

TABLE II. ESTIMATES OF GLOBAL FLUXES ( $T_g$  N/yr) OF N-OXIDES AND RELATED COMPOUNDS

| Pathway  | Delwiche (1970)          | Burns and Hardy (1975)         | Söderlund and Svensson (1976)         | Robinson and Robbins (1975) | Liu et al. (1977)         | CAST (1976)                   | Sze and Rice (1976)       | Chameides (1977) | Crutzen and Ehhalt (1977) |
|--|--------------------------|--------------------------------|---------------------------------------|-----------------------------|---------------------------|-------------------------------|---------------------------|------------------|---------------------------|
| a. Biological denitrification (land and sea) . . . . .   | 83<br>( $N_2$ , $N_2O$ ) | 190 ( $N_2$ )<br>20 ( $N_2O$ ) | 96-191 ( $N_2$ )<br>36-149 ( $N_2O$ ) | 341 ( $N_2O$ )              | 270<br>( $N_2$ , $N_2O$ ) | 171-200<br>( $N_2$ , $N_2O$ ) | 260<br>( $N_2$ , $N_2O$ ) |                  |                           |
| a <sub>1</sub> . Land . . . . .                          |                          | 13 ( $N_2O$ )                  | 16-69 ( $N_2O$ )                      |                             |                           | 7 ( $N_2O$ )                  |                           |                  | 12-80 ( $N_2O$ )          |
| a <sub>2</sub> . Ocean . . . . .                         |                          | 7 ( $N_2O$ )                   | 20-80 ( $N_2O$ )                      |                             |                           |                               |                           |                  | 40-90 ( $N_2O$ )          |
| b. Deposition of $N_2O$ to land . . . . .                |                          |                                |                                       | 320                         |                           |                               |                           |                  |                           |
| c. Biological $N_2$ -fixation (land and sea) . . . . .   | 54                       | 175                            | 169-269                               | 117                         | 240                       |                               | 260                       |                  |                           |
| d. Total gaseous $NH_3$ dry deposition . . . . .         |                          |                                | 67-134                                | 679                         |                           |                               |                           |                  |                           |
| d <sub>1</sub> . Land . . . . .                          |                          |                                | 57-114                                |                             |                           |                               |                           |                  |                           |
| d <sub>2</sub> . Ocean . . . . .                         |                          |                                | 10-20                                 |                             |                           |                               |                           |                  |                           |
| e. Total $NH_4^+$ deposition . . . . .                   |                          |                                | 43-102                                | 190                         |                           |                               |                           |                  |                           |
| e <sub>1</sub> . Total wet . . . . .                     |                          |                                | 38-85                                 | 150                         |                           |                               |                           |                  |                           |
| e <sub>2</sub> . Land . . . . .                          |                          |                                | 30-60                                 |                             |                           |                               |                           |                  |                           |
| e <sub>3</sub> . Ocean . . . . .                         |                          |                                | 8-25                                  |                             |                           |                               |                           |                  |                           |
| e <sub>4</sub> . Total dry . . . . .                     |                          |                                | 5-17                                  | 40                          |                           |                               |                           |                  |                           |
| e <sub>5</sub> . Land . . . . .                          |                          |                                | 4-12                                  |                             |                           |                               |                           |                  |                           |
| e <sub>6</sub> . Ocean . . . . .                         |                          |                                | 1-5                                   |                             |                           |                               |                           |                  |                           |
| f. Total gaseous $NH_3$ emissions . . . . .              |                          | 165                            | 113-244                               | 866                         |                           |                               |                           |                  |                           |
| f <sub>1</sub> . Land . . . . .                          |                          |                                | 113-244                               |                             |                           |                               |                           |                  |                           |
| f <sub>2</sub> . Ocean . . . . .                         |                          |                                | 0                                     |                             |                           |                               |                           |                  |                           |
| g. Total particulate $NO_3^-$ deposition . . . . .       |                          | 60                             | 18-51                                 | 95                          |                           |                               |                           |                  |                           |
| g <sub>1</sub> . Wet . . . . .                           |                          |                                | 0.3-3                                 | 75                          |                           |                               |                           |                  |                           |
| g <sub>2</sub> . Dry . . . . .                           |                          |                                | 18-46                                 | 20                          |                           |                               |                           |                  |                           |
| h. Total $N_2$ atmospheric fixation . . . . .            | 38                       | 60                             |                                       |                             |                           |                               |                           |                  |                           |
| h <sub>1</sub> . Combustion . . . . .                    | 18                       | 20                             | 19                                    | } 15                        | 18                        | 21                            |                           |                  |                           |
| h <sub>2</sub> . Industrial . . . . .                    | 12                       | 30                             | 36                                    |                             | 36                        |                               |                           |                  |                           |
| h <sub>3</sub> . Lightning . . . . .                     | 8                        | 10                             |                                       |                             | 9                         |                               |                           | 30-40            | 8-40                      |
| i. Total $NO_2$ formed in atmosphere . . . . .           |                          | 20                             |                                       | 95                          |                           |                               |                           |                  |                           |
| j. Total $NO$ natural emissions . . . . .                |                          |                                |                                       | 212                         |                           |                               |                           |                  |                           |
| j <sub>1</sub> . Land . . . . .                          |                          |                                | 21-89                                 |                             |                           |                               |                           |                  |                           |
| j <sub>2</sub> . Ocean . . . . .                         |                          |                                |                                       |                             |                           |                               |                           |                  |                           |
| k. Total $NO_2$ deposition . . . . .                     |                          | 49                             | 43-116                                | 132                         |                           |                               |                           |                  |                           |
| k <sub>1</sub> . Land . . . . .                          |                          | 31                             | 32-83                                 |                             |                           |                               |                           |                  |                           |
| k <sub>2</sub> . Ocean . . . . .                         |                          | 18                             | 11-33                                 |                             |                           |                               |                           |                  |                           |
| l. $NH_3 \rightarrow NO$ . . . . .                       |                          | 30                             | 3-8                                   |                             |                           |                               |                           |                  |                           |
| m. $NO$ stratosphere $\rightarrow$ troposphere . . . . . |                          | 5                              | 0.3                                   | 2                           |                           |                               |                           |                  |                           |