and would have to be determined monitoring the permeability changes caused by the flux in the sand. We have also seen that, with the boundary and initial conditions used, the relaxation time of the flux, that is the time to reach stability, is about 10 hours which in turn implies that the compaction of the sand in the sample has the same relaxation time. However in terms of the memory model the flux and the associated relaxation time are now defined by two parameters, and not only one as in the classic theory; the parameters are the order of fractional derivative n and the pseudodiffusivity. Finally we show that the flux rate variations observed during the experiments are compatible with the compaction of sand, due to the amount of fluid which went through the grains locally, and therefore with the reduction of porosity, in fact in all experiments we observed that flux decreases in time to about 70 percent of initial value and that the volume of sand reduces of about 3 percent; moreover, using empirical Fair and Hatch law for permeability, the sand volume and flux reductions seem compatible; which proves that mechanical compaction occurring during diffusion is caused by the permeability changes which in turn cause the flux variations.

H22D MCC: Level 2 Tuesday 1330h

Remote Sensing of the Land Surface III Posters *(joint with A, B)*

Presiding: **E Wood,** Princeton University

H22D-0950 1330h POSTER

Soil Moisture Mapping During SMEX03 Using Airborne NOAA C- and X-band Polarimetric Scaning Radiometer (PSR)

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Remote sensing of soil moisture can be accomplished using L-band (1.4 GHz) microwave radiometry, and such data provides reasonable penetration of crop vegetation canopy as well as measurements of soil moisture at soil depths of up to 10 cm. Radiometry using higher microwave frequencies provides progressively less penetration of vegetation and soil probing depth, but is more amenable to implementation using airborne or spaceborne antennas of practical size. The Japanese AMSR-E imaging radiometer on board the NASA EOS Aqua satellite is one such sensor capable of retrieving soil moisture using a microwave channel at 6.9 GHz with 75 km spatial resolution. Aqua was launched in May 2002, and will provide a global soil moisture product based on AMSR-E data The Soil Moisture Experiments in 2002 and 2003 (SMEX02/03) campaign were designed to provide early post-launch validation for Aqua via an airborne imaging study that simulates AMSR-E low-frequency microwave imagery. The airborne sensor used for the simulation is the NOAA Polarimetric Scanning Radiometer (PSR) operated on the NASA Wallops Flight Facility's P-3B aircraft. The PSR is the only operational airborne radiometer system to provide multiband polarimetric brightness imagery. It was developed at the Georgia Institute of Technology and the NOAA Environmental Technology Laboratory starting in 1995 in response to a general national need for high-resolution multiband polarimetric imagery for satellite algorithm development and calibration/validation studies. Objectives of the PSR flights during SMEX03 included: (1) providing high-resolution AMSR-E (55° incidence) underflight data at vertical and horizontal polarization, (2) developing algorithms using combined C- and X-band data for soil moisture retrieval in the presence of several types of vegetation canopies, (3) studying the detailed spatial and temporal signatures associated with soil moisture variations on a sectional (1-km) spatial scale, (4) developing algorithms relating C- and X-band soil moisture imagery with coincident L-band imagery for future L-band satellite development purposes, (5) developing hardware and algorithms for mitigating anthropogenic radio frequency interference in soil moisture radiometry, and (6) providing soil moisture data at field scale for land surface hydrology studies. We will present composited quick-look PSR/CX images of eight high-altitude flights conducted over two regional areas in Oklahoma during the July 2–14, 2003 period. Images show general drying in both regions interspaced with short periods of increased soil moisture following brief rainfall events.

