

Fig. 6. Noise-removal image of PALSAR.

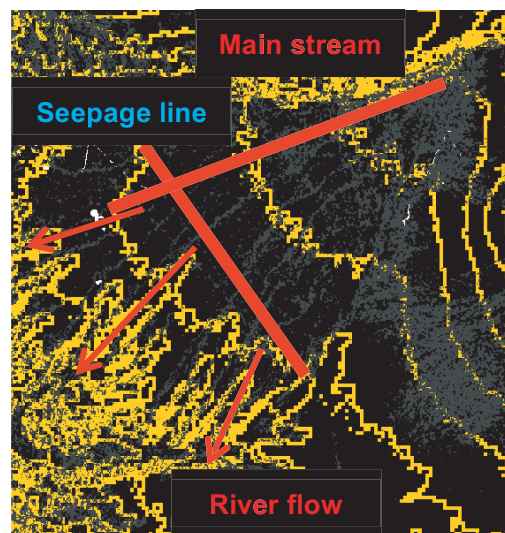


Fig. 8. Checked-up image of bright lines (red).

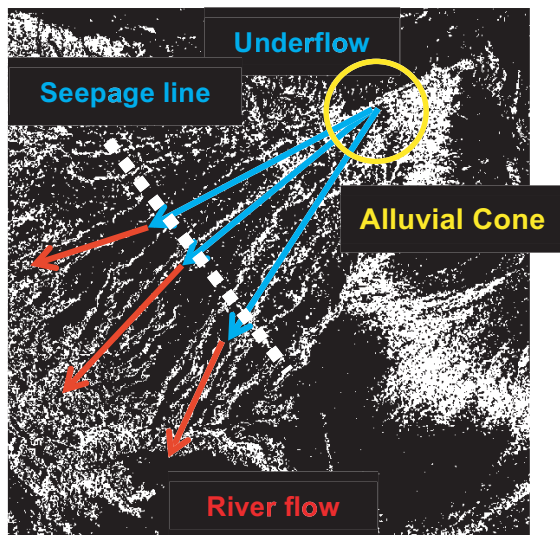


Fig. 7. Binary image of PALSAR.

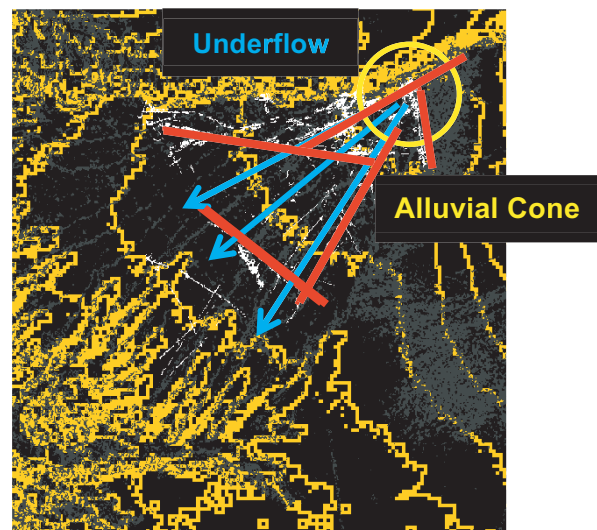


Fig. 9. Checked-up image of dark lines (red). Bright lines correspond to rivers. Dark lines correspond to underflows.

luvial cone once agriculture might exist. By deforestation over the mountains agriculture disappeared finally.

4. Discussion

Extraction of the Nazca lines was attempted. Since the pixel values of dark lines were near the ones of quebradas and gullies in ALOS/PRISM, extraction of dark lines was difficult. Then the conditions except the pixel values were expected to increase accuracy of the extraction. As the widths of the lines were narrower than the resolution of 2.5 m for PRISM, extracted lines became broken partially. Therefore, more advanced extraction method should be attempted for images with less than resolution (Sakurai *et al.*, 2005).

Moreover, examining the contour lines and extracted lines, the bright lines of ALOS/PALSAR and the Nazca lines coincided, directing to northeast of the highland and southwest of the lowland. As ALOS/PALSAR indicates the bright pixels where soil moisture was high, the lines

would indicate the position and direction of groundwater flow which flowed from the surrounding mountains, while the pictures of animals and plants would indicate seepage points. In fact, more than 40 underground canals were found in Nazca, which were designed for agriculture by taking the groundwater. Still these canals are available for agriculture.

At present, this area is a desert shown in Fig. 1, ALOS/PRISM. But there once were many rivers with underflows as shown in Fig. 6, ALOS/PALSAR. Invisible ancient rivers remain as *quebradas* or gullies today and underflows remain as thin bright lines in PALSAR. Deforestation would make a desert and gullies. Probably deforestation might mainly relate with production of ceramics and metals. Before deforestation there would be many agricultural fields in this area.

“Astronomical calendar” theory was dominant at that time. Because the movement of the sun is east to west,