Assessing the geodynamics of strongly arcuate subduction zones in the eastern Caribbean subduction setting

Menno Fraters, Cedric Thieulot Wim Spakman and Douwe van Hinsbergen
6 May 2020
Welcome to the Caribbean...

Figure 1: The Caribbean tectonic setting. (From http://www.ugr.es, compilation by García-Casco et al. (2006))
Welcome to the Caribbean...

Figure 1: The Caribbean tectonic setting. (From http://www.ugr.es, compilation by García-Casco el al. (2006))
What happens when a trench is dragged?
What happens when a trench is dragged?
What happens when a trench is dragged?
In this strongly arcuate subduction system, we investigate:

1. the feasibility of slab dragging
2. The stress field in the slab
Setting up the model
World Builder:

- Single text-file as input
- Using plate tectonic terminology
- Up-to-date documentation
- Open source, contributions welcome!

ASPECT:

- Adaptive mesh refinement
- Scales up to thousand of cores
- Easy to add new functionality
- Open source community code!
Model design: tomographic basis

- No consensus on the 3D geometry and structure of the slab
- Model based on tomography by Harris et al. 2018:
Model design: 2D setup
Model design: 2D setup
Model design: 2D setup
Model design: 3D setup
Back to the Caribbean question
The eastern trench is stationary
The eastern trench is stationary
Slab dragging and stationary eastern slab

1 Myr

10 Myr
Next images we look from the South and West
More slab dragging

0 Myr

5 Myr

10 Myr
Direction of maximum shear stress from south

1 Myr

5 Myr

10 Myr
Direction of maximum shear stress from west

1 Myr

5 Myr

10 Myr
1. Assessed the first-order characteristics of strongly arcuate subduction zones through the Caribbean example

2. Started with an advanced stage subduction

3. Showed slab dragging as a feasible process

4. Found that the direction of maximum shear stress is non-trivial