URL: http://www.etl.noaa.gov/data/psr/smex03/

H22D-0951 1330h POSTER

Estimating broadband emissivity of North Africa using satellite thermal infrared multispectral radiometers

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Surface broadband (8-13.5 micrometer) emissivity in the thermal infrared region is an important parameter for the studies of energy budget and surface energy balance. This paper focuses on estimating broadband emissivity using two sensors on NASA's Earth Observing System (EOS) Terra satellite, Advanced Spaceborne Thermal Emission and reflection Radiometer (ASTER) and MODerate resolution Imaging Spectrometer (MODIS). We developed a method to estimate broadband emissivity using two regressions. The first regression is to relate the broadband emissivity to the emissivities for the five ASTER channels using libraries of spectral emissivity. This regression is used for mapping the broadband emissivity, which is necessary for the calibration of the second regression. The second regression is to extend the map to continental scales using the relationship between (a) the ASTER broadband emissivity map and (b) spectral emissivity and spectral reflectance data from MODIS data. The broadband emissivity values calculated from first regression were used to calibrate the second regression. We applied this regression to MODIS data and generated a broadband emissivity map over the Sahara Desert. The range of the broadband emissivity was found to be between 0.86 and 0.96 for the desert area. The expected RMS error of the map is about 0.02. Such emissivity map could be used as an input of climate model and could contribute to improve the surface and air temperature up to 1 degree C.

H22D-0952 1330h POSTER

Remote Sensing Spatial Resolution Analysis Using a Two-Source Energy Balance Model for SMEX02/SMACEX

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As part of the Soil Moisture Atmosphere Coupling Experiment (SMACEX) conducted during the Soil Moisture Experiment 2002 (SMEX02) in June and July, the potential impact of spatial resolution of input data derived by remote sensing on flux estimation was analyzed. Land surface temperature and the Normalized Difference Water Index (NDWI) derived from remotely sensed data along with meteorological data were used as provide inputs for a two-source canopy model. This model evaluates soil and vegetation contributions to the energy fluxes and radiometric surface temperature. The primary source of remotely sensed data was the Landsat satellites. The model and the Landsat data were used to estimate land surface fluxes over the watershed area. These high resolution estimates clearly showed spatial and temporal variations due to the different crop covers (primarily corn and soybean) and management practices. In particular, surface temperature showed very significant spatial variation at the Landsat pixel resolution. These spatial variations are difficult to observe in a coarse resolution image, such as MODIS or AVHRR and it is clear that a great deal of spatial information that is useful at the field scale is lost when AVHRR or MODIS is used. As validation, the fluxes estimated from the two-source model were compared with those derived from aircraft based flux data. Although there are differences the simple two-source model provides a useful technique to use with remotely sensed thermal and NIR/SWIR data. Spatial variations in the fluxes at different spatial scales were also analyzed to investigate the impact of resolution on radiative properties and resulting impact on energy and water flux estimation.

H22D-0953 1330h POSTER

Determining the Snow Depth Distribution on a Mountain Slope Using an Airborne Laser Scanner

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In heavy snow districts in Japan, snow cover makes slopes more unstable. For example, the snow load affects the normal stress and the snow glide affects the shear stress of the slope. Furthermore, snow thaws in spring and changes into meltwater, which increases the pore water pressure in the ground. To understand quantitatively the effect of snow cover on slope stability, the distribution of snow depth must be obtained. However, it has conventionally been estimated by multi-point measurement only by a probe pole with low plane resolution. In this study, we used an airborne laser scanner both during the snow period and non-snow period to measure both surface elevations. We determined the snow depth distribution by calculating the difference in each value with high accuracy and high resolution. The scanned area is located near the west coast of Japan. The scanning slope has an area of 18 ha and elevation of 500 m to 700 m above sea level. In midwinter, this area is normally covered with snow up tp 3 - 4 m depth. The scanning was conducted in February 2003 for the snow period and in May 2003 for the non-snow period. The calculated snow depth was 2.3 m on average. However, snow depths of more than 4 m or less than 1 m sometimes appeared, showing that the snow cover was not uniformly distributed on the mountain slope. Furthermore, our research revealed the following characteristics of the distribution. 1) The snow depth on a north-facing slope is larger than that on a south-facing slope, which we consider to be the result of the difference in solar radiation between the slopes. 2) The snow depth is less on a steep slope near the mountaintop and ridge, and is larger between the contour line where the slope gradient changes from steep to gentle. This is thought to be because snow is blown off by the wind or that snow drifts are formed.

