# 1 IROE Retrievals

Document version: April 6, 2002

## 1.1 Data

- Microwindow data from jul01 selection copied 21 Feb 02 from ftp florence.atm.ox.ac.uk
- Averaging kernels supplied by S. Ceccherini, email 15 Feb 02. Created using perturbation method ('method 1').
- Residuals supplied by S. Ceccherini 7 Mar 02.

## 1.2 Notes

- Averaging kernels calculated using perturbation method ('method 1').
- No averaging kernel for pressure retrieval.
- Retrieval sequence: $pT$, $H_2O$, $O_3$, $HNO_3$, $CH_4$, $N_2O$ then $NO_2$.
- Residuals also supplied for masked points in microwindows. points

## 1.3 REC Analysis

Table 1: REC analysis for IROE retrievals

| error source | all points $c$ | all points $\sigma$ | unmasked only $c$ | unmasked only $\sigma$ |
|---|---|---|---|---|
| `o3` | 0.06 | 0.00 | 0.01 | 0.01 |
| `so2` | 0.01 | 0.01 | 0.00 | 0.01 |
| `no2` | 0.06 | 0.01 | 0.06 | 0.01 |
| `hno3` | 0.08 | 0.01 | 0.04 | 0.01 |
| `ch4` | 0.02 | 0.01 | −0.01 | 0.02 |
| `n2o` | 0.27 | 0.02 | 0.10 | 0.02 |
| `nonlte` | 0.65 | 0.02 | 0.55 | 0.03 |
| `h2o_12` | 0.10 | 0.02 | 0.01 | 0.03 |
| `h2o_st` | 0.59 | 0.03 | 0.04 | 0.04 |
| `nh3` | −0.15 | 0.05 | −0.37 | 0.14 |
| `pre` | −2.77 | 0.06 | −0.80 | 0.10 |
| `n2o5` | −0.05 | 0.06 | −0.22 | 0.09 |
| `hcn` | −0.43 | 0.08 | −1.55 | 0.76 |
| `co2mix` | 0.02 | 0.09 | 0.07 | 0.11 |

