

High resolution IR cloudy radiances simulations: comparison between RTTOV-11.3 and VLIDORT

Jérôme Vidot (CMS)

Laurent C. Labonnote (LOA)

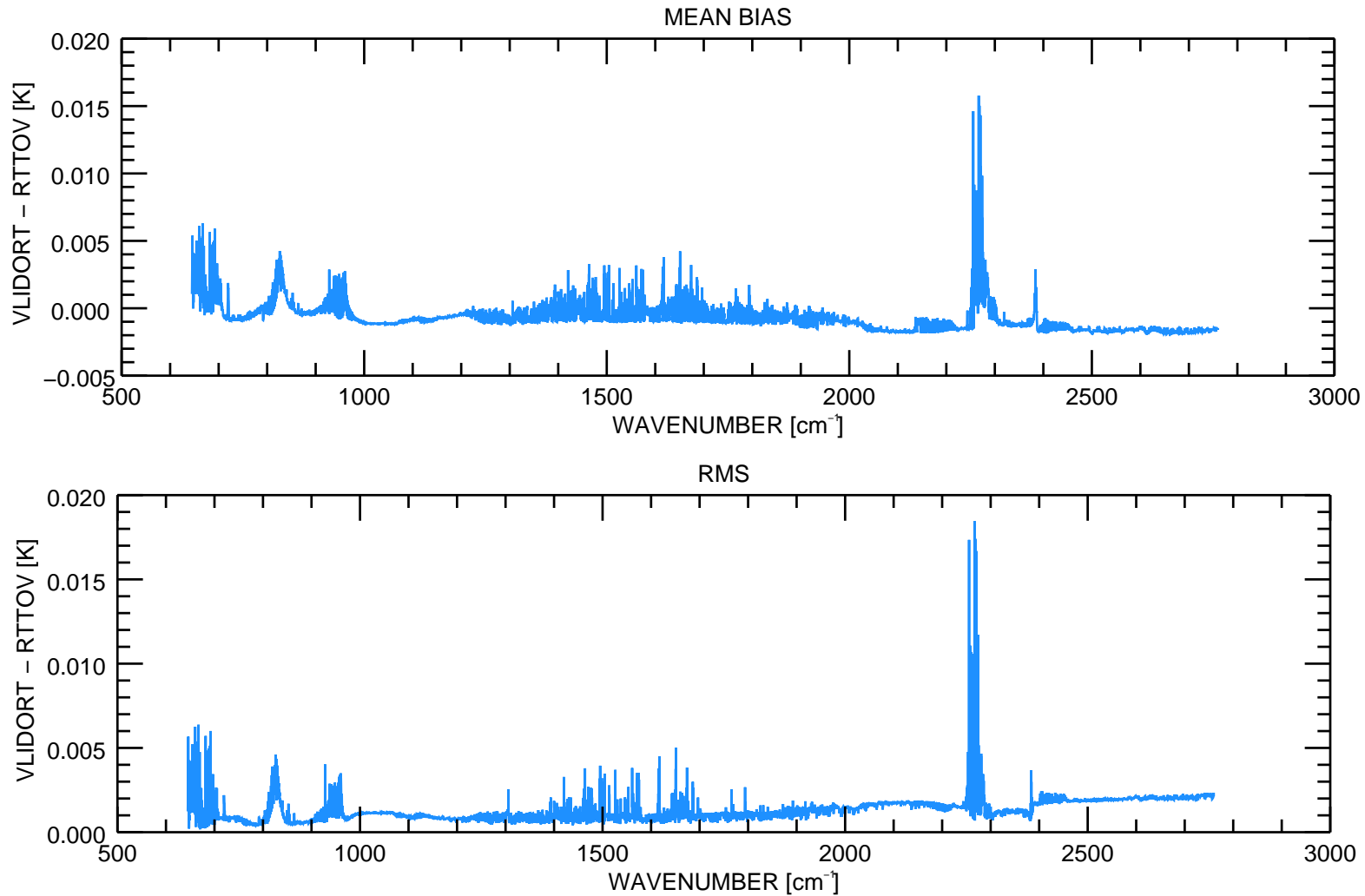


Objective and Method

- Objective:
 - ⇒ Evaluate the scattering approximation of RTTOV in IR for ice cloud
- 2 RTMs:
 - ⇒ RTTOV v11.3 : « Chou scaling » approximation, Baran ice clouds model (Vidot et al., JGR 2015)
 - ⇒ VLIDORT (Spurr, JQSRT 2006) : Full scattering model, 16 streams
- Configuration:
 - ⇒ VLIDORT inputs: RTTOV transmittances, surface emissivities, cloud optical properties
 - ⇒ Lambertian surface, pseudo-spherical geometry and cloud fraction = 1
- Two datasets :
 - ⇒ RTTOV 83 training profiles @101L (for sanity check)
 - ⇒ NWP SAF profiles dataset @137L (for the study)