H22D-0954 1330h POSTER

The Hydrosphere State Mission (HYDROS) Soil Moisture and Freeze/Thaw Exploratory Mission

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The Hydrosphere State Mission (HYDROS) is a pathfinder mission in the NASA's Earth System Pathfinder Program (ESSP). The objective of the mission is to provide exploratory measurements that constitute the first global scale measurement of Earth's soil moisture and land surface freeze/thaw conditions. The mission builds on the heritage of ground-based and airborne passive and active low-frequency microwave measurements that have demonstrated and validated the effectiveness of the measurements and associated algorithms for estimating the amount and phase (frozen or thawed) of surface soil moisture. The mission data will enable advances weather and climate prediction and in mapping processes that link the water, energy and carbon cycles. The proposed HYDROS instrument is a combined radar and radiometer system operating at 1.26 GHz (with VV, HH, and HV polarizations) and 1.41 GHz (with H, V, and U polarizations). The radar and the radiometer share the aperture of a 6-meter antenna pointing at 35° with respect to nadir. The lightweight deployable mesh antenna is rotated at 14.6 rpm to provide a constant look-angle scan swath of 1000 km. The large swath provides a global coverage of the

Earth in 2 to 3 days with a temporal sampling less than 2 days at latitude above 50N. The radar measurements allow the retrieval of soil moisture at high resolution (3 to 10 km). The radiometer measurements allow retrieval of soil moisture in diverse (non-forested) landscapes with a resolution of 40 km. The mission includes combined radar/radiometer data products that will use the synergy of the two sensors to deliver enhanced quality soil moisture estimates.

H22D-0955 1330h POSTER

SATELLITE-BASED DAILY ACTUAL EVAPOTRANSPIRATION ESTIMATION

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Many water resources and agricultural applications require the knowledge of evapotranspiration (ET) over a range of spatial and temporal scales. Due to paucity of surface based hydro-meteorological stations, the spatial resolution of ET estimates is fairly coarse and is not particularly suitable or reliable for hydrologic modeling, water resources planning and decision making. We have developed an ET estimation algorithm by combining data from satellite and ground observations. Our proposed approach is simple, input data-adaptive, scalable, and end-user oriented with an evolution strategy. Our approach is based on an extension of the Priestley-Taylor equation and a relationship between remotely sensed surface temperature and vegetation index. The required parameters for this approach are derived from the Advanced High Resolution Radiometer aboard NOAA-14 over South Florida for 1998 and 1999. It first estimates the evaporative fraction (EF) by utilizing the relationship between NDVI and radiometric surface temperature observed from AVHRR for each day. Then spatio-temporal interpolation and filtering techniques were applied to obtain daily EF values for cloudy pixels to produce the EF map for the entire region. Daily ET (DAET) maps are derived from these EF maps and net radiation maps obtained from ground-based observations. The comparisons between satellite derived DAET and ground measured DAET showed overall low bias and root-mean-square-error for both clear and cloudy days in 1998 and 1999. The proposed DAET algorithm, primarily driven by satellite data and validated by multi-year real-time ground observations over the South Florida region, appears to be robust and can produce near real-time land surface evapotranspiration monitoring over large heterogeneous areas at a very fine space and time resolution.

H22D-0956 1330h POSTER

Remote Sensing Applications to Improve Seasonal Forecasting of Streamflow and Reservoir Storage in the Upper Snake River Basin

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Mountain snowmelt contributes over eighty percent of the water supply in the Western U.S. Accurate estimates and forecasts of snow cover and snowmelt are important to many local, state, and Federal agencies that have interests in agriculture, hydropower, and recreation. Water resource managers depend on accurate water supply predictions to allocate a finite supply of water to often competing demands. Although quantitative forecasts of seasonal snowmelt runoff have been made at many locations in the West for over 50 years, these forecasts are limited by accurate knowledge of winter season precipitation and snow accumulation in remote areas, which presently are estimated via in situ networks like the NRCS' SNOTEL. We evaluate the potential to improve on methods based solely on in situ observations through a strategy that combines nowcasts of soil moisture, snow water content, and other hydrologic variables using the Variable Infiltration Capacity (VIC) macroscale hydrologic model, updated with a combination of SNOTEL-based estimates of snow water equivalent and remote sensing (MODIS) estimates of snow areal extent. The method is evaluated for the Upper Snake River basin, for which a long-term retrospective VIC run for the period 1950-2002 provides a model climatology, and the basis for a retrospective evaluation of seasonal streamflow forecast skill absent updating. For winters 2001-2 and 2002-3, we evaluate the impact of both replacing and augmenting our updating scheme based on SNOTEL data with corrections from two remote sensing products: course spatial resolution MODIS snow-cover data and, on a more experimental basis, an AMSR snow water equivalent product. In addation to seasonal streamflow forecasts based on an adaptation of the Extended Streamflow Prediction (ESP) method, we implement and evaluate experimental reservoir forecasts produced with the SNAKESIM Snake River reservoir management model for forecasts made in the winters of 2001-2 and 2003-4 for the following summers.

