

Quasi-Biennial Oscillations (QBO) As Seen in GPS/CHAMP Tropospheric and Ionospheric Data

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Outline

- A brief review of QBO
- Characteristics of small-scale oscillations in GPS/CHAMP 50-Hz raw measurements
- Variations of lower atmospheric variances
- Variations of E-region variances
- Summary

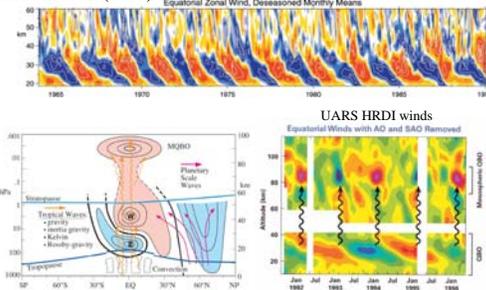
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The Quasi-Biennial Oscillation

Baldwin et al. (1999)

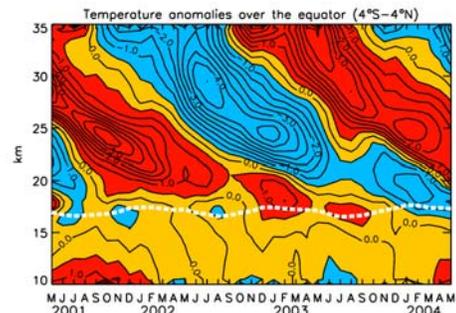


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GPS/CHAMP Temperature (Schmidt et al, 2004, ACPD)



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What are the QBO forcings?

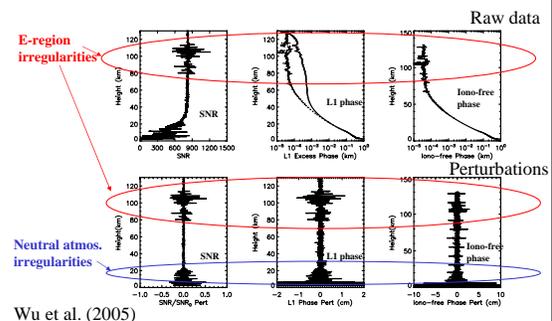
- The stratospheric QBO circulation driven by equatorial eddies;
- Kelvin and Rossby-gravity wave breaking as the restoring forces (Lindzen and Holton 1968; Holton and Lindzen 1972) -> lack of Rossby-gravity wave observations?
- Gravity waves: plausible but mostly based on numerical simulations -> lacks of observations and a clear theory; -> capable to couple variations between the lower and upper atmospheres
- The mesospheric/thermospheric QBO poorly studied.

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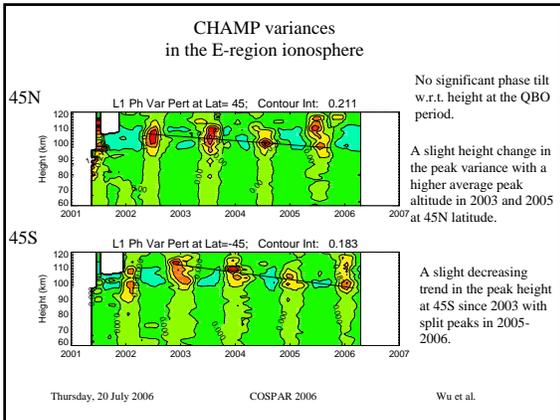
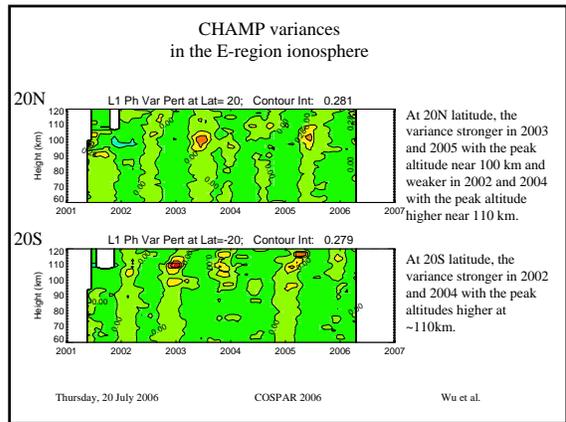
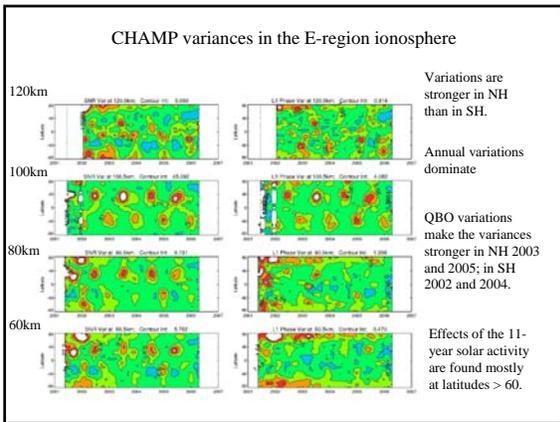
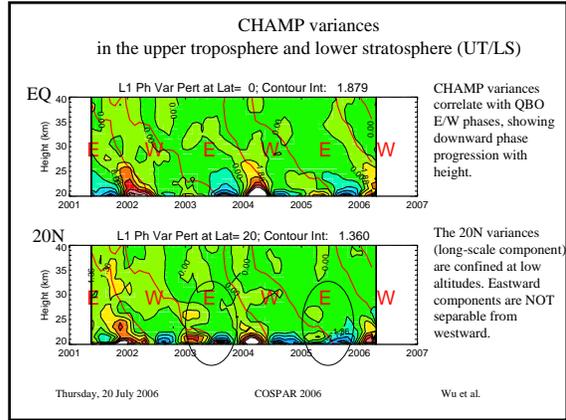
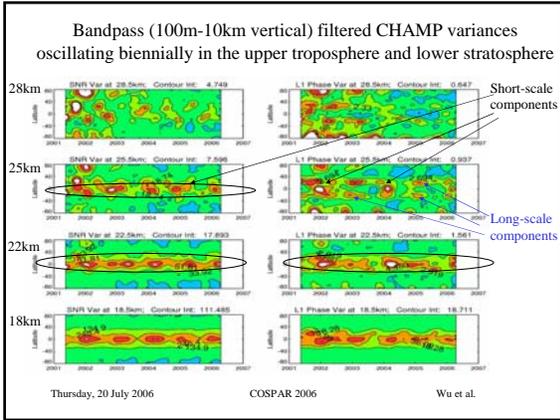
CHAMP 50-Hz sampling data



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Summary

- In the UT/LS, small-scale CHAMP variances likely due to T/P variabilities at similar scales;
- Significant correlation between stratospheric QBO and the CHAMP variances, showing downward progression with height;
- Two variance modes found with distinct latitudinal distributions and corresponding to different vertical scales;
- In the E-region, significant QBO modulations on the annually-varying sporadic-E variance, affecting both amplitude and location of the variance;
- A longer-term (> 4 years) also evident in the E-region variance, showing the peak altitude decreasing with time and splitting into two.

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