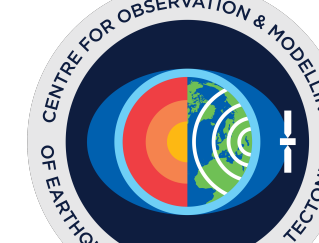


2024-2025 Fentale dike sequence: InSAR observations and models

Fentale-Dofen magmatic segment, Main Ethiopian Rift

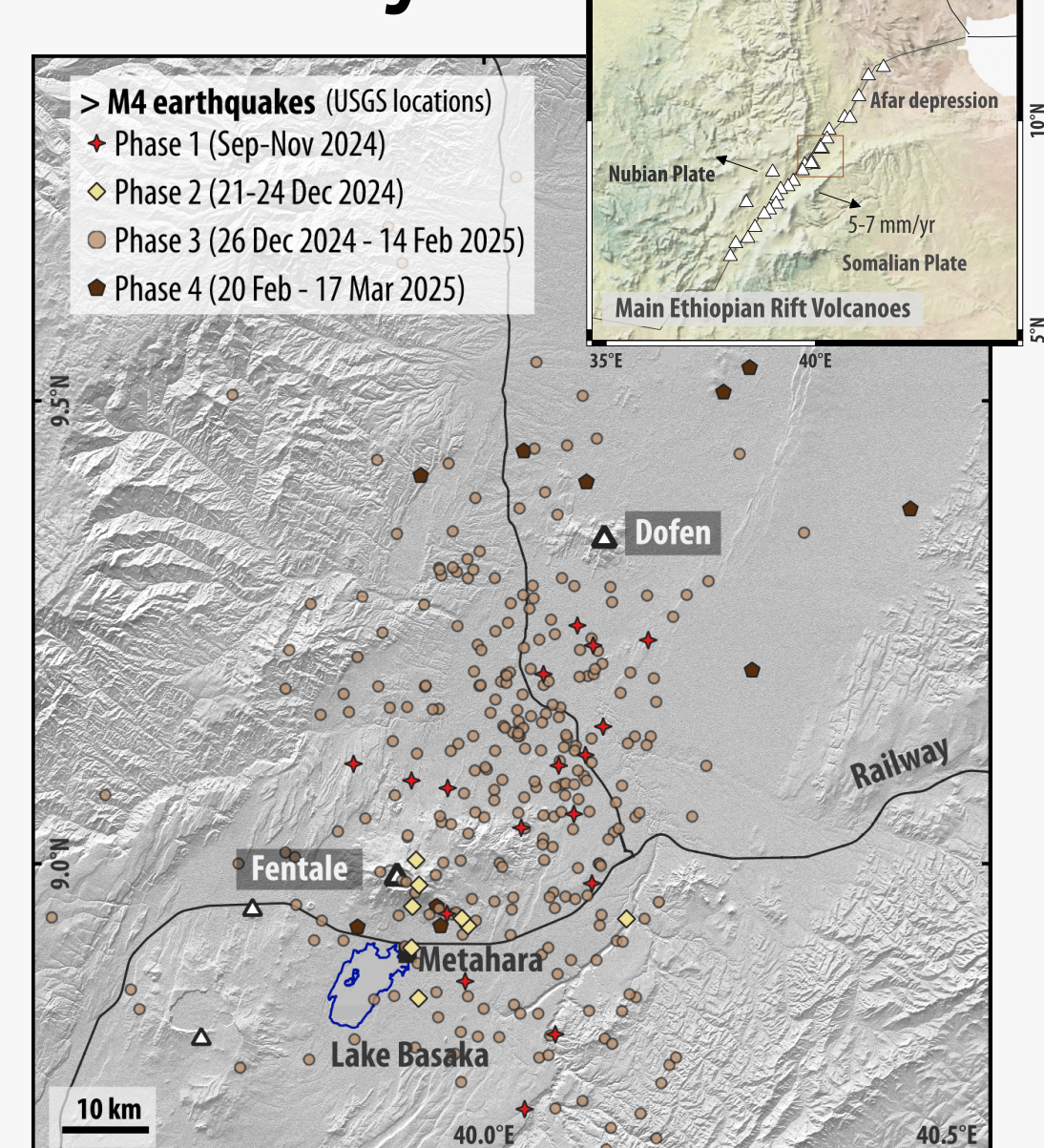
Lin Way^{*1}, Juliet Biggs¹, Weiyu Zheng¹, Sam Wimpenny¹, Milan Lazecky², Tim Wright², Elias Lewi³

