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abstract

In addition to T1.1-P26, examples and results of the re-processing are shown. Please note that the current re-processing (PMCC 5.7) based on the latest configuration (Fig. 2-C) is still ongoing for a couple of stations. Therefore the global overviews shown here refer to PMCC 4.4 and the configuration shown in Fig. 2-B.

microbaroms

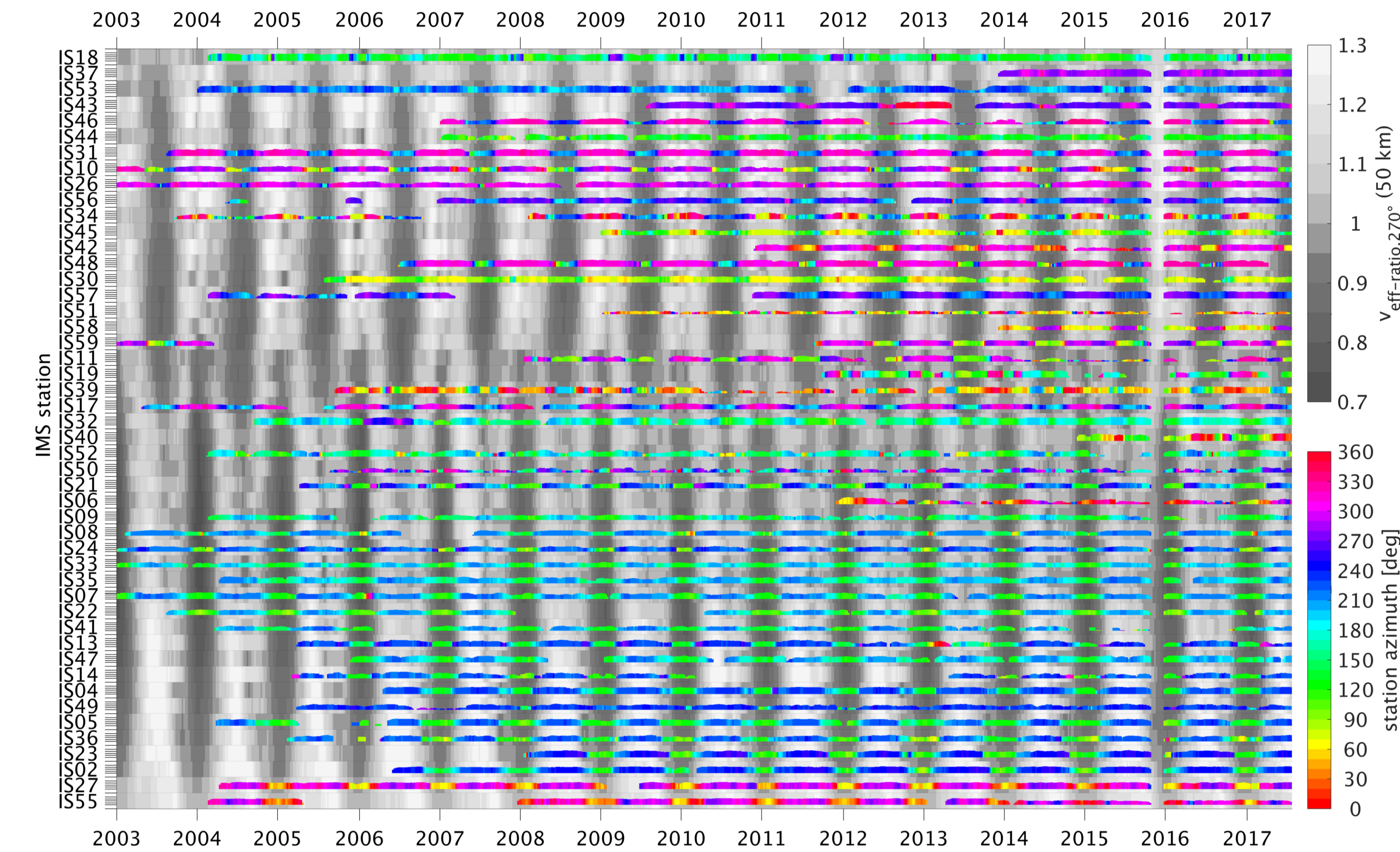


Fig. 5: An infrasound signal detected at the majority of IMS stations is ambient noise from microbaroms (0.1–0.5 Hz), originating from ocean wave interactions. These ubiquitous sources allow the monitoring of both the network performance and the middle atmosphere. Here, each box denotes the number of detections (logarithmic scale: 10^1 – 10^4) within 30 d (time step 7 d), and the mean station azimuth of the microbarom detections within the sliding time window is color-coded. The