Sanity check

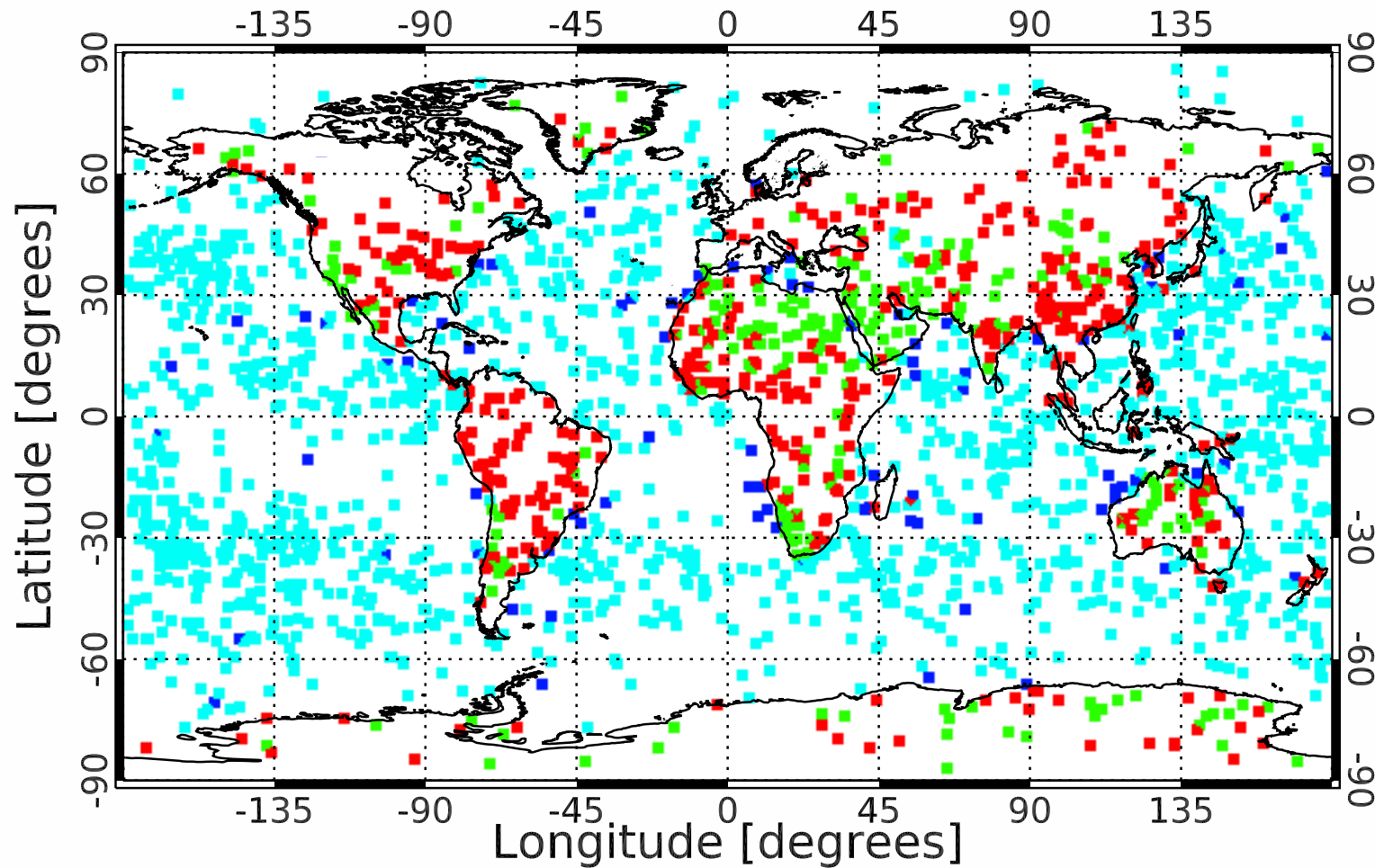
- RTTOV 83 training profiles @ 101L, surface emissivity = 1, nadir view



