Global gravity wave detections at infrasound stations of the International Monitoring System

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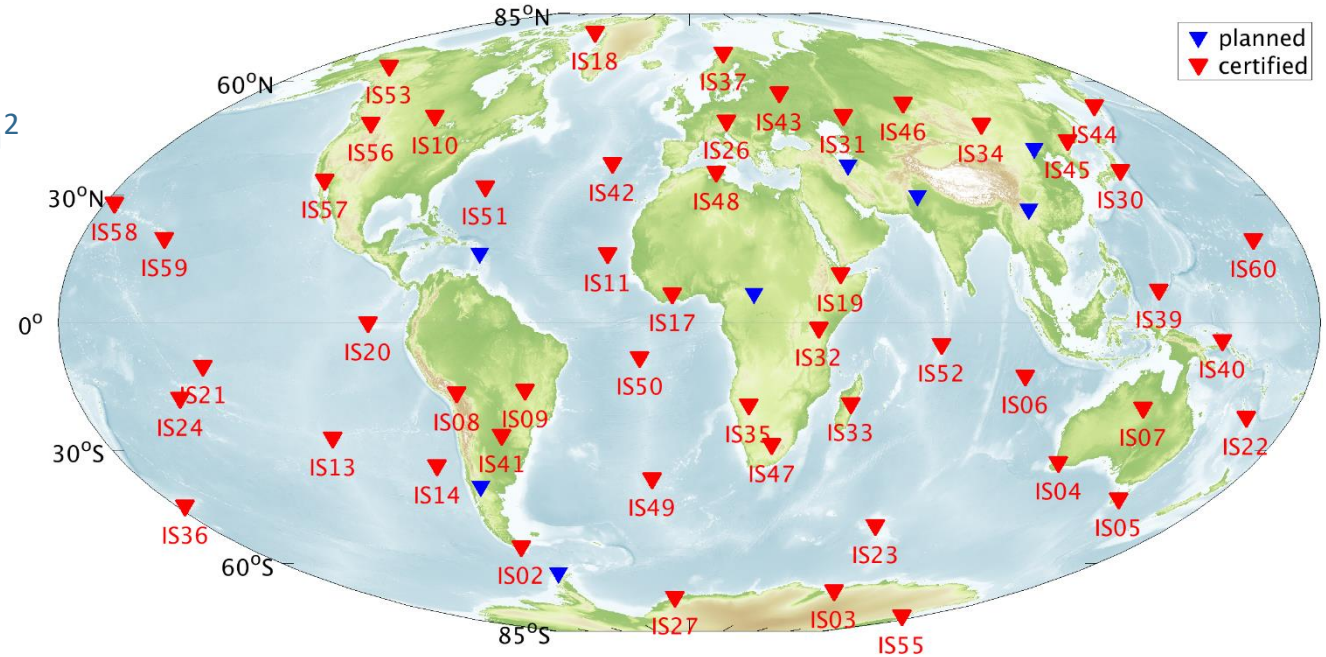
EGU2020: Sharing Geoscience Online
Session AS1.21, Contribution D2797
08 May 2020



The IMS infrasound network as of June 2019

Gravity waves (GWs) in the atmosphere

- GWs play a critical role in atmospheric dynamics as they transport energy and momentum
- methods for measuring GW parameters are rare
- ground-based high-resolution technologies (e.g. lidar) lack continuity and global distribution
- global estimates of GW activity often reflect the middle atmosphere only (satellite-based observations)

- IMS infrasound: ground-based network of more than 50 stations, dedicated to verifying compliance with the Comprehensive nuclear-Test-Ban Treaty (CTBT)
- each infrasound station (array) consists of at least four barometric sensors

