SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

CTBTO
PREPARATORY COMMISSION

Recording of T-phases from the M7.4 Kermadec Trench earthquake in 2020 at the CTBT IMS HA03 hydrophone station

Tiago Oliveira, Ying-Tsong Lin, Sérgio Jesus, Peter Nielsen and Noriyuki Kushida

P1.3-425

POSTER

universidade de aveiro
theoria poiesis praxis

WOODS HOLE
OCEANOGRAPHIC
INSTITUTION

UAlg
UNIVERSIDADE DO ALGARVE

CTBTO
PREPARATORY COMMISSION

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
Poster No.: P1.3-425

Recording of T-phases from the M7.4 Kermadec Trench earthquake in 2020 at the CTBT IMS HA03 hydrophone station

Tiago Oliveira (toliveira@ua.pt), Ying-Tsong Lin (ytlin@whoi.edu), Sérgio Jesus (sjesus@ualg.pt), Peter Nielsen (peter.nielsen@ctbto.org) and Noriyuki Kushida (noriyuki.kushida@ctbto.org)

CTBTO PREPARATORY COMMISSION

ABSTRACT

- On 18 June 2020, energetic underwater acoustic T-phase signals were recorded at the Comprehensive Nuclear-Test-Ban Treaty (CTBT) International Monitoring System (IMS) hydrophone station HA03, located at the Juan Fernandez Islands, Chile.
- In this work, we investigate the origin of these T-phases, which were associated to an M7.4 submarine earthquake with epicenter in the Kermadec Trench located at approximately 8700 km from HA03.
- Data recorded at HA10 (Ascension Island, South Atlantic) and HA11 (Wake Island, Pacific Ocean) is also analyzed.
- Analysis of the recorded T-phases was performed using the Progressive Multi-Channel Correlation algorithm (DTKGPMCC) installed on the CTBTO virtual Data Exploitation Centre (vDEC).
- The back azimuth results suggest that T-phases could be triggered at different locations along the Trench and far from the declared earthquake epicenter.
- Much higher Transmission Loss (TL) is observed in the propagation path between epicenter-H11S than epicenter-H03S and epicenter-H10N. Moreover, for H10N and H11S, discrepancies between expected and measured arrival angles were observed.
- A three-dimensional (3D) geodesic Cartesian parabolic equation model (Lin and Duda, 2012; Oliveira and Lin, 2019) has been utilized to identify the cause of these differences in TL and arrival angles.

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Poster No.: P1.3-425

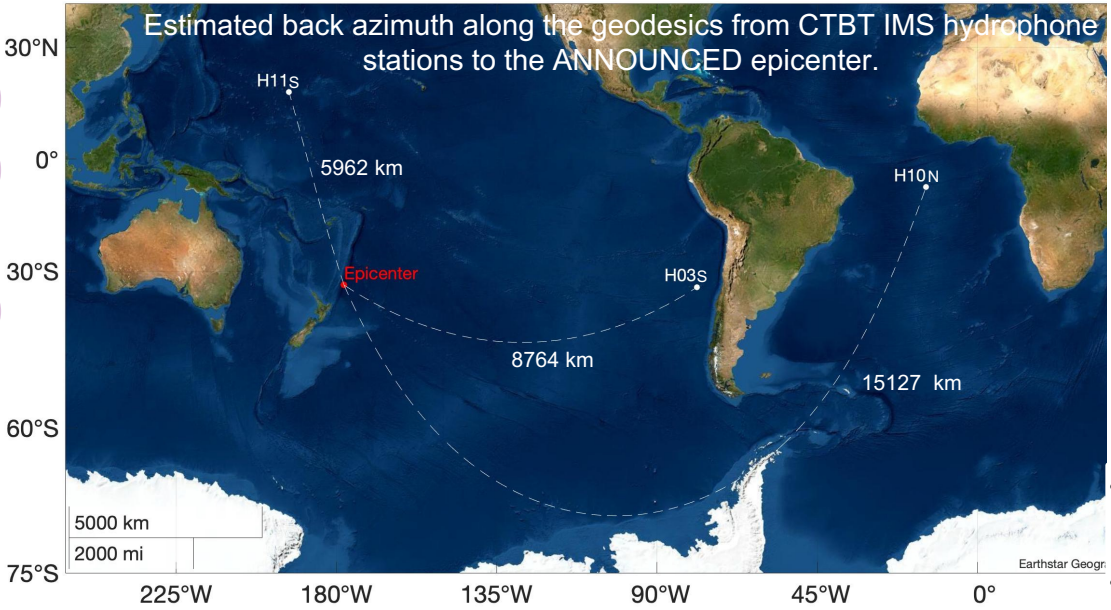
Recording of T-phases from the M7.4 Kermadec Trench earthquake in 2020 at the CTBT IMS HA03 hydrophone station