⇒ Mean Bias and RMS < 0.02 K

NWP SAF 137L profiles dataset

- Use of cloud condensate sampling (5000 profiles): Land/sea mask, T, H, O₃, IWC, month



CLEAR-SKY over sea = 92 profiles

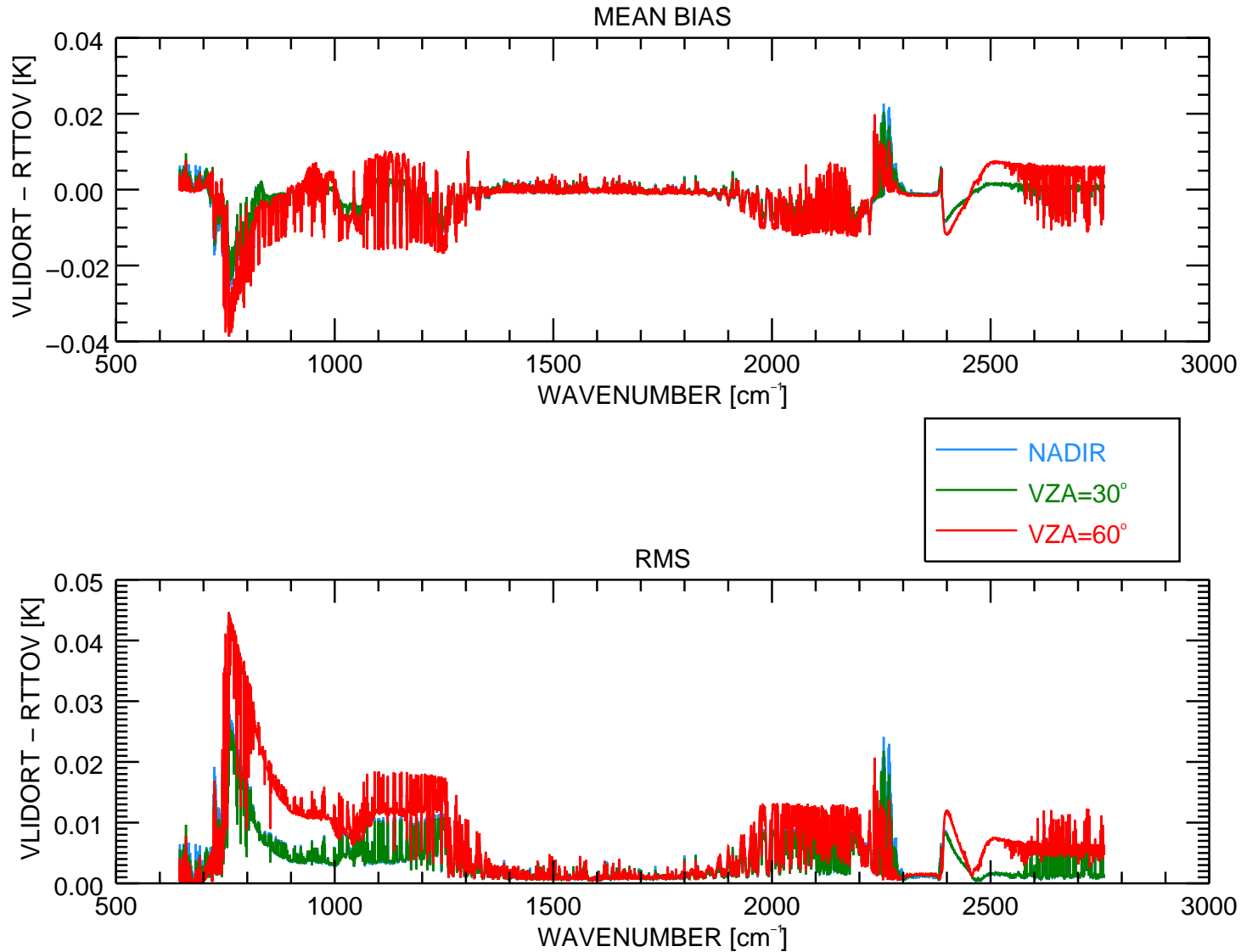
CLOUDY-SKY over sea = 1467 profiles

CLEAR-SKY over land = 251 profiles

CLOUDY-SKY over land = 456 profiles

Clear-sky cases over sea (92 profiles)