COMET Event
Response Reports

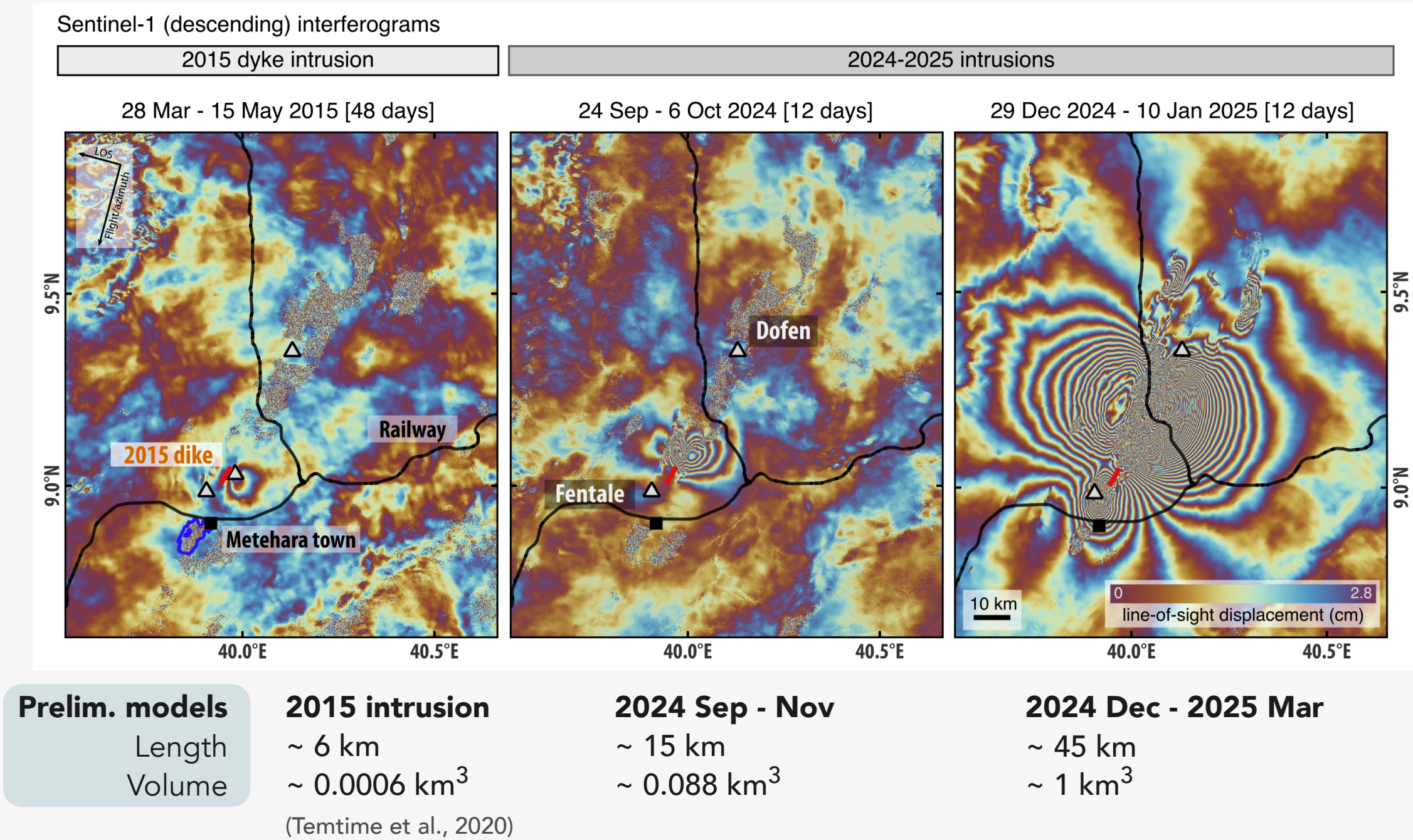


Context

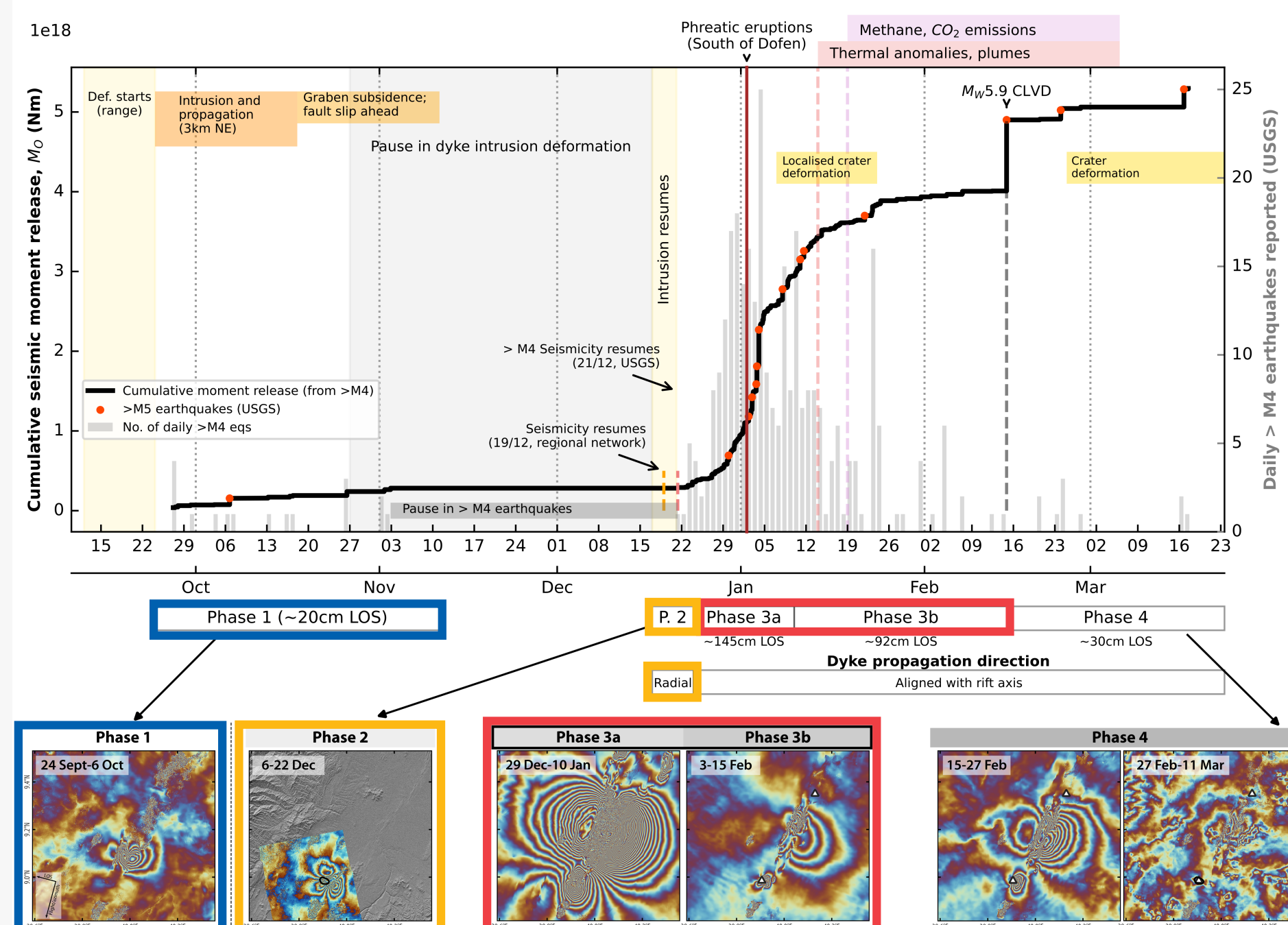
Seismicity



2015 vs 2024-2025 intrusions



Timeline (Sept 2024 - Mar 2025)



Science questions

What is feeding the intrusions?

Can the total intruded volume be (solely) explained by subsidence at Fentale, via volumetric and/or temporal correlations?
(after accounting for magma compressibility and host rock rigidity)

Possible source(s)

Single deflating source

More complex feeder system

Future uplift / accumulation at Fentale could be used to inform dike nucleation predictions

Different stages of activation?

Can we predict each dike pulse retrospectively?

-- Are the location, length, and dike volume predictable?

