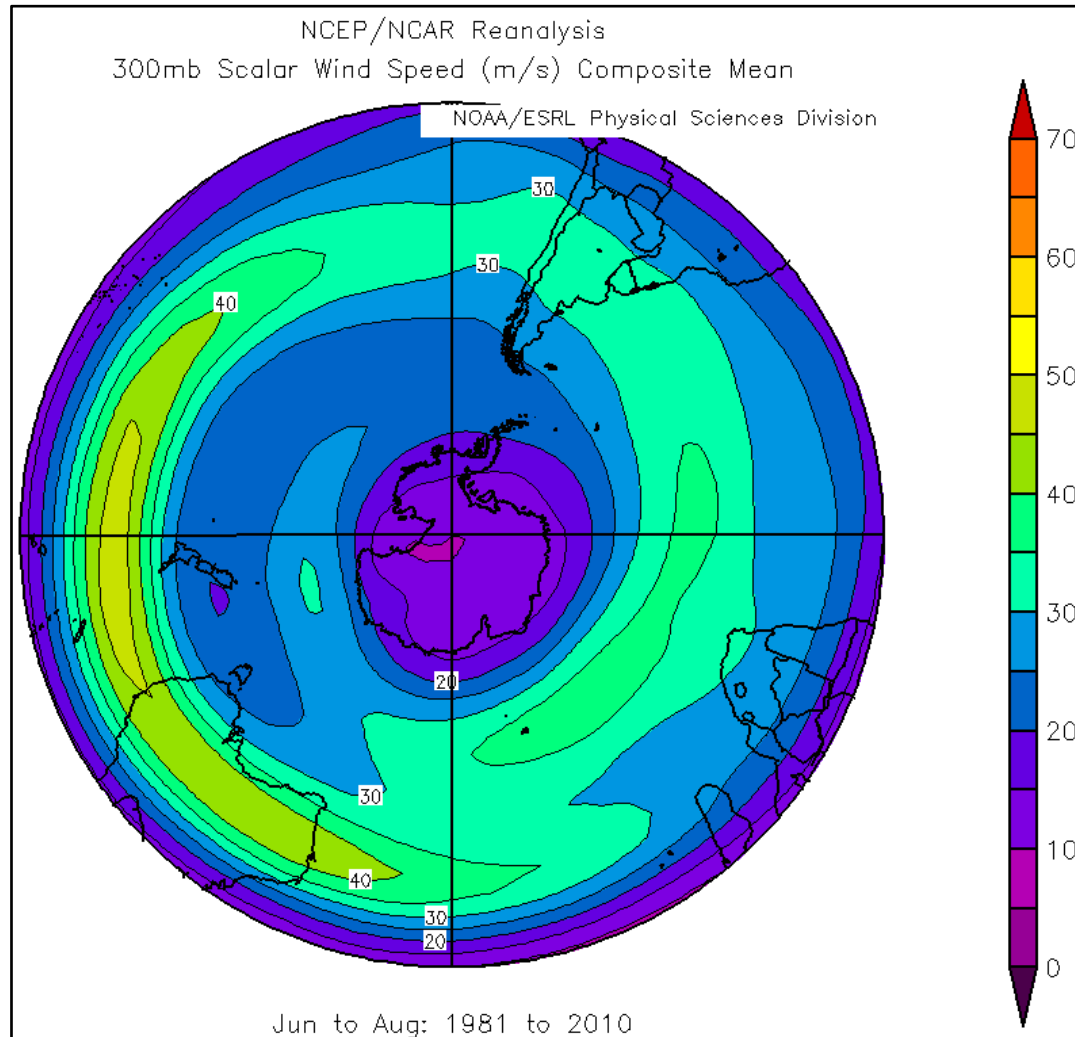
- 2 major jet cores
 - West Pacific
 - (Pacific Jet)
 - West Atlantic
 - (Atlantic Jet)
- Weaker flow/mean split over western NA and western Europe