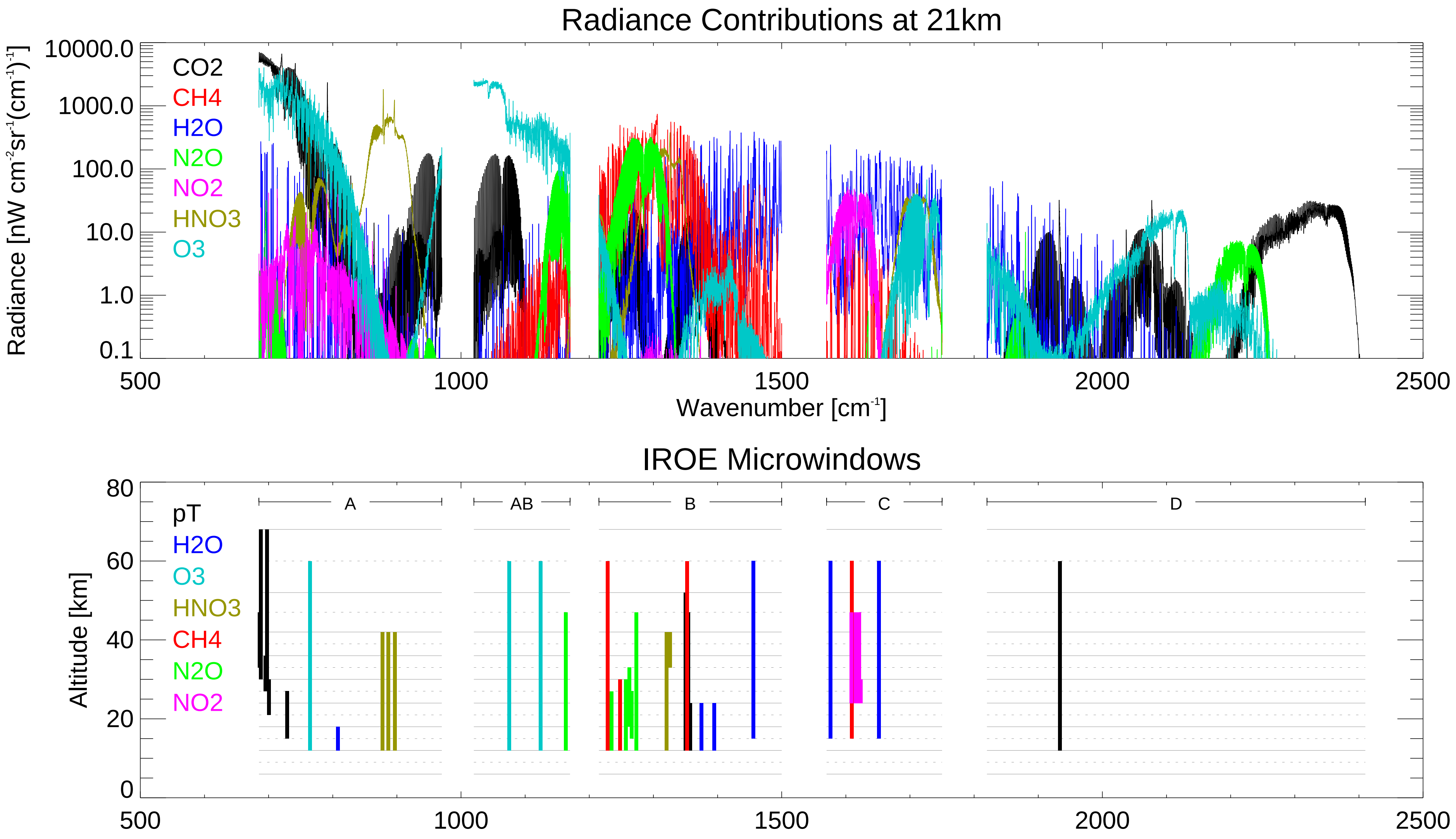



Figure 1: IROE microwindows

## 1.4 Pressure-Temperature

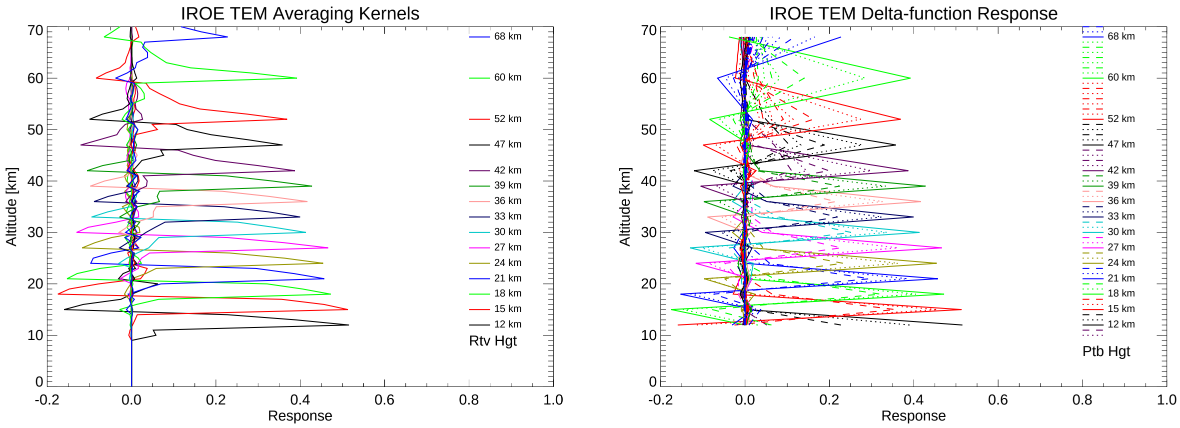



Figure 2: IROE temperature averaging kernel matrix

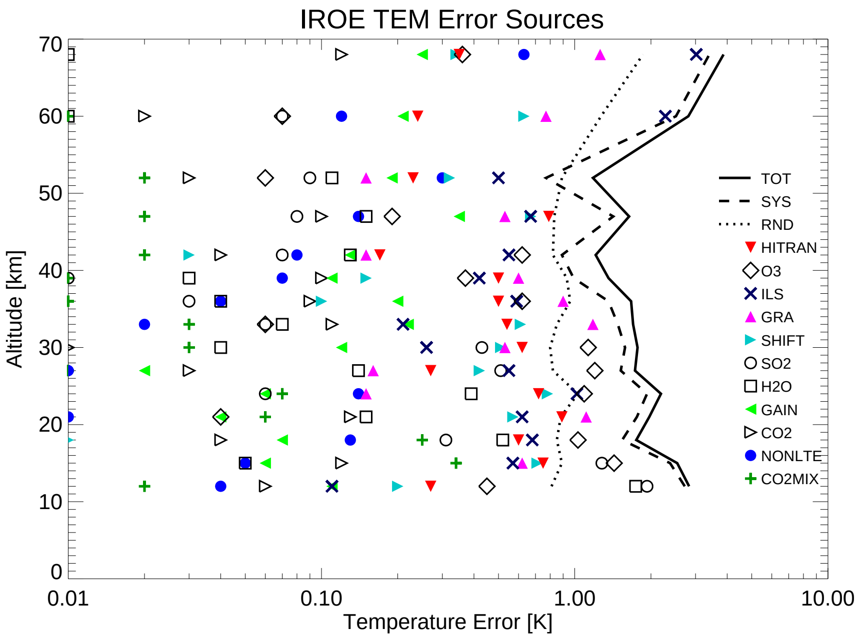
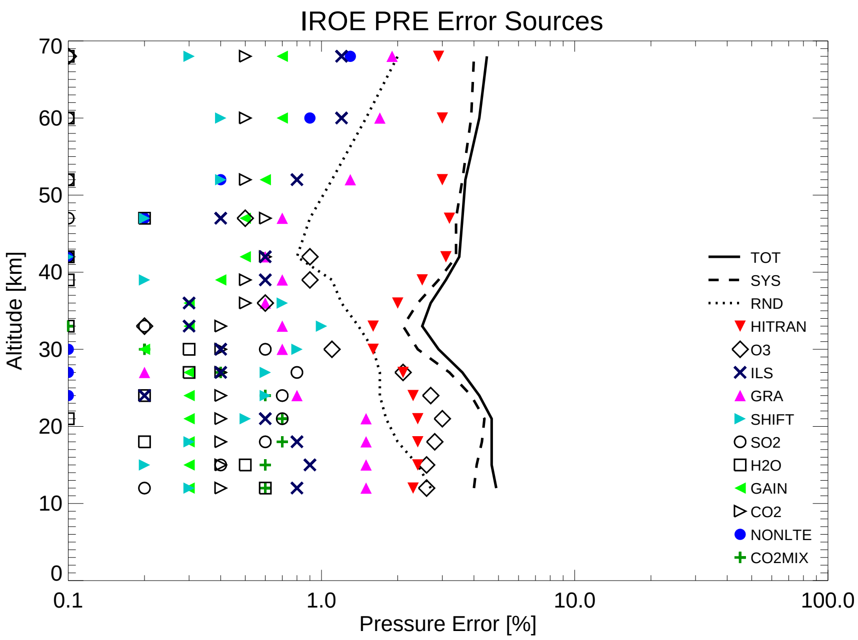



Figure 3: IROE temperature retrieval errors

REC Analysis

| source | $c$ | $\sigma$ |
|---|---|---|
| so2 | 0.02 | 0.01 |
| o3 | −1.13 | 0.05 |
| h2o_12 | −0.46 | 0.12 |
| h2o_st | −0.27 | 0.15 |
| ch4 | 0.50 | 0.18 |
| co2mix | −1.98 | 0.18 |
| nonlte | 0.72 | 0.18 |
| pre | 0.07 | 0.18 |

[no pressure averaging kernel matrix available]




REC Analysis

| source | $c$ | $\sigma$ |
|---|---|---|
| so2 | 0.02 | 0.01 |
| o3 | −1.13 | 0.05 |
| h2o_12 | −0.46 | 0.12 |
| h2o_st | −0.27 | 0.15 |
| ch4 | 0.50 | 0.18 |
| co2mix | −1.98 | 0.18 |
| nonlte | 0.72 | 0.18 |
| pre | 0.07 | 0.18 |