gray shading in the background indicates the effective sound speed ratio (the sound speed maximum at around 50 km relative to the sound speed at the ground) for an eastward propagation (light gray: favorable conditions). In general, the annual patterns in the microbarom detections reflect the propagation conditions in the stratosphere. Abnormal variations are only rarely recognized in the Southern Hemisphere (e.g., IS13 in early 2013); whereas in the Northern Hemisphere, the distribution of the source regions results in a broader variety in the detections.

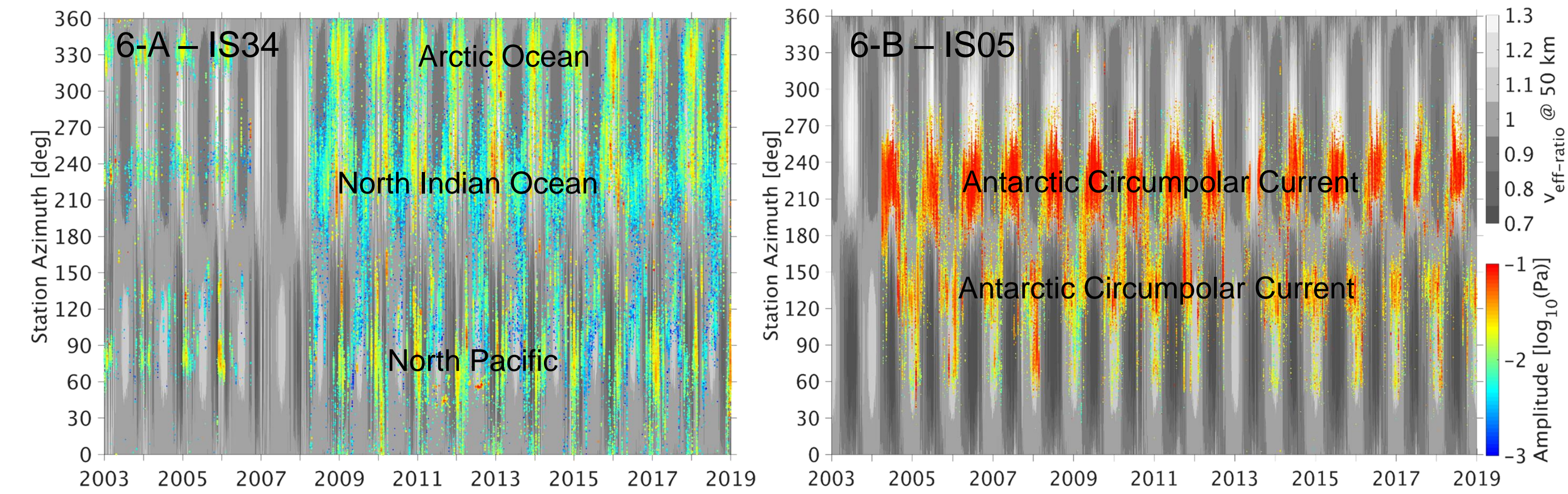


Fig. 6: The variety in the station azimuth and the amplitude (color-coded) of the detected microbarom signals is much broader at IS34 (Mongolia, 6-A) in the Northern Hemisphere, compared to IS05 (Tasmania, 6-B) in the Southern Hemisphere which reflects sources within the dominant Antarctic Circumpolar Current.