Southern Hemisphere Winter



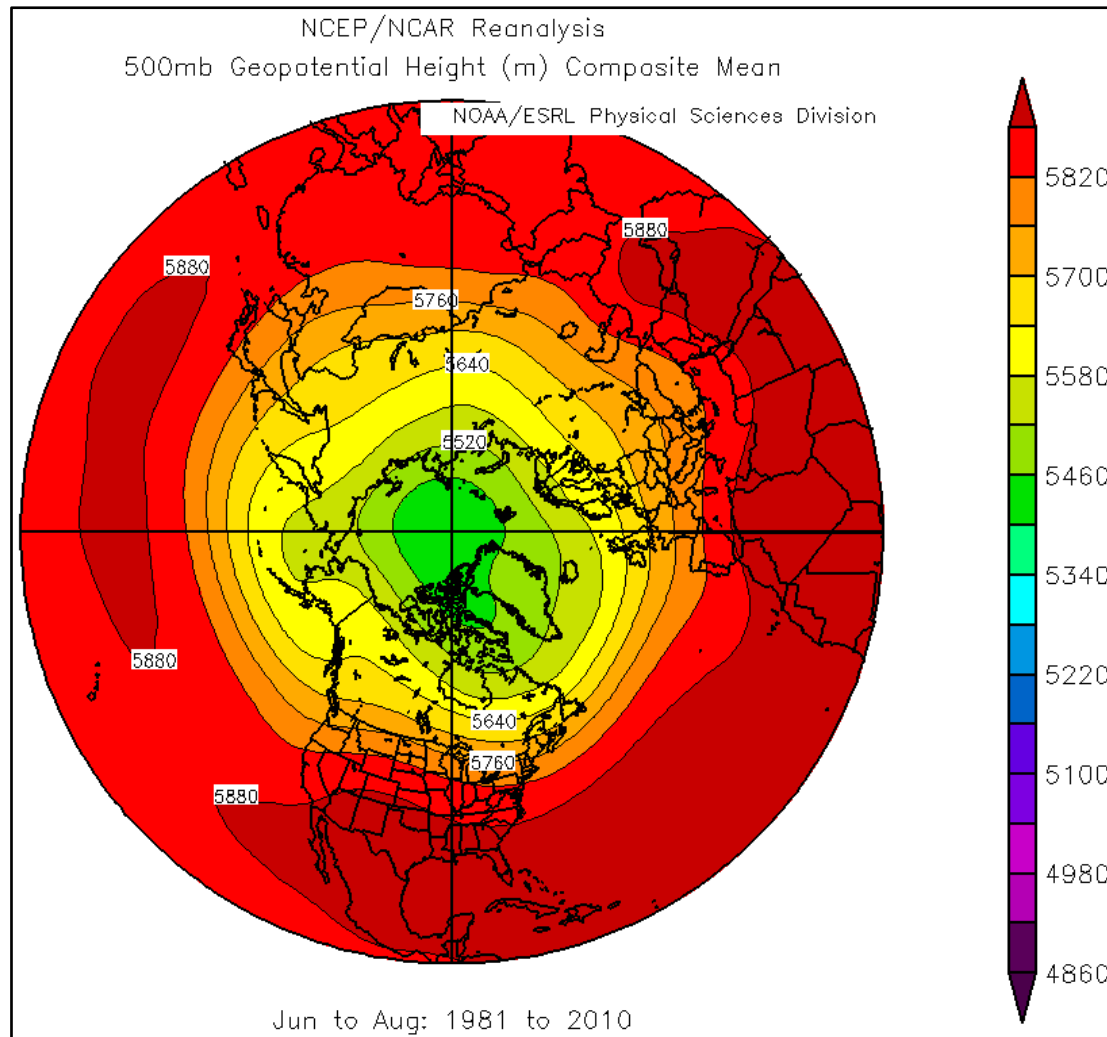
- More maritime hemisphere, plus
 - High-elevation continent at pole
 - Less extensive mid latitude topography
- Strong, symmetrical circumpolar vortex
- Lowest heights over Ross Sea
- Weak wave 3 pattern