Figure 4: IROE pressure retrieval errors

## 1.5 Methane

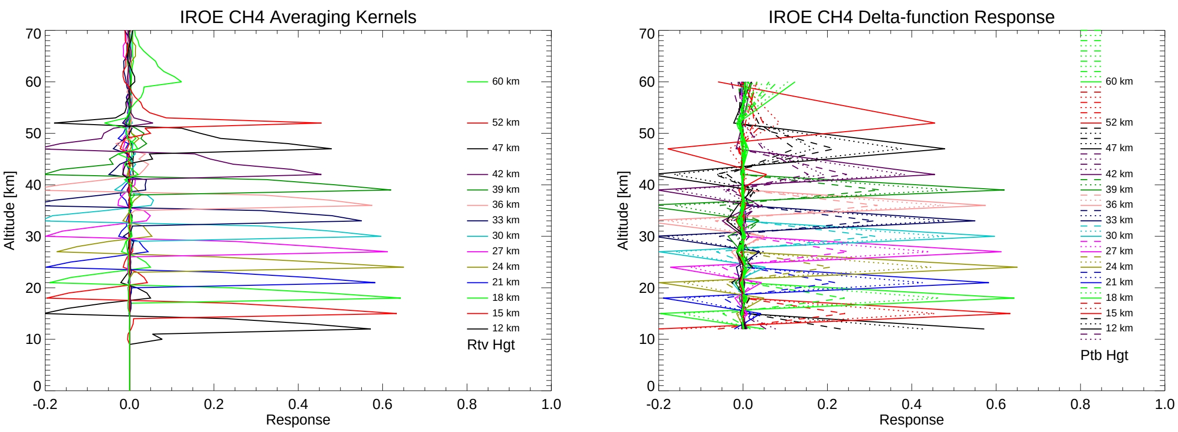
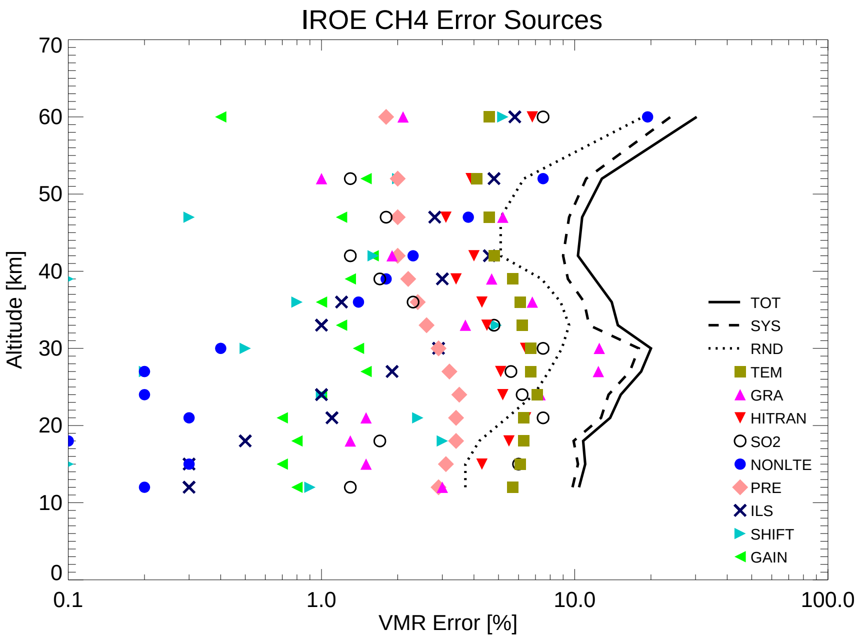



Figure 5: IROE methane averaging kernel matrix




REC Analysis

| source | $c$ | $\sigma$ |
|---|---|---|
| so2 | −0.01 | 0.01 |
| no2 | 0.08 | 0.02 |
| ch4 | −0.08 | 0.03 |
| h2o_12 | 0.07 | 0.09 |
| n2o | 0.89 | 0.11 |
| nonlte | 0.09 | 0.13 |
| n2o5 | −0.84 | 0.13 |
| h2o_st | −0.05 | 0.15 |
| cof2 | −0.79 | 0.28 |

Figure 6: IROE methane retrieval errors

## 1.6 Water Vapour

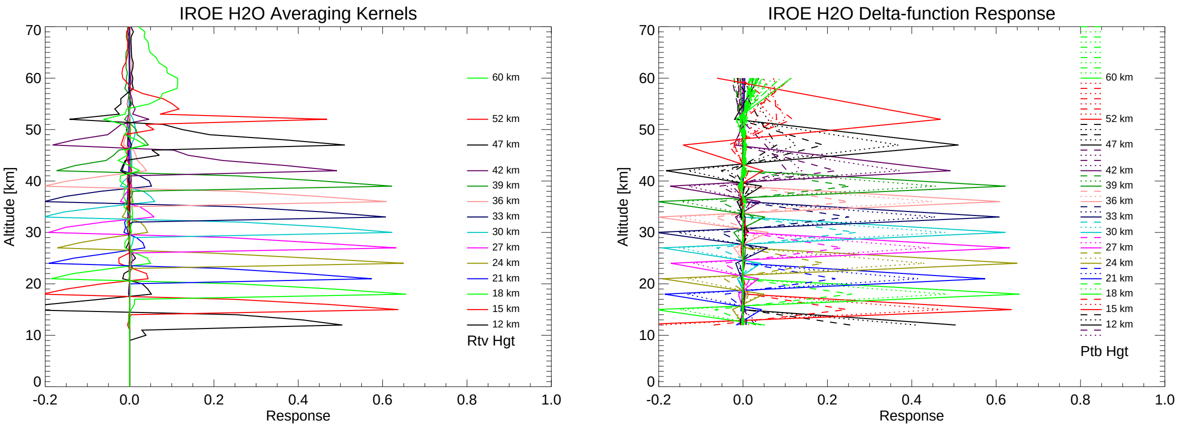
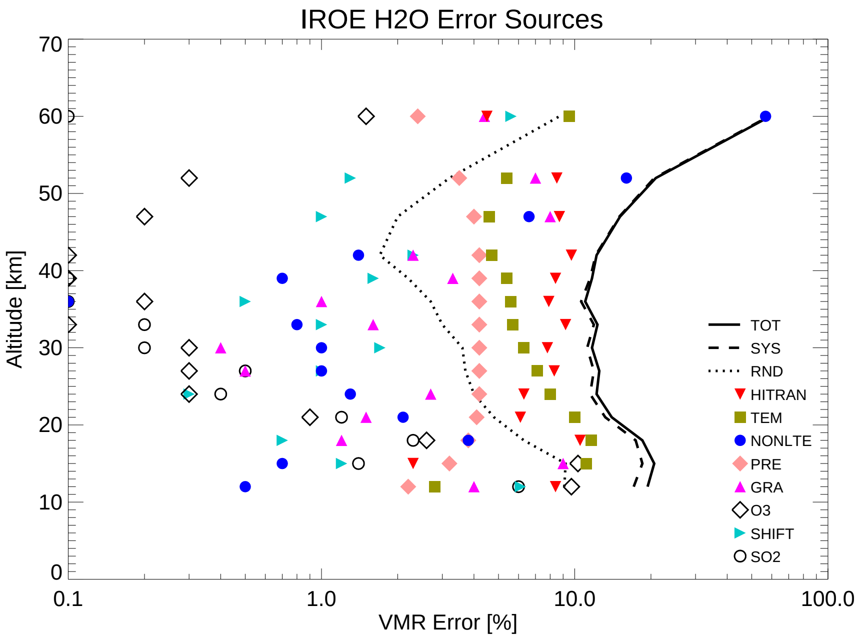