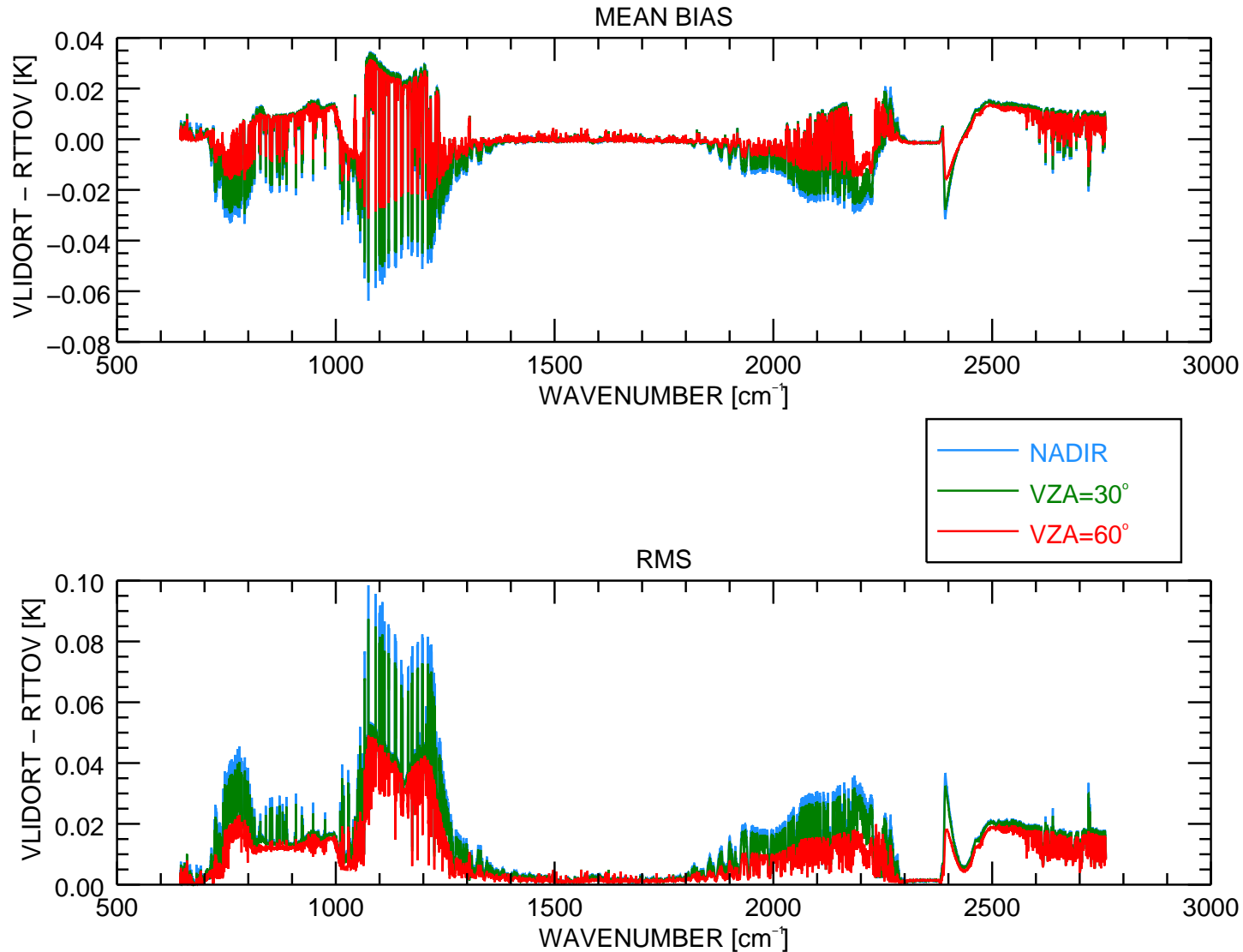
- Surface emissivities from ISEM



⇒ Mean Bias and RMS < 0.05 K and error increase with VZA

Clear-sky cases over land (251 profiles)

