In Situ Measurements of the Atmospheric CH_4 Mixing Ratio at Cape Ochi-ishi and Hateruma Island, Japan

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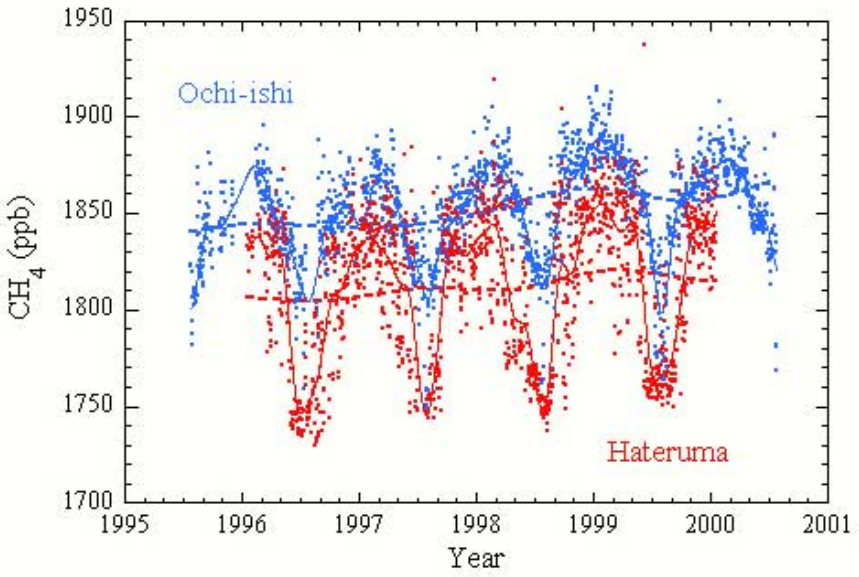
In situ measurements of atmospheric methane (CH_4) from the monitoring stations at Hateruma Island (latitude, 24°03'N, longitude, 123°48'E) from July 1995 to July 2000 and at Cape Ochi-ishi (latitude, 43°10'N, longitude, 145°30'E) from January 1996 to January 2000 are presented. A fully automated gas chromatograph equipped with a flame ionization detector (FID) measured the CH_4 mixing ratios at a frequency of more than 80 air samples per day. The CH_4 mixing ratios at both sites are considered to be representative of large, well-mixed volumes of the troposphere because strong local CH_4 sources are not identified and the diurnal cycles were insignificant.

Average growth rates of CH_4 mixing ratios during the individual observation periods were rather low (4.3 ppb yr^{-1} for Ochi-ishi and 4.7 ppb yr^{-1} for Hateruma), but there are significant fluctuations in the instantaneous growth rates for both sites with peak-to-peak differences of about 30 ppb yr^{-1}. The peak-to-peak amplitude of seasonal variations determined from the smooth curve fits were 73 ppb for Ochi-ishi and 94 ppb for Hateruma. These seasonal amplitudes, especially for Hateruma, are quite large when compared with those at the CMDL sampling network sites. Analysis of the back trajectories indicates that the air masses are transported from the Asian continent in winter and from the Pacific Ocean in summer at both sites. Since there are strong CH_4 sources in the Asian continent but no strong sources in the Pacific Ocean, the seasonality of flow patterns can explain the enhancement of the seasonal cycles. The back trajectories reaching Hateruma cover a wide extent of the latitude. This fact, combined with clear seasonality of flow regime at Hateruma and the latitudinal gradient of CH_4 mixing ratio in the Northern Hemisphere, result in the significantly large seasonality at Hateruma.



Daily average CH_4 mixing ratios at Ochi-ishi (blue dots) and Hateruma (red dots). The solid lines are smooth curve fits to the data, and the dashed lines are the deseasonalized long-term trends.