H22D-0957 1330h POSTER

Local Spatial Scales of Tropical Deep Convection Inferred from SMM/I Precipitation Data

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The local time and space scales of organized tropical deep convection have been studied by L. Ricciardulli and P. D. Sardeshmukh (2002, J. Climate, 15, 2775; hereafter RS) using Global Cloud Imagery. The SSM/I data from the DMSP satellites provides a complimentary data set for this purpose with the advantage of well-tested algorithms for converting brightness temperatures into precipitation. The disadvantage is that the sampling interval of 12 hours is too long to study the short time scales. Taking several months of data using the precipitation algorithm of Ferriday and Avery, convectively active months were defined as those having greater than 2 mm/hr of rain greater than 5% of the time. A plot of the probability of precipitation in the ± 30 degree latitude window will be shown estimated as the percentage of the total 12-hourly average precipitation values using a 40 x 40 km grid having greater than 2 mm/hr. Finally, spatial autocorrelations were preformed on the grid cells for convectively active months and a plot of the spatial scale distribution derived from the autocorrelations was made following RS. These results will be compared with those of RS and will be used as a basis to extend the study to complete global coverage.

H22D-0958 1330h POSTER

An Observing System Simulation Experiment for HYDROS Soil Moisture Retrievals

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The Hydrosphere State (HYDROS) mission is designed to provide global estimates of surface soil moisture and freeze/thaw state. In this paper we present results of a simulation study of soil moisture products to be derived from the HYDROS mission. The study illustrates different approaches being developed for HYDROS soil moisture retrieval using L-band radar and radiometer observations, and indicates how retrieval accuracy is affected by landcover heterogeneity and vegetation water content (VWC) at different spatial resolutions. The study is based on a modeled geophysical domain in the south-central United States, with simulated landcover, soil moisture, and soil temperature characteristics over a one-month period. Simulated microwave backscatter and emission measurements were computed from the geophysical fields and averaged to the HYDROS radar and radiometer spatial resolutions of 3-km and 40-km, respectively. Representative instrument sampling and noise characteristics were included. The prototype HYDROS retrieval algorithms were applied to the simulated observations, and accuracies of soil moisture products at 3, 40, and 10 km resolutions were estimated. The simulations afford a capability to examine trade-offs of resolution and accuracy, as well as sensitivity to instrument noise and model error. The simulations indicate the degree to which increasing VWC and degree of heterogeneity degrade the retrieval accuracy. The results confirm that the HYDROS 10-km product acuracy goal of 4% volumetric soil moisture is feasible for footprint-averaged vegetation water content up to approximately 5 kg m-2.

H22D-0959 1330h POSTER

Retrieval of Soil Moisture From Passive and Active L/S Sensor Observations During the Soil Moisture Experiments in 2002

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The Soil Moisture Experiments in 2002 (SMEX02) were conducted in Iowa from June 25th through July 12th. A major aim of the experiments was extension of existing algorithms for soil moisture retrieval from active and passive microwave remote sensing parameters to more challenging vegetation conditions. This paper examines the performance of the Passive and Active L and S band sensor (PALS) by comparing stimulated brightness temperatures and backscattering coefficients with the instrument observations. Sensitivity of the PALS instrument to soil moisture in both active and passive channels has been analyzed under varying conditions of soil moisture and vegetation cover. A change detection algorithm that combines observations in the active and passive channels to arrive at

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soil moisture estimates has also been employed to investigate the performance of the PALS active channel. Comparative studies of the L and S bands have been done to illustrate the greater sensitivity of the instrument at lower frequency.