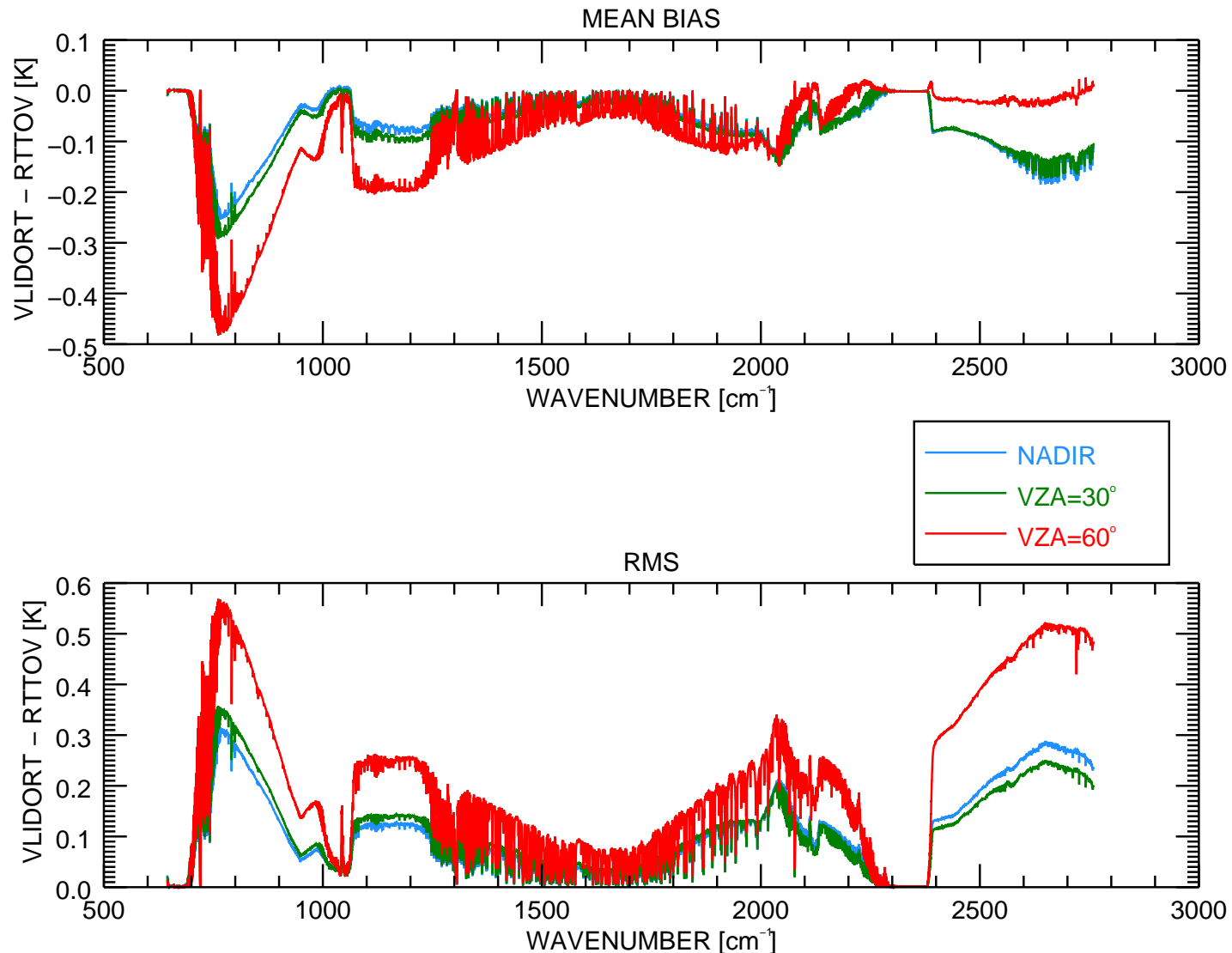
- Surface emissivities from UWIREMIS atlas



⇒ Mean Bias and RMS < 0.1 K and error decrease with VZA

Cloudy-sky cases over sea (1467 profiles)