Figure 7: IROE water vapour averaging kernel matrix




REC Analysis

| source | $c$ | $\sigma$ |
|---|---|---|
| so2 | 0.01 | 0.02 |
| h2o_12 | 0.02 | 0.03 |
| o3 | −0.02 | 0.04 |
| nonlte | 0.54 | 0.05 |
| h2o_st | 0.23 | 0.07 |
| no2 | 0.02 | 0.09 |
| ch4 | 0.78 | 0.13 |
| pre | −1.39 | 0.27 |
| clono2 | −0.07 | 0.28 |

Figure 8: IROE water vapour retrieval errors

## 1.7 Nitric Acid

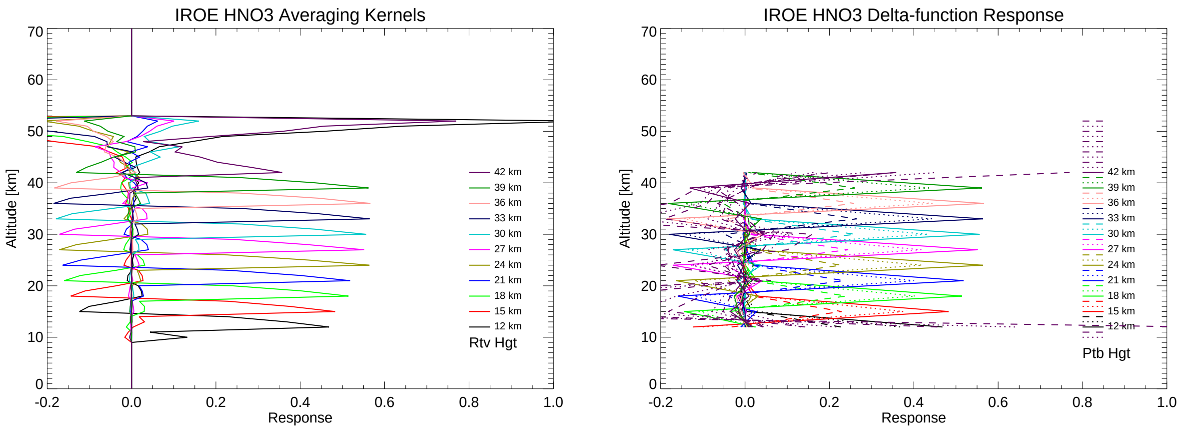
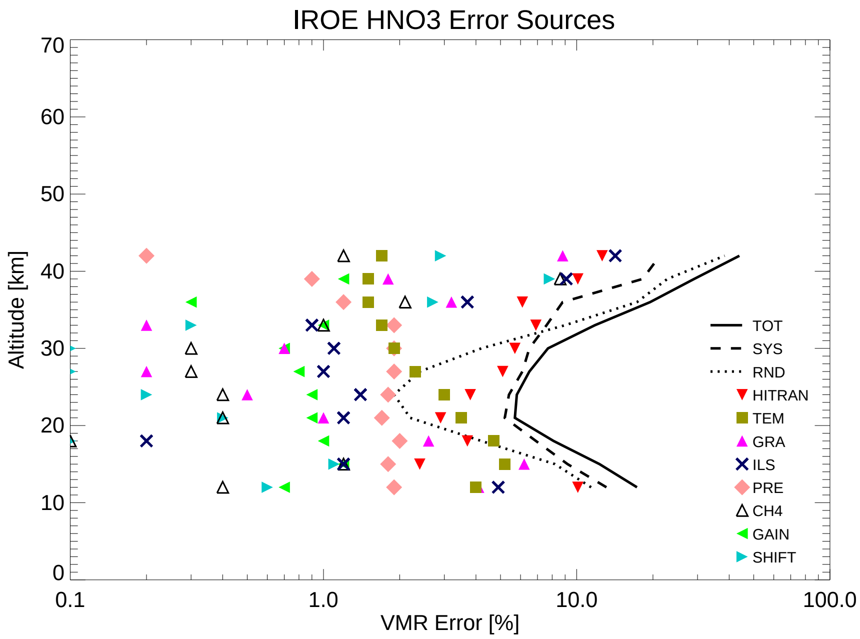