H22D-0960 1330h POSTER

Application of Remote Sensing Data in a Distributed Hydrological Model for the Gambia River Basin

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Distributed hydrological models have an extensive demand of high resolution spatial and temporal data for driving and validating the models. Most of the variables are only available as point measurements which impose serious constraints to the applicability and the credibility of such models particularly for large regional scales and in areas where the availability and quality of hydrological data are limited. Remote sensing information appears to offer useful data that not only can fill some of the gaps in data availability but also can supply data at the appropriate scale for distributed hydrological models. In this study we tested three types of remote sensing derived variables in a distributed hydrological model of the 42,000 km2 Gambia River Basin in West Africa: (1) potential evapotranspiration estimated by the Makkink equation and based on daily global radiation fields derived from the geostationary meteorological satellite Meteosat, (2) leaf area index (LAI) based on data from the MODIS satellite, and (3) Temperature Vegetation Dryness Index (TVDI) derived form NOAA AVHRR images. The remote sensing derived time series of potential evapotranspiration and LAI were used as input to the model while TVDI was used for validating the spatial simulations of soil moisture. The effects of introducing remote sensing based input were evaluated for both discharge simulations and spatial outputs by comparing the model simulations to those based on traditional data. Application of remote sensing based input of potential evapotranspiration and LAI had in both cases little effects on the simulated discharges while some effects were seen on the spatial and temporal variation of variables like actual evapotranspiration and soil moisture. Improved spatial simulations of these variables may potentially allow for better design of e.g. irrigation schemes. The comparative analysis of TVDI estimates and spatial model simulations of soil moisture content in the root zone was however inconclusive.

H22D-0961 1330h POSTER

Intercomparison and Validation of GPCP One-Degree Daily Rainfall Estimates with Surface-based Radar Estimates in the Mississippi River Basin

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The Global Precipitation Climatology Project (GPCP) has been producing truly global daily precipitation estimates at 1-degree resolution (1DD) for the period of January 1997 - to date by combining data from different satellite sensors. Quantification of the errors in such estimates, through direct comparisons with independent high-quality surface-based rainfall estimates, is essential to provide a quantitative confidence level on the estimates and to further improve the quality of such estimates. The purpose of this study is to perform extensive quantitative assessment of the GPCP-1DD estimates by comparing them with independent radar-based rainfall estimates over the Mississippi river basin, for the period 1997-2000. The archive of radar-based estimates used, conveniently referred to as the MRB hereafter, is suitable to perform validation studies in view of its high space-time resolution, large areal coverage, and relatively long time series. The Mississippi river basin covers 435 one-degree grids. The authors used several comparison statistics which fall into unconditional continuous statistics, conditional (quasi-)continuous statistics, and categorical statistics. The analyses include annual and seasonal time periods. The results are presented for each 1-degree grid and for a combination of these grids in certain regions. Highlights of the results are as follows. (1) There is a very good correspondence between the GPCP and MRB estimates both spatially and temporally, as evidenced by correlations in excess of 0.90 mostly. (2) The GPCP has a very high skill in discriminating rainy from nonrainy days as reported by the MRB estimates, at a large range of rainfall thresholds. (3) There is a systematic difference between the two estimates, with the GPCP overestimating at almost all locations and seasons. Both the bias and the root-mean-square difference consistently increase with increasing rain rate. The bias varies from 0.09 to 7.21 mm day-1, at the MRB-estimated means of 0.10 and 17.26 mm day-1, respectively. The bias-adjusted root-mean-square difference varies from 0.22 to 5.87 mm day-1, at the MRB-estimated means of 0.10 and 17.26 mm day-1, respectively. (4) The GPCP estimates for winter show slightly larger systematic error and less rain presence/absence diagnosis skill compared to other seasons. Finally, although the errors in the MRB estimates are expected to be relatively small, the authors acknowledge that the MRB estimates are subject to error sources, and they describe how the statistics of the GPCP-MRB difference are partitioned into the GPCP error and the MRB error components.