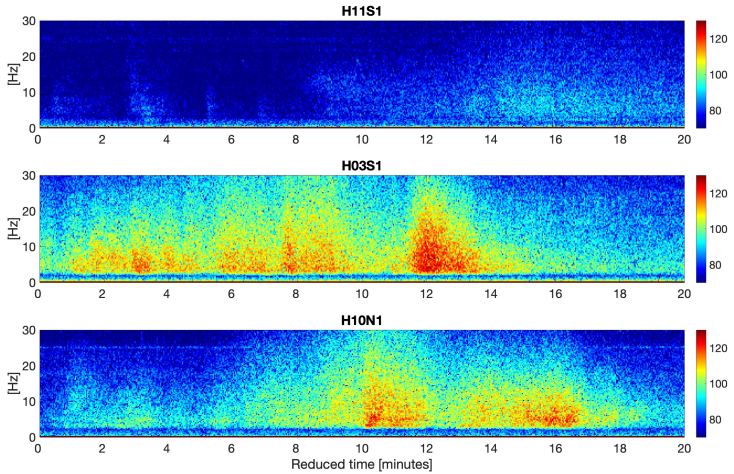
Tiago Oliveira (toliveira@ua.pt), Ying-Tsong Lin (ytlin@whoi.edu), Sérgio Jesus (sjesus@ualg.pt), Peter Nielsen (peter.nielsen@ctbto.org) and Noriyuki Kushida (noriyuki.kushida@ctbto.org)

CTBTO PREPARATORY COMMISSION

INTRODUCTION

- According to the United States Geological Survey (USGS) earthquake database, a moment magnitude (Mw) 7.4 submarine earthquake occurred on June 18, 2020, at 12:49:53.70 (UTC) in the Kermadec Trench (in the south Pacific Ocean) with epicenter at 33.29°S 177.86°W (uncertainty ± 10km) and depth 10.0 km (uncertainty ± 1.7km).





- T-phases from the earthquake were recorded at CTBT IMS hydrophone stations HA10, HA03, and HA11.
- Higher TL observed between epicenter and H11S (5962 km) than between epicenter and H03S (8764 km).