Southern Hemisphere Winter



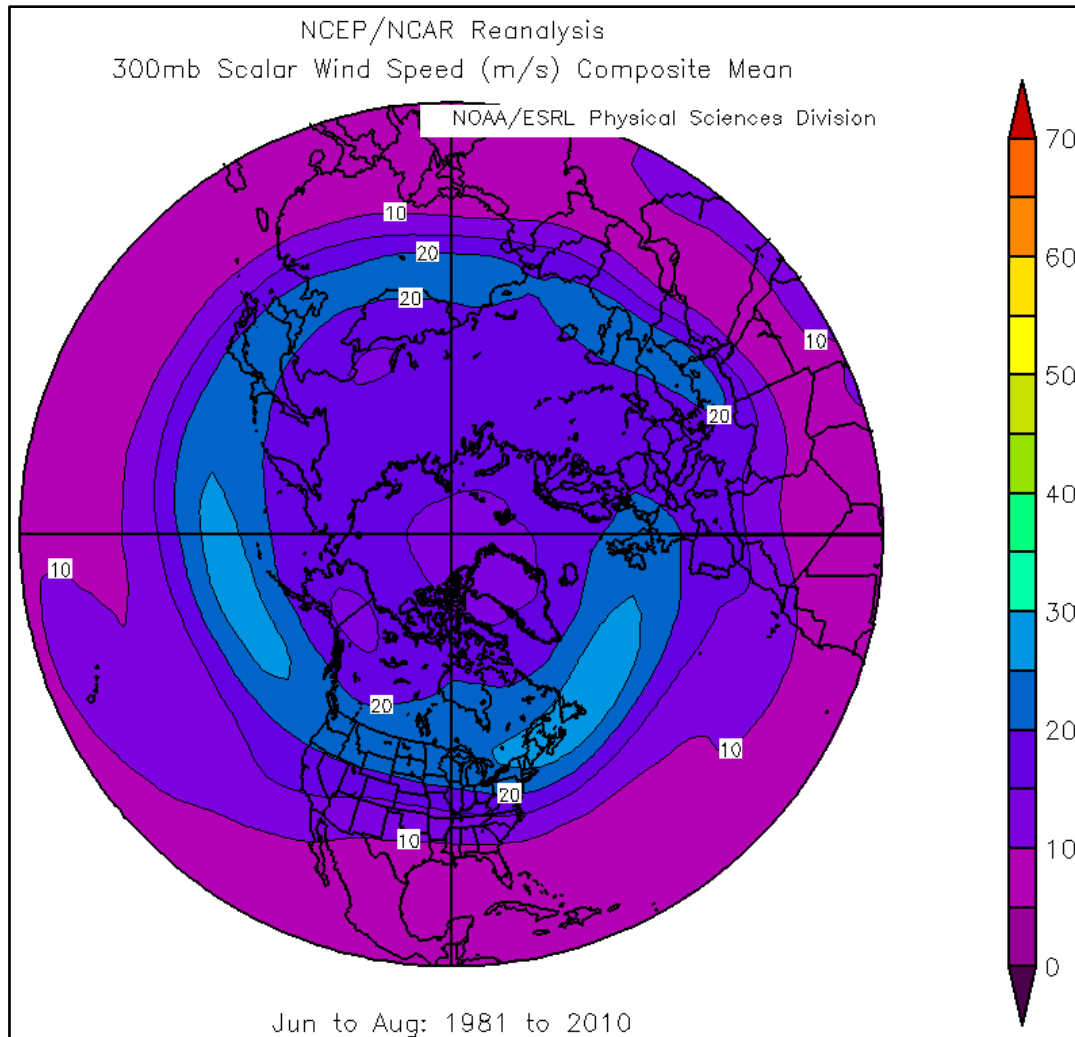
- More zonally continuous jet than in NH winter
- Strongest flow over Australia and western Pacific
- Secondary jet maximum between Africa and Antarctica