Figure 9: IROE nitric acid averaging kernel matrix




REC Analysis

| source | $c$ | $\sigma$ |
|---|---|---|
| `hno3` | −0.01 | 0.02 |
| `h2o_12` | −0.17 | 0.06 |
| `n2o` | 0.36 | 0.10 |
| `ch4` | 0.06 | 0.11 |
| `h2o_st` | 0.12 | 0.14 |
| `nh3` | −0.02 | 0.24 |

Figure 10: IROE nitric acid retrieval errors

## 1.8 Nitrous Oxide

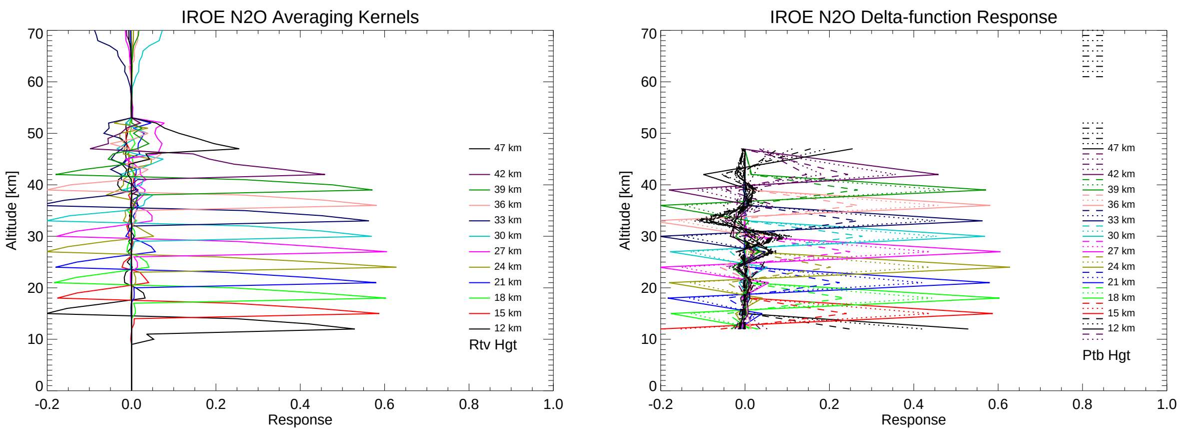
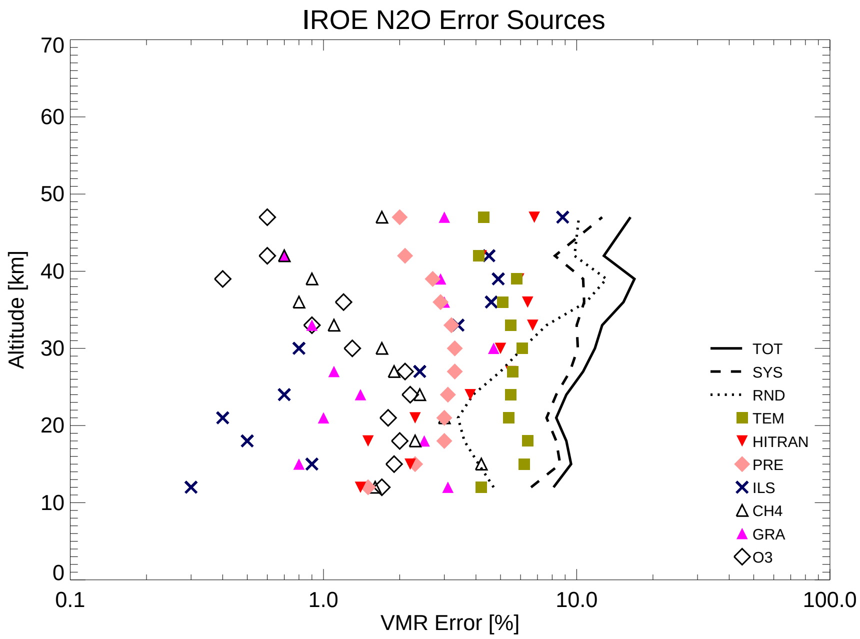



