THE FIRST MULTI-CONSTITUENT KALMAN FILTER ANALYSIS OF ATMOSPHERIC CHEMISTRY FROM 1991-2007

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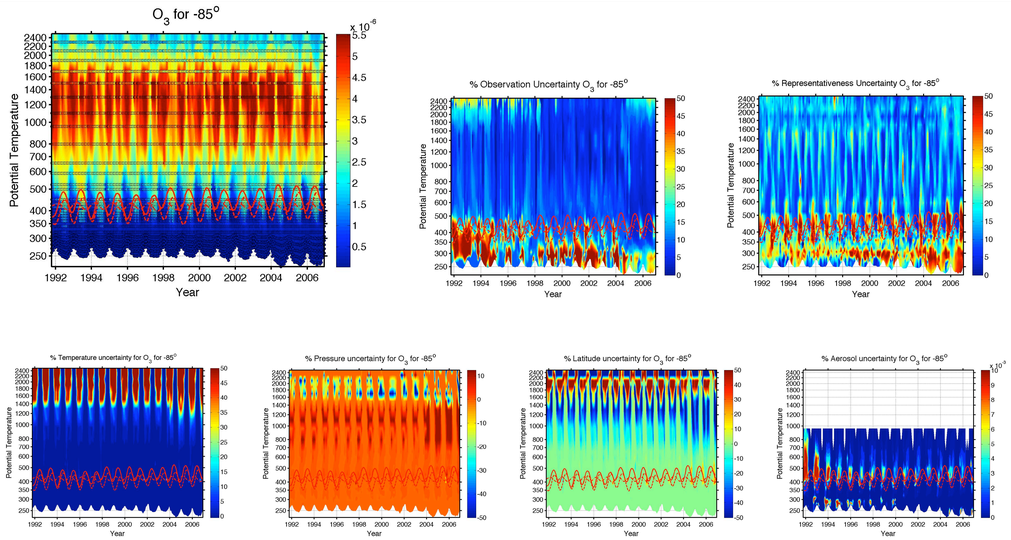
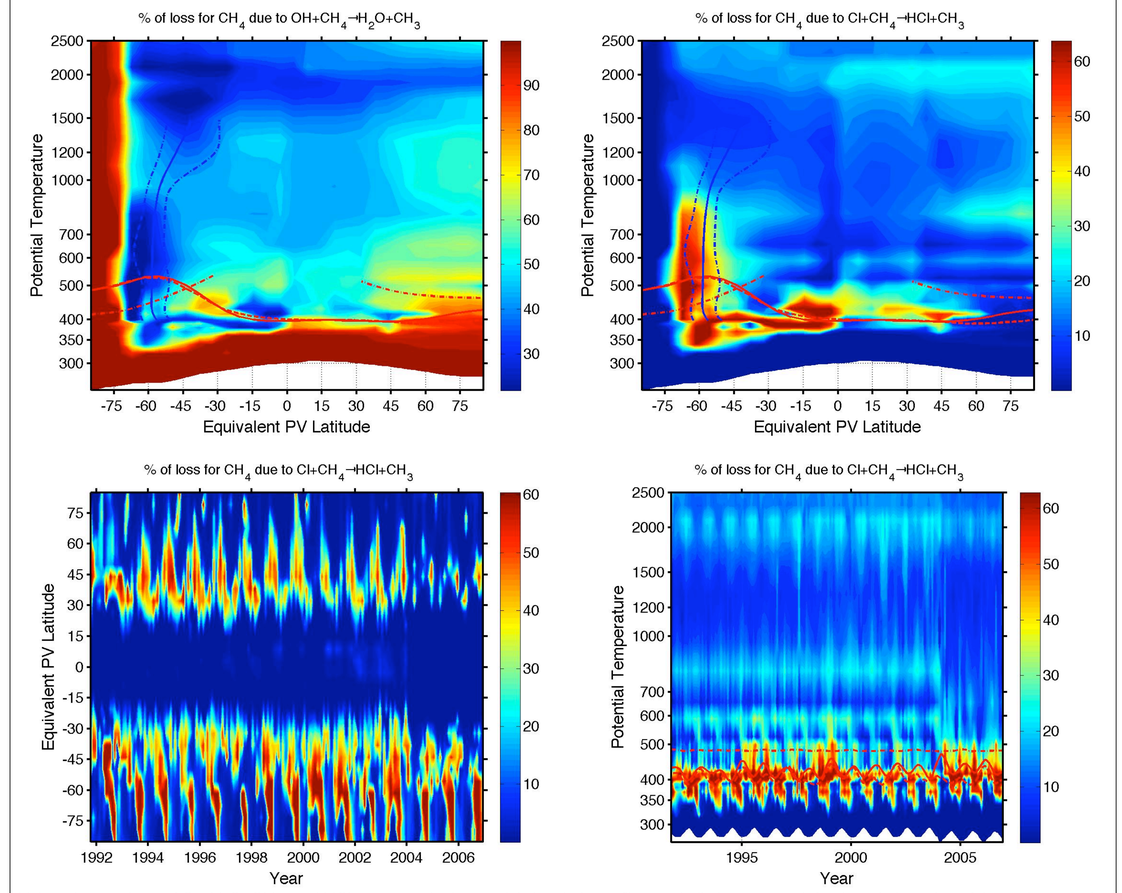
Abstract. We present the first 16 year multi-constituent chemical analyses produced by a full Kalman filter. It is global from the surface to the upper stratosphere. Daily solar irradiance values are used, observed sulfate aerosol areas and radii from UARS HALOE, and constituent observations of O_3, H_2O, CH_4, HNO_3 and HCl from UARS, ATMOS, CRISTA, MkIV, ILAS, Aura, SAGE, SBUV, POAM, Mozaic, Sondes and aircraft. The analyses are available on line at www.CDACentral.info. They are being used for a variety of purposes from NASA Aura validation to understanding of the interactions between the distributions of ozone, water vapor, aerosols, temperature, and relevant trace constituents, notably chlorine and bromine compounds and nitrogen oxides. A particular interest has been under standing the role of halogens in hydrocarbon oxidation in the upper free troposphere.