Northern Hemisphere Summer



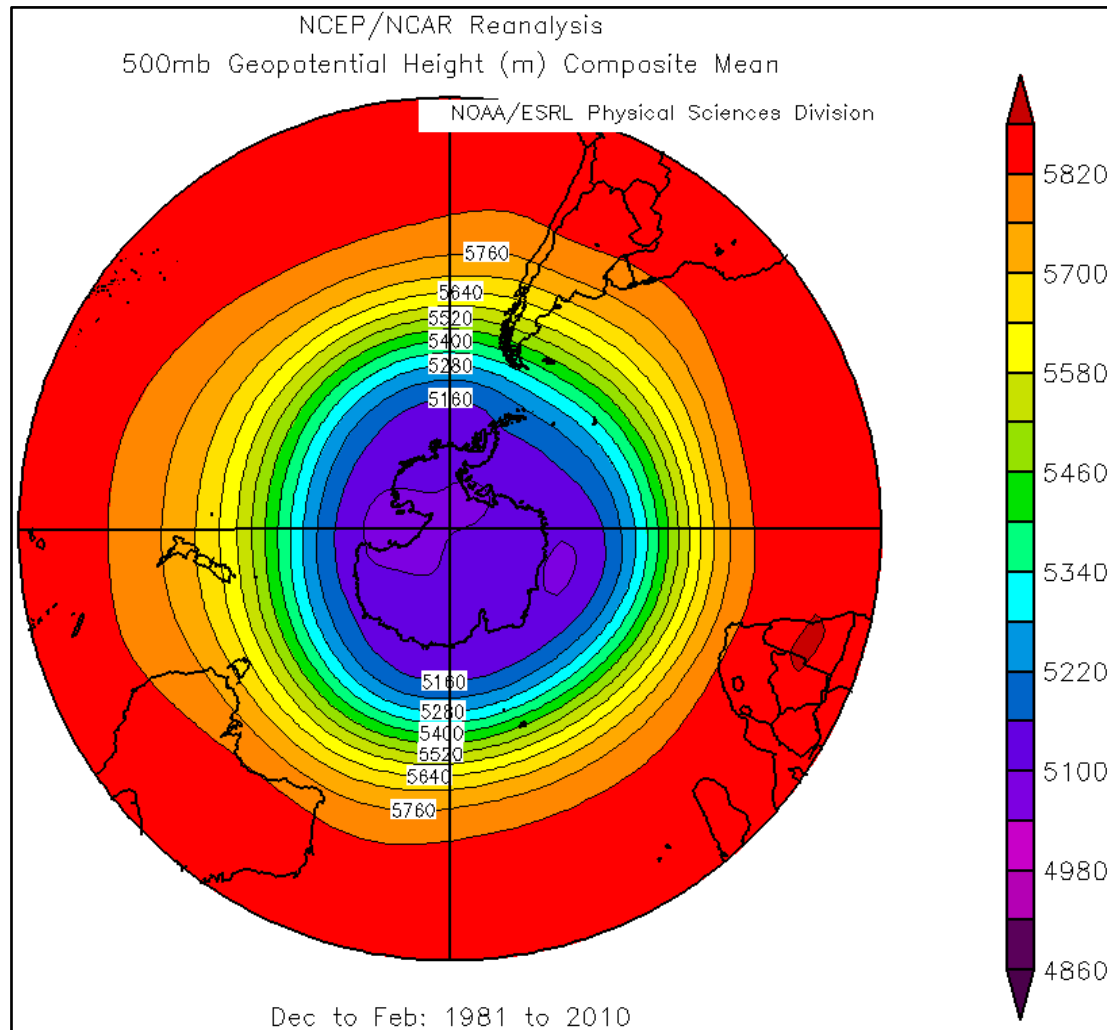
- Weak circumpolar westerlies
 - Height gradient further north than in winter
- Weak, wave #4 with troughs over
 - NE North America
 - Bering Sea
 - Northern Russia
 - Western Europe
- Subtropical ridging with easterly monsoonal flow near equator