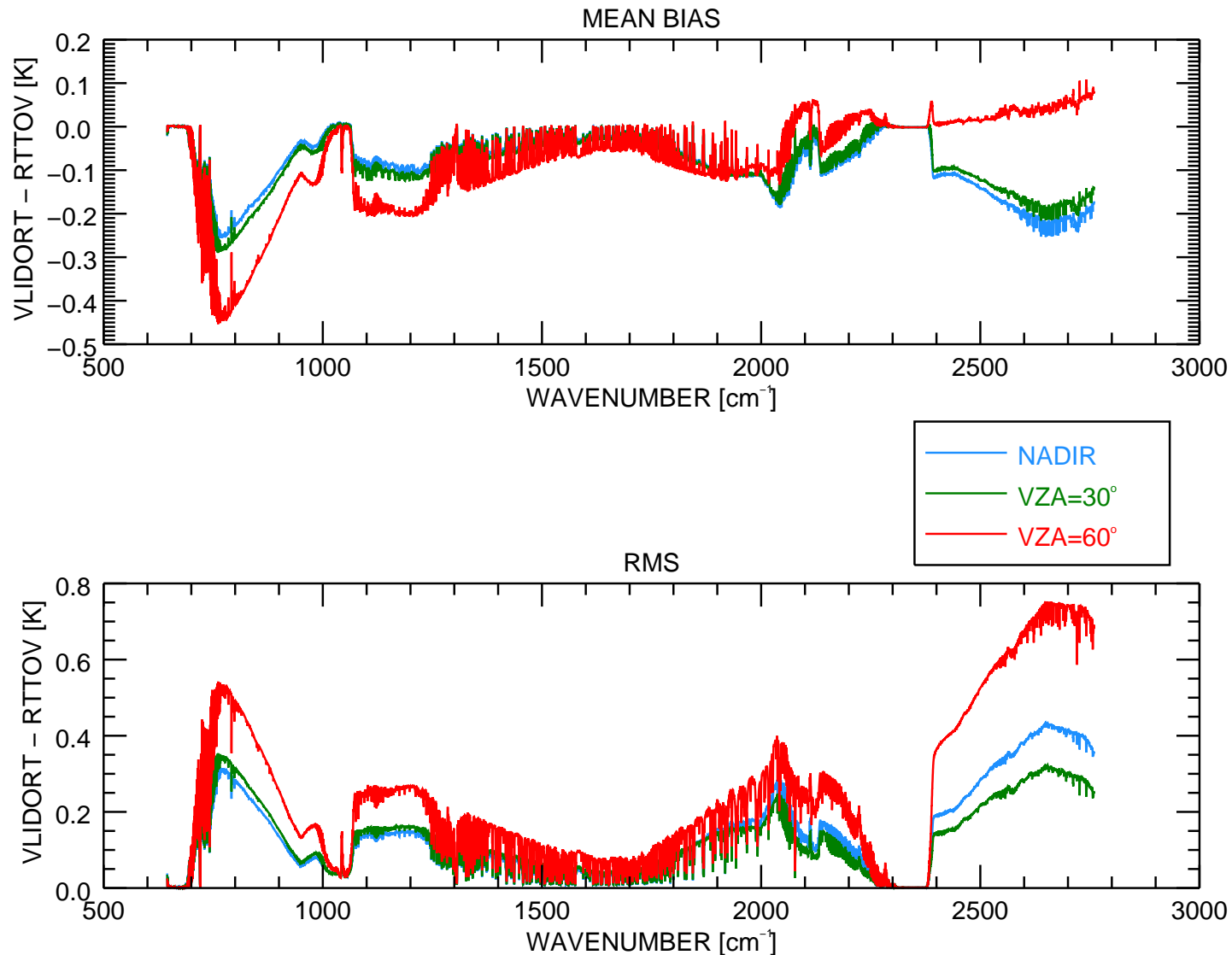
- Surface emissivities from ISEM



⇒ Mean Bias and RMS < 0.6 K and error increase for large VZA

Cloudy-sky cases over land (456 profiles)