H22D-0962 1330h POSTER

Multi-Watershed Evaluation of WSR-88D (NEXRAD) Radar-Precipitation Products for Hydrologic and Natural Resources Modeling Applications

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The National Weather Service (NWS) operates a network of Doppler-radar stations (NEXRAD, WSR-88D) that produce hourly-rainfall estimates, at approximately 4-km^2 resolution, with nominal coverage of 96% of the conterminous US. Utilization of these data by the NWS are primarily for the detection and modeling of extreme-weather events. Radar-precipitation estimates were compared with gauge estimates at 6 ARS watershed-research locations in Idaho, Arizona, Oklahoma, Georgia and Mississippi, to evaluate the utility of these data for hydrologic and natural resources modeling applications. Radar precipitation estimates underestimated gauge readings for all locations except Tucson. In all cases, the total number of hours with measured-radar precipitation was much less than hours containing gauge-precipitation estimates. Additional modification of NWS precipitation processing procedures will be necessary to improve accessibility and utility of these data for hydrologic and natural resource modeling applications.

H22D-0963 1330h POSTER

Evaluation of Two Methods for Determining Surface Soil Moisture from Radar Imagery

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Distributed soil moisture data are useful for determining cross-country mobility, irrigation scheduling, pest management strategy, biomass production and potential for soil erosion and infiltration. Large area monitoring of surface soil moisture (to depths of 5 cm) is possible with radar remote sensing techniques, but accuracy must be assessed before it can be implemented operationally. Two methods for predicting surface soil moisture from radar satellite imagery were tested in sparsely vegetated, semi-arid Arizona rangelands. In the first approach, the Integral Equation Method (IEM) model was run in the forward direction to generate a Look-Up-Table (LUT) of radar backscatter for the expected range of surface roughness and moisture content in the study area. The LUT was used to derive surface soil moisture estimates from radar images acquired at the study site. In the second approach, a difference index was made from time series differences in radar backscatter signals from wet and dry soils. The difference index minimized variations in surface roughness and resulted in a direct relation between difference and surface soil moisture. For both approaches, results were validated against in situ measurements of surface soil moisture at 46 sites with dielectric probes at the time of satellite overpass. The modeling approach requires surface roughness inputs which may be difficult to obtain, whereas the difference technique requires only a dry surface reference backscatter for comparison with wetter surface backscatter to determine moisture content.

H22D-0964 1330h POSTER

Automated Geo-Referencing of JERS-1 SAR Mosaics Using SRTM DEM Data

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Mosaics produced from SAR images serve as base maps for many vast, remote areas such as the Amazon basin and Siberia. However, these mosaics are usually not precisely geo-referenced due to the distortion caused by terrain relief and SAR geometry, therefore their scientific value is limited. Since high-resolution digital elevation models (DEMs) were not widely available, terrain distortion was commonly not removed during the mosaic generation process. Recently, the SRTM (Shuttle Radar Topography Mission) mission has provided geolocation-accurate DEM data at high resolution (roughly 100 m) for nearly global coverage for the first time, and makes it possible to produce precisely located SAR mosaics. Rather than beginning with each individual SAR scene and rectifying it, this paper introduces an automated method for directly removing terrain distortion from SAR mosaics and precisely geo-referencing them. The proposed procedures include SAR image simulation from SRTM DEM, image matching between SAR mosaics and the simulated SAR image, automated ground control point (GCP) selection and screening, TIN-based (Triangular Irregular Network) registration using the GCPs for localized adjustment, and producing rectified SAR mosaics by transforming from the simulated SAR coordinate system to the SRTM system. The proposed method was tested in the Amazon basin using both the low water and high water GRFM (Global Rain Forest Mapping) mosaics. These mosaics, produced by NASA JPL from hundreds of JERS-1 SAR images, cover an area of 8 by 18 degrees in latitude and longitude with a resolution of 100 m. The offset between these original mosaics and the DEM-simulated SAR image is up to 22 pixels in mountainous areas. Implemented using IDL® on a 3.06G Hz Windows platform, it cost about 3 hours to rectify both mosaics. 1-pixel geo-referencing accuracy was achieved using about 100,000 automatically

selected GCPs in both cases. The rectified mosaics serve as base maps in our Amazon basin GIS database, and work great with other layers in the database.