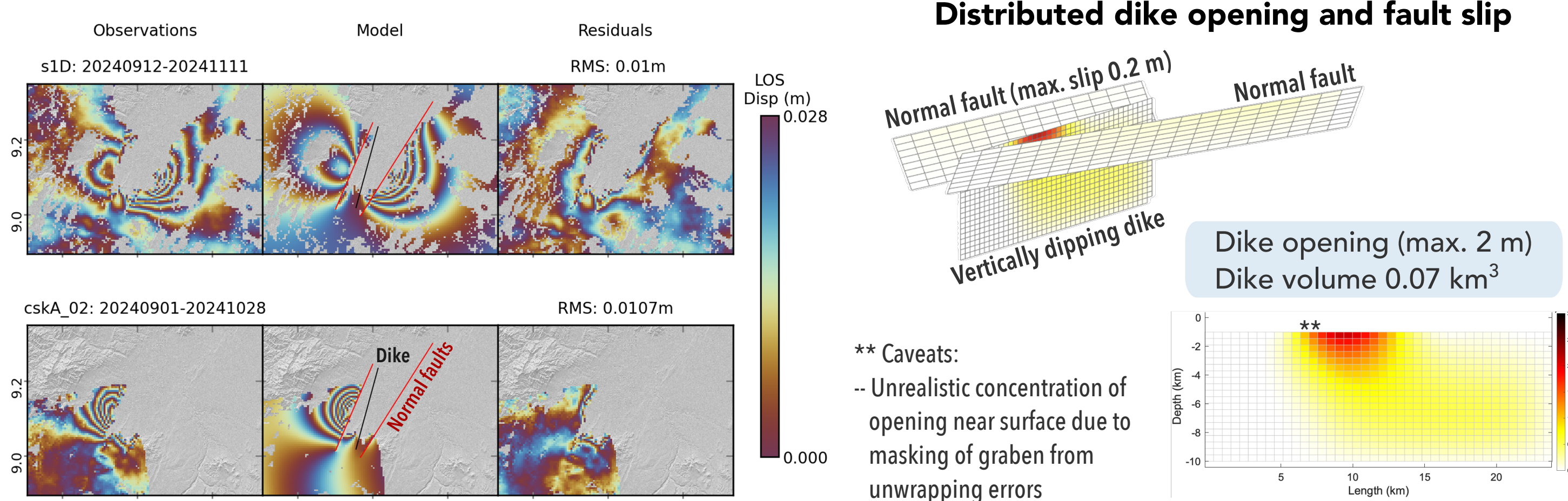
-- Relative controls of pre-existing stress state vs. stress changes from intrusion

↳ If each subsequent pulse is dominantly controlled by stress changes induced by the previous dike, this can feed into future near-real-time forecasting