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

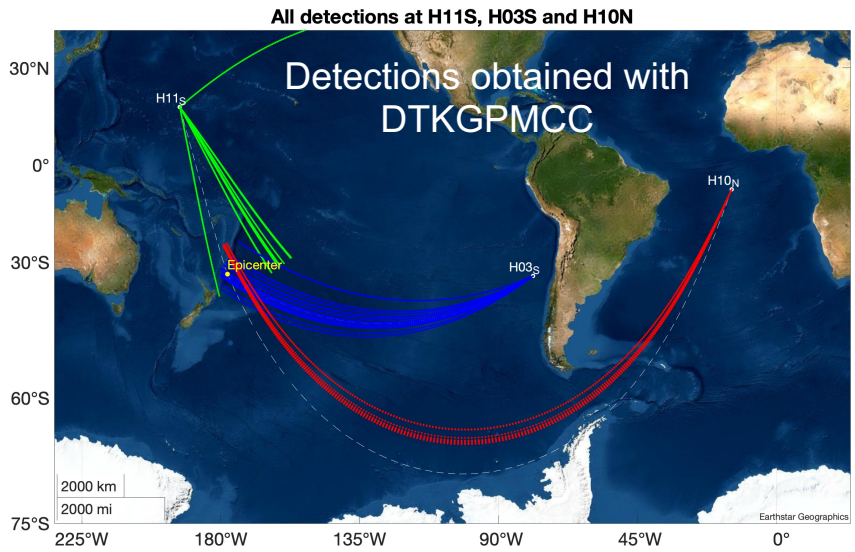
Poster No.: P1.3-425

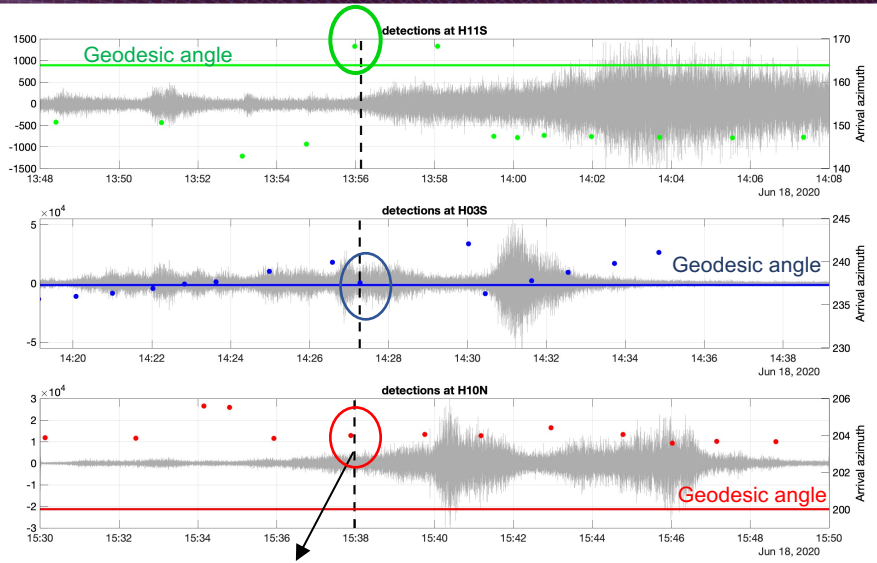
Recording of T-phases from the M7.4 Kermadec Trench earthquake in 2020 at the CTBT IMS HA03 hydrophone station

Tiago Oliveira (toliveira@ua.pt), Ying-Tsong Lin (ytlin@whoi.edu), Sérgio Jesus (sjesus@ualg.pt), Peter Nielsen (peter.nielsen@ctbto.org) and Noriyuki Kushida (noriyuki.kushida@ctbto.org)

CTBTO PREPARATORY COMMISSION

RESULTS





Detection close to the theoretical arrival time (considering c_w=1500m/s)

- Several arrivals (detections) were identified at the three hydrophone stations related with the earthquake. The source of T-phases was moving during the observation, and the event location could not necessarily correspond to the sound generation point.

- Discrepancies between expected and measured arrival angles were observed. For the detection near the theoretical arrival time, the arrival azimuth is higher than the geodesic for H11S (4.4 deg) and H10N (4 deg), and close to the geodesic for H03S (0.3 deg);

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Poster No.: P1.3-425

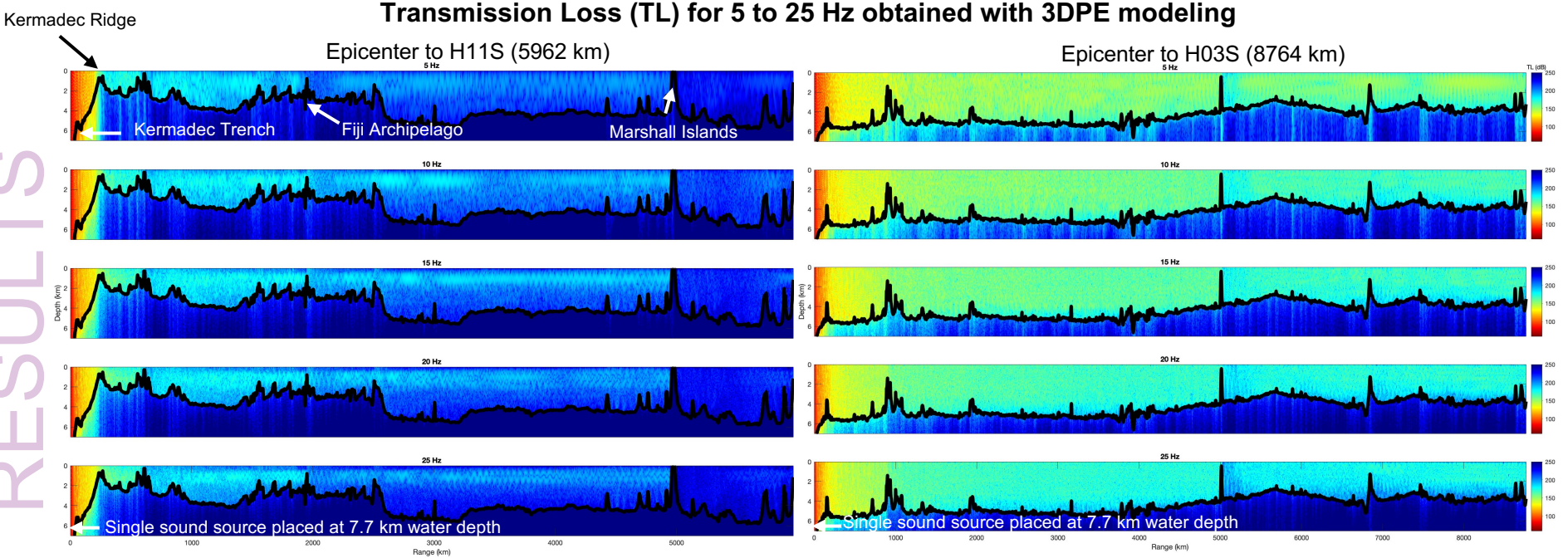
Recording of T-phases from the M7.4 Kermadec Trench earthquake in 2020 at the CTBT IMS HA03 hydrophone station