H22D-0965 1330h POSTER

Thermal infrared remote sensing and its usefulness in determining regional stream temperatures

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Stream temperatures are an important water quality variable in the Pacific Northwest, especially due their impact on health of regional salmon and steelhead runs. With several of these runs classified as threatened or endangered by the National Marine Fisheries Service in the last decade, monitoring of regional stream temperatures has never been more important. Networks of in-situ temperature observation sites tend to be costly to install and maintain, limiting their ability to monitor large regions in detail. Thermal infrared (TIR) remote sensing from aircraft and satellite based platforms have the potential to provide high resolution regional information about stream temperatures at a specific time. We present results from a three-year study, conducted to investigate the usefulness of TIR images in monitoring and observing regional stream temperatures. This project compared satellite-, aircraft- and ground-based TIR sensors with a network of in-stream temperature loggers and volunteer observations to assess the accuracy and uncertainty of TIR derived stream temperatures. Accuracy and uncertainty of temperatures extracted from the TIR images are strongly related to our ability to correct imagery for the effects of surface emissivity, atmospheric conditions and thermal scattering from the near-bank environment. Limited observations of atmospheric water vapor are of particular concern, however, total column water predictions from a meso-scale atmospheric model can be a useful substitute. The biggest limiting factor in using remote sensing for the evaluation of regional stream temperatures is the resolution of the sensor. Satellite-based sensors are unable to fully resolve all but the largest regional rivers. Higher-resolution aircraft-based images can resolve most regional rivers and stream, but may be unable to yield accurate temperatures in the presence of dense riparian zone vegetation. Very high-resolution images from the ground-based TIR sensors can resolve detailed temperature patterns within the stream, but image noise and the look-angle relative to the stream's surface become significant in analysis.

H22D-0966 1330h POSTER

The GLOBE Soil Moisture Campaign's Light Bulb Oven

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The GLOBE Soil Moisture Campaign (SMC) (www.hwr.arizona.edu/globe/sci/SM/SMC) has developed a light bulb oven to provide a low budget, low-technology method for drying soil samples. Three different soils were used to compare the ability of the light bulb oven to dry soils against a standard laboratory convection oven. The soils were: 1) a very fine sandy loam (the "Gila" soil); 2) a silty clay (the "Pima" soil); and 3) a sandy soil (the "Sonoran" soil). A large batch of each soil was wetted uniformly in the laboratory. Twelve samples of each soil were placed in the light bulb oven and twelve samples were placed in the standard oven. The average gravimetric soil moisture of the Gila soil was 0.214 g/cm3 for both ovens; the average Pima soil moisture was 0.332 g/cm3 and 0.331 g/cm3 for the traditional and light bulb ovens, respectively; and the Sonoran soil moisture was 0.077 g/cm3 for both ovens. These results demonstrate that the low technology light-bulb oven was able to dry the soil samples as well as a standard laboratory oven, offering the ability to make gravimetric water content measurements when a relatively expensive drying oven is not available.

H22D-0967 1330h POSTER

Ground and Space-based Sensor Web System: Streamlining Spacecraft Observation Response to Flood Detection.

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Some of the most important hydrologic phenomena occur in transient fashion and at arbitrary times over regions of varying scales. Major flooding events, such as those that have devastated parts of the world (e.g., major flooding from tropical storms and monsoon-induced activity), often result in tremendous loss of life, major structural damage, and notable modification of the landscape. Such flood-related phenomena can be readily sensed from orbital radar platforms to improve the scientific understanding necessary to mitigate their disastrous consequences. For example, satellite-based flood detection provides important information for governmental agencies monitoring disasters and supplies data to scientists seeking to understand the responses of surface processes to storm events at synoptic scales (e.g., see Dartmouth Flood Observatory, http://www.dartmouth.edu/artsci/geog/floods/). Efforts are underway to streamline the process by which data are obtained and processed in order to effectively monitor transient catastrophic flooding, perform timely hazard assessment, and appraise governmental agencies of pending disasters. The flood sensor web is an application of networked sensor technology that is being applied to flood monitoring. The flood sensor web system utilizes NASA QuikSCAT radar scatterometer data providing global coverage every 2.5 days. Vv/Hh polarity ratios from the radar return are computed and geolocated at JPL, this information is transmitted to Dartmouth, and anomalous results occurring within Dartmouth's global array of river measurement reaches are flagged for the next possible EO-1 acquisition. In addition, JPL automatically generates a spacecraft command sequence that is then transmitted to Goddard Space Flight Center for uplink to the Earth Observing 1 (EO-1) spacecraft. This enables rapid-response, high-resolution multispectral (ALI) and hyperspectral (Hyperion) observations to be obtained of the flood target as quickly as possible. Autonomous Sciencecraft Experiment [1] software onboard EO-1 can then process the data and report the change detection results (e.g., number and location of active pixels). [1] Chien et al. (2003) LPSC34 abstract #1458.