Northern Hemisphere Summer



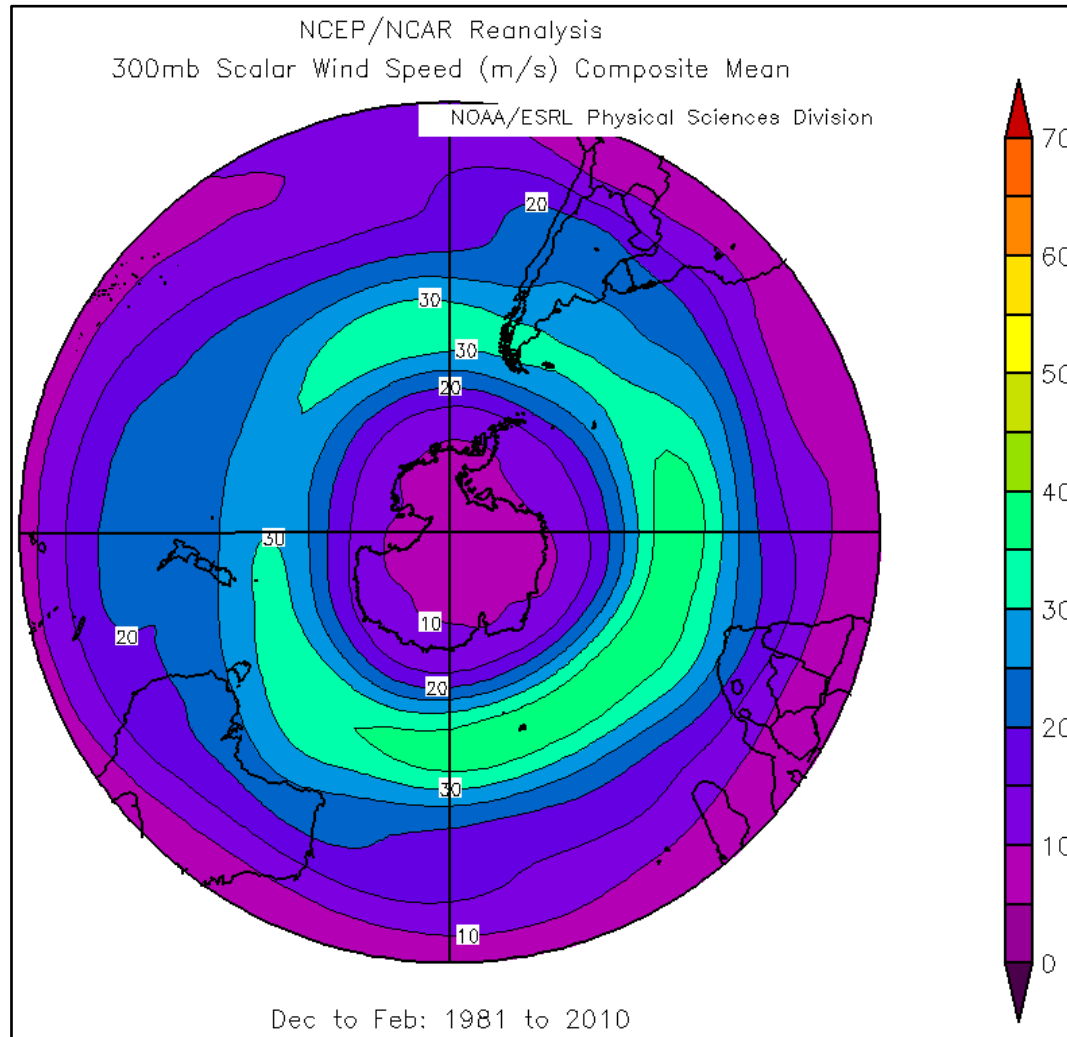
- Weaker westerlies with jet core poleward of 40°
- Jet is more zonally continuous than in winter
 - Weaknesses near west coasts of Europe and North America

Southern Hemisphere Summer



- Strong band of westerlies persists
 - Slight retraction toward pole compared to winter, but weaker than in NH
- Hint of wave #3

