Project of Your Choice: Research and analyze a remote sensing product. Attempt a simple retrieval on real data

Introduction: In lieu of any kind of exam, you are asked to do background reading on a remote sensing instrument of your choice, attempt a simple retrieval on some real level-1B data from the instrument, and compare your retrieval to that from the instrument. You will then do a write-up as well as a presentation.

Step 1: Pick an instrument / product that interests you! It need not be directly related to your research, but it certainly can be. It should be an instrument that has data available, so sorry, no future instruments allowed (though follow-on instruments can certainly be mentioned in the write-up/presentation).

Step 2: Background Reading:

Read up on the instrument. Read at least 2 peer-reviewed articles on the instrument. Choose one of the standard products from the instrument to be your focus. Find and read a thorough description of the retrieval algorithm for this product. It may be in the form of an ATBD (algorithm theoretical basis document), or a peer-reviewed article.

Step 3: Retrieval Construction or Data Analysis

After discussing with the instructor, you have a choice to either:

- Create and implement a simplified retrieval, and apply it to real L1B data
  It may use any technique discussed in class. It is expected that your retrieval may not fully work, or work as well as the "standard" algorithm, but should contain the basic physics required. Compare your results to those of the standard algorithm over a region that interests you, or the whole globe. Please compare to significantly more than one sounding, though what is feasible may depend on the instrument. Plot some metrics of your retrieval, such as how well your L1B model fits the observations (typically in terms of radiances or brightness temperatures).

OR

- Use data from the instrument to learn about a real-world phenomenon
  Download L2 or L3 data from an instrument or instruments and analyze it in the context of a real phenomenon or science application. E.g. , the scale of deep convection, onset of rain, Asian air pollution, Sea ice interannual variability, Saharan dust events, ocean surface temperature patterns and their relationship to ocean color, etc.

Step 4: Reporting.

This consists of two parts: a short (10-15 min) presentation a write-up, and detailed write-up.

Talk (December 3 and 5): The format of the talk is mostly up to you, but should include something on each of the following:

- Basic technology on which the sensor works (for instance, passive microwave radiometer, diffraction grating spectrometer, interferometer, pulsed lidar, etc); frequencies used, emission vs. extinction vs. scattering, etc.
- Duration of operation. If satellite: which satellite(s) it is flying on, what orbit (polar, geostationary, etc). If ground based: location, etc.
- Description of a single product (e.g. AIRS carbon dioxide) - how does the retrieval work? Optimal estimation, statistical, linear regression, etc…
- Some results from the sensor for this single product.
- Description of your simple retrieval or data analysis, & preliminary results.

Write-up (Due December 17): In your write-up, you should have the following elements:

- Introduction – introduce the instrument and what it was built to do, and the particular product you will focus on.
- Describe the product or products you focused on: basics of how the operational retrieval works, and some results from this product(s). You should cite one or two papers that used the product(s)!
- Retrieval or data analysis description: background, what you did, your results.
- Summarize what you learned, and how you would continue to work with this instrument/product in the future (should you choose to).

Possible Instrument Choices

Here are some possible instruments from which you may choose. They include mostly space-based but some ground-based instruments as well. You may of course do something not on this list; just run it by me first.

Name	Acronym	Platform/Locations	Measures
Past + Present Satellite-Based Missions			
Atmospheric Infrared	AIRS	Aqua	T,q profiles, cloud props, some trace gases, surface temp
(Advanced) Microwave Sounding Unit	MSU , AMSU	NOAA-N	Atmospheric Temperature
MODerate Resolution Imaging Spectrometer	MODIS	Aqua, Terra	Cloud props, aerosol, land surface properties, ocean color, …
Advanced Microwave Scanning Radiometer for EOS	AMSR-E	Aqua	Cloud water, precipitation, column water vapor, ocean surface wind speed, soil moisture
TRMM Microwave Radiometer	TMI	TRMM	Cloud water, precipitation, column water vapor, ocean surface wind speed
TRMM Precipitation Radar	PR	TRMM	Precip profiles
Special Sensor Microwave Imager (+ Sounder)	SSM/I + SSMIS	DMSP Satellites (F8, F10, F11, F13, F14, F15…)	Cloud water, precipitation, column water vapor, ocean surface wind speed
Multi-Angle Imaging SpectroRadiometer	MISR	Terra	Clouds, aerosols, land surface properties
Advanced Very-High Resolution Radiometer	AVHRR	NOAA-(6 thru 19), MetOp-A	Clouds, SST, some aerosol info, NDVI
Microwave Limb Sounder	MLS	UARS, Aura	Atmospheric Chemistry + Composition, Cloud Ice
Ozone Monitoring Instrument and/or Total Ozone Mapping Spectrometer	OMI, TOMS	OMI-Aura TOMS-Multiple	Ozone, aerosols
Tropospheric Emission Spectrometer	TES	Aura	Trace gase profiles (CO, CO2, O3, etc), many other species
Monitoring of Pollution in the Earth's Troposphere	MOPITT	Terra	CO, also CH4
SCanning Imaging Absorption SpectroMeter for Atmospheric CartograpHY	SCIAMACHY	ENVISAT	Trace gas concentrations
TANSO-FTS	TANSO-FTS	GOSAT	Trace gas concentrations
Earth Radiation Budget Experiment	ERBE	ERBS, NOAA-9, NOAA-10	Outgoing Longwave & Shortwave Flux

Clouds and Earth's Radiant Energy System	CERES	Aqua, Terra	Outgoing Longwave & Shortwave Flux
SeaWinds	SeaWinds	QuickScat	Ocean Surface Winds
Sea-viewing Wide Field-of-view Sensor	SeaWiFS	SeaStar	Ocean surface winds, Ocean Color (chlorophyll)
Geoscience Laser Altimeter System	GLAS	IceSAT	Ice sheets, land topography
TOPEX/POSEIDON, Jason-1, Jason-2		Multiple	Ocean surface topography
Cloud-Aerosol Lidar with Orthogonal Polarization	CALIOP	CALIPSO	Thin Clouds and Aerosols
Cloud Profiling Radar	CPR	CloudSat	Cloud Profiles
Ground-Based			
Aerosol Robotic Network	AERONET	> 100 sites	Aerosols
Baseline Surface Radiation Network	BSRN	~ 40 stations	Downwelling longwave & shortwave fluxes
UV-B Monitoring & Research Program	UVMRP	~40 stations	Ozone, air quality
Network for the Detection of Atmospheric Composition Change	NDACC (formerly NDSC)	~ 70 stations	Trends in various trace gases, mostly stratosphere and upper troposphere
Total Column Carbon Observing Network	TCCON	~20 stations	Total column CO2, CH4, HDO, NO3, etc.