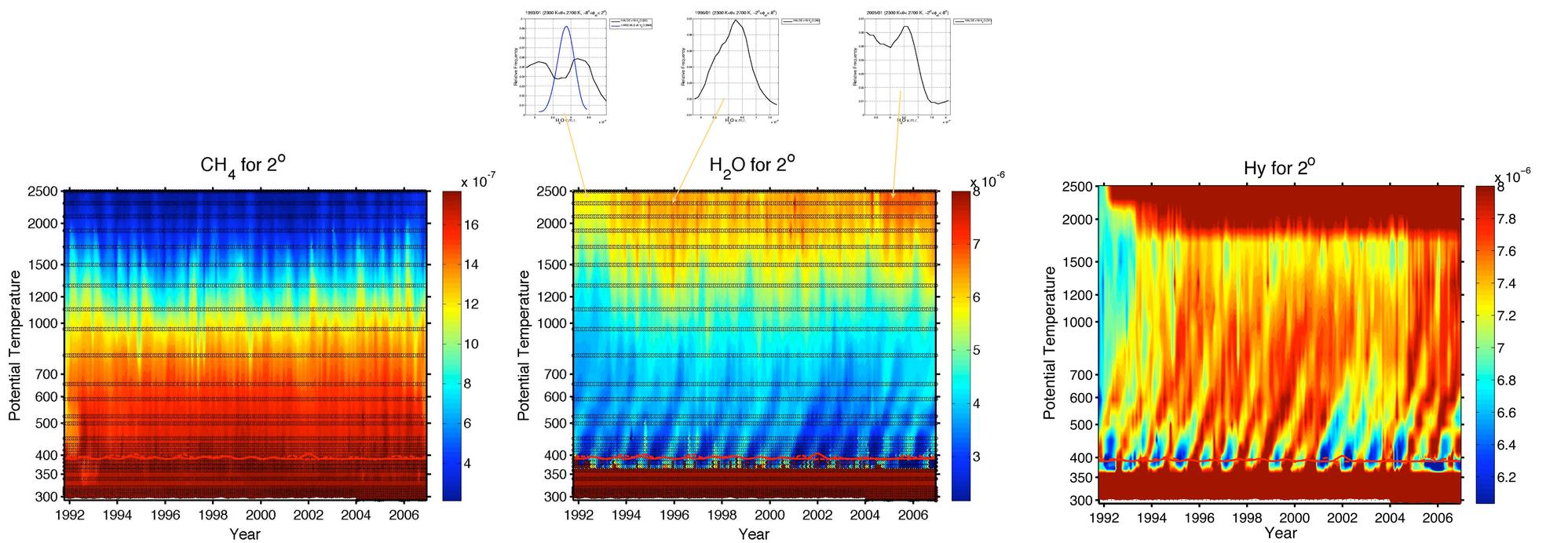
Time series through the assimilated ozone analyses. In the large panel the background colors represent the assimilated analyses and the overlaid color-filled circles are the medians of the observation PDFs. The two right panels on the top row show the observational and representativeness (spatial variability in a grid cell) uncertainties. The lower panels show the model uncertainties due to temperature, pressure, illumination and aerosol loading.



Using observations of O_3, H_2O, CH_4, and HCl to constrain the model via a kalman filter assimilation we can infer the relative roles of the various methane oxidation channels. We find that chlorine plays a persistent role in oxidizing methane in the upper free troposphere.

Instrument	Time Range
UARS MLS v5 205 GHz	1991-1999
UARS MLS v5 183 GHz	1991-1993
UARS HALOE v19	1991-2005
SPOT-4 POAM3 v4	1998-2005
SPOT-3 POAM2 v6	1993-1996
Ozone sondes	1991-2007
Rawinsondes	1991-2007
SBUV2 v8	1991-2005
SCISAT-1 ACE v2.2	2004-2007
MOZAIC v4.1	1994-2000
MOZAIC v5.3	2001-2006
Aura MLS v1	2004-2007
ADEOS ILAS v6.1	1996-1997
ERBS SAGE 2 v6.2	1991-2005

Instruments used in this study



Assimilated time-series of CH_4, H_2O and inferred H_y from 1991-present. The tape recorder signal in water and H_y is clearly visible, as is the stratospheric dry period from 2001-2004. The background colors represent the assimilated analyses and the overlaid color-filled circles are the medians of the observation PDFs.