mountain-associated waves ... and severe storms

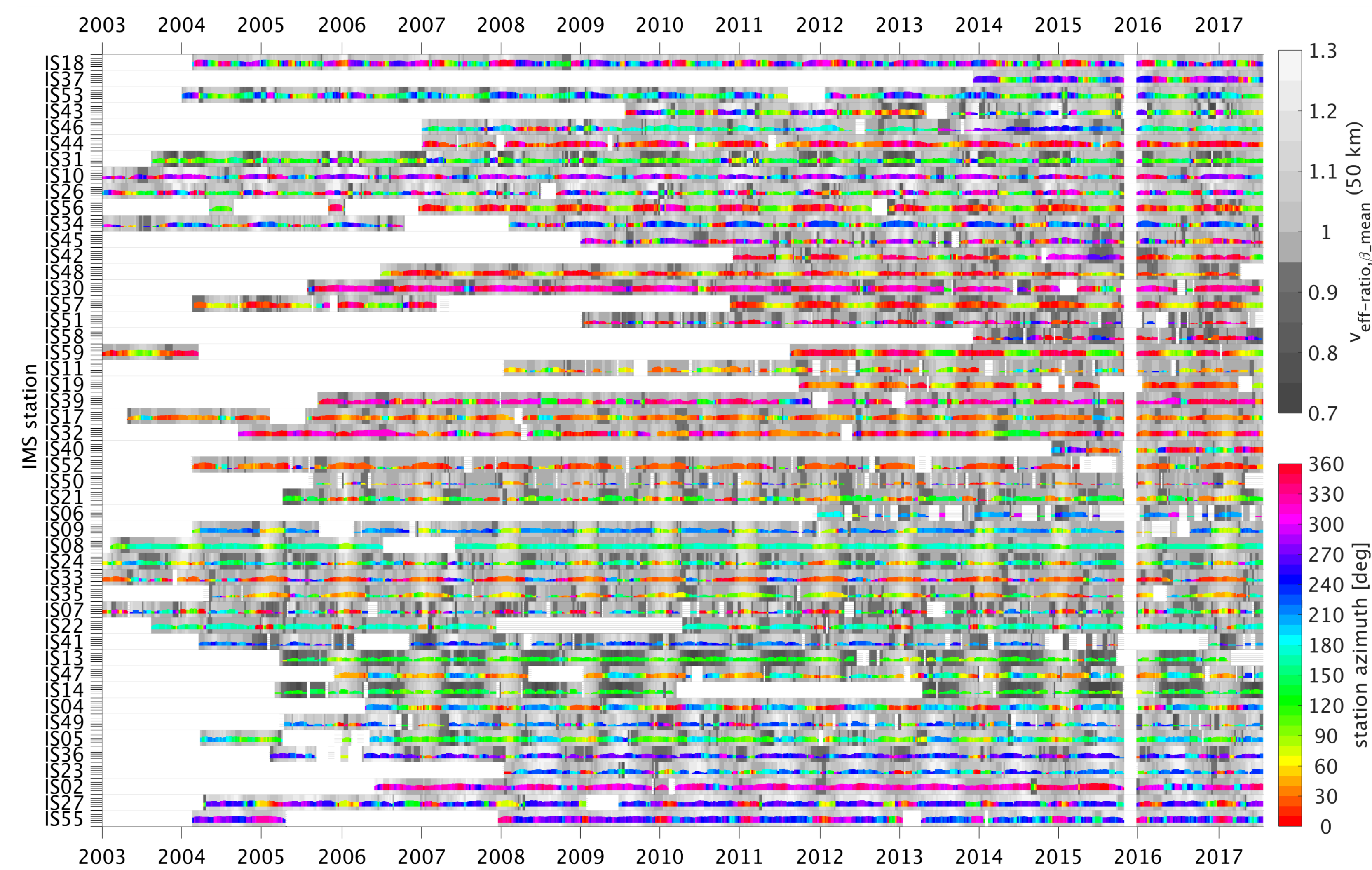


Fig. 7: Another natural infrasound source is the Mountain-Associated Wave (MAW, 0.01–0.1 Hz). The MAW detections are shown analogously to Fig. 5, but the effective sound speed ratio corresponds to the direction of the mean station azimuth. Consequently, light-gray background shading implies a stratospheric propagation path of the dominant detections. Dark-gray shading indicates other propagation paths, most likely thermospheric; for instance, MAW detections at IS08 (Bolivia) and IS13 (Easter Island) show almost continuous detections from the southern Andes, independently of the stratospheric waveguide. The directions of MAW detections mainly depend on the limited source regions, and the detected amplitudes are an attenuation effect of the propagation paths. MAWs can be long-lasting events (hours to days; e.g., Larson et al., 1971), but are not continuously detected such as microbaroms. Therefore smaller time windows are more appropriate for the evaluation shown in this figure. The ongoing processing will better allow an analysis using daily or weekly time windows because of an increased number of detections in the lower-frequency bands. In addition, the data gap of end-2015 will be filled.