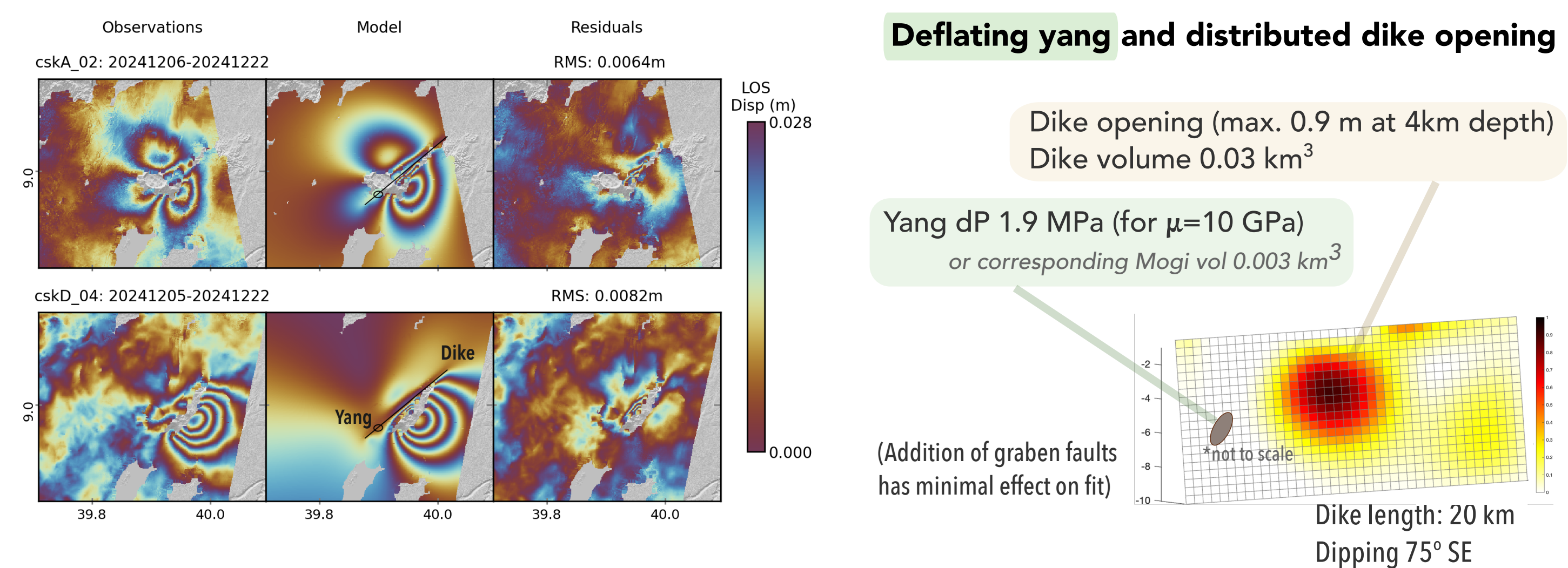
Preliminary kinematic models

Data: Sentinel-1 and COSMO-SkyMed

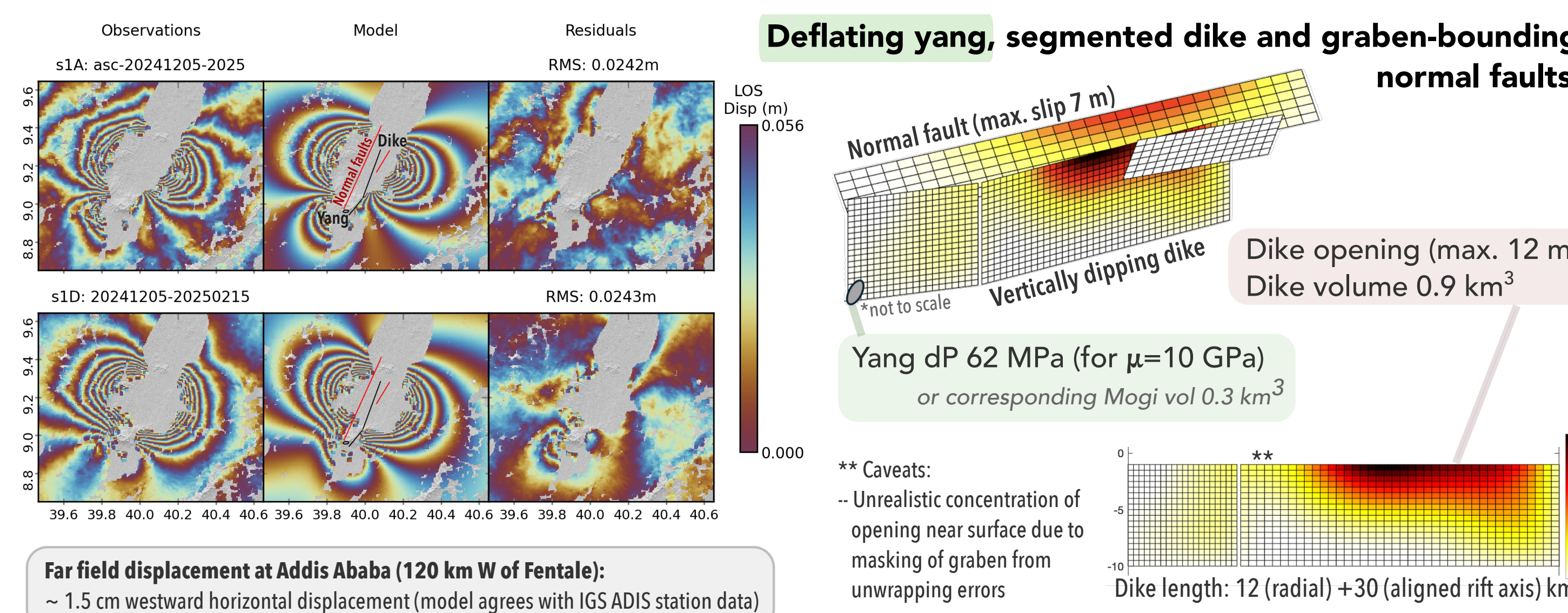
Phase 1 (Sep - Nov 2024)