Southern Hemisphere Summer

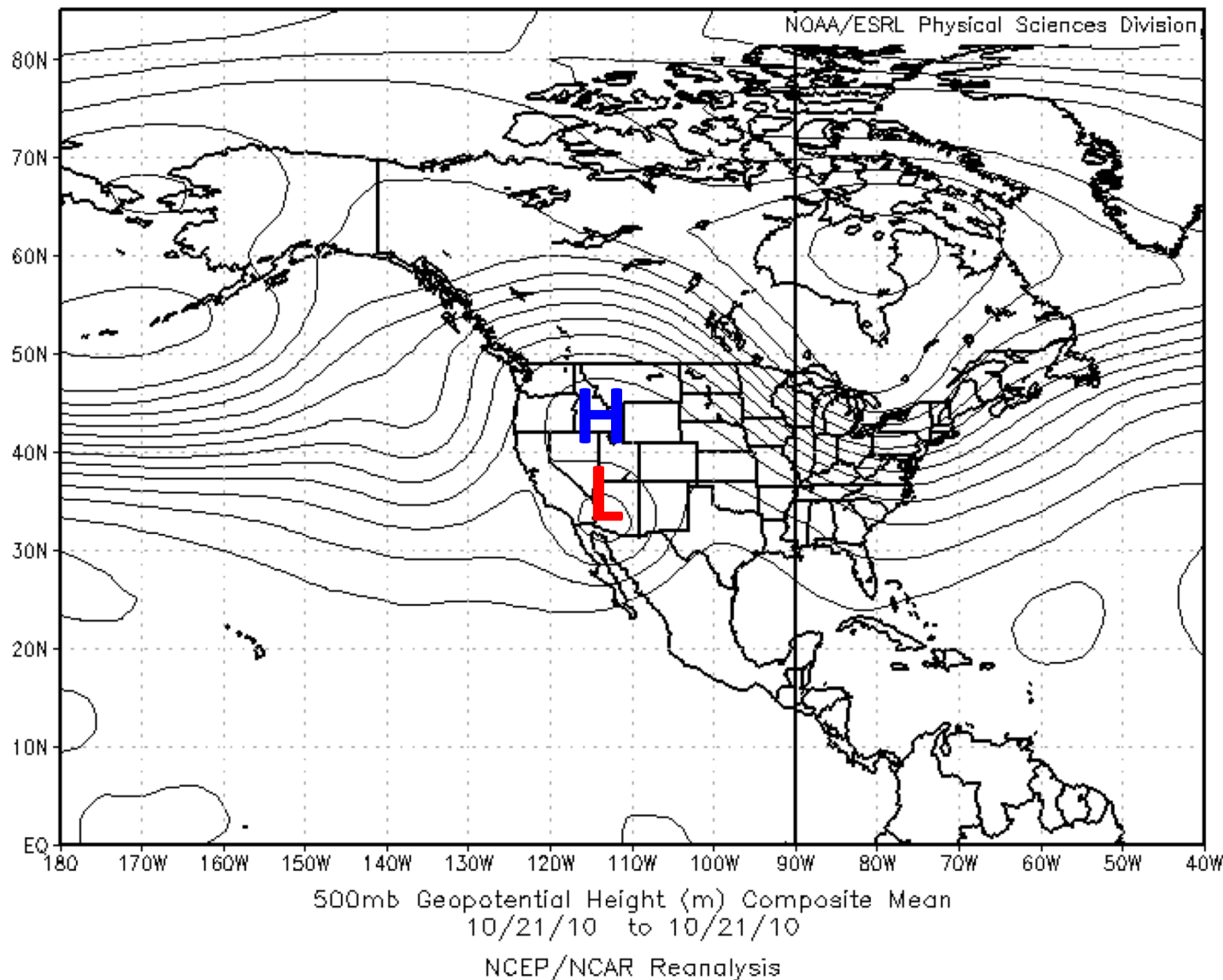


- Jet displaced slightly poleward of winter position
- Strong zonal continuity of jet with maximum across southern Oceans