Figure 11: IROE nitrous oxide averaging kernel matrix




REC Analysis

| source | $c$ | $\sigma$ |
|---|---|---|
| n2o | −0.02 | 0.03 |
| o3 | 0.03 | 0.06 |
| so2 | −0.01 | 0.08 |
| ch4 | −0.29 | 0.10 |
| h2o_12 | 0.10 | 0.11 |
| n2o5 | 0.24 | 0.14 |
| cof2 | −0.71 | 0.20 |
| pre | 0.73 | 0.29 |

Figure 12: IROE nitrous oxide retrieval errors

## 1.9 Nitrogen Dioxide

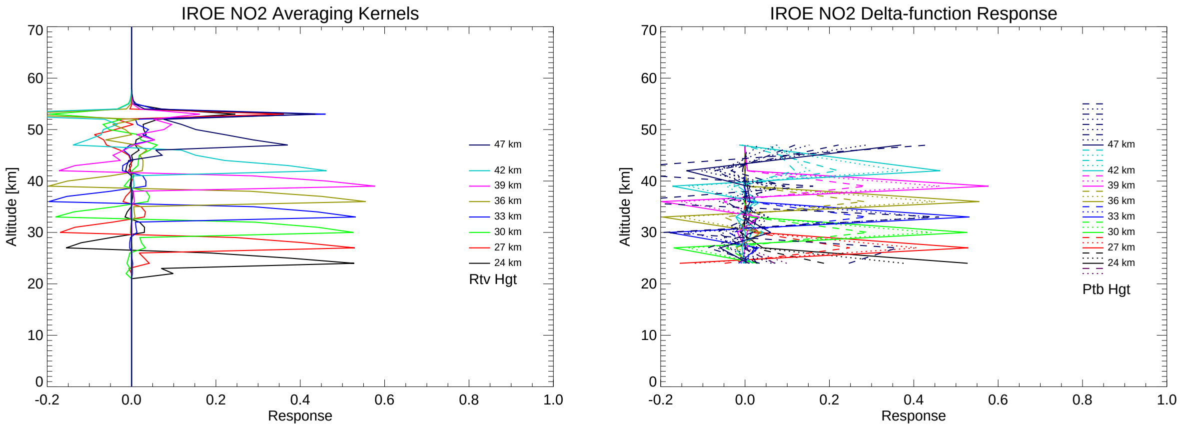
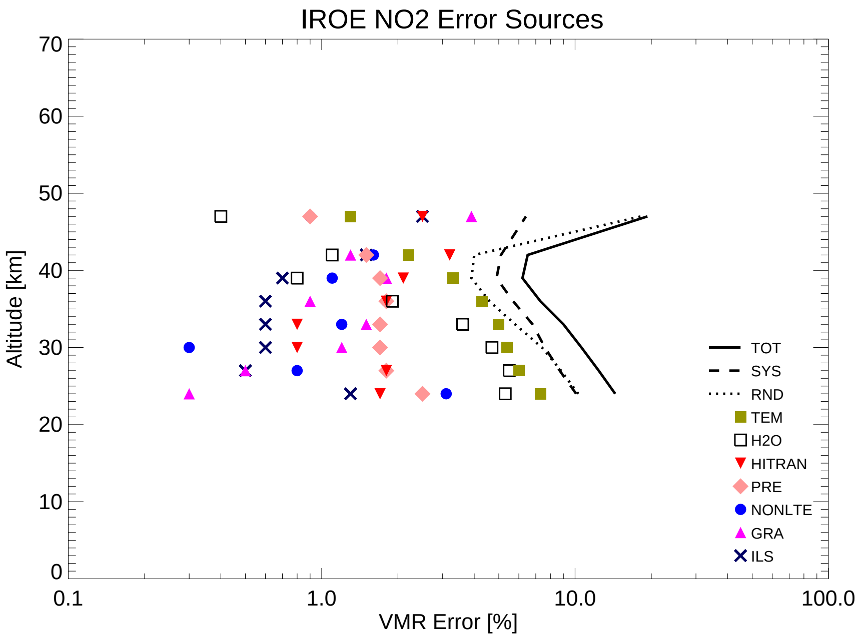