Phase 2 (Dec 17-24 2024): Radial propagation

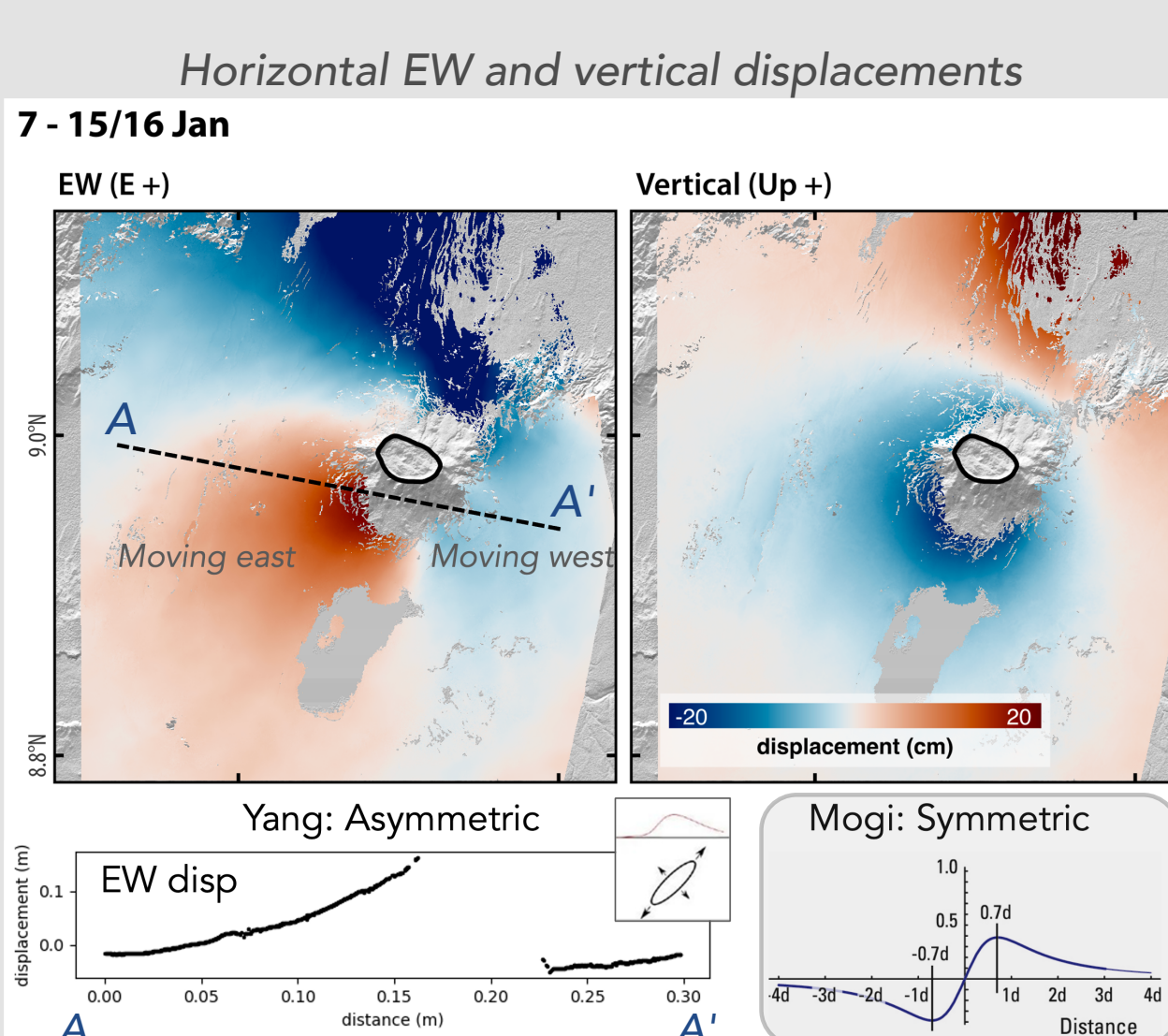


Phases 2 to 3 (Dec 17 - Feb 15)