Blocking

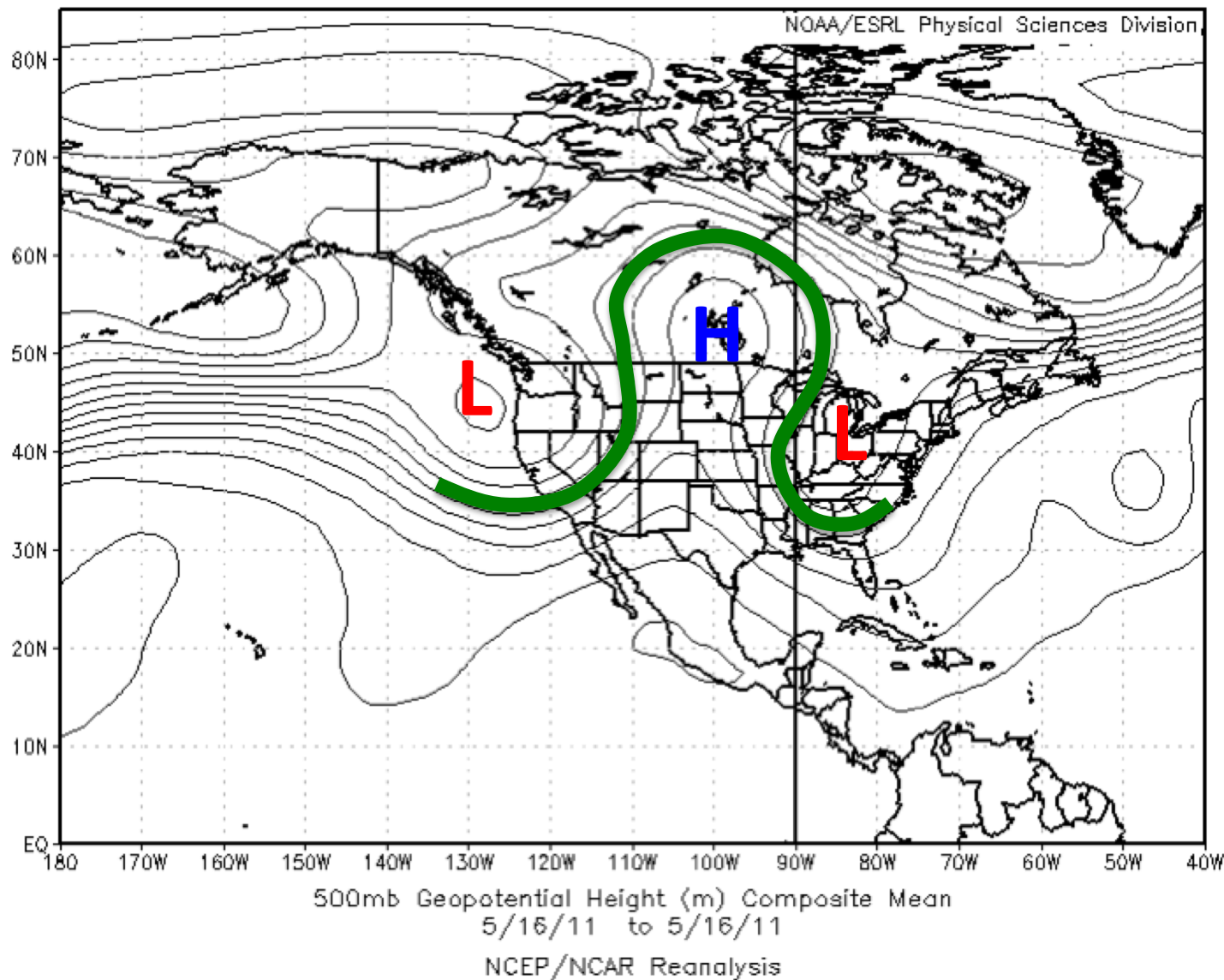
- Definition: The large-scale obstruction of the normal west-to-east progression of cyclones, anticyclones, and upper-level waves at midlatitudes
 - Can persist in some instances for 10 days or more
- Types
 - High over low (a.k.a. “Rex” block)
 - Omega
 - High amplitude ridge

