Highlights of the HITRAN2020 edition CENTER FOR LAND



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Major improvement over previous editions

- Improved spectral parameters for existing lines of the majority of HITRAN molecules.
- Non-Voigt line shapes. Every line of CO₂, N₂O and CO now has speed-dependent Voigt and first order line mixing parameters. See R. Hashemi (2.5a) poster for details.
- Extended spectral coverage and added new isotopologues for many molecules
- Six new molecules (e.g. a very potent greenhouse gas NF₃). Bringing total to 55
- Broadening by H_2O added
- Added new experimental cross-sections
- Major update of the CIA section
- Extensive validations against laboratory and atmospheric spectra were carried out

HAPI and HAPIEST updated



HITRAN2020 line-by-line section (55 molecules)

Molecules (isotopologues) in the line-by-line portion of HITRAN

H ₂ O (7)	SO ₂ (4)	HI (2)	H ₂ O ₂ (1)	HO ₂ (1)	CH ₃ CN (1)	COCl ₂ (2)
CO ₂ (12)	NO ₂ (2)	CIO (2)	C ₂ H ₂ (3)	O (1)	CF ₄ (1)	SO (1)
O ₃ (5)	NH ₃ (2)	OCS (6)	C ₂ H ₆ (3)	CIONO ₂ (2)	C ₄ H ₂ (1)	CH ₃ F (1)
N ₂ O (5)	HNO ₃ (2)	H₂CO (3)	PH ₃ (1)	NO ⁺ (1)	HC ₃ N (1)	GeH ₄ (4)
CO (6+3) 😼	ОН (3)	HOCI (2)	COF ₂ (2)	HOBr (2)	H ₂ (2)	CS ₂ (4)
CH ₄ (4)	HF (2)	N ₂ (2)	SF ₆ (1)	C ₂ H ₄ (2)	CS (4)	CH₃I (1)
O ₂ (3)	HCI (4)	HCN (3)	H ₂ S (3)	CH ₃ OH (1)	SO ₃ (1)	NF ₃ (1)
NO (3)	HBr (4)	$CH_{3}CI(2)$	HCOOH (1)	CH_3Br (2)	$C_2 N_2 (1)$	

Molecules for which the line lists were updated/extended with respect to HITRAN2016 are in bold New molecules or increased amount of isotopologues for existing molecules are highlighted in red;

Example: H₂O

- Update based on Conway et al. (2020) JQSRT 241, 106711 and ACP 20, 1005.
- The dataset extended from ~25500 to 42000 cm⁻¹
- Updated VP "Diet" for half-widths (γ) and shifts (δ). Fixes issues in HITRAN2016





Figure above. HITRAN2020 and HITRAN2016 compared at modelling the atmospheric transmittance. Compared to high-resolution solar spectrum Baker et al. ApJ 2020

Figure on the left. Comparison of the HITRAN2020 and HITRAN2016 line lists against the empirical water-vapor cross sections from Harder and Brault, JGR 102 (1997) 6245.

Example: CO₂

- Improved broadening and line-mixing parameters
- Added more bands above 8000 cm⁻¹
- Fixed intensity consistency. Overall, improved window-to-window consistency of retrieved amounts. See figure below (courtesy Geoff Toon (JPL) showing VSF from the MkIV balloon.



Example: 0₂

- A-band: Adapted recent ABSCO parameters
- 1.27 µm band: New model based on separation of magnetic dipole and electric quadrupole thanks to recent data from Grenoble and NIST. See TCCON retrieval below.



Cross sections (.xsc)

 Dataset of experimental cross-sections has been expanded, with the ones relevant to this conference summarized below



Update of the CIA section



Karman, *et al.*, "Update of the HITRAN collision-induced absorption section", *Icarus* 328 (2019) 160-175. +more

Summary and Acknowledgments:

- Article describing the HITRAN2020 edition is currently being revised for resubmission to JQSRT
- 88 authors from all over the globe
- 300+ pages (On Overleaf)
- 885 references
- The database will be released upon acceptance of the manuscript



We would like to thank all the contributors and collaborators who have worked towards the HITRAN2020 edition and validated the data. It was not easy in the times of pandemic.



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