Spatial Variation of slip behavior beneath the Alaska Peninsula including Shumagin and Semidi Islands along Alaska-Aleutian Subduction Zone



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Outline

- □ Background and Motivation
- GPS Data

Preliminary Results

- □ Inconsistency between the horizontal and vertical velocities
- □ Models for different segments
- □ Locate the Boundaries where there are sharp changes in coupling distribution
- □ Test for sharp versus gradual along-strike change in coupling distribution
- □ Relationship between the plate fabric from magnetic anomaly and the estimated fault coupling distribution

□ Summary

Background and Motivation

Previous study of Along-strike Variation In Fault Coupling



Research Motivation

1. Given a more dense GPS network, what is the Alongstrike variation in the coupling distribution?

2. Does the estimated coupling distribution correlate with. features of the overriding or downgoing plates from other observations (ALEUT Program)?



Data Used in the Previous Study



Jeff's GeoPRISMS Report

... and now



Jeff's GeoPRISMS Report

□ Inconsistency between the horizontal and vertical velocities

- □ Models for different segments
- □ Locate the Boundaries where there are sharp changes in coupling distribution
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Inconsistency between horizontal and vertical velocities

Best fit model for inverted coupling distribution by using horizontal and vertical velocities both (smoothing factor = 4e8)





Inconsistency between horizontal and vertical velocities

Possible factors explaining the inconsistency:

- Differences in the geometry of the plate interface ---- Do not explain the inconsistency
- Glacial Isostatic Adjustment
 --- Existing models do not explain this
- Reference frame errors
 --- Do not explain this

For the following models, we only use horizontal component of GPS velocities.

□ Inconsistency between the horizontal and vertical velocities

□ Models for different segments

- □ Locate the Boundaries where there are sharp changes in coupling distribution
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Models for Different Segments

Problems:

A standard optimal inversion model has significant
 <u>oversmoothing</u> of the coupling distribution

 and underestimates the strong coupling variations in the along-strike direction

Models for Different Segments



Models for Different Segments

Forward model:

Initial coupling distribution based on the average values from best fit models in four segments.



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Locate the boundaries where there are sharp changes in coupling distribution



Locate the boundaries where there are sharp changes in coupling distribution



Optimal Model

- □ Inconsistency between the horizontal and vertical velocities
- □ Models for different segments
- □ Locate the Boundaries where there are sharp changes in coupling distribution
- □ Test for sharp versus gradual along-strike change in coupling distribution
- □ Relationship between plate fabric from magnetic anomaly and the estimated fault coupling distribution

Test for sharp versus gradual along-strike change in coupling distribution



- □ Inconsistency between the horizontal and vertical velocities
- □ Models for different segments
- □ Locate the Boundaries where there are sharp changes in coupling distribution
- □ Test for sharp versus gradual along-strike change in coupling distribution
- **Relationship between plate fabric from magnetic anomaly and the estimated fault coupling distribution**

Link between Variation in Plate Fabric, Hydration and Bending Faulting Along-Strike



Relationship between Significant Change in Estimated Fault Coupling and Change in Pre-existing Plate Fabric



Digital Magnetic Anomaly polygons provided by Peter Haeussler and Keith Labay

Origin: Atwater 1989; Atwater and Severinghaus, 1989

- Kula-Pacific spreading center
- Average rate ~60 mm/yr
- Spreading age: 80 to 56 Ma
- Farallon-Pacific spreading center
- Half rate ~40 mm/yr
- Spreading age: 100 to 55 Ma
- Vancouver-Pacific spreading center
- Similar rate as Farallon-Pacific
- Spreading age: 53 to 30 Ma

<u>Black Line:</u>

- Transition from strong to weak fault coupling
- Change in pre-existing plate fabric due to
 - Cessation of Kula-Pacific spreading
 - The northern portion of Farallon Plate broke off and became the "Vancouver" plate in new spreading direction



Summary

- 1. There is an inconsistency between the horizontal and vertical velocities, and long-wavelength systematic misfits in the vertical velocities still remain unsolved.
- 2. The width of the locked region decreases step-wise from NE to SW along strike
- **3.** There are three sharp boundaries separating segments with different fault coupling
- 4. The significant change in fault coupling from strong to weak is linked with the change in pre-existing plate fabric caused by
 - Cessation of the Kula-Pacific spreading
 - Reorientation of the northern section of Farallon-Pacific spreading to Vancouver-Pacific spreading

Thank you