URL: http://ASE.jpl.nasa.gov

H22D-0968 1330h POSTER

Statistical Relationship Between Drought Indices and NDVI Departure at Regional Scale

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In recent years, satellite data have become widely available at global scales and resolutions that are adequate for monitoring drought conditions. Therefore the development of drought monitoring tools that can benefit from such data holds the potential for improving the timeliness and access to drought information without the cost of extensive ground monitoring stations especially in developing countries where meteorological networks are sparse at best, if at all available. This work is motivated by the need to develop a satellite-based drought monitoring tools. The objective is to contribute to the development of such tools through detailed analysis of existing widely used drought indices and information that can be generated from widely used satellite vegetation data. To accomplish these objectives, time-series of several widely used drought indices such as the Palmer Drought Severity Index (PDSI), derived from meteorological data, are analyzed in conjunction with concurrent time series of a coarse resolution Normalized Difference Vegetation Index (NDVI), derived from the Advanced Very High Resolution Radiometer (AVHRR) imagery. In this study, the relationships between several "palmer-based" drought indices and the departure of NDVI from its long-term mean were investigated over semi-arid climate regions in the state of Arizona. The crosscorrelation analysis shows an agreement between the NDVI data and three out of the four Palmer drought indices as far as the spatial distribution is concerned for all climate regions. The subscaling of NDVI data from climate division to vegetation cover type has improved the crosscorrelation between NDVI and drought indices. This test showed positive and stronger correlation for particular vegetation covers such as open shrublands and needleleaf forest.

H22E MCC: 3024 Tuesday 1340h

Early Results From NASA's EOS Aqua Spacecraft Mission I *(joint with A, OS)*

Presiding: **C L Parkinson,** NASA Goddard Space Flight Center**; S Platnick,** NASA Goddard Space Flight Center

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H22E-01 1340h INVITED

Potential for Observing the Global Water Cycle from Space

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The fundamental challenge in observing the global water cycle is to understand where the water is, and where it is moving. Of course, the answer to the "where is it?" question is "mostly in the oceans and ice sheets", but when one considers relative mobility, the focus becomes somewhat different. From the standpoint of the land surface, moisture stored in the atmosphere, and especially that released from the atmosphere as precipitation and returned to it as evapotranspiration, are the largest fluxes over most of the globe. Runoff and streamflow, although usually a somewhat smaller fraction of precipitation than ET, are critically important, as they are the source of or contribute directly to much of the water available for human use. Water stored in the subsurface, especially as soil moisture, controls vegetation moisture stress, and hence ET under many conditions. Soil moisture "antecedent conditions" are well known to affect storm runoff production as well. Furthermore, groundwater and variations therein are important both for human use, and through interactions with soil moisture and streamflow, depending on the particular conditions. Current estimates of the terms in the global water cycle are based primarily on in situ observations. For instance, over land, most estimates of precipitation are primarily gage-based. The same is true of streamflow. ET is measured directly only at a relatively small number of sites; large area estimates are primarily based either on the difference between precipitation and runoff (ignoring storage change in the long-term mean) or atmospheric budget analyses. Soil moisture, groundwater, and snow storage (except glaciers) are generally not well enough measured to provide quantitative estimates, except through use of models. Of the major terms on the land surface branch of the global water cycle, most terms (precipitation, streamflow, soil moisture, and snow water storage) are more or less directly