Figure 13: IROE nitrogen dioxide averaging kernel matrix




REC Analysis

| source | $c$ | $\sigma$ |
|---|---|---|
| no2 | 0.09 | 0.01 |
| nonlte | 0.49 | 0.10 |
| ch4 | 0.12 | 0.13 |
| h2o_st | 0.41 | 0.14 |

Figure 14: IROE nitrogen dioxide retrieval errors

## 1.10 Ozone

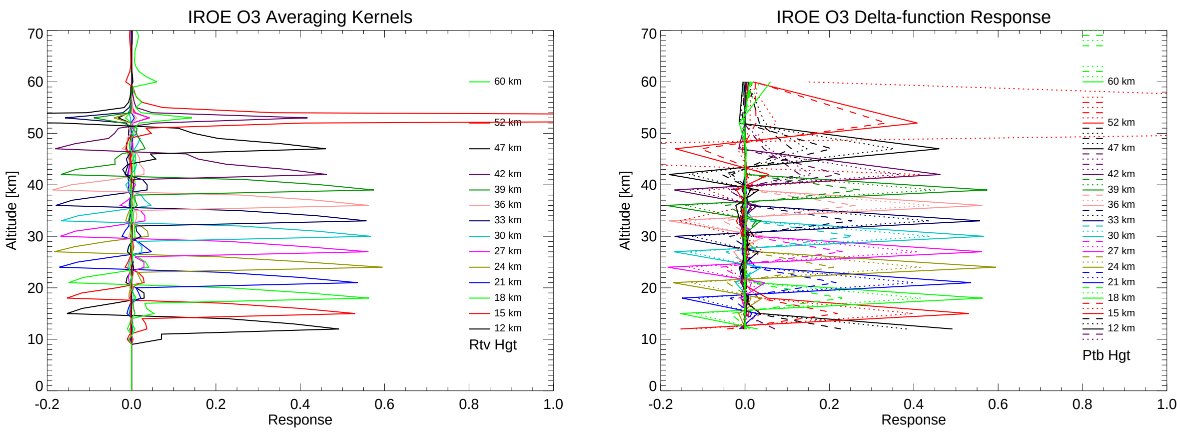
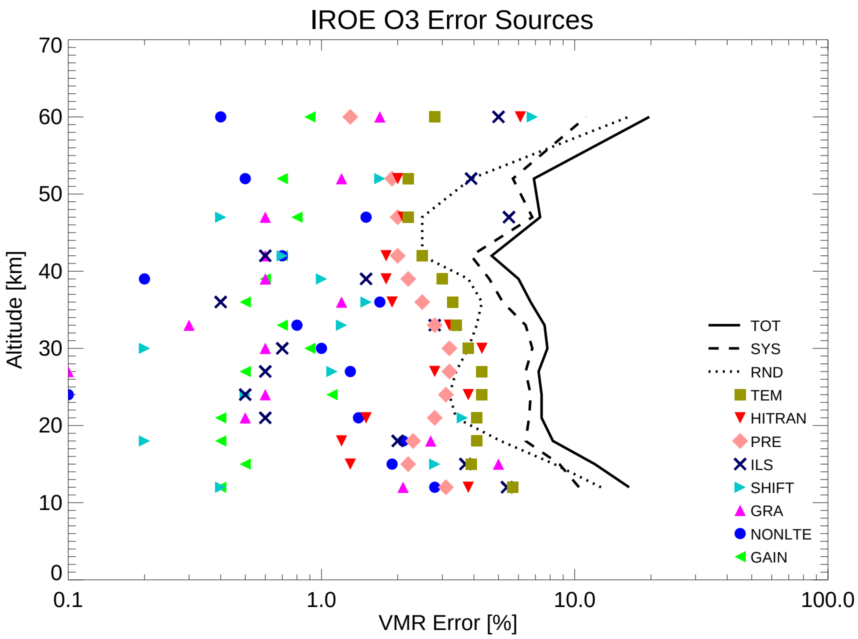



Figure 15: IROE ozone averaging kernel matrix




REC Analysis

| source | $c$ | $\sigma$ |
|---|---|---|
| o3 | 0.03 | 0.01 |
| nonlte | 0.95 | 0.06 |
| so2 | 0.16 | 0.11 |
| nh3 | −0.50 | 0.18 |
| pre | 0.49 | 0.24 |
| h2o_12 | 0.73 | 0.27 |

Figure 16: IROE ozone retrieval errors