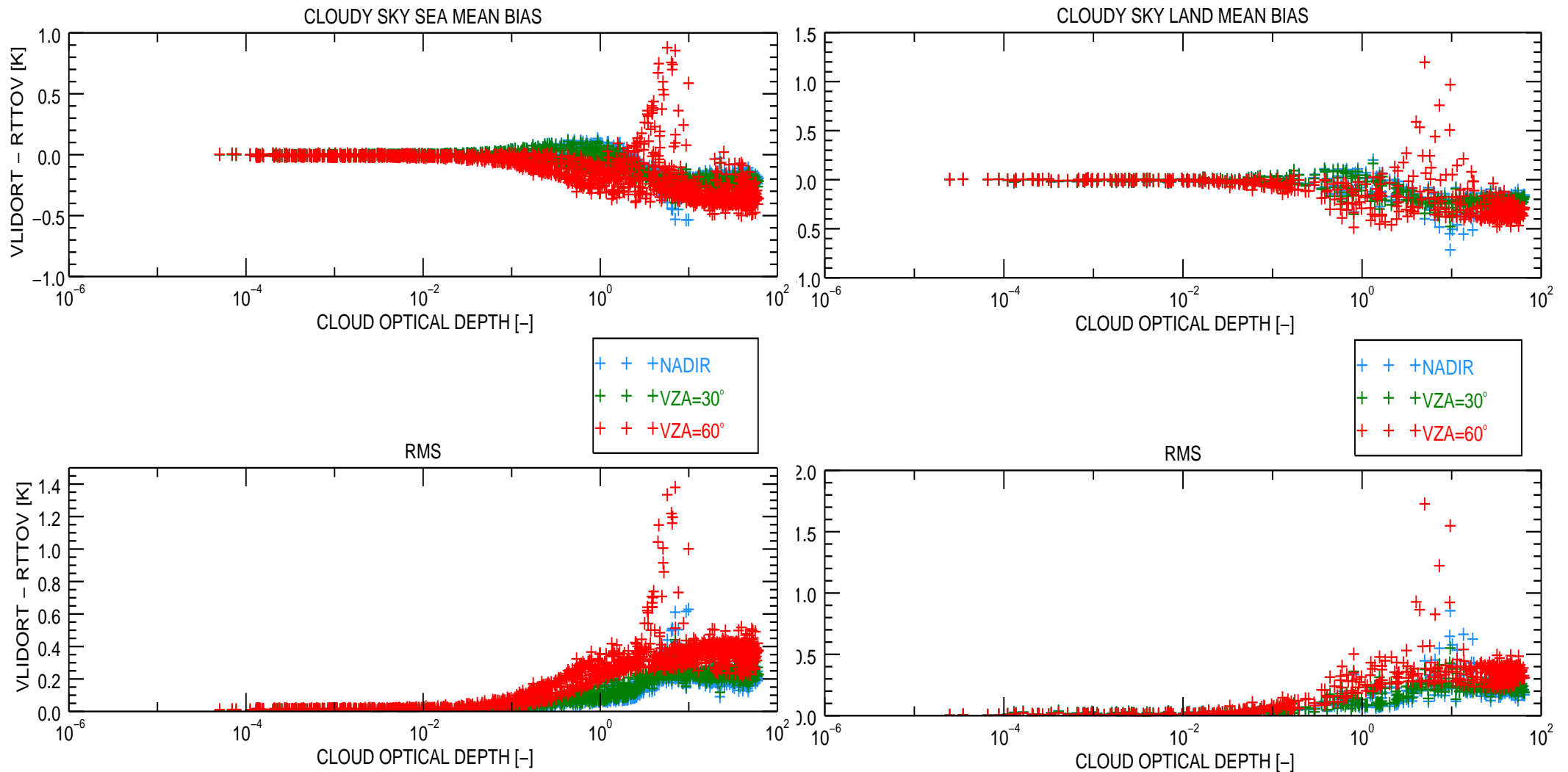
- Surface emissivities from UWIREMIS atlas



⇒ Mean Bias and RMS < 0.8 K and error increase for large VZA

Error vs cloud optical depth

- Based on cloud channel selection (Martinet et al., QJRMS 2014)



⇒ Even for large COD, error of cloud channel selection is below 0.5 K

Conclusions & perspectives

- Conclusions:

- ⇒ The error of the « Chou scaling » scattering approximation of RTTOV for ice cloud simulations is $< 0.8 \text{ K}$ for all channels and is $< 0.5 \text{ K}$ for Martinet's cloud channel selection (overestimation from RTTOV)
- ⇒ Error is ~ 2 times lower for low viewing zenith angles.
- ⇒ Results are consistent in absolute values with Matricardi (2005)
- ⇒ VLIDORT is well suited for IR RTTOV validation (w-w/o scattering)

- Perspectives:

- ⇒ Apply the method for liquid cloud (easy with NWP SAF profiles dataset)
- ⇒ Do the comparison for Jacobians (feasible with VLIDORT)
- ⇒ Simulations vs observations (complex for good cloudy profile collocations)
- ⇒ Comparison vs other RTMs : CRTM, 4A/OP, Sigma-IASI, kCARTA,... (hard to organize – RTSP Working Group)

Thank you for your attention