Tiago Oliveira (toliveira@ua.pt), Ying-Tsong Lin (ytlin@whoi.edu), Sérgio Jesus (sjesus@ualg.pt), Peter Nielsen (peter.nielsen@ctbto.org) and Noriyuki Kushida (noriyuki.kushida@ctbto.org)

CTBTO PREPARATORY COMMISSION

RESULTS

Transmission Loss (TL) for 5 to 25 Hz obtained with 3DPE modeling



- High TL when T-phases have to cross the Kermadec Ridge. Higher TL between epicenter-H11S (5962 km) than epicenter-H03S (8764 km).
- Simulations run in GPU (DGX-station) at CTBTO (Kushida et al., 2020, see poster P1.3-095 by Dr. Noriyuki Kushida).

SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Poster No.: P1.3-425

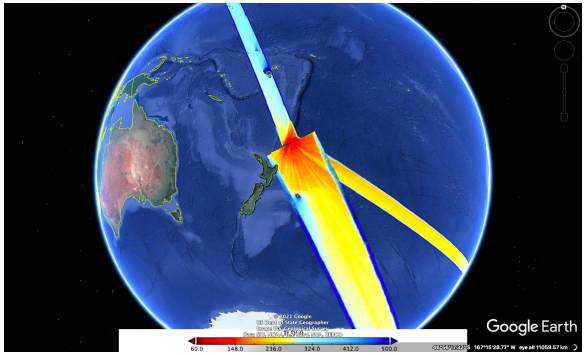
Recording of T-phases from the M7.4 Kermadec Trench earthquake in 2020 at the CTBT IMS HA03 hydrophone station

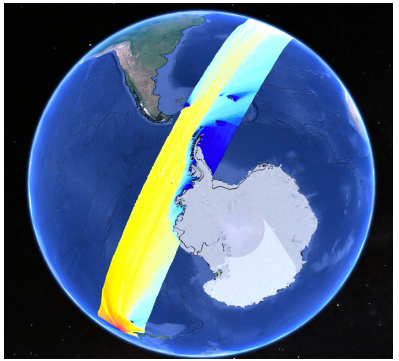
Tiago Oliveira (toliveira@ua.pt), Ying-Tsong Lin (ytlin@whoi.edu), Sérgio Jesus (sjesus@ualg.pt), Peter Nielsen (peter.nielsen@ctbto.org) and Noriyuki Kushida (noriyuki.kushida@ctbto.org)

CTBTO PREPARATORY COMMISSION

CONCLUSIONS

Depth integrated TL for 5 Hz near the epicenter for three different propagation domains considered.





Depth integrated TL between epicenter and H10N (15127 km) for 5 Hz. Detail of 3D effects induced by Antarctica peninsula.

- Data and 3D model results indicate much higher TL between epicenter and H11S (5962 km) than between epicenter and H03S (8764 km).
- High TL is observed when T-phases have to cross the Kermadec Ridge, which is the case of the sound path between epicenter and HA11.
- 3D model indicates significant horizontal reflection between epicenter and H11S (up to ~3 deg) and between epicenter-H10N (up to ~3 deg), and small for H03S (up to ~ 0.4 deg). As expected, horizontal reflection is frequency dependent.
- Numerical results revealed the importance of 3D effects induced by the, Kermadec Ridge, Fiji archipelago and Marshall Islands on sound propagation to HA11 and Antarctica peninsula to HA10.