# Deriving Atmospheric Instability Indices Directly from Geostationary Interferometric Infrared Sounder (GIIRS) Radiances

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## Introduction:

The FengYun-4 (FY-4) series are the new generation of Chinese geostationary orbit meteorological satellites. The first FY-4A satellite is scheduled to be launched in 2016 time frame. The Geo. Interferometric Infrared Sounder(GIIRS) with High-spectral resolution onboard FY-4A will have a capability of continuous monitoring about the atmospheric state, the surface information and the cloud properties.

Li et al. (2012) showed that the advanced infrared sounders such as the Atmospheric Infrared Sounder (AIRS) and Infrared Atmospheric Sounding Interferometer (IASI) provide atmospheric temperature and moisture profiles with high vertical resolution and high accuracy in pre-convection environments. The derived atmospheric instability indices such as convective available potential energy (CAPE) and lifted index (LI) from advanced IR soundings can provide critical information 1 - 6 hours before the development of severe convective storms.

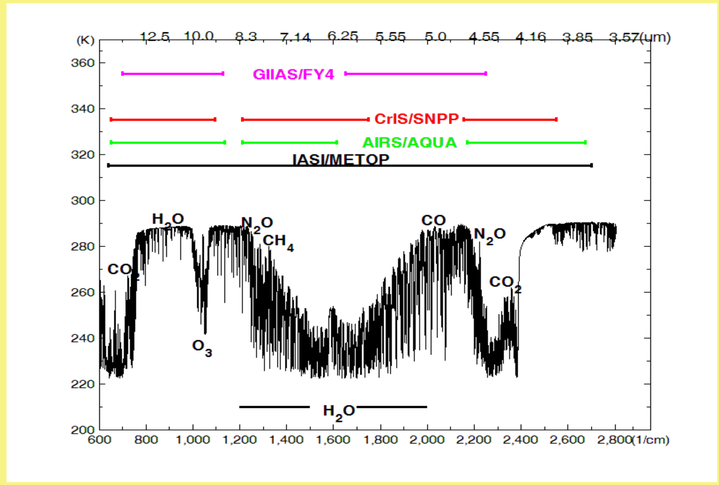
Compared to AIRS, IASI and other advanced infrared sounders, GIIRS is insured by the 60 min repeat cycle and also up to 16km pixel resolution, providing forecasters with useful information much more frequently than the soundings available only twice daily from polar orbiting meteorological satellites. The high-spectral resolution, the broad range of spatial coverage and the high temporal resolution mean a larger amount of data, so we had to consider time of data processing.

A method must be found to get instability indices efficiently with GIIRS observations, in order to assess the pre-convective conditions and forecast convection with a sufficient lead-time. We have done a series of tests about calculating atmospheric instability indices directly in order to meet the latency requirement, to avoid the sounding retrievals for atmospheric instability indices.

## FY4- GIIRS specification

| band | Res [cm$^{-1}$] | Spectral Range [cm$^{-1}$] | NEDR | #points |
|---|---|---|---|---|
| LW | 0.8 | 700-1130 | 0.5 | 538 |
| MW | 1.6 | 1650-2250 | 0.1 | 375 |

## The spectral coverage for the current and future spaced-based sounders with high spectral resolution




## Atmospheric Instability Indices

Used 4 indices are defined as :

(1)TT= (T(850) – T(500)) +( TD(850) – T(500));

(2)KI = (T(850) – T(500)) + TD(850) – (T(700) – TD(700));

(3)SI = (T(500) – TLifted from 850(500));

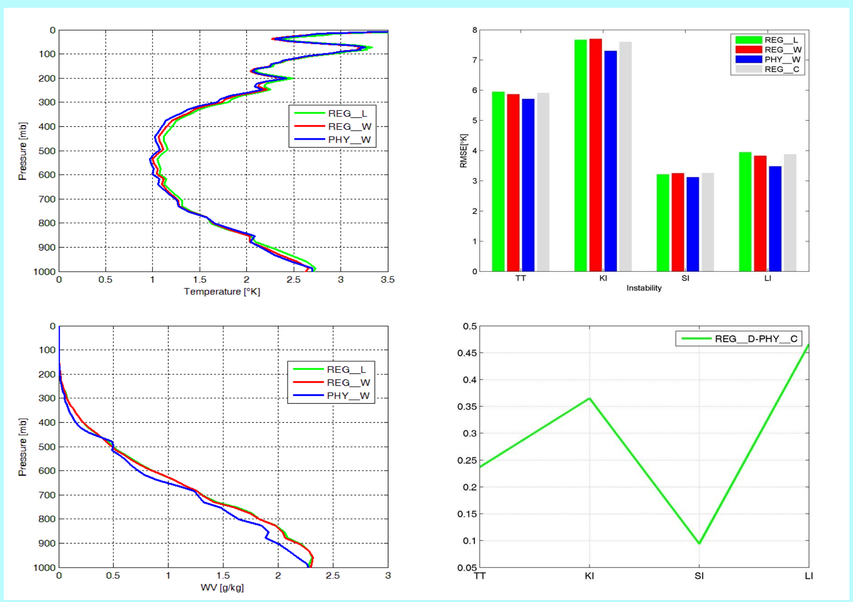
(4)LI = (T(500) – TLifted from surface(500)).