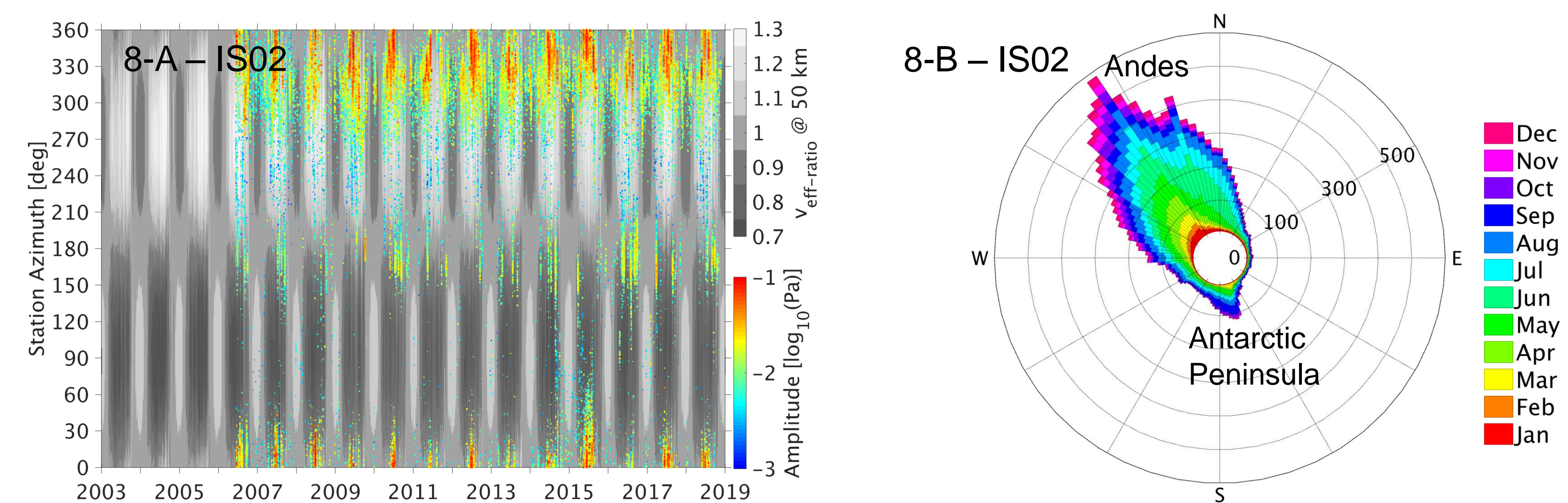


Fig. 8: At IS02 in southern Argentina, MAWs are a dominant signal in the PMCC detections. The most signals and the largest amplitudes are detected in the austral winter (8-A). The average annual distribution of the azimuth shows the majority of the detections being associated with the southern Andes source region in the north-northwest of the IMS infrasound station (8-B). A secondary source is in the south, which is the Antarctic Peninsula. The monthly distribution peaks have been used for a global cross-bearing approach for identifying source regions of MAWs.