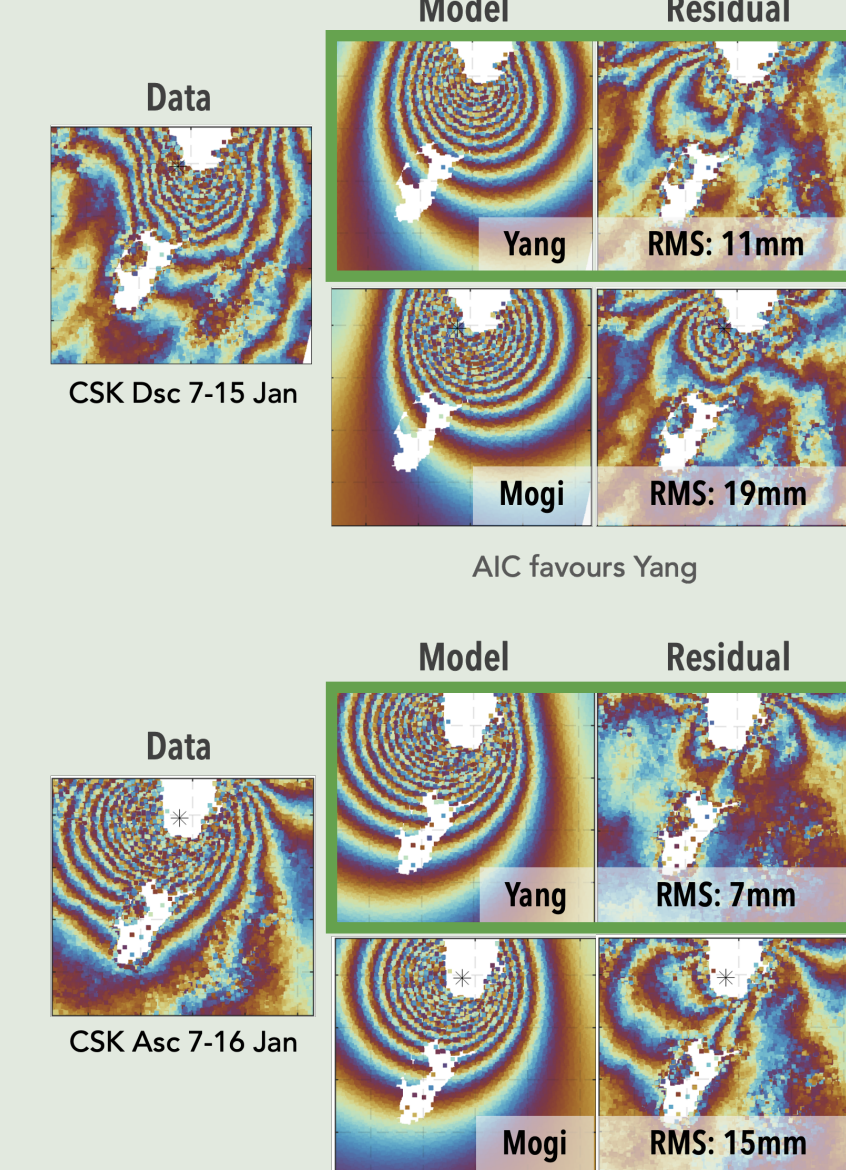


Deflating source beneath Fentale

Is a Mogi source suitable?



or a dipping ellipsoid (Yang) ?



How does the 2024-2025 Fentale dike sequence compare with other rifting events?

Rifting events	No. of intrusions	Dike length (max)	Opening	Total intruded volume	Timescale
Fentale 2024-5 (preliminary)	3 ?	~ 45 km (2 nd dike)	~ 10 m (max) ?	> 1 km ³ ?	6 months ?
Barðarbunga 2014-5		~ 50 km	4 m max	0.5 km ³	6 months
Afar 2005-10	14	60 km (initial dike)	8 m max	> 3.5 km ³ (~2.5 km ³ initial)	5 years
Krafla 1975-84	20	60 km (initial dike)	4-5 m mean	1-2 km ³	9 years

References

Bardarbunga: Gudmundsson et al., 2016; Spaans & Hooper 2018; Woods et al., 2019
Afar: Hamling et al., 2010; Grandin et al., 2011
Krafla: Wright et al., 2012; Hollingsworth et al., 2013

(near-) Future work

- Improve data quality within graben [See Weiyu's poster]
- Include offsets and BOI in inversions
- Correlating intruded volumes with broad subsidence at Fentale
- Investigate dike opening variations within each phase

online poster