Rex Block Example



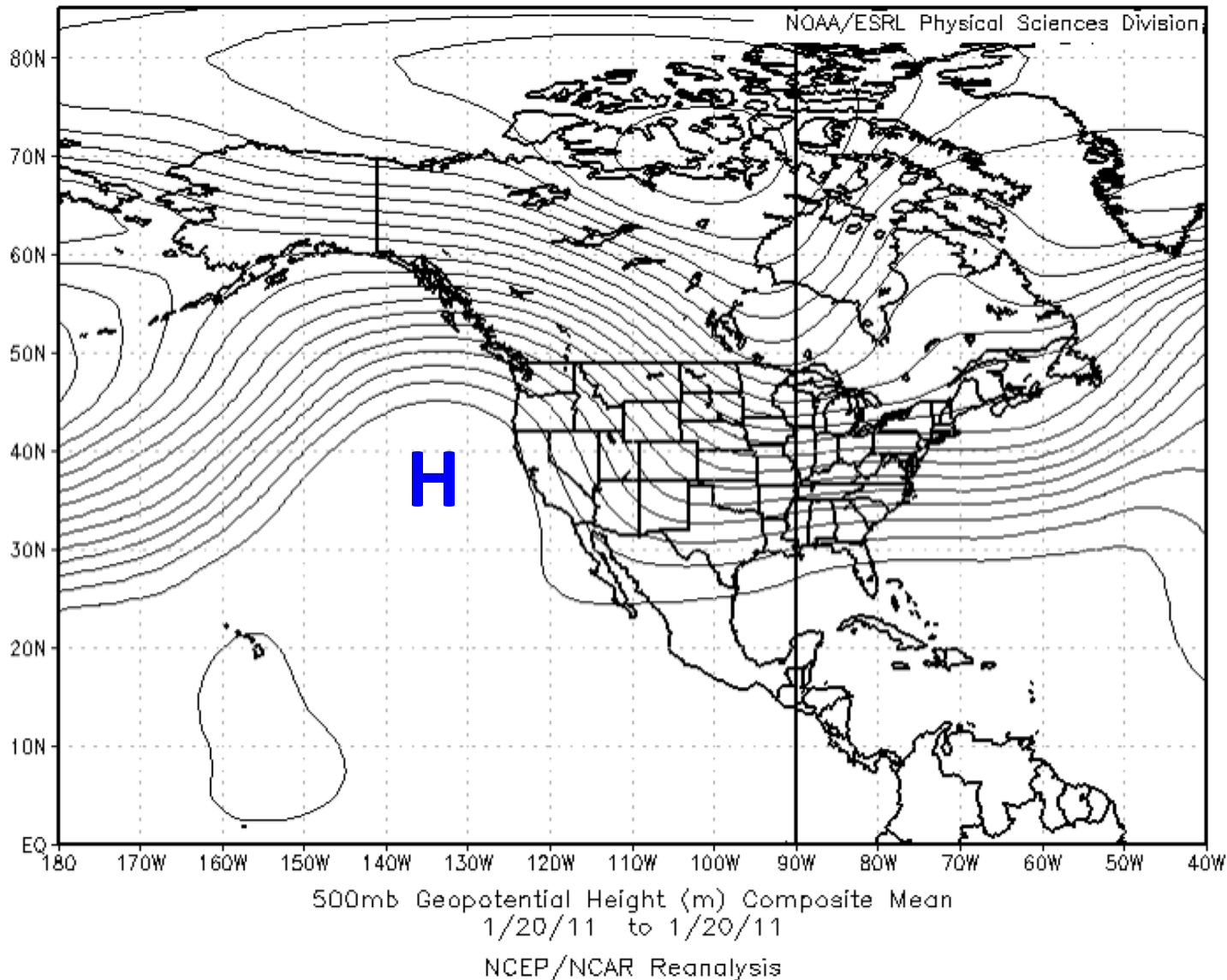
- Most common over western North America and Europe
- Pattern sometimes referred to as “split flow”
- Topography and/or land-sea contrasts probably play a role in creation and persistence of Rex blocks

Omega Block Example



- Shaped like Greek letter Ω
- High sandwiched between two lows

High Amplitude Ridge Example



- Mainly associated with dry weather (when beneath it) although over western U.S. in winter they can be associated with persistent valley and basin fog

More on Blocks

- Not completely understood
- Can be the result of topographic interactions
 - Blocks frequently found over or upstream of major mountain ranges
- Can form or be maintained in response to surface cyclogenesis

More on Blocks

- High Index Pattern: Characterized by strong zonal flow, progression, and lack of blocking
- Low Index Pattern: Characterized by weak zonal flow and blocking
- Vacillation: Alternating from high to low zonal index flows