- **Can the IMS infrasound arrays contribute to GW observations?**

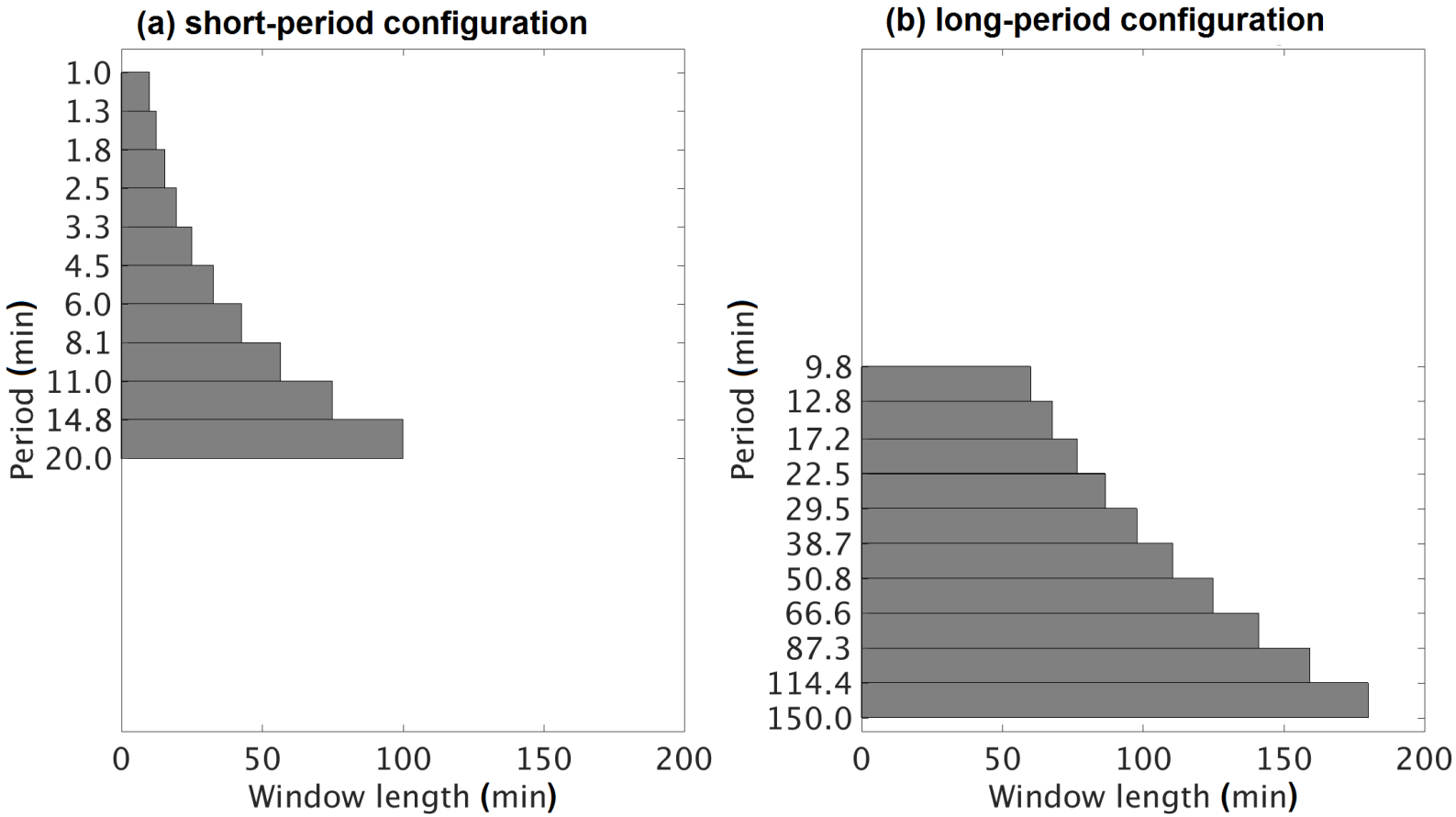
Associated publication:
Hupe, P., Ceranna, L., Le Pichon, A. (2019) How Can the International Monitoring System Infrasound Network Contribute to Gravity Wave Measurements? *Atmosphere*, **10**, 399, DOI: 10.3390/atmos10070399.

Adjusting the common infrasound array-processing algorithm configuration

- Progressive Multi-Channel Correlation (PMCC) algorithm (Cansi, 1995; Le Pichon et al., 2010), V4.4
- common frequency range for infrasound processing: 0.02 Hz – 5 Hz