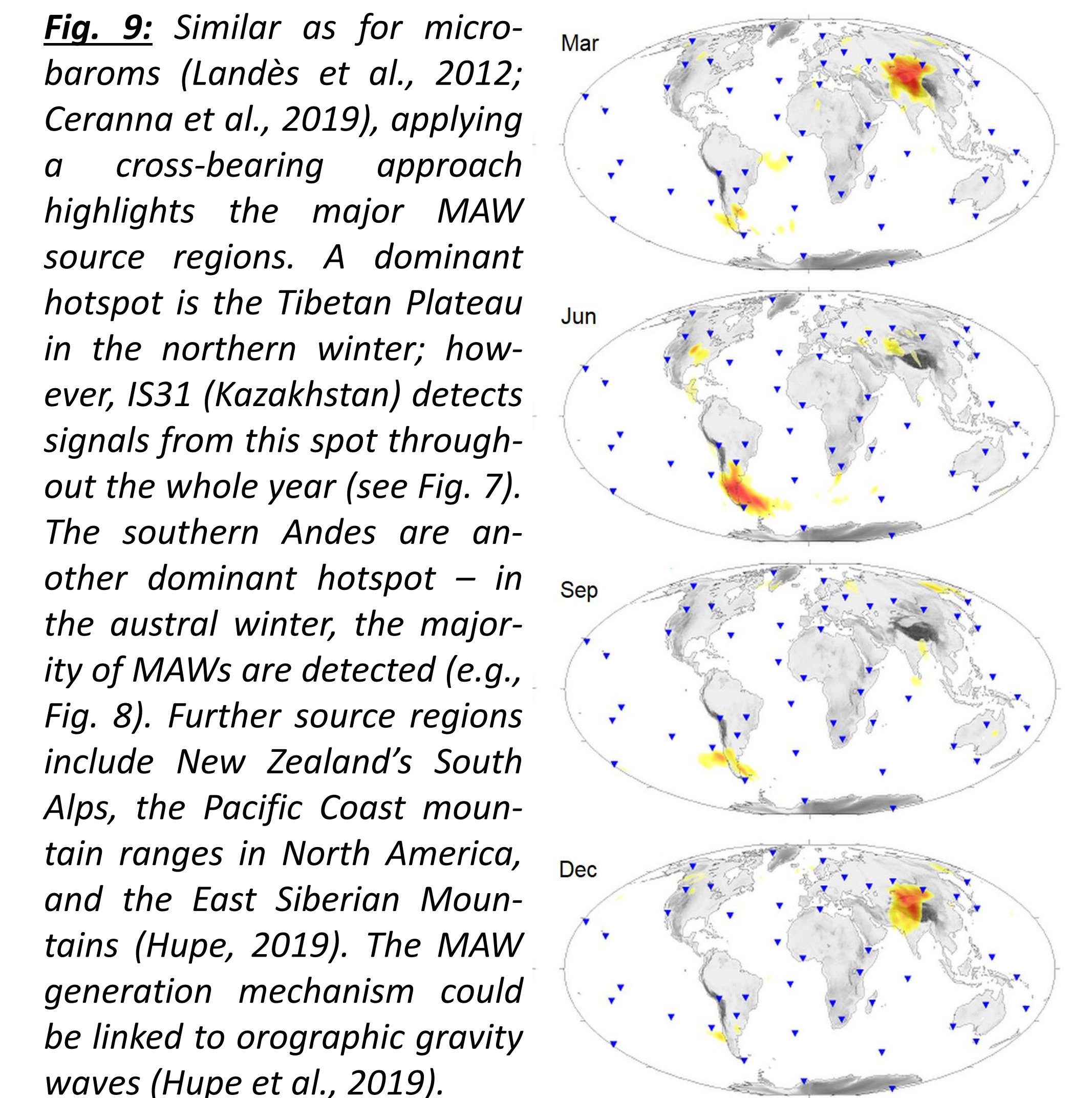


Fig. 9: Similar as for microbaroms (Landès et al., 2012; Ceranna et al., 2019), applying a cross-bearing approach highlights the major MAW source regions. A dominant hotspot is the Tibetan Plateau in the northern winter; however, IS31 (Kazakhstan) detects signals from this spot throughout the whole year (see Fig. 7). The southern Andes are another dominant hotspot – in the austral winter, the majority of MAWs are detected (e.g., Fig. 8). Further source regions include New Zealand’s South Alps, the Pacific Coast mountain ranges in North America, and the East Siberian Mountains (Hupe, 2019). The MAW generation mechanism could be linked to orographic gravity waves (Hupe et al., 2019). A non-MAW source region has been detected in the same frequency range, but in the summer of the Northern Hemisphere. The spot in the central USA, determined by the triangulation, is most likely related to severe storms which feature hail storms and tornadoes. The identified region is also known as ‘tornado alley’.

conclusions

- Added value for operational monitoring purposes (source discrimination, IMS infrasound network detection performance).
- Enabling the source localization of large-scale perturbations, such as MAWs/GWs, which impact the global circulation.
- Continuous and global monitoring of the stratospheric dynamics using frequently-detected microbaroms.

These capabilities of the presented broadband processing also provide an opportunity to assess (T1.1-P6) and improve the middle-atmosphere representation in global circulation models, which lack of continuous data in this altitude region (Charlton-Perez et al., 2013). All of these applications benefit from the latest processing configuration (T1.1-P26) since this features the low-frequency bands.

References:

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- Hupe, 2019: Global infrasound observations and their relation to atmospheric tides and mountain waves, Ph.D. thesis, LMU Munich, Germany.
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- Landès et al., 2012: Localization of microbarom sources using the IMS infrasound network, J. Geophys. Res. 117.
- Larson et al., 1971: Correlation of Winds and Geographic Features with Production of Certain Infrasonic Signals in the Atmosphere, Geophys. J. Int. 26.