Here, T is the Temperature and TD is the Dewpoint Temperature at the specified height.

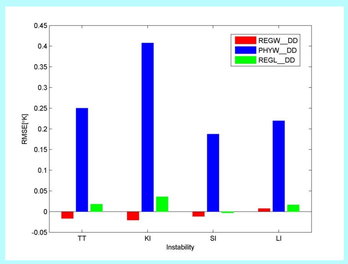
## Test1-Indirect calculation and direct regression

REG_L: direct regression retrieval of indices REG_W: regression retrieval of FY4 pre-research

REG_C: calculated with sounding retrievals PHY_W: physical retrieval of FY4 pre-research




## Test2-Different effect of noise between indirect calculation and direct regression




REGL_DD: effect of noise on direct regression

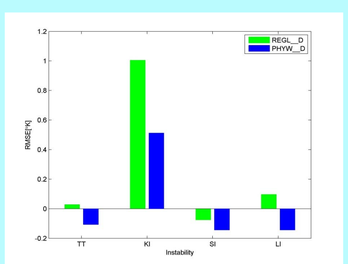
REG_W: : effect of noise on calculating with regression retrieval of FY4 pre-research

PHY_W: : effect of noise on calculating with physical retrieval of FY4 pre-research

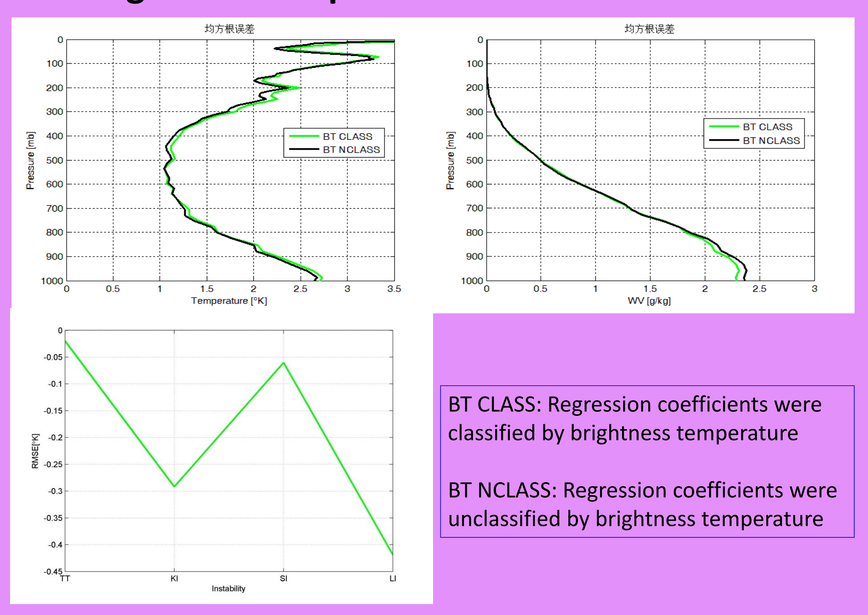
## Test3-Effect of channel selection between indirect calculation and direct regression

D_REGL: effect of channel selection on direct regression

D_PHYW: : effect of channel selection on indirect calculation with physical retrieval




## Test4-Effect of brightness temperature classification

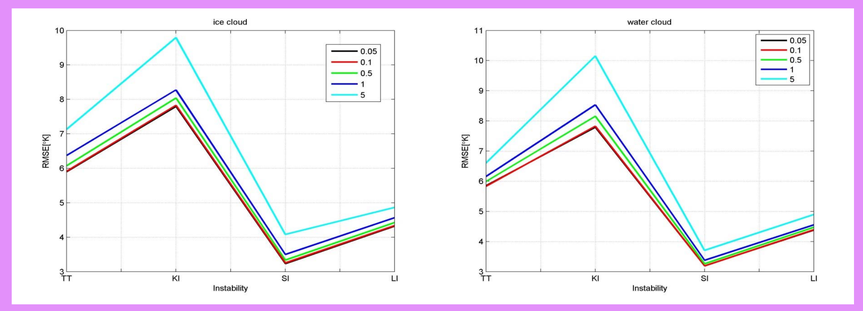



BT CLASS: Regression coefficients were classified by brightness temperature

BT NCLASS: Regression coefficients were unclassified by brightness temperature

## Test5-Effect of ice cloud and water cloud

Cloud optical thickness were assigned 0.05, 0.1, 0.1, 1.0, 5.0




## Summery:

The accuracy of atmospheric instability indices is similar no matter that calculated directly or indirectly, and direct regression instability indices can be calculated in a very short time. Effect of noise change on the accuracy of direct regression is smaller, and effect of channel selection on the accuracy of direct regression is also smaller. Ice or thin cloud affects less than water or thick cloud.

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