This study: data set 2009-2018

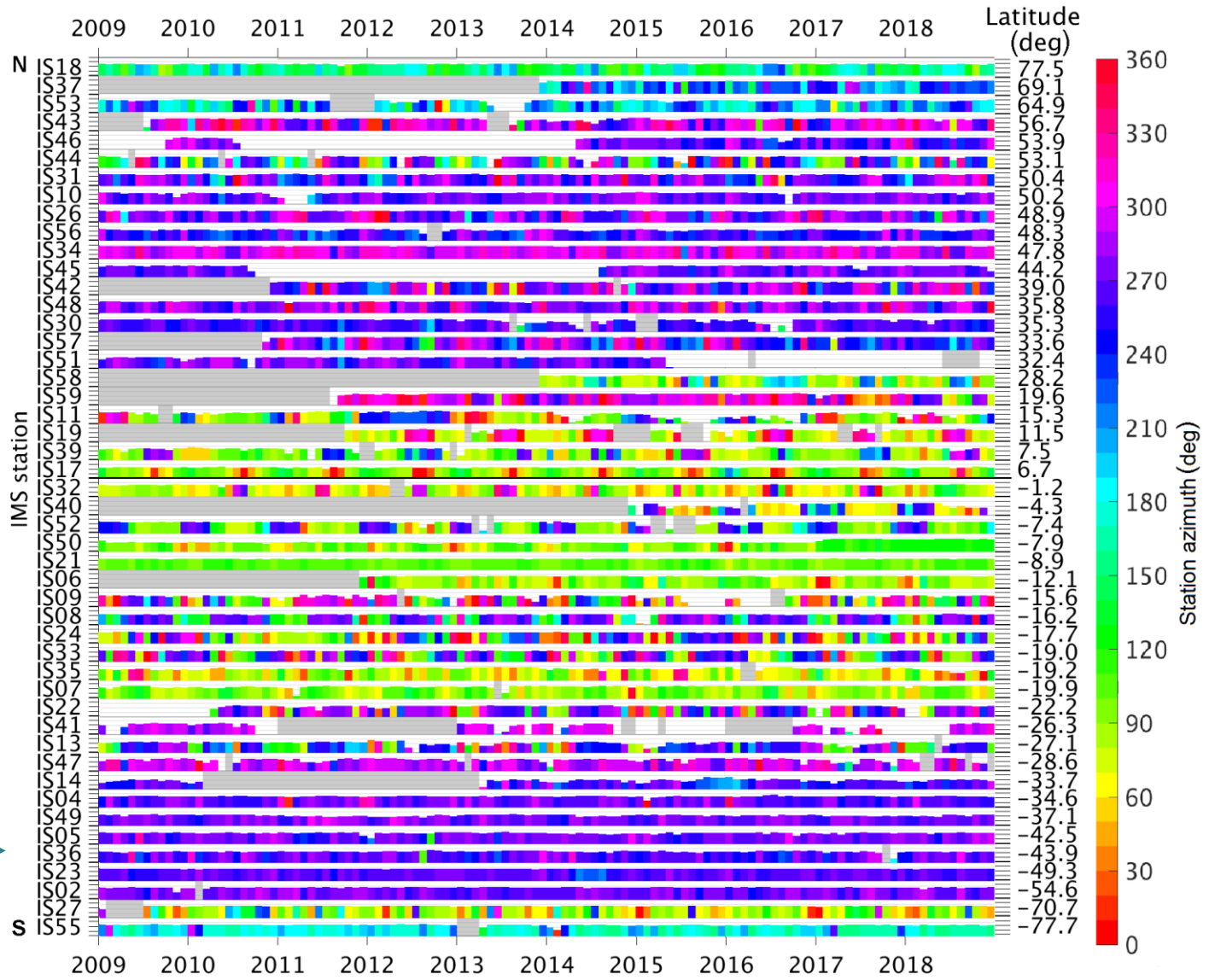
- two configurations in the (short-period) GW range, 1 min – 2.5 hrs
- PMCC detections filtered:
  - apparent phase velocity must be lower than 50 m/s
  - Fisher ratio must exceed 3 (see Olson, 2004)



Global detections at IMS stations

- seasonal variations in back-azimuth at the tropical stations
- correlation with the ITCZ at a couple of stations
- less variations in back-azimuth at mid-latitude stations, westerly directions
- coherent noise due to strong tropospheric winds, instead of (trapped) GWs?

Detailed discussion of the observations:
https://doi.org/10.3390/atmos10070399



Detections using the long-period configuration →
Each box depicts the number of detections (vertical scale) per month and the average back-azimuth (color)

Conclusions & Outlook

- the IMS infrasound network and the adaptation of the PMCC configuration allow low-frequency detections in the GW range
- detections at tropical stations correspond to the seasonal ITCZ movement
- coherent, drifting density structures can lead to overestimating the GW presence
- array configuration limits GW detectability

➔ further investigations required

➔ optimized sub-networks of IMS stations could lead to a better discrimination of GWs from other low-frequency detections

➔ collocated observations (e.g. lidar) for characterizing the detections (to be investigated during ARISE follow-up?!)

MDPI atmosphere

Article

How Can the International Monitoring System Infrasound Network Contribute to Gravity Wave Measurements?

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Received: 10 June 2019; Accepted: 12 July 2019; Published: 16 July 2019

Full text (open access), figures and references:
https://doi.org/10.